WORKSHOP MANUAL

N SERIES

ISUZU

PubNo. N∗R99.00.01-01-E

THIS MANUAL INCLUDES FOLLOWING SECTIONS:

G. Export 99.00MY

SECTION	CONTENTS
0	GENERAL INFORMATION
1	HEATING,VENTILATION AND AIR CONDITIONING
2	FRAME AND CAB
3	STEERING,SUSPENSION WHEELS AND TIRES
4	PROPELLER SHAFT AND AXLE
5	BRAKES
6	ENGINE (4H SERIES)
6	ENGINE (4J SERIES)
7	AUTOMATIC TRANSMISSION (450-43LE)
7	MANUAL TRANSMISSION AND CLUTCH (MSB TYPE)
7	MANUAL TRANSMISSION AND CLUTCH (MXA TYPE)
7	MANUAL TRANSMISSION AND CLUTCH (MBP TYPE)
8	CAB AND CHASSIS ELECTRICAL (LEFT HAND DRIVE MODEL)
8	CAB AND CHASSIS ELECTRICAL (RIGHT HAND DRIVE MODEL)
———	POWER TAKE OFF

THIS MANUAL INCLUDES FOLLOWING SECTIONS:

Europe 00MY

SECTION	CONTENTS
0	GENERAL INFORMATION (EUROPE)
1	HEATING,VENTILATION AND AIR CONDITIONING
2	FRAME AND CAB
3	STEERING,SUSPENSION WHEELS AND TIRES
4	PROPELLER SHAFT AND AXLE
5	BRAKES
6	ENGINE (4H SERIES)
6	ENGINE (4J SERIES)
7	MANUAL TRANSMISSION AND CLUTCH (MSB TYPE)
7	MANUAL TRANSMISSION AND CLUTCH (MXA TYPE)
7	MANUAL TRANSMISSION AND CLUTCH (MBP TYPE)
8	CAB AND CHASSIS ELECTRICAL (LEFT HAND DRIVE MODEL)
8	CAB AND CHASSIS ELECTRICAL (RIGHT HAND DRIVE MODEL)

THIS MANUAL INCLUDES FOLLOWING SECTIONS:

Europe 01MY

SECTION	CONTENTS
0	GENERAL INFORMATION (EUROPE)
1	HEATING,VENTILATION AND AIR CONDITIONING
2	FRAME AND CAB
3	STEERING,SUSPENSION WHEELS AND TIRES
4	PROPELLER SHAFT AND AXLE
5	BRAKES
5A4	ANTI-LOCK BRAKE SYSTEM (ABS)
6	ENGINE (4H SERIES)
6	ENGINE (4J SERIES)
7	MANUAL TRANSMISSION AND CLUTCH (MSB TYPE)
7	MANUAL TRANSMISSION AND CLUTCH (MXA TYPE)
7	MANUAL TRANSMISSION AND CLUTCH (MBP TYPE)
8	CAB AND CHASSIS ELECTRICAL (LEFT HAND DRIVE MODEL)
8	CAB AND CHASSIS ELECTRICAL (RIGHT HAND DRIVE MODEL)
8	CAB AND CHASSIS ELECTRICAL (ANTI-LOCK BRAKE SYSTEM<ABS>SUPPLEMENT)

THIS MANUAL INCLUDES FOLLOWING SECTIONS:

Australia 00MY

SECTION	CONTENTS
1	HEATING,VENTILATION AND AIR CONDITIONING
2	FRAME AND CAB
3	STEERING,SUSPENSION WHEELS AND TIRES
4	PROPELLER SHAFT AND AXLE
5	BRAKES
6	ENGINE (4H SERIES)
7	MANUAL TRANSMISSION AND CLUTCH (MXA TYPE)
7	MANUAL TRANSMISSION AND CLUTCH (MBP TYPE)
8	CAB AND CHASSIS ELECTRICAL (RIGHT HAND DRIVE MODEL)

WORKSHOP MANUAL

NHR • NKR • NPR

ENGINE
4H SERIES

SECTION 6

ISUZU

MEMO

NOTICE

Before using this Workshop Manual to assist you in performing vehicle service and maintenance operations, it is recommended that you carefully read and thoroughly understand the information contained in Section 0A under the headings "GENERAL REPAIR INSTRUCTIONS" and "HOW TO USE THIS MANUAL".

All material contained in this Manual is based on latest product information available at the time of publication.
All rights are reserved to make changes at any time without prior notice.

Applicable Model :

N Series		
NKR66	NPS66	NQR71
NPR66	NPS71	
NPR70	NQR66	
NPR71	NQR70	

This manual is applicable to 1996 year model and later vehicles except those sold in the United States of America, and Canada.

THIS MANUAL INCLUDES THE FOLLOWING SECTIONS:

SECTION NO.	CONTENTS
00	Service Information
6A	Engine Mechanical
6A3	Engine (4HF1/4HF1-2/4HE1-T/4HE1-TC/4HG1/4HG1-T)
6B	Engine Cooling
6C	Fuel System
6D	Engine Electrical
6E	Emission and Electrical Diagnosis
6F	Exhaust
6G	Turbocharger

SECTION 00

SERVICE INFORMATION

CONTENTS

	PAGE
Troubleshooting	00 - 2
Main Data and Specifications	00 - 19
Service Standard	00 - 28
Servicing	00 - 42
Fixing Torque	00 - 59
Special Tools	00 - 70
Lubricating System	00 - 72

TROUBLESHOOTING

CONTENTS

	PAGE
Hard Starting	00 - 3
Starter Motor Inoperative	00 - 3
Starter Motor Operates but Engine does not turn over	00 - 3
Engine turns over but does not start	00 - 4
Fuel is not being delivered to the injection pump	00 - 4
Fuel is being delivered to the injection pump	00 - 4
Quick-on Start System	00 - 5
Unstable Idling	00 - 10
Insufficient Power	00 - 11
Excessive Fuel Consumption	00 - 12
Excessive Oil Consumption	00 - 12
Overheating	00 - 13
White Exhaust Smoke	00 - 13
Dark Exhaust Smoke	00 - 14
Oil Pressure Does Not Rise	00 - 14
Abnormal Engine Noise	00 - 15
Engine Knocking	00 - 15
Gas Leakage Noise	00 - 15
Continuos Noise	00 - 15
Slapping Noise	00 - 16
Engine Cooling Trouble	00 - 17
Starter Motor Does Not Stop	00 - 18

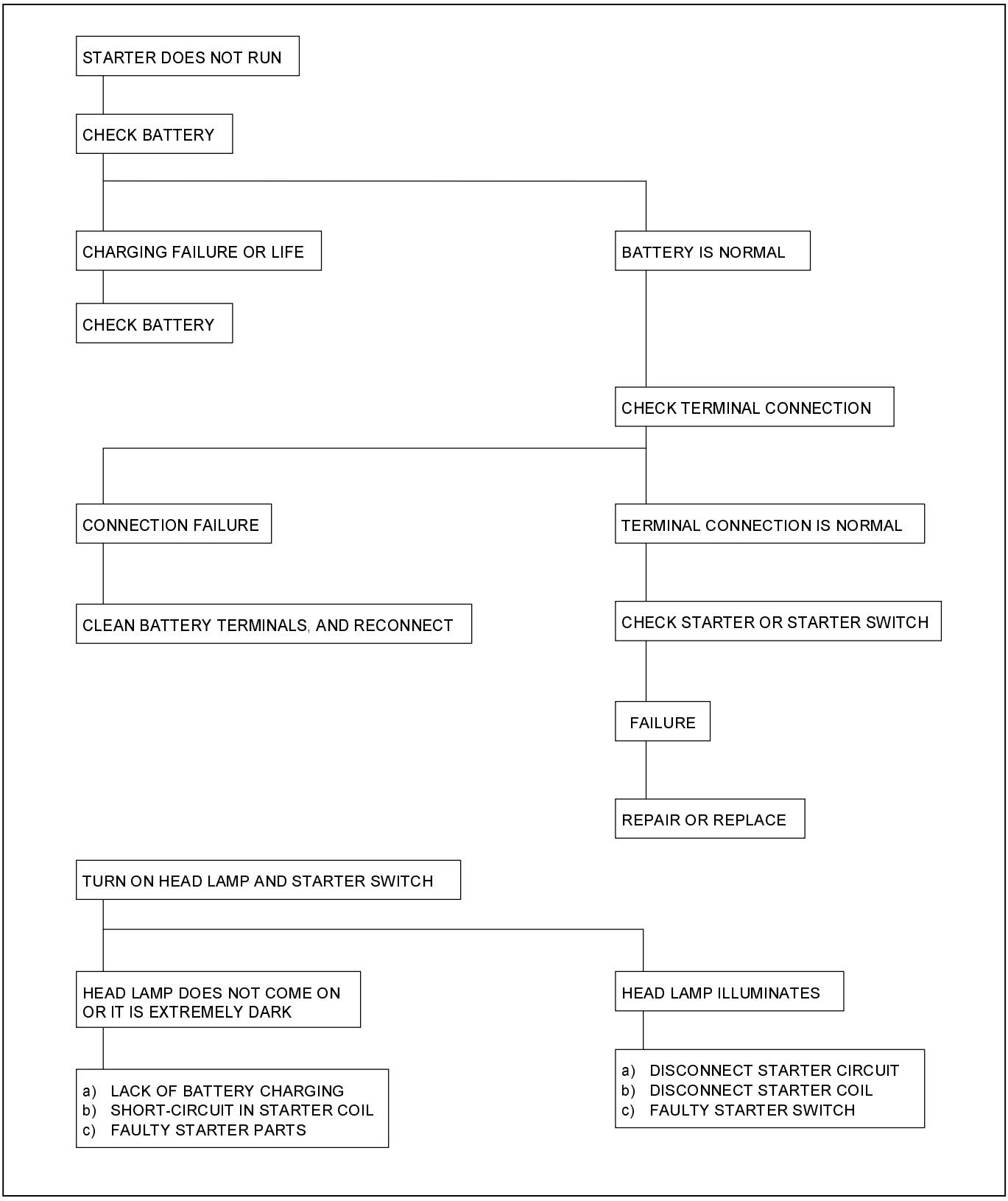
1. HARD STARTING

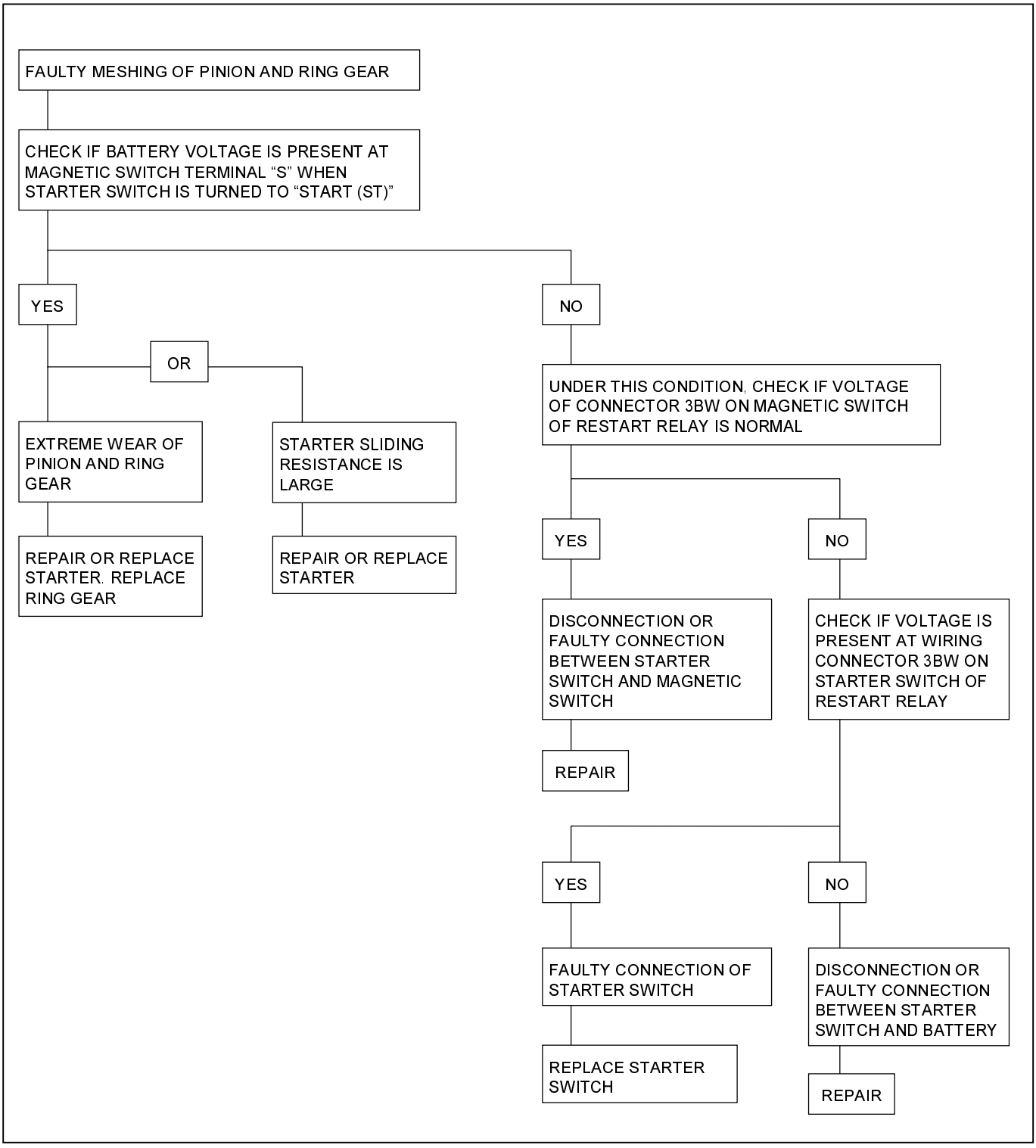
1. STARTER MOTOR INOPERATIVE		
Checkpoint	**Possible cause**	**Correction**
Battery	Loose battery cable terminal Poor connections due to rusting	Clean and/or retighten the battery cable terminal
	Battery discharged or weak	Recharge or replace the battery
	Fan belt loose or broken	Adjust or replace the fan belt
Fusible link	Fusible link shorted	Replace the fusible link
Starter switch	Defective starter switch or starter relay	Replace the starter switch or the starter relay
Starter motor	Defective magnetic switch or starter relay	Repair or replace the magnetic switch
	Defective starter motor	Repair or replace the starter motor
2. STARTER MOTOR OPERATES BUT ENGINE DOES NOT TURN OVER		
Battery	Loose battery cable terminal Poor connections due to rusting	Clean and/or retighten the battery cable terminal
	Battery discharged or weak	Recharge or replace the battery
	Fan belt loose or broken	Adjust or replace the fan belt
Starter motor	Defective pinion gear	Replace the pinion gear
	Defective magnetic switch	Repair or replace the magnetic switch
	Brush wear, Weak brush spring	Replace the brush and/or the brush spring
Engine	Piston, crank bearing seizure, or other damage	Repair or replace the related parts

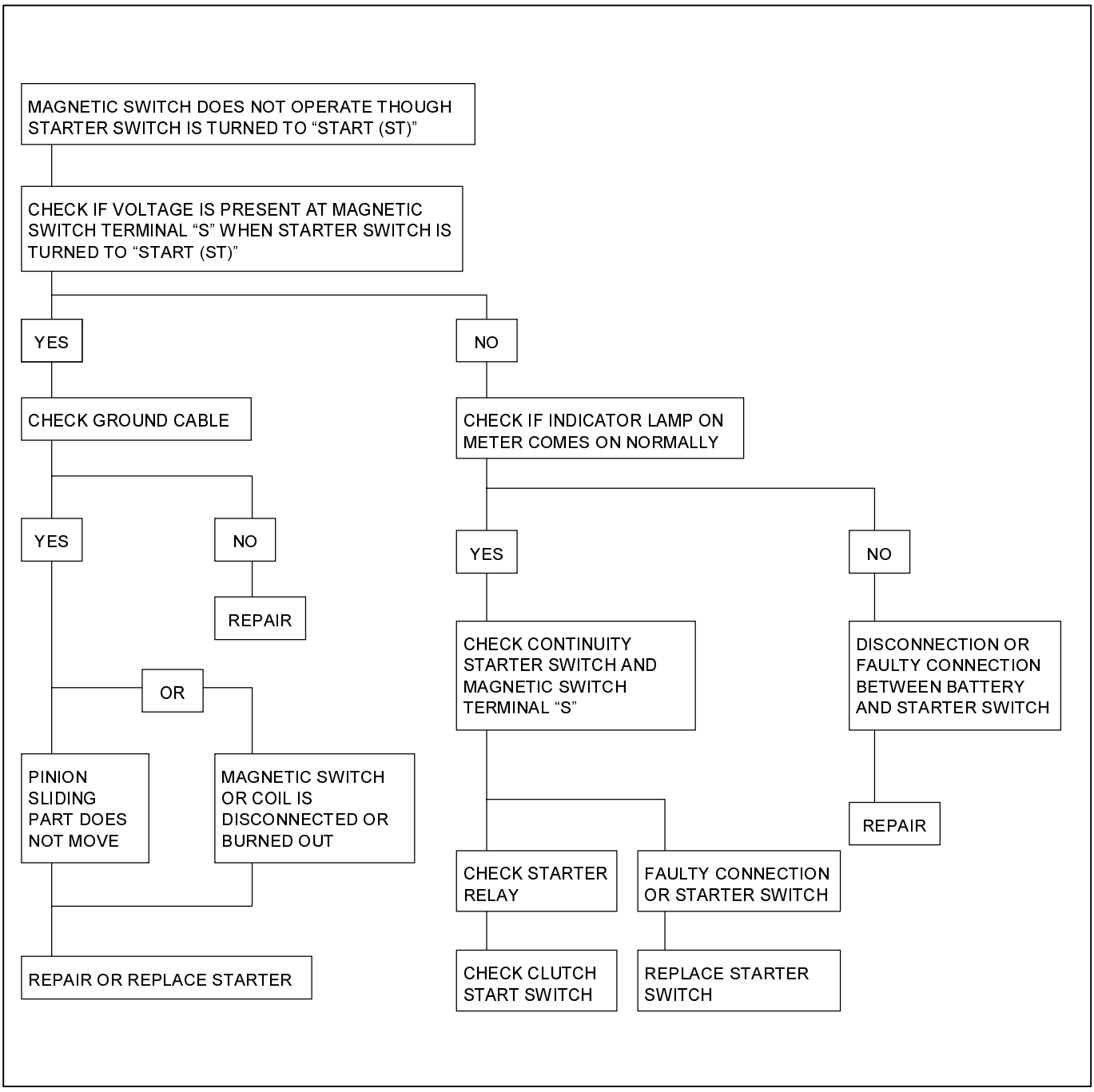
3. ENGINE TURNS OVER BUT DOES NOT START		
Checkpoint	**Possible cause**	**Correction**
Engine stop mechanism	Defective fuel cut solenoid valve	Replace the fuel cut solenoid valve
FUEL IS NOT BEING DELIVERED TO THE INJECTION PUMP		
Fuel	Fuel tank is empty	Fill the fuel tank
Fuel piping	Clogged or damaged fuel lines. Loose fuel line connection	Repair or replace the fuel lines Retighten the fuel line connection
Fuel filter	Fuel filter overflow valve does not close	Repair or replace the fuel filter overflow valve
	Clogged fuel filter element	Replace the fuel filter element or the filter cartridge
Fuel system	Air in the fuel system	Bleed the air from the fuel system
Fuel feed pump	Defective feed pump	Repair or replace the feed pump
FUEL IS BEING DELIVERED TO THE INJECTION PUMP		
Fuel	Use of the wrong fuel	Use the correct fuel
	Water particles in the fuel	Charge the fuel
Fuel system	Air in the injection pump	Bleed the air from the fuel system
Injection nozzle	Injection nozzle sticking	Replace the injection nozzle
	Injection nozzle injection starting pressure too low Improper spray condition	Adjust or replace the injection nozzle
Injection pump	Defective fuel injection nozzle resulting in the fuel drippage after fuel injection	Replace the delivery valve
	Defective injection pump control rack operation	Repair or replace the injection pump control rack
	Injection pump plunger worn or stuck	Replace the injection pump plunger assembly
	Injection pump drive shaft seizure or other damage	Replace the injection drive shaft
	Injection pump governor spring seizure	Replace the injection pump governor spring

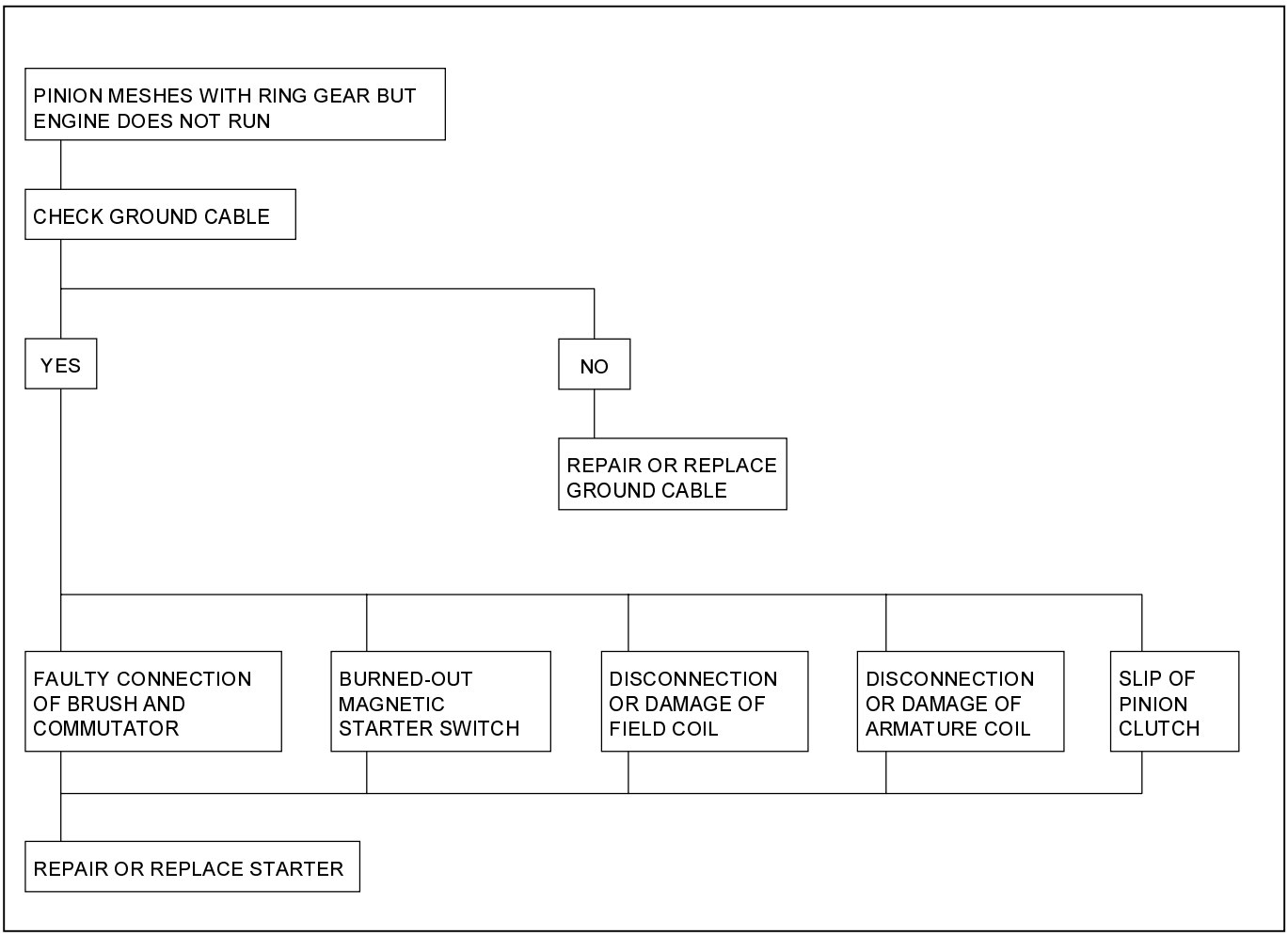
4. QUICK-ON START SYSTEM		
Check point	**Possible cause**	**Correction**
Glow plug indicator light does not turn on.	1. Defective Fusible link wire 2. Broken indicator light fuse 3. Defective indicator bulb	Replace the fusible link wire Replace the indicator light fuse Replace the indicator light bulb
Preheating system dose not work	1. Defective fusible link wire shorted 2. Defective glow plug relay connector 3. Defective glow plug connector 4. Defective quick-on start timer connector	Replace the fusible link wire Replace or Repair glow plug relay connector Replace or Repair glow plug connector Replace or Repair quick-on start timer connector
Preheating time to long or to short	1. Defective thermo switch include defective wiring harness 2. Defective glow plug 3. Defective timer unit	Replace thermo switch Replace glow plug Replace timer unit

Check if battery is normal, then perform the following diagnosis.




FAULTY MESHING OF PINION AND RING GEAR
CHECK IF BATTERY VOLTAGE IS PRESENT AT MAGNETIC SWITCH TERMINAL “S” WHEN STARTER SWITCH IS TURNED TO “START (ST)”
YES
OR
EXTREME WEAR OF PINION AND RING GEAR
REPAIR OR REPLACE STARTER. REPLACE RING GEAR
STARTER SLIDING RESISTANCE IS LARGE
REPAIR OR REPLACE STARTER
NO
UNDER THIS CONDITION, CHECK IF VOLTAGE OF CONNECTOR 3BW ON MAGNETIC SWITCH OF RESTART RELAY IS NORMAL
YES
DISCONNECTION OR FAULTY CONNECTION BETWEEN STARTER SWITCH AND MAGNETIC SWITCH
REPAIR
NO
CHECK IF VOLTAGE IS PRESENT AT WIRING CONNECTOR 3BW ON STARTER SWITCH OF RESTART RELAY
YES
FAULTY CONNECTION OF STARTER SWITCH
REPLACE STARTER SWITCH
NO
DISCONNECTION OR FAULTY CONNECTION BETWEEN STARTER SWITCH AND BATTERY
REPAIR


MAGNETIC SWITCH DOES NOT OPERATE THOUGH STARTER SWITCH IS TURNED TO “START (ST)”
CHECK IF VOLTAGE IS PRESENT AT MAGNETIC SWITCH TERMINAL “S” WHEN STARTER SWITCH IS TURNED TO “START (ST)”
YES
NO
CHECK GROUND CABLE
CHECK IF INDICATOR LAMP ON METER COMES ON NORMALLY
YES
NO
REPAIR
YES
NO
OR
CHECK CONTINUITY STARTER SWITCH AND MAGNETIC SWITCH TERMINAL “S”
DISCONNECTION OR FAULTY CONNECTION BETWEEN BATTERY AND STARTER SWITCH
PINION SLIDING PART DOES NOT MOVE
MAGNETIC SWITCH OR COIL IS DISCONNECTED OR BURNED OUT
REPAIR
CHECK STARTER RELAY
FAULTY CONNECTION OR STARTER SWITCH
REPAIR OR REPLACE STARTER
CHECK CLUTCH START SWITCH
REPLACE STARTER SWITCH


PINION MESHES WITH RING GEAR BUT ENGINE DOES NOT RUN
CHECK GROUND CABLE
YES
NO
REPAIR OR REPLACE GROUND CABLE
FAULTY CONNECTION OF BRUSH AND COMMUTATOR
BURNED-OUT MAGNETIC STARTER SWITCH
DISCONNECTION OR DAMAGE OF FIELD COIL
DISCONNECTION OR DAMAGE OF ARMATURE COIL
SLIP OF PINION CLUTCH
REPAIR OR REPLACE STARTER

2. UNSTABLE IDLING

Check point	Possible cause	Correction
Idling system	Idling improperly adjusted	Adjust the idling
Fast idling speed control device	Defective fast idling speed control device	Repair or replace the fast idling speed control device
Accelerator control system	Accelerator control system improperly adjusted	Adjust the accelerator control system
Fuel system	Fuel system leakage or blockage	Repair or replace the fuel system
	Air in the fuel system	Bleed the air from the fuel system
	Water particles in the fuel system	Change the fuel
Fuel filter	Clogged fuel filter element	Replace the fuel filter element or the fuel filter cartridge
Fuel feed pump	Defective fuel feed pump	Repair or replace the fuel feed pump
Injection nozzle	Injection nozzle sticking	Replace the injection nozzle
	Injection nozzle injection starting pressure too low Improper spray condition	Adjust or replace the injection nozzle
Injection pump	Defective delivery valve resulting in fuel drippage after fuel injection	Replace the delivery valve
Injection pump (Cont'd)	Injection timing improperly adjusted	Adjust the injection timing
	Insufficient injection volume	Adjust the injection volume
	Defective idle spring	Replace the idle spring
	Defective governor lever operation	Repair or replace the governor lever
	Regulator valve improperly adjustment	Adjust or replace the regulator valve
	Broken plunger spring	Replace the plunger spring
	Worn plunger	Replace the plunger assembly
	Worn cam disc	Replace the cam disc
Valve clearance	Valve clearance improperly adjusted	Adjust the valve clearance
Compression pressure	Blown out cylinder head gasket Worn cylinder liner Piston ring sticking between the valve and the valve seat	Replace the related parts

3. INSUFFICIENT POWER

Check point	Possible cause	Correction
Air cleaner	Clogged air cleaner element	Clean or replace the air cleaner element
Fuel	Water particle in the fuel	Replace fuel
Fuel filter	Clogged fuel filter element	Replace the fuel filter element or the fuel filter cartridge
Fuel feed pump	Defective fuel feed pump	Repair or replace the fuel feed pump
Injection nozzle	Injection nozzle sticking	Replace the injection nozzle
	Injection nozzle injection starting pressure too low Improper spray condition	Adjust or replace the injection nozzle
Fuel injection pipes	Fuel injection pipes damaged or obstructed	Replace the fuel injection pipes
Injection pump	Defective regulating valve	Repair or replace the regulating valve
	Defective delivery valve	Replace the delivery valve
	Defective timer	Repair or replace the timer
	Worn cam disk	Replace the cam disk
	Improper control lever operation	Adjust or replace the control lever
	Defective injection timing	Adjust the injection timing Repair or replace the injection pump timer
	Weak governor spring	Replace the governor spring
	Worn plunger	Replace the plunger assembly
Compression pressure	Blown out cylinder head gasket Worn cylinder liner Piston ring sticking	Replace the related parts
Valve clearance	Valve clearance improperly adjusted	Adjust the valve clearance
Valve spring	Valve spring weak or broken	Replace the valve spring
Exhaust system	Exhaust pipe clogged	Clean the exhaust pipe
Full load adjusting screw seal	Open and improperly set adjusting screw seal	Adjust and reseal the adjusting screw

4. EXCESSIVE FUEL CONSUMPTION

Check point	Possible cause	Correction
Fuel system	Fuel leakage	Repair or replace the fuel system related parts
Air cleaner	Clogged air cleaner element	Clean or replace the air cleaner element
Idling speed	Poorly adjusted idling speed	Adjust the idling speed
Injection nozzle	Injection nozzle injection starting pressure too low Improper spray condition	Adjust or replace the injection nozzle
Fuel injection timing	Fuel injection timing improperly	Adjust the fuel injection timing
Injection pump	Defective delivery valve resulting is fuel drippage after fuel injection	Replace the delivery valve
Valve clearance	Valve clearance improperly adjusted	Adjust the valve clearance
Compression pressure	Blown out cylinder head gasket Worn cylinder liner Piston ring sticking	Replace the related parts
Valve spring	Valve spring weak or broken	Replace the valve spring

5. EXCESSIVE OIL CONSUMPTION

Check point	Possible cause	Correction
Engine oil	Engine oil unsuitable Too much engine oil	Replace the engine oil Correct the engine oil level
Oil seal and gasket	Oil leakage from the oilseal and/or the gasket	Replace the oil seal and/or the gasket
Air breather	Clogged air breather	Clean the air breather
Intake and exhaust valve	Worn valve stems and valve guides	Replace the intake and exhaust valves and the valve guides

6. OVERHEATING

Check point	Possible cause	Correction
Cooling water	Insufficient cooling water	Replenish the cooling water
Fan clutch	Oil leakage from the fan clutch	Replace the fan clutch
Fan belt	Fan belt loose or cracked causing slippage	Replace the fan belt
Radiator	Defective radiator cap or clogged radiator core	Replace the radiator cap or clean the radiator core
Water pump	Defective water pump	Repair or replace the water pump
Cylinder head and cylinder body sealing cap	Defective sealing cap resulting in water leakage	Replace the sealing cap
Thermostat	Defective thermostat	Replace the thermostat
Cooling system	Cooling system clogged by foreign material	Clean the foreign material from the cooling system
Fuel injection timing	Fuel injection timing improperly adjusted	Adjust the fuel injection timing

7. WHITE EXHAUST SMOKE

Check point	Possible cause	Correction
Fuel	Water particles in the fuel	Replace the fuel
Fuel injection timing	Delayed fuel injection timing	Adjust the fuel injection timing
Compression pressure	Blown out cylinder head gasket Worn cylinder liner Piston ring sticking	Replace the related parts
Inlet and exhaust valves Valves seals	Defective valve seales Worn valves stems and valve guides	Replace the valve seales, the valves, and the valve guides

8. DARK EXHAUST SMOKE

Check point	Possible cause	Correction
Air cleaner	Clogged air cleaner element	Clean or replace the air cleaner element
Injection nozzle	Injection nozzle injection starting pressure too low Improper spray condition	Adjust or replace the injection nozzle
Fuel injection timing	Fuel injection timing improperly adjusted	Adjust the fuel injection timing
Injection pump	Defective delivery valve resulting in fuel drippage after fuel injection	Replace the delivery valve
	Excessive injection volume	Adjust the injection volume

9. OIL PRESSURE DOES NOT RISE

Check point	Possible cause	Correction
Engine oil	Improper viscosity engine oil Insufficient engine oil	Replace the engine oil Correct the engine oil volume
Oil pressure gauge or unit Oil pressure indicator light	Defective oil pressure gauge or unit Defective indicator light	Repair or replace the oil pressure gauge or unit Replace the indicator light
Oil filter	Clogged oil filter element	Replace the oil filter element or the oil filter cartridge
Relief valve and by-pass valve	Relief valve sticking and/or weak by-pass valve spring	Replace the relief valve and/or the by-pass valve spring
Oil pump	Clogged oil pump strainer	Clean the oil pump strainer
	Worn oil pump related parts	Replace the oil pump related parts
Rocker arm shaft	Worn rocker arm bushing	Replace the rocker arm bushing
Camshaft	Worn camshaft and camshaft bearing	Replace the camshaft and the camshaft bearing
Crankshaft and bearings	Worn crankshaft and bearings	Replace the crankshaft and/or the bearings

10. ABNORMAL ENGINE NOISE

1. ENGINE KNOCKING

Check to see that the engine has been thoroughly warmed up before beginning the troubleshooting procedure.

Check point	Possible cause	Correction
Fuel	Fuel unsuitable	Replace the fuel
Fuel injection timing	Fuel injection timing improperly adjusted	Adjust the fuel injection timing
Injection nozzle	Improper injection nozzle starting pressure and spray condition	Adjust or replace the injection nozzle
Compression pressure	Blown out head gasket	Broken piston ring Replace the head gasket or the piston ring
2. GAS LEAKAGE NOISE		
Exhaust pipes	Loosely connected exhaust pipes Broken exhaust pipes	Tighten the exhaust pipe connections Replace the exhaust pipes
Injection nozzles and/or glow plugs	Loose injection nozzles and /or glow plugs	Replace the washers Tighten the injection nozzles and/or the glow plugs
Exhaust manifold	Loosely connected exhaust manifold and/or glow plugs	Tighten the exhaust manifold connections
Cylinder head gasket	Damaged cylinder head gasket	Replace the cylinder head gasket
3. CONTINUOUS NOISE		
Fan belt	Loose fan belt	Readjust the fan belt tension
Cooling fan	Loose cooling fan	Retighten the cooling fan
Water pump bearing	Worn or damaged water pump bearing	Replace the water pump bearing
Alternator or vacuum pump	Defective alternator or vacuum pump	Repair or replace the alternator or the vacuum pump
Valve clearance	Clearance improperly adjust	Adjust the valve clearance

4. SLAPPING NOISE		
Check point	**Possible cause**	**Correction**
Valve clearance	Valve clearance improperly adjusted	Adjust the valve clearance
Rocker arm	Damaged rocker arm	Replace the rocker arm
Flywheel	Loose flywheel bolts	Retighten the flywheel bolts
Crankshaft and thrust bearings	Worn or damaged crankshaft and/or thrust bearings	Replace the crankshaft and/or the thrust bearings
Crankshaft and connecting rod bearings	Worn or damaged crankshaft and/or connecting rod bearings	Replace the crankshaft and/or the connecting rod bearings
Connecting rod bushing and piston pin	Worn or damaged connecting rod bushing and piston pin	Replace the connecting rod bushing and/or the piston pin
Piston and cylinder liner	Worn or damaged piston and cylinder liner Foreign material in the cylinder	Replace the piston and the cylinder liner

11. ENGINE COOLING TROUBLE

Condition	Possible cause	Correction
Engine overheating	Low coolant level	Replenish
	Thermo unit faulty	Replace
	Faulty thermostat	Replace
	Faulty coolant unit	Repair or replace
	Clogged radiator	Clean or replace
	Faulty radiator cap	Replace
	Low engine oil level or use of improper engine oil	Replenish or change oil Replenish
	Damaged cylinder head gasket	Replace
	Clogged exhaust system	Clean exhaust system or replace faulty parts
	Loose fan belt	Adjust
	Excessive fuel injected	Adjust
	Improper injection timing	Adjust
Engine overcooling	Faulty thermostat	Replace
Too long engine warm-up time	Faulty thermostat	Replace
	Thermo unit faulty	Replace

12. STARTER MOTOR DOES NOT STOP

STARTER DOES NOT STOP THOUGH STARTER SWITCH IS RETURNED TO “ON”

DISCONNECTED STARTER SWITCH WIRING CONNECTOR, AND CHECK STARTER SWITCH OPERATION.

STARTER SWITCH KEY POSITION		Connector No.	B-67				B-68				
		Terminal No.	1	2	3	4	1	2	4	5	6
		Terminal No.	ACC	B	ON	ST	B_1	P_1	P_2	W	W
OFF	LOCK						○—○				
ON	ACC		○—○							○—○	
	ON		○—○	○—○	○		○—○		○		
	START			○—○	○—○	○	○—○		○		

THERE MUST BE NO CONTINUITY EXCEPT ABOVE LINES.

YES

MAGNETIC SWITCH CONTACTS ARE FUSED AND NOT MOVED, OR A RETURN SPRING IS BROKEN OR DETERIORATED

REPLACE MAGNETIC SWITCH

NO

REPLACE STARTER SWITCH

MAIN DATA AND SPECIFICATIONS

MAIN DATA AND SPECIFICATIONS

Item \ Engine Model			4HF1	4HF1-2
Engine type			Four-cycle, overhead camshaft, water cooled	
Combustion chamber type			Direct injection	
Cylinder liner type			Dry liner, special compound metal	
Timing drive system			Gear drive	
No. of cylinders - Bore x stroke		mm (in)	4 - 112 × 110 (4 - 4.41 × 4.33)	
No. of piston rings			Compression rings: 2, Oil ring: 1	
Total piston displacement		cm^3 (in^3)	4334 (264.5)	
Compression ratio		to : 1	19.0	
Compression pressure		kPa (kg / cm^2 / psi) - rpm	3,040 (31/441) – 200	3,226 (32.9/468) - 200
Fuel injection order			1 - 3 - 4 - 2	
Fuel injection timing (BTDC)		deg	8 7° (Taiwan only)	12
Specified fuel type			SAE No. 2 diesel fuel	
Idling speed		rpm	550 ~ 600 (M/T)	575 ~ 625 (M/T)
Valve system				
Valve clearances (At cold): Intake		mm (in)	0.4 (0.016)	
	Exhaust	mm (in)	0.4 (0.016)	
Valve timing (At valve clearances 0.4 mm (0.016 in))				
Intake valves	Open at (BTDC)	deg	18	
	Close at (ABDC)	deg	50	
Exhaust valves	Open at (BBDC)	deg	51	
	Close at (ATDC)	deg	17	
Fuel system				
Injection pump type			Bosch in-line type with automatic timer	Bosch “VE” distributor with automatic timer
Plunger outside diameter		mm (in)	9.5 (0.374)	12 (0.472)
Plunger lift		mm (in)	11.0 (0.433)	2.8 (0.110)
Governor type			RLD-F mechanical (Variable speed)	Half all speed governor
Automatic timer type			SCDM, centrifugal, flyweight	Hydraulic speed sensing type
Fuel feed pump type			Piston	Vane
Injection nozzle type				
Injection nozzle type			Hole type (with 5 orifices)	
Pressure		MPa (kg / cm^2 / psi)	18.1 (185 / 2,631)	
Pressure adjustment			Shim adjusted	
Main fuel filter type			Disposal spin-on cartridge and remote mounted water separator	

Item \ Engine Model		4HF1	4HF1-2
Lubricating system			
Lubrication method		Full flow pressure circulation	
Specified engine oil (API grade)		CD or above	
Oil pressure	kPa (kg /cm^2 / psi) - rpm	147 (1.5 / 21)-700 (SAE 10W-30 API CD grade engine oil at 80°C (176°F))	
Oil pump type		Gear type	
Oil filter type		Spin-on cartridge	
Oil capacity	lit (US / UK gal)	10.5 (2.77 / 2.31)	
Oil cooler type		Water cooled	
Cooling system			
Radiator type		Corrugated fin with reserve tank	
Coolant capacity	lit (US / UK gal)	12 (3.17 / 2.64)	
Water pump type		Centrifugal impeller, V-belt drive	
Pump to crankshaft speed ratio	to : 1	1.16 (175 / 151)	
Delivery volume	lit (US / UK gal)/min	200 (52.8 / 44.0) (Pump speed at 3,300 rpm Water temperature at 82°C (180°F))	
Pump bearing type		Double row shaft	
Thermostat type		Wax pellet	
Valve initial opening temperature	°C (°F)	With jiggle valve: Primary : 85±1.5 (182 - 188)	Without jiggle valve (Heaterless): Primary : 85±1.5 (182 - 188) Secondary: 82±1.5 (177 - 182)
Valve lift	mm (in)	8 (0.3) or more at 95°C (203°F)	
Air cleaner type		Dry paper element	
Battery type	Volt-amp.hr.	55D23R / 12-60 : 2 pcs	
Generator			
Type		AC brush with IC regulator and vacuum pump	
Voltage	V	24	
Drive and rotation		V-belt, clockwise viewed from the drive pulley	
Ground polarity		Negative	
Maximum output	A	35 at 5,000 rpm (For Thailand and Indonesian) / 60 at 5,000 rpm	50 at 5,000 rpm / 80 at 5,000 rpm
Maximum speed	rpm	7,500 ~ 10,000	

Item \ Engine Model		4HF1	4HF1-2
Regulator			
Type		IC	
Regulating voltage	V	28 - 29	
Vacuum pump			
-500 mmHg (-9.67 psi / -66.7 kPa) build-up time		13 seconds or less at 1,000 rpm 4 seconds or less at 5,000 rpm	
Maximum vacuum		-680 mmHg (-13.1 psi / -90.7 kPa) or more at 5,000 rpm	
Starter motor			
Type		Magnetic solenoid-controlled	
Model		S25-168	
Rated voltage	V	24	
Rated output	kW	4.0	
Load characteristics			
Terminal voltage	V	18.55	
Load current	A	250	
Torque	N•m (kg•m / lb•ft)	14.22 (1.45 / 10.49) at 1,500 rpm or more	
Preheating system		Quick-On-Start System II	
Exhaust system			
Pipe outside diameter X thickness			
Front pipe	mm (in)	60.5 x 2.0 (2.38 x 0.079)	
Middle pipe	mm (in)	60.5 x 2.0 (2.38 x 0.079)	
Rear pipe	mm (in)	60.5 x 1.6 (2.38 x 0.063)	
Silencer		Circular section-shell construction of triple	
Type		skin and end plates, internal construction of baffles and perforated tubes	
Inside diameter	mm (in)	Approximately 200 (7.87)	

MAIN DATA AND SPECIFICATIONS

GENERAL SPECIFICATIONS

Item \ Engine Model			4HG1	4HG1-T
Engine type			Four-cycle, overhead camshaft, water cooled	
Combustion chamber type			Direct injection	
Cylinder liner type			Dry liner, special compound metal	
Timing drive system			Gear drive	
No. of cylinders - Bore × stroke		mm (in)	4 - 115 × 110 (4 - 4.53 × 4.33)	
No. of piston rings			Compression rings: 2, Oil ring: 1	
Total piston displacement		cm^3 (in^3)	4570 (278.9)	
Compression ratio		to : 1	19.0	
Compression pressure		kPa (kg / cm^2 / psi) - rpm	3,226 (32.9/468) - 200	
Fuel injection order			1 - 3 – 4 - 2	
Fuel injection timing (BTDC)		deg	9	7 (Except Colombia) 9 (For Colombia)
Specified fuel type			SAE No. 2 diesel fuel	
Idling speed		rpm	550 ~ 600 (M/T)	600 ~ 650 (M/T)
Valve system				
Valve clearances (At cold): Intake		mm (in)	0.4 (0.016)	
	Exhaust	mm (in)	0.4 (0.016)	
Valve timing (At valve clearances 0.4 mm (0.016 in))				
Intake valves	Open at (BTDC)	deg	18	
	Close at (ABDC)	deg	50	
Exhaust valves	Open at (BBDC)	deg	51	
	Close at (ATDC)	deg	17	
Fuel system				
Injection pump type			Bosch in-line type with automatic timer	
Plunger outside diameter		mm (in)	9.5 (0.374)	10.5 (0.413)
Plunger lift		mm (in)	11.0 (0.433)	
Governor type			RLD-F mechanical (Variable speed)	
Automatic timer type			SCDM, centrifugal, flyweight	
Fuel feed pump type			Piston	
Injection nozzle opening				
Injection nozzle type			Hole type (with 5 orifices)	
Pressure		MPa (kg / cm^2 / psi)	18.1 (185 / 2,631)	1st 18.1 (185 / 2,631) 2nd 21.1 (215 / 3,057)
Pressure adjustment			Shim adjusted	
Main fuel filter type			Disposal spin-on cartridge and remote mounted water separator	

Item \ Engine Model	4HG1	4HG1-T
Lubricating system		
Lubrication method	Full flow pressure circulation	
Specified engine oil (API grade)	CD or above	
Oil pressure kPa (kg /cm^2 / psi) - rpm	147 (1.5 / 21)-700 (SAE 10W-30 API CD grade engine oil at 80°C (176°F))	
Oil pump type	Gear type	
Oil filter type	Spin-on cartridge	
Oil capacity lit (US / UK gal)	10.5 (2.77 / 2.31)	
Oil cooler type	Water cooled	
Cooling system		
Radiator type	Corrugated fin with reserve tank	
Coolant capacity lit (US / UK gal)	12 (3.17 / 2.64)	
Water pump type	Centrifugal impeller, V-belt drive	
Pump to crankshaft speed ratio to : 1	1.19 (175 / 147)	
Delivery volume lit (US / UK gal)/min	200 (52.8 / 44.0) (Pump speed at 3,300 rpm Water temperature at 82°C (180°F))	
Pump bearing type	Double row shaft	
Thermostat type	Wax pellet	
Valve initial opening temperature °C (°F)	With jiggle valve: Primary : 85±1.5 (182 - 188)	Without jiggle valve (Heaterless): Primary : 85±1.5 (182 - 188) Secondary: 82±1.5 (177 - 182)
Valve lift mm (in)	8 (0.3) or more at 95°C (203°F)	
Air cleaner type	Dry paper element or oil bath	
Battery type Volt-amp.hr.	75D23R / 12-65 : 2 pcs	
Generator		
Type	AC brush with IC regulator and vacuum pump	
Voltage V	24	12 or 24
Drive and rotation	V-belt, clockwise viewed from the drive pulley	
Ground polarity	Negative	
Maximum output A	35 at 5,000 rpm	50 at 5,000 rpm
	60 at 5,000 rpm	80 (12V) at 5,000 rpm
Maximum speed rpm	7,500 ~ 10,000	

Item \ Engine Model		4HG1	4HG1-T	
Regulator				
Type			IC	
Regulating voltage	V	28 - 29	14.4 ± 0.3	28 - 29
Vacuum pump				
-66.7kPa (-500 mmHg / -9.67 psi) build-up time			13 seconds or less at 1,000 rpm 4 seconds or less at 5,000 rpm	
Maximum vacuum			-90.7 kPa (-680 mmHg / -13.1 psi) or more at 5,000 rpm	
Starter motor				
Type			Magnetic solenoid-controlled	
Model		S25-168	R3.0	S25 - 168
Rated voltage	V	24	12	24
Rated output	kW	4.0	3.0	4.0
Load characteristics				
Terminal voltage	V	18.55	14.0	18.55
Load current	A	250	890 (MAX)	250
Torque	N•m (kg•m / lb•ft)	14.22 (1.45 / 10.49) at 1,500 rpm or more	29.4 (2.99 / 21.63) at 860 rpm or more	14.22 (1.45 / 10.49) at 1,500 rpm or more
Preheating system			Quick-On-Start System II	
Exhaust system				
Pipe outside diameter x thickness				
Front pipe	mm (in)		60.5 x 2.0 (2.38 x 0.079)	
Middle pipe	mm (in)		60.5 x 2.0 (2.38 x 0.079)	
Rear pipe	mm (in)		60.5 x 1.6 (2.38 x 0.063)	
Silencer type			Circular section-shell construction of triple skin and end plates, internal construction of baffles and perforated tubes	
Inside diameter	mm (in)		Approximately 200 (7.87)	

MAIN DATA AND SPECIFICATIONS

GENERAL SPECIFICATIONS

Item \ Engine Model			4HE1-T	4HE1-TC
Engine type			Four-cycle, overhead camshaft, water cooled	
Combustion chamber type			Direct injection	
Cylinder liner type			Dry liner, special compound metal	
Timing drive system			Gear drive	
No. of cylinders - Bore × stroke		mm (in)	4 - 110 × 125 (4 - 4.33 × 4.92)	
No. of piston rings			Compression rings 2, oil ring 1	Compression rings 3, oil ring 1
Total piston displacement		cm^3 (in^3)	4751(289.9)	
Compression ratio		to : 1	18	17.3
Compression pressure		kPa (kg / cm^2 / psi) - rpm	3,040 (31/441) - 200	
Fuel injection order			1 - 3 - 4 - 2	
Fuel injection timing (BTDC)		deg	7	8
Specified fuel type			SAE No. 2 diesel fuel	
Idling speed		rpm	550 ~ 600 (M/T) 640 ~ 690 (A/T)	775 ~ 825 (M/T) 775 ~ 825 (A/T)
Valve system				
Valve clearances (At cold): Intake		mm (in)	0.4 (0.016)	
Exhaust		mm (in)	0.4 (0.016)	
Valve timing (At valve clearances 0.4 mm (0.016 in))				
Intake valves	Open at (BTDC)	deg	14	
	Close at (ABDC)	deg	51	
Exhaust valves	Open at (BBDC)	deg	49	
	Close at (ATDC)	deg	16	
Fuel system				
Injection pump type			Bosch in-line type with automatic timer	
Plunger outside diameter		mm (in)	10 (0.394)	11 (0.433)
Plunger lift		mm (in)	9.0 (0.354)	12 (0.472)
Governor type			RLD-F mechanical (Variable speed)	RLD-M mechanical (Variable speed)
Automatic timer type			SCDM, centrifugal, flyweight	
Fuel feed pump type			Piston	
Injection nozzle opening				
Injection nozzle type			Hole type (with 5 orifices)	Hole type (with 6 orifices)
Pressure		MPa (kg / cm^2 / psi)	1st 17.5 (180 / 2,560) 2nd 21.57 (220 / 3,128)	21.57 (220 / 3,128)
Pressure adjustment			Shim adjusted	
Main fuel filter type			Disposal spin-on cartridge and remote mounted water separator	

Item \ Engine Model		4HE1-T	4HE1-TC
Lubricating system			
Lubrication method		Full flow pressure circulation	
Specified engine oil (API grade)		CD or above	
Oil pressure	kPa (kg /cm^2 / psi) - rpm	147 (1.5 / 21)-700 (SAE 10W-30 API CD grade engine oil at 80°C (176°F))	
Oil pump type		Gear type	
Oil filter type		Spin-on cartridge	
Oil capacity	lit (US / UK gal)	13 (3.43 / 2.86)	
Oil cooler type		Water cooled	
Cooling system			
Radiator type		Corrugated fin with reserve tank	
Coolant capacity	lit (US / UK gal)	14 (3.70 / 3.08)	
Water pump type		Centrifugal impeller, V-belt drive	
Pump to crankshaft speed ratio	to : 1	1.16	
Delivery volume	lit (US / UK gal)/min	200 (52.8 / 44.0) (Pump speed at 3,300 rpm Water temperature at 82°C (180°F))	
Pump bearing type		Double row shaft	
Thermostat type		Wax pellet	
		Without jiggle valve	With jiggle valve
Valve initial opening temperature	°C (°F)	Primary : 80 - 184 (176 - 183) Secondary: 83 - 87 (181 - 189)	83.5 – 86.5 (182 - 188) -
Valve lift	mm (in)	8 (0.3) or more at 95°C (203°F)	8 (0.3) or more at 100°C (212°F)
Air cleaner type		Dry paper element or wet paper element	
Battery type	Model / Volt-amp.hr.	75D23R / 12-65 : 2 pcs	80D26R / 12-65 : 2 pcs
Generator			
Type		AC brush with IC regulator and vacuum pump	
Voltage	V	24	12 or 24
Drive and rotation		V-belt, clockwise viewed from the drive pulley	
Ground polarity		Negative	
Maximum output	V / A / rpm	24 / 35 at 5,000 (Denso) 24 / 60 at 5,000 (Hitachi)	24 / 50 at 5,000 (Hitachi) 12 / 80 at 5,000 (Hitachi)
Maximum speed	rpm	7,500 ~ 10,000	

Item \ Engine Model		4HE1-T	4HE1-TC	
Regulator				
Type			IC	
Regulating voltage	V	28 - 29	14.4 ± 0.3	28 - 29
Vacuum pump				
-500 mmHg (-9.67 psi / -66.7 kPa) build-up time			13 seconds or less at 1,000 rpm 4 seconds or less at 5,000 rpm	
Maximum vacuum	mmHg (psi / kPa)		-680 (-13.1 / -90.7) or more at 5,000 rpm	
Starter motor				
Type			Magnetic solenoid-controlled	
Model		S25-305A	R3.0	S25-305A
Rated voltage	V	24	12	24
Rated output	kW	4.5	3.0	4.5
Load characteristics				
Terminal voltage	V	14.30	14.0	14.30
Load current	A	400	890 (MAX)	400
Torque	N•m (kg•m / lb•ft)	28.44 (2.90 / 20.98) at 1,500 rpm or more	29.4 (2.99 / 21.63) at 860 rpm or more	28.44 (2.90 / 20.98) at 1,500 rpm or more
Preheating system			Quick-On-Start System II	
Exhaust system				
Pipe outside diameter x thickness				
Front pipe	mm (in)		60.5 x 2.0 (2.38 x 0.079)	
Middle pipe	mm (in)		60.5 x 2.0 (2.38 x 0.079)	
Rear pipe	mm (in)		60.5 x 1.6 (2.38 x 0.063)	
Silencer type			Circular section-shell construction of triple skin and end plates, internal construction of baffles and perforated tubes	
Inside diameter	mm (in)		Approximately 200 (7.87)	

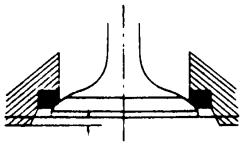
SERVICE STANDARD

Item	Service Standard	Service Limit

ENGINE

Compression Pressure KPa (kg / cm^2 / psi) / rpm	3040 (31 / 441) or more Variance in pressure between the cylinders: less than 294 (3 / 43) / 200	2,157 (22 / 312)

CYLINDER HEAD

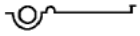
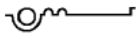
Inlet and Exhaust Valve Seat Depression mm (in) 	0.7 - 1.2 (0.028 - 0.047) Measurement should be taken by using a new valve.	2.5 (0.098)
Cylinder Head Lower Face Warpage mm (in)	0.05 (0.002) or less Do not regrind the cylinder head lower face.	0.2 (0.008)
Manifold Fitting Face Warpage mm (in)	0.05 (0.002) or less	0.2 (0.008)
Water Leak Test kPa (kg / cm^2 / psi)	490 (5 / 71) - 3 minutes	Repair or replace those having water leak.

Cylinder Head Gasket Selection
mm (in)

Remarks:
The grade mark of the cylinder head gasket is shown by semicircular notches on the left side of the front portion of the gasket.

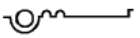
4HF1/4HF1-2/4HG1-T

Cylinder Head Gasket Selection mm (in)

Gasket Grade		Ti max	Gasket Thickness (Reference)
A		0.579 - 0.659 (0.0228 - 0.0259)	1.70 (0.0669)
B		0.659 - 0.739 (0.0259 - 0.0291)	1.75 (0.0689)
C		0.739 – 0.819 (0.0291 – 0.0322)	1.80 (0.0708)

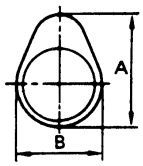
4HE1-T/4HE1-TC

Cylinder Head Gasket Selection mm (in)

Gasket Grade		Ti max	Gasket Thickness (Reference)
A		0.529 - 0.609 (0.0208 - 0.0240)	1.70 (0.0669)
B		0.609 - 0.679 (0.0240 - 0.0267)	1.75 (0.0689)
C		0.679 – 0.759 (0.0267 – 0.0300)	1.80 (0.0708)

Item	Service Standard	Service Limit

CAMSHAFT

Cam Height 	mm (in)	52.75 - 52.91 (2.076 - 2.083)	51.8 (2.039)
Camshaft Journal Uneven Wear	mm (in)	0.015 (0.0006) or less	0.05 (0.002)
Camshaft Journal Wear	mm (in)	39.950 - 39.975 (1.5728 - 1.5738)	39.850 (1.569)
Camshaft Journal and Bearing Clearance	mm (in)	0.025 - 0.087 (0.00098 - 0.00343)	0.15 (0.0059)
Camshaft Run-Out	mm (in)	0.04 (0.0016) or less against the adjacent journal	0.05 (0.002)

ROCKER ARM AND ROCKER ARM SHAFT

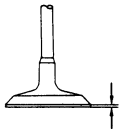
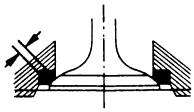
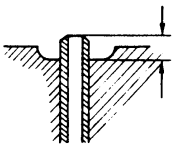
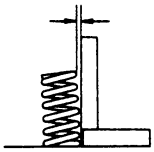
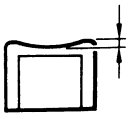
Rocker Arm Shaft Wear	mm (in)	21.979 – 22.000 (0.8653 – 0.8661)	21.85 (0.860)
Rocker Arm Bushing Wear	mm (in)	22.010 – 22.035 (0.8665 – 0.8675)	22.15 (0.872)
Rocker Arm and Rocker Arm Shaft Clearance	mm (in)	0.010 - 0.056 (0.0004 - 0.0022)	0.2 (0.008)
Rocker Arm Shaft Run-Out	mm (in)		0.3 (0.012)
Rocker Arm Roller and Pin Clearnace	mm (in)	0.040 - 0.084 (0.0016 - 0.0033)	0.5 (0.020)
Roller Surface			When there is an excessive wear or deformation found, replace it. When it is damaged only slightly, correct it with an oil stone.

VALVE

Valve Stem Wear mm (in)	Inlet	8.946 - 8.961 (0.3522 - 0.3528)	8.88 (0.35)
	Exhaust	8.921 - 8.936 (0.3512 - 0.3529)	8.80 (0.34)
Valve Stem and Valve Guide Clearance mm (in)	Inlet	0.038 - 0.071 (0.0015 - 0.0028)	0.20 (0.0079)
	Exhaust	0.064 - 0.096 (0.0025 - 0.0038)	0.25 (0.0098)

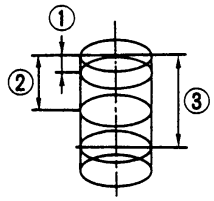
Item	Service Standard	Service Limit

VALVE (CONT.)

Valve Guide and Cylinder Head Interference mm (in)		0.005 - 0.040 (0.0020 - 0.0016) Press it in with the valve guide applied with engine oil.	
Valve Thickness mm (in) 	Inlet	Nominal size 1.80 (0.071)	1.3 (0.051)
	Exhaust	Nominal size 1.75 (0.069)	1.3 (0.051)
Valve Contact Width mm (in) 	Inlet	Nominal size 2.5 (0.098)	3.0 (0.118)
	Exhaust	Nominal size 2.0 (0.079)	2.5 (0.098)
Valve Guide Upper End Height mm (in) 		14.1±0.2 (0.555±0.008)	
Valve Stem Seal Lip Wear mm (in)		8.3 - 8.7 (0.3268 - 0.3425)	8.8 (0.346)
Valve Spring Tension N (kg / lb)		414 – 477 (42.2 - 48.6 / 93 - 107) Set length 47.0 mm (1.85 in)	40.9 (98 / 401)
Valve Spring Free Height mm (in)		Nominal size 62.5 (2.46)	59.4 (2.34)
Valve Spring Squareness mm (in) 			1.0 (0.04)
Valve Clearance (At cold) mm (in)		0.4 (0.016)	
Valve Stem Cap Wear mm (in) 			0.5 (0.02) Replace it when worn or deformed excessively.

Item	Service Standard	Service Limit

CYLINDER BODY

<table>
<tr>
<td>Cylinder Liner Bore Wear mm (in)
 
① 20 mm (0.79 in)
② 90 mm (3.54 in)
③ 160 mm (6.30 in)</td>
<td>4HF1:
4HF1-2: 112.021 - 112.050 (4.4103 - 4.4114)

4HG1:
4HG1-T: 115.021 - 115.050 (4.5284 - 4.5295)

4HE1-T:
4HE1-TC: 110.041 - 110.080 (4.3323 - 4.3338)</td>
<td>112.20 (4.417)

115.20 (4.535)

115.20 (4.535)</td>
</tr>
<tr>
<td>Cylinder Liner Grade Selection

Remarks:
Cylinder Bore Grade Mark Position
The grade mark (1, 2 or 3) of the cylinder bore is stamped on the position just beside each cylinder on the upper left side (the upper portion of the oil cooler installation face) of the cylinder body.

Cylinder Liner Grade Mark Position
The outside diameter grade mark (1, 2 or 3) of the cylinder liner is stamped on the position approximately 160mm from the top face of the liner.</td>
<td colspan="2">4HF1/4HF1-2
<table>
<tr><th>Line Grade</th><th>Cylinder Bore Diameter mm (in)</th><th>Service Grade</th><th>Liner Outside Diameter mm (in)</th></tr>
<tr><td>1</td><td>115.001 - 115.010 (4.5276 - 4.5279)</td><td>1X</td><td>114.991 - 115.000 (4.5272 - 4.5276)</td></tr>
<tr><td>2</td><td>115.011 - 115.020 (4.5280 - 4.5283)</td><td rowspan="2">3X</td><td rowspan="2">115.001 - 115.010 (4.5276 - 4.5279)</td></tr>
<tr><td>3</td><td>115.021 - 115.030 (4.5284 - 4.5287)</td></tr>
</table>
4HG1/4HG1-T
<table>
<tr><td>1</td><td>118.001 - 118.010 (4.6457 - 4.6461)</td><td>1X</td><td>117.991 - 118.000 (4.6453 - 4.6457)</td></tr>
<tr><td>2</td><td>118.011 - 118.020 (4.6461 - 4.6464)</td><td rowspan="2">3X</td><td rowspan="2">118.001 - 118.010 (4.6457 - 4.6461)</td></tr>
<tr><td>3</td><td>118.021 - 118.030 (4.6465 - 4.6468)</td></tr>
</table>
4HE1-T / 4HE1-TC
<table>
<tr><td>1</td><td>115.001 - 115.010 (4.5276 - 4.5279)</td><td>1X</td><td>115.021 - 115.030 (4.5284 - 4.5287)</td></tr>
<tr><td>2</td><td>115.011 - 115.020 (4.5280 - 4.5283)</td><td rowspan="2">3X</td><td rowspan="2">115.031 - 115.040 (4.5289 - 4.5291)</td></tr>
<tr><td>3</td><td>115.021 - 115.030 (4.5284 - 4.5287)</td></tr>
</table></td>
</tr>
<tr>
<td>Cylinder Liner Projection mm (in)</td>
<td>0.10 - 0.14 (0.0039 - 0.0055)
The difference in the cylinder liner projection height between any two adjacent cylinders must not exceed 0.03 (0.0012)</td>
<td>There must be a projection on the cylinder liner.</td>
</tr>
<tr>
<td>Cylinder Body Upper Face Warpage mm (in)</td>
<td>0.05 (0.002) or less

Do not regrind the cylinder body upper face.</td>
<td>0.02 (0.008)</td>
</tr>
<tr>
<td>Water Leak Test kPa (kg / cm^2 / psi)</td>
<td>490 (5 / 71) - 3 minutes</td>
<td>Repair or replace those having water leak.</td>
</tr>
</table>

Item	Service Standard	Service Limit

CRANKSHAFT

Crankshaft Jurnal and Crankpin Uneven Wear mm (in)			0.05 (0.002)
Crankshaft Journal Wear mm (in)	No. 1, 2, 4 and 5	81.905 - 81.925 (3.2246 - 3.2254)	81.85 (3.2224)
	No. 3	81.890 - 81.910 (3.2240 - 3.2248)	81.85 (3.2224)
Crankshaft Journal and Bearing Clearance mm (in)	No. 1, 2, 4 and 5	0.037 - 0.072 (0.0015 - 0.0028)	0.11 (0.0043)
	No. 3	0.051 - 0.086 (0.0020 - 0.0034)	0.11 (0.0043)

Crankshaft Journal Bearing Selection mm (in)

Remarks:

Crankshaft Bearing Housing Grade Mark Position

The crankshaft bearing housing grade marks (1 or 2) are stamped collectively for all cylinders on the underside of the left front portion of the cylinder body.

Crankshaft Journal Grade Mark Position

The crankshaft journal grade marks (1 or 2) are stamped collectively for all cylinders on the front side of the crankshaft No. 1 balancer

Crankshaft Bearing Grade Mark Position

The identification color code (black, brown or blue) of the crankshaft journal bearing grade mark is applied on the side of each bearing.

Crankshaft Journal No. 1, 2, 4 and 5

Bearing Housing		Crankshaft Journal		Crankshaft Bearing Color Code
Grade Mark	(Reference) Inside Diameter	Grade Mark	(Reference) Outside Diameter	
1	87.000 - 87.009 (3.4252 - 3.4255)	1	81.905 - 81.915 (3.2246 - 3.2250)	Black
		2	81.916 - 81.925 (3.2250 - 3.2254)	Brown
2	87.010 - 87.019 (3.4256 - 3.4259)	1	81.905 - 81.915 (3.2246 - 3.2250)	Blue
		2	81.916 - 81.925 (3.2250 - 3.2254)	Black

Crankshaft Journal No. 3

Bearing Housing		Crankshaft Journal		Crankshaft Bearing Color Code
Grade Mark	(Reference) Inside Diameter	Grade Mark	(Reference) Outside Diameter	
1	87.000 - 87.009 (3.4252 - 3.4255)	1	81.890 - 81.900 (3.2240 - 3.2244)	Black
		2	81.901 - 81.910 (3.2244 - 3.2248)	Brown
2	87.010 - 87.019 (3.4256 - 3.4259)	1	81.890 - 81.900 (3.2240 - 3.2244)	Blue
		2	81.901 - 81.910 (3.2244 - 3.2248)	Black

Item	Service Standard	Service Limit

CRANKSHAFT (CONT.)

Crankpin Wear	4HF1, 4HG1, 4HG1-T: 65.902 - 65.992 (2.5946 - 2.5954) 4HE1-T, 4HE1-TC: 72.920 - 72.922 (2.8709 - 2.8433)	65.85 (2.5925) 72.850 (2.8681)
Crankshaft Journal Bearing Spread mm (in)		87 (3.43)
Crankshaft End Play mm (in)	0.104 - 0.205 (0.0041 - 0.0081)	0.35 (0.014)
Crankshaft Run-Out mm (in)	0.05 (0.002) or less	0.3 (0.012)
Crankshaft Front and Rear Oil Seal and Slinger Wear		When there is an oil leak found, the oil seal and slinger must be replaced as a set. Insert it securely with a special tool.

PISTON

Piston and Cylinder Liner Clearance mm (in)	4HF1: 0.081 - 0.113 (0.0032 - 0.0044) 4HG1: 0.081 - 0.116 (0.0032 - 0.0044) 4HE1-T: 0.091 - 0.131 (0.0036 - 0.0052) 4HE1-TC: 0.091 - 0.131 (0.0036 - 0.0052)	
Piston Grade Selection mm (in) Remarks: Piston Grade Mark Position The piston grade marks (i.e. A, B, C) are stamped on the piston upper face. Piston Outside Diameter Measuring Position Take measurement of the Piston at the position 82mm (3.23 in) from the top in the direction of the longer diameter.	Piston Grade	

Engine model	Cylinder Liner Bore Diameter mm (in)	Piston Service Grade	Piston Outside Diameter mm (in)
4HF1 4HF1-2	112.041 - 112.060 (4.4111 - 4.4118)	-	111.947 - 111.960 (4.4074 - 4.4079)
4HG1 4HG1-T	115.040 - 115.060 (4.5291 - 4.5299)	-	114.944 - 114.959 (4.5253 - 4.5259)
4HE1-T 4HE1-TC	110.066 - 110.075 (4.3333 - 4.3337)	AX	109.944 - 109.959 (4.3285 - 4.3291)
		CX	109.960 - 109.975 (4.3291 - 4.3297)

Item	Service Standard	Service Limit

PISTON PIN

Piston Pin Wear mm (in)	4HF1 4HF1-2 4HG1 4HG1-T	35.995 - 36.000 (1.4171 - 1.4173)	35.970 (1.4161)
	4HE1-T 4HE1-TC	39.995 - 40.000 (1.5746 - 1.5748)	39.970 (1.5736)
Piston and Piston Pin Clearance mm (in)	0.004 - 0.017 (0.0002 - 0.0007) Clearance should be wide enough for the piston pin to be inserted under the condition where the piston is heated to the temperature of 80°C to 100°C (176°F to 212°F).		0.04 (0.0016) When an abnormal striking sound is heard, replace the piston and the piston pin.

PISTON RING

Piston Ring Gap (Inside the cylinder) mm (in)	4HF1 4HF1-2	1st Compression Ring	0.24 - 0.39 (0.0094 - 0.0153)	1.50 (0.0591)
		2nd Compression Ring	0.35 - 0.50 (0.0138 - 0.0197)	1.50 (0.0591)
		Oil Ring	0.02 - 0.40 (0.0008 - 0.0157)	1.50 (0.0591)
	4HG1 4HG1-T	1st Compression Ring	0.24 - 0.39 (0.0094 - 0.0153)	1.50 (0.0591)
		2nd Compression Ring	0.35 - 0.50 (0.0138 - 0.0197)	1.50 (0.0591)
		Oil Ring	0.15 - 0.35 (0.00591 - 0.0138)	1.50 (0.0591)
	4HE1-T	1st Compression Ring	0.24 - 0.40 (0.0094 - 0.0157)	1.50 (0.0591)
		2nd Compression Ring	0.56 - 0.71 (0.0220 - 0.0279)	1.50 (0.0591)
		Oil Ring	0.20 - 0.40 (0.0078 - 0.0157)	1.50 (0.0591)
	4HE1-TC	1st Compression Ring	0.24 - 0.40 (0.0094 - 0.0157)	1.50 (0.0591)
		2nd Compression Ring	0.30 - 0.40 (0.0118 - 0.0157)	1.50 (0.0591)
		3rd Compression Ring	0.30 - 0.40 (0.0118 - 0.0157)	1.50 (0.0591)
		Oil Ring	0.02 - 0.40 (0.0008 - 0.0157)	1.50 (0.0591)
Piston Ring & Piston Ring Groove Clearance mm (in)	4HF1 4HF1-2	1st Compression Ring	0.062 - 0.092 (0.0024 - 0.0036)	0.2 (0.0078)
		2nd Compression Ring	0.04 - 0.08 (0.0015 - 0.0031)	0.15 (0.0059)
		Oil Ring	0.02 - 0.06 (0.0008 - 0.0024)	0.15 (0.0059)
	4HG1 4HG1-T	1st Compression Ring	0.062 - 0.092 (0.0024 - 0.0036)	0.2 (0.0078)
		2nd Compression Ring	0.04 - 0.08 (0.0015 - 0.0031)	0.15 (0.0059)
		Oil Ring	0.02 - 0.06 (0.0008 - 0.0024)	0.15 (0.0059)
	4HE1-T	1st Compression Ring	0.09 - 0.13 (0.0035 - 0.0051)	0.2 (0.0078)
		2nd Compression Ring	0.09 - 0.13 (0.0035 - 0.0051)	0.2 (0.0078)
		Oil Ring	0.03 - 0.07 (0.0012 - 0.0028)	0.15 (0.0059)
	4HE1-TC	1st Compression Ring	0.09 - 0.13 (0.0035 - 0.0051)	0.2 (0.0078)
		2nd Compression Ring	0.09 - 0.13 (0.0035 - 0.0051)	0.2 (0.0078)
		3rd Compression Ring	0.09 - 0.13 (0.0035 - 0.0051)	0.2 (0.0078)
		Oil Ring	0.03 - 0.07 (0.0012 - 0.0028)	0.15 (0.0059)
The direction of the piston ring connecting end			Alternately at 180°. Don't position the connecting end in the side pressure direction. Place the connecting end of the oil ring and that of the expander coil at 180° alternately.	

Item	Service Standard	Service Limit

CONNECTING ROD

<table>
<tr><td rowspan="2">Connecting Rod Alignment mm (in)</td><td>Distortion</td><td>0.05 (0.002) or less</td><td>0.20 (0.008)</td></tr>
<tr><td>Parallelism</td><td>0.05 (0.002) or less</td><td>0.20 (0.008)</td></tr>
<tr><td colspan="2">Connecting Rod Small End Bushing and Piston Pin Clearance mm (in)</td><td>0.012 - 0.027 (0.0005 - 0.0011)
There must be clearance enough to rotate the piston pin while holding it lightly with its large end fixed.</td><td>0.05 (0.002)</td></tr>
<tr><td colspan="2">Connecting Rod Bearing Spread mm (in)</td><td></td><td>70 (2.77) or more</td></tr>
<tr><td colspan="2">Connecting Rod Bearing and Crankpin Clearance mm (in)</td><td>0.036 - 0.077 (0.0014 - 0.0030)</td><td>0.10 (0.004)</td></tr>
<tr><td colspan="2">Connecting Rod Bearing Selection mm (in)

Remarks:
The connecting rod big end inside diameter grade marks (A or B) are stamped on top of the cylinder number align marks of the big end.</td><td colspan="2">• 4HF1 • 4HF1-2 • 4HG1 • 4HG1-T
<table>
<tr><th colspan="2">Connecting Rod Big End</th><th>Crankpin</th><th rowspan="2">Big End Bearing Color Code</th></tr>
<tr><th>Grade Mark</th><th>(Reference) Inside Diameter</th><th>(Reference) Outside Diameter</th></tr>
<tr><td>A</td><td>69.985 - 69.992
(2.7553 - 2.7556)</td><td>65.902 - 65.922
(2.5946 - 2.5954)</td><td>Green</td></tr>
<tr><td>B</td><td>69.993 - 70.000
(2.7556 - 2.7559)</td><td>65.902 - 65.922
(2.5946 - 2.5954)</td><td>Yellow</td></tr>
</table>
• 4HE1-T • 4HE1-TC
<table>
<tr><td>A</td><td>77.985 - 77.992
(3.0702 - 3.0705)</td><td>72.902 - 72.922
(2.8702 - 2.8709)</td><td>Green</td></tr>
<tr><td>B</td><td>77.993 - 78.000
(3.0706 - 3.0709)</td><td>72.902 - 72.922
(2.8702 - 2.8709)</td><td>Yellow</td></tr>
</table></td></tr>
<tr><td colspan="2">The difference in weight between the connecting rod and the piston when assembled. N (gr / lb)</td><td></td><td>0.2 (20 / 0.28)</td></tr>
</table>

FLYWHEEL

Flywheel Thickness	mm (in)	31.4 - 31.6 (1.236 - 1.244) (Flywheel friction surface - crankshaft setting face)	31.0 (1.22)
Friction Surface Run-Out	mm (in)		0.2 (0.008)
Friction Surface Roughness	mm (in)	0.006 (0.0002) or less	
Ring Gear			The tooth face burr must be chamfered. Replace ones when damaged excessively.

Item	Service Standard	Service Limit

GEAR TRAIN

Timing Gear Backlash Gear to Gear (In the direction of a normal line) mm (in)	0.10 - 0.17 (0.0039 - 0.0067) Hold both the gear to be checked and the adjoining gear stationaly.	0.30 (0.012)
Crankshaft Gear and Crankshaft Interference mm (in)	0.03 - 0.093 (0.0012 - 0.0037)	
Camshaft Gear and Camshaft Interference mm (in)	0.015 - 0.023 (0.0006 - 0.0009)	
Idle Gear Shaft Wear mm (in)	29.959 - 29.980 (1.1795 - 1.1803)	29.80 (1.1732)
Idle Gear Bushing Wear mm (in)	30.000 - 30.021 (1.1811 - 1.1819)	30.1 (1.185)
Idle Gear Bushing and Idle Gear Shaft Clearance mm (in)	0.020 - 0.062 (0.0008 - 0.0024)	0.2 (0.008)
Idle Gear End Play mm (in)	0.058 - 0.115 (0.0002 - 0.005)	0.2 (0.008)

LUBRICATION SYSTEM

Oil Pump	Gear Teeth and Inner Wall Clearance mm (in)	0.125 - 0.220 (0.0049 - 0.0087)	0.3 (0.012)
	Gear and Pump Cover Clearance mm (in)	0.064 - 0.109 (0.0018 - 0.0043)	0.2 (0.008)
	Gear Shaft Wear mm (in)	15.989 - 16.000 (0.6295 - 0.6299)	15.9 (0.626)
	Gear Shaft and Bushing Clearance mm (in)	0.04 - 0.07 (0.0016 - 0.0028)	0.2 (0.012)
	Delivery Volume cc (cu•in)/rev	16.54 (1.0) Delivery Pressure: 392kPa (4 kg/cm^2 / 56.9 psi) Oil Temperature: 50 ± 2°C (122 ± 3.6°F) Oil Viscosity: SAE 30	
Relief Valve Opening Pressure kPa (kg/cm^2 / psi)	Oil Gallery	441.3 (4.5 / 64.0)	(Reference)
	Oil Pump	784.5 (8.0 / 113.8)	(Reference)

Item	Service Standard	Service Limit

COOLING SYSTEM

Water Pump	External appearance	Check the following: • Cracks and damages of the pump body • Cracks and corrosion of the impeller • Water leak from the seal unit When an abnormal condition is found, replace the water pump as an assembly.	
	Seal Unit	Push the fan center in the radial direction while rotating it and check the seal unit for any excessive play or abnormal sound. When there is any abnormal condition found, replace the water pump as an assembly.	
	Delivery Volume lit (US / UK gal) / min	200 or more Water Pump Speed: 3,300 rpm Water Temperature: 80 ± 2°C (176 ± 3.6°F)	
Fan Drive Belt Tension mm (in)		8 - 12 (0.31 - 0.47) … New belt 10 - 14 (0.39 - 0.55) … Reuse belt Depress the drive belt mid-portion with a 98N (10kg / 22lb) force	
Thermostat With Jiggle Valve	Valve Initial Opening Temperature °C (°F)	85 ± 1.5 (185 ± 2.7)	
	Valve Lift At 100°C (212°F) mm (in)	8 (0.31) or more	
Thermostat With-Out Jiggle Valve	Valve Initial Opening Temperature °C (°F)	Primary: 85 ± 2 (185 ± 3.6) Secondary: 82 ± 2 (179.6 ± 3.6)	
	Valve Lift At 95°C (203°F) mm (in)	8 (0.31) or more	
Radiator	External appearance	• Check the radiator for any corrosion, water leak, fin damage, or clogging. When there is any abnormal condition found, correct the radiator or replace it. • When deterioration, cracking or water leak is found in the rubber hose, replace the rubber hose.	
	Pressure Valve Opening Pressure kPa (kg /cm^2 / psi)	103.0 ± 14.7 (1.05 ± 0.15 / 14.9 ± 2.1)	
	Vacuum Valve Opening Pressure kPa (kg /cm^2 / psi)	M/T: 1.0 - 4.9 (0.01 - 0.05 / 0.14 - 0.71) A/T: 2.0 - 4.9 (0.02 - 0.05 / 0.28 - 0.71)	

Item	Service Standard	Service Limit

COOLING SYSTEM (CONT.)

Cooling Fan	Cooling Fan Pulley Speed rpm	M/T: 3,900 A/T: 3,850	Rotate the fan by hand, and when it doesn't rotate smoothly, or when there is oil leak from the fan clutch, replace the fan clutch.
	Cold Condition (Bi-metal lower than 40°C (104°F) rpm	M/T: 900 or lower A/T: 1,200 or lower	
	Hot Condition (Bi-metal higher than 70°C (158°F) rpm	M/T: 3,300 ± 150 A/T: 3,450 ± 150	
	Pulley Ratio (Crankshaft/Fan)	175 / 151	

FUEL SYSTEM

Fuel Feed Pump	Suction capacity	The suction must be completed in 25 times or less. Priming Pump Speed : 60 - 100 times/minute Pipe Inside Diameter : 8mm (0.31in) Suction Pipe Length : 2,000mm (78.7 in) Suction Height : 1,000mm (39.4in)	
Injection Nozzle	Needle Valve Seat Portion Oil Tight sec Time required for the pressure to fall from 16,180 kPa (165 kg /cm^2 / 2,346 psi) to 14,220 kPa (145 kPa (kg /cm^2 / 2,062 psi)	5 or more	
	Spray Condition	• The spray must be fine and uniform. • The injection must be directed in the center direction with no stray spray. • The spray from each nozzle hole must be uniform	

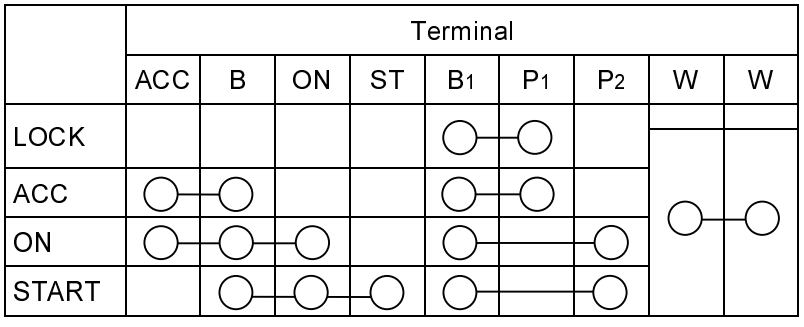
Item	Service Standard	Service Limit

ENGINE ELECTRICAL

Generator	Ball bearing			When it doesn't rotate smoothly or is giving out an abnormal sound, or when there is an oil leak from the seal, replace it.
	Slip Ring Diameter mm (in)		Nominal size 31.6 (1.244)	30.6
	Rotor	Coil Resistance Ω	Nominal resistance 12.6	When the resistance differs largely from the standard value, or when a poor insulation is found, replace it.
		Coil Insulation Resistance MΩ	1 or more (500 volt megger tester)	
	Stator	Coil Resistance Ω	Nominal resistance 0.17 (Between coil end and each coil end)	
		Coil Insulation Resistance MΩ	1 or more (500 volt megger tester)	
	Brush Length mm (in)		Nominal size 20 (0.79)	6 (0.24)
IC Voltage Regulator	Rectifier		The rectifier is normal when there is continuity with the tester ⊖ terminal connected to "B" (battery) terminal and the ⊕ terminal to the rectifier holder, and when there is no continuity with their connections reversed.	When there is continuity in both directions, or when there is no continuity in both directions, replace the rectifier.
	Battery Power V		<4HF1 / 4HF1-2 / 4HG1 / 4HG1-T> LR 250 - 504 (24V - 60A) LR 250 - 508B (24V - 50A) DENSO (12V - 35A) <4HE1-T / 4HE1-TC> LR 250 - 510 (24V - 50A) LR 180 - 510 (12V - 80A)	28 – 29 28 – 29 27.8 - 28.8 28 – 29 14.1 - 14.7
	Output Current A		1300rpm 2000rpm 4000rpm <4HF1 / 4HF1-2 / 4HG1 / 4HG1-T> LR 250 - 504 18 35 53 LR 250 - 508B 15 32 46 DENSO 12 18 37 <4HE1-T / 4HE1-TC> LR 250 - 510 15 32 43 LR 180 - 510 25 58 82	
	Pulley Ratio (Crankshaft/Generator)		175 / 82	

Item	Service Standard	Service Limit

ENGINE ELECTRICAL (CONT.)

Vacuum Pump	Pump Housing Inside Diameter mm (in)	60.0 - 60.1 (2.362) (4HF1•4HF1-2) (4HG1•4HG1-T)	(Reference)
	Vane Length mm (in)	14.2 - 15.2 (0.559 - 0.598) (4HF1•4HF1-2) (4HG1•4HG1-T)	(Reference)
	Performances Time required for the pressure to get to -66.7kPa (-500mmHg / -9.7psi).	1,000 rpm 13 sec or less 1,000 rpm 35 sec or less (LR 180 - 510 only) 5,000 rpm 4 sec or less 5,000 rpm 10 sec or less (LR 180 - 510 only) Oil Viscosity : SAE 30 Oil Temperature : 70 ± 5°C (158 ± 9°F) Oil Pressure : 441kPa (4.5 kg / cm^2 / 64psi) Tank Capacity : 7,000cc (427 cu•in)	
	Check Valve	• Apply 98 – 490 kPa (1-5 kg/cm^2 14-71 psi) compressd air to pump side of the check valve. • Check for air leakage from the check valve. • If there is air leakage, the check valve must be replaced.	
Starter	Commutator Run-Out mm (in)	0.05 (0.002) or less	0.2 (0.008)
	Commutator Outside Diameter mm (in) M/T	36.5 (1.437)	35.5 (1.398)
	Commutator Outside Diameter mm (in) A/T	38.0 (1.496)	36.6 (1.441)
	Mica Segment Depth mm (in)	0.5 - 0.8 (0.020 - 0.031)	0.2 (0.008)
	Brush Length mm (in) M/T	15.0 (0.591)	10.5 (0.413)
	Brush Length mm (in) A/T	18.0 (0.709)	11.0 (80.443)
	Brush Spring Tension N (kg / lb) M/T	24.5 - 34.3 (2.5 - 3.5 / 5.5 - 7.7)	
	Brush Spring Tension N (kg / lb) A/T	28.4 - 35.3 (2.9 - 3.6 / 6.4 - 7.9)	
	Load Characteristics Terminal Voltage V Load Current A Torque N•m (kg•m / lb•ft) Speed rpm	M/T: 18.55 A/T : 14.30 M/T: 250 A/T : 400 M/T: 14.2 (1.45 / 10.5) or more A/T : 28.4 (2.9 / 21.0) or more A/T : 1,500 M/T: 860	
			

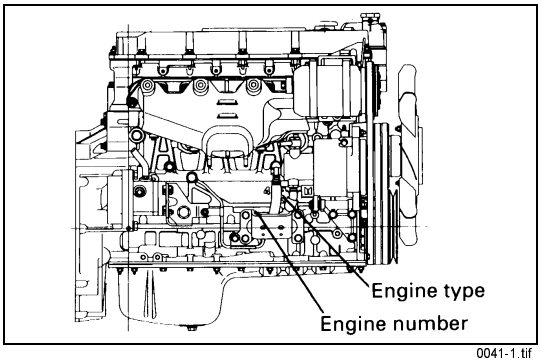
Item	Service Standard	Service Limit

ENGINE ELECTRICAL (CONT.)

Preheating system (QOSII)	Time required for the glow indicator to light up sec	3.5 After the key switch is turned to "ON" position without engine turned.	
	Time required for the source voltage to be supplied to the glow plug sec	18 After the key switch is turned to "ON" position without engine turned.	
	Glow Relay Coil Resistance Ω	Nominal resistance 51.5	
	Thermo Switch Operating Temperature °C (°F)	OFF → ON: 7 - 13 (44.6 - 55.4) ON → OFF: Less 3 (37.4)	
	Glow Plug Continuity		If no continuity exists, must be replaced.

SERVICING

Servicing refers to general maintenance procedures to be performed by qualified service personnel.

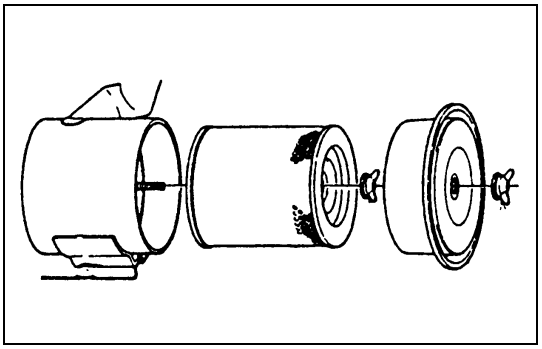


0041-1.tif

MODEL IDENTIFICATION

Engine Serial Number

The engine number is stamped on the front left hand side of the cylinder body.


0041-2.tif

AIR CLEANER

Dry Type Washable Paper Element

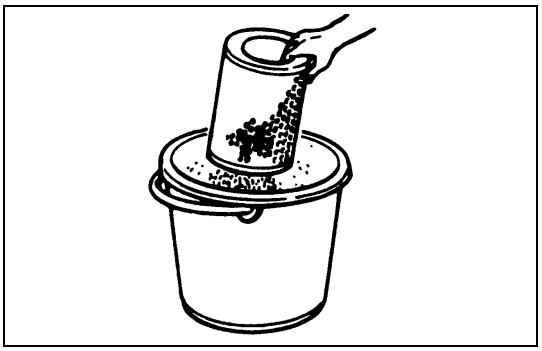
Element cleaning procedures will vary according to the condition of the element.

0041-3.tif

Dust Fouled Element

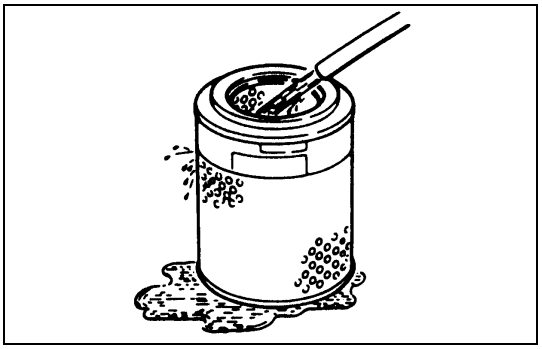
Rotate the element with your hand while applying compressed air to the inside of the element. This will blow the dust free.

Compressed air pressure must not exceed 7 kg/cm^2 (99.6 psi/686 kPa)


0041-4.tif

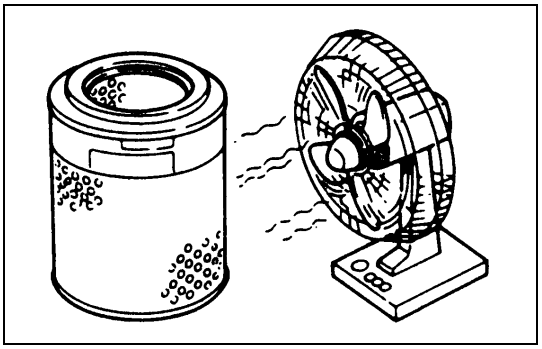
Carbon and Dust Fouled Element

1. Prepare a cleaning solution of Isuzu Genuine Element Cleaner (Donaldson D1400) diluted with water.
2. Immerse the element in the solution for twenty minutes.



0042-1.tif

3. Remove the element from the solution and rinse it well with running water.
   Water pressure must not exceed 2.8 kg/cm^2 (39.8 psi/274kPa).



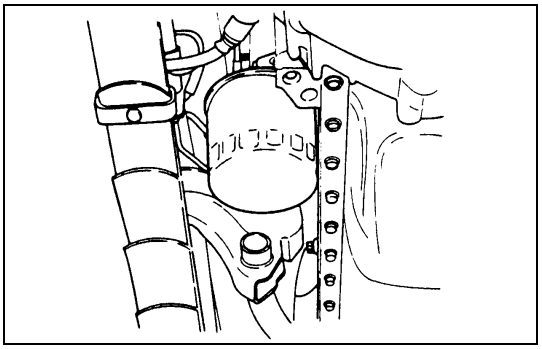
0042-2.tif

4. Dry the element in a well ventilated area.
   An electric fan will hasten drying.

CAUTION:

Do not use compressed air or an open flame to dry the element quickly. Damage to the element will result.

It will usually take two or three days for the element to dry completely. Therefore, it is a good idea to have a spare on hand to use in the interim.



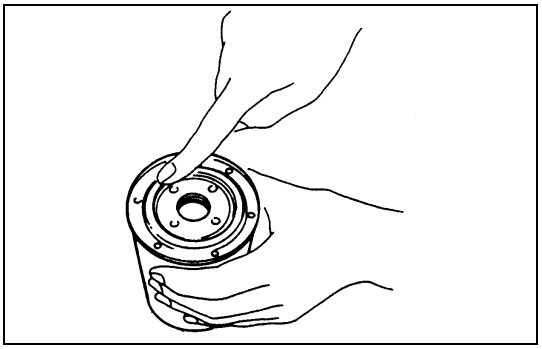
0042-3.tif

LUBRICATING SYSTEM

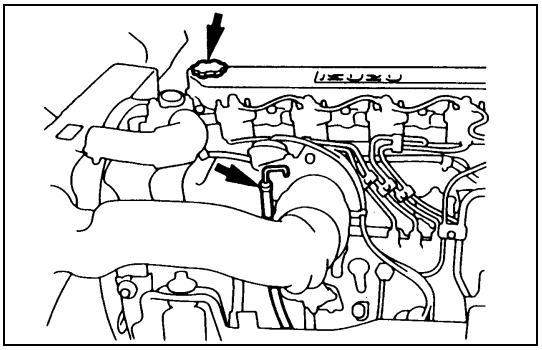
Main Oil Filter (Disposable Spin-On Cartridge Element)

Replacement Procedure

1. Loosen the used oil filter by turning it counterclockwise with the filter wrench.
   Filter Wrench: 1-85221-097-0
2. Clean the oil filter fitting face.
   This will allow the new oil filter to seat properly.
3. Apply a light coat of engine oil to the O-ring.
4. Turn in the new oil filter until the filter O-ring is fitted against the sealing face.
5. Use the filter wrench to turn in the filter an additional one full turn.



0042-4.tif

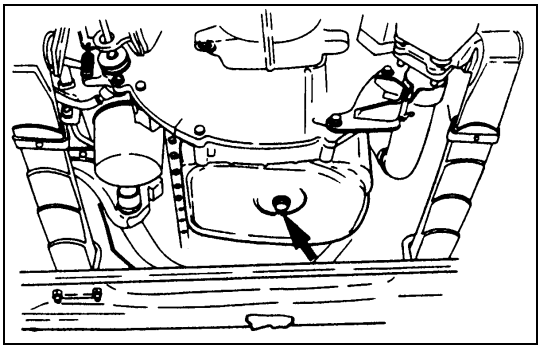


0042-5.tif

6. Check the engine oil level and replenish to the specified level if required.

Engine Oil Replenishment	lit (US/UK gal)
0.7 (0.19/0.15)	

7. Start the engine and check for oil leakage from the main oil filter.



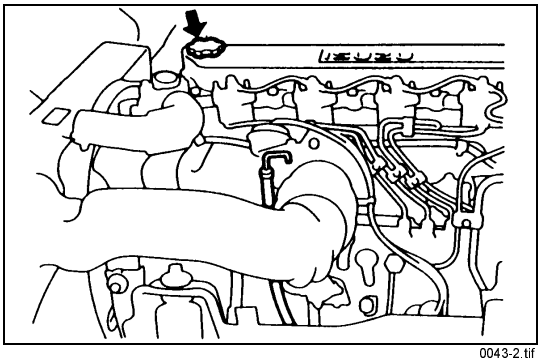
0043-1.tif

Engine Oil Replacement

Draining

1. Remove the drain plug to completely drain the engine oil.
   Do this while the engine is hot.
2. Replace the drain plug.
3. Tighten the drain plug to the specified torque.

Drain Plug Torque	N•m (kg•m/lb•ft)
	78 (8.0/58)

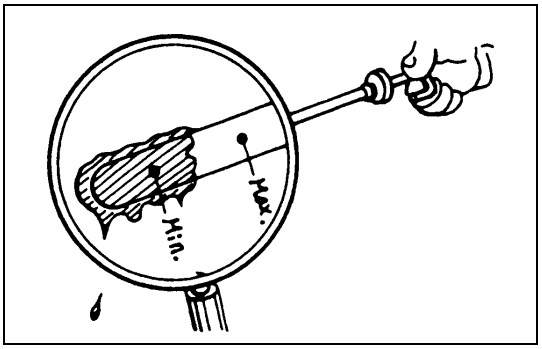


0043-2.tif

Replenishment

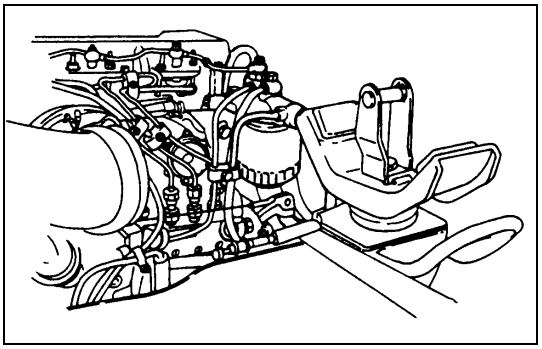
1. Remove the filler cap.
2. Pour the specified engine oil into the crankcase through the oil filler.
3. Replace the filler cap.

Crankcase and Filter Oil Capacity	lit (US/UK gal)
	10.5 (2.8/2.3)



0043-3.tif

4. Start the engine and allow it to idle for a few minutes.
5. Stop the engine.
6. Use the dipstick to check the oil level.
   If the oil level is below the “MIN” line, add oil through the oil filler.
   If the oil level is above the “MAX” line, drain off the excess oil through the drain plug.



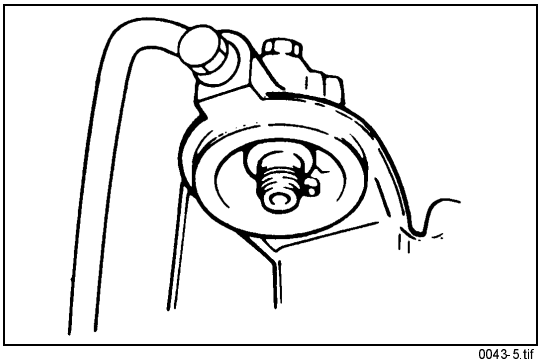
0043-4.tif

FUEL SYSTEM

Fuel Filter

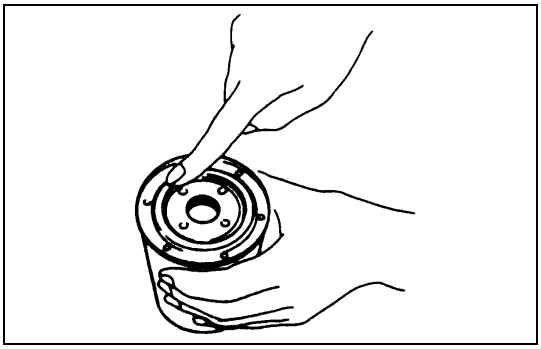
Replacement Procedure

1. Loosen the used fuel filter by turning it counterclockwise with the universal filter wrench.



0043-5.tif

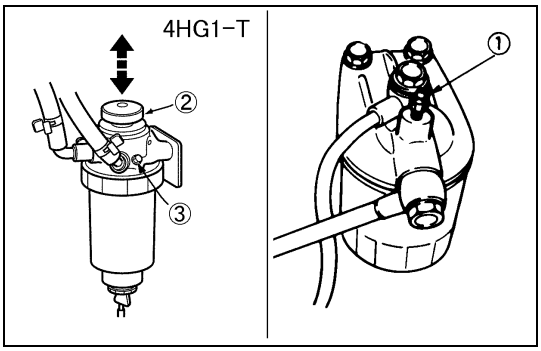
2. Clean the upper cover fitting face.
   This will allow the new fuel filter to seat properly.



0046-1.tif

3. Apply a light coat of engine oil to the O-ring.
4. Supply fuel to the new fuel filter to facilitate bleeding.
5. Turn in the new fuel filter until the filter O-ring is fitted against the sealing face.
   Be very careful to avoid fuel spillage.
6. Use the filter wrench to turn in the fuel filter an additional 1/3 to 2/3 of a turn.

7. Operate the priming pump to bleed the air from the fuel line.

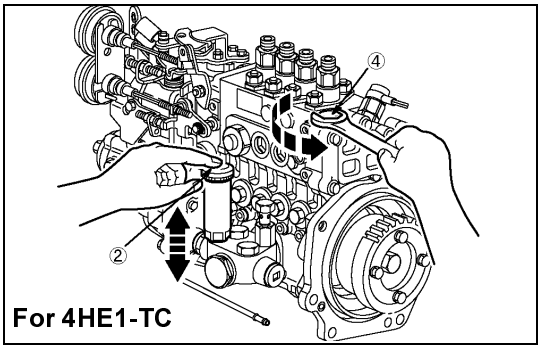


0046-2-1.tif

Bleeding the Fuel System

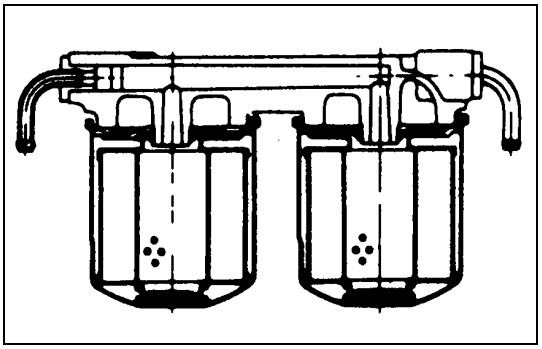
- Loosen the priming pump cap ②.
- Loosen the air bleeding plug; ③.
  (4HG1-T model only)
- Operate the priming pump.
  Pump the primer pump until fuel flow is free of air bubbles.
  (Except 4HG1-T model)
- Tighten the air bleeding plug ③.
  (4HG1-T model only)
- Loosen the bleeding plug ①.
- Operate the priming pump.
  Pump the primer pump until fuel flow is free of air bubbles.
- Tighten the bleeder plug ①.
- Operate the priming pump.
  Pump the primer pump until fuel flow is free of air bubbles.
  (Except 4HE1-TC model)
- Loosen the bleeding plug on the injection pump ④.
  (4HE1-TC model only)
- Operate the priming pump.
  Pump the primer pump until fuel flow is free of air bubbles.
  (4HE1-TC model only)
- Tighten the bleeding plug on the injection pump ④.
  (4HE1-TC model only)
- Lock the priming pump cap ②.

NOTE:
Check for fuel leakage from around the injection pump and the fuel filter.



080LW001-1.tif

8. Start the engine.
   Crank the engine for ten seconds or until it starts.
   If the engine does not start after ten seconds, repeat Step 7.

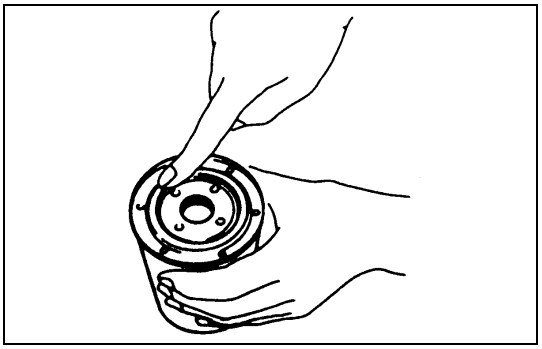


0046-4.tif

Sub Fuel Filter (Dual Type)

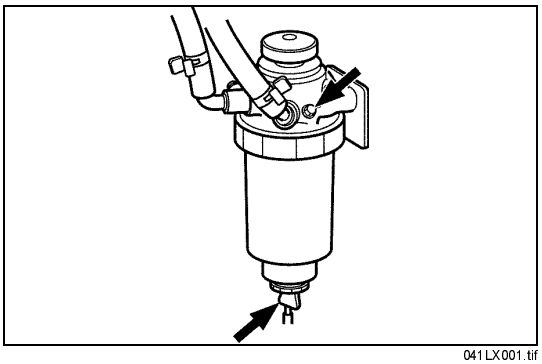
Replacement Procedure

1. Loosen the fuel filters by turning them counterclockwise with the universal filter wrench.
2. Clean the upper cover fitting faces.
   This will allow the new fuel filters to seat properly.



0045-1.tif

3. Apply a thin coat of engine oil to the O-rings.
4. Install the filter assemblies.
   Carefully turn each assembly clockwise until the O-ring is fitted against the filter cover sealing face.
5. Use the filter wrench to turn in each filter assembly an additional 1/3 to 2/3 of turn.
6. Operate the priming pump on the fuel filter to bleed the fuel system.
   Refer to “AIR BLEEDING” for more detailed information.



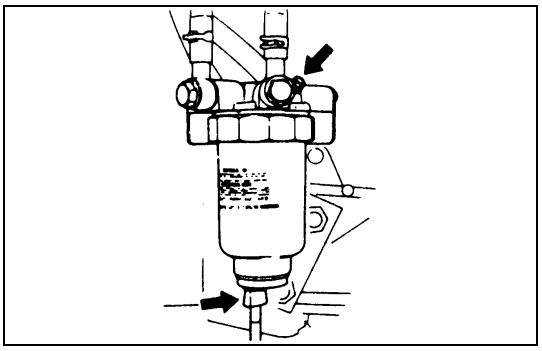
041LX001.tif

Pre-fuel Filter Water Draining Procedure

The indicator light will come on when the water level in the water separator exceeds the specified level.

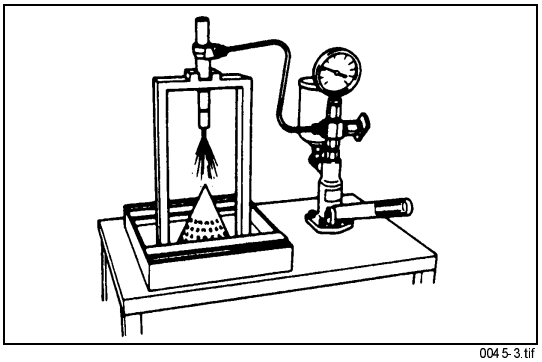
Drain the water and foreign material from the water separator with the following procedure.

1. Place the end of a vinyl hose (beneath the drain plug) in a container.
2. Loosen the air intake plug and drain plug, then drain water.



0045-2.tif

3. After draining, securely tighten the drain plug and air intake plug.
4. Then, operate the priming pump on the injection pump to bleed the fuel system.
5. After starting the engine, check to see that no fuel leaks from the drain plug.


0045-3.tif

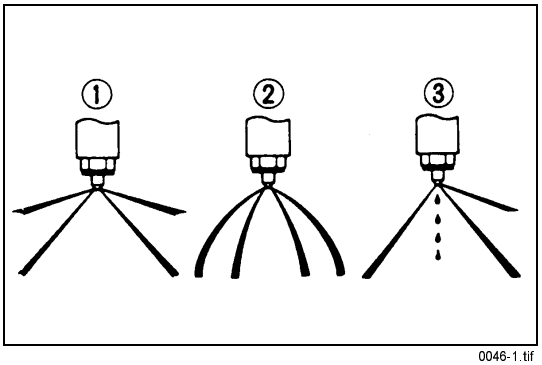
Injection Nozzle

Pressure and Spray Condition Check

1. Use a nozzle tester to check the injection nozzle opening pressure.
   If the opening pressure is above or below the specified value, the injection nozzle must be replaced or adjusted.
   Refer to “Adjustment.”

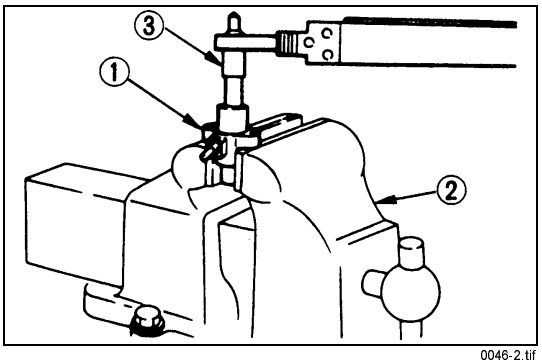
Injection Nozzle Opening Pressure — Mpa (kg/cm^2/psi)

4HF1/4HF1-2/4HG1	18.14 (185/2,631)
4HE1-TC	21.57 (220/3,128)
4HG1-T	1st 18.1 (185/2,631) 2nd 21.1 (215/3,057)
4HE1-T	1st 17.65 (180/2,560) 2nd 21.57 (220/3,128)



0046-1.tif

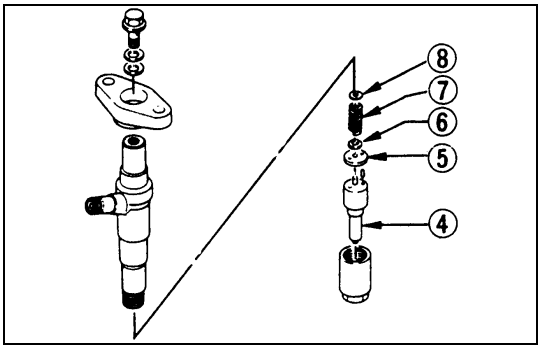
2. Check the spray condition.
   Refer to the illustration.
   Spray Condition
   ① Correct
   ② Incorrect (Restrictions in orifice)
   ③ Incorrect (Dripping)
   If the spray condition is bad, the injection nozzle must be replaced or adjusted.
   Refer to “6C FUEL SYSTEM”.



0046-2.tif

Adjustment

1. Clamp the injection nozzle holder ① in a vise ②.
2. Use a wrench to remove the injection nozzle retaining nut ③.



0046-3.tif

3. Remove the injection nozzle holder from the vise.
4. Remove the injection nozzle ④, the spacer ⑤, the spring seat ⑥ the spring ⑦ and the adjusting shim ⑧.
5. Install the new adjusting shim, the spring, the spring seat, the spacer, the injection nozzle, and the retaining nut.
6. Clamp the injection nozzle holder in the vise.
7. Tighten the injection nozzle holder retaining nut to the specified torque.

Injection Nozzle Holder Retaining Nut Torque	N•m (kg•m/lb•ft)
34 (3.5/25)	

8. Remove the injection nozzle holder from the vise.
9. Attach the injection nozzle holder to the injection nozzle tester.
10. Apply pressure to the nozzle tester to check that the injection nozzle opens at the specified pressure.

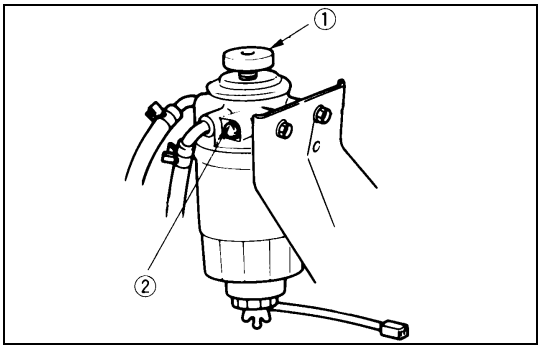
    If the injection nozzle does not open at the specified pressure, install or remove the appropriate number or adjusting shims to adjust it.

    Removing or installing one shim will increase or decrease the nozzle opening pressure approximately 3.77 kg/cm^2 (53.6 psi/370kPa).

Adjusting Shim Availability	mm (in)
Range	0.5 - 1.5 (0.02 - 0.06)
Increment	0.025 (0.001)
Total Number of Shims	41

Air Bleeding (Except 4HF1-2 model only)

Above works refer to “FUEL SYSTEM” in this section.



0047-3.tif

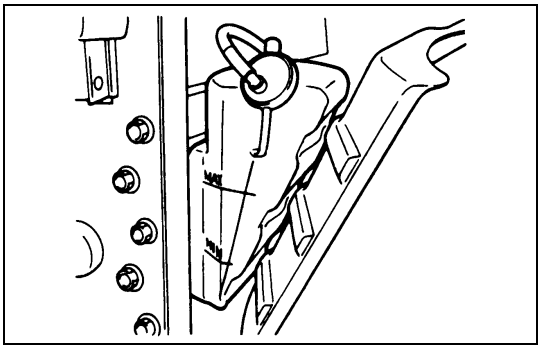
Air Bleeding (4HF1-2 model only)

1. Actuate the priming pump ① to send the air in the fuel system to the injection pump.
2. Loosen the sedimenter air bleeding plug ② and operate the priming pump until no bubbles appear.
3. Tighten the air bleeding plug completely.
4. Try to start the engine. If the engine is not started within 10 seconds, air bleeding should be conducted once agian.
5. Check that there is no fuel leak ,and then tighten the priming pump completely.

Water Drain

If more water than specified has collected, the warning light is lit. Under this condition, follow the following water drain procedure:

1. Place a container (Approximately 0.2 liters capacity) beneath the drain plug on the separator.
2. Loosen the drain plug and air bleeding plug.
3. After draining, tighten the drain plug.
4. Operate the priming pump several times again and check for fuel leak.
5. Tighten the air bleeding plug.
6. Make sure that the warning light in the instrument panel is off. (Except 4HE1-TC model)

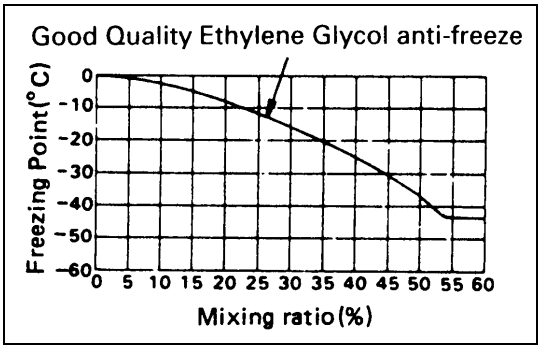

0048-1.tif

COOLING SYSTEM

Coolant Level

Check the coolant level and replenish the radiator reserve tank if necessary.

If the coolant level falls below the “MIN” line, carefully check the cooling system for leakage. Then add enough coolant to bring the level up to the “MAX” line.



0048-2.tif

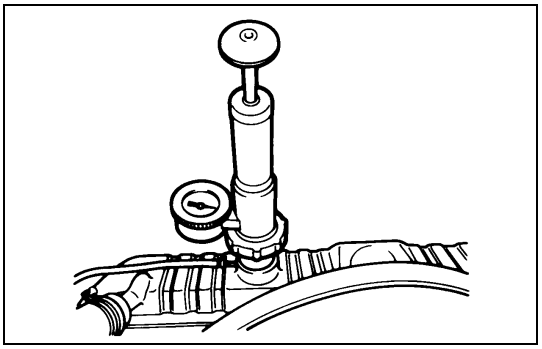
NOTE:

Do not overfill the reserve tank.

Remove the radiator filler cap only when absolutely necessary.

Always check the coolant level when the engine is cold.

Always refer to the chart at the left to determine the correct cooling water to antifreeze solution mixing ratio.


0048-3.tif

Cooling System Leakage Inspection

Clog up the reserver tank hose carefully and check the cooling system for leakage with a radiator cap tester by applying an air pressure of 196 kPa (2 kg/cm^2/28 psi) from filler neck to inside the radiator.

As the radiator upper tank is provided with a valve, the pressure fails to rise higher than the valve opening pressure unless the hose is clogged up.

Radiator Valve Inspection

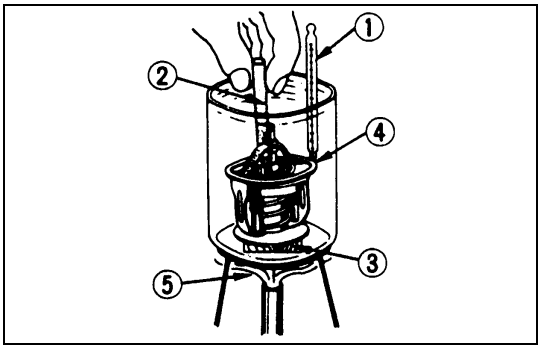
Apply air pressure from filler neck using radiator cap tester and check the opening pressure of radiator valve. If the valve opening pressure is out of the standard value range, replace with a new radiator valve.

Radiator valve opening pressure	kPa (kg/cm^2/psi)
93 - 123 (0.95 - 1.25/13.5 - 17.8)	

Remove the radiator valve and check a negative pressure valve as the center of the valve seat side. If the negative pressure valve does not work smoothly, clean or replace the radiator valve.

Radiator valve fixing torque	N•m (kg•m/lb•ft)
6 (0.6/4)	

Conduct cooling system leakage check after reinstalling the radiator valve.



0049-1.tif

Thermostat Operating Test

1. Completely submerge the thermostat in water.
2. Heat the water.
   Stir the water constantly to avoid direct heat being applied to the thermostat.
3. Check the valve initial opening temperature.

Valve Initial Opening Temperature °C (°F)

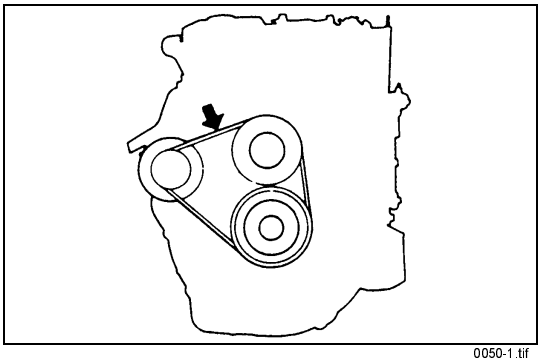
		Standard
without jiggle valve	Primary valve	83 - 87 (181 - 189)
	Secondary valve	80 - 84 (176 - 183)
with jiggle valve		83.5 - 86.5 (182 - 188)

4. Check the valve lift full opening temperature.

Valve Lift Full Opening Temperature °C (°F)

	Standard
without jiggle valve	95 (203)
with jiggle valve	100 (212)

① Thermometer
② Aditating rod
③ Wooden piece
④ Thermostat
⑤ Heat


0050-1.tif

Fan Belt

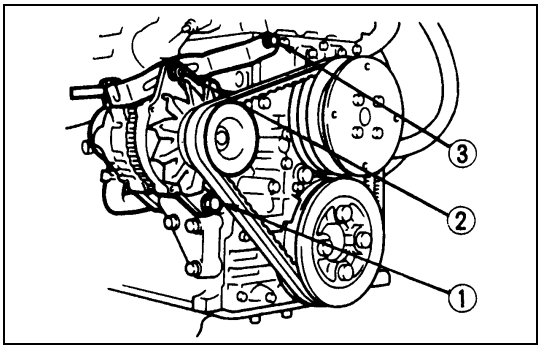
Check the drive belt tension.

Depress the drive belt mid-portion with a 98 N (10 kg/22 lb) force.

Drive Belt Deflection	mm (in)
8 - 12 (0.31 - 0.47) ... New belt 10 - 14 (0.39 - 0.55) ... Reuse belt	

Check the drive belt for cracking and other damage.

- Crankshaft damper pulley
- Generator pulley
- Cooling fan pulley



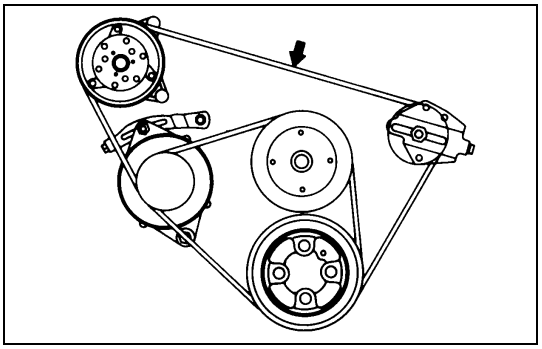
0050-2.tif

Fan Belt Adjustment

Fan belt tension is adjusted by moving the generator.

Torque	N•m (kg•m/lb•ft)
①	40 (4.1/30)
②	24 (2.4/17)
③	46 (4.7/34)

If equipped with A/C compressor, loosen the A/C drive belt tension pulley adjust bolt and lock nut. Then free the A/C drive belt. When finishing the fan belt adjustment, adjust the A/C drive belt and check the belt tension.


0050-3.tif

Air Conditioning (A/C) Compressor Drive Belt

Check the drive belt tension.

- Depress the drive belt mid-portion with a 98 N (10 kg/22 lb) force.

Drive Belt Deflection	mm (in)
16 - 20 (0.63 - 0.79) ... New belt 18 - 22 (0.71 - 0.87) ... Reuse belt	

Check the drive belt for cracking and other damage.

A/C compressor drive belt tension is adjusted by moving the tension pulley.

When finishing the fan drive belt, then adjust the A/C drive belt.

Locking Nut Torque	N•m (kg•m/lb•ft)
27 (2.8/20)	

① A/C compressor pulley
② Tension pulley
③ Generator pulley
④ Crankshaft damper pulley
⑤ Tension pulley lock nut

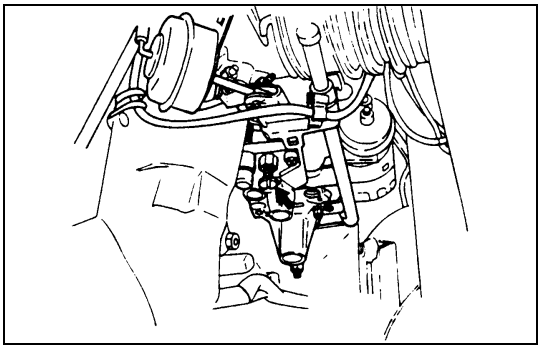
ENGINE CONTROL

Idling Speed Inspection

1. Set the vehicle parking brake and chock the drive wheels.
2. Place the transmission in neutral.
3. Start the engine and allow it to warm up.
4. Check that the idling control knob is in the engine idling position.
5. Set a tachometer to the engine.
6. Check the engine idling speed.
   Engine idling speed should be as below.

Engine Idling Speed		rpm
	(M/T) 550 ~ 600	
	(A/T) 640 ~ 690	

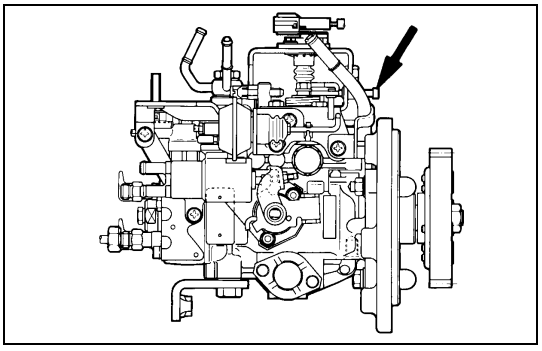
If the engine idling speed is outside the specified range, it must be adjusted.



0051-1.tif

Idling Speed Adjustment

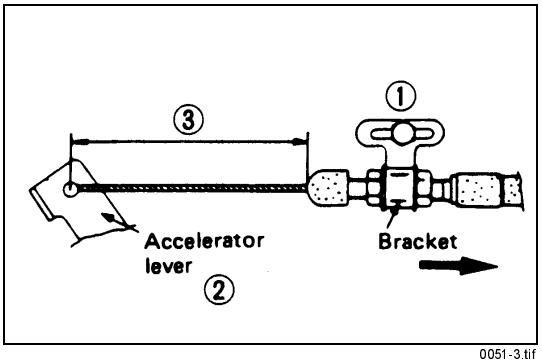
1. Loosen the idling set bolt lock nut on the injection pump.
2. Adjust the idling speed with the idling set bolt.
3. Tighten the lock nut.



0051-2.tif

Idling Speed Check & Adjustment (4HF1-2 model only)

1. Warm up the engine.
2. Measure idling speed by means of tachometer.
3. If idling speed is out of the standard, adjust with an idling adjust bolt (indicated by an arrow mark).
   Idling speed: 575 - 625 rpm

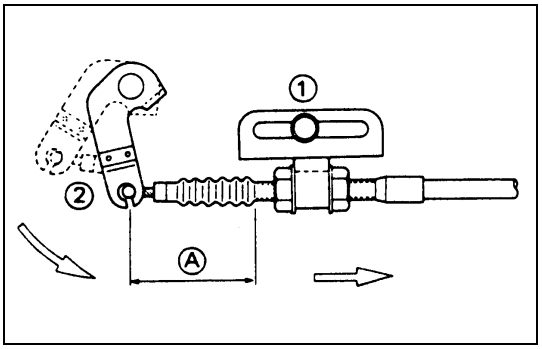


0051-3.tif

ACCELERATOR CONTROL

Accelerator Control Cable Adjustment

1. Loosen the accelerator cable clamp bolt ①.
2. Check that the idling control knob is in the engine idling position.
3. Hold the accelerator lever ② in the fully closed position and stretch the control cable ③ in the direction indicated by the arrow to remove any slack.

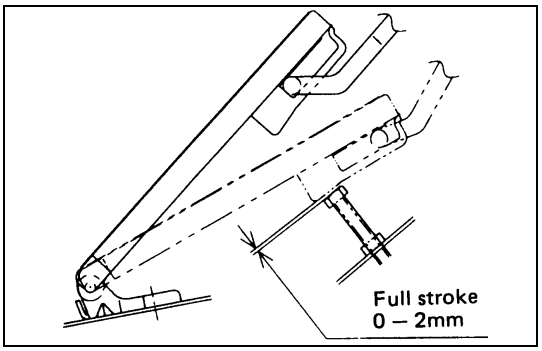


0052-1.tif

ENGINE STOP CONTROL

Adjustment

1. Check that the key switch is either in the “LOCK” position or removed from the engine.
2. Loosen the bolt ①.
3. Pull the fuel cut lever ② as far as possible and hold it.
4. Remove cable slackness Ⓐ by pulling the cable in the direction of the arrow in the illustration.
5. Tighten the bolt ①.

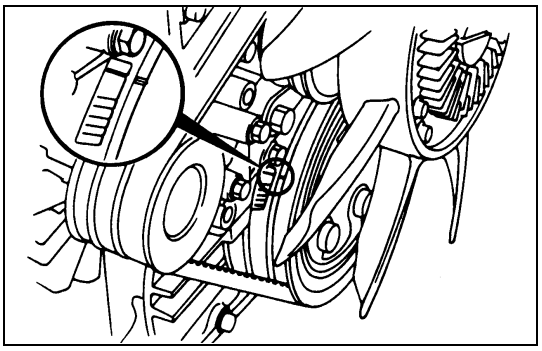


0052-2.tif

Accelerator Pedal Adjustment

1. Press the accelerator pedal to the floorboard and hold it.
2. Use the stopper bolt ④ to adjust the clearance between the stopper bolt end and the accelerator pedal ⑤ lower face.

Accelerator Pedal Clearance	mm (in)
0 - 2 (0 - 0.079)	

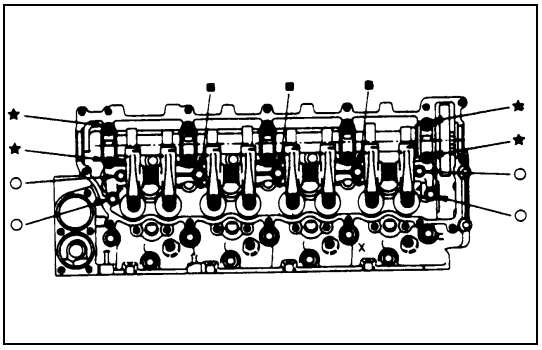

0052-3.tif

VALVE CLEARANCE ADJUSTMENT

1. Bring the piston in either the No.1 cylinder or the No.4 cylinder to TDC on the compression stroke by turning the crankshaft until the crankshaft damper pulley timing mark is aligned with the TDC notched line.

Note:

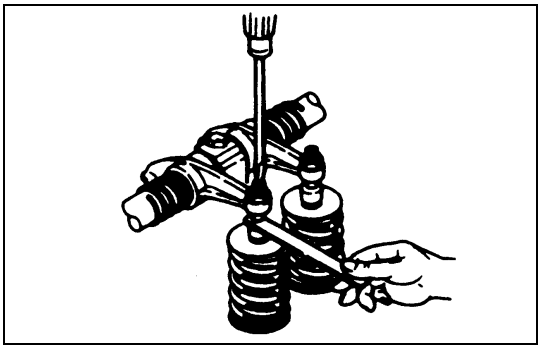
If there are two marks on the crank pulley, the front side of mark is for setting BTDC 49° and the rear side of mark is for setting TDC.

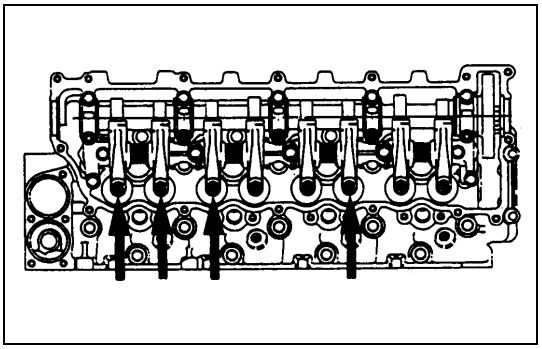

0052-4.tif

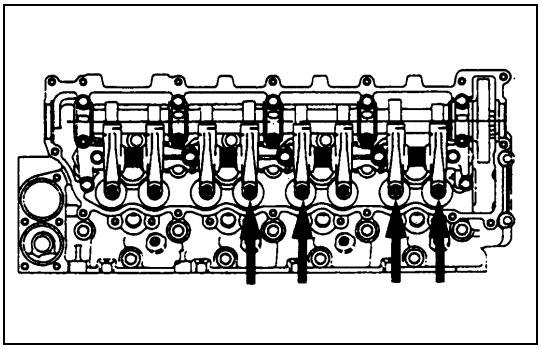
2. Tighten the rocker arm shaft bracket nuts and bolts to the specified torque in numerical order a little at a time as shown in the illustration.

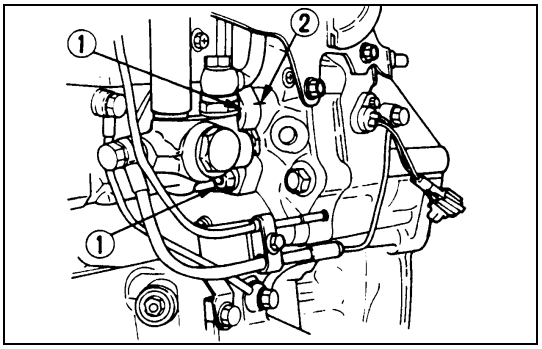
Rocker Arm Shaft Bracket Nut and Bolt Torque	N•m (kg•m/lb•ft)
★ Nut	27(2.8/20)
■ Bolt	56(5.7/41)
○ Bolt	27(2.8/20)

- Apply engine oil to the threaded portion of the nuts marked with “★” and the bolts with “■” shown in the illustration left, and then tighten them to the specified torque.


0053-1.tif


0053-2.tif


0053-3.tif



0053-4.tif

3. Check for play in the No.1 intake and exhaust valve rocker arms.
   If the No.1 cylinder intake and exhaust valve rocker arms have play, the No.1 piston is at TDC on the compression stroke.
   If the No.1 cylinder intake and exhaust valve rocker arms are depressed, the No.4 piston is at TDC on the compression stroke.

Adjust the No.1 or the No.4 cylinder valve clearance while their respective cylinders are at TDC on the compression stroke.

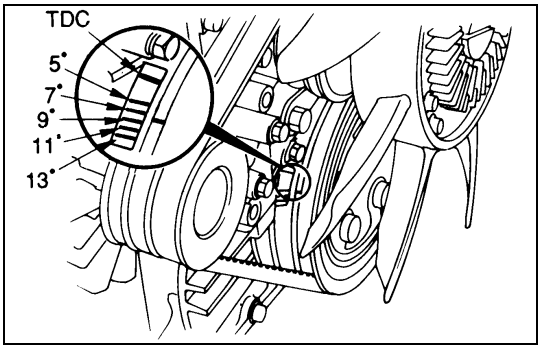
Valve Clearance	mm (in)
At cold	0.40 (0.016)

4. Loosen each valve clearance adjusting screw as shown in the illustration.
5. Insert a feeler gauge of the appropriate thickness between the rocker arm and the valve stem end.
6. Turn the valve clearance adjusting screw until a slight drag can be felt on the feeler gauge.
7. Tighten the lock nut securely.
8. Rotate the crankshaft 360 degrees.
9. Realign the crankshaft damper pulley timing mark with the TDC notched line.
10. Adjust the clearance for the remaining valves as shown in the illustration.

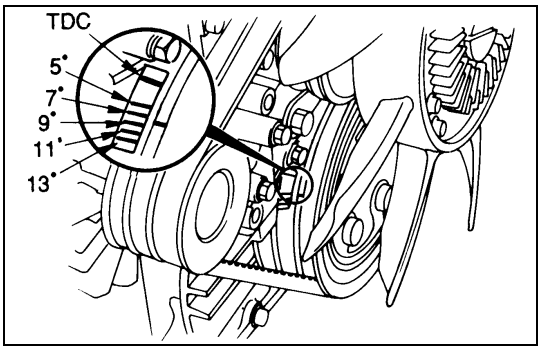
INJECTION TIMING ADJUSTMENT

Injection Pump Notched Line Inspection

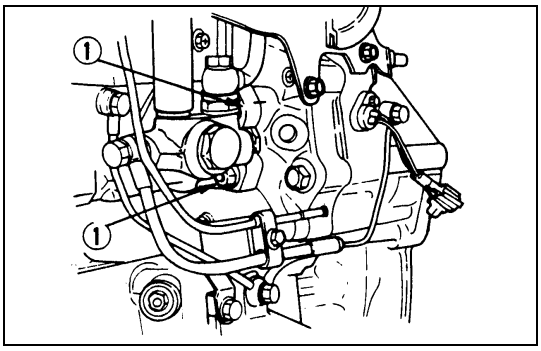
1. Check the injection pump bracket nuts ① for looseness.
   Tighten as required.
2. Check that the notched lines on the injection pump bracket and the timing gear case are aligned.
   If the notched lines are not aligned, the injection timing must be checked.
3. Some time, check injection timing on the crank damper pulley.
   If the injection timing aligned with in correct, the injection timing must be readjusted.



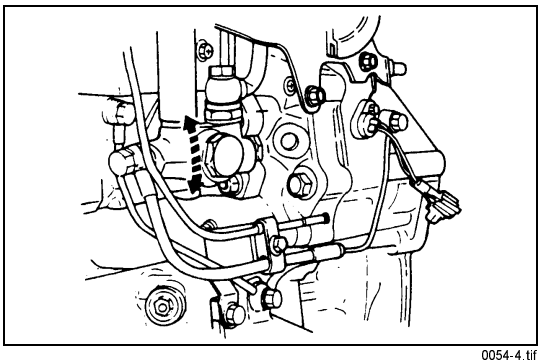
0054-1.tif

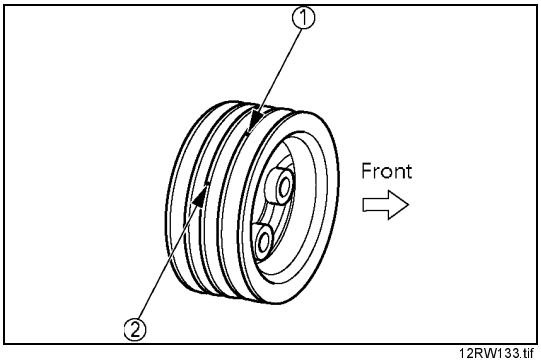


0054-2.tif



0054-3.tif


0054-4.tif



12RW133.tif

Injection Timing Adjustment

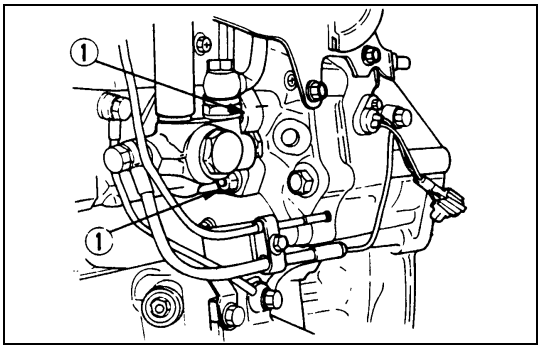
1. Turn the crankshaft until the timing mark on the crankshaft damper pulley is aligned with the BTDC (injection timing of each engine model) mark in the illustration.

Injection Timing deg

4HF1: 4HEl-TC	BTDC 8
4HG1	BTDC 9
4HG1-T	BTDC 7 (Except Colombia) BTDC 9 (For Colombia)
4HEl-T	BTDC 7

2. Remove the two foam rubbers.
3. Loosen the four injection pump fixing nuts.
   This will allow the pump to pivot.
   Do not bend or scratch the fuel pipe.
4. Align the notched line between the injection pump bracket and the timing gear case.
   Make sure that the timing mark on the crank damper pulley is aligned with correct injection timing.

Note:
In case the crank pulley has two marks as illustrated, ① BTDC 49° mark on the second crest and ② TDC mark on the third crest (as viewed from the front side), be sure to set at the mark ②. (If there are two different marks on one and same crest, set at the mark which comes second when rotated in the normal direction.)
The mark ① is used when installing the injection pump for 4HF1-2.

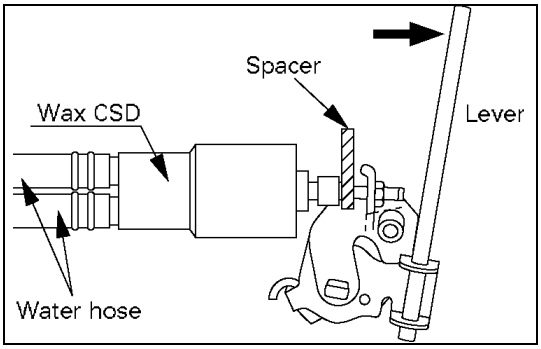


0055-1.tif

5. Tighten the injection pump fixing nuts to the specified torque.

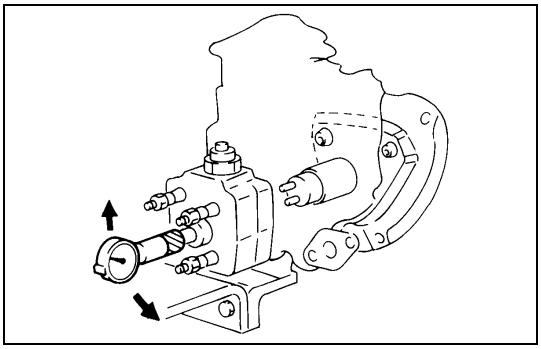
Injection Pump Fixing Nut Torque	N•m (kg•m/lb•ft)
25 (2.6/19)	

Injection Timing Check (4HF1-2 model only)

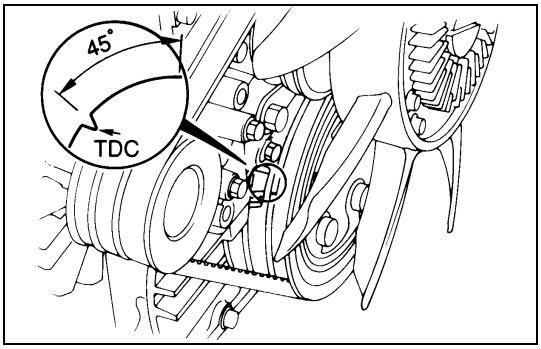


080LX001.tif

1. Set No. 1 Cylinder to the TDC in the compression stroke.
2. Disconnect Injection Pipe.
3. Put down Wax CSD lever, insert a spacer (10 - 20 mm/0.39 - 0.47 in) thick between the plunger and adjust bolt, and cancel the Wax CSD.

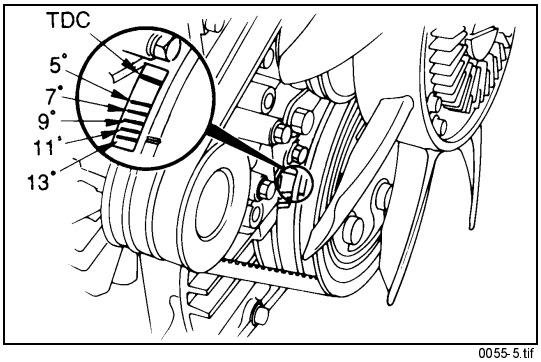

0055-3.tif

4. Remove the pump rear plug, connect a dial gage and set the lift at 1 mm (0.039 in).
   Special Tool
   Measuring device: 5-8840-0145-0



0055-4.tif

5. Set the crankshaft damper pulley TDC mark to the pointer or 45° before TDC.
6. Set the dial gage to the “0” position.
7. Turn the crankshaft leftwise and rightwise a little and make sure that the needle stays in the “0” position.



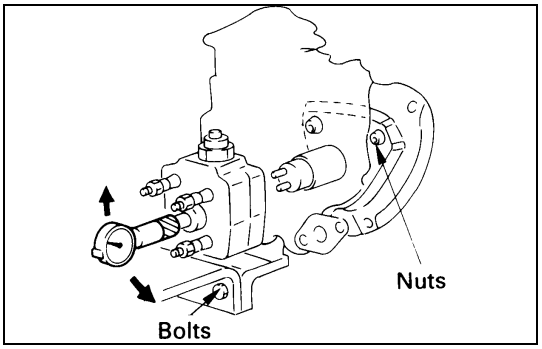
0055-5.tif

8. Turn the crankshaft in the normal direction and read the measuring device’s indication at the 12° before TDC position.

NOTE:

As there is no 12° mark, set midway between the 11° and 13° marks.

Standard value: 0.5 mm (0.0197 in)



0056-1.tif

Injection Timing Adjustment (4HF1-2 model only)

If injection timing is out of the specified range, follow the following procedure for adjustment:

1. Loosen injection pump fiixng nuts and bracket bolt.
2. Adjust the mounting angle of injection pump:
   - If injection timing is too fast, bring the injection pump closer to the engine.
   - If injection timing is too slow, put the injection pump more distant from the engine.
3. When the dial gage has indicated the specified value, tighten the fixing nuts and bolt to specified torque:

Nut Tightening Torque	N•m (kg•m/lb•ft)
24 (2.4/17)	

Bolt Tightening Torque	N•m (kg•m/lb•ft)
48 (4.9/35)	

4. Disconnect the dial gage, install and tighten the plug to specified torque. (Make sure of a copper washer being attached to the plug)

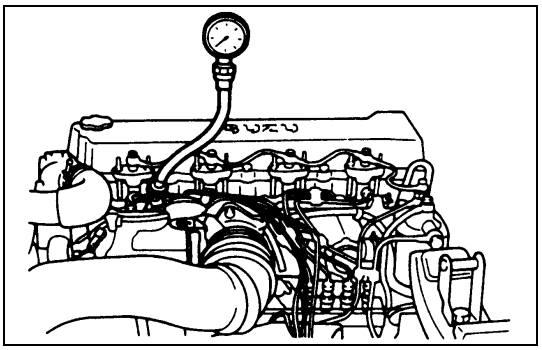
Plug Tightening Torque	N•m (kg•m/lb•ft)
17 (1.7/12)	

5. Release the wax CSD and connect the injection pipe.

Pipe Sleeve Nut Tightening Torque	N•m (kg•m/lb•ft)
29 (3.0/22)	

COMPRESSION PRESSURE MEASUREMENT

1. Start the engine and allow it to warm up.
   Engine Coolant Temperature: Above 80°C (176°F)
2. Stop the engine.
3. Remove the following parts.
   - Glow plugs.
   - In case VE pump;
     Fuel cut solenoid connector.
   - In case line pump;
     Number 17 fuel in fuse box.

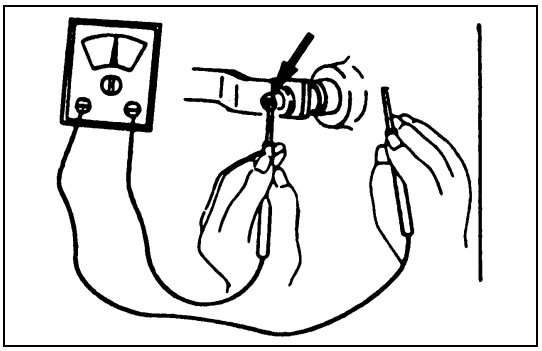


0057-1.tif

4. Set the adapter and the compression gauge to the No.1 cylinder glow plug hole.
   Compression Gauge (With Adapter): 5-8840-2675-0
   Adapter: 5-8531-7001-0
5. Connect a tachometer and check that engine cranking speed is 200 rpm or higher.
6. Turn the engine over with the starter motor and take the compression gauge reading.
7. Repeat the procedure (steps 4,5 and 6) for the remaining cylinders.

Compression Pressure	kPa (kg/cm^2/psi) at 200 rpm
Standard	More than 2,942 (30/426)
Limit for use	2,157(22/312)
Variance in pressure between cylinders	Less than 294 (3/43)

If the measured valve is less than the specified limit, above works refer to “TROUBLESHOOTING” Section in this manual.



0057-2.tif

QUICK-ON-START II SYSTEM

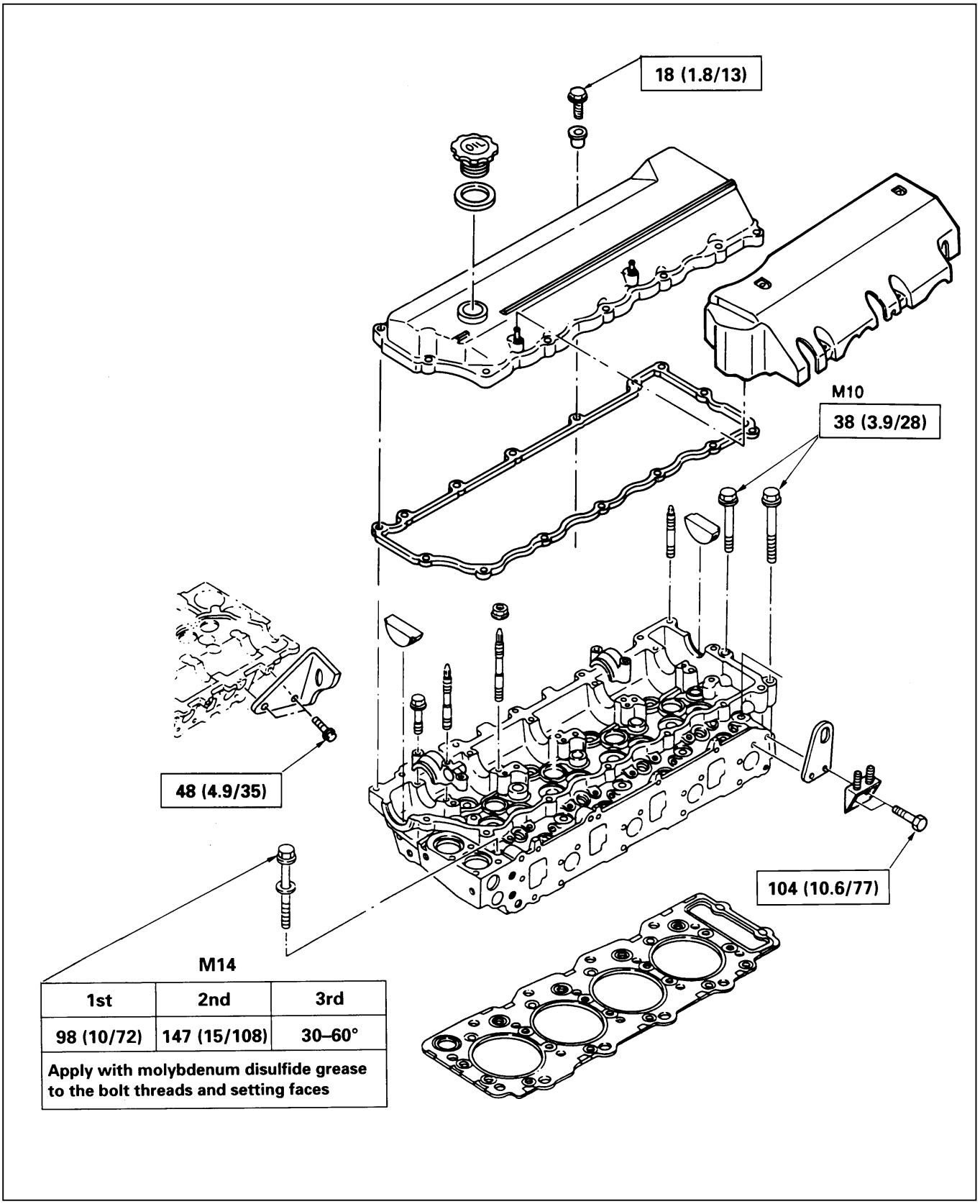
Inspection Procedure

1. Disconnect the thermoswitch connection on the thermostat outlet pipe.
2. Turn the key switch to the “ON” position.
   If the Quick-ON-Start II system is operating properly, the flow relay will make a clicking sound within three seconds.
3. Measure the glow plug terminal voltage with a circuit tester as soon as possible after turning the key switch to the “ON” position.
4. Check the glow plug heating time.

Approximate Glow Plug Heating Time	sec

FIXING TORQUE

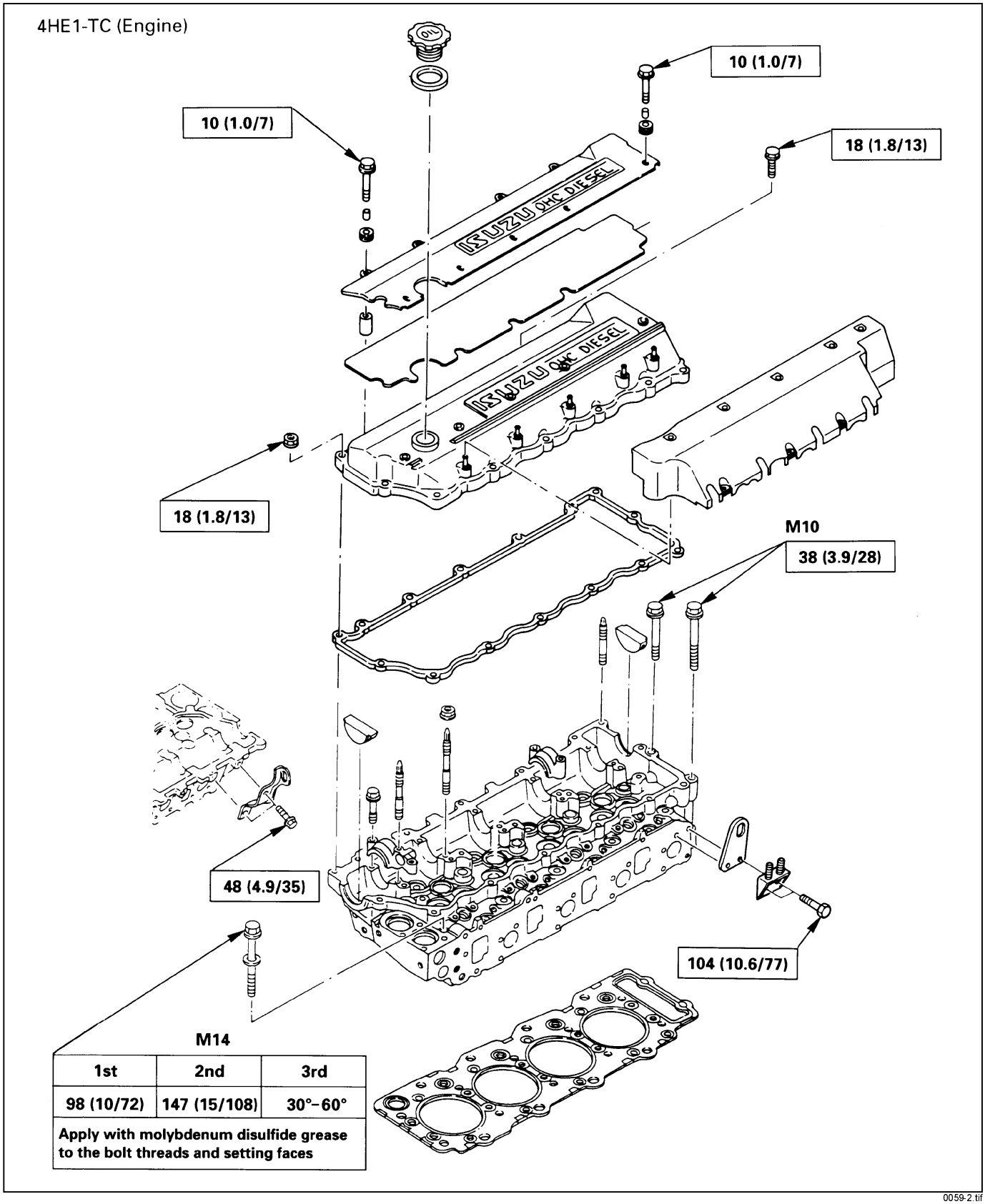
CYLINDER HEAD, HEAD GASKET AND HEAD COVER N•m (kg•m/lb•ft)



1st	2nd	3rd
98 (10/72)	147 (15/108)	30–60°
Apply with molybdenum disulfide grease to the bolt threads and setting faces		

0058-1.tif

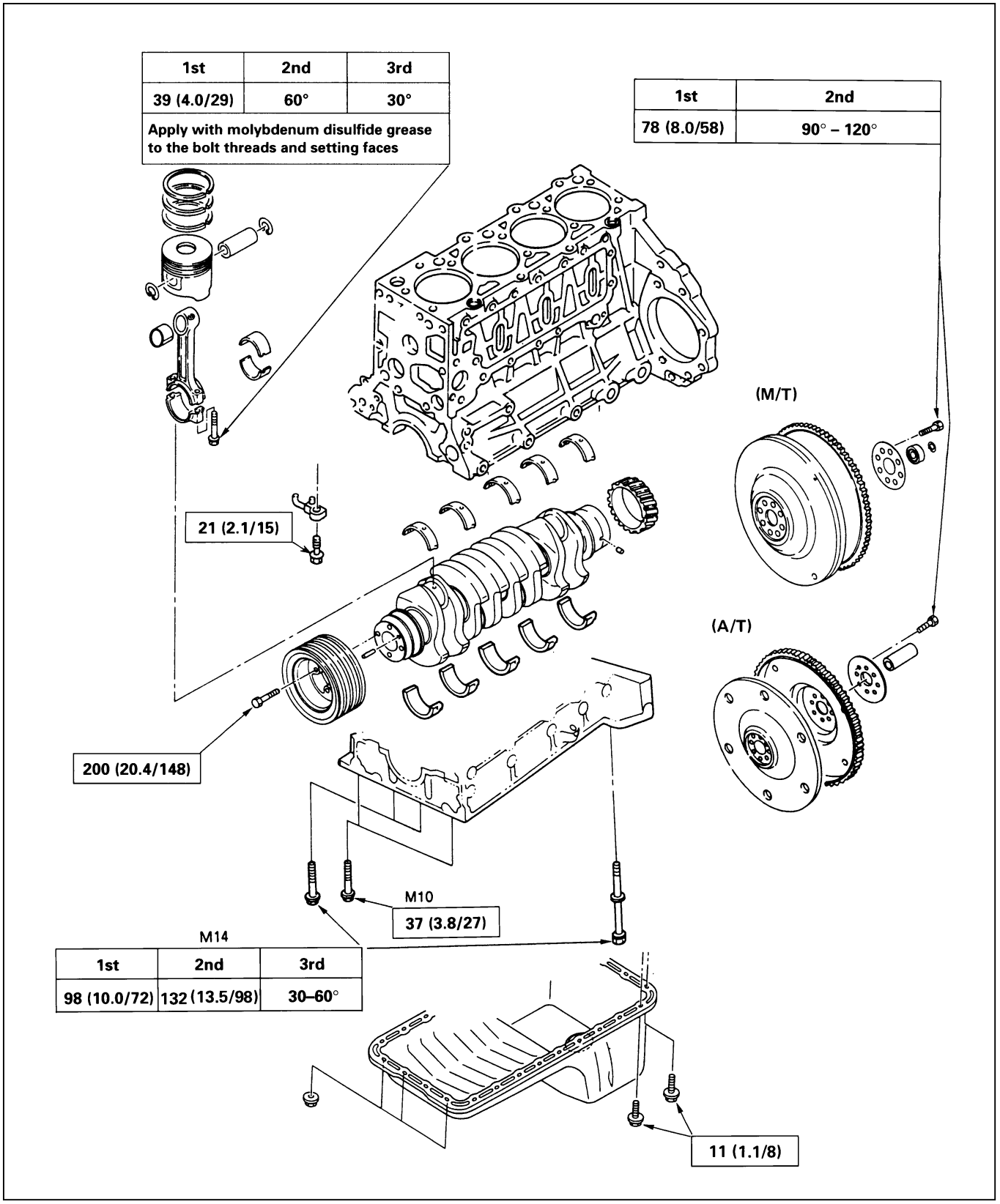
CYLINDER HEAD, HEAD GASKET AND HEAD COVER N•m (kg•m/lb•ft)



0059-2.tif

CRANKSHAFT, FLYWHEEL, DAMPER PULLEY, CONNECTING ROD AND OIL PAN

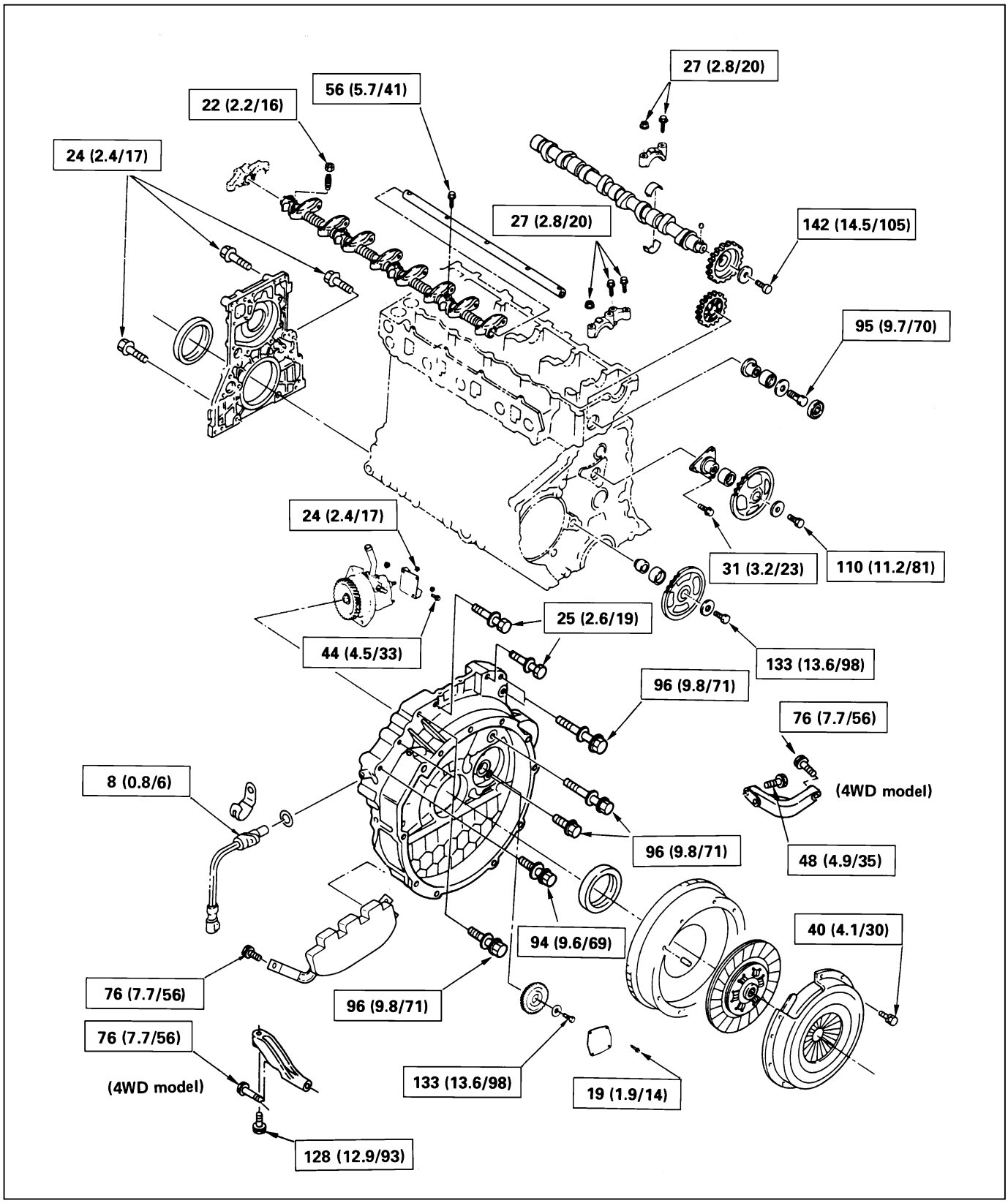
N•m (kg•m/lb•ft)



0060-1.tif

GEAR TRAIN, CAMSHAFT, ROCKER ARM SHAFT, FRONT RETAINER, FLYWHEEL HOUSING

N•m (kg•m/lb•ft)

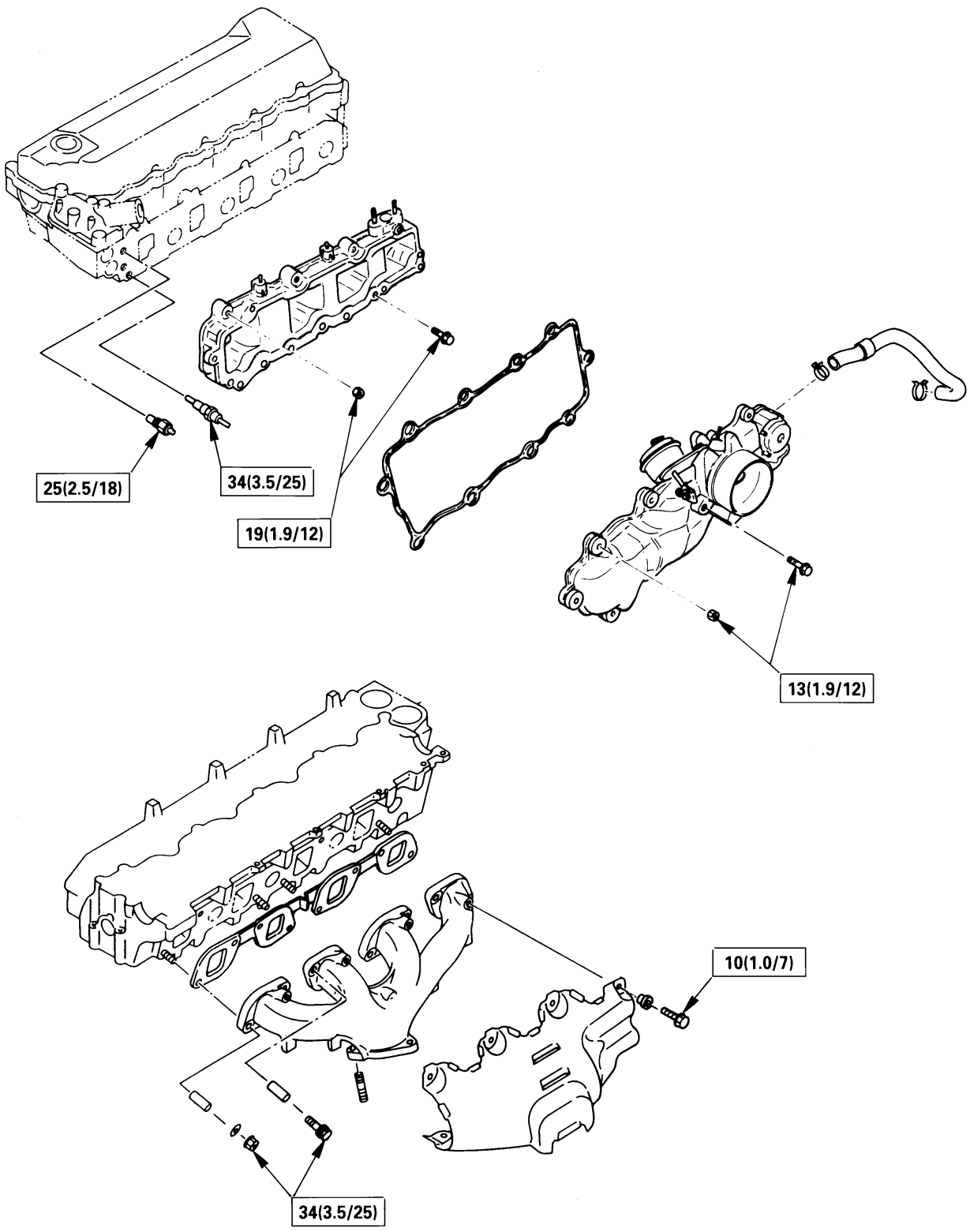


0061-1.tif

INLET COVER AND EXHAUST MANIFOLD

N•m (kg•m/lb•ft)

4HF1 / 4HG1 Engine

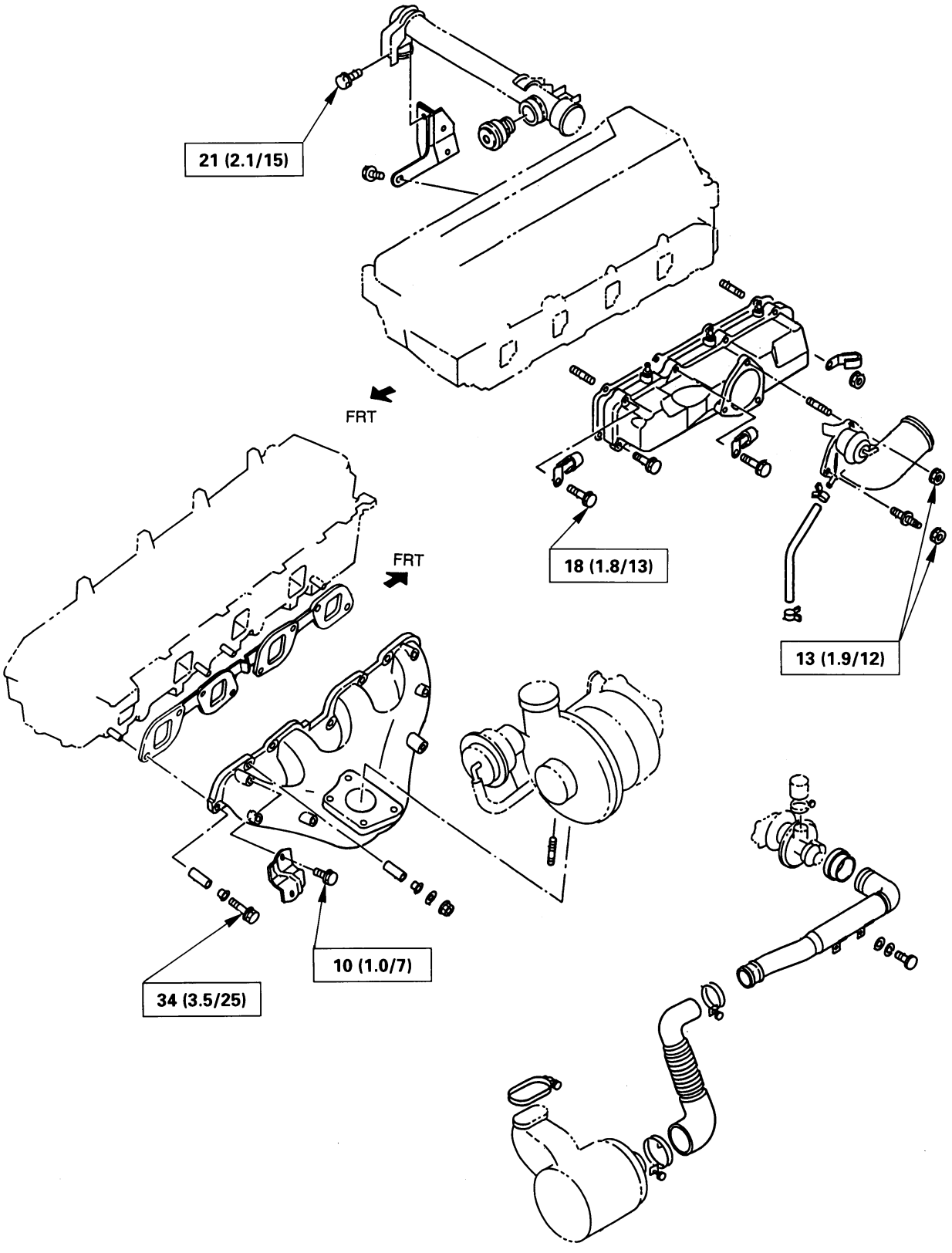


0062-1.tif

INLET COVER AND EXHAUST MANIFOLD

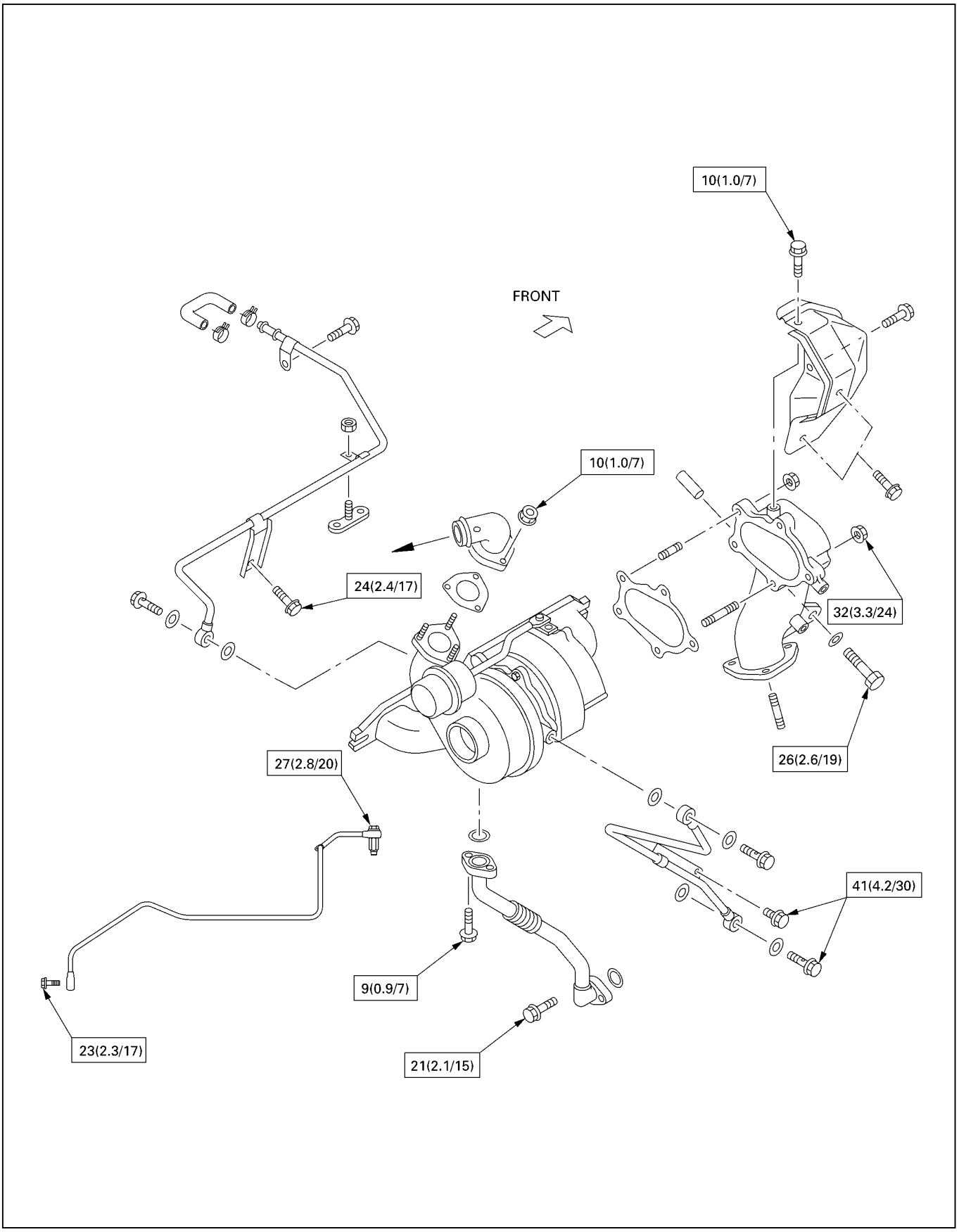
N•m (kg•m/lb•ft)

4HE1-T / 4HE1-TC Engine



0063-1.tif

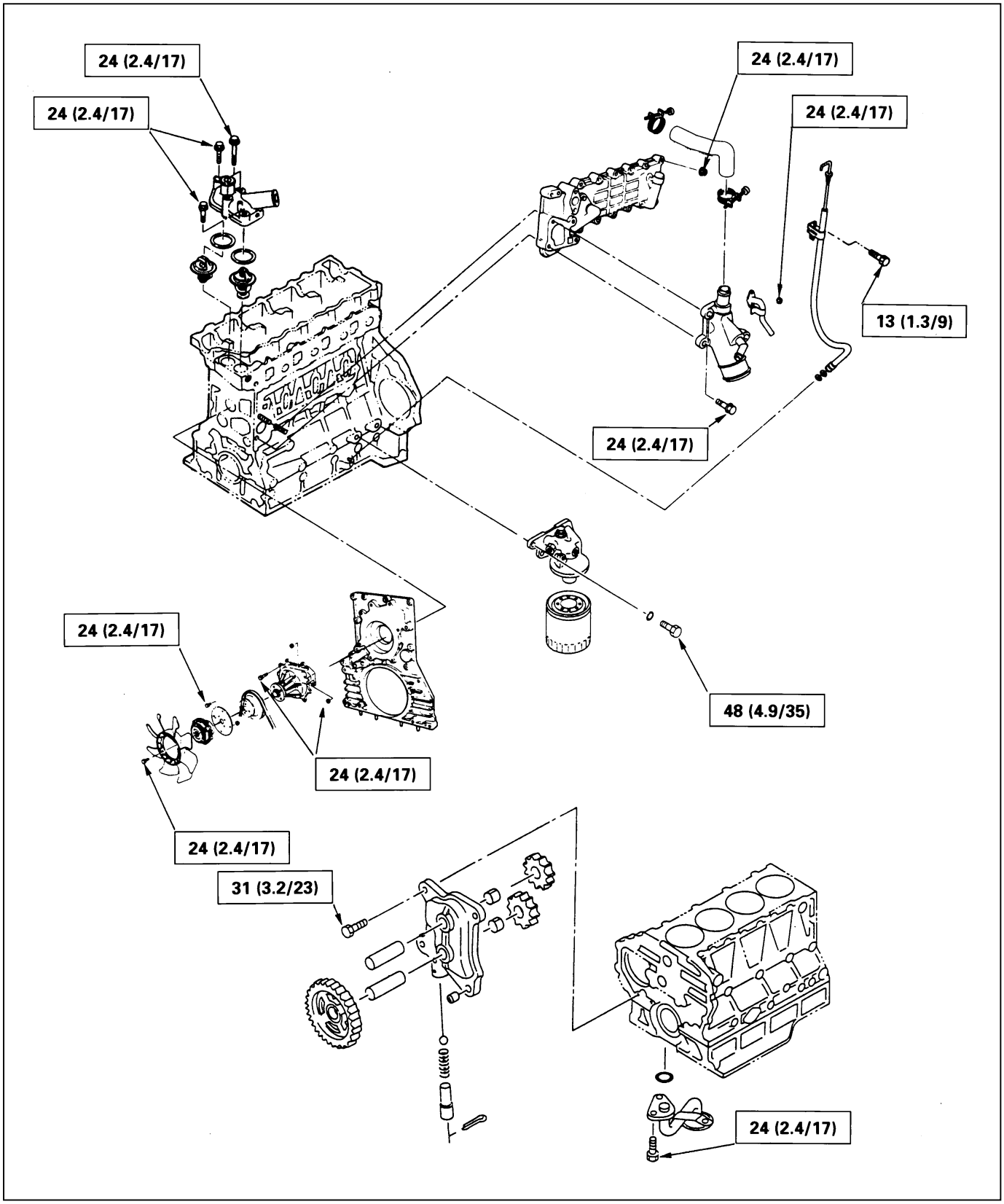
TURBOCHARGER, WATER PIPE AND OIL PIPE N•m (kg•m/lb•ft)



036LX007.tif

WATER PUMP, WATER OUTLET PIPE, OIL PUMP, OIL COOLER AND OIL FILTER

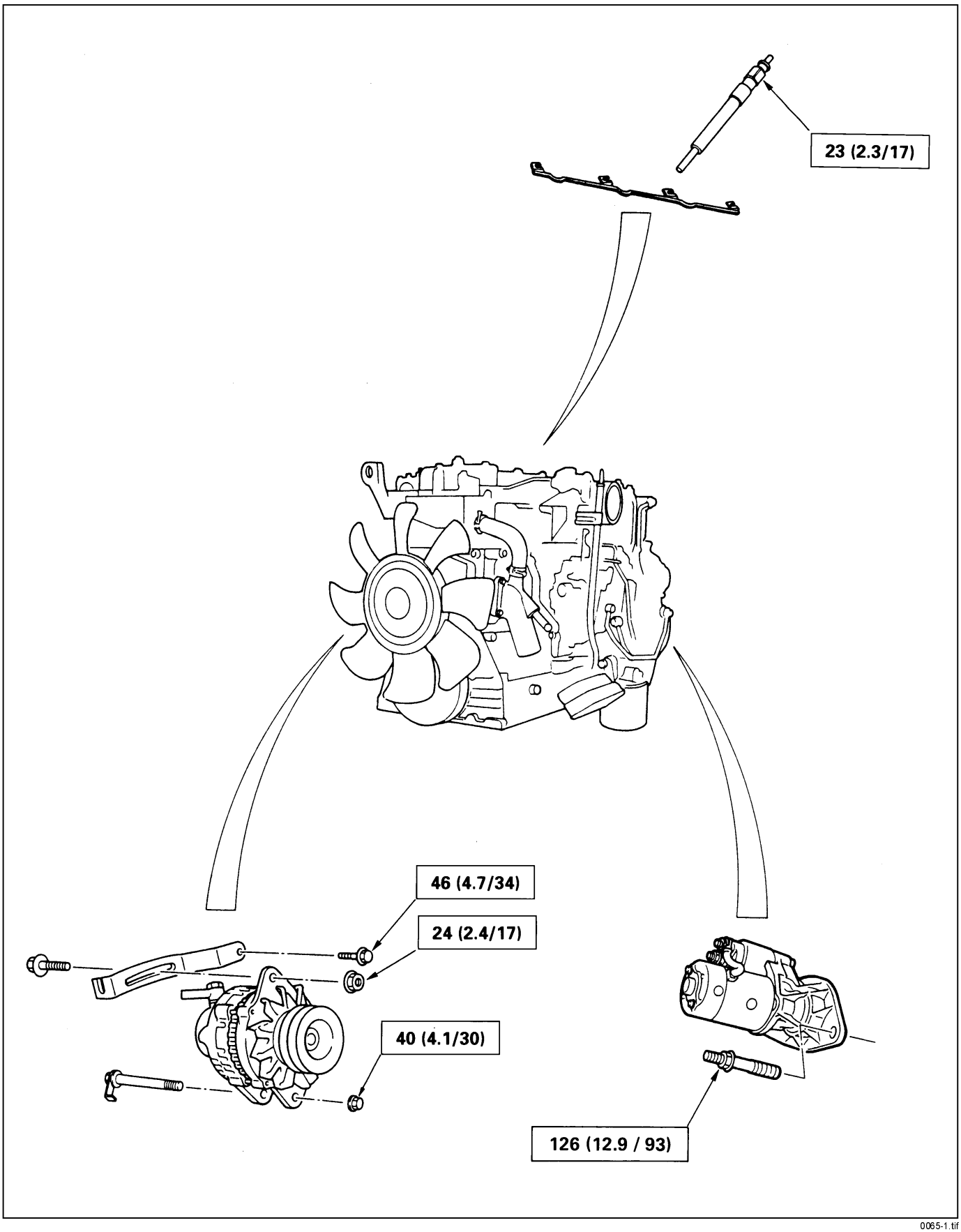
N•m (kg•m/lb•ft)



0064-1.tif

GENERATOR, STARTER AND GLOW PLUG

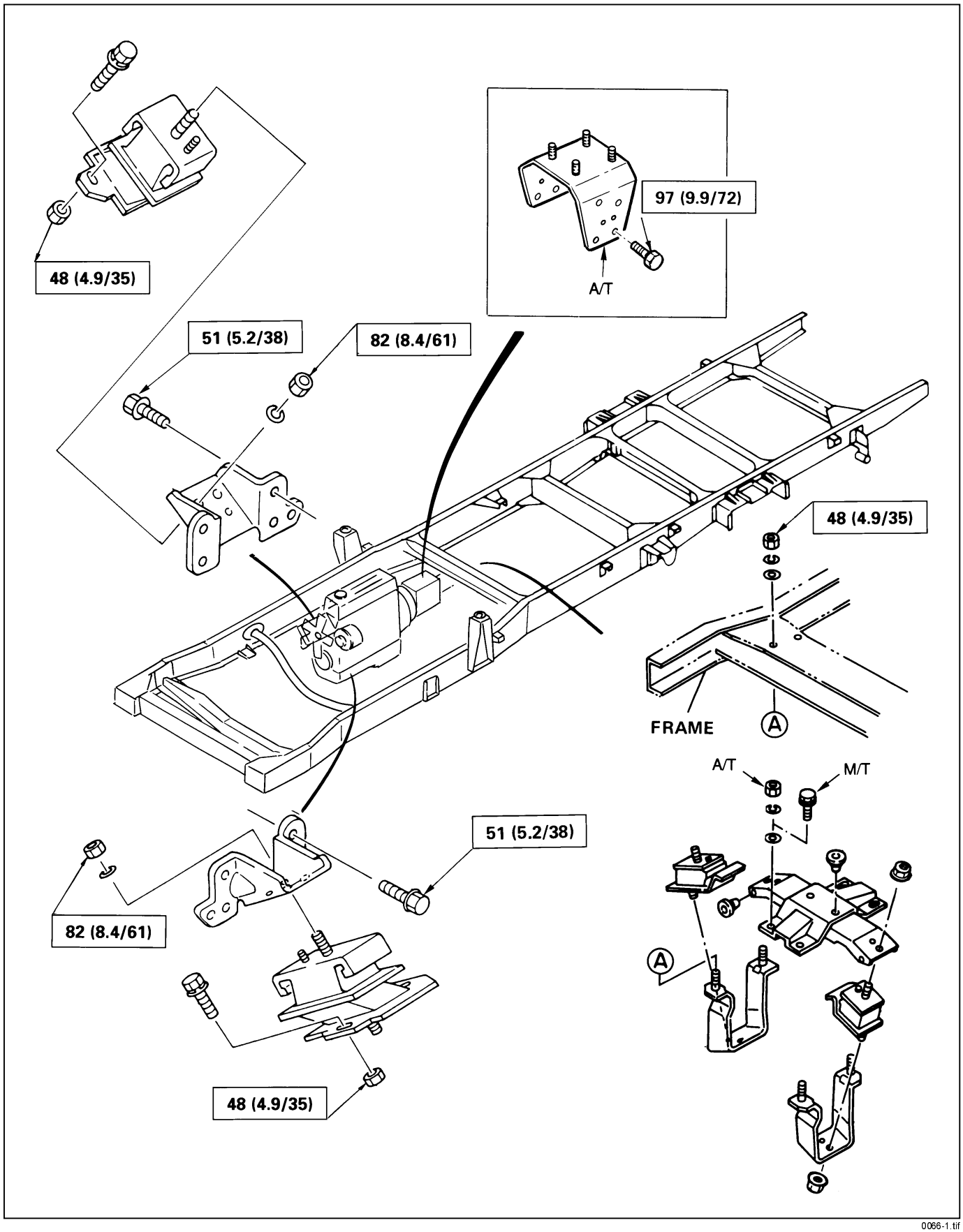
N•m (kg•m/lb•ft)



0065-1.tif

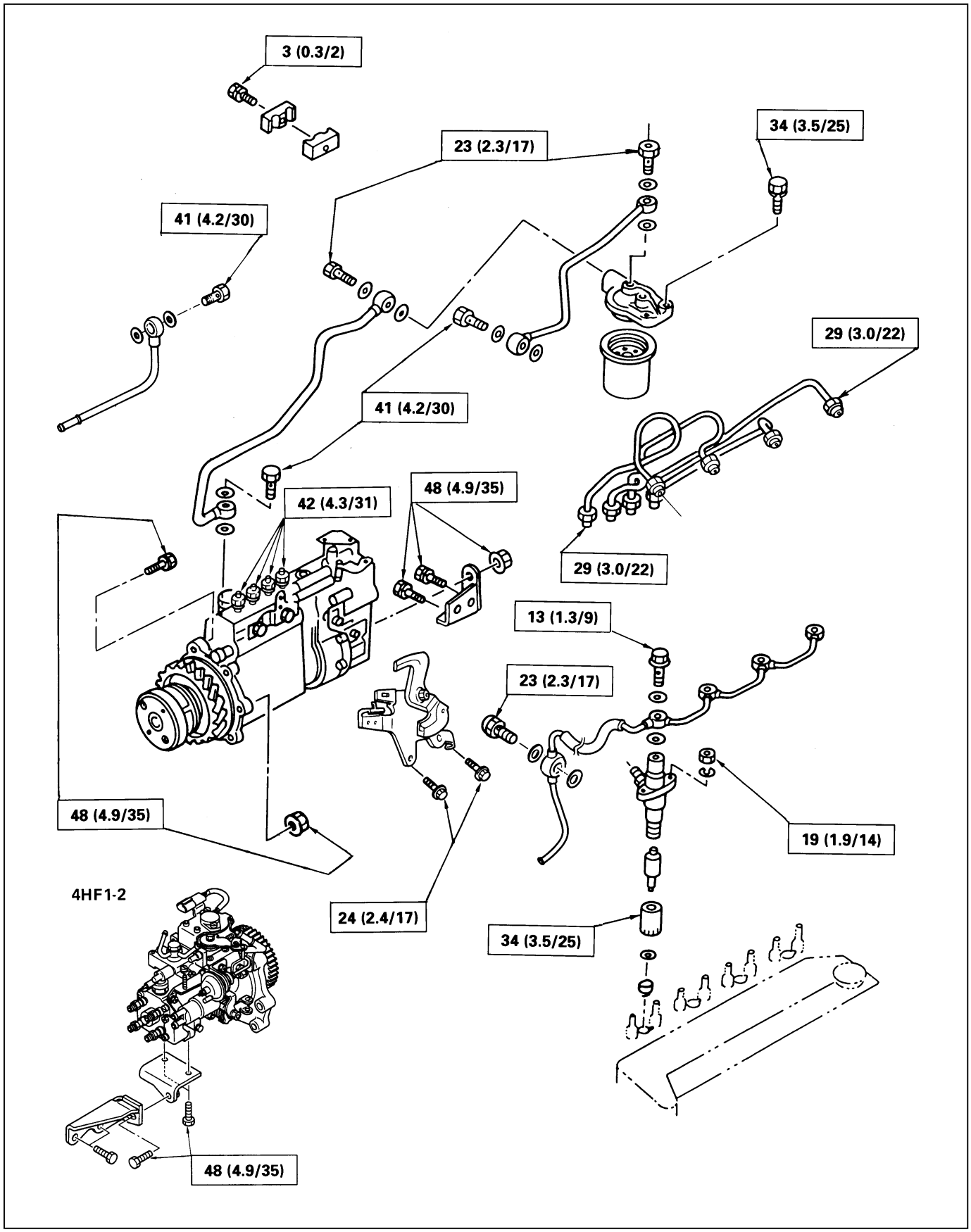
ENGINE MOUNTING

N•m (kg•m/lb•ft)



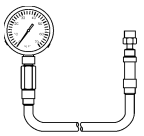
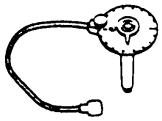
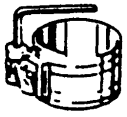
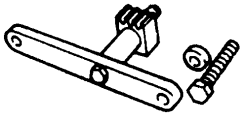
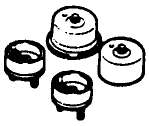
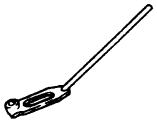
0066-1.tif

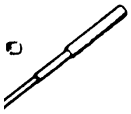
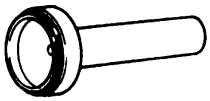
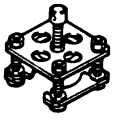
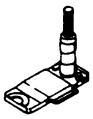
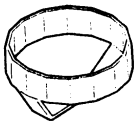
INJECTION PUMP, INJECTION PIPE AND FUEL PIPE N•m (kg•m/lb•ft)



0067-1.tif

SPECIAL TOOLS

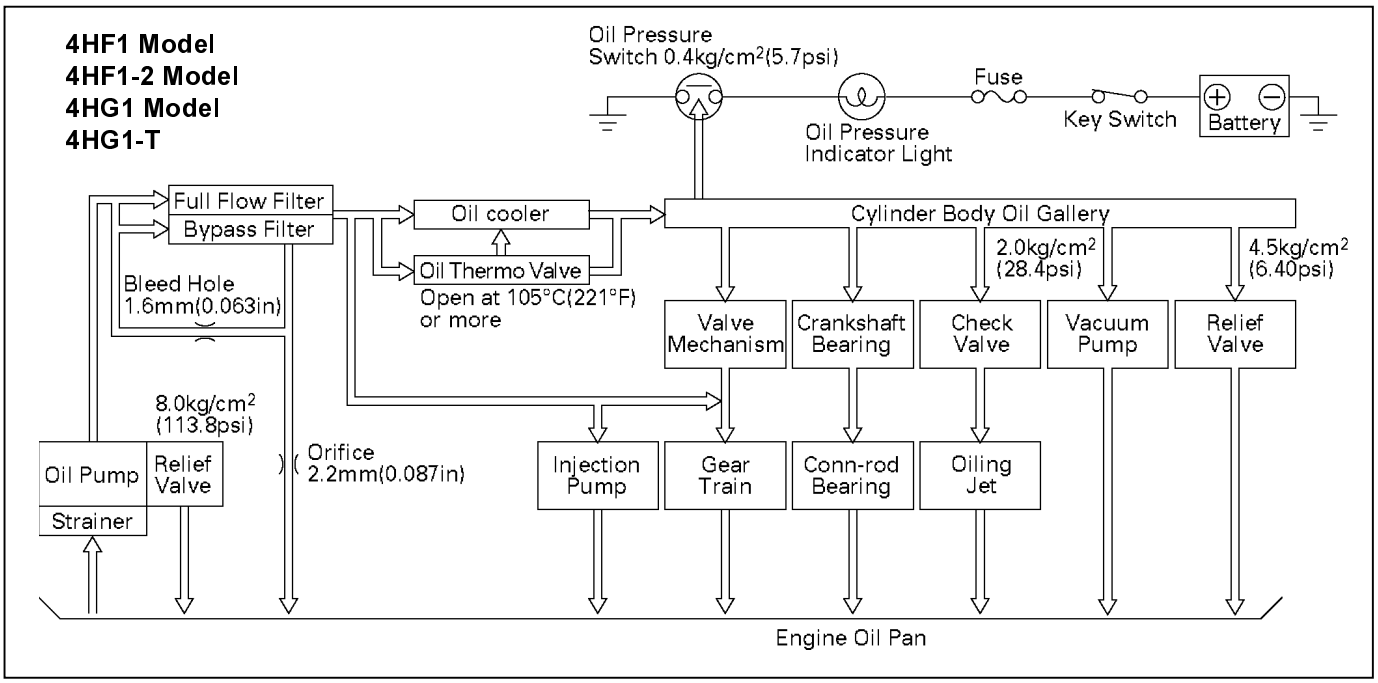
Item No.	Illustration	Part No.	Part Name	Remarks
1		1-8522-1097-0	Oil filter wrench	
2		5-8840-2675-0	Compression gauge with adapter	
3		5-8531-7001-0	Compression gauge adapter	
4		5-8840-0266-0	Angle gauge	For angular bolt and nut tightening
5		5-8840-9018-0	Piston installer	
6		5-8840-2230-0	Crankshaft stopper	
7		5-8840-2360-0	Slinger puller	For crankshaft front and rear slinger remove
8		5-8840-2431-0	Oil seal setting tool kit	For crankshaft front and rear oil seal and slinger install
9		5-8840-2240-0	Clutch pilot aligner	
10		5-8840-2228-0	Valve spring compressor	

Item No.	Illustration	Part No.	Part Name	Remarks
11		5-8840-2227-0	Valve guide replacer	
12		8-9439-6815-0	Valve guide seal installer	
13		5-8840-2222-0	Sealing cup installer	
14		9-8523-1169-0	Cylinder liner remover	
15		5-8840-2220-0 5-8840-2397-0 (4HG1)	Cylinder liner remover ankle	
16		5-8840-2337-0	Cylinder Liner Installer (4HE1-T and 4HE1-TC only)	
17		8-9439-6818-0	Crankshaft gear remover	
18		8-9439-6819-0	Crankshaft gear installer	
19		5-8840-2340-0	Conrod bush replacer	
20		5-8840-2094-0	Oil filter wrench	4WD model

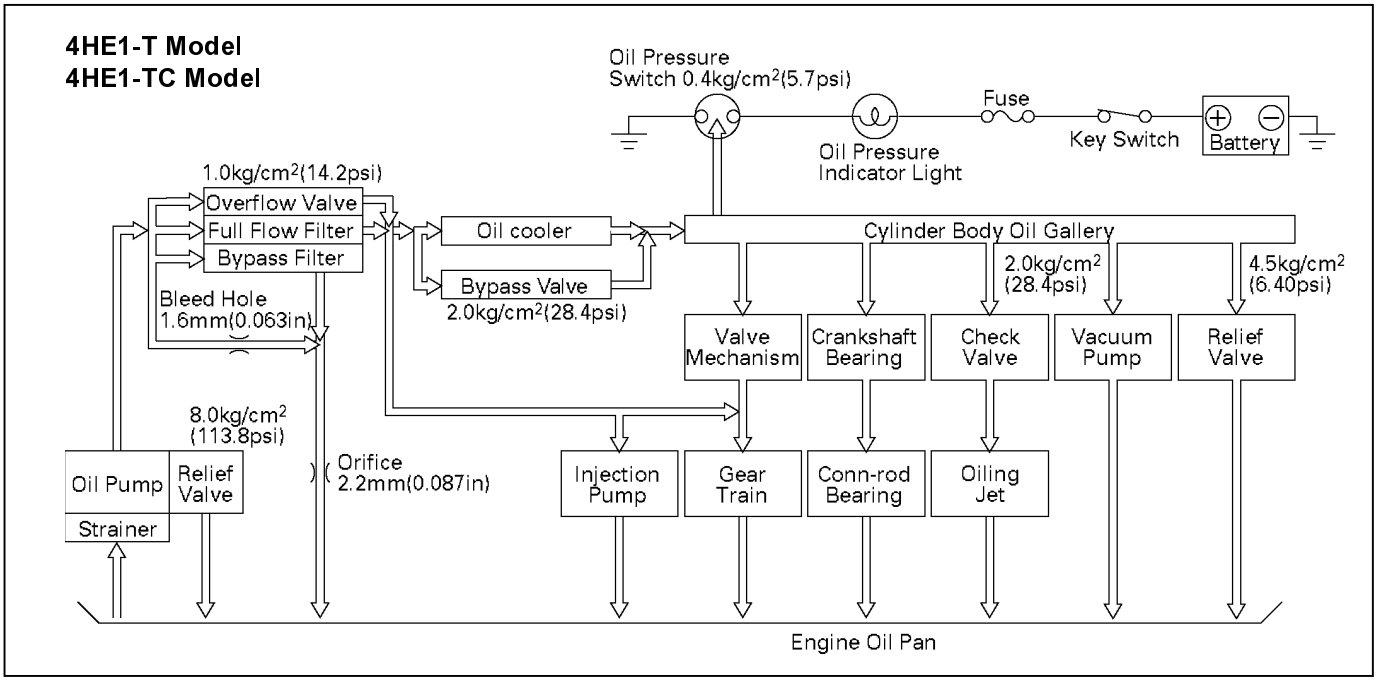
LUBRICATING SYSTEM

GENERAL DESCRIPTION

LUBRICATING OIL FLOW



901LW006.tif



901LW007.tif

The engine lubricating system is a full flow type.

Lubricating oil is pumped from the oil pump to the cylinder body oil gallery through the oil filter and the oil cooler. It is then delivered to the vital parts of the engine from the cylinder body oil gallery.

Oil jets installed on the cylinder body spray engine oil to the piston inside faces to achieve maximum cooling effect.

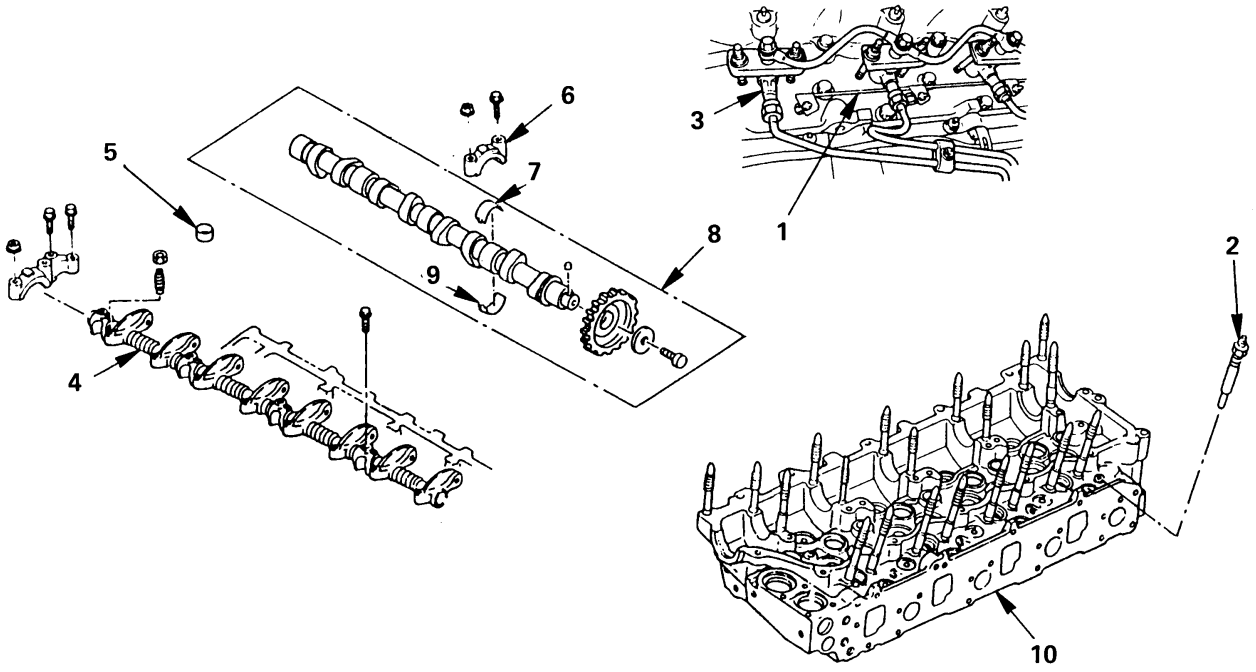
SECTION 6A

ENGINE MECHANICAL

CONTENTS

	PAGE
Cylinder Head	6A - 2
Valve Spring, Valve Guide Oil Seal, Valve, Valve Guide	6A - 8
Camshaft	6A - 16
Rocker Arm Assembly	6A - 19
Oil Pump	6A - 23
Crankshaft	6A - 29
Piston and Connecting Rod	6A - 53
Cylinder Block	6A - 63

CYLINDER HEAD



Disassembly steps
1. Glow plug connector
2. Glow plug
3. Injection nozzle holder assembly
4. Rocker arm shaft assembly
5. Valve cap
6. Camshaft bearing cap
7. Camshaft bearing upper
8. Camshaft assembly
9. Camshaft bearing lower
10. Cylinder head

Reassembly steps
To reassemble, follow the disassembly steps in the reverse order.

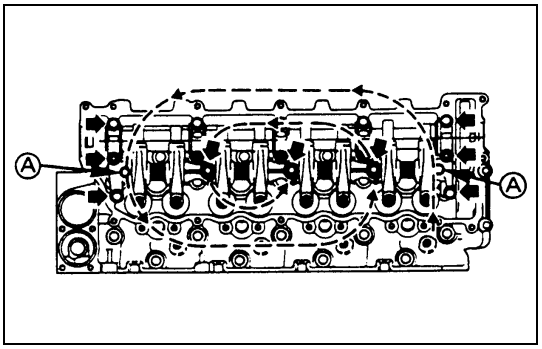
6A2-1.tif

NOTE:

- **During disassembly, be sure that the valve train components are kept together and identified so that they can be re-installed in their original locations.**
- **Before removing the cylinder head from the engine and before disassembling the valve mechanism, make a compression test and note the results.**

DISASSEMBLY

1. **Glow Plug Connector**
2. **Glow Plug**
3. **Injection Nozzle Holder Assembly**
   Mark the nozzle holder assemblies fitting positions by tagging each nozzle holder assembly with the cylinder number from which it was removed.



6A3-1.tif

4. Rocker Arm Shaft Assembly

1) Loosen the rocker arm shaft bracket nuts and bolts in numerical order a little at a time and remove the rocker arm shaft assembly with the camshaft brackets.
2) Leave the Ⓐ indicated bolt unremoved on this occasion, since it is the rocker arm fixing bolt.

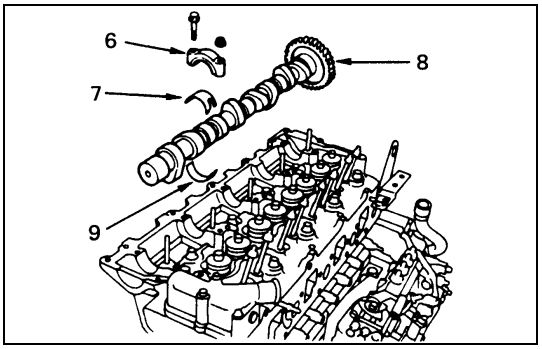
CAUTION:

Failure to loosen the rocker arm shaft bracket nuts and bolts in numerical order a little at a time will adversely affect the rocker arm shaft.

5. Valve Cap

CAUTION:

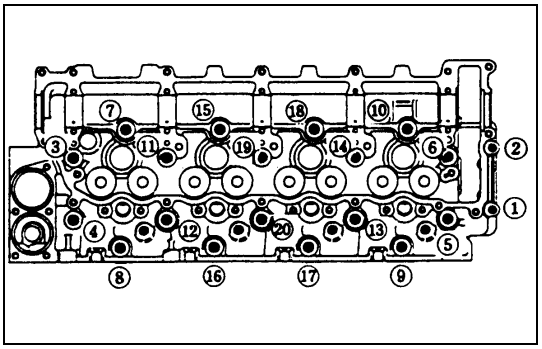
Take sufficient care not to let valve caps fall into the gear case or oil return hole.



6A3-2.tif

6. Camshaft Bearing Cap
7. Camshaft Bearing Upper
8. Camshaft Assembly
9. Camshaft Bearing Lower

If the camshaft bearings are to be reinstalled, mark their fitting positions by tagging each bearing with the cylinder number from which it was removed.



6A3-3.tif

10. Cylinder Head

Loosen the cylinder head bolts in numerical order a little at a time.

CAUTION:

Failure to loosen the cylinder head bolts in numerical order a little at a time will adversely affect the cylinder head lower surface.

- Refer to Section 6A3 “CYLINDER HEAD”.

CLEAN

- Cylinder head bolts
- Cylinder head

  Carefully remove all varnish, soot and carbon to the bare metal. Do not use a motorized wire brush on any gasket sealing surface.

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.

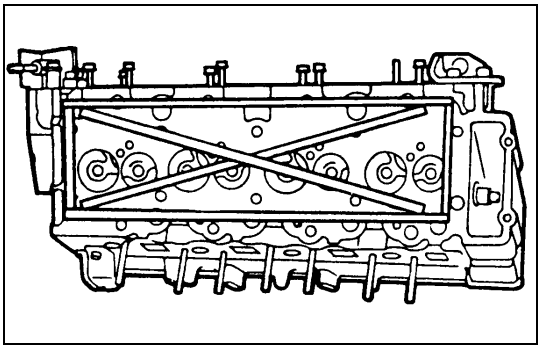
- Cylinder head gasket and mating surfaces for leaks, corrosion and blow-by. If the gasket has failed, determine the cause;
  - Improper installation
  - Loose or warped cylinder head
  - Insufficient torque on head bolts
  - Warped case surface

1) Cylinder head bolts for damaged threads or stretching and damaged heads caused by improper use of tools.

CAUTION:
Suspected bolts must be replaced.

2) Cylinder head for cracks, especially between valve seats and in the exhaust ports.
3) Cylinder head deck for corrosion, sand particles in head and porosity.

CAUTION:
Do not attempt to weld the cylinder head. Replace it.



6A4-1.tif

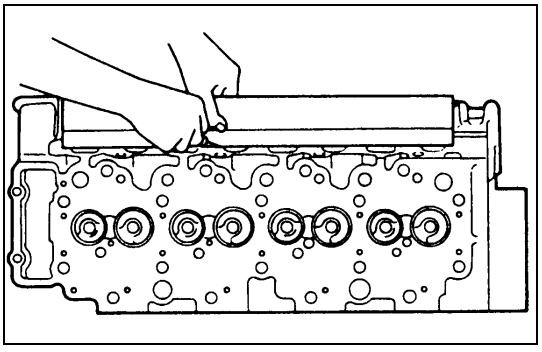
Cylinder Head Lower Face Warpage

1) Use a straight edge and a feeler gauge to measure the four sides and the two diagonals of the cylinder head face.
2) If the measured values exceed the specified limit, the cylinder head must be replaced.

NOTE:
Do not regrind the cylinder head lower face.

Cylinder Head Lower Face Warpage mm (in)

Standard	Limit
0.05 (0.002) or less	0.2 (0.008)



6A4-2.tif

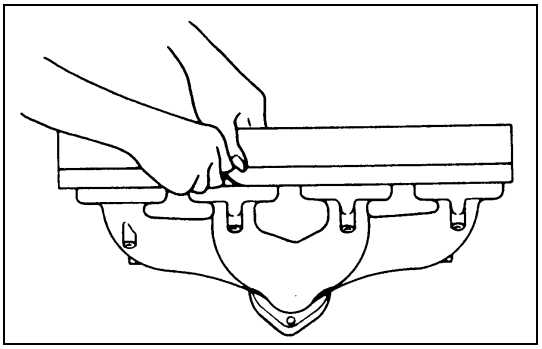
Manifold Fitting Face Warpage

Use a straight edge and a feeler gauge to measure the manifold cylinder head fitting face warpage.

Regrind the manifold cylinder head fitting faces if the measured value is greater than the specified limit.

Manifold Fitting Face Warpage mm (in)

Standard	Limit
0.05 (0.002) or less	0.2 (0.008)


6A5-1.tif

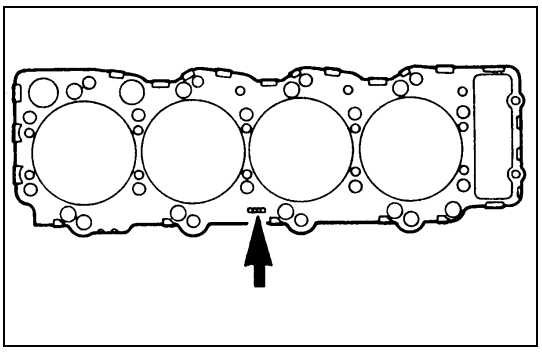
Exhaust Manifold Warpage

Use a straight edge and a feeler gauge to measure the manifold cylinder head fitting face warpage.

If the measured values exceed the specified limit, the manifold must be replaced.

Exhaust Manifold Warpage mm(in)

Standard	Limit
0.05 (0.002) or less	0.24 (0.008)


6A5-2.tif

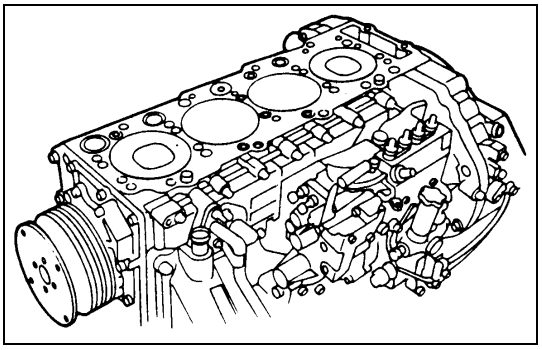
REASSEMBLY

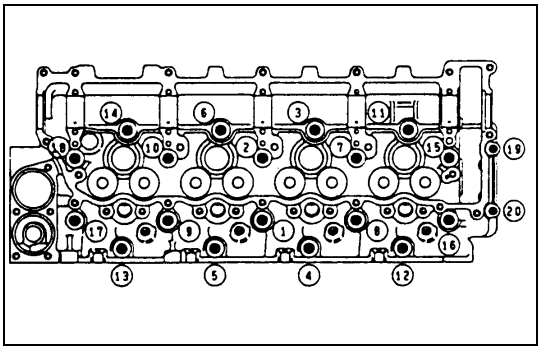
Install the cylinder head gasket with its “PART NUMBER” mark facing up and toward the left of the engine.

CAUTION:

Do not reuse the cylinder head gasket.

Above works refer to “CYLINDER BLOCK” section in this manual.


6A5-3.tif



6A5-4.tif

10. Cylinder Head

1) Align the cylinder body dowels and the cylinder head dowel holes.
2) Carefully place the cylinder head on the cylinder head gasket.
3) Apply a coat of molybdenum disulfide grease to the M14 cylinder head bolt threads and setting faces and apply a coat of engine oil to the M10 cylinder head bolt threads and setting faces.
4) Use the angular tightening method to tighten the bolts (M14) to the specified torque in three steps following the numerical order shown in the illustration.

Cylinder Head Bolt Torque (M14) (① ~ ⑱)

N•m (kg•m/lb•ft)

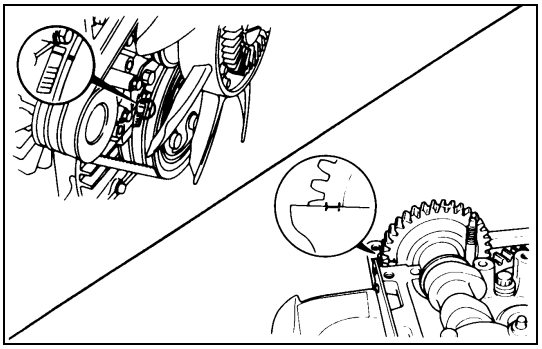
1st step	2nd step	3rd step
98 (10/72)	147 (15/108)	30° - 60°

5) Tighten the cylinder head to the flywheel housing bolts (M10) to the specified torque.

Cylinder Head Bolt Torque (M10) (⑲~⑳)

N•m (kg•m/lb•ft)

38 (3.9/28)

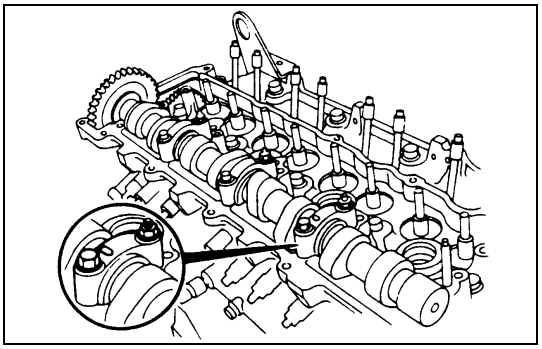


6A6-1.tif

9. Camshaft Bearing Lower

8. Camshaft Assembly

1) Turn the crankshaft in the direction of normal rotation until the timing mark on the crankshaft damper pulley is aligned with the TDC notched line. (Confirm that the No. 1 cylinder piston comes to the compression top dead center.)
2) Apply engine oil to the camshaft journal and the camshaft bearing surfaces before installation.
3) Carefully align the camshaft gear "I" mark and the cylinder head upper face shown in the illustration.

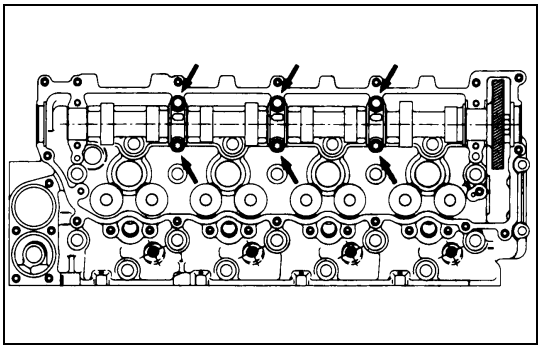


6A6-2.tif

7. Camshaft Bearing Upper

6. Camshaft Bearing Cap

1) Install the bearing caps with the bearing cap head mark (arrow) facing forward.
2) Apply a coat of engine oil to the bearing cap bolt and stud threads.

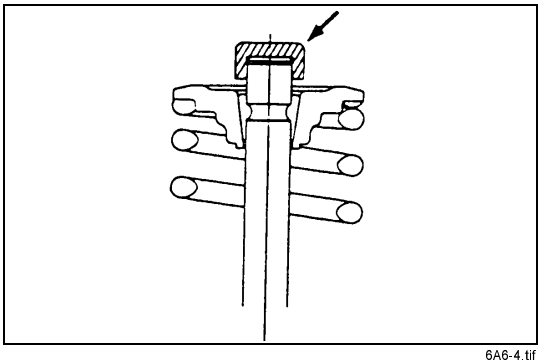


6A6-3.tif

3) Tighten the bearing cap bolts and studs to the specified torque.

Camshaft Bearing Cap Nut and Bolt Torque

N•m (kg•m/lb•ft)
27 (2.8/20)



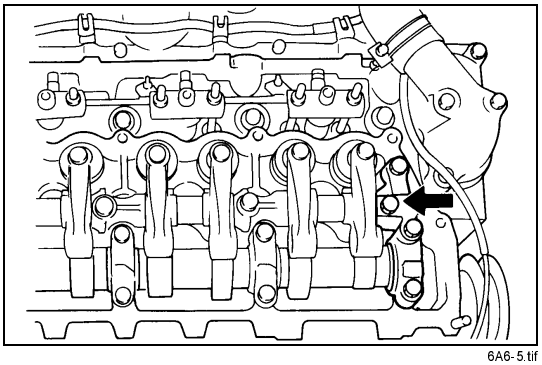
6A6-4.tif

5. Valve Cap

Apply engine oil to the inside of the valve caps and install them to the valve stem end.

CAUTION:

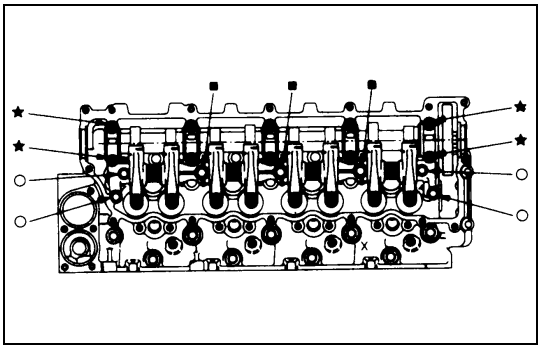
Take sufficient care not to let valve caps fall into the gear.



6A6-5.tif

4. Rocker Arm Shaft Assembly

1) Temporarily tighten the bolts marked with the arrow in the illustration.
2) Loosen the rocker arm adjust screws and apply engine oil to the rocker arm roller portions.
3) Install the rocker arm assembly on the cylinder head.



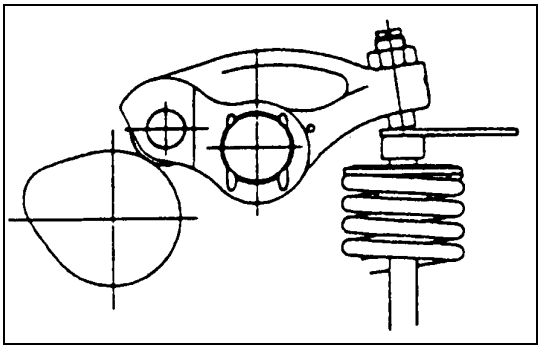
6A7-1.tif

4) Tighten the rocker arm shaft bracket nuts and bolts to the specified torque in numerical order a little at a time as shown in the illustration.

Rocker Arm Shaft Bracket Nut and Bolt Torque — N•m (kg•m/lb•ft)

★ Nut	27 (2.8/20)
■ Bolt	56 (5.7/41)
□ Bolt	27 (2.8/20)

5) Apply engine oil to the threaded portion of the nuts marked with "★" and the bolts with "■" shown in the illustration left, and tighten them to the specified torque.



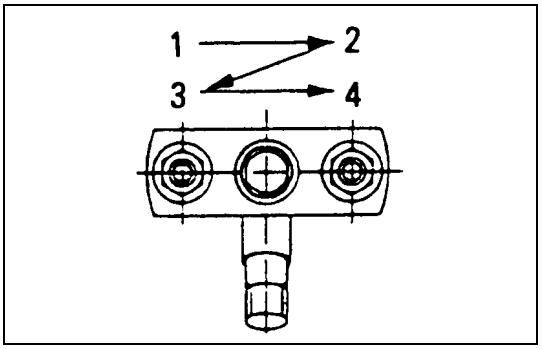
6A7-2.tif

Adjust the valve clearance.

Valve Clearance — mm (in)

At cold	0.4 (0.016)

Above works refer to "SERVICING" "VALVE CLEARANCE ADJUSTMENT" previously section in this manual.



6A7-3.tif

3. Injection Nozzle Holder Assembly

Tighten the nozzle holder flange nuts to the specified torque in the numerical order shown in the illustration.

Nozzle Holder Flange Nut Torque — N•m (kg•m/lb•ft)

19 (1.9/14)

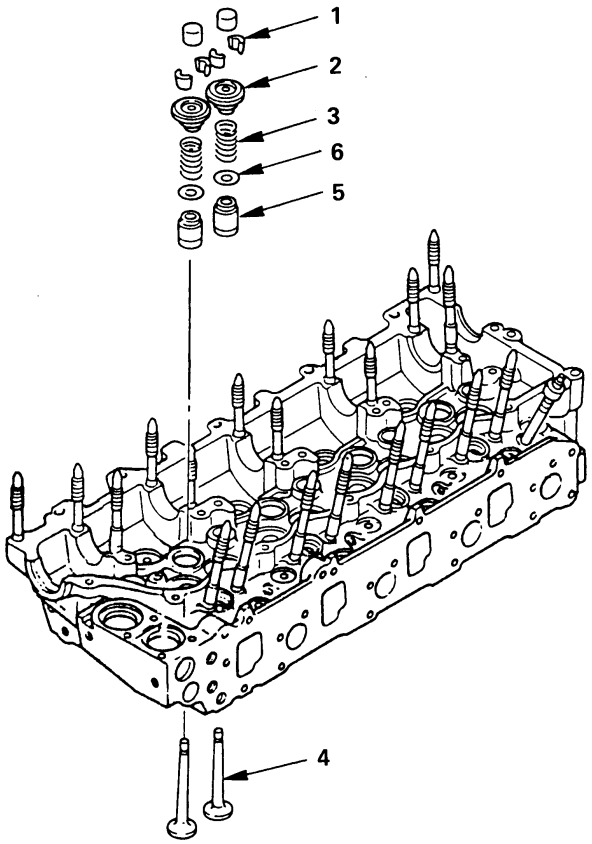
2. Glow Plug

Glow Plug Torque — N•m (kg•m/lb•ft)

23 (2.3/17)

1. Glow Plug Connector

VALVE SPRING, VALVE GUIDE OIL SEAL, VALVE, VALVE GUIDE



Disassembly steps
1. Split collar
2. Spring upper seat
3. Valve spring
4. Intake and exhaust valve
5. Valve guide seal
6. Spring lower seat

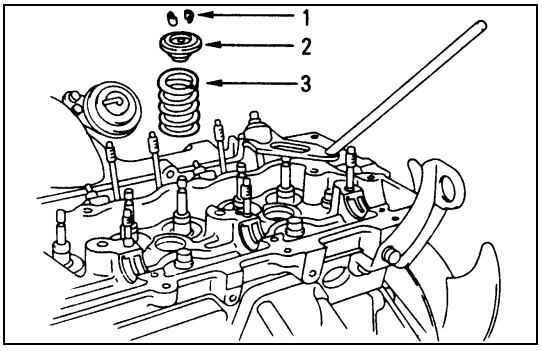
Reassemblt steps
To reassemble, follow the disassebly steps in the reverse order.

6A8-1.tif

DISASSEMBLY

Preparation

- Remove all the parts only with the cylinder head assembly left.
  (Above works refer to “CYLINDER HEAD GASKET” section 6A3 in this manual.)



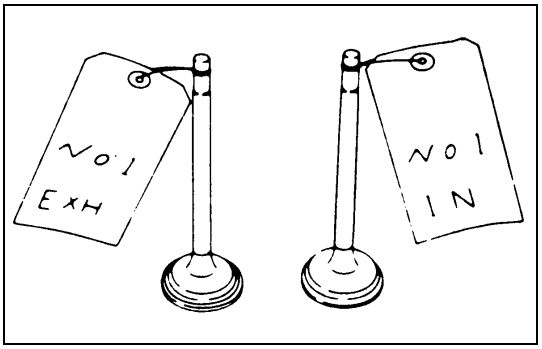
6A8-2.tif

1. Cotter Collar

1) Place the cylinder head on a flat wooden surface.
2) Use the valve spring compressor to remove the cotter collar.
   Do not allow the valve to fall from the cylinder head.
   Valve Spring Compressor: 5-8840-2228-0

2. Spring Upper Seat

3. Valve Spring

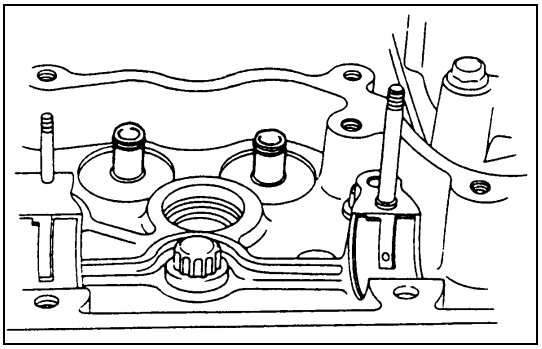


6A9-1.tif

4. **Intake and Exhaust Valve**

   If the intake and exhaust valves are to be reinstalled, mark their installation positions by tagging each valve with the cylinder number from which it was removed.

   If the intake and exhaust valves are to be replaced, the valve guides must also be replaced.

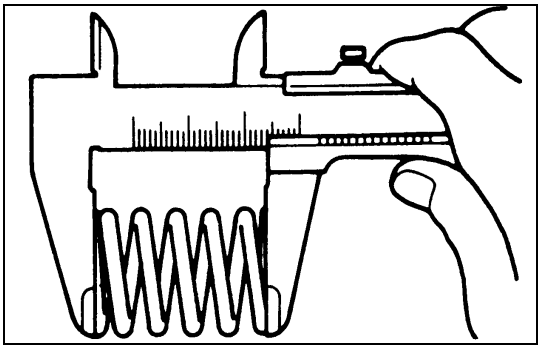


6A9-2.tif

5. **Valve Guide Seal**
6. **Spring Lower Seat**

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.



6A9-3.tif

Valve Spring Free Height

Use a vernier caliper to measure the valve spring free height.

If the measured valve is less than the specified limit, the valve spring must be replaced.

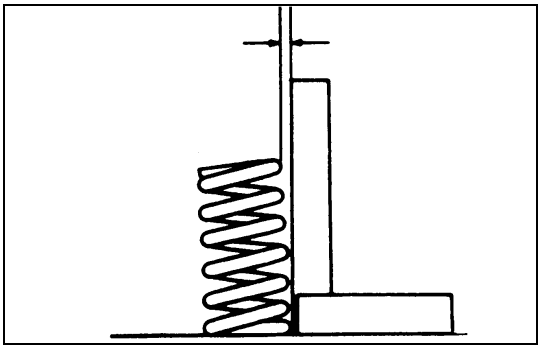
Valve Spring Free Height mm (in)

4HF1: 4HF1-2: 4HG1: 4HG1-T

Nominal Size	Limit
62.5 (2.46)	59.4 (2.34)

4HE1-T: 4HE1-TC:

	Nominal size	Limit
Intake Inner	53.2 (2.094)	50.1 (1.972)
Intake Outer	55.6 (2.189)	52.5 (2.067)
Exhaust Inner	58.6 (2.307)	55.5 (2.185)
Exhaust Outer	62.0 (2.441)	58.9 (2.319)



6A10-1.tif

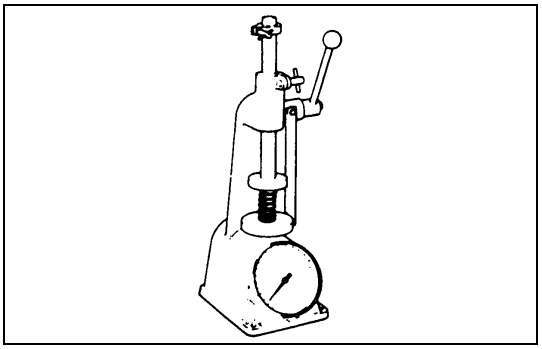
Valve Spring Squareness

Use a surface plate and a square to measure the valve spring squareness.

If the measured value exceeds the specified limit, the valve spring must be replaced.

Valve Spring Squareness mm (in)

Limit	1.0 (0.04)



6A10-2.tif

Valve Spring Tension

Use spring tester to measure the valve spring tension.

If the measured valve is less than the specified limit, the valve spring must be replaced.

Valve Spring Tension N (kg/lb)

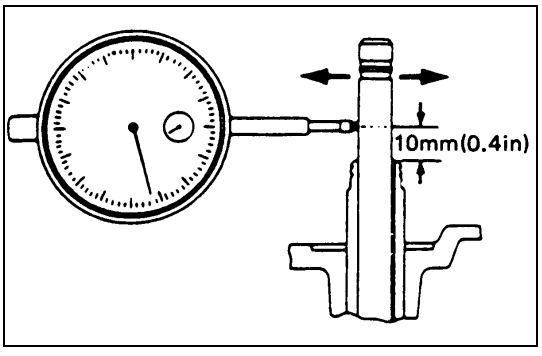
Set Length mm(in)	Standard	Limit
47.0 (1.85)	414 - 477 (42.2 - 48.6/93 - 107)	401 (40.9/98)

Valve Guide

CAUTION:

Taking care not to damage the valve seat contact surface, when removing carbon adhering to the valve head.

Carefully inspect the valve stem for scratching or abnormal wear. If these conditions are present, the valve and the valve guide must be replaced as a set.



6A10-3.tif

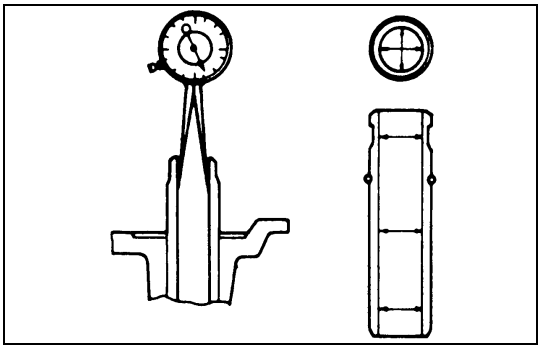
Valve Stem and Valve Guide Clearance

(Measuring Method-I)

1) Set the dial indicator to the valve stem measuring point.
2) Move the valve stem end from side to side.
   Read the dial indicator.
   Note the total indicator reading.
   If the measured values exceed the specified limit, the valve and the valve guide must be replaced as a set.

Total Dial Indicator Reading
(Valve Stem and Valve Guide Clearance) mm (in)

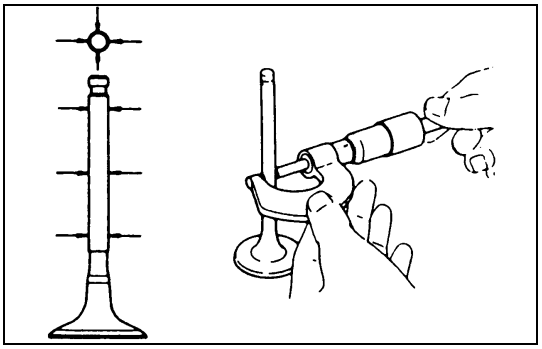
Valve	Standard	Limit
Intake Valve	0.038 - 0.071 (0.0015 - 0.0028)	0.20 (0.0079)
Exhaust Valve	0.064 - 0.096 (0.0025 - 0.0038)	0.25 (0.0098)



6A11-1.tif

(Measuring Method-II)

1) Measure the valve stem outside diameter.
   Refer to the "Valve Stem Outside Diameter."
2) Use a caliper calibrator or a telescoping gauge to measure the valve guide inside diameter.
3) Calculate the clearance between the valve guide inside diameter and the valve stem outside diameter.
   If the clearance exceeds the specified limit, the valve and the valve guide must be replaced as a set.



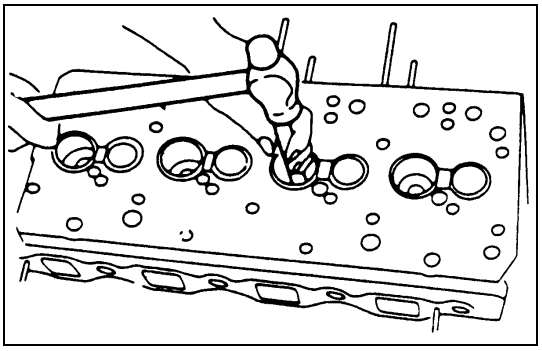
6A11-2.tif

Valve Stem Outside Diameter

Measure the valve stem diameter at three points.
If the measured valve is less than the specified limit, the valve and the valve guide must be replaced as a set.

Valve Stem Outside Diameter mm (in)

Valve	Standard	Limit
Intake Valve	8.946 - 8.962 (0.3522 - 0.3528)	8.88 (0.350)
Exhaust Valve	8.921 - 8.936 (0.3512 - 0.3529)	8.80 (0.346)

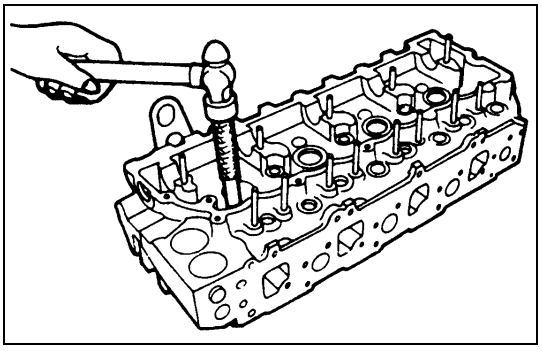


6A11-3.tif

Valve Guide Replacement

Valve Guide Removal

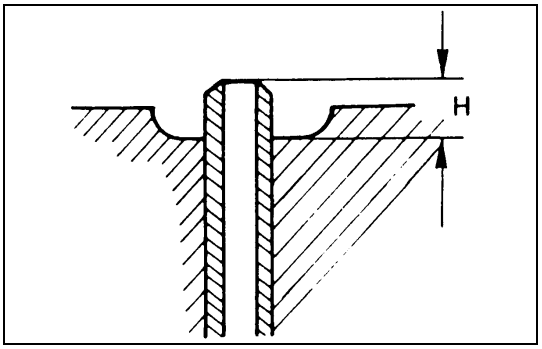
Use a hammer and the valve guide replacer to drive out the valve guide from the cylinder head lower face.
Valve Guide Replacer: 5-8840-2227-0



6A11-4.tif

Valve Guide Installation

1) Apply engine oil to the valve guide outer circumference.
2) Attach the valve guide installer to the valve guide.
   Valve Guide Replacer: 5-8840-2227-0
3) Use a hammer to drive the valve guide into position from the cylinder head upper face.



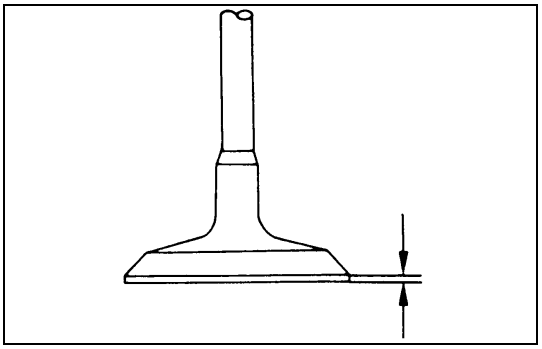
6A12-1.tif

4) Measure the height (H) of the valve guide upper end from the cylinder head upper face.

Valve Guide Upper End Height (H)	mm (in)
14.1 ± 0.2 (0.555 ± 0.008)	

NOTE:

If the valve guide has been removed, both the valve and the valve guide must be replaced as a set.



6A12-2.tif

VALVE AND VALVE SEAT INSERT

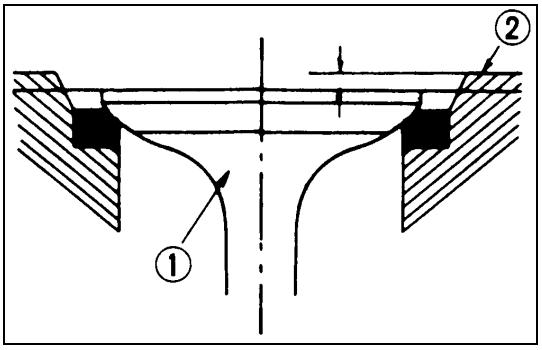
Valve Thickness and Depression

1) Measure the valve thickness.

   If the measured value is less than the specified limit, the valve and the valve seat insert must be replaced as a set.

Intake and Exhaust Valve Thickness mm(in)

Valve	Nominal Size	Limit
Inlet	1.8 (0.071)	1.3 (0.051)
Exhaust	1.75 (0.069)	1.3 (0.051)



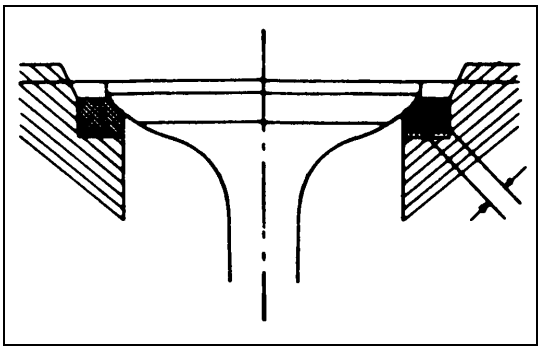
6A12-3.tif

2) Install the new valve ① to the cylinder head ②.
3) Use a depth gauge or a straight edge with steel rule to measure the valve depression from the cylinder head lower surface.

   If the measured value exceeds the specified limit, the valve seat insert and/or the valve must be replaced.

Intake and Exhaust Valve Depression mm (in)

Standard	Limit
0.7 - 1.2 (0.028 - 0.047)	2.5(0.098)



6A12-4.tif

Valve Contact Width

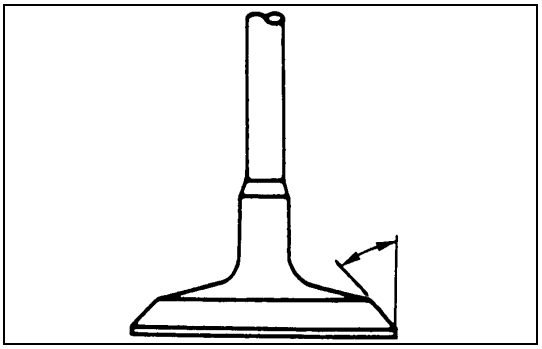
1) Check the valve contact faces for roughness and unevenness.

   Make smooth the valve contact surfaces.
2) Measure the valve contact width.

   If the measured value exceeds the specified limit, the valve seat insert must be corrected or replaced.

Valve Contact Width mm (in)

Valve	Nominal Size	Limit
Intake	2.5 (0.098)	3.0 (0.118)
Exhaust	2.0 (0.079)	2.5 (0.098)

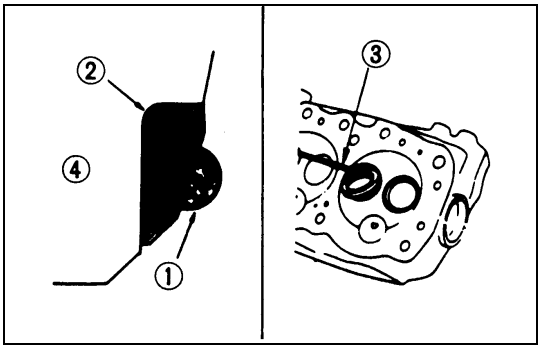


6A13-1.tif

Contact Surface Angle on Valve Seat on Valve

1) Measure contact surface angle on valve seat.
2) If the measured value exceeds the limit, replace valve, valve guide and valve seat as a set.

Standard	Degrees
45°	

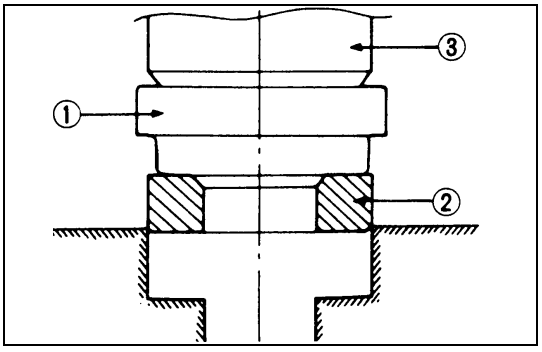


6A13-2.tif

Valve Seat Insert Replacement

Valve Seat Insert Removal

1) Arc weld the entire inside circumference ① of the valve seat insert ②.
2) Allow the valve seat insert to cool for a few minutes.
   This will invite contraction and make removal of the valve seat insert easier.
3) Use a screwdriver ③ to pry the valve seat insert free.
   Take care not to damage the cylinder head ④.
4) Carefully remove carbon and other foreign material from the cylinder head insert bore.



6A13-3.tif

Valve Seat Insert Installation

1) Carefully place the attachment ① (having a smaller outside diameter than the valve seat insert) on the valve seat insert ②.

NOTE:

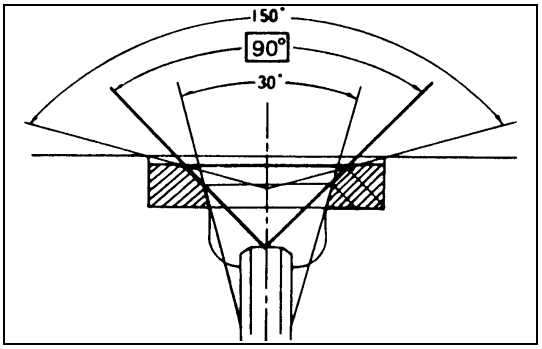
The smooth side of the attachment must contact the valve seat insert.

2) Use a bench press ③ to gradually apply pressure to the attachment and press the valve seat insert into place.

CAUTION:

Do not apply an excessive amount of pressure with the bench press. Damage to the valve seat insert will result.

3) The valve should be lapped before final assembly to ensure a good valve seal.
   Above works refer to “Valve Seat Insert Correction” section in this manual.

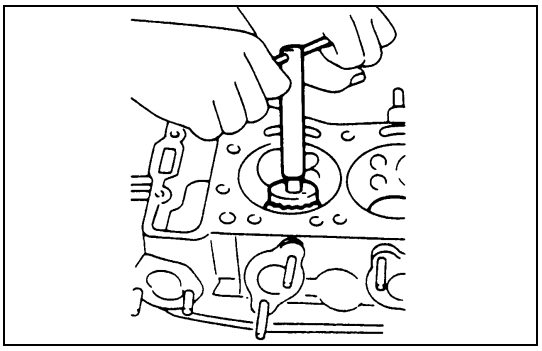


6A14-1.tif

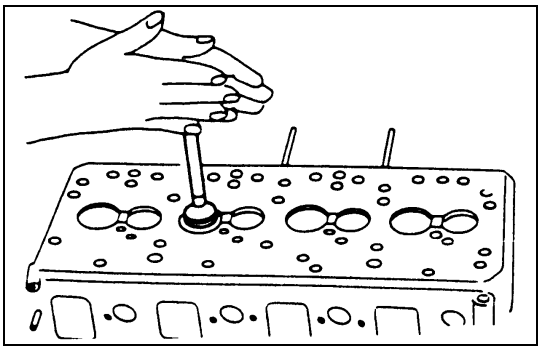
Valve Seat Insert Correction

1) Remove the carbon from the valve seat insert surface.
2) Use a valve cutter (15°, 45°, and 75° blades) to minimize scratches and other rough areas. This will bring the contact width back to the standard value.
   Remove only the scratches and rough areas. Do not cut away too much. Take care not to cut away unblemished areas of the valve seat surface.

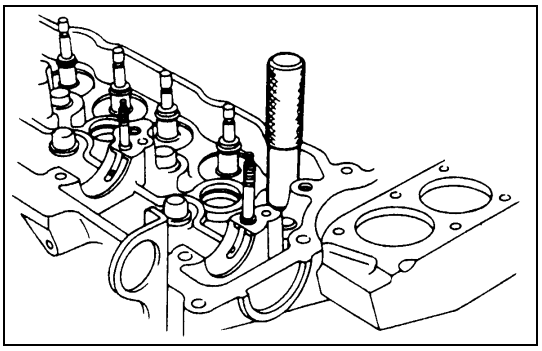
Valve Seat Angle	Degrees
45°	


6A14-2.tif

NOTE:
Use an adjustable valve cutter pilot.
Do not allow the valve cutter pilot to wobble inside the valve guide.


6A14-3.tif

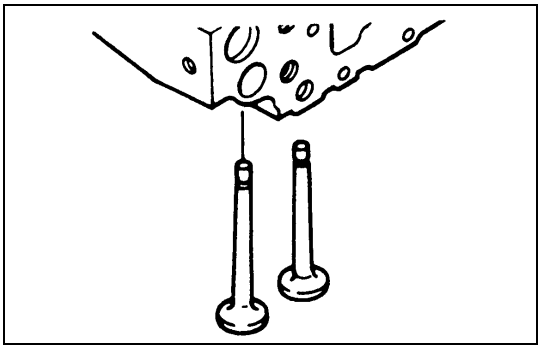
3) Apply abrasive compound to the valve seat insert surface.
4) Insert the valve into the valve guide.
5) Turn the valve while tapping it to fit the valve seat insert.
6) Check to see if the valve contact width is correct.
7) Check to see if the valve seat insert surface is in contact with the entire circumference of the valve.


6A14-4.tif

REASSEMBLY

6. Spring Lower Seat
5. Valve Guide Seal

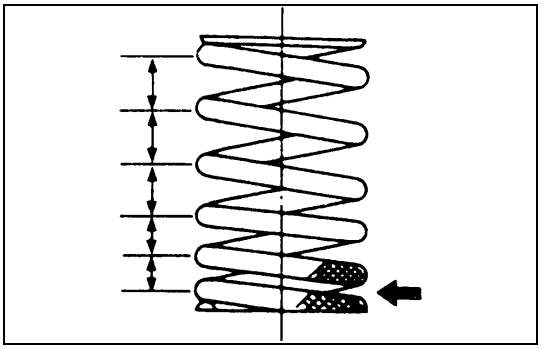
1) Apply a coat of engine oil to the valve guide seal inner face.
2) Use a valve guide seal installer to install the valve guide seal to the valve guide
   Valve Guide Seal Installer: 8-9439-6815-0



6A15-1.tif

4. Intake and Exhaust Valve

1) Apply a coat of engine oil to each valve stem before installation.
2) Install the intake and exhaust valve.
3) Turn the cylinder head up to install the valve spring.
   Take care not to allow the installed valves to fall free.

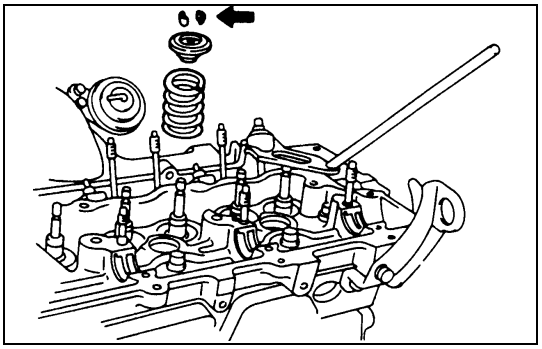


6A15-2.tif

3. Valve Spring

Install the valve spring with its fine pitched (or painted) end side sown.

2. Spring Upper Seat

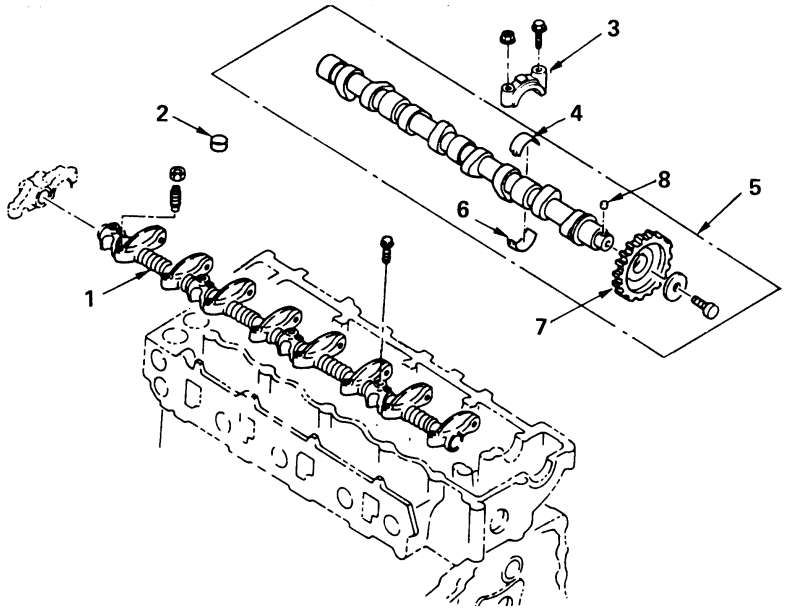


6A15-3.tif

1. Cotter Collar

1) Use the valve spring compressor to push the valve spring into position.
   Valve Spring Compressor: 5-8840-2228-0
2) Install the cotter collar to the valve stem.
3) Set the cotter collar by tapping around the head of the collar with a rubber hammer.

CAMSHAFT



Disassembly steps
1. Rocker arm shaft assembly
2. Valve cap
3. Camshaft bearing cap
4. Camshaft bearing upper
5. Camshaft assembly
6. Camshaft bearing lower
7. Camshaft gear
8. Key

Reassembly steps
To install, follow the disassembly steps in the reverse order.

6A16-1.tif

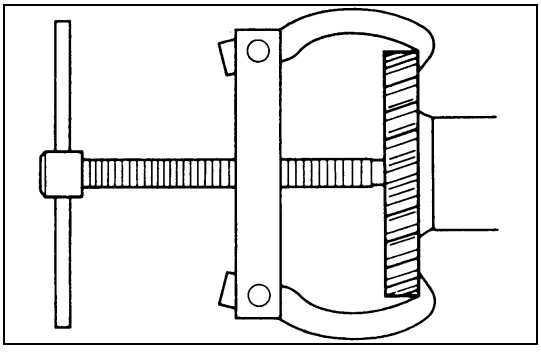
DISASSEMBLY

1. **Rocker Arm Shaft Assembly**
2. **Valve Cap**
3. **Camshaft Bearing Cap**
4. **Camshaft Bearing Upper**
5. **Camshaft Assembly**
6. **Camshaft Bearing Lower**

   Above works refer to “CYLINDER HEAD” section in this manual.
7. **Camshaft Gear**

   Use the universal puller to pull out the camshaft gear.

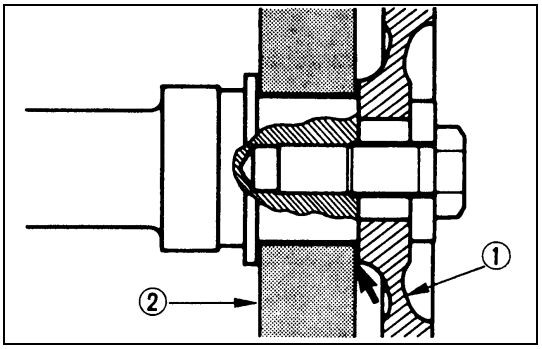
   Universal puller: 5-8840-2027-0/(5-8840-0086-0)
8. **Key**



6A16-2.tif

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.



6A17-1.tif

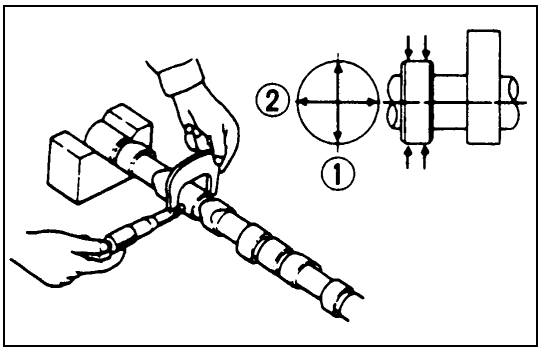
Camshaft End Play

Use a thickness gauge to measure the clearance between the camshaft gear ① and the camshaft bracket ②.

If the measured value exceeds the specified limit, the camshaft gear or the camshaft must be replaced.

Camshaft End Play mm (in)

Standard	Limit
0.085 - 0.205 (0.0033 - 0.0081)	0.25 (0.0098)



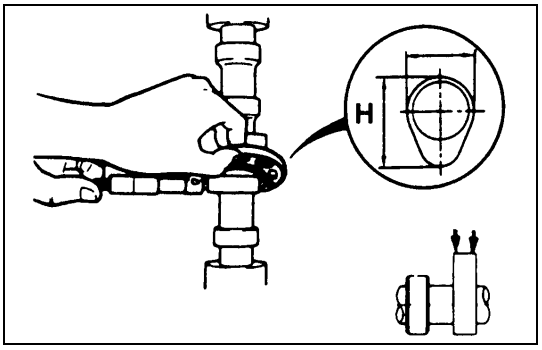
6A17-2.tif

Camshaft Journal Diameter

Use a micrometer to measure each camshaft journal diameter in two directions (① and ②). If the measured value is less than the specified limit, the camshaft must be replaced.

Camshaft Journal Diameter mm (in)

Standard	Limit
39.950 - 39.975 (1.5728 - 1.5738)	39.850 (1.569)



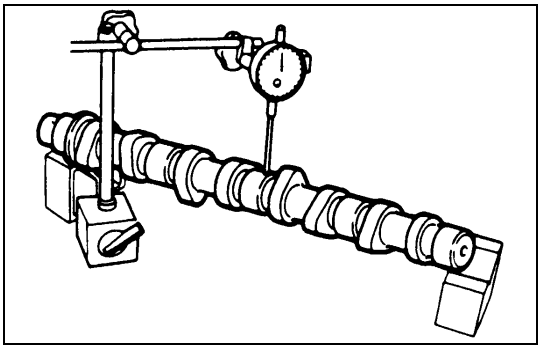
6A17-3.tif

Cam Height

Measure the cam height "H" with a micrometer. If the measured value is less than the specified limit, the camshaft must be replaced.

Cam Height "H" mm (in)

Engine model	Standard	Limit
Other model	52.8 (2.078)	51.8 (2.039)
4HE1-T 4HE1-TC	53.6 (2.110)	52.6 (2.071)

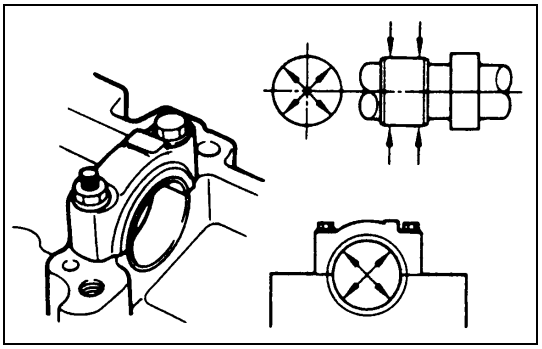

6A17-4.tif

Camshaft Run-Out

1) Mount the camshaft on V-blocks.
2) Measure the run-out with a dial indicator.
   If the measured value exceeds the specified limit, the camshaft must be replaced.

Camshaft Run-Out mm (in)

Limit	0.05 (0.002)



6A18-1.tif

Camshaft and Camshaft Bearing Clearance

Use an inside dial indicator to measure the camshaft bearing inside diameter.

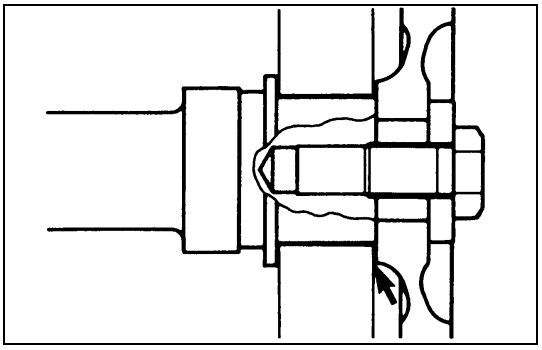
Camshaft Bearing Inside Diameter mm (in)

Standard	40.000 - 40.037 (1.5748 - 1.5763)

If the clearance between the camshaft bearing inside diameter and the journal exceeds the specified limit, the camshaft bearing must be replaced.

Camshaft Bearing Clearance mm (in)

Standard	Limit
0.025 - 0.087 (0.00098 - 0.00343)	0.15 (0.0059)



6A18-2.tif

REASSEMBLY

8. **Key**
7. **Camshaft Gear**
   - With the projection of the camshaft gear center boss turned to the camshaft side, set it to the knock pin and install the camshaft gear.

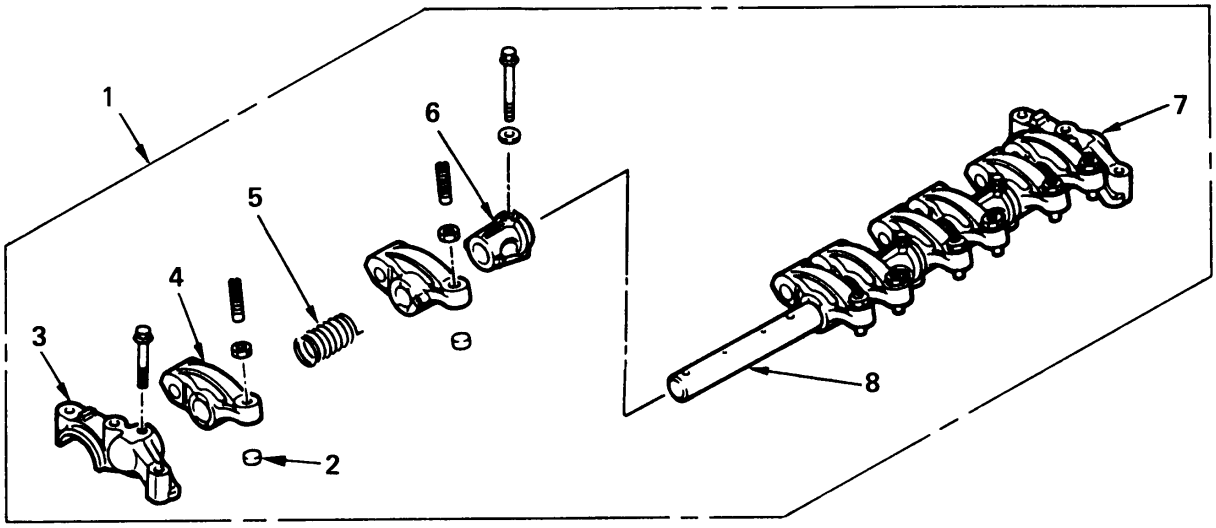
   Camshaft Gear Bolt Torque N•m (kg•m/lb•ft)

142 (14.5/105)

6. **Camshaft Bearing Lower**
5. **Camshaft Assembly**
4. **Camshaft Bearing Upper**
3. **Camshaft Bearing Cap**
2. **Valve Cap**
1. **Rocker Arm Shaft Assembly**

   Above works refer to “CYLINDER HEAD” section in this manual.

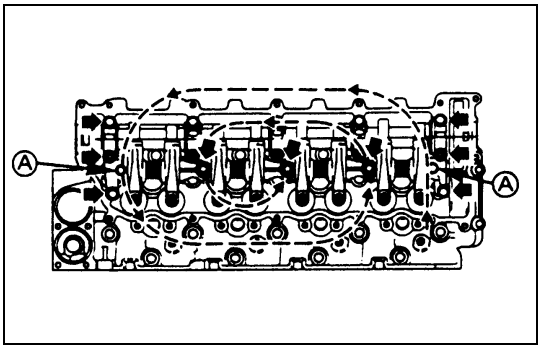
ROCKER ARM ASSEMBLY



Removal steps
1. Rocker arm assembly
2. Valve cap
3. Camshaft bracket
4. Rocker arm
5. Spring
6. Rocker arm bracket
7. Camshaft bracket
8. Rocker arm shaft

Installation steps
To install, follow the removal steps in the reverse order.

6A19-1.tif



6A19-2.tif

DISASSEMBLY

1. **Rocker Arm Shaft Assembly**
   1) Loosen the rocker arm shaft bracket nuts and bolts in numerical order a little at a time and remove the rocker arm shaft assembly with the camshaft brackets.
   2) Leave the Ⓐ indicated bolt unremoved on this occasion, since it is the rocker arm fixing bolt.

CAUTION:
Failure to loosen the rocker arm shaft bracket nuts and bolts in numerical order a little at a time will adversely affect the rocker arm shaft.

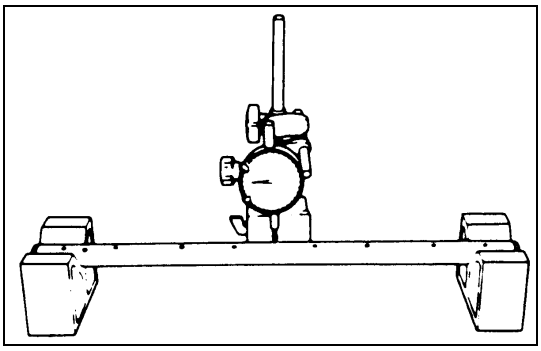
2. **Valve Cap**

CAUTION:
Take sufficient care not to let valve caps fall into the gear case or oil return hole.

3. **Camshaft Bracket**
4. **Rocker Arm**
5. **Spring**
6. **Rocker Arm Bracket**
7. **Camshaft Bracket**
8. **Rocker Arm Shaft**

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.

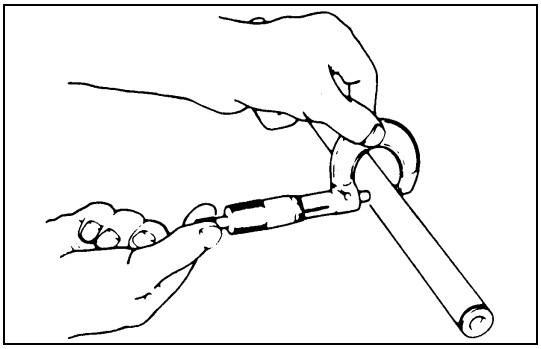

6A20-1.tif

Rocker Arm Shaft Run-Out

1) Place the rocker arm shaft on V-blocks.
2) Use a dial indicator to measure the rocker arm shaft central portion run-out.
   If the run-out is very slight, correct the rocker arm shaft run-out with a bench press. The rocker arm must be at cold condition.
   If the measured rocker arm shaft run-out exceeds the specified limit, the rocker arm shaft must be replaced.

Rocker Arm Shaft Run-Out mm (in)

Limit	0.3 (0.012)

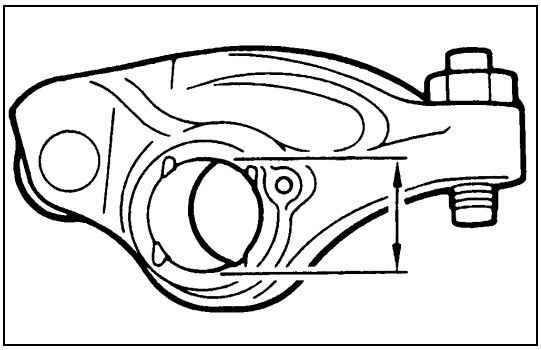

6A20-2.tif

Rocker Arm Shaft Outside Diameter

Use a micrometer to measure the rocker arm fitting portion outside diameter.
If the measured value is less than the specified limit, the rocker arm shaft must be replaced.

Rocker Arm Shaft Outside Diameter mm (in)

Standard	Limit
21.979 - 22.000 (0.8653 - 0.8661)	21.85 (0.8602)


6A20-3.tif

Rocker Arm Bushing Inside Diameter

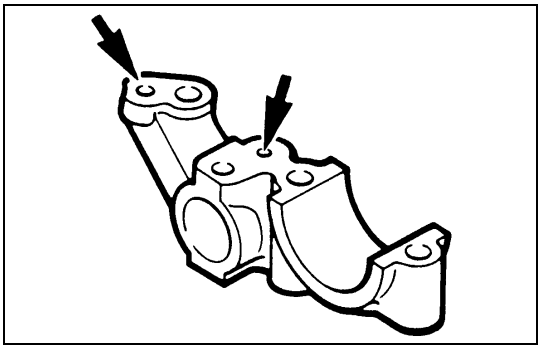
Use either a vernier caliper or a dial indicator to measure the rocker arm bushing inside diameter.

Rocker Arm Bushing Inside Diameter mm (in)

Standard	Limit
22.010 - 22.035 (0.8665 - 0.8675)	22.15 (0.8720)

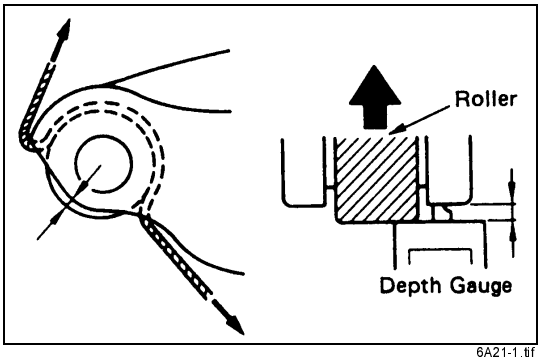
Rocker Arm and Rocker Arm Shaft Clearance mm (in)

Standard	Limit
0.010 - 0.056 (0.0004 - 0.0022)	0.2 (0.0079)


6A20-4.tif

Check to see if the rocker arm oil port is free of obstructions.

If necessary, use compressed air to clean the rocker arm oil port.



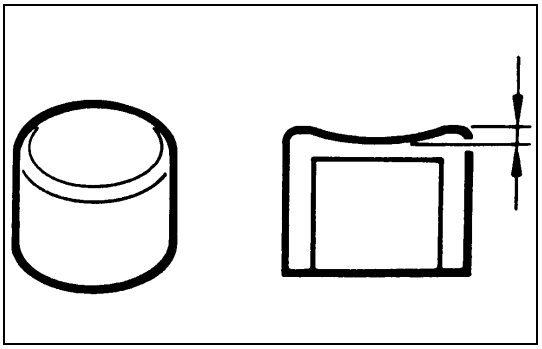
6A21-1.tif

Rocker Arm Roller and Rocker Arm Pin

1) Pass a string through the rocker arm-roller clearance and measure the roller protrusion while pulling both ends of the string in the arrow-indicated directions to push out the roller.
2) Mark the measuring point and draw out the string.
   Measure the roller protrusion again while the roller is pushed in.
3) Note the difference in the above measurements is the standard roller-rocker arm pin clearance. Should the clearance exceed the limit, replace the rocker arm.

Rocker Arm Roller and Pin Clearance mm (in)

Standard	Limit
0.040 - 0.084 (0.0016 - 0.0033)	0.5 (0.02)


6A21-2.tif

Valve Cap Wear

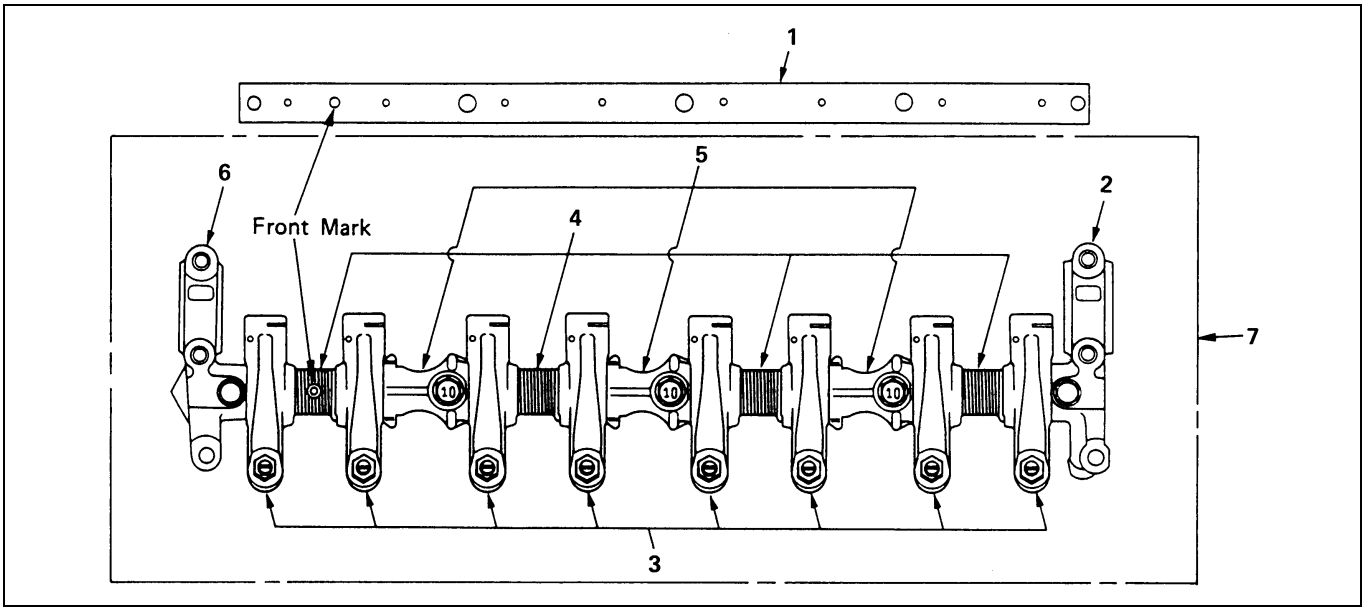
Inspect the valve cap surface contacting the rocker arm using a dial gauge.

If wear exceeds the limit, replace the valve cap with a new one.

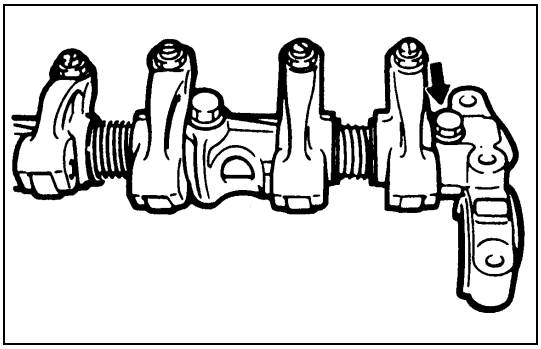
Valve Cap Worn mm (in)

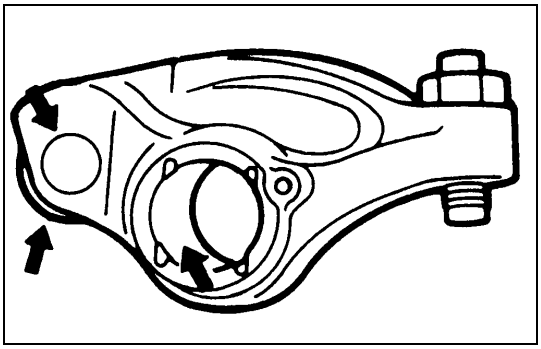
Limit	0.1 (0.004)

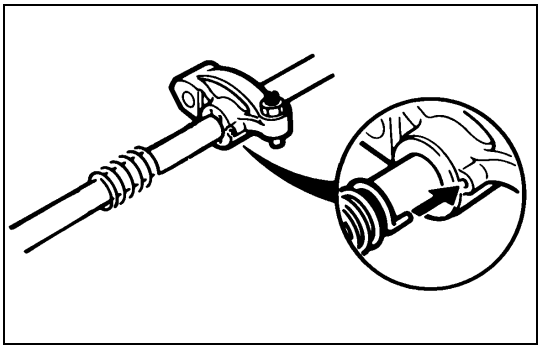
REASSEMBLY

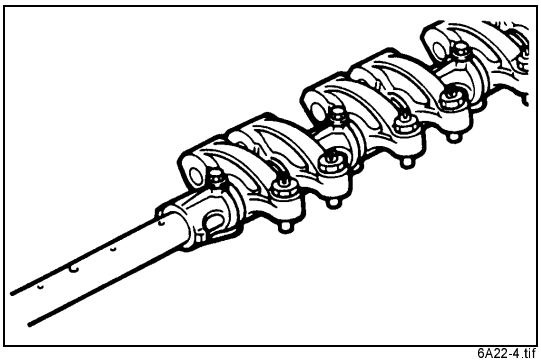


6A21-3.tif


6A22-1.tif

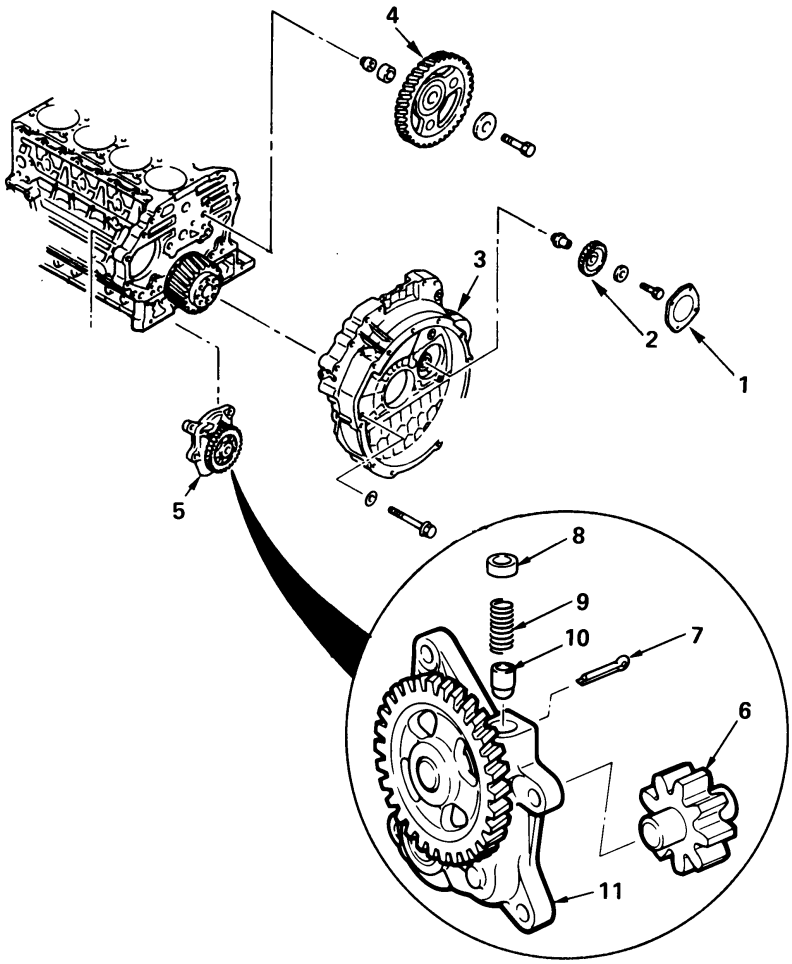

6A22-2.tif


6A22-3.tif


6A22-4.tif

1. **Rocker Arm Shaft**
   1) Use compressed air to thoroughly clean the rocker arm shaft oil holes.
   2) Apply a coat of engine oil to the rocker arm shaft.
   3) Install the rocker arm shaft with the “Front” mark facing up and toward the front of the engine.
2. **Camshaft Bracket**
   Install the camshaft bracket to the rocker arm shaft and temporarily tighten the camshaft bracket fixing bolt as shown in the illustration.
3. **Rocker Arm**
   Apply engine oil to the rocker arm bushing and the roller pin and then install it to the rocker arm shaft.
4. **Spring**
   Insert the spring end into the rocker arm.
5. **Rocker Arm Bracket**
6. **Camshaft Bracket**
   Temporarily tighten the camshaft bracket fixing bolt.
8. **Valve Cap**
7. **Rocker Arm Shaft Assembly**
   Above works refer to “CYLINDER HEAD” section in this manual.

OIL PUMP

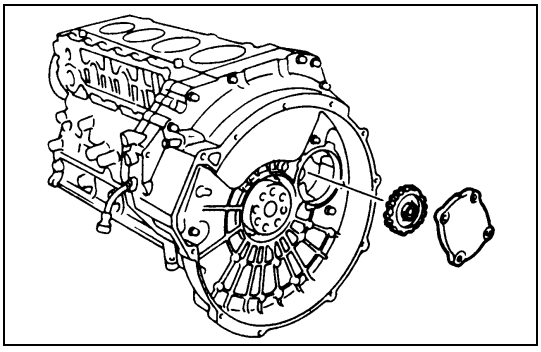


Disassembly steps
1. Power steering pump idle gear cover
2. Power steering pump idle gear
3. Flywheel housing
4. Idle gear A
5. Oil pump assembly
6. Driven gear and shaft
7. Cotter pin
8. Spring seat
9. Oil relief valve spring
10. Oil relief valve
11. Pump cover

Reassembly steps
To install, follow the disassembly steps in the reverse order.

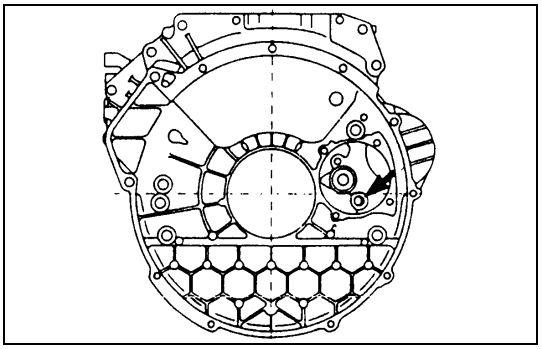
6A23-1.tif

DISASSEMBLY



6A23-2.tif

1. **Power Steering Pump Idle Gear Cover**
2. **Power Steering Pump Idle Gear**

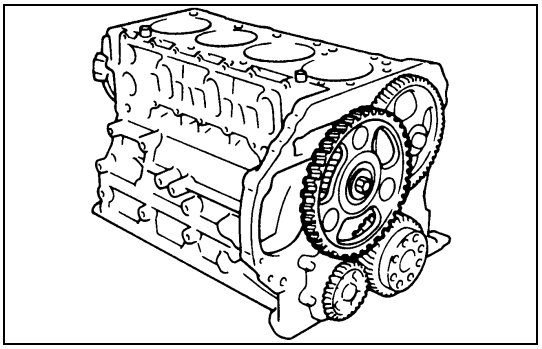


6A24-1.tif

3. Flywheel Housing

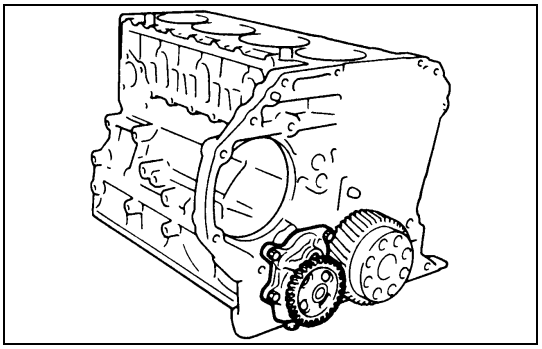
   NOTE:

   Be careful not to fail to remove the bolts shown in the illustration.



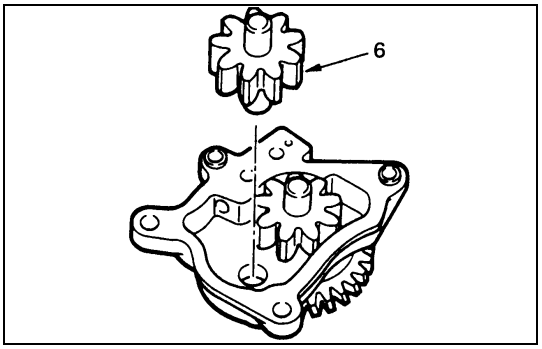
6A24-2.tif

4. Idle Gear A



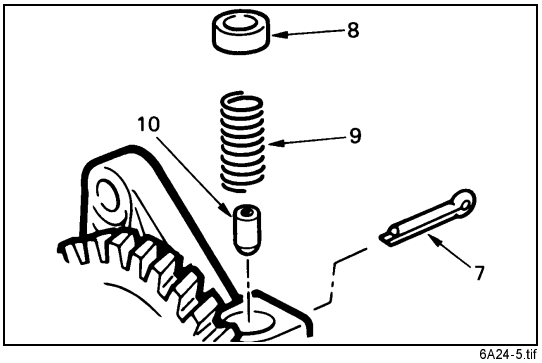
6A24-3.tif

5. Oil Pump Assembly



6A24-4.tif

6. Driven Gear and Shaft

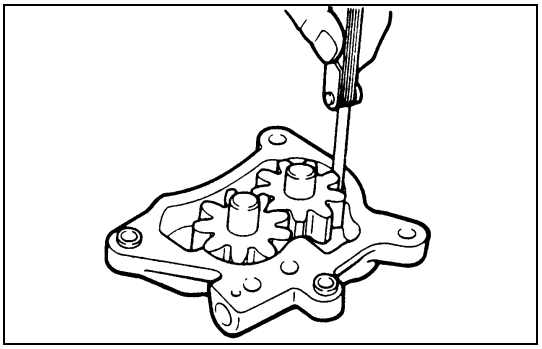


6A24-5.tif

7. Cotter Pin
8. Spring Seat
9. Oil Relief Valve Spring
10. Oil Relief Valve
11. Pump Cover

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.


6A25-1.tif

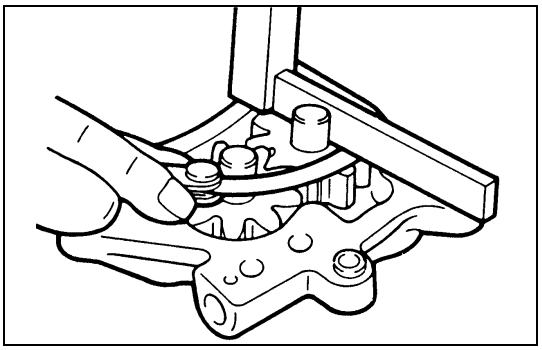
Gear Teeth and Cover Inner Wall Clearance

Use a feeler gauge to measure the clearance between the gear teeth and the cover inner wall.

If the clearance between the gear teeth and the cover inner wall exceeds the specified limit, the oil pump assembly must be replaced.

Gear Teeth and Cover Inner Wall Clearance mm (in)

Standard	Limit
0.125 - 0.220 (0.0049 - 0.0087)	0.3 (0.012)


6A25-2.tif

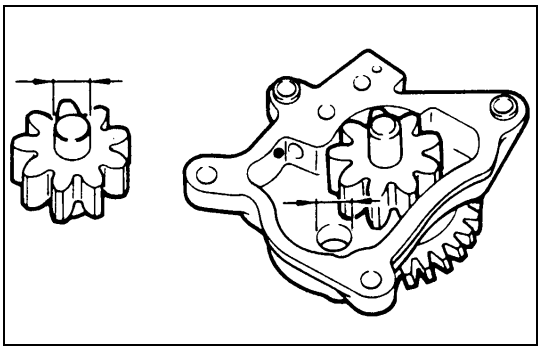
Gear and Cover Clearance

Use a feeler gauge to measure the clearance between the cover and the gear.

If the clearance between the gear and the cover exceeds the specified limit, the oil pump assembly must be replaced.

Gear and Cover Clearance mm (in)

Standard	Limit
0.064 - 0.109 (0.0025 - 0.0043)	0.2 (0.008)

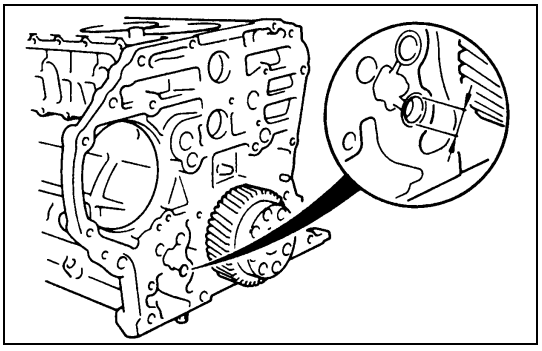

6A25-3.tif

Driven Gear Shaft and Bushing Clearance

1) Use a micrometer to measure the gear shafts outside diameter.

Gear Shaft Outside Diameter mm (in)

Standard	Limit
15.989 - 16.000 (0.6295 - 0.6299)	15.9 (0.626)


6A25-4.tif

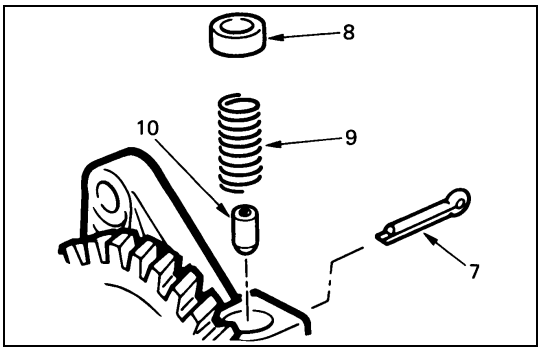
2) Use an inside dial indicator or inside micrometer to measure the pump cover bushing inside diameter and the cylinder body inside diameter.
If clearance between the gear shaft and the bushing exceeds the specified limit, the oil pump assembly must be replaced.

Gear Shaft and Bushing Clearance mm (in)

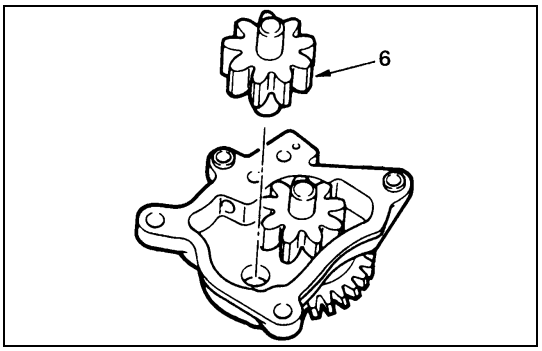
Standard	Limit
0.04 - 0.07 (0.0016 - 0.0028)	0.2 (0.012)

REASSEMBLY

11. Pump Cover
10. Oil Relief Valve
9. Oil Relief Valve Spring
8. Sprig Seat
7. Cotter Pin



6A26-1.tif



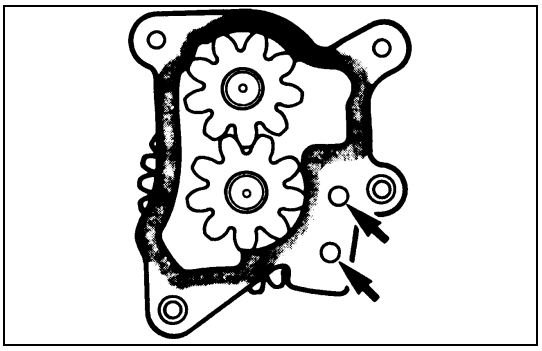
6A26-2.tif

6. Driven Gear and Shaft

Apply the engine oil to the driven gear shaft.

5. Oil Pump Assembly

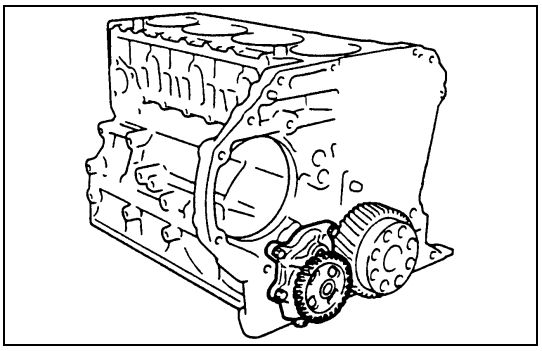
1) Carefully wipe any foreign material from cylinder body rear surface.
2) Apply the recommended liquid gasket (Three Bond 1141E) or its equivalent to the shaded areas shown in the illustration.

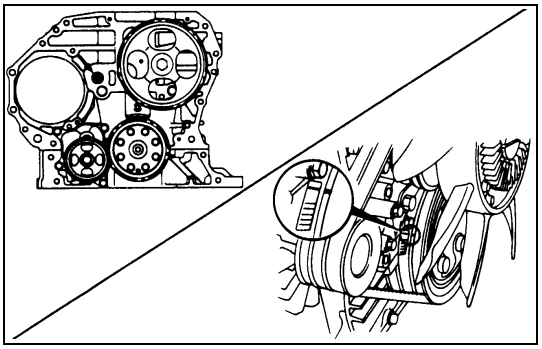

6A26-3.tif

CAUTION:
Be careful that no liquid gasket gets into the holes in the arrow-marked portion in the illustration and the inside of the oil pump cover.

3) Install the oil pump to the cylinder body.
4) Tighten the oil pump to the specified torque.

Oil Pump Bolt Torque	N•m (kg•m/lb•ft)
	31 (3.2/23)

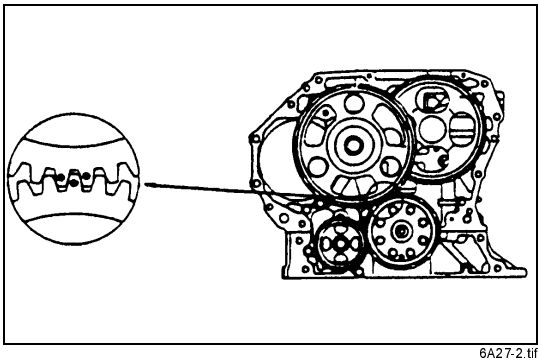

6A26-4.tif

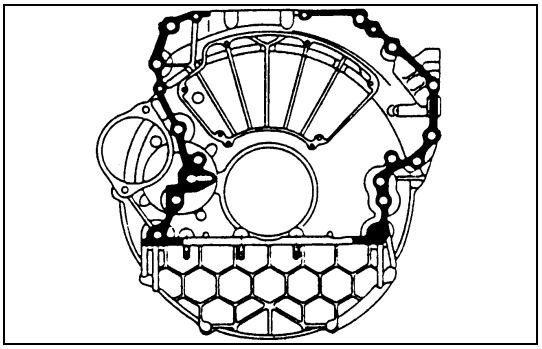

6A27-1.tif

4. Idle Gear A

1) Turn the crankshaft clockwise so that the engagement mark of the crankshaft gear faces to the shaft center of the idle gear A and the No.1 cylinder piston comes to the top dead center.
2) Align the crankshaft gear with the engagement mark of the idle gear and install the idle gear A.

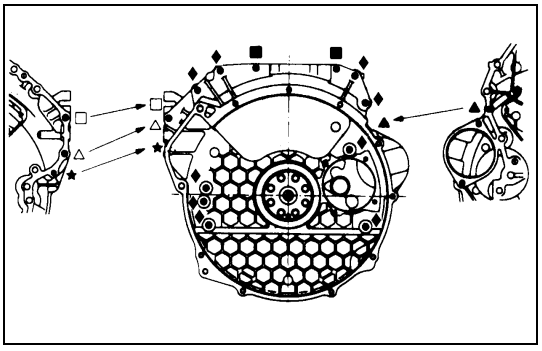
Idle Gear A Bolt Torque	N•m (kg•m/lb•ft)
	133 (13.6/98)


6A27-2.tif


6A27-3.tif

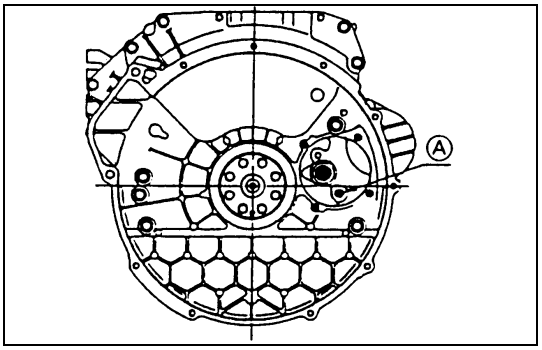
3. Flywheel Housing

1) Carefully wipe any foreign material from the cylinder body rear face.
2) Apply the recommended liquid gasket (Three Bond 1207C) or its equivalent to the shaded areas shown in the illustration.


6A27-4.tif

3) Align the cylinder body knock pins with the flywheel housing knock pin holes.
4) Tighten the flywheel housing bolts to the specified torque shown in the illustration.

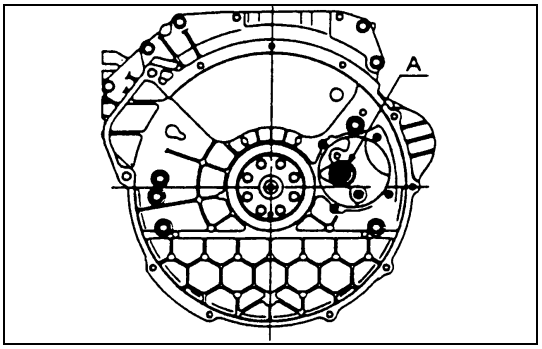
Flywheel Housing Bolt Torque	N•m (kg•m/lb•ft)
♦:	96 (9.8/71)
★:	48 (4.9/35)
□:	94 (9.6/69)
■:	25 (2.6/19)
△:	76 (7.7/56)
▲:	38 (3.9/28)



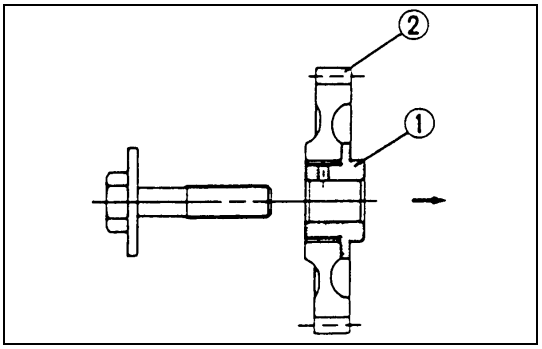
6A27-5.tif

- Tighten the bolts marked with " △ " or " ★ " from the injection pump side, and those with " ▲ " from the cylinder body side.

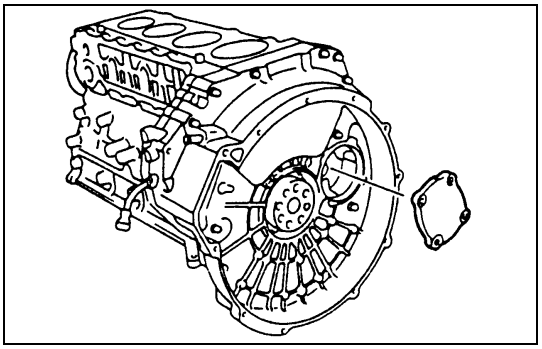
Flywheel Housing Bolt Torque	N•m (kg•m/lb•ft)
Ⓐ :	96 (9.8/71)



6A28-1.tif



6A28-2.tif



6A28-3.tif

2. Power Steering Pump Idle Gear

1) Apply the engine oil to the idle gear shaft.
2) Install the idle gear shaft ① with the idle gear ② to the cylinder body "A" portion as shown in the illustration.

Idle Gear Shaft Bolt Torque — N•m (kg•m/lb•ft)

133 (13.6/98)

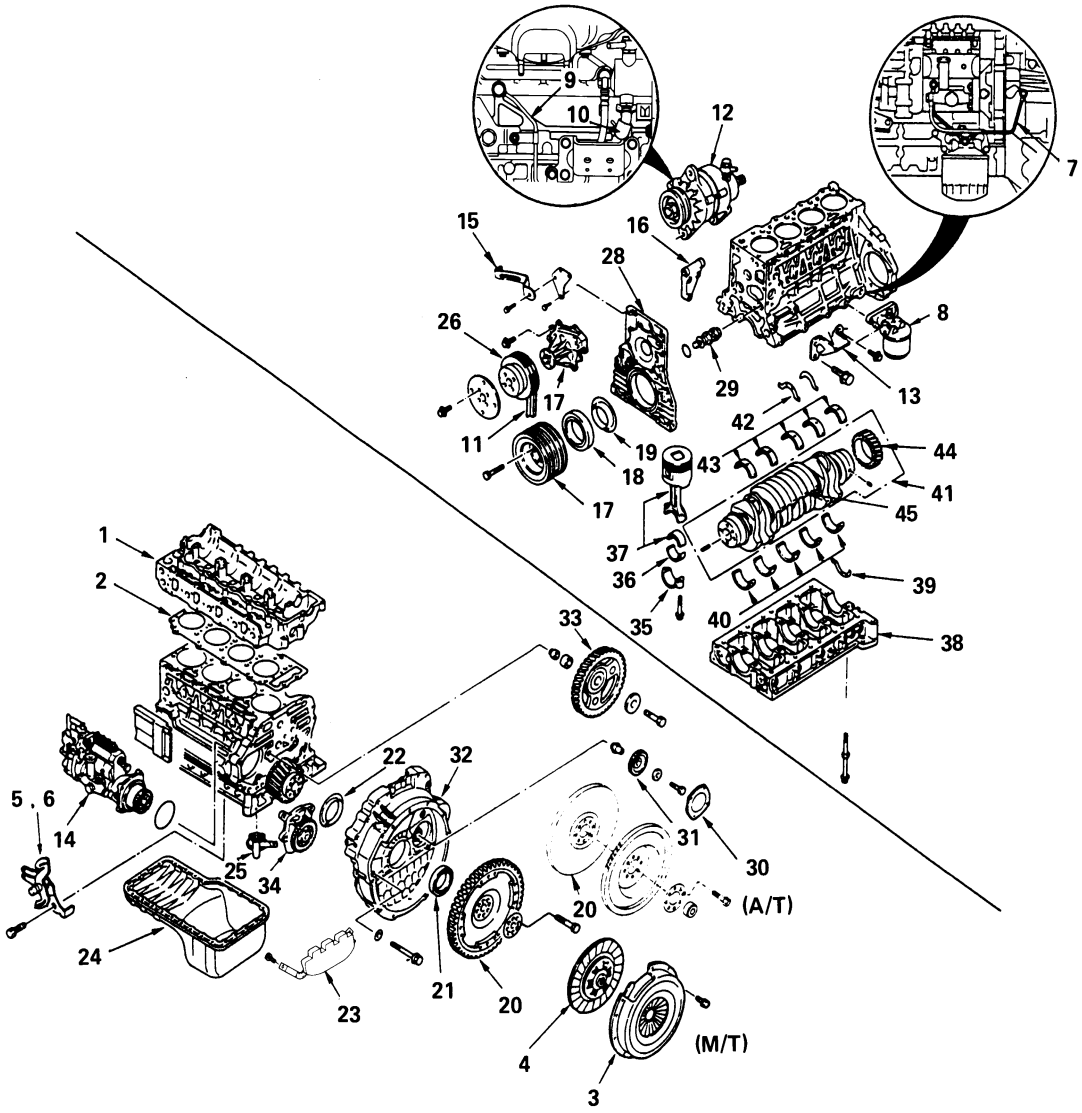
1. Power Steering Pump Idle Gear Cover

Install the gear cover with the O-ring.

Gear Cover Bolt Torque — N•m (kg•m/lb•ft)

19 (1.9/14)

CRANKSHAFT



Disassembly steps

1. Cylinder head assembly
2. Cylinder haed gasket
3. Clutch pressure plate assembly
4. Driven plate
5. Engine control wire
6. Engine control lever assembly
7. Oil pipe
8. Oil filter assembly
9. Vacuum pump oil pipe
10. Vacuum pump rubber hose
11. Fan belt
12. Generator
13. Engine foot
14. Injection pump assembly
15. Fan belt adjust plate
16. Generator bracket
17. Crankshaft pulley
18. Crankshaft front oil seal
19. Crankshaft front slinger
20. Flywheel
21. Crankshaft rear oil seal
22. Crankshaft rear slinger
23. Spacer rubber
24. Oil pan
25. Oil pump strainer
26. Water pump pulley
27. Water pump
28. Front retainer
29. Oil thermo valve
30. Power steering pump idle gear cover
31. Power steering pump idle gear
32. Flywheel housing
33. Idle gear A
34. Oil pump assembly
35. Connecting rod cap assembly
36. Connecting rod lower bearing
37. Piston and connecting
38. Crankcase
39. Thrust bearing lower
40. Crankshaft bearibg lower
41. Crankshaft assembly
42. Thrust bearing upper
43. Crankshaft bearing upper
44. Crankshft gear
45. Crankshaft

Reassembly steps

To reassemble, follow the disassembly steps in the reverse order.

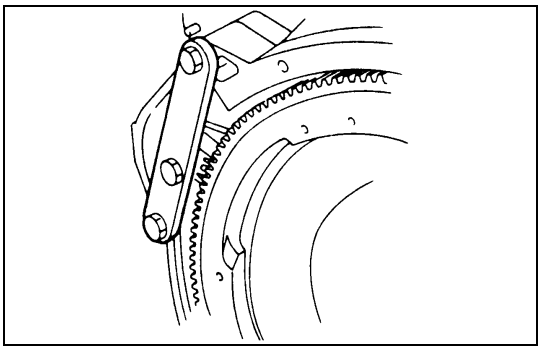
6A29-1.tif

DISASSEMBLY

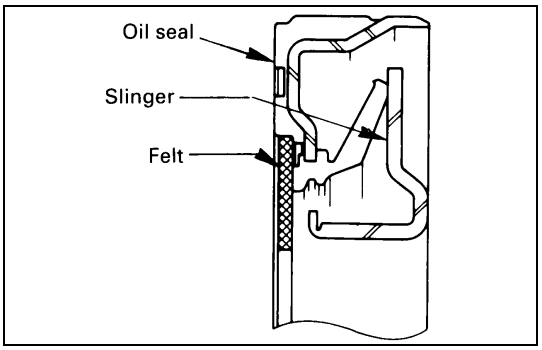
1. **Cylinder Head Assembly**
   Above works refer to “CYLINDER HEAD” section in this manual.
2. **Cylinder Head Gasket**

CAUTION:
Do not reuse the cylinder head gasket.

3. **Clutch Pressure Plate Assembly**
4. **Driven Plate**
5. **Engine Control Wire**
6. **Engine Control Lever Assembly**
7. **Oil Pipe**
8. **Oil Filter Assembly**
9. **Vacuum Pump Oil Pipe**
10. **Vacuum Pump Rubber Hose**
11. **Fan Belt**
12. **Generator**
13. **Engine Foot**
14. **Injection Pump Assembly**
15. **Fan Belt Adjust Plate**
16. **Generator Bracket**
    Above works refer to “CYLINDER BLOCK” section in this manual.


6A30-1.tif

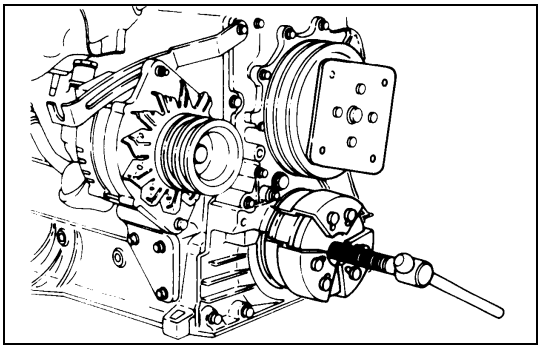
17. **Crankshaft Damper Pulley**
    1) Use the crankshaft stopper to prevent the crankshaft from turning.
       Crankshaft Stopper: 5-8840-2230-0
    2) Loosen the damper pulley bolts and remove the damper pulley.



6A30-2.tif

18. **Crankshaft Front Oil Seal**

CAUTION:
Be careful not to damage the crankshaft oil seal contact surface during the removal procedure.



6A31-1.tif

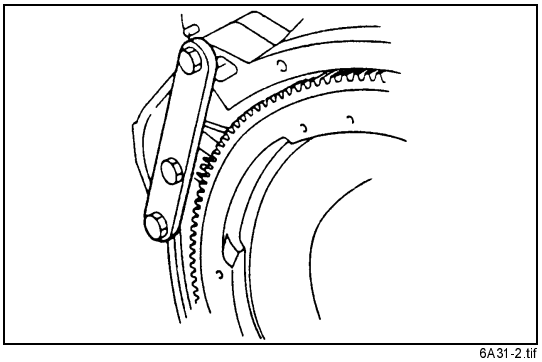
19. Crankshaft Front Slinger

Use the slinger puller to pull out the slinger.

Slinger Puller: 5-8840-2360-0

NOTE:

If the oil seal has been removed, both the oil seal and slinger must be replaced as a set.



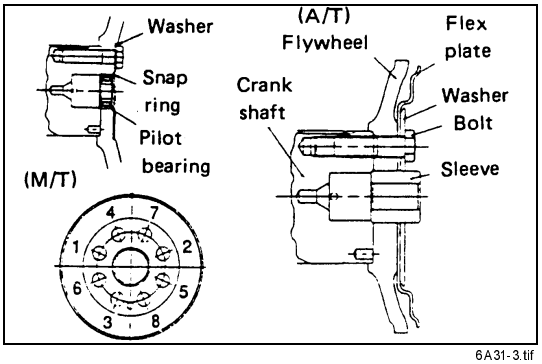
6A31-2.tif

20. Flywheel Assembly

1) Use the crankshaft stopper to prevent the crankshaft from turning

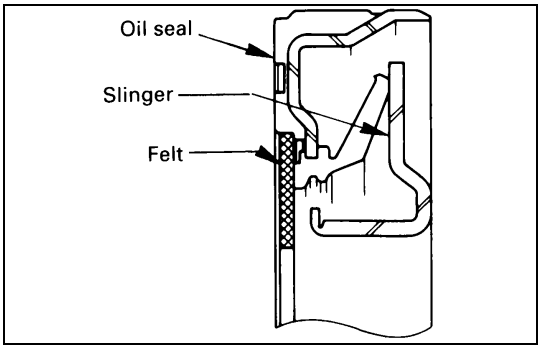
Crankshaft Stopper: 5-8840-2230-0

2) Loosen the flywheel bolts in numerical order a little at a time as shown in the illustration.
3) Remove the flywheel stopper and the flywheel assembly.



6A31-3.tif

For the A/T vehicle, loosened the flywheel fixing bolts, and remove the washer, the flexible plate, the flywheel and the sleeve in this order.

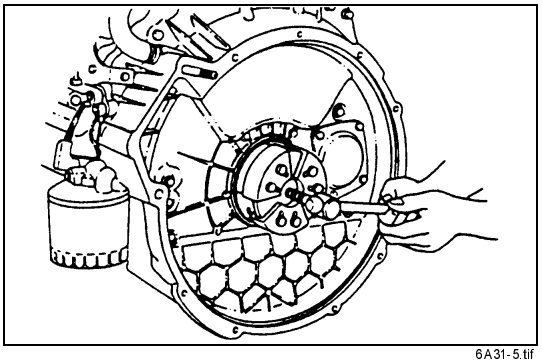


6A31-4.tif

21. Crankshaft Rear Oil Seal

CAUTION:

Be careful not to damage the crankshaft oil seal contact surface during the removal procedure.



6A31-5.tif

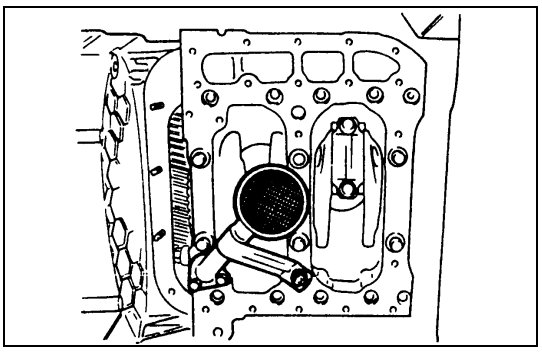
22. Crankshaft Rear Slinger

Use the slinger puller to pull out the slinger.

Slinger Puller: 5-8840-2360-0

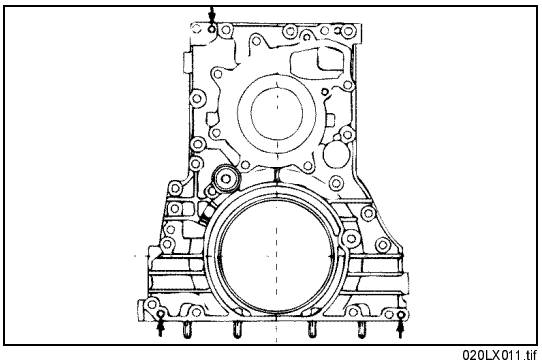
23. Spacer Rubber (NKR model only)

24. Oil Pan



6A32-1.tif

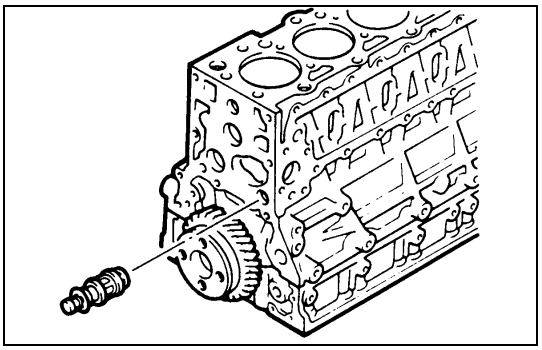
25. Oil Pump Strainer
26. Water Pump Pulley
27. Water Pump



020LX011.tif

28. Front Retainer

Install the three front retainer fixing bolts to the front retainer replacer holes as shown in the illustration, and tighten the bolts alternately a little at a time.



6A32-3.tif

29. Oil Thermo Valve (4HF1, 4HF1-2, 4HG1, 4HG1-T)

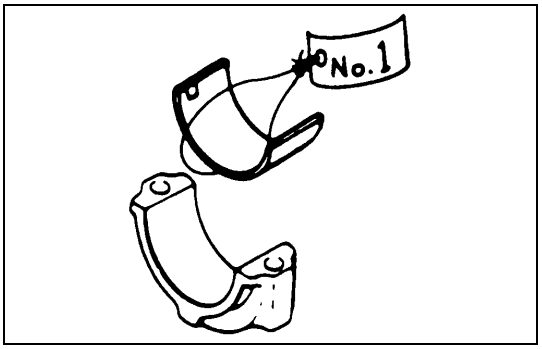
Pull out the thermo valve from the cylinder body.

29-1. Bypass Valve (4HE1-T, 4HE1-TC)

Pull out the bypass valve from the cylinder body.

30. Power Steering Pump Idle Gear Cover
31. Power Steering Pump Idle Gear
32. Flywheel Housing
33. Idle Gear A
34. Oil Pump Assembly

Above works refer to “OIL PUMP” section in this manual.

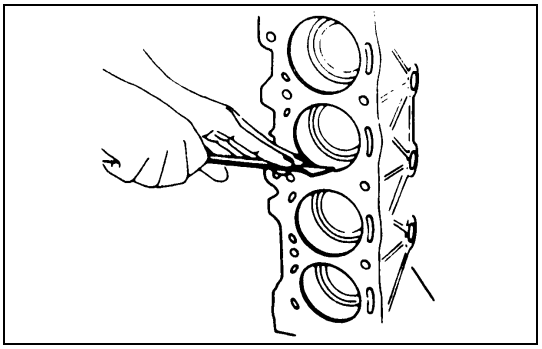


6A33-1.tif

35. Connecting Rod Cap

36. Connecting Rod Lower Bearing

1) Take out the connecting rod bearing cap bolts and remove the bearing cap with the lower bearing.
2) If the connecting rod lower bearings are to be reinstalled, mark their fitting positions by tagging each bearing with the cylinder number from which it was removed.


6A33-2.tif

37. Piston and Connecting Rod Assembly

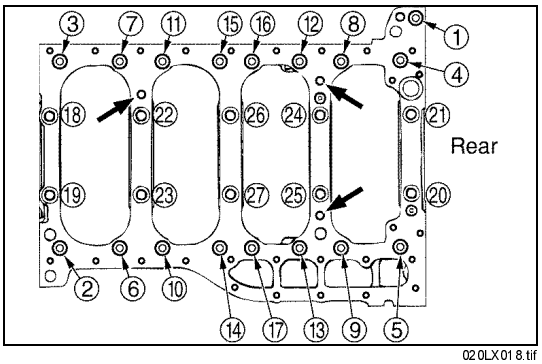
1) To facilitate smooth removal of piston, remove carbon from the upper part of the cylinder wall using a scraper or equivalent.
2) Remove the piston and connecting rod assembly upward by pushing on the edge of the connecting rod with a hammer handle or equivalent.
3) If the connecting rod bearing are to be reinstalled, mark their fitting positions by tagging each bearing with the cylinder number from which it was removed.

CAUTION:

Do not bend or damage the oiling jet.

NOTE:

When removing the piston and connecting rod assembly, pull the connecting rod in parallel with the cylinder bore.



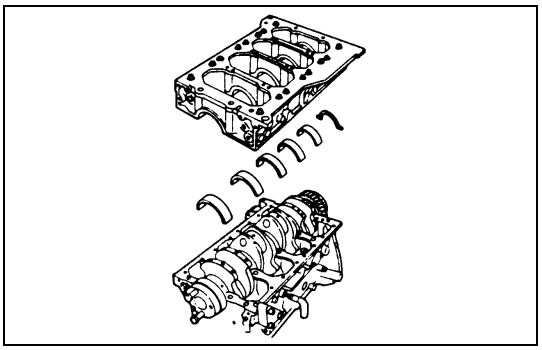
020LX018.tif

38. Crankcase

1) Loosen the crankcase bolts in numerical order a little at a time.
2) Install the three crankcase fixing bolts (See left arrow marks) to the crankcase replacer holes as shown in the illustration, and tighten the bolts alternate a little at a time.

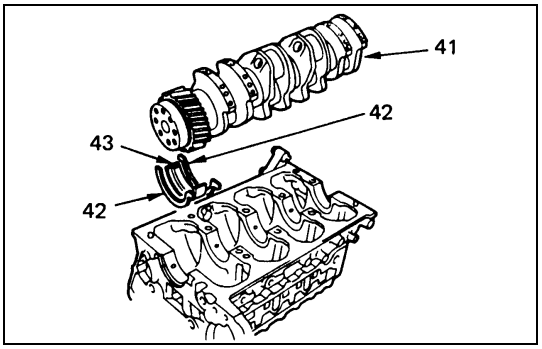
NOTE:

When removing the crankcase, be sure to remove the oil pump and the generator bracket before that.


6A33-4.tif

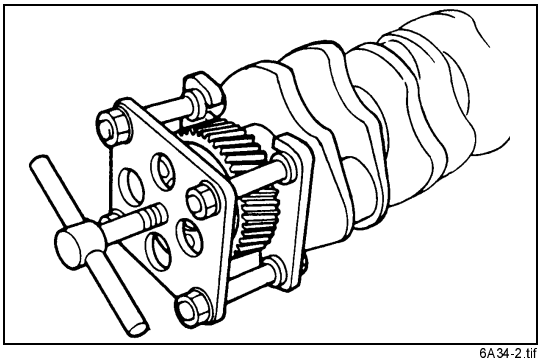
39. Thrust Bearing Lower

40. Crankshaft Bearing Lower



6A34-1.tif

41. Crankshaft Assembly
42. Thrust Bearing Upper
43. Crankshaft Bearing Upper


6A34-2.tif

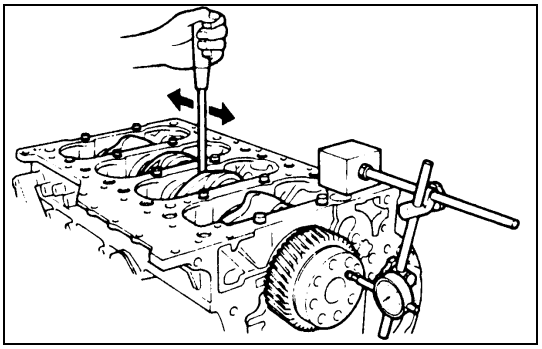
44. Crankshaft Gear

1) Use the crankshaft gear remover to remove the crankshaft gear.
   Crankshaft Gear Remover: 8-9439-6818-0
2) Remove the crankshaft feather key.

45. Crankshaft

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.


6A34-3.tif

Crankshaft End Play

1) Set the dial indicator to the crankshaft end and measure the end play.
2) If the measured value exceeds the specified limit, the thrust bearings must be replaced.

Crankshaft End Play mm (in)

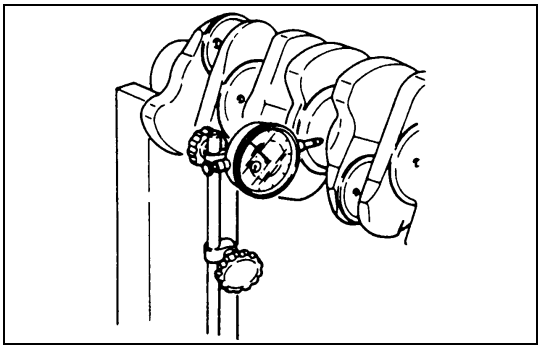
Standard	Limit
0.104 - 0.205 (0.0041 - 0.0081)	0.35 (0.014)

CRANKSHAFT AND BEARING

Inspect the surface of the crankshaft journals and crankpins for excessive wear and damage.

Inspect the oil seal fitting surfaces for excessive wear and damage.

Inspect the oil ports for obstructions.


6A35-1.tif

Crankshaft Run-Out

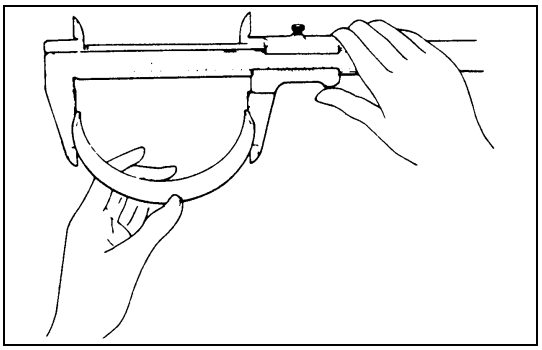
1) Set a dial indicator to the center of the crankshaft journal.
2) Gently turn the crankshaft in the normal direction of rotation.

Read the dial indicator as you turn the crankshaft.

If the measured value exceeds the specified limit, the crankshaft must be replaced.

Crankshaft Run-Out mm (in)

Standard	Limit
0.05 (0.002) or less	0.30 (0.012)


6A35-2.tif

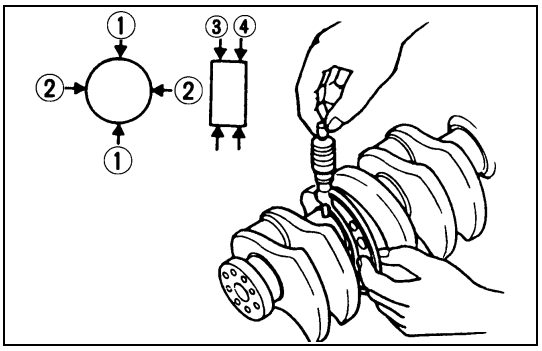
Bearing Spread

Use a vernier caliper to measure the bearing spread.

If the measured value is less than the specified limit, the bearing must be replaced.

Bearing Spread mm (in)

Limit	87 (3.43)



6A35-3.tif

Crankshaft Journal and Crankpin Diameter

1) Use a micrometer to measure the crankshaft journal diameter across points ① - ① and ② - ②.
2) Use the micrometer to measure the crankshaft journal diameter at the two points ③ and ④.
3) Repeat Steps 1 and 2 to measure the crankpin diameter.

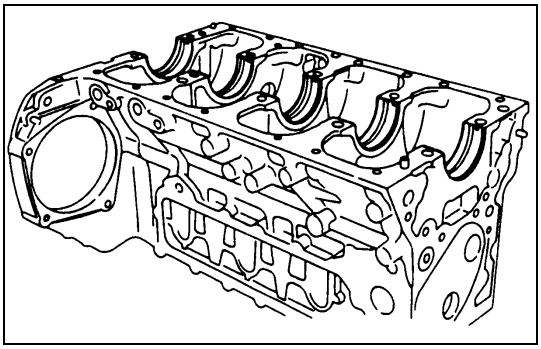
   If the measured values are less than the limit, the crankshaft must be reground or replaced.

Crankshaft Journal and Crankpin Diameter mm (in)

Engine model		Standard	Limit
ALL	No.1,2,4 and 5 Journal	81.905 - 81.925 (3.2246 - 3.2254)	81.85 (3.2224)
ALL	No.3 Journal	81.891 - 81.911 (3.2240 - 3.2248)	81.85 (3.2224)
Except 4HE1-T 4HE1-TC	Crankpin	65.902 - 65.922 (2.5946 - 2.5954)	65.85 (2.5925)
4HE1-T 4HE1-TC	Crankpin	72.902 - 72.922 (2.8702 - 2.8433)	72.85 (2.8681)

Crankshaft Journal and
Crankpin Diameter Uneven Wear mm (in)

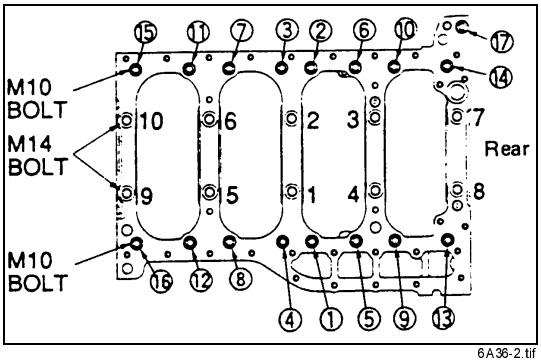
Except 4HE1-T, 4HE1-TC	Limit	0.050 (0.002)
4HE1-T, 4HE1-TC		0.0050 (0.0002)



6A36-1.tif

Crankshaft Journal and Bearing Clearance

1) Clean the cylinder body and crankcase, the journal bearing fitting surface, and the journal bearings.
2) Install the bearings to the cylinder body and crankcase.
3) Install the crankcase to the cylinder body.



6A36-2.tif

4) Tighten the crankcase to the specified torque in the numerical order shown in the illustration.

Crankcase Bolt Torque(M14: 1~10) N•m (kg•m/lb•ft)

1st step	2nd step	3rd step
98 (10/72)	132 (13.5/98)	30° - 60°

Crankcase Bolt Torque(M10:①~⑰) N•m (kg•m/lb•ft)

37 (3.8/27)

5) Use a dial indicator to measure the crankshaft journal inside diameter.
6) If the clearance between the crankshaft journal and the bearing exceeds the specified limit, the crankshaft must be either reground or replaced.

Crankshaft Journal and
Bearing Clearance mm (in)

	Standard	Limit
No.1, 2, 4 and 5 Journal	0.037 - 0.072 (0.0015 - 0.0028)	0.11 (0.0043)
No.3 Journal	0.051 - 0.086 (0.0020 - 0.0034)	0.11 (0.0043)

7) Remove the crankcase and the bearings.

Undersized Crankshaft Journal Bearing
Availability (Except 4HE1-T, 4HE1-TC) mm (in)

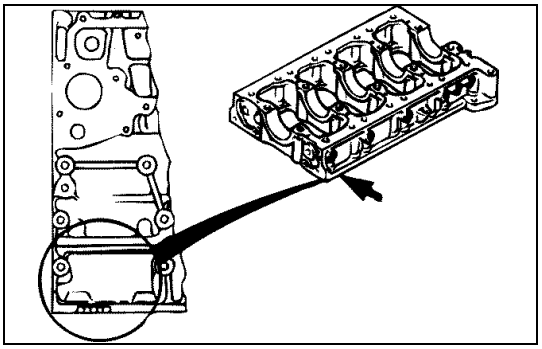
0.25 (0.01)	0.50 (0.02)

Crankshaft Bearing Selection

Refer to the following table when replacing the crankshaft and/or the crankshaft bearings.

Crankshaft bearing selection is based on the measured diameters of the crankshaft journals and the bearing housing.

Match the crankshaft bearing housing grade marks and the crankshaft journal grade marks in the table below to determine the correct crankshaft bearing size.



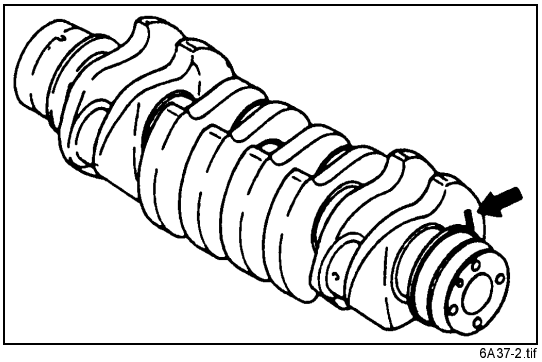
015LX073.tif

Crankshaft Bearing Insert Grade Mark Position

The crankshaft bearing housing grade marks (1 or 2) are stamped collectively for all cylinders on the underside of the left front portion of the crankcase.

Example:

1	2	1	1	2
↑	↑	↑	↑	↑
No.1 Bearing Housing	No. 2 Bearing Housing	No. 3 Bearing Housing	No. 4 Bearing Housing	No. 5 Bearing Housing



6A37-2.tif

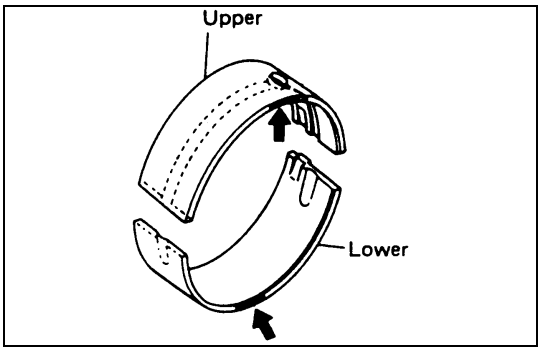
Crankshaft Journal Grade Mark Position

The crankshaft journal grade marks (1 or 2) are stamped collectively for all cylinders on the front side of the crankshaft No.1 balancer.

The clearance between the crankshaft journal and the bearing must be the same for each position after installation of the crankshaft and the crankshaft bearings.

Example:

2	1	2	2	1
↑	↑	↑	↑	↑
No.1 Journal	No.2 Journal	No.3 Journal	No.4 Journal	No.5 Journal



6A37-3.tif

Crankshaft Bearing Combination (Reference) mm (in)

Bearing Housing		Crankshaft Journal No.1, 2, 4, 5		Crankshaft Bearing	Oil Clearance
Grade Mark	Diameter	Grade Mark	Diameter	Color Code	
1	87.000 - 87.009 (3.4252 - 3.4255)	1	81.905 - 81.915 (3.2246 - 3.2250)	Black	0.039 - 0.070 (0.0015 - 0.0028)
		2	81.916 - 81.925 (3.2250 - 3.2254)	Brown	0.037 - 0.068 (0.0015 - 0.0027)
2	87.010 - 87.019 (3.4256 - 3.4259)	1	81.905 - 81.915 (3.2246 - 3.2250)	Blue	0.041 - 0.072 (0.0016 - 0.0028)
		2	81.916 - 81.925 (3.2250 - 3.2254)	Black	0.039 - 0.070 (0.0015 - 0.0028)

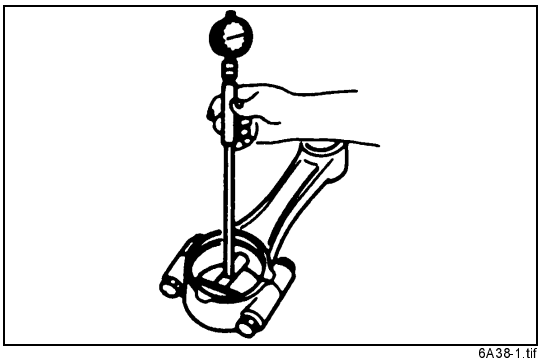
Bearing Housing		Crankshaft Journal No.3		Crankshaft Bearing	Oil Clearance
Grade Mark	Diameter	Grade Mark	Diameter	Color Code	
1	87.000 - 87.009 (3.4252 - 3.4255)	1	81.890 - 81.900 (3.2240 - 3.2244)	Black	0.053 - 0.084 (0.0021 - 0.0033)
		2	81.901 - 81.910 (3.2244 - 3.2248)	Brown	0.051 - 0.082 (0.0020 - 0.0032)
2	87.010 - 87.019 (3.4256 - 3.4259)	1	81.890 - 81.900 (3.2240 - 3.2244)	Blue	0.055 - 0.086 (0.0022 - 0.0034)
		2	81.901 - 81.910 (3.2244 - 3.2248)	Black	0.053 - 0.084 (0.0021 - 0.0033)

Crankpin and Connecting Rod Bearing Clearance

1) Clean the crankshaft, the connecting rod, the bearing cap, and the bearings.
2) Install the bearing to the connecting rod and the bearing cap.
3) Apply a coat of molybdenum disulfide grease to the bearing cap bolt threads and setting faces.
4) Prevent the connecting rod from moving.
5) Tighten the bearing cap to the specified torque.

Connecting Rod Bearing Cap Bolt Torque — N•m (kg•m/lb•ft)

1st step	2nd step	3rd step
39 (4.0/29)	60°	30°


6A38-1.tif

6) Use the dial indicator to measure the connecting rod bearing inside diameter.

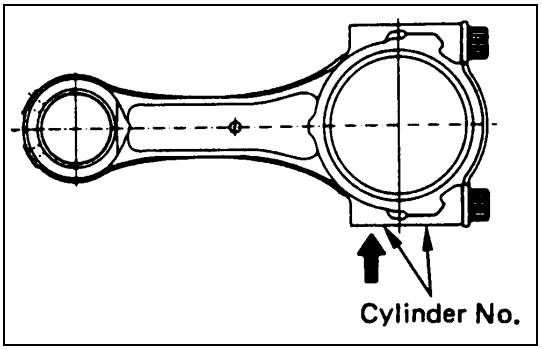
Crankpin and Connecting Rod Bearing Clearance — mm (in)

Standard	Limit
0.036 - 0.077 (0.0014 - 0.0030)	0.10 (0.004)

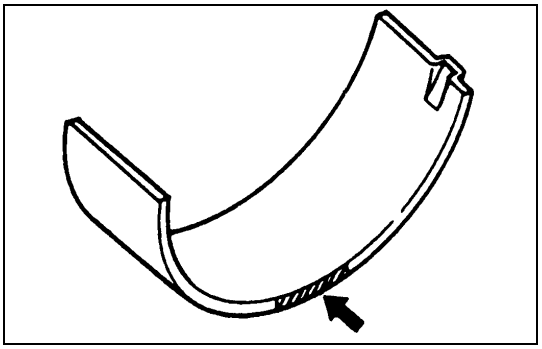
7) If the clearance between the measured bearing inside diameter and the crankpin exceeds the specified limit, the bearing and/or the crankshaft must be replace or reground. (Except 4HE1-T, 4HE1-TC)
8) Remove the bearing cap and the bearings.

Undersized Connecting Rod Bearing Availability — mm (in)

0.25 (0.01)	0.50 (0.02)



6A38-2.tif



6A39-1.tif

Connecting Rod Bearing Selection

Refer to the following table when installing or replacing the connecting rod bearings.

Pay close attention to the size mark on the big end of the connecting rod.

Do not confuse the size mark on the big end of connecting rod with the alignment cylinder No. mark.

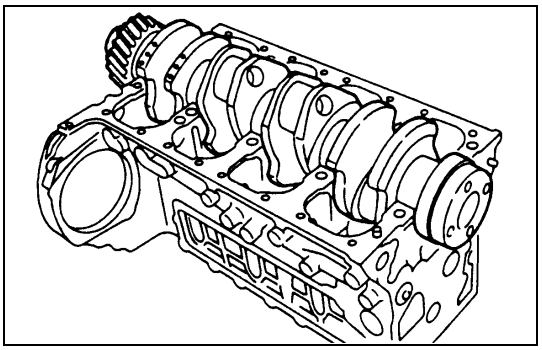
Connecting Rod Bearing Combination mm (in)

Engine Model	Connecting Rod Big End		Crankpin	Connecting Rod Bearing	Oil Clearance
	Grade Mark	Diameter	Diameter	Color Code	
4HF1 4HF1-2 4HG1 4HG1-T	A	69.985 – 69.992 (2.7553 – 2.7556)	65.902 – 65.992 (2.5946 – 2.5954)	Green	0.036 - 0.077 (0.0014 - 0.0030)
	B	69.993 – 70.000 (2.7556 – 2.7559)	65.902 – 65.922 (2.5946 - 2.5954)	Yellow	0.036 - 0.070 (0.0014 - 0.0030)
4HE1-T 4HE1-TC	A	77.985 – 77.992 (3.0703 - 3.0705)	72.902 – 72.922 (2.8702 - 2.8709)	Green	0.037 - 0.077 (0.0015 - 0.0030)
	B	77.993 - 78.000 (3.0706 - 3.0709)		Yellow	

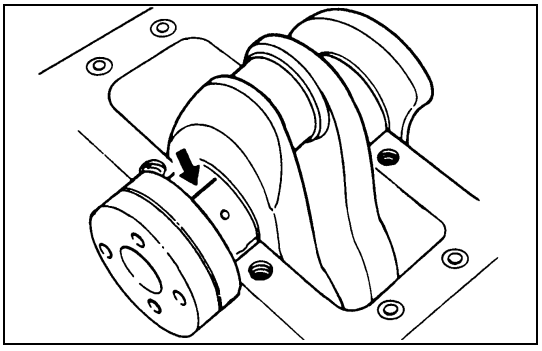
Clearance Measurements (With Plastigage)

Crankshaft Journal and Bearing Clearance

1) Clean the cylinder body and crankcase, the journal bearing fitting surface, and the journal bearings.
2) Install the bearings to the cylinder body and crankcase.
3) Carefully place the crankshaft on the bearings.
4) Rotate the crankshaft approximately 30 degrees to seat the bearing.

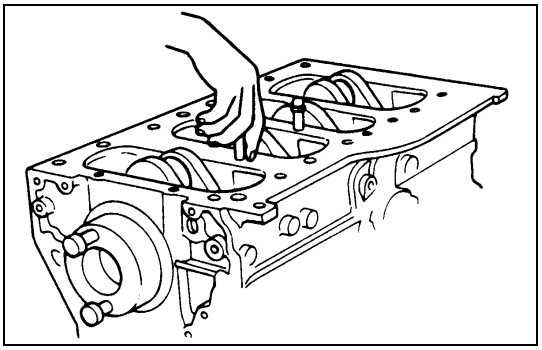


6A39-2.tif



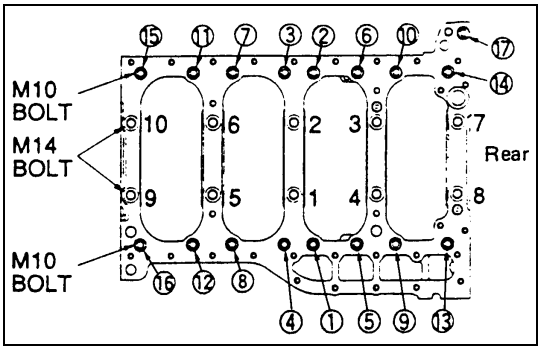
6A39-3.tif

5) Place the Plastigage (arrow) over the crankshaft journal across the full width of the bearing.



6A39-1.tif

6) Install the crankcase to the cylinder body.



6A40-1.tif

7) Tighten the crankcase to the specified torque in the numerical order shown in the illustration.

Crankcase Bolt Torque (M14: 1~10) N•m (kg•m/lb•ft)

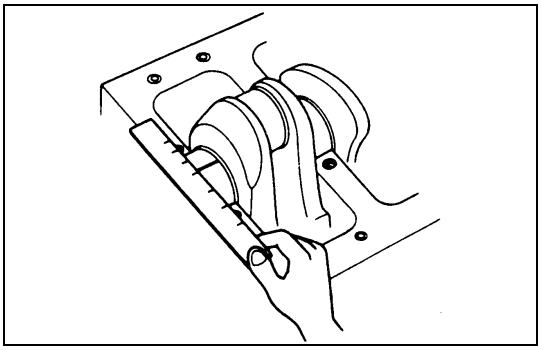
1st step	2nd step	3rd step
98 (10/72)	132 (13.5/98)	30° - 60°

Crankcase Bolt Torque (M10: ① ~ ⑰) N•m (kg•m/lb•ft)

3.9 ± 0.7 (28 ± 5/38 ± 7)

Do not allow the crankshaft to turn during bearing cap installation and tightening.

8) Remove the bearing beam and the crankcase with bearings.



6A40-2.tif

9) Compare the width of the Plastigage attached to either the crankshaft or the bearing with the scale printed on the Plastigage container.

Crankshaft Journal and Bearing Clearance mm (in)

	Standard	Limit
No.1, 2, 4 and 5 Journal	0.037 - 0.072 (0.0015 - 0.0028)	0.11 (0.0043)
No.3 Journal	0.051 - 0.086 (0.0020 - 0.0034)	0.11 (0.0043)

10) If the measured value exceeds the limit, perform the following additional steps.

- Use a micrometer to measure the crankshaft outside diameter.
- Use an inside dial indicator to measure the bearing inside diameter.

  If the crankshaft journal and bearing clearance exceeds the limit, the crankshaft and/or the bearing must be reground (Except 4HE1-T, 4HE1-TC) or replaced.

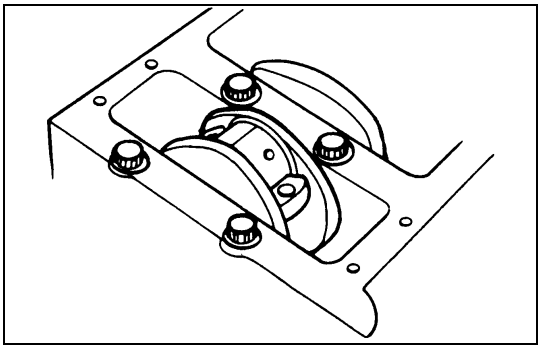
Undersized Crankshaft Journal Bearing Availability (Except 4HE1-T, 4HE1-TC) mm (in)

0.25 (0.01)	0.50 (0.02)

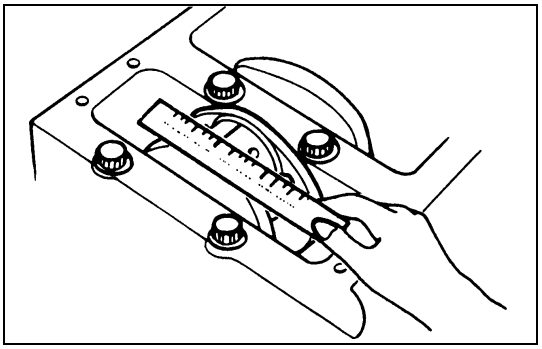
11) Remove the crankshaft and bearings.

Crankpin and Connecting Rod Bearing Clearance

1) Clean the crankshaft, the connecting rod, the bearing cap, and the bearings.
2) Install the bearing to the connecting rod and the bearing cap.
   Do not allow the crankshaft to move when installing the bearing cap.
3) Prevent the connecting rod from moving.
4) Attach the Plastigate to the crankpin.
   Apply engine oil to the Plastigate to keep it from falling.



6A41-1.tif



6A41-2.tif

5) Apply a coat of molybdenum disulfide grease to the bearing cap bolt threads and setting faces.
6) Install the bearing cap and tighten it to the specified torque
   Do not allow the connecting rod to move when installing and tightening the bearing cap.

Connecting Rod Bearing Cap Bolt Torque — N•m (kg•m/lb•ft)

1st step	2nd step	3rd step
39(4.0/29)	60°	30°

7) Remove the bearing cap.
8) Compare the width of the Plastigate attached to either the crankshaft or the bearing against the scale printed on the Plastigage container.

Crankpin and Connecting Rod Bearing Clearance — mm (in)

Standard	Limit
0.036 – 0.077 (0.0014 – 0.0030)	0.10 (0.004)

9) If the measured value exeeds the specified limit, perform the following additional steps.
   - Use a micrometer to measure the crankpin outside diameter.
   - Use an inside dial indicator to measure the bearing inside diameter.
     If the clearance between the crankpin and the bearing exceeds the specified limit, the cranksharft and / or the bearing must be reground (except 4HE1-T, 4HE1-TC) or replaced.

Undersized Connecting Rod

Bearing Availability (Except 4HE1-T, 4HE1-TC)	mm (in)
0.25 (0.01)	0.50 (0.02)

Crankshaft Regrinding (Except 4HE1-T, 4HE1-TC)

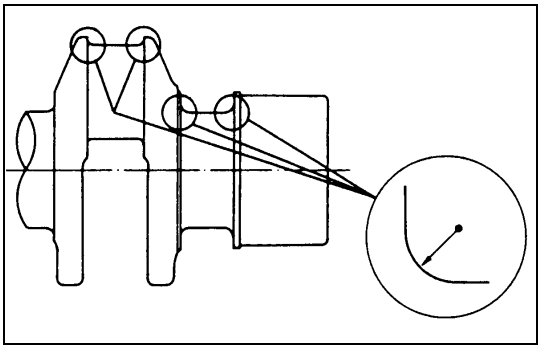
To ensure crankshaft reliability, pay close attention to the following items during and after the crankshaft journal and crankpin regrinding procedure.

Undersized Bearing Availiability	mm (in)
0.25 (0.01)	0.50 (0.02)

Crankshaft Journal and Crankpin

Grinding Limit (Reference)		mm (in)
Journal	No.1, 2, 4, 5	81.405 (3.2049)
	No.3	81.390 (3.2043)
Crankpin		65.402 (2.5749)

Crankshaft Regrinding Procedure (Except 4HE1-T, 4HE1-TC)



6A42-1.tif

1) Regrind the crankshaft journals and the crankpins
2) Fillet the crankshaft journals and the crankpin radiuses to a minimum of R 4.8 ± 0.2mm (0.189 ± 0.0078 in). There must be no stepping around the fillet area.
3) Finish the crankshaft journals, the crankpins, and the oil port corners to a smooth surface having a chamfer radius of 1 mm (0.04 in).

Crankshaft Journal and Crankpin Roughness
0.4 μ or less

4) Check the crankshaft journal and crankpin clearance. Refer to the “Crankshaft Journal and Bearing Clearance” and “Crankpin and Connecting Rod Bearing Clearance.”
5) Check the crankshaft run-out. Refer to the “Crankshaft Run-Out.”

CAUTION:

The crankshaft for 4HE1-T and 4HE1-TC are applied soft nitrided surface (Taftriding).
Therefore, the crankshaft for 4HE1-T and 4HE1-TC not could be ground.

Inspection procedure for soft nitrided (Taftriding) crankshaft (For 4HE1-T, 4HE1-TC)

1. Inspect the crankshaft following points.
   - Excessive wear and damage on the surface of crankshaft journals.
   - Excessive wear and damage on the surface of crankpin.
   - Excessive wear and damage on the oil seal fitting surface.
   - Inspect the oil ports foe obstructions.
2. Inspect the crankshaft soft nitrided surface (Taftriding).

   The soft nitrided crankshaft has been applied to increase crankshaft strength.

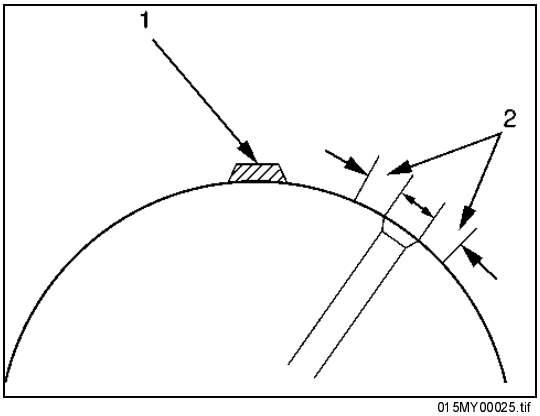
   Becase of this, it is not possible to regrind the crankshaft surfaces.

   2.1. Inspection conditions.
   - Remove the oil and other material on the crankshaft inspection area.
   - The portion to be tested must be held horizontally so as not let the test solution flow.
   - Test liquid should not be applied to the approximately 10 mm area around the oil port (2).

   2.2. Inspection method
   - Use an organic cleaner to thoroughly clean the crankshaft. There must be no traces of oil the surfaces to be inspected.
   - Prepare a 5 - 10 percent solution of ammonium cupric chloride (dissolved in distilled water).
   - Use a syringe to apply the solution (1) to the surface to be inspected. Hold the surface to be inspected perfectly horizontal to prevent the solution from running.

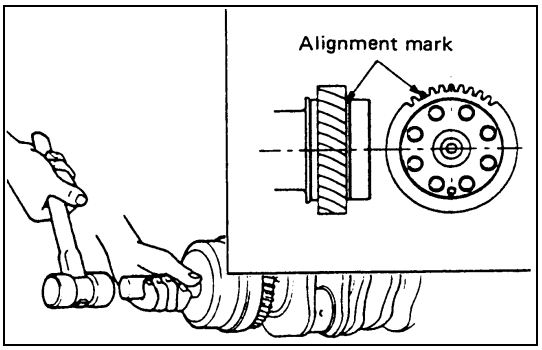
   2.3. Judgement
   - Wait for thirty to forty seconds. If there is no discoloration after thirty to forty seconds, the crankshaft is usable. If discoloration appears (the surface being tested will become the color copper), the crankshaft must be replaced.
   - Steam clean the crankshaft surface immediately after completing the inspection.

Note: The ammonium cupric chloride solution is highly corrosive. Because of this, it is imperative that the surfaces being inspected be cleaned immediately after completing the inspection.



01 5MY00025.tif

REASSEMBLY



6A43-1.tif

45. Crankshaft

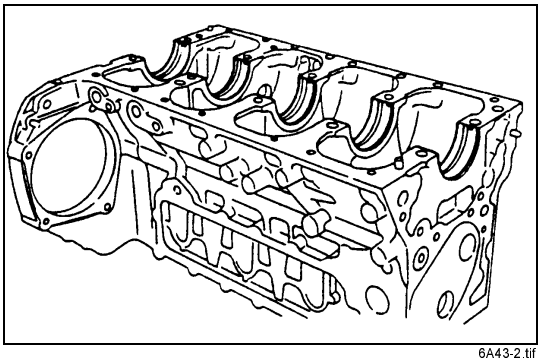
44. Crankshaft Gear

1) Use a piston heater to heat the crankshaft gear to 170° - 250°C (338° - 482°F).
2) With the alignment mark "S" on the side of the crankshaft gear turned outward, align the groove on the gear side with the crankshaft pin position and hammer it in with a crankshaft gear installer until it hits the bottom.

CAUTION:

When hammered in with the gear slanted, the crankshaft gear may be caught in the middle and cannot be hammered in fully. Hammer it inquickly enough not to allow a shaft line along the gear and the crankshaft to slant.

Crankshaft Gear Installer: 8-9439-6819-0


6A43-2.tif

43. Crankshaft Bearing Upper

When replacing the crankshaft or the crankshaft bearing with a new one, select the crankshaft bearing according to the respective grades stamped on the crankshaft and the cylinder body.

Above works refer to "CRANKSHAFT" section in this manual.

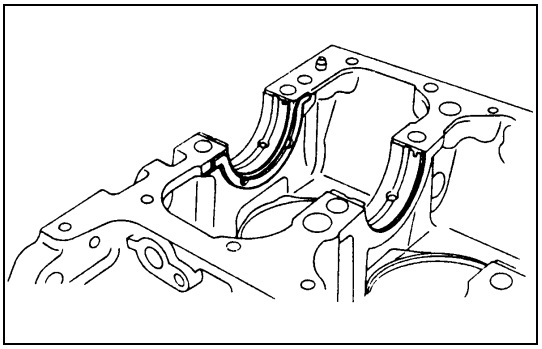
All upper bearings have oil grooves.

1) Carefully wipe any foreign material from the upper bearing.

CAUTION:

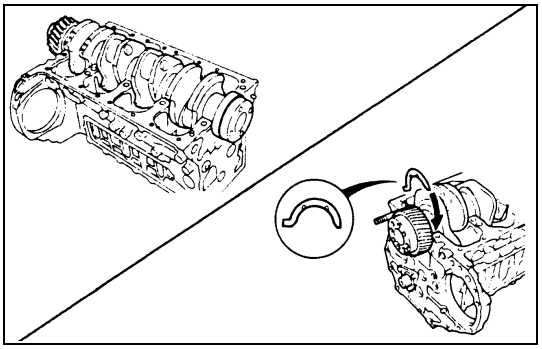
Do not apply engine oil to the bearing back faces and the cylinder body bearing fitting surfaces.

2) Locate the position mark applied at disassembly if the removed upper bearings are to be reused.


6A43-3.tif

42. Thrust Bearing Upper

1) Install the thrust bearing upper to the front side of the cylinder body No.5 journal. At this time, the thrust bearing upper may be pasted to the cylinder body with grease. However, wipe off any excessive grease clean.
2) The thrust bearing oil grooves must be facing the sliding faces.


6A44-1.tif

41. Crankshaft Assembly

1) Apply an ample coat of engine oil to the crankshaft journals and the crankshaft bearing surfaces before installing the crankshaft with timing gear.
2) With the installed crankshaft pressed on to the rear side, install the thrust bearing upper to the rear side of the cylinder body No.5 journal.
3) The thrust bearing oil grooves must be facing the sliding faces.

40. Crankshaft Bearing Lower

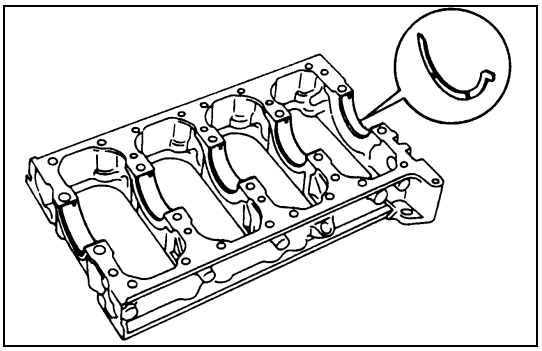
All lower bearings does not have oil grooves.

1) Carefully wipe any foreign material from the lower bearing.

CAUTION:

Do not apply engine oil to the bearing back faces and the crankcase bearing fitting surfaces.

2) Locate the position mark applied at disassembly if the removed lower bearings are to be reused.


6A44-2.tif

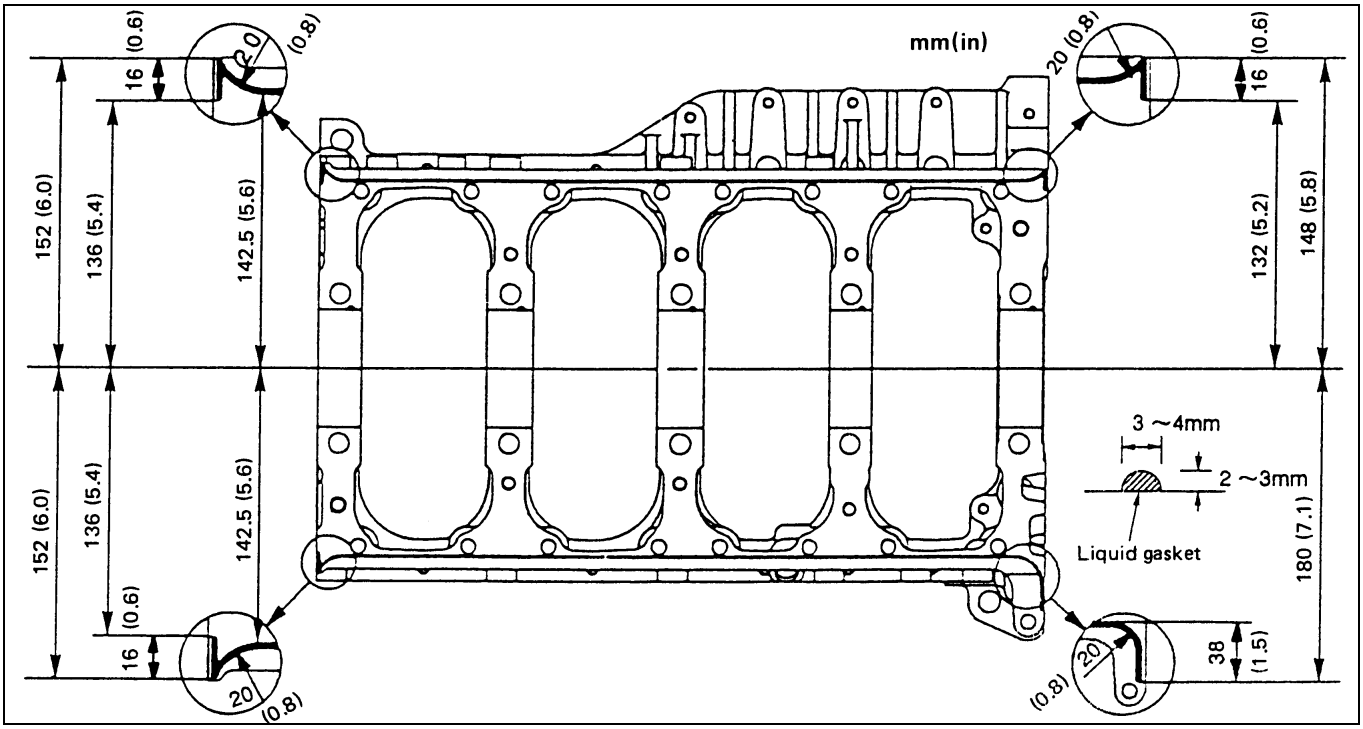
39. Thrust Bearing Lower

1) Install the thrust bearing lower to the rear side of the crankcase No.5 journal.
2) The thrust bearing oil grooves must be facing the sliding faces.

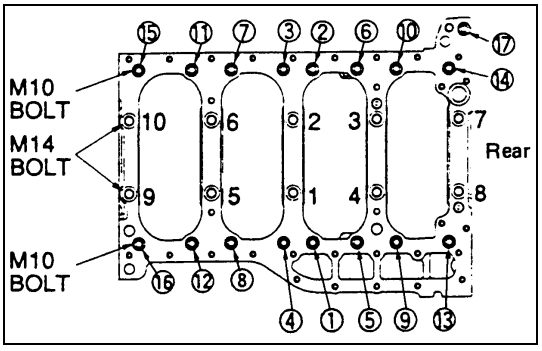
38. Crankcase

1) Apply a 3 mm (0.1 inch) bead of recommended liquid gasket (Three Bond 1207C) or its equivalent to the crankcase upper surface as shown in the illustration.
2) Carefully place the crankcase on the cylinder body.

- Install the crankcase within 20 minutes after application of liquid gasket.



6A45-1.tif



6A45-2.tif

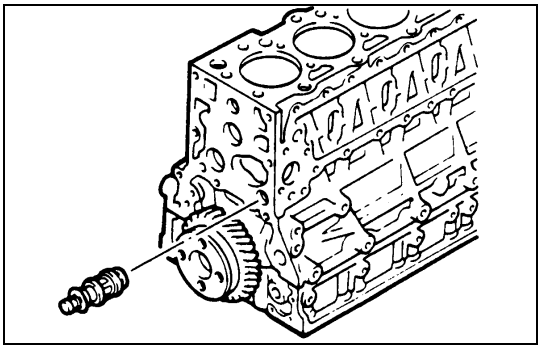
3) Tighten the crankcase to the specified torque in the numerical order shown in the illustration.

Crankcase Bolt Torque (M14: 1~10)		N•m (kg•m/lb•ft)
1st step	2nd step	3rd step
98 (10/72)	132 (13.5/98)	30° - 60°

Crankcase Bolt Torque (M10: ① ~ ⑰) N•m (kg•m/lb•ft)
37 (3.8/27)

Angle gauge: 5-8840-0266-0

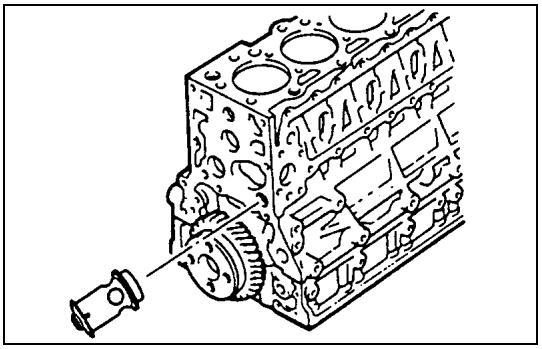
37. Piston and Connecting Rod Assembly
36. Connecting Rod Bearing
35. Connecting Rod Cap
Above works refer to “PISTON AND CONNECTING ROD” section in this manual.
34. Oil Pump Assembly
33. Idle Gear A
32. Flywheel Housing
31. Power Steering Pump Idle Gear
30. Power Steering Pump Idle Gear Cover
Above works refer to “OIL PUMP” section in this manual.



6A46-1.tif

29. Oil Thermo Valve (4HF1, 4HF1-2, 4HG1, 4HG1-T)

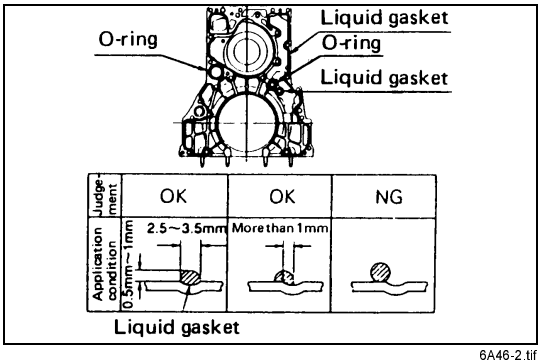
Insert the oil thermo valve into the cylinder body.



6A46-1-1.tif

29-1. Bypass Valve (4HE1-T, 4HE1-TC)

Insert the bypass valve into the cylinder body.

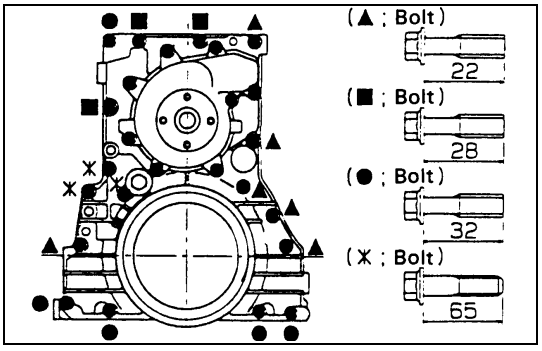


6A46-2.tif

28. Front Retainer

1) Carefully wipe any foreign material from the cylinder body front face.
2) Apply 2.5mm-3.5mm bead of the recommended liquid gasket (Three Bond 1207C) or its equivalent on the groove of the front retainer fitting surface shown in the illustration.
3) Install the O-rings (2 pieces) to the front retainer.

- Install the front retainer within 7 minutes after application of liquid gasket.
- For the dislocation of liquid gasket, refer to the illustration.



6A46-3.tif

4) Align the cylinder body knock pins with the front retainer knock pin holes.

Front Retainer Bolt Torque	N•m (kg•m/lb•ft)
24 (2.4/17)	

27. Water Pump Assembly

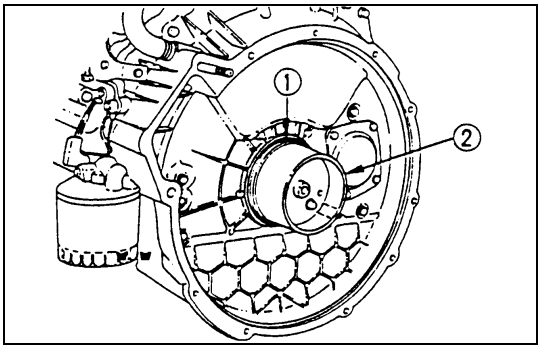
26. Water Pump Pulley

25. Oil Pump Strainer

24. Oil Pan

23. Spacer Rubber (NKR model only)

Above works refer to “CYLINDER BLOCK” section in this manual.

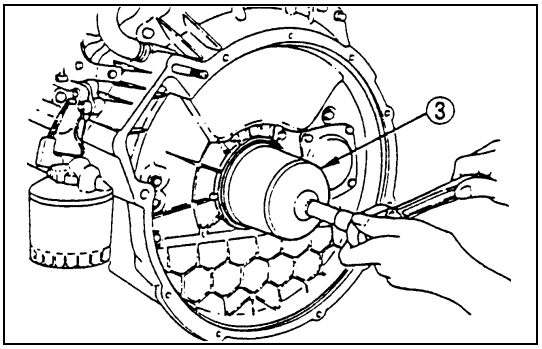


6A47-1.tif

22. Crankshaft Rear Slinger

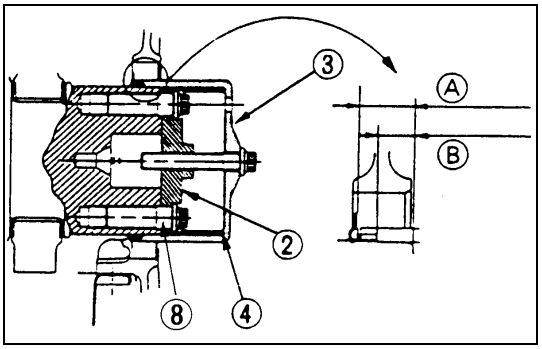
Press in the slinger using oil seal setting tool kit.

1) Insert the slinger ① into the end of adapter ② and install the adapter on the crankshaft.



6A47-2.tif

2) Cover the sleeve ③ and tighten the bolt until the sleeve comes to contact the adapter stopper ④.



6A47-3.tif

3) Make sure of measurements specified in the illustration as well as of slinger deflection.
   Ⓐ : 17.3 ± 0.3 mm (0.681 ± 0.012 in)
   Ⓑ : 10.8 ± 0.1 mm (0.425 ± 0.004 in)

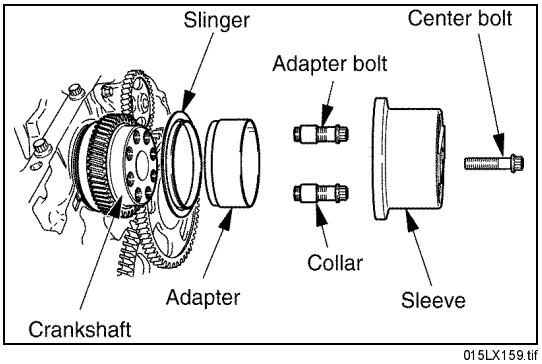
NOTE:

Be sure to replace the slinger and oil seal as a set.

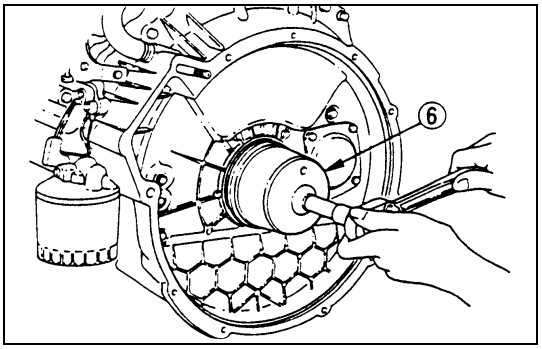
Oil Seal Setting Tool Kit: 5-8840-2431-0

Rear slinger and oil seal setting tools

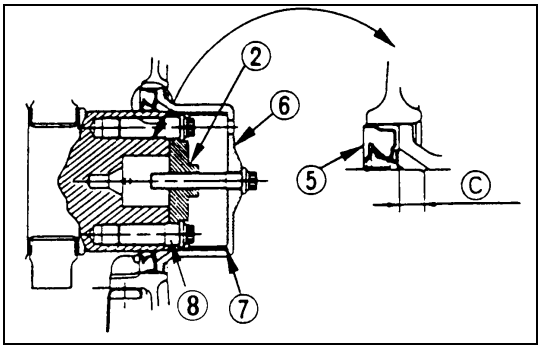
Part Name	Stamp	Slinger	Oil Seal
Adapter	RR	O	O
Sleeve	RR	O	O
Oil seal adapter ring	RR		O
Center bolt	-	O	O
Adapter bolt	-	O	O
Adapter bolt collar	RR	O	O



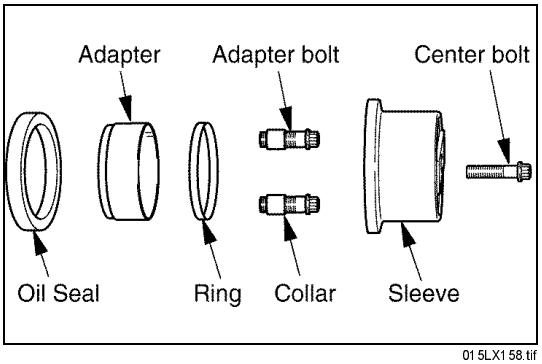
015LX159.tif



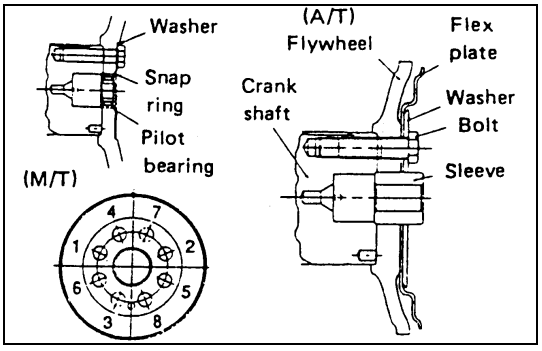
6A48-1.tif



6A48-2.tif



015LX158.tif



6A48-3.tif

21. Crankshaft Rear Oil Seal

1) Apply engine oil to the lip of the oil seal.
2) Press in the oil seal using rear oil seal setting tool kit.
3) Remove the slinger sleeve and insert the oil seal ⑤ into the adapter ②.
4) Install the adapter ring into the sleeve.
5) Install the oil seal sleeve ⑥ to the adapter ② and tighten the center bolt until the sleeve comes to contact the adapter stopper ⑦.
6) With the oil seal pressed in, make sure of the measurements specified in the illustration.
   Ⓒ : 7.8 ± 0.3 mm (0.307 ± 0.012 in)

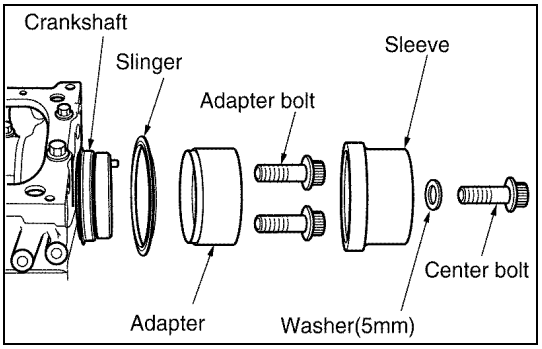
20. Flywheel Assembly

1) Apply molybdenum disulfide grease to the flywheel bolt threads and setting faces.
   For A/T refer to section 6A3 "Flywheel and pilot bearing".
2) Align the flywheel with the crankshaft knock pin and temporarily tighten the flywheel bolts.
3) Use the crankshaft stopper to prevent the crankshaft from turning.
   Crankshaft Stopper: 5-8840-2230-0
4) Install the washer and the flywheel bolts and tighten to the specified torque in numerical order show in the illustration.

Flywheel Bolt Torque N•m (kg•m/lb•ft)

1st step	2nd step
78 (8.0/58)	90° - 120°

5) Remove the crankshaft stopper.

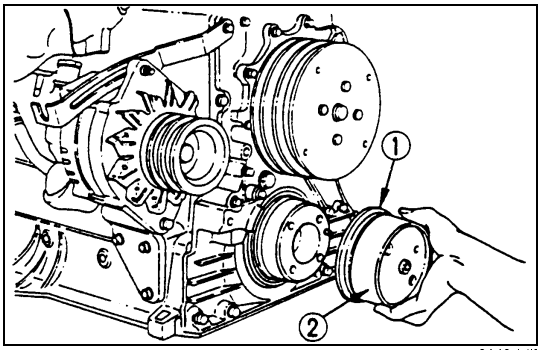


015LX160.tif

19. Crankshaft Front Slinger

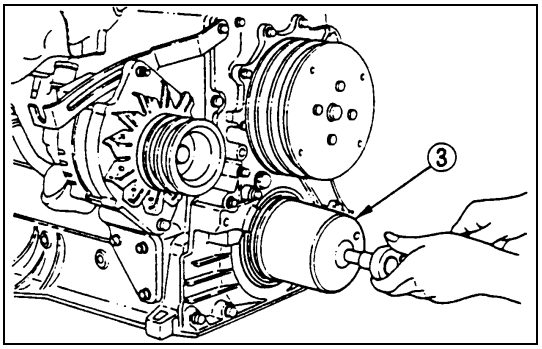
Press in the slinger using oil seal setting tool kit.
Oil Seal Setting Tool Kit: 5-8840-2431-0
Front slinger and oil seal setting tools

Part Name	Stamp	Slinger	Oil Seal
Adapter	FT	O	O
Sleeve	FT	O	O
Oil seal adapter ring	FT		O
Center bolt	-	O	O
Adapter bolt	-	O	O



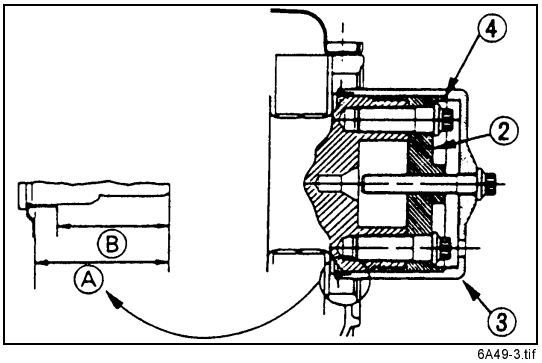
6A49-1.tif

1) Insert the slinger ① into the end of adapter ② and install the adapter on the crankshaft.



6A49-2.tif

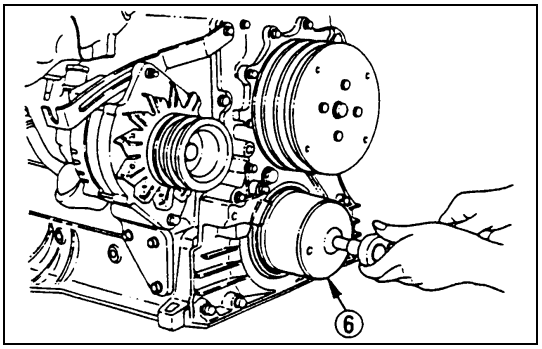
2) Cover the sleeve ③ and tighten the bolt until the sleeve comes to contact the adapter stopper ④.



6A49-3.tif

3) Make sure of measurements specified in the illustration as well as of slinger deflection.
   Ⓐ : 40.5 ± 0.3 mm (1.594 ± 0.012 in)
   Ⓑ : 34.0 ± 0.1 mm (1.339 ± 0.004 in)

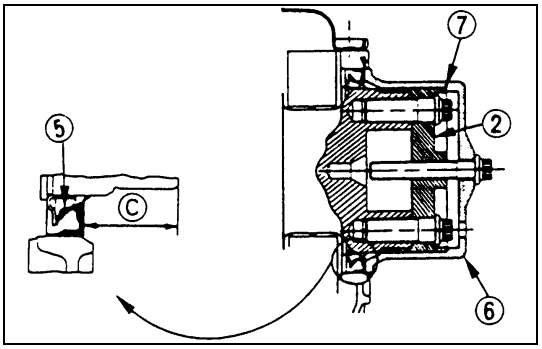
NOTE:
Be sure to replace the slinger and oil seal as a set.
Use about 5mm thickness plain washer on the center bolt.



6A50-1.tif

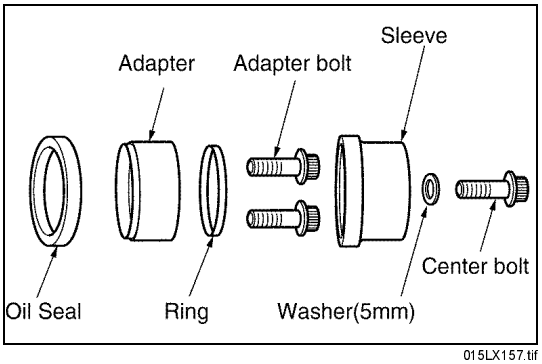
18. Crankshaft Front Oil Seal

1) Apply engine oil to the lip of the oil seal.
2) Press in the oil seal using front oil seal setting tool kit.
3) Remove the slinger sleeve and insert the oil seal ⑤ into the adapter ②.
4) Install the adapter ring into the sleeve.
5) Install the oil seal sleeve ⑥ to the adapter ② and tighten the center bolt until the sleeve comes to contact the adapter stopper ⑦.

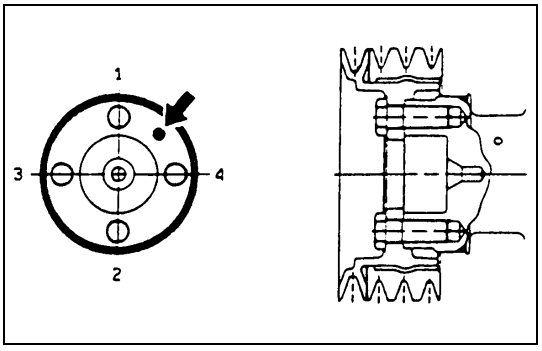


6A50-2.tif

6) Make sure of the measurements specified in the illustration.
   Ⓒ : 31 ± 0.3 mm (1.220 ± 0.012 in)



015LX157.tif



6A50-3.tif

17. Crankshaft Damper Pulley

1) Apply a coat of engine oil to the threads of the bolts.
2) Align the damper pulley with the crankshaft knock pin and tighten the bolts to the specified torque in numerical order.

Damper Pulley Bolt Torque	N•m (kg•m/lb•ft)
200 (20.4/147)	

16. Generator Bracket
15. Fan Belt Adjust Plate
14. Injection Pump Assembly
13. Engine Foot
12. Generator
11. Fan Belt

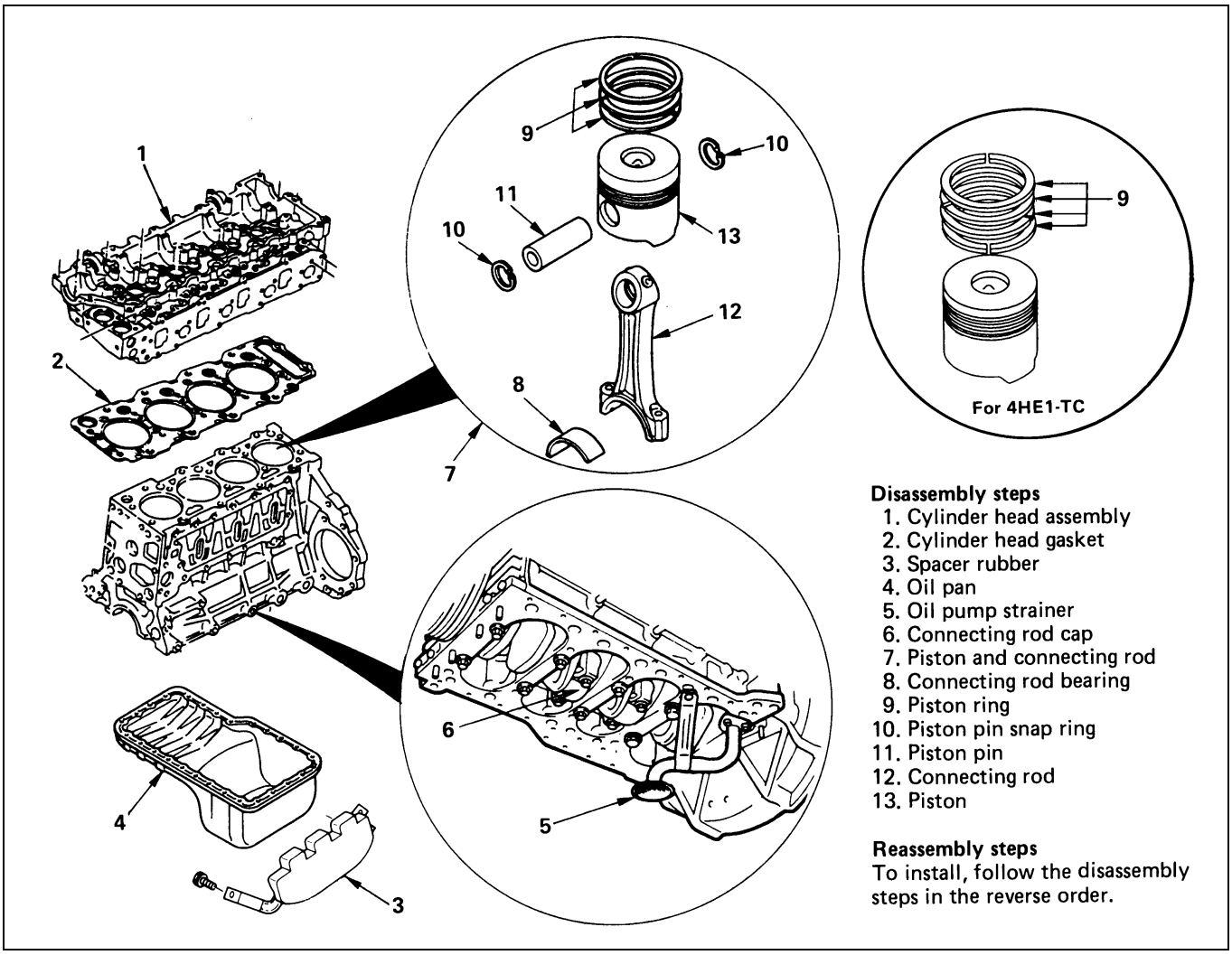
Fan Belt Adjustment

10. **Vacuum Pump Rubber Hose**
9. **Vacuum Pump Oil Pipe**
8. **Oil Filter Assembly**
7. **Oil Pipe**
6. **Engine Control Lever Assembly**
5. **Engine Control Wire**
4. **Driven Plate**
3. **Clutch Pressure Plate Assembly**
2. **Cylinder Head Gasket**

   Above works refer to “CYLINDER BLOCK” section in this manual.
1. **Cylinder Head Assembly**

   Above works refer to “CYLINDER HEAD” section in this manual.

PISTON AND CONNECTING ROD



Disassembly steps
1. Cylinder head assembly
2. Cylinder head gasket
3. Spacer rubber
4. Oil pan
5. Oil pump strainer
6. Connecting rod cap
7. Piston and connecting rod
8. Connecting rod bearing
9. Piston ring
10. Piston pin snap ring
11. Piston pin
12. Connecting rod
13. Piston

Reassembly steps
To install, follow the disassembly steps in the reverse order.

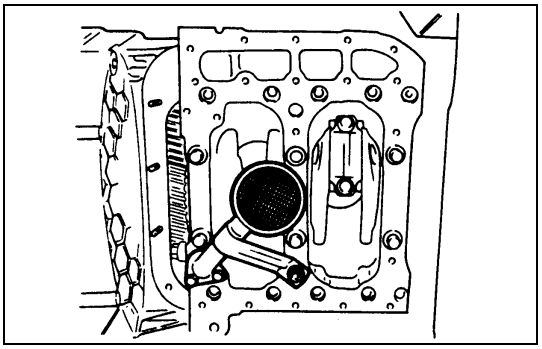
6A52-1.tif

DISASSEMBLY

1. **Cylinder Head Assembly**
   Above works refer to “CYLINDER HEAD” section in this manual.
2. **Cylinder Head Gasket**

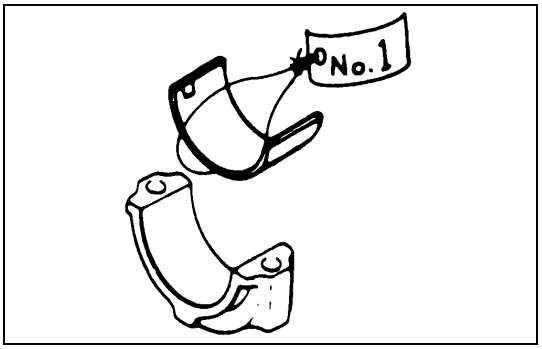
CAUTION:
Do not reuse the cylinder head gasket.

3. **Spacer Rubber**
4. **Oil Pan**



6A53-1.tif

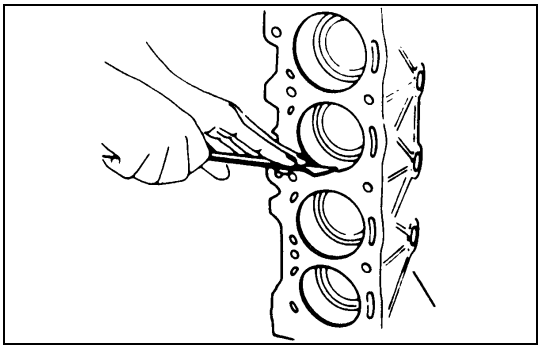
5. Oil Pump Strainer



6A53-2.tif

6. Connecting Rod Cap

1) Take out the connecting rod bearing cap bolts and remove the bearing cap with the lower bearing.
2) If the connecting rod lower bearings are to be reinstalled, mark their fitting positions by tagging each bearing with the cylinder number from which it was removed.



6A53-3.tif

7. Piston and Connecting Rod Assembly

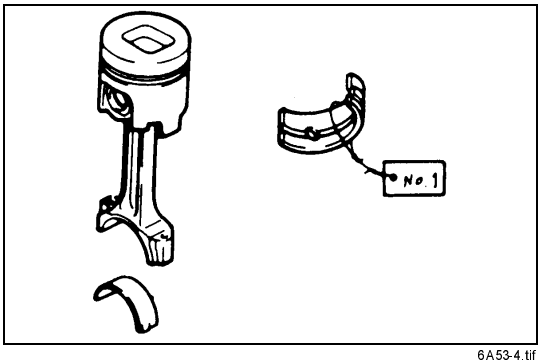
1) To facilitate smooth removal of piston, remove carbon from the upper part of the cylinder wall using a scraper or equivalent.
2) Remove the piston and connecting rod assembly upward by pushing on the edge of the connecting rod with a hammer handle or equivalent.
3) If the connecting rod bearing are to be reinstalled, mark their fitting positions by taggfing each bearing with the cylinder number from which it was removed.

CAUTION:

Do not bend or damage the oiling jet.

NOTE:

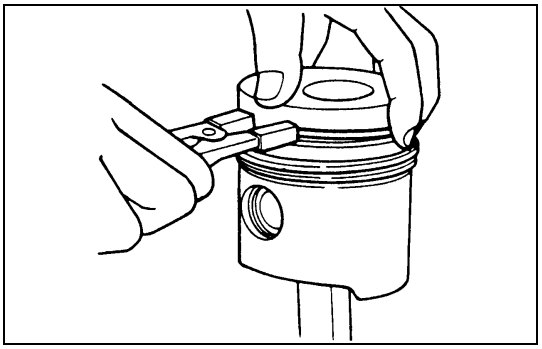
When removing the piston and connecting rod assembly, pull the connecting rod in parallel with the cylinder bore.



6A53-4.tif

8. Connecting Rod Bearing

If the connecting rod bearings are to be reinstalled, mark their fitting positions by tagging each bearing with the cylinder number from which it was removed.

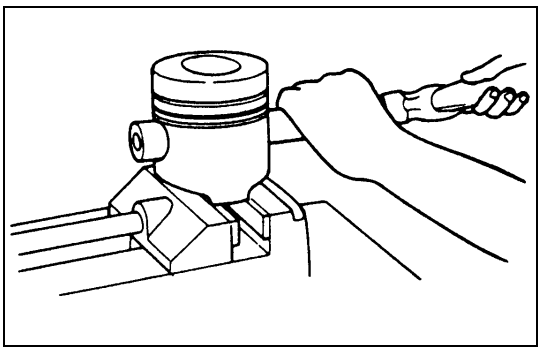

6A54-1.tif

9. Piston Ring

1) Clamp the connecting rod in a vise.
   Take care not to damage the connecting rod.
2) Use piston ring replacer to remove the piston rings.
   Do not attempt to use some other tool to remove the piston rings. Piston ring stretching will result in reduced piston ring tension.

10. Piston Pin Snap Ring

Use a pair of snap ring pliers to remove the piston pin snap rings.


6A54-2.tif

11. Piston Pin
12. Connecting Rod
13. Piston

Tap the piston pin out with a hammer and a brass bar.
If the pistons are to be reinstalled, mark their installation positions by tagging each piston with the cylinder number from which it was removed.

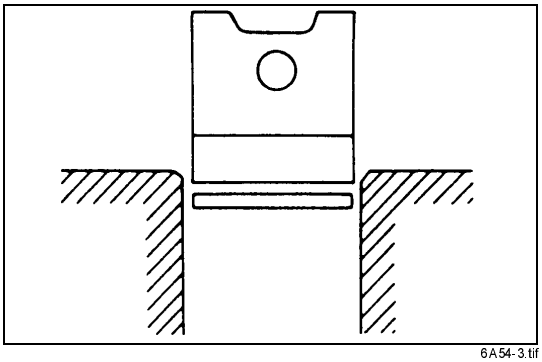
INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.

Piston Grade Selection and Cylinder Bore Measurement

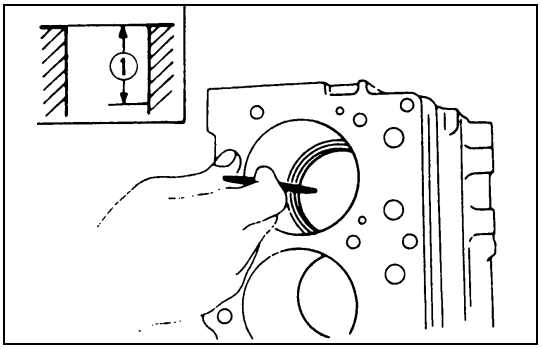
Refer to the Section “CYLINDER BLOCK”, Item “Cylinder Liner Bore Measurement” for details on piston grade selection and cylinder liner bore measurement.

Piston Ring


6A54-3.tif

Piston Ring Gap

1) Insert the piston ring horizontally (in the position it would assume if it were installed to the piston) into the cylinder liner bore.



6A55-1.tif

2) Push the piston ring into the cylinder liner bore until it reaches the point ① where the cylinder liner bore is the smallest.
   Do not allow the piston ring to slant to one side or the other. It must be perfectly horizontal.

Measuring Point	mm (in)
Approx. 150 (6)	

3) Use a feeler gauge to measure the piston ring gap.
   If the measured valve exceeds the specified limit, the piston ring must be replaced.

Piston Ring Gap / 4HF1 / 4HF1-2 mm (in)

	Standard	Limit
1st compression ring gap	0.24 - 0.39 (0.0094 - 0.0153)	1.50 (0.0591)
2nd compression ring gap	0.35 - 0.50 (0.0138 - 0.0197)	
Oil ring gap	0.02 - 0.40 (0.0008 - 0.0157)	

Piston Ring Gap / 4HG1 / 4HG1-T mm (in)

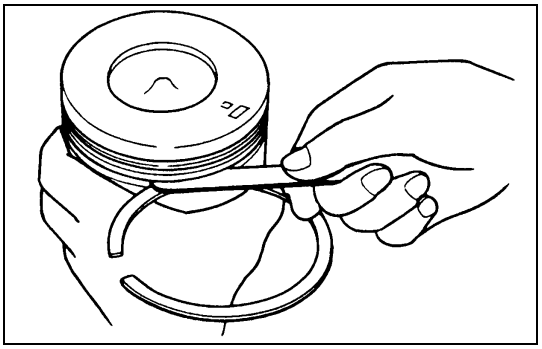
	Standard	Limit
1st compression ring gap	0.24 - 0.39 (0.0094 - 0.0153)	1.50 (0.0591)
2nd compression ring gap	0.35 - 0.50 (0.0138 - 0.0197)	
Oil ring gap	0.15 - 0.35 (0.00591 - 0.0138)	

Piston Ring Gap / 4HE1-T mm (in)

	Standard	Limit
1st compression ring gap	0.24 - 0.40 (0.0094 - 0.0157)	1.50 (0.0591)
2nd compression ring gap	0.56 - 0.71 (0.0220 - 0.0279)	
Oil ring gap	0.20 - 0.40 (0.0078 - 0.0157)	

Piston Ring Gap / 4HE1-TC mm (in)

	Standard	Limit
1st compression ring gap	0.24 - 0.40 (0.0094 - 0.0157)	1.50 (0.0591)
2nd compression ring gap	0.30 - 0.450 (0.0118 - 0.0177)	
Oil ring gap	0.20 - 0.40 (0.0078 - 0.0157)	


6A56-1.tif

Piston Ring and Piston Ring Groove Clearance

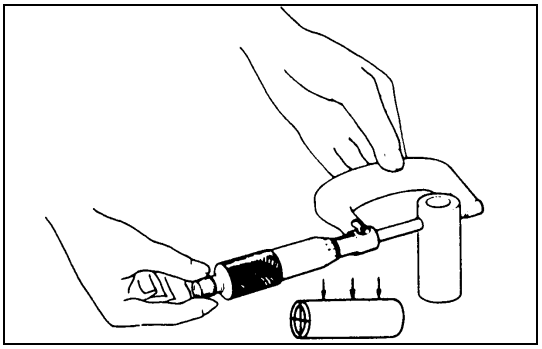
1) Use a feeler gauge to measure the clearance between the piston ring and the piston ring groove at several points around the piston.

Piston Ring and Piston Ring Groove Clearance / 4HF1, 4HF1-2: 4HG1, 4HG1-T mm (in)

	Standard	Limit
1st Compression Ring	0.062 - 0.092 (0.0024 - 0.0036)	0.20 (0.0079)
2nd Compression Ring	0.04 - 0.08 (0.0015 - 0.0031)	0.15 (0.0059)
Oil Ring	0.02 - 0.06 (0.0008 - 0.0024)	

Groove Clearance / 4HE1-T: 4HE1-TC mm (in)

	Standard	Limit
1st Compression Ring	0.09 - 0.13 (0.0035 - 0.0051)	0.20 (0.0078)
2nd and 3rd Compression Ring	0.09 - 0.13 (0.0035 - 0.0051)	
Oil Ring	0.03 - 0.07 (0.0012 - 0.0028)	0.15 (0.0059)


6A56-2.tif

2) Visually inspect the piston ring grooves.
If a piston ring groove is damaged or distorted, the piston must be replaced.

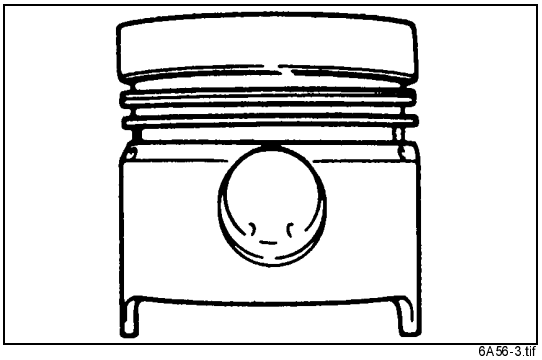
Piston Pin

Piston Pin Diameter

Use a micrometer to measure the piston pin outside diameter at several points.
If the measured value is less than the specified limit, the piston pin must be replaced.

Piston Pin Diameter mm (in)

Engine model	Standard	Limit
Except 4HE1-T 4HE1-TC	35.995 - 36.000 (1.4171 - 1.4173)	35.970 (1.4161)
4HE1-T 4HE1-TC	39.995 - 40.000 (1.5746 - 1.5748)	39.970 (1.5736)

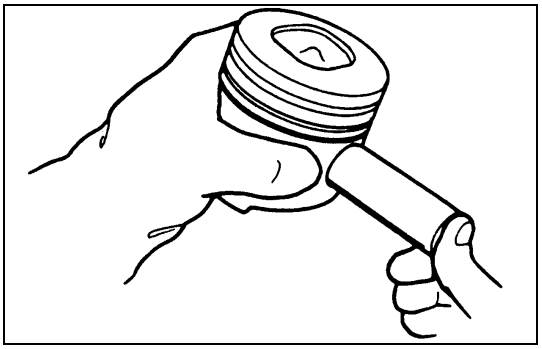

6A56-3.tif

Piston Pin Hole and Piston Pin Clearance

Use an inside dial indicator to measure the piston pin hole (in the piston).

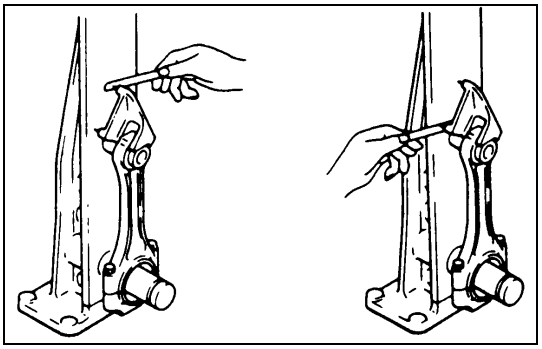
Piston Pin Hole and Piston Pin Clearance mm (in)

Standard	Limit
0.004 - 0.017 (0.00016 - 0.00067)	0.04 (0.0016)


6A57-1.tif

If an inside dial indicator is not available, use the following procedure to check the piston pin clearance.

1) Use a piston heater to heat the piston to approximately 80-100°C (176-212°F)
2) Push strongly against the piston pin with your thumbs.
   The piston pin should move smoothly with little or no resistance.


6A57-2.tif

Connecting Rod

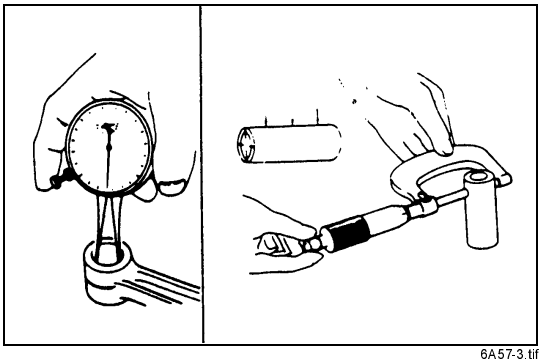
Connecting Rod Alignment

Use a connecting rod aligner to measure the distortion and the parallelism between the connecting rod big end hole and the connecting rod small end hole.

If either the measured distortion or parallelism exceeds the specified limit, the connecting rod must be replaced.

Connecting Rod Alignment mm (in)

Per Length of 100 (3.94)		
	Standard	Limit
Distortion	0.05 (0.002) or less	0.20 (0.008)
Parallelism		


6A57-3.tif

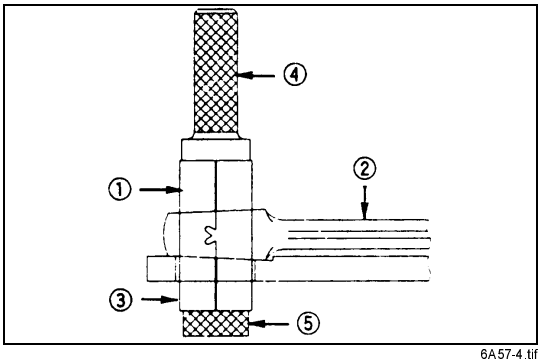
Piston Pin and Connecting rod Small End Bushing Clearance

Use a caliper calibrator and a dial indicator to measure the clearance between the piston pin and connecting rod small end bushing.

If the clearance between the piston pin and the connecting rod small end bushing exceeds the specified limit, replace the piston pin and/or the connecting rod bushing.

Piston Pin and Connecting Rod
Small End Bushing Clearance mm (in)

Standard	Limit
0.012 - 0.027 (0.0005 - 0.0011)	0.05 (0.002)

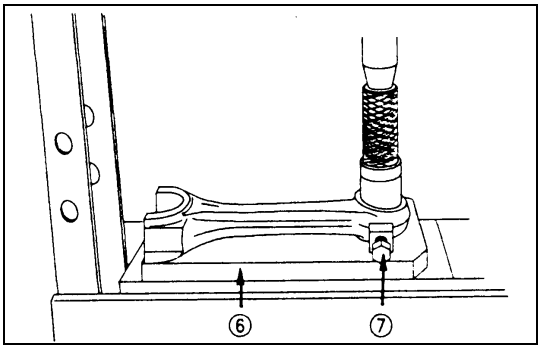


6A57-4.tif

Connecting Rod Bushing Replacement

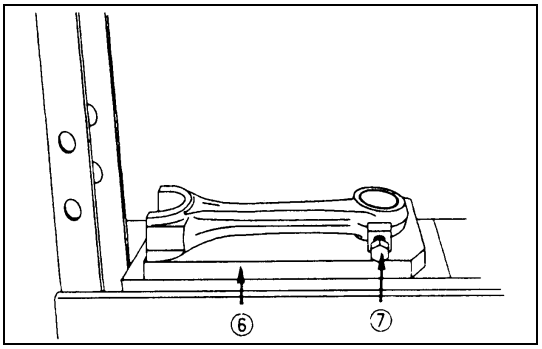
Connecting Rod Bushing Removal

1) Set the collar ①, the connecting rod ②, and the collar ③ to the setting bar ④.
   Connecting Rod Bushing Replacer: 5-8840-2340-0
2) Hand-tighten the nut ⑤ until there is no more gap.



6A58-1.tif

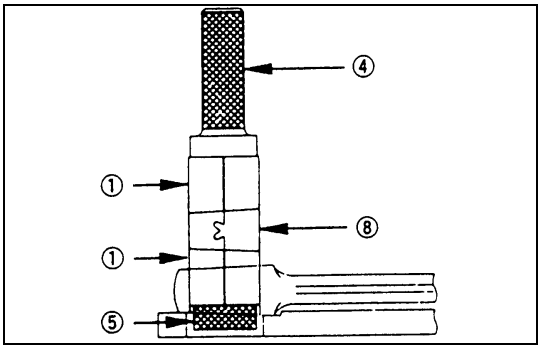
3) Set the connecting rod bushing replacer base ⑥ to the bench press.
4) Set the connecting rod to the connecting rod bushing replacer base.
5) Tighten the bolt ⑦.
6) Use the bench press to force the bushing from the connecting rod.



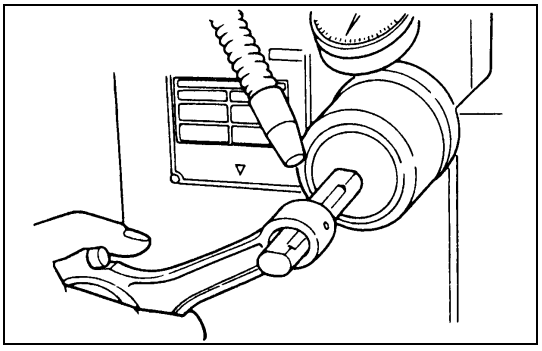
6A58-2.tif

Connecting Rod Bushing Installation

1) Set connecting rod bushing replacer base ① to the bench press.
   Connecting Rod Bushing Replacer: 5-8840-2340-0
2) Set the connecting rod to the connecting rod replacer base.
   The connecting rod must be perfectly horizontal.
3) Tighten the bolt ② to hold the connecting rod small end in place.
4) Install the two collars ③ and the new bushing ④ to the setting bar ⑤.
   Align the bushing clinch line and the collar setting marks.
   Tighten the nut ⑥.
5) Use the bench press to press the new bushing into position inside the connecting rod.
   Check that the bushing oil holes and the connecting rod oil holes are aligned.



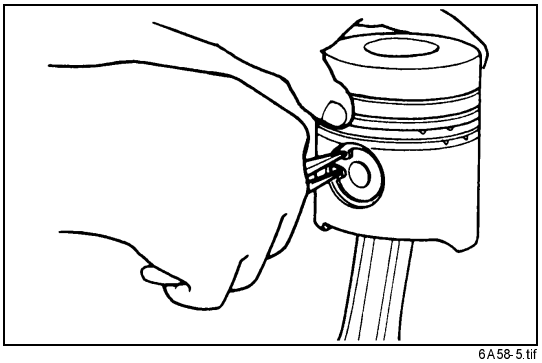
6A58-3.tif


6A58-4.tif

6) Use a pinhole grinder to finish the new bushing.

Connecting Rod Small End Bushing
Inside Diameter mm (in)

Others	36.012 - 36.022 (1.4178 - 1.4182)
4HE1-T 4HE1-TC	40.012 - 40.022 (1.5753 - 1.5767)

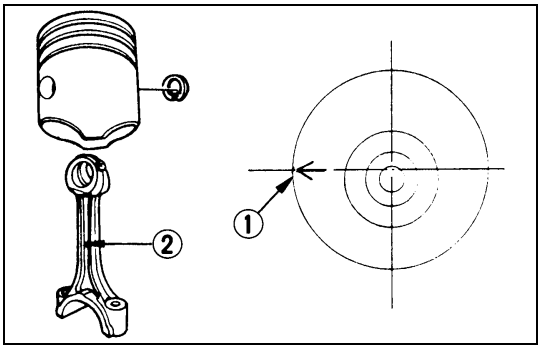

6A58-5.tif

REASSEMBLY

13. Piston

10. Piston Pin Snap Ring

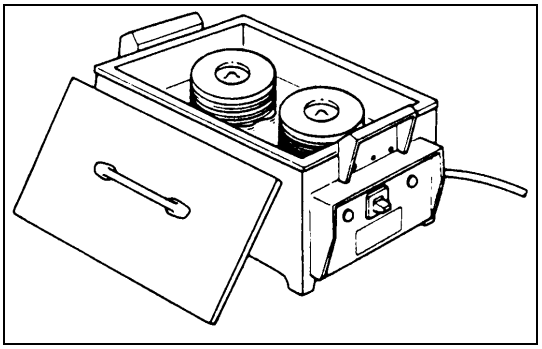
Use a pair of snap ring pliers to install the piston pin snap ring to the piston.



6A59-1.tif

12. Connecting Rod

1) Clamp the connecting rod in a vise.
   Take care not to damage the connecting rod.
2) Install the connecting rod so that the piston head front mark ① and the connecting rod forging mark (projecting) ② are set in the same direction.


6A59-2.tif

11. Piston Pin

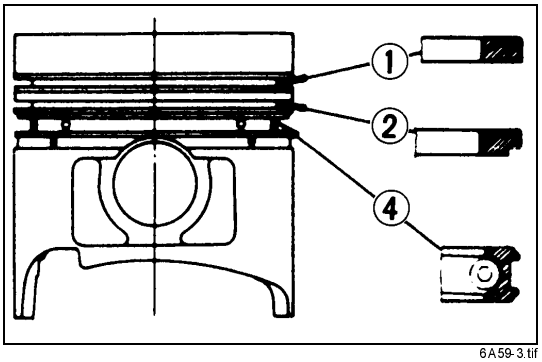
If could not be installed piston pin, it is recommended to remove it by following procedure.

1) Use a piston heater to heat the piston to 80-100°C (176-212°F).
2) Apply a coat of engine oil to the piston pin.
3) Use your fingers to force the piston pin into the piston until it makes contact with the snap ring.
4) Check to see if the connecting rod moves smoothly on the piston pin.

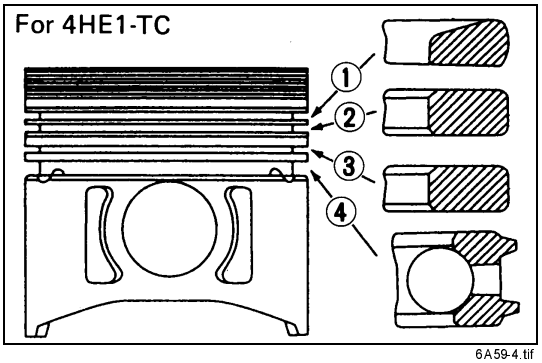
10. Snap Ring

9. Piston Ring

1) Use a piston ring replacer to install the three piston rings.
   Install the piston rings in the order shown in the illustration.
   ① 1st compression ring
   ② 2nd compression ring
   ③ 3rd compression ring (For 4HE1-TC)
   ④ Oil ring



6A59-3.tif



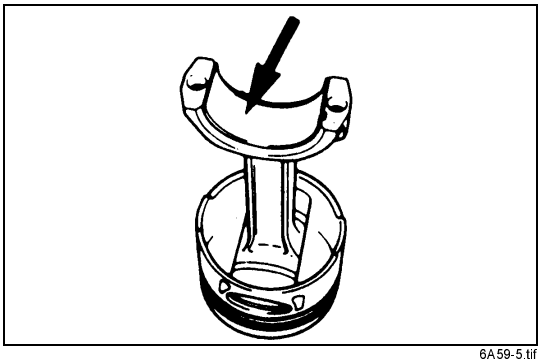
6A59-4.tif

NOTE:

Insert the expander coil into the oil ring groove so that there is no gap on either side of the expander coil before installing the oil ring.

Install the compression rings with the stamped side facing up.

2) Apply engine oil to the piston ring surfaces.
3) Check to see if the piston rings rotate smoothly in the piston ring grooves.


6A59-5.tif

8. Connecting Rod Bearing

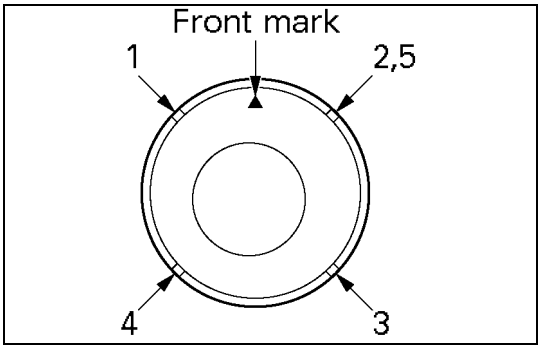
Carefully wipe any oil or other foreign material from the connecting rod bearing back face and the connecting rod bearing fitting surface.

7. Piston and Connecting Rod Assembly

NOTE:

When installing new connecting rod and/or connecting rod bearings, refer to the selection table. Above works refer to "CRANKSHAFT" section in this manual.

1) Apply a coat of engine oil to the circumference of each piston ring and piston.



012HW002.tif

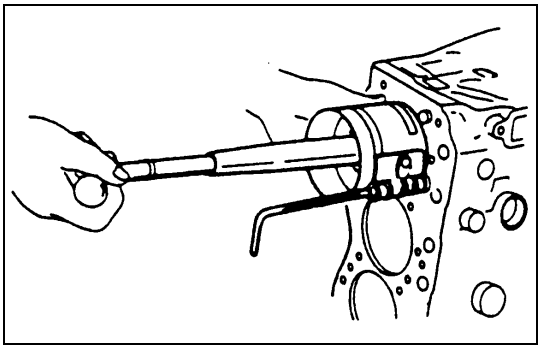
2) Position the piston ring gaps as shown in the illustration.
   ① 1st compression ring
   ② 2nd compression ring
   ③ 3rd compression ring (4HE1-TC only)
   ④ Oil ring
   ⑤ Coil expander

3) Apply a coat of molybdenum disulfide grease to the two piston skirts.
   This will facilitate smooth break-in when the engine is first started after reassembly.

4) Apply a coat of engine oil to the upper bearing surfaces.

5) Apply a coat of engine oil to the cylinder wall.

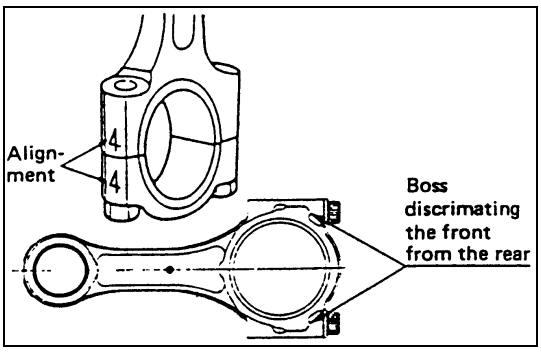
6) Position the piston head front mark so that it is facing the front of the engine.


6A60-2.tif

7) Use the piston ring compressor to compress the piston rings.
   Piston Ring Compressor: 5-8840-9018-0

8) Use a hammer grip to push the piston in until the connecting rod makes contact with the crankpin.
   At the same time, rotate the crankshaft until the crankpin is at bottom dead center.

CAUTION:
Do not bend or damage the oiling jet.



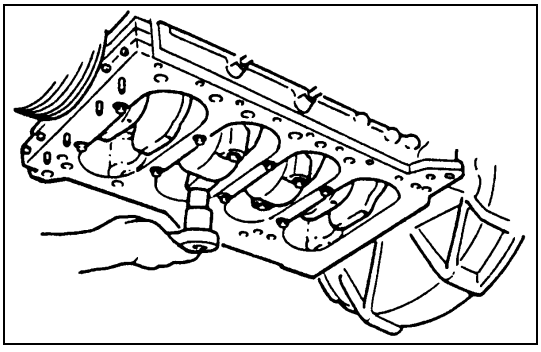
6A60-3.tif

6. Connecting Rod Cap

1) Install the connecting rod bearing caps.

2) Align the bearing cap cylinder number marks and the connecting rod cylinder number marks.

3) Apply a coat of molybdenum disulfide grease to the threads and setting faces of each connecting rod cap bolts.


6A60-4.tif

4) Tighten the connecting rod caps to the specified torque.

Connecting Rod Bearing Cap

Bolt Torque — N•m (kg•m/lb•ft)

1st step	2nd step	3rd step
39 (4.0/29)	60°	30°

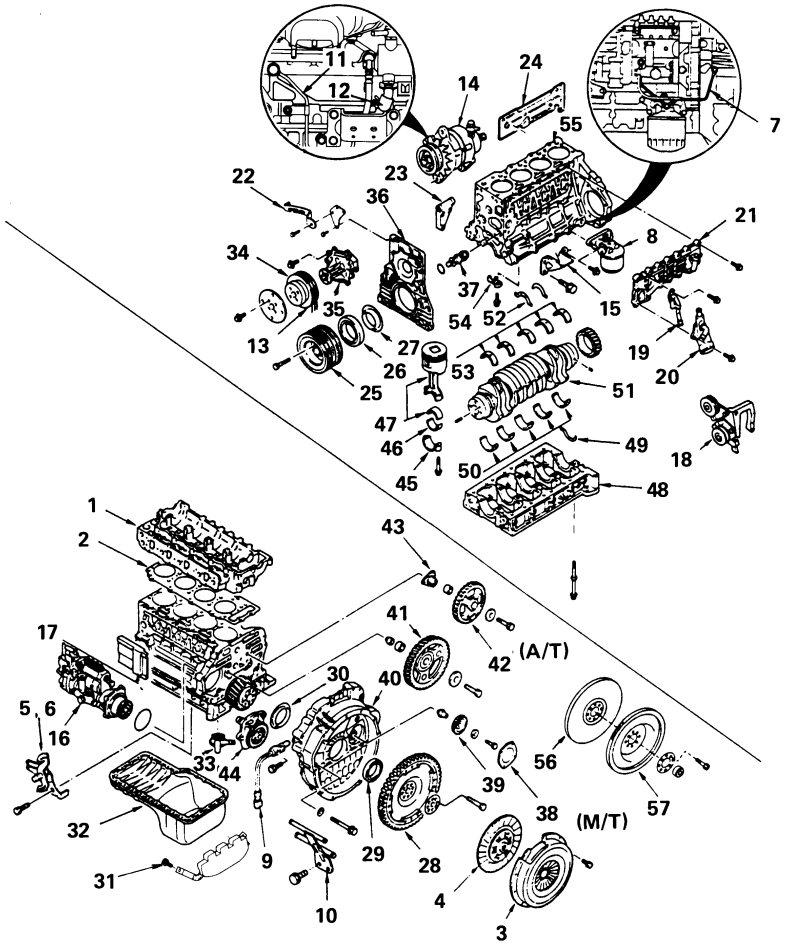
Angle gauge: 5-8840-0266-0

5. **Oil Pump Strainer**
4. **Oil Pan**
3. **Spacer Rubber (NKR model only)**
2. **Cylinder Head Gasket**

   Above works refer to “CYLINDER BLOCK” section in this manual.
1. **Cylinder Head Assembly**

   Above works refer to “CYLINDER HEAD” section in this manual.

CYLINDER BLOCK



Disassembly steps

1. Cylinder head assembly
2. Cylinder head gasket
3. Clutch pressure plate assembly
4. Driven plate
5. Engine control wire
6. Engine control lever assembly
7. Oil pipe
8. Oil filter assembly
9. Tachometer sensor
10. Fuel pipe bracket
11. Vacuum pump oil
12. Vacuum pump rubber hose
13. Fan belt
14. Generator
15. Engine foot
16. Injection pump assembly
17. Injection pump rubber spacer
18. Idle pulley bracket
19. Heater pipe
20. Water suction pipe
21. Oil cooler assembly
22. Fan belt adjust plate
23. Generator bracket
24. Cover
25. Crankshaft pulley
26. Crankshaft front oil seal
27. Crankshaft front slinger
28. Flywheel assembly (M/T)
29. Crankshaft rear oil seal
30. Crankshaft rear slinger
31. Spacer rubber
32. Oil pan
33. Oil pump strainer
34. Water pump pulley
35. Water pump
36. Front retainer
37. Oil thermo valve
38. Power steering pump idle gear cover
39. Power steering pump idle gear
40. Flywheel housing
41. Idle gear A
42. Idle gear B
43. Idle gear B shaft
44. Oil pump assembly
45. Connecting rod cap
46. Connecting rod lower bearing
47. Piston and connecting
48. Crankcase
49. Thrust bearing lower
50. Crankshaft bearing lower
51. Crankshaft assembly
52. Thrust bearing upper
53. Crankshaft bearing upper
54. Piston oil jet
55. Cylinder block
56. Flywheel (A/T)
57. Flexible plate(A/T)

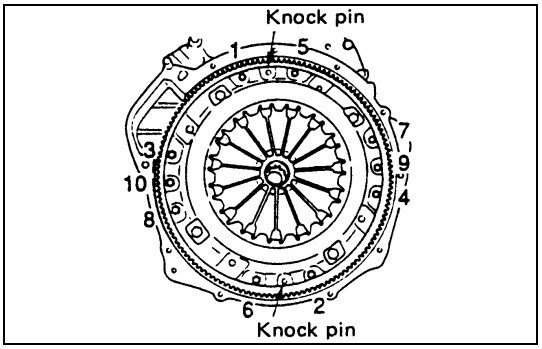
Reassembly steps

To reassemble, follow the disassembly steps in the reverse order.

6A62-1.tif

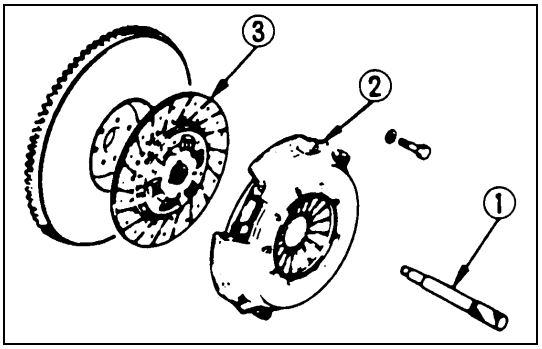
DISASSEMBLY

1. **Cylinder Head Assembly**
   Above works refer to “CYLINDER HEAD” section in this manual.
2. **Cylinder Head Gasket**
   CAUTION:
   Do not reuse the cylinder head gasket.



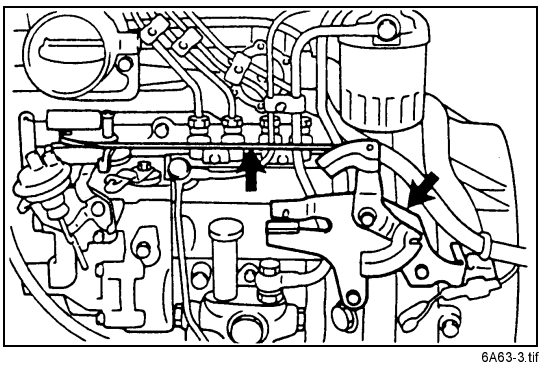
6A63-1.tif

3. **Clutch Pressure Plate Assembly**
   1) Insert the clutch pilot a sligner to the clutch assembly.
      Clutch Pilot Aligner: 5-8840-2240-0
   2) Loosen the pressure plate bolts in numerical order a little at a time as shown in the illustration.
   3) Remove the pressure plate assembly.

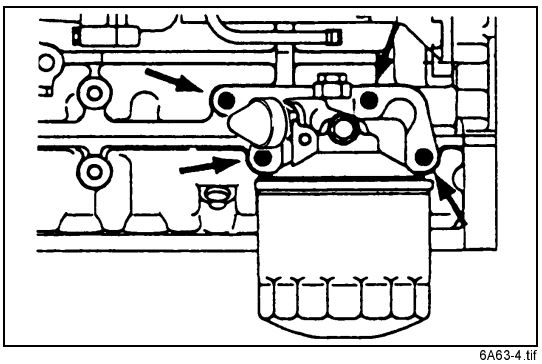


6A63-2.tif

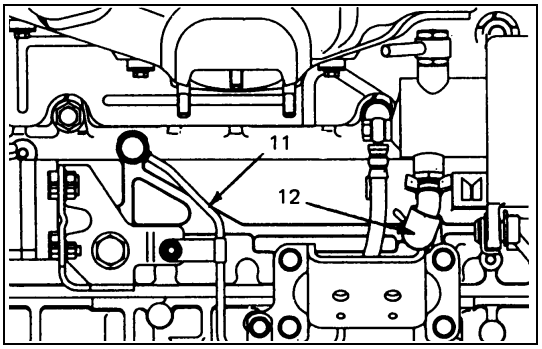
4. **Driven Plate**
   Remove the driven plate with the clutch pilot aligner.
   ① Clutch pilot aligner
   ② Clutch pressure plate assembly
   ③ Driven plate


6A63-3.tif

5. **Engine Control Wire**
6. **Engine Control Lever Assembly**
7. **Oil Pipe**

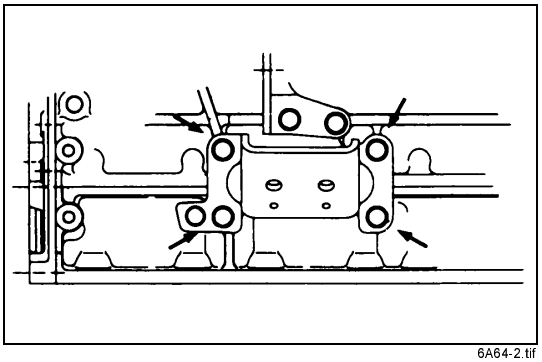

6A63-4.tif

8. **Oil Filter Assembly**
9. **Tachometer Sensor**
10. **Fuel Pipe Bracket**

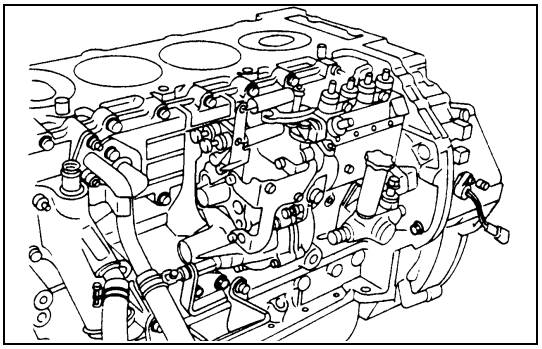


6A64-1.tif

11. Vacuum Pump Oil Pipe
12. Vacuum Pump Rubber Hose
13. Fan Belt
14. Generator

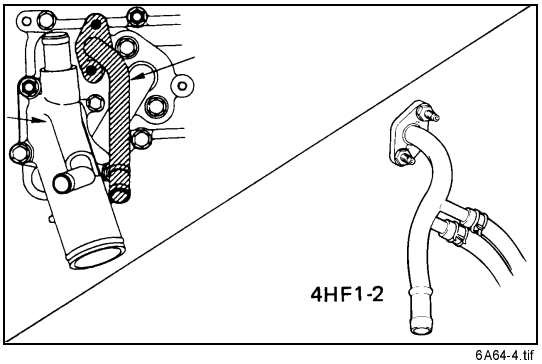

6A64-2.tif

15. Engine Foot


6A64-3.tif

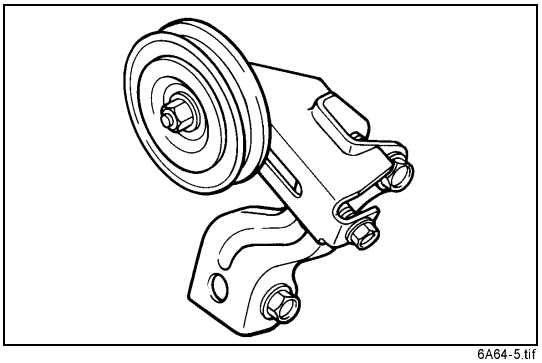
16. Injection Pump Assembly
1) Remove the injection pump bracket bolts and the injection pump rear bracket bolts.
2) Then remove the injection pump assembly.

17. Injection Pump Rubber Spacer

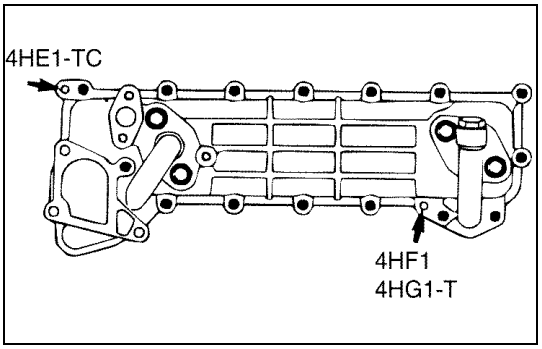


6A64-4.tif

18. Idle Pulley Bracket (If equipped with A/C)


6A64-5.tif

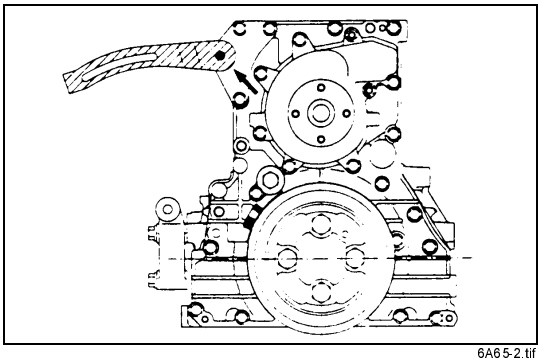
19. Heater Pipe
20. Water Suction Pipe



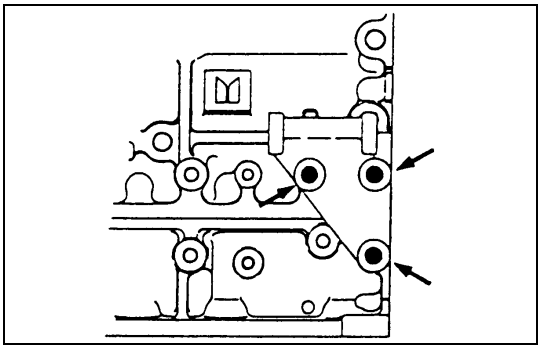
050LX031.tif

21. Oil Cooler Assembly

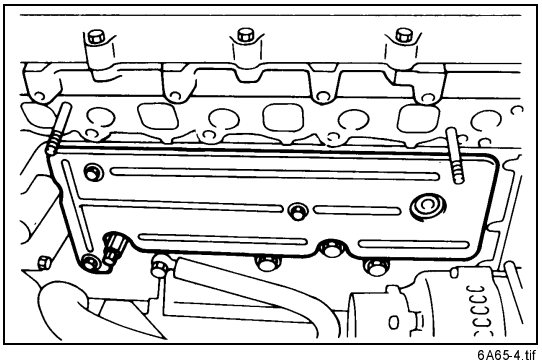
1) Remove the oil cooler bolts.
2) Install a oil cooler fixing bolt to the oil cooler replacer hole as shown in the illustration, and tighten the bolt alternately a little at a time.


6A65-2.tif

22. Fan Belt Adjust Plate


6A65-3.tif

23. Generator Bracket

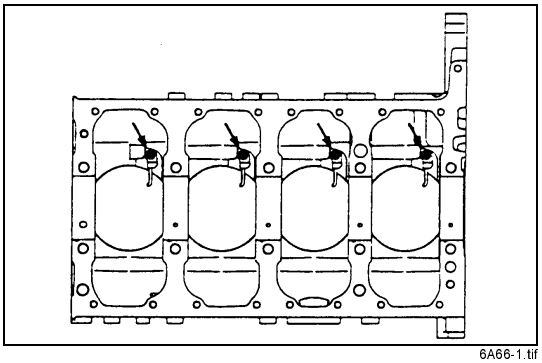

6A65-4.tif

24. Cover

25. Crankshaft Damper Pulley
26. Crankshaft Front Oil Seal
27. Crankshaft Front Slinger
28. Flywheel Assembly
29. Crankshaft Rear Oil Seal
30. Crankshaft Rear Slinger
31. Space Rubber (NKR model only)
32. Oil Pan
33. Oil Pump Strainer

34. Water Pump Pulley
35. Water Pump
36. Front Retainer
37. Oil Thermo Valve
38. Power Steering Pump Idle Gear Cover
39. Power Steering Pump Idle Gear
40. Flywheel Housing
41. Idle Gear A
42. Idle Gear B
43. Idle Gear B Shaft
44. Oil Pump Assembly
45. Connecting Rod Cap
46. Connecting Rod Lower Bearing
47. Piston and Connecting Rod Assembly
48. Crankcase
49. Thrust Bearing Lower
50. Crankshaft Bearing Lower
51. Crankshaft Assembly
52. Thrust Bearing Upper
53. Crankshaft Bearing Upper

Above works refer to “CRANKSHAFT” section in this manual.


6A66-1.tif

54. Oiling Jet

Loosen the check valves to remove both the check valves and the oiling jets.

Take care not to bend or damage the oiling jets.

55. Cylinder Block

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.

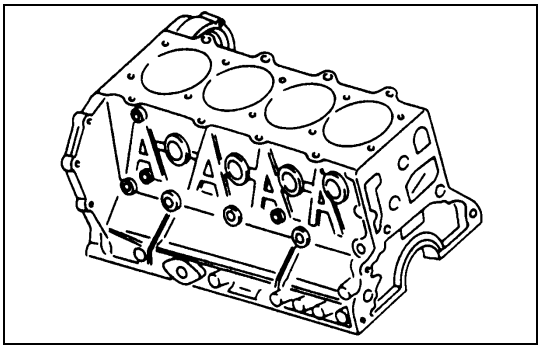
1) Remove the gasket and any other material adhering to the upper surface of the cylinder block.

   Be very careful not to allow any material to accidentally drop into the cylinder block.

   Be very careful not to scrtatch the cylinder block.

2) Carefully remove the oil pump, Rear Oil Seal, and oil pan installation surface seal.

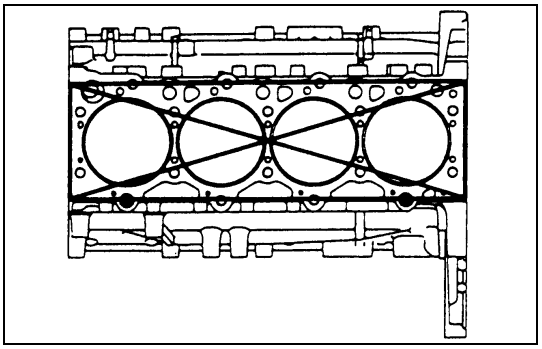
3) Wipe the cylinder block clean.



6A67-1.tif

Cylinder Body Upper Face Warpage

1) Remove the cylinder body dowel.
2) Remove the cylinder liner.
   Refer to “Cylinder Liner Replacement.”



6A67-2.tif

3) Use a straight edge and a feeler gauge to measure the four sides and the two diagonals of the cylinder body upper face.
4) If the measured values exceed the specified limit, the cylinder body must be replaced.

CAUTION:

Do not regrind the cylinder body upper face.

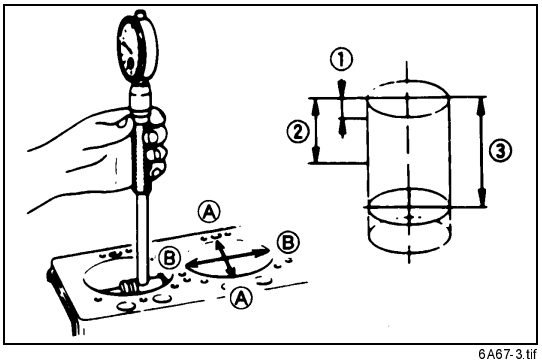
Cylinder Body Upper Face Warpage mm (in)

Standard	Limit
0.05 (0.002) or less	0.20(0.008)

Cylinder Body Height (H) (Reference) mm (in)

Standard
279.965 - 280.035 (11.022 - 11.025)

5) Reinstall the cylinder liner.
   Refer to the “Cylinder Body Bore Measurement.”
6) Reinstall the cylinder body dowel.



6A67-3.tif

Cylinder Liner Bore Measurement

Use a cylinder indicator to measure the cylinder bore at measuring points ①, ② and ③ in the Ⓐ - Ⓐ and Ⓑ - Ⓑ directions of the crankshaft.

Measuring points:

① 20 mm (0.79 in)

② 90 mm (3.54 in)

③ 160 mm (6.30 in)

If the measured value exceeds the specified limit, the cylinder liner must be replaced.

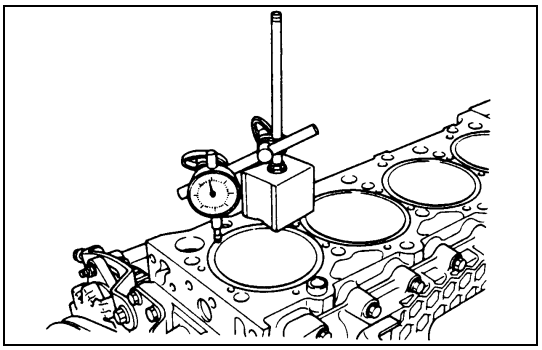
Cylinder Liner Bore mm (in)

	Standard	Limit
4HF1 4HF1-2	112.021 - 112.050 (4.4103 - 4.4114)	112.20 (4.417)
4HG1 4HG1-T	115.021 - 115.050 (4.5284 - 4.5295)	115.20 (4.535)
4HE1-T 4HE1-TC	110.041 - 110.080 (4.3323 - 4.3338)	110.23 (4.340)

NOTE:

The inside of the dry type cylinder liner is made of thin cast iron. It cannot be rebored or honed.

If the inside of the cylinder liner is scored or scorched, the cylinder liner must be replaced.



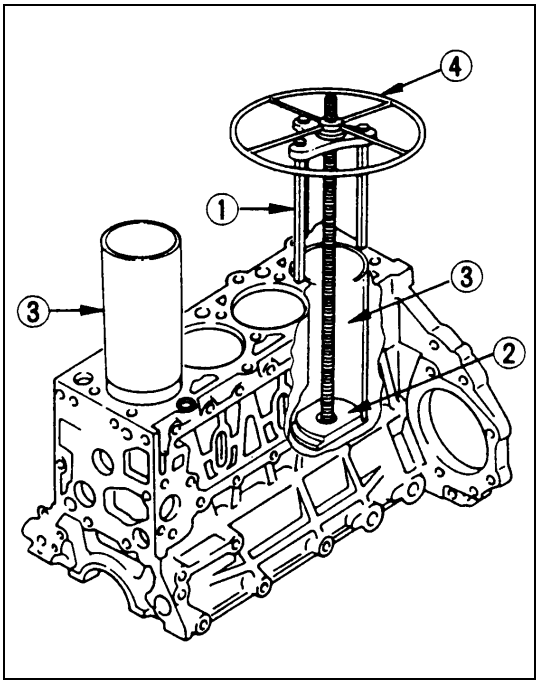
6A68-1.tif

Cylinder Liner Projection Inspection

Use a dial gauge to measure the projection of each cylinder.

Cylinder Liner Projection	mm (in)
Standard	
0.09 - 0.14 (0.0035 - 0.0055)	

The difference in the cylinder liner projection height between any two adjacent cylinders must not exceed 0.03 mm (0.0012 in).



6A68-2.tif

Cylinder Liner Replacement

Cylinder Liner Removal

If could not be removed cylinder liner, it is recommended to remove it by following procedure.

1) Set the cylinder liner remover ① to the cylinder liner ③.
2) Check to see if the remover shaft ankle ② is firmly gripping the cylinder liner bottom edge.
3) Slowly turn the remover shaft handle ④ clockwise to pull the cylinder liner free.

Cylinder Liner Remover: 9-8523-1169-0

Cylinder Liner Remover Ankle: 5-8840-2220-0

Ankle: 5-8840-2397-0 (4HG1)

CAUTION:

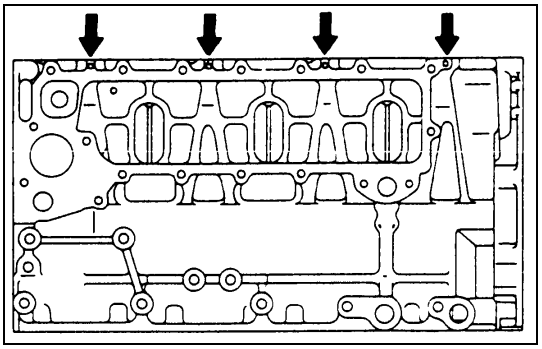
Take care not to damage the cylinder body upper face during the cylinder liner removal procedure.

Cylinder Liner Grade Selection and Standard Fitting Interference

Accurately measured fitting interference and proper cylinder liner grade selection are extremely important.

If the cylinder liner fitting interference is too small, engine cooling efficiency will be adversely affected.

If the cylinder liner fitting interference is too large, it will be difficult to insert the cylinder liner into the cylinder body.


6A69-1.tif

A mark was stamped on the left side of the cylinder block during production to indicate the correct liner. The liner grade (i.e.1, 2, 3) is indicated in metal stamp.

Cylinder Liner Grade

4HF1 / 4HF1-2

Line Grade	Cylinder Bore Diameter mm (in.)	Service Grade	Liner Outside Diameter mm (in.)
1	115.001 - 115.010 (4.5276 - 4.5279)	1X	114.991 - 115.000 (4.5272 - 4.5276)
2	115.011 - 115.020 (4.5280 - 4.5283)	3X	115.001 - 115.010 (4.5276 - 4.5279)
3	115.021 - 115.030 (4.5284 - 4.5287)		

4HG1 / 4HG1-T

1	118.001 - 118.010 (4.6457 - 4.6461)	1X	117.991 - 118.000 (4.6453 - 4.6457)
2	118.011 - 118.020 (4.6461 - 4.6464)	3X	118.001 - 118.010 (4.6457 - 4.6461)
3	118.021 - 118.030 (4.6465 - 4.6468)		

4HE1-T / 4HE1-TC

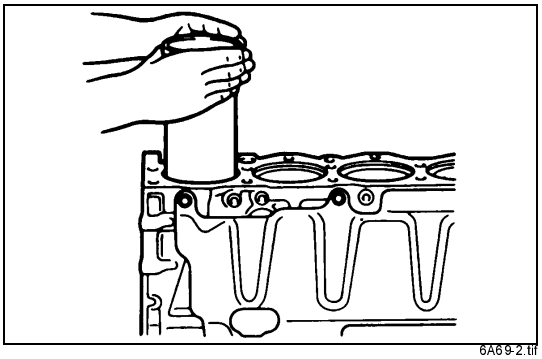
1	115.001 - 115.010 (4.5276 - 4.5279)	1X	115.021 - 115.030 (4.5284 - 4.5287)
2	115.011 - 115.020 (4.5280 - 4.5283)	3X	115.031 - 115.040 (4.5289 - 4.5291)
3	115.021 - 115.030 (4.5284 - 4.5287)		

The cylinder liner grade is stamped on the outside of the cylinder liner.

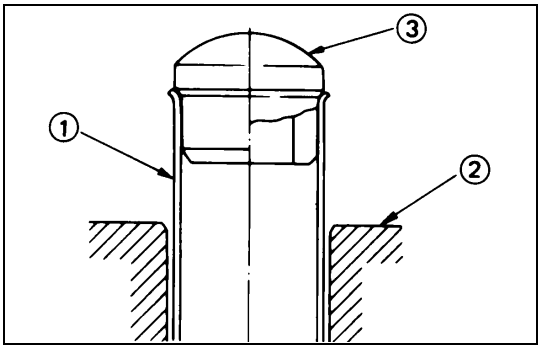
Cylinder Liner Installation (For 4HF1, 4HF1-2, 4HG1 and 4HG1-T Engine)

1) Use new kerosene or diesel oil to thoroughly clean the cylinder liners and bores.
2) Use compressed air to blow dry the cylinder liner and bore surfaces.

CAUTION:
All foreign material must be carefully removed from the cylinder liner and the cylinder bore before installation.


6A69-2.tif

3) Install cylinder liner perpendicularly to cylinder bore. Do not give any excessive force such as knocking while inserting cylinder liner into cylinder bore.



6A70-1.tif

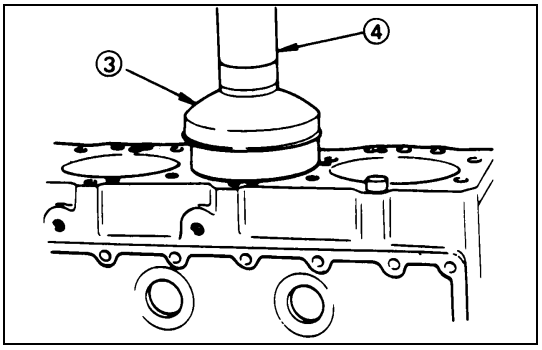
Cylinder Liner Installation (For 4HE1-T and 4HE1-TC Engine)

1) Cylinder Liner Installation Using The Special Tool
   - Use new kerosene or diesel oil to thoroughly clean the cylinder liners and bores.
   - Use compressed air to blow-dry the cylinder liner and bore surfaces.

CAUTION:

All foreign material must be carefully removed from the cylinder liner and the cylinder bore before installation.

- Insert the cylinder liner ① into the cylinder body ② from the top of the cylinder body.



6A70-2.tif

- Set the cylinder liner installer ③ to the top of the cylinder liner.
  Cylinder Liner Installer: 5-8840-2337-0
- ③ is directly beneath the bench press shaft center ④.

CAUTION:

Check that the cylinder liner is set perpendicular to the bench press and that there is no wobble.

- Use the bench press to apply a seating force of 4,900 N (500 kg/1,102.5 lb) to the cylinder liner.
- Apply a force of 24,500 N (2,500 kg/5,512.5 lb) to fully seat the cylinder liner.
- After installing the cylinder liner, measure the cylinder liner projection.
  Refer to “Cylinder Liner Projection Inspection”.

2) Cylinder Liner Installation Using Dry Ice
   If the cylinder liner is a chrome plated dry type, it is advisable to use dry ice during the installation procedure.
   Cooling the cylinder liner with dry ice will cause the cylinder liner to contract, thus making installation easier.

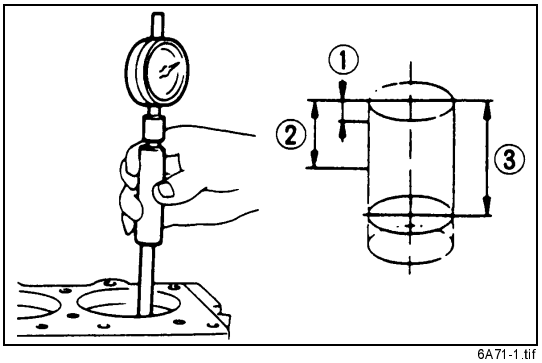
CAUTION:

It is important that the cylinder liner be inserted to the cylinder body immediately after it has been cooled.

WARNING:

Dry ice must be used with great care. Careless handling of dry ice can result in severe frostbite.

PISTON GRADE SELECTION



6A71-1.tif

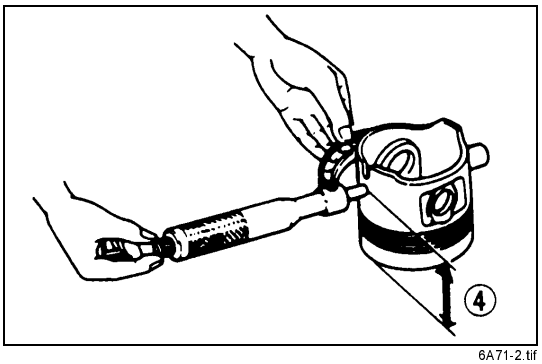
Measure the cylinder liner bore after installing the cylinder liner. Then select the appropriate piston grade for the installed cylinder liner.

1) Measure the cylinder liner bore.
   Refer to the “Cylinder Liner Bore Measurement”.
   Measuring Point ① 20 mm (0.79 in)
   Measuring Point ② 90 mm (3.54 in)
   Measuring Point ③ 160 mm (6.30 in)

Cylinder Liner Bore mm (in)

	Standard	Limit
4HF1 4HF1-2	112.021 - 112.050 (4.4103 - 4.4114)	112.20 (4.417)
4HG1 4HG1-T	115.021 - 115.050 (4.5284 - 4.5295)	115.20 (4.535)
4HE1-T 4HE1-TC	110.041 - 110.080 (4.3323 - 4.3338)	110.23 (4.340)

CAUTION:
It is most important that the correct piston grade be used. Failure to select the correct piston grade will result in engine failure. Always measure the cylinder bore and select the correct piston grade.

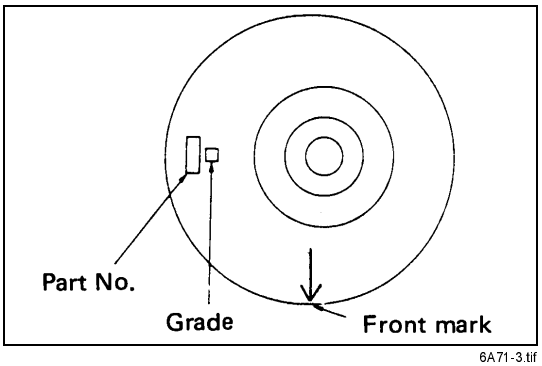


6A71-2.tif

2) Measure the piston outside diameter (Reference).
Piston Measuring Point ④: 82 mm (3.23 in)

Cylinder Liner and Piston Clearance mm (in)

4HF1 / 4HF1-2: 0.081 - 0.113 (0.0032 - 0.0044)
4HG1 / 4HG1-T: 0.081 - 0.116 (0.0032 - 0.0046)
4HE1-T / 4HE1-TC: 0.091 - 0.131 (0.0036 - 0.0052)



6A71-3.tif

The piston grade (i.e. A, B, C) is indicated in metal stamp on the piston upper face.

Piston Grade

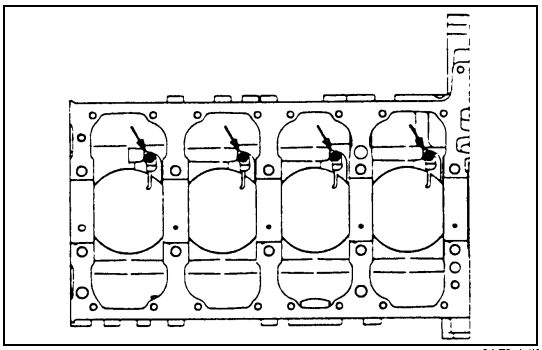
Engine Model	Cylinder Liner Bore Diameter	Piston Service Grade	Piston Outside Diameter
4HF1 4HF1-2	112.041 - 112.060 (4.4111 - 4.4118)	-	111.947 - 111.960 (4.4074 - 4.4079)
4HG1 4HG1-T	115.040 - 115.060 (4.5291 - 4.5299)	-	114.944 - 114.959 (4.5253 - 4.5259)
4HE1-T 4HE1-TC	110.066 - 110.075 (4.3333 - 4.3337)	AX	109.944 - 109.959 (4.3285 - 4.3291)
		CX	109.960 - 109.975 (4.3291 - 4.3297)

CAUTION:
Cylinder liner kit clearances are preset. However, the cylinder liner installation procedure may result in slight decreases in cylinder liner clearances. Always measure the cylinder linner clearance after installation to be sure that it is correct.

REASSEMBLY

55. Cylinder Block

Use compressed air to thoroughly clean the inside and outside surfaces of the cylinder body, the oil holes, and the water jackets.


6A72-1.tif

54. Oiling Jet

1) Install the oiling jets together with the check valves. Take care not to damage the oiling jet nozzles.
2) Tighten the check valves and oiling jets to the specified torque.

Check Valve and Oiling Jet Torque	N•m (kg•m/lb•ft)
21 (2.1/15)	

53. Crankshaft Bearing Upper
52. Thrust Bearing Upper
51. Crankshaft Assembly
50. Crankshaft Bearing Lower
49. Thrust Bearing Lower
48. Crankcase

Above works refer to “CRANKSHAFT” section in this manual.

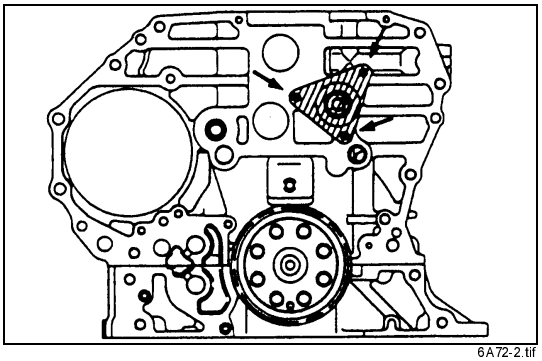
47. Piston and Connecting Rod Assembly
46. Connecting Rod Bearing
45. Connecting Rod Cap

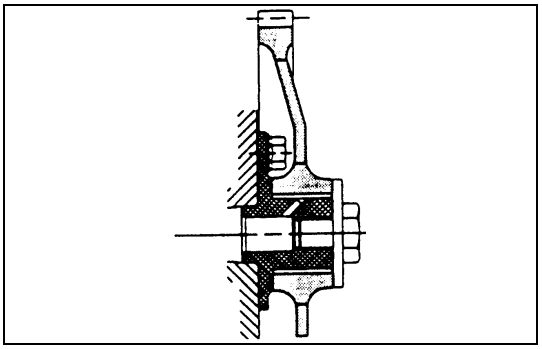
Above works refer to “PISTON AND CONNECTING ROD” section in this manual.

44. Oil Pump Assembly
43. Idle Gear B Shaft

Idle Gear B Shaft Bolt Torque	N•m (kg•m/lb•ft)
31 (3.2/23)	

Apply the engine oil to the idle gear shaft after installation.


6A72-2.tif



6A73-1.tif

42. Idle Gear B

The face of the idle gear B with longer boss should be positioned toward the rear side shown in the illustration.

Idle Gear B Bolt Torque	N•m (kg•m/lb•ft)
	110 (11.2/81)

41. Idle Gear A

40. Flywheel Housing

39. Power Steering Pump Idle Gear

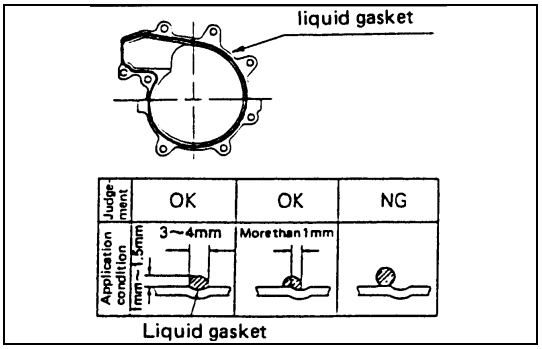
38. Power Steering Pump Idle Gear Cover

Above works refer to "OIL PUMP" section in this manual.

37. Oil Thermo Valve

36. Front Retainer

Above works refer to "CRANKSHAFT" section in this manual.



6A73-3.tif

35. Water Pump Assembly

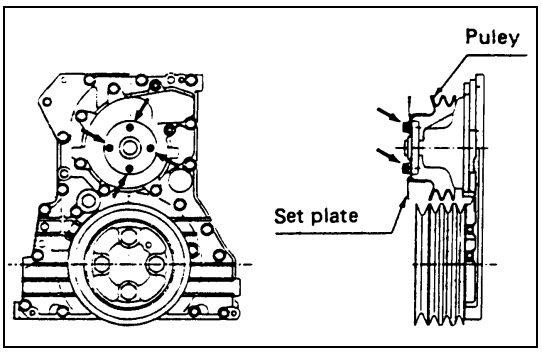
1) Apply 3mm-4mm bead of the recommended liquid gasket (Three Bond 1207C) or its equivalent on the water pump fitting surface.
2) Install the water pump to the front retainer.

Water Pump Bolt Torque	N•m (kg•m/lb•ft)
	24 (2.4/17)

- Install the water pump within 7 minutes after application of liquid gasket.
- For the dislocation of liquid gasket, refer to the illustration.

CAUTION:

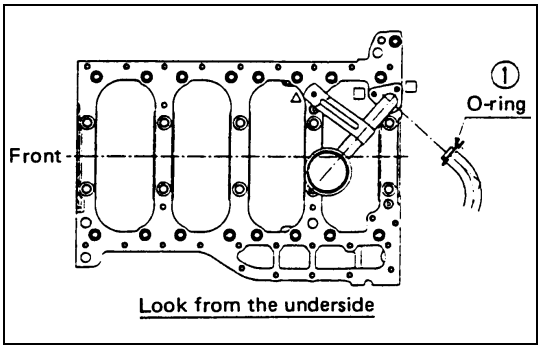
The water pump clamping bolt is also used to tighten the front retainer. So, install the water pump before liquid gasket gets dry immediately after installation of the front retainer.



6A73-2.tif

34. Water Pump Pulley

Water Pump Pulley Bolt Torque	N•m (kg•m/lb•ft)
	24 (2.4/17)

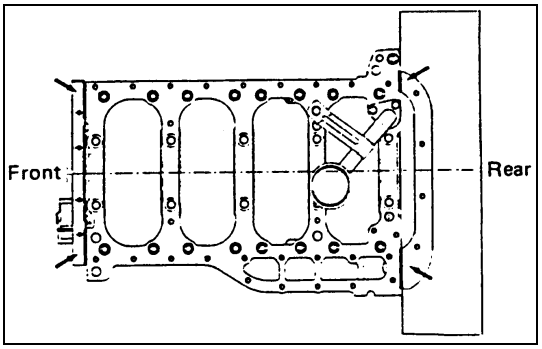


6A74-1.tif

33. Oil Pump Strainer

Install the O-ring ① to the oil pump strainer pipe and install the oil pump strainer to the cylinder body shown in the illustration.

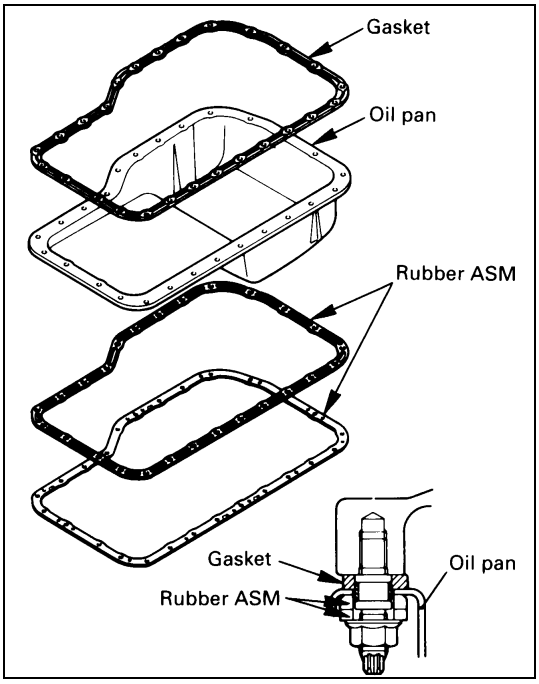
Oil Pump Strainer Bolt Torque	N•m (kg•m/lb•ft)
24 (2.4/17)	



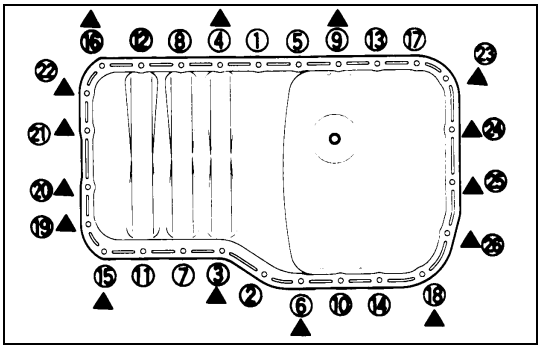
6A74-2.tif

32. Oil Pan

1) Apply a 3 mm (0.1inch) bead of recommended liquid gasket (Three Bond 1207C) or its equivalent to the shaded areas shown in the illustration.



6A74-3.tif



6A74-4.tif

3) Tighten the oil pan nuts and bolts to the specified torque in the numerical order as shown in the illustration.

▲ marks are located on nut positions.

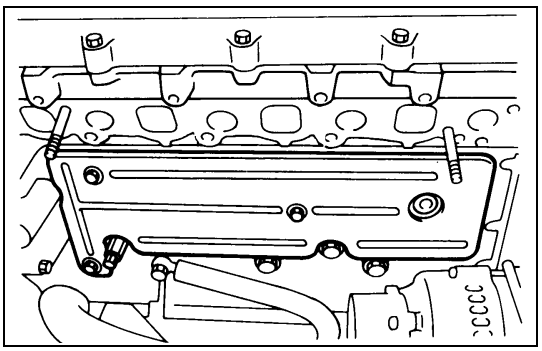
Oil Pan Nuts and Bolts Torque	N•m (kg•m/lb•ft)
11 (1.1/8)	

31. Spacer Rubber (NKR model only)

Spacer Rubber Bolt Torque	N•m (kg•m/lb•ft)
76 (7.7/56)	

30. Crankshaft Rear Slinger
29 Crankshaft Rear Oil Seal
28. Flywheel Assembly
27. Crankshaft Front Slinger
26. Crankshaft Front Oil Seal
25. Crankshaft Damper Pulley

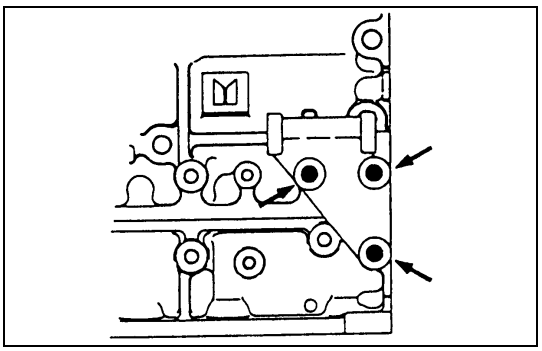
Above works refer to “CRANKSHAFT” section in this manual.



6A75-1.tif

24. Cover

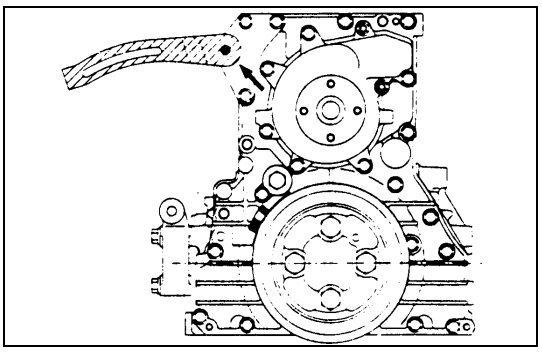
Cover Bolt Torque	N•m (kg•m/lb•ft)
13 (1.3/9)	



6A75-2.tif

23. Generator Bracket

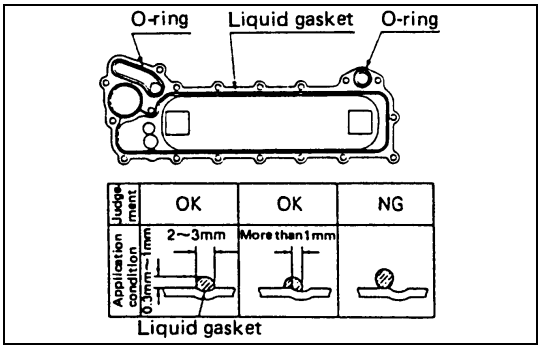
Generator Bracket Bolt Torque	N•m (kg•m/lb•ft)
48 (4.9/35)	



6A75-3.tif

22. Fan Belt Adjust Plate

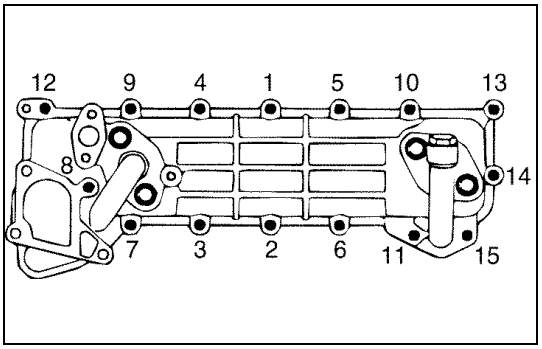
Install the adjust plate and temporarily tighten the adjust plate bolt.



6A76-1.tif

21. Oil Cooler Assembly

1) Apply 2 mm - 3 mm bead of the recommended liquid gasket (Three Bond 1207C) or its equivalent on the oil cooler fitting surface.
2) Apply a coat of engine oil to the O-rings (2 pieces) and install the O-rings to the oil cooler.



050LX032.tif

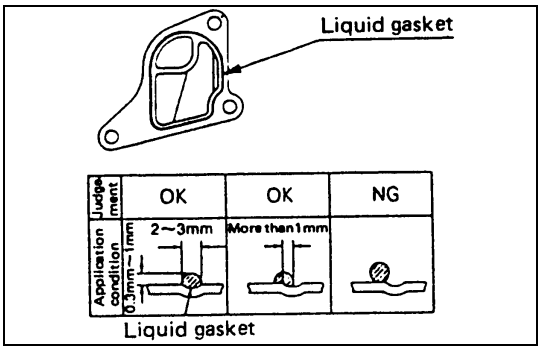
NOTE:

Take care that the O-ring is not smeared with liquid gasket.

- Install it within 7 minutes after application of liquid gasket.
- For the dislocation of liquid gasket, refer to the illustration.

3) Tighten the oil cooler bolts and nut to the specified torque a little at a time in the sequence shown in the illustration.

Oil Cooler Bolt and Nut Torque	N•m (kg•m/lb•ft)
	24 (2.4/17)

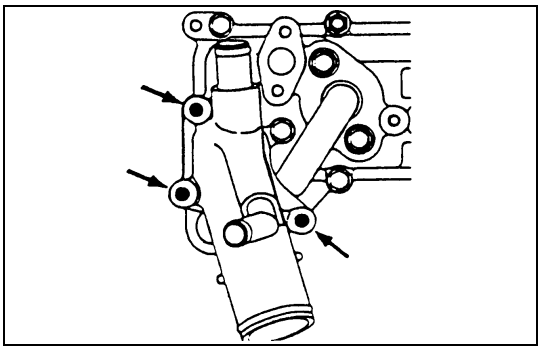


6A76-3.tif

20. Water Suction Pipe

1) Apply 2 mm - 3 mm bead of the recommended liquid gasket (Three Bond 1207C) or its equivalent on the groove of the water suction pipe fitting surface.
2) Install the water suction pipe to the oil cooler.

- For the dislocation of liquid gasket, refer to the illustration.

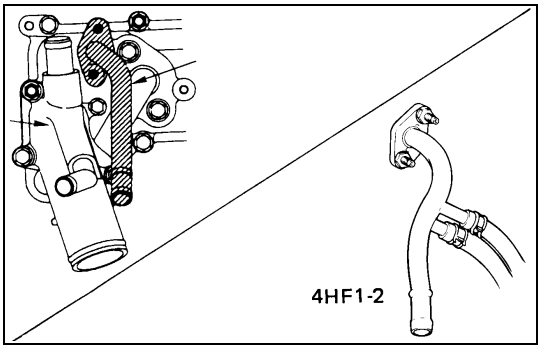


6A76-4.tif

Water Suction Pipe Bolt and Nuts Torque	N•m (kg•m/lb•ft)
	24 (2.4/17)

NOTE:

Install the water suction pipe immediately after the installation of the oil cooler.



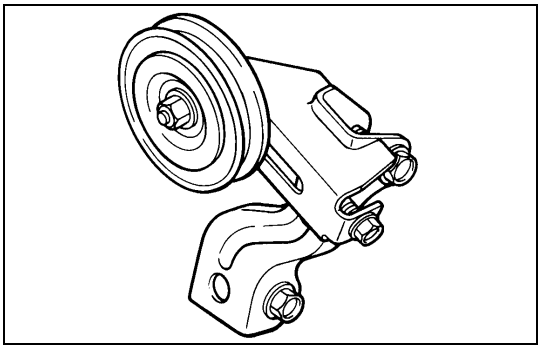
6A77-1.tif

19. Heater Pipe

1) Install the O-ring to the heater pipe.
2) Install the heater pipe to the oil cooler.

Heater Pipe Bolt Torque — N•m (kg•m/lb•ft)

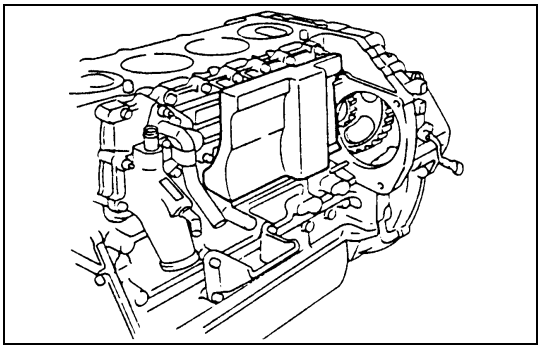
24 (2.4/17)


6A77-2.tif

18. Idle Pulley Bracket (If equipped with A/C)

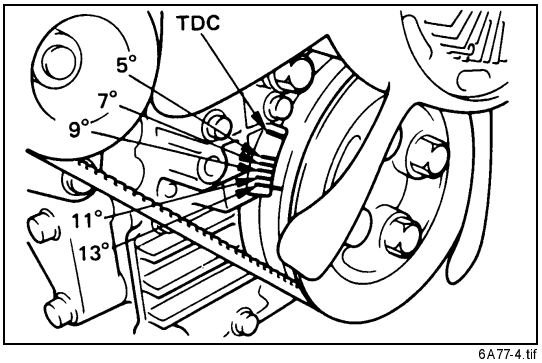
Idle Pulley Bracket Bolt Torque — N•m (kg•m/lb•ft)

48 (4.9/35)

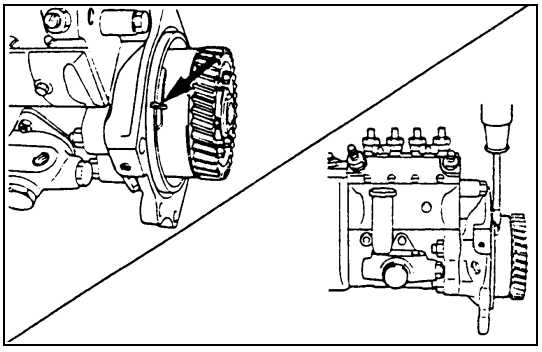

6A77-3.tif

17. Injection Pump Rubber Spacer

Stick the rubber spacer to the location indicated in the illustration with pressure sensitive adhesive double coated tape.



6A77-4.tif


6A77-5.tif

16. Injection Pump Assembly (Except 4HF1-2)

1) Turn the crankshaft until the timing mark on the crankshaft damper pulley is aligned with "13°" line.

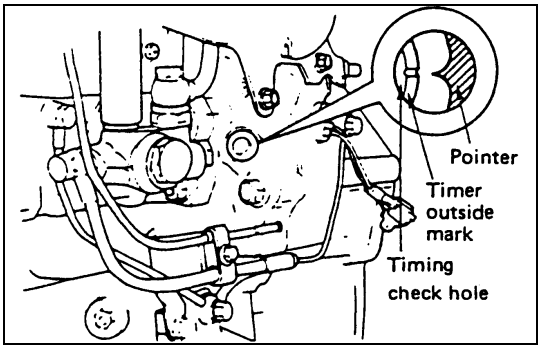
NOTE:

BTDC 13° to be aligned with here is an angle at which the injection pump is installed, and has nothing to do with the injection timing.

2) Remove the inspection hole plug from the cylinder body.
3) Install the O-ring to the injection pump bracket.
4) Align the injection pump bracket slit with the timer slit.
5) Install the injection pump assembly to the cylinder body.

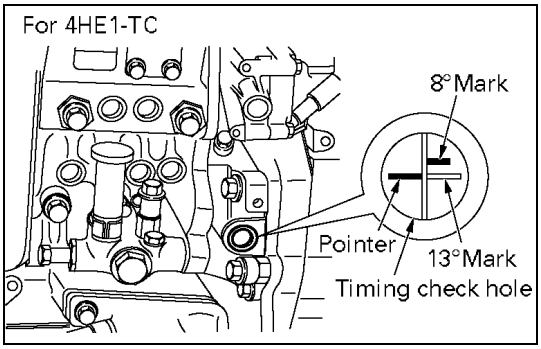
NOTE:

When the injection pump has a poor gear engagement while installing the assembly to the cylinder body, insert a screwdriver into the slit on the timer peripheral with the pump bracket slit used as a guide, and move it up and down to get it into forcibly.



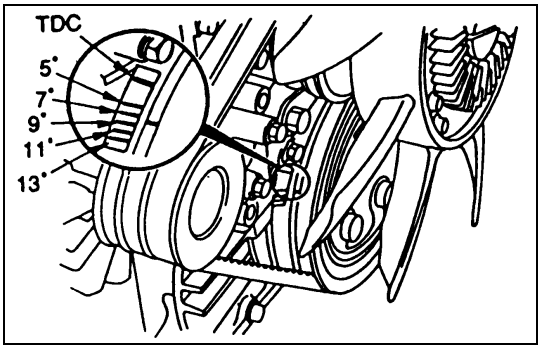
6A78-1.tif

6) After installation of the injection pump, the injection timing can be checked through the timing check hole provided to the injection pump bracket.
Set the No.1 cylinder to BTDC (Injection timing of each engine model) on the compression stroke. When the pointer of the timing check hole comes in line with the mark on the timer periphery of the injection pump as shown in the illustration, the injection timing is normal.
After completion of the injection timing check, tighten the check hole plug to the specified torque.



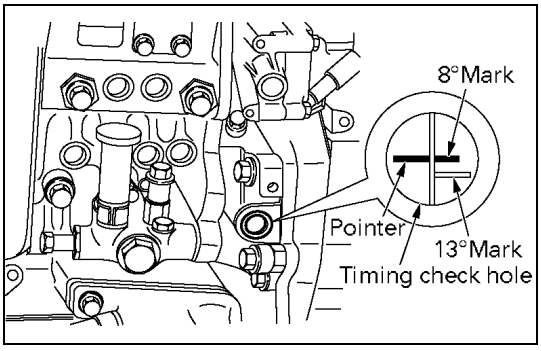
140RW080.tif

Injection Timing	deg
4HF1: 4HE1-TC	BTDC 8
4HG1	BTDC 9
4HG1-T	BTDC 7 (Except Colombia) BTDC 9 (For Colombia)
4HE1-T	BTDC 7



6A78-3.tif

7) Turn the crankshaft until the timing mark on the crankshaft damper pulley is aligned with “8°” line.
NOTICE: Position in its normal rotating direction. (for 4HE1-TC only)

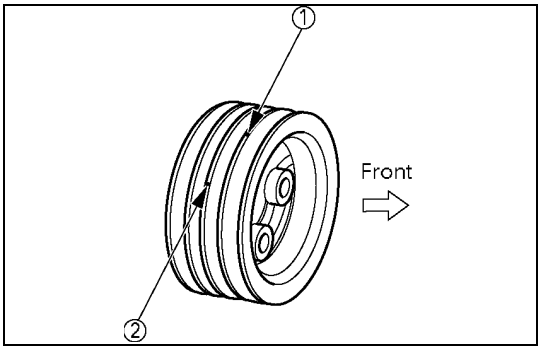


140RW079.tif

8) Adjust injection pump downward so that the “8°” comes to postion in the timing check hole.
(for 4HE1-TC only)

NOTE:

When ever the injection pump is replaced, be sure to adjust the injection timing for the details of the adjustment, refer to the “SECTION 00 SERVICING: INJECTION TIMING INSPECTION AND ADJUSTMENT.”

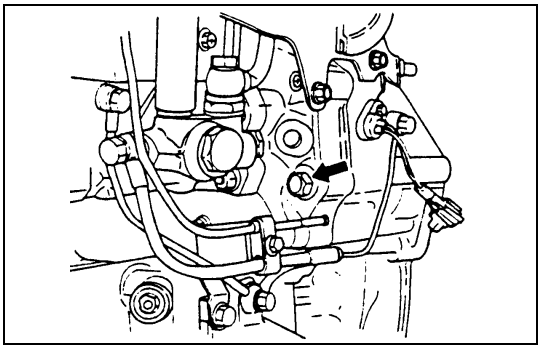


012RW133.tif

Note:

In case the crank pulley has two marks as illustrated, ① BTDC 49° mark on the second crest and ② TDC mark on the third crest (as viewed from the front side), be sure to set at the mark ②. (If there are two different marks on one and same crest, set at the mark which comes second when rotated in the normal direction.)

The mark ① is used when installing the injection pump for 4HF1-2.


6A79-1.tif

9) Tighten the injection pump bracket nuts and bolts to the specified torque.

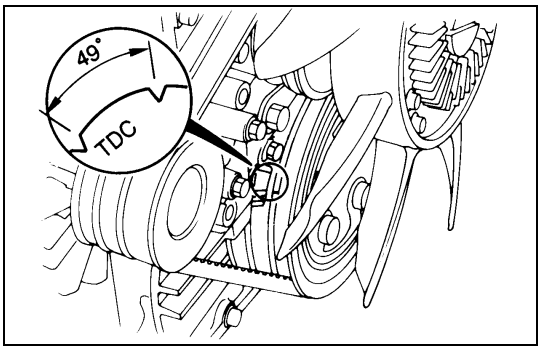
Injection Pump Bracket Nut and Bolt Torque	N•m (kg•m/lb•ft)
	48 (4.9/35)

10) Install the injection pump rear bracket.

Injection Pump Rear Bracket Bolt Torque	N•m (kg•m/lb•ft)
	48 (4.9/35)

11) Install the inspection hole plug.

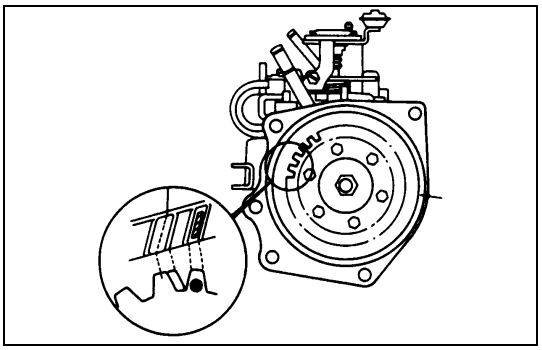
Inspection Hole Plug Torque	N•m (kg•m/lb•ft)
	48 (4.9/35)



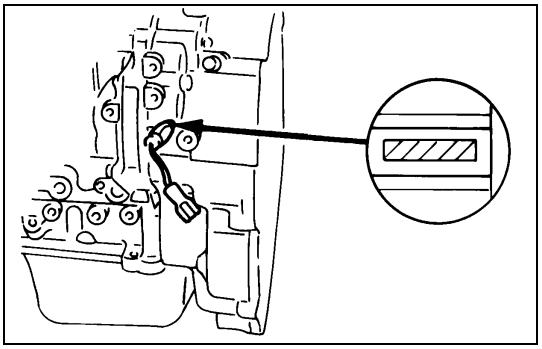
6A79-2.tif

16-1 Injection Pump Assembly (4HF1-2 model only)

1) Turn the crankshaft to set No.1 cylinder to 49° before TDC in its compression stroke.
   (49° is a pump installing alignment angle, not related to injection timing.)


6A79-3.tif

2) Install O-ring to the injection pump.
3) Apply paint on the ● (Z) marked side of the injection pump gear.
4) Align the pump bracket mark with the tooth (under side of the pump) just before the ● (Z) marked tooth.
5) Insert the pump using the block side of stud bolt as a guide.

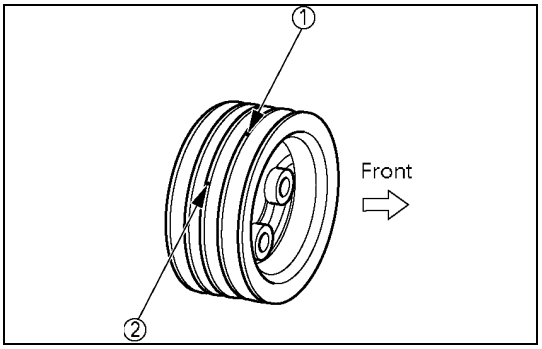

6A79-4.tif

6) After installing the injection pump, remove the tachometer sensor from the housing, and make sure that the painted gear is at the center of the sensor mounting hole.
7) Tighten injection pump clamping bolt and nut to specified torque:

Bolt Tightening Torque	N•m (kg•m/lb•ft)
	48 (4.9/35)

Nut Tightening Torque	N•m (kg•m/lb•ft)
	24 (2.4/17)

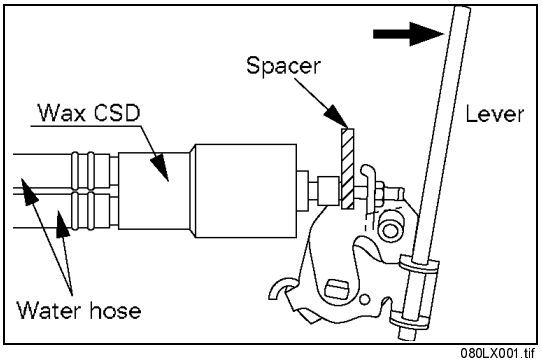
8) With reference to Injection Timing Check & Adjustment, set No. 1 Cylinder to 12° before its TDC.



012RW133.tif

Note:

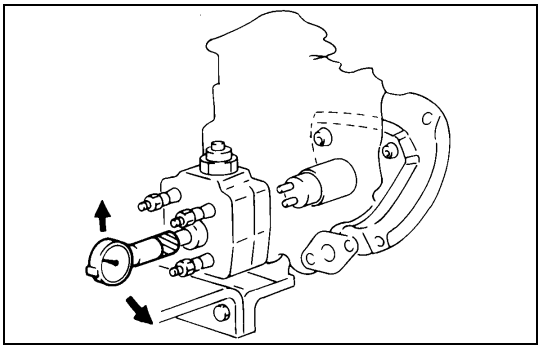
In case the crank pulley has two marks as illustrated, ① BTDC 49° mark on the second crest and ② TDC mark on the third crest (as viewed from the front side), be sure to set at the mark ②. (If there are two different marks on one and same crest, set at the mark which comes second when rotated in the normal direction.)



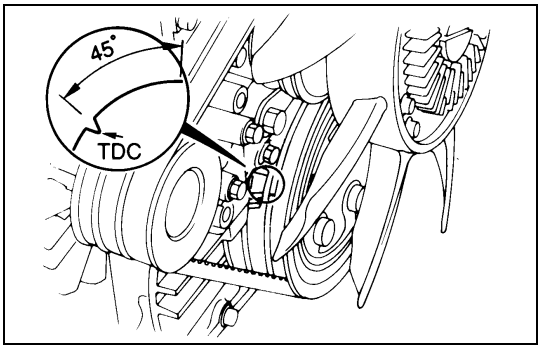
080LX001.tif

Injection Timing Check (4HF1-2 model only)

1. Set No. 1 Cylinder to the TDC in the compression stroke.
2. Disconnect Injection Pipe.
3. Put down Wax CSD lever, insert a spacer (10 - 20 mm/0.39 - 0.47 in) thick between the plunger and adjust bolt, and cancel the Wax CSD.

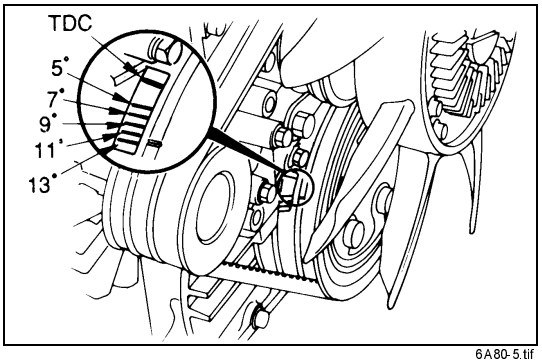

6A00-3.tif

4. Remove the pump rear plug, connect a dial gage and set the lift at 1 mm (0.039 in).
   Special Tool
   Measuring device: 5-8840-0145-0



6A80-4.tif

5. Set the crankshaft damper pulley TDC mark to the pointer or 45° before TDC.
6. Set the dial gage to the “0” position.
7. Turn the crankshaft leftwise and rightwise a little and make sure that the needle stays in the “0” position.



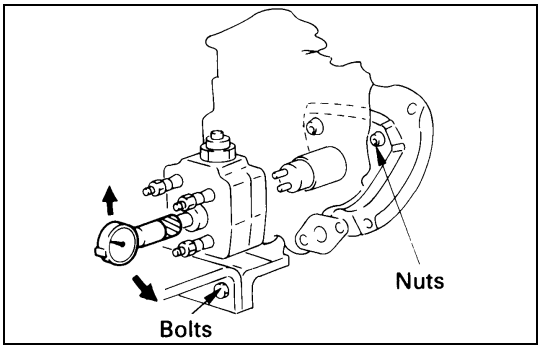
6A80-5.tif

8. Turn the crankshaft in the normal direction and read the measuring device’s indication at the 12° before TDC position.

NOTE:

As there is no 12° mark, set midway between the 11° and 13° marks.

Standard value: 0.5 mm (0.0197 in)



6A81-1.tif

Injection Timing Adjustment (4HF1-2 model only)

If injection timing is out of the specified range, follow the following procedure for adjustment:

1. Loosen injection pump fiixng nuts and bracket bolt.
2. Adjust the mounting angle of injection pump:
   - If injection timing is too fast, bring the injection pump closer to the engine.
   - If injection timing is too slow, put the injection pump more distant from the engine.
3. When the dial gage has indicated the specified value, tighten the fixing nuts and bolt to specified torque:

Nut Tightening Torque	N•m (kg•m/lb•ft)
24 (2.4/17)	

Bolt Tightening Torque	N•m (kg•m/lb•ft)
48 (4.9/35)	

4. Disconnect the dial gage, install and tighten the plug to specified torque. (Make sure of a copper washer being attached to the plug)

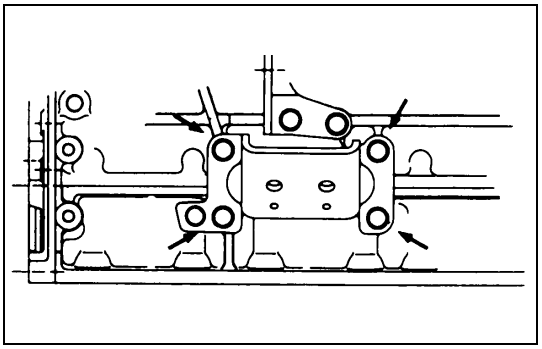
Plug Tightening Torque	N•m (kg•m/lb•ft)
17 (1.7/12)	

5. Release the wax CSD and connect the injection pipe.

Pipe Sleeve Nut Tightening Torque	N•m (kg•m/lb•ft)
29 (3.0/22)	

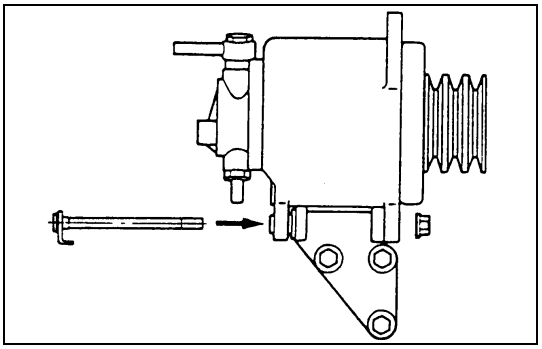
Note:

If there are two marks on the crank pulley, the front side of mark is for setting BTDC 49° and the rear side of mark is for setting TDC.


6A82-1.tif

15. Engine Foot

Engine Foot Bolt Torque	N•m (kg•m/lb•ft)
51 (5.2/38)	

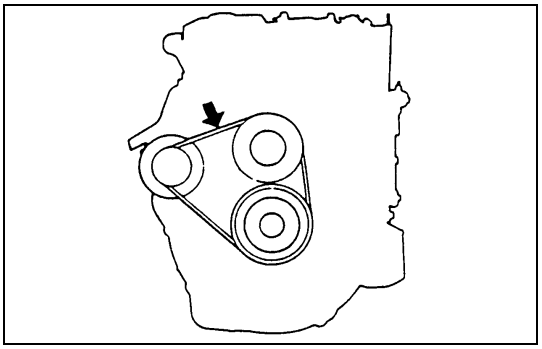

6A82-2.tif

14. Generator

NOTE:

Before tightening the generator securely, tighten it temporarily in advance after adjusting the fan belt.

Put the lower fixing bolt through from the rear side and tighten it with the nut on the front side as shown in the illustration.


6A82-3.tif

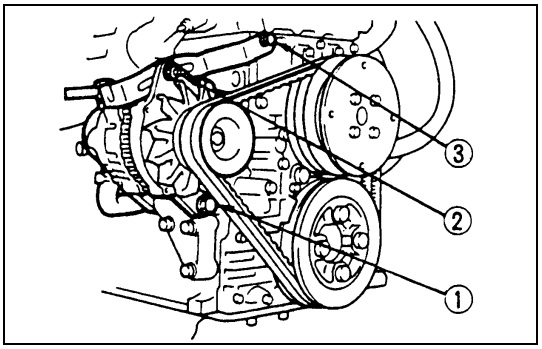
13. Fan Belt

Check the drive belt tension.

Depress the drive belt mid-portion with a 10 kg (22 lb/ 98 N) force.

Drive Belt Deflection	mm (in)
8 - 12 (0.31 - 0.47)..... New belt 10 - 14 (0.39 - 0.55)..... Reuse belt	

Check the drive belt for cranking and other damage.

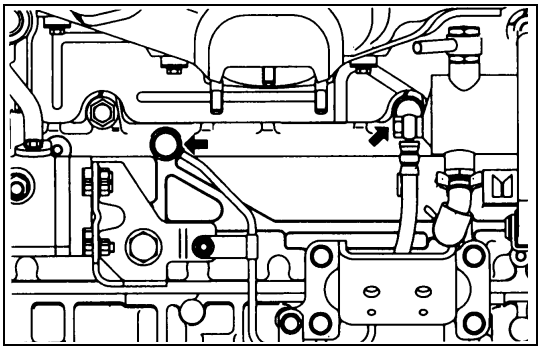


6A82-4.tif

Fan Belt Adjustment

Fan belt tension is adjusted by moving the alternator.

Torque	N•m (kg•m/lb•ft)
①	40 (4.1/30)
②	24 (2.4/17)
③	46 (4.7/34)


6A82-5.tif

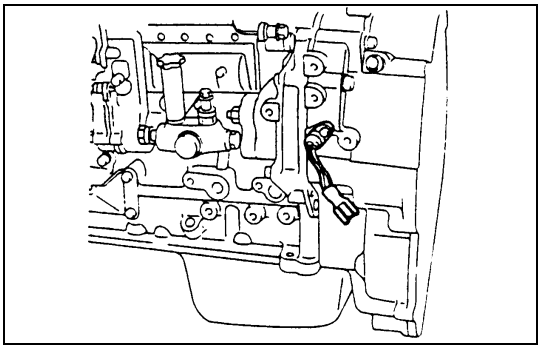
12. Vacuum Pump Rubber Hose

11. Vacuum Pump Oil Pipe

Cylinder Body Side	N•m (kg•m/lb•ft)
41 (4.2/30)	

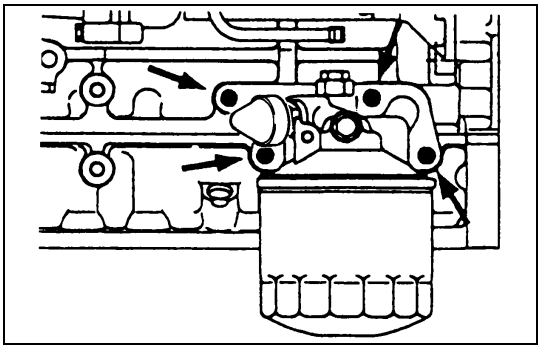
Generator Side	N•m (kg•m/lb•ft)
23 (2.3/17)	

10. Fuel Pipe Bracket


6A83-1.tif

9. Tachometer Sensor

Tachometer Bolt Torque	N•m (kg•m/lb•ft)
8 (0.8/6)	

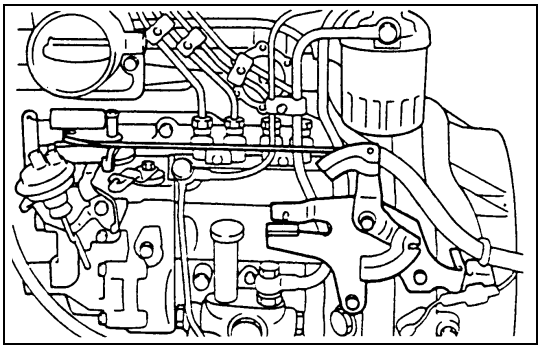

6A83-2.tif

8. Oil Filter Assembly

Oil Filter Bolt Torque	N•m (kg•m/lb•ft)
48 (4.9/35)	

7. Oil Pipe

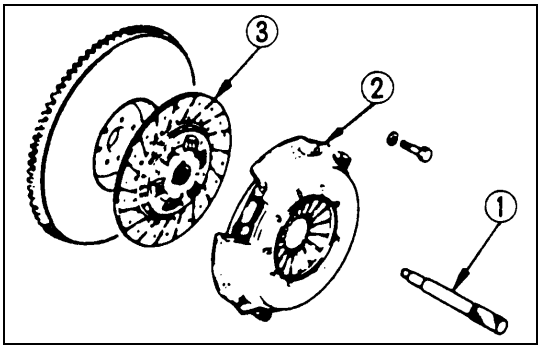
Oil Pipe Joint Bolt Torque	N•m (kg•m/lb•ft)
17 (1.7/12)	


6A83-3.tif

6. Engine Control Lever Assembly

Engine Control Lever Bolt Torque	N•m (kg•m/lb•ft)
24 (2.4/17)	

5. Engine Control Wire



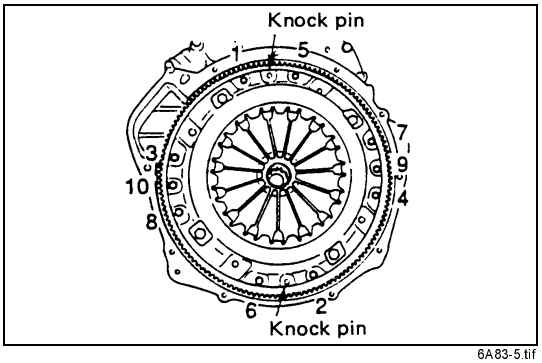
6A83-4.tif

4. Driven Plate

Use the clutch pilot aligner to install the driven plate.

Clutch Pilot Aligner: 5-8840-2240-0

① Clutch pilot aligner
② Clutch pressure plate assembly
③ Driven plate



6A83-5.tif

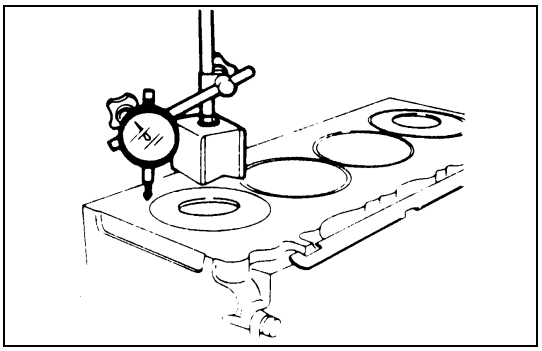
Clutch Pressure Plate Assembly

1) Align the clutch pressure plate with the flywheel knock pin.
2) Tighten the pressure plate bolts to the specified torque in numerical order.

Clutch Pressure Plate Bolt Torque	N•m (kg•m/lb•ft)
40 (4.1/30)	

2. Cylinder Head Gasket

1) When any of the cylinder block, crankshaft, crankshaft bearing, connecting rod, connecting rod bearing, and piston is replaced with a new one, cylinder head gasket thickness should be determined newly.
2) When replacing the cylinder head gasket alone without replacing any of the parts mentioned in 1) above, the gasket to be used should be the same grade as the one used before.
3) Correct cylinder head gasket thickness is important. Installing the wrong thickness gasket can result in greatly reduced engine performance.
4) There are three cylinder head gaskets available.



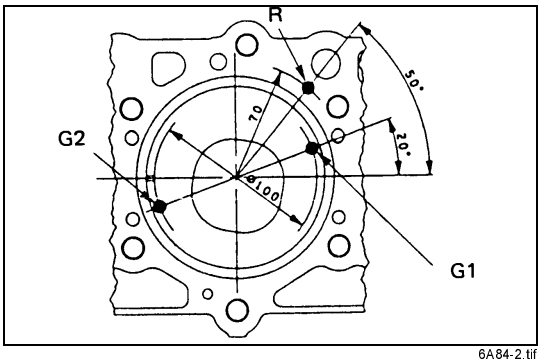
6A84-1.tif

Piston Head Projection Measurement

- Select a cylinder head gasket.
- Clean thoroughly the top faces of the piston head and the cylinder body.
- Use the dial gauge to measure the piston head projection. Take measurements at two locations for each cylinder.
- The measurement points of the piston head and the reference point of the cylinder body are shown in the illustration left.

  Measurement points: Points G1 and G2 of the piston head

  Reference point: Point R on the top face of the cylinder body

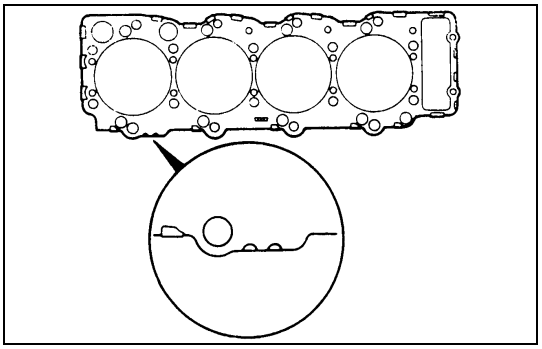


6A84-2.tif

NOTE:

Note that there are three types of a cylinder head gasket available as shown in the table below, according to the piston projection.

- For each cylinder, calculate the average value (Ti) of the piston projection.
- Find the maximum value (Timax) of the average value (Ti) of each cylinder.
- Based on the Timax obtained, select a gasket of the appropriate grade.


6A85-1.tif

4HF1/4HF1-2/4HG1-T

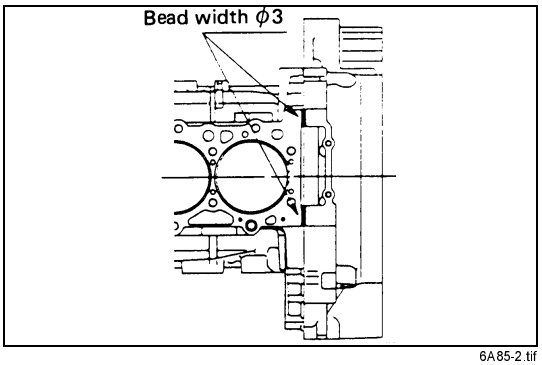
Cylinder Head Gasket Selection mm (in)

Gasket Grade	Ti max	Gasket Thickness (Reference)
A	0.579 - 0.659 (0.0228 - 0.0259)	1.70 (0.0669)
B	0.659 - 0.739 (0.0259 - 0.0291)	1.75 (0.0689)
C	0.739 - 0.819 (0.0291 - 0.0322)	1.80 (0.0708)

4HE1-T/4HE1-TC

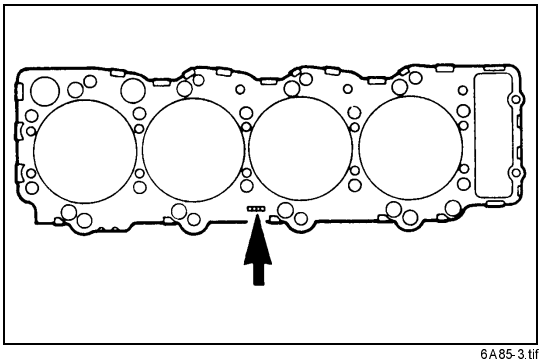
Cylinder Head Gasket Selection mm (in)

Gasket Grade	Ti max	Gasket Thickness (Reference)
A	0.529 - 0.609 (0.0208 - 0.0240)	1.70 (0.0669)
B	0.609 - 0.679 (0.0240 - 0.0267)	1.75 (0.0689)
C	0.679 - 0.759 (0.0267 - 0.0300)	1.80 (0.0708)



6A85-2.tif

- Apply a 3 mm (0.1 inch) bead or recommended liquid gasket or its equivalent to the shaded areas shown in the illustration.


6A85-3.tif

- Install the cylinder head gasket with its “PART NUMBER” mark facing up and toward the left of the engine.

CAUTION:

Do not reuse the cylinder head gasket.

1. **Cylinder Head Assembly**

   Above works refer to “CYLINDER HEAD” section 6A3 in this manual.

SECTION 6A3

ENGINE
(4HF1 / 4HF1-2 / 4HE1-T / 4HE1-TC / 4HG1 / 4HG1-T)

CONTENTS

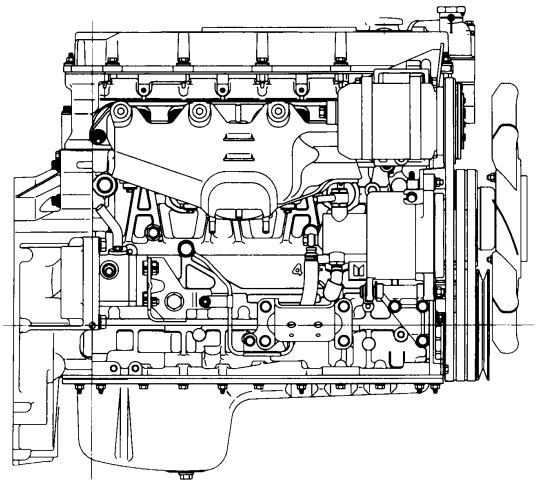
	PAGE
General Description	6A3 - 2
Engine Mount (RH, LH)	6A3 - 10
Cylinder Head Cover	6A3 - 12
Inlet Cover/Inlet Case	6A3 - 14
Exhaust Manifold	6A3 - 20
Timing Gear Replacement	6A3 - 23
Valve Guide Seal & Valve Spring	6A3 - 33
Rocker Arm Shaft Assembly	6A3 - 37
Camshaft Assembly	6A3 - 39
Cylinder Head	6A3 - 42
Circumference Parts Of Cylinder Head	6A3 - 52
Oil Filter Assembly	6A3 - 57
Oil Filter Cartridge	6A3 - 59
Oil Cooler	6A3 - 60
Oil Pan	6A3 - 69
Oil Pump Assembly	6A3 - 72
Oil Relief Valve	6A3 - 77
Piston, Piston Ring, Piston Pin and Connecting Rod	6A3 - 78
Flywheel and Pilot Bearing	6A3 - 83
Crankshaft Front Oil Seal	6A3 - 88
Crankshaft Rear Oil Seal	6A3 - 93
Crankshaft	6A3 - 98
Cylinder Block	6A3 -113
Engine Assembly	6A3 -135

GENERAL DESCRIPTION

The engine is a four-cycle, four-cylinder, in-line, direct fuel injection type diesel engine with the piston displacement of 4,334 cc. It features a gear driven OHC (overhead camshaft) timing train and the unique mechanisms and systems designed for outstanding cleanness, economy and durability. Its torque characteristics promise dynamic ride at high speed, high power at low speed, and smooth and continuous torque at medium to high ranges.

RIGHT SIDE VIEW

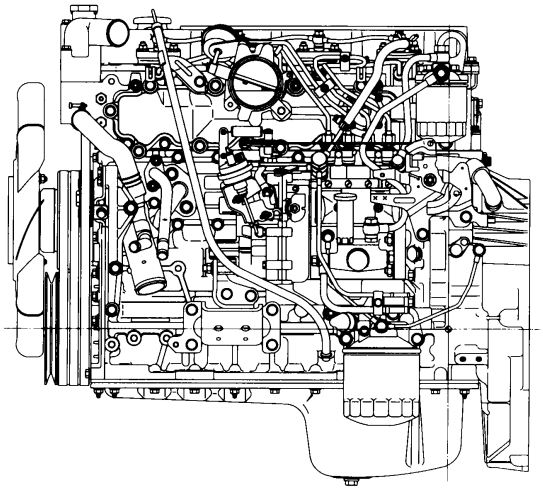
For 4HF1



6A3-2-1.tif

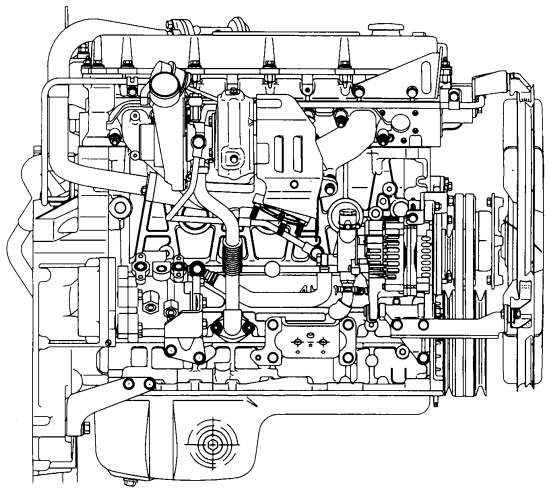
LIFT SIDE VIEW

For 4HF1



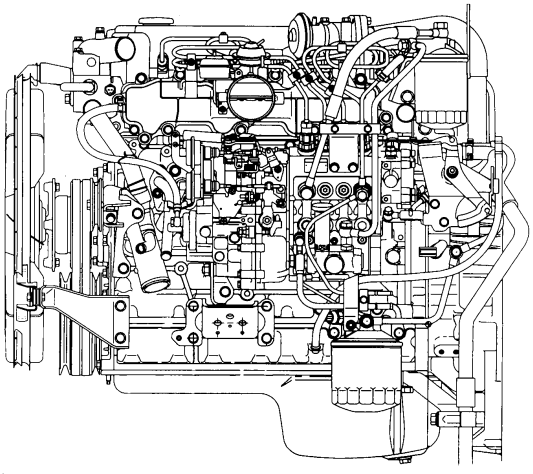
6A3-2-2.tif

For 4HE1-TC



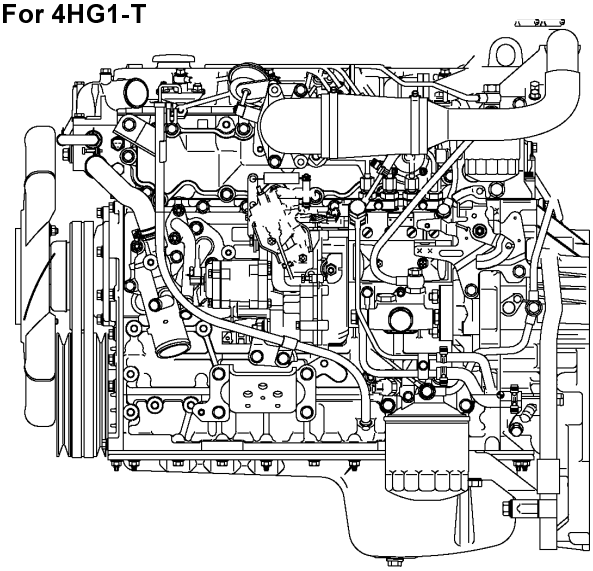
6A3-2-3.tif

For 4HE1-TC



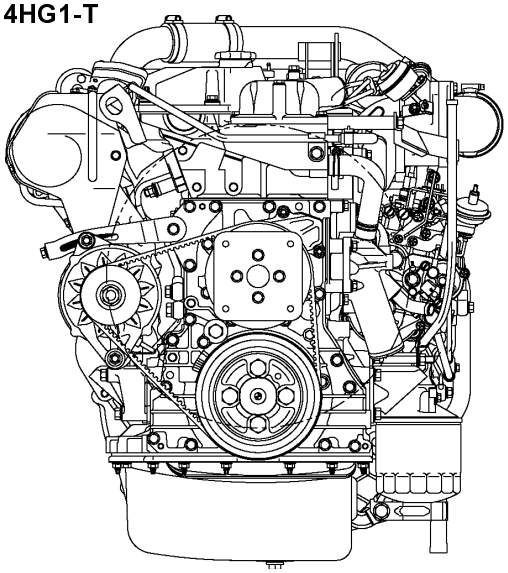
6A3-2-4.tif

For 4HG1-T



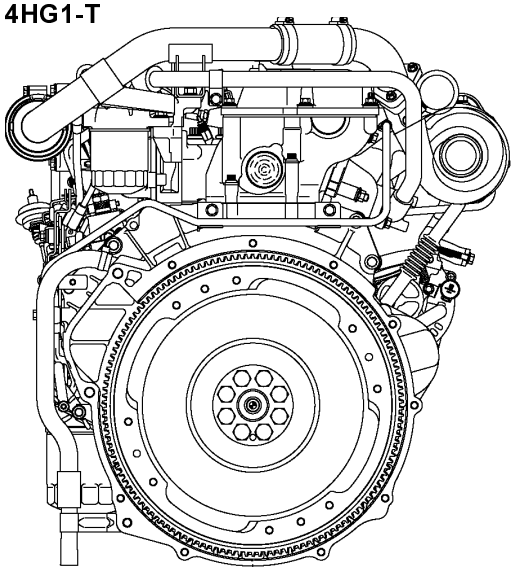
F06LX010.tif

For 4HG1-T

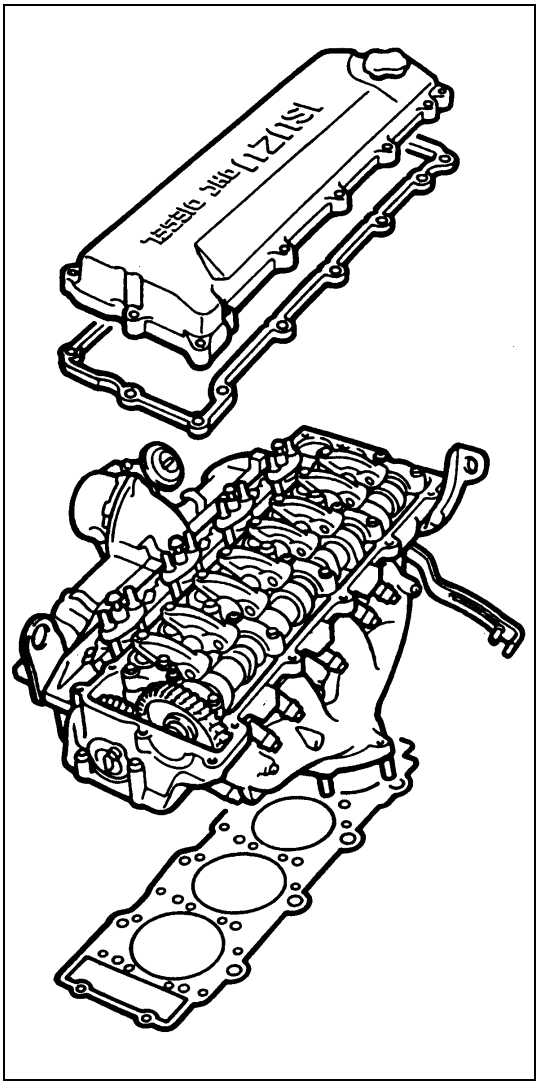


F06LX009.tif

For 4HG1-T



F06LX011.tif

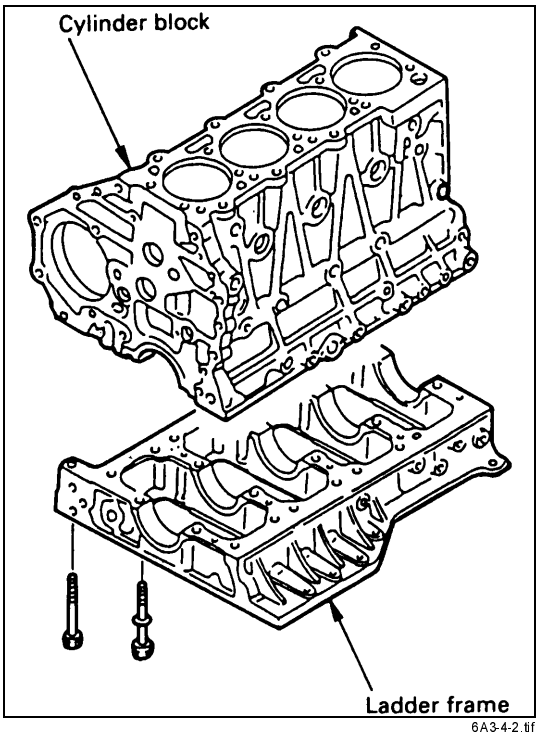


6A3-4-1.tif

CYLINDER HEAD

- The cylinder head is made of cast iron and has a crossflow layout with the intake system in the left side and the exhaust system in the right side, designed to reduce resistance in the intake and exhaust systems.
- The valve diameter is increased to offset the mass of the valve operating system reduced by the introduction of the OHC mechanism.

  In addition, the intake and exhaust ports are put in a smoother and less resistant layout to enhance intake and exhaust efficiency.
- The cylinder head gasket is of the laminated steel of least fatigue in combination with the angular cylinder head bolt tightening method, equally designed to increase reliability against gas and water leakage, in addition, selective assembly of gaskets of various thicknesses minimizes the wasted space between the piston and the cylinder head to maintain performance at a high level.
- The cylinder head cover is made of aluminum to reduce noise.

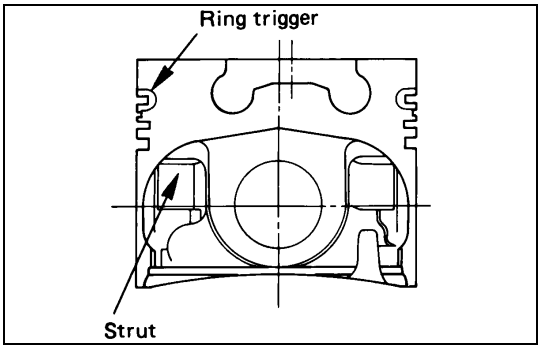


6A3-4-2.tif

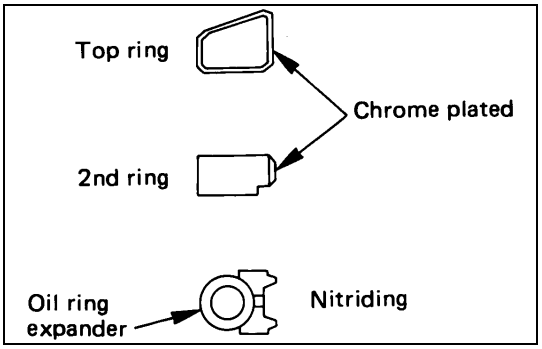
CYLINDER BLOCK

- The cylinder block is made of cast iron having dry cylinder liner and five bearings.

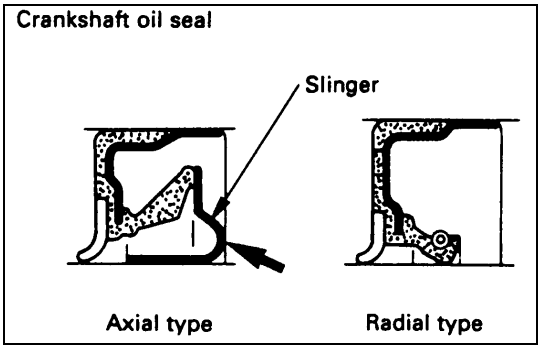
  The bearing cap has a ladder frame construction integrating the crankcase to increase rigidity.
- The cylinder liner is made of thin iron plus special alloys and is combined with the chrome-plated piston ring to ensure good resistance against wear.
- The oil pan is made of vibration-damping steel to reduce noise.



6A3-5-1.tif



6A3-5-2.tif



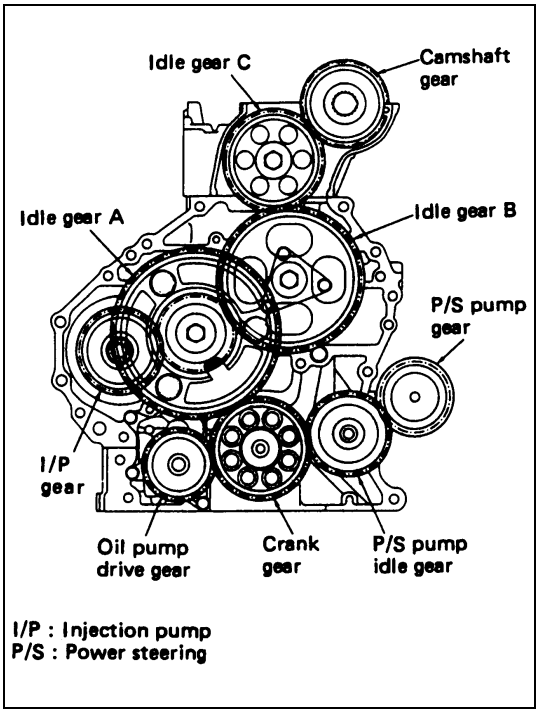
6A3-5-3.tif

PISTON, CONNECTING ROD, AND CRANKSHAFT

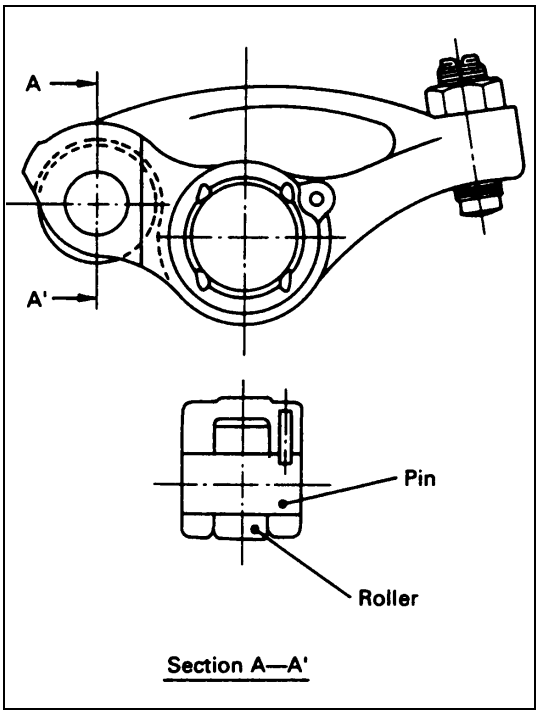
- The piston is made of aluminum alloy. A ring trigger is cast into the top ring groove and chrome plating is applied to four sides of the top ring to ensure sufficient strength and wear resistance of the ring and the ring groove. The piston bottom has a thermal flow shape to increase cooling efficiency of the oil jet. This design reduces thermal load while increasing rigidity (see figure).
- The combustion chamber has a square shelf of proven performance to ensure outstanding stability in exhaust gas control (see figure).
- The autothermatic piston and offset piston pin reduces piston flapping and other noise.
- The crankshaft is made of cast carbon steel with five bearings and eight counterweights to reduce revolution load to the bearing. The ladder frame design that integrates the bearing cap and the crankcase increases bearing rigidity. The angular tightening method of the bearing bolt further increases reliability and durability.
- The connecting rod is made of cast carbon steel and the cap is bolted by angular tightening method to maintain reliability.
- The bearing, as well as the crank journal and crank pin bearings, are made of Kelmet metal.

  Oil clearance is controlled accurately through selective assembly by thickness to reduce noise and increase reliability.
- The crankshaft has the axial type oil seal that drastically improves durability and reliability.

  Compared with the conventional radial type (lips in a radial orientation), the axial type oil seal has lips in an axial orientation to minimize lip wear. It also precludes lip peeling and damage, spring dislocation and other problems associated with the radial type oil seal (see figure).



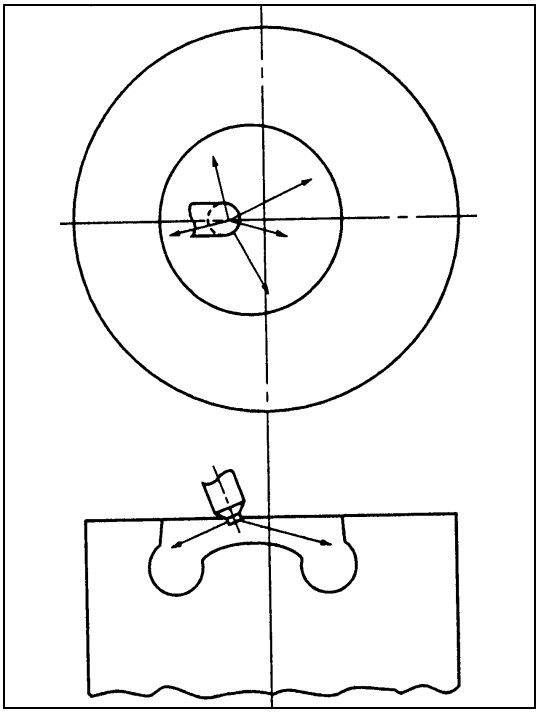
6A3-6-1.tif



6A3-6-2.tif

VALVE TRAIN

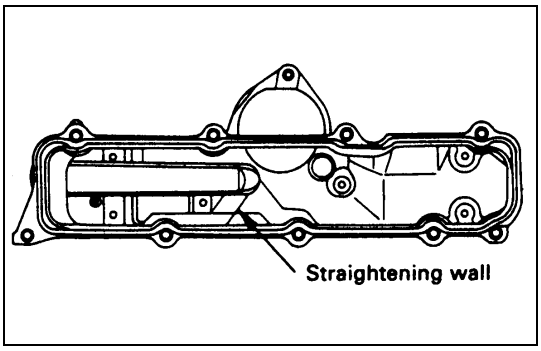
- The gear train is located at the end of the cylinder block to minimize influence of the torsional vibration of the crankshaft and the radiant sound. Noise is further reduced, to the same level as a timing belt driven system, by integrating the crank gear with the crankshaft by shrink fit and by careful turning of the gear precision, teeth contact ratio of gear, backlash, bearing rigidity, neutral frequency, etc. (See figure).
- Gears are of the forged type. Gears are tufftrided to secure sufficient durability.
- The camshaft is made of carbon steel with five bearings. The cam's nose and the journal are induction-hardened to secure sufficient durability.
- The cam has a Fourier-dyne profile to maximize the intake and exhaust valve lifts and the valve opening and closing timing is optimized to increase intake and exhaust efficiency.
- The valve spring is a single spring having an eggshaped cross section to reduce weight while reducing stress. Coupled with the unique cam profile, the spring increases the jump-and bounce-free limit at high-speed operation to provide reserve characteristics.
- The rocker arm is made of diecast aluminum and is of the center pivot type having a roller. This increases reliability while reducing friction and contributes to increased power output and fuel efficiency (See figure).
- The rocker shaft is chrome plated to secure sufficient durability.



6A3-7-1.tif

FUEL SYSTEM

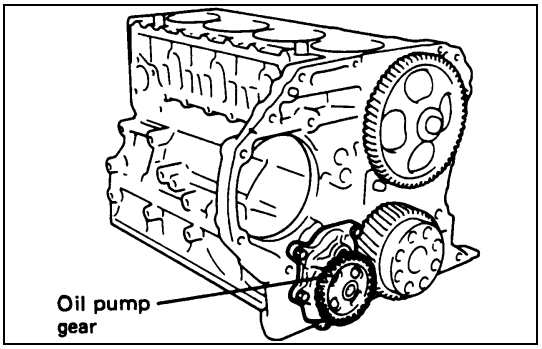
- The injection pump is of Bosch A type with the plunger outside diameter of 9.5mm and cam lift of 9mm.
  The plunger has a special notch for advancing the timing at starting.
- The governor is of a mechanical RLD type to ensure sustained power at high speed.
- The timer is of the SCDM(eccentric) type.
- The injection nozzle is of the P type to bring it as technically close as possible to the center of the combustion chamber. The nozzle inclination is also reduced to minimum to increase combustion efficiency. The nozzle has four jets and the valve opening pressure is set at 185kg/cm^2(2,630 psi, 18,142 kPa) (See figure).
- The injection pipe is laid in such a way that the overall length is minimized to enhance performance.



6A3-7-2.tif

INTAKE AND EXHAUST SYSTEMS

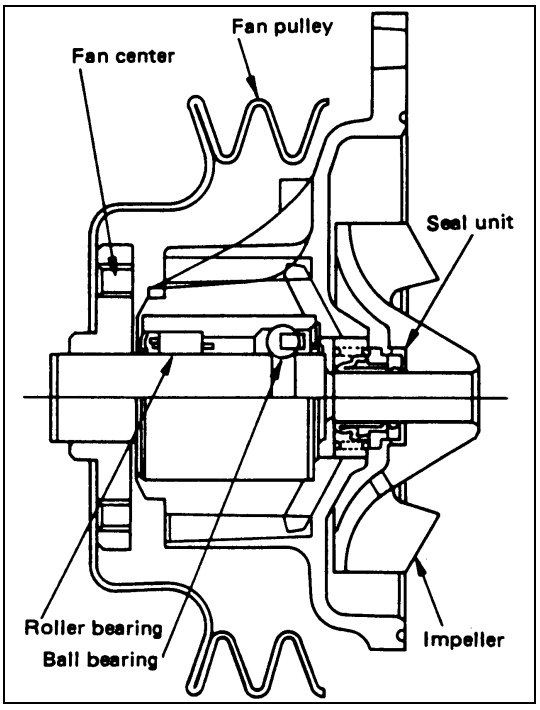
- The resin-made intake manifold is of the cover type having an inner cover made of rubber and steel. This design effectively reduces radiant sound and transmitted sound.
- The intake manifold has a straightening vane inside to stabilize swirl and improve performance. It also contains a built-in Positive Crankcase Ventilation (PCV) valve to minimize the overall size(See figure).
- The exhaust manifold is mode of cast iron and heatresisting alloys. Ports are shaped carefully to minimize exhaust resistance.



6A3-8-1.tif

LUBRICATION SYSTEM

- The oil pump is driven by the crank gear directly to increase durability while maintaining sufficient delivery. The pump body is partially integrated with the cylinder block to reduce the overall size and weight (See figure)
- The oil filter is of the cartridge type integrating the fullflow filter and bypass filter as a single unit. This presents several advangates such as an extended interval between oil exchanges and greater ease of maintenance resulting in cost reduction. The bypass valve is fitted to the body itself to avoid flow of foreign matter due to bypassing of oil thereby maintaining sufficient reliability.
- The oil cooler is of a large-capacity, water-cooled and multiple-partition type built into the side of the cylinder block. This design maintains necessary stability in oil temperature. It also has a bypass valve to minimize delay of the oil gallery pressure build-up for cold starting.



6A3-8-2.tif

COOLING SYSTEM

- The water pump is driven by a V-belt and the pump body is made of diecast aluminum. Part of the swirlchamber is built into the engine front cover to reduce the overall size and weight.

  A sintered carbon type seal unit is chosen to secure reliability. The shaft bearing combines roller bearing and ball bearing to maintain necessary durability. The outlet for draining is located behind the pulley to prevent dust from entering the system as much as possible.(See figure)
- The cooling fan operation is regulated by a temperature-sensitive clutch to enhance fuel efficiency while reducing noise.

IMPORTANT OPERATIONS

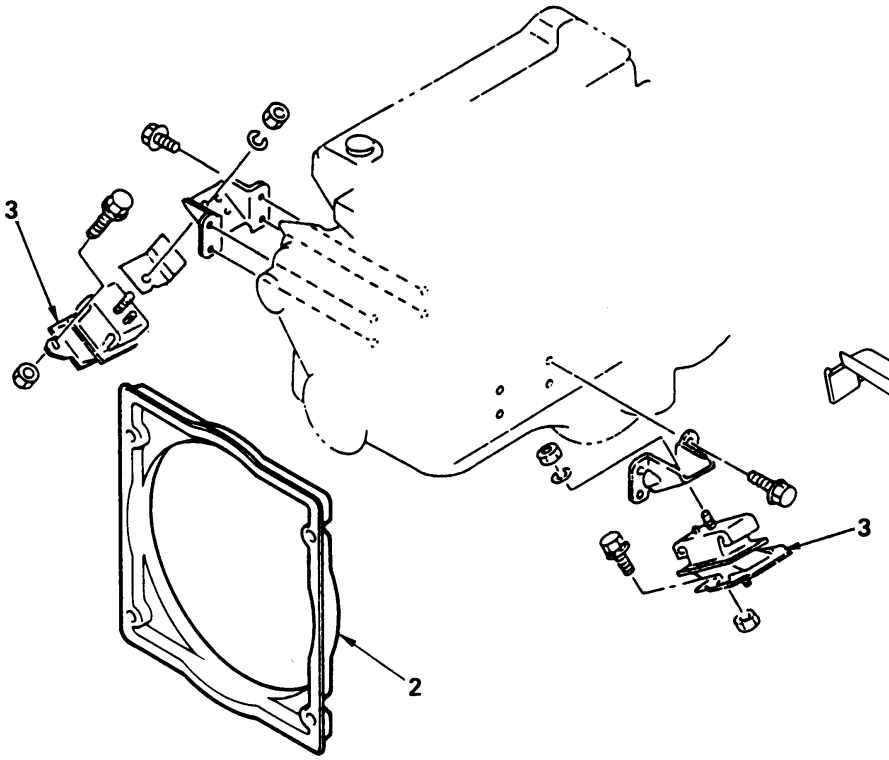
1. **Axial Type Oil Seal**
   - As crankshaft front and rear oil seals are both axial type, attention must be paid to the following: when replacing, replace oil seal and slinger as a set.
   - Be sure to use the special tool correctly since oil seal and slinger must be set accurately in their longitudinal direction.

2. **Valve Cap**
   - As intake and exhaust valves have caps, take sufficient care not to let them fall into the gear case or oil return hole during disassembly or reassembly.

3. **Application of Liquid Gasket**
   - Oil pan, crankcase, oil cooler, retainer front, and water pump are not sealed with sheet gasket but with liquid gasket only.
   - Prior to application, be sure to remove old hardened liquid gasket or oil from those surfaces to which new gasket will be applied. Further, if the old gasket can hardly be removed, mask such surfaces with gasket remover (Three Bond PANDO-391D; ISUZU Genuine Parts No.1-8844-0542-0) or equivalent in accordance with the instructions manual.
   - Liquid gasket should be applied evenly so that no breaks and omissions may be made. Further, where O-ring is used should not be exposed to liquid gasket.

4. **Plastic-Region Angular Nut & Bolt Tightening Method**
   - Clamping bolts of connecting rod and cylinder head (M14 only) are tightened by plastic region angular nut and bolt tightening method. This method is applied with bolt threads and setting faces coated with molybdenum disulfide grease.

ENGINE MOUNT (RH,LH)



Removal steps
1. Transmission panel (M/T only)
2. Fan guide
3. Engine mount

Installation steps
To install, follow the removal steps in the reverse order.

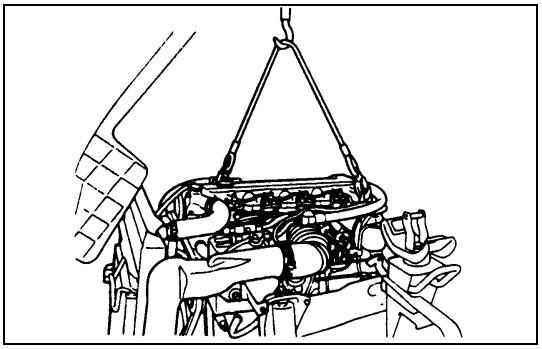
6A3-10-1.tif

REMOVAL

Preparation

- Disconnect battery ground cable.
- Tilt the cab.

1. **Transmission Panel (M/T only)**
2. **Fan Guide**
   Remove the fan guide and hang it on the fan side.



6A3-11-1.tif

3. Engine Mount

1) Hang the engine by the hoist before dismounting the engine mount.
2) Remove the nuts that fix the engine foot and the engine mount.
3) Remove the fixing bolts on the chassis frame side of the engine mount.
4) Hoist the engine assembly a little, and dismount the engine mount.

INSTALLATION

3. Engine Mount

Tighten the fixing bolts to the specified torque.

Chassis Frame Side Bolt Torque	N•m (kg•m/lb•ft)
	48 (4.9/35)

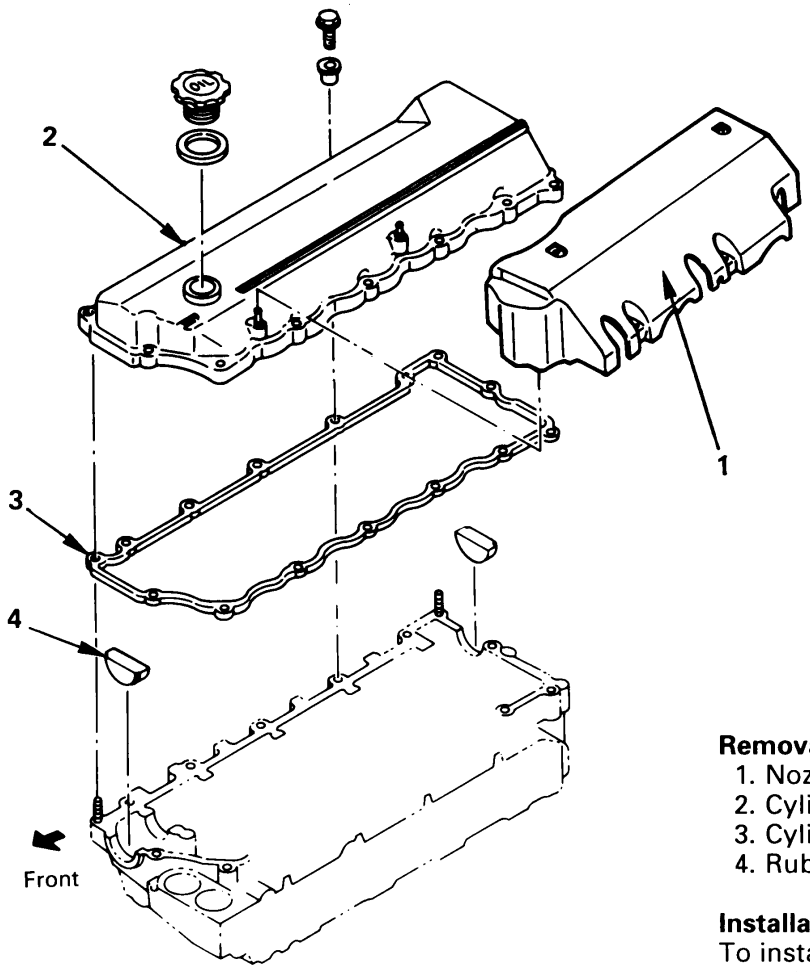
Engine Foot Side Nut Torque	N•m (kg•m/lb•ft)
	82 (8.4/61)

2. Fan Guide

1. Transmission Panel (M/T only)

1) Connect the negative battery cable.
2) Lower the cab
3) Start the engine, and check for any abnormal conditions with the engine mount.

CYLINDER HEAD COVER



Removal steps
1. Nozzle cover
2. Cylinder head cover
3. Cylinder head cover gasket
4. Rubber plug

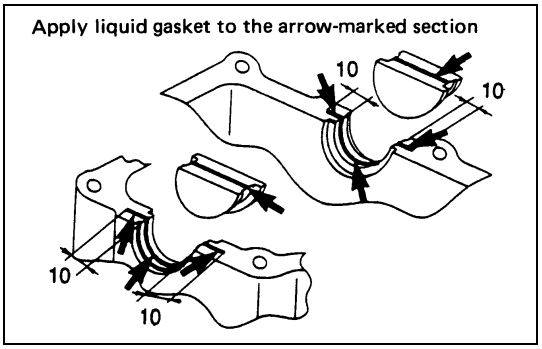
Installation steps
To install, follow the removal steps in the reverse order.

6A3-12-1.tif

REMOVAL

Preparation
- Disconnect battery ground cable.
- Tilt the cab.

1. **Nozzle Cover**
2. **Cylinder Head Cover**
3. **Cylinder Head Cover Gasket**
4. **Rubber Plug**



6A3-13-1.tif

INSTALLATION

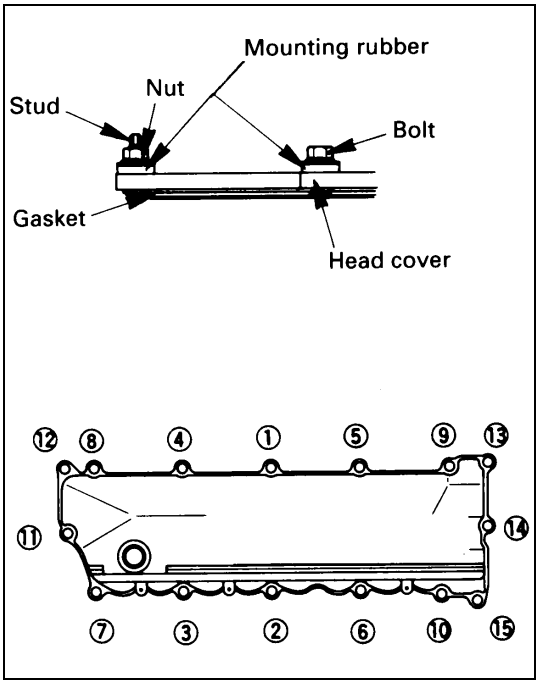
4. Rubber Plug

1) Apply a 3mm-4mm bead of the recommended liquid gasket (Three Bond 1207B) or its equivalent to the cylinder head front and rear plug arch.
2) Install the rubber plugs to the cylinder head upper faces.
3) Apply a 3mm-4mm bead of the recommended liquid gasket (Three Bond 1207B) or its equivalent to the rubber plugs and cylinder head upper faces. Refer to the illustration.

Install the cylinder head cover within 7 minutes after application of liquid gasket.

3. Cylinder Head Cover Gasket

Install the gasket to the cylinder head cover.



6A3-13-2.tif

2. Cylinder Head Cover

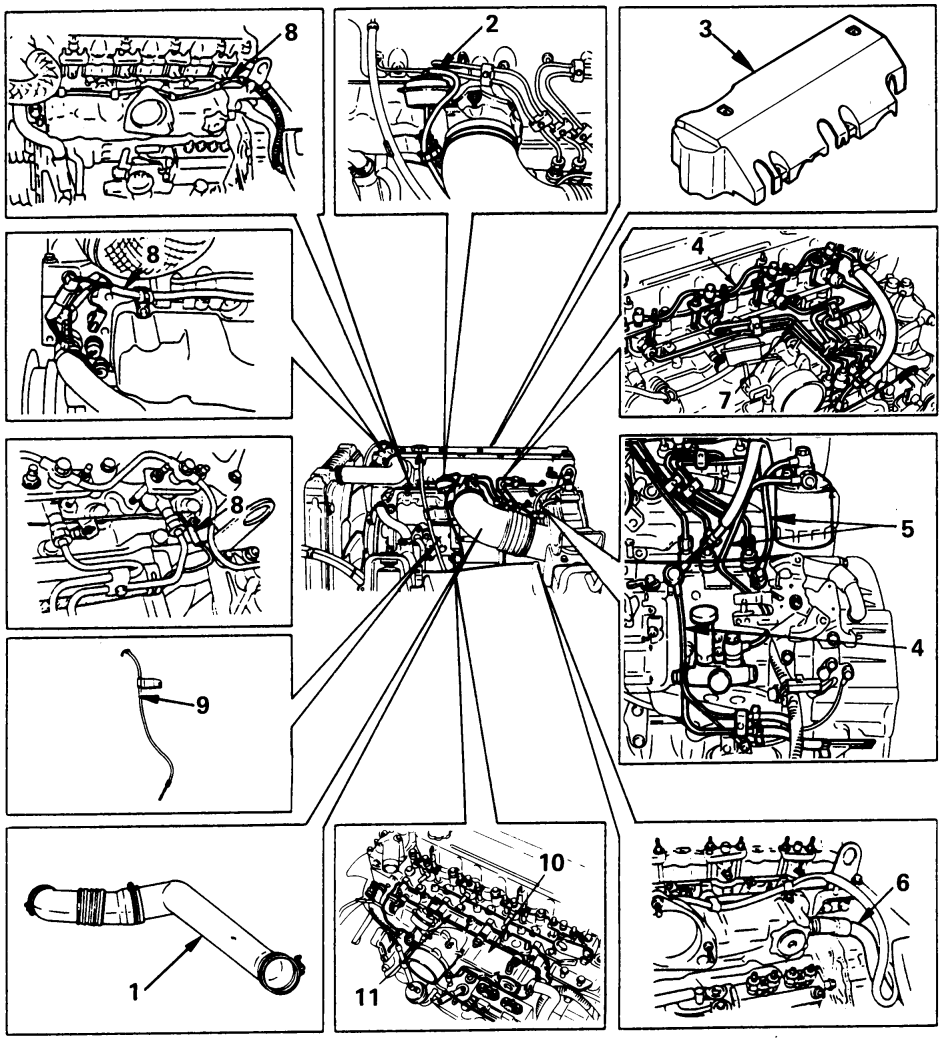
1) Install the cylinder head cover.
2) Tighten the cylinder head cover nuts and bolts to the specified torque in the numerical order shown in the illustration.

Cylinder Head Cover Nut and Bolt Torque	N•m (kg•m/lb•ft)
	18 (1.8/13)

1. Nozzle Cover

- Connect the negative battery cable.
- Lower the cab.
- Start engine and check for oil leakage carefully.

INLET COVER / INLET CASE



for 4HF1

Removal steps
1. Intake air duct
2. Vacuum hose
3. Nozzle cover
4. Leak off pipe
5. Fuel pipe
6. PCV hose
7. Injection pipe
8. Engine harness
9. Oil level guide tube
10. Inlet cover
11. Inlet case

Installation steps
To install, follow the removal steps in the reverse order.

6A3-14-1.tif

REMOVAL

Preparation

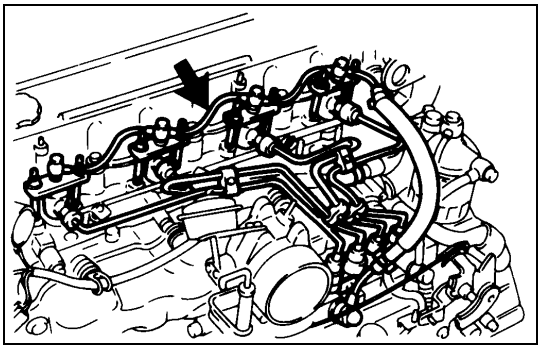
- Disconnect battery ground cable.
- Tilt the cab.

1. Intake Air Duct

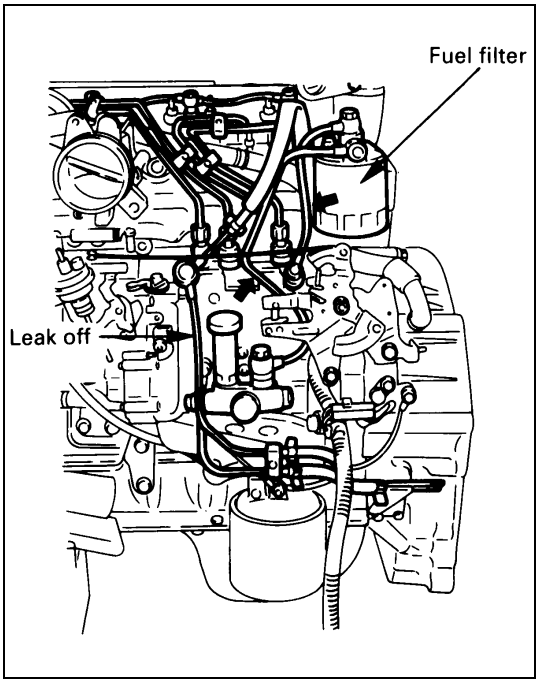
1) Remove the clips at the connections with the inlet cover and with the air cleaner.
2) Remove the intake air duct with the connector hose attached.

2. Vacuum Hose

3. Nozzle Cover


6A3-15-1.tif

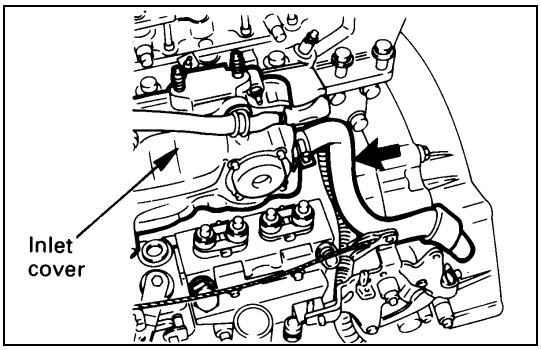
4. Leak off Pipe



6A3-15-2.tif

5. Fuel Pipe

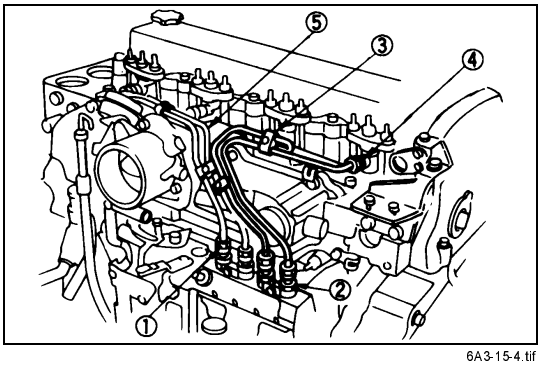
Do not apply excessive force to the fuel pipes.



6A3-15-3.tif

6. Positive Crankcase Ventilation (PCV) Hose

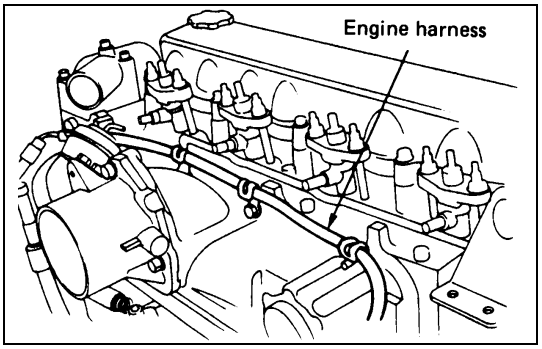
Disconnect the PCV hose from inlet cover.



6A3-15-4.tif

7. Fuel Injection

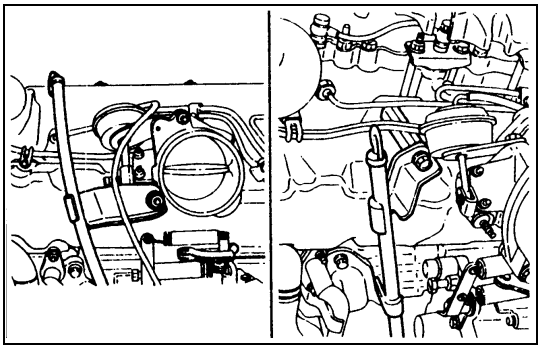
1) Loosen the injection pipe sleeve nuts ①.
2) Do not apply excessive force to the injection pipes ⑤.
3) Loosen the injection pipes clips ③.
4) Remove the injection pipe assembly.
   Plug the delivery valve holder ② ports and nozzle holder ④ ports with caps to prevent the entry of foreign material.



6A3-16-1.tif

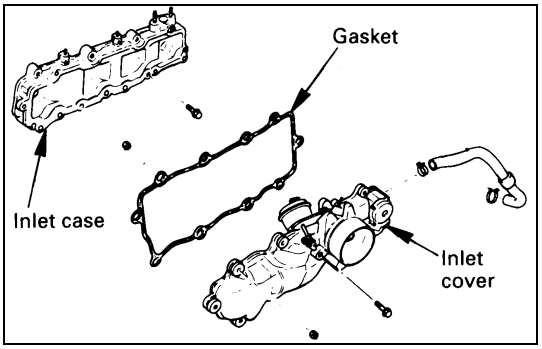
8. Engine Harness

Disconnect thermometer unit, thermo switch, tachometer sensor and glow plug harness connectors and separate harness from clips.


6A3-16-2.tif

9. Oil Level Gauge Guide Tube

Remove the guide tube fixing bolt and pull out the guide tube.



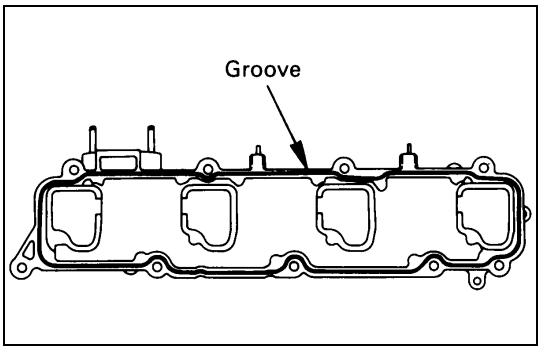
6A3-16-3.tif

10. Inlet Cover

11. Inlet Case

Remove the inlet case while removing the liquid gasket.

INSTALLATION

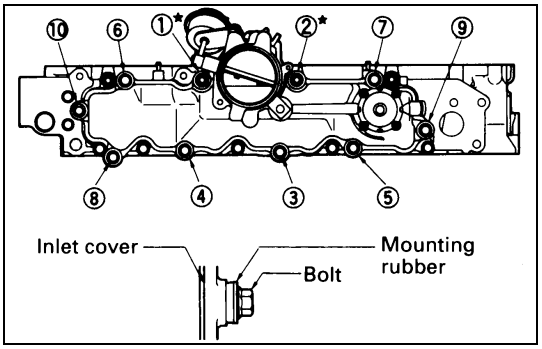


6A3-16-4.tif

11. Inlet Case

1) Apply 2 mm-3 mm bead of the recommended liquid gasket (Three Bond 1207C) or its equivalent on the groove of the inlet case fitting surfaces shown in the illustration.
   - Clean the inlet case fitting surface of the cylinder head.
2) Install the inlet case to the cylinder head.
   - Install the inlet case within 7 minutes after application of liquid gasket.
3) Tighten the inlet case to the specified torque.

Inlet Case Nuts and Bolts Torque	N•m (kg•m/lb•ft)
	19 (1.9/14)

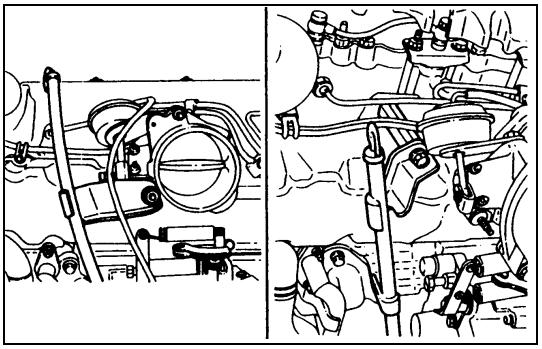


6A3-17-1.tif

10. Inlet Cover

1) Attach harness clips (①, ⑥ and ⑦) and tighten the inlet cover bolts and nuts to the specified torque in the numerical order shown in the illustration.
2) ★ marks are located on the nut positions.

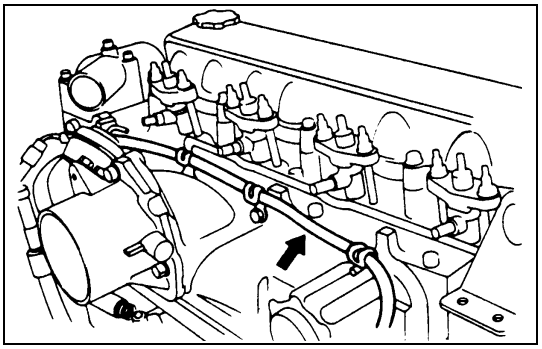
Inlet Cover Bolt and Nut Torque	N•m (kg•m/lb•ft)
13 (1.3/9)	


6A3-17-2.tif

9. Oil Level Gauge Guide Tube

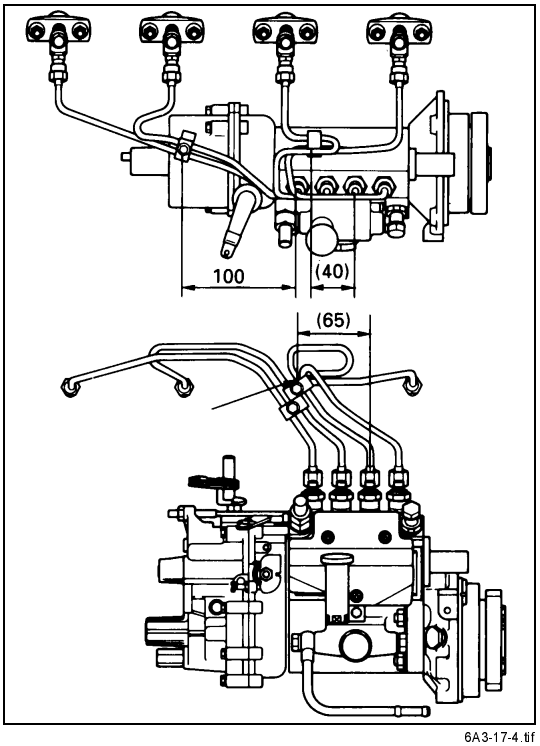
1) Install the O-rings to the guide tube lower portion and insert the guide tube completely to the cylinder body.
2) Tighten the guide tube bolt to the specified torque.

Guide Tube Bolt Torque	N•m (kg•m/lb•ft)
13 (1.3/9.4)	


6A3-17-3.tif

8. Engine Harness

Connect thermometer unit, thermo switch, tachometer sensor and glow plug harness connector and fasten the engine harness with clips.



6A3-17-4.tif

7. Fuel Injection Pipe Assembly

1) Install the injection pipe assembly and temporarily tighten the injection pipe sleeve nuts.
2) Set the clips in the prescribed position shown in the illustration.

CAUTION:

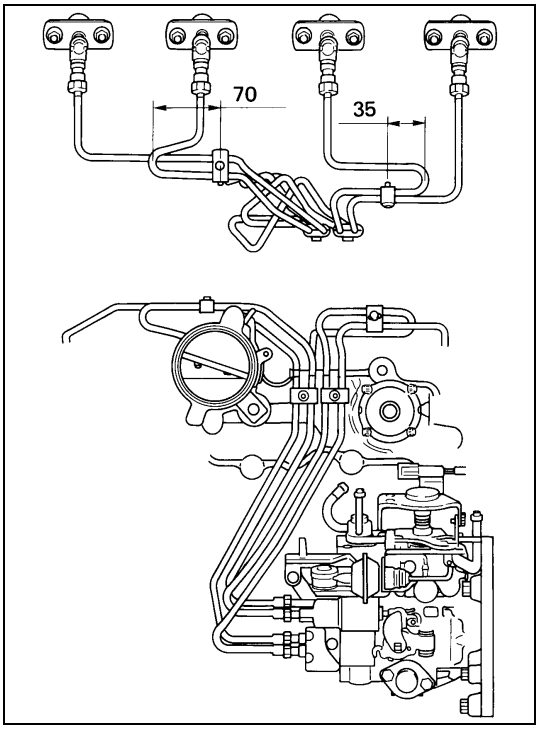
Make absolutely sure that the clip is correctly positioned.

An improperly positioned clip will result in injection pipe breakage and fuel pulsing noise.

Clip Screw Torque	N•m (kg•m/lb•in)
3 (0.3/26)	

3) Tighten the injection pipe sleeve nuts to the specified torque.

Injection Pipe Sleeve Nut Torque	N•m (kg•m/lb•ft)
29 (3/22)	



6A3-18-1.tif

Fuel Injection Pipe Assembly (4HF1-2 model only)

1) Install the injection pipe assembly and temporarily tighten the injection pipe sleeve nuts.
2) Set the clips in the prescribed position shown in the illustration.

CAUTION:

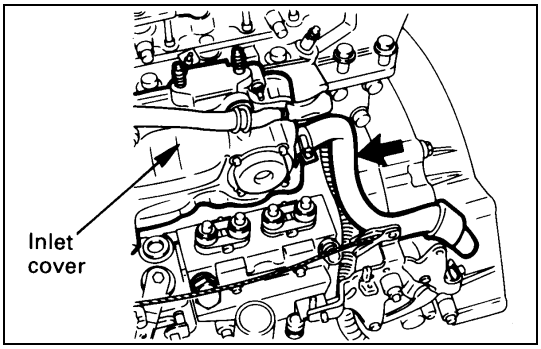
Make absolutely sure that the clip is correctly positioned.

An improperly positioned clip will result in injection pipe breakage and fuel pulsing noise.

Clip Screw Torque	N•m (kg•m/lb•in)
3 (0.3/26)	

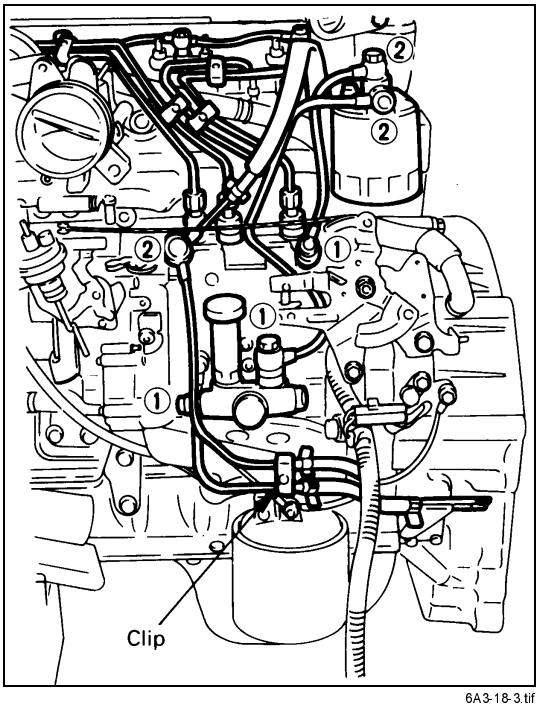
3) Tighten the injection pipe sleeve nuts to the specified torque.

Injection Pipe Sleeve Nut Torque	N•m (kg•m/lb•ft)
29 (3/22)	



6A3-18-2.tif

6. Positive Crankcase Ventilation (PCV) Hose



6A3-18-3.tif

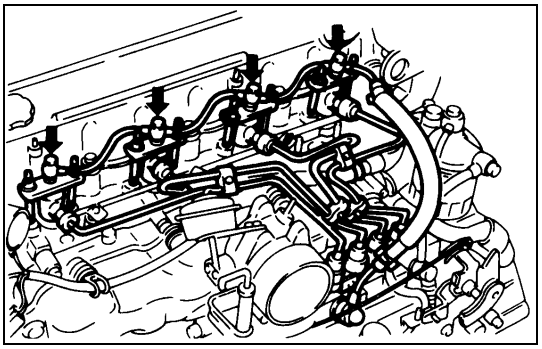
5. Fuel Pipe

Do not apply excessive force to the fuel pipe.

Fuel Pipe Joint Bolt ① Torque	N•m (kg•m/lb•ft)
41 (4.2/30)	

Fuel Pipe Joint Bolt ② Torque	N•m (kg•m/lb•ft)
23 (2.3/17)	

Clip Screw Torque	N•m (kg•m/lb•in)
4 (0.4/35)	



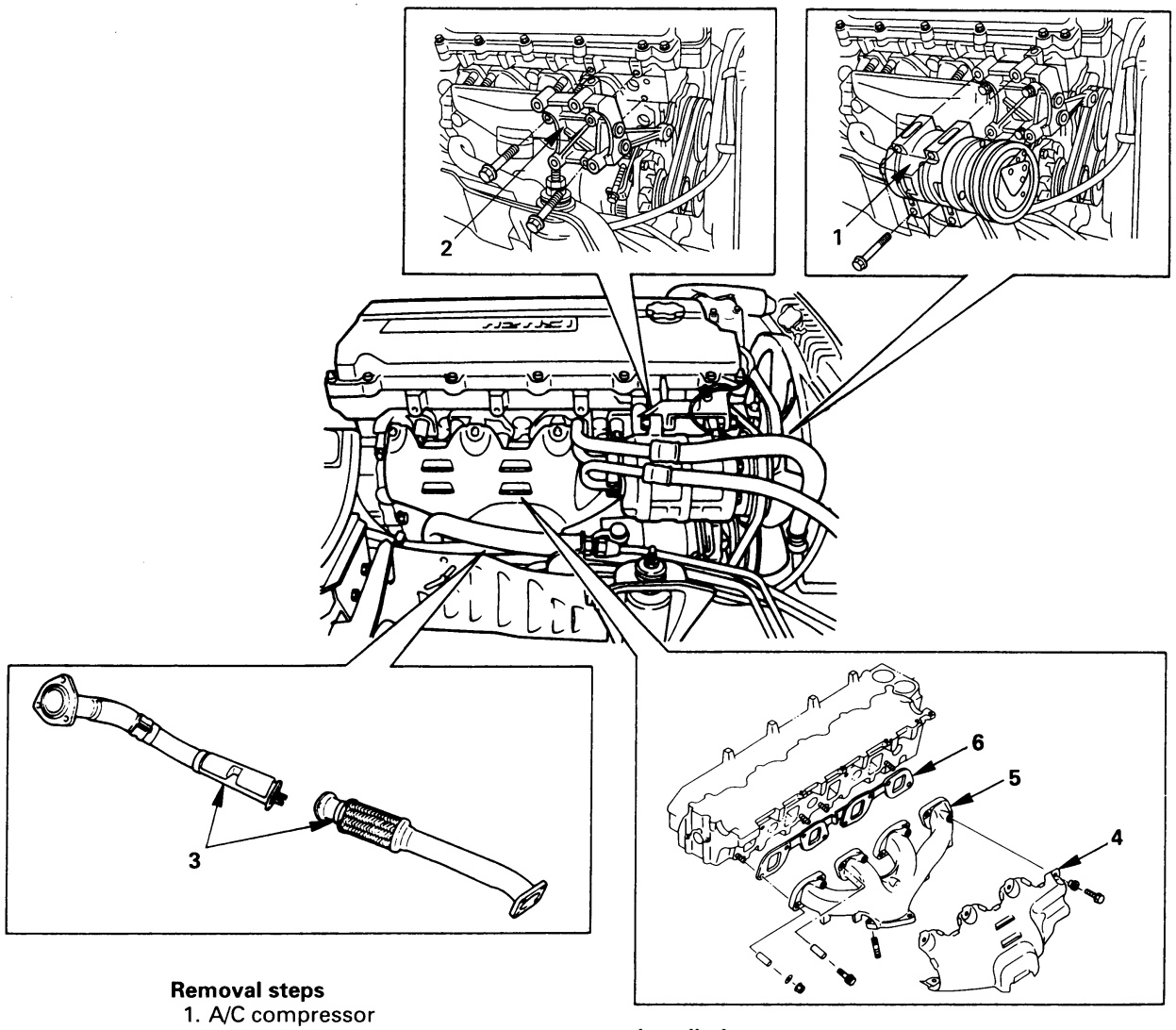
6A3-19-1.tif

4. **Leak Off Pipe**

Leak-Off Pipe Joint Bolt Torque	N•m (kg•m/lb•in)
	13 (1.3/113)

3. **Nozzle Cover**
2. **Vacuum Hose**
1. **Intake Air Duct**
   - Connect the negative battery cable.
   - Lower the cab.
   - Start engine and check for fuel leakage carefully.

EXHAUST MANIFOLD



Removal steps
1. A/C compressor (If equipped with A/C)
2. A/C compressor bracket (If equipped with A/C)
3. Front exhaust pipe
4. Heat protector
5. Exhaust manifold

Installation steps
To install, follow the removal steps in the reverse order.

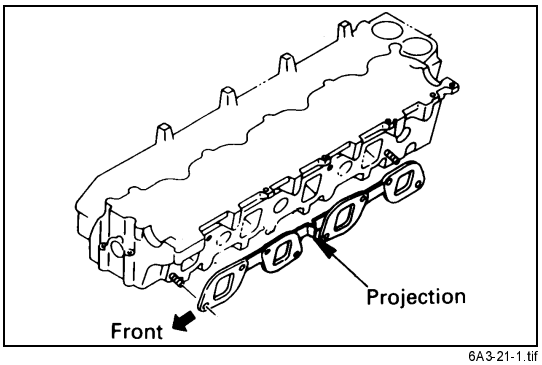
6A3-20-1.tif

REMOVAL

Preparation
- Disconnect battery ground cable.
- Tilt the cab.

1. Air Conditioning (A/C) Compressor (If equipped with A/C)
1) Disconnect magnetic clutch harness connector.
2) Dismount the compressor together with the hoses from the A/C compressor bracket, and fasten it to the appropriate location with a wire.

2. **A/C Compressor Bracket (If equipped with A/C)**
3. **Front Exhaust Pipe**
4. **Heat Protector**
5. **Exhaust Manifold**
6. **Exhaust Gasket**

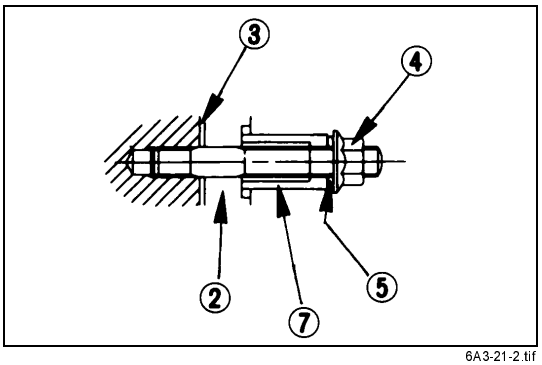


6A3-21-1.tif

INSTALLATION

6. Exhaust Gasket

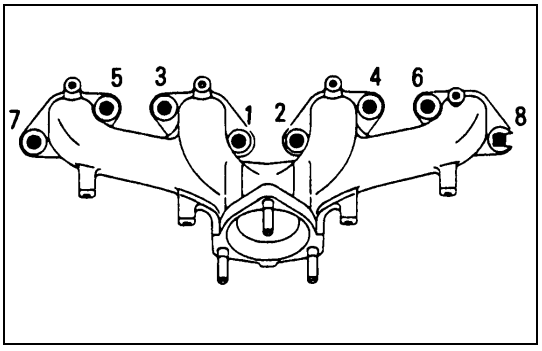
Insert the gasket into the stud provided to the cylinder head (with the projection of the gasket on this side).



6A3-21-2.tif

5. Exhaust Manifold

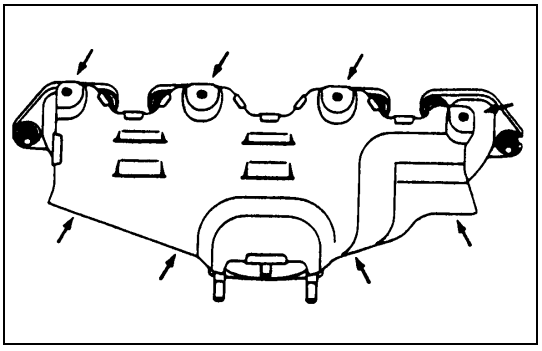
1) Install exhaust manifold gaskets ③, exhaust manifold ②, distance pieces ⑦, dish washers ⑤ and nuts ④ to the stud bolts shown in the illustration.



6A3-21-3.tif

2) Tighten the nuts to the specified torque in the numerical order shown in the illustration.

Exhaust Manifold Nut Torque	N•m(kg•m/lb•ft)
34(3.5/25)	


6A3-21-4.tif

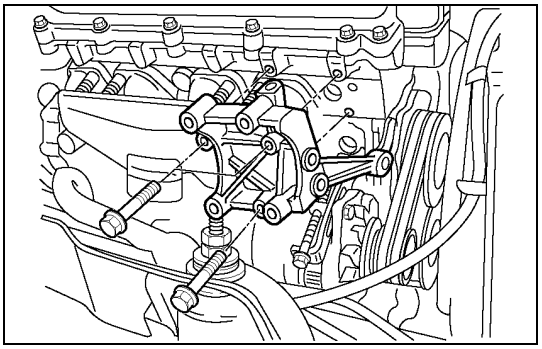
4. Heat Protector

Heat Protector Bolt Torque	N•m (kg•m/lb•ft)
10 (1.0/7)	

3. Front Exhaust Pipe

Exhaust Manifold Side	N•m (kg•m/lb•ft)
67 (6.8/49)	

Exhaust Brake Side	N•m (kg•m/lb•ft)
17 (1.7/12)	

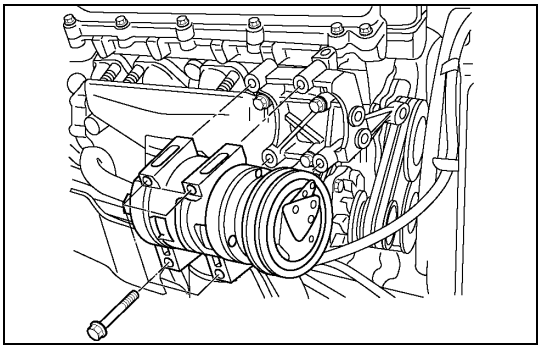


901LV057.tif

2. Air Conditioning (A/C) Compressor Bracket (If equipped with A/C)

Tighten fixing bolts to the specified torque.

A/C Compressor Bracket Bolt Torque	N•m (kg•m/lb•ft)
48 (4.9/35)	



901LV058.tif

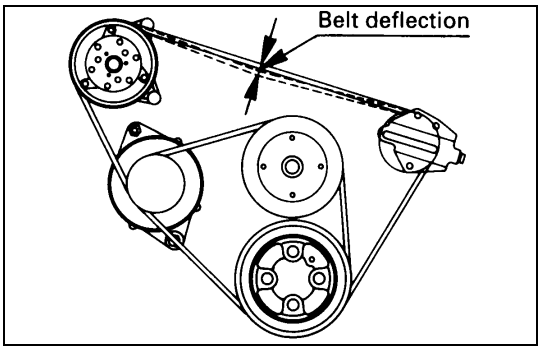
1. A/C Compressor (If equipped with A/C)

1) Tighten fixing bolts to the specified torque.

A/C Compressor Bolt Torque	N•m (kg•m/lb•ft)
48 (4.9/35)	

Note:

When tightening the compressor fixing bolts, tighten first the 2 bolts on the rear side, and then the remaining 2 on the front.



6A3-22-3.tif

2) Install drive belt adjust belt tension by adjusting bolt and tighten locking nut to the specified torque.

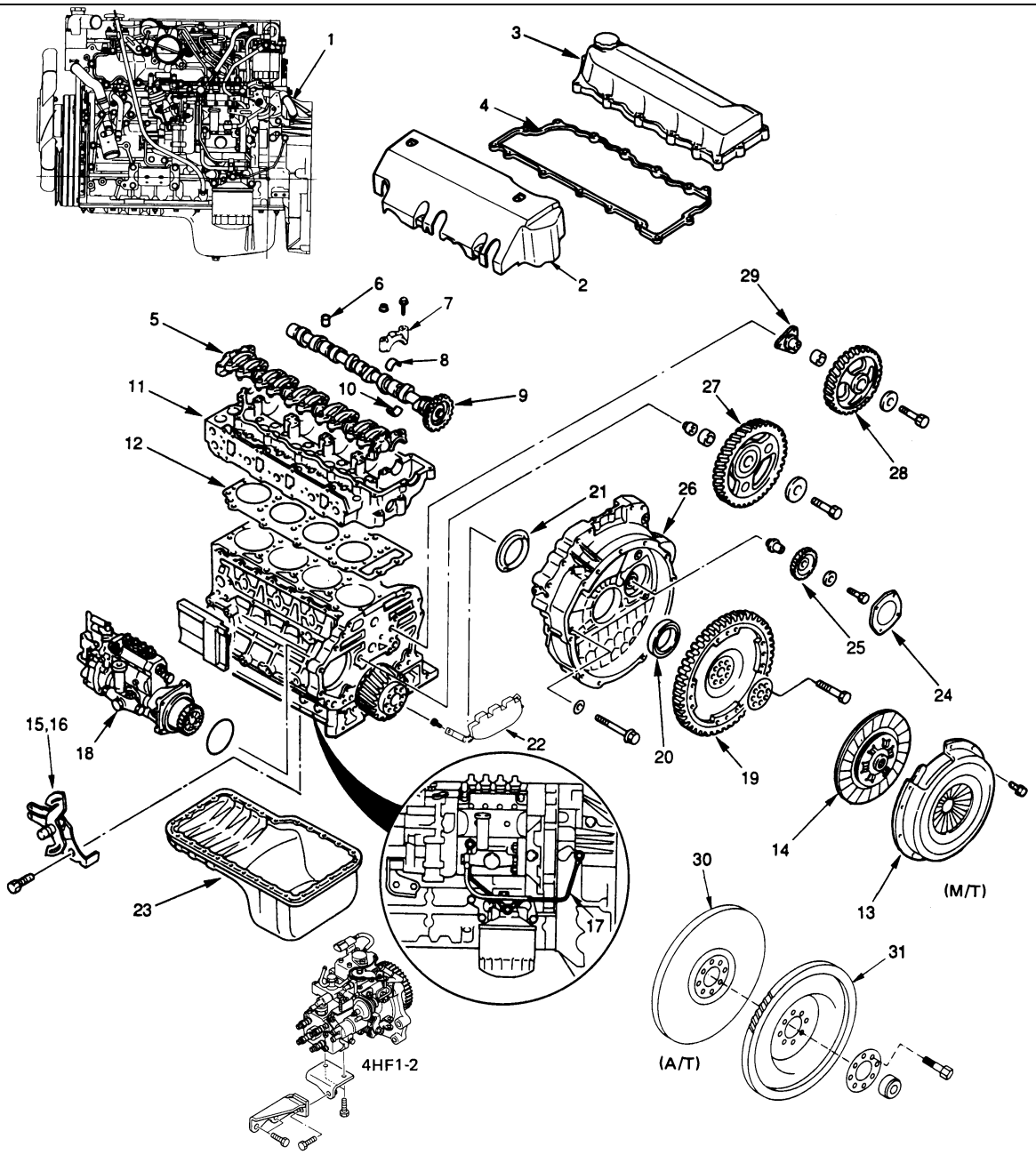
3) Depress the drive belt mid-portion with a 98N (10kg/22lb) force.

Drive Belt Deflection	mm (in)
16 - 20 (0.63 - 0.79) ... New belt 18 - 22 (0.71 - 0.87) .. Reuse belt	

Locking Nut Torque	N•m (kg•m/lb•ft)
27 (2.8/20)	

- Connect the negative battery cable.
- Lower the cab.
- Start engine and check for gas leakage carefully.

TIMING GEAR REPLACEMENT



Removal steps

1. Engine assembly
2. Nozzle cover
3. Cylinder head cover
4. Head cover gasket
5. Rocker arm shaft assembly
6. Valve cap
7. Camshaft bearing cap
8. Camshaft bearing upper
9. Camshaft assembly
10. Camshaft bearing lower
11. Cylinder head assembly
12. Cylinder head gasket
13. Clutch pressure plate assembly
14. Driven plate
15. Engine control wire
16. Engine control lever assembly
17. Oil pipe
18. Injection pump assembly
19. Flywheel (M/T)
20. Rear oil seal
21. Slinger
22. Spacer rubber (NKR model only)
23. Oil pan
24. Power steering pump idle gear cover
25. Power steering pump idle gear
26. Flywheel housing
27. Idle gear A
28. Idle gear B
29. Idle gear B shaft
30. Flywheel (A/T)
31. Flexible plate (A/T)

Installation steps

To install, follow the removal steps in the reverse order.

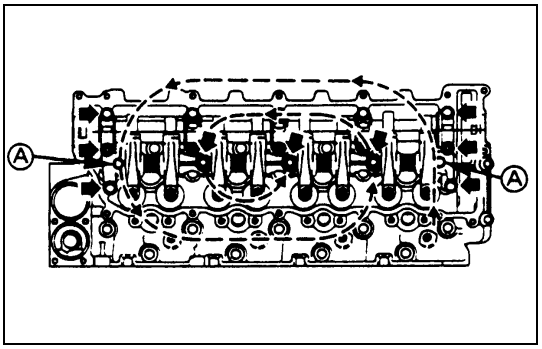
6A3-23-1.tif

REMOVAL

Preparation

- Disconnect battery ground cable.
- Tilt the cab.
- Drain coolant and engine oil.

1. **Engine Assembly**
   Above works refer to “ENGINE ASSEMBLY” section in this manual.
2. **Nozzle Cover**
3. **Cylinder Head Cover**
4. **Head Cover Gasket**
5. **Rocker Arm Shaft Assembly**
   1) Loosen the rocker arm shaft bracket nuts and bolts in numerical order a little at a time and remove the rocker arm shaft assembly with the camshaft brackets.
   2) Leave the Ⓐ indicated bolt unremoved on this occasion, since it is the rocker arm fixing bolt.

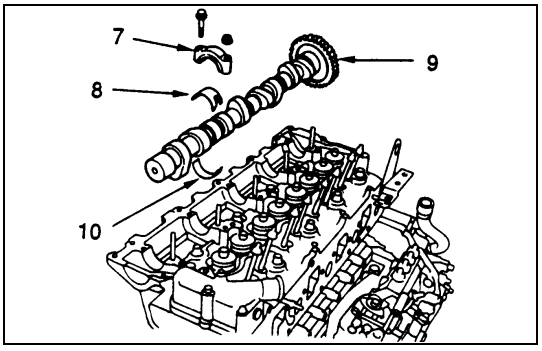


6A3-24-1.tif

CAUTION:
Failure to loosen the rocker arm shaft bracket nuts and bolts in numerical order a little at a time will adversely affect the rocker arm shaft.

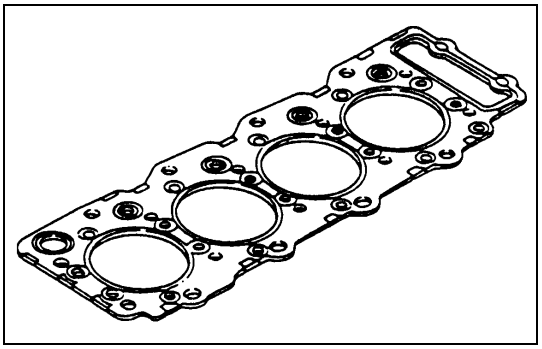
6. **Valve Cap**

CAUTION:
Take sufficient care not to let valve caps fall into the gear case or oil return hole.



6A3-24-2.tif

7. **Camshaft Bearing Cap**
8. **Camshaft Bearing Upper**
9. **Camshaft Assembly**
10. **Camshaft Bearing Lower**
    If the camshaft bearings are to be reinstalled, mark their fitting positions by tagging each bearing with the cylinder number from which it was removed.
11. **Cylinder Head Assembly**
    Above works refer to “CYLINDER HEAD” section in this manual.

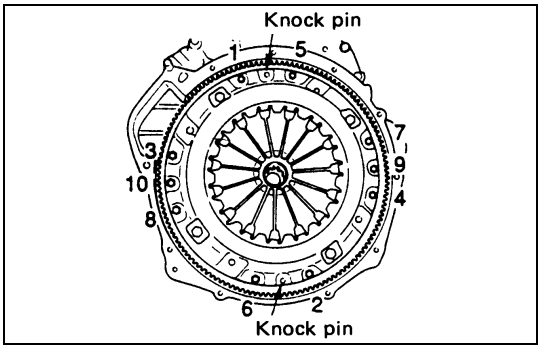


6A3-25-1.tif

12. Cylinder Head Gasket

CAUTION:

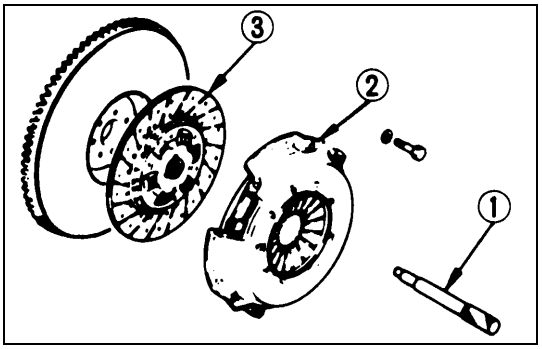
Do not reuse the cylinder head gasket.



6A3-25-2.tif

13. Clutch Pressure Plate Assembly

1) Insert the clutch pilot aligner to the clutch assembly.
   Clutch Pilot Aligner: 5-8840-2240-0
2) Loosen the pressure plate bolts in numerical order a little at a time as shown in the illustration.
3) Remove the pressure plate assembly.

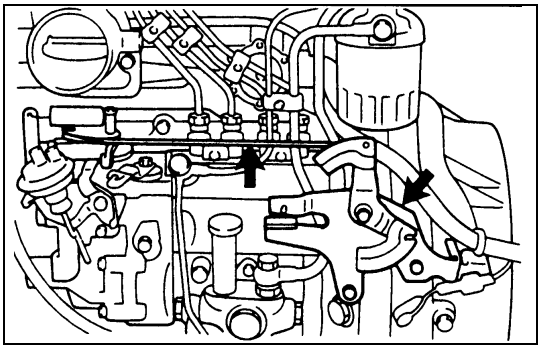


6A3-25-3.tif

14. Driven Plate

Remove the driven plate with the clutch pilot aligner.

① Clutch pilot aligner
② Clutch pressure plate assembly
③ Driven plate

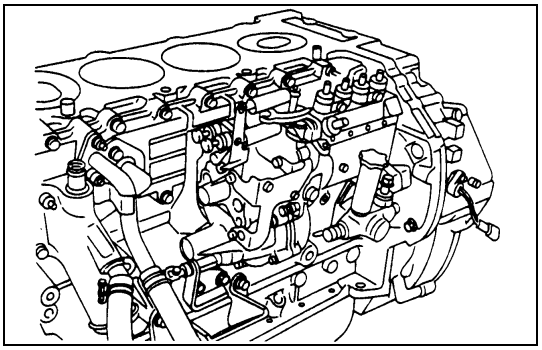


6A3-25-4.tif

15. Engine Control Wire

16. Engine Control Lever Assembly

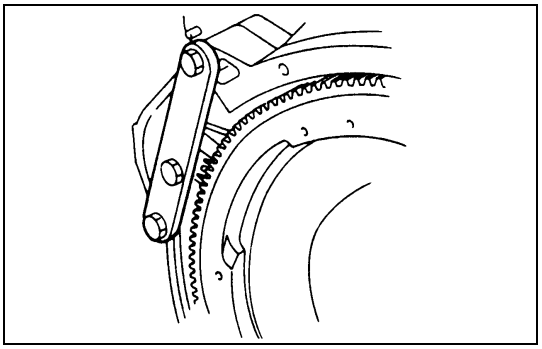
17. Oil Pipe



6A3-25-5.tif

18. Injection Pump Assembly

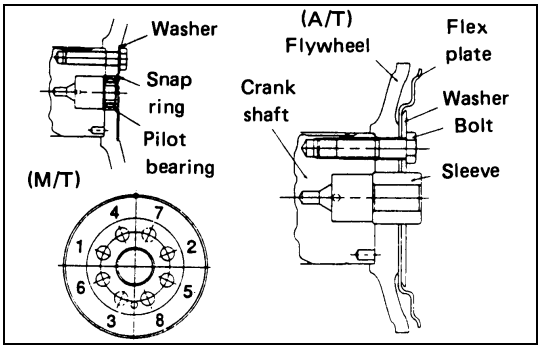
1) Remove the injection pump bracket bolts and the injection pump rear bracket bolts.
2) Then remove the injection pump assembly.



6A3-26-1.tif

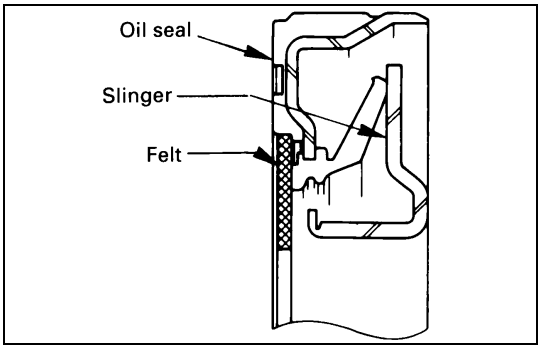
19. Flywheel Assembly

1) Use the crankshaft stopper to prevent the crankshaft from turning.
   Crankshaft Stopper: 5-8840-2230-0
2) Loosen the flywheel bolts in numerical order a little at a time as shown in the illustration.
3) Remove the flywheel stopper and the flywheel assembly.



6A3-26-2.tif

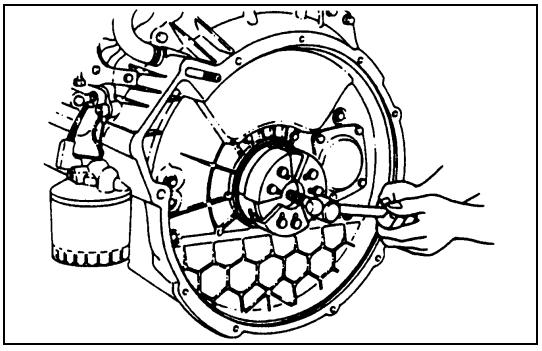
For the A/T vehicle, after loosening the flywheel fixing bolt, remove the washer, the flexible plate, the flywheel and the sleeve in this order.



6A3-26-3.tif

20. Crankshaft Rear Oil Seal

CAUTION:
Be careful not to damage the crankshaft oil seal contact surface during the removal procedure.



6A3-26-4.tif

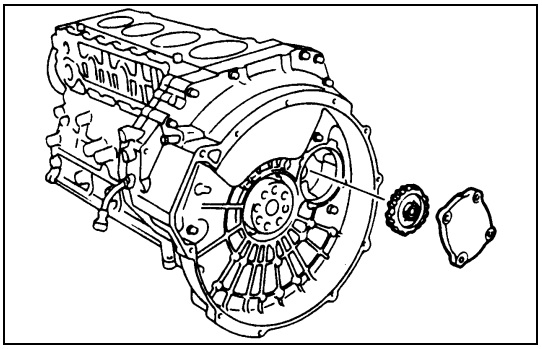
21. Crankshaft Rear Slinger

Use the slinger puller to pull out the slinger.
Slinger Puller: 5-8840-2360-0

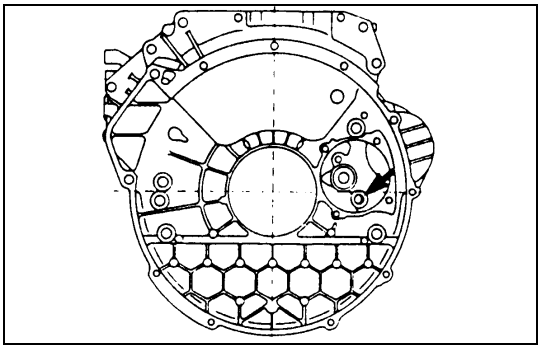
22. Spacer Rubber (NKR model only)

(For the 4WD model vehicle, remove the stiffener before removing the spacer rubber.)

23. Oil Pan


6A3-27-1.tif

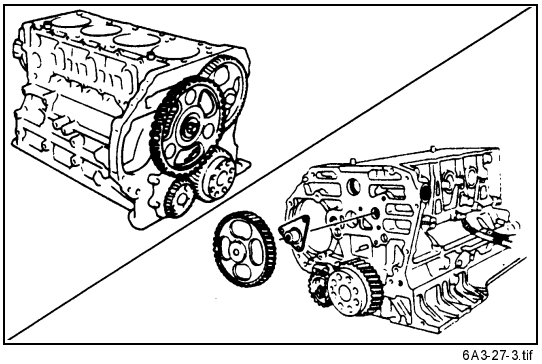
24. Power Steering Pump Idle Gear Cover
25. Power Steering Pump Idle Gear


6A3-27-2.tif

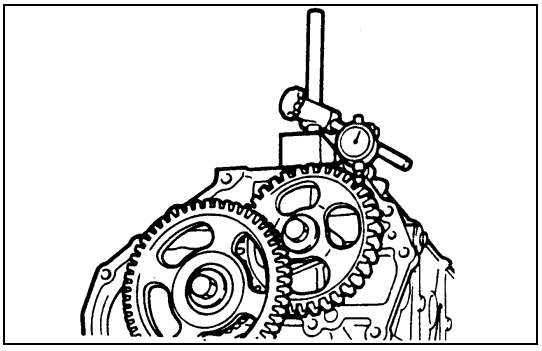
26. Flywheel Housing

NOTE:

Be careful not to fail to remove the bolts shown in the illustration.


6A3-27-3.tif

27. Idle Gear A
28. Idle Gear B
29. Idle Gear B shaft


6A3-27-4.tif

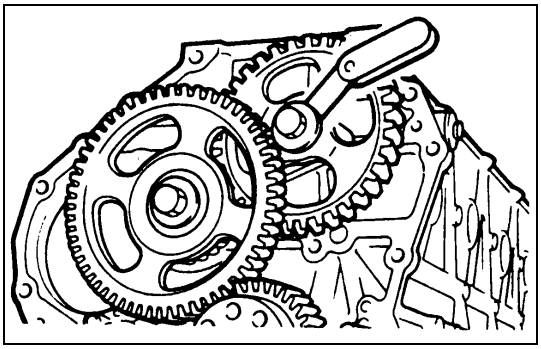
INSPECTION

Idle Gear Backlash Measurement

1) Set a dial indicator to the timing gear to be measured. Hold both the gear to be checked and the adjoining gear stationary.
2) Move the gear to be checked right and left as far as possible. Take the dial indicator reading.

Timing Gear Backlash Gear to Gear mm (in)

Standard	Limit
0.10 ~ 0.17 (0.0039 ~ 0.0067)	0.30 (0.012)


6A3-28-1.tif

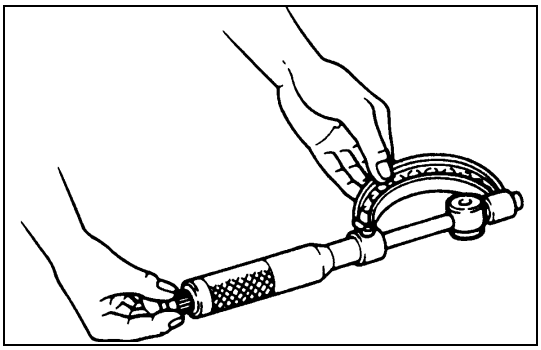
Idler Gear End Play Measurement

Insert a feeler gauge between the idler gear and the thrust collar to measure the gap and determine the idler gear end play.

If the measured value exceeds the specified limit, the thrust collar must be replaced.

Idler Gear End Play mm (in)

Standard	Limit
0.058 - 0.115 (0.002 - 0.005)	0.2 (0.008)


6A3-28-2.tif

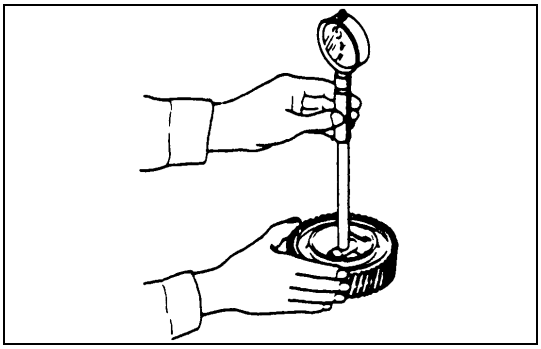
Idler Gear Shaft Outside Diameter

Use a micrometer to measure the idler gear shaft outside diameter.

If the measured value is less than the specified limit, the idler gear must be replaced.

Idler Gear Shaft Outside Diameter mm (in)

Standard	Limit
29.959 - 29.980 (1.1795 - 1.1803)	29.80 (1.1732)


6A3-28-3.tif

Idler Gear Inside Diameter

Use an inside dial indicator or an inside micrometer to measure the idler gear inside diameter.

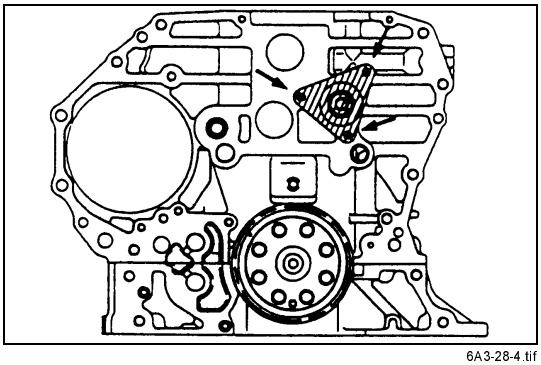
Idler Gear Inside diameter mm (in)

Standard	Limit
30.000 - 30.021 (1.1811 - 1.1819)	30.100 (1.1850)

If the clearance between the idler gear shaft outside diameter and the idler gear inside diameter exceeds the limit, the idler gear must be replaced.

Idler Gear Shaft and Idler Gear clearance mm (in)

Standard	Limit
0.020 - 0.062 (0.0008 - 0.0024)	0.200 (0.0079)


6A3-28-4.tif

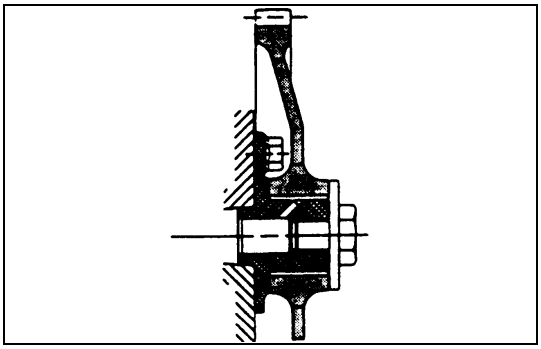
INSTALLATION

29. Idler Gear B Shaft

Idle Gear B Shaft Bolt Torque N•m (kg•m/lb•ft)

31 (3.2/23)

Apply the engine oil to the idle gear shaft after installation.

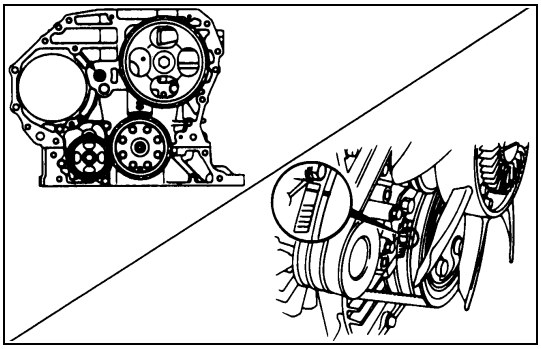


6A3-29-1.tif

28. Idle Gear B

The face of the idle gear B with longer boss should be positioned toward the rear side shown in the illustration.

Idle Gear B Bolt Torque	N•m (kg•m/lb•ft)
	110 (11.2/81)

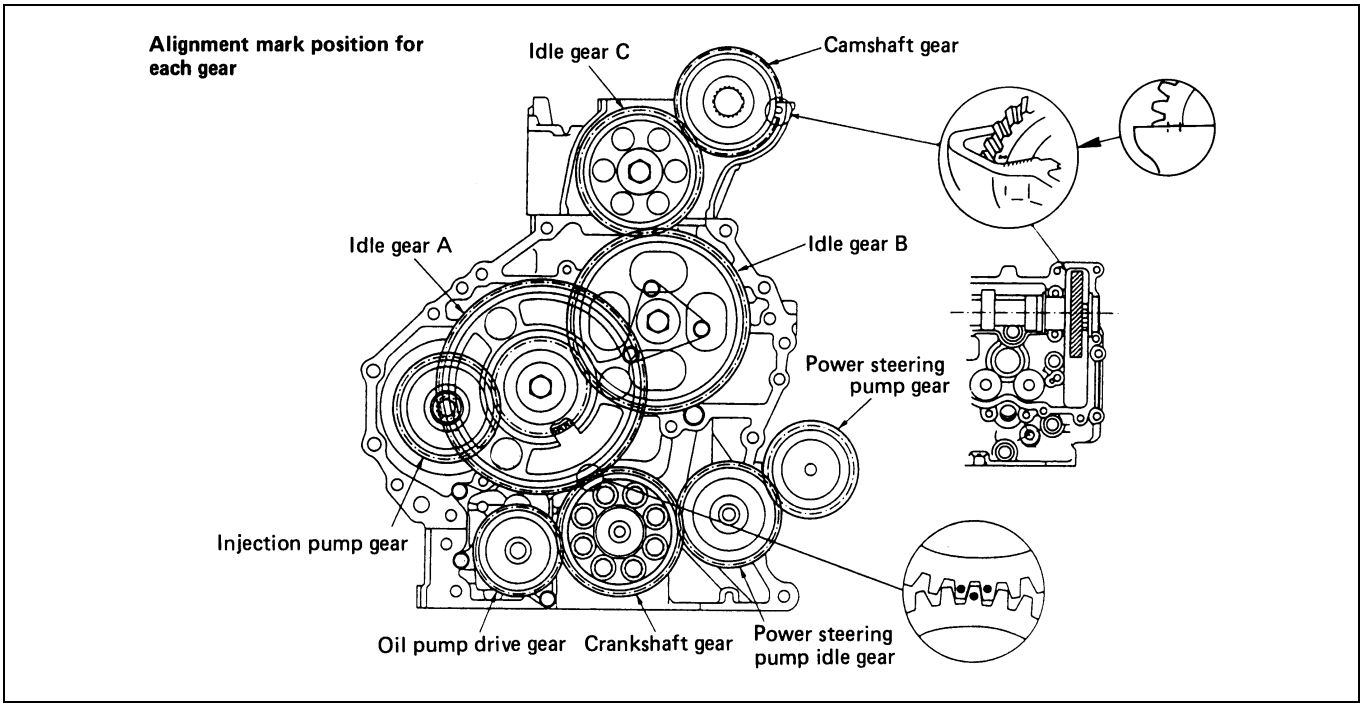


6A3-29-2.tif

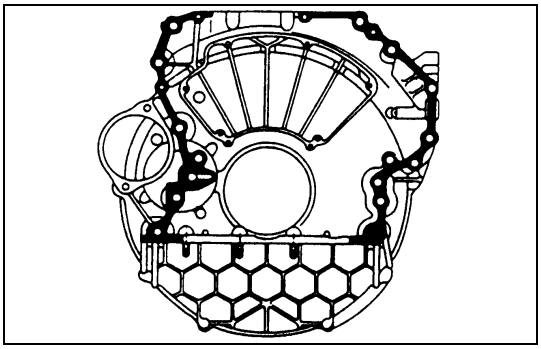
27. Idle Gear A

1) Turn the crankshaft clockwise so that the engagement mark of the crankshaft gear faces to the shaft center of the idle gear A and the No.1 cylinder piston comes to the top dead center.
2) Align the crankshaft gear with the engagement mark of the idle gear and install the idle gear A.

Idle Gear A Bolt Torque	N•m (kg•m/lb•ft)
	133 (13.6/98)



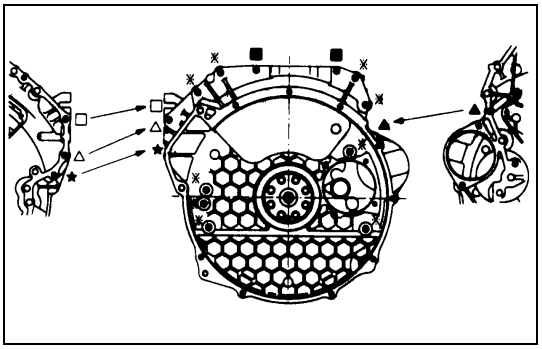
6A3-29-3.tif



6A3-29-4.tif

26. Flywheel Housing

1) Carefully wipe any foreign material from the cylinder body rear face.
2) Apply the recommended liquid gasket (Three Bond 1207C) or its equivalent to the shaded areas shown in the illustration.

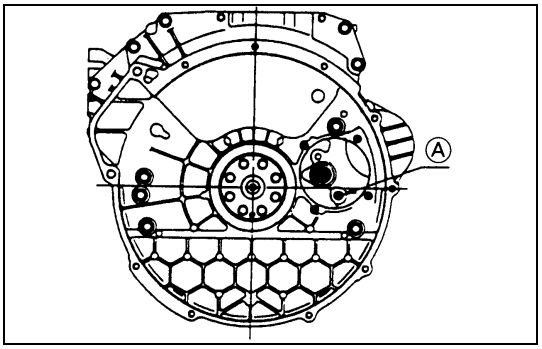


6A3-30-1.tif

3) Align the cylinder body knock pins with the flywheel housing knock pin holes.

4) Tighten the flywheel housing bolts to the specified torque shown in the illustration.

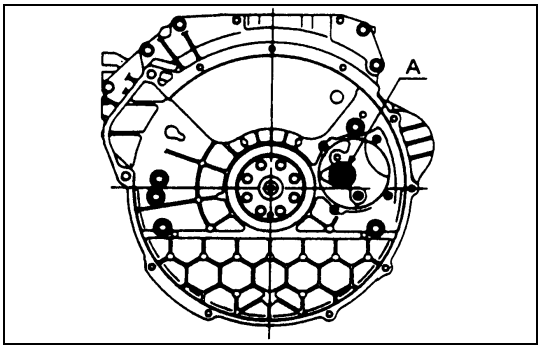
Flywheel Housing Bolt Torque	N•m (kg•m/lb•ft)
* :	96 (9.8/71)
★ :	48 (4.9/35)
□ :	94 (9.6/69)
■ :	25 (2.6/19)
△ :	76 (7.7/56)
▲ :	48 (4.9/35)



6A3-30-2.tif

- Tighten the bolts marked with "△" or "★" from the injection pump side, and those with "▲" from the cylinder body side.

Flywheel Housing Bolt Torque	N•m (kg•m/lb•ft)
Ⓐ :	96 (9.8/71)



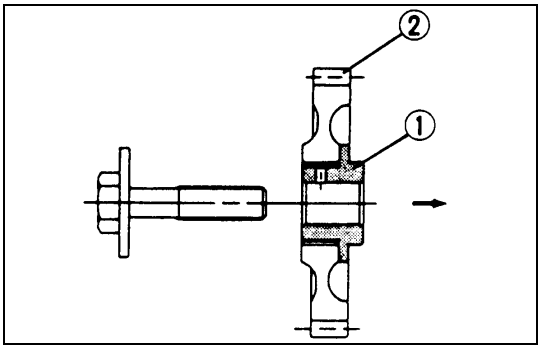
6A3-30-3.tif

25. Power Steering Pump Idle Gear

1) Apply the engine oil to the idle gear shaft.

2) Install the idle gear shaft ① with the idle gear ② to the cylinder body A portion as shown in the illustration.

Idle Gear Shaft Bolt Torque	N•m (kg•m/lb•ft)
135 (13.6/98)	

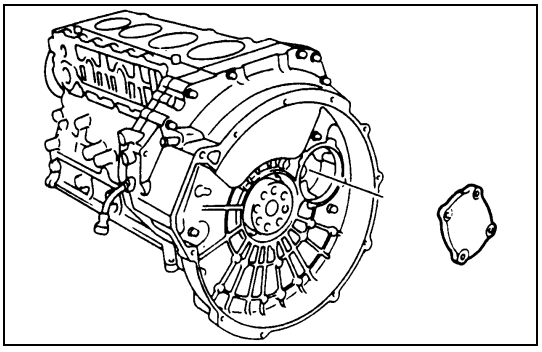


6A3-30-4.tif

24. Power steering Pump Idle Gear Cover

Install the gear cover with the O-ring.

Gear Cover Bolt Torque	N•m (kg•m/lb•ft)
19 (1.9/14)	



6A3-30-5.tif

23. Oil Pan

22. Spacer Rubber (NKR model only)

Above works refer to “OIL PAN” section in this manual.

21. Crankshaft Rear Slinger

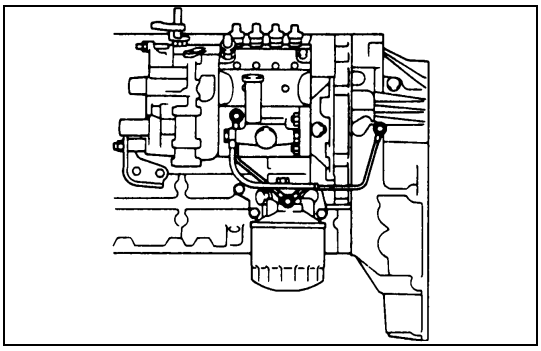
20. Crankshaft Rear Oil Seal

19. Flywheel Assembly

Above works refer to “CRANKSHAFT REAR OIL SEAL” section in this manual.

18. Injection Pump Assembly

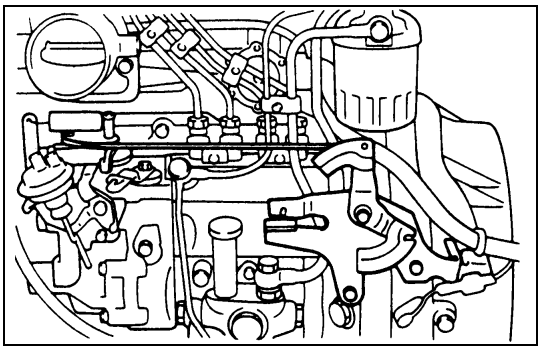
Above works refer to “INJECTION PUMP ASSEMBLY” section in this manual.



6A3-31-1.tif

17. Oil Pipe

Oil Pipe Joint Bolt Torque	N•m (kg•m/lb•ft)
	17 (1.7/12)

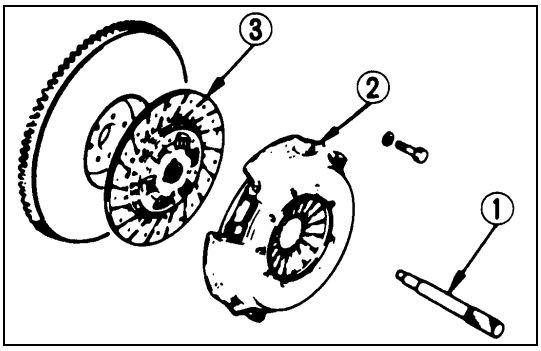


6A3-31-2.tif

16. Engine Control Lever Assembly

Engine Control Lever bolt Torque	N•m (kg•m/lb•ft)
	24 (2.4/17)

15. Engine Control Wire



6A3-31-3.tif

14. Driven Plate

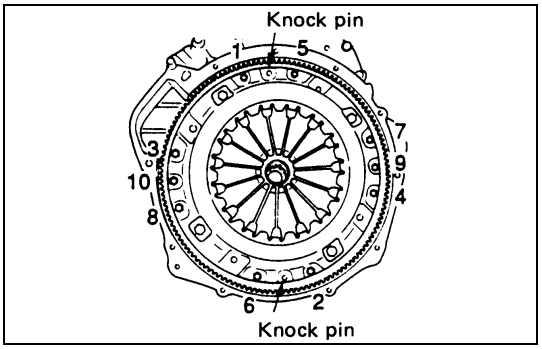
Use the clutch pilot aligner to install the driven plate.

Clutch Pilot Aligner: 5-8840-2240-0

① Clutch pilot aligner.

② Clutch pressure plate assembly.

③ Driven plate



6A3-32-1.tif

13. Clutch Pressure Plate Assembly

1) Align the clutch pressure plate with the flywheel knock pin.
2) Tighten the pressure plate bolts to the specified torque in numerical order.

Clutch Pressure Plate Bolt Torque	N•m (kg•m/lb•ft)
40 (4.1/30)	

12. Cylinder Head Gasket

Above works refer to “CYLINDER HEAD GASKET” section in this manual.

11. Cylinder Head Assembly

Above works refer to “CYLINDER HEAD GASKET” section in this manual.

10. Camshaft Bearing Lower

9. Camshaft Assembly

8. Camshaft Bearing Upper

7. Camshaft Bearing Cap

6. Valve Cap

5. Rocker Arm Shaft Assembly

Above works refer to “CAMSHAFT ASSEMBLY” section in this manual.

4. Head Cover Gasket

3. Cylinder Head Cover

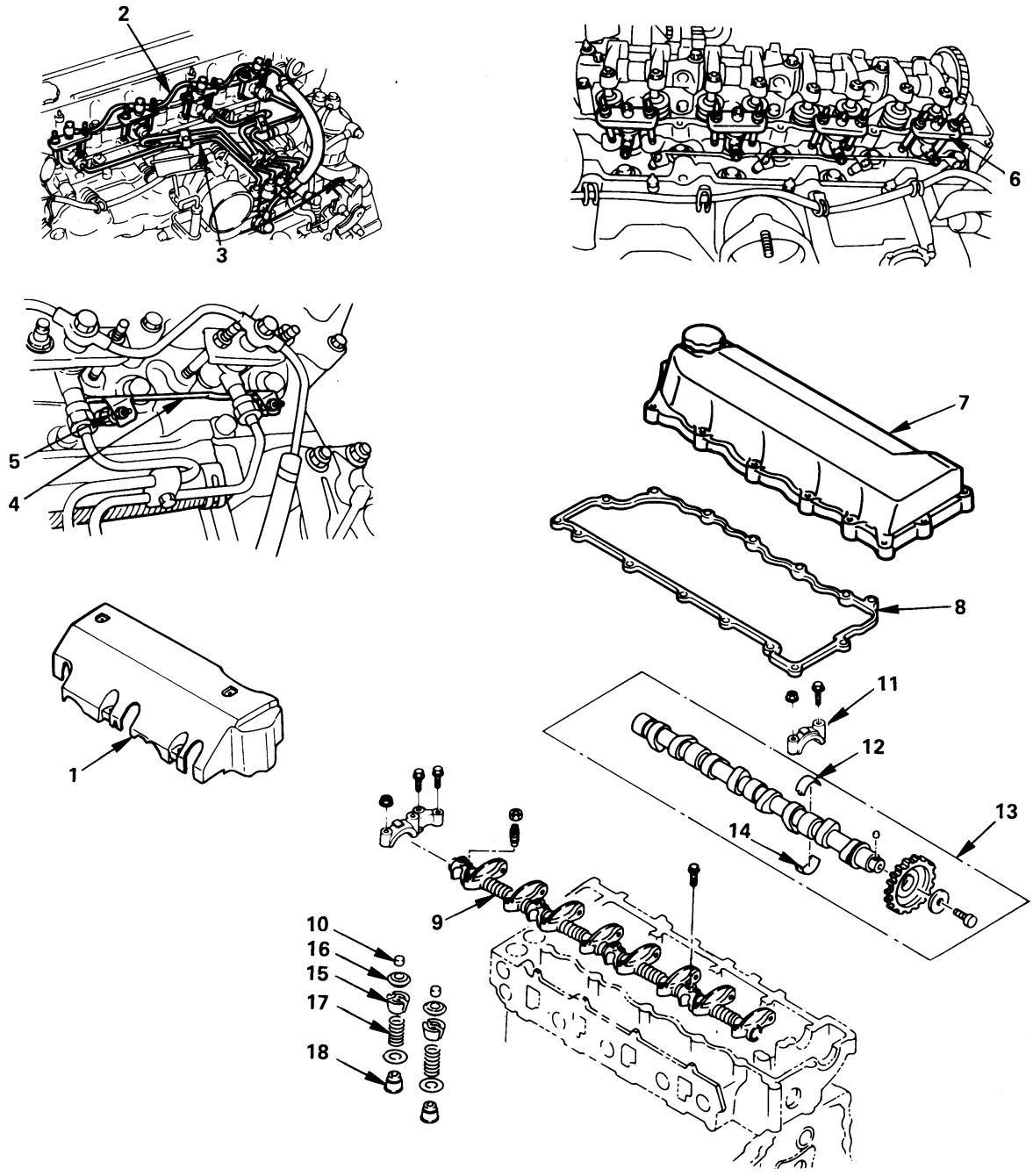
Above works refer to “CYLINDER HEAD COVER” section in this manual.

2. Nozzle Cover

1. Engine Assembly

Above works refer to “ENGINE ASSEMBLY” section in this manual.

VALVE GUIDE SEAL & VALVE SPRING



Removal steps

1. Nozzle cover
2. Leak off pipe
3. Injection pipe
4. Glow plug connector
5. Glow plug
6. Injection nozzle holder assembly
7. Cylinder head cover
8. Cylinder head cover gasket
9. Rocker arm shaft assembly
10. Valve cap
11. Camshaft bearing cap
12. Camshaft bearing upper
13. Camshaft assembly
14. Camshaft bearing lower
15. Cotter collar
16. Spring upper seat
17. Valve spring
18. Valve guide seal

Installation steps

To install, follow the removal steps in the reverse order.

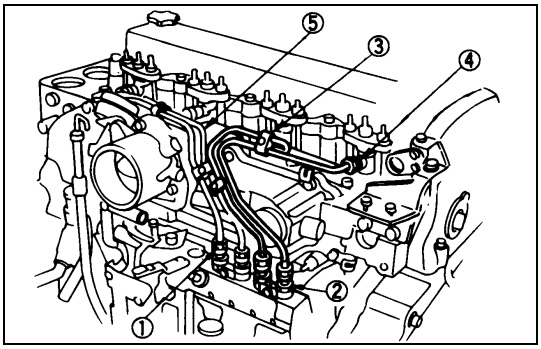
6A3-33-1.tif

REMOVAL

Preparation

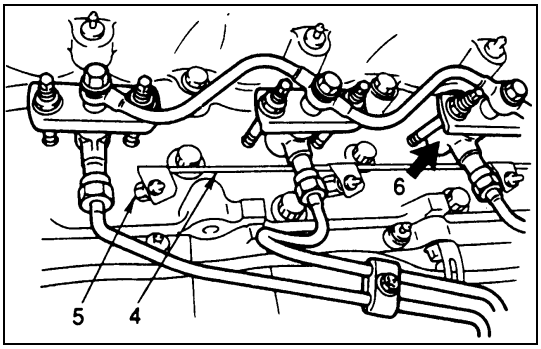
- Disconnect battery ground cable.
- Tilt the cab.

1. **Nozzle Cover**
2. **Leak Off Pipe**



6A3-34-1.tif

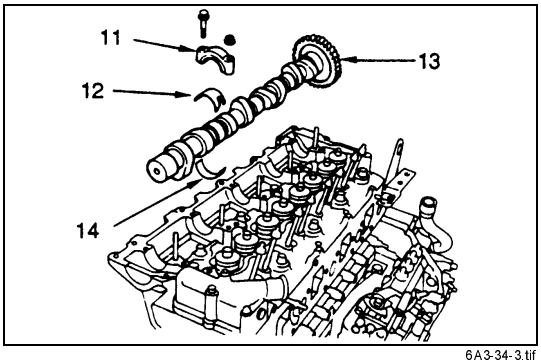
3. **Injection Pipe**
   - Loosen the injection pipe sleeve nuts ①.
     Do not apply excessive force to the injection pipes ⑤.
   - Loosen the injection pipes clips ③.
     Remove the injection pipe assembly.
     Plug the delivery valve holder ② ports and nozzle holder ④ ports with caps to prevent the entry of foreign material.



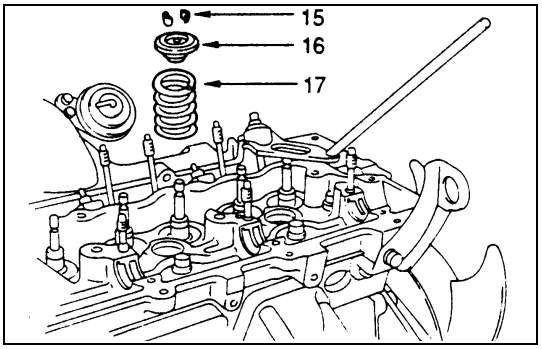
6A3-34-2.tif

4. **Glow Plug Connector**
5. **Glow Plug**
6. **Injection Nozzle Holder Assembly**
   Mark the nozzle holder assemblies fitting positions by tagging each nozzle holder assembly with the cylinder number from which it was removed.
7. **Cylinder Head Cover**
8. **Cylinder Head Cover Gasket**

9. **Rocker Arm Shaft Assembly**
   Above works refer to “ROCKER ARM SHAFT ASSEMBLY” section in this manual.
10. **Valve Cap**
11. **Camshaft Bearing Cap**
12. **Camshaft Bearing Upper**
13. **Camshaft Assembly**
14. **Camshaft Bearing Lower**
    - If the camshaft bearings are to be reinstalled, mark their fitting positions by tagging each bearing with the cylinder number from which it was removed.



6A3-34-3.tif



6A3-35-1.tif

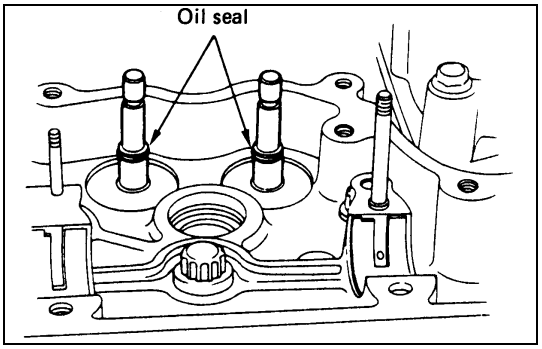
15. Cotter Collar

16. Spring Upper Seat

17. Valve Spring

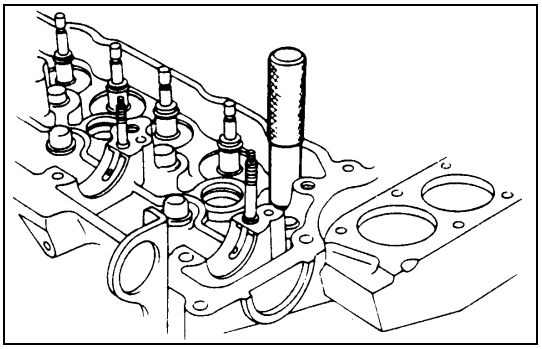
- Apply compressed air to cylinder from the glow plug hole to hold the valve in place.
- Using special tool, compress valve spring and remove cotter collar.

Valve Spring Compressor: 5-8840-2228-0



6A3-35-2.tif

18. Valve Guide Seal

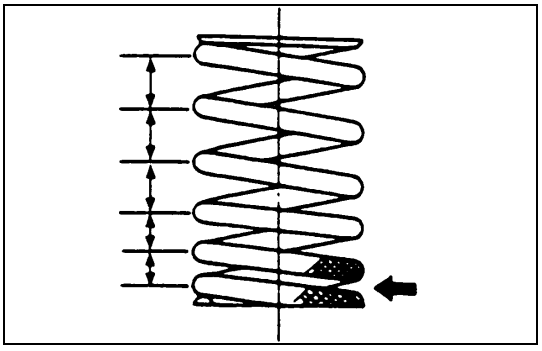

6A3-35-3.tif

INSTALLATION

18. Valve Guide Seal

- Apply a coat of engine oil to the valve guide seal inner face.
- Use a valve guide seal installer to install the valve guide seal to the valve guide

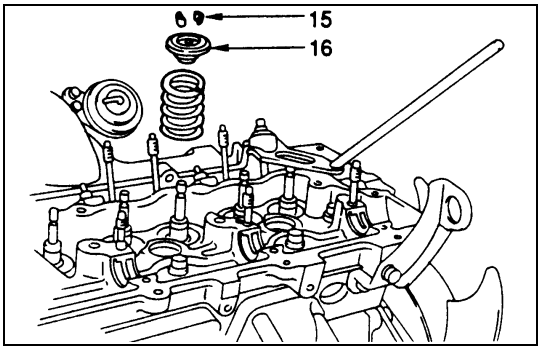
Valve Guide Seal Installer: 8-9439-6815-0


6A3-35-4.tif

17. Valve Spring

Install the valve spring with its fine pitched (or painted) end side down.

16. Spring Upper Seat



6A3-35-5.tif

15. Cotter Collar

1) Use the valve spring compressor to push the valve spring into position.
   Valve Spring Compressor: 5-8840-2228-0
2) Install the cotter collar to the valve stem.
3) Set the cotter collar by tapping around the head of the collar with a rubber hammer.

14. Camshaft Bearing Lower

13. **Camshaft Assembly**
12. **Camshaft Bearing Upper**
11. **Camshaft Bearing Cap**
10. **Valve Cap**

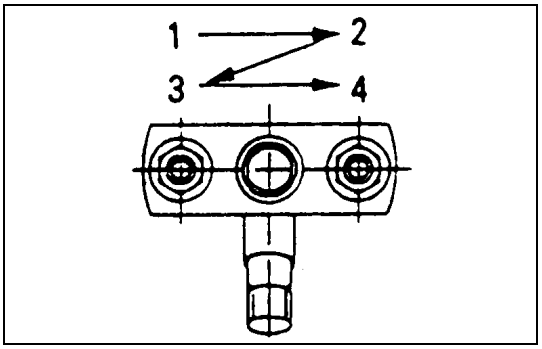
    Above works refer to “CAMSHAFT ASSEMBLY” section in this manual.

9. **Rocker Arm shaft Assembly**

    Above works refer to “ROCKER ARM SHAFT ASSEMBLY” section in this manual.

8. **Head Cover Gasket**
7. **Cylinder Head Cover**

    Above works refer to “CYLINDER HEAD COVER” section in this manual.

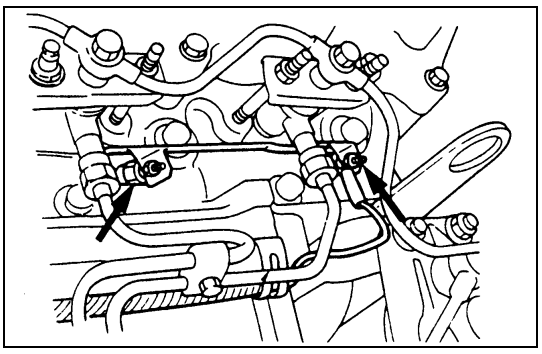


6A3-36-1.tif

6. **Injection Nozzle Holder Assembly**

    Tighten the nozzle holder flange nuts to the specified torque in the numerical order shown in the illustration.

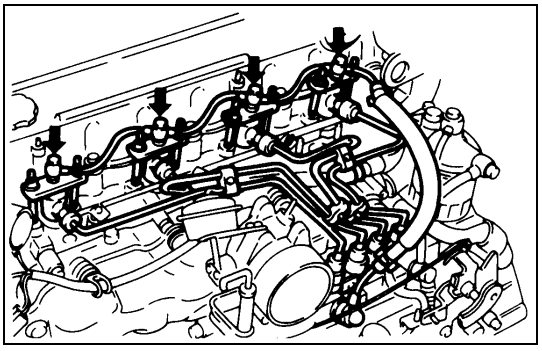
Nozzle Holder Flange Nut Torque	N•m (kg•m/lb•ft)
	19 (1.9/14)


6A3-36-2.tif

5. **Glow Plug**

Glow Plug Torque	N•m (kg•m/lb•ft)
	23 (2.3/17)

4. **Glow Plug Connector**

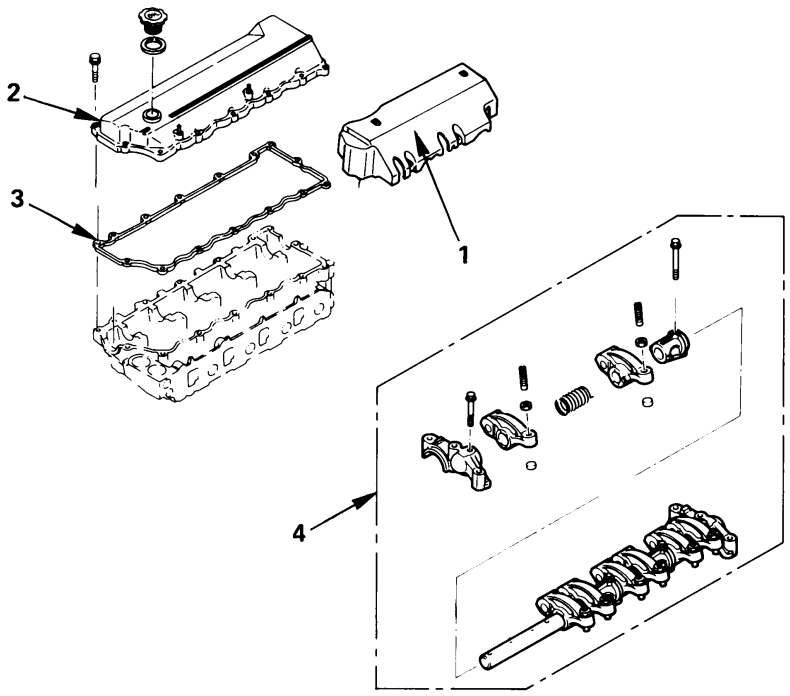

6A3-36-3.tif

3. **Injection Pipe**
2. **Leak Off Pipe**

    Above works refer to “INJECTION PUMP ASSEMBLY” section in this manual.

1. **Nozzle Cover**
    - Connect the negative battery cable
    - Lower the cab
    - Start engine and check for fuel leakage carefully.

ROCKER ARM SHAFT ASSEMBLY



Removal steps
1. Nozzle cover
2. Cylinder head cover
3. Cylinder head cover gasket
4. Rocker arm shaft assembly

Installation steps
To install, follow the removal steps in the reverse order.

6A3-37-1.tif

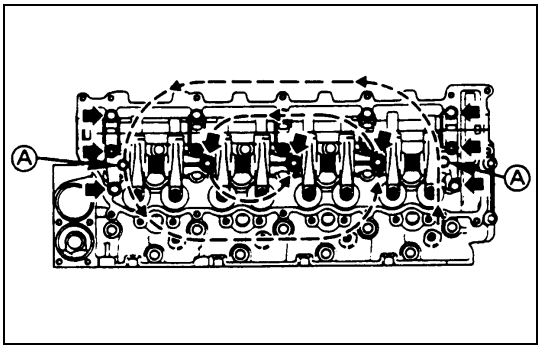
REMOVAL

Preparation
- Disconnect battery ground cable.
- Tilt the cab.

1. Nozzle Cover

2. Cylinder Head Cover

3. Cylinder Head Cover Gasket



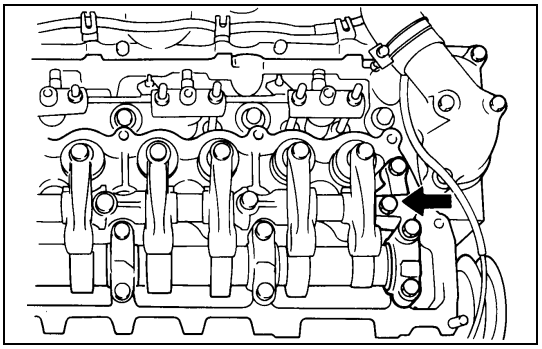
6A3-37-2.tif

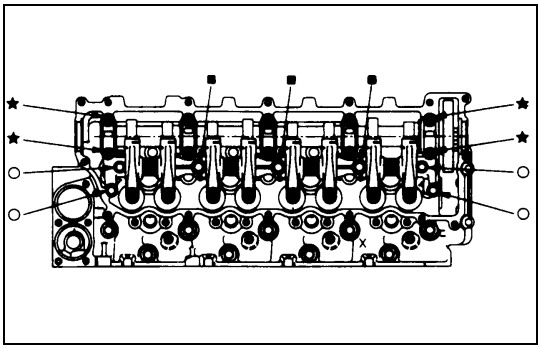
4. Rocker Arm Shaft Assembly

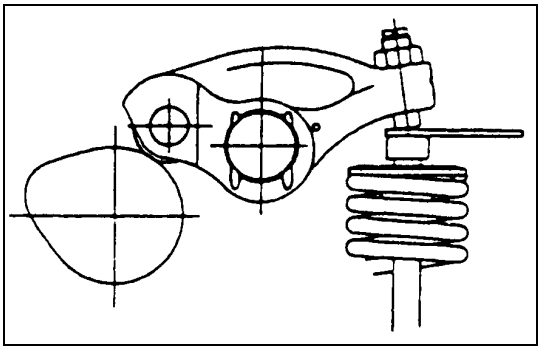
1) Loosen the rocker arm shaft bracket nuts and bolts in numerical order a little at a time and remove the rocker arm shaft assembly with the camshaft brackets.
2) Leave the Ⓐ indicated bolt unremoved on this occasion, since it is the rocker arm fixing bolt.

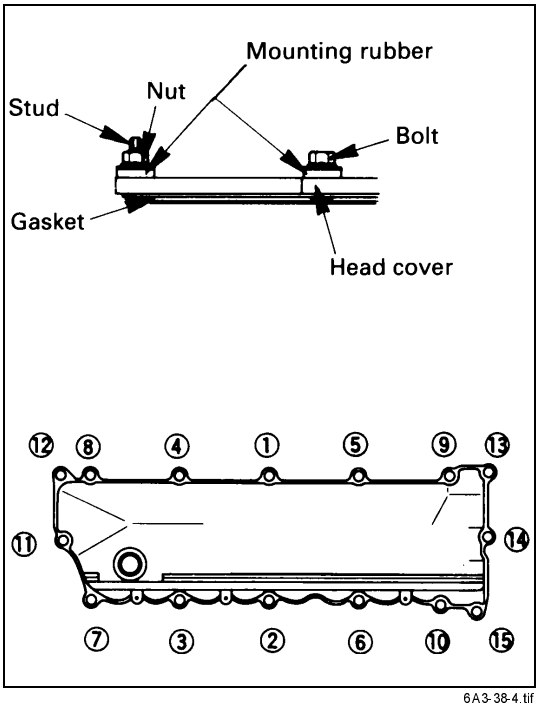
CAUTION:

Failure to loosen the rocker arm shaft bracket nuts and bolts in numerical order a little at a time will adversely affect the rocker arm shaft.


6A3-38-1.tif


6A3-38-2.tif


6A3-38-3.tif



6A3-38-4.tif

INSTALLATION

4. Rocker Arm Shaft Assembly

1) Slightly loosen the bolts marked with the arrow in the illustration.
2) Loosen the rocker arm adjust screws and apply engine oil to the rocker arm roller portions.
3) Install the rocker arm assembly on the cylinder head.
4) Tighten the rocker arm shaft breaker nuts and bolts to the specified torque in numerical order a little at a time as shown in the illustration.

Rocker Arm Shaft Bracket Nut and Bolt Torque — N•m (kg•m/lb•ft)

★ Nut	27 (2.8/20)
■ Bolt	56 (5.7/41)
□ Bolt	27 (2.8/20)

5) Apply engine oil to the threaded portion of the nuts marked with "★" and the bolts with "■" shown in the illustration left, and then tighten them to the specified torque.

Adjust the valve clearance.

Valve Clearance — mm (in)

At cold	0.4 (0.016)

Above works refer to "SERVICING" VALVE CLEARANCE ADJUSTMENT" previously section in this manual.

3. Head Cover Gasket

Install the gasket to the cylinder head cover.

2. Cylinder Head Cover

1) Install the cylinder head cover.
2) Tighten the cylinder head cover nuts and bolts to the specified torque in the numerical order shown in the illustration.

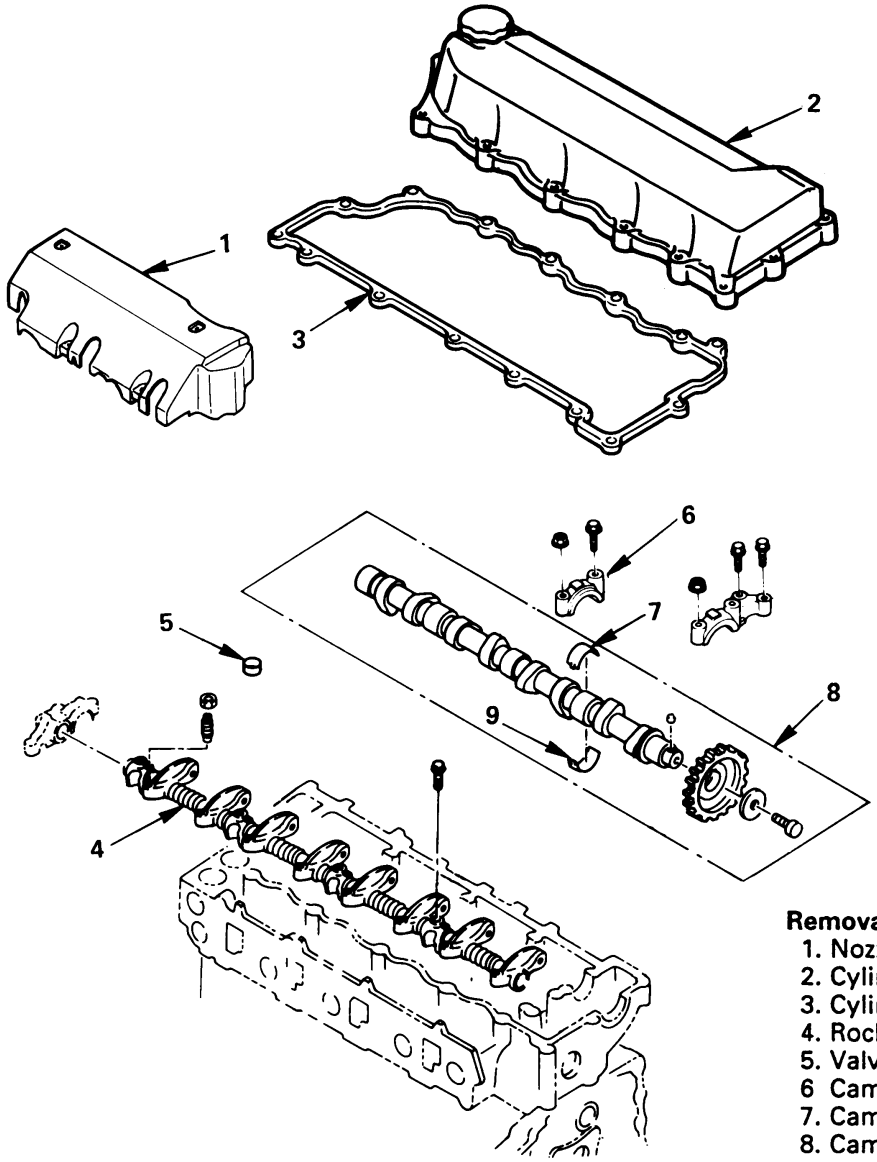
Cylinder Head Cover Nut and Bolt Torque — N•m (kg•m/lb•ft)

18 (1.8/13)

1. Nozzle Cover

- Connect the battery ground cable.
- Lower the cab.
- Start the engine and check for the oil leakage carefully.

CAMSHAFT ASSEMBLY



Removal steps
1. Nozzle cover
2. Cylinder head cover
3. Cylinder head cover gasket
4. Rocker arm shaft assembly
5. Valve cap
6 Camshaft bearing cap
7. Camshaft bearing upper
8. Camshaft assembly
9. Camshaft bearing lower

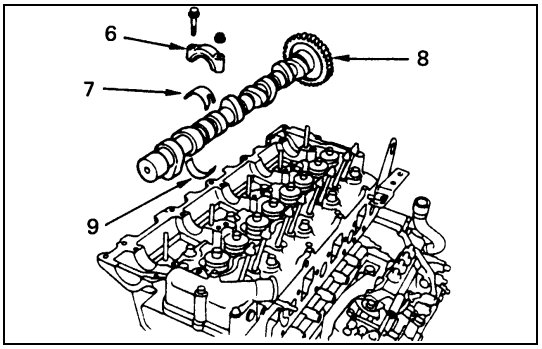
Installation steps
To install, follow the removal steps in the reverse order.

6A3-39-1.tif

REMOVAL

Preparation
- Disconnect battery ground cable.
- Tilt the cab.

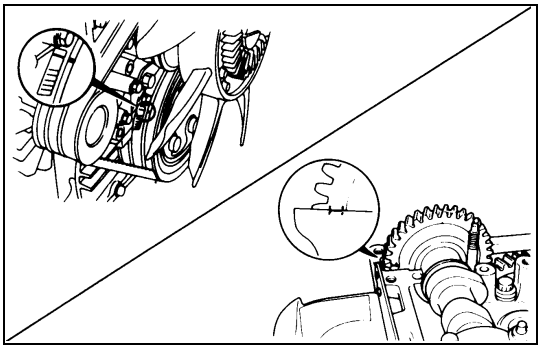
1. **Nozzle Cover**
2. **Cylinder Head Cover**
3. **Cylinder Head Cover Gasket**



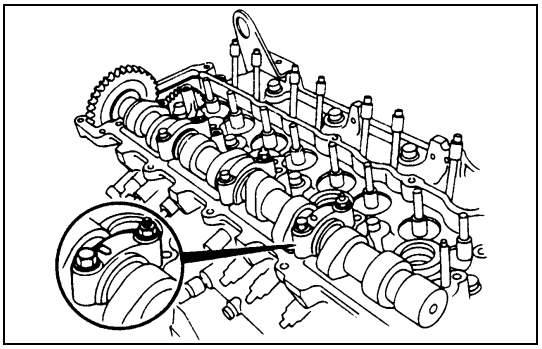
6A3-40-1.tif

4. **Rocker Arm Shaft Assembly**
   Above works refer to “ROCKER ARM SHAFT ASSEMBLY” section in this manual.
5. **Valve Cap**
6. **Camshaft Bearing Cap**
7. **Camshaft Bearing Upper**
8. **Camshaft Assembly**
9. **Camshaft Bearing Lower**
   - If the camshaft bearings are to be reinstalled, mark their fitting positions by tagging each bearing with the cylinder number from which it was removed.

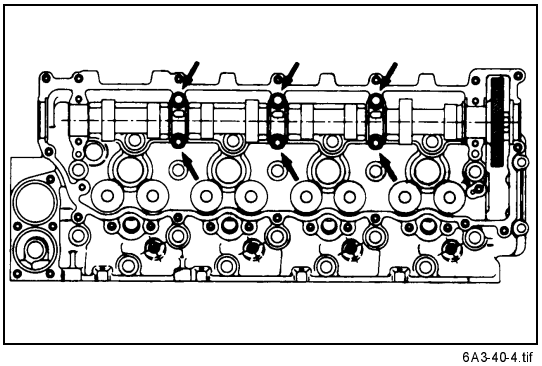
INSTALLATION


6A3-40-2.tif

9. **Camshaft Bearing Lower**
8. **Camshaft Assembly**
   1) Turn the crankshaft in the direction of normal rotation until the timing mark on the crankshaft damper pulley is aligned with the TDC notched line.
   2) Apply engine oil to the camshaft journal and the camshaft bearing surfaces before installation.
   3) Carefully align the camshaft gear “I” mark and the cylinder head upper face shown in the illustration.

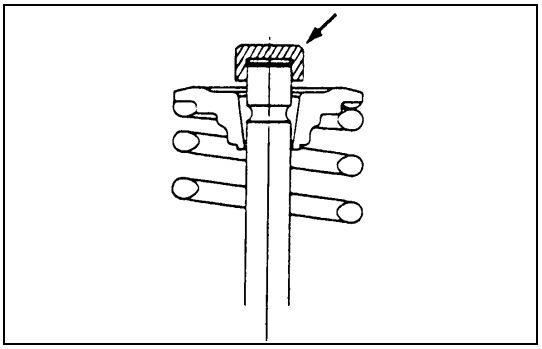

6A3-40-3.tif

7. **Camshaft Bearing Upper**
6. **Camshaft Bearing Cap**
   - Install the bearing caps with the bearing cap head mark (arrow) facing forward.
   - Apply a coat of engine oil to the bearing cap bolt and stud threads.


6A3-40-4.tif

- Tighten the bearing cap bolts and studs to the specified torque.

Camshaft Bearing Cap Nut and Bolt Torque	N•m (kg•m/lb•ft)
	27 (2.8/20)



6A3-41-1.tif

5. Valve Cap

1. Apply engine oil to the inside of the valve caps and install them to the valve stem end.

CAUTION:

Take sufficient care not to let valve caps fall into the gear.

4. Rocker Arm Shaft Assembly

Above works refer to “ROCKER ARM SHAFT ASSEMBLY” section in this manual.

3. Cylinder Head Cover Gasket

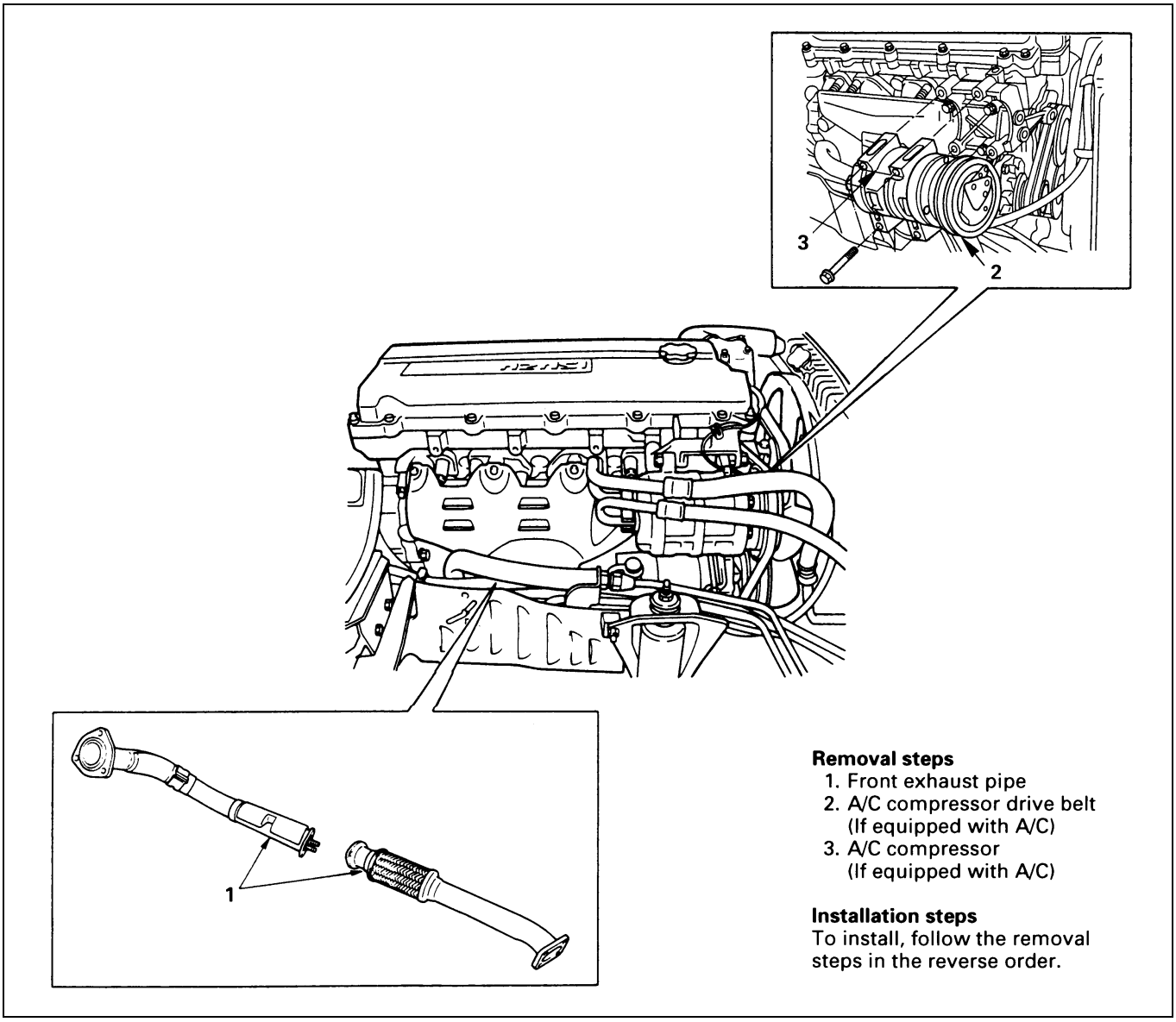
2. Cylinder Head Cover

Above works refer to “CYLINDER HEAD COVER” section in this manual.

1. Nozzle Cover

- Connect the battery ground cable.
- Lower the cab.
- Start engine and check for oil leakage carefully.

CYLINDER HEAD
(Engine right side)



Removal steps
1. Front exhaust pipe
2. A/C compressor drive belt (If equipped with A/C)
3. A/C compressor (If equipped with A/C)

Installation steps
To install, follow the removal steps in the reverse order.

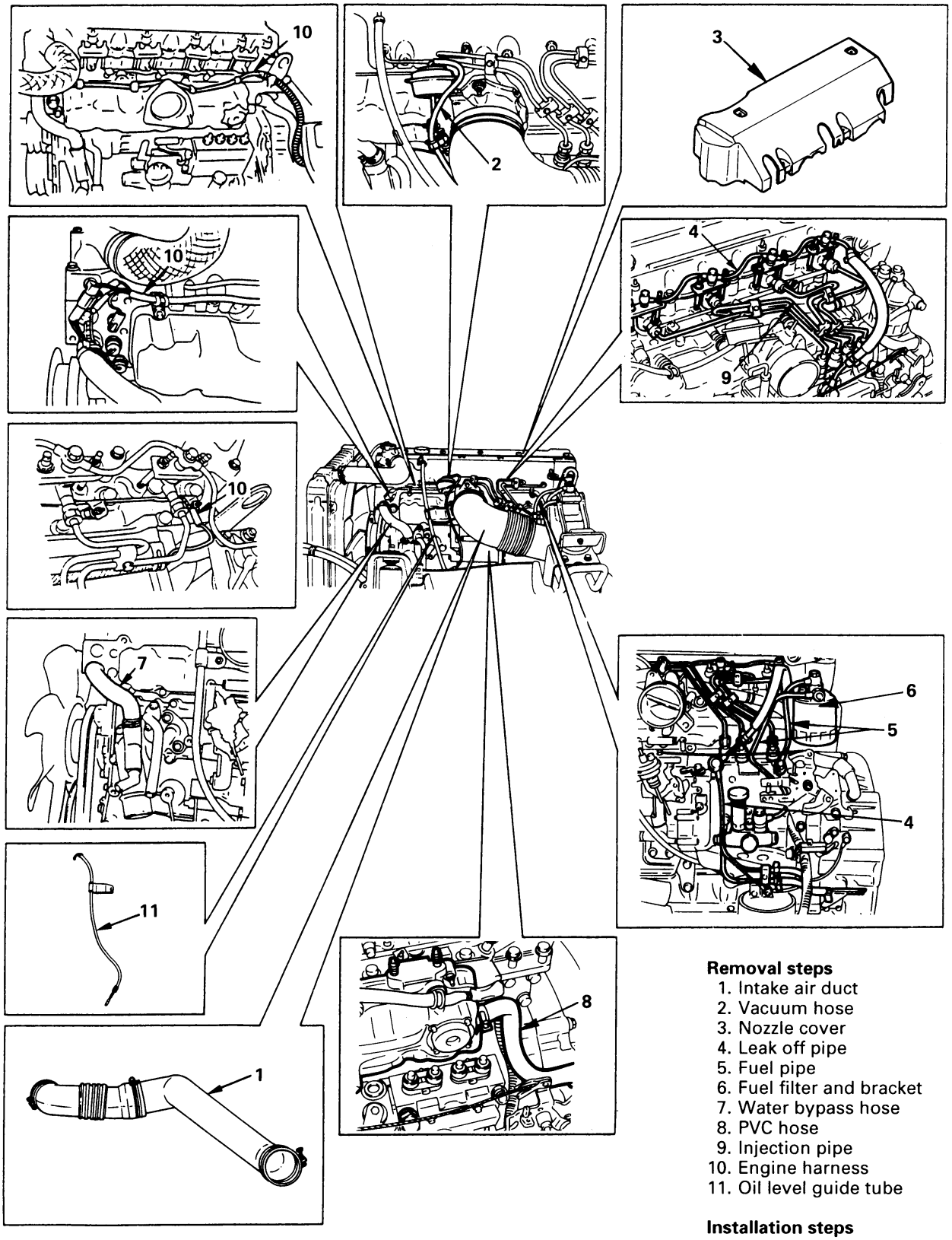
6A3-42-1.tif

REMOVAL

Preparation
- Disconnect battery ground cable
- Tilt the cab.
- Drain coolant

1. **Front Exhaust Pipe**
2. **Air Conditioning (A/C) Compressor Drive Belt (If equipped with A/C)**
3. **A/C Compressor (If equipped with A/C)**
   1) Disconnect magnetic clutch harness connector.
   2) Dismount the compressor together with the hoses from the A/C compressor bracket, and fasten it with a wire to the appropriate location.

(Engine left side)



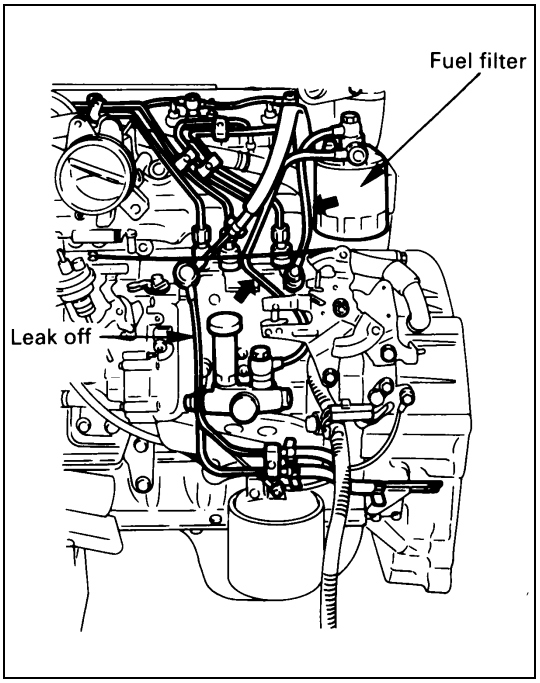
Removal steps
1. Intake air duct
2. Vacuum hose
3. Nozzle cover
4. Leak off pipe
5. Fuel pipe
6. Fuel filter and bracket
7. Water bypass hose
8. PVC hose
9. Injection pipe
10. Engine harness
11. Oil level guide tube

Installation steps
To install, follow the removal steps in the reverse order.

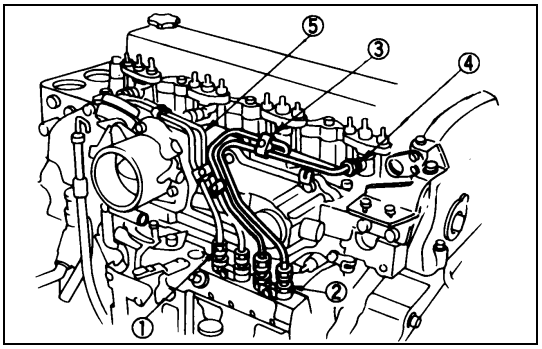
6A3-43-1.tif

REMOVAL

1. **Intake Air Duct**
   1) Remove the clips at the connections with the inlet cover and with the air cleaner.
   2) Remove the intake air duct with the connecting hoses attached.
2. **Vacuum Hose**
3. **Nozzle Cover**
4. **Leak Off Pipe**
5. **Fuel Pipe**
6. **Fuel filter & Bracket**
7. **Water Bypass Hose**
8. **Positive Crankcase Ventilation (PCV) Hose**

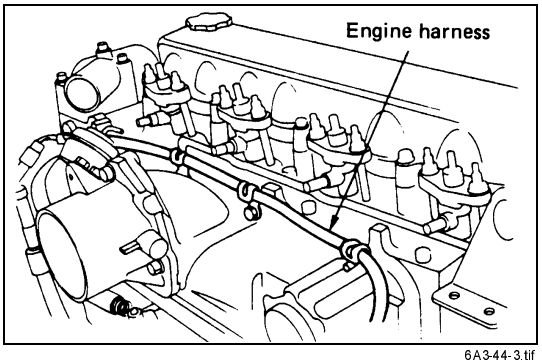


6A3-44-1.tif



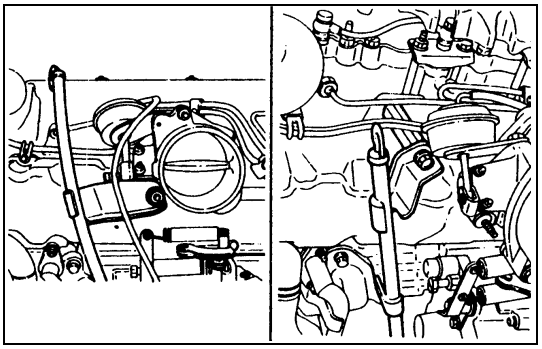
6A3-44-2.tif

9. **Injection Pipe**
   1) Loosen the injection pipe sleeve nuts ①.
      Do not apply excessive force to the injection pipes ⑤.
   2) Loosen the injection pipes clips ③.
   3) Remove the injection pipe assembly.
      Plug the delivery valve holder ② ports and nozzle holder ④ ports with caps to prevent the entry of foreign material.



6A3-44-3.tif

10. **Engine Harness**
    Disconnect thermometer unit, thermo switch, tachometer sensor and glow plug harness connectors an separate harness from clips.

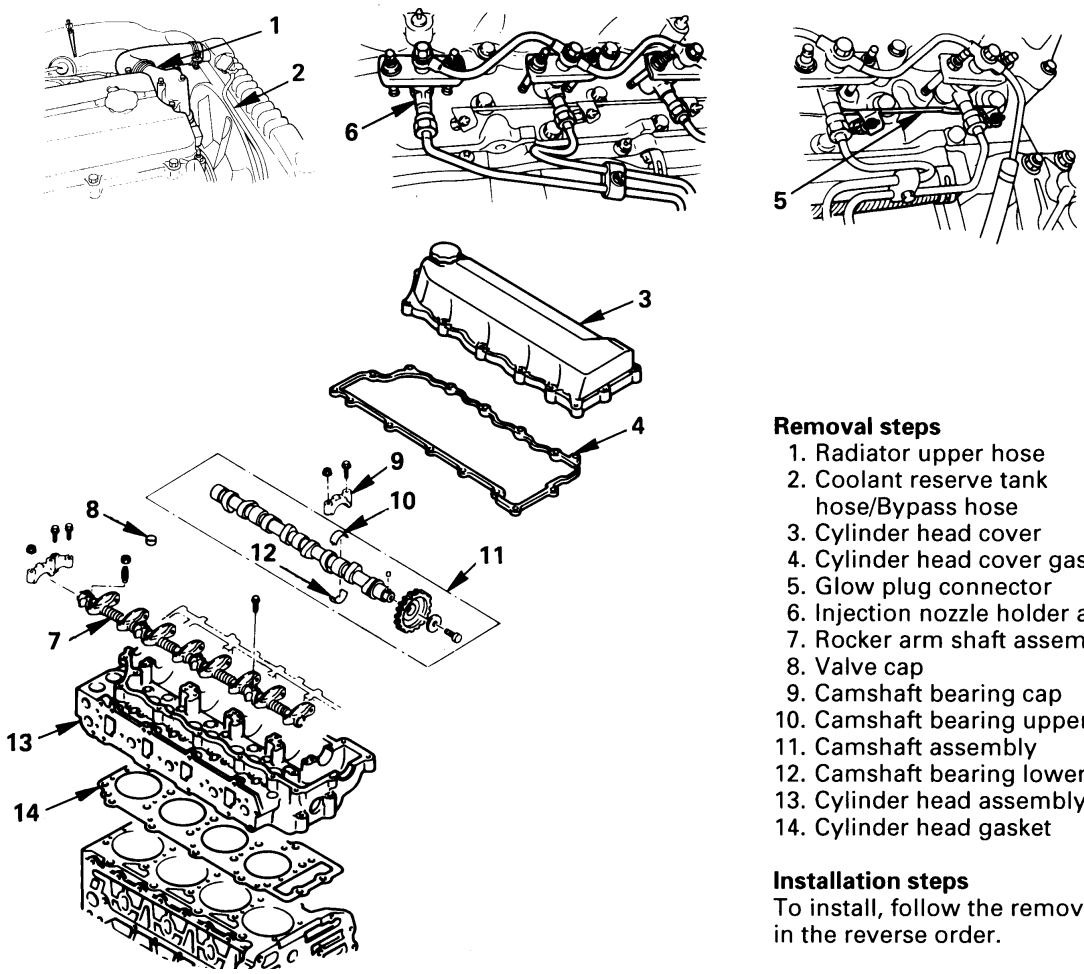


6A3-45-1.tif

11. Oil Level Gauge Guide Tube

Remove the guide tube fixing bolt and pull out the guide tube.

(Cylinder head side)



Removal steps

1. Radiator upper hose
2. Coolant reserve tank hose/Bypass hose
3. Cylinder head cover
4. Cylinder head cover gasket
5. Glow plug connector
6. Injection nozzle holder assembly
7. Rocker arm shaft assembly
8. Valve cap
9. Camshaft bearing cap
10. Camshaft bearing upper
11. Camshaft assembly
12. Camshaft bearing lower
13. Cylinder head assembly
14. Cylinder head gasket

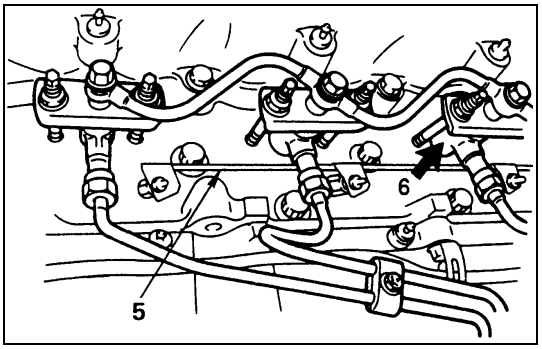
Installation steps

To install, follow the removal steps in the reverse order.

6A3-45-2.tif

REMOVAL

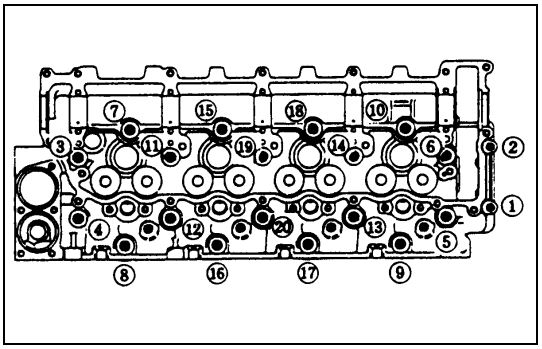
1. **Radiator Upper Hose**
2. **Coolant Reserve Tank Hose/Bypass Hose**
3. **Cylinder Head Cover**
4. **Cylinder Head Cover Gasket**



6A3-46-1.tif

5. **Glow Plug Connector**
6. **Injection Nozzle Holder Assembly**
   Mark the nozzle holder assemblies fitting positions by tagging each nozzle holder assembly with the cylinder number from which it was removed.

7. **Rocker Arm Shaft Assembly**
8. **Valve Cap**
9. **Camshaft Bearing Cap**
10. **Camshaft Bearing Upper**
11. **Camshaft Assembly**
12. **Camshaft Bearing Lower**
    Above works refer to “ROCKER ARM SHAFT ASSEMBLY AND CAMSHAFT ASSEMBLY” section in this manual.



6A3-46-2.tif

13. **Cylinder Head Assembly**
    Loosen the cylinder head bolts in numerical order a little at a time.

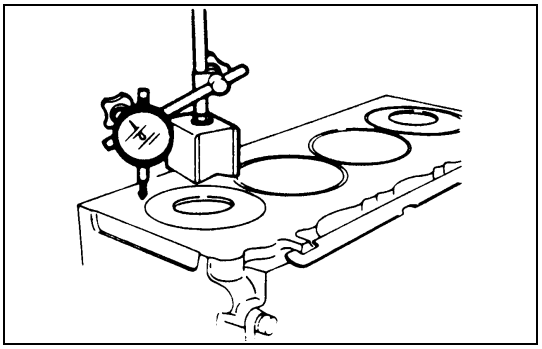
CAUTION:
Failure to loosen the cylinder head bolts in numerical order a little at a time will adversely affect the cylinder head lower surface.

14. **Cylinder Head Gasket**

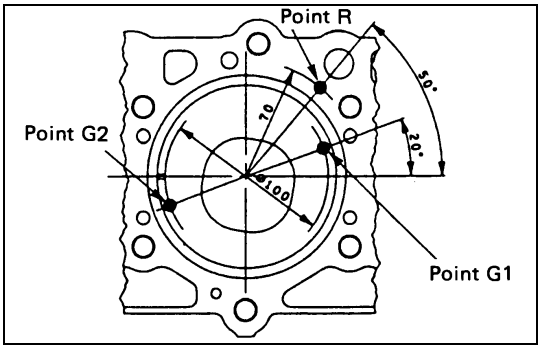
CAUTION:
Do not reuse the cylinder head gasket.

INSTALLATION

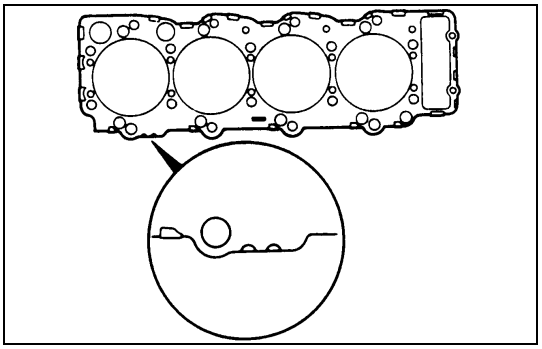
14. **Cylinder Head Gasket**
    1) When any of the cylinder block, crankshaft, crankshaft bearing, connecting rod, connecting rod bearing, and piston is replaced with a new one, cylinder head gasket thickness ahold be determined newly.
    2) When replacing the cylinder head gasket alone without replacing any of the parts mentioned in 1) above, the gasket to be used should be the same grade as the one used before.
    3) Correct cylinder head gasket thickness is important. Installing the wrong thickness gasket can result in greatly reduced engine performance.
    4) There are three cylinder head gaskets available.



6A3-47-1.tif



6A3-47-2.tif



6A3-47-3.tif

Piston Head Projection Measurement

- Select a cylinder head gasket.
- Clean thoroughly the top faces of the piston head and the cylinder body.
- Use the dial gauge to measure the piston head projection. Take measurements at two location for each cylinder.
- The measurement points of the piston head and the reference point of the cylinder body are shown in the illustration left.

Measurement points : Points G1 and G2 of the piston head
Reference point : Point R on the top face of the cylinder body

NOTE:

Note that there are three types of a cylinder head gasket available as below, according to the piston projection.

- For each cylinder, calculate the average value (Ti) of the piston projection.
- Find the maximum value (Timax) of the average of each cylinder.
- Based on the Timax obtained, select a gasket of the appropriate grade.

4HF1/4HF1-2/4HG1-T

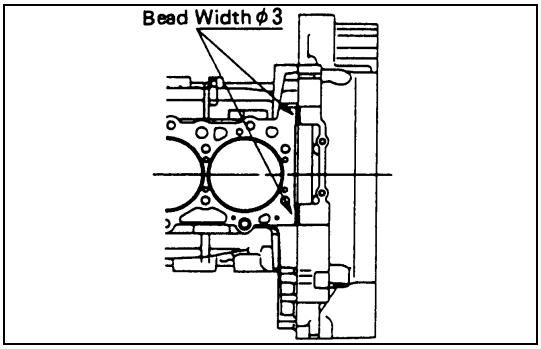
Cylinder Head Gasket Selection mm (in)

Gasket Grade	Ti max	Gasket Thickness (Reference)
A	0.579 - 0.659 (0.0228 - 0.0259)	1.70 (0.0669)
B	0.659 - 0.739 (0.0259 - 0.0291)	1.75 (0.0689)
C	0.739 - 0.819 (0.0291 - 0.0322)	1.80 (0.0708)

4HE1-T/4HE1-TC

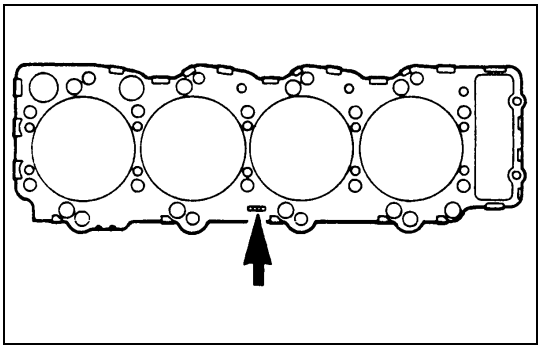
Cylinder Head Gasket Selection mm (in)

Gasket Grade	Ti max	Gasket Thickness (Reference)
A	0.529 - 0.609 (0.0208 - 0.0240)	1.70 (0.0669)
B	0.609 - 0.679 (0.0240 - 0.0267)	1.75 (0.0689)
C	0.679 - 0.759 (0.0267 - 0.0300)	1.80 (0.0708)



6A3-48-1.tif

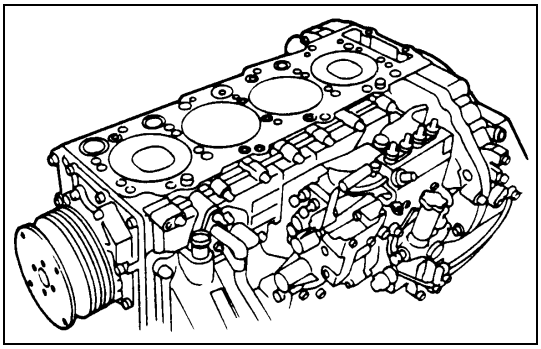
5) Apply a 3mm (0.1 inch) bead or recommended liquid gasket (Three Bond 1207C) or its equivalent to the shaded areas shown in the illustration.


6A3-48-2.tif

6) Install the cylinder head gasket with its “PART NUMBER” mark facing up and toward the left of the engine.

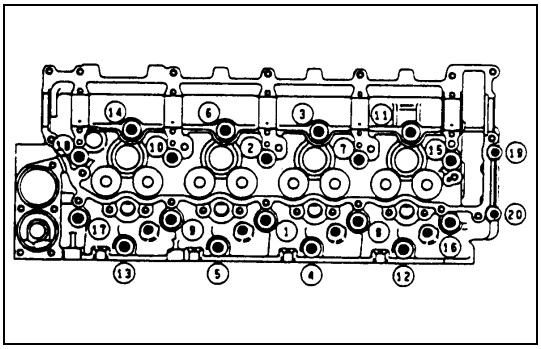
CAUTION:

Do not reuse the cylinder head gasket.


6A3-48-3.tif

13. Cylinder Head Assembly

1) Align the cylinder body dowels and the cylinder head dowel holes.
2) Carefully place the cylinder head on the cylinder head gasket.
3) Apply a coat of molybdenum disulfide grease to the M14 cylinder head bolt threads and setting faces and apply a coat of engine oil to the M10 cylinder head bolt threads and setting faces.
4) Use the angular tightening method to tighten the bolts (M14) to the specified torque in three steps following the numerical order shown in the illustration.



6A3-48-4.tif

Cylinder Head Bolt Torque

(M14) (① ~ ⑱)		N•m (kg•m/lb•ft)
1st Step	2nd Step	3rd Step
98 (10/72)	147 (15/108)	30° - 60°

5) Tighten the cylinder head to the flywheel housing bolts (M10) to the specified torque.

Cylinder Head Bolt Torque

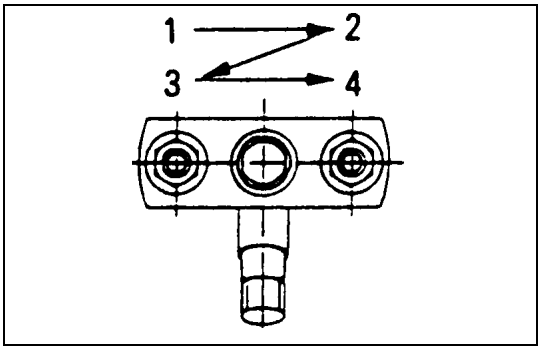
(M10) (19 ~ 20)	N•m (kg•m/lb•ft)
38 (3.9/28)	

12. **Camshaft Bearing Lower**
11. **Camshaft Assembly**
10. **Camshaft Bearing Upper**
9. **Camshaft Bearing Cap**
8. **Valve Cap**

Above works refer to “CAMSHAFT ASSEMBLY” section in this manual.

7. **Rocker Arm Shaft Assembly**

Above works refer to “ROCKER ARM SHAFT ASSEMBLY” section in this manual.



6A3-49-1.tif

6. **Injection Nozzle Holder Assembly**

Tighten the nozzle holder flange nuts to the specified torque in the numerical order shown in the illustration.

Nozzle Holder Flange Nut Torque	N•m (kg•m/lb•ft)
	19 (1.9/14)

5. **Glow Plug Connector**
4. **Head Cover Gasket**

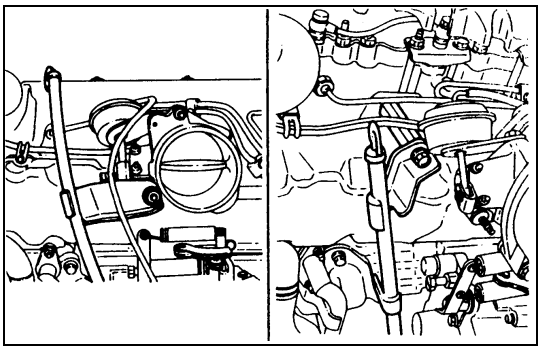
Install the gasket to the cylinder head cover.

3. **Cylinder Head Cover**

Above works refer to “CYLINDER HEAD COVER” section in this manual.

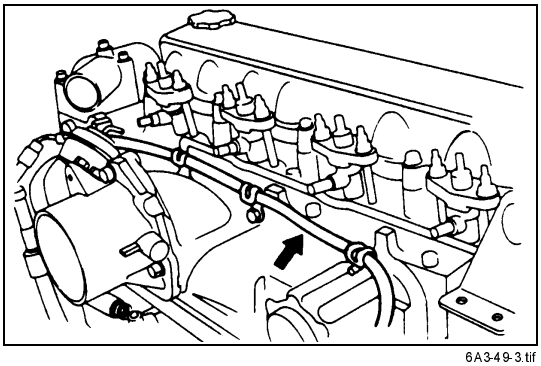
2. **Coolant Reserve Tank Hose/Bypass Hose**
1. **Radiator Upper Hose**

INSTALLATION (Engine left side)


6A3-49-2.tif

11. **Oil Level Gauge Guide Tube**
    1) Install the O-rings to the guide tube lower portion and insert the guide tube completely to the cylinder body.
    2) Tighten the guide tube bolt to the specified torque.

Guide Tube Bolt Torque	N•m (kg•m/lb•in)
	13 (1.3/113)

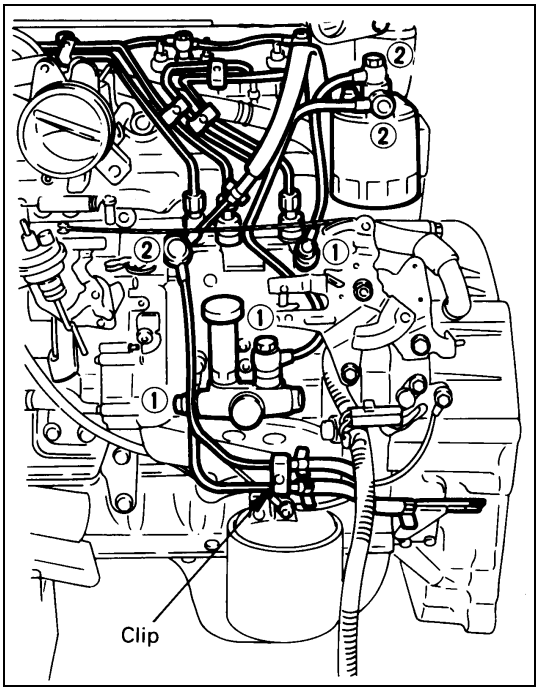

6A3-49-3.tif

10. **Engine Harness**

Connect thermometer unit, thermo switch, tachometer sensor and glow plug harness connector and fasten the engine harness with clips.

9. **Fuel Injection Pipe Assembly**
   Above works refer to “INJECTION PUMP ASSEMBLY” section in this manual.
8. **Positive Crankcase Ventilation (PCV) Hose**
7. **Water Bypass Hose**
6. **Fuel Filter & Bracket**

Fuel Filter Bracket Torque	N•m (kg•m/lb•ft)
	34 (3.5/25)



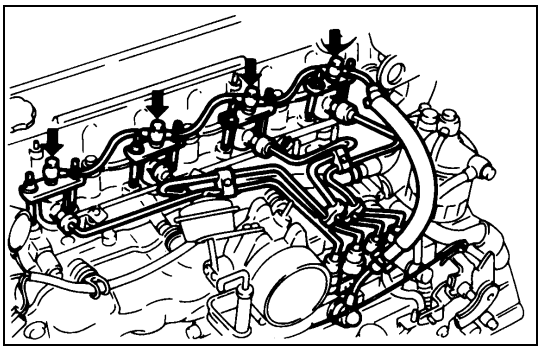
6A3-50-1.tif

5. **Fuel Pipe**
   Do not apply excessive force to the fuel pipe.

Fuel Pipe Joint Bolt ① Torque	N•m (kg•m/lb•ft)
	41 (4.2/30)

Fuel Pipe Joint Bolt ② Torque	N•m (kg•m/lb•ft)
	23 (2.3/17)

Clip Screw Torque	N•m (kg•m/lb•in)
	4 (0.4/35)

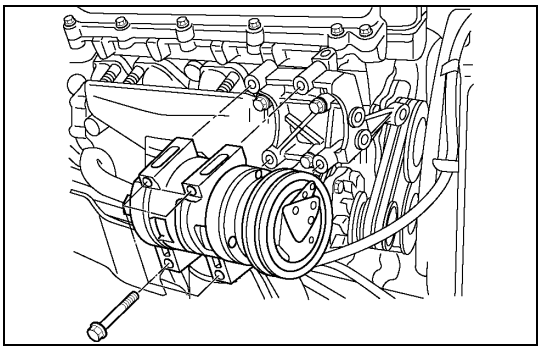

6A3-50-2.tif

4. **Leak Off Pipe**

Leak-off Pipe Joint Bolt Torque	N•m (Kg•m/lb•in)
	13 (1.3/113)

3. **Nozzle Cover**
2. **Vacuum Hose**
1. **Intake Air Duct**

INSTALLATION (Engine right side)



901LV058.tif

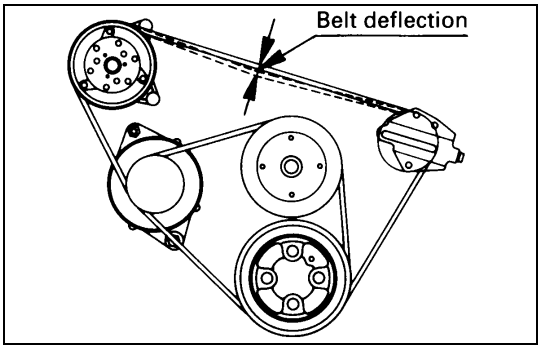
3. Air Conditioning (A/C) Compressor (If equipped with A/C)

Tighten fixing bolts to the specified torque.

A/C Compressor Bolt Torque	N•m (kg•m/lb•ft)
48 (4.9/35)	

Note:

When tightening the compressor fixing bolts, tighten first the 2 bolts on the rear side, and then the remaining 2 on the front side.



6A3-51-2.tif

2. A/C Compressor Drive Belt (If equipped with A/C)

1) Install drive belt adjust belt tension by adjusting bolt and tighten locking nut to the specified torque.
2) Depress the drive belt mid-portion with a 10kg (22lb/98N) force.

Drive Belt Deflection	mm (in)
16 - 20 (0.63 - 0.79)...New belt 18 - 22 (0.71 - 0.87)...Reuse belt	

Locking Nut Torque	N•m (kg•m/lb•ft)
27 (2.8/20)	

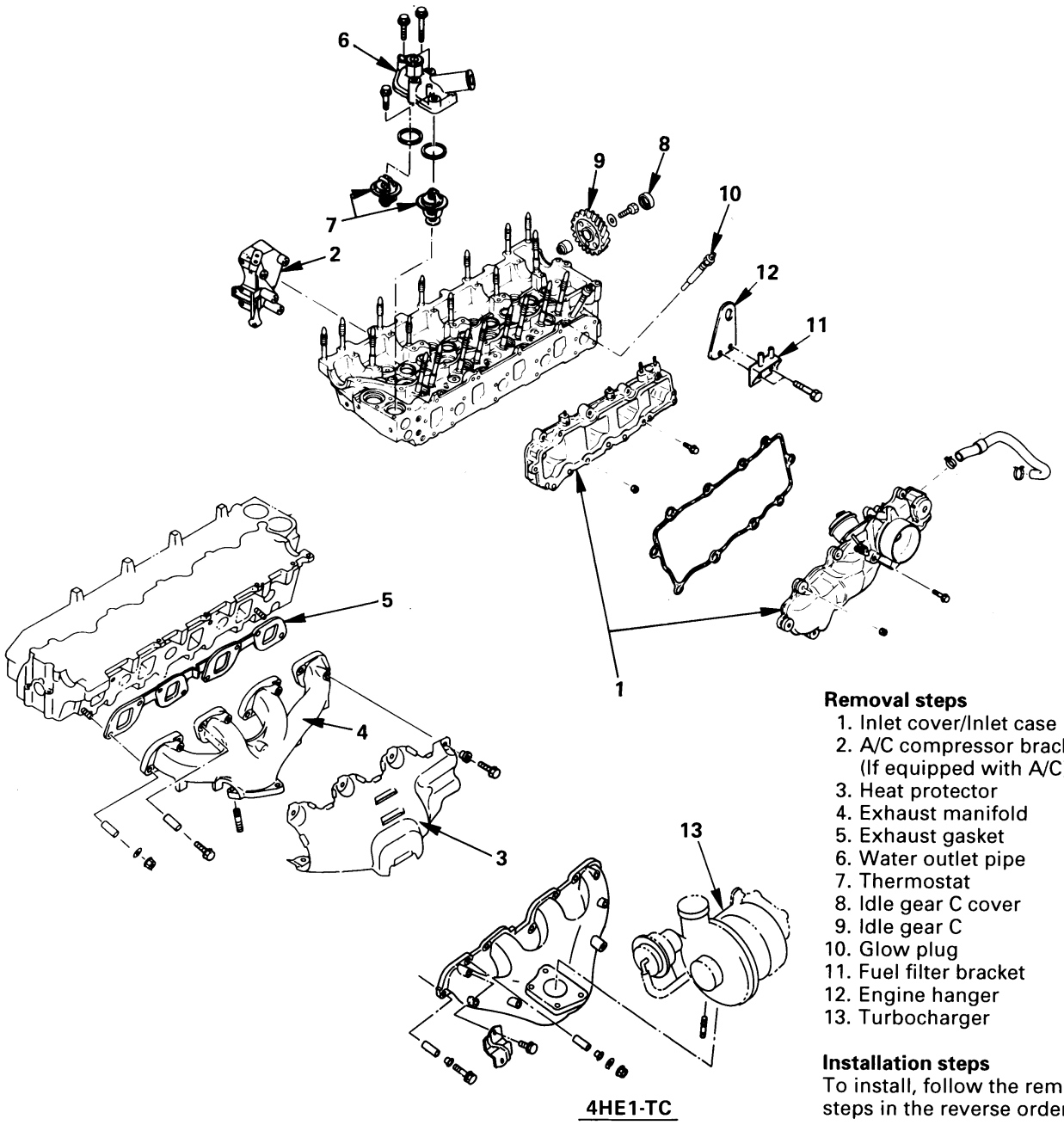
1. Front Exhaust Pipe

Exhaust Manifold Side Torque	N•m (kg•m/lb•ft)
67 (6.8/49)	

Exhaust Brake Side	N•m (kg•m/lb•ft)
17 (1.7/12)	

- Connect the negative battery cable.
- Lower the cab.
- Start engine and check for oil, fuel and water leakage care fully.

CIRCUMFERENCE PARTS OF CYLINDER HEAD



Removal steps
1. Inlet cover/Inlet case
2. A/C compressor bracket (If equipped with A/C)
3. Heat protector
4. Exhaust manifold
5. Exhaust gasket
6. Water outlet pipe
7. Thermostat
8. Idle gear C cover
9. Idle gear C
10. Glow plug
11. Fuel filter bracket
12. Engine hanger
13. Turbocharger

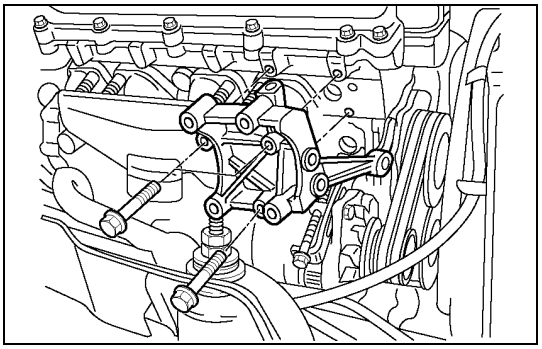
Installation steps
To install, follow the removal steps in the reverse order.

6A3-52-1.tif

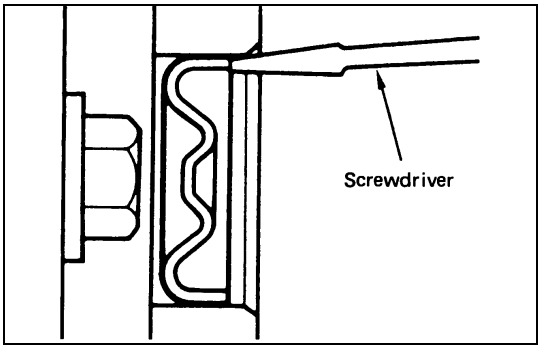
REMOVAL

Preparation

- Disconnect battery ground cable
- Tilt the cab
- Drain coolant
- Remove each part from the cylinder head assembly. For details, refer to the “CYLINDER HEAD” in this section.

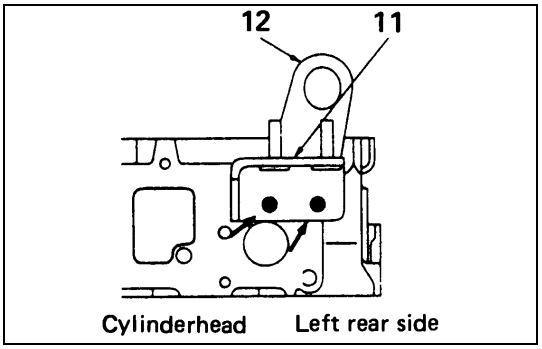

901LV057.tif

1. Inlet Cover/Inlet Case
2. Air Conditioning (A/C) Compressor Bracket (If equipped with A/C)
3. Heat Protector
4. Exhaust Manifold
5. Exhaust Gasket
6. Water Outlet Pipe
7. Thermostat



6A3-53-2.tif

8. Idle Gear C Cover
   Tap the outside of the sealing cup with a screwdriver to deform one end of it and draw it out with pliers.
9. Idle Gear C
10. Glow Plug



6A3-53-3.tif

11. Fuel Filter Bracket
12. Engine Hanger

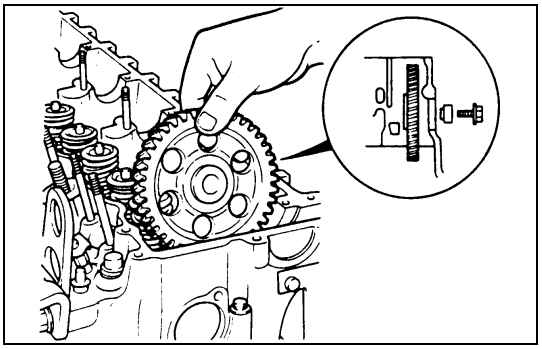
INSTALLATION

12. Engine Hanger
11. Fuel Filter Bracket

Fuel Filter Bracket Bolt Torque	N•m (kg•m/lb•ft)
	104 (10.6/77)

10. Glow Plug

Glow Plug Torque	N•m (kg•m/lb•ft)
	23 (2.3/17)

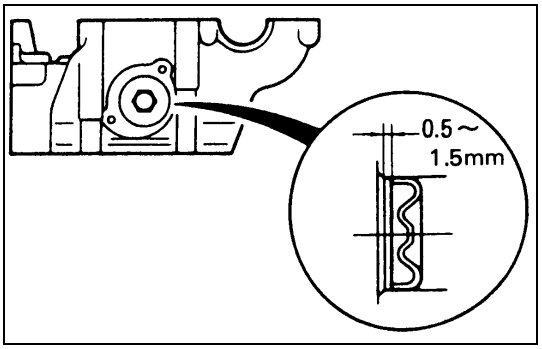


6A3-54-1.tif

9. Idle Gear C

1) Apply engine oil to the idle gear shaft, bushing and idle gear before installation.
2) Install the idle gear with the boss side facing to the camshaft as shown in the illustration.

Idle Gear C Bolt Torque	N•m (kg•m/lb•ft)
	95 (9.7/70)

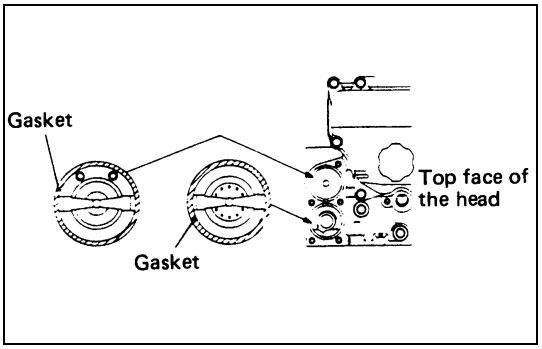


6A3-54-2.tif

8. Idle Gear C Cover

1) Apply the recommended liquid gasket (LOCTITE 262) or its equivalent to the outside of the sealing cup and install it to the cylinder head.
2) Use the sealing cup installer and a hammer to drive the sealing cup into position from the cylinder head side as shown in the illustration.

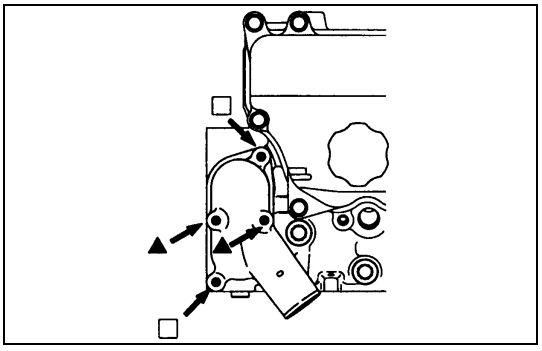
   Sealing Cup Installer: 5-8840-2222-0



6A3-54-3.tif

7. Thermostat

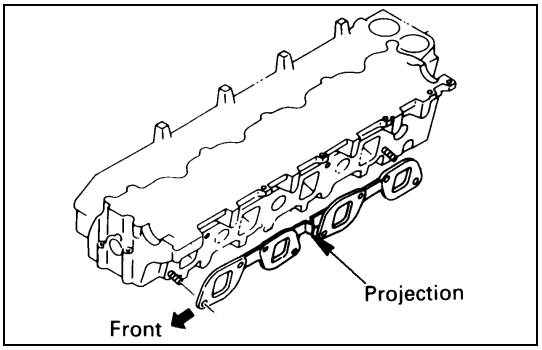
Install the gaskets to the thermostat and install them to the cylinder head as shown in the illustration.



6A3-54-4.tif

6. Water Outlet Pipe

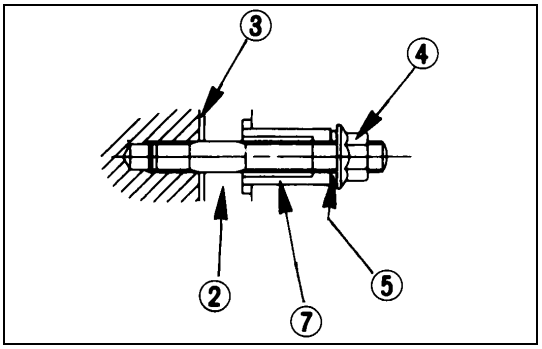
Water Outlet Pipe Bolt Torque	N•m (kg•m/lb•ft)
	24 (2.4/17)



6A3-54-5.tif

5. Exhaust Gasket

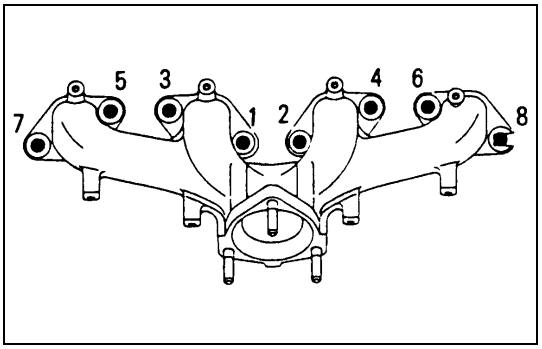
Insert the gasket into the stud provided to the cylinder head (with the projection of the gasket on this side).



6A3-55-1.tif

4. Exhaust Manifold

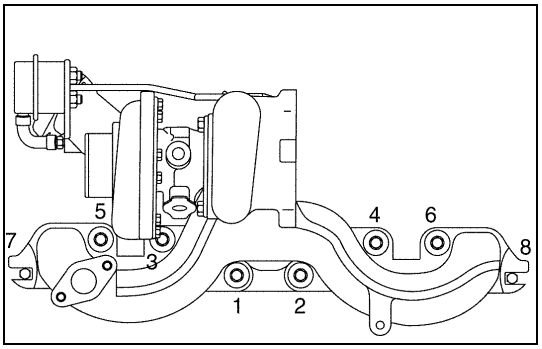
1. Install exhaust manifold gaskets ③, exhaust manifold ②, distance pieces ⑦, dish washers ⑤ and nuts ④ to the stud bolts shown in the illustration.



6A3-55-2.tif

2. Tighten the nuts to the specified torque in the numerical order shown in the illustration.

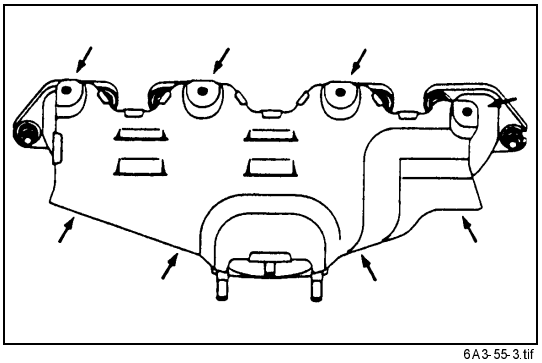
Exhaust Manifold Nut Torque	N•m (kg•m/lb•ft)
	34 (3.5/25)



036LX005.tif

3. Heat Protector

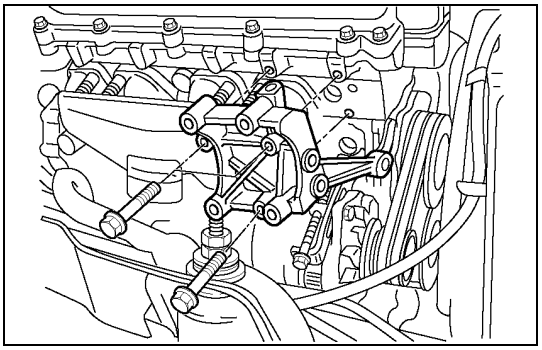
Heat Protector Bolt Torque	N•m (kg•m/lb•in)
	10 (1.0/87)

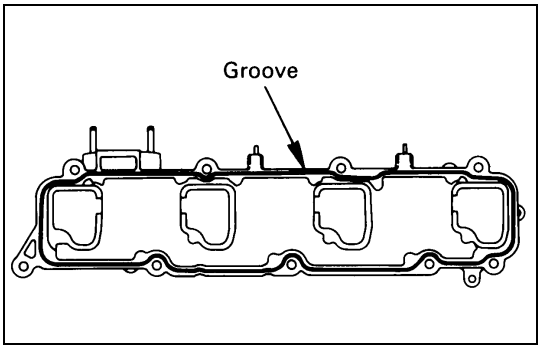

6A3-55-3.tif

2. Air Conditioning (A/C) Compressor Bracket (If equipped with A/C)

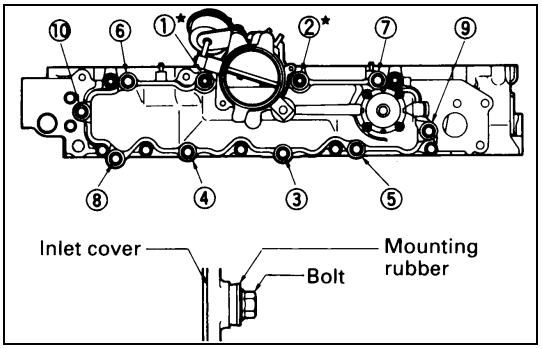
Tighten fixing bolts to the specified torque.

A/C Compressor Bracket Bolt Torque	N•m (kg•m/lb•ft)
	48 (4.9/35)


901LV057.tif



6A3-55-5.tif



6A3-56-1.tif

1. Inlet Cover/Inlet Case

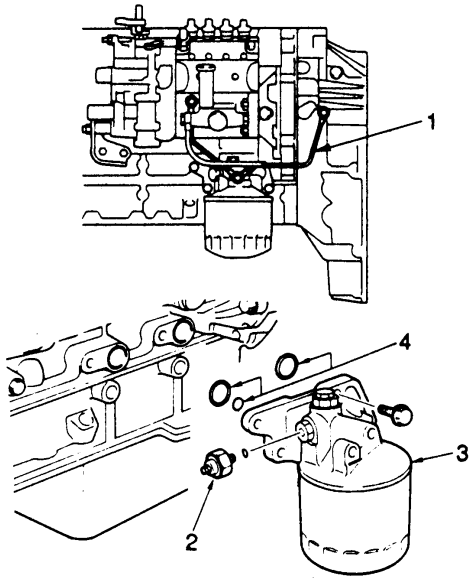
1) Apply 2mm-3mm (0.16-0.20 in) bead of the recommended liquid gasket (Three Bond 1207C)or its equivalent on the groove of the inlet case fitting surfaces shown in the illustration.
   - Clean the inlet case fitting surface of the cylinder head.
2) Install the inlet case to the cylinder head.
   - Install the inlet case within 7 minutes after application of liquid gasket.

- Attach harness clips (①, ⑥ and ⑦) and tighten the inlet cover bolts and nuts to the specified torque in the numerical order shown in the illustration.
- ★ marks are located on nut positions.

Inlet Cover Bolt and Nut Torque	N•m (kg•m/lb•ft)
13 (1.3/9)	

Referring to “CYLINDER HEAD” in this section, install the remaining parts.

OIL FILTER ASSEMBLY



Removal steps
1. Oil pipe
2. Oil pressure switch
3. Oil filter
4. O-ring

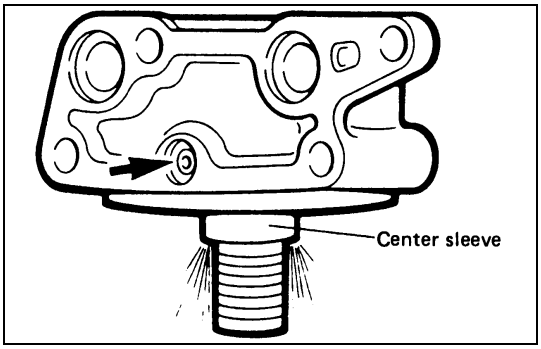
Installation steps
To install, follow the removal teps in the reverse order.

6A3-57-1.tif

REMOVAL

Preparation
- Disconnect battery ground cable.
- Place a receptacle beneath the oil filter to contain the drained oil.

1. **Oil Pipe**
2. **Oil Pressure Switch**
3. **Oil Filter Body**
4. **O-ring**

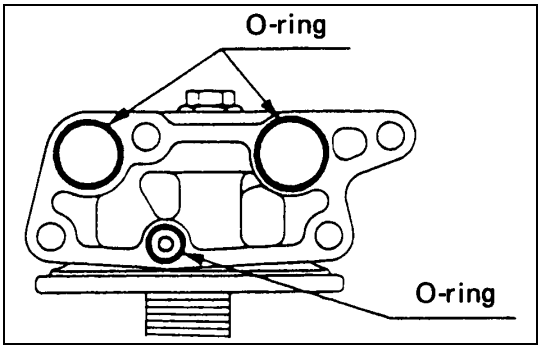


6A3-57-2.tif

INSPECTION

Oil Filter Cover

1. Check the partial filter orifice for any clogging.
2. Send air into the arrow-marked hole in the illustration, and check to see if the air blows out from the small holes in the center sleeve.

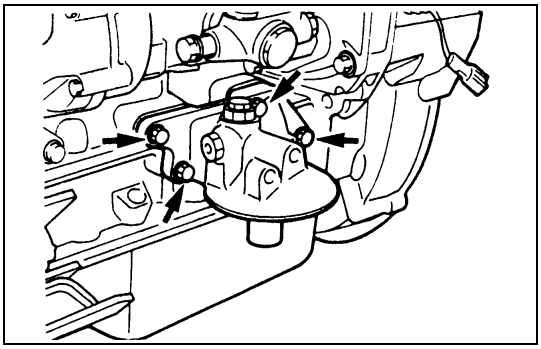


6A3-57-3.tif

INSTALLATION

4. **O-Ring**

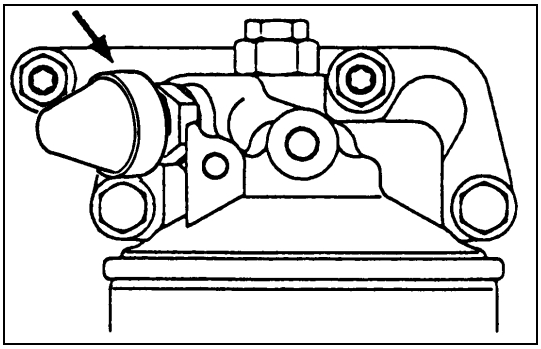
Apply a coat of engine oil to the O-rings and install them to the cylinder body.



6A3-58-1.tif

3. Oil Filter Body

Oil Filter Cover Bolt Torque	N•m (kg•m/lb•ft)
48 (4.9/35)	



6A3-58-2.tif

2. Oil Pressure Switch

1) Apply the recommended liquid gasket (LOCTITE 262) or its equivalent to at least 2-3 of the oil pressure switch threaded areas.
2) Install the oil pressure switch to the oil filter cover.

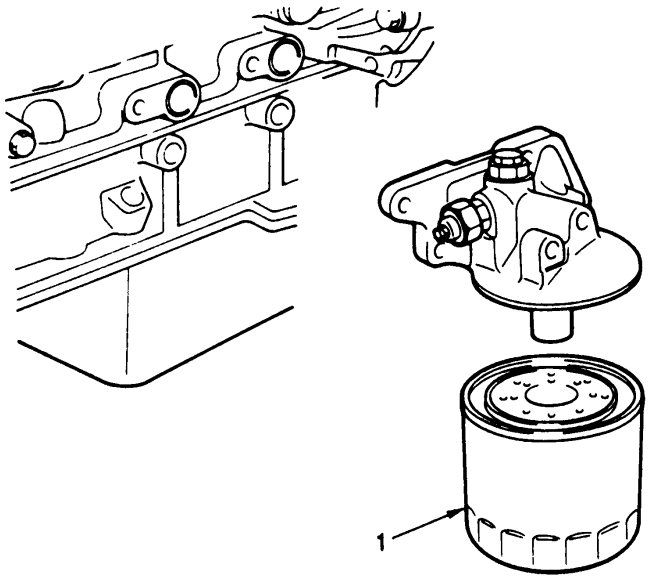
Oil Pressure Switch Torque	N•m (kg•m/lb•in)
13 (1.3/113)	

1. Oil Pipe

Oil Pipe Joint Bolt Torque	N•m (kg•m/lb•ft)
17 (1.7/12)	

- Connect battery ground cable.
- Start engine and check for oil leakage carefully.

OIL FILTER CARTRIDGE



Removal steps
1. Oil filter cartridge

Installation steps
To install, follow the removal steps in the reverse order.

6A3-59-1.tif

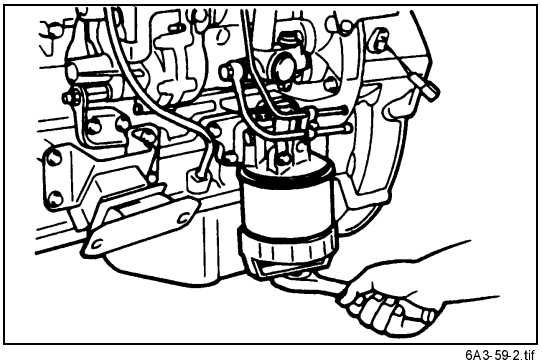
REMOVAL

Preparation
- Disconnect battery ground cable.
- Place a receptacle beneath the oil filter to contain the drained oil.

1. Oil Filter Cartridge

Use an oil filter wrench to remove the oil filter cartridge.

Oil Filter Wrench: 1-8522-1097-0
5-8840-2094-0 (4WD model)



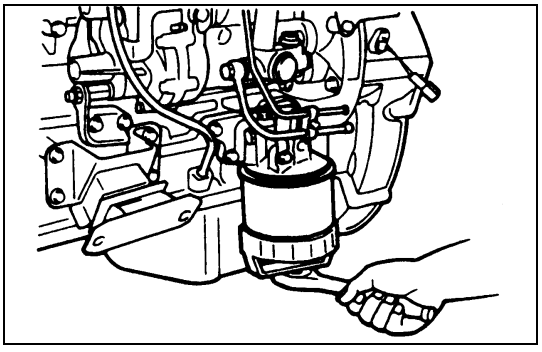
6A3-59-2.tif

INSTALLATION

1. Oil Filter Cartridge

1) Clean the oil filter fitting face.
2) Apply a light coat of engine oil to the O-ring.
3) Turn in the new oil filter until the filter O-ring is fitted against the sealing face.
4) Use an oil filter wrench to install the new oil filter cartridge.

Oil Filter Wrench: 1-8522-1097-0
5-8840-2094-0 (4WD model)

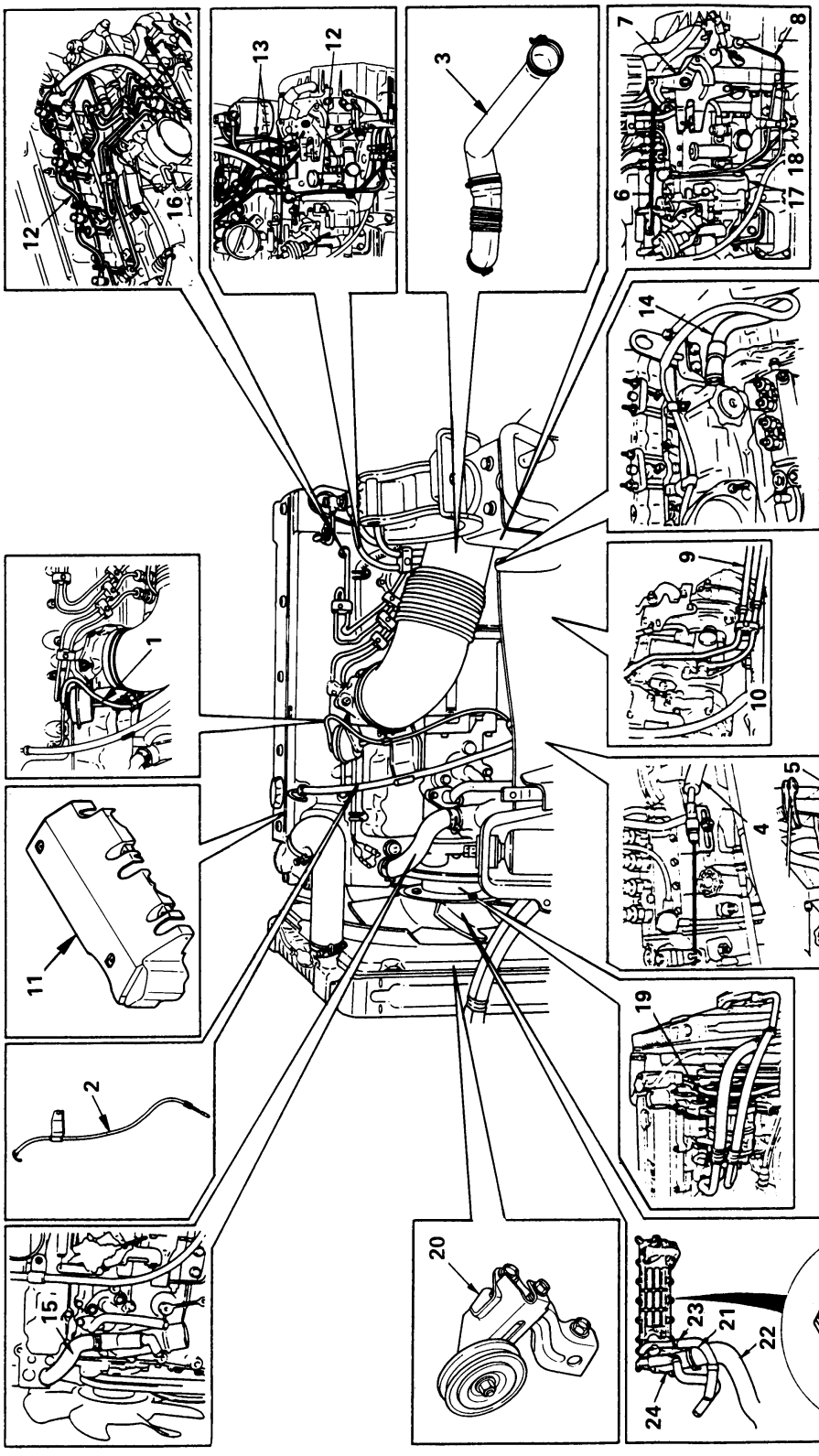


6A3-59-3.tif

N•m (kg•m/lb•ft)

64 (6.5/47)

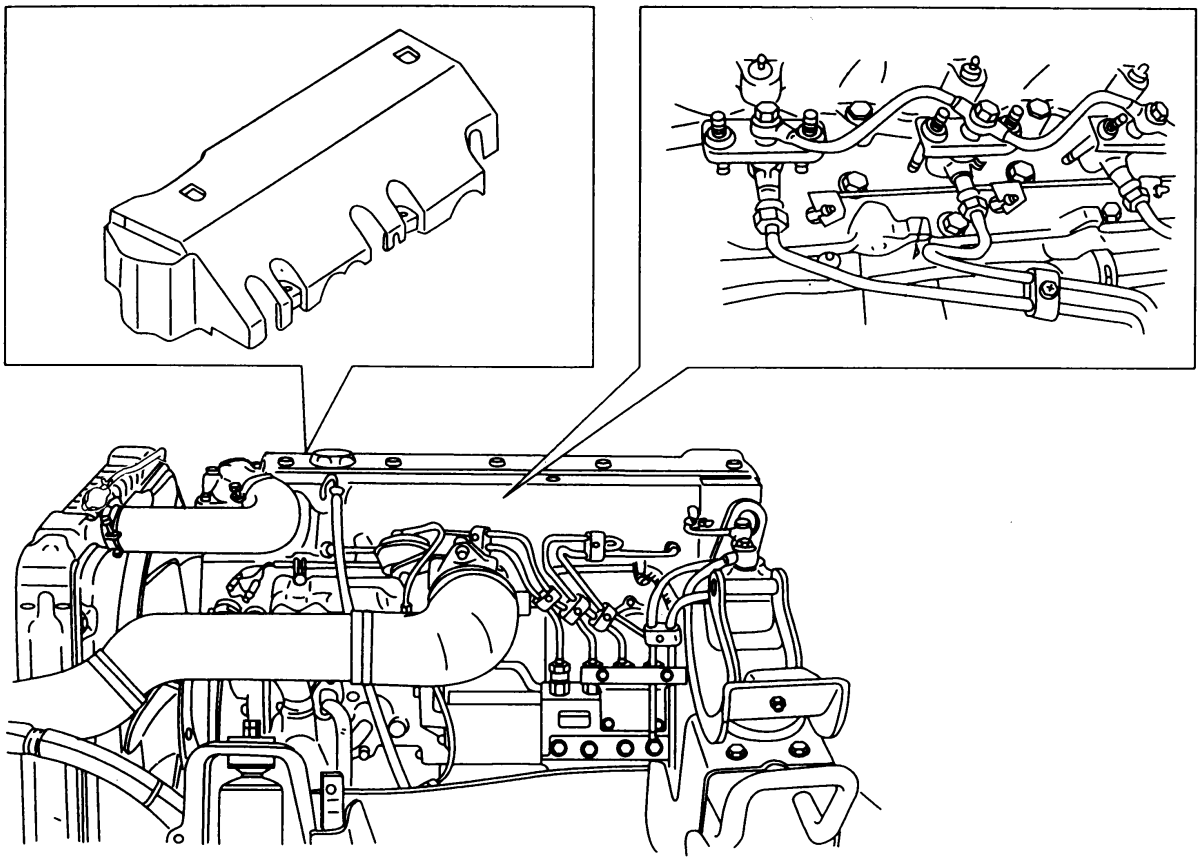
OIL COOLER



Removal steps
1. Vacuum hose
2. Oil level guide tube
3. Intake air duct
4. Engine stop cable
5. Accelerator control cable
6. Engine control cable
7. Engine control lever assembly
8. Oil pipe
9. Fuel return hose
10. Fuel feed hose
11. Nozzle cover
12. Leak off pipe
13. Fuel pipe
14. PCV hose
15. Water bypass hose
16. Injection pipe
17. Injection pump assembly
18. Injection pump rubber space
19. A/C drive belt
    (If equipped with A/C)
20. Idle pulley bracket
    (If equipped with A/C)
21. Heater hose
22. Radiator lower hose
23. Heater pipe
24. Water suction pipe
25. Oil cooler assembly
26. O-ring

Installation steps
To install, follow the removal steps in the reverse order.

6A3-60-1.tif



6A3-62-1.tif

REMOVAL

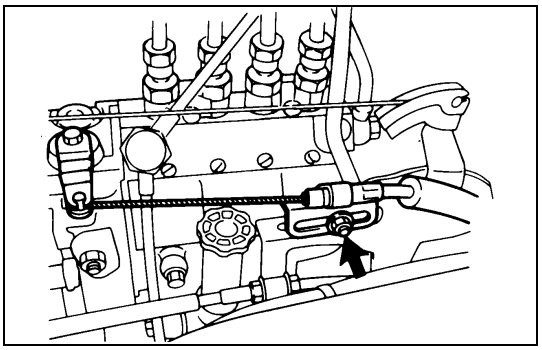
Preparation

- Disconnect the battery ground cable
- Drain coolant

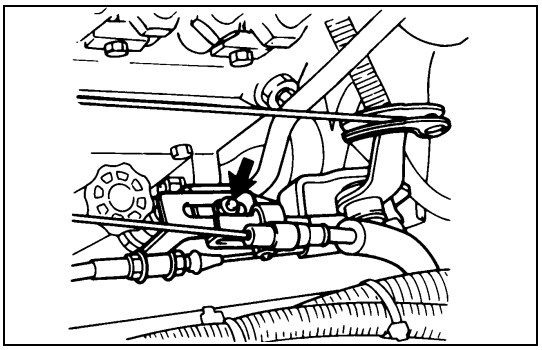
1. **Vacuum Hose**
2. **Oil Level Guide Tube**

   Remove the guide tube fixing bolt and pull out the guide tube.
3. **Intake Air Duct**
4. **Engine Stop Cable**

   Loosen the locking nut at the bracket and disconnect engine stop cable from injection pump stop lever.



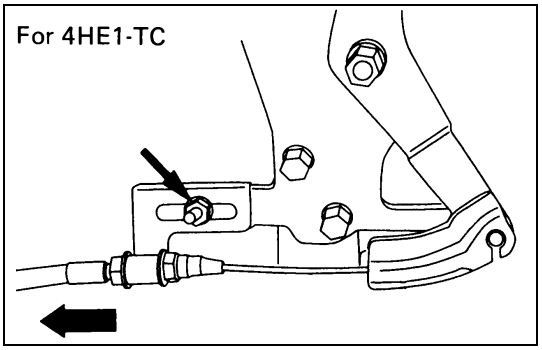
6A3-62-1.tif



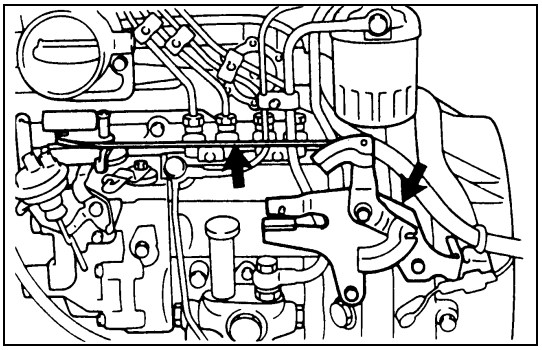
6A3-62-2.tif

5. **Accelerator Control Cable**

   Loosen the locking nut at the bracket and disconnect accelerator control cable from injection pump control lever.



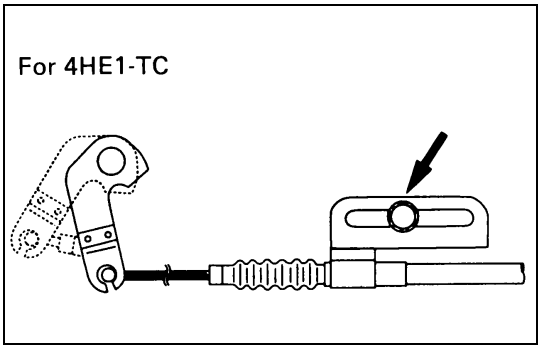
6A3-62-3.tif



6A3-62-4.tif

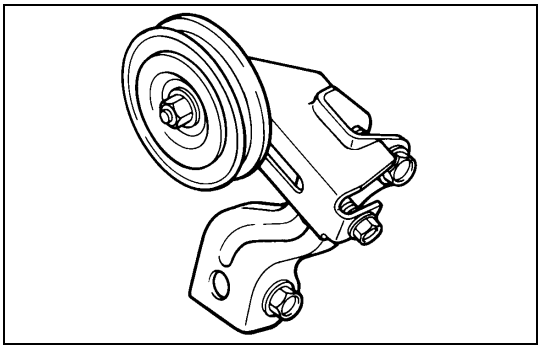
6. **Engine Control Cable**
7. **Engine Control Lever**
8. **Oil Pipe**
9. **Fuel Return Hose**
10. **Fuel Feed Hose**

    Disconnect fuel hose from injection pump side and take care not to spill and enter dust.
11. **Nozzle Cover**

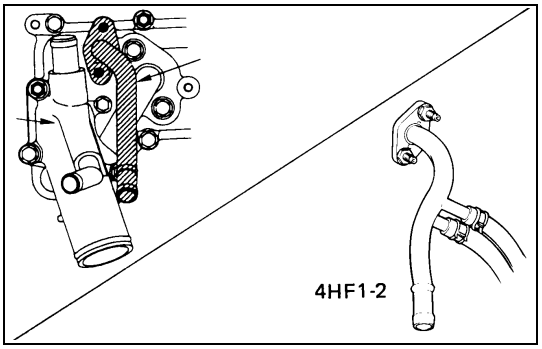


6A3-63-1.tif

12. Leak Off Pipe
13. Fuel Pipe
14. Positive Crankcase Ventilation (PCV) Hose
15. Water Bypass Hose
16. Injection Pipe
17. Injection Pump Assembly
Above works refer to “INJECTION PUMP ASSEMBLY” section in this manual.
18. Injection Pump Rubber Spacer (for 4HF1/4HG1T/4HE1-T)
19. Air Conditioning (A/C) Drive Belt (If equipped with A/C)
20. Idle Pulley Bracket (If equipped with A/C)
After removal of the A/C drive belt, remove the 3 bracket fixing bolts. Then, remove the bracket with the tensioner and the idler attached.
21. Heater Hose
22. Radiator Lower Hose

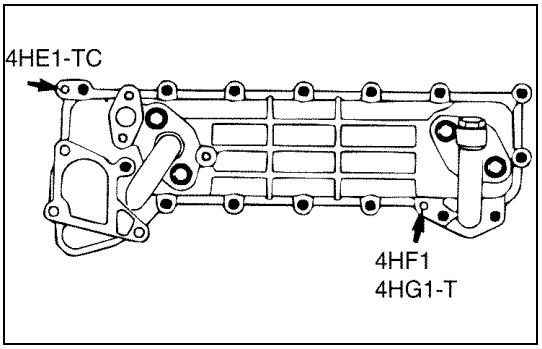


6A3-63-2.tif



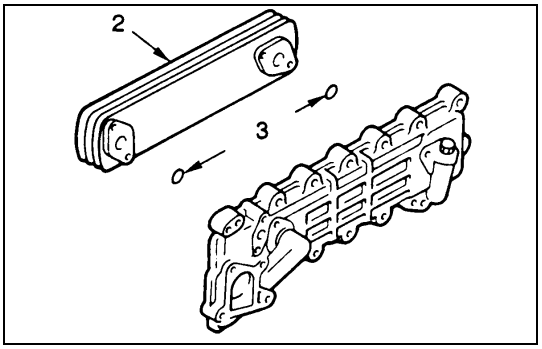
6A3-63-3.tif

23. Heater Pipe
24. Water Suction Pipe



050LX031.tif

25. Oil Cooler Assembly
1) Remove the oil cooler bolts.
2) Install a oil cooler fixing bolt to the oil cooler replace hole as shown in the illustration, and tighten the bolt alternately a little at a time.
26. O-Ring

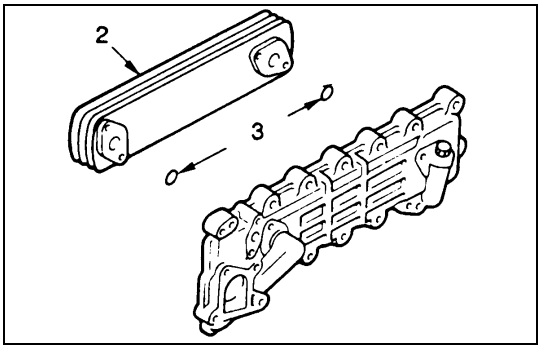


6A3-64-1.tif

DISASSEMBLY

(Oil Cooler Assembly)

1. **Element fixing bolts**
2. **Element**
3. **O-Ring**



6A3-64-2.tif

REASSEMBLY

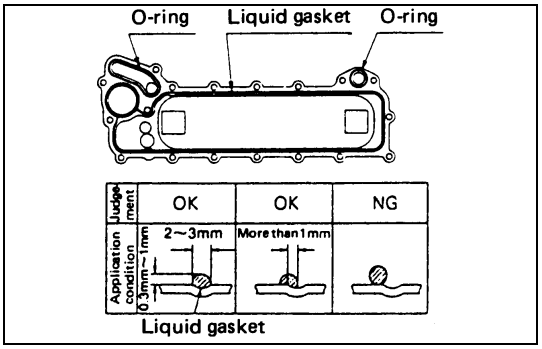
3. **O-Ring**

Apply a coat of engine oil to the O-rings and install the O-rings the oil cooler.

2. **Element**
1. **Element fixing bolts**

N•m (kg•m/lb•ft)

20 (2.0/14)

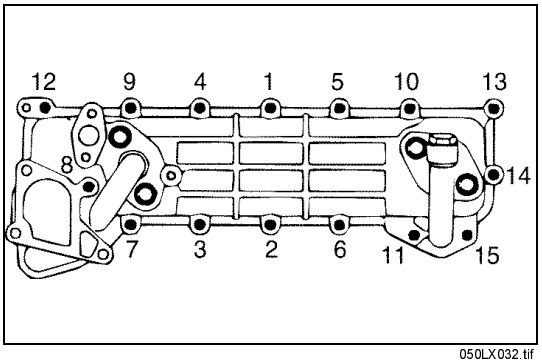


6A3-64-3.tif

INSTALLATION

26. **O-Ring**
25. **Oil Cooler Assembly**

1) Apply 2mm-3mm (0.08-0.1 in) bead of the recommended liquid gasket (Three Bond 1207C) or its equivalent on the oil cooler fitting surface.
2) Apply a coat of engine oil to the O-rings (2 pieces) and install the O-rings to the oil cooler.



050LX032.tif

NOTE:

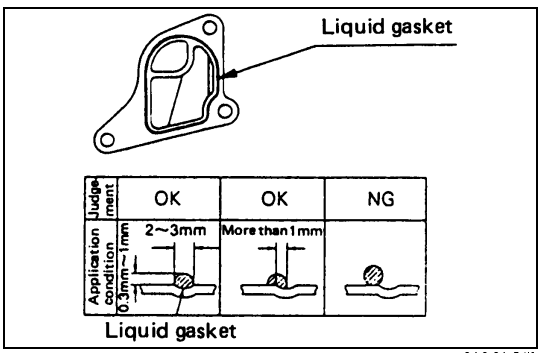
Take care that the O-ring is not smeared with liquid gasket.

- Install the oil cooler within 7 minutes after application of liquid gasket.
- For the dislocation of liquid gasket, refer to the illustration.

3) Tighten the oil cooler bolts and nut to the specified torque a little at a time in the sequence shown in the illustration.

Oil Cooler Bolt and Nut Torque N•m (kg•m/lb•ft)

24 (2.4/17)

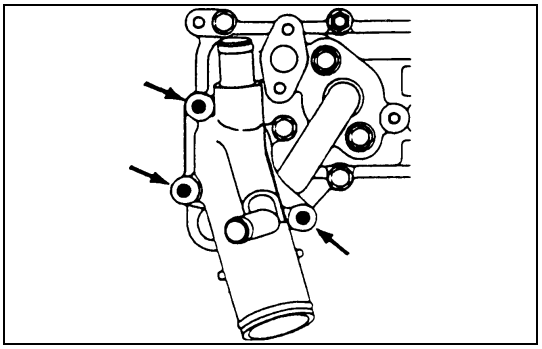


6A3-64-5.tif

24. **Water Suction Pipe**

1) Apply 2mm-3mm bead of the recommended liquid gasket (Three Bond 1207C) or its equivalent on the groove of the water suction pipe fitting surface.
2) Install the water suction pipe to the oil cooler.

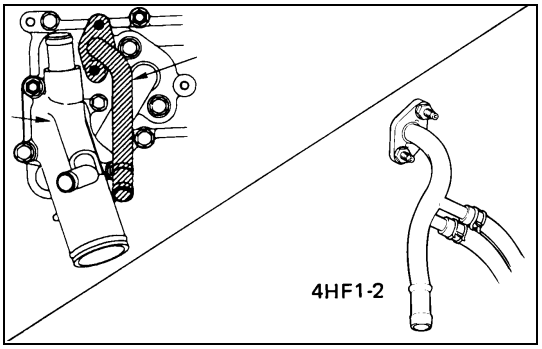
- For the dislocation of liquid gasket, refer to the illustration.



6A3-65-1.tif

Water Suction Pipe Bolt Torque	N•m (kg•m/lb•ft)
24 (2.4/17)	

NOTE:
Install the water suction pipe immediately after the installation of the oil cooler.

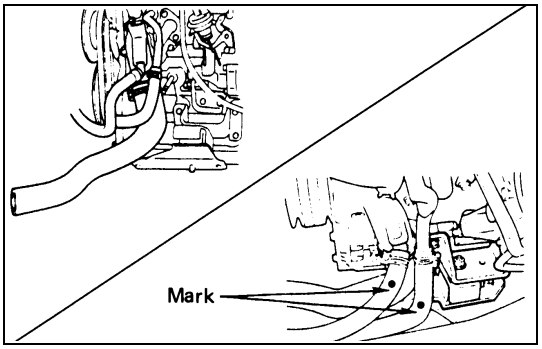


6A3-65-2.tif

23. Heater Pipe

1) Install the O-ring to the heater pipe.
2) Install the heater pipe to the oil cooler.

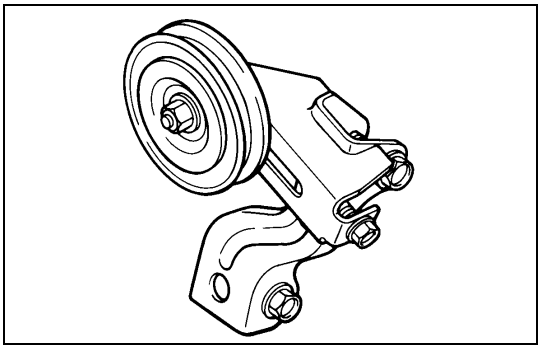
Heater Pipe Bolt Torque	N•m (kg•m/lb•ft)
24 (2.4/17)	



6A3-65-3.tif

22. Radiator Lower Hose

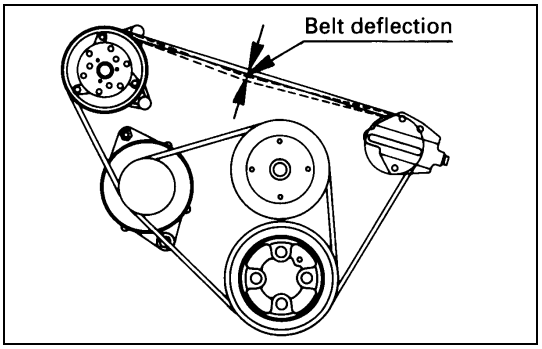
21. Heater Hose



6A3-65-4.tif

20. Idle Pulley Bracket (If equipped with A/C)

Idle Pulley Bracket Bolt Torque	N•m (kg•m/lb•ft)
48 (4.9/35)	



6A3-66-1.tif

19. Air Conditioning (A/C) Drive Belt (If equipped with A/C)

- Install drive belt adjust belt tension by adjusting bolt and tighten locking nut to the specified torque.
- Depress the drive belt mid-portion with a 10kg (22lb/98N) force.

Drive Bolt Deflection	mm (in)
16 - 20 (0.63 - 0.79) .... New belt 18 - 22 (0.71 - 0.87) .... Reuse belt	

Locking Nut Torque	N•m (kg•m/lb•ft)
27 (2.8/20)	

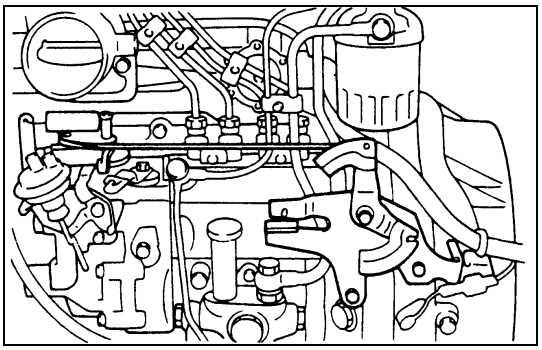
18. Injection Pump Rubber Spacer (4HF1/4HG1T/4HE1-T)
17. Injection Pump Assembly
16. Injection Pipe
15. Water Bypass Hose
14. Positive Crankcase Ventilation (PCV) Hose
13. Fuel Pipe
12. Leak Off Pipe
11. Nozzle Cover
10. Fuel Feed Hose
9. Fuel Return Hose

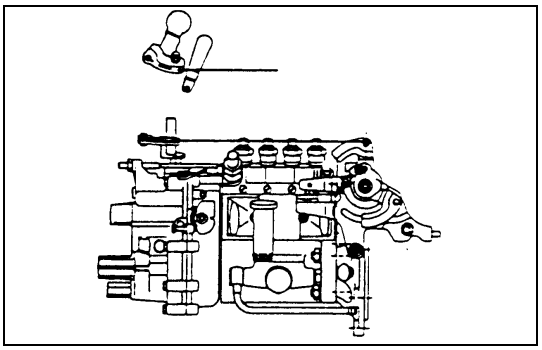
Air Bleeding

Above works refer to “INJECTION PUMP ASSEMBLY” section in this manual.

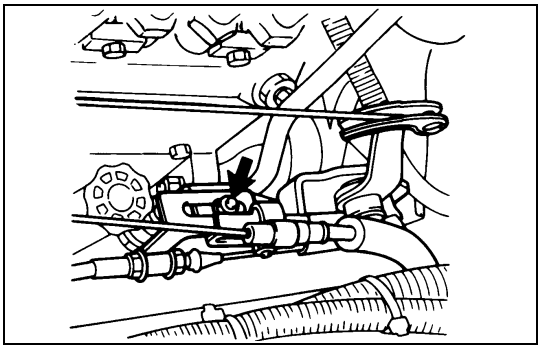
8. Oil Pipe
7. Engine Control Lever Assembly

Engine Control Lever Bolt Torque	N•m (kg•m/lb•ft)
24 (2.4/17)	


6A3-66-2.tif


6A3-66-3.tif

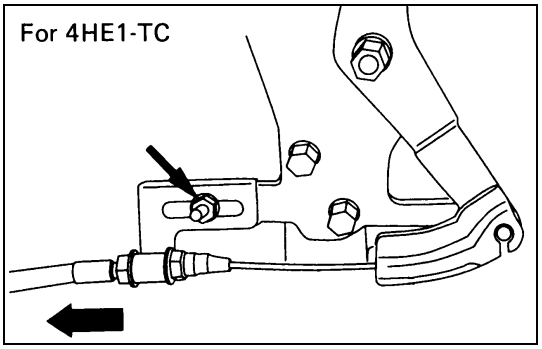
6. Engine Control Cable



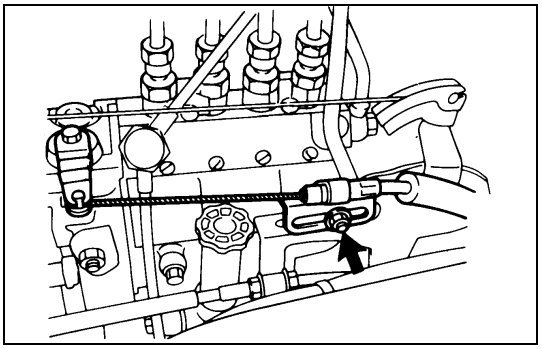
6A3-67-1.tif

5. Accelerator Control Cable

1) Check to see if the idling control knob is turned to the utmost limit to the left.
2) Install the end tip of the cable to the engine control lever.
3) With the outer cable pulled toward the front of the vehicle, provide the engine control wire and the inner cable with the appropriate play. Then, fasten the clamp with a nut.
4) Check to see if the control lever of the injection pump is set at the idling position (with the lever attached to the stopper bolt).



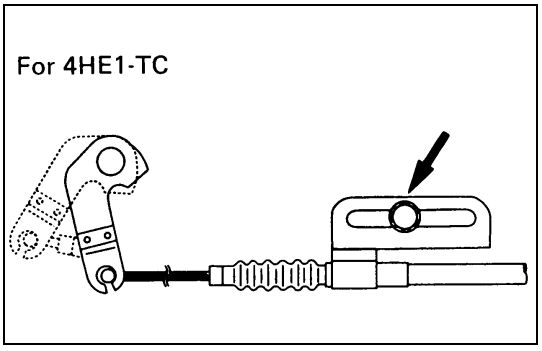
6A3-67-2.tif



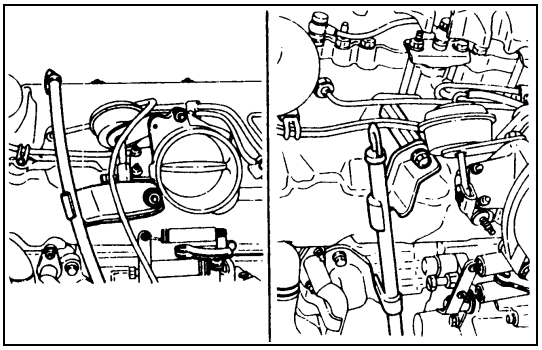
6A3-67-3.tif

4. Engine Stop Cable

1) Install the end tip of the cable to the engine stop lever.
2) Pull the cable toward the rear of the vehicle, and fasten the clamp with a nut at the position where the lever stops.



6A3-67-4.tif



6A3-67-5.tif

3. Intake Air Duct

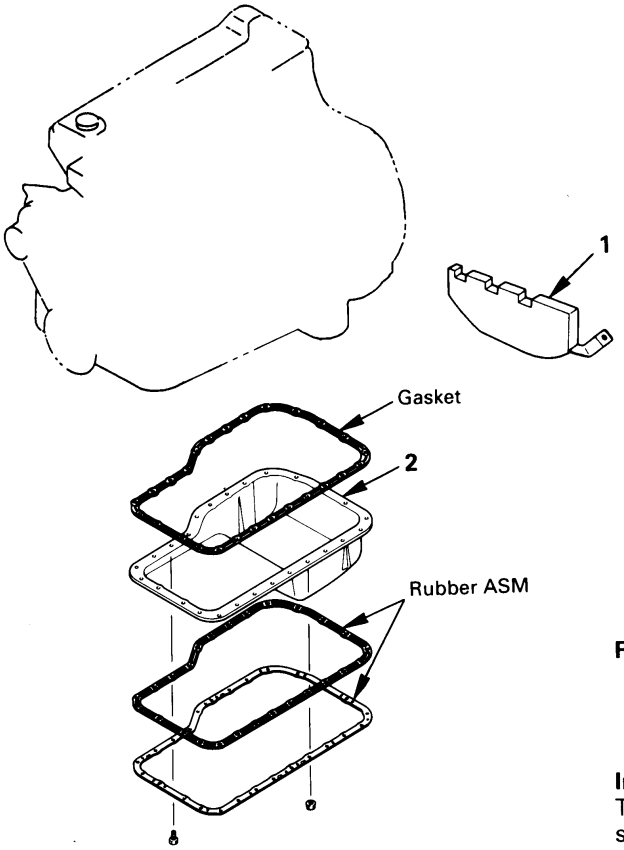
2. Oil Level Gauge Guide Tube

1) Install the O-rings to the guide tube lower portion and insert the guide tube completely to the cylinder body.
2) Tighten the guide tube bolt to the specified torque.

Guide Tube Bolt Torque	N•m (kg•m/lb•in)
	13 (1.3/113)

1. **Vacuum Hose**
   - Pour coolant into radiator.
   - Connect battery ground cable.
   - Start engine and check for oil and water leakage carefully.

OIL PAN



Removal steps
1. Spacer rubber (NKR model only)
2. Oil pan

Installation steps
To install, follow the removal steps in the reverse order.

6A3-69-1.tif

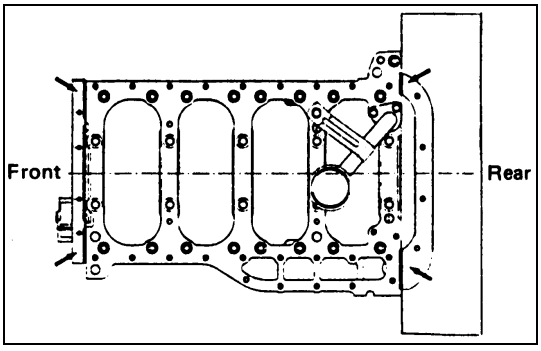
REMOVAL

Preparation
- Disconnect battery ground cable
- Lift up car
- Drain engine oil

1. Spacer Rubber (NKR model only)
- For the 4WD model vehicle, remove the stiffener before removing the spacer rubber.

2. Oil Pan

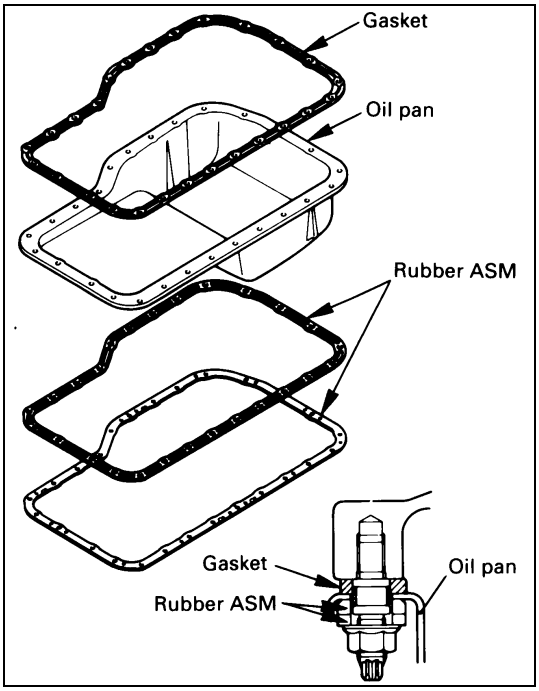
INSTALLATION



6A3-69-2.tif

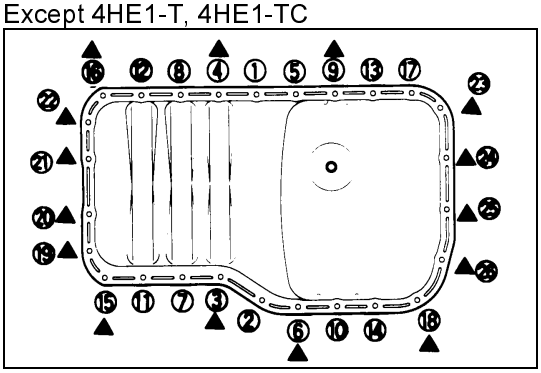
2. Oil Pan

1) Apply a 3mm (0.1 inch) bead of recommended liquid gasket (Three Bond 1207C) or its equivalent to the shaded areas shown in the illustration.



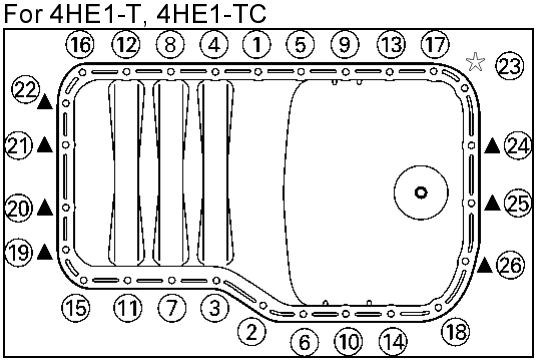
6A3-70-1.tif

Except 4HE1-T, 4HE1-TC



6A3-70-2.tif

For 4HE1-T, 4HE1-TC



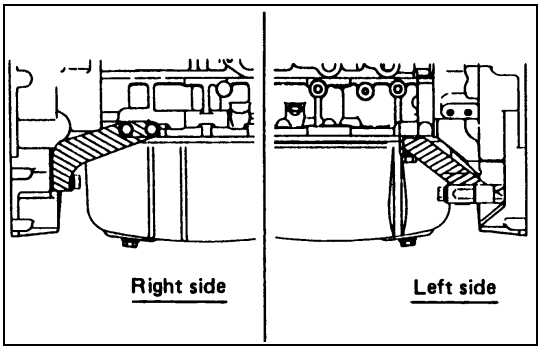
013LX00001.tif

3) Tighten the oil pan nuts and bolts to the specified torque in the numerical order as shown in the illustration.

▲ marks are located on nut positions.

Oil Pan Nuts and Bolts Torque N•m (kg•m/lb•ft)

Others	11 (1.1/8)
4HE1-T 4HE1-TC	24 (2.4/17) 18 (1.8/13) for star mark



6A3-70-3.tif

1. **Spacer Rubber (NKR model only)**

Spacer Rubber Bolts Torque	N•m (kg•m/lb•ft)
76 (7.7/56)	

- For the 4WD model vehicle, tighten the spacer rubber together with the stiffener.

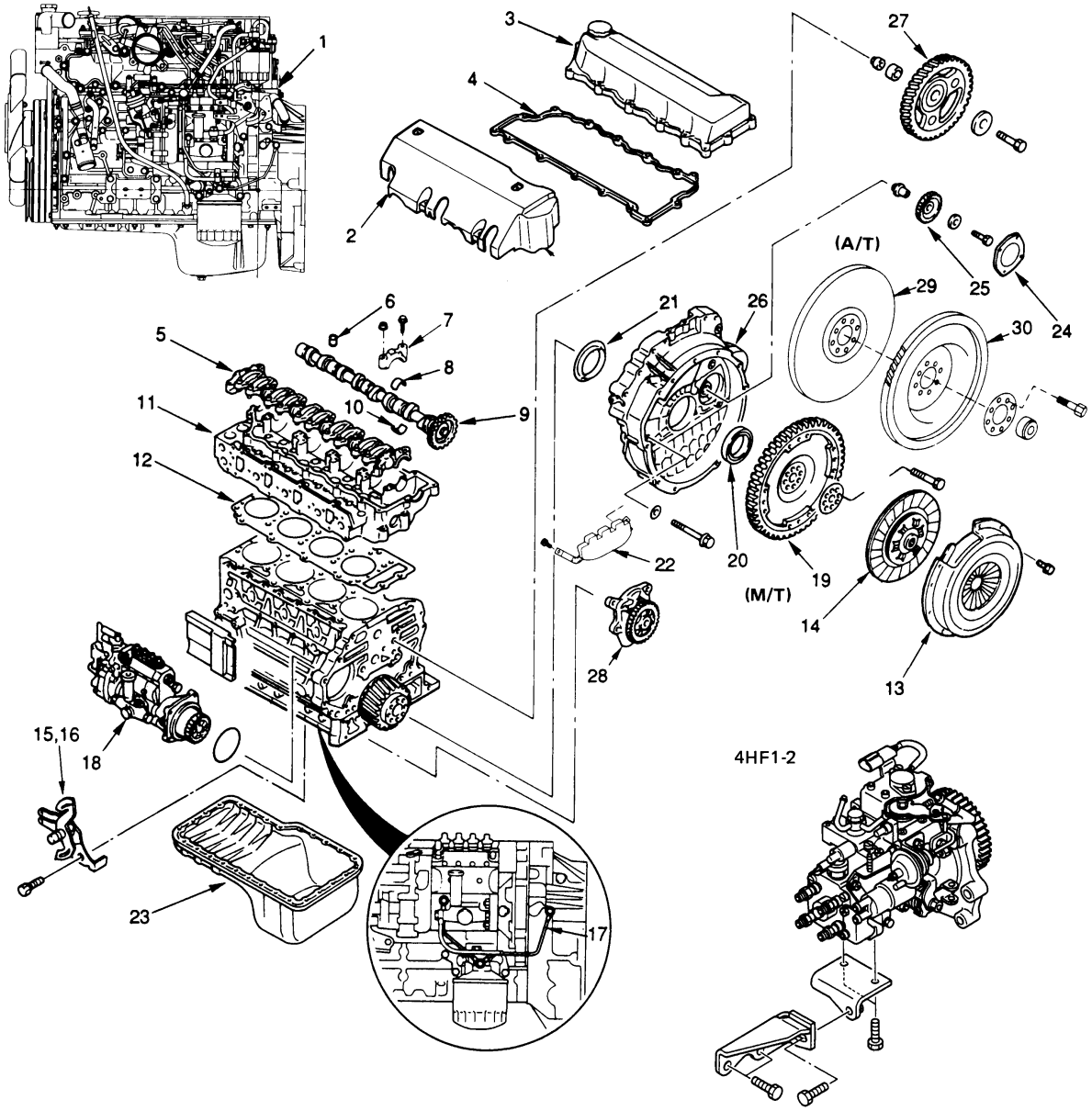
Cylinder Body RH Side	N•m (kg•m/lb•ft)
48 (4.9/35)	

Cylinder Body LH Side	N•m (kg•m/lb•ft)
128 (12.9/93)	

Flywheel Housing Side	N•m (kg•m/lb•ft)
76 (7.7/56)	

- Pour engine oil into engine
- Connect battery ground cable
- Start engine and check for oil leakage from oil pan.

OIL PUMP ASSEMBLY



Removal steps

1. Engine assembly
2. Nozzle cover
3. Cylinder head cover
4. Head cover gasket
5. Rocker arm shaft assembly
6. Valve cap
7. Camshaft bearing cap
8. Camshaft bearing upper
9. Camshaft assembly
10. Camshaft bearing lower
11. Cylinder head assembly
12. Cylinder head gasket
13. Clutch pressure plate assembly
14. Driven plate
15. Engine control wire
16. Engine control lever assembly
17. Oil pipe
18. Injection pump assembly
19. **Flywheel** (M/T)
20. **Rear oil seal**
21. **Slinger**
22. Spacer rubber (NKR model only)
23. Oil pan
24. Power steering pump idle gear cover
25. Power steering pump idle gear
26. Flywheel housing
27. Idle gear A
28. Oil pump assembly
29. Flywheel (A/T)
30. Flexible plate (A/T)

Installation steps

To install, follow the removal steps in the reverse order.

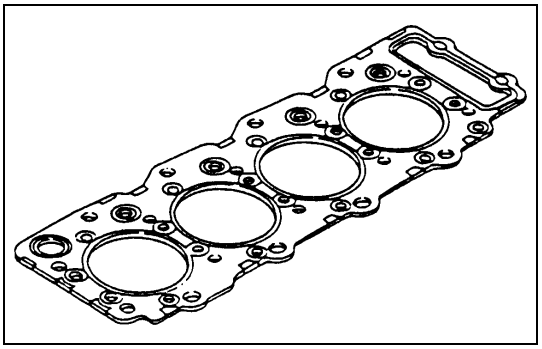
6A3-71-1.tif

REMOVAL

Preparation

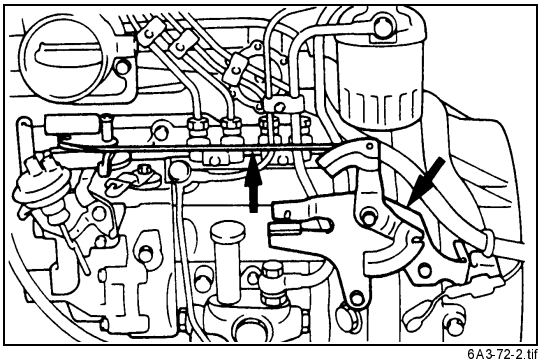
- Disconnect battery ground cable.
- Tilt the cab.
- Drain coolant and engine oil

1. **Engine Assembly**
   Above works refer to "ENGINE ASSEMBLY" section in this manual.
2. **Nozzle Cover**
3. **Cylinder Head Cover**
4. **Head Cover Gasket**
5. **Rocker Arm Shaft Assembly**
6. **Valve Cap**
7. **Camshaft Bearing Cap**
8. **Camshaft Bearing Upper**
9. **Camshaft Assembly**
10. **Camshaft Bearing Lower**
    Above works refer to "ROCKER ARM SHAFT ASSEMBLY AND CAMSHAFT ASSEMBLY" section in this manual.
11. **Cylinder Head Assembly**
    Above works refer to "CYLINDER HEAD" section in this manual.



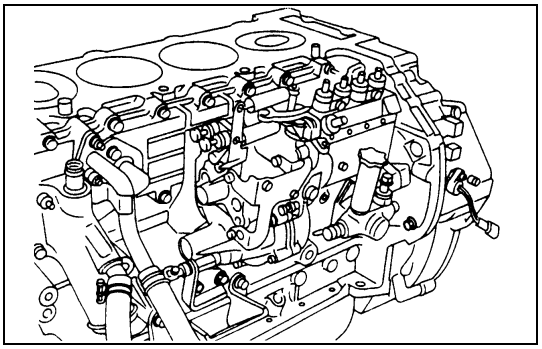
6A3-72-1.tif

12. **Cylinder Head Gasket**
    CAUTION:
    Do not reuse the cylinder head gasket.
13. **Clutch Pressure Plate Assembly**
14. **Driven Plate**
    Above works refer to "TIMING GEAR REPLACEMENT" section in this manual.



6A3-72-2.tif

15. **Engine Control Wire**
16. **Engine Control Lever Assembly**
17. **Oil Pipe**



6A3-73-1.tif

18. Injection Pump Assembly

1) Remove the injection pump bracket bolts and the injection pump rear bracket bolts.
2) Then remove the injection pump assembly.

19. Flywheel Assembly

20. Crankshaft Rear Oil Seal

21. Crankshaft Rear Slinger

Above works refer to “CRANKSHAFT REAR OIL SEAL” section in this manual.

22. Spacer Rubber (NKR model only)

For the 4WD model vehicle, remove the stiffener before removing the spacer rubber.

23. Oil Pan

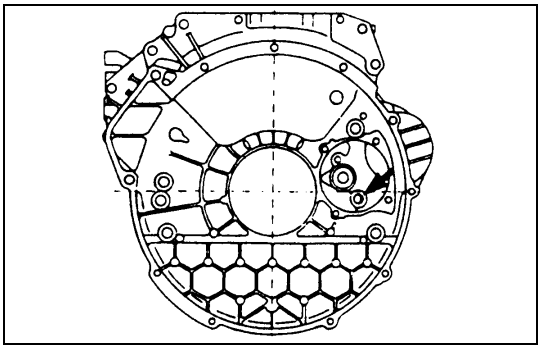
24. Power Steering Pump Idle Gear Cover

25. Power Steering Pump Idle Gear

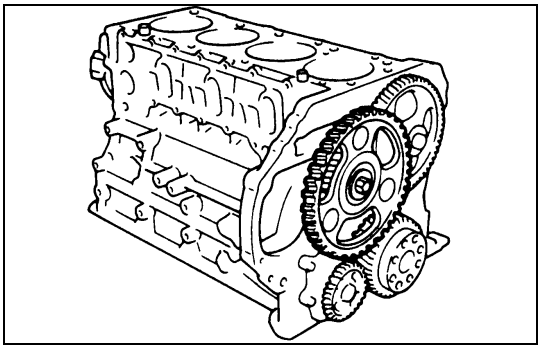
26. Flywheel Housing

NOTE:

Be careful not to fail to remove the bolts shown in the illustration.

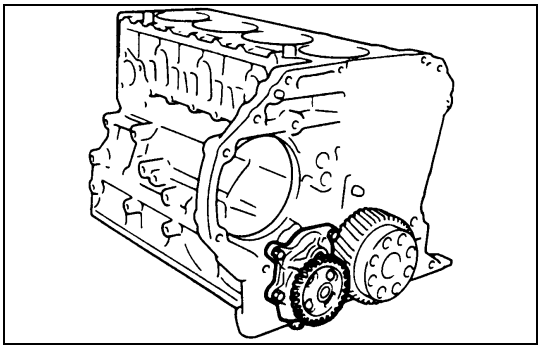


6A3-73-2.tif

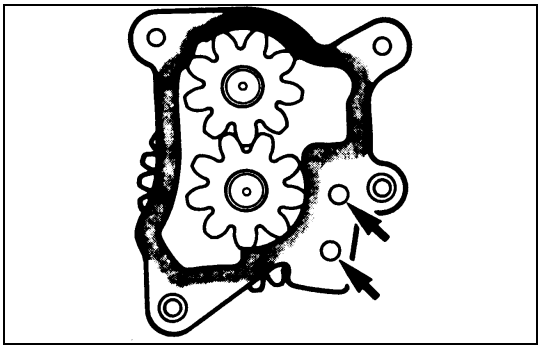


6A3-73-3.tif

27. Idle Gear A


6A3-74-1.tif

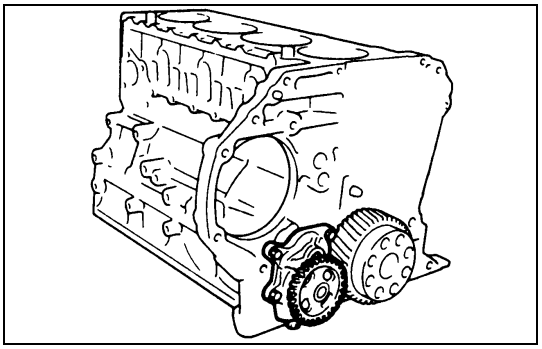
28. Oil Pump Assembly


6A3-74-2.tif

INSTALLATION

28. Oil Pump Assembly

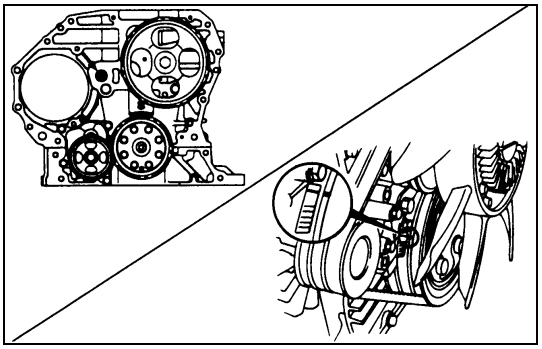
1) Carefully wipe any foreign material from the cylinder body rear surface.
2) Apply the recommended liquid gasket (Three Bond 1141E) or its equivalent to the shaded areas shown in the illustration.


6A3-74-3.tif

CAUTION:
Be careful that no liquid gasket gets into the holes in the arrow-marked portion in the illustration and the inside of the oil pump cover.

3) Install the oil pump to the cylinder body.
4) Tighten the oil pump to the specified torque.

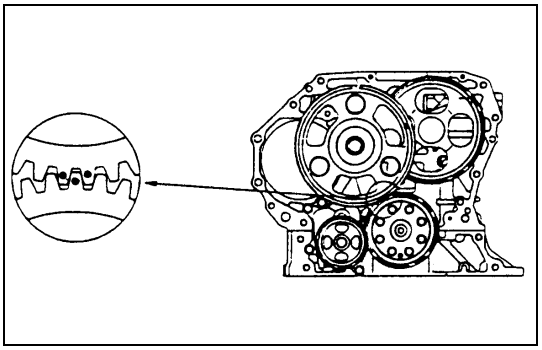
Oil Pump Bolt Torque	N•m (kg•m/lb•ft)
	31 (3.2/23)


6A3-74-4.tif

27. Idle Gear A

1) Turn the crankshaft clockwise so that the engagement mark of the crankshaft gear faces to the shaft center of the idle gear A and the No.1 cylinder piston comes to the top dead center.
2) Align the crankshaft gear with the engagement mark of the idle gear and install the idle gear A.

Idle Gear A Bolt Torque	N•m (kg•m/lb•ft)
	133 (13.6/98)


6A3-74-5.tif

26. **Flywheel Housing**
25. **Power Steering Pump Idle Gear**
24. **Power Steering Pump Idle Gear Cover**

    Above works refer to “TIMING GEAR REPLACEMENT” section in this manual.
23. **Oil Pan**
22. **Spacer Rubber(NKR mode)**

    Above works refer to “OIL PAN” section in this manual.
21. **Crankshaft Rear Slinger**
20. **Crankshaft Rear Oil Seal**
19. **Flywheel Assembly**

    Above works refer to “CRANKSHAFT REAR OIL SEAL” section in this manual.
18. **Injection Pump Assembly**

    Above works refer to “INJECTION PUMP ASSEMBLY” section in this manual.
17. **Oil Pipe**
16. **Engine Control Lever Assembly**
15. **Engine Control Wire**

    Above works refer to “INJECTION PUMP ASSEMBLY” section in this manual.
14. **Driven Plate**
13. **Clutch Pressure Plate Assembly (M/T) or Flexible Plate (A/T)**

    Above works refer to “TIMING GEAR REPLACEMENT” section in this manual.
12. **Cylinder Head Gasket**

    Above works refer to “CYLINDER HEAD” section in this manual.
11. **Cylinder Head Assembly**

    Above works refer to “CYLINDER HEAD” section in this manual.
10. **Camshaft Bearing Lower**
9. **Camshaft Assembly**
8. **Camshaft Bearing Upper**
7. **Camshaft Bearing Cap**
6. **Valve Cap**

    Above works refer to “CAMSHAFT ASSEMBLY” section in this manual.
5. **Rocker Arm Shaft Assembly**

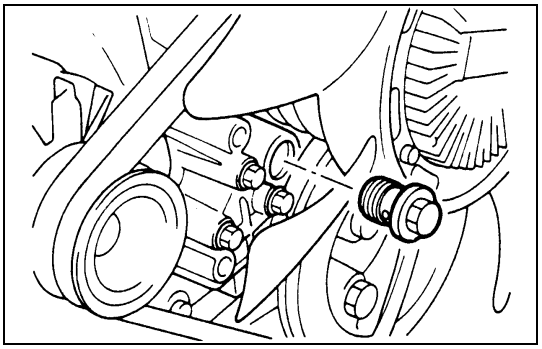
    Above works refer to “ROCKER ARM SHAFT ASSEMBLY” section in this manual.
4. **Head Cover Gasket**
3. **Cylinder Head Cover**

    Above works refer to “CYLINDER HEAD COVER” section in this manual.
2. **Nozzle Cover**
1. **Engine Assembly**

    Above works refer to “ENGINE ASSEMBLY” section in this manual.

OIL RELIEF VALVE

REMOVAL



6A3-76-1.tif

1. **Oil Relief Valve**

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.

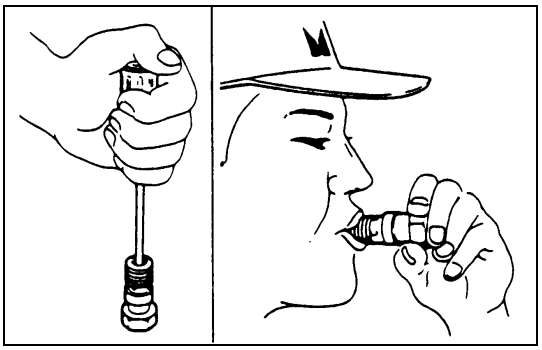
Valve

Push the valve with a screwdriver to check it for binding.

When the valve is binding, replace the relief valve with a new one.

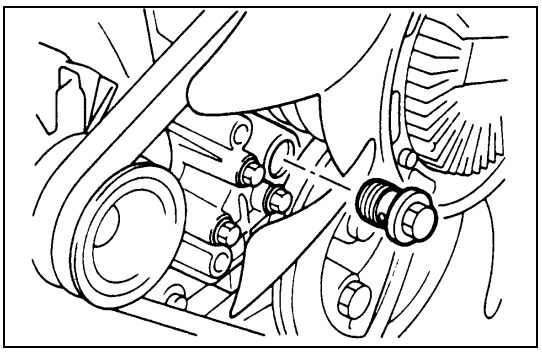
Spring

Blow the valve and check it for air leak. When there is any air leak in the valve, replace it with a new one.



6A3-76-2.tif

INSTALLATION

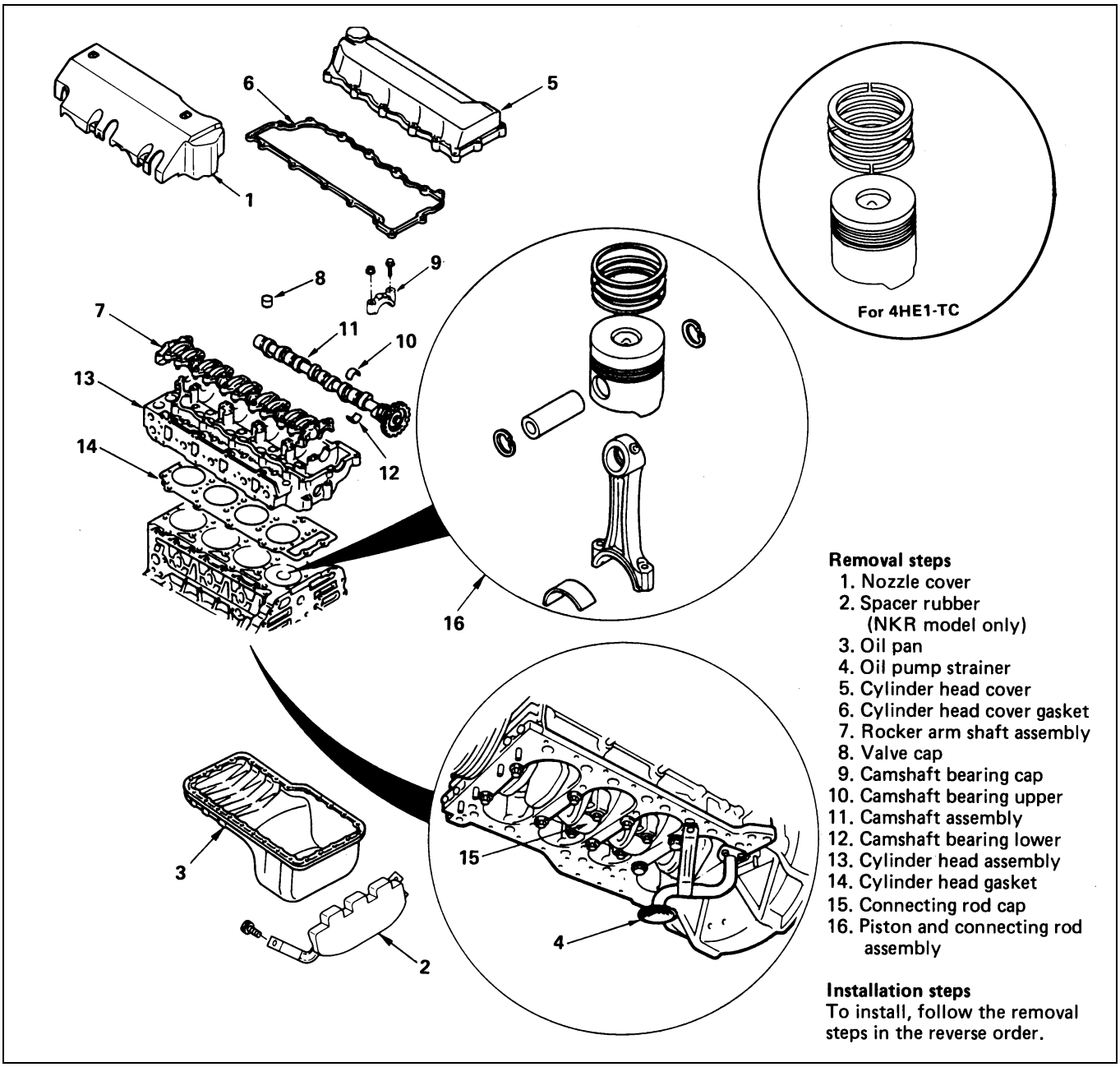


6A3-76-3.tif

1. **Oil Relief Valve**

Oil Relief Valve Torque	N•m (kg•m/lb•ft)
	39 (4.0/29)

PISTON, PISTON RING, PISTON PIN AND CONNECTING ROD



6A3-77-1.tif

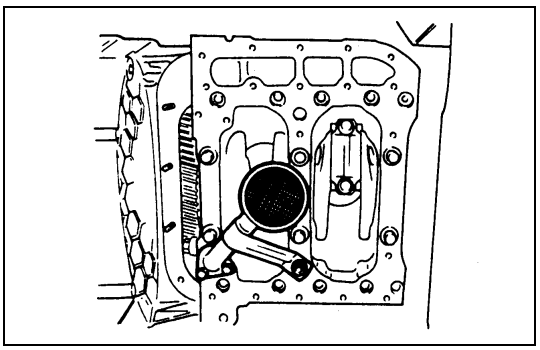
REMOVAL

Preparation

- Disconnect battery ground cable.
- Tilt the cab.
- Drain coolant and engine oil.

1. **Nozzle Cover**
2. **Spacer Rubber (NKR model only)**

   For the 4WD model vehicle, remove the stiffener before removing the spacer rubber.

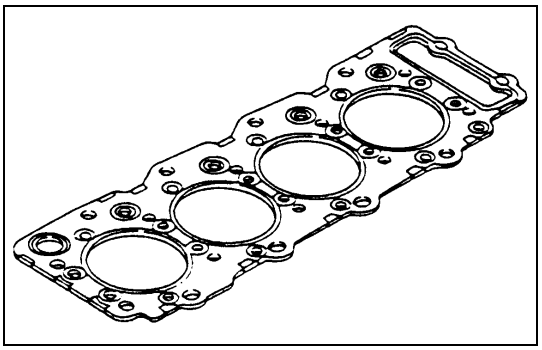

6A3-78-1.tif

3. **Oil Pan**
4. **Oil Pump Strainer**
5. **Cylinder Head Cover**
6. **Cylinder Head Cover Gasket**

7. **Rocker Arm Shaft Assembly**
   Above works refer to “ROCKER ARM SHAFT ASSEMBLY” section in this manual.
8. **Valve Cap**

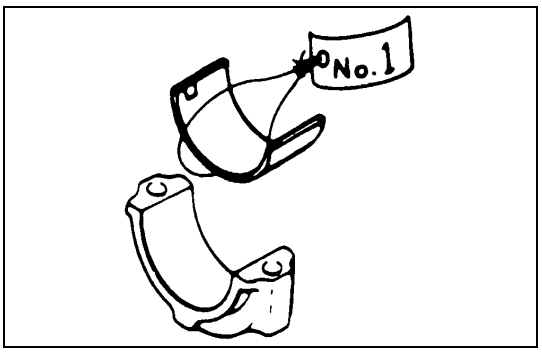
CAUTION:
Take sufficient care not to let valve caps fall into the gear case or oil return hole.

9. **Camshaft Bearing Cap**
10. **Camshaft Bearing Upper**
11. **Camshaft Assembly**
12. **Camshaft Bearing Lower**
    Above works refer to “CAMSHAFT ASSEMBLY” section in this manual.
13. **Cylinder Head Assembly**
    Above works refer to “CYLINDER HEAD” section in this manual.


6A3-78-2.tif

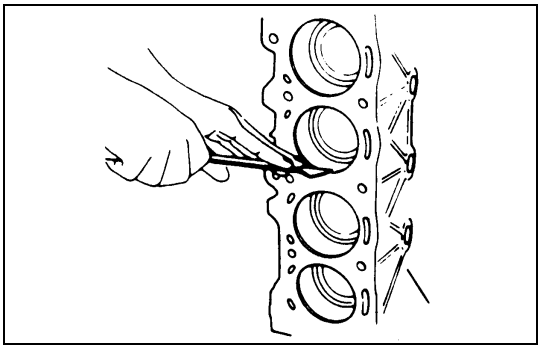
14. **Cylinder Head Gasket**

CAUTION:
Do not reuse the cylinder head gasket.



6A3-78-3.tif

15. **Connecting Rod Cap**
    1) Take out the connecting rod bearing cap bolts and remove the bearing cap with the lower bearing.
    2) If the connecting rod lower bearings are to be reinstalled, mark their fitting positions by tagging each bearing with the cylinder number from which it was removed.



6A3-79-1.tif

16. Piston and Connecting Rod Assembly

1) To facilitate smooth removal of piston, remove carbon from the upper part of the cylinder wall using a scraper or equivalent.
2) Remove the piston and connecting rod assembly upward by pushing on the edge of the connecting rod with a hammer handle or equivalent.
3) If the connecting rod bearing are to be reinstalled, mark their fitting positions by tagging each bearing with the cylinder number from which it was removed.

CAUTION:

Do not bend or damage the oiling jet.

NOTE:

When removing the piston and connecting rod assembly, pull the connecting rod in parallel with the cylinder bore.

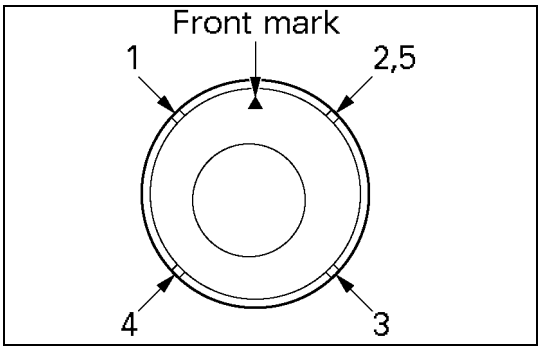
INSTALLATION

16. Piston and Connecting Rod Assembly

NOTE:

When installing new connecting rod and/or connecting rod bearings, refer to the selection table. Above works refer to "CRANKSHAFT" section 6A in this manual.

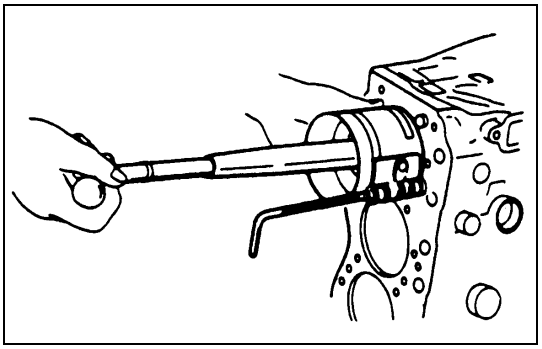
1) Apply a coat of engine oil to the circumference of each piston ring and piston.
2) Position the piston ring gaps as shown in the illustration.



012HW002.tif

① 1st compression ring
② 2nd compression ring
③ 3rd compression ring (4HE1-TC only)
④ Oil ring
⑤ Coil expander

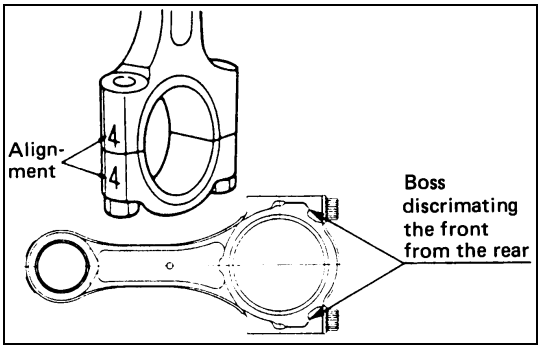
3) Apply a coat of molybdenum disulfide grease to the two piston skirts.
   This will facilitate smooth break-in when the engine is first started after reassembly.
4) Apply a coat of engine oil to the upper bearing surfaces.
5) Apply a coat of engine oil to the cylinder wall.
6) Position the piston head front mark so that it is facing the front of the engine.



6A3-80-1.tif

7) Use the piston ring compressor to compress the piston rings.
   Piston Ring Compressor: 5-8840-9018-0
8) Use a hammer grip to push the piston in until the connecting rod makes contact with the crankpin.
   At the same time, rotate the crankshaft until the crankpin is at bottom dead center.

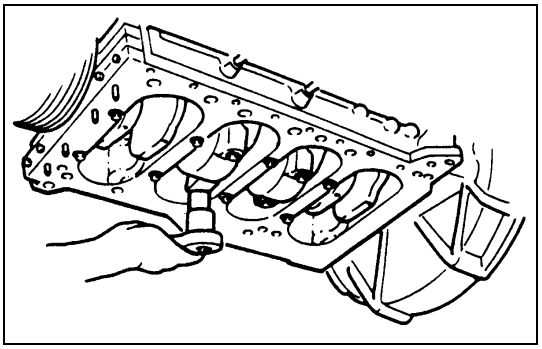
CAUTION:
Do not bend or damage the oiling jet.



6A3-80-2.tif

15. Connecting Rod Cap

1) Install the connecting rod bearing caps.
2) Align the bearing cap cylinder number marks and the connecting rod cylinder number marks.
3) Apply a coat of molybdenum disulfide grease to the threads and setting faces of each connecting rod cap bolts.



6A3-80-3.tif

4) Tighten the connecting rod caps to the specified torque.

Connecting Rod Bearing Cap

Bolt Torque — N•m (kg•m/lb•ft)

1st step	2nd step	3rd step
39 (4.0/29)	60°	30°

Angle gauge : 5-8840-0266-0

14. Cylinder Head Gasket
Above works refer to “CYLINDER HEAD” section in this manual.

13. Cylinder Head Assembly
Above works refer to “CYLINDER HEAD” section in this manual.

12. Camshaft Bearing Lower

11. Camshaft Assembly

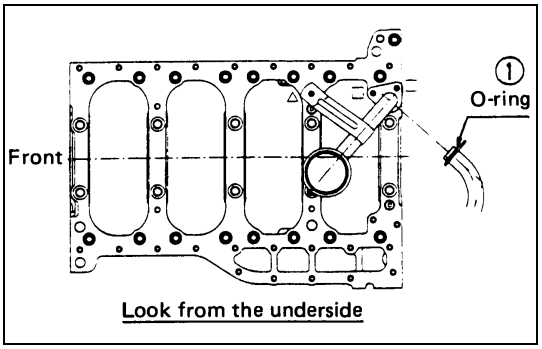
10. Camshaft Bearing Upper

9. Camshaft Bearing Cap

8. Valve Cap
Above works refer to “CAMSHAFT ASSEMBLY” section in this manual.

7. Rocker Arm Shaft Assembly
Above works refer to “ROCKER ARM SHAFT ASSEMBLY” section in this manual.

6. Cylinder Head Gasket
Above works refer to “CYLINDER HEAD” section in this manual.



6A3-81-1.tif

5. Cylinder Head Cover

Above works refer to “CYLINDER HEAD COVER” section in this manual.

4. Oil Pump Strainer

Install the O-ring ① to the oil pump strainer pipe and install the oil pump strainer to the cylinder body shown in the illustration.

Oil Pump Strainer Bolt Torque	N•m (kg•.m/lb•ft)
	24 (2.4/17)

3. Oil Pan

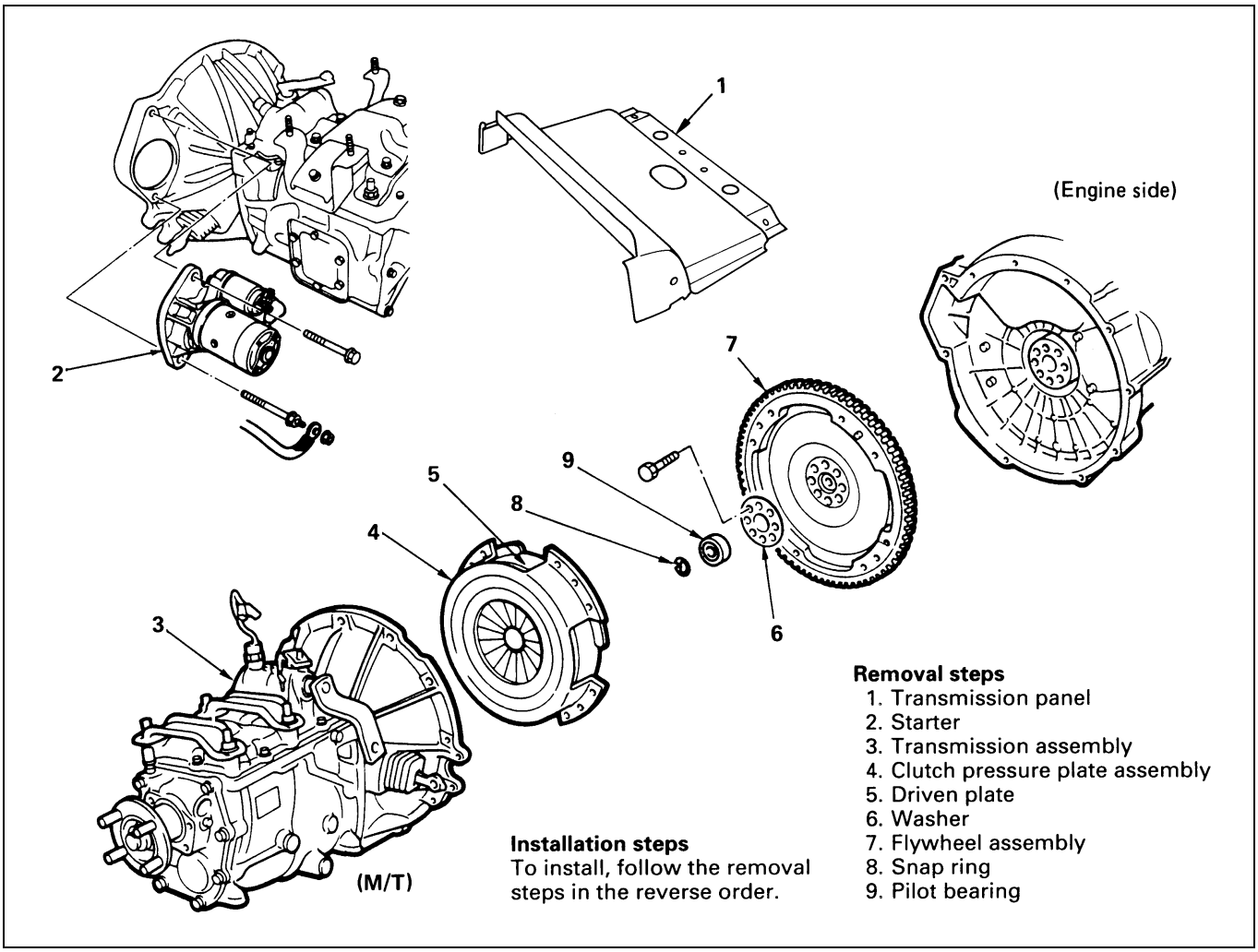
2. Spacer Rubber (NKR model only)

Above works refer to “OIL PAN” section in this manual.

1. Nozzle Cover

- Pour engine oil and coolant into engine
- Connect battery ground cable
- Start engine and check for coolant and oil leakage

FLYWHEEL AND PILOT BEARING



6A3-82-1.tif

REMOVAL

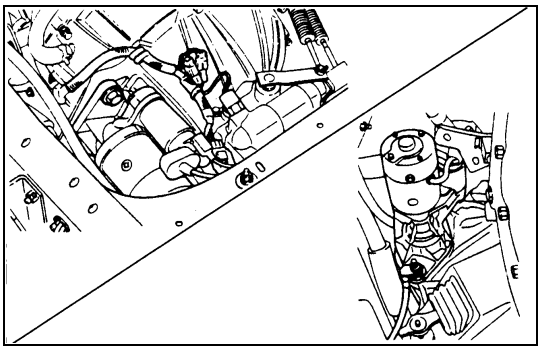
Preparation

- Disconnect battery ground cable.

1. Transmission Panel (M/T model only)

2. Starter

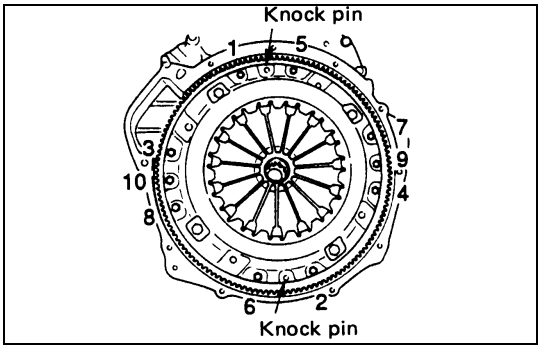
1) Disconnect the battery cable at the starter motor.
2) Remove the starter assembly from flywheel housing.



6A3-82-2.tif

3. Transmission Assembly

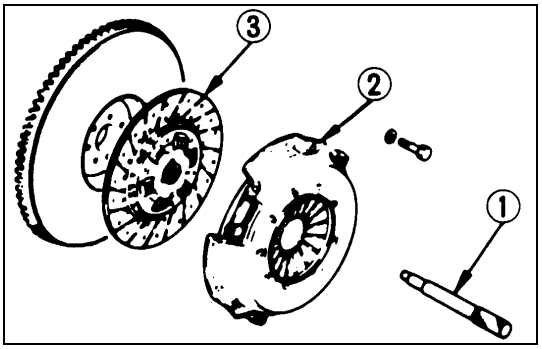
Above works refer to “ENGINE ASSEMBLY” section in this manual.



6A3-83-1.tif

4. Clutch Pressure Plate Assembly

1) Insert the clutch pilot aligner to the clutch assembly.
   Clutch Pilot Aligner: 5-8840-2240-0
2) Loosen the pressure plate bolts in numerical order a little at a time as shown in the illustration.
3) Remove the pressure plate assembly.

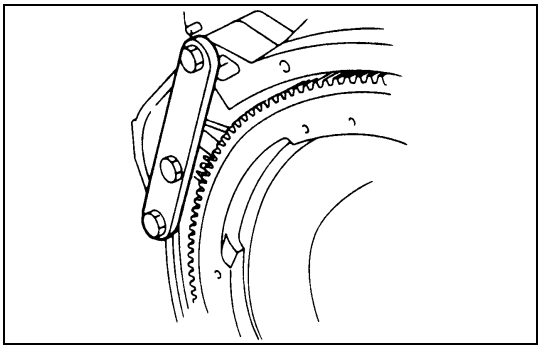


6A3-83-2.tif

5. Driven Plate

Remove the driven plate with the clutch pilot aligner.

① Clutch pilot aligner
② Clutch pressure plate assembly
③ Driven plate

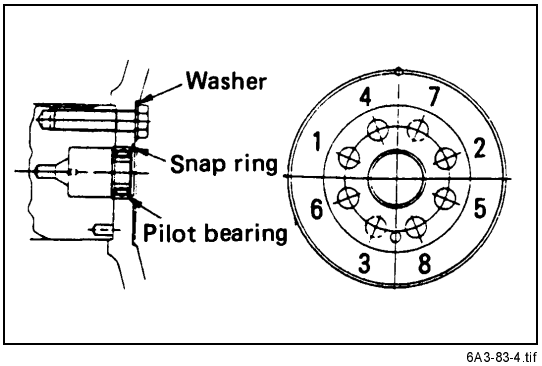

6A3-83-3.tif

6. Washer

7. Flywheel

1) Use the crankshaft stopper to prevent the crankshaft from turning.
   Crankshaft Stopper: 5-8840-2230-0
2) Loosen the flywheel bolts in numerical order a little at a time as shown in the illustration.
3) Remove the flywheel stopper and the flywheel assembly.

For the A/T vehicle, loosen first the flywheel fixing bolt, and then remove the washer, the flexible plate, the flywheel and the sleeve in this order.

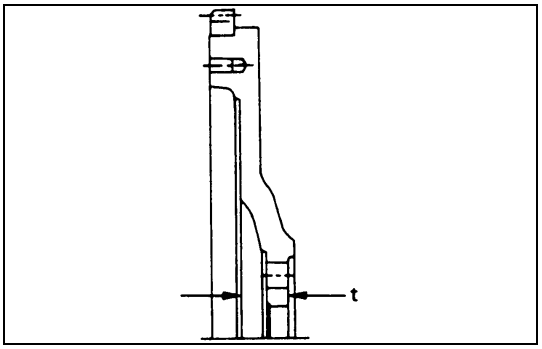


6A3-83-4.tif

8. Snap Ring

Use a snap ring pliers to remove the snap ring from the flywheel.

9. Pilot Bearing



6A3-84-1.tif

INSPECTION AND REPAIR

Flywheel

1) Inspect the flywheel friction surface for excessive wear and heat cracks.
2) Measure the flywheel thickness (t) between the flywheel friction surface and crankshaft setting face.
   If the measured value is between the standard and the specified limit, the flywheel may be reground.
   If the measured value exceeds the specified limit, the flywheel must be replaced.

Flywheel Thickness (t) mm (in)

Engine model	Standard	Limit
Others	31.4 - 31.6 (1.236 -1 .244)	31.0 (1.220)
4HE1-T, 4HG1-TC	37.4 - 37.6 (1.472 -1.480)	37.0 (1.457)

Flywheel Friction Surface Roughness mm (in)

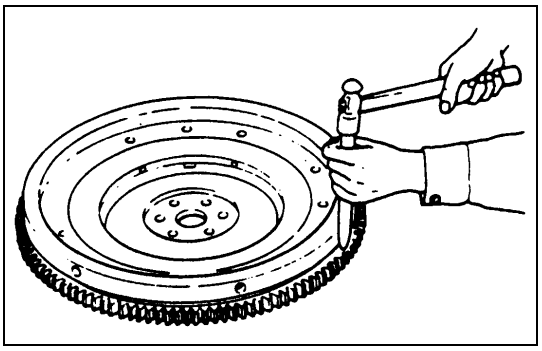
Less than 0.006(0.00024)

Ring Gear

Inspect the ring gear

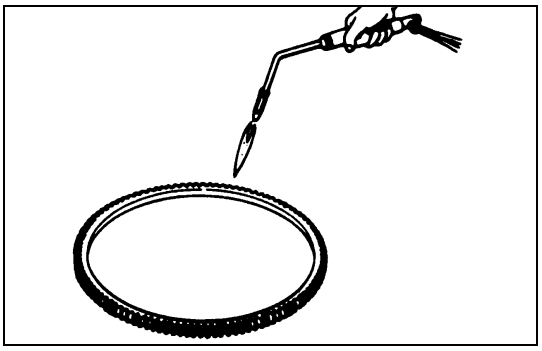
If the ring gear teeth are broken or excessively worn, the ring gear must be replaced.

Ring Gear Replacement


6A3-84-2.tif

Removal

Strike around the edges of the ring gear with a hammer and chisel to remove it.

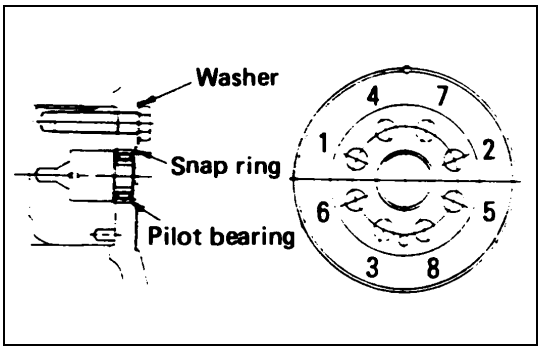

6A3-84-3.tif

Installation

1) Heat the ring gear evenly with a gas burner to invite thermal expansion.
2) Install the ring gear when it is sufficiently heated.
   The ring gear must be installed with the chamfer facing the clutch.

Pilot Bearing

Check the pilot bearing for wear or damage and replace with a new one if any abnormal condition is noticeable.



6A3-85-1.tif

INSTALLATION

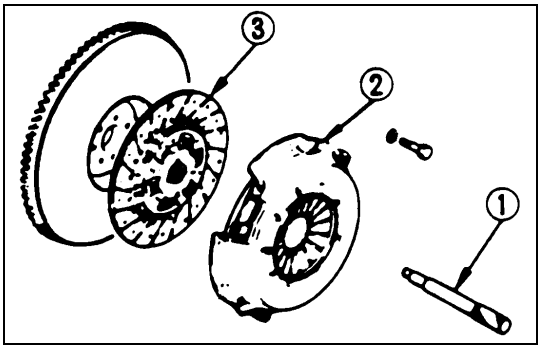
9. **Pilot Bearing**
8. **Snap Ring**
7. **Flywheel Assembly**
6. **Washer**

1) Align the flywheel with the crankshaft knock pin and temporarily tighten the flywheel bolts.
2) Use the crankshaft stopper to prevent the crankshaft from turning.
   Crankshaft stopper:5-8840-2230-0
3) Install the washer and the flywheel bolts and tighten to the specified torque in numerical order show in the illustration.

Flywheel Bolt torque — N•m (kg•m/lb•ft)

1st step	2nd step
78 (8.0/58)	90°-120°

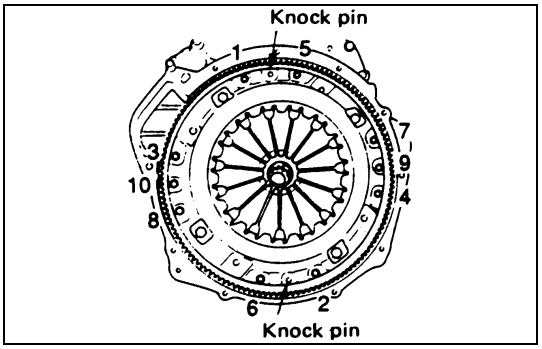
4) Remove the crankshaft stopper.



6A3-85-2.tif

5. **Driven Plate**

Use the clutch pilot aligner to install the driven plate.
Clutch Pilot Aligner: 5-8840-2240-0
① Clutch pilot aligner.
② Clutch pressure plate assembly.
③ Driven plate



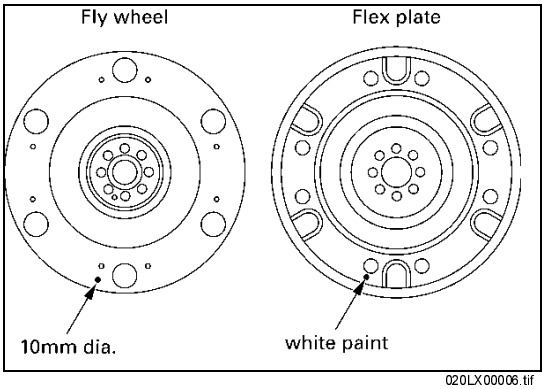
6A3-85-3.tif

4. **Clutch Pressure Plate Assembly**

1) Align the clutch pressure plate with the flywheel knock pin.
2) Tighten the pressure plate bolts to the specified torque in numerical order.

Clutch Pressure Plate Bolt Torque — N•m (kg•m/lb•ft)

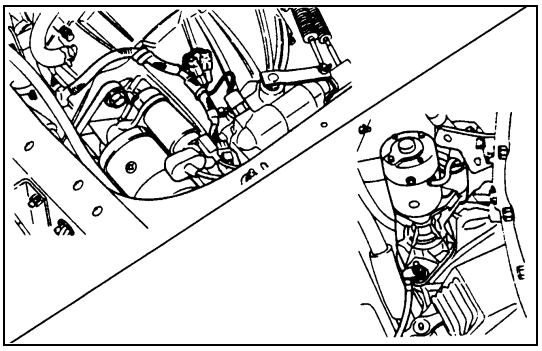
40 (4.1/30)



020LX00006.tif

For A/T model

1. Align the knock pin on the crankshaft to install the flywheel.
2. Install the flexible plate with alignment mark (10 mm diameter dent on the flywheel and 10 mm diameter white paint on the flexible plate) and washer.
3. Apply molybdenum disulfide grease to the bolt thread and seat to install the flywheel fixing hole.
   Tighten bolt to two stage tightening method in the numerical order.
   1st step; 78 N•m (58 lbft)
   2nd step; 90 - 120 degrees.


6A3-85-4.tif

3. Transmission Assembly

Above works refer to “ENGINE ASSEMBLY” section in this manual.

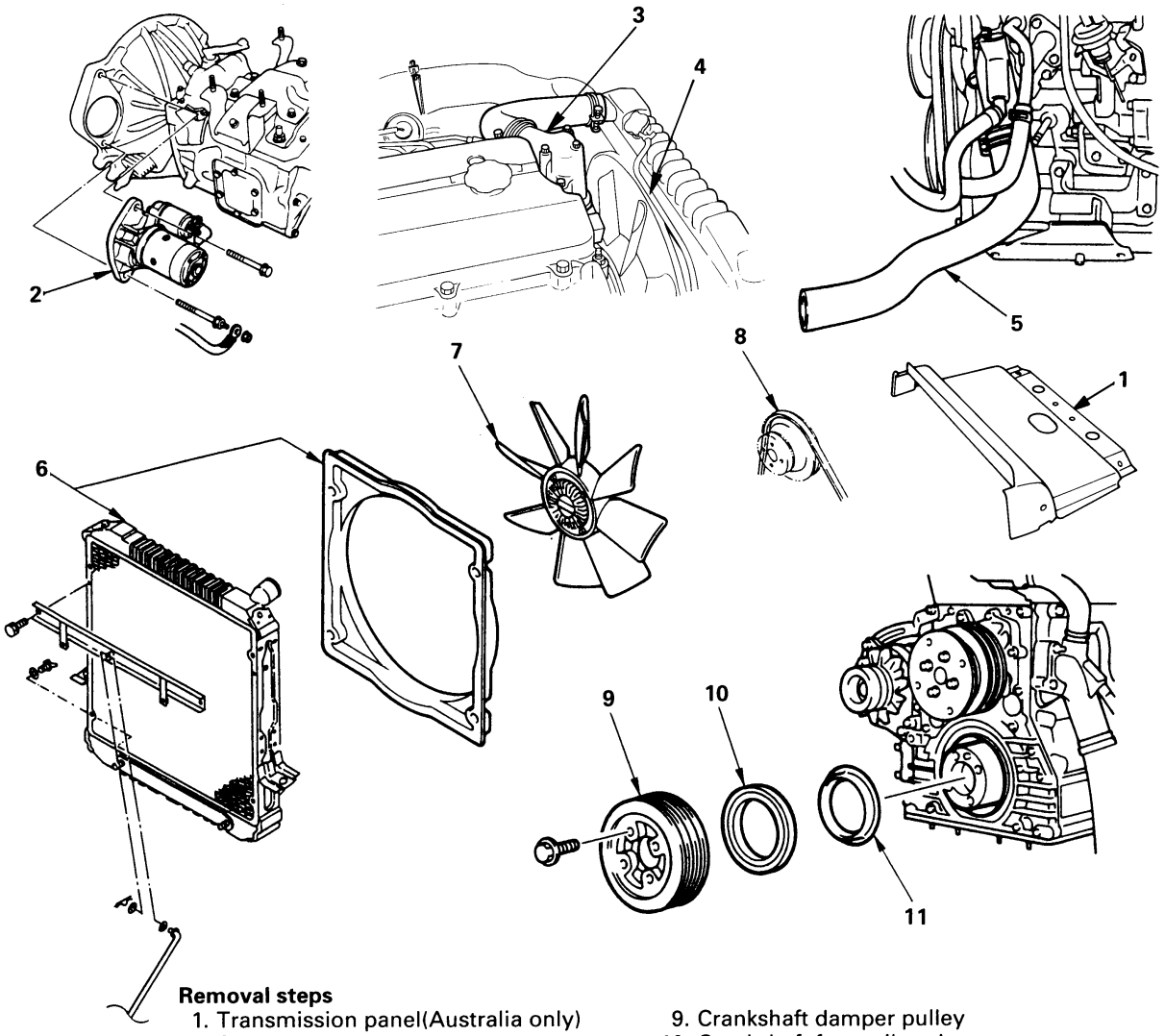
2. Starter

Starter Bolt Torque	N•m (kg•m/lb•ft)
	76 (7.7/56)

1. Transmission Panel (M/T model only)

- Connect the battery ground cable.

CRANKSHAFT FRONT OIL SEAL



Removal steps
1. Transmission panel(Australia only)
2. Starter
3. Radiator upper hose
4. Coolant reserve tank hose/Bypass hose
5. Radiator lower hose
6. Radiator (with guide)
7. Fan assembly
8. Fan belt
9. Crankshaft damper pulley
10. Crankshaft front oil seal
11. Crankshaft front slinger

Installation steps
To install, follow the removal steps in the reverse order.

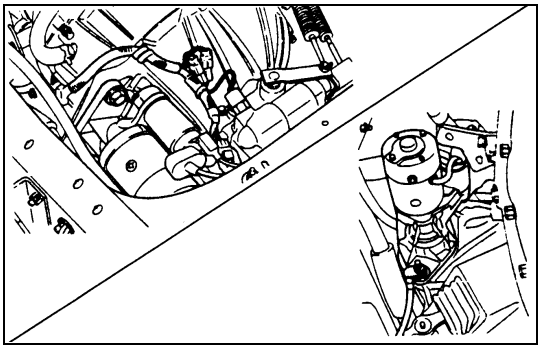
6A3-86-1.tif

REMOVAL

Preparation

- Disconnect battery ground cable.
- Tilt the cab.
- Drain coolant

1. Transmission Panel (M/T model only)


6A3-87-1.tif

2. Starter
- Disconnect the battery cable at the starter motor.
- Remove the starter assembly from flywheel housing.

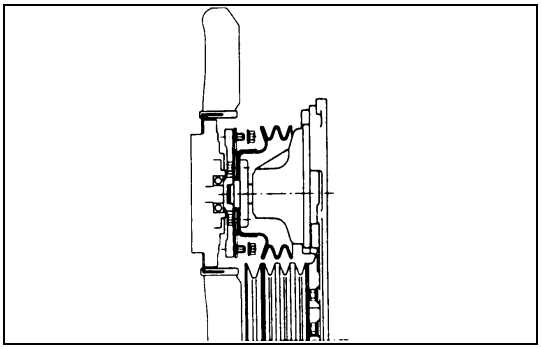
3. Radiator Upper Hose

4. Coolant Reserve Tank Hose/Bypass Hose

5. Radiator Lower Hose

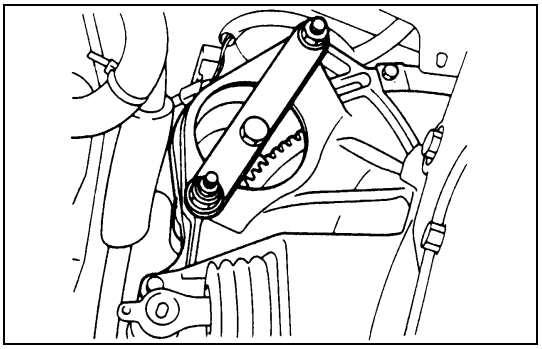
6. Radiator (with Guide)

For the A/T model vehicle, remove the oil cooler pipe first.


6A3-87-2.tif

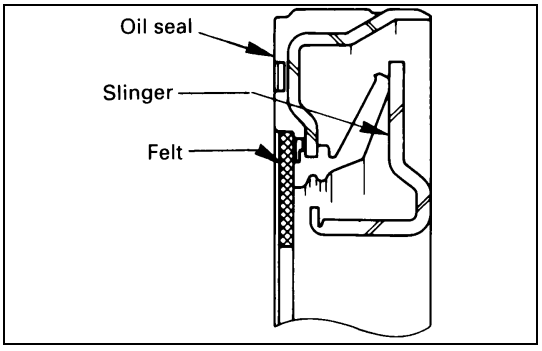
7. Fan Assembly

8. Fan Belt


6A3-87-3.tif

9. Crankshaft Damper Pulley

1) Use the crankshaft stopper to prevent the crankshaft from turning.
   Crankshaft Stopper: 5-8840-2230-0
2) Loosen the damper pulley bolts and remove the damper pulley.

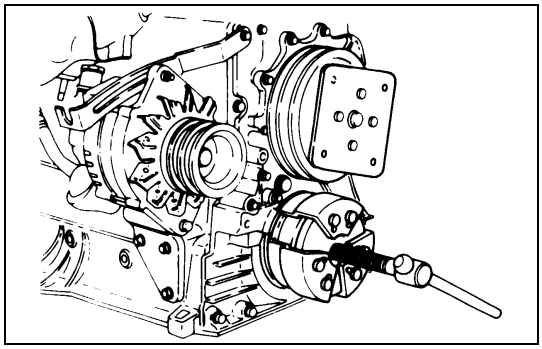


6A3-87-4.tif

10. Crankshaft Front Oil Seal

CAUTION:

Be careful not to damage the crankshaft oil seal contact surface during the removal procedure.

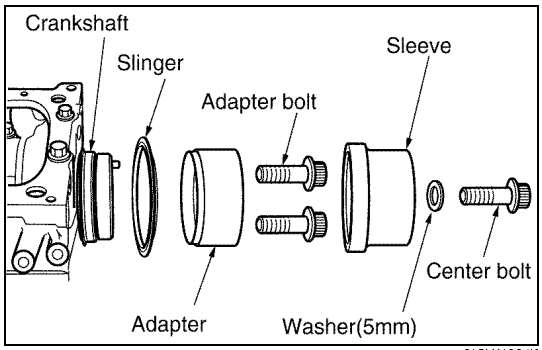

6A3-88-1.tif

11. Crankshaft Front Slinger

Use the slinger puller to pull out the slinger.
Slinger Puller: 5-8840-2360-0

INSTALLATION

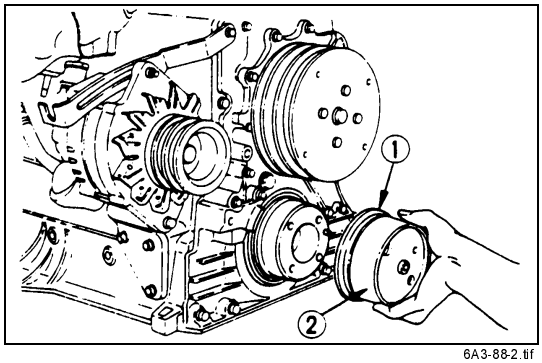
11. Crankshaft Front Slinger



015LX160.tif

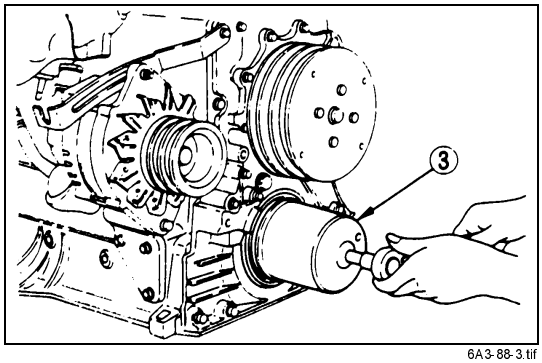
Press in the slinger using oil seal setting tool kit.
Oil Seal Setting Tool Kit: 5-8840-2431-0
Front slinger and oil seal setting tools

Part Name	Stamp	Slinger	Oil Seal
Adapter	FT	O	O
Sleeve	FT	O	O
Oil seal adapter ring	FT		O
Center bolt	-	O	O
Adapter bolt	-	O	O



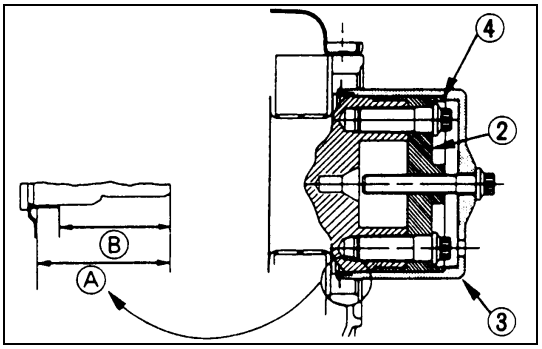
6A3-88-2.tif

1) Insert the slinger ① into the end of adapter ② and install the adapter on the crankshaft.



6A3-88-3.tif

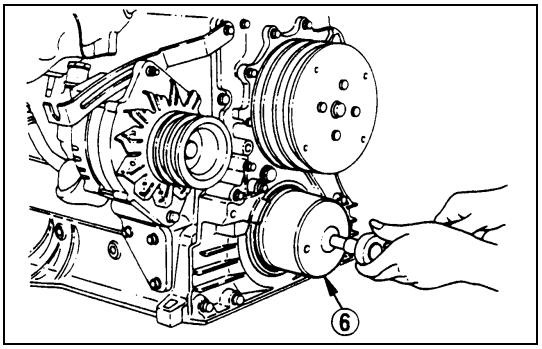
2) Cover the sleeve ③ and tighten the bolt until the sleeve comes to contact the adapter stopper ④.



6A3-89-1.tif

3) With the slinger pressed in, make sure of measurements specified in the illustration as well as of slinger deflection.
   Ⓐ : 40.5 ± 0.3mm (1.594 ± 0.012 in)
   Ⓑ : 34.0 ± 0.1mm (1.339 ± 0.004 in)

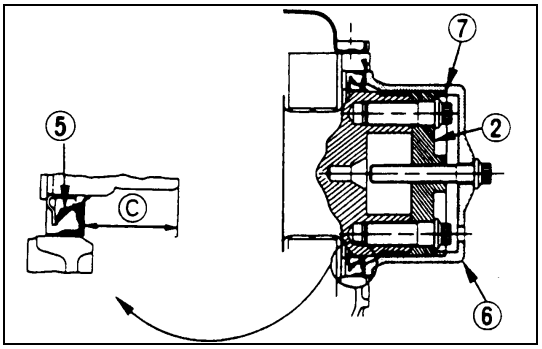
NOTE:
Be sure to replace the slinger and oil seal as a set.
Use about 5 mm thickness plain washer on the center bolt.



6A3-89-2.tif

10. Crankshaft Front Oil Seal

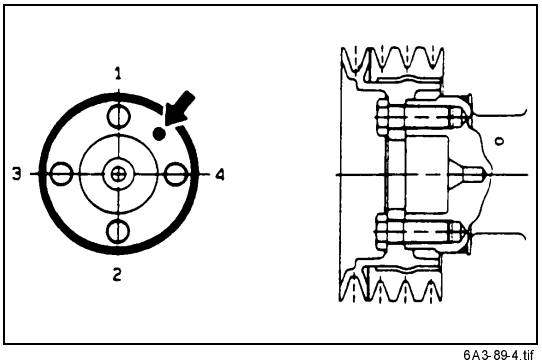
1) Apply engine oil to the lip of the oil seal.
2) Press in the oil seal using the front oil seal setting tool kit.
   - Remove the slinger sleeve and insert the oil seal ⑤ into the adapter ②.
   - Install the oil seal sleeve ⑥ to the adapter ② and tighten the center bolt until the sleeve comes to contact the adapter stopper ⑦.



6A3-89-3.tif

- With the oil seal pressed in, make sure of the measurements specified in the illustration.
  Ⓒ : 31 ± 0.3 mm (1.220 ± 0.012 in)

NOTE:
Be sure to replace the slinger and oil seal as a set.
Use about 5 mm thickness plain washer on the center bolt.

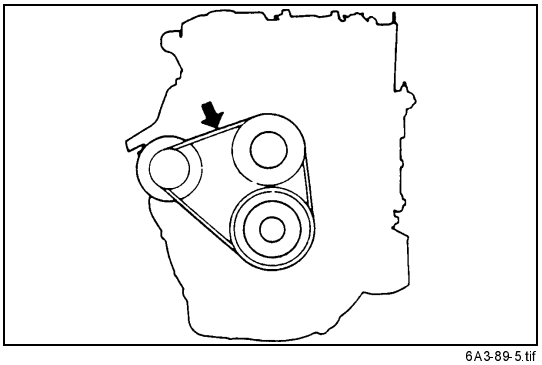


6A3-89-4.tif

9. Crankshaft Damper Pulley

1) Apply a coat of engine oil to the threads of the bolts.
2) Align the damper pulley with the crankshaft knock pin and tighten the bolts to the specified torque in numerical order.

Damper Pulley Bolt Torque	N•m (kg•m/lb•ft)
200 (20.4/147)	

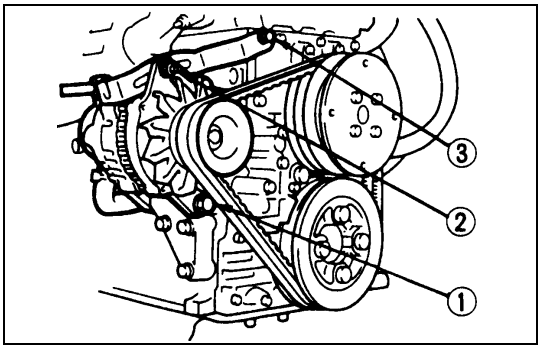

6A3-89-5.tif

8. Fan Belt

Check the drive belt tension.
Depress the drive belt mid-portion with a 98N (10kg/22lb) force.

Drive Belt Deflection	mm (in)
8 - 12 (0.31 - 0.47) ... New belt 10 - 14 (0.39 - 0.55) ... Reuse belt	

Check the drive belt for cranking and other damage.

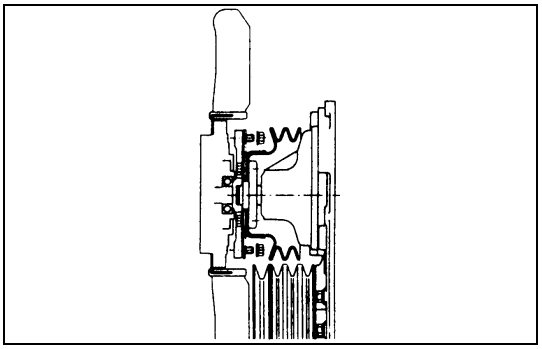


6A3-90-1.tif

Fan Belt Adjustment

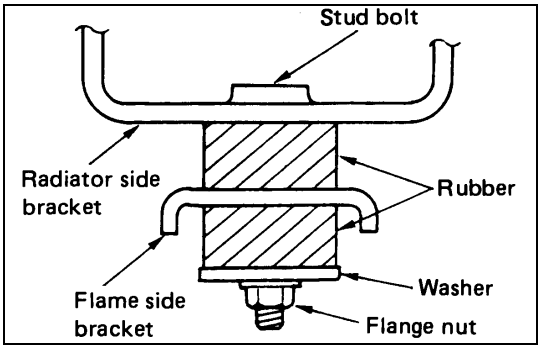
Fan belt tension is adjusted by moving the generator.

Torque	N•m (kg•m/lb•ft)
①	40 (4.1/30)
②	24 (2.4/17)
③	46 (4.7/34)


6A3-90-2.tif

7. Fan Assembly

Fan Bolt Torque	N•m (kg•m/lb•ft)
24 (2.4/17)	



6A3-90-3.tif

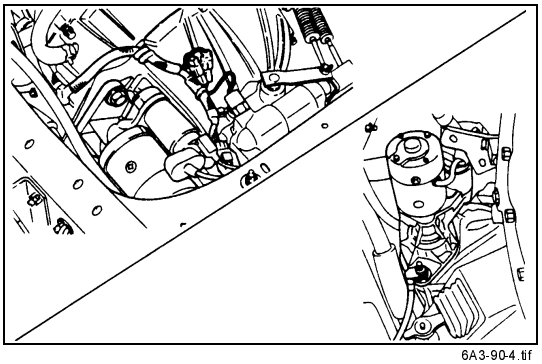
6. Radiator (with Guide)

Radiator Bolt Torque	N•m (kg•m/lb•ft)
55 (5.6/41)	

5. Radiator Lower Hose

4. Coolant reserve Tank Hose/Bypass Hose

3. Radiator Upper Hose


6A3-90-4.tif

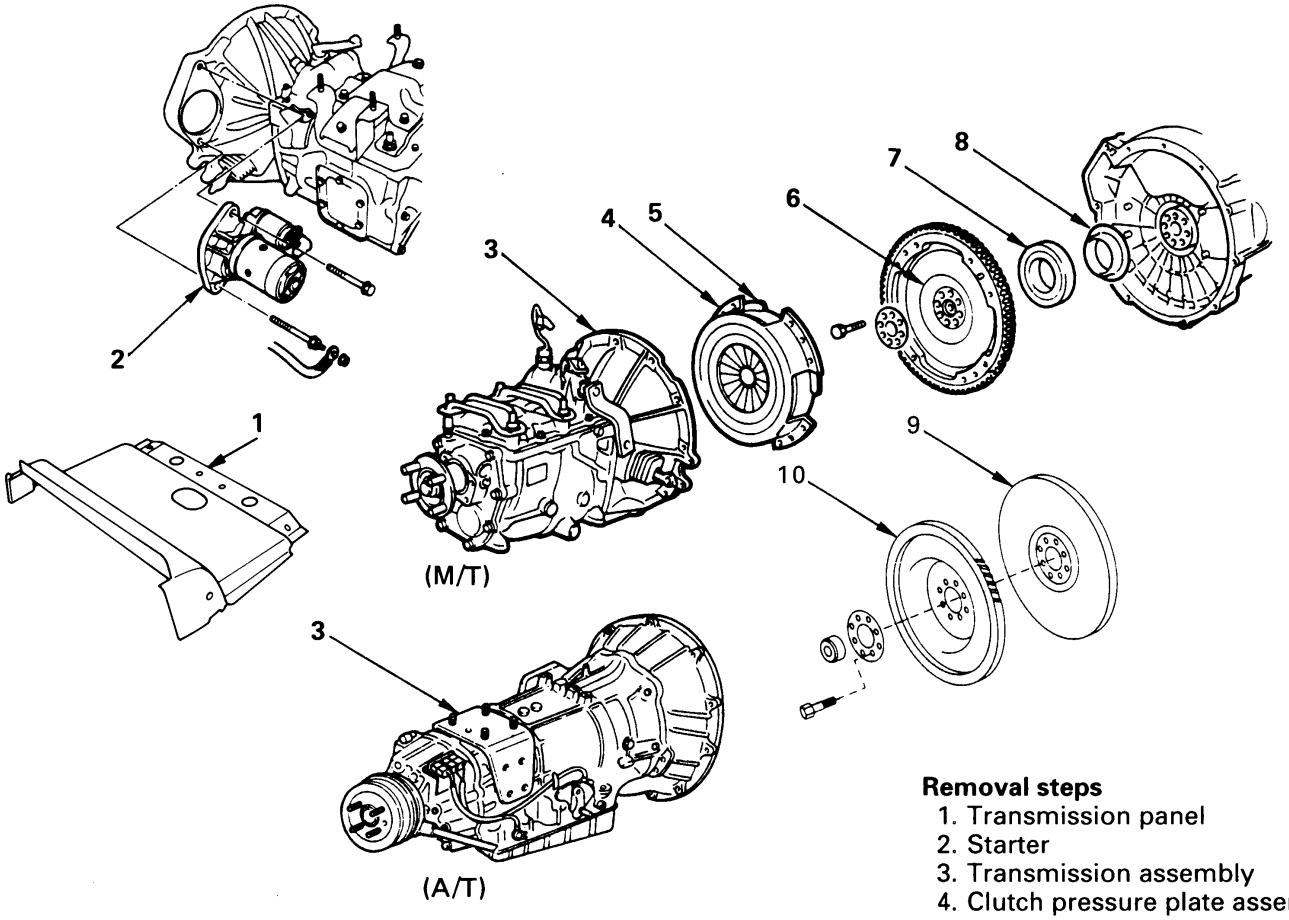
2. Starter

Starter Bolt Torque	N•m (kg•m/lb•ft)
76 (7.7/56)	

1. Transmission Panel
(M/T model only)

- Connect battery ground cable
- Pour engine coolant into engine.

CRANKSHAFT REAR OIL SEAL



Removal steps
1. Transmission panel
2. Starter
3. Transmission assembly
4. Clutch pressure plate assembly
5. Driven plate
6. Flywheel assembly (M/T)
7. Crankshaft rear oil seal
8. Crankshaft rear slinger
9. Flywheel (A/T)
10. Flexible plate (A/T)

Installation steps
To install, follow the removal steps in the reverse order.

6A3-91-1.tif

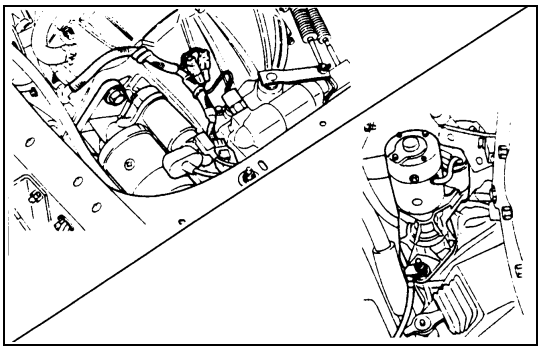
REMOVAL

Preparation
- Disconnect battery ground cable.

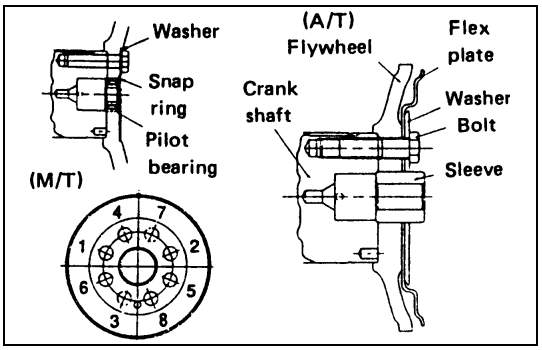
1. Transmission Panel (M/T model only.)

2. Starter
1) Disconnect the battery cable at the starter motor.
2) Remove the starter assembly from flywheel housing.

3. Transmission Assembly
Above works refer to “ENGINE ASSEMBLY” section in this manual.



6A3-91-2.tif

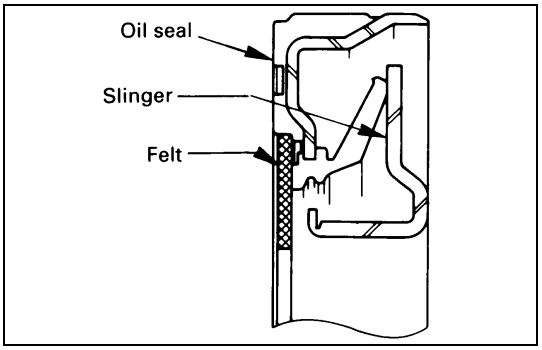


6A3-92-1.tif

4. **Clutch Pressure Plate Assembly**
5. **Driven Plate**
6. **Flywheel Assembly**

Above works refer to “FLYWHEEL AND PILOT BEARING” section in this manual.

For the A/T vehicle, loosen the flywheel fixing bolt and then remove the washer, the flexible plate, the flywheel and the sleeve in this order.

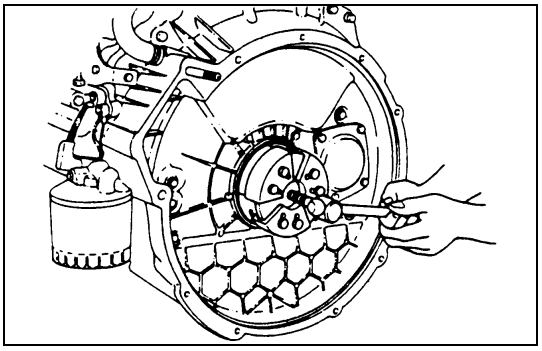


6A3-92-2.tif

7. **Crankshaft Rear Oil Seal**

CAUTION:

Be careful not to damage the crankshaft oil seal contact surface during the removal procedure.

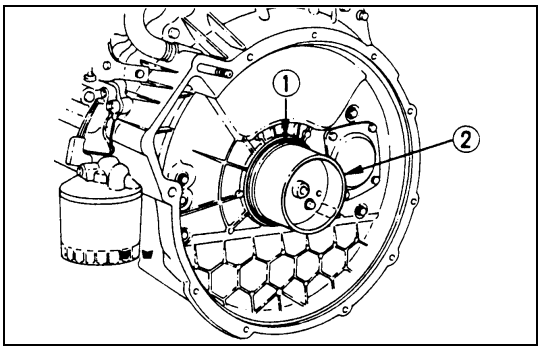

6A3-92-3.tif

8. **Crankshaft Rear Slinger**

Use the slinger puller to pull out the slinger.

Slinger Puller: 5-8840-2360-0

INSTALLATION

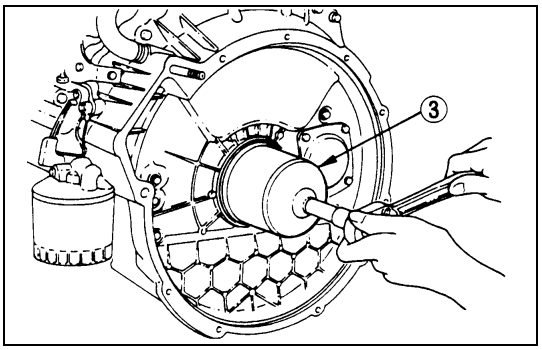


6A3-93-1.tif

8. Crankshaft Rear Slinger

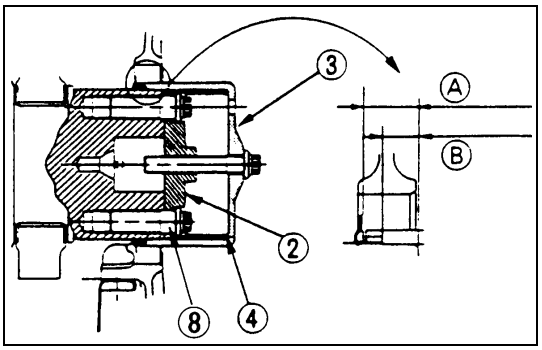
Press in the slinger using oil seal setting tool kit.

- Insert the slinger ① into the end of adapter ② and install the adapter on the crankshaft.



6A3-93-2.tif

- Cover the sleeve ③ and tighten the bolt until the sleeve comes to contact the adapter stopper ④.



6A3-93-3.tif

- Make sure of measurements specified in the illustration as well as of slinger deflection.
  Ⓐ :17.3 ± 0.3mm (0.681 ± 0.012 in)
  Ⓑ :10.8 ± 0.1mm (0.425 ± 0.004 in)

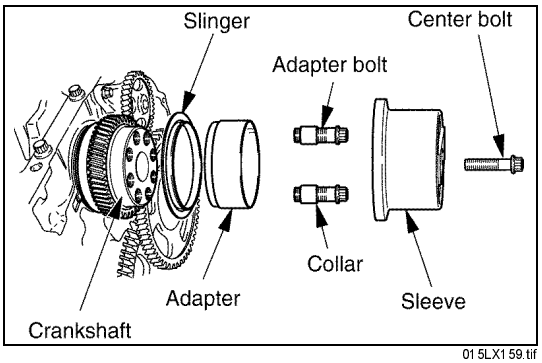
NOTE:

Be sure to replace the slinger and oil seal as a set.

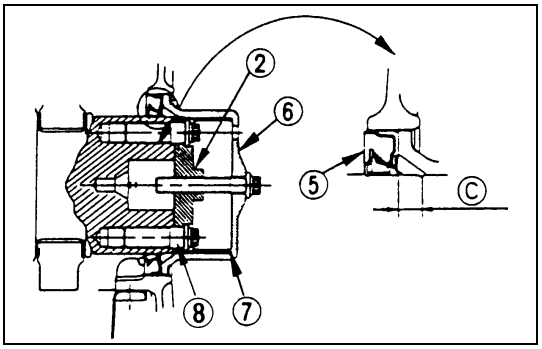
Oil Seal Setting Tool Kit: 5-8840-2431-0

Rear slinger and oil seal setting tools

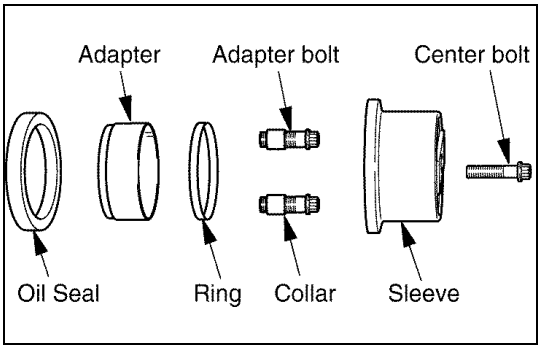
Part Name	Stamp	Slinger	Oil Seal
Adapter	RR	O	O
Sleeve	RR	O	O
Oil seal adapter ring	RR		O
Center bolt	-	O	O
Adapter bolt	-	O	O
Adapter bolt collar	RR	O	O



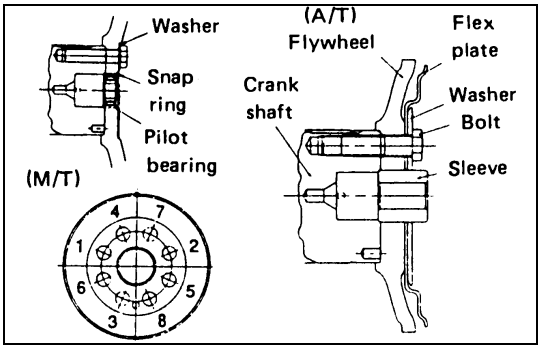
015LX159.tif



6A3-94-2.tif



015LX158.tif



6A3-94-3.tif

7. Crankshaft Rear Oil Seal

1) Apply engine oil to the lip of the oil seal.
2) Press in the oil seal using rear oil seal setting tool kit.

- Remove the slinger sleeve and insert the oil seal ⑤ into the adapter ②.
- Install the atapter ring into the sleeve.
- Install the oil seal sleeve ⑥ to the adapter ② and tighten the center bolt until the sleeve comes to contact the adapter stopper ⑦.

- Make sure of the measurements specified in the illustration.
  Ⓒ : 7.8 ± 0.3mm (0.307 ± 0.012 in)

6. Flywheel Assembly

1) Apply a coat of molybdenum disulfide grease to the flywheel bolt threads and setting faces.
2) Align the flywheel with the crankshaft knock pin and temporarily tighten the flywheel bolts.
3) Use the crankshaft stopper to prevent the crankshaft from turning.
   Crankshaft Stopper: 5-8840-2230-0
4) Install the washer and the flywheel bolts and tighten to the specified torque in numerical order show in the illustration.

Flywheel Bolt Torque — N•m (kg•m/lb•ft)

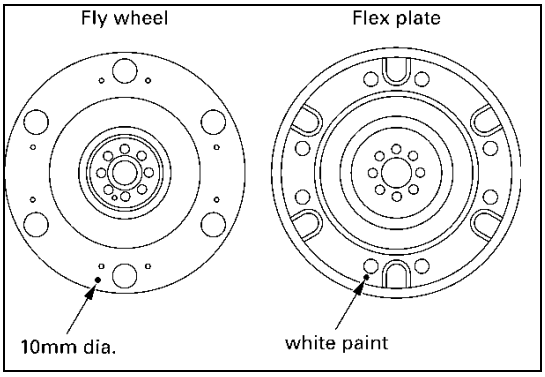
1st step	2nd step
78 (8.0/58)	90°-120°

5) Remove the crankshaft stopper.

5. Driven Plate

4. Clutch Pressure Plate Assembly

Above works refer to “FLYWHEEL AND PILOT BEARING” section in this manual.



020LX00006.tif

For A/T model

1. Align the knock pin on the crankshaft to install the flywheel.
2. Install the flexible plate with alignment mark (10 mm diameter dent on the flywheel and 10 mm diameter white paint on the flexible plate) and washer.
3. Apply molybdenum disulfide grease to the bolt thread and seat to install the flywheel fixing hole.

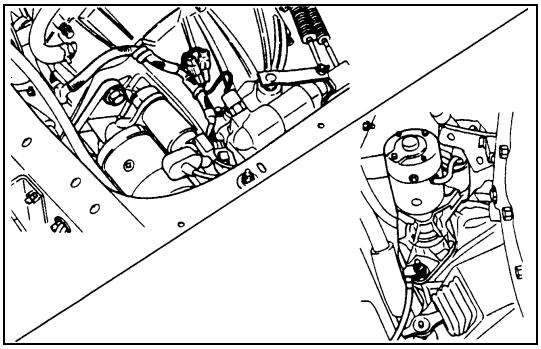
   Tighten bolt to two stage tightening method in the numerical order.

   1st step; 78 N•m (58 lbft)

   2nd step; 90 - 120 degrees.

3. Transmission Assembly

Above works refer to “ENGINE ASSEMBLY” section in this manual.


6A3-95-1.tif

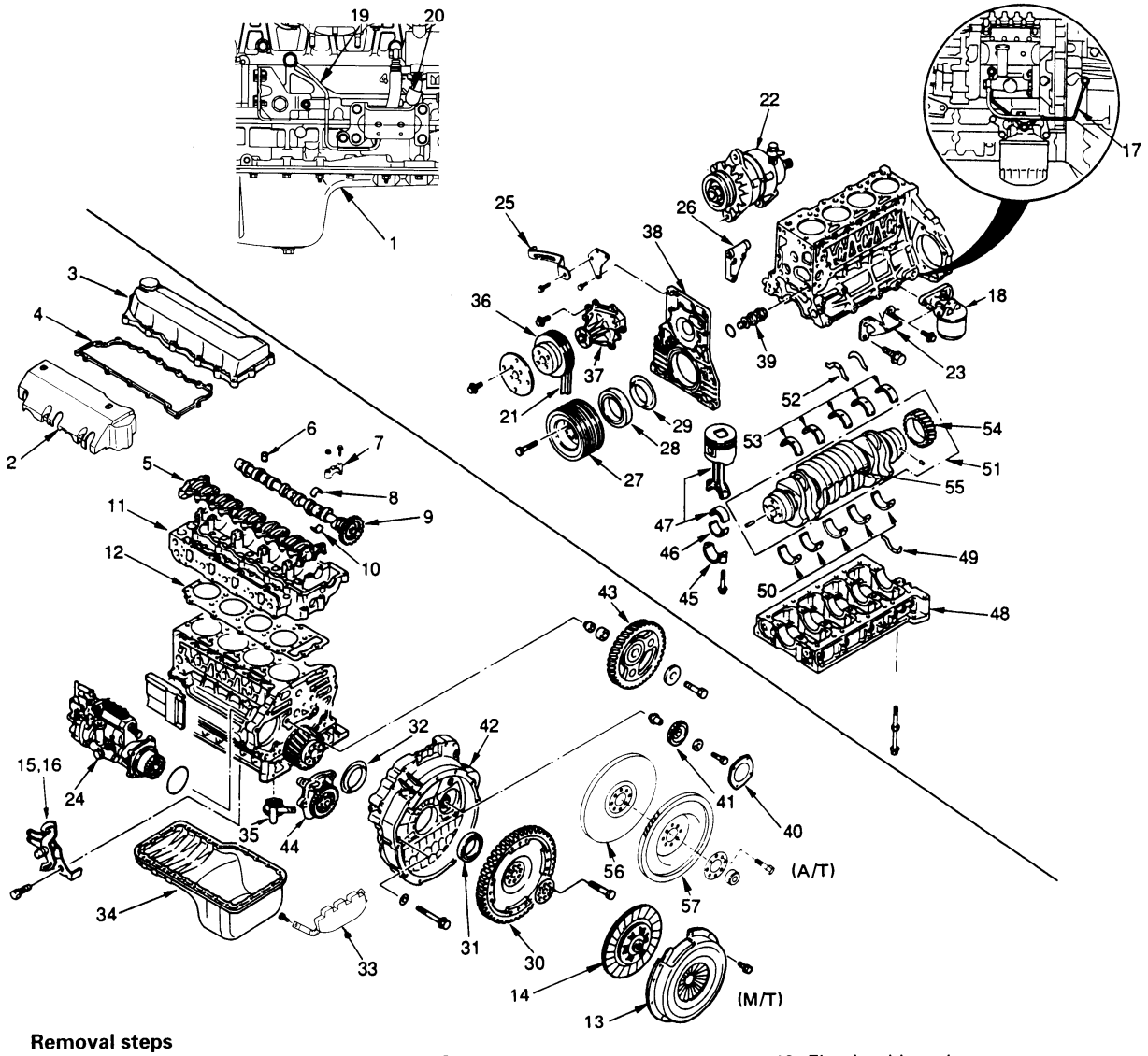
2. Starter

Starter Bolt Torque	N•m (kg•m/lb•ft)
	76 (7.7/56)

1. Transmission Panel (M/T model only)

- Connect the battery ground cable.

CRANKSHAFT



Removal steps

1. Engine cover
2. Nozzle cover
3. Cylinder head cover
4. Cylinder head cover gasket
5. Rocker arm shaft assembly
6. Valve cap
7. Camshaft bearing cap
8. Camshaft bearing upper
9. Camshaft assembly
10. Camshaft bearing lower
11. Cylinder head assembly
12. Cylinder head gasket
13. Clutch pressure plate assembly
14. Driven plate
15. Engine control wire
16. Engine control lever assembly
17. Oil pipe
18. Oil filter assembly
19. Vacuum pump oil pipe
20. Vacuum pump rubber hose
21. Fan belt
22. Generator
23. Engine foot
24. Injection pump assembly
25. Fan belt adjust plate
26. Generator bracket
27. Crankshaft pulley
28. Crankshaft front oil seal
29. Crankshaft front slinger
30. Flywheel (M/T)
31. Crankshaft rear oil seal
32. Crankshaft rear slinger
33. Spacer rubber
34. Oil pan
35. Oil pump strainer
36. Water pump pulley
37. Water pump
38. Front retainer
39. Oil thermo valve
40. Power steering pump idle gear cover
41. Power steering pump idle gear
42. Flywheel housing
43. Idle gear A
44. Oil pump assembly
45. Connecting rod cap assembly
46. Connecting rod lower bearing
47. Piston and connecting rod assembly
48. Crankcase
49. Thrust bearing lower
50. Crankshaft bearing lower
51. Crankshaft assembly
52. Thrust bearing upper
53. Crankshaft bearing upper
54. Crankshaft gear
55. Crankshaft
56. Flywheel (A/T)
57. Flexible plate(A/T)

Installation steps

To install, follow the removal steps in the reverse order.

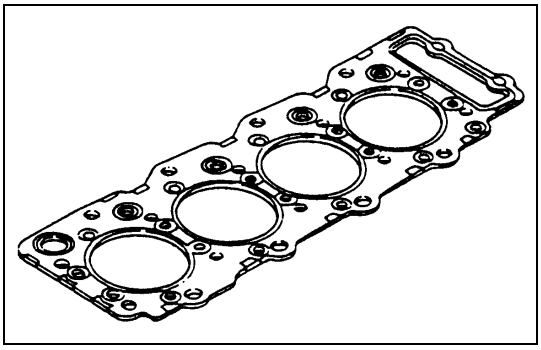
6A3-96-1.tif

REMOVAL

Preparation

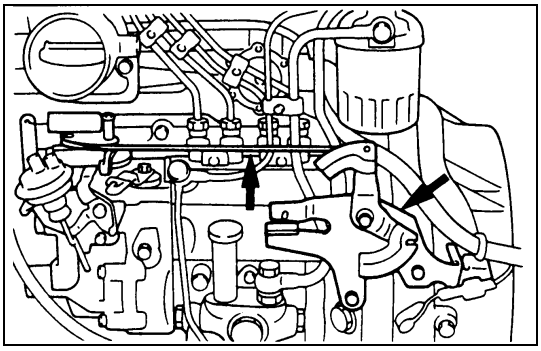
- Disconnect battery ground cable.
- Tilt the cab
- Drain coolant and engine oil

1. **Engine Assembly**
   Above works refer to “ENGINE ASSEMBLY” section in this manual.
2. **Nozzle Cover**
3. **Cylinder Head Cover**
4. **Cylinder Head Cover Gasket**
5. **Rocker Arm Shaft Assembly**
   Above works refer to “ROCKER ARM SHAFT ASSEMBLY” section in this manual.
6. **Valve Cap**
7. **Camshaft Bearing Cap**
8. **Camshaft Bearing Upper**
9. **Camshaft Assembly**
10. **Camshaft Bearing Lower**
    Above works refer to “CAMSHAFT ASSEMBLY” section in this manual.
11. **Cylinder Head Assembly**
    Above works refer to “CYLINDER HEAD” section in this manual.
12. **Cylinder Head Gasket**

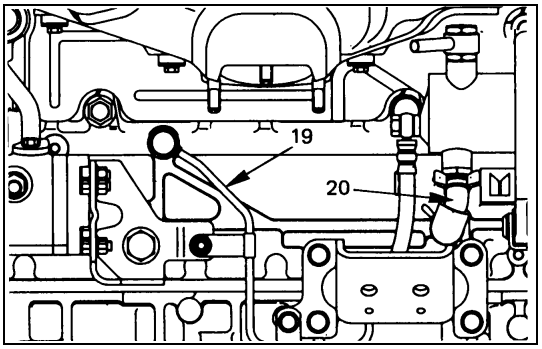

6A3-97-1.tif

CAUTION:
Do not reuse the cylinder head gasket.

13. **Clutch Pressure Plate Assembly**
14. **Driven Plate**
    Above works refer to “FLYWHEEL AND PILOT BEARING” section in this manual.
15. **Engine Control Wire**
16. **Engine Control Lever Assembly**
17. **Oil Pipe**

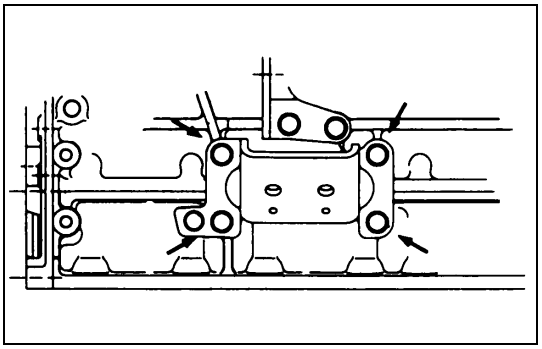

6A3-67-2.tif

18. **Oil Filter Assembly**

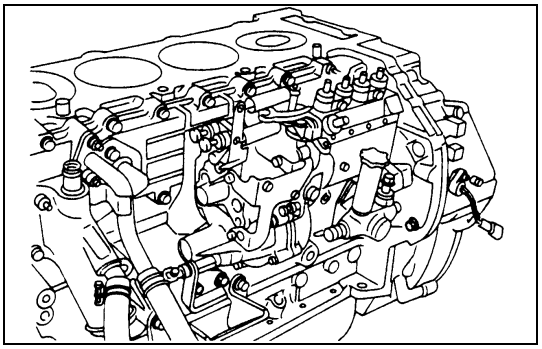


6A3-98-1.tif

19. Vacuum Pump Oil Pipe
20. Vacuum Pump Rubber Hose
21. Fan Belt
22. Generator

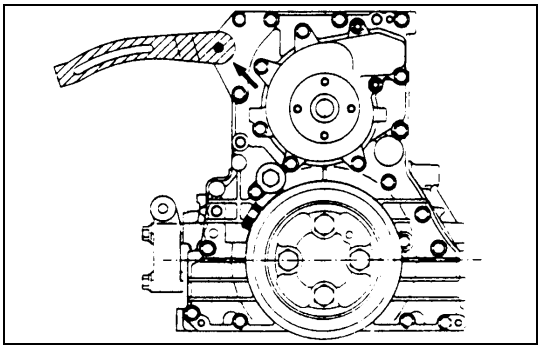

6A3-98-2.tif

23. Engine Foot

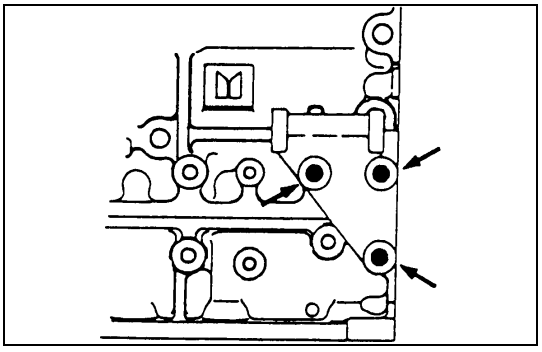

6A3-98-3.tif

24. Injection Pump Assembly

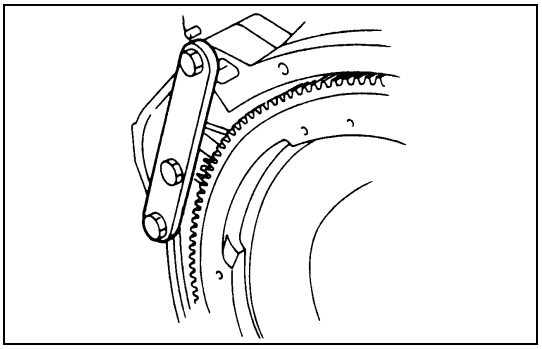
1) Remove the injection pump bracket bolts and the injection pump rear bracket bolts.
2) Then remove the injection pump assembly.


6A3-98-4.tif

25. Fan Belt Adjust Plate


6A3-98-5.tif

26. Generator Bracket



6A3-99-1.tif

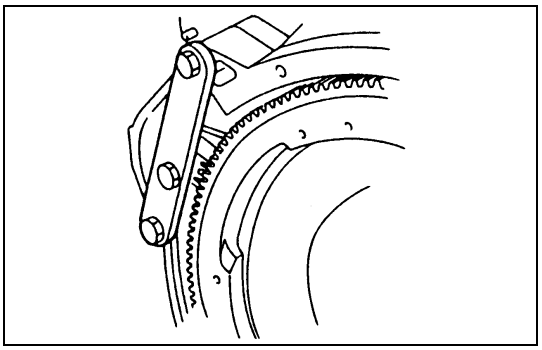
27. Crankshaft Damper Pulley

1) Use the crankshaft stopper to prevent the crankshaft from turning.
   Crankshaft Stopper:5-8840-2230-0
2) Loosen the damper pulley bolts and remove the damper pulley.

28. Crankshaft Front Oil Seal

29. Crankshaft Front Slinger

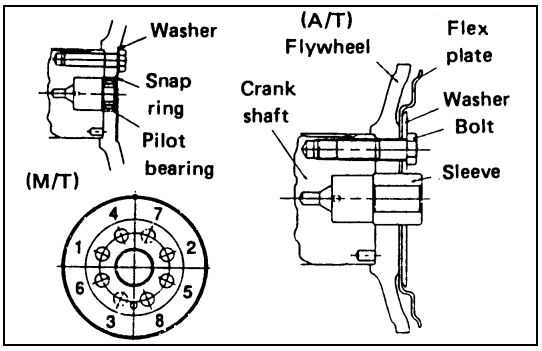
Above works refer to “CRANKSHAFT FRONT OIL SEAL” section in this manual.



6A3-99-2.tif

30. Flywheel Assembly

1) Use the crankshaft stopper to prevent the crankshaft from turning
   Crankshaft Stopper:5-8840-2230-0
2) Loosen the flywheel bolts in numerical order a little at a time as shown in the illustration.
3) Remove the flywheel stopper and the flywheel assembly.



6A3-99-3.tif

For the A/T vehicle, loosen first the flywheel fixing bolt, and then remove the washer, the flexible plate, the flywheel and the sleeve in this order.

31. Crankshaft Rear Oil Seal

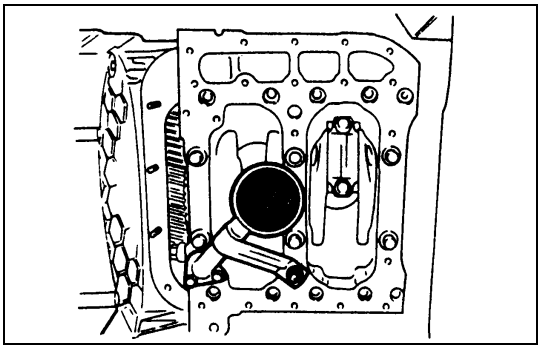
32. Crankshaft Rear Slinger

Above works refer to “CRANKSHAFT REAR OIL SEAL” section in this manual.

33. Spacer Rubber (NKR model only)

For the 4WD model vehicle, remove the stiffener before removing the spacer rubber.

34. Oil Pan

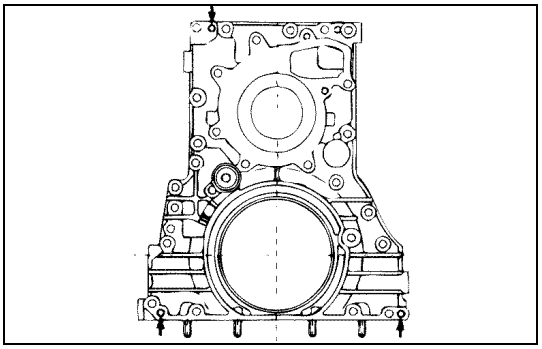


6A3-100-1.tif

35. Oil Pump Strainer

36. Water Pump Pulley

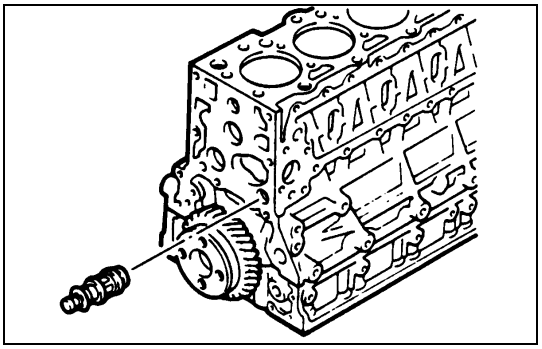
37. Water Pump



020LX011.tif

38. Front Retainer

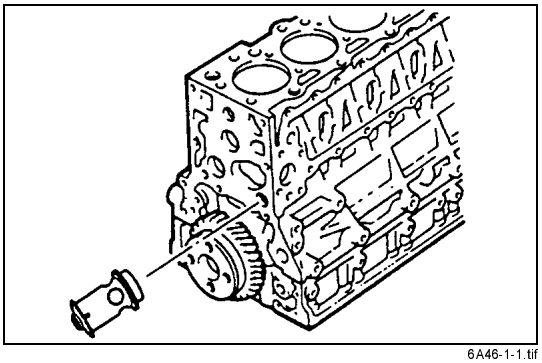
Install the three front retainer fixing bolts to the front retainer replacer holes as shown in the illustration, and tighten the bolts alternately a little at a time.



6A3-100-3.tif

39. Oil Thermo Valve (4HF1, 4HF1-2, 4HG1, 4HG1-T)

Pull out the thermo valve from the cylinder body.



6A46-1-1.tif

39-1. Bypass Valve (4HE1-T, 4HE1-TC)

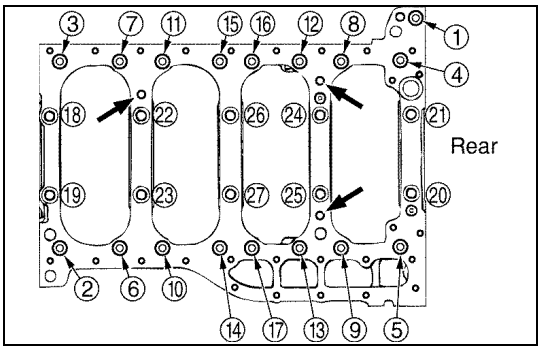
Pull out the bypass valve from the cylinder body.

40. Power Steering Pump Idle Gear Cover
41. Power Steering Pump Idle Gear
42. Flywheel Housing
43. Idle Gear A
44. Oil Pump Assembly

Above works refer to “TIMING GEAR REPLACEMENT” section in this manual.

45. Connecting Rod Cap
46. Connecting Rod Lower Bearing
47. Piston and Connecting Rod Assembly

Above works refer to “PISTON AND CONNECTING ROD” section in this manual.

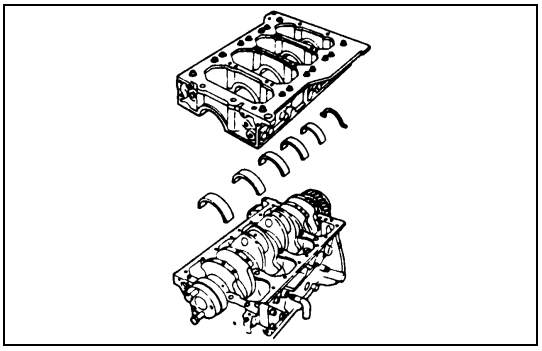


020LX018.tif

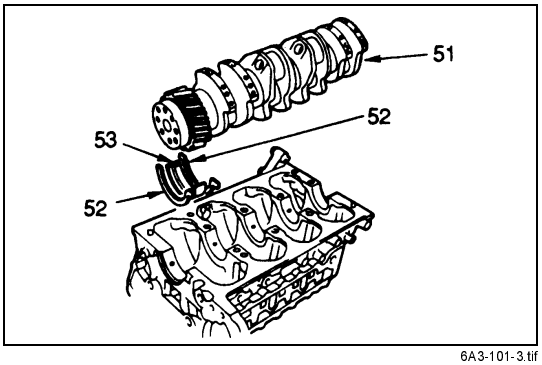
48. Crankcase

1) Loosen the crankcase bolts in numerical order a little at a time.
2) Install the three crankcase fixing bolts (See left arrow marks) to the crankcase replacer holes as shown in the illustration, and tighten the bolts alternate a little at a time.

NOTE:
When removing the crankcase, be sure to remove the oil pump and the generator bracket before that.

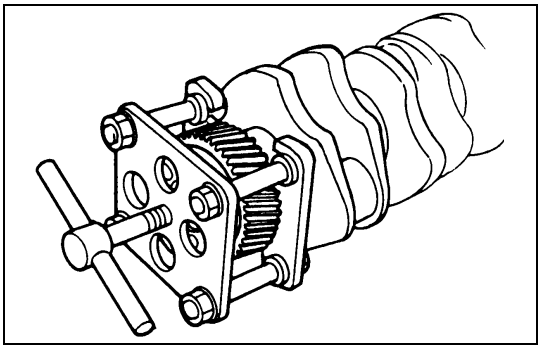

6A3-101-2.tif

49. Thrust Bearing Lower
50. Crankshaft Bearing Lower



6A3-101-3.tif

51. Crankshaft Assembly
52. Thrust Bearing Upper
53. Crankshaft Bearing Upper

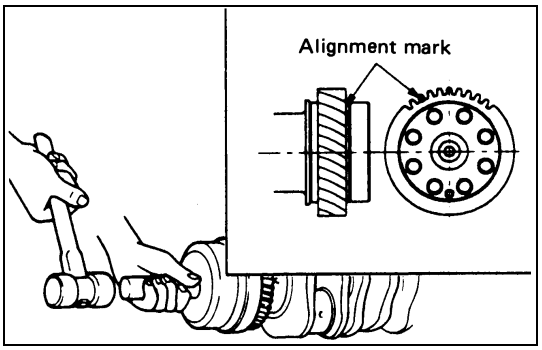

6A3-101-4.tif

54. Crankshaft Gear

1) Use the crankshaft gear remover to remove the crankshaft gear.
   Crankshaft Gear Remover: 8-9439-6818-0
2) Remove the crankshaft feather key.

55. Crankshaft

INSTALLATION



6A3-102-1.tif

55. Crankshaft

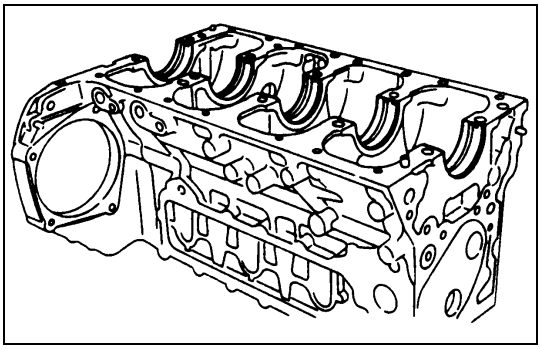
54. Crankshaft Gear

1) Use a piston heater to heat the crankshaft gear to 170° - 250°C (338° - 482°F).
2) With the alignment mark “S” on the side of the crankshaft gear turned outward, align the groove on the gear side with the crankshaft pin position and hammer it in with a crankshaft gear installer until it hits the bottom.

CAUTION:

When hammered in with the gear slanted, the crankshaft gear may be caught in the middle and cannot be hammered in fully. Gear it in quickly enough not to allow a shaft line along the gear and the crankshaft to slant.

Crankshaft Gear Installer:8-9439-6819-0


6A3-102-2.tif

53. Crankshaft Bearing Upper

When replacing the crankshaft or the crankshaft bearing with a new one, select the crankshaft bearing according to the respective grades stamped on the crankshaft and the cylinder body.

Refer to the “CRANKSHAFT” in this section 6A.

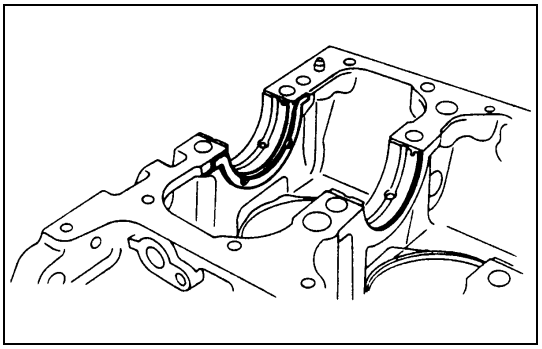
All upper bearings have oil grooves.

1) Carefully wipe any foreign material from the upper bearing.

CAUTION:

Do not apply engine oil to the bearing back faces and the cylinder body bearing fitting surfaces.

2) Locate the position mark applied at disassembly if the removed upper bearings are to be reused.



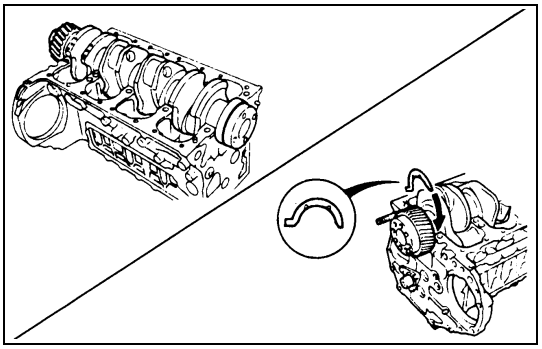
6A3-102-3.tif

52. Thrust Bearing Upper

Install the thrust bearing upper to the front side of the cylinder body No.5 journal. At this time, the thrust bearing upper may be pasted to the cylinder body with grease. However, be sure to wipe off any excessive grease.

CAUTION:

The thrust bearing oil grooves must be facing the sliding faces.



6A3-103-1.tif

51. Crankshaft Assembly

Apply an ample coat of engine oil to the crankshaft journals and the crankshaft bearing surfaces before installing the crankshaft with timing gear.

- While pressing on the installed crankshaft toward the rear side, insert the thrust bearing upper into the rear side of the cylinder body No.5 journal.

The thrust bearing oil grooves must be facing the sliding faces.

50. Crankshaft Bearing Lower

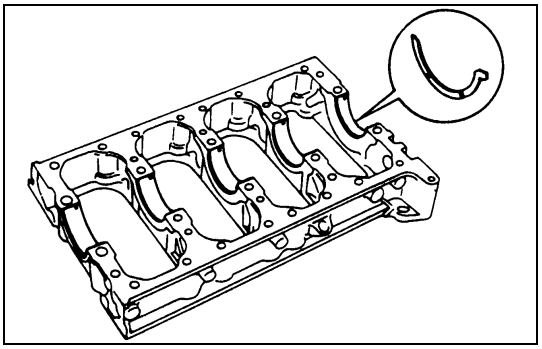
All lower bearings does not have oil grooves.

1) Carefully wipe any foreign material from the lower bearing.

CAUTION:

Do not apply engine oil to the bearing back faces and the crankcase bearing fitting surfaces.

2) Locate the position mark applied at disassembly if the removed lower bearings are to be reused.



6A3-103-2.tif

49. Thrust Bearing Lower

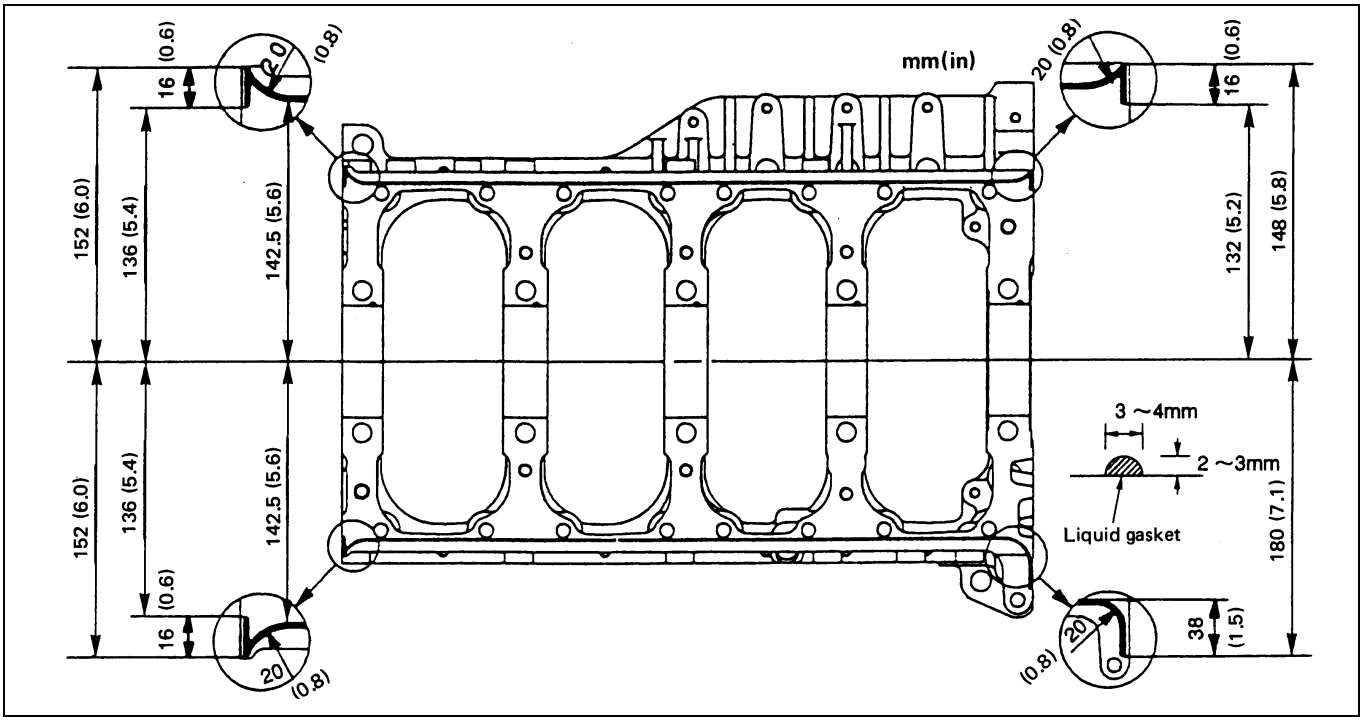
Install the thrust bearing lower to the rear side of the crankcase No.5 journal.

The thrust bearing oil grooves must be facing the sliding faces.

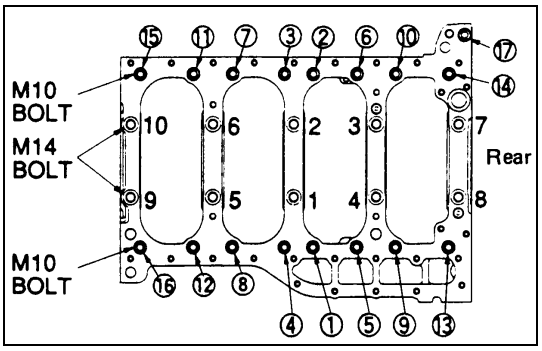
48. Crankcase

1) Apply a 3mm (0.1 inch) bead of recommended liquid gasket (Three Bond 1207C) or its equivalent to the crankcase upper surface as shown in the illustration.
2) Carefully place the crankcase on the cylinder body.

- Install the crankcase within 20 minutes after application of liquid gasket.



6A3-104-1.tif



6A3-104-2.tif

3) Tighten the crankcase to the specified torque in the numerical order shown in the illustration.

Crankcase Bolt Torque (M14:1 ~ 10)		N•m (kg•m/lb•ft)
1st step	2nd step	3rd step
98 (10/72)	132 (13.5/98)	30° - 60°

Crankcase Bolt Torque (M10: ① ~ ⑰)	N•m (kg•m/lb•ft)
37 (3.8/27)	

Angle gauge: 5-8840-0266-0

47. Piston and Connecting Rod Assembly

46. Connecting Rod Bearing

45. Connecting Rod Cap

Above works refer to “PISTON AND CONNECTING ROD” section in this manual.

44. Oil Pump Assembly

43. Idle Gear A

Above works refer to “OIL PUMP ASSEMBLY” section in this manual.

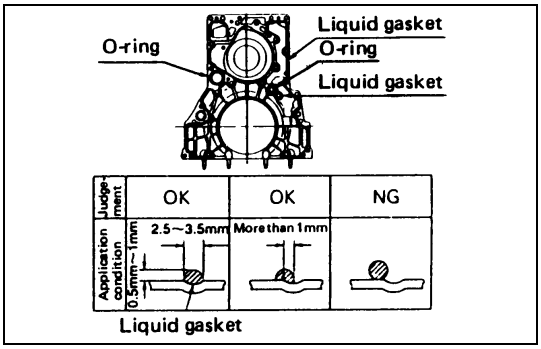
42. Flywheel Houisng

41. Power Steering Pump Idle Gear

40. Power Steering Pump Idle Gear Cover

39. Oil Thermo Valve

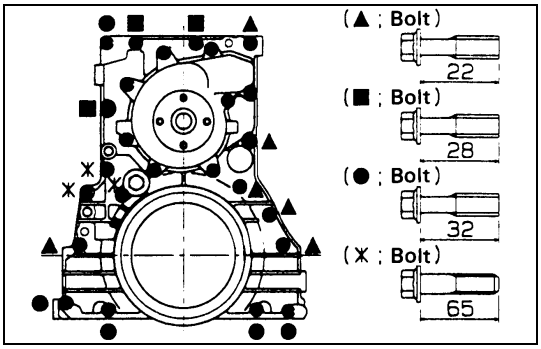
Above works refer to “TIMING GEAR REPLACEMENT” section in this manual.



6A3-105-1.tif

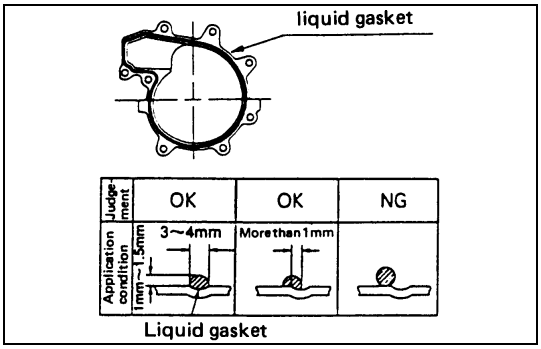
38. Front Retainer

1) Carefully wipe any foreign material from the cylinder body front face.
2) Apply 2.5mm-3.5mm bead of the recommended liquid gasket (Three Bond 1207C) or its equivalent on the groove of the front retainer fitting surface shown in the illustration.
3) Install the O-rings (2 pieces) to the front retainer.
   - Install the front retainer within 7 minutes after application of liquid gasket.
   - For the dislocation of liquid gasket, refer to the illustration.
4) Align the cylinder body knock pins with the front retainer knock pin holes.



6A3-105-2.tif

Front Retainer Bolt Torque	N•m (kg•m/lb•ft)
24 (2.4/17)	



6A3-105-3.tif

37. Water Pump Assembly

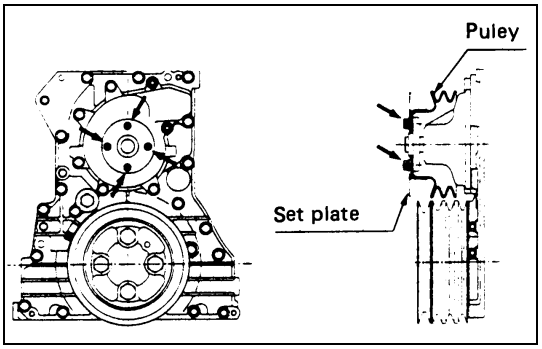
1) Apply 3mm-4mm bead of the recommended liquid gasket (Three Bond 1207C) or its equivalent on the water pump fitting surface.
2) Install the water pump to the front retainer.

Water Pump Bolt Torque	N•m (kg•m/lb•ft)
24 (2.4/17)	

- Install the water pump within 7 minutes after application of liquid gasket.
- For the dislocation of liquid gasket, refer to the illustration.

CAUTION:

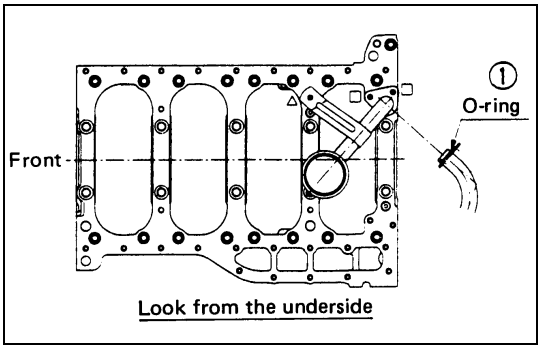
The water pump clamping bolt is also used to tighten the front retainer. So, install the water pump before liquid gasket gets dry immediately after installation of the front retainer.



6A3-106-1.tif

36. Water Pump Pulley

Water Pump Pulley Bolt Torque	N•m (kg•m/lb•ft)
24 (2.4/17)	



6A3-106-2.tif

35. Oil Pump Strainer

Install the O-ring ① to the oil pump strainer pipe and install the oil pump strainer to the cylinder body shown in the illustration.

Oil Pump Strainer Bolt Torque	N•m (kg•m/lb•ft)
24 (2.4 17)	

34. Oil Pan

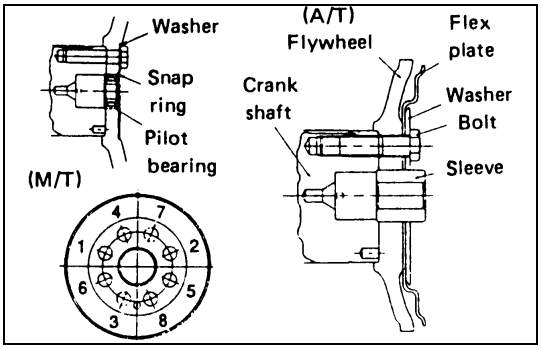
33. Spacer Rubber (NKR model only)

Above works refer to “OIL PAN” section in this manual.

32. Crankshaft Rear Slinger

31. Crankshaft Rear Oil Seal

Above works refer to “CRANKSHAFT REAR OIL SEAL” section in this manual.



6A3-106-3.tif

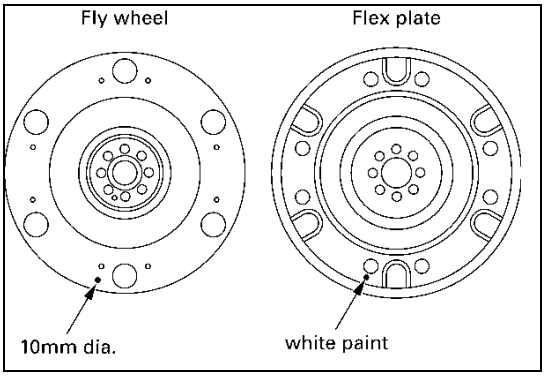
30. Flywheel Assembly

1) Align the flywheel with the crankshaft knock pin and temporarily tighten the flywheel bolts.
2) Use the crankshaft stopper to prevent the crankshaft from turning.
   Crankshaft Stopper: 5-8840-2230-0
3) Install the washer and the flywheel bolts and tighten to the specified torque in numerical order show in the illustration.

Flywheel Bolt Torque N•m (kg•m/lb•ft)

1st step	2nd step
78 (8.0/58)	90°- 120°

4) Remove the crankshaft stopper.



020LX00006.tif

For A/T model

1. Align the knock pin on the crankshaft to install the flywheel.
2. Install the flexible plate with alignment mark (10 mm diameter dent on the flywheel and 10 mm diameter white paint on the flexible plate) and washer.
3. Apply molybdenum disulfide grease to the bolt thread and seat to install the flywheel fixing hole.

   Tighten bolt to two stage tightening method in the numerical order.

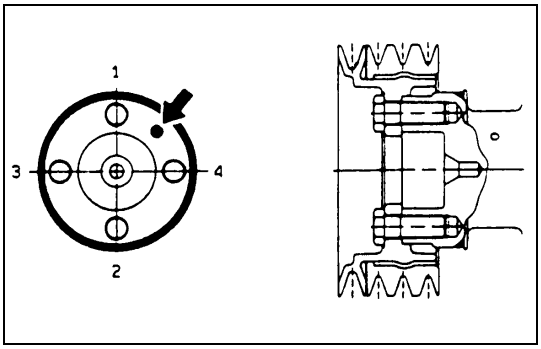
   1st step; 78 N•m (58 lbft)

   2nd step; 90 - 120 degrees.

29. Crankshaft Front Slinger

28. Crankshaft Front Oil Seal

Above works refer to "CRANKSHAFT FRONT OIL SEAL" section in this manual.

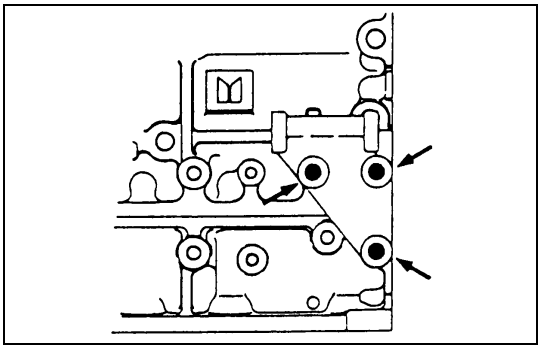


6A3-107-1.tif

27. Crankshaft Damper Pulley

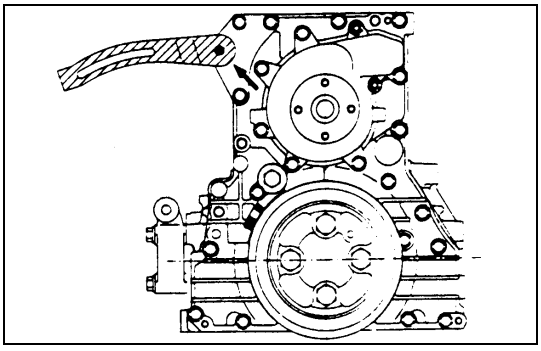
1) Apply a coat of engine oil to the threads of the bolts.
2) Align the damper pulley with the crankshaft knock pin and tighten the bolts to the specified torque in numerical order.

Damper Pulley Bolt Torque	N•m (kg•m/lb•ft)
200 (20.4/147)	


6A3-107-2.tif

26. Generator Bracket

Generator Bracket Bolt Torque	N•m (kg•m/lb•ft)
48 (4.9/35)	

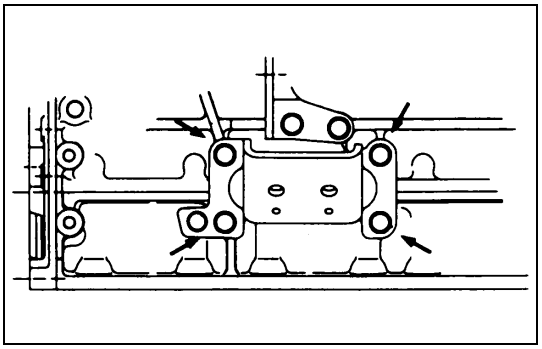

6A3-107-3.tif

25. Fan Belt Adjust Plate

Install the adjust plate and temporarily tighten the adjust plate bolt.

24. Injection Pump Assembly

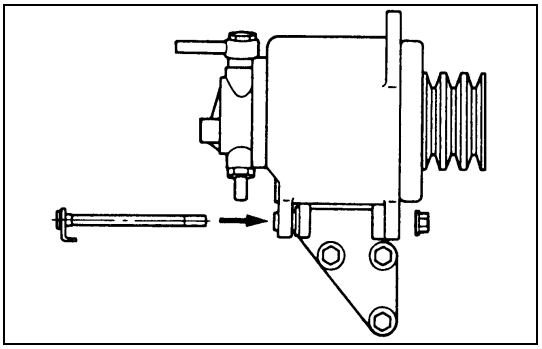
Above works refer to "INJECTION PUMP ASSEMBLY" section 6C in this manual.



6A3-108-1.tif

23. Engine Foot

Engine Foot Bolt Torque	N•m (kg•m/lb•ft))
51 (5.2/38)	



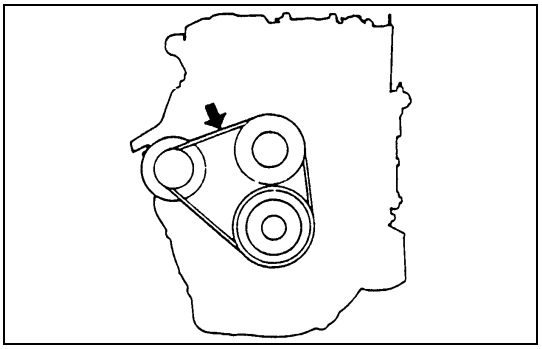
6A3-108-2.tif

22. Generator

NOTE:

When tightening the generator, tighten in advance the fan belt temporarily after its adjustment.

- Insert through the lower fixing bolt from the rear side as shown in the illustration, and tighten it with a nut on the front side.



6A3-108-3.tif

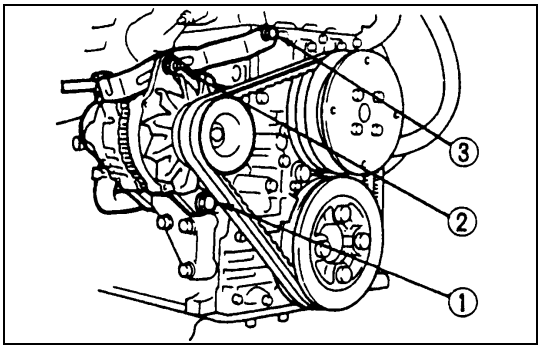
21. Fan Belt

Check the drive belt tension.

Depress the drive belt mid-portion with a 98N (10kg/22lb) force.

Drive Belt Deflection	mm (in)
8 - 12 (0.31 - 0.47)... New belt 10 - 14 (0.39 - 0.55)... Reuse belt	

Check the drive belt for cranking and other damage.

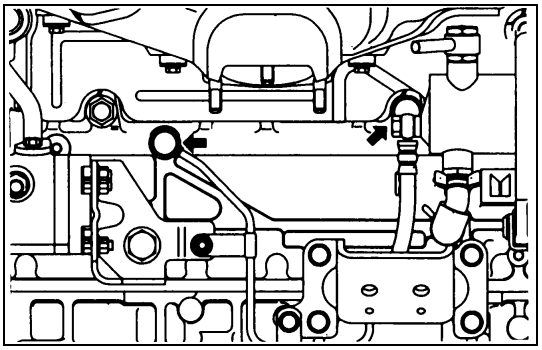


6A3-108-4.tif

Fan Belt Adjustment

Fan belt tension is adjusted by moving the generator.

Torque	N•m (kg•m/lb•ft)
①	40 (4.1/30)
②	24 (2.4/17)
③	46 (4.7/34)



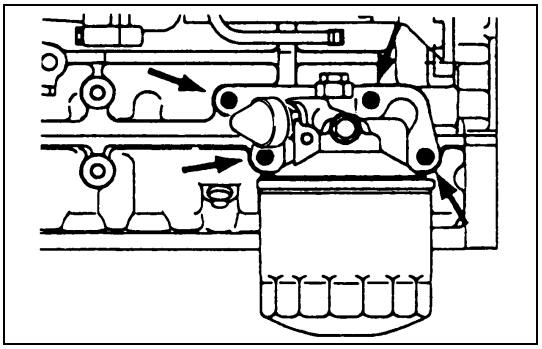
6A3-108-5.tif

20. Vacuum Pump Rubber Hose

19. Vacuum Pump Oil Pipe

Cylinder Body Side	N•m (kg•m/lb•ft)
41 (4.2/30)	

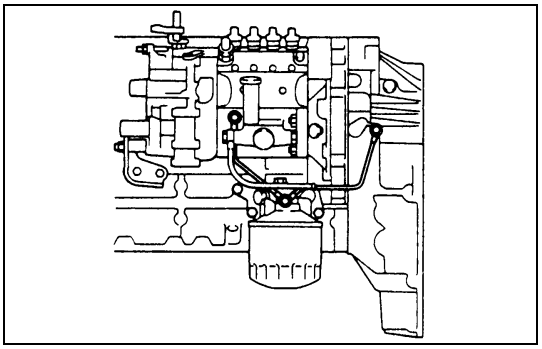
Generator Side	N•m (kg•m/lb•ft)
23 (2.3/17)	



6A3-109-1.tif

18. Oil Filter Assembly

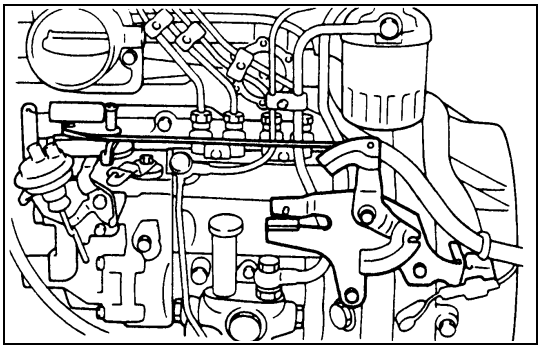
Oil Filter Bolt Torque	N•m (kg•m/lb•ft)
48 (4.9/35)	



6A3-109-2.tif

17. Oil Pipe

Oil Pipe Joint Bolt Torque	N•m (kg•m/lb•ft)
17 (1.7/12)	



6A3-109-3.tif

16. Engine Control Lever Assembly

Engine Control Lever Bolt Torque	N•m (kg•m/lb•ft)
24 (2.4/17)	

15. Engine Control Wire

14. Driven Plate

13. Clutch Pressure Plate Assembly
Above works refer to “FLYWHEEL AND PILOT BEARING” section in this manual.

12. Cylinder Head Gasket
Above works refer to “CYLINDER HEAD” section in this manual.

11. Cylinder Head Assembly
Above works refer to “CYLINDER HEAD” section in this manual.

10. Camshaft Bearing Lower

9. Camshaft Assembly

8. Camshaft Bearing Upper

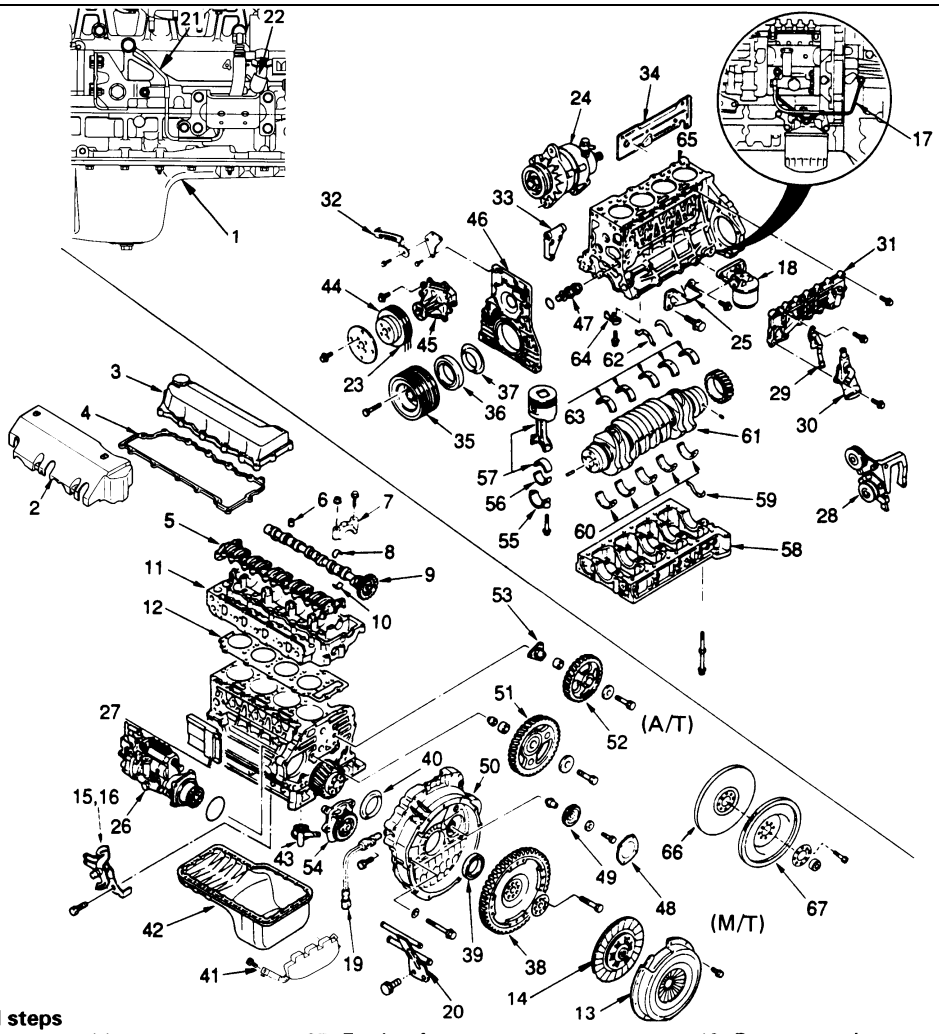
7. Camshaft Bearing Cap

6. Valve Cap
Above works refer to “CAMSHAFT ASSEMBLY” section in this manual.

5. Rocker Arm Shaft Assembly
Above works refer to “ROCKER ARM SHAFT ASSEMBLY” section in this manual.

4. **Head Cover Gasket**
   Above works refer to “CYLINDER HEAD” section in this manual.
3. **Cylinder Head Cover**
   Above works refer to “ROCKER ARM SHAFT ASSEMBLY” section in this manual.
2. **Nozzle Cover**
1. **Engine Assembly**
   Above works refer to “ENGINE ASSEMBLY” section in this manual.

CYLINDER BLOCK



Removal steps

1. Engine assembly
2. Nozzle cover
3. Cylinder head cover
4. Cylinder head cover gasket
5. Rocker arm shaft assembly
6. Valve cap
7. Camshaft bearing cap
8. Camshaft bearing upper
9. Camshaft assembly
10. Camshaft bearing lower
11. Cylinder head assembly
12. Cylinder head gasket
13. Clutch pressure plate assembly
14. Driven plate
15. Engine control wire
16. Engine control lever assembly
17. Oil pipe
18. Oil filter assembly
19. Tachometer sensor
20. Fuel pipe bracket
21. Vacuum pump oil pipe
22. Vacuum pump rubber hose
23. Fan belt
24. Generator
25. Engine foot
26. Injection pump assembly
27. Injection pump rubber spacer
28. Idle pulley bracket
29. Heater pipe
30. Water suction pipe
31. Oil cooler assembly
32. Fan belt adjust plate
33. Generator bracket
34. Cover
35. Crankshaft pulley
36. Crankshaft front oil seal
37. Crankshaft front slinger
38. Flywheel assembly (M/T)
39. Crankshaft rear oil seal
40. Crankshaft rear slinger
41. Spacer rubber
42. Oil pan
43. Oil pump strainer
44. Water pump pulley
45. Water pump
46. Front retainer
47. Oil thermo valve
48. Power steering pump idle gear cover
49. Power steering pump idle gear idle gear
50. Flywheel housing
51. Idle gear A
52. Idle gear B
53. Idle gear B shaft
54. Oil pump assembly
55. Connecting rod cap
56. Connecting rod lower bearing
57. Piston and connecting
58. Crankcase
59. Thrust bearing lower
60. Crankshaft bearing lower
61. Crankshaft assembly
62. Thrust bearing upper
63. Crankshaft bearing upper
64. Piston oil jet
65. Cylinder block
66. Flywheel (A/T)
67. Flexible Plate(A/T)

Installation steps

To install, follow the removal steps in the reverse order.

6A3-111-1.tif

REMOVAL

Preparation

- Disconnect battery ground cable.
- Tilt the cab
- Drain coolant and engine oil

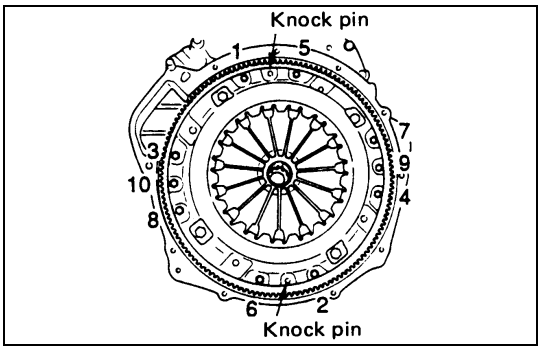
1. **Engine Assembly**
   Above works refer to “ENGINE ASSEMBLY” section in this manual.
2. **Nozzle Cover**
3. **Cylinder Head Cover**
4. **Cylinder Head Cover Gasket**
5. **Rocker Arm shaft Assembly**
   Above works refer to “ROCKER ARM SHAFT ASSEMBLY” section in this manual.
6. **Valve Cap**

CAUTION:

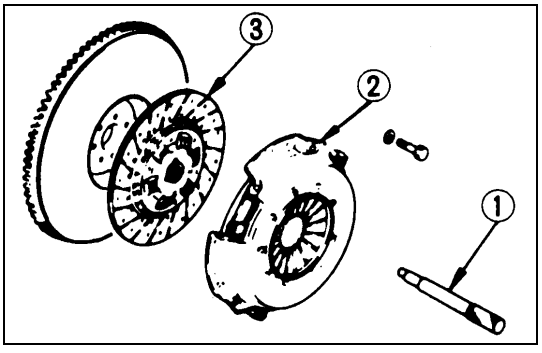
Take sufficient care not to let valve caps fall into the gear case or oil return hole.

7. **Camshaft Bearing Cap**
8. **Camshaft Bearing Upper**
9. **Camshaft Assembly**
10. **Camshaft Bearing Lower**
    Above works refer to “CAMSHAFT ASSEMBLY” section in this manual.
11. **Cylinder Head Assembly**
    Above works refer to “CYLINDER HEAD” section in this manual.
12. **Cylinder Head Gasket**
13. **Clutch Pressure Plate Assembly**
    1) Insert the clutch pilot aligner to the clutch assembly.
       Clutch Pilot Aligner: 5-8840-2240-0
    2) Loosen the pressure plate bolts in numerical order a little at a time as shown in the illustration.
    3) Remove the pressure plate assembly.

    For the A/T vehicle, loosen first the flywheel fixing bolt, and then remove the washer, the flexible plate, the flywheel and the sleeve in this order.

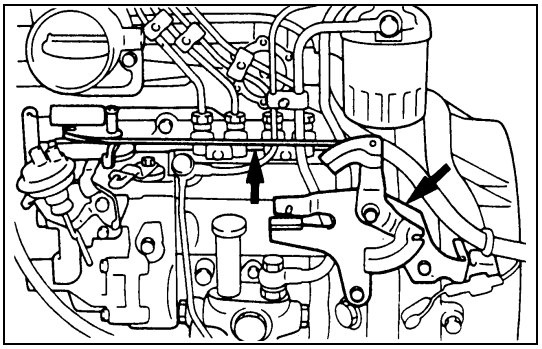


6A3-112-1.tif



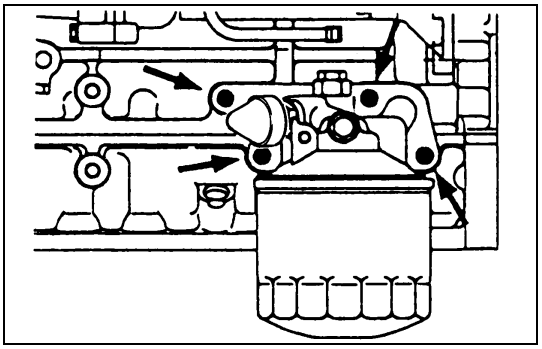
6A3-112-2.tif

14. **Driven Plate**
    Remove the driven plate with the clutch pilot aligner.
    ① Clutch pilot aligner
    ② Clutch pressure plate assembly
    ③ Driven plate



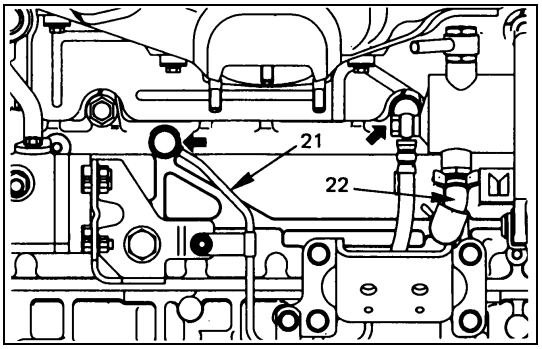
6A3-113-1.tif

15. Engine Control Wire
16. Engine Control Lever Assembly
17. Oil Pipe



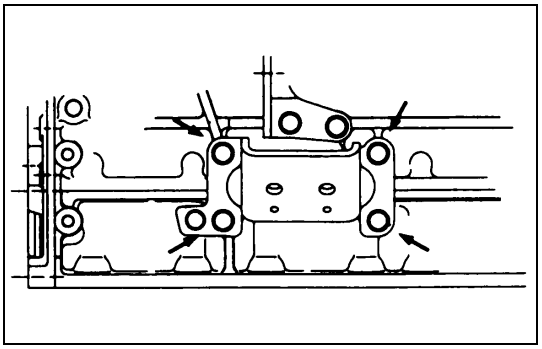
6A3-113-2.tif

18. Oil Filter Assembly
19. Tachometer Sensor
20. Fuel Pipe Bracket



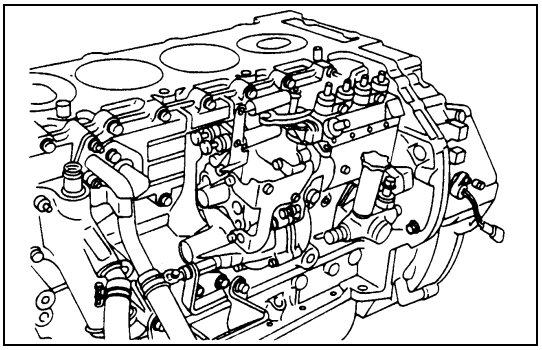
6A3-113-3.tif

21. Vacuum Pump Oil Pipe
22. Vacuum Pump Rubber Hose
23. Fan Belt
24. Generator



6A3-113-4.tif

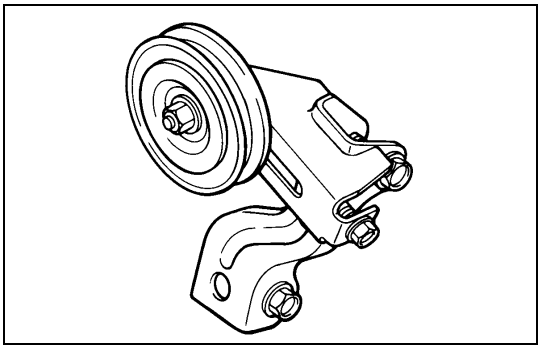
25. Engine Foot



6A3-113-5.tif

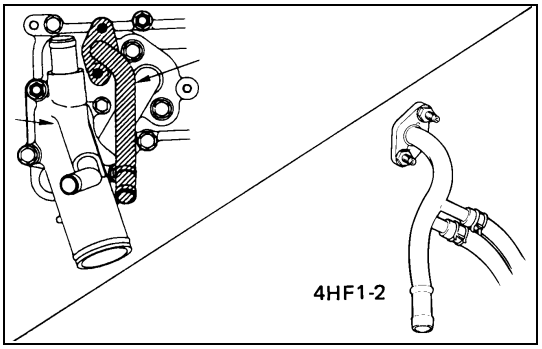
26. Injection Pump Assembly
1) Remove the injection pump bracket bolts and the injection pump rear bracket bolts.
2) Then remove the injection pump assembly.

27. Injection Pump Rubber Spacer



6A3-114-1.tif

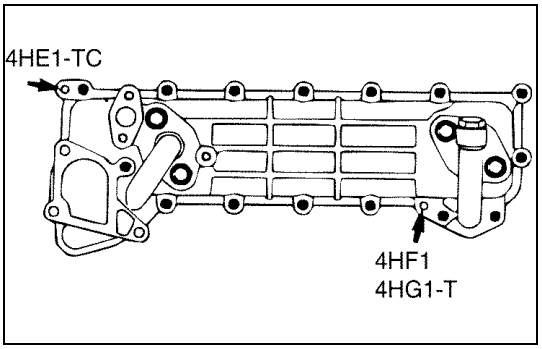
28. Idle Pulley Bracket (If equipped with A/C)



6A3-114-2.tif

29. Heater Pipe

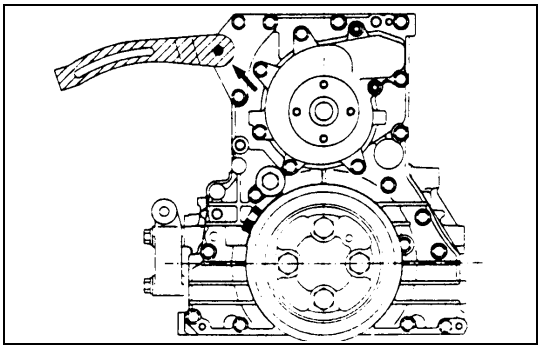
30. Water Suction Pipe



050LX031.tif

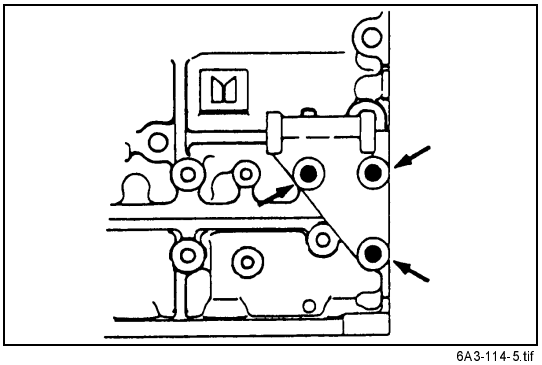
31. Oil Cooler Assembly

1) Remove the oil cooler bolts.
2) Install a oil cooler fixing bolt to the oil cooler replacer hole as shown in the illustration, and tighten the bolt alternately a little at a time.



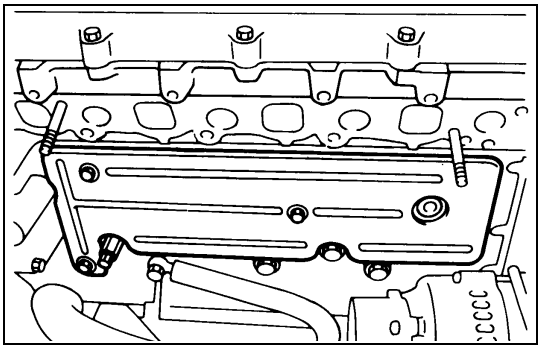
6A3-114-4.tif

32. Fan Belt Adjust Plate



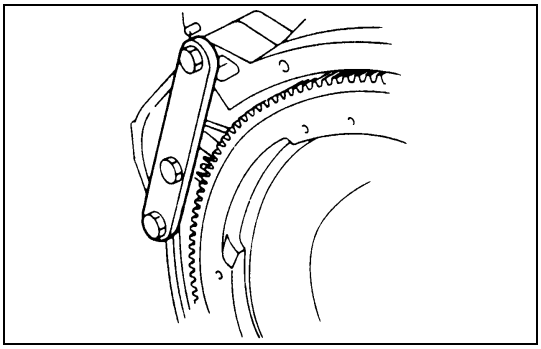
6A3-114-5.tif

33. Generator Bracket



6A3-115-1.tif

34. Cover



6A3-115-2.tif

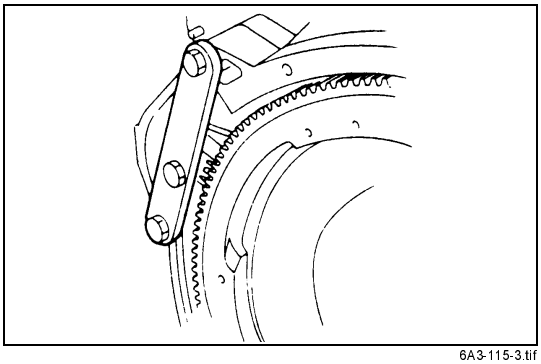
35. Crankshaft Damper Pulley

1) Use the crankshaft stopper to prevent the crankshaft from turning.
   Crankshaft Stopper: 5-8840-2230-0
2) Loosen the damper pulley bolts and remove the damper pulley.

36. Crankshaft Front Oil Seal

37. Crankshaft Front Slinger

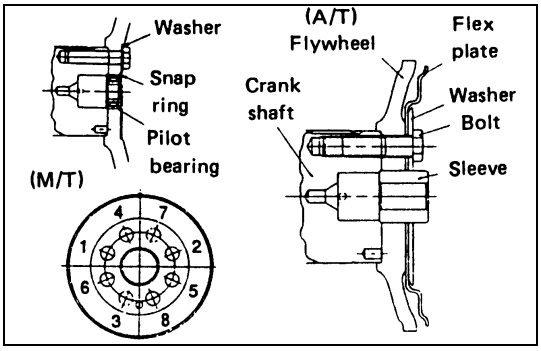
Above works refer to “CRANKSHAFT FRONT OIL SEAL” section in this manual.



6A3-115-3.tif

38. Flywheel Assembly

1) Use the crankshaft stopper to prevent the crankshaft from turning
   Crankshaft Stopper: 5-8840-2230-0
2) Loosen the flywheel bolts in numerical order a little at a time as shown in the illustration.
3) Remove the flywheel stopper and the flywheel assembly.



6A3-115-4.tif

For the A/T vehicle, loosen first the flywheel fixing bolt, and then remove the washer, the flexible plate, the flywheel and the sleeve in this order.

39. Crankshaft Rear Seal

40. Crankshaft Rear Slinger

Above works refer to “CRANKSHAFT REAR OIL SEAL” section in this manual.

41. Spacer Rubber (NKR model only)

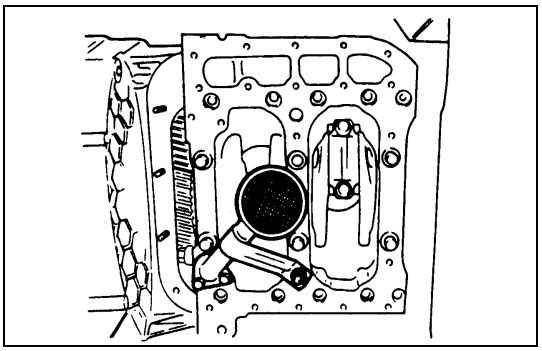
For the 4WD model vehicle, remove the stiffener before removing the spacer rubber.

42. Oil Pan

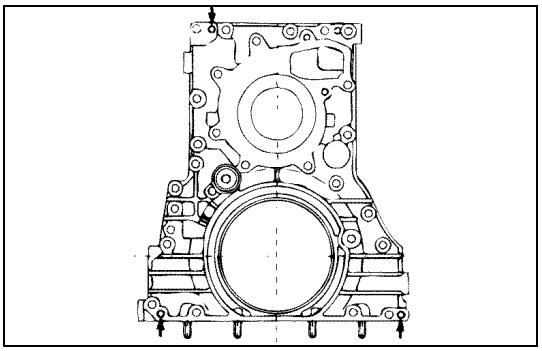
43. Oil Pump Strainer

44. Water Pump Pulley

45. Water Pump



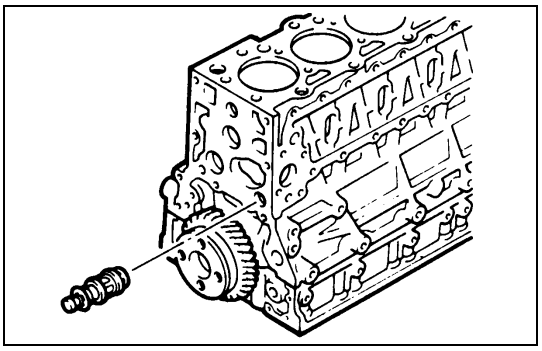
6A3-116-1.tif



020Ix011.tif

46. Front Retainer

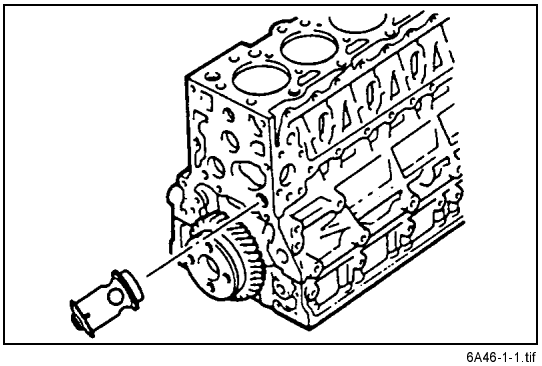
Install the three front retainer fixing bolts to the front retainer replacer holes as shown in the illustration, and tighten the bolts alternately a little at a time.



6A3-116-3.tif

45. Oil Thermo Valve (4HF1, 4HF1-2, 4HG1, 4HG1-T)

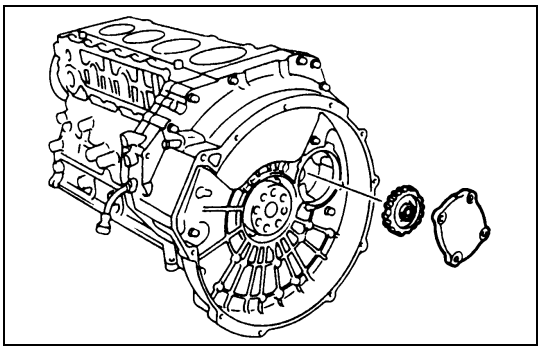
Pull out the thermo valve from the cylinder body.



6A46-1-1.tif

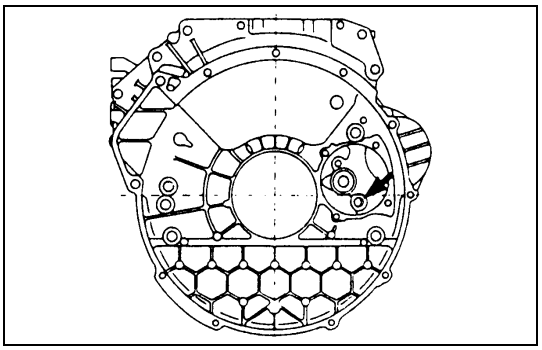
45-1. Bypass Valve (4HE1-T, 4HE1-TC)

Pull out the bypass valve from the cylinder body.



6A3-116-4.tif

48. Power Steering Pump Idle Gear Cover
49. Power Steering Pump Idle Gear

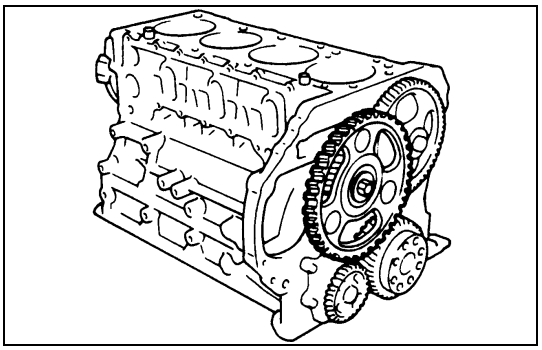


6A3-117-1.tif

50. Flywheel Housing

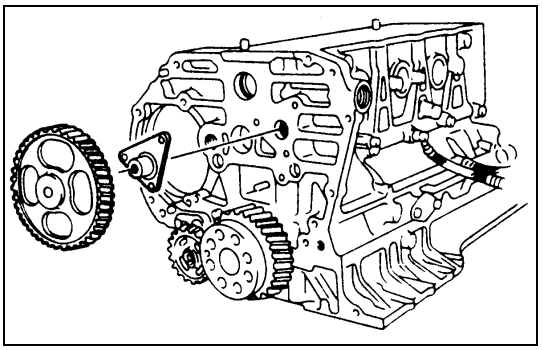
    NOTE:

    Be careful not to fail to remove the bolts shown in the illustration.



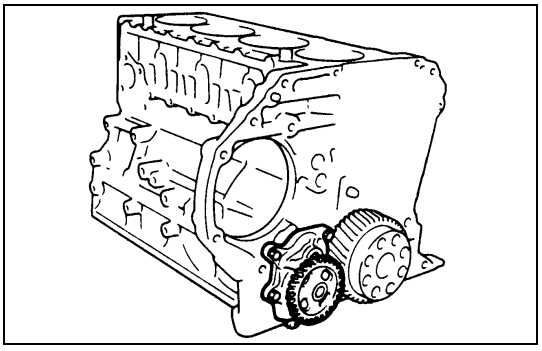
6A3-117-2.tif

51. Idle Gear A



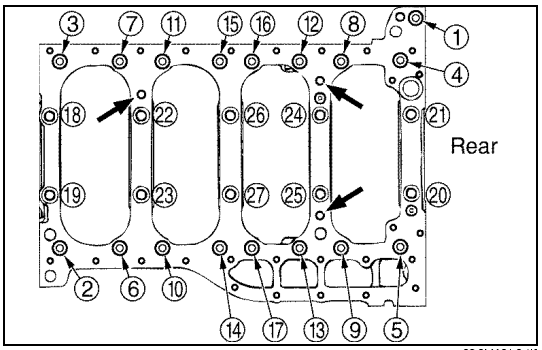
6A3-117-3.tif

52. Idle Gear B
53. Idle Gear B Shaft



6A3-117-4.tif

54. Oil Pump Assembly



020LX018.tif

55. Connecting Rod Cap

56. Connecting Rod Lower Bearing

57. Piston and Connecting Rod Assembly

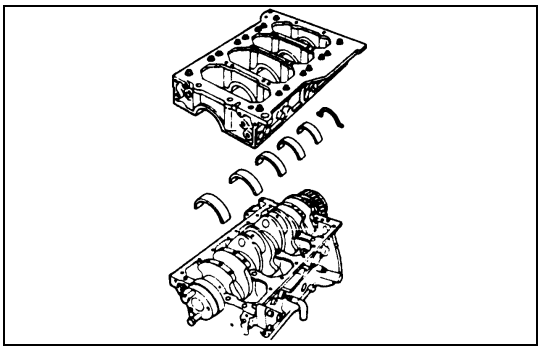
Above works refer to “PISTON AND CONNECTING ROD” section in this manual.

58. Crankcase

1) Loosen the crankcase bolts in numerical order a little at a time.
2) Install the three crankcase fixing bolts (See left arrow marks) to the crankcase replacer holes as shown in the illustration, and tighten the bolts alternate a little at a time.

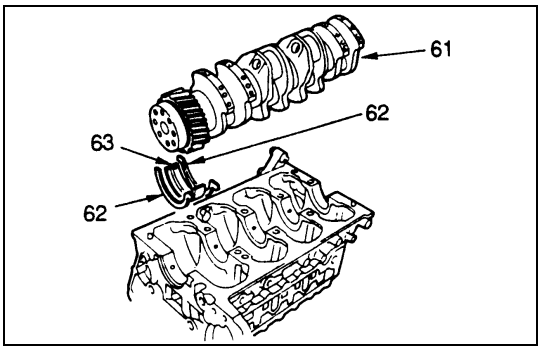
NOTE:

When removing the crankcase, be sure to remove the oil pump and the generator bracket before that.


6A3-118-2.tif

59. Thrust Bearing Lower

60. Crankshaft Bearing Lower

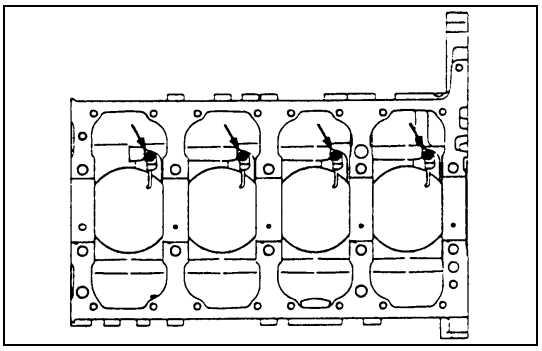


6A3-118-3.tif

61. Crankshaft Assembly

62. Thrust Bearing Upper

63. Crankshaft Bearing Upper


6A3-118-4.tif

64. Oiling Jet

Loosen the check valves to remove both the check valves and the oiling jets.

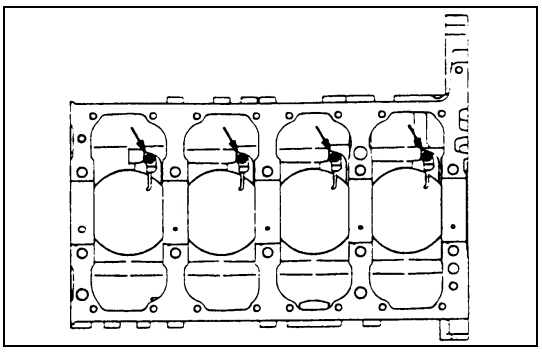
Take care not to bend or damage the oiling jets.

65. Cylinder Block

INSTALLATION

65. Cylinder Block

Use compressed air to thoroughly clean the inside and outside surfaces of the cylinder body, the oil holes, and the water jackets.

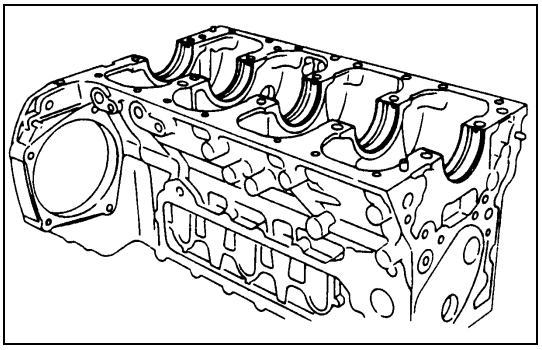


6A3-119-1.tif

64. Oiling Jet

1) Install the oiling jets together with the check valves.
   Take care not to damage the oiling jet nozzles.
2) Tighten the check valves and oiling jets to the specified torque.

Check Valve and Oiling Jet Torque	N•m (kg•m/lb•ft)
21 (2.1/15)	



6A3-119-2.tif

63. Crankshaft Bearing Upper

When replacing the crankshaft or the crankshaft bearing with a new one, select the crankshaft bearing according to the respective grades stamped on the crankshaft and the cylinder body.

Refer to the “CRANKSHAFT” in section 6A.

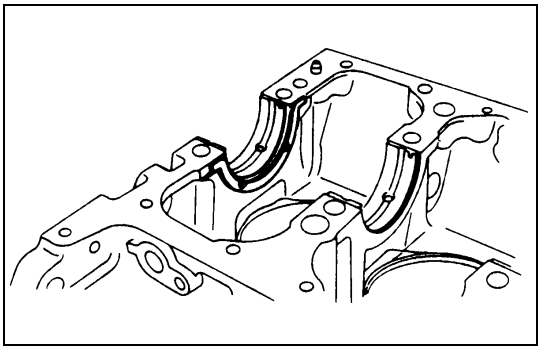
All upper bearings have oil grooves.

1) Carefully wipe any foreign material from the upper bearing.

CAUTION:

Do not apply engine oil to the bearing back faces and the cylinder body bearing fitting surface.

2) Locate the position mark applied at disassembly if the removed upper bearings are to be reused.

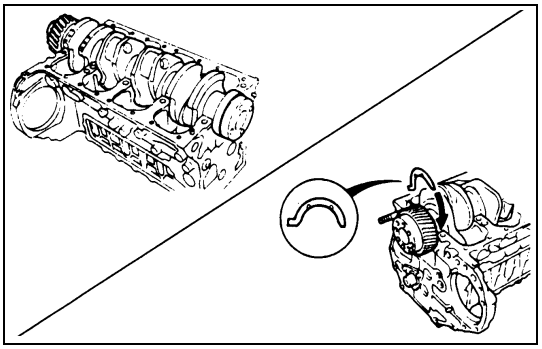


6A3-119-3.tif

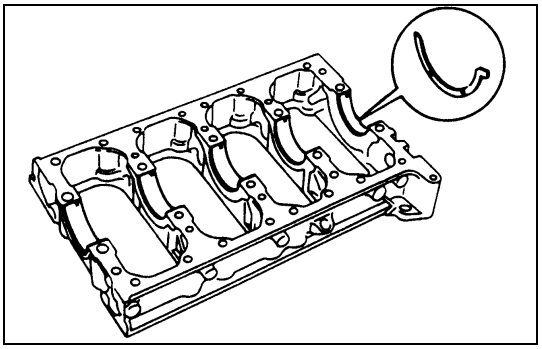
62. Thrust Bearing Upper

Install the thrust bearing upper to the front side of the cylinder body No.5 journal. At this time, the thrust bearing upper may be pasted to the cylinder body with grease. However, be sure to wipe off nay excessive grease.

The thrust bearing oil grooves must be facing the sliding faces.



6A3-120-1.tif



6A3-120-2.tif

61. Crankshaft Assembly

Apply an ample coat of engine oil to the crankshaft journals and the crankshaft bearing surfaces before installing the crankshaft with timing gear.

60. Crankshaft Bearing Lower

All lower bearings does not have oil grooves.

1) Carefully wipe any foreign material from the lower bearing.

CAUTION:

Do not apply engine oil to the bearing back faces and the crankcase bearing fitting surfaces.

2) Locate the position mark applied at disassembly if the removed lower bearings are to be reused.

59. Thrust Bearing Lower

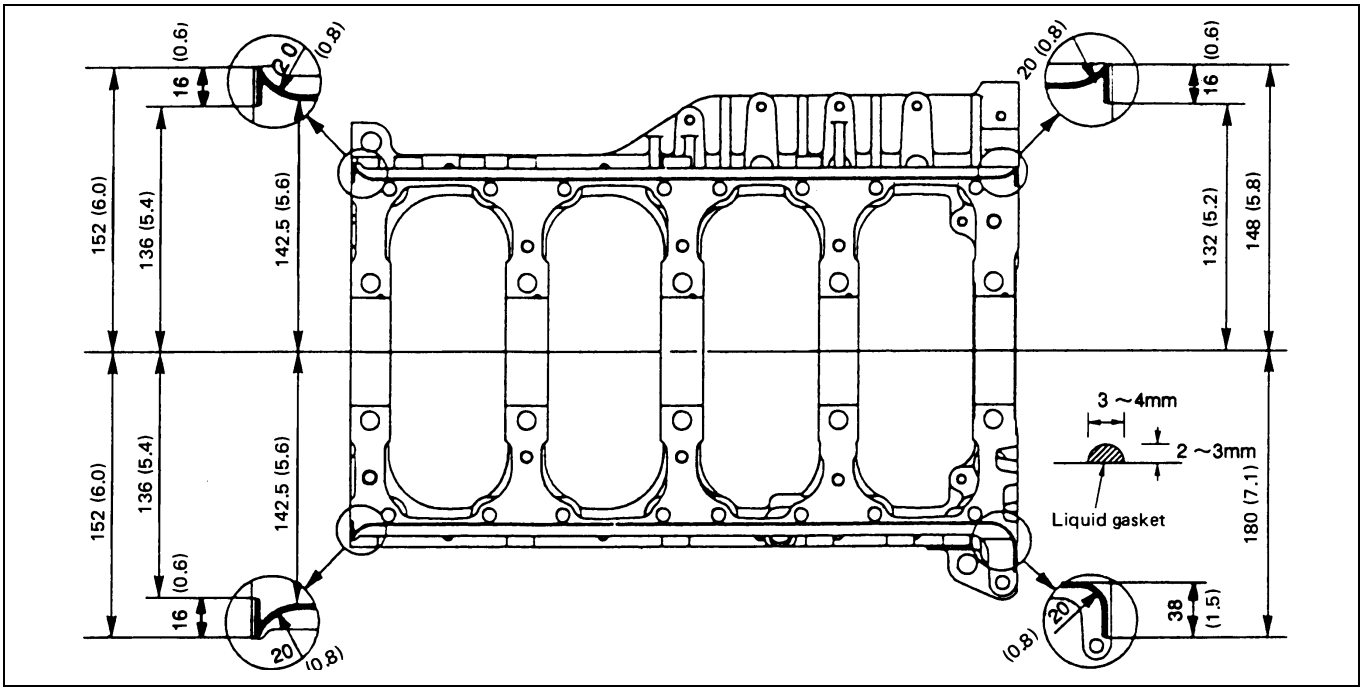
Install the thrust bearing lower to the rear side of the crankcase No.5 journal.

The thrust bearing oil grooves must be facing the sliding faces.

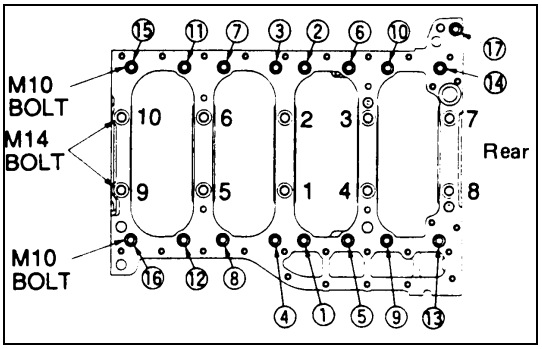
58. Crankcase

1) Apply a 3mm (0.1 inch) bead of recommended liquid gasket (Three Bond 1207C) or its equivalent to the crankcase upper surface as shown in the illustration.
2) Carefully place the crankcase on the cylinder body.

- Install the crankcase within 20 minutes after application of liquid gasket.



6A3-120-3.tif



6A3-121-1.tif

3) Tighten the crankcase to the specified torque in the numerical order shown in the illustration.

Crankcase Bolt Torque (M14:1 ~ 10) N•m (kg•m/lb•ft)

1st step	2nd step	3rd step
98 (10/72)	132 (13.5/98)	30° - 60°

Crankcase Bolt Torque (M10: ① ~ ⑰) N•m (kg•m/lb•ft)

37 (3.8/27)

Angle gauge: 5-8840-0266-0

57. Piston and Connecting Rod Assembly

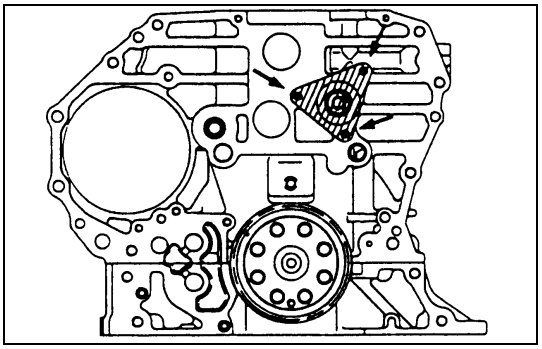
56. Connecting Rod Bearing

55. Connecting Rod Cap

Above works refer to “PISTON AND CONNECTING ROD” section in this manual.

54. Oil Pump Assembly

Above works refer to “OIL PUMP ASSEMBLY” section in this manual.

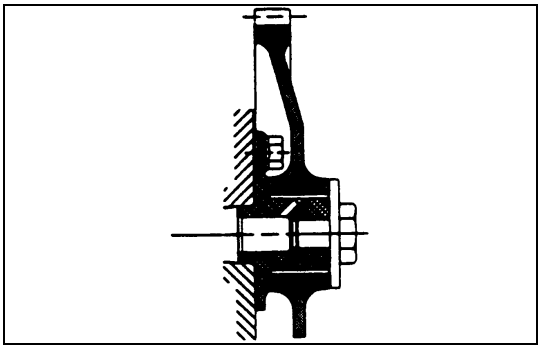

6A3-121-2.tif

53. Idle Gear B Shaft

Idle Gear B Shaft Bolt Torque N•m (kg•m/lb•ft)

31 (3.2/23)

Apply the engine oil to the idle gear shaft after installation.

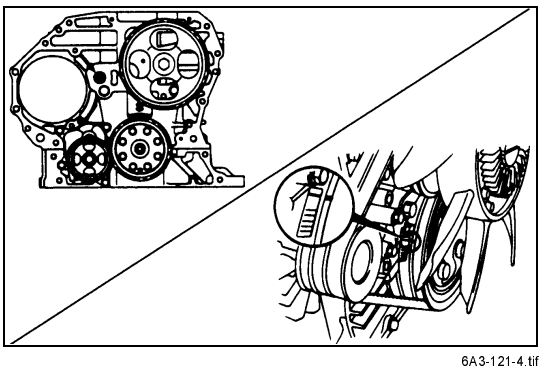

6A3-121-3.tif

52. Idle Gear B

The face of the idle gear B with longer boss should be positioned toward the rear side shown in the illustration

Idle Gear B Bolt Torque N•m (kg•m/lb•ft)

110(11.2/81)

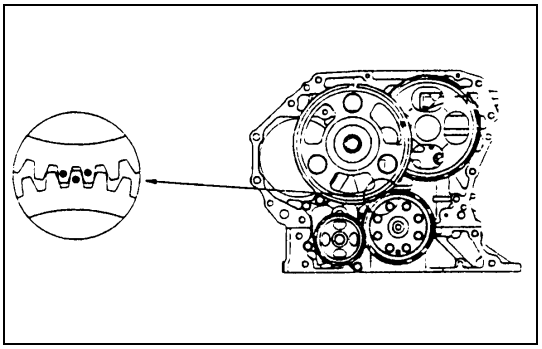

6A3-121-4.tif

51. Idle Gear A

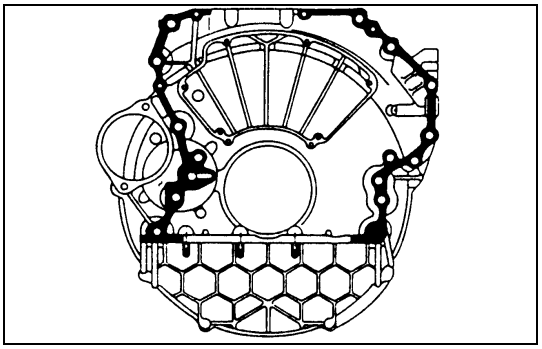
1) Turn the crankshaft clockwise so that the engagement mark of the crankshaft gear faces to the shaft center of the idle gear A and the No.1 cylinder piston comes to the top dead center.
2) Align the crankshaft gear with the engagement mark of the idle gear and install the idle gear A.

Idle Gear A Bolt Torque N•m (kg•m/lb•ft)

133 (13.6/98)



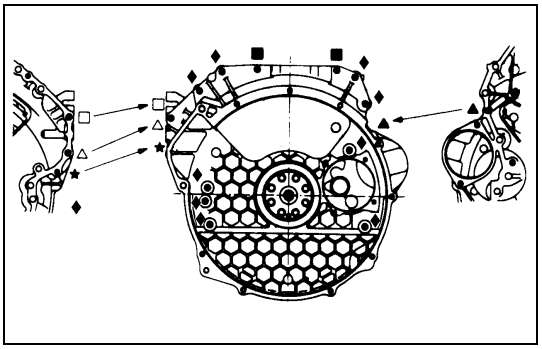
6A3-122-1.tif



6A3-122-2.tif

50. Flywheel Housing

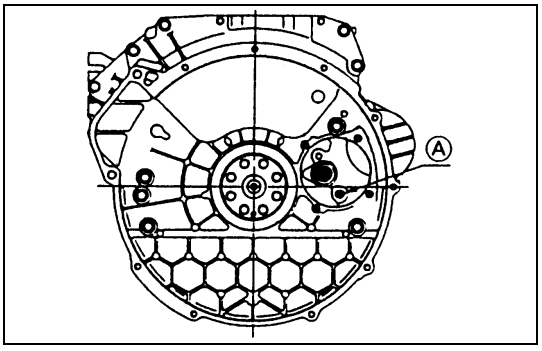
1) Carefully wipe any foreign material from the cylinder body rear face.
2) Apply the recommended liquid gasket (Three Bond 1207C) or its equivalent to the shaded areas shown in the illustration.



6A3-122-3.tif

3) Align the cylinder body knock pins with the flywheel housing knock pin holes.
4) Tighten the flywheel housing bolts to the specified torque shown in the illustration.

Flywheel Housing Bolt Torque	N•m (kg•m/lb•ft)
♦ :	96 (9.8/71)
★ :	48 (4.9/35)
□ :	94 (9.6/69)
■ :	25 (2.6/19)
△ :	76 (7.7/56)
▲ :	48 (4.9/35)

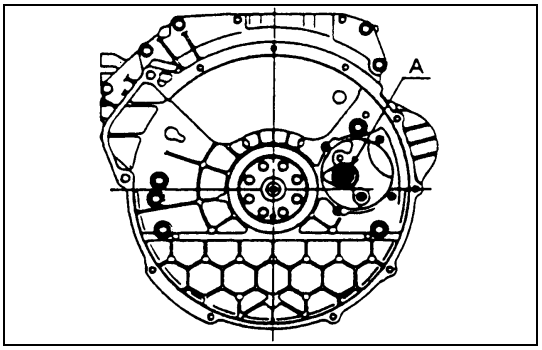


6A3-122-4.tif

- Tighten the bolts marked with "△" or "★" from the injection pump side, and those with "▲" from the cylinder body side.

Flywheel Housing Bolt Torque	N•m (kg•m/lb•ft)
Ⓐ :	96 (9.8/71)

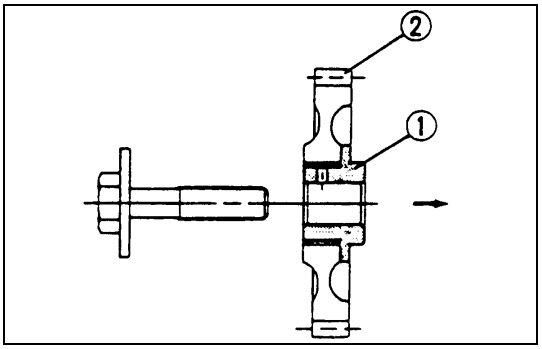
49. Power Steering Pump Idle Gear



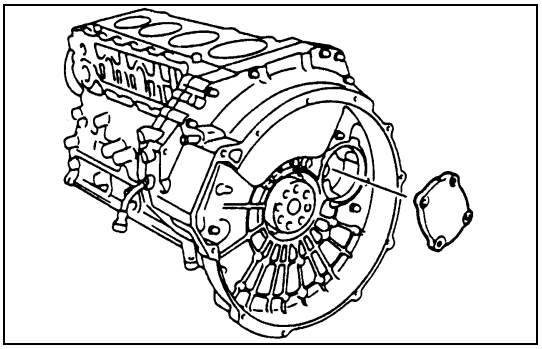
6A3-122-5.tif

1) Apply the engine oil to the idle gear shaft.
2) Install the idle gear shaft ① with the idle gear ② to the cylinder body A portion as shown in the illustration.

Idle Gear Shaft Bolt Torque	N•m (Kg•m/lb•ft)
133 (13.6/98)	



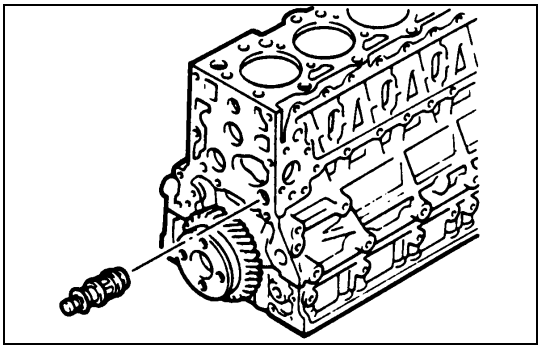
6A3-123-1.tif


6A3-123-2.tif

48. Power Steering Pump Idle Gear Cover

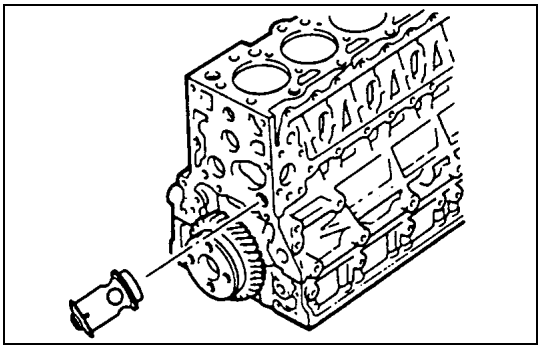
Install the gear cover with the O-ring.

Gear Cover Bolt Torque	N•m (kg•m/lb•ft)
	19 (1.9/14)


6A3-123-3.tif

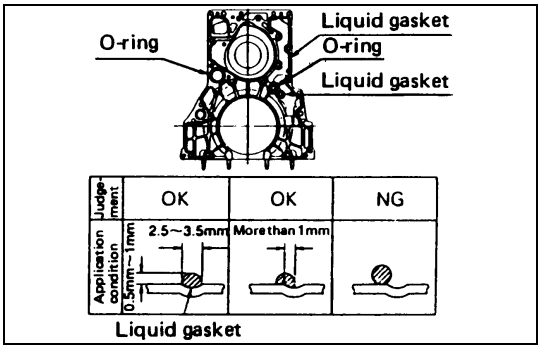
47. Oil Thermo Valve (4HF1, 4HF1-2, 4HG1, 4HG1-T)

Insert the oil thermo valve into the cylinder body.

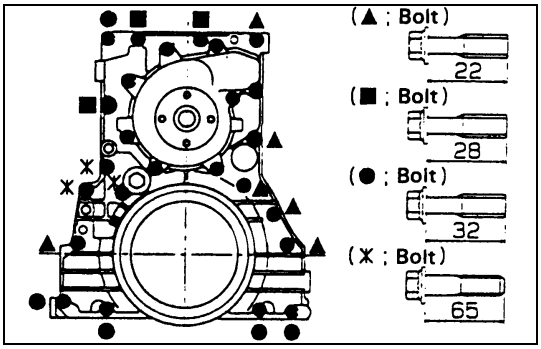

6A3-123-3-1.tif

47-1. Bypass Valve (4HE1-T, 4HE1-TC)

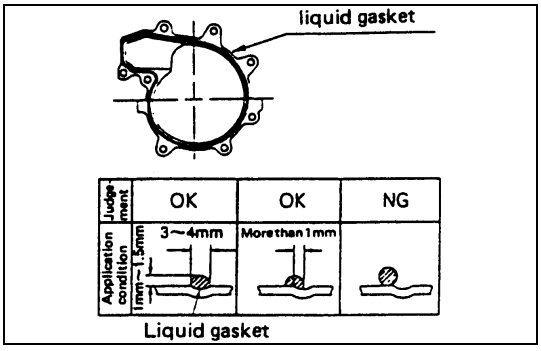
Insert the bypass valve into the cylinder body.



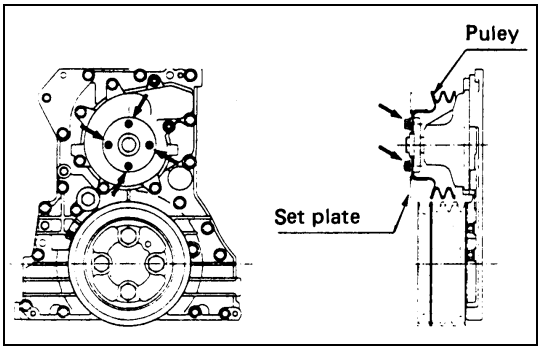
6A3-123-4.tif



6A3-123-5.tif



6A3-124-1.tif



6A3-124-2.tif

46. Front Retainer

1) Carefully wipe any foreign material from the cylinder body front face.
2) Apply a 2.5mm-3.5mm (0.10-0.14 in) bead of the recommended liquid gasket (Three Bond 1207C) or its equivalent on the groove of the front retainer fitting surface shown in the illustration.
3) Install the O-rings (2 pieces) to the front retainer.
   - Install the front retainer within 7 minutes after application of the liquid gasket.
   - For the dislocation of liquid gasket, refer to the illustration.
4) Align the cylinder body knock pins with the front retainer knock pin holes.

Front Retainer Bolt Torque	N•m (kg•m/lb•ft)
	24 (2.4/17)

45. Water Pump Assembly

1) Apply 3mm-4mm bead of the recommended liquid gasket (Three Bond 1207C) or its equivalent on the water pump fitting surface.
2) Install the water pump to the front retainer.

Water Pump Bolt Torque	N•m (kg•m/lb•ft)
	24 (2.4/17)

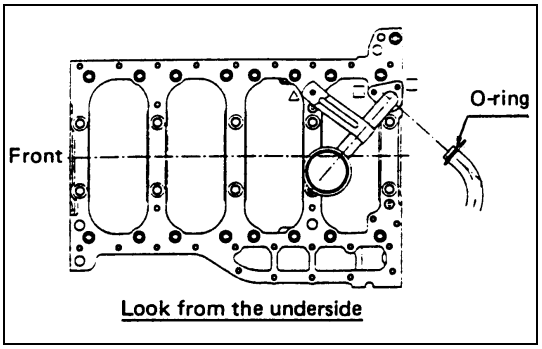
- Install the water pump within 7 minutes after application of liquid gasket.
- For the dislocation of liquid gasket, refer to the illustration.

CAUTION:

The water pump clamping bolt is also used to tighten the front retainer. So, install the water pump before liquid gasket gets dry immediately after installation of the front retainer.

44. Water Pump Pulley

Water Pump Pulley Bolt Torque	N•m (kg•m/lb•ft)
	24 (2.4/17)



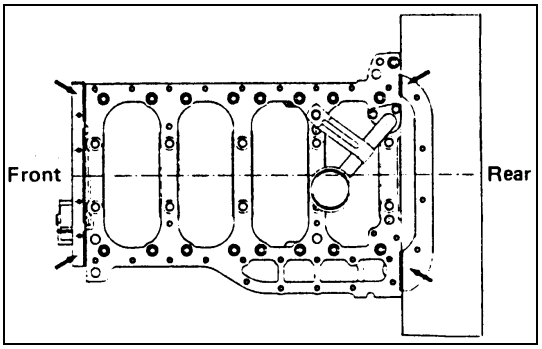
6A3-123-3.tif

43. Oil Pump Strainer

Install the O-ring ① to the oil pump strainer pipe and install the oil pump strainer to the cylinder body shown in the illustration.

Oil Pump Strainer Bolt Torque — N•m (kg•m/lb•ft)

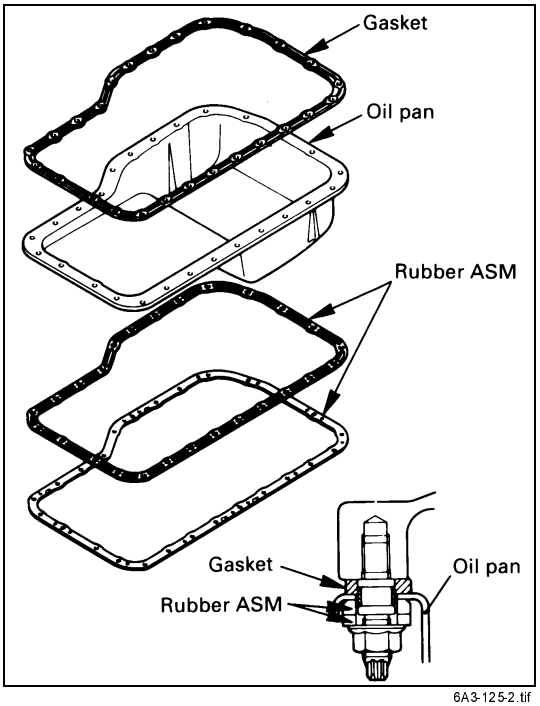
24 (2.4/17)



6A3-125-1.tif

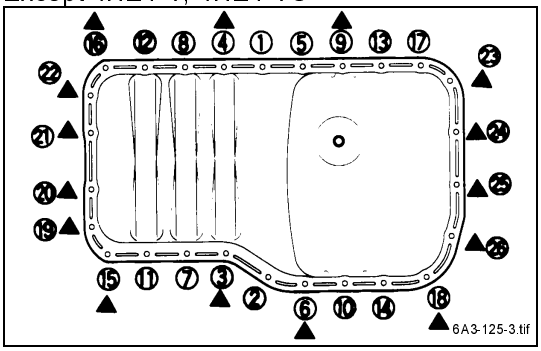
42. Oil Pan

1) Apply a 3mm (0.1 inch) bead of recommended liquid gasket (Three Bond 1207C) or its equivalent to the shaded areas shown in the illustration.



6A3-125-2.tif

Except 4HE1-T, 4HE1-TC



6A3-70-2.tif

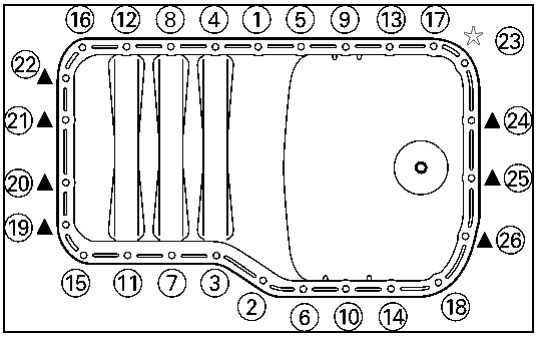
2) Tighten the oil pan nuts and bolts to the specified torque in the numerical order as shown in the illustration.

▲ marks are located on nut positions.

Oil Pan Nuts and Bolts Torque — N•m (kg•m/lb•ft)

Others	11 (1.1/8)
4HE1-T 4HE1-TC	24 (2.4/17) 18 (1.8/13) for star mark

For 4HE1-T, 4HE1-TC



013LX00001.tif

41. Spacer Rubber (NKR model only)

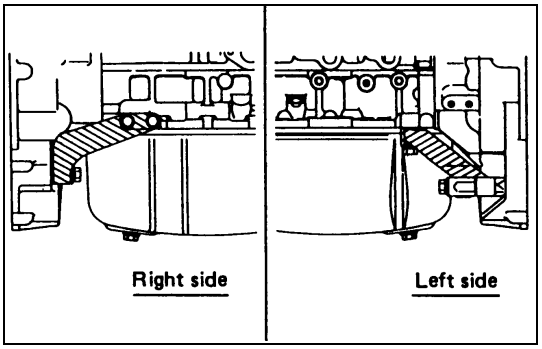
Spacer Rubber Bolt Torque	N•m (kg•m/lb•ft)
	76 (7.7/56)

- For the 4WD model vehicle, tighten the spacer rubber together with the stiffener.

Cylinder Body RH Side	N•m (kg•m/lb•ft)
	48 (4.9/35)

Cylinder Body LH Side	N•m (kg•m/lb•ft)
	128 (12.9/93)

Flywheel Housing Side	N•m (kg•m/lb•ft)
	76 (7.7/56)

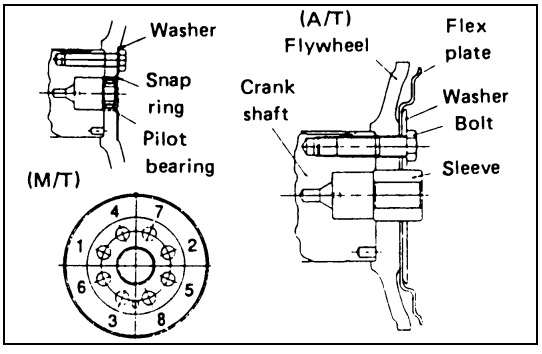


6A3-126-1.tif

40. Crankshaft Rear Slinger

39. Crankshaft Rear Oil Seal

Above works refer to “CRANKSHAFT REAR OIL SEAL” section in this manual.



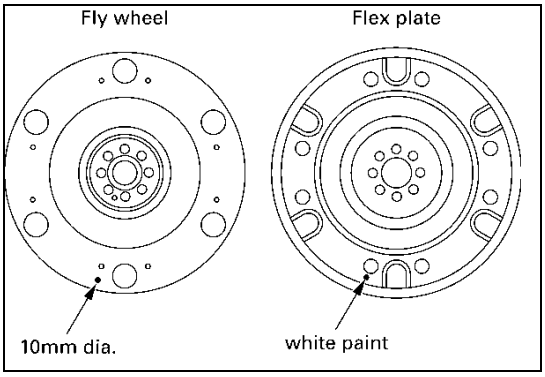
6A3-126-2.tif

38. Flywheel Assembly

1) Align the flywheel with the crankshaft knock pin and temporarily tighten the flywheel bolts.
2) Use the crankshaft stopper to prevent the crankshaft from turning.
   Crankshaft Stopper:5-8840-2230-0
3) Install the washer and the flywheel bolts and tighten to the specified torque in the numerical order show in the illustration.

Flywheel Bolt Torque	N•m (kg•m/lb•ft)
1st step	2nd step
78 (8.0/58)	90° - 120°

4) Remove the crankshaft stopper.



For A/T model

1. Align the knock pin on the crankshaft to install the flywheel.
2. Install the flexible plate with alignment mark (10 mm diameter dent on the flywheel and 10 mm diameter white paint on the flexible plate) and washer.
3. Apply molybdenum disulfide grease to the bolt thread and seat to install the flywheel fixing hole.

   Tighten bolt to two stage tightening method in the numerical order.

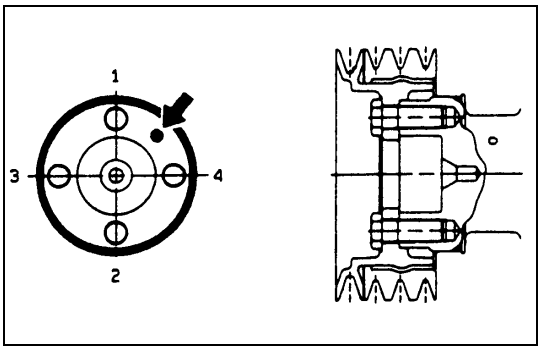
   1st step; 78 N•m (58 lbft)

   2nd step; 90 - 120 degrees.

37. Crankshaft Front Slinger

36. Crankshaft Front Oil Seal

Above works refer to “CRANKSHAFT FRONT OIL SEAL” section in this manual.

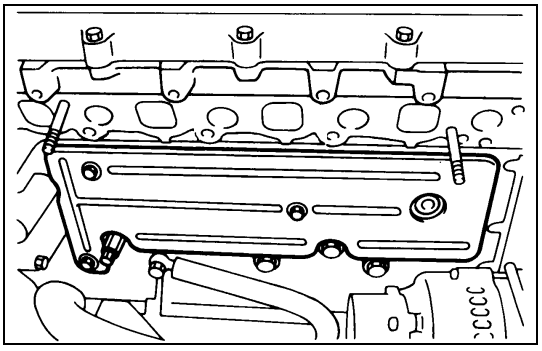


6A3-126-3.tif

35. Crankshaft Damper Pulley

1) Apply a coat of the engine oil to the threads of the bolts.
2) Align the damper pulley with the crankshaft knock pin and tighten the bolts to the specified torque in the numerical order.

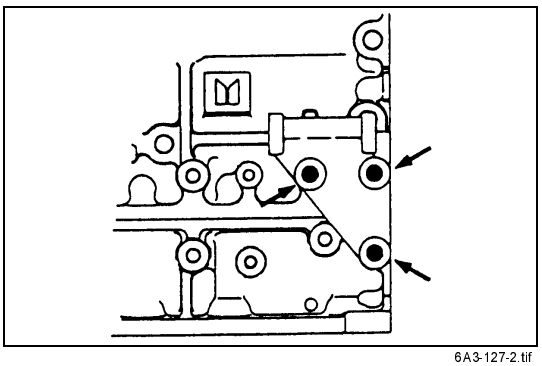
Damper Pulley Bolt Torque	N•m (kg•m/lb•ft)
	200 (20.4/147)



6A3-127-1.tif

34. Cover

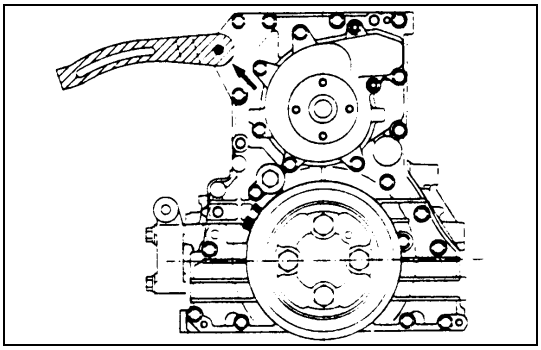
Cover Bolt Torque	N•m (kg•m/lb•in)
	13 (1.3/113)



6A3-127-2.tif

33. Generator Bracket

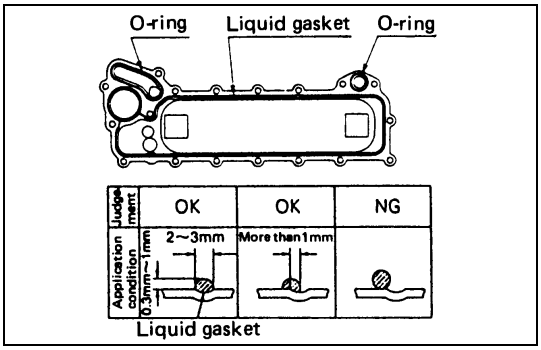
Generator Bracket Bolt Torque	N•m (kg•m/lb•ft)
	48 (4.9/35)



6A3-127-3.tif

32. Fan Belt Adjust Plate

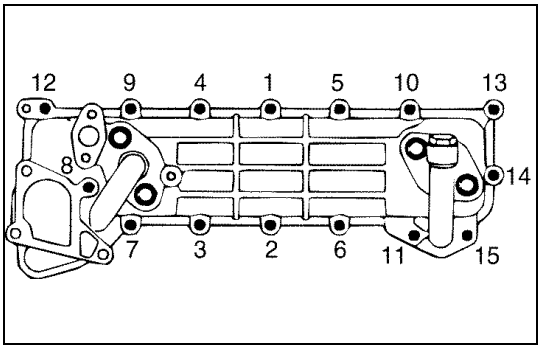
Install the adjust plate and temporarily tighten the adjust plate bolt.



6A3-127-4.tif

31. Oil Cooler Assembly

1) Apply 2mm-3mm bead of the recommended liquid gasket (Three Bond 1207C) or its equivalent on the oil cooler fitting surface.
2) Apply a coat of engine oil to the O-rings (2 pieces) and install the O-rings to the oil cooler.



050LX032.tif

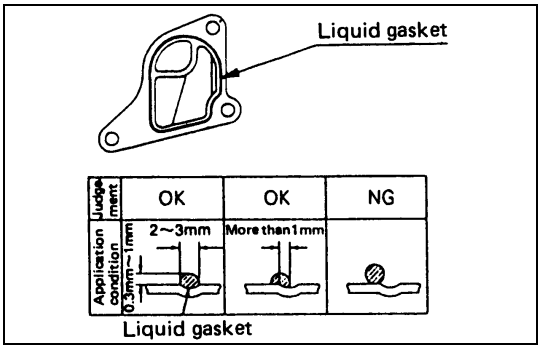
NOTE:

Take care that the O-ring does not get smeared with liquid gasket.

- Install the oil cooler within 7 minutes after application of the liquid gasket.
- For the dislocation of the liquid gasket, refer to the illustration.

3) Tighten the oil cooler bolts and nut to the specified torque a little at a time in the sequence shown in the illustration.

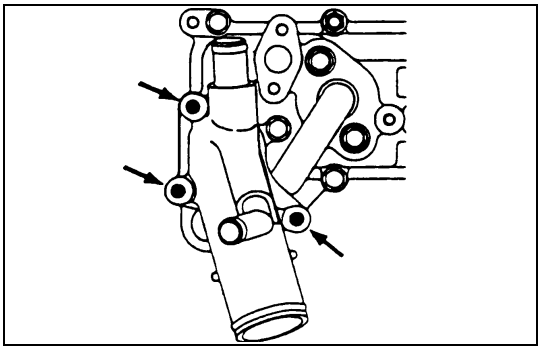
Oil Cooler Bolt and Nut Torque	N•m (kg•m/lb•ft)
24 (2.4/17)	



6A3-128-2.tif

30. Water Suction Pipe

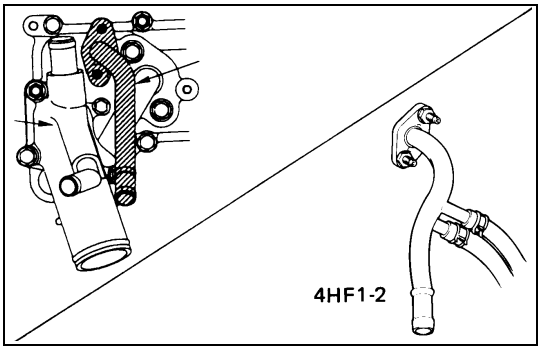
1) Apply a 2mm-3mm bead of the recommended liquid gasket (Three Bond 1207C) or its equivalent on the groove of the water suction pipe fitting surface.
2) Install the water suction pipe to the oil cooler.
- For the dislocation of liquid gasket, refer to the illustration.


6A3-128-3.tif

Water Suction Pipe Bolt and Nuts Torque

N•m (kg•m/lb•ft)
24 (2.4/17)

NOTE:
Install the water suction pipe immediately after the installation of the oil cooler.



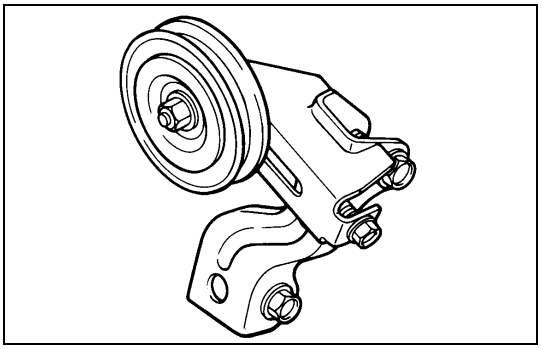
6A3-128-4.tif

29. Heater Pipe

1) Install the O-ring to the heater pipe.
2) Install the heater pipe to the oil cooler.

Heater Pipe Bolt Torque

N•m (kg•m/lb•ft)
24 (2.4/17)


6A3-128-5.tif

28. Idle Pulley Bracket (If equipped with A/C)

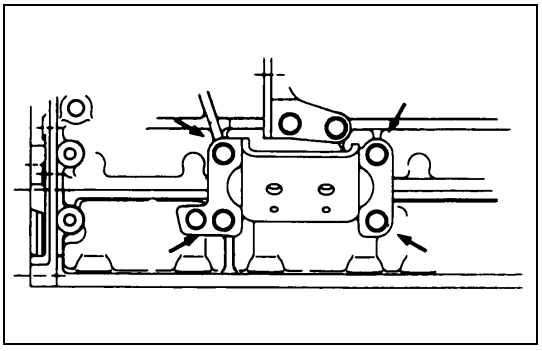
Idle Pulley Bracket Bolt Torque

N•m (kg•m/lb•ft)
48 (4.9/35)

27. Injection Pump Rubber Spacer

26. Injection Pump Assembly

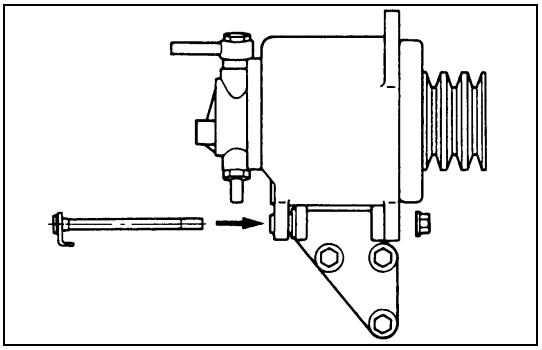
Above works refer to “INJECTION PUMP ASSEMBLY” section in this manual.


6A3-129-1.tif

25. Engine Foot

Engine Foot Bolt Torque

N•m (kg•m/lb•ft))
51 (5.2/38)

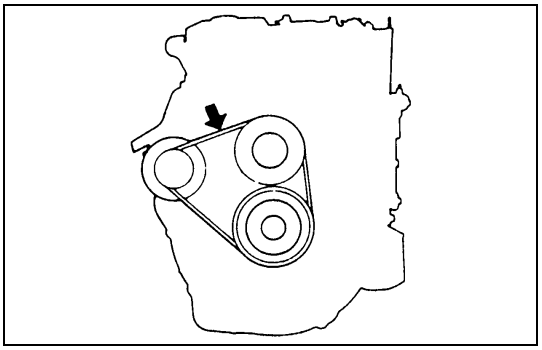

6A3-129-2.tif

24. Generator

NOTE:

When tightening the generator, tighten in advance the fan belt temporarily after its adjustment.

- Insert through the lower fixing bolt from the rear side as shown in the illustration, and tighten it with a nut on the front side.


6A3-129-3.tif

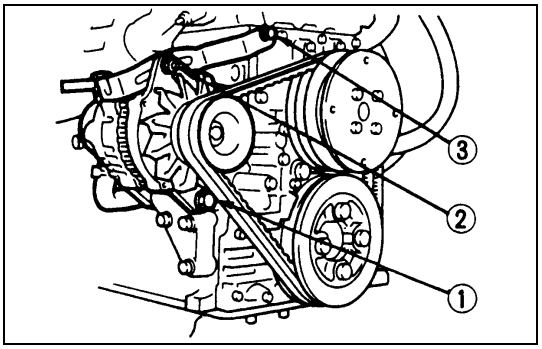
23. Fan Belt

Check the drive belt tension.

Depress the drive belt mid-portion with a 98N (10kg/22lb) force.

Drive Belt Deflection	mm (in)
8 - 12 (0.31 - 0.47) ... New belt 10 - 14 (0.39 - 0.55) ... Reuse belt	

Check the drive belt for cranking and other damage.

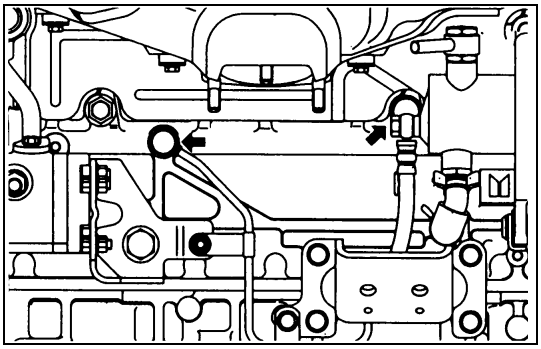


6A3-129-4.tif

Fan Belt Adjustment

Fan belt tension is adjusted by moving the generator.

Torque	N•m (kg•m/lb•ft)
①	40(4.1/30)
②	24(2.4/17)
③	46(4.7/34)

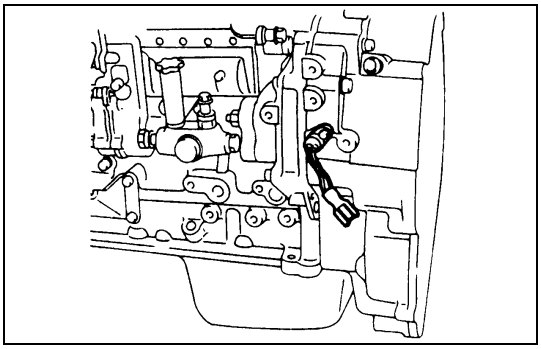

6A3-130-1.tif

22. Vacuum Pump Rubber Hose

21. Vacuum Pump Oil Pipe

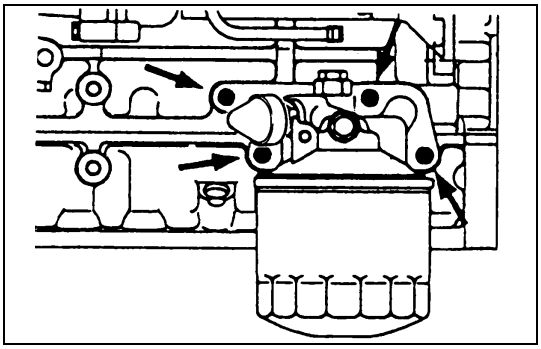
	Cylinder Body Side	N•m (kg•m/lb•ft)
		41 (4.2/30)
	Generator Side	N•m (kg•m/lb•ft)
		23 (2.3/17)

20. Fuel Pipe Bracket


6A3-130-2.tif

19. Tachometer Sensor

	Tachometer Bolt Torque	N•m (kg•m/lb•in)
		8 (0.8/69)

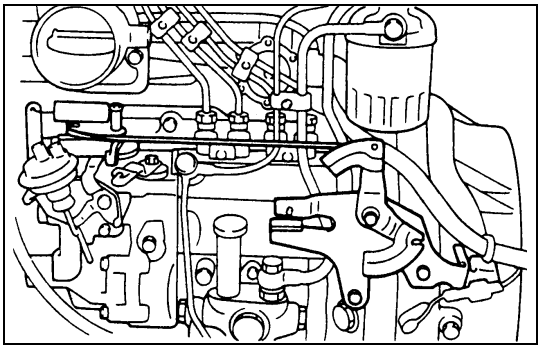

6A3-130-3.tif

18. Oil Filter Assembly

	Oil Filter Bolt Torque	N•m (kg•m/lb•ft)
		8 (4.9/35)

17. Oil Pipe

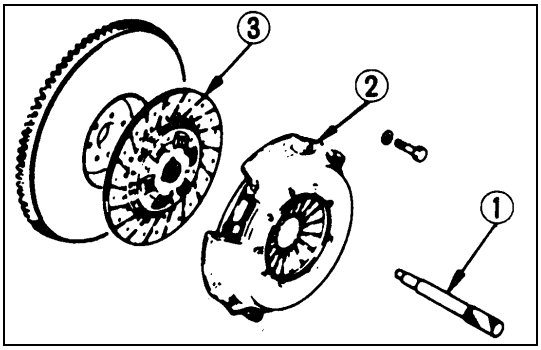
	Oil Pipe Joint Bolt Torque	N•m (kg•m/lb•ft)
		17 (1.7/12)


6A3-130-4.tif

16. Engine Control Lever Assembly

	Engine Control Lever Bolt Torque	N•m (kg•m/lb•ft)
		24 (2.4/17)

15. Engine Control Wire



6A3-130-5.tif

14. Driven Plate

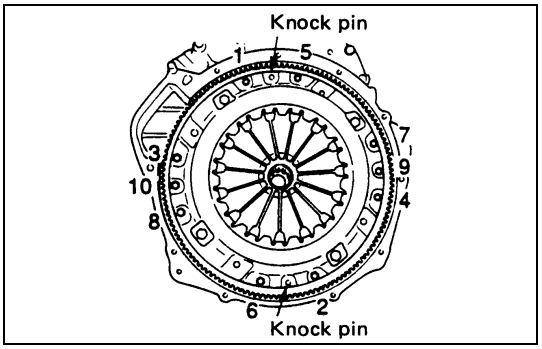
Use the clutch pilot aligner to install the driven plate.

Clutch Pilot Aligner: 5-8840-2240-0

① Clutch pilot aligner.

② Clutch pressure plate assembly

③ Driven plate



6A3-131-1.tif

13. Clutch Pressure Plate Assembly

1) Align the clutch pressure plate with the flywheel knock pin.
2) Tighten the pressure plate bolts to the specified torque in numerical order.

Clutch Pressure Plate Bolt Torque	N•m (kg•m/lb•ft)
40 (4.1/30)	

12. Cylinder Head Gasket

11. Cylinder Head Assembly

Above works refer to “CYLINDER HEAD” section in this manual.

10. Camshaft Bearing Lower

9. Camshaft Assembly

8. Camshaft Bearing Upper

7. Camshaft Bearing Cap

6. Valve Cap

Above works refer to “CAMSHAFT ASSEMBLY” section in this manual.

5. Rocker Arm Shaft Assembly

Above works refer to “ROCKER ARM SHAFT ASSEMBLY” section in this manual.

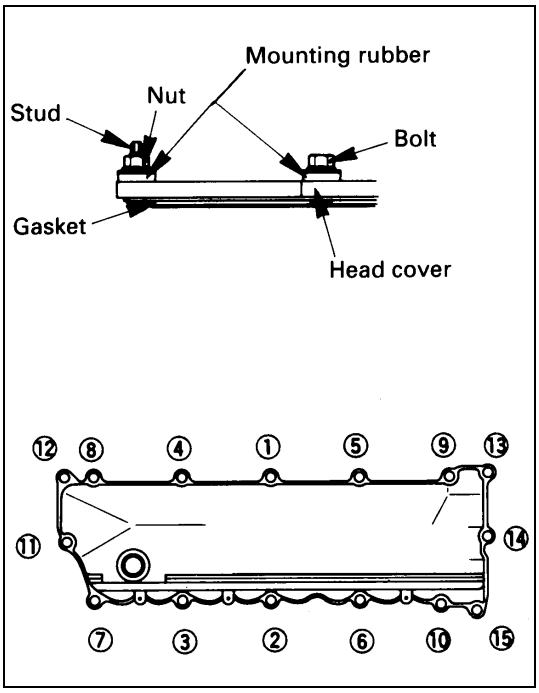
4. Head Cover Gasket

Above works refer to “CYLINDER HEAD” section in this manual.

3. Cylinder Head Cover

1) Install the cylinder head cover.
2) Tighten the cylinder head cover nuts and bolts to the specified torque in the numerical order shown in the illustration.

Cylinder Head Cover Nut and Bolt Torque	N•m (kg•m/lb•ft)
18 (1.8/13)	



6A3-131-2.tif

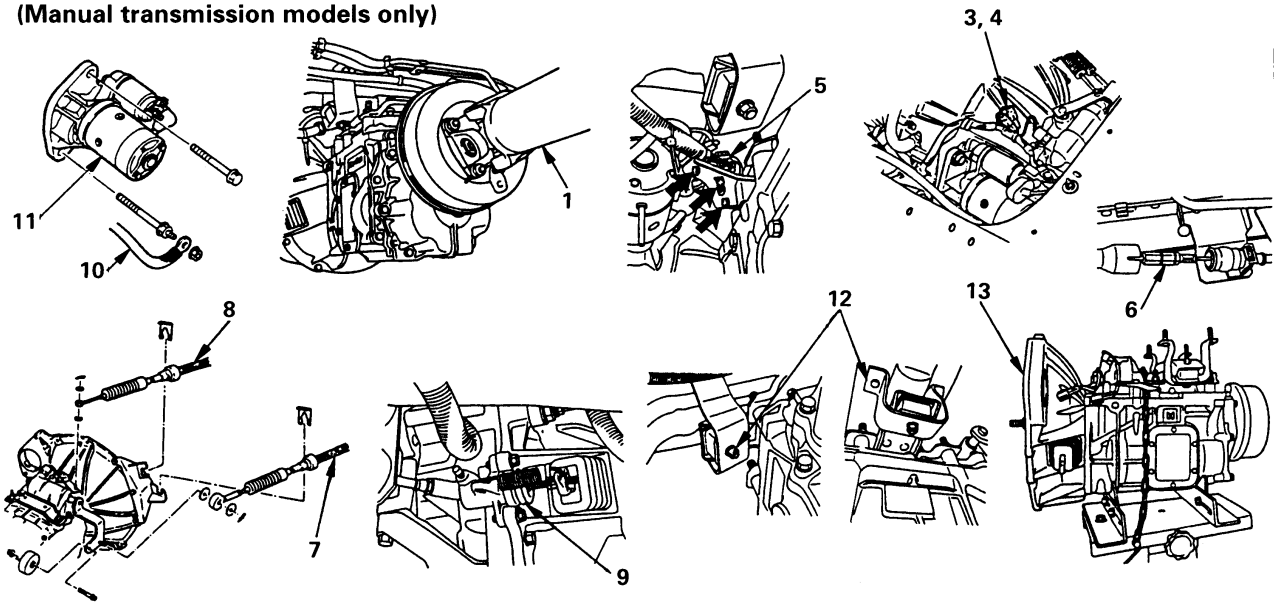
2. Nozzle Cover

1. Engine Assembly

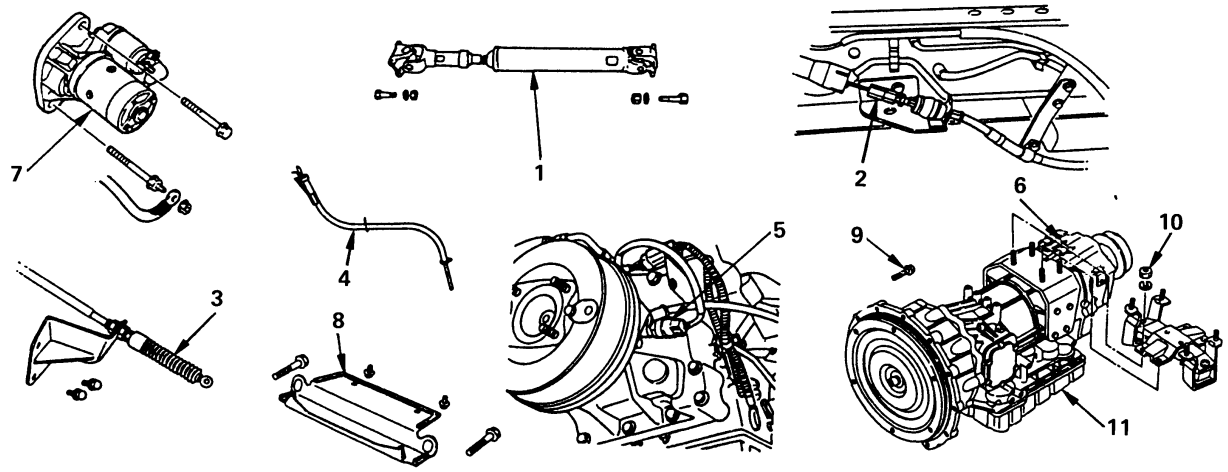
Above works refer to “ENGINE ASSEMBLY” section in this manual.

ENGINE ASSEMBLY
(Transmission side)

(Manual transmission models only)



(Automatic Transmissionmodels only)



Removal steps (Manual Transmission)
1. Propeller shaft assembly
2. Car speed sensor connector
3. Neutral switch connector
4. Back-up lamp connector
5. Harness connector
6. Parking brake cable
7. Shift cable
8. Select cable
9. Clutch slave cylinder assembly
10. Starter earth cable
11. Starter
12. Transmission mounting unit
13. Transmission assembly

Removal steps (Automatic Transmission)
1. Propeller shaft assembly
2. Parking brake cable
3. Control cable
4. Oil level gauge
5. Harness connector
6. ATF cooler pipe
7. Starter
8. Under cover
9. Torque converter bolt
10. Transmission mounting
11. Transmission assembly

Installation steps
To install, follow the removal steps in the reverse order.

6A3-132-1.tif

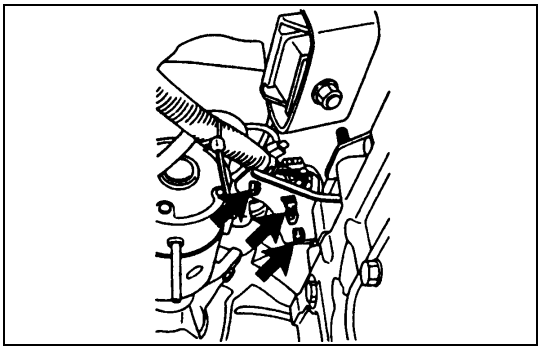
REMOVAL

Preparation

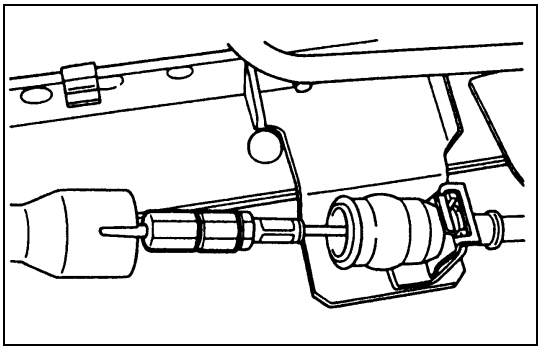
- Disconnect battery ground cable
- Tilt the cab
- Transmission cover
- Drain coolant

(Manual Transmission)

1. **Propeller shaft Assembly**
   1) Put in advance an alignment mark to the drum and the flange yoke.
   2) Put the drum and the flange yoke aside and hang them with a wire so that they do not interfere with servicing work.
2. **Car Speed Censer Connector**
3. **Neutral Switch Connector**
4. **Back-up Lamp Connector**
5. **Harness Connector**
   Remove the connectors from the harness bracket. At that time, take care not to cause any damages to the clips.

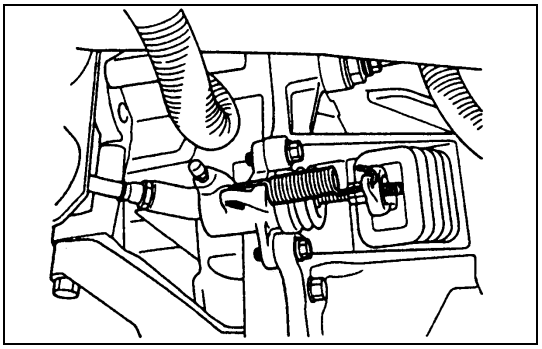


6A3-133-1.tif



6A3-133-2.tif

6. **Parking Brake Cable**
   Remove the clip and slide the cover provided in the middle of the cable. Then, loosen the longer nut on the front side of the vehicle to disconnect the parking brake cable.
7. **Shift Cable**
8. **Select Cable**



6A3-133-3.tif

9. **Clutch Slave Cylinder**
   1) Disconnect the clutch return spring from the clutch slave cylinder.
   2) Remove the slave cylinder from the clutch shift fork.
10. **Starter Earth Cable**
11. **Starter**
    1) Disconnect the battery cable at the starter motor.
    2) Remove the starter assembly from flywheel housing.

12. Transmission Mounting Nut

1) Check that the engine lifting is securely supporting the engine.
2) Remove the engine rear mounting bracket nuts from the No.3 crossmember.

13. Transmission Assembly

Remove the transmission nuts and bolts from the flywheel housing.

- Remove the transmission by pulling it toward the rear of the vehicle while slowly lowering the transmission jack.

(Automatic Transmission)

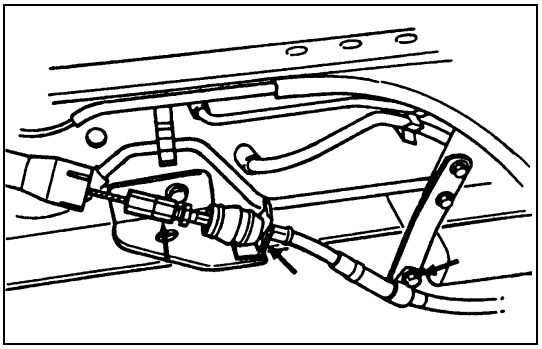
- Drain Automatic transmission fluid.

1. Propeller Shaft Assembly

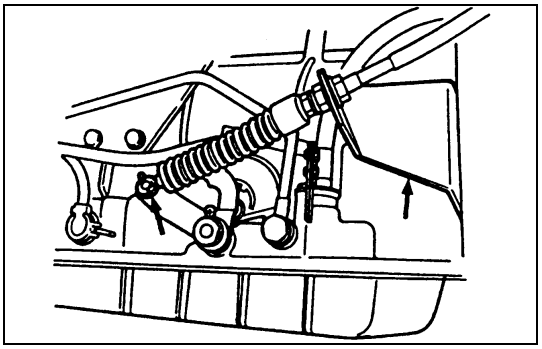
1) Put an alignment mark in advance to the drum and the flange yoke.
2) Put the drum and the flange yoke aside and hang them with a wire so that they do not interfere with servicing work.

2. Parking Brake Cable

Remove the clip and slide the cover provided in the middle of the cable. Then, loosen the longer nut on the front side of the vehicle to disconnect the parking brake cable.



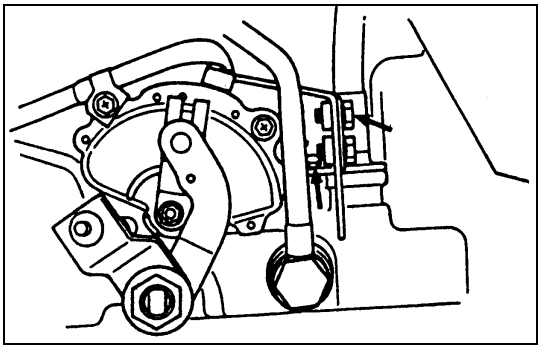
6A3-134-1.tif



6A3-134-2.tif

3. Control Cable

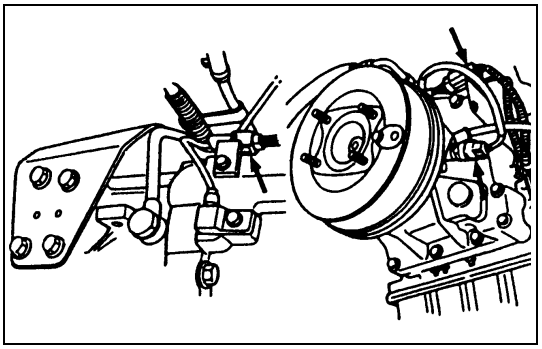
1) Disconnect the control cable from the lever.
2) Remove the control cable bracket from the transmission.



6A3-135-1.tif

4. Oil Level Gauge

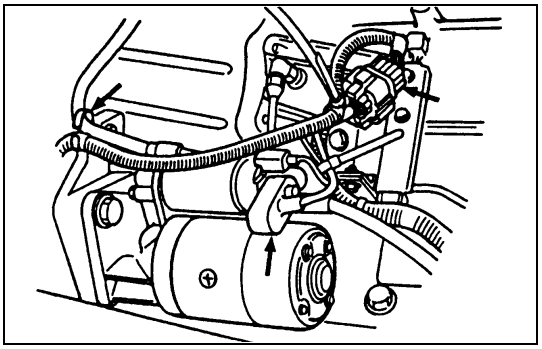
1) Remove the fixing bolts of the oil filler and the protector.
2) Remove the oil filler bolt.
3) Remove the bolt that tightens the oil filler and the housing.



6A3-135-2.tif

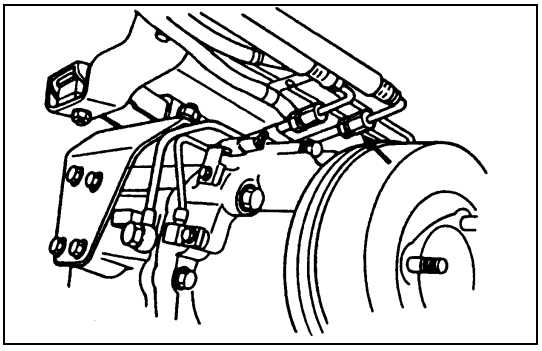
5. Harness Connector

1) Disconnect the speedometer sensor harness connector.
2) Remove the connector protector.
3) Remove the inhibitor switch and disconnect the solenoid harness connector.
4) Disconnect the A/T vehicle speed sensor harness connector.



6A3-135-3.tif

5) Disconnect the harness connector from the transmission upper bracket.



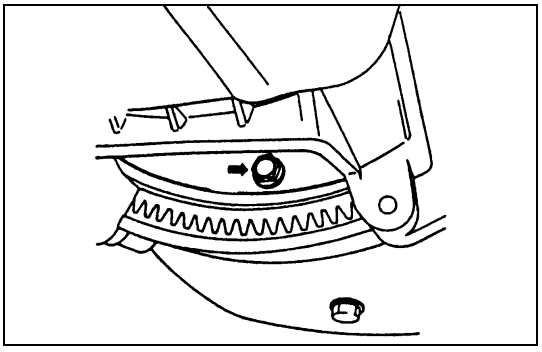
6A3-135-4.tif

6. ATF Cooler Pipe

Disconnect the harness connector from the transmission upper bracket.

7. Starter

1) Disconnect the battery cable at the starter motor.
2) Remove the starter assembly from flywheel housing.

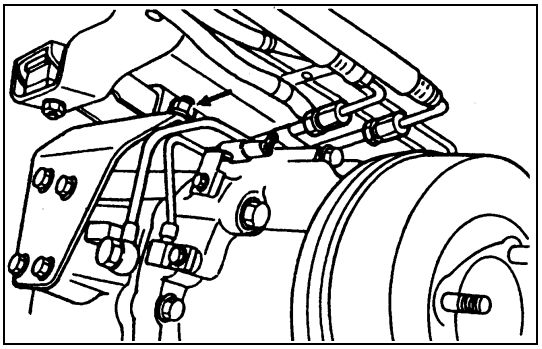


6A3-135-5.tif

8 Under Cover

9. Torque Converter Bolt

1) Remove the under cover from the lower section of the housing.
2) Remove the 6 torque converter bolts while turning the flywheel.



6A3-136-1.tif

10. Transmission Mounting Nut

1) Check that the engine lifting is securely supporting the engine.
2) Remove the engine rear mounting bracket nuts from the No.3 crossmember.

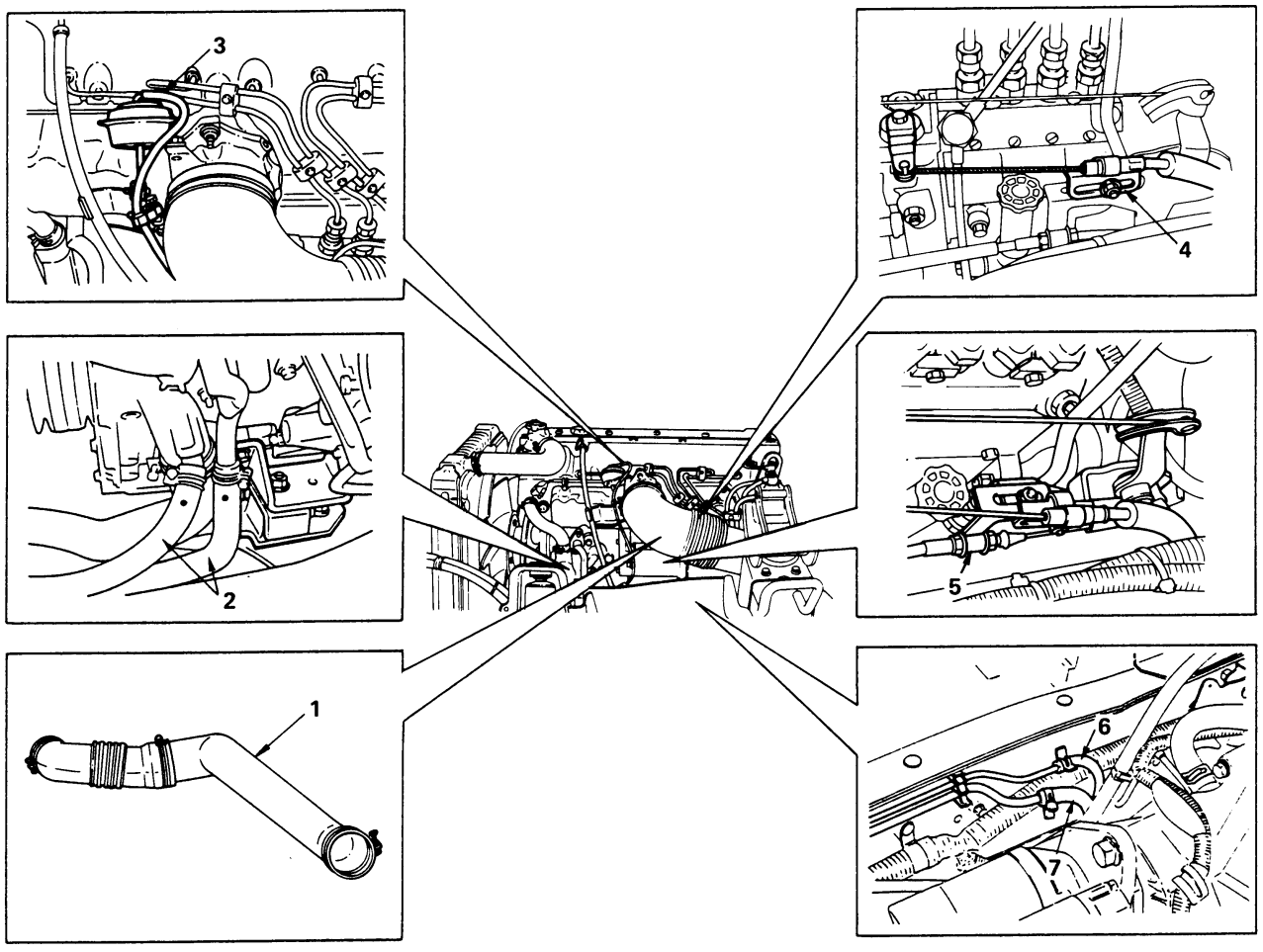
11. Transmission Assembly

1) Remove the transmission nuts and bolts from the flywheel housing.
2) Remove the transmission by pulling it toward the rear of the vehicle while slowly lowering the transmission jack.

NOTE:

Hold up a little the front section of the transmission so that the torque converter does not get off.

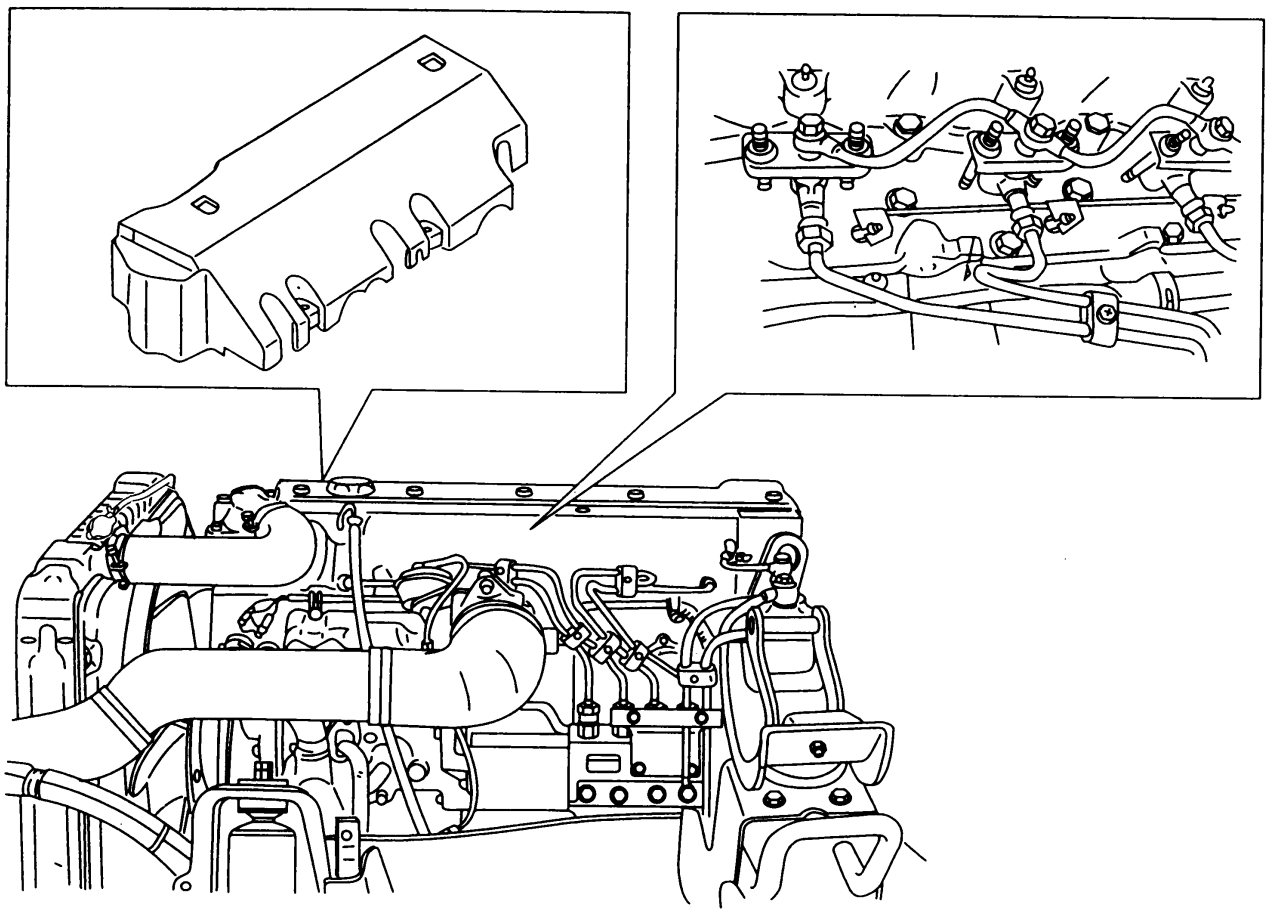
(Engine left side)



Removal steps
1. Intake air duct
2. Heater hose
3. Vacuum hose
4. Engine stop cable
5. Accelerator control cable
6. Fuel return hose
7. Fuel feed hose

Installation steps
To install, follow the removal steps in the reverse order.

6A3-136-2.tif

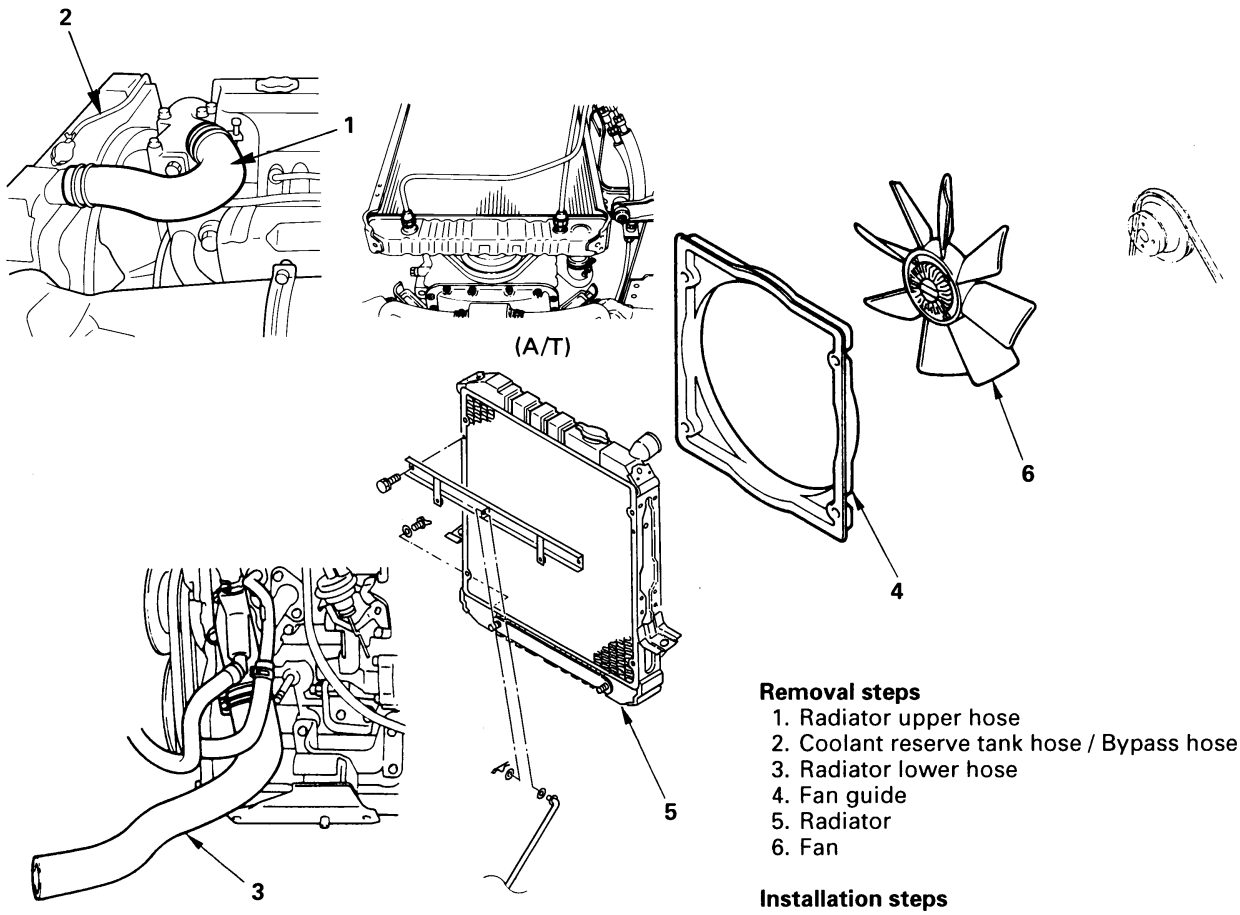


6A3-137-1.tif

REMOVAL

1. **Intake Air Duct**
2. **Heater Hose**
3. **Vacuum Hose**
4. **Engine Stop Cable**
   Loosen locking nut at bracket and disconnect engine stop cable from injection pump stop lever.
5. **Accelerator Control Cable**
   Loosen locking nut at bracket and disconnect accelerator control cable from injection pump control lever.
6. **Fuel Return Hose**
7. **Fuel Feed Hose**
   Disconnect fuel hose from injection pump side and take care not to spill and enter dust.

(Engine front side)



Removal steps
1. Radiator upper hose
2. Coolant reserve tank hose / Bypass hose
3. Radiator lower hose
4. Fan guide
5. Radiator
6. Fan

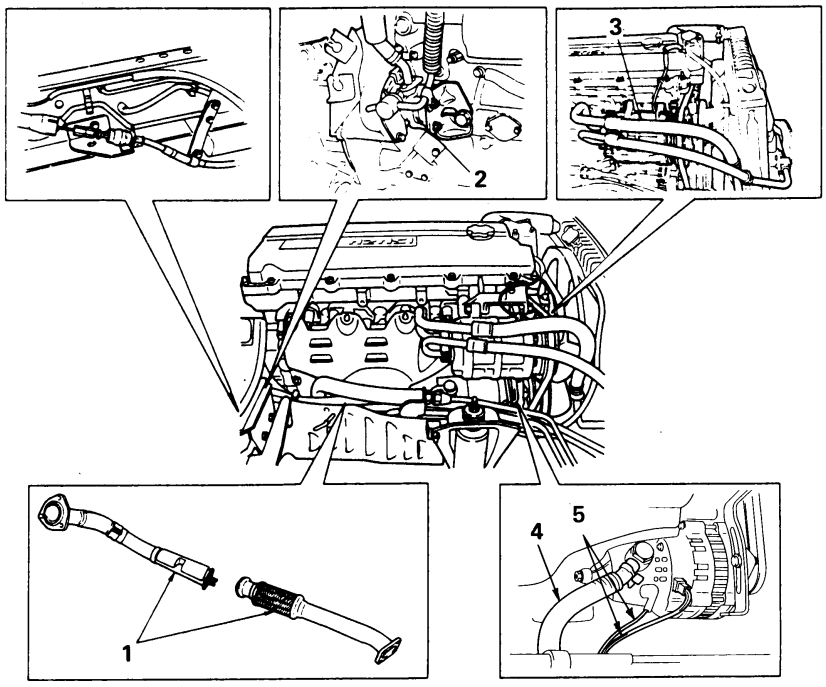
Installation steps
To install, follow the removal steps in the reverse order.

6A3-138-1.tif

REMOVAL

1. **Radiator Upper Hose**
2. **Coolant Reserve Tank Hose/Bypass Hose**
3. **Radiator Lower Hose**
4. **Fan Guide**
5. **Radiator**
   For the A/T model vehicle, remove the oil cooler pipe.
6. **Fan**

(Engine right side)



Removal steps
1. Front exhaust pipe
2. Power steering pump
3. A/C compressor
4. ACG vacuum hose
5. ACG harness

Installation steps
To install, follow the removal steps in the reverse order.

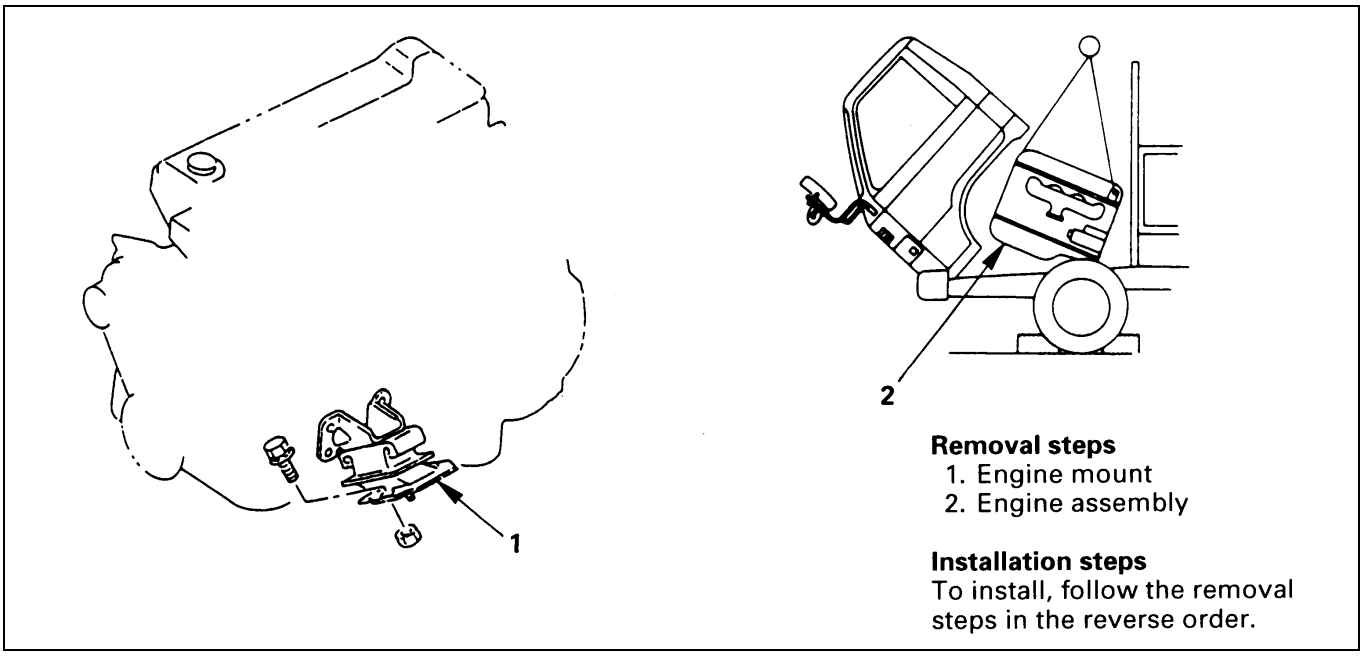
6A3-139-1.tif

REMOVAL

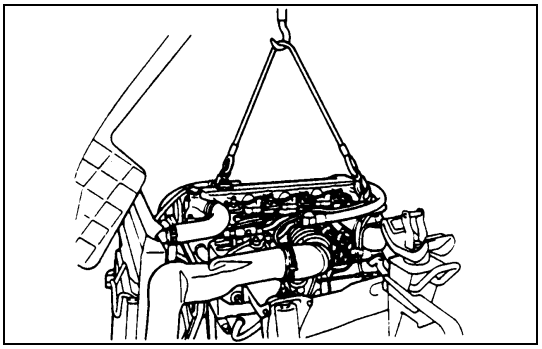
1. **Front Exhaust Pipe**
2. **Power Steering Pump**
   Remove the power steering pump from the engine side with the bracket attached, and fasten it with a wire to the appropriate location, together with the hoses.
3. **Air Conditioning (A/C) Compressor (If equipped with A/C)**
   1) Remove the A/C compressor drive belt.
   2) Dismount the compressor from the A/C compressor bracket, and fasten it with a wire to the appropriate location, together with the hoses.

4. **ACG Vacuum Hose**
   Disconnect the vacuum hoses from vacuum pump side.
5. **ACG Harness**
   Disconnect the B terminal cable and harness connector from generator.

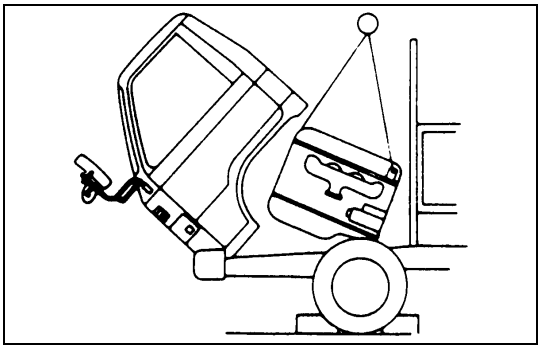
(Engine mounting side)



6A3-140-1.tif



6A3-140-2.tif

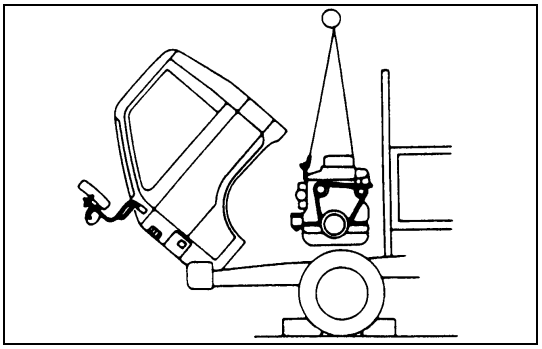


6A3-140-3.tif

REMOVAL

1. **Engine Mount**
   Attach lifting wires to the engine lifting hangers and slightly raise the engine.
   Remove the engine mounting rubber nuts attaching the engine mounting crossmembers.

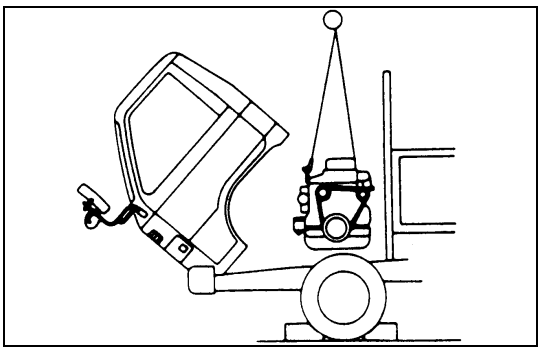
2. **Engine Assembly**
   1) Make sure that the connecting pipes, hoses, and cables have all been removed from the engine.
   2) Operate the hoist to slowly raise the engine until it is clear of the chassis frame.


6A3-141-1.tif

3) Rotate the engine 90 degrees.
4) Continue to lift the engine from the chassis.
5) Carefully move the hoist and engine.
6) Set the engine on an engine stand.

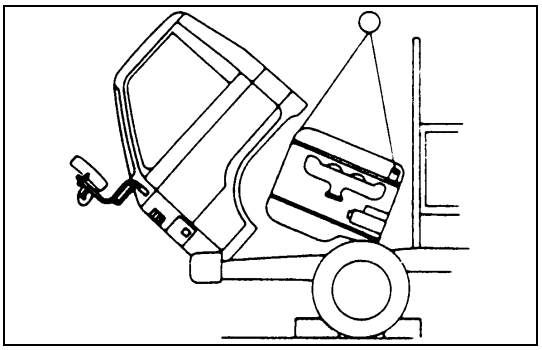
INSTALLATION

(Engine mounting side)

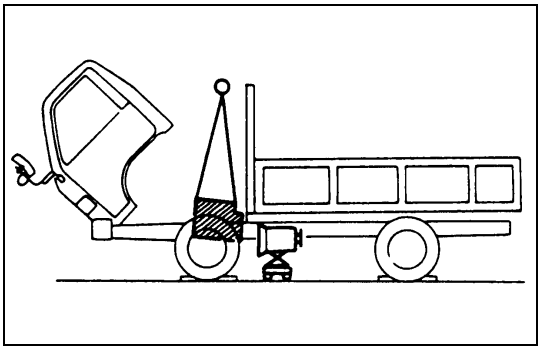

6A3-141-2.tif

2. Engine Assembly

1) Attach a lifting wire to the engine lifting hangers.
2) Operate the hoist to position the engine above the chassis frame.
3) Carefully lower the engine until it is just above the chassis frame.


6A3-141-3.tif

4) Rotate the engine 90° to position it for final installation.
5) Carefully set the engine to the chassis.
   The front of the engine should be held higher than the rear at this time.
   Be careful not to damage the exposed parts.


6A3-141-4.tif

6) Lower the engine until it contacts the engine mounting crossmember.
7) Set the engine mounting rubbers to the engine mounting crossmember.
8) Temporarily tighten the engine mounting rubber bolts.
   The bolts will be finally tightened after the transmission has been installed to the engine and the engine rear mounting bracket and the No.3 crossmember connected.

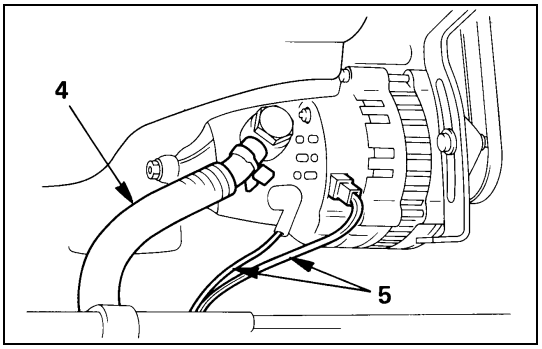
1. Engine Mount

Install the engine mount with it set to the holes of the engine mount crossmember. Then tighten it to the specified torque.

Mounting Rubber Nut Torque	N•m (kg•m/lb•ft)
	48 (4.9/35)

INSTALLATION

(Engine right side)

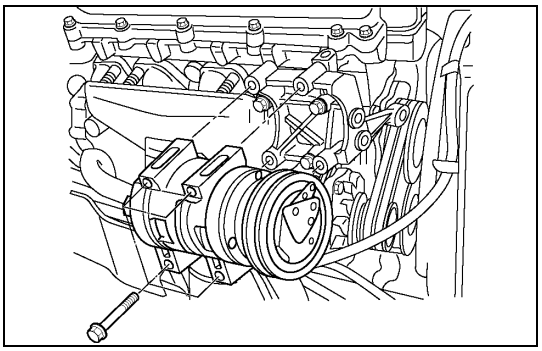


6A3-142-1.tif

5. ACG Harness

4. ACG Vacuum Hose

1) Connect the B terminal cable and the harness connector.
2) Connect the vacuum hoses to the vacuum pump.


901LV058.tif

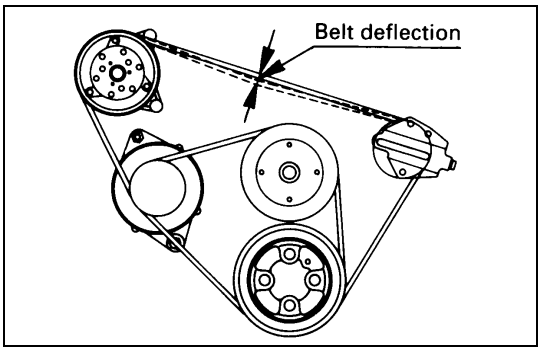
3. Air Conditioning (A/C) Compressor

- Tighten the fixing bolts to the specified torque.

A/C Compressor Bolt Torque	N•m (kg•m/lb•ft)
48 (4.9/35)	

NOTE:

When tightening the compressor fixing bolts, tighten the first 2 bolts on the rear side, and then the remaining 2 on the front.

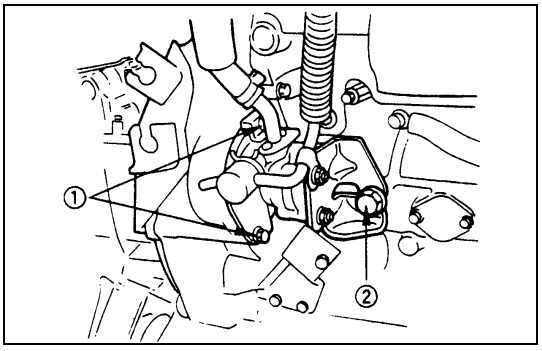


6A3-142-3.tif

- Install the drive belt adjust belt tension by adjusting bolt and tighten the locking nut to the specified torque.
- Depress the drive belt mid-portion with a 10 kg (22lb/98N) force.

Drive Bolt Deflection	mm(in)
16 - 20 (0.63 - 0.79) .. New belt 18 - 22 (0.71 - 0.87) .. Reuse belt	

Locking Nut Torque	N•m (kg•m/lb•ft)
27 (2.8/20)	



6A3-142-4.tif

2. Power Steering Pump

① Bolt Torque	N•m (kg•m/lb•ft)
43 (4.4/32)	

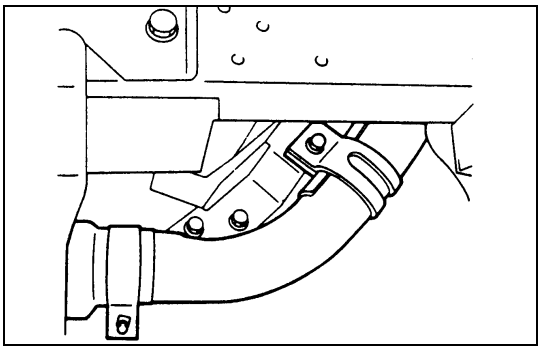
② Bolt Torque	N•m (kg•m/lb•ft)
44 (4.5/33)	

1. Front Exhaust Pipe

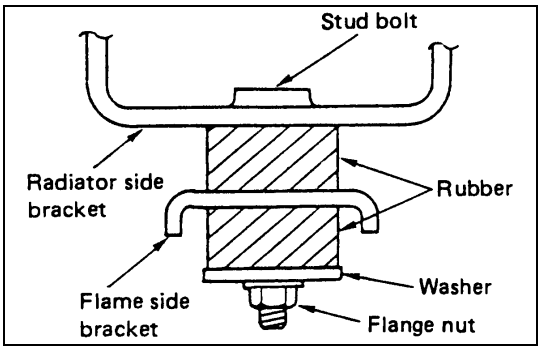
Exhaust Manifold Side	N•m (kg•m/lb•ft)
67 (6.8/49)	

Exhaust Brake Side	N•m (kg•m/lb•ft)
17 (1.7/12)	

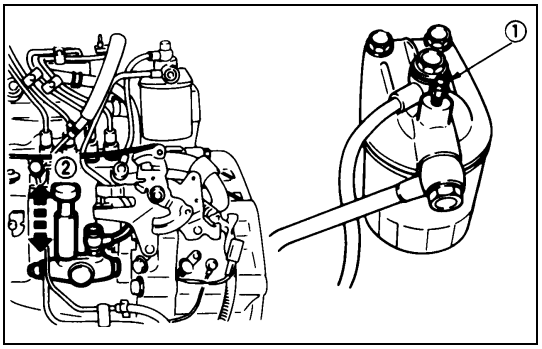
Cylinder Body side	N•m (kg•m/lb•ft)
17 (1.7/12)	



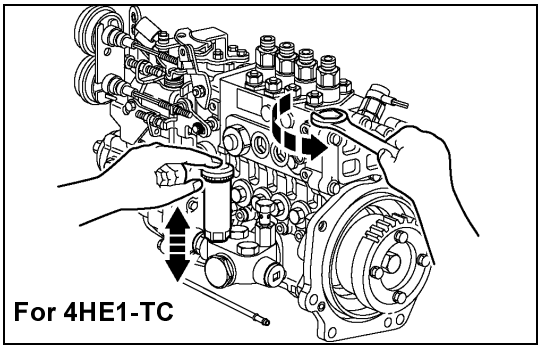
6A3-143-1.tif



6A3-143-2.tif



6A3-143-3.tif



6A3-143-4.tif

INSTALLATION

(Engine front side)

6. **Fan**

Fan Bolt Torque	N•m (kg•m/lb•ft)
	24 (2.4/17)

5. **Radiator**

Radiator Bracket Bolt Torque	N•m (kg•m/lb•ft)
	55 (5.6/41)

4. **Fan Guide**
3. **Radiator Lower Hose**
2. **Coolant Reserve Tank Hose/Bypass Hose**
1. **Radiator Upper Hose**

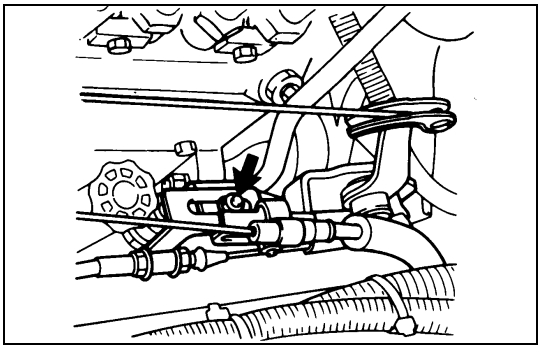
INSTALLATION

(Engine left side)

7. **Fuel Feed Hose**
6. **Fuel Return Hose**

Air Bleeding

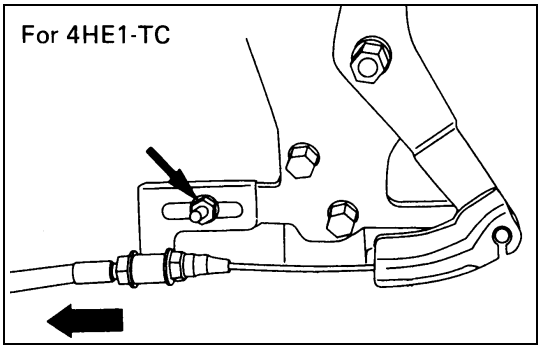
1) Loosen the priming pump cap ② at the side of the injection pump.
2) Loosen the bleeder valve ① (4HF1) at the top of the fuel filter.
3) Operate the priming pump to bleed the air from the injection pump.
4) Retighten the bleeder valve.
5) Operate the priming pump.
   Check for fuel leakage from around the injection pump and the fuel filter.
6) Lock the priming pump cap to the injection pump.



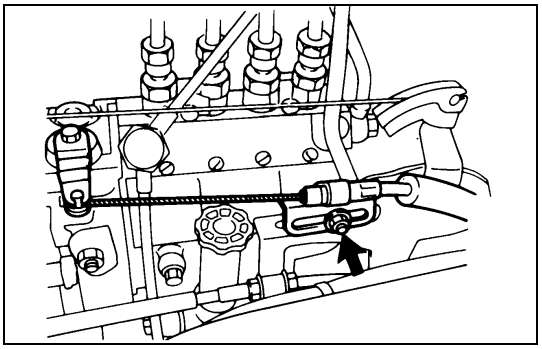
6A3-144-1.tif

5. Accelerator Control Cable

1) Check to see if the idling control knob is turned to the extreme left.
2) Attach the end tip of the cable to the engine control lever.
3) Pull the outer cable toward the front of the vehicle, and provide the engine control wire and the inner cable with an appropriate play before fastening the clamp with a nut.
4) Check to see if the control lever of the injection pump is at the idle position (with the lever in touch with the stopper bolt).



6A3-144-2.tif

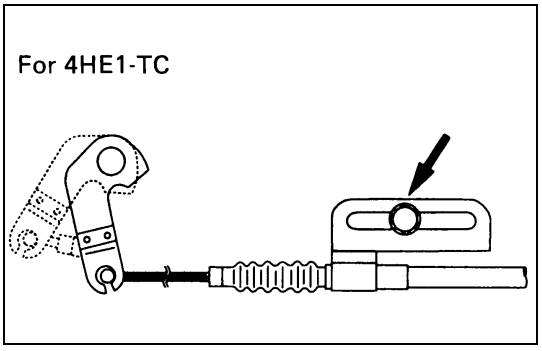


6A3-144-3.tif

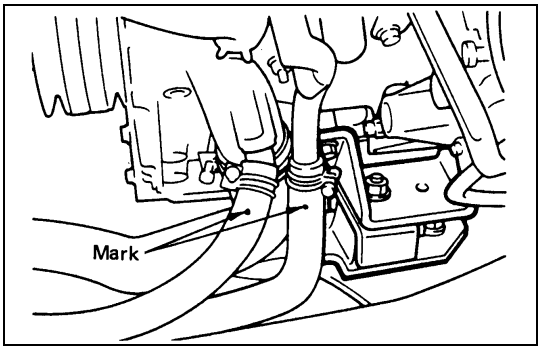
4. Engine Stop Cable

1) Attach the end tip of the cable to the engine stopper lever.
2) Pull the cable toward the rear side of the vehicle, and fasten the clamp with a nut at the position where the lever stops.

3. Vacuum Hose



6A3-144-4.tif



6A3-144-5.tif

2. Heater Hose

Install the hose with its mark turned up.

1. Intake Air Duct

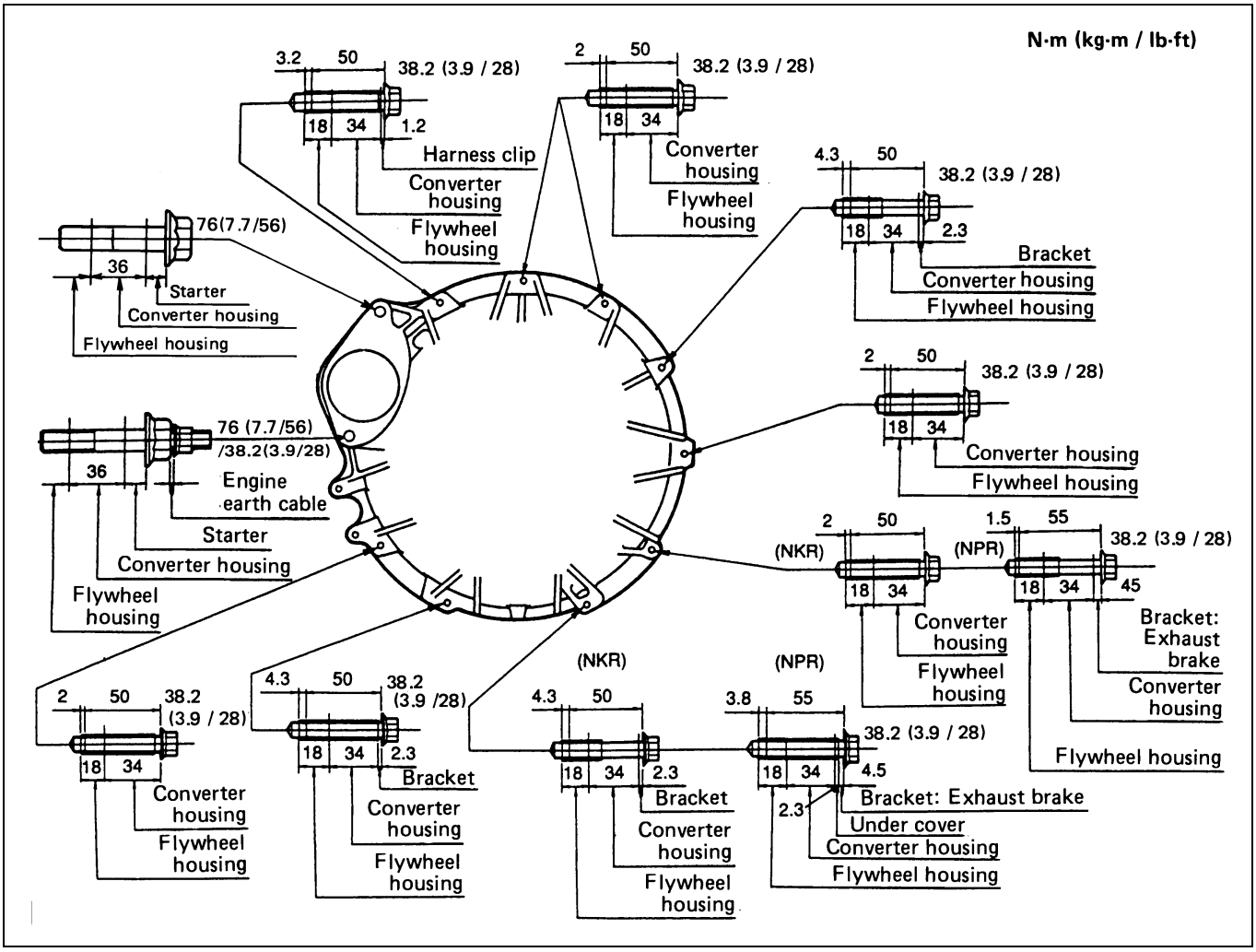
INSTALLATION

(Automatic Transmission)

11. Transmission Assembly

Fasten the transmission to the transmission jack with a chain in the same manner as when dismounting it, and tighten the clutch housing clamping bolt to the specified torque.

(Refer to the illustration below)



6A3-145-1.tif

10. Transmission Mounting Nut

Transmission Mounting Nut Torque	N•m (kg•m/lb•ft)
	38 (3.9/28)

9. Torque Cover for Bolt

	N•m (kg•m/lb•ft)
	40 (4.1/30)

8. Under Cover

Under Cover Bolt Torque	N•m (kg•m/lb•in)
	9 (0.9/78)

7. Starter

Refer to the preceding page.

6. ATF Cooler Pipe

N•m (kg•m/lb•ft)
44 (4.5/33)

5. Harness Connector

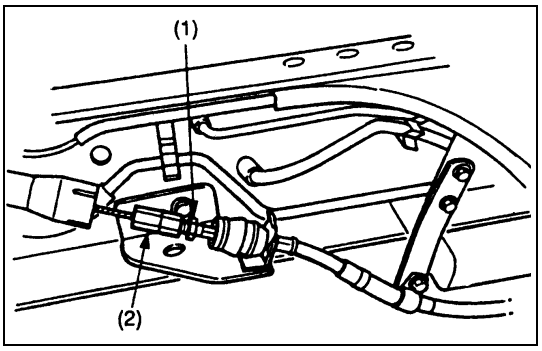
4. Oil Level Gauge

N•m (kg•m/lb•in)
9 (0.9/78)

3. Control Cable

2. Parking Brake Cable

1) With the lock nut (1) of the parking brake side cable tightened to the limit, rotate the nut (2) to connect it with the front side cable.
2) After tightening the front side nut (2) to the limit, fasten the parking brake cable with the lock nut (1).
3) Pull the parking brake lever to the limit (with the operating force of about 15kg at the hand), and adjust the lever with the lever adjusting nut so that the number of notches becomes 6 to 8 notches.



6A3-146-1.tif

1. Propeller Shaft Assembly

Propeller Shaft Bolt Torque	N•m (kg•m/lb•ft)
103 (10.5/76)	

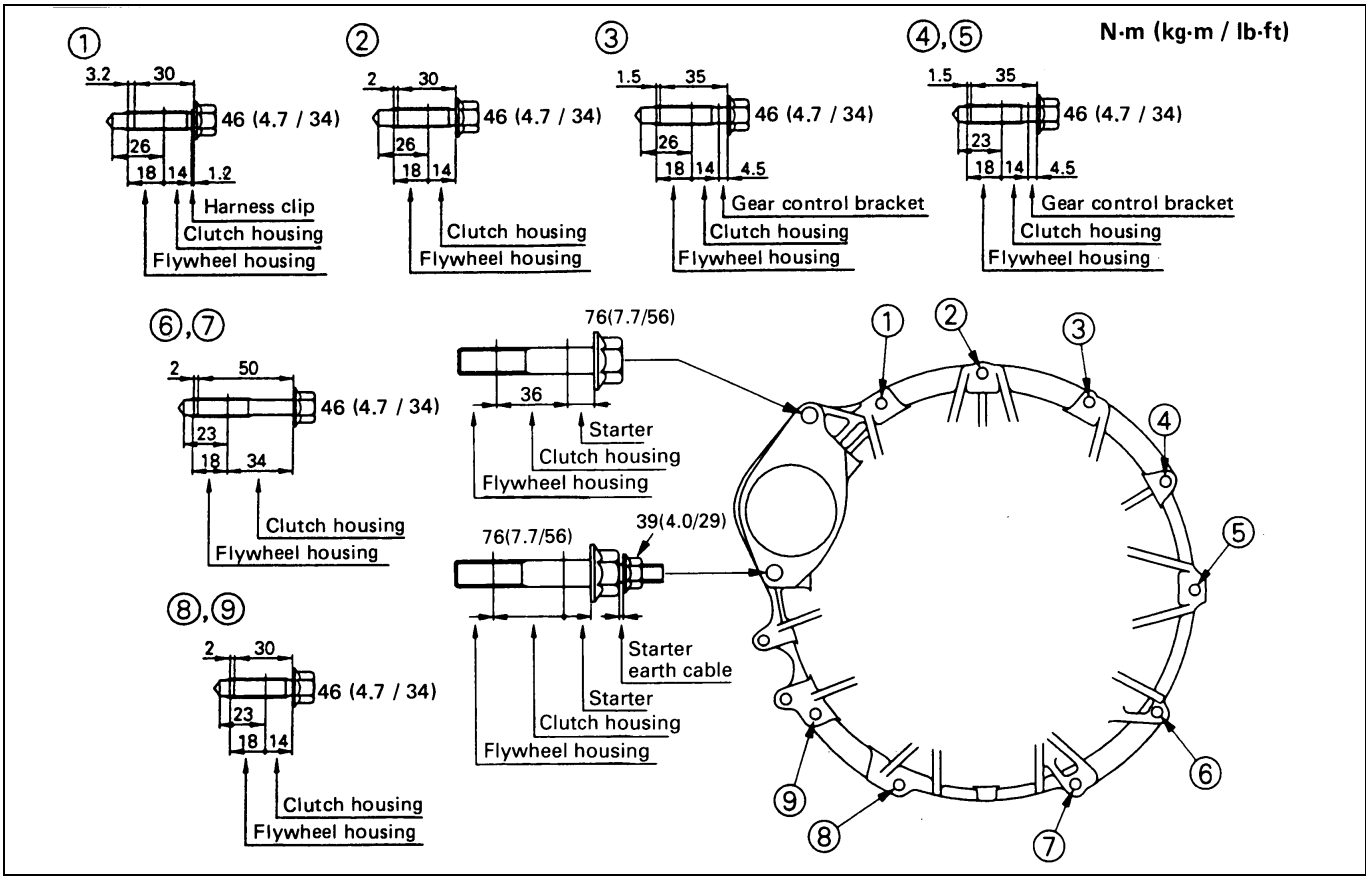
INSTALLATION

(Manual Transmission)

13. Transmission Assembly

Fasten the transmission to the transmission jack with a chain in the same manner as when dismounting it, and tighten the clutch housing clamping bolt to the specified torque.

(Refer to the illustration below.)



6A3-147-1.tif

12. Transmission Mounting Nut

Transmission Mounting Nut Torque	N•m (Kg•m/lb•ft)
40 (4.1/30)	

11. Starter

10. Starter Earth Cable

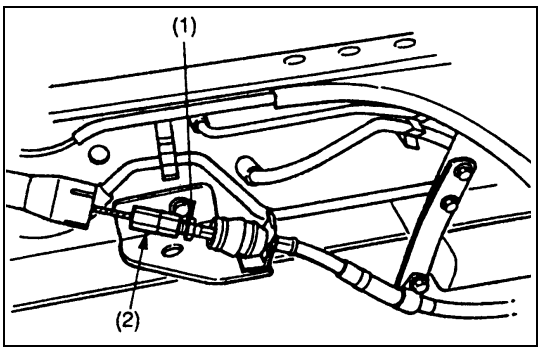
Refer to the preceding page.

9. Clutch Slave Cylinder

1) Install the clutch slave cylinder.

Slave Cylinder Bolts Torque	N•m (Kg•m/lb•ft)
16 (1.6/12)	

2) Install the clutch return spring to the clutch shift fork.



6A3-148-1.tif

8. **Select Cable**
7. **Shift Cable**
6. **Parking Brake Cable**
   1) With the lock nut (1) of the parking brake side cable tightened to the limit, rotate the nut (2) to connect it with the front side cable.
   2) After tightening the front side nut (2) to the limit, fasten the parking brake cable with the lock nut (1).
   3) Pull the parking brake lever to the limit (with the operating force of about 15 kg at the hand), adjust the lever with the lever adjusting nut so that the number of notches becomes 6 to 8 notches.
5. **Harness Connector**
4. **Back-up Lamp Connector**
3. **Neutral Switch Connector**
2. **Car Speed Sensor Connector**
1. **Propeller Shaft Assembly**

Propeller Shaft Bolt Torque	N•m (kg•m/lb•ft)
103 (10.5/76)	

Engine Warm-Up

After completing the required maintenance procedures, start the engine and allow it to warm up. Then check the following:

1) Engine idling speed
   Refer to "Servicing" for the idling speed adjustment procedure.
2) Engine noise level
3) Engine oil, coolant and fuel leakage
4) Engine control cable operation
5) Clutch engagement
6) Indicator warning light operation

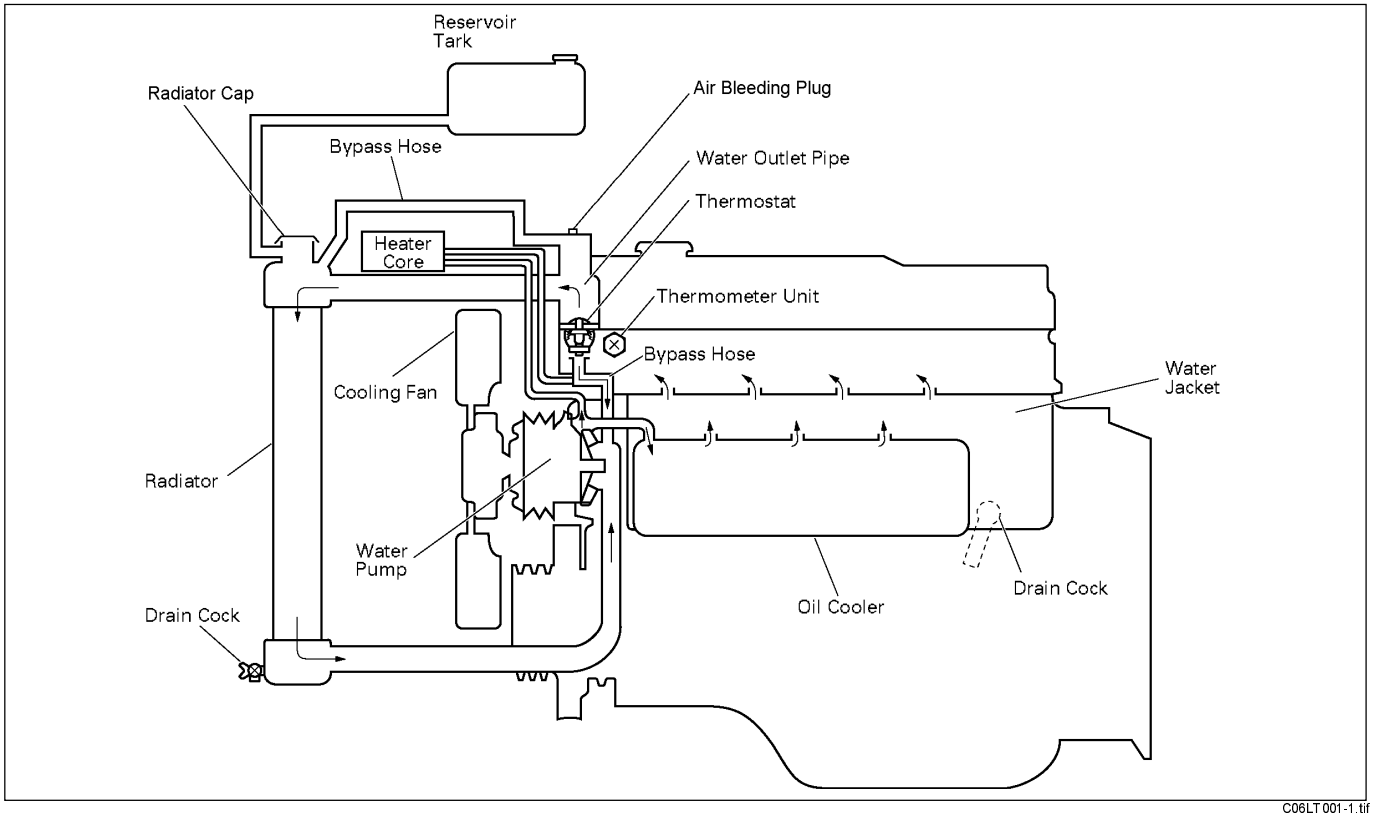
SECTION 6B

ENGINE COOLING

CONTENTS

	PAGE
General Description	6B - 1
On Vehicle Service	6B - 5
Water Pump	6B - 5
Thermostat	6B - 8
Radiator	6B - 10
Drive Belt Adjustment	6B - 13

GENERAL DESCRIPTION



The engine cooling system consists of the radiator, the water pump, the cooling fan, and the thermostats.

To quickly increase cold engine coolant temperature for smooth engine operation, the coolant is circulated by the water pump and thermostats through the by-pass hose and back to the cylinder body. The coolant does not circulate through the radiator.

When the coolant temperature reaches 82°C (180°F), the thermostat will begin to open and a gradually increasing amount of coolant will circulate through the radiator.

The thermostats will be fully open when the coolant temperature reaches 100°C (212°F). All of the coolant is now circulating through the radiator for effective engine cooling.

Engine coolant change procedure.

1. To change engine coolant, make sure that the engine is cool.

   WARNING:

   When the coolant is heated to a high temperature, be sure not to loosen or remove the radiator cap. Otherwise you might get scalded by hot vapor or boiling water. To open the radiator cap, put a piece of thick cloth on the cap and loosen the cap slowly to reduce the pressure when the coolant has become cooler.

2. Open radiator cap and drain the cooling system by loosening the drain valve on the radiator and on the cylinder body.

   NOTE:

   For best result it is suggested that the engine cooling system be flushed at least once a year. It is advisable to flash the interior of the cooling system including the radiator before using anti-freeze (ethylene-glycol based).

   Replace damaged rubber hoses as the engine anti-freeze coolant is liable to leak out even minor cracks.

   Isuzu recommends to use Isuzu genuine anti-freeze (ethylene-glycol based) or equivalent, for the cooling system and not add any inhibitors or additives.

   CAUTION:

   A failure to correctly fill the engine cooling system in changing or topping up coolant may sometimes cause the coolant to overflow from the filler neck even before the engine and radiator are completely full.

   If the engine runs under this condition, shortage of coolant may possibly result in engine overheating. To avoid such trouble, the following precautions should be taken in filling the system.

3. To refill engine coolant, pour coolant up to filler neck using a filling hose which is smaller in outside diameter of the filler neck. Otherwise air between the filler neck and the filling hose will block entry, preventing the system from completely filling up.
4. Keep a filling rate of 9 liter/min or less. Filling over this maximum rate may force air inside the engine and radiator.

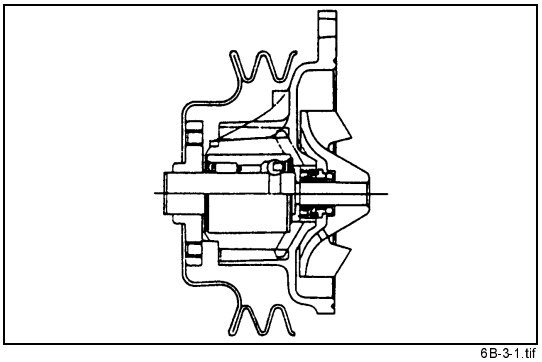
   And also, the coolant overflow will increase, making it difficult to determine, whether or not the system is completely full.
5. After filling the system to the full, pull out the filling hose and check to see if air trapped in the system is dislodged and the coolant level goes down. Should the coolant level go down, repeat topping-up until there is no more drop in the coolant level.
6. After directly filling the radiator, fill the reservoir to the maximum level.
7. Install and tighten radiator cap and start the engine. After idling for 2 to 3 minutes, stop the engine and reopen radiator cap. If the water level is lower, replenish.

   WARNING:

   When the coolant is heated to a high temperature, be sure not to loosen or remove the radiator cap. Otherwise you might get scalded by hot vapor or boiling water. To open the radiator cap, put a piece of thick cloth on the cap and loosen the cap slowly to reduce the pressure when the coolant has become cooler.

8. After tightening radiator cap, warm up the engine at about 2,000 rpm.

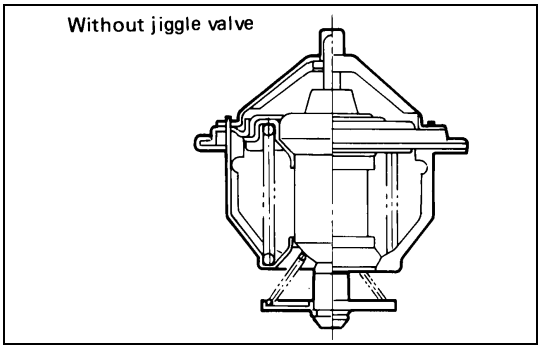
   Set heater adjustment to the highest temperature position, and let the coolant circulate also into heater water system.
9. Check to see the thermostat has opened through the needle position of water thermometer, conduct a 5-minute idling again and stop the engine.
10. When the engine has been cooled, check filler neck for water level and replenish if required. Should extreme shortage of coolant is found, check the coolant system and reservoir tank hose for leakage.
11. Fill the coolant into the reservoir tank up to “MAX” line.



6B-3-1.tif

WATER PUMP

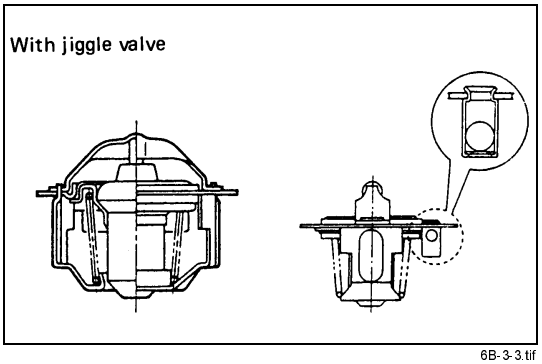
The coolant pump is a centrifugal impeller type and is driven by V type drive belt.



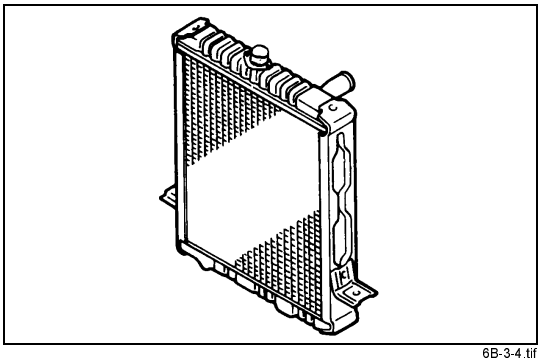
6B-3-2.tif

THERMOSTAT

The thermostat is a wax pellet type with a jiggle valve and is installed in the outlet pipe.



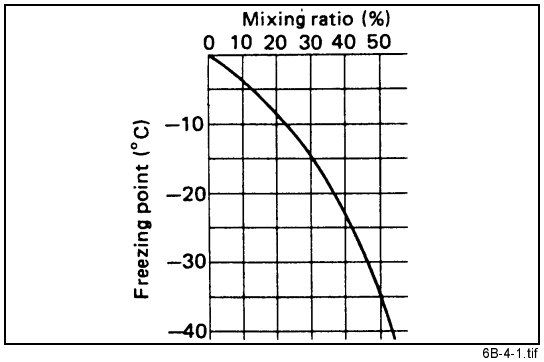
6B-3-3.tif



6B-3-4.tif

RADIATOR

The radiator is a tube type with corrugated fins. In order to raise the boiling point of coolant, the radiator is adjusted through a valve fitted to the upper tank to a pressure range of 93 - 123 kPa (0.95 - 1.25 kg/cm^2). The cap fitted to the cylinder head thermostat housing has only a water supply function.



6B-4-1.tif

ANTI-FREEZE SOLUTION

- Relation between Mixing ratio and Freezing point
  Freezing temperature of the engine coolant varies with the ratio of anti-freeze solution in water.
  Proper mixing ratio can be determined by referring to the chart. Supplemental inhibitors or additives claiming to increase cooling capability that have not been specifically approved by Isuzu are not recommended for addition to the cooling system.
- Calculation of mixing ratio
  Mixing ratio

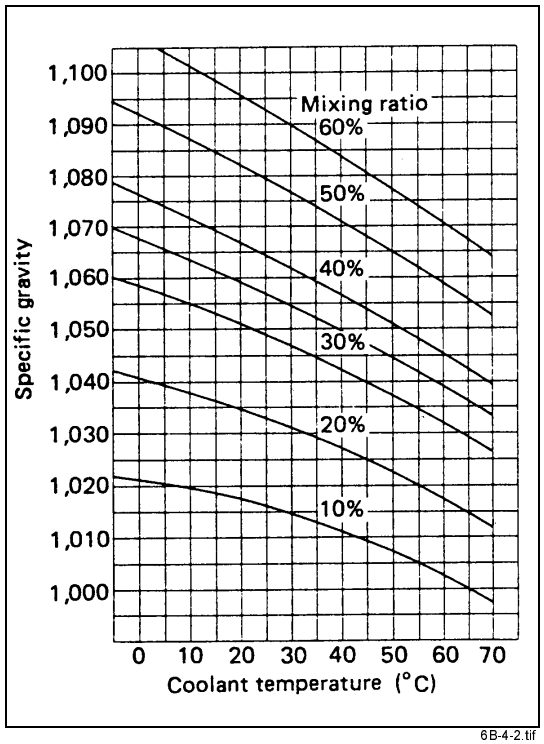
$$= \frac{\text{Anti-freeze solution (Lit/qt.)}}{\text{Anti-freeze solution (Lit/qt.)} + \text{water (Lit/qt.)}}$$

Note:

Anti-freeze solution + Water = 12 lit
Total cooling system capacity.

In case of 6.8 lit total cooling system capacity

Mixing ratio(%)	Anti-freeze solution: lit.(imp.qt./U.S.qt)	Water: lit. (imp.qt/U.S. qt)
0	0 0	6.8 (5.98/7.19)
5	0.3 (0.26/0.32)	6.5 (5.71/6.87)
10	0.7 (0.62/0.74)	6.0 (5.28/6.34)
15	1.0 (0.88/0.93)	5.8 (5.1/6.13)
20	1.4 (1.23/1.48)	5.4 (4.75/5.7)
25	1.7 (1.50/1.80)	5.1 (4.49/5.39)
30	2.0 (1.76/1.86)	4.8 (4.22/5.04)
35	2.4 (2.11/2.23)	4.4 (3.87/4.65)
40	2.7 (2.38/2.85)	4.1 (3.6/4.33)
45	3.1 (2.72/2.87)	3.7 (3.26/3.91)
50	3.4 (2.99/3.60)	3.4 (2.99/3.60)

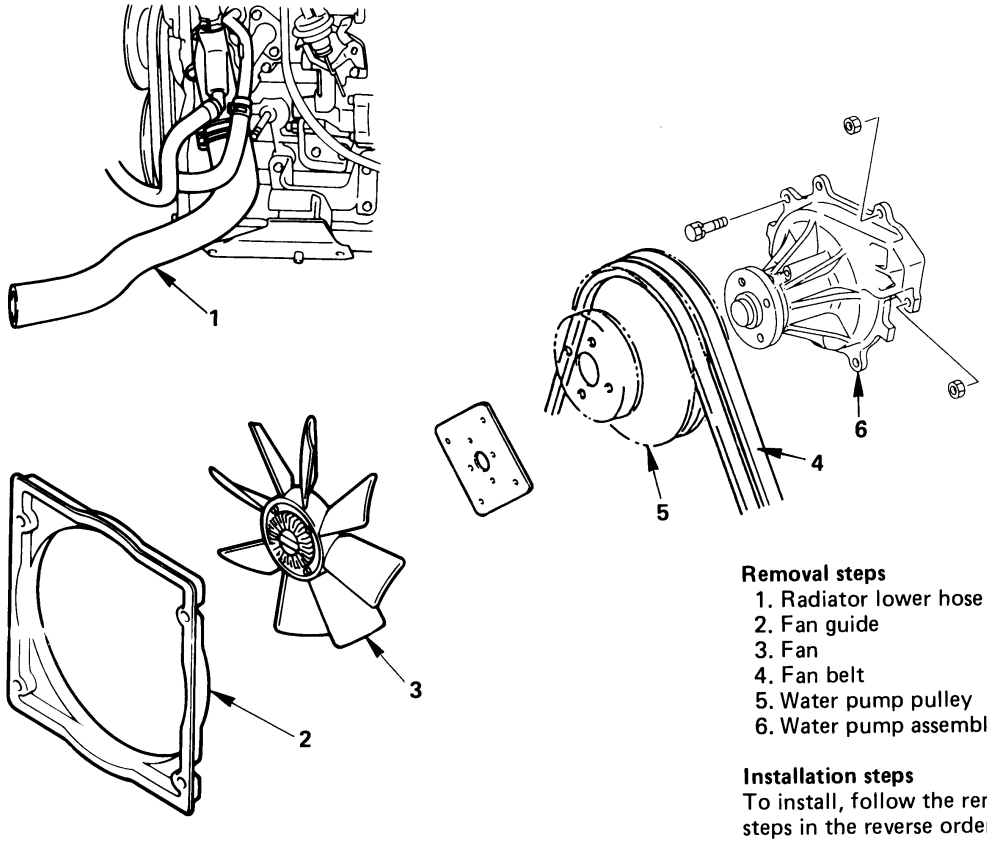


6B-4-2.tif

- Mixing ratio
  Check the specific gravity of engine coolant in the cooling system in temperature ranges from 0°C to 50°C using a suction type hydrometer, then determine the mixing ratio of the coolant by refering to the table at left.

ON-VEHICLE SERVICE

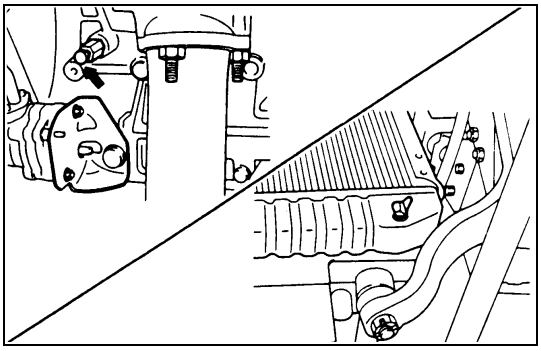
WATER PUMP



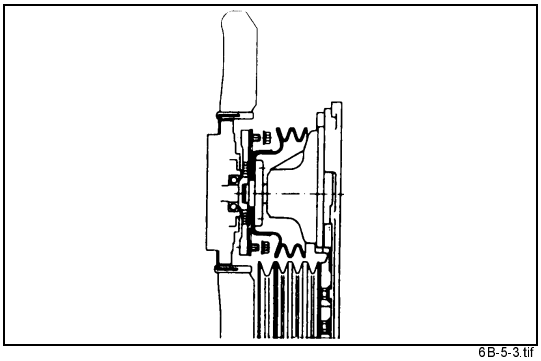
Removal steps
1. Radiator lower hose
2. Fan guide
3. Fan
4. Fan belt
5. Water pump pulley
6. Water pump assembly

Installation steps
To install, follow the removal steps in the reverse order.

6B-5-1.tif



6B-5-2.tif



6B-5-3.tif

REMOVAL

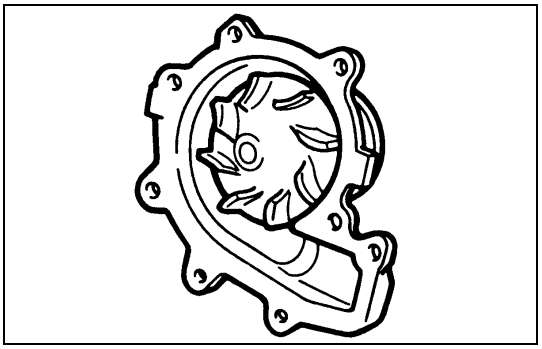
Preparation

- Disconnect battery ground cable.
- Drain coolant.
- Tilt the cab.

1. **Radiator Lower Hose**
   Disconnect radiator Lower hose from radiator.
2. **Fan Guide**
3. **Fan**
4. **Fan Belt**
5. **Water Pump Pulley**
6. **Water Pump Assembly**

INSPECTION

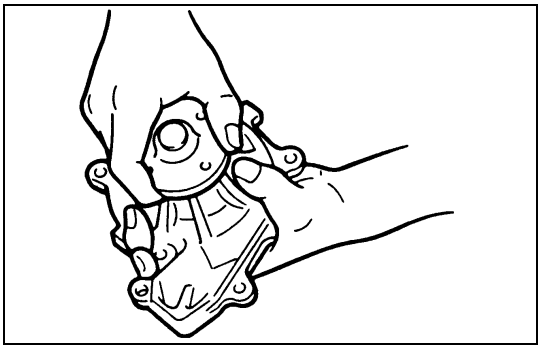
Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.



6B-6-1.tif

Water Pump Assembly

1) Check the pump body for crack and damage.
2) Check the impeller for crack and corrosion.
3) Check the seal unit leakage.
4) If there is any abnormal condition, replace the water pump as an assembly.

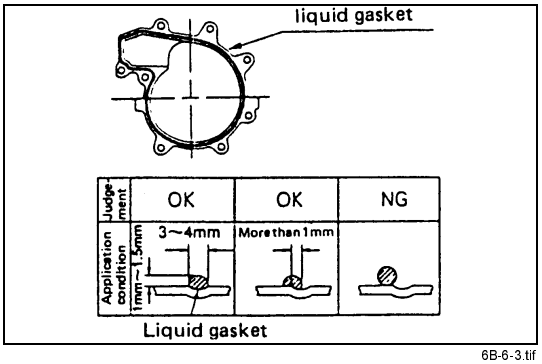


6B-6-2.tif

Bearing Unit

1) Rotate the fan center while pushing it toward the radius, and check to see if there is any excessive play or noise.
2) When there is any excessive play or noise found, replace it as a water pump assembly.

INSTALLATION



6B-6-3.tif

6. Water Pump Assembly

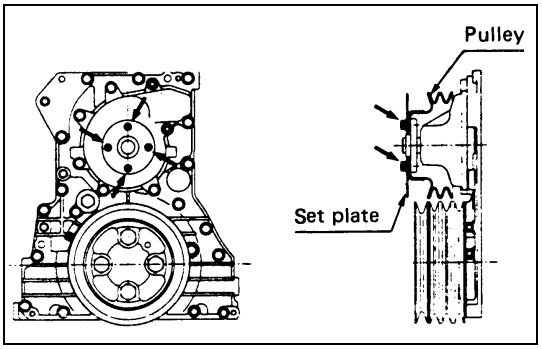
1) Apply 3mm-4mm bead of the recommended liquid gasket (Three Bond 1207C) or its equivalent on the water pump fitting surface.
2) Install the water pump to the front retainer.

Water Pump Bolt Torque	N·m (kg·m/lb·ft)
24 (2.4/17)	

- Install the water pump within 7 minutes after application of liquid gasket.
- For the dislocation of liquid gasket, refer to the illustration.

CAUTION:

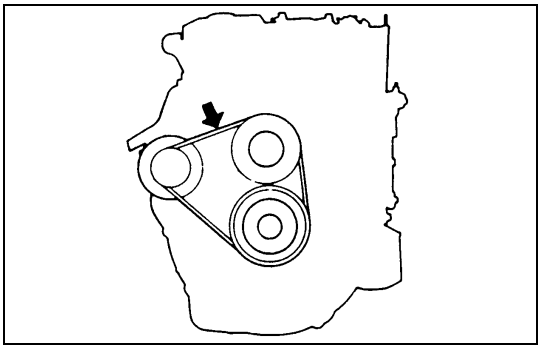
The water pump clamping bolt is also used to tighten the front retainer. So, install the water pump before liquid gasket gets dry immediately after installation of the front retainer.



6B-7-1.tif

5. Water Pump Pulley

Water Pump Pulley Bolt Torque	N·m (kg·m/lb·ft)
24 (2.4/17)	


6B-7-2.tif

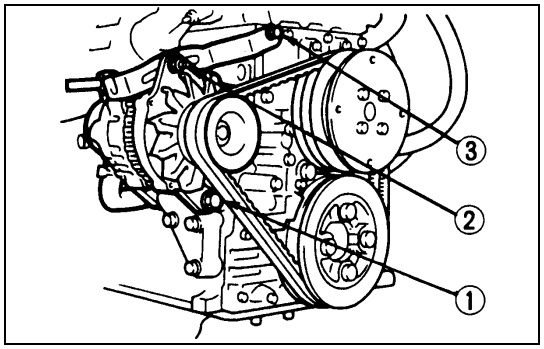
4. Fan Belt

Check the drive belt tension.

Depress the drive belt mid-portion with a 10kg (22lb/98N) force.

Drive Belt Deflection	mm (in)
8 - 12 (0.31 - 0.47) … New belt 10 - 14 (0.39 - 0.55) … Reuse belt	

Check the drive belt for cranking and other damage.



6B-7-3.tif

Fan Belt Adjustment

Fan belt tension is adjusted by moving the generator.

Torque	N·m (kg·m/lb·ft)
①	40 (4.1/30)
②	24 (2.4/17)
③	46 (4.7/34)

3. Fan

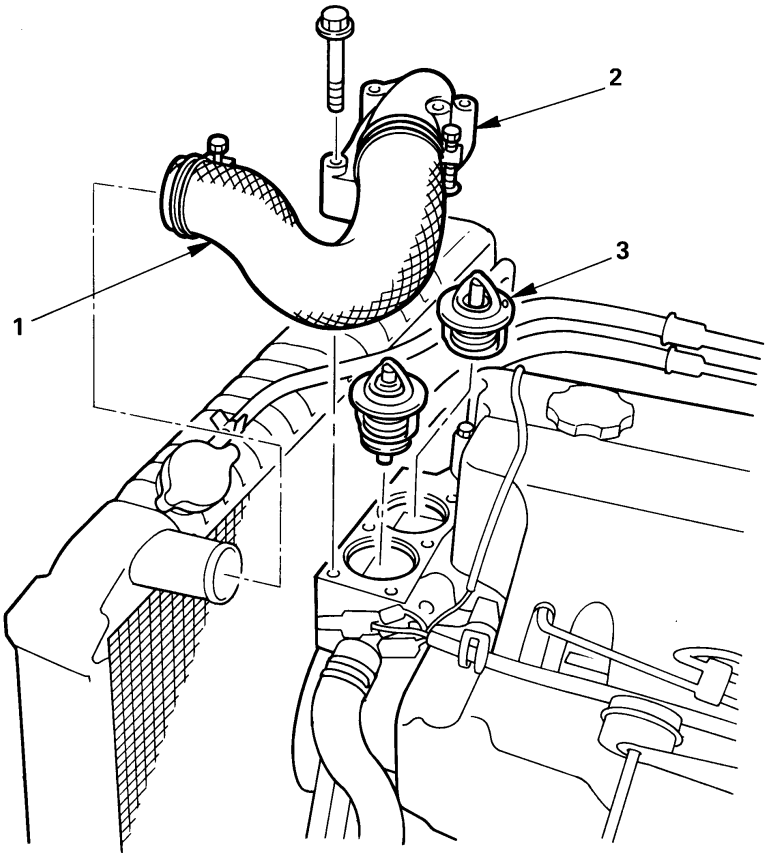
Fan Bolt Torque	N·m (kg·m/lb·ft)
24 (2.4/17)	

2. Fan Guide

1. Radiator Lower Hose

- Pour coolant into radiator.
- Connect battery ground cable.
- Start engine and check for water leakage carefully.

THERMOSTAT



Removal steps
1. Radiator upper hose
2. Water outlet pipe
3. Thermostat

Installation steps
To install, follow the removal steps in the reverse order.

6B-8-1.tif

REMOVAL

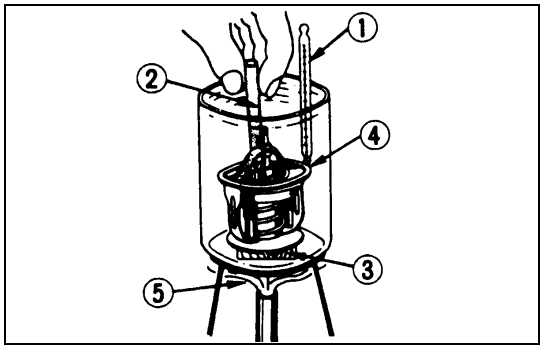
Preparation

- Disconnect battery ground cable
- Drain coolant

1. **Radiator Upper Hose**
   Disconnect radiator upper hose from radiator.
2. **Water Outlet Pipe**
   Remove mounting bolt and remove outlet pipe together with radiator upper hose.
3. **Thermostat**

INSPECTION

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.



6B-9-1.tif

Operating Test

1) Completely submerge the thermostat in water.
2) Heat the water.
   Stir the water constantly to avoid direct heat being applied to the thermostat.
3) Check the valve initial opening temperature.

Valve Initial Opening Temperature °C (°F)

		Standard
without jiggle valve	Primary valve	80-84(176-183)
	Secondary valve	83-87(181-189)
with jiggle valve		83.5-86.5(182-188)

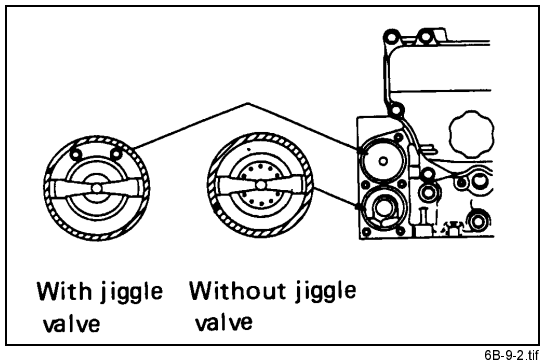
4) Check the valve lift full opening temperature.

Valve Lift Full Opening Temperature °C (°F)

	Standard
without jiggle valve	95 (203)
with jiggle valve	100 (212)

① Thermometer
② Agitating rod
③ Wooden piece
④ Thermostat
⑤ Heat

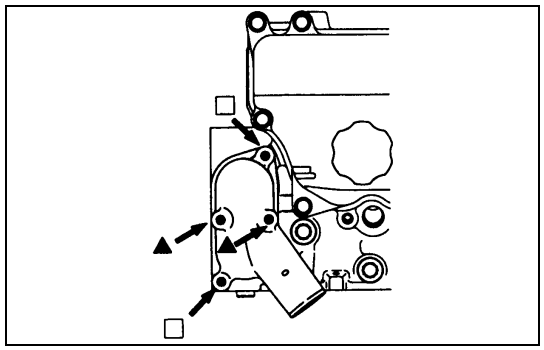
INSTALLATION



6B-9-2.tif

3. Thermostat

Install the gaskets to the thermostats and the thermostats to the cylinder head as shown in the illustration.


6B-9-3.tif

2. Water Outlet Pipe

Install the water outlet pipe with thermostat to the cylinder head.

Tighten the water outlet pipe bolts to the specified torque.

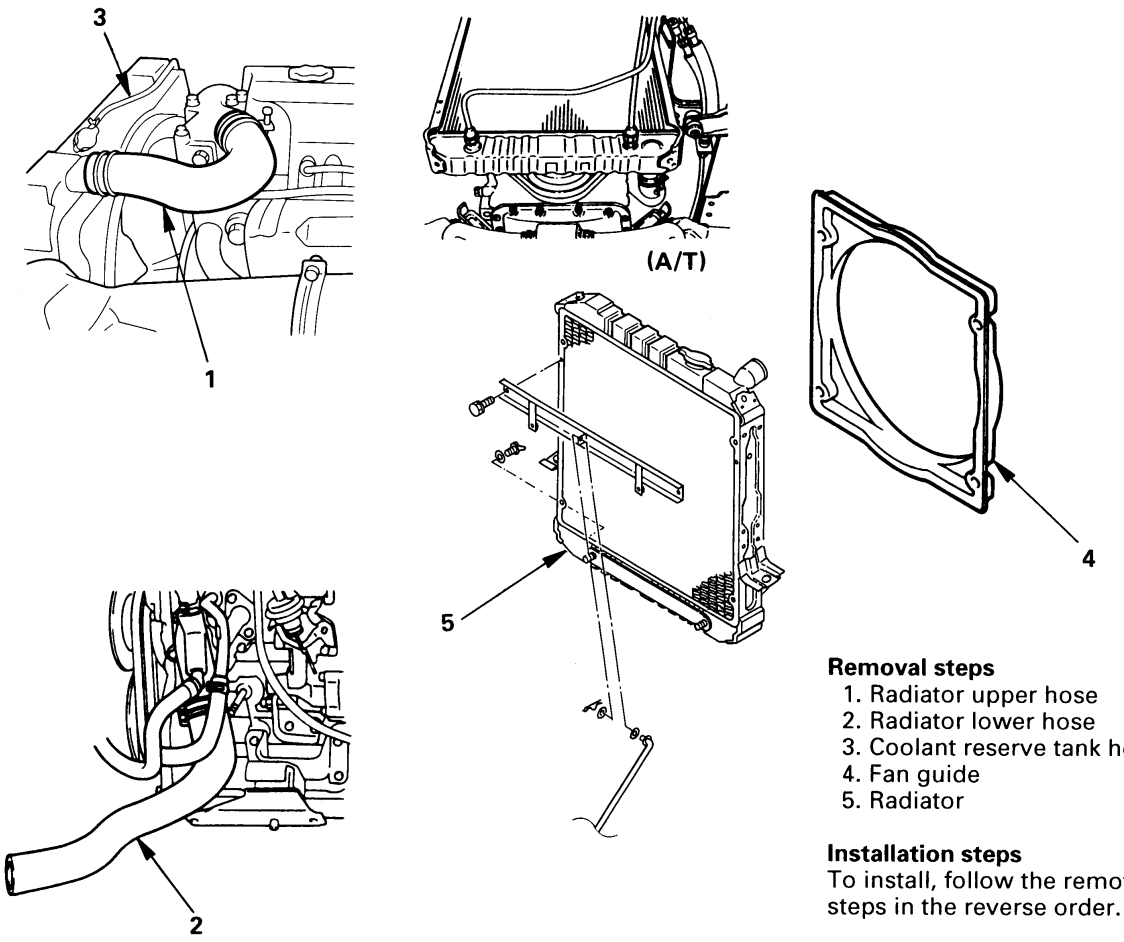
Water Outlet Pipe Bolt Torque N·m (kg·m/lb·ft)

24(2.4/17)

1. Radiator Upper

- Connect battery ground cable.
- Pour coolant
- Start the engine and check coolant leakage.

RADIATOR

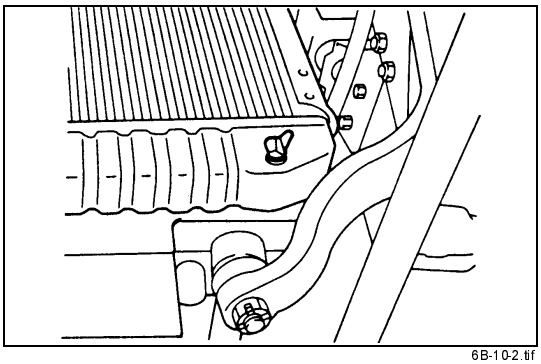


Removal steps
1. Radiator upper hose
2. Radiator lower hose
3. Coolant reserve tank hose
4. Fan guide
5. Radiator

Installation steps
To install, follow the removal steps in the reverse order.

6B-10-1.tif

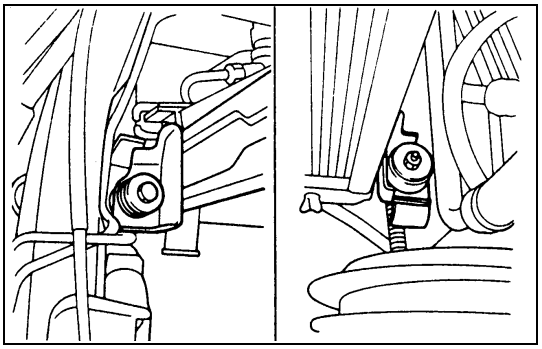
REMOVAL



6B-10-2.tif

- Disconnect battery ground cable.
- Tilt the cab.
- Loosen drain plug to drain coolant.

1. **Radiator Upper Hose**
2. **Radiator Lower Hose**
   Disconnect upper hose and lower hose from the radiator.
3. **Coolant Reserve Tank Hose**


6B-11-1.tif

4. **Fan Guide**
5. **Radiator**
   1) Remove upward the radiator assembly with hose, taking care not to damage the radiator core by fan blade.
   2) For the A/T model vehicle, remove the oil cooler pipe.

INSPECTION

Radiator Valve Check

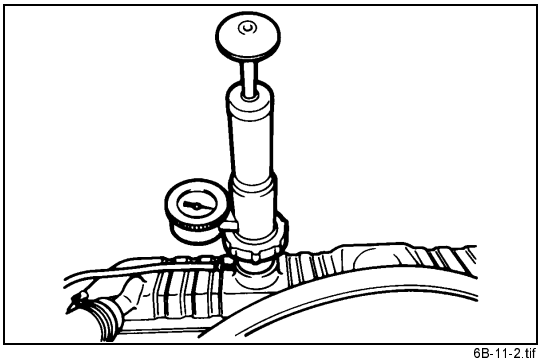
1) Apply air pressure from filler neck using radiator cap tester and check the opening pressure of radiator valve. If the valve opening pressure is out of the standard value range, replace with a new radiator valve.

Radiator Valve Opening Pressure	kPa^2 (kg/cm^2/psi)
	93 - 123 (0.95 - 1.25/13.5 - 17.8)

2) Remove the radiator valve and check a negative pressure valve as the center of the valve seat side. If the negative pressure valve does not work smoothly, clean or replace the radiator valve.

Radiator Valve Fixing Torque	N·m (kg·m/lb ft)
	6 (0.6/4)

3) Conduct cooling system leakage check after reinstalling the radiator valve.


6B-11-2.tif

Cooling System Leakage Check

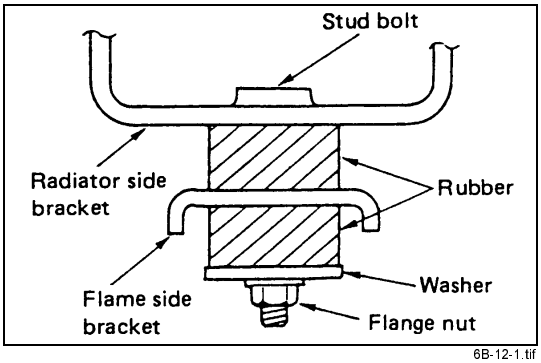
1) Clog up the reserver tank hose carefully and check the cooling system for leakage with a radiator cap tester by applying an air pressure of 196 kPa (2 kg/cm^2/28 psi) from filler neck to inside the radiator.
2) As the radiator upper tank is provided with a valve, the pressure fails to rise higher than the valve opening pressure unless the hose is clogged up.

Radiator Core

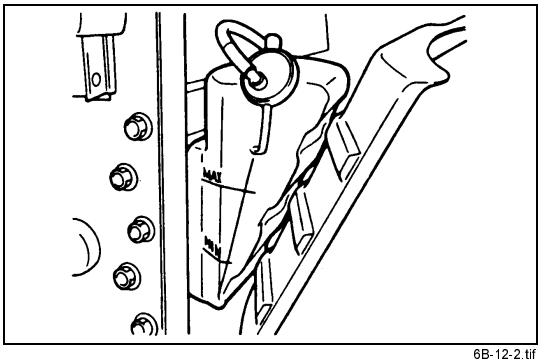
1) Deformed radiator fins could reduce radiation effects, resulting in overheat. Straighten the fins. In such a case, take care not to damage the fin roots.
2) Remove dust and other foreign materials.

Flushing the Radiator

Wash the inside of radiator and the coolant passage with water and neutral detergent. Remove all scales and rust.



6B-12-1.tif



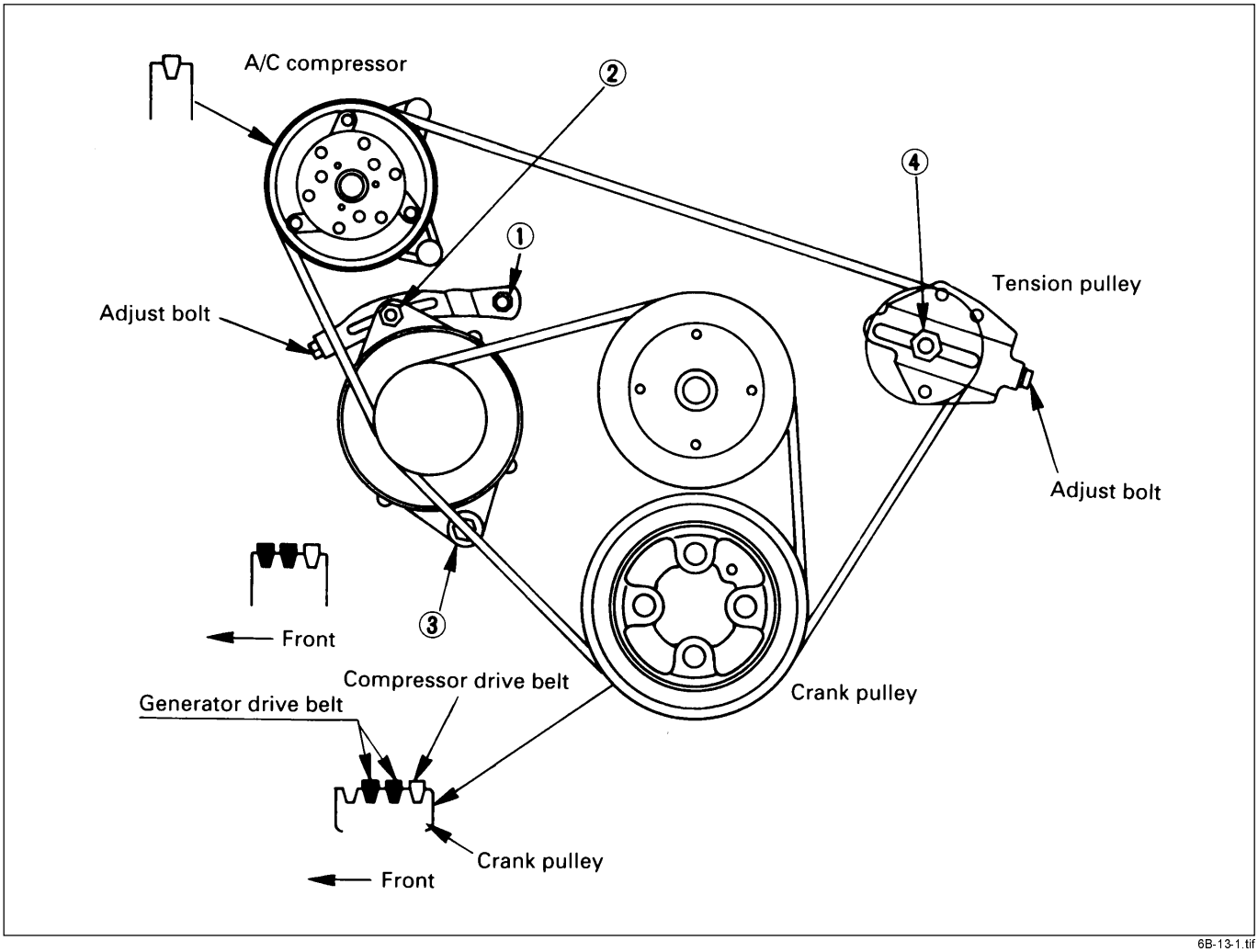
6B-12-2.tif

INSTALLATION

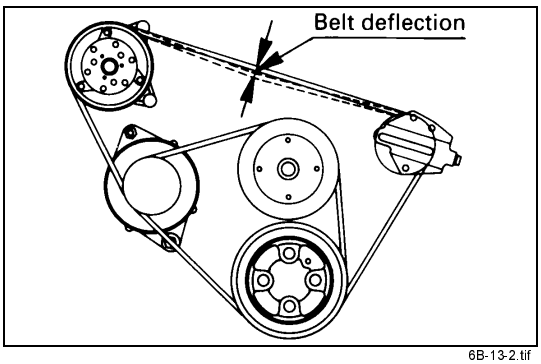
5. **Radiator**

   With due attention paid not to damage the radiator core by the fan blades, install the both brackets of the radiator to the brackets on the frame as shown in the illustration.
4. **Fan Guide**
3. **Coolant Reserve Tank Hose**
2. **Radiator Lower Hose**
1. **Radiator Upper Hose**
   - Connect battery ground cable.
   - Pour coolant
   - Pour coolant up to filler neck of outlet pipe, and up to MAX mark of reserve tank.
   - Start engine to warm up, and check for coolant level. Replenish coolant if it does not reach the outlet pipe filler neck, and tighten the cap completely.

DRIVE BELT ADJUSTMENT



6B-13-1.tif



6B-13-2.tif

INSPECTION

Check drive belts for wear or damage, and replace with new ones as necessary. Check belts for tension, and adjust as necessary.

1) Check drive belts tension
2) Push the middle of belts with a force of 98N (10kg/22 lb) and check each belt for deflection.
3) Standard deflection

Fan Drive Belt Deflection	mm (in)
8 - 12 (0.31 - 0.47)	... New belt
10 - 14 (0.39 - 0.55)	... Reuse belt

A/C Drive Belt Deflection	mm (in)
16 - 20 (0.63 - 0.79)	... New belt
18 - 22 (0.71 - 0.87)	... Reuse belt

TENSION ADJUSTMENT

(Refer to the illustration on the previous page.)

1. Generator & Water Pump Pulley Drive Belt

1) Loosen the Air Conditioining (A/C) drive belt tension pulley adjust bolt and lock nut ④. Then free the A/C drive belt.
2) Loosen the adjust plate lock nut ② , the fixing bolt ① , and the fixing bolts ③ on the lower side of the generator.
3) Rotate the adjust bolt to adjust the belt.
4) After adjustment, tighten each section to the specified torque.

Torque	N·m (kg·m/lb·ft)
①	46 (4.7/34)
②	24 (2.4/17)
③	40 (4.1/30)

5) Adjust the A/C drive belt tension.

2. A/C Compressor Drive Belt

1) Loosen the tension pulley lock nut ④, and rotate the adjust bolt to adjust the belt.
   When finishing the fan drive belt adjustment, then adjust the A/C drive belt.
2) After adjustment, tighten the lock nut ④ to the specified torque.

Lock Nut ④ Torque	N·m (kg·m/lb·ft)
27 (2.8/20)	

SECTION 6C
FUEL SYSTEM

CONTENTS

	PAGE
General Description	6C - 2
On-Vehicle Service	6C - 8
Fuel Filter Assembly (Except 4HF1-2 model)	6C - 8
Fuel Filter Assembly (4HF1-2 model only)	6C - 12
Injection Nozzle Assembly	6C - 14
Injection Pump Assembly (Except 4HF1-2 model)	6C - 33
Injection Pump Assembly (4HF1-2 model only)	6C - 39
Injection Timing Adjustment	6C - 44
Injection Pump Data	6C - 48
Aneroid Compensator Adjustment	6C - 75
Fuel Tank	6C - 76
Fuel Gauge Unit	6C - 78
Accelerator Control	6C - 79
Accelerator Control Cable	6C - 79
Accelerator Pedal	6C - 81
Idling Control Cable	6C - 82
Air Cleaner Element	6C - 84

GENERAL DESCRIPTION

When working on the fuel system, there are several things to keep in mind:

- Any time the fuel system is being worked on, disconnect the negative battery cable except for those tests where battery voltage is required.
- Always keep a dry chemical (Class B) fire extinguisher near the work area.
- Replace all pipes with the same pipe and fittings that were removed.

  Clean and inspect “O” rings. Replace where required.
- Always relieve the line pressure before servicing any fuel system components.
- Do not attempt repairs on the fuel system until you have read the instructions and checked the pictures relating to that repair.

DESCRIPTION

Fuel Filters

The Purpose of the fuel filters is to clean the fuel of any dirt particles that can cause wear on the fuel injection nozzle’s sliding surface; and to separate any water from the fuel, which is ever-present from the condensation in the fuel tank. The pre-fuel filter (water separator) is located between the fuel tank and the injection pump. The secondary fuel filter is located between the fuel pump and the injection pump.

Pre-Fuel Filter

When the condensed water in the pre-fuel filter (water separator) comes to the warning level indicated on its plastic body, drain the fluid immediately from the drain plug located bottom of water separator.

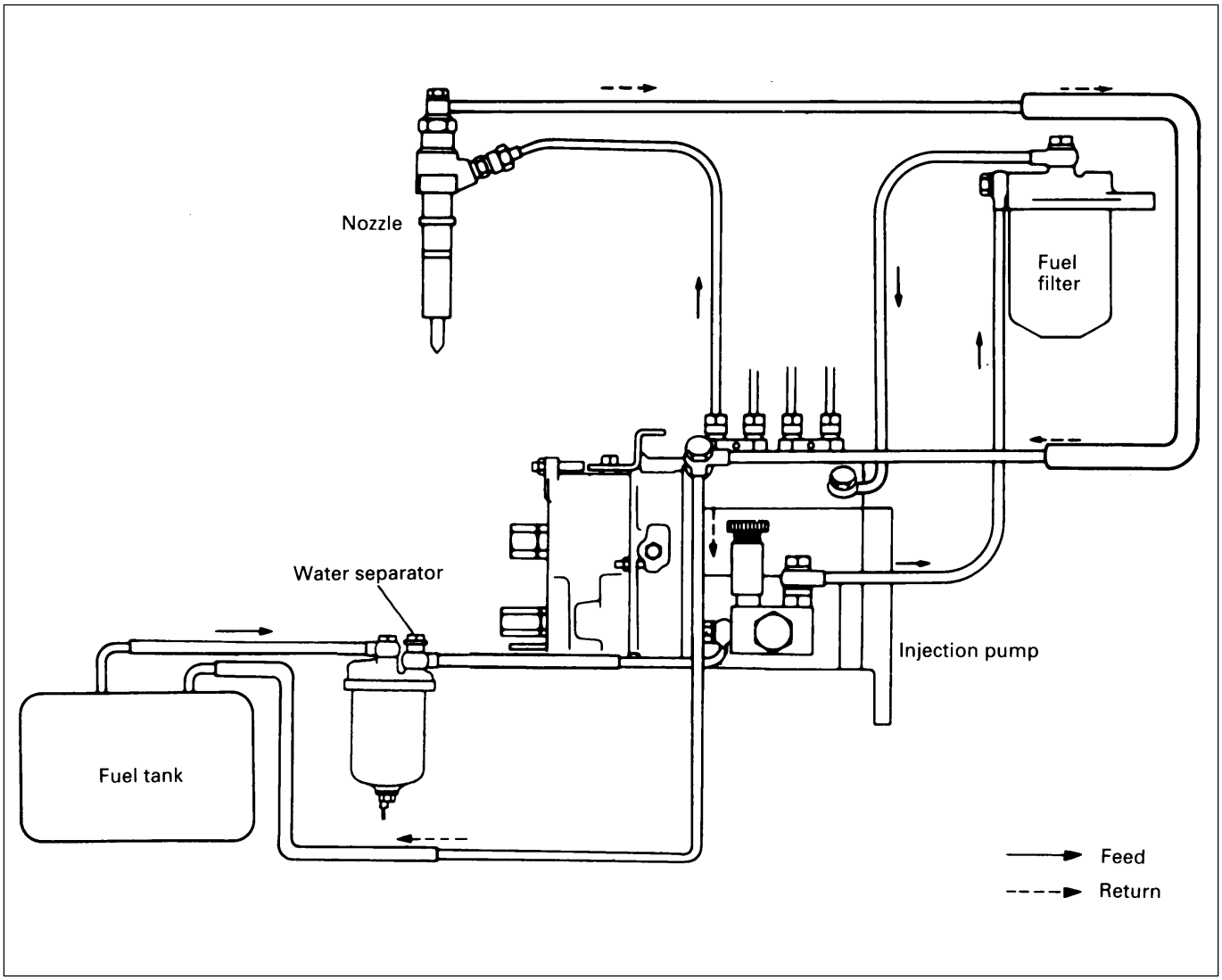
Injection Pump

The fuel injection system includes a fuel tank, fuel hoses and lines, a fuel/water separator, fuel filters, a fuel pump, a Bosch-type in-line fuel injection pump with an internal governor, delivery valves, fuel injection lines and for fuel injection nozzles.

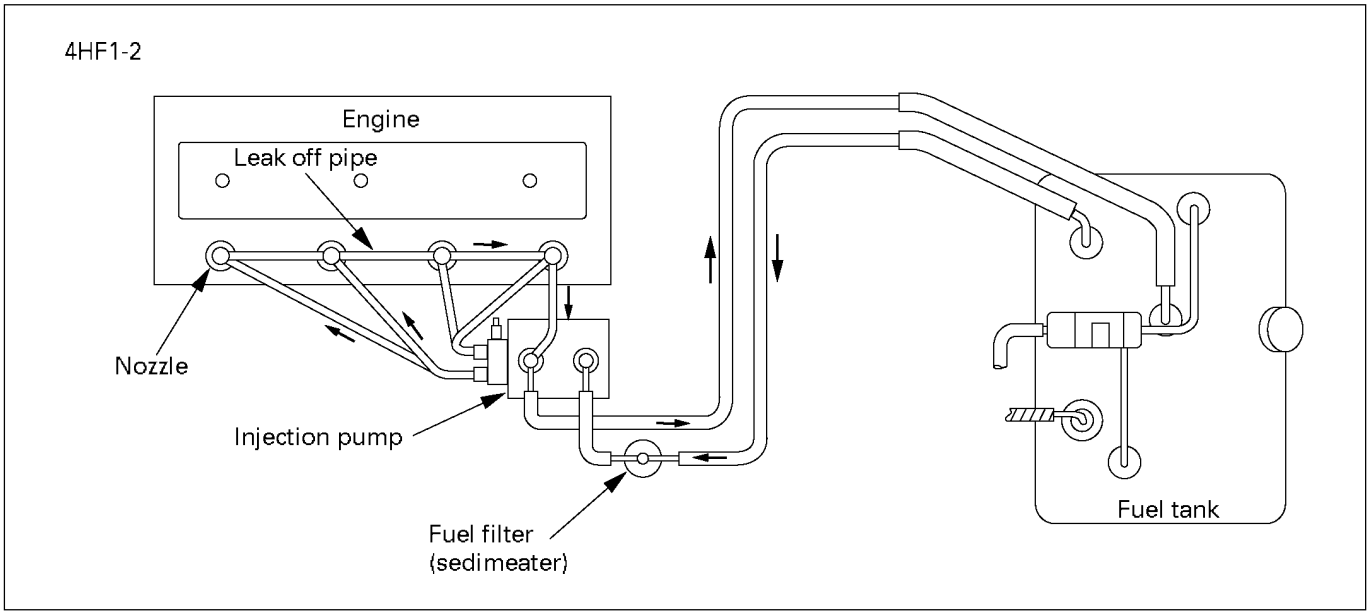
The fuel pump, injection pump and the nozzle are manufactured by ZEXEL corporation, but serviced by Bosch.

Remove the injection pump and governor assembly as a unit to have it services. Do not open or break any seals on the pump or the warranty is void. The injection pump has an identification plate attached to the pump body.

FUEL FLOW



6C-3-1.tif

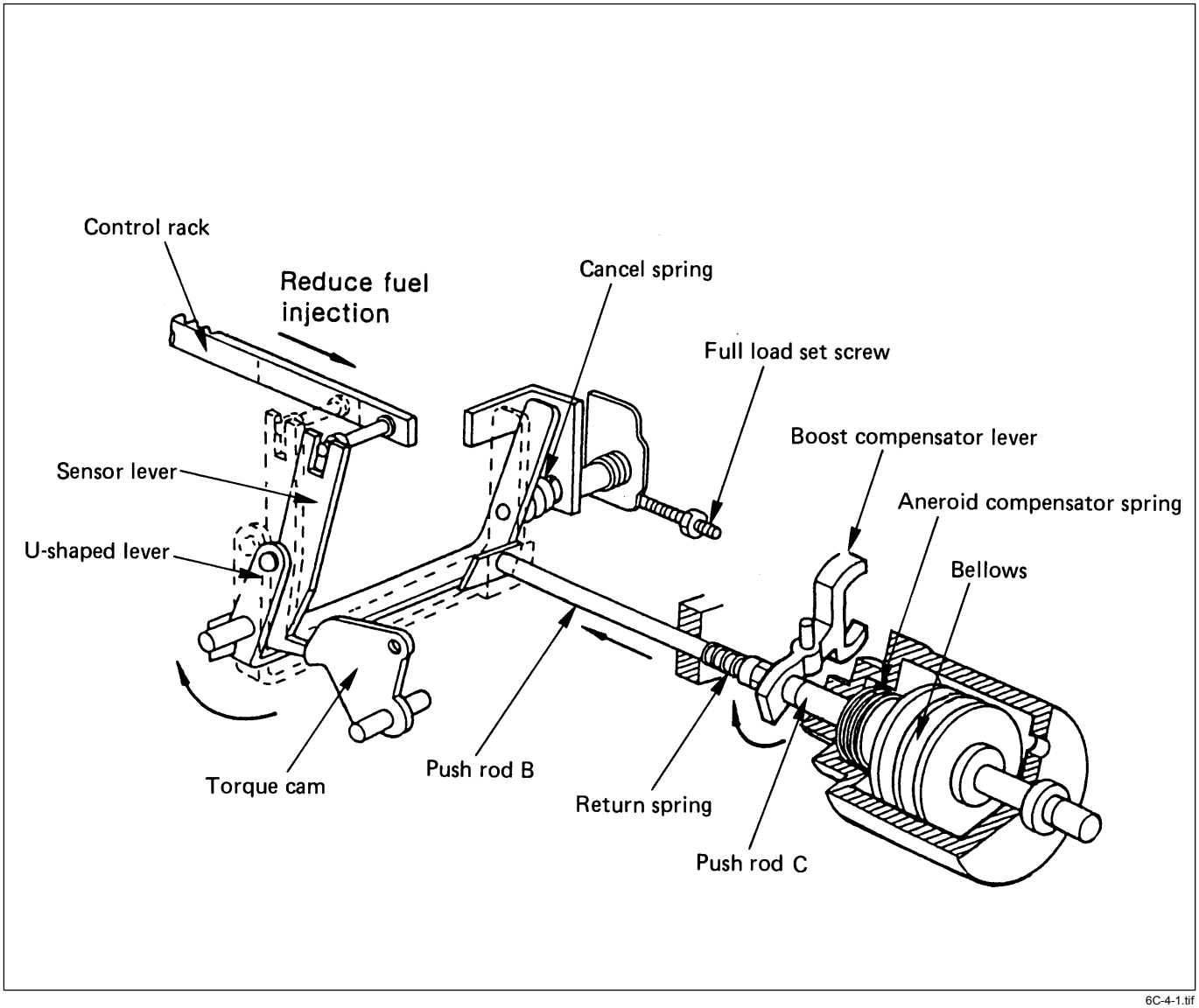


040LX005.tif

Aneroid Compensator Function

The bellows in the aneroid compensator is provided with an initial set force by the aneroid compensator spring (10) and is compressed by the push rod C (11). As the atmospheric pressure drops, the bellows (9) begins to expand against the force of the aneroid compensator spring (10), which in turn causes the push rod B (13), through the push rod C (11) and the boost compensator lever (12)F, to move to the left.

Then the push rod B (13) comes into contact with the U-shaped lever (16) and, as the expanding bellows over come the force of the cancel spring installed on the U-shaped lever (16), causes the U-shaped lever to turn clockwise. Because the bottom of the sensor lever (15) is in touch with the torque cam (51), the torque cam (51) then works as a pivot on which the top of the sensor lever (15) moves to the right together with the U-shaped lever (16). At the same time, the control rack (19), which is hooked on the sensor lever (15), moves toward the governor to reduce fuel injection.



6C-4-1.tif

BRIEF EXPLANATION OF EMISSION AND ELECTRICAL CONTROL SYSTEM

MITICS (Mechanically Integrated Timing and Injection Control System)

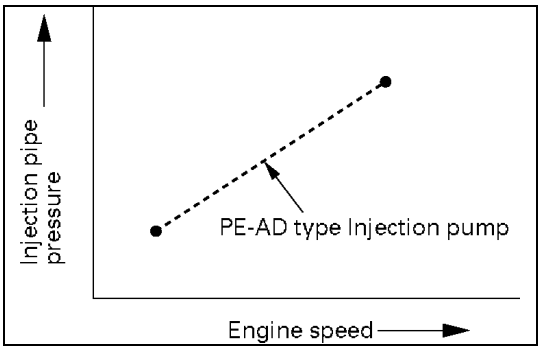
4HE1-TC

The Mechanically Integrated Timing and Injection rate Control System(MITICS) utilizes mechanical control, in comparison with TICS systems, which utilize electronic control.

MITICS is equipped with the RLD-M type governor, which contains a pre-stroke control mechanism. With this, pre-stroke position (ie., beginning of static injection) can be varied to control injection timing and injection rate (i.e., the fuel injection quantity injected from the nozzle per cam angle degree).

This enables high injection rates1 in the low and medium speed ranges through a short injection interval, thus contributing to higher engine torque and cleaner exhaust.

MITICS was developed in response to the demands of medium sized diesel engines for low cost, low fuel consumption, high output and cleaner emissions.

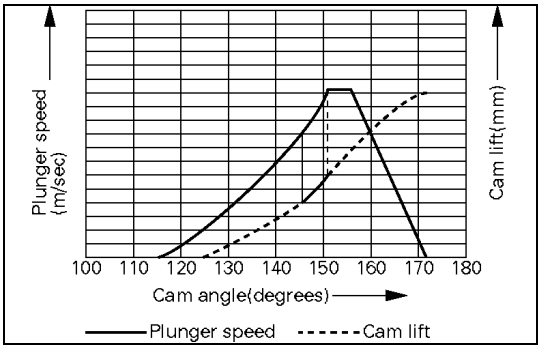


040LW006.tif

High injection rates using a short injection interval.

- The speed at which the injection pump plunger rises slows as engine speed decreases and the pressure inside the injection pipe decreases. Because of this, the nozzle spray deteriorates and makes it impossible to obtain the proper fuel - air mixture.

  To obtain the proper mixture at low and medium speeds, it is necessary to increase the pressure inside the injection pipes using a short injection interval.



040LW007-1.tif

- The left hand figure shows plunger speed and cam lift in relation to cam angle. It can be seen from the graph that plunger speed increases together with cam lift.

  MITICS varies the beginning of injection position at low and medium speeds so that injection occurs when the plunger speed increases during the latter half of cam lift (shown by the bold line). At high speeds, injection is performed when the plunger speed decreases during the first half of cam lift to prevent an excessive increase in injection pipe pressure.

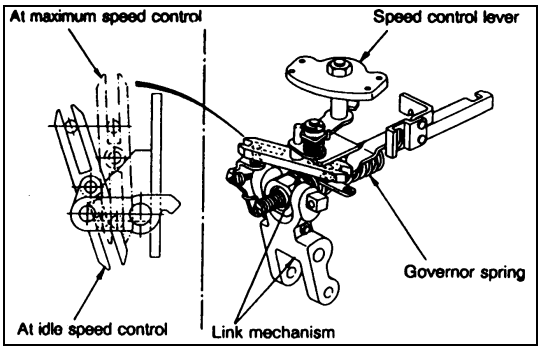
  This enables high pressures at low and medium speeds with a fast plunger speed. Thus, a fine fuel oil spray is injected into the cylinder from the nozzles within a short time to provide the proper mixture for combustion, helping to increase torque and keep exhaust emissions clean.

GOVERNOR (MODEL RLD-M)

4HE1-TC

The RLD-J type governor can be used with the MI, MITICS injection pumps, and was designed to have better control and endurance than the previous RLD type governor.

Although the basic construction is identical to that of the RLD type governor, the RLD-M type is larger to match the applicable pumps' larger size.



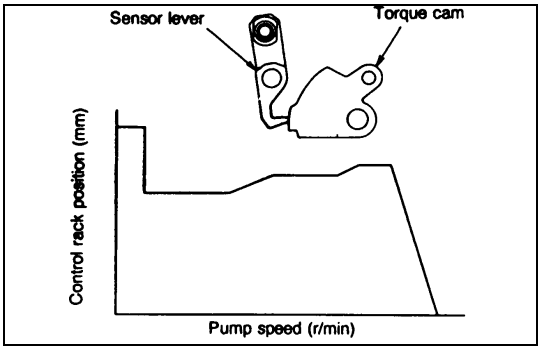
6C-6-1.tif

FEATURES

1. Variable speed control governor with decreased lever reaction force

As with the previous RLD type governor, RLD-M governor control is accomplished using the speed control lever to change the fulcrum of the internal link mechanism.

Consequently, as the reaction force of the governor spring does not act directly on the speed control lever, only a very small lever reaction force is exerted on the accelerator pedal.

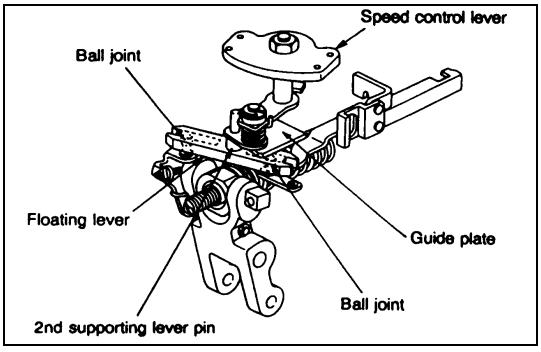


6C-6-2.tif

2. Set torque characteristics through internal torque cam

At full load, the tip of the sensor lever traces the face of the torque cam to determine the full load rack position and control the full load injection quantity.

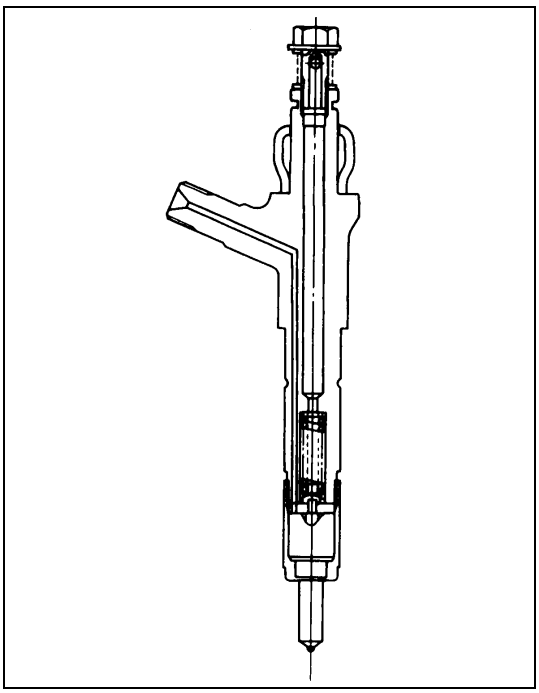
Consequently, the torque characteristics demanded by the engine can be freely set by changing the shape of the torque cam face.



6C-6-3.tif

3. Improved control through internal guide plate

When the speed control lever is operated, the 2nd supporting lever's pin moves along the guide plate. The floating lever connected to the pin thus moves to change the ball joint fulcrum positions. In the intermediate to high speed ranges, the guide plate causes the floating lever to move to increase the lever ratio continuously from 1.1 (idling) - 6 (full speed). This increase in the lever ratio in the intermediate to high speed range improves speed droop.

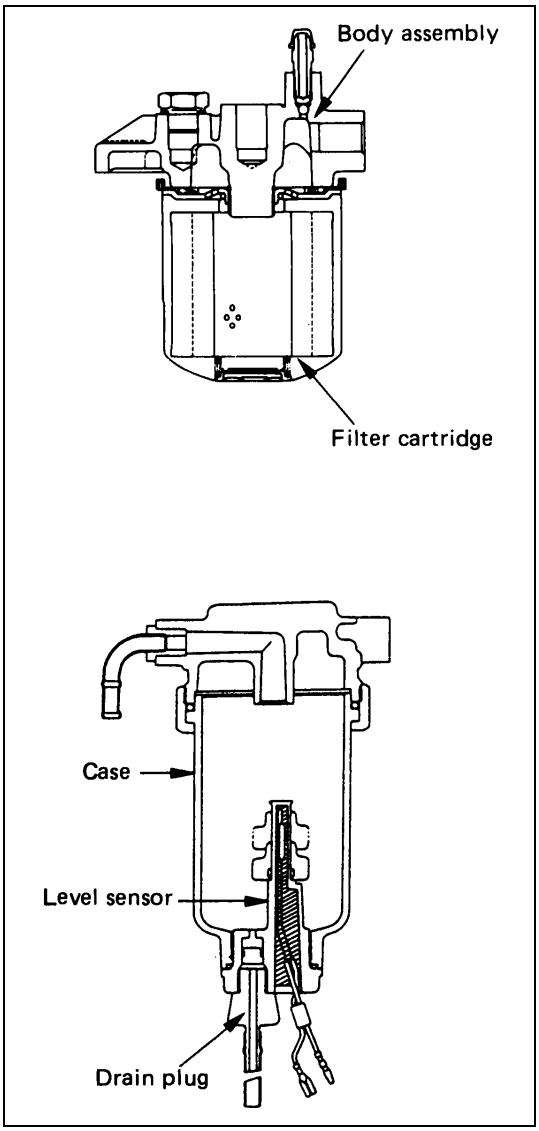


6C-7-1.tif

INJECTION NOZZLE

A Bosch hole type injection nozzle is used. It consists of the nozzle body and the needle valve assembly.

The injection nozzle assembly sprays pressurized fuel from the injection pump into the combustion chamber through the nozzle body injection orifice.



6C-7-2.tif

FUEL FILTER AND WATER SEPARATOR

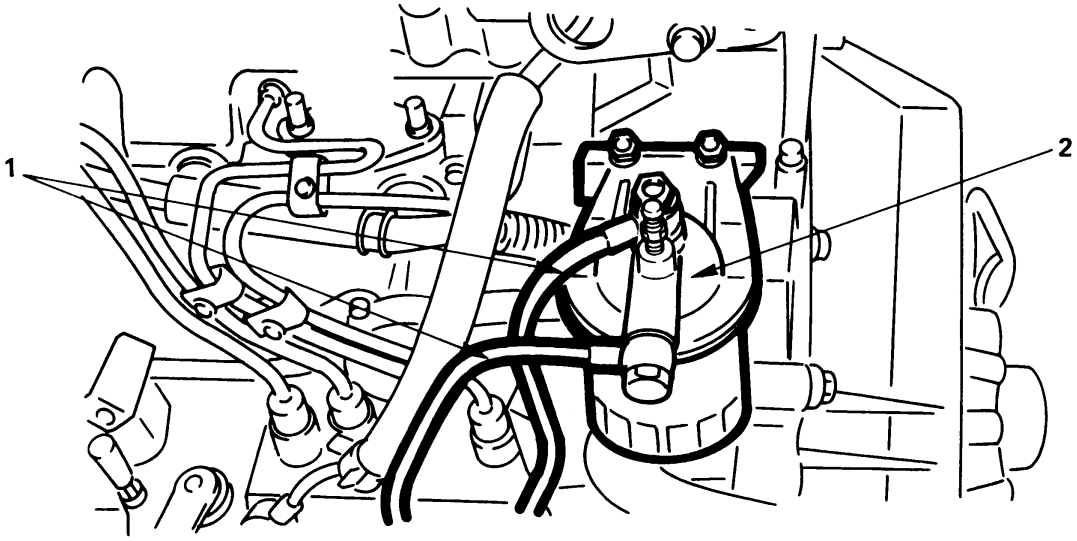
A cartridge type fuel filter and a water separator are used along with the in-line type injection pump.

As the inside of the injection pump is lubricated by the fuel which it is pumping, the fuel must be perfectly clean. The fuel filter and the water separator remove water particles and other foreign material from the fuel before it reaches the injection pump.

The water separator has an internal float. When the float reaches the specified level, a warning light comes on to remind you to drain the water from the separator.

ON-VEHICLE SERVICE

FUEL FILTER ASSEMBLY (Except 4HF1-2 model)



Removal steps
1. Fuel pipe
2. Fuel filter assembly

Installation steps
To install, follow the removal steps in the reverse order.

6C-8-1.tif

REMOVAL

Preparation
- Disconnect battery ground cable.
- Tilt the cab

1. Fuel Pipe

2. Fuel Filter Assembly

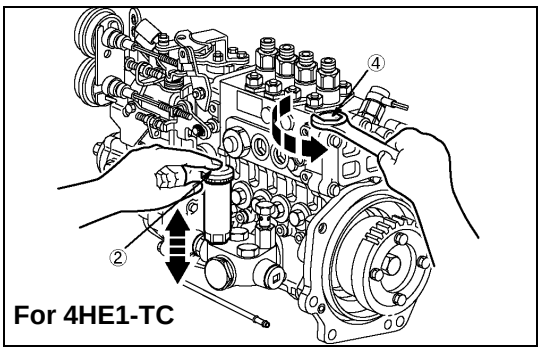
INSTALLATION

2. Fuel Filter Assembly

Fuel Filter Bracket Torque	N·m (kg·m/lb·ft)
	34 (3.5/25)

1. Fuel Pipe

Fuel Pipe Joint Bolt Torque	N·m (kg·m/lb·ft)
	23 (2.4/17)

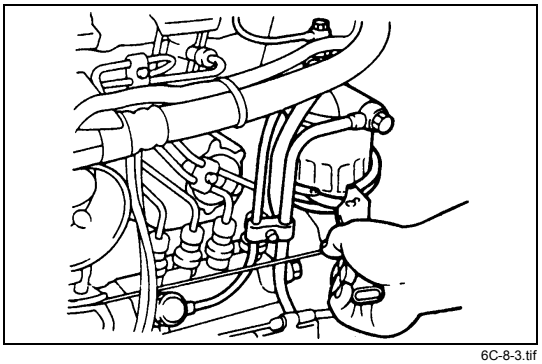


080LW001-1.tif

Air Bleeding

- Loosen the priming pump cap ②.
- Loosen the air bleeding plug; ③.
  (4HG1-T model only)
- Operate the priming pump.
  Pump the primer pump until fuel flow is free of air bubbles.
  (Except 4HG1-T model)
- Tighten the air bleeding plug ③.
  (4HG1-T model only)
- Loosen the bleeding plug ①.
- Operate the priming pump.
  Pump the primer pump until fuel flow is free of air bubbles.
- Tighten the bleeder plug ①.
- Operate the priming pump.
  Pump the primer pump until fuel flow is free of air bubbles.
  (Except 4HE1-TC model)
- Loosen the bleeding plug on the injection pump ④.
  (4HE1-TC model only)
- Operate the priming pump.
  Pump the primer pump until fuel flow is free of air bubbles.
  (4HE1-TC model only)
- Tighten the bleeding plug on the injection pump ④.
  (4HE1-TC model only)
- Lock the priming pump cap ②.

NOTE:
Check for fuel leakage from around the injection pump and the fuel filter.



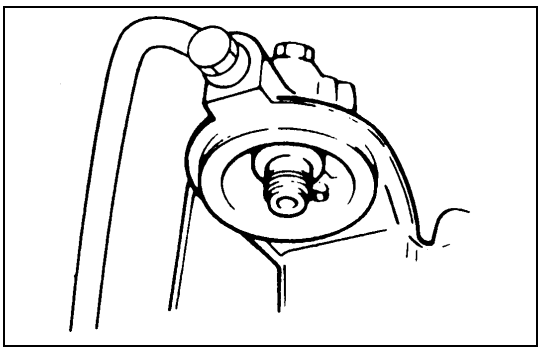
6C-8-3.tif

CARTRIDGE REPLACEMENT

REMOVAL

Replacement Procedure

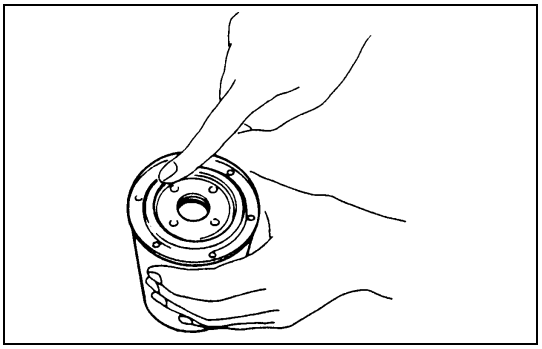
1. Loosen the used fuel filter by turning it counterclockwise with the filter wrench.



6c-8-4.tif

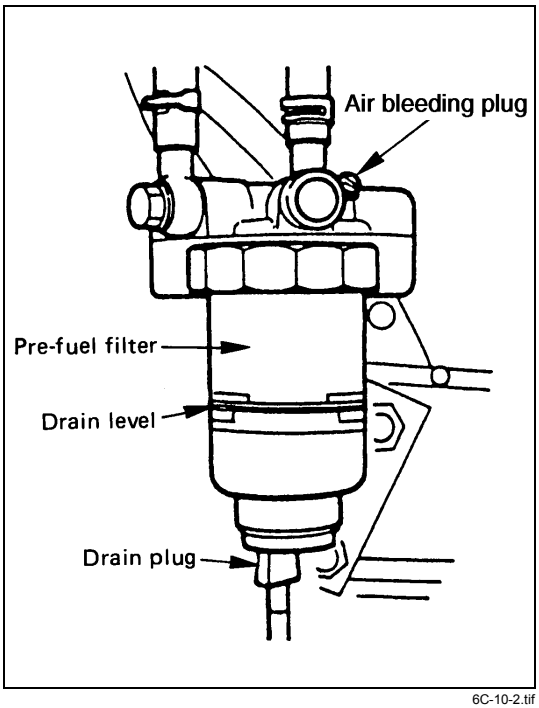
INSTALLATION

1. Clean the upper cover fitting face.
   This will allow the new fuel filter to seat properly.



6C-10-1.tif

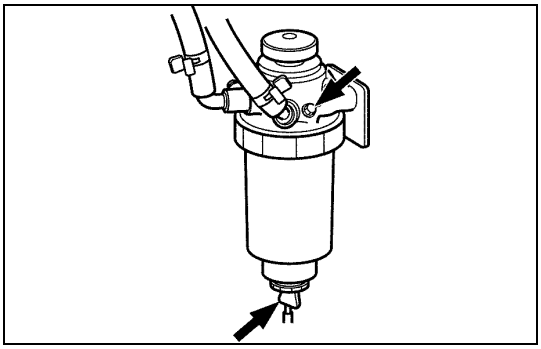
2. Apply a light coat of engine oil to the O-ring.
3. Supply fuel to the new fuel filter to facilitate bleeding.
4. Turn in the new fuel filter until the filter O-ring is fitted against the sealing face.
   Be very careful to avoid fuel spillage.
5. Use the filter wrench to turn in the fuel filter an additional 1/3 to 2/3 of a turn.
6. Operate the priming pump to bleed the air from the fuel line.
   Refer to “FUEL FILTER ASSEMBLY” for more detailed information.
7. Start the engine.
   Crank the engine for ten seconds or until it starts.
   If the engine does not start after ten seconds, repeat Step 6.



6C-10-2.tif

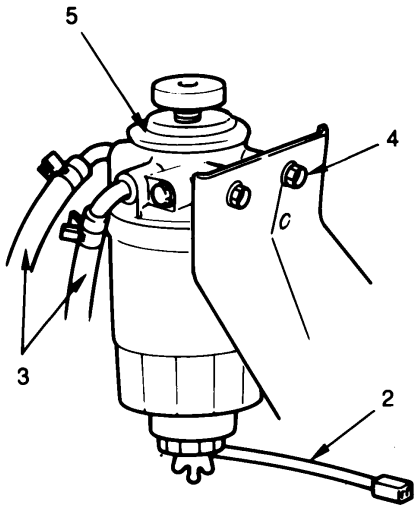
DRAINING THE PRE-FUEL FILTER

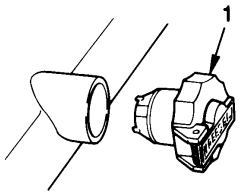
1. Loosen the air bleeding plug and drain plug by turning them counterclockwise.
2. Drain approximately 0.1 liters (3.4 oz) of water.
3. Securely tighten the drain plug.
4. Operate the primer pump on the fuel pump to bleed the fuel system.
5. Tighten the air bleeding plug.
6. Start the engine and check to be sure no fuel is leaking from the drain plug.
7. Make sure that the warning light in the instrument panel is off.
   (Except 4HE1-TC)



041LX001.tif

FUEL FILTER ASSEMBLY (4HF1-2 model only)

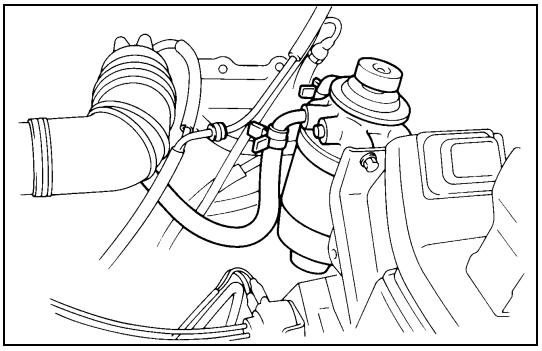




Removal steps
1. Filler cap
2. Lead switch wiring connector
3. Fuel hoses
4. Fuel filter installing bolt
5. Fuel filter assembly

Installation steps
To install, follow the removal steps in the reverse order.

6C-11-1.tif



6C-11-2.tif

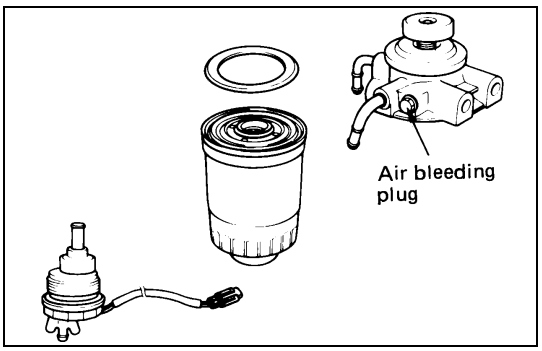
REMOVAL

Preparation
- Disconnect battery ground cable.

1. **Filler cap**
2. **Lead switch wiring connector**
3. **Fuel hose**
   - Draw out inlet and outlet hoses from the fuel filter and cork the hoses to prevent fuel outflow.
4. **Fuel filter installing bolt**
5. **Fuel filter assembly**

INSTALLATION

5. **Fuel filter assembly**
4. **Fuel filter installing bolt**
3. **Fuel hose**
   - Connect the inlet hose and outlet hose.
2. **Lead switch wiring connector**
1. **Filler cap**

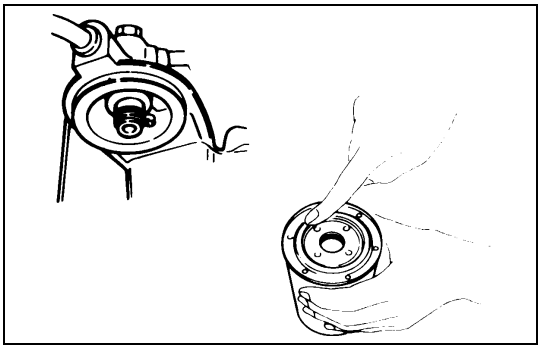


6C-12-1.tif

CARTRIDGE REPLACEMENT

Removal

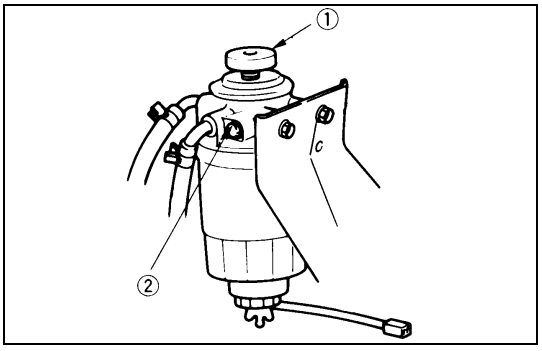
1) Remove the cartridge using a filter wrench.
   Special Tool
   Filter wrench: 5-8840-0253-0
2) Remove the sedimenter/center.



6C-12-2.tif

Reassembly

1) Fit the sedimenter/center in a new cartridge.
2) Clean the cartridge mounting surface of the filter body so that the new cartridge can be seated completely.
3) Apply engine oil thinly to the new cartridge O-ring.
4) Fill the new cartridge with light oil to facilitate air bleeding.
5) Tighten the cartridge until the O-ring comes into contact with the sealing surface. Sufficient care should be taken not to spill the light oil.
   Give 1/3 to 2/3 of a turn using a filter wrench.
   Special Tool
   Filter wrench: 5-8840-0253-0



6C-12-3.tif

Air Bleeding

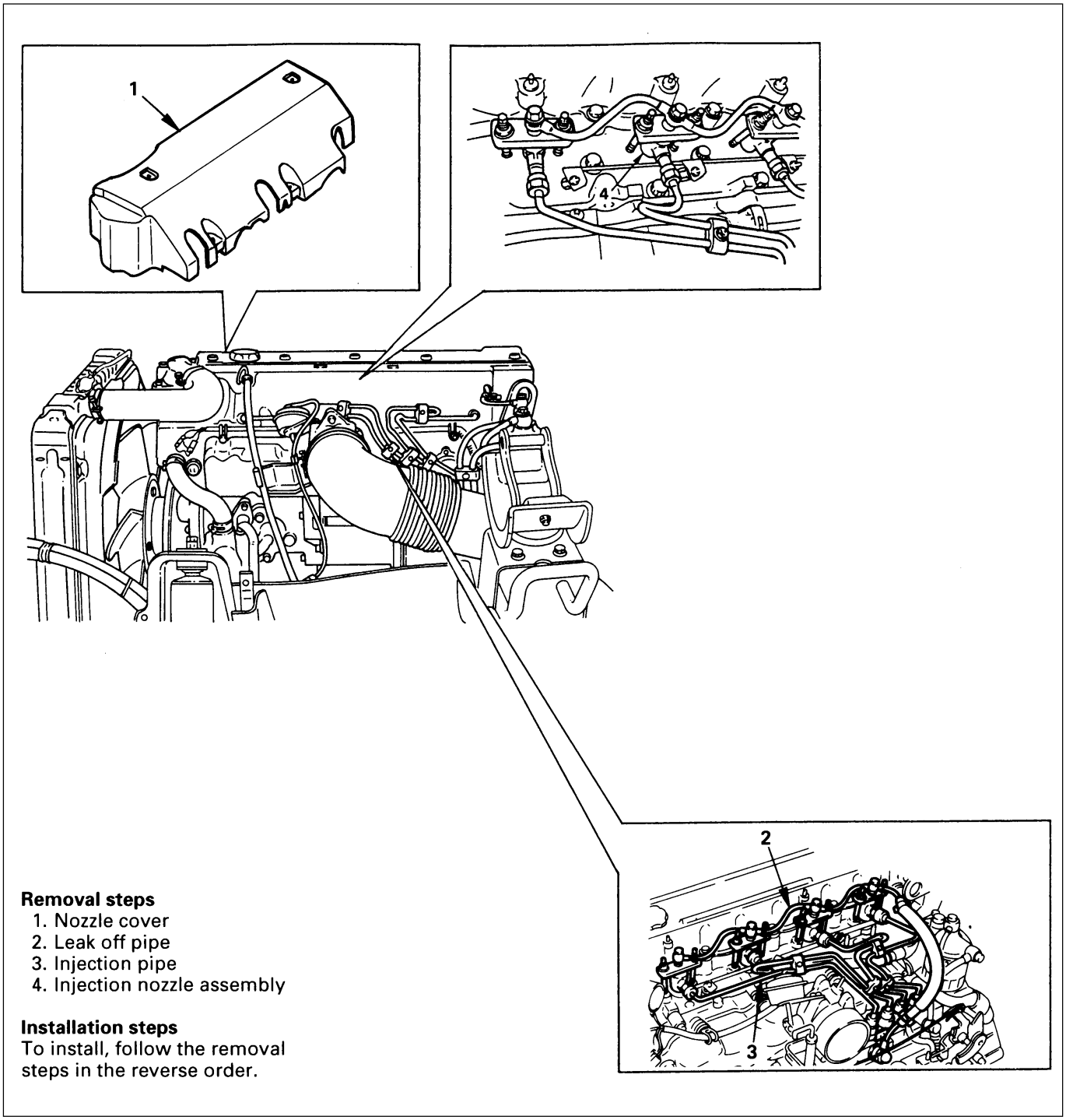
1) Actuate the priming pump 1 to send the air in the fuel system to the injection pump.
2) Loosen the sedimenter air bleeding plug 2 and operate the priming pump until no bubbles appear.
3) Tighten the air bleeding plug completely.
4) Try to start the engine. If the engine is not started within 10 seconds, air bleeding should be conducted once again.
5) Check that there is no fuel leak, and then tighten the priming pump completely.

Water Drain

If more than specified has collected, the warning light is lit. Under this condition, follow the following water drain procedure:

1) Place a container (Approximately 0.2 liters capacity) beneath the drain plug on the separator.
2) Loosen the drain plug and air bleeding plug.
3) After draining, tighten the drain plug.
4) Operate the priming pump several times again and check for fuel leak.
5) Tighten the air bleeding plug.
6) Make sure that the warning light in the instrument panel is off.

INJECTION NOZZLE ASSEMBLY



Removal steps
1. Nozzle cover
2. Leak off pipe
3. Injection pipe
4. Injection nozzle assembly

Installation steps
To install, follow the removal steps in the reverse order.

6C-13-1.tif

REMOVAL

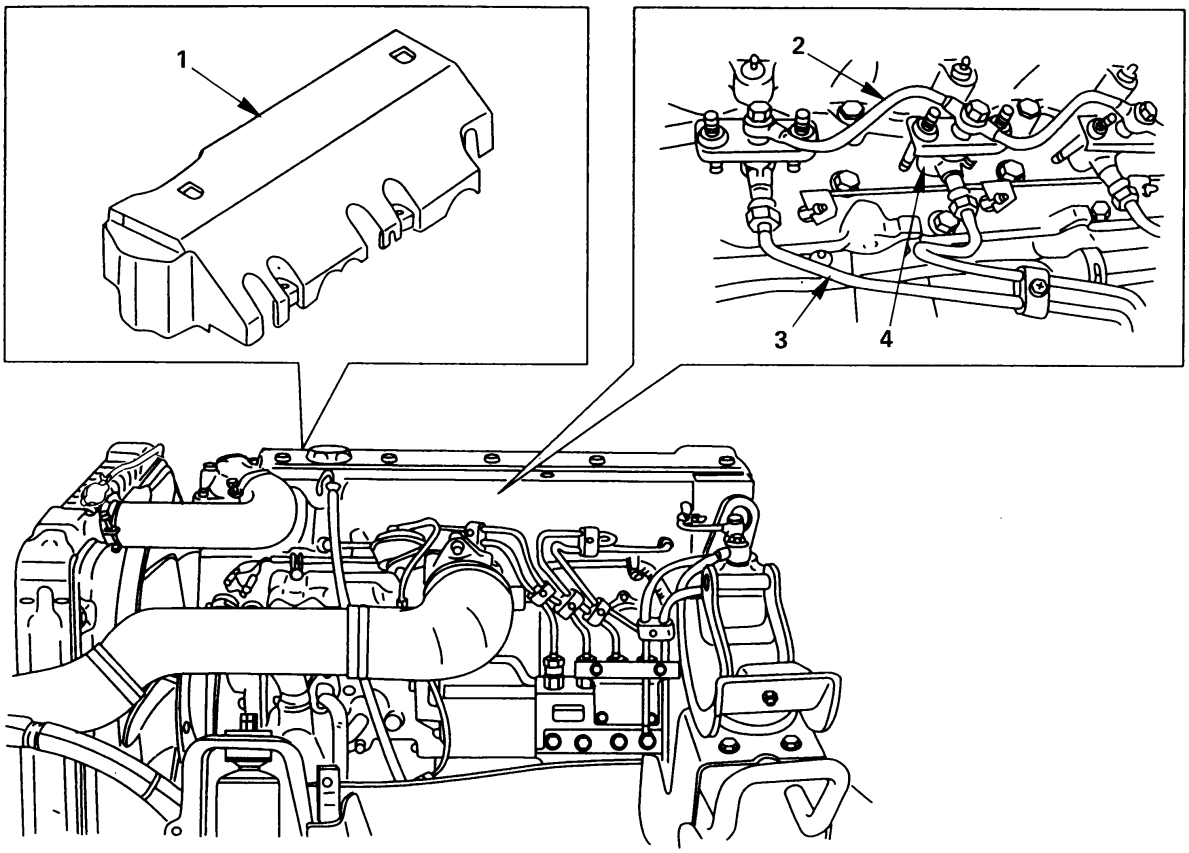
Preparation

- Disconnect battery ground cable.
- Tilt the cab.

1. Nozzle Cover

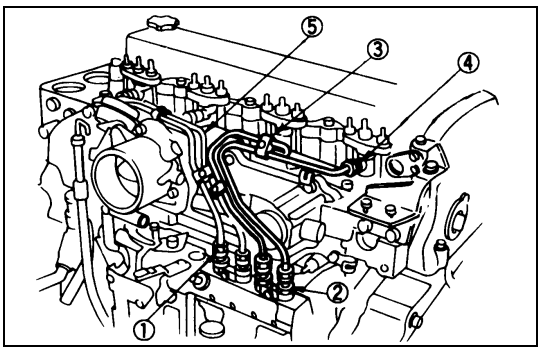
2. Leak-Off Pipe

4HE1-TC (Engine)



1. Nozzle cover
2. Leak off pipe
3. Injection pipe
4. Injection nozzle assembly

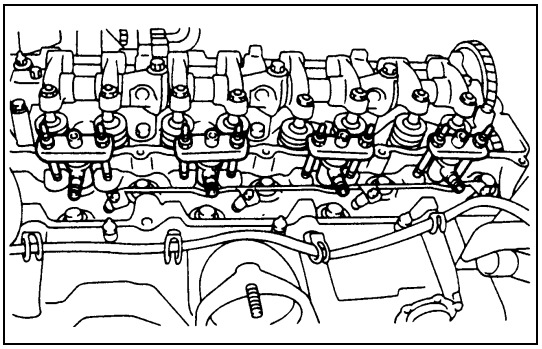
6C-14-1.tif



6C-15-1.tif

3. Fuel Injection

1) Loosen the injection pipe sleeve nuts ①.
   Do not apply excessive force to the injection pipes ⑤.
2) Loosen the injection pipes clips ③.
3) Remove the injection pipe assembly.
   Plug the delivery valve holder ② ports and nozzle holder ④ ports with caps to prevent the entry of foreign material.

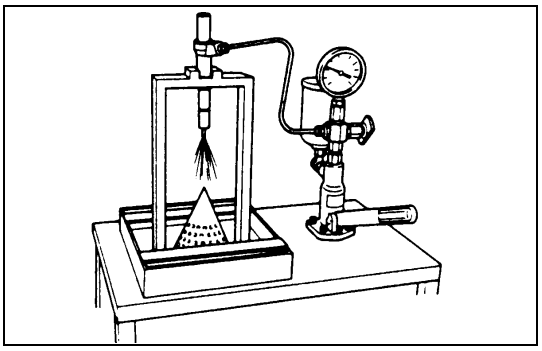

6C-15-2.tif

4. Injection Nozzle Assembly

Mark the nozzle holder assemblies fitting positions by tagging each nozzle holder assembly with the cylinder number from which it was removed.

INSPECTION

Before disassembling the injection nozzle assembly, check nozzle opening pressure, spray pattern, chatter and oil leakage.

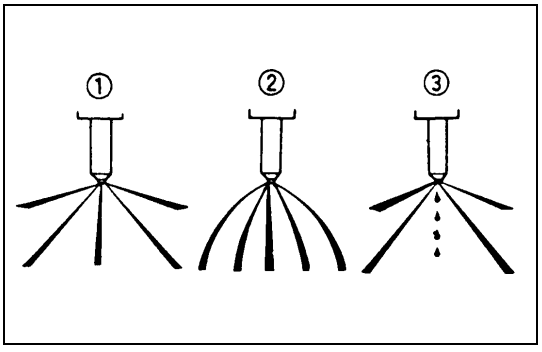

6C-15-3.tif

Opening Pressure

Use a nozzle tester to check the injection nozzle opening pressure.
If the opening pressure is above or below the specified value, the injection nozzle must be replaced or adjusted.

Injection Nozzle Opening Pressure Mpa (kg/cm^2/psi)

4HF1/4HF1-2/4HG1		18.14 (185/2,631)
4HE1-TC		21.57 (220/3,128)
4HG1-T	1st 2nd	18.1 (185/2,631) 21.1 (215/3,057)
4HE1-T	1st 2nd	17.65 (180/2,560) 21.57 (220/3,128)



6C-15-4.tif

Spray Pattern

Check the spray pattern
Refer to the illustration.
Spray Condition

- Correct
- Incorrect (Restrictions in orifice)
- Incorrect (Dripping)

If the spray condition is bad, the injection nozzle must be replaced or adjusted.

Leakage

Hold the tester handle to about 2070 kPa (300 psi) below the opening pressure. If no drops of fuel fall from the nozzle tip within 10 seconds, the nozzle is not leaking

Chatter

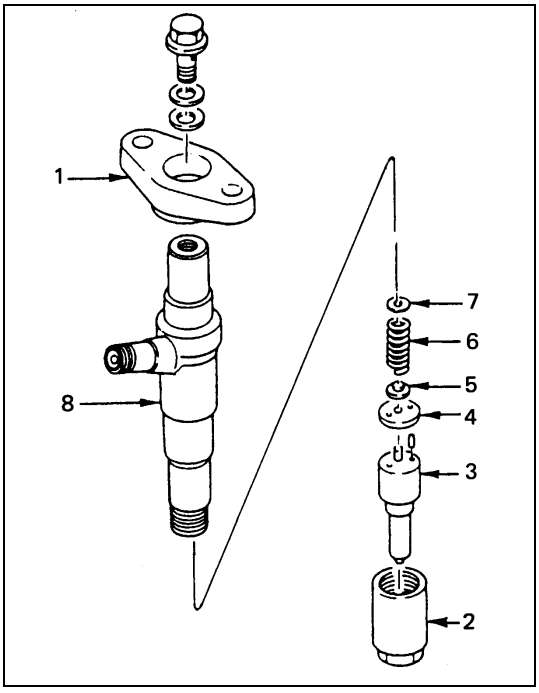
An easily audible chatter at all pump lever speeds should be heard.

WARNING:

TEST FLUID FROM THE INJECTION NOZZLE WILL SPRAY OUT UNDER GREAT PRESSURE. IT CAN EASILY PUNCTURE A PERSON'S SKIN. KEEP YOUR HANDS AWAY FROM THE INJECTION NOZZLE TESTER AT ALL TIMES.

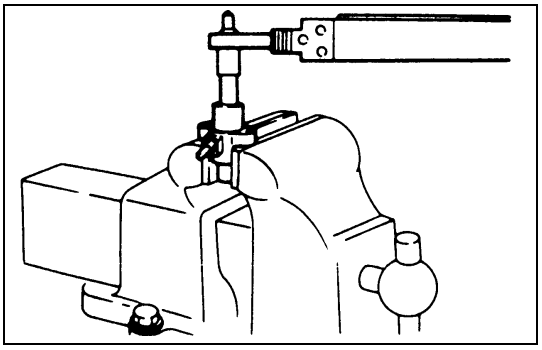
DISASSEMBLY

Clamp the injection nozzle holder in a vice.



6C-16-1.tif

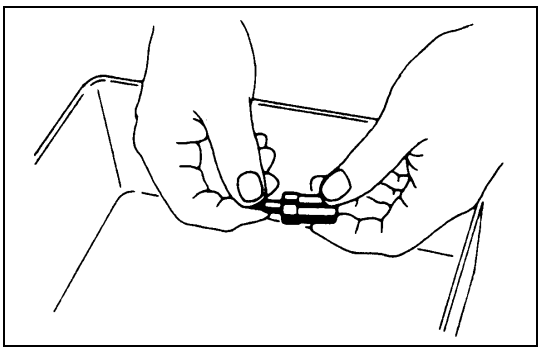
1. Flange



6C-16-2.tif

2. Retaining Nut

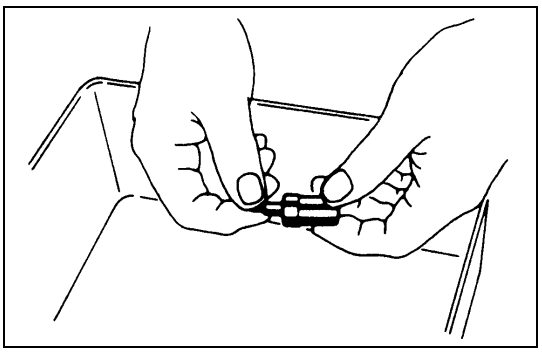
Use a wrench to remove the injection nozzle retainer nut.


6C-17-1.tif

3. **Injection Nozzle**
   Keep the nozzle along with the needle valve separately to maintain the original nozzle to needle valve combination.
4. **Spacer**
5. **Spring Seat**
6. **Nozzle Spring**
7. **Adjusting Shim**
   Keep the adjusting shims in the original groups to hold the initial shim to nozzle spring combination.
8. **Nozzle Holder Body**

CAUTION

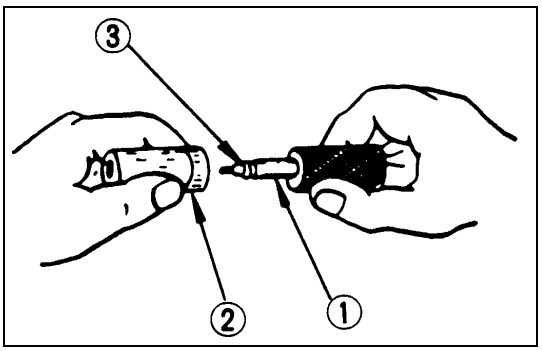
- **Wash all the parts removed and arrange them on a cylinder basis, care should be taken not to miss any parts.**
- **Soak the nozzle ASM in a parts receptacle filled with light oil.**
- **Care should be taken not to miss shim, if used.**


6C-17-2.tif

INSPECTION

Injection Nozzle Needle

1) Remove the nozzle from the nozzle body.
2) Carefully wash the nozzle needle and the nozzle body in clean diesel fuel.
3) Check that the nozzle needle moves smoothly inside the injection nozzle body.
   If the nozzle does not move smoothly, it must be repaired (See “Nozzle Lapping Procedure” below).



6C-17-3.tif

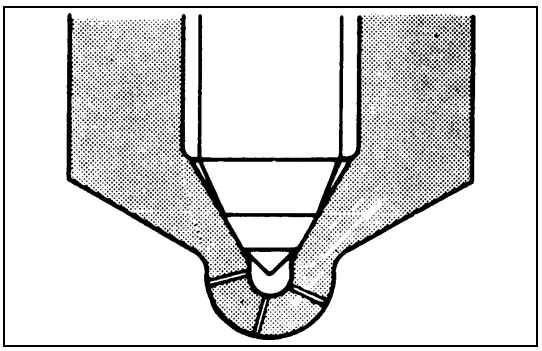
Nozzle Lapping Procedure

1) Lap the nozzle needle ① and the nozzle body ② by applying a compound of oxidized chrome and animal oil ③.

NOTE:

Do not apply an excessive amount of the oxidized chrome and animal oil compound to the injection needle valve seat area.

2) Carefully wash the needle valve and the nozzle body in clean diesel fuel after lapping.



6C-18-1.tif

Nozzle Body and Needle Valve

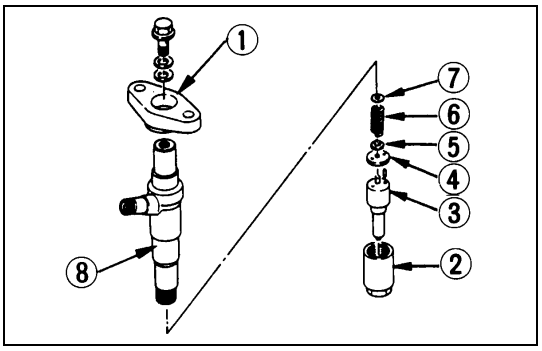
Check the nozzle body and the needle valve for damage and deformation.

The nozzle and body assembly must be replaced if either of these two conditions are discovered during inspection.

NOTE:

New nozzles must be cleaned in a solvent to remove protective coating.

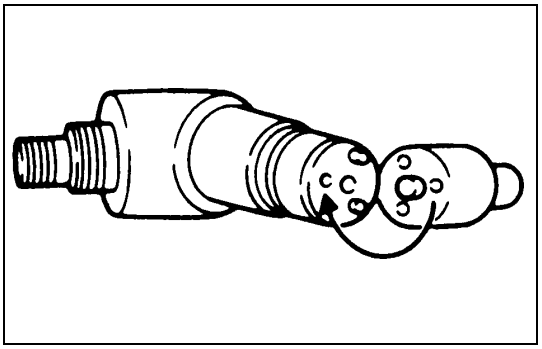
The nozzle body and needle must always be replace as an assembly.



6C-18-2.tif

REASSEMBLY

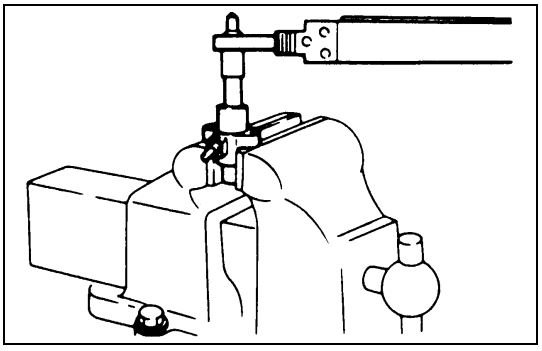
8. **Nozzle Holder Body**
7. **Adjusting Shim**
6. **Nozzle Spring**
5. **Spring Seat**
4. **Spacer**



6C-18-3.tif

3. **Injection Nozzle**

   Install the nozzle dowel pin with it set to the dowel hose of the nozzle holder body.



6C-18-4.tif

2. **Retaining Nut**

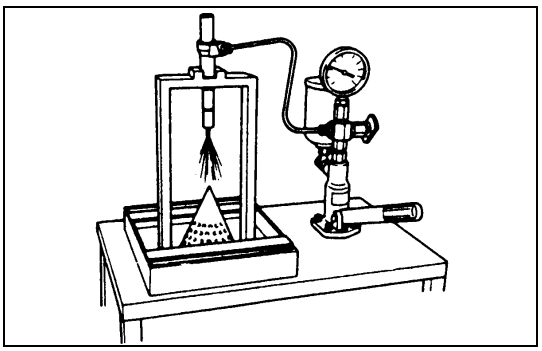
   Clamp the injection nozzle holder in a vice.

   Tighten the injection nozzle holder retaining nut to the specified torque.

Injection Nozzle Holder Retaining Nut Torque	N·m (kg·m/lb·ft)
	34 (3.5/25)

   Remove the injection nozzle holder from the vice.

1. **Flange**



6C-19-1.tif

ADJUSTMENT OF INJECTION STARTING PRESSURE

After reassemble of the injection nozzle, recheck the opening pressure and spray condition.

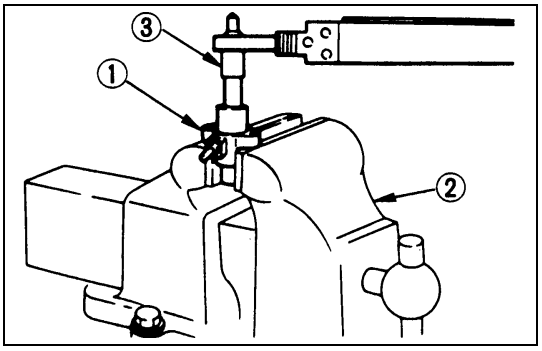
Opening Pressure

Attach the injection nozzle holder to the injection nozzle tester.

Apply pressure to the nozzle tester to check that the injection nozzle opens at the specified pressure.

If the injection nozzle does not open at the specified pressure, install or remove the appropriate number of adjusting shims to adjust it.

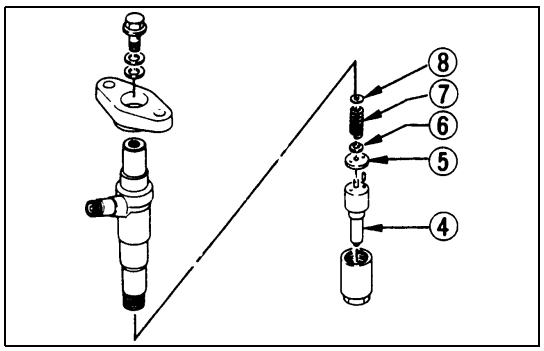
Injection Nozzle Opening Pressure	Kpa (kg/cm^2/psi)
	18,142 (185/2,631)



6C-19-2.tif

Opening Pressure Adjustment

1) Clamp the injection nozzle holder ① in a vise ②.
2) Use a wrench to remove the injection nozzle retaining nut ③.



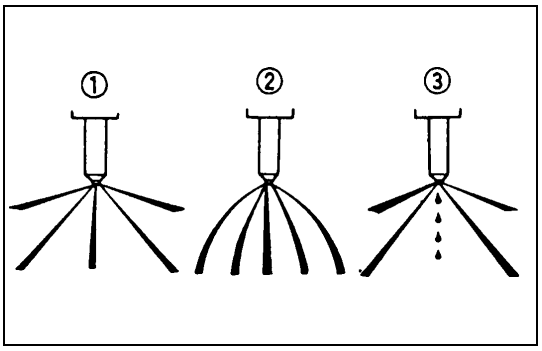
6C-20-1.tif

3) Remove the injection nozzle holder from the vise.
4) Remove the injection nozzle ④, the spacer ⑤, the spring seat ⑥ the spring ⑦ and the adjusting shim ⑧.
5) Install the new adjusting shim, the spring, the sprig seat, the spacer, the injection nozzle, and the retaining nut.
6) Clamp the injection nozzle holder in the vise.
7) Tighten the injection nozzle holder retaining nut to the specified torque.

Injection Nozzle Holder Retaining Nut Torque	N·m (kg·m/lb·ft)
	34 (3.5/25)

8) Remove the injection nozzle holder from the vise.
9) Attach the injection nozzle holder to the injection nozzle tester.
10) Apply pressure to the nozzle tester to check that the injection nozzle opens at the specified pressure.
    If the injection nozzle does not open at the specified pressure, install or remove the appropriate number or adjusting shims to adjust it.
    Removing or installing one shim will increase or decrease the nozzle opening pressure approximately 3.77 kg/cm^2 (53.6 psi/370 kPa).

Adjusting Shim Availability	mm(in)
Range	0.5 - 1.5 (0.02 - 0.06)
Increment	0.025 (0.001)
Total Number of Shims	41



6C-20-2.tif

Spray Pattern

Check the spray condition.
Refer to the illustration.
Spray Condition

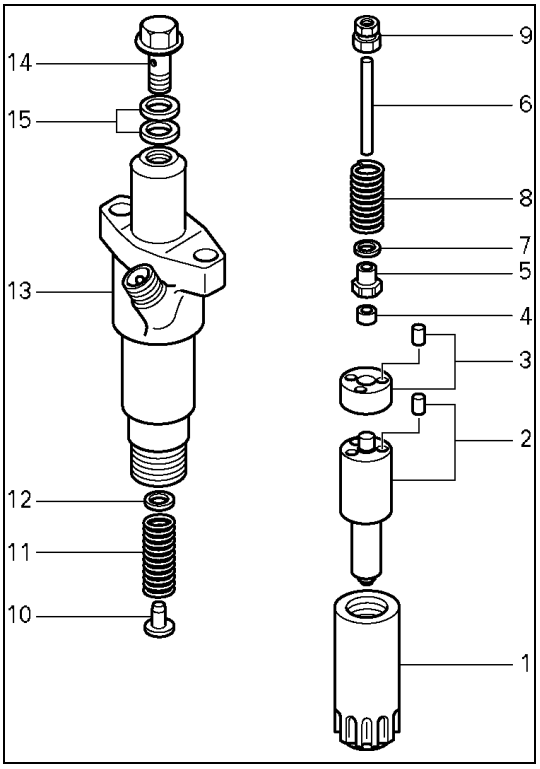
- Correct
- Incorrect (Restrictions in orifice)
- Incorrect (Dripping)

If the spray condition is bad, the injection nozzle must be replaced or adjusted.
Refer to “Adjustment”.

Note:

Adjust the nozzle in a well ventilated area. Do not inhale oil or spray injected from the nozzle.

4-1 Injection Nozzle (Two spring nozzle holder) (4HG1-T, 4HE1-T only)



080LX002.tif

The two-spring nozzle holder has been developed to reduce NOx (Nitrogen Oxides) and particulates from direct injection diesel engine exhaust.

Disassembly

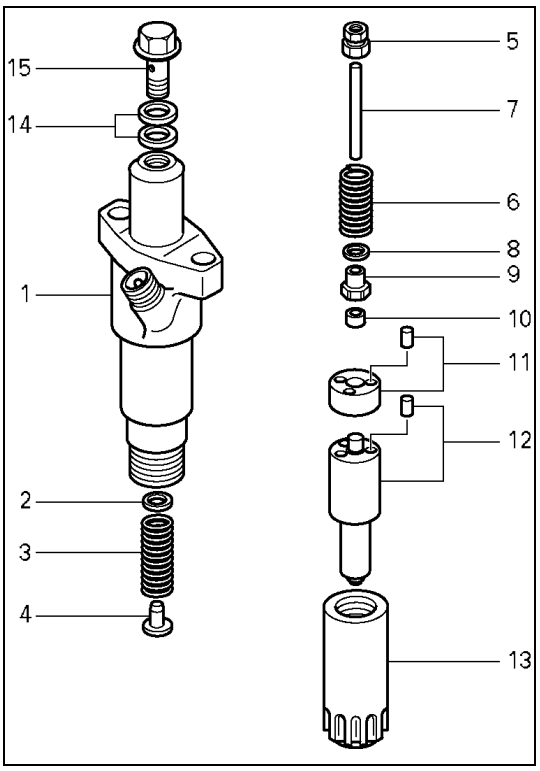
1. Retaining nut
2. Nozzle & pin
3. Spacer & pin
4. Lift piece
5. Spring seat
6. Push rod
7. Shim (Second nozzle opening pressure adjustment)
8. Second spring
9. Collar
10. Spring seat
11. First spring
12. Shim (First nozzle opening pressure adjustment)
13. Nozzle holder body
14. Eye bolt
15. Gasket

(1) Before disassembly remove carbon deposit from nozzle and nozzle holder using a wire brush and wash the outside nozzle holder assembly.

Caution:

Do not touch nozzle holes with the wire brush during cleaning it.

(2) Disassemble the nozzle holder assembly to numerical order.



080LX003.tif

REASSEMBLY AND OPENING PRESSURE ADJUSTMENT

1. Nozzle holder body
2. Shim (First opening pressure adjustment)
3. First spring
4. Spring seat
5. Collar
6. Second spring
7. Push rod
8. Shim (Second opening pressure adjustment)
9. Spring seat
10. Lift piece
11. Spacer & pin
12. Nozzle & pin
13. Retaining nut
14. Gasket
15. Eye bolt

The nozzle holder is adjusted as the components are reassembled in the sequence above.

As adjustment of the two-spring nozzle holder is made in hundredths of a millimeter, clean the parts thoroughly in light oil to completely remove any dirt or foreign matter.

REASSEMBLY AND ADJUSTMENT PROCEDURE

1 First nozzle opening pressure adjustment

Adjust the first nozzle opening pressure using the shim.

2 Full needle valve lift confirmation

Confirm the full needle valve lift in accordance with the closed method.

3 Pre-lift confirmation

Confirm pre-lift in accordance with the closed method.

CAUTION:

If not as specified, replace the nozzle assembly, lift piece, pins and spacer using the nozzle service kit.

4 Second nozzle opening pressure confirmation

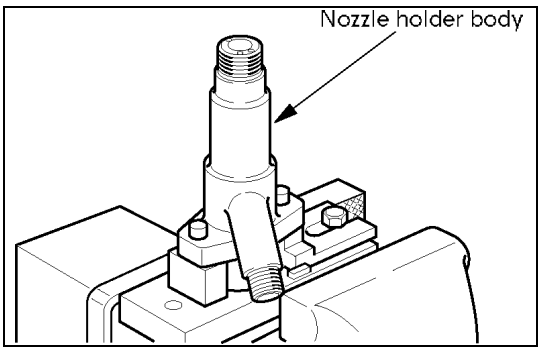
Confirm the second nozzle opening pressure in accordance with the closed method.

5 Second nozzle opening pressure adjustment

Adjust the second nozzle opening pressure using the shim.

6 Final inspection

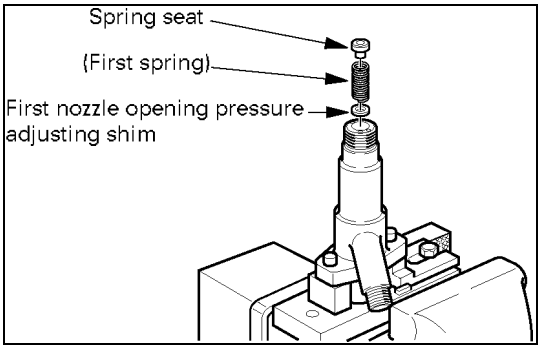
Confirm the condition of the fuel spray with the nozzle and nozzle holder assembled.



040MV015.tif

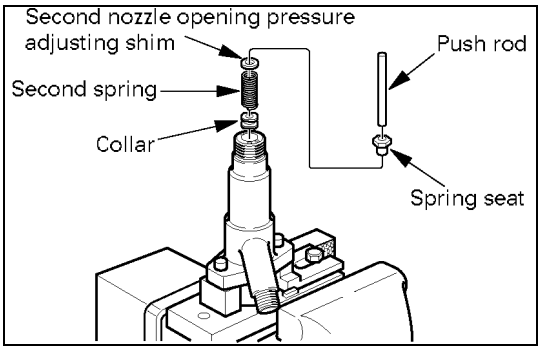
First nozzle opening pressure adjustment

1. Clamp the nozzle holder in a vise.



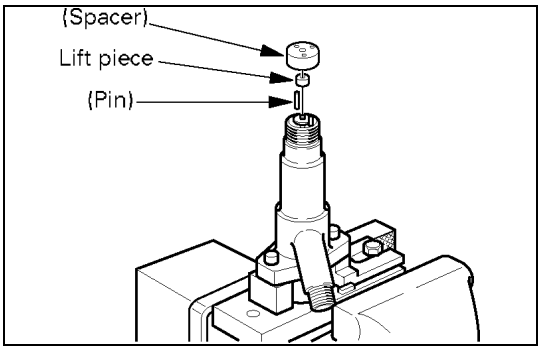
040MV016.tif

2. Install the shim, first spring and spring seat in the nozzle holder.



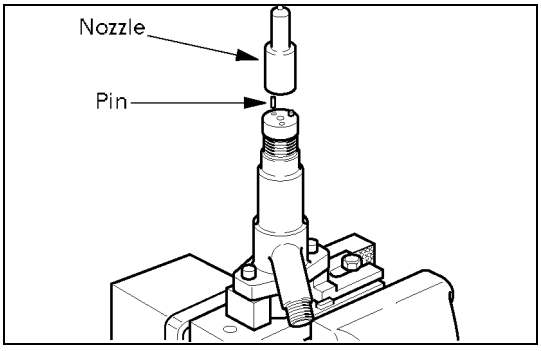
040MV017.tif

3. Install the collar, second spring, shim, spring seat and pushrod in the nozzle holder.



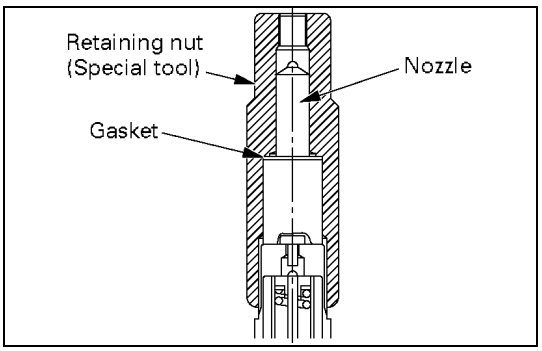
040MV018.tif

4. Install the pins, lift piece and spacer in the nozzle holder.



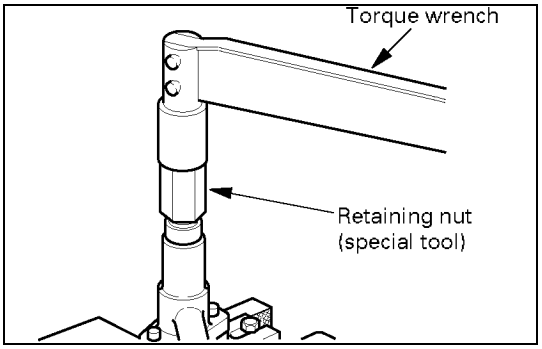
040MV019.tif

5. Install the pins in the spacer.
6. Install the nozzle on the spacer.



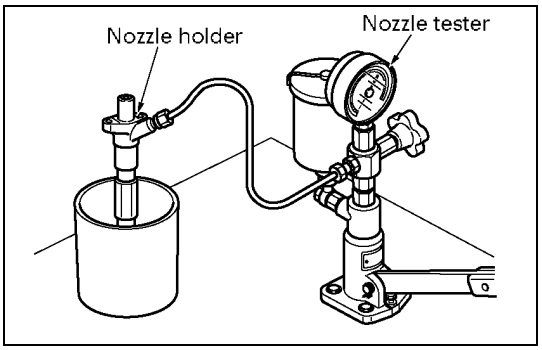
040MV010.tif

7. Hand-tighten the adjustment retaining nut together with the gasket to the nozzle holder.
   Retaining nut: 157892-3200 (ZEXEL)
   Gasket: 157892-5100 (ZEXEL)



040MV014-1.tif

8. Tighten the adjustment retaining nut to the specified torque.
   Torque: 29 - 39 N·m (3.0 - 4.0 kg·m)

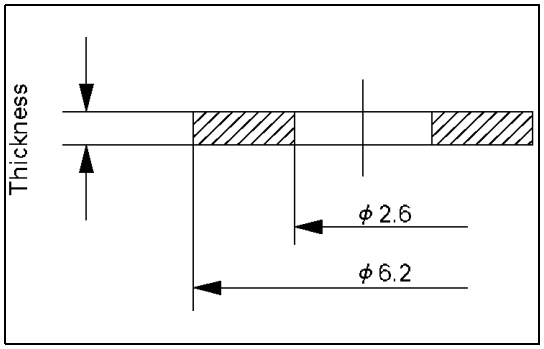


040MV030.tif

9. Set the nozzle holder to the nozzle tester.
10. Operate the nozzle tester and measure the first nozzle opening pressure.
11. If the first nozzle opening pressure is not as specified, disassemble the nozzle holder and replace the shim until the pressure is as specified.

CAUTION:

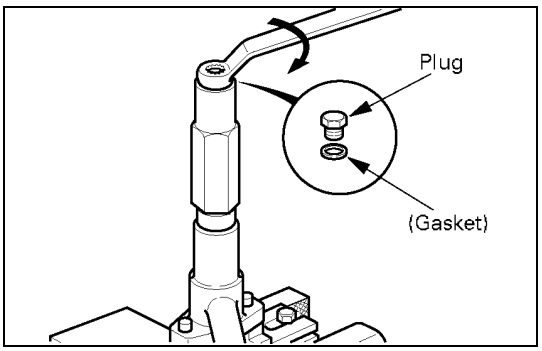
Use a micrometer to measure shim thickness.



040LX010.tif

- First nozzle opening pressure adjusting shims

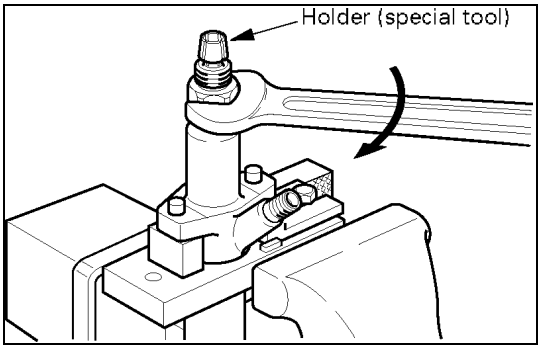
Part No. (ZEXEL)	Thickness (mm)
150538-9800	0.40
150538-9900	0.50
150539-0000	0.52
150539-0100	0.54
150539-0200	0.56
150539-0300	0.58
150539-0400	0.60
150539-0500	0.70



040MV013.tif

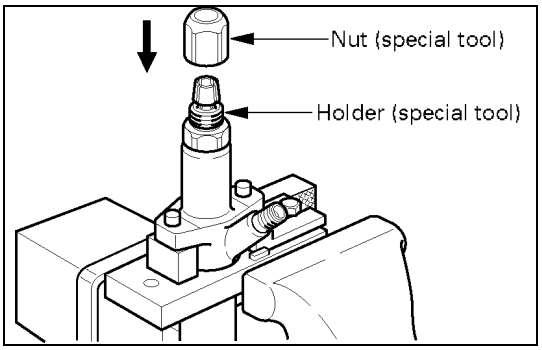
Full needle valve lift confirmation

1. Install the gasket and plug on the adjustment retaining nut.
   Gasket: 026508-1140 (ZEXEL)
   Plug: 157892-1600 (ZEXEL)



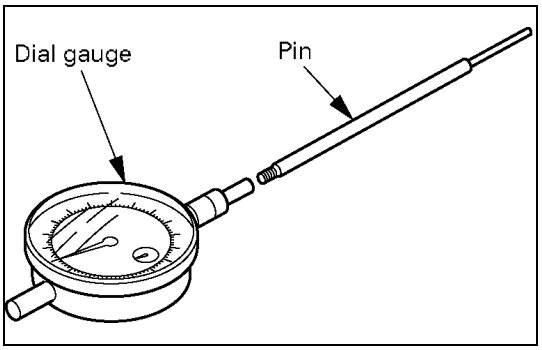
040MV012.tif

2. Position the nozzle holder with the nozzle facing down and install the dial gauge holder on the nozzle holder.
   Dial gauge holder: 157892-5000 (ZEXEL)



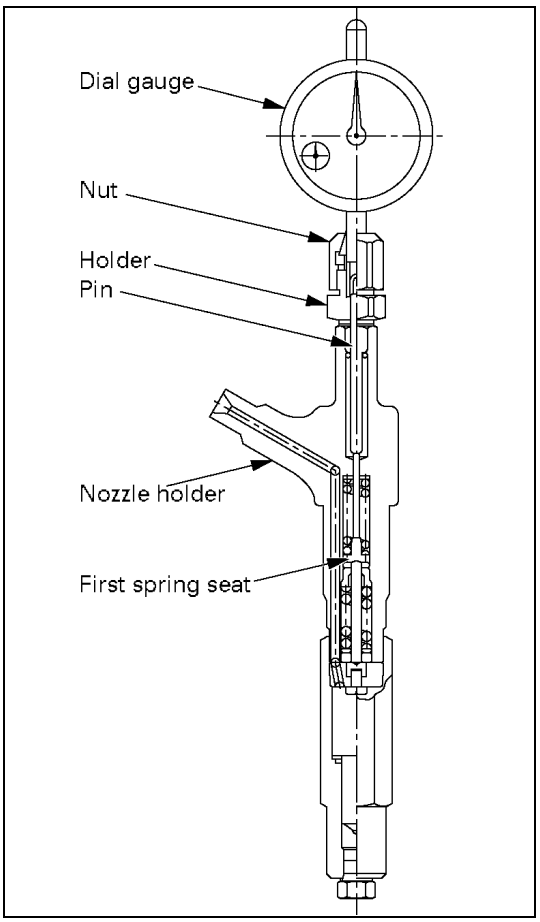
040MV011.tif

3. Install the nut on the dial gauge holder.
   Nut: 157892-1000 (ZEXEL)



040MV029.tif

4. Install the pin to the dial gauge.
   Note:
   The lengths of the pins do not include the threaded portions.
   Pin (λ=100 mm): 157892-5200 (ZEXEL)
   Dial gauge: 157954-3800 (ZEXEL)

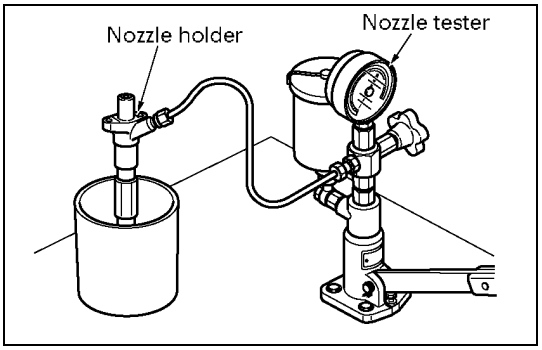


040MV009.tif

5. Secure the dial gauge to the nozzle holder using the nut so that the pin contacts the tip of the first spring seat.

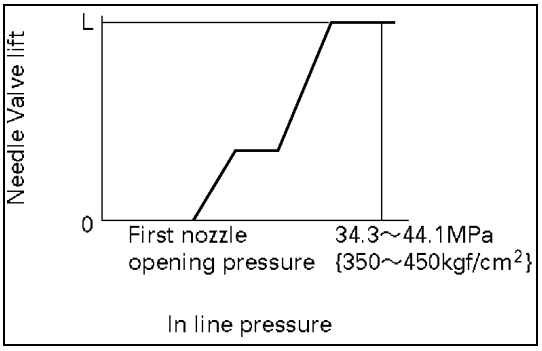
CAUTION:

- **Secure the dial gauge so that a stroke of 2 mm can be measured.**
- **Do not over-tighten the nut as the dial gauge shaft may jam. (Confirm from the dial gauge that the shaft moves smoothly.)**



040MV030.tif

6. Set the nozzle holder to the nozzle tester and put needle to zero on the dial gauge.
7. Operate the nozzle tester to bleed any air from inside the retaining nut and to confirm that no fuel leaks.



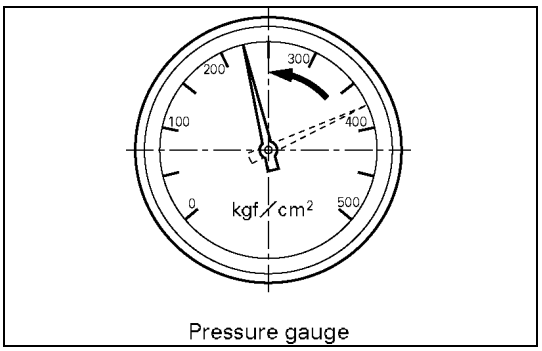
040MV008.tif

8. Operate the nozzle tester and increase the in-line pressure to 34.3 - 44.1 MPa (350 - 450 kg/cm^2) so that the nozzle's needle valve moves through its full lift.

   Record full lift 'L'. (Read dial gauge)

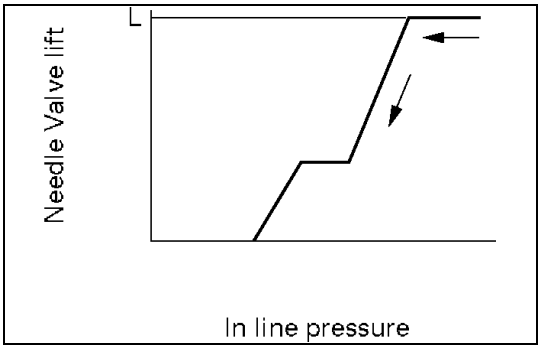
   Note:

   The above operation is used to determine whether the nozzle seat is worn and whether the nozzle assembly is in good condition.

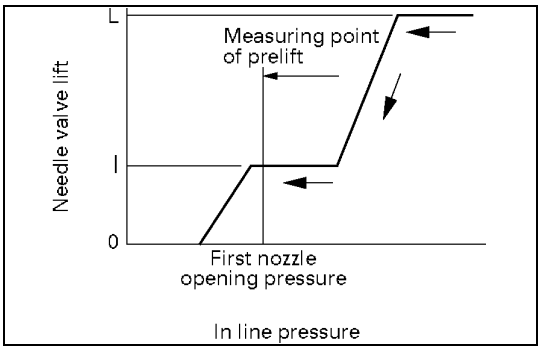


Pressure gauge

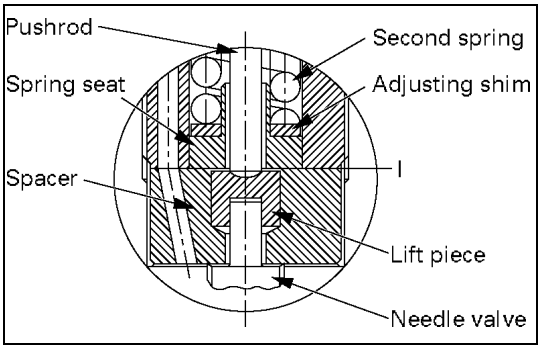
040MV007.tif



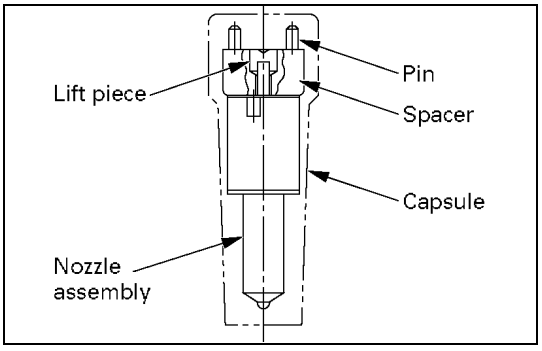
040MV006.tif



040MV025-1.tif



040MV005.tif



040MV031.tif

Pre-lift confirmation

1. With the needle valve at full lift, release the nozzle tester handle.

   Note:

   The in-line pressure will decrease and needle valve lift (as indicated on the dial gauge) will also decrease a little.

2. Read the needle valve lift 'λ' from the dial gauge indication (once the needle valve has descended when the second spring has stopped operating). Refer to the pre-lift measuring point for 'λ'.

Pre-lift measuring point:
Read the dial gauge at first nozzle opening pressure +approx 1 MPa (10 kg/cm^2).

   Note:
   This point can be found while the pressure is decreasing.

3. Confirm that pre-lift 'λ' is as specified.

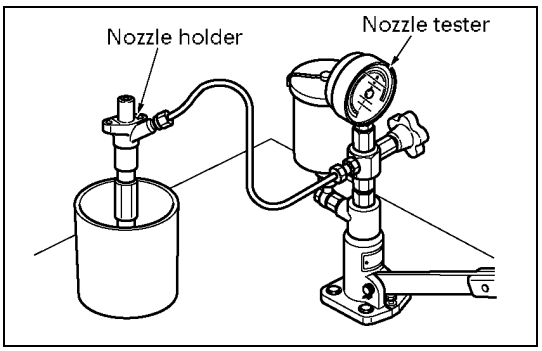
Pre-lift mm

4HG1-T	0.04
4HE1-T	0.10

4. If pre-lift is not as specified, replace the pins, lift piece, spacer and nozzle assembly as a set with the service kit.

   Service kit: ZEXEL

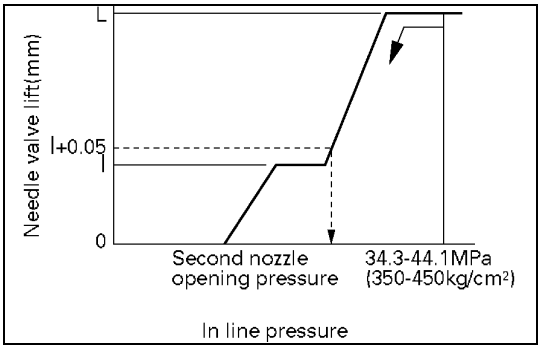
4HG1-T	105019-2310
4HE1-T	105019-1070



040MV030.tif

Second nozzle opening pressure confirmation

1. After pre-lift confirmation, operate the nozzle tester to increase in-line pressure to 34.3 - 44.1 MPa (350 - 450 kg/cm^2) so that the nozzle's needle valve moves through its full lift.

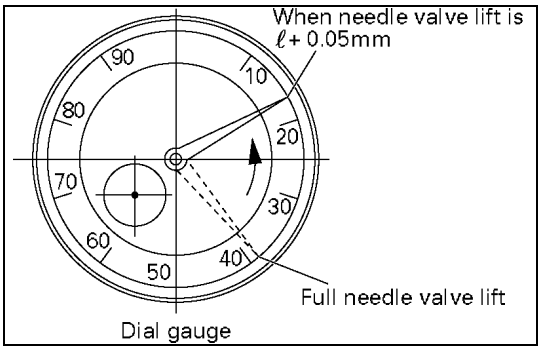


040MV022.tif

2. Release the nozzle tester handle so that in-line pressure decreases.

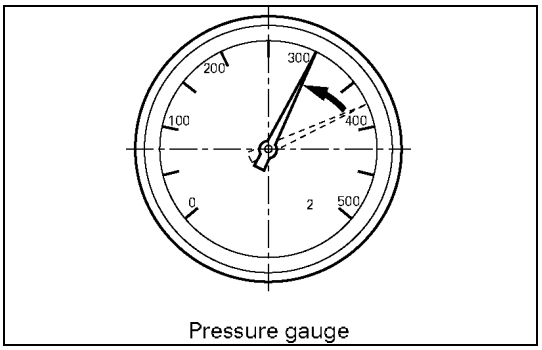
   Note:

   The in-line pressure will decrease and needle valve lift (as indicated on the dial gauge) will also decrease a little.

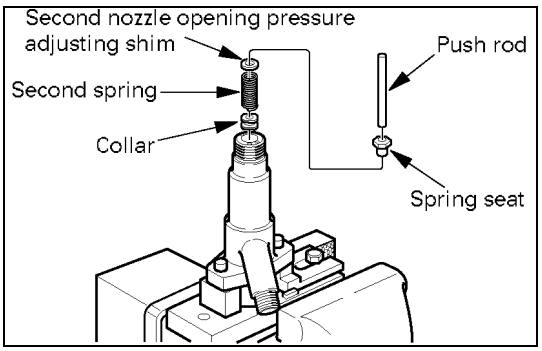


040MV024.tif

3. Then, read the pressure gauge indication (second nozzle opening pressure) the instant that the dial gauge indicates the specified needle valve lift (usually pre-lift λ + 0.05 mm).



040MV026.tif



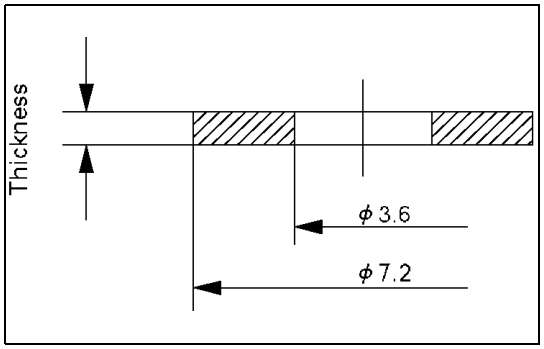
040MV017.tif

Second nozzle opening pressure adjustment

If the second nozzle opening pressure is not as specified, disassemble the nozzle from the nozzle holder and replace the shim until the pressure is as specified.

CAUTION:

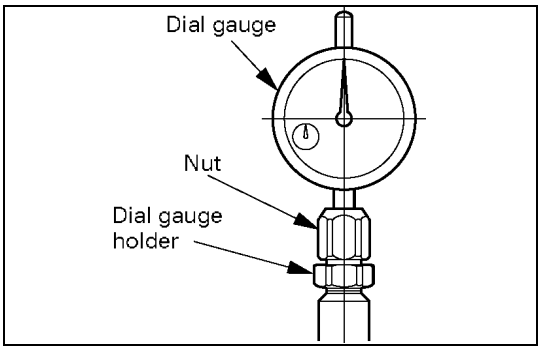
- **Because the second opening pressure changes when the first opening pressure changes, the second opening pressure must be adjusted when the first opening pressure changes.**
- **Use a micrometer to measure shim thickness.**



040LX009.tif

- Second nozzle opening pressure adjusting shims

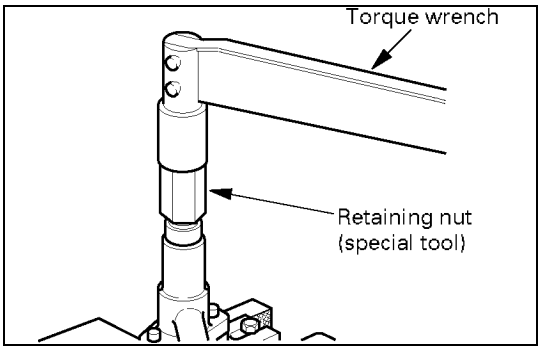
Part No. (ZEXEL)	Thickness (mm)
150591-4000	0.40
150591-5000	0.50
150591-5200	0.52
150591-5400	0.54
150591-5600	0.56
150591-5800	0.58
150591-5900	0.59



040MV028.tif

Final inspection

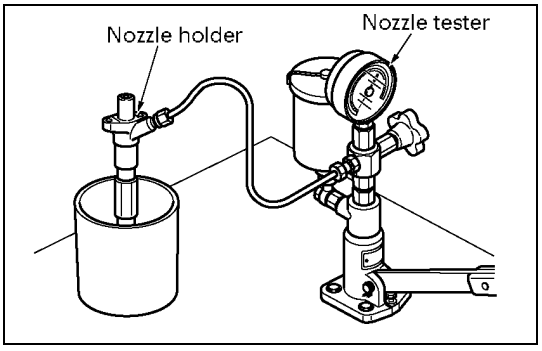
1. Remove the dial gauge, nut and dial gauge holder.



040MV014-1.tif

2. Remove the adjustment retaining nut and gasket.
3. Install the original retaining nut, confirm that the pins are inserted fully into the nozzle, and then hand-tighten the retaining nut. Then, tighten the original retaining nut to the specified torque.

   Torque: 59 - 79 N·m (6.0 - 8.0 kg·m)

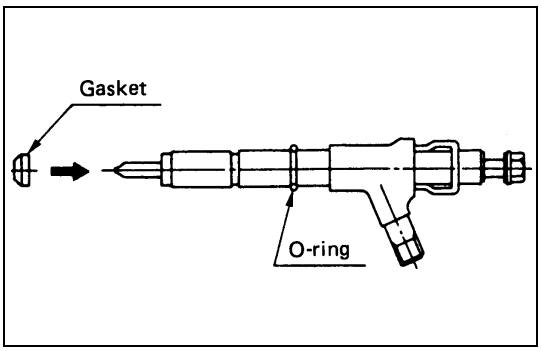


040MV030.tif

4. Set the nozzle holder to the nozzle tester and check first nozzle opening pressure, spray condition, seat oil tightness and each part for oil leaks.
5. When replacing the nozzle, replace the nozzle, lift piece, pins and spacer as a set with the nozzle service kit.

CAUTION:

Pre-lift will not be as specified if only the nozzle is replaced.

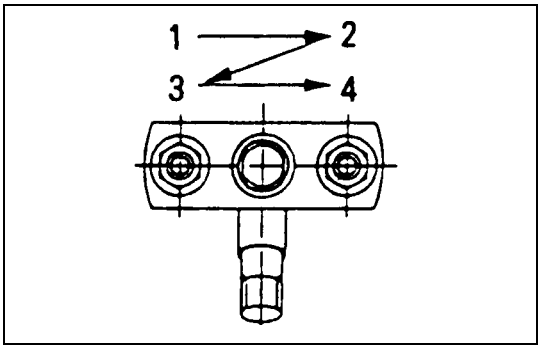


6C-30-1.tif

INSTALLATION

4. Injection Nozzle Assembly

1) Install a new injection nozzle gasket and O-ring to the nozzle holder, and then install the nozzle holder to the cylinder head as shown in the illustration.



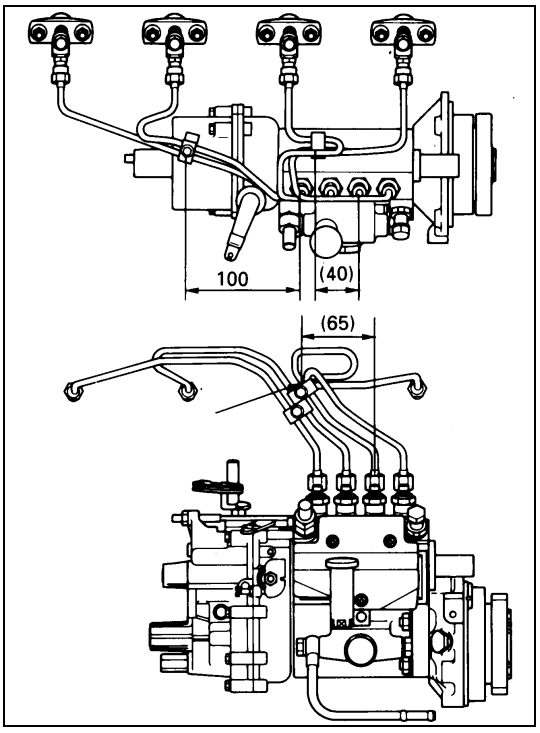
6C-30-2.tif

2) Tighten the nozzle holder flange nuts to the specified torque in the numerical order.

Nozzle Holder Flange Nuts Torque	N·m (kg·m/lb·ft)
	19 (1.9/14)

3. Fuel Injection Pipe

1) Install the injection pipe assembly and temporarily tighten the injection pipe sleeve nuts.
2) Set the clips in the prescribed position shown in the illustration.



6C-30-3.tif

CAUTION:

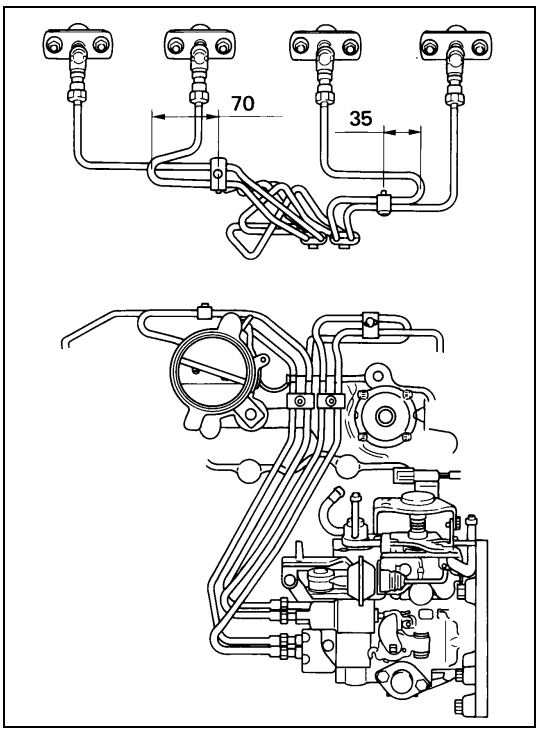
Make absolutely sure that the clip is correctly positioned.

An improperly positioned clip will result in injection pipe breakage and fuel pulsing noise.

Clip Screw Torque	N·m (kg·m/lb·in)
	3 (0.3/26)

3) Tighten the injection pipe sleeve nuts to the specified torque.

Injection Pipe Sleeve Nut Torque	N·m (kg·m/lb·ft)
	29 (3/22)



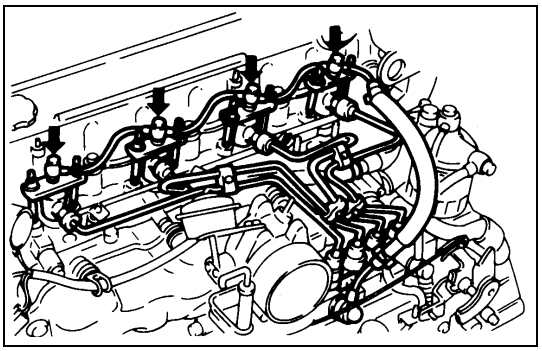
6C-31-1.tif

Fuel Injection Pipe (4HF1-2 model only)

1) Connect Injectin Pipe and fix with clips as illustrated.

Injection Pipe Tightening Torque	N·m (kg·m/lb·ft)
29 (3.0/22)	

Clip Tightening Torque	N·m (kg·m/lb·in)
3 (0.3/26)	



6C-31-2.tif

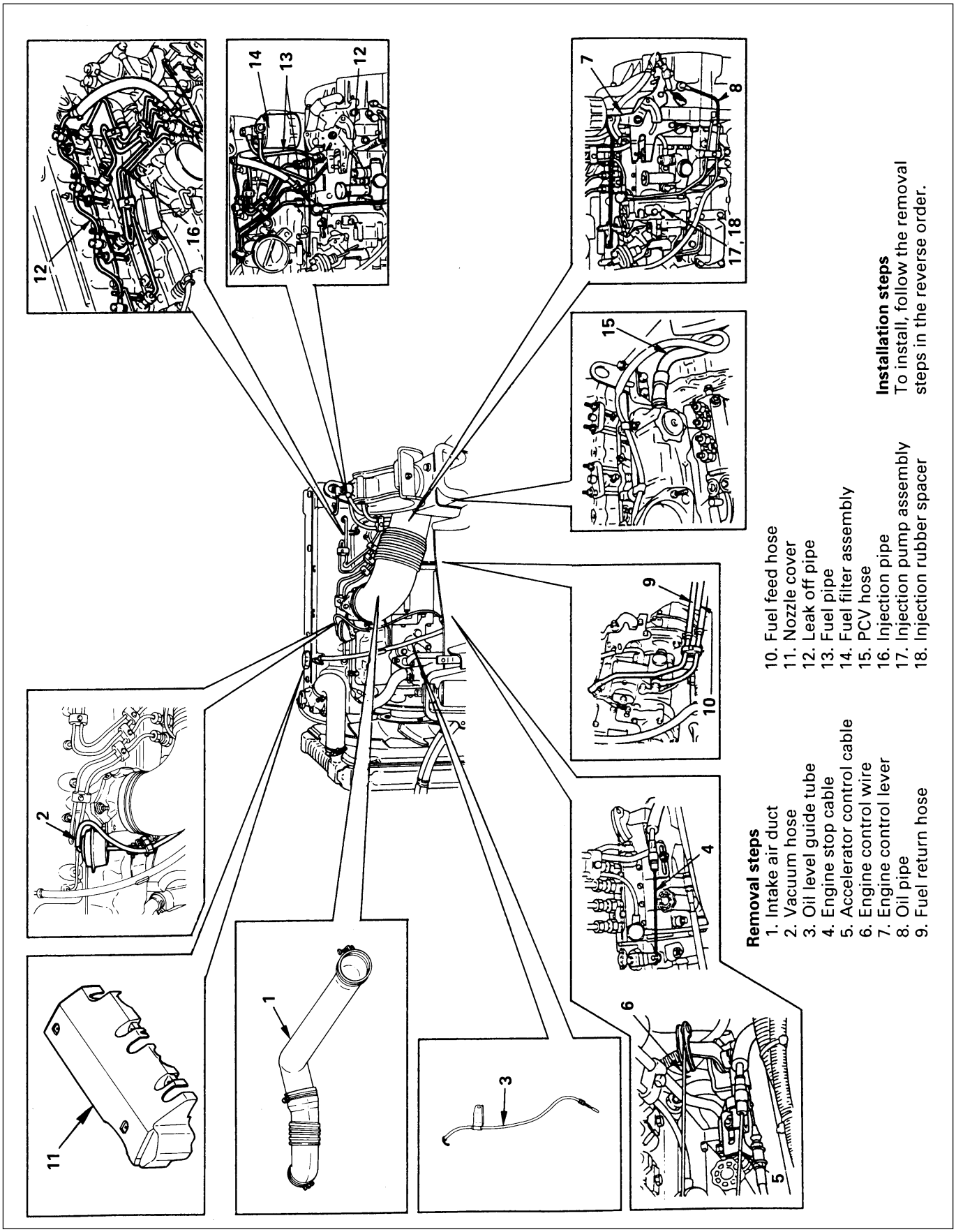
2. Leak Off Pipe

Leak-Off Pipe Joint Bolt Torque	N·m (kg·m/lb·in)
13 (1.3/113)	

1. Nozzle Cover

- Connect battery ground cable.

INJECTION PUMP ASSEMBLY (Except 4HF1-2 model)



6C-32-1.tif

REMOVAL

Preparation

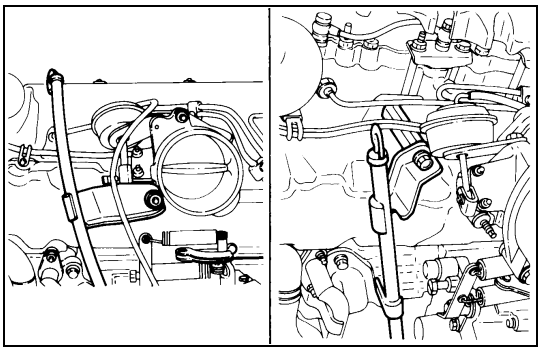
- Disconnect battery ground cable
- Drain coolant

1. Intake Air Duct

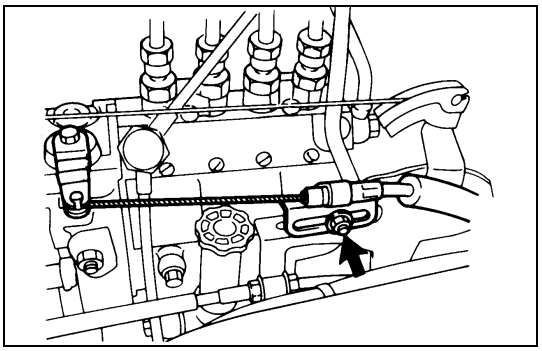
2. Vacuum Hose

3. Oil Level Guide Tube

- Remove the guide tube fixing bolt and pull out the guide tube.



6C-33-1.tif

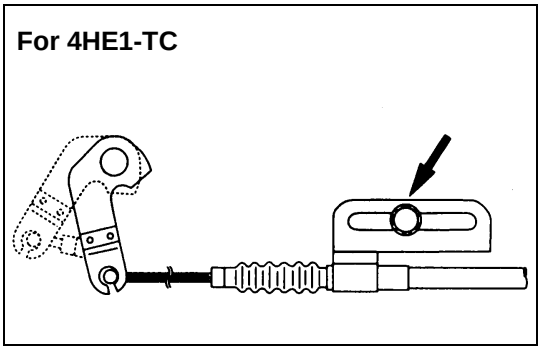


6C-33-2.tif

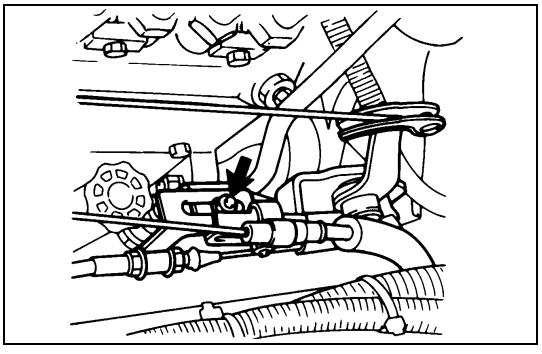
4. Engine Stop Cable

- Loosen locking nut at bracket and disconnect.
- Engine stop cable from injection pump stop lever.

For 4HE1-TC



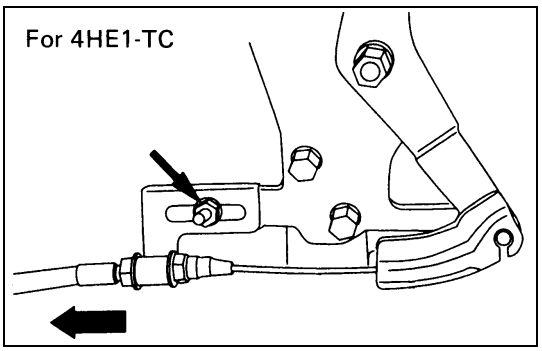
6C-33-3.tif



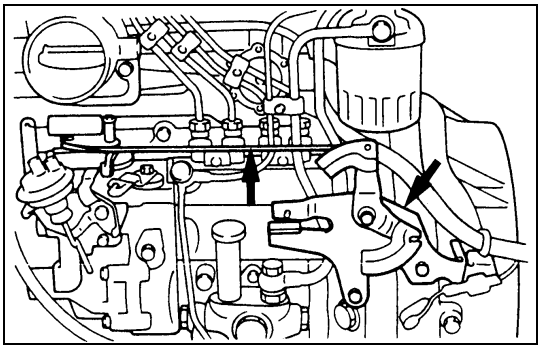
6C-33-4.tif

5. Accelerator Control Cable

- Loosen locking nut at bracket and disconnect accelerator control cable from injection pump control lever.



6C-34-1.tif



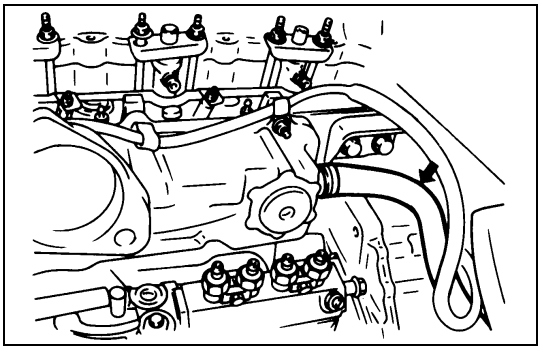
6C-34-2.tif

6. Engine Control Wire
7. Engine Control Lever
8. Oil Pipe
9. Fuel Return Hose
10. Fuel Feed Hose

- Disconnect fuel hose from injection pump side and take care not to spill and enter dust.

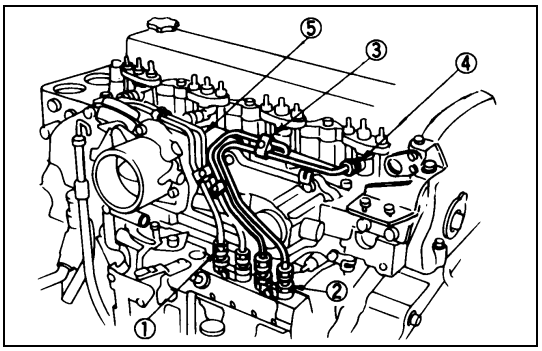
11 Nozzle Cover

12. Leak-Off Pipe
13. Fuel Pipe
14. Fuel Filter Assembly



6C-34-3.tif

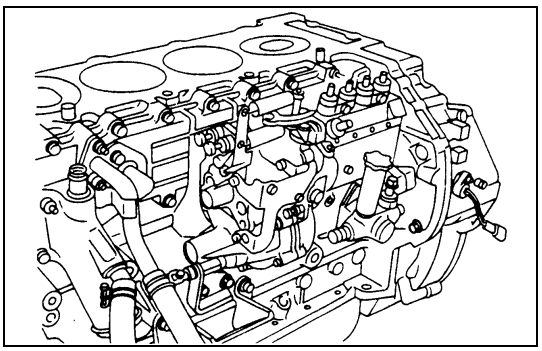
15. PCV Hose



6C-34-4.tif

16. Injection Pipe

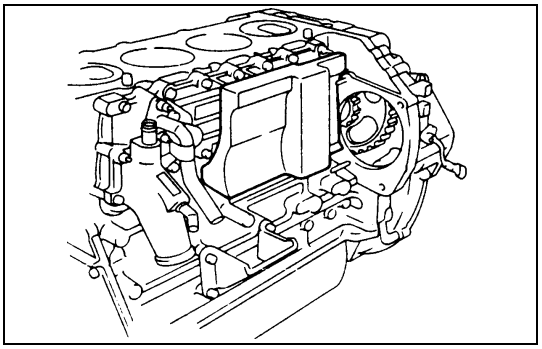
- Loosen the injection pipe sleeve nuts ①.
  Do not apply excessive force to the injection pipes ⑤.
- Loosen the injection pipes clips ③.
- Remove the injection pipe assembly.
  Plug the delivery valve holder ② ports and nozzle holder ④ ports with caps to prevent the entry of foreign material.



6C-35-1.tif

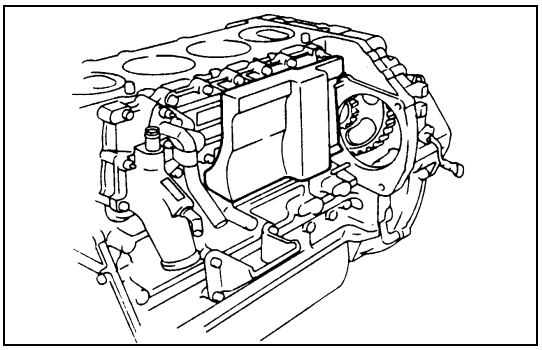
17. Injection Pump Assembly

1) Remove the injection pump bracket bolts and the injection pump rear bracket bolts.
2) Then remove the injection pump assembly.



6C-35-2.tif

18. Injection Pump Rubber Spacer (For 4HF1/4HG1/4HE1-T)

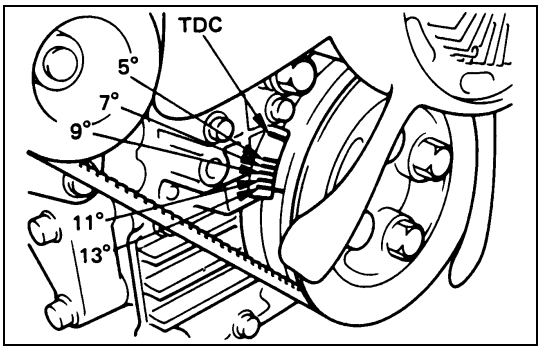


6C-35-3.tif

INSTALLATION

18. Injection Pump Rubber Spacer

Stick the rubber spacer to the location indicated in the illustration with pressure sensitive adhesive double coated tape. (4HF1/4HG1/4HE1-T Engine)



6C-35-4.tif

17. Injection Pump Assembly

1) Turn the crankshaft until the timing mark on the crankshaft damper pulley is aligned with “13°” line.
2) Check the No.1 cylinder intake and exhaust valve rocker arms for any play.

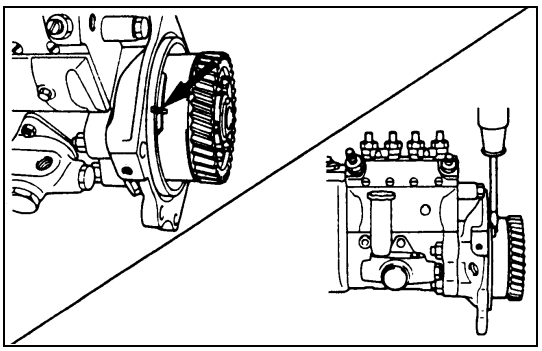
   If the No.1 cylinder intake and exhaust valve rocker arms are depressed the No.4 piston is at on the compression stroke.

   Rotate the crankshaft one full turn (360 degrees) and realign the crankshaft damper pulley timing mark with the “13°” line.

NOTE:

BTDC 13° to be aligned with here is an angle at which the injection pump is installed, and has nothing to do with the injection timing.

- Remove the inspection hole plug from the cylinder body.
- Install the O-ring to the injection pump bracket.

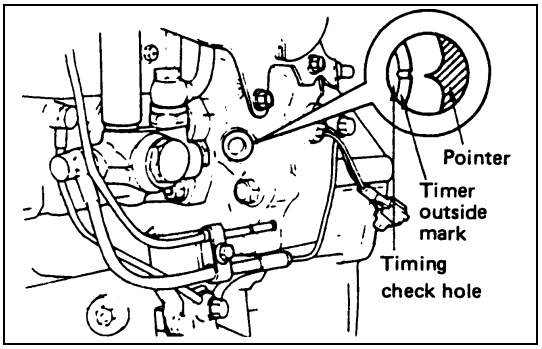


6C-36-1.tif

3) Align the injection pump bracket slit with the timer slit.
4) Install the injection pump assembly to the cylinder body.

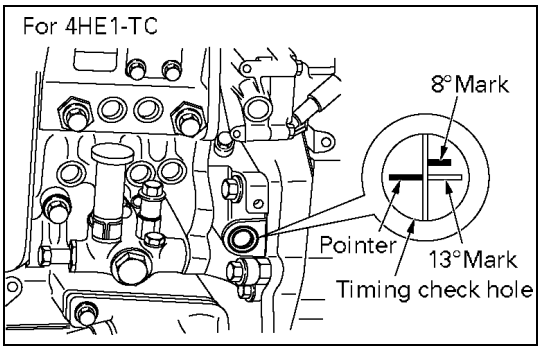
NOTE:

When the injection pump has a poor gear engagement while installing the assembly to the cylinder body, insert a screwdriver into the slit on the time peripheral with the pump bracket slit used as a guide, and move it up and down to get it into forcibly.



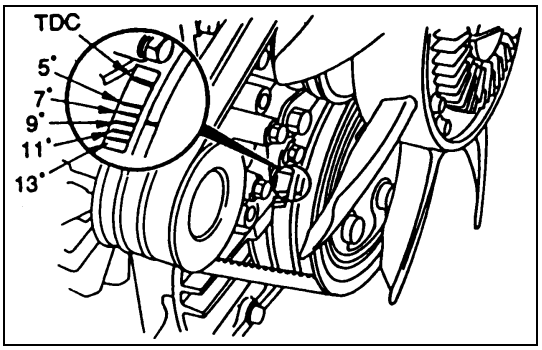
6C-36-2.tif

5) After installing the injection pump, the injection timing can be checked through the timing check hole provided at the injection pump bracket.
   Set the No.1 cylinder to the BTDC (injection timing of engine mode) on the compression stroke. When the pointer of the timing check hole comes in line with the mark on the timer periphery of the injection pump as shown in the illustration, the injection timing is normal.
   After completion of the injection timing check, tighten the check hole plug to the specified torque.



140RW080.tif

Injection Timing	deg
4HF1: 4HE1-TC	BTDC 8
4HG1	BTDC 9
4HG1-T	BTDC 7 (Except Colombia) BTDC 9 (For Colombia)
4HE1-T	BTDC 7

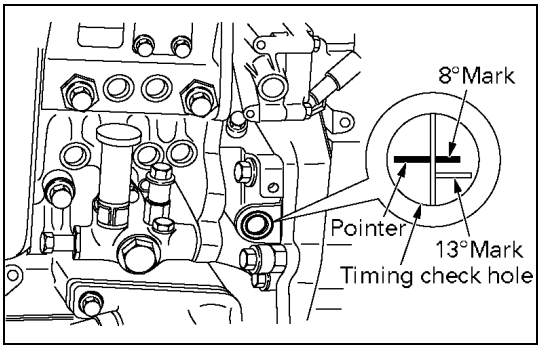


6C-36-4.tif

6) Turn the crankshaft until the timing mark on the crankshaft damper pulley is aligned with “8°” line

NOTE:

Position in its normal rotating direction. (for 4HE1-TC only)

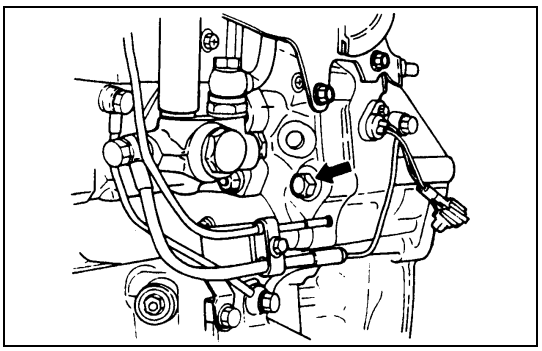


140RW079.tif

7) Adjust injection pump downward so that the “8°” comes to position in the timing check hole.
   (for 4HE1-TC only)

NOTE:

Whenever the injection pump is replaced, be sure to adjust the injection timing. For the details of the adjustment, refer to the “SECTION 00 SERVICING: INJECTION TIMING INSPECTION AND ADJUSTMENT”.


6C-37-1.tif

8) Tighten the injection pump bracket nuts and bolts to the specified torque.

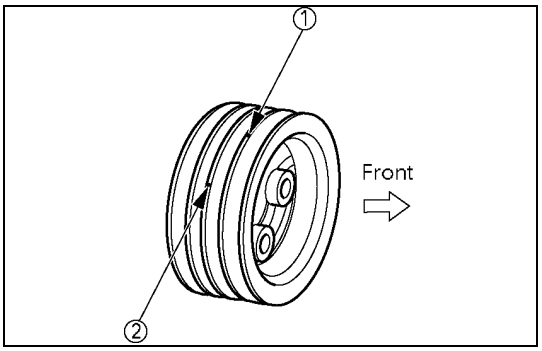
Injection Pump Bracket Nut and Bolt Torque	N·m (kg·m/lb·ft)
	48 (4.9/35)

9) Install the injection pump rear bracket.

Injection Pump Rear Bracket Bolt Torque	N·m (kg·m/lb·ft)
	48 (4.9/35)

10) Install the inspection hole plug.

Inspection Hole Plug Torque	N·m (kg·m/lb·ft)
	48 (4.9/35)

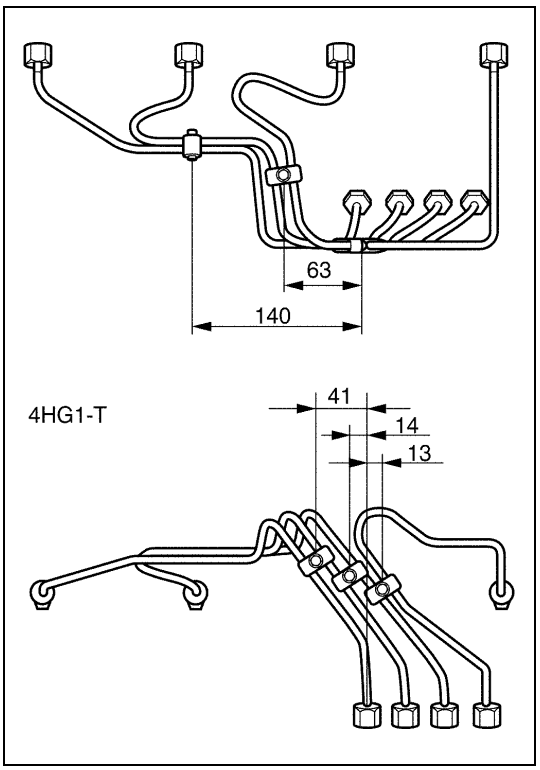


012RW133.tif

Note:

In case the crank pulley has two marks as illustrated, ① BTDC 49° mark on the second crest and ② TDC mark on the third crest (as viewed from the front side), be sure to set at the mark ②. (If there are two different marks on one and same crest, set at the mark which comes second when rotated in the normal direction.)

The mark ① is used when installing the injection pump for 4HF1-2.



040LX020.tif

16. Fuel Injection Pipe

1) Install the injection pipe assembly and temporarily tighten the injection pipe sleeve nuts.
2) Set the clips in the prescribed position shown in the illustration.

CAUTION:

Make absolutely sure that the clip is correctly positioned.

An improperly positioned clip will result in injection pipe breakage and fuel pulsing noise.

Clip Screw Torque	N·m (kg·m/lb·in)
	3 (0.3/26)

3) Tighten the injection pipe sleeve nuts to the specified torque.

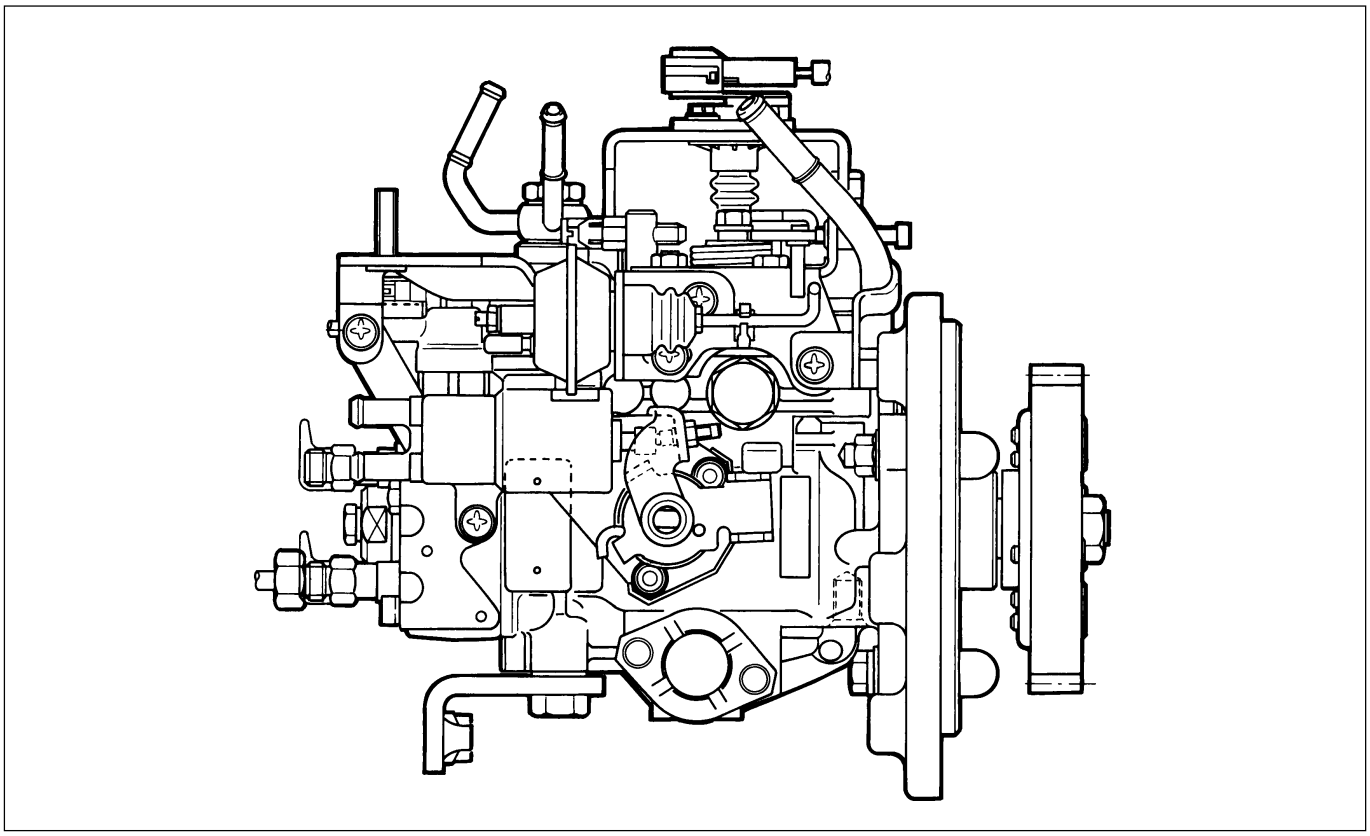
Injection Pipe Sleeve Nut Torque	N·m (kg·m/lb·ft)
	29 (3/22)

15. PCV Hose

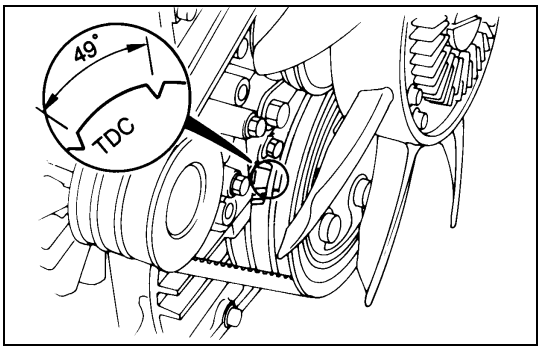
14. Fuel Filter

Fuel Filter Bracket Bolt Torque	N·m (kg·m/lb·ft)
	34 (3.5/25)

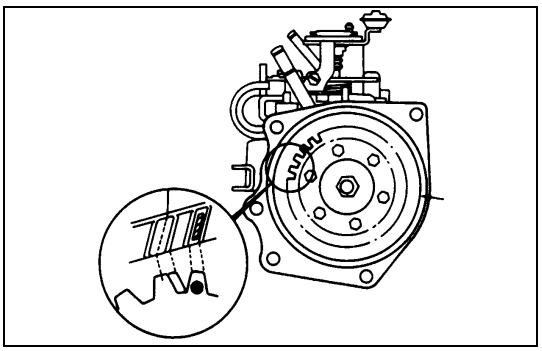
INJECTION PUMP ASSEMBLY (4HF1-2 model only)



6C-38-1.tif



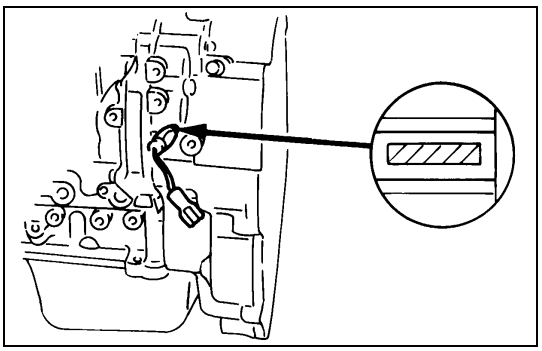
6C-38-2.tif



6C-38-3.tif

INSTALLATION

1) Turn the crankshaft to set No. 1 cylinder to 49° before TDC in its compression stroke.
   (49° is a pump assembling angle, not related to injection timing.)
2) Install O-ring to the injection pump.
3) Apply paint on the ● (Z) marked side of the injection pump gear.
4) Align the pump bracket mark with the tooth (under side of the pump) just before the ● (Z) marked tooth.
5) Insert the pump using the block side of stud bolt as a guide.



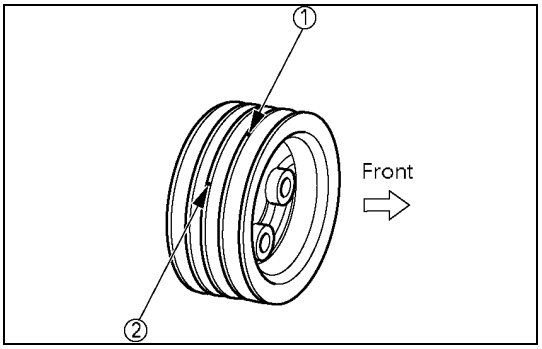
6C-39-1.tif

6) After installing the injection pump, remove the tachometer sensor from the housing, and make sure that the painted gear is at the center of the sensor mounting hole.
7) Tighten injectin pump clamping bolt and nut to specified torque:

Bolt Tightening Torque	N·m (kg·m/lb·ft)
48 (4.9/35)	

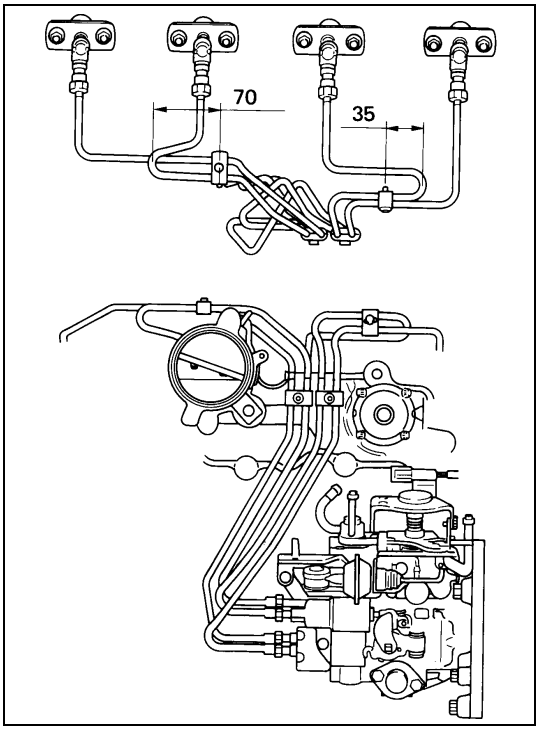
Nut Tightening Torque	N·m (kg·m/lb·ft)
24 (2.4/17)	

8) With reference to Injection Timing Check & Adjustment, set No. 1 Cylinder to 12° before its TDC.



012RW133.tif

Note:
In case the crank pulley has two marks as illustrated, ① BTDC 49° mark on the second crest and TDC mark on the third crest (as viewed from the front side), be sure to set at the mark ②. (If there are two different marks on one and same crest, set at the mark which comes second when rotated in the normal direction.)



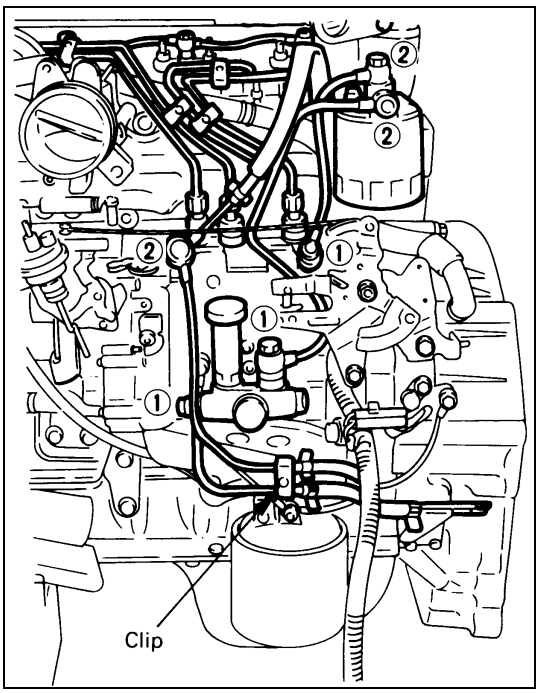
6C-39-3.tif

Injection Pipe (4HF1-2 model only)

1) Connect Injection Pipe and fix with clips as illustrated.

Injection Pipe Tightening Torque	N·m (kg·m/lb·ft)
29 (3.0/22)	

Clip Tightening Torque	N·m (kg·m/lb·in)
3 (0.3/26)	



6C-40-1.tif

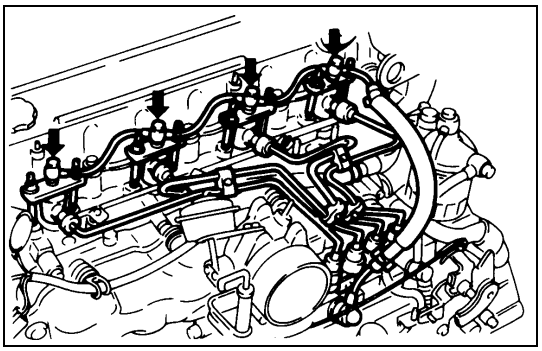
13. Fuel Pipe

Do not apply excessive force to the fuel pipe.

Fuel Pipe Joint Bolt ① Torque	N·m (kg·m/lb·ft)
41 (4.2/30)	

Fuel Pipe Joint Bolt ② Torque	N·m (kg·m/lb·ft)
23 (2.3/17)	

Clip Screw Torque	N·m (kg·m/lb·in)
4 (0.4/35)	



6C-40-2.tif

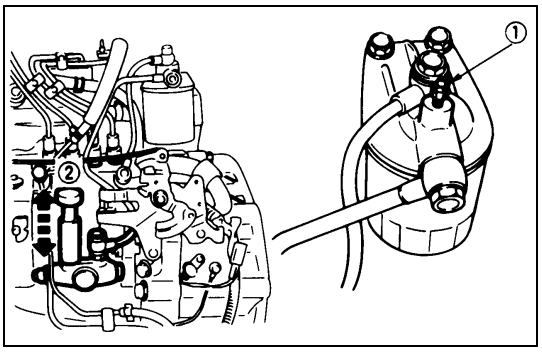
12. Leak Off Pipe

Leak-Off Pipe Joint Bolt Torque	N·m (kg·m/lb·in)
13 (1.3/113)	

11. Nozzle Cover

10. Fuel Feed Hose

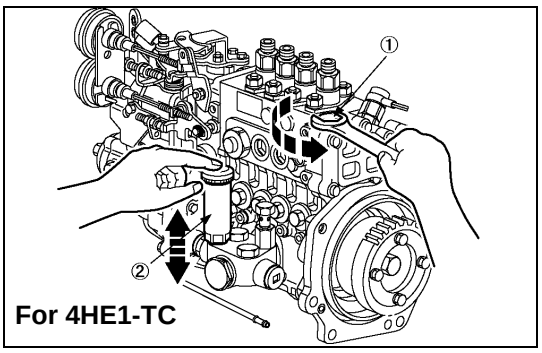
9. Fuel Return Hose



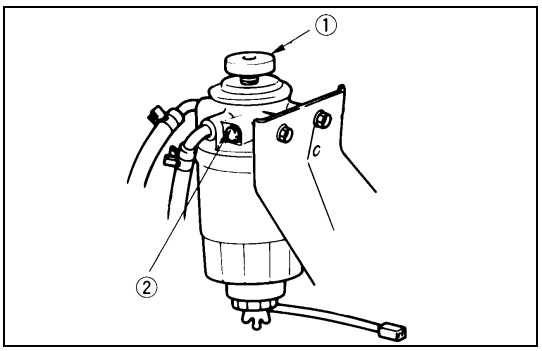
6C-40-3.tif

Air Bleeding

1) Loosen the priming pump cap ② at the side of the injection pump.
2) Loosen the bleeder valve ① at the top of the fuel filter.
3) Operate the priming pump to bleed the air from the injection pump.
4) Retighten the bleeder valve.
5) Operate the priming pump.
   Check for fuel leakage from around the injection pump and the fuel filter.
6) Lock the priming cap to the injection pump.



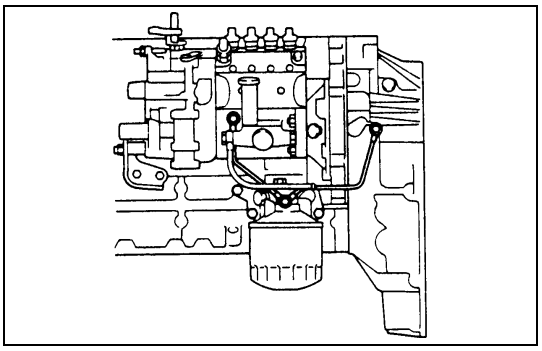
080LW001-1.tif



6C-41-1.tif

Air Bleeding (4HF1-2 model only)

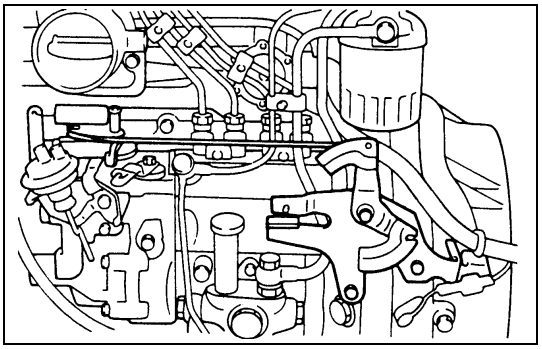
1) Actuate the priming pump ① to send the air in the fuel system to the injection pump.
2) Loosen the sedimenter air bleeding plug ② and operate the priming pump until no bubbles appear.
3) Tighten the air bleeding plug completely.
4) Try to start the engine. If the engine is not started within 10 seconds, air bleeding should be conducted once again.
5) Check that there is not fuel leak, and then tighten the priming pump completely.



6C-41-2.tif

8. Oil Pipe

Oil Pipe Joint Bolt Torque	N·m (kg·m/lb·ft)
	17 (1.7/12)

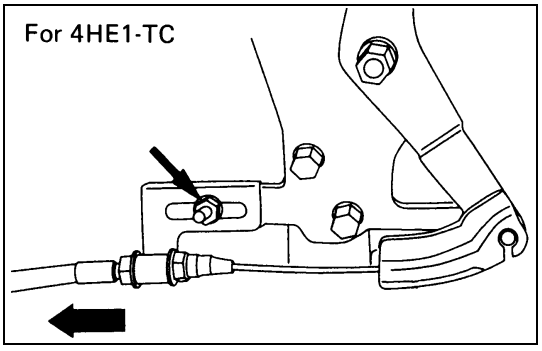


6C-41-3.tif

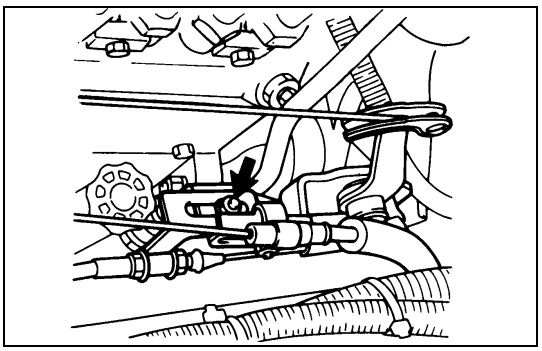
7. Engine Control Lever Assembly

Engine Control Lever Bolt Torque	N·m (kg·m/lb·ft)
	24 (2.4/17)

6. Engine Control Wire



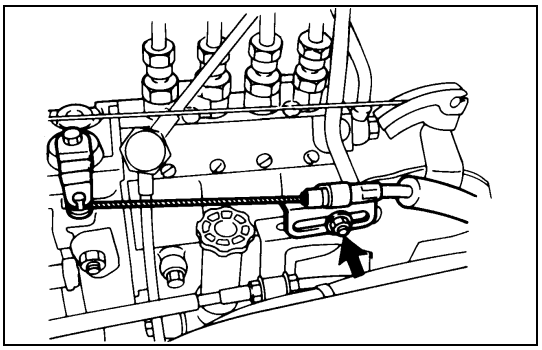
6C-41-4.tif



6C-42-1.tif

5. Accelerator Control Cable

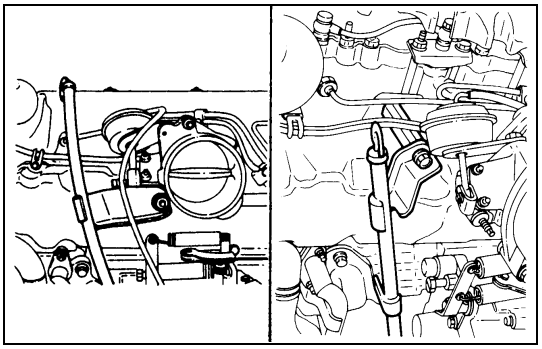
1) Check to see if the idling control knob is turned to the extreme left.
2) Attach the tip end of the cable to the engine control lever.
3) Pull the outer cable toward the front side of the vehicle, and provide the engine control wire and the inner cable with an appropriate play before fastening the clamp with a nut.
4) Check to see if the injection pump control lever is at the idling position (with the lever in touch with the stopper bolt).



6C-42-2.tif

4. Engine Stop Cable

1) Attach the end tip of the cable to the engine stop lever.
2) Pull the cable toward the rear side of the vehicle, and fasten the clamp with a nut at the position where the lever stops.



6C-42-3.tif

3. Oil Level Gauge Guide Tube

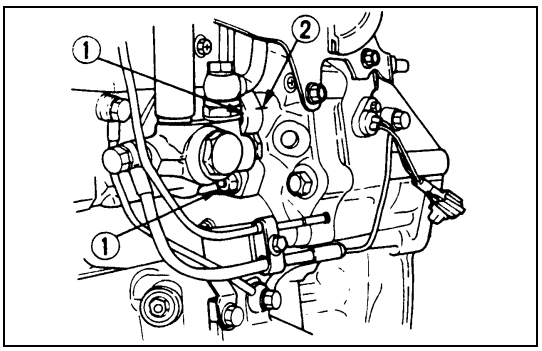
1) Install the O-rings to the guide tube lower portion and insert the guide tube completely to the cylinder body.
2) Tighten the guide tube bolt to the specified torque.

Guide Tube Bolt Torque	N·m (kg·m/lb·in)
	13 (1.3/113)

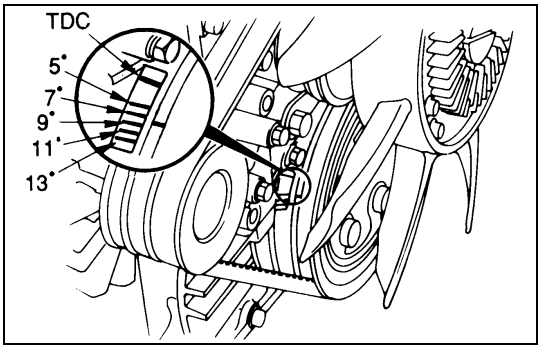
2. Vacuum Hose

1. Intake Air Duct

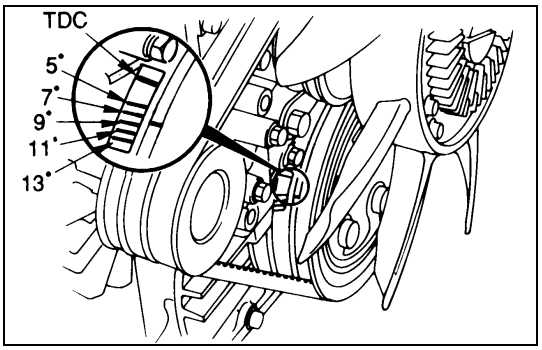
- Pour coolant into radiator.
- Connect battery ground cable.
- Start engine and check for oil and fuel leakage carefully.



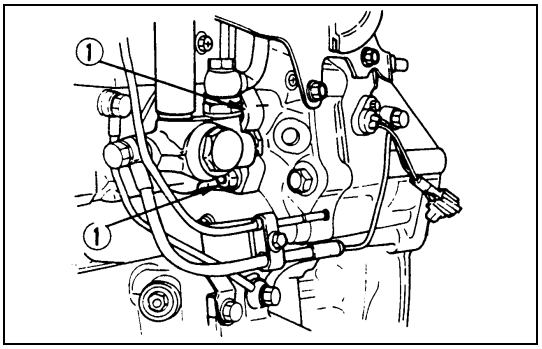
6C-43-1.tif



6C-43-2.tif



6C-43-3.tif



6C-43-4.tif

INJECTION TIMING ADJUSTMENT

Injection Pump Notched Line Inspection

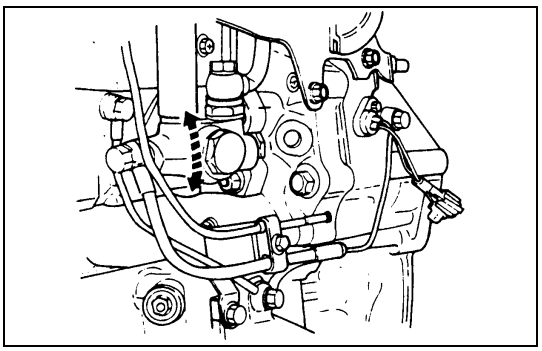
1) Check the injection pump bracket nuts ① for looseness.
   Tighten as required.
2) Check that the notched lines ② on the injection pump bracket and the timing gear case are aligned.
   If the notched lines are not aligned, the injection timing must be checked.
3) Same time, check injection timing on the crank damper pulley. If the injection timing aligned with incorrect, the injection timing must be readjusted.

Injection Timing Adjustment (Except 4HF1-2 model)

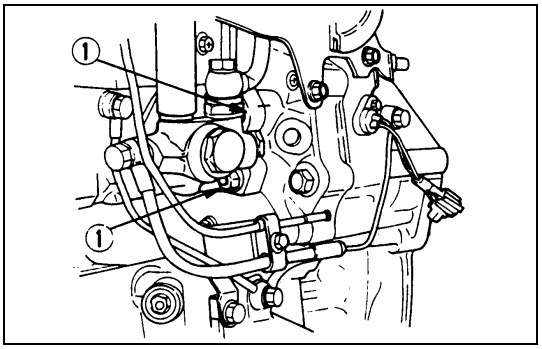
1) Turn the crankshaft until the timing mark on the crankshaft damper pulley is aligned with the injection timing of each engine mode mark in the illustration.

Injection Timing	deg
4HF1 : 4HE1-TC	BTDC 8
4HG1	BTDC 9
4HG1-T : 4HE1-T	BTDC 7

2) Remove the two foam rubbers.
3) Loosen the four injection pump fixing nuts ①.
   This will allow the pump to pivot.
   Do not bend or scratch the fuel pipe.
4) Aligne the notched line between the injection pump bracket and the timing gear case.
   Make sure that the timing mark on the crank damper pulley is aligned with correct injection timing.



6C-44-1.tif



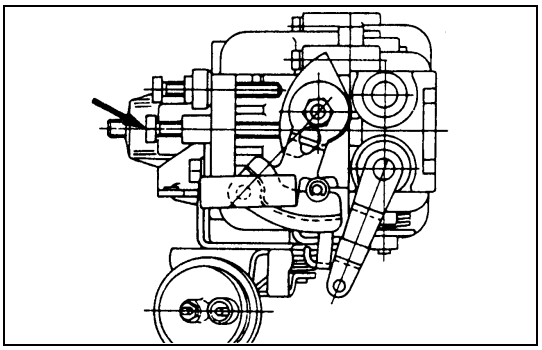
6C-44-2.tif

5) Tighten the injection pump fixing nuts ① to the specified torque.

Injection Pump Fixing Nut Torque	N·m (kg·m/lb·ft)
	25 (2.6/19)

Note:

If there are two marks on the crank pulley, the front side of mark is for setting BTDC 49° and the rear side of mark is for setting TDC.



6C-44-3.tif

Idling Speed Adjustment (Except 4HF1-2 model)

1. Idling Rotation Check
   1) Idle the engine.
   2) Measure the number of the idling rotations with a tachometer.
   3) When the number of the idling rotations is outside the specified value, adjust it with the idling adjust bolt (arrow-marked).

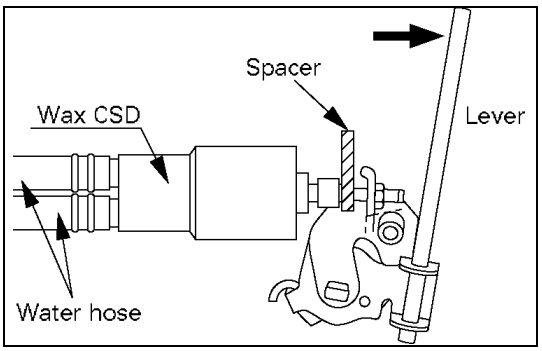
   Number of idling rotations:

   550 to 600 rpm (at M/T standard)

   640 to 690 rpm (at A/T standard)

   (4HE1-TC)

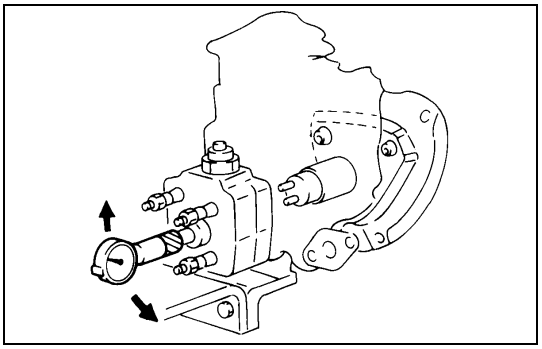
   775 to 825 rpm (at M/T and A/T standard)



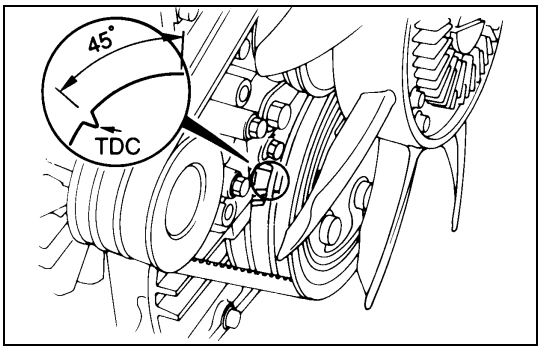
080LX001.tif

Injection Timing Check (4HF1-2 model only)

1) Set No. 1 Cylinder to the TDC in the compression stroke.
2) Disconnect Injection Pipe.
3) Put down Wax CSD lever, insert a spacer (10 ~ 12 mm/0.39 ~ 0.47 in) thick between the plunger and adjust bolt, and cancel the Wax CSD.

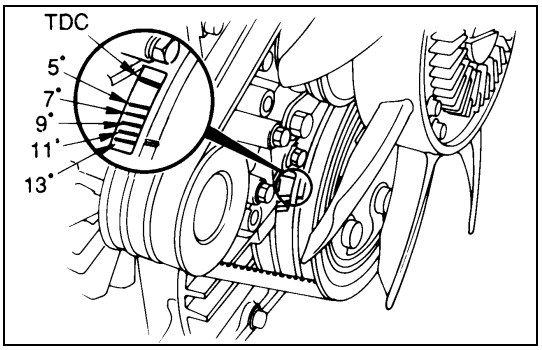

6C-45-2.tif

4) Remove the pump rear plug, connect a dial gage and set the lift at 1 mm (0.039 in).
   Special Tool
   Measuring device: 5-9940-0145-0



6C-45-3.tif

5) Set the crankshaft damper pulley TDC mark to the pointer or 45° before TDC.
6) Set the dial gage to the “0” position.
7) Turn the crankshaft leftwise and rightwise a little and make sure that the needle stays in the “0” position.



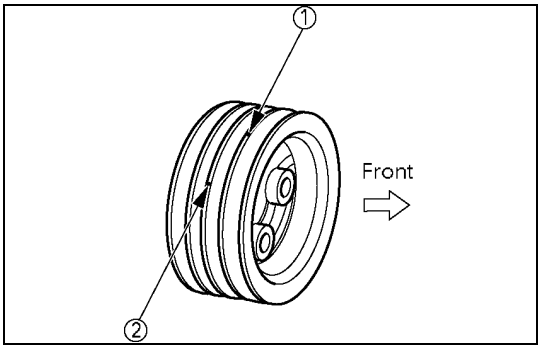
6C-45-4.tif

8) Turn the crankshaft in the normal direction and read the measuring device’s indication at the 12° before TDC position.

NOTE:

As there is no 12° mark, set midway between the 11° and 13° marks.

Standard value: 0.5 mm (0.0197 in)

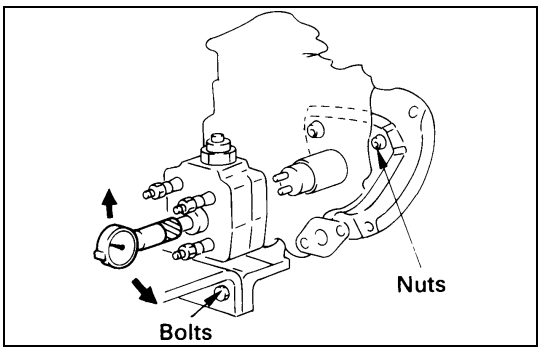


012RW133.tif

Note:

In case the crank pulley has two marks as illustrated, ① BTDC 49° mark on the second crest and ② TDC mark on the third crest (as viewed from the front side), be sure to set at the mark ②. (If there are two different marks on one and same crest, set at the mark which comes second when rotated in the normal direction.)

The mark ① is used when installing the injection pump for 4HF1-2.



6C-46-1.tif

Injection Timing Adjustment (4HF1-2 model only)

If injection timing is out of the specified range, follow the following procedure for adjustment:

1) Loosen injection pump fixing nuts and bracket bolt.
2) Adjust the mounting angle of injection pump:
- If injection timing is too fast, bring the injection pump closer to the engine.
- If injection timing is too slow, put the injection pump more distant from the engine.
3) When the dial gage has indicated the specified value, tighten the fixing nuts and bolt to specified torque.

Nut Tightening Torque	N·m (kg·m/lb·ft)
24 (2.4/17)	

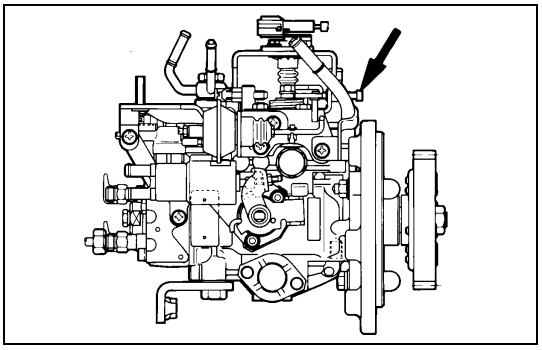
Bolt Tightening Torque	N·m (kg·m/lb·ft)
48 (4.9/35)	

4) Disconnect the dial gage, install and tighten the plug to specified torque. (Make sure of a coper washer being attached to the plug)

Plug Tightenng Torque	N·m (kg·m/lb·ft)
17 (1.7/12)	

5) Release the wax CSD and connect the injection pipe.

Pipe Sleeve Nut Tightening Torque	N·m (kg·m/lb·ft)
29 (3.0/22)	



6C-46-2.tif

IDLING SPEED CHECK & ADJUSTMENT (4HF1-2 model only)

1) Warm up the engine.
2) Measure idling speed by means of tachometer.
3) If idling speed is out of the standard, adjust with an idling adjust bolt (indicated by and arrow mark).
   Idling speed: 575 - 625 rpm

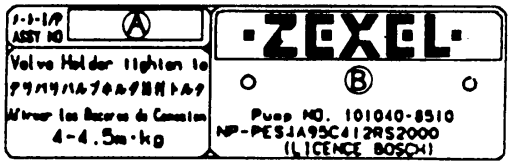
INJECTION PUMP DATA

INJECTION VOLUME ADJUSTMENT

TEST CONDITIONS

4HF1 Engine

Item		Condition
Injection nozzle and holder assembly		ZEXEL Part No.: 105118-6050
Injection nozzle		ZEXEL Part No.: 105017-1860
Nozzle holder		ZEXEL Part No.: 105048-3673
Injection nozzle opening pressure	kg/cm^2 (psi/kPa)	185 (2,631/18,142)
Injection line dimensions		
Inside diameter	mm (in)	2.0 (0.079)
Outside diameter	mm (in)	6.0 (0.236)
Length	mm (in)	500 (19.7)
Fuel delivery pressure	kg/cm^2 (psi/kPa)	1.6 (22.75/156.9)
Test fuel		SAE Standard Test Diesel Fuel (SAE J967d) ISO Standard Test Diesel Fuel (ISO 4113)
Test fuel temperature	°C (°F)	40 - 45 (104 - 113)
Identification numbers		101401-7070 101401-7060 101401-7090 101401-7311



Ⓐ Isuzu Part No. (Pump Assembly No.)
Ⓑ ZEXEL Pump Assembly No.

6C-47-1.tif

IDENTIFICATION PLATE AND NUMBER

Use the data following the injection pump identification number to adjust the injection volume.

INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

Identification Numbers : 101401-7070/101401-7060
[4HF1 Engine]
Pre-stroke : No. 1 plunger 4.1 ± 0.05 mm
Injection order : 1 - 3 - 4 - 2 (interval 90° ± 30') Plungers are numbered from the Governor side
Tappet clearance : Bolt adjustment type : More than 0.3 mm for all cylinders.
: Shim adjustment type : Manually rotate the camshaft 2-3 times and confirm that it rotates smoothly.

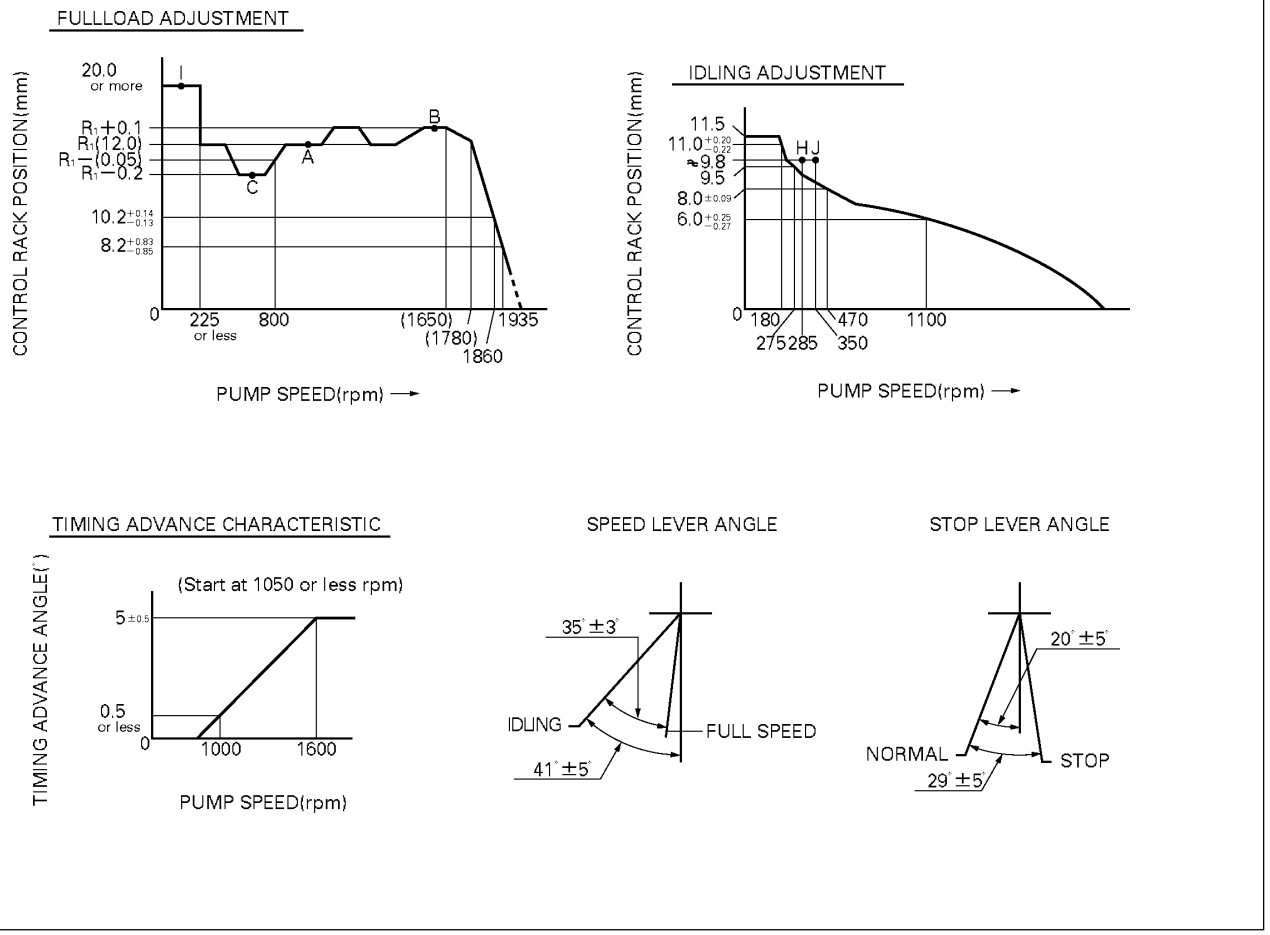
Injection Volume

Adjusting point	Pump speed (r.p.m.)	Injection volume (cc/1000 strokes)	Variance (%)	Remarks
	960	61 ± 1.6	±4	Basic
H	285	16 ± 1.3	±10.0	
A	960	61 ± 1	-	Basic
B	1,600	(62) ± 2	-	
C	500	(60.5) ± 2	-	
I	150	(82) $^{+16}_{-0}$	-	

Timing Advance Specification

Pump Speed (r.p.m.)	1,050 or less	1,000	1,600 or more
Degree for Angle of Lead (deg.)	Start	0.5 or less	Finish 5 ± 0.5

Governor Adjustment



B06LT001-1.tif

INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

Identification Numbers : 101401-7090
[4HF1 Engine]
Pre-stroke : No. 1 plunger 4.1 ± 0.05 mm
Injection order : 1 - 3 - 4 - 2 (interval 90° ± 30') Plungers are numbered from the Governor side
Tappet clearance : Bolt adjustment type : More than 0.3 mm for all cylinders.
: Shim adjustment type : Manually rotate the camshaft 2-3 times and confirm that it rotates smoothly.

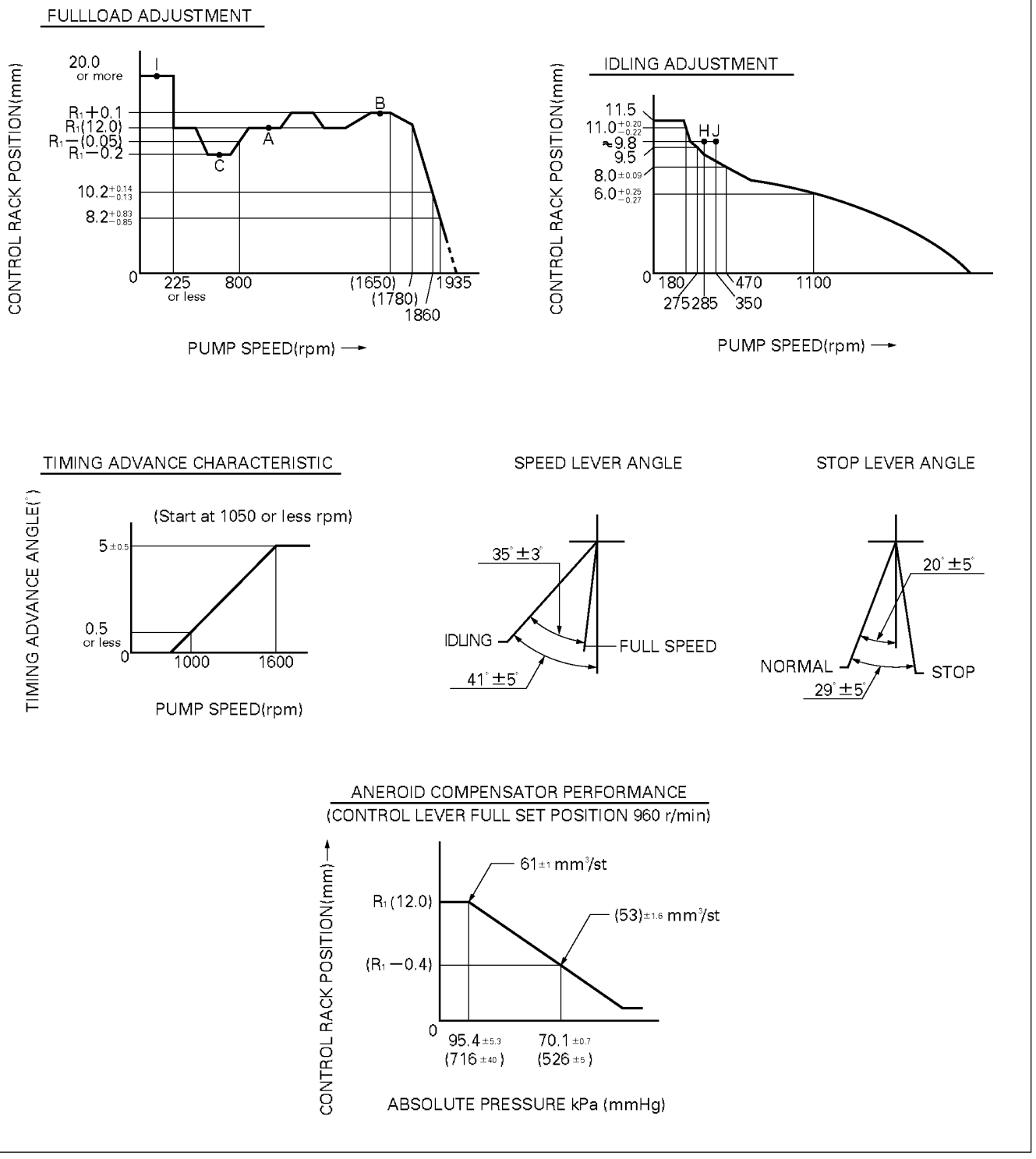
Injection Volume

Adjusting point	Pump speed (r.p.m.)	Injection volume (cc/1000 strokes)	Variance (%)	Remarks
	960	61 ± 1.6	±4	Basic
H	285	16 ± 1.3	±10.0	
A	960	61 ± 1	-	Basic
B	1,600	(62) ± 2	-	
C	500	(60.5) ± 2	-	
I	150	(82) $^{+16}_{-0}$	-	

Timing Advance Specification

Pump Speed (r.p.m.)	1,050 or less	1,000	1,600 or more
Degree for Angle of Lead (deg.)	Start	0.5 or less	Finish 5 ± 0.5

Governor Adjustment



B06LT002-1.tif

INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

Identification Numbers : 101401-7311
[4HF1 Engine]
Pre-stroke : No. 1 plunger 4.1 ± 0.05 mm
Injection order : 1 - 3 - 4 - 2 (interval 90° ± 30') Plungers are numbered from the Governor side
Tappet clearance : Bolt adjustment type : More than 0.3 mm for all cylinders.
: Shim adjustment type : Manually rotate the camshaft 2-3 times and confirm that it rotates smoothly.

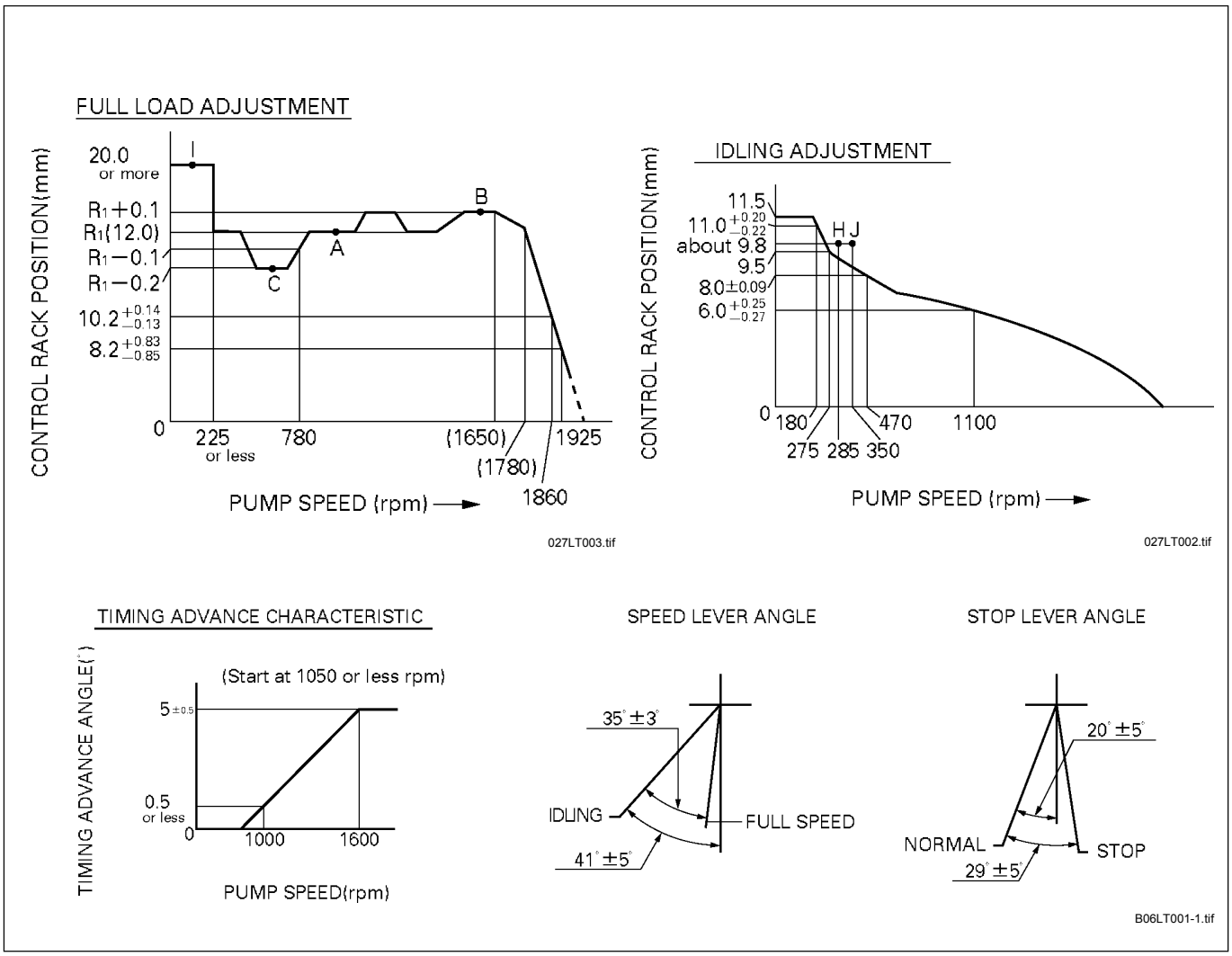
Injection Volume

Adjusting point	Pump speed (r.p.m.)	Injection volume (cc/1000 strokes)	Variance (%)	Remarks
	960	61 ± 1.6	±4	Basic
H	285	16 ± 1.3	±10.0	
A	960	65 ± 1	-	Basic
B	1,600	(62) ± 2	-	
C	500	(63.5) ± 2	-	
I	150	(82) $^{+16}_{-0}$	-	

Timing Advance Specification

Pump Speed (r.p.m.)	1,000	1,600 or more
Degree for Angle of Lead (deg.)	0.5 or less	Finish 5 ± 0.5

Governor Adjustment

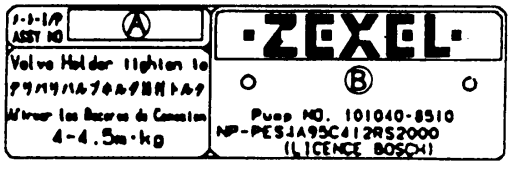


INJECTION VOLUME ADJUSTMENT

TEST CONDITIONS

4HF1-2 (Bosch distributor type)

Item		Condition
Injection nozzle and holder assembly		ZEXEL Part No.: -
Injection nozzle		ZEXEL Part No.: 105780-0060
Nozzle holder		ZEXEL Part No.: 105780-2150
Injection nozzle opening pressure	kg/cm^2 (psi/kPa)	133 (1,891 / 1,304)
Injection line dimensions		
Inside diameter	mm (in)	2.0 (0.079)
Outside diameter	mm (in)	6.0 (0.236)
Length	mm (in)	450 (17.7)
Fuel delivery pressure	kg/cm^2 (psi/kPa)	0.2 (2.84/19.6)
Test fuel		SAE Standard Test Diesel Fuel (SAE J967d) ISO Standard Test Diesel Fuel (ISO 4113)
Test fuel temperature	°C (°F)	40 - 45 (104 - 113)
Identification numbers		104742-1630



Ⓐ Isuzu Part No. (Pump Assembly No.)
Ⓑ ZEXEL Pump Assembly No.

6C-54-1.tif

IDENTIFICATION PLATE AND NUMBER

Use the data following the injection pump identification number to adjust the injection volume.

INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

Identification Numbers : 104742-1630
[4HF1-2 Engine]
Pre-stroke : No. 1 plunger 0.45 ± 0.05 mm
Injection order : 1 - 3 - 4 - 2 (interval 90° ± 30') Plungers are numbered from the Governor side

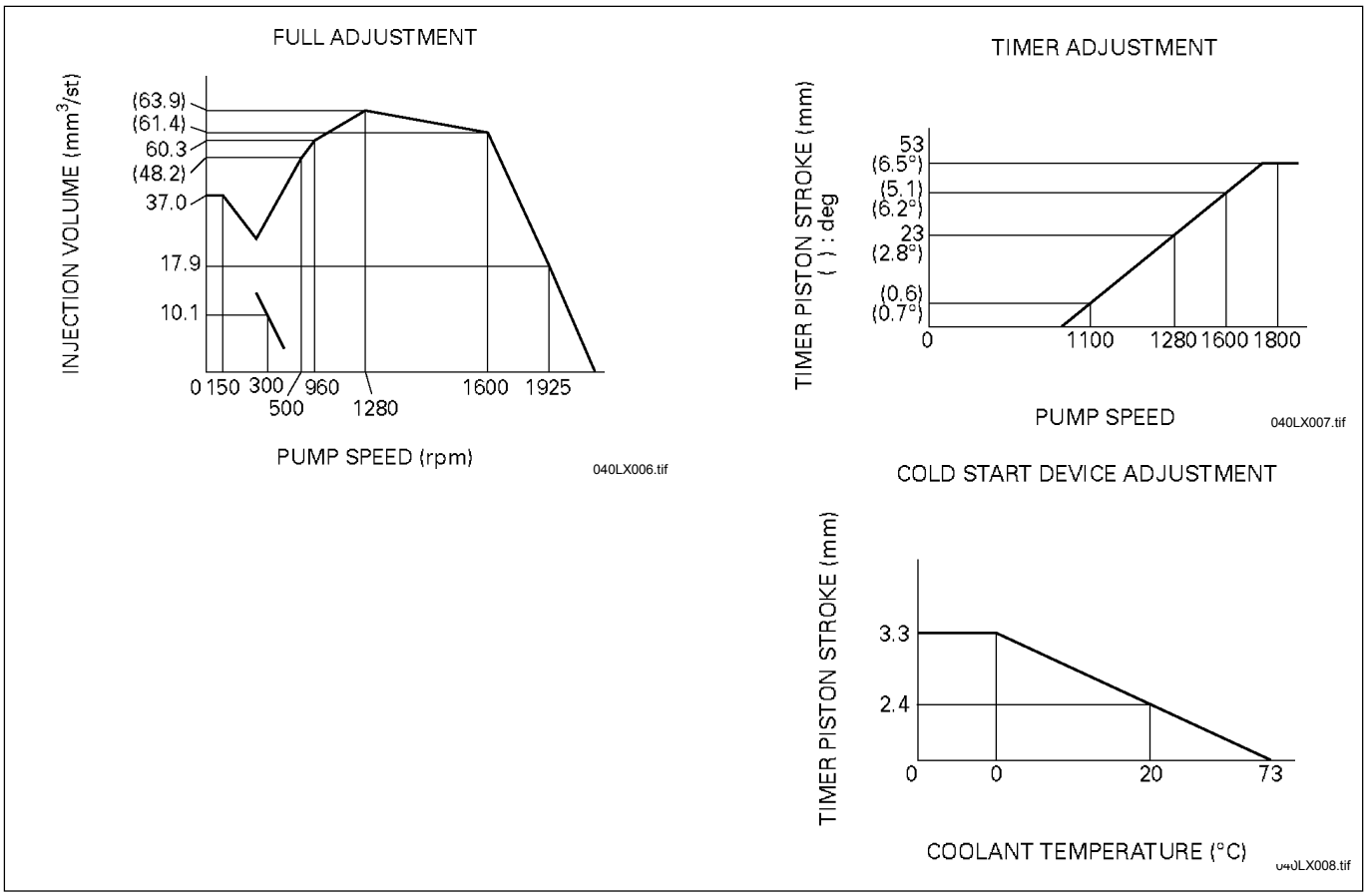
Injection Volume

Pump speed (r.p.m.)	Injection volume (mm^3/strokes)	Uneven amplitude (mm^3/strokes)	Oil temperature (°C)	Remarks
500	(48.2 ± 4.5)	-	48 ± 2	
960	60.3 ± 1.0	5.0	50 ± 2	Basic
1280	(63.9 ± 3.5)	-	50 ± 2	
1600	(61.4 ± 4.5)	-	50 ± 2	
1925	17.9 ± 3.0	5.5	50 ± 2	Basic
300	10.1 ± 2.0	2.0	48 ± 2	Basic
150	37.0 ± 10	-	48 ± 2	

Timing Advance Specification

Pump Speed (r.p.m.)	1,100	1,280	1,600	1,800
Degree for Angle of Lead (deg.)	0.7	2.8	6.2	Finish 6.5

Governor Adjustment (4HF1-2)

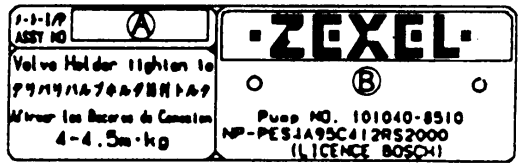


INJECTION VOLUME ADJUSTMENT

TEST CONDITIONS

4HG1 Engine

Item		Condition
Injection nozzle and holder assembly		ZEXEL Part No.: 105118-6041
Injection nozzle		ZEXEL Part No.: 105017-1850
Nozzle holder		ZEXEL Part No.: 105048-3673
Injection nozzle opening pressure	kg/cm^2 (psi/kPa)	185 (2,631/18,142)
Injection line dimensions		
Inside diameter	mm (in)	2.0 (0.079)
Outside diameter	mm (in)	6.0 (0.236)
Length	mm (in)	600 (23.6)
Fuel delivery pressure	kg/cm^2 (psi/kPa)	1.6 (22.75/156.9)
Test fuel		SAE Standard Test Diesel Fuel (SAE J967d) ISO Standard Test Diesel Fuel (ISO 4113)
Test fuel temperature	°C (°F)	40 - 45 (104 - 113)
Identification numbers		101401-7430 101401-7440



Ⓐ Isuzu Part No. (Pump Assembly No.)
Ⓑ ZEXEL Pump Assembly No.

6C-56-1.tif

IDENTIFICATION PLATE AND NUMBER

Use the data following the injection pump identification number to adjust the injection volume.

INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

Identification Numbers : 101401-7430
[4HG1 Engine] : 101401-7440
Pre-stroke : No. 1 plunger 4.1 ± 0.05 mm
Injection order : 1 - 3 - 4 - 2 (interval 90° ± 30') Plungers are numbered from the Governor side
Tappet clearance : Bolt adjustment type : More than 0.3 mm for all cylinders.
: Shim adjustment type : Manually rotate the camshaft 2-3 times and confirm that it rotates smoothly.

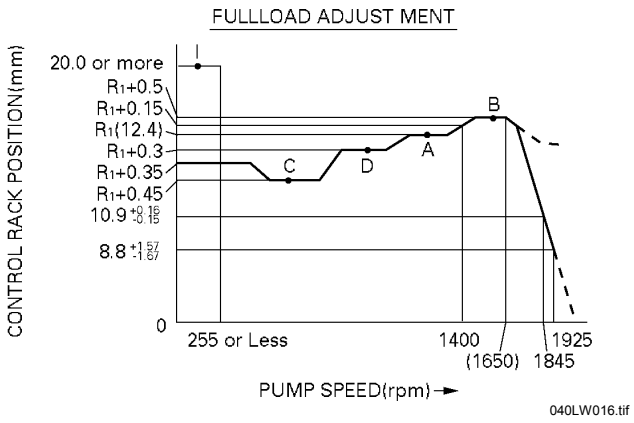
Injection Volume

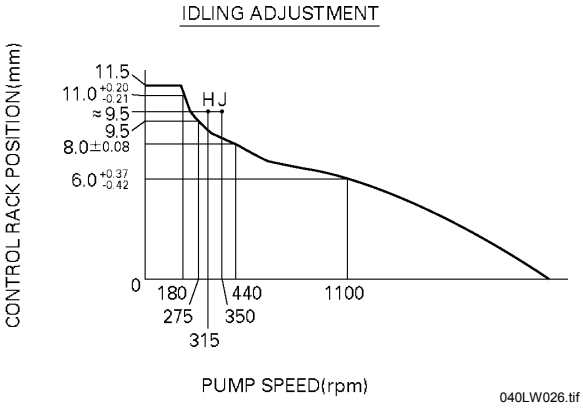
Adjusting point	Pump speed (r.p.m.)	Injection volume (cc/1000 strokes)	Variance (%)	Remarks
	1,310	70.5 ± 1.6	±4	Basic
H	315	10 ± 1.3	±10.0	
A	1,310	70.5 ± 1	-	Basic
B	1,600	(75.5) ± 2	-	
C	520	(64) ± 2	-	
D	960	$(70.5)\ ^{+2}_{-0}$	-	
I	150	$(95)\ ^{+16}_{-0}$	-	

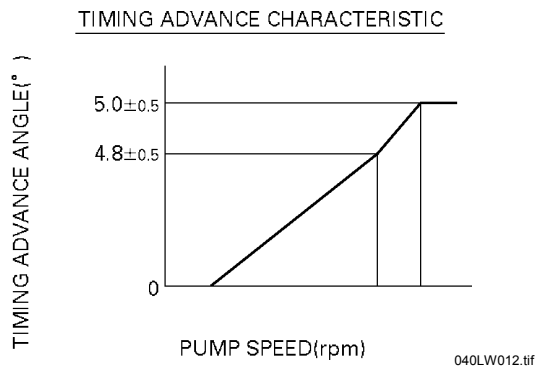
Timing Advance Specification

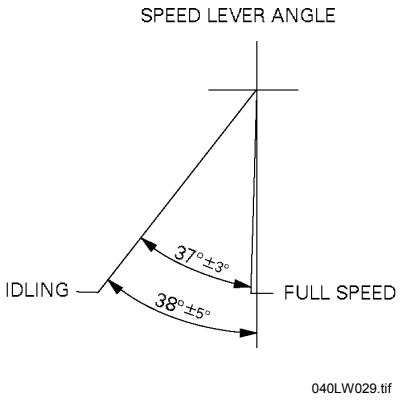
Pump Speed (r.p.m.)	1,050 or less	1,000	1,600 or more
Degree for Angle of Lead (deg.)	Start	0.5 or less	Finish 5 ± 0.5

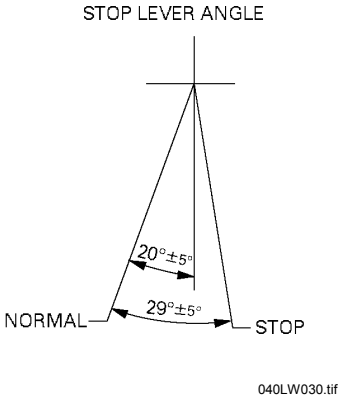
Governor Adjustment

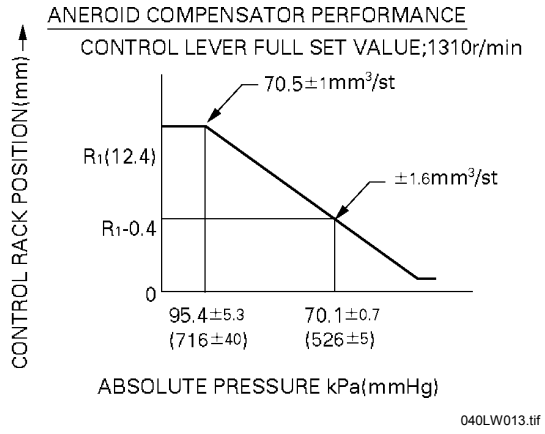










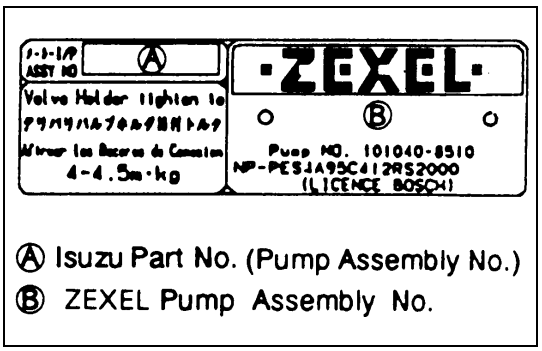


INJECTION VOLUME ADJUSTMENT

TEST CONDITIONS

4HG1-T

Item		Condition
Injection nozzle and holder assembly		ZEXEL Part No.: 105118-7541
Injection nozzle		ZEXEL Part No.: 105017-2650
Nozzle holder		ZEXEL Part No.: 105048-4280
Injection nozzle opening pressure	kg/cm^2 (psi/kPa)	184 (2,616/18,044)
Injection line dimensions		
Inside diameter	mm (in)	2.2 (0.086)
Outside diameter	mm (in)	6.0 (0.236)
Length	mm (in)	600 (23.6)
Fuel delivery pressure	kg/cm^2 (psi/kPa)	2.6 (36.97/254.9)
Test fuel		SAE Standard Test Diesel Fuel (SAE J967d) ISO Standard Test Diesel Fuel (ISO 4113)
Test fuel temperature	°C (°F)	40 - 45 (104 - 113)
Identification numbers		101401-7452



6C-59-1.tif

IDENTIFICATION PLATE AND NUMBER

Use the data following the injection pump identification number to adjust the injection volume.

INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

Identification Numbers : 101401-7452
[4HG1-T Engine]
Pre-stroke : No. 1 plunger 3.8 ± 0.05 mm
Injection order : 1 - 3 - 4 - 2 (interval 90° ± 30') Plungers are numbered from the Governor side
Tappet clearance : Shim adjustment type : Manually rotate the camshaft 2-3 times and confirm that it rotates smoothly.
: Bolt adjustment type : More than 0.3 mm for all cylinders.

Injection Volume

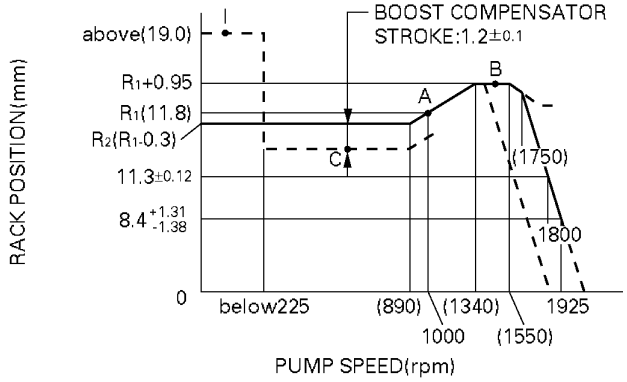
Adjusting point	Rack Position (mm)	Pump Speed (rpm)	Injection q'ty (cm^3/1000 strokes)	Max var bet. cyl. (%)	Fixed	Remarks
	11.5	1000	73.5 ± 1.6	±4	Rack	Basic
H	Approx. 8.9	315	(Measure) ± 1.3	±10	Rack	
A	R1 (11.5)	1000	73.5 ± 1	-	Lever	Basic Boost press. kPa (mmHg) Above 62.0 (Above 465)
B	R1 +1.0	1500	(78.5) ± 2	-	Lever	Boost press. kPa (mmHg) Above 62.0 (Above 465)
C	R2 –0.8	500	(66.5) ± 2	-	Lever	Boost press. 0
I	-	150	(Measure) ± 16	-	Lever	Boost press. 0
						Confirm that the timing of is advanced 1°±30' from A.

Timing Advance Specification

Pump speed (rpm)	Below (N1 + 50)	N1	N3				
Advance angle (°)	Start	Below 0.5	Finish 4.0 ± 0.5				

Governor Adjustment (4HG1-T)

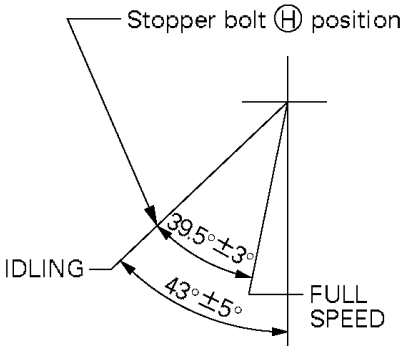
FULL LOAD ADJUSTMENT



Confirm that Vist=2.97±0.28 at N=1500, R=R+0.95
at rack sensor voltage 5±0.01 V.

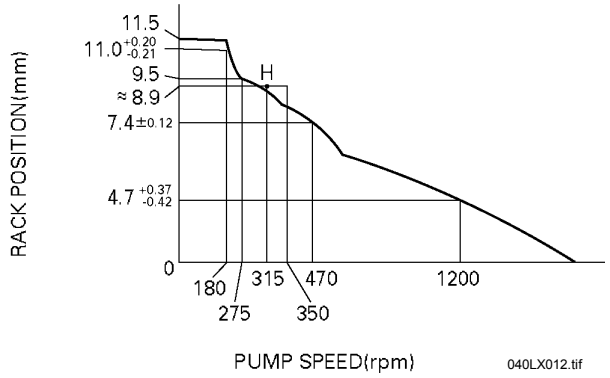
040LX011.tif

SPEED LEVER ANGLE



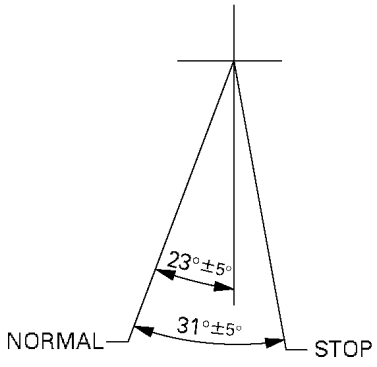
040LX014.tif

IDLING ADJUSTMENT



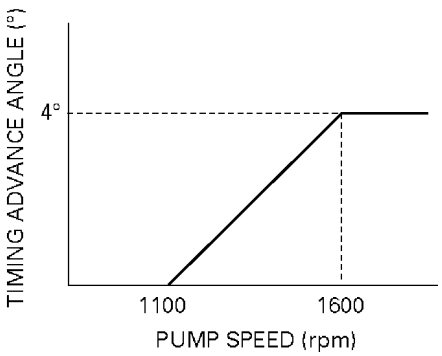
040LX012.tif

STOP LEVER ANGLE



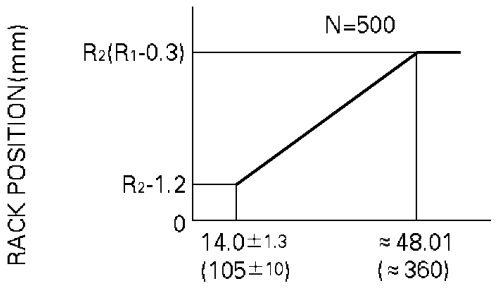
040LX015.tif

TIMING ADVANCE CHARACTERISTIC



040LX003.tif

BOOST COMPENSATOR ADJUSTMENT



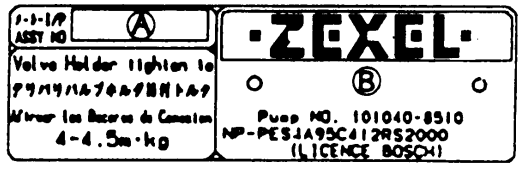
040LX013.tif

INJECTION VOLUME ADJUSTMENT

TEST CONDITIONS

4HE1-T

Item		Condition
Injection nozzle and holder assembly		ZEXEL Part No.: 105048-3831
Injection nozzle		ZEXEL Part No.: 105017-1840
Nozzle holder		ZEXEL Part No.: 105048-3831
Injection nozzle opening pressure	kg/cm^2 (psi/kPa)	185 (2,631/18,142)
Injection line dimensions		
Inside diameter	mm (in)	2.0 (0.079)
Outside diameter	mm (in)	6.0 (0.236)
Length	mm (in)	600 (23.6)
Fuel delivery pressure	kg/cm^2 (psi/kPa)	2.6 (36.97/254.9)
Test fuel		SAE Standard Test Diesel Fuel (SAE J967d) ISO Standard Test Diesel Fuel (ISO 4113)
Test fuel temperature	°C (°F)	40 - 45 (104 - 113)
Identification numbers		101401-7410 101401-7420 101401-7273



Ⓐ Isuzu Part No. (Pump Assembly No.)
Ⓑ ZEXEL Pump Assembly No.

6C-62-1.tif

IDENTIFICATION PLATE AND NUMBER

Use the data following the injection pump identification number to adjust the injection volume.

INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

Identification Numbers : 101401-7410/101401-7420/101401-7273
[4HE1-T Engine]
Pre-stroke : No. 1 plunger 3.8 ± 0.05 mm
Injection order : 1 - 3 - 4 - 2 (interval 90° ± 30') Plungers are numbered from the Governor side
Tappet clearance : Bolt adjustment type : More than 0.3 mm for all cylinders.
: Shim adjustment type : Manually rotate the camshaft 2-3 times and confirm that it rotates smoothly.

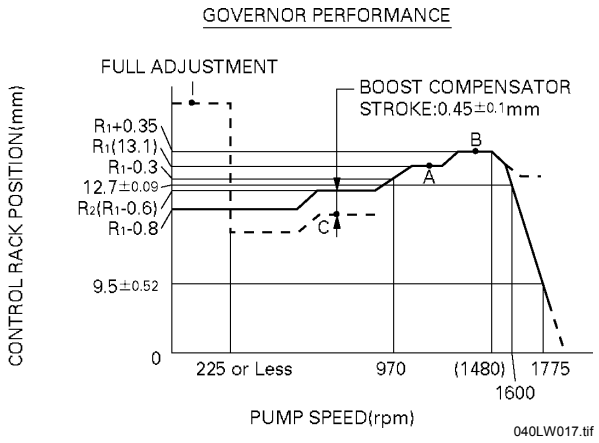
Injection Volume

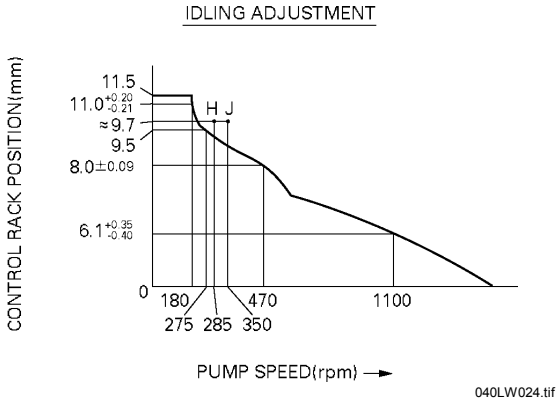
Adjusting point	Pump speed (r.p.m.)	Injection volume (cc/1000 strokes)	Variance (%)	Remarks
	1,160	96.5 ± 1.6	±4	Basic
H	375	14.5 ± 1.3	±10.0	
Z	375	-	-	Basic
A	1,160	96.5 ± 1	-	
B	1,450	(97) ± 2	-	
C	700	(81) ± 2	-	
I	150	(100) $^{+18}_{-0}$	-	

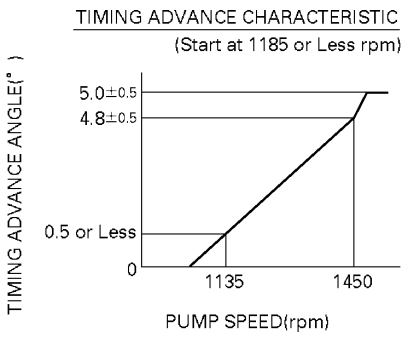
Timing Advance Specification

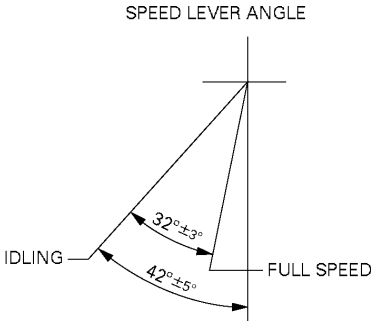
Pump Speed (r.p.m.)	1,185 or less	1,135	1,450 or more
Degree for Angle of Lead (deg.)	Start	0.5 or less	Finish 4.8 ± 0.5

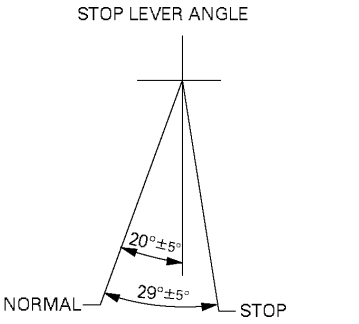
Governor Adjustment

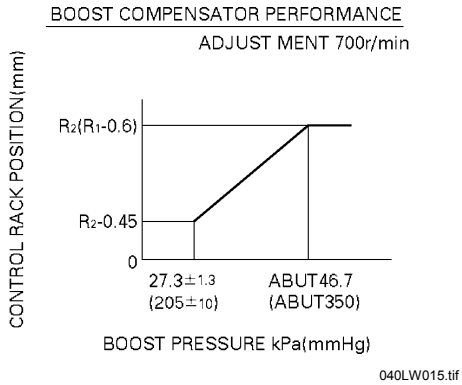










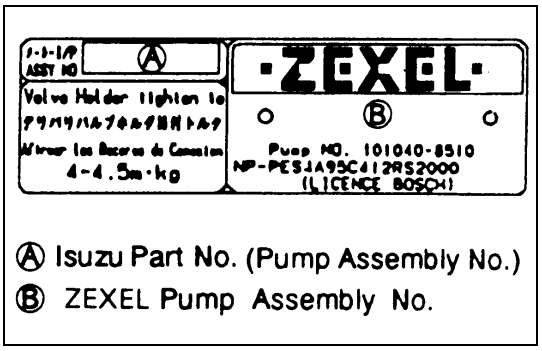


INJECTION VOLUME ADJUSTMENT

TEST CONDITIONS

4HE1-TC Engine

Item		Condition
Injection nozzle and holder assembly		ZEXEL Part No.: 105118-6460
Injection nozzle		ZEXEL Part No.: 105017-2180
Nozzle holder		ZEXEL Part No.: 105048-3673
Injection nozzle opening pressure	kg/cm^2 (psi/kPa)	185 (2,631/18,142)
Injection line dimensions		
Inside diameter	mm (in)	3.0 (0.118)
Outside diameter	mm (in)	8.0 (0.315)
Length	mm (in)	600 (23.6)
Fuel delivery pressure	kg/cm^2 (psi/kPa)	2.6 (36.97/254.9)
Test fuel		SAE Standard Test Diesel Fuel (SAE J967d) ISO Standard Test Diesel Fuel (ISO 4113)
Test fuel temperature	°C (°F)	40 - 45 (104 - 113)
Identification numbers		107492-1023 107492-1062 107492-1032 107492-1100 107492-1110 107492-1120 107492-1130 897212-9350 (ISUZU NO.)



Ⓐ Isuzu Part No. (Pump Assembly No.)
Ⓑ ZEXEL Pump Assembly No.

6C-65-1.tif

IDENTIFICATION PLATE AND NUMBER

Use the data following the injection pump identification number to adjust the injection volume.

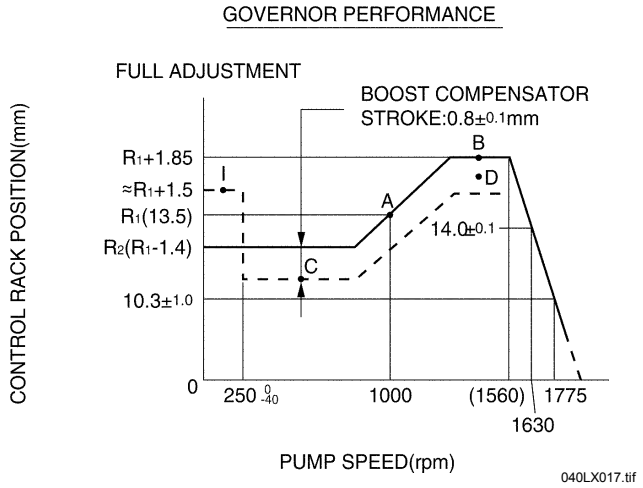
INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

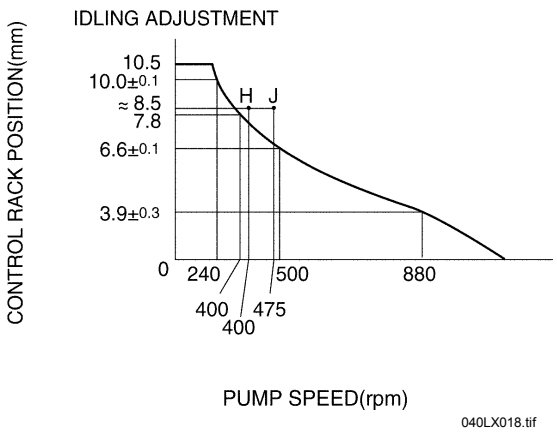
Identification Numbers : 107492-1110
[4HE1-TC Engine]
Pre-stroke : No. 1 plunger 4.0 ± 0.03 mm
Injection order : 1 - 3 - 4 - 2 (interval 90° ± 15') Plungers are numbered from the Governor side
Tappet clearance : Bolt adjustment type : More than 0.3 mm for all cylinders.
: Shim adjustment type : Manually rotate the camshaft 2-3 times and confirm that it rotates smoothly.

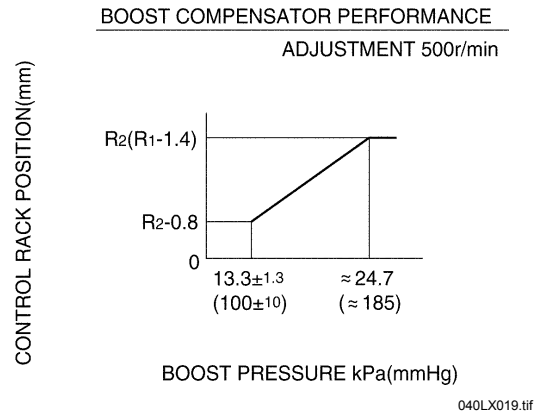
Injection Volume

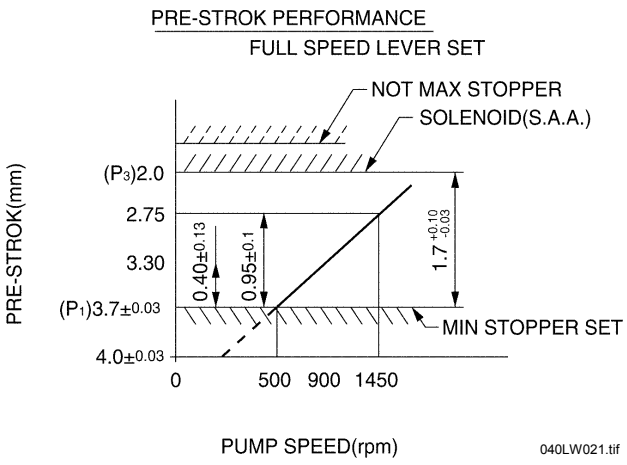
Adjusting point	Pump speed (r.p.m.)	Injection volume (cc/1000 strokes)	Variance (%)	Remarks
	1000	82.5 ± 1.6	± 4	Basic
H	400	19 ± 1.5	± 14	
Z	500	-	-	
A	1000	82.5 ± 1	-	Basic
B	1,450	(92.5) ± 2	-	
C	500	(67)	-	
D	1,450	(89.5)	-	
I	150	(220)	-	

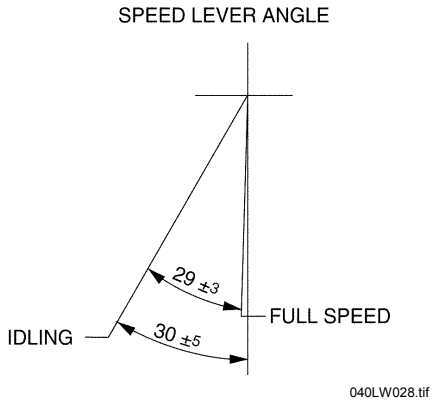
Governor Adjustment











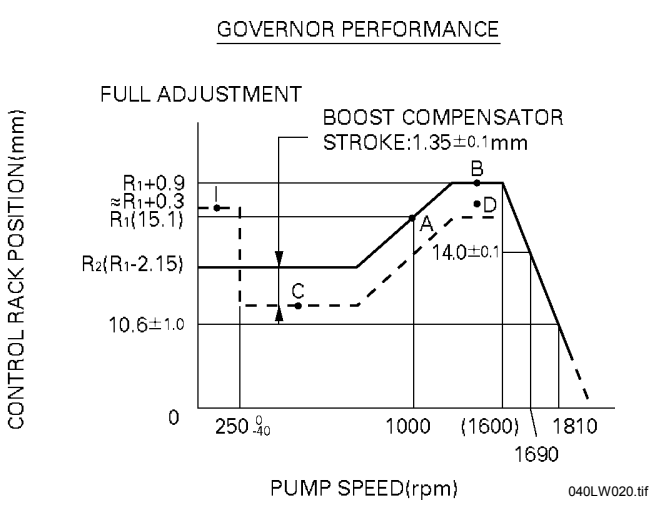
INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

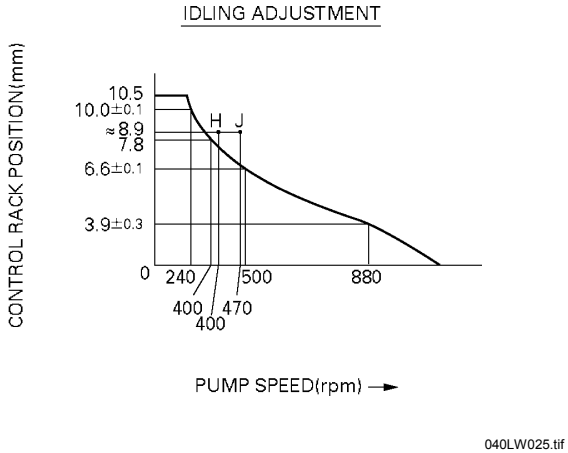
Identification Numbers : 107492-1023 / 107492-1100
[4HE1-TC Engine]
Pre-stroke : No. 1 plunger 4.0 ± 0.03 mm
Injection order : 1 - 3 - 4 - 2 (interval 90° ± 15') Plungers are numbered from the Governor side
Tappet clearance : Bolt adjustment type : More than 0.3 mm for all cylinders.
: Shim adjustment type : Manually rotate the camshaft 2-3 times and confirm that it rotates smoothly.

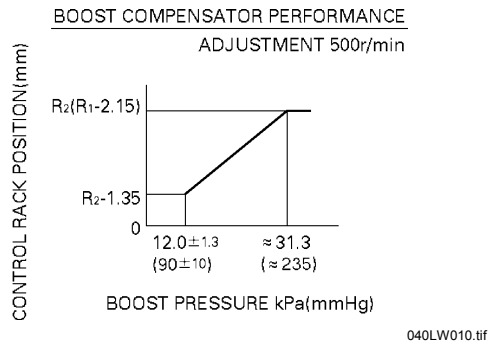
Injection Volume

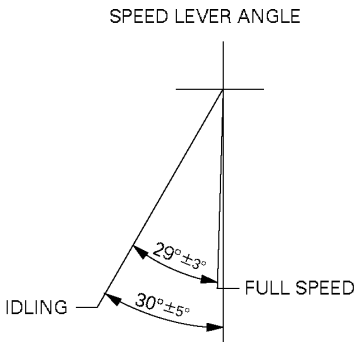
Adjusting point	Pump speed (r.p.m.)	Injection volume (cc/1000 strokes)	Variance (%)	Remarks
	1,000	107.5 ± 1.6	±4	Basic
H	400	22 ± 1.5	±10.0	
Z	510	-	-	Basic
A	1,000	107.5 ± 1	-	
B	1,200	(112.5) ± 2	-	
C	500	(78)	-	
D	1,200	(103)	-	
I	150	(235)	-	

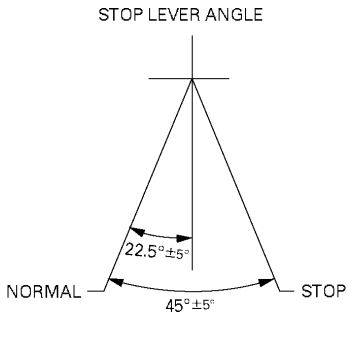
Governor Adjustment

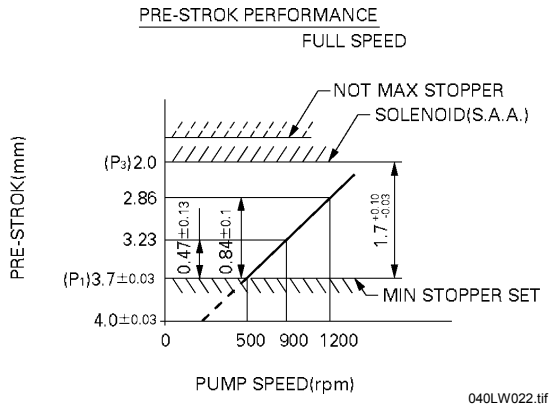












INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

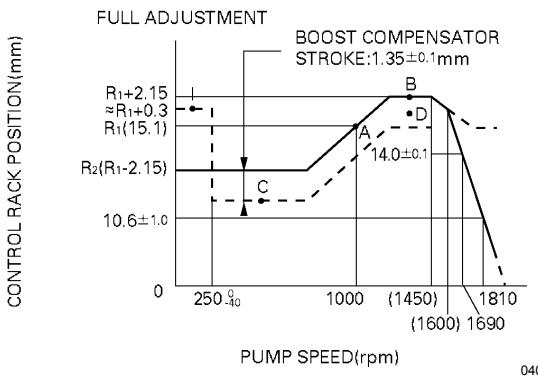
Identification Numbers : 107492-1062 / 107492-1120 / 897212-9350 (ISUZU NO.)
[4HE1-TC Engine]
Pre-stroke : No. 1 plunger 4.0 ± 0.03 mm
Injection order : 1 - 3 - 4 - 2 (interval 90° ± 15')-Plungers are numbered from the Governor side
Tappet clearance : Bolt adjustment type : More than 0.3 mm for all cylinders.
: Shim adjustment type : Manually rotate the camshaft 2-3 times and confirm that it rotates smoothly.

Injection Volume

Adjusting point	Pump speed (r.p.m.)	Injection volume (cc/1000 strokes)	Variance (%)	Remarks
	1,000	107.5 ± 1.6	± 4	Basic
H	400	22 ± 1.5	± 14	
Z	510	-	-	Basic
A	1,000	107.5 ± 1	-	
B	1,400	(121.5) ± 2	-	
C	500	(78) ± 2	-	
D	1,400	(113)	-	
I	150	(235)	-	

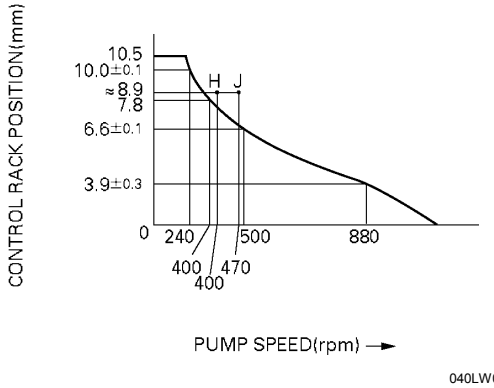
Governor Adjustment

GOVERNOR PERFORMANCE



040LW019.tif

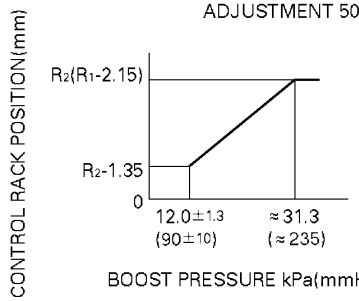
IDLING ADJUSTMENT



040LW025.tif

BOOST COMPENSATOR PERFORMANCE

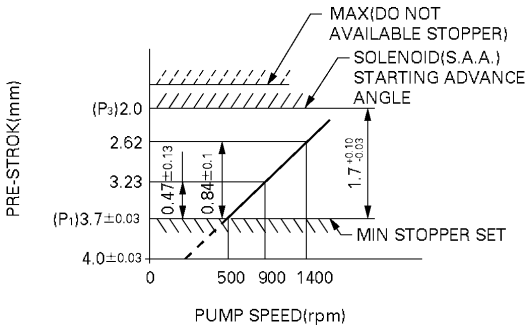
ADJUSTMENT 500r/min



040LW010.tif

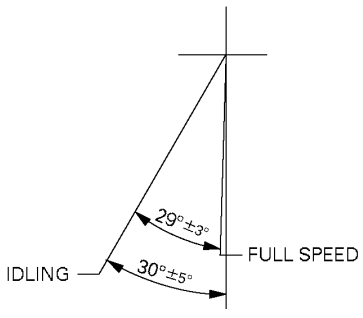
PRE-STROK PERFORMANCE

AT SPEED LEVER FULL POSITION



040LW023.tif

SPEED LEVER ANGLE



040LW028.tif

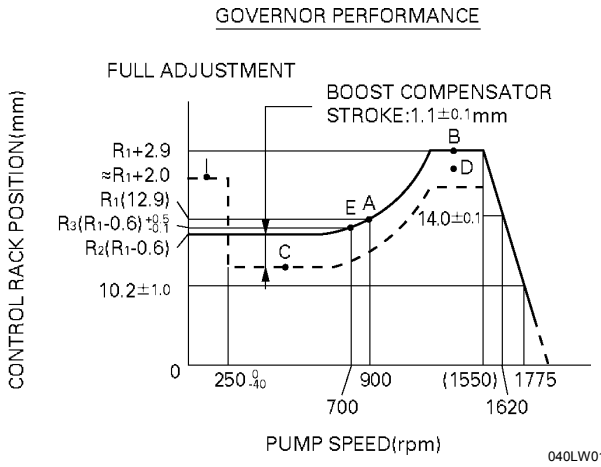
INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

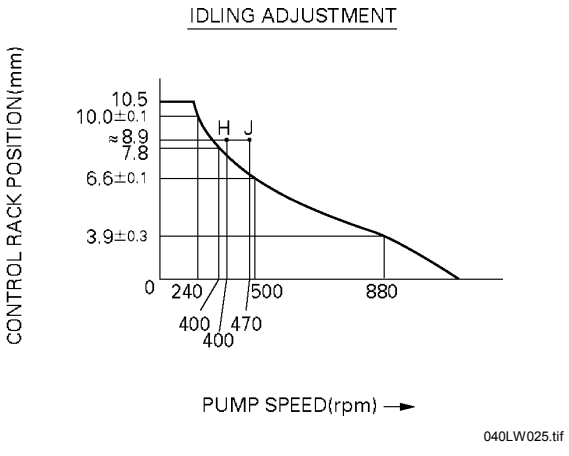
Identification Numbers : 10749-1032 / 107492-1130
[4HE1-TC Engine]
Pre-stroke : No. 1 plunger 4.0 ± 0.03 mm
Injection order : 1 - 3 - 4 - 2 (interval 90° ± 15') Plungers are numbered from the Governor side
Tappet clearance : Bolt adjustment type : More than 0.3 mm for all cylinders.
: Shim adjustment type : Manually rotate the camshaft 2-3 times and confirm that it rotates smoothly.

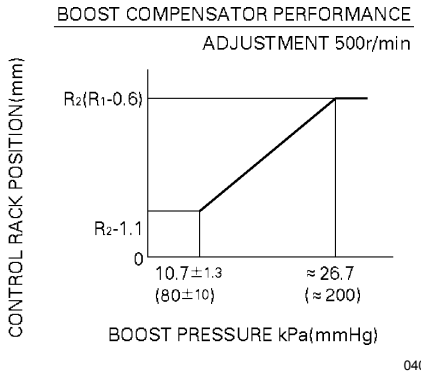
Injection Volume

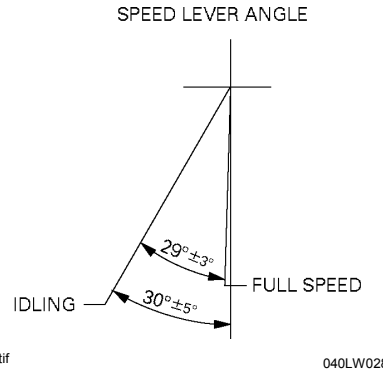
Adjusting point	Pump speed (r.p.m.)	Injection volume (cc/1000 strokes)	Variance (%)	Remarks
	900	78 ± 1.6	± 4	Basic
H	400	19 ± 1.5	± 14	
Z	500	-	-	Basic
A	900	78 ± 1	-	
B	1,450	(98.5) ± 2	-	
C	500	(67.5)	-	
D	1,450	(91.5)	-	
E	700	(78)	-	
I	150	(220)	-	

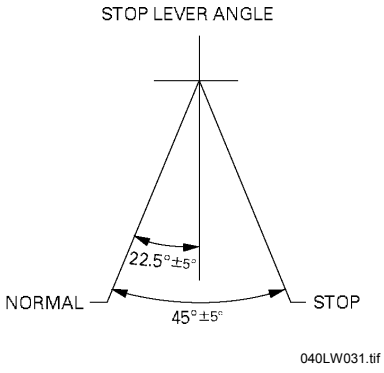
Governor Adjustment

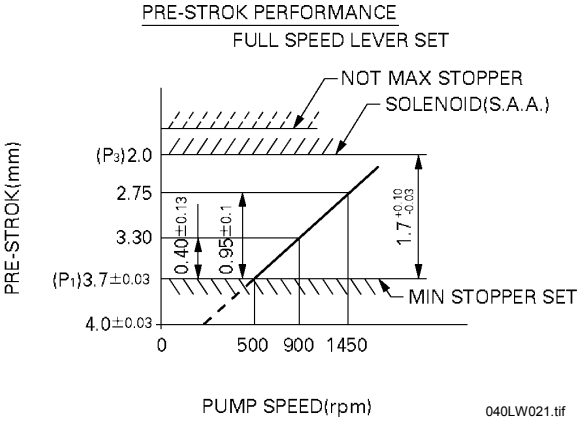




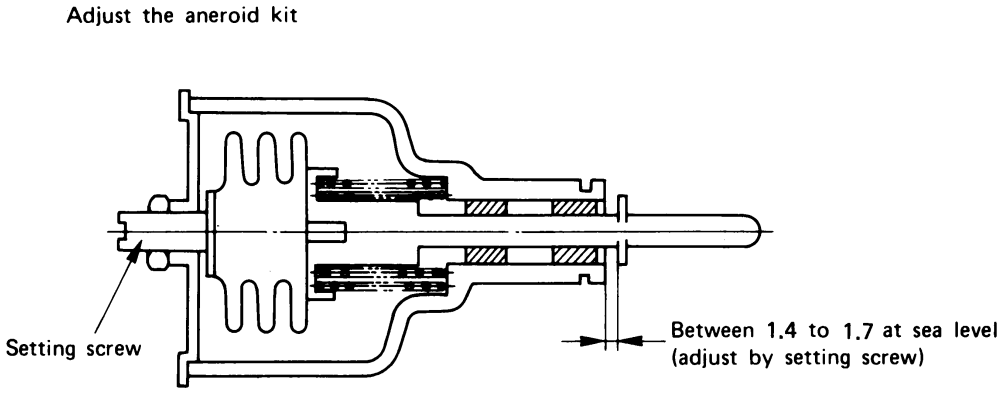






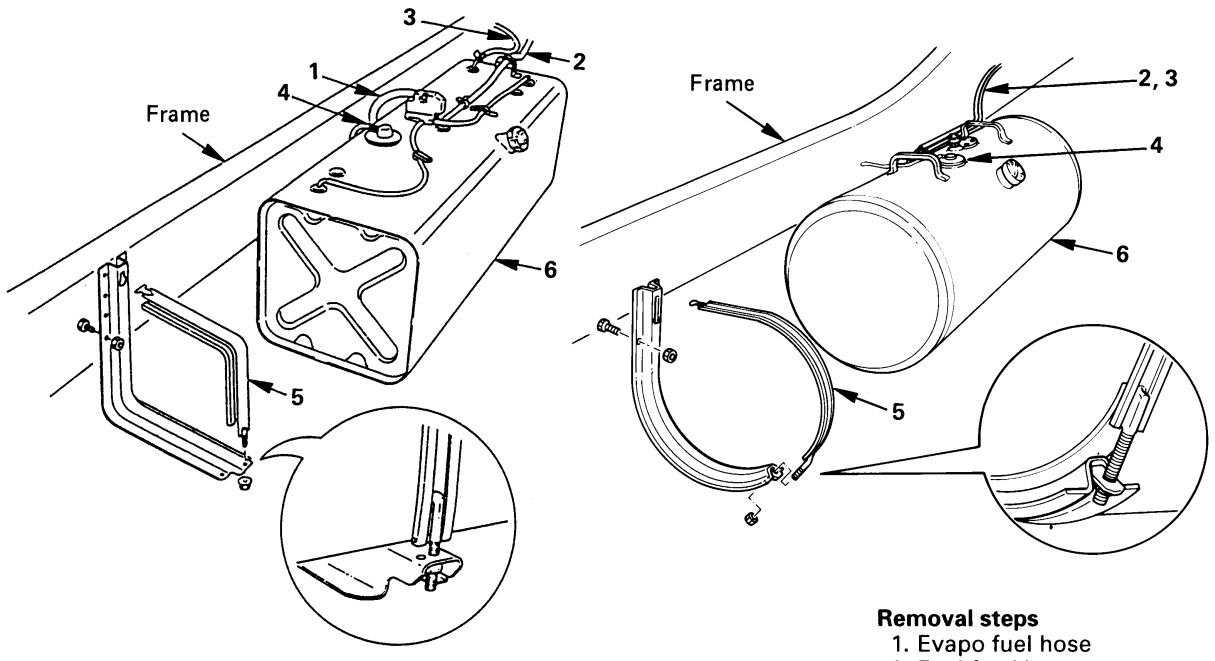


ANEROID COMPENSATOR ADJUSTMENT



6C-74-1.tif

FUEL TANK



Removal steps
1. Evapo fuel hose
2. Fuel feed hose
3. Fuel return hose
4. Fuel gauge unit connector
5. Band
6. Fuel tank

Installation steps
To install, follow the removal steps in the reverse order.

6C-75-1.tif

REMOVAL

Preparation

- Disconnect battery ground cable.
- Loosen fuel filler cap.
- Drain fuel from drain plug.
- After the drain fuel, tighten the drain plug to the specified torque.

N·m (kg·m/lb·ft)

29 (3/22)

1. **Evapo Fuel Hose**
2. **Fuel Feed Hose**
3. **Fuel Return Hose**
   - Plugging the return hose to prevent fuel from getting spilt, tie it to the fame with the plugged end up.
4. **Fuel Gauge Unit Connector**
   - Remove the fuel gauge unit connector.
5. **Band**
   - Remove the nut of the fuel tank fixing band, and then remove the band end on the frame side.

6. **Fuel Tank**
   - Pull out the fuel tank to the outside.

   NOTE:

   When it is not possible to pull out the fuel tank, remove the bracket and then draw out the fuel tank downward.

INSTALLATION

6. **Fuel Tank**

   NOTE:

   When the bracket was removed to take off the fuel tank, install the bracket to the frame and tighten it to the specified torque.

N·m (kg·m/lb·ft)
55 (5.6/41)

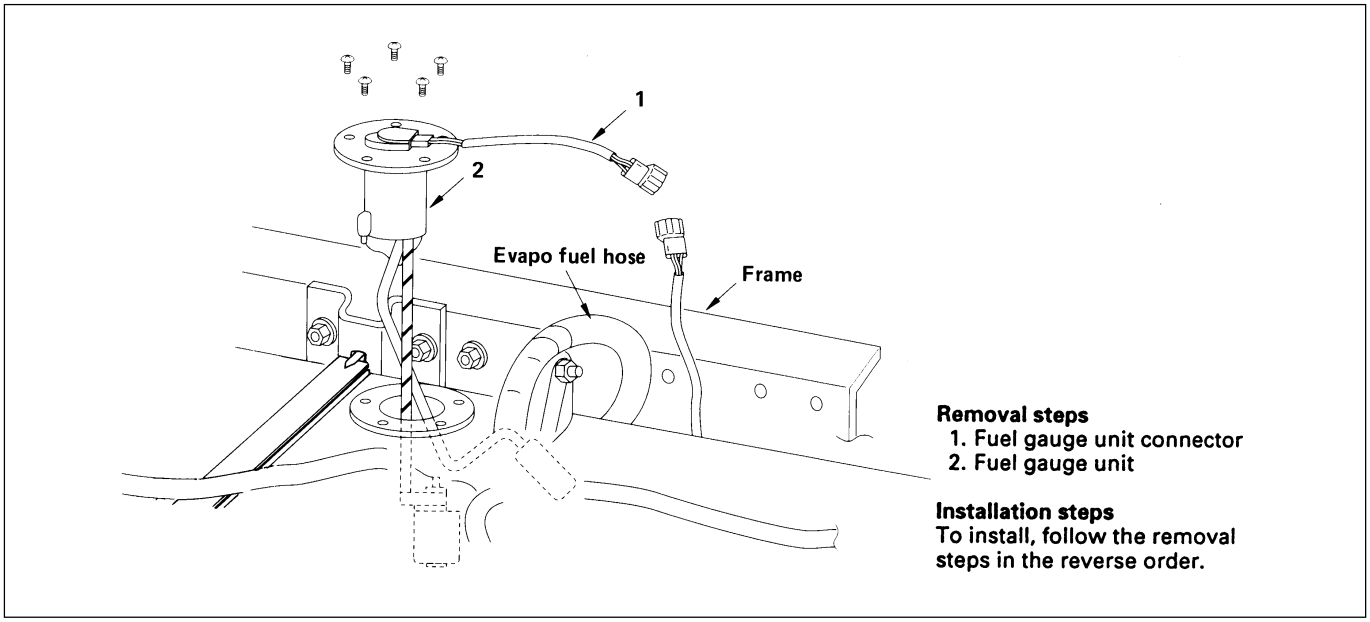
   Also, when mounting the fuel tank to the bracket, place the packing section attached to the fuel tank securely on the bracket.

5. **Band**
   - Tighten the band to the specified torque

N·m (kg·m/lb·in)
12 (1.2/104)

4. **Fuel Gauge Unit Connector**
   - Connect the fuel gauge unit connector.
3. **Fuel Return Hose**
2. **Fuel Feed Hose**
   - Set the hose to the pipe more than 25mm deep.
1. **Evapo Fuel Hose**
   - Fill the fuel to the fuel tank.
   - Connect battery ground cable.

FUEL GAUGE UNIT



6C-77-1.tif

REMOVAL

Preparation: Disconnect Battery ground cable.

1. **Fuel Gauge Unit Connector**
   - Disconnect fuel gauge unit connector from fuel gauge unit.
2. **Fuel Gauge Unit**
   - Remove fuel gauge unit fixing screw and fuel gauge unit.

NOTE:

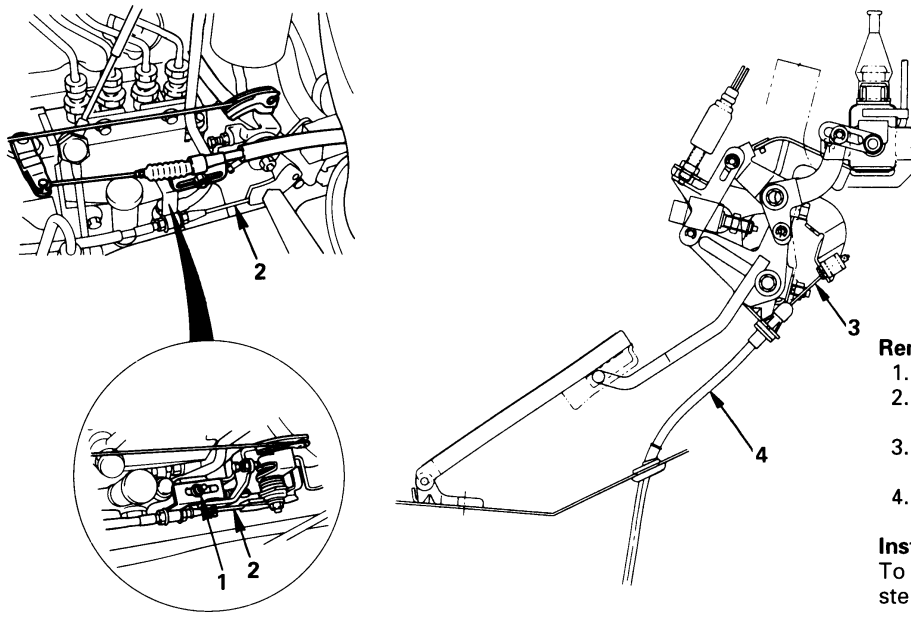
- **After removing fuel gauge unit, cover fuel tank with waste to prevent any dust entering**

INSTALLATION

2. **Fuel Gauge Unit**
1. **Fuel Gauge Unit Connector**
   - Connect the wiring connector to the fuel gauge unit.

ACCELERATOR CONTROL

ACCELERATOR CONTROL CABLE



Removal steps
1. Adjust nut
2. Accelerator control wire (Injection pump side)
3. Accelerator control wire (Accelerator pedal side)
4. Accelerator control cable

Installation steps
To install, follow the removal steps in the reverse order.

6C-78-1.tif

REMOVAL

1. **Adjust Nut**
   - Loosen the adjust nut on the cable bracket mounted.
2. **Accelerator Control Wire (Injection pump side)**
   - Remove the control wire from injection pump control lever.
3. **Accelerator Control Wire (Accelerator pedal side)**
   - Remove the Accelerator control wire from accelerator pedal.
4. **Accelerator Control Cable**
   - Pull out the wire to the chassis side through the grommet hole of the floor board, and remove the control cable.

INSPECTION

Check the following items, and replace the control cable if any abnormality is found.
- The control cable should move smoothly.
- The control cable should not be bent or kinked.
- The control cable should be free of damage and corrosion.

INSTALLATION

5. Accelerator Control Cable

- Take care that the core wire of the cable does not get damaged or inded.
- Put the cable through the grommet hole from under the floor.
- Set the groove of the grommet securely into the floor panel.

4. Accelerator Control Wire (Accelerator Pedal side)

- Connect the accelerator control wire to Accelerator pedal.

3. Cable Clips

- Install the cable clip to chassis frame.
- Tighten the cable clips to the specified torque

N·m (kg·m/lb·ft)
16 (1.6/12)

2. Accelerator Control Wire

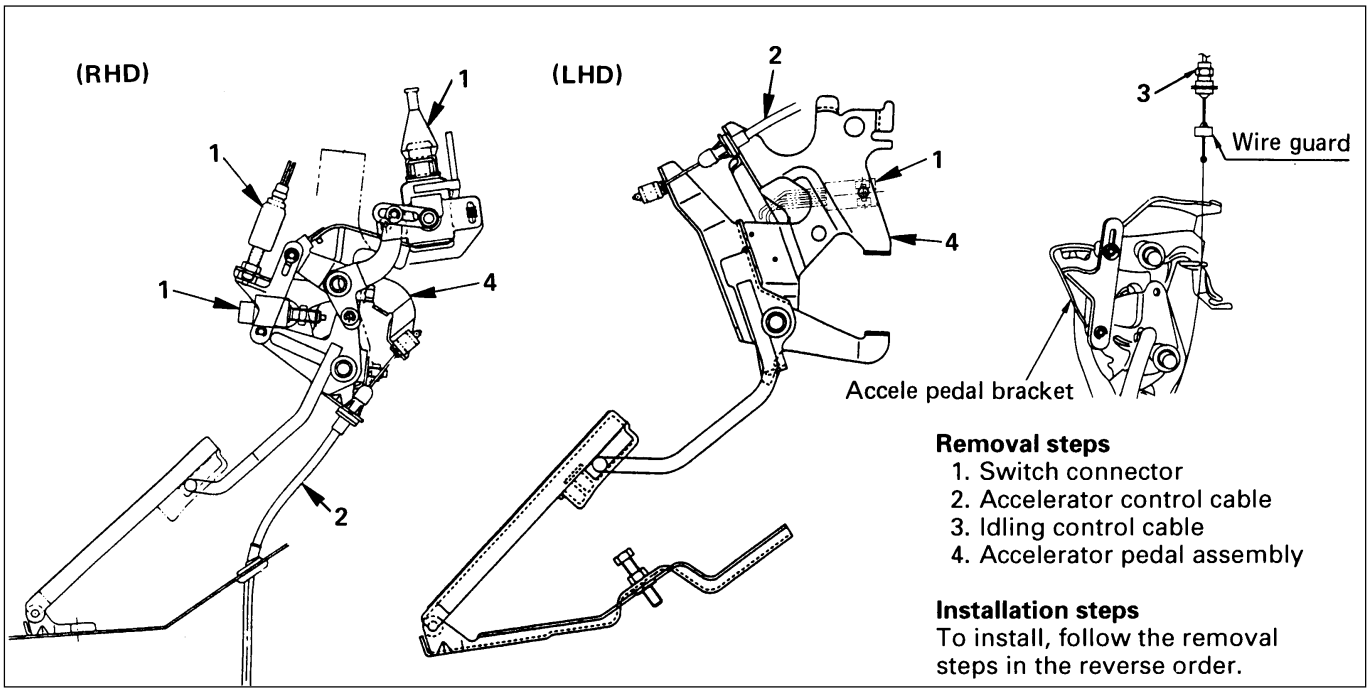
1. Adjust Nut

- Attach the end tip of the wire to the engine control lever.
- Pull the outer cable gently toward the front of the vehicle, and provide the engine control wire and the accelerator control wire an appropriate play before fastening the clamp with a nut.

N·m (kg·m/lb·in)
8 (0.8/69)

- Check to see if the injection pump lever is at the idle position (with the lever in touch with the stopper bolt).
- Connect the battery ground cable.
- Check to see if the accelerator pedal fully is in the range of 5 to 10mm above the pedal pad.
- Press down on the accelerator pedal fully, and check to see if the engine rotates at the maximum speed with the linkage in the smooth operation.
- In the operating range of the accelerator pedal, check to see if the accelerator pedal and the injection pump lever return without fail to the original positions.

ACCELERATOR PEDAL



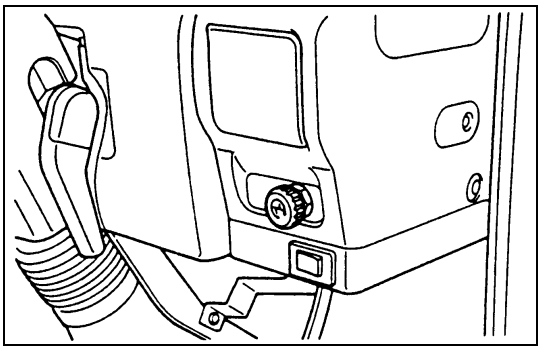
6C-80-1.tif

REMOVAL

1. **Switch Connector**
2. **Accelerator Control Cable.**
   - Remove control cable from Accelerator pedal bracket.
3. **Idling Control Cable**
   - Remove control cable from accelerator pedal bracket.
4. **Accelerator Pedal Assembly**
   - Remove accelerator pedal assembly from brake pedal bracket.

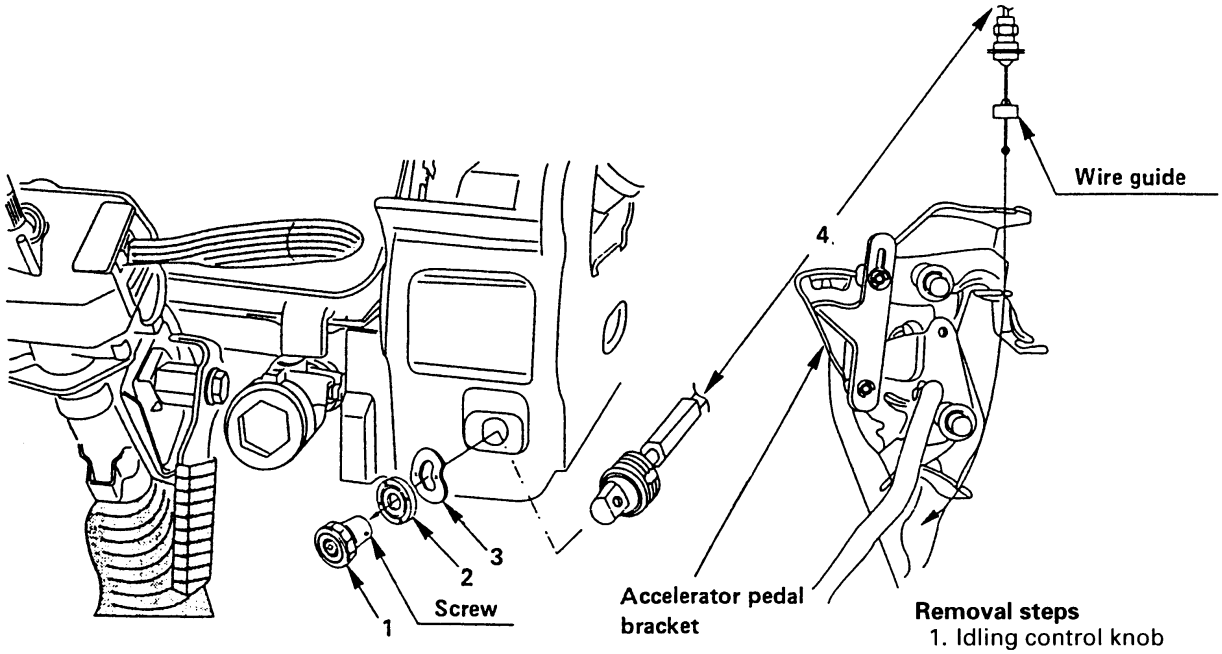
INSTALLATION

4. **Accelerator Pedal Assembly**
   - Apply grease to the sliding portion, and install it to the brake pedal bracket.
3. **Idling Control Cable**
   - Install the idling control cable to the lever of the accelerator pedal bracket.
2. **Accelerator Control Cable**
   - After confirming that the idling control knob is turned fully to the left, install the accelerator control cable.
1. **Switch Connector**



6C-80-2.tif

IDLING CONTROL CABLE



Removal steps
1. Idling control knob
2. Idling control cable nut
3. Wave washer
4. Idling control cable

Installation steps
To install, follow the removal steps in the reverse order.

6C-81-1.tif

REMOVAL

1. **Idling Control Knob**
   - Loosen the idling control knob screw and remove the knob from cable.
2. **Idling Control Cable Nut**
3. **Wave Washer**
4. **Idling Control Cable**
   - Remove control cable from accelerator pedal bracket.

INSTALLATION

4. **Idling Control Cable**
   - Install control cable to Accelerator pedal bracket.
3. **Wave Washer**
2. **Idling Control Cable Nut**
   - Insert the idling control cable into the specified hole of the instrument panel.
   - Install the washer to the cable, and tighten it with a nut.

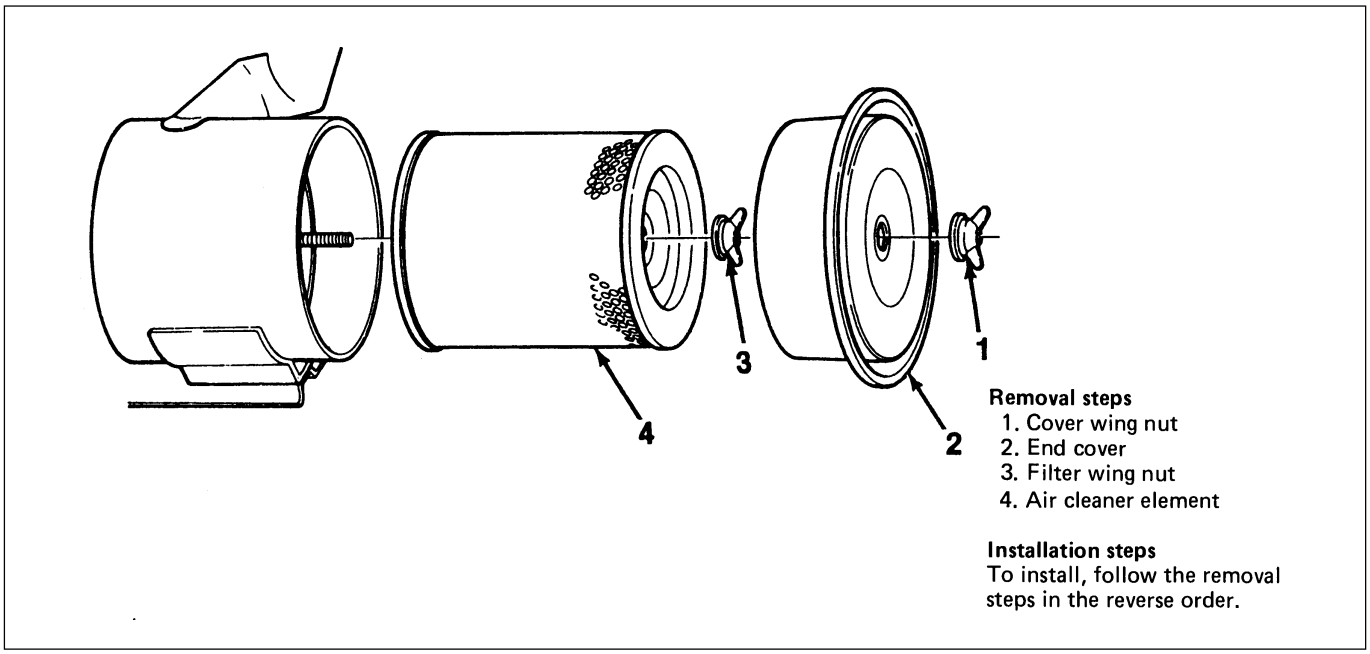
1. Idling Control Knob

- Insert the idling control knob into the cable, and tighten the screw.

Inspection:

- With the idling control knob not in use, check to see if the injection pump lever is at the idle position (with the lever in contact with the stopper bolt).
- With the idling control knob turned fully to the right, check to see if the number of the engine idling rotations gets to 1,500 rpm or more.

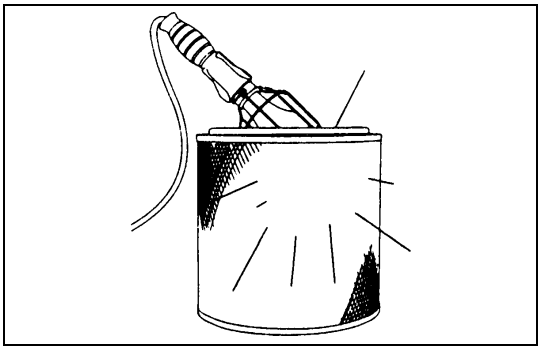
AIR CLEANER ELEMENT



6C-83-1.tif

REMOVAL

1. **Cover Wing Nut**
2. **End Cover**
3. **Filter Wing Nut**
4. **Air Cleaner Element**



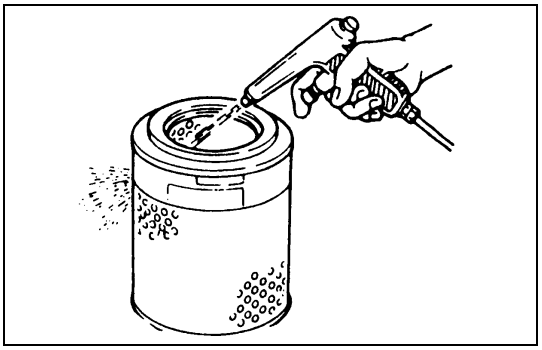
6C-83-2.tif

Clean

- Wipe out the inside of the Air cleaner assembly
- Wipe off the Cover

Inspection

- The air filter with a light for fears or holes.



6C-83-3.tif

Cleaning Method

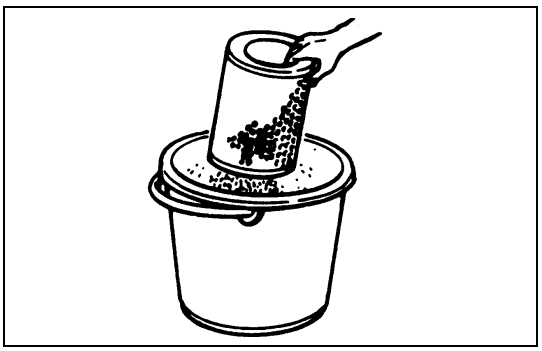
Dust Fouled Element

Rotate the element with your hand while applying compressed air to the inside of the element. This will blow the dust free.

Compressed air pressure	Kpa (Kg/cm^2/Psi)
392 - 490 (4 - 5/57 - 71)	

CAUTION

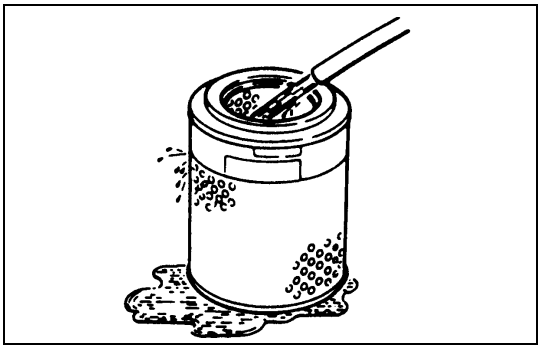
Do not bang the element against another object in an attempt to clean it. Damage to the element will result.



6C-84-1.tif

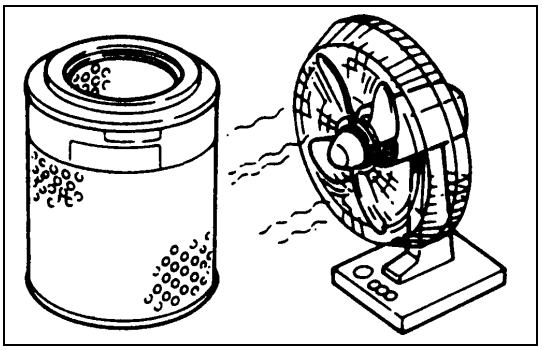
Carbon and Dust Fouled Element

1. Prepare a cleaning solution of Isuzu Genuine Element Cleaner (Donaldson D1400) diluted with water.
2. Submerge the element in the solution for twenty minutes.



6C-84-2.tif

3. Remove the element from the solution and rinse it well with running water.
   Water pressure must not exceed 274 Kpa (2.8 kg/cm^2/40 Psi)



6C-84-3.tif

4. Dry the element in a well ventilated area.
   An electric fan will hasten drying.

NOTE:

Do not use compressed air or an open flame to dry the element quickly. Damage to the element will result.

It will usually take two or three days for the element to dry completely. Therefore, it is a good idea to have a spare on hand to use in the interim.

INSTALLATION

4. **Air Cleaner Element**
3. **Filter Wing Nut**
2. **End Cover**
1. **Cover Wing Nut**

MEMO

SECTION 6D

ENGINE ELECTRICAL

CONTENTS

PAGE

Battery ..... Section 6D1

Starting System..... Section 6D2

Charging System ..... Section 6D3

QOS-II Preheating System ..... Section 6D6

SECTION 6D1

BATTERY

CONTENTS

PAGE

General Description..... 6D1 - 1

Diagnosis..... 6D1 - 2

On-Vehicle Service ..... 6D1 - 4

Battery Charging..... 6D1 - 4

Jump Starting ..... 6D1 - 4

Removal and Installation of The Battery ..... 6D1 - 6

Main Data and Specifications ..... 6D1 - 6

GENERAL DESCRIPTION

There are six battery fluid caps at the top of the battery.

The battery is completely sealed except for the six small vent holes at the side. These vent holes permit the escape of small amounts of gas generated by the battery.

This type of battery has the following advantages over conventional batteries:

1. There is no need to add water during the entire service life of the battery.
2. The battery protects itself against overcharging.
   The battery will refuse to accept an excessive charge.
   (A conventional battery will accept an excessive charge, resulting in gassing and loss of battery fluid.)
3. The battery is much less vulnerable to self-discharge than a conventional type battery.

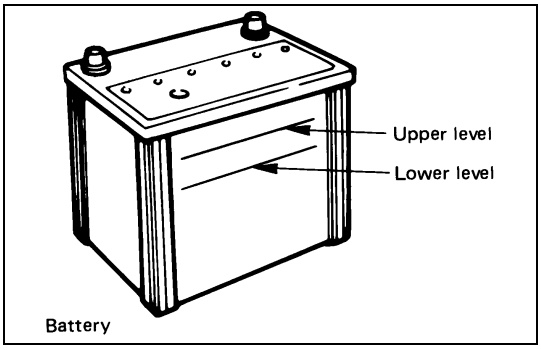
DIAGNOSIS

1. VISUAL INSPECTION

Inspect the battery for obvious physical damage, such as a cracked or broken case, which would permit electrolyte loss.

Replace the battery if obvious physical damage is discovered during inspection.

Check for any other physical damage and correct it as necessary. If not, proceed to Step 2.



6D1-2-1.tif

2. HYDROMETER CHECK

There is a built-in hydrometer (Charge test indicator) at the top of the battery. It is designed to be used during diagnostic procedures.

Before trying to read the hydrometer, carefully clean the upper battery surface.

If your work area is poorly lit, additional light may be necessary to read the hydrometer.

a. BLUE RING OR DOT VISIBLE - Go to Step 4.
b. BLUE RING OR DOT NOT VISIBLE - Go to Step 3.

3. FLUID LEVEL CHECK

The fluid level should be between the upper level line and lower level line on side of the battery.

a. CORRECT FLUID LEVEL - Charge the battery.
b. BELOW LOWER LEVEL - Replace battery.

4. VOLTAGE CHECK

(1) Put voltmeter test leads to battery terminals.
   a. VOLTAGE IS 12.4V OR ABOVE - Go to Step 5.
   b. VOLTAGE IS UNDER 12.4V - Go to procedure (2) below.

(2) Determine fast charge amperage from specification. (See Main Data and specifications in this section).

   Fast charge battery for 30 minutes at amperage rate no higher than specified value.

   Take voltage and amperage readings after charge.

   a. VOLTAGE IS ABOVE 16V AT BELOW 1/3 OF AMPERAGE RATE - Replace battery.
   b. VOLTAGE IS ABOVE 16V AT ABOVE 1/3 OF AMPERAGE RATE - Drop charging voltage to 15V and charge for 10-15 hours.

   Then go to Step 5.

   c. VOLTAGE IS BETWEEN 12V AND 16V - Continue charging at the same rate for an additional 3-1/2 hours. Then go to Step 5.
   d. VOLTAGE IS BELOW 12V - Replace battery.

5. LOAD TEST

(1) Connect a voltmeter and a battery load tester across the battery terminals.

(2) Apply 300 ampere load for 15 seconds to remove surface charge from the battery.

Remove load.

(3) Wait 15 seconds to let battery recover. Then apply specified load from specifications (See Main Data and Specifications in this section).

Read voltage after 15 seconds, then remove load.

a. VOLTAGE DOES NOT DROP BELOW THE MINIMUM LISTED IN FOLLOWING TABLE - The battery is good and should be returned to service.

b. VOLTAGE IS LESS THAN MINIMUM LISTED - Replace battery.

ESTIMATED TEMPERATURE		MINIMUM VOLTAGE
°F	°C	
70	21	9.6
60	16	9.5
50	10	9.4
40	4	9.3
30	-1	9.1
20	-7	8.9
10	-12	8.7
0	-18	8.5
The battery temperature must be estimated by feel and by the temperature the battery has been exposed to for the preceding few hours.		

ON-VEHICLE SERVICE

BATTERY CHARGING

Observe the following safety precautions when charging the battery:

1. Never attempt to charge the battery when the fluid level is below the lower level line on the side of the battery. In this case, the battery must be replaced.
2. Pay close attention to the battery during the charging procedure.

   Battery charging should be discontinued or the rate of charge reduced if the battery feels hot to the touch.

   Battery charging should be discontinued or the rate of charge reduced if the battery begins to gas or spew electrolyte from the vent holes.
3. In order to more easily view the hydrometer blue dot or ring, it may be necessary to jiggle or tilt the battery.
4. Battery temperature can have a great effect on battery charging capacity.
5. The sealed battery used on this vehicle may be either quick-charged or slow-charged in the same manner as other batteries.

   Whichever method you decide to use, be sure that you completely charge the battery. Never partially charge the battery.

JUMP STARTING

JUMP STARTING WITH AN AUXILIARY (BOOSTER) BATTERY

CAUTION:

Never push or to the vehicle in an attempt to start it. Serious damage to the emission system as well as other vehicle parts will result.

Treat both the discharged battery and the booster battery with great care when using jumper cables. Carefully follow the jump starting procedure, being careful at all times to avoid sparking.

WARNING:

Failure to carefully follow the jump starting procedure could result in the following:

1. **serious personal injury, particularly to your eyes.**
2. **Property damage from a battery explosion, battery acid, or an electrical fire.**
3. **Damage to the electronic components of one or both vehicles particularly.**

Never expose the battery to an open flame or electrical spark. Gas generated by the battery may catch fire or explode.

Remove any rings, watches, or other jewelry before working around the battery. Protect your eyes by wearing an approved set of goggles.

Never allow battery fluid t come in contact with your eyes or skin.

Never allow battery fluid to come in contact with fabrics or painted surfaces.

Battery fluid is a highly corrosive acid.

Should battery fluid come in contact with your eyes, skin, fabric, or a painted surface, immediately and thoroughly rinse the affected area with clean tap water.

Never allow metal tools or jumper cables to come in contact with the positive battery terminal, or any other metal surface of the vehicle. This will protect against a short circuit.

Always keep batteries out of the reach of young children.

JUMP STARTING PROCEDURE

1. Set the vehicle parking brake.

   If the vehicle is equipped with an automatic transmission, place the selector lever in the “PARK” position.

   If the vehicle is equipped with a manual transmission place the shift lever in the “NEUTRAL” position.

   Turn “OFF” the ignition.

   Turn “OFF” all lights and any other accessory requiring electrical power.
2. Look at the built-in hydrometer.

   If the indication area of the built-in hydrometer is completely clear, do not try to jump start.
3. Attach the end of one jumper cable to the positive terminal of the booster battery.

   Attach the other end of the same cable to the positive terminal of the discharged battery.

   Do not allow the vehicles to touch each other.

   This will cause a ground connection, effectively neutralizing the charging procedure.

   Be sure that the booster battery has a 12 volt rating.
4. Attach one end of the remaining cable to the negative terminal of the booster battery.

   Attach the other end of the same cable to a solid engine ground (such as the A/C compressor bracket or the generator mounting bracket) of the vehicle with the discharged battery.

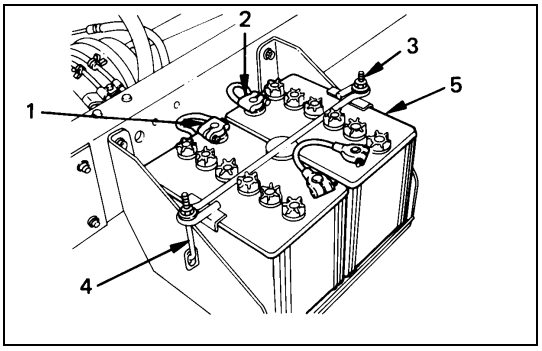
   This ground connection must be at least 450 mm (18 in) from the battery of the vehicle whose battery is being charged.

WARNING:

Never attach the end of the jumper cable directly to the negative terminal of the dead battery.

5. Start the engine of the vehicle with the good battery.
   Make sure that all unnecessary electrical accessories have been turned “OFF”.
6. Start the engine of the vehicle with the dead battery.
7. To remove the jumper cables, follow the above directions in the reverse order.
   Be sure to first disconnect the negative cable from the vehicle with the discharged battery.

REMOVAL AND INSTALLATION OF THE BATTERY



6D1-6-1.tif

REMOVAL

1. Negative cable
2. Positive cable
3. Retainer screw and rods
4. Retainer
5. Battery

INSTALLATION

To install the battery, follow the removal procedure in the reverse order, noting the following points:

1. Make sure that the rod is hooked on the body side.

MAIN DATA AND SPECIFICATIONS

Model	(JIS)	55D23R	75D23R	80D26R	643-700	DELCO 31-750
Voltage	(V)	12	12	12	12	12
Cold-Cranking Performance	(Amp)	356	520	356	700	750
Reserve Capacity	(Min.)	99	180	133	180	160

SECTION 6D2
STARTING SYSTEM

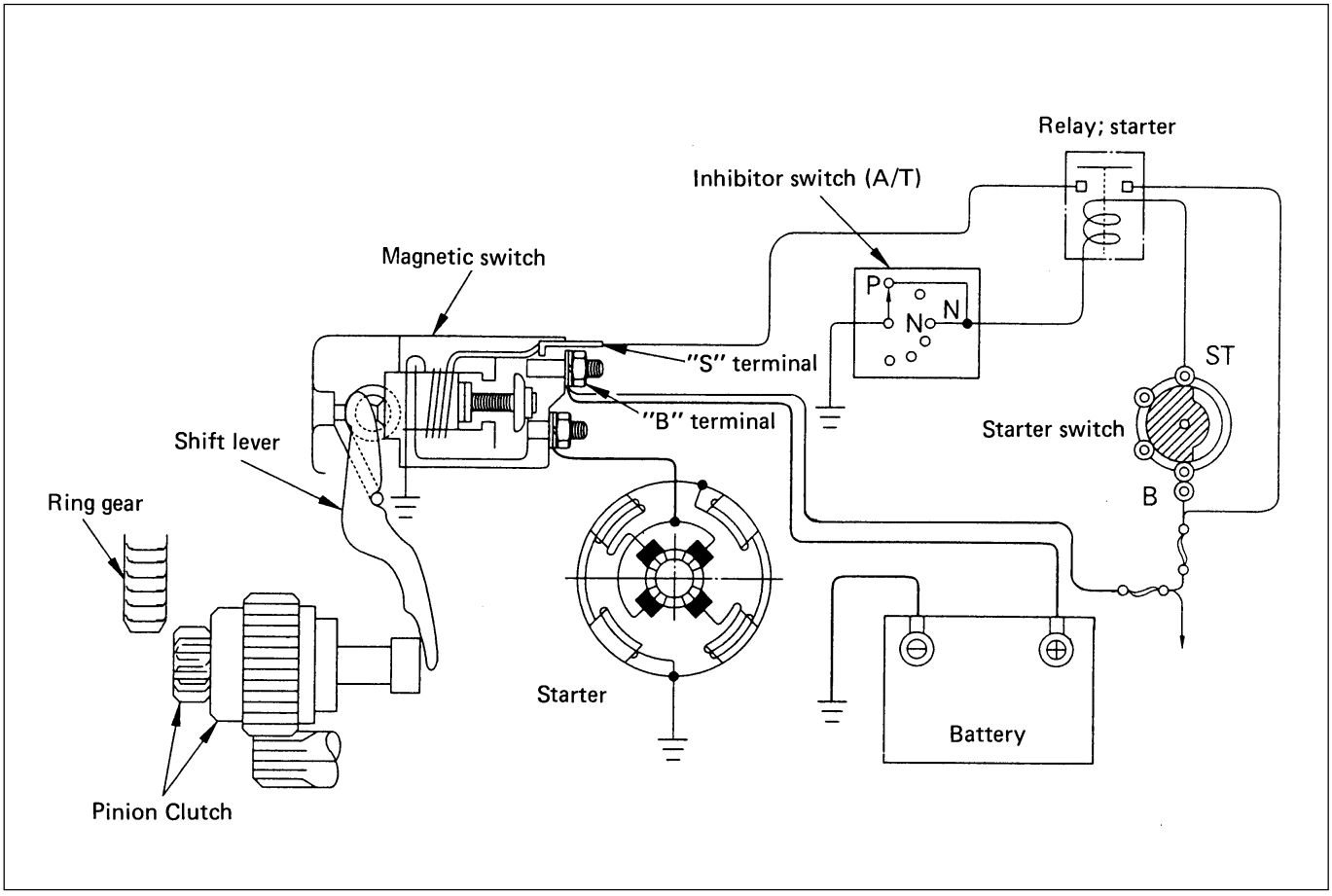
CONTENTS

	PAGE
General Description	6D2 - 1
On-Vehicle Service	6D2 - 4
Unit Repair	6D2 - 6
Reassembly	6D2 - 15

GENERAL DESCRIPTION

STARTING CIRCUIT

The cranking system consists of a battery, starter, starter switch, starter relay, etc. and these main components are connected as shown in Figure. For details of the starting circuit.

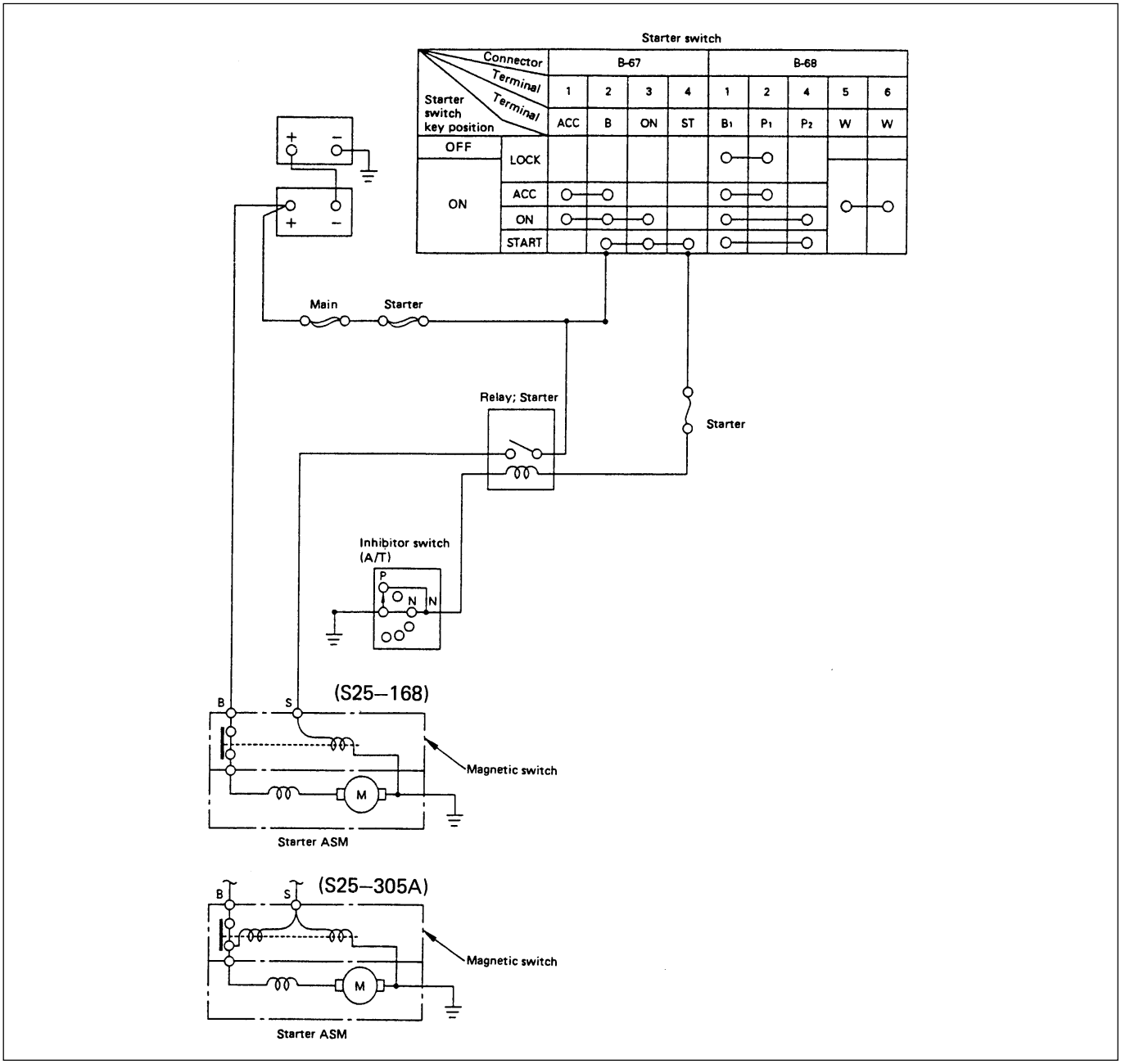


6D2-1-1.tif

STARTER

The starting system employs a magnetic type reduction starter in which the motor shaft is also used as a pinion shaft. When the starter switch is turned on, the contacts of magnetic switch are closed, and the armature rotates. At the same time, the plunger is attracted, and the pinion is pushed forward by the shift lever to mesh with ring gear. Then, the ring gear runs to start the engine. When the engine starts and the starter switch is turned off, the plunger returns, the pinion is disengaged from ring gear, and the armature stops rotation. When the engine speed is higher than the pinion, the pinion idles, so that the armature is not driven.

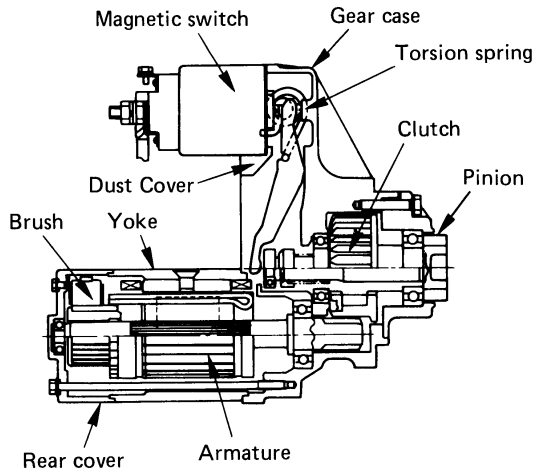
STARTING CIRCUIT



6D2-2-1.tif

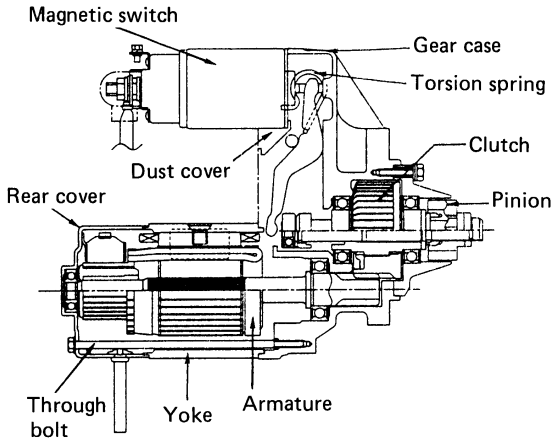
STARTING MOTOR

S25—168



6D2-3-1.tif

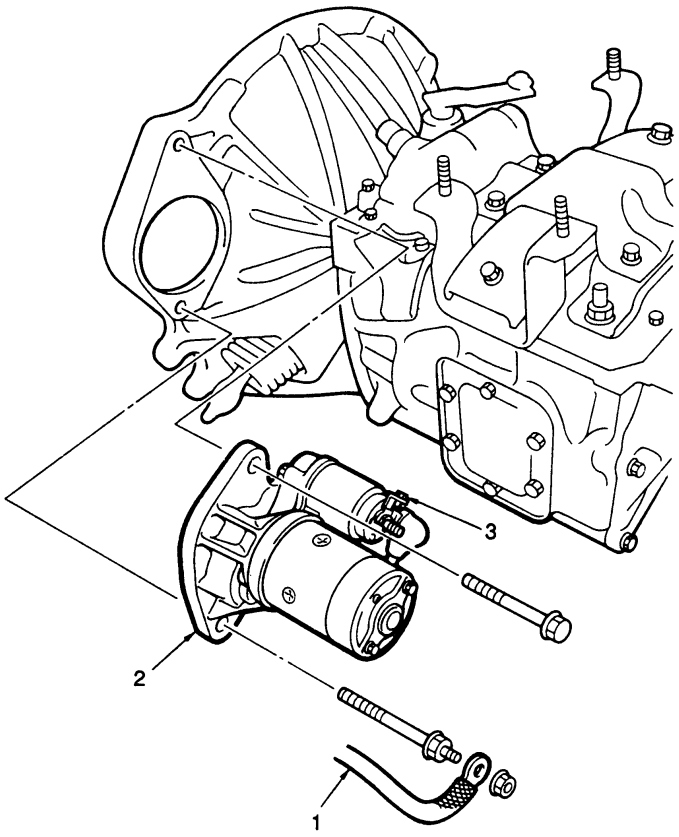
S25—305A



6D2-3-2.tif

ON-VEHICLE SERVICE

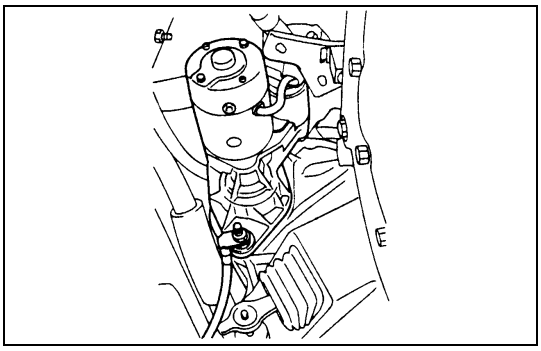
STARTER



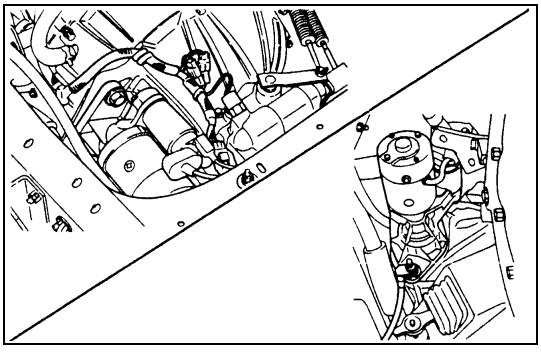
Removal steps
1. Starter earth cable
2. Starter assembly
3. Starter wiring connector

Installation steps
To install, follow the removal steps in the everse order.

6D2-4-1.tif



6D2-4-2.tif



6D2-4-3.tif

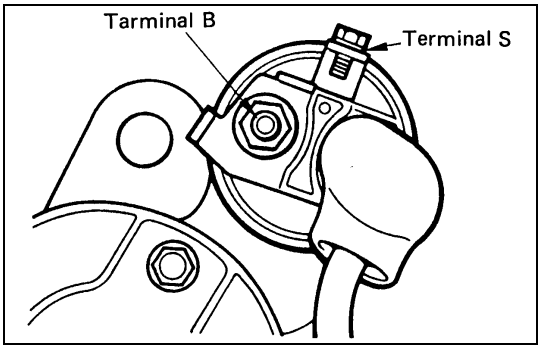
REMOVAL

Preparation
- Battery ground cable (both batteries)

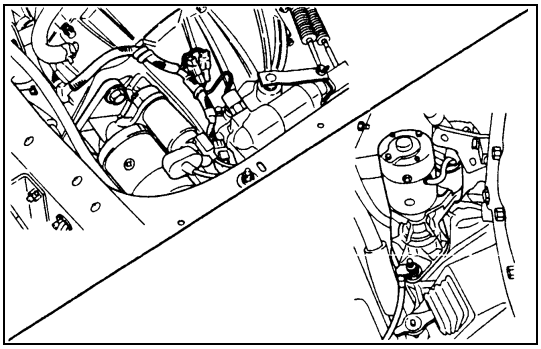
1. Starter Earth Cable
- Disconnect the starter earth cable at the starter motor.
- Disconnect the front frame harness connector somewhere near the control box of the transmission, remove each clip that fastens the harness.

2. Starter Assembly
- Remove the starter assembly from flywheel housing.

3. Starter Wiring Connector



6D2-5-1.tif



6D2-5-2.tif

INSTALLATION

3. Starter Wiring Connector

2. Starter Assembly

- Install the starter to the flywheel housing.

Starter Bolt Torque	N·m (kg·m/lb·ft)
	126 (12.9/93)

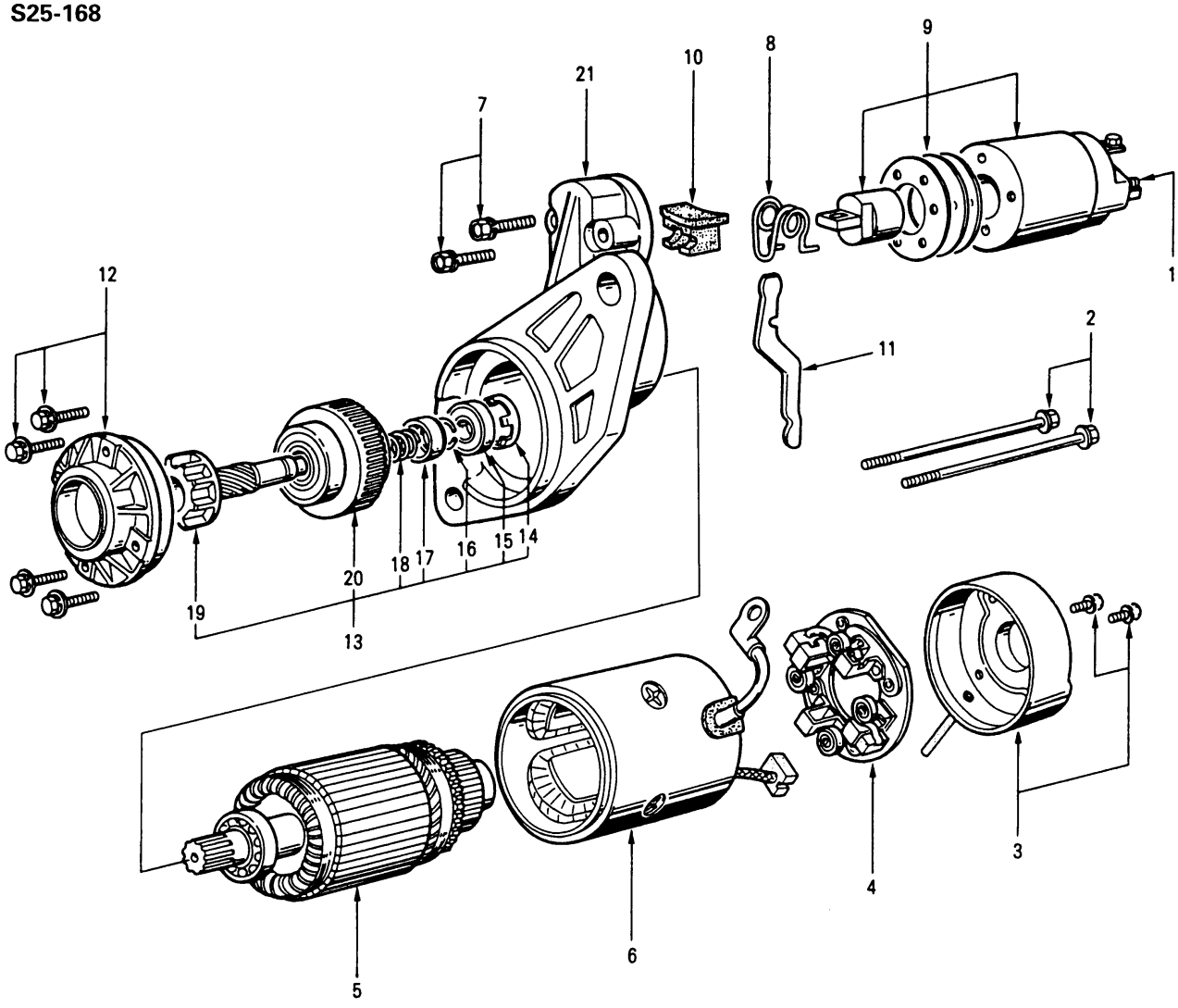
1. Starter Earth Cable

- Connect the earth cable to the starter motor.
- Connect the battery ground cable.

UNIT REPAIR

S25-168

S25-168



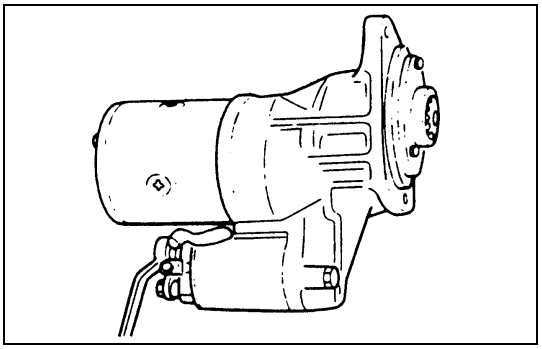
Disassembly steps

1. Lead wire nut
2. Through bolt
3. Rear cover
4. Brush holder
5. Armature
6. Yoke
7. Bolt
8. Torsion spring
9. Magnetic switch assembly
10. Dust cover
11. Shift lever
12. Braring retainer
13. Clutch assembly
14. Bearing holder
15. Ball bearing
16. Pinion stopper
17. Pinion stopper
18. Return spring
19. Pinion shaft
20. Pinion clutch
21. Gear case

Reassembly steps

To reassemble, follow the disassembly steps in the reverse order.

6D2-6-1.tif

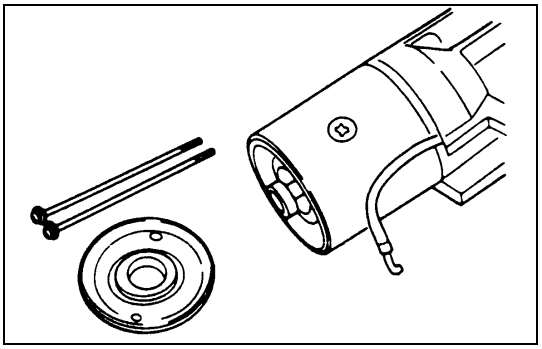


6D2-7-1.tif

DISASSEMBLY

1. **Lead Wire Nut**

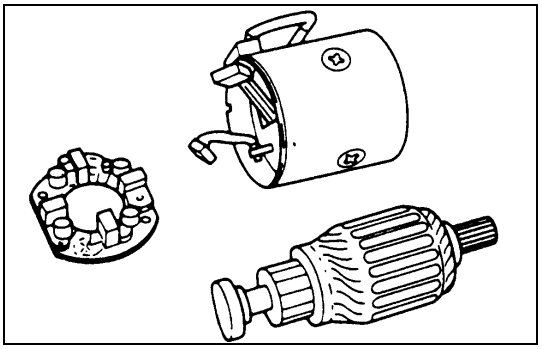
   Disconnect the lead wire at the magnetic switch.



6D2-7-2.tif

2. **Through Bolt**
3. **Rear Cover**

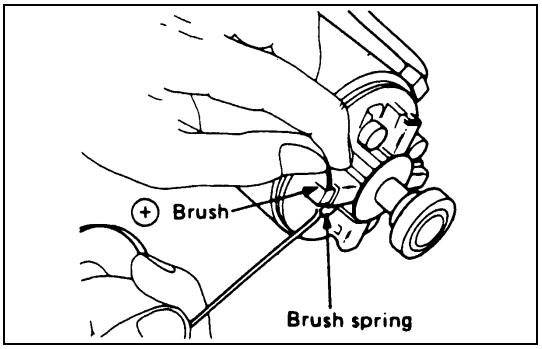
   Remove the through bolts, then remove the rear cover.



6D2-7-3.tif

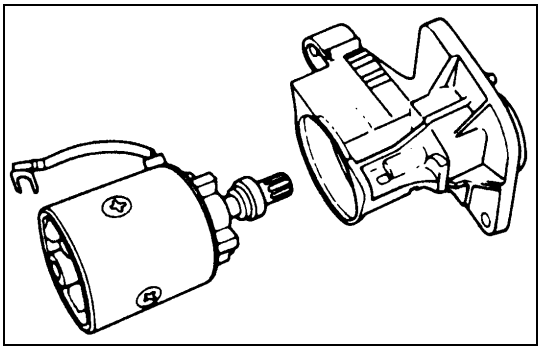
4. **Brush Holder**
5. **Armature**
6. **Yoke**

   Remove the brush holder and pull the armature assembly from the yoke.



6D2-7-4.tif

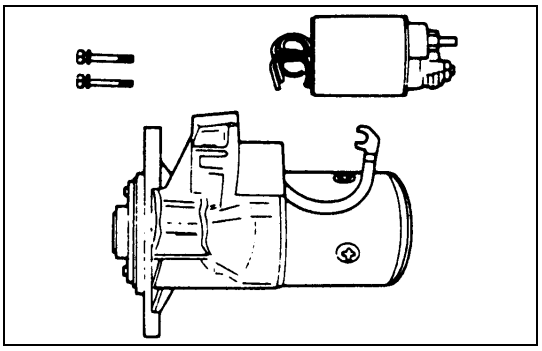
Remove the four brushes from the brush holders.



6D2-7-5.tif

Remove the yoke along with the armature and the brush holder from the drive housing.

Remove the brushes and commutator carefully so as not to allow them in contact with the adjacent parts.



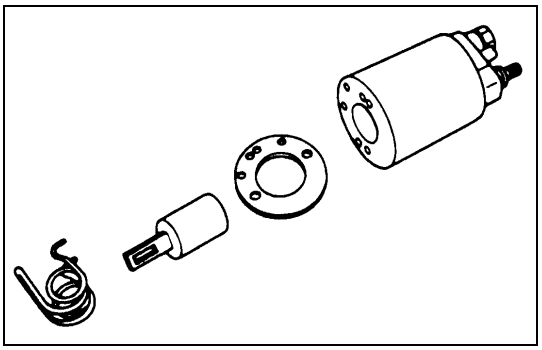
6D2-8-1.tif

7. Bolt

8. Torsion Spring

9. Magnetic Switch Assembly

Remove the magnetic switch bolts, then remove the switch from the shift lever.

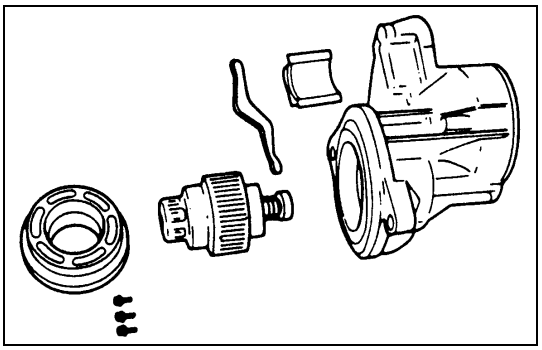


6D2-8-2.tif

Remove the torsion spring from the magnetic switch.

10. Dust Cover

11. Shift Lever



6D2-8-3.tif

12. Bearing Retainer

13. Clutch Assembly

1) Remove the bearing retainer.
2) Remove the clutch assembly from the gear case.

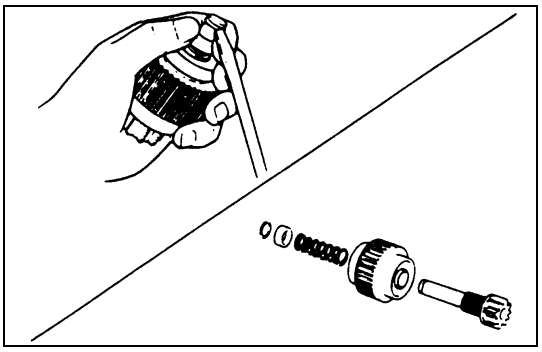
14. Bearing Holder

15. Ball Bearing

16. Pinion Stopper Clip

17. Pinion Stopper

18. Return Spring



6D2-8-4.tif

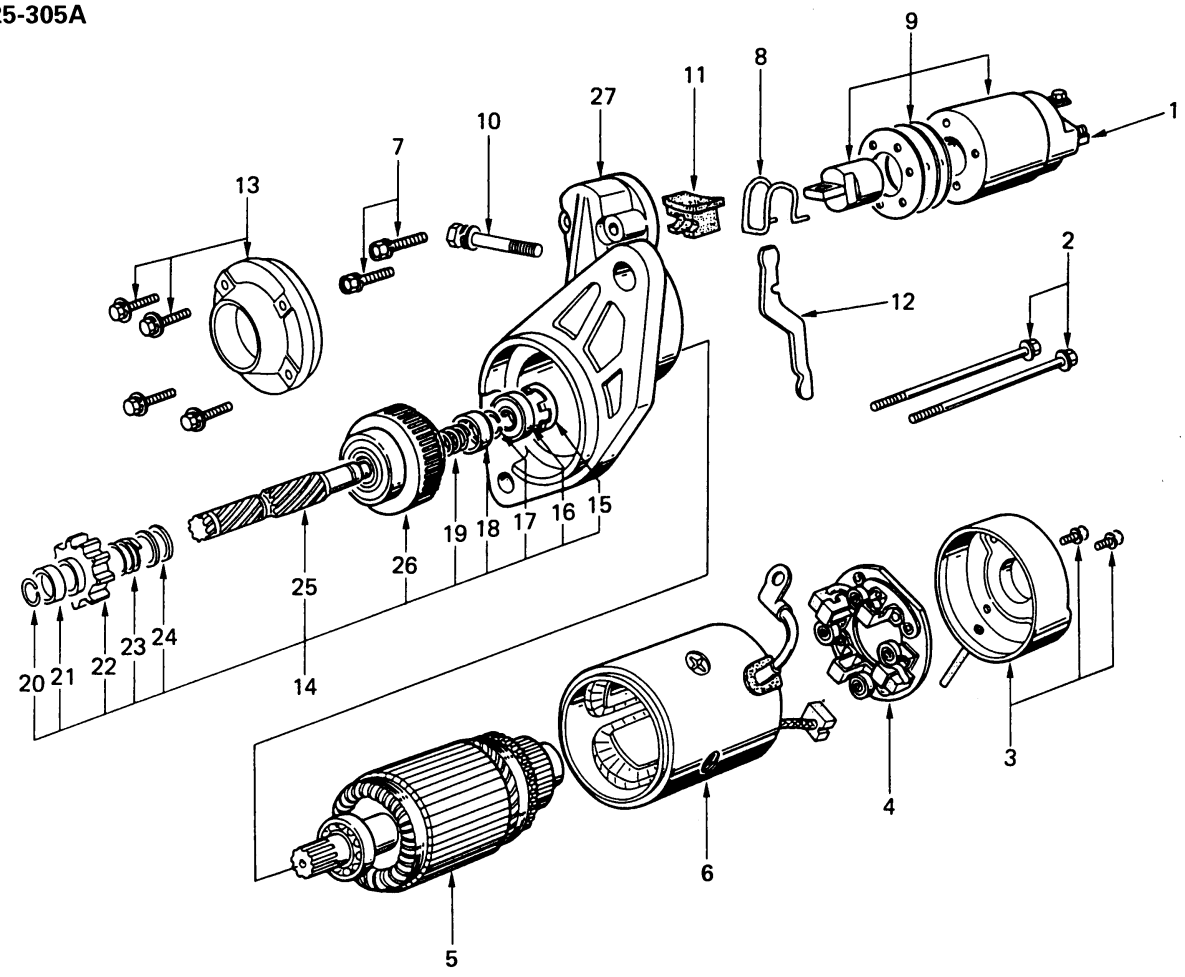
19. Pinion Shaft

20. Pinion Clutch

Use a screwdriver to remove the stopper clip. Then disassemble the clutch assembly.

S25-305A

S25-305A



Disassembly steps
1. Lead wire nut
2. Throtu bolt
3. Rear cover
4. Brish holder
5. Armature
6. Yoke
7. Bolt
8. Torsion spring
9. Magnetic switdh assembly
10. Bolt
11. Dust cover
12. Shift lever
13. Bearing retainer
14. Clutch assembly
15. Bearing holder
16. Ball bearing
17. Pinion stopper crip
18. Pinion stopper
19. Return spring
20. Crip
21. Pinion stepper
22. Pinion
23. Cushion spring
24. Washer
25. Pinion shaft
26. Pinion clutch
27. Gear case

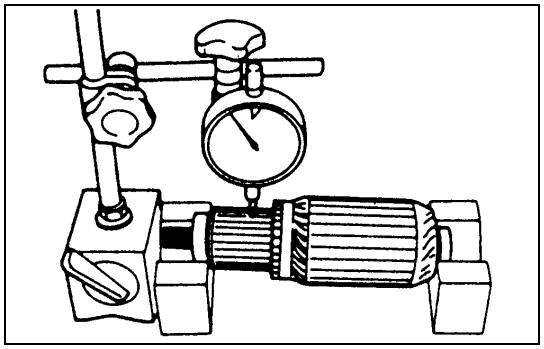
Reassembly steps
To reassemble, follow the disassembly steps in the reverse order.

For disassembling, refer to S25-163C.

6D2-9-1.tif

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.



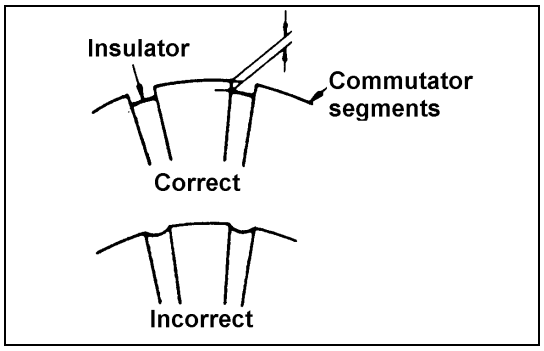
6D2-10-1.tif

ARMATURE

1. Measure the commutator run-out.
   Replace the commutator if the measured run-out exceeds the specified limit.

Commutator Run-Out mm (in)

Standard	Limit
0.05 (0.002) or less	0.2 (0.008)



6D2-10-2.tif

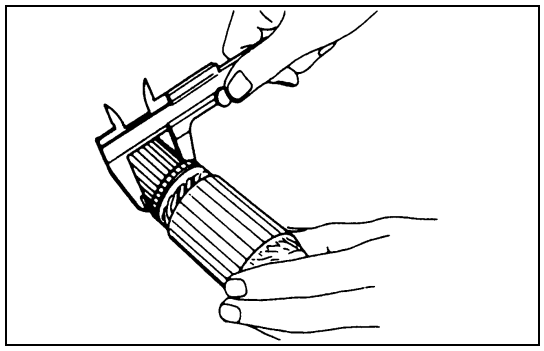
2. Check the commutator mica segments for excessive wear.
3. Measure the mica segment depth.

Mica Segment Depth mm (in)

Standard	Limit
0.5 - 0.8 (0.020 - 0.031)	0.2 (0.008)

If the mica segment depth is less than the standard but more than the limit, the commutator may be reground.

If the mica segment depth is less than the limit, the commutator must be replaced.



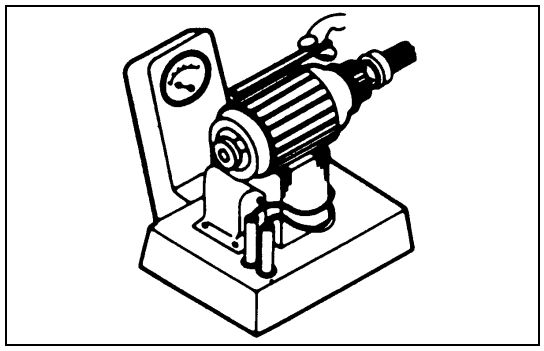
6D2-10-3.tif

4. Measure the commutator outside diameter.

Commutator Outside Diameter mm (in)

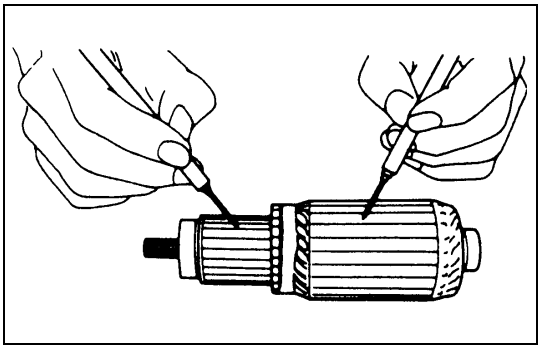
Model	Yoke Diameter	Standard	Limit
S25-163C	ø80	36.5 (1.437)	35.5 (1.398)
S25-305C	ø90	38.0 (1.496)	36.6 (1.441)

If the measured outside diameter is less than the specified limit, the commutator must be replaced.

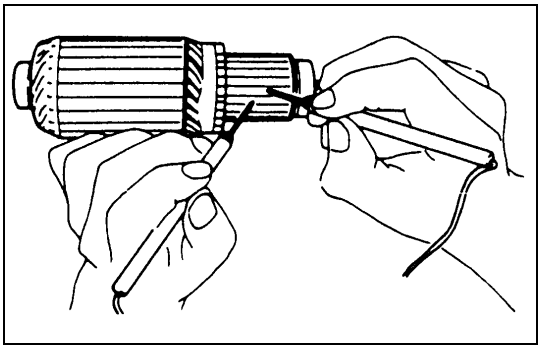


6D2-10-4.tif

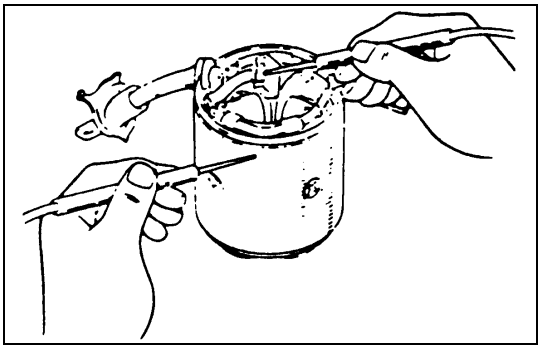
5. Test the armature for short circuiting.
   a. Place the armature in a growler tester.
   b. Hold a hacksaw blade against the armature core.
      If the armature has a short circuit, the hacksaw blade will vibrate.
      Replace the armature if there is a short circuit.



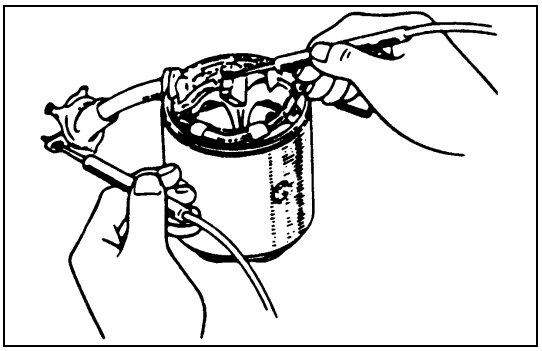
6D2-11-1.tif



6D2-11-2.tif



6D2-11-3.tif



6D2-11-4.tif

6. Use a circuit tester to check the armature for grounding.
   1) Hold one probe of the circuit tester against the commutator segment.
   2) Hold the other circuit tester probe against the armature core.

   If the circuit tester indicates continuity, the armature is grounded.

   The armature must be replaced.

7. Use the circuit tester to check the armature for continuity.
   1) Hold the circuit tester probes against two armature core segments.
   2) Repeat Step 1 at different segments of the armature core.

   There should be continuity between all segments of the armature core.

   If there is not, the armature must be replaced.

YOKE

1. Use a circuit tester to check the field winding ground.
   1) Hold one circuit tester probe against the field winding end or brush.
   2) Hold the other circuit tester probe against the bare surface of the yoke body.

   There should be no continuity.

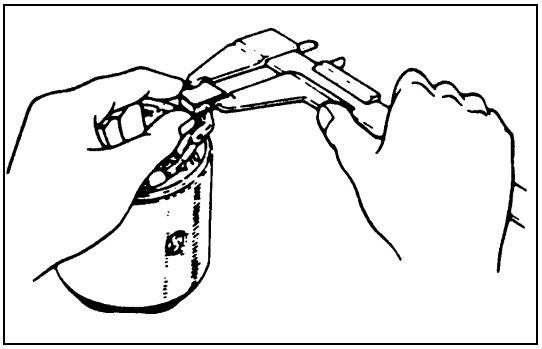
   If there is continuity, the field coil is grounded.

   The yoke must be replaced.

2. Use the circuit tester to check the field winding continuity.
   1) Hold one circuit tester probe against the “C” terminal lead wire.
   2) Hold the other circuit tester probe against the field winding brush.

   There should be continuity.

   If there is no continuity, the yoke must be replaced.



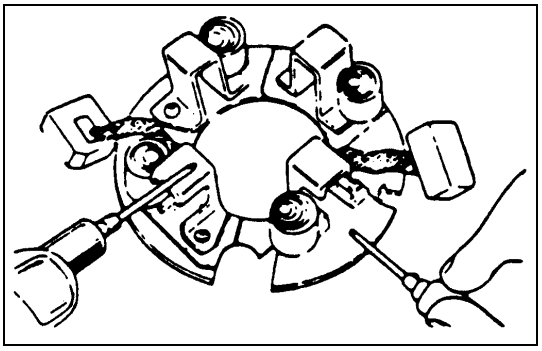
6D2-12-1.tif

BRUSH AND BRUSH HOLDER

1. Use a vernier caliper to measure the brush length (four brushes).
   Replace the brushes as a set if one or more of the brush length is less than the specified limit.

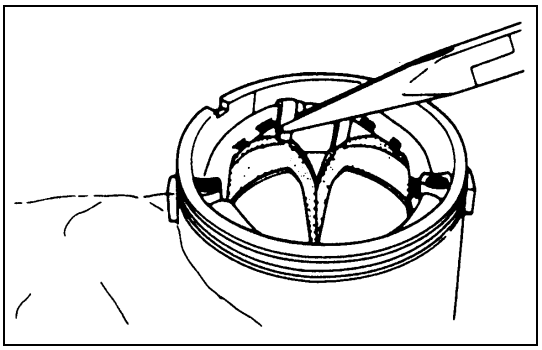
Brush Length mm (in)

Model	Yoke Diameter	Standard	Limit
S25-168	ø80	15.0 (0.591)	10.5 (0.413)
S25-305	ø90	18.0 (0.709)	11.0 (0.433)



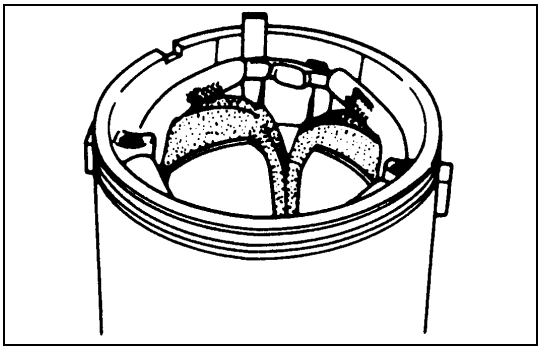
6D2-12-2.tif

2. Use a circuit tester to check the brush holder insulation.
   Touch one probe to the holder plate and the other probe to the positive brush holder.
   There should be no continuity.
3. Inspect the brushes for excessive wear.
   If the negative brushes have excessive wear, the entire brush holder assembly must be replaced.
   If the positive brushes have excessive wear, only the brushes must be replaced.



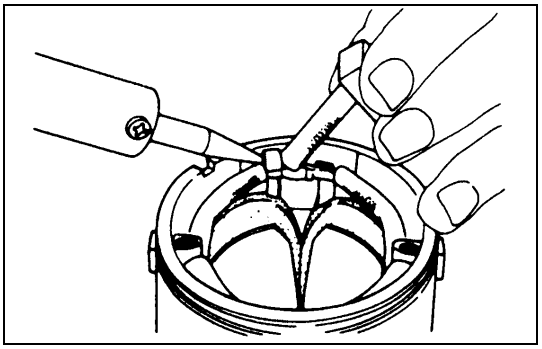
6D2-12-3.tif

1) Use a pair of side cutters to cut the lead wire from the brush.
2) File away any foreign material clinging to the edge of the lead wire.
3) Remove the brushes from the brush holder.
4) Install the new brushes.



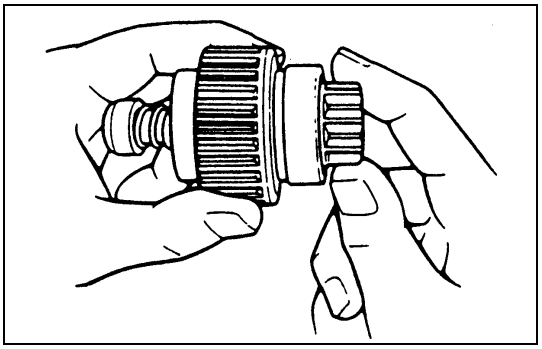
6D2-12-4.tif

5) Straighten the bent portion of the clip.
6) File away any foreign material clinging to the clip surface.



6D2-13-1.tif

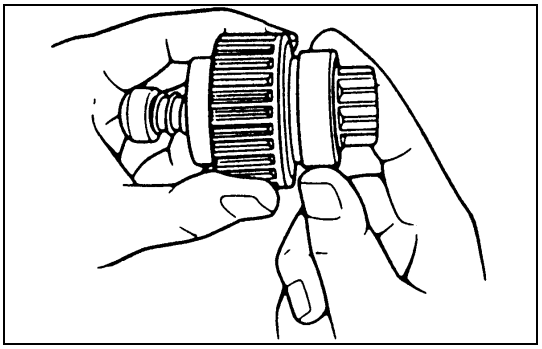
7) Place the lead wire in the clip.
8) Bend the clip shut.
9) Solder the brush lead.
10) Repeat the procedure for each of the brushes.



6D2-13-2.tif

OVERRUNNING CLUTCH

1. Inspect the overrunning clutch gear teeth for excessive wear and damage.
   Replace the overrunning clutch if necessary.
2. Rotate the pinion clockwise.
   It should turn smoothly.
3. Try to rotate the pinion in the opposite direction.
   The pinion should lock.



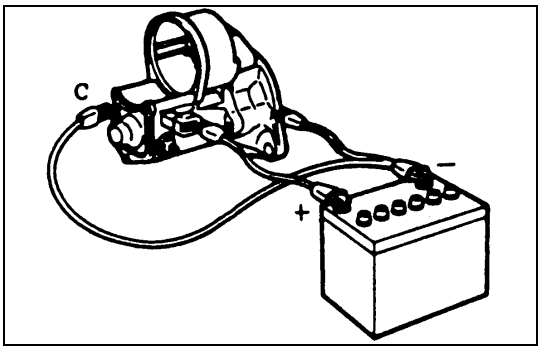
6D2-13-3.tif

BALL BEARING

Inspect the bearings for excessive wear and damage.
Replace the bearings if necessary.

MAGNETIC SWITCH

The following tests must be performed with the starter motor fully assembled.
The yoke lead wire must be disconnected from the “C” terminal.
To prevent coil burning, complete each test as quickly as possible (within three to five seconds).

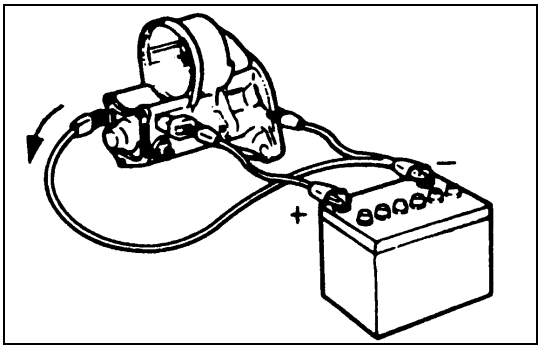


6D2-13-4.tif

Temporarily connect the magnetic switch between the clutch and the housing and run the following test.
Complete each test within three to five seconds.

1. Pull-Out Test

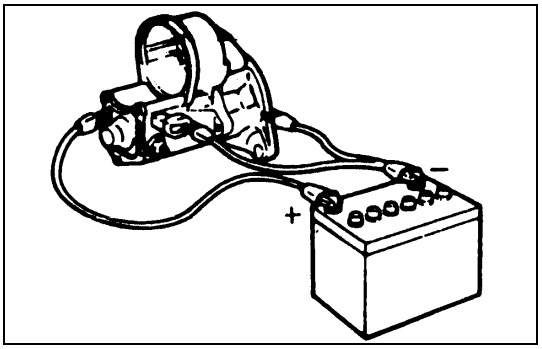
Connect the battery negative terminal with the magnetic switch body and the C terminal. When current is applied to the 50 terminal from the battery positive terminal, the pinion should flutter.



6D2-14-1.tif

2. Hold-in Maintenance Test

Disconnect the lead at the C terminal. The pinion should continue to flutter.



6D2-14-2.tif

3. Return Test

Connect the battery negative leads to the starter body and the 50 terminal.

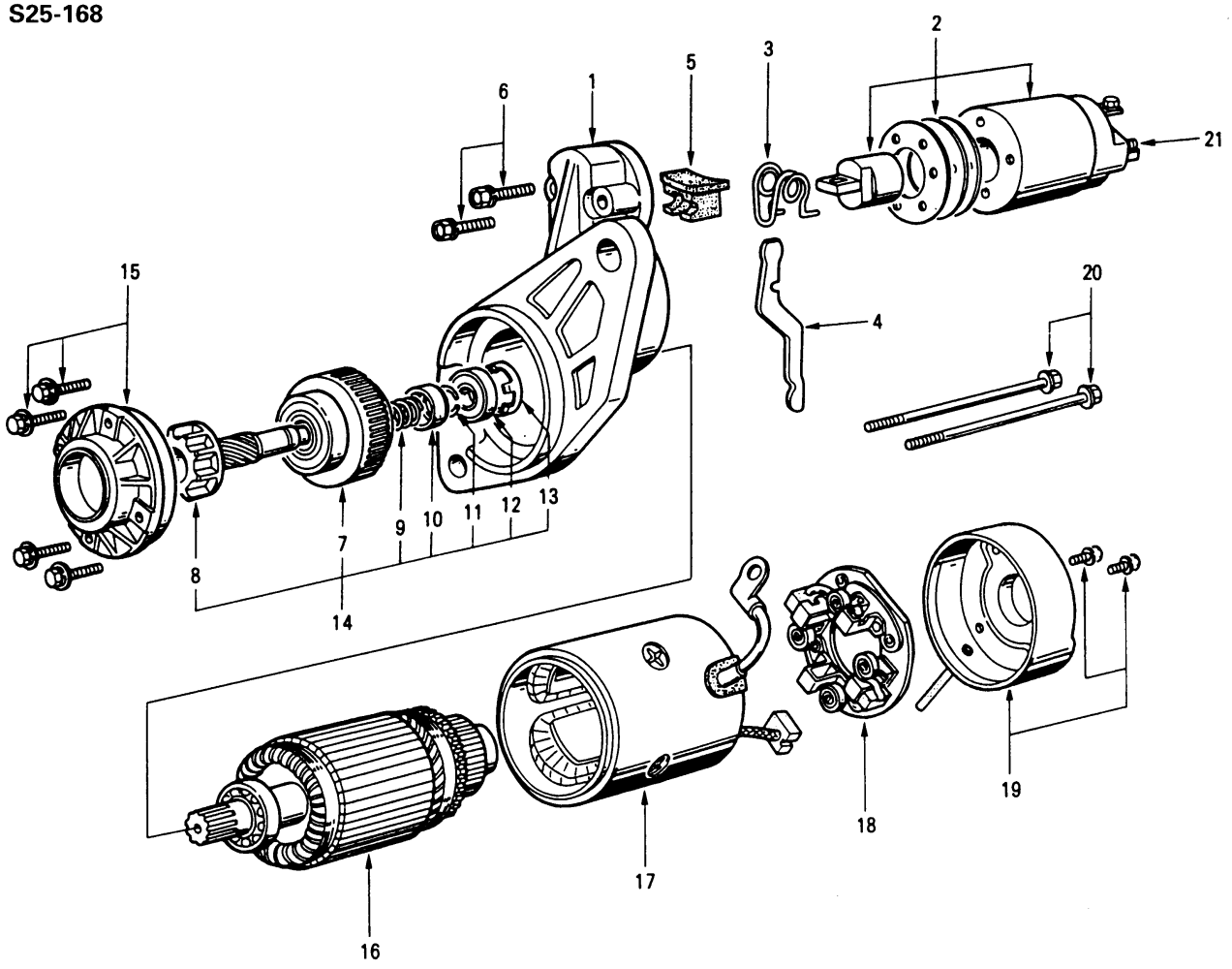
Connect the battery positive lead at the C terminal.

The pinion should return to its home position.

REASSEMBLY

S25-168

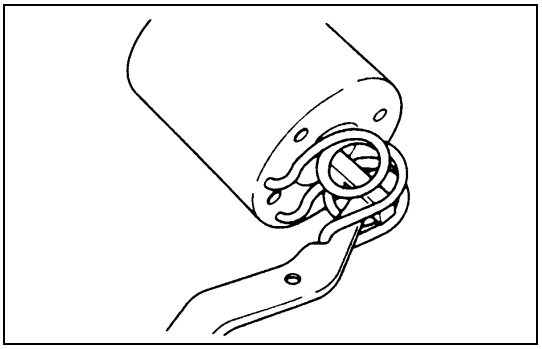
S25-168



Reassembly Steps

1. Gear case
2. Magnetic switch assembly
3. Torsion spring
4. Shift lever
5. Dust cover
6. Bolt
7. Pinion clutch
8. Pinion shaft
9. Return spring
10. Pinion stopper
11. Pinion stopper crip
12. Ball bearing
13. Bearing holder
14. Clutch assembly
15. Bearing retainer
16. Armature
17. Yoke
18. Brush holder
19. Rear cover
20. Through bolt
21. Lead wire nut

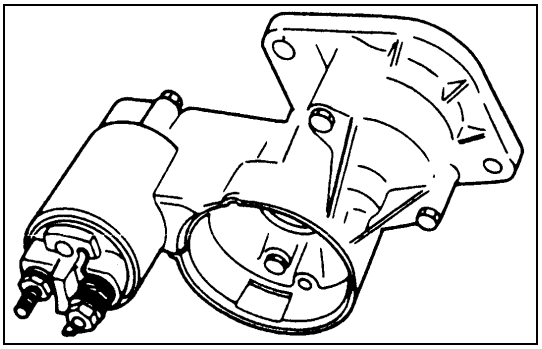
6D2-15-1.tif



6D2-16-1.tif

REASSEMBLY

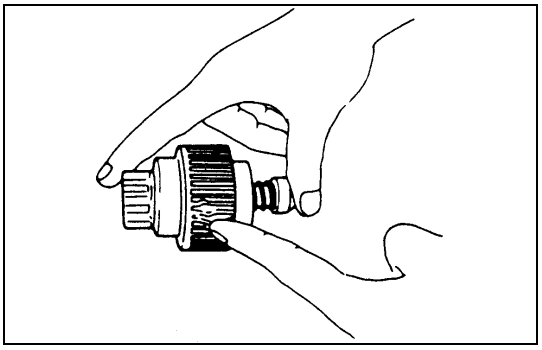
1. **Gear Case**
2. **Magnetic Switch Assembly**
3. **Torsion Spring**
4. **Shift Lever**
   1) Attach the torsion spring to the hole in the magnetic switch as illustrated.
   2) Insert the shift lever into the plunger hole of the magnetic switch.



6D2-16-2.tif

5. **Dust Cover**
   Install the dust cover.
6. **Bolt**
   Install the magnetic switch assembly in the gear case and tighten the bolt to the specified torque.

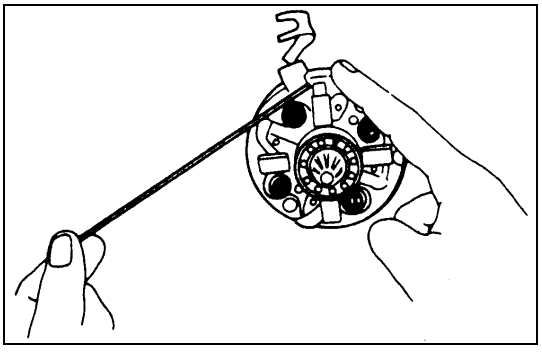
Gear Case Bolt Torque	N·m (kg·m/lb·in)
	8 (0.8/69)



6D2-16-3.tif

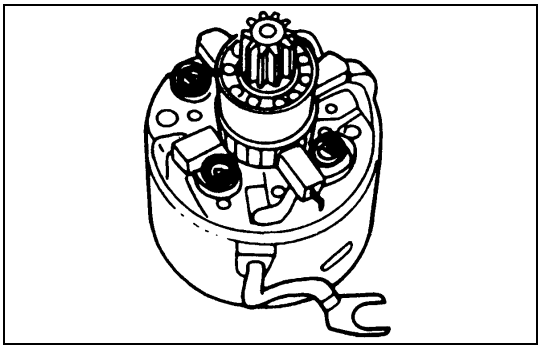
7. **Pinion Clutch**
8. **Pinion Shaft**
   Apply a coat of grease to the pinion clutch gear and install the pinion assembly to the armature shaft.
9. **Return Spring**
10. **Pinion Stopper**
11. **Pinion Stopper Clip**

12. **Ball Bearing**
13. **Bearing Holder**
14. **Clutch Assembly**
15. **Bearing Retainer**
16. **Armature**
17. **Yoke**



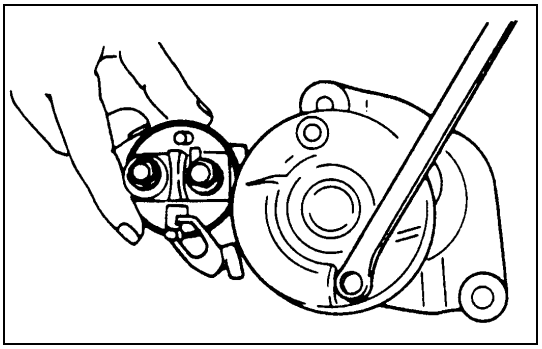
6D2-16-4.tif

21. **Brush Holder**
    1) Twist the holder spring and hold it.
    2) Install the brush to the brush holder.
    3) Repeat step 1 and 2 for the reaming holders.



6D2-17-1.tif

4) Install the brush holder assembly to the yoke.
Take care not to damage the commutator face and the brushes.



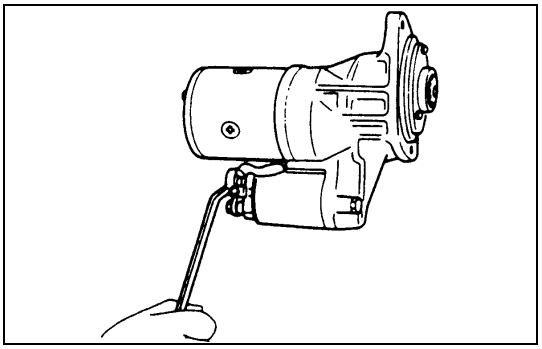
6D2-17-2.tif

19. Rear Cover

20. Through Bolt

Install the through bolts in the rear cover and tighten them to the specified torque.

Through Bolt Torque	N·m (kg·m/lb·in)
6 (0.6/52)	

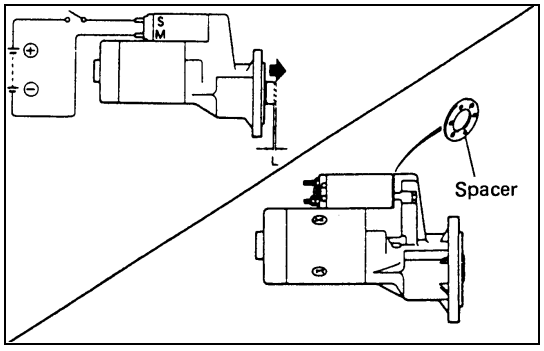


6D2-17-3.tif

21. Lead Wire Nut

Connect the lead wire in the magnetic switch and tighten the terminal nut to the specified torque.

Lead Wire Terminal Nut Torque	N·m (kg·m/lb·in)
10 (1.0/87)	



6D2-17-4.tif

Pinion Jump-out dimension

- Connect the (+) cable of battery to terminal S and the (-) cable to terminal M. Turn the switch on, and measure pinion travel dimension “L” in thrust direction from the jump-out position.

In measuring the dimension, pull the pinion out a little in the arrow direction.

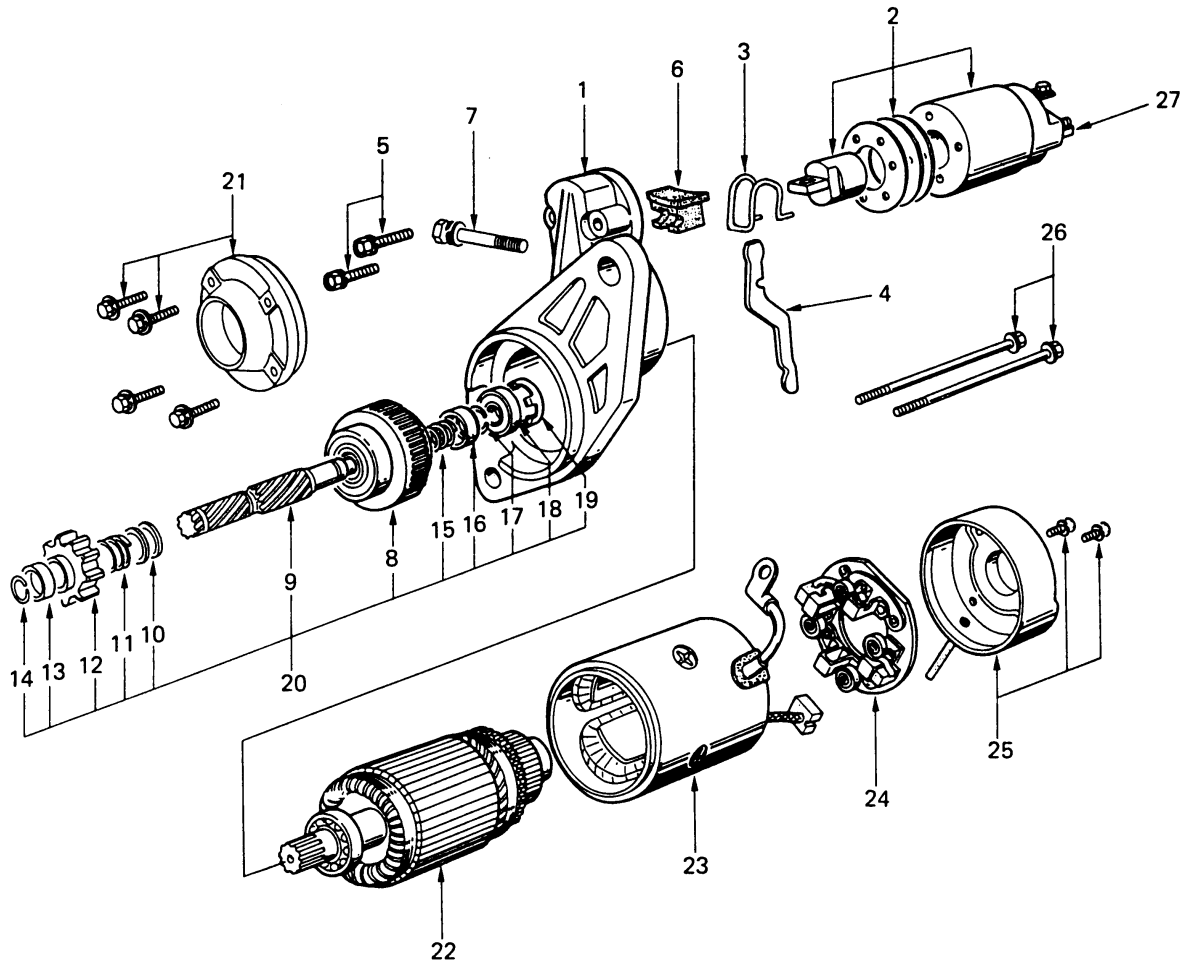
mm (in)

Dimension	Standard
L	0.3 - 0.1 (0.01 - 0.004)

If the measured value is out of standard, adjust the of shims.

S25-305A

S25-305A



Reassembly Steps

1. Gear case
2. magnetic switch assembly
3. Torsion spring
4. Shift lever
5. Bolt
6. Dust cover
7. Bolt
8. Pinion clutch
9. Pinion shaft
10. Washer
11. Cushion spring
12. Pinion
13. Pinion stopper
14. Clip
15. Return spring
16. Pinion stopper
17. Pinion stopper clip
18. Ball bearing
19. Bearing holder
20. Clutch assembly
21. Bearing retainer
22. Armature
23. Yoke
24. Brush holder
25. Rear cover
26. Through bolt
27. Lead wire nut

6D2-18-1.tif

REASSEMBLY

For reassembly, refer to S25-168.

SECTION 6D3
CHARGING SYSTEM

CONTENTS

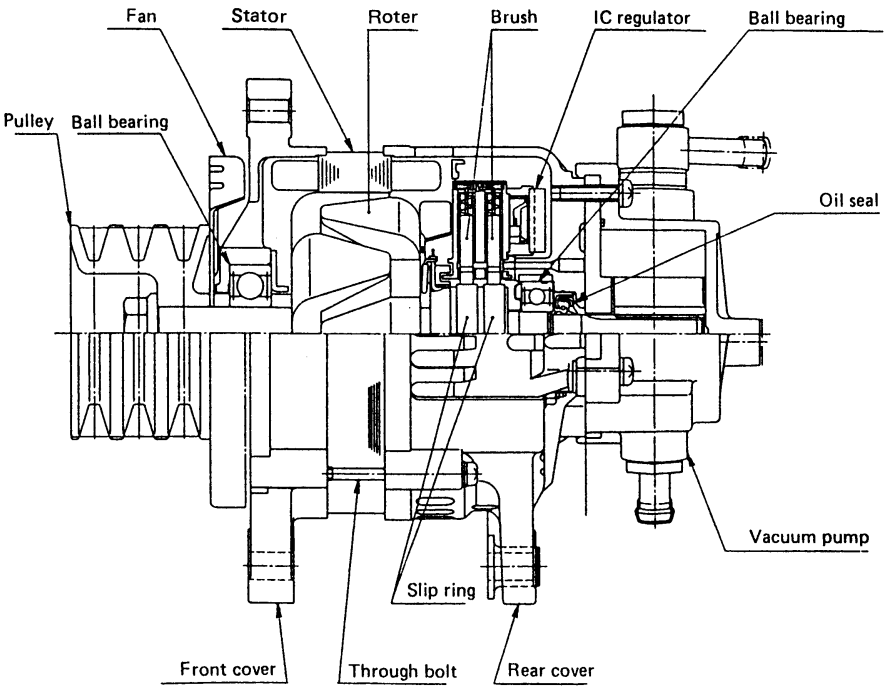
	PAGE
General Description	6D3 - 1
Diagnosis	6D3 - 3
On-Vehicle Service	6D3 - 4
Unit Repair	6D3 - 7
Reassembly	6D3 - 16

GENERAL DESCRIPTION

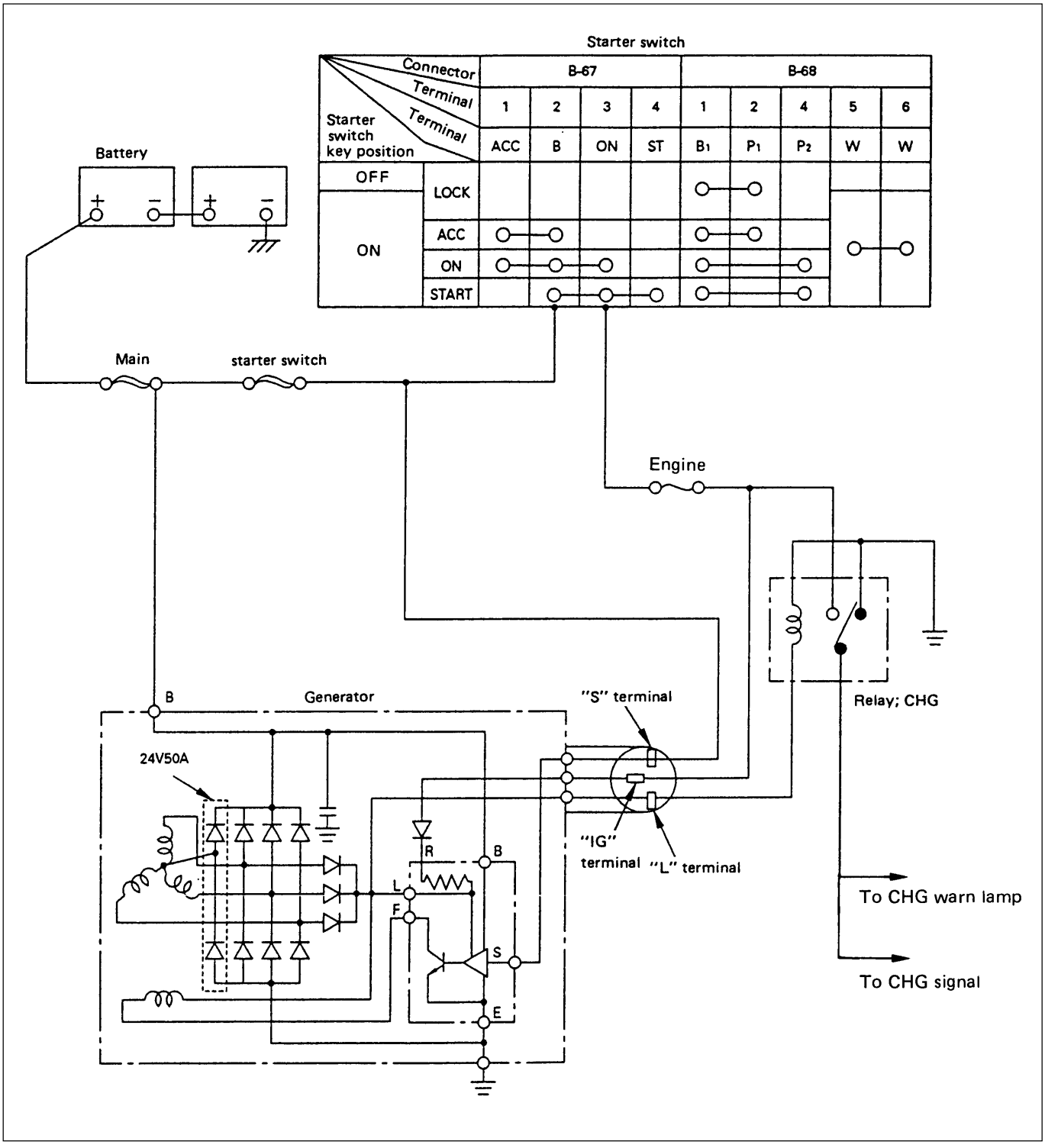
The charging system is the IC integral regulator charging system and its main components are connected as shown in Figure.

The regulator is a solid state type and it is mounted along with the brush holder assembly inside the generator installed on the rear end cover.

The generator does not require particular maintenance such as voltage adjustment. The rectifier aconnected to the stator coil has nine diodes to transform A.C. voltage into D.C. voltage. This D.C. voltage is connected to the output terminal of generator.



6D3-1-1.tif

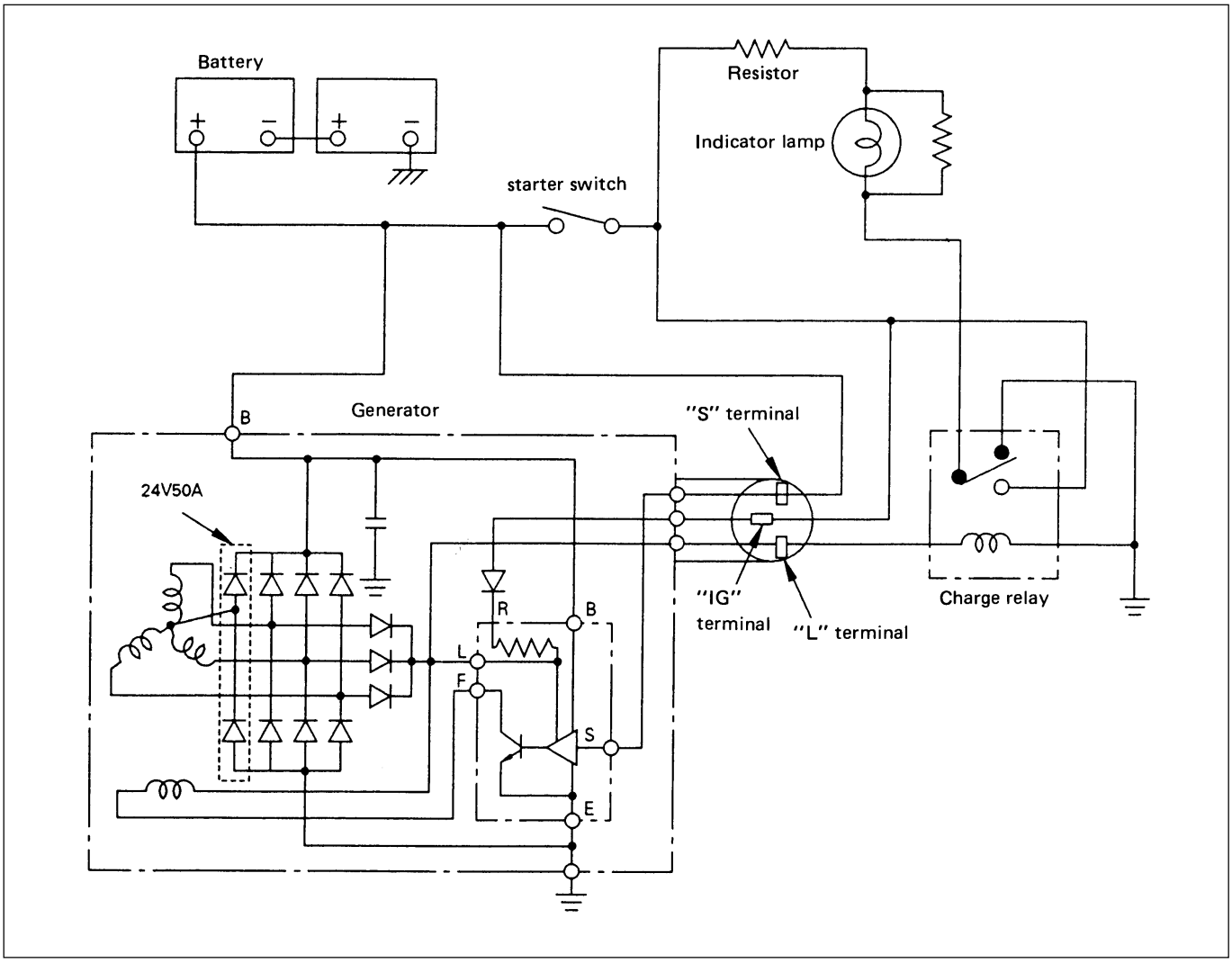

Starter switch
Connector
Terminal
Terminal
Starter switch key position
B-67
B-68
1
2
3
4
1
2
4
5
6
ACC
B
ON
ST
B1
P1
P2
W
W
OFF
LOCK
ON
ACC
ON
START
Battery
Main
starter switch
Engine
Relay; CHG
B
Generator
"S" terminal
24V50A
R
B
L
F
S
E
"IG" terminal
"L" terminal
To CHG warn lamp
To CHG signal

6D3-2-1.tif

DIAGNOSIS

GENERAL ON-VEHICLE INSPECTION

The operating condition of charging system is indicated by the charge warning lamp. The warning lamp comes on when the starter switch is turned to “ON” position. The charging system operates normally if the lamp goes off when the engine starts. If the warning lamp shows abnormality or if undercharged or overcharged battery condition is suspected, perform diagnosis by checking the charging system as follows:

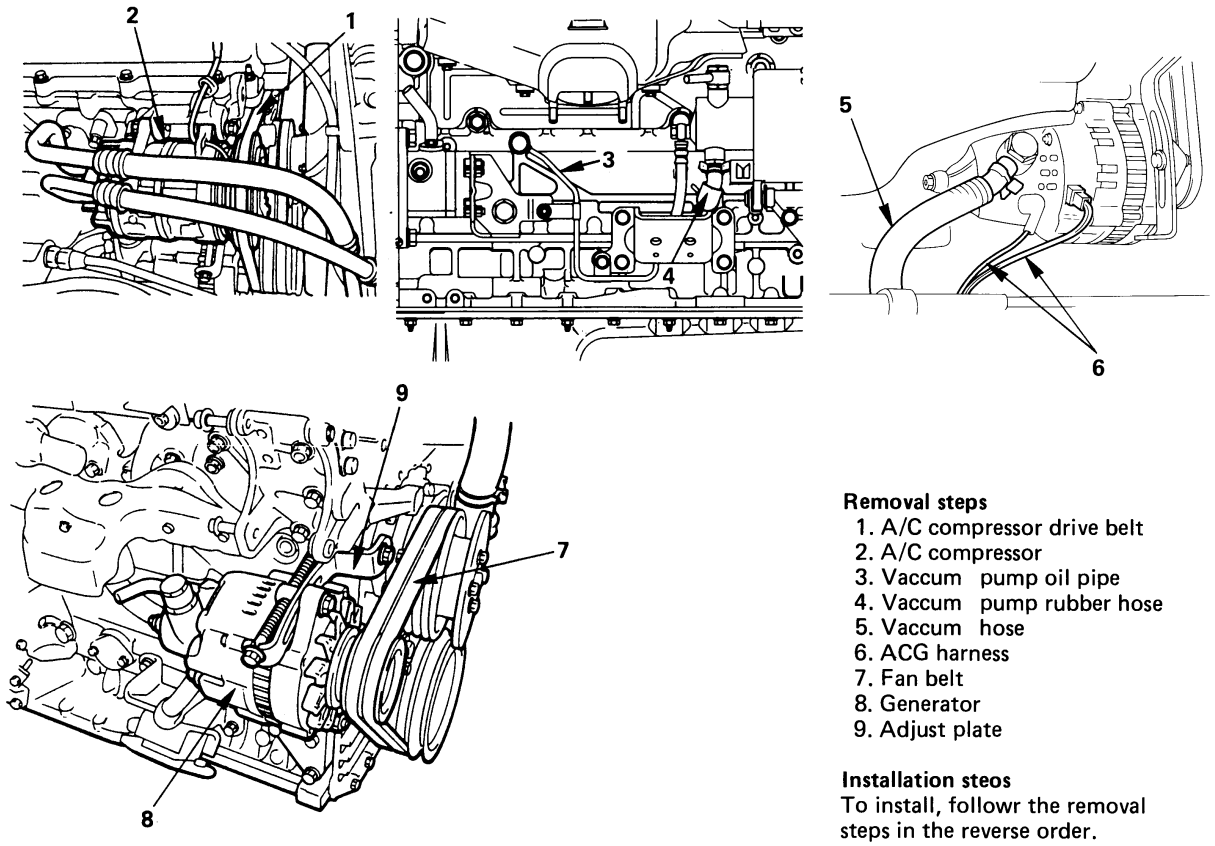


6D3-3-1.tif

1. Check visually the belt and wiring connector.
2. With the engine in stop status, turn the starter switch to “ON” position and observe the warning lamp.
   - If lamp does not come on:
     Disconnect wiring connector from generator, an ground the terminal “L” on connector side.
   - If lamp comes on:
     Repair or replace the generator.

ON-VEHICLE SERVICE

GENERATOR



Removal steps
1. A/C compressor drive belt
2. A/C compressor
3. Vaccum pump oil pipe
4. Vaccum pump rubber hose
5. Vaccum hose
6. ACG harness
7. Fan belt
8. Generator
9. Adjust plate

Installation steos
To install, followr the removal steps in the reverse order.

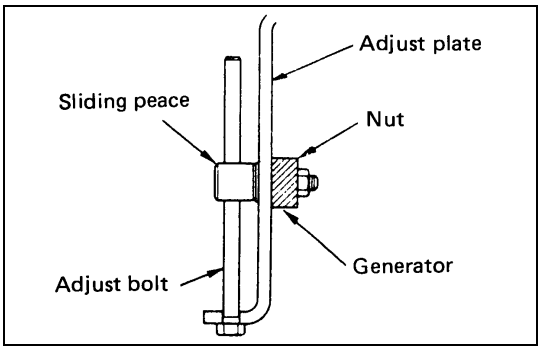
6D3-4-1.tif

REMOVAL

Preparation
- Battery ground cable
- Tilt the cab

1. **A/C Compressor Drive Belt (If equipped with A/C)**
2. **A/C Compressor (If equipped with A/C)**
   - After disconnecting the A/C compressor harness connector, demount the compressor from the A/C compressor bracket and fasten it with a wire to an appropriate location together with the hoses.
3. **Vacuum Pump Oil Pipe**
4. **Vacuum Pump Rubber Hose**
5. **Vacuum Hose**
6. **ACG Harness**
   Disconnect the B terminal cable and harness connector from generator.
7. **Fan Belt**
8. **Generator**
9. **Adjust Plate**

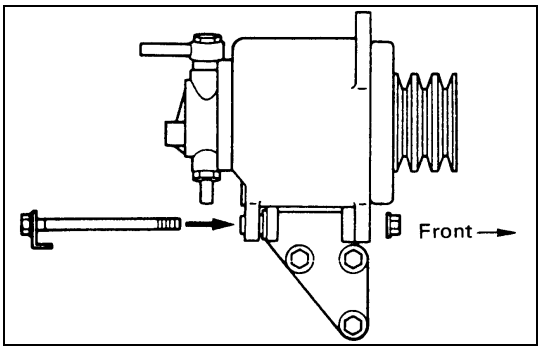
INSTALLATION



6D3-5-1.tif

9. Adjust Plate

Install the adjust plate as shown in the illustration



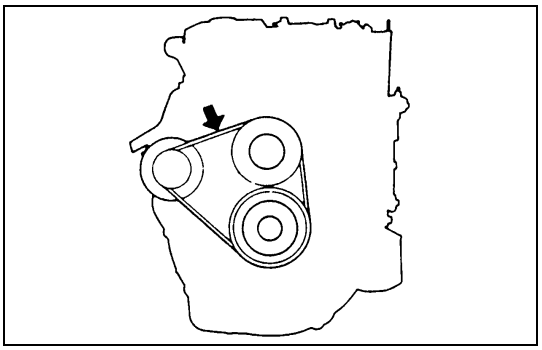
6D3-5-2.tif

8. Generator

Note:

Before tightening the generator, tighten in advance the fan belt temporarily after its adjustment.

- Insert the lower fixing bolt from the rear side as shown in the illustration, and tighten it with a nut on the front side.



6D3-5-3.tif

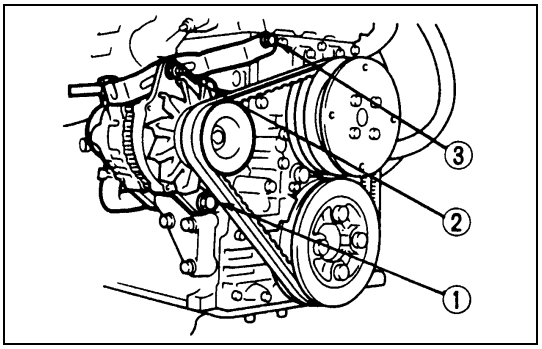
7. Fan Belt

Check the drive belt tension.

Depress the drive belt mid-portion with a 10 kg (22 lb/98 N) force.

Drive Belt Deflection	mm (in)
8 - 12 (0.31 - 0.47) ··· New belt 10 - 14 (0.39 - 0.55) ··· Reuse belt	

Check the drive belt for cranking and other damage.



6D3-5-4.tif

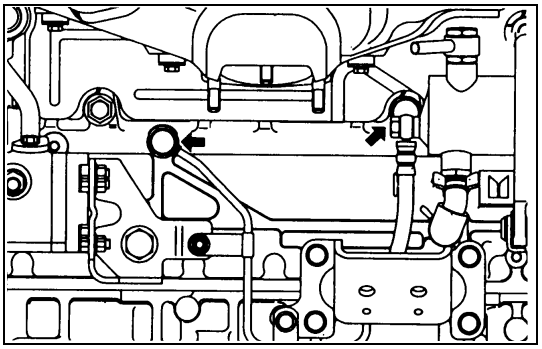
Fan Belt Adjustment

Fan belt tension is adjusted by moving the generator.

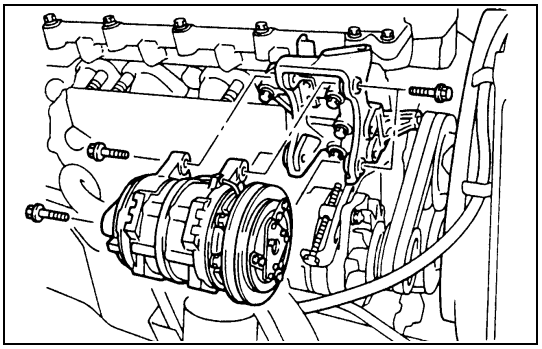
Torque	N·m (kg·m/lb·ft)
①	40 (4.1/30)
②	24 (2.4/17)
③	46 (4.7/34)

6. ACG Harness

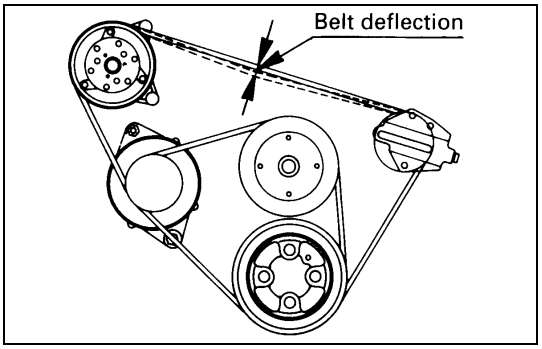
5. Vacuum Hose



6D3-6-1.tif



6D3-6-2.tif



6D3-6-3.tif

4. **Vacuum Pump Rubber Hose**
3. **Vacuum Pump Oil Pipe**

Cylinder Body Side	N·m (kg·m/lb·ft)
	41 (4.2/30)

Generator Side	N·m (kg·m/lb·ft)
	23 (2.3/17)

2. **A/C Compressor (If equipped with A/C)**
   - Tighten fixing bolts to the specified torque.

A/C Compressor Bolt Torque	N·m (kg·m/lb·ft)
	48 (4.9/35)

Note:
When installing the compressor fixing bolts, tighten first the 2 bolts on the rear side, and then the remaining 2 on the front side.

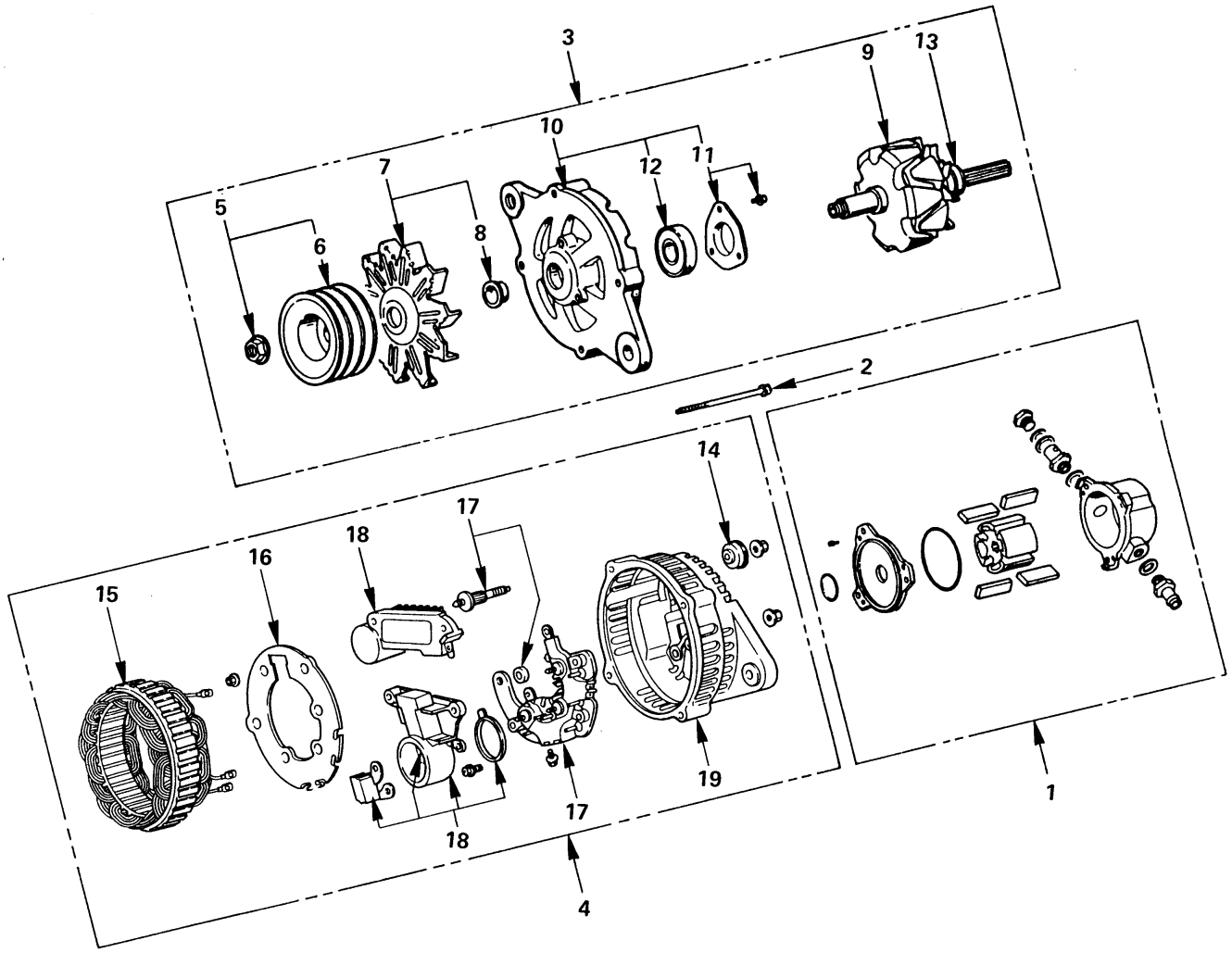
1. **A/C Compressor Drive Belt (If equipped with A/C)**
   - Install drive belt adjust belt tension by adjusting bolt and tighten locking nut to the specified torque.
   - Depress the drive belt mid-portion with a 10 kg (22 lb/98 N) force.

Drive Belt Deflection	mm (in)
	16 - 20 (0.63 - 0.79) ···New belt 18 - 22 (0.71 - 0.87) ···Reuse belt

Locking Nut Torque	N·m (kg·m/lb·ft)
	27 (2.8/20)

   - Connect the negative battery cable.
   - Lower the cab.

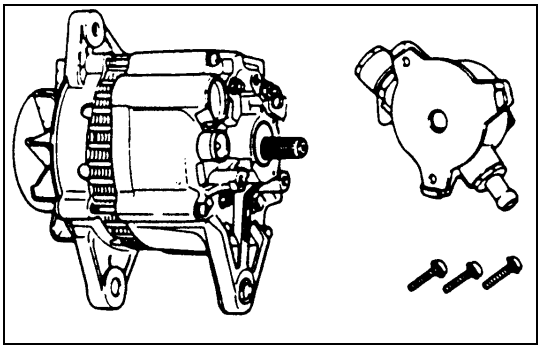
UNIT REPAIR



Disassembly Steps

1. Vacuum pump assembly
2. Through bolt
3. Rotor and front cover assembly
4. Stator and rear cover assembly
5. Pulley nut
6. Pulley
7. Fan
8. Spacer
9. Rotor
10. Front cover
11. Bearing retainer
12. Front ball bearing
13. Rear ball bearing
14. Terminal nut and bolt
15. Stator
16. Fan guide
17. Rectifier
18. Brush and IC regulator
19. Rear cover

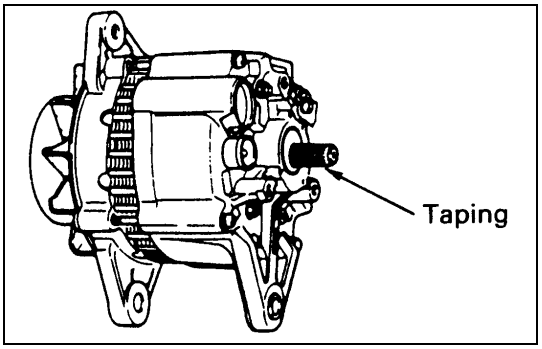
6D3-7-1.tif



6D3-8-1.tif

DISASSEMBLY

1. **Vacuum Pump Assembly**
   1) Loosen the vacuum pump fixing bolts.
   2) Support the vacuum pump center plate.
   3) Carefully remove the vacuum pump.



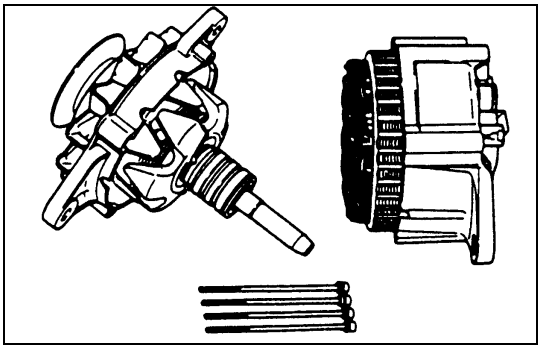
6D3-8-2.tif

2. **Through Bolt**
3. **Rotor and Front Cover Assembly**
4. **Stator and Rear Cover Assembly**
   1) Loosen the through bolts.
   2) Remove the rotor and front cover assembly from the stator and rear cover assembly.

      Do not allow the stator to separate from the rear cover.

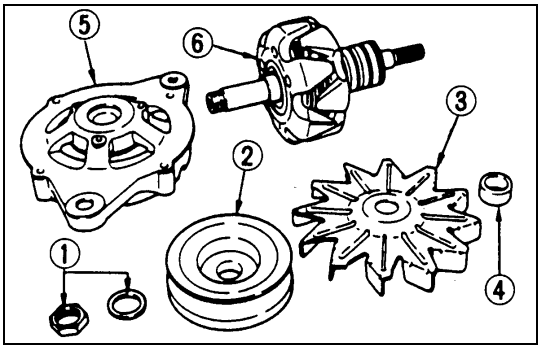
      Take care not to damage the oil seal.

      Tape the rotor splines to protect them from damage.



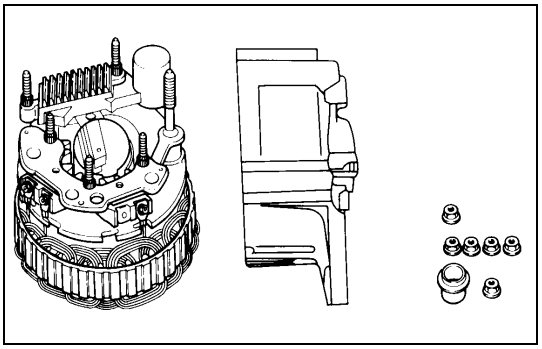
6D3-8-3.tif

5. **Pulley Nut**
6. **Pulley**
7. **Fan**
8. **Spacer**
9. **Rotor**
   1) Carefully clamp the rotor assembly in a vice.
   2) Loosen the pulley nut ①.
   3) Remove the pulley ②, the fan ③, the spacer ④, the front cover ⑤ and the rotor ⑥.



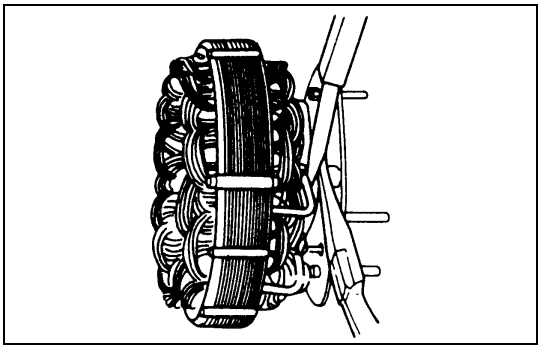
6D3-8-4.tif

10. **Front Cover**
11. **Bearing Retainer**
12. **Front Ball Bearing**
13. **Rear Ball Bearing**
14. **Terminal Nut and Bolt**

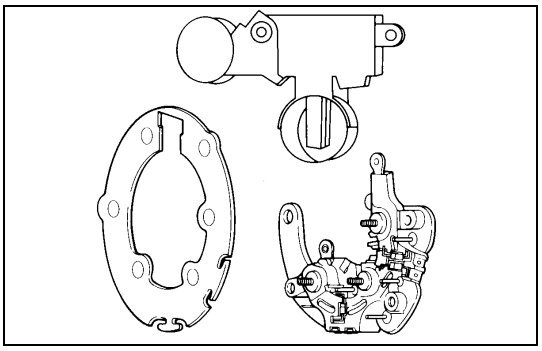


6D3-8-5.tif

15. **Stator**
    1) Loosen the terminal nuts and bolts.
    2) Remove the lead wire, the insulators, and the washers.
    3) Remove the stator and the IC regulator assembly from the rear cover.



6D3-9-1.tif



6D3-9-2.tif

16. **Fan guide**
17. **Rectifier**
18. **Brush and IC Regulator**

    Disconnect the stator coil leads between each rectifier and the N-terminal by melting the solder connection.

    NOTE:

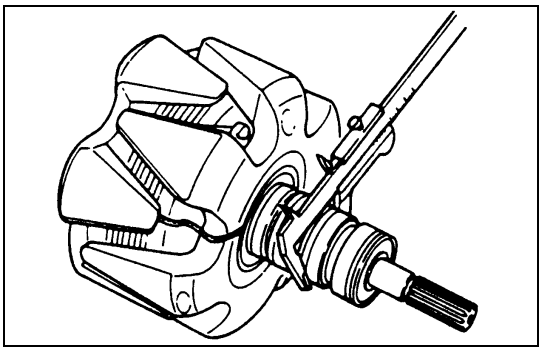
    Hold the lead wire between the solder and the rectifier with a pair of long nose pliers.

    This will prevent heat transfer and resultant damage to the rectifier.

    Refer to "INSPECTION AND REPAIR" for the IC regulator, the rectifier, the brush holder, and the condenser replacement procedures.
19. **Rear Cover**

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.



6D3-9-3.tif

ROTOR

1. Inspect the slip ring faces for dirt and pitting.

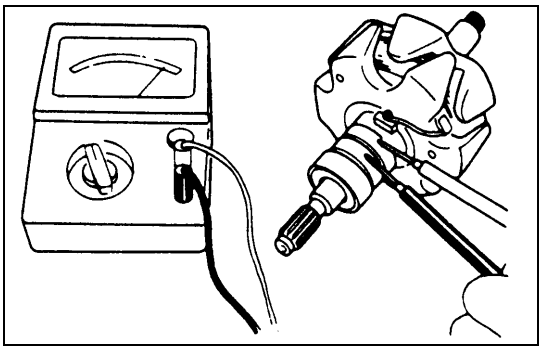
   Wipe away any dirt with a clean cloth soaked in alcohol.

   Use a hand grinder to remove pitting.
2. Measure the slip ring diameter.

Slip Ring Diameter — mm (in)

Standard	Limit
37.6 (1.480)	36.6 (1.441)

If the slip ring diameter is less than the specified limit, the slip rings must be replaced.

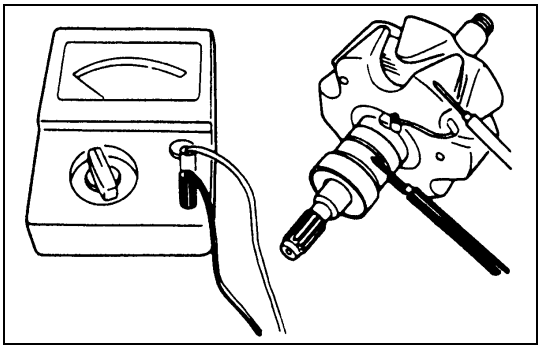


6D3-9-4.tif

3. Measure the rotor coil resistance.

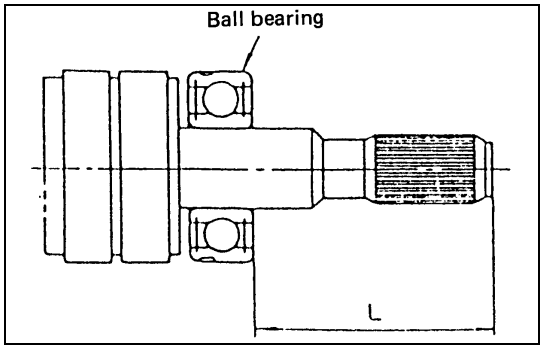
Rotor Coil Resistance at 20°C (68°F) — ohms

Standard	12.6



6D3-10-1.tif

4. Check for continuity between the slip rings and the rotor core or shaft.
   If there is continuity, the entire rotor assembly must be replaced.



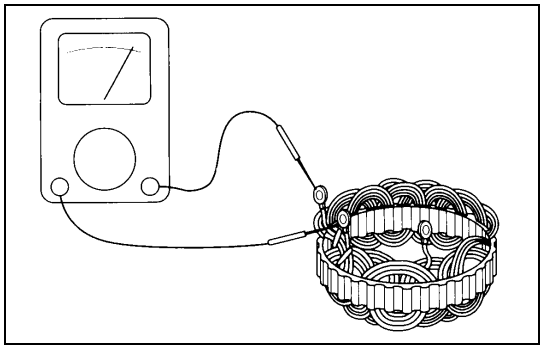
6D3-10-2.tif

5. Rear ball bearing
- Check to see if the ball bearings rotate lightly with no noise heard.
- As the result of inspection, it is found that the ball bearing do not rotate lightly or any noises are heard, replace them with new ones.

Press-in measurement (L) when changing bearings — mm (in)

Standard	58.0 - 58.2 (2.283 - 2.291)

STATOR

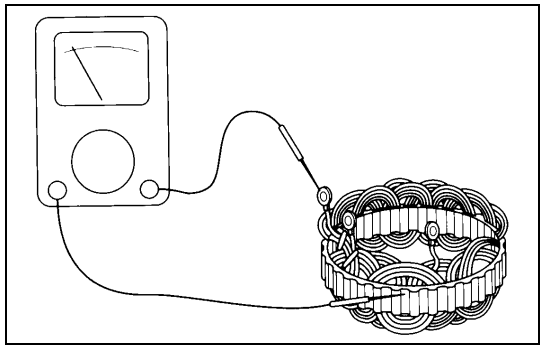


6D3-10-3.tif

1. Check for continuity across the stator coils.
   If there is no continuity, the stator coils must be replaced.

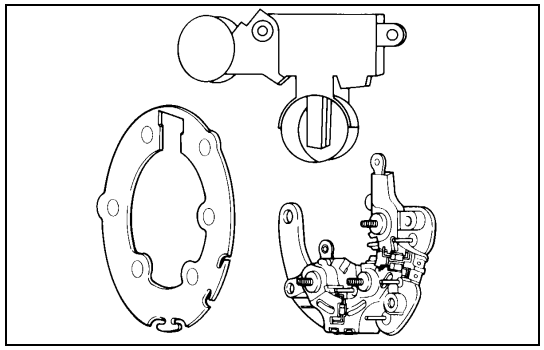
Resistance Between The Coil End “N” And The Each Coil Ends (Reference) — ohms

Standard	0.17



6D3-10-4.tif

2. Check for continuity between each stator coil and the stator core.
   If there is continuity, the stator coils must be replaced.



6D3-10-5.tif

RECTIFIER, IC REGULATOR, AND BRUSH HOLDER ASSEMBLY

Disassembly

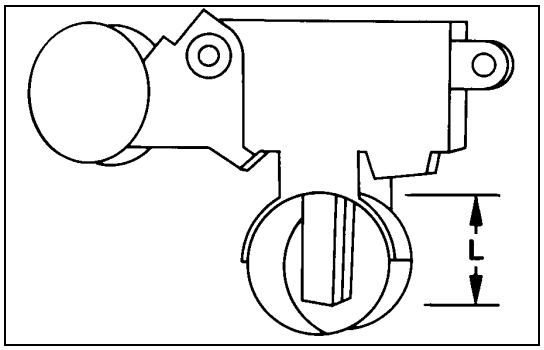
1. Disconnect the IC regulator and the rectifier by melting the solder connections.
2. Loosen the terminal bolt to remove the rectifier.

3. Disconnect the IC regulator, the brush holder, and the condenser by melting the solder connections.
4. Remove the IC regulator from the terminal plates.
5. Remove the stud bolts from the terminal plate.

NOTE:

If the brushed, brush holder, and the condenser to be reused, do not remove the stud bolts.

6. Remove the brush holder from the terminal plate.



6D3-11-1.tif

Inspection

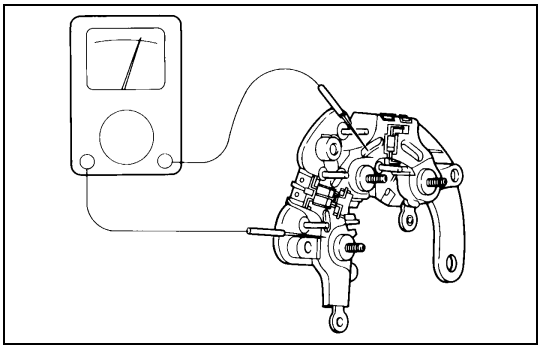
Brush

Each brush has a line to indicate whether or not the brush is serviceable.

If the line is not visible, the brush must be replaced.

Brush Length (Reference) mm (in)

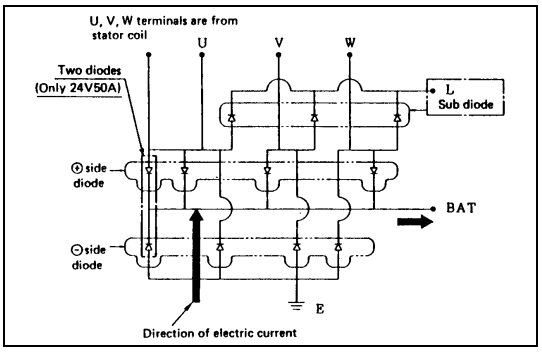
Standard	Limit
25 (0.984)	6 (0.236)



6D3-11-2.tif

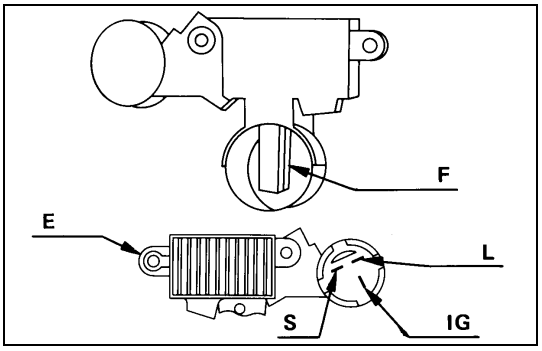
Rectifier

1. Check for continuity with a circuit tester between the battery and each of the three stator coil lead terminals.
   If there is continuity from battery to each of the three stator coil lead terminals, the rectifier is normal.
   If there is no continuity, the rectifier must be replaced.
   Check for continuity with a circuit tester between the earth and each of the three stator coil lead terminals.
   If there is continuity from each of the three stator coil lead terminals to earth, the rectifier is normal.
   If there is no continuity, the rectifier must be replaced.



6D3-11-3.tif

2. Reverse the polarity of the test probes.
   If there is no continuity, the rectifier is normal.
   If there is continuity, the rectifier must be replaced.



6D3-11-4.tif

IC Regulator

The IC regulator may be tested with either a circuit tester or pair of standard voltmeters.

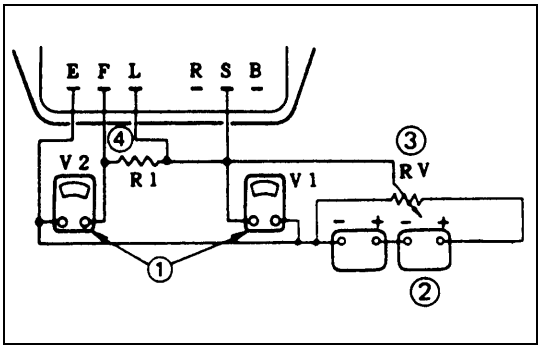
Refer to the illustration.

① Circuit tester (or voltmeter) range is from 0 to 50 volts in 0.5 volt increments.

② Two twelve volt batteries are required.

③ Note the variable resistor.

④ This resistor is rated at 100 watts/3 ohms.



6D3-12-1.tif

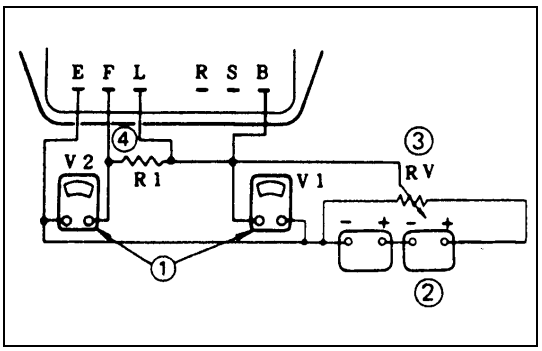
Testing the IC Regulator

Refer to the wiring diagram when testing the IC regulator.

1. Connect the batteries in series.
2. Measure the battery power (voltage).

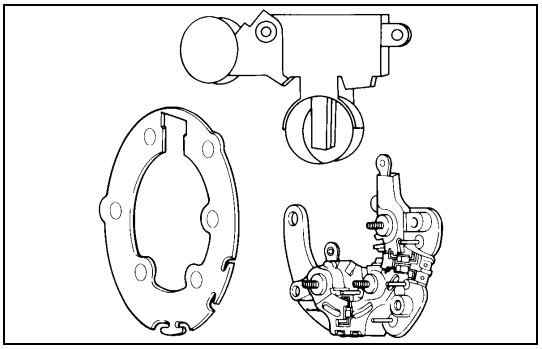
Battery Power	V
28 - 29	

3. Connect the circuit tester ① (or voltmeter V2) as shown in the illustration.
4. Set the variable resistor ③ to zero.
5. Slowly increase the resistance of the variable resistor toward the build-up point.
   Measure the voltage between E and F.
   As long as the resistance is below the build-up point, the voltage reading should be stable and less than two volts.
   When the resistance exceeds the build-up point, the voltage reading should be two volts or greater.
   If the voltage does not exceed two volts after reaching the build-up point, the IC regulator must be replaced.
6. Return the variable resistor ③ to zero.
7. Connect the circuit tester (or voltmeter V1) as shown in the illustration.
8. Measure the voltage at terminals S, L, and E.
9. Slowly increase the resistance of the variable resistor.
   Note the point at which the voltage quickly builds up to between 2 and 6 volts.
   This will indicate the point at which the voltage regulator begins to function.
   If the measured voltage is outside the specified range, the voltage regulator must be replaced.



6D3-12-2.tif

10. Repeat Steps 3 through 5 to measure the voltage between terminals B ,L, and E.
    Refer to the wiring diagram.
    The regulator voltage should be between 0.5 and 3 volts higher than the measured voltage.
    If the regulator voltage is outside this range, the voltage regulator must be replaced.



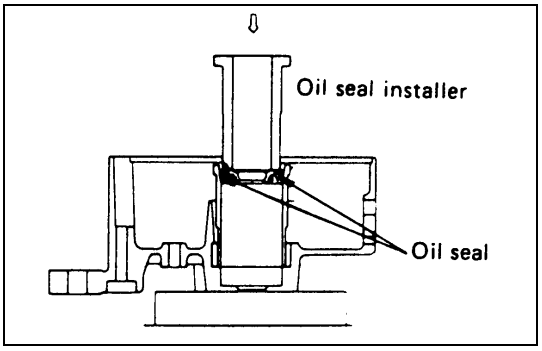
6D3-13-1.tif

Reassembly

1. Install the brush holder and the stud bolts to the terminal plate.
   Check that the stud bolts fit properly.
2. Attach the IC regulator to the terminal plate.
3. Solder the IC regulator, the brush holder and the condenser.
   Take care not to heat the IC regulator.
   Over-heating will resulting damage to the IC regulator.
4. Set the rectifier to the IC regulator assembly.
5. Solder rectifier and IC regulator.
   Take care not to heat the IC regulator.
   Over-heating will resulting damage to the rectifiers and the IC regulator.
6. Tighten the rectifier terminal bolt.

OIL SEAL

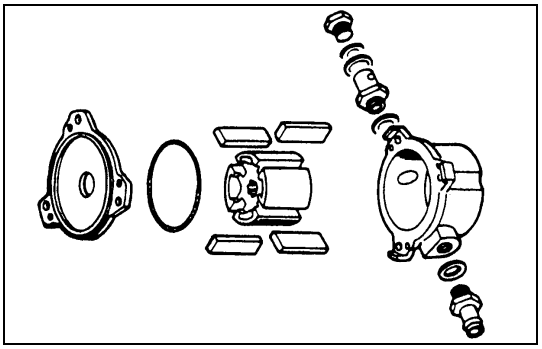
Check the rear cover oil seal bore for oil leakage.



6D3-13-2.tif

Oil Seal Replacement

1. Use a screwdriver to remove the oil seal from the rear cover side.
   Take care not to damage the oil seal bore.
2. Discard the used oil seal.
3. Use the oil seal installer to install the new oil seal.

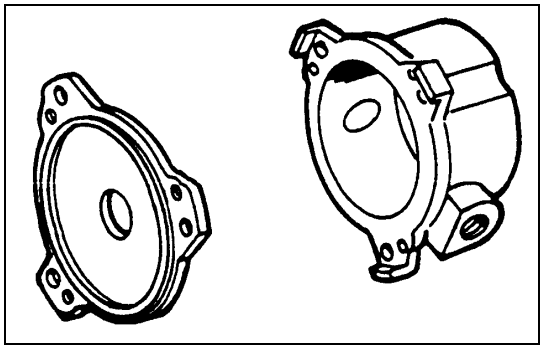


6D3-14-1.tif

VACUUM PUMP

Disassembly

1. Remove the center plate from the vacuum pump housing.
2. Remove the vacuum pump rotor and the vanes from the housing.



6D3-14-2.tif

Inspection and Repair

Vacuum Pump Housing and Center Plate

Inspect the vacuum pump housing and the center plate for excessive wear, abrasion, and scoring.

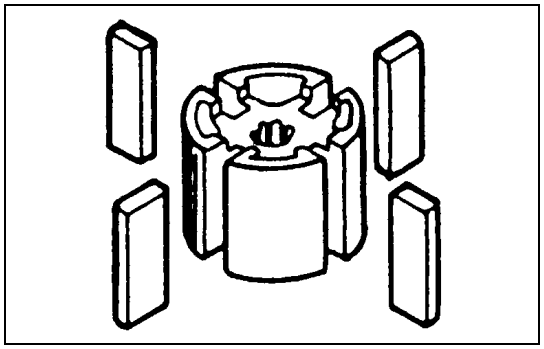
If any of these conditions are present, the vacuum pump housing and center plate must be replaced.

Inspect the vacuum pump housing inside for wear and damage.

If the measured inside diameter is outside the specified range, replace the vacuum pump housing.

Vacuum Pump Housing Inside Diameter (Reference) mm (in)

Standard	69.5 - 69.6 (2.736 - 2.740)



6D3-14-3.tif

Vane

Inspect the vanes for excessive wear and damage.

Replace all four vanes if either of these conditions are present.

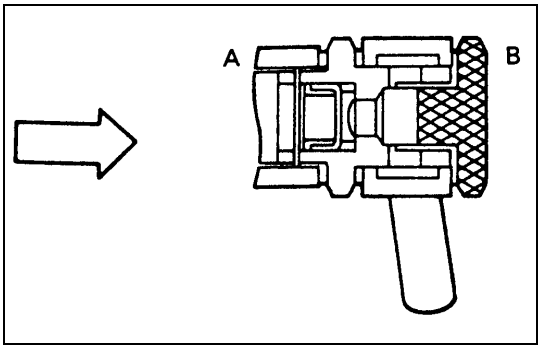
Never replace only one vane.

Vane Length (Reference) mm (in)

Standard	18.0 (0.709)

Rotor

1. Inspect the rotor for excessive wear, abrasion, and scoring.
   Pay particular attention to the internal spline.
   Replace the rotor if any of these conditions are present.
2. Inspect the generator rotor shaft splines for backlash.
   Replace the rotor if backlash is present.



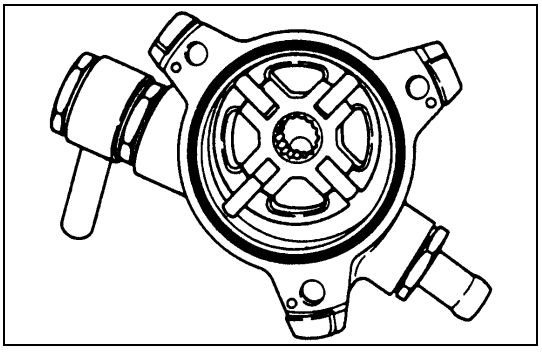
6D3-15-1.tif

Check Valve

1. Carefully force the valve from the “B” side as shown in the illustration.
   The valve must move smoothly.
   If it does not, the check valve must replaced.
2. Apply compressed air to the “A” side.

Air Pressure	kPa (kg/cm^2/psi)
	98 - 490 (1 - 5/14.22 - 71.10)

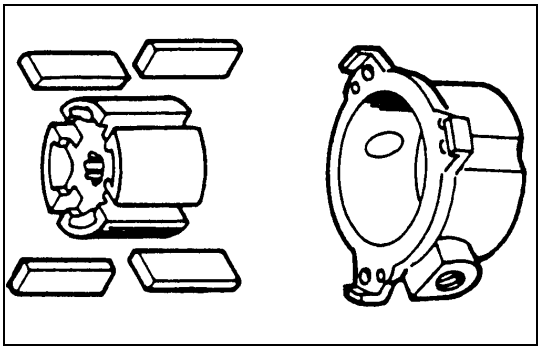
Check for air leakage from the check valve.
If there is air leakage, the valve must be replaced.



6D3-15-2.tif

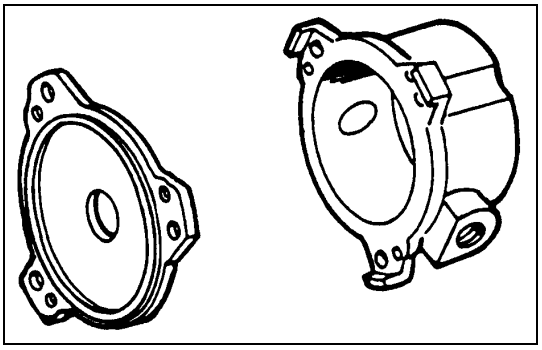
Reassembly

1. Install the vanes to the rotor slits.
   The rounded side of the vanes must be facing the rotor housing.



6D3-15-3.tif

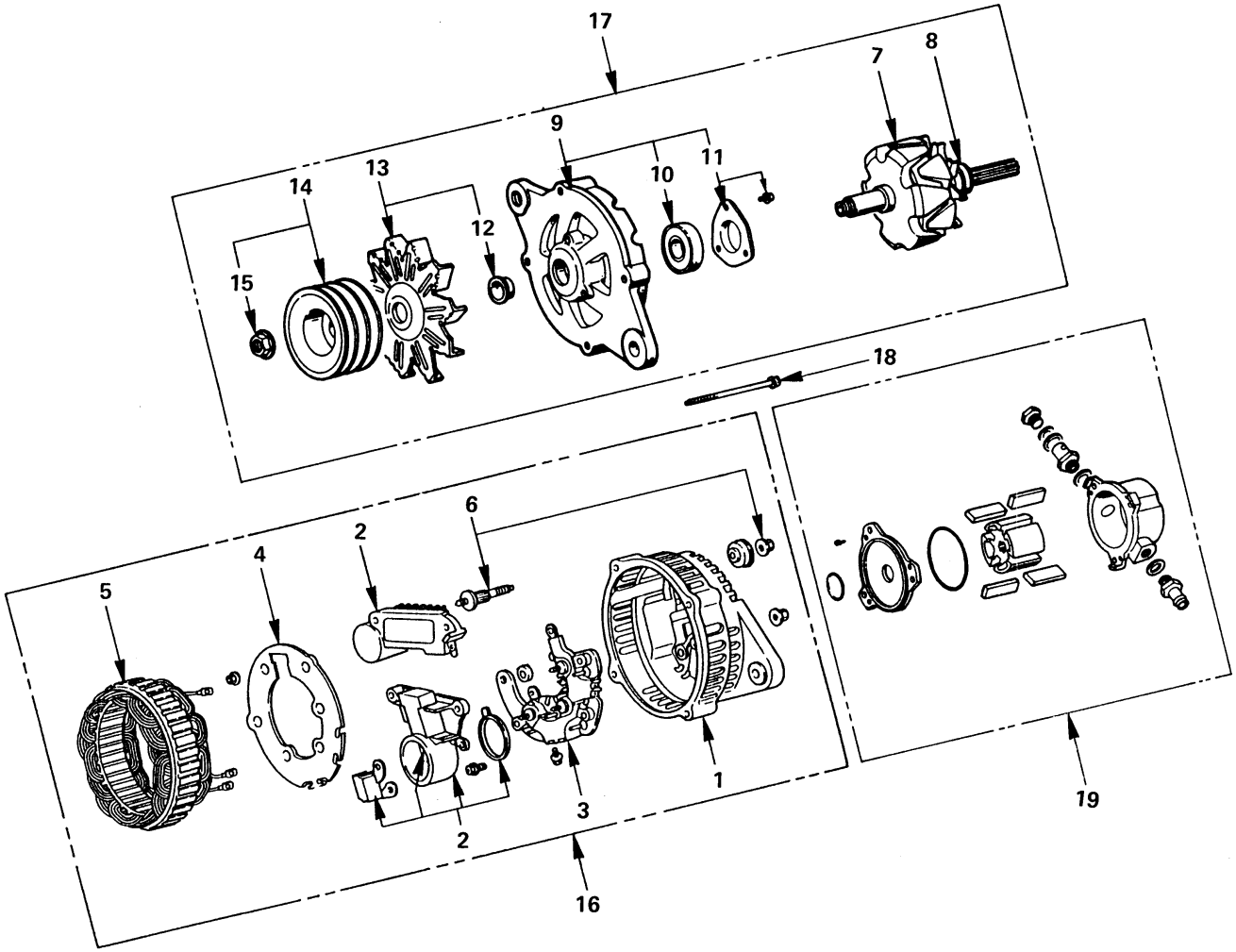
2. Install the rotor with the concave side facing the center plate.



6D3-15-4.tif

3. Install the center plate to the rotor housing.
   Be sure to use a new O-rings.

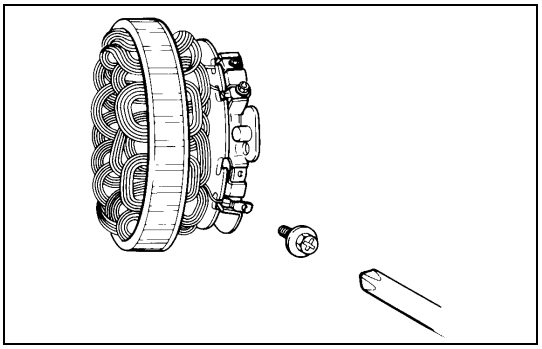
REASSEMBLY



Reassembly Steps

1. Rear cover
2. Brush and IC regulator
3. Rectifier
4. Fan guide
5. Stator
6. Terminal nut and bolt
7. Rotor
8. Rear ball bearing
9. Front cover
10. Front ball bearing
11. Bearing retainer
12. Spacer
13. Fan
14. Pulley
15. Pulley nut
16. Stator and rear cover assembly
17. Rotor and front cover assembly
18. Through bolt
19. Vacuum pump assembly

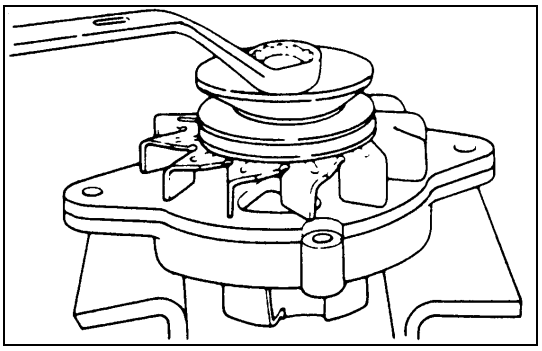
6D3-16-1.tif



6D3-17-1.tif

REASSEMBLY

1. **Rear Cover**
2. **Brush and IC Regulator**
3. **Rectifier**
4. **Fan Guide**
5. **Stator**
   1) Solder together the rectifier and stator leads.
      Hold the rectifier lead near the rectifier with a pair or long-nose pliers to protect the rectifier from heat.
      Complete the soldering procedure as quickly as possible.
   2) Install the IC regulator/stator assemblies to the rear cover.
      Be absolutely sure that the washers and the insulators are reinstalled to their original positions.
      Hold the stator coil against the rear cover.
6. **Terminal Nut and Bolt**
7. **Rotor**
8. **Rear Ball Bearing**
9. **Front Cover**
10. **Front Ball Bearing**
11. **Bearing Retainer**
12. **Spacer**
13. **Fan**

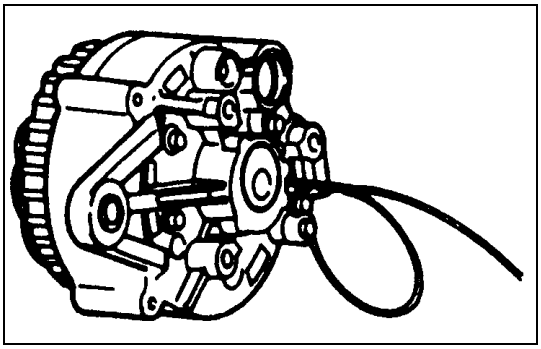


6D3-17-2.tif

14. **Pulley**
15. **Pulley Nut**
    1) Carefully clamp the rotor and cover assembly in a vise.
    2) Install the pulley and the pulley nut.
    3) Tighten the pulley to the specified torque.

Pulley Nut Torque	N·m (kg·m/lb·ft)
	98 (10.0/72)

NOTE:
Take care not to damage the rotor when clamping it in a vise.



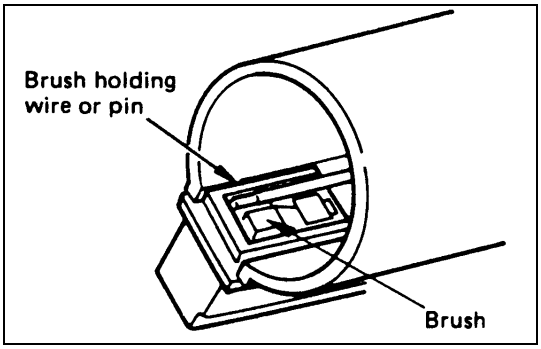
6D3-18-1.tif

16. Stator and Rear Cover Assembly

17. Rotor and Front Cover Assembly

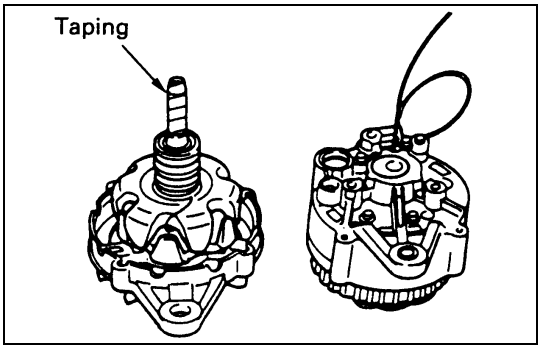
18. Through Bolt

1) Prepare a brush holding wire or a pin.
2) Set the holding wire or the pin to the brushes from the vacuum pump side.



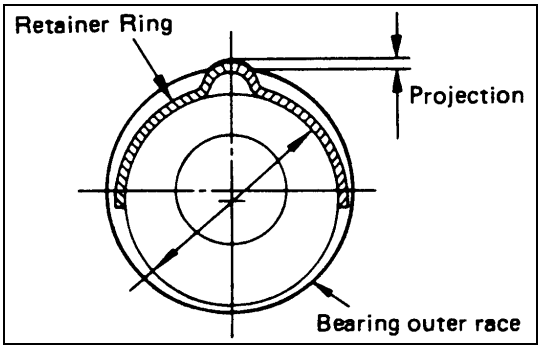
6D3-18-2.tif

3) Push the brushes into the holder.
4) Bend the wire end to hold the brushes.
   If the holding wire does not hold the brushes properly, the brushes will be damaged.



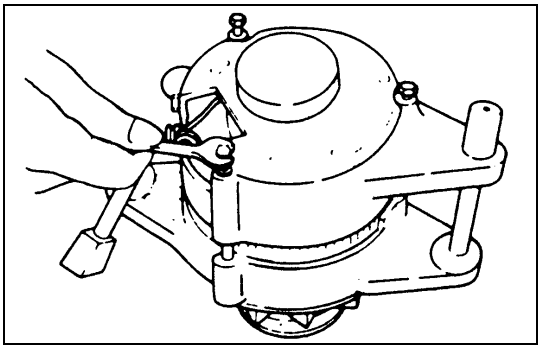
6D3-18-3.tif

5) Tape the rotor shaft spline.
   This will prevent oil seal damaged.



6D3-18-4.tif

6) Place the bearing retainer ring.
   Ring projection must be less than 0.65 mm (0.025 in)

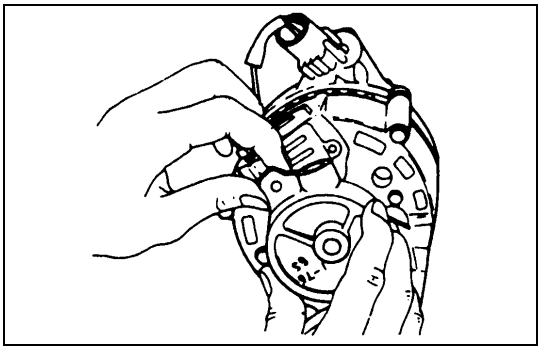


6D3-19-1.tif

7) Install the front cover and rotor assembly to the rear cover.
   Take care not to damage the rotor, the coil leads, the oil seal lip, and the splines.
8) Place the guide bar into the rear cover bracket hole.
   Align the front cover bracket hole with the guide bar.
9) Install the through bolts.
10) Tighten the through bolts to the specified torque.

Through Bolt Torque	N·m (kg·m/lb·in)
	4 (0.4/35)

11) Carefully remove the holding wire from the rear cover.



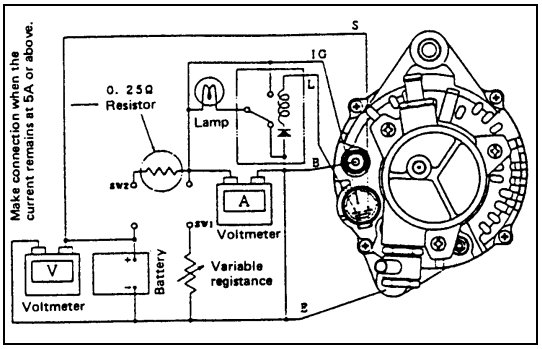
6D3-19-2.tif

19. Vacuum Pump Assembly

1) Position the pump rotor together with the pump housing on the center plate.
   The rotor serrated side must be facing up.
2) Rotate the rotor to align the rotor bore with the center plate bore.
3) Install the housing, the rotor, and the center plate.
   The O-ring must not be projecting beyond the center plate slot.
   Take care not to scratch the vanes.
4) Turn the housing to align it with the center plate.
5) Tighten the vacuum pump fixing bolts.

Vacuum Pump Fixing Bolt Torque	N·m (kg·m/lb·in)
	7 (0.7/61)

6) Add 5cc of engine oil through the filler port.
7) Check that the generator spins smoothly by turning it with your hand.



6D3-20-1.tif

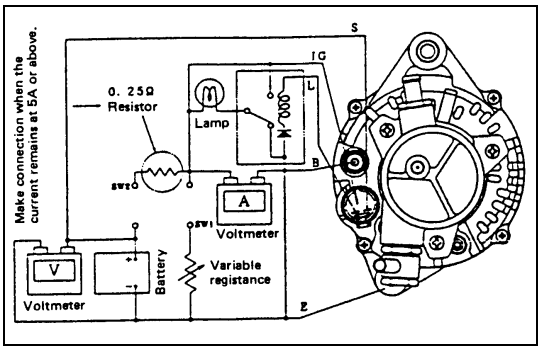
Inspection

Performance test

1. **Generator**
   - Connect the generator as shown in the illustration.
   - Use a fully charged battery to conduct the measurement with the current outputted from the battery terminals at 5A or less.

   Note when conducting the performance test:

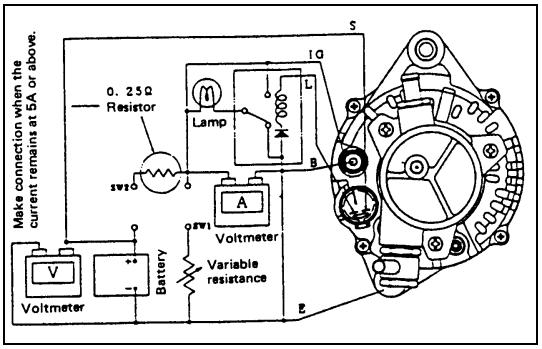
   For the connection between the generator B terminal and the battery ⊕ terminal and between the E terminal and the battery ⊖ terminal, use a lead wire with a cross section of 8 mm^2 and the length of 2.5 m or less.



6D3-20-2.tif

2. **Adjusting voltage measurement**
   - Open SW1 and close SW2.
   - With the number of the generator rotations raised up to its rated rotations of 5,000 rpm, measure the adjusting voltage.

   Adjusting voltage = 28 - 29V
   - Check to see if the fluctuation in the adjusting voltage is not caused by the increased number of rotations.
3. **Measurement of the number of rotations at 27V**
   - Open SW1 and close SW2.
   - Increase the number of the generator rotations gradually until the reading of the voltmeter indicates 27V. Measure the number of rotations at this time.

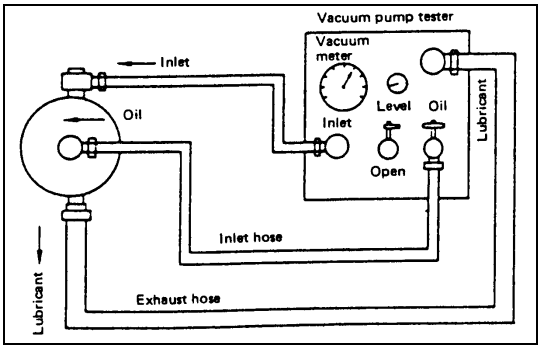


6D3-20-3.tif

4. **Output current measurement**
   - Set the resistance of the variable resistor at the minimum, and rotate the generator with SW1 and SW2 closed.
   - While keeping the voltage steady at 27V after adjusting the variable resistor, read the indicated value of the ammeter at the generator rotation of 5,000 rpm.

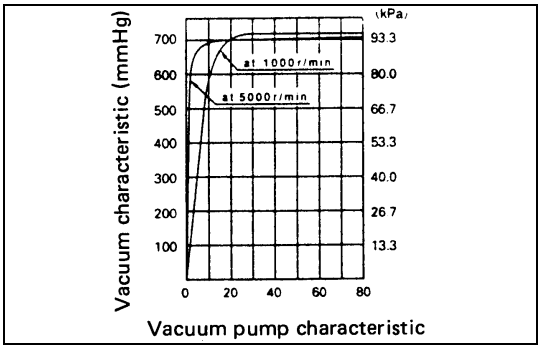
   Current at 27V with 5,000 rpm = 35A or more (for 35A specification)

   Current at 27V with 5,000 rpm = 45A or more (for 50A specification)

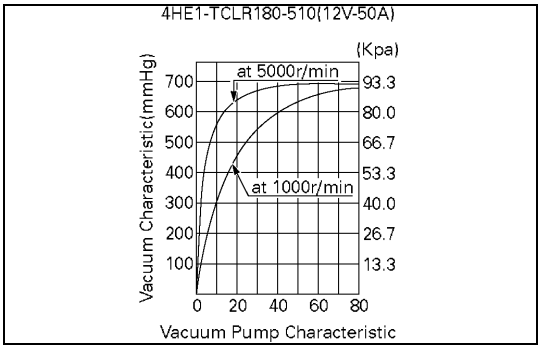


6D3-20-4.tif

5. **Unit test of vacuum pump**
   - With a pipe arrangement as shown in the illustration, use the vacuum pump tester to conduct the measurement.



6D3-21-1.tif



066LW003.tif

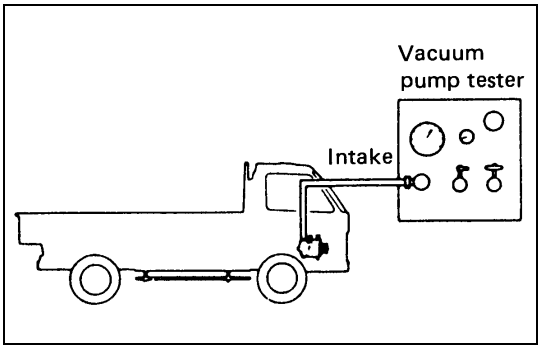
Item	Performance		Specifications
Vacuum characteristic	5000 rpm–66.7 kPa (500 mmHg)		Less than 4 sec.
	Max. 5000 rpm		More than 90.7 kPa (680 mmHg)
Vacuum-down performance	Valve of vacuum-down 15 sec. after the vacuum pump is stopped at 53.3 kPa (400 mmHg).		Less tan 2.67 kPa (20 mmHg)
Test condition	Oil used	Mobil oil #30	
	Oil amount	75 ± 5°C	
	Oil pressure	441kPa (4.5 kgf/cm²)	

6D3-21-3.tif

4HE1-TC LR180-510(12V-50A)			
Item	Performance		Specifications
Vacuum characteristic	5000 rpm-66.7kPa (500mmHg)		Less than 10 sec.
	Max. 5000 rpm		More than 90.7 kPa (680 mmHg)
Vacuum-down performance	Valve of vacuum-down 15 sec. after the vacuum pump is stopped at 53.3 kPa(400 mmHg).		Less tan 2.67 kPa (20 mmHg)
Test condition	Oil used	Mobil oil #30	
	Oil amount	75±5°C	
	Oil pressure	441kPa(4.5kgf/cm²)	

6D3-21-4.tif

- Pour about 20 liter of engine oil into the vacuum pump tester.
- Increase the generator rotations gradually, and check to see if the engine oil is fully circulated by discharging oil from the exhaust side of the vacuum pump.
- Close the release valve and measure the “vacuum characteristic” and the “vacuum drop characteristic (air tight characteristic).” Then check the obtained values based on the table left.



6D3-22-1.tif

6. On-vehicle test of the vacuum pump

- Install the generator to the engine.
- With the engine idling, check to see if oil is being discharged sufficiently from the exhaust side of the vacuum pump.
- Idle the engine until the engine oil temperature gets to the range of 70 to 80°C.
- Connect the pipe only to the suction side of the vacuum pump tester, and conduct the test in the same manner as in the unit test. When the resulting value is outside the specified range, re-check the vacuum pump.

SECTION 6D6
QOS II PREHEATING SYSTEM

CONTENTS

PAGE

General Description ..... 6D6 - 1

Starting Circuit Diagram (Reference) ..... 6D6 - 3

Inspection and Repair ..... 6D6 - 4

Troubleshooting ..... 6D6 - 7

GENERAL DESCRIPTION

QOS II preheating system features a quick-on glow plug with thermometer control of the glowing time and the afterglow time function.

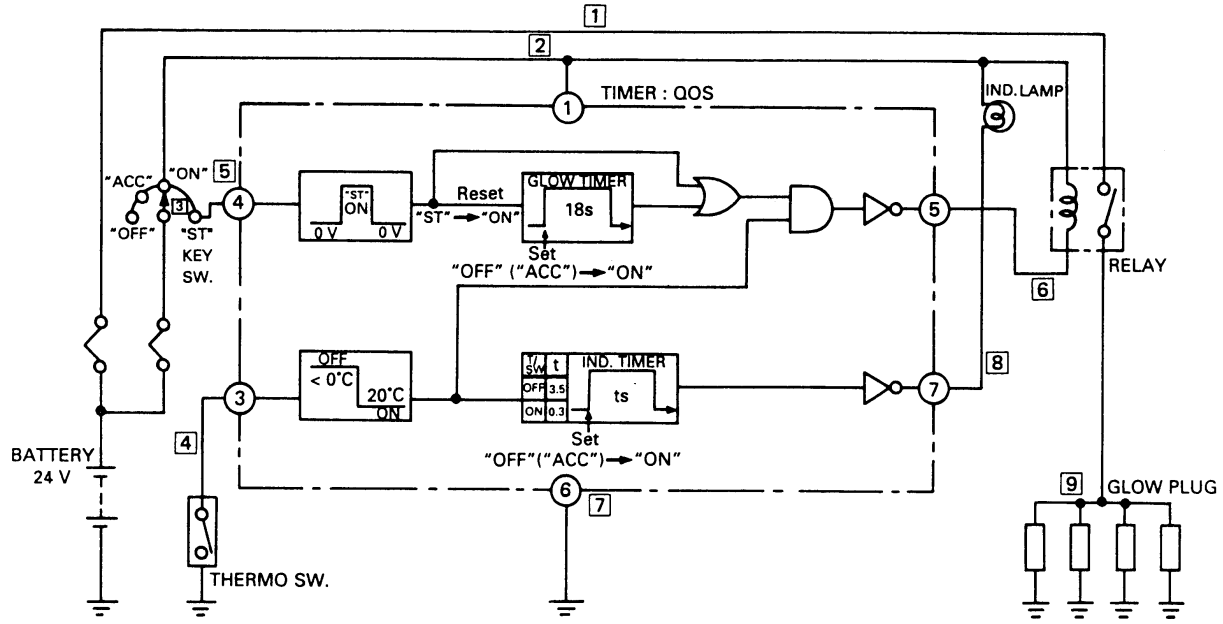
The system consists of a timer, indicator lamp, thermosensor, relay and temperature self-control type glow plug (4 pcs).

With the employment of the thermosensor, the glow time changes according to the engine coolant temperature, thus allowing optimum starting conditions to be obtained.

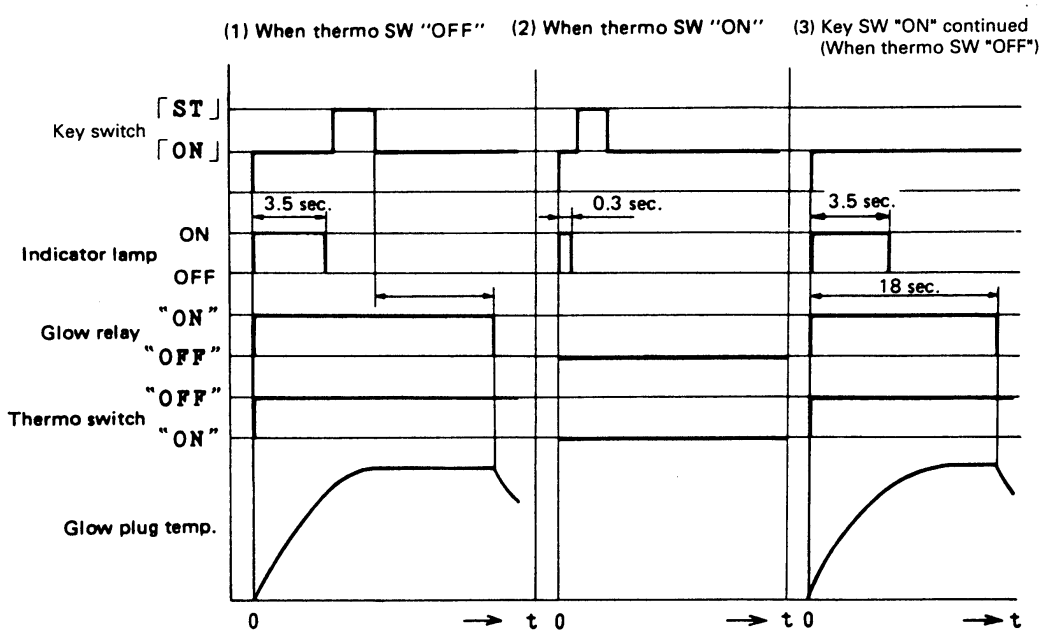
The afterglow time function is controlled by thermosensor.

QUICK-ON-START II (QOS II)

SYSTEM DIAGRAM

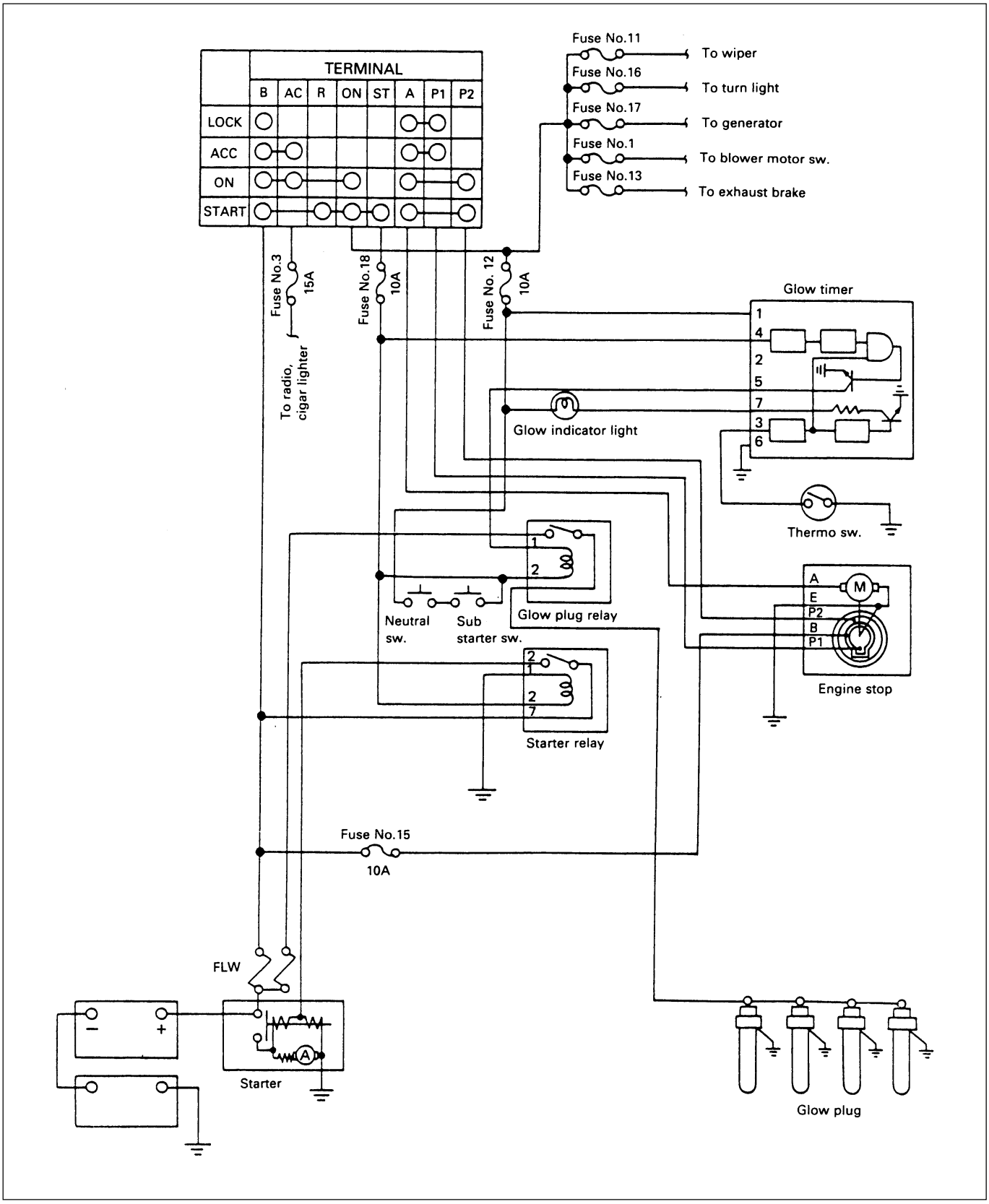


TIMING CHART



6D6-2-1.tif

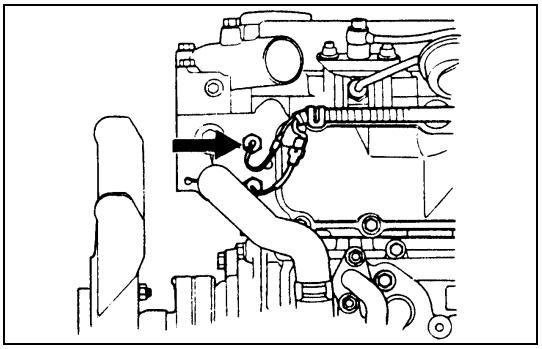
STARTING CIRCUIT DIAGRAM (REFERENCE)



6D6-3-1.tif

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.

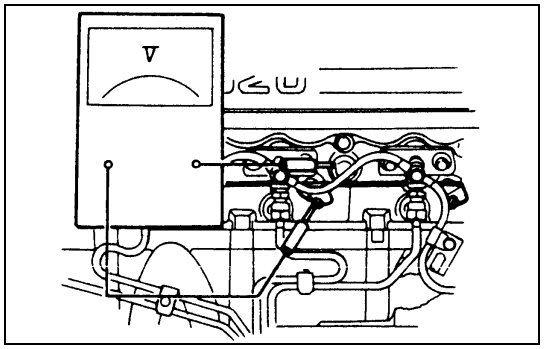


6D6-4-1.tif

QUICK-ON-START II (QOS II)

System

1. Disconnect the connector of the thermo switch.



6D6-4-2.tif

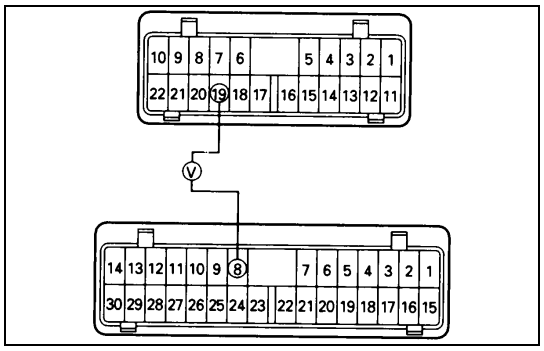
2. Set the voltage meter in connection as shown in the illustration.
3. Turn the key switch to “ON” position without engine turned and check the following items.

Glow Indicator Lighting Time	Seconds
Standard	3.5

Power Source Voltage Indicating Time	Seconds
Standard	18

When abnormal, check the QOS timer, the glow relay and the thermo switch.

When normal, check the glow plug.

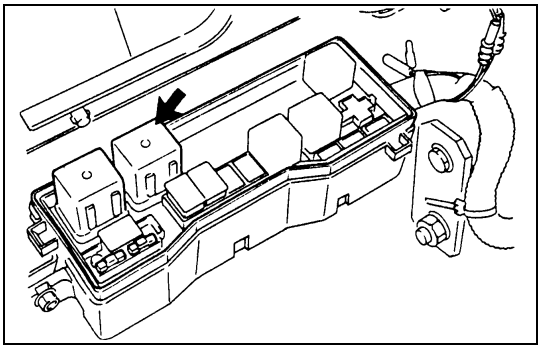


6D6-4-3.tif

Timer

1. Disconnect the connector of the thermo switch.
2. Set the voltage meter in connection as shown the illustration with connector connected.
3. Turn the key switch to “ON” position without engine turned, and check the following.

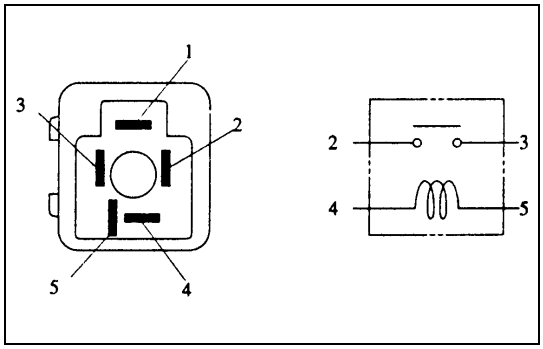
0 Volts Indicating Time	Seconds
Standard	18



6D6-5-1.tif

GLOW PLUG RELAY

Location



6D6-5-2.tif

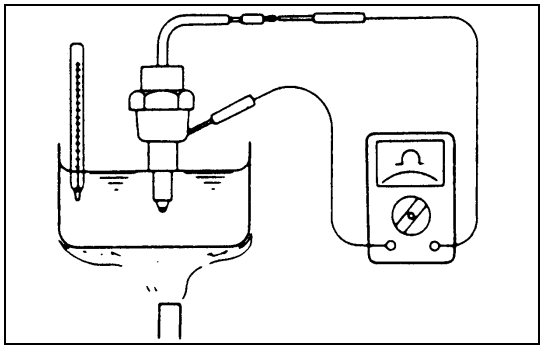
Specification

Measure the glow relay resistance between the terminal ④ and the ⑤ with a circuit tester.

If the measured resistance is outside the specified range, the glow relay must be replaced.

Glow Relay Resistance (Reference) ohms

Standard	100



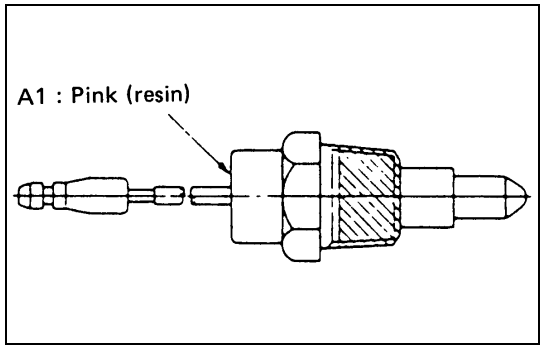
6D6-5-3.tif

THERMO-SWITCH

Specification

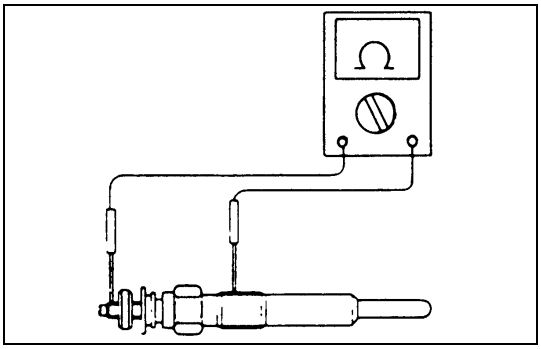
Operating Temperature °C (°F)

OFF → ON	7 - 13 (44.6 - 55.4)
ON → OFF	Over 3 (37.4)

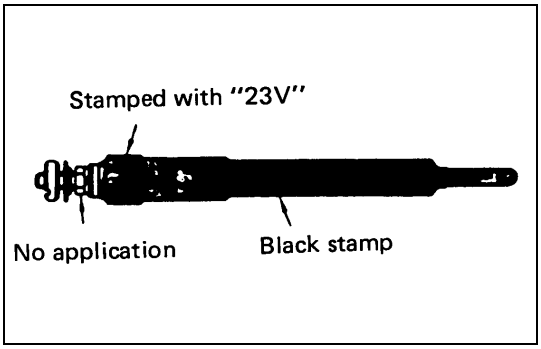


6D6-5-4.tif

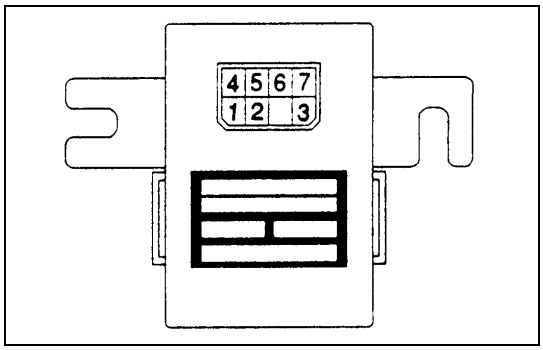
- Before installing the thermo-switch, apply LOCTITE 262 or its equivalent to the portion shown in the illustration.



6D6-6-1.tif



6D6-6-2.tif



6D6-6-3.tif

Glow plug check

- Use the circuit tester to measure the continuity of the glow plug.
- When the obtained value is outside the specified range, replace the glow plug with a new one.

Glow plug resistance=About 4Ω (at room temperature)

NOTE:

When changing glow plugs, use a set of 4 glow plugs of the same manufacture.

- Note that an identification mark is provided to prevent any possible faulty assembly.

Type	Rated Voltage (V)	Total length mm (in)
Standard	23	141 (5.55)

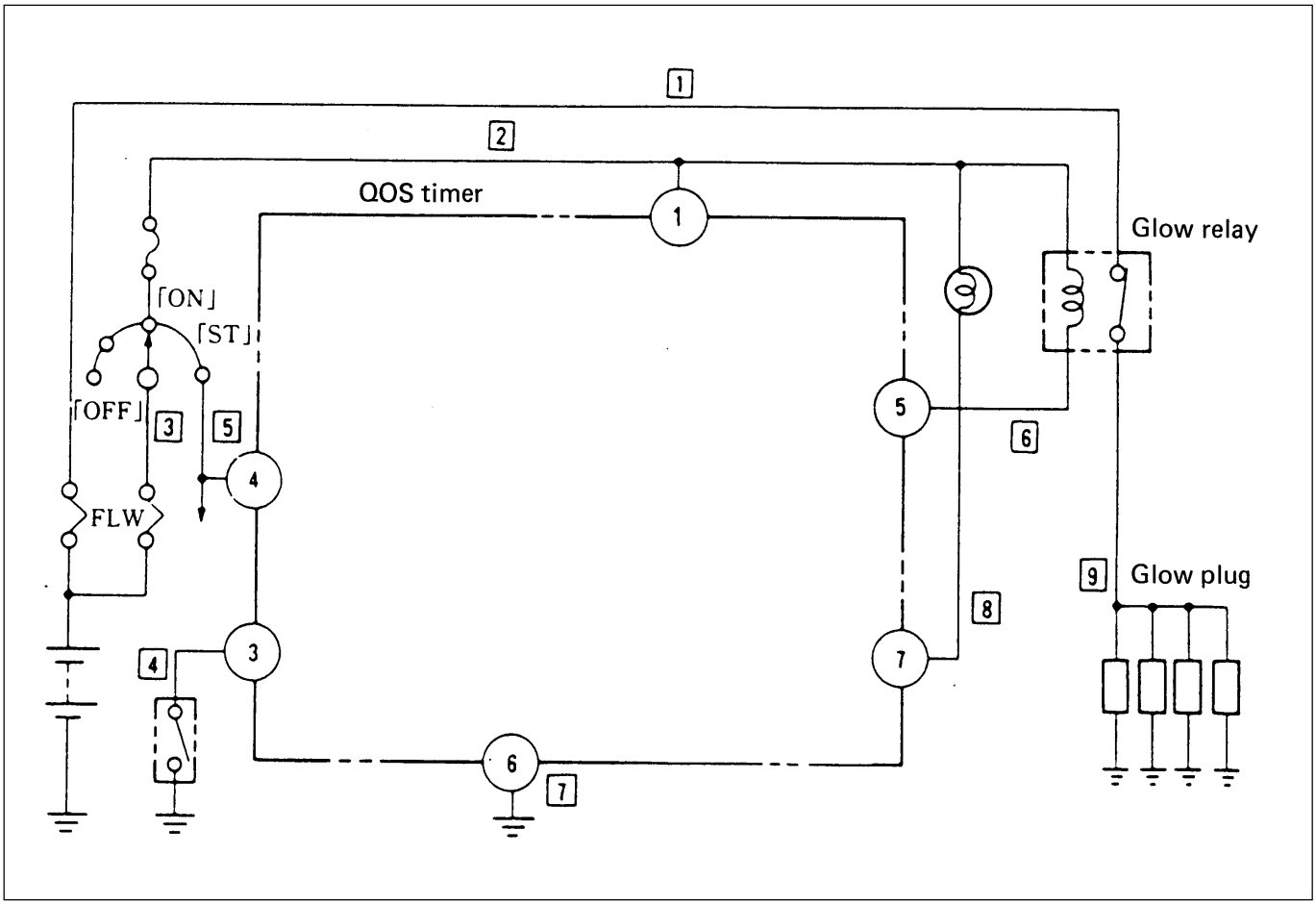
QOS TIMER

Timer Specification

No.	Connection to
1	Starter SW"ON"
2	-
3	Thermo SW
4	Starter SW "ST"
5	Glow relay
6	Earth (ground)
7	Indicator lamp

TROUBLESHOOTING

1. Circuit diagram



6D6-7-1.tif

Note:
A figure in a circle "○" shows a terminal No.
A figure in a square "□" shows a circuit No.

2. When the cooling water temperature is below 0°C.

Condition	Possible cause	Circuit
The glow relay does not turn on.	① Defective connection in fusible link between battery and starter switch	3
	② Defective connection or broken wire in starter switch circuit	
	③ Defective connection or broken wire in fuse No.8 } Items 3 and 4 above coincide with troubles	2
	④ Defective starter switch } in other circuits.	
	⑤ Defective connection of glow relay terminal	1
	⑥ Broken wire in glow relay excitation coil	
	⑦ Broken wire in the circuit between glow relay and timer	6
	⑧ Defective glow relay (There is no continuity in main connection.)	
	⑨ Defective connection in QOS timer Defective QOS timer	
	⑩ Defective ground circuit in QOS timer	7
	⑪ Defective thermo-switch(The thermo-switch does not turn off even when water temperature is below zero.)	
	⑫ Defective ground circuit in thermo-switch	7
Glow relay turns on, but does not get preheated.	① Defective connection of fusible link between battery and start switch	1
	② Defective connection of glow relay main link terminal connector, or broken wire in preheating circuit	
	③ Defective connection of plug connector with preheating circuit	9
Glow relay remains on, and does not turn off.	① Defective QOS timer	
	② Circuit is shorted to ground between QOS timer terminal ⑤ and glow relay	6
	③ Defective glow relay	
Indicator lamp does not light on.	① Defective QOS timer	
	② Broken wire in bulb	8
	③ Broken wire in indicator lamp harness	

3. When the cooling water temperature is over 0°C.

Condition	Possible cause	Circuit
Indicator lamp does not light on.	① Defective QOS timer	
	② Broken wire in bulb	8
Indicator lamp lights on for a long time.	① Defective thermo-switch, or broken wire in thermo-switch circuit (Indicator lights on for about 3.5 sec.)	4
	② Defective QOS timer	
Glow relay is ready to turn on, or remains on.	① Circuit is shorted to ground between terminal ⑤ and glow relay.	6

SECTION 6E (4HE1-T/TC/4HG1-T Only)

EMISSION AND ELECTRICAL DIAGNOSIS

CAUTION:
When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size and strength for (stronger) may be used. Fasteners that are not reused, and those requiring thread locking compound, will be called out. The correct torque values must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

CONTENTS

SUBJECT	PAGE
GENERAL DESCRIPTION	6E - 4
NOTES FOR WORKING ON ELECTRICAL ITEM	6E - 4
SYMBOLS AND ABBREVIATIONS	6E - 9
CONNECTOR INSPECTING PROCEDURE	6E - 11
PARTS FOR ELECTRICAL CIRCUIT	6E - 12
DIAGNOSIS (4HE1-T/TC ONLY)	6E - 14
STRATEGY-BASED DIAGNOSTICS	6E - 14
GENERAL SERVICE INFORMATION	6E - 16
ON-BOARD DIAGNOSTIC (OBD)	6E - 17
READING DIAGNOSTIC TROUBLE CODES USING A TECH2 OR OTHER SCAN TOOL	6E - 19
TYPICAL SCAN DATA VALUES	6E - 23
TROUBLESHOOTING	6E - 24
SELF-DIAGNOSIS FUNCTIONS	6E - 25
DIAGNOSIS TROUBLE CODE LIST	6E - 28
LOCATION OF SENSOR AND SWITCH	6E - 31
PARTS LOCATION	6E - 33
ENGINE CONTROL MODULE (ECM)	6E - 34
CHART OF ECM INPUT/OUTPUT	6E - 35
LOCATION OF THE ECM CONNECTOR	6E - 37
LOCATION OF DLC	6E - 37
BRIEF EXPLANATION OF EMISSION AND ELECTRICAL CONTROL SYSTEM	6E - 38
MITICS (MECHANICALLY INTEGRATED TIMING AND INJECTION CONTROL SYSTEM)	6E - 38
GOVERNOR (MODEL RLD-M)	6E - 39
EGR (EXHAUST GAS RECIRCULATION) SYSTEM	6E - 40

VSS (VARIABLE SWIRL SYSTEM) ..... 6E - 41
ECM SYSTEM WIRING DIAGRAM ..... 6E - 42
AUXILIARY ENGINE CONTROL SYSTEM ..... 6E - 44
VSV CIRCUIT ..... 6E - 46
EXHAUST BRAKE AND WARM-UP CONTROL ..... 6E - 48
DTC-P13 ECT SENSOR CIRCUIT HIGH VOLTAGE ..... 6E - 49
DTC-P14 ECT SENSOR CIRCUIT LOW VOLTAGE ..... 6E - 52
DTC-P21 RACK SENSOR CIRCUIT LOW VOLTAGE ..... 6E - 55
DTC-P22 RACK SENSOR CIRCUIT HIGH VOLTAGE ..... 6E - 58
DTC-P23 SOLENOID SWITCH CONTROL CIRCUIT LOW VOLTAGE ..... 6E - 61
DTC-P24 SOLENOID SWITCH CONTROL CIRCUIT HIGH VOLTAGE ..... 6E - 65
DTC-P26 QWS RELAY CONTROL CIRCUIT HIGH VOLTAGE ..... 6E - 69
DTC-P31 EGR EVRV SOLENOID CIRCUIT LOW VOLTAGE ..... 6E - 73
DTC-P32 EGR EVRV SOLENOID CIRCUIT HIGH VOLTAGE ..... 6E - 76
DTC-P33 VSS CONTROL CIRCUIT LOW VOLTAGE ..... 6E - 79
DTC-P34 VSS CONTROL CIRCUIT HIGH VOLTAGE ..... 6E - 82
DTC-P35 EGR QUICK CUT VSV CONTROL CIRCUIT LOW VOLTAGE ..... 6E - 85
DTC-P36 EGR QUICK CUT VSV CONTROL CIRCUIT HIGH VOLTAGE ..... 6E - 88
DTC-P41 QOS RELAY CONTROL CIRCUIT LOW VOLTAGE ..... 6E - 91
DTC-P42 QOS RELAY CONTROL CIRCUIT HIGH VOLTAGE ..... 6E - 95
DTC-P43 ANEROID COMPENSATOR VSV CONTROL CIRCUIT LOW VOLTAGE ..... 6E - 99
DTC-P44 ANEROID COMPENSATOR VSV CONTROL CIRCUIT HIGH VOLTAGE ..... 6E -102
DTC-P45 ENGINE SPEED SENSOR CIRCUIT LOW VOLTAGE ..... 6E -105
DTC-P52 EEPROM ERROR ..... 6E -109
DTC-P61 BAROMETRIC PRESSURE SENSOR CIRCUIT ERROR ..... 6E -110
WITHOUT DIAGNOSIS TROUBLE CODE ..... 6E -111
ENGINE HUNTING ..... 6E -112
STARTUP FAILURE ..... 6E -113
WHITE SMOKE (EXCESSIVE) ..... 6E -115
BLACK SMOKE (EXCESSIVE) ..... 6E -117
LACK OF POWER ..... 6E -119
HIGH IDLE ENGINE SPEED ..... 6E -121
SOLENOID SWITCH MALFUNCTION ..... 6E -122
EXHAUST BRAKE MALFUNCTION ..... 6E -123
EGR SYSTEM MALFUNCTION ..... 6E -128
VSS SYSTEM MALFUNCTION ..... 6E -131
ANEROID COMPENSATOR MALFUNCTION ..... 6E -134

QWS SYSTEM MALFUNCTION ..... 6E -137
FICD SYSTEM MALFUNCTION ..... 6E -141
SPECIAL TOOLS ..... 6E -144

DIAGNOSIS (4HG1-T ONLY) ..... 6E -146
STRATEGY-BASED DIAGNOSTICS ..... 6E -146
GENERAL SERVICE INFORMATION ..... 6E -147
TROUBLESHOOTING ..... 6E -148
SELF-DIAGNOSIS FUNCTIONS ..... 6E -149
DIAGNOSIS TROUBLE CODE (DTC) LIST ..... 6E -151
LOCATION OF SENSOR AND SWITCH ..... 6E -153
PARTS LOCATION ..... 6E -155
ENGINE CONTROL MODULE (ECM) ..... 6E -156
CHART OF ECM INPUT/OUTPUT ..... 6E -157
LOCATION OF THE ECM CONNECTOR ..... 6E -158
LOCATION OF DLC ..... 6E -158
ECM SYSTEM WIRING DIAGRAM ..... 6E -159
AUXILIARY ENGINE CONTROL SYSTEM ..... 6E -160
VSV CIRCUIT ..... 6E -161
EXHAUST BRAKE CONTROL ..... 6E -162
DTC-13 ECT SENSOR CIRCUIT HIGH VOLTAGE ..... 6E -163
DTC-14 ECT SENSOR CIRCUIT LOW VOLTAGE ..... 6E -166
DTC-21 RACK SENSOR CIRCUIT LOW VOLTAGE ..... 6E -169
DTC-22 RACK SENSOR CIRCUIT HIGH VOLTAGE ..... 6E -172
DTC-31 EGR VSV SOLENOID CIRCUIT LOW VOLTAGE ..... 6E -175
DTC-32 EGR VSV SOLENOID CIRCUIT HIGH VOLTAGE ..... 6E -178
DTC-41 QOS RELAY CONTROL CIRCUIT LOW VOLTAGE ..... 6E -181
DTC-42 QOS RELAY CONTROL CIRCUIT HIGH VOLTAGE ..... 6E -185
DTC-52 EEPROM ERROR ..... 6E -189
WITHOUT DIAGNOSIS TROUBLE CODE ..... 6E -190
STARTUP FAILURE (QOS Only) ..... 6E -191
BLACK SMOKE (EXCESSIVE) ..... 6E -193
LACK OF POWER ..... 6E -195
EXHAUST BRAKE MALFUNCTION (Exhaust Brake Only) ..... 6E -197
EGR SYSTEM MALFUNCTION ..... 6E -202
SPECIAL TOOLS ..... 6E -205

GENERAL DESCRIPTION

The emission and electrical control system operates on a twenty four volt power supply with negative ground polarity. Each wire in the vehicle is of a specific size and has an identifying colored insulation.

These colors are indicated in wiring diagrams and will help in tracing circuits and making proper connections. Wire size is determined by load capacity and circuit length. Some wires are grouped together and taped. Such a grouping of wires is called a harness.

The harness use a split corrugated tube to protect the wires from the elements. Each circuit consists of the following:

- Power source - the battery and the alternator.
- Wires - To carry electrical current through the circuit.
- Fuses - To protect the circuit against current overload.
- Relays - To protect voltage drop between the battery and the circuit parts and to protect the switch points against burning.
- Switches - To open and close the circuit.
- Load - Any device, such as a light or a motor, which converts the electrical current into useful work.
- Ground - To allow the current to flow back to the power source.

In this manual, such electrical device is classified by system. For major parts shown on the circuit based on the circuit diagram for each system, inspection and removal and installation procedures are detailed.

NOTES FOR WORKING ON ELECTRICAL ITEMS

BATTERY CABLE

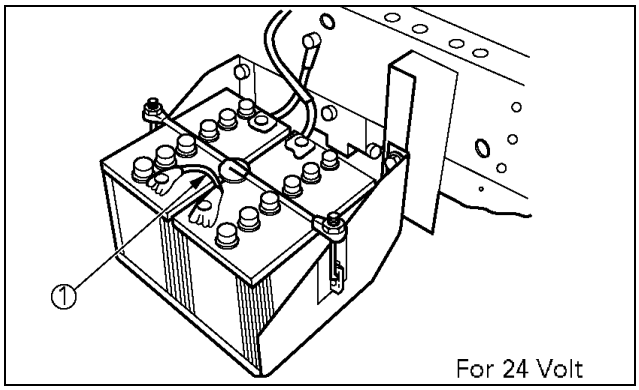
Disconnecting the Battery Cable

1) All switches should be in the "OFF" position.
2) Disconnect the battery ground cable.
3) Disconnect the battery positive cable
4) Disconnect the battery cable ①.

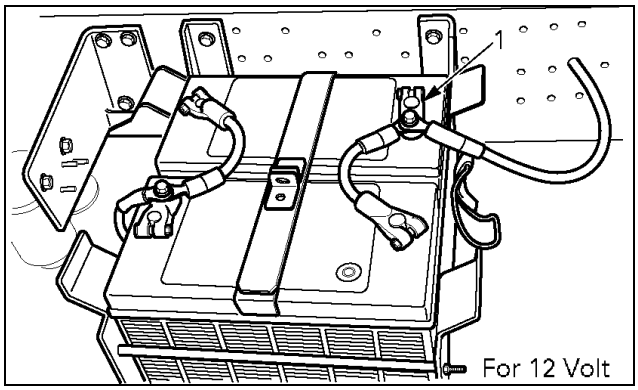
CAUTION:

It is important that the battery ground cable be disconnected first.

Disconnecting the battery positive cable first can result in a short circuit.



826LW014.tif



826LW007.tif

Connecting the Battery Cable

Follow the disconnecting procedure in the reverse order.

CAUTION:

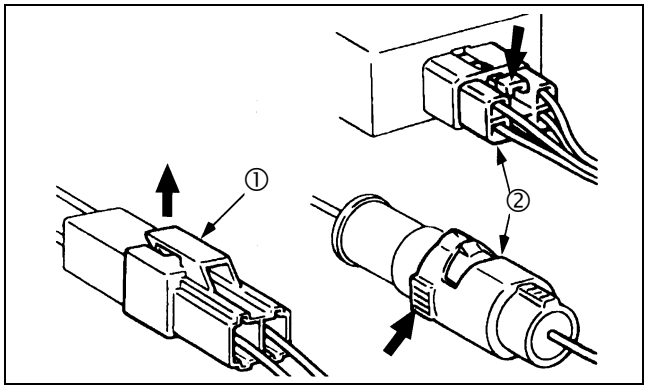
Clean the battery terminal and apply a light coat of grease to prevent terminal corrosion.

Connecting Handling

Disconnecting The Connectors

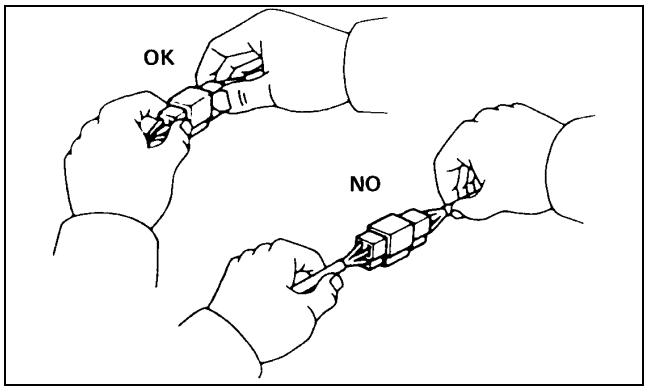
Some connectors have a tang lock to hold the connectors together during vehicle operation.
Some tang locks are released by pulling them towards you ①.
Other tang locks are released by pressing them forward ②.
Determine which type of tang lock is on the connector being handled.
Firmly grasp both sides (male and female) of the connector.

Release the tang lock and carefully pull the two halves of the connector apart.



6E-001.tif

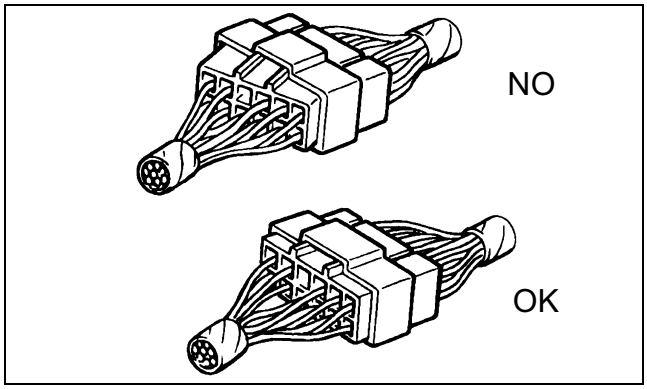
Never pull on the wires to separate the connectors. This will result in wire breakage.



8-4-1.tif

Connecting the Connector

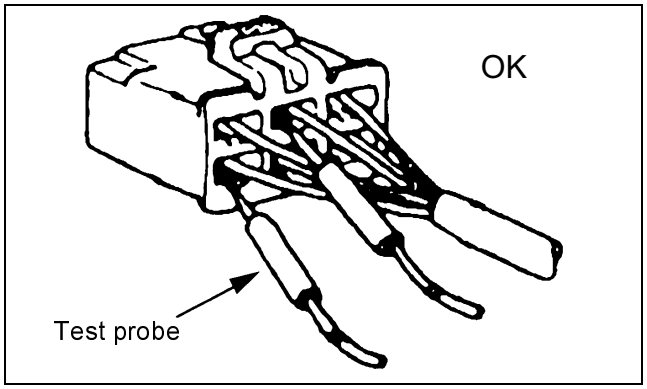
Firmly grasp both sides (male and female) of the connector. Be sure that the connector pins and pin holes match. Be sure that both sides of the connector are aligned with each other. Firmly but carefully push the two sides of the connector together until a distinct click is heard.



6E-002.tif

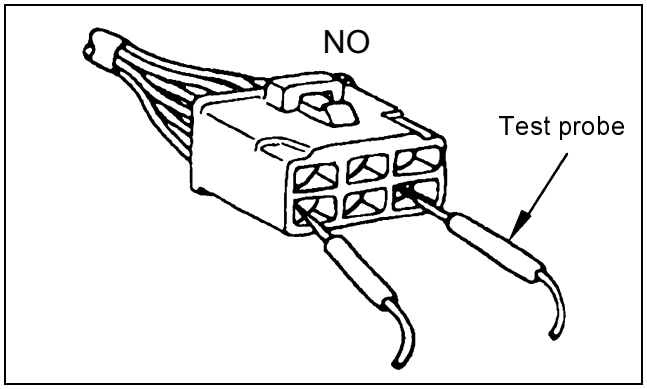
Connector Inspection

Use a circuit tester to check the connector for continuity. Insert the test probes from the connector wire side.



6E-003.tif

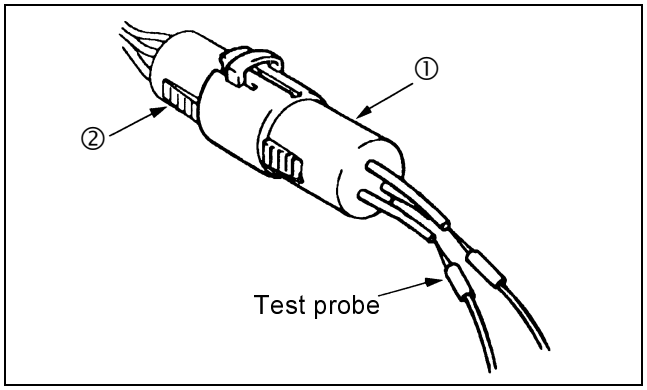
Never insert the circuit tester test probes into the connector open end to test the continuity. Broken or open connector terminals will result.



6E-004.tif

Waterproof Connector Inspection

It is not possible to insert the test probes into the connector wire side of a waterproof connector. Use one side of a connector (1) with its wires cut to make the test. Connect the test connector (2) to the connector to be tested. Connect the test probes to the cut wires to check the connector continuity.

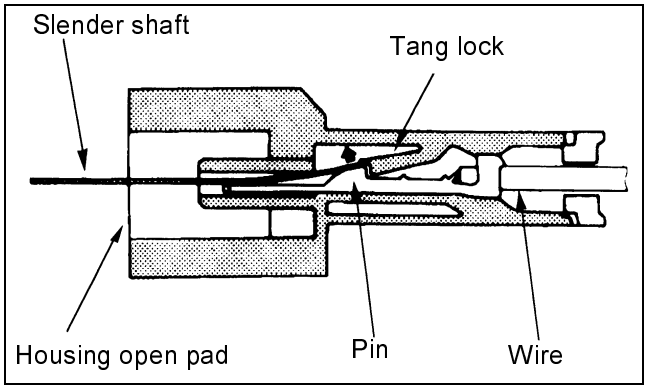


6E-005.tif

Connector Pin Removal

Connector Housing Tang Lock Type

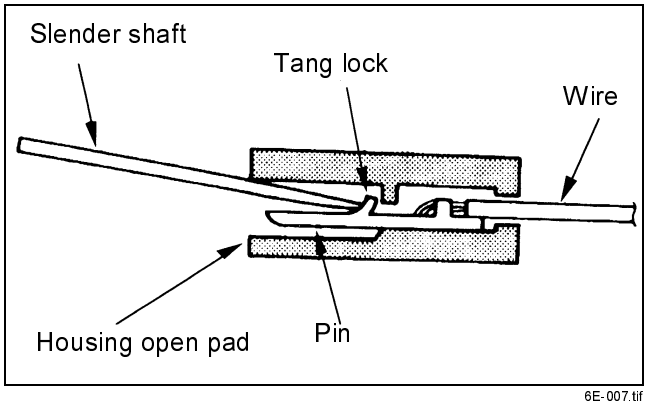
1) Insert a slender shaft into the connector housing open end.
2) Push the tang lock up (in the direction of the arrow in the illustration). Pull the wire with pin free from the wire side of the connector.



6E-006.tif

Pin Tang Lock Type

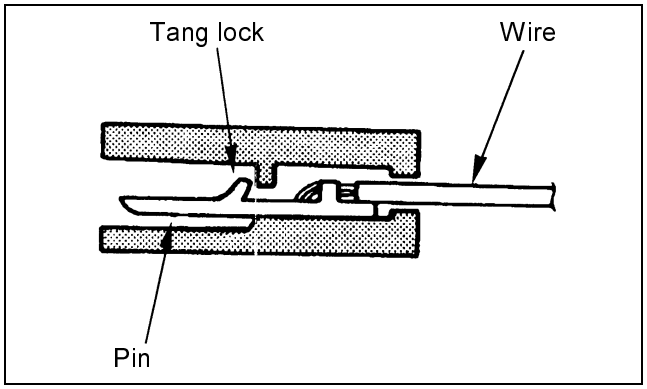
1) Insert a slender shaft into the Connector housing open end.
2) Push the tang lock flat (toward the wire side of the connector). Pull the wire with pin free from the wire side of the connector.



6E-007.tif

Connector Pin Insertion

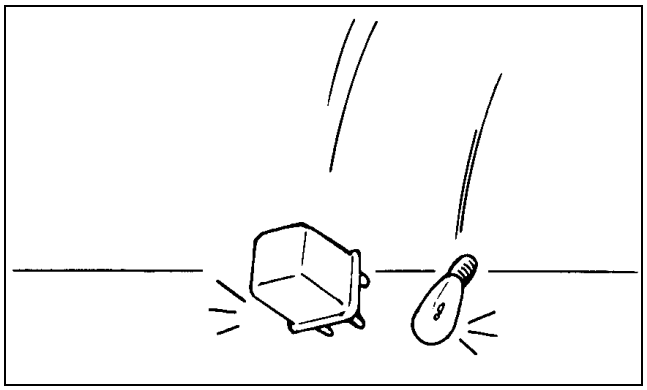
1) Check that the tang lock is fully up.
2) Insert the pin from the connector wire side.
   Push the pin in until the tang lock closes firmly.
3) Gently pull on the wires to make sure that the connector pin is firmly set in place.



6E-008.tif

Parts Handling

Be careful when handling electrical parts. They should not be dropped or thrown, because short circuit or other damage may result.

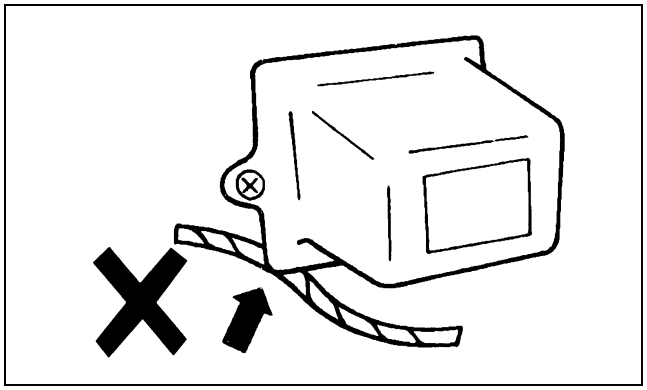


8-5-5.tif

Cable Harness

When installing the parts, be careful not to pinch or wedge the wiring harness.

All electrical connections must be kept clean and tight.



6E-009.tif

SPLICING WIRE

1. Open the Harness

If the harness is taped, remove the tape. To avoid wire insulation damage, use a sewing "seam ripper" (available from sewing supply stores) to cut open the harness.

If the harness has a block plastic conduit, simply pull out the desired wire.

2. Cut the wire

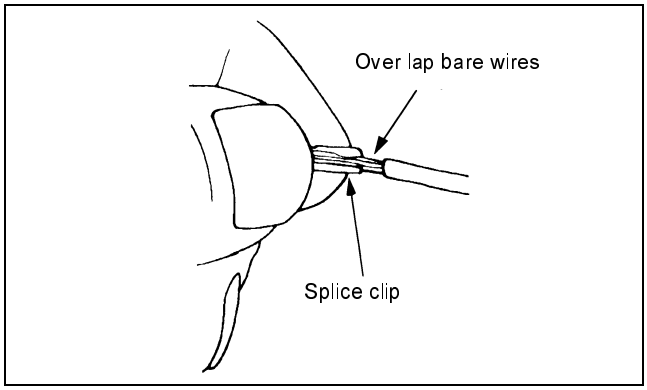
Begin by cutting as little wire off the harness as possible. You may need the extra length of wire later if you decide to cut more wire off to change the location of a splice. You may have to adjust splice locations to make certain that each splice is at least 1-1/2in (40 mm) away from other splices, harness branches, or connectors.

3. Strip the insulation

When replacing a wire, use a wire of the same size as the original wire. Check the stripped wire for nicks or cut stands. If the wire is damaged, repeat the procedure on a new section of wire. The two stripped wire ends should be equal in length.

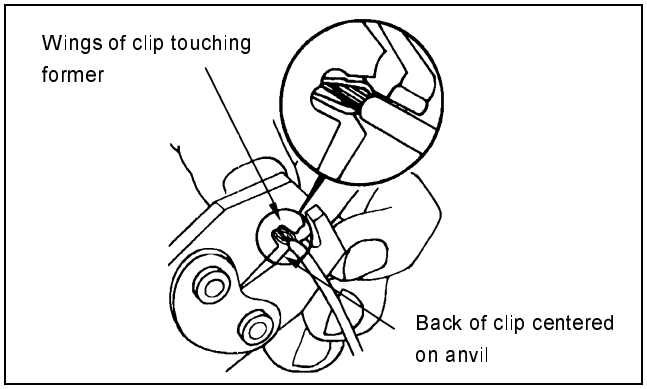
4. Crimp the Wires

Select the proper clip to secure the splice. To determine the proper clip size for the wire being spliced, follow the directions included with your clips. Select the correct anvil on the crimper. (On most crimpers your choice is limited to either a small or large anvil.) Overlap the two stripped wire ends and hold them between your thumb and forefinger. Then, center the splice clip under the stripped wires and hold it in place.



6E-010.tif

- Open the crimping tool to its full width and rest one handle on a firm flat surface.
- Center the back of the splice clip on the proper anvil and close the crimping tool to the point where the back of the splice clip touches the wings of the clip.
- Make sure that the clip and wires are still in the correct position. then, apply steady pressure until the crimping tool closes.

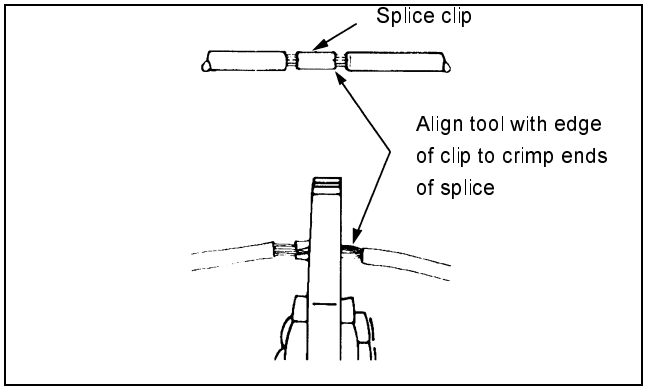


6E-011.tif

Before crimping the ends of the clip, be sure that:

- The wires extend beyond the clip in each direction.
- No stands of wire are cut loose, and
- No insulation is caught under the clip.

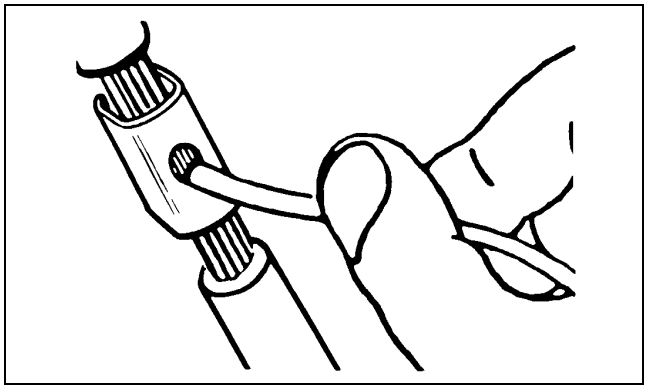
Crimp the splice again, once on each end. Do not let the crimping tool extend beyond the edge of the clip or you may damage or nick the wires.



6E-012.tif

5. Solder

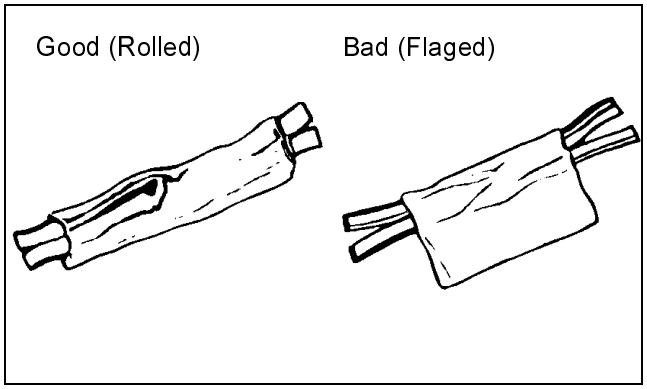
Apply 60/40 rosin core colder to the opening in the back of the clip. Follow the manufacturer's instructions for the solder equipment you are using.



8-8-1.tif

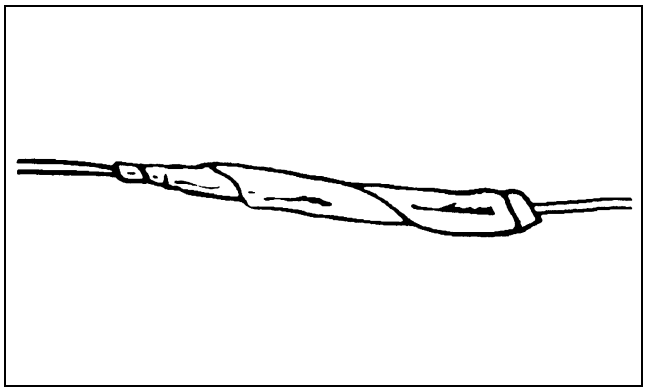
6. Tape the Splice

Center and roll the splicing tape. The tape should cover the entire splice. Roll on enough tape to duplicate the thickness of the insulation on the existing wires. Do not flag the tape. Flagged tape may not provide enough insulation, and the flagged ends will tangle with the other wires in the harness.



8-8-2.tif & 8-8-3

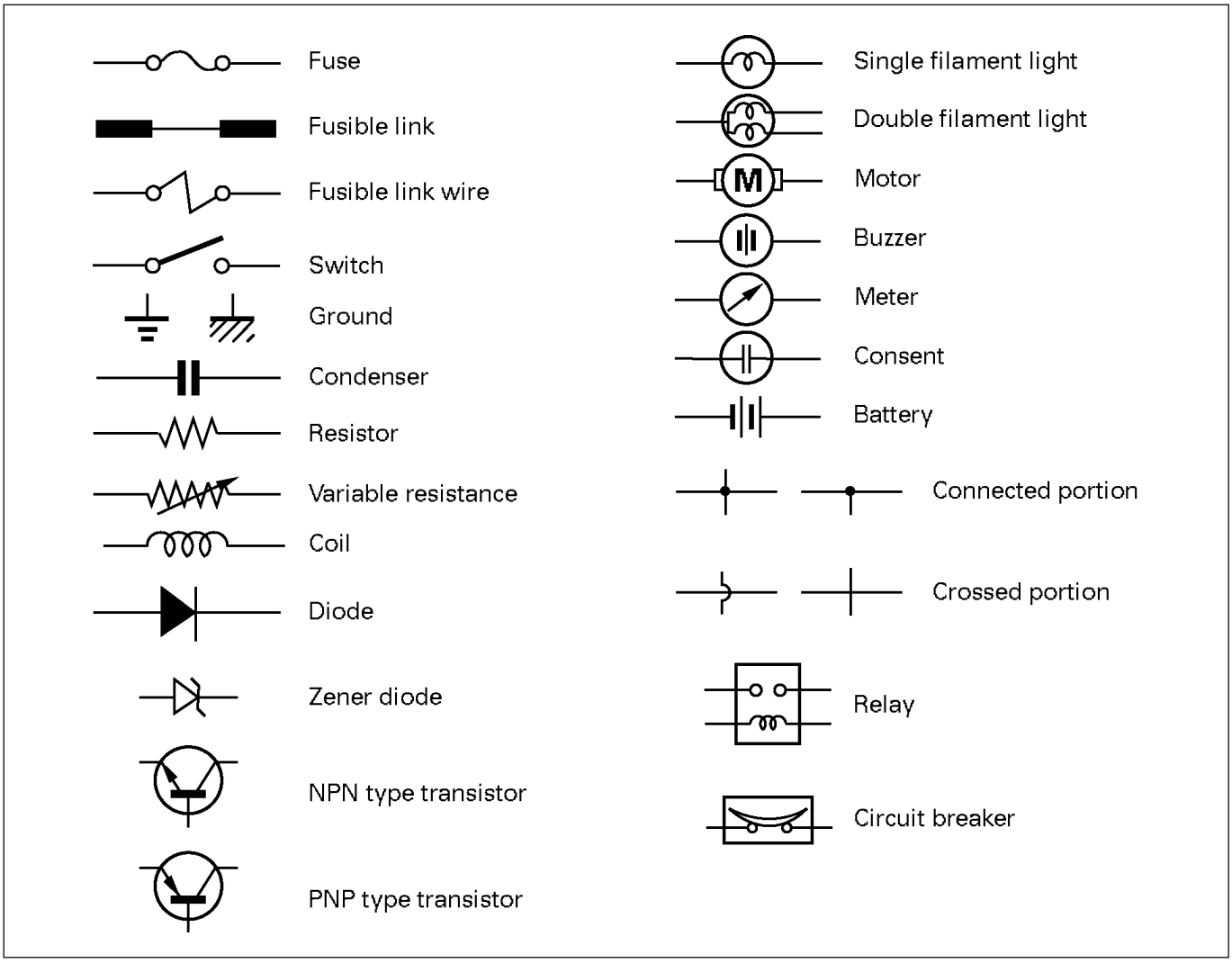
If the wire does not belong in a conduit or other harness covering, tape the wire again. Use a winding motion to cover the first piece of tape.



8-8-4.tif

SYMBOLS AND ABBREVIATIONS

Symbols



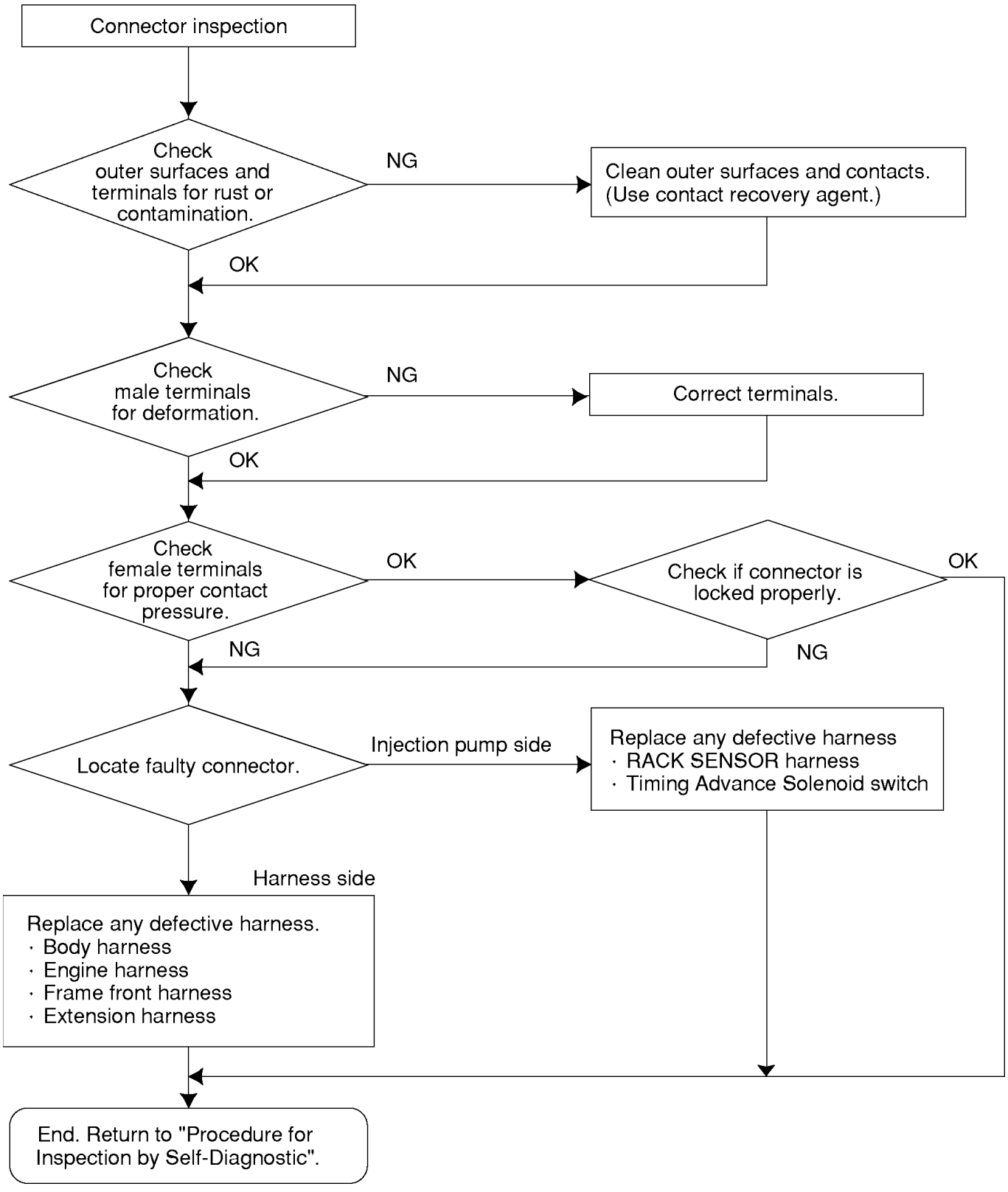
F08MT001.tif

Abbreviations

Abbreviation	Meaning	Abbreviation	Meaning
A/C	Air Conditioner	OBD	BOARD Diagnostic
ACC	Accessory	OFF	Turn Off (Switch/Lamp)
ACT	Actuator	ON	Turn On (Switch/Lamp)
ASSIT	Assistant	OPT	Option
BATT	Battery	P/BRAKE	Parking Brake
		PGND	Power Ground (To Body Earth)
CAS	Cab Air Suspension	PIN	Pin or Terminal
CAS C/U	Cab Air Suspension Control Unit	P/L	Pilot (Warning) Lamp
CCS	Combined Charging System	PRESS	Pressure
CONN	Connector	P/T	Power Train
C/U	Control Unit	PTO	Power Take Off
DC	Direct Current	Q ADJUSTMENT	Injection Quantity Adjustment
D/CONN	Diagnosis Connector	QOS	Quick On Start
DTC	Diagnostic Trouble Code	QWS	Quick Warm System
EC	Electrical Control Governor	RH	Right Hand (Side)
ECM	Engine Control Module	RHD	Right Hand Drive
ECT	Engine Coolant Temperature	R/L	Relay
EGR	Exhaust Gas Recirculation	RR	Rear
EH	Electrical And Hydraulic Timer		
EXH	Exhaust	S/ASB	Shock Absorber
EVRV	Electronic Vacuum Regulating Valve	SIG	Signal
		SS	Speed Sensor
FICD	Fast Idle Control Device	SS C/U	Speed Sensor Control Unit
FRT	Front	STD	Standard
		SUSP	Suspension
GND	Ground (Body Earth)	SW	Switch
IE	ISUZU Economy System	TCV	Trailer Cock Valve
IN	Inlet, Intake	TICS	Timing And Injection Rate Control
IVES	ISUZU Variable Electric And Economy Swirl		System
		VGS	Variable Geometry Turbocharging System
LH	Left Hand (Side)		
LHD	Left Hand Drive	VSS	Variable Swirl System
		VSV	Vacuum Switching Valve
MAG	Magnetic		
ME/CONN	Memory Eraser Connector	W/L	Warning Lamp
MIL	Malfunction Indicator Lamp	W/	With
M/V	Magnetic Valve	W/O	Without
N	Neutral (Transmission Gear)		
N-TDC	Numbers Top Dead Center		
NR	Noise Reducer		

CONNECTOR INSPECTING PROCEDURE

Connector inspecting procedure



Flow01Cntr.tif

PARTS FOR ELECTRICAL CIRCUIT

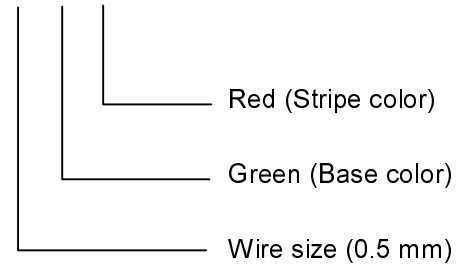
Wiring

Wire Color

All wires have color-coded insulation.

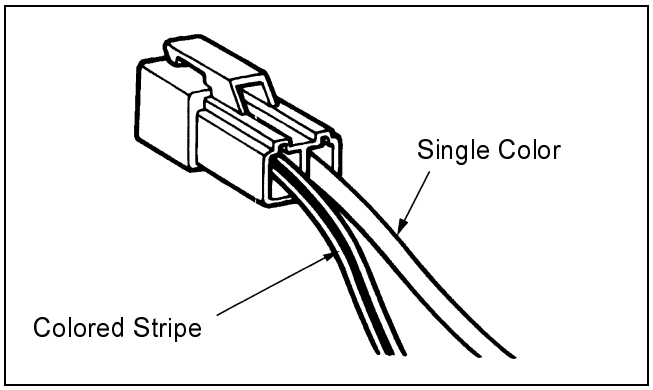
Wires belonging to a system's main harness will have a single color. Wires belonging to a system's sub circuits will have a colored stripe. Striped wires use the following code to show wire size and colors.

Example: 0.5 G R

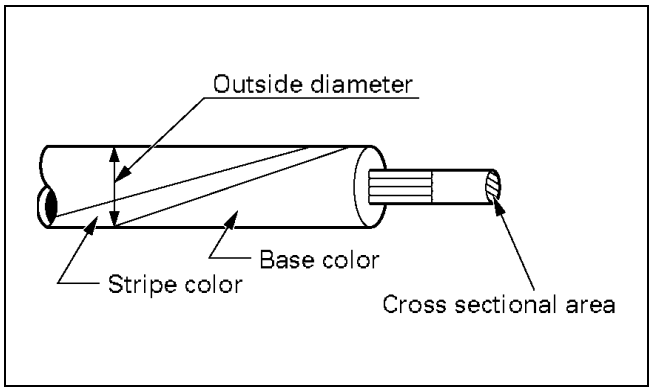


Abbreviations are used to indicate wire color within a circuit diagram.

Refer to the following table.



6E-013.tif



F06HV020.tif

Wire Color Coding

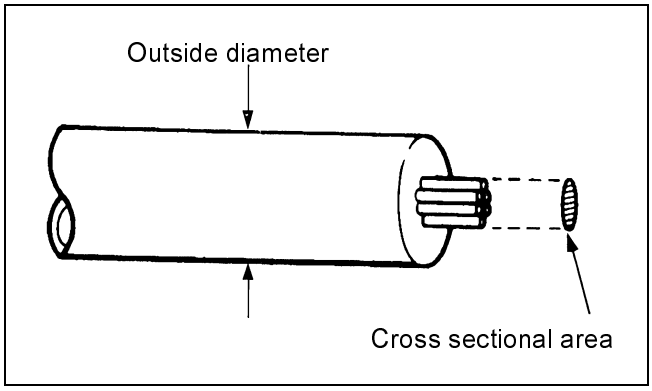
Color-coding	Meaning	Color-coding	Meaning
B	Black	Br	Brown
W	White	Lg	Light green
R	Red	Gr	Gray
G	Green	P	Pink
Y	Yellow	Sb	Sky blue
L	Blue	V	Violet
O	Orange		

Stripe Color Coding

Color-code	Base Color	Stripe Color
LB	Blue	Black
OB	Orange	Black
PB	Pink	Black
PG	Pink	Green
PL	Pink	Blue
RY	Red	Yellow
VR	Violet	Red
VW	Violet	White
YB	Yellow	Black
YB	Yellow	Green
YV	Yellow	Violet

Wire Size

The size of wire, used in a circuit is determined by the amount of current (amperage), the length of the circuit, and the voltage drop allowed. The following wire size and load capacity, shown below, are specified by JIS (Japanese Industrial Standard) (Nominal size means approximate cross sectional area)



6E-014.tif

Nominal size	Cross sectional area (mm^2)	Outside diameter (mm)	Allowable current (A)
0.3	0.372	1.8	9
0.5	0.563	2.0	12
0.85	0.885	2.2	16
1.25	1.287	2.5	21
2	2.091	2.9	28
3	3.296	3.6	37.5
5	5.227	4.4	53
8	7.952	5.5	67
15	13.36	7.0	75
20	20.61	8.2	97

DIAGNOSIS (4HE1-T/TC Only)

STRATEGY-BASED DIAGNOSTICS

Strategy-Based Diagnostics

The strategy-based diagnostic is a uniform approach to repair all Electrical/Electronic (E/E) systems. The diagnostic flow can always be used to resolve an E/E system problem and is a starting point when repairs are necessary. The following steps will instruct the technician how to proceed with a diagnosis:

1. Verify the customer complaint.
   - To verify the customer complaint, the technician should know the normal operation of the system.
2. Perform preliminary checks.
   - Conduct a thorough visual inspection.
   - Review the service history.
   - Detect unusual sounds or odors.
   - Gather diagnostic trouble code information to achieve an effective repair.
3. Check bulletins and other service information.
   - This includes videos, newsletters, etc.
4. Refer to service information (manual) system check (s).
   - “System checks” contain information on a system that may not be supported by one or more DTCs.

     System checks verify proper operation of the system. This will lead the technician in an organized approach to diagnostics.
5. Refer to service diagnostics.

Diagnostic Trouble Code (DTC) Stored

Follow the designated DTC chart exactly to make an effective repair.

No DTC

Select the symptom from the symptom tables. Follow the diagnostic paths or suggestions to complete the repair. You may refer to the applicable component/system check in the system checks.

No Matchig Symptom

1. Analyze the complaint.
2. Develop a plan for diagnostics.
3. Utilize the wiring diagrams and the theory of operation.

Call technical assistance for similar cases where repair history may be available. Combine technician knowledge with efficient use of the available service information.

Intermittents

Conditions that are not always present are called intermittents. To resolve intermittents, perform the following steps:

1. Observe history DTCs, DTC modes.
2. Evaluate the symptoms and the conditions described by the customer.
3. Use a check sheet or other method to identify the circuit or electrical system component.
4. Follow the suggestions for intermittent diagnosis found in the service documentation.

Most scan tool, such as the Tech II have data-capturing capabilities that can assist in detecting intermittents.

No Trouble Found

This condition exists when the vehicle is found to operate normally. The condition described by the customer may be normal. Verify the customer complaint against another vehicle that is operating normally. The condition may be intermittent. Verify the complaint under the conditions described by the customer before releasing the vehicle.

1. Re-examine the complaint

   When the Complaint cannot be successfully found or isolated, a re-evaluation is necessary. The complaint should be re-verified and could be intermittent as defined in Intermittents, or could be normal.
2. Repair and verify.

   After isolating the cause, the repairs should be made.

   Validate for proper operation and verify that the symptom has been corrected. This may involve road testing or other methods to verify that the complaint has been resolved under the following conditions:
   - Conditions noted by the customer.
   - If a DTC was diagnosed, verify a repair by duplicating conditions present according to customer complaint.

Verifying Vehicle Repair

Verification of the vehicle repair will be more comprehensive for vehicles with OBD system diagnostics. Following a repair, the technician should perform the following steps:

IMPORTANT:

Follow the steps below when you verify repairs on board diagnostic systems. Failure to follow these steps could result in unnecessary repairs.

1. Review and record the Failure Records for the DTC which has been diagnosed.
2. Clear the DTC (S).
3. Operate the vehicle within conditions according to customer complaint.
4. Monitor the Diagnostic Trouble Code (DTC) status information for the specific DTC which has been diagnosed until the diagnostic test associated with that DTC runs.

GENERAL SERVICE INFORMATION

On Board Diagnostic (OBD) Serviceability Issues

The list of non-vehicle faults that could affect the performance of the OBD system has been complied. These non-vehicle faults vary from environmental conditions to the quality of fuel used.

The illumination of the Malfunction Indicator Lamp (MIL) (“Check Engine” lamp) due to a non-vehicle fault could lead to misdiagnosis of the vehicle, increased warranty expense and cuctomer dissatisfaction. The following list of non-vehicle faults does not include every possible fault and may not apply equally to all product lines.

Poor Vehicle Maintenance

The sensitivity of OBD diagnostics will cause the MIL to turn on if the vehicle is not maintained properly. Restricted air filters, fuel filters, and crankcase deposits due to lack of oil changes or improper oil viscosity can trigger actual vehicle faults that were not previously monitored prior to OBD. Poor vehicle maintenance can not be classified as a “non-vehicle fault”, but with the sensitivity of OBD diagnostics, vehicle maintenance schedules must be more closely followed.

Maintenance Schedule

Refer to the maintenance Schedule.

Visual/Physical Engine Compartment Inspection

Perform a careful visual and physical engine compartment inspection when performing any diagnostic procedure or diagnosing the cause of an emission test failure. This can often lead to repairing a problem without further steps. Use the following guidelines when performing a visual/physical inspection:

- Inspection all vacuum hoses for punches, cuts, disconnects, and correct rouring.
- Inspect hoses that are difficult to see behind other components.
- Inspect all wires in a engine compartment for proper connections, burned or chafed spots, pinched wires, contact with sharp edges or contact with hot exhaust manifolds or pipes.

Basic Knowledge of Tools Required

NOTE:

Lack of basic knowledge of this powertrain when performing diagnostic procedures could result in an incorrect diagnosis or damage to powertrain components. Do not attempt to diagnose a powertrain problem without this basic knowledge.

A basic understanding of hand tools is necessary to effectively use this section of the Servise Manual.

ON-BOARD DIAGNOSTIC (OBD)

On-Board Diagnostic Tests

A diagnostic test is a series of steps, the result of which is a pass or fail reported to the diagnostic executive. When a diagnostic test reports a pass result, the diagnostic executive records the following data:

- The diagnostic test has been completed since the last ignition cycle.
- The diagnostic test has passed during the current ignition cycle.
- The fault identified by the diagnostic test is not currently active.

When a diagnostic test reports a fail result, the diagnostic executive records the following data:

- The diagnostic test has been completed since the last ignition cycle.
- The fault identified by the diagnostic test is currently active.
- The fault has been active during this ignition cycle.
- The operating conditions at the time of the failure.

Common OBD Terms

Diagnostic

When used as a noun, the word diagnostic refers to any on-board test run by the vehicle's Diagnostic Management System. A diagnostic is simply a test run on a system or component to determine if the system or component is operating according to specification.

Enable Criteria

The term “enable criteria” is engineering language for the conditions necessary for a given diagnostic test to run. Each diagnostic has a specific list of conditions which must be met before the diagnostic will run. “Enable criteria” is another way of saying “conditions required”.

Trip

Technically, a trip is a key on-run-key off cycle in which all the enable criteria for a given diagnostic are met, allowing the diagnostic to run. Unfortunately, this concept is not quite that simple. A trip is official when all the enable criteria for a given diagnostic are met. But because the enable criteria vary from one diagnostic to another, the definition of trip varies as well. Some diagnostic are run when the vehicle is at operating temperature, some when the vehicle first start up; some require that the vehicle be cruising at a steady highway speed, some run only when the vehicle is idle. Some run only immediately following a cold engine start-up.

A trip then, is defined as a key on-run-key off cycle in which the vehicle was operated in such a way as to satisfy the enables criteria for a given diagnostic, and this diagnostic will consider this cycle to be one trip. However, another diagnostic with a different set of enable criteria (which were not met) during this driving event, would not consider it a trip. No trip will occur for that particular diagnostic until the vehicle is driven in such a way as to meet all the enable criteria.

Diagnostic Information

The diagnostic charts and functional checks are designed to locate a faulfy circuit or component through a process of logical decisions. The charts are prepared with the requirement that the vehicle functioned correctly at the time of assembly and that there are not multiple faults present.

There is a continuous self-diagnosis on certain control functions. This diagnostic capability is complemented by the diagnostic procedures contained in this manual. The language of communicating the source of the malfunction is a system of diagnostic trouble codes. When a malfunction is detected by the control module, a diagnostic trouble code is set and the Malfunction Indicator Lamp (MIL) is illuminated.

Data Link Connector (DLC)

The provision for communication with the control module is the Data Link Connector (DLC). It is located at near the A post of driver side. The DLC is used to connect to a scan tool. Some common uses of the scan tool are listed below:

- Identifying stored Diagnostic Trouble Codes (DTCs).
- Clearing DTCs.
- Reading serial data.

Decimal/Binary/Hexadecimal Conversions

All scan tool manufacture will display a variety of vehicle information which will aid in repairing the vehicle. Some scan tools will display encoded messages which will aid in determining the nature of the concern. The method of encoding involves the use of a two additional numbering systems: Binary and Hexadecimal.

The binary number system has a base of two numbers. Each digits is either a 0 or a 1. A binary number is an eight digit number and is read from right to left. Each digit has a position number with the farthest right being the 0 position and the farthest left being the 7 position. The 0 position, when displayed by a 1, indicates 1 in decimal.

Each position to the left is double the previous position and added to any other position values marked as a 1.

A hexadecimal system is composed of 16 different alpha numeric characters. The alpha numeric characters used are numbers 0 through 9 and letters A through F. The hexadecimal system is the most natural and common approach for scan tool manufactures to display data represented by binary numbers and digital code.

Verifying Vehicle Repair

Verification of vehicle repair will be more comprehensive for vehicle with OBD system diagnostic. Following a repair, the technician should perform the following steps:

1. Review and record the Fail Records for the DTC which has been diagnosed.
2. Clear DTC (s).
3. Operate the vhicle within conditions noted in the Fail Records.
4. Monitor the DTC status information for the specific DTC which has been diagnosed until the diagnostic test associated with that DTC runs.

Following these steps are very important in verifying repairs on OBD systems. Failure to follow these steps could result in unnecessary repairs.

ON-BOARD DIAGNOSTIC (OBD) System Check

OBD System should be checked as follows:

1. When Ignition key is turned from the “OFF” to the “ON” position, make sure that MIL is lit for 0.3 sec. to 0.8 sec.
2. Connect Scan Tool and check to see if MIL is always lit.

   If so, OBD System is normal.

READING DIAGNOSTIC TROUBLE CODES USING A TECH 2 OR OTHER SCAN TOOL

The procedure for reading diagnostic trouble codes is to be used a diagnostic scan tool. When reading DTCs, follow instructions supplied by tool manufacturer.

Clearing Diagnostic Trouble Codes

IMPORTANT: Do not clear DTCs unless directed to do so by the service information provided for each diagnostic procedure. When DTCs are cleared, the Freeze Frame and Failure Record data which may help diagnose an intermittent fault will also be erased from memory.

If the fault that caused the DTC to be stored into memory has been corrected, the Diagnostic Executive will begin to count the "warm-up" cycles with no further faults detected, the DTC will automatically be cleared from the Engine Control Module (ECM) memory.

To clear Diagnostic Trouble Codes (DTCs), use the diagnostic scan tool "clear DTCs" or "clear Information" function. When clearing DTCs follow instructions supplied by the tool manufacturer.

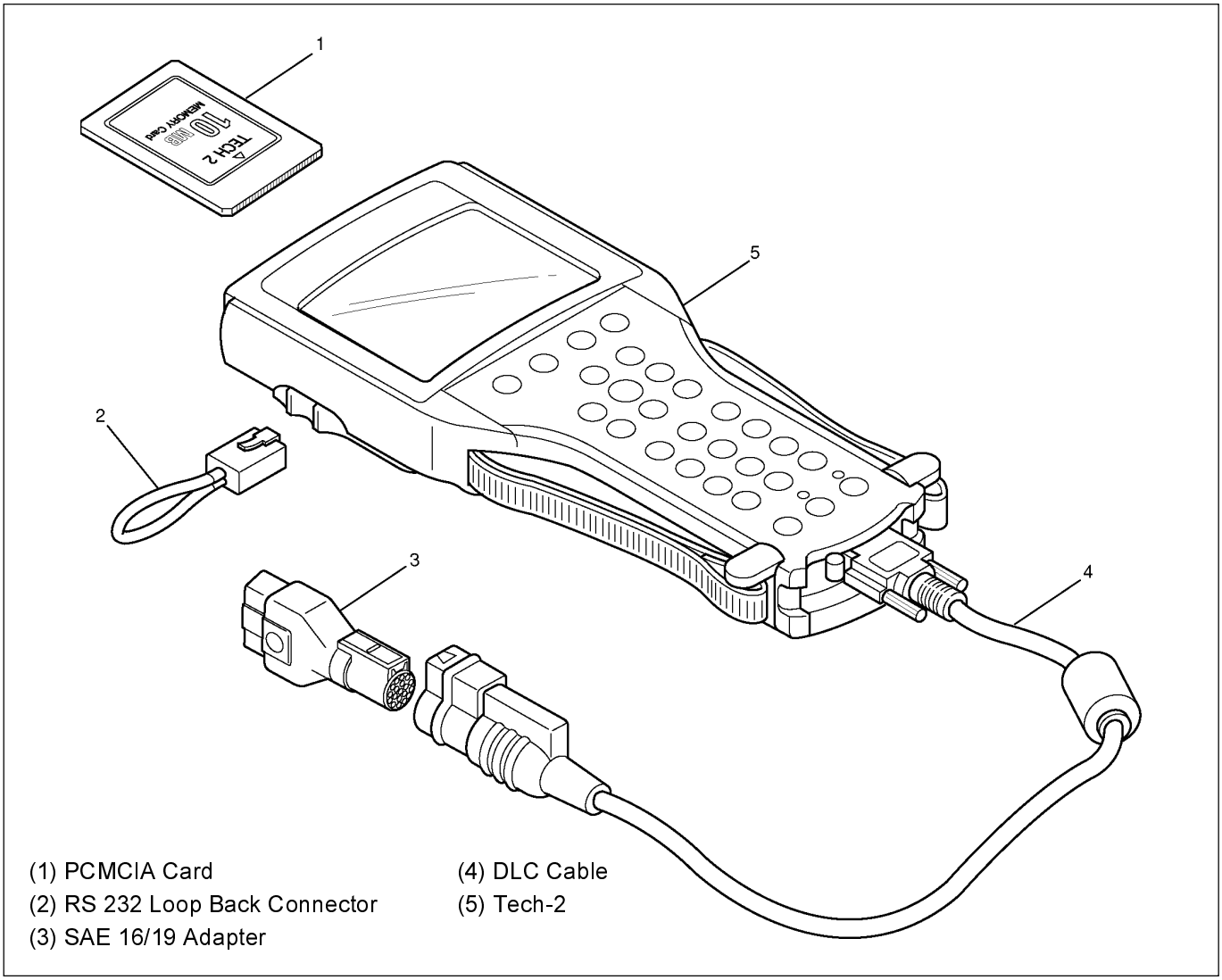
When a scan tool is not available, DTCs can also be cleared by disconnecting one of the following sources for at least thirty (30) seconds.

NOTE: To prevent system damage, the ignition key must be "OFF" when disconnecting or reconnecting battery power.

- The power source to the control module. Examples: fuse, pigtail at battery ECM connectors etc.
- The negative battery cable. (Disconnecting the negative battery cable will result in the loss of other on-board memory data, such as preset radio tuning).

Tech 2 Scan Tool

From 98 MY, Isuzu Dealer service departments are recommended to use Tech 2. Refer to Tech 2 scan tool user guide.



(1) PCMCIA Card
(2) RS 232 Loop Back Connector
(3) SAE 16/19 Adapter
(4) DLC Cable
(5) Tech-2

901RW180.tif

Getting Started

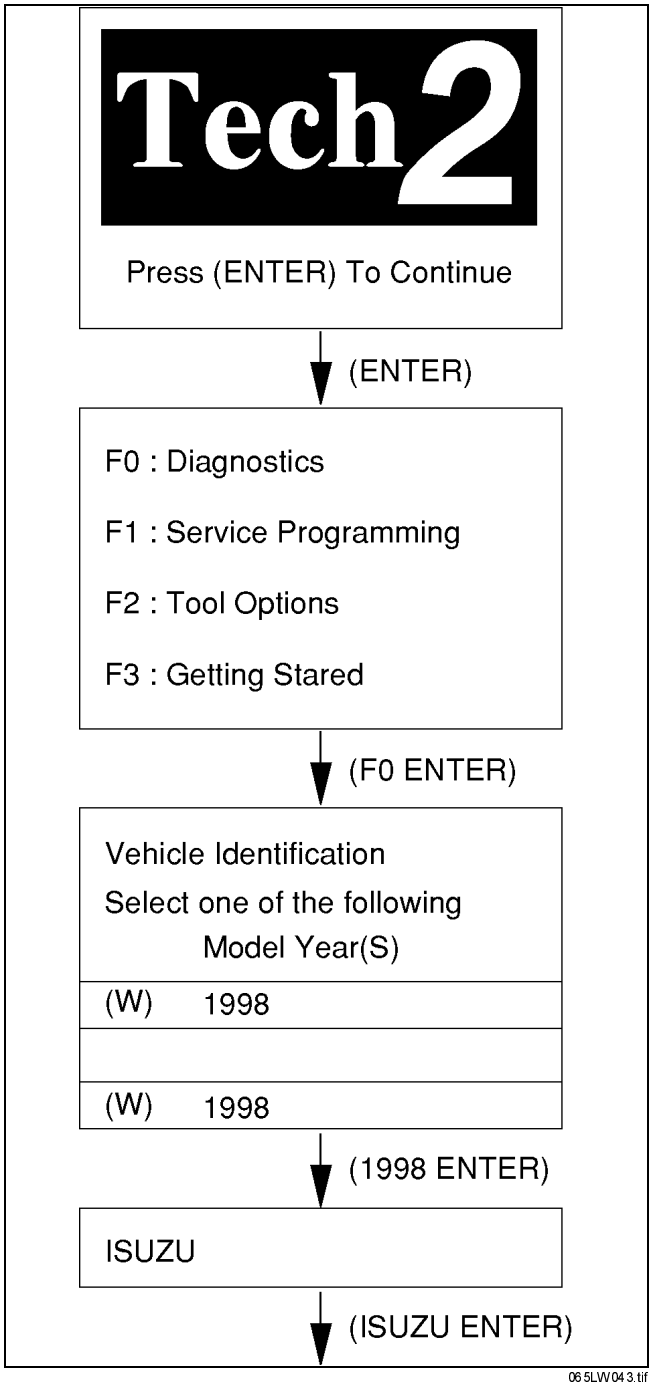
- Before operating the Isuzu PCMCIA card with the Tech 2, the following steps must be performed:
  1. The Isuzu 98 System PCMCIA card (1) inserts into the tech 2 (5).
  2. Connect the SAE 16/19 adapter (3) to the DLC cable (4).
  3. Connect the DLC cable to the Tech 2 (5).
  4. Make sure the vehicle ignition key is off.
  5. Connect the Tech 2 SAE 16/19 adapter to the vehicle ALDL/DLC.
  6. The vehicle ignition turns on.
  7. Verify the Tech 2 power up display.

012RW105.tif

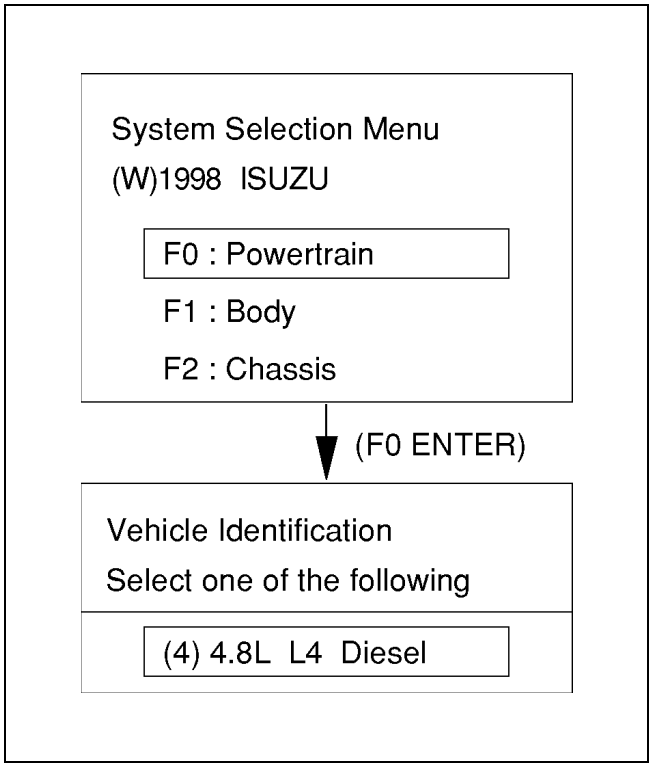
NOTICE: The RS232 Loop back connector is only to use for diagnosis of Tech 2 and refer to user guide of the Tech 2.

Operating Procedure (For example)

The power up screen is displayed when you power up the tester with the Isuzu systems PCMCIA card. Follow the operating procedure below.

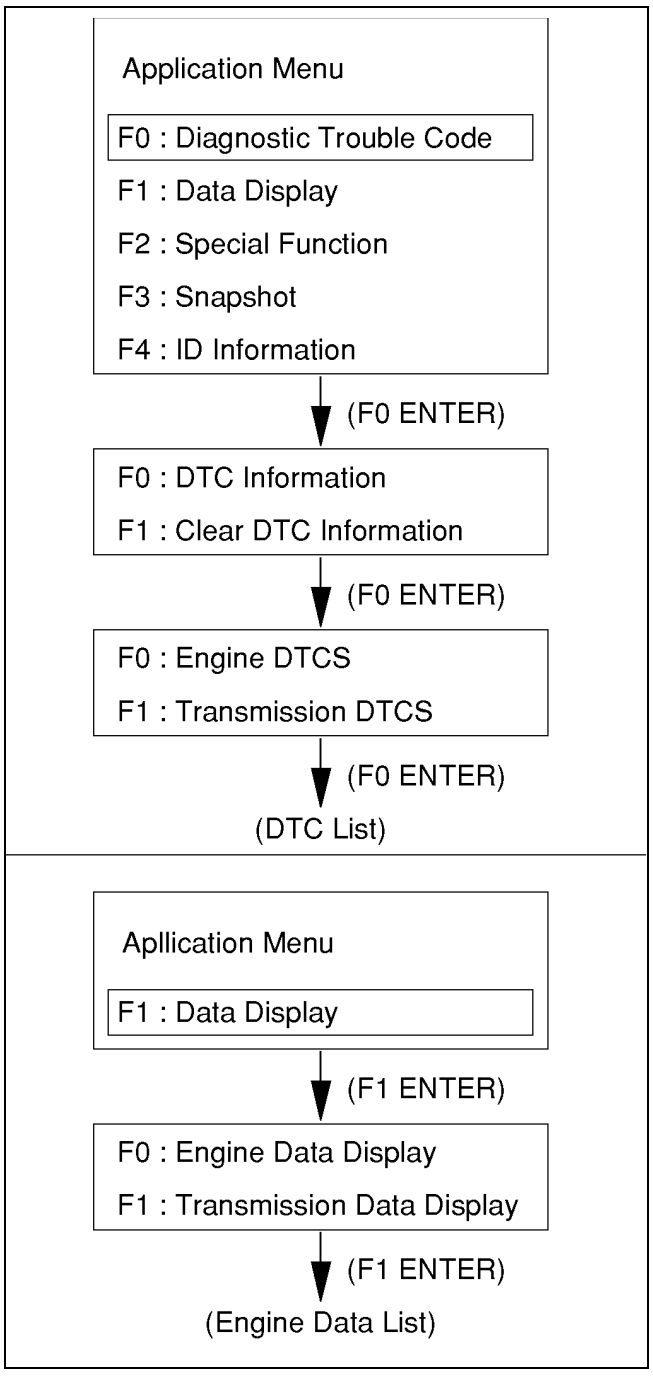


065LW043.tif

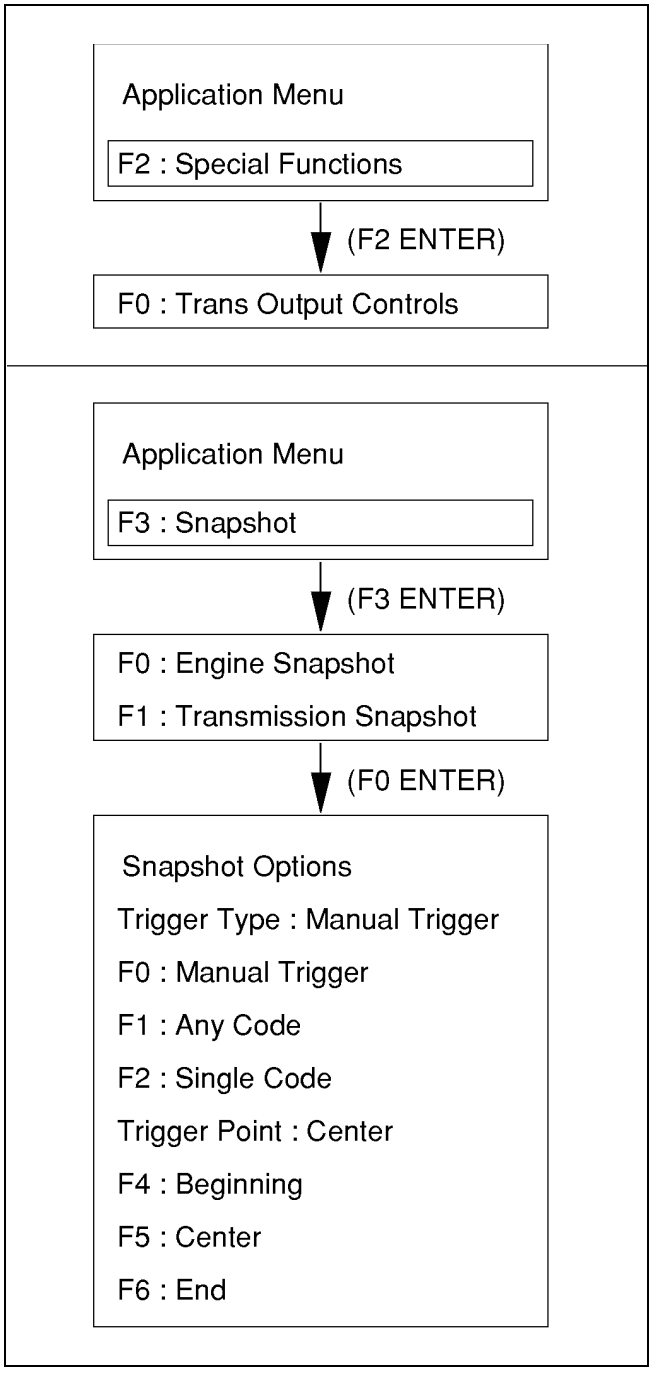


065LW044.tif

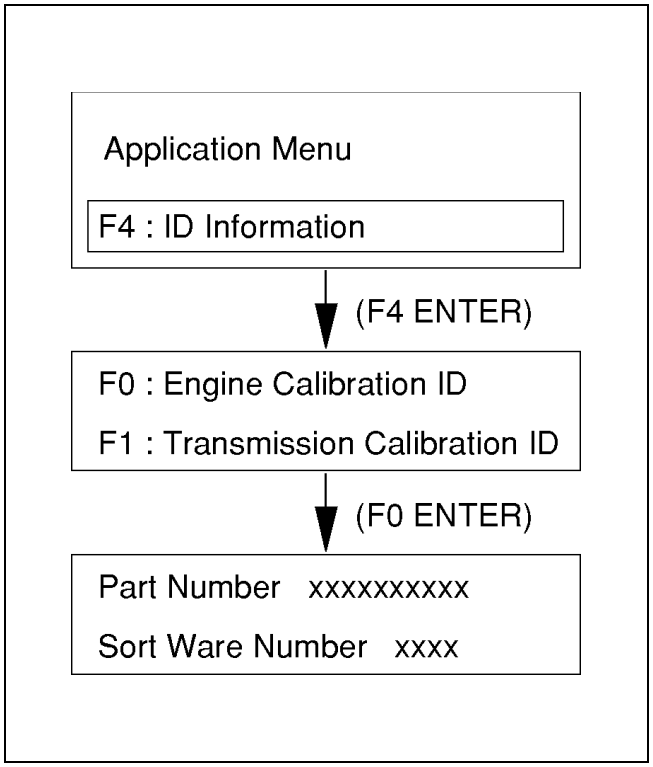
- The following table shows, which functions are used the available equipment versions.



065LW045.tif



065LW046.tif



065LW047.tif

TYPICAL SCAN DATA VALUES

Use the Typical Scan Data Values Table only after the On-Board Diagnostic System Check has been completed, no diagnostic trouble codes were noted, and you have determined that the on-board diagnostics are functioning properly. Scan tool values from a properly-running engine may be used for comparison with the engine you are diagnosing. The typical scan data values represent values that would be seen on a normally-running engine.

Note: A scan tool that displays faulty data should not be used, and the problem should be reported to the scan tool manufacturer. Use of a faulty scan tool can result in misdiagnosis and unnecessary replacement of parts.

Only the parameters listed below are referred to in this service manual for use in diagnosis. For further information on using the scan tool to diagnose the engine control module and related sensors, refer to the applicable reference section listed below. If all values are within the typical range described below, refer to the symptoms section for diagnosis.

Test Conditions

Engine running, lower radiator hose hot, transmission in park or neutral, closed loop, accessaries off, brake not applied and air conditioning off.

DATA LIST (TYPICAL DATA)

TECH 2 STRING		TYPICAL DATA VALUES (IDLE)
Ignition Switch	(On/Off)	On
Starter Switch	(On/Off)	Off
Exhaust Break Switch	(On/Off)	Off
Transmission Gear Position Switch		N.2.3.4.5.6 (M/T only)
Transmission Spec. Select Switch	(AT/MT)	Automatic Trans
Engine Spec. Select Switch	(S/N)	S
IAT Switch	(Yes/No and High/Low)	High
EGR/VSS System	(Yes/No)	Yes
Rack Sensor Voltage	(V)	1.0
Engine Coolant Temp	(V)	2.6
Engine Coolant Temp	*F(°C)	89.6 (32)
Engine Speed	(rpm)	800
Barometric Pressure	(V)	2.9
Barometric Pressure	(mmHg)	761

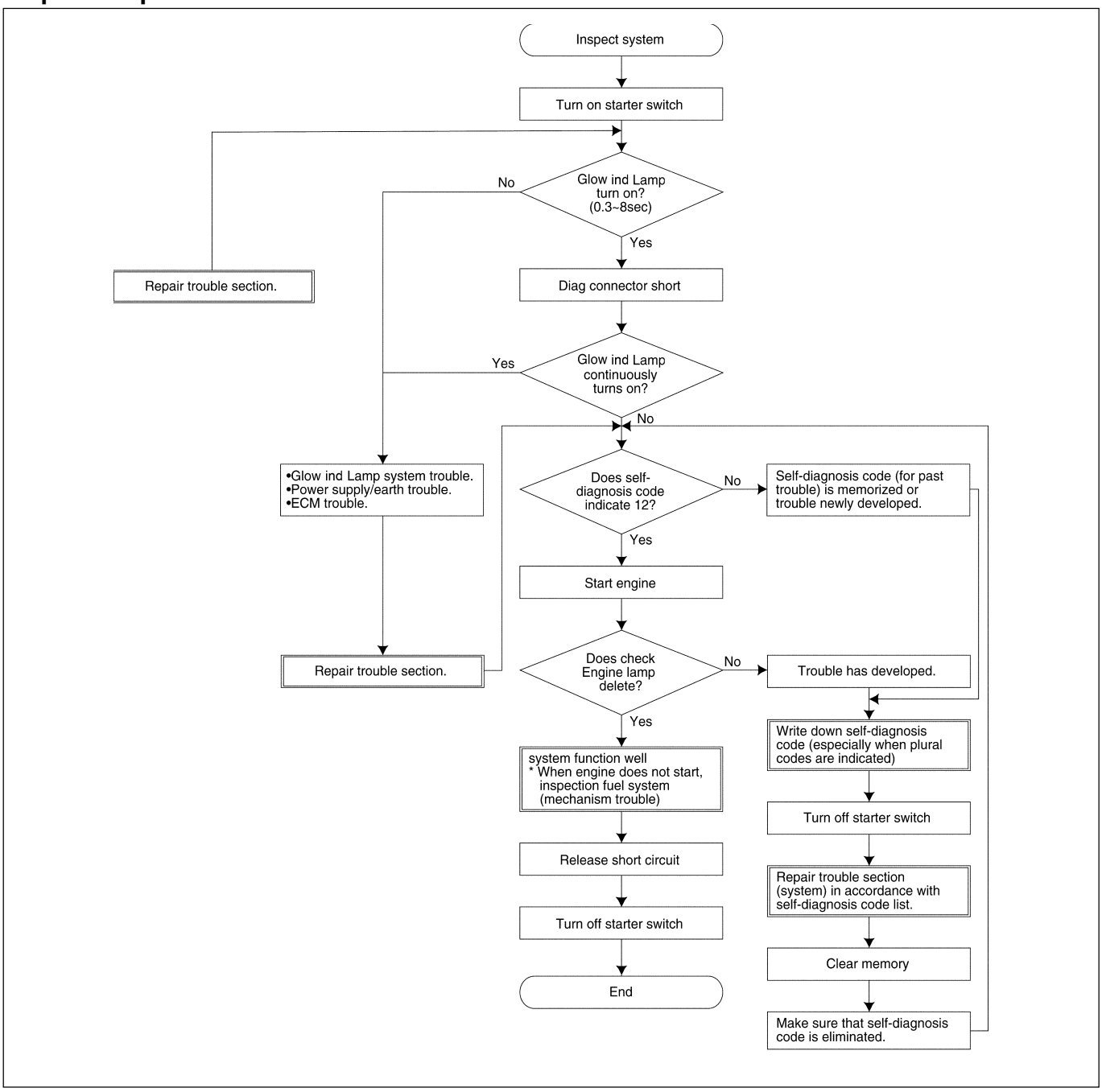
TROUBLESHOOTING

Caution taken in inspecting

(1) In inspecting system, write down self-diagnosis code to be indicated. (especially, when plural self-diagnosis codes are indicated.)

(2) Before eliminating the indicated self-diagnosis codes by a memory clear switch, doubly inspect abnormal place as indicated in self-diagnosis code. (Self-diagnosis code means 'Warning.' Make sure to inspect abnormal section.)

Inspection procedure flowchart



Flowchart1 3-2.tif

NOTE:

Please note that some items of self-diagnosis code may not be generated unless the engine is warmed up or unless the vehicle is driven under load.

SELF-DIAGNOSIS FUNCTIONS

(1) Memorization of self-diagnosis code

The self-diagnosis code indicated will be memorized in Electronically Erasable Programmable Read Only Memory (EEPROM) with in the Engine Control Module (ECM). Accordingly even if the starter switch turns off or the ECM is removed from the vehicle, the memorized self-diagnosis code will not be eliminated.

* Unless an elimination procedure is taken, the self-diagnosis code will remain in memory. (The memory will be eliminated only by a memory clear switch.)

(2) Elimination of self-diagnosis code

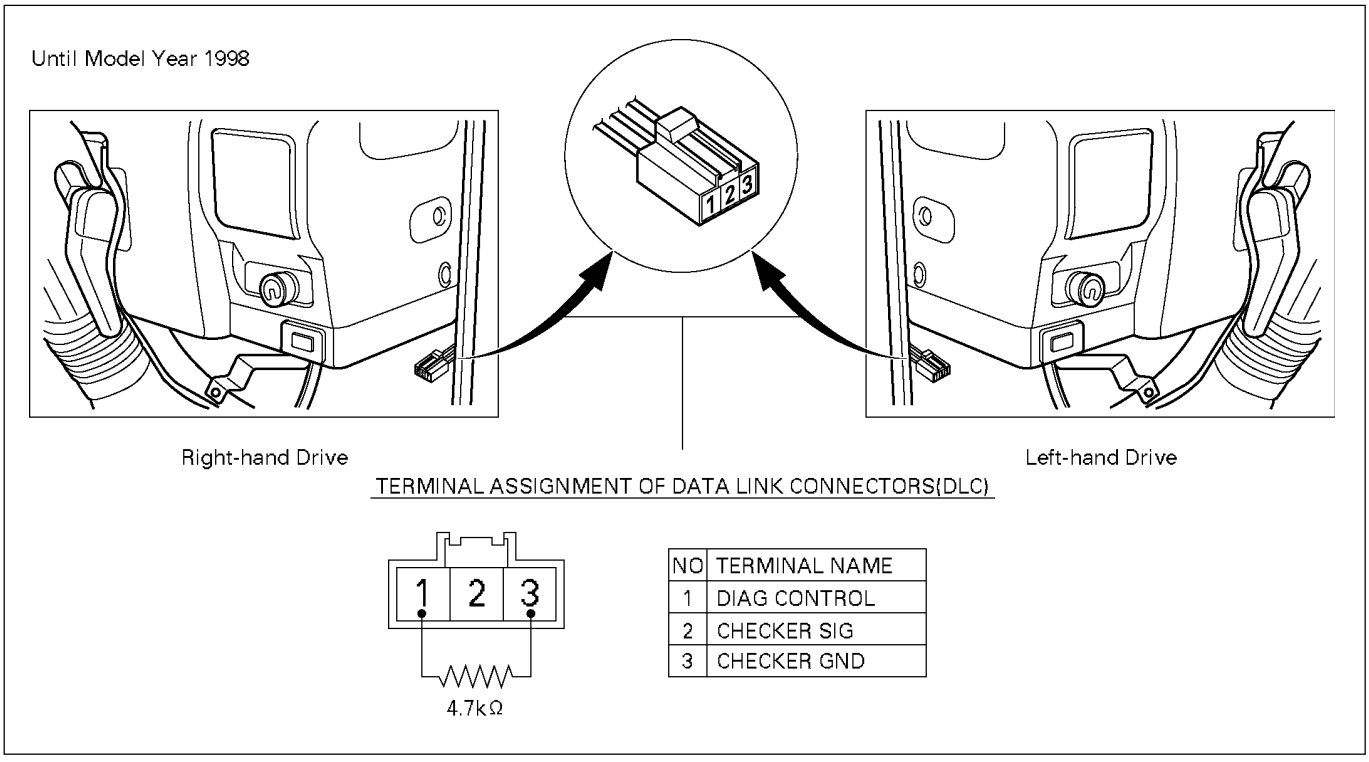
The self-diagnosis code memorized in the EEPROM with in the ECM can be eliminated only by Scan Tool or the operation of the memory clear switch.

The elimination method memory clear switch will be described below:

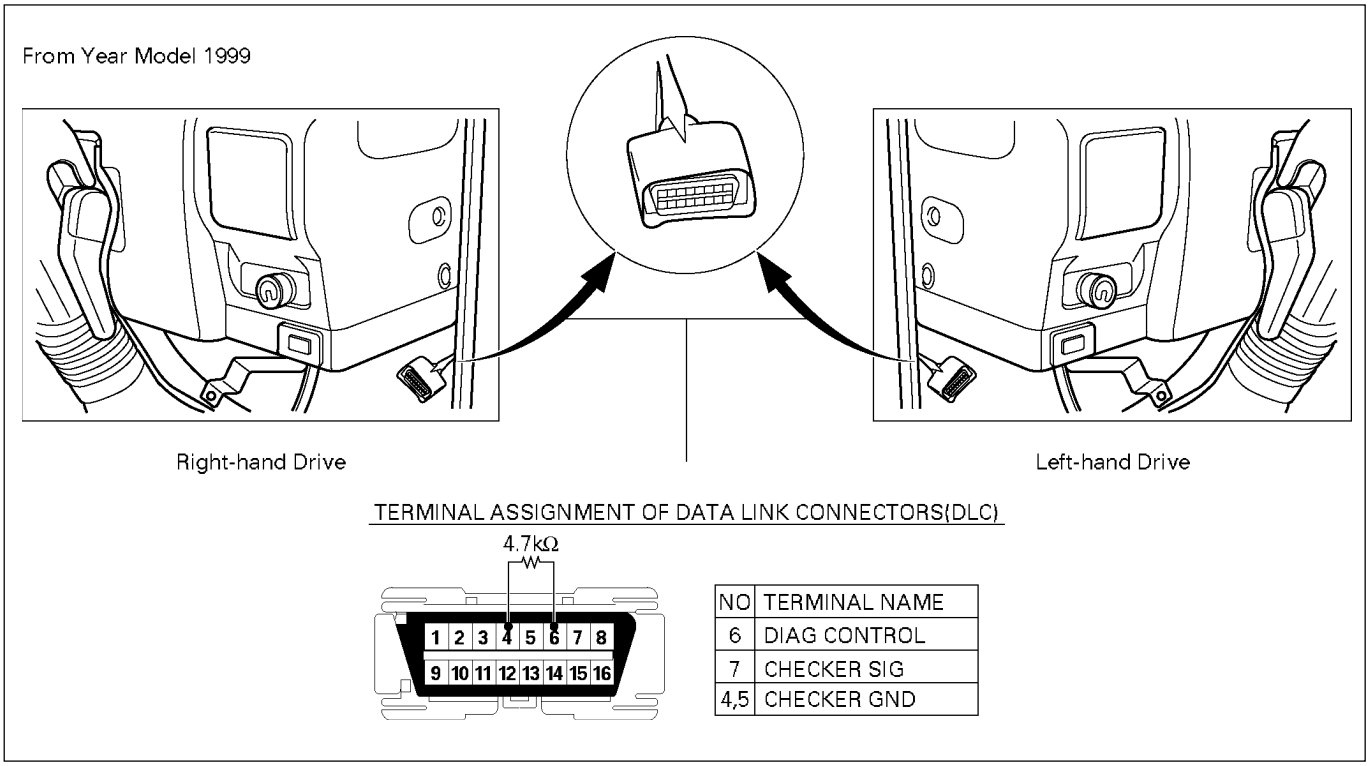
1. Turn OFF ignition switch.
2. Use 4.7kΩ resistance and make short circuit on memory clear switch.
3. Turn ON ignition switch. The indication lamp turn on (lighting) continuously after three seconds flashing the indication lamp.
4. Turn OFF ignition switch.
5. Remove shortage resistance from memory clear switch.

15-1. Location of the memory clear switch

Location of the memory clear switch (DATA LINK CONNECTOR)



056LX009.tif



NO	TERMINAL NAME
6	DIAG CONTROL
7	CHECKER SIG
4,5	CHECKER GND

056LX006.tif

How to read flashing of the indicator lamp:

The two-digit self-diagnosis code flashes starting from ten's figure to indicate the self-diagnosis code.

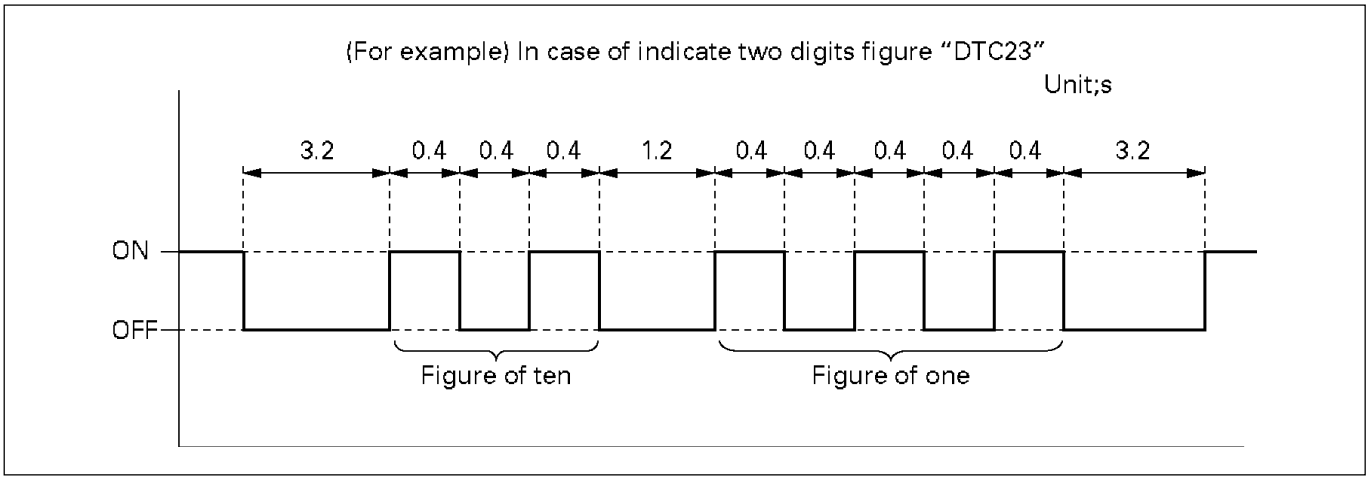
Please read the self-diagnosis code from the flashing.

If the plural self-diagnosis codes are indicated, the same self-diagnosis code is flashed repeatedly in steps of three times.

Please read it correctly.

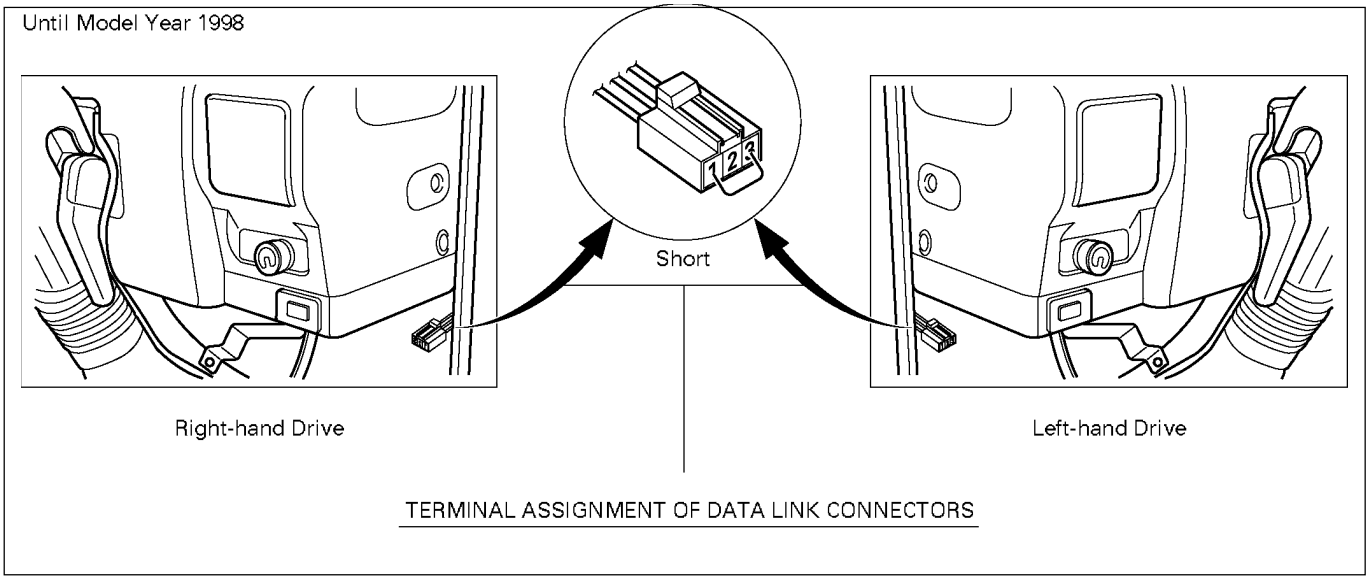
- Diagnostic Trouble Code (DTC) outputting is done in decreasingly order of DTC number.
- Indication is changed over on completion of output DTC indication.
- DTC indicator is stopped with diagnostic switch being off.
- When there is no DTC output, "1" is outputted in normal DTC code.
- After indicating 3 times pear 1 DTC, shift is conducted to the next DTC. (After making a round, the indications are repeated again.)
- In case of the same diagnostic code, it is used 1 DTC (3 times indication.)

Example Diagnosis Trouble Code Output

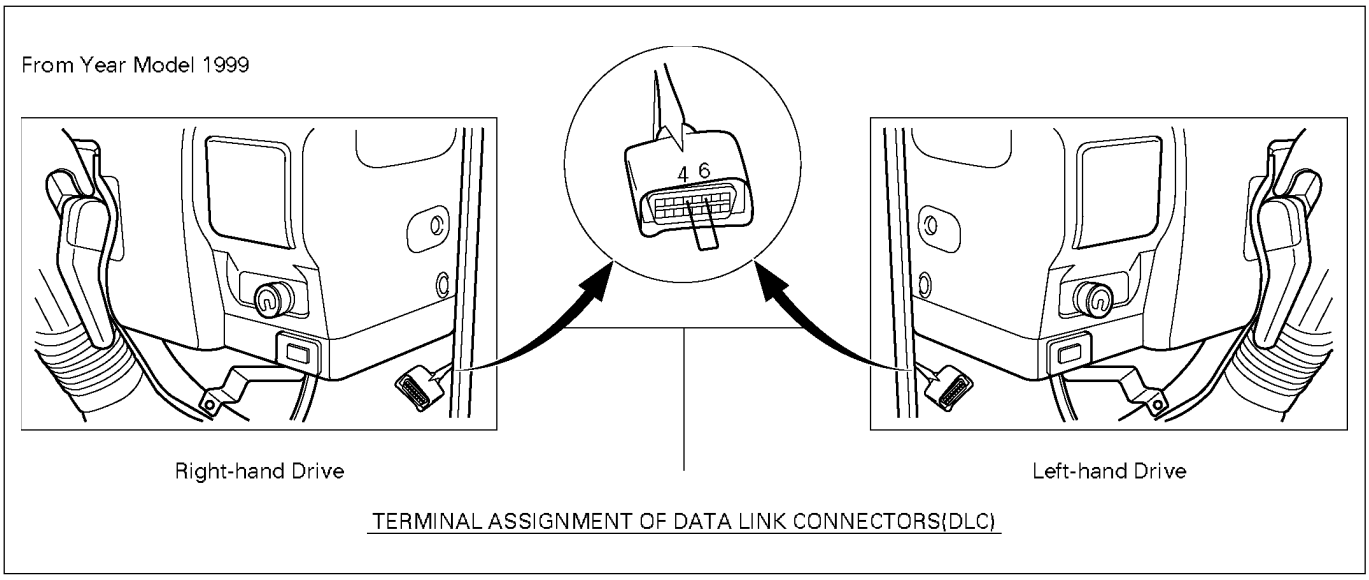


826LW012.tif

Flashing of Indicator Lamp



056LX015.tif



056LX014.tif

DIAGNOSIS TROUBLE CODE LIST

DTC#	TECH 2 STRING
P21	Rack Sensor Circuit Low
P22	Rack Sensor Circuit High
P13	Engine Coolant Temperature (ECT) Sensor Circuit High
P14	ECT Sensor Circuit Low
P31 *	Exhaust Gas Recirculation (EGR) Electronic Vacuum Regulating Valve (EVRV) Solenoid Circuit Low
P32 *	EGR EVRV Solenoid Circuit High
P41	Quick On Start (QOS) Relay Control Circuit Low
P42	QOS Relay Control Circuit High
P23	Magnetic Switch Control Circuit Low
P24	Magnetic Switch Control Circuit High
P26	Quick Warm System (QWS) Relay Control Circuit High
P33 *	Variable Swirl System (VSS) Control Circuit Low
P34 *	VSS Control Circuit High
P43	Aneroid Compensator Vacuum Switching Valve (VSV) Control Circuit Low
P35 *	EGR Quick Cut VSV Control Circuit Low
P36 *	EGR Quick Cut VSV Control Circuit High
P44	Aneroid Compensator VSV Control Circuit High
P45	Engine Speed Sensor Circuit Low
P61	Barometric Sensor Circuit Error
P52	Electronically Erasable Programmable Read Only Memory (EEPROM) Error

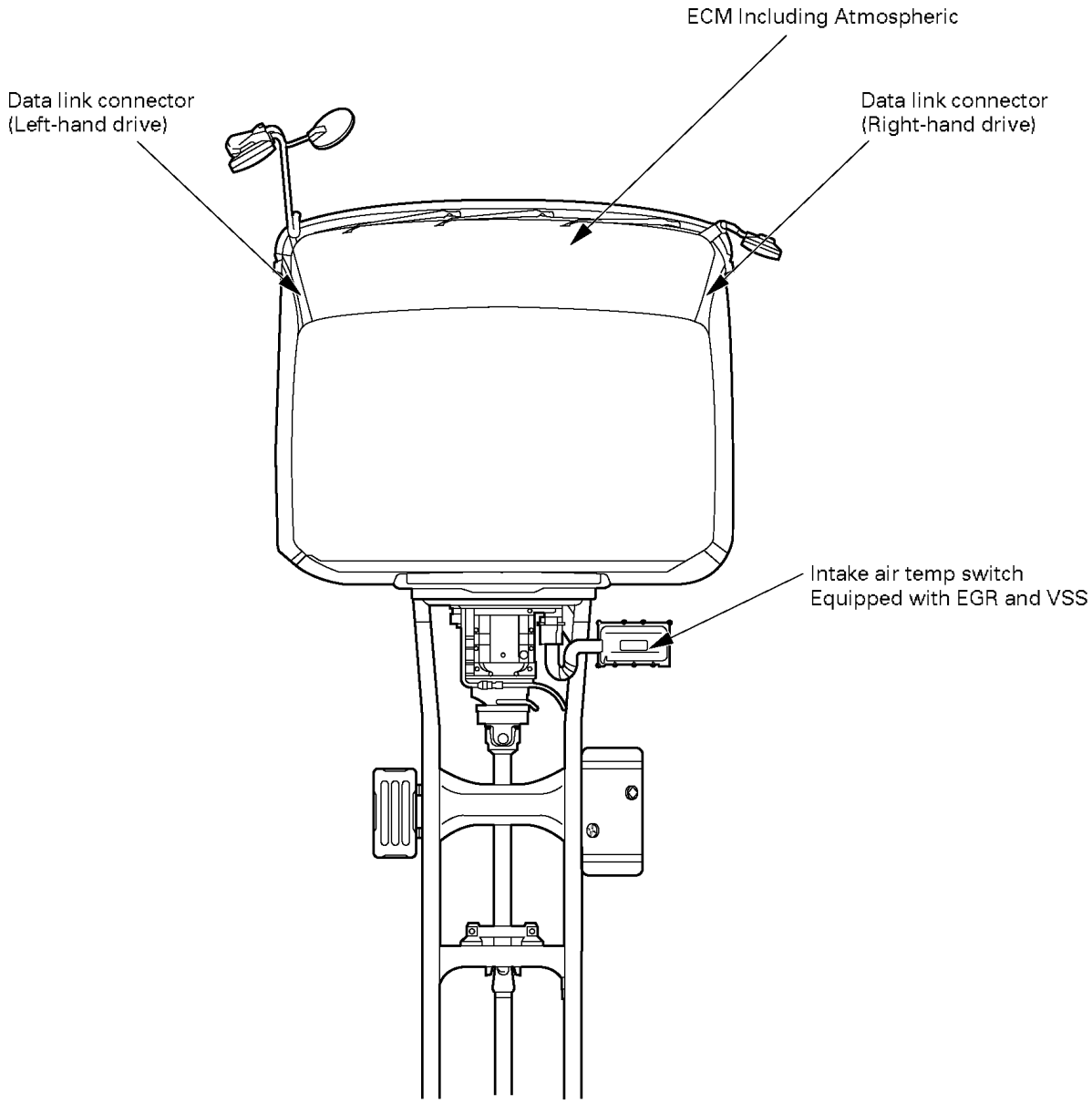
* Equipped with EGR and VSS

Error Classified		Trouble Code	Diagnostic Condition	Return Condition	Back Up	Judging Time
Relay: QWS	+B short	P26	Output TR Monitor	When forward normal	QWS: R/L Non-Continuity.	0.52 sec
VSV: VSS	Harness Open GND short	* P33	Output TR Monitor	When forward normal	VSS: VSV Output stop.	0.52 sec
	+B short	* P34				
VSV: ANECON	Harness Open GND short	P43	Output TR Monitor	When forward normal	ANECON: VSV Output stop.	0.52 sec
	+B short	P44				
VSV: EGR Quick	Harness Open GND short	* P35	Output TR Monitor	When forward normal	EVRV: EGR VSV: EGR Quick Cut The above output stops.	0.52 sec
	+B short	* P36				
Atmospheric Pressure Sensor	Output Abnormal	P61	1.5V (374mmHg) or lower, or 4.5V (1200mmHg) or higher detected.	When forward normal	EVRV: EGR VSV: EGR Quick Cut The above output stops. ANECON: VSV is actuated.	0.52 sec
	ECM EEPROM error	P61	Check when ECM is started and when Trouble Code is written.	When forward normal	Trouble Code other than 52 (EEPROM error) not indicated.	

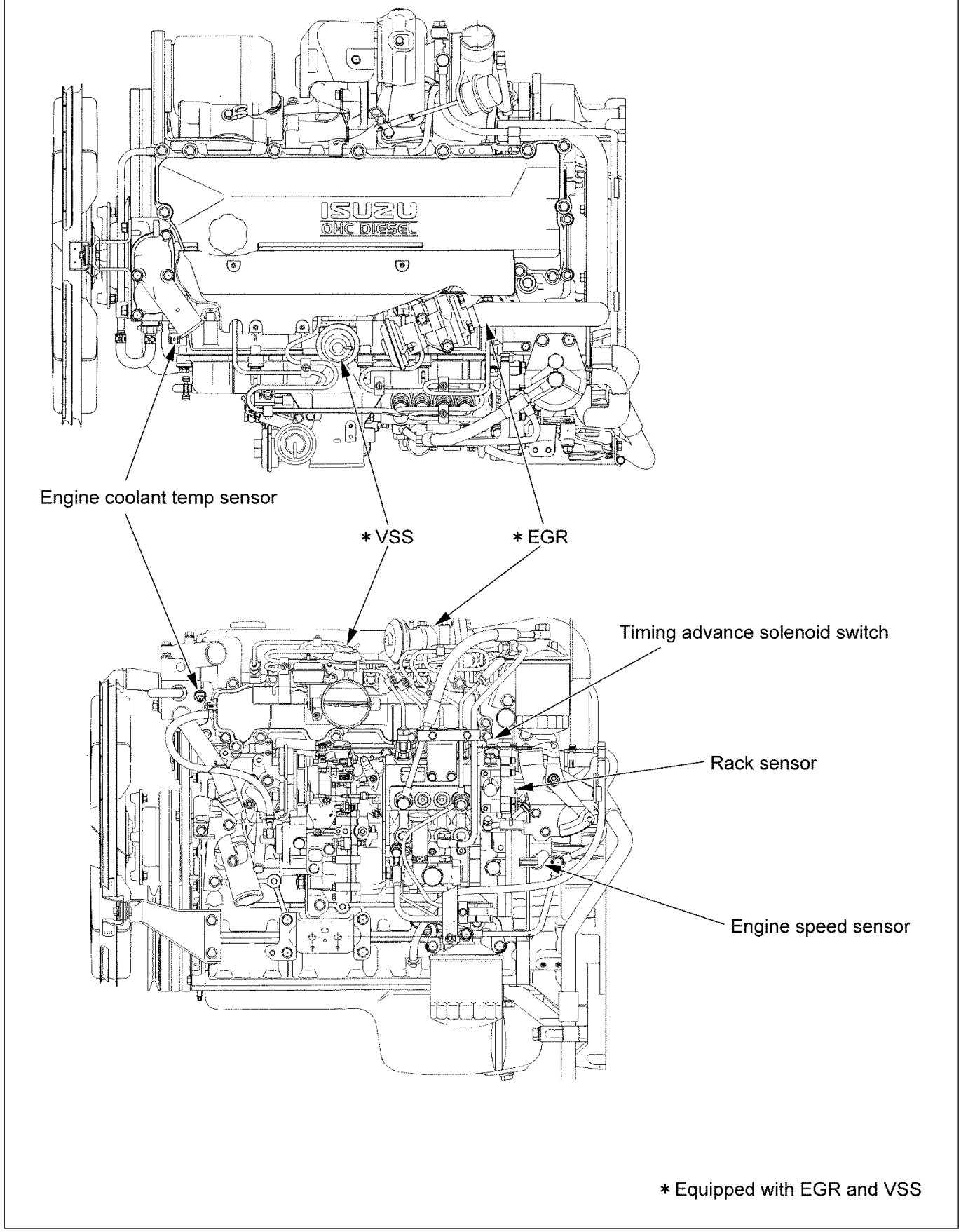
Error Classified		Trouble Code	Diagnostic Condition	Return Condition	Back Up	Judging Time
Normal		P12	No other trouble code.		No history of this diagnosis recorded	-
Rack Sensor	Harness Open GND short	P21	Rack Voltage 0.3V or lower, Engine speed 600~900rpm, and water Temp. 0°C or higher are detected for 3 sec running.	When forward normal	EVRV: EGR VSV: EGR Quick Cut VSV: VSS The above outputs stop. R/L: QWS Non-continuity Idle position output stop. The above outputs stop. Rack Learning valve: 0	3.52 sec
	+5V short Rack Sensor Power Voltage	P22	5V or higher Rack Voltage detected.			0.52 sec
Water Temp Sensor	Harness Open +B short	P13	-79°C (390kΩ) or lower, or 120°C (115kΩ) or higher detected.	When forward normal	EVRV: EGR VSV: EGR Quick Cut VSV: VSS MV: Timing Advance The above outputs stop. VSV: ANECON is actuated QOS: 0°C or lower control	0.52 sec
	GND short	P14				
EVRV: EGR	Harness Open GND short	* P31	Output TR Monitor	When forward normal	EVRV: EGR VSV: EGR Quick Cut The above outputs stop.	1.57 sec
	+B short	* P32				
Relay QOS	Harness Open GND short	P41	Output TR Monitor	When forward normal	QOS: RL Non-continuity	0.52 sec
	+B short	P41				
Magnetic Volume Timing	Harness Open	P23	Output TR Monitor	When forward normal	Timing Advance: MV output stop.	0.52 sec
	GND short +B short	P24				
	Harness Open GND short	P45	Engine speed 0, Rack Voltage ≥ 0.3V ≤ 0.57 is detected.	When forward normal	EVRV: EGR VSV: EGR Quick Cut VSV: VSS R/L: QWS The above outputs Idling position output stop when T/M POS SW outputted. VSV: ANECON is actuated	1.52 sec

* Equipped with EGR and VSS

LOCATION OF SENSOR AND SWITCH

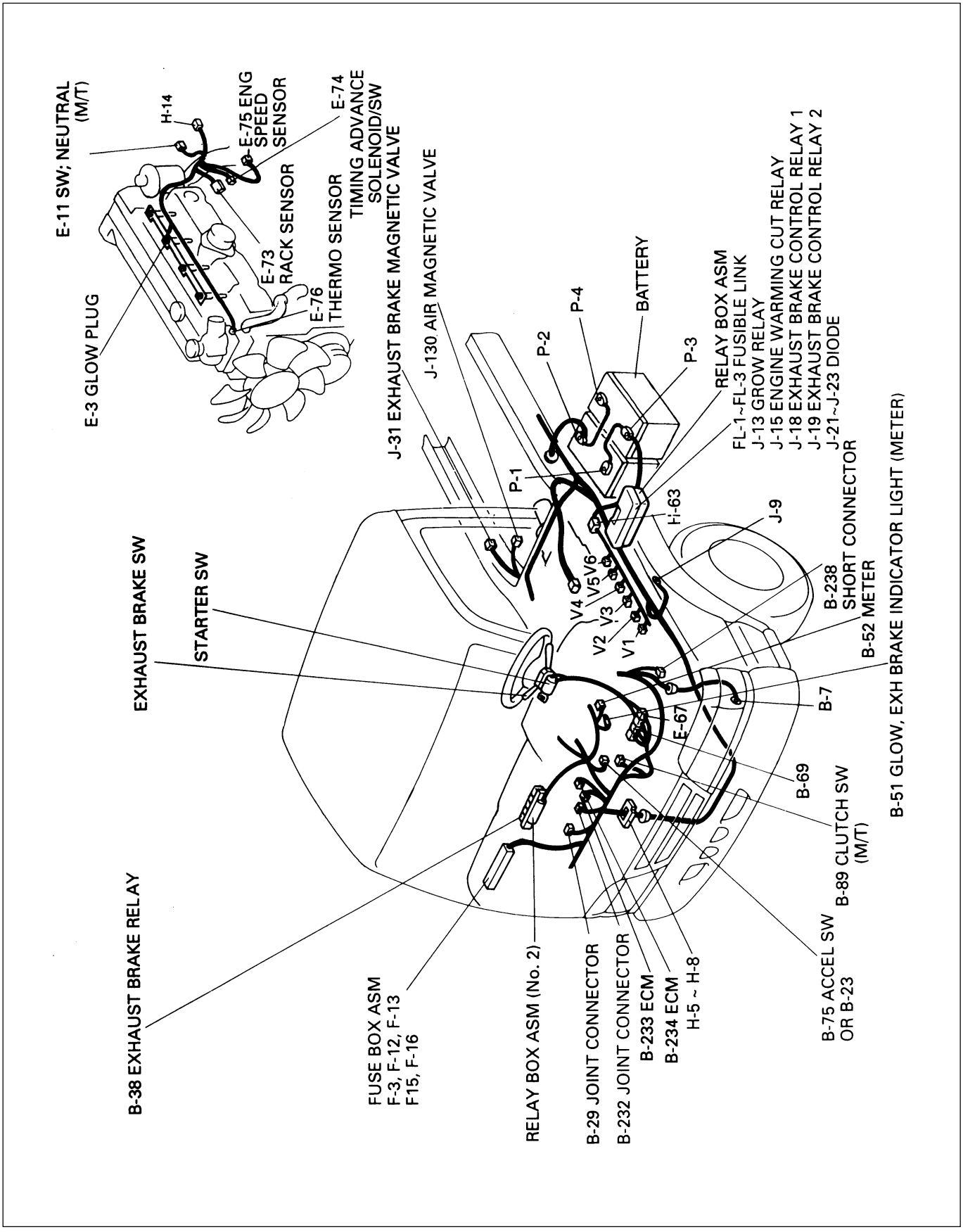


056LW033.tif



056LW035.tif

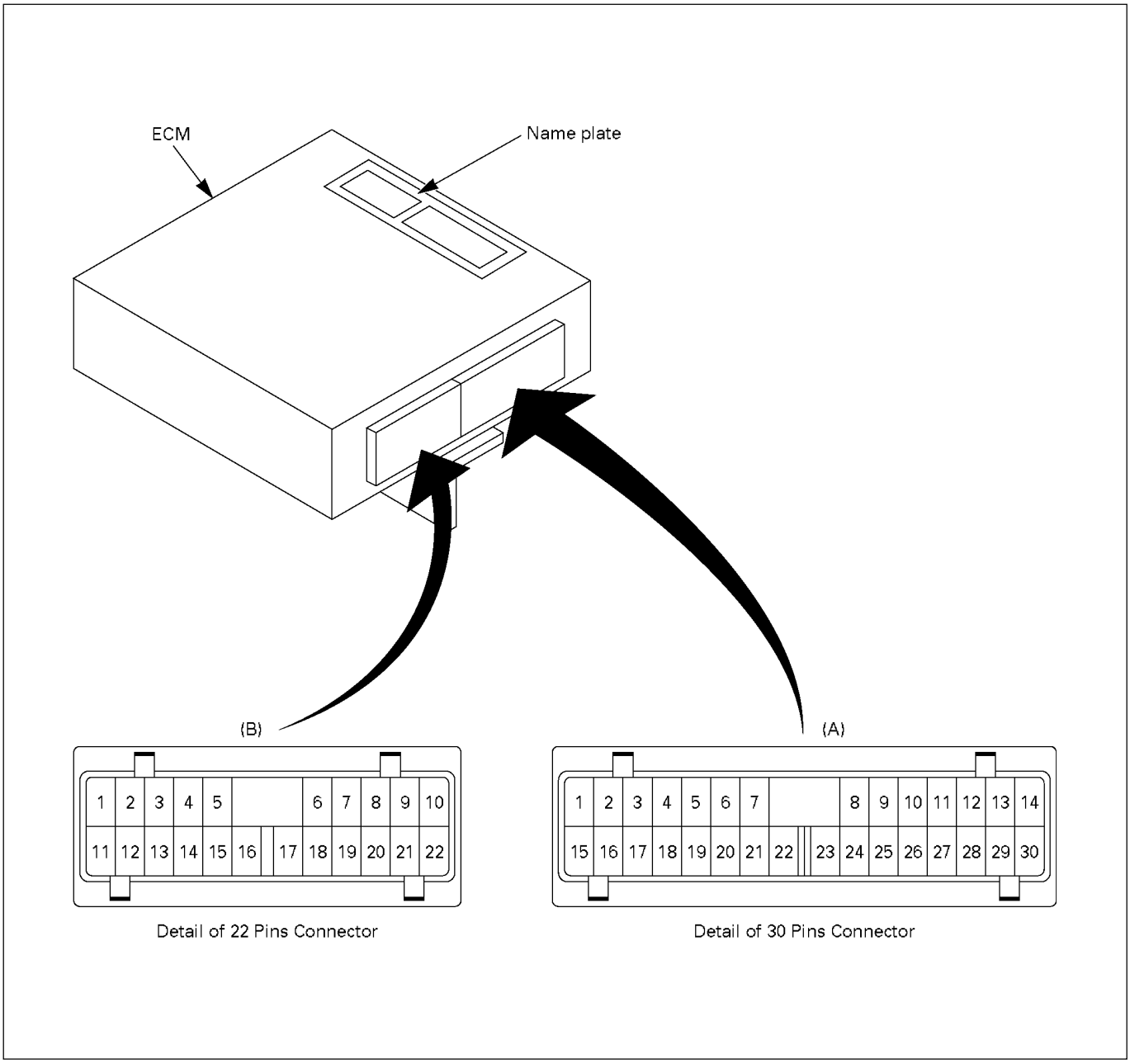
PARTS LOCATION



6E-32-1.tif

ENGINE CONTROL MODULE (ECM)

Appearance of ECM



826LW006-1.tif

CHART OF ENGINE CONTROL MODULE (ECM) INPUT/OUTPUT

Connector	Connector number	Connector name	Equipped without EGR and VSS		Equipped with EGR and VSS		
			S-SPEC		N-SPEC	S-SPEC	
			M/T	A/T	M/T		A/T
Connector 30 pin	1	Checker SIG (Serial Communication)	○	○	○	○	○
	2	Intake Temperature Switch			○	○	○
	3	Engine Type			○		
	4	Not be used	-	-	-	-	-
	5	Transmission Type		○			○
	6	Rack Sensor (+5V)	○	○	○	○	○
	7	Rack Sensor SIG	○	○	○	○	○
	8	Battery (+)	○	○	○	○	○
	9	Ignition Key	○	○	○	○	○
	10	Not be used	-	-	-	-	-
	11	Timing Advance Solenoid Switch Relay	○	○	○	○	○
	12	Not be used	-	-	-	-	-
	13	Electric Vacuum Regulating Valve Power Supply	×	×	○	○	○
	14	Electric Vacuum Regulating Valve GND	×	×	○	○	○
	15	Checker GND	○	○	○	○	○
	16	Diag Control	○	○	○	○	○
	17	Not be used	-	-	-	-	-
	18	Not be used	-	-	-	-	-
	19	Not be used	-	-	-	-	-
	20	Not be used	-	-	-	-	-
	21	Rack Sensor GND	○	○	○	○	○
	22	ECM GND	○	○	○	○	○
	23	Not be used	-	-	-	-	-
	24	Not be used	-	-	-	-	-
	25	Not be used	-	-	-	-	-
	26	Not be used	-	-	-	-	-
	27	Transmission Position Switch			○		
	28	Not be used	-	-	-	-	-
	29	Not be used	-	-	-	-	-
	30	FICD Magnetic Valve Power Supply	○	○	○	○	○

Connector	Connector number	Connector name	Equipped without EGR and VSS		Equipped with EGR and VSS		
			S-SPEC		N-SPEC	S-SPEC	
			M/T	A/T	M/T		A/T
Connector 22 pin	1	EGR Cut Magnetic Valve Power Supply	×	×	○	○	○
	2	Glow Relay	○	○	○	○	○
	3	Glow Indicator Lamp	○	○	○	○	○
	4	Rack Idle Position Out Put		○			○
	5	Not be used	-	-	-	-	-
	6	Not be used	-	-	-	-	-
	7	Engine Coolant Temperature Sensor GND	○	○	○	○	○
	8	Engine Coolant Temperature Sensor SIG	○	○	○	○	○
	9	Engine Revolation Sensor GND	○	○	○	○	○
	10	Engine Revolation Sensor SIG	○	○	○	○	○
	11	VSS Magnetic Valve Power Supply	×	×	○	○	○
	12	QWS Relay	○	○	○	○	○
	13	Aneroid Compensator Magnetic Valve	○	○	○	○	○
	14	Not be used	-	-	-	-	-
	15	Not be used	-	-	-	-	-
	16	Not be used	-	-	-	-	-
	17	Not be used	-	-	-	-	-
	18	Starter Switch	○	○	○	○	○
	19	Exhaust Brake Status Switch	○	○	○	○	○
	20	Not be used	-	-	-	-	-
	21	Not be used	-	-	-	-	-
	22	Not be used	-	-	-	-	-

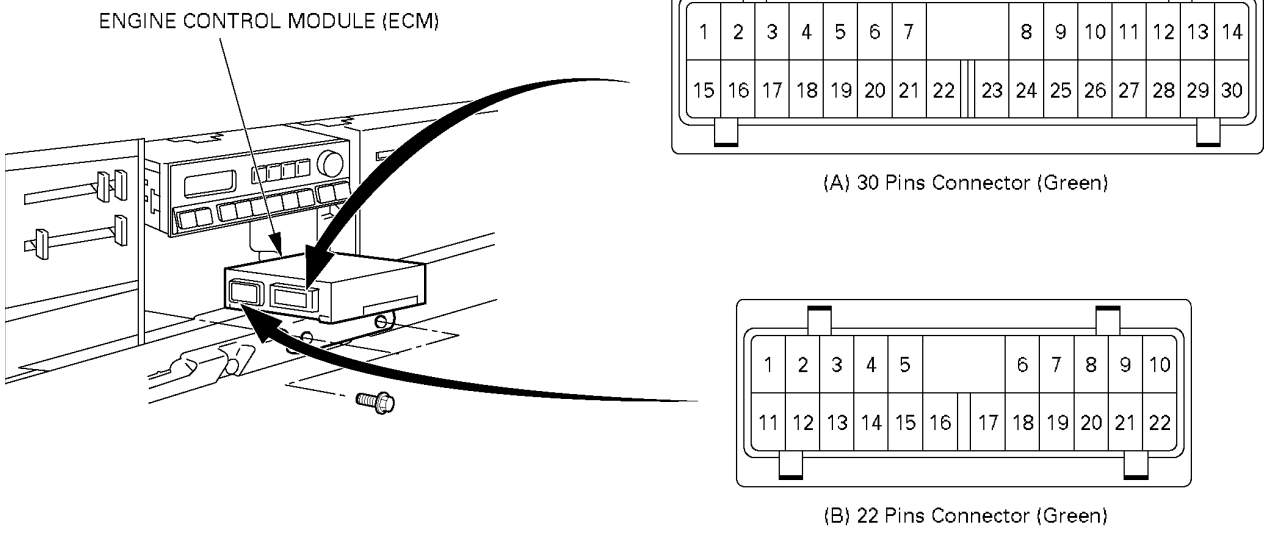
Note: The meaning of symbol marks are:

○ : Connect

BLANK : Not

× : Not Connect

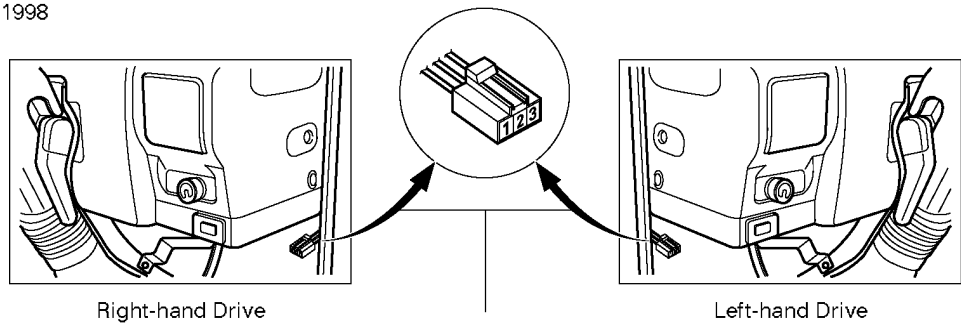
Location of the Engine Control Module (ECM) Connector



826LW008-1.tif

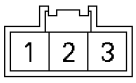
Location of Data Link Connector (DLC)

Until Model Year 1998



TERMINAL ASSIGNMENT OF DATA LINK CONNECTORS(DLC)

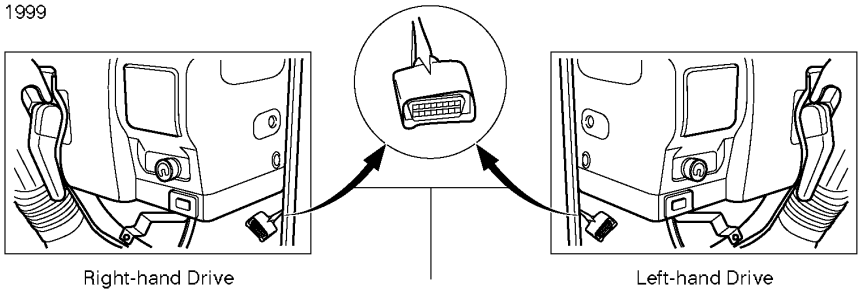
HOUSING COLOR;NATURAL TERMINAL;FEMALE



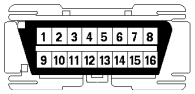
NO	TERMINAL NAME
1	DIAG CONTROL
2	CHECKER SIG
3	CHECKER GND

056LX008.tif

From Year Model 1999



TERMINAL ASSIGNMENT OF DATA LINK CONNECTORS(DLC)



NO	TERMINAL NAME
6	DIAG CONTROL
7	CHECKER SIG
4,5	CHECKER GND

056LX010.tif

BRIEF EXPLANATION OF EMISSION AND ELECTRICAL CONTROL SYSTEM

MITICS (Mechanically Integrated Timing and Injection Control System)

The Mechanically Integrated Timing and Injection rate Control System (MITICS) utilizes mechanical control, in comparison with TICS systems, which utilize electronic control.

MITICS is equipped with the RLD-M type governor, which contains a pre-stroke control mechanism. With this, pre-stroke position (ie., beginning of static injection) can be varied to control injection timing and injection rate (i.e., the fuel injection quantity injected from the nozzle per cam angle degree).

This enables high injection rates1 in the low and medium speed ranges through a short Injection interval, thus contributing to higher engine torque and cleaner exhaust.

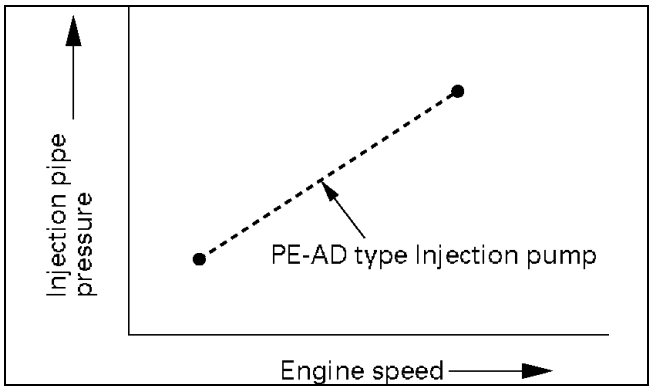
MITICS was developed in response to the demands of medium sized diesel engines for low cost, low fuel consumption, high output and cleaner emissions.

High injection rates using a short injection interval.

- The speed at which the injection pump plunger rises slows as engine speed decreases and the pressure inside the injection pipe decreases.

  Because of this, the nozzle spray deteriorates and makes it impossible to obtain the proper fuel - air mixture.

  To obtain the proper mixture at low and medium speeds, it is necessary to increase the pressure inside the injection pipes using a short injection interval.



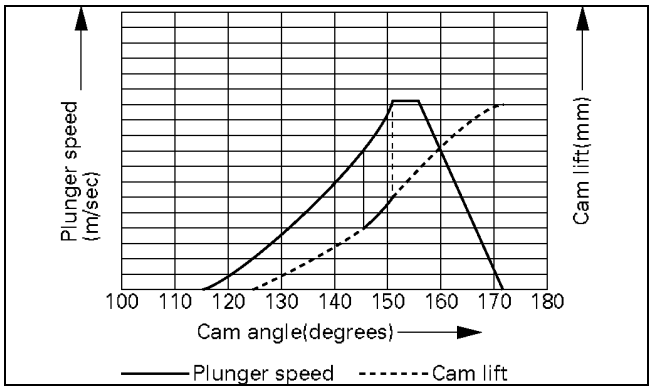
040LW006.tif

- The left hand figure shows plunger speed and cam lift in relation to cam angle. It can be seen from the graph that plunger speed increases together with cam lift.

  MITICS varies the beginning of injection position at low and medium speeds so that injection occurs when the plunger speed increases during the latter half of cam lift (shown by the bold line).

  At high speeds, injection is performed when the plunger speed decreases during the first half of cam lift to prevent an excessive increase in injection pipe pressure.

  This enables high pressures at low and medium speeds with a fast plunger speed. Thus, a fine fuel oil spray is injected into the cylinder from the nozzles within a short time to provide the proper mixture for combustion, helping to increase torque and keep exhaust emissions clean.



040LW007.tif

GOVERNOR (MODEL RLD-M)

The RLD-J type governor can be used with the MI, MITICS injection pumps, and was designed to have better control and endurance than the previous RLD type governor.

Although the basic construction is identical to that of the RLD type governor, the RLD-M type is larger to match the applicable pumps' larger size.

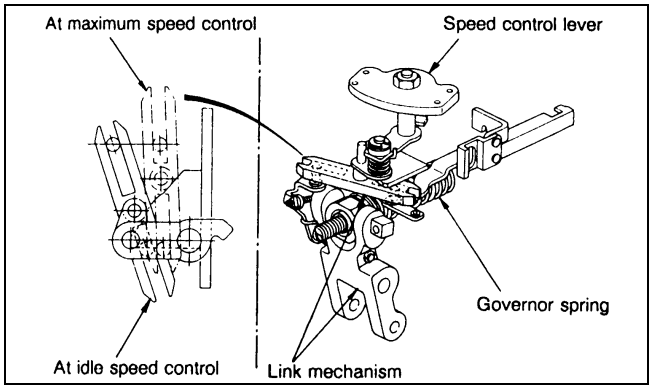
FEATURES

1. Variable speed control governor with

decreased lever reaction force

As with the previous RLD type governor, RLD-M governor control is accomplished using the speed control lever to change the fulcrum of the internal link mechanism.

Consequently, as the reaction force of the governor spring does not act directly on the speed control lever, only a very small lever reaction force is exerted on the accelerator pedal.

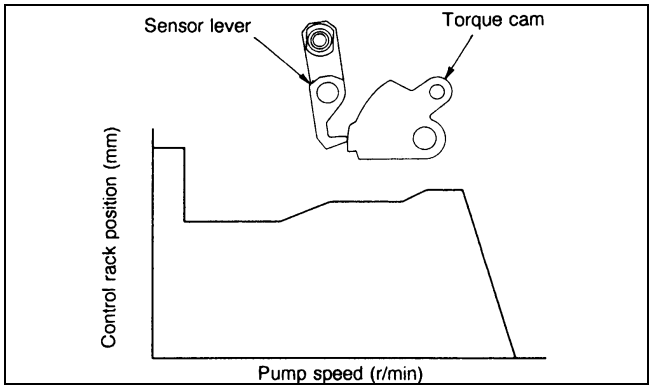


6E-38-1.tif

2. Set torque characteristics through internal torque cam

At full load, the tip of the sensor lever traces the face of the torque cam to determine the full load rack position and control the full load injection quantity.

Consequently, the torque characteristics demanded by the engine can be freely set by changing the shape of the torque cam face.

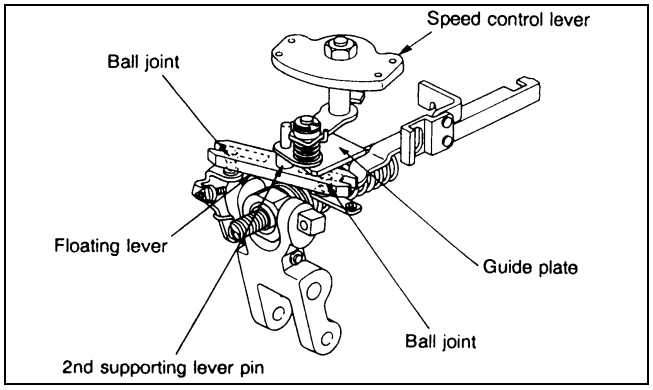


6E-38-1.tif

3. Improved control through internal guide plate

When the speed control lever is operated, the 2nd supporting lever's pin moves along the guide plate. The floating lever connected to the pin thus moves to change the ball joint fulcrum positions.

In the intermediate to high speed ranges, the guide plate causes the floating lever to move to increase the lever ratio continuously from 1.1 (idling) - 6 (full speed). This increase in the lever ratio in the intermediate to high speed range improves speed droop.



6E-38-1.tif

4. Timing Advance Control

Timing advance control is measuring the ECT to calculate drive current of the solenoid switch for the injection timing advance.

The injection timing is controlled by according to the ECT when engine is started.

5. Solenoid Switch

The solenoid switch is installed on the top of the injection pump to push the advance lever in the injection pump when 12 or 24 volts is supplied.

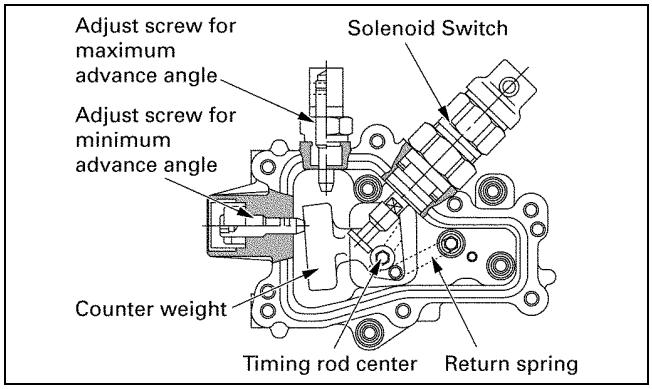
In this condition the injection timing is an additional.

10 degree (BTDC) from noamal injection timing.

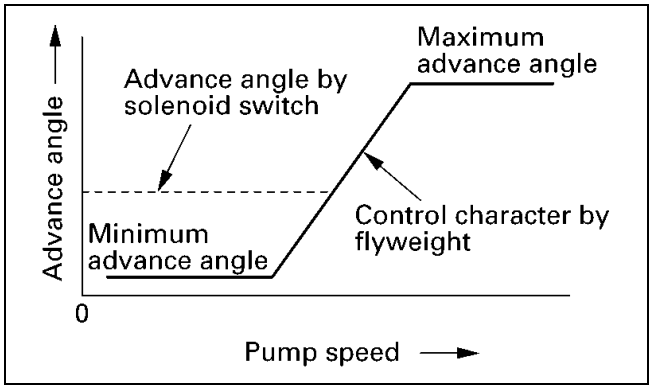
If there is some trouble for electricity current, it will set the DTC-P23 or P24.

Refer to the DTC chart.

If remove the solenoid switch, it can not be reinstalled because it is necesserry to readjust advance value on the injection pump tester.



040LY00001



040LY00002

EGR (Exhaust Gas Recirculation) SYSTEM

EGR Purpose

The exhaust gas recirculation (EGR) system is use to reduce emission levels of the oxdes of nitrogen (NOx). The NOx emission levels are caused by a high combustion temperrature. The EGR system lowers the NOx emission levels by decreasing the combustion temperature.

EGR control

The main element of the system is the EGR valve.

The EGR valve feeds small amounts of the exhaust gas back into the intake manifold.

The EGR valve is controlled by the ECM and the ECM uses information from the following sensors to control the EGR valve.

- Engine coolant temperature (ETC) sensor.
- Engine speed sensor.
- Rack sensor
- Exhaust brake switch condition.
- Atmospheric pressure sensor.

EGR valve Operation and Results of Incorrect Operation

The EGR valve is designed to accurately supply EGR to the engine independent of he intake manifold.

The EGR valve controls EGR flow from the exhaust manifold to the intake manifold through the VSV (Vacuum Switching Valve) with a ECM controlled EVRV (Electrical Variable Regulating Valve).

The ECM monitors related sensor or switch condition, if EVRV solenioid has incorrect operation, DTC P31 or P32 will be set.

If DTCs P13, P14, P21, P22,P35, P36, P45 or P61 are set, refer to the DTC charts.

Rack Sensor

The rack sensor is engaged with tip of injection pump rack.

The rack sensor signal will send during vehicle operating to the ECM, the ECM calculate together with other sensor's signal, the ECM output activation signal for EVRV.

Atmospheric Pressure Sensor

The atmospheric pressure censor is built-in the ECM.

The EVRV activity will be stopped, when the atmospheric pressure will comes below the setting pressure.

Exhaust Brake Switch

The exhaust brake switch is equipped on the steering column.

The exhaust brake switch is controlled by vehicle operator, when during the vehicle operating the vehicle operator will demand to apply the exhaust brake for assist the main brake system.

EGR quick cut control

During the VSV action, when the EVRV drive current will comes over the setting valve (the drive current will decide relation of the engine load and speed) immediate stop the VSV.

Result of this action will reduce the PM (Particulate Mater).

EVRV control

The EGR is controlled under normal temperture with separate stage by the ECT of engine condition.

ECM refer to EGR action map to demand the EVRV drive current, also ECM controls agree EVRV drive current and EVRV actual drive current each other .

Otherwise the ECM transitional stage controls for current of EVRV when EGR is controlled moving OFF area to ON area on the EGR action map.

Also stop the EVRV drive for stop the EGR system under following conditions.

When under low temperature of the ECT.

When acting the QWS system.

When acting the exhaust brake

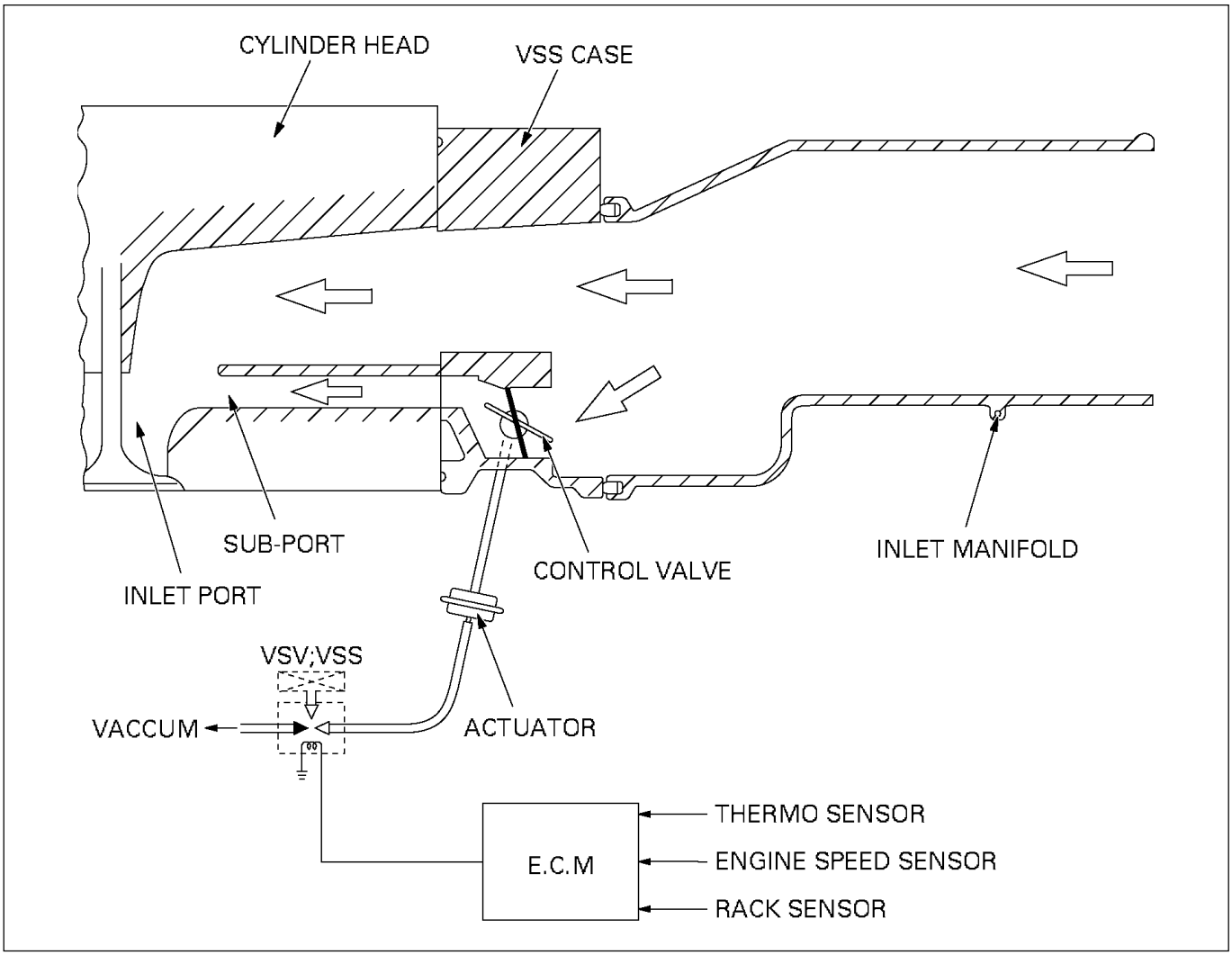
When the atomspheric pressure comes under setting the pressure valve.

VSS (Variable Swirl System)

The Variable Swirl System (VSS) is designed to adjust the intensity of swirl by allowing or not allowing air to flow through a sub-port (or bypass) the runs in parallel with the intake port for each cylinder. The swirl intensifies when there is no air flow through the sub-port, and vice versa.

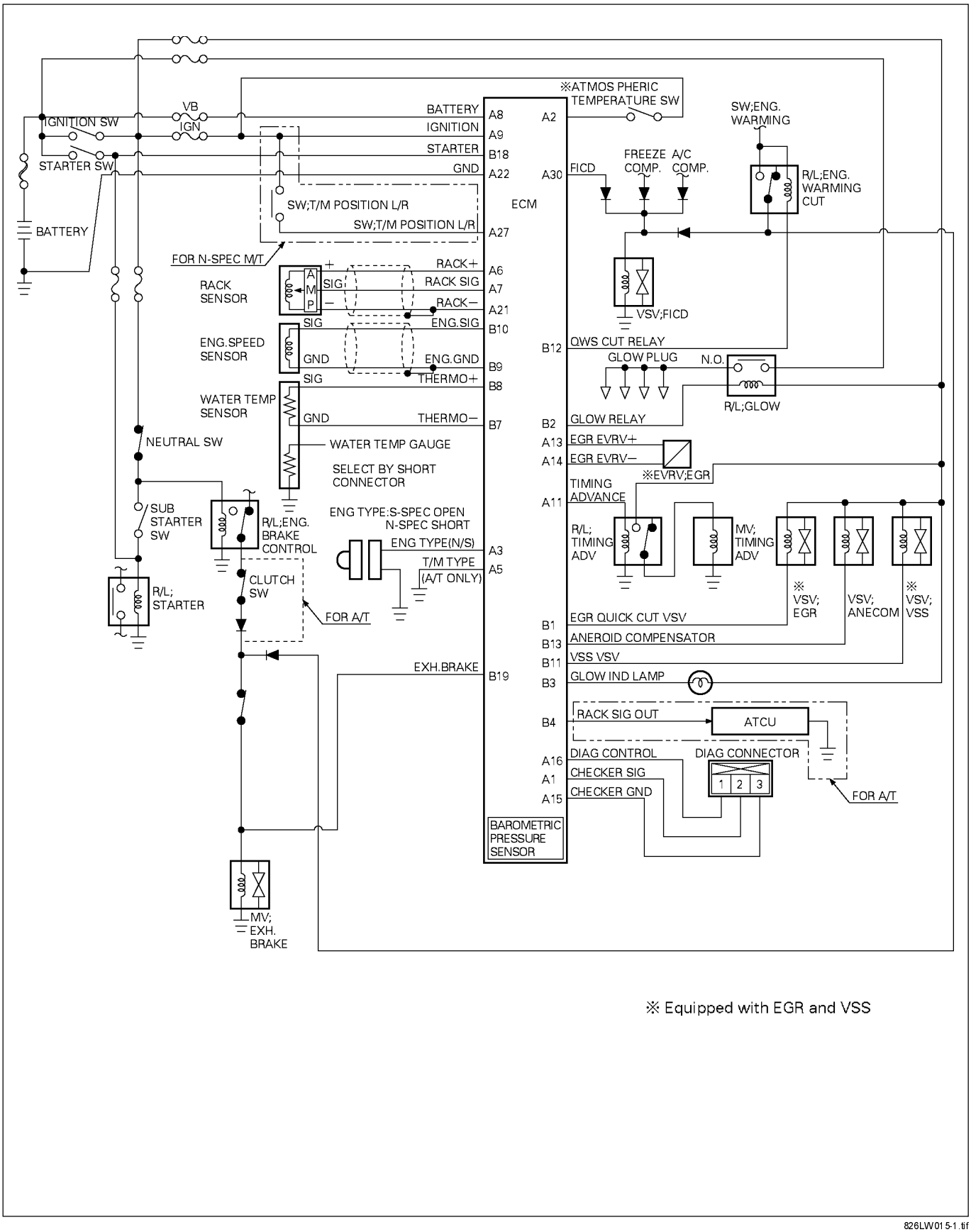
The air flow is controlled by the on-off valve at the inlet to the sub-port and the valve in turn is turned on and off by computer signals which are dependent on engine speed, load and coolant temperature. Basically, the air is cut off at low speeds to maintain high swirl and is allowed to flow at high speeds to maintain low swirl.

VARIABLE SWIRL SYSTEM (Equipped with EGR and VSS)



028LW001.tif

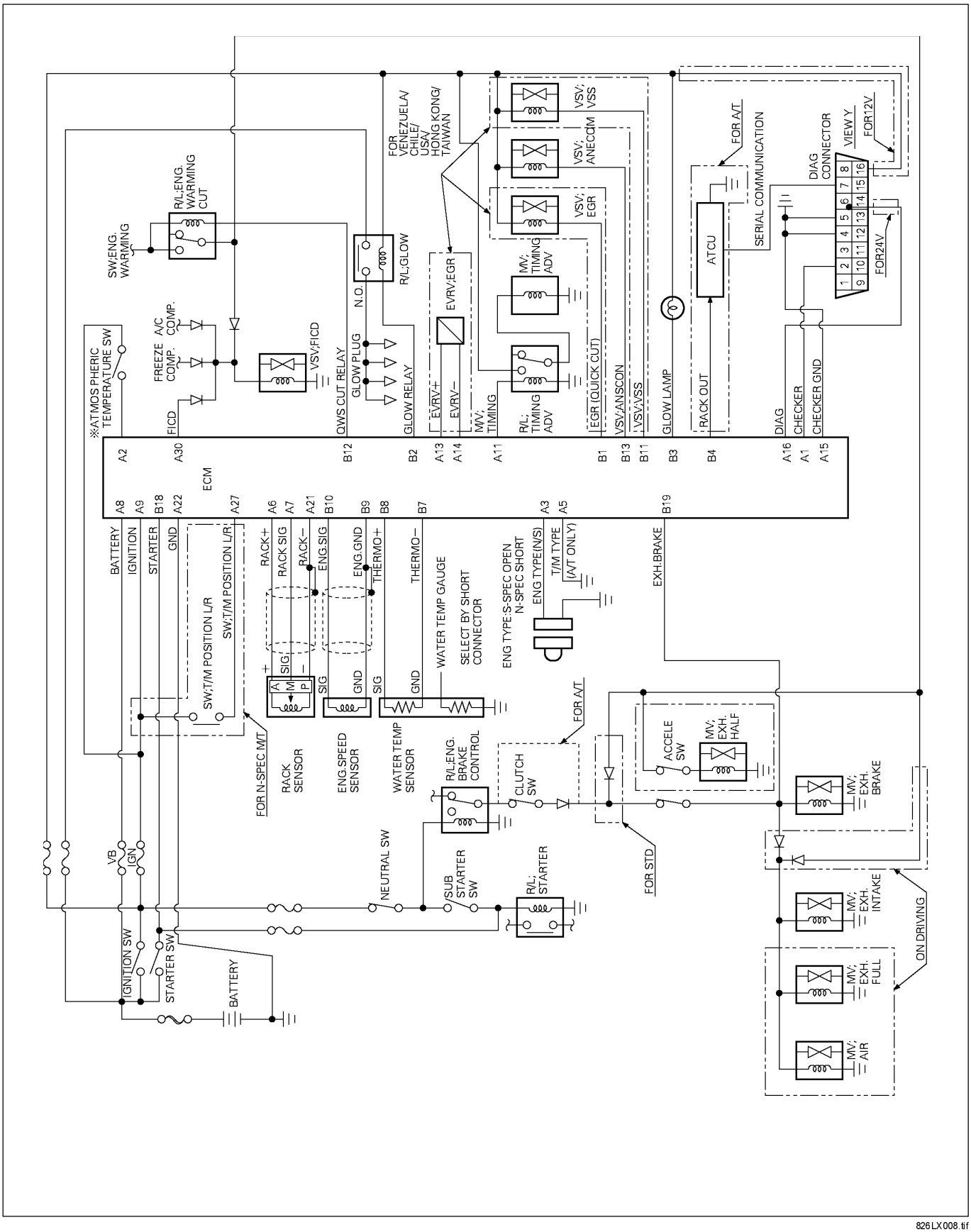
ENGINE CONTROL MODULE (ECM) SYSTEM WIRING DIAGRAM (Until Model Year 1998)



※ Equipped with EGR and VSS

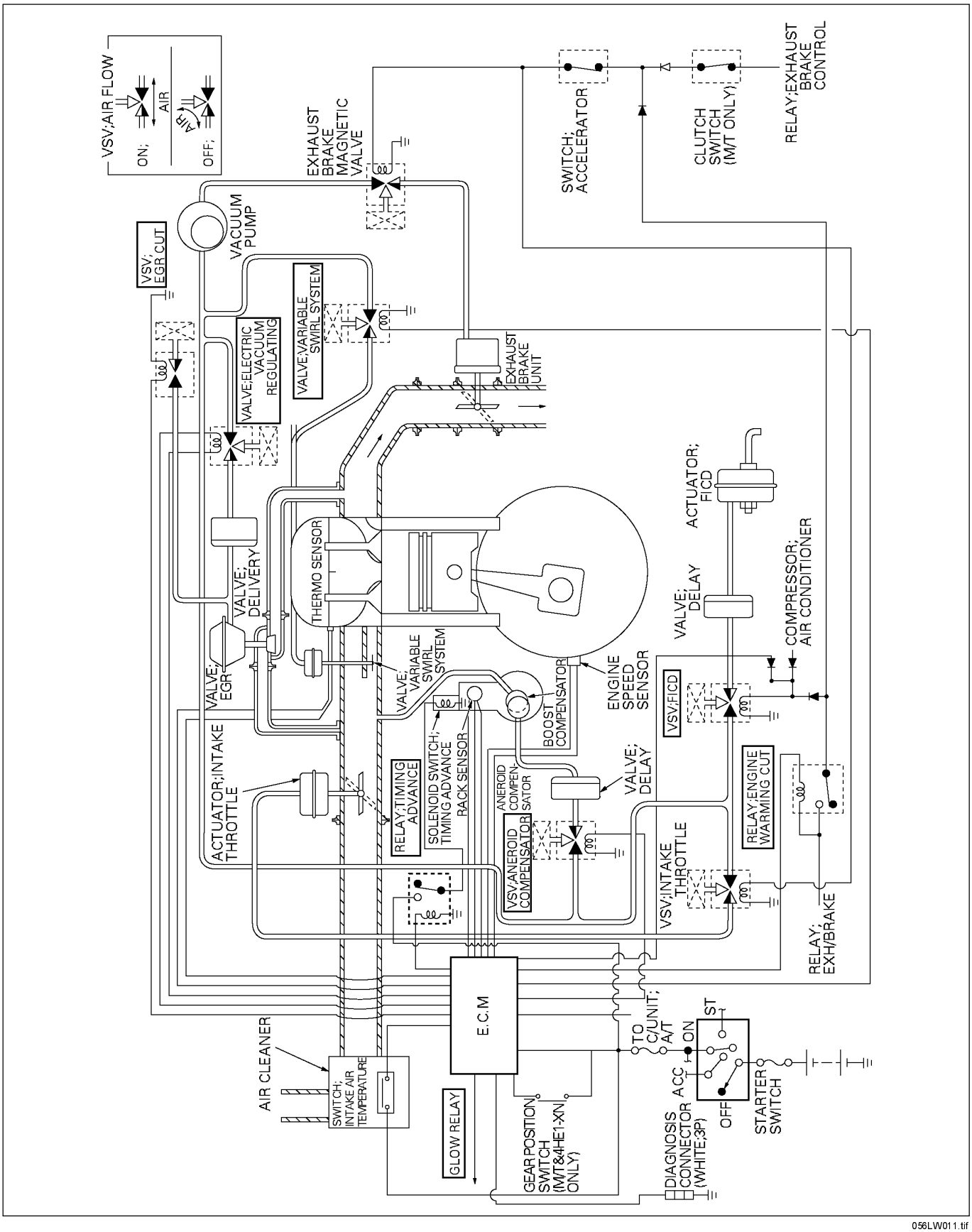
826LW015-1.tif

ENGINE CONTROL MODULE (ECM) SYSTEM WIRING DIAGRAM (From Model Year 1999)



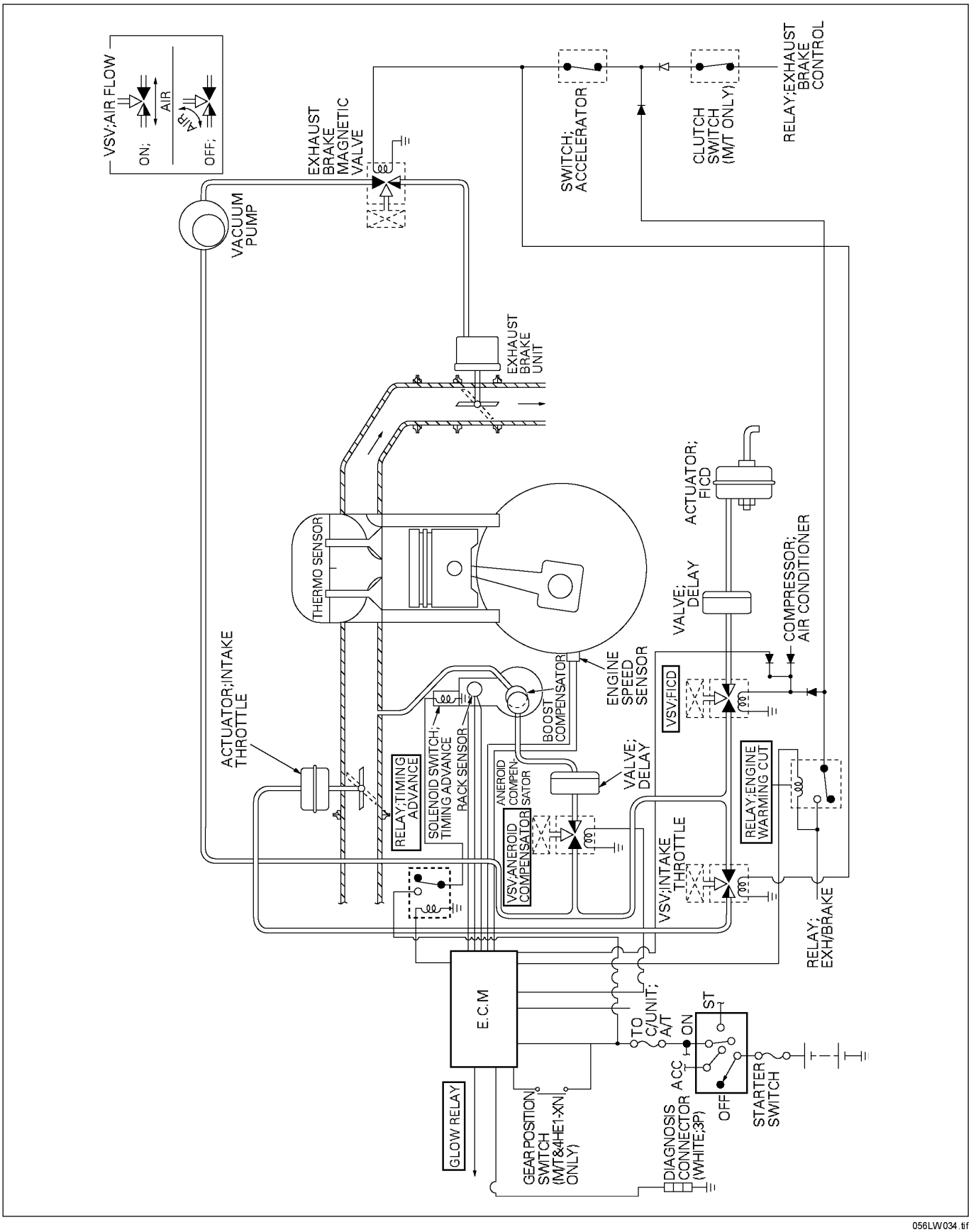
826LX008.tif

AUXILIARY ENGINE CONTROL SYSTEM
(Equipped with Exhaust Gas Recirculation and Variable Swirl System)



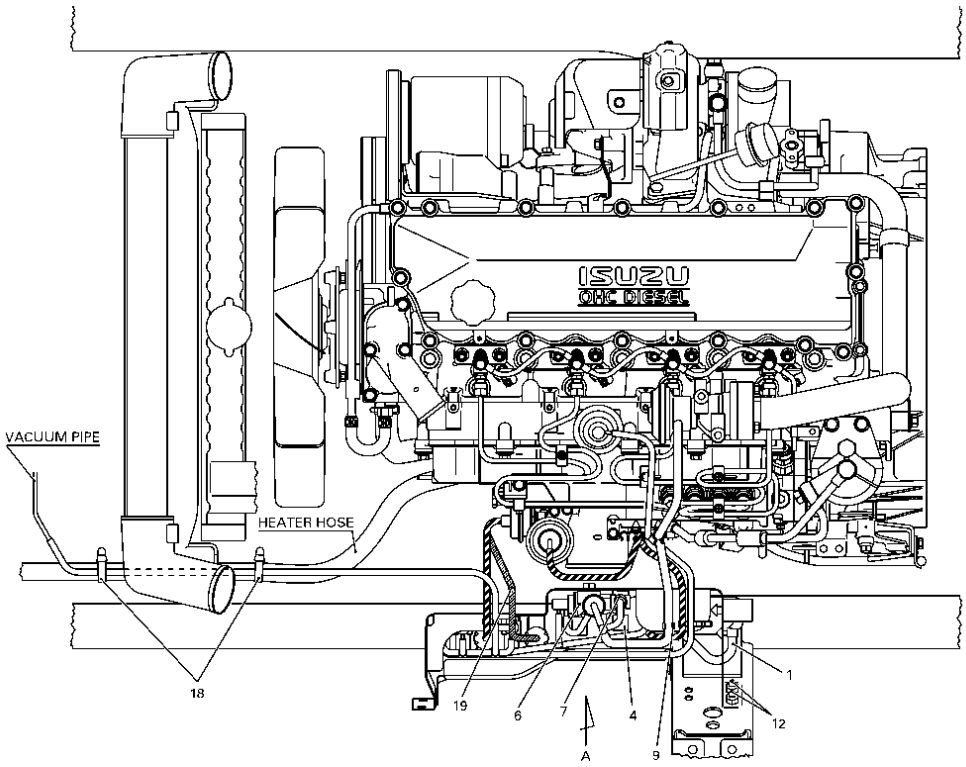
056LW011.tif

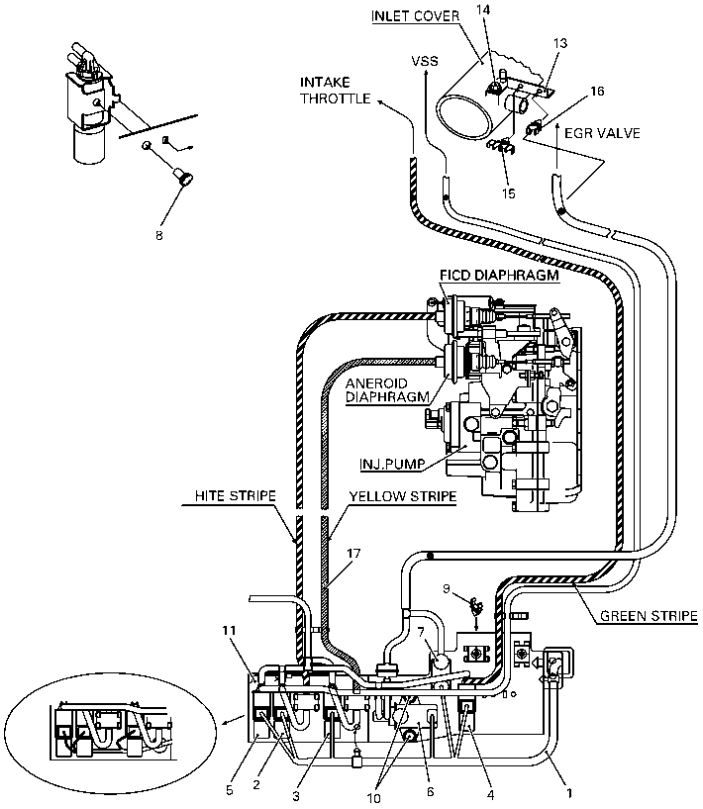
AUXILIARY ENGINE CONTROL SYSTEM
(Equipped without Exhaust Gas Recirculation and Variable Swirl System)



056LW034.tif

VACUUM SWITCHING VALVE (VSV) CIRCUIT
(Equipped with Exhaust Gas Recirculation and Variable Swirl System)

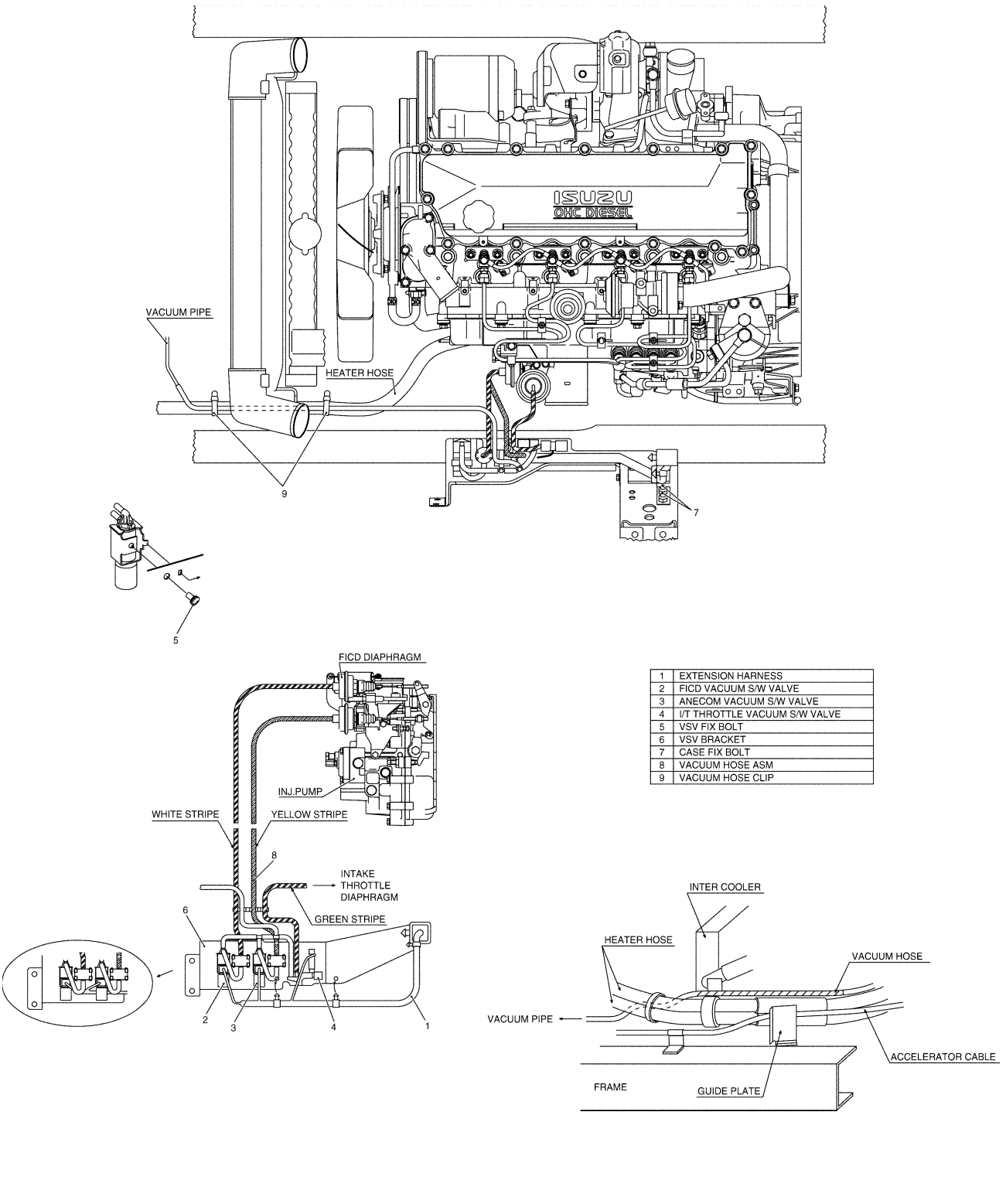




1	EXTENSION HARNESS
2	FICD VACUUM S/W VALVE
3	ANECOM VACUUM S/W VALVE
4	I/T THROTTLE VACUUM S/W VALVE
5	VSS VACUUM S/W VALVE
6	E/VACUUM REGULATING VALVE
7	EGR CUT VACUUM S/W VALVE
8	VSV FIX BOLT
9	EGR HOSE,INJ PUMP CLIP
10	VALVE FIX BOLT
11	VSV BRACKET
12	CASE FIX BOLT
13	RUBBER HOSE BRACKET
14	BRACKET FIX BOLT
15	VSS HOSE,I J PIPE CLIP
16	EGR HOSE,INJ PIPE CLIP
17	VACUUM HOSE ASM
18	VACUUM HOSE CLIP

028LW002.tif

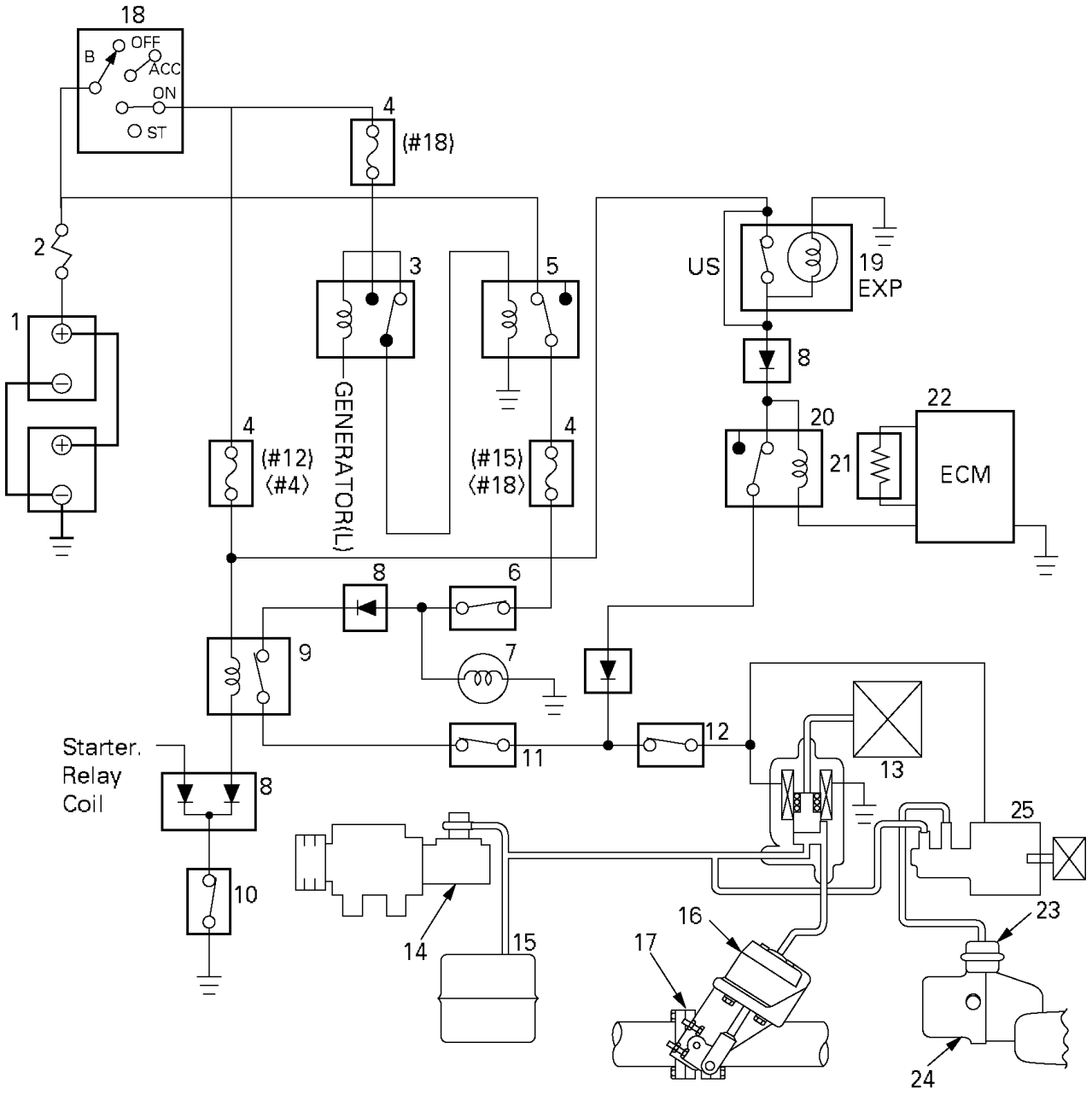
VACUUM SWITCHING VALVE (VSV) CIRCUIT
(Equipped without Exhaust Gas Recirculation and Variable Swirl System)



1	EXTENSION HARNESS
2	FICD VACUUM S/W VALVE
3	ANECOM VACUUM S/W VALVE
4	I/T THROTTLE VACUUM S/W VALVE
5	VSV FIX BOLT
6	VSV BRACKET
7	CASE FIX BOLT
8	VACUUM HOSE ASM
9	VACUUM HOSE CLIP

028LW003.tif

EXHAUST BRAKE AND ENGINE WARM-UP CONTROL

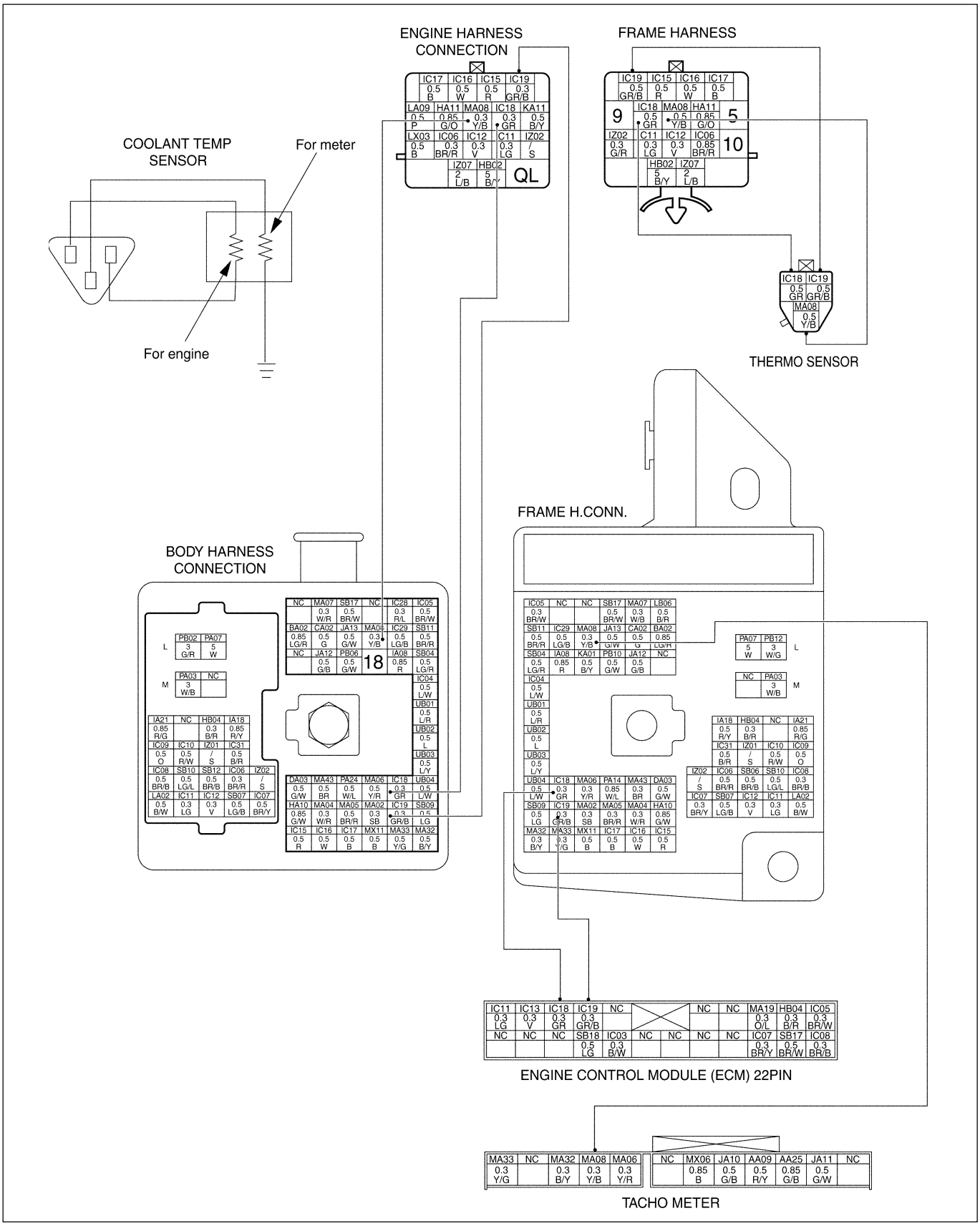


1. Batteries
2. Fusible Link Wire
3. Charge Relay
4. Fuse
5. Exhaust Brake Relay
6. Exhaust Brake Switch
7. Indicator Light
8. Diode
9. Exhaust Brake Control Relay
10. Neutral Switch (M/T)
    Inhibitor Switch (A/T)
11. Clutch Switch (M/T only)
12. Accelerator Switch
13. Magnetic Valve: Exhaust Brake
14. Vacuum Pump
15. Vacuum Tank
16. Vacuum Chamber: Exhaust Brake
17. Exhaust Brake Valve
18. Key Switch
19. Engine Warming-up Switch
20. Engine Warming Cut Relay
21. Engine Coolant Temperature Sensor
22. ECM
23. Vacuum Chamber: Intake Throttle
24. Intake throttle
25. Magnetic Valve Intake Throttle

A/T: Automatic Transmission
M/T: Manual Transmission

052LW001.tif

DTC-P13 ENGINE COOLANT TEMPERATUR (ECT) SENSOR CIRCUIT HIGH VOLTAGE



065LW038.tif

Appearance of water temperature sensor and connector pin assignment.

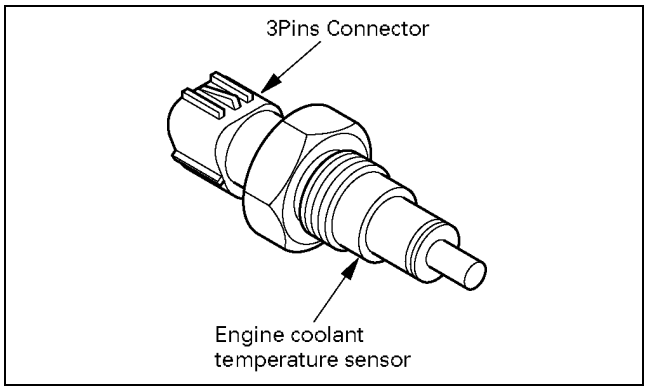


Figure. Temperature sensor 056LW017.tif

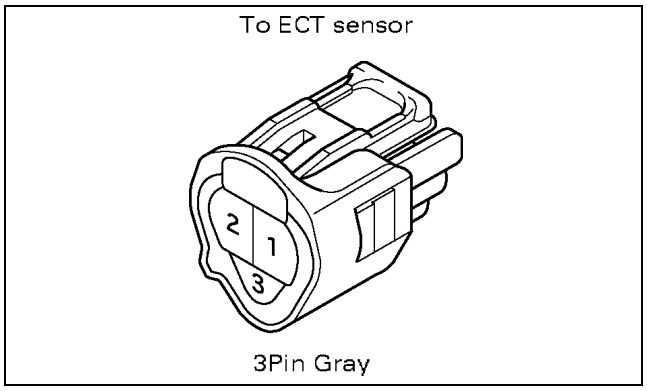
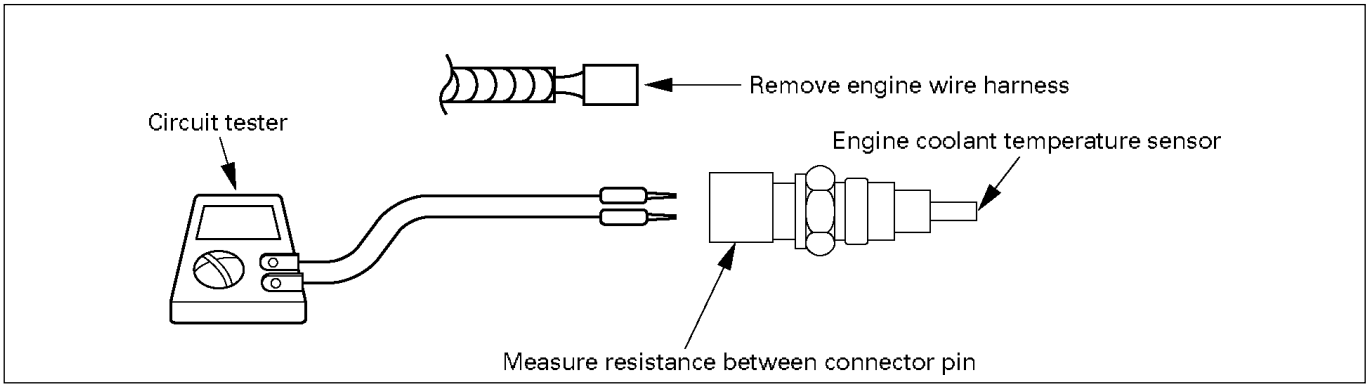


Figure. Connector pin assignment 056LW012.tif

Connector No	Signal
1	Thermistor for engine
2	Thermistor for engine
3	Thermistor for meter

Measure resistance at Engine Coolant Temperature (ECT) sensor



056LW023.tif

CAUTION:
When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

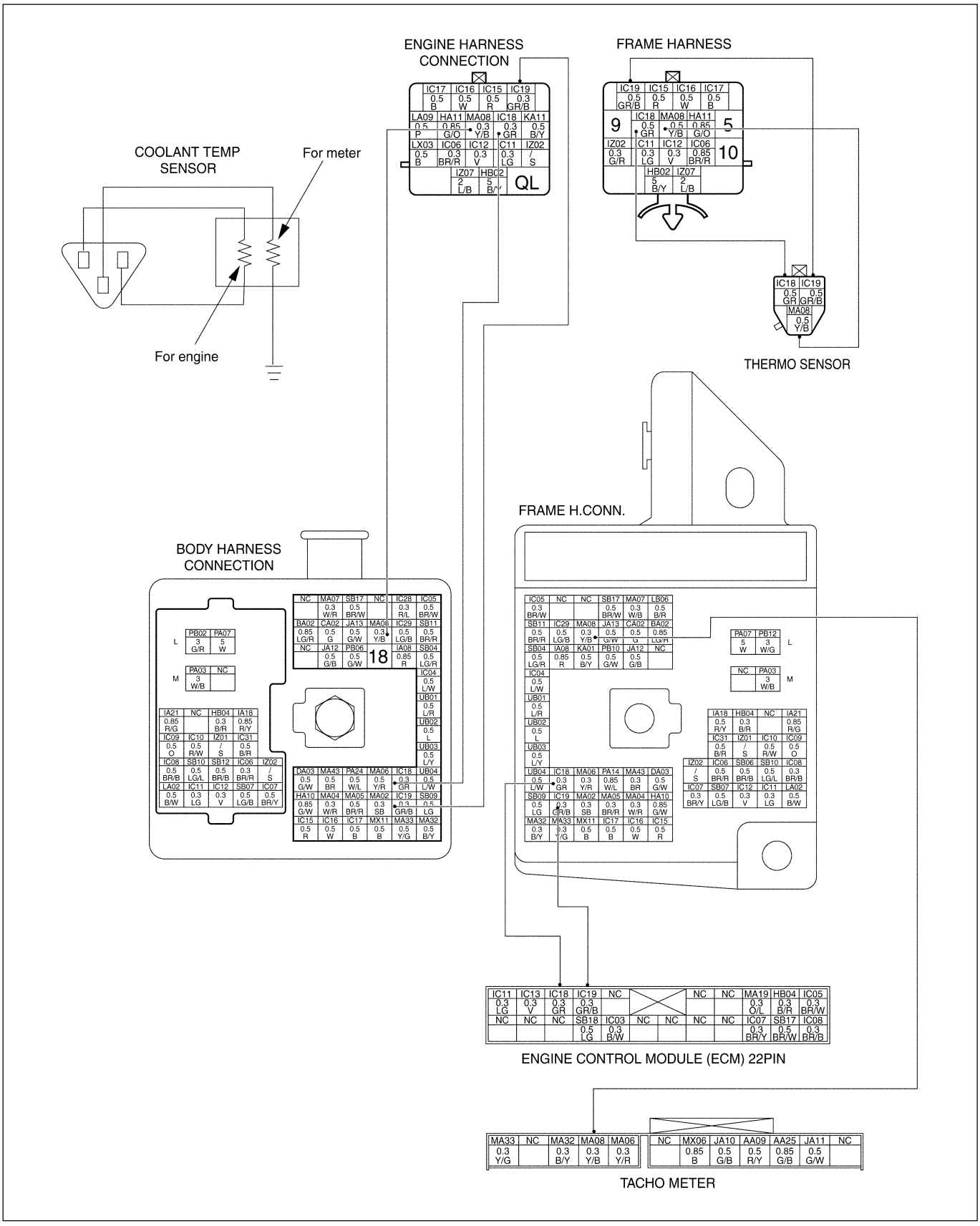
Resistance value

Inspection Point		Resistance Value	Temperature on sensor	Reference
Connector	Pin No.			
3 pin Black	1 ←→ 3	∞	-	Thermistor for ENGINE ←→ Thermistor for meter
	1 ←→ 2	2.5 (kΩ)	20 (°C)	Thermistor for ENGINE
		247 (Ω)	90 (°C)	
	1 ←→ Body	∞	-	Thermistor for ENGINE ←→ Body
	2 ←→ 3	∞	-	Thermistor for ENGINE ←→ Thermistor for meter
	3 ←→ Body	146.6 (Ω)	60 (°C)	Thermistor for meter ENGINE
	2 ←→ Body	∞	-	Thermistor for ECM ←→ Body

Note: Resistance value is difference according to the temperature of temperature sensor.

Step	Action	Value (s)	Yes	No
1	Was the “on-board diagnostic (OBD) system check” performed?	-	Go to Step 2	Go to self diag system check
2	1. Ignition “OFF” 2. Disconnect ECT sensor electrical connector. 3. Jumper the ECT sensor signal circuit and the ECT sensor ground circuit together at the ECT sensor harness connector. 4. Observe the “Engine cool temp” display on the scan tool. Is the “Engine cool temp” at the specified value?	248°F (120°C)	Go to Step 4	Go to Step 3
3	1. Ignition “OFF” 2. Jumper the ECT signal circuit at the ECT sensor harness connector to chassis ground. 3. Observe the “Engine cool temp” display on the scan tool. Is the “Engine cool temp” at the specified value?	248°F (120°C)	Go to Step 5	Go to Step 6
4	Check for poor connection at the ECT sensor and replace terminals if necessary. Did any terminals require replacement?	-	Go to Step 8	Go to Step 10
5	1. Ignition “OFF”. 2. Disconnect the ECM, and check the ECT sensor ground circuit for an open. 3. If the ECT sensor ground circuit is open, repair it as necessary. Was the ECT sensor ground circuit open?	-	Go to Step 7	Go to Step 10
6	1. Ignition “OFF”. 2. Disconnect the ECM, and check the ECT sensor signal circuit for an open. 3. If the ECT signal circuit is open, repair it as necessary. Was the ECT sensor signal circuit open?	-	Go to Step 7	Go to Step 10
7	Check for poor sensor ground or ECT sensor signal circuit terminal connection at the ECU and replace terminal(s) if necessary. Did any of the terminals need to be replaced?	-	Go to Step 9	Go to Step 10
8	1. Ignition “OFF” 2. Replace the ECT Sensor. Is the action complete?	-	Go to Step 10	-
9	1. Replace the ECM. Is the action complete?	-	Go to Step 10	-
10	1. Reconnect all the connectors removed. 2. Ignition “ON”, Engine “OFF” Is DTC 13 all right under Scan Tool Check?	-	Go to Step 11	Go to Step 2
11	Is any current trouble other than DTC 13 displayed by scan tool?	-	Go to trouble code section	Trouble code clear

DTC-P14 ENGINE COOLANT TEMPERATURE (ECT) SENSOR CIRCUIT LOW VOLTAGE



065LW038.tif

Appearance of water temperature sensor and connector pin assignment.

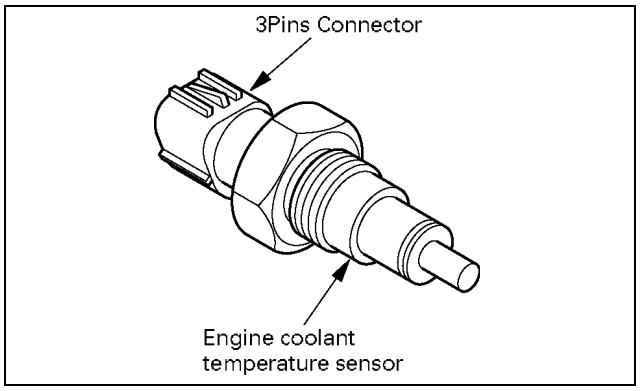


Figure. Temperature sensor 056LW017.tif

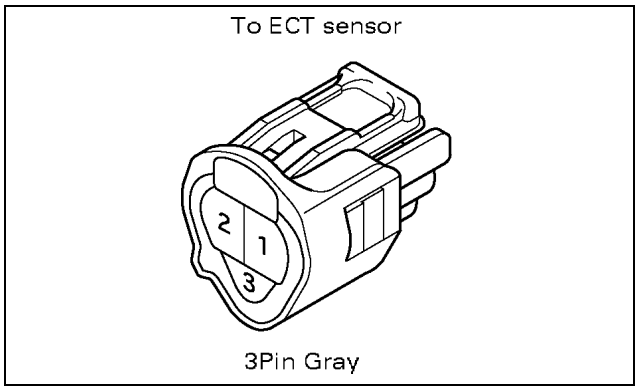
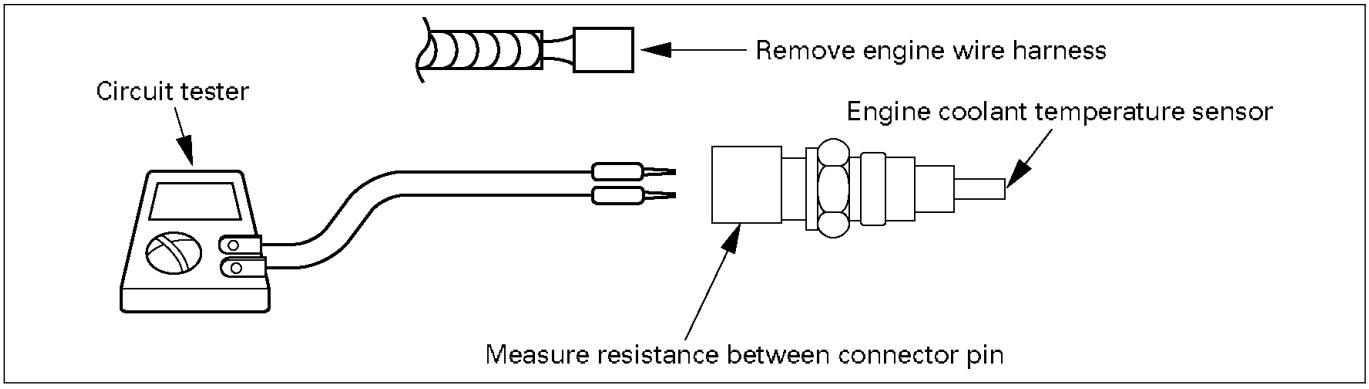


Figure. Connector pin assignment 056LW012.tif

Connector No	Signal
1	Thermistor for engine
2	Thermistor for engine
3	Thermistor for meter

Measure resistance at Engine Coolant Temperature (ECT) sensor



056LW023.tif

CAUTION:
When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

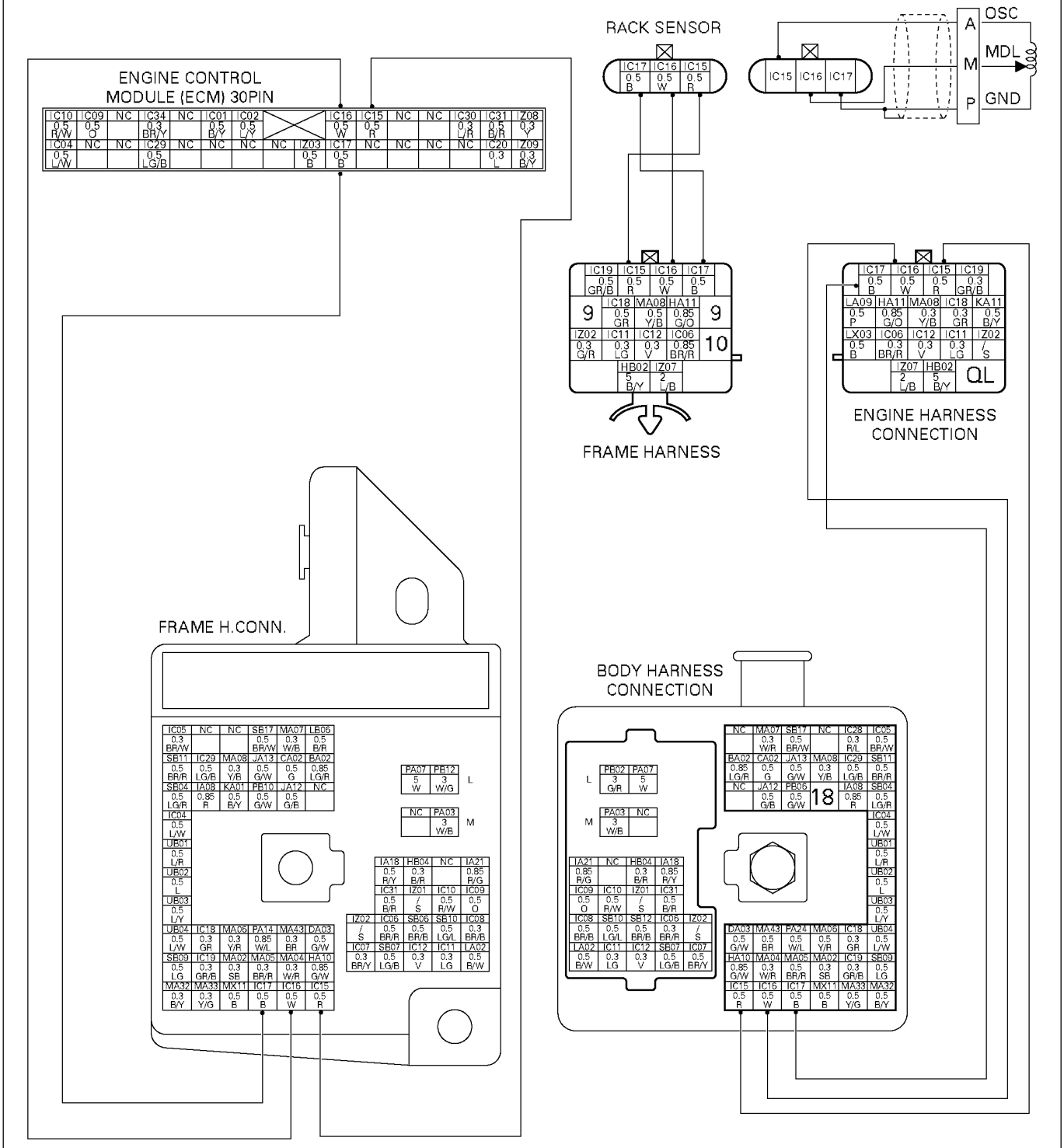
Resistance value

Inspection Point		Resistance Value	Temperature on sensor	Reference
Connector	Pin No.			
3 pin Black	1 ←→ 3	∞	-	Thermistor for ENGINE ←→ Thermistor for meter
	1 ←→ 2	2.5 (kΩ)	20 (°C)	Thermistor for ENGINE
		247 (Ω)	90 (°C)	
	2 ←→ Body	∞	-	Thermistor for ENGINE ←→ Body
	2 ←→ 3	∞	-	Thermistor for ENGINE ←→ Thermistor for meter
	3 ←→ Body	146.6 (Ω)	60 (°C)	Thermistor for meter ENGINE
	2 ←→ Body	∞	-	Thermistor for ECM ←→ Body

Note: Resistance value is difference according to the temperature of temperature sensor.

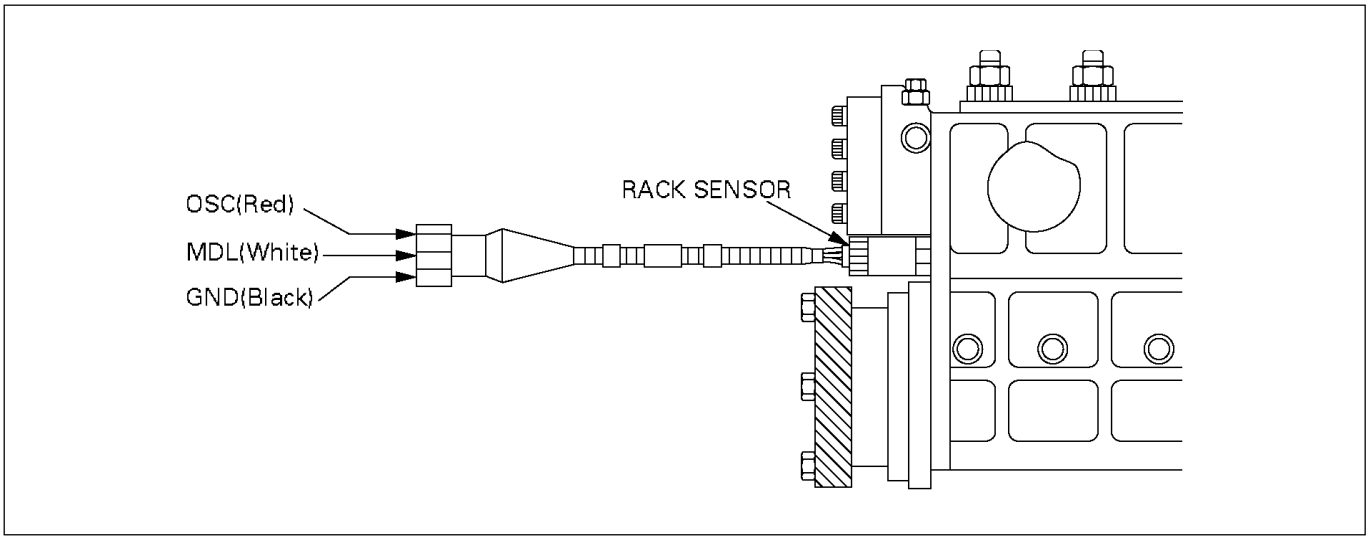
Step	Action	Value (s)	Yes	No
1	Was the “on-board diagnostic (OBD) system check” performed?	-	Go to Step 2	Go to self diag system check
2	1. Ignition “OFF” 2. Disconnect the ECT sensor. 3. Ignition “ON”, Engine “OFF” 4. See scan Tool Display and Ignore trouble code 13. 5. Does code 14 still remain faulty?	-	Go to Step 3	Go to Step 6
3	1. Ignition “OFF” 2. Check Connector ECT Sensor Harness for interterminal short. 3. Repair if necessary. Was ECT Sensor connector shorted?	-	Go to Step 4	Go to Step 8
4	1. Ignition “OFF” 2. Check the ECM connector terminal short? 3. Repair if necessary. Was ECM terminal shorted?	-	Go to Step 5	Go to Step 8
5	1. Disconnect the ECM. 2. Check if ECT sensor signal circuit for a short to ground or a short to ground circuit. 3. Repair if necessary. Is ECT sensor signal circuit shorted to ground.	-	Go to Step 7	Go to Step 8
6	1. Ignition “OFF” 2. Replace the ECT Sensor. Is the action complete?	-	Go to Step 8	-
7	1. Replace the ECM. Is the action complete?	-	Go to Step 8	-
8	1. Reconnect all the connectors removed. 2. Ignition “ON”, Engine “OFF” Is DTC 14 all right under Scan Tool Check?	-	Go to Step 9	Go to Step 2
9	Is any current trouble other than DTC 14 displayed by scan tool?	-	Go to trouble code section	Trouble code clear

DTC-P21 RACK SENSOR CIRCUIT LOW VOLTAGE



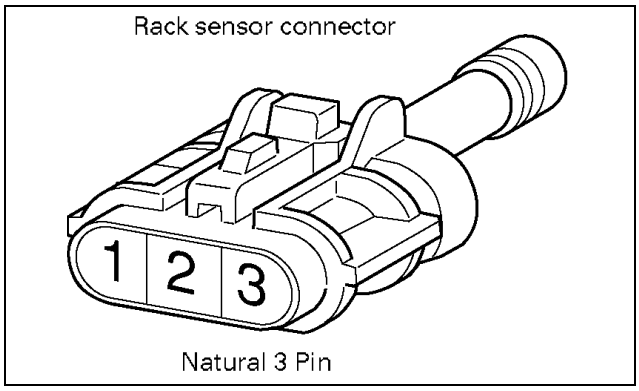
065LW037.tif

Location of Rack sensor connector



040LW032.tif

Connector name of Rack sensor



065LW001.tif

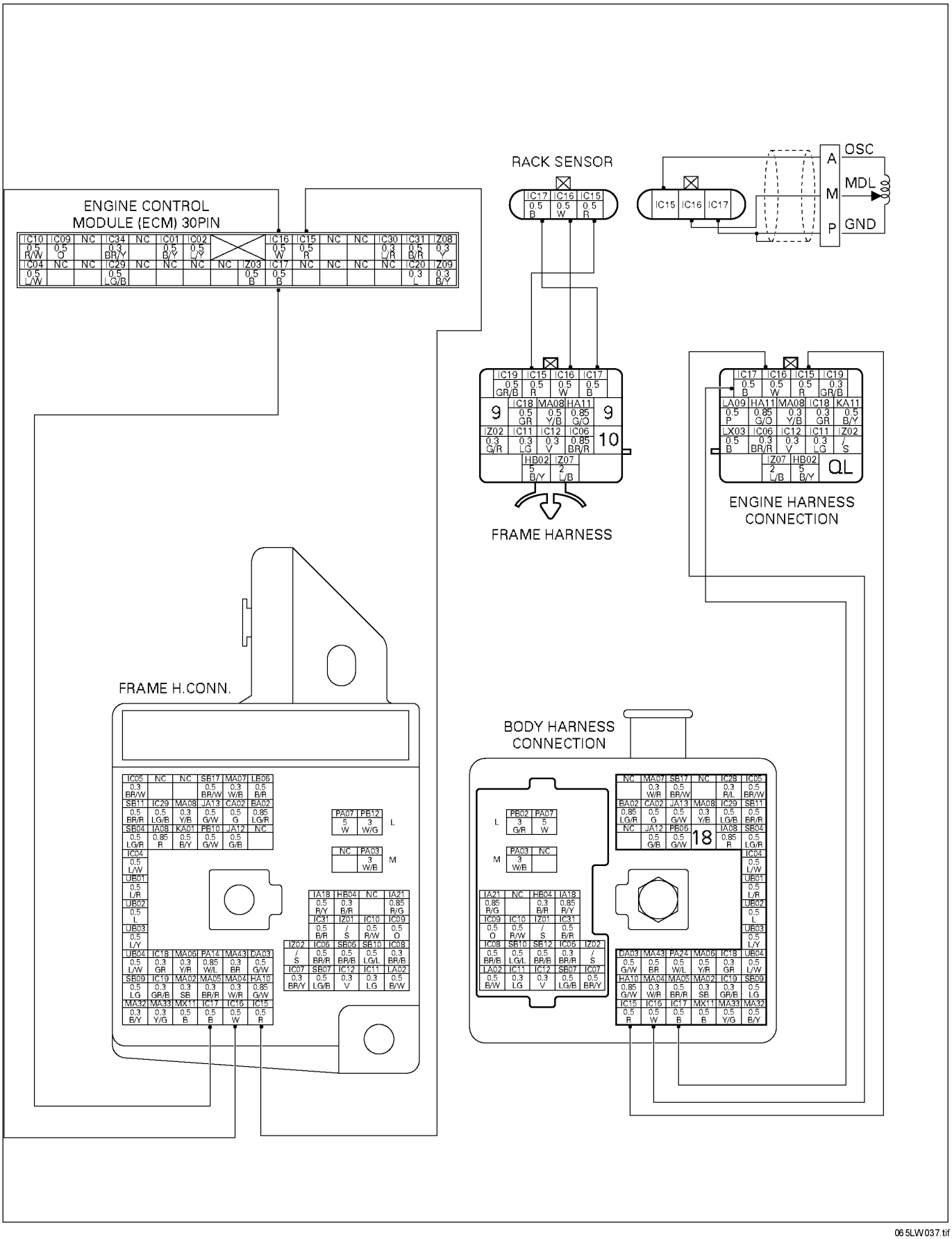
NOTE: Mark "___" on connector which is plugged, therefore, should be confirmed to be played.

Relation between connector number and signal name

Connector No.	Signal name	Wire color
1	Rack sensor (OSC)	R
2	Rack sensor (MDL)	W
3	Rack sensor (GND)	B

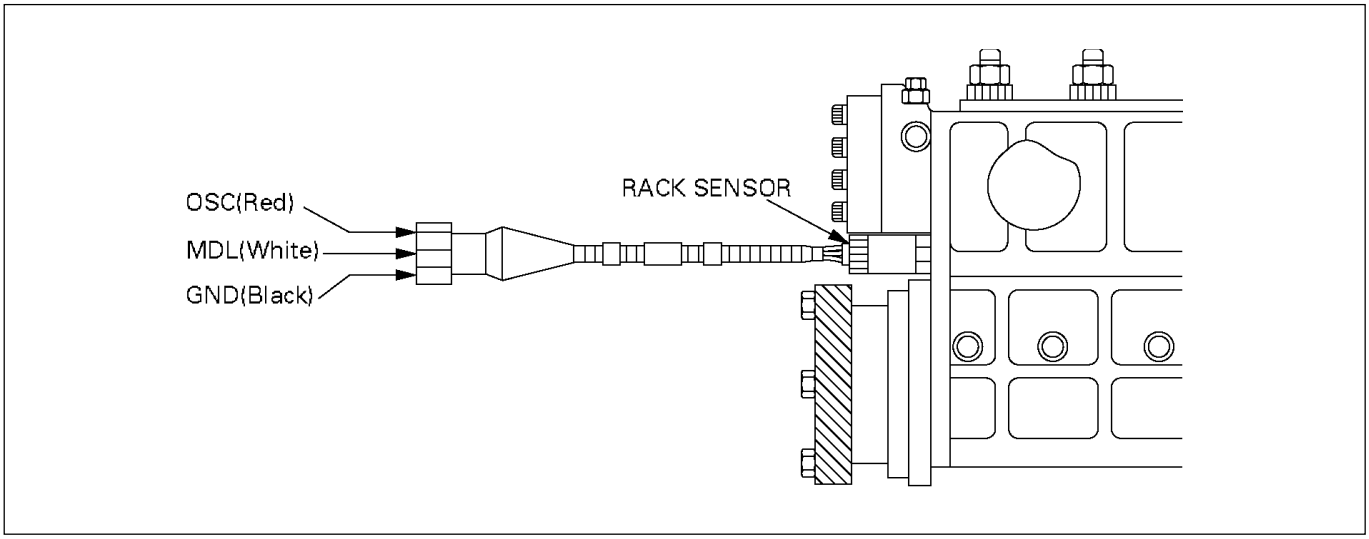
Step	Action	Value (s)	Yes	No
1	Was the “on-board diagnostic (OBD) system check” performed?	-	Go to Step 2	Go to self diag system check
2	1. Check harness side power source circuit and signal circuit for GND short. 2. Repair if necessary. 3. Has DTC21 been corrected?	-	Go to Step 10	Go to Step 3
3	Disconnect Sensor Connector. Jumper RACK+ and RACK sig. Free from trouble now? Ignore code 22.	-	Go to Step 4	Go to Step 6
4	1. Apply 5V to RACK+ TERMINAL. Measure RACK SIG Voltage. Is RACK SIG VOLTAGE as specified?	0.9-2.0V (Idling speed)	Go to Step 7	Go to Step 5
5	1. Check Rack Sensor Harness Signal Circuit and power source for GND short. Check signal circuit for disconnect. 2. Repair if necessary. 3. Free from trouble now?	-	Go to Step 10	Go to Step 7
6	1. Check harness signal circuit and power source circuit for disconnect. 2. Repair if necessary. 3. Free from trouble now?	-	Go to Step 10	Go to Step 8
7	1. Check the iron core of RACK Sensor for damage, seizure, and wear. 2. After check, repair if necessary. Was there any trouble in the iron core (RACK end) inside RACK Sensor?	-	Go to Step 10	Go to Step 9
8	Replaced RACK Sensor?	-	Go to Step 10	-
9	1. Replace the ECM. Is the action complete?	-	Go to Step 10	-
10	1. Reconnect all the connectors removed. 2. Ignition -ON+, Engine “OFF” Is DTC 21 all right under Scan Tool Check?	-	Go to Step 10	Go to Step 2
11	Is any current trouble other than DTC 21 displayed by scan tool?	-	Go to trouble code section	Trouble code clear

DTC-P22 RACK SENSOR CIRCUIT HIGH VOLTAGE



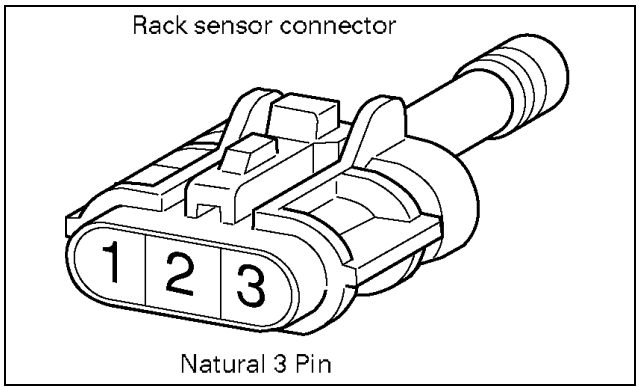
065LW037.tif

Location of Rack sensor connector



040LW032.tif

Connector name of Rack sensor



065LW001.tif

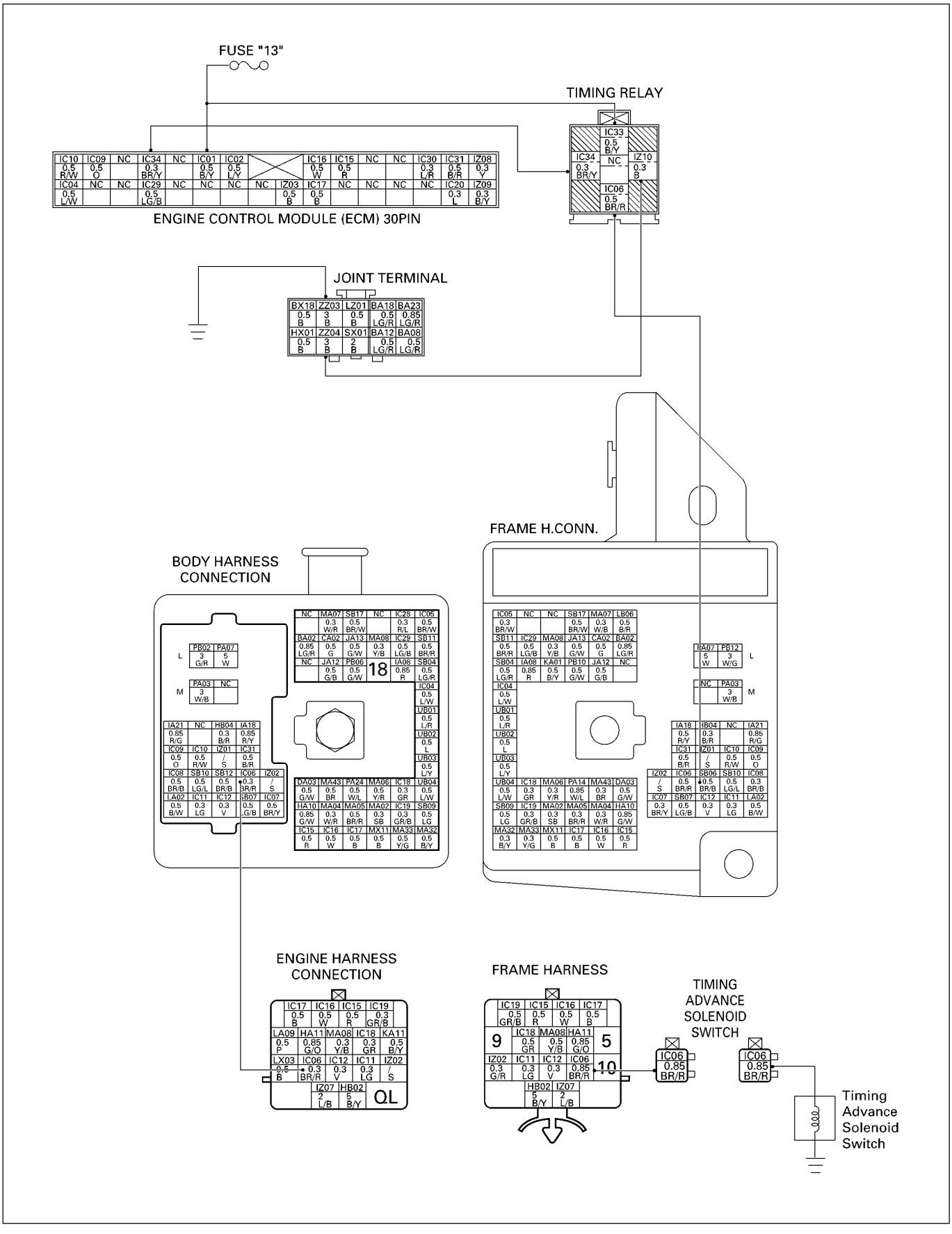
NOTE: Mark "___" on connector which is plugged, therefore, should be confirmed to be played.

Relation between connector number and signal name

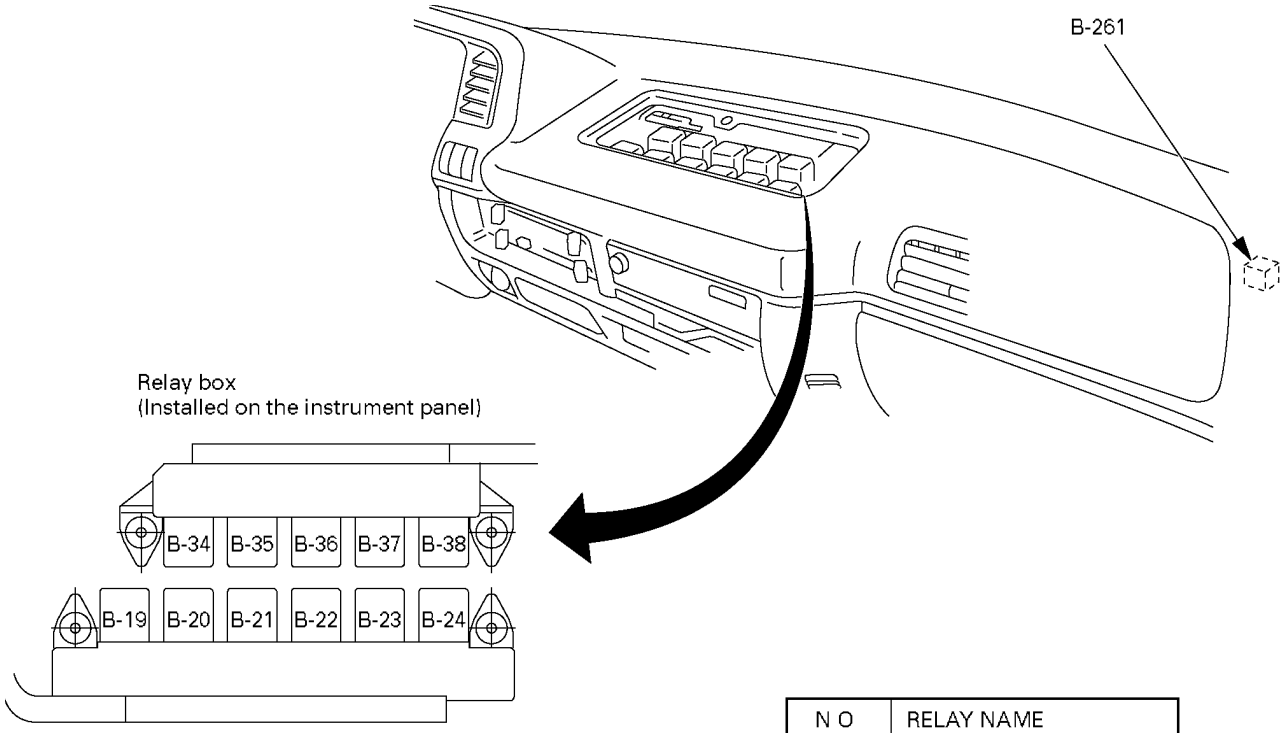
Connector No.	Signal name	Wire color
1	Rack sensor (OSC)	R
2	Rack sensor (MDL)	W
3	Rack sensor (GND)	B

Step	Action	Value (s)	Yes	No
1	Was the “on-board diagnostic (OBD) system check” performed?	-	Go to Step 2	Go to self diag system check
2	Remove Sensor Connector. Has DTC22 been corrected? (Ignore DTC21)	-	Go to Step 3	Go to Step 7
3	1. Jump between Harness signal Terminal and GND terminal at the Sensor side of Connector. 2. Ignition “ON” Has DTC22 been corrected?	-	Go to Step 4	Go to Step 5
4	1. Check Sensor Connector for inter terminal short. After check, repair if necessary. Was Connector Terminal shorted?	-	Go to Step 12	Go to Step 6
5	1. Check GND Circuit for disconnect. After check, repair if necessary. Is GND circuit disconnect?	-	Go to Step 12	Go to Step 11
6	1. Check Sensor Harness signal circuit and power source circuit for short. After check, repair if necessary. Was Harness shorted?	-	Go to Step 12	Go to Step 8
7	1. Check Harness signal circuit and power source for short. After check, repair if necessary. Was Harness shorted?	-	Go to Step 12	Go to Step 11
8	1. Apply 5V to RACK+ TERMINAL. 2. Measure RACK SIG Voltage. Is RACK SIG VOLTAGE as specified?	0.9-2.0V (Idling speed)	Go to Step 9	Go to Step 10
9	1. Check the iron core of RACK Sensor for damage, seizure, and wear. 2. After check, repair if necessary. Was there any trouble in the iron core(RACK end) inside RACK Sensor?	-	Go to Step 12	Go to Step 11
10	Replaced sensor. Was Sensor replaced?	-	Go to Step 12	-
11	Replace the ECM. Is the action complete?	-	Go to Step 12	-
12	1. Reconnect all the connectors removed. 2. Ignition “ON”, Engine “OFF” Is DTC22 all right under Scan Tool Check?	-	Go to Step 13	Go to Step 2
13	Is any current trouble other than DTC 22 displayed by scan tool?	-	Go to trouble code section	Trouble code clear

DTC-P23 SOLENOID SWITCH CONTROL CIRCUIT LOW VOLTAGE



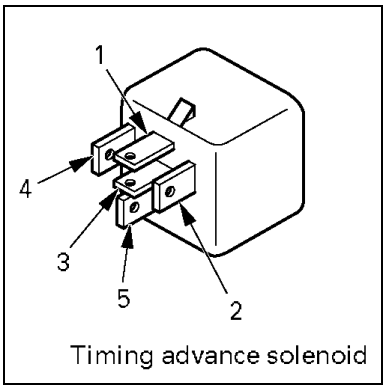
Location of relay



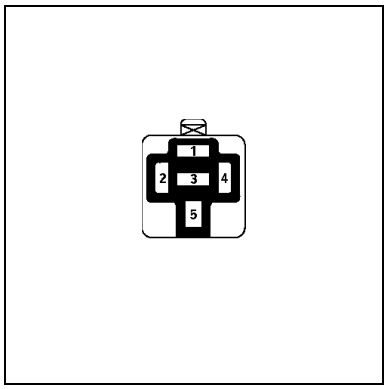
N O	RELAY NAME
B-19	CHARGE
B-20	HEAD LIGHT
B-21	HEATER & A/C
B-22	TAIL
B-23	DIMMER
B-24	HORN
B-34	BUZZER CANCEL
B-35	CORNERING LIGHT
B-36	POWER/WINDOW
B-37	A/C THERMO
B-38	EXH BRAKE
B-261	TIMING

056LW037.tif

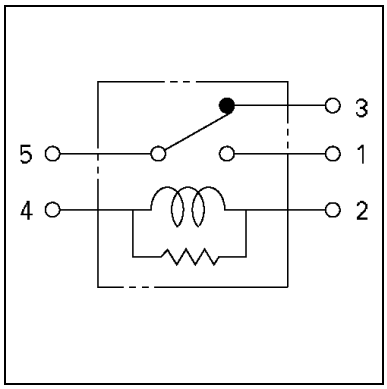
Inspection for Timing Advance Solenoid Switch cut relay



056LW019.tif



5-12.tif



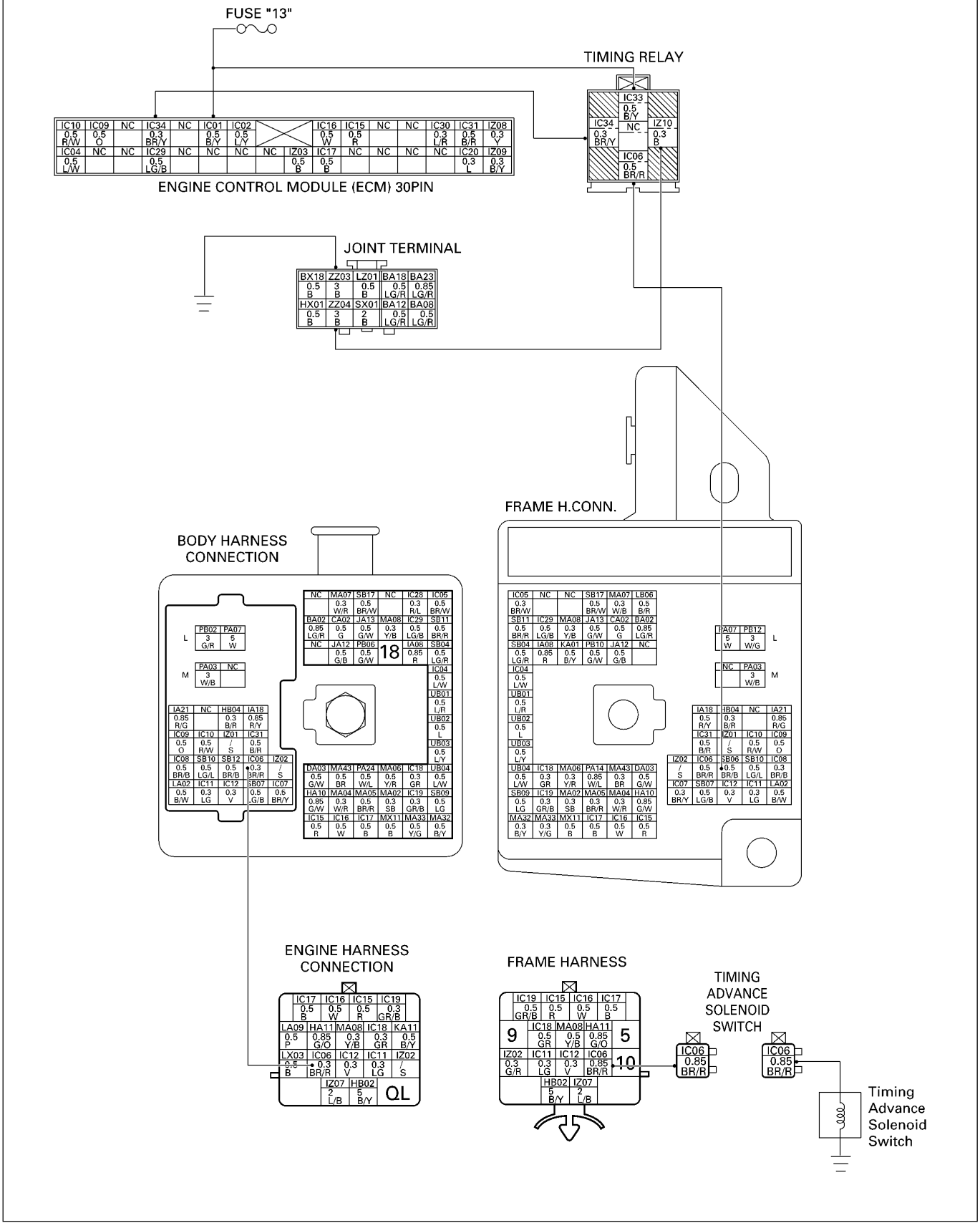
F06HV087.tif

Resistance value

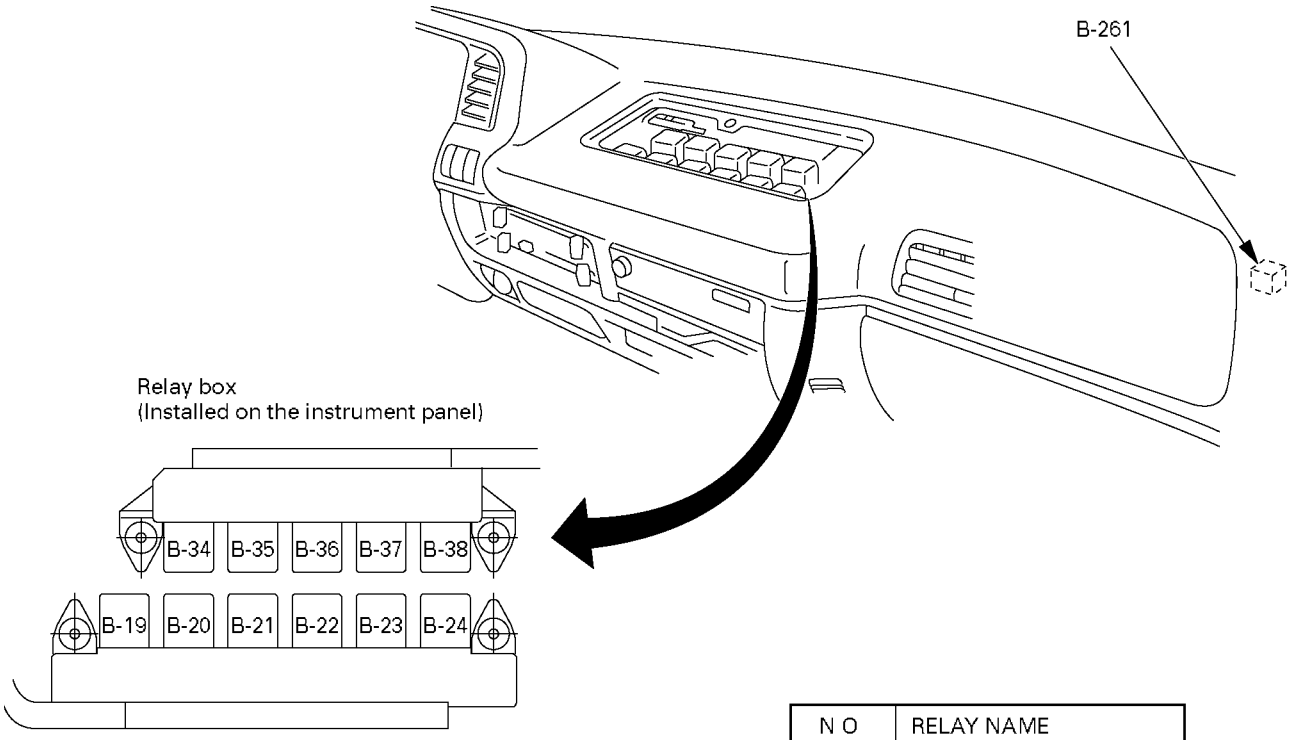
Inspection Point		Resistance	Reference
Inspection relay unit	2 ⟷ 4	240 to 290 (Ω) (for 12 volt) 256 to 276 (Ω) (for 24 volt)	
	1 ⟷ 5	∞	Not be supplied electricity
		Below 0.5 (Ω)	Be supplied electricity
	3 ⟷ 5	Below 0.5 (Ω)	Be supplied electricity
		∞	Not be supplied electricity

Step	Action	Value (s)	Yes	No
1	Was the “on-board diagnostic (OBD) system check” performed?	-	Go to Step 2	Go to self diag system check
2	1. Ignition “OFF”, Engine “ON”. 2. Jumper the magnetic switch Relay ground circuit at the Relay connector to chassis ground. 3. Observe the “Relay; solenoid switch” circuit open status on the scan tool. Has DTC23 been corrected?	-	Go to Step 4	Go to Step 3
3	1. Check for poor connector at the Relay connector and replace the terminals if necessary. Did any terminals require replacement?	-	Go to Step 11	Go to Step 5
4	1. Check the Relay ground circuit for an open. 2. If the Relay ground circuit is open, repair it as necessary. Was the Relay ground circuit open?	-	Go to Step 11	Go to Step 2
5	1. Ignition “OFF”, with scan tool disconnected. 2. Disconnect the Solenoid switch Relay connector. 3. Apply a circuit tester with voltage range or a test light to the output line for the Relay. 4. Ignition “ON”, Measure the voltage or check the test light “ON”. Ignition “OFF”	≧ 8V or light “ON” (for 12 Volt) ≧ 16V or light “ON” (for 24 Volt)	Go to Step 8	Go to Step 6
6	6. Ignition “ON”. 7. Disconnect ECM, and check for the Relay signal circuit terminal connector at the ECM and clean or replace terminal if necessary. Did any terminals need to be repaired?	-	Go to Step 11	Go to Step 7
7	1. Check the Relay signal circuit for an open. 2. If the Relay signal circuit is open, repair it as necessary. Was the Relay signal circuit open?	-	Go to Step 11	Go to Step 8
8	1. Disconnect the Relay. 2. Measure the resistance between the coil circuit terminals of the Relay. Is the resistance within specific value?	240~290Ω (for 12 Volt) 256~276Ω (for 24 Volt)	Go to Step 10	Go to Step 9
9	1. Replace the Relay. Is the action complete?	-	Go to Step 11	-
10	1. Replace the ECM Is the action complete?	-	Go to Step 11	-
11	1. Reconnect all the connectors removed. 2. Ignition “ON”, Engine “OFF”. 3. Ignition “OFF” after 30 sec. 4. Install Scan tool. Is DTC 23 all right under Scan Tool Check?	-	Go to Step 12	Go to Step 2
12	Is any other trouble them 23 displayed by scan tool?	-	Go to trouble code section	Trouble code clear

DTC-P24 SOLENOID SWITCH CONTROL CIRCUIT HIGH VOLTAGE



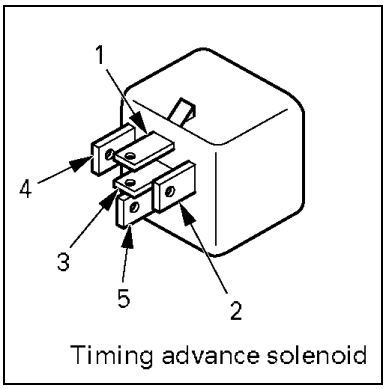
Location of relay



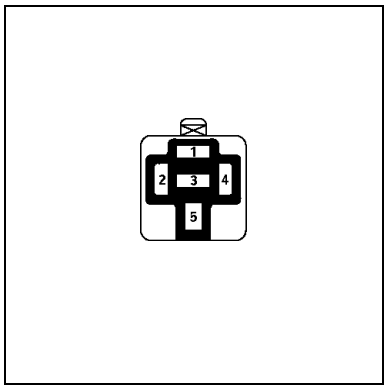
N O	RELAY NAME
B-19	CHARGE
B-20	HEAD LIGHT
B-21	HEATER & A/C
B-22	TAIL
B-23	DIMMER
B-24	HORN
B-34	BUZZER CANCEL
B-35	CORNERING LIGHT
B-36	POWER/WINDOW
B-37	A/C THERMO
B-38	EXH BRAKE
B-261	TIMING

056LW037.tif

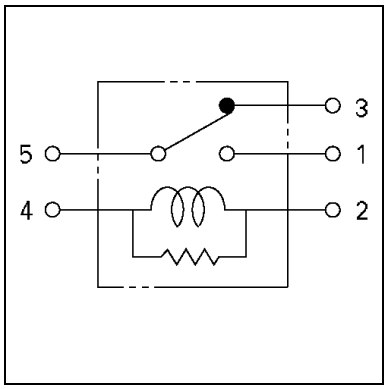
Inspection for Timing Advance Solenoid Switch cut relay



056LW019.tif



5-12.tif



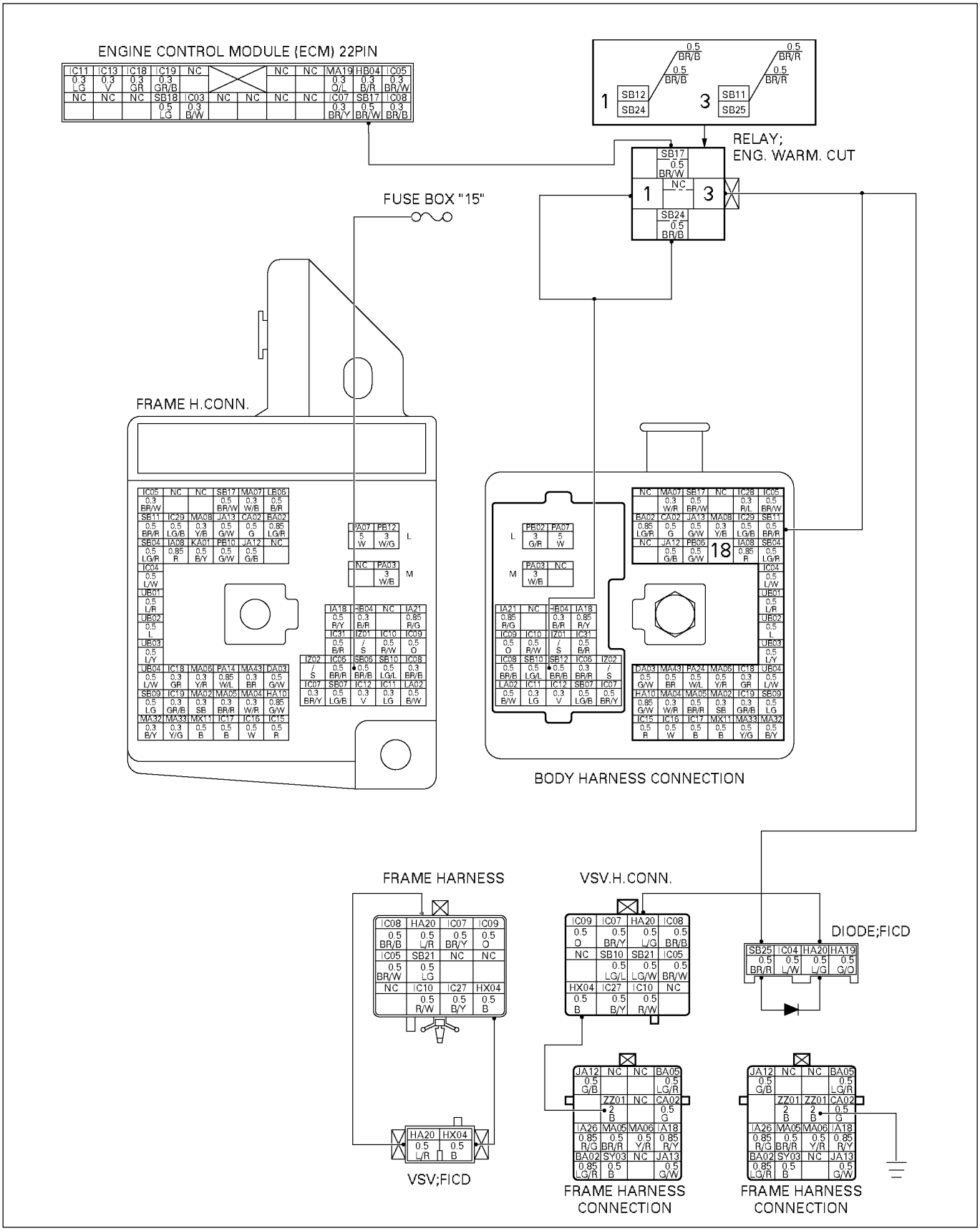
F06HV087.tif

Resistance value

Inspection Point		Resistance	Reference
Inspection relay unit	2 ←→ 4	240 to 290 (Ω) (for 12 volt) 256 to 276 (Ω) (for 24 volt)	
	1 ←→ 5	∞	Not be supplied electricity
		Below 0.5 (Ω)	Be supplied electricity
	3 ←→ 5	Below 0.5 (Ω)	Be supplied electricity
		∞	Not be supplied electricity

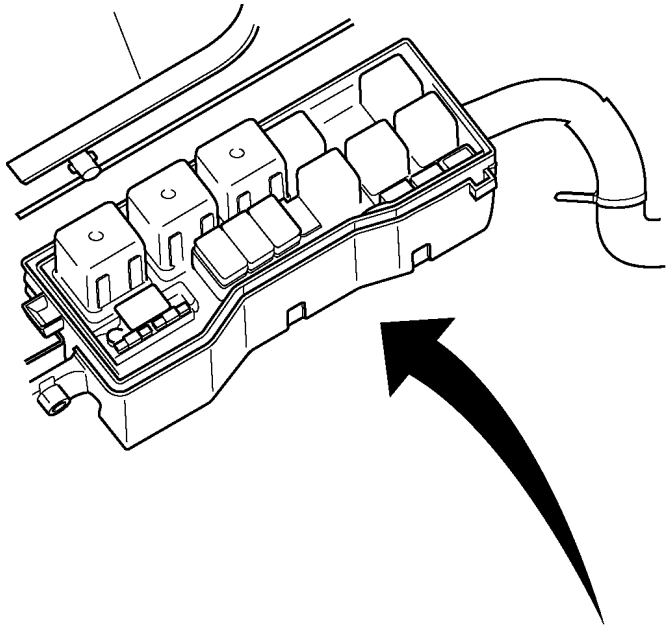
Step	Action	Value (s)	Yes	No
1	Was the “on-board diagnostic (OBD) system check” performed?	-	Go to Step 2	Go to self diag system check
2	1. Ignition “OFF”, with scan tool disconnected. 2. Disconnect the Relay solenoid switch from the Relay box. 3. Apply a circuit tester with the voltage range or a test light to the output circuit for the Relay. 4. Ignition “ON”, Engine “OFF”. Is voltage as prescribed, or is test Light lit untils 18 sec?	≧8V or light “ON” (for 12 Volt) ≧16V or light “ON” (for 24 Volt)	Go to Step 6	Go to Step 3
3	1. Ignition “OFF”. 2. Check if there is no short between Relay Box Terminals. 3. Repair if necessary. Shorted between Relay Box Terminals?	-	Go to Step 8	Go to Step 4
4	1. Disconnect the ECM. 2. Check if Relay Sig Circuit for a short to Chassis/GND or short to voltage. 3. Repair if necessary. Was Relay signal circuit shorted?	-	Go to Step 8	Go to Step 6
5	1. Disconnect the Relay. 2. Measure the resistance between the coil circuit terminal of the Relay. Is the resistance with in specific valve.	240~290Ω (for 12 Volt) 256~276Ω (for 24 Volt)	Go to Step 8	Go to Step 6
6	1. Ignition “OFF”. 2. Replace the Relay. Is the action complete?	-	Go to Step 8	-
7	1. Ignition “ON”. 2. Replace the ECM. Is the action complete?	-	Go to Step 8	-
8	1. Reconnect all the connectors removed. 2. Ignition “ON”, Engine OFF, and Ignition off after 30sec. 3. Install Scan tool. 4. Ignition “ON”, Engine “OFF”. Is DTC 24 all right under Scan Tool Check?	-	Go to Step 9	Go to Step 2
9	Is any current trouble other than DTC 24 displayed by scan tool?	-	Go to trouble code section	Trouble code clear

DTC-P26 QUICK WARM SYSTEM (QWS) RELAY CONTROL CIRCUIT HIGH VOLTAGE

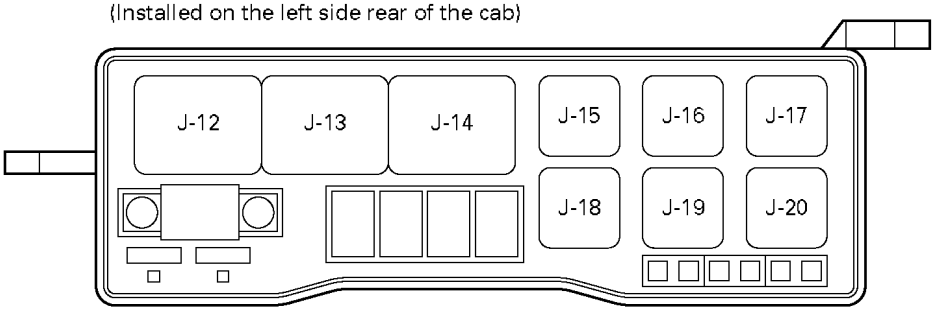


065LW034.tif

Location of relay



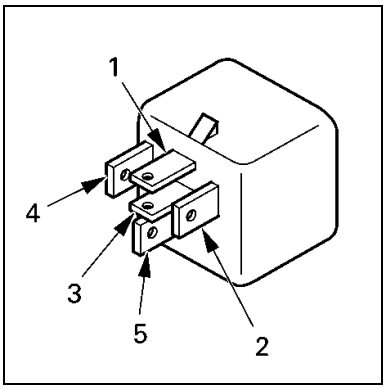
Relay box
(Installed on the left side rear of the cab)



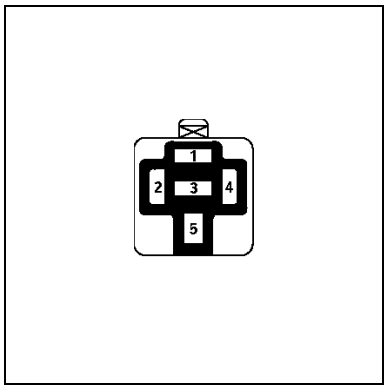
No.	RELAY NAME
J-12	STARTER
J-13	GLOW1 (QOS)
J-14	C/HEATER
J-15	ENG. WARM CUT (QWS)
J-16	———
J-17	CONDENSER FAN
J-18	EXH. BRAKE CONTROL
J-19	———
J-20	MARKER LAMP

826LW038.tif

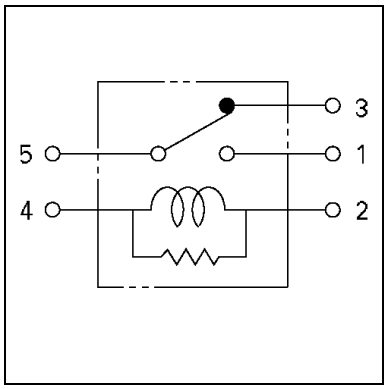
Inspection for Quick Warm System (QWS) cut relay



056LX00007



5-12.tif



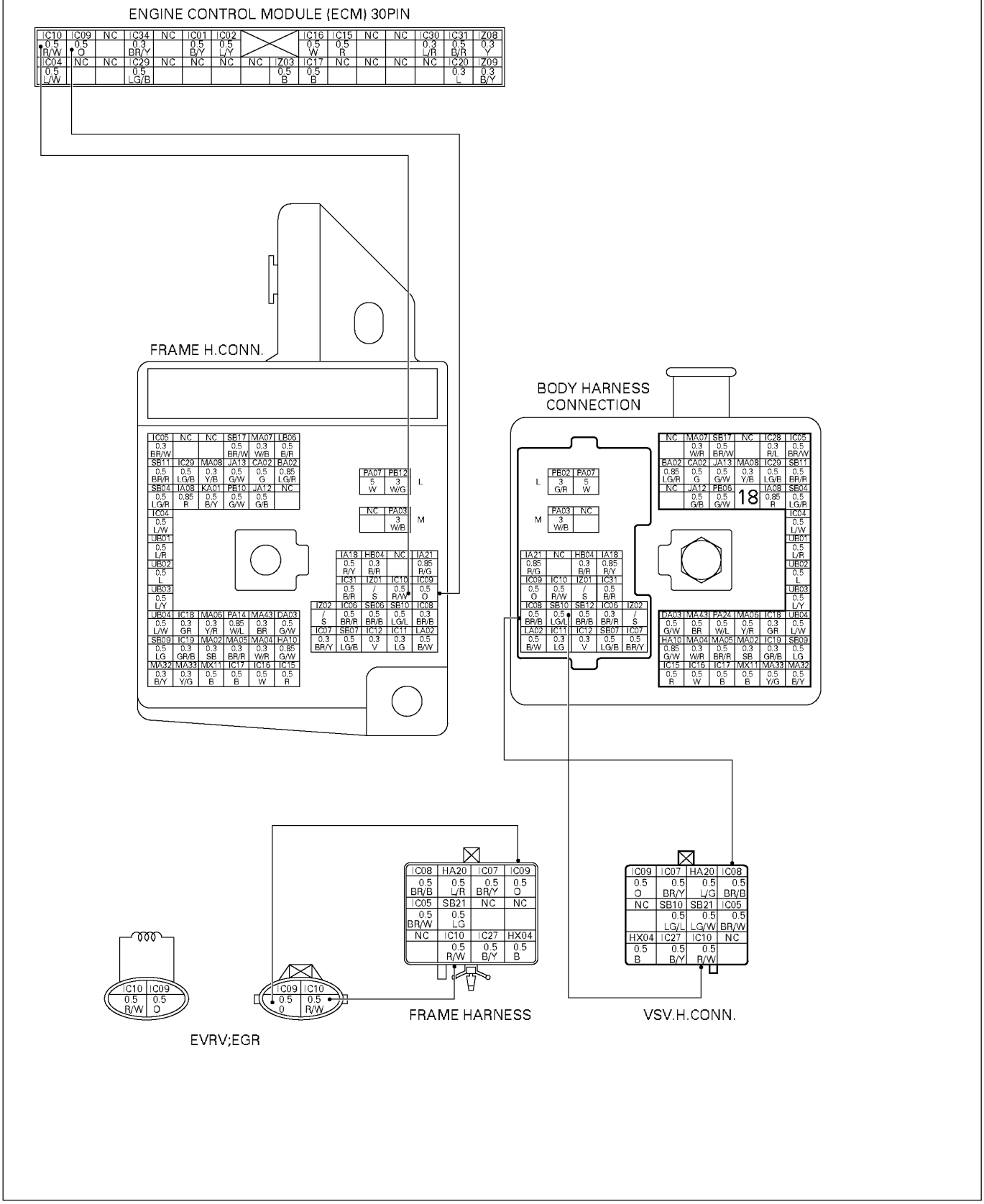
F06HV087.tif

Resistance value

Inspection Point		Resistance	Reference
Inspection relay unit	2 ⟷ 4	240 to 290 (Ω) (for 12 volt) 256 to 276 (Ω) (for 24 volt)	
	1 ⟷ 5	∞	Not be supplied electricity
		Below 0.5 (Ω)	Be supplied electricity
	3 ⟷ 5	Below 0.5 (Ω)	Be supplied electricity
		∞	Not be supplied electricity

Step	Action	Value (s)	Yes	No
1	Was the “on-board diagnostic (OBD) system check” performed?	-	Go to Step 2	Go to self diag system check
2	Using the DVM, check the resistance of inter “2” “4” terminal. Does the DVM read the following Value?	240~290Ω (for 12 Volt) 256~276Ω (for 24 Volt)	Go to Step 3	Go to Step 4
3	1. Ignition “OFF” 2. Disconnect the ECM connector from ECM. 3. Check the short to voltage of Relay circuit between the ECM and Relay connector. 4. Repair if necessary. Has DTC 26 been corrected?	-	Go to Step 6	Go to Step 5
4	Replace the Relay. Is the action complete?	-	Go to Step 6	-
5	Replace the ECM. Is the action complete?	-	Go to Step 6	-
6	1. Reconnect all the connectors removed. 2. Ignition “ON”, Engine “OFF” Is DTC 26 all right under Scan Tool Check?	-	Go to Step 7	Go to Step 2
7	Is any current trouble other than DTC 26 displayed by scan tool?	-	Go to trouble code section	Trouble code clear

DTC-P31 EXHAUST GAS RECIRCULATION (EGR) ELECTRONIC VACUUM REGULATING VALVE (EVRV) SOLENOID CONTROL LOW VOLTAGE



06.5LW041.tif

Appearance of Electronic Vacuum Regulating Valve (EVRV): Exhaust Gas Recirculation (EGR) sensor and connector name

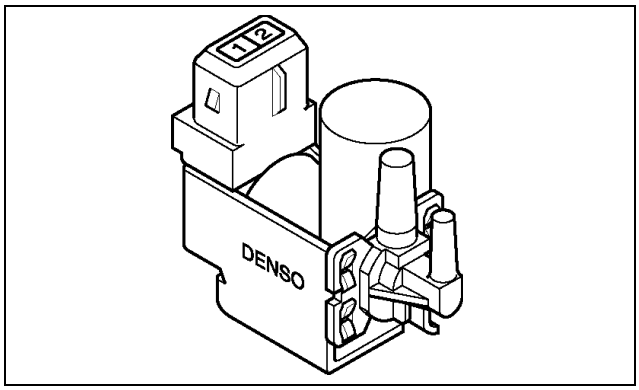


Figure. EVRV:EGR 056LW024.tif

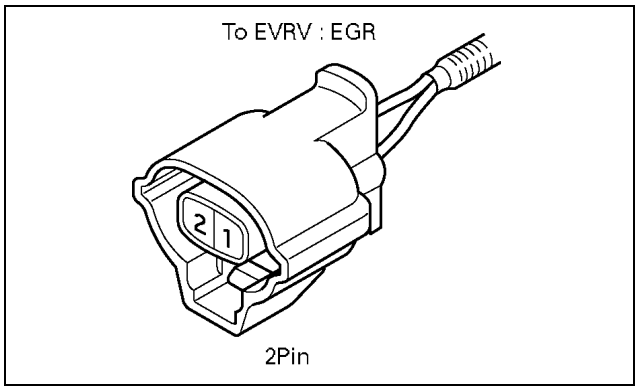
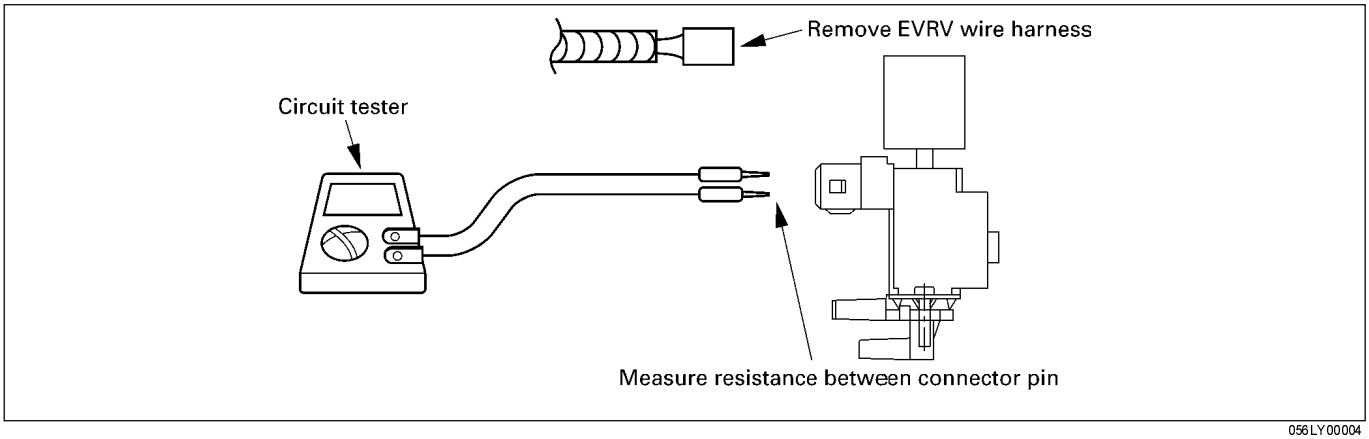


Figure. EVRV:EGR connector 056LW016.tif

Connector No	Signal
1 2	GND SIG

Measure resistance at EVRV: EGR



056LY00004

CAUTION:

When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

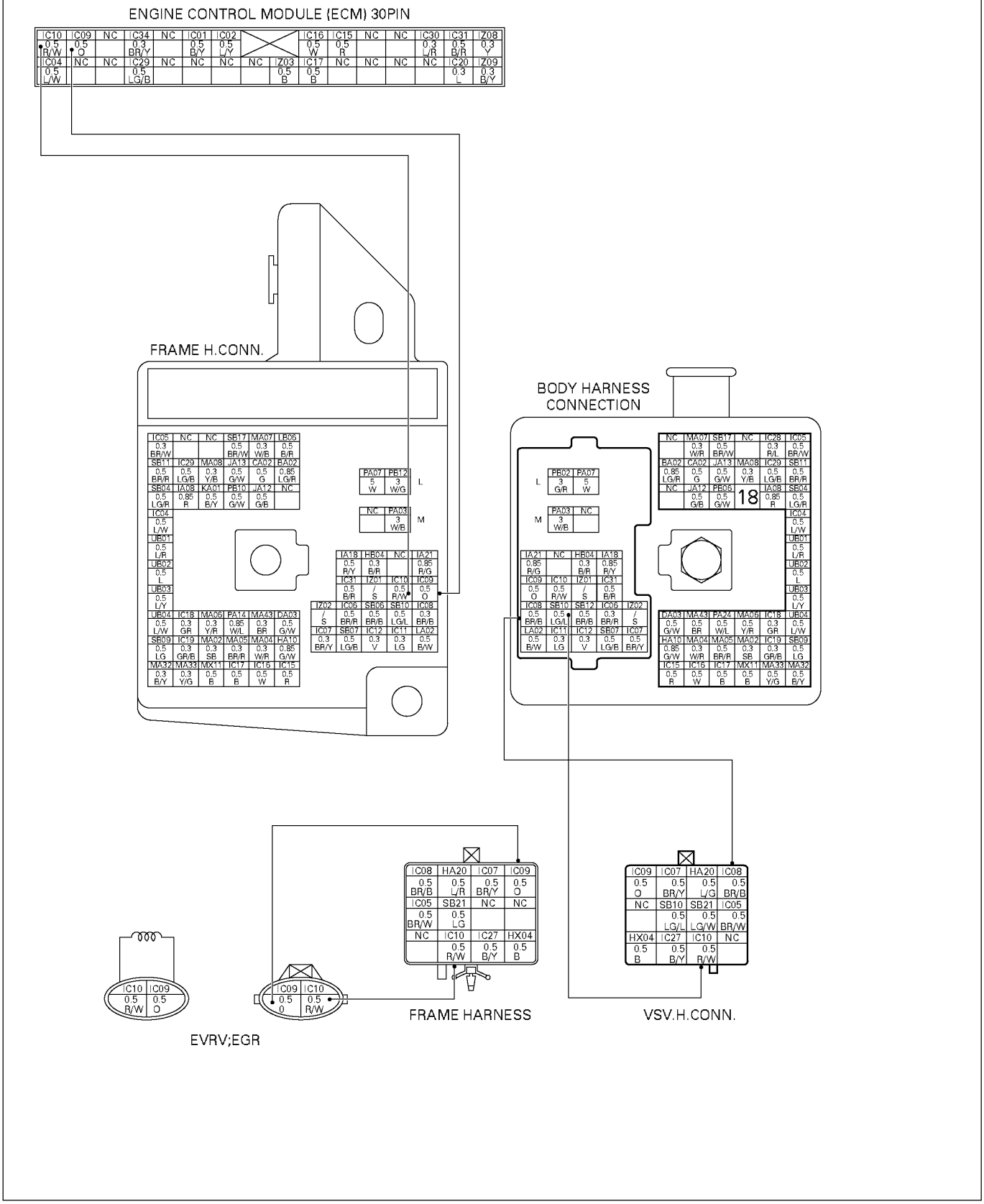
Resistance value

Inspection Point		Resistance Value (kΩ)	Reference
Connector	Pin No.		
2 pin Black	2 ⟷ 1	12±1 (for 12 volt) 48±2 (for 24 volt)	SIG ⟷ GND
	1 ⟷ Body	∞	SIG ⟷ Body

Note: Resistance value is difference according to the engine temperature (condition of engine warming up)

Step	Action	Value (s)	Yes	No
1	Was the “on-board diagnostic (OBD) system check” performed?	-	Go to Step 2	Go to self diag system check
3	1. Ignition “OFF” 2. Disconnect the EVRV from the wiring harness connector. 3. Check the EVRV signal circuit between the EVRV connector and the ECM for the following condition. * A short to ground * An open circuit 2. Repair if necessary. Has DTC31 been corrected?	-	Go to Step 8	Go to Step 4
4	Using the DVM, check the resistance of the EVRV Does the DVM read the following Value?	12Ω (for 12 Volt) 48Ω (for 24 Volt)	Go to Step 5	Go to Step 6
5	1. Ignition “OFF” 2. Check an open circuit of the EVRV ground circuit between the ECM and EVRV connector. 3. Repair if necessary. Has DTC31 been corrected?	-	Go to Step 8	Go to Step 7
6	Replace the EVRV Is the action complete?	-	Go to Step 8	Go to Step 7
7	Replace the ECM. Is the action complete?	-	Go to Step 8	-
8	1. Reconnect all the connectors removed. 2. Ignition “ON”, Engine “OFF” Is DTC31 all right under Scan Tool Check?	-	Go to Step 9	Go to Step 2
9	Is any current trouble other than DTC31 displayed by scan tool?	-	Go to trouble code section	Trouble code clear

DTC-P32 EXHAUST GAS RECIRCURATION (EGR) ELECTRONIC VACUUM REGULATING VALVE (EVRV) SOLENOID CONTROL HIGH VOLTAGE



065LW041.tif

Appearance of Electronic Vacuum Regulating Valve (EVRV): Exhaust Gas Recirculation (EGR) and connector name

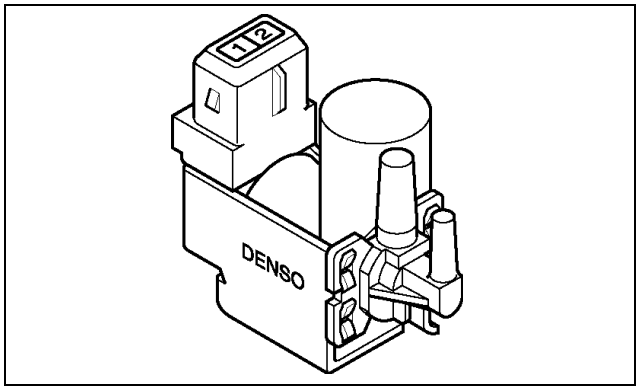


Figure. EVRV:EGR 056LW024.tif

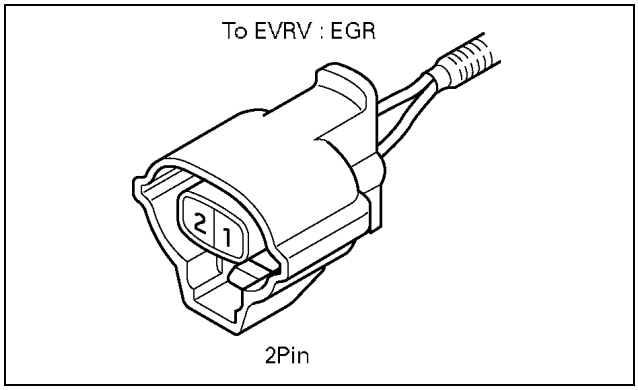
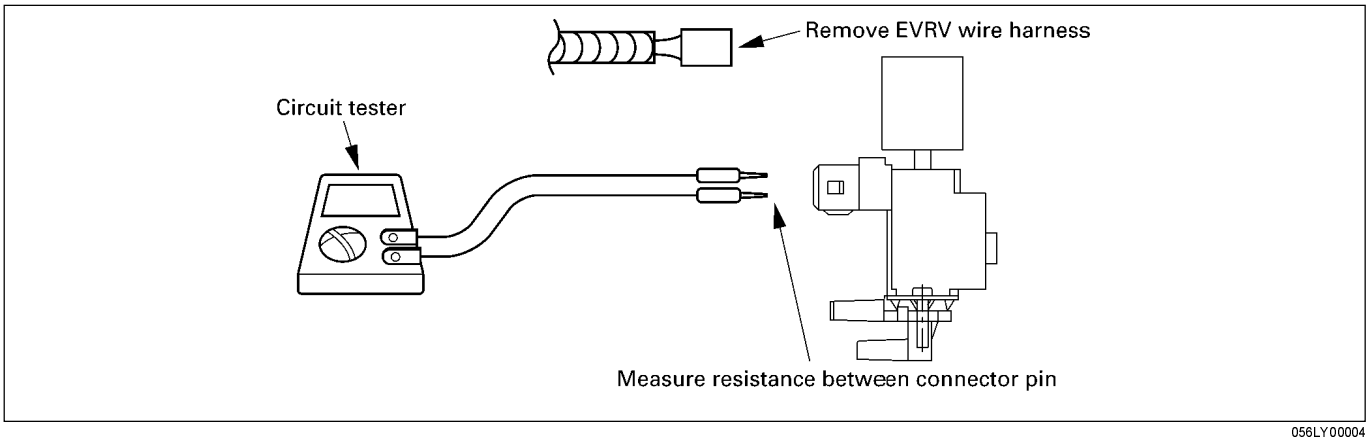


Figure. EVRV:EGR connector 056LW016.tif

Connector No	Signal
1 2	GND SIG

Measure resistance at EVRV: EGR



056LY00004

CAUTION:

When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

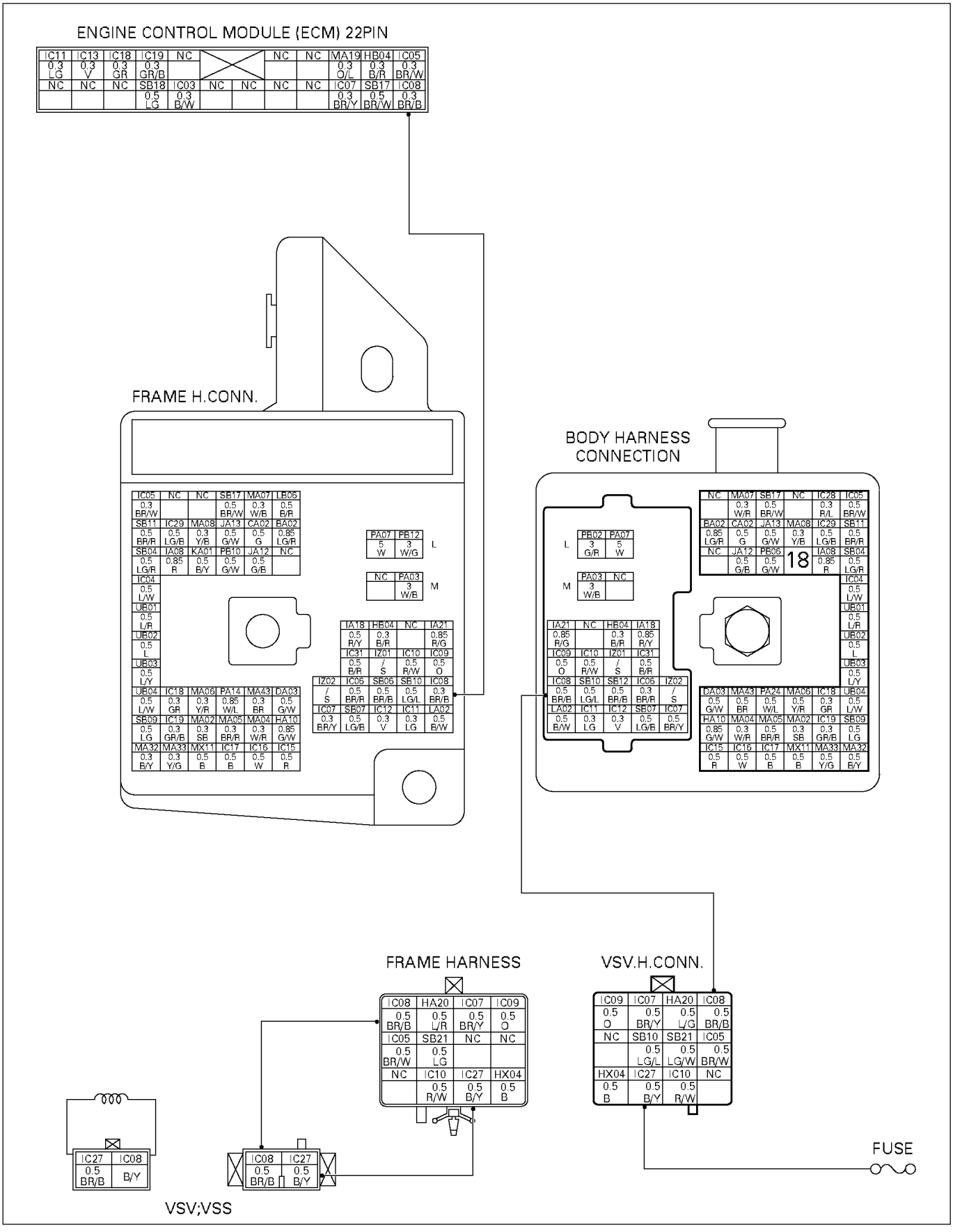
Resistance value

Inspection Point		Resistance Value (kΩ)	Reference
Connector	Pin No.		
2 pin Black	2 ⟷ 1	12±1 (for 12 volt) 48±2 (for 24 volt)	SIG ⟷ GND
	1 ⟷ Body	∞	SIG ⟷ Body

Note: Resistance value is difference according to the engine temperature (condition of engine warming up)

Step	Action	Value (s)	Yes	No
1	Was the “on-board diagnostic (OBD) system check” performed?	-	Go to Step 2	Go to self diag system check
2	1. Ignition “OFF” 2. Disconnect the EVRV from the wiring harness connector. 3. Check a short to voltage of the EVRV signal circuit and GND circuit between the EVRV connector and the ECM. 4. Repair if necessary. Has DTC32 been corrected?	-	Go to Step 5	Go to Step 3
3	1. Ignition “OFF” 2. Disconnect the ECM connector from ECM. 3. Check the short to voltage of EVRV circuit between the ECM and EVRV connector 4. Repair if necessary. Has DTC32 been corrected?	-	Go to Step 5	Go to Step 4
4	Replace the ECM. Is the action complete?		Go to Step 5	-
5	1. Reconnect all the connectors removed. 2. Ignition “ON”, Engine “OFF” Is DTC32 all right under Scan Tool Check?	-	Go to Step 6	Go to Step 2
6	Is any current trouble other than DTC32 displayed by scan tool?	-	Go to trouble code section	Trouble code clear

DTC-P33 VARIABLE SWIRL SYSTEM (VSS) CONTROL CIRCUIT LOW VOLTAGE



065LW039.tif

Appearance of VSV for VSS and connector name

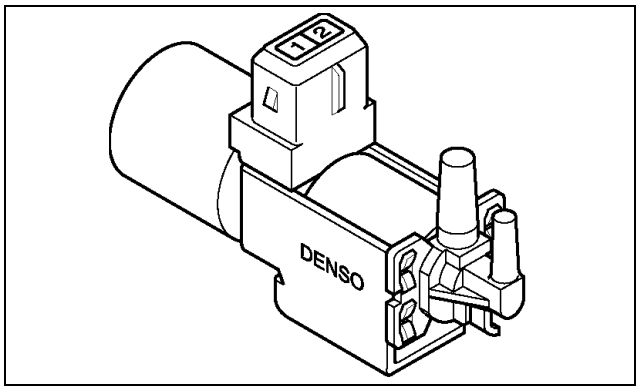


Figure. VSV for VSS 056LW001.tif

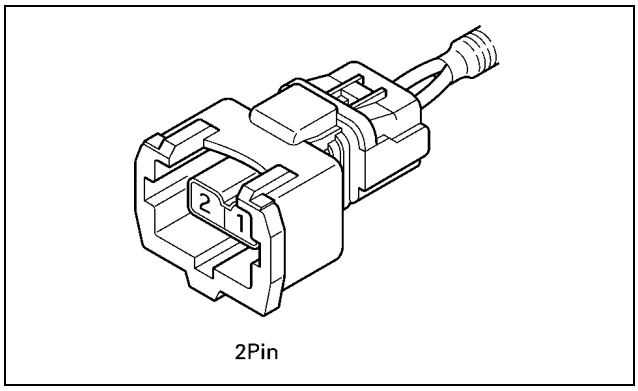
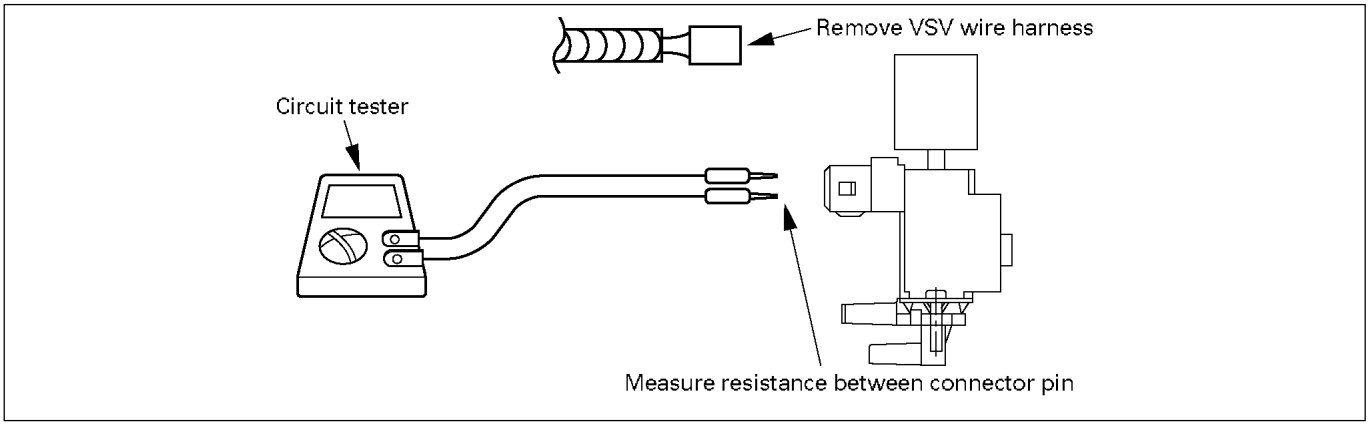


Figure. VSV connector 056LY00003

Connector No	Signal
1 2	SIG GND

Measure resistance at VSV for VSS



056LW005.tif

CAUTION:

When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

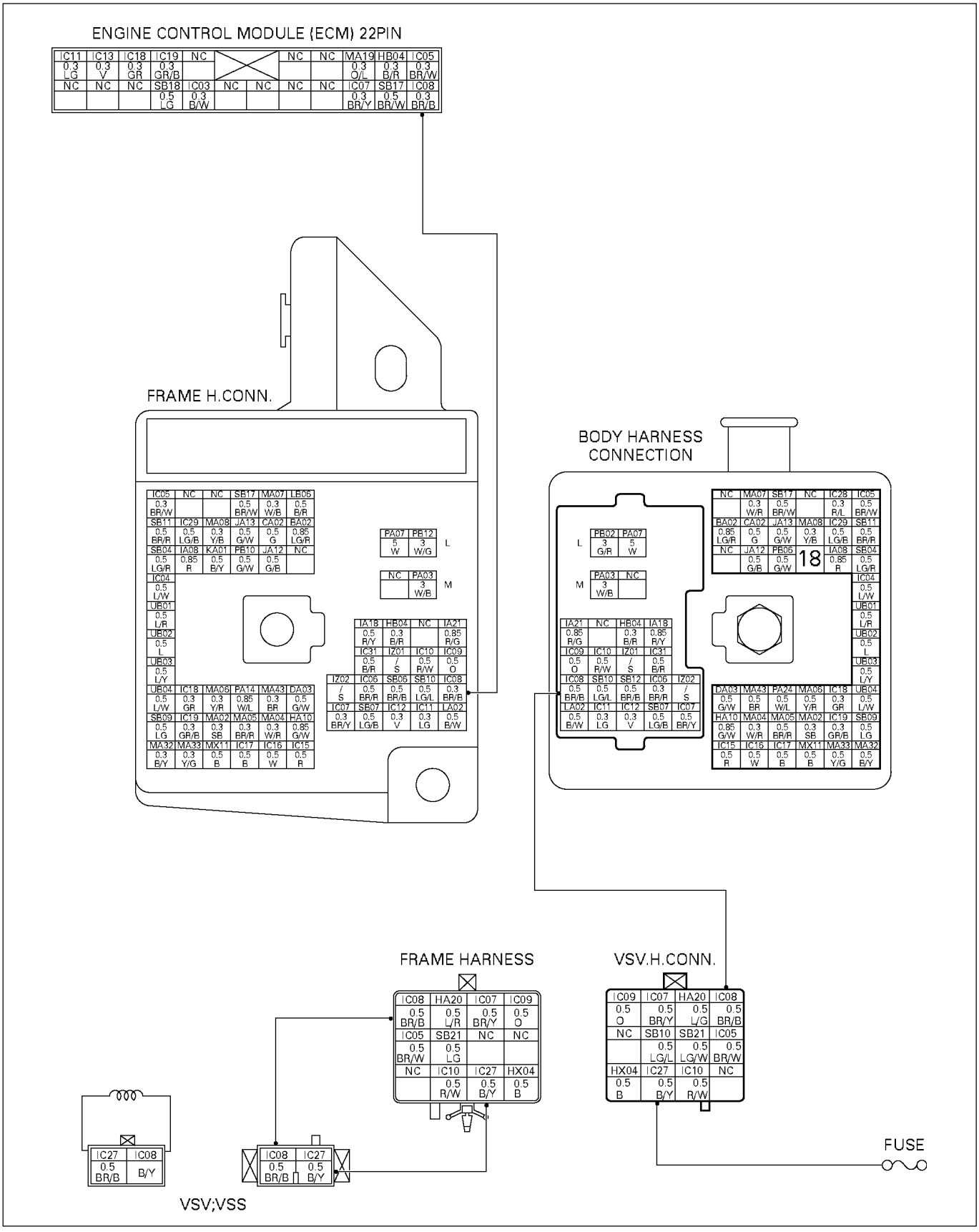
Resistance value

Inspection Point		Resistance Value (kΩ)	Reference
Connector	Pin No.		
2 pin Gray	2 ←→ 1	37 to 44 (for 12 volt) 159 to 169 (for 24 volt)	SIG ←→ GND
	1 ←→ Body	∞	SIG ←→ Body

Note: Resistance value is difference according to the engine temperature (condition of engine warming up)

Step	Action	Value (s)	Yes	No
1	Was the “on-board diagnostic (OBD) system check” performed?	-	Go to Step 2	Go to self diag system check
2	1. Ignition “OFF” 2. Disconnect the VSV from the wiring harness connector. 3. Ignition “ON” Engine “OFF” 4. Using the Digital Voltmeter (DVM), check for voltage on the “IC27” of the VSV harness connector. Does the DVM read the following value?	12 Volt or 24 Volt	Go to Step 4	Go to Step 3
3	1. Check the suspect circuit between the VSV connector and “Engine Ignition.” Fuse for the following condition. * A short to ground * An open circuit 2. Repair if necessary. Has DTC 33 been corrected?	-	Go to Step 8	-
4	Using the DVM, check the resistance of the VSV Does the DVM read the following Value?	37 ~ 44Ω (for 12 Volt) 159 ~ 169Ω (for 24 Volt)	Go to Step 5	Go to Step 6
5	1. Ignition “OFF” 2. Disconnect the ECM connector from ECM. 3. Check the VSV circuit between the ECU and VSV connector * A short to ground * An open circuit 2. Repair if necessary. Has DTC 33 been corrected?	-	Go to Step 8	Go to Step 7
6	Replace the VSV Is the action complete?	-	Go to Step 8	-
7	Replace the ECM. Is the action complete?	-	Go to Step 8	-
8	1. Reconnect all the connectors removed. 2. Ignition “ON”, Engine “OFF” Is DTC 33 all right under Scan Tool Check?	-	Go to Step 9	Go to Step 2
9	Is any current trouble other than DTC 33 displayed by scan tool?	-	Go to trouble code section	Trouble code clear

DTC-P34 VARIABLE SWIRL SYSTEM (VSS) CONTROL CIRCUIT HIGH VOLTAGE



06.5LW039.tif

Appearance of VSV for VSS and connector name

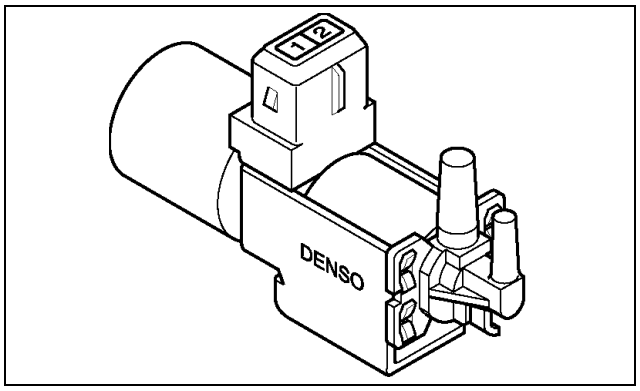


Figure. VSV for VSS 056LW001.tif

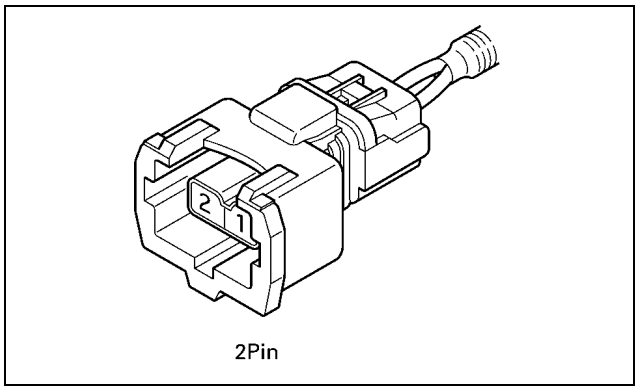
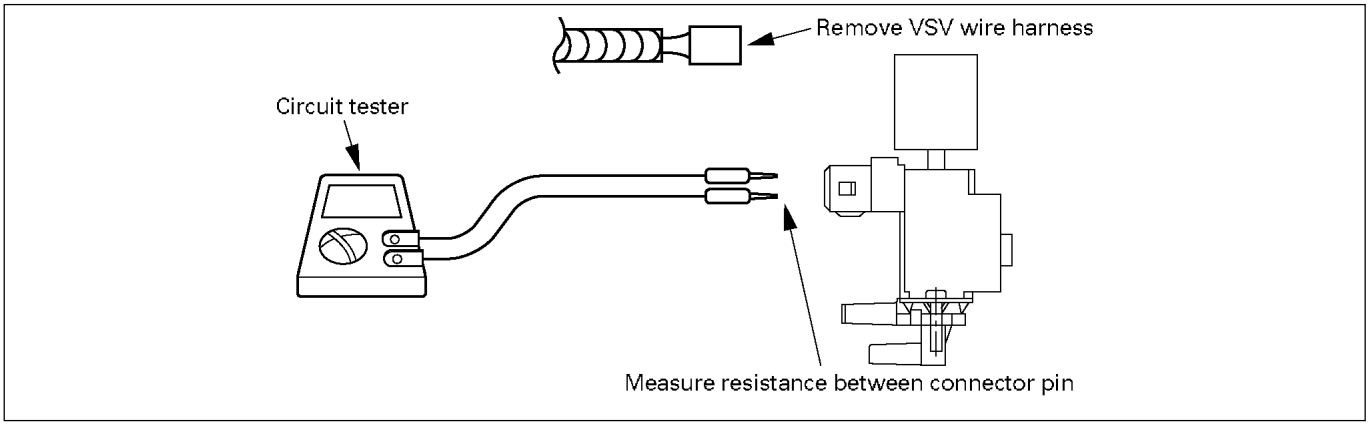


Figure. VSV connector 056LY00003

Connector No	Signal
1 2	SIG GND

Measure resistance at VSV for VSS



056LW005.tif

CAUTION:

When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

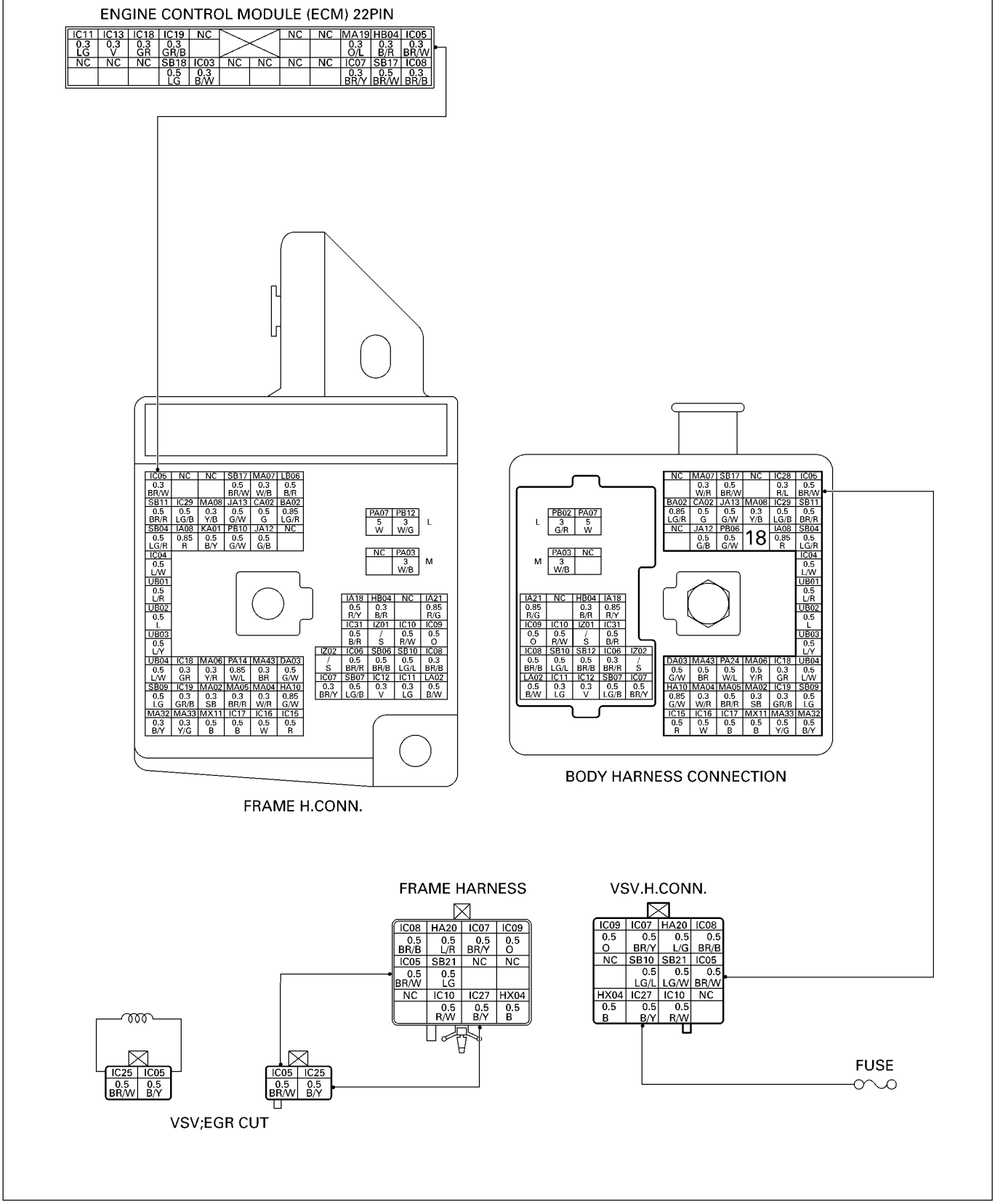
Resistance value

Inspection Point		Resistance Value (kΩ)	Reference
Connector	Pin No.		
2 pin Gray	2 ←→ 1	37 to 44 (for 12 volt) 159 to 169 (for 24 volt)	SIG ←→ GND
	1 ←→ Body	∞	SIG ←→ Body

Note: Resistance value is difference according to the engine temperature (condition of engine warming up)

Step	Action	Value (s)	Yes	No
1	Was the “on-board diagnostic (OBD) system check” performed?	-	Go to Step 2	Go to self diag system check
2	Using the DVM, check the resistance of the VSV Does the DVM read the following Value?	37 ~ 44Ω (for 12 Volt) 159 ~ 169Ω (for 24 Volt)	Go to Step 3	Go to Step 4
3	1. Ignition “OFF” 2. Disconnect the ECM connector from ECM. 3. Check the short to voltage of VSV circuit between the ECM and VSV connector 4. Repair if necessary. Has DTC 34 been corrected?	-	Go to Step 6	Go to Step 5
4	Replace the VSV Is the action complete?	-	Go to Step 6	-
5	Replace the ECM. Is the action complete?	-	Go to Step 6	-
6	1. Reconnect all the connectors removed. 2. Ignition “ON”, Engine “OFF” Is DTC 34 all right under Scan Tool Check?	-	Go to Step 7	Go to Step 2
7	Is any current trouble other than DTC 34 displayed by scan tool?	-	Go to trouble code section	Trouble code clear

DTC-P35 EXHAUST GAS RECIRCULATION (EGR) QUICK CUT VACUUM SWITCHING VALVE (VSV) CONTROL CIRCUIT LOW VOLTAGE



065LW036

Appearance of Vacuum Switching Valve (VSV): Exhaust Gas Recirculation(EGR) CUT and connector name

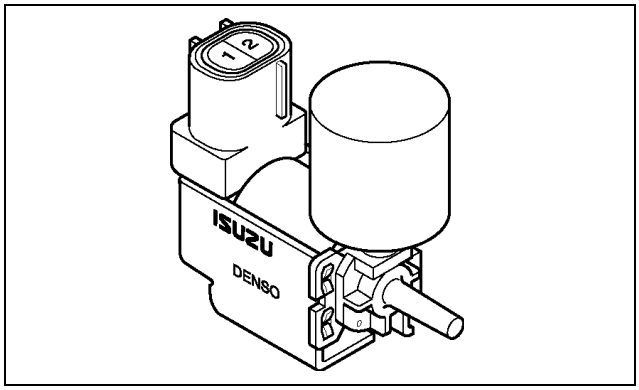


Figure. VSV:EGR CUT 056LW002.tif

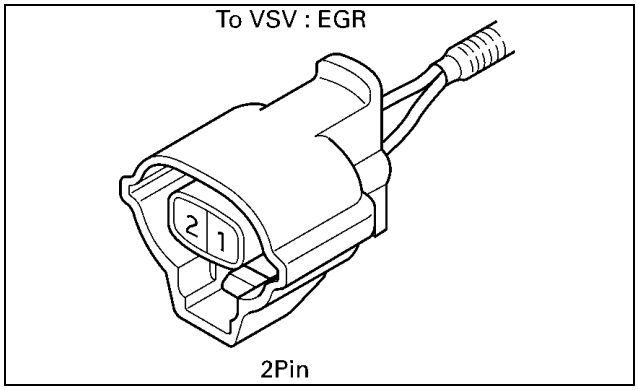
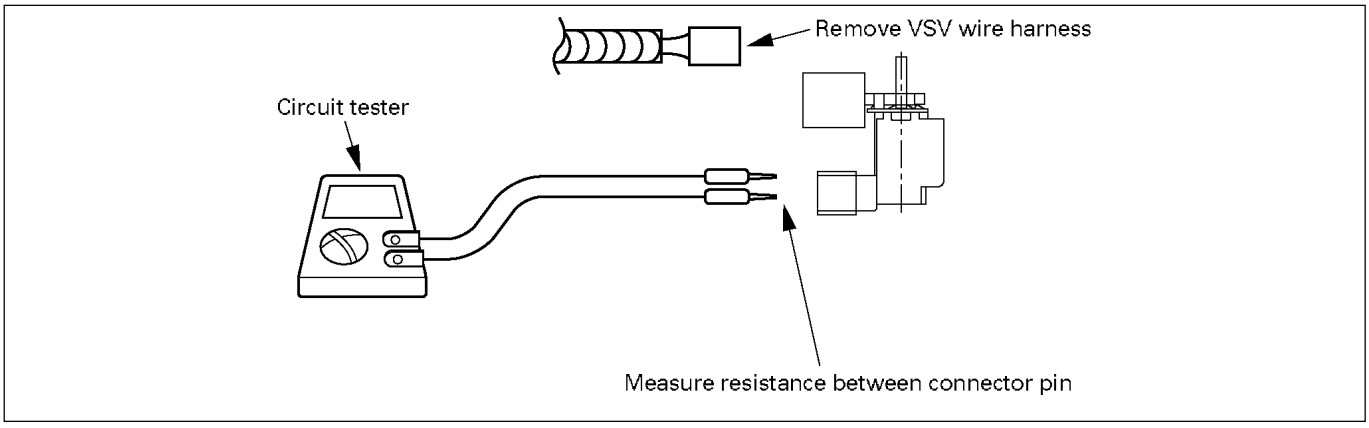


Figure. VSV:EGR CUT connector 056LW016-1

Connector No	Signal
1 2	SIG GND

Measure resistance at VSV:EGR CUT



056LW004.tif

CAUTION:

When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

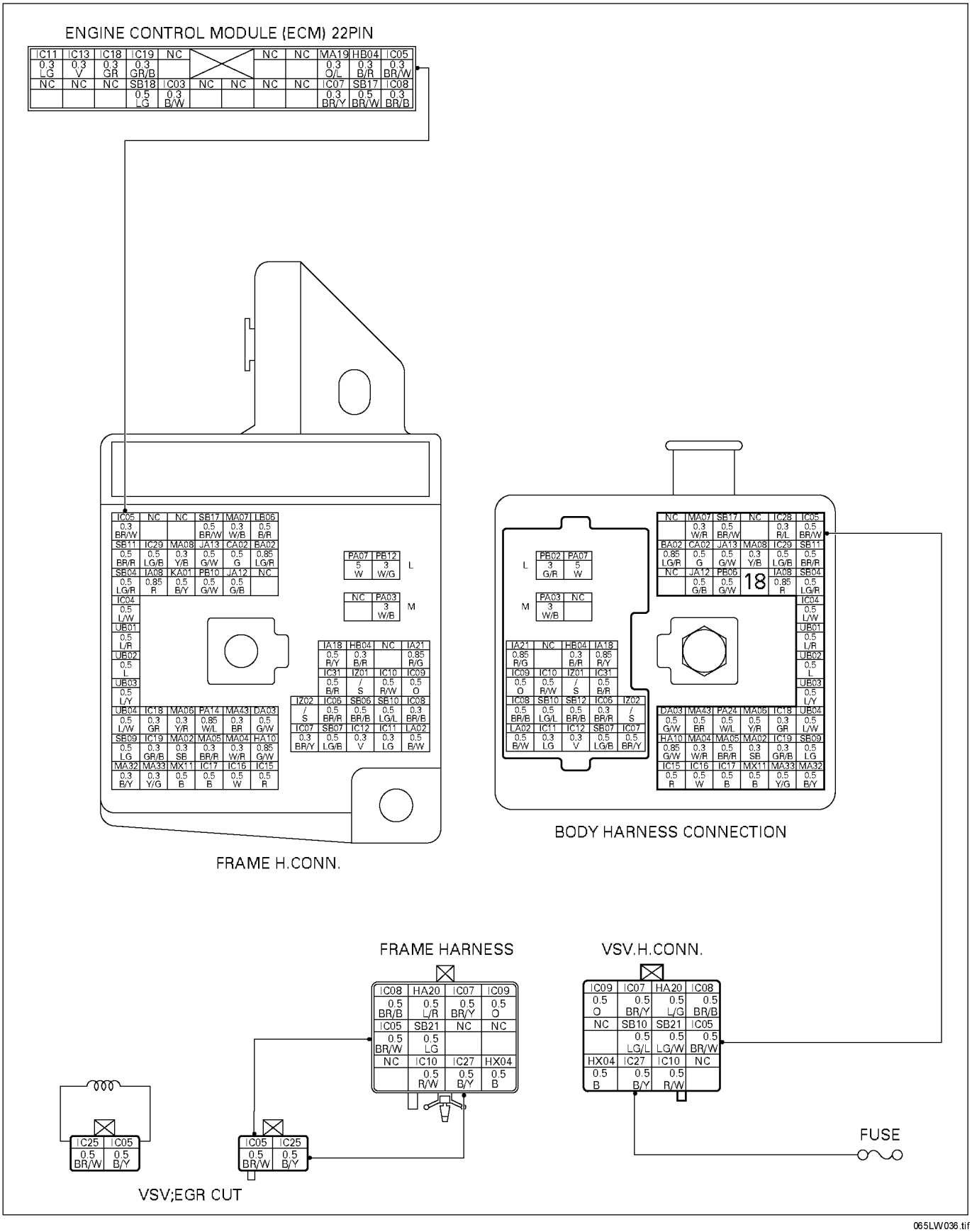
Resistance value

Inspection Point		Resistance Value (kΩ)	Reference
Connector	Pin No.		
2 pin Black	2 ←→ 1	37 to 44 (for 12 volt) 159 to 169 (for 24 volt)	SIG ←→ GND
	1 ←→ Body	∞	SIG ←→ Body

Note: Resistance value is difference according to the engine temperature (condition of engine warming up)

Step	Action	Value (s)	Yes	No
1	Was the “on-board diagnostic (OBD) system check” performed?	-	Go to Step 2	Go to self diag system check
2	1. Ignition “’OFF” 2. Disconnect the VSV from the wiring harness connector. 3. Ignition “ON” Engine “OFF” 4. Using the Digital Voltmeter (DVM), check for voltage on the “IC25” of the VSV harness connector. Does the DVM read the following value?	12 Volt or 24 Volt	Go to Step 4	Go to Step 3
3	1. Check the suspect circuit between the VSV connector and “Engine Ignition.” Fuse for the following condition. * A short to ground * An open circuit 2. Repair if necessary. Has DTC 35 been corrected?	-	Go to Step 8	-
4	Using the DVM, check the resistance of the VSV Does the DVM read the following Value?	37 ~ 44Ω (for 12 Volt) 159 ~ 169Ω (for 24 Volt)	Go to Step 5	Go to Step 6
5	1. Ignition “OFF” 2. Disconnect the ECM connector from ECM. 3. Check the VSV circuit between the ECM and VSV connector * A short to ground * An open circuit 2. Repair if necessary. Has DTC 35 been corrected?	-	Go to Step 8	Go to Step 7
6	Replace the VSV Is the action complete?	-	Go to Step 8	-
7	Replace the ECM. Is the action complete?	-	Go to Step 8	-
8	1. Reconnect all the connectors removed. 2. Ignition “ON”, Engine “OFF” Is DTC 35 all right under Scan Tool Check?	-	Go to Step 9	Go to Step 2
9	Is any current trouble other than DTC 35 displayed by scan tool?	-	Go to trouble code section	Trouble code clear

DTC-P36 EXHAUST GAS RECIRCULATION (EGR) QUICK CUT VACUUM SWITCHING VALVE (VSV) CONTROL CIRCUIT HIGH VOLTAGE



065LW036.tif

Appearance of Vacuum Switching Valve (VSV): Exhaust Gas Recirculation(EGR) CUT sensor and connector name

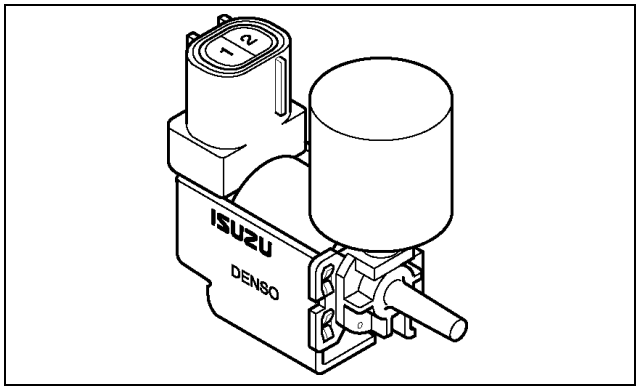


Figure. VSV:EGR CUT

056LW002.tif

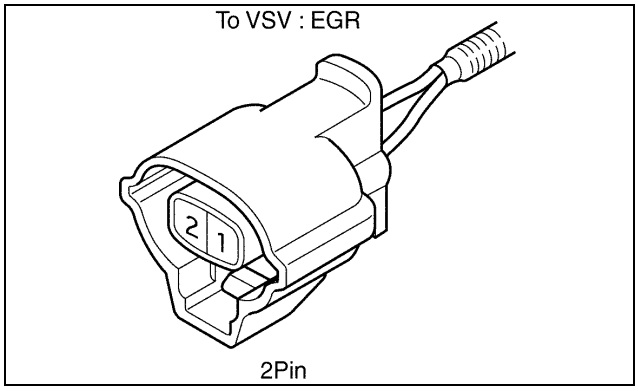
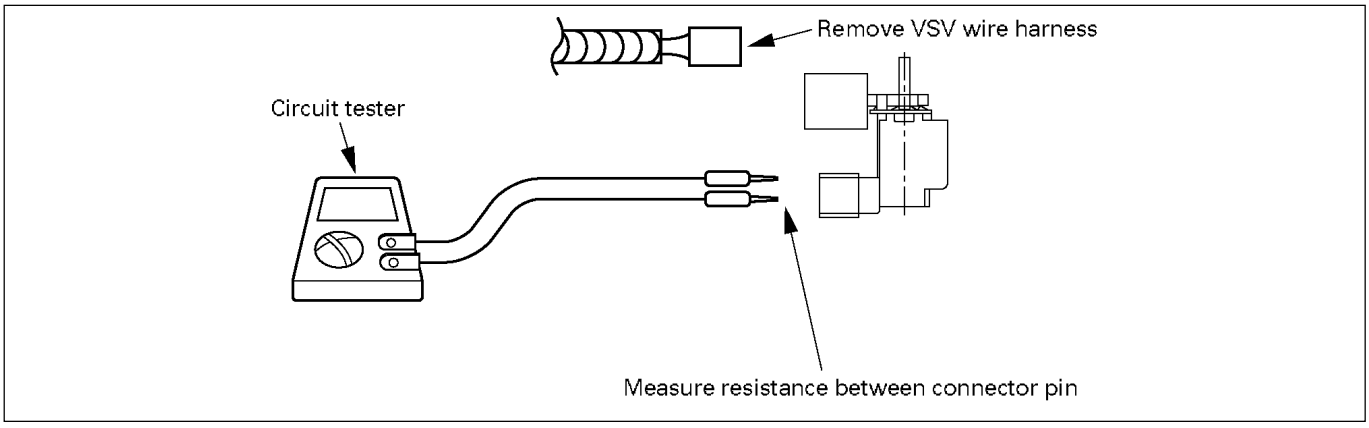


Figure. VSV:EGR CUT connector

056LW016.tif

Connector No	Signal
1 2	SIG GND

Measure resistance at VSV:EGR CUT



056LW004.tif

CAUTION:
When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

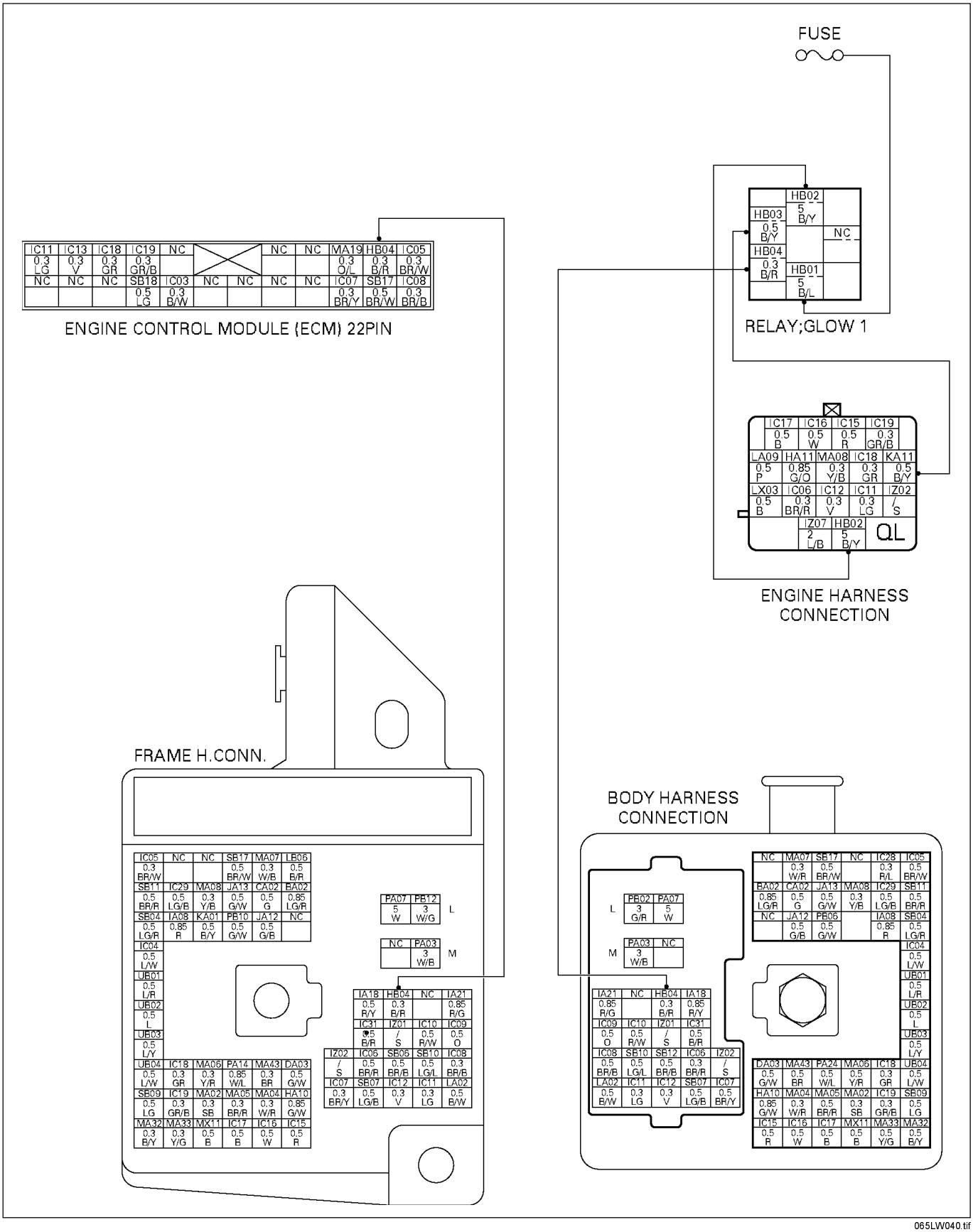
Resistance value

Inspection Point		Resistance Value (kΩ)	Reference
Connector	Pin No.		
2 pin Black	2 ←→ 1	37 to 44 (for 12 volt) 159 to 169 (for 24 volt)	SIG ←→ GND
	1 ←→ Body	∞	SIG ←→ Body

Note: Resistance value is difference according to the engine temperature (condition of engine warming up)

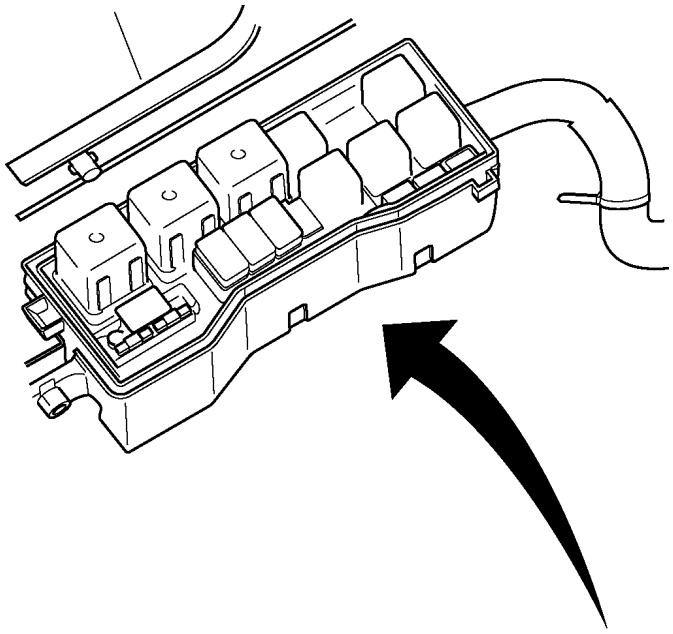
Step	Action	Value (s)	Yes	No
1	Was the “on-board diagnostic (OBD) system check” performed?	-	Go to Step 2	Go to self diag system check
2	Using the DVM, check the resistance of the VSV Does the DVM read the following Value?	37 ~ 44Ω (for 12 Volt) 159 ~ 169Ω (for 24 Volt)	Go to Step 3	Go to Step 4
3	1. Ignition “OFF” 2. Disconnect the ECM connector from ECM. 3. Check the short to voltage of VSV circuit between the ECM and VSV connector 4. Repair if necessary. Has DTC 36 been corrected?	-	Go to Step 6	Go to Step 5
4	Replace the VSV Is the action complete?	-	Go to Step 6	-
5	Replace the ECM. Is the action complete?	-	Go to Step 6	-
6	1. Reconnect all the connectors removed. 2. Ignition “ON”, Engine “OFF” Is DTC 36 all right under Scan Tool Check?	-	Go to Step 7	Go to Step 2
7	Is any current trouble other than DTC 36 displayed by scan tool?	-	Go to trouble code section	Trouble code clear

DTC-P41 QUICK ON START (QOS) RELAY CONTROL CIRCUIT LOW VOLTAGE

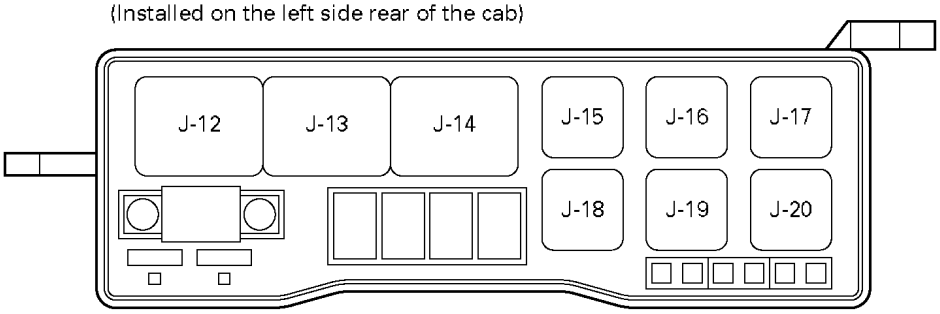


065LW040.tif

Location of relay



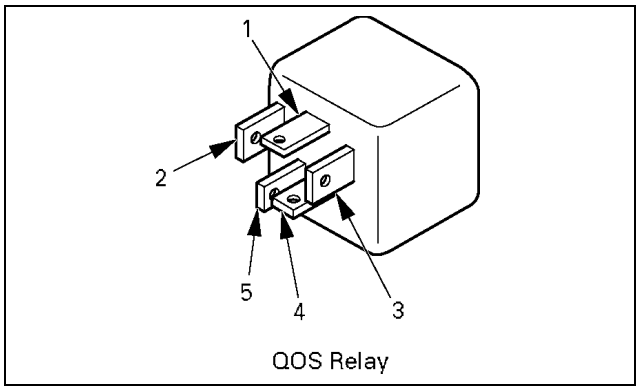
Relay box
(Installed on the left side rear of the cab)



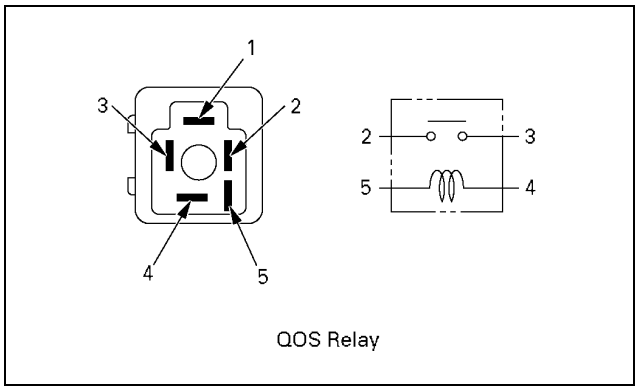
No.	RELAY NAME
J-12	STARTER
J-13	GLOW1 (QOS)
J-14	C/HEATER
J-15	ENG. WARM CUT (QWS)
J-16	———
J-17	CONDENSER FAN
J-18	EXH. BRAKE CONTROL
J-19	———
J-20	MARKER LAMP

826LW038.tif

Inspection for quick on start (QOS) power cut relay



056LW021.tif



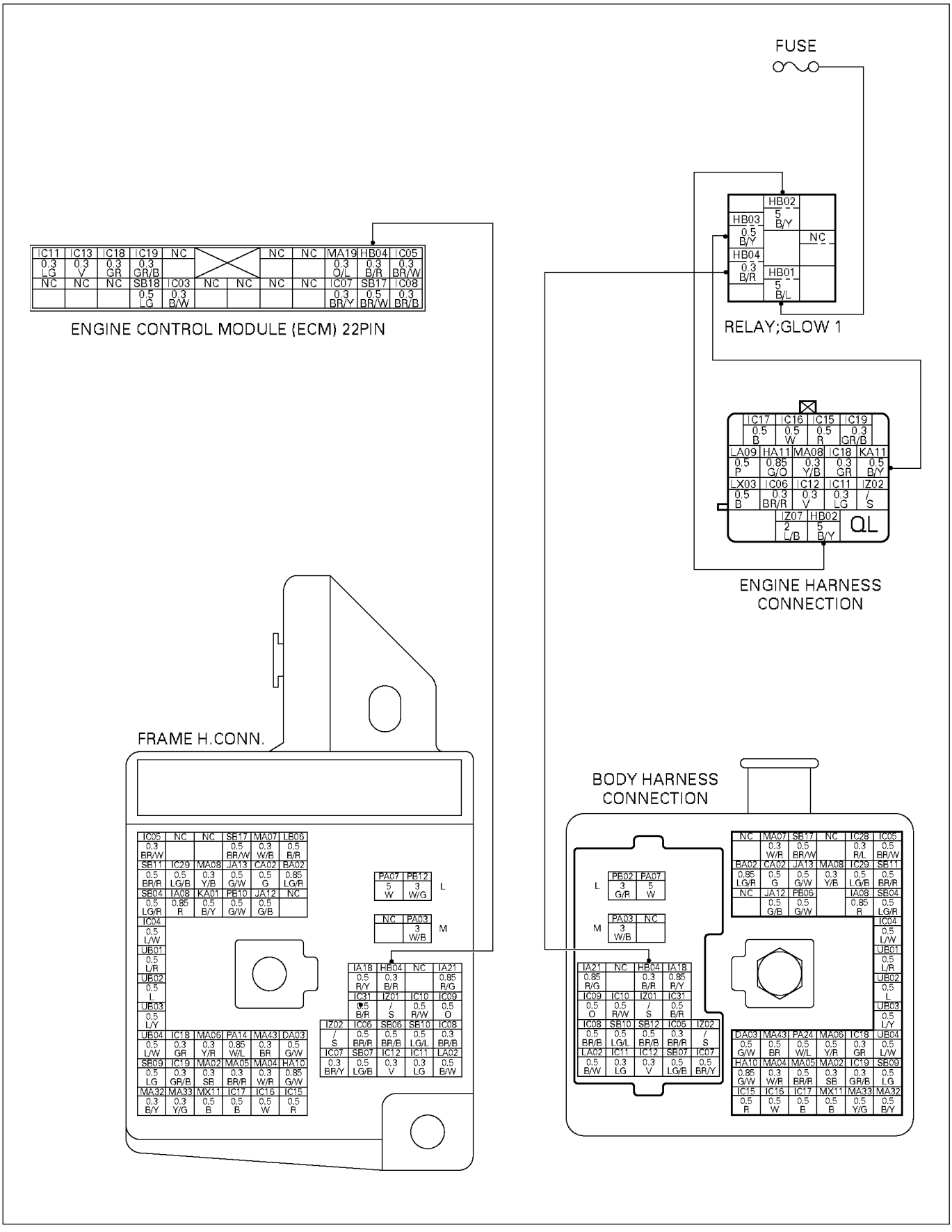
056LW020.tif

Resistance value

Inspection Point		Resistance	Reference
Inspection relay unit	4 ⟷ 5	23 (Ω) (for 12 volt) 100 (Ω) (for 24 volt)	
	2 ⟷ 3	∞	Not be supplied electricity to coil
		Below 0.5 (Ω)	Be supplied electricity to coil

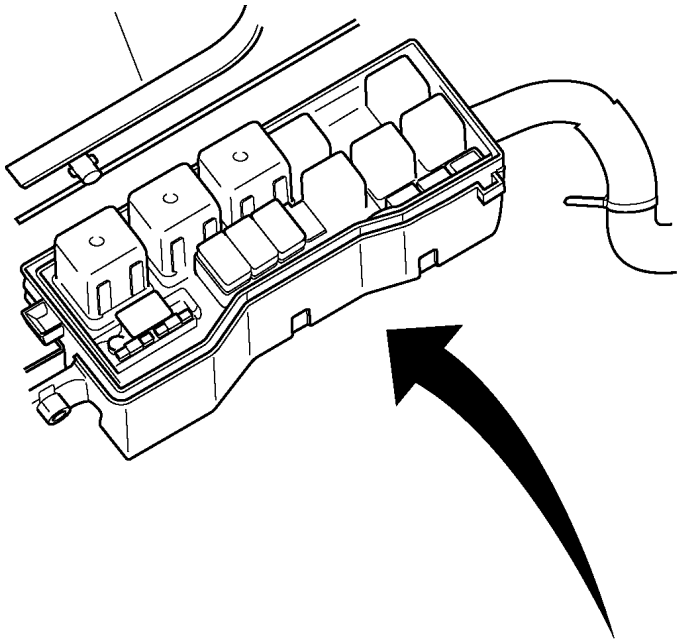
Step	Action	Value (s)	Yes	No
1	Was the “on-board diagnostic (OBD) system check” performed?	-	Go to Step 2	Go to self diag system check
2	1. Ignition “OFF” 2. Disconnect the Relay from the Relay box connector. 3. Ignition “ON” Engine “OFF” 4. Using the Digital Voltmeter (DVM), check for voltage on the “HBOL” terminal of the Relay Box Connector. Does the DVM read the following value?	12 Volt or 24 Volt	Go to Step 4	Go to Step 3
3	1. Check the suspect circuit between the Relay connector. Fuse for the following condition. * A short to ground * An open circuit 2. Repair if necessary. Has DTC 41 been corrected?	-	Go to Step 8	Go to Step 4
4	Using the DVM, check the resistance of inter “4” “5” Relay terminal. Does the DVM read the following Value?	23Ω (for 12 Volt) 100Ω (for 24 Volt)	Go to Step 5	Go to Step 6
5	1. Ignition “OFF” 2. Disconnect the ECM connector from ECM. 3. Check the VSV circuit between the ECU and Relay connector * A short to ground * An open circuit 2. Repair if necessary. Has DTC 41 been corrected?	-	Go to Step 8	Go to Step 7
6	Replace the Relay. Is the action complete?	-	Go to Step 8	-
7	Replace the ECM. Is the action complete?	-	Go to Step 8	-
8	1. Reconnect all the connectors removed. 2. Ignition “ON”, Engine “OFF” Is DTC 41 all right under Scan Tool Check?	-	Go to Step 9	Go to Step 2
9	Is any current trouble other than DTC 41 displayed by scan tool?	-	Go to trouble code section	Trouble code clear

DTC-P42 QUICK ON START (QOS) RELAY CONTROL CIRCUIT HIGH VOLTAGE

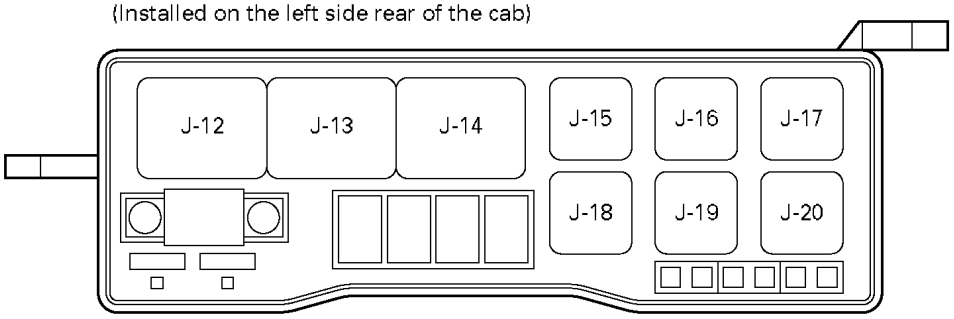


065LW040.tif

Location of relay



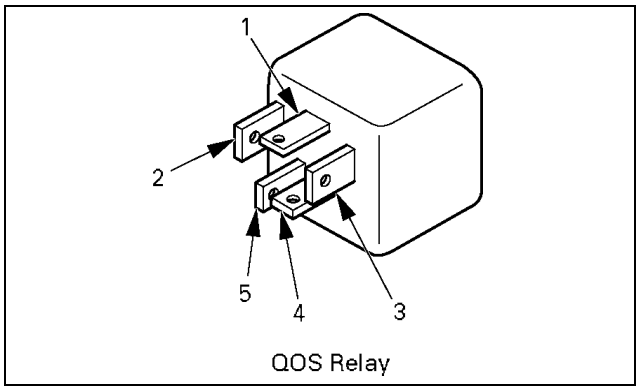
Relay box
(Installed on the left side rear of the cab)



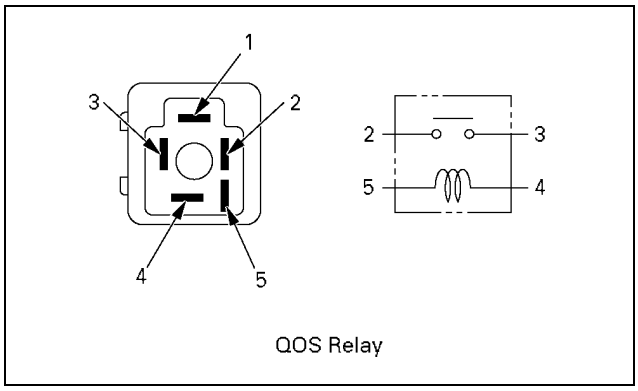
No.	RELAY NAME
J-12	STARTER
J-13	GLOW1 (QOS)
J-14	C/HEATER
J-15	ENG. WARM CUT (QWS)
J-16	———
J-17	CONDENSER FAN
J-18	EXH. BRAKE CONTROL
J-19	———
J-20	MARKER LAMP

826LW038.tif

Inspection for Quick On Start (QOS) power cut relay



056LW021.tif



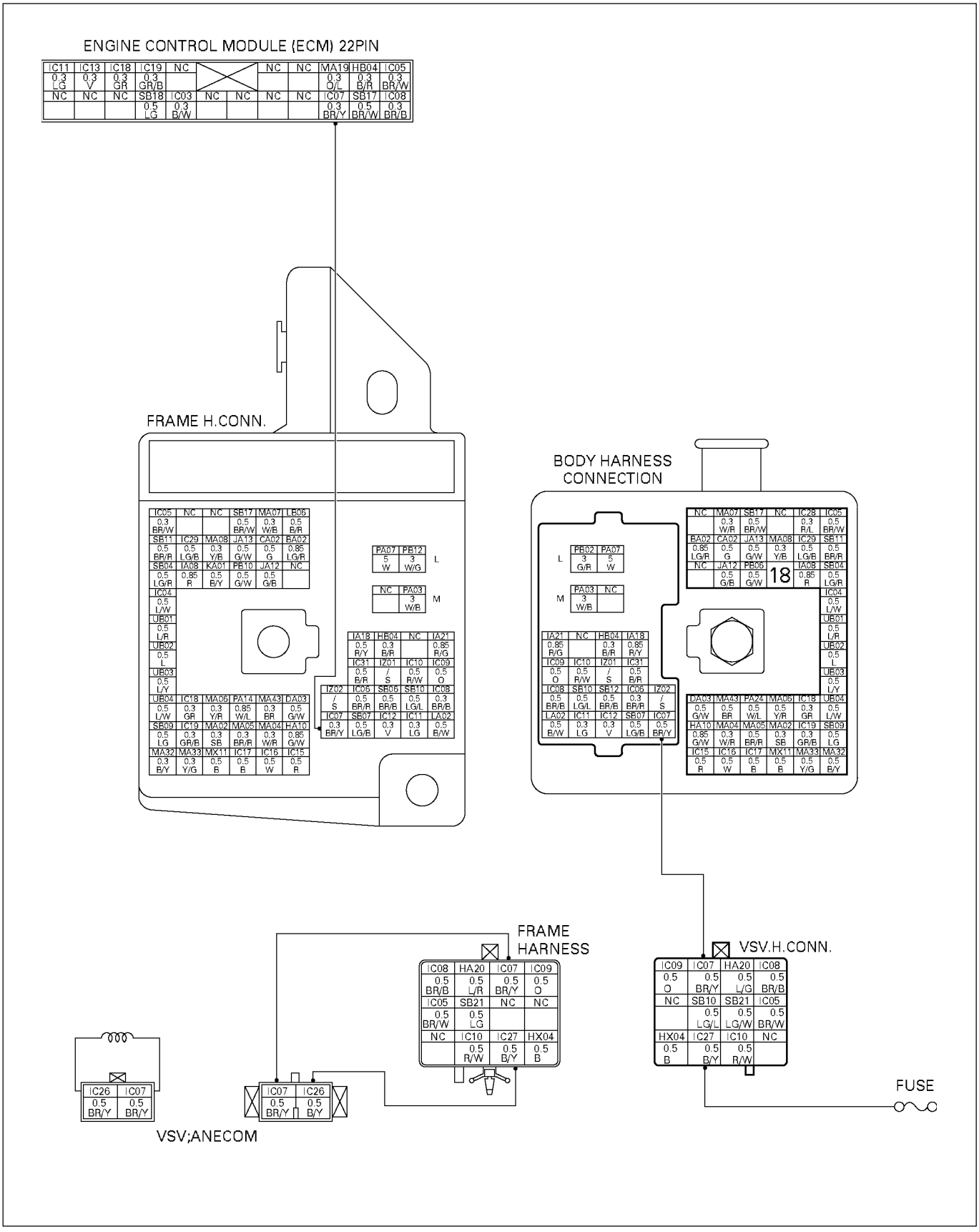
056LW020.tif

Resistance value

Inspection Point		Resistance	Reference
Inspection relay unit	4 ⟷ 5	23 (Ω) (for 12 volt) 100 (Ω) (for 24 volt)	
	2 ⟷ 3	∞	Not be supplied electricity to coil
		Below 0.5 (Ω)	Be supplied electricity to coil

Step	Action	Value (s)	Yes	No
1	Was the “on-board diagnostic (OBD) system check” performed?	-	Go to Step 2	Go to self diag system check
2	Using the DVM, check the resistance of the Relay Does the DVM read the following Value?	23Ω (for 12 Volt) 100Ω (for 24 Volt)	Go to Step 3	Go to Step 4
3	1. Ignition “OFF” 2. Disconnect the ECM connector from ECM. 3. Check the short to voltage of Relay circuit between the ECM and Relay connector 4. Repair if necessary. Has DTC 42 been corrected?	-	Go to Step 6	Go to Step 5
4	Replace the VSV Is the action complete?	-	Go to Step 6	-
5	Replace the ECM. Is the action complete?	-	Go to Step 6	-
6	1. Reconnect all the connectors removed. 2. Ignition “ON”, Engine “OFF” Is DTC 42 all right under Scan Tool Check?	-	Go to Step 7	Go to Step 2
7	Is any current trouble other than DTC 42 displayed by scan tool?	-	Go to trouble code section	Trouble code clear

DTC-P43 ANEROID COMPENSATOR VACUUM SWITCHING VALVE (VSV) CONTROL CIRCUIT LOW VOLTAGE



065LW033.tif

Appearance of Vacuum Switching Valve (VSV): Aneroid compensator and connector name

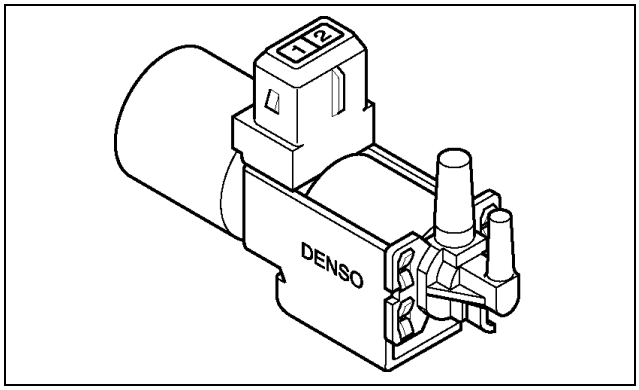


Figure. VSV:Aneroid compensator 056LW001.tif

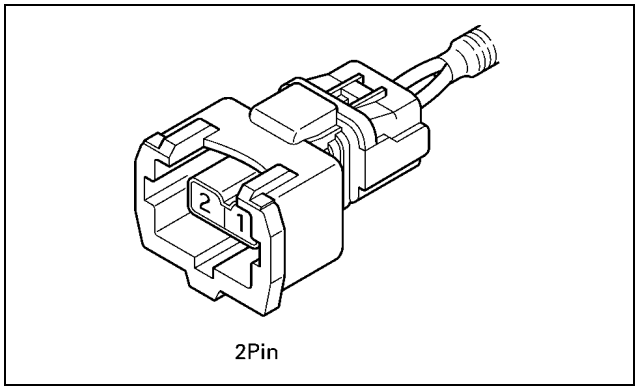
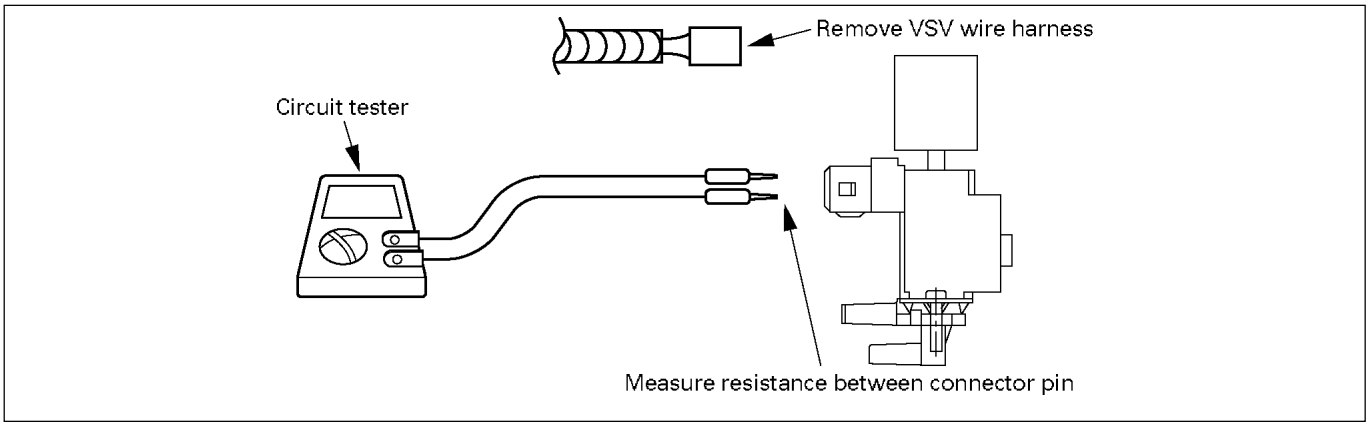


Figure. VSV:Aneroid compensator connector 056LY00003

Connector No	Signal
1 2	SIG GND

Measure resistance at VSV Aneroid compensator



056LW005.tif

CAUTION:

When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

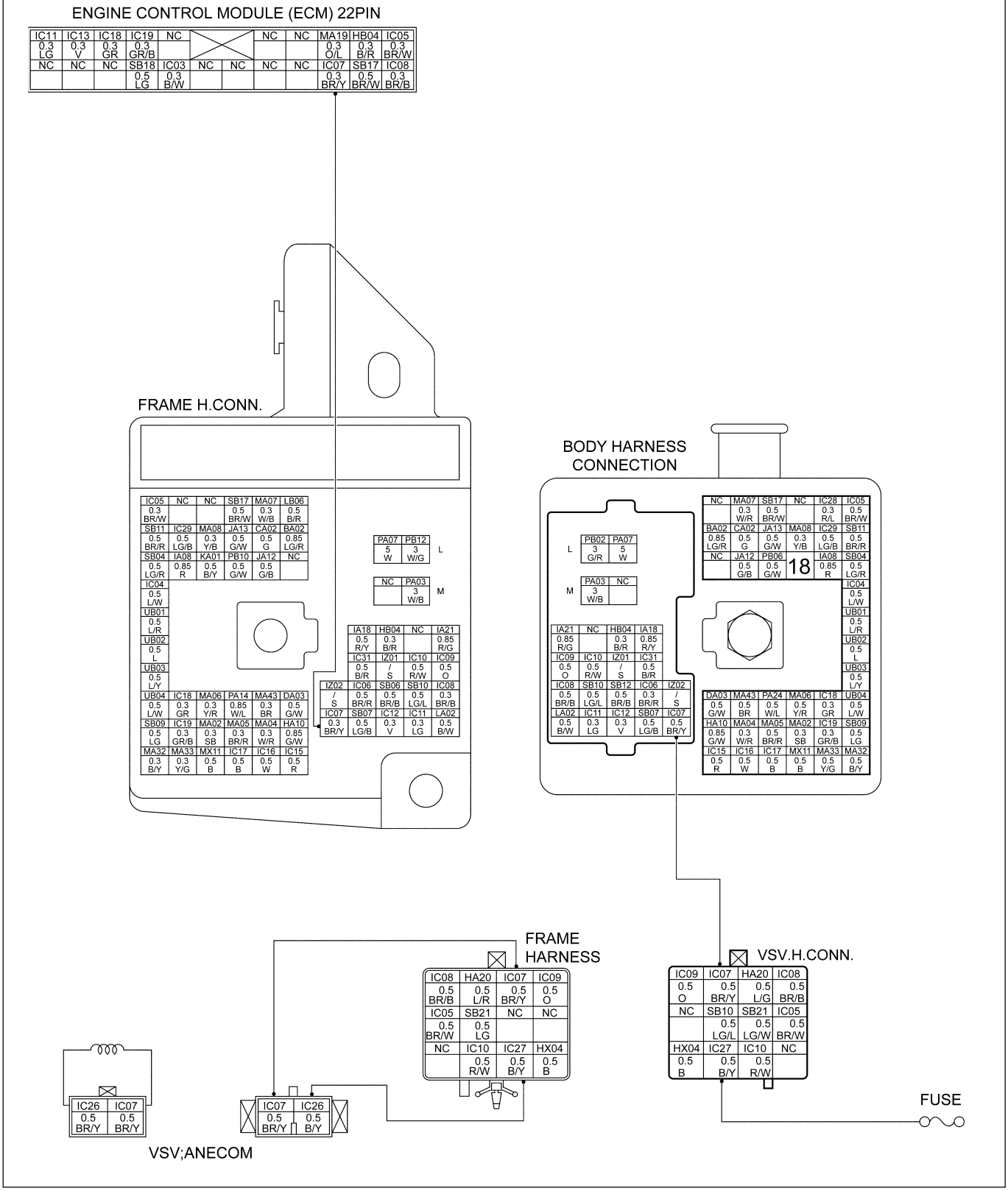
Resistance value

Inspection Point		Resistance Value (kΩ)	Reference
Connector	Pin No.		
2 pin Gray	2 ←→ 1	37 to 44 (for 12 volt) 159 to 169 (for 24 volt)	SIG ←→ GND
	1 ←→ Body	∞	SIG ←→ Body

Note: Resistance value is difference according to the engine temperature (condition of engine warming up)

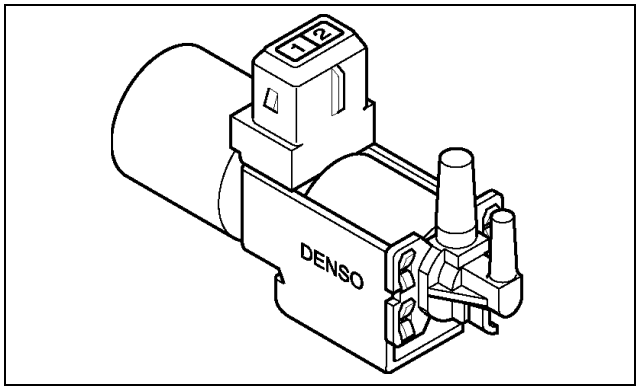
Step	Action	Value (s)	Yes	No
1	Was the “on-board diagnostic (OBD) system check” performed?	-	Go to Step 2	Go to self diag system check
2	1. Ignition “OFF” 2. Disconnect the VSV from the wiring harness connector. 3. Ignition “ON” Engine “OFF” 4. Using the Digital Voltmeter (DVM), check for voltage on the “IC26” of the VSV harness connector. Does the DVM read the following value?	12 Volt or 24 Volt	Go to Step 4	Go to Step 3
3	1. Check the suspect circuit between the VSV connector and “Engine Ignition.” Fuse for the following condition. * A short to ground * An open circuit 2. Repair if necessary. Has DTC 43 been corrected?	-	Go to Step 8	Go to Step 4
4	Using the DVM, check the resistance of the VSV Does the DVM read the following Value?	37 ~ 44Ω (for 12 Volt) 159 ~ 169Ω (for 24 Volt)	Go to Step 5	Go to Step 6
5	1. Ignition “OFF” 2. Disconnect the ECM connector from ECM. 3. Check the VSV circuit between the ECM and VSV connector * A short to ground * An open circuit 2. Repair if necessary. Has DTC 43 been corrected?	-	Go to Step 8	Go to Step 7
6	Replace the VSV Is the action complete?	-	Go to Step 8	-
7	Replace the ECM. Is the action complete?	-	Go to Step 9	-
8	1. Reconnect all the connectors removed. 2. Ignition “ON”, Engine “OFF” Is DTC 43 all right under Scan Tool Check?	-	Go to Step 9	Go to Step 2
9	Is any current trouble other than DTC 43 displayed by scan tool?	-	Go to trouble code section	Trouble code clear

DTC-P44 ANEROID COMPENSATOR VACUUM SWITCHING VALVE (VSV) CONTROL CIRCUIT HIGH VOLTAGE



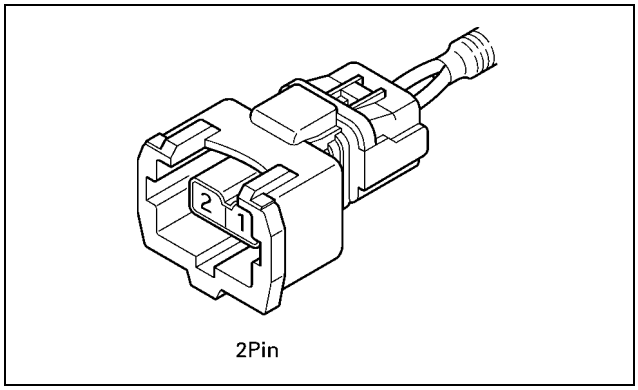
065LW033.tif

Appearance of Vacuum Switching Valve (VSV): Ameroid compensator and connector name



056LW001.tif

Figure. VSV:Aneroid Compensator

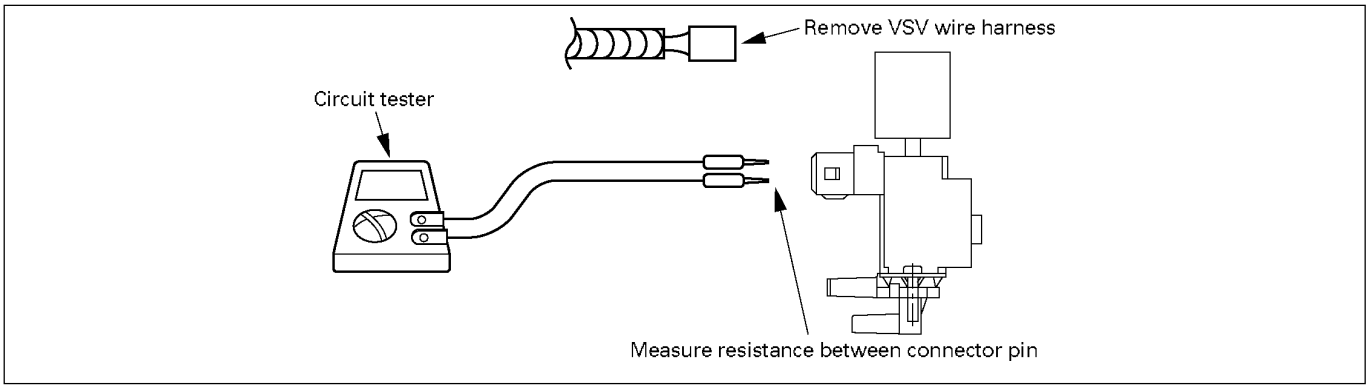


056LY00003

Figure. VSV:Aneroid compensator

Connector No	Signal
1 2	SIG GND

Measure resistance at VSV Aneroid compensator



056LW005.tif

CAUTION:
When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

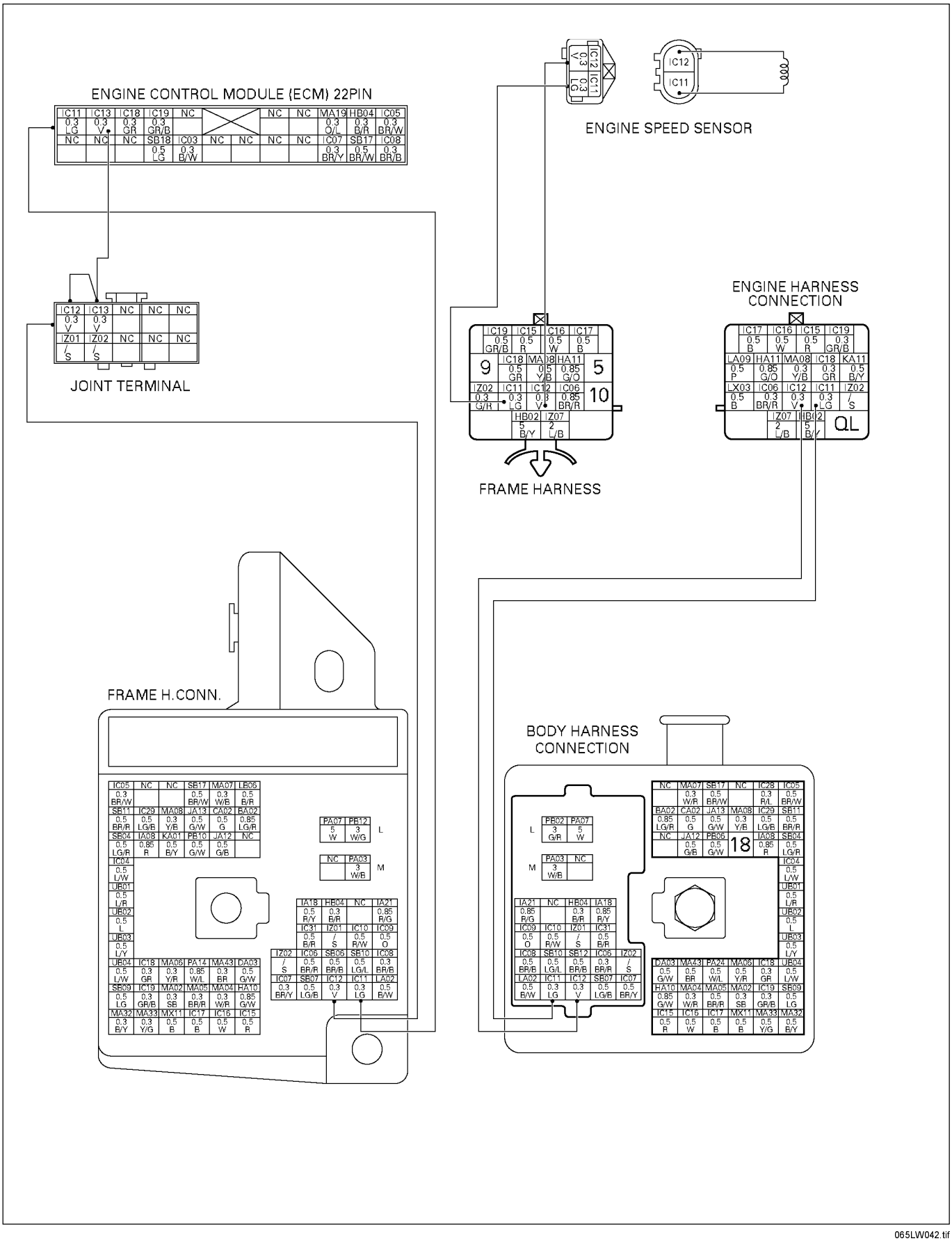
Resistance value

Inspection Point		Resistance Value (kΩ)	Reference
Connector	Pin No.		
3 pin Green	2 ⟷ 1	37 to 44 (for 12 volt) 159 to 169 (for 24 volt)	SIG ⟷ GND
	1 ⟷ Body	∞	SIG ⟷ Body

Note: Resistance value is difference according to the engine temperature (condition of engine warming up)

Step	Action	Value (s)	Yes	No
1	Using the DVM, check the resistance of the VSV Does the DVM read the following Value?	37 ~ 44Ω (for 12 Volt) 159 ~ 169Ω (for 24 Volt)	Go to Step 4	Go to Step 3
2	1. Ignition “OFF” 2. Disconnect the ECM connector from ECM. 3. Check the short to voltage of VSV circuit between the ECM and VSV connector 4. Repair if necessary. 5. Clear trouble code by Scan Tool. 6. Ignition “ON” Engine “ON”. 7. Does the MIL blink?	-	Go to Step 6	Go to Step 5
3	Replace the VSV Is the action complete?	-	Go to Step 6	-
4	Replace the ECM. Is the action complete?	-	Go to Step 6	-
5	1. Reconnect all the connectors removed. 2. Ignition “ON”, Engine “OFF”. Clear trouble code by Scan Tool. 3. Ignition “ON” Engine “ON”. 4. Does the MIL blink?	-	Go to Step 7	Go to Step 2
6	Connect Scan Tool. Is any current trouble other than DTC 44 displayed by scan tool?	-	Go to trouble code section	Trouble code clear

DTC-P45 ENGINE SPEED SENSOR CIRCUIT LOW VOLTAGE



065LW042.tif

Appearance of Engine Speed sensor and connector name

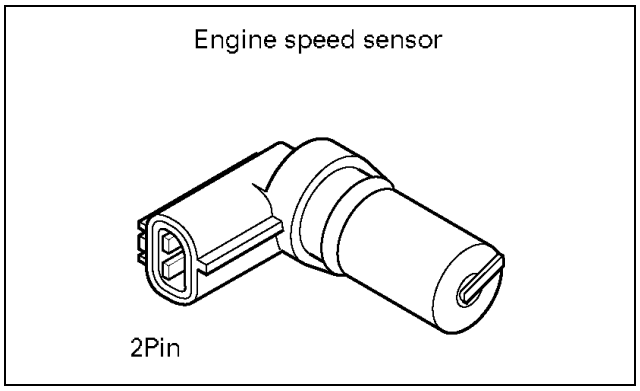


Figure. Engine Speed sensor 056LW014.tif

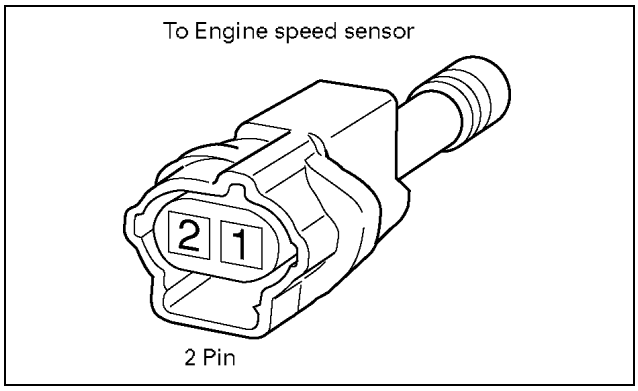
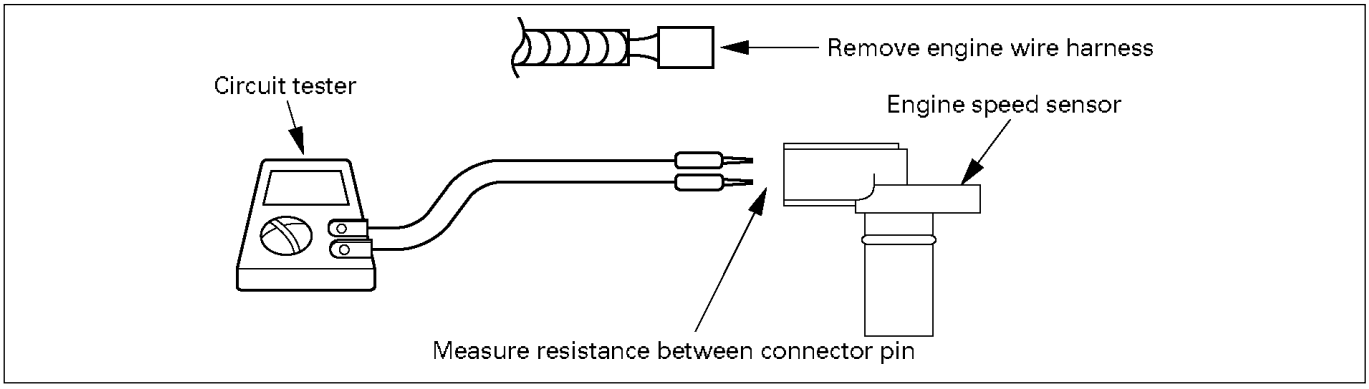


Figure. Engine Speed sensor connector 056LW008.tif

Connector No	Signal
1 2	GND SIG

Measure resistance at Engine Speed sensor



056LW022.tif

CAUTION:

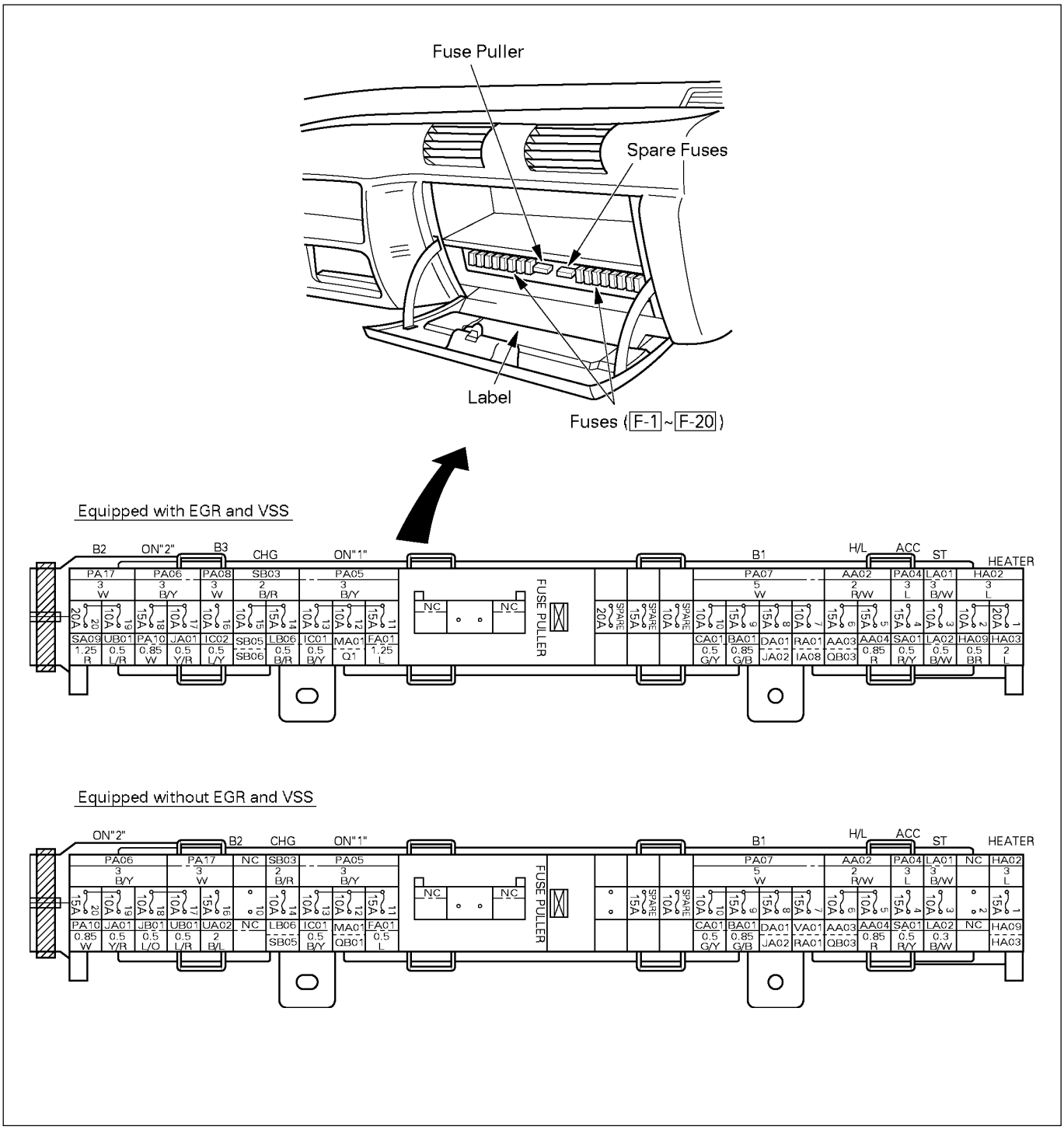
When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

Resistance value

Inspection Point		Resistance Value (kΩ)	Reference
Connector	Pin No.		
2 pin Black	2 ⟷ 1 2 ⟷ Body	840±20% ∞	SIG ⟷ GND SIG ⟷ Body

Note: Resistance value is difference according to the engine temperature (condition of engine warming up)

Location of fuse



056LW030.tif

Step	Action	Value (s)	Yes	No
1	1. Ignition “ON”, Engine “OFF” 2. Connect a voltmeter to the ECM connector terminals (ENGINE+) and (ENGINE-) Is the voltage 0V?	-	Go to Step 3	Go to Step 5
2	1. Ignition “ON”, Engine “ON” 2. Connect a voltmeter to the ECM connector terminals (ENGINE+) and (ENGINE-). Is the voltage under the range of 0-1V (AC intermittently) when the engine speed is about 2000RPM? Does the Voltage increase as the engine speed is increased?	-	Go to Step 4	Go to Step 6
3	Check for poor sensor ground or sensor signal circuit terminal connection and terminal shorted at the ECM and replace terminal(s) if necessary. Did any of the terminals need to be replaced?	-	Go to Step 9	Go to Step 8
4	1. Check sensor signal circuit for disconnection and power source for short. 2. Check sensor GND circuit for disconnection and power source for short. Repair if necessary was repair needed?	-	Go to Step 9	Go to Step 8
5	1. Check signal circuit for GND short. 2. Repair if necessary. Was repair needed?	-	Go to Step 9	Go to Step 7
6	Replaced sensor. Was sensor replaced?	-	Go to Step 9	-
7	Replace the ECM. Is the action complete?	-	Go to Step 9	-
8	1. Reconnect all the connectors removed. 2. Ignition “ON”, Engine “OFF” 3. Connect the Scan Tool. 4. Ignition “ON” Engine “OFF” 5. Make Scan Tool indicate engine speed. Is a speed range of 700 rpm to 900 rpm indicated with the engine idling (accel. off)? And as engine speed rises with accel. on, does the indicated value rise?	-	Go to Step 9	Go to Step 2
9	Is any current trouble other than DTC 45 displayed by scan tool?	-	Go to trouble code section	Trouble code clear

DTC-P52 ELECTRONICALLY ERASABLE PROGRAMMABLE READ ONLY MEMORY (EEPROM) ERROR

Step	Action	Value (s)	Yes	No
1	Was the “on-board diagnostic (OBD) system check” performed?	-	Go to Step 2	Go to self diag system check
2	Replace the ECM Is the action complete?	-	Go to Step 3	-
3	1. Reconnect all the connectors removed. 2. Ignition “ON”, Engine “OFF” Is DTC 52 all right under Scan Tool Check?	-	Go to Step 4	Go to Step 2
4	Is any current trouble other than DTC 52 displayed by scan tool?	-	Go to trouble code section	Trouble code clear

DTC-P61 BAROMETRIC PRESSURE SENSOR CIRCUIT ERROR

Step	Action	Value (s)	Yes	No
1	Was the “on-board diagnostic (OBD) system check” performed?	-	Go to Step 2	Go to self diag system check
2	Replace the ECM Is the action complete?	-	Go to Step 3	-
3	1. Reconnect all the connectors removed. 2. Ignition “ON”, Engine “OFF” Is DTC 61 all right under Scan Tool Check?	-	Go to Step 4	Go to Step 2
4	Is any current trouble other than DTC 61 displayed by scan tool?	-	Go to trouble code section	Trouble code clear

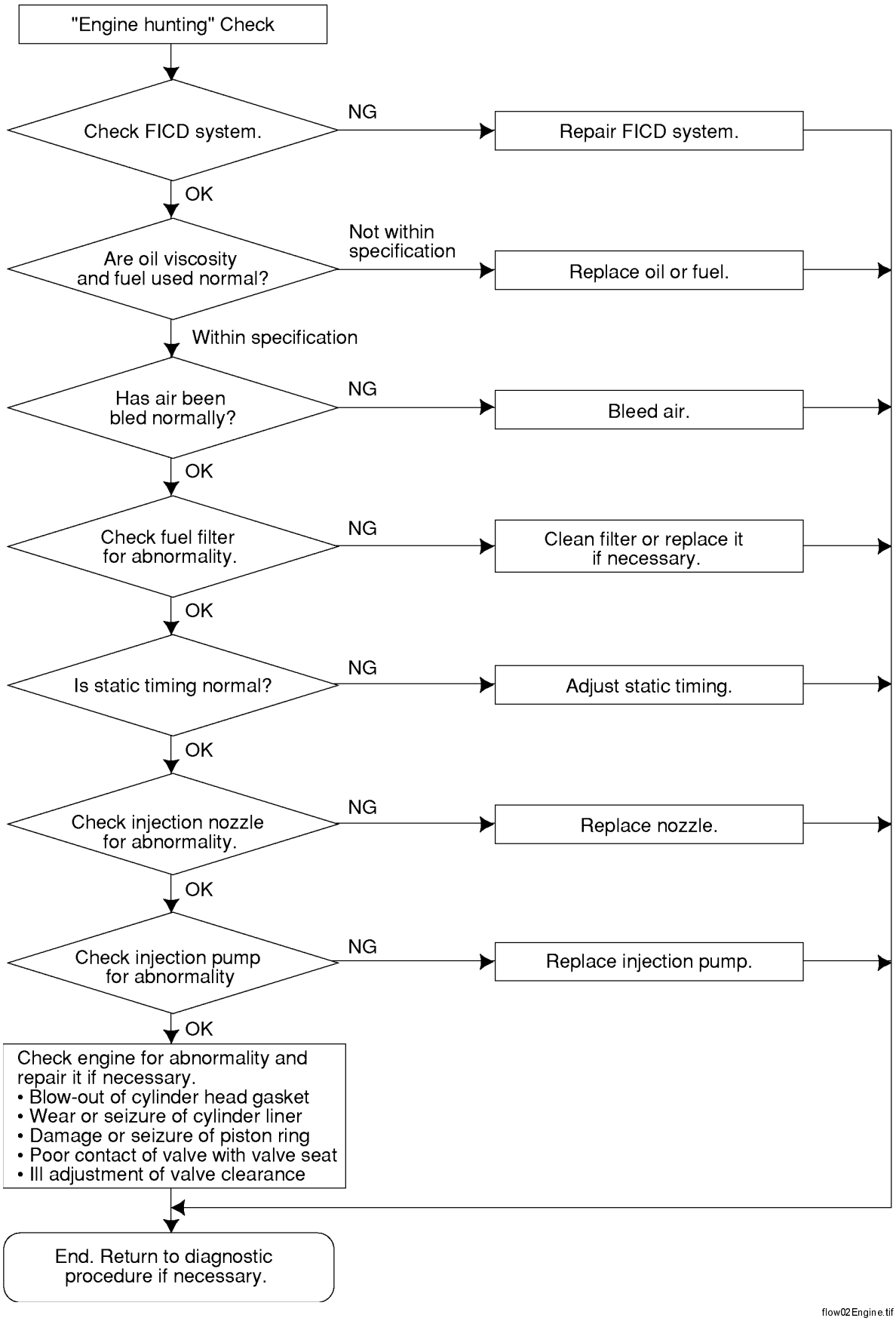
WITHOUT DIAGNOSIS TROUBLE CODE

INTRODUCTION

If there occurs a malfunction although no Diagnostic Trouble Code (DTC) is generated, then inspect and repair the system in accordance with the flowcharts given on the following pages.

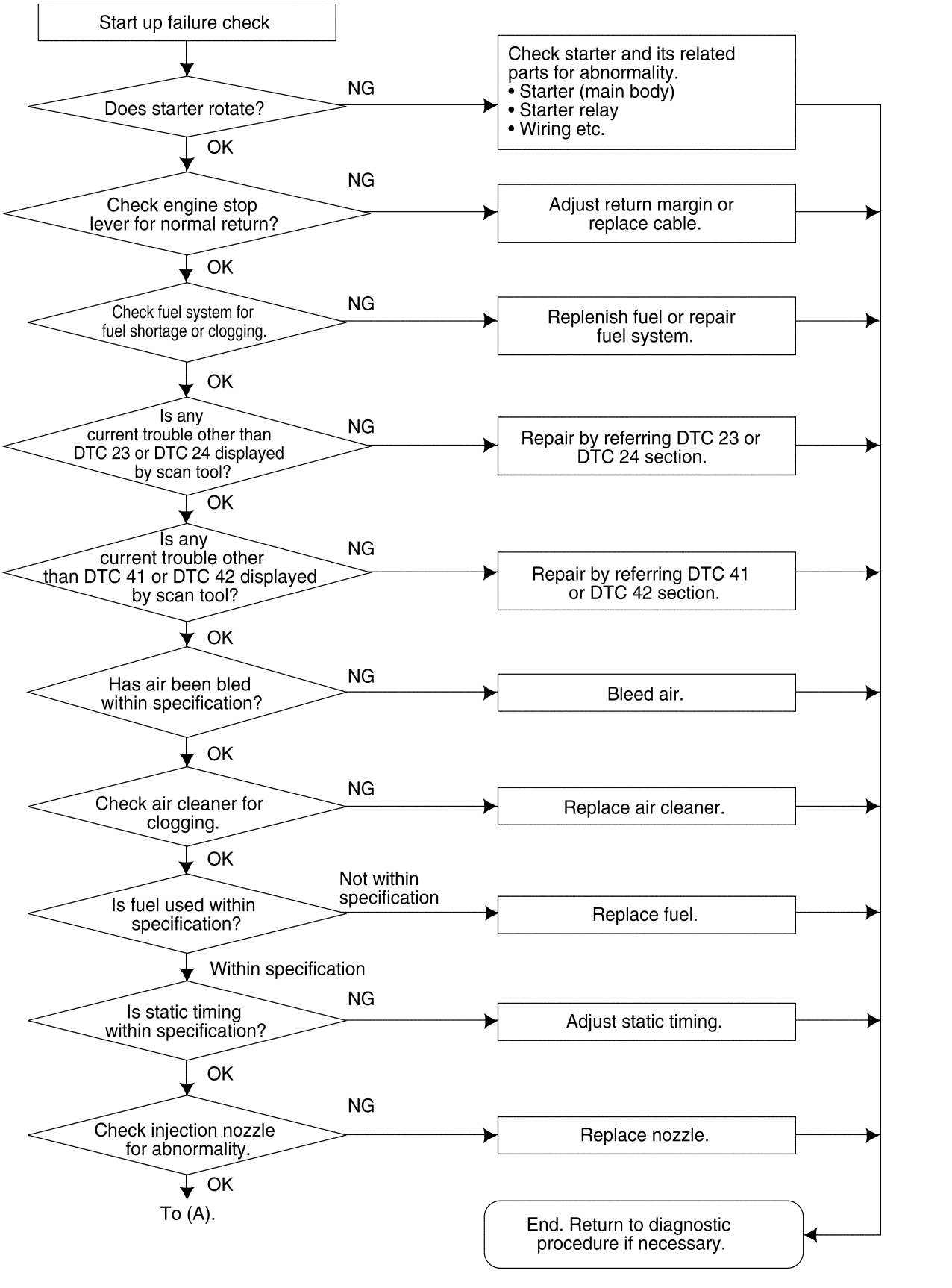
When a Diagnostic Trouble Code (DTC) is produced, inspect and repair system with reference to “EMISSION AND ELECTRICAL DIAGNOSIS”

ENGINE HUNTING

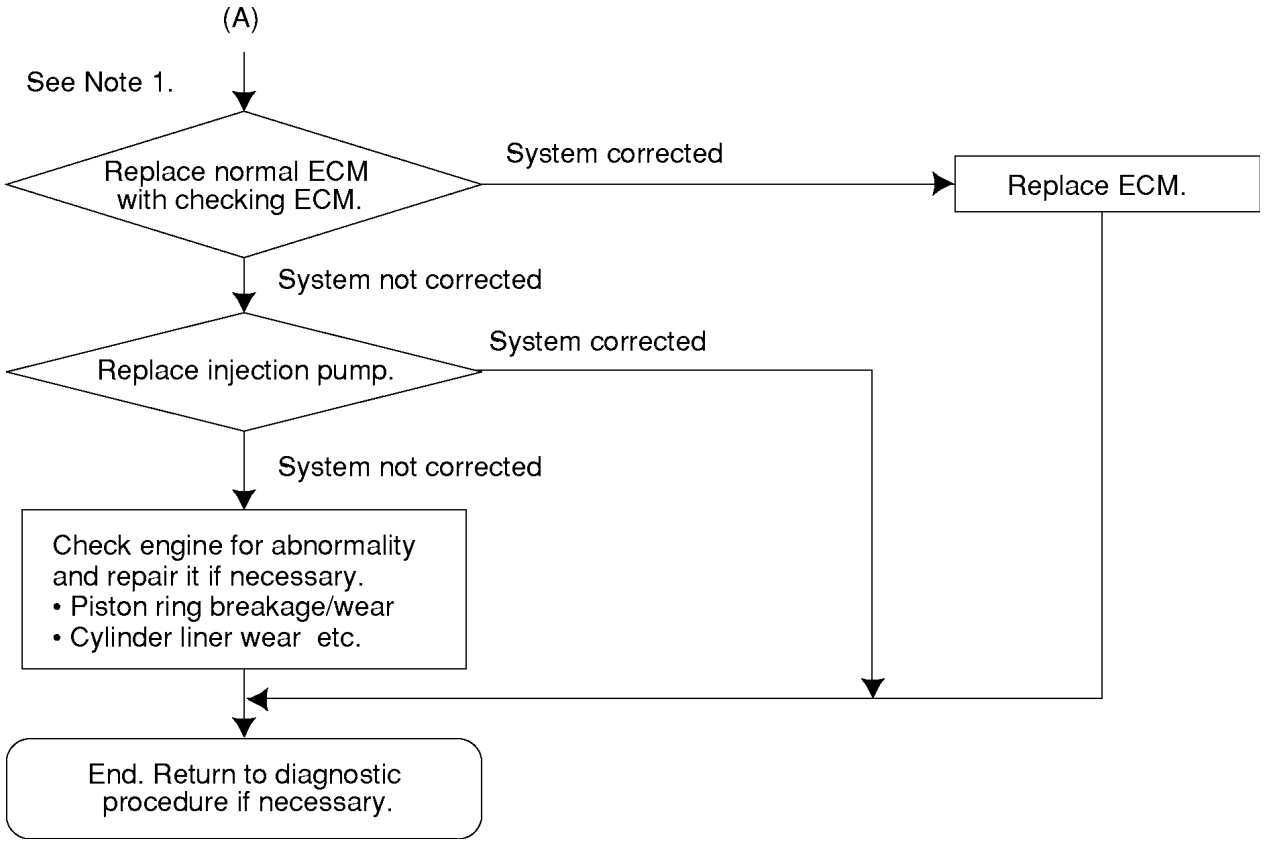


flow02Engine.tif

STARTUP FAILURE



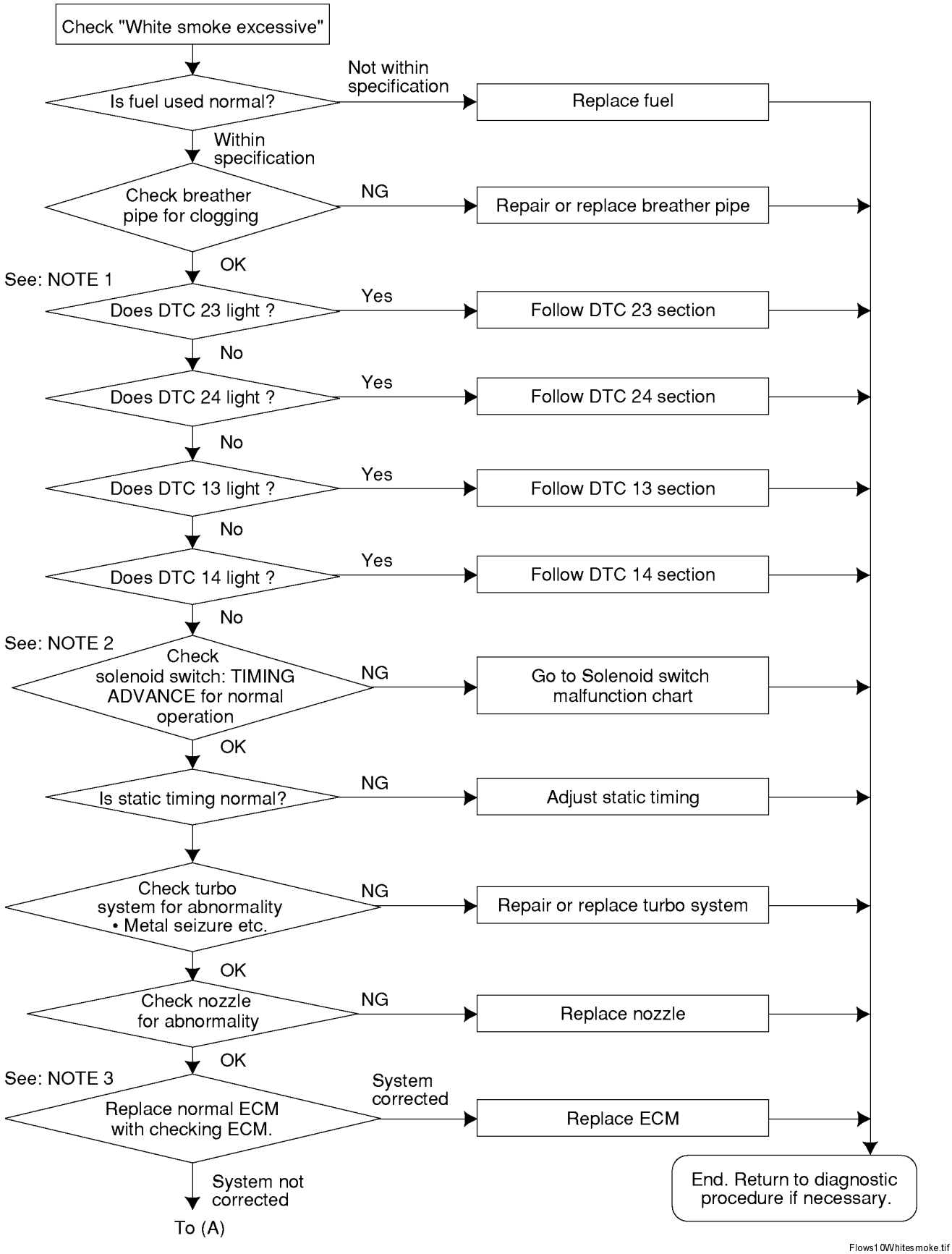
Flow03AStartup.tif



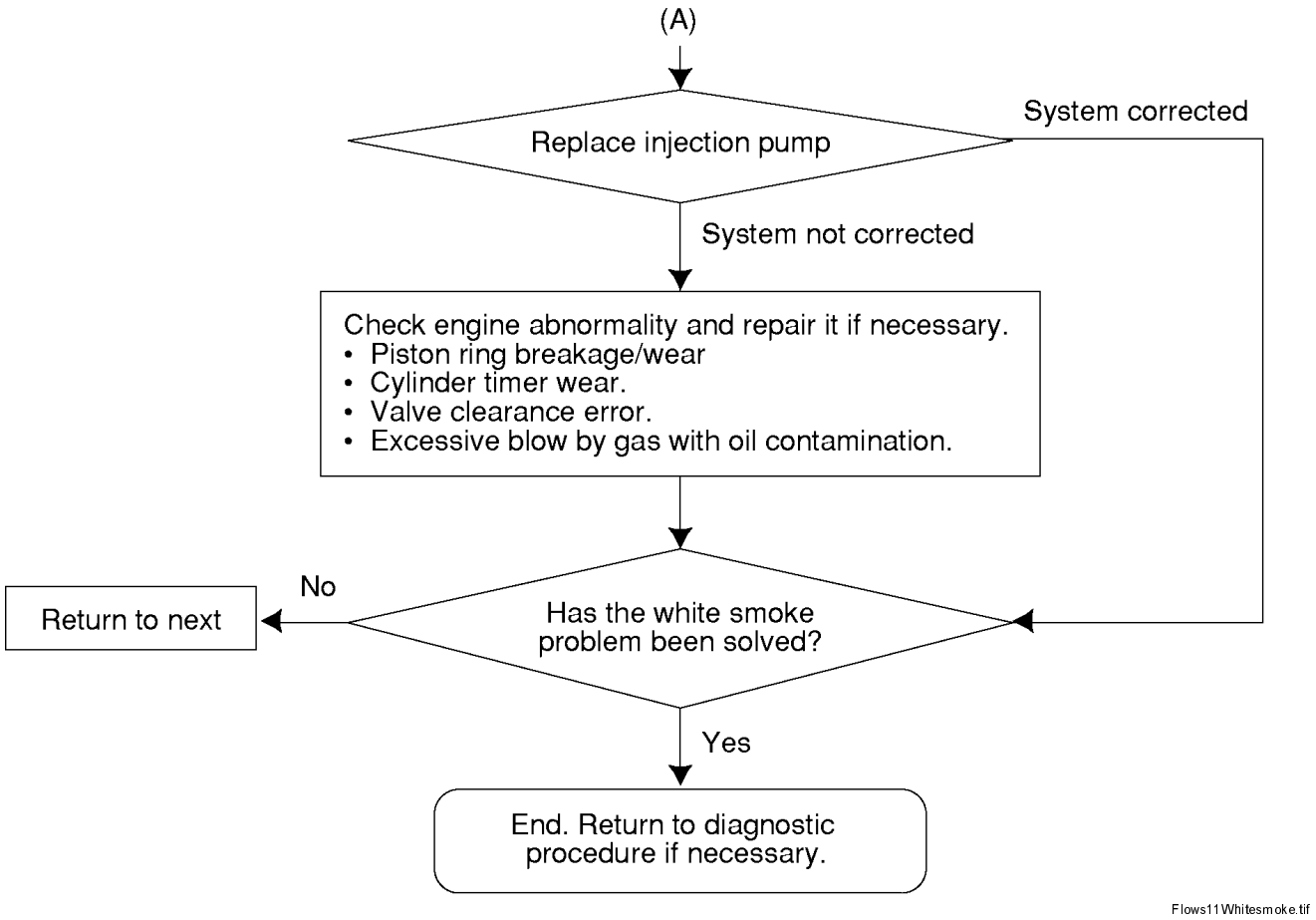
NOTE 1:

The condition of the system in which the malfunction has occurred should be checked by making comparisons between the vehicle Engine Control Module (ECM) and the checking ECM.

WHITE SMOKE (EXCESSIVE)



Flows10Whitesmoke.tif



NOTE 1:

"Follow (DTC-13, 14, 23, 24)" means to refer "Workshop Manual EMISSION AND ELECTRICAL DIAGNOSIS 4HE1 6E Section of Diagnosis Trouble Code (DTC-13, 14, 23, 24)" for other DTC code, follow concerned DTC sections.

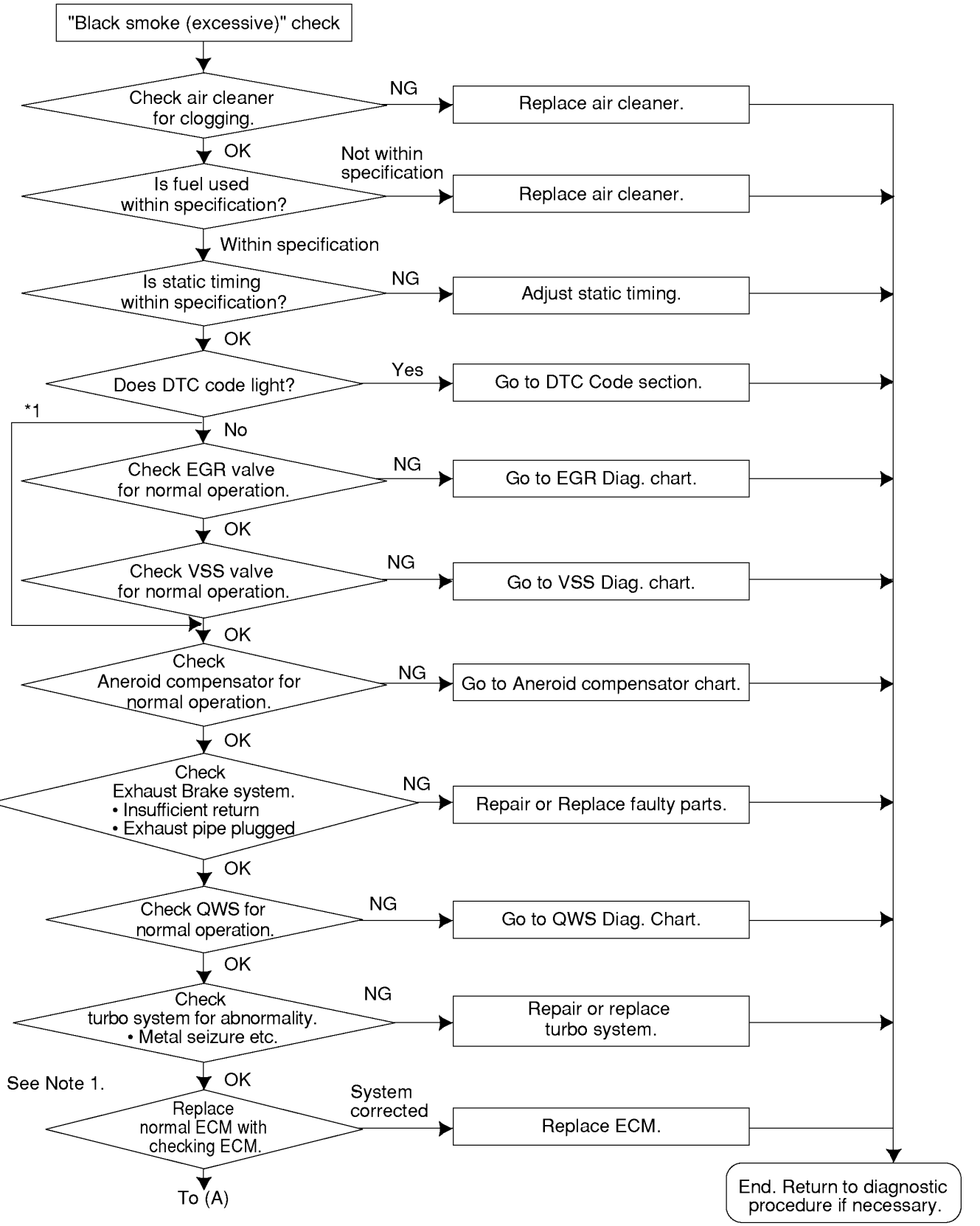
NOTE 2:

Turn the ignition key from the "OFF" position to the "ON" position to put on the solenoid switch attached to the injection pump. After the solenoid switch being on for 18 consecutive seconds, check from the outside of the vehicle if the release sound of the solenoid switch is heard.

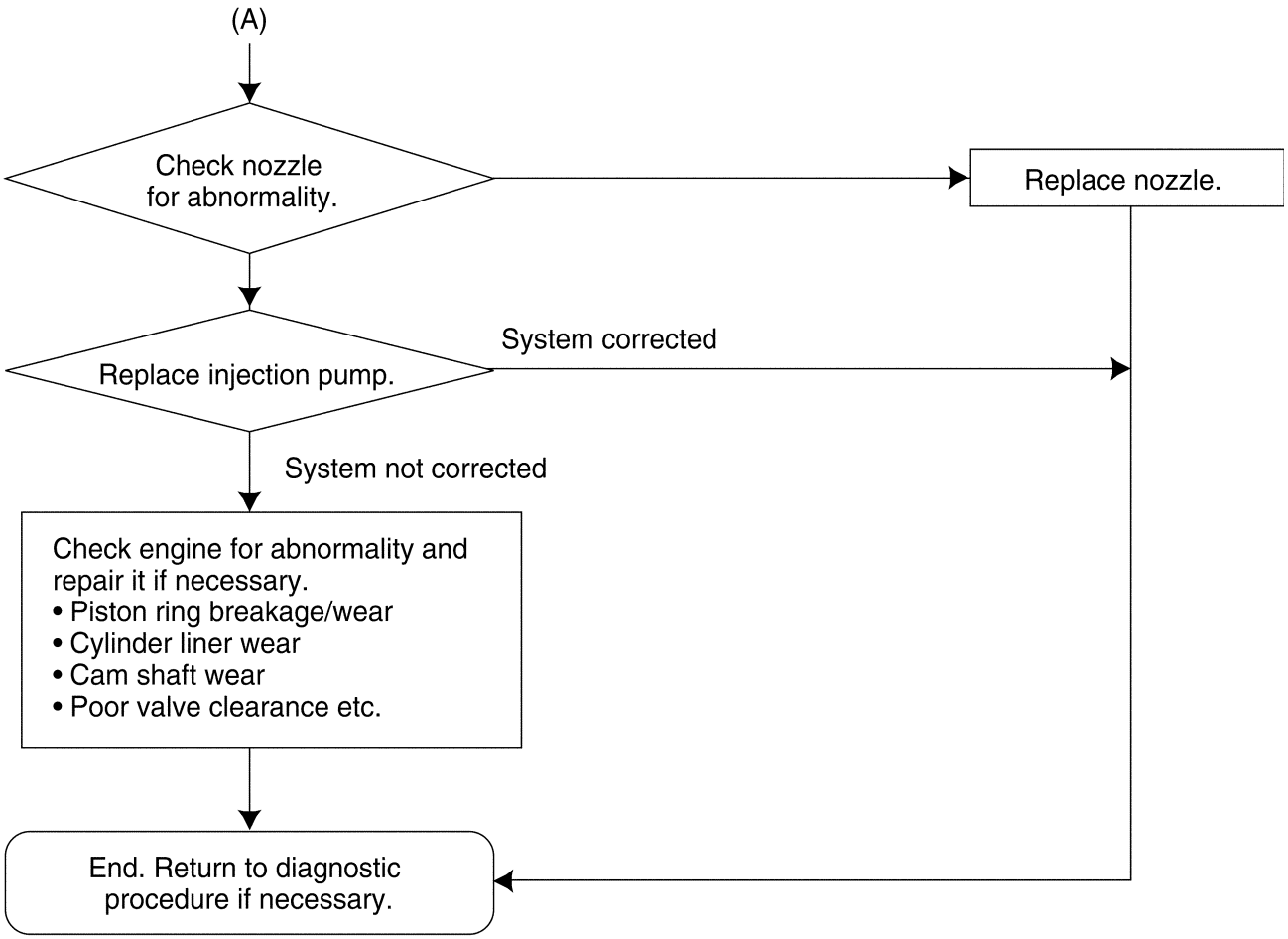
NOTE 3:

The condition of the system in which the malfunction has occurred should be checked by making comparisons between the vehicle Engine Control Module (ECM) and the checking ECM.

BLACK SMOKE (EXCESSIVE)



Flow04ABlack.tif



Flow04BBlack.tif

NOTE 1:

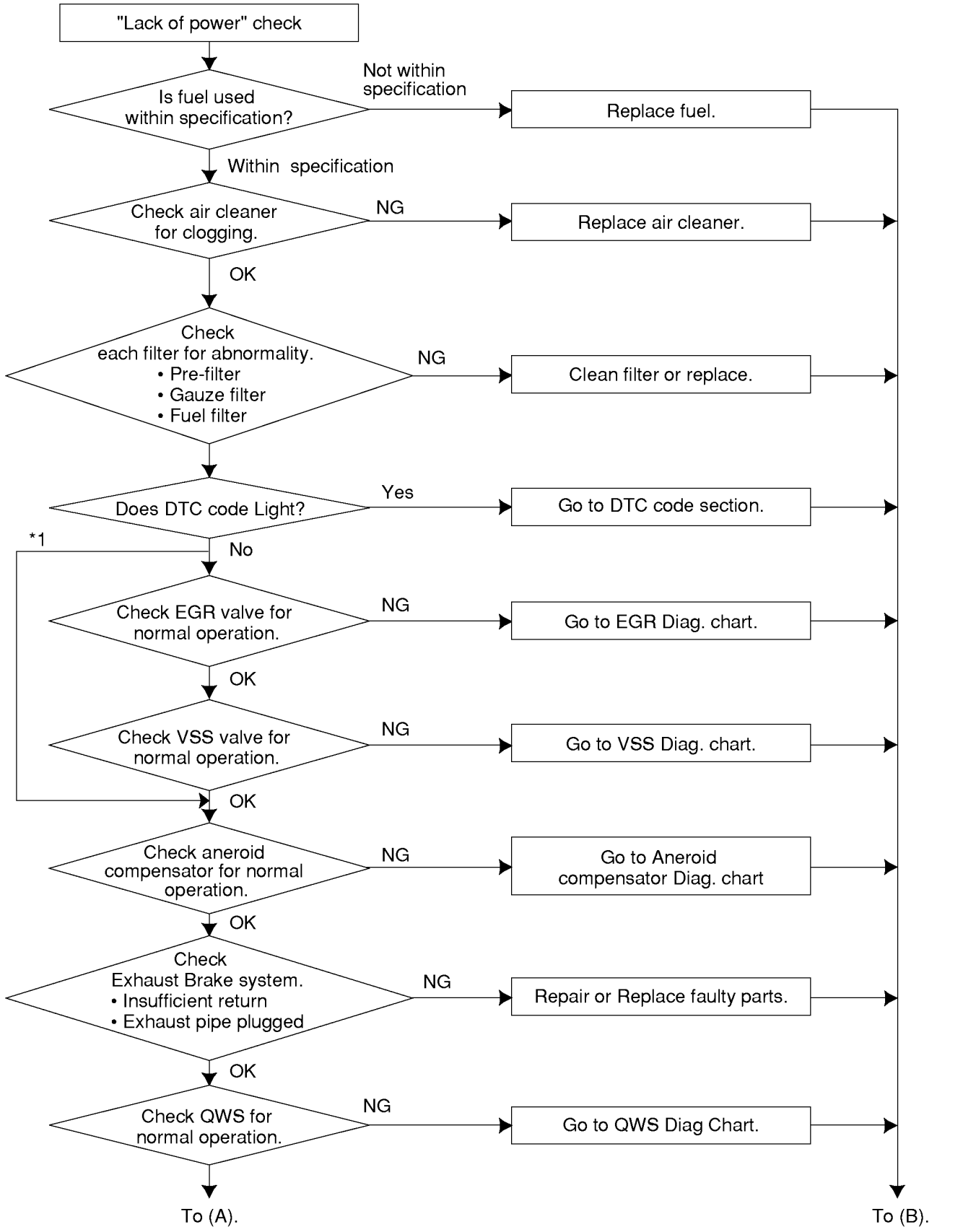
The condition of the system in which the malfunction has occurred should be checked by making comparisons between the vehicle Engine Control Module (ECM) and the checking ECM.

NOTE 2:

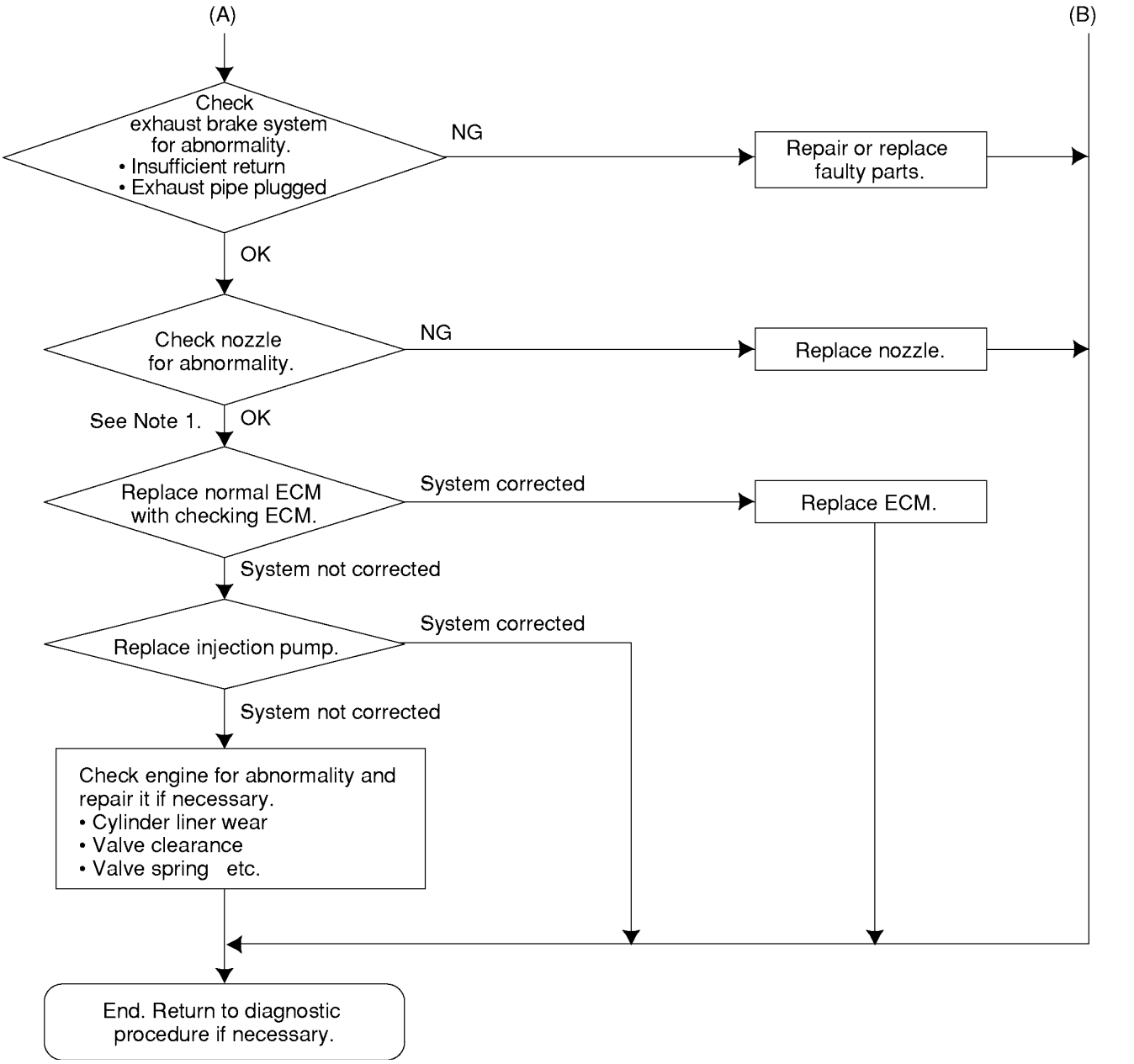
Refer to a trouble code for a supplier's check, if available.

***1. Equipped without Exhaust Gas Recirculation (EGR) and Variable Swirl System (VSS).**

LACK OF POWER



Flow05ALackof.tif



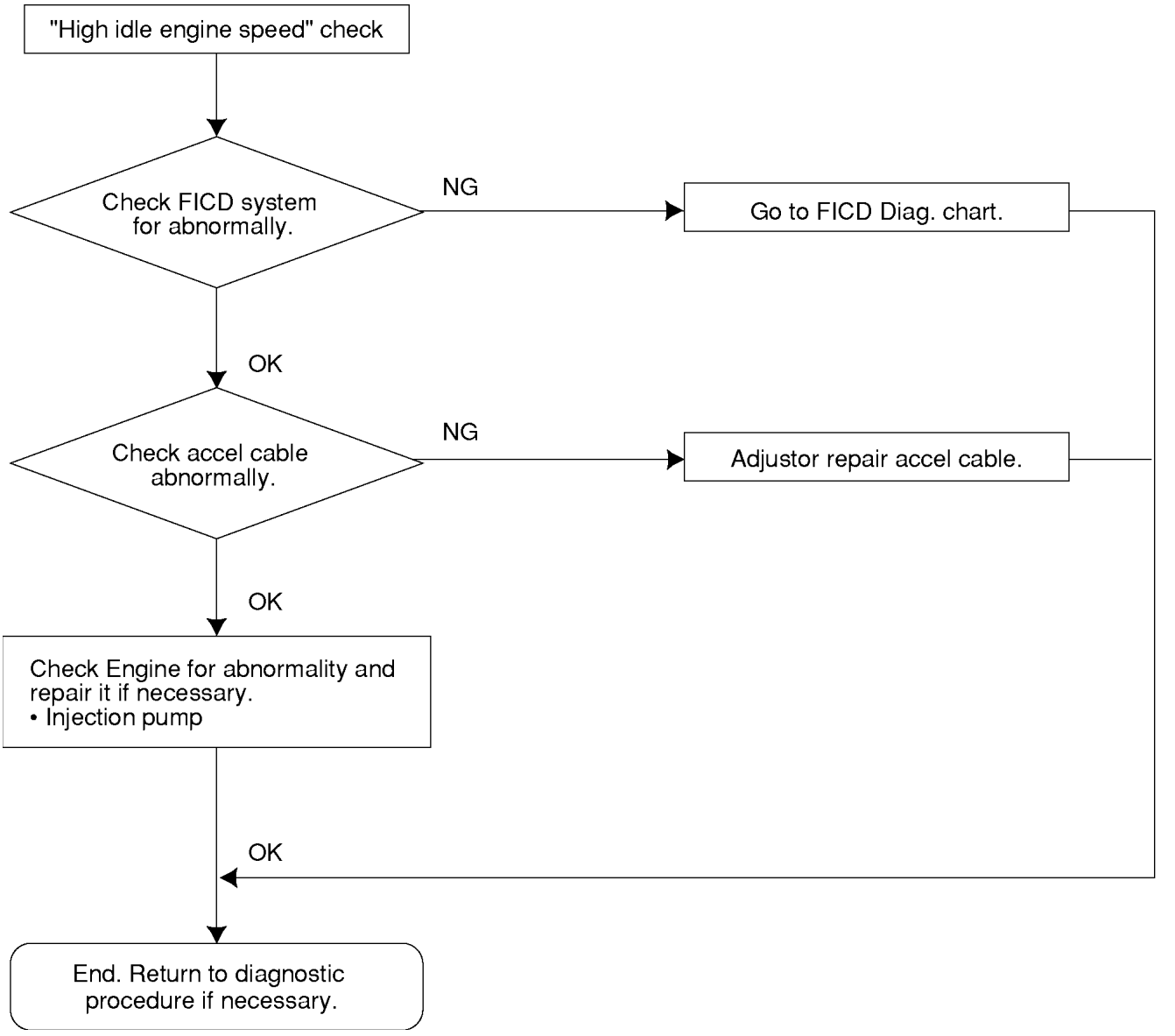
Flow05BLackof.tif

NOTE 1:

The condition of the system in which the malfunction has occurred should be checked by making comparisons between the vehicle Engine Control Module (ECM) and the checking ECM.

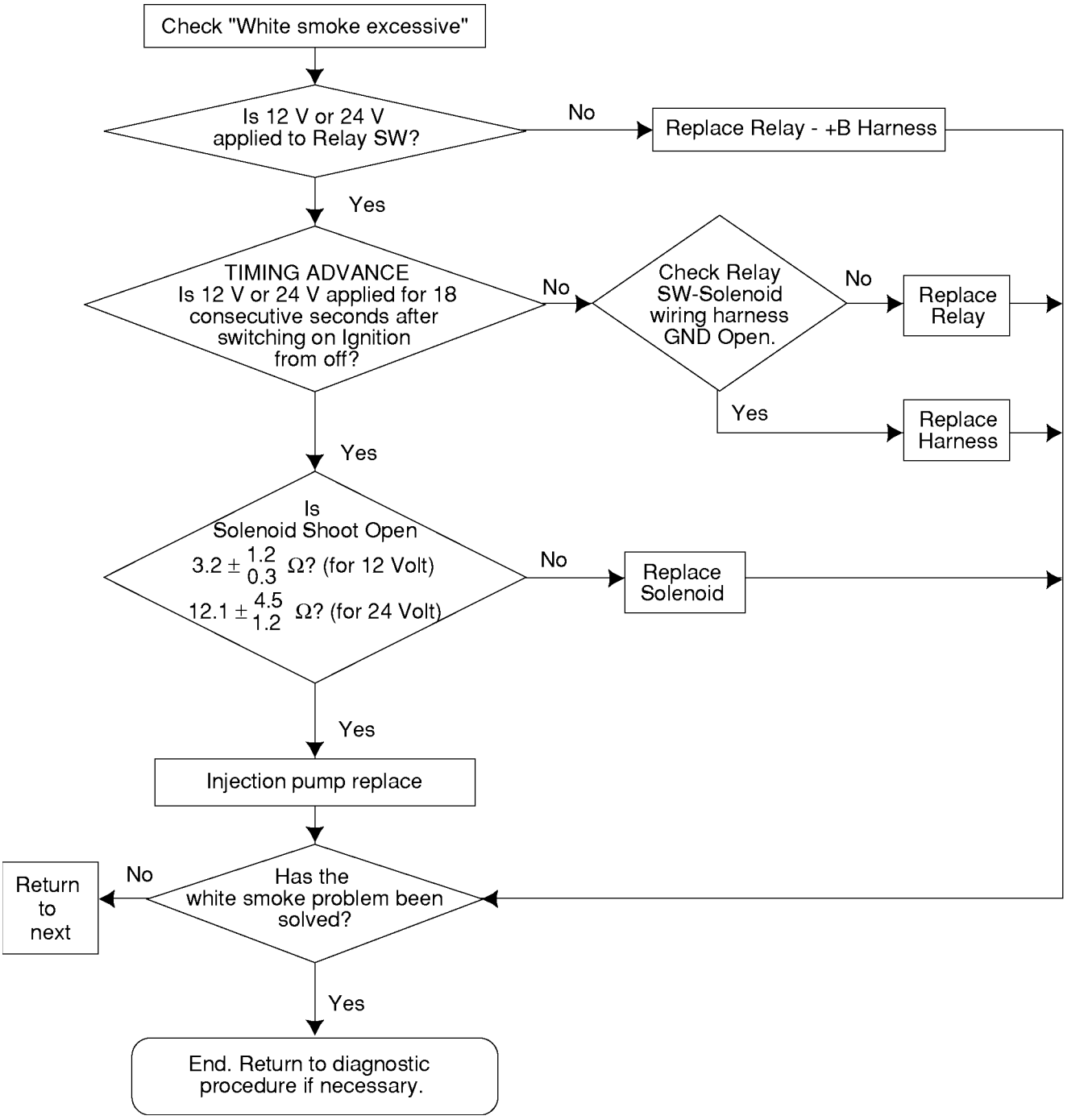
***1. Equipped without Exhaust Gas Recirculation (EGR) and Variable Swirl System (VSS).**

HIGH IDLE ENGINE SPEED



Flow10Highidle.tif

SOLENOID SWITCH MALFUNCTION



Flows12Solenoid.tif

INSPECTION

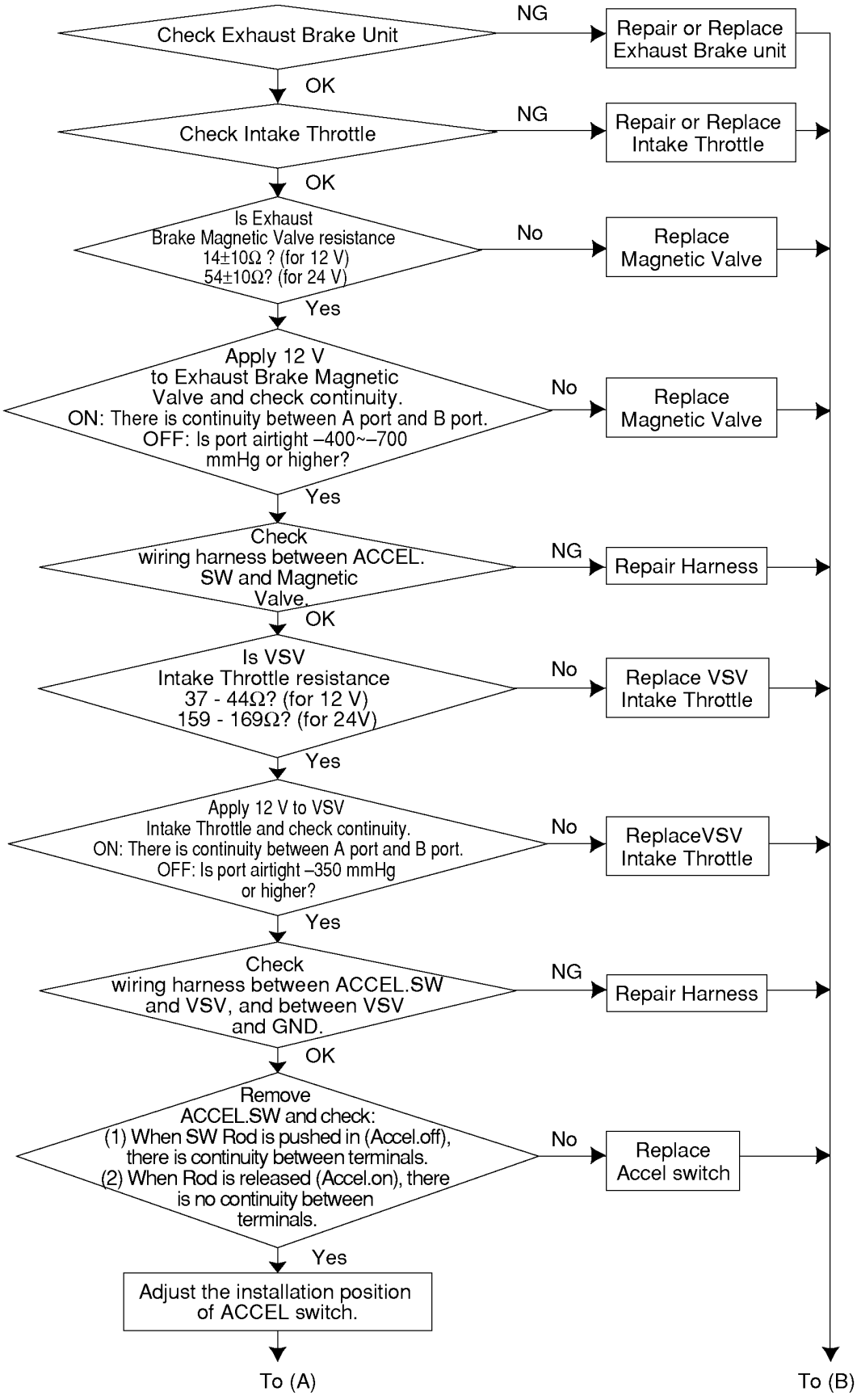
Solenoid Switch

Disconnect the connector on the solenoid switch.

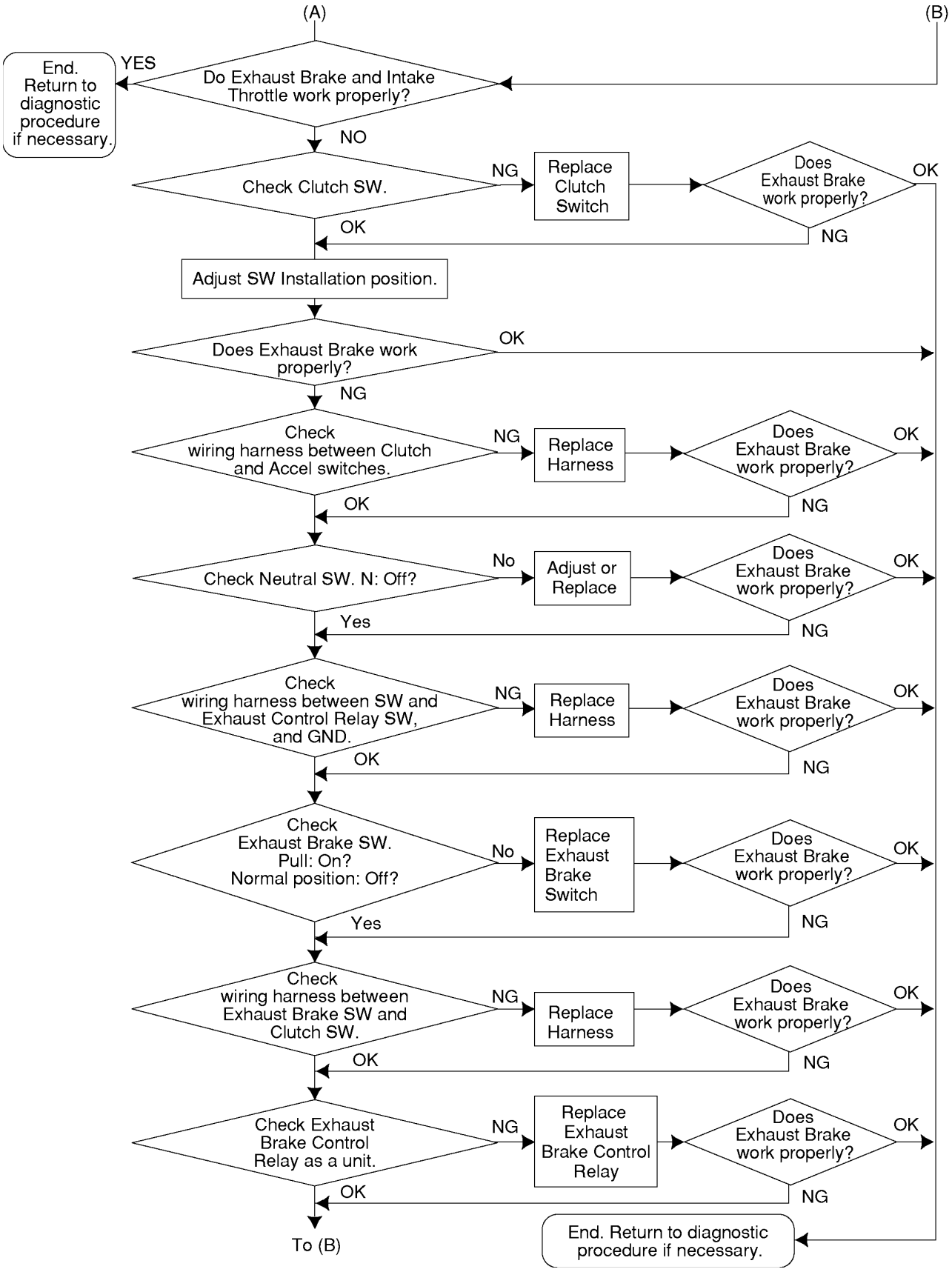
Apply 12 volts or 24 volts DC to the solenoid switch and hear the touching noise between solenoid switch and advance lever in the injection pump.

If can not hear the touching noise, do not remove the solenoids switch and contact injection pump service shop to repair it.

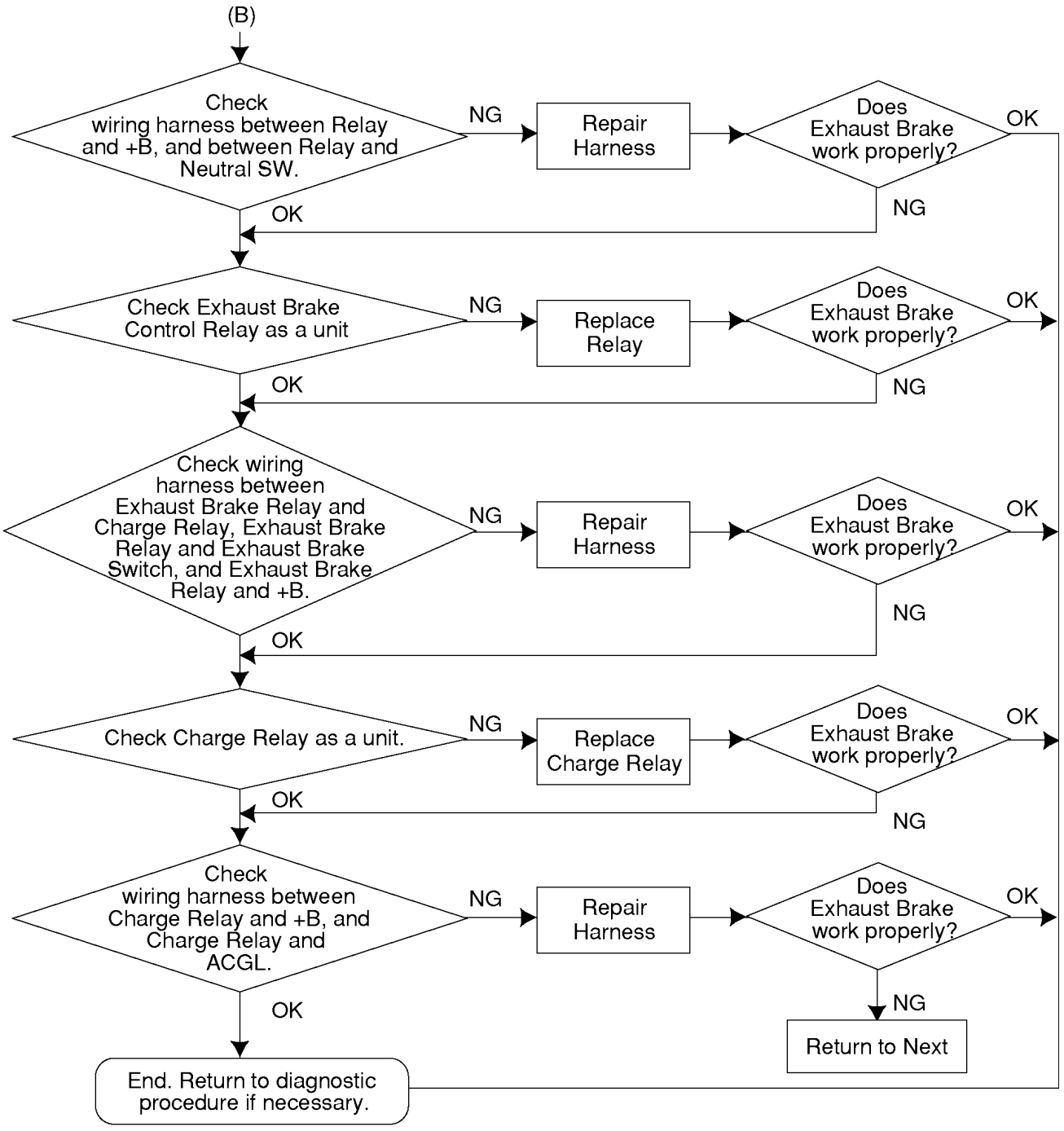
EXHAUST BRAKE MALFUNCTION



Flows07ExhaustBk.tif



Flows 08QWSsysCheck.tif



* Repair of wiring harness includes diode check.

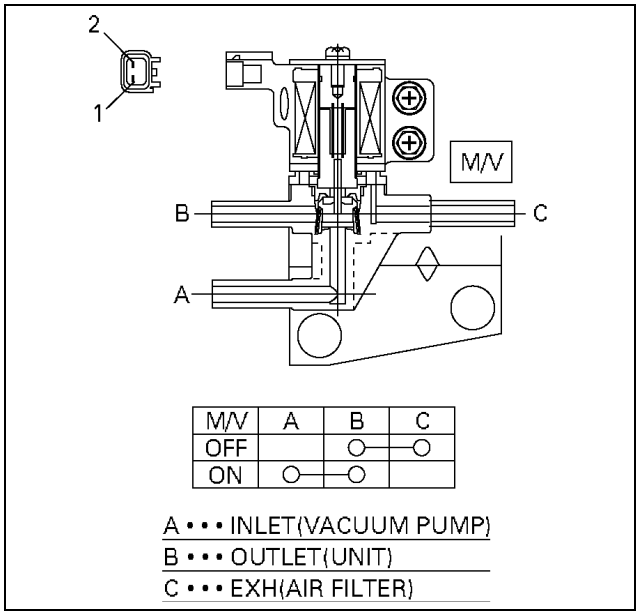
Flows 09QWSsys Check.tif

INSPECTION

1. Exhaust Brake Magnetic Valve

Inspection

Connect the magnetic valve connector terminal No.1 and No.2 to (+) terminal and (-) terminal of battery, respectively, and check the continuity between the ports.



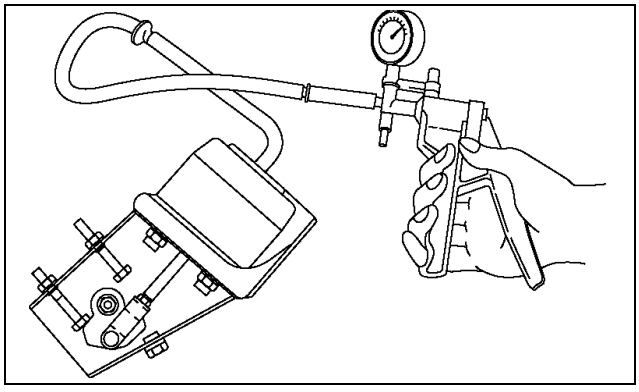
056LW010.tif

CAUTION: When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

2. Exhaust Throttle Valve

Working

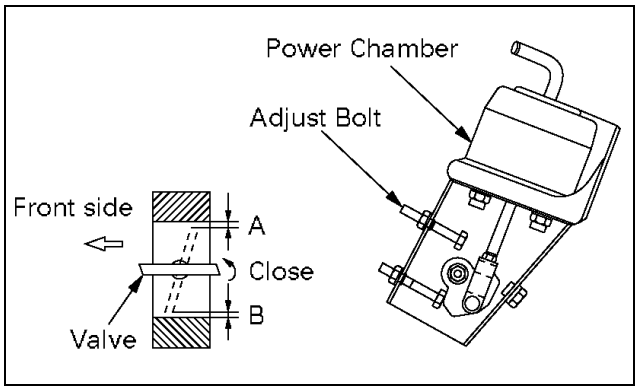
Actuate the exhaust brake with the engine idling and make sure that you hear the valve strike on the stopper.



157LW002.tif

Unit

Apply a negative pressure of 53.3 kPa - 93.3 kPa {400 mmHg - 700 mmHg} to the power chamber by means of a vacuum pump and make sure of the smooth opening/closing of the exhaust brake valve.

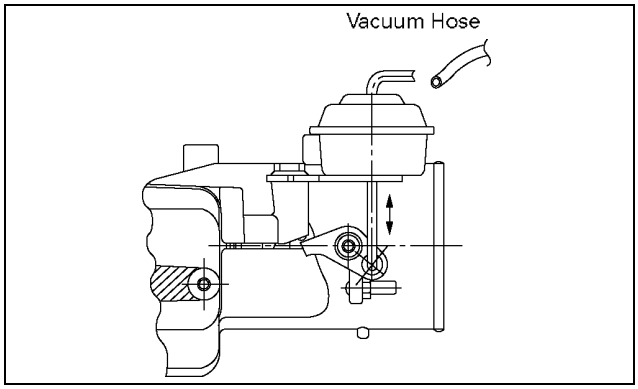


157LW001.tif

Apply a negative pressure of 86.7 - 93.3 kPa {650 - 700 mmHg} to the power chamber using a vacuum pump and make sure the average of measurements at Point A and Point B of the clearance between valve and body is as follows:

0.4 mm - 0.6 mm (Minimum: 0.4mm)

If the clearance is out of this range, adjust with the adjusting bolt.



025LW001.tif

3. Intake Throttle Valve

Working

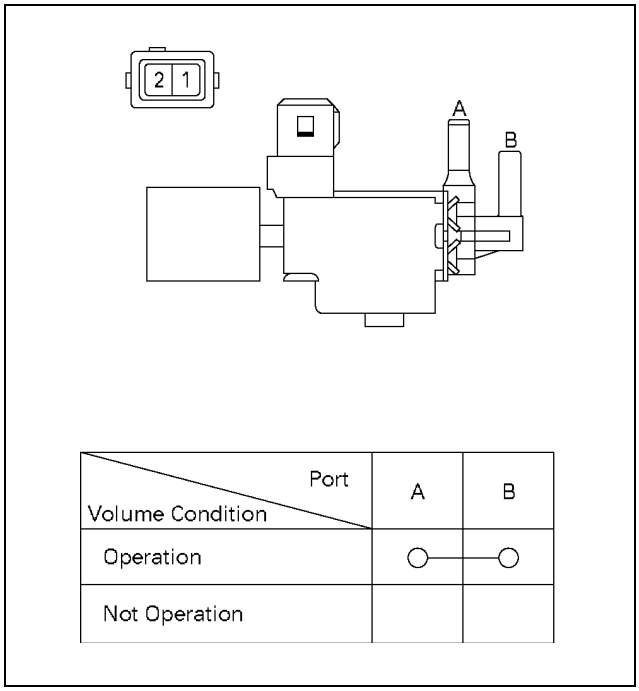
Disconnect the vacuum hose from the actuator and try to move the rod by hand, making sure of the smooth move of the rod.

4. Vacuum Switching Valve; Intake Throttle

Inspection

Connect the vacuum switching valve connector terminals No.1 and No.2 to (+) terminal and (-) terminals of battery, respectively, and check the continuity between the ports.

If the check result is abnormal, repair or replace the valve.



Volume Condition \ Port	A	B
Operation	○	○
Not Operation		

065LW005.tif

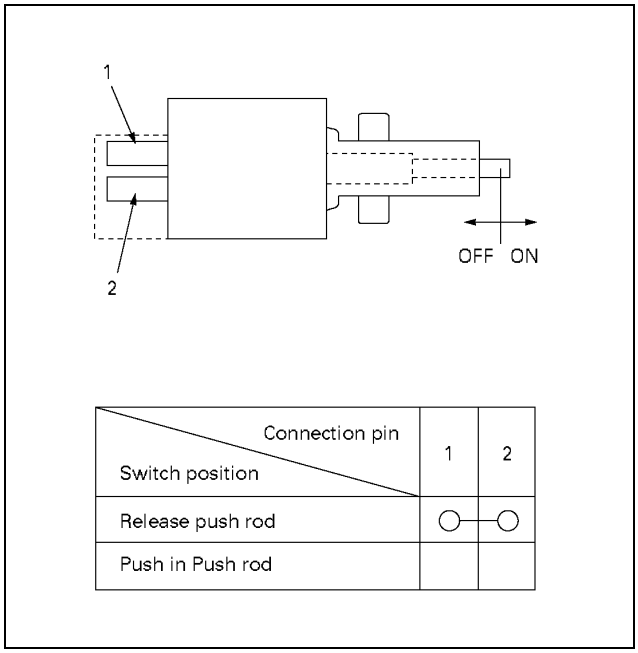
5. Accelerator Switch (2-pole connector type)

Inspection

1. Check the continuity between the switch connector terminals.

CAUTION: When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

2. Check the smooth move of the pushrod. If the check result is abnormal, repair or replace the pushrod.



Switch position \ Connection pin	1	2
Release push rod	○	○
Push in Push rod		

065LW003.tif

Removal

1. Accelerator Switch
   Disconnect the connector.
   Loosen the lock nut.
   Turn the switch to remove.

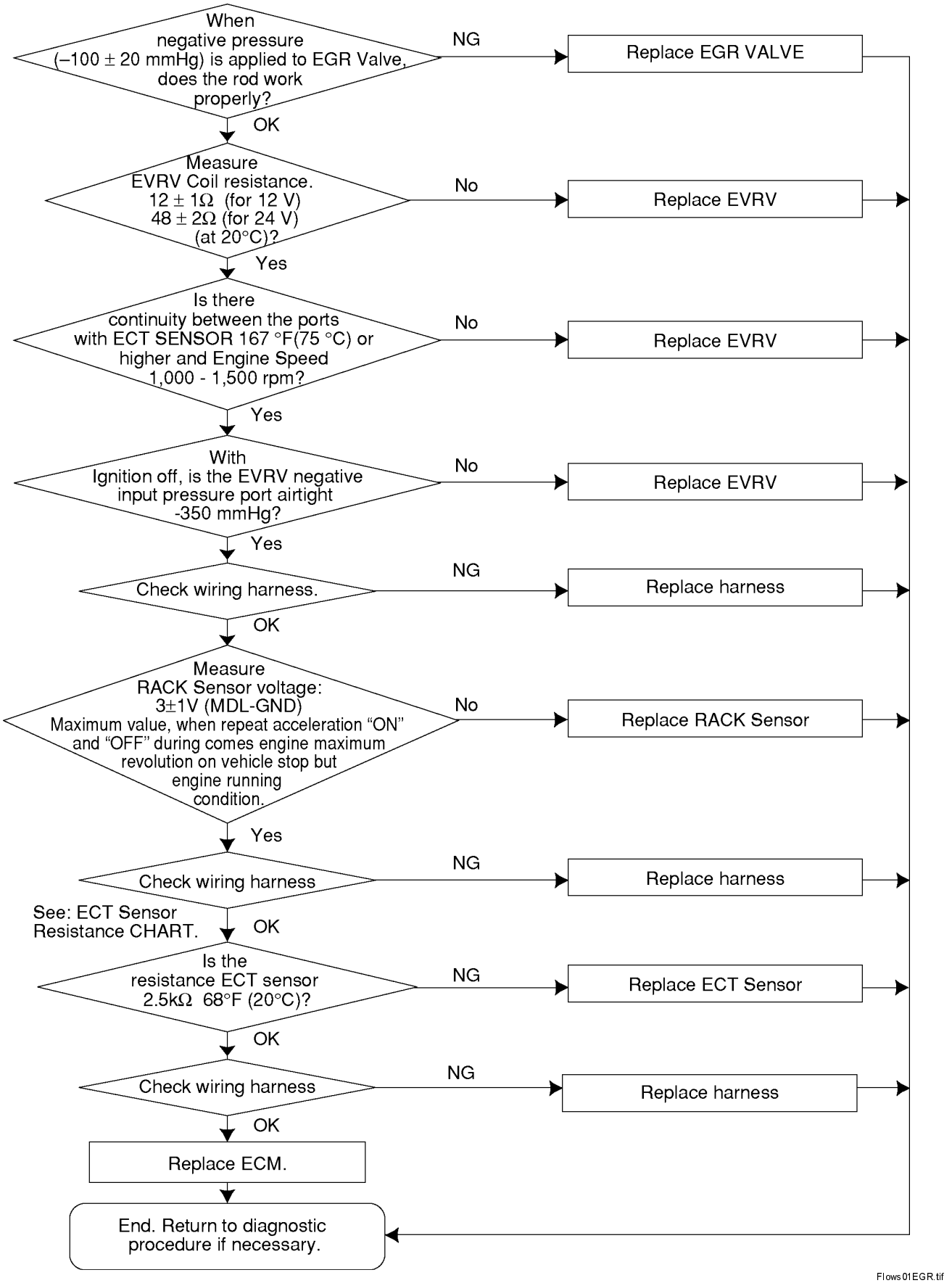
Re installation

To install, follow the removal procedure in reverse order:

1. Drive the threaded part of the switch until its end surface becomes flush with that of the bracket side of nut.
2. Tighten the lock nut.

   Tightening torque: 1.3 N·m {130 kg·cm}

EGR SYSTEM MALFUNCTION

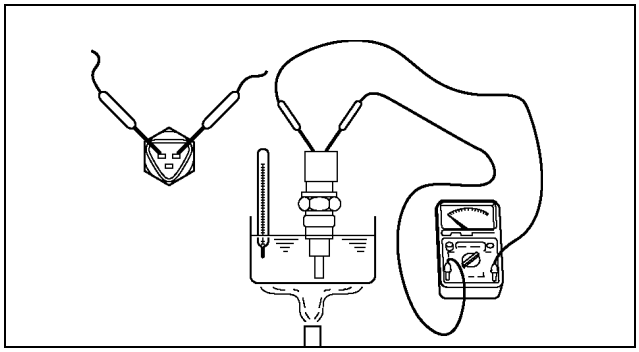


Flows01EGR.tif

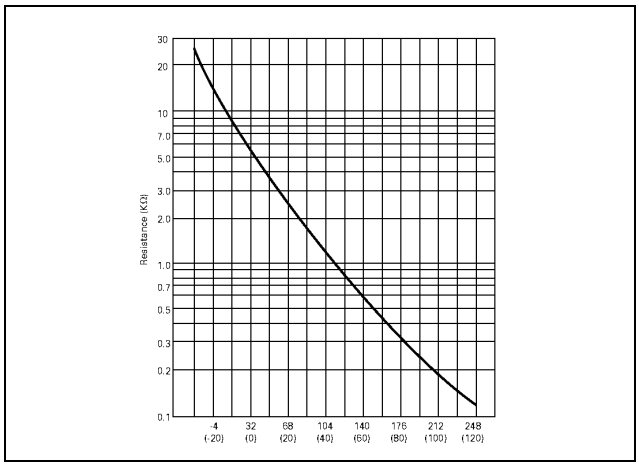
INSPECTION

1. Thermosensor (Engine Coolant Temperature)

Soak the temperature sensitive part of a thermosensor in the water,and while changing the water temperature, make sure the resistance is changed as the following graph shows:



010LW001.tif

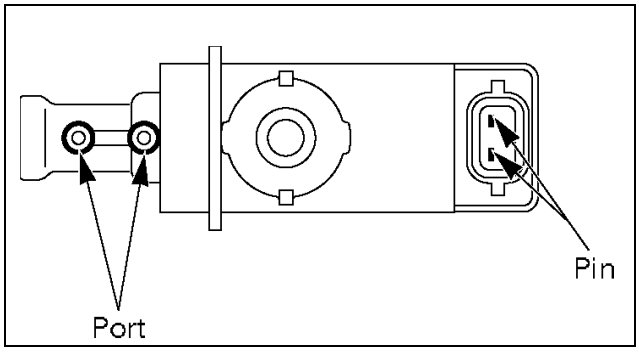


065LW004.tif

2. Electronic Vacuum Regulating Valve (EVRV) (Equipped with Exhaust Gas Recirculation (EGR) and Variable Swirl System (VSS))

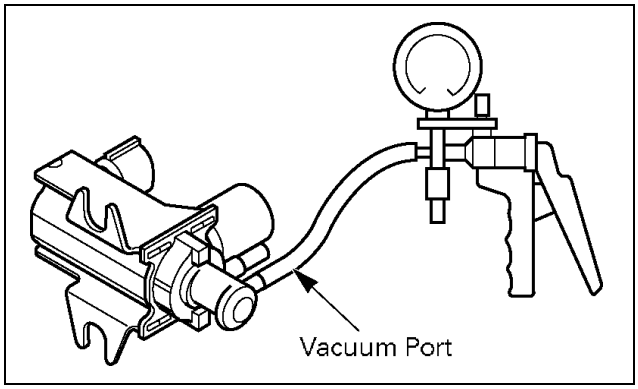
1. Resistance Check

Check the resistance between the EVRV connector terminals using a circuit tester.
Cold Resistance: 12±1 (Ω)



065LW031.tif

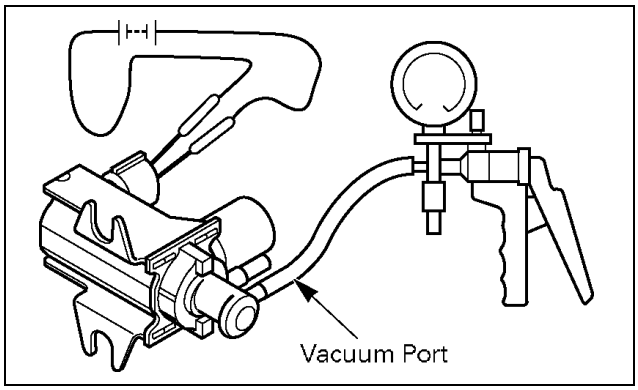
Connect battery voltage between EVRV connector terminals and make sure of the continuity between the ports.



065LW002.tif

2. Airtight Check

Apply negative pressure to the negative pressure input port as illustrated on the left.
Although there is leakage, it is no problem if the negative pressure rises to -350 mmHg (-47 kPa) or more.



065LW032.tif

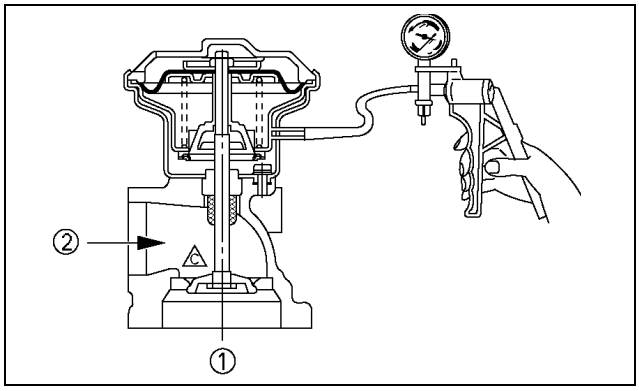
3. Working Check

Apply powervoltage between the terminals, there is no problem if the negative pressure does not rise when applied to the input port.

CAUTION: When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

3. Exhaust Gas Recirculation (EGR) Valve (Equipped with EGR and Variable Swirl System (VSS))

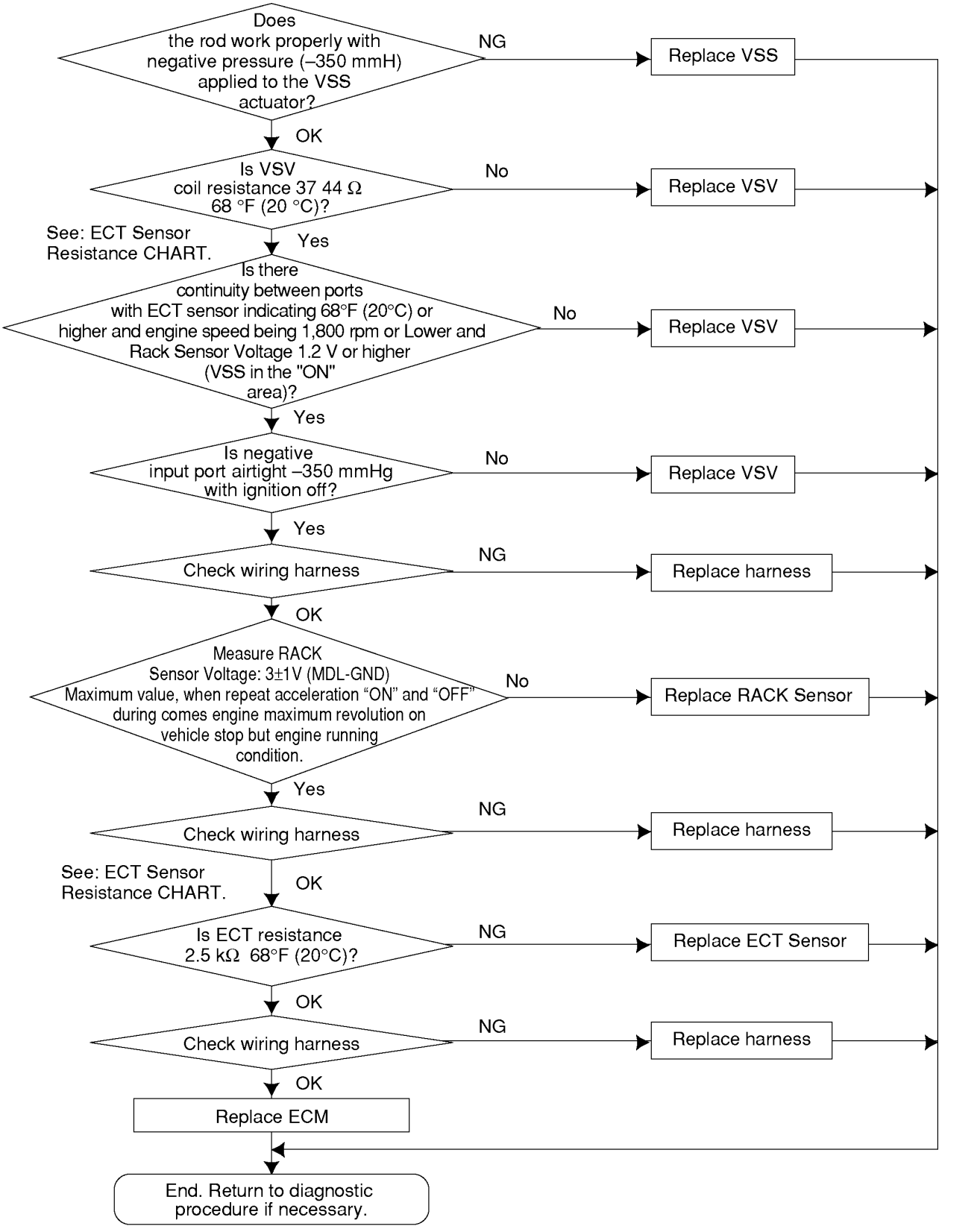
With negative pressure applied to the diaphragm chamber, make sure that the valve is smoothly actuated to make the area between (1) and (2) ventilated.
Startup: About -100 mmHg ± 20 mmHg



056LW009.tif

Check to see if EGR valve is normally actuated under the following conditions:
QWS off (After warming up)
Engine coolant temp.: 80 °C or higher

VARIABLE SWIRL SYSTEM (VSS) SYSTEM MALFUNCTION (Equipped with Exhaust gas recirculation and VSS)

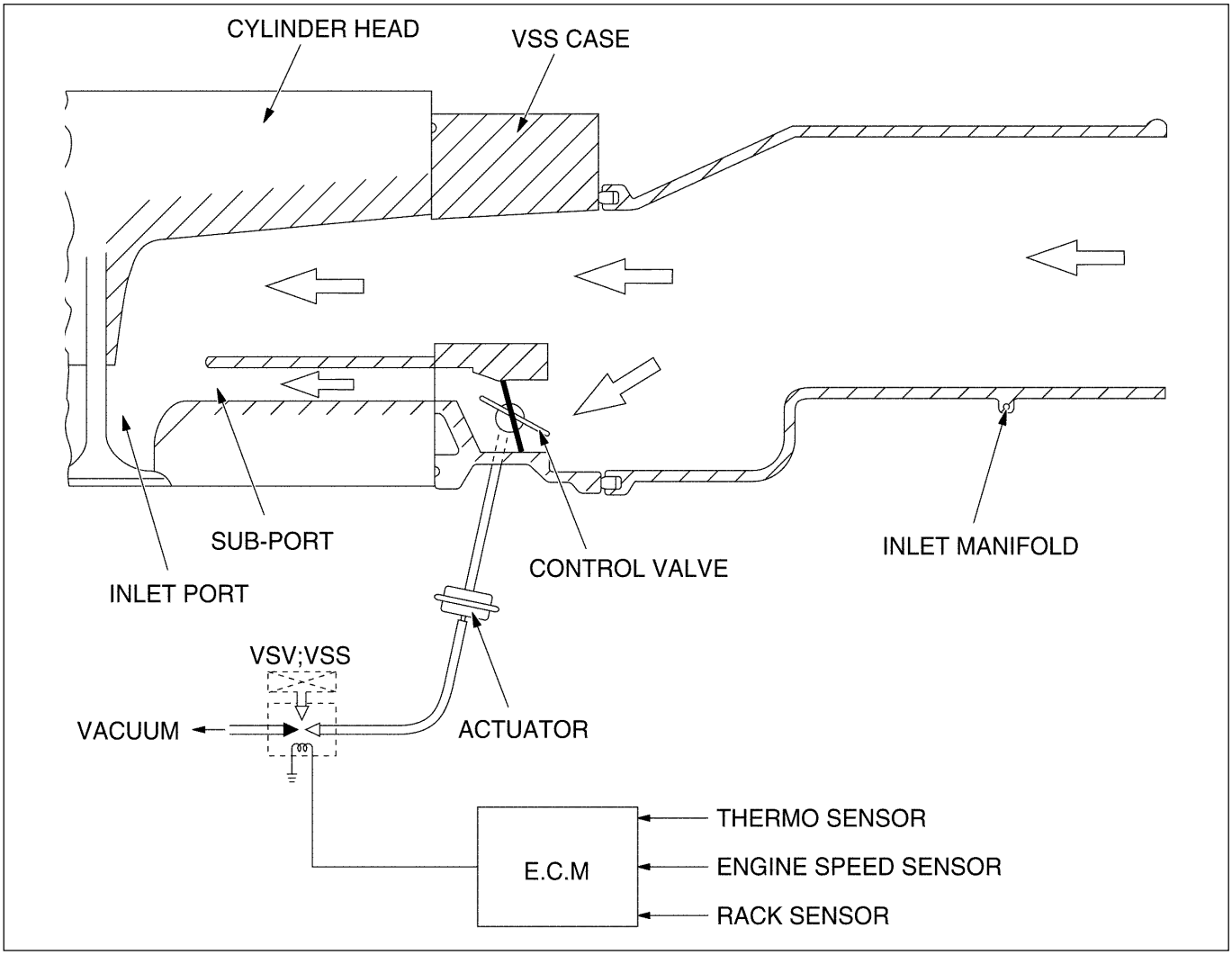


Flows04VSSys.tif

VSS (VARIABLE SWIRL SYSTEM)

The Variable Swirl System (VSS) is designed to adjust the intensity of swirl by allowing or not allowing air to flow through a sub-port (or bypass) the runs in parallel with the intake port for each cylinder. The swirl intensifies when there is no air flow through the sub-port, and vice versa.
The air flow is controlled by the on-off valve at the inlet to the sub-port and the valve in turn is turned on and off by computer signals which are dependent on engine speed, load and coolant temperature, Basically, the air is cut off at low speeds to maintain high swirl and is allowed to flow at high speeds to maintain low swirl.

VARIABLE SWIRL SYSTEM (Equipped with Exhaust gas recirculation (EGR) and VSS)

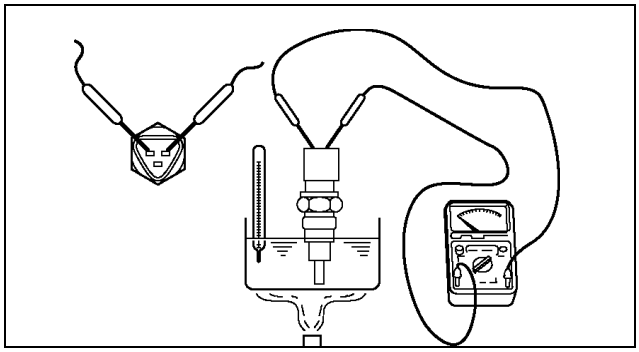


028LW001.tif

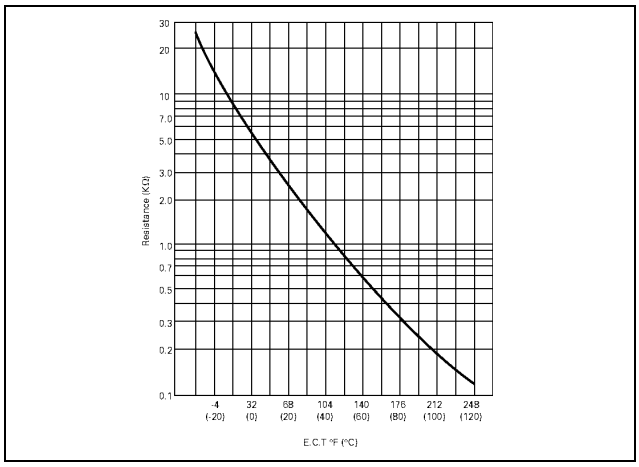
INSPECTION

1. Thermosensor (Engine coolant temperature)

Soak the temperature sensitive part of a thermosensor in the water, and while changing the water temperature, make sure the resistance is changed as the following graph shows:



010LW001.tif



065LW004.tif

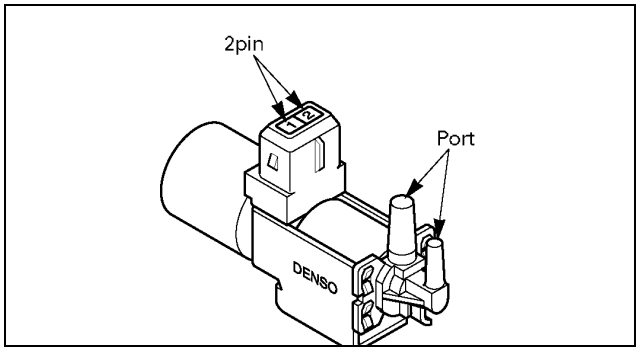
2. Vacuum Switching Valve (VSV)

1. Resistance Check

Check the resistance between the VSV connector terminals using a circuit tester.

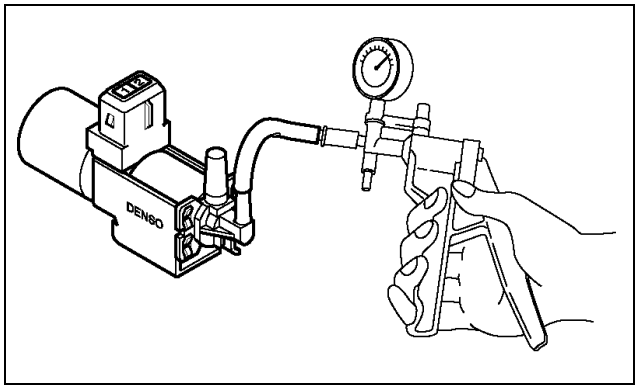
Cold Resistance: 37 - 44 (Ω) (for 12 volt)

: 159 - 169 (Ω) (for 24 volt)



056LW026.tif

Connect battery voltage between VSV connector terminals and make sure of the continuity between the ports.

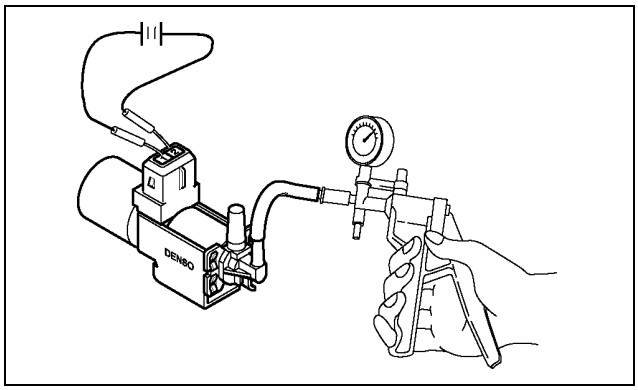


056LW028.tif

2. Airtight Check

Apply negative pressure to the negative pressure input port as illustrated on the left.

Although there is leakage, it is no problem if the negative pressure rises to -350 mmHg (-47 kPa) or more.



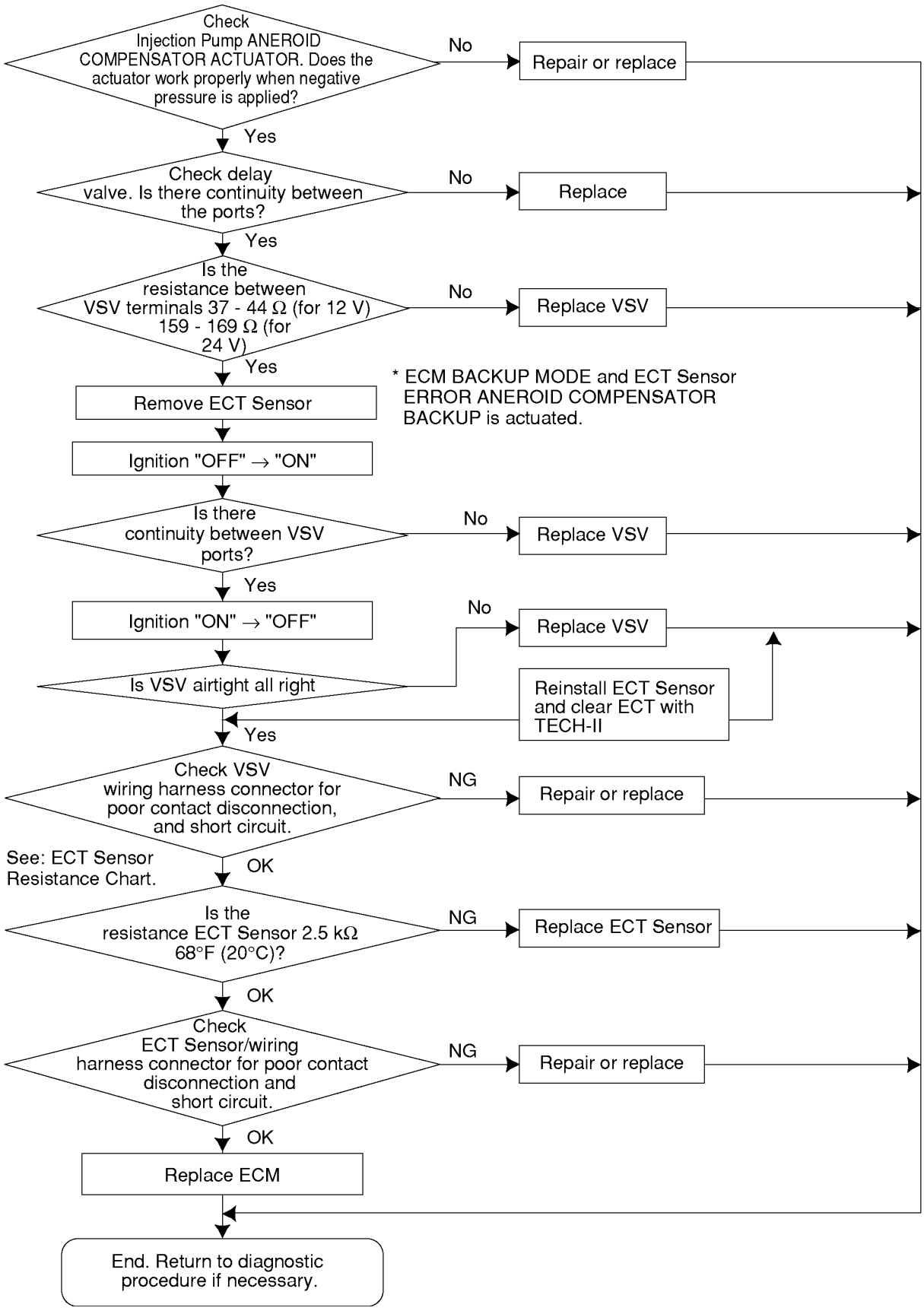
056LW027.tif

3. Working Check

Apply powervoltage between the terminals, there is no problem if the negative pressure does not rise when applied to the input port.

CAUTION: When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

ANEROID COMPENSATOR MALFUNCTION

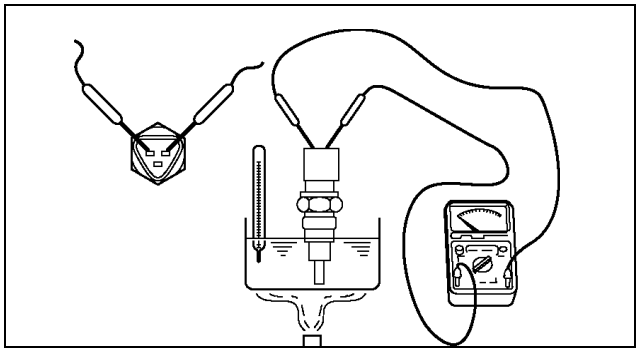


Flows03Aneroid.tif

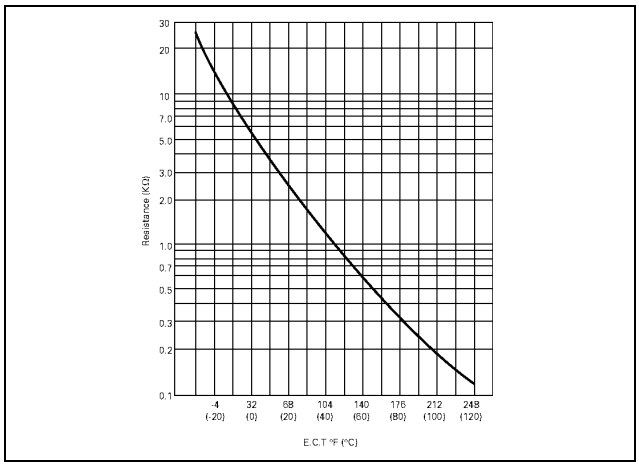
INSPECTION

1. Thermosensor (Engine coolant temperature (ECT))

Soak the temperature sensitive part of a thermosensor in the water, and while changing the water temperature, make sure the resistance is changed as the following graph shows:



010LW001.tif



065LW004.tif

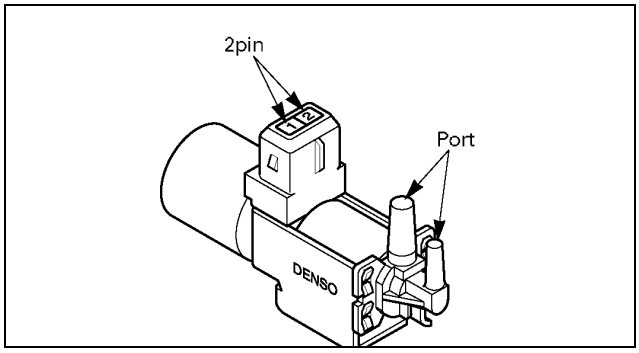
2. Vacuum Switching Valve (VSV)

1. Resistance Check

Check the resistance between the VSV connector terminals using a circuit tester.

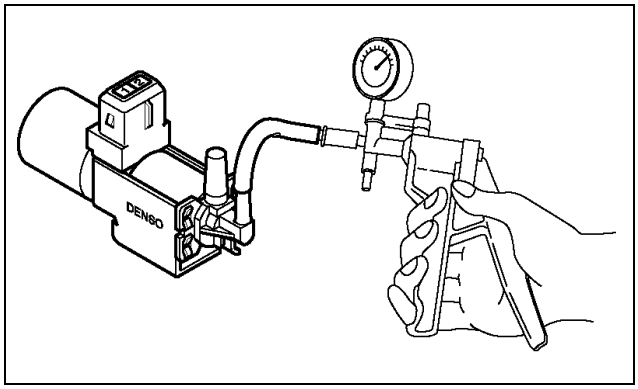
Cold Resistance: 37 - 44 (Ω) (for 12 Volt)

: 159 - 169 (Ω) (for 24 Volt)



056LW026.tif

Connect battery voltage between VSV connector terminals and make sure of the continuity between the pots.

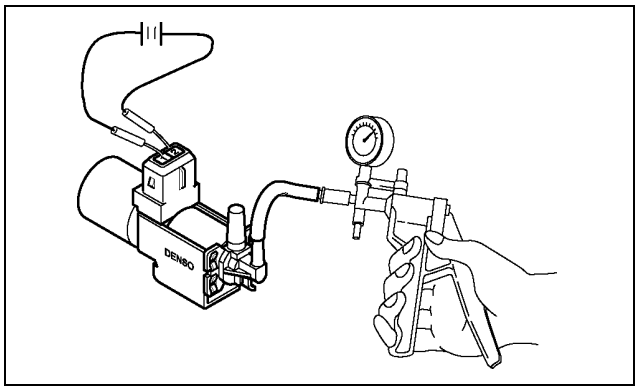


056LW028.tif

2. Airtight Check

Apply negative pressure to the negative pressure input port as illustrated on the left.

Although there is leakage, it is no problem if the negative pressure rises to -350 mmHg (-47 kPa) or more.



056LW027.tif

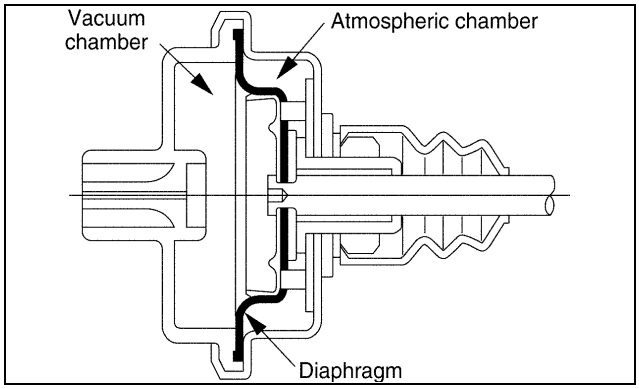
3. Working Check

Apply powervoltage between the terminals, there is no problem if the negative pressure does not rise when applied to the input port.

CAUTION: When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

3. Actuator

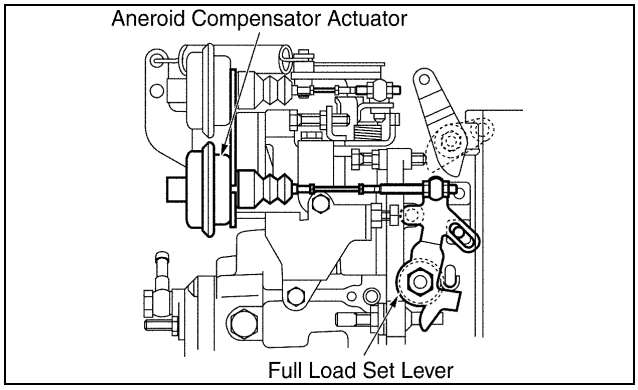
Diaphragm is built in the actuator, by which the inside of the actuator is divided into two, atmospheric room and negative pressure room.



040LW005.tif

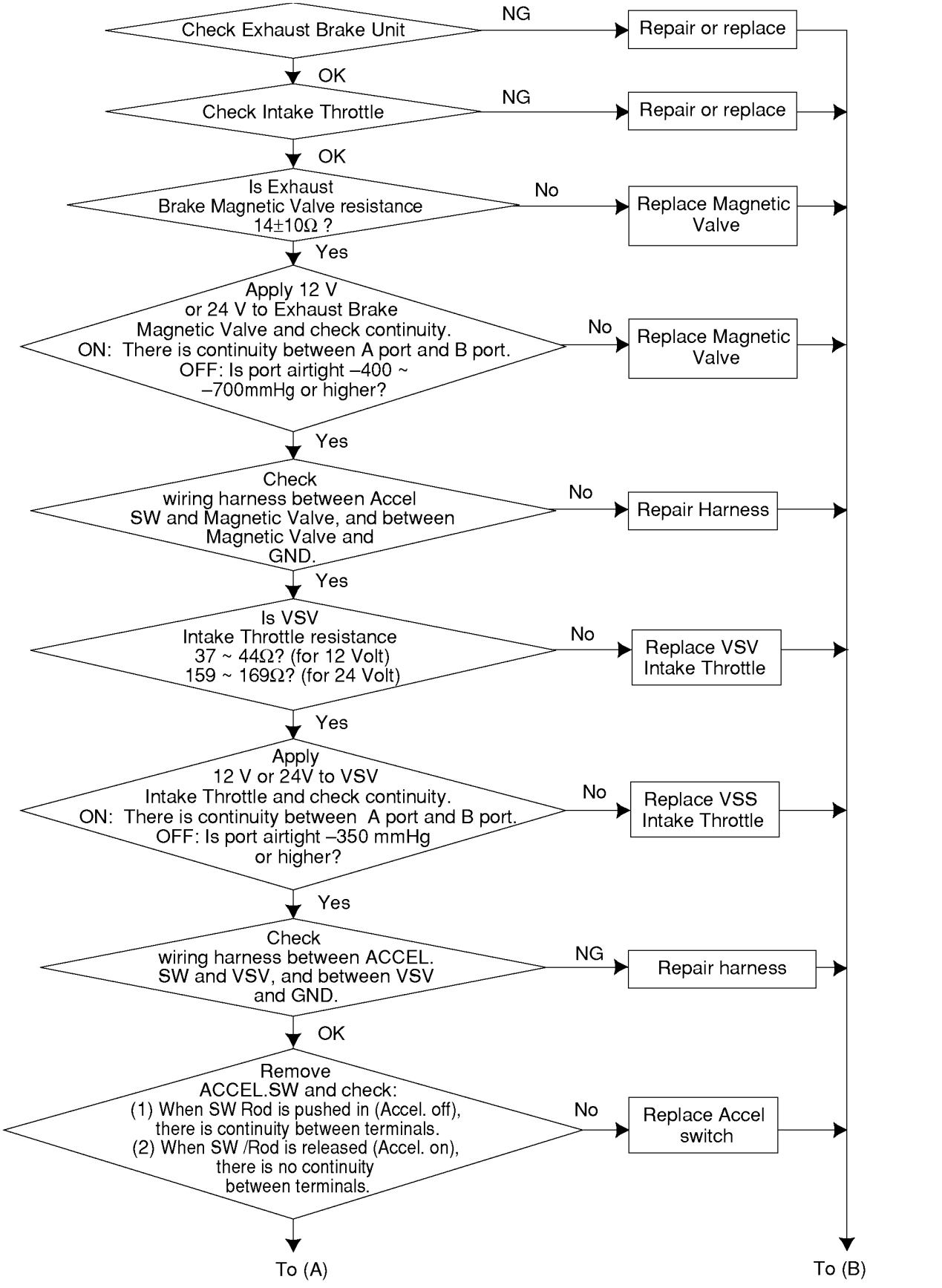
4. Aneroid compensator Actuator

The link of the actuator for the aneroid compensator is connected to full load set lever. The full load set lever is connected to a U-lever. When the atmospheric sensor built in Engine Control Module (ECM) makes the actuator work, the full load set lever and U-lever are rotated to a specified position so that the control rack is drawn in the direction of reducing fuel injection amount.

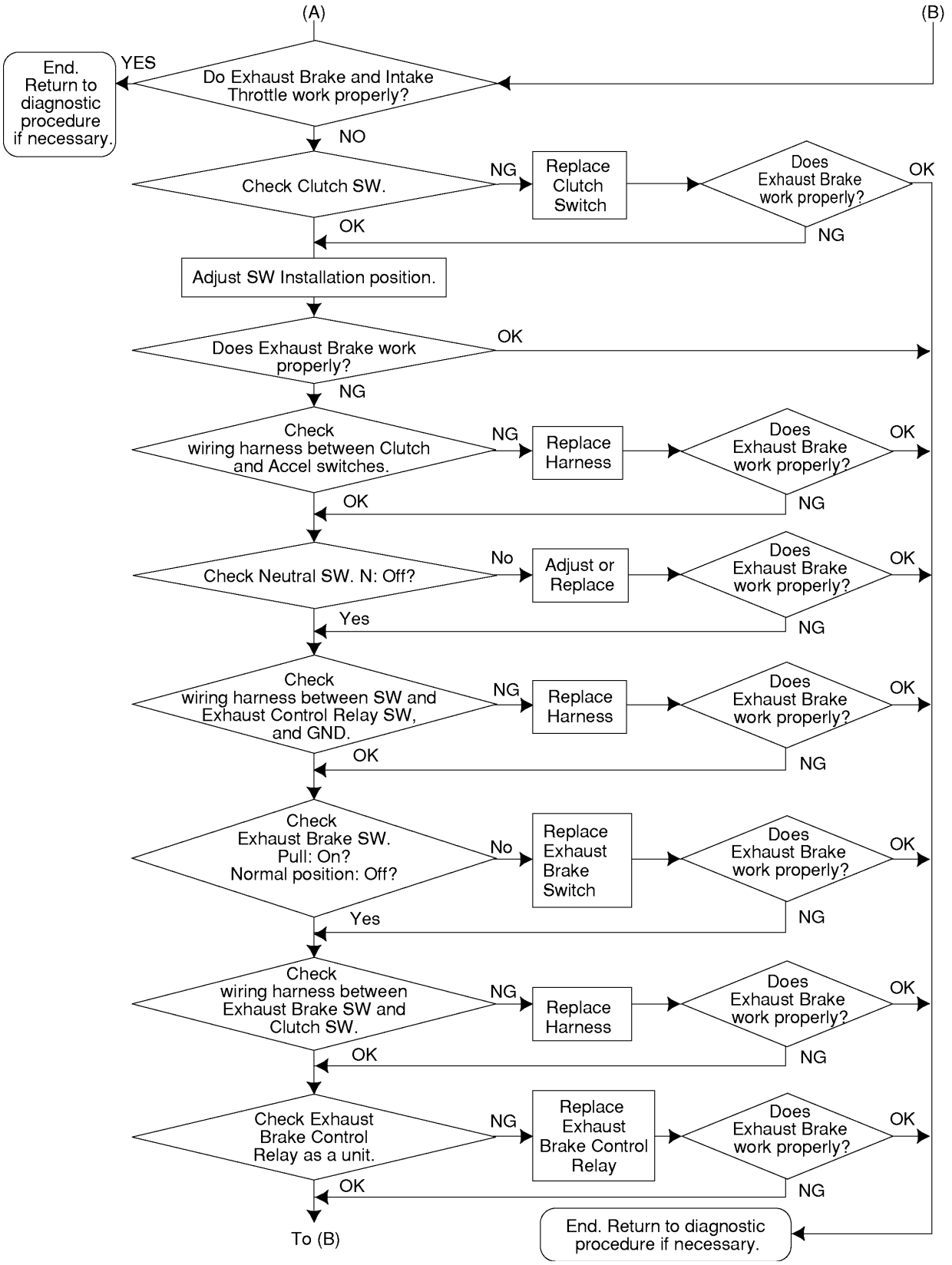


040LW003.tif

QUICK WARM SYSTEM MALFUNCTION



Flows 05QWS.tif



Flows 08QWSsysCheck.tif

INSPECTION

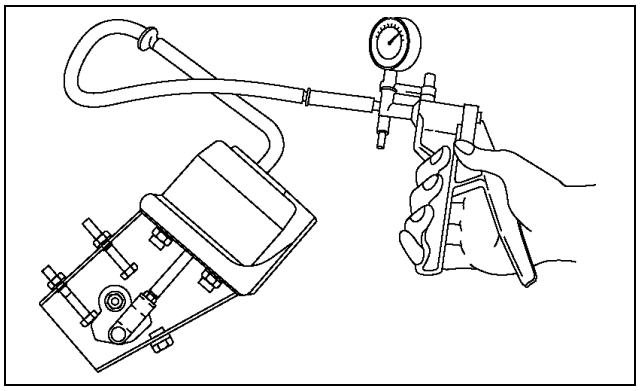
1. Exhaust Throttle Valve

Working

Actuate the exhaust brake with the engine idling and make sure that you hear the valve strike on the stopper.

Unit

apply a negative pressure of -53.3 kPa ~ -93.3 kPa {-400 mmHg ~ -700 mmHg} to the power chamber by means of a vacuum pump and make sure of the smooth opening/closing of the exhaust brake valve.

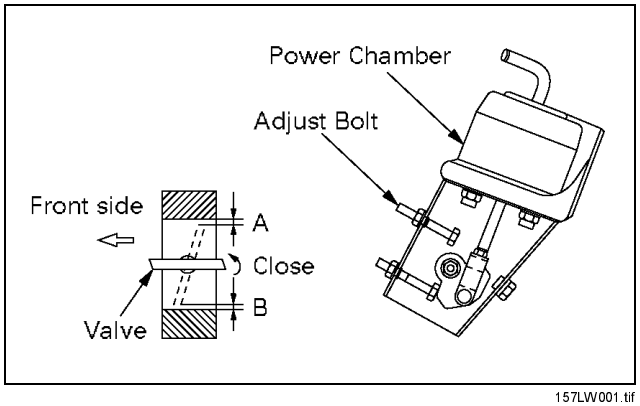


157LW002.tif

Apply a negative pressure of -86.7 ~ -93.3 kPa {-650 ~ -700 mmHg} to the power chamber using a vacuum pump and make sure the average of measurements at Point A and Point B of the clearance between valve and body is as follows:

0.4 mm - 0.6 mm (Minimum: 0.4 mm)

If the clearance is out of this range adjust with the adjusting bolt.

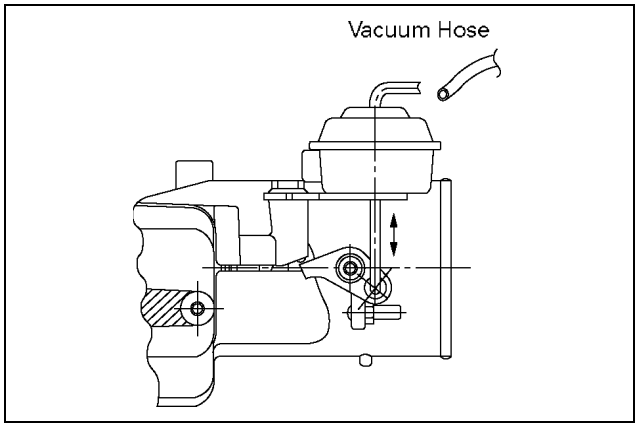


157LW001.tif

2. Intake Throttle Valve

Working

Disconnect the vacuum hose from the actuator and try to move the rod by hand, making sure of the smooth move of the rod.

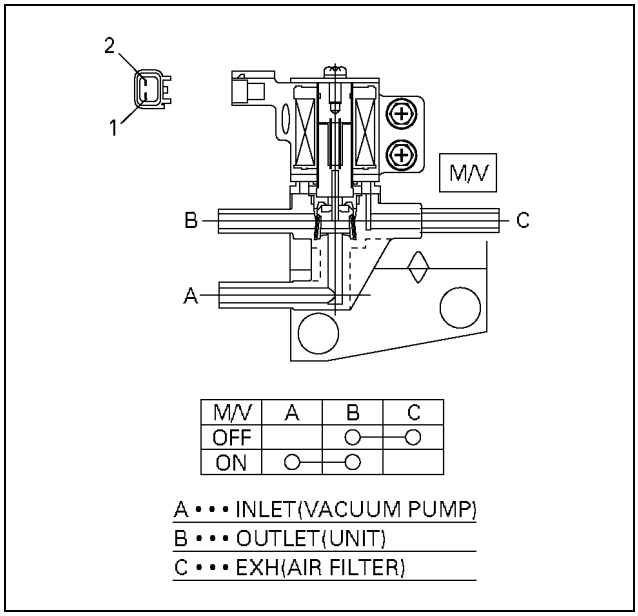


025LW001.tif

3. Exhaust Brake Magnetic Valve

Inspection

Connect the magnetic valve connector terminal No.1 and No.2 to (+) terminal and (-) terminal of battery respectively, and check the continuity between the ports.



M/V	A	B	C
OFF		○	○
ON	○	○	

A • • • INLET(VACUUM PUMP)
B • • • OUTLET(UNIT)
C • • • EXH(AIR FILTER)

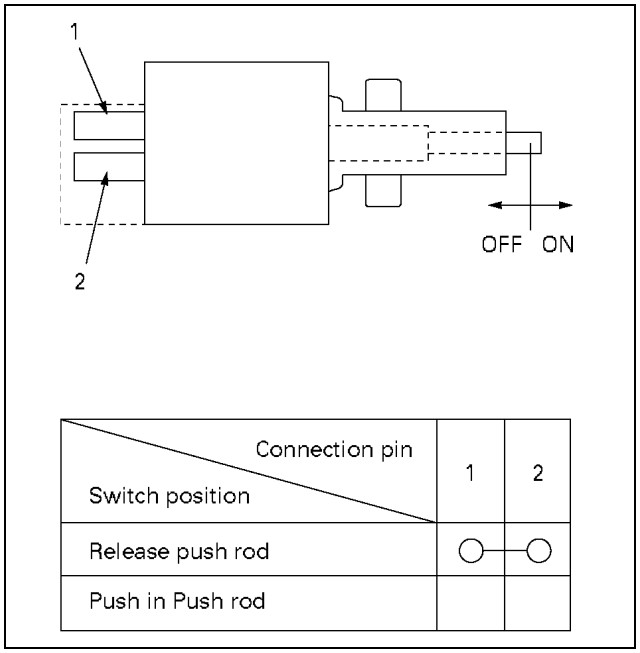
056LW010.tif

4. Accelerator Switch (2-pole connector type)

Inspection

1. Check the continuity between the switch connector terminals.
2. Check the smooth move of the pushrod. If the check result is abnormal, repair or replace the pushrod.

CAUTION: When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.



Switch position \ Connection pin	1	2
Release push rod	○	○
Push in Push rod		

065LW003.tif

Removal

1. Accelerator Switch
   Disconnect the connector.
   Loosen the lock nut.
   Turn the switch to remove.

Reinstallation

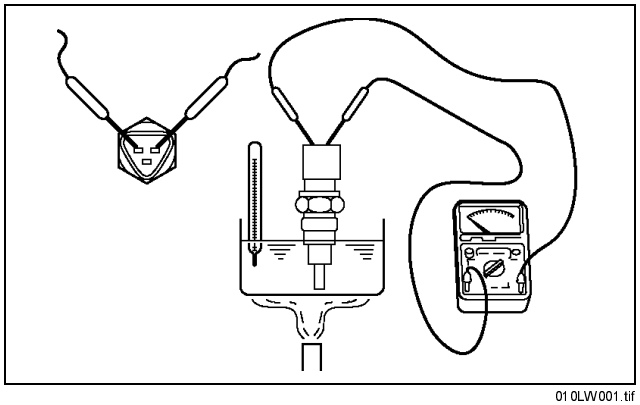
To install, follow the removal procedure in reverse order:

1. Drive the threaded part of the switch until its end surface becomes flush with that of the bracket side of nut.
2. Tighten the lock nut.

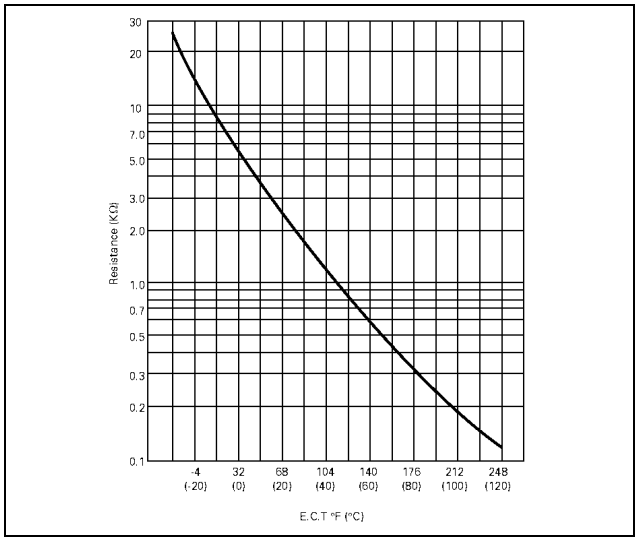
Tightening torque: 1.3 N·m {130 kg·cm}

5. Thermosensor (Engine coolant temperature)

Soak the temperature sensitive part of a thermosensor in the water, and while changing the water temperature, make sure the resistance is changed as the following graph shows:



010LW001.tif

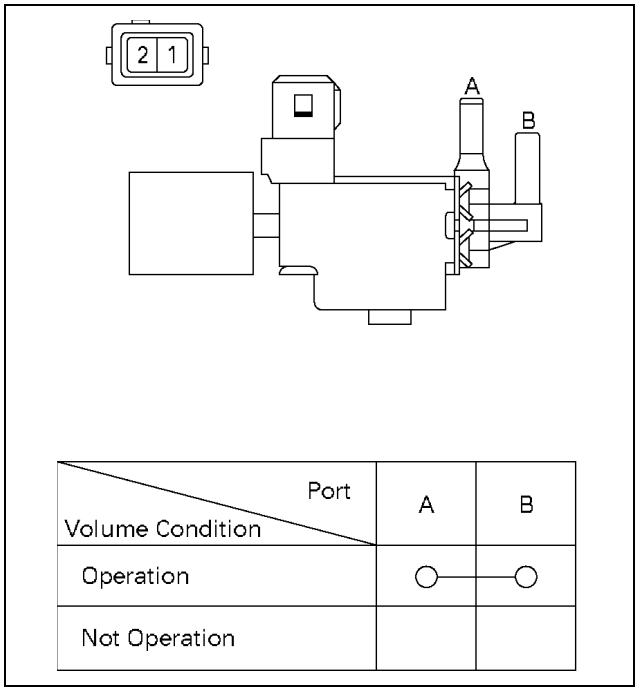


065LW004.tif

6. Vacuum Switching Valve; Intake Throttle

Inspection

Connect the vacuum switching valve connector terminals No.1 and No.2 to (+) terminal and (-) terminals of battery respectively, and check the continuity between the ports.
If the check result is abnormal, repair or replace the valve.

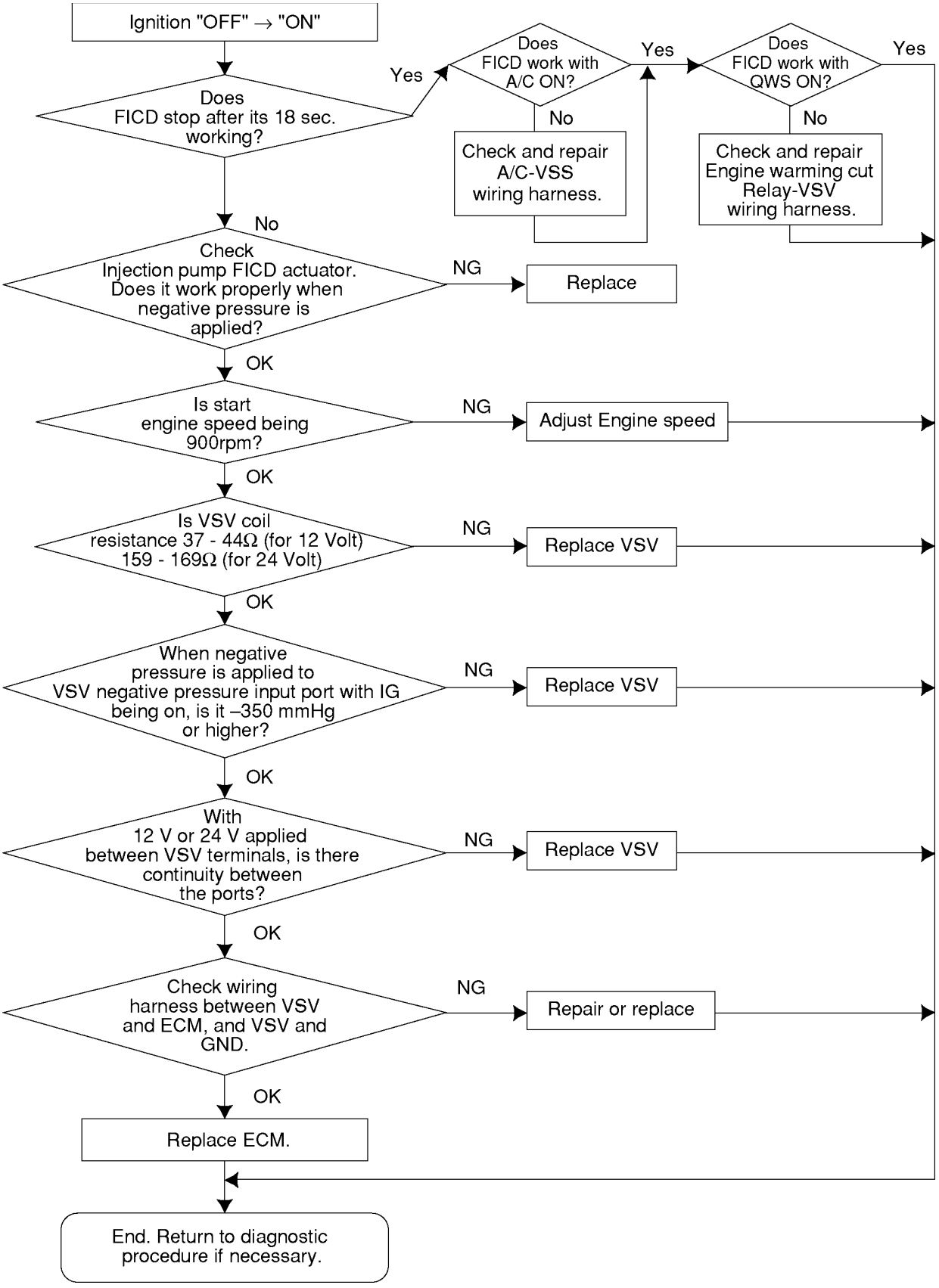


Volume Condition \ Port	A	B
Operation	○	○
Not Operation		

065LW005.tif

CAUTION: When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

FAST IDLE CONTROL DEVICE (FICD) SYSTEM MALFUNCTION



Flows02FICD.tif

INSPECTION

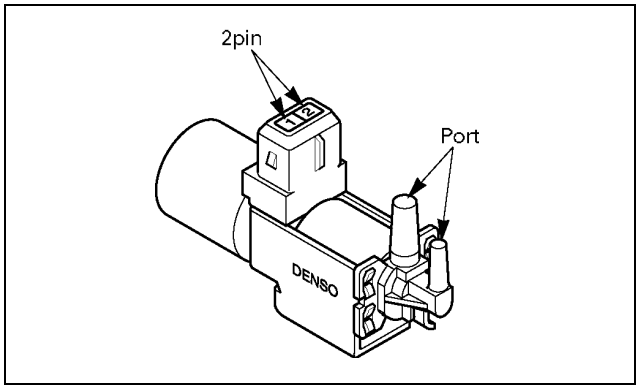
1. Vacuum Switching Valve (VSV)

1. Resistance Check

Check the resistance between the VSV connector terminals using a circuit tester.

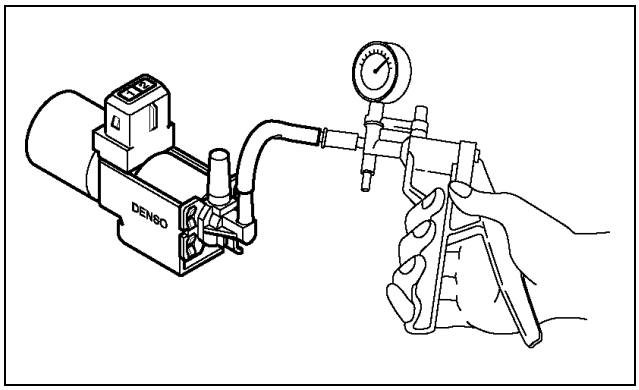
Cold Resistance: 37 - 44 (Ω) (for 12 Volt)

: 159 - 169 (Ω) (for 24 Volt)



056LW026.tif

Connect battery voltage between VSV connector terminals and make sure of the continuity between the ports.

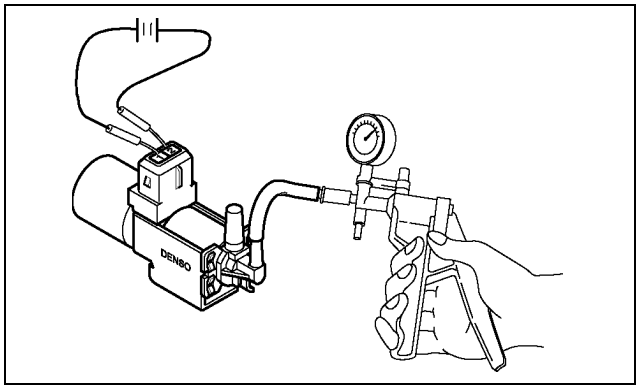


056LW028.tif

2. Airtight Check

Apply negative pressure to the negative pressure input port as illustrated on the left.

Although there is leakage, it is no problem if the negative pressure rises to -350 mmHg (-47 kPa) or more.

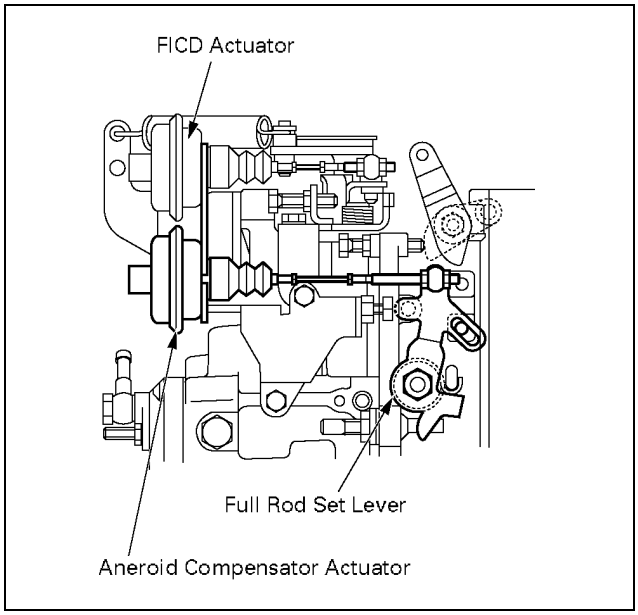


056LW027.tif

CAUTION: When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

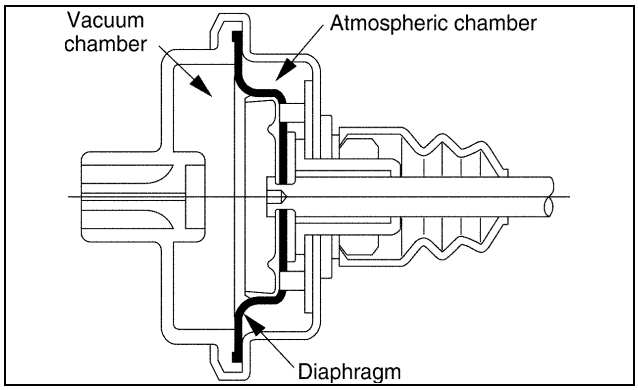
3. Working Check

Apply powervoltage between the terminals, there is no problem if the negative pressure does not rise when applied to the input port.



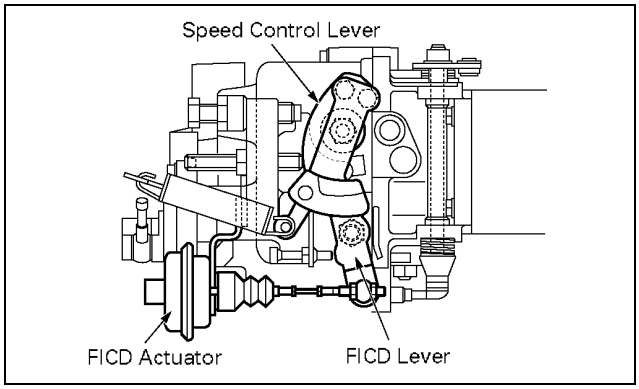
040LW009.tif

1) Diaphragm is built in the actuator, by which the inside of the actuator is divided into two, atmospheric room and negative pressure room.



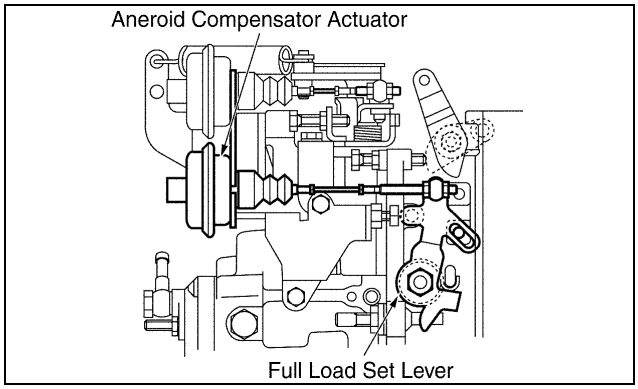
040LW005.tif

2) Fast Idle Control Device (FICD) actuator link is connected to FICD lever, setting speed control lever at a specified speed when FICD is at work at the time of idling.



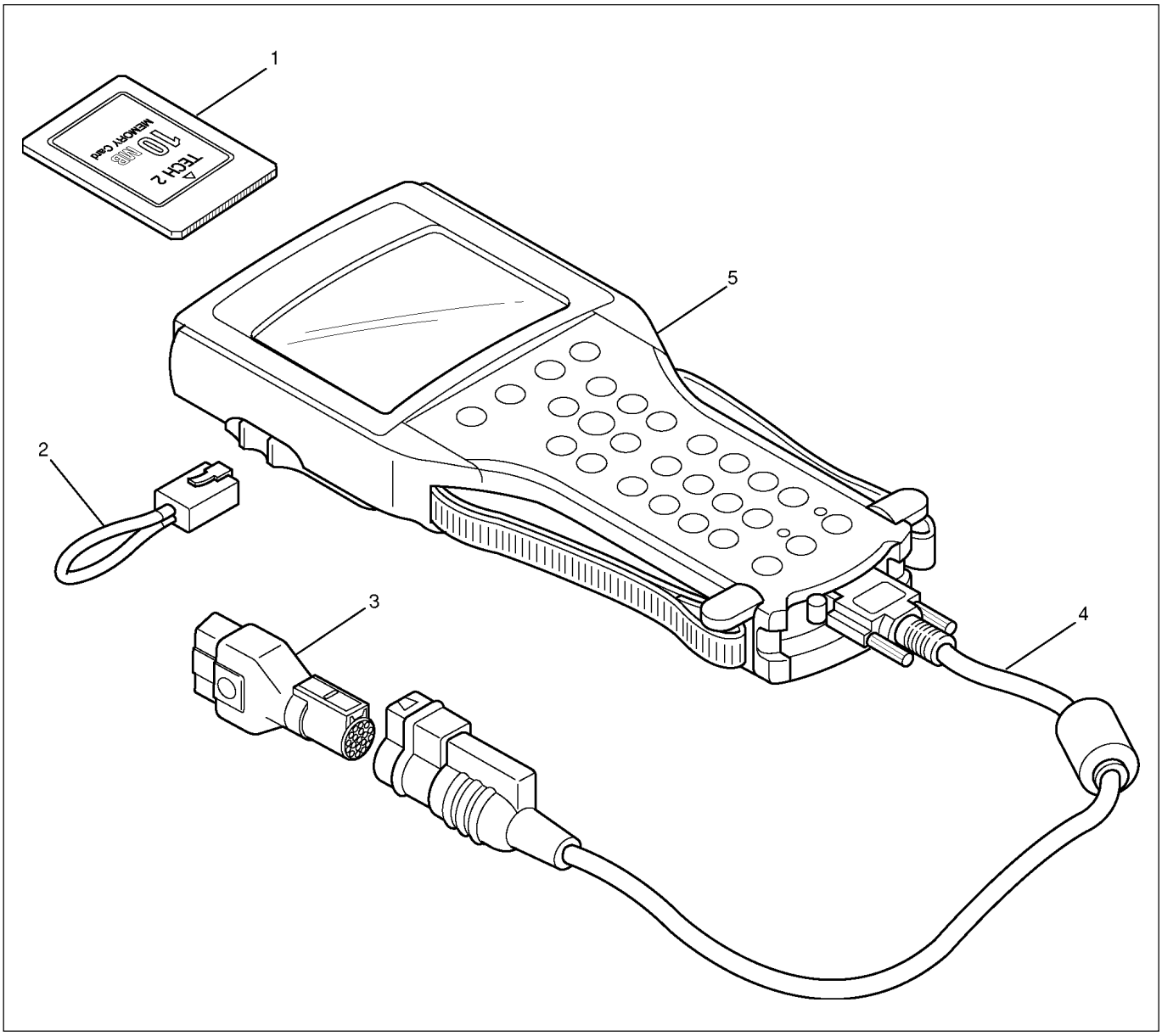
040LW004.tif

3) The link of the actuator for the aneroid compensator is connected to full load set lever. The full load set lever is connected to a U-lever. When the atmospheric sensor built in Engine Control Module (ECM) makes the actuator work, the full load set lever and U-lever are rotated to a specified position so that the control rack is drawn in the direction of reducing fuel injection amount.



040LW003.tif

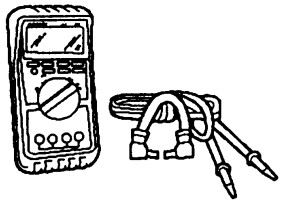
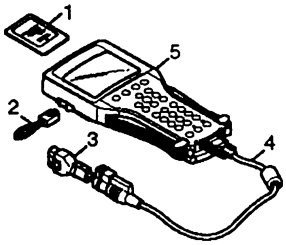
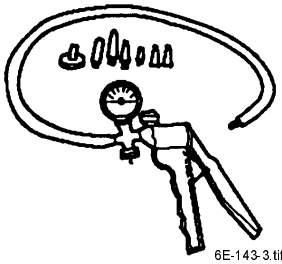
SPECIAL TOOLS



901RW180.tif

Legend

(1) PCMCIA Card
(2) RS232 Loop Back Connector
(3) SAE 16/19 Adapter
(4) DLC Cable
(5) TECH-2

ILLUSTRATION	**TOOL NO.** TOOL NAME
 6E-143-1..tif	**5-8840-0366-0** **(J 39200)** High Impedance Multimeter (Digital Voltmeter-DVM)
 6E-143-2.tif	(1) PCMCIA Card (2) RS232 Loop Back (3) SAE 16/19 Adapter (4) DLC Cable (5) TECH-2
 6E-143-3.tif	**5-8840-0279-0** **(J 23738-A)** Vacuum Pump with Gauge

DIAGNOSIS (4HG1-T Only)
STRATEGY-BASED DIAGNOSTICS

Strategy-Based Diagnostics

The strategy-based diagnostic is a uniform approach to repair all Electrical/Electronic (E/E) systems. The diagnostic flow can always be used to resolve an E/E system problem and is a starting point when repairs are necessary. The following steps will instruct the technician how to proceed with a diagnosis:

1. Verify the customer complaint.
   - To verify the customer complaint, the technician should know the normal operation of the system.
2. Perform preliminary checks.
   - Conduct a thorough visual inspection.
   - Review the service history.
   - Detect unusual sounds or odors.
   - Gather diagnostic trouble code information to achieve an effective repair.
3. Check bulletins and other service information.
   - This includes videos, newsletters, etc.
4. Refer to service information (manual) system check (s).
   - “System checks” contain information on a system that may not be supported by one or more DTCs.
     System checks verify proper operation of the system. This will lead the technician in an organized approach to diagnostics.
5. Refer to service diagnostics.

Diagnostic Trouble Code (DTC) Stored

Follow the designated DTC chart exactly to make an effective repair.

No DTC

Select the symptom from the symptom tables. Follow the diagnostic paths or suggestions to complete the repair. You may refer to the applicable component/system check in the system checks.

No Matchig Symptom

1. Analyze the complaint.
2. Develop a plan for diagnostics.
3. Utilize the wiring diagrams and the theory of operation.

Call technical assistance for similar cases where repair history may be available. Combine technician knowledge with efficient use of the available service information.

Intermittents

Conditions that are not always present are called intermittents. To resolve intermittents, perform the following steps:

1. Evaluate the symptoms and the conditions described by the customer.
2. Use a check sheet or other method to identify the circuit or electrical system component.
3. Follow the suggestions for intermittent diagnosis found in the service documentation.

No Trouble Found

This condition exists when the vehicle is found to operate normally. The condition described by the customer may be normal. Verify the customer complaint against another vehicle that is operating normally. The condition may be intermittent. Verify the complaint under the conditions described by the customer before releasing the vehicle.

1. Re-examine the complaint
   When the Complaint cannot be successfully found or isolated, a re-evaluation is necessary. The complaint should be re-verified and could be intermittent as defined in Intermittents, or could be normal.
2. Repair and verify.
   After isolating the cause, the repairs should be made.
   Validate for proper operation and verify that the symptom has been corrected. This may involve road testing or other methods to verify that the complaint has been resolved under the following conditions:
   - Conditions noted by the customer.
   - If a DTC was diagnosed, verify a repair by duplicating conditions present according to customer complaint.

Verifying Vehicle Repair

Verification of the vehicle repair will be more comprehensive for vehicles with self diagnostic system diagnostics. Following a repair, the technician should perform the following steps:

IMPORTANT:

Follow the steps below when you verify repairs on self diagnostic systems. Failure to follow these steps could result in unnecessary repairs.

1. Review and record the Failure Records for the DTC which has been diagnosed.
2. Clear the DTCs.
3. Operate the vehicle within conditions according to customer complaint.

4. Monitor the Diagnostic Trouble Code (DTC) status information for the specific DTC which has been diagnosed until the diagnostic test associated with that DTC runs.

GENERAL SERVICE INFORMATION

Visual/Physical Engine Compartment Inspection

Perform a careful visual and physical engine compartment inspection when performing any diagnostic procedure or diagnosing the cause of an emission test failure. This can often lead to repairing a problem without further steps. Use the following guidelines when performing a visual/physical inspection:

- Inspection all vacuum hoses for punches, cuts, disconnects, and correct rouring.
- Inspect hoses that are difficult to see behind other components.
- Inspent all wires in a engine compartment for proper connections, burned or chafed spots, pinched wires, contact with sharp edges or contact with hot exhaust manifolds or pipes.

Basic Knowledge of Tools Required

NOTE:

Lack of basic knowledge of this powertrain when performing diagnostic procedures could result in an incorrect diagnosis or damage to powertrain components. Do not attempt to diagnose a powertrain problem without this basic knowledge.

A basic understanding of hand tools is necessary to effectively use this section of the Servise Manual

SELF DIAGNOSTIC System Check

Self Diagnostic System should be checked as follows:

1. When Ignition key is turned from the “OFF” to the “ON” position, make sure that Malfunction Indicator Lamp (MIL) is lit for 0.3 sec. to 0.8 sec.
2. Connect Scan Tool and check to see if MIL is always lit.
   If so, Self Diagnostic System is normal.

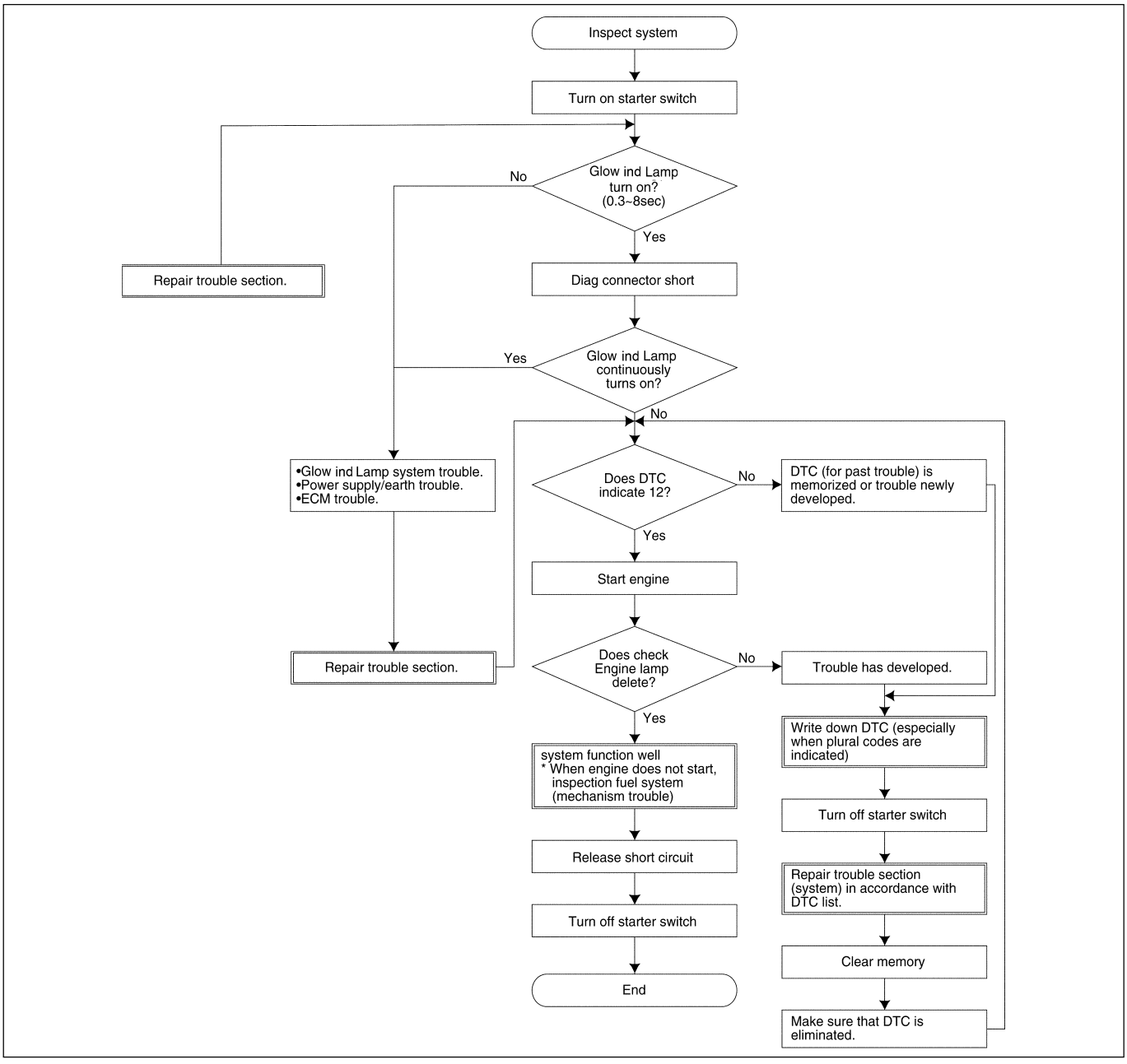
TROUBLESHOOTING

Caution taken in inspecting

(1) In inspecting system, write down Diagnostic Trouble Code (DTC) to be indicated. (especially, when plural self-diagnosis codes are indicated.)

(2) Before eliminating the indicated DTC by a memory clear switch, doubly inspect abnormal place as indicated in DTC.

Inspection procedure flowchart (Diagnostic System Check)



flowchart_13-2.tif

NOTE:

Please note that some items of DTC may not be generated unless the engine is warmed up or unless the vehicle is driven under load.

SELF-DIAGNOSIS FUNCTIONS

(1) Memorization of diagnostic trouble code

The self-diagnosis code indicated will be memorized in Electronically Erasable Programmable Read Only Memory (EEPROM) with in the Engine Control Module (ECM). Accordingly even if the starter switch turns off or the ECM is removed from the vehicle, the memorized self-diagnosis code will not be eliminated.

* Unless an elimination procedure is taken, the diagnostic trouble code (DTC) will remain in memory. (The memory will be eliminated only by a memory clear switch.)

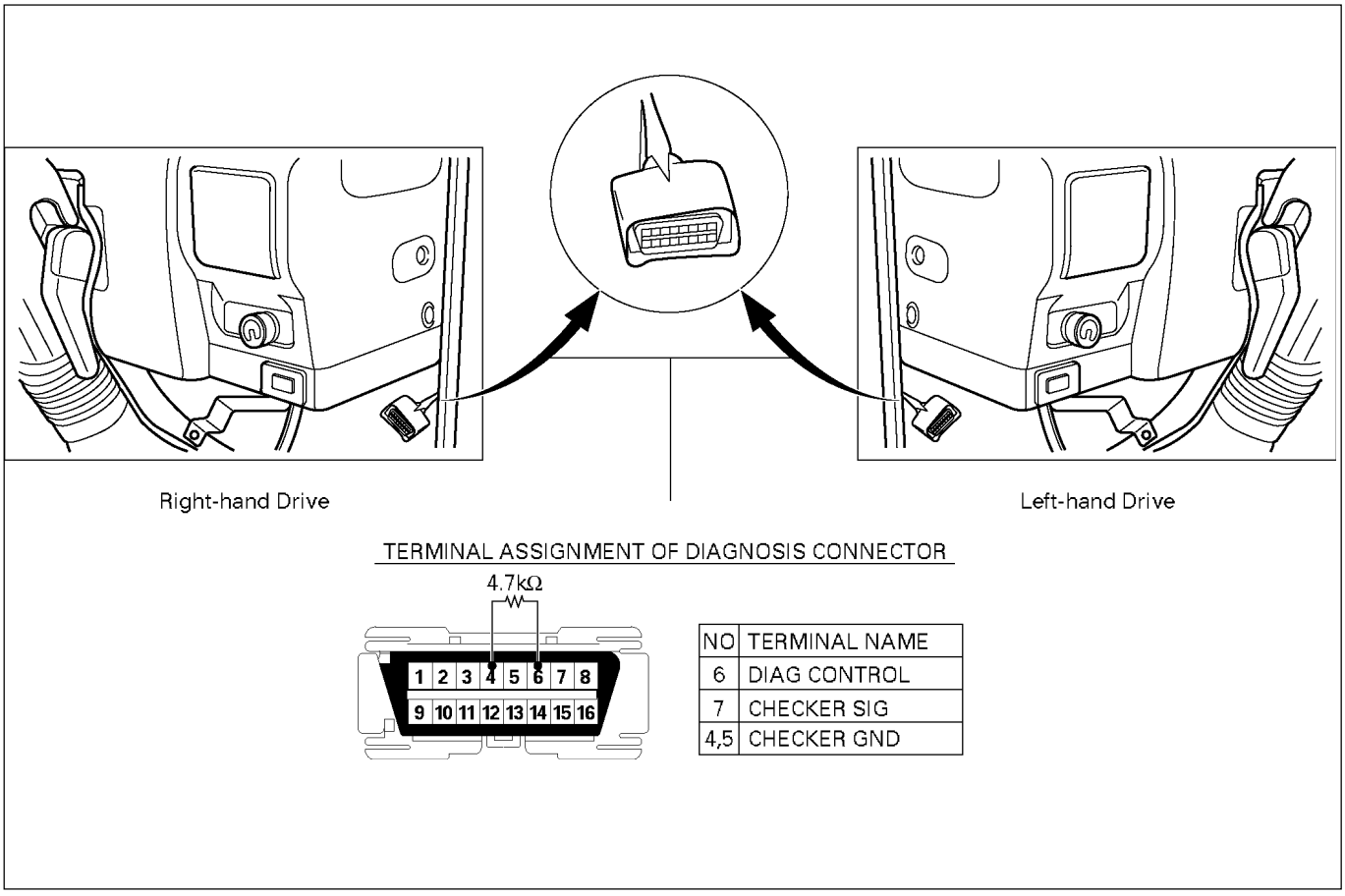
(2) Elimination of diagnostic trouble code

The DTC memorized in the EEPROM with in the ECM can be eliminated only by the operation of the memory clear switch.
The elimination method memory clear switch will be described below:

1. Turn OFF ignition switch.
2. Use 4.7kΩ resistance and make short circuit on memory clear switch.
3. Turn ON ignition switch. The indication lamp turn on (lighting) continuously after three seconds flashing the indication lamp.
4. Turn OFF ignition switch.
5. Remove shortage resistance from memory clear switch.

Location of the memory clear switch

Location of the memory clear switch (DIAGNOSIS CONNECTOR)



NO	TERMINAL NAME
6	DIAG CONTROL
7	CHECKER SIG
4,5	CHECKER GND

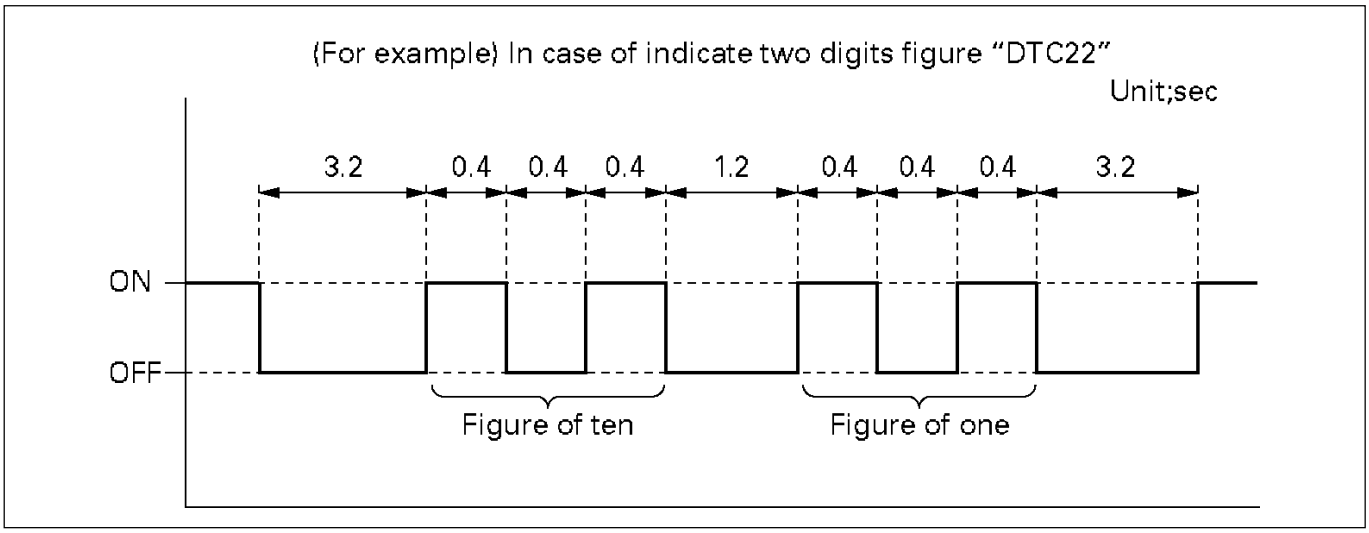
056LX012.tif

How to read flashing of the indicator lamp:

The two-digit diagnosis code flashes starting from ten's figure to indicate the diagnosis code.
Please read the diagnosis code from the flashing.
If the plural diagnosis codes are indicated, the same diagnosis code is flashed repeatedly in steps of three times.
Please read it correctly.

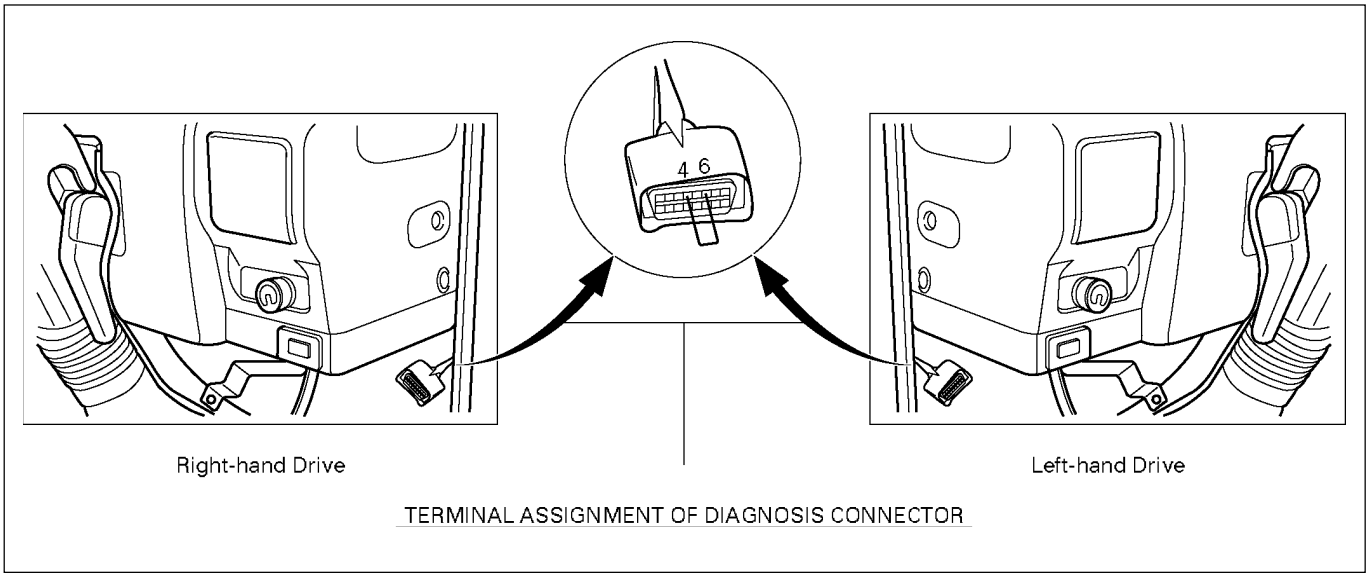
- Diagnostic Trouble Code (DTC) outputting is done in decreasingly order of DTC number.
- Indication is changed over on completion of output DTC indication.
- DTC indicator is stopped with diagnostic switch being off.
- When there is no DTC output, -12+ is outputted in normal DTC code.
- After indicating 3 times pear 1 DTC, shift is conducted to the next DTC. (After making a round, the indications are repeated again.)
- In case of the same diagnostic code, it is used 1 DTC (3 times indication.)

Example Diagnosis Trouble Code Output



826LX001.tif

Flashing of Indicator Lamp



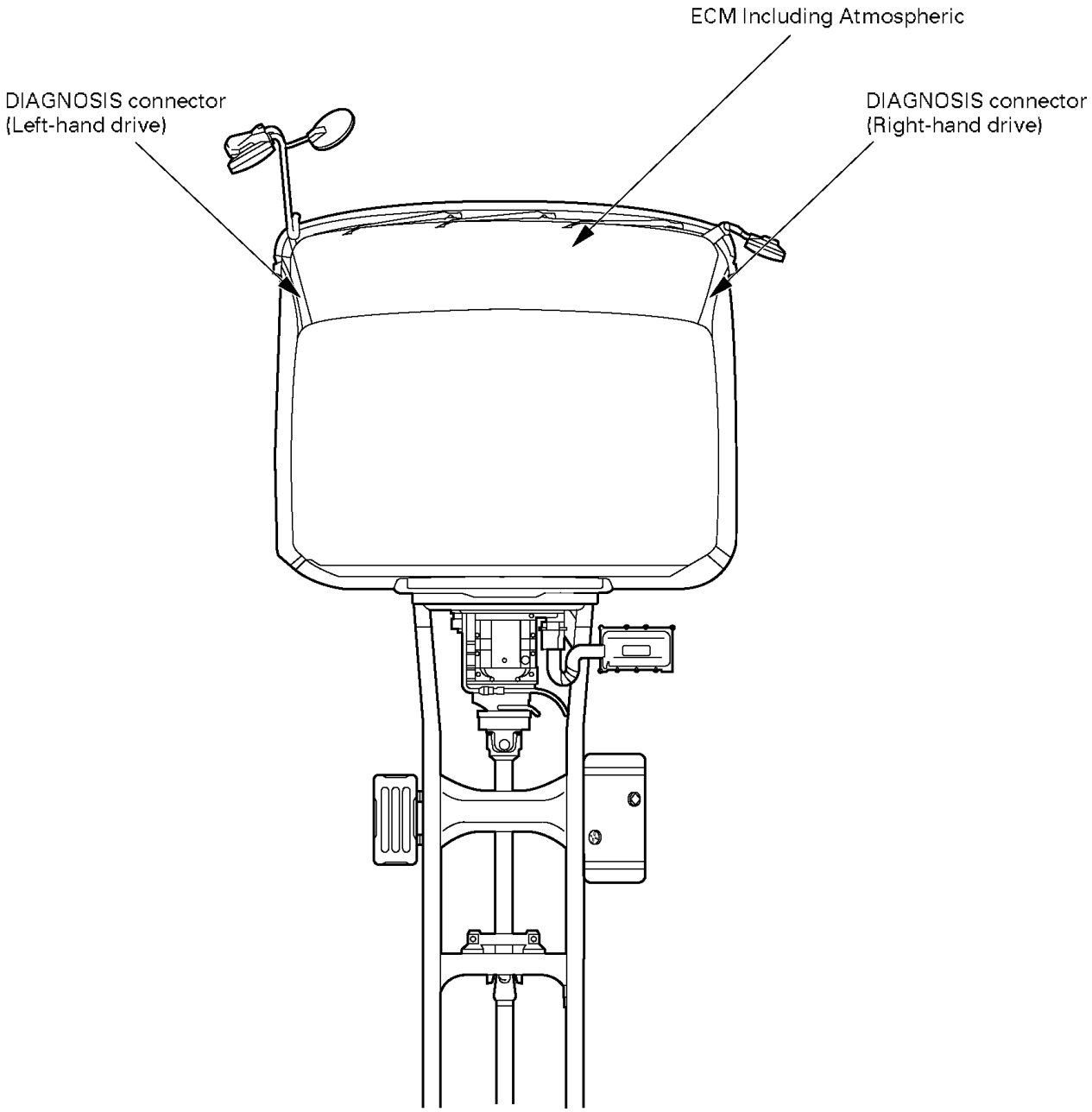
056LX011.tif

DIAGNOSIS TROUBLE CODE (DTC) LIST

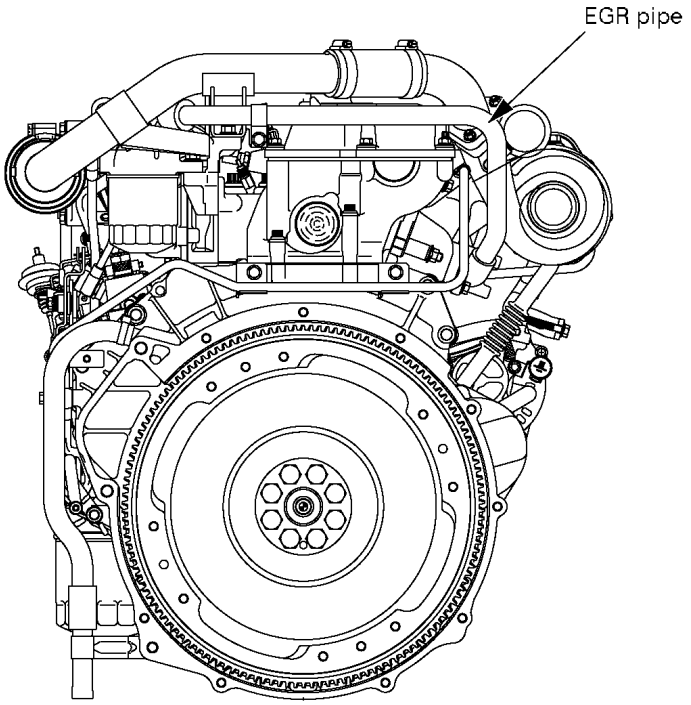
DTC#	TECH 2 STRING
21	Rack Sensor Circuit Low Voltage
22	Rack Sensor Circuit High Voltage
13	Engine Coolant Temperature (ECT) Sensor Circuit High Voltage
14	ECT Sensor Circuit Low Voltage
31	Exhaust Gas Recirculation (EGR) Vacuum Switching Valve (VSV) Solenoid Circuit Low Voltage
32	EGR VSV Solenoid Circuit High Voltage
52	Electronically Erasable Programmable Read Only Memory (EEPROM) Error

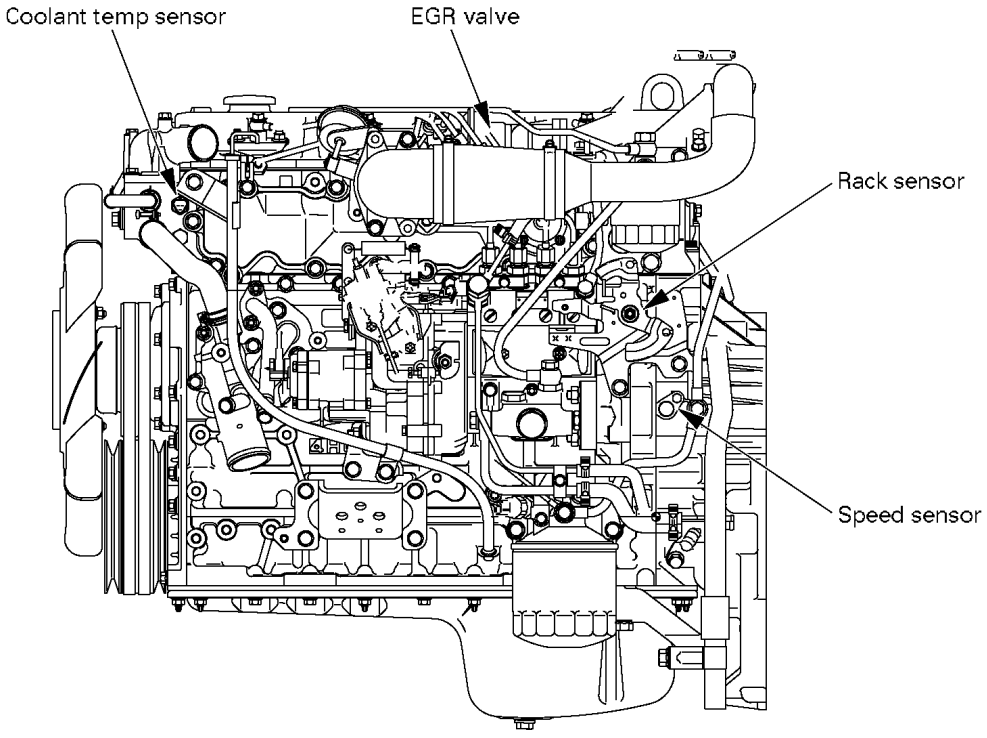
Error Classified		Trouble Code	Diagnostic Condition	Return Conditi	Back Up	Judging Time
Normal		12	No other trouble code.		No history of this diagnosis recorded	-
Rack Sensor	Harness Open GND short	21	Rack Voltage 0.3V or lower, Engine speed 600~900rpm, and water Temp. 0°C or higher are detected for 3 sec running.	When forward normal	VSV: EGR Output stop. Rack Learning valve: 0	3.52 sec
	+5V short Rack Sensor Power Voltage	22	5V or higher Rack Voltage detected.			0.52 sec
Water Temp Sensor	Harness Open +B short	13	-79°C (390kΩ) or lower, or 120°C (115kΩ) or higher detected.	When forward normal	VSV: EGR Output stop.	0.52 sec
	GND short	14				
VSV: EGR	Harness Open GND short	* 31	Output TR Monitor	When forward normal	VSV: EGR Output stop.	1.57 sec
	+B short	* 32				
	ECM EEPROM error	52	Check when ECM is started and when Trouble Code is written.	When forward normal	Trouble Code other than 52 (EEPROM error) not indicated.	

LOCATION OF SENSOR AND SWITCH



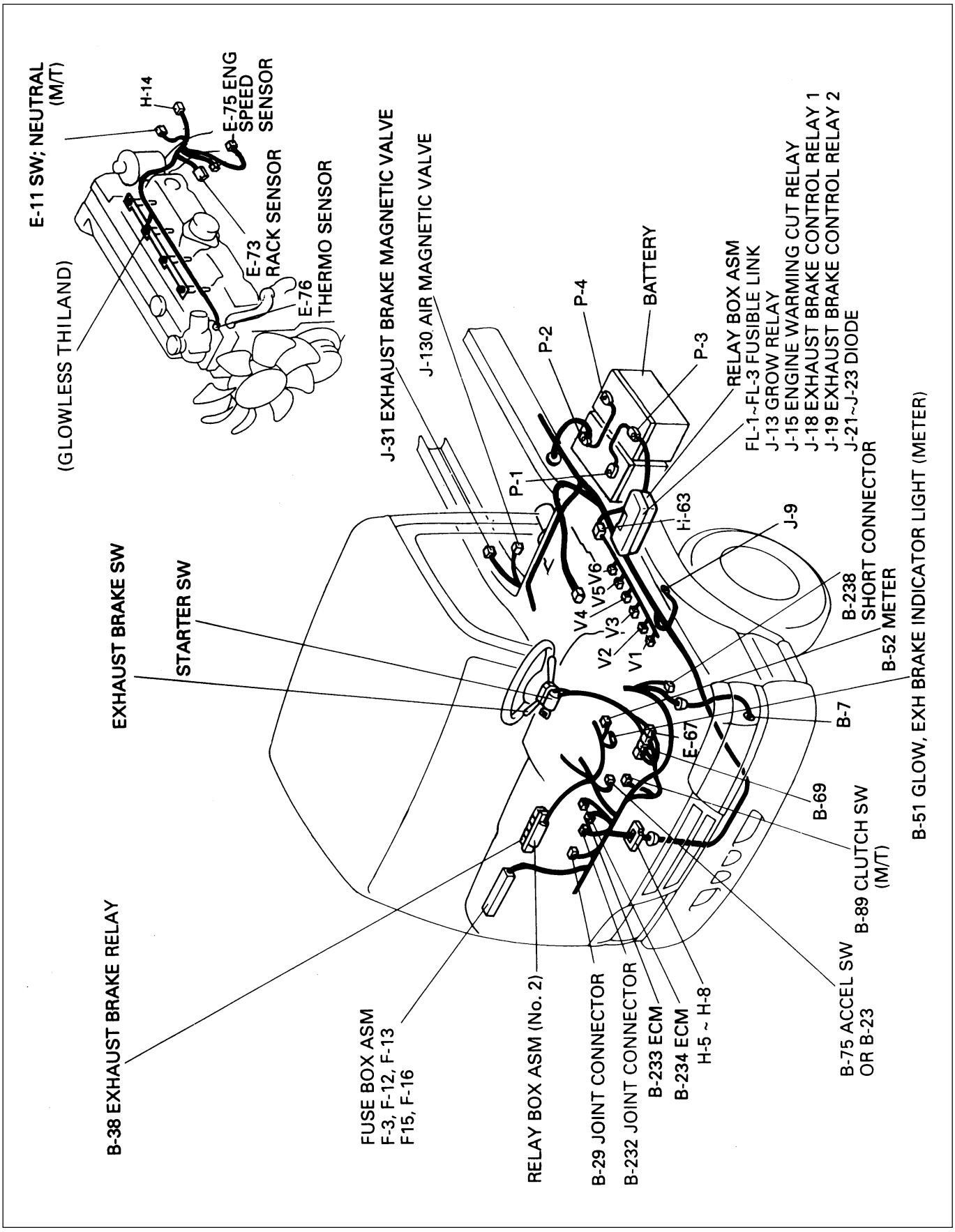
056LX004.tif





056LX005.tif

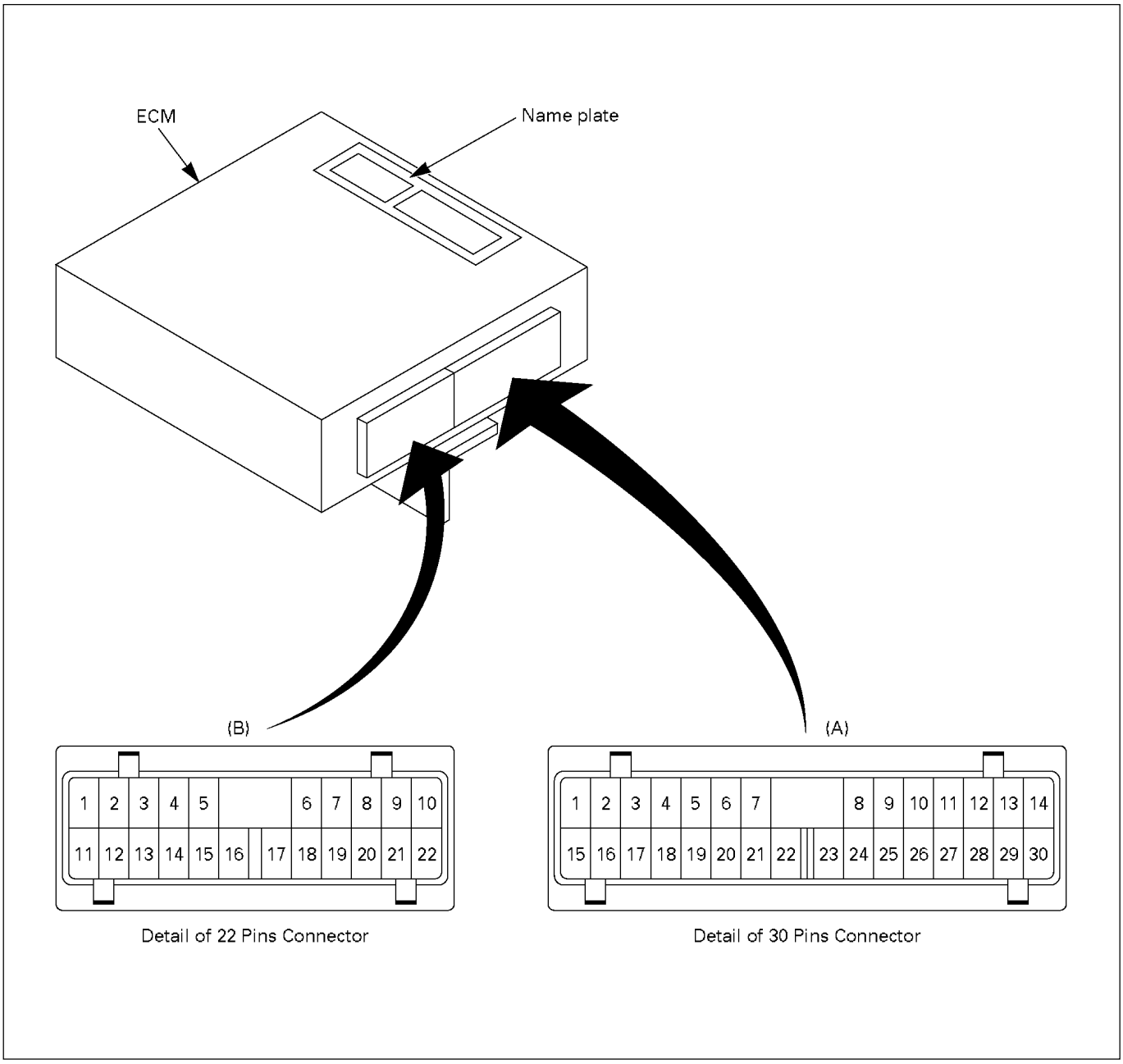
PARTS LOCATION



6E-153-1.tif

ENGINE CONTROL MODULE (ECM)

Appearance of ECM



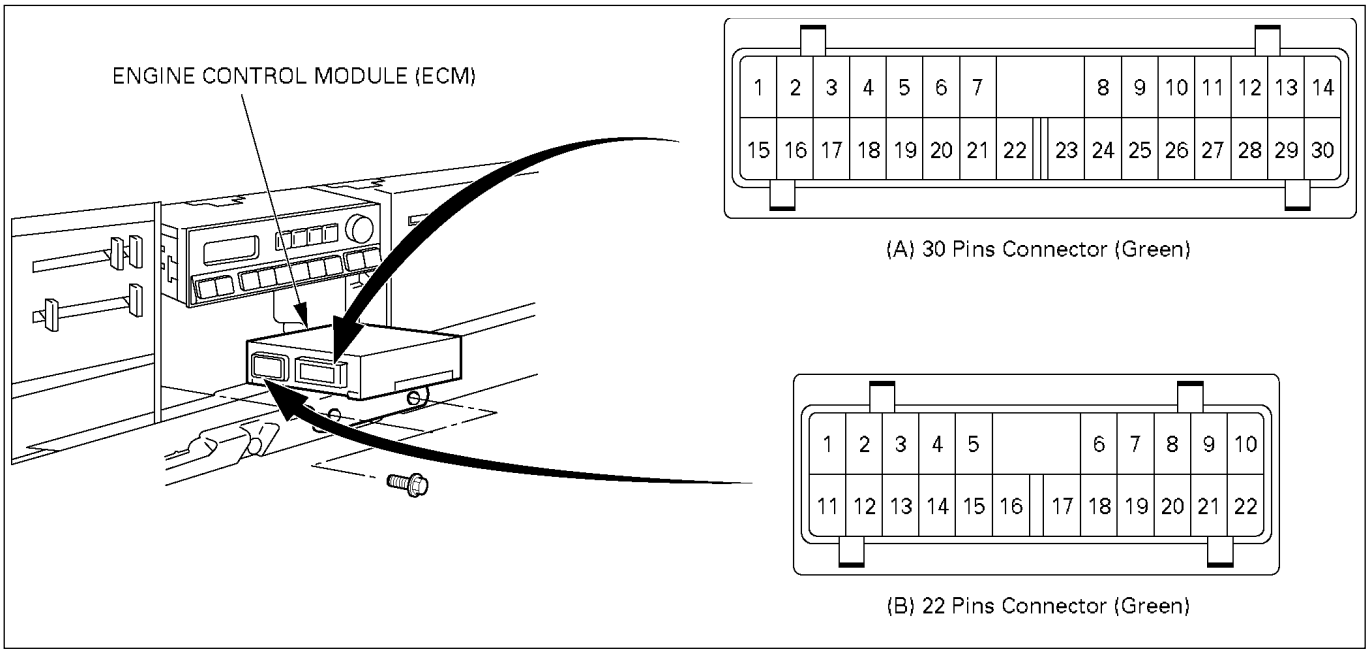
826LW006-1.tif

CHART OF ENGINE CONTROL MODULE (ECM) INPUT/OUTPUT

Connector number	Connector name
A-1	CHECKER
A-2	Not used
A-3	QOS (W/Glow only)
A-4	Not used
A-5	Not used
A-6	RACK+
A-7	RACK SIG
A-8	BATTERY
A-9	IGKBY
A-10	Not used
A-11	Not used
A-12	Not used
A-13	Not used
A-14	Not used
A-15	CHECKER GND
A-16	DIAG
A-17	Not used
A-18	Not used
A-19	Not used
A-20	Not used
A-21	RACK-
A-22	GND
A-23	Not used
A-24	Not used
A-25	Not used
A-26	Not used
A-27	Not used
A-28	Not used
A-29	Not used
A-30	Not used

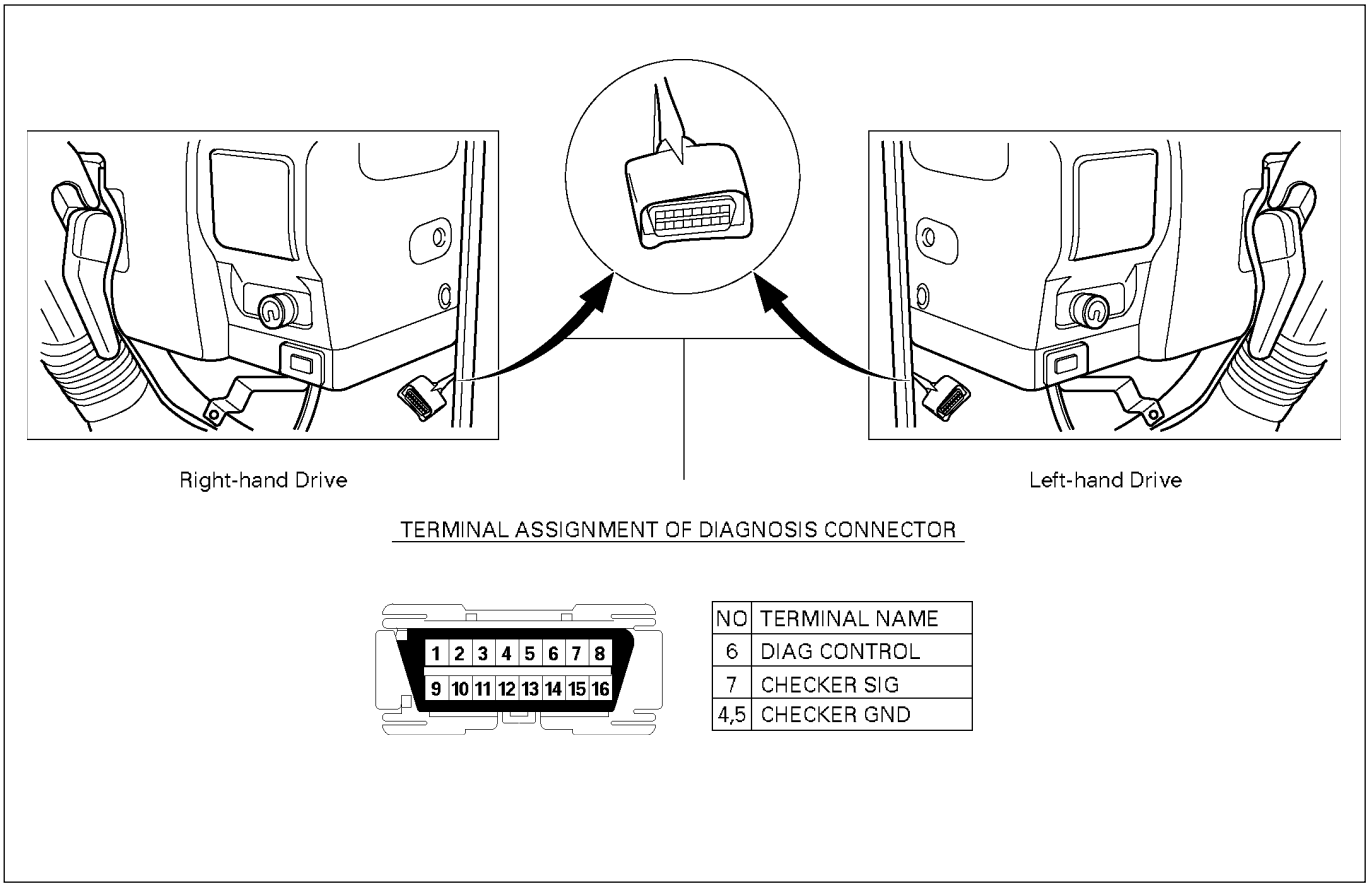
Connector number	Connector name
B-1	VSV : EGR
B-2	GLOW RELAY
B-3	GLOW IND LAMP
B-4	Not used
B-5	Not used
B-6	Not used
B-7	THERMO -
B-8	THERMO +
B-9	ENGINE -
B-10	ENGINE +
B-11	Not used
B-12	Not used
B13	Not used
B-14	Not used
B-15	Not used
B-16	Not used
B-17	Not used
B-18	STARTER
B-19	EXH BRAKE
B-20	Not used
B-21	Not used
B-22	Not used

LOCATION OF THE ENGINE CONTROL MODULE (ECM) CONNECTOR



826LW008-1.tif

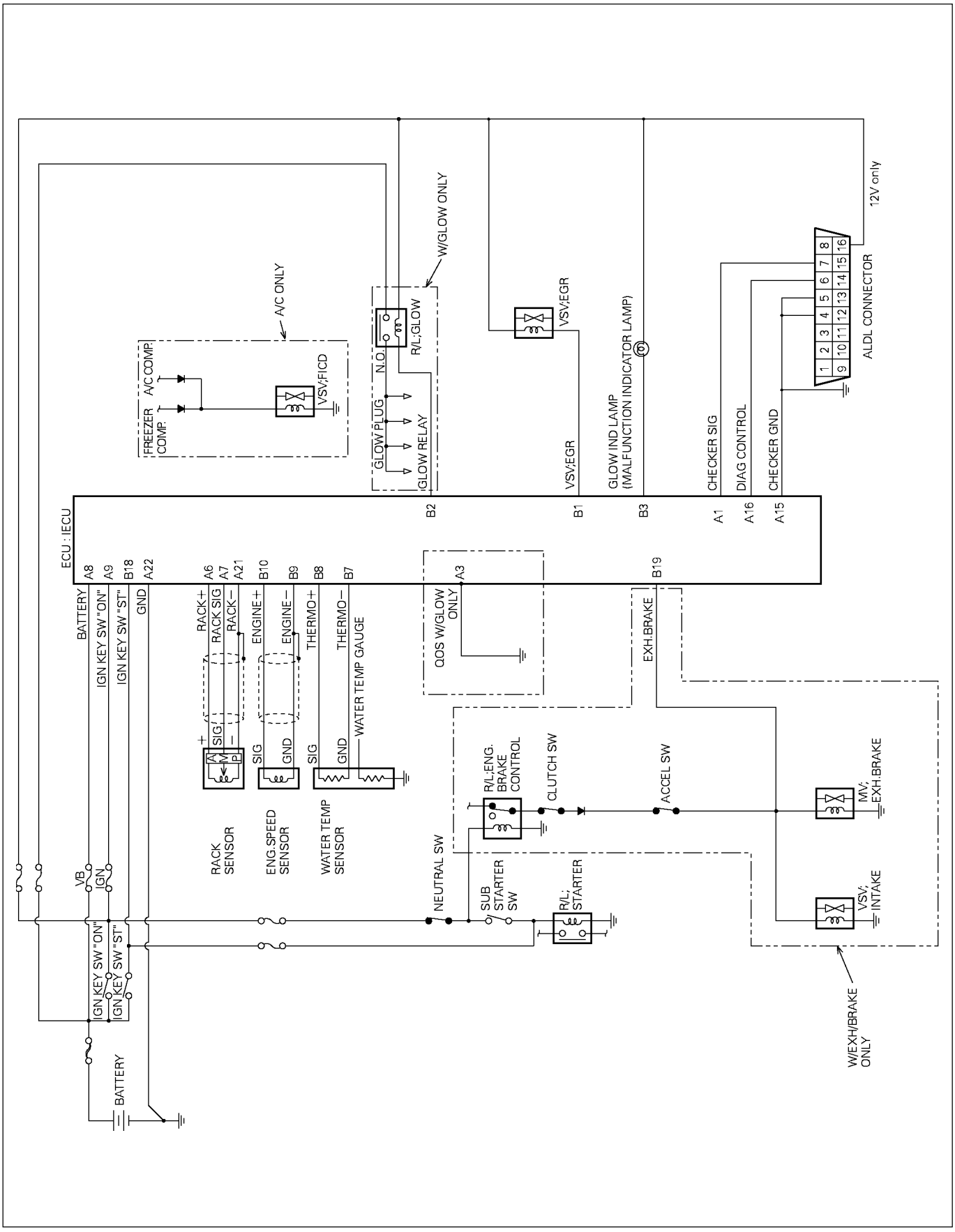
LOCATION OF DATA LINK CONNECTOR (DLC)



NO	TERMINAL NAME
6	DIAG CONTROL
7	CHECKER SIG
4,5	CHECKER GND

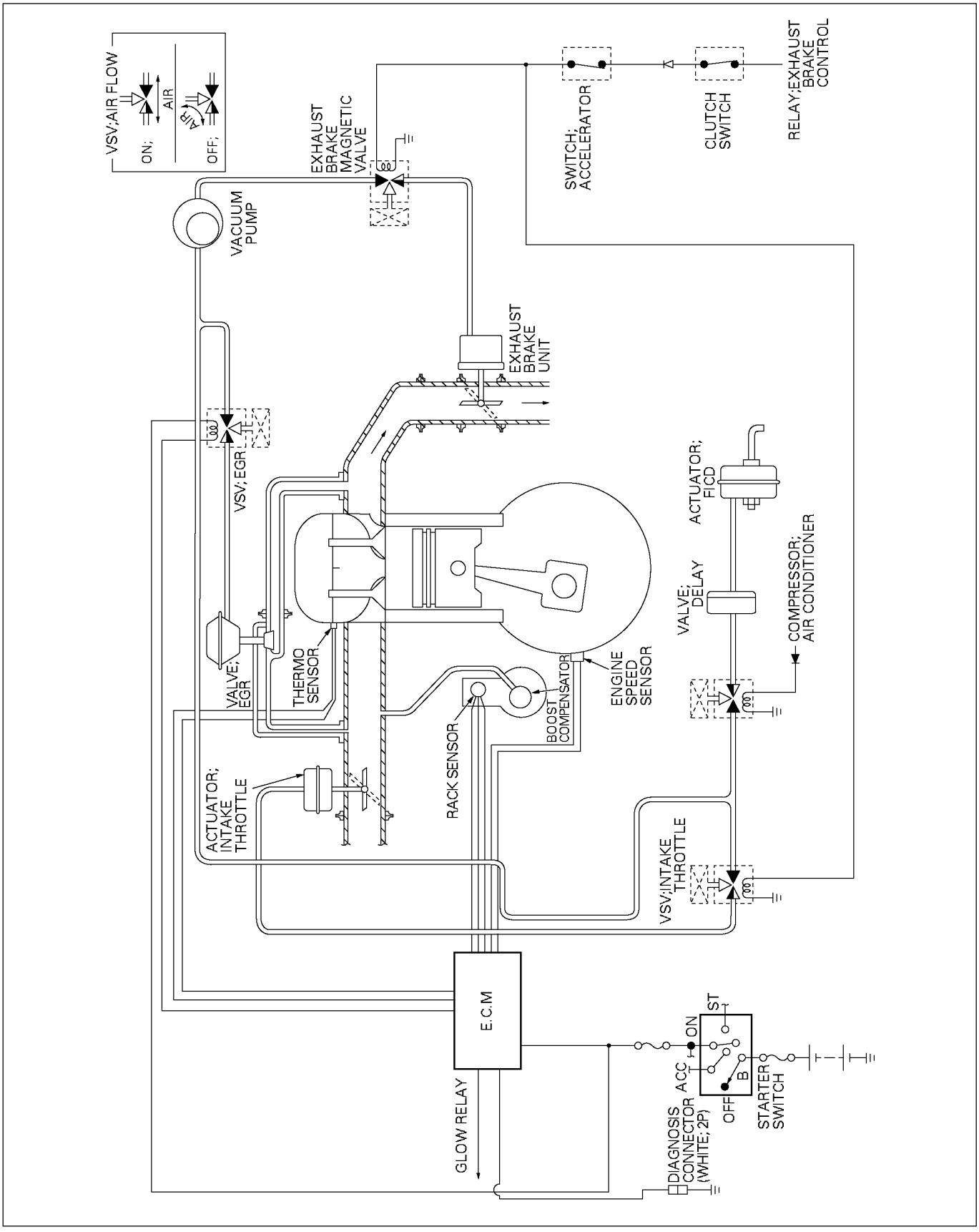
056LX013.tif

ENGINE CONTROL MODULE (ECM) SYSTEM WIRING DIAGRAM



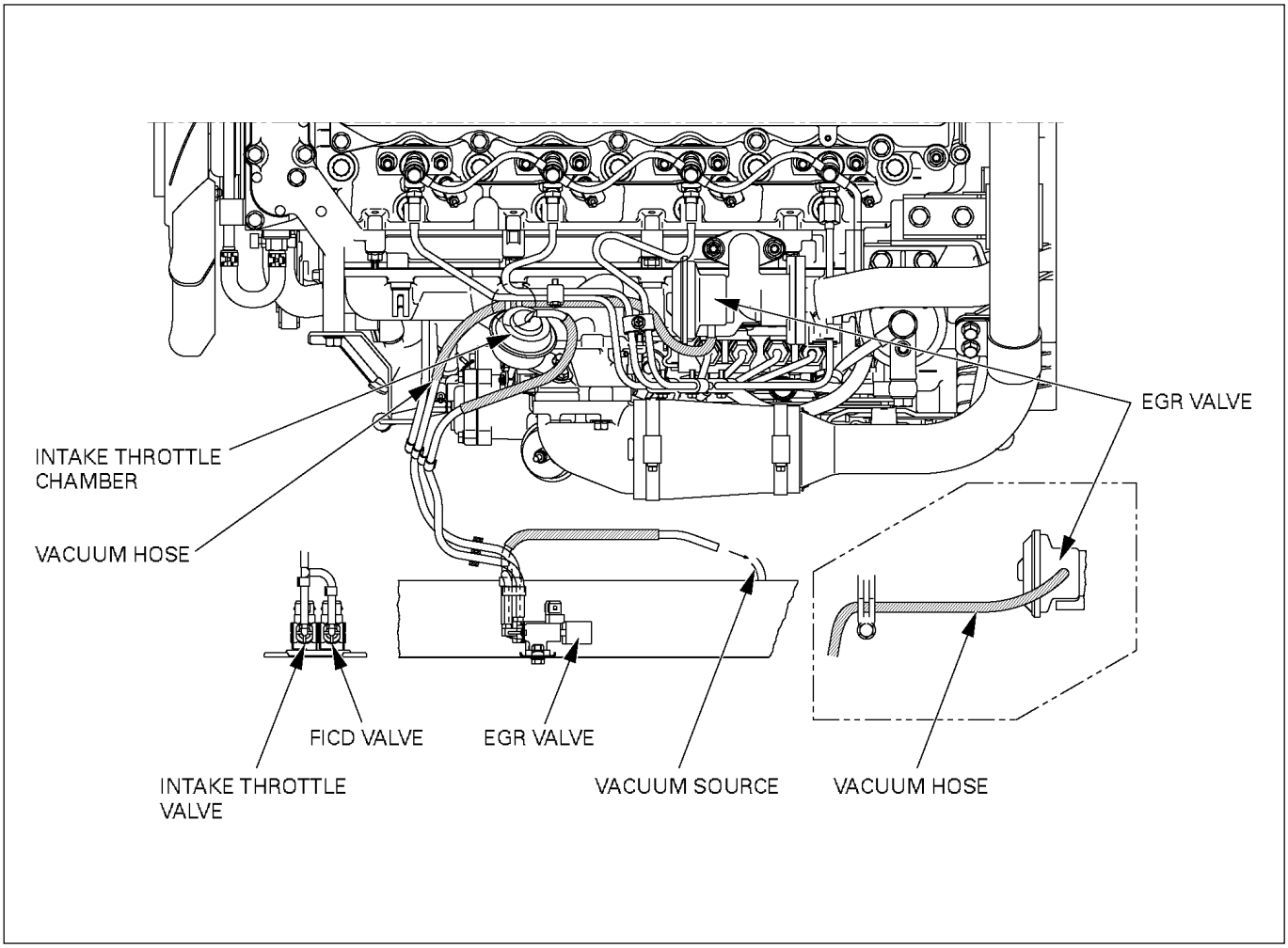
826LX003.tif

AUXILIARY ENGINE CONTROL SYSTEM (Equipped with Exhaust gas recirculation (EGR))



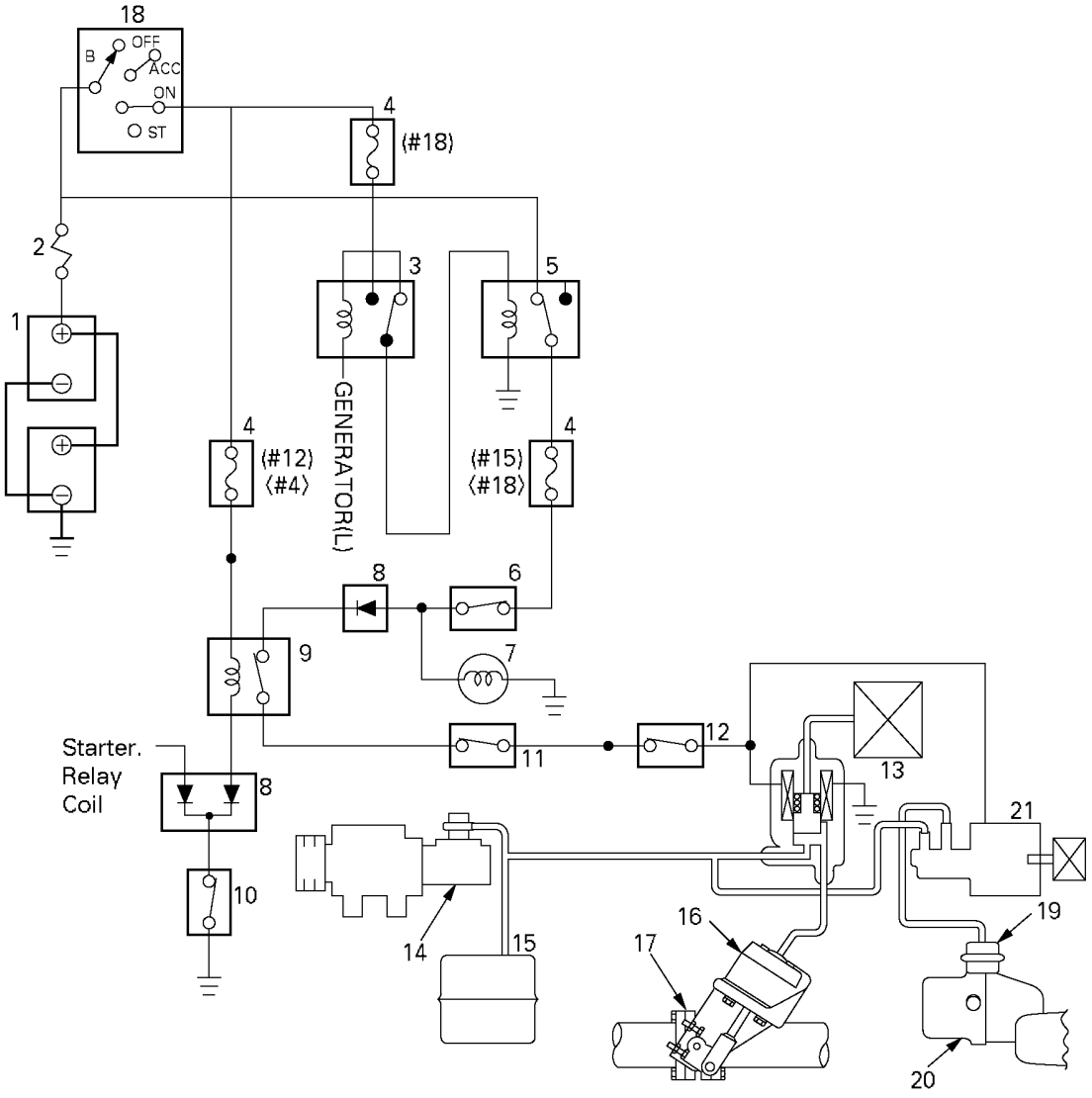
056LX003.tif

VACUUM SWITCHING VALVE (VSV) CIRCUIT (Equipped with Exhaust gas recirculation (EGR))



028LX001.tif

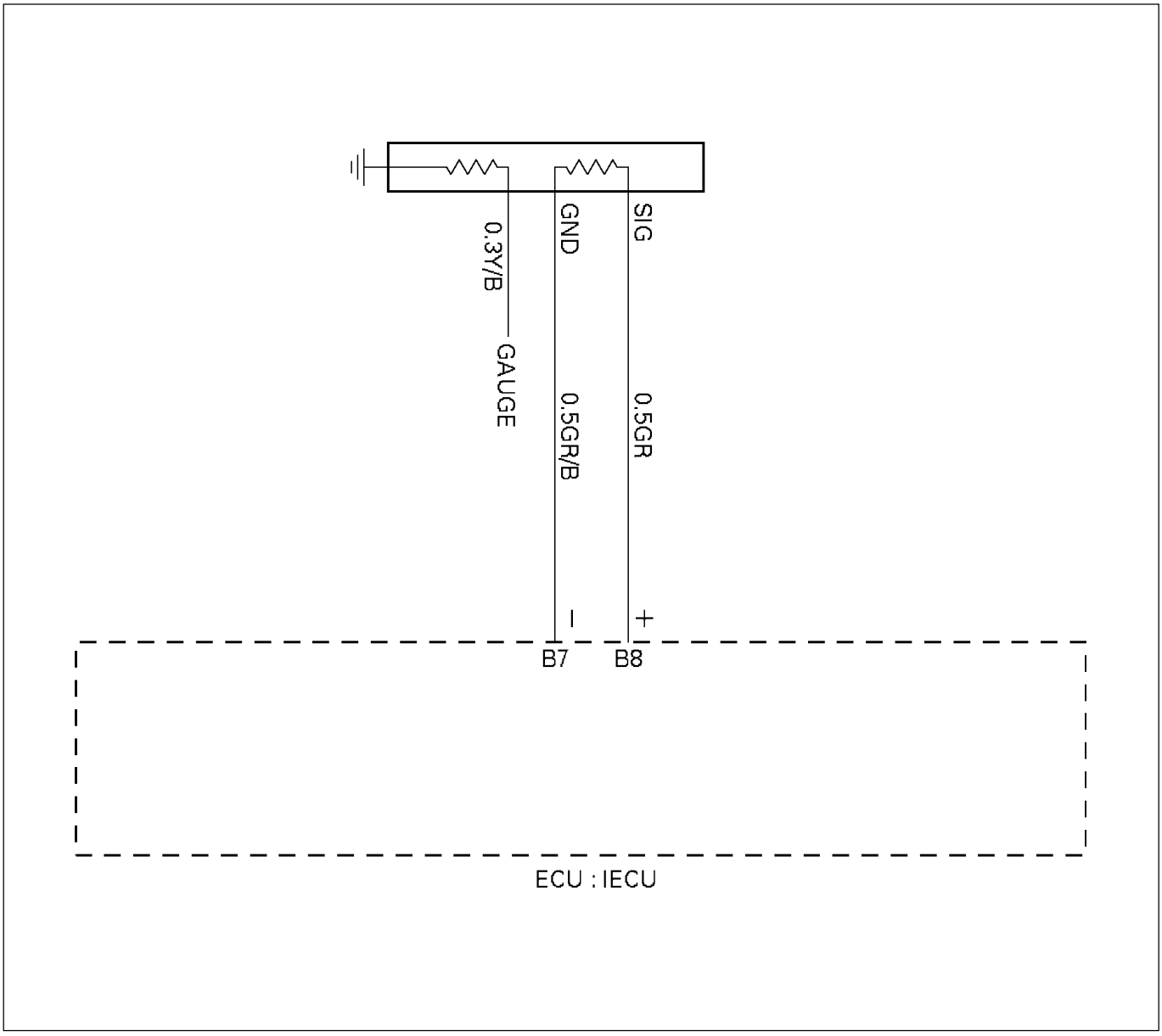
EXHAUST BRAKE CONTROL



1. Batteries
2. Fusible Link Wire
3. Charge Relay
4. Fuse
5. Exhaust Brake Relay
6. Exhaust Brake Switch
7. Indicator Light
8. Diode
9. Exhaust Brake Control Relay
10. Neutral Switch
11. Clutch Switch (M/T only)
12. Accelerator Switch
13. Magnetic Valve: Exhaust Brake
14. Vacuum Pump
15. Vacuum Tank
16. Vacuum Chamber: Exhaust Brake
17. Exhaust Brake Valve
18. Key Switch
19. Vacuum Chamber: Intake Throttle
20. Intake Throttle
21. Magnetic Valve Intake Throttle

052LX001.tif

DTC-13 ENGINE COOLANT TEMPERATURE (ECT) SENSOR CIRCUIT HIGH VOLTAGE



826LX004.tif

Appearance of water temperature sensor and connector pin assignment.

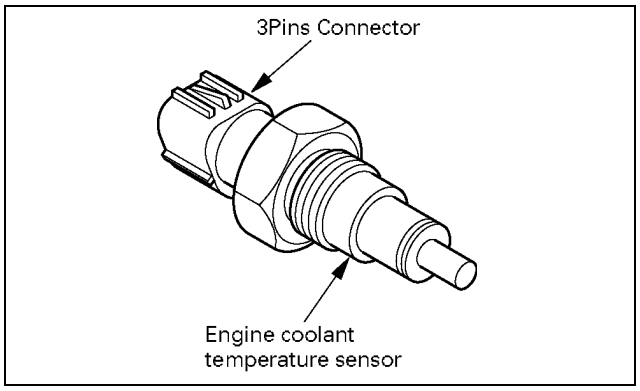


Figure. Temperature sensor 056LW017.tif

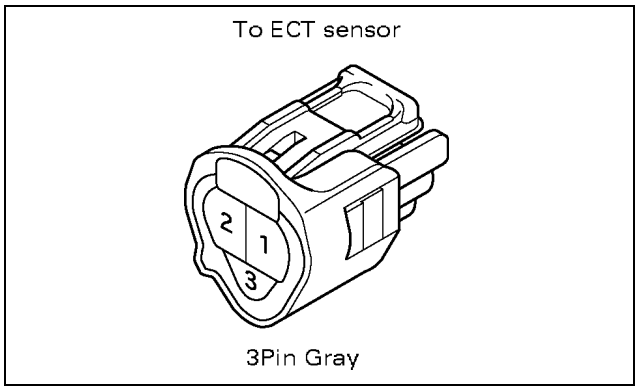
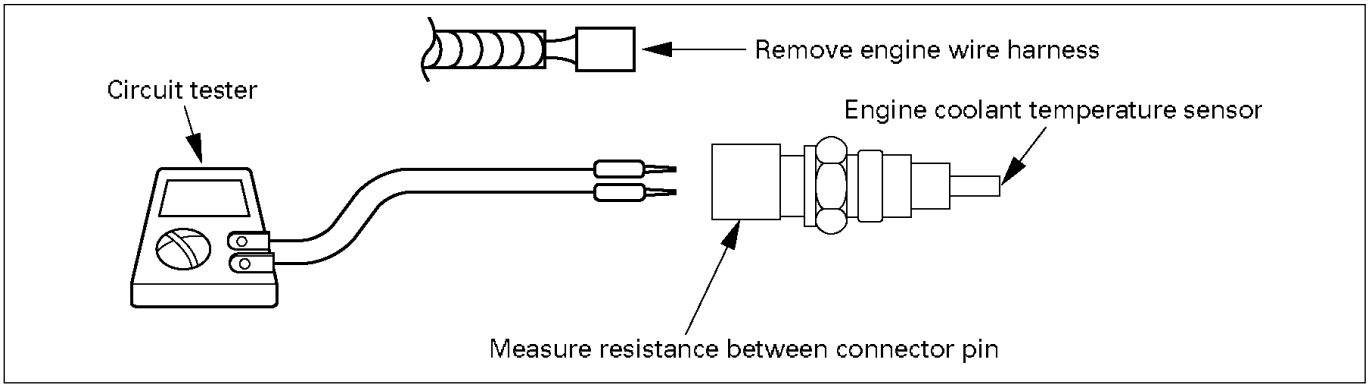


Figure. Connector pin assignment 056LW012.tif

Connector No	Signal
1	Thermistor for engine
2	Thermistor for engine
3	Thermistor for meter

Measure resistance at Engine Coolant Temperature (ECT) sensor



056LW023.tif

CAUTION:

When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

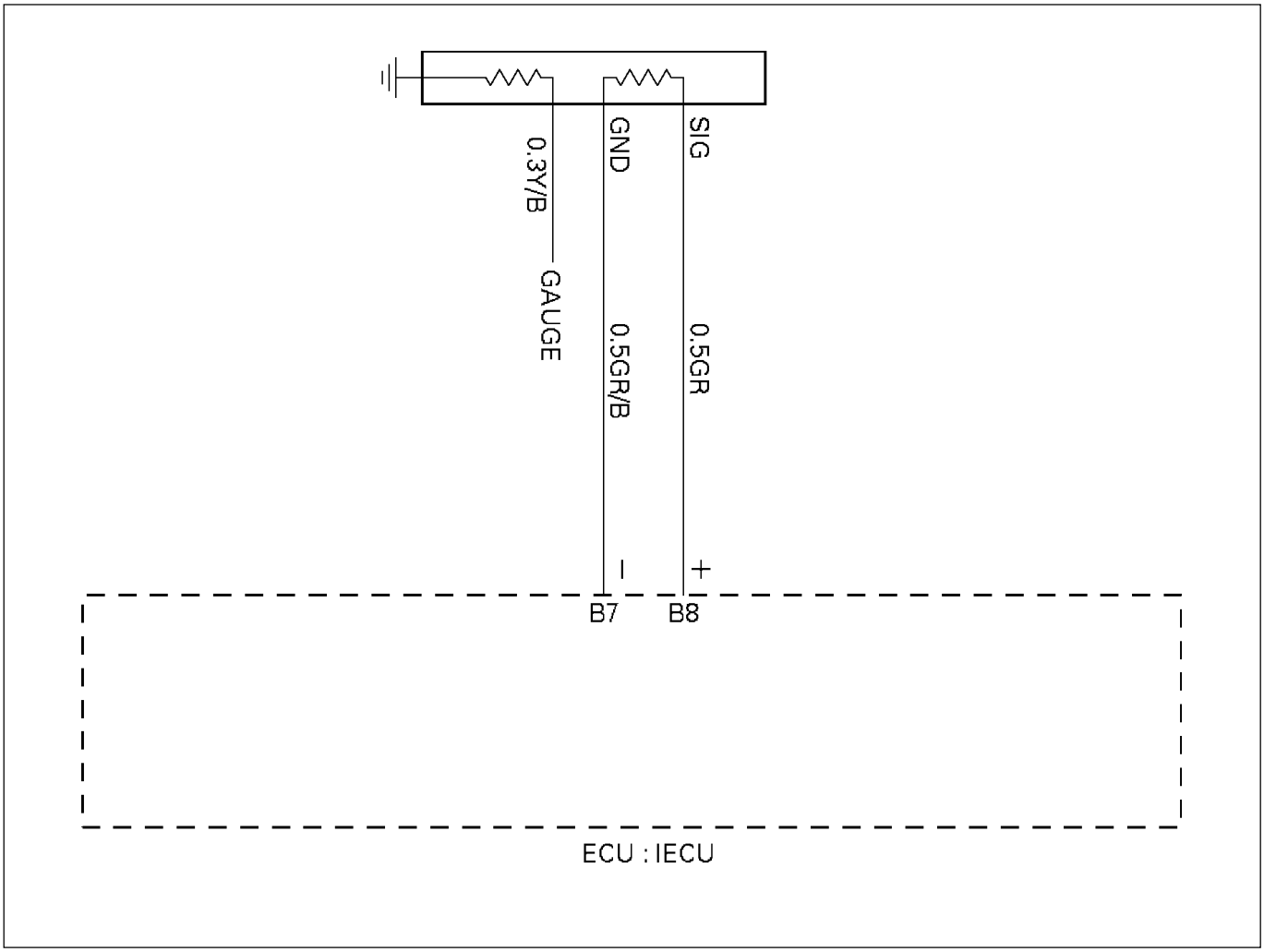
Resistance value

Inspection Point		Resistance Value	Temperature on sensor	Reference
Connector	Pin No.			
3 pin Black	1 ←→ 3	∞	-	Thermistor for ENGINE ←→ Thermistor for meter
	1 ←→ 2	2.5 (kΩ)	20 (°C)	Thermistor for ENGINE
		247 (Ω)	90 (°C)	
	1 ←→ Body	∞	-	Thermistor for ENGINE ←→ Body
	2 ←→ 3	∞	-	Thermistor for ENGINE ←→ Thermistor for meter
	3 ←→ Body	146.6 (Ω)	60 (°C)	Thermistor for meter ENGINE
	2 ←→ Body	∞	-	Thermistor for ECM ←→ Body

Note: Resistance value is difference according to the temperature of temperature sensor.

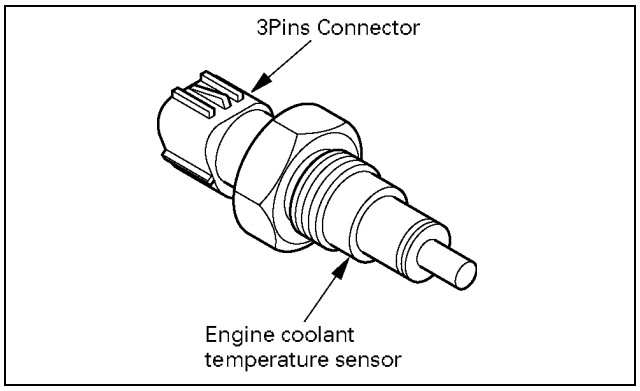
Step	Action	Value (s)	Yes	No
1	Was the “Diagnostic system check” performed?	-	Go to Step 2	Go to self diagnostic system check
2	1. Ignition “OFF” 2. Disconnect ECT sensor electrical connector. 3. Jumper the ECT sensor signal circuit and the ECT sensor ground circuit together at the ECT sensor harness connector. 4. Does indicate DTC 14?	-	Go to Step 4	Go to Step 3
3	1. Ignition “OFF” 2. Jumper the ECT signal circuit at the ECT sensor harness connector to chassis ground. 3. Does indicate DTC 14?	-	Go to Step 5	Go to Step 6
4	Check four poor connection at the ECT sensor and replace terminals if necessary. Did any terminals require replacement?	-	Go to Step 10	Go to Step 8
5	1. Ignition “OFF”. 2. Disconnect the ECM, and check the ECT sensor ground circuit for an open. 3. If the ECT sensor ground circuit is open, repair it as necessary. Was the ECT sensor ground circuit open?	-	Go to Step 10	Go to Step 7
6	1. Ignition “OFF”. 2. Disconnect the ECM, and check the ECT sensor signal circuit for an open. 3. If the ECT signal circuit is open, repair it as necessary. Was the ECT sensor signal circuit open?	-	Go to Step 10	Go to Step 7
7	Check for poor sensor ground or ECT sensor signal circuit terminal connection at the ECU and replace terminal(s) if necessary. Did any of the terminals need to be replaced?	-	Go to Step 10	Go to Step 9
8	1. Ignition “OFF” 2. Replace the ECT Sensor. Is the action complete?	-	Go to Step 10	-
9	1. Replace the ECM. Is the action complete?	-	Go to Step 10	-
10	1. Reconnect all the connectors removed. 2. Ignition “ON”, Engine “OFF” Does DTC 13 come normal condition?	-	Go to Step 11	Go to Step 2
11	Is any current trouble other than DTC 13 displayed by indicator light?	-	Go to trouble code section	Trouble code clear

DTC-14 ENGINE COOLANT TEMPERATURE (ECT) SENSOR CIRCUIT LOW VOLTAGE



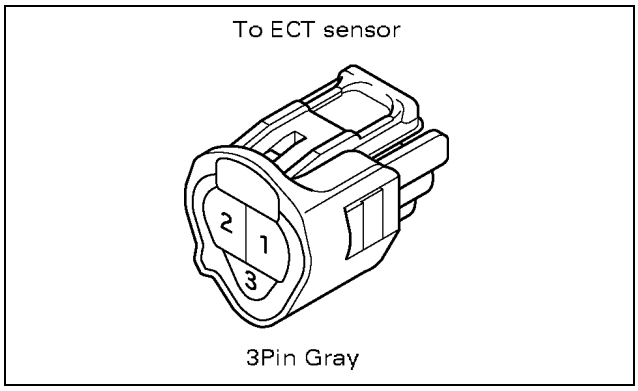
826LX004.tif

Appearance of water temperature sensor and connector pin assignment.



056LW017.tif

Figure. Temperature sensor

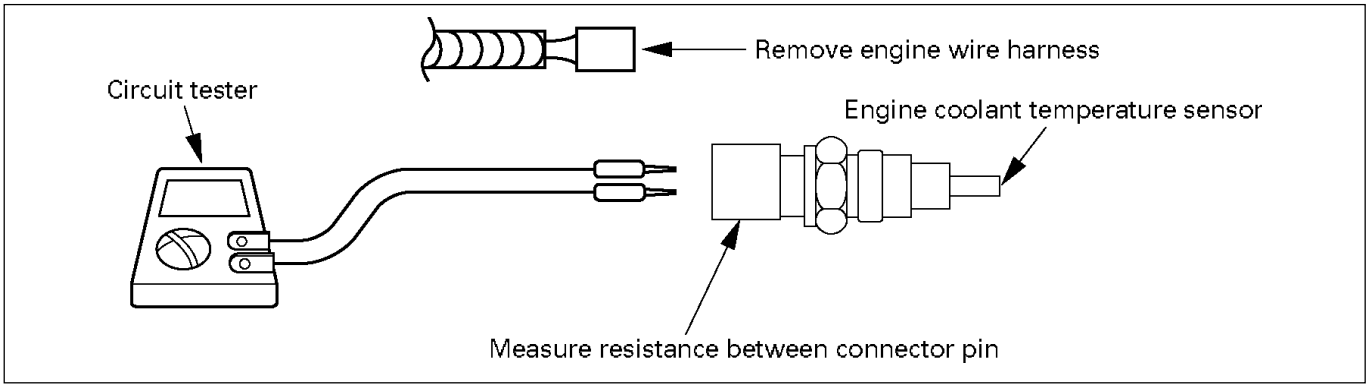


056LW012.tif

Figure. Connector pin assignment

Connector No	Signal
1	Thermistor for engine
2	Thermistor for engine
3	Thermistor for meter

Measure resistance at Engine Coolant Temperature (ECT) sensor



056LW023.tif

CAUTION:

When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

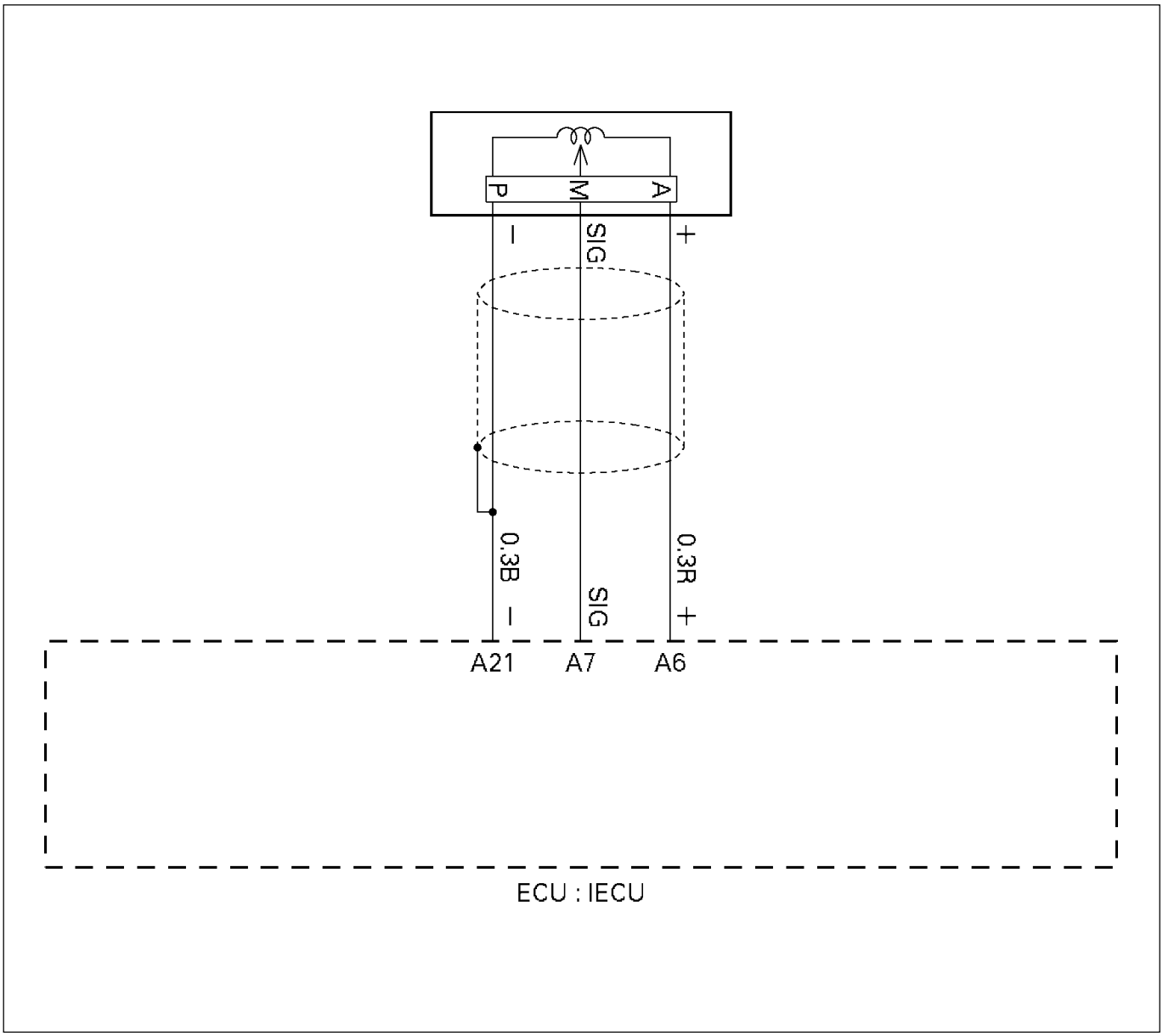
Resistance value

Inspection Point		Resistance Value	Temperature on sensor	Reference
Connector	Pin No.			
3 pin Black	1 ←→ 3	∞	-	Thermistor for ENGINE ←→ Thermistor for meter
	1 ←→ 2	2.5 (kΩ)	20 (°C)	Thermistor for ENGINE
		247 (Ω)	90 (°C)	
	1 ←→ Body	∞	-	Thermistor for ENGINE ←→ Body
	2 ←→ 3	∞	-	Thermistor for ENGINE ←→ Thermistor for meter
	3 ←→ Body	146.6 (Ω)	60 (°C)	Thermistor for meter ENGINE
	2 ←→ Body	∞	-	Thermistor for ECM ←→ Body

Note: Resistance value is difference according to the temperature of temperature sensor.

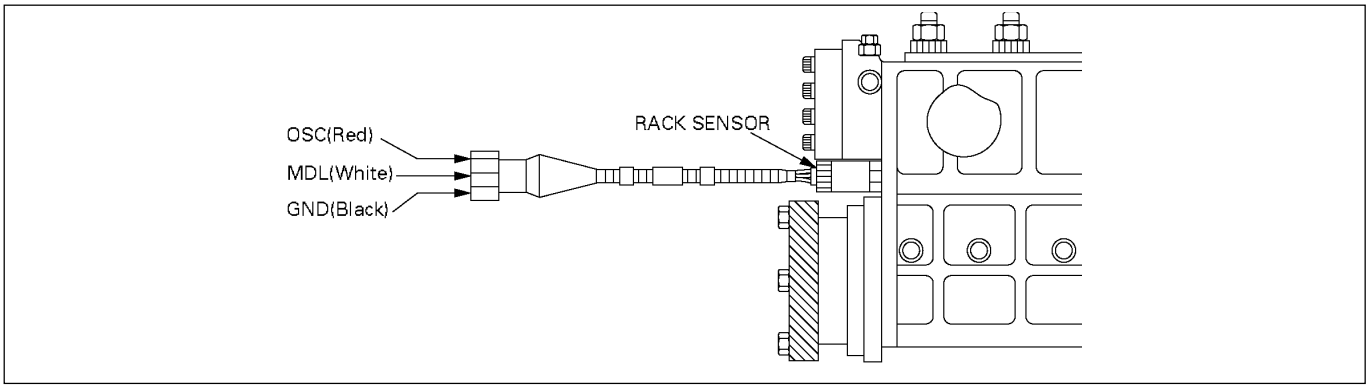
Step	Action	Value (s)	Yes	No
1	Was the “Diagnostic system check” performed?	-	Go to Step 2	Go to self diagnostic system check
2	1. Memory DTC to ECM. 2. Clear DTC 3. Ignition “OFF” 4. Disconnect the ECT sensor. 5. Ignition “ON”, Engine “OFF” 6. Does indicate DTC 14? (Ignore DTC 13)	-	Go to Step 3	Go to Step 6
3	1. Ignition “OFF” 2. Check Connector ECT Sensor Harness for interterminal short. 3. Repair if necessary. Was ECT Sensor connector shorted?	-	Go to Step 8	Go to Step 4
4	1. Ignition “OFF” 2. Check the ECM connector terminal short? 3. Repair if necessary. Was ECM terminal shorted?	-	Go to Step 8	Go to Step 5
5	1. Disconnect the ECM. 2. Check if ECT sensor signal circuit for a short to ground or a short to ground circuit. 3. Repair if necessary. Is ECT sensor signal circuit shorted to ground.	-	Go to Step 8	Go to Step 7
6	1. Ignition “OFF” 2. Replace the ECT Sensor. Is the action complete?	-	Go to Step 8	-
7	1. Replace the ECM. Is the action complete?	-	Go to Step 8	-
8	1. Reconnect all the connectors removed. 2. Ignition “ON”, Engine “OFF” Does DTC 13 come normal condition?	-	Go to Step 9	Go to Step 2
9	Is any current trouble other than DTC 14 displayed by indicator light?	-	Go to trouble code section	Trouble code clear

DTC-21 RACK SENSOR CIRCUIT LOW VOLTAGE



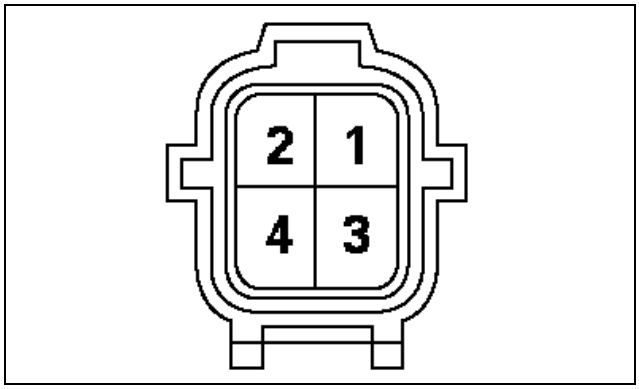
826LX005.tif

Location of Rack sensor connector



040LW032.tif

Connector name of Rack sensor



4-16-1.tif

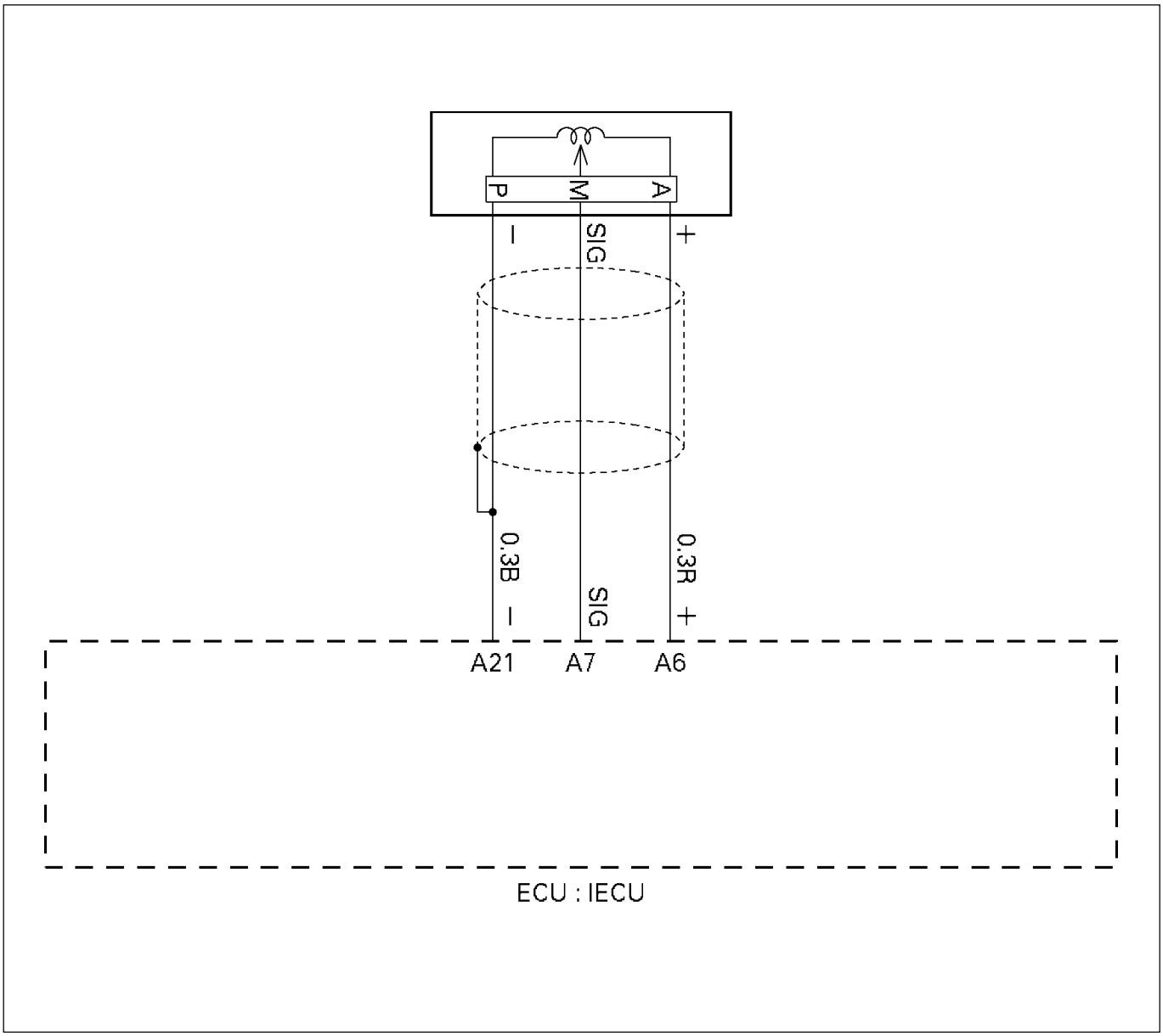
NOTE: Mark "___" on connector which is plugged, therefore, should be confirmed to be played.

Relation between connector number and signal name

Connector No.	Signal name	Wire color
1	Rack sensor (OSC)	R
2	Rack sensor (GND)	W
4	Rack sensor (MDL)	B

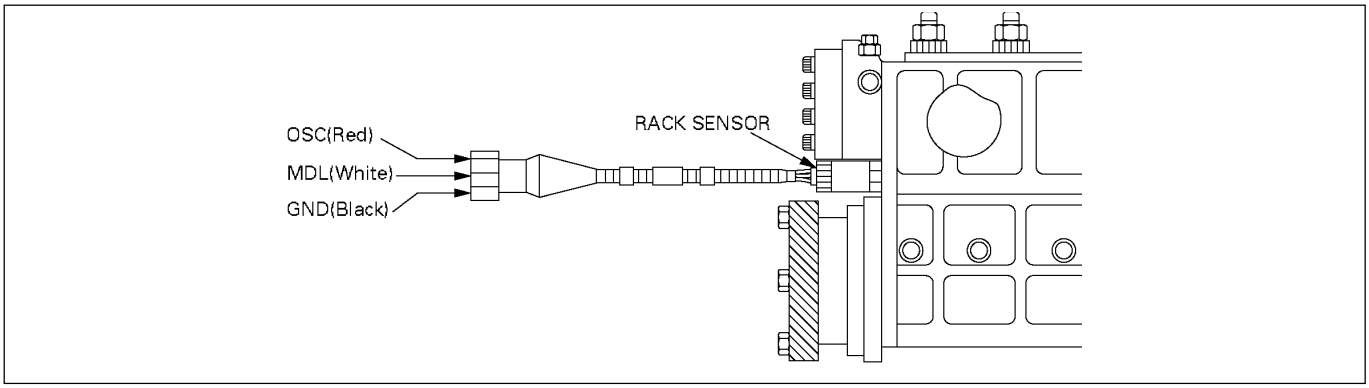
Step	Action	Value (s)	Yes	No
1	Was the “Diagnostic system check” performed?	-	Go to Step 2	Go to diagnostic system check
2	1. Check harness side power source circuit and signal circuit for GND short. 2. Repair if necessary. 3. Has DTC21 been corrected?	-	Go to Step 10	Go to Step 3
3	Disconnect Sensor Connector. Jumper RACK+ and RACK sig. Free from trouble now? Ignore code 22.	-	Go to Step 4	Go to Step 6
4	1. Apply 5V to RACK+ TERMINAL. Measure RACK SIG Voltage. Is RACK SIG VOLTAGE as specified?	0.9-2.0V (Idling speed)	Go to Step 7	Go to Step 5
5	1. Check Rack Sensor Harness Signal Circuit and power source for GND short. Check signal circuit for disconnect. 2. Repair if necessary. 3. Free from trouble now?	-	Go to Step 10	Go to Step 7
6	1. Check harness signal circuit and power source circuit for disconnect. 2. Repair if necessary. 3. Free from trouble now?	-	Go to Step 10	Go to Step 9
7	1. Check the iron core of RACK Sensor for damage, seizure, and wear. 2. After check, repair if necessary. Was there any trouble in the iron core (RACK end) inside RACK Sensor?	-	Go to Step 10	Go to Step 8
8	Replaced RACK Sensor?	-	Go to Step 10	-
9	1. Replace the ECM. Is the action complete?	-	Go to Step 10	-
10	1. Reconnect all the connectors removed. 2. Ignition “ON”, Engine “OFF” Is DTC 21 all right under Scan Tool Check?	-	Go to Step 10	Go to Step 2
11	Is any current trouble other than DTC 21 displayed by scan tool?	-	Go to trouble code section	Trouble code clear

DTC-22 RACK SENSOR CIRCUIT HIGH VOLTAGE



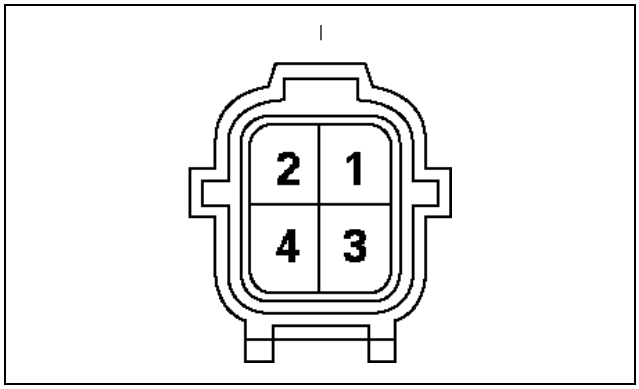
826LX005.tif

Location of Rack sensor connector



040LW032.tif

Connector name of Rack sensor



4-16.tif

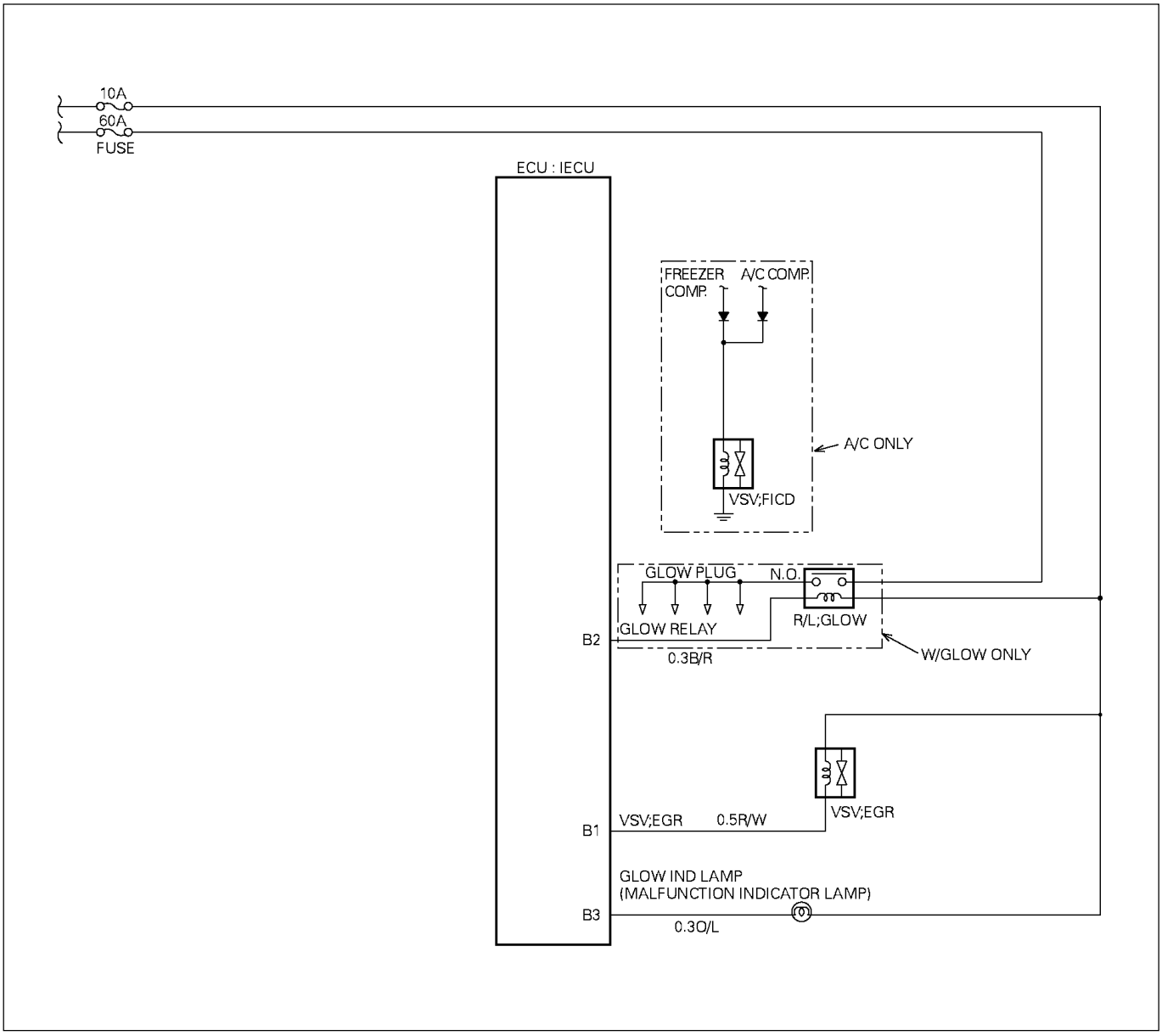
NOTE: Mark "___" on connector which is plugged, therefore, should be confirmed to be played.

Relation between connector number and signal name

Connector No.	Signal name	Wire color
1	Rack sensor (OSC)	R
2	Rack sensor (GND)	B
4	Rack sensor (MDL)	W

Step	Action	Value (s)	Yes	No
1	Was the “Diagnostic system check” performed?	-	Go to Step 2	Go to diagnostic system check
2	Remove Sensor Connector. Has DTC22 been corrected? (Ignore DTC 21)	-	Go to Step 3	Go to Step 7
3	1. Jumper Harness signal Terminal and GND terminal at the Sensor side of Connector. 2. Ignition “ON” Has DTC22 been corrected?	-	Go to Step 4	Go to Step 5
4	1. Check Sensor Connector for inter terminal short. After check, repair if necessary. Was Connector Terminal shorted?	-	Go to Step 12	Go to Step 6
5	1. Check GND Circuit for disconnect. After check, repair if necessary. Is GND circuit disconnect?	-	Go to Step 12	Go to Step 11
6	1. Check Sensor Harness signal circuit and power source circuit for short. After check, repair if necessary. Was Harness shorted?	-	Go to Step 12	Go to Step 8
7	1. Check Harness signal circuit and power source for short. After check, repair if necessary. Was Harness shorted?	-	Go to Step 12	Go to Step 11
8	1. Apply 5V to RACK+ TERMINAL. 2. Measure RACK SIG Voltage. Is RACK SIG VOLTAGE as specified?	0.9-2.0V (Idling speed)	Go to Step 9	Go to Step 10
9	1. Check the iron core of RACK Sensor for damage, seizure, and wear. 2. After check, repair if necessary. Was there any trouble in the iron core(RACK end) inside RACK Sensor?	-	Go to Step 12	Go to Step 11
10	Replaced sensor. Was Sensor replaced?	-	Go to Step 12	-
11	Replace the ECM. Is the action complete?	-	Go to Step 12	-
12	1. Reconnect all the connectors removed. 2. Ignition “ON”, Engine “OFF” Is DTC22 all right under Scan Tool Check?	-	Go to Step 13	Go to Step 2
13	Is any current trouble other than DTC 22 displayed by indicator light?	-	Go to trouble code section	Trouble code clear

DTC-31 EXHAUST GAS RECIRCULATION (EGR) VACUUM SWITCHING VALVE (VSV) SOLENOID CONTROL LOW VOLTAGE



826LX006.tif

Appearance of Vacuum Switching Valve (VSV): Exhaust Gas Recirculation (EGR) connector

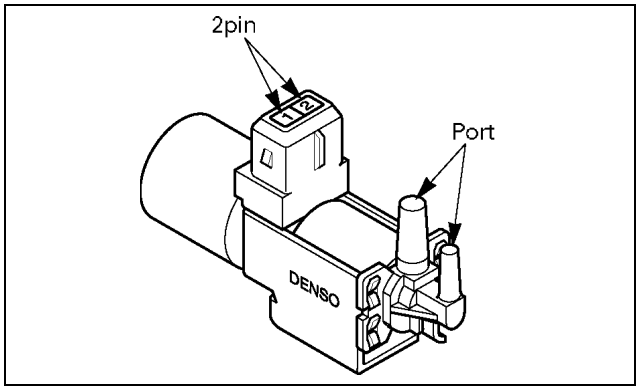


Figure. VSV:EGR

056LW026.tif

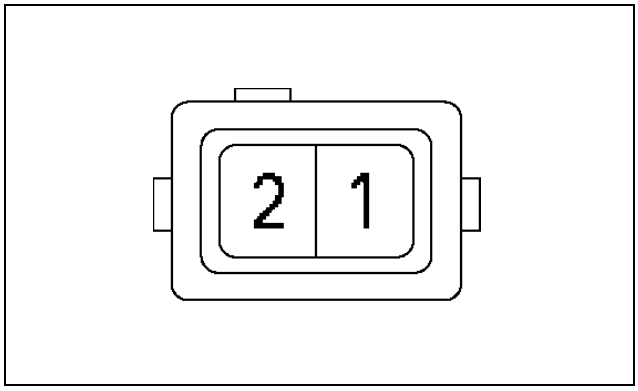
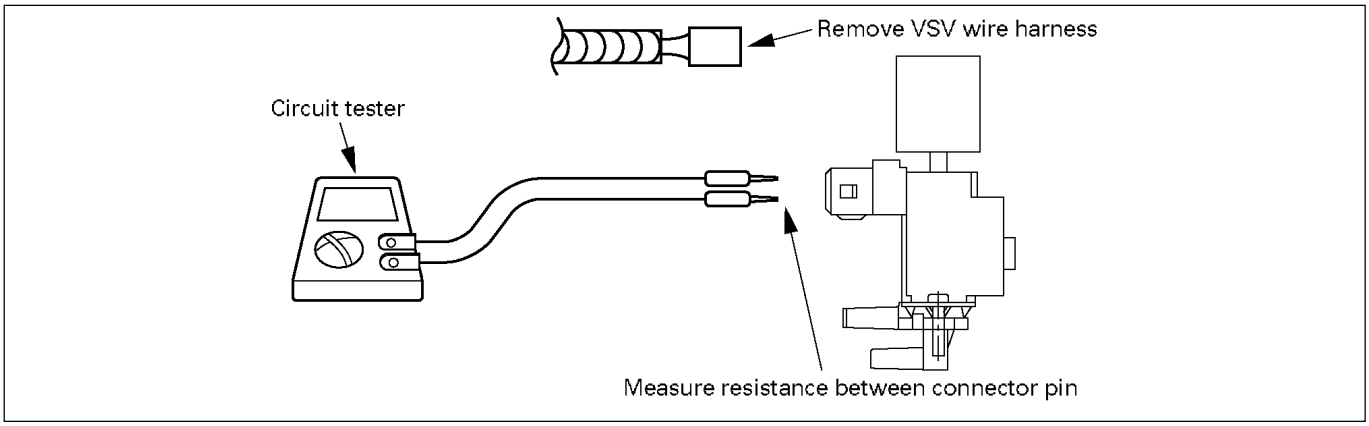


Figure. VSV:EGR connector

821LX001.tif

Connector No	Signal
1 2	GND SIG

Measure resistance at VSV:EGR



056LW005.tif

CAUTION:
When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

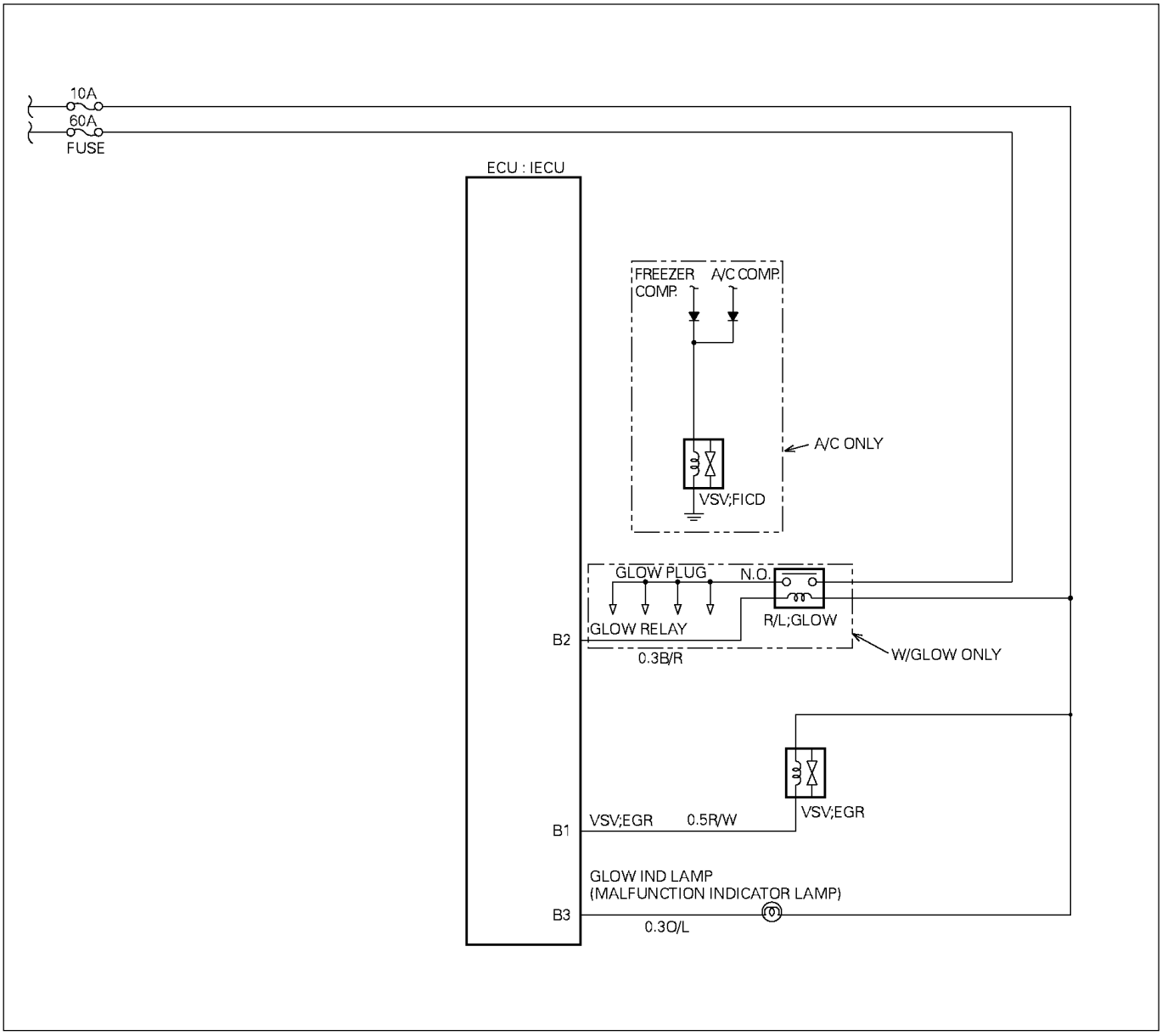
Resistance value

Inspection Point		Resistance Value (Ω)	Reference
Connector	Pin No.		
2 pin Black	2 ←→ 1	37 - 44 (for 12 volt) 159 - 169 (for 24 volt)	SIG ←→ GND
	1 ←→ Body	∞	SIG ←→ Body

Note: Resistance value is difference according to the engine temperature (condition of engine warming up)

Step	Action	Value (s)	Yes	No
1	Was the “Diagnostic system check” performed?	-	Go to Step 2	Go to diagnostic system check
2	1. Ignition “OFF”. 2. Disconnect the VSV from the wiring harness connector. 3. Ignition “ON” Engine “OFF”. 4. Using the Digital Voltmeter (DVM), check for voltage on the “Power supply side terminal” of the VSV harness connector. Does the DVM read the following value?	(12 Volt) 24 Volt	Go to Step 4	Go to Step 3
3	1. Check the suspect circuit between the VSV connector and “Engine Ignition”. Fuse for the following condition. * A short to ground * An open circuit 2. Repair if necessary. Has DTC 31 been corrected?	-	Go to Step 8	-
4	Using the DVM, check the resistance of the VSV Does the DVM read the following Value?	37 ~ 44Ω 159 ~ 169Ω	Go to Step 5	Go to Step 6
5	1. Ignition “OFF” 2. Disconnect the ECM connector from ECM. 3. Check the VSV circuit between the ECU and VSV connector. * A short to ground * An open circuit 2. Repair if necessary. Has DTC 31 been corrected?	-	Go to Step 8	Go to Step 7
6	Replace the VSV. Is the action complete?	-	Go to Step 8	-
7	Replace the ECM. Is the action complete?	-	Go to Step 8	-
8	1. Reconnect all the connectors removed. 2. Ignition “ON”, Engine “OFF”. Does DTC 33 come normal condition?	-	Go to Step 9	Go to Step 2
9	Is any current trouble other than DTC 33 displayed by indicator light?	-	Go to trouble code section	Trouble code clear

DTC-32 EXHAUST GAS RECIRCULATION (EGR) VACUUM SWITCHING VALVE (VSV) SOLENOID CONTROL HIGH VOLTAGE



826LX006.tif

Appearance of Vacuum Switching Valve (VSV): Exhaust Gas Recirculation (EGR) connector

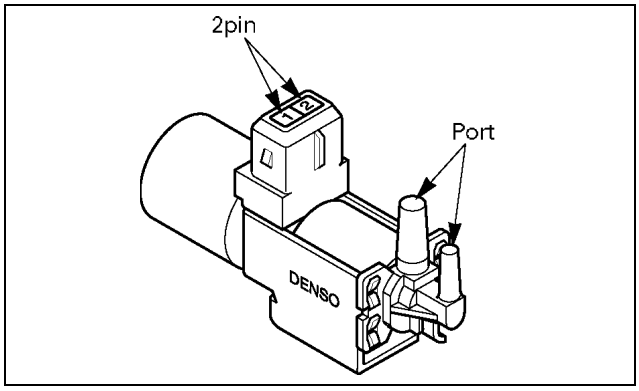


Figure. VSV:EGR

056LW026.tif

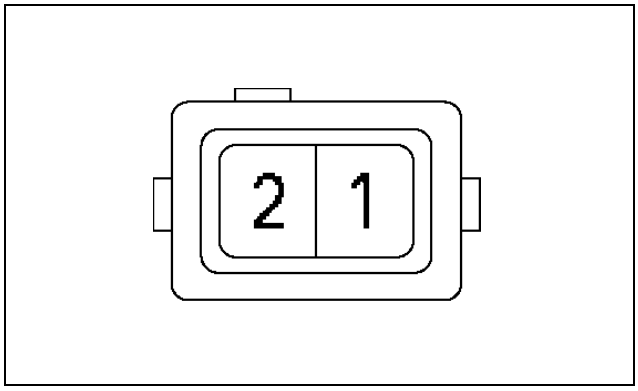
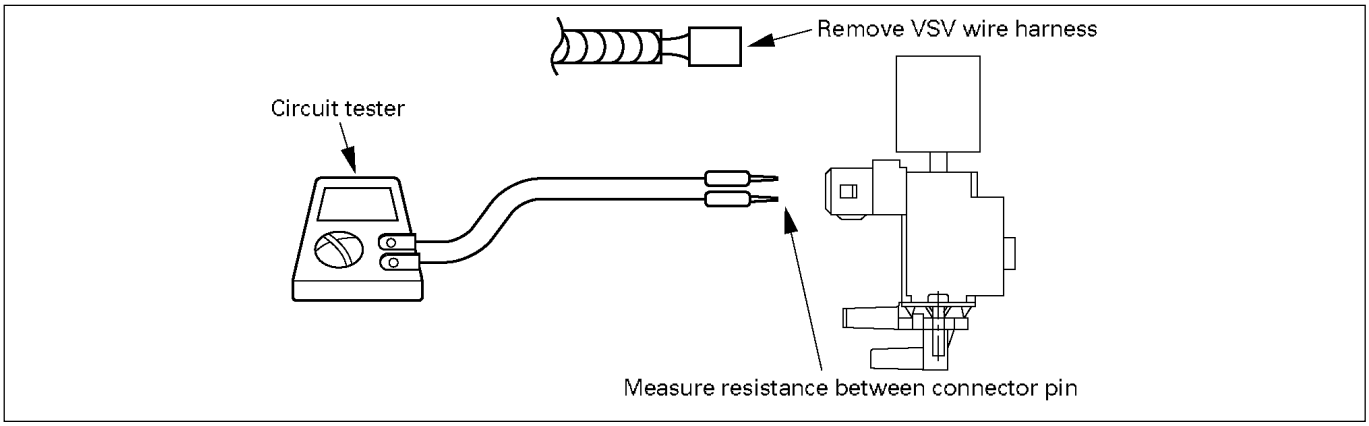


Figure. VSV:EGR connector

821LX001.tif

Connector No	Signal
1 2	GND SIG

Measure resistance at VSV:EGR



056LW005.tif

CAUTION:
When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

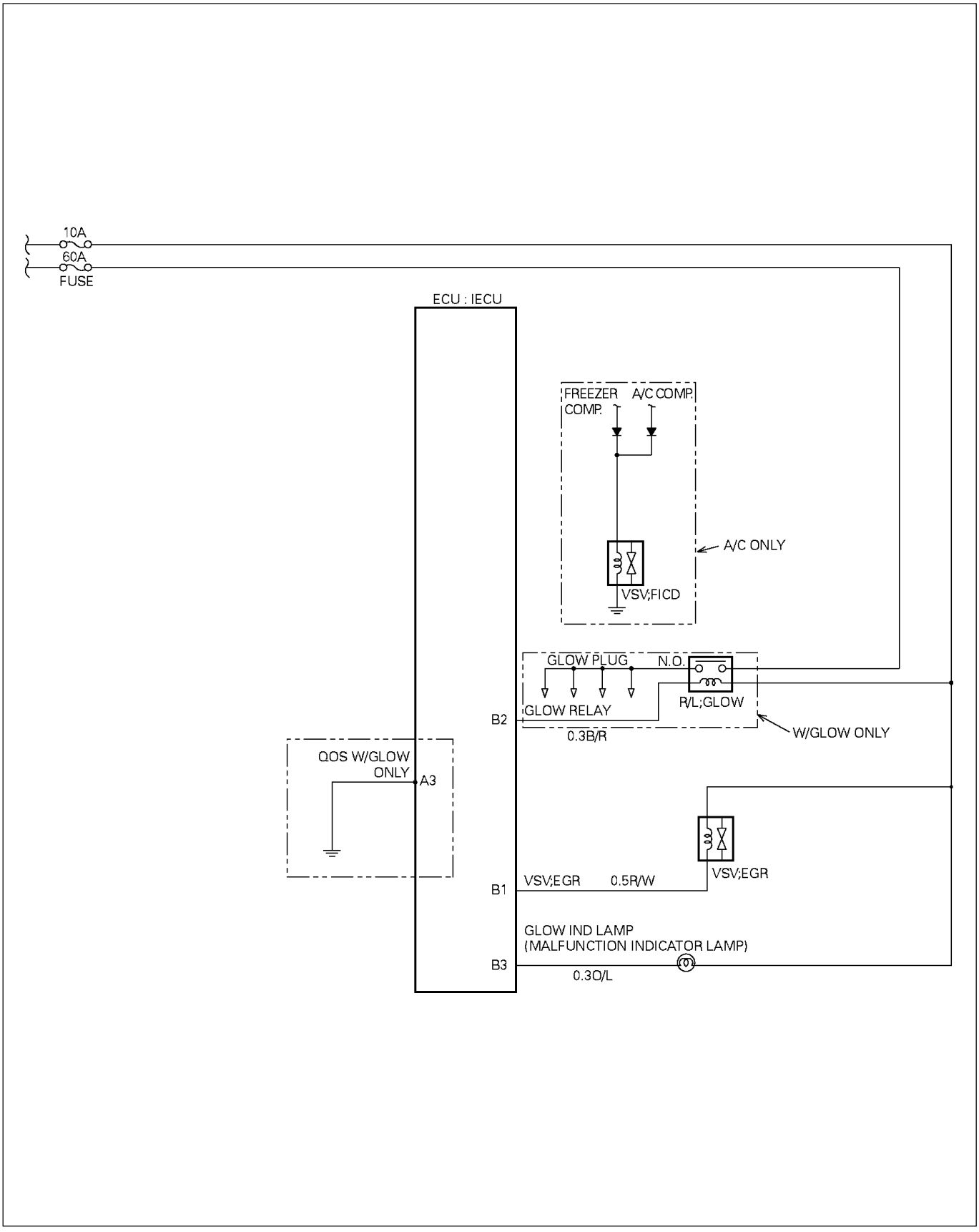
Resistance value

Inspection Point		Resistance Value (Ω)	Reference
Connector	Pin No.		
2 pin Black	2 ←→ 1	37 - 44 (for 12 volt) 159 - 169 (for 24 volt)	SIG ←→ GND
	1 ←→ Body	∞	SIG ←→ Body

Note: Resistance value is difference according to the engine temperature (condition of engine warming up)

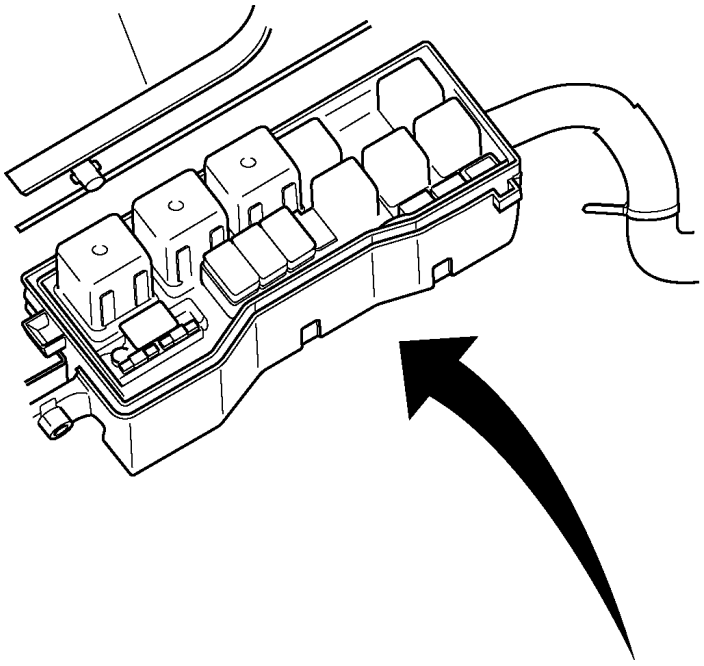
Step	Action	Value (s)	Yes	No
1	Was the “Diagnostic system check” performed?	-	Go to Step 2	Go to diagnostic system check
2	Using the DVM, check the resistance of the VSV Does the DVM read the following Value?	37 ~ 44Ω 159 ~ 169Ω	Go to Step 3	Go to Step 4
3	1. Ignition “OFF”. 2. Disconnect the ECM connector from ECM. 3. Check the short to voltage of VSV circuit between the ECM and VSV connector. 4. Repair if necessary. Has DTC 32 been corrected?	-	Go to Step 6	Go to Step 5
4	Replace the VSV. Is the action complete?	-	Go to Step 6	-
5	Replace the ECM. Is the action complete?	-	Go to Step 6	-
6	1. Reconnect all the connectors removed. 2. Ignition “ON”, Engine “OFF”. Does DTC 32 come normal condition?	-	Go to Step 7	Go to Step 2
7	Is any current trouble other than DTC 34 displayed by indicator light?	-	Go to trouble code section	Trouble code clear

DTC-41 QUICK ON START (QOS) RELAY CONTROL CIRCUIT LOW VOLTAGE

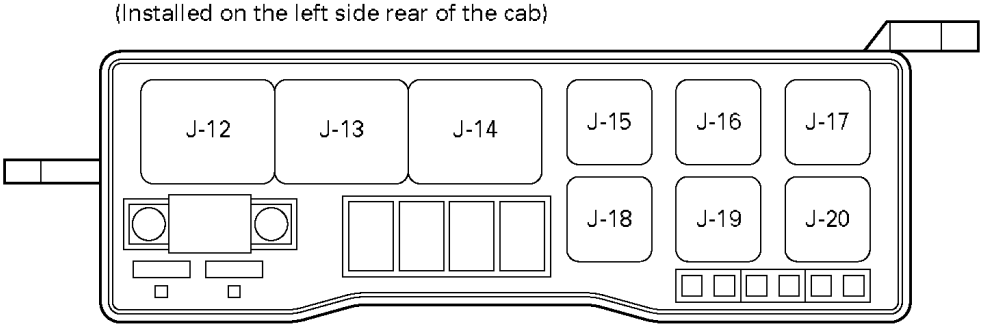


826LX009.tif

Location of relay



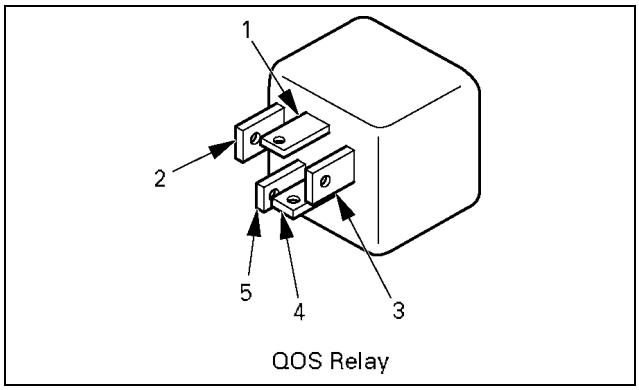
Relay box
(Installed on the left side rear of the cab)



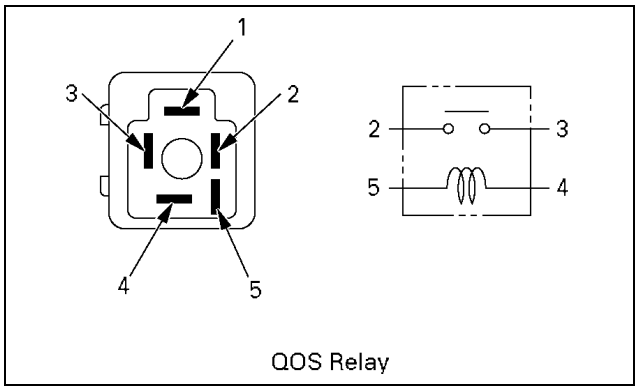
No.	RELAY NAME
J-12	STARTER
J-13	GLOW1 (QOS)
J-14	C/HEATER
J-15	ENG. WARM CUT (QWS)
J-16	———
J-17	CONDENSER FAN
J-18	EXH. BRAKE CONTROL
J-19	———
J-20	MARKER LAMP

826LW038.tif

Inspection for prestroke power cut relay



056LW021.tif



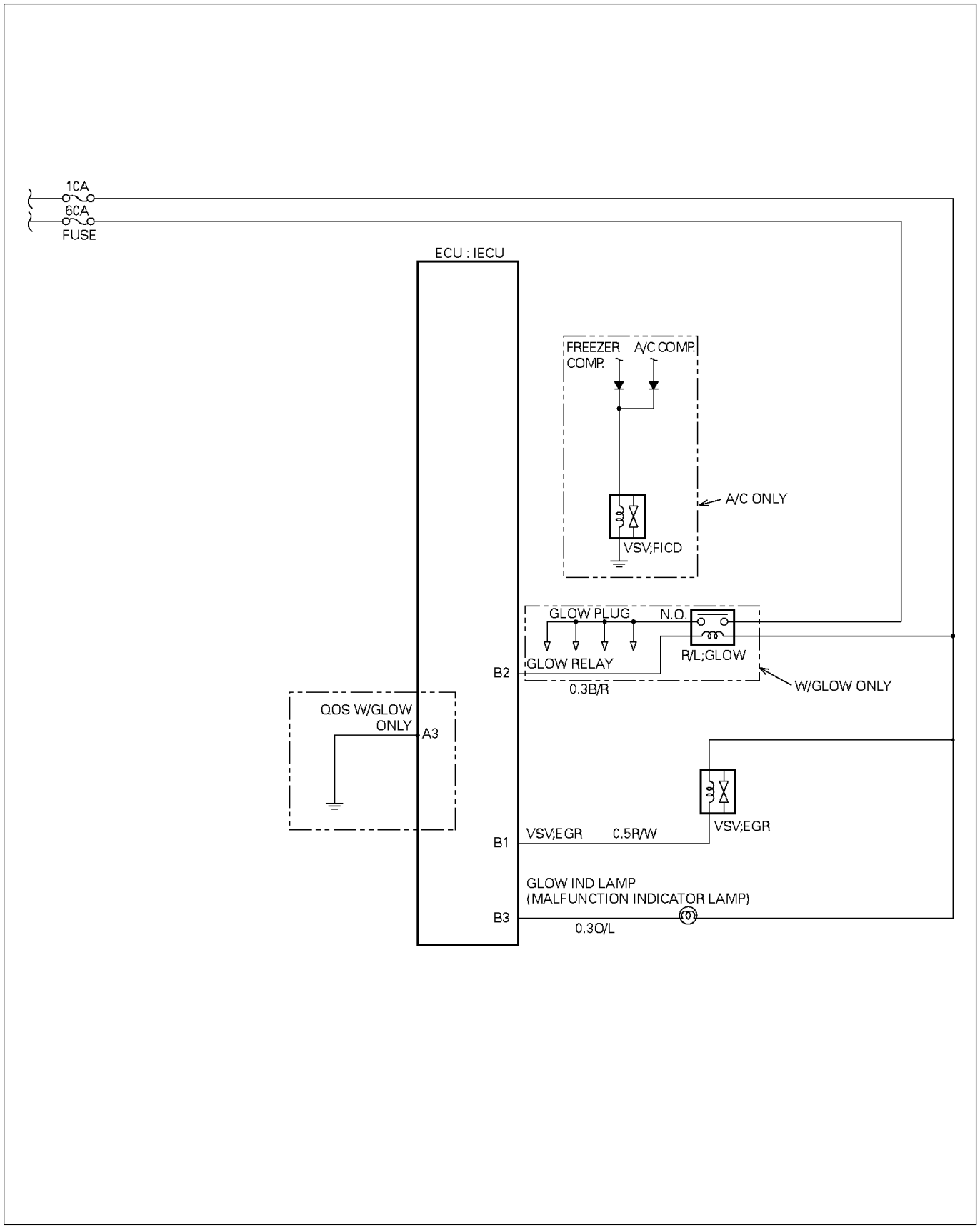
056LW020.tif

Resistance value

Inspection point		Resistance	Reference
Inspection relay unit	4 ⟷ 5	23 (Ω) (for 12 volt) 100 (Ω) (for 24 volt)	
	2 ⟷ 3	∞	Not be supplied electricity to coil
		Below 0.5 (Ω)	Be supplied electricity to coil

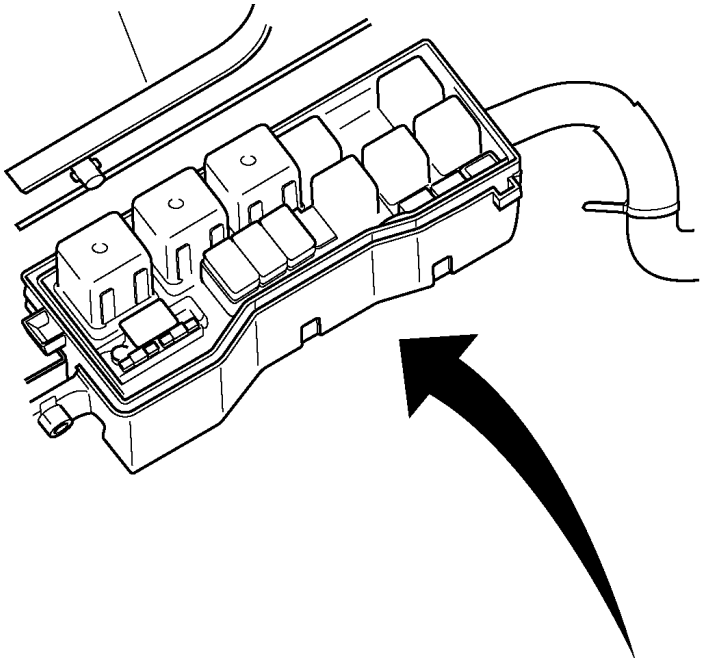
Step	Action	Value (s)	Yes	No
1	Was the “Diagnostic system check” performed?	-	Go to Step 2	Go to diagnostic system check
2	1. Ignition “OFF” 2. Disconnect the Relay from the Relay box connector. 3. Ignition “ON” Engine “OFF” 4. Using the Digital Voltmeter (DVM), check for voltage on the “Power supply side terminal” terminal of the Relay Box Connector. Does the DVM read the following value?	(12 Volt) or 24 Volt	Go to Step 4	Go to Step 3
3	1. Check the suspect circuit between the Relay connector. Fuse for the following condition. * A short to ground * An open circuit 2. Repair if necessary. Has DTC 41 been corrected?	-	Go to Step 8	-
4	Using the DVM, check the resistance of inter “4” “5” Relay terminal. Does the DVM read the following Value?	23Ω (for 12 Volt) 100Ω (for 24 Volt)	Go to Step 5	Go to Step 6
5	1. Ignition “OFF” 2. Disconnect the ECM connector from ECM. 3. Check the Relay circuit between the ECU and Relay connector * A short to ground * An open circuit 2. Repair if necessary. Has DTC 41 been corrected?	-	Go to Step 8	Go to Step 7
6	Replace the Relay. Is the action complete?	-	Go to Step 8	-
7	Replace the ECM. Is the action complete?	-	Go to Step 8	-
8	1. Reconnect all the connectors removed. 2. Ignition “ON”, Engine “OFF” Does DTC 41 come normal condition?	-	Go to Step 9	Go to Step 2
9	Is any current trouble other than DTC 41 displayed by indicator light?	-	Go to trouble code section	Trouble code clear

DTC-42 QUICK ON START (QOS) RELAY CONTROL CIRCUIT HIGH VOLTAGE

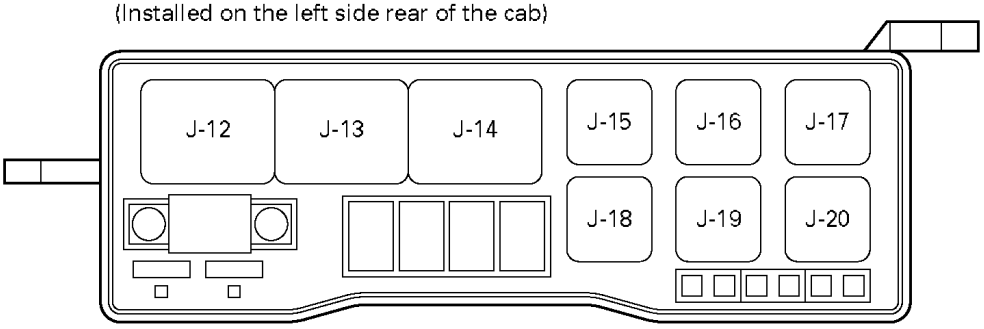


826LX009.tif

Location of relay



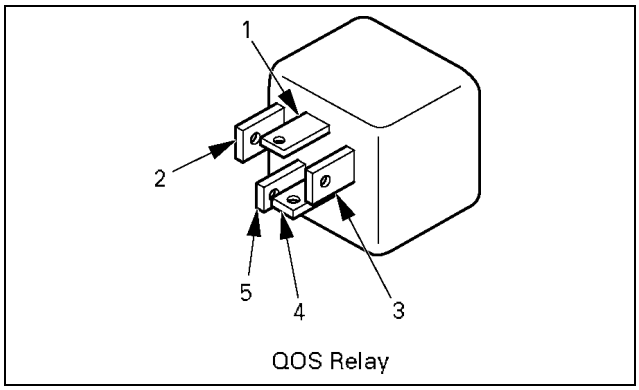
Relay box
(Installed on the left side rear of the cab)



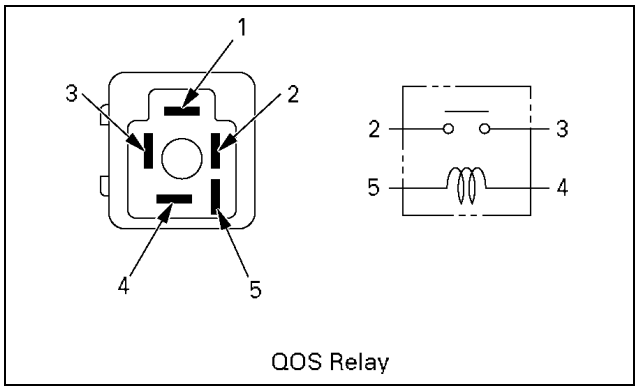
No.	RELAY NAME
J-12	STARTER
J-13	GLOW1 (QOS)
J-14	C/HEATER
J-15	ENG. WARM CUT (QWS)
J-16	———
J-17	CONDENSER FAN
J-18	EXH. BRAKE CONTROL
J-19	———
J-20	MARKER LAMP

826LW038.tif

Inspection for Quick On Start (QOS) power cut relay



056LW021.tif



056LW020.tif

Resistance value

Inspection point		Resistance	Reference
Inspection relay unit	4 ⟷ 5	23 (Ω) (for 12 volt) 100 (Ω) (for 24 volt)	
	2 ⟷ 3	∞	Not be supplied electricity to coil
		Below 0.5 (Ω)	Be supplied electricity to coil

Step	Action	Value (s)	Yes	No
1	Was the “Diagnostic system check” performed?	-	Go to Step 2	Go to diagnostic system check
2	Using the DVM, check the resistance between terminal number 4 and 5 of the Relay. Does the DVM read the following Value?	23Ω (for 12 Volt) 100Ω (for 24 Volt)	Go to Step 3	Go to Step 4
3	1. Ignition “OFF” 2. Disconnect the ECM connector from ECM. 3. Check the short to voltage of Relay circuit between the ECM and Relay connector 4. Repair if necessary. Has DTC 42 been corrected?	-	Go to Step 6	Go to Step 5
4	Replace the Relay. Is the action complete?	-	Go to Step 6	-
5	Replace the ECM. Is the action complete?	-	Go to Step 6	-
6	1. Reconnect all the connectors removed. 2. Ignition “ON”, Engine “OFF” Does DTC 42 come normal condition?	-	Go to Step 7	Go to Step 2
7	Is any current trouble other than DTC 42 displayed by indicator light?	-	Go to trouble code section	Trouble code clear

DTC-52 ELECTRONICALLY ERASABLE PROGRAMMABLE READ ONLY MEMORY (EEPROM) ERROR

Step	Action	Value (s)	Yes	No
1	Was the “Diagnostic system check” performed?	-	Go to Step 2	Go to diagnostic system check
2	Replace the ECM Is the action complete?	-	Go to Step 3	-
3	1. Reconnect all the connectors removed. 2. Ignition “ON”, Engine “OFF” Is DTC 52 all right under Scan Tool Check?	-	Go to Step 4	Go to Step 2
4	Is any current trouble other than DTC 52 displayed by indicator light?	-	Go to trouble code section	Trouble code clear

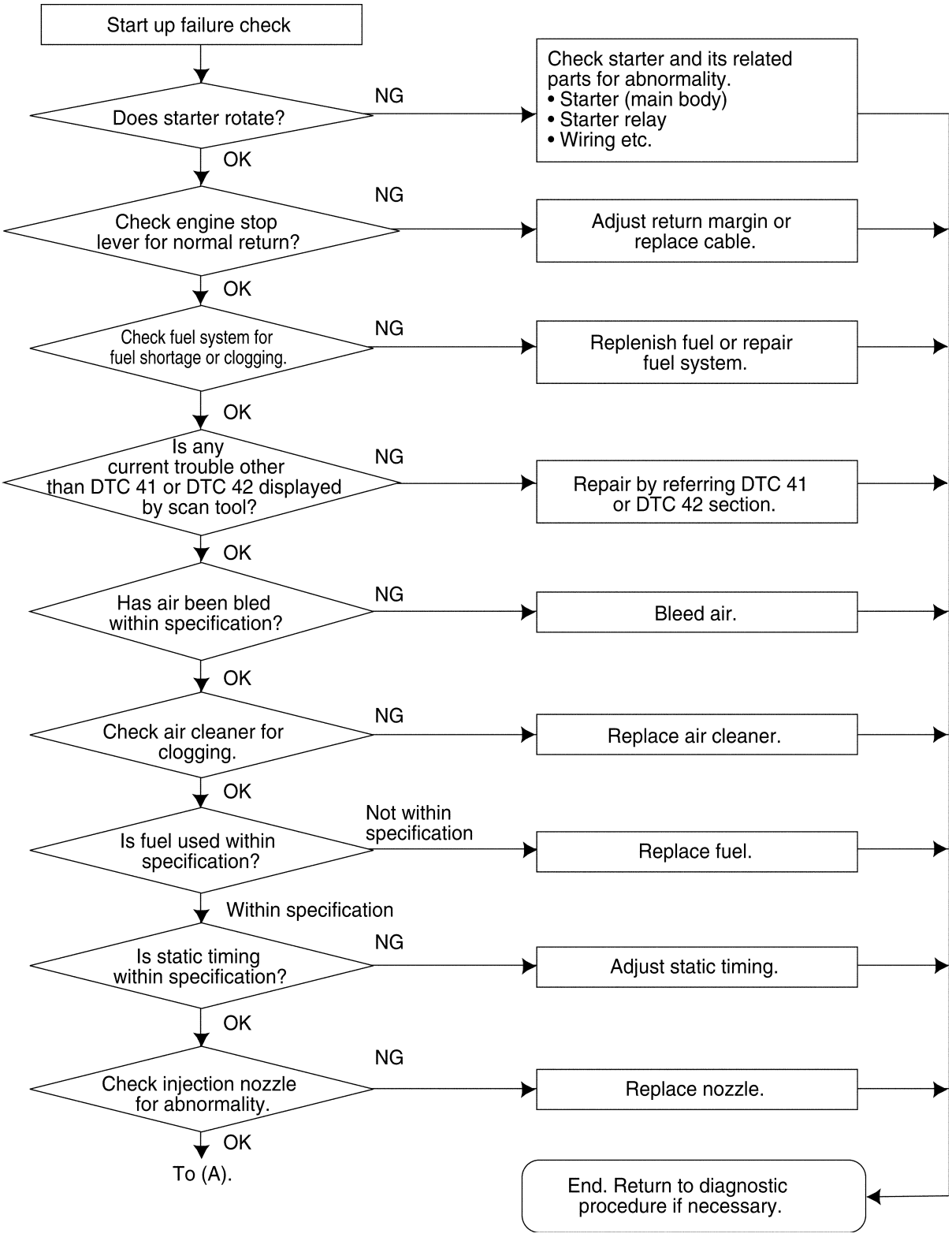
WITHOUT DIAGNOSIS TROUBLE CODE

INTRODUCTION

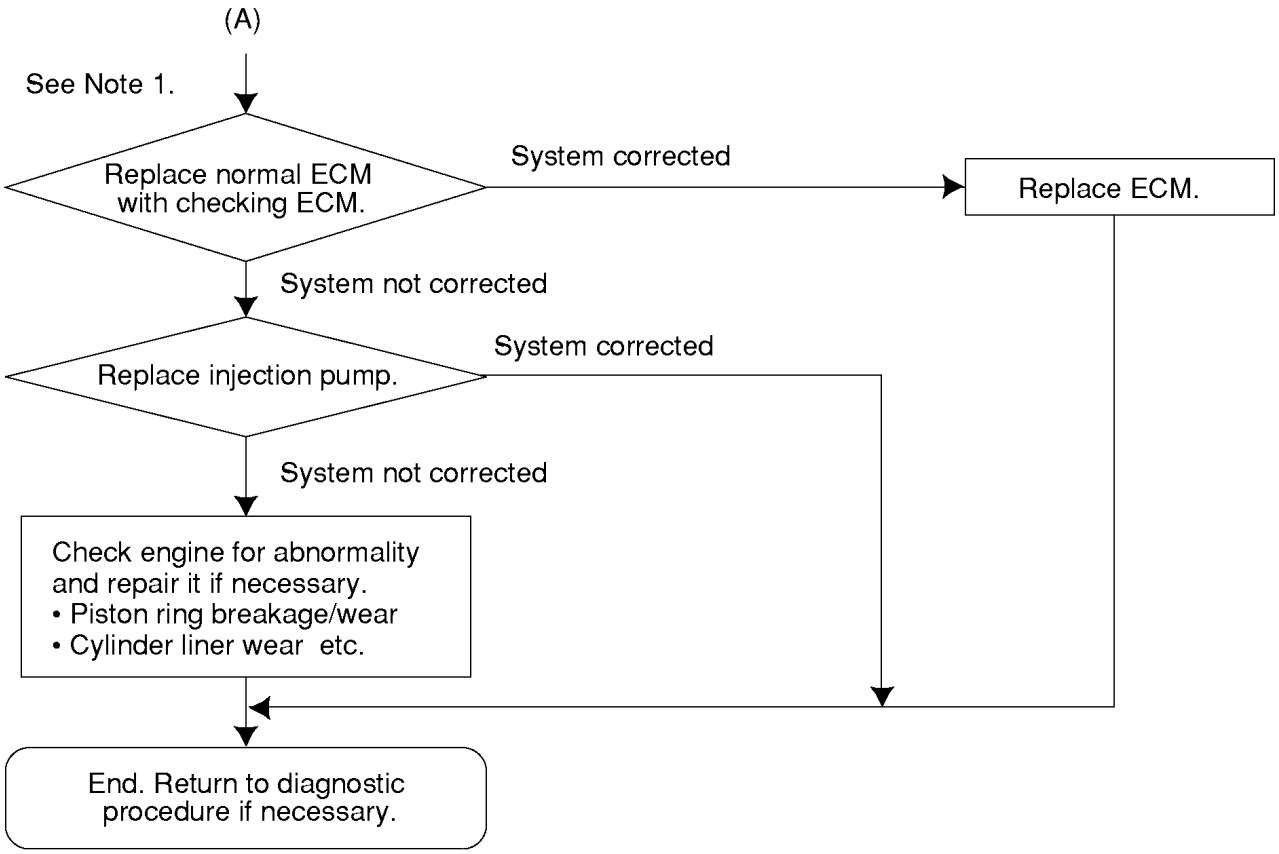
If there occurs a malfunction although no Diagnostic Trouble Code (DTC) is generated, then inspect and repair the system in accordance with the flowcharts given on the following pages.

When a Diagnostic Trouble Code (DTC) is produced, inspect and repair system with reference to “EMISSION AND ELECTRICAL DIAGNOSIS”

STARTUP FAILURE (Quick On Start only)



Flow189.tif

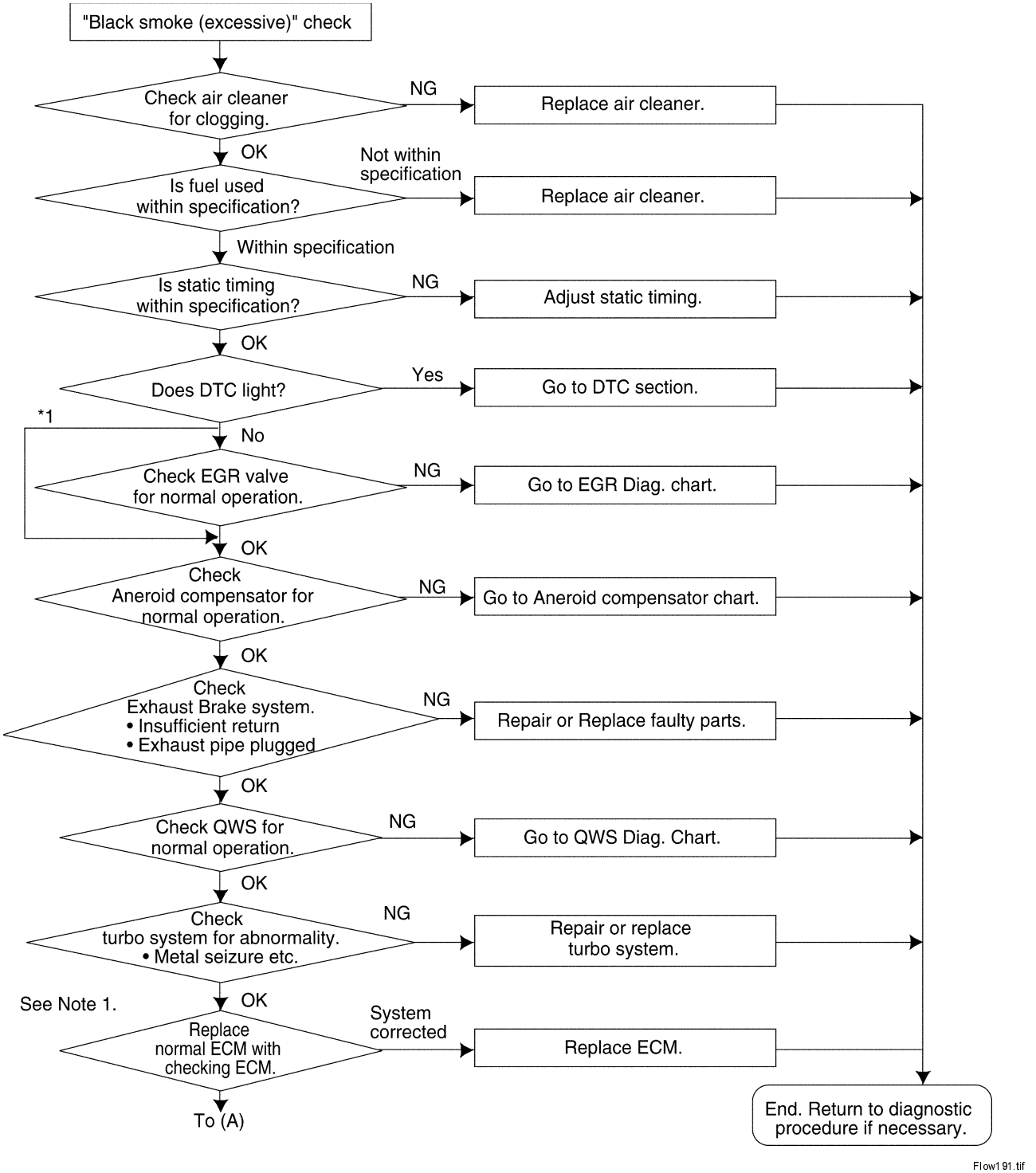


flow03BStartup.tif

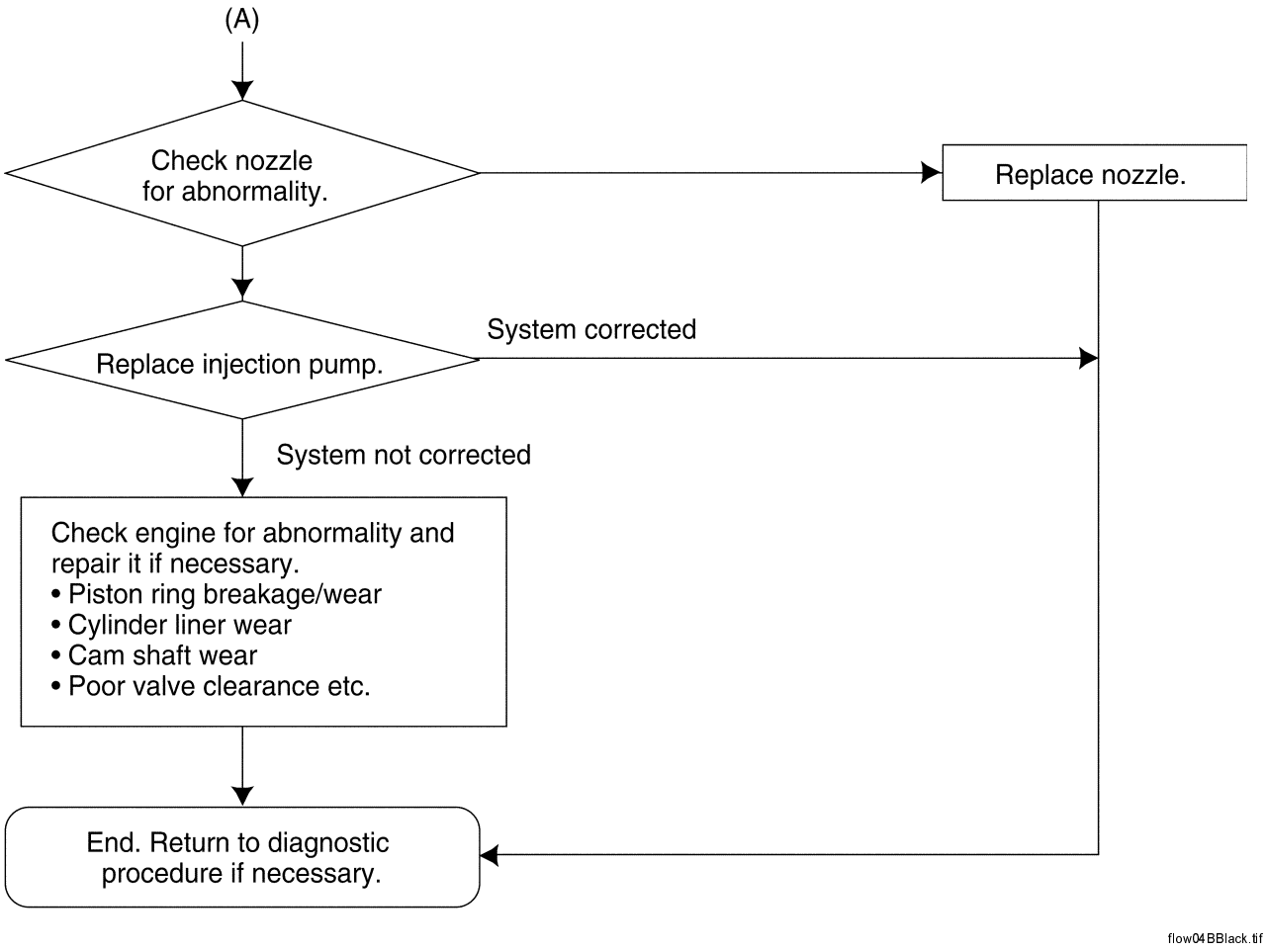
NOTE 1:

The condition of the system in which the malfunction has occurred should be checked by making comparisons between the vehicle Engine Control Module (ECM) and the checking ECM.

BLACK SMOKE (EXCESSIVE)



Flow191.tif



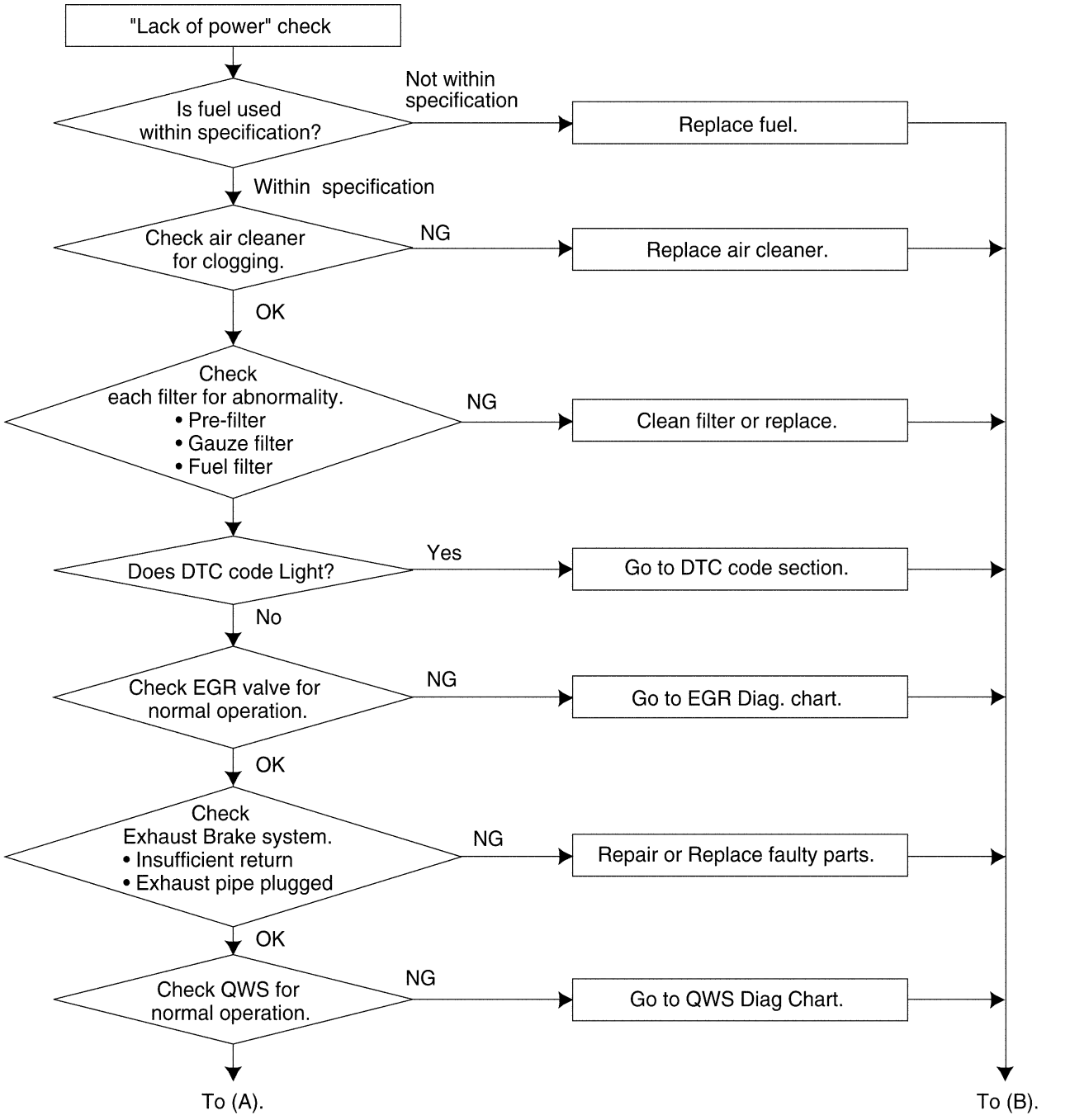
NOTE 1:

The condition of the system in which the malfunction has occurred should be checked by making comparisons between the vehicle Engine Control Module (ECM) and the checking ECM.

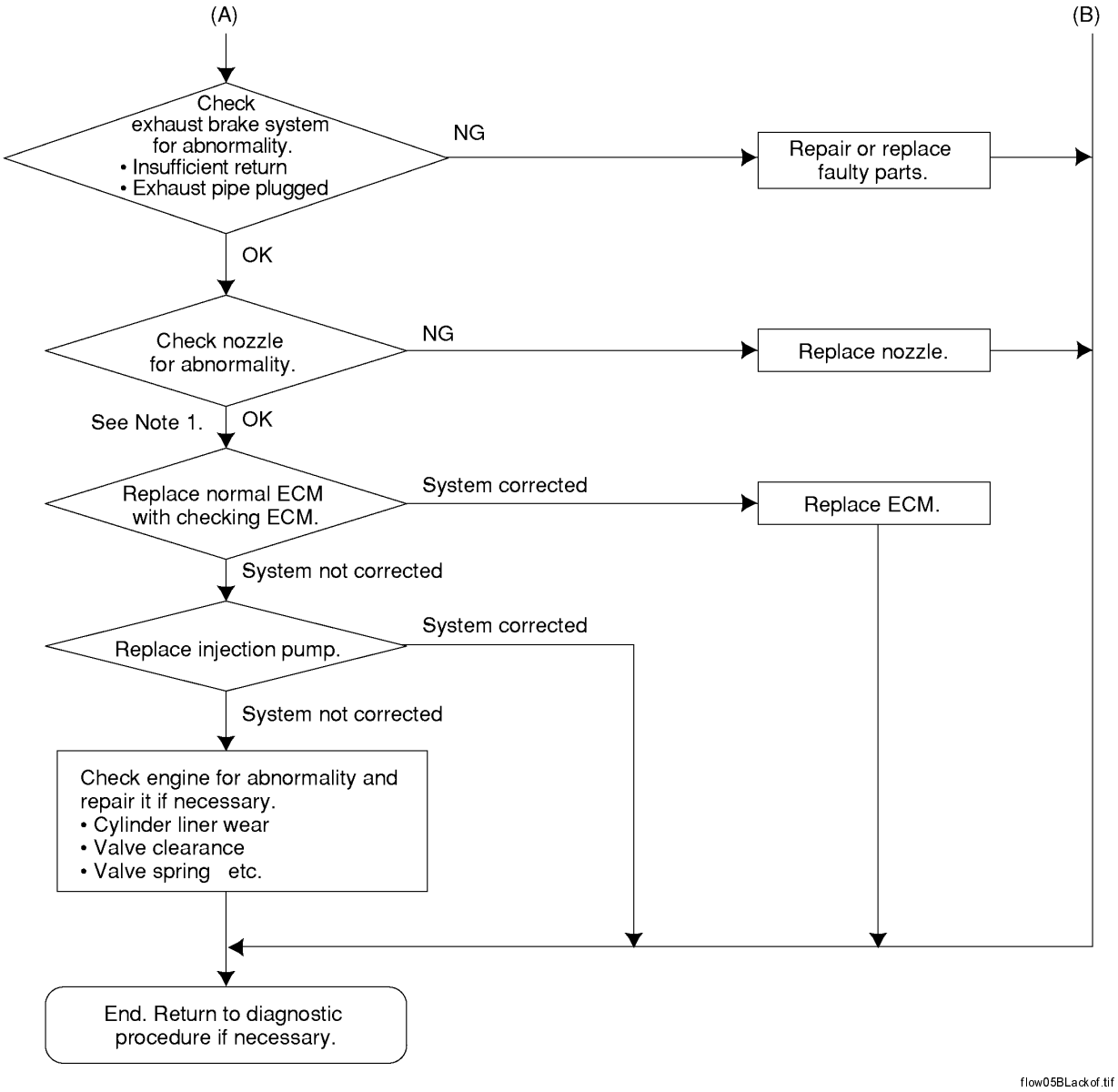
NOTE 2:

Refer to a trouble code for a supplier's check, if available.

LACK OF POWER



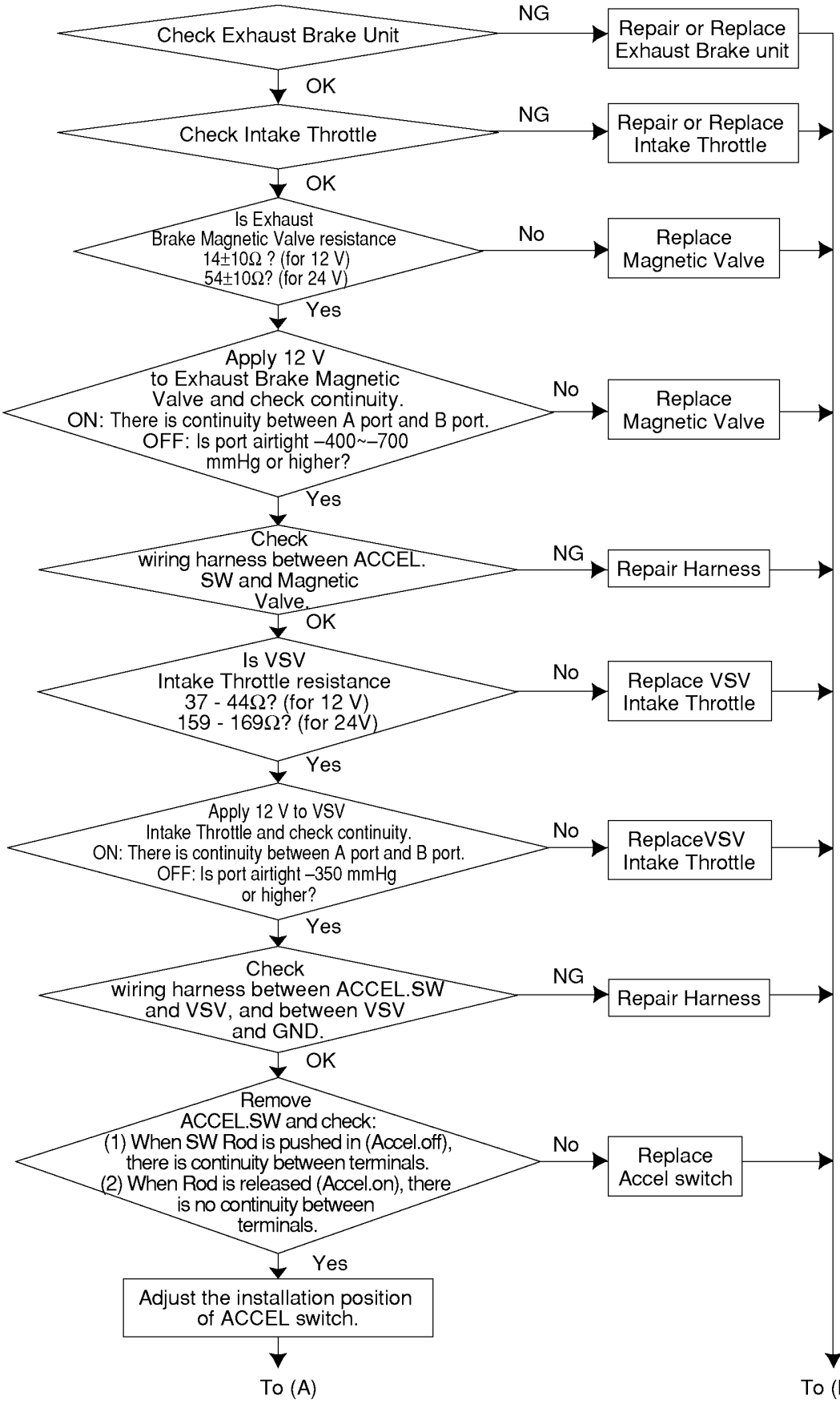
Flow193.tif



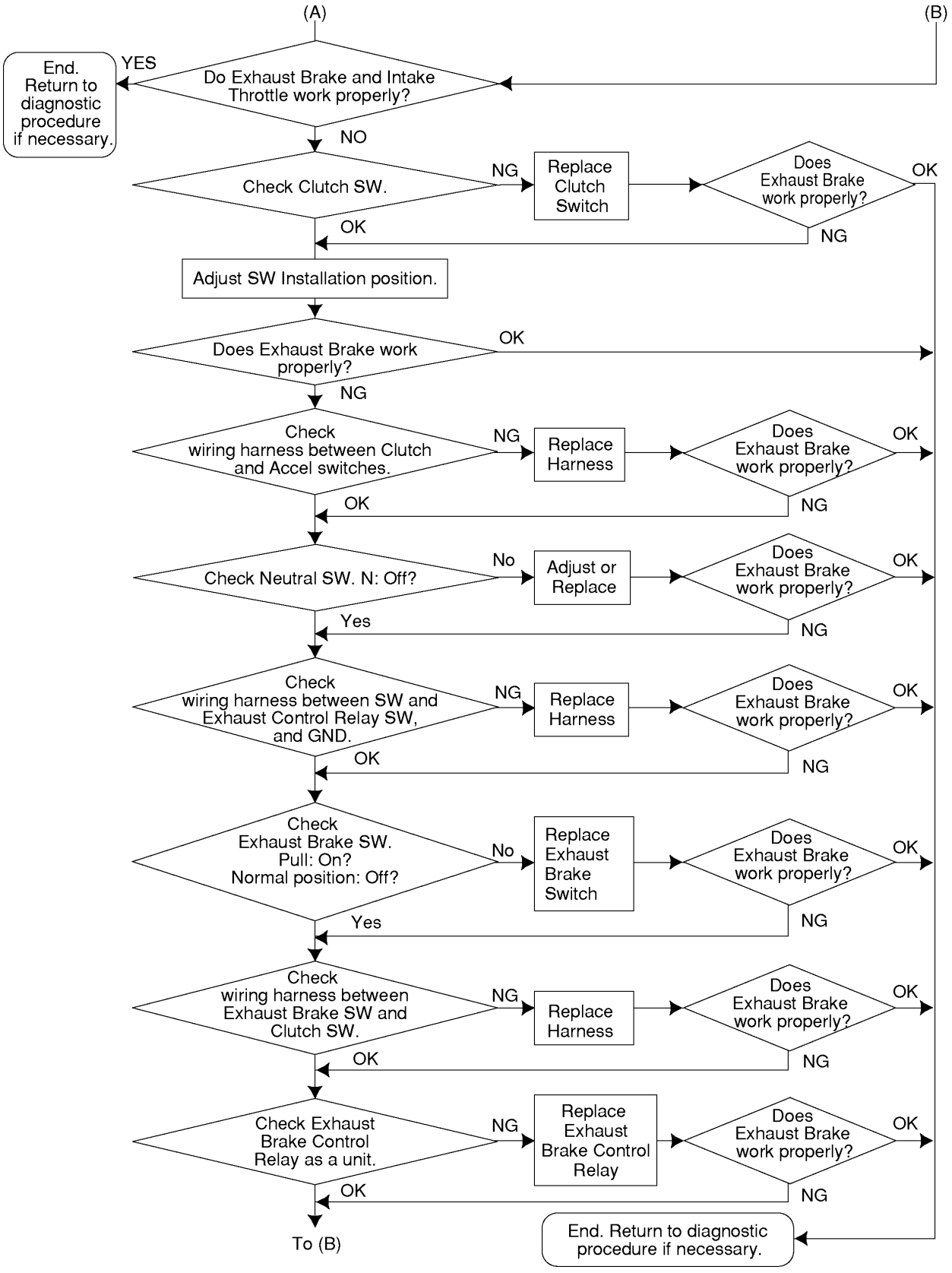
NOTE 1:

The condition of the system in which the malfunction has occurred should be checked by making comparisons between the vehicle Engine Control Module (ECM) and the checking ECM.

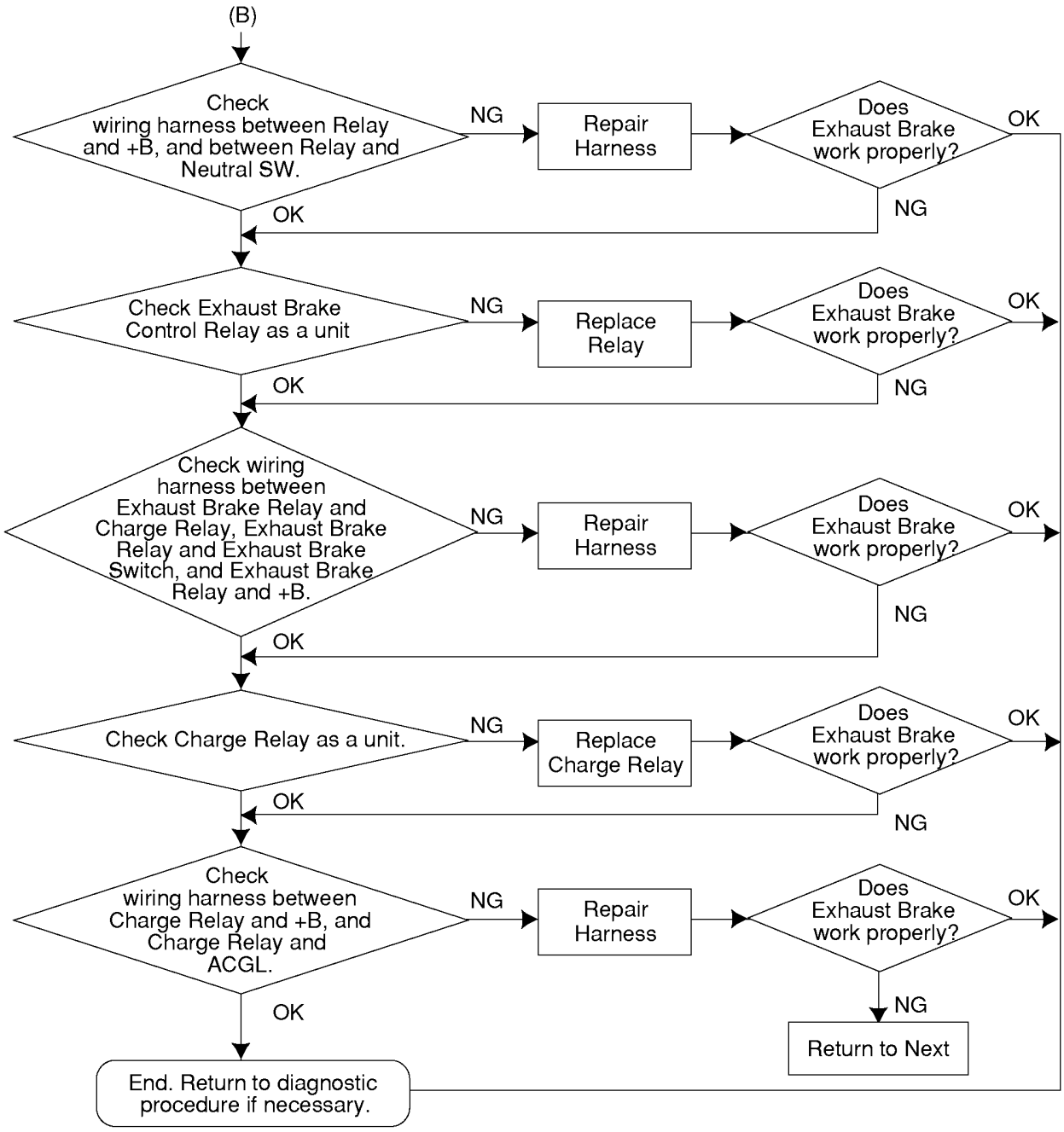
EXHAUST BRAKE MALFUNCTION (Exhaust Brake only)



flows07ExhaustBk.tif



flows08QWSsysCheck.tif



* Repair of wiring harness includes diode check.

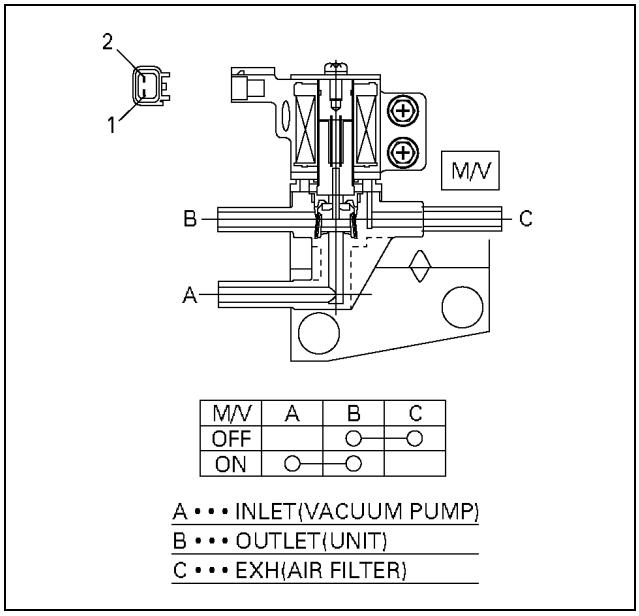
flows09QWSsysCheck.tif

INSPECTION

1. Exhaust Brake Magnetic Valve

Inspection

Connect the magnetic valve connector terminal No.1 and No.2 to (+) terminal and (-) terminal of battery, respectively, and check the continuity between the ports.



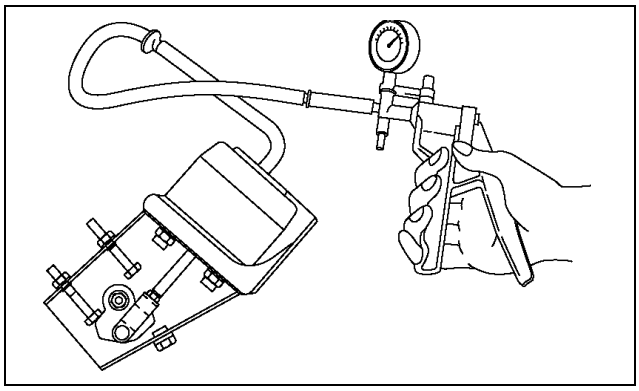
056LW010.tif

CAUTION: When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

2. Exhaust Throttle Valve

Working

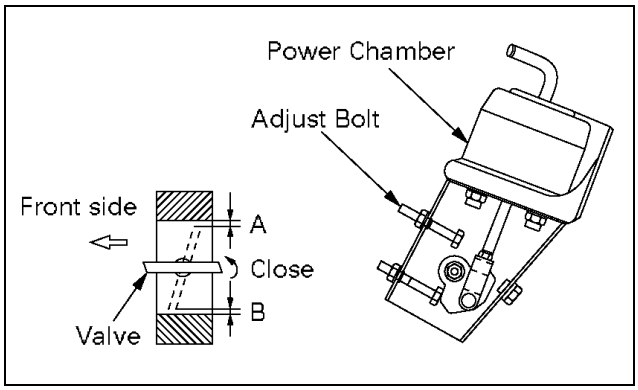
Actuate the exhaust brake with the engine idling and make sure that you hear the valve strike on the stopper.



157LW002.tif

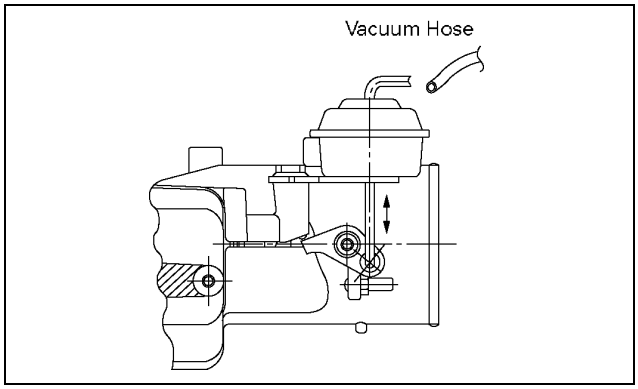
Unit

Apply a negative pressure of 53.3 kPa - 93.3 kPa {400 mmHg - 700 mmHg} to the power chamber by means of a vacuum pump and make sure of the smooth opening/closing of the exhaust brake valve.



157LW001.tif

Apply a negative pressure of 86.7 - 93.3 kPa {650 - 700 mmHg} to the power chamber using a vacuum pump and make sure the average of measurements at Point A and Point B of the clearance between valve and body is as follows:
0.4 mm - 0.6 mm (Minimum: 0.4mm)
If the clearance is out of this range, adjust with the adjusting bolt.



025LW001.tif

3. Intake Throttle Valve

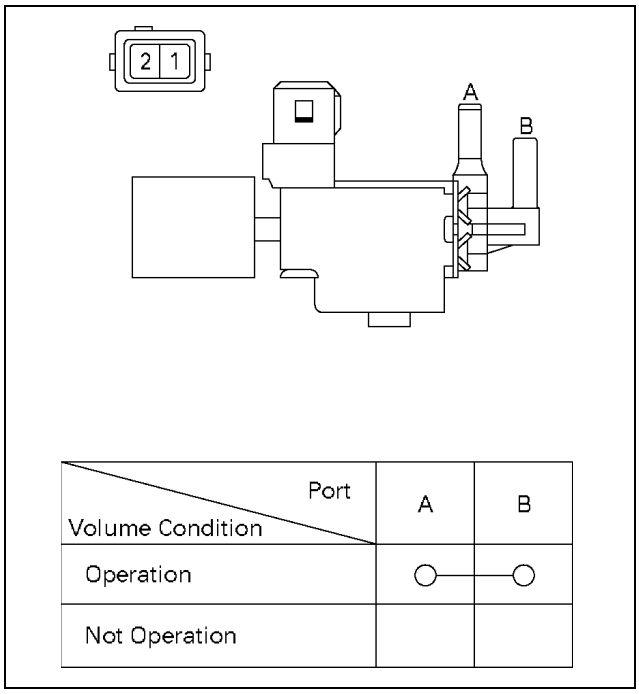
Working

Disconnect the vacuum hose from the actuator and try to move the rod by hand, making sure of the smooth move of the rod.

EXHAUST GAS RECIRCULATION (EGR) SYSTEM MALFUNCTION4. Vacuum Switching Valve; Intake Throttle

Inspection

Connect the vacuum switching valve connector terminals No.1 and No.2 to (+) terminal and (-) terminals of battery, respectively, and check the continuity between the ports.
If the check result is abnormal, repair or replace the valve.



Volume Condition \ Port	A	B
Operation	○	○
Not Operation		

065LW005.tif

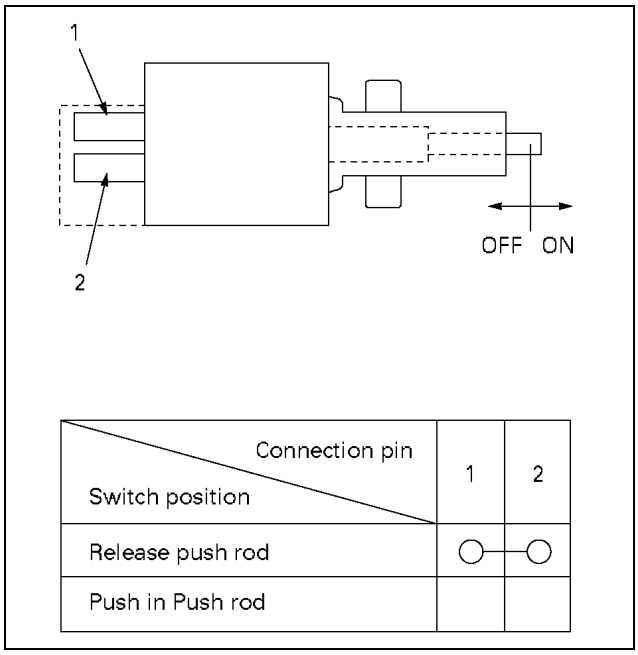
5. Accelerator Switch (2-pole connector type)

Inspection

1. Check the continuity between the switch connector terminals.

CAUTION: When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

2. Check the smooth move of the pushrod. If the check result is abnormal, repair or replace the pushrod.



Switch position \ Connection pin	1	2
Release push rod	○	○
Push in Push rod		

065LW003.tif

Removal

1. Accelerator Switch
   Disconnect the connector.
   Loosen the lock nut.
   Turn the switch to remove.

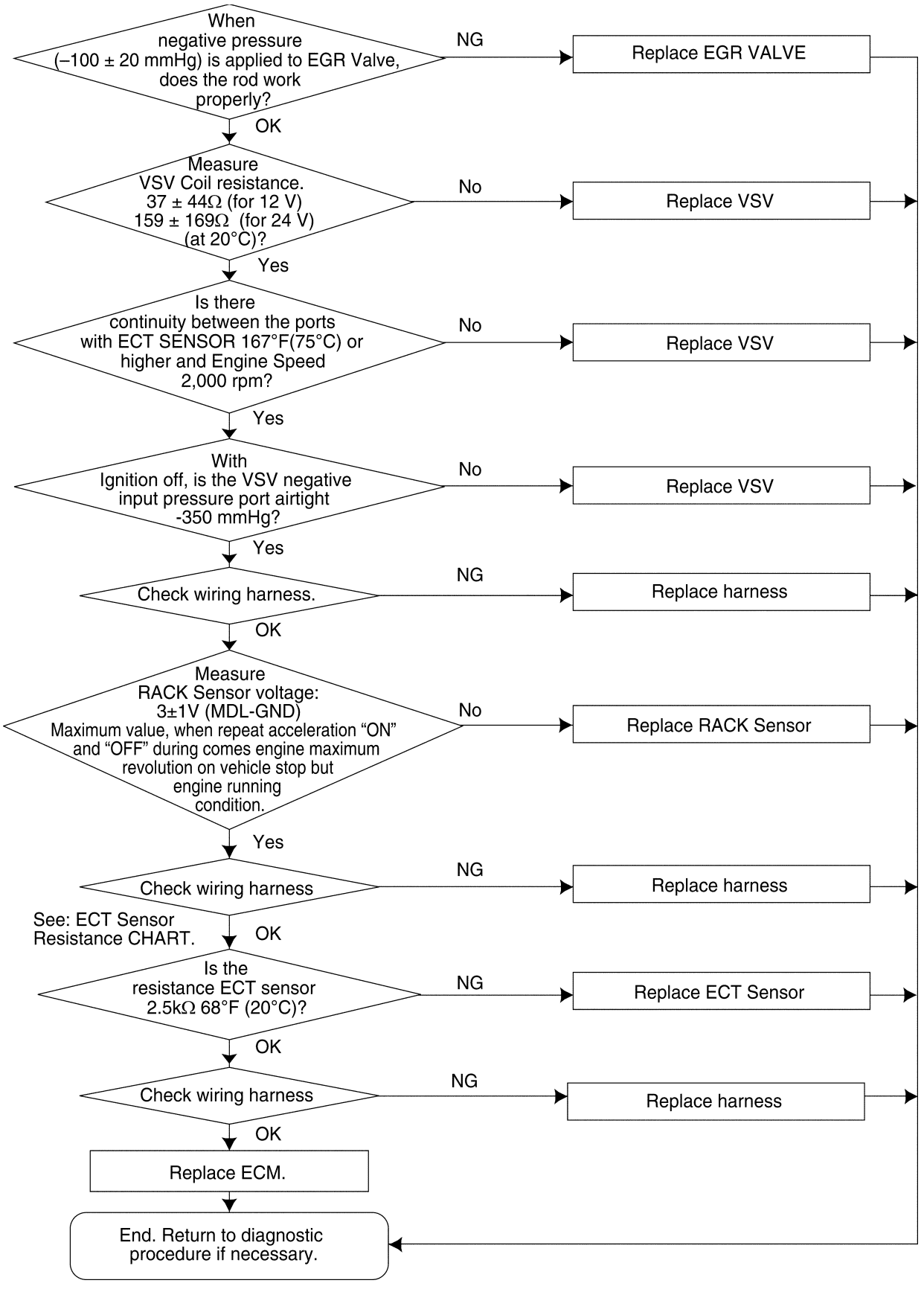
Re installation

To install, follow the removal procedure in reverse order:

1. Drive the threaded part of the switch until its end surface becomes flush with that of the bracket side of nut.
2. Tighten the lock nut.

   Tightening torque: 1.3 N·m {130 kg··cm}

EXHAUST GAS RECIRCULATION (EGR) SYSTEM MALFUNCTION

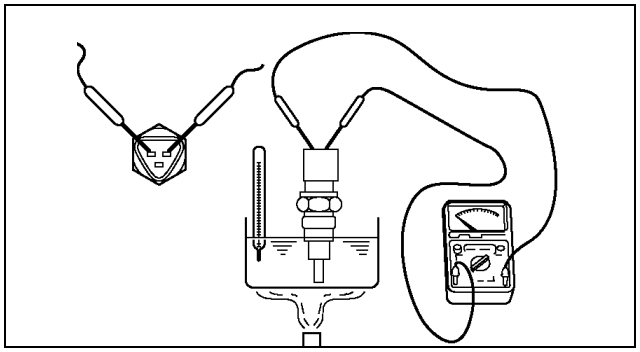


Flow200.tif

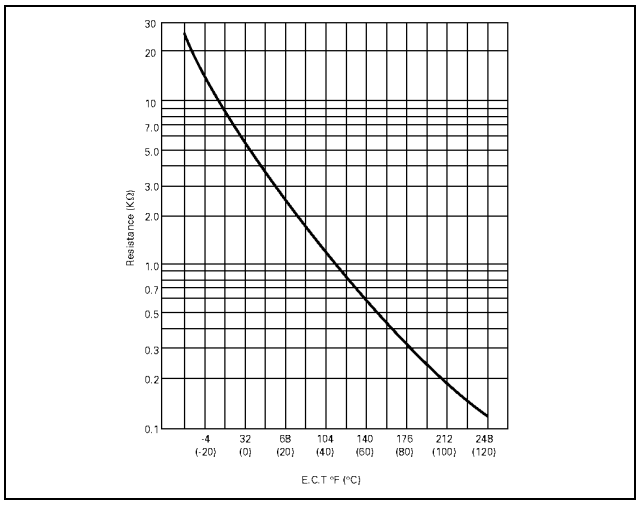
INSPECTION

1. Thermosensor (Engine coolant temperature)

Soak the temperature sensitive part of a thermosensor in the water,and while changing the water temperature, make sure the resistance is changed as the following graph shows:



010LW001.tif



065LW004.tif

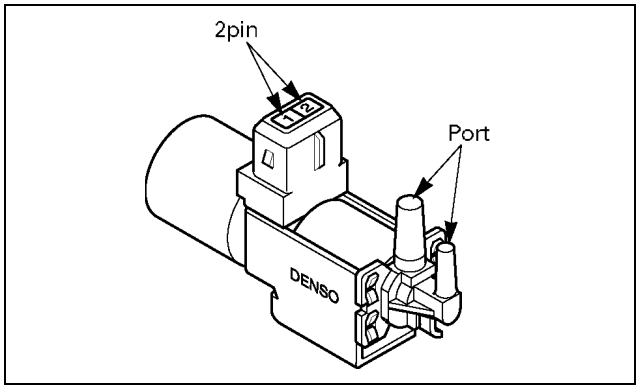
2. Vacuum Switching Valve (VSV)

1. Resistance Check

Check the resistance between the VSV connector terminals using a circuit tester.

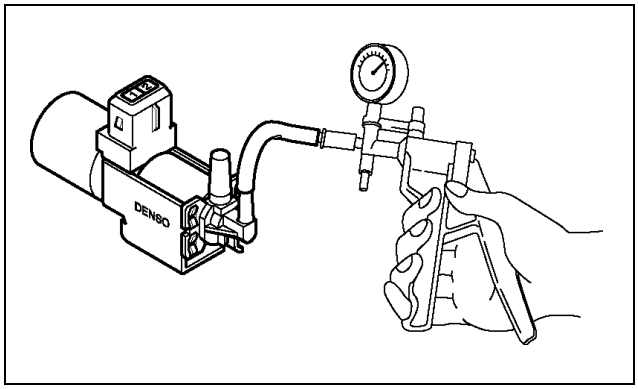
Cold Resistance: 37-44 (Ω) (for 12 volt model)

: 159-169 (Ω) (for 24 volt model)



056LW026.tif

Connect battery voltage between VSV connector terminals and make sure of the continuity between the ports.

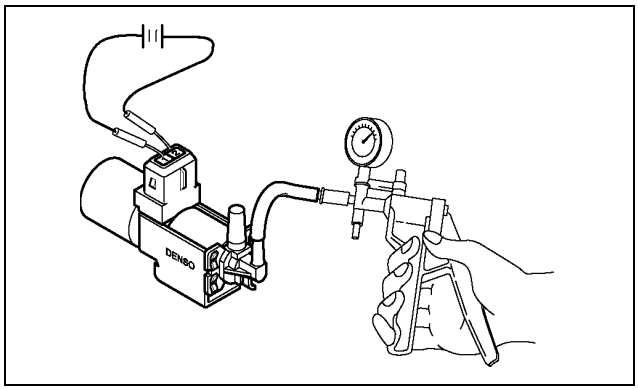


056LW028.tif

2. Airtight Check

Apply negative pressure to the negative pressure input port as illustrated on the left.

Although there is leakage, it is no problem if the negative pressure rises to -350 mmHg (-47 kPa) or more.



056LW027.tif

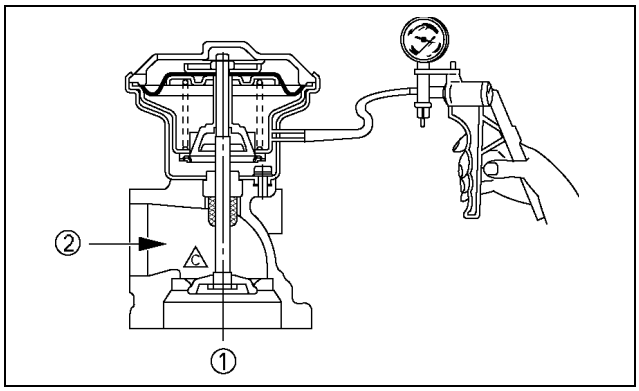
3. Working Check

Apply powervoltage between the terminals, there is no problem if the negative pressure does not rise when applied to the input port.

CAUTION: When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

3. Exhaust Gas Recirculation (EGR) Valve

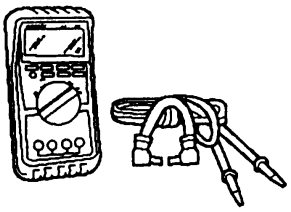
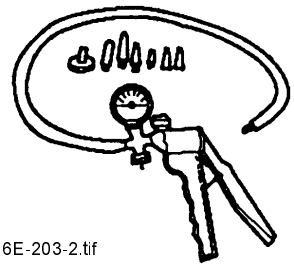
With negative pressure applied to the diaphragm chamber, make sure that the valve is smoothly actuated to make the area between (1) and (2) ventilated.
Startup: About -100 mmHg ± 20 mmHg



056LW009.tif

Check to see if EGR valve is normally actuated under the following conditions:
Engine coolant temp.: 80 °C or higher

SPECIAL TOOLS

ILLUSTRATION	TOOL NO. TOOL NAME
 6E-203-1.tif	**5-8840-0366-0** **(J 39200)** High Impedance Multimeter (Digital Voltmeter-DVM)
 6E-203-2.tif	**5-8840-0279-0** **(J 23738-A)** Vacuum Pump with Gauge

SECTION 6F

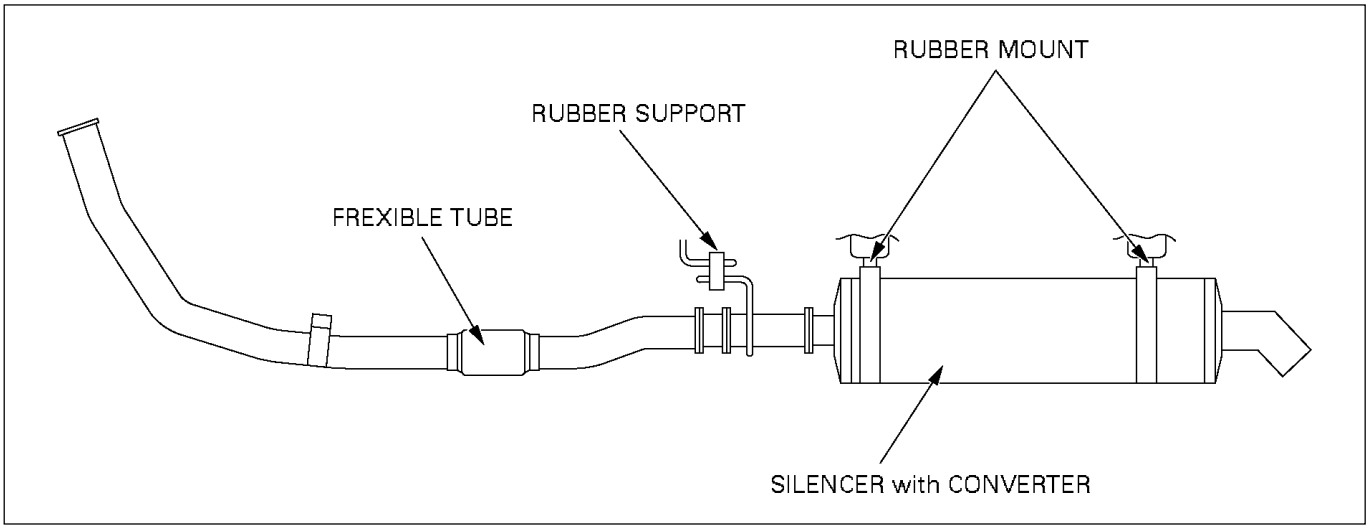
EXHAUST

CAUTION:
Exhaust system components must have enough clearance from the underbody to prevent overheating of the floor pan and possible damage to the passenger compartment, insulation and trim materials.

CONTENTS

	PAGE
General Description	**6F - 2**
Gasket	**6F - 2**
On-Vehicle Service	**6F - 3**
Front Exhaust Pipe	**6F - 3**

GENERAL DESCRIPTION



150LX007.tif

The vehicle is equipped with a single horizontal exhaust system which consists of a front exhaust pipe with a heat shield attached, a main exhaust pipe, a silencer with catalytic converter and a tail pipe.

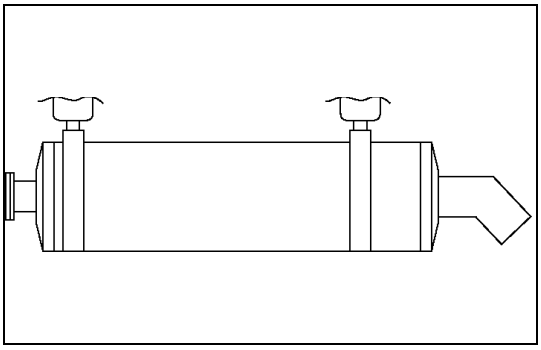
An engine exhaust brake is attached between the front exhaust pipe and the exhaust manifold.

The exhaust brake, when turned on, restricts the flow of exhaust gases and thereby slows the engine.

Be sure the exhaust brake system is turned off before performing any exhaust system diagnosis.

GASKET

The gasket must be replaced whenever a new exhaust pipe, muffler or exhaust throttle is installed.



150LX006.tif

THREE WAY CATALYTIC CONVERTER

The three way catalytic converter is an emission control device added to the exhaust system to reduce pollutants from the exhaust gas stream.

CAUTION:

- **The catalytic converter requires the use of unleaded fuel only.**

Periodic maintenance of the exhaust system is not required. If the vehicle is raised for other service, it is advisable to check the condition of the complete exhaust system.

A dual bed monolith catalytic converter is used in combination with three way catalytic converter.

Catalytic Types:

Three way (Reduction/Oxidation) catalyst

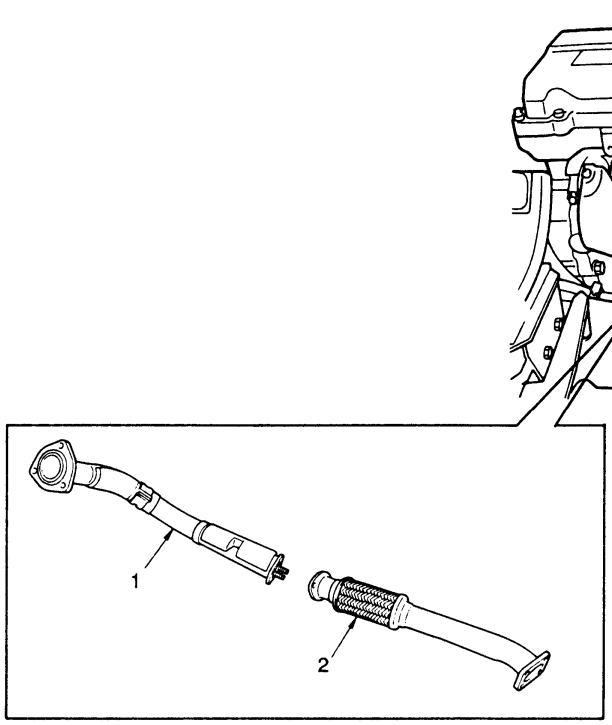
The catalyst coating on the three way (reduction) converter contains platinum and rhodium which lowers the levels of nitrogen oxides (NOx) as well as hydrocarbons (HC) and carbon monoxide (Co).

ON-VEHICLE SERVICE

Rattles and noise vibrations in the exhaust system are usually caused by misalignment of parts. When aligning the system, leave all bolts or nuts loose until all parts are properly aligned; then tighten, working from front to rear.

1. Check connections for looseness or damage, especially for exhaust gas leakage.
2. Check clamps and rubbers for weakness, cracks or damage.
3. Check for dents or damage and for any holes or cracks caused by corrosion.

FRONT EXHAUST PIPE



Removal steps
1. Front exhaust pipe I (Exhaust manifold side)
2. Front exhaust pipe II (Exhaust brake side)

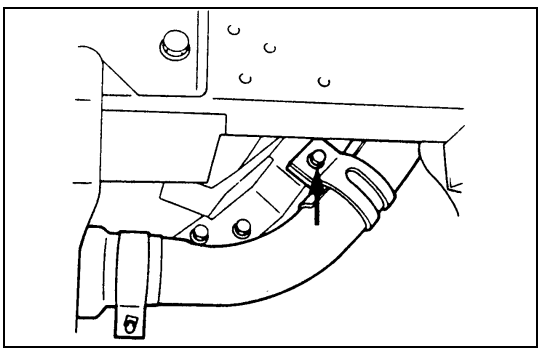
Installation steps
To install, follow the removal steps in the reverse order.

6F-3-1.tif

REMOVAL

Preparation

- Battery negative cable.

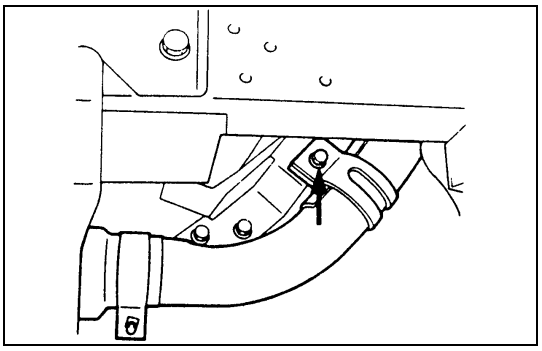


6F-3-2.tif

1. Front Exhaust Pipe I (Exhaust manifold side)

- Remove three nuts from front exhaust pipe I (exhaust manifold side)
- Remove the bolt from mounting bracket (engine right side)
- Remove four bolts and nuts from front exhaust pipe II (exhaust brake side)

2. Front Exhaust Pipe II (exhaust brake side)



6F-4-1.tif

INSTALLATION

2. Front Exhaust Pipe II (exhaust brake side)

Exhaust Brake Unit fixing Bolt Torque	N·m (kg·m/lb·ft)
	17 (1.7/12)

1. Front Exhaust Pipe I (exhaust manifold side)

Exhaust Pipe II side	N·m (kg·m/lb·ft)
	17 (1.7/12)

Mounting Bracket Bolt Torque	N·m (kg·m/lb·ft)
	18 (1.8/13)

Manifold Fixing Nut Torque	N·m (kg·m/lb·ft)
	67 (6.8/49)

- Connect battery ground cable.
- Start engine and check for exhaust gas leakage from exhaust pipes.

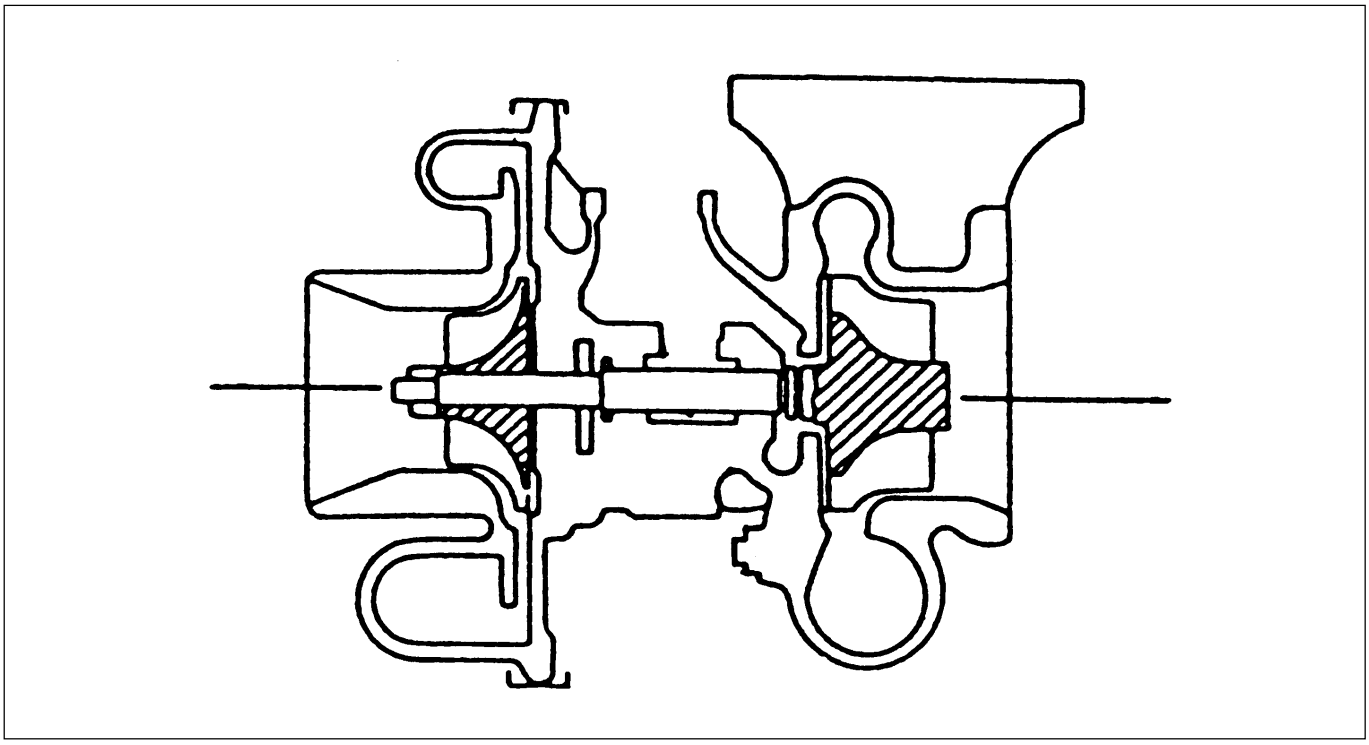
SECTION 6G
TURBOCHARGER

CONTENTS

	PAGE
General Description	6G - 2
On-Vehicle Service	6G - 3
Charge Air Pipe	6G - 4
Intake Manifold	6G - 4
Turbocharger	6G - 5
Inspection and Repair	6G - 6
Oil Leakage Check	6G - 7
Exhaust Manifold	6G - 9
Turbocharger Turbine Housing Replacement (For 4HG1-T model)	6G - 9
Charge Air Cooler	6G -12

GENERAL DESCRIPTION

TURBOCHARGER



6G-2-1.tif

Garrett turbocharger components are constituted the Center Housing and Rotating Assembly (CHRA), the compressor housing, and the turbine housing.

Rotating parts include the turbine shaft, the compressor wheel, the shaft bearings, the thrust bearings and the oil seal rings. These parts are supported by the center housing.

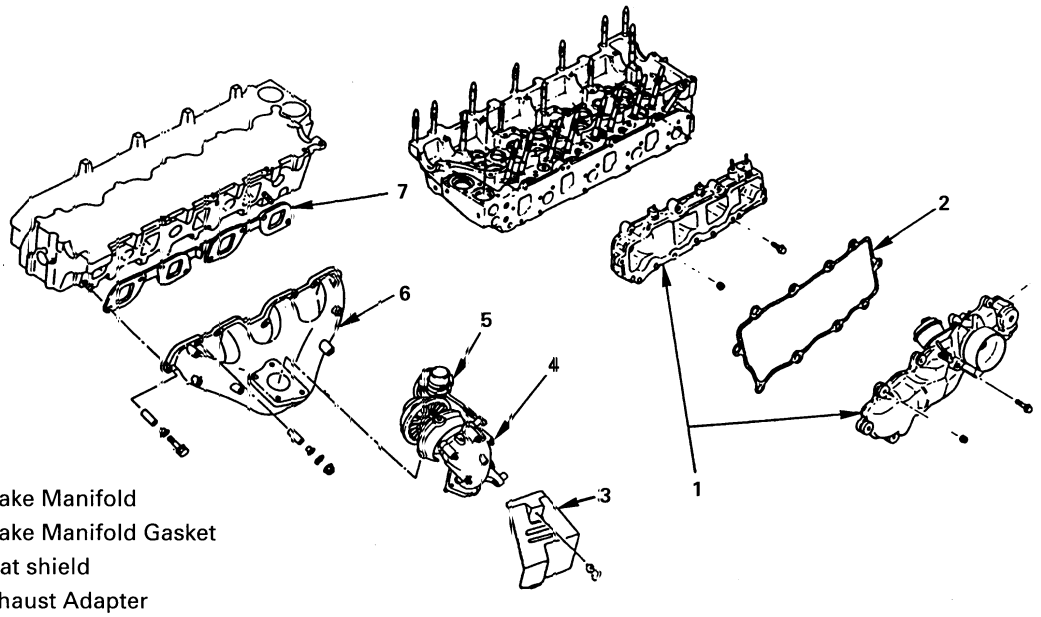
The turbocharger bearing and turbine shaft are lubricated with engine oil and at the same time are cooled with engine coolant to improve their durability.

The turbocharger increase air intake efficiency, the results in increased engine power, reduced fuel consumption and minimal engine noise.

Turbocharger rotating parts operate at very high speeds and temperatures. The parts materials have been carefully selected and machined to extremely high precision.

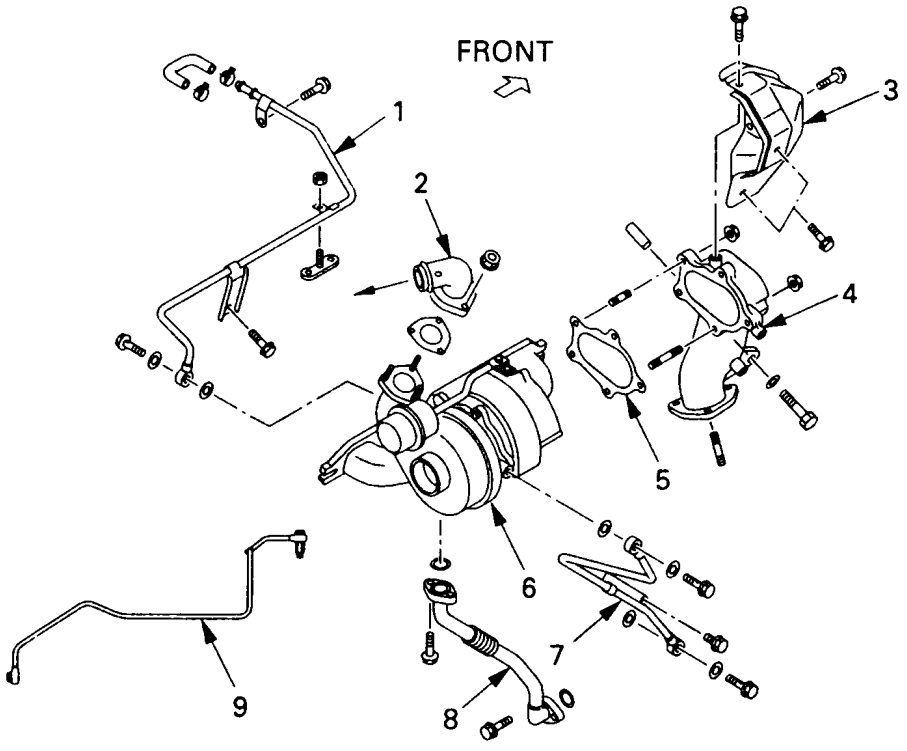
The turbocharger for 4HG1T Engine has a unit construction of turbine housing and exhaust manifold.

ON-VEHICLE SERVICE



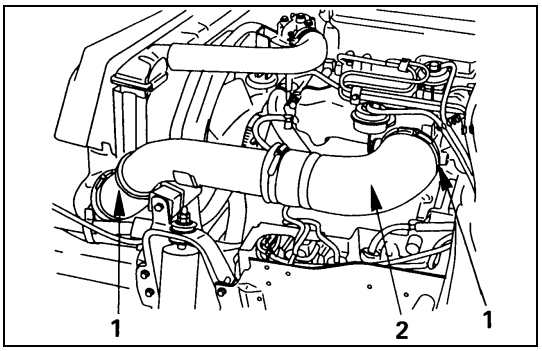
1. Intake Manifold
2. Intake Manifold Gasket
3. Heat shield
4. Exhaust Adapter
5. Turbocharger
6. Exhaust Manifold
7. Exhaust Manifold Gasket

6G-3-1.tif



036LX008.tif

CHARGE AIR PIPE



6G-4-1.tif

REMOVAL

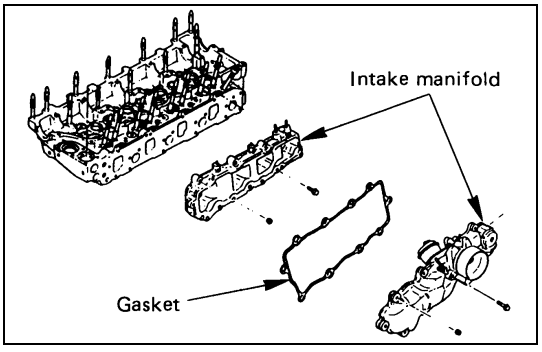
1. Connecting house clamps.
2. Connecting hoses.
3. Bracket bolts and washers and charge air pipe.
4. Clamps.
5. Connecting hose.
6. Bracket accelerator cable.
7. Bracket engine stop cable and vacuum hose.
8. Engine harness connector.
9. Charge air pipe.
10. Gasket.

CAUTION:
- Hoses for deterioration, or damage.
- Charge air pipes for damage.

INSTALLATION

1. Gasket to the intake manifold.
2. Charge air pipe.
3. Engine harness connector.
4. Bracket engine stop cable and vacuum hose.
5. Bracket accelerator cable.
6. Connecting hose.
7. Clamps.
8. Charge air pipe and bracket bolts.
9. Connecting hoses.
10. Clamps.

INTAKE MANIFOLD



6G-4-2.tif

REMOVAL

1. PCV hose.
2. Accelerator cable injection pump side.
3. Connecting hose.
4. Bracket accelerator cable.
5. Bracket engine stop cable and vacuum hose.
6. Engine harness connector.
7. Charge air pipe.
8. Gasket.
9. Injection pipe.
10. Intake manifold.
11. Gasket and discard.

INSTALLATION

1. **Intake manifold.**

Tighten

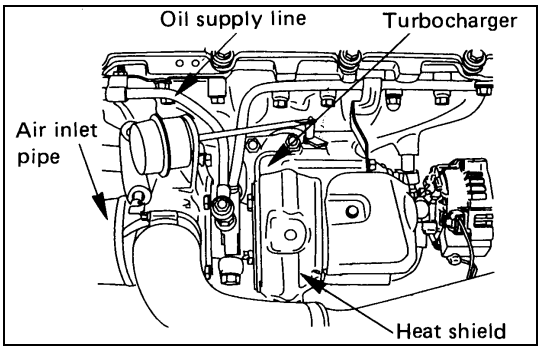
Intake manifold	N·m (kg·m/lb·ft)
	19 (1.9 / 14)

2. **Injection pipe**

Tighten

Fuel injector line nuts	N·m (kg·m/lb·ft)
	26 (2.7 / 20)

3. **Gasket**
4. **Charge air pipe.**
5. **Engine harness connector.**
6. **Bracket engine stop cable and vacuum hose.**
7. **Bracket accelerator cable.**
8. **Connecting hose.**
9. **Accelerator cable injection pump side.**
10. **PCV hose.**



6G-5-1.tif

TURBOCHARGER

Refer to “Statement on Cleanliness and Care” previously in this section.

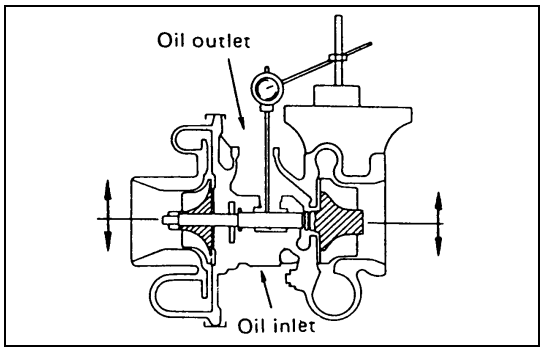
REMOVAL

1. **Turbocharger air inlet pipe.**
2. **Turbocharger intake pipe.**
3. **Connecting hose.**
4. **Exhaust gas recirculation (EGR) pipe.**
5. **Heat shield bolt.**
6. **Water feed and drain lines.**
7. **Oil feed line.**
8. **Oil drain line.**
9. **Exhaust pipe to exhaust adapter nuts.**
10. **Exhaust adapter to turbocharger nuts.**
11. **Turbocharger to exhaust manifold nuts.**

CAUTION:
The turbocharger for 4HG1-T Engine has a unit construction of turbin housing and exhaust manifold.

INSPECTION AND REPAIR

CAUTION:
- **Turbocharger housing for cracks or damage.**
- **Gasket surfaces for damage.**
- **Seals and gaskets for damage.**
- **Turbine and compressor blades for damage or carbon buildup.**
- **Air and exhaust exit openings for oil or wetness.**
- **For grinding or roughness when spinning turbine and compressor wheels by hand.**
- **For evidence of turbine or compressor blades contacting the shroud or housing. If any of the above conditions exist, the turbocharger must be replaced or repaired by an authorized repair facility.**



6G-6-1.tif

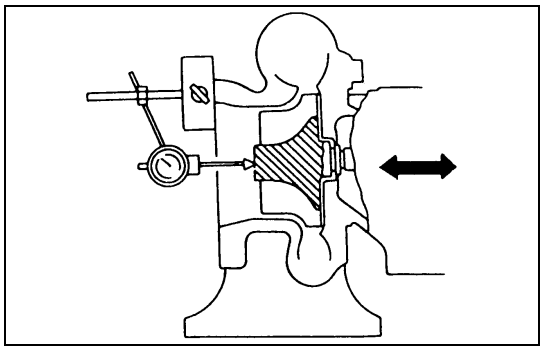
PLAY IN RADIAL CLEARANCE

Moving the rotor in the radial clearance, measure the play by a dial gage.
- Measure the play at several points while letting the rotor revolve.
- Use only the flat dial gage attachment. Do not use the pointed one.
- Attach the turbocharger and dial gage firmly.

Play in radial clearance mm (in)

Standard	Limit
0.056 - 0.127 (0.0022 - 0.0050)	0.140 (0.0055)

If excessive, replace the turbocharger.


6G-6-2.tif

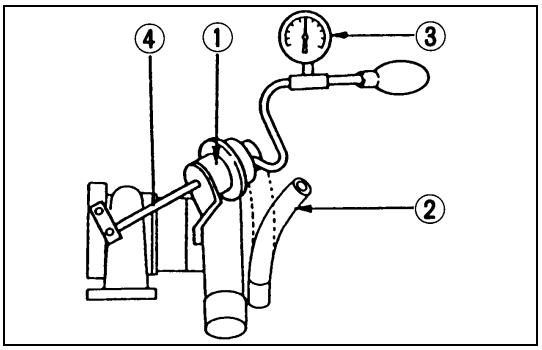
PLAY IN AXIAL CLEARANCE

Moving the rotor in the axial clearance, measure the play by a dial gage.
- Measure the play at several points while letting the rotor revolve.
- Attach the turbocharger and dial gage firmly.

Play in axial clearance mm (in)

Standard	Limit
0.013 - 0.097 (0.0005 - 0.0038)	0.097 (0.0038)

If excessive, replace the turbocharger.



6G-6-3.tif

Operation of waist gate

- Disconnect hose ② from waist gate ①, and install pressure gauge ③ as shown in the figure.
- With the engine stopped, operate the pressure gauge pump to apply pressure to the waist gate for check the waist gate function.

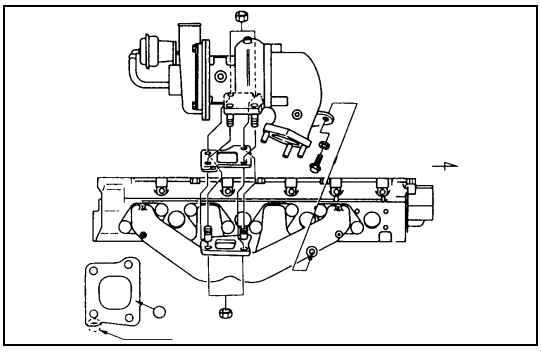
OIL LEAKAGE CHECK

1. Remove the charge air pipe connecting hose to the compressor side of the turbocharger.
2. Clean the area around the compressor wheel.
3. Remove the blow-by hose.
4. Start the engine and let idle. Rev the engine and hold at wide open throttle (WOT) for five seconds, then release and let idle for five seconds. Repeat this cycle for a total of five times then let the engine idle steady for five minutes.
5. Shut off the engine.
6. Check the compressor area for an oil stream.

CAUTION:

- **A stream of oil indicates a possible defective turbocharger. If mist or spray is present, however, this is normal and is NOT indicative of a turbocharger problem.**

7. If the turbocharger is suspect, refer to the on-vehicle service procedures in this section.



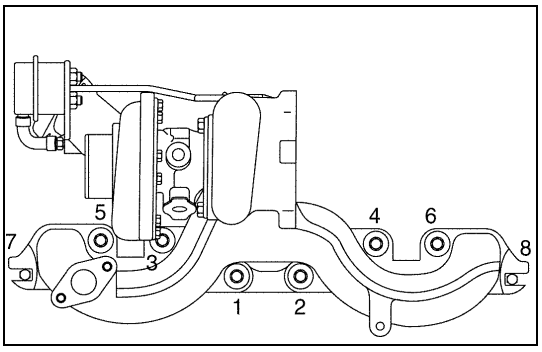
6G-7-1.tif

INSTALLATION

1. **Exhaust manifold to turbocharger.**
2. **New gasket and turbocharger to exhaust manifold.**

Tighten

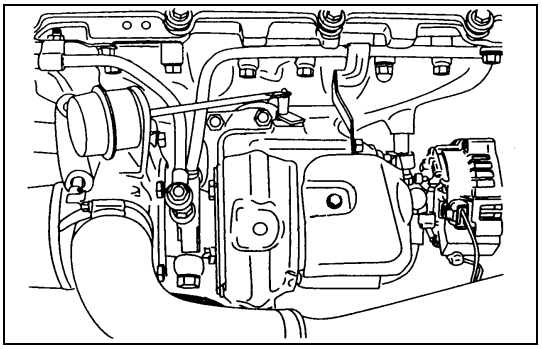
Turbocharger	N·m (kg·m/lb·ft)
	52 (5.3 / 38)



036LX005.tif

3. **Cylinder head to turbinhousing and exhaust manifold. (4HG1-T)**

Exhaust manifold	N·m (kg·m/lb·ft)
	34 (3.5 / 25)


6G-7-2.tif

4. **Turbocharger to exhaust adapter.**

Tighten

Exhaust adapter	N·m (kg·m/lb·ft)
32 (3.3 / 24)	

5. **Exhaust pipe to exhaust adapter.**

Tighten

Exhaust pipe	N·m (kg·m/lb·ft)
67 (6.8 / 49)	

6. **Turbocharger oil drain line.**

Tighten

Oil drain line	N·m (kg·m/lb·ft)
Turbocharger	9 (0.9 / 6)
Cyliner body	21 (2.1 / 15)

7. **Turbocharger oil supply line to turbocharger.**

Tighten

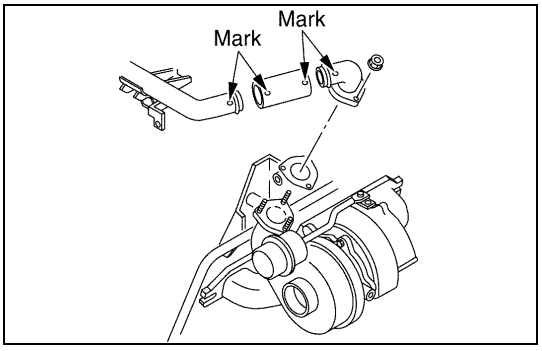
Oil supply line	N·m (kg·m/lb·ft)
27 (2.8 / 20)	

8. **Water supply and drain lines.**

Tighten

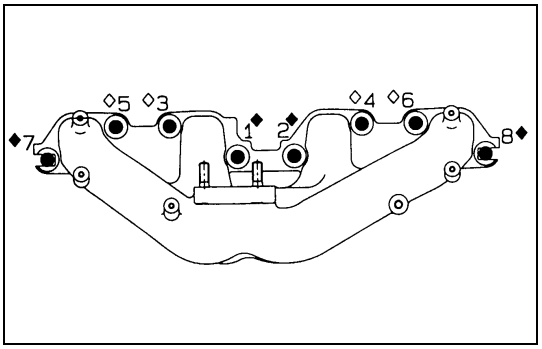
Water supply	N·m (kg·m/lb·ft)
41 (4.2 / 30)	

9. **Heat shield to exhaust adapter**
10. **Charge air pipe connecting hoses and clamps to turbocharger.**
11. **Air inlet pipe to turbocharger.**



036LX006.tif

12. **Fit the connecting hose over the pipe to its projecting part. (4HG1-T)**
13. **Align connecting hose and pipe marks with each other (4HG1-T)**



6G-8-1.tif

EXHAUST MANIFOLD

REMOVAL

1. **Turbocharger as outlined previously in this section.**
2. **Heat shield**
3. **Exhaust manifold Bolts, nuts and washers.**
4. **Exhaust manifold**
5. **Gaskets**

CAUTION:

- **Exhaust manifold and cylinder head for cracks or damage to gasket surfaces.**

INSTALLATION

1. **Gaskets.**
2. **Exhaust manifold.**
3. **Washers nuts and bolts.**

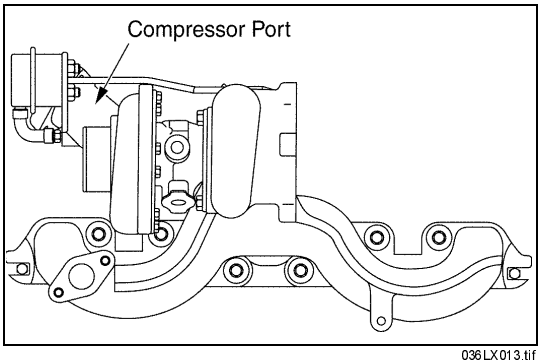
Tighten

Exhaust manifold	N·m (kg·m/lb·ft)
	34 (3.5 / 25)

4. **Heat shield**
5. **Turbocharger as outlined previously in this section.**

TURBOCHARGER TURBINE HOUSING REPLACEMENT (For 4HG1-T model)

Changing the turbine housing of the turbocharger (integrated with the exhaust manifold)



036LX013.tif

INSPECTION

Before replacing the turbine housing, make sure there are no abnormalities in other parts.

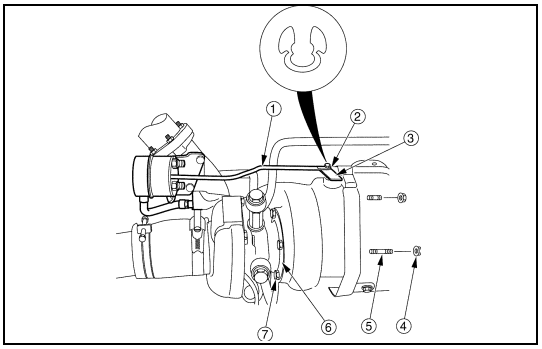
Note:

- **It is normal to find some oil inside the compressed-air duct. The oil is to lubricate the turbine shaft, and as long as the exhaust is not abnormally white in color, this does not indicate a problem.**

1) Make sure the parts have no cracks, impeded movement, damage, or distortion of shape, that there is no oil leakage from the seal, and that there is no gas leakage.
2) Turn the rotor to see if it rotates smoothly, also checking the rotation direction as well as the amount of slack.

   Refer to the separate reference sheet for the proper amount of slack.

   If there is an abnormality in any of the above, you will have to change the turbocharger as a unit.



036LX009.tif

DISASSEMBLY

1) Separate the end of the actuator rod ① from the E Ring ②, then remove the crank ③ from the end of the rod ①.
2) Remove the turbine housing tie-down bolts ⑦.
3) Separate the turbine housing from the sensor housing.

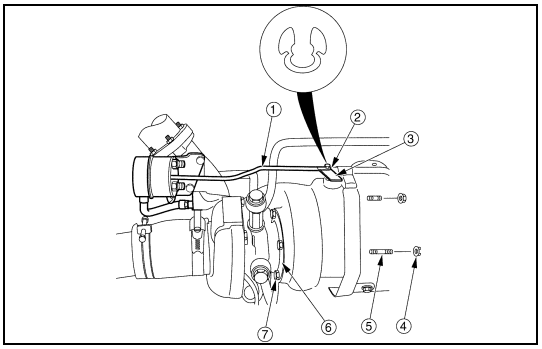
Note:

- **Be careful not to scratch the turbine blades when removing parts.**

Inspecting the center housing assembly:

Check that none of the blades is bent, cracked, or scratched. Make sure there are no obstructions that would interfere with the movement of the blades or with mounting the new housing. Remove any excess carbon or oil.

REPLACING PARTS



036LX009.tif

When reassembling, be sure to replace the following parts. (Use only genuine Isuzu parts.)

1) E Ring ②
2) Turbine housing tie-down bolts ⑦
3) Turbine housing clamp ⑥
4) Adapter nut
5) Adapter stud ⑤

CLEANING

Thoroughly clean off the oil and carbon from abutting surfaces, the oil passages, flange surfaces, air and exhaust ducts, etc. Always air-dry the parts after cleaning.

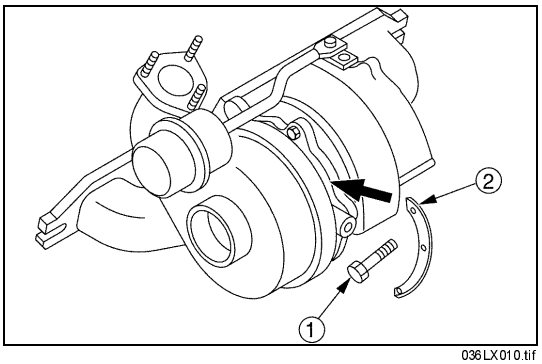
ASSEMBLY

1) Insert the sensor housing into the turbine housing.

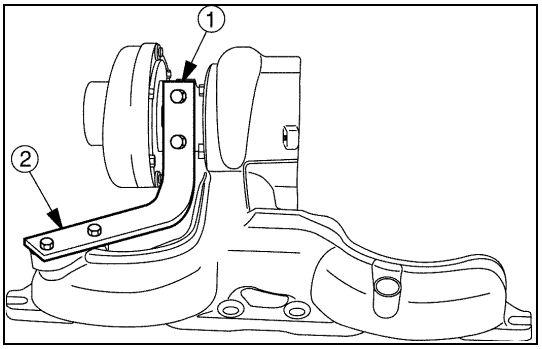
Note:

- **When inserting the sensor housing, make sure it will not impede the movement of the turbine blades.**

2) Apply molybdenum disulfide to the thread and underside of the head of each bolt ①.
3) Temporarily secure the sensor housing in place with the clamp ②.



036LX010.tif



036LX014.tif

4) Connect the oil side of the sensor housing ① and the EGR-connection side of the exhaust manifold ② to the angle setting gauge, then tighten the bolt to secure the gauge in place. (The angle of the sensor housing and turbine housing will be set with the use of this gauge).

Turbocharger housing setting gauge: 5-8840-2673-0

① M6 x P = 1.00

② M8 x P = 1.25

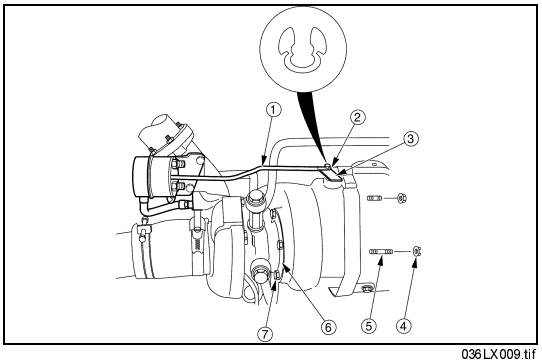
5) To give the sensor housing some slack, loosen the bolt on side ① by half a turn.

6) Tighten the turbine housing tie-down bolts to the specified torque.

Tightening torque of housing tie-down bolts	N-m (kg-m/lb-ft)
	2.6 (2.2 / 16)

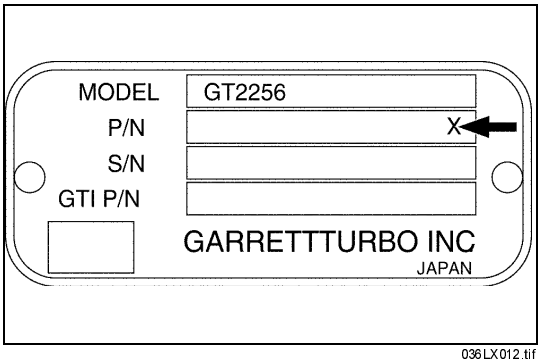
7) Remove the bolt that secures the pressure gauge, then remove the gauge.

8) Manually turn the rotor clockwise to be sure it it rotates smoothly. Check for abnormal noise, drag, etc.



036LX009.tif

9) Attach the end of the actuator rod ① to the crank at the waist gate ③, and secure with the E Ring ②.



036LX012.tif

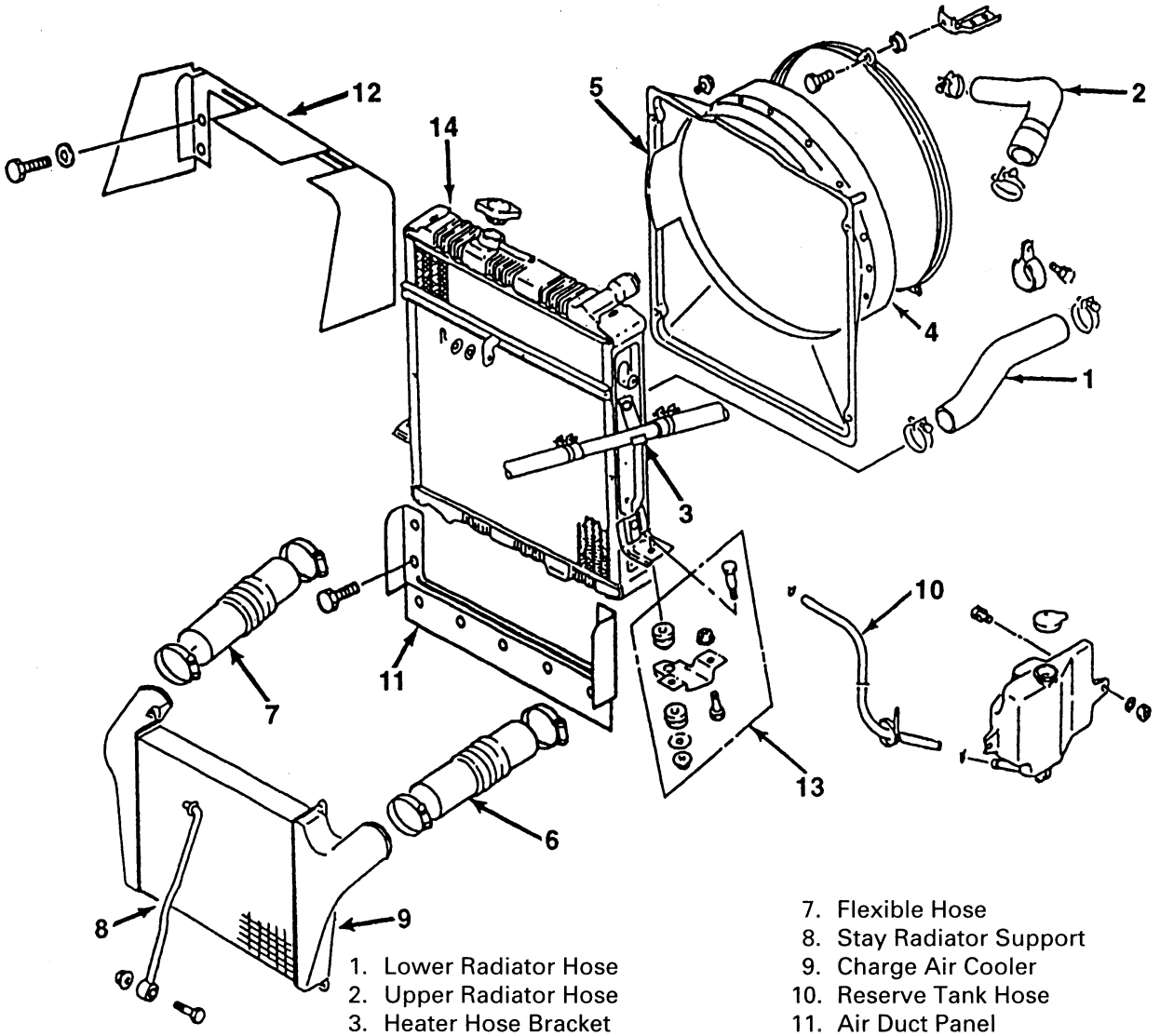
10) (Indicate on the nameplate that parts were replaced.)

11) Pour clean oil through the oil filler port to prevent corrosion.

12) Seal the air and exhaust ducts of the turbocharger, as well as the water and oil filler ports to prevent foreign matter from entering.

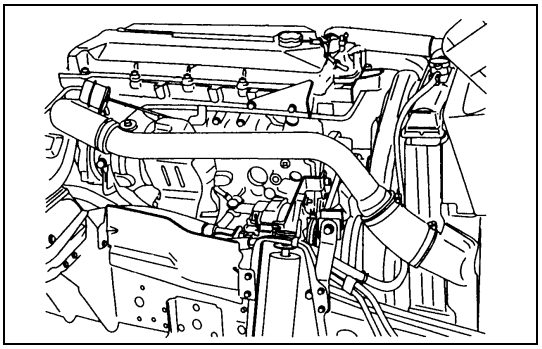
Follow the assembly directions to reattach to the engine.

CHARGE AIR COOLER

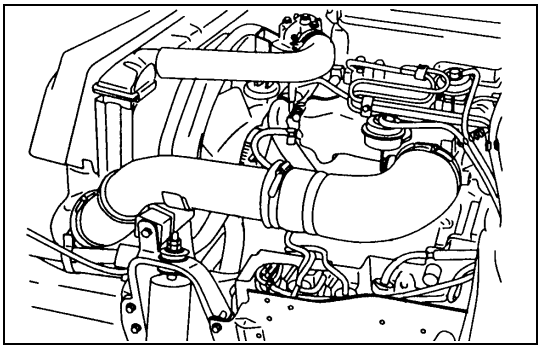


1. Lower Radiator Hose
2. Upper Radiator Hose
3. Heater Hose Bracket
4. Rubber Ring and Bell-Mouth
5. Fan Shroud Assembly
6. Flexible Hose
7. Flexible Hose
8. Stay Radiator Support
9. Charge Air Cooler
10. Reserve Tank Hose
11. Air Duct Panel
12. Guide Panel
13. Mount Nut and Cushion Rubber
14. Radiator Assembly

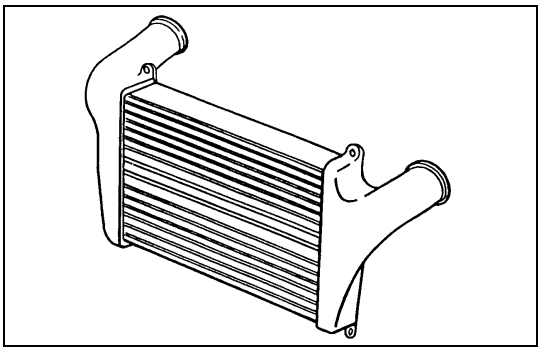
6G-9-1.tif



6G-10-1.tif



6G-10-2.tif



6G-10-3.tif

REMOVAL

- Disconnect the battery ground cables.
- Drain the engine coolant.

1. **Lower radiator hoses.**
2. **Upper radiator hoses.**
3. **Heater hose bracket.**
4. **Rubber Ring, bell-mouth to shroud.**
5. **Fan shroud assembly.**
6. **Flexible hose LH.**
7. **Flexible hose RH.**
8. **Stay radiator support.**
9. **Charge air cooler.**
10. **Reserve tank hose.**
11. **Air duct panel.**
12. **Guide panel.**
13. **Mount nut and cushion rubber.**
14. **Radiator assembly.**

INSTALLATION

14. **Radiator assembly.**
13. **Mount nut and cushion rubber.**
12. **Guide panel.**
11. **Air duct panel.**
10. **Reserve tank hose.**
9. **Charge air cooler.**
8. **Stay radiator support**
7. **Flexible hose RH.**
6. **Flexible hose LH.**
5. **Fan shroud assembly.**
4. **Rubber Ring.**
3. **Heater hose bracket.**
2. **Upper radiator hoses.**
1. **Lower radiator hoses.**

or brackets that were removed.

- Fill the system with new engine coolant as described in COOLING SYSTEM (SEC. 6B) of this manual. Then check the system for leaks.
- Battery ground cables.

LG4H-WE-9691

You are requested to order this manual using the manual number that is shown above.

This manual is applicable for vehicles in all countries except the USA and Canada.

All rights reserved. This manual may not be reproduced in whole or in part, without the permission in writing of ISUZU MOTORS LIMITED.

Issued by

ISUZU MOTORS LIMITED

INTERNATIONAL SERVICE DEPARTMENT

Tokyo, Japan

First edition Feb., 1999 9911-13K-1

No. HGSTG-WE-661 PRINTED IN JAPAN

WORKSHOP MANUAL

NHR • NKR • NPR

ENGINE
4J SERIES

SECTION 6

ISUZU

MEMO

NOTICE

Before using this Workshop Manual to assist you in performing vehicle service and maintenance operations, it is recommended that you carefully read and thoroughly understand the information contained in Section 0A under the headings "GENERAL REPAIR INSTRUCTIONS" and "HOW TO USE THIS MANUAL".

All material contained in this Manual is based on the latest product information available at the time of publication.
All rights are reserved to make changes at any time without prior notice.

Applicable Model : NHR55. NKR55. NPR55. NPR69

This manual is applicable to 1994 year model and later vehicles.

THIS MANUAL INCLUDES THE FOLLOWING SECTIONS:

SECTION NO.	CONTENTS
00	Service Information
6A	Engine Mechanical
6A1	4JB1/4JB1T/4JB1-TC/4JG2 Engine
6B	Engine Cooling
6C	Fuel System
6D	Engine Electrical
6E	Exhaust Gas Recirculation (EGR) System
6F	Exhaust
6G	Turbocharger

SECTION 00
SERVICE INFORMATION

CONTENTS

PAGE

Troubleshooting ..... 00 - 2
Main Data and Specifications ..... 00 - 30
Service Standard ..... 00 - 34
Servicing ..... 00 - 38
Fixing Torque ..... 00 - 51
Special Tools ..... 00 - 60

TROUBLESHOOTING

CONTENTS

PAGE

Hard Starting ..... 00 - 3
Starter Inoperative ..... 00 - 3
Starter Motor Operates but Engine Does Not Turn Over ..... 00 - 3
Engine Turns Over but Does Not Start ..... 00 - 4
Quick-on Start System ..... 00 - 5
Unstable Idling ..... 00 - 6
Insufficient Power ..... 00 - 7
Excessive Fuel Consumption ..... 00 - 9
Excessive Oil Consumption ..... 00 - 9
Overheating ..... 00 - 10
White Exhaust Smoke ..... 00 - 10
Dark Exhaust Smoke ..... 00 - 11
Oil Pressure Does Not Rise ..... 00 - 11
Abnormal Engine Noise ..... 00 - 12
Engine Knocking ..... 00 - 12
Gas Leakage Noise ..... 00 - 12
Continuous Noise ..... 00 - 12
Slapping Noise ..... 00 - 13
Engine Cooling Trouble ..... 00 - 14
Engine Electrical Part Trouble ..... 00 - 15
Turbocharger ..... 00 - 20
Lubrication Chart ..... 00 - 29

1. HARD STARTING

1. STARTER INOPERATIVE		
Checkpoint	**Possible cause**	**Correction**
Battery	Loose battery cable terminal poor connections due to rusting	Clean and/or retighten the battery cable terminal
	Battery discharged or weak	Recharge or replace the battery
	Fan belt loose or broken	Adjust or replace the fan belt
Fusible link	Fusible link shorted	Replace the fusible link
Starter switch	Defective starter switch or starter relay	Replace the starter switch or the Starter relay
Starter motor	Defective magnetic switch or starter relay	Repair or replace the magnetic switch
	Defective starter motor	Repair or replace the starter motor
2. STARTER MOTOR OPERATES BUT ENGINE DOES NOT TURN OVER		
Battery	Loose battery cable terminal	Clean and/or retighten the battery cable terminal
	Poor connections due to rusting	Recharge or replace the battery
	Battery discharged or weak	Recharge or replace the battery
	Fan belt loose or broken	Adjust or replace the fan belt
Starter	Defective pinion gear	Replace the pinion gear
	Defective magnetic switch	Repair or replace the magnetic switch
	Brush wear, Weak brush spring	Replace the brush and/or the brush spring
Engine	Piston, crank bearing seizure, or other damage	Repair or replace the related parts

3. ENGINE TURNS OVER BUT DOES NOT START		
Checkpoint	**Possible cause**	**Correction**
Engine stop mechanism	Defective fuel cut solenoid valve	Replace the fuel cut solenoid valve
FUEL IS NOT BEING DELIVERED TO THE INJECTION PUMP		
Fuel	Fuel tank is empty	Fill the fuel tank
Fuel piping	Clogged or damaged fuel lines. Loose fuel line connection	Repair or replace the fuel lines Retighten the fuel line connection
Fuel filter	Fuel filter overflow valve does not close	Repair or replace the fuel filter overflow valve
	Clogged fuel filter element	Replace the fuel filter element or the filter cartridge
Fuel system	Air in the fuel system	Bleed the air from the fuel system
Fuel feed pump	Defective feed pump	Repair or replace the feed pump
FUEL IS BEING DELIVERED TO THE INJECTION PUMP		
Fuel	Use of the wrong fuel	Use the correct fuel
	Water particles in the fuel	Change the fuel
Fuel system	Air in the injection pump	Bleed the air from the fuel system
Injection nozzle	Injection nozzle sticking	
	Injection nozzle injection starting pressure too low Improper spray condition	Adjust or replace the injection nozzle
Injection pump	Defective fuel injection nozzle resulting in the fuel drippage after fuel injection	Replace the delivery valve
	Defective injection pump control rack operation	Repair or replace the injection pump control rack
	Injection pump plunger worn or stuck	Replace the injection pump plunger assembly
	Injection pump drive shaft seizure or other damage	Replace the injection drive shaft
	Injection pump governor spring seizure	Replace the injection pump governor spring

4. QUICK-ON START SYSTEM

PREPARATION
1 Disconnect the thermoswitch connector.
2. Determine whether or not the glow plugs are receiving power.
   a) Make sure that the starter switch is “OFF”.
   b) Connect a voltmeter between one of the glow plugs and the cylinder wall.
   c) Move the starter switch to the “ON” position.
      The voltmeter needle will show the souse voltage (12V) if the glow plugs are receiving power.
      If the voltmeter needle does not move, the glow plugs are not receiving power.
3. Perform the troubleshooting procedure.

GLOW PLUGS ARE RECEIVING POWER

Checkpoint	Possible cause	Correction
Glow plug indicator light does not turn on	Defective indicator light bulb	Replace the indicator light bulb
Quick-on start timer	Defective quick-on start timer	Replace the quick-on start timer
Glow plug indicator light turns on the 0.3 seconds	Defective quick-on start timer	Replace the quick-on start timer
Glow plug indicator light turns on for 3.5 seconds	Return the starter switch to the “ON” position from the “START” position after the engine starts if the glow plug relay remains on less than 14 seconds, the quick-on start timer is defective	Replace the quick-on start timer
	Move the starter switch from the “OFF” position to the “ON” position if the glow plug relay remains on less than 14 seconds, the quick-on start timer is defective	Replace the quick-on start timer
Thermoswitch	Defective thermoswitch	Replace the thermoswitch
Glow plug continuity	No glow plug continuity	Replace the glow plugs

GLOW PLUGS ARE NOT RECEIVING POWER

Glow plug indicator light does not turn on	Broken indicator light fuse	Replace the fuse
Quick-on start timer	Defective quick-on start timer	Replace the quick-on start timer

GLOW PLUGS ARE NOT RECEIVING POWER (Cont'd)		
Checkpoint	**Possible cause**	**Correction**
Glow plug indicator light turns on for 3.5 seconds	Defective glow plug relay The glow plug relay does not turn on after the starter switch is moved from the "OFF" position to the "ON" position	Replace the glow plug relay
	Defective quick-on start timer	Replace the quick-on start timer
	Defective glow plug relay wiring harness	Repair or replace the wiring harness
	Defective fusible link or wiring harness The glow plug relay turns on when the starter switch is moved from the "OFF" position to the "ON" position	Replace the fusible link or the wiring harness

2. UNSTABLE IDLING

Checkpoint	Possible cause	Correction
Idling system	Idling improperly adjusted	Adjust the idling
Fast idling speed	Defective fast idling speed control device	Repair or replace the fast idling speed control device
Accelerator control system	Accelerator control system improperly adjusted	Adjust the accelerator control system
Fuel system	Fuel system leakage or blockage	Repair or replace the fuel system
	Air in the fuel system	Bleed the air from the fuel system
	Water particles in the fuel system	Change the fuel
Fuel filter	Clogged fuel filter element	Replace the fuel filter element or the fuel filter cartridge
Fuel feed pump	Defective fuel feed pump	Repair or replace the fuel feed pump
Injection nozzle	Injection nozzle sticking	Replace the injection nozzle
	Injection nozzle injection starting pressure too low Improper spray condition	Adjust or replace the injection nozzle
Injection pump	Defective delivery valve resulting in fuel drippage after fuel injection	Replace the delivery valve

Checkpoint	Possible cause	Correction
Injection pump (Cont'd)	Injection timing improperly adjusted	Adjust the injection timing
	Insufficient injection volume	Adjust the injection volume
	Defective idle spring	Replace the idle spring
	Defective governor lever operation	Repair or replace the governor lever
	Regulator valve improperly adjustment	Adjust or replace the regulator valve
	Broken plunger spring	Replace the plunger spring
	Worn plunger	Replace the plunger assembly
	Worn cam disc	Replace the cam disc
Valve clearance	Valve clearance improperly adjusted	Adjust the valve clearance
Compression pressure	Blown out cylinder head gasket. Worn cylinder liner. Piston ring sticking	Replace the related parts

3. INSUFFICIENT POWER

Checkpoint	Possible cause	Correction
Air cleaner	Clogged air cleaner element	Clean or replace the air cleaner element
Fuel	Water particle in the fuel	Replace fuel
Fuel filter	Clogged fuel filter element	Replace the fuel filter element or the fuel filter cartridge
Fuel feed pump	Defective fuel feed pump	Repair or replace the fuel feed pump
Injection nozzle	Injection nozzle sticking	Replace the injection nozzle
	Injection nozzle injection starting pressure too low Improper spray condition	Adjust or replace the injection nozzle
Fuel injection pipes	Fuel injection pipes damaged or obstructed	Replace the fuel injection pipes

Checkpoint	Possible cause	Correction
Injection pump	Defective regulating valve	Repair or replace the regulating valve
	Defective delivery valve	Replace the delivery valve
	Defective timer	Repair or replace the timer
	Worn cam disc	Replace the cam disc
	Improper control lever operation	Adjust or replace the control lever
	Defective injection timing	Adjust the injection timing Repair or replace the injection pump timer
	Weak governor spring	Replace the governor spring
	Worn plunger	Replace the plunger assembly
Compression pressure	Blown out cylinder head gasket. Worn cylinder liner. Piston ring sticking	Replace the related parts
Valve clearance	Valve clearance improperly adjusted	Adjust the valve clearance
Valve spring	Valve spring weak or broken	Replace the valve spring
Exhaust system	Exhaust pipe clogged	Clean the exhaust pipe
Full load adjusting screw seal	Open and improperly set adjusting screw seal	Adjust and reseal the adjusting screw

4. EXCESSIVE FUEL CONSUMPTION

Checkpoint	Possible cause	Correction
Fuel system	Fuel leakage	Repair or replace the fuel system related parts
Air cleaner	Clogged air cleaner element	Clean or replace the air cleaner element
Idling speed	Poorly adjusted idling speed	Adjust the idling speed
Injection nozzle	Injection nozzle injection starting pressure too low Improper spray condition	Adjust or replace the injection nozzle
Fuel injection timing	Fuel injection timing improperly	Adjust the fuel injection timing
Injection pump	Defective Delivery valve resulting is fuel drippage after fuel injection	Replace the delivery valve
Valve clearance	Valve clearance improperly adjusted	Adjust the valve clearance
Compression pressure	Blown out cylinder head gasket. Worn cylinder liner. Piston ring sticking	Replace the related parts
Valve spring	Valve spring weak or broken	Replace the valve spring

5. EXCESSIVE OIL CONSUMPTION

Checkpoint	Possible cause	Correction
Engine oil	Engine oil unsuitable Too much engine oil	Replace the engine oil Correct the engine oil level
Oil seal and gasket	Oil leakage from the oil seal and/or the gasket	Replace the oil seal and/or the gasket
Air breather	Clogged air breather	Clean the air breather
Intake and exhaust valve	Worn valve stems and valve guides	Replace the intake and exhaust valves and the valve guides

6. OVERHEATING

Checkpoint	Possible cause	Correction
Cooling water	Insufficient cooling water	Replenish the cooling water
Fan clutch	Oil leakage from the fan clutch	Replace the fan clutch
Fan belt	Fan belt loose or cracked causing slippage	Replace the fan belt
Radiator	Defective radiator cap or clogged radiator core	Replace the radiator cap or clean the radiator core
Water pump	Defective water pump	Repair or replace the water pump
Cylinder head and cylinder body sealing cap	Defective sealing cap resulting in water leakage	Replace the sealing cap
Thermostat	Defective thermostat	Replace the thermostat
Cooling system	Cooling system clogged by foreign material	Clean the foreign material from the cooling system
Fuel injection timing	Fuel injection timing improperly adjusted	Adjust the fuel injection timing

7. WHITE EXHAUST SMOKE

Checkpoint	Possible cause	Correction
Cooling water	Insufficient cooling water	Replace the cooling water
Fuel	Water particles in the fuel	Replace the fuel
Fuel injection timing	Delayed fuel injection timing	Adjust the fuel injection timing
Compression pressure	Blown out cylinder head gasket. Worn cylinder liner. Piston ring sticking	Replace the related parts
Inlet and exhaust valve Valves seals	Defective valve seals. Worn valves stems and valve guides	Replace the valve seals, the valves, and the valve guides

8. DARK EXHAUST SMOKE

Checkpoint	Possible cause	Correction
Air cleaner	Clogged air cleaner element	Clean or replace the air cleaner element
Injection nozzle	Injection nozzle injection starting pressure too low Improper spray condition	Adjust or replace the injection nozzle
Fuel injection timing	Fuel injection timing improperly adjusted	Adjust the fuel injection timing
Injection pump	Defective delivery valve resulting in fuel drippage after fuel injection	Replace the delivery valve
	Excessive injection volume	Adjust the injection volume

9. OIL PRESSURE DOES NOT RISE

Checkpoint	Possible cause	Correction
Engine oil	Improper viscosity engine oil. Insufficient engine oil	Replace the engine oil Correct the engine oil volume
Oil pressure gauge or unit Oil pressure indicator light	Defective oil pressure gauge or unit Defective indicator light	Repair or replace the oil pressure gauge or unit Replace the indicator light
Oil filter	Clogged oil filter element	Replace the oil filter element or the oil filter cartridge
Relief valve and by-pass valve	Relief valve sticking and/or weak by-pass valve spring	Replace the relief valve and/or the by-pass valve spring
Oil pump	Clogged oil pump strainer	Clean the oil pump strainer
	Worn oil pump related parts	Replace the oil pump related parts
Rocker arm shaft	Worn rocker arm bushing	Replace the rocker arm bushing
Camshaft	Worn camshaft and camshaft bearing	Replace the camshaft and the camshaft bearing
Crankshaft and bearings	Worn crankshaft and bearings	Replace the crankshaft and/or the bearings

10. ABNORMAL ENGINE NOISE

1. ENGINE KNOCKING

Check to see that the engine has been thoroughly warmed up before beginning the troubleshooting procedure.

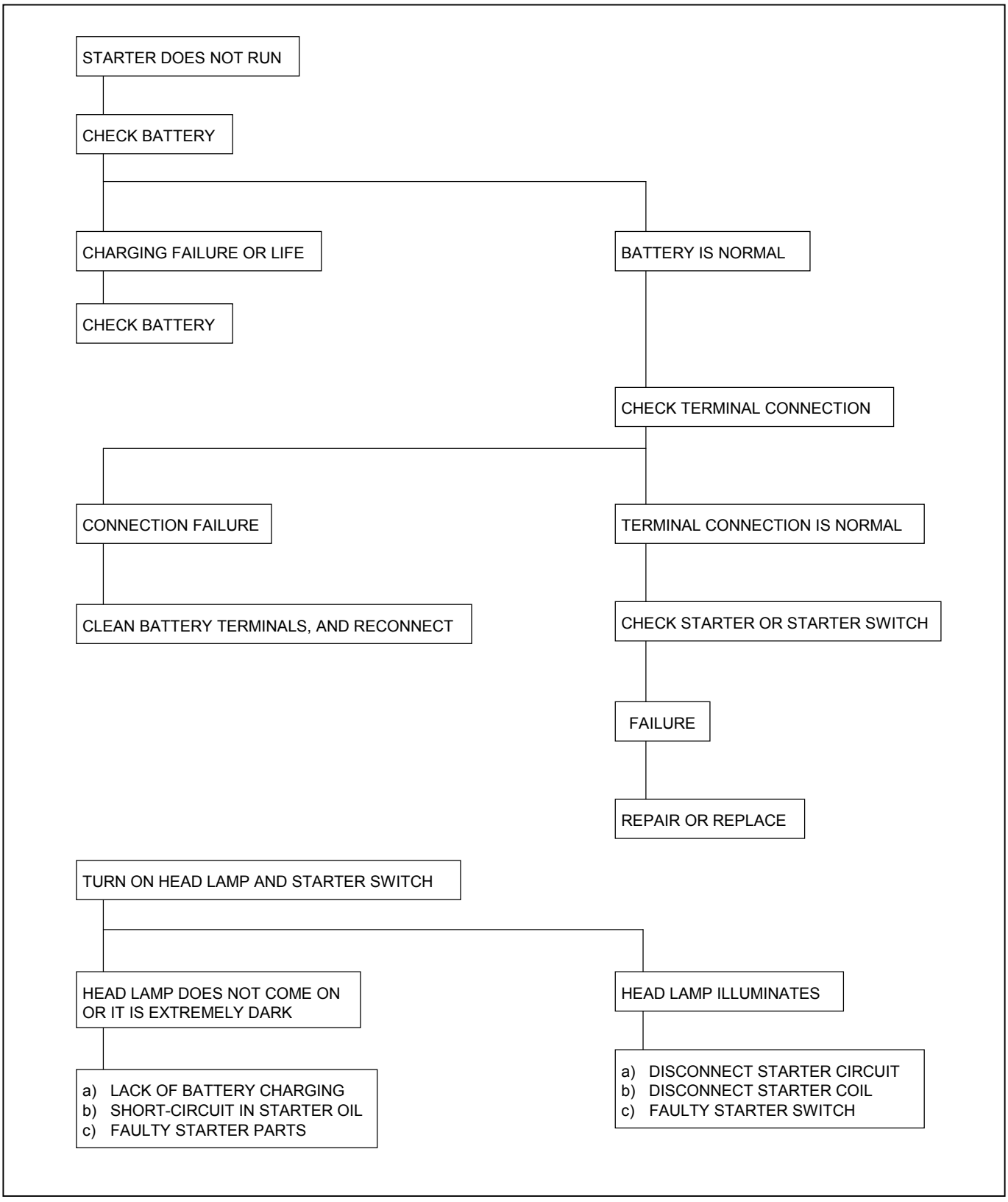
Checkpoint	Possible cause	Correction
Fuel	Fuel unsuitable	Replace the fuel
Fuel injection timing	Fuel injection timing improperly adjusted	Adjust the fuel injection timing
Injection nozzle	Improper injection nozzle starting pressure and spray condition	Adjust or replace the injection nozzle
Compression pressure	Blown out head gasket Broken piston ring	Replace the head gasket or the piston ring
2. GAS LEAKAGE NOISE		
Exhaust pipes	Loosely connected exhaust pipes. Broken exhaust pipes	Tighten the exhaust pipe connections Replace the exhaust pipes
Injection nozzles and/or glow plugs	Loose injection nozzles and/or glow plugs	Replace the washers Tighten the injection nozzles and/or the glow plugs
Exhaust manifold	Loosely connected exhaust manifold and/or glow plugs	Tighten the exhaust manifold connections
Cylinder head gasket	Damaged cylinder head gasket	Replace the cylinder head gasket
3. CONTINUOUS NOISE		
Fan belt	Loose fan belt	Readjust the fan belt tension
Cooling fan	Loose cooling fan	Retighten the cooling fan
Water pump bearing	Worn or damaged water pump bearing	Replace the water pump bearing
Generator or vacuum pump	Defective generator or vacuum pump	Repair or replace the generator or the vacuum pump
Valve clearance	Clearance improperly adjust	Adjust the valve clearances

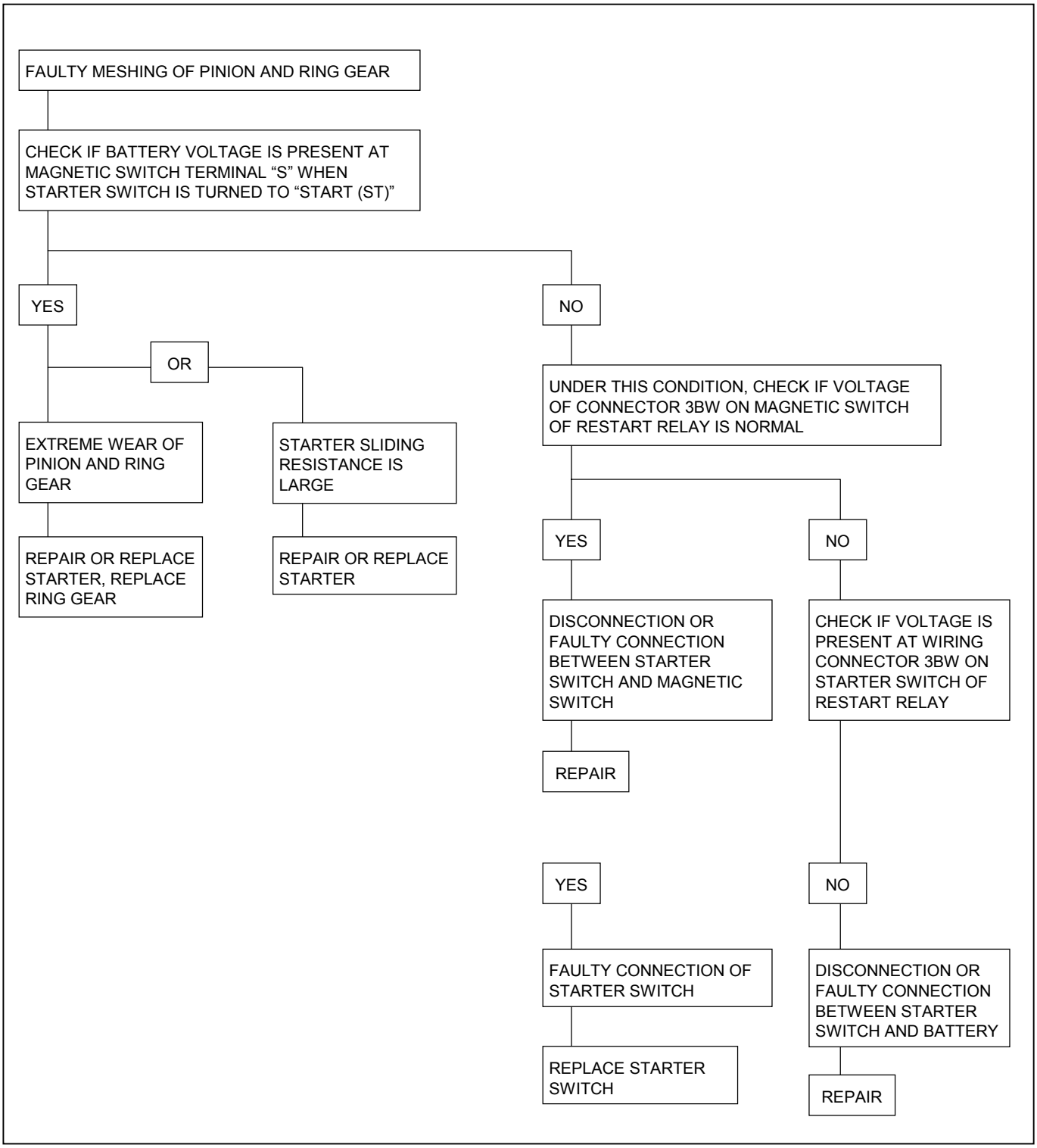
4. SLAPPING NOISE		
Checkpoint	**Possible cause**	**Correction**
Valve clearance	Valve clearance improperly adjusted	Adjust the valve clearance
Rocker arm	Damaged rocker arm	Replace the rocker arm
Flywheel	Loose flywheel bolts	Retighten the flywheel bolts
Crankshaft and thrust bearings	Worn or damaged crankshaft and/or thrust bearings	Replace the crankshaft and/or the thrust bearings
Crankshaft and connecting rod bearings	Worn or damaged crankshaft and/or connecting rod bearings	Replace the crankshaft and/or the connecting rod bearings
Connecting rod bushing and piston pin	Worn or damaged connecting rod bushing and piston pin	Replace the connecting rod bushing and/or the piston pin
Piston and cylinder liner	Worn or damaged piston and cylinder liner.	Replace the piston and the cylinder liner.

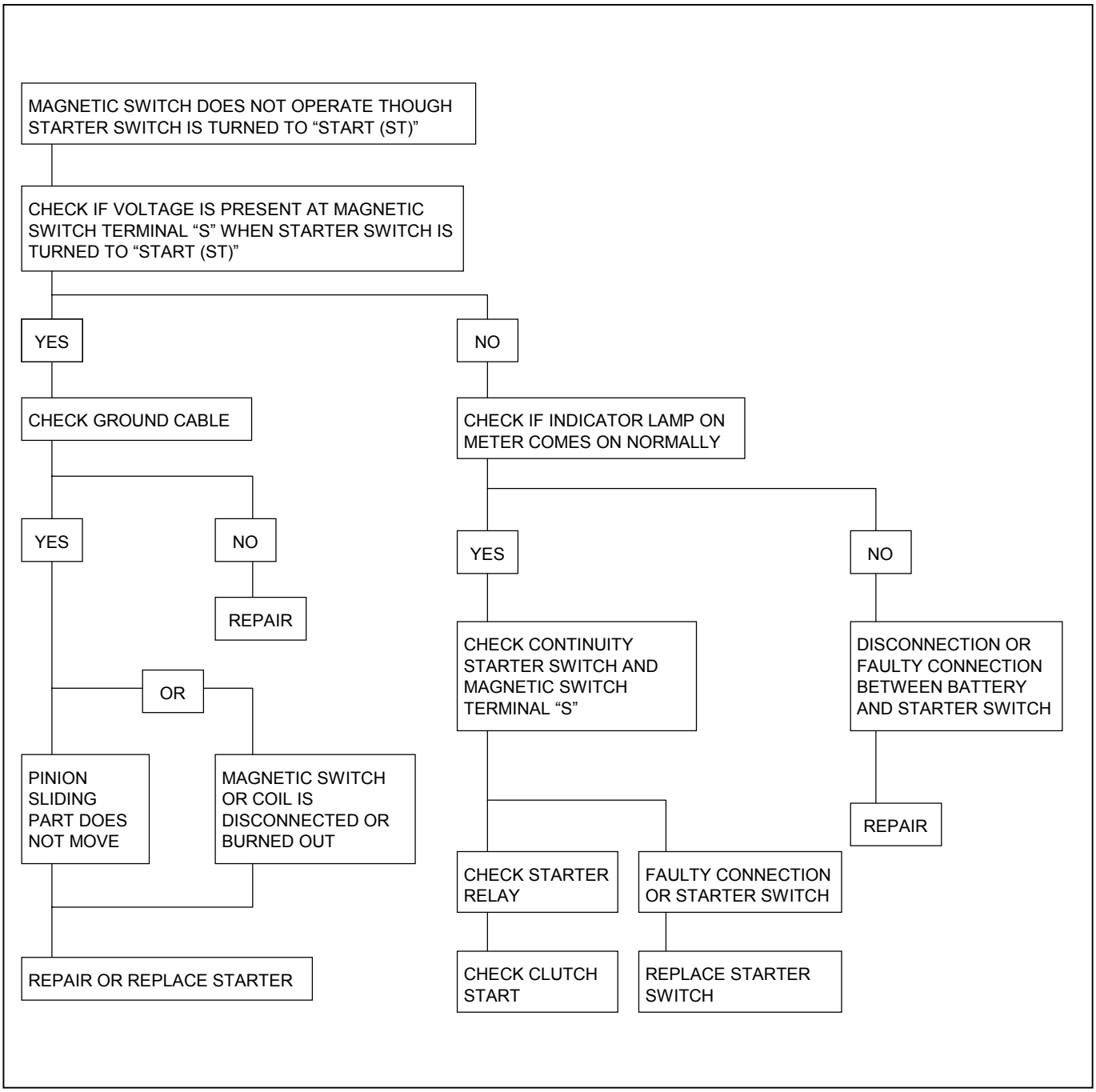
11. ENGINE COOLING TROUBLE

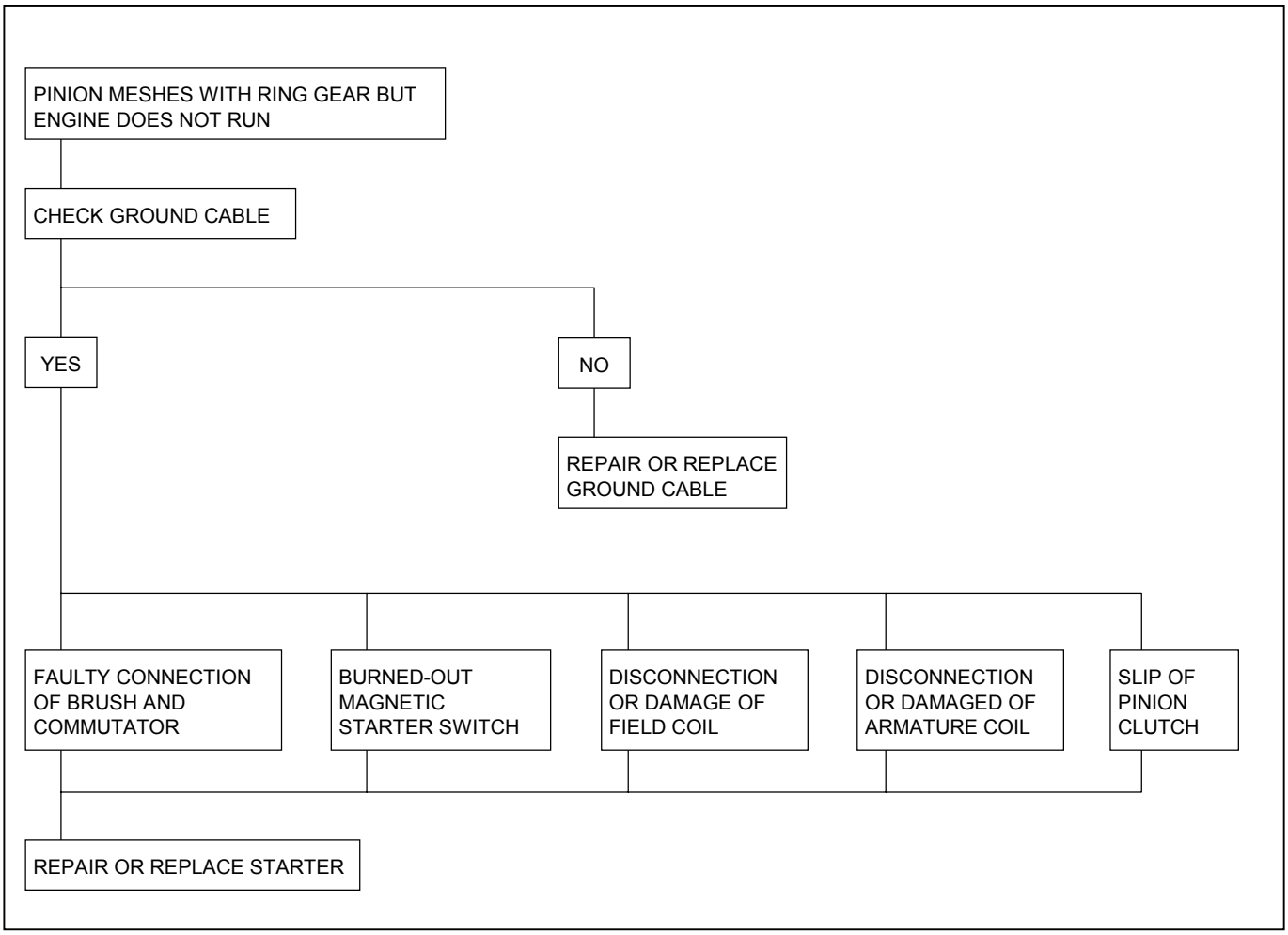
Checkpoint	Possible cause	Correction
Engine overheating	Low coolant level	Replenish
	Thermo unit faulty	Replace
	Faulty thermostat	Replace
	Faulty coolant unit	Repair or replace
	Clogged radiator	Clean or replace
	Faulty radiator cap	Replace
	Low engine oil level or use of improper engine oil	Replenish or change oil Replenish
	Damaged cylinder head gasket	Replace
	Clogged exhaust system	Clean exhaust system or replace faulty parts
	Loose fan belt	Adjust
	Excessive fuel injected	Adjust
	Improper injection timing	Adjust
Engine overcooling	Faulty thermostat	Replace
Too long engine warm-up time	Faulty thermostat	Replace
	Thermo unit faulty	Replace

12. ENGINE ELECTRICAL PART TROUBLE




FAULTY MESHING OF PINION AND RING GEAR
CHECK IF BATTERY VOLTAGE IS PRESENT AT MAGNETIC SWITCH TERMINAL “S” WHEN STARTER SWITCH IS TURNED TO “START (ST)”
YES
OR
EXTREME WEAR OF PINION AND RING GEAR
REPAIR OR REPLACE STARTER, REPLACE RING GEAR
STARTER SLIDING RESISTANCE IS LARGE
REPAIR OR REPLACE STARTER
NO
UNDER THIS CONDITION, CHECK IF VOLTAGE OF CONNECTOR 3BW ON MAGNETIC SWITCH OF RESTART RELAY IS NORMAL
YES
DISCONNECTION OR FAULTY CONNECTION BETWEEN STARTER SWITCH AND MAGNETIC SWITCH
REPAIR
NO
CHECK IF VOLTAGE IS PRESENT AT WIRING CONNECTOR 3BW ON STARTER SWITCH OF RESTART RELAY
YES
FAULTY CONNECTION OF STARTER SWITCH
REPLACE STARTER SWITCH
NO
DISCONNECTION OR FAULTY CONNECTION BETWEEN STARTER SWITCH AND BATTERY
REPAIR


MAGNETIC SWITCH DOES NOT OPERATE THOUGH STARTER SWITCH IS TURNED TO “START (ST)”
CHECK IF VOLTAGE IS PRESENT AT MAGNETIC SWITCH TERMINAL “S” WHEN STARTER SWITCH IS TURNED TO “START (ST)”
YES
NO
CHECK GROUND CABLE
CHECK IF INDICATOR LAMP ON METER COMES ON NORMALLY
YES
NO
REPAIR
YES
NO
OR
CHECK CONTINUITY STARTER SWITCH AND MAGNETIC SWITCH TERMINAL “S”
DISCONNECTION OR FAULTY CONNECTION BETWEEN BATTERY AND STARTER SWITCH
PINION SLIDING PART DOES NOT MOVE
MAGNETIC SWITCH OR COIL IS DISCONNECTED OR BURNED OUT
REPAIR
CHECK STARTER RELAY
FAULTY CONNECTION OR STARTER SWITCH
REPAIR OR REPLACE STARTER
CHECK CLUTCH START
REPLACE STARTER SWITCH


PINION MESHES WITH RING GEAR BUT ENGINE DOES NOT RUN
CHECK GROUND CABLE
YES
NO
REPAIR OR REPLACE GROUND CABLE
FAULTY CONNECTION OF BRUSH AND COMMUTATOR
BURNED-OUT MAGNETIC STARTER SWITCH
DISCONNECTION OR DAMAGE OF FIELD COIL
DISCONNECTION OR DAMAGED OF ARMATURE COIL
SLIP OF PINION CLUTCH
REPAIR OR REPLACE STARTER

STARTER DOES NOT STOP THOUGH STARTER SWITCH IS RETURNED TO “ON” FROM “START”

DISCONNECTED STARTER SWITCH WIRING CONNECTOR, AND CHECK STARTER SWITCH OPERATION.

KEY POSITION	BATTERY B1	IGNITION IG1	BATTERY B2	ACCESSORIES ACC	IGNITION IG2	STARTER ST
LOCK						
OFF						
ACC			● —	— ●		
ON	● —	— ●	● —	— ●	— ●	
START	● —	— ●	● —		— ●	— ●

THERE MUST BE NO CONTINUITY EXCEPT ABOVE LINES.

YES

MAGNETIC SWITCH CONTACTS ARE FUSED AND NOT MOVED, OR A RETURN SPRING IS BROKEN OR DETERIORATED

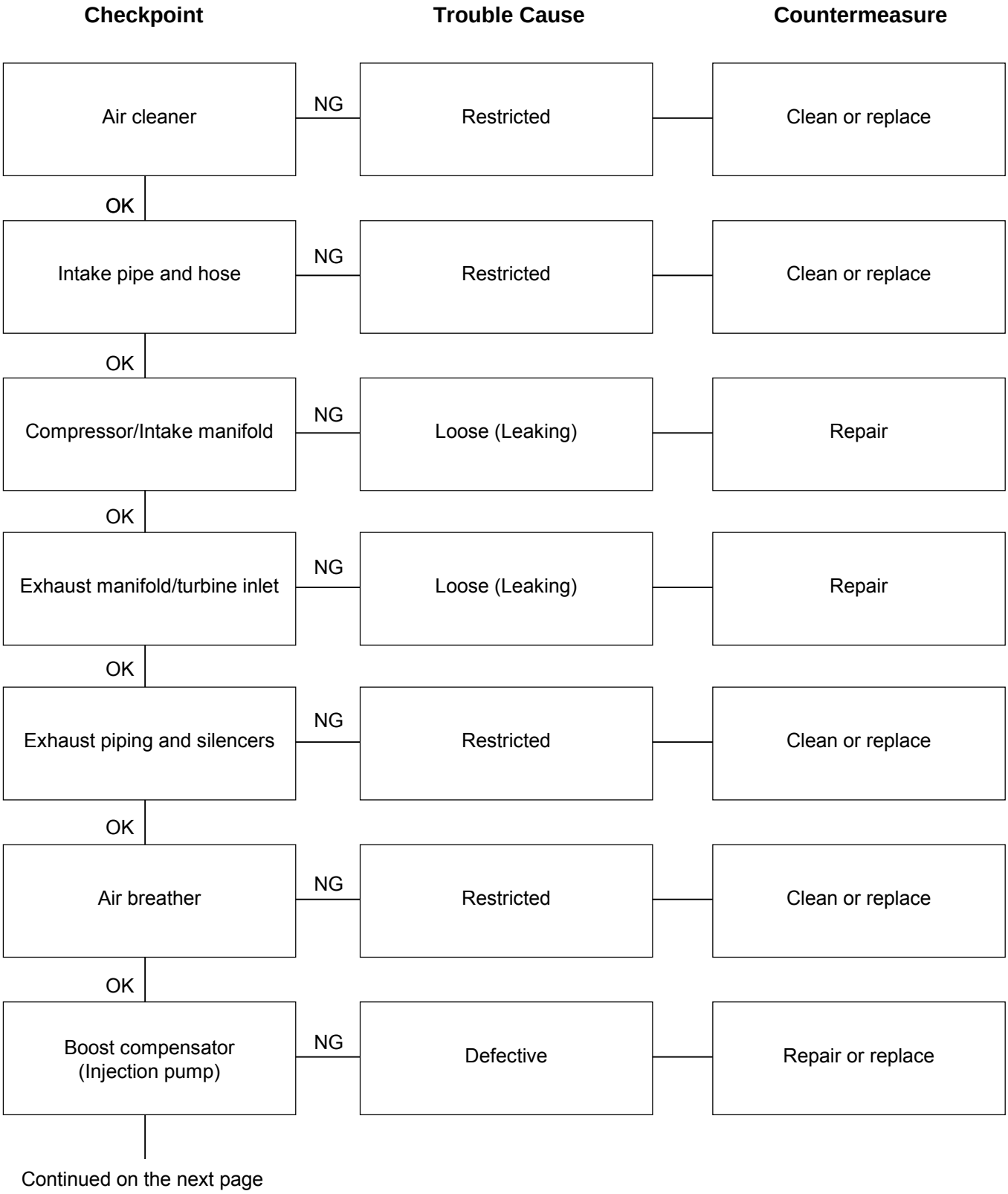
REPLACE MAGNETIC SWITCH

NO

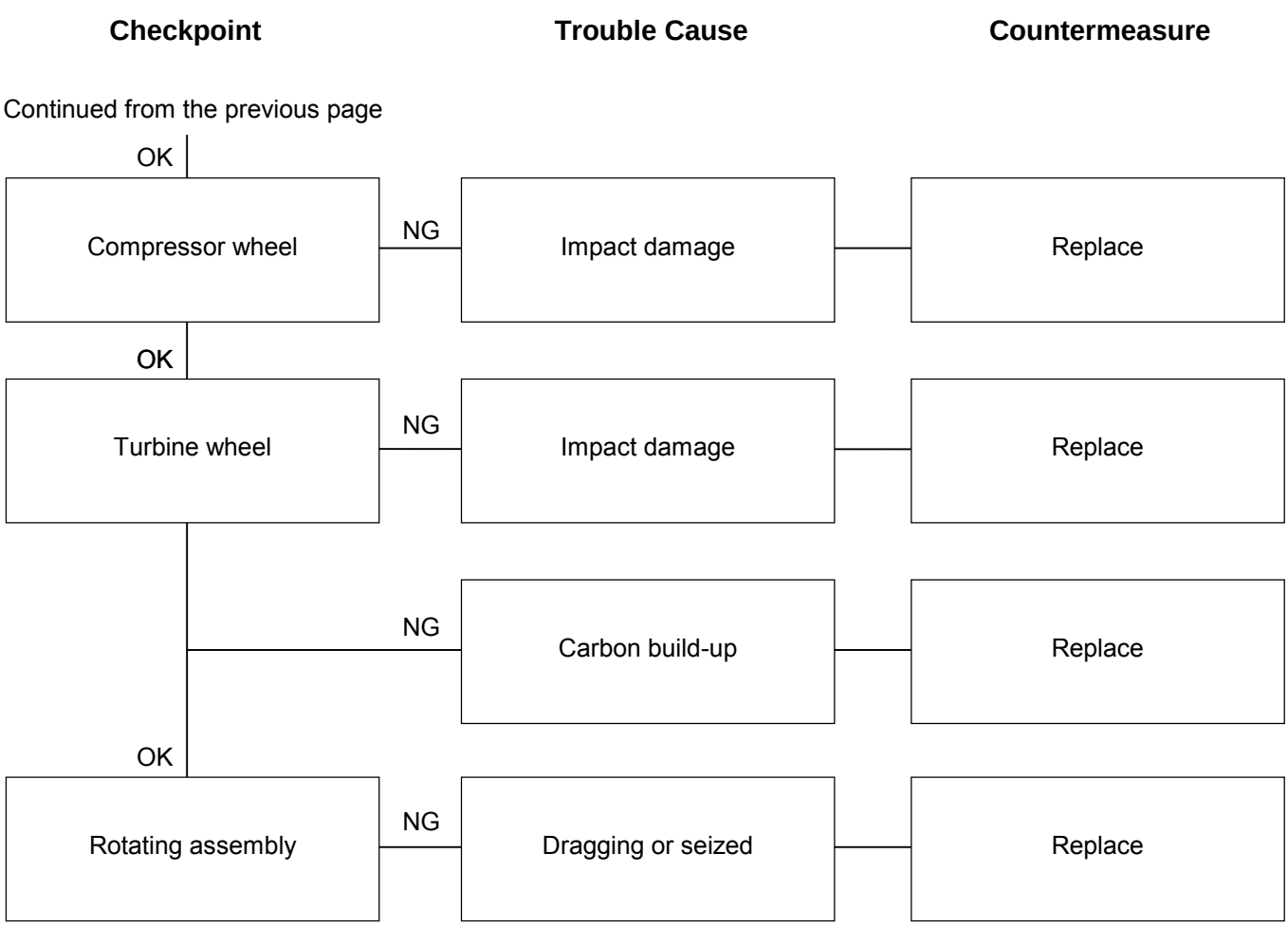
REPLACE STARTER SWITCH

13. TURBOCHARGER

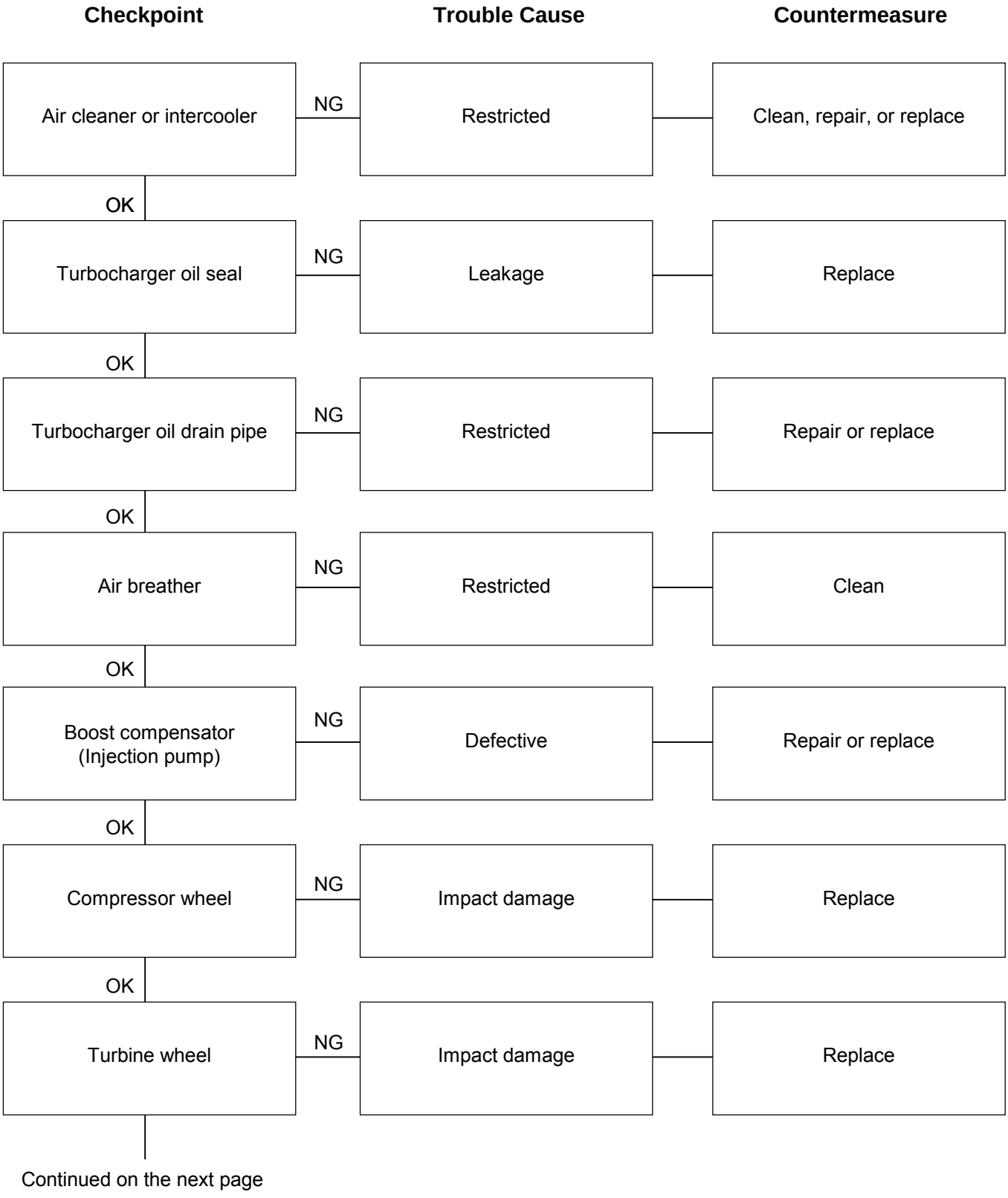
1) ENGINE HAS LESS THAN NORMAL POWER



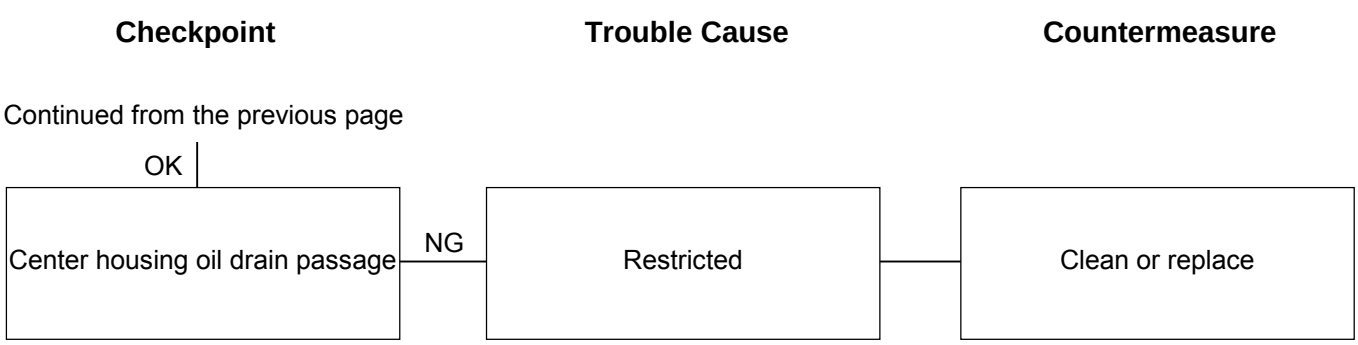
Continued on the next page


Checkpoint
Trouble Cause
Countermeasure
Continued from the previous page
OK
Compressor wheel
NG
Impact damage
Replace
OK
Turbine wheel
NG
Impact damage
Replace
NG
Carbon build-up
Replace
OK
Rotating assembly
NG
Dragging or seized
Replace

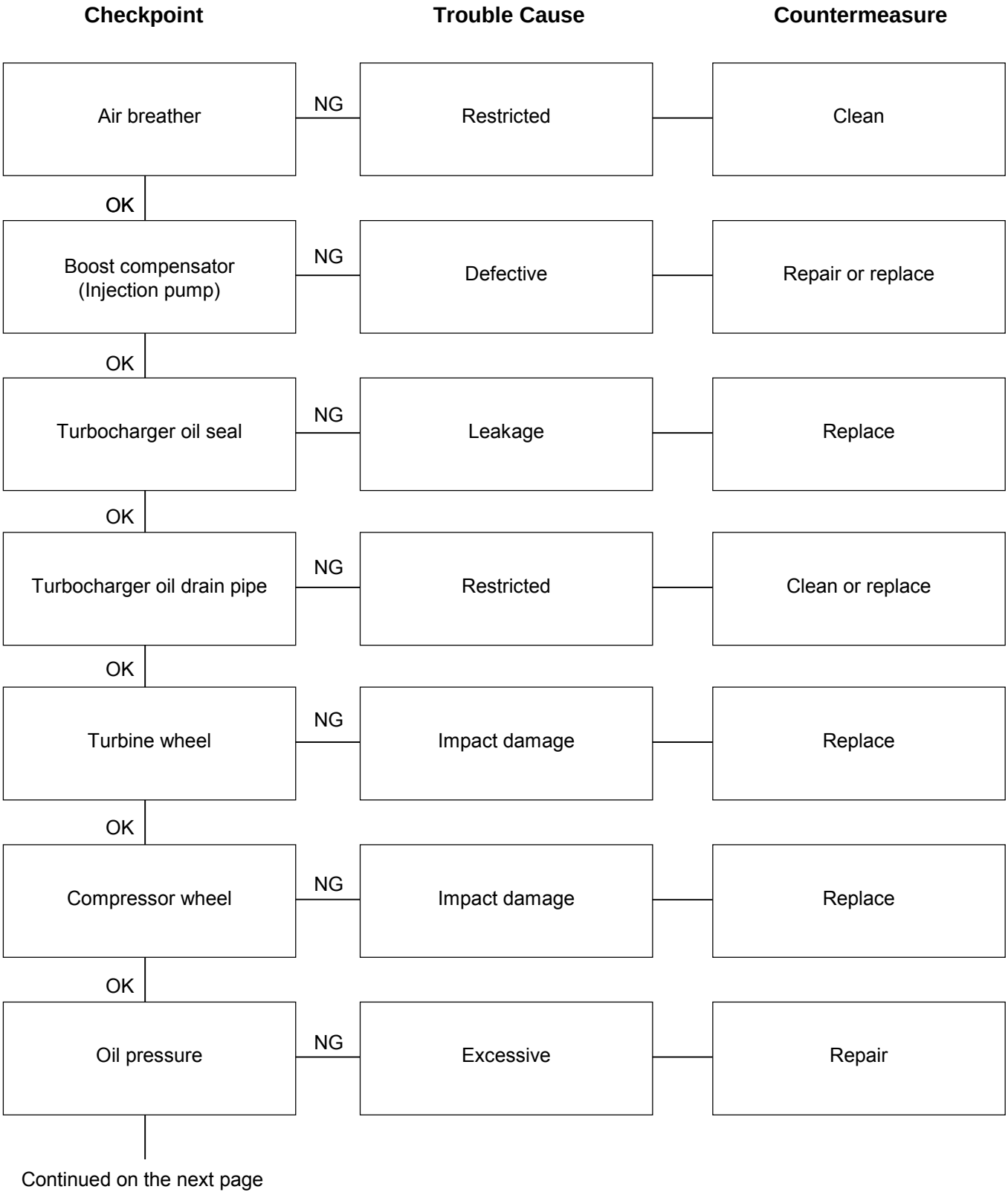
2) BLUE OR BLACK SMOKE



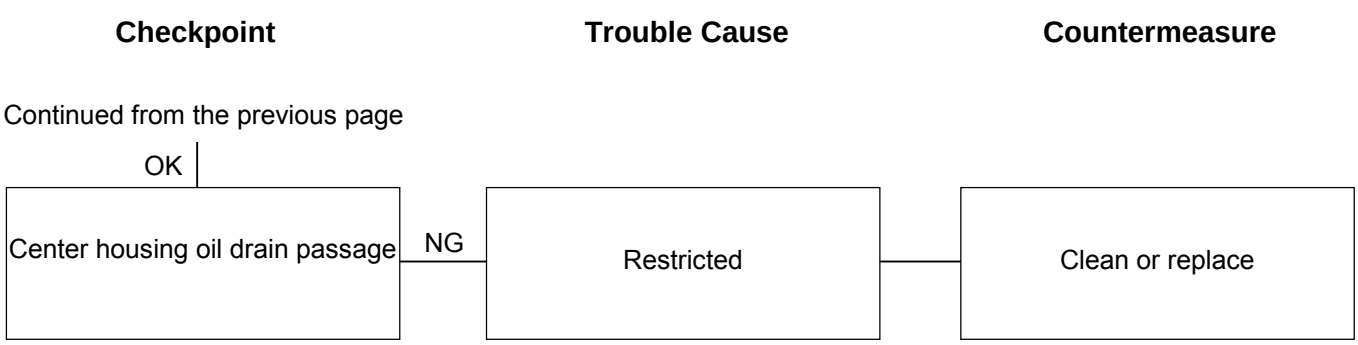
Continued on the next page


Checkpoint
Trouble Cause
Countermeasure
Continued from the previous page
OK
Center housing oil drain passage
NG
Restricted
Clean or replace

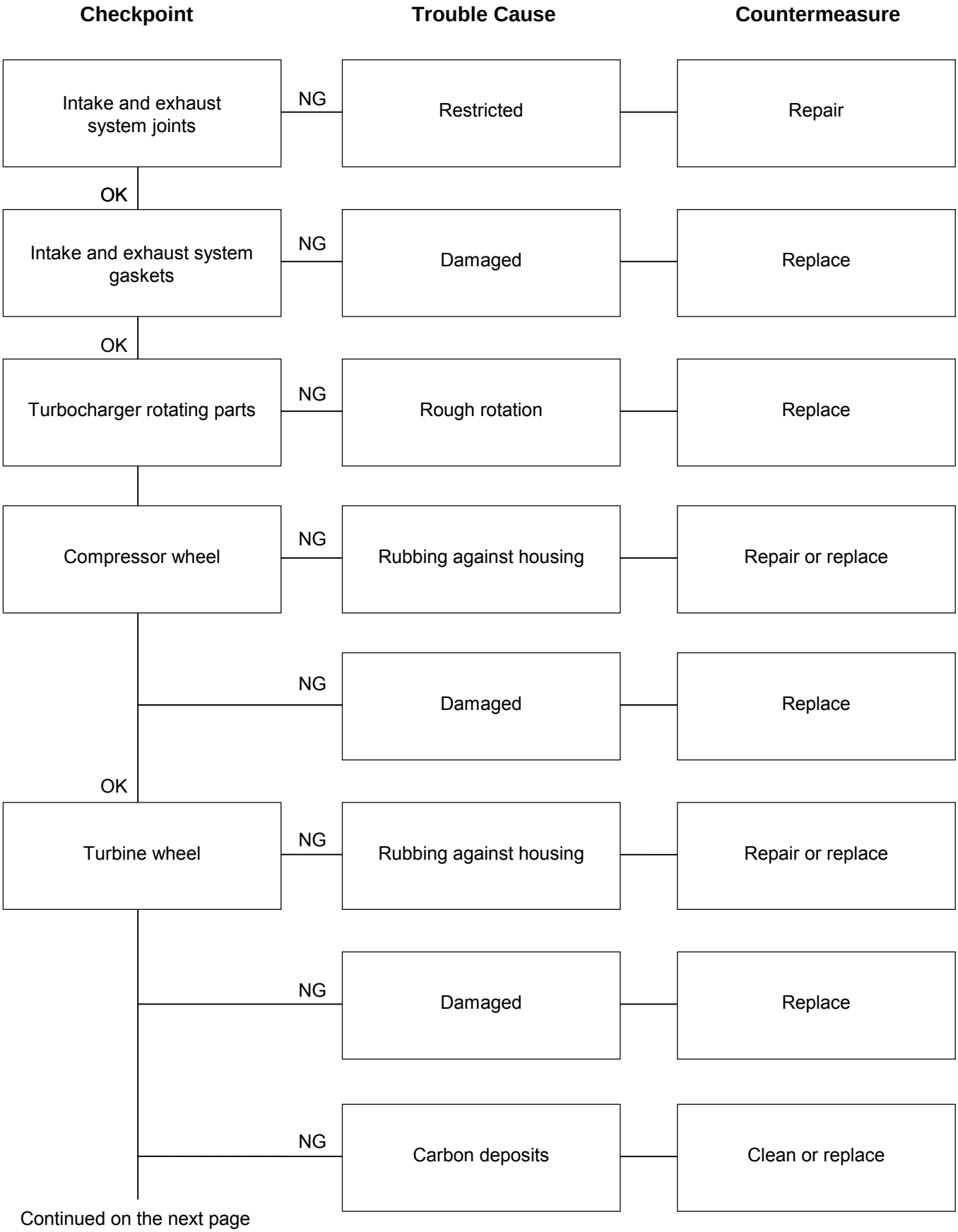
3) EXCESSIVE OIL CONSUMPTION



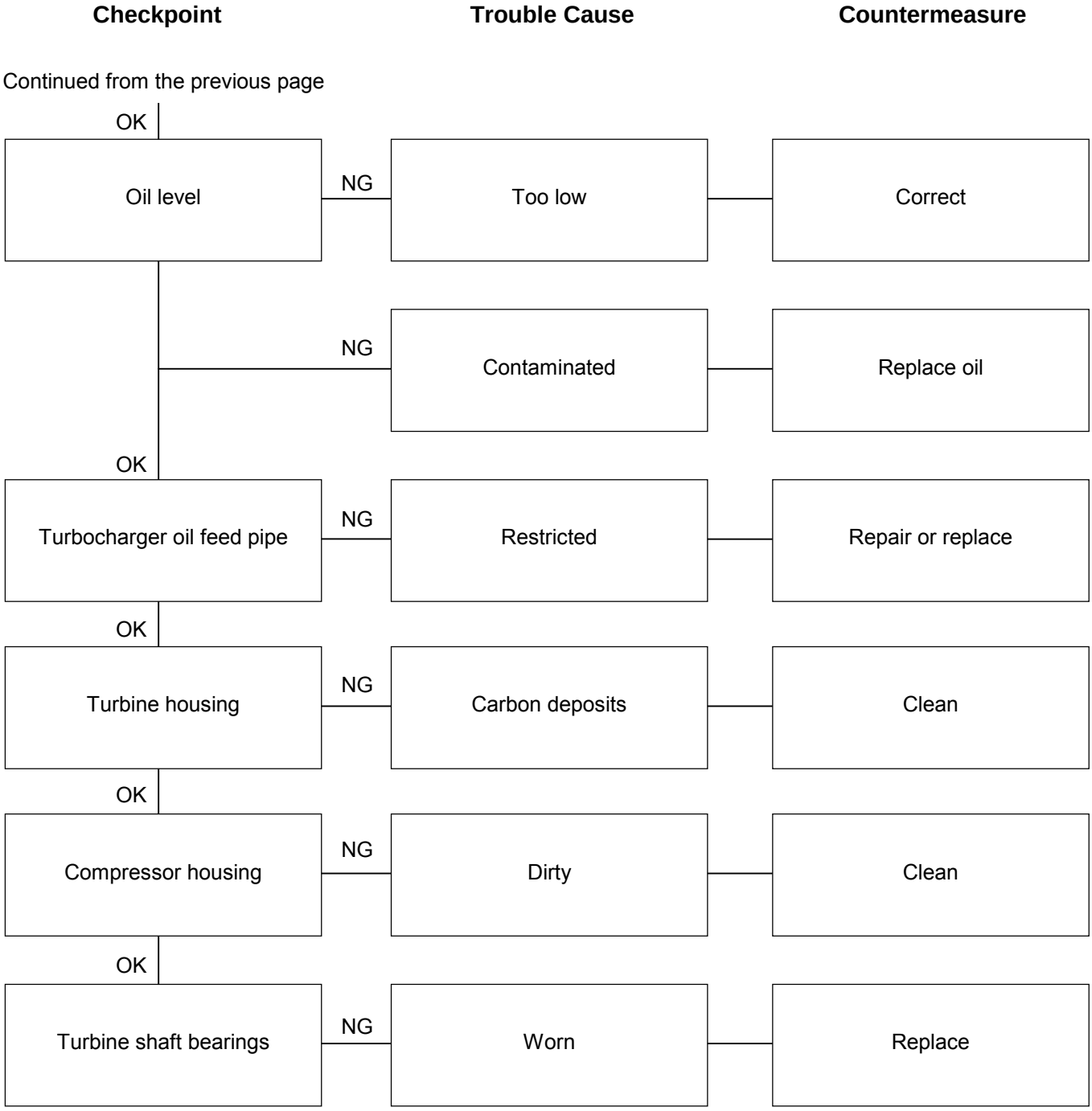
Continued on the next page


Checkpoint
Trouble Cause
Countermeasure
Continued from the previous page
OK
Center housing oil drain passage
NG
Restricted
Clean or replace

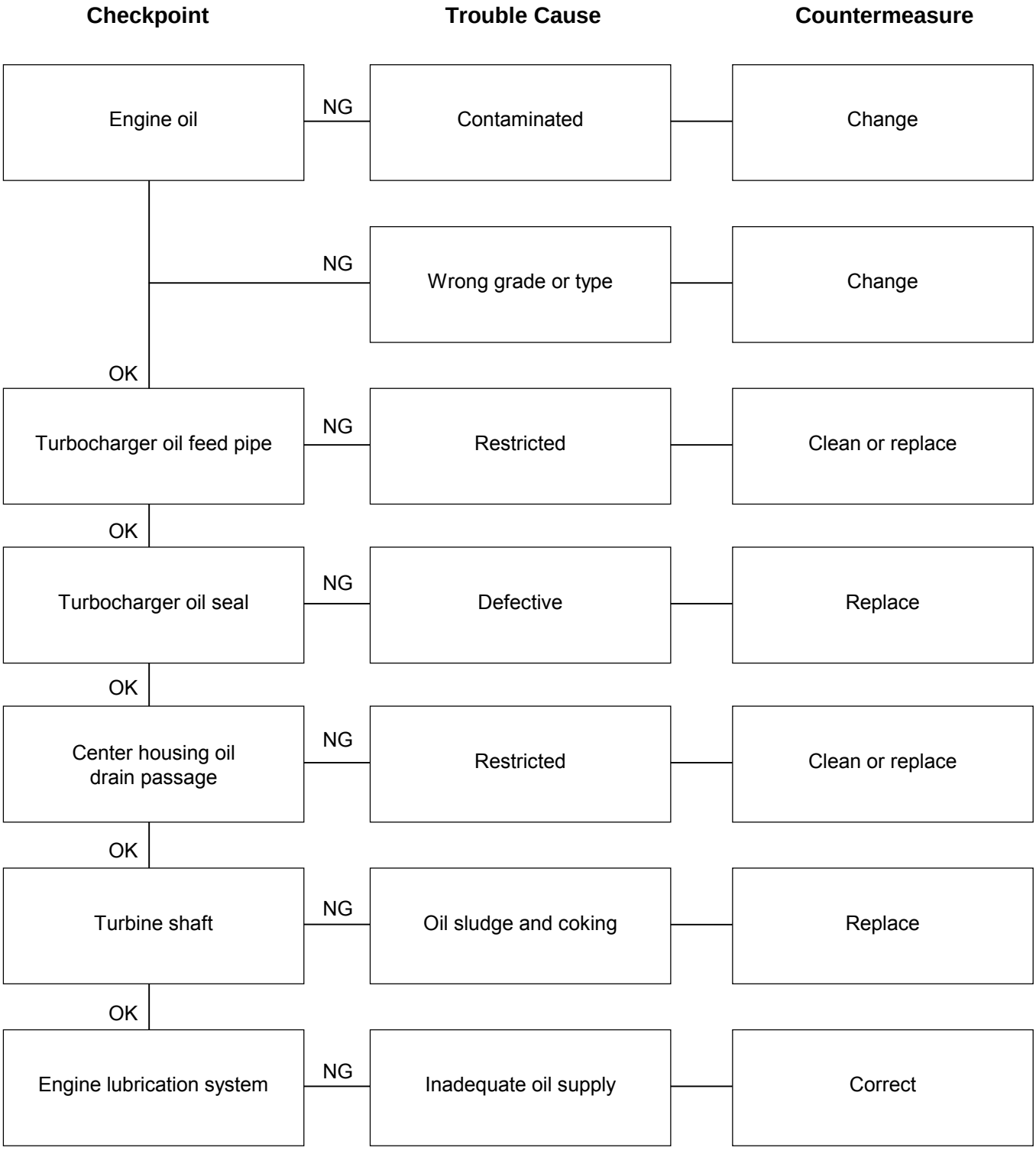
4) EXCESSIVE TURBOCHARGER NOISE



Continued on the next page

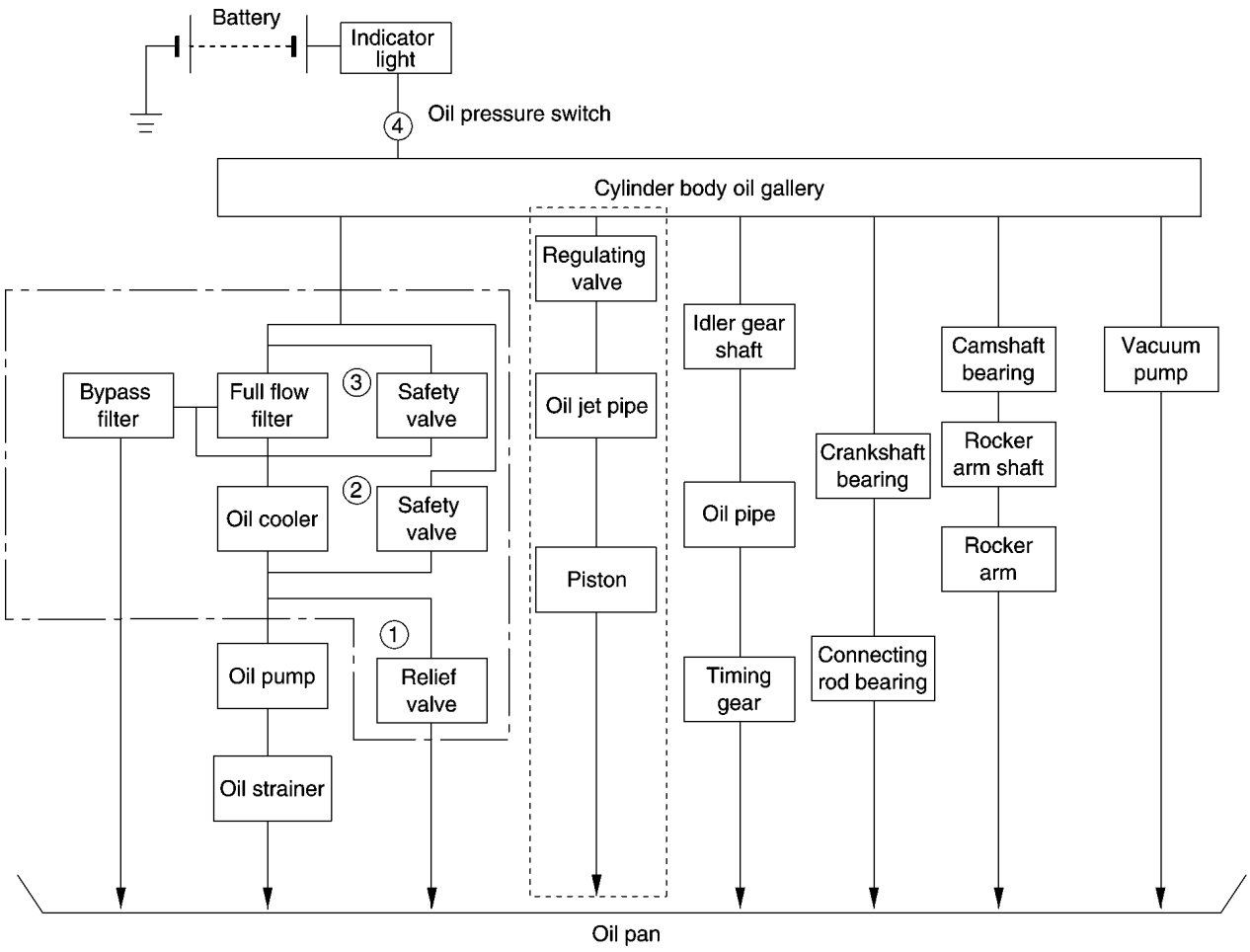

Checkpoint
Trouble Cause
Countermeasure
Continued from the previous page
OK
Oil level
NG
Too low
Correct
NG
Contaminated
Replace oil
OK
Turbocharger oil feed pipe
NG
Restricted
Repair or replace
OK
Turbine housing
NG
Carbon deposits
Clean
OK
Compressor housing
NG
Dirty
Clean
OK
Turbine shaft bearings
NG
Worn
Replace

5) EXCESSIVE ROTATING PART WEAR



LUBRICATION CHART

4JB1, 4JB1TC, 4JG2, Oil Filter & Oil Cooler



kPa (Kg/cm^2/psi)

①	Oil filter relief valve opening pressure	:	559 - 0618 (5.7 - 6.3/81 - 90)
②	Oil cooler safety valve opening pressure	:	314 - 373 (3.2 - 3.8/46 - 54)
③	Oil filter safety valve opening pressure	:	78 - 118 (0.8 - 1.2/11 - 19)
④	Oil pressure switch opening pressure	:	29.4 - 49.0 (0.3 - 0.5/4.3 - 7.1)

Lubu Chart 5J.tif

The 4J Series engine lubricating system is a full flow type.

Lubricating oil is pumped from the oil pump to the cylinder body oil gallery through the oil cooler and the oil filter (replaceable type oil filters have on oil cooler). It is then delivered to the vital parts of the engine from the cylinder body oil gallery.

MAIN DATA AND SPECIFICATIONS

MAIN DATA AND SPECIFICATIONS

Item \ Engine Model	4JB1 / 4JB1T / 4JB1TC	4JG2 (G. EXP & EC)
Engine type	Four-cycle, overhead valve, water cooled	
Combustion chamber type	Direct injection	In direct injection
Cylinder liner type	Dry type, chrome plated, stainless steel tube	
Timing train system	Gear drive	Gear and Belt Drive
No. of cylinders - Bore x stroke mm (in)	4 - 93 x 102 (3.66 x 4.02)	4 - 95.4 x 107 (3.76 x 4.21)
No. of piston rings	Compression rings: 2 / Oil ring: 1	
Total piston displacement cm^3 (in^3)	2,771 (169.0)	3,059 (186.6)
Compression ratio (to 1)	18.2 (4JB1) 18.1 (4JB1T/4JB1TC)	20.1
Compression pressure kPa (kg/cm^2/psi)	3,038 (31 / 441)	3,334 (34 / 483.8) (For EC 2,363 (24.1 / 531))
Engine weight (Dry) N (kg/lb)	Approximately 2,245 (229 / 505) (4JB1) 2,511 (256 / 564) (4JB1T/4JB1TC)	Approximately 2,403 (245 / 540)
Fuel injection order	1 - 3 - 4 - 2	
Fuel injection timing deg	BTDC 14 (4JB1) BTDC 12 (’91/542A) (4JB1) BTDC 11 (4JB1T) BTDC 4 (4JB1TC)	ATDC 1 (Belt ’91/542A) TDC 0° (Belt ’91/542B) ATDC 2 (Gear ’91/542A)
Specified fuel type	SAE No. 2 diesel fuel	
Idling speed rpm	750 - 790	700 – 740
Valve clearances (At cold): Intake mm(in)	0.40 (0.016)	
Exhaust mm(in)	0.40 (0.016)	
Valve clearances (At hot): Intake mm(in)	0.45 (0.018)	
Exhaust mm(in)	0.45 (0.018)	
Intake valves Open at (BTDC) deg	24.5	
Close at (ATDC) deg	55.5	
Exhaust valves Open at (BTDC) deg	54	
Close at (ATDC) deg	26	

NOTE: G.EXP : General Export Model
EC : European Countries
Emission Gas Control Standard
’91/542A : Euro 1
’91/542B : Euro 2

Item \ Engine Model	4JB1 / 4JB1T / 4JB1TC	4JG2 (G. EXP & EC)
Lubricating system		
Lubrication method	Pressurized circulation	
Specified engine oil (API grade)	CC (4JB1) CD (4JB1T/4JB1TC)	CC
Oil pump type	Gear	
Oil filter type	Disposable cartridge (Spin-on) Paper element	
Oil capacity (Including oil filter) lit (US/UK gal)	6.6 - 7.1 (1.74 - 1.87/2.62 - 2.82) (For EC 6.2 - 8.2 (2.17 - 1.64 / 1.36 - 1.80))	
Oil cooler type	Water cooled	
Fuel system		
Injection pump type	Bosch distributor	
Governor type	Mechanical (Partially variable speed) (For EC Variable speed)	
Injection nozzle type	Hole	Pinttle
Injection nozzle opening pressure kPa (kg/cm^2/psi)	18,142 (185 / 2,631) (4JB1/4JB1T) 1st: 19,500 (199 / 2,830) 2nd: 26,500 (270 / 3,840) (4JB1TC)	14,710 (150/2,133)
Main fuel filter type	Cartridge paper element and water separator	
Air cleaner type	Dry paper element	
Generator capacity V-A (W)	12 - 40 (480) and 12 - 50 (600)	12 - 50 (600) (For EC 12 - 60 (720))
Starter motor output V-kW	12 - 2.0 and 12 - 2.2	12 - 2.2 (For EC 12 - 2.0)
Turbocharger	IHI RHB5 (4JB1T) IHI RHF4 (4JB1TC)	

Engine Cooling

Cooling system		Coolant forced circulation
Radiator		(2 tube in row) Tube type Corrugated
Heat radiation capacity	kcal/h	71400
Heat radiation area	m^2 (ft^2)	11.78 (126.8)
Front area	m^2 (ft^2)	0.216 (2.325)
Dry weight	N (Kg/lb)	105 (10.7/23.6)
Radiator cap		
Valve opening pressure	kPa (Kg/cm^2/psi)	88.2 - 116.7 (0.899 - 1.199/12.78 - 17.05)
Coolant capacity	lit (Imp.qt./US qt.)	3.1 (2.73/3.28) (For EC 5.8 (5.1/6.13))
Coolant pump		
Pulley type		Centrifugal impeller type
Pulley ratio		1.2
Thermostat type		wax pellet with jiggle valve. Without jiggle valve (Thailand only)
Valve opening	°C (°F)	82 (180)
Valve full open	°C (°F)	95 (203)
Coolant total capacity	lit (Imp.qt./US qt.)	10 (8.80/10.57) (For EC 7.3 (6.42/7.71))

Starting System

Manufacturer		DENSO	
Engine Model		4JB1 / 4JB1T / 4JB1TC	4JG2 (G.EXP & EC)
Rating			
Voltage	V	12	
Output	kW	2.0	2.2
Time	Sec	30	
Number of tooth of pinion		9	
Rotating direction (as viewed from pinion)		Clockwise	
Weight (approx.)	kg	4.6	5.4
No-load characteristics			
Voltage/current	V/A	11.5/100 or less	
Speed	rpm	3700 or more	
Load characteristics			
Voltage/current	V/A	7.5/500 or less	
Torque	N•m(Kg•m/lb•ft)	13.7 (1.4/10.1)	
Speed	rpm	1200 or more	1400 or more
Locking characteristics			
Voltage/current	V/A	2.4/800 or less	2.0/850 or less
Torque	N•m(Kg•m/lb•ft)	18 (1.8/13) or more	16 (1.6/12) or more

Charging System

Manufacturer		HITACHI LR150-449B	DENSO
Rated voltage	V	12	12
Rated output	A	50	40
Rotating direction (As viewed from pulley)		Clockwise	Clockwise
Pulley effective diameter	mm (in)	80 (3.15)	82 (3.23)
Weight (with pump)	kg (lb)	6.0 (13.27) 4JB1TC for G.E 4JB1TC for EC	6.7 (14.77) 4JB1TC for Thailand

SERVICE STANDARD

Engine Mechanical

mm (in)

Parts	Items	Service standard		Service limit		Remarks
		4JG2	4JB1 / 4JB1T / 4JB1TC	4JG2	4JB1 / 4JB1T / 4JB1TC	
Cylinder Head	Cylinder head deck, and exhaust manifold mating surface for flatness	0.05 (0.002) or less		0.2 (0.0079)		
	Cylinder head height	92.0 (3.622)		91.55 (3.6043)		Cannot be Reground
	Cylinder Head Lower Face Warpage.	0.05 (0.002)or less		0.20 (0.008)		
	Manifold Warpage.	0.05 (0.002) or less		0.20 (0.008)		
	Hot plug sinking	-		0.02 (0.0008)		
	Hot plug exert pressure	4,500 – 5,500 kg (9922.5 - 12127.5 lbs)		-		
Valve Spring	Free height	48.0 (1.891)		47.10 (1.856)		
	Squareness	-		1.7 (0.067)		
	Spring tension N (kg/lb)	296 (30.2/66.4)		257.9 (26.3/57.9)		At installed height 38.9 (1.531)
Valve and Valve Guide	Diameter Valve Stem IN	7.946 - 7.961 (0.3128 - 0.3134)		7.880 (0.3102)		
	EX	7.921 - 7.936 (0.3118 - 0.3124)		7.850 (0.3090)		
	Valve and valve guide clearance IN	0.039 - 0.069 (0.0015 - 0.0027)		0.200 (0.0079)		
	EX	0.064 - 0.096 (0.0025 - 0.0038)		0.250 (0.0098)		
	Valve guide upper end height (Measured from the Cylinder head upper face)	13.0 (0.512)		-		
	Valve guide margin	1.1 (0.0433)		1.6 (0.0630)		
	Valve thickness IN	1.41 (0.0556)	1.79 (0.0705)	1.1 (0.0433)	1.5 (0.06)	
	EX	1.39 (0.0547)	1.83 (0.0720)	1.1 (0.0433)	1.5 (0.06)	
	Valve seat contact surface angle	45°				
	Valve seat contact width IN	1.7 (0.0669)		2.2 (0.0866)		
	EX	2.0 (0.0787)		2.5 (0.0984)		

mm (in)

Parts	Items	Service standard		Service limit		Remarks
		4JG2	4JB1 / 4JB1T / 4JB1TC	4JG2	4JB1 / 4JB1T / 4JB1TC	
Push rod	Curvature	-		0.4 (0.0157) or less		
Camshaft	End play	0.08 (0.0031)		0.2 (0.0079)		
	Cam lobe height	42.02 (1.6543)		41.65 (1.6397)		
	Journal diameter	49.945 - 49.975(1.9663-1.9675)		49.60 (1.9527)		
	Runout	0.02 (0.0008) or less		0.10 (0.0039)		
	Camshaft bearing inside diameter	50.000 - 50.030 (1.9685 - 1.9697)		50.08(1.9716)		
	Camshaft oil clearance	0.025 - 0.085 (0.0098 - 0.00334)		0.12 (0.0047)		
Tappet	Outside diameter	12.97 - 12.99 (0.5106 - 0.5114)		12.95 (0.5098)		
	Oil clearance (Between tappet and cylinder body)	0.03 (0.0118)		0.10 (0.0039)		
Rocker arm Assembly	Rocker shaft outside diameter	18.98 - 19.00 (0.7472 - 0.7480)		18.90 (0.7440)		
	Rocker arm inside diameter	19.036 - 19.060 (0.7494 - 0.7504)		19.10 (0.7520)		
	Oil clearance (Between rocker arm and rocker shaft)	0.06 - 0.08 (0.00235 - 0.00315)		0.10 (0.004)		
	Rocker shaft runout	-		0.2 (0.0079) or less		
Oil pump	Oil clearance Body and gear	0.14 (0.0055)	0.13 - 0.14 (0.0051-0.0055)	0.20 (0.0079)	0.15 (0.0059)	
	Body cover and gear	0.06 (0.0024)	0.02 - 0.07 (0.0008-0.0028)	0.15 (0.0059)		
Crankshaft	Thrust clearance	0.10 (0.0039)		0.30 (0.018)		
	Main bearing clearance (Between main bearing and Crankshaft)	0.031-0.063 (0.0012-0.0025)	0.035-0.080 (0.0014-0.0032)	0.11 (0.0043)		
	Crankshaft runout	0.05 (0.00197) or less		0.08 (0.0031)		
	Main journal diameter	69.917 - 69.932 (2.7526 - 2.7532)		69.91 (2.7524)		
	Crankshaft pin diameter	52.915 - 52.930 (2.0833 - 2.0839)		52.90 (2.0827)		
	Crankshaft Journal and Crank Pin uneven wear	0.05 (0.002) or less		0.08 (0.003)		
	Crank Pin and Bearing Clearance.	0.029 - 0.066 (0.0011 - 0.0026)		0.100 (0.0039)		

mm (in)

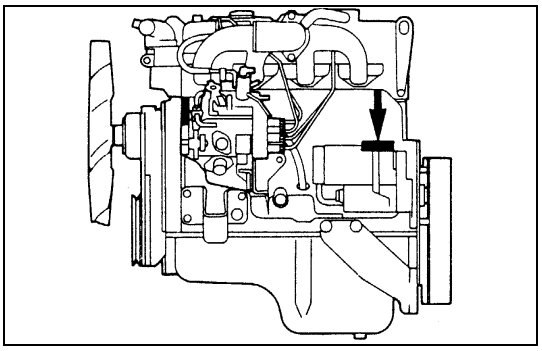
Parts	Items	Service standard		Service limit		Remarks
		4JG2	4JB1 / 4JB1T / 4JB1TC	4JG2	4JB1 / 4JB1T / 4JB1TC	
Piston, Piston pin, Piston ring and Connect-ing rod	Piston diameter	95.365 - 95.404 (3.7545-3.9039)	92.985 - 93.024 (3.6600-3.6623)	-		
	Piston Clearance (Between piston and Cylinder liner)	0.047 - 0.065 (0.0019-0.0026)	0.025 - 0.045 (0.0010-0.0018)	-		
	Piston ring gap 1st	0.20 - 0.35 (0.0079 – 0.0138)	0.20 - 0.40 (0.0079 – 0.0157)	1.5 (0.0591)		
	2nd	0.37 - 0.52 (0.0146 - 0.0205)	0.20 - 0.40 (0.0079 - 0.00157)	1.5 (0.0591)		
	Oil	0.20 - 0.40 (0.0079 - 0.00157)	0.10 - 0.30 (0.0039 - 0.0118)	1.5 (0.0591)		
	Piston ring clearance 1st	0.09 - 0.13 (0.0035 - 0.0051)	0.090 - 0.125 (0.0035 - 0.0049)			
	2nd	0.05 - 0.09 (0.002 - 0.0035)	0.050 - 0.075 (0.0020 - 0.0030)	0.15 (0.0059)		
	Oil	0.03 - 0.07 (0.0012 - 0.0028)		0.15 (0.0059)		
	Piston pin diameter	33.995 - 34.000 (1.3384-1.3386)	30.995 - 31.000 (1.2202-1.2204)	33.970 (1.3374)	30.970 (1.2190)	
	Fitting interference (Between connecting rod and piston pin)	0.008 - 0.020 (0.0003 - 0.0008)		0.05 (0.0020)		
	Fitting interference (Between piston and piston pin)	0.002 - 0.015 (0.0001 - 0.0006)		0.04 (0.0016)		
	Connecting rod alignment Bend	0.08 (0.0031) or less		0.20 (0.0079)		Per 100 (3.94)
	Twist	0.05 (0.0020) or less		0.15 (0.0059)		Per 100 (3.94)
	Piston pin and Connecting Rod Bushing Clearance	0.008 - 0.020 (0.0003 - 0.0008)		0.050 (0.0020)		
	Connecting rod thrust clearance	0.230 (0.0091)		0.35 (0.0138)		
	Oil clearance (Between crank pin and Connecting rod)	0.029 -0.083 (0.0014 - 0.0033)	0.029 - 0.066 (0.0011 - 0.0026)	0.100 (0.0039)		

mm (in)

Parts	Items	Service standard		Service limit		Remarks
		4JG2	4JB1 / 4JB1T / 4JB1TC	4JG2	4JB1 / 4JB1T / 4JB1TC	
Cylinder Block	Warpage (Upper surface of the cylinder block)	-		0.20 (0.0079)		
	Cylinder bore diameter	97.000 - 97.040 (3.8189 - 3.8205)	95.011 - 95.040 (3.7406 - 3.7417)			
	Cylinder liner projection	0.0-0.1 (0.00-0.0039)				
	Cylinder liner inside diameter	95.420 - 95.460 (3.7567 - 3.7583)	93.020 - 93.060 (3.6622 - 3.6638)			
	Cylinder liner outside diameter	97.011-97.050 (3.8193 - 3.8209)	95.011 - 95.050 (3.7405 - 3.7421)			

SERVICING

Servicing refers to general maintenance procedures to be performed by qualified service personnel.



0038-1.tif

MODEL IDENTIFICATION

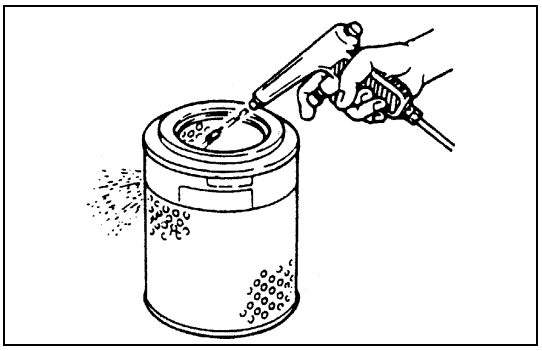
Engine Serial Number

The engine number is stamped on the front left hand side of the cylinder body.

AIR CLEANER

Dry Type Paper Element

Element cleaning procedures will vary according to the condition of the element.



0038-2.tif

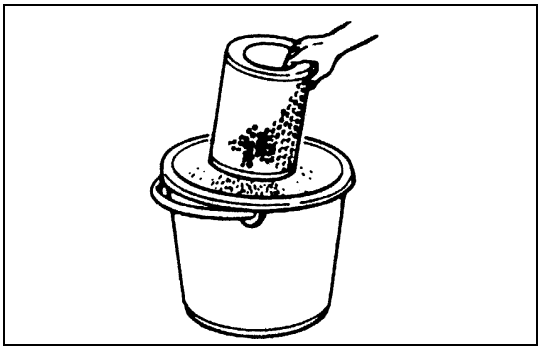
Dust fouled Element

Rotate the element with your hand while applying compressed air to the inside of the element. This will blow the dust free.

Compressed air pressure	kPa (kg/cm^2 /Psi)
392 - 490 (4 - 5/57 - 71)	

CAUTION

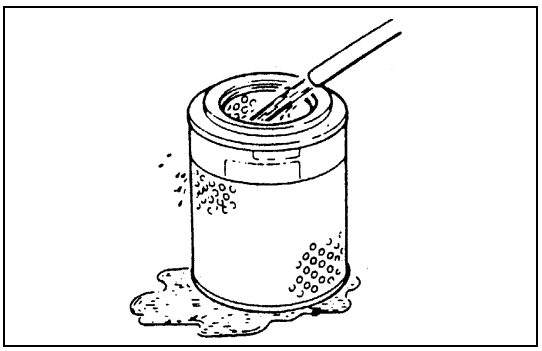
Do not bang the element against another object in an attempt to clean it. Damage to the element will result.



0038-3.tif

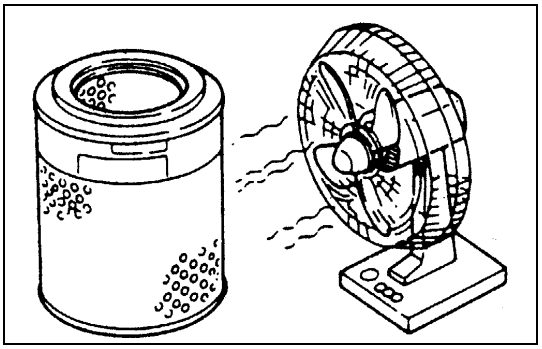
Carbon and Dust Fouled Element

1. Prepare a cleaning solution of Isuzu Genuine Element Cleaner (Donaldson D1400) diluted with water.
2. Submerge the element in the solution for twenty minutes.



0039-1.tif

3. Remove the element from the solution and rinse it well with running water.
   Water pressure must not exceed 274 kPa (2.8 kg/cm^2 /40Psi)



0039-2.tif

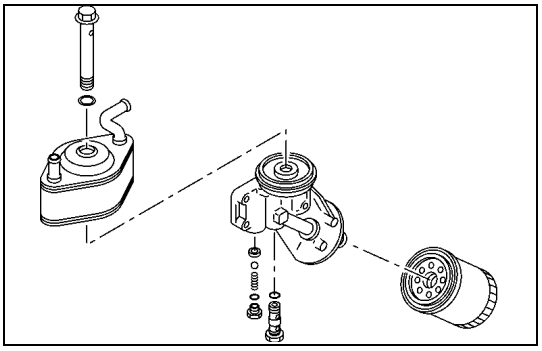
4. Dry the element in a well ventilated area.
   An electric fan will hasten drying.

NOTE:

Do not use compressed air or an open flame to dry the element quickly. Damage to the element will result. It will usually take two or three days for the element to dry completely. Therefore, it is a good idea to have a spare on hand to use in the interim.

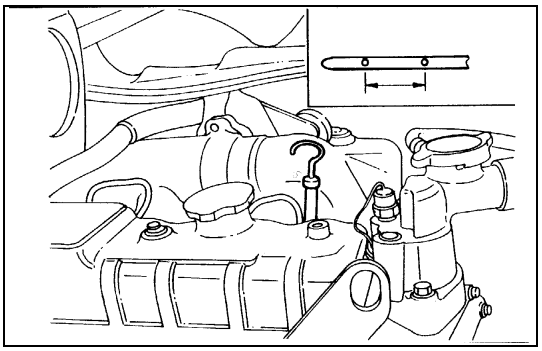
LUBRICATING SYSTEM

Main Oil Filter (Cartridge Type Paper Element) Replacement Procedure



050LX001.tif

1. Loosen the used oil filter by turning it counterclockwise with the filter wrench.
2. Clean the oil filter fitting face.
   This will allow the new oil filter to seat properly.
3. Apply a light coat of engine oil to the O-ring.
4. Turn in the new oil filter until the filter O-ring is fitted against the sealing face.
5. Use the filter wrench to turn in the filter an additional 1 and 1/4 turns.
   Filter Wrench : 5-8840-0200-0 (89mm/3.5in)
   5-8840 0202-0 (106mm/4.2in)
   5-8840-2209-0 (100.6mm/4.0in)

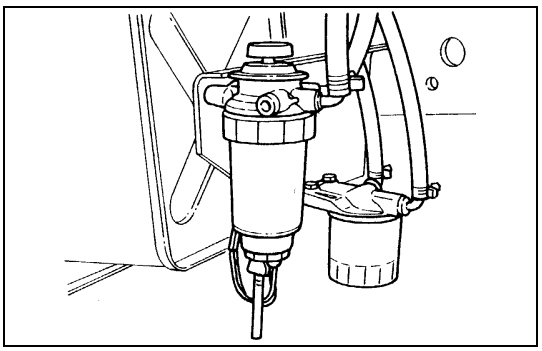


0039-4.tif

6. Check the engine oil level and replenish to the specified level if required.

Replenishment Engine Oil	lit (Imp qt/US qt)
	0.7 (0.62/0.74)

7. Start the engine and check for oil leakage from the main oil filter.



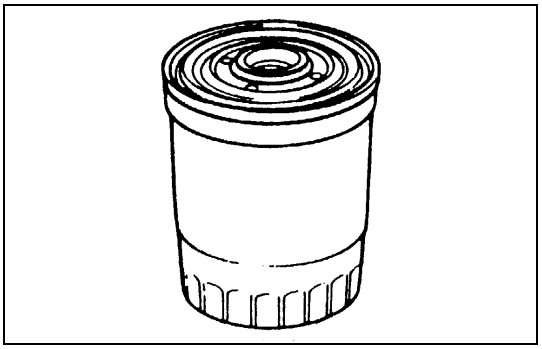
0040-1.tif

FUEL SYSTEM

Fuel Filter

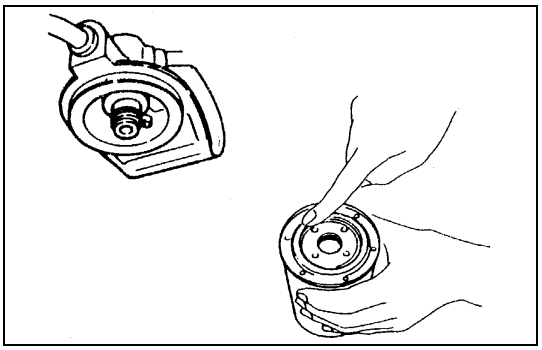
Replacement Procedure

1. Loosen the used fuel filter by turning it counterclockwise with the filter wrench.
   Filter Wrench: 5-8840-0253-0 (J-22700)



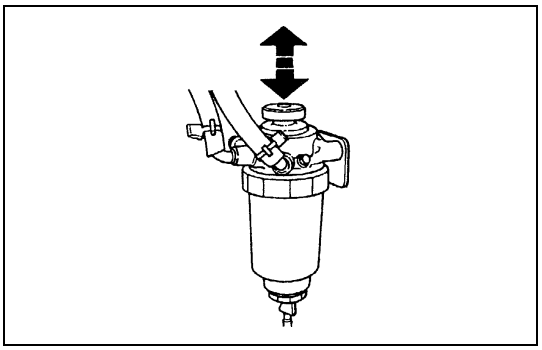
0040-2.tif

2. Clean the filter cover fitting faces.
   This will allow the new fuel filter to seat properly.



0040-3.tif

3. Turn in the fuel filter until the sealing face comes in contact.
4. Turn in the fuel filter an additional 2/3 of a turn with a filter wrench.
   Filter Wrench: 5-8840-0253-0 (J-22700)

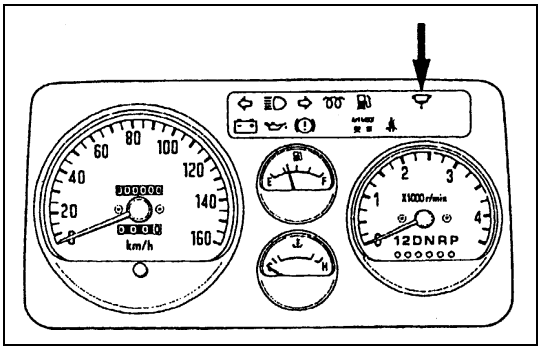


0040-4.tif

5. Loosen the bleeder plug on the injection pump overflow valve.
6. Operate the priming pump until fuel begins to flow from the fuel filter.
7. Retighten the bleeder plug.
8. Operate the priming pump several times and check for fuel leakage.

NOTE:

The use of an ISUZU genuine fuel filter is strongly recommended.

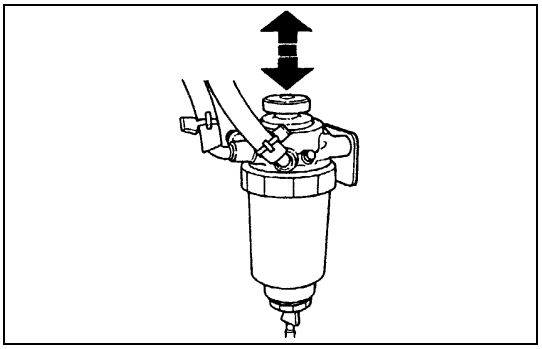


0041-1.tif

Fuel Filter Water Draining Procedure

The indicator light will come on when the water level in the water separator exceeds the specified level.

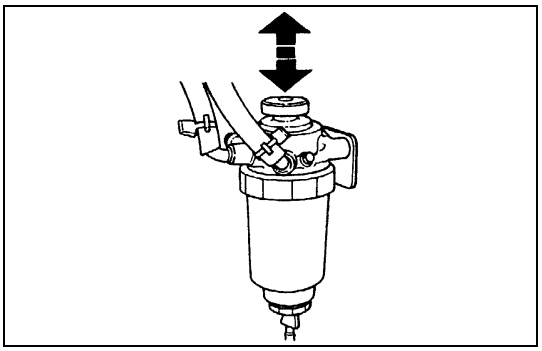
Drain the water and foreign material from the water separator with the following procedure.



0041-2.tif

1. Find a safe place to park the vehicle.
2. Open the engine hood and place a container (Approximately 0.2 liter capacity) at the end of the vinyl hose beneath the drain plug on the separator.
3. Loosen the drain plug by turning it counterclockwise (Approximately 5 turns) and operate the priming pump up and down about 10 times until water is drained approximately 0.1 liter.
4. After draining, securely tighten the drain plug by turning it clockwise and operate the priming pump manually up and down several times.
5. After starting the engine, check to see that there is no fuel leak from the drain plug. Also check to see that the fuel filter water indicator light has turned off.

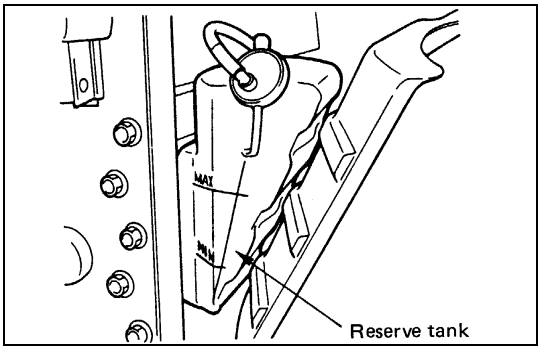
   If water separator requires frequent draining, have the fuel tank drained for removal of water at your Isuzu Dealer.



0041-3.tif

Air Bleeding

1. Loosen the bleeder screw on the injection pump overflow valve.
2. Operate the priming pump until fuel mixed with foam flows from the bleeder screw.
3. Tighten the bleeder screw.
4. Operate the priming pump several times and check for fuel leakage.



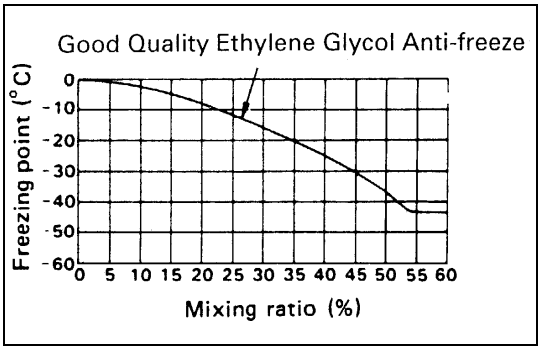
0041-4.tif

COOLING SYSTEM

Coolant Level

Check the coolant level and replenish the radiator reserve tank as necessary.

If the coolant level falls below the “MIN” line, carefully check the cooling system for leakage. Then add enough coolant to bring the level up to the “MAX” line.



0042-1.tif

Engine coolant change procedure

1. To change engine coolant, make sure that the engine is cool.

WARNING:
When the coolant is heated to a high temperature, be sure not to loosen or remove the radiator cap. Otherwise you might get scalded by hot vapor or boiling water. To open the radiator cap, put a piece of thick cloth on the cap and loosen the cap slowly to reduce the pressure when the coolant has become cooler.

2 Open radiator cap and drain the cooling system by loosening the drain valve on the radiator and on the cylinder body.

NOTE:

For best result it is suggested that the engine cooling system be flushed at least once a year. it is advisable to flush the interior of the cooling system including the radiator before using anti-freeze (ethylene-glycol based).

Replace damaged rubber hoses as the engine anti-freeze coolant is liable to leak out even minor cracks. Isuzu recommends to use Isuzu genuine anti-freeze (ethylene-glycol based) or equivalent, for the cooling system and not add any inhibitors or additives.

CAUTION:

A failure to correctly fill the engine cooling system in changing or topping up coolant may sometimes cause the coolant to overflow from the filler neck even before the engine and radiator are completely full. If the engine runs under this condition, shortage of coolant may possibly result in engine overheating. To avoid such trouble, the following precautions should be taken in filling the system.

3 To refill engine coolant, pour coolant up to filler neck using a filling hose which is smaller in outside diameter of the filler neck.
Othewise air between the filler neck and the filling hose will block entry, preventing the system from completely filling up.

4 Keep a filling rate of 9 liter/min. or less. Filling over this maximum rate may force air inside the engine and radiator. And also, the coolant overflow will increase, making it difficult to determine, whether or not the system is completely full.

5 After filling the system to the full, pull out the filling hose and check to see if air trapped in the system is dislodged and the coolant level goes down. Should the coolant level go down, repeat topping-up until there is no more drop in the coolant level.

6 After directly filling the radiator, fill the reservoir to the maximum level.

7 Install and tighten radiator cap and start the engine. After idling for 2 to 3 minutes, stop the engine and reopen radiator cap. If the water level is lower, replenish.

WARNING:

When the coolant is heated to a high temperature, be sure not to loosen or remove the radiator cap. Otherwise you might get scalded by hot vapor or boiling water. To open the radiator cap, put a piece of thick cloth on the cap and loosen the cap slowly to reduce the pressure when the coolant has become cooler.

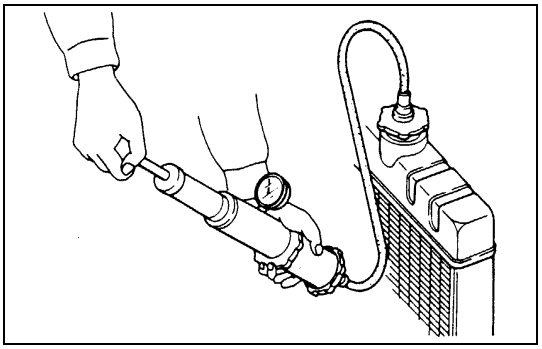
8 After tightening radiator cap, warm up the engine at about 2,000 rpm. Set heater adjustment to the highest temperature position, and let the coolant circulate also into heater water system.

9 Check to see the thermostat has opened through the

needle position of water thermomete, conduct a 5 minutes idling again and stop the engine.

10 When the engine has been cooled, check filler neck for water level and replenish if required. Should extreme shortage of coolant is found, Check the coolant system and reservoir tank hose for leakage.

11 Fill the coolant into the reservoir tank up to “MAX” line.



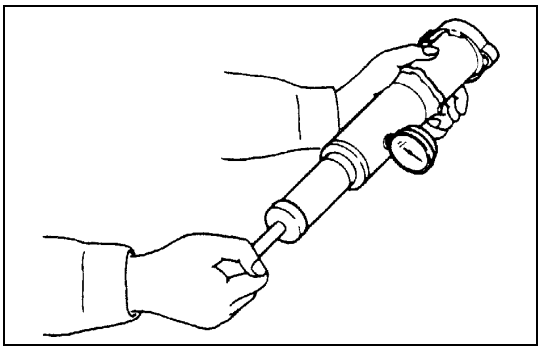
0042-2.tif

Cooling System Inspection

Install a radiator filler cap tester to the radiator. Apply testing pressure to the cooling system to check for leakage.

The testing pressure must not exceed the specified pressure.

Testing Pressure	kPa (Kg/cm^2/psi)
147 (1.5/21)	



0042-3.tif

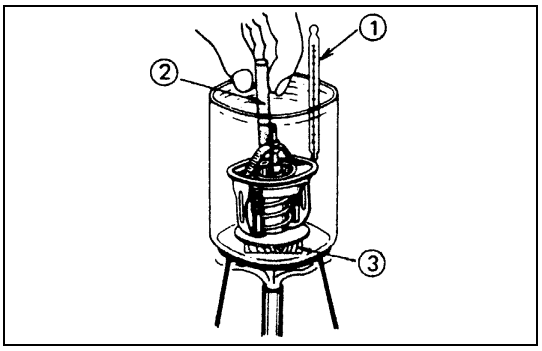
Radiator Cap Inspection

The radiator filler cap is designed to maintain coolant pressure in the cooling system at 1.05 kg/cm^2 (15 psi / 103 kPa). Check the radiator filler cap with a radiator filler cap tester. The radiator filler cap must be replaced if it fails to hold the specified pressure during the test procedure.

Radiator Filler Cap Pressure

Pressure Valve	kPa (Kg/cm^2/psi)
88 - 118 (0.9 - 1.2/12.8 - 17.1)	

Negative Valve (Reference)	kPa (Kg/cm^2/psi)
1.0 - 13.9 (0.01 - 0.04/0.14 - 0.57)	



0042-4.tif

Thermostat Operating Test

1. Completely submerge the thermostat in water.
2. Heat the water.
   Stir the water constantly by suitable wood bar (2) to avoid direct heat being applied use wood plate (3) to the thermostat.
3. Check the thermostat initial opening temperature.

Thermostat Initial

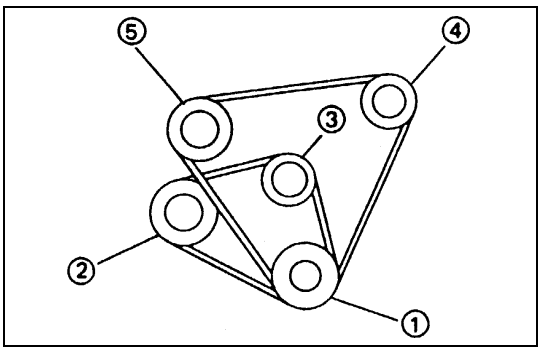
Opening Temperature	°C (°F)
82 (180)	

4. Check the thermostat full opening temperature.

Thermostat Full

Opening Temperature	°C (°F)
95 (203)	

Valve Lift at Fully Open Position	mm (in)
10 (0.39)	



0043-1.tif

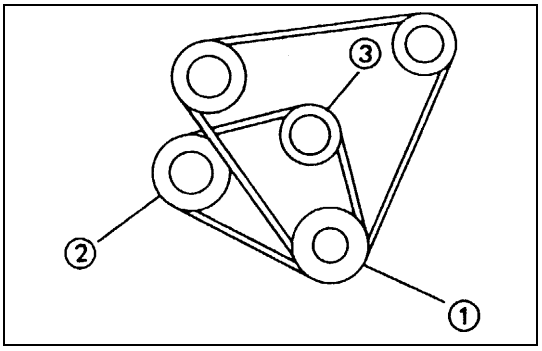
Drive Belt Adjustment

Depress the drive belt mid portion with a 98N (10 kg/22 lb) force.

Drive Belt Deflection	mm (in)
10 (0.39)	

Check the drive belt for cracking and other damage.

1. Crankshaft damper pulley
2. Generator pulley
3. Cooling fan pulley
4. Oil pump pulley or idler pulley
5. Compressor pulley or idle pulley



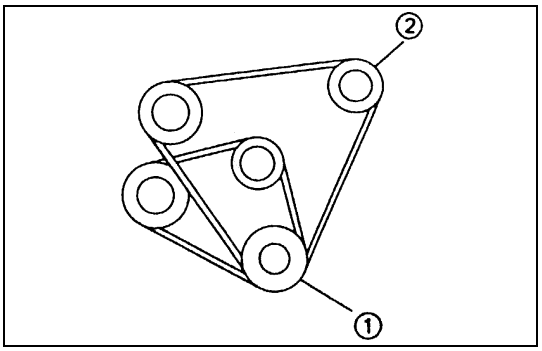
0043-2.tif

Cooling Fan Pulley Drive Belt

Fan belt tension is adjusted by moving the generator.

Depress the drive belt mid portion with a 98N (10 kg/22 lb) force.

1. Crankshaft damper pulley
2. Generator pulley
3. Cooling fan pulley



0043-3.tif

Compressor Pulley Drive Belt

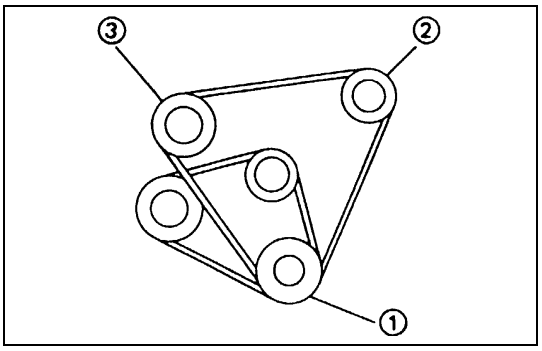
Move the idler pulley as required to adjust the compressor drive belt tension.

If the vehicle is equipped with power steering, move the oil pump as required.

Depress the drive belt mid portion with a 98N (10 kg/22 lb) force.

Belt Deflection	mm (in)
14 - 17 (0.55 - 0.67)	

1. Crankshaft damper pulley
2. Oil pump pulley or idler pulley



0043-4.tif

Power Steering Oil Pump Pulley Drive Belt

Move the oil pump as required to adjust the oil pump drive belt tension.

On air conditioner equipped models, both drive belts pulley must always be replaced as a set.

Depress the drive belt mid portion with a 98N (10 kg/22 lb) force.

Belt Deflection	mm (in)
14 - 17 (0.55 - 0.67)	

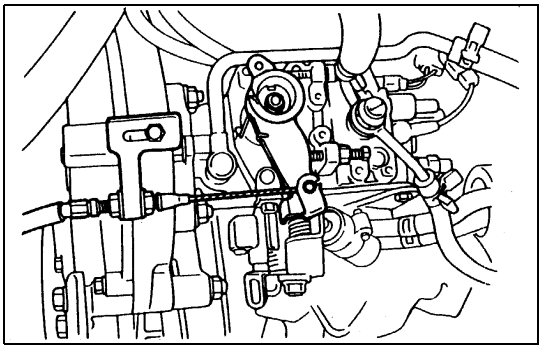
1. Crankshaft damper pulley
2. Oil pump pulley
3. Compressor pulley or idler pulley

ENGINE CONTROL

Idling Speed Inspection

1. Set the vehicle parking brake and choke the drive wheels.
2. Place the transmission in neutral.
3. Start the engine and allow it to warm up.
4. Disconnect the engine control cable from the control lever.
5. Set a tachometer to the engine.
6. Check the engine idling speed.
   If the engine idling speed is outside the specified range, it must be adjusted.

Engine Idling Speed	rpm
4JB1 / 4JB1T / 4JB1TC	750 - 790
4JG2	700 - 740



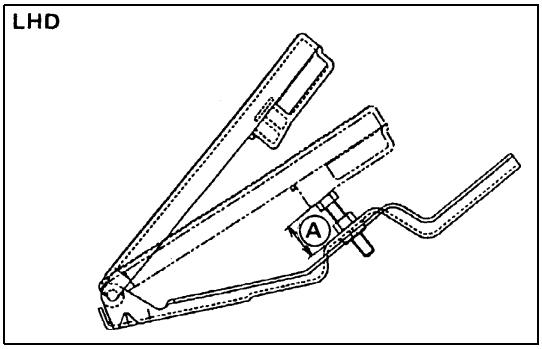
0044-1.tif

Idling Speed Adjustment

1. Loosen the idling set bolt lock nut on the injection pump idling set bolt.
2. Adjust the idling speed to the specified range by turning the idling set bolt.
3. Lock the idling set bolt with the idling set bolt lock nut.
4. Check that the idling control cable is tight (free of slack).
   If required, remove the slack from the cable.

Accelerator Control Cable Adjustment

1. Loosen the accelerator cable clamp bolt.
2. Check that the idling control knob on the instrument panel is in the engine idling position.
3. Hold the accelerator lever in the fully closed position and stretch the control cable in the direction indicated by the arrow to remove any slack.

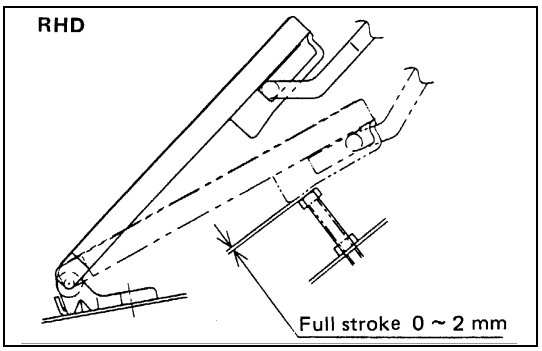


0044-2.tif

Accelerator Pedal Adjustment

1. Loosen the lock nut.
2. Adjust bolt height from floor.

Adjust Bolt Height Ⓐ	mm (in)
18 - 28 (0.71 - 1.1)	

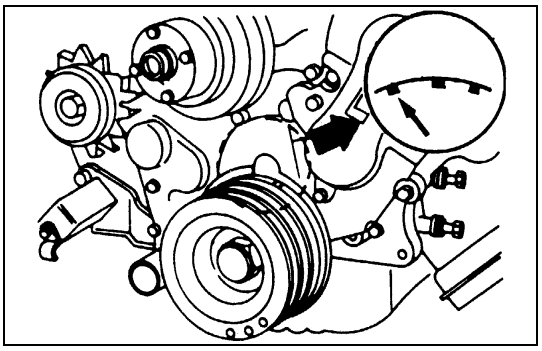


0045-1.tif

1. Hold the accelerator pedal pad securely by hand, and give it a full stroke.
2. Adjust the stopper bolt so that the clearance between the pad stopper bolt and the rear side of the pad becomes the specified length.

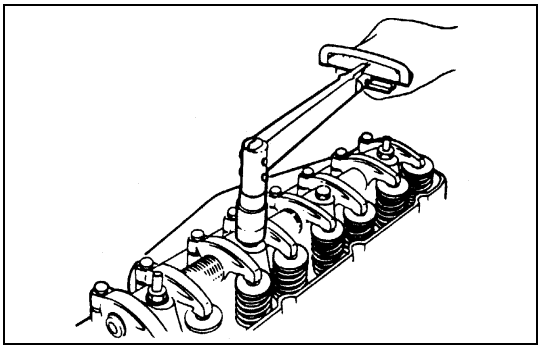
mm (in)
0 - 2 (0 - 0.079)

3. Check to see if the accelerator pedal play is in the range of 5 to 10mm above the pedal pad.
4. Press down on the accelerator pedal fully and check to see if the engine rotates at its maximum speed with each of the linkage in the smooth operation.
5. In the operating range of accelerator pedal and the injection pump lever returns to their respective original positions without fail.


0045-2.tif

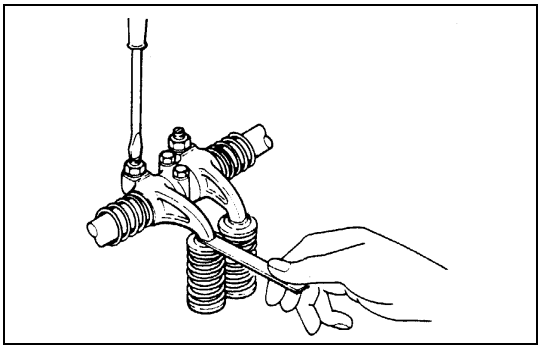
VALVE CLEARANCE ADJUSTMENT

1. Bring the piston in either the No. 1 cylinder or the No. 4 cylinder to TDC on the compression stroke by turning the crankshaft until the crankshaft damper pulley TDC line is aligned with the timing pointer.

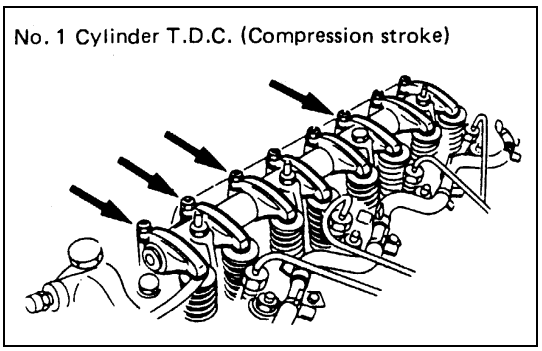

0045-3.tif

2. Check the rocker arm shaft bracket nuts for looseness.
   Tighten any loose rocker arm shaft bracket nuts before adjusting the valve clearance.

Rocker Arm Shaft Bracket Nut Torque	N·m (kg·m/lb·ft)
	54 (5.5/40)


0045-4.tif

3. Check for play in the No. 1 intake and exhaust valve push rods.
   If the No. 1 cylinder intake and exhaust valve push rods have play, the No. 1 piston is at TDC on the compression stroke.
   If the No. 1 cylinder intake and exhaust valve push rods are depressed, the No. 4 piston is at TDC on the compression stroke.

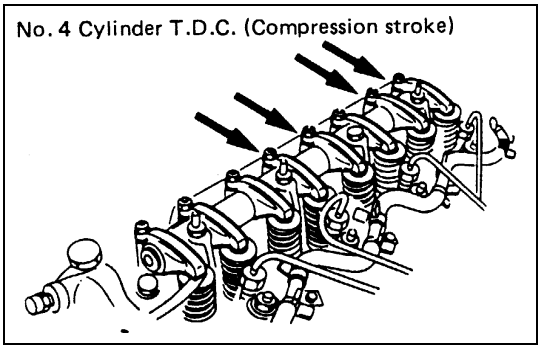


0046-1.tif

Adjust the No. 1 or the No. 4 cylinder valve clearance while their respective cylinders are at TDC on the compression stroke.

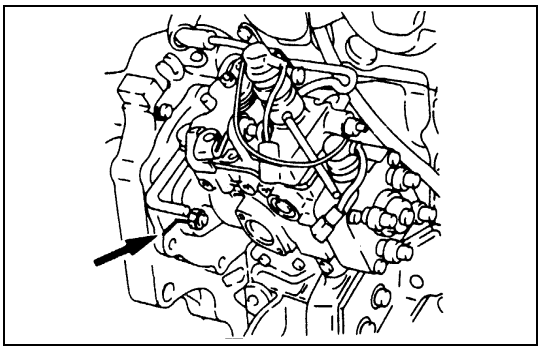
Valve Clearance (At Cold)	mm (in)
0.4 (0.016)	

4. Loosen each valve clearance adjusting screw as shown in the illustration.
5. Insert a feeler gauge of the appropriate thickness between the rocker arm and the valve stem end.



0046-2.tif

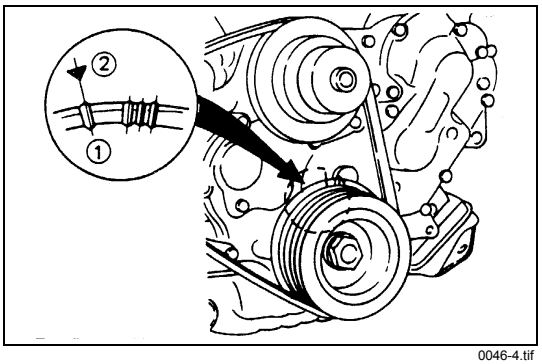
6. Turn the valve clearance adjusting screw until a slight drag can be felt on the feeler gauge.
7. Tighten the lock nut securely.
8. Rotate the crankshaft 360°.
9. Realign the crankshaft damper pulley TDC notched line with the timing pointer.
10. Adjust the clearance for the remaining valves as shown in the illustration.



0046-3.tif

INJECTION TIMING ADJUSTMENT

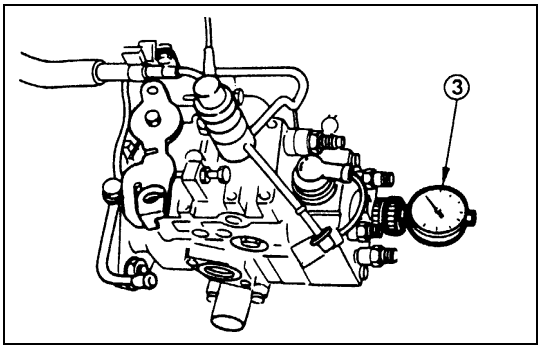
1. Check that the notched line on the injection pump flange is aligned with the front plate or the timing gear case notched line.



0046-4.tif

2. Bring the piston in the No. ① cylinder to TDC 1 on the compression stroke by turning the crankshaft until the crankshaft pulley TDC line is aligned with the timing mark ②.

Note:
Check for play in the No. 1 intake and exhaust valve push rods.
If the No. 1 cylinder intake and exhaust valve push rods have play, the No. 1 piston is at TDC on the compression stroke.

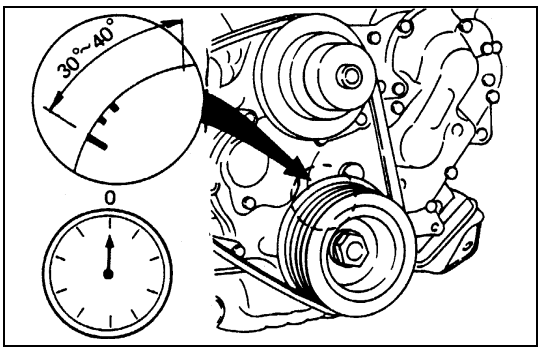


0046-5.tif

3. Disconnect the injection pipe from the injection pump.
4. Remove one bolt from the distributor head.
5. Insert a screwdriver into a hole in the fast idle lever and turn the lever to release the W-C.S.D. function. (If so equipped)
6. Install the static timing gauge ③.

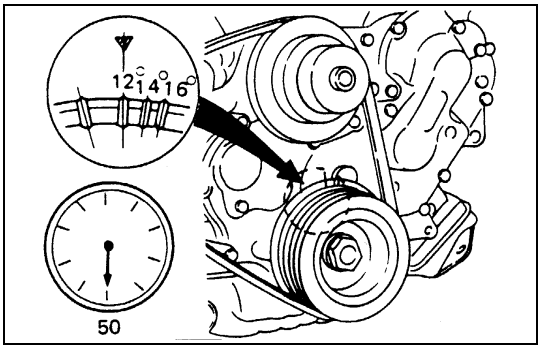
   The probe of the gauge should be depressed inward approximately 2 mm (0.079 in).

   Static Timing Gauge : 5-8840-0145-0 (J-28827)



0047-1.tif

7. Rotate the crankshaft to bring the piston in the No. 1 cylinder to a point 30 - 40° BTDC.
8. Set the timing gauge needle to zero.
9. Move the crankshaft pulley slightly in both directions to check that the gauge indication is stable.



0047-2.tif

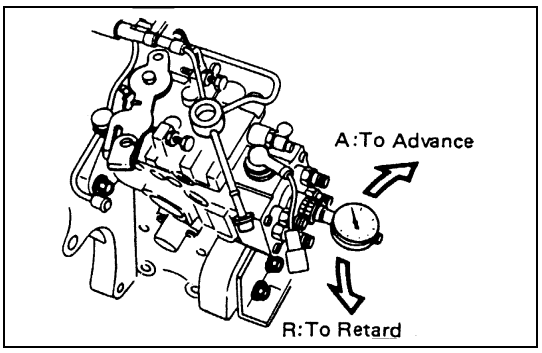
10. Turn the crankshaft clockwise and read the gauge indication when the crankshaft pulley timing mark is aligned with the pointer.

mm (in)

4JB1	BTDC 14°
4JB1T	BTDC 11°
4JB1TC	BTDC 4°
4JG2	ATDC 2°

Standard Reading	mm (in)
0.5 (0.02)	

If the injection timing is outside the specified range, continue with the following steps.



0047-3.tif

11. Loosen the injection pump fixing nuts and bracket bolts.
12. Adjust the injection pump setting angle.

	When large than standard value	When smaller than standard value
Gear drive	A	B

A : Move the injection pump toward the engine.

B : Move the injection pump away from the engine.

Tighten the pump fixing nut, adjust bolt and pump distributor head plug to the specified torque.

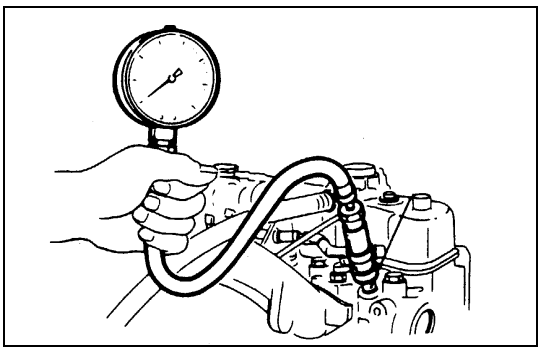
Pump Fixing Bolt	N·m (kg·m/lb·ft)
24 (2.4/17)	

Adjust Bolt	N·m (kg·m/lb·ft)
19 (1.9/14)	

Injection Pump Distributor Head Plug	N·m (kg·m/lb·ft)
17 (1.7/12)	

CAUTION

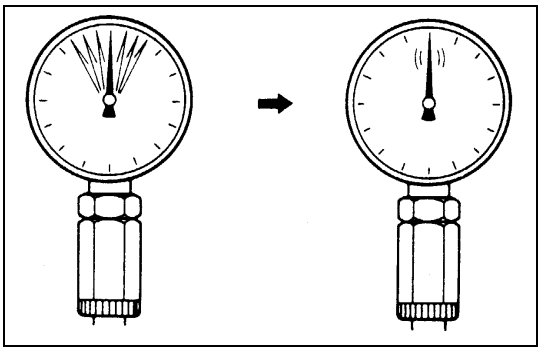
- **When installing the distributor head/plug, be sure to use new copper washer.**



0048-1.tif

COMPRESSION PRESSURE MEASUREMENT

1. Start the engine and allow it to idle until the coolant temperature reaches 70 - 80°C (158 - 176°F).
2. Remove the following parts.
   * Glow plugs
   * Fuel cut solenoid connector
   * QOS (Quick-On Start System) fusible link wire at the connector.
3. Set the adapter and compression gauge to the No. 1 cylinder glow plug hole.
   Compression Gauge
   (with Adapter): 5-8840-2008-0 (J-29762)
   Adapter: 5-8531-7001-0
4. Turn the engine over with the starter motor and take the compression gauge reading.

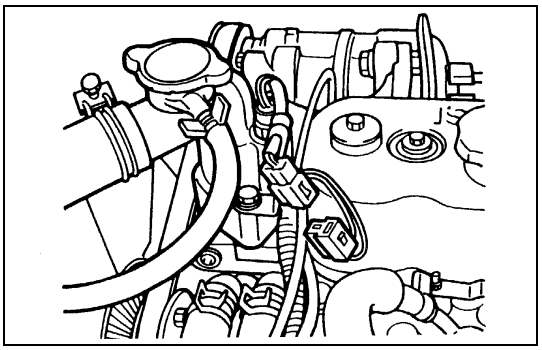


0048-2.tif

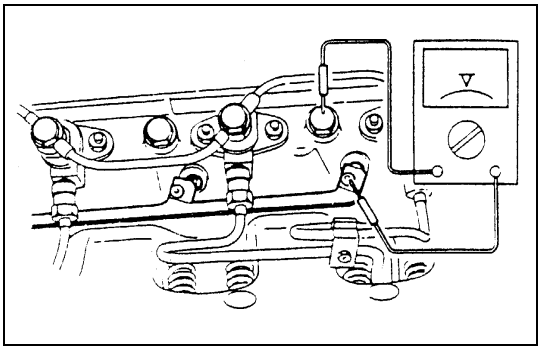
Compression Pressure at 200 rpm kPa (Kg/cm^2/psi)

	Standard	Limit
4JB1	3,038 (31/441)	2,157 (22/313)
4JG2	3,334 (34/484)	2,452 (25/356)

5. Repeat the procedure (Steps 3 and 4) for the remaining cylinders.
   If the measured value is less than the specified limit, refer to “Troubleshooting” in this Manual.



0048-3.tif



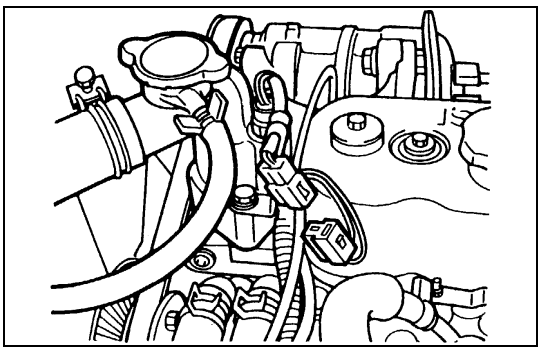
0048-4.tif

QUICK-ON START II SYSTEM (4JB1 / 4JB1T / 4JB1TC only)

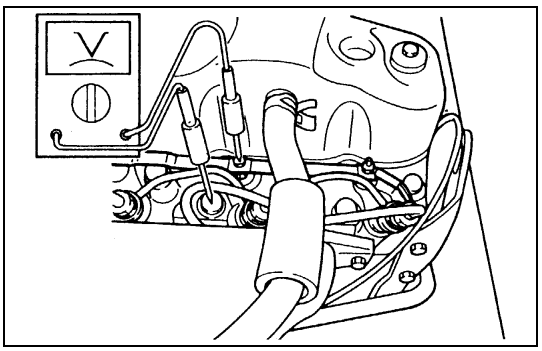
Quick-On Start System Inspection Procedure

1. Disconnect the thermo-sensor connection on the thermostat outlet pipe.
2. Turn the starter switch to the “ON” position.
   If the Quick-On Start II System is operating properly, the glow relay will make a clicking sound within 15 seconds after the starter switch is turned on.
3. Measure the glow plug terminal voltage with a circuit tester immediately after turning the starter switch to the “ON” position.

Glow Plug Terminal Voltage	V
Approx. 11	



0049-1.tif



0049-2.tif

QUICK-ON START III SYSTEM (4JG2 only)

Quick-On Start System Inspection Procedure

1. Disconnect the thermo-sensor connection on the thermostat outlet pipe.
2. Turn the starter switch to the “ON” position.
   If the Quick-On Start III System is operating properly, the glow relay will make a clicking sound within seven seconds after the starter switch is turned on.

3. Measure the glow plug terminal voltage with a circuit tester immediately after turning the starter switch to the “ON” position.

Glow Plug Terminal Voltage	V
8 – 9	

NOTE:

Electrical power to the quick-on start system will be cut after the starter has remained in the “ON” position for twenty seconds.

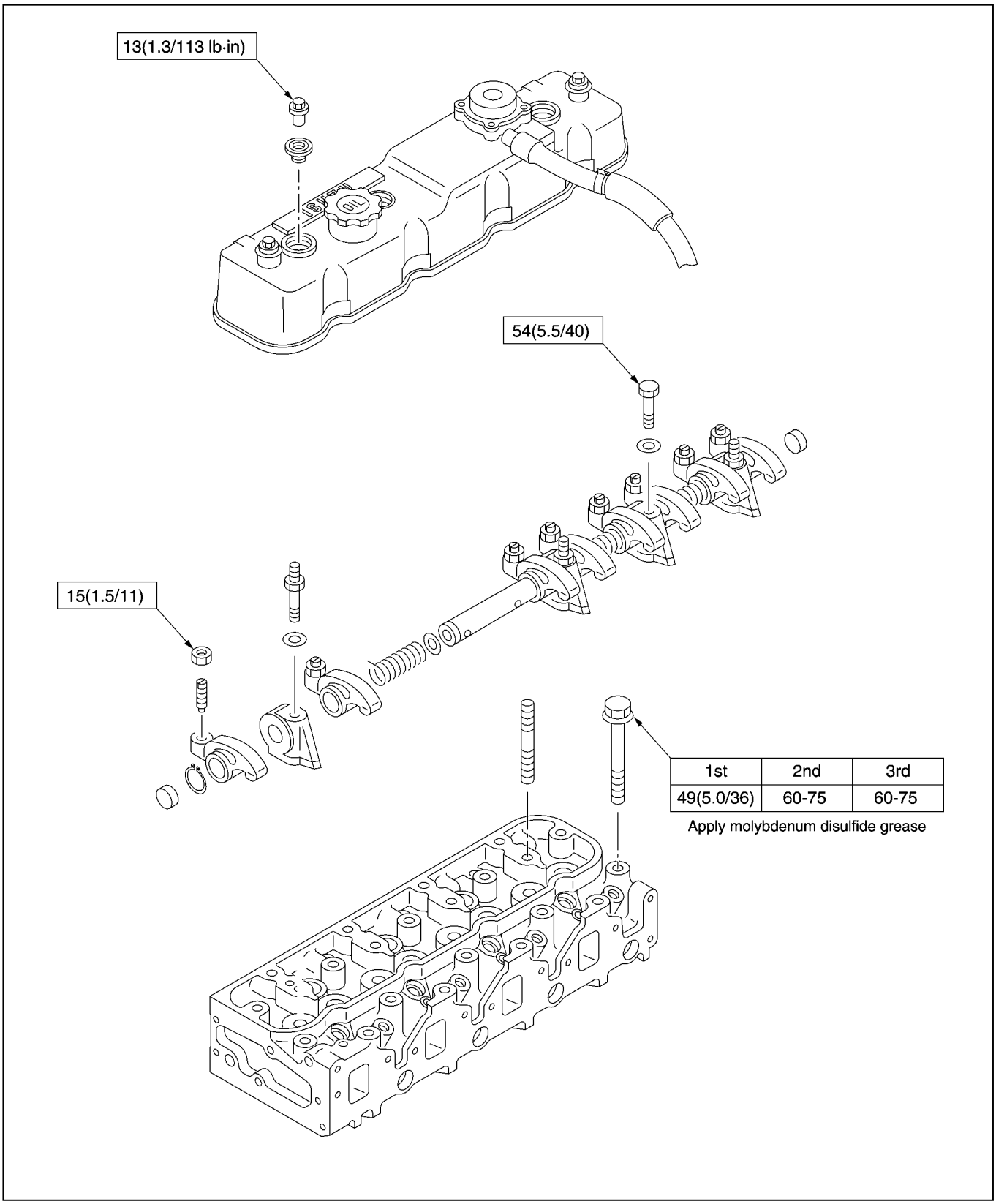
Turn the starter switch to the “OFF” position and back to the “ON” position.

This will reset the Quick-On Start III System.

FIXING TORQUE

CYLINDER HEAD COVER, CYLINDER HEAD ROCKER, SHAFT BRAKER

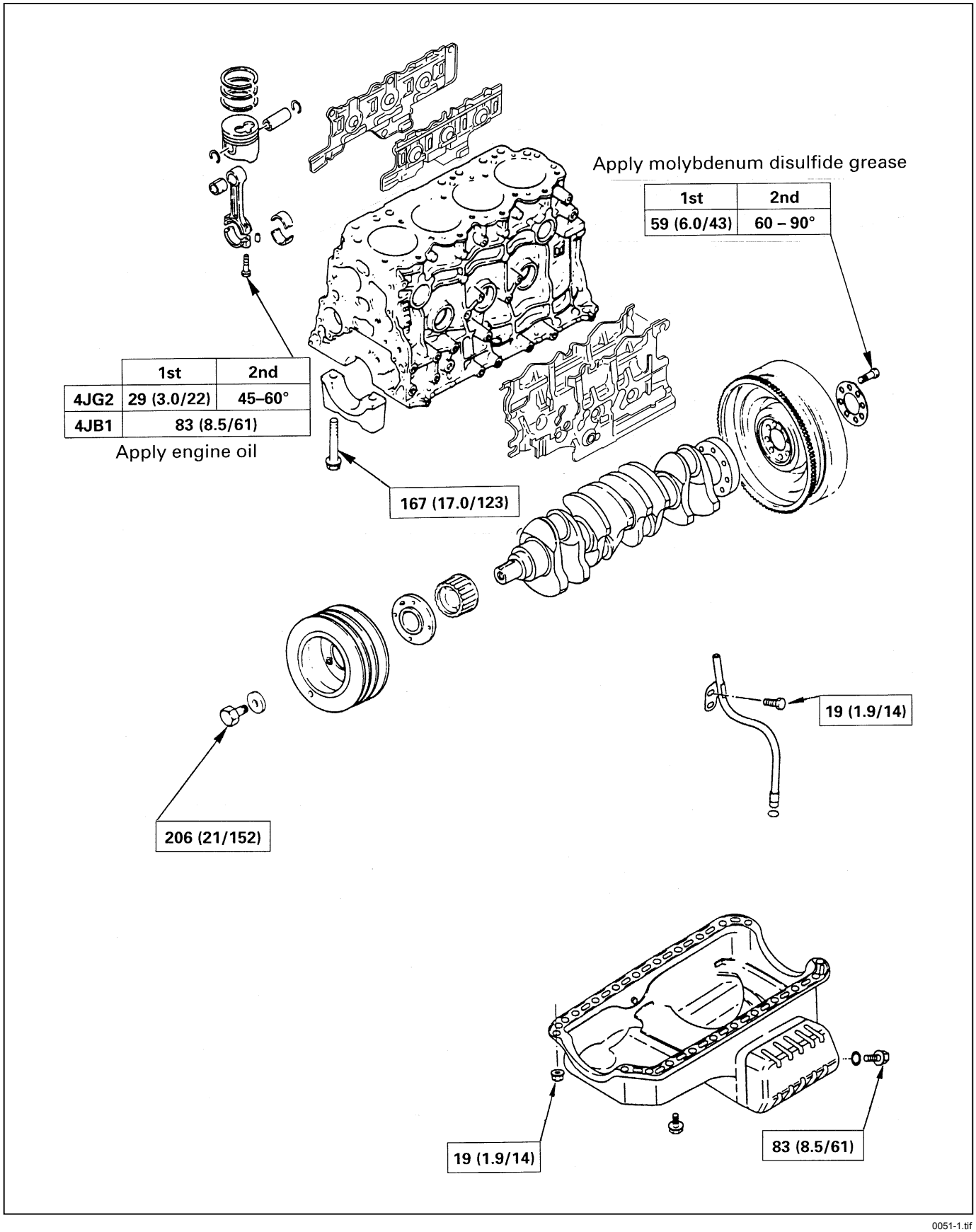
N·m (kg·m/lb·ft)



011LX002.tif

Crankshaft, Bearing Cap, Connecting Rod Bearing Cap, Crankshaft Damper Pulley, Flywheel, Oil Pan

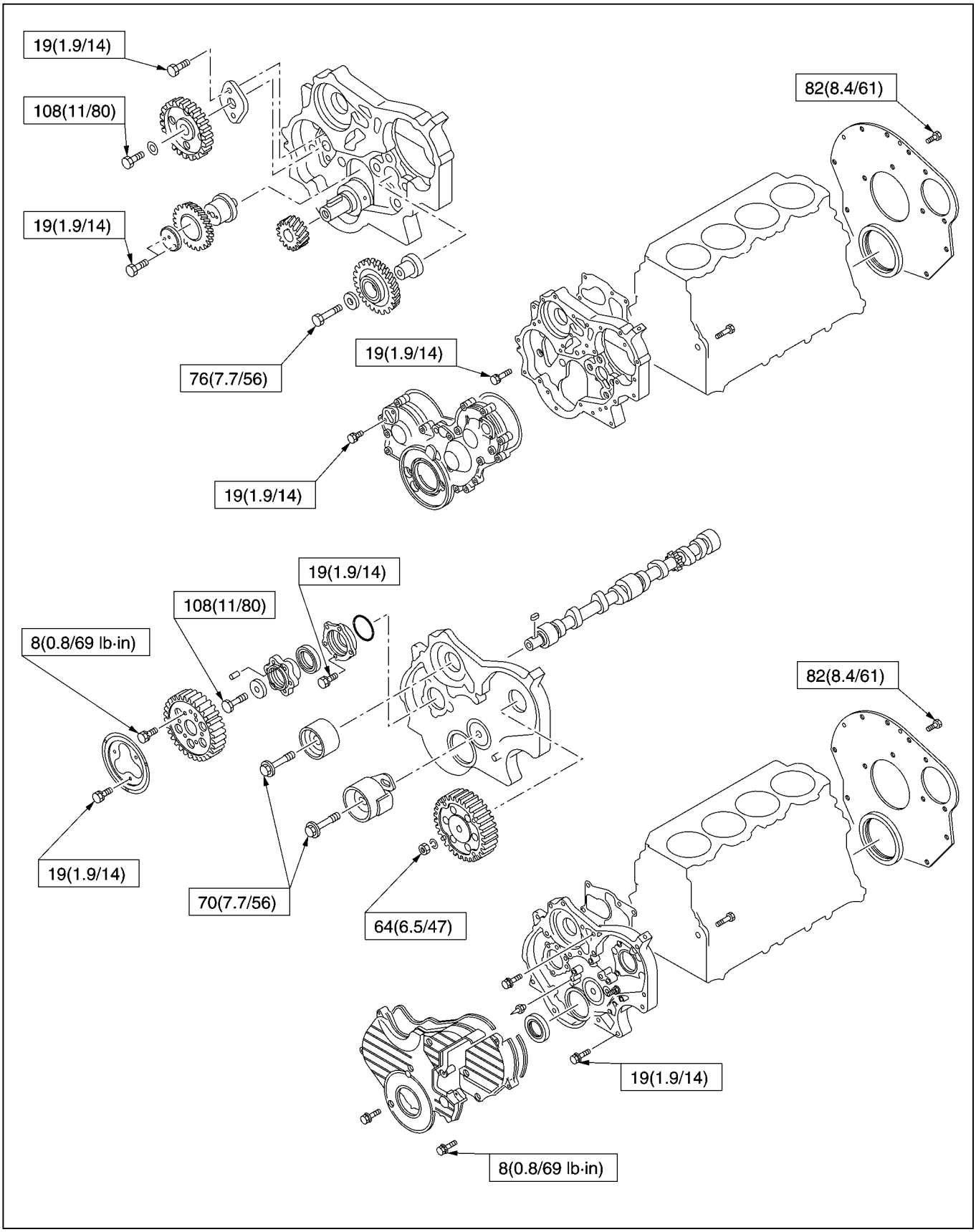
N·m (kg·m/lb·ft)



0051-1.tif

Timing Pulley Housing, Timing Pulley, Timing Gear, Camshaft Oil Seal Retainer

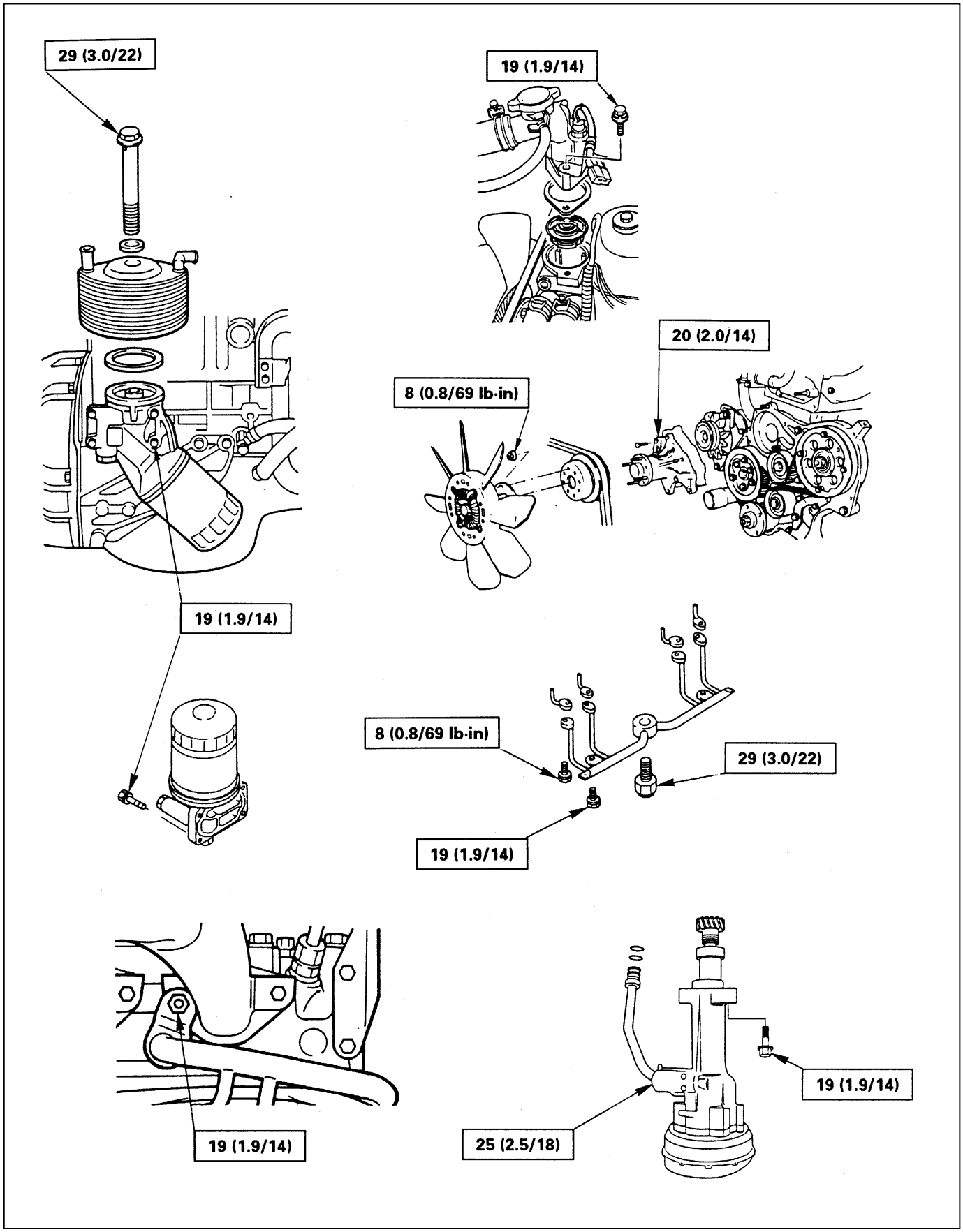
N·m (kg·m/lb·ft)



014LX001.tif

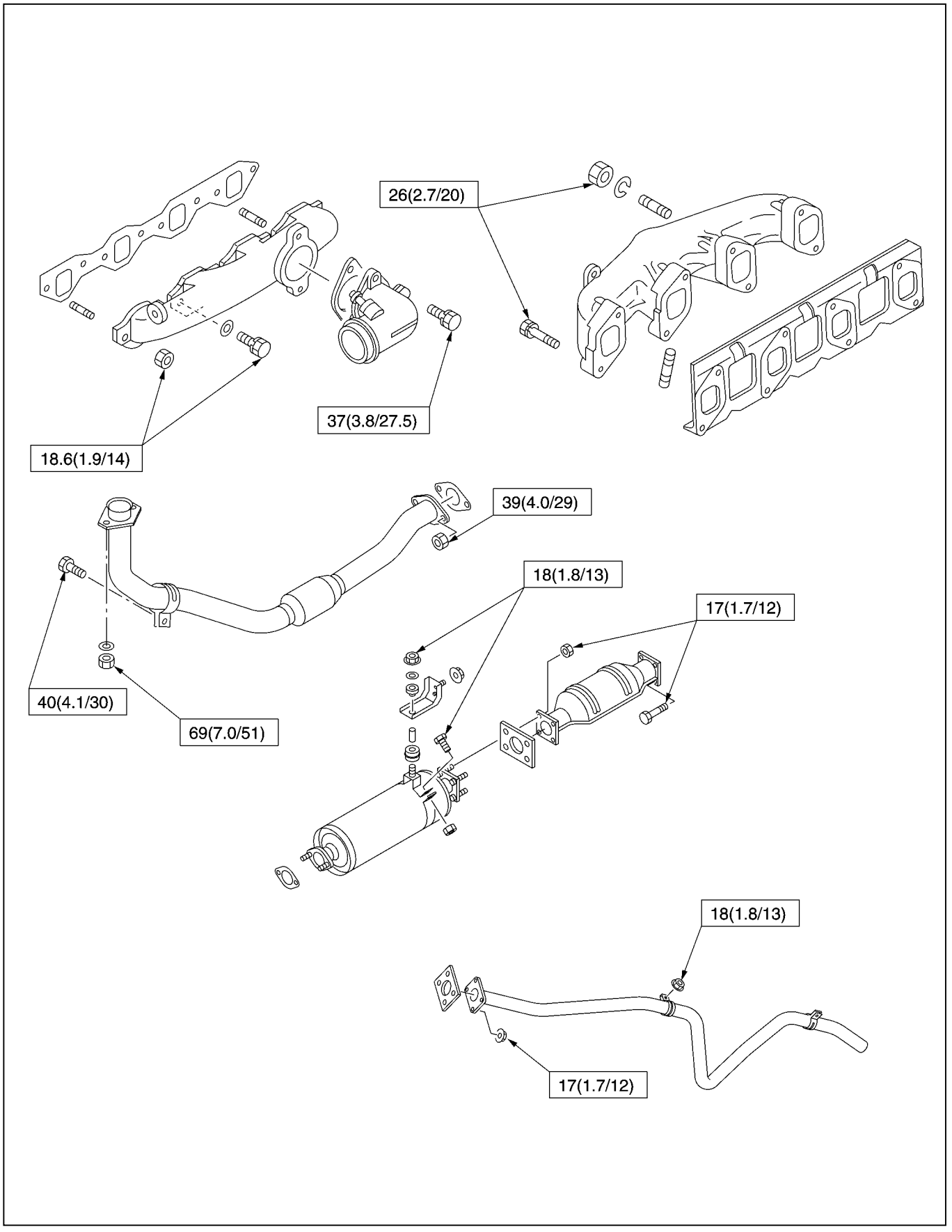
Cooling System and Lubrication System

N·m (kg·m/lb·ft)



Intake Manifold, Exhaust Manifold, Exhaust Pipe

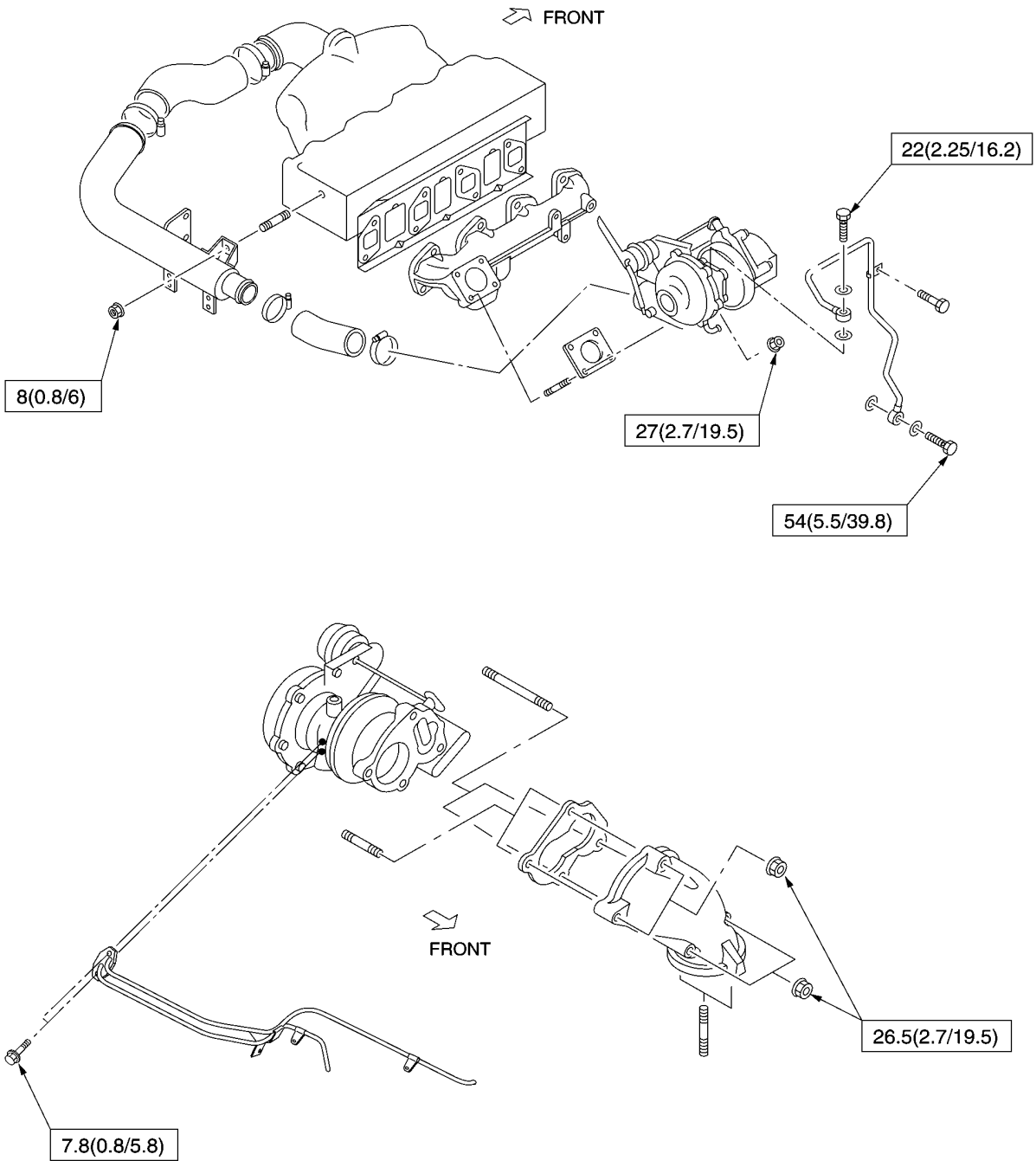
N·m (kg·m/lb·ft)



150LX004.tif

N·m (kg·m/lb·ft)

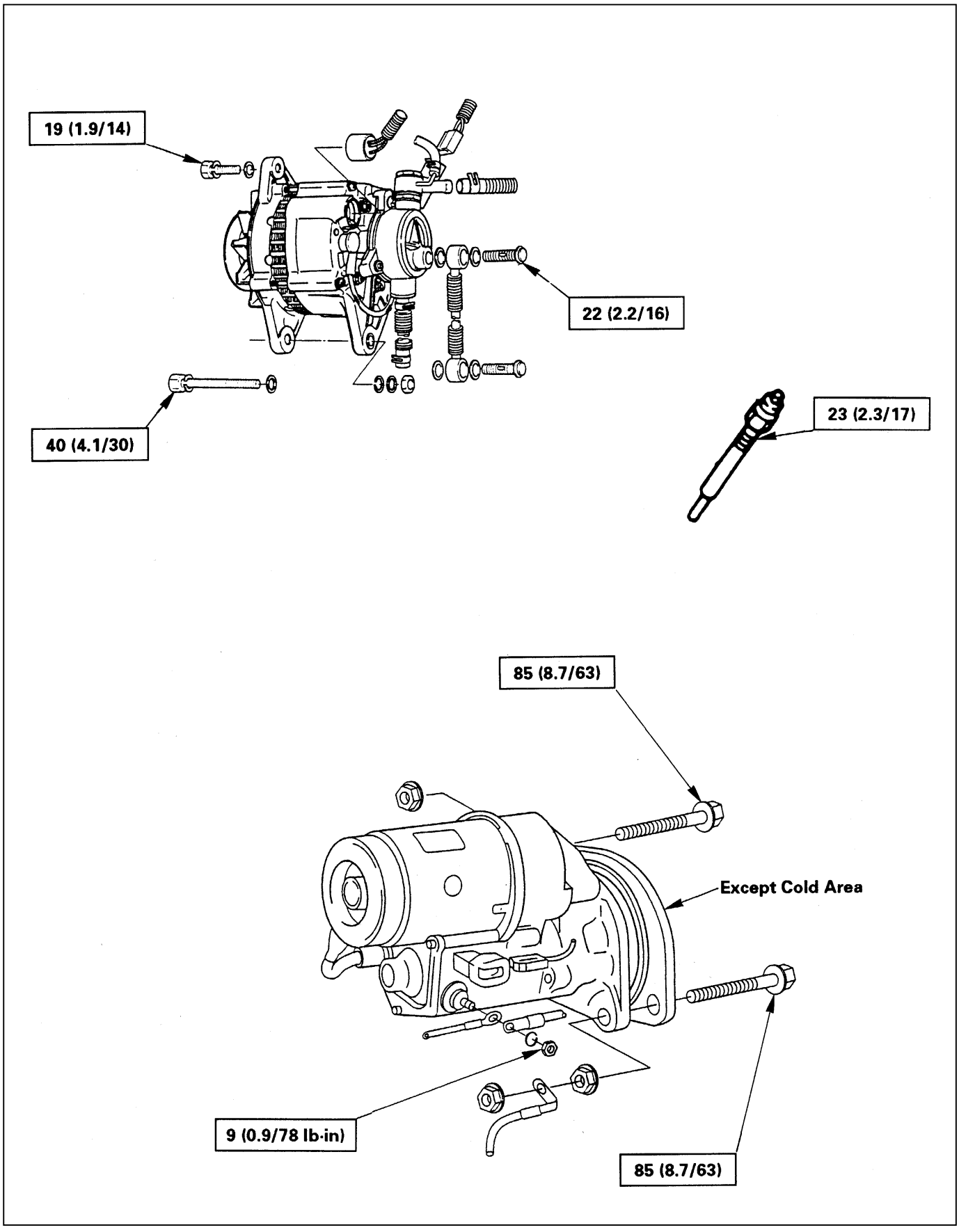
4JB1-TC



036LX003.tif

Engine Electricals

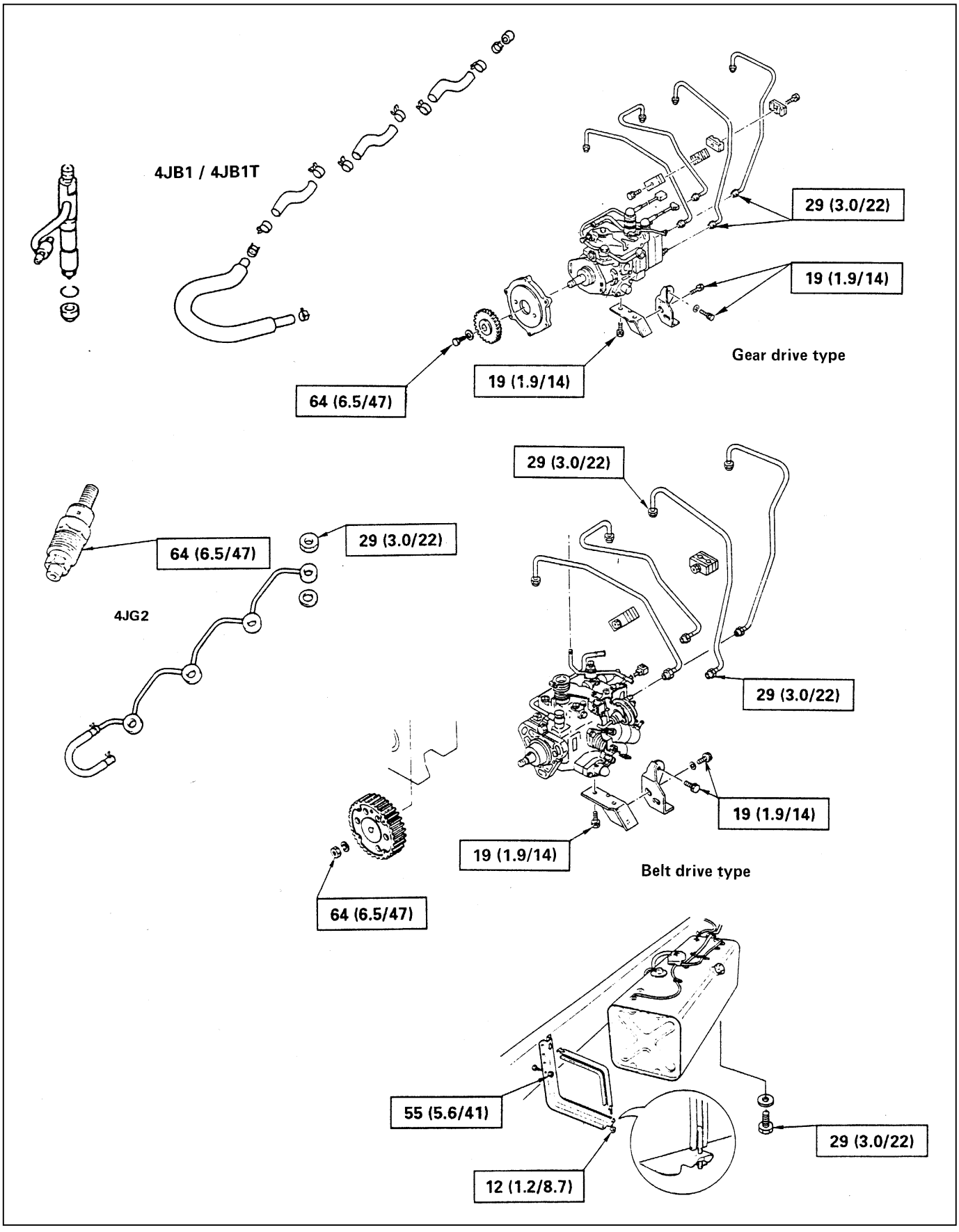
N·m (kg·m/lb·ft)



0056-1.tif

Engine Fuel

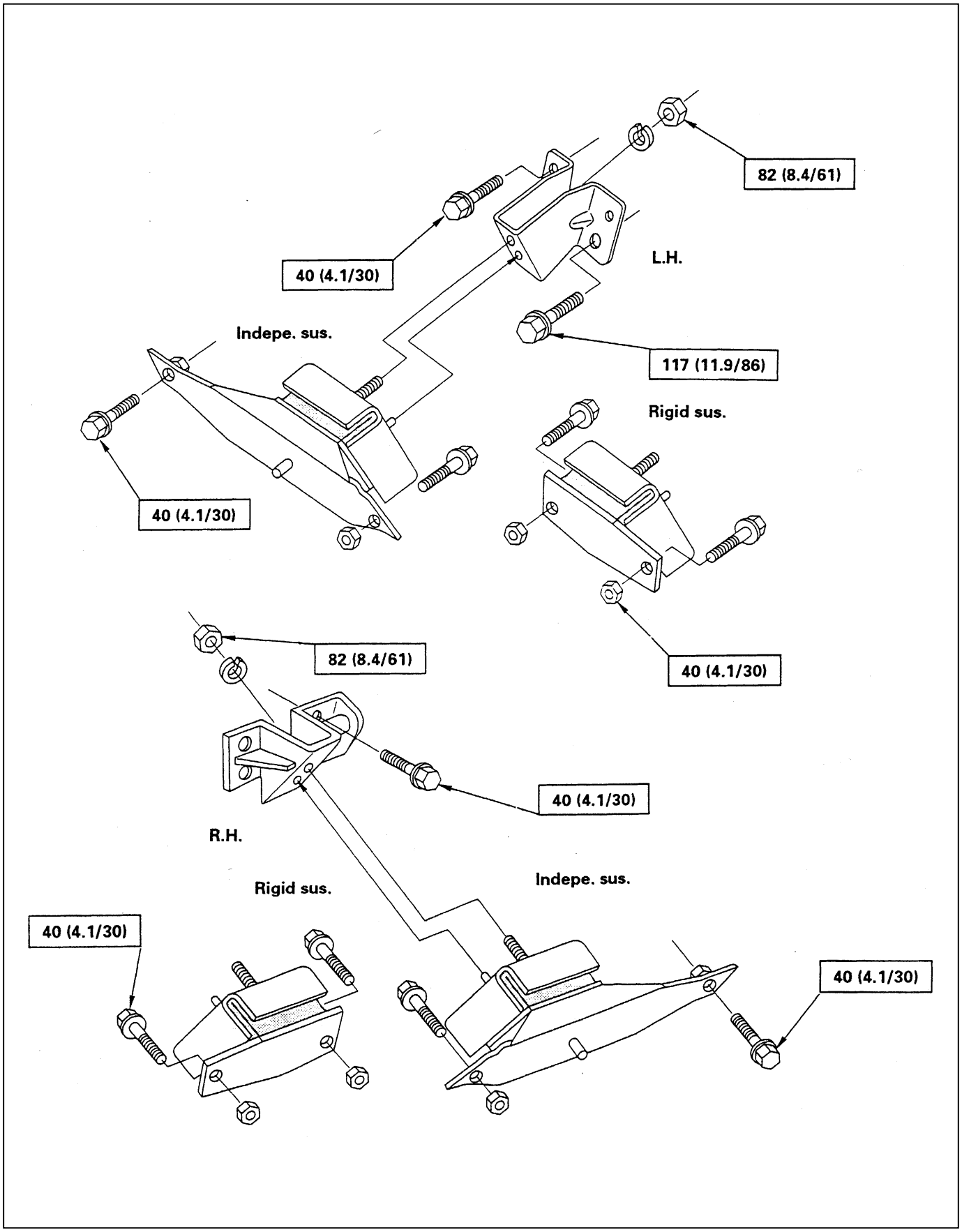
N·m (kg·m/lb·ft)



0057-1.tif

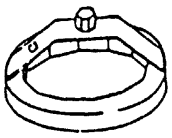
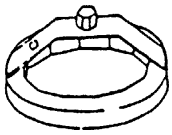
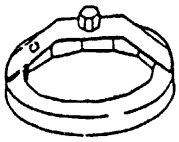
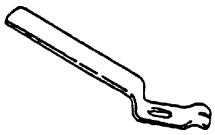
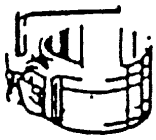
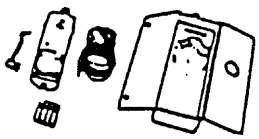
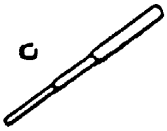
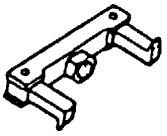
Engine Mounting Bracket

N·m (kg·m/lb·ft)

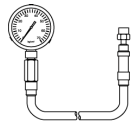
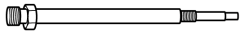
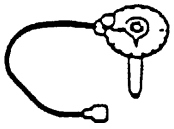
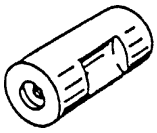


0058-1.tif

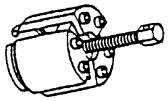
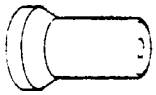
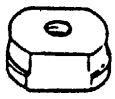
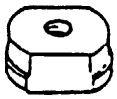
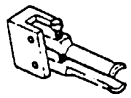
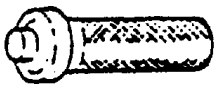
SPECIAL TOOLS

ILLUSTRATION	TOOL NO.	TOOL NAME
	5-8840-2035-0	Crank Timing Pulley (4JG2 Belt Drive only)
	5-8840-0200-0	Oil Filter Wrench (89.0 mm/3.5 in)
	5-8840-0202-0	Oil Filter Wrench (106.0 mm/4.2 in)
	5-8840-2209-0	Oil Filter Wrench (100.6 mm/4.0 in)
	9-8523-1423-0 (J-29760)	Valve Spring Compressor
	5-8840-2033-0	Oil Seal Installer
	5-8840-9018-0	Piston Ring Compressor
	5-8840-2093-0	Tacho Meter
	9-8523-1212-0	Valve Guide Replacer
	5-8840-0086-0	Camshaft Timing Pulley Remover (4JG2 Belt Drive only)
	5-8840-0199-0	Rubber Hardness Tester

SPECIAL TOOLS (CONT.1)

ILLUSTRATION	TOOL NO.	TOOL NAME
	5-8840-2675-0	Compression gauge
	5-8531-7001-0	Gauge Adapter
	5-8531-7002-0	Gauge Adapter
	5-8840-0145-0	Measuring Device
	5-8522-0024-0	Crankshaft Timing Pulley Installer (4JG2 Belt Drive only)
	5-8840-0266-0	Angle Gauge
	5-8840-9016-0	Injection Nozzle Tester
	5-8840-2034-0	Nozzle Holder Remover (4JB1 only)
	5-8840-2038-0	Camshaft Bearing Replacer
	5-8840-2036-0	Front Oil Seal Installer (4JB1, 4JG2, Gear Drive only)

SPECIAL TOOLS (CONT.2)

LLUSTRATION	TOOL NO.	TOOL NAME
	5-8840-0259-0	Nozzle Holder Wrench (4JG2 only)
	5-8840-0253-0 (J-22700)	Fuel Filter Wrench
	5-8840-2362-0	Front Oil Seal Remover (4JG2, Belt Drive only)
	5-8840-2361-0	Front Oil Seal Installer (4JG2, Belt Drive only)
	5-8840-2360-0	Rear Oil Seal Remover
	5-8840-2359-0	Rear Oil Seal Installer
	5-8840-2040-0	Cylinder Liner Installer (4JB1 only)
	5-8840-2313-0	Cylinder Liner Installer (4JG2 only)
	5-8840-2039-0	Cylinder Liner Remover (4JB1 only)
	5-8840-2304-0	Cylinder Liner Remover Ankle (4JG2 only)
	5-8840-2000-0	Pilot Bearing Remover
	5-8840-0019-0	Sliding Hammer
	5-8522-0024-0	Pilot Bearing Installer

MEMO

SECTION 6A

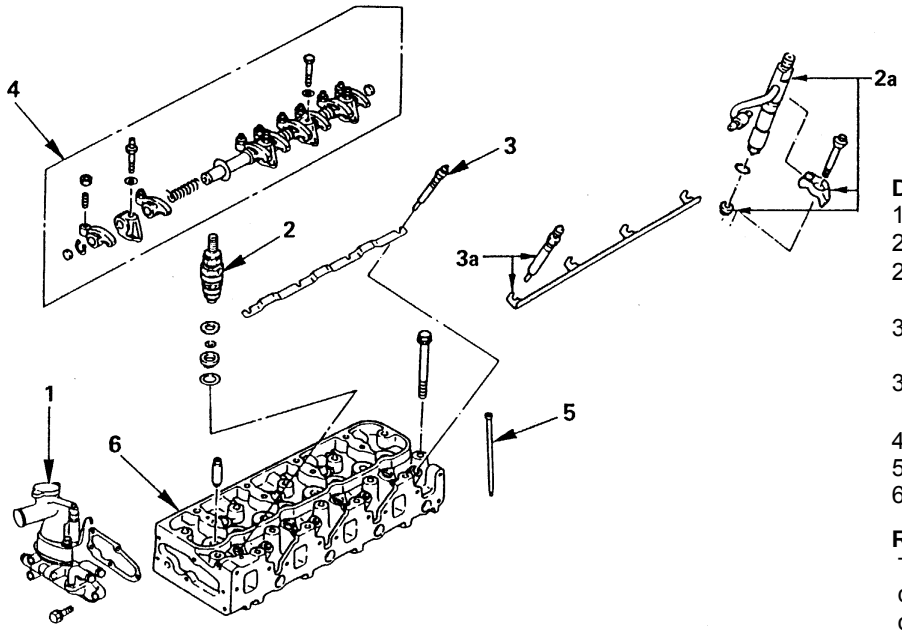
GENERAL ENGINE MECHANICAL

CONTENTS

PAGE

Cylinder Head ..... 6A - 2
Valve Spring, Valve Guide Oil Seal, Valve Guide, Push Rod ..... 6A - 10
Camshaft, Tappet ..... 6A - 17
Rocker Arm Assembly ..... 6A - 24
Oil Pump ..... 6A - 27
Crankshaft ..... 6A - 31
Piston and Connecting Rod ..... 6A - 47
Cylinder Block ..... 6A - 56

CYLINDER HEAD



Disassembly steps
1. Thermostat housing Assembly
2. Injection nozzle holder (4JG2)
2a. Injection nozzle holder (4JB1・4JB1TC)
3. Glow plug and plug connector (4JG2)
3a. Glow plug and plug connector (4JB1・4JB1TC)
4. Rocker arm shaft and rocker arm
5. Push rod
6. Cylinder head

Reassembly steps
To reassemble, follow the disassembly steps in the reverse order.

6A-2-1.tif

NOTE:

- **During disassembly, be sure that the valve train components are kept together and identified so that they can be re-installed in their original locations.**
- **Before removing the cylinder head from the engine and before disassembling the valve mechanism, make a compression test and note the results.**

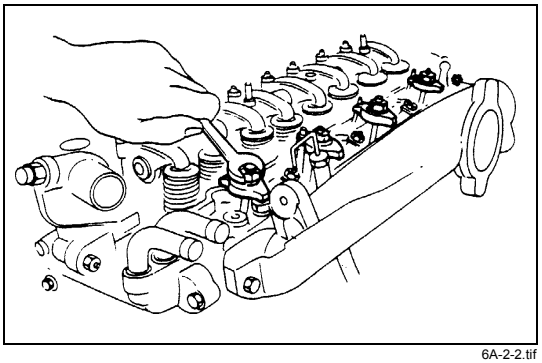
DISASSEMBLY

1. Thermostat Housing Assembly

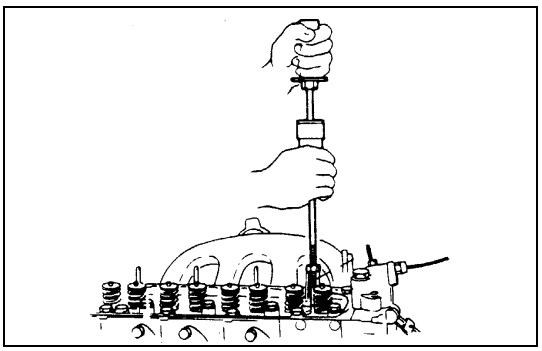
2. Injection Nozzle Holder (4JG2)

2a. Injection Nozzle Holder (4JB1, 4JB1TC)

1) Remove the nozzle holder bracket nuts.



6A-2-2.tif



6A-3-1.tif

2) Use the nozzle holder remover and the sliding hammer to remove the nozzle holder together with the holder bracket.

Nozzle Holder	Remover: 5-8840-2034-0
Sliding	Hammer: 5-8840-0019-0

3. Glow Plug and Glow Plug Connector (4JG2)

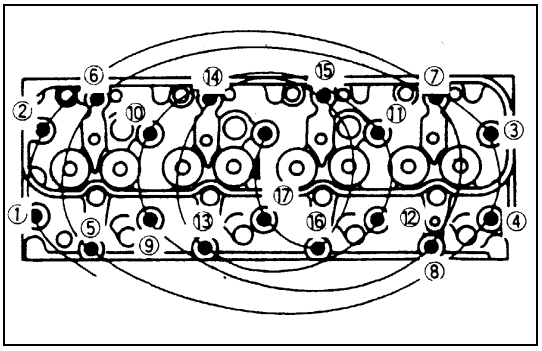
3a. Glow Plug and Glow Plug Connector (4JB1, 4JB1TC)

4. Rocker Arm Shaft and Rocker Arm

5. Push Rod

6. Cylinder Head

- Loosen the cylinder head bolts a little at a time in the numerical order shown in the illustration.



6A-3-2.tif

NOTE:

Failure to loosen the cylinder head bolts a little at a time in numerical order will adversely effect the cylinder head lower surface.

CLEAN

- Cylinder head bolts
- Cylinder head

  Carefully remove all varnish, soot and carbon to the bare metal. Do not use a motorized wire brush on any gasket sealing surface.

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.

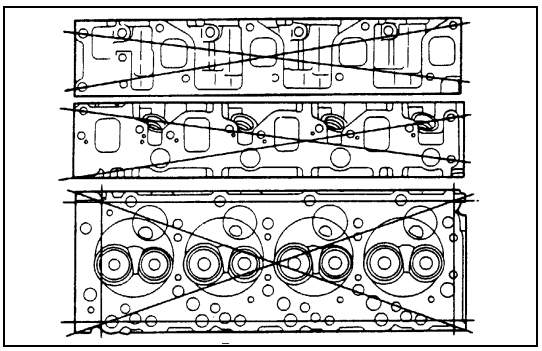
- Cylinder head gasket and mating surfaces for leaks, corrosion and blow-by. If the gasket has failed, determine the cause;
  - Improper installation
  - Loose or warped cylinder head
  - Insufficient torque on head bolts
  - Warped case surface

1. Cylinder head bolts for damaged threads or stretching and damaged heads caused by improper use of tools.

CAUTION:

Suspected bolts must be replaced.

2. Cylinder head for cracks, especially between valve seats and in the exhaust ports.
3. Cylinder head deck for corrosion, sand particles in head and porosity.



6A-4-1.tif

CAUTION:

Do not attempt to weld the cylinder head. Replace it.

4. Cylinder head deck, intake and exhaust manifold mating surfaces for flatness.

   These surfaces may be re-conditioned by milling (except cylinder head lower face). If the surfaces are “out of flat” by more than specification, the surface should be grinded to within specifications. If more than limit of specification, it should be replaced.

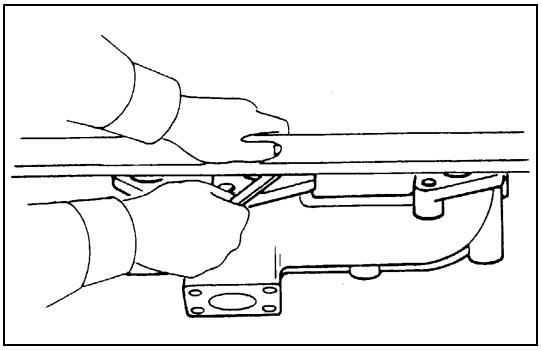
NOTE:

The cylinder head lower face cannot be reground.

mm (in)

	Standard	Limit
Cylinder Head Lower Face Warpage	0.05 (0.002) or less	0.20 (0.0079)
Cylinder Head Height	92 (3.622)	91.55 (3.6043)

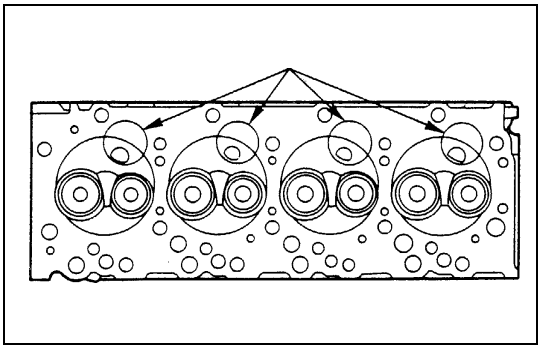
5. Water jacket sealing plugs seating surfaces.
6. Use a straight edge and a feeler gauge to measure the manifold cylinder head lifting face warpage.
   Regrind the exhaust manifold cylinder head lifting surfaces if the measured values are between the specified limit and the standard.
   If the measured values exceed the specified limit, the manifold must be replaced.



6A-4-2.tif

Exhaust Manifold Warpage mm (in)

Standard	Limit
0.05 (0.002) or less	0.20 (0.0079)



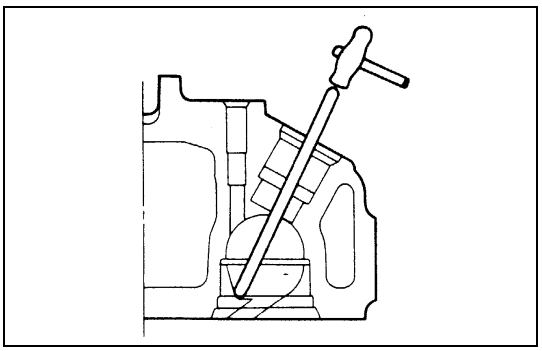
6A-4-3.tif

Hot plug depression (4JG2 only)

1. Clean the cylinder head lower side, taking care not to damage the hot plug surfaces.
2. Use a straight edge and feeler gauge to measure hot plug depression in a straight line from the No. 1 hot plug to the No. 4 hot plug.
   If the measured value exceeds the limit, the hot plugs must be replaced.

Depression Limit mm (in)

0.02 (0.0008)

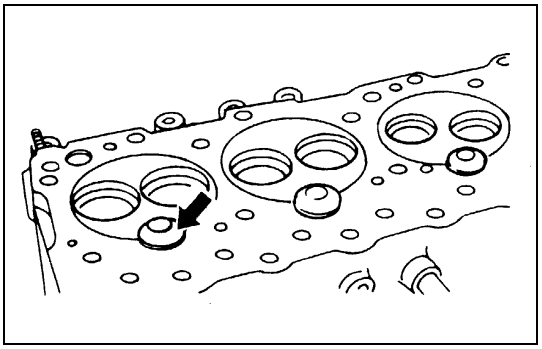


6A-4-4.tif

Hot plug removal (4JG2 only)

1. Insert a 3.0 - 5.0 (0.12 - 0.20.) diameter bar into the nozzle holder fitting hole unit it makes contact with the hot plug.
2. Lightly tap the bar with a hammer to drive the hot plug free.

   If the measured value exceeds the limit, the hot plugs must be replaced.



6A-5-1.tif

Combustion chamber inspection (4JG2 only)

1. Remove the carbon adhering to the inside of the combustion chamber. Take care not to damage the hot plug fitting positions.
2. Inspect the inside of the combustion chamber, the hot plug, and the hot plug machined faces for cracking and other damage.

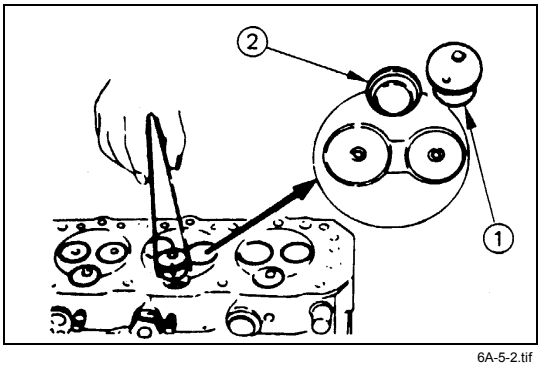
   If cracking or damage is present, the cylinder head must be replaced.

NOTE:

Be absolutely certain that there are no scratches or protuberance on the combustion chamber surfaces which will be in contact with the hot plug after it is installed. There flaws will prevent the hot plug from seating correctly.

Hot plug inspection

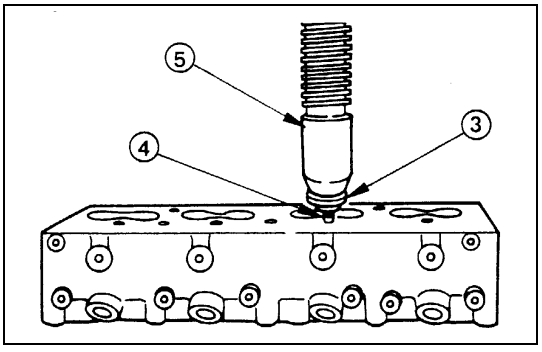
Inspection the hot plugs for excessive wear and other damage. Replace the hot plugs if either of these conditions are discovered.



6A-5-2.tif

Hot plug installation (4JG2 only)

1. Align the hot plug knock ball ① with the cylinder head groove ② and tap it temporarily into position with a plastic hammer.



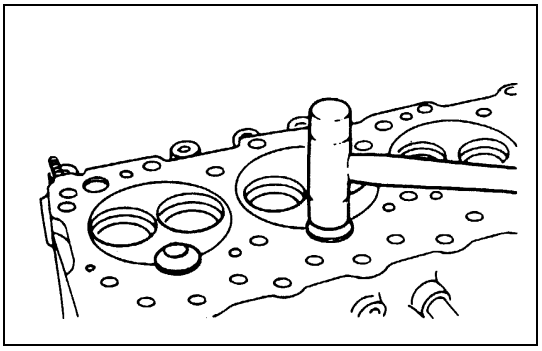
6A-5-3.tif

2. Place an appropriate metal plate ③ thick over the hot plug upper surface ④
3. Use a press ⑤ to exert a pressure of 44130 - 53937N (4500 - 5500 kg/9923 - 12128 lbs.) on the metal plate covering the hot plug upper surface. This will drive the hot plug into position.
4. Lightly tap the hot plug heads to make sure that they are firmly seated.
5. Repeat the procedure Steps 1-4 for the remaining hot plugs.

CAUTION:

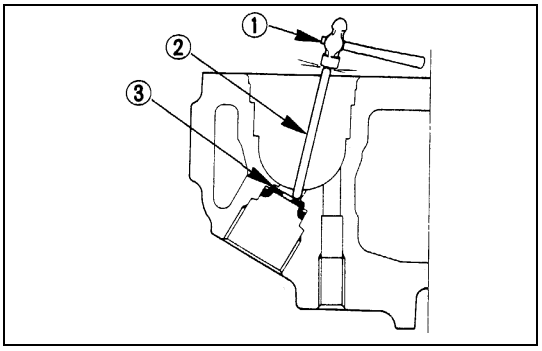
Do not apply pressure greater than that specified. Damage to the cylinder head will result.

6. Use a surface grinder to grind off any hot plug surface protuberances.
   The hot plug surfaces must be perfectly flush with the cylinder head.
7. After grinding, make sure that the hot plug surfaces are completely free of protuberances.
   The hot plug surfaces must also be free of depressions.



6A-6-1.tif

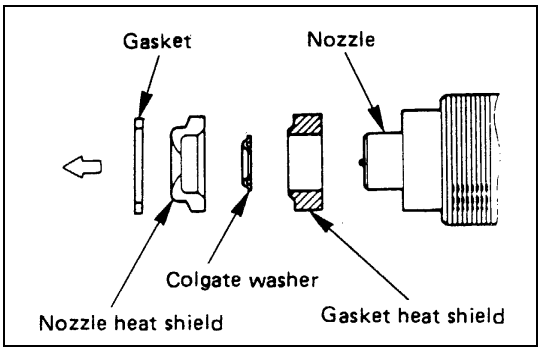
Once again, lightly tap the hot plug heads to make sure that they are firmly seated.



6A-6-2.tif

Heat shield removal (4JG2 only)

After removing the hot plugs, use a hammer ① and a brass bar ② to lightly tap the lower side of the heat shield ③ and drive it free.



6A-6-3.tif

Heat shield installation (4JG2 only)

Install the heat shield washer and the heat shield to the cylinder head from the nozzle holder installation hole side. Lightly tap the flange into place with a brass bar.

The heat shield flange side must be facing up.

NOTE:

Always install a new heat shield. Never reuse the old heat shield.

REASSEMBLY

6. Cylinder Head

1) Hot plug

- Set the nock ball in the positioning groove on the cylinder head side according to the order of the cylinders, and hit it lightly with a plastic hammer.

NOTE:
After being pressed into the cylinder head, the hot plugs were provided with surface grinding. Accordingly, their dimensions are different individually among them, and take care not confuse the order of the cylinders.

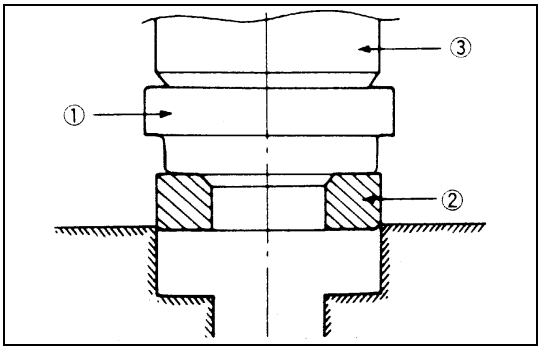
When replacing the hot plug with new one:

When assembling a new hot plug, set the knock ball in the positioning groove on the cylinder side and hit it lightly with a plastic hammer until the hot plug is set in stably.

With patch attached to the hot plug to prevent it from being damaged, press it in with a force of 4.5 to 5.5 ton applied.

After pressing the hot plug, grind its surface to the cylinder head.

And finally, hit the hot plug lightly with a plastic hammer and check it for any excessive sinking, protrusion or backlash.



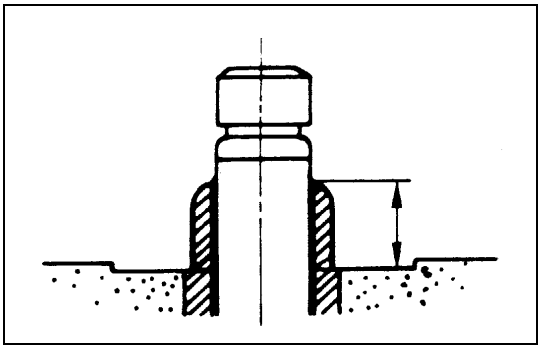
6A-7-1.tif

2) Valve Seat Insert Installation

1. Carefully place the attachment ① (having a smaller outside diameter than the valve seat insert) on the valve seat insert ②.

NOTE:
The smooth side of the attachment must contact the valve seat insert.

2. Use the bench press ③ to gradually apply pressure to the attachment and press the valve seat insert into place.

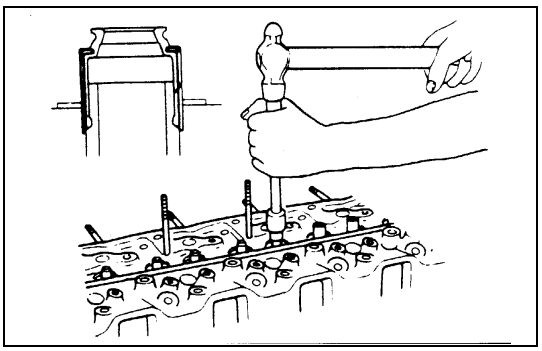

6A-7-2.tif

NOTE:
Do not apply an excessive amount of pressure with the bench press. Damage to the valve seat will result.

Measure the height of the valve guide upper end from the upper face of the cylinder head.

Valve Guide Upper End Height (H) (Reference) mm (in)
13 (0.51)

NOTE:
If the valve guide has been removed, both the valve and the valve guide must be replaced as a set.



6A-7-3.tif

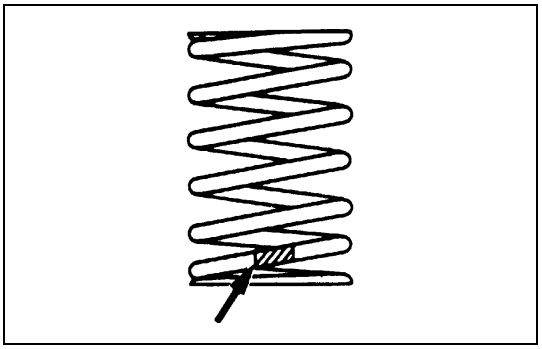
3) Spring lower seat

4) Valve stem oil seal

- Install a new oil controller in the valve.
- Guide using special tool
  Oil seal installer: 5-8840-2003-0

5) Valve

- Apply engine oil to the outside of the valve stem before installing it.



6A-8-1.tif

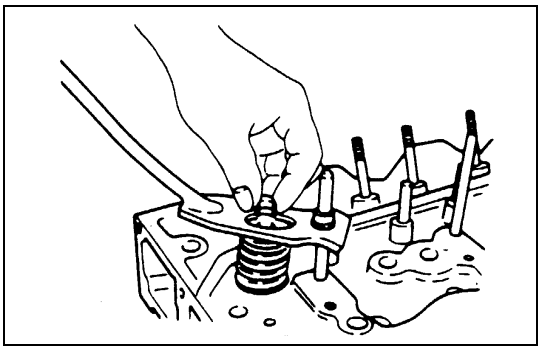
6) Valve Spring

- Attach the valve spring to the upper spring seat.

CAUTION

- **The painted area of the valve spring should be facing downward.**
- **Apply compressed air to cylinder from the glow plug hole to hold the valve in place.**
- **Install split collar by special tool.**

Valve spring compressor: 9-8523-1423-0 (J-29760)



6A-8-2.tif

7) Split Collar

- Use a spring compressor to push the valve spring into position.
- Install the spring seat split collar.
- Set the split collar by tapping lightly around the head of the collar with a rubber hammer.

Valve spring compressor: 9-8523-1423-0 (J-29760)

5. Push Rod

4. Rocker Arm Shaft and Rocker Arm

- Tighten rocker arm shaft fixing bolts

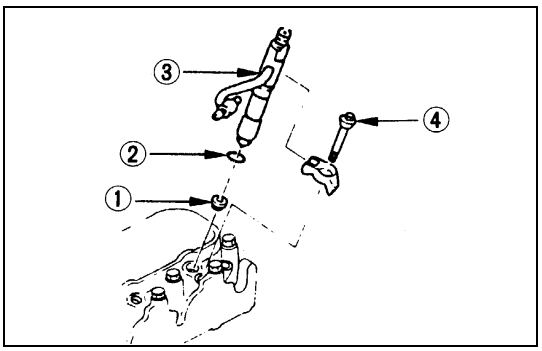
N·m (kg·m/lb·ft)
54 (5.5/40)

3a. Glow Plug and Glow Plug Connector (4JB1/4JB1T only)

3. Glow Plug and Glow Plug Connector

- Tighten glow plugs

N·m (kg·m/lb·ft)
23 (2.3/17)

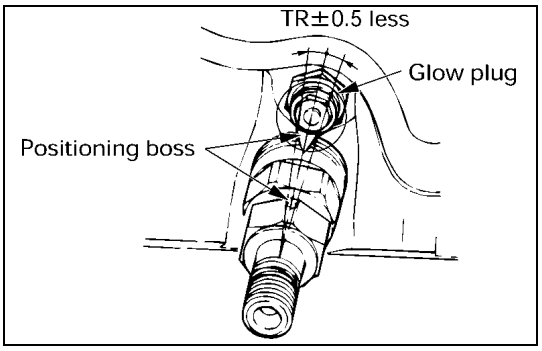


6A-8-3.tif

2a. Injection Nozzle Holder (4JB1/4JB1T/4JB1TC only)

1) Install the injection nozzle gasket ① and the O-ring ② to the injection nozzle holder ③.
   Be sure that the O-ring fits snugly in the injection nozzle groove.
2) Apply engine oil to the cylinder head nozzle holder hole.
3) Install the nozzle holder together with the nozzle holder bracket ④ to the cylinder head.

N·m (kg·m/lb·ft)
37 (3.8/27)



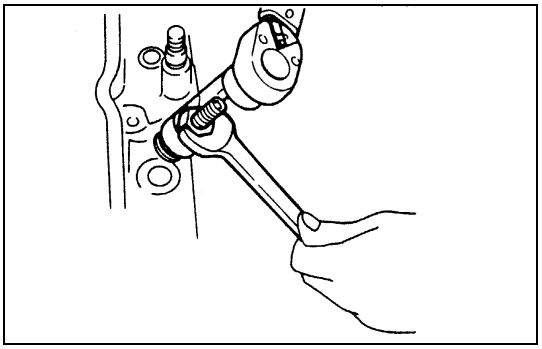
040LX016.tif

2. Injection Nozzle (4JG2 only)

- Lightly tighten the holder nut to suck extent that the nozzle holder can turn one word and one word.
- Set positioning confirmation drilled hole (ø2) within a nozzle turning angle of ±5° against the cylinder head-side positioning boss.
- Apply a wrench as illustrated and tighten the holder nut to the specified torque using a special tool.

CAUTION

- **After tightening the holder nut, make sure that the drilled hole makes ±5° or smaller with the cylinder head-side positioning boss.**
- **When mounting leak off pipe, injection nozzle and pipe, clean then with air so that dust may not enter.**


6A-9-1.tif

Nozzle Fixing Torque	N·m (kg·m/lb·ft)
64 (6.5/47)	

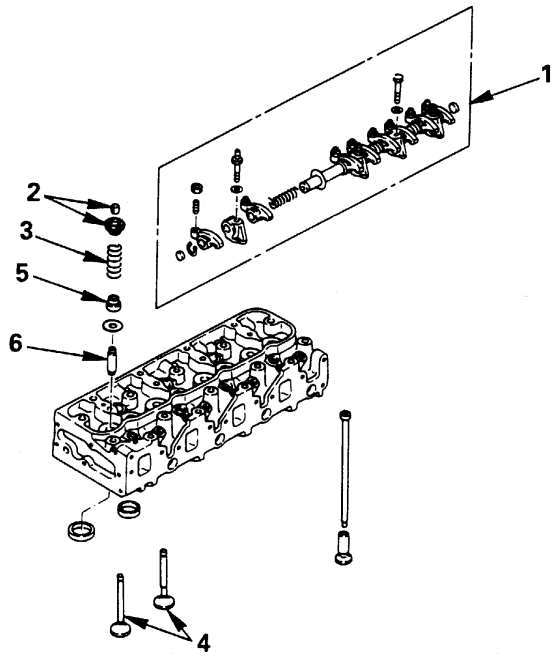
Wrench: Nozzle holder 5-8840-0259-0

1. Thermostat Housing Assembly

- Tighten thermostat housing assembly fixing bolt.

N·m (kg·m/lb·ft)
19 (1.9/14)

VALVE SPRING, VALVE GUIDE OIL SEAL, VALVE GUIDE, PUSH ROD

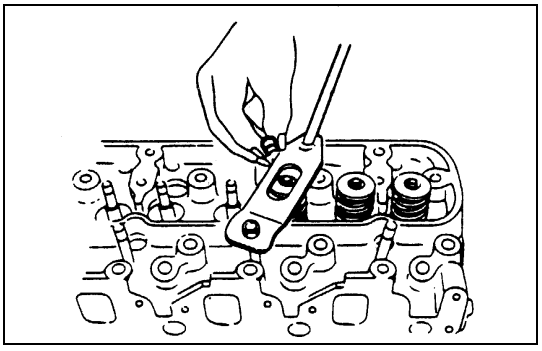


Disassembly steps
1. Rocker arm ASM
2. Split collar
3. Valve spring
4. Valve
5. Valve guide oil seal
6. Valve guide

Reassembly steps
To reassemble, follow the disassembly steps in the reverse order.

6A-10-1.tif

DISASSEMBLY

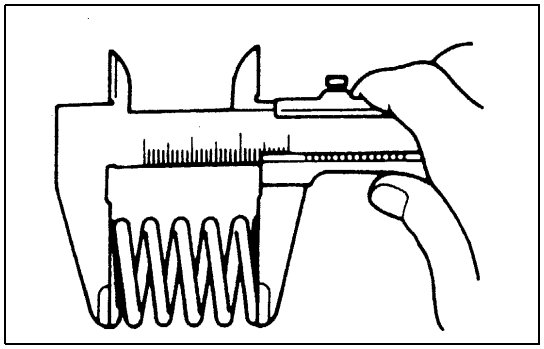


6A-10-2.tif

1. **Rocker Arm Assembly**
2. **Split Collar**
   Using special Tool, compress valve spring
   Valve spring compressor: 9-8523-1423-0 (J-29760)
3. **Valve Spring**
4. **Valve**
5. **Valve Guide Oil Seal**
6. **Valve Guide**
   Valve Guide Replacer: 9-8523-1212-0

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.



6A-11-1.tif

Valve spring

CAUTION:

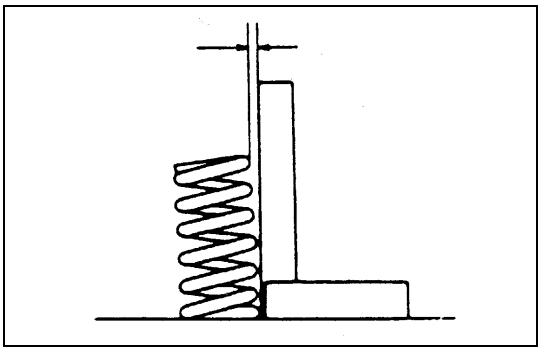
Visually inspect the valve springs and replace them if damage or abnormal wear is evident.

1. Free height

- Measure the free height of the springs. The springs must be replaced if the height is below the specified limit.

Free Height mm (in)

Standard	Limit
48.0 (1.891)	47.100 (1.8560)



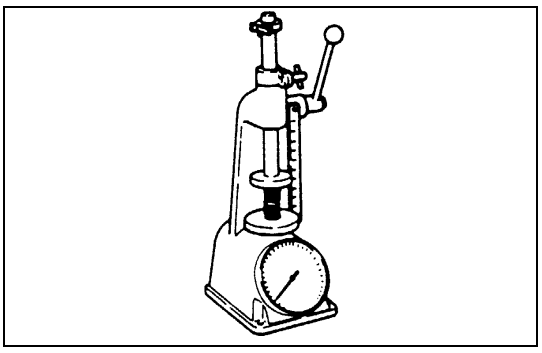
6A-11-2.tif

2. Squareness

- Measure the valve spring squareness with a steel square.
- Replace the valve springs if the measured value exceeds the specified limit.

Limit mm (in)

1.7 (0.067)



6A-11-3.tif

3. Spring tension

- Use spring tester to compress the springs to the installed height. Measure the compressed spring tension.

  Replace the springs if the measured tension is below the specified limit.

Tension N (kg/lb)

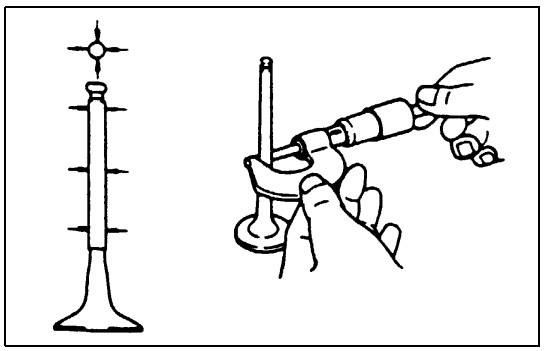
At installed height	Standard	Limit
38.9 mm (1.5 in)	296.2 (30.2/66.6)	257.9 (26.3/57.9)

Valve Guide

CAUTION:

Taking care not to damage the valve seat contact surface, when removing carbon adhering to the valve head.

Carefully inspect the valve stem for scratching or abnormal wear. If these conditions are present, the valve and the valve guide must be replaced as a set.



6A-12-1.tif

1. Valve Guide Clearance

- Measure the valve stem diameter with a micrometer.
  If the valve stem diameter is less than the specified limit, the valve and the valve guide must be replaced as a set.

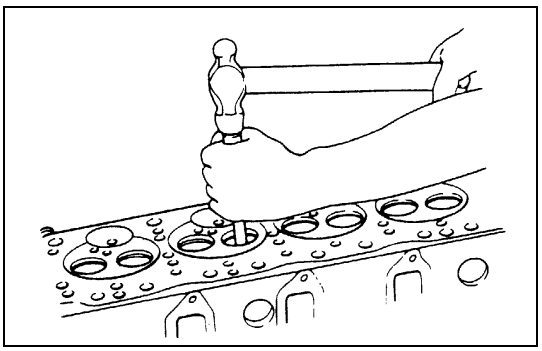
mm (in)

		Standard	Limit
Diameter of Valve stem	Inlet	7.946 - 7.961 (0.3128 - 0.3134)	7.880 (0.310.2)
	Exhaust	7.921 - 7.936 (0.3118 - 0.3124)	7.850 (0.3091)

- Measure the inside diameter of the valve guide with a micrometer.
- Subtract the measured outer diameter of the valve stem from the measured inner diameter of the valve guide. If the valve exceeds of the valve guide.
  If the valve exceeds the specified limit, the valve and the valve guide must be replaced as a set.

Valve Guide Clearance mm (in)

	Standard	Limit
Inlet clearance	0.039 - 0.069 (0.0015 - 0.0027)	0.200 (0.0079)
Exhaust clearance	0.064 - 0.096 (0.0025 - 0.0038)	0.250 (0.0098)

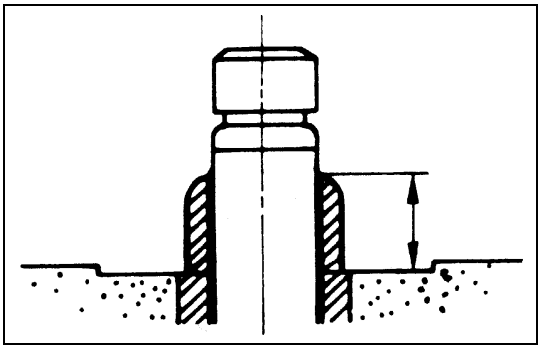


6A-13-1.tif

Valve Guide Replacement

1. Using special tool, drive out the valve guide from the combustion chamber side.

Valve guide replacer: 9-8523-1212-0



6A-13-2.tif

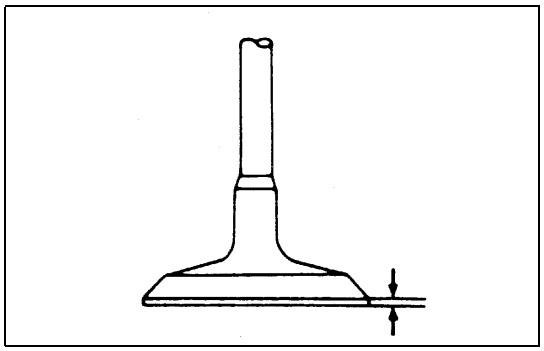
2. Apply engine oil to the outside of the valve guide.
   Using special tool, drive in a new valve guide from cylinder head upper face side, and check the valve guide height.

Valve guide replacer: 9-8523-1212-0

Height	mm (in)
13 (0.51)	

NOTE:

If the valve guide has been removed, both the valve and the valve guide must be replaced as a set.



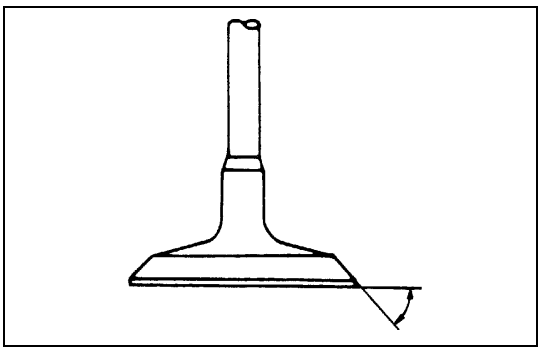
6A-13-3.tif

Valve Thickness

1. Measure the valve thickness
2. If the measured value is less than the specified limit the valve and the valve guide must be replaced as a set.

Valve Thickness mm (in)

	Standard		Limit
4JB1 4JB1T 4JB1TC	Inlet	1.79 (0.0705)	1.5 (0.06)
	Exhaust	1.83 (0.0720)	
4JG2	Inlet	1.41 (0.0555)	1.1 (0.043)
	Exhaust	1.39 (0.0547)	

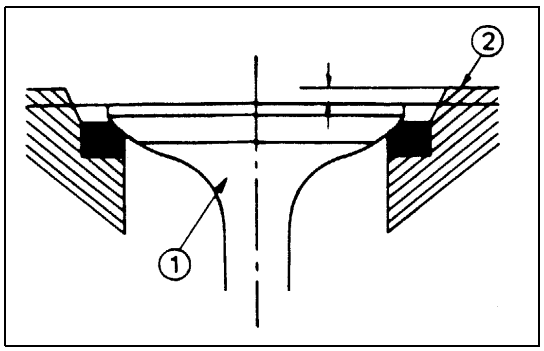


6A-13-4.tif

Contact surface angle on valve seat on valve

1. Measure contact surface angle on valve seat.
2. If the measured value exceeds the limit, replace valve guide and valve seat as a set.

Standard	Degrees
45°	



6A-14-1.tif

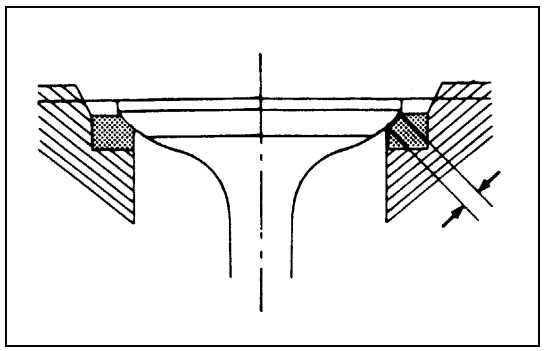
Valve depression

1. Install the valve (1) to the cylinder head (2).
2. Use a depth gauge or a straight edge with steel rule to measure the valve depression from the cylinder head lower surface.

   If the measured value exceeds the specified limit, the valve seat insert must be replaced.

Valve Depression mm (in)

	Standard		Limit
4JB1 4JB1T 4JB1TC	Inlet	0.73 (0.029)	1.28 (0.050)
	Exhaust	0.70 (0.028)	1.20 (0.047)
4JG2	Inlet	1.1 (0.043)	1.6 (0.063)
	Exhaust		


6A-14-2.tif

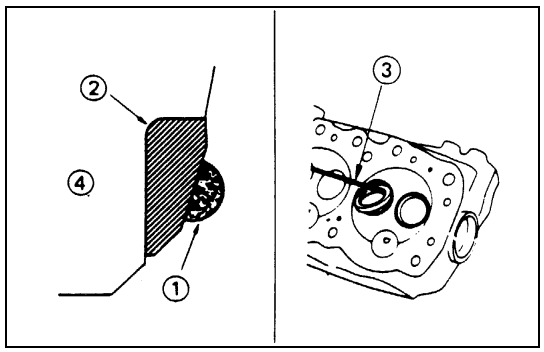
Valve Contact Width

1. Check the valve contact faces for roughness and unevenness. Make smooth the valve contact surfaces.
2. Measure the valve contact width.

   If the measured value exceeds the specified limit, the valve seat insert must be replaced.

Contact Width mm (in)

	Standard	Limit
Inlet	1.7 (0.0670)	2.2 (0.0866)
Exhaust	2.0 (0.0788)	2.5 (0.0984)



6A-14-3.tif

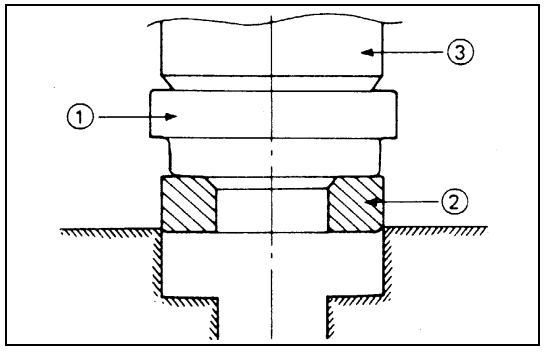
Valve Seat Insert Replacement

Valve Seat Insert Removal

1. Arc weld the tire inside circumference ① of the valve seat insert ②.
2. Allow the valve seat insert to cool for a few minutes.

   This will invite contraction and make removal of the valve seat insert easier.
3. Use a screwdriver ③ to pry the valve seat insert free.

   Take care not to damage the cylinder head ④.
4. Carefully remove carbon and other foreign material from the cylinder head insert bore.



6A-14-4.tif

Valve Seat Insert Installation

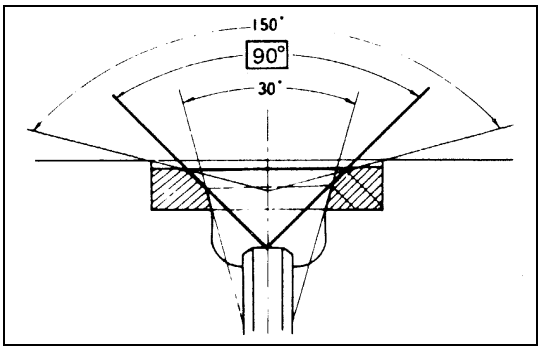
1. Carefully place the attachment ① (having a smaller outside diameter than the valve seat insert) on the valve seat insert ②.

NOTE:

The smooth side of the attachment must contact the valve seat insert.

2. Use a bench press ③ to gradually apply pressure to the attachment and press the valve seat insert into place.

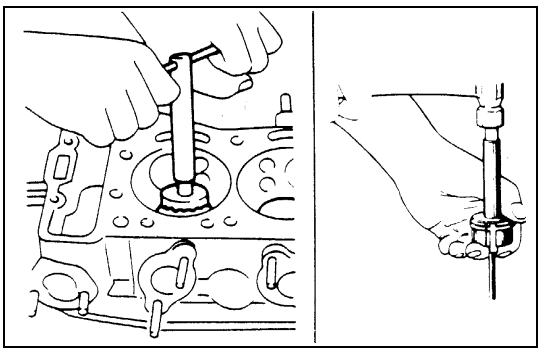
NOTE:
Do not apply an excessive amount of pressure with the bench press. Damage to the valve seat insert will result.



6A-15-1.tif

Valve Seat Insert Correction

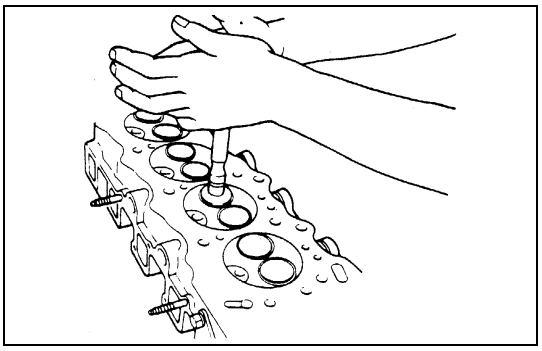
1. Remove the carbon from the valve seat insert surface.
2. Use a valve cutter (15°, 45°, and 75° blades) to minimize scratches and other rough areas, this will bring the contact width back to the standard value.
   Remove only the scratches and rough areas. Do not cut away too much. Take care not to cut away unblemished area of the valve seat surface.

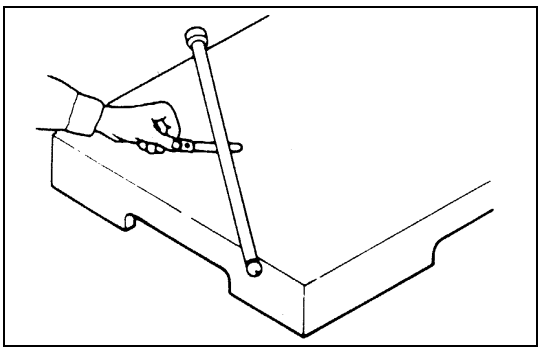

6A-15-2.tif

Valve Seat Angle	degree
45°	

NOTE:
Use an adjustable valve cutter pilot.
Do not allow the valve cutter pilot to wobble inside the valve guide.

3. Apply abrasive compound to the valve seat insert surface.
4. Insert the valve into the valve guide.
5. Turn the valve while tapping it to fit the valve seat insert.
6. Check that the valve contract width is correct.
7. Check that the valve seat insert surface is in contact with the entire circumference of the valve.


6A-15-3.tif


6A-15-4.tif

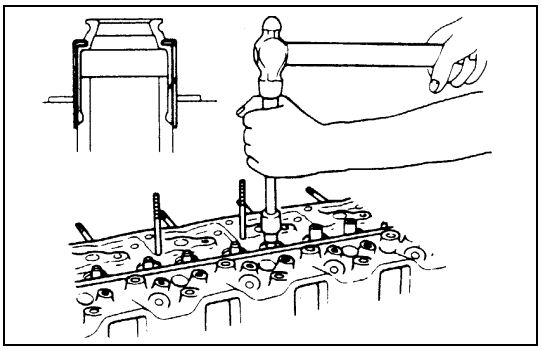
Push Rod Curvature

1. Lay the push rod on a surface plate.
2. Roll the push rod along the surface plate and measure the push rod curvature with a thickness gauge.
   If the measure value exceeds the specified limit, the push rod must be replaced.

Push Rod Curvature Limit	mm (in)
0.4 (0.0157) or less	

3. Visually inspect both ends of the push rod for excessive wear and damage. The push rod must be replaced if these conditions are discovered during inspection.

REASSEMBLY



6A-16-1.tif

6. Valve Guide

- Apply engine oil to the outside of the valve guide.

Using special tool, drive in a new valve guide from the rocker arm shaft side.

Valve guide replacer: 9-8523-1212-0

5. Valve Guide Oil Seal

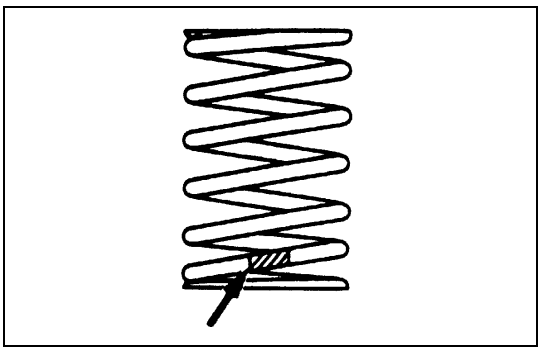
- Using special tool, drive in a new oil seal

Oil special tool, drive in a new oil seal

Oil seal installer: 5-8840-2033-0

4. Valve

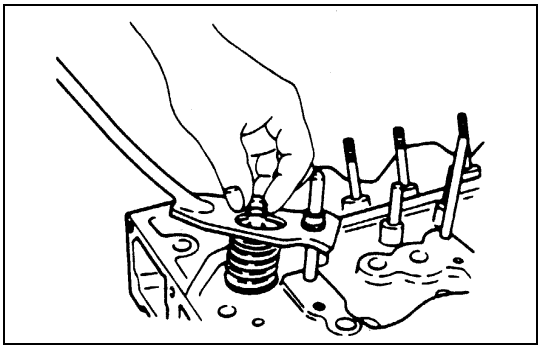
- Apply engine oil to the outside of the valve stem.



6A-16-2.tif

3. Valve Spring

- Attach the valve seat to the upper spring seat. The painted area of the valve spring should be facing downward.

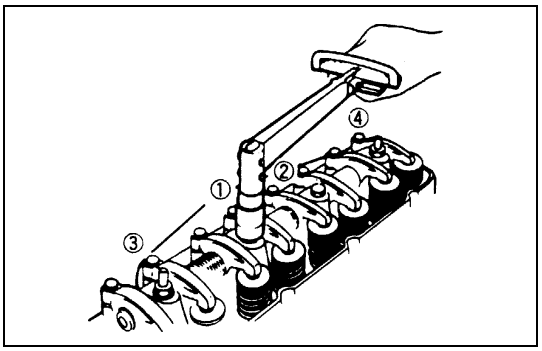


6A-16-3.tif

2. Split Collar

- Use a spring compressor to push the valve spring into position.
- Install the spring seat split collar.
- Set the split collar by tapping lightly around the head of the collar with a rubber hammer.

Valve spring compressor: 9-8523-1423-0 (J-29760)

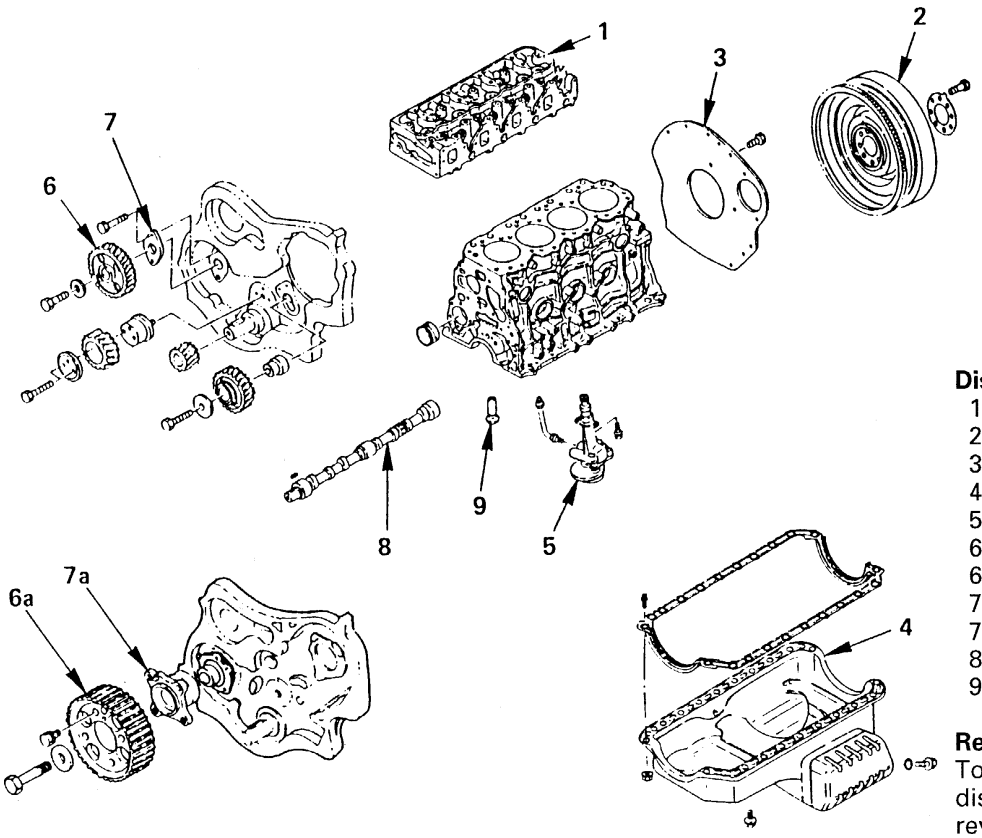


6A-16-4.tif

1. Rocker Arm Assembly

N·m (kg·m/lb·ft)
54 (5.5/40)

CAMSHAFT, TAPPET



Disassembly steps
1. Cylinder head ASM
2. Flywheel
3. Cylinder block rear plate
4. Oil pan ASM
5. Oil pump ASM
6. Camshaft timing gear
6a. Camshaft timing pulley
7. Camshaft thrust plate
7a. Camshaft pulley center
8. Camshaft
9. Tappet

Reassembly steps
To reassemble, follow the disassembly steps in the reverse order.

6A-17-1.tif

DISASSEMBLY

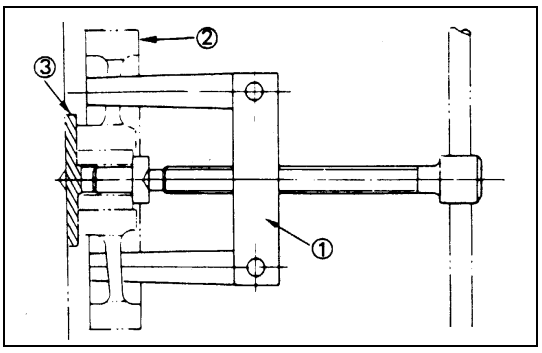
1. **Cylinder Head Assembly**
2. **Flywheel**
3. **Cylinder Block Rear Plate**
4. **Oil Pan Assembly**
5. **Oil Pump Assembly**
6. **Camshaft Timing Gear (Gear Drive Model)**
   - Remove the camshaft timing gear bolt from the camshaft.

   NOTE:

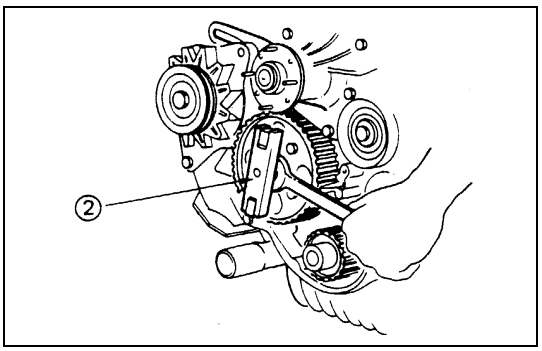
   Hold the camshaft stationary to prevent the camshaft from turning.

   - Use the universal puller ① to pull out the camshaft timing gear ②.
   - Universal Puller: 5-8521-0002-0

     Remove the thrust plate ③.



6A-17-2.tif



6A-18-1.tif

6a. Camshaft Timing Pulley (Belt Drive Model)

- Use the timing pulley puller ② to remove the pulley.
  Timing Pulley Puller: 5-8840-0086-0
- Remove the stopper bolt.

7. Camshaft Thrust Plate (Gear Drive Model)

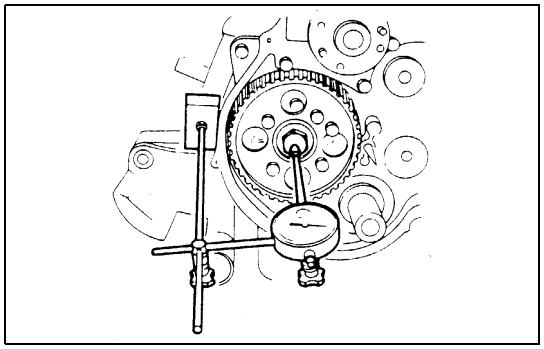
7a. Camshaft Pulley Center (Belt Drive Model)

8. Camshaft

9. Tappet

INSPECTION AND REPAIR

Make the necessary adjustment, repairs, and part replacements if excessive wear or damage is discovered during inspection.



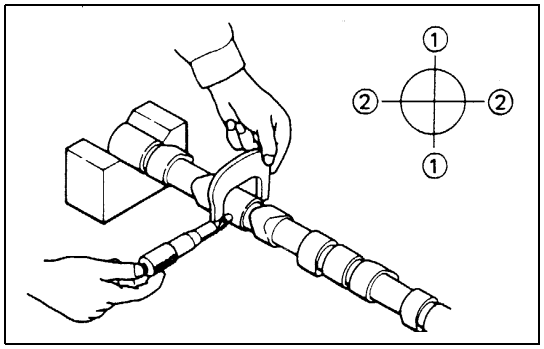
6A-18-2.tif

1. Measure the Camshaft Thrust Clearance

- Use a dial indicator to measure the camshaft end play.
  This must be done before removing the camshaft gear.
  If the camshaft end play exceeds the specified limit, the thrust plate must be replaced.

Camshaft End Play mm (in)

Standard	Limit
0.08 (0.0031)	0.2 (0.0079)



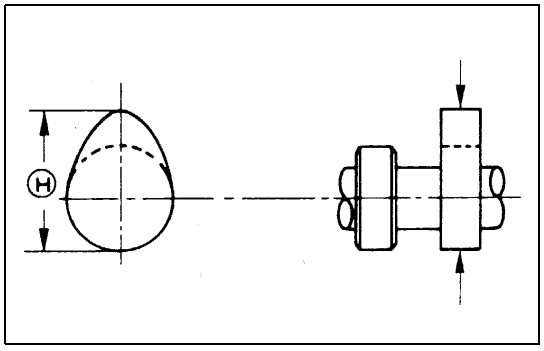
6A-18-3.tif

2. Camshaft Journal Diameter

- Use a micrometer to measure each camshaft journal diameter in two directions ① and ②. If the measured value is less than the specified limit, the camshaft must be replaced.

Journal Diameter mm (in)

Standard	Limit
49.945 - 49.975 (1.9663 - 1.9675)	49.60 (1.9528)



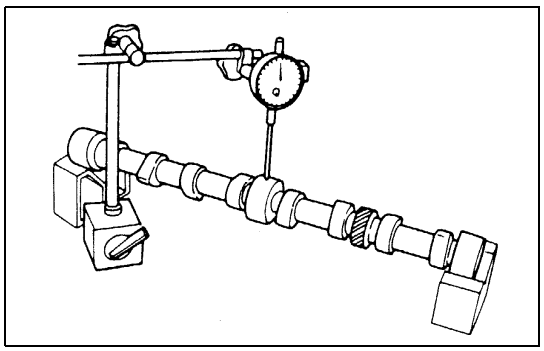
6A-18-4.tif

3. Cam Height

- Measure the cam height Ⓗ with a micrometer. If the measured value is less than the specified limit, the camshaft must be replaced.

Cam Height mm (in)

Standard	Limit
42.02 (1.6543)	41.65 (1.6398)



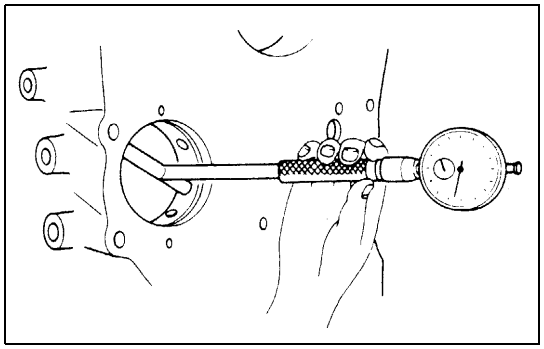
6A-19-1.tif

4. Camshaft Run-Out

- Mount the camshaft on V-blocks.
- Measure the run-out with a dial indicator.
  If the measured value exceeds the specified limit, the camshaft must be replaced.

Run-Out mm (in)

Standard	Limit
0.02 (0.008) or less	0.10 (0.0039)



6A-19-2.tif

5. Camshaft and Camshaft Bearing Clearance

- Use an inside dial indicator to measure the camshaft bearing inside diameter.

Camshaft Bearing Inside Diameter mm (in)

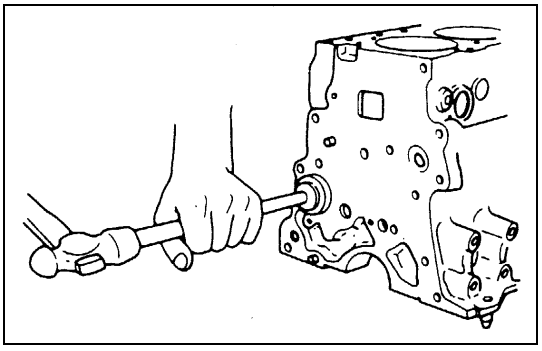
Standard	Limit
50.00 - 50.03 (1.9685 - 1.9696)	50.08 (1.9716)

Camshaft Bearing Clearance mm (in)

Standard	Limit
0.025 - 0.085 (0.0010 - 0.0033)	0.12 (0.005)

- If the clearance between the camshaft bearing inside diameter and the journal exceeds the specified limit, the camshaft bearing must be replaced.

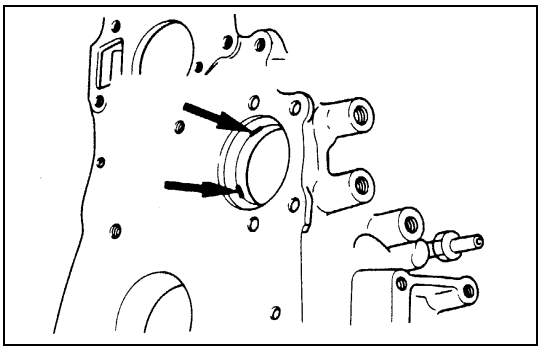
Camshaft Bearing Replacement



6A-19-3.tif

Camshaft Bearing Removal

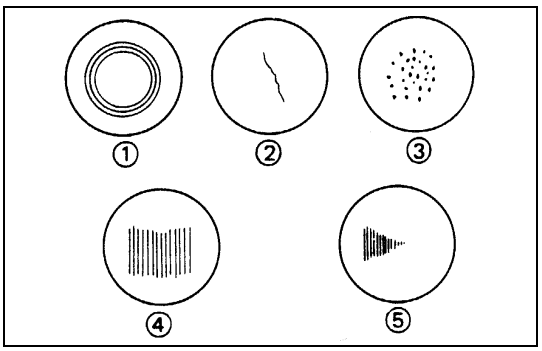
1. Remove the cylinder body plug plate.
2. Use the bearing replacer to remove the camshaft bearing.
   Bearing Replacer: 5-8840-2038-0



6A-19-4.tif

Camshaft Bearing Installation

1. Align the bearing oil holes with the cylinder body oil holes.
2. Use the replacer to install the camshaft bearing.
   Bearing Replacer: 5-8840-2038-0



6A-20-1.tif

TAPPET

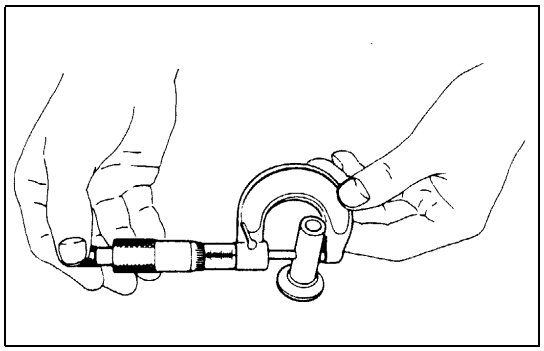
Visually inspect the tappet camshaft contact surfaces for pitting, cracking, and other abnormal conditions. The tappet must be replaced if any of these conditions are present.

Refer to the illustration at the left.

① Normal contact
② Cracking
③ Pitting
④ Irregular contact
⑤ Irregular contact

NOTE:

The tappet surfaces are spherical. Do not attempt to grind them with an oil stone or similar tool in an effort to repair the tappet. If the tappet is damaged, it must be replaced.

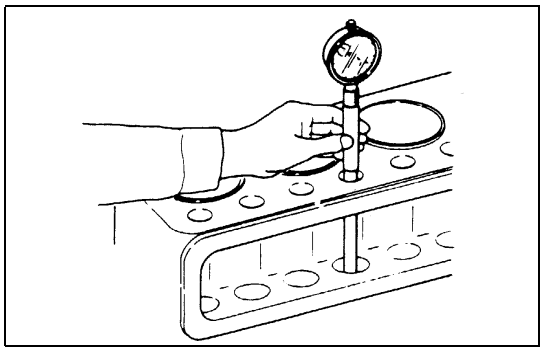

6A-20-2.tif

Tappet Outside Diameter

1. Measure the tappet outside diameter with a micrometer. If the measured value is less than the specified limit, the tappet must be replaced.

Tappet Outside Diameter mm (in)

Standard	Limit
12.97 - 12.99 (0.510 - 0.511)	12.95 (0.509)

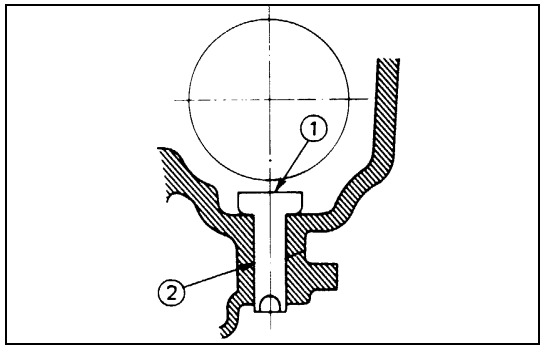

6A-20-3.tif

2. Measure the inside diameter tappet on the cylinder block and calculate the clearance.

   If the clearance exceeds the limit, replace tappet or/and cylinder block.

Tappet and Cylinder Body Clearance mm (in)

Standard	Limit
0.03 (0.001)	0.10 (0.004)



6A-20-4.tif

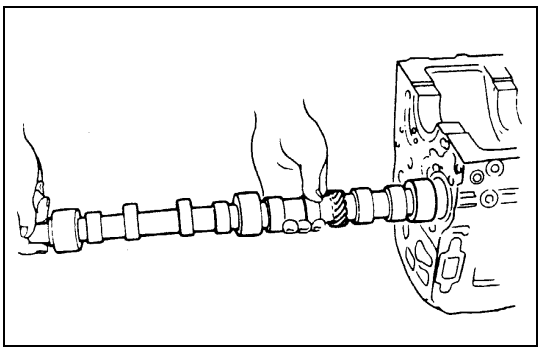
REASSEMBLY

9. Tappet

1) Apply a coat of engine oil to the tappet 1 and the cylinder body tappet insert holes 2.
2) Locate the position mark applies at disassembly (if the tappet is to be reused).

NOTE:

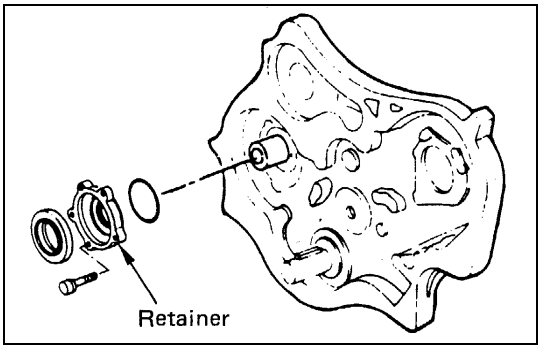
The tappet must be installed before the camshaft.



6A-21-1.tif

8. Camshaft

1) Apply a coat of engine oil to the camshaft and the camshaft bearings.
2) Install the camshaft to the cylinder body.
   Take care not damage the camshaft bearings.

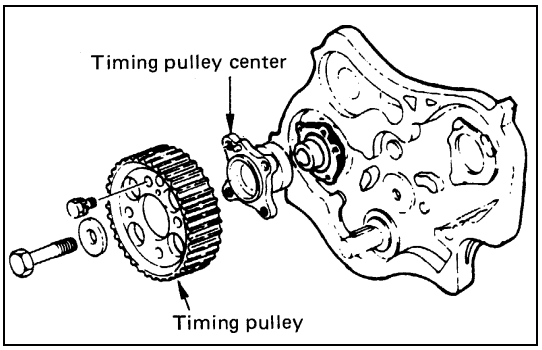


6A-21-2.tif

7a. Camshaft Timing Pulley Center (Belt Drive Model)

- Apply engine oil to the oil seal lip portion of the oil seal retainer.
- Apply the recommended liquid gasket or its equivalent to the retainer.
- Install the oil seal retainer to the cylinder body.
- Tighten the retainer bolts to the specified torque.

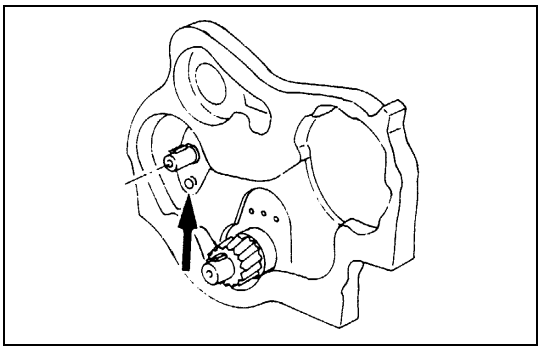
Oil Seal Retainer Bolt Torque	N·m (kg·m/lb·ft)
	19 (1.9/14)



6A-21-3.tif

- Align the camshaft timing pulley center with the camshaft key.
- Tighten the timing pulley bolts to the specified torque.

Timing Pulley Bolt Torque	N·m (kg·m/lb·in)
	8 (0.8/69)

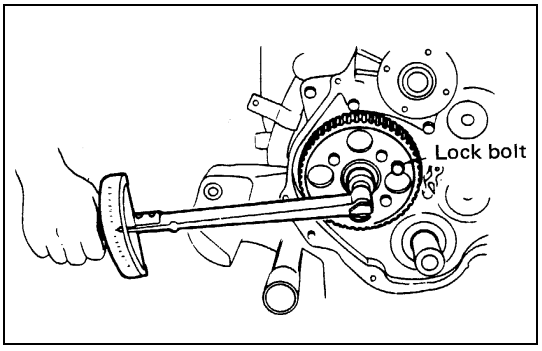


6A-21-4.tif

7. Camshaft Thrust Plate (Gear Drive Model)

Install the thrust plate to the cylinder body and tighten the thrust plate bolts to specified torque.

Thrust Plate Bolt Torque	N·m (kg·m/lb·ft)
	18 (1.8/13)

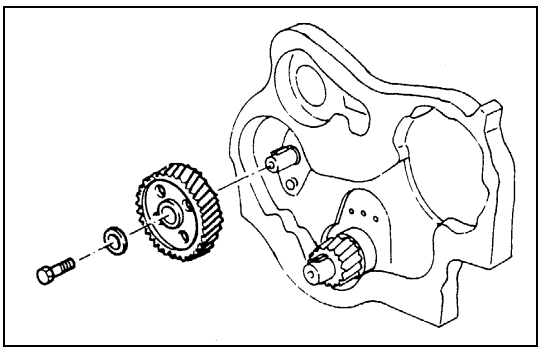


6A-21-5.tif

6a. Camshaft Timing Pulley (Belt Drive Model)

- Prevent the camshaft from turning when tightening the timing center bolt.
- Tighten the timing pulley center bolt to the specified torque.

Center Bolt Torque	N·m (kg·m/lb·ft)
	64 (6.5/47)



6A-22-1.tif

6. Camshaft Timing Gear (Gear Drive Model)

1) Install the camshaft timing gear to the camshaft.
   The timing gear mark (“Y-Y”) must be facing outward.
2) Tighten the timing gear to the specified torque

Timing Gear Bolt Torque	N·m (kg·m/lb·ft)
	64 (6.5/47)

5. Oil Pump Assembly

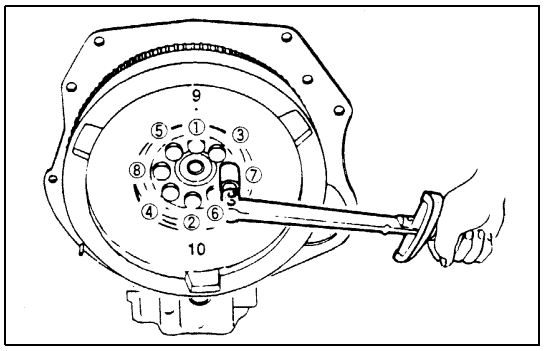
4. Oil Pan Assembly

Above works refer to “OIL PUMP” Section in this manual.

3. Cylinder Block Rear Plate

- Tighten cylinder block rear plate fixing bolts to the specified torque.

Rear Plate Bolt Torque	N·m (kg·m/lb·ft)
	82 (8.4/61)



6A-22-2.tif

2. Flywheel

- Apply engine oil to fixing bolts.
- Tighten the flywheel bolts to the specified torque in two steps using the Angular Tightening Method.
  Follow the numerical order shown in the illustration.

Flywheel Bolt Torque	N·m (kg·m/lb·ft)
1st Step (Snug Torque)	2nd Step (Final Torque)
59 (6.0/43)	60° - 90°

1. Cylinder Head Assembly

1) Hot plug

- Set the nock ball in the positioning groove on the cylinder head side according to the order of the cylinders, and hit it lightly with a plastic hammer.

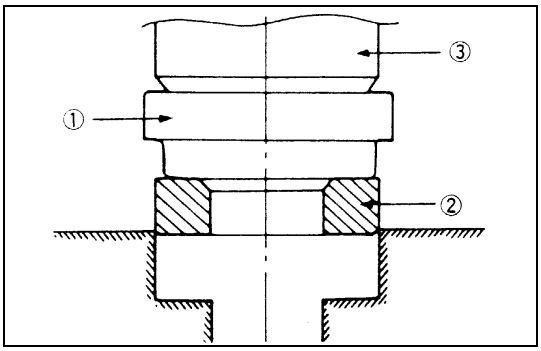
NOTE:

After being pressed into the cylinder head, the hot plugs were provided with surface grinding. Accordingly, their dimensions are different individually among them, and take care not confuse the order of the cylinders.

When replacing the hot plug with new one:

When assembling a new hot plug, set the knock ball in the positioning groove on the cylinder side and hit it lightly with a plastic hammer until the hot plug is set in stably.

With patch attached to the hot plug to prevent it from being damaged, press it in with a force of 4.5 ~ 5.5 ton applied.



6A-23-1.tif

2) Valve Seat Insert Installation

1. Carefully place the attachment ① (having a smaller outside diameter than the valve seat insert) on the valve seat insert ②.

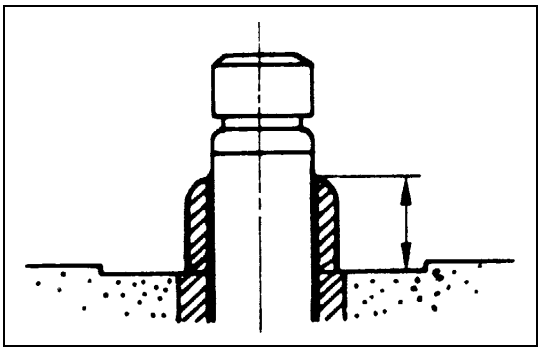
NOTE:

The smooth side of the attachment must contact the valve seat insert.

2. Use the bench press ③ to gradually apply pressure to the attachment and press the valve seat insert into place.

NOTE:

Do not apply an excessive amount of pressure with the bench press. Damage to the valve seat insert will result.


6A-23-2.tif

Measure the height of the valve guide upper end from the upper face of the cylinder head.

Valve Guide Upper End Height (H) (Reference) mm (in)
13 (0.51)

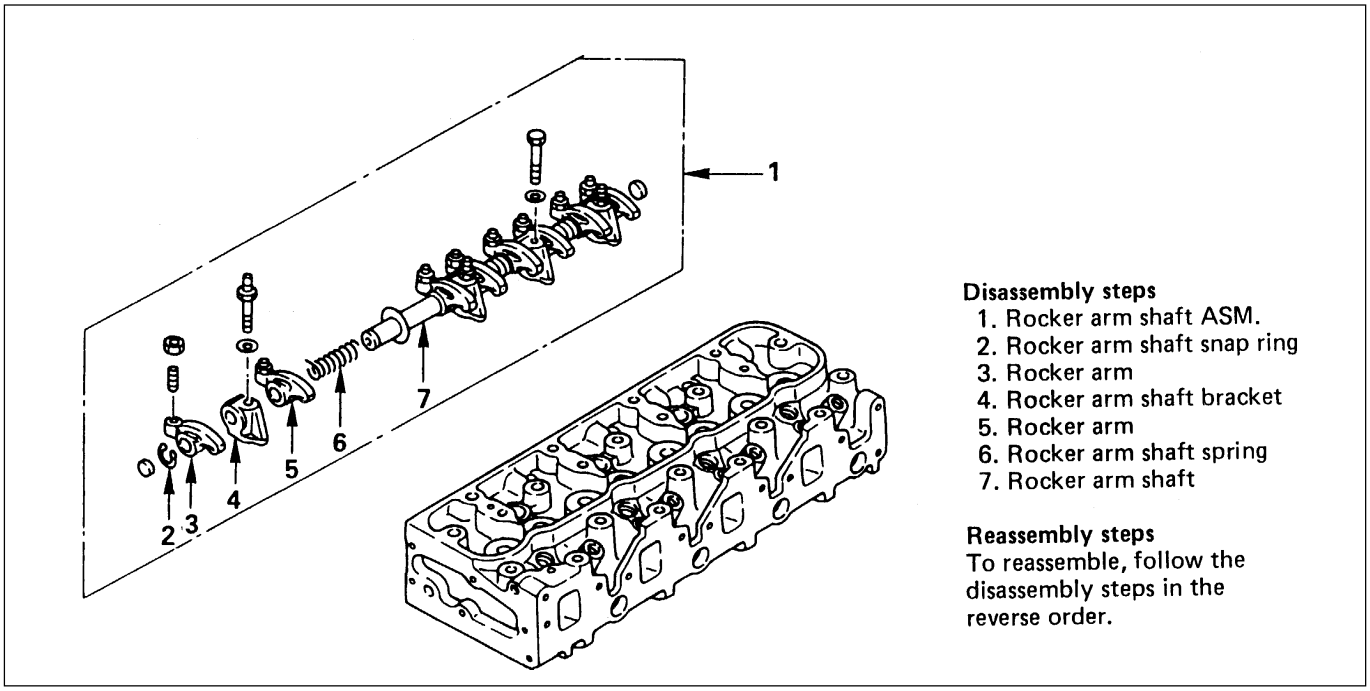
NOTE:

If the valve guide has been removed, both the valve and the valve guide must be replaced as a set.

3) Spring Lower Seat
4) Valve Stem Oil Seal
5) Valve
6) Valve Spring
7) Split Collar

Above works refer to “VALVE” Section in this manual.

ROCKER ARM ASSEMBLY



Disassembly steps
1. Rocker arm shaft ASM.
2. Rocker arm shaft snap ring
3. Rocker arm
4. Rocker arm shaft bracket
5. Rocker arm
6. Rocker arm shaft spring
7. Rocker arm shaft

Reassembly steps
To reassemble, follow the disassembly steps in the reverse order.

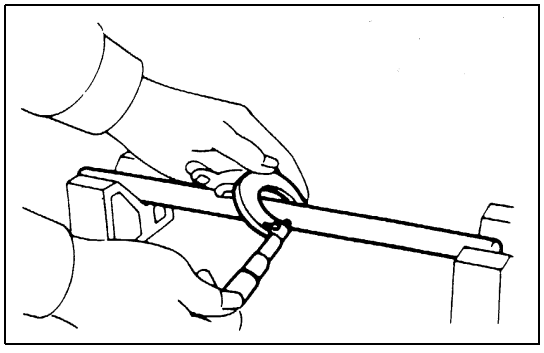
6A-24-1.tif

DISASSEMBLY

1. **Rocker Arm Shaft Assembly**
2. **Rocker Arm Shaft Snap Ring**
3. **Rocker Arm**
4. **Rocker Arm Shaft Bracket**
5. **Rocker Arm**
6. **Rocker Arm Shaft Spring**
7. **Rocker Arm Shaft**

INSPECTION AND REPAIR

Make the necessary adjustment, repairs, and part replacements if excessive wear or damage is discovered during inspection.



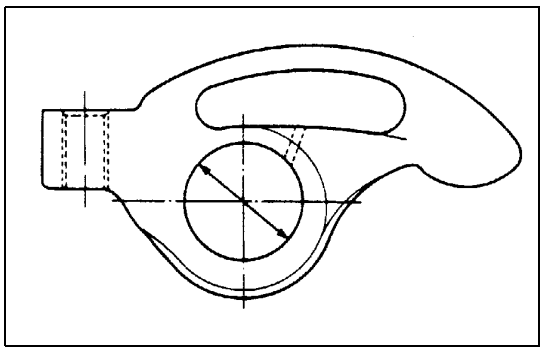
6A-24-2.tif

Use a micrometer to measure the rocker shaft outside diameter at the point where the rocker arm moves on the rocker shaft.

Replace the rocker shaft if the diameter exceeds the specified limit.

mm (in)

Standard	Limit
18.98 - 19.00 (0.7472 - 0.7480)	18.9 (0.744)



6A-25-1.tif

Oil Clearance

1. Use either a vernier caliper or a dial indicator to measure the rocker arm inside diameter.

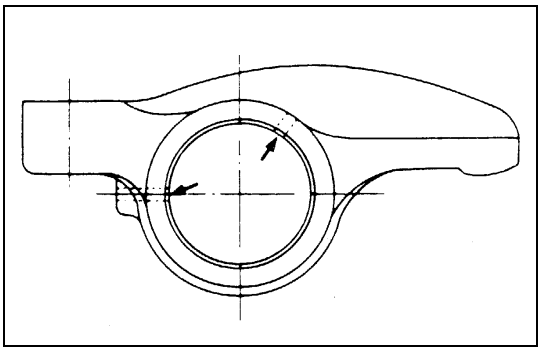
Rocker Arm Inside Diameter mm (in)

Standard	Limit
19.036 - 19.060 (0.7494 - 0.7503)	19.100 (0.7519)

2. Measure the rocker arm shaft outside diameter.
   If the measured value exceeds the specified limit, replace either the rocker arm or the rocker arm shaft.

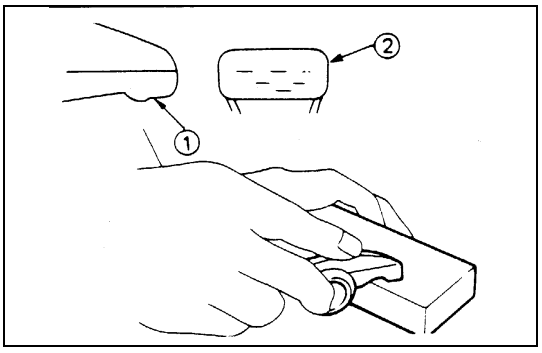
Rocker Arm and
Rocker Shaft Clearance mm (in)

Standard	Limit
0.06 - 0.08 (0.0024 - 0.0031)	0.10 (0.0039)



6A-25-2.tif

3. Check that the rocker arm oil port is free is obstructions.
   If necessary, use compressed air to clean the rocker arm oil port.



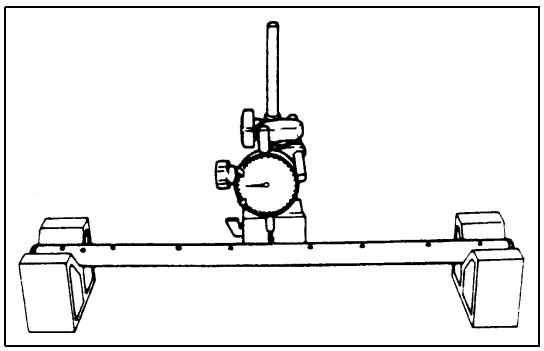
6A-25-3.tif

Rocker Arm Correction

Inspection the rocker arm valve stem contact surface for step wear ① and scoring ②.

If the contact surfaces have light step wear or scoring, they may be honed with an oil stone.

If the step wear or scoring is severe, the rocker arm must be replaced.



6A-26-1.tif

Rocker Arm Shaft Run-Out

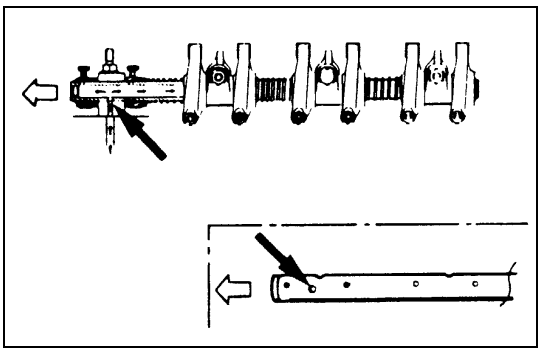
1. Place the rocker arm shaft on a V-block.
2. Use a dial indicator to measure the rocker arm shaft central portion run-out.

   If the run-out is very slight, correct the rocker arm shaft run-out with a bench press. The rocker arm must be at cold condition.

   If the measured rocker arm shaft run-out exceeds the specified limit, the rocker arm shaft must be replaced.

Rocker Arm Shaft Run-Out mm (in)

	Limit
4JB1 / 4JB1T / 4JB1TC	0.2 (0.008)
4JG2	



6A-26-2.tif

REASSEMBLY

7. Rocker Arm Shaft

- Apply a light coat of engine oil to the rocker arm shafts.
- Position the rocker arm shaft with the large oil hole (4ø) facing the front of the engine.
- Install the rocker shaft together with the rocker arm, the rocker arm shaft bracket, and the spring.

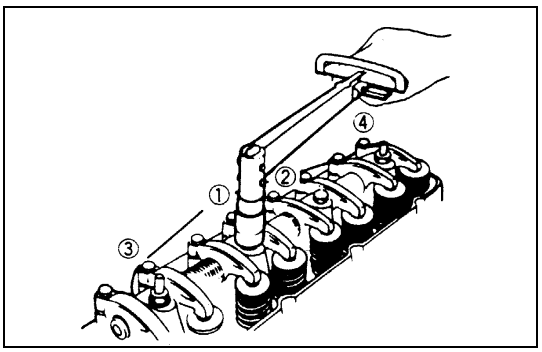
6. Rocker Arm Shaft Spring

5. Rocker Arm

4. Rocker Arm Shaft Bracket

3. Rocker Arm

2. Rocker Arm Shaft Snap Ring

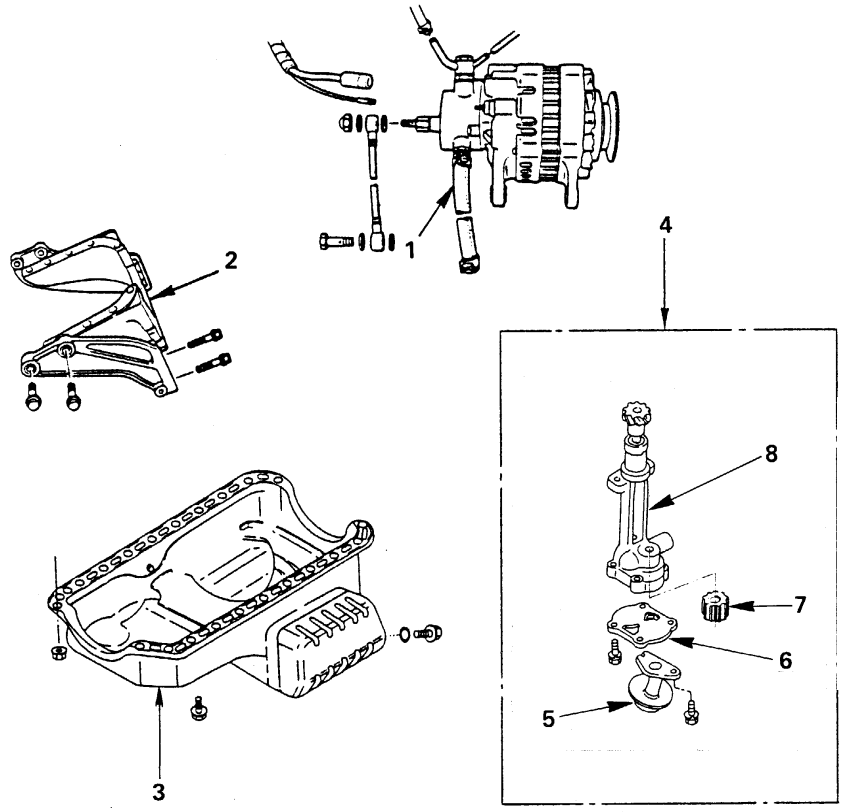


6A-26-3.tif

1. Rocker Arm Shaft Assembly

- Install the rocker arm shaft assembly in cylinder head.
- Tighten the rocker arm shaft fixing bolts to the specified torque.

OIL PUMP

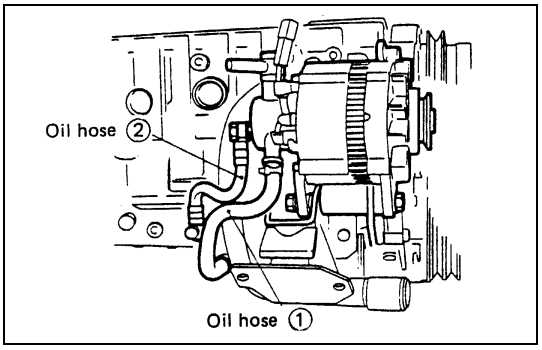


Disassembly steps
1. Vacuum pump oil hose
2. Stiffener and space rubber
3. Oil pan Assembly
4. Oil pump Assembly
5. Strainer
6. Pump cover
7. Driven gear
8. Oil pump body

Reassembly steps
To reassemble, follow the disassembly steps in the reverse order.

6A-27-1.tif

DISASSEMBLY



6A-27-2.tif

1. **Vacuum Pump Oil Hose**
   - Remove the oil hose ① from oil pan.
2. **Stifner & Space Rubber**
   - Remove the stiffener from of the oil pan left & right side.
   - Take out space rubber.
3. **Oil Pan Assembly**

4. **Oil Pump Assembly**
5. **Strainer**
6. **Pump Cover**
7. **Driven Gear**
8. **Oil Pump Body**

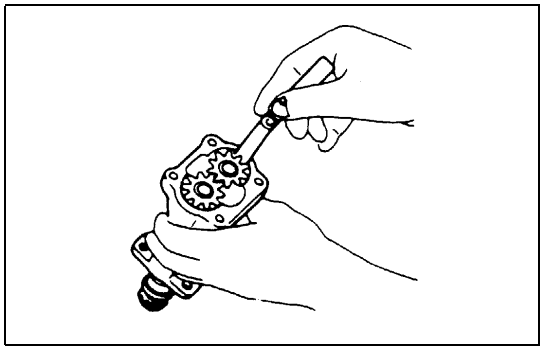
INSPECTION AND REPAIR

Make the necessary adjustment, repairs, and part replacements if excessive wear or damage is discovered during inspection.

Body and gears

The pump assembly must be replaced if one or more of the conditions below is discovered during inspection.

- Badly worn or damaged driven gear guide.
- Badly worn or damaged gear teeth.



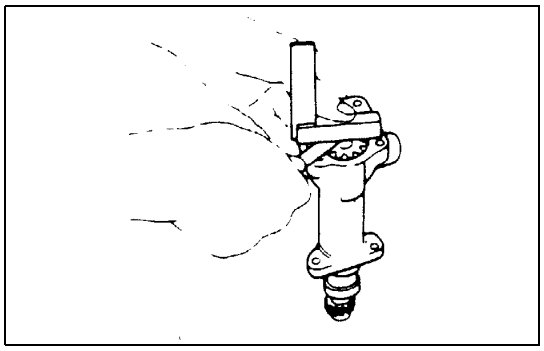
6A-28-1.tif

Gear Teeth and Body Inner Wall Clearance

- Use a feeler gauge to measure the clearance between the gear teeth and the body inner wall.
- If the clearance between the gear teeth and the body inner wall exceeds the specified limit, either the gear or the body must be replaced.

Gear Teeth and Body
Internal Wall Clearance mm (in)

Standard	Limit
0.14 (0.0055)	0.20 (0.0079)



6A-28-2.tif

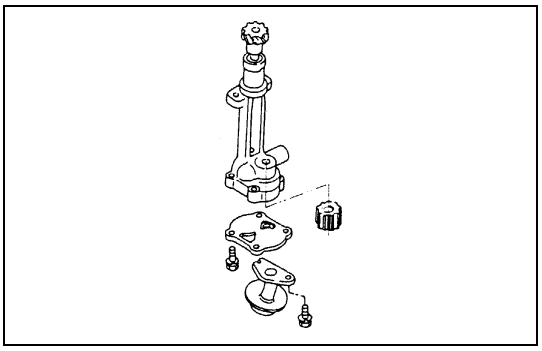
Gear and Body Clearance

- Use a feeler gauge to measure the clearance between the body and the gear.
- If the clearance between the gear and the body exceeds the specified limit, the body must be replaced.

Gear and Body Clearance mm (in)

Standard	Limit
0.06 (0.024)	0.15 (0.0059)

REASSEMBLY



6A-29-1.tif

8. Oil Pump Body

7. Driven Gear

6 Pump Cover

5. Strainer

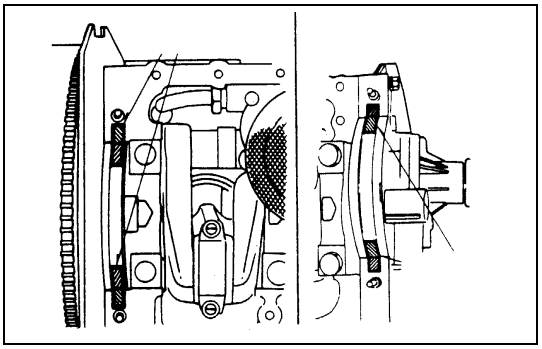
- Install the strainer assembly and tighten the strainer assembly fixing bolts.

	N·m (kg·m/lb·ft)
	16 (1.6/12)

4. Oil Pump Assembly

- Apply molybdenum mixed engine oil to drive gear of camshaft and driven gear of oil pump.
- Tighten the oil pump fixing bolt to the specified torque.

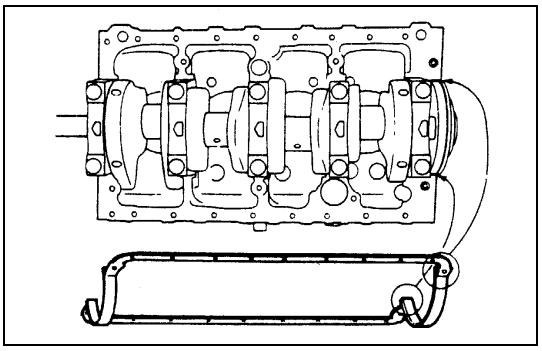
	N·m (kg·m/lb·ft)
	19 (1.9/14)



6A-29-2.tif

3. Oil Pan Assembly

- Apply the recommended liquid gasket or its equivalent to the No. 5 bearing cap arches, the grooves, the cylinder block and the timing gear case filting face at the positions shown in the illustration.



6A-29-3.tif

- Fit the gasket rear lipped portion into the No. 5 groove.
- Be absolutely sure that the lipped portion is fitted snugly into the groove.
- Install the oil pan to the cylinder body.
- Tighten the oil pan bolts to the specified torque.

Oil Pan Bolt Torque	N·m (kg·m/lb·ft)
	19 (1.9/14)

2. Stiffener & Space Rubber

- Install the space rubber.
- Install the stiffener tighten to the specified torque.

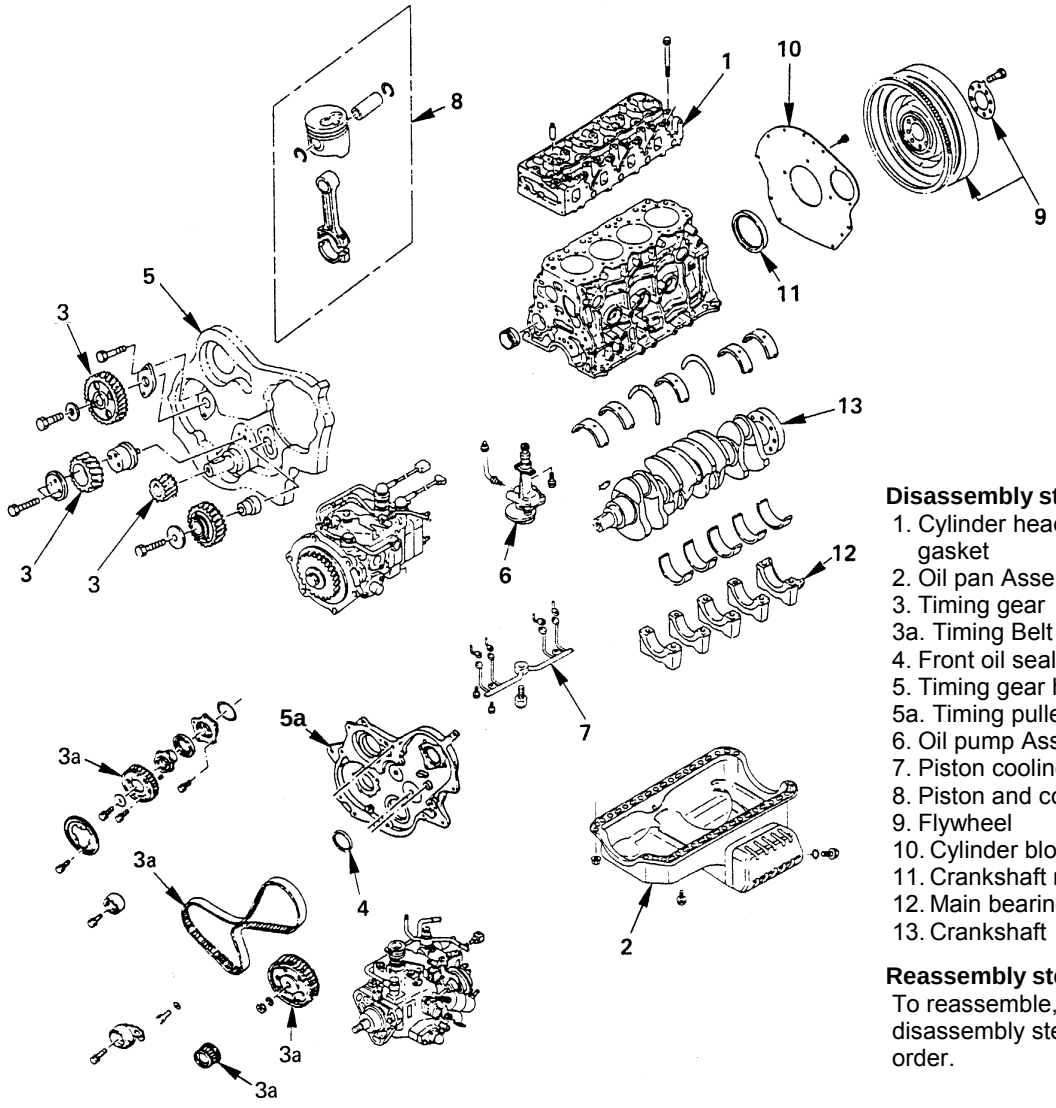
	Engine Body Side	N·m (kg·m/lb·ft)
	37 (3.8/27)	

	Clutch Housing Side	N·m (kg·m/lb·ft)
	78 (8.0/58)	

1. Vacuum Pump Oil Hose

- Install the oil hose to oil pan.

CRANKSHAFT



Disassembly steps
1. Cylinder head Assembly and gasket
2. Oil pan Assembly
3. Timing gear
3a. Timing Belt and Pulley
4. Front oil seal
5. Timing gear housing
5a. Timing pulley housing
6. Oil pump Assembly
7. Piston cooling oil pipe
8. Piston and connecting rod
9. Flywheel
10. Cylinder block rear plate
11. Crankshaft rear oil seal
12. Main bearing cap
13. Crankshaft

Reassembly steps
To reassemble, follow the disassembly steps in the reverse order.

6A-31-1.tif

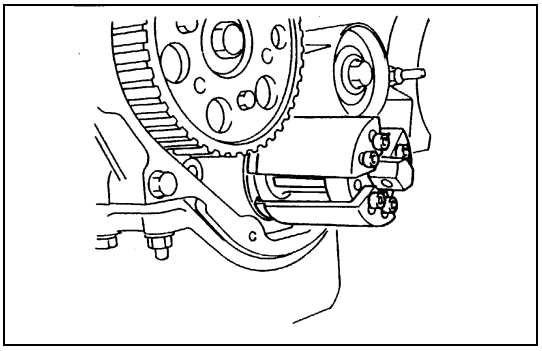
DISASSEMBLY

1. **Cylinder Head Assembly and Gasket**
2. **Oil Pan Ambly**
3. **Timing Gear (Gear Drive Model)**

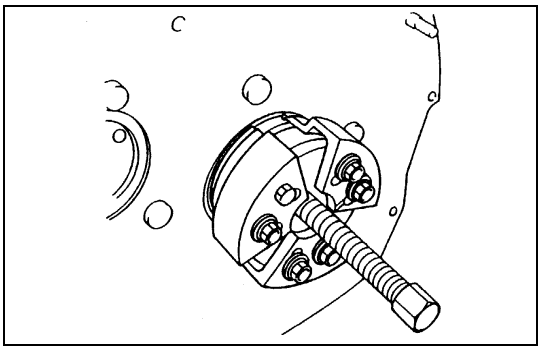
3a. Timing Belt and Pulley (Belt Drive Model)

4. **Front Oil Seal**
   - With the oil seal pushed in deep, install the special tool as shown in the illustration to remove the oil seal.

     Remover: 5-8840-2362-0



5. **Timing Gear Housing**
5a. **Timing Pulley Housing**
6. **Oil Pump Assembly**
7. **Piston Cooling Oil Pipe**
8. **Piston and Connecting Rod**
9. **Flywheel**
10. **Cylinder Block Rear Plate**



6A-32-1.tif

11. **Crankshaft Rear Oil Seal (Gear and Belt Drive Model)**
    - With the oil seal pushed in deep, install the special tool as shown in the illustration to remove the oil seal.
      Remover: Rear Oil Seal 5-8840-2360-0

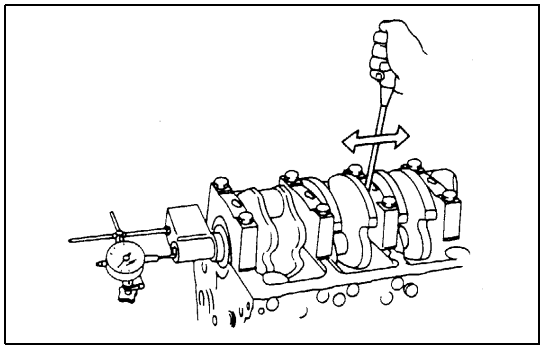
NOTE:

Take care not to damage sealing surface of rear plate and crankshaft when removing oil seal.

12. **Main Bearing Cap**
13. **Crankshaft**

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.



6A-32-2.tif

1. **Crankshaft**

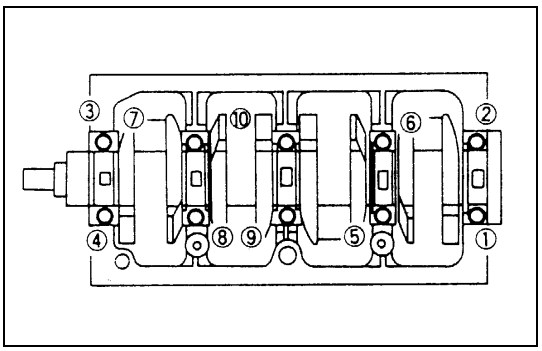
Thrust clearance

Set the dial indicator as shown in the illustration and measure the crankshaft thrust clearance.

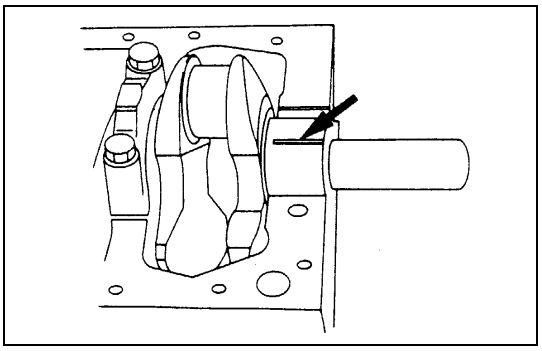
If the thrust clearance exceeds the specified limit, replace the thrust bearing as a set.

Thrust clearance mm (in)

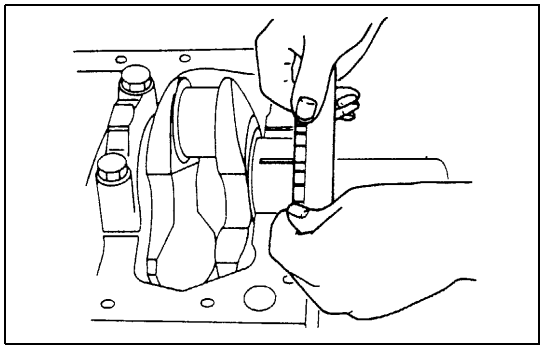
Standard	Limit
0.10 (0.0039)	0.30 (0.0118)



6A-33-1.tif



6A-33-2.tif



6A-33-3.tif

2. Main bearing clearance

1) Remove the main bearing caps in the sequence shown in the illustration.

   Arrange the removed main bearing caps in the cylinder number order.
2) Remove the crankshaft. Remove the main bearings.
3) Clean the upper and lower bearings as well as the crankshaft main journal.
4) Check the bearings for damage or excessive wear.

   The bearings must be replace as a set if damage or excessive wear is discovered during inspection.
5) Set the upper bearings and the thrust washers to their original positions. Carefully install the crankshaft.
6) Set the lower bearings to the bearing cap original position.
7) Apply plastigage to the crankshaft journal unit as shown in the illustration.
8) Install the main bearing caps. Apply engine oil to the bolt threads and the seats. Tighten the bolts to the specified torque.

N·m (kg·m/lb·ft)
167 (17/123)

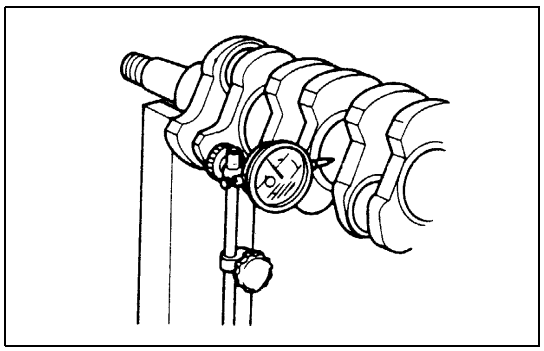
NOTE:

Do not allow the crankshaft to rotate.

9) Remove the main bearing caps.
10) Measure the plastigage width and determine the oil clearance. If the oil clearance exceeds the specified limit, replace the main bearings as a set and/or replace the crankshaft.
11) Clean the plastigage from the bearings and the crankshaft.
12) Remove the crankshaft and the bearings.

Oil Clearance mm (in)

	Standard	Limit
4JB1 /4JB1T 4JB1TC	0.035 - 0.080 (0.0014 - 0.0036)	0.11 (0.0043)
4JG2	0.031 - 0.063 (0.0012 - 0.0025)	



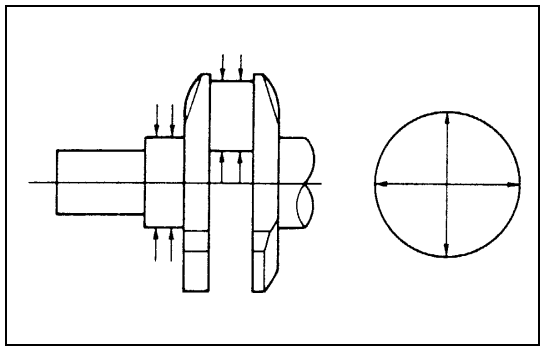
6A-34-1.tif

3. Run-out

1) Carefully set the crankshaft on the V-blocks.
   Slowly rotate the crankshaft and measure the runout.
   If the crankshaft runout exceeds the specified limit, the crankshaft must be replaced.

Run-Out mm (in)

Standard	Limit
0.05 (0.0020) or less	0.08 (0.0031)



6A-34-2.tif

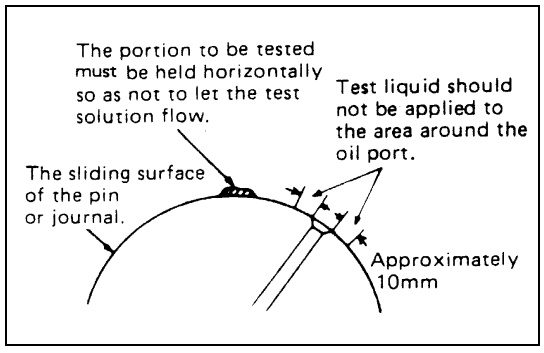
Measure the diameter and the uneven wear of main journal and crank pin.
If the crankshaft wear exceeds the specified limit, crankshaft must be replaced.

mm (in)

	Standard	Limit
Main journal diameter	69.917-69.932 (2.7526 - 2.7532)	69.91 (2.7524)
Crank pin diameter	52.915 - 52.930 (2.0833)	52.90 (2.0843)
Uneven wear limit	0.05 (0.0020) or less	0.08 (0.0031)

Crankshaft inspection

Inspect the surface of the crankshaft journals and crank pins for excessive wear and damage.
Inspect the oil seal fitting surfaces for excessive wear and damage.
Inspect the oil ports for obstructions.



6A-34-3.tif

Crankshaft tufftriding inspection

The portion to be tested must be held horizontally so as not let the test solution flow.
Test liquid should not be applied to the area around the oil port.
The sliding surface of the pin or journal.
Approximately 10mm

NOTE:

To increase crankshaft strength, Tufftride Method (Soft nitriding) has been applied. Because of this, it is not possible to regrind the crankshaft surfaces.

1. Use an organic cleaner to thoroughly clean the crankshaft. There must be no traces of oil the surfaces to be inspected.
2. Prepare a 5-10% solution of ammonium cupric chloride (dissolved in distilled water).

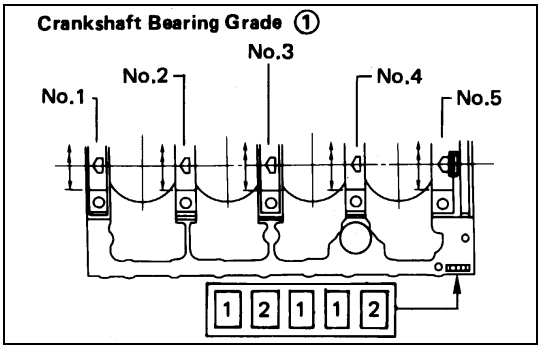
3. Use a syringe to apply the solution to the surface to be inspected.
   Hold the surface to be inspected perfectly horizontal to prevent the solution from running.

NOTE:
Do not allow the solution to come in contact with the oil ports and their surrounding area.

Testing

1. Wait for thirty to forty seconds.
   If there is no discoloration after thirty or forty seconds, the crankshaft is usable.
   If discoloration appears (the surface being tested will become the color copper), the crankshaft must be replaced.
2. Steam clean the crankshaft surface immediately after completing the test.

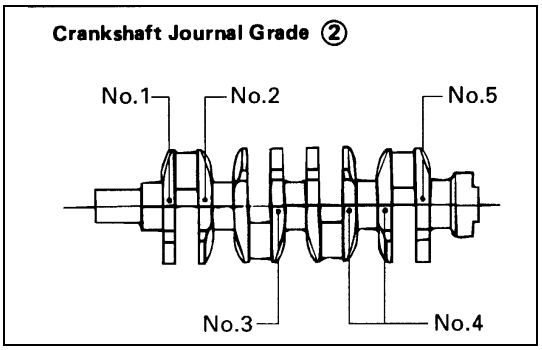
NOTE:
The ammonium cupric chloride solution is highly corrosive. Because of this, it is imperative that the surfaces being tested be cleaned immediately after completing the test.



6A-35-1.tif

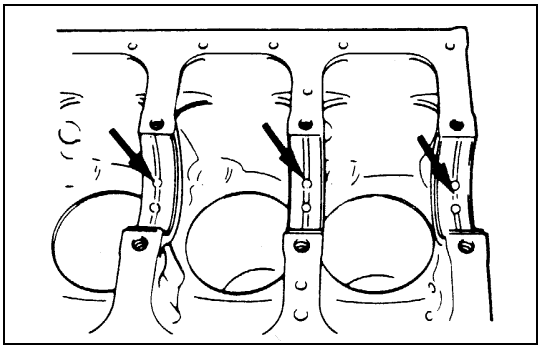
CRANKSHAFT BEARING SELECTION

When installing new crankshaft bearings or replacing old bearings, refer to the selection table.



6A-35-2.tif

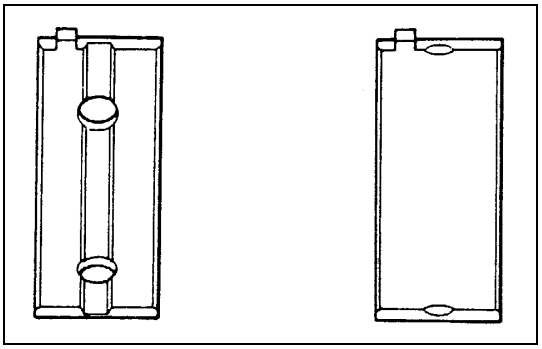
NOTE:
Please note that some Crankshaft No. 4 journals made during a limited production period have their number (No. 4) marked on either their front or rear side of webs as shown below.



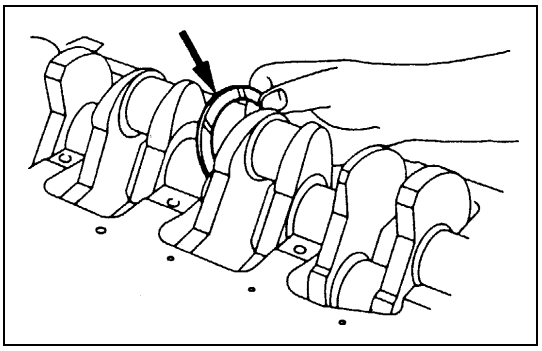
6A-35-3.tif

NOTE:
Although all upper journal bearings (cylinder body side) have oil grooves and holes, all lower bearings (bearing cap side) have no groove and hole.
Play close attention to the distinction during the installation procedure.

Main Bearing Bore Diameter mm (in.)		Crankshaft Main Journal Diameter mm (in.)		Crankshaft Bearing Size Mark	Oil Clearance mm (in.)
Size Mark	Inside Diameter	Size Mark	Outside Diameter		
1	73.987~74.000 (2.9129~2.9134)	1 or -	69.927~69.942 (2.7530~2.7536)	Black	0.035~0.061 (0.0014~0.0024)
		2 or -	69.922~69.927 (2.7528~2.7530)	Blue	0.032~0.058 (0.0013~0.0023)
		3 or -	69.917~69.922 (2.7526~2.7528)		0.037~0.063 (0.0015~0.0025)
2	73.975~73.987 (2.9124~2.9129)	1 or -	69.927~69.942 (2.7530~2.7536)	Green	0.031~0.056 (0.0012~0.0022)
		2 or -	69.922~69.927 (2.7528~2.7530)		0.036~0.048 (0.0014~0.0019)
		3 or -	69.917~69.922 (2.7526~2.7528)	Black	0.033~0.058 (0.0013~0.0023)



6A-36-1.tif



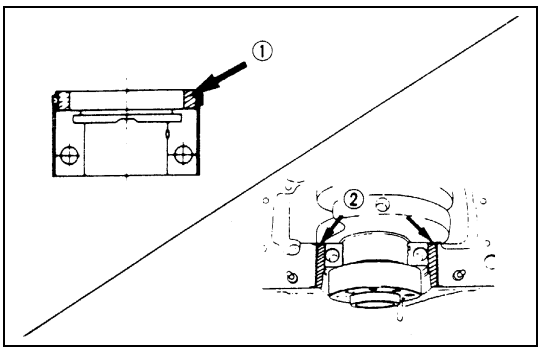
6A-36-2.tif

REASSEMBLY

13. Crankshaft

- Install the main bearings to the cylinder body and the main bearing caps.
- Be sure that they are positioned correctly.
- Apply new engine oil to the upper and lower main bearing faces.
- Carefully mount the crankshaft.
- Apply engine oil to the thrust washer.

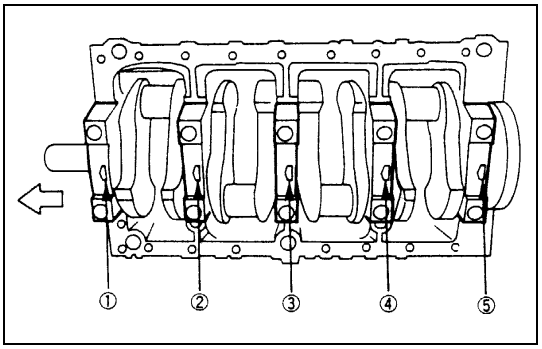
- Assemble the thrust washer to the No.3 bearing journal. The oil grooves must face the crankshaft.



6A-37-1.tif

12. Main Bearing Cap

- Apply the recommended liquid gasket or its equivalent to the No. 5 crankshaft bearing cap ① as shown in the illustration.
- Install the arch gasket ② to the No. 5 bearing cap.
  Use your fingers to push the arch gasket into the bearing cap groove.

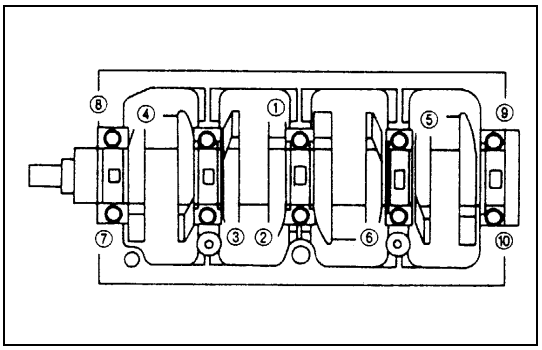


6A-37-2.tif

NOTE:

Be sure that the bearing cap fitting surface is completely free of oil before applying the liquid gasket.

Do not allow the liquid gasket to obstruct the cylinder thread holes and bearings.



6A-37-3.tif

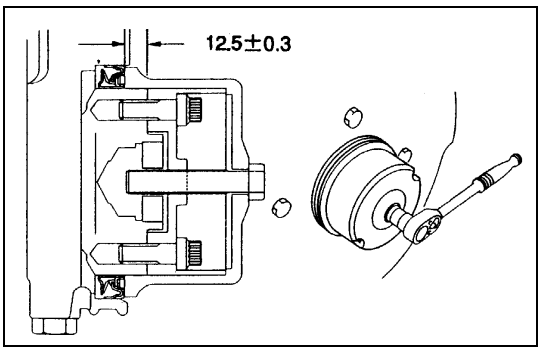
- Install the bearing caps with the bearing cap head arrow mark facing the front of the engine.
- Apply engine oil to the crankshaft bearing cap bolts.
- Tighten the crankshaft bearing cap bolts to the specified torque a little at a time in the sequence shown in the illustration.

N·m (kg·m/lb·ft)

167 (17.0/123)

NOTE:

Check to see that the crankshaft turns smoothly by rotating it manually.



6A-38-1.tif

11. Crankshaft Rear Oil Seal (Gear and Belt Drive Model)

Use the oil seal installer to install the oil seal to the cylinder body.

Installer: Rear Oil Seal 5-8840-2359-0

NOTES:

Wipe off rust and scraps clean from the press-in portion of the oil seal.

Take note of the press-in direction of the oil seal.

1) Install the adapter of the special tool to the rear end of the crankshaft with two bolts.
2) Install the oil seal to the outer circumference of the adapter.
3) Insert the slave into the adapter portion, and tighten it in with the bolt (M12 x 1.75L=70) until the adapter section hits the slave.
4) Remove the adapter and the slave.
5) After installing the oil seal, check the measurement of the oil seal.

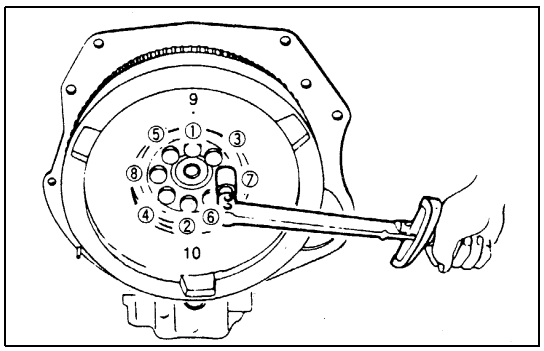
Standard	mm (in)
12.2 - 12.8 (0.48 - 0.50)	

10. Cylinder Block Rear Plate

Align the rear plate with the cylinder body knock pins.

Tighten the rear plate to the specified torque

N·m (kg·m/lb·ft)
82 (8.4/61)



6A-38-2.tif

9. Flywheel

1) Thoroughly clean the remove the oil from the threads of crankshaft.
2) Mount the flywheel on the crankshaft and then install the washer.
3) Apply a coat of engine oil to the threads of the flywheel bolts.
4) Align the flywheel with the crankshaft dowel pin.
5) Tighten the flywheel bolts to the specified torque in two steps using the Angular Tightening Method.

   Follow the numerical order shown in the illustration.

Flywheel Bolt Torque N·m (kg·m/lb·ft)

1st Step	2nd Step
59 (6.0/43)	60° - 90°

8. Piston and Connecting Rod

7. Piston Cooling Oil Pipe

6. Oil Pump Assembly

Above works refer to “PISTON AND CONNECTING ROD” Section in this manual.

5a. Timing Pulley Housing

1) Install the timing pulley housing to the cylinder body.

NOTE:

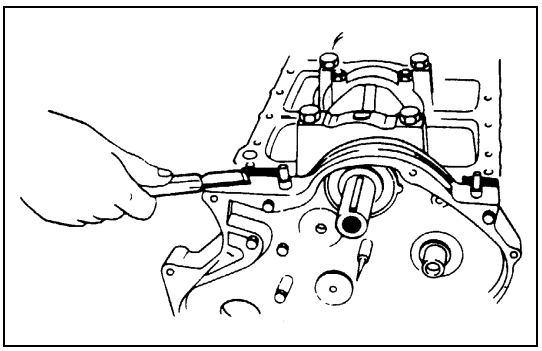
Take care not to twist the front oil seal.

2) Tighten the timing pulley housing bolt together with the timing pulley housing gasket to the specified torque.

N·m (kg·m/lb·ft)

19 (1.9/14)

3) Cut away the gasket protruding above the fitting surfaces (as shown in the illustration)



6A-39-1.tif

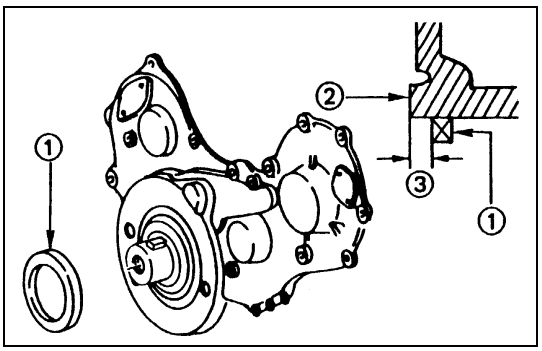
5. Timing Gear Housing

1) Install the timing gear housing to the cylinder body.
2) Tighten the timing gear housing bolt together with the timing gear housing gasket to the specified torque.

N·m (kg·m/lb·ft)

19 (1.9/14)

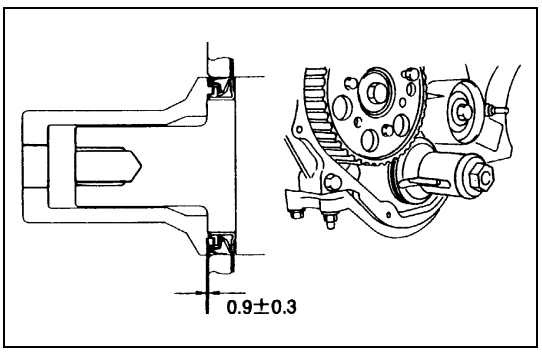
3) Cut away the gasket protruding above the fitting surface (as shown in the illustration).



6A-39-2.tif

4. Front Oil Seal (Gear Drive Model)

- Install oil seal using special tool.
  Installer: 5-8840-2061-0



6A-39-3.tif

4. Front Oil Seal (Belt Drive Model)

- Install oil seal using special tool.
  Installer: 5-8840-2361-0

NOTE:

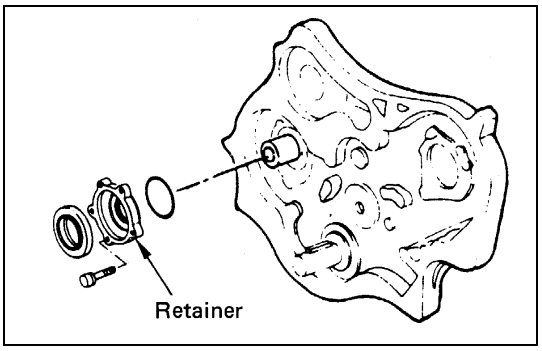
Wipe off rust and scraps clean from the press-in portion of the oil seal.

Take note of the press-in direction of the oil seal.

1) With the oil seal attached to the sleeve, put it in the front end of the crankshaft.
2) With the edge of the oil seal attached securely to the crankshaft, tighten it with the center bolt until the sleeve hits securely against the reference plane at the front end of the crankshaft.
3) Remove the sleeve.

4) After pressing in the oil seal, check the measurement of the oil seal.

Standard	mm (in)
0.6 - 1.2 (0.024 - 0.047)	



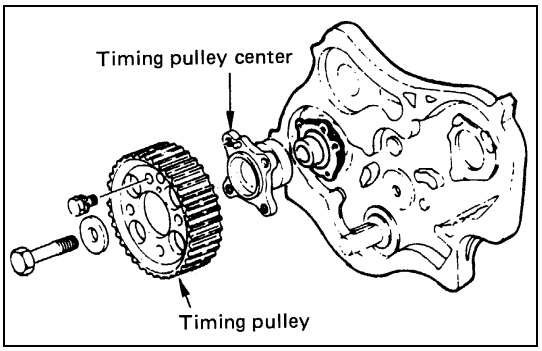
6A-40-1.tif

3a. Timing Belt and Pulley (Belt Drive Model)

7) Camshaft Timing Pulley

- Apply engine oil to the oil seal lip portion of the oil seal retainer.
- Apply the recommended liquid gasket or its equivalent to the retainer.
- Install the oil seal retainer to the cylinder body.
- Tighten the retainer bolts to the specified torque.

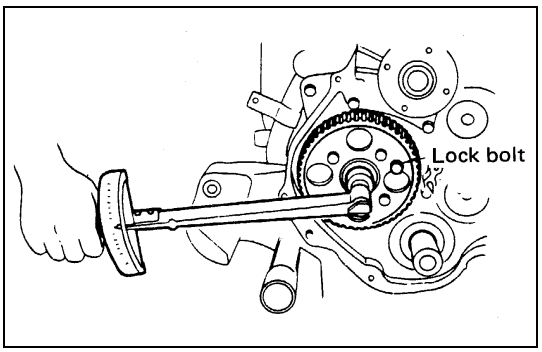
Oil Seal Retainer Bolt Torque	N·m (kg·m/lb·ft)
19 (1.9/14)	



6A-40-2.tif

- Align the camshaft timing pulley center with the camshaft key.
- Tighten the timing pulley bolts to the specified torque.

Timing Pulley Bolt Torque	N·m (kg·m/lb·in)
8 (0.8/69)	



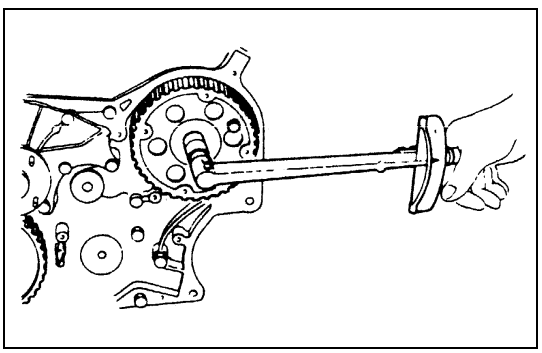
6A-40-3.tif

- Prevent the camshaft from turning when tightening the timing center bolt.
- Tighten the timing pulley center bolt to the specified torque.

Center Bolt Torque	N·m (kg·m/lb·ft)
64 (6.5/47)	

- Install the crank pulley.
- Install the idle pulley and idler pulley.

	N·m (kg·m/lb·ft)
76 (7.8/56)	


6A-40-4.tif

- Install the injection pump assembly and install timing pulley.
- Align the timing pulley with the pump shaft key.
- Install the stopper bolt to the timing pulley.
  This will prevent the timing pulley from moving.
- Tighten the timing pulley nut to the specified torque.

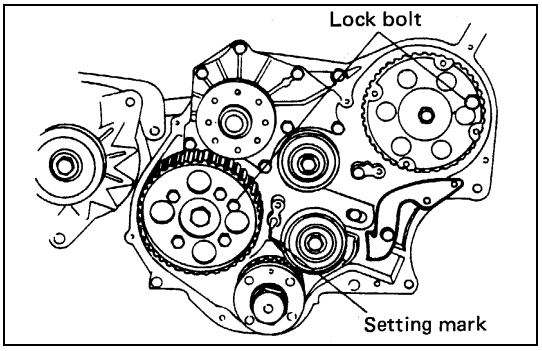
Injection Pump Timing Pulley Nut Torque	N·m (kg·m/lb·ft)
64 (6.5/47)	

- Remove the stopper bolt from the injection timing.

6) Timing Belt

NOTE:

- When the timing belt is removed, be sure to replace it with a new one.
- The tension of the timing belt may be affected by the changes in temperature. Be sure to install it while the engine cold.
- When the timing belt is bent forcibly, the cord may got snapped, thus resulting in the reduced strength. Do not bend it unnecessarily.



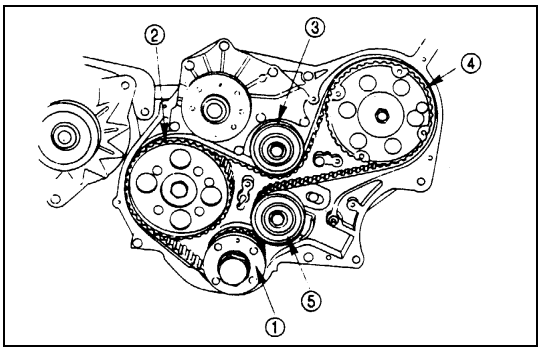
6A-41-1.tif

① Check that the stopper bolts are properly installed to the camshaft timing pulley and the injection pump timing pulley.

② Check that the timing pulley housing mark and the crankshaft timing pulley mark are aligned.

The No. 1 cylinder should be at TDC on the compression stroke.

Rotate the crankshaft damper pulley clockwise to align the marks.



6A-41-2.tif

③ Install the timing belt to the crankshaft timing pulley ①, the camshaft timing pulley ②, the tensioner idler ③, and the injection timing pulley ④.

Follow the numerical order.

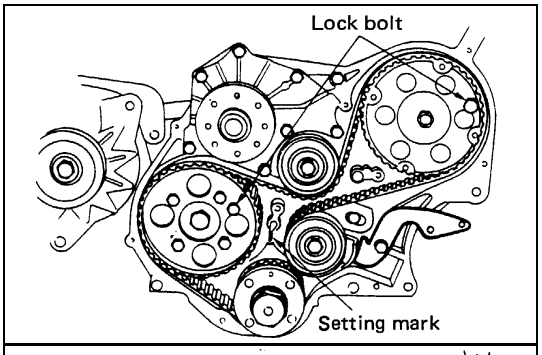
④ Install the timing belt tensioner ⑤ to the timing pulley housing.

⑤ Temporarily tighten the tensioner bolt.

The tensioner should move freely

NOTE:

The timing belt is easily damaged. Be careful.

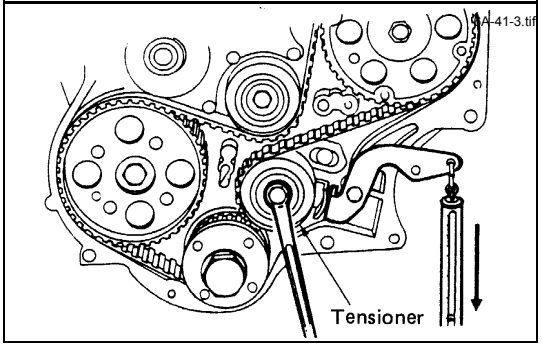


6A-41-3.tif

NOTE:

After completion of the installation of the timing belt, check to see if the alignment mark of the crankshaft timing pulley is in line with the alignment mark provided on the housing.

- When the alignment marks are not in line with each other, set them together and reinstall the timing belt.



6A-42-1.tif

⑥ Set the tensioner adjusting lever to the timing pulley housing.

⑦ Remove the stopper bolts from the camshaft timing pulley and the injection pump timing pulley.

⑧ Attach the spring balancer.

⑨ Adjust the timing belt tension by pulling straight down on the spring balancer with the specified force.

Tension Adjusting Lever Force	N (kg/lb)
	98 - 118 (10 - 12/22 - 26)

NOTE:

Timing belt tension must be adjusted.

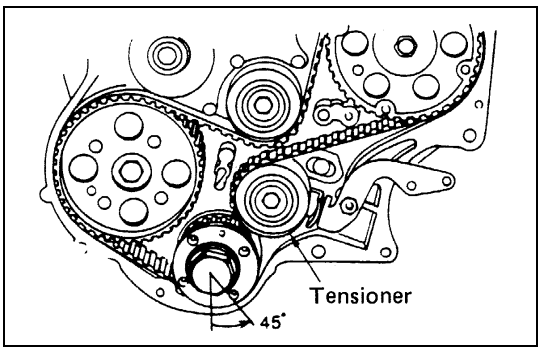
Failure to adjust the timing belt tension will result in timing belt damage.

⑩ Tighten the tension bolt.

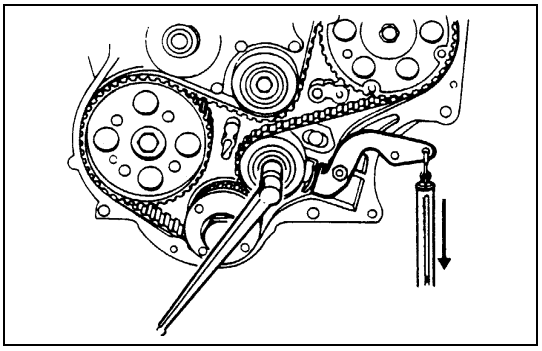
⑪ Rotate the crankshaft 45 degrees counterclockwise.

NOTE:

Never rotate the crankshaft clockwise when adjusting the timing belt.



6A-42-2.tif

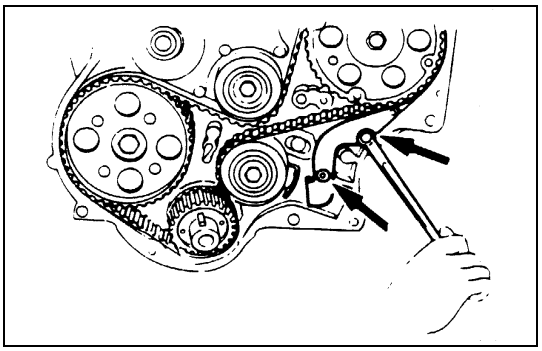


6A-42-3.tif

⑫ Readjust the timing belt tension.
Refer to Step 9
This will remove any remaining timing belt slack.

⑬ Tighten the tensioner bolt to the specified torque.

Tensioner Bolt Torque	N·m (kg·m/lb·ft)
	76 (7.7/56)



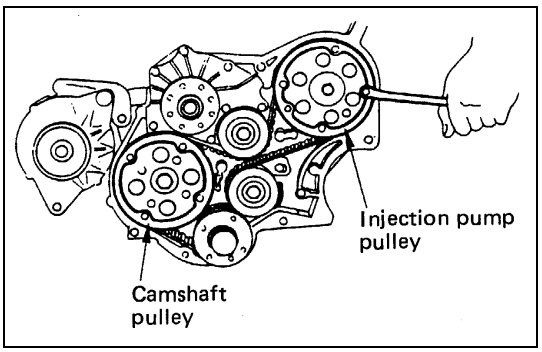
6A-42-4.tif

⑭ Tighten the tension adjusting lever nut and bolt.

NOTE:

If on-vehicle timing belt replacement is performed, the crankshaft must not be allowed to turn.

If the crankshaft is allowed to turn, piston and valve damage will result.



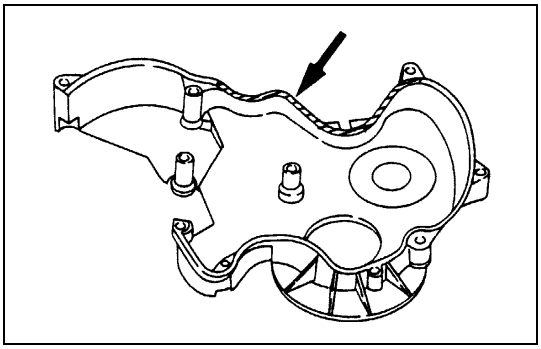
6A-43-1.tif

5) Flange: Camshaft Pulley

4) Flange: Injection Pump Pulley

- Install the timing pulley flange to the camshaft and injection pump timing pulley.
- Tighten the timing pulley flange bolts to the specified torque.

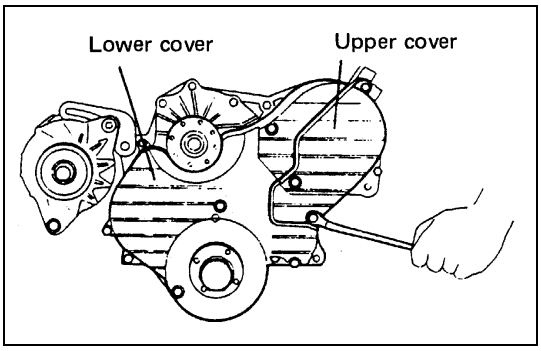
Timing Pulley Flange Bolt Torque	N·m (kg·m/lb·ft)
	19 (1.9/14)



6A-43-2.tif

3) Timing Pulley Lower Cover
- Apply the recommended liquid gasket or its equivalent to the timing pulley lower cover.
- Install the lower cover to the timing pulley housing.
- Use the lower cover guide bolts to prevent the liquid gasket from running.

2) Timing Pulley Upper Cover
- Install the upper cover to the lower cover and the pulley housing.



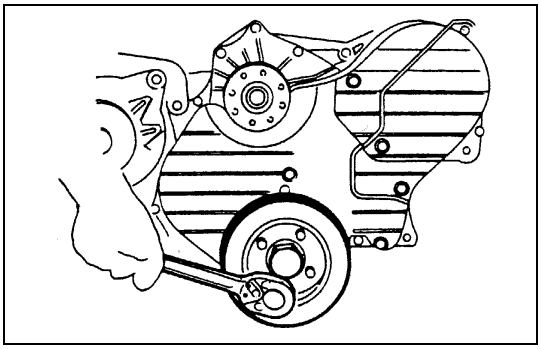
6A-43-3.tif

- Tighten the timing pulley cover bolts to the specified torque a little at a time.

Timing Pulley Cover Bolt Torque	N·m (kg·m/lb·ft)
	8 (0.81/6)

- Remove the lower cover guide pin.

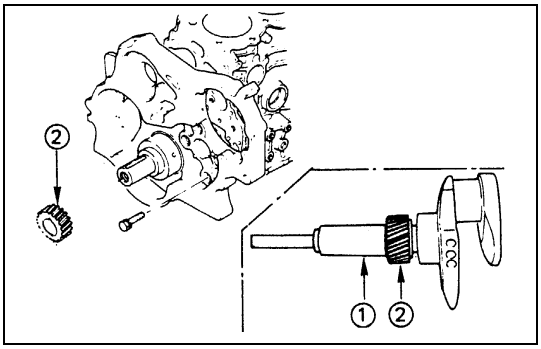
Crankshaft Center Pulley Torque	N·m (kg·m/lb·ft)
	206 (21/152)



6A-43-4.tif

1) Crankshaft Damper Pulley
- Install the damper pulley and tighten bolts to the specified torque.

Pulley Bolts Torque	N·m (kg·m/lb·ft)
	19 (1.9/14)



6A-43-5.tif

3. Timing Gear (Gear Drive Model)

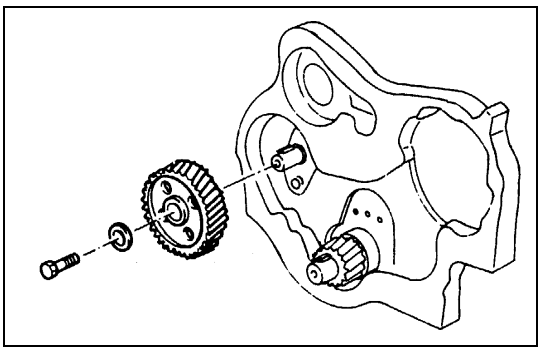
11) Crank Shaft Gear

① Install the crankshaft gear.

② Use the crankshaft gear installer ① to install the crankshaft gear ②.

The crankshaft gear timing mark (“X – X”) must be facing outward.

Crankshaft Gear Installer: 9-8522-0020-0



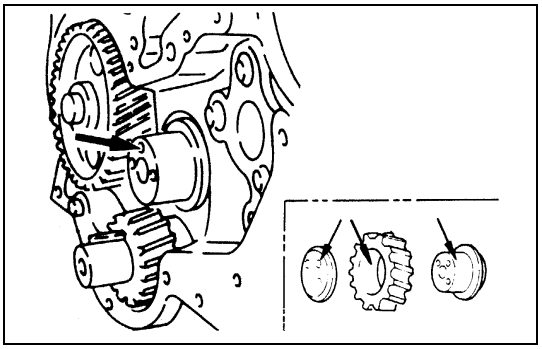
6A-44-1.tif

10) Crankshaft Timing Gear

① Install the camshaft timing gear to the camshaft.
The timing gear mark (“Y – Y”) must be facing outward.

② Tighten the timing gear to the specified torque.

N·m (kg·m/lb·ft)
64 (6.5/47)

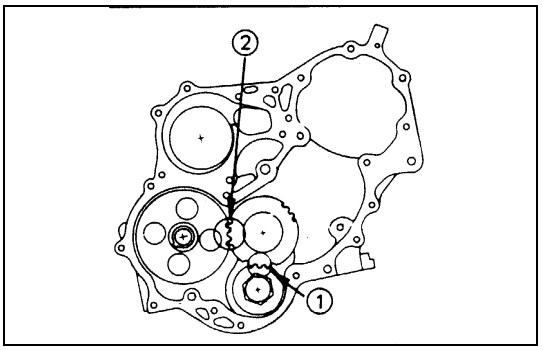


6A-44-2.tif

9) Idle Gear

① Apply engine oil to the idle gear and the idler gear shaft.
The idler shaft oil hole must be facing up.

② Position the idler gear setting marks “X” and “Y” so that they are facing the front of the engine.



6A-44-3.tif

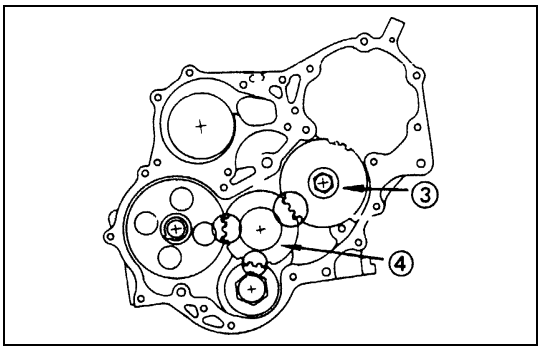
③ Align the idler gear “X” setting mark with the crankshaft timing gear ① “X – X” setting mark.

④ Align the idler gear “Y” setting mark with the camshaft timing gear ① “Y – Y” setting mark.

⑤ Install the thrust collar and bolts to the cylinder body through the shaft.
The thrust collar oil hole must be facing up, and the thrust collar chamfered must be outward.

⑥ Tighten the idler gear bolt to the specified torque.

N·m (kg·m/lb·ft)
19 (1.9/14)



6A-44-4.tif

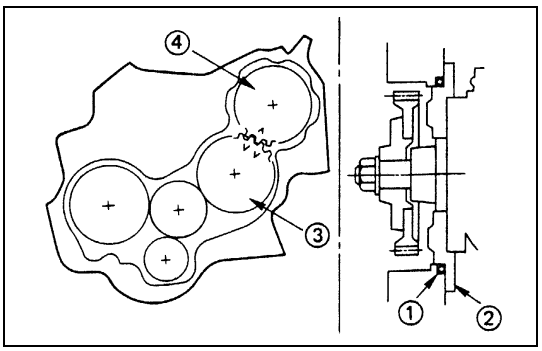
8) Idler Gear “B” and Shaft

① Apply engine oil to the idler gear and the idler gear shaft.

② Align the idler gear “B” ③ “Z” setting mark with the idler gear “A” ④ “Z-Z” setting mark.

③ Tighten the idler gear bolt to the specified torque.

N·m (kg·m/lb·ft)
76 (7.7/56)

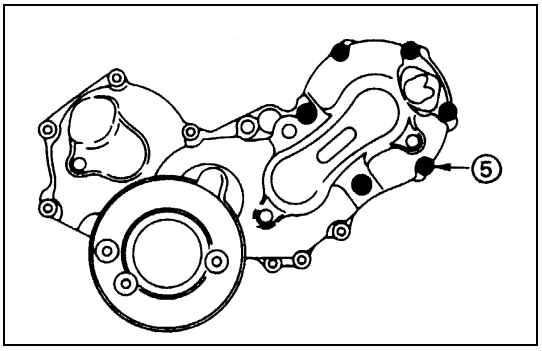


6A-44-5.tif

7) Injection Pump

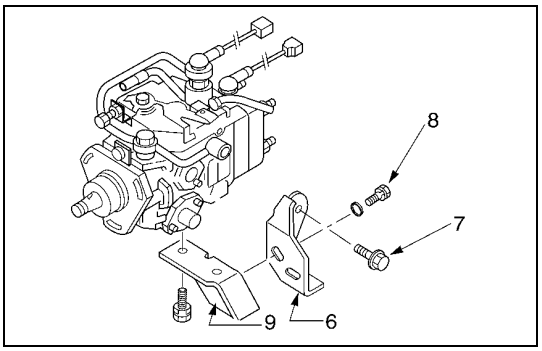
① Install the O-ring ① to the injection pump flange ②.

② Install the injection pump to the timing gear case.
Align the idler gear “B” ③ “V-V” mark.



6A-45-1.tif

③ Temporarily tighten the six injection pump nuts ⑤.
The injection pump nuts will be finally tightened after the injection pump rear bracket bolts.



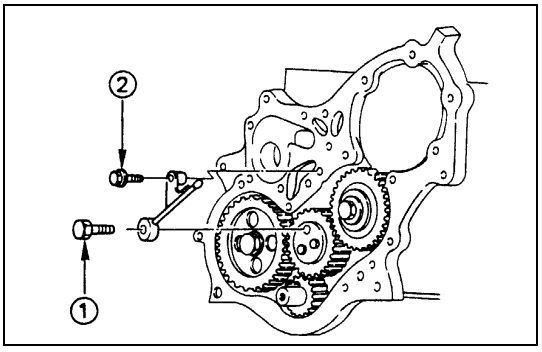
040LV001.tif

④ Install the injection pump rear bracket ⑥ and the rear bracket bolts ⑦ to the cylinder body.

⑤ Install the rear bracket bolts ⑧ to the injection pump bracket ⑨.
Do not tighten the bolts.
The rear bracket bolts ⑦ and ⑧ will be finally tightened to the specified torque.

N·m (kg·m/lb·ft)

19 (1.9/14)



6A-45-3.tif

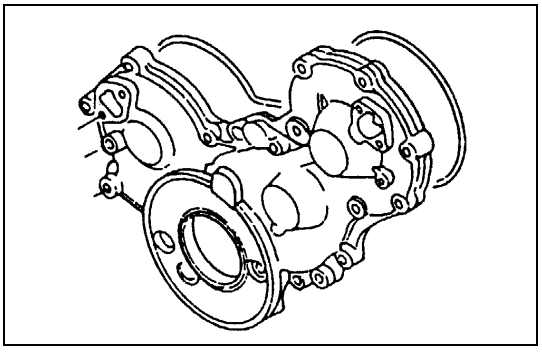
6) Timing Gear Oil Pipe

① Install the oil pipe to the timing gear case and idler gear “A”.

② Tighten the oil pipe eye bolt ① and bolt ② to the specified torque.

N·m (kg·m/lb·ft)

13 (1.3/9)



6A-45-4.tif

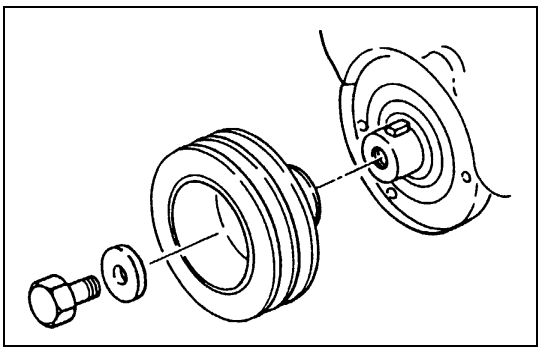
5) Timing Gear Case Cover

① Align the gear case with the timing gear case knock pin and then install the timing gear case cover.

② Tighten the gear case cover bolts to the specified torque.

N·m (kg·m/lb·in)

8 (0.8/69)



6A-45-5.tif

4) Crankshaft Damper Pulley
Tighten the crankshaft damper pulley bolt to the specified torque.

NOTE:
Hold the flywheel ring gear stationary to prevent the crankshaft from turning when tightening the damper pulley.

N·m (kg·m/lb·ft)
206 (21/152)

3) Cooling Fan Assembly
- Mount fan pulley, distance piece, and cooling fan asm (in this order) on the water pump, and tighten to the specified torque.

N·m (kg·m/lb·in)
8 (0.8/69)

2) AC Generator, Power Steering Pump Drive Belt
- Install AC Generator, Power Steering pump drive belt and adjust belt tension.
- Depress the drive belt mid-portion with a 98 N (10 kg/22 lb) force.

Drive Belt Deflection	mm (in)
8 (0.31) - 12 (0.47)	

- Tighten the idler lock nut to the specified torque.

N·m (kg·m/lb·ft)
27 (2.8/20)

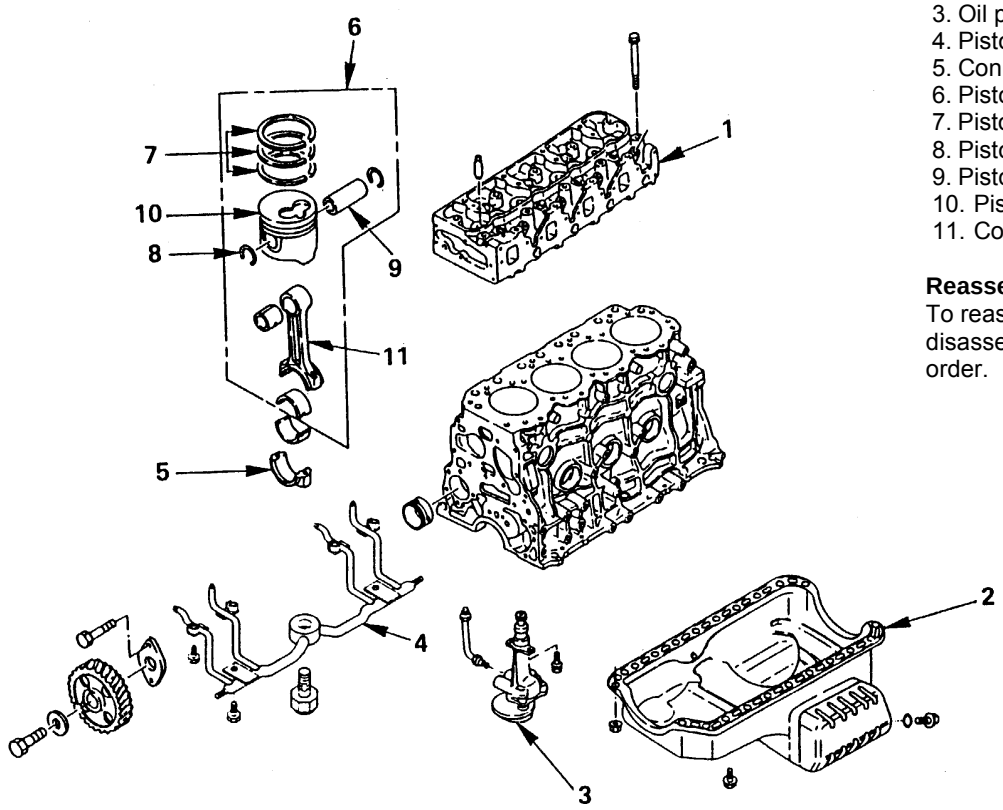
1) Fan Shroud
- Install the fan shroud and reservoir tank hose.
- Pour coolant
- Start the engine and check coolant leakage.

2. Oil Pan Assembly
Above works refer to “OIL PUMP” Section in this manual.

1. Cylinder Head Assembly and Gasket
- **Piston Head Projection Measurement Point**
- **Cylinder Head Assembly**
- **Push Rod**
- **Rocker Arm Shaft Assembly**

Valve clearance adjustment.
Above works refer to “CYLINDER BLOCK” Section in this manual.

PISTON AND CONNECTING ROD



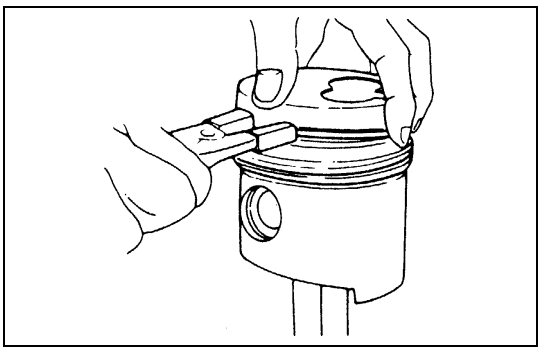
Disassembly steps
1. Cylinder head Assembly
2. Oil pan Assembly
3. Oil pump Assembly
4. Piston cooling oil pipe
5. Connecting rod bearing cap
6. Piston and connecting rod
7. Piston ring
8. Piston pin snap ring
9. Piston pin
10. Piston
11. Connecting rod

Reassembly steps
To reassemble, follow the disassembly steps in the reverse order.

6A-47-1.tif

DISASSEMBLY

1. **Cylinder Head Assembly**
2. **Oil Pan Assembly**
3. **Oil Pump Assembly**
4. **Piston Cooling Oil Pipe**
5. **Connecting Rod Bearing Cap**
6. **Piston and Connecting Rod**
   - Remove carbon deposits from the upper portion of the cylinder wall with a scraper before removing the piston and connecting rod.

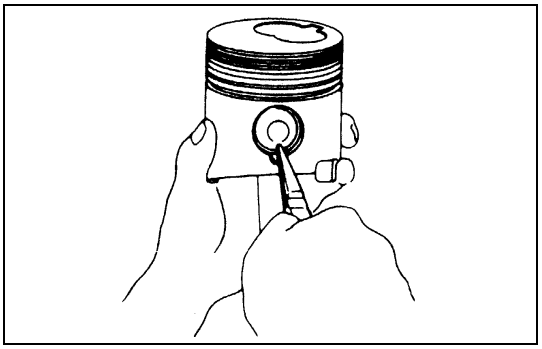


6A-48-1.tif

7. Piston Ring

Remove the piston rings with a piston ring expander.

Arrange the removed piston rings in the cylinder number order.



6A-48-2.tif

8. Piston Pin Snap Ring

- Use a pair of pliers to remove the piston pin snap rings.

9. Piston Pin

NOTE:

Keep the parts removed from each cylinder separate. All parts must be reinstalled in their original positions.

10. Piston

11. Connecting Rod

INSPECTION AND REPAIR

PISTON AND PISTON RING

Pistons

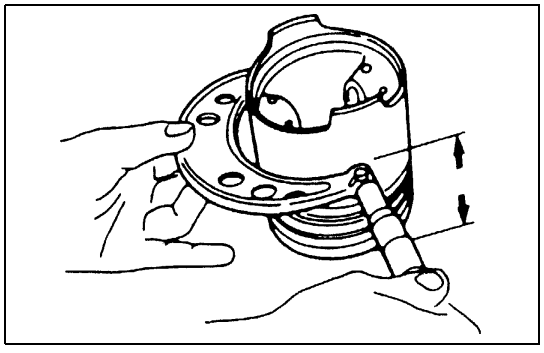
Carefully clean away all the carbon adhering to the piston head and the piston ring grooves.

NOTE:

Never use a wire brush to clean the pistons. Damage will result.

Visually check each piston for cracking, scoring, and other signs of excessive wear.

If any of the above conditions are present, the piston must be replaced.



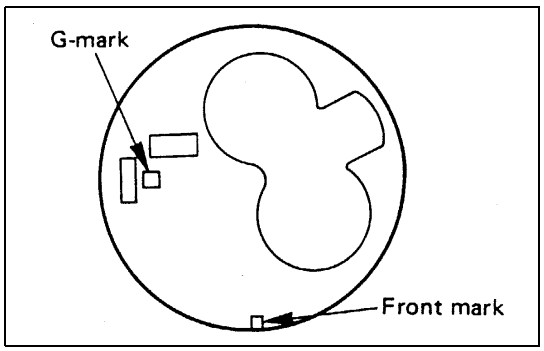
6A-48-3.tif

Piston Diameter

1. Measure the piston outside diameter with micrometer at the piston grading position.

Piston Grading Position — mm (in)

4JB1 / 4JB1T / 4JB1TC	74 (2.913)
4JG2	71.00 (2.797)



6A-49-1.tif

4JB1 / 4JB1T / 4JB1TC mm (in)

Size Mark	Outside Diameter
A	92.985 - 92.994 (3.6608 - 3.6612)
B	92.995 - 93.004 (3.6612 - 3.6616)
C	93.005 - 93.014 (3.6616 - 3.6620)
D	93.015 - 93.024 (3.6620 - 3.6624)

4JG2 mm (in)

Size Mark	Outside Diameter
A	95.365 - 95.374 (3.7545 - 3.7549)
B	95.375 - 95.384 (3.7549 - 3.7553)
C	95.385 - 95.394 (3.7553 - 3.7557)
D	95.395 - 95.404 (3.7557 - 3.7561)

The grading position for piston outside diameter is represented by the 'G' as shown in Figure.
Measure the cylinder bore inside diameter (refer to "inspection of the cylinder Block" in this Section).
If the piston clearance does not conform to the specified valve, the piston and/or cylinder liners must be replaced.

Piston Clearance mm (in)

4JB1 / 4JB1T / 4JB1TC	0.061 (0.0024)
4JG2	0.066 (0.0026)

Selection method of piston grade for service parts.

If you find piston grade A from size mark or piston outside diameter measurement result, you will select AX for service piston grade.
The stamped piston grade on the head of piston for service parts.

Service piston grade

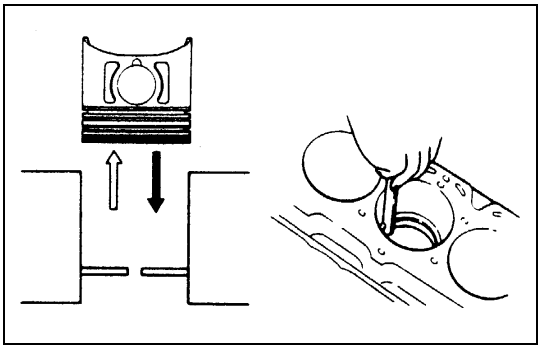
Piston Size Mark	Service Parts Grade
A	AX
B	AX
C	CX
D	CX

Service piston diameter mm (in)

Piston Grade	4JB1 / 4JB1T / 4JB1TC
AX	92.989 - 93.004 (3.6610 - 3.6616)
CX	93.005 - 93.020 (3.6616 - 3.6622)

Piston Grade	4JG2
AX	95.369 - 95.384 (3.7547 - 3.7553)
CX	95.385 - 95.400 (3.7553 - 3.7559)

NOTE:
It is most important that the correct piston grade be used. Failure to select the correct piston grade will result in engine failure. Always measure the cylinder bore and select the correct piston grade.



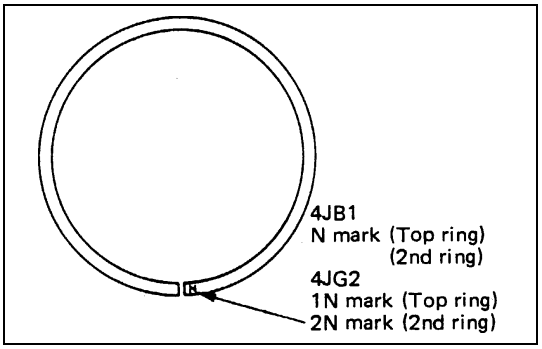
6A-50-1.tif

Piston rings

Any worn or damaged part discovered during engine overhaul must be replaced with a new one.

1. Ring end gap measurement

- Insert the piston ring into the bore.
- Push the ring by the piston, at a right angle to the wall, into the point ring at which the cylinder bore diameter is the smallest.



6A-50-2.tif

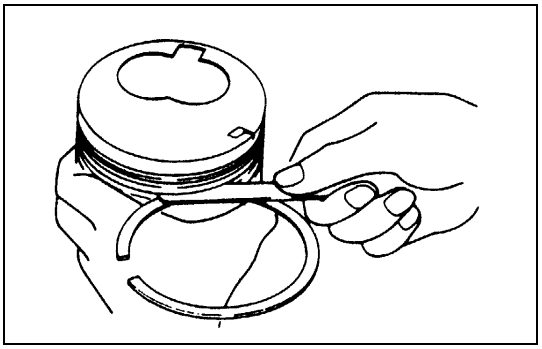
- The top mark of the piston ring are shown in the illustration.

4JB1 / 4JB1T / 4JB1TC mm.(in)

		Standard	Limit
Compression ring	1st	0.20 - 0.40 (0.0079 - 0.0157)	1.5 (0.059)
	2nd	0.20 - 0.40 (0.0079- 0.0157)	
Oil ring		0.10 - 0.30 (0.0039 - 0.0118)	

4JG2 mm.(in)

		Standard	Limit
Compression ring	1st	0.20 - 0.35 (0.0079 - 0.0138)	1.5 (0.059)
	2nd	0.37 - 0.52 (0.0146 - 0.0205)	
Oil ring		0.20 - 0.40 (0.0079 - 0.0157)	



6A-50-3.tif

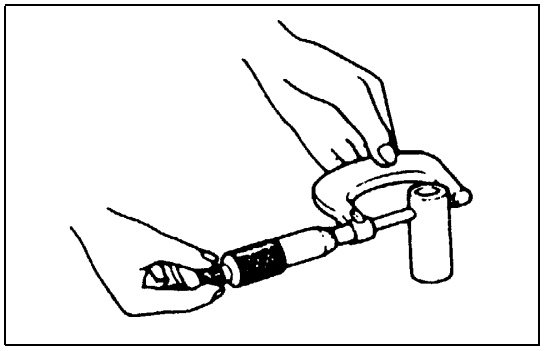
2. Measure the clearance between the piston ring groove and the piston ring with a feeler gauge. If the piston ring groove/piston ring clearance exceeds the specified limit, the piston must be replaced.

4JB1 / 4JB1T / 4JB1TC mm (in)

		Standard	Limit
Compression ring	1st	0.090 - 0.125 (0.0035 - 0.0049)	0.15 (0.0059)
	2nd	0.050 - 0.075 (0.0020 - 0.0030)	
Oil ring		0.03 - 0.07 (0.0012 - 0.0028)	

4JG2 mm (in)

		Standard	Limit
Compression ring	1st	0.09-0.13 (0.0035 - 0.0051)	0.15 (0.0059)
	2nd	0.05 - 0.07 (0.0020 - 0.0028)	
Oil ring		0.03-0.07 (0.0012-0.0028)	



6A-51-1.tif

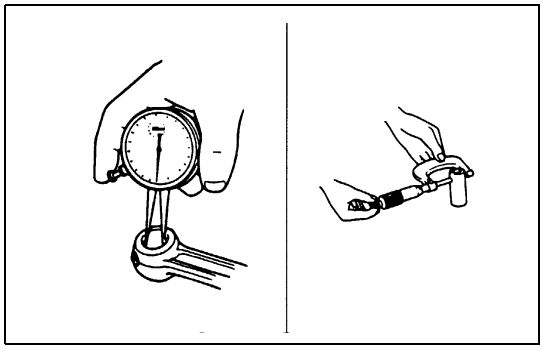
Piston pin

Visually inspect the piston pin for cracks, flaws, and other damage and replace if necessary.

1. Use a micrometer to measure the piston pin outside diameter in both directions at three different positions. If the measurement exceed the specified limit the piston pin must be replaced.

Piston pin outside diameter mm (in)

	Standard	Limit
4JB1 / 4JB1T 4JB1TC	30.995 - 31.000 (1.2202 - 1.2204)	30.970 (1.2190)
4JG2	33.995 - 34.000 (1.3384 - 1.3386)	33.970 (1.3374)



6A-51-2.tif

2. Measure the inside diameter of the connecting rod small end. If the clearance between the small end and pin does not conform to the specified value, the connecting rod or bushing and pin must be replaced.

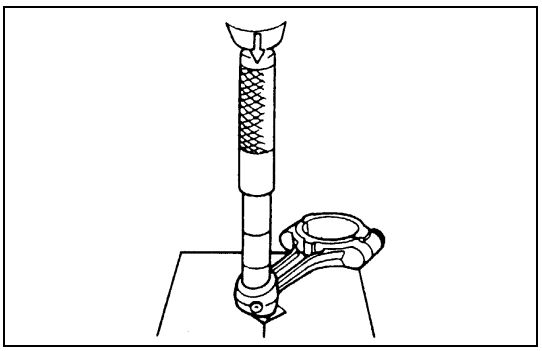
mm (in)

	Standard	Limit
Clearance	0.008 - 0.020 (0.0003 - 0.0008)	0.05 (0.0020)

3. Insert the piston pin into the piston and rotate it. If the pin rotates smoothly with no backlash, the clearance is normal. If there is backlash or roughness, measure the clearance. If the clearance exceeds the specified limit, the piston and the piston pin must be replaced.

mm (in)

	Standard	Limit
Clearance	0.002 - 0.004 (0.00008 - 0.00016)	0.04 (0.0016)



6A-52-1.tif

Bushing replacement

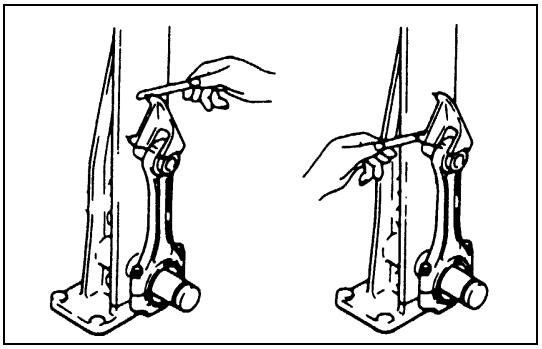
Removal: Use a suitable bar and bench press or hammer.

Installation: Use a suitable bar and bench press.

NOTE:

Align the bushing with the connecting rod oil port.

After installing a new bushing, finish the bushing bore with a pin hole grinder.



6A-52-2.tif

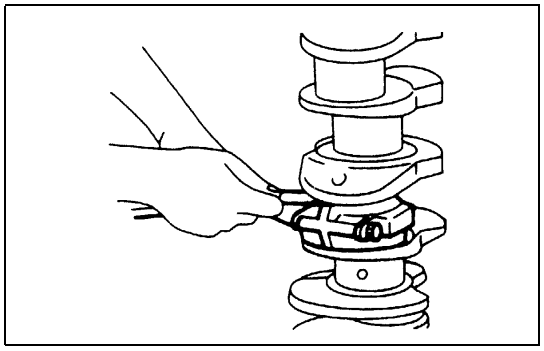
Connecting rods

1. Check the connecting rod alignment with a connecting rod aligner.

   If either the bend or the twist exceeds the specified limit, the connecting rod must be replaced.

mm (in)

	Standard	Limit
Bend per 100 (3.94)	0.08 (0.0031) or less	0.20 (0.0079)
Twist per 100 (3.94)	0.05 (0.0020) or less	0.15 (0.0059)



6A-52-3.tif

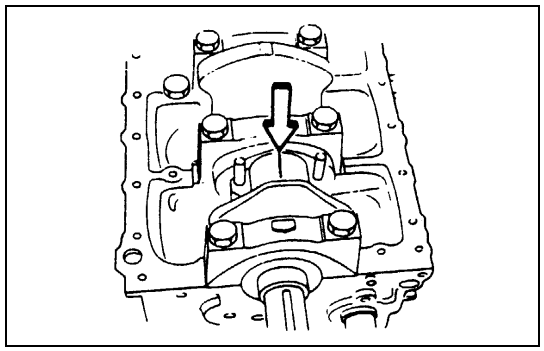
2. Measure the connecting rod thrust clearance.

   Use a feeler gauge to measure the thrust clearance at the big end of the connecting rod.

   If the clearance exceeds the specified limit, the connecting rod must be replaced.

Thrust Clearance mm (in)

Standard	Limit
0.230 (0.0091)	0.350 (0.0138)



6A-52-4.tif

3. Measure the oil clearance between the connecting rod and the crankshaft by:
   1) Remove the connecting rod cap nuts and the rod caps.

      Arrange the removed rod caps in the cylinder number order.
   2) Clean the rod bearings and the crankshaft pins.
   3) Carefully check the rod bearings.

      If even one bearing is found to be damaged or badly worn, the entire bearing assembly must be replaced as a set. Reinstall the bearings in their original positions.

      Apply plastigage to the crank pin.
   4) Reinstall the rod caps to their original positions

5) Tighten the cap nuts in 2 steps, using angular tightening method as shown in the following specifications. (4JG2)

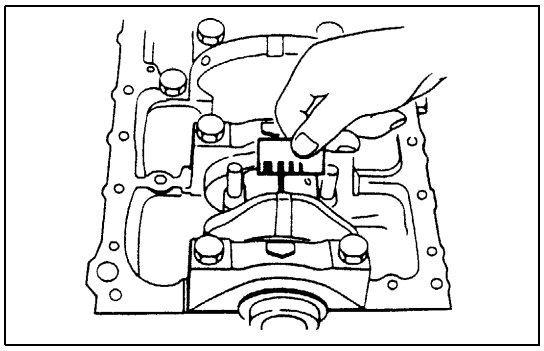
4JG2 N·m (kg·m/lb·ft)

1st Steps	2nd Step
29 (3.0/22)	45° - 75°

4JA1, 4JB1, 4JB1TC N·m (kg·m/lb·ft)

83 (8.5/61)

NOTE:
Do not allow the crankshaft to rotate.


6A-53-1.tif

6) Remove the rod caps.
7) Measure the width of the plastigage and determine the oil clearance. If the oil clearance exceeds the limit, replace the rod bearings as a set.
8) Clean the plastigage from the bearings and the crankshaft pins.

Crankshaft Journal and Bearing Clearance mm (in)

	Standard	Limit
4JB1 / 4JB1T / 4JB1TC	0.029 - 0.066 (0.0011 - 0.0026)	0.100 (0.0039)
4JG2	0.029 - 0.083 (0.0011 - 0.0033)	

REASSEMBLY

11. Connecting Rod
10. Piston
9. Piston Pin

Apply a cost of engine oil to the piston pin and the piston pin hole.

8. Piston Pin Snap Ring

Apply a thin coat of engine oil to the piston pin.

Try to insert the piston pin into the piston pin hole with normal finger pressure.

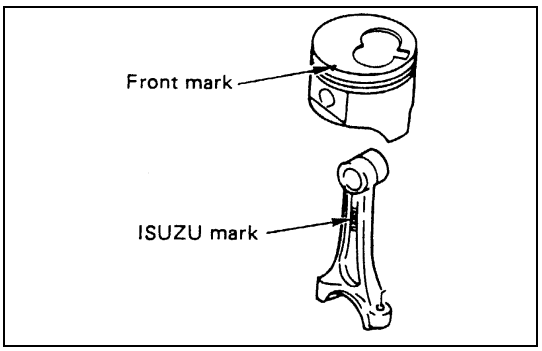
Weigh each piston and connecting rod assembly.

Select piston and connecting rod combinations so that the weight variation of the different assemblies a held within the specified limits.

g (oz)

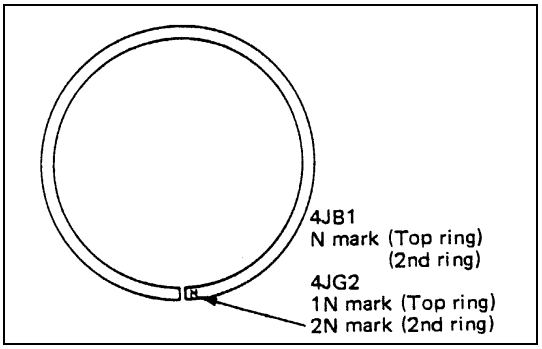
Variance in weight after assembly	Less than 3 (0.1058)

NOTE:
When changing piston/connecting rod combinations, do not change the piston/piston pin combination



6A-54-1.tif

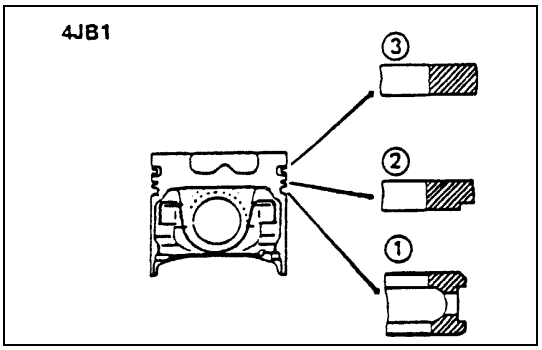
- Attach the piston to the connecting rod with the piston front mark and the connecting rod ISUZU mark on the same side.



6A-54-2.tif

7. Piston Ring

- Install the piston rings with the piston ring expander.
  The compression ring must be set with the 1N, 2N mark (4JG2) facing up.
- Discrimination mark is painted as shown in the illustration.



6A-54-3.tif

- Install piston rings in the following sequence.

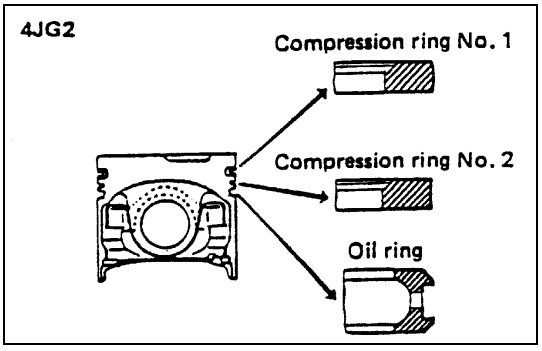
1) Oil ring

① Expander ring
② Upper side rail
③ Lower side rail

2) 2nd compression ring

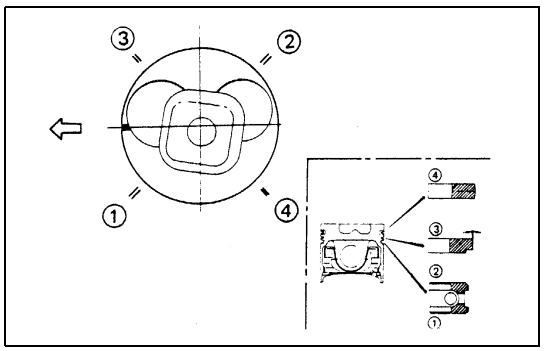
3) 1st compression ring

- The compression ring must be set with the 1N or 2N mark (4JG2) facing up.



6A-54-4.tif

- 1st compression ring: 1N (4JG2), N (4JB1)
- 2nd compression ring: 2N (4JG2), N (4JB1)
- After installation, apply engine oil to the entire circumference of the piston rings.
  Check to see that all the rings rotate smoothly.
- Insert the bearings into the connecting rods and caps.
  Apply new engine oil to the bearing faces.
  Cap side bearings have no oil hole.
  Conn rod side bearings oil hole should be aligned with oil hole on the conn rod.



6A-55-1.tif

6. Piston and Connecting Rod

- Apply engine oil to the cylinder bores, the connecting rod bearings and the crankshaft pins.
- Check to see that the piston ring end gaps are correctly positioned.
- Insert the piston/connecting rod assemblies into each cylinder with the piston ring compressor.
- The front marks must be facing the front of the engine.

5. Connecting Rod Bearing Cap

- Tighten the cap nuts in 2 steps, using angular tightening method as shown in the following specifications.

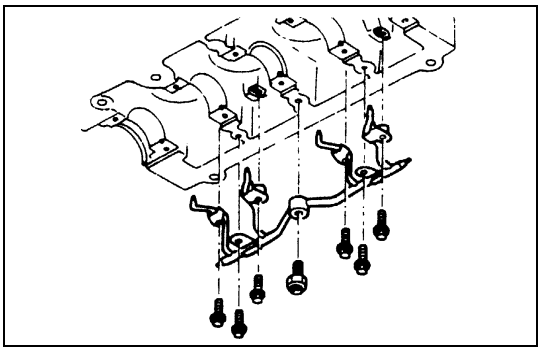
4JG2 N·m (kg·m/lb·ft)

1st Steps	2nd Step
29 (3.0/22)	45° - 75°

4JA1, 4JB1, 4JB1TC N·m (kg·m/lb·ft)

83 (8.5/61)

After tightening the cap nuts, check to see that the crankshaft rotates smoothly.



6A-55-2.tif

4. Piston Cooling Oil Pipe

- Install the piston cooling oil pipe to the cylinder body.
- Tighten the oil pipe bolts and relief valve to the specified torque.

Oil Pipe Bolt Torque N·m (kg·m/lb·ft)

(1) M8 x 1.25	19 (1.9/14)

N·m (kg·m/lb·in)

(2) M6 x 1.00	8 (0.8/69)

Oil Pressure Regulating Valve Torque N·m (kg·m/lb·ft)

(3) M16 x 1.5	29 (3.0/22)

NOTE:
Check that there is no interference between the piston and the oiling jet pipe by slowly rotating the crankshaft.

3. Oil Pump Assembly

2. Oil Pan Assembly

Above works refer to “OIL PUMP” Section in this manual.

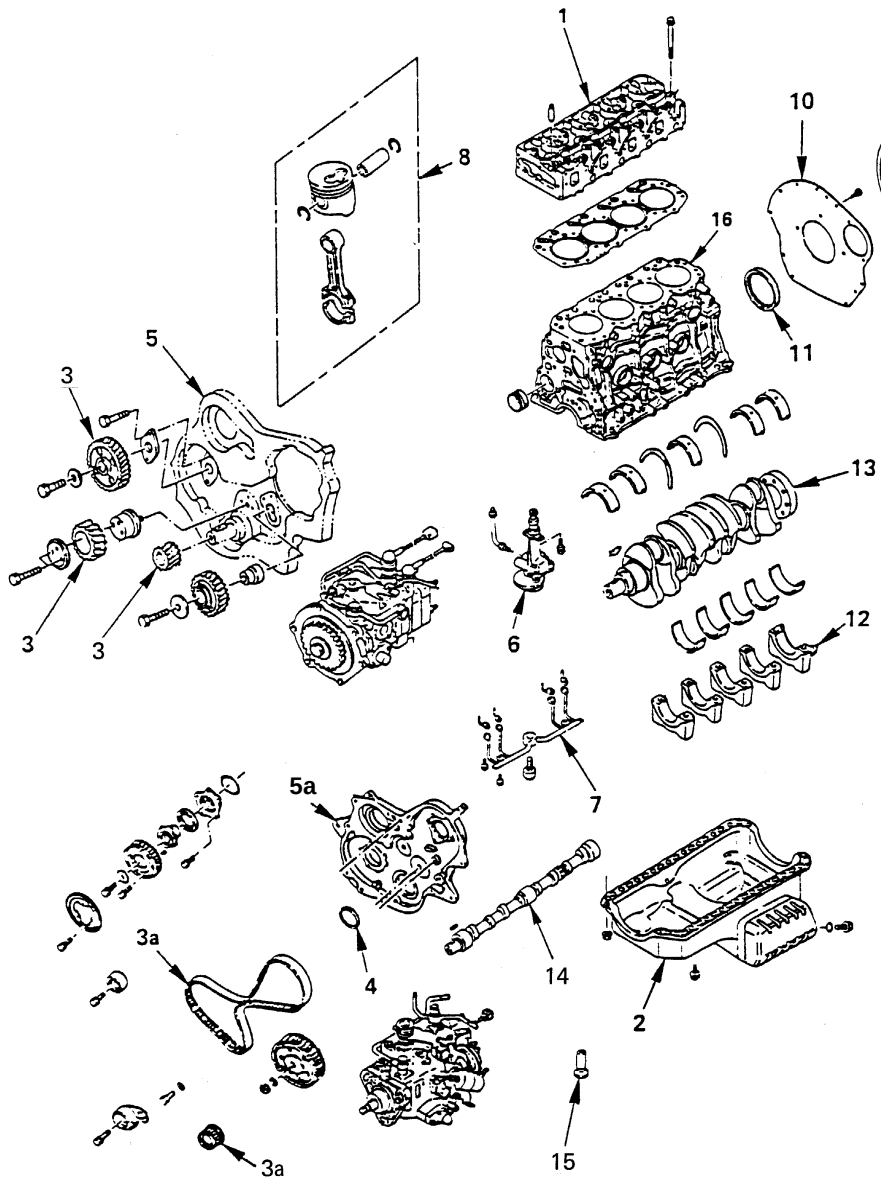
1. Cylinder Head Assembly

- **Piston Head Projection Measurement Point**
- **Cylinder Head ASM**
- **Push Rod**
- **Rocker Arm Shaft ASM**

Valve clearance adjustment.

Above works refer to “CYLINDER BLOCK” Section in this manual.

CYLINDER BLOCK



Disassembly steps

1. Cylinder head Assembly and gasket
2. Oil pan Assembly
3. Timing gear
3a. Timing belt and pulley
4. Front oil seal
5. Timing gear housing
5a. Timing pulley housing
6. Oil pump Assembly
7. Piston cooling oil pipe
8. Piston and connecting rod
9. Flywheel
10. Cylinder block rear plate
11. Crankshaft rear oil seal
12. Main bearing cap
13. Crankshaft
14. Camshaft
15. Tappet
16. Cylinder block

Reassembly steps

To reassemble, follow the disassembly steps in the reverse order.

6A-56-1.tif

DISASSEMBLY

1. **Cylinder Head Assembly and Gasket**
2. **Oil Pan Assembly**
3. **Timing Gear**

3a. Timing Belt and Pulley

4. **Front Oil Seal (Belt Drive Model)**
5. **Timing Gear Housing**

5a. Timing Pulley Housing

6. **Oil Pump Assembly**

7. **Piston Cooling Oil Pipe**
8. **Piston and Connecting Rod**
9. **Flywheel**
10. **Cylinder Block Rear Plate**
11. **Crankshaft Rear Oil Seal**
12. **Main Bearing Cap**
13. **Crankshaft**
14. **Camshaft**
15. **Tappet**
16. **Cylinder Block**

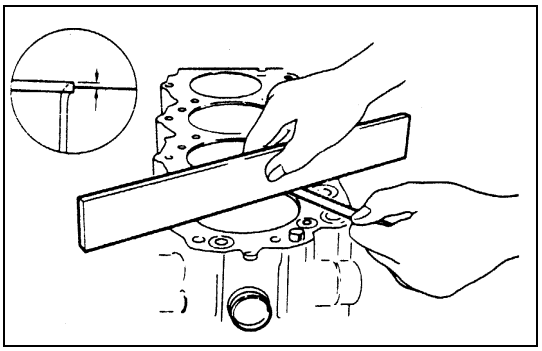
INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.

1. Remove the gasket and any other material adhering the upper surface of the cylinder block.

   Be very careful not to allow any material to accidental drop into the cylinder block.

   Be very careful not to scratch the cylinder block.
2. Carefully remove the oil pump, Rear Seal retainer and oil pan installation surface seal.
3. Wipe the cylinder block clean.



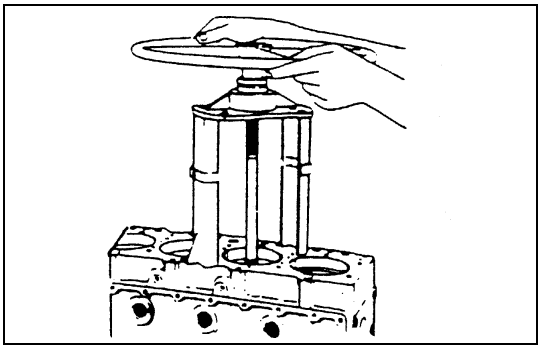
6A-57-1.tif

Cylinder Liner Projection Inspection

1. Hold a straight edge ① along the top edge of the cylinder liner to be measured.
2. Use a feeler gauge ② to measure each cylinder line projection.

   The difference in the cylinder liner projection height between any two adjacent cylinders must not exceed 0.03 mm (0.0012 in).

Standard	mm (in)
0.0 - 0.1 (0.0000 - 0.0039)	



6A-57-2.tif

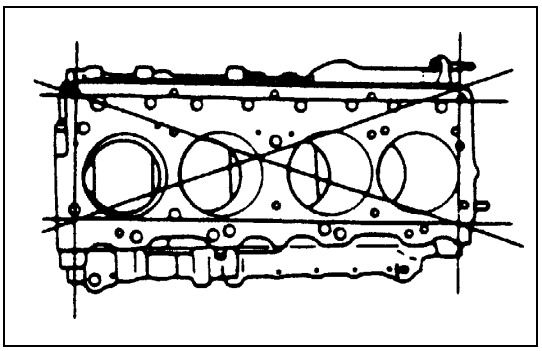
Flatness

1. Remove the cylinder body dowel.
2. Set the cylinder liner remover to the cylinder liner.
3. Check that the remover shaft ankle is firmly gripping the cylinder liner bottom edge.
4. Slowly turn the remover shaft handle counterclockwise to pull the cylinder liner free.

   Cylinder Liner Remover Ankle: 5-8840-2304-0 (4JG2)
   5-8840-2039-0
   (4JB1/4JB1T/4JB1TC)

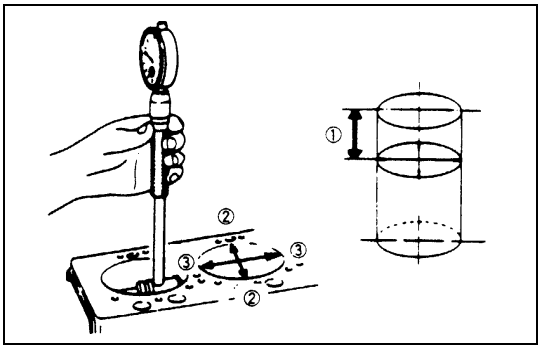
NOTE:

Take care not to damage the cylinder body upper during the cylinder liner removal procedure.



6A-58-1.tif

5. Use a straight edge ① and a feeler gauge ② to measure the four sides and the two diagonals of the cylinder body upper face.
   If the measured values exceeds the limit, the cylinder body must be replaced.



6A-58-2.tif

Cylinder Liner Bore Measurement

Use a cylinder indicator to measure the cylinder liner bore at measuring point ① in the thrust ② - ② and axial ③ direction of the crankshaft.

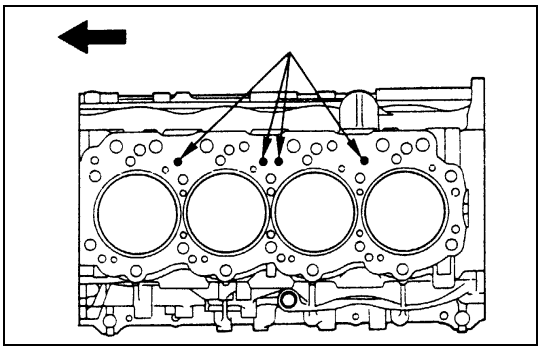
Measuring Point ① 20mm (0.79 in)

If the measured value exceeds the specified limit, the cylinder liner must be replaced.

NOTE:

The inside of the dry type cylinder liner is chrome plated. It cannot be rebored or honed.

If the inside of the cylinder liner is scored or scorched, the cylinder liner must be replaced.



6A-58-3.tif

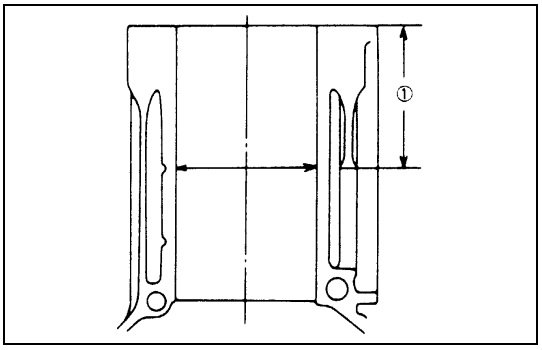
Cylinder Liner Grade Selection

Measure the cylinder body inside diameter and select the appropriate cylinder liner grade.

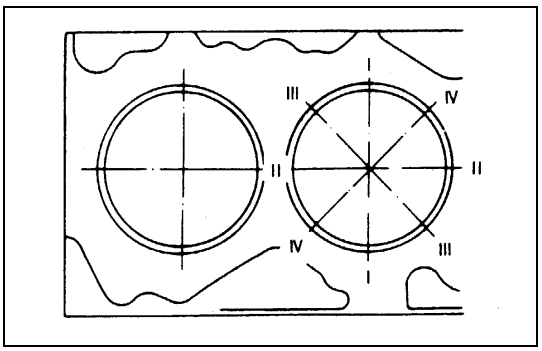
Standard Lifting Interference	mm (in)
0.01 - 0.019 (0.0004 - 0.0007)	

If the cylinder liner fitting interference is too small, engine cooling efficiency will be adversely effected.

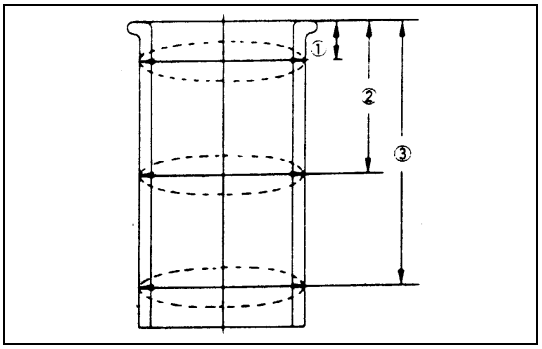
If the cylinder liner fitting interference is too large, it will be difficult to insert the cylinder liner into the cylinder body.



6A-58-4.tif



6A-59-1.tif



6A-59-2.tif

Cylinder Body Bore Measurement

1) Take measurements at measuring point (A) across positions ① - ①, ② - ②, ③ - ③, and ④ - ④.

Measuring Point (A) 98mm (3.86 in).

2) Calculate the average value of the four measurements to determine the correct cylinder grade.
3) Consult the following table with the resultant diameter for the correct liner application.

Selection method of cylinder liner and piston grade for service parts.

The production line stamped cylinder liner grade on the top of cylinder body, the cylinder liner outside diameter grade 1, 2, 3, 4.

If you find cylinder liner outside diameter grade 1 and piston outside diameter B on the cylinder body or result of measurement for each parts, you will select service parts grade for cylinder liner 1, AX grade and for piston AX grade.

The stamping grade code on the service parts are;

For cylinder liner grade stamped on the outside of cylinder liner.

For piston grade stamped on the head of piston.

4JB1 / 4JB1T / 4JB1TC mm (in)

Liner outside Grade	Cylinder bore diameter average	Liner outside diameter	Liner bore Grade	Service liner bore measurement
1	95.001 - 95.010 (3.7402 - 3.7406)	95.011 - 95.020 (3.7406 - 3.7409)	AX	93.035 (3.6628) - 93.050 (3.6634)
			CX	93.051 (3.6634) - 93.066 (3.6640)
2	95.011 - 95.020 (3.7406 - 3.7409)	95.021 - 95.030 (3.7410 - 3.7413)	AX	93.035 (3.6628) - 93.050 (3.6634)
			CX	93.051 (3.6634) - 93.066 (3.6640)
3	95.021 - 95.030 (3.7410 - 3.7413)	95.031 - 95.040 (3.7414 - 3.7417)	AX	93.035 (3.6628) - 93.050 (3.6634)
			CX	93.051 (3.6634) - 93.066 (3.6640)
4	95.031 - 95.040 (3.7414 - 3.7417)	95.041 - 95.050 (3.7418 - 3.7421)	AX	93.035 (3.6628) - 93.050 (3.6634)
			CX	93.051 (3.6634) - 93.066 (3.6640)

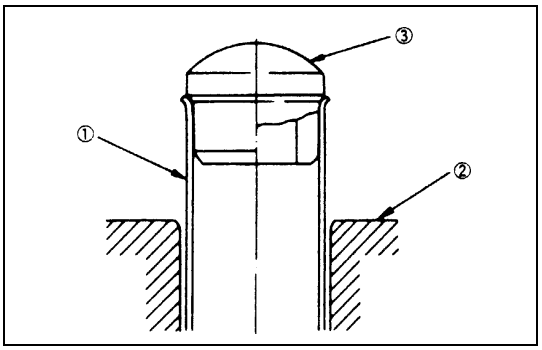
4JG2 mm (in)

Liner outside Grade	Cylinder bore diameter average	Liner outside diameter	Liner bore Grade	Service liner bore measurement
1	97.001 - 97.010 (3.8189 - 3.8193)	97.011 - 97.020 (3.8193 - 3.8197)	AX	95.435 (3.7573) - 95.450 (3.7579)
			CX	95.451 (3.7579) - 95.466 (3.7585)
2	97.011 - 97.020 (3.8193 - 3.8197)	97.021 - 97.030 (3.8197 - 3.8201)	AX	95.435 (3.7573) - 95.450 (3.7579)
			CX	95.451 (3.7579) - 95.466 (3.7585)
3	97.021 - 97.030 (3.8197 - 3.8201)	97.031 - 97.040 (3.8201 - 3.8205)	AX	95.435 (3.7573) - 95.450 (3.7579)
			CX	95.451 (3.7579) - 95.466 (3.7585)
4	97.031 - 97.040 (3.8201 - 3.8205)	97.041 - 97.050 (3.8205 - 3.8209)	AX	95.435 (3.7573) - 95.450 (3.7579)
			CX	95.451 (3.7579) - 95.466 (3.7585)

NOTE:

It is most important that the correct piston grade be used. Failure to select the correct piston grade will result in engine failure. Always measure the cylinder bore and select the correct piston grade.

Cylinder liner kit clearances are preset. However, the cylinder liner installation procedure may result in slight decreases in cylinder liner clearances. Always measure the cylinder liner clearance after installation to be sure that it is correct.



6A-60-1.tif

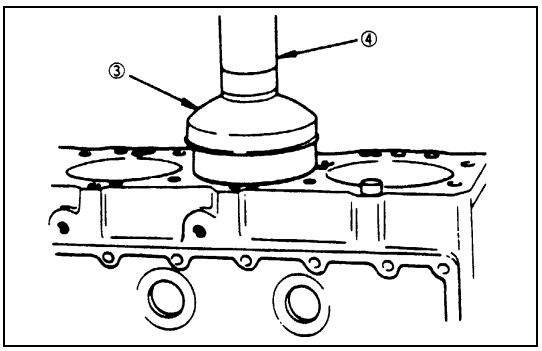
Cylinder Liner Installation

1. Cylinder Liner Installation Using The Special Tool.
   1) Use new kerosene or diesel oil to thoroughly clean the cylinder liners and bores.
   2) Use compressed air to blow-dry the cylinder liner and bore surfaces.

Cylinder Liner Installer: 5-8840-2313-0 (4JG2)
: 5-8840-2040-0 (4JB1 / 4JB1T/ 4JB1TC)

NOTE:

All foreign material must be carefully removed from the cylinder liner and the cylinder bore before installation.



6A-60-2.tif

3) Insert the cylinder liner ① into the cylinder body ② from the top of the cylinder body.

4) Set the cylinder liner installer 3 to the top of the cylinder liner.
   Position the cylinder body so that the installer center is directly beneath the bench press shaft center 4.

Cylinder Liner Installer: 5-8840-2313-0 (4JG2)
: 5-8840-2040-0 (4JB1/4JB1T/4JB1TC)

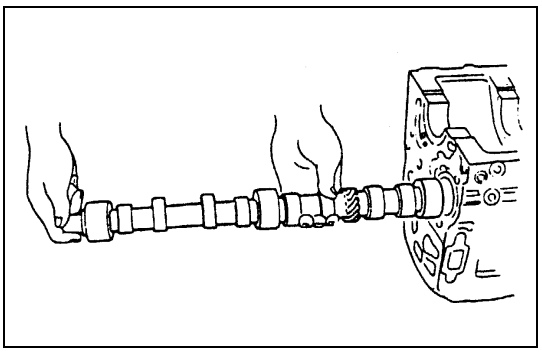
NOTE:
Check that the cylinder liner is set perpendicular to the bench press and that there is no wobble.

5) Use the bench press to apply a seating force of 500 kg (1,102.5 lb/4,900 N) to the cylinder liner.
6) Apply a force 2,500 kg (5,512.5 lb/24,500 N) to fully seat the cylinder liner.
7) After installing the cylinder liner, measure the cylinder liner projection.
8) After installing the cylinder liner, measure the cylinder liner projection.
   Refer to “Cylinder Liner Projection Inspection” in this Section.
   Measure the cylinder liner bore inside diameter and select the appropriate piston grade.

REASSEMBLY

16. Cylinder Block
15. Tappet
14. Camshaft

- Apply a coat of engine oil to the tappet and the cylinder body tappet insert holes.
- Locate the position mark applied at disassembly (if the tappet is to be reused).
- Apply a coat of engine oil to the camshaft and the camshaft bearings.
- Install the camshaft to the cylinder body.
  Take care not to damage the camshaft bearings.



6A-61-1.tif

13. Crankshaft
12. Main Bearing Cap
11. Crankshaft Rear Oil Seal
10. Cylinder Block Rear Plate
9. Flywheel
Above works refer to “CRANKSHAFT” Section in this manual.

8. Piston and Connecting Rod

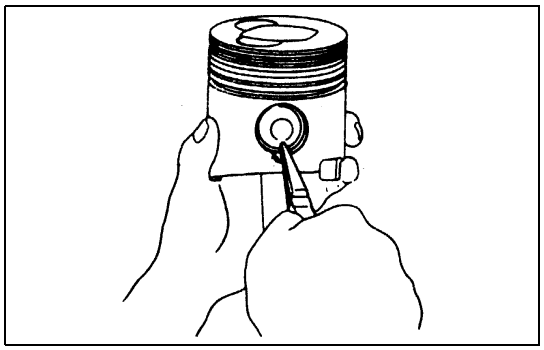
1) Try to insert the piston pin into the piston pin hole with normal finger pressure.

   Weigh each piston and connecting rod assembly.

   Select piston and connecting rod combinations so that the weight variation of the different assemblies is held within the specified limits.

g (oz)

Variance in weight after assembly	Less than 3 (0.1058)



6A-62-1.tif

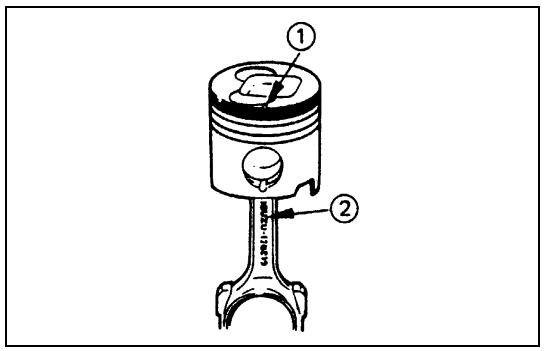
2) Clamp the connecting rod in a vise.

   Take care not to damage the connecting rod.

3) Use a pair of pliers to install the piston pin snap ring to the piston.

NOTE:

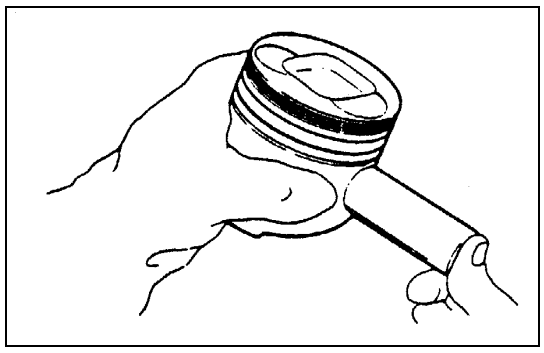
When changing piston/connecting rod combinations, do not change the piston/piston pin combination.



6A-62-2.tif

4) Install the piston to the connecting rod.

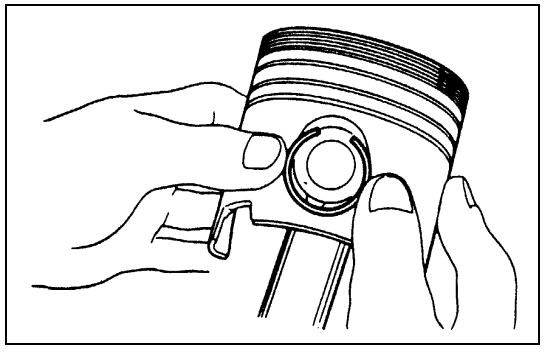
   The piston head front mark ① and the connecting rod "ISUZU" casting mark ② must be facing the same direction.



6A-62-3.tif

5) Apply a coat of engine oil to the piston pin and the piston pin hole.

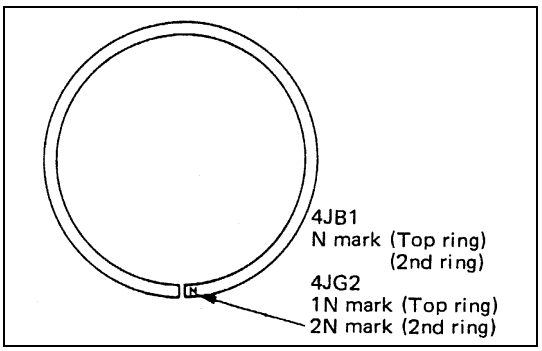
   Use your fingers to force the piston pin into the piston until it makes contact with the snap ring.



6A-62-4.tif

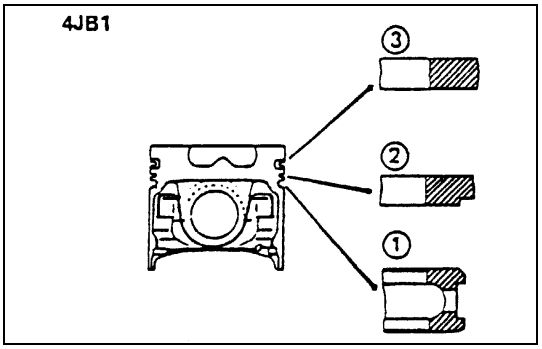
6) Use your fingers to force the piston pin snap ring into the piston snap ring groove.

   Check that the connecting rod moves smoothly on the piston pin.



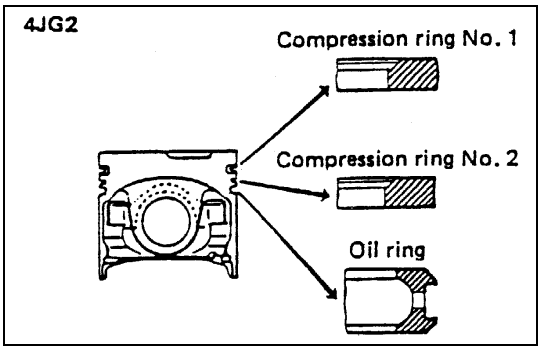
6A-63-1.tif

7) Install the piston rings with the piston ring expander.
The compression ring must be set with the 1N, 2N mark (4JG2) facing up.
Discrimination mark is painted as shown in the illustration.



6A-63-2.tif

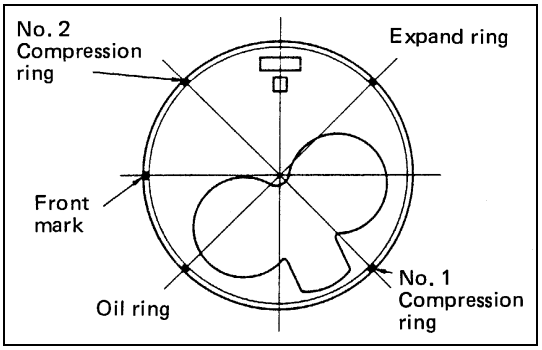
8) Use a piston ring replacer to install the three piston rings.
Piston Ring Replacer:
Install the piston rings in the numerical order shown in the illustration.
① Oil ring
② 2nd compression ring
③ 1st compression ring



6A-63-3.tif

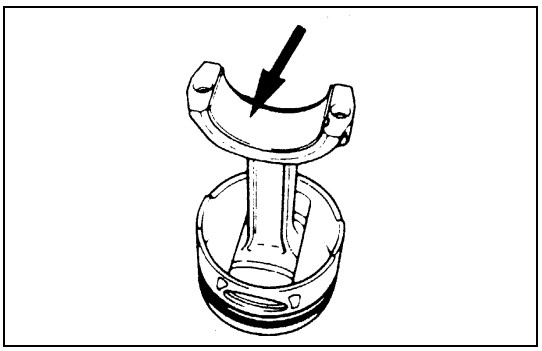
NOTE:
Install the compression rings with the stamped side facing up.
Insert the expander coil into the oil ring groove so that there is no gap on either side of the expander coil before installing the oil ring.

9) Apply engine oil to the piston ring surfaces.
10) Check that the piston rings rotate smoothly in the piston ring grooves.



6A-63-4.tif

11) Position the piston ring gaps as shown in the illustration.

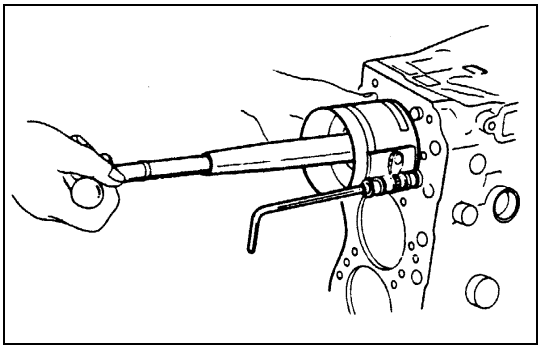


6A-64-1.tif

12) Carefully wipe any oil or other foreign material from connect rod bearing back face and the connecting rod bearing fitting surface.

13) Apply a coat of engine oil to the upper bearing surfaces.

Apply a coat of engine oil to the cylinder wall.



6A-64-2.tif

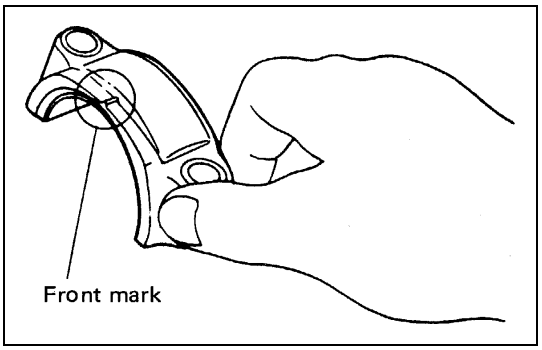
14) Position the piston head from mark so that it is facing the front of engine.

Use the piston ring compressor to compress the piston rings.

Piston Ring Compressor: 5-8840-9018-0 (J-8037)

15) Use a hammer grip to push the piston in until the connecting rod makes contact with the crankpin.

At the same time, rotate the crankshaft until the crankpin is at BDC.

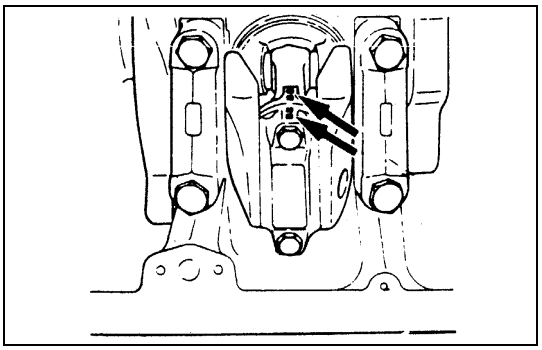


6A-64-3.tif

16) Position the bearing cap front mark so that it is facing the front of the engine.

17) Install the connecting rod bearing caps.

Align the bearing cap cylinder number marks and the connecting rod cylinder number marks.



6A-64-4.tif

18) Apply a coat of engine oil to the threads and setting faces of each connecting rod cap bolt.

19) Tighten the connecting rod bearing cap bolts to the specified torque in two steps using the Angular Tightening Method.

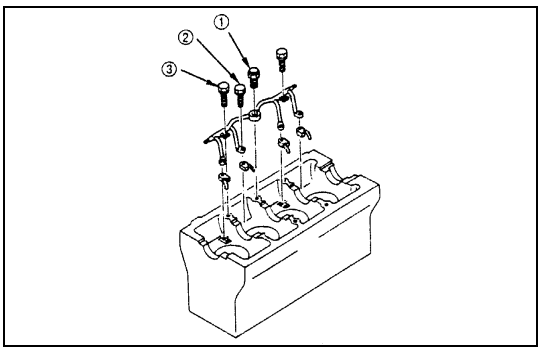
Connecting Rod Bearing Cap Bolt

Torque N·m (kg·m/lb·ft)

	1st Step	2nd Step
4JG2	29 (3.0/22)	45° - 75°
4JB1/4JB1TC	83 (8.5/61)	

NOTE

Check to see that the crankshaft turns smoothly by rotating it manually.



6A-65-1.tif

7. Piston Cooling Oil Pipe

1) Fix the oil jet pipes with knock pins on the cylinder block.
2) Install the oil pipe for piston cooling in the cylinder block, tightening a relief valve ① and four joint bolts ② to the specified torque.

Oil pipe fixing bolts	N·m (kg·m/lb·ft)
	M8: 19 (1.9/14) M6: 8 (0.8/69 lb·in.)

Relief valve fixing bolt	N·m (kg·m/lb·ft)
	29 (3.0/22)

CAUTION:

After installed the piston assembly. Check and see that there is appropriate clearance between pistons and oil jet pipes by rotating crankshaft slowly.

6. Oil Pump Assembly

Above works refer to “OIL PUMP” Section in this manual.

5a. Timing Pulley Housing

5. Timing Gear Housing

4. Front Oil Seal (Belt Drive Model)

3a. Timing Belt and Pulley

6) Camshaft Timing Pulley
5) Timing Belt
4) Flange: Camshaft Pulley
3) Timing Pulley Lower Cover
2) Timing Pulley Upper Cover
1) Crankshaft Damper Pulley

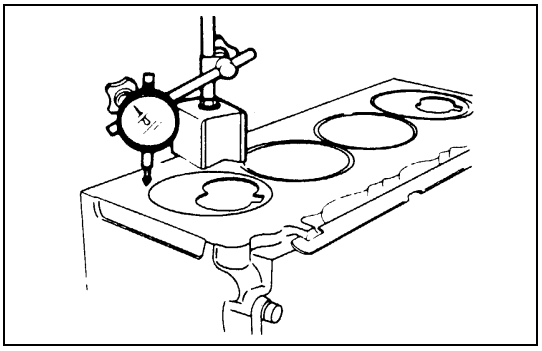
3. Timing Gear (Gear Drive Model)

11) Crankshaft Gear
10) Crankshaft Timing Gear
9) Idle Gear
8) Idler Gear "B" and Shaft
7) Injection Pump
6) Timing Gear Oil Pipe
5) Timing Gear Case Cover
4) Crankshaft Damper Pulley
3) Cooling Fan Assembly
2) AC Generator, Power Steering Pump Drive Belt
1) Fan Shroud

Above works refer to “CRANKSHAFT” Section in this manual.

2. Oil Pan Assembly

Above works refer to “OIL PUMP” Section in this manual.



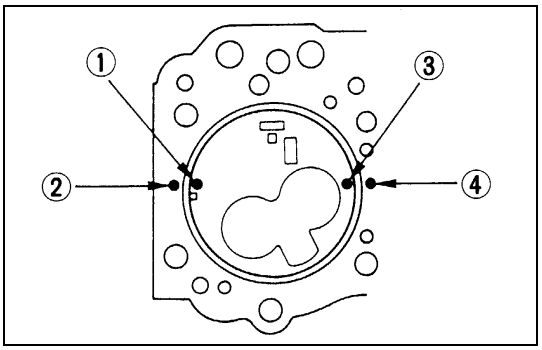
6A-66-1.tif

1. Cylinder Head Assembly and Gasket

① Cylinder head gasket is determined by the piston head projection from the cylinder body upper surface, in order to improve engine performance.

Three types of gasket are provided by the difference of thickness. Select the adequate one out of three grades of gasket, according to the following procedure.

Before measurement, clear off carbon from the piston head and cylinder body surface and also clean the place where a gasket was installed.



6A-66-2.tif

Piston Head Projection Measurement Point

② Use a dial indicator to measure the piston projection amount.

③ Refer to the illustration for the piston head projection measuring positions.

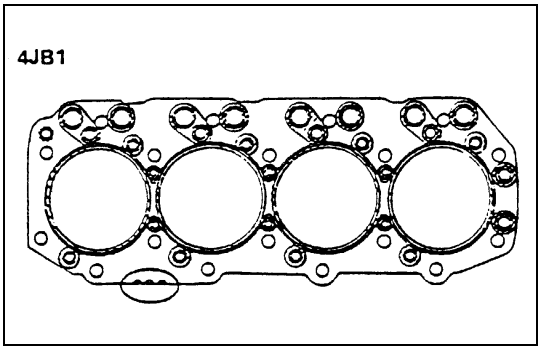
All measuring positions should be as close as possible to the cylinder liner.

④ Measure the points ① ② ③ ④ and obtain two difference ① - ② and ③ - ④ on each cylinder.

Calculate the average value of the piston head projection on each cylinder.

⑤ Obtain the maximum value in the four cylinders.

⑥ Determine the gasket grade required to the maximum value described above in accordance with the following table.



6A-66-3.tif

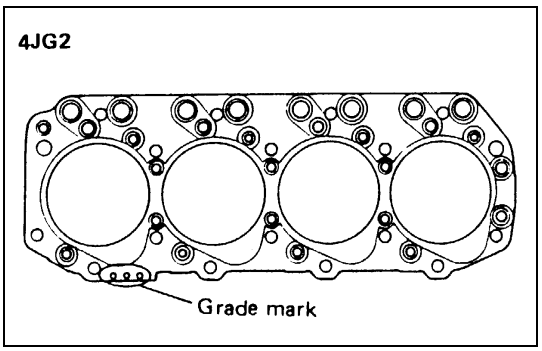
4JB1 / 4JB1T / 4JB1TC

Cylinder Head Gasket Thickness mm (in)

Gasket Grade Mark		Piston Projection	Gasket Thickness (Reference)
A		0.758-0.813 (0.030-0.032)	1.60 (0.0630)
B		0.813-0.859 (0.032-0.034)	1.65 (0.0650)
C		0.859-0.914 (0.034-0.036)	1.70(0.0670)

NOTE:

The difference between the highest measured piston head projection and the lowest measured piston head projection must not exceed 1.0mm (0.039 in).

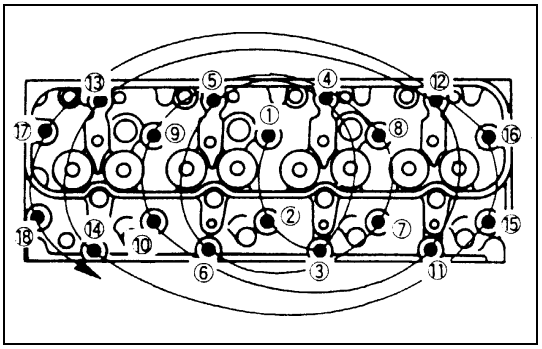


6A-67-1.tif

4JG2 Cylinder Head Gasket Thickness mm (in)

Grade mark		Average Piston projection	Gasket thickness
A		0. 658-0.713 (0.0259-0.0281)	1.60 (0.0630)
B		0.713-0.759 (0.0281-0.0299)	1.65 (0.0650)
C		0.759-0.814 (0.0299-0.0320)	1.70 (0.0670)

NOTE:
The difference between the highest measured piston head projection and the lowest measured piston head projection must not exceed 1.0mm (0.039 in).



6A-67-2.tif

Cylinder Head Assembly

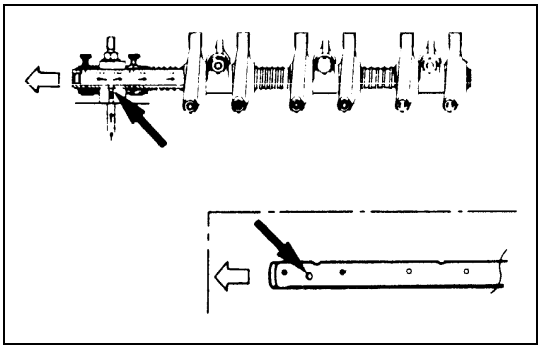
① Install the dowel in cylinder block.
② Install the cylinder head gasket with top mark up.
③ Clean up cylinder head lower surface and cylinder body upper surface.
④ Install the cylinder head as softly.
⑤ Apply molybdenum disulfide grease to screw and seat of cylinder head bolts.
⑥ Tighten the cylinder head bolts to the specific torque in three step following the numerical and shown in the illustration.

Cylinder Head Bolts Torque N·m (kg·m/lb·ft)

1st Step	2nd Step	3rd Step
49 (5.0/36)	60° - 75°	60° - 75°

Push Rod

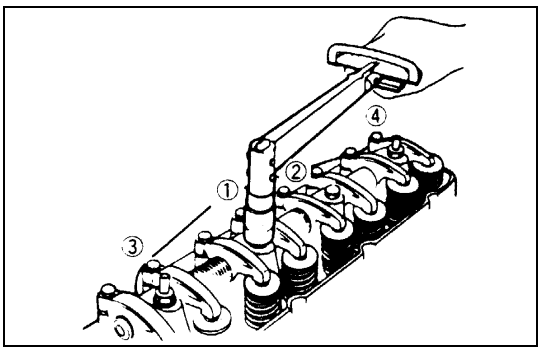
- Apply engine oil to push rod and into the cylinder head.



6A-67-3.tif

Rocker Arm Shaft Assembly

① Loosen all adjusting screws.
② Position the rocker arm shaft with the large oil hole (4ø) facing the front of the engine.



6A-68-1.tif

③ Tighten the rocker arm shaft bracket bolts to the specified torque in the numerical order shown in the illustration.

Rocker Arm Shaft Bracket Bolt Torque	N·m (kg·m/lb·ft)
	54 (5.5/40)

- Valve clearance adjustment.

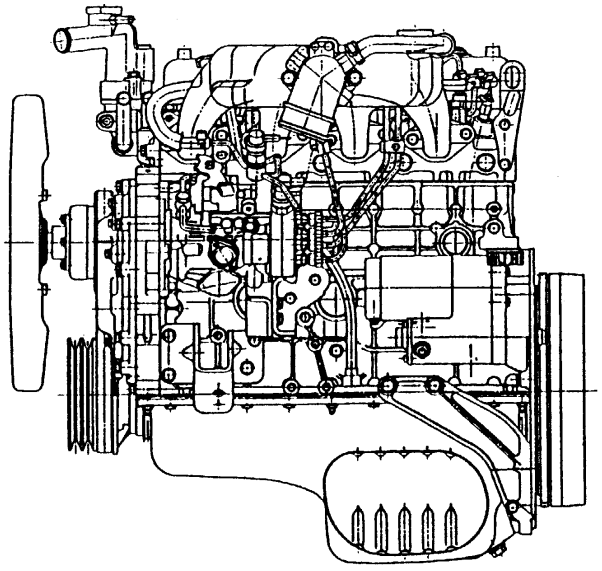
SECTION 6A1

4JB1/4JB1T/4JB1TC/4JG2-ENGINE

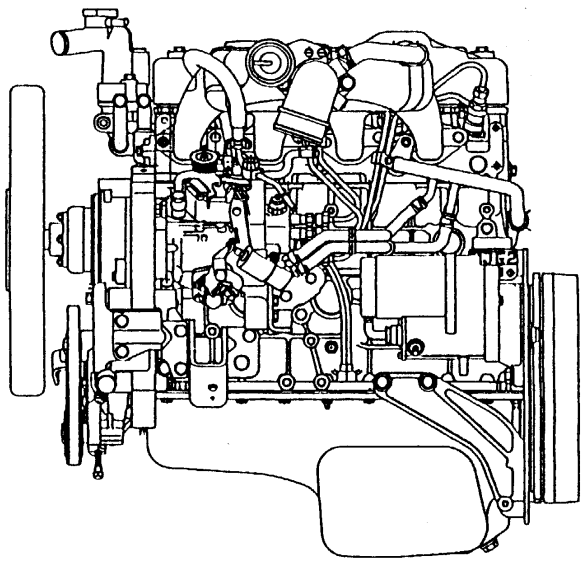
CONTENTS

	PAGE
General Description	6A1- 2
Engine Mount (RH)	6A1- 4
Engine Mount (LH)	6A1- 6
Inlet Manifold	6A1- 8
Exhaust Manifold	6A1- 10
Oil Cooler	6A1- 12
Oil Filter Cartridge	6A1- 14
Cylinder Head Cover	6A1- 15
Rocker Arm Shaft Assembly	6A1- 17
Valvestem Oil Controller and Valve Spring	6A1- 20
Timing Gear	6A1- 23
Timing Belt	6A1- 30
Cylinder Head Assembly and Gasket	6A1- 37
Oil Pan	6A1- 48
Oil Pump Assembly	6A1- 51
Piston, Piston Ring and Connecting Rod	6A1- 54
Camshaft and Tappet	6A1- 63
Crankshaft Front Oil Seal (Gear Drive Type)	6A1- 71
Crankshaft Front Oil Seal (Belt Drive Type)	6A1- 73
Crankshaft Rear Oil Seal (Gear & Belt Drive Type)	6A1- 76
Flywheel and Pilot Bearing	6A1- 83
Crankshaft and Main Bearings	6A1- 85
Engine Assembly	6A1- 96

GENERAL DESCRIPTION



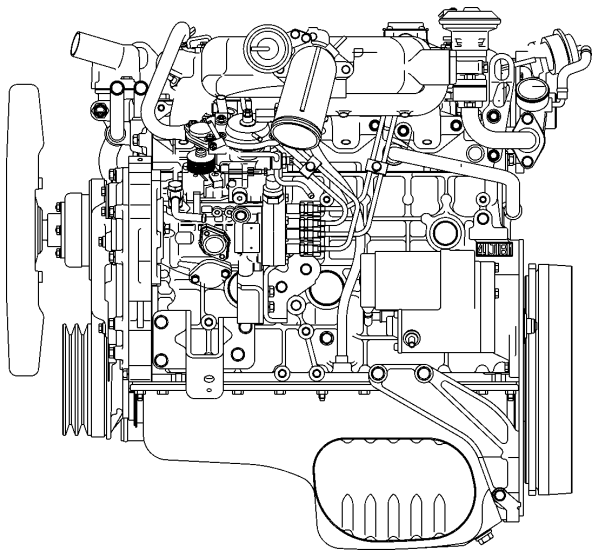
4JB1



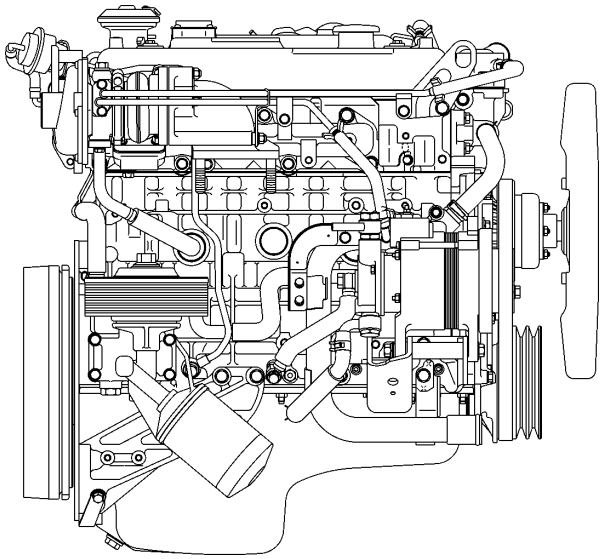
4JG2

6A1-2-1.tif

4JB1-TC



F06LX002.tif



F06LX005.tif

The 4JB1 Model engine employs a square troidal type combustion chamber provided with a fence around it. These designs employed allow a superior fuel economy over a wide range of driving conditions.

The 4JG2 Model engine employs, for its combustion chamber, the RECARD Comet V Type swirl combustion chamber which provides a superior driving performance, fuel economy and silent combustion over a wide range of driving conditions.

For the cylinder head gasket steel sheets, laminated steel sheets are employed.

Three grades of the gaskets according to the piston head projection measured from the cylinder block are employed to minimize the fluctuation of the engine compression ratio.

The Angular Tightening Method is employed to tighten the cylinder head fixing bolts, connecting rod fixing bolts and flywheel fixing bolts.

The chrome-plated steel dry type (Chromard) cylinder liners provide the highest durability.

Auto-thermic pistons with cast steel struts are used to reduce thermal expansion and resulting engine noise experienced while the engine is cold.

The tufftrided crankshaft has a long service life. Because it is tufftrided, it cannot be reground.

The crankshaft main bearings and the connecting rod bearings are of aluminum alloy. These bearings are especially vulnerable to foreign materials such as metal scraps. It is very important to keep the oil ports and other related surfaces clean and free of foreign materials.

The tufftriding treatment (nitriding treatment) of the crankshaft for the increased strength eliminates the regrinding of crankpins and journals.

An oiling jet device for piston cooling is provided in the lubricating oil circuit which runs through the check valve from the cylinder block oil gallery.

Take care not to damage the oiling jet when removing or installing the piston and the connecting assembly.

The 4JG2 engine use a single spring pintle type injection nozzle.

The 4JB1 Model employs a direct injection type engine provided with a nozzle with four holes, which makes it possible to obtain an excellent mixing ratio of intake air and fuel spray.

4JB1-TC engine has two springs injection nozzle system for efficient control.

The turbocharger increase air intake efficiency, the results in increased engine power, reduced fuel consumption and minimal engine noise.

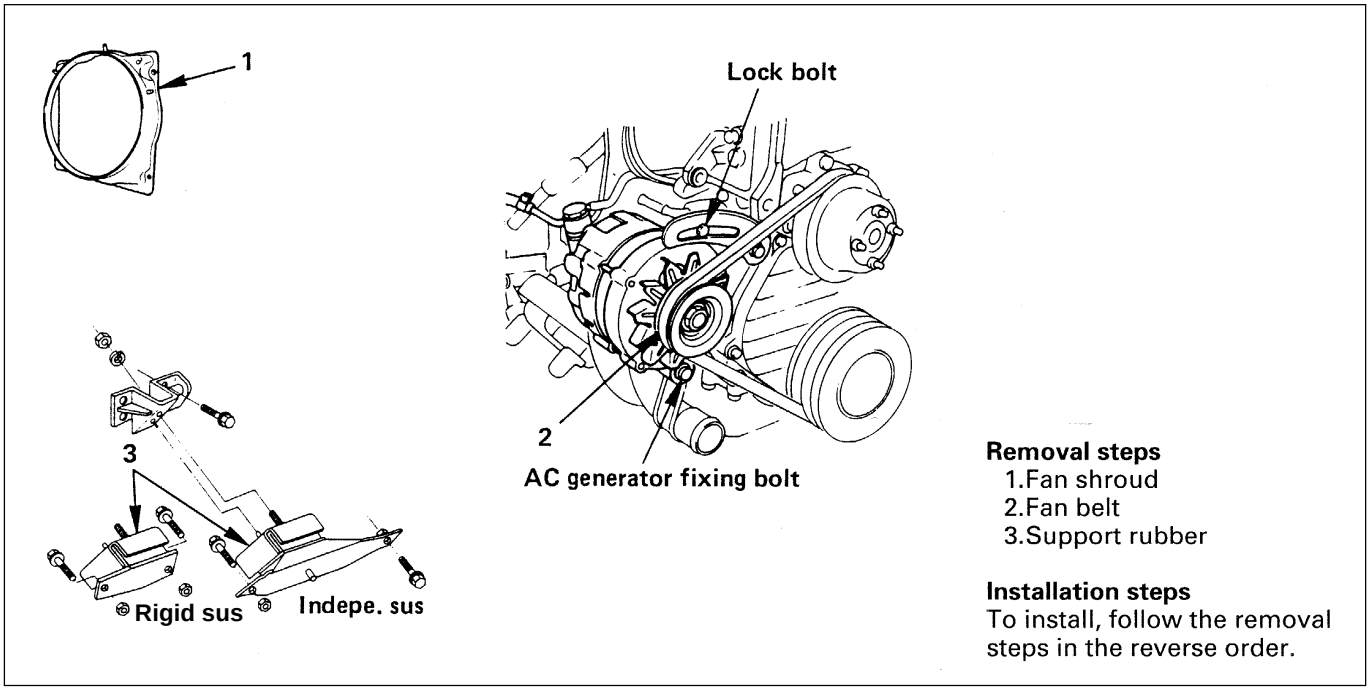
Turbocharger rotating parts operate at very high speeds and temperatures. The parts materials have been carefully selected and machined to extremely high precision.

The 4JB1 Model engine employs the QOS II preheating system which features a quick-on glow to control the glow time and the afterglow time by the thermometer.

The 4JG2 engine employs the QOS III system which allows the most suitable starting conditions for the glow time to change according to the engine water temperature, and the optimum for the glow time to change according to the engine water temperature, and the optimum changes according to the water temperature immediately after the start of the engine.

The belt-driven type timing drive belt of the 4JG2 Model engine is a very important functional part, and requires the specified maintenance.

ENGINE MOUNT (RH)



Removal steps
1.Fan shroud
2.Fan belt
3.Support rubber

Installation steps
To install, follow the removal steps in the reverse order.

6A1-4-1.tif

REMOVAL

Preparation:

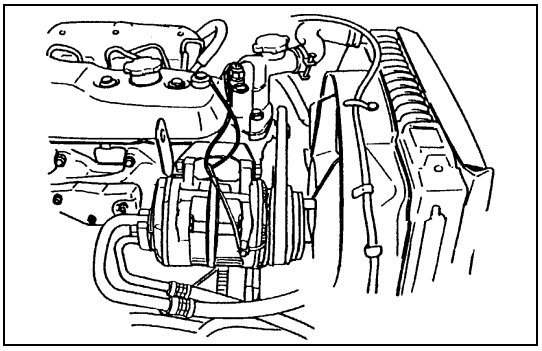
- Disconnect battery ground cable.

1. Fan Shroud

- Remove reservoir tank hose and fan shroud.

2. Fan Belt

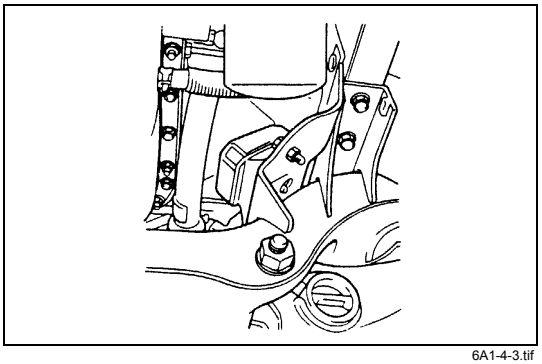
- Remove adjust plate lock bolt.
- Loosen generator fixing bolt then remove fan belt.



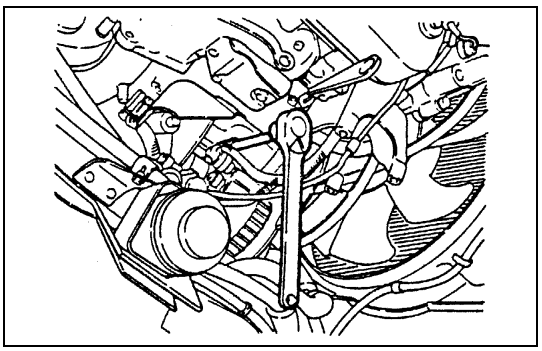
6A1-4-2.tif

3. Support Rubber

- Remove two fixing nuts at the crossmember side.



6A1-4-3.tif



6A1-5-1.tif

- Separate the generator from the engine.
- Remove the support rubber nut from engine foot side.
- Remove the support rubber while raising the engine.

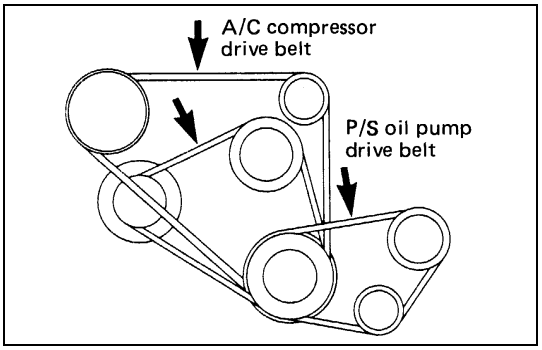
INSTALLATION

3. Support Rubber

- Install the support rubber while raising the engine.
- Tighten the fixing nuts to the specified torque.

Engine foot side	N·m(kg·m/lb·ft)
	82(8.4/61)

Crossmember side	N·m(kg·m/lb·ft)
	40(4.1/30)



6A1-5-2.tif

2. Fan Belt

- Install the fan belt.
- Depress the fan belt mid-portion with a 98N (10kg/22lb) force.
- Tighten the fixing bolt to the specified torque.

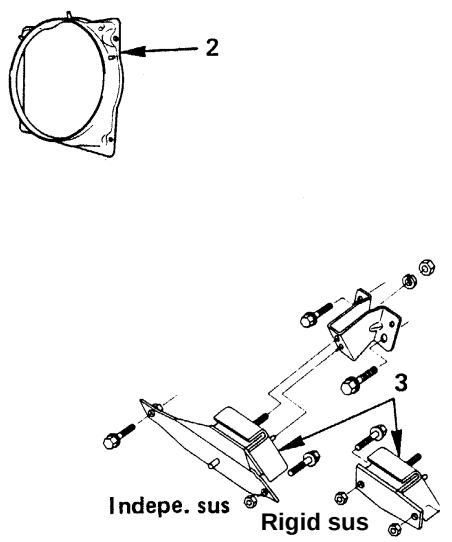
Adjust plate lock bolt	N·m(kg·m/lb·ft)
	19(1.9/14)

Generator fixing bolt	N·m(kg·m/lb·ft)
	40(4.1/30)

1. Fan Shroud

- Install the fan shroud and clip the reservoir tank hose.

ENGINE MOUNT (LH)



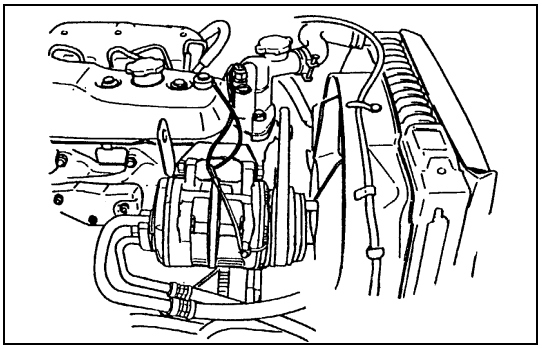
Removal steps
1. Air intake duct
2. Fan shroud
3. Support rubber

Installation steps
To install, follow the removal steps in the reverse order.

6A1-6-1.tif

REMOVAL

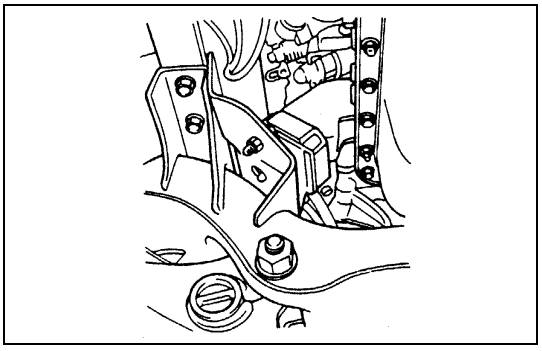
Preparation:
- Disconnect battery ground cable.



6A1-6-2.tif

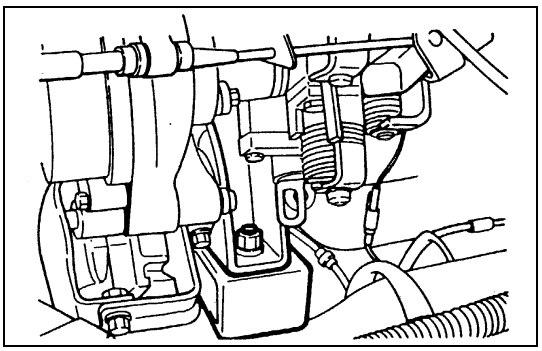
1. Air Intake Duct
- Remove the intake duct.

2. Fan Shroud
- Remove reservoir tank hose and fan shroud.



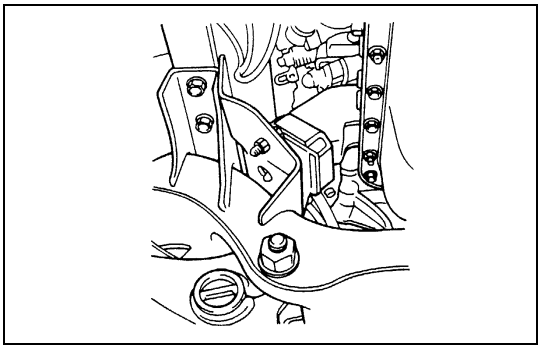
6A1-6-3.tif

3. Support Rubber
- Remove two fixing bolts at the crossmember side.



6A1-7-1.tif

- Remove the support rubber nut from engine foot side.
- Remove the support rubber while raising the engine.



6A1-7-2.tif

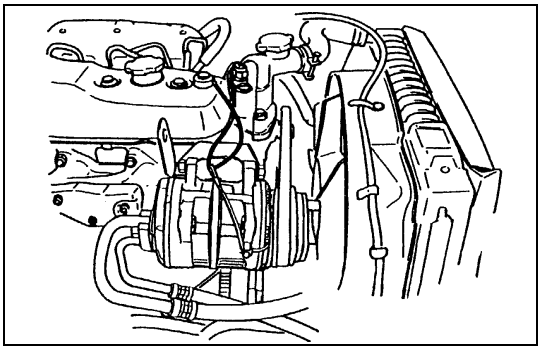
INSTALLATION

3. Support Rubber

- Install the support rubber while raising the engine.
- Tighten the fixing nuts to the specified torque.

Engine foot side	N·m (kg·m/lb·ft)
82 (8.4/61)	

Crossmember side	N·m (kg·m/lb·ft)
40 (4.1/30)	



6A1-7-3.tif

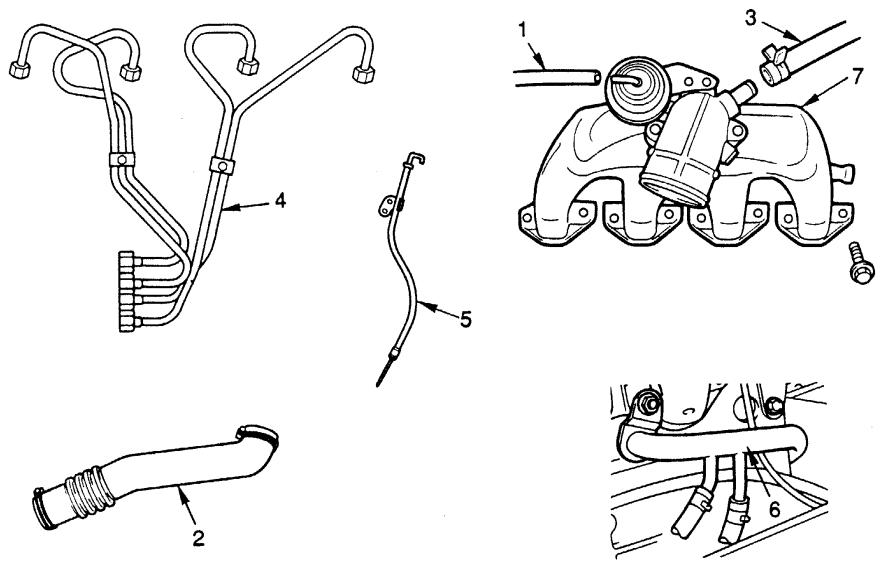
2. Fan shroud

- Install the fan shroud and clip the reservoir tank hose.

1. Air Intake Duct

- Install the air intake duct.
- Connect battery ground cable.

INLET MANIFOLD



Removal steps
1. Vacuum hose
2. Air intake duct
3. PCV hose
4. Injection pipe
5. Oil level gauge guide tube
6. Oil cooler water pipe (Oil Cooler Model)
7. Inlet manifold

Installation steps
To install, follow the removal steps in the reverse order.

6A1-8-1.tif

REMOVAL

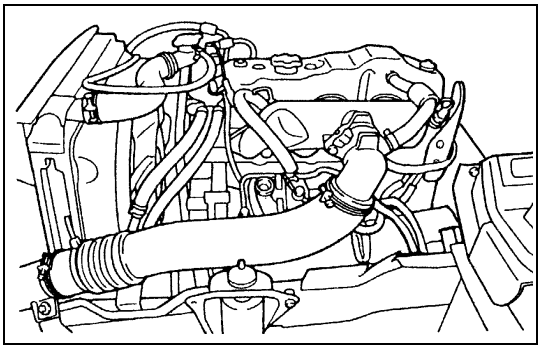
Preparation:
- Disconnect battery ground cable.
- Drain coolant.

1. Vacuum Hose

2. Air Intake Duct

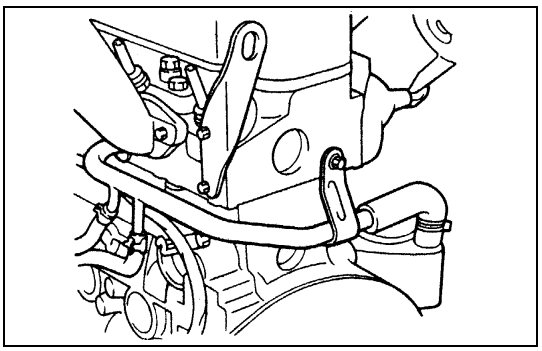
3. PCV Hose

4. Injection Pipe
- Release injection pipe clip.
- Loosen the flare nut on the injection pump side.
- Loosen the flare nut on the injection nozzle side, disconnect and put a side the pipe.



6A1-8-2.tif

5. Oil Level Gauge Guide Tube
- Remove the fixing bolt and remove level gauge guide tube.



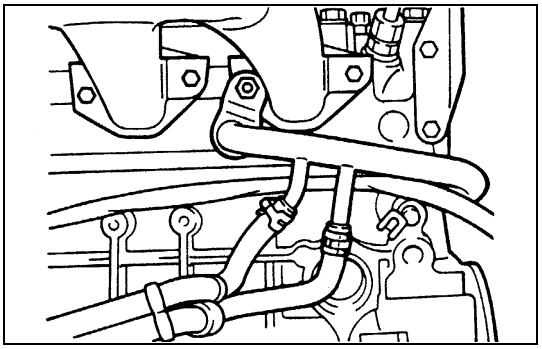
6A1-9-1.tif

6. **Oil Cooler Water Pipe (Oil Cooler Model)**
   - Remove the water pipe bracket bolt.
   - Remove the inlet manifold fixing nut.
7. **Inlet Manifold**
   - Remove the manifold fixing bolt and nut.

INSTALLATION

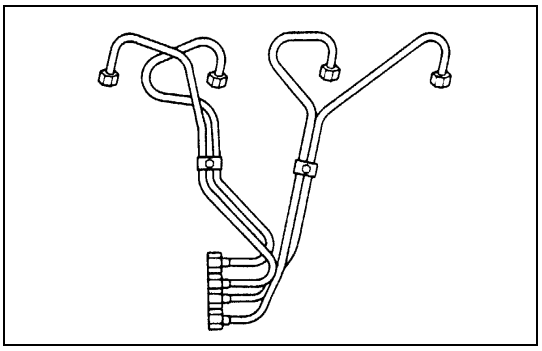
7. **Inlet Manifold**
   - Tighten the fixing bolts and nuts to the specified torque.

Bolt & Nut	N·m(kg·m/lb·ft)
	19(1.9/14)



6A1-9-2.tif

6. **Oil Cooler Water Pipe (Oil Cooler Model)**
   - Install the water pipe and tighten the manifold with water pipe.
   - Tighten the pipe bracket bolt of cylinder head rear side.
5. **Oil Level Gauge Guide Tube**
   - Install the guide tube and tighten the manifold with guide tube.



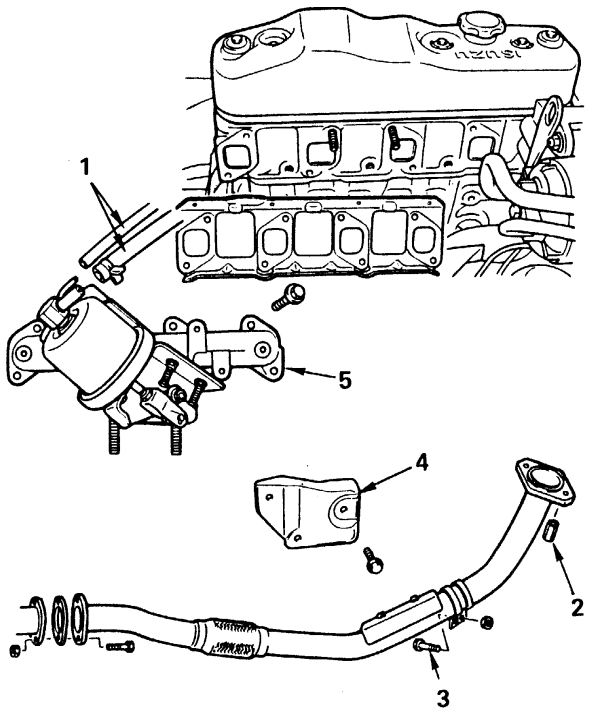
6A1-9-3.tif

4. **Injection Pipe**
   - Connect the injection pipe and tighten flare nut to the specified torque.

Flare nut torque	N·m(kg·m/lb·ft)
	29(3.0/22)

   - Install the pipe clip to the original position.
3. **PCV Hose**
2. **Air Intake Duct**
1. **Vacuum Hose**
   - Connect the battery ground cable.
   - Pour coolant.
   - Start the engine and check coolant leakage.

EXHAUST MANIFOLD



Removal steps
1. Vacuum hose
2. Front exhaust pipe nut
3. Front exhaust pipe stay bolt
4. Heat protector
5. Exhaust manifold

Installation steps
To install, follow the removal steps in the reverse order.

6A1-10-1.tif

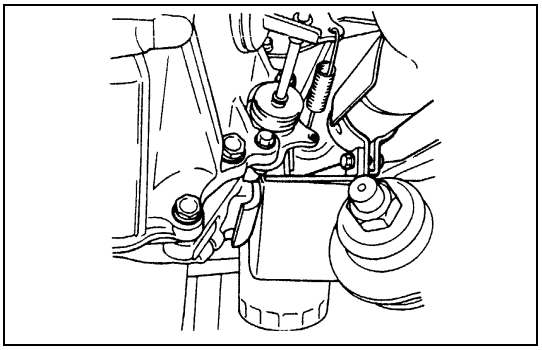
REMOVAL

Preparation:
- Disconnect battery ground cable.

1. Vacuum Hose (Exhaust Brake Model)
- Remove the vacuum actuator hose.

2. Front Exhaust Pipe Nut
- Remove the fixing nuts from exhaust manifold side.

3. Front Exhaust Pipe Stay Bolt



6A1-10-2.tif

4. Heat Protector

5. Exhaust Manifold
- Remove the manifold bolt and nut, then remove the manifold and gasket.

INSTALLATION

5. Exhaust Manifold

- Tighten the fixing nuts and bolts to the specified torque.

Manifold Bolt Torque	N·m(kg·m/lb·ft)
26 (2.7/20)	

4. Heat Protector

- Remove the heat protector and tighten to the specified torque.

Heat Protector Bolt Torque	N·m(kg·m/lb·ft)
19 (1.9/14)	

3. Front Exhaust Pipe Stay Bolt

- Tighten the fixing bolts to the specified torque.

Stay Bolt Torque	N·m(kg·m/lb·ft)
40 (4.1/30)	

2. Front Exhaust Pipe Nut

- Tighten the fixing nuts to the specified torque.

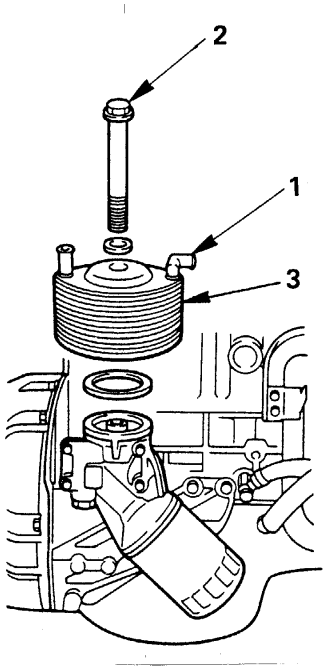
Without Exhaust Brake	N·m(kg·m/lb·ft)
69 (7/51)	

With Exhaust Brake	N·m(kg·m/lb·ft)
69 (7/51)	

1. Vacuum Hose (Exhaust Brake Model)

- Install the two hose a vacuum actuator.
- Connect battery ground cable.
- Start the engine and check coolant leakage.

OIL COOLER (Oil Cooler Model)



(4JG2, 4JB1, 4JB1TC)

Removal steps
1. Water hose
2. Oil cooler fixing bolt
3. Oil cooler

Installation steps
To install, follow the removal steps in the reverse order.

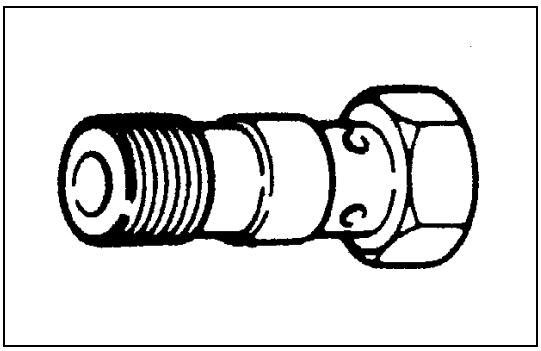
6A1-12-1.tif

REMOVAL

Preparation:

- Disconnect battery ground cable
- Drain coolant
- Put rag to beneath side of oil cooler to prevent oil leaking.

1. **Water Hose**
   - Disconnect water inlet and outlet hose.
2. **Oil Cooler Fixing Bolt**
3. **Oil Cooler**



6A1-13-1.tif

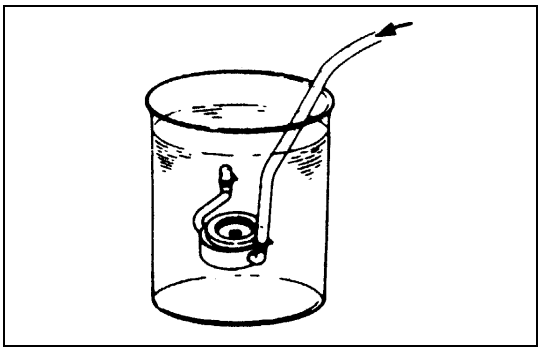
INSPECTION

Relief Valve

1. Attach an oil pressure gauge to the oil gallery near the oil filter.
2. Start the engine to check the relief valve opening pressure.

Relief Valve Opening Pressure kPa (kg/cm^2/psi)

Type1	559-618 (5.7-6.3/81.0-89.6)
Type2	422-461 (4.3-4.7/61.1-66.8)

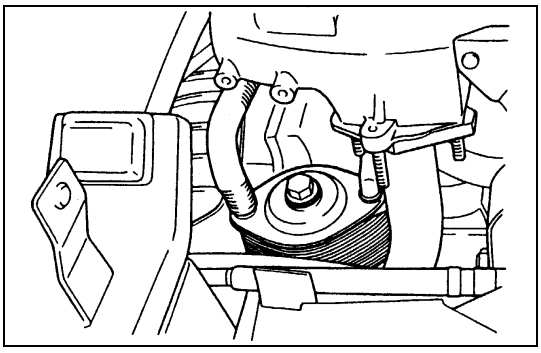


6A1-13-2.tif

Oil Cooler

Check for water leakage at the water passage.

1. Plug one side of the oil cooler water passage.
2. Submerge the oil cooler in water.
3. Apply compressed air (2 kg/cm^2 (28.5psi/196.0kPa)) to the other side of the oil cooler water passage.
   If air bubbles rise to the surface, there is water leakage.



6A1-13-3.tif

INSTALLATION

3. Oil Cooler

- Install the O-ring to oil filter body and set the oil cooler.

2. Oil Cooler Fixing Bolt

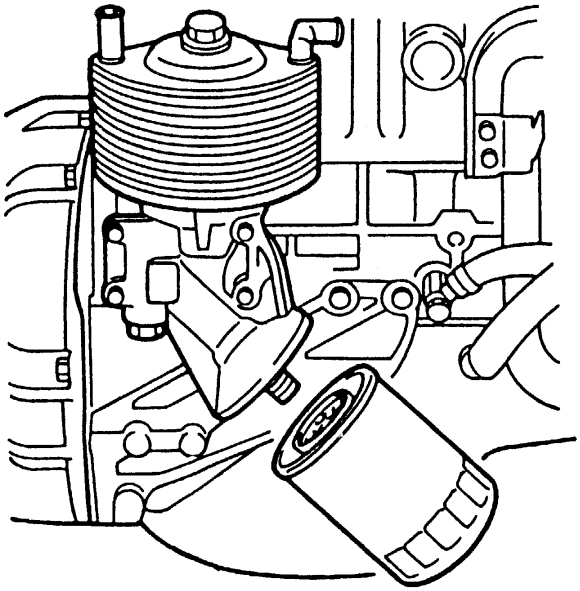
Oil Cooler Bolt Torque N·m (kg·m/lb·ft)

29 (3.0/22)

1. Water Hose

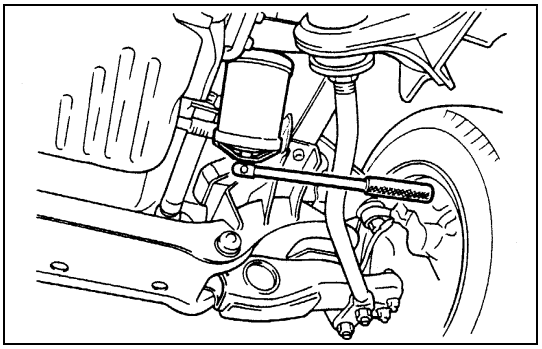
- Connect water hose.

OIL FILTER CARTRIDGE



(4JG2, 4JB1, 4JB1TC)

6A1-14-1.tif



6A1-14-2.tif

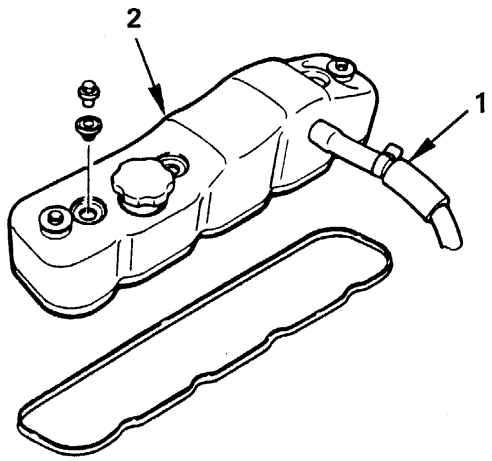
REMOVAL

- Place a receptacle beneath the oil filter to contain the drained oil.
- Remove the oil filter cartridge using filter wrench.
  Filter wrench: 5-8840-0200-0

INSTALLATION

- Lightly oil the O-ring of oil filter cartridge.
- Turn in the new oil filter cartridge by hand until the sealing face is fiffted against the O-ring.
- Use the filter wrench to turn in the oil filter and additional one and 1.1/8 turns.
- Start the engine and check for oil leakage from oil filter.

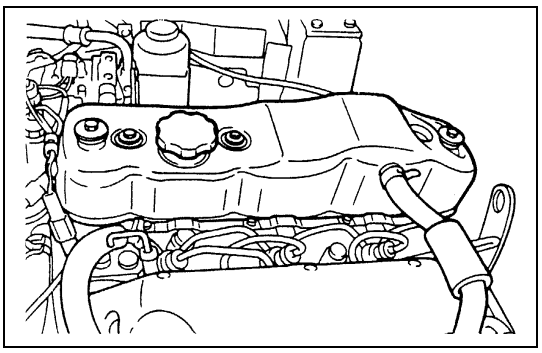
CYLINDER HEAD COVER



Removal steps
1. PCV hose
2. Cylinder head cover

Installation steps
To install, follow the removal steps in the reverse order.

6A1-15-1.tif



6A1-15-2.tif

REMOVAL

Preparation:
- Disconnect battery ground cable.

1. PCV Hose
- Disconnect the PCV hose from intake pipe side.

2. Cylinder Head Cover

INSTALLATION

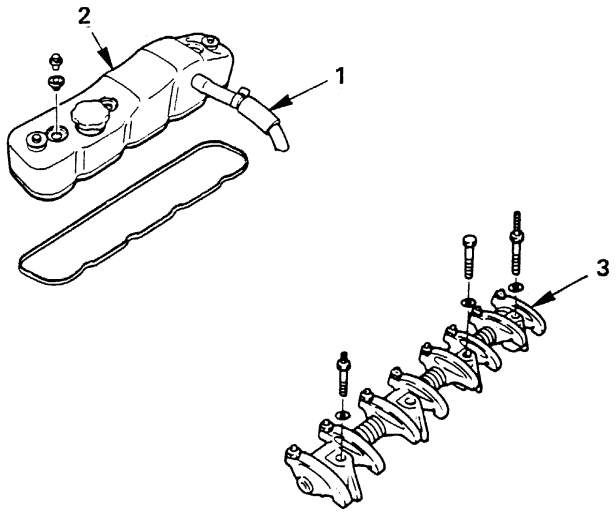
2. Cylinder Head Cover
- Apply engine oil to the rocker arms and the valve springs.
- Install the cylinder head cover gasket to the cylinder head cover.
- The gasket must be perfectly smooth with no loose areas.
- Tighten the cylinder head cover nuts to the specified torque.

N·m (kg·m/lb·ft)

13 (1.3/9)

1. **PCV Hose**
   - Connect the PCV hose to the intake pipe.
   - Connect battery ground cable.

ROCKER ARM SHAFT ASSEMBLY



Removal steps
1. PCV hose
2. Cylinder head cover
3. Rocker arm shaft Assembly

Installation steps
To install, follow the removal steps in the reverse order.

6A1-17-1.tif

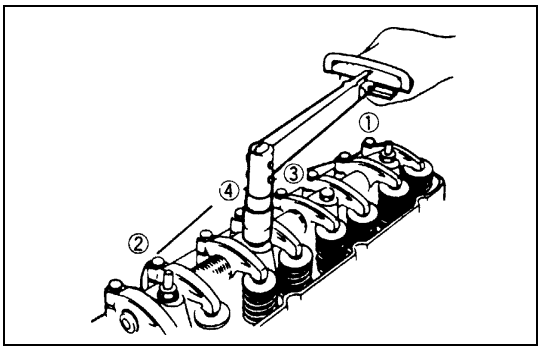
REMOVAL

Preparation:
- Disconnect battery ground cable.

1. PCV Hose

2. Cylinder Head Cover

3. Rocker Arm Shaft Assembly
- Loosen bolts and nuts of rocker shaft bracket by turns and remove rocker shaft assembly.



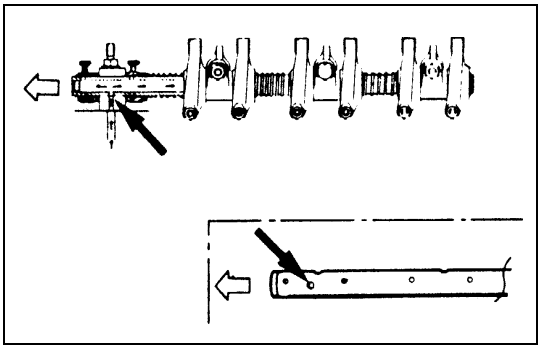
6A1-17-2.tif

INSTALLATION

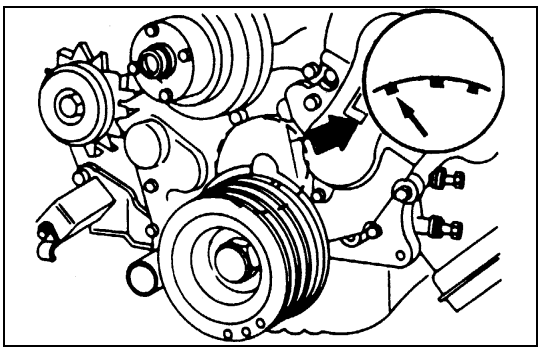
3. Rocker Arm Shaft Assembly
- Install rocker arm shaft with larger oil hole (ϕ4) to the front of engine.
- Align fixing bolt with nut of rocker arm shaft and tighten fixing bolts to the specified torque.

N·m (kg·m/lb·ft)

54 (5.5/40)



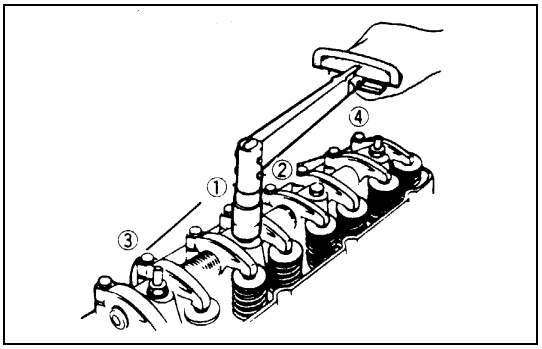
6A1-17-3.tif



6A1-18-1.tif

Valve Clearance Adjustment

① Bring the piston in either the No.1 cylinder or the No.4 cylinder to TDC on the compression stroke by turning the crankshaft until the crankshaft damper pulley TDC line is aligned with the timing pointer.

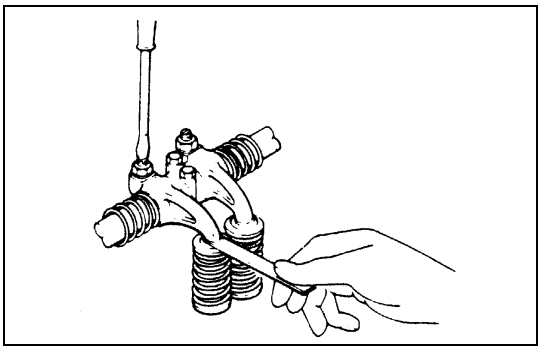


6A1-18-2.tif

② Check the rocker arm shaft bracket nuts for looseness.

Tighten any loose rocker arm shaft bracket nuts before adjusting the valve clearance.

Rocker Arm Shaft Bracket Nut Torque	N·m (kg·m/lb·ft)
	54 (5.5/40)

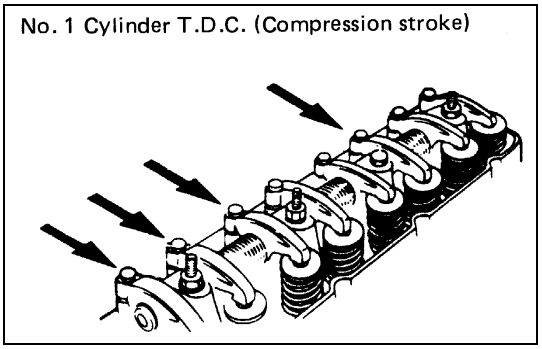


6A1-18-3.tif

③ Check for play in the No.1 intake and exhaust valve push rods.

If the No.1 cylinder intake and exhaust valve push rods have play, the No.1 piston is at TDC on the compression stroke.

If the No.1 cylinder intake and exhaust valve push rods are depressed, the No.4 piston is at TDC on the compression stroke.



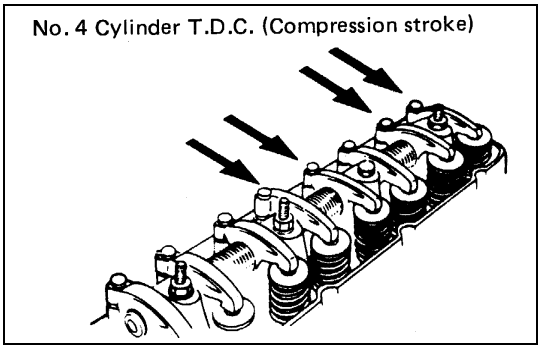
6A1-18-4.tif

Adjust the No.1 or the No.4 cylinder valve clearances while their respective cylinders are at TDC on the compression stroke.

Valve Clearance (At Cold)	mm (in)
	0.4 (0.016)

④ Loosen each valve clearance adjusting screw as shown in the illustration.

⑤ Insert a feeler gauge of the appropriate thickness between the rocker arm and the valve stem end.



6A1-18-5.tif

⑥ Turn the valve clearance adjusting screw until a slight drag can be felt on the feeler gauge.

⑦ Tighten the lock nut securely.

⑧ Rotate the crankshaft 360°.

⑨ Realign the crankshaft damper pulley TDC notched line with the timing pointer.

⑩ Adjust the clearances for the remaining valves as shown in the illustration.

2. Cylinder Head Cover

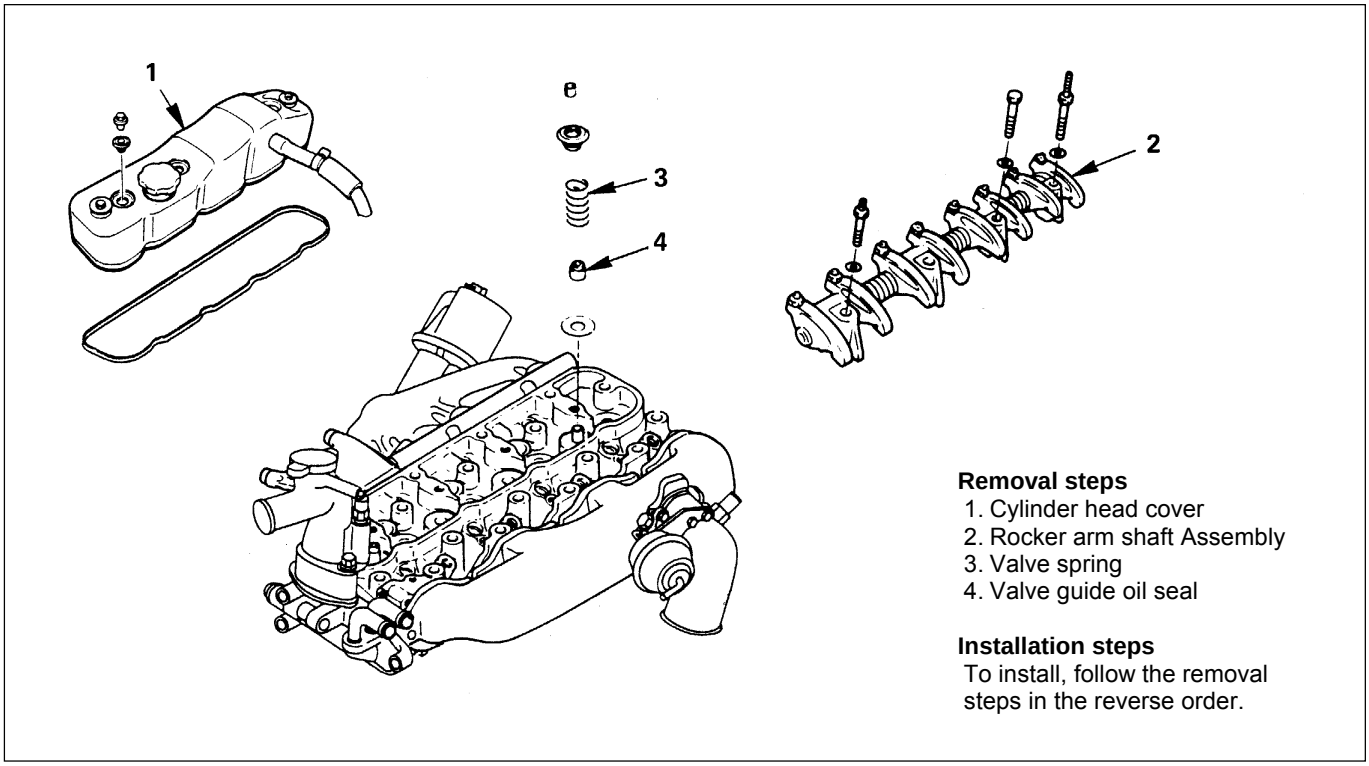
- Install cylinder head cover and tighten bolts to the specified torque.

N·m (kg·m/lb·in)
13 (1.3/113)

1. PCV Hose

- Connect battery ground cable.

VALVESTEM OIL CONTROLLER & VALVE SPRING



Removal steps
1. Cylinder head cover
2. Rocker arm shaft Assembly
3. Valve spring
4. Valve guide oil seal

Installation steps
To install, follow the removal steps in the reverse order.

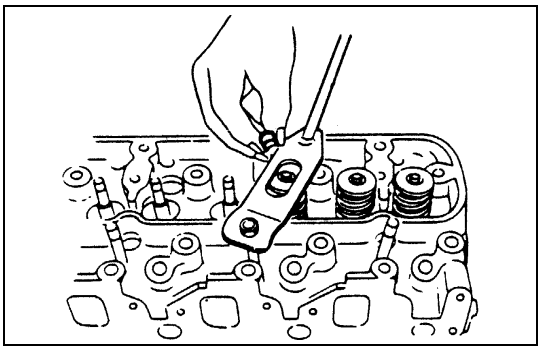
6A1-20-1.tif

REMOVAL

Preparation:
- Disconnect battery ground cable.

1. Cylinder Head Cover

2. Rocker Arm Shaft Assembly
- Loosen bolts and nuts of rocker shaft
- Bracket by turns and removal rocker shaft assembly.

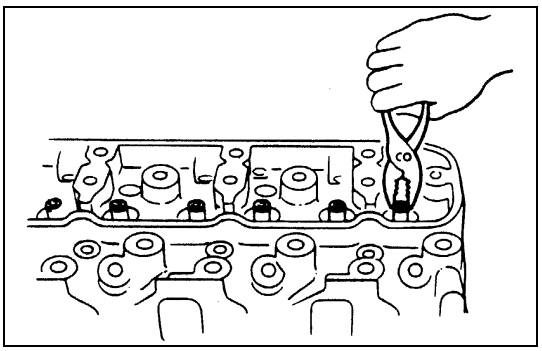


6A1-20-2.tif

3. Valve Spring
- Apply compressed air to cylinder from the glow plug hole hold the valve in place.
- Using special tool, compress valve spring and removal split collar.

Valve spring compressor: 9-8523-1423-0 (J-29760)

CAUTION
- Put removed valve springs in the order of cylinder number.



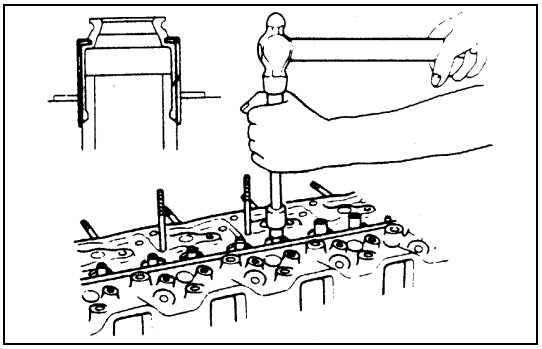
6A1-21-1.tif

4. Valve Guide Oil Seal

- Removal valve guide oil seal by pliers.

CAUTION

- Removed oil controller should not be reused.



6A1-21-2.tif

INSTALLATION

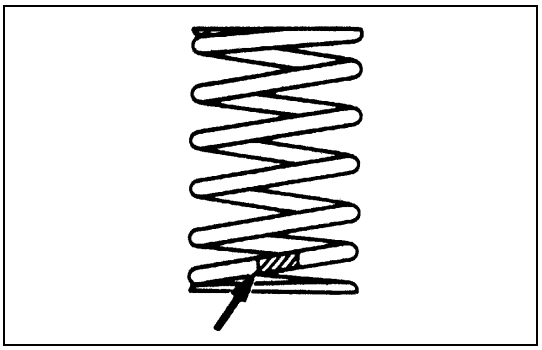
4. Valve Guide Oil Seal

- Install new valve guide oil seal in valve.
- Guide using special tool.

  Special tool: 5-8840-2033-0

3. Valve Spring

- Attach the valve spring to the upper spring seat.

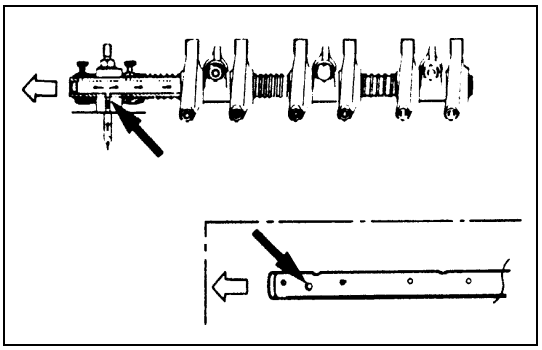


6A1-21-3.tif

CAUTION

- The painted area of the valve spring should be facing toward.
- Apply compressed air to cylinder from the glow plug hole to hold the valve in place.
- Install split collar by special tool.

  Valve spring compressor: 9-8523-1423-0 (J-29760)



6A1-21-4.tif

2. Rocker Shaft Assembly

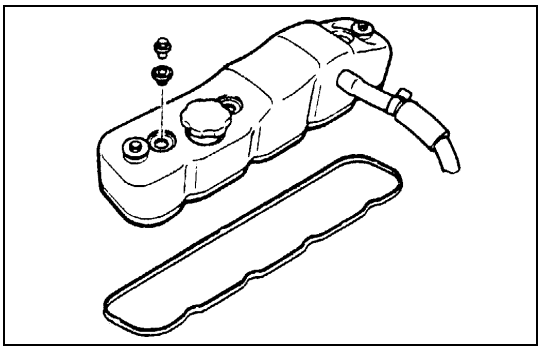
- Install rocker arm shaft with a larger oil hole (ϕ4) to the front of engine.
- Align fixing bolt with not of rocker arm shaft and tighten fixing bolt to the specified torque.

N·m (kg·m/lb·ft)
54 (5.5/40)

- Valve clearance adjustment

Valve Clearance Adjustment

Above works refer to “ROCKER ARM SHAFT ASSEMBLY” Section in this manual.



6A1-22-1.tif

1. Cylinder Head Cover

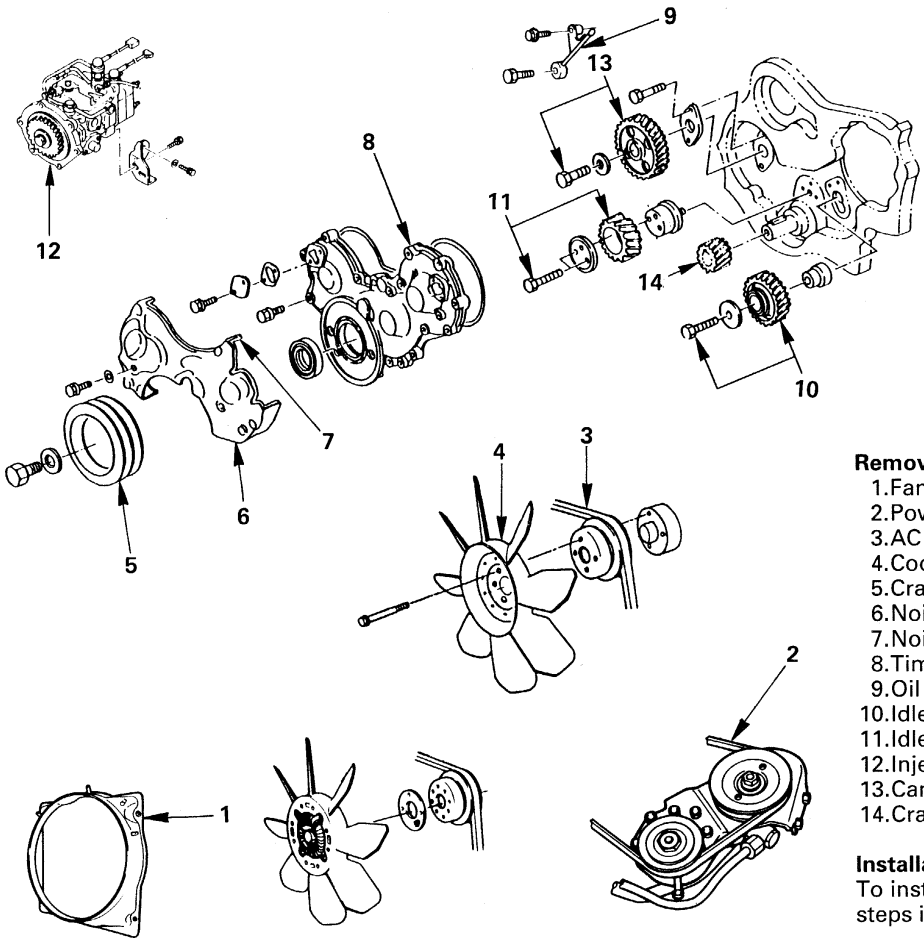
- Apply engine oil to the rocker arms and the valve spring.
- Install the cylinder head cover gasket to the cylinder head cover.

  The gasket must be perfectly smooth with no loose areas.
- Install cylinder head cover and tighten bolt to the specified torque.

Head Cover Bolt Torque	N·m (kg·m/lb·in)
	13 (1.3/113)

- Connected PCV hose.
- Connect battery ground cable.

TIMING GEAR (4JB1, 4JB1TC, 4JG2 Gear Type)



Removal steps
1. Fan shroud
2. Power steering pump drive belt
3. AC generator drive belt
4. Cooling fan ASM
5. Crankshaft damper pulley
6. Noise shield cover
7. Noise cover spacer
8. Timing gear case cover
9. Oil pipe
10. Idle gear
11. Idle gear
12. Injection pump
13. Camshaft timing gear
14. Crankshaft gear

Installation steps
To install, follow the removal steps in the reverse order.

6A1-23-1.tif

REMOVAL

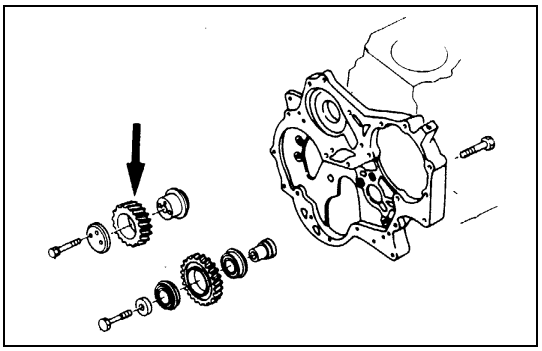
Preparation:
- Disconnect battery ground cable.
- Drain coolant.

1. **Fan Shroud**
2. **Power Steering Pump Drive Belt (P/S Model)**
   - Loosen power steering pump mounting bolt and adjust bolt, and remove the drive belt.
3. **AC Generator Drive Belt**
   - Loosen AC Generator mounting bolt (under side) and adjust plate lock bolt, and remove the drive belt.
4. **Cooling Fan Assembly**
   - Remove clamp nut, and remove cooling fan assembly, distant pipe, and fan pulley.
5. **Crankshaft Damper Pulley**
6. **Noise Shield Cover**

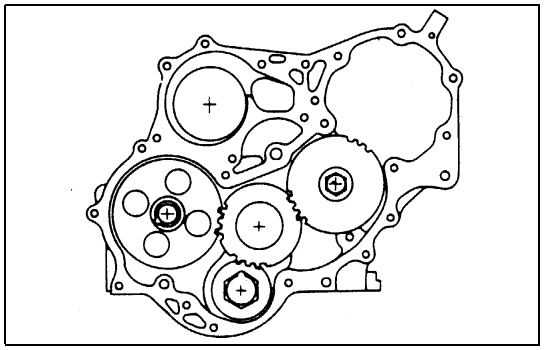
7. **Noise Cover Spacer**
8. **Timing Gear Case Cover**
9. **Oil Pipe**
10. **Idler Gear**
    1) Measure the camshaft timing gear backlash and the crankshaft timing gear backlash before removing the idler gear.
    2) Measure the idler gear end play before removing the idler gear.

NOTE:

Refer to the following items for details on the backlash and end play measurement procedures.



6A1-24-1.tif



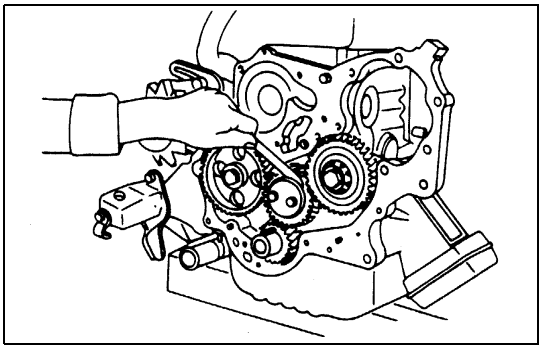
6A1-24-2.tif

Timing Gear Backlash Measurement

1) Set a dial indicator to the timing gear to measured.
   Hold both the gear to be checked and the adjoining gear stationary.
2) Move the gear to be checked as far as possible to both the right and the left.
   Take the dial indicator reading.
   If the measured value exceeds the specified limit, the timing gear must be replaced.

Timing Gear Backlash mm (in)

Standard	Limit
0.10-0.17 (0.0039-0.0067)	0.30 (0.012)



6A1-24-3.tif

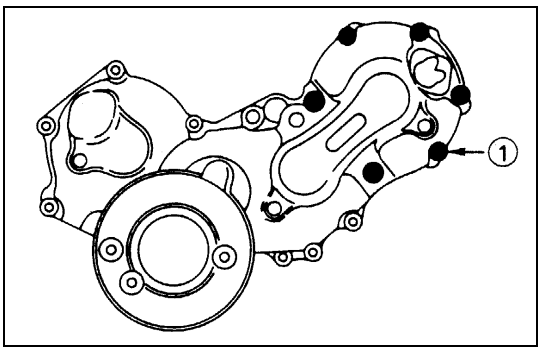
Idler Gear "A" End Play Measurement

Insert a feeler gauge between the idler gear and the thrust collar to measure the gap and determine the idler gear end play.

If the measured value exceeds the specified limit, the thrust collar must be replaced.

Idle Gear End Play mm (in)

Standard	Limit
0.07 (0.0028)	0.2 (0.0079)

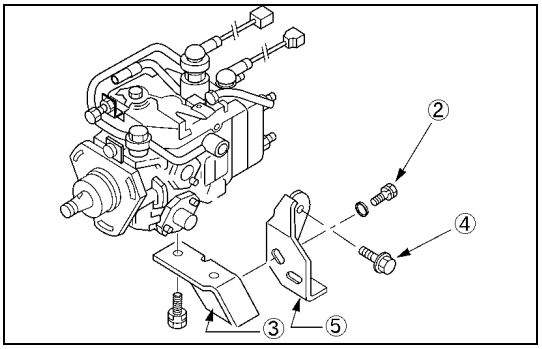


6A1-25-1.tif

11. Idle Gear

12. Injection Pump

1) Remove the six injection pump bracket bolts ① from the timing gear case.

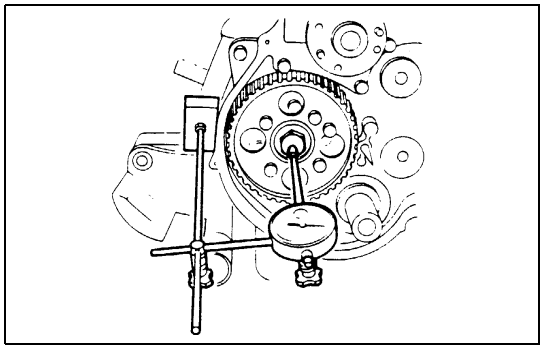


040LV002.tif

2) Remove the injection pump rear bracket bolts ② from the injection pump bracket ③.
3) Remove the injection pump rear bracket bolts ④ and the bracket ⑤ from the cylinder body.
4) Pull the injection pump along with the injection pump timing gear free toward the rear of the engine.

NOTE:

Plug the injection pump delivery holder ports with the shipping caps (or the equivalent) to prevent the entry of foreign material.



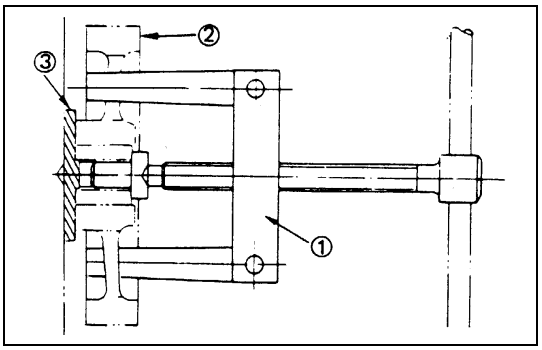
6A1-25-3.tif

13. Camshaft Timing Gear

1) Use a dial indicator to measure the camshaft end play.
   This must be done before removing the camshaft gear.
   If the camshaft end play exceeds the specified limit, the thrust plate must be replaced.

Camshaft End Play mm (in)

Standard	Limit
0.050-0.114 (0.002-0.0044)	0.2 (0.008)



6A1-25-4.tif

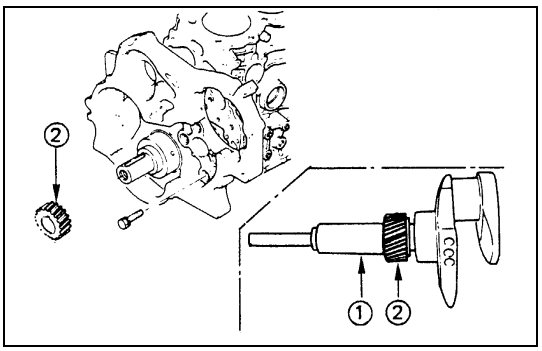
2) Remove the camshaft timing gear bolt from the camshaft.

NOTE:

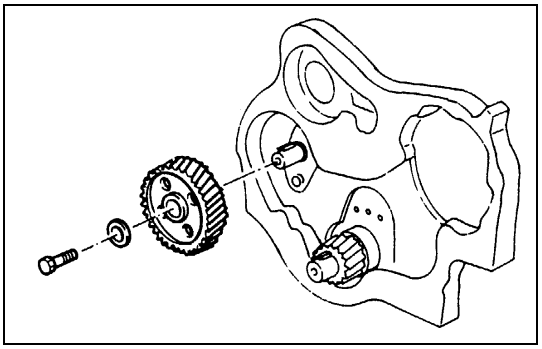
Hold the camshaft stationary to prevent the camshaft from turning.

3) Use the universal puller ① to pull out the camshaft timing gear ②.
   Universal Puller: 5-8521-0002-0
4) Remove the thrust plate ③.

14. Crankshaft Gear



6A1-26-1.tif


6A1-26-2.tif

INSTALLATION

14 Crankshaft Gear

1) Install the crankshaft gear.
2) Use the crankshaft gear installer ① to install the crankshaft gear ②.
   The crankshaft gear timing mark ("X-X") must be facing outward.
   Crankshaft Gear Installer: 9-8522-0020-0

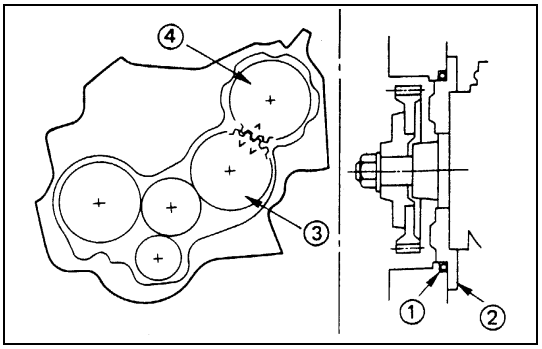
13. Camshaft Timing Gear

1) Install the thrust plate to the cylinder body.
2) Tighten the thrust plate bolts to the specified torque.

N·m (kg·m/lb·ft)
18 (1.8/13)

3) Install the camshaft timing gear to the camshaft.
   The timing gear mark ("Y-Y") must be facing outward.
4) Tighten the timing gear to the specified torque.

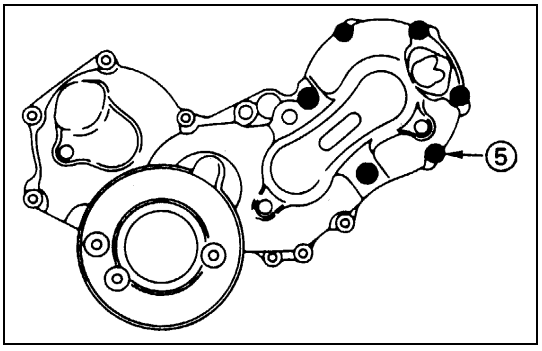
N·m (kg·m/lb·ft)
64 (6.5/47)



6A1-27-2.tif

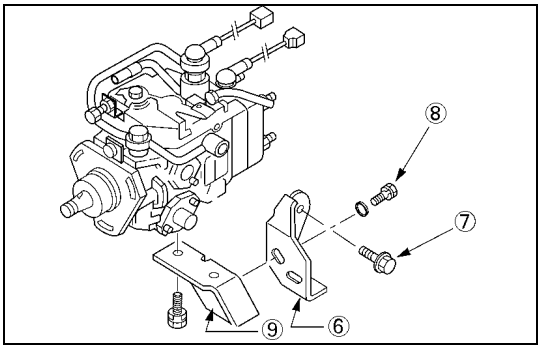
12. Injection Pump

1) Install the O-ring ① to the injection pump flange ②.
2) Install the injection pump to the timing gear case.
   Align the idler gear "B" ③ "V-V" mark with the injection pump timing gear ④ "V" mark.



6A1-27-3.tif

3) Temporarily tighten the six injection pump nuts ⑤.
   The injection pump nuts will be finally tightened after the injection pump rear bracket bolts.



040LV001

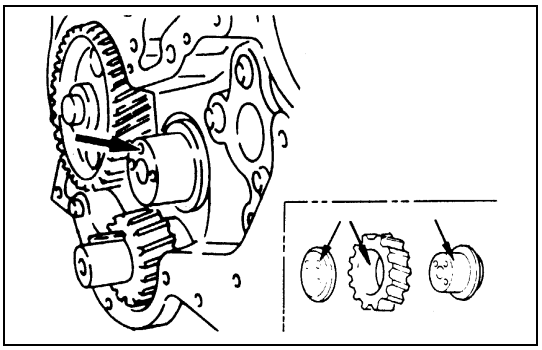
4) Install the injection pump rear bracket ⑥ and the rear bracket bolts ⑦ to the cylinder body.
5) Install the rear bracket bolts ⑧ to the injection pump bracket ⑨.
   Do not tighten the bolts.
   The rear bracket bolts ⑦ and ⑧ will be finally tightened to the specified torque after tighten the injection pump nuts.

6) Tighten the injection pump nuts to the specified torque.

N·m (kg·m/lb·ft)
19 (1.9/14)

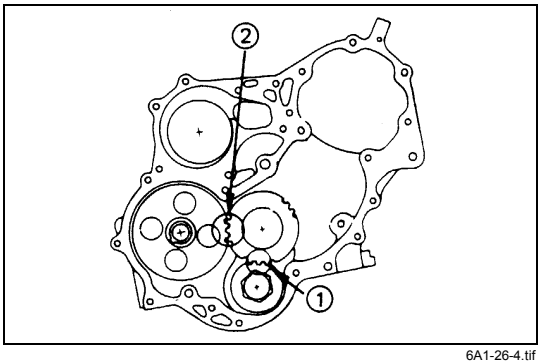
7) Tighten the injection pump bracket bolts to the specified torque.

N·m (kg·m/lb·ft)
19 (1.9/14)


6A1-26-3.tif

11. Idler Gear

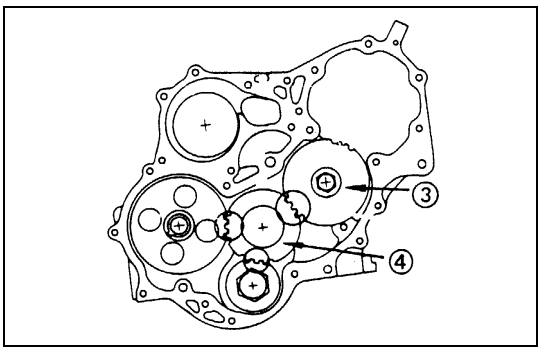
1) Apply engine oil to the idler gear and the idler gear shaft.
   The idler gear shaft oil hole must be facing up.
2) Position the idler gear setting marks "X" and "Y" so that they are facing the front of the engine.



6A1-26-4.tif

3) Align the idler gear "X" setting mark with the crankshaft timing gear ① "X-X" setting mark.
4) Align the idler gear "Y" setting mark with the camshaft timing gear ② "Y-Y" setting mark.
5) Install the thrust collar and bolts to the cylinder body through the shaft.
   The thrust collar oil hole must be facing up, and the thrust collar chamfered must be outward.
6) Tighten the idler gear bolt to the specified torque.

N·m (kg·m/lb·ft)
19 (1.9/14)



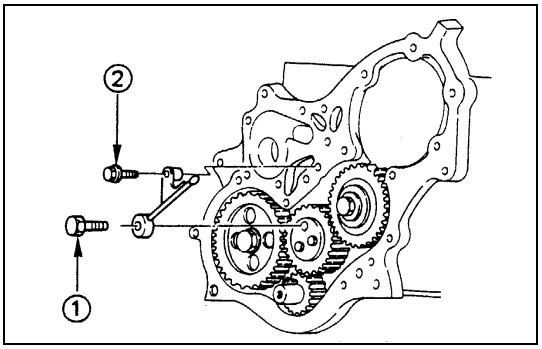
6A1-27-1.tif

10. Idler Gear

1) Apply engine oil to the idler gear and the idler gear shaft.
2) Align the idler gear "B" ③ "Z" setting mark with the idler gear "A" ④ "Z-Z" setting mark.
3) Tighten the idler gear bolt to the specified torque.

N·m (kg·m/lb·ft)

76 (7.7/56)

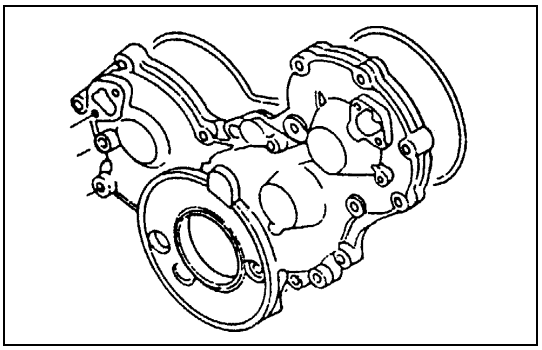


6A1-28-1.tif

9. Oil Pipe

1) Install the oil pipe to the timing gear case and idler gear "A".
2) Tighten the oil pipe eye bolt ① and bolt ② to the specified torque.

Oil Pipe Eye Bolt Torque	N·m (kg·m/lb·ft)
13 (1.3/9)	

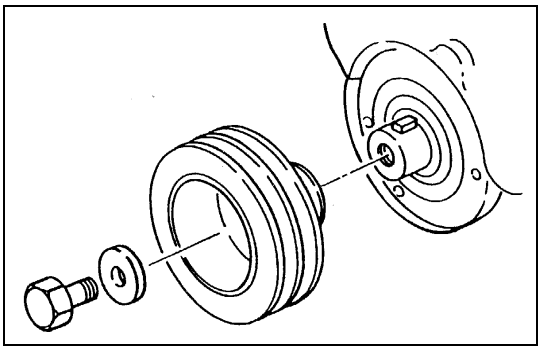

6A1-28-2.tif

8. Timing Gear Case Cover

1) Align the gear case with the timing gear case knock pin and then install the timing gear case cover.
2) Tighten the gear case cover bolts to the specified torque.

7. Noise Cover Spacer

6. Noise Shield Cover


6A1-28-3.tif

5. Crankshaft Damper Pulley

Tighten the crankshaft damper pulley bolt to the specified torque.

NOTE:

Hold the flywheel ring gear stationary to prevent the crankshaft from turning when tightening the damper pulley.

Pulley Boss Bolt Torque	N·m (kg·m/lb·ft)
206 (21/152)	

4. Cooling Fan Assembly

- Mount fan pulley, distance piece, and cooling fan assembly (in this order) on the water pump, and tighten to the specified torque.

N·m (kg·m/lb·in)

8 (0.8/69)

3. AC Generator Drive Belt

- Install AC Generator drive belt and adjust belt tension.
- Depress the drive belt mid-portion with a 98N (10kg/22lb) force.

Drive Belt Deflection	mm (in)
8 (0.31) - 12 (0.47)	

- Tighten the idler lock nut to the specified torque.

N·m (kg·m/lb·ft)
27 (2.8/20)

2. Power Steering Pump Drive Belt (P/S Model)

- Install Power Steering pump drive belt and adjust belt tension.
- Depress the drive belt mid-portion with a 98N (10kg/22lb) force.

Drive Belt Deflection	mm (in)
8 (0.31)-12(0.47)	

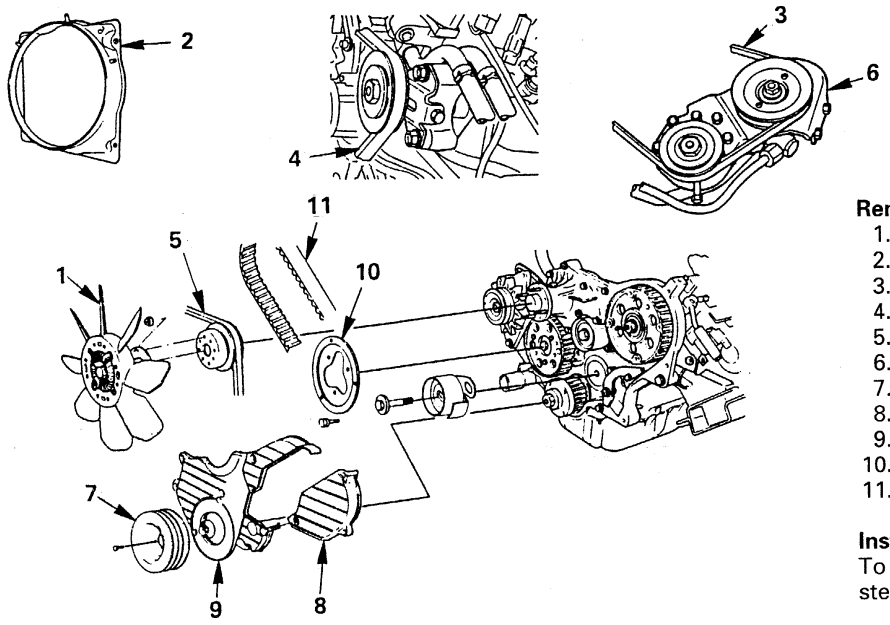
- Tighten the idler lock nut to the specified torque.

N·m (kg·m/lb·ft)
27 (2.8/20)

1. Fan shroud

- Install the fan shroud and reservoir tank hose.
- Pour coolant
- Start the engine and check coolant leakage.

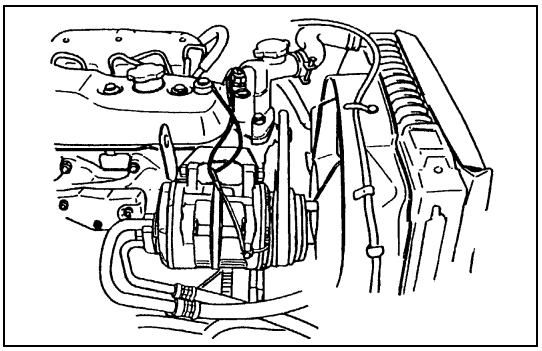
TIMING BELT (4JG2 Belt Type)



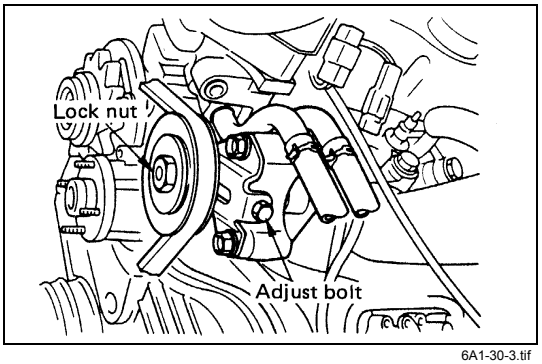
Removal steps
1. Cooling fan ASM
2. Fan shroud
3. Power steering pump drive belt
4. A/C compressor drive belt
5. AC Generator drive belt
6. Power steering pump bracket ASM.
7. Crankshaft damper pulley
8. Timing pulley upper cover
9. Timing pulley lower cover
10. Flange ; Camshaft pulley
11. Timing belt

Installation steps
To install, follow the removal steps in the reverse order.

6A1-30-1.tif



6A1-30-2.tif



6A1-30-3.tif

REMOVAL

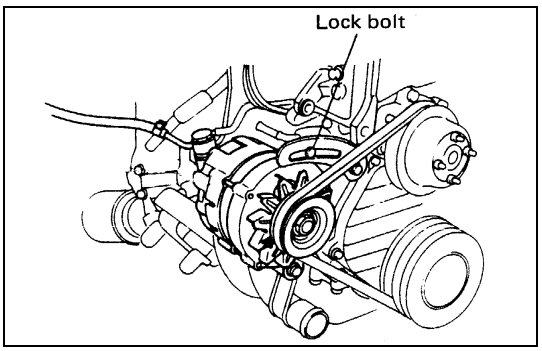
Preparation:
- Disconnect battery ground cable.
- Drain coolant.

1. Cooling Fan Assembly
- Remove clamp nut, and remove cooling fan asm, distant pipe, and fan pulley.

2. Fan Shroud
- Removal reservoir tank hose and fan shroud.

3. Power Steering Pump Drive Belt (P/S Model)
- Loosen power steering pump idle pulley lock nut and adjust bolt, and remove the drive belt.

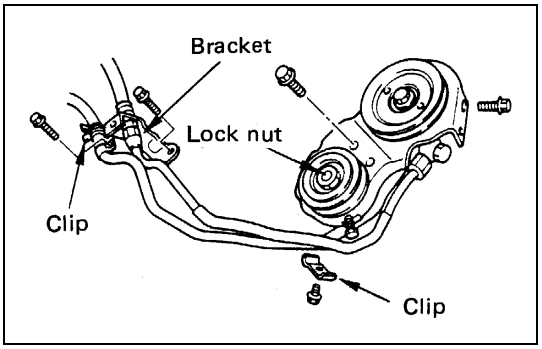
4. A/C Compressor Drive Belt (A/C Model)
- Loosen A/C compressor idle pulley lock nut and adjust bolt, and remove the drive belt.



6A1-31-1.tif

5. AC Generator Drive Belt

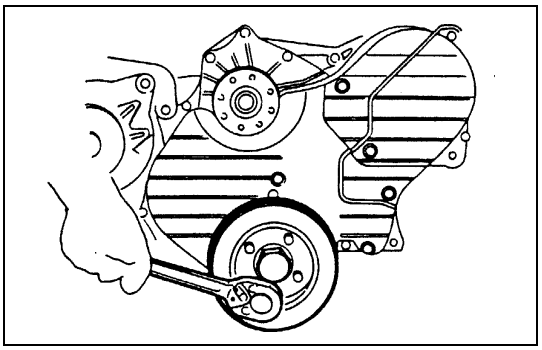
- Loosen AC Generator mounting bolt (under side) and adjust plate lock bolt, and remove the drive belt.



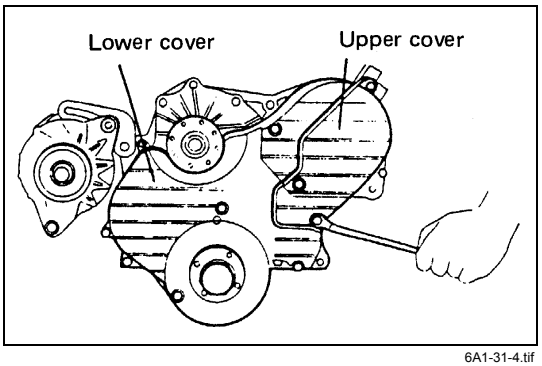
6A1-31-2.tif

6. Power Steering Pump Bracket Assembly (P/S Model)

- Loosen power steering oil pipe bracket and clip.
- Remove power steering pump bracket assembly and hang the power steering pump bracket assembly.


6A1-31-3.tif

7. Crankshaft Damper Pulley

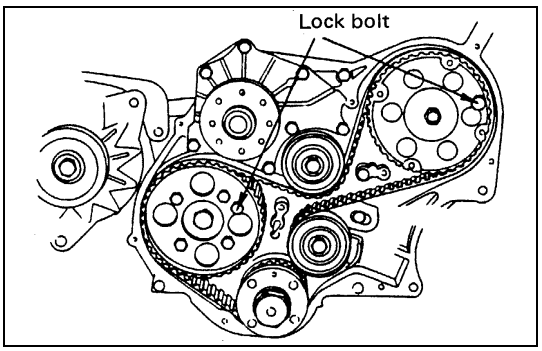


6A1-31-4.tif

8. Timing Pulley Upper Cover

9. Timing Pulley Lower Cover

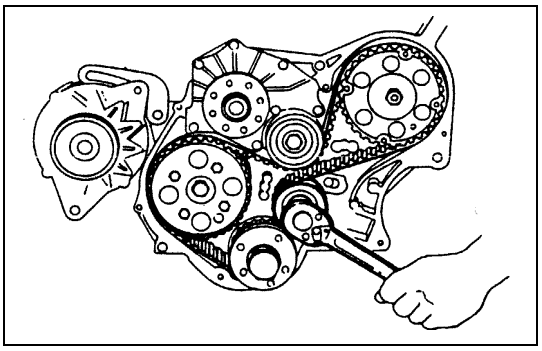
10. Flange; Camshaft Pulley



6A1-32-1.tif

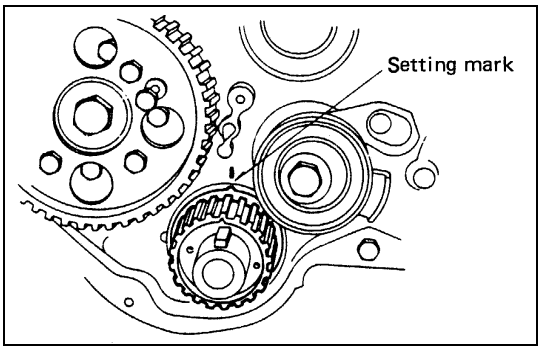
11. Timing Belt

- Prepare a fixing bolt (M8x40, P=1.25)
- Turn crankshaft timing pulley in the normal direction pulley side mark to timing pulley housing side mark.
- Make sure that the camshaft pulley and injection timing pulley fixing bolt holes are set to each other. Then fit in a fixing bolt and lightly tighten.
- No.1 cylinder should be at top dead center.
  If the fixing bolt holes are not set (No.4 cylinder is at top dead center) give another turn.
- Remove tensioner and timing belt.


6A1-32-2.tif

WARNING

IF CRANKSHAFT AND CAMSHAFT AND TURNED WITH TIMING BELT BEING NOT MOUNTED, PISTON AND VALVE WILL INTERFERE WITH EACH OTHER. THEREFORE, THE SHAFTS MUST NOT BE TURNED.



6A1-32-3.tif

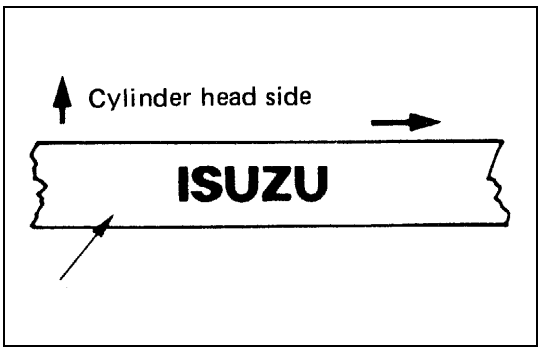
INSTALLATION

11. Timing Belt

- When removing the belt, make sure the marks on the bolt fixed camshaft, injection pulley and crankshaft timing pulley are set to each other.

CAUTION

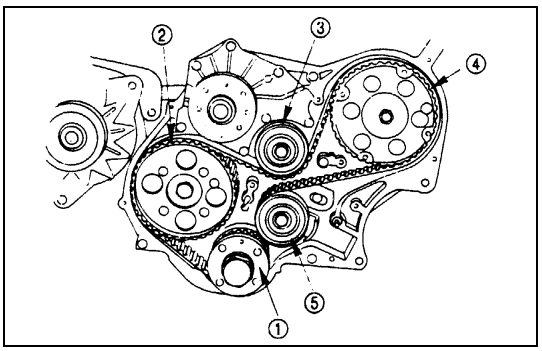
Do not turn crankshaft because otherwise piston and valve will interfere with each other.



6A1-32-4.tif

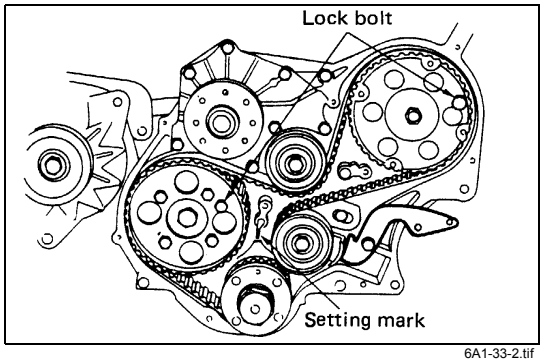
CAUTION

For accurate mounting, be sure to mount the belt in the direction that letters on the belt are readable.



6A1-33-1.tif

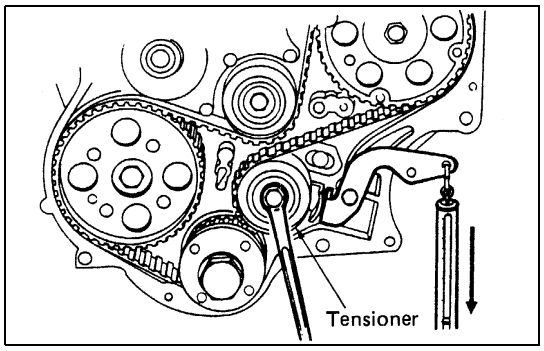
- Mount new timing belt on pulleys in the following steps.
  Crankshaft timing pulley ① → camshaft
  Timing pulley ② → Idle pulley ③ → Injection
  Pump pulley ④ → tensioner ⑤
- Set the belt on crankshaft timing pulley and hold with one hand.
- Stretch and pass the belt round each pulley with the other hand.
- After passing it round injection pump pulley, install tensioner while taking care not to slacken the belt.



6A1-33-2.tif

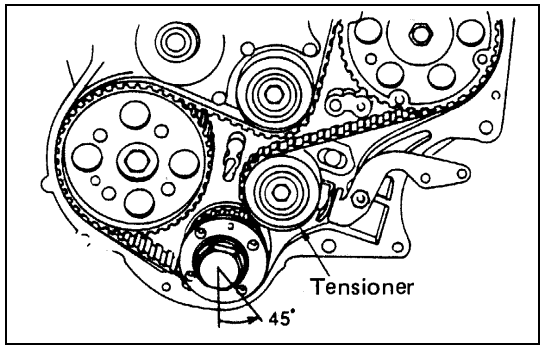
CAUTION

- On completion of belt passing, make sure that the setting mark on crankshaft timing pulley is set.
- If not set, reset the mark and repeat the belt passing.
- Remove tension adjust, lever mounting bolt, and loosen the fulcrum bolt to such extent that the lever is movable.
- Hung a spring balance from the end hole of tension adjust lever, and with the balance pulled down with 9kg., loosen once the tensioner mounting bolt and there retighten it.
- Turn the crankshaft by 45° counterclockwise to shift belt slackness on to the tensioner.
- Again hang the spring balance from the end hole of tension adjust lever and pull it down with the specified force. Under this condition, loosen tensioner mounting bolt to absorb belt slackness and retighten is to specified torque.



6A1-33-3.tif

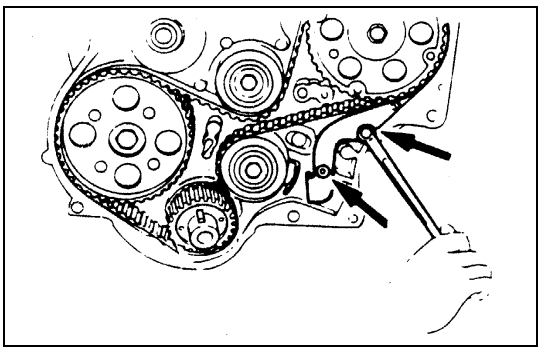
Belt	N·(kg/lb)
Tension	98 - 118 (10 - 12/22 - 26)



6A1-33-4.tif

Bolt	N·m (kg·m/lb·ft)
76 (7.8/56)	

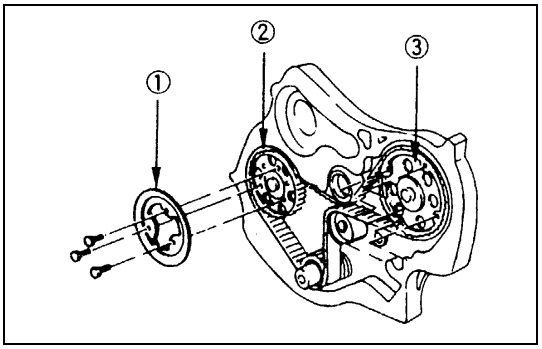
- Fix the tension adjust lever.



6A1-34-1.tif

CAUTION

- In case where the timing belt has been replaced with the actuation of warning light, put off the light with change over switch on the reverse side of meter.
- Refer to Chassis Electrical in Section 8.
- Tighten the tension adjusting lever nut and bolt.

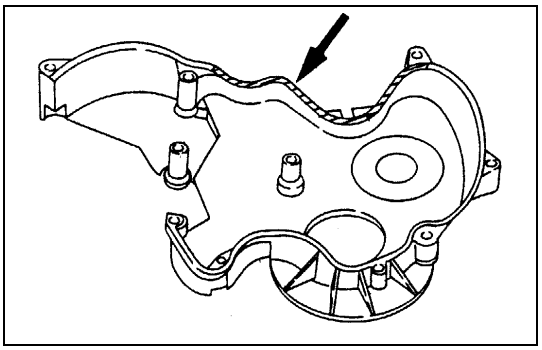


6A1-34-2.tif

10. Flange; Camshaft Pulley

- Install the timing pulley flange ① to the camshaft timing pulley ②.

Flange Bolts Torque	N·m (kg·m/lb·ft)
	19 (1.9/14)

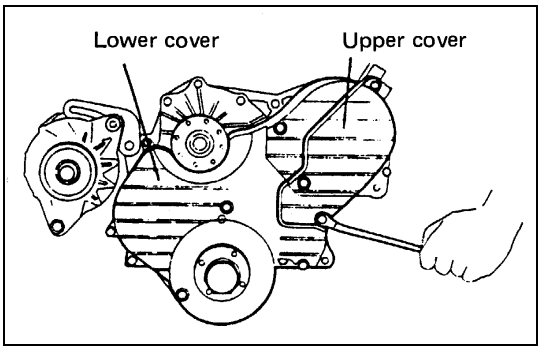


6A1-34-3.tif

9. Timing Pulley Lower Cover

- Install timing pulley lower cover and tighten bolt to the specified torque.

Cover Bolts Torque	N·m (kg·m/lb·in)
	8 (0.8/69)

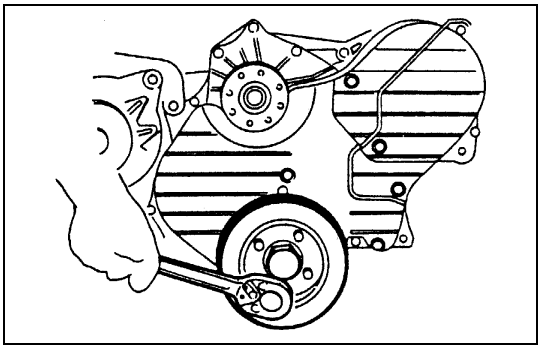


6A1-34-4.tif

8. Timing Pulley Upper Cover

- Install timing pulley upper cover and tighten bolt to the specified torque.

Cover Bolts Torque	N·m (kg·m/lb·in)
	8 (0.8/69)

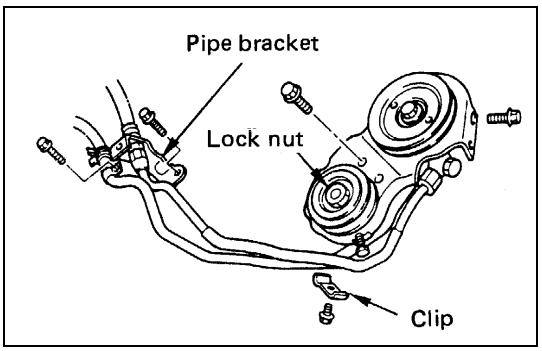


6A1-34-5.tif

7. Crankshaft Damper Pulley

- Install crankshaft damper pulley and tighten bolt to the specified torque.

	N·m (kg·m/lb·ft)
	19 (1.9/14)



6A1-35-1.tif

6. Power Steering Pump Bracket Assembly (P/S Model)

- Install the pipe bracket & clip and tighten bolts to the specified torque.

Pipe Bracket Bolts Torque	N·m (kg·m/lb·ft)
	19 (1.9/14)

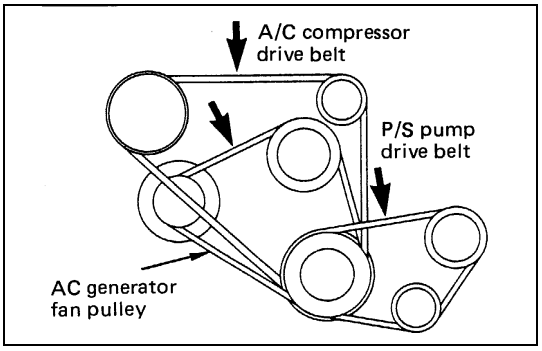
Pipe Clip Bolts Torque	N·m (kg·m/lb·in)
	10 (1.0/87)

- Install the P/S pump & bracket assembly.

10M bolts	N·m (kg·m/lb·ft)
	40 (4.1/30)

8M bolts	N·m (kg·m/lb·ft)
	19 (1.9/14)

Lock nut	N·m (kg·m/lb·ft)
	27 (2.8/20)



6A1-35-2.tif

5. AC Generator Drive Belt

- Install AC Generator drive belt and adjust belt tension.
- Depress the drive belt mid-portion with a 98N (10kg/22lb) force.

Drive Belt Deflection	mm (in)
	8 (0.31) - 12(0.47)

- Install fixing bolt and tighten bolts to the specified torque.

Generator Fixing Bolt	N·m (kg·m/lbvft)
	40 (4.1/30)

Adjust Plate Fixing Bolt	N·m (kg·m/lb·ft)
	19 (1.9/14)

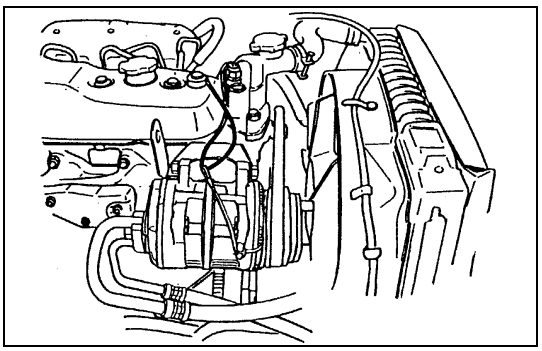
4. A/C Compressor Drive Belt (A/C type)

- Install A/C compressor drive belt and adjust belt tension.
- Depress the drive belt mid-portion with a 98N (10kg/22lb) force.

Drive Belt Deflection	mm (in)
	8 (0.31) - 12 (0.47)

- Tighten the idler lock nut to the specified torque.

	N·m (kg·m/lb·ft)
	27 (2.8/20)



6A1-36-1.tif

3. Power Steering Pump Drive Belt (P/S pump model)

- Install PS pump drive belt and adjust belt tension.
- Depress the drive belt mid-portion with a 98N (10kg/22lb) force.

Drive Belt Deflection	mm (in)
8 (0.31) - 12 (0.47)	

- Tighten the idler lock nut to the specified torque.

N·m (kg·m/lb·ft)
27 (2.8/20)

2. Fan Shroud

- Install the fan shroud and reservoir tank hose.

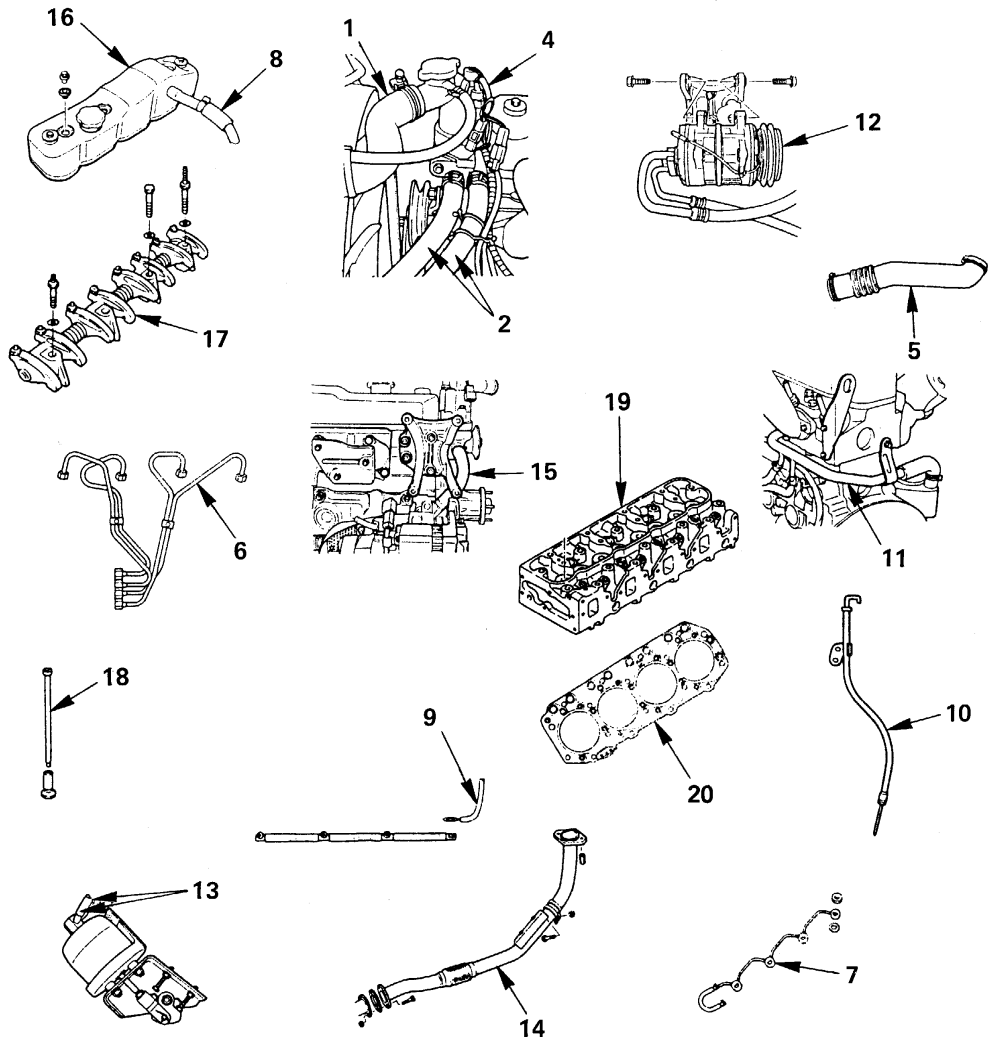
1. Cooling Fan Assembly

- Mount fan pulley, distance piece, and cooling fan asm (in this order) on the water pump, and tighten to the specified torque.

N·m (kg·m/lb·in)
8 (0.8/69)

- Connect battery ground cable.
- Pour coolant.
- Start the engine and check coolant leakage.

CYLINDER HEAD ASSEMBLY AND GASKET



Removal steps
1. Radiator hose upper
2. Heater hose
3. A/C Compressor drive belt
4. Engine harness
5. Air intake duct
6. Injection pipe
7. Leak off pipe
8. PCV hose
9. Glow plug harness
10. Oil level gauge guide tube
11. Oil cooler water pipe
12. A/C Compressor Assembly
13. Vacuum actuator hose
14. Front exhaust pipe
15. By-pass hose
16. Cylinder head cover
17. Rocker arm shaft
18. Push rod
19. Cylinder head Assembly
20. Cylinder head gasket

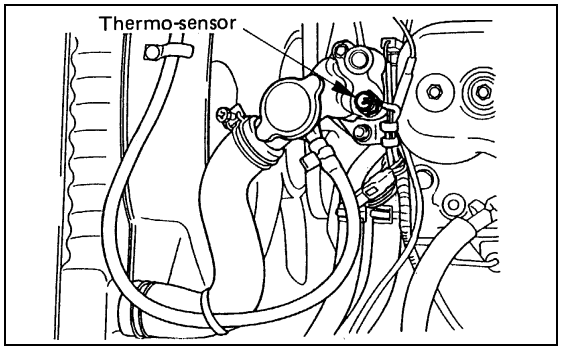
Installation steps
To install, follow the removal steps in the reverse order.

6A1-37-1.tif

REMOVAL

Preparation:
- Disconnect battery ground cable.
- Drain coolant from the radiator and engine.

1. Radiator Hose Upper
- Disconnect upper radiator hose from engine side.



6A1-38-1.tif

2. Heater Hose
- Disconnect heater hose from heater pipe.

3. A/C Compressor Drive Belt
- Loosen idler lock nut.
- Loosen adjust bolt and remove drive belt.

4. Engine Harness
- Disconnect harness connectors from units on thermostat housing.

5. Air Intake Duct
- Remove the clip and air intake duct.

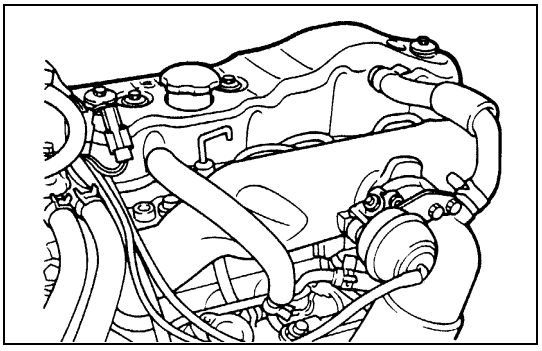
6. Injection Pipe
- Release injection pipe clip.
- Remove flare nut injection pump side.
- Remove flare nut injection nozzle side and remove injection pipe.

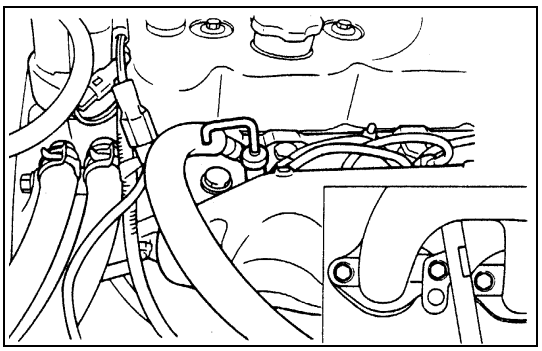
NOTE:

Plug the injection nozzle holder and the delivery holder to prevent the entry of foreign matters into them.

7. Leak Off Pipe
- Remove the leak off pipe side of leak off hose.

8. PCV Hose
- Remove the PCV hose from air intake pipe.


6A1-38-2.tif

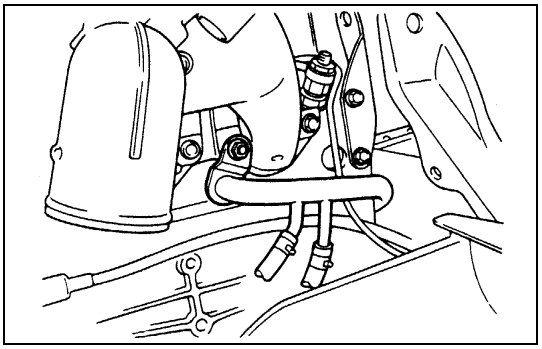


6A1-39-1.tif

9. Glow Plug Harness

10. Oil Level Gauge Guide Tube

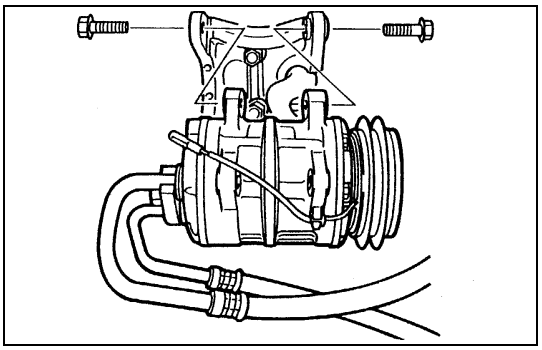
- Remove the guide tube from cylinder head.



6A1-39-2.tif

11. Oil Cooler Water Pipe (Oil Cooler Model)

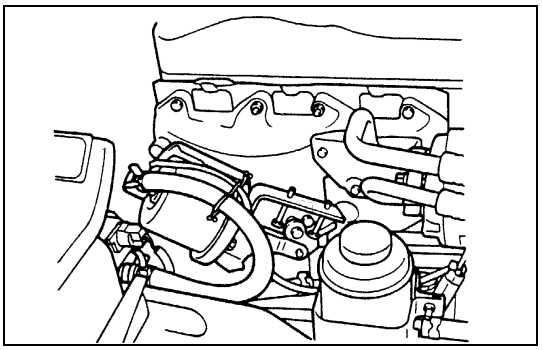
- Remove the pipe fixing bolt of cylinder head rear side.
- Remove the oil cooler water pipe fixing nut from inlet manifold.



6A1-39-3.tif

12. A/C Compressor Assembly (A/C Model)

- Remove the clutch harness connector.
- Remove the A/C compressor fixing bolts and temporally tighten the A/C compressor to chassis frame side use the wire.



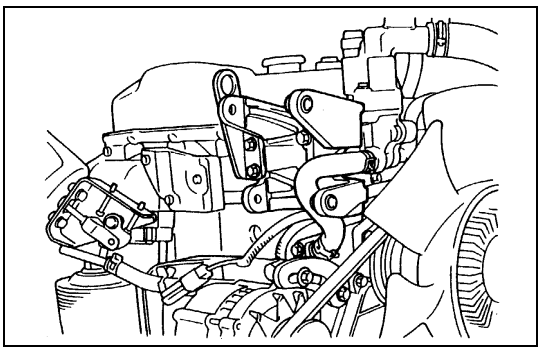
6A1-39-4.tif

13. Vacuum Actuator Hose (Exhaust Brake Model)

- Remove the vacuum hoses from vacuum actuator.

14. Front Exhaust Pipe

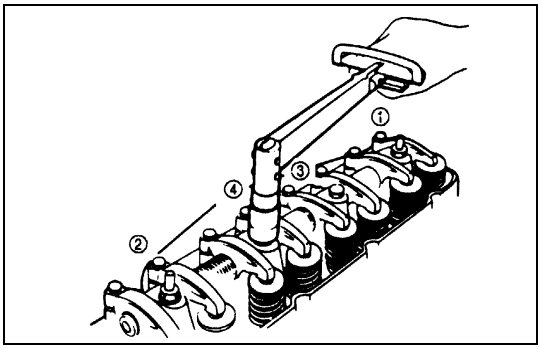
- Remove the exhaust pipe fixing bolts from exhaust manifold.
- Remove the exhaust pipe stay bolt.



6A1-40-1.tif

15. By-pass Hose

16. Cylinder Head Cover



6A1-40-2.tif

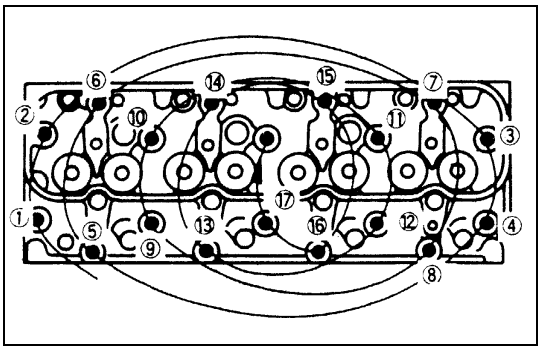
17. Rocker Arm Shaft

- Loosen the rocker arm shaft bracket bolts a little at a time in the numerical order shown in the illustration.

NOTE:

Failure to loosen the rocker arm shaft bracket bolts a little at a time in numerical order will adversely effect the rocker arm shaft.

18. Push Rod



6A1-40-3.tif

19. Cylinder Head Assembly

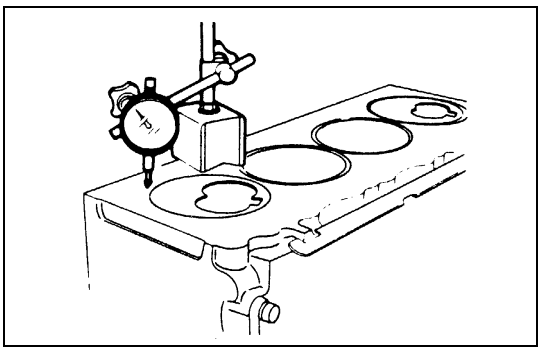
- Loosen the cylinder head bolts a little at a time in the numerical order shown in the illustration.

NOTE:

Failure to loosen the cylinder head bolts a little at a time in numerical order will adversely effect the cylinder head lower surface.

20. Cylinder Head gasket

- Remove the cylinder head gasket and dowel.



6A1-41-1.tif

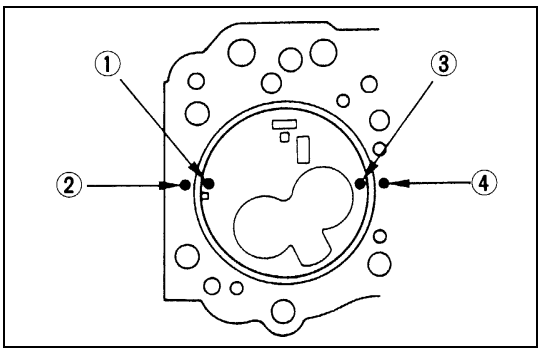
INSTALLATION

20. Cylinder Head Gasket

Cylinder head gasket is determined by the piston head projection from the cylinder body upper surface, in order to improve engine performance.

Three types of gasket are provided by the difference of thickness. Select the adequate one out of three grades of gasket, according to the following procedure.

Before measurement, clear off carbon from the piston head and cylinder body surface and also clean the place where a gasket was installed.



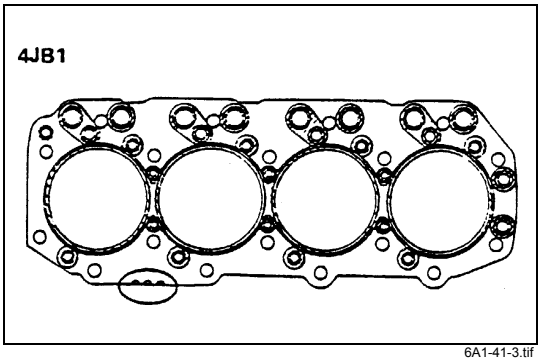
6A1-41-2.tif

Piston Head Projection Measurement Point

1) Use a dial indicator to measure the piston projection amount.
2) Refer to the illustration for the piston head projection measuring positions.

   All measuring positions should be as close as possible to the cylinder liner.
3) Measure the points ①②③④ and obtain two differences ①-② and ③-④ on each cylinder.

   Calculate the average value of the piston head projection on each cylinder.
4) Obtain the maximum value in the four cylinders.
5) Determine the gasket grade required to the maximum value described above in accordance with the following table.



6A1-41-3.tif

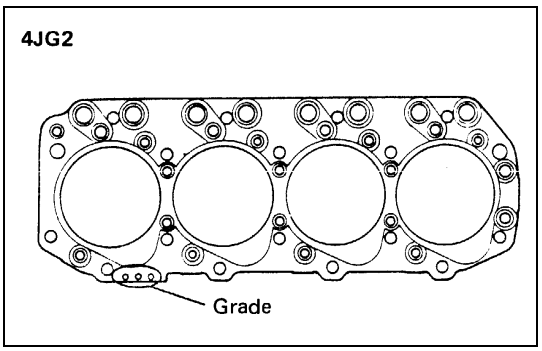
4JB1/4JB1T/4JB1TC Cylinder Head Gasket Thickness

mm (in)

Gasket Grade Mark		Piston Projection	Gasket Thickness (Reference)
A		0.758 - 0.813 (0.030 - 0.032)	1.60 (0.0630)
B		0.813 - 0.859 (0.032 - 0.034)	1.65 (0.0650)
C		0.859 - 0.914 (0.034 - 0.036)	1.70 (0.0670)

NOTE:

The difference between the highest measured piston head projection and the lowest measured piston head projection must not exceed 1.0 mm(0.039 in).



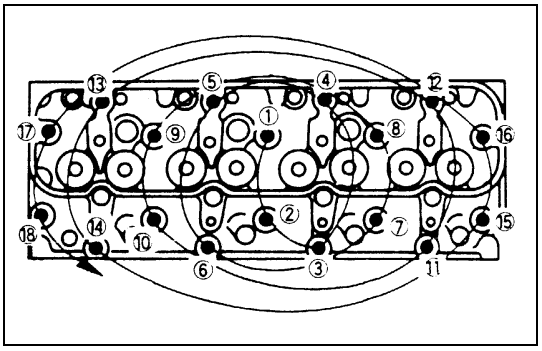
6A1-42-1.tif

4JG2 Cylinder Head Gasket Thickness mm (in)

Gasket Grade Mark		Piston Projection	Gasket Thickness (Reference)
A		0.658 - 0.713 (0.026 - 0.028)	1.60 (0.0630)
B		0.713 - 0.759 (0.028 - 0.030)	1.65 (0.0650)
C		0.759 - 0.814 (0.030 - 0.032)	1.70 (0.0670)

NOTE:

The difference between the highest measured piston head projection and the lowest measured piston head projection must not exceed 1.0 mm (0.039 in).



6A1-42-2.tif

19. Cylinder Head Assembly

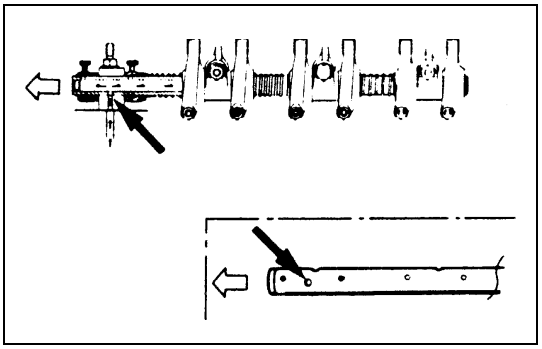
1) Install the dowel in cylinder block.
2) Install the cylinder head gasket with top mark up.
3) Clean up cylinder head lower surface and cylinder body upper surface.
4) Install the cylinder head as softly.
5) Apply engine oil to screw and seat of cylinder head bolts.
6) Tighten the cylinder head bolts to the specified torque in three steps following the numerical order shown in the illustration.

Cylinder Head bolts Torque N·m (kg·m/lb·ft)

1st Step	2nd Step	3rd Step
49 (5.0/36)	60 - 75°	60 - 75°

18. Push Rod

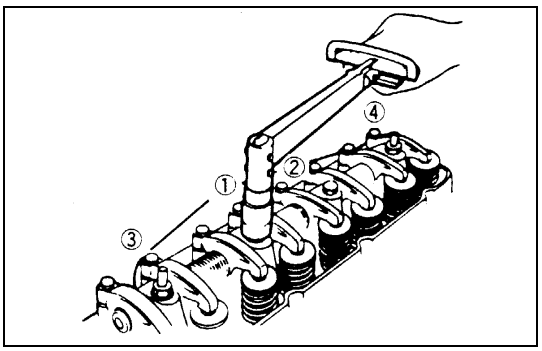
- Apply engine oil to push rod and in to the cylinder head.



6A1-42-3.tif

17. Rocker Arm shaft

1) Loosen all adjusting screws.
2) Position the rocker arm shaft with the large oil hole (4ø) facing the front of the engine.



6A1-43-1.tif

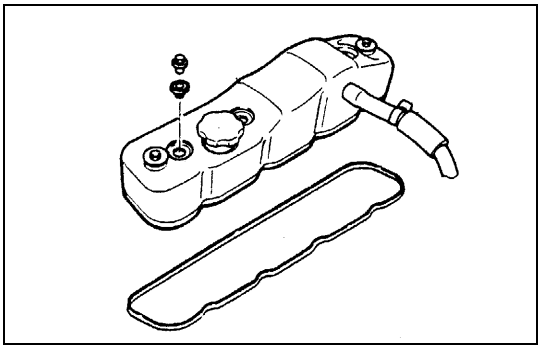
3) Tighten the rocker arm shaft bracket bolts to the specified torque in the numerical order shown in the illustration.

Rocker Arm Shaft Bracket Bolt Torque	N·m (kg·m/lb·ft)
	54 (5.5/40)

- Valve clearance adjustment.

Valve Clearance Adjustment

Above works refer to “ROCKER ARM SHAFT ASSEMBLY” Section in this manual.

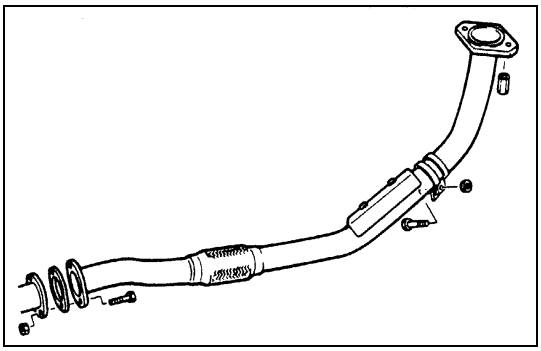


6A1-44-1.tif

16. Cylinder Head Cover

- Apply engine oil to the rocker arms and the valve spring.
- Install the cylinder head cover gasket to the cylinder head cover.
- The gasket must be perfectly smooth with no loose areas.
- Tighten the cylinder head cover nuts to the specified torque in the numerical order shown in the illustration.

Cylinder Head Cover Torque	N·m (kg·m/lb·in)
13 (1.3/113)	



6A1-44-2.tif

15. By-Pass Hose

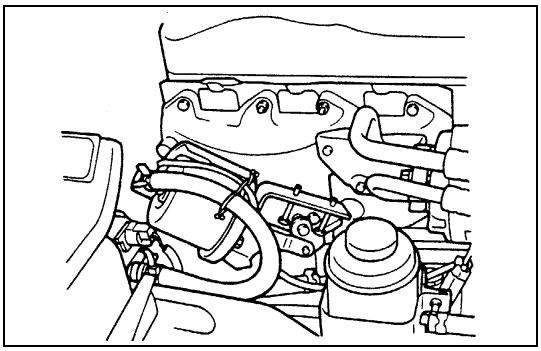
14. Front Exhaust Pipe

- Install the pipe to manifold and tighten bolts and nuts to the specified torque.

W/Exhaust Brake Manifold Nut Torque	N·m (kg·m/lb·ft)
37 (3.8/27)	

WO/Exhaust Brake Manifold Nut Torque	N·m (kg·m/lb·ft)
40 (4.1/30)	

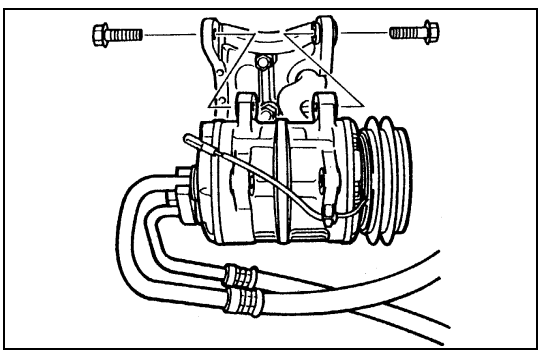
Pipe Stay Bolts Torque	N·m (kg·m/lb·ft)
40 (4.1/30)	



6A1-44-3.tif

13. Vacuum Actuator Hose (Exhaust Brake Model)

- Install the vacuum hose to the vacuum actuator.

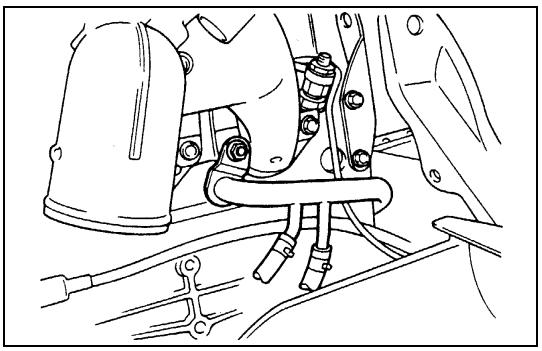


6A1-44-4.tif

12. A/C Compressor Assembly (A/C Model)

- Install the A/C compressor fixing bolts and tighten bolts to the specified torque.

Compressor Bolts Torque	N·m (kg·m/lb·ft)
37 (3.8/27)	



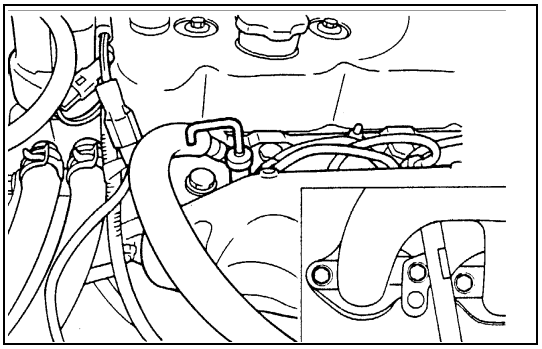
6A1-45-1.tif

11. Oil Cooler Water Pipe (Oil Cooler Model)

- Install the water pipe bolt and tighten bolt to the specified torque.

Water Pipe Nut Torque	N·m (kg·m/lb·ft)
19 (1.9/14)	

Pipe Bracket Bolt Torque	N·m (kg·m/lb·ft)
40 (4.1/30)	



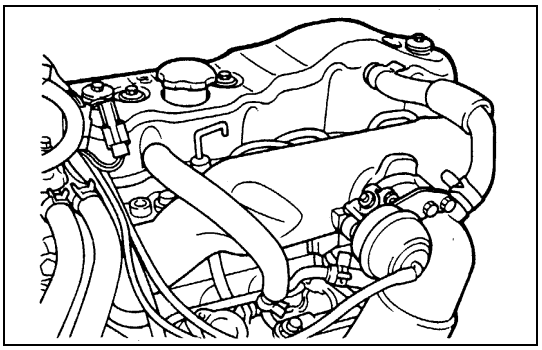
6A1-45-2.tif

10. Oil Level Gauge Guide Tube

- Install the guide tube bolt and tighten bolt to the specified torque.

Guide Tube Bolt Torque	N·m(kg·m/lb·ft)
19 (1.9/14)	

9. Glow Plug Harness

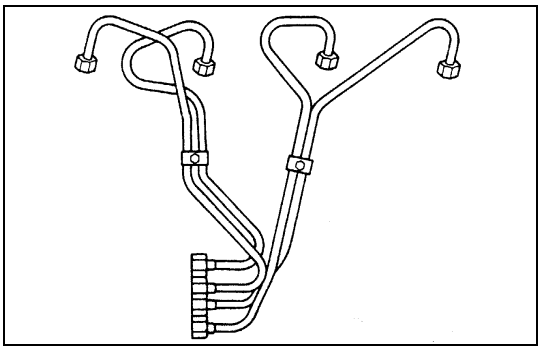


6A1-45-3.tif

8. PCV Hose

7. Leak Off Pipe

- Mount using a new copper washer.



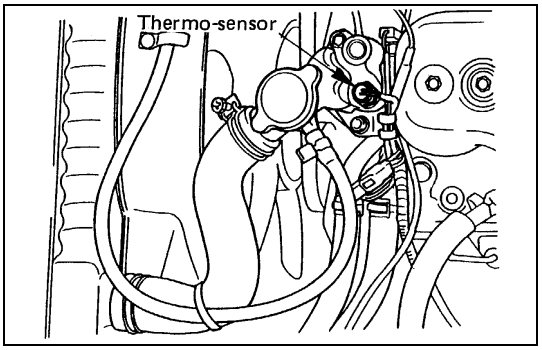
6A1-45-4.tif

6. Injection Pipe

- Install the flare nut to injection pump side.
- Install the flare nut to injection nozzle side.
- Tighten the flare nut to the specified torque.

Flare Nut torque	N·m (kg·m/lb·ft)
29 (3.0/22)	

- Fit pipe clip in specified torque.

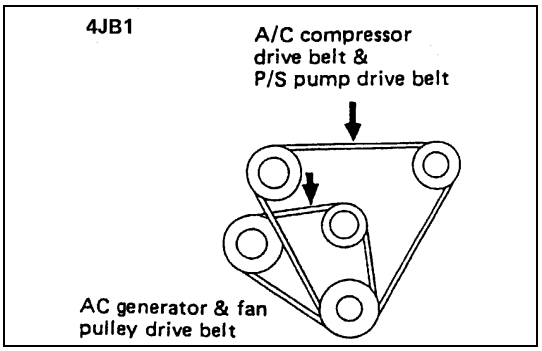


6A1-46-1.tif

5. Air Intake Duct

4. Engine Harness

- Connect the thermo-sensor harness and thermo-meter unit harness.



6A1-46-2.tif

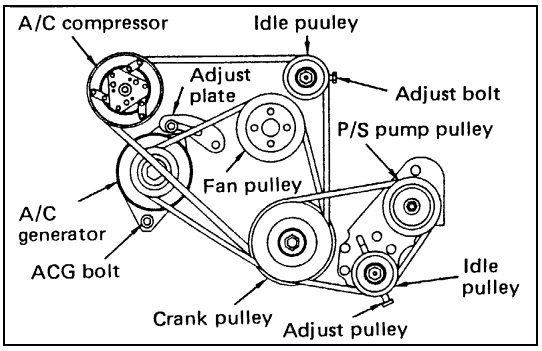
3. A/C Compressor Drive Belt (A/C Model)

Check drive belts for wear or damage, and replace with new ones as necessary. Check belts for tension, and adjust as necessary.

- Check drive belts tension.
- Push the middle of belts with a force of 10kg and check each bolt for deflection.
- Standard deflection

mm (in)

	Initial tension
AC generator & fan pulley drive belt	8 - 12 (0.31 - 0.47)
A/C compressor drive belt	
P/S pump drive belt	



6A1-46-3.tif

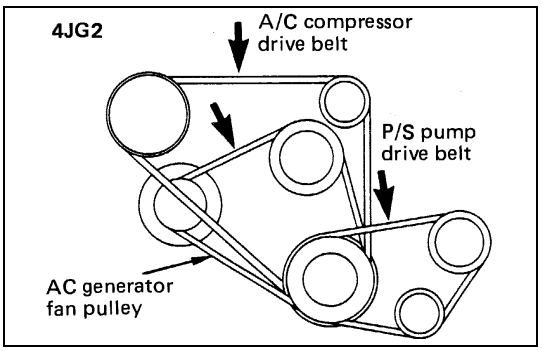
TENSION ADJUSTMENT

P/S oil pump and A/C compressor pulley belt

- With P/S pump lock bolt loose, adjust belt tension with adjust belt.

Cooling fan pulley belt

- With AC Generator mounting and lock bolts loose, adjust belt tension with adjuster's adjust bolt.

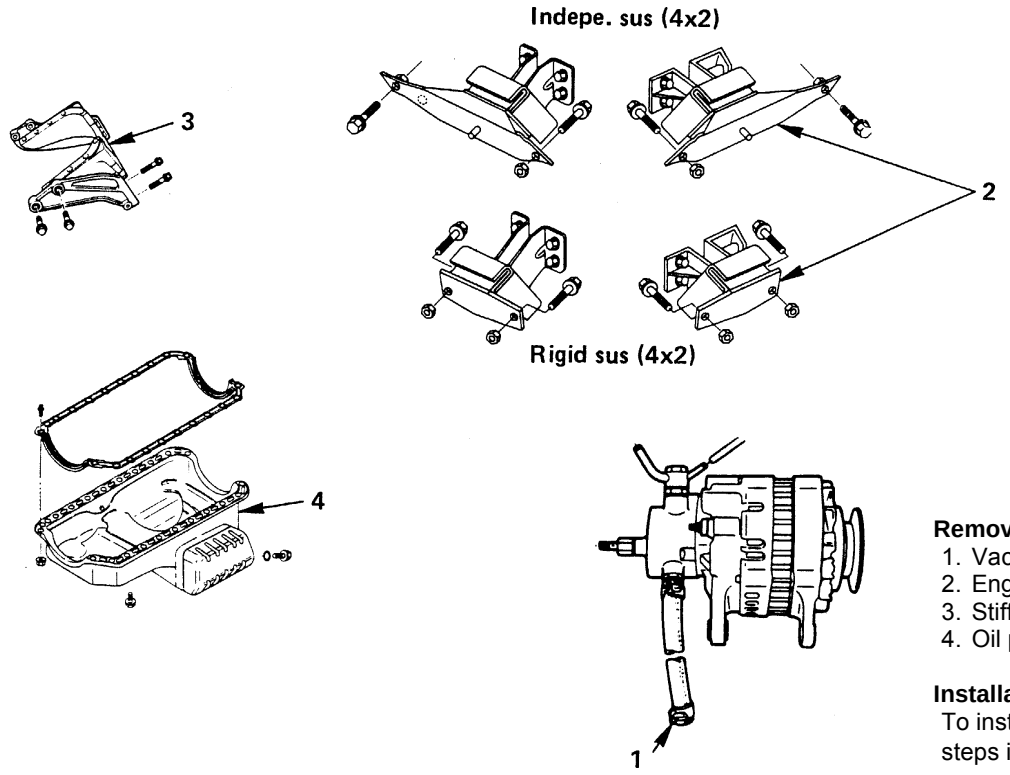


6A1-46-4.tif

Torque Standard	N·m (kg·m/lb·ft)
AC generator fixing bolt	40 (4.1/30)
Adjust plate fixing bolt	19 (1.9/14)
Adjust plate lock bolt	19 (1.9/14)

2. **Heater Hose**
   - Connect the heater hose them tighten clip securely.
1. **Radiator Hose Upper**
   - Connect the radiator hose them tighten clip securely.
   - Pour coolant
   - Connect battery ground cable.
   - Start the engine and check coolant leakage.

OIL PAN



Removal steps
1. Vacuum pump oil hose
2. Engine mount bolts
3. Stiffener and space rubber
4. Oil pan Assembly

Installation steps
To install, follow the removal steps in the reverse order.

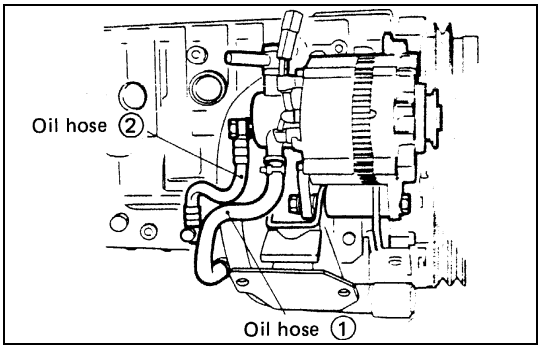
6A1-48-1.tif

REMOVAL

Preparation:
- Disconnect battery ground cable.
- Lift up car.
- Drain engine oil.

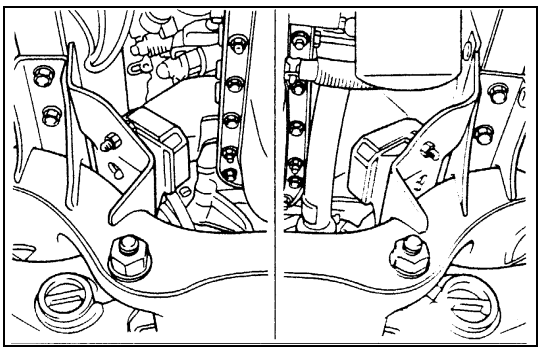
NOTE
Install drain plug with new gasket.

	N·m(kg·m/lb·ft)
	44 (4.5/33)



6A1-48-2.tif

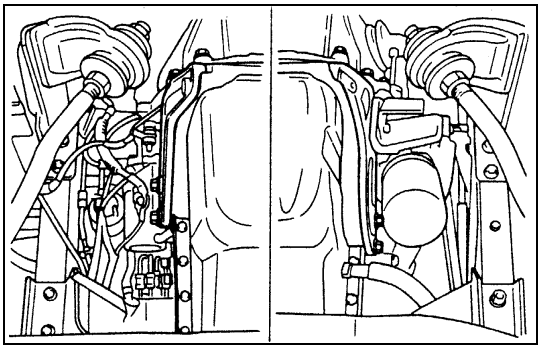
1. Vacuum Pump Oil Hose
- Remove oil hose ① from oil pan.



6A1-49-1.tif

2. Engine Mount Bolts

- Remove the engine mount bolts right & left side.



6A1-49-2.tif

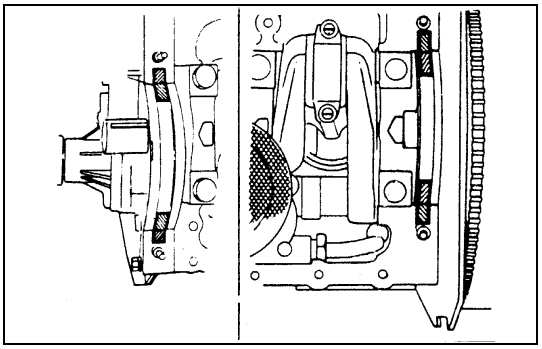
3. Stiffener & Space Rubber

- Remove the exhaust pipe bracket.
- Remove the stiffener from of the oil pan left & right side.
- Take out space rubber.

4. Oil Pan Assembly

- Raising the engine about 50mm.
- Remove the oil pan from cylinder block.

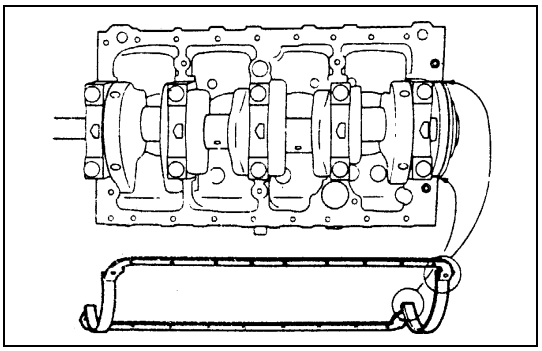
INSTALLATION



6A1-50-1.tif

4. Oil Pan Assembly

- Apply the recommended liquid gasket or its equivalent to the No.5 bearing cap arches, the grooves, and the timing gear case arches at the positions shown in the illustration.



6A1-50-2.tif

- Fit the gasket rear lipped portion into the No.5 groove.
- Be absolutely sure that the lipped portion in fitted snugly in to the groove.
- Install the oil pan to the cylinder body.
- Tighten the oil pan bolts to the specified torque.

Oil Pan Bolt Torque	N·m (kg·m/lb·ft)
	19 (1.9/14)

3. Stiffener and Space Rubber

- Install the space rubber.
- Install the stiffener left side and right side tighten bolt to the specified torque.

Engine body Side	N·m (kg·m/lb·ft)
	37 (3.8/27)

Clutch Housing Side	N·m (kg·m/lb·ft)
	78 (8.0/58)

- Install exhaust pipe bracket.

2. Engine Mount Bolts

- Install the mount bolts and tighten to the specified torque.

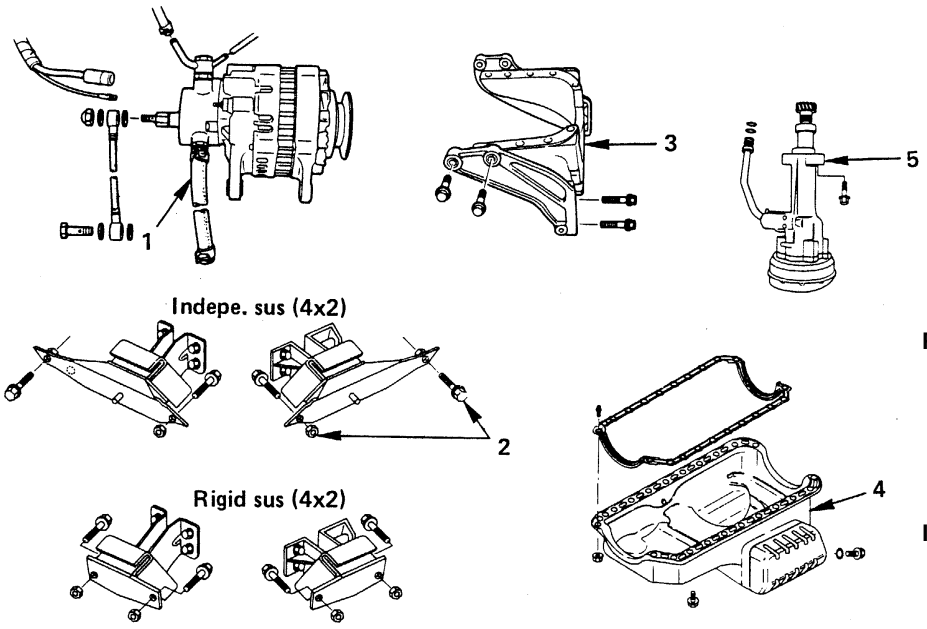
Mount Bolt Torque	N·m (kg·m/lb·ft)
	40 (4.1/30)

- Install the oil hose to oil pan.

1. Vacuum Pump Oil Hose

- Pour engine oil
- Connect battery ground cable.
- Start the engine and check coolant leakage.

OIL PUMP ASSEMBLY



Removal steps
1. Vacuum pump oil hose
2. Engine mount bolts
3. Stiffener and space rubber
4. Oil pan Assembly
5. Oil pump Assembly

Installation steps
To install, follow the removal steps in the reverse order.

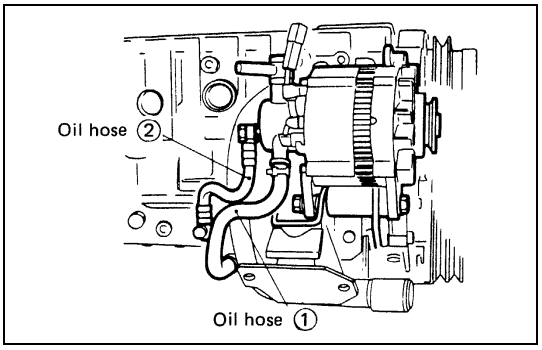
6A1-51-1.tif

REMOVAL

Preparation:
- Disconnect battery ground cable.
- Lift up car.
- Drain engine oil.

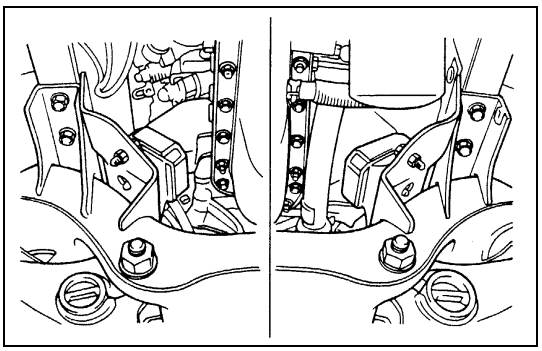
NOTE
Install drain plug with new washer.

N·m(kg·m/lb·ft)
44 (4.5/33)

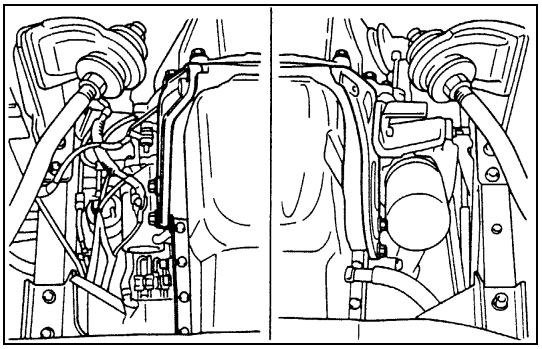


6A1-51-2.tif

1. Vacuum Pump Oil Hose
- Remove the oil hose ① from oil pan.



6A1-52-1.tif



6A1-52-2.tif

2. Engine Mount Bolts

- Remove the engine mount bolts right & left side.

3. Stiffener & Space Rubber

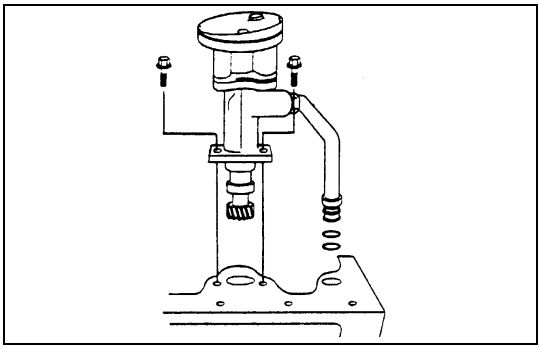
- Remove the exhaust pipe bracket.
- Remove the stiffener from of the oil pan left & right side.
- Take out space rubber.

4. Oil Pan Assembly

- Raise the engine about 50mm.
- Remove the oil pan from cylinder block.

5. Oil Pump Assembly

- Remove the oil pump from cylinder block.


6A1-53-1.tif

INSTALLATION

- Prepare a solution of 80% engine oil and 20% molybdenum disulfide.
- Apply and ample coat of the solution to the teeth of the oil pump pinion.

5. Oil Pump Assembly

- Apply engine oil to oil pipe O-ring and insert the O-ring in O-ring hold on cylinder block.
- Install oil pump asm with oil pipe in cylinder block and tighten fixing bolts to the specified torque.

N·m (kg·m/lb·ft)
19 (1.9/14)

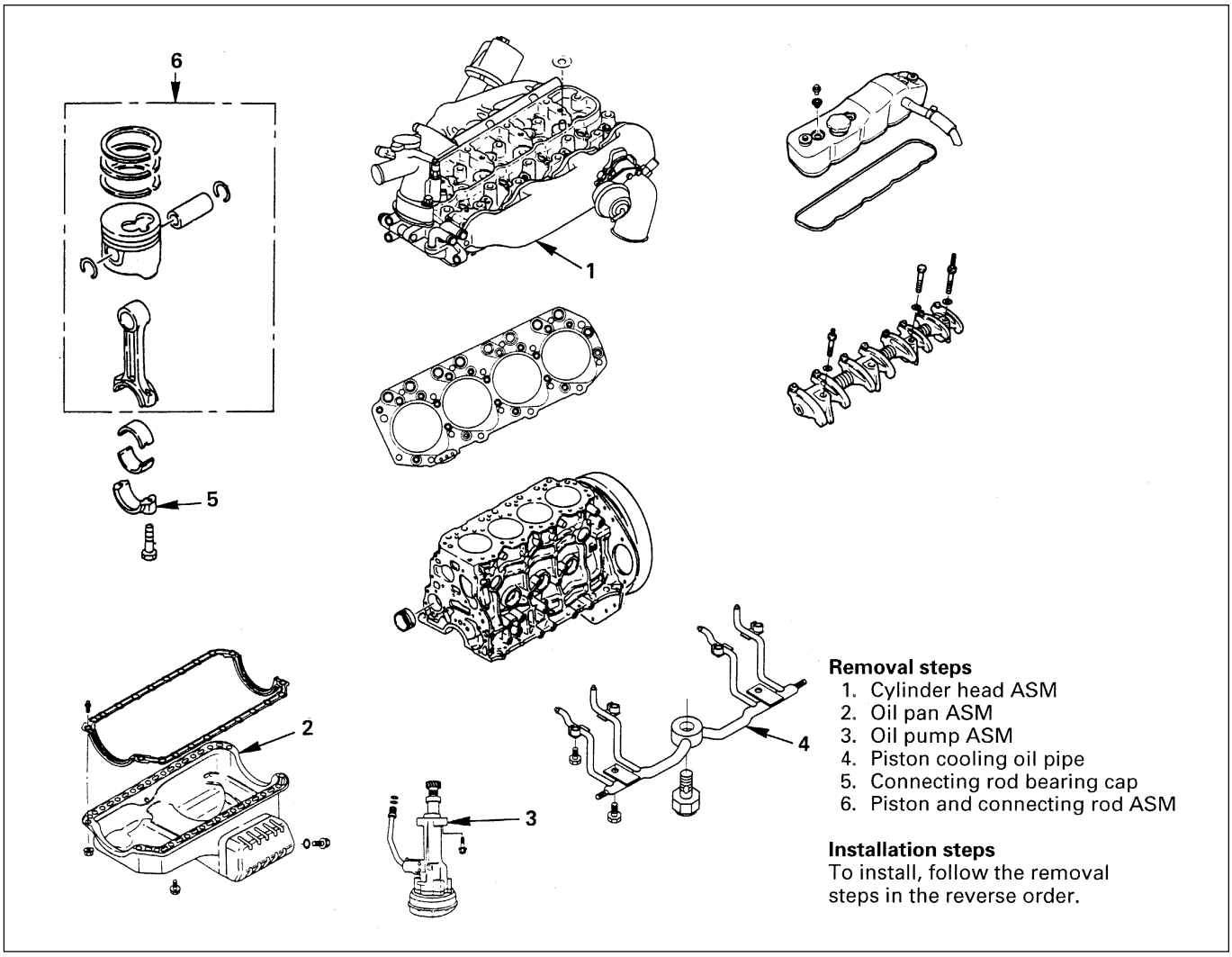
- Tighten sleeve nut to the specified torque.

N·m (kg·m/lb·ft)
25 (2.5/18)

4. Oil Pan Assembly
3. Stiffener & Space Rubber
2. Engine Mount Bolts
1. Vacuum Pump Oil Hose

Above works refer to “OIL PAN” Section in this manual.

PISTON, PISTON RING AND CONNECTING ROD



6A1-45-1.tif

REMOVAL

Preparation:

- Disconnect battery ground cable
- Drain coolant
- Drain engine oil

NOTE

- Install drain plug with new washer.

N·m (kg·m/lb·ft)
44 (4.5/33)

1. Cylinder Head Assembly

1) Radiator hose upper
2) Heater hose
3) A/C compressor drive belt
4) Engine harness
5) Air intake duct

6) Injection pipe
7) Leak off pipe
8) PCV hose
9) Glow plug harness
10) Oil level gauge guide tube
11) Oil cooler water pipe (Oil Cooler Model)
12) A/C compressor assembly (A/C Model)
13) Vacuum actuator hose (Exhaust Brake Model)
14) Front exhaust pipe
15) By-pass hose
16) Cylinder head cover
17) Rocker arm shaft
18) Push rod
19) Cylinder head assembly
20) Cylinder head gasket

Above works refer to “CYLINDER HEAD ASSEMBLY AND GASKET” Section in this manual.

2. Oil Pan Assembly

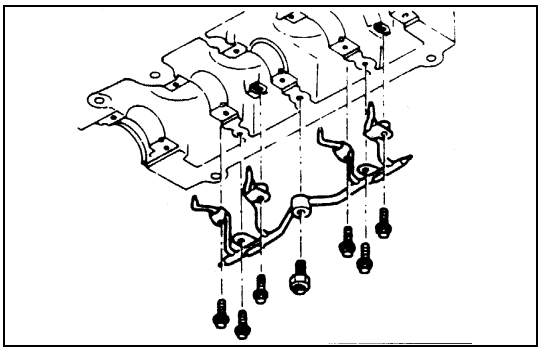
1) Vacuum pump oil hose
2) Engine mount bolt
3) Stiffener and spacer rubber
4) Oil pan

Above works refer to “OIL PAN” Section in this manual.

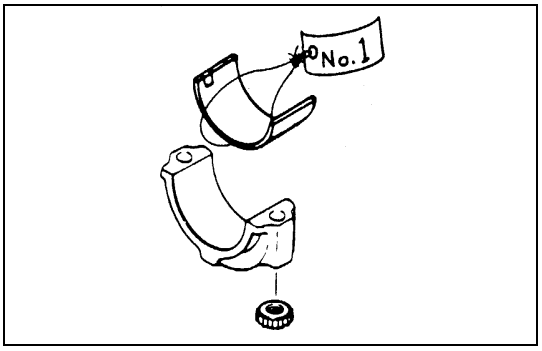
3. Oil Pump Assembly

4. Piston Cooling Oil Pipe

- Remove the relief valve and oil pipe.



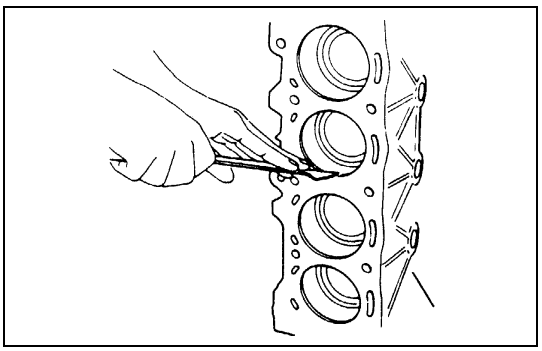
6A1-55-1.tif



6A1-55-2.tif

5. Connecting Rod Bearing Cap

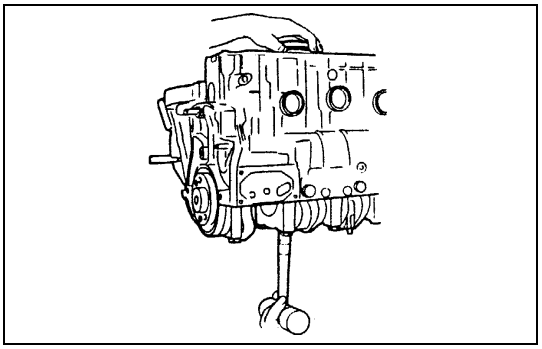
- If the connecting rod lower bearings are to be reinstalled, mark their fitting positions by tagging each bearing with the cylinder number from which it was removed.



6A1-56-1.tif

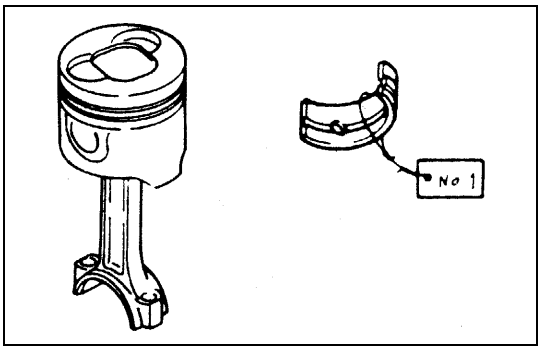
6. Piston and Connecting Rod Assembly

1) Remove carbon deposits from the upper portion of the cylinder wall with a scraper before removing the piston and connecting rod.



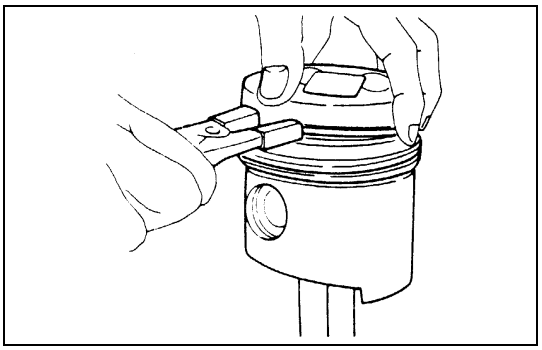
6A1-56-2.tif

2) Move the piston to the top of the cylinder and tap it with a hammer grip or similar object from the connecting rod lower side to drive it out.



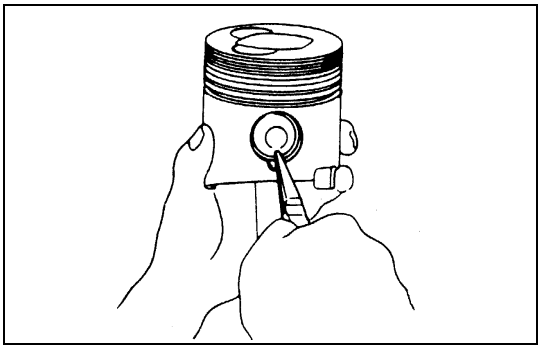
6A1-56-3.tif

3) If the connecting rod upper bearings are to be reinstalled, mark their fitting positions by tagging each bearing with the cylinder number from which it was removed.



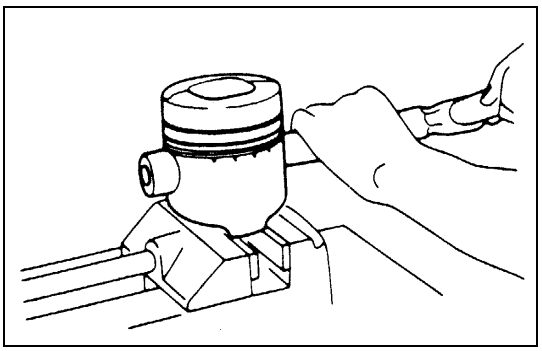
6A1-56-4.tif

4) Clamp the connecting rod in a vise.
   Take care not to damage the connecting rod.
   Use a piston ring replacer to remove the piston rings.
   Piston Ring Replacer
   Do not attempt to use some other tool to remove the piston rings. Piston ring stretching will result in reduced piston ring tension.



6A1-56-5.tif

5) Use a pair of pliers to remove the piston pin snap rings.



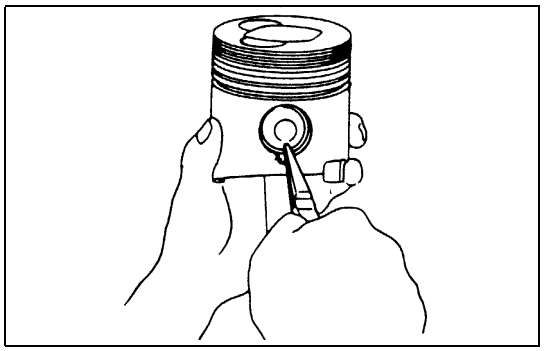
6A1-57-1.tif

6) Tap the piston pin out with a hammer and a brass bar.
   If the pistons and piston pins are to be reinstalled, mark their installation positions by tagging each piston and piston pin with the cylinder number from which it was removed.

INSTALLATION

6. Piston and Connecting Rod Assembly

1) Try to insert the piston pin into the piston pin hole with normal finger pressure.
   Weigh each piston and connecting rod assembly.
   Select piston and connecting rod combinations so that the weight variation of the different assemblies is held within the specified limits.



6A1-57-2.tif

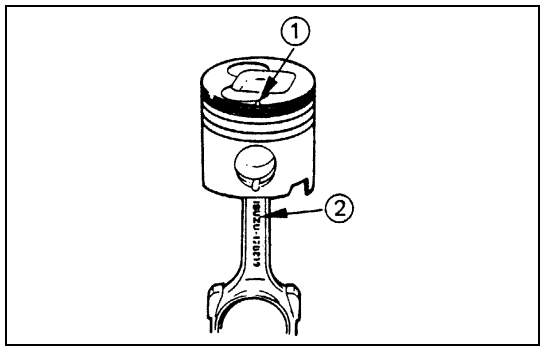
g(oz)

Variance in weight	Less than
after assembly	3(0.1058)

2) Clamp the connecting rod in a vise.
   Take care not to damage the connecting rod.
3) Use a pair of pliers to install the piston pin snap ring to the piston.

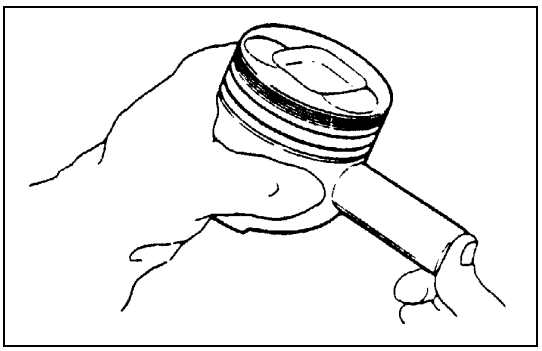
NOTE:

When changing piston/connecting rod combinations, do not change the piston/piston pin combination.



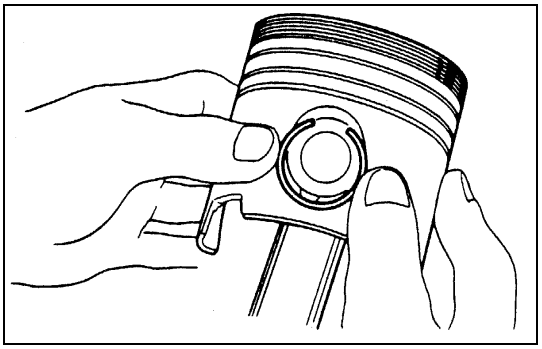
6A1-57-3.tif

4) Install the piston to the connecting rod.
   The piston head front mark ① and the connecting rod "ISUZU" casting mark ② must be facing the same direction.



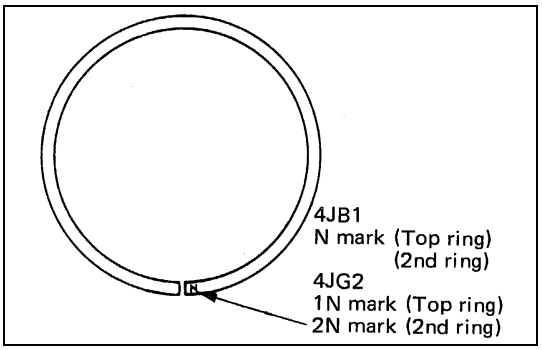
6A1-58-1.tif

5) Apply a coat of engine oil to the piston pin and the piston pin hole.
Use your fingers to force the piston pin into the piston until it makes contact with the snap ring.



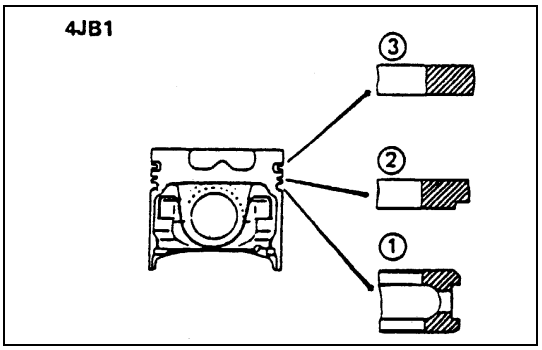
6A1-58-2.tif

6) Use your fingers to force the piston pin snap ring into the piston snap ring groove.
Check that the connecting rod moves smoothly on the piston pin.



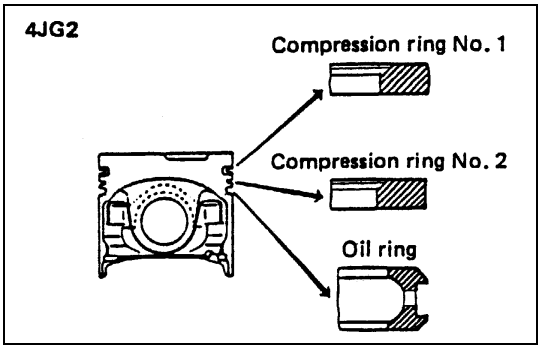
6A1-58-3.tif

7) Install the piston rings with the piston ring expander.
The compression ring must be set with the 1N, 2N mark facing up.
Discrimination mark is painted as shown in the illustration.



6A1-58-4.tif

8) Use a piston ring replacer to install the three piston rings.
Piston Ring Replacer
Install the piston rings in the numerical order shown in the illustration.
① Oil ring
② 2nd compression ring
③ 1st compression ring



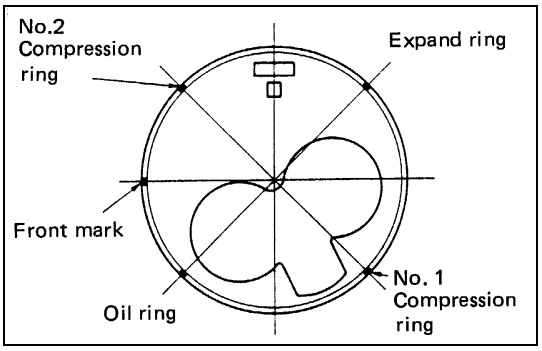
6A1-58-5.tif

NOTE:

Install the compression rings with the stamped side facing up.

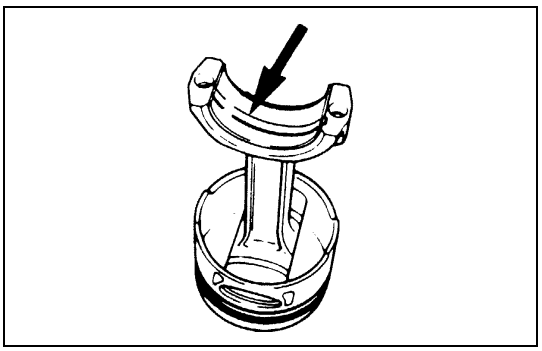
Insert the expander coil into the oil ring groove so that there is no gap on either side of the expander coil before installing the oil ring.

9) Apply engine oil to the piston ring surfaces.
10) Check that the piston rings rotate smoothly in the piston ring grooves.
11) Position the piston ring gaps as shown in the illustration.

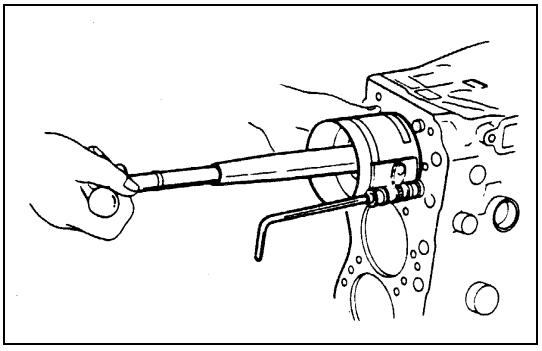


6A1-59-1.tif

12) Carefully wipe any oil or other foreign material from the connecting rod bearing back face and the connecting rod bearing fitting surface.
13) Apply a coat of engine oil to the upper bearing surfaces.
Apply a coat of engine oil the cylinder wall.

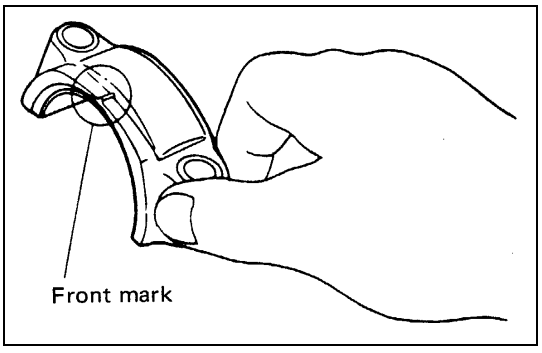

6A1-59-2.tif

14) Position the piston head front mark so that it is facing the front of the engine.
Use the piston ring compressor to compress the piston rings.
Piston Ring Compressor: 5-8840-9018-0(J-8037)
15) Use a hammer grip to push the piston in until the connecting rod makes contact with the crankpin.
At the same time, rotate the crankshaft until the crankpin is at BDC.

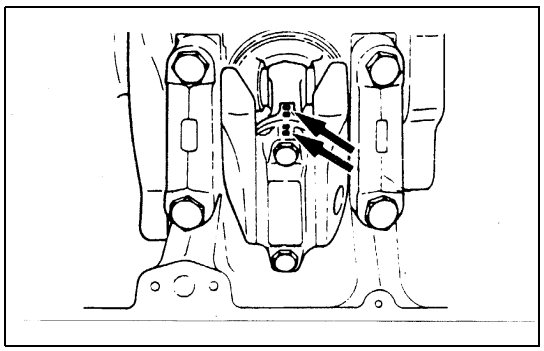

6A1-59-3.tif

5. Connecting Rod Bearing Cap

1) Position the bearing cap front mark so that it is facing the front of the engine.
2) Install the connecting rod bearing caps.
Align the bearing cap cylinder number marks and the connecting rod cylinder number marks.



6A1-59-4.tif



6A1-60-1.tif

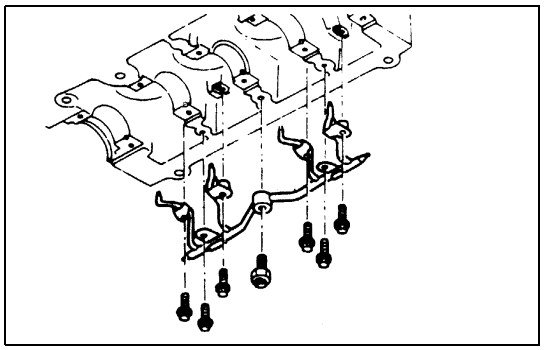
3) Apply a coat of engine oil to the threads and setting faces of each connecting rod cap bolt.
4) Tighten the connecting rod bearing cap bolts to the specified torque in two steps using the Angular Tightening Method.

Connecting Rod Bearing Cap Bolt Torque N·m (kg·m/lb·ft)

1st Step	2nd Step
29 (3.0/22)	45° - 60°

NOTE

Check to see that the crankshaft turns smoothly by rotating it manually.



6A1-60-2.tif

4. Piston Cooling Oil Pipe

1) Install the piston cooling oil pipe to the cylinder body.
2) Tighten the oil pipe bolts and relief valve to the specified torque.

Oil Pipe Bolt Torque	N·m (kg·m/lb·ft)
① M8x1.25	19 (1.9/14)
	N·m (kg·m/lb·in)
② M6x1.00	8 (0.8/69)

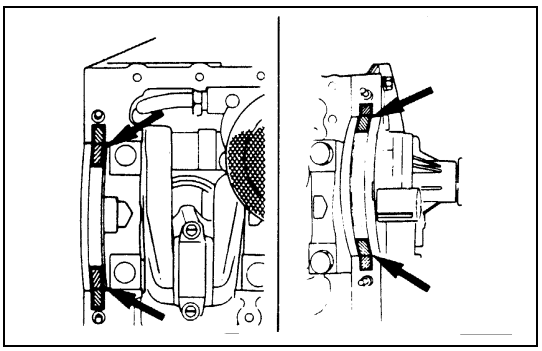
Oil Pressure Regulating Valve Torque	N·m (kg·m/lb·ft)
③ M6x1.5	29 (3.0/22)

NOTE:

Check that there is no interference between the piston and the oiling jet pipe by slowly rotating the crankshaft.

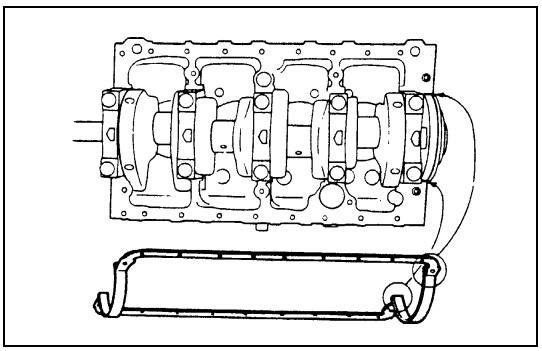
3. Oil Pump Assembly

Above works refer to “OIL PUMP” Section in this manual.



2. Oil Pan Assembly

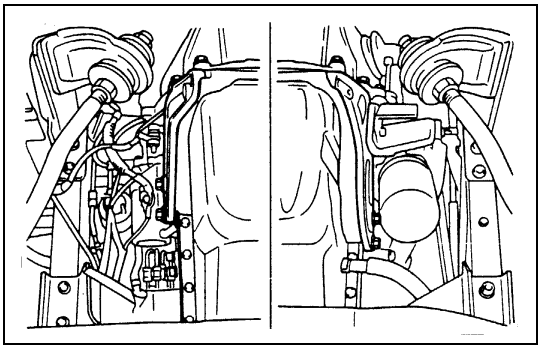
1) Apply the recommended liquid gasket or its equivalent to the No.5 bearing cap arches, the grooves, and the timing gear case arches at the positions shown in the illustration.



6A1-60-1.tif

2) Fit the gasket rear lipped portion into the No.5 groove.
Be absolutely sure that the lipped portion is fitted snugly into the groove.
3) Install the oil pan to the cylinder body.
• Tighten the oil pan bolts to the specified torque.

Oil Pan Bolts Torque	N·m (kg·m/lb·ft)
	19 (1.9/14)



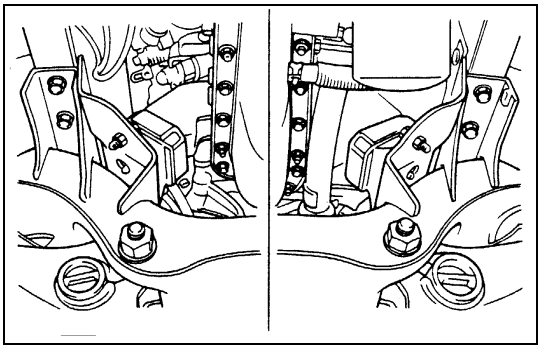
6A1-60-2.tif

4) Install the space rubber and stiffener (right & left side) then tighten bolts to the specified torque.

Engine Body Side Stiffener Bolts Torque	N·m (kg·m/lb·ft)
	37 (3.8/27)

Clutch Housing Side Stiffener Bolts Torque	N·m (kg·m/lb·ft)
	78 (8.0/58)

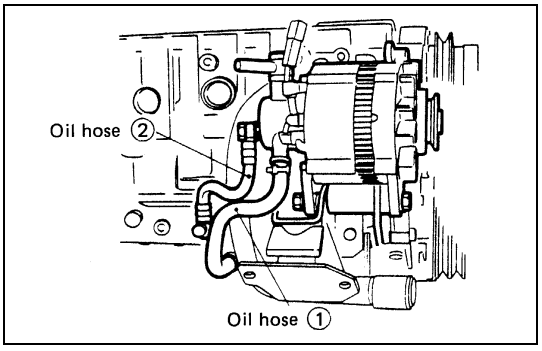
5) Install the exhaust pipe bracket.



6A1-60-3.tif

6) Install the support rubber and tighten nuts to the specified torque.

Support Rubber Nut Torque	N·m (kg·m/lb·ft)
	40 (4.1/30)



6A1-60-4.tif

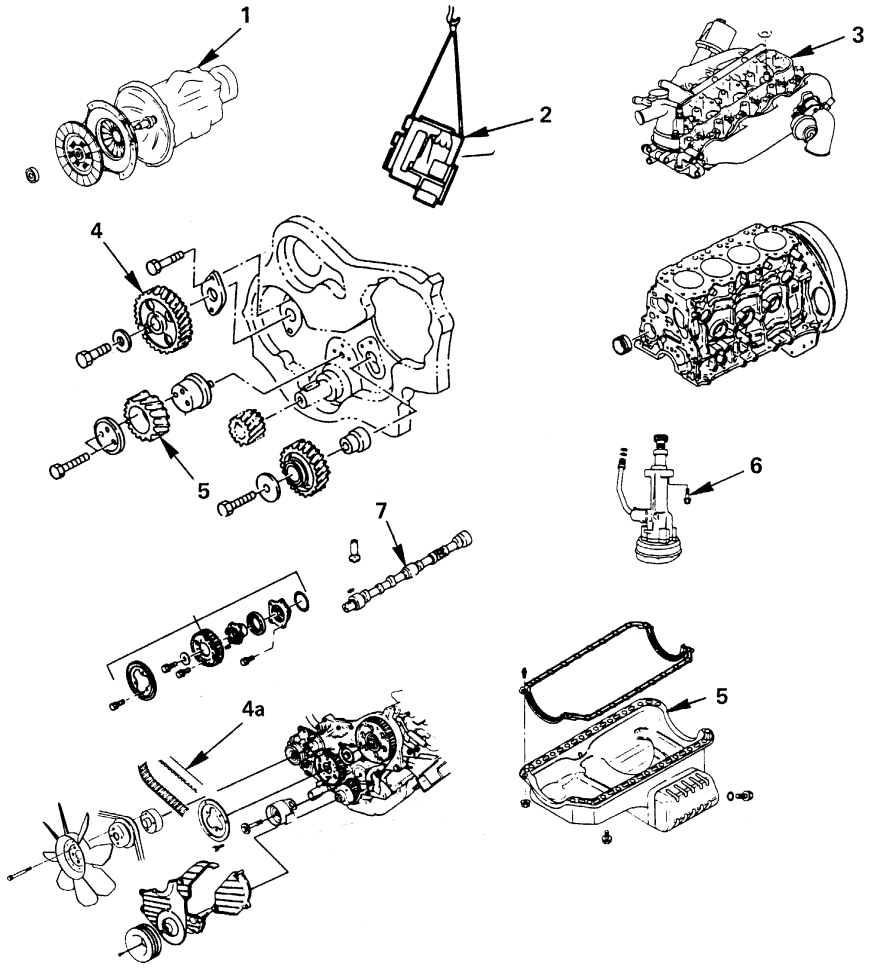
7) Install the vacuum pump oil hose ① to oil pan.

1. Cylinder Head ASM

1) Cylinder head gasket
2) Cylinder head assembly
3) Push rod
4) Rocker arm shaft
5) Valve clearance adjustment
6) Cylinder head cover
7) By-pass hoses
8) Front exhaust pipe
9) Vacuum actuator hose (Exhaust Brake Model)
10) A/C compressor assembly (A/C Model)
11) Oil cooler water pipe (Oil Cooler Model)
12) Oil level gauge guide tube
13) Glow plug harness
14) PCV hose
15) Leak off pipe
16) Injection pipe
17) Air intake duct
18) Engine harness
19) A/C compressor drive belt (With A/C Model)
20) Heater hose

Above works refer to “CYLINDER HEAD ASSEMBLY AND GASKET” Section in this manual.

CAMSHAFT AND TAPPET



Removal steps
1. Transmission and clutch Assembly
2. Engine Assembly
3. Cylinder head Assembly and gasket
4. Timing gear (Gear drive model)

4a. Timing belt (Belt drive model)

5. Oil pan
6. Oil pump
7. Camshaft and tappets

Installation steps
To install, follow the removal steps in the reverse order.

6A1-63-1.tif

REMOVAL

Preparation:
- Disconnect battery ground cable.
- Drain coolant.
- Drain engine oil.

NOTE
Install drain plug with new washer.

Drain Plug Torque	N·m (kg·m/lb·ft)
	83 (8.5/61)

1. Transmission and Clutch Assembly

1) Transmission
2) Clutch

2. Engine Assembly

1) Radiator assembly
2) Intake air duct
3) Heater hose
4) Engine control cable
5) Glow plug harness
6) Fuel hose
7) Oil pressure switch harness
8) A/C compressor assembly (A/C Model)
9) Power steering pump & bracket assembly (Power steering Model)
10) Actuator vacuum hose (Exh. Brake Model)
11) Vacuum pump hose (Exh. Brake Model)
12) Front exhaust pipe
13) Support rubber
14) Engine assembly

Above works refer to “ENGINE ASSEMBLY” Section in this manual.

3. Cylinder Head Assembly and Gasket

1) Injection pipe
2) Leak off pipe
3) PCV hose
4) Glow plug harness
5) Oil level gauge guide tube
6) Oil cooler water pipe (Oil Cooler Model)
7) By-pass hose
8) Cylinder head cover
9) Rocker arm shaft
10) Push rod
11) Cylinder head assembly
12) Cylinder head gasket

Above works refer to “CYLINDER HEAD ASSEMBLY AND GASKET” Section in this manual.

4. Timing Gear (Gear Drive Model)

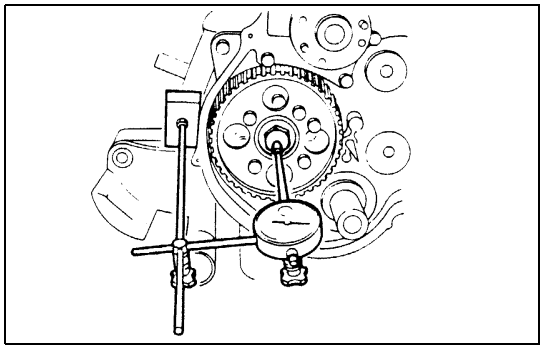
1) Cooling fan assembly
2) Crankshaft damper pulley
3) Noise shield cover
4) Noise cover spacer
5) Timing gear case cover
6) Camshaft timing gear

Above works refer to “TIMING GEAR (Gear Type)” Section in this manual.

4a. Timing Belt (Belt Drive Model)

1) Cooling fan assembly
2) Crankshaft damper pulley
3) Timing pulley upper cover
4) Timing pulley lower cover
5) Flange: camshaft pulley
6) Flange: injection pump pulley
7) Timing belt

   Above works refer to “TIMING BELT (Belt Type)” Section in this manual.
8) Camshaft timing pulley



6A1-65-1.tif

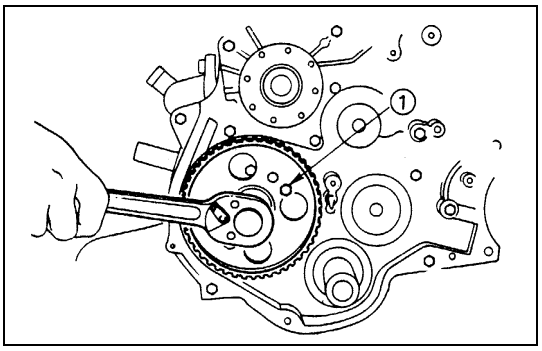
- Use a dial indicator to measure the camshaft end play.

  This must be done before removing the oil pump.

  If the camshaft end play exceeds the specified limit, the camshaft and/or the driven gear must be replaced.

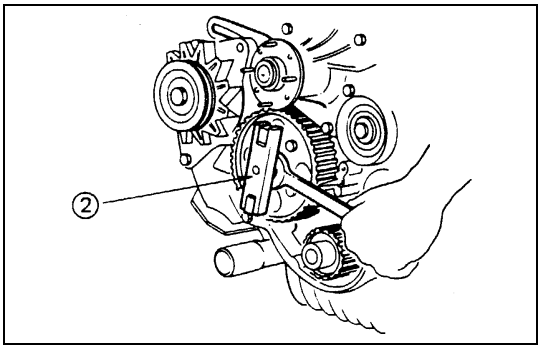
Camshaft End Play mm(in)

Standard	Limit
0.08 (0.003)	0.20 (0.008)



6A1-65-2.tif

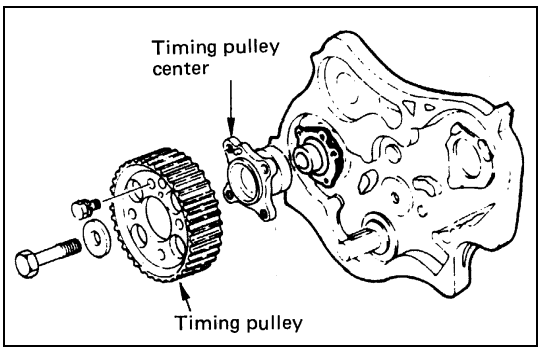
- Install the stopper bolt ① to the timing pulley to prevent the pulley from turning.
- Loosen the center bolt.



6A1-65-3.tif

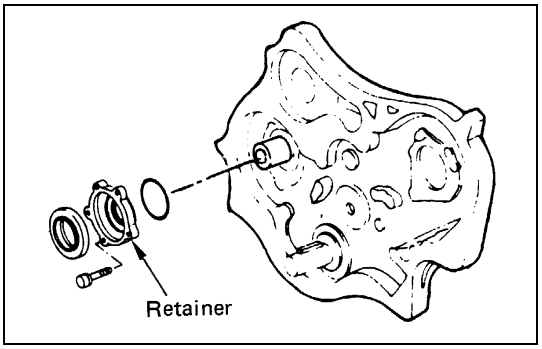
- Use the timing pulley puller ② to remove the pulley.

  Timing Pulley Puller: 5-8840-0086-0
- Remove the stopper bolt.



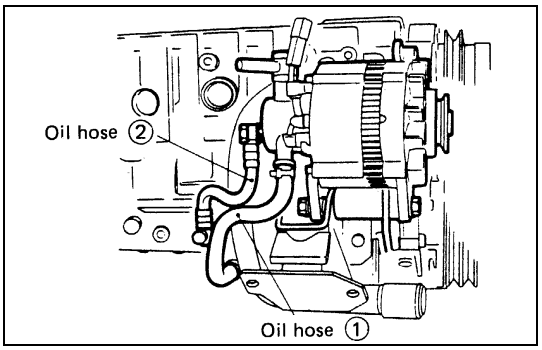
6A1-66-1.tif

- Remove the center bolt and remove the timing pulley with pulley center.



6A1-66-2.tif

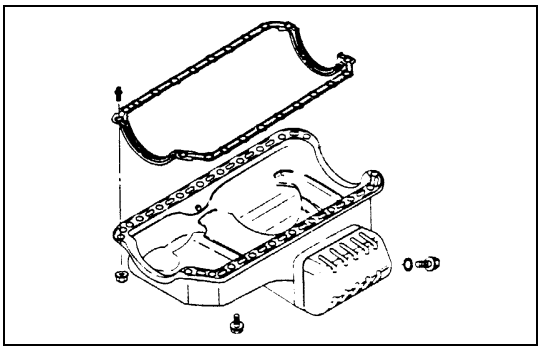
- Remove the oil seal retainer.



6A1-66-3.tif

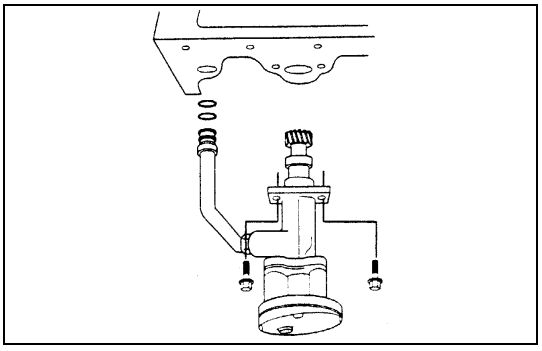
5. Oil Pan Assembly

- Disconnect vacuum pump oil hose ① from oil pan.



6A1-66-4.tif

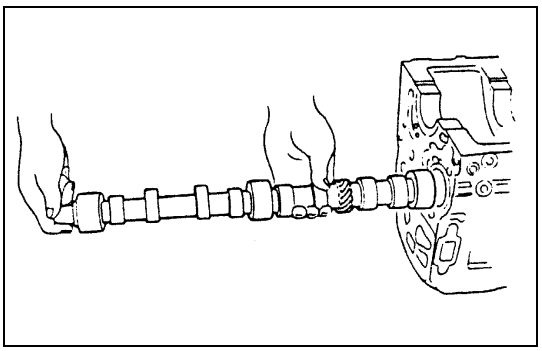
- Remove the stiffener and space rubber from oil pan both side.
- Remove the oil pan bolts and remove oil pan from cylinder body.



6A1-66-5.tif

6. Oil Pump Assembly

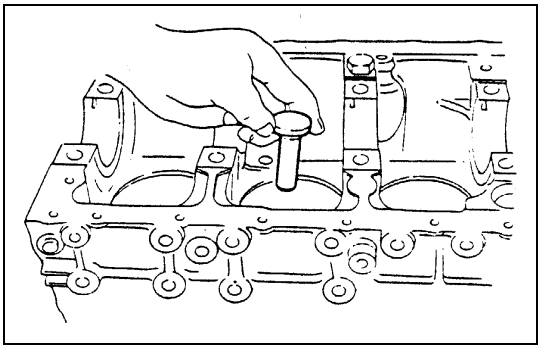
- Remove the oil pump assembly from cylinder body.



6A1-67-1.tif

7. Camshaft and Tappets

- Remove the camshaft from cylinder body.
- Take care not to damage the camshaft bearings.



6A1-67-2.tif

- Take out the tappets from cylinder body.

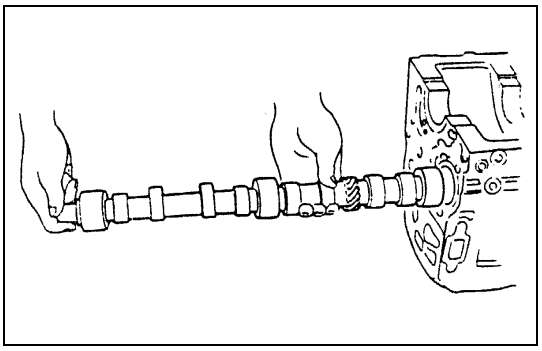
INSTALLATION

7. Camshaft and Tappets

- Apply a coat of engine oil to the tappet and the cylinder body tappet insert holes.
- Locate the position mark applied at disassembly (if the tappet is to be reused).

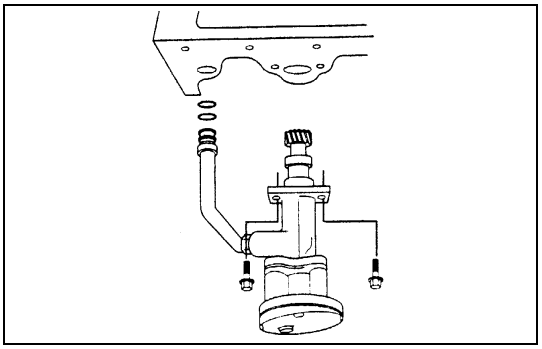
NOTE:

The tappet must be installed before the camshaft.



6A1-68-1.tif

- Apply a coat of engine oil to the camshaft and the camshaft bearings.
- Install the camshaft to the cylinder body.
  Take care not to damage the camshaft bearings.



6A1-68-2.tif

6. Oil Pump Assembly

- Prepare a solution of 80% engine oil and 20% molybdenum disulfide.
- Apply and ample coat of the solution to the teeth of the oil pump pinion.
- Apply engine oil to oil pipe O-ring and insert the O-ring in O-ring hold on cylinder block.
- Install oil pump asm with oil pipe in cylinder block and tighten fixing bolts to the specified torque.

Oil Pump Bolt Torque	N·m (kg·m/lb·ft)
	19 (1.9/14)

- Tighten sleeve nut to the specified torque.

Sleeve Nut Torque	N·m (kg·m/lb·ft)
	25 (2.5/18)

5. Oil Pan Assembly

Above works refer to “OIL PAN” Section in this manual.

4a. Timing Belt

8) Camshaft timing pulley
7) Timing belt
6) Flange: injection pump pulley
5) Flange: camshaft pulley
4) Timing pulley lower cover
3) Timing pulley upper cover
2) Crankshaft damper pulley
1) Cooling fan assembly

Above works refer to “TIMING BELT (Belt Type)” Section in this manual.

4. Timing Gear (Gear Type)

6) Camshaft timing gear
5) Timing gear case cover
4) Noise cover spacer
3) Noise shield cover
2) Crankshaft damper pulley
1) Cooling fan assembly

Above works refer to “TIMING GEAR (Gear Type)” Section in this manual.

3. Cylinder Head Assembly and Gasket

12) Cylinder head gasket

Piston Head Projection Measurement Point

11) Cylinder head assembly
10) Push rod
9) Rocker arm shaft

Valve Clearance Adjustment

8) Cylinder head cover
7) By-pass hose
6) Oil cooler water pipe (Oil cooler Model)
5) Oil level gauge guide tube
4) Glow plug harness
3) PCV hose
2) Fuel leak off pipe
1) Injection pipe

Above works refer to “CYLINDER HEAD ASSEMBLY AND GASKET” Section in this manual.

2. Engine Assembly

14) Engine assembly
13) Support rubber
12) Front exhaust pipe
11) Vacuum pump hose
10) Actuator vacuum hose
9) Power steering pump & bracket assembly (With Power Steering Model)
8) A/C compressor assembly (A/C Model)
7) Oil pressure switch harness
6) Fuel hose
5) Glow plug harness
4) Engine control cable
3) Heater hose
2) Intake air duct
1) Radiator assembly

1. Transmission and Clutch Assembly

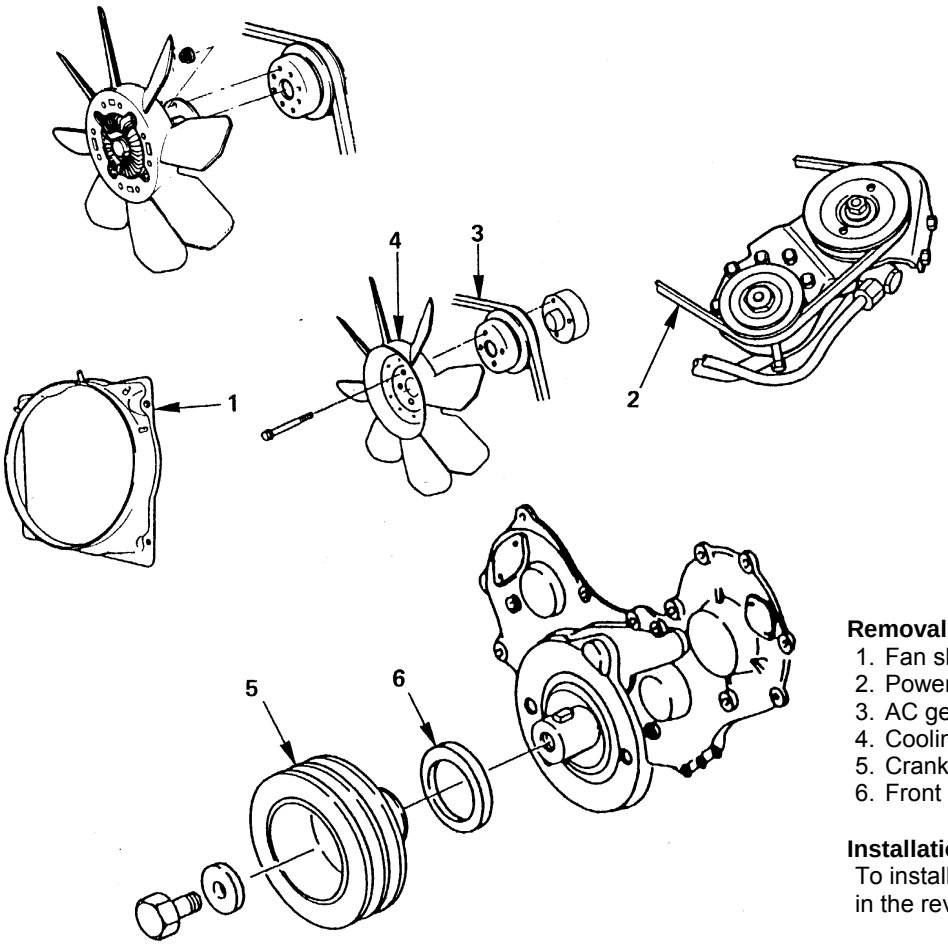
2) Clutch

1) Transmission

Above works refer to “ENGINE ASSEMBLY” Section in this manual.

- Connect the battery ground cable.
- Pour coolant
- Pour engine oil
- Start the engine and check coolant leakage.

CRANKSHAFT FRONT OIL SEAL (Gear Drive Type)



Removal steps
1. Fan shroud
2. Power steering pump drive belt
3. AC generator drive belt
4. Cooling fan Assembly
5. Crankshaft damper pulley
6. Front oil seal

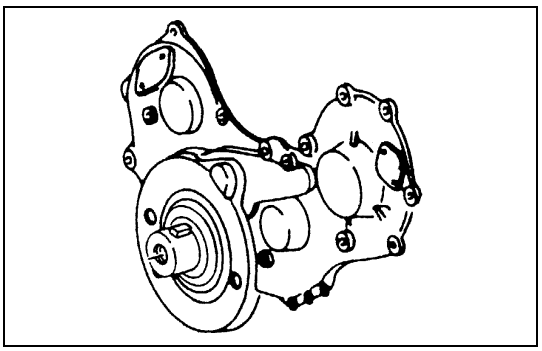
Installation steps
To install, follow the removal steps in the reverse order.

6A1-71-1.tif

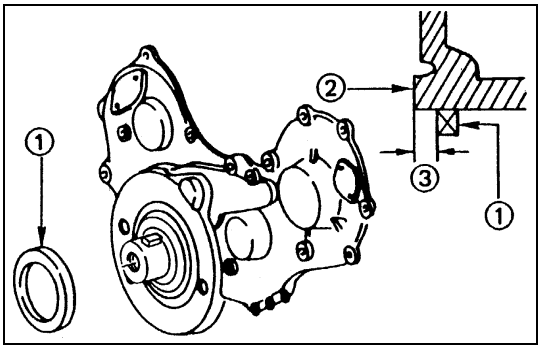
REMOVAL

Preparation:
- Disconnect battery ground cable.
- Drain coolant.

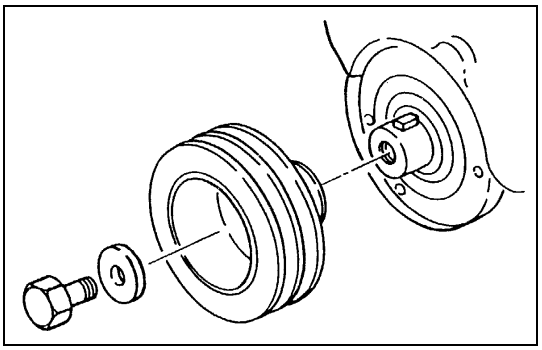
1. **Fan Shroud**
2. **Power Steering Pump Drive Belt**
   - Loosen power steering pump mounting bolt and adjust bolt, and remove the drive belt.
3. **AC Generator Drive Belt**
   - Loosen AC Generator mounting bolt (under side) and adjust plate lock bolt, and remove the drive belt.
4. **Cooling Fan Assembly**
   - Remove clamp nut, and remove cooling fan assembly, distant pipe, and fan pulley.
5. **Crankshaft Damper Pulley**



6A1-72-1.tif



6A1-72-2.tif



6A1-72-3.tif

6. Front Oil Seal

- Use a plastic hammer and a screwdriver to top around the oil seal to free it from the gear case cover.
  Take care not to damage the oil seal fitting surfaces.

INSTALLATION

6. Front Oil Seal

- Use the installer to install the front oil seal ① to the gear case cover ②.
  Oil Seal Installer: 5-8840-2061-0
  Note the oil seal installation depth ③ shown in the illustration.
  Depth ③ = 1 mm (0.039 in.)

5. Crankshaft Damper Pulley

Tighten the crankshaft damper pulley bolt to the specified torque.

NOTE:

Hold the flywheel ring gear stationary to prevent the crankshaft from turning when tightening the damper pulley.

Pulley Boss Bolt Torque	N·m (kg·m/lb·ft)
	206 (21/152)

4. Cooling Fan Assembly

- Mount fan pulley, distance piece, and cooling fan asm (in this order) on the water pump, and tighten to the specified torque.

	N·m (kg·m/lb·in)
	8 (0.8/69)

3. AC Generator Drive Belt

- Install AC Generator drive belt and adjust belt tension.
- Refer to Drive Belt Adjustment in this section.

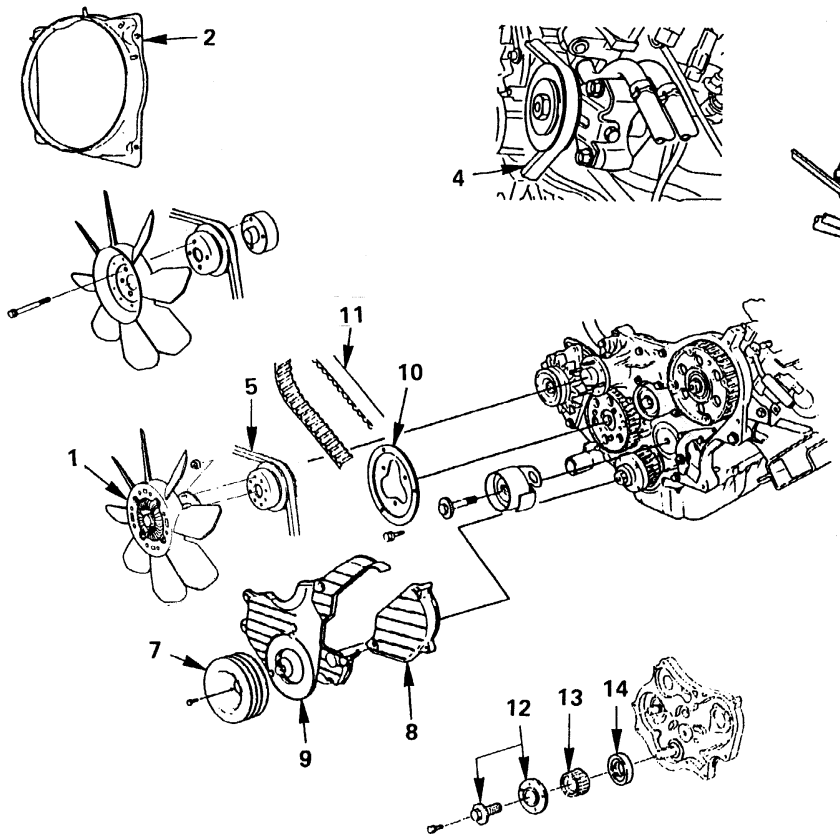
2. Power Steering Pump Drive Belt

- Install power steering pump drive belt and adjust belt tension.
- Refer to “Drive Belt Adjustment” in this section.

1. Fan Shroud

- Install the fan shroud and reservoir tank hose.
- Pour coolant
- Start the engine and check coolant leakage.

CRANKSHAFT FRONT OIL SEAL (Belt Drive Type)



Removal steps
1. Cooling fan ASM.
2. Fan shroud
3. Power steering pump drive belt
4. A/C compressor drive belt
5. AC generator drive belt
6. Power steering pump bracket ASM.
7. Crankshaft damper pulley
8. Timing pulley upper cover
9. Timing pulley lower cover
10. Flange ; Camshaft pulley
11. Timing belt
12. Crankshaft pulley center
13. Crankshaft timing pulley
14. Front oil seal

Installation steps
To install, follow the removal steps in the reverse order.

6A1-73-1.tif

REMOVAL

Preparation:
- Disconnect battery ground cable.
- Drain coolant.

1. **Cooling Fan Assembly**
2. **Fan Shroud**
3. **Power Steering Pump Drive Belt (P/S Model)**
4. **A/C Compressor Drive Belt (A/C Model)**
5. **AC Generator Drive Belt**
6. **Power Steering Pump Bracket Assembly (P/S Model)**
7. **Crankshaft Damper Pulley**
8. **Timing Pulley Upper Cover**
9. **Timing Pulley Lower Cover**
10. **Flange; Camshaft Pulley**
11. **Timing Belt**

    Above works refer to “TIMING BELT (Belt Type)” Section in this manual.

12. Crankshaft Pulley Center

- Remove the pulley center by using special tool.
  Remover: 5-8840-0161-0

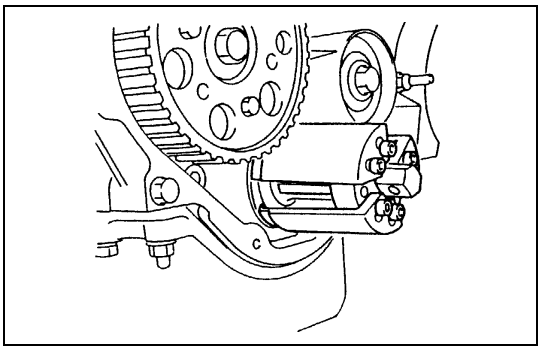
13. Crankshaft Timing Pulley

14. Front Oil Seal

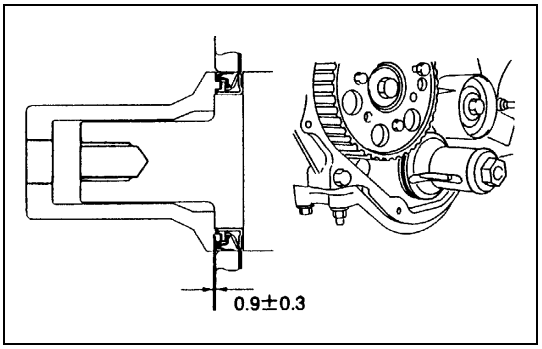
- Remove the oil seal by using special tool.
- With the oil seal pushed in deep, install the special tool as shown in the illustration to remove the oil seal.
  Front oil seal remover: 5-8840-2362-0

NOTE:

Take care not to damage sealing surface of front plate and crankshaft when removing oil seal.



6A1-74-1.tif



6A1-74-2.tif

INSTALLATION

14. Front Oil Seal

- Install the oil seal by using special tool.
  Installer: Front oil seal: 5-8840-2361-0

1) With the sleeve attached to the oil seal, put it in the front end of the crankshaft.
2) With the edge portion of the oil seal attached securely to the crankshaft, tighten it with the center bolt until the sleeve hits securely against the reference plane at the front end of the crankshaft.
3) Remove the sleeve.
4) After pressing in the seal, check the measurement of the oil seal.

Standard	mm (in)
0.6 - 1.2 (0.024 - 0.047)	

NOTE:

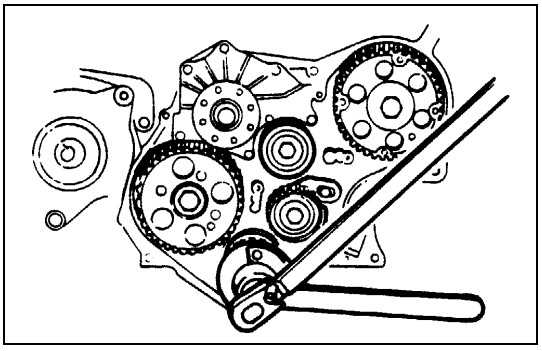
- **Install the oil seal after assembling the timing pulley housing.**
- **The lip portion of the oil seal is applied with oil.**
- **Take note of the press-in direction of the oil seal.**

13. Crankshaft Timing Pulley

12. Crankshaft Pulley Center

- Install the timing pulley center and tighten bolt to the specified torque.

Pulley Center Bolt Torque	N·m (kg·m/lb·ft)
206 (21/152)	

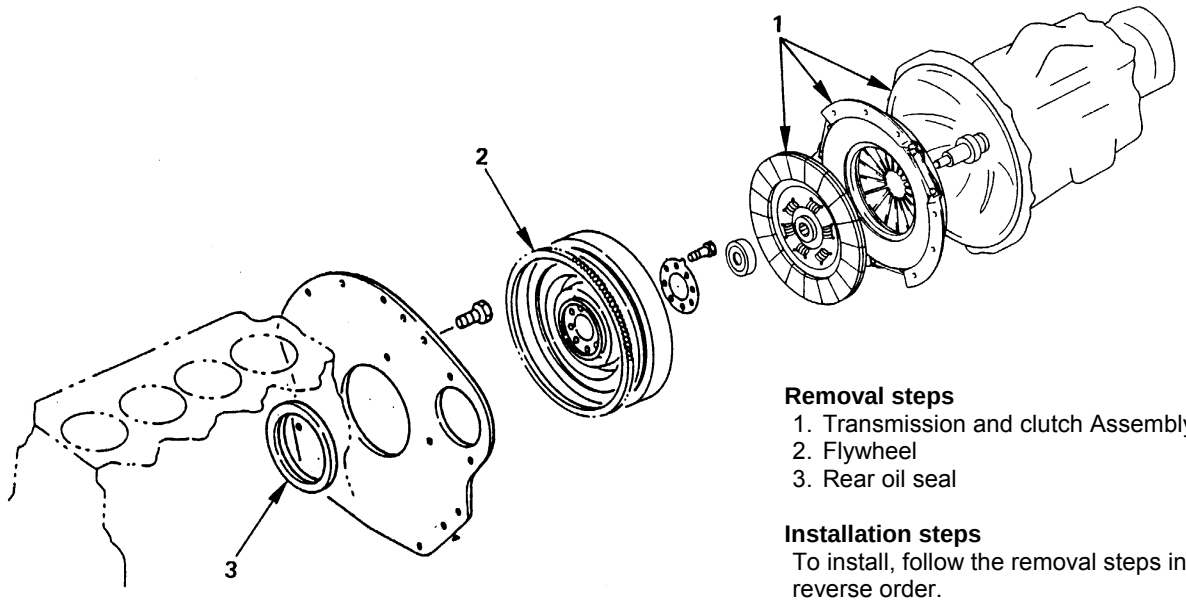


6A1-74-3.tif

11. **Timing Belt**
10. **Flange; Camshaft Pulley**
9. **Timing Pulley Lower Cover**
8. **Timing Pulley Upper Cover**
7. **Crankshaft Damper Pulley**
6. **Power Steering Pump Bracket Assembly (P/S Model)**
5. **AC Generator Drive Belt**
4. **A/C Compressor Drive Belt (A/C Model)**
3. **Power Steering Pump Drive Belt (P/S pump Model)**
2. **Fan Shroud**
1. **Cooling Fan Assembly**

Above works refer to “TIMING BELT (Belt Type)” Section in this manual.

CRANKSHAFT REAR OIL SEAL (Gear & Belt Drive Type)



Removal steps
1. Transmission and clutch Assembly
2. Flywheel
3. Rear oil seal

Installation steps
To install, follow the removal steps in the reverse order.

6A1-76-1.tif

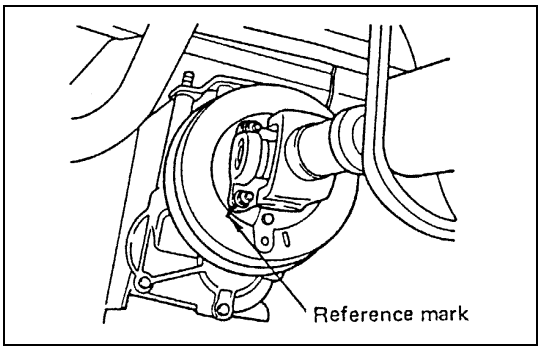
REMOVAL

Preparation:
- Disconnect battery ground cable

1. Transmission and Clutch Assembly
- Raise vehicle and support with suitable safely.

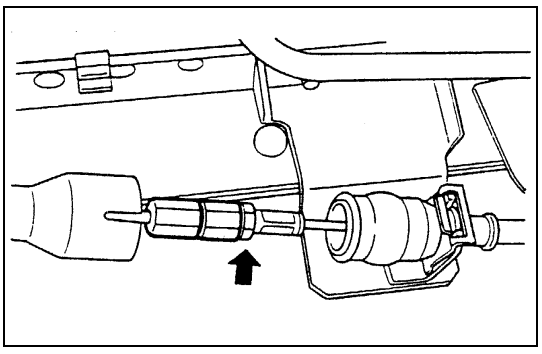
1) Transmission

① Transmission



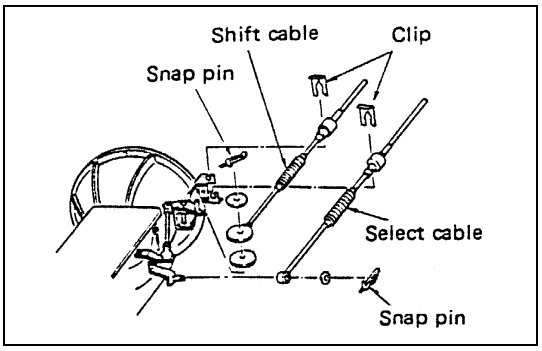
6A1-76-2.tif

- Reference mark the flange yoke to the parking brake drum.
- Disconnect the propeller shaft at flange yoke.
- Put aside the propeller shaft and tie it to the frame so that it does not interface with servicing work.



6A1-76-3.tif

② Parking Brake Cable
- Move the joint cover.
- Disconnect the joint bolt.
- Remove the clip then disconnect the cable from the bracket.



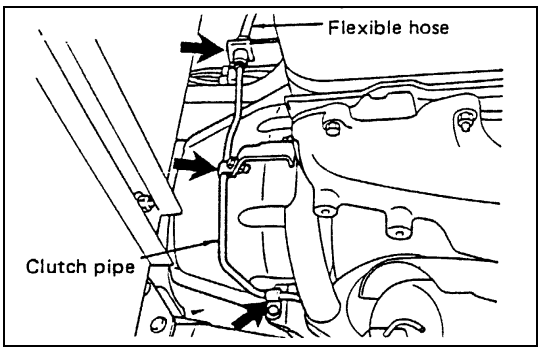
6A1-77-1.tif

③ Wiring Connector

- Disconnect the wiring connectors from the car speed sensor, the neutral switch and the back-up light switch.

④ Shift Cable and Select Cable

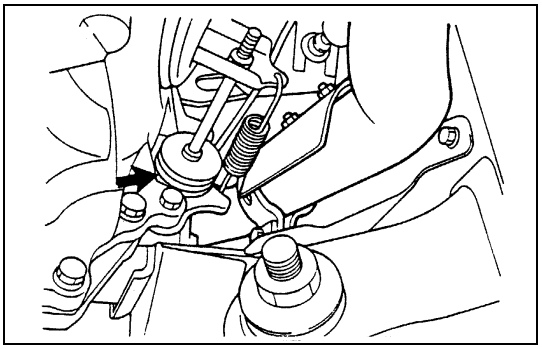
- Disconnect the shift cable and select cable on the transmission side.



6A1-77-2.tif

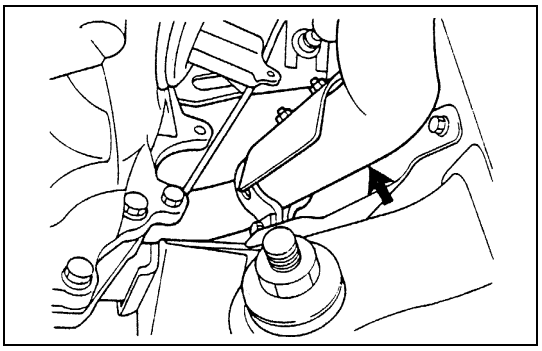
⑤ Clutch Slave Cylinder

- Remove the clutch pipe fixing clips and the clip bracket (Right hand drive models only).



6A1-77-3.tif

- Remove the slave cylinder assembly with the flexible hose attached, and then tie it to the frame so that it does not interface with servicing work.



6A1-77-4.tif

⑥ Exhaust Brake Assembly

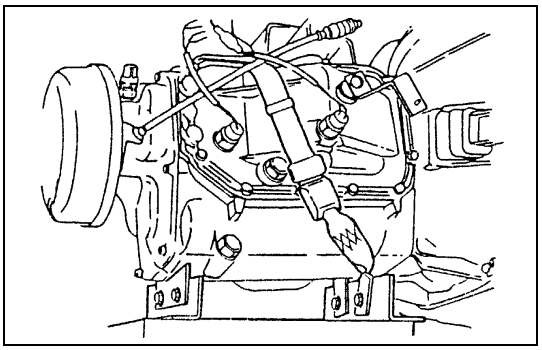
⑦ Front Exhaust Pipe

⑧ Transmission Assembly

NOTE:

The exhaust pipe bracket, the gear control bracket and the clips are sometimes installed in the wrong position or direction confusedly. To prevent incorrect installation of these parts, put a correct installation mark on them.

- Support the transmission with mission jack.



6A1-78-1.tif

CAUTION:

To prevent the falling of the transmission, tie it firmly to the jack with a chain or belt.

Do not allow transmission to hang unsupported from clutch. Damage to the clutch assembly will result.

- Remove the nuts of the transmission mounting bracket on the crossmember side.
- Engine and transmission angles may need to be adjusted for removal.
- Hold the rear section of the engine by the jack or hoist.

CAUTION:

When lifting the engine by the jack, use wood blockes to prevent any possible damage to the oil pan.

- Remove transmission fastening bolts.
- Pull out the transmission assembly rearward.

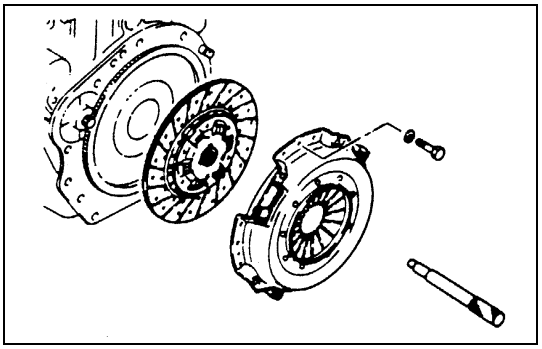
⑨ Mounting Bracket

2) Clutch

- Raise vehicle and support with suitable safety stands.

CAUTION:

Do not let clutch fluid remain on a painted surface, Wash it off immediately.



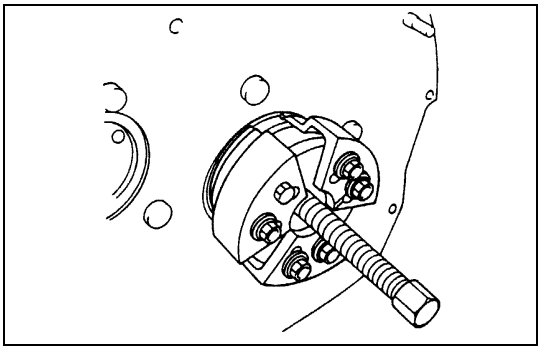
6A1-79-1.tif

① Pressure Plate Assembly

② Driven Plate Assembly

- Use the pilot aligner to prevent the driven plate assembly from falling free.
  Pilot Aligner: 5-5825-3001-0
- Mark the flywheel and pressure plate lug for alignment when installing.
- Loosen the pressure plate assembly fixing bolts.

2. Flywheel



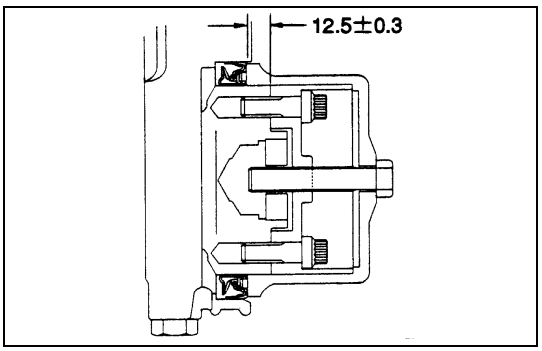
6A1-79-2.tif

3. Rear Oil Seal

- With the oil seal pushed in deep, install the special tool as shown in the illustration to remove the oil seal.
- Rear oil seal Remove: 5-8840-2360-0

NOTE:

Take care not to damage the crankshaft or oil seal retainer when removing oil seal.



6A1-80-1.tif

INSTALLATION

3. Rear Oil Seal

- Use the oil seal installer the oil seal to the cylinder body.

  Rear oil seal Install: 5-8840-2359-0

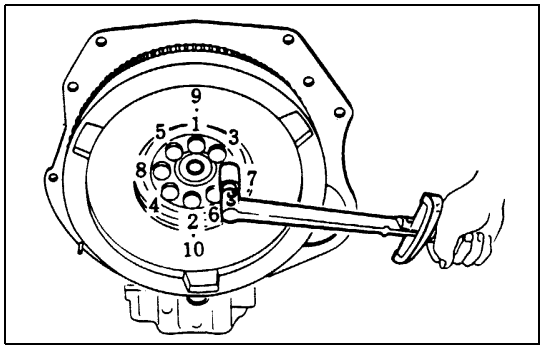
NOTE:

Wipe off rust and scraps clean from the press-in portion of the oil seal.

Take note of the press-in direction of the oil seal.

1) Install the adapter of the special tool to the rear end of the crankshaft with two bolts.
2) Install the oil seal to the outer circumference of the adapter.
3) Insert the sleeve into the adapter portion, and tighten it in with the bolt (M12x1.75L=70) until the adapter section hits the sleeve.
4) Remove the adapter and the sleeve.
5) After installing the oil seal, check the measurement of the oil seal.

Standard	mm (in)
12.2 - 12.8 (0.48 - 0.50)	



6A1-80-2.tif

2. Flywheel

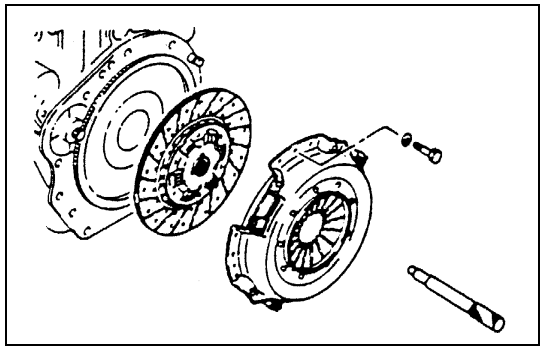
- Apply engine oil to fixing bolts.
- Tighten the flywheel bolts to the specified torque in two steps using the Angular Tightening Method.

  Follow the numerical order shown in the illustration.

Flywheel Bolt Torque	N·m (kg·m/lb·ft)
1st Step	2nd Step
59 (6.0/43)	60° - 90°

1. Transmission and Clutch Assembly

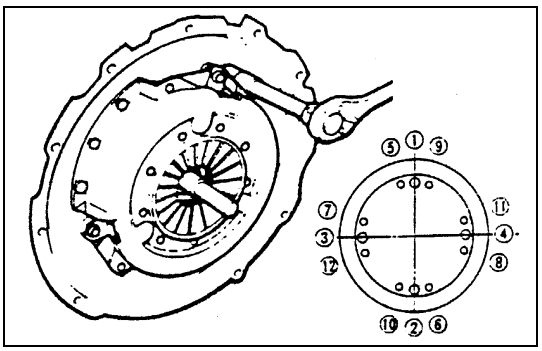
2) Clutch


6A1-80-3.tif

② Driven Plate Assembly

- Apply multi-purpose with MOS2 type grease to the driven plate hub spline.
- Use the pilot aligner to install the driven plate assembly.

  Pilot Aligner: 5-5825-3001-0



6A1-81-1.tif

① Pressure Plate Assembly

- Tighten pressure plate assembly fixing bolts in numerical order.

Pressure Plate Fixing Bolt Torque	N·m (kg·m/lb·ft)
	18 (1.8/13)

- Remove the pilot aligner.

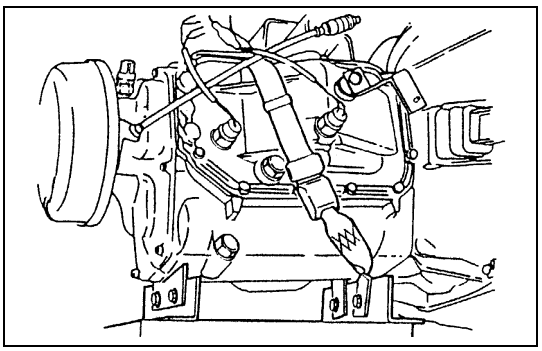
NOTE:

In case a new pressure plate assembly is mounted, after tightening a pressure plate at the specified torque, be sure to remove the wiring for protection of a diaphragm spring.

1) Transmission

⑨ Mounting Bracket

Mounting Bracket Nuts Torque	N·m (kg·m/lb·ft)
	69 (7.0/51)



6A1-81-2.tif

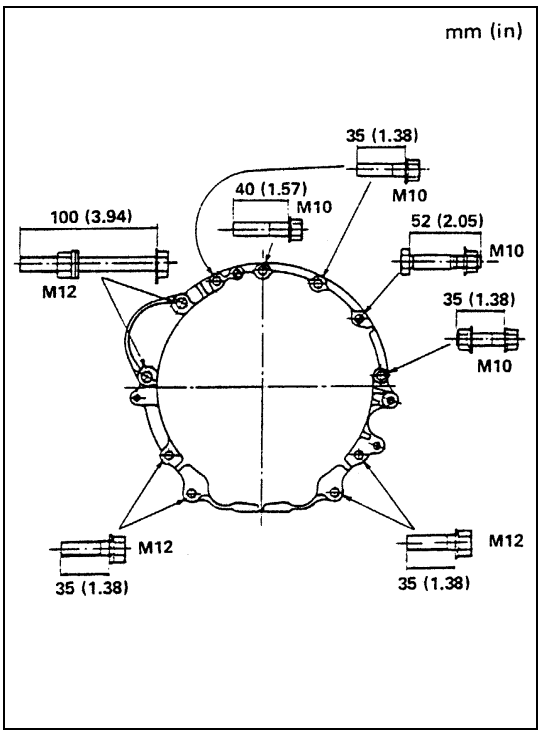
⑧ Transmission Assembly

- Support the transmission with mission jack.

CAUTION:

To prevent the falling of the transmission, tie it securely to the jack with a chain or belt.

- Shift transmission into high gear.
- Align transmission with engine slope.
- Turn output parking brake drum to aid clutch spring engagement.



6A1-81-3.tif

Clutch Housing to Flywheel Hosing Bolts Torque	N·m (kg·m/lb·ft)
	M10 : 46 (4.7/34) M12 : 91 (9.3/67)

- Raise engine and transmission up into rear transmission mount.

Engine Rear Mounting Nuts and Bolts Torque	N·m (kg·m/lb·ft)
	M10 : 40 (4.1/30) M12 : 69 (7.0/51)

⑦ Front Exhaust Pipe

Front Exhaust Pipe Bolts Torque	N·m (kg·m/lb·ft)
37 (3.8/27)	

⑥ Exhaust Brake Assembly

Exhaust Brake Bolts Torque	N·m (kg·m/lb·ft)
17 (1.8/12)	

⑤ Clutch Slave Cylinder

Slave Cylinder Bolts Torque	N·m (kg·m/lb·ft)
19 (1.9/14)	

- Perform slave cylinder adjustment before installation of the return spring.
  a) Loosen the lock nut of the push rod.
  b) Turn the adjust nut until it reaches the shift fork.
  c) Back off the adjust nut 1.5 turns. (shift fork free play Approximately 2 mm/0.1 in).
  d) Tighten the lock nut.

Push Rod Lock Nut Torque	N·m (kg·m/lb·ft)
16 (1.6/12)	

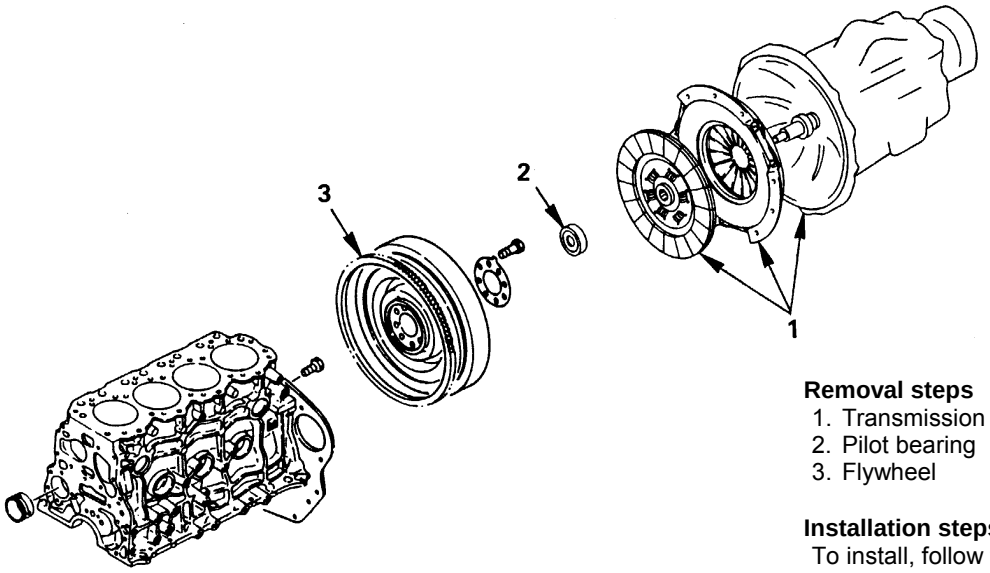
④ Shift Cable and Select Cable
③ Wiring Connector
- Color of Connector
  Back-up Light Switch: Brown
  Neutral Switch: Gray

② Parking Brake Cable
① Propeller Shaft
- Line up reference mark.

Propeller Shaft Nuts Torque	N·m (kg·m/lb·ft)
66 (6.7/48)	

- Connect battery ground cable.

FLYWHEEL AND PILOT BEARING



Removal steps
1. Transmission and clutch Assembly
2. Pilot bearing
3. Flywheel

Installation steps
To install, follow the removal steps in the reverse order.

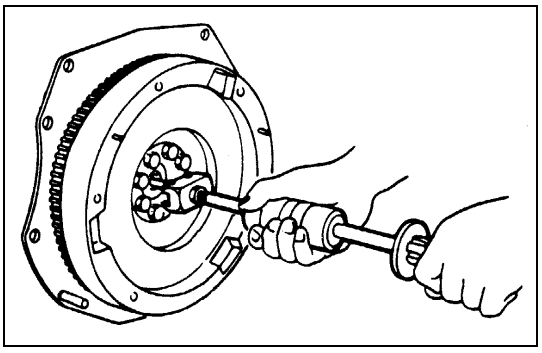
6A1-83-1.tif

REMOVAL

Preparation:
- Disconnect battery ground cable.

1. Transmission and Clutch Assembly
1) Transmission
2) Clutch

Above works refer to “ENGINE ASSEMBLY” Section in this manual.



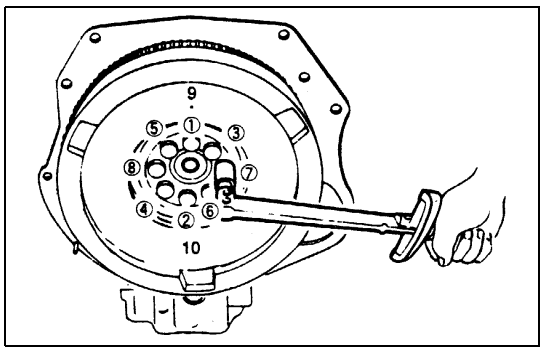
6A1-83-2.tif

2. Pilot Bearing
- Remove pilot bearing using remover.

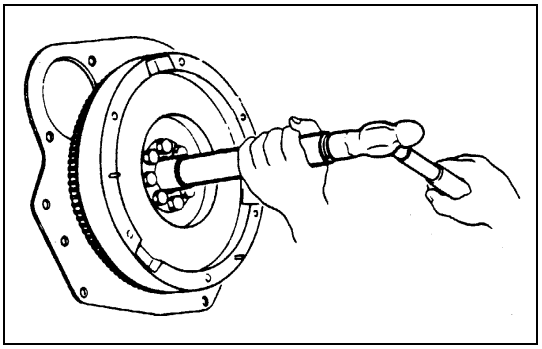
Pilot Bearing Puller: 5-8840-2000-0

Sliding hammer: 5-8840-0019-0

3. Flywheel
- Set the flywheel stopper.
- Loosen flywheel fixing bolts then remove the flywheel.



6A1-84-1.tif



6A1-84-2.tif

INSTALLATION

3. Flywheel

- Apply engine oil to fixing bolts.
- Tighten the flywheel bolts to the specified torque in two steps using the Angular Tightening Method.

  Follow the numerical order shown in the illustration.

Flywheel Bolt Torque N·m (kg·m/lb·ft)

1st Step	2nd Step
59 (6.0/43)	60° - 90°

2. Pilot Bearing

- Install the pilot bearing using installer.

  Pilot bearing Installer: 5-8522-0024-0

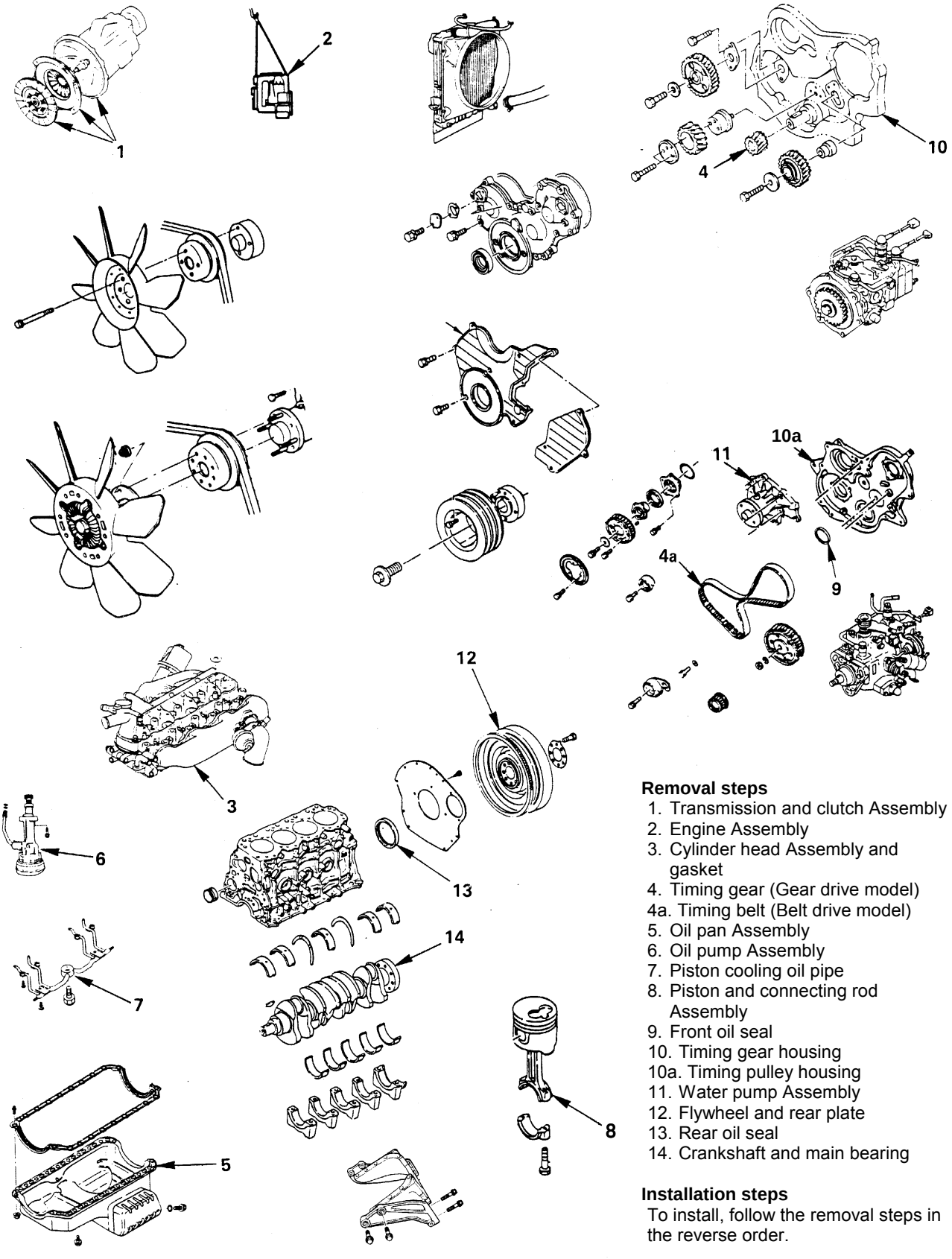
1. Transmission and Clutch Assembly

2) Clutch

1) Transmission

Above works refer to “ENGINE ASSEMBLY” Section in this manual.

CRANKSHAFT AND MAIN BEARINGS



Removal steps

1. Transmission and clutch Assembly
2. Engine Assembly
3. Cylinder head Assembly and gasket
4. Timing gear (Gear drive model)

4a. Timing belt (Belt drive model)

5. Oil pan Assembly
6. Oil pump Assembly
7. Piston cooling oil pipe
8. Piston and connecting rod Assembly
9. Front oil seal
10. Timing gear housing

10a. Timing pulley housing

11. Water pump Assembly
12. Flywheel and rear plate
13. Rear oil seal
14. Crankshaft and main bearing

Installation steps

To install, follow the removal steps in the reverse order.

6A1-85-1.tif

REMOVAL

Preparation:

- Disconnect battery ground cable.
- Drain coolant from the radiator and engine.

1. Transmission and Clutch Assembly

1) Transmission
2) Clutch

Above works refer to “ENGINE ASSEMBLY” Section in this manual.

2. Engine Assembly

1) Radiator assembly
2) Intake air duct
3) Heater hose
4) Engine control cable
5) Glow plug harness
6) Fuel hose
7) Oil pressure switch harness
8) A/C compressor assembly
9) Power steering pump bracket assembly (Power Steering Model)
10) Actuator vacuum hose (Exh. Brake Model)
11) Vacuum pump hose (Exh. Brake Model)
12) Front exhaust pipe
13) Support rubber
14) Engine assembly

Above works refer to “ENGINE ASSEMBLY” Section in this manual.

3. Cylinder Head Assembly and Gasket

1) Injection pipe
2) Leak off pipe
3) PCV hose
4) Glow plug harness
5) Oil level gauge guide tube
6) Oil cooler water pipe (Oil Cooler Model)
7) By-pass hose
8) Cylinder head cover
9) Rocker arm shaft
10) Push rod
11) Cylinder head assembly
12) Cylinder head gasket

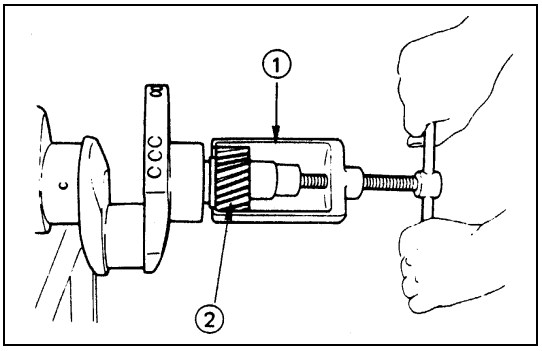
Above works refer to “CYLINDER HEAD ASSEMBLY AND GASKET” Section in this manual.

4. Timing Gear (Gear Drive Model)

1) Cooling fan assembly
2) Crankshaft damper pulley
3) Noise shield cover
4) Noise cover spacer
5) Timing gear case cover
6) Oil pipe
7) Idle gear
8) Idle gear “B" and shaft
9) Injection pump
10) Camshaft timing gear

Above works refer to “TIMING GEAR (Gear Type)” Section in this manual.

11) Crankshaft gear



6A1-87-1.tif

- Use the crankshaft timing gear remover ① to remove the crankshaft gear ②.

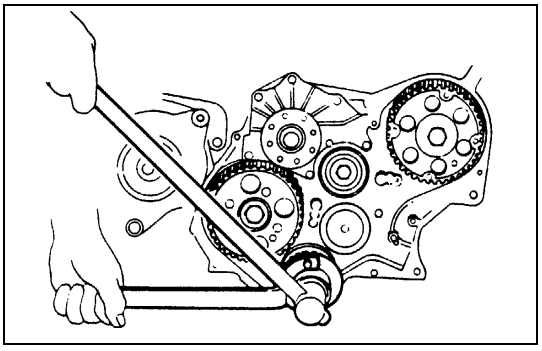
  Crankshaft Timing Gear Remover: 5-8840-2057-0

4a. Timing Belt (Belt Drive Model)

1) Cooling fan assembly
2) Crankshaft damper pulley
3) Timing pulley upper cover
4) Timing pulley lower cover
5) Flange: camshaft pulley
6) Flange: injection pump pulley
7) Timing belt

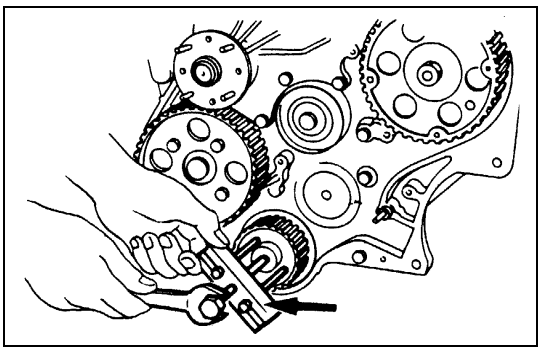
Above works refer to “TIMING BELT (Belt Type)” Section in this manual.

8) Crankshaft timing pulley center


6A1-87-2.tif

- Use the fixing wrench to prevent the crankshaft from turning.

  Fixing Wrench: 5-8840-0161-0
- Remove the timing pulley center from the crankshaft.



6A1-88-1.tif

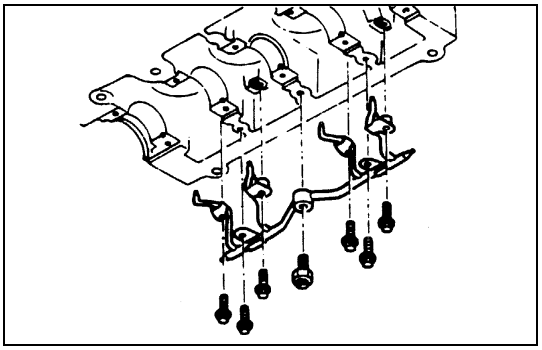
9) Crankshaft timing pulley
- Block the crankshaft with a piece of hard wood.
- Use the crankshaft timing pulley puller to remove the timing pulley.
  Crankshaft Timing Pulley Puller: 5-8840-2035-0

10) Injection pump timing pulley
11) Injection pump
    Above works refer to “CYLINDER BLOCK ASSEMBLY” Section in this manual.
12) Camshaft timing pulley

5. Oil Pan Assembly

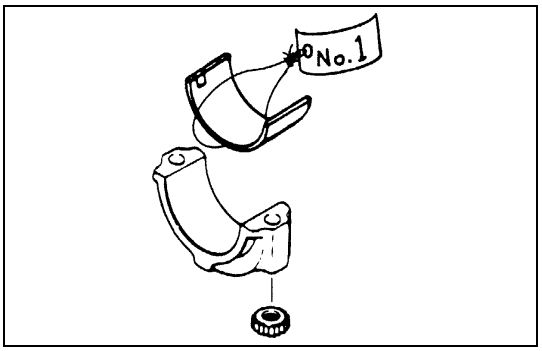
6. Oil Pump Assembly

Above works refer to “CAMSHAFT AND TAPPET” Section in this manual.



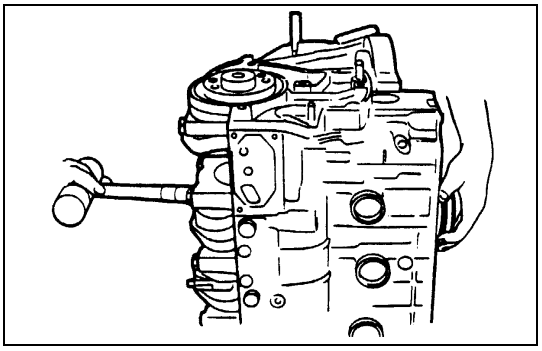
6A1-88-2.tif

7. Piston Cooling Oil Pipe
- Remove the oil pipe from cylinder block.



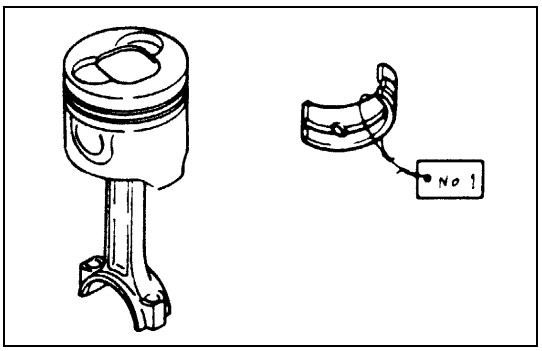
6A1-88-3.tif

8. Piston and Connecting Rod Assembly
- If the connecting rod lower bearings are to be reinstalled, mark their fitting positions by tagging each bearing with the cylinder number from which it was removed.



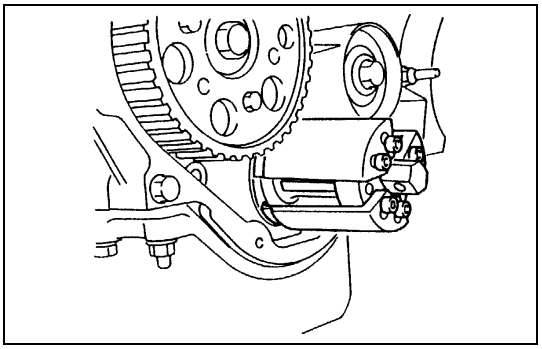
6A1-88-4.tif

- Remove carbon deposits from the upper portion of the cylinder wall with a scraper before removing the piston and connecting rod.
  Move the piston to the top of the cylinder and tap it with a hammer grip or similar object from the connecting rod lower side to drive it out.



6A1-89-1.tif

- If the connecting rod upper bearings are to be reinstalled, mark their fitting positions by tagging each bearing with the cylinder number from which it was removed.



6A1-89-2.tif

9. Front Oil Seal (Belt Drive Model)

- With the oil seal pushed in deep, install the special tool as shown in the illustration to remove the oil seal.

  Front Oil Seal Remover: 5-8840-2362-0

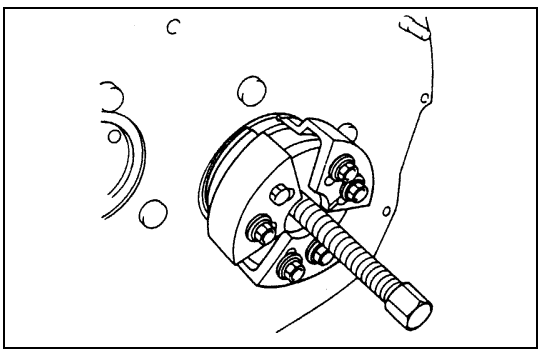
10. Timing Gear Housing

10a. Timing Pulley Housing

11. Water Pump Assembly

12. Flywheel and Cylinder Body Rear Plate

- Set the flywheel stopper.
- Loosen the flywheel fixing bolts then remove the flywheel.
- Remove the cylinder block rear plate.



6A1-89-3.tif

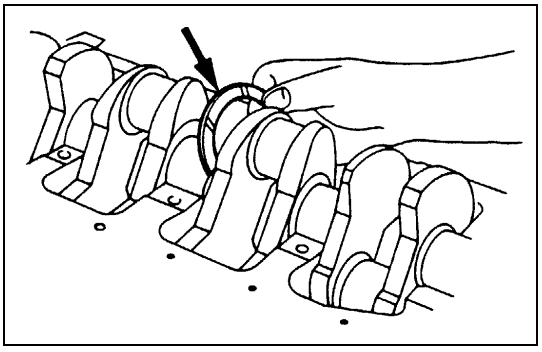
13. Rear Oil Seal (Gear and Belt Drive Model)

- With the oil seal pushed in deep, install the special tool as shown in the illustration to remove the oil seal.

  Rear Oil Seal Remover: 5-8840-2360-0

NOTE:

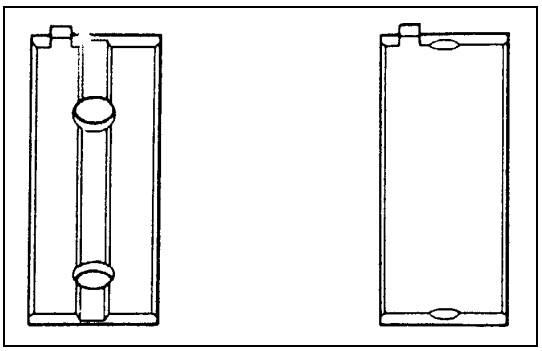
Take care not to damage sealing surface of front plate and crankshaft when removing oil seal.



6A1-89-4.tif

14. Crankshaft and Main Bearing

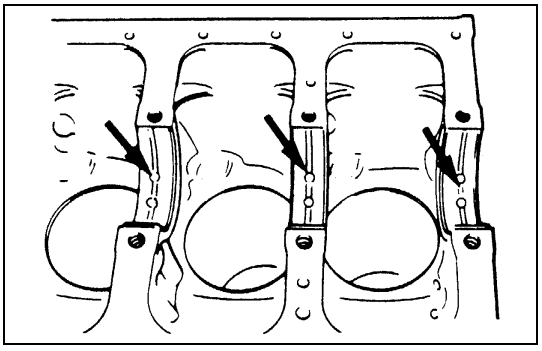
1) Remove the main bearing caps and thrust washer.
2) Remover the crankshaft with care.
3) Remove the crankshaft upper bearing.


6A1-90-1.tif

INSTALLATION

14. Crankshaft and Main Bearings

- The crankshaft upper bearings have an oil hole and an oil groove. The lower bearings do not…
- Install main bearings in the cylinder body and main bearing cap respectively.
- Apply new engine oil to upper and lower main bearings.
- Make sure that main bearing are in correct position.

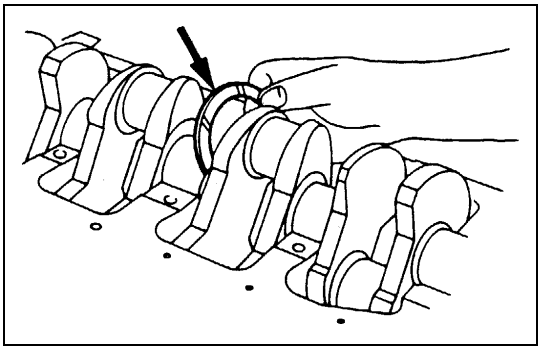

6A1-90-2.tif

- Carefully wipe any foreign material from the upper bearing.
- Install the main bearings to the cylinder body and the main bearing caps.

NOTE:

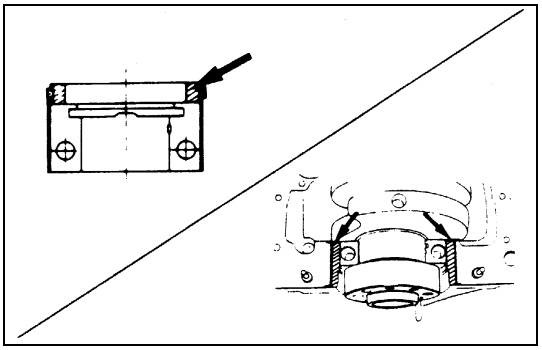
Do not apply engine oil to the bearing back faces and the cylinder body bearing fitting surfaces.

- Be sure that they are positioned correctly.
- Apply new engine oil to the upper and lower main bearing faces.


6A1-90-3.tif

- Carefully mount the crankshaft.
- Apply engine oil to the thrust washer.
- Install thrust washer on No.3 journal.

  Oil grooves in thrust washer must face the crankshaft.

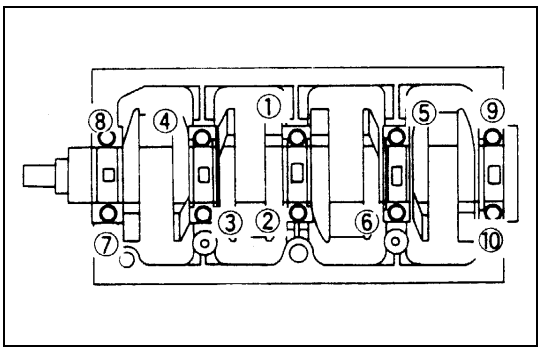

6A1-90-4.tif

- Apply the recommended liquid gasket or its equivalent to the No.5 crankshaft bearing cap cylinder body fitting surfaces at points and shown in the illustration.

NOTE:

Be sure that the bearing cap fitting surface is completely free of oil before applying the liquid gasket.

Do not allow the liquid gasket to obstruct the cylinder thread holes and bearings.



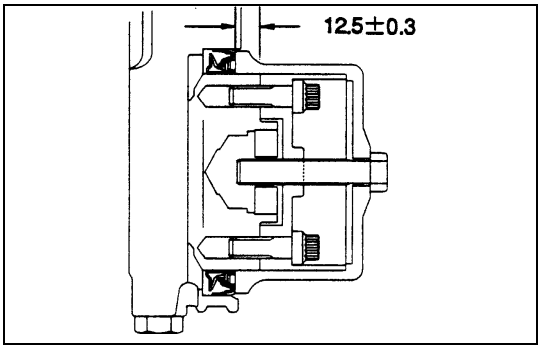
6A1-91-1.tif

- Install the bearing caps with the bearing cap head arrow mark facing the front of the engine.
- Apply engine oil to the front of the engine.
- Tighten the crankshaft bearing cap bolts to the specified torque a little at a time in the sequence shown in the illustration.

N·m (kg·m/lb·ft)
167 (17.0/123)

NOTE:

Check to see that the crankshaft turns smoothly by rotating it manually.



6A1-91-2.tif

13. Crankshaft Rear Oil Seal

Use the oil seal installer to install the oil seal to the cylinder body.

Rear Oil Seal Installer: 5-8840-2361-0

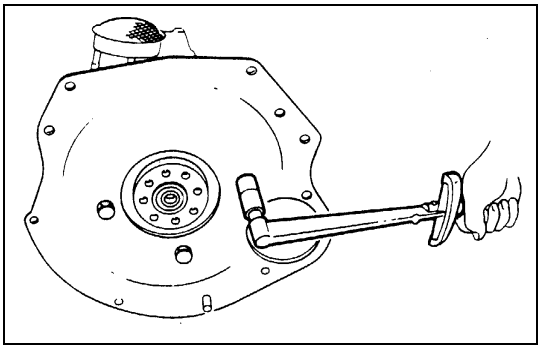
NOTE:

Wipe off rust and scraps clean from the press-in portion of the oil seal.

Take note of the press-in direction of the oil seal.

1) Install the adapter of the special tool to the rear end of the crankshaft with two bolts.
2) Install the oil seal to the outer circumference of the adapter.
3) Insert the slave into the adapter portion, and tighten it in with the bolt (M12x1.75L=70) until the adapter section hits the slave.
4) Remove the adapter and the slave.
5) After installing the oil seal, check the measurement of the oil seal.

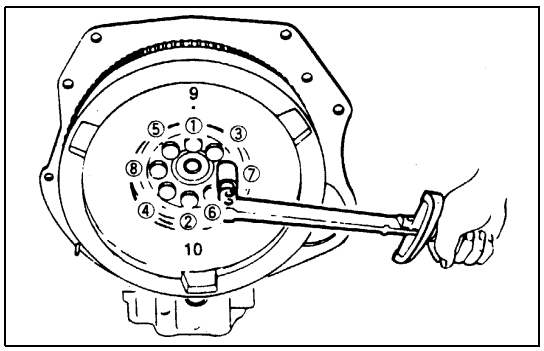
Standard	mm (in)
12.2 - 12.8 (0.48 - 0.50)	


6A1-92-3.tif

12. Flywheel and Cylinder Body Rear Plate

- Align the rear plate with the cylinder body knock pins.
- Tighten the rear plate to the specified torque.

Rear Plate Bolts Torque	N·m (kg·m/lb·ft)
82 (8.4/61)	



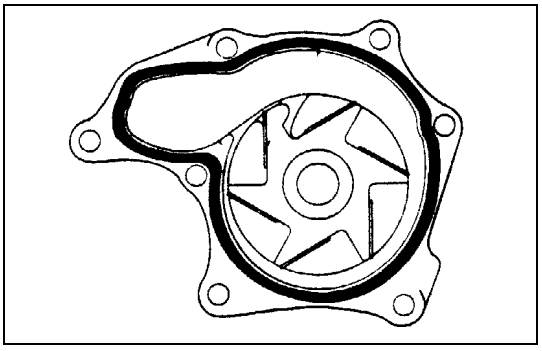
6A1-92-1.tif

- Block the crankshaft with a piece of hard wood to prevent the flywheel form turning.
- Apply a coat of engine oil to the threads of the flywheel bolts.
- Align the flywheel with the crankshaft dowel pin.
- Tighten the flywheel bolts to the specified torque in two steps using the Angular Tightening Method.

  Follow the numerical order shown in the illustration.

Flywheel Bolt Torque N·m (kg·m/lb·ft)

1st Step	2nd Step
59 (6.0/43)	60° - 90°

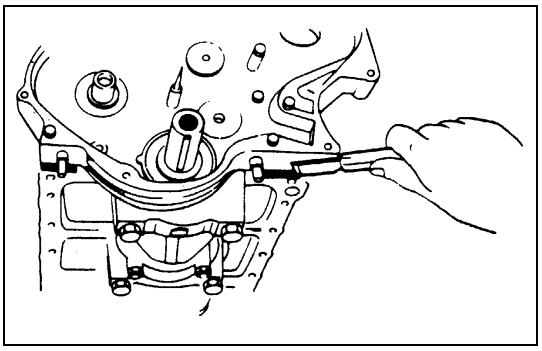

6A1-92-2.tif

11. Water Pump Assembly

- Fit the O-ring to the water pump body.
- Remove the water pump assembly and tighten bolts to the specified torque.

Water Pump Bolt Torque N·m (kg·m/lb·in)

20 (2.0/14)


6A1-92-3.tif

10a. Timing Pulley Housing

- Install the timing pulley housing the cylinder body. Take care not to twist the front oil seal.
- Tighten the timing pulley housing together with the timing pulley housing gasket to the specified torque.

Timing Pulley Housing Bolt Torque N·m (kg·m/lb·ft)

19 (1.9/14)

- Cut away the flash from the gasket.

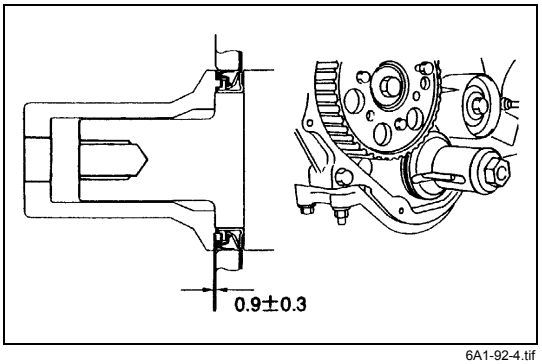
10. Timing Gear Housing

- Install the timing gear housing the cylinder body.
- Tighten the timing gear housing together with the timing gear housing gasket to the specified torque.

Timing Gear Housing Bolt Torque N·m (kg·m/lb·ft)

19 (1.9/14)

- Cut away the flash from the gasket.



6A1-92-4.tif

9. Front Oil Seal (Belt Drive Model)

- Install oil seal using special tool.

  Front Oil Seal Installer: 5-8840-2361-0

Notes:

Wipe off rust and scraps clean from the press-in portion of the oil seal.

Take note of the press-in direction of the oil seal.

1) With the oil seal attached to the sleeve, put it in the front end of the crankshaft.

2) With the edge of the oil seal attached securely to the crankshaft, tighten it with the center bolt until the sleeve hits securely against the reference plane at the front end of the crankshaft.
3) Remove the sleeve.
4) After pressing in the oil seal, check the measurement of the oil seal.

Standard	mm (in)
0.6 - 1.2 (0.024 - 0.047)	

8. Piston and Connecting Rod Assembly

7. Piston Cooling Oil Pipe

Above works refer to “PISTON” Section in this manual.

6. Oil Pump Assembly

5. Oil Pan Assembly

Above works refer to “OIL PUMP AND OIL PAN” Section in this manual.

4a. Timing Belt (Belt Drive Model)

12) Camshaft timing pulley

Above works refer to “CAMSHAFT AND TAPPET” Section in this manual.

11) Injection pump

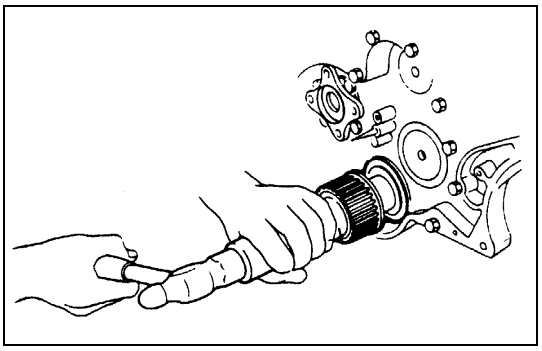
10) Injection pump timing pulley

Above works refer to “CYLINDER BLOCK ASSEMBLY” Section in this manual.

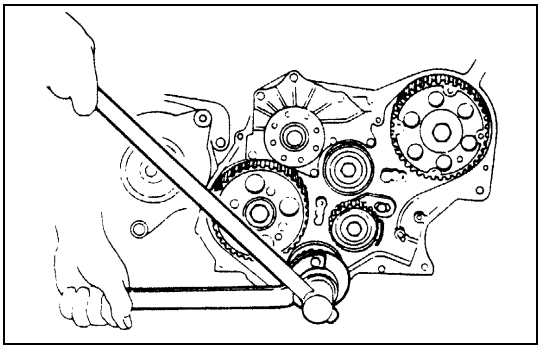
9) Crankshaft timing pulley

- Use the crankshaft timing pulley installer to install the timing pulley.
- The timing pulley flange must be facing the cylinder body.

Crankshaft Timing Pulley Installer: 5-8522-0020-0



6A1-93-1.tif



6A1-93-2.tif

8) Crankshaft timing pulley center

- Install the crankshaft pulley center.
- Use the fixing wrench to prevent the crankshaft from turning.

Fixing Wrench: 5-8840-0161-0

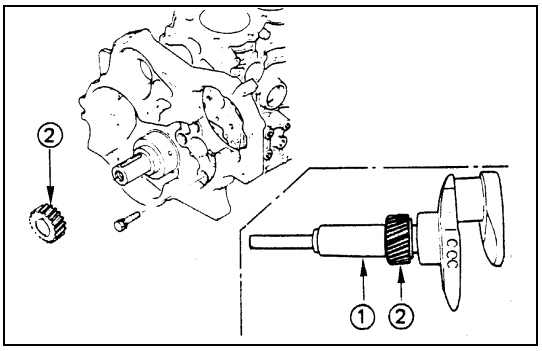
- Tighten the crankshaft pulley center bolt to the specified torque.

Crankshaft Pulley Center Bolt Torque	N·m (kg·m/lb·ft)
206 (21/152)	

7) Timing belt
6) Flange: camshaft pulley
5) Flange: injection pump pulley
4) Timing pulley lower cover
3) Timing pulley upper cover

2) Crankshaft damper pulley
1) Cooling fan assembly
Above works refer to “TIMING GEAR (Belt Type)” Section in this manual.

4. Timing Gear (Gear Drive Model)



6A1-94-1.tif

11) Crankshaft gear
- Install the crankshaft gear.
- Use the crankshaft gear installer ① to install the crankshaft gear ②.
- The crankshaft gear timing mark ("X-X") must be facing outward.

Crankshaft Gear Installer: 9-8522-0020-0

10) Camshaft timing gear
9) Injection pump
8) Idler gear "B" and shaft
7) Idle gear
6) Timing gear oil pipe
5) Timing gear case cover
4) Noise cover spacer
3) Noise shield cover
2) Crankshaft damper pulley
1) Cooling fan assembly
Above works refer to “TIMING GEAR (Gear Type)” Section in this manual.

3. Cylinder Head Assembly and Gasket

12) Cylinder head gasket
11) Cylinder head assembly
10) Push rod
9) Rocker arm shaft assembly

Valve Clearance Adjustment

8) Cylinder head cover
7) By-pass hose
6) Oil cooler water pipe (Oil Cooler Model)
5) Oil level gauge guide tube
4) Glow plug harness connector
3) PCV hose
2) Fuel leak off pipe
1) Injection pipe
Above works refer to “CYLINDER HEAD ASSEMBLY AND GASKET” Section in this manual.

2. Engine Assembly

13) Support rubber
12) Front exhaust pipe
11) Vacuum pump hose
10) Actuator vacuum hose (Exhaust Brake Model)
9) Power steering pump & bracket assembly (Power Steering Model)
8) A/C compressor assembly (A/C Model)
7) Oil pressure switch harness
6) Fuel hose
5) Glow plug harness
4) Engine control cable
3) Heater hose
2) Intake air duct
1) Radiator assembly

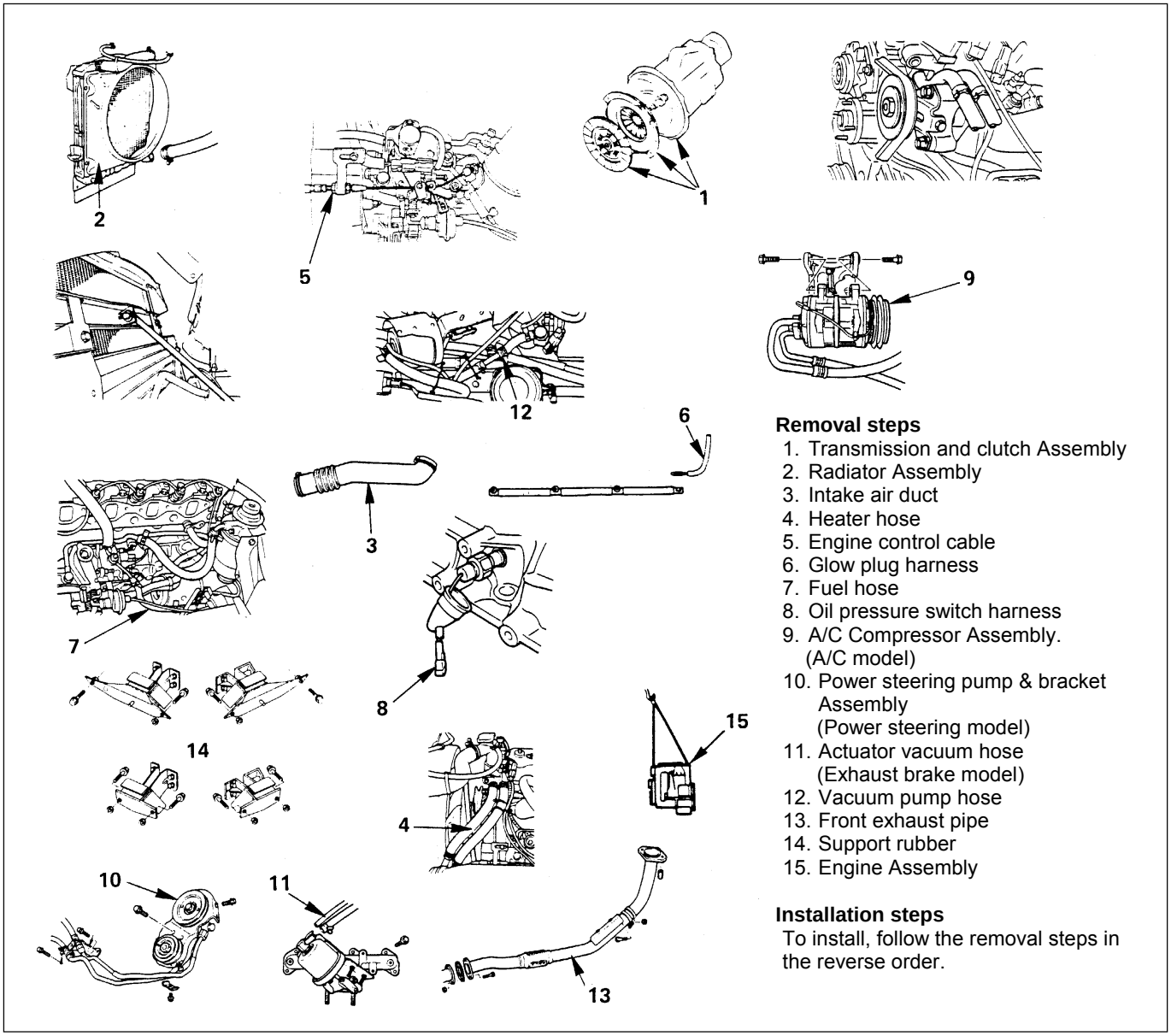
Above works refer to “ENGINE ASSEMBLY” Section in this manual.

1. Transmission and Clutch Assembly

2) Clutch
1) Transmission

Above works refer to “ENGINE ASSEMBLY” Section in this manual.

ENGINE ASSEMBLY



Removal steps

1. Transmission and clutch Assembly
2. Radiator Assembly
3. Intake air duct
4. Heater hose
5. Engine control cable
6. Glow plug harness
7. Fuel hose
8. Oil pressure switch harness
9. A/C Compressor Assembly. (A/C model)
10. Power steering pump & bracket Assembly (Power steering model)
11. Actuator vacuum hose (Exhaust brake model)
12. Vacuum pump hose
13. Front exhaust pipe
14. Support rubber
15. Engine Assembly

Installation steps

To install, follow the removal steps in the reverse order.

6A1-96-1.tif

REMOVAL

Preparation:

- Disconnect Battery Ground Cable
- Drain Coolant

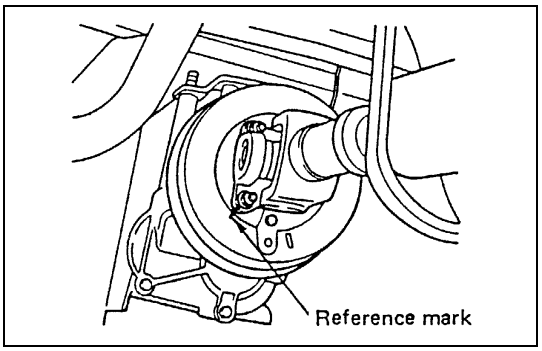
1. Transmission and Clutch Assembly

- Raise vehicle and support with suitable safely.

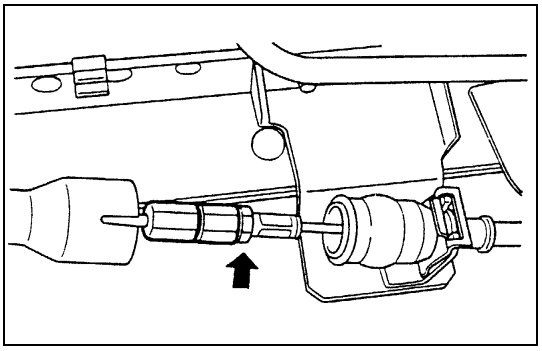
1) Transmission

① Propeller Shaft

- Reference mark the flange yoke to the parking brake drum.
- Disconnect the propeller shaft at flange yoke.
- Put aside the propeller shaft and tie it to the frame so that it does not interface with servicing work.



6A1-97-1.tif



6A1-97-2.tif

② Parking Brake Cable

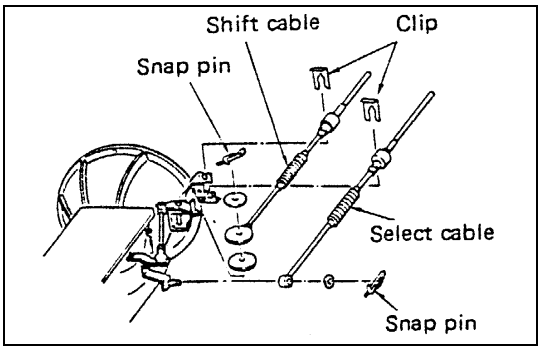
- Move the joint cover.
- Disconnect the joint bolt.
- Remove the clip then disconnect the cable from the bracket.

③ Wiring Connector

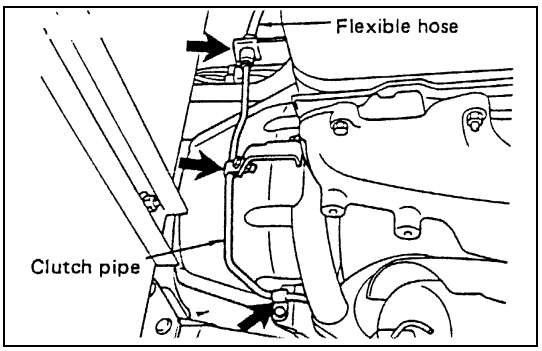
- Disconnect the wiring connectors from the car speed sensor, the neutral switch and the back-up light switch.

④ Shift Cable and Select Cable

- Disconnect the shift cable and select cable on the transmission side.



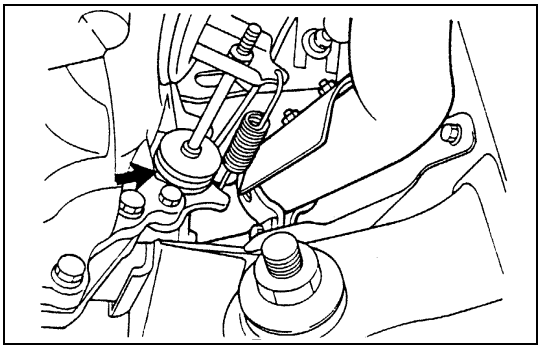
6A1-97-3.tif



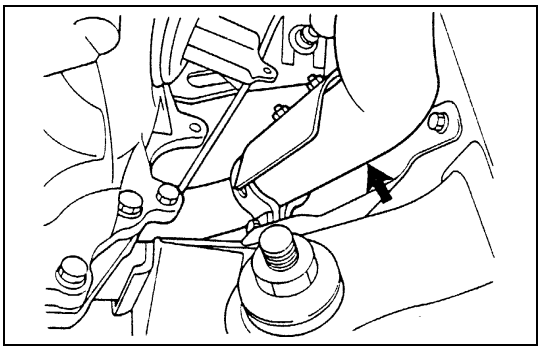
6A1-98-1.tif

⑤ Clutch Slave Cylinder

- Remove the clutch pipe fixing clips and the clip bracket (Right hand drive models only).


6A1-98-2.tif

- Remove the slave cylinder assembly with the flexible hose attached, and then tie it to the frame so that it does not interface with servicing work.


6A1-98-3.tif

⑥ Exhaust Brake Assembly

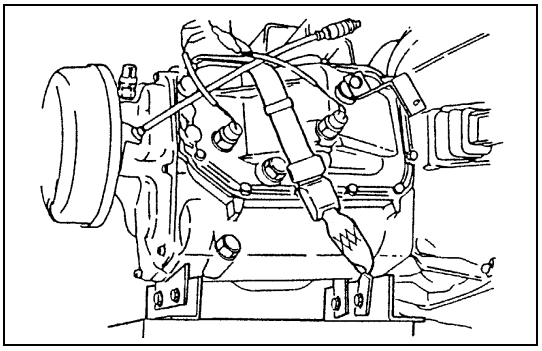
⑦ Front Exhaust Pipe

⑧ Transmission Assembly

NOTE:

The exhaust pipe bracket, the gear control bracket and the clips are sometimes installed in the wrong position or direction confusedly. To prevent incorrect installation of these parts, put a correct installation mark on them.

- Support the transmission with mission jack.


6A1-98-4.tif

CAUTION:

To prevent the falling of the transmission, tie it firmly to the jack with a chain or belt.

Do not allow transmission to hang unsupported from clutch. Damage to the clutch assembly will result.

- Remove the nuts of the transmission mounting bracket on the crossmember side.
- Engine and transmission angles may need to be adjusted for removal.
- Hold the rear section of the engine by the jack or hoist.

CAUTION:

When lifting the engine by the jack, use wood blocks to prevent any possible damage to the oil pan.

- Remove transmission fastening bolts.
- Pull out the transmission assembly rearward.

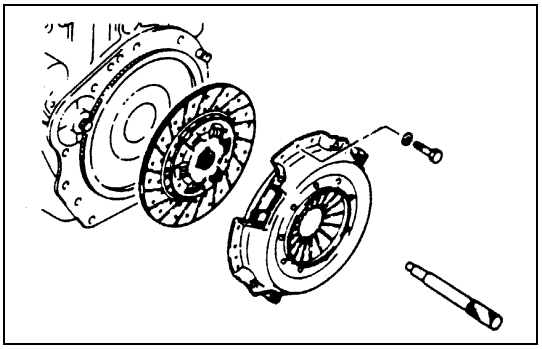
⑨ Mounting Bracket

2) Clutch

- Raise vehicle and support with suitable safety stands.

CAUTION:

Do not let clutch fluid remain on a painted surface, Wash it off immediately.



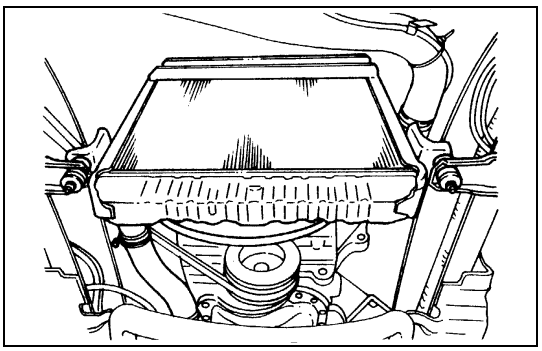
6A1-99-1.tif

① Pressure Plate Assembly

② Driven Plate Assembly

- Use the pilot aligner to prevent the driven plate assembly from falling free.

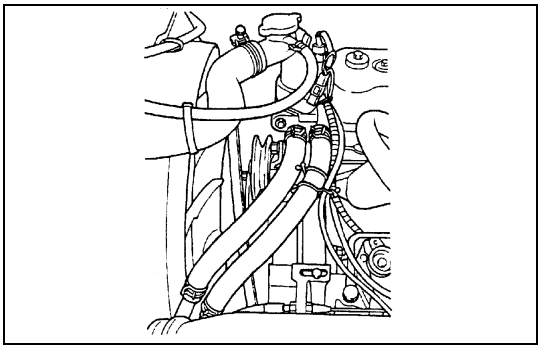
  Pilot Aligner: 5-5825-3001-0
- Mark the flywheel and pressure plate lug for alignment when installing.
- Loosen the pressure plate assembly fixing bolts.



6A1-100-1.tif

2. Radiator Assembly

1) Remove the radiator hose upper and lower.
2) Remove the reservoir tank hose
3) Remove the cushion rubbers on both sides.
4) Remove the radiator stay.



6A1-100-2.tif

3. Intake Air Duct

4. Heater Hose

5. Engine Control Cable

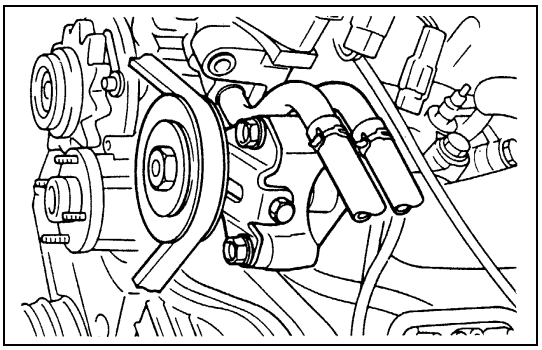
- Loosen the locking nut at the bracket and disconnect accelerator cable from injection pump control lever.

6. Glow Plug Harness

7. Fuel Hose

- Remove the fuel inlet hose and fuel return hose.

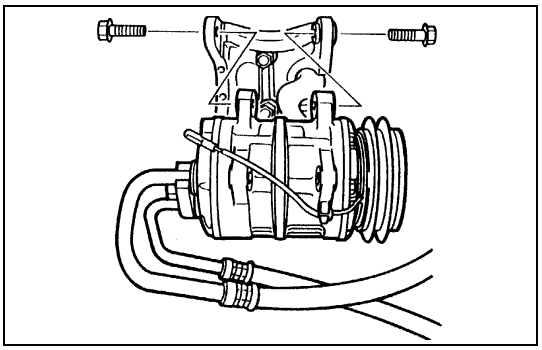
8. Oil Pressure Switch Harness



6A1-100-3.tif

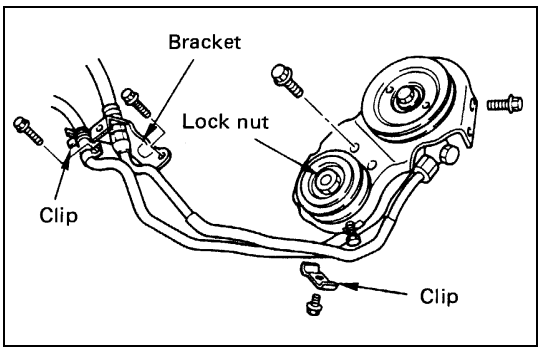
9. A/C Compressor Assembly

- Loosen the idler pulley lock nut.
- Loosen the adjust bolt then remove the drive belt.



6A1-100-4.tif

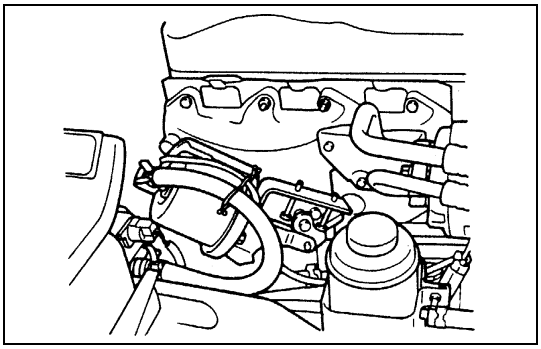
- Disconnect magnetic clutch harness connector.
- Remove the A/C compressor fixing bolts and temporally tighten the A/C compressor to chassis frame side use the wire.



6A1-101-1.tif

10. Power Steering Pump & Bracket Assembly (Power Steering Model)

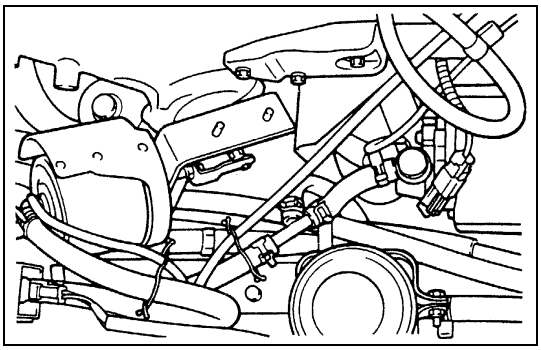
1) Loosen the idler pulley lock nut.
2) Loosen the adjust bolt then remove the drive belt.
3) Remove the pipe bracket fixing bolt and clip.
4) Remove the power steering pump fixing bolts pump to chassis frame side use the wire.



6A1-101-2.tif

11. Actuator Vacuum Hose (Exh. Brake Model)

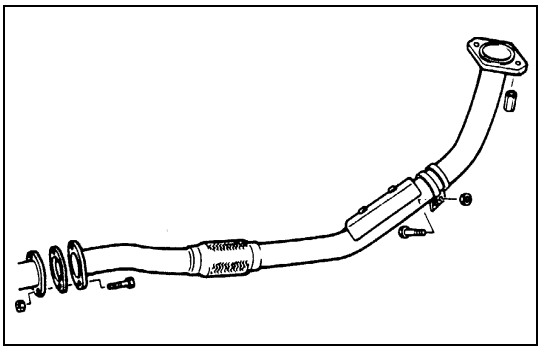
- Disconnect the vacuum hose from actuator side.



6A1-101-3.tif

12. Vacuum Pump Hose (Exh. Brake Model)

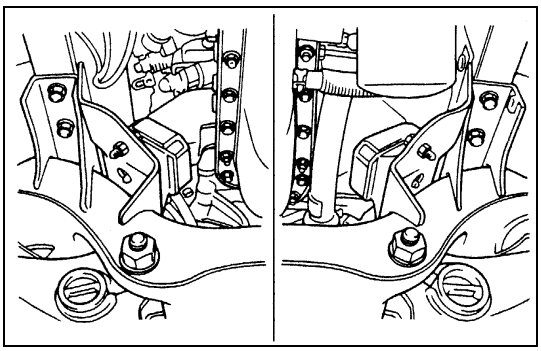
- Disconnect the vacuum hose from vacuum tank side and magnetic valve side.



6A1-101-4.tif

13. Front Exhaust Pipe

- Remove the exhaust pipe fixing bolts from exhaust manifold.
- Remove the exhaust pipe stay bolt.
- Remover the fixing nuts from front pipe.

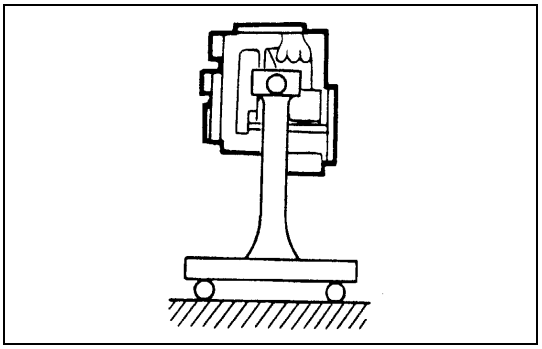


6A1-101-5.tif

14. Support Rubber

1) Right Hand

- Remove two fixing nuts at the crossmember side.



6A1-102-1.tif

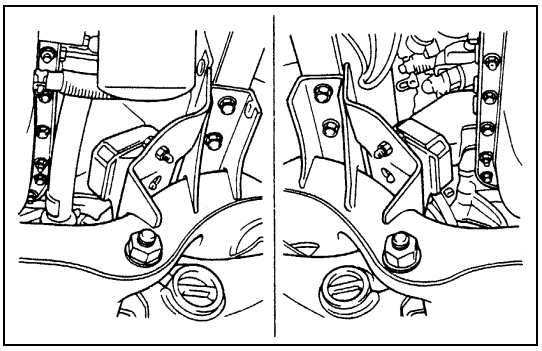
2) Left Hand

- Remove two fixing nuts at the crossmember side.

15. Engine Assembly

1) Lift engine carefully by using hoist.
2) Lift front part of engine higher than rear part of it.
3) Take out engine assembly taking care not to damage full pipes, brake pipes and etc.

INSTALLATION



6A1-103-1.tif

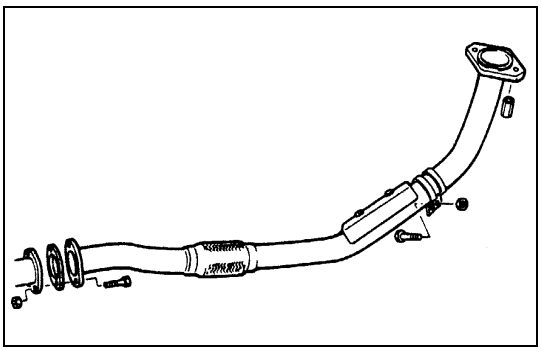
15. Engine Assembly

- Position engine mountings by using hoist.

14. Support Rubber

- After all fixing bolts (left:two bolts, right:two bolts) were inserted to every holes, and engine asm and tighten fixing bolts to the specified torque.

N·m (kg·m/lb·ft)
40 (4.1/30)



6A1-103-2.tif

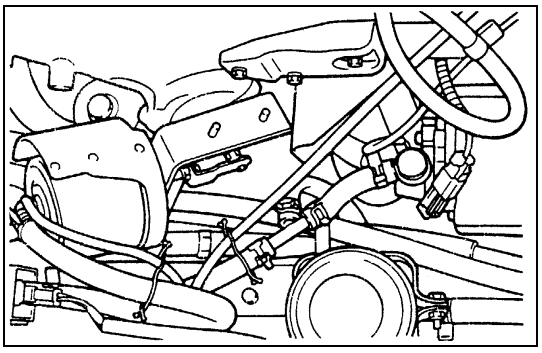
13. Front Exhaust Pipe

- Connect the exhaust pipe and tighten nut to the specified torque.

Exhaust Pipe Nut Torque	N·m (kg·m/lb·ft)
	69 (7.0/51)

- Install the exhaust pipe stay and tighten bolt nut to the specified torque.

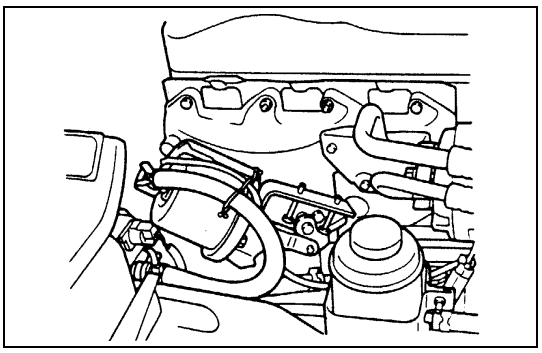
Stay Bolt Nut Torque	N·m (kg·m/lb·ft)
	40 (4.1/30)



6A1-103-3.tif

12. Vacuum Pump Hose (Exh. Brake Model)

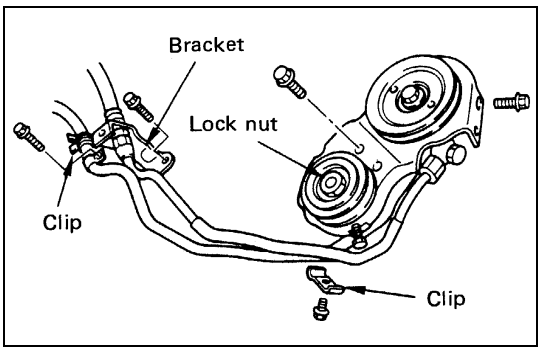
- Connect the vacuum hose to vacuum tank side and magnetic valve side.



6A1-103-4.tif

11. Actuator Vacuum Hose (Exh. Brake Model)

- Connect the vacuum hose to actuator.



6A1-104-1.tif

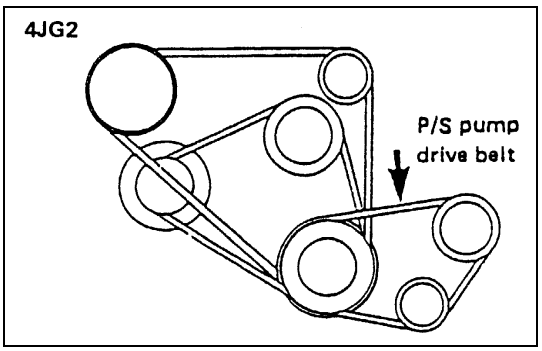
10. Power Steering Pump & Bracket Assembly (Power Steering Model)

- Install the power steering pump and pipe bracket then tighten bolts to the specified torque.

Pump Bolts Torque	N·m (kg·m/lb·ft)
19 (1.9/14)	

Pipe Bracket Bolts Torque	N·m (kg·m/lb·ft)
19 (1.9/14)	

Clip Bolt Torque	N·m (kg·m/lb·in)
10 (1.0/87)	

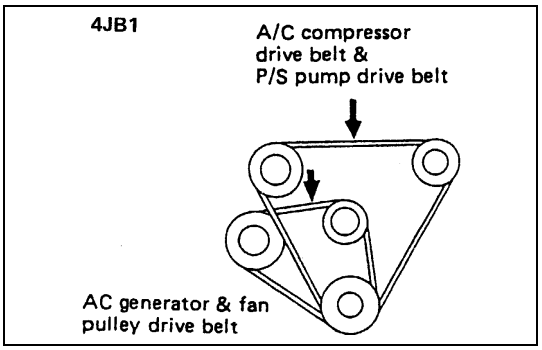


6A1-104-2.tif

- Install Power Steering pump drive belt and adjust belt tension.
  Check drive belts for wear or damage, and replace with new ones as necessary.
  Check belts for tension, and adjust as necessary.
- Push the middle of belts with a force of 10kg and check each bolt for deflection.
- Standard deflection

mm (in)

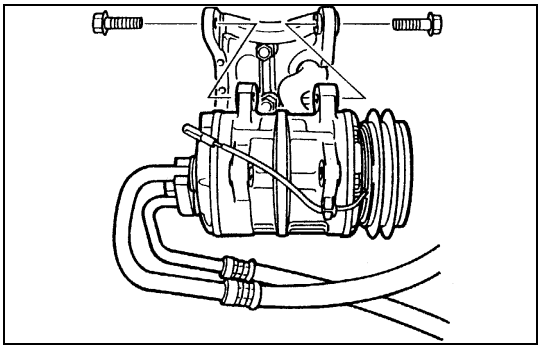
	Initial tension
P/S pump drive belt	8 - 12 (0.31 - 0.47)



6A1-104-3.tif

- P/S pump lock bolt loose, adjust belt tension with adjust belt.

Idler Lock Nut Torque	N·m (kg·m/lb·ft)
27 (2.8/20)	

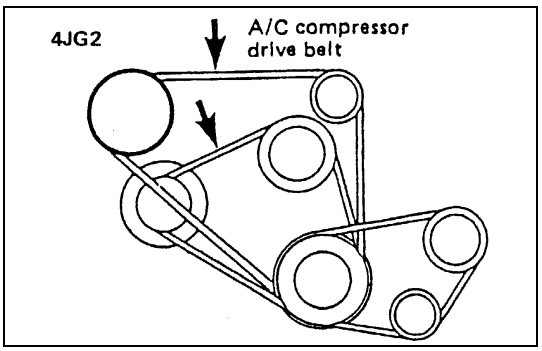

6A1-104-4.tif

9. A/C Compressor Assembly (A/C Model)

- Install the A/C compressor fixing bolts and tighten bolts to the specified torque.

Compressor Fixing Bolts Torque	N·m (kg·m/lb·ft)
37 (3.8/27)	

- Connect the magnetic clutch harness connector.



6A1-105-1.tif

- Install A/C compressor drive belt and adjust belt tension.

  Check drive belts for wear or damage, and replace with new ones as necessary. Check belts for tension, and adjust as necessary.
- Push the middle of belts with a force of 10kg and check each bolt for deflection.
- Standard deflection

mm (in)

	Initial tension
A/C compressor drive belt	8 - 12(0.31 - 0.47)

- A/C compressor pulley lock bolt loose, adjust belt tension with adjuster's adjust bolt.

Idler Lock Nut Torque	N·m (kg·m/lb·ft)
	27 (2.8/20)

8. Oil Pressure Switch Harness

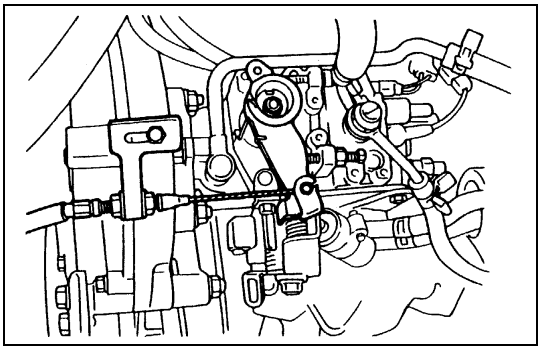
- Connect the oil pressure switch harness connector.

7. Fuel Hose

- Connect the fuel feed hose and return hose then tighten clip securely.

6. Glow Plug Harness

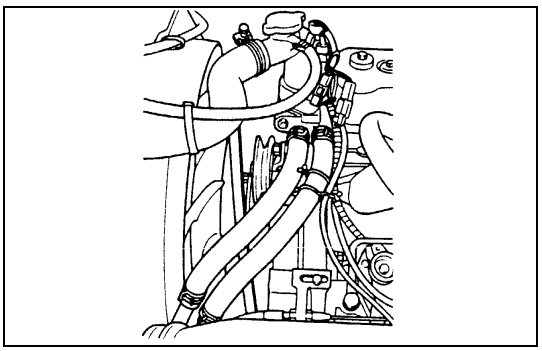
- Install the harness connector then tighten bolt securely.



6A1-105-2.tif

5. Engine Control Cable

1) Install the control wire to the engine control lever.
2) Hold accelerator lever in the fully closed position and stretch the control cable in the direction indicated by the arrow to remove any slack.
3) Tighten the accelerator cable bracket bolt.



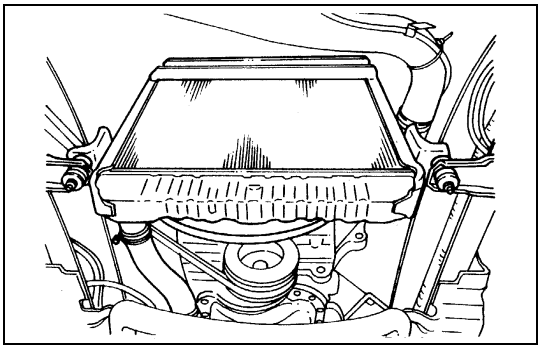
6A1-106-1.tif

4. Heater Hose

- Connect the heater hose then tighten clip securely.

3. Intake Air Duct

- Connect the air duct then tighten clip securely.



6A1-106-2.tif

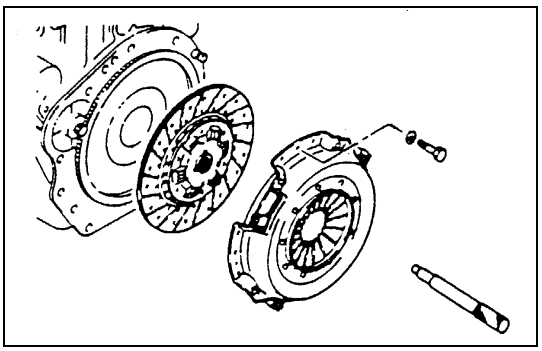
2. Radiator Assembly

1) Install the cushion rubber on both sides.
2) Install the radiator stay
3) Connect the radiator hose upper and lower.
4) Connect the reservoir tank hose.

1. Transmission and Clutch Assembly

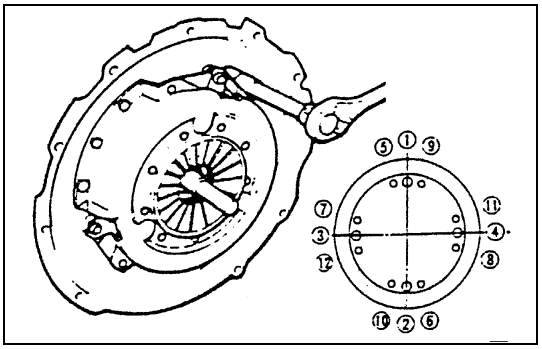
2) Clutch

② Driven Plate Assembly



6A1-106-3.tif

- Apply multi-purpose with MOS2 type grease to the driven plate hub spline.
- Use the pilot aligner to install the driven plate assembly.
  Pilot Aligner: 5-5825-3001-0



6A1-106-4.tif

① Pressure Plate Assembly

- Tighten pressure plate assembly fixing bolts in numerical order.

Pressure Plate Fixing Bolt Torque	N·m (kg·m/lb·ft)
	18 (1.8/13)

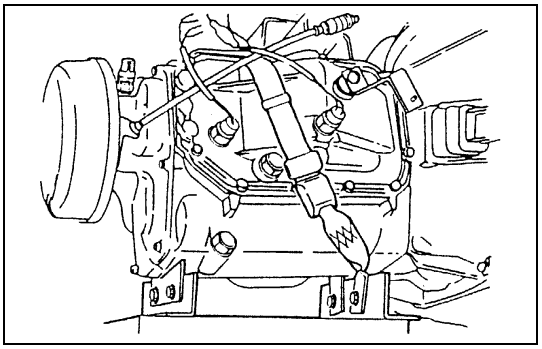
- Remove the pilot aligner.

NOTE:

In case a new pressure plate assembly is mounted, after tightening a pressure plate at the specified torque, be sure to remove the wiring for protection of a diaphragm spring.

1) Transmission
⑨ Mounting Bracket

Mounting Bracket Nuts Torque	N·m (kg·m/lb·ft)
	69 (7.0/51)



6A1-107-1.tif

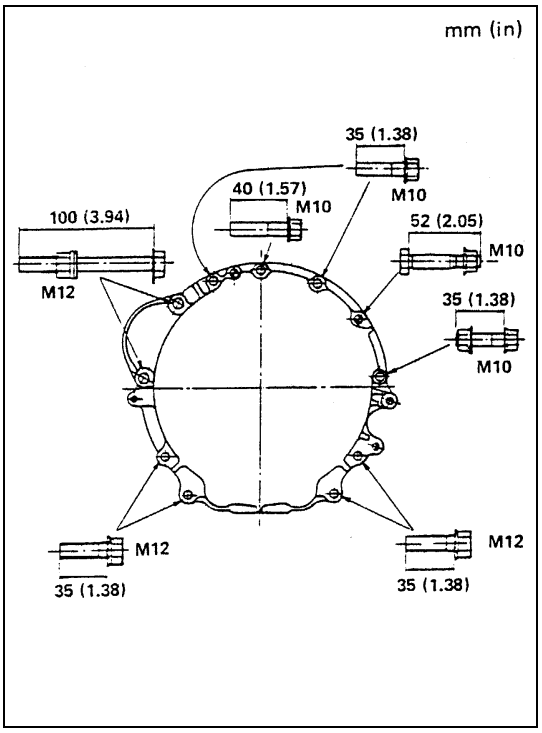
⑧ Transmission Assembly

- Support the transmission with mission jack.

CAUTION:

To prevent the falling of the transmission, tie it securely to the jack with a chain or belt.

- Shift transmission into high gear.
- Align transmission with engine slope.
- Turn output parking brake drum to aid clutch spring engagement.



6A1-107-2.tif

Clutch Housing to Flywheel Housing Bolts Torque	N·m (kg·m/lb·ft)
	M10 : 46(4.7/34) M12 : 91(9.3/67)

- Raise engine and transmission up into rear transmission mount.

Engine Rear Mounting Nuts and Bolts Torque	N·m (kg·m/lb·ft)
	M10 : 40(4.1/30) M12 : 69(7.0/51)

⑦ Front Exhaust Pipe

Front Exhaust Pipe Bolts Torque	N·m (kg·m/lb·ft)
37 (3.8/27)	

⑥ Exhaust Brake Assembly

Exhaust Brake Bolts Torque	N·m (kg·m/lb·ft)
1 7(1.8/12)	

⑤ Clutch Slave Cylinder

Slave Cylinder Bolts Torque	N·m (kg·m/lb·ft)
19 (1.9/14)	

- Perform slave cylinder adjustment before installation of the return spring.
  a) Loosen the lock nut of the push rod.
  b) Turn the adjust nut until it reaches the shift fork.
  c) Back off the adjust nut 1.5 turns. (shift fork free play Approximately 2 mm/0.1 in).
  d) Tighten the lock nut.

Push Rod Lock Nut Torque	N·m (kg·m/lb·ft)
16 (1.6/12)	

④ Shift Cable and Select Cable
③ Wiring Connector
- Color of Connector
  Back-up Light Switch: Brown
  Neutral Switch: Gray

② Parking Brake Cable
① Propeller Shaft
- Line up reference mark.

Propeller Shaft Nuts Torque	N·m (kg·m/lb·ft)
66 (6.7/48)	

- Connect the battery ground cable
- Pour coolant
- Start the engine and check coolant leakage

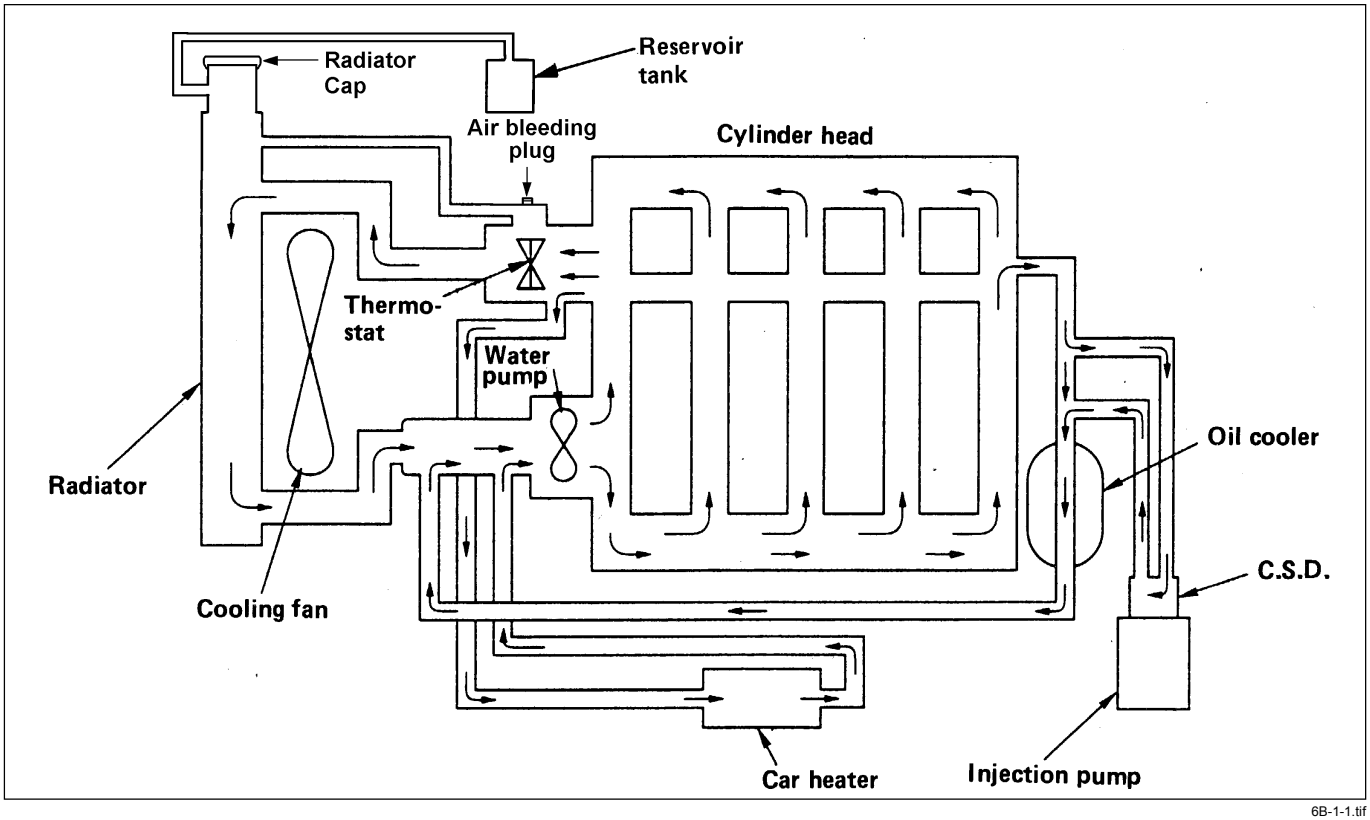
SECTION 6B
ENGINE COOLING

CONTENTS

PAGE

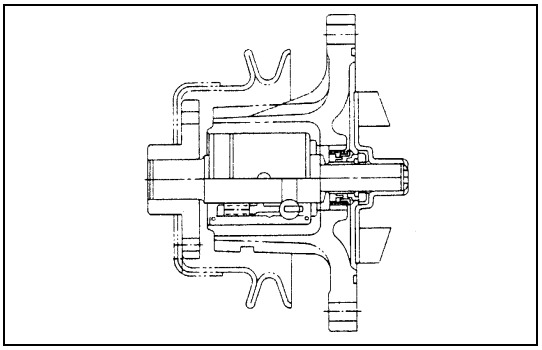
General Description ..... 6B - 1
On-Vehicle Service ..... 6B - 6
Water Pump ..... 6B - 6
Thermostat ..... 6B -10
Radiator ..... 6B -12
Drive Belt Adjustment ..... 6B -15

GENERAL DESCRIPTION



6B-1-1.tif

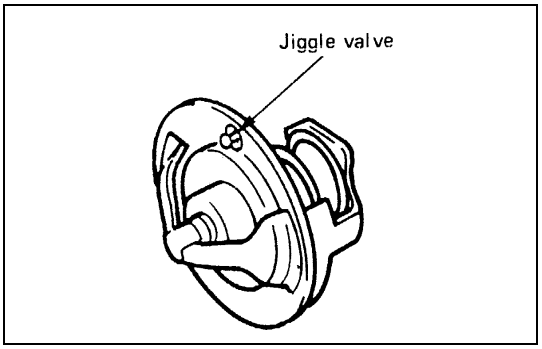
The cooling system is a pressurized coolant forced circulation type which consists of water pump, thermostat cooling fan, radiator and other components. The circulating coolant cools the lubricating oil in the oil filter and turbocharger.



6B-2-1.tif

WATER PUMP

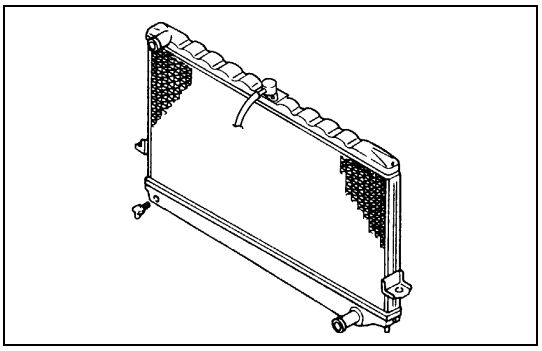
The coolant pump is a centrifugal impeller type and is driven by V type drive belt.
The water pump is not disassembled type.



6B-2-2.tif

THERMOSTAT

The thermostat is a wax pellet type with a juggle valve and is installed in the thermostat housing.



6B-2-3.tif

RADIATOR

The radiator is a tube type with corrugated fins. In order to raise the boiling point of coolant, the radiator is adjusted through a valve fitted to the upper tank to a pressure range of 93 - 123 kPa (0.95 - 1.25 kg/cm^2). The cap fitted to the cylinder head thermostat housing has only a water supply function.

Engine coolant change procedure

1. To change engine coolant, make sure that the engine is cool.

   WARNING:
   When the coolant is heated to a high temperature, be sure not to loosen or remove the radiator cap. Otherwise you might get scalded by hot vapor or boiling water. To open the radiator cap, put a piece of thick cloth on the cap and loosen the cap slowly to reduce the pressure when the coolant has become cooler.

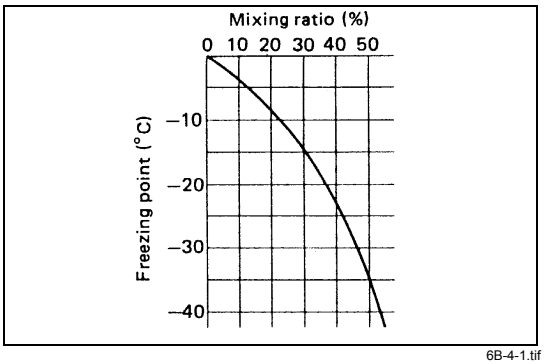
2. Open radiator cap and drain the cooling system by loosening the drain valve on the radiator and on the cylinder body.

   NOTE:
   For best result it is suggested that the engine cooling system be flushed at least once a year. It is advisable to flush the interior of the cooling system including the radiator before using anti-freeze (ethylene-glycol based).
   Replace damaged rubber hoses as the engine anti-freeze coolant is liable to leak out even minor cracks. Isuzu recommends to use Isuzu genuine anti-freeze (ethylene-glycol based) or equivalent, for the cooling system and not add any inhibitors or additives.

   CAUTION:
   A failure to correctly fill the engine cooling system in changing or topping up coolant may sometimes cause the coolant to overflow from the filler neck even before the engine and radiator are completely full.
   If the engine runs under this condition, shortage of coolant may possibly result in engine overheating. To avoid such trouble, the following precautions should be taken in filling the system.

3. To refill engine coolant, pour coolant up to filler neck using a filling hose which is smaller in outside diameter of the filler neck.
   Otherwise air between the filler neck and the filling hose will block entry, preventing the system from completely filling up.
4. Keep a filling rate of 9 liter/min. or less. Filling over this maximum rate may force air inside the engine and radiator. And also, the coolant overflow will increase, making it difficult to determine, whether or not the system is completely full.
5. After filling the system to the full, pull out the filling hose and check to see if air trapped in the system is dislodged and the coolant level goes down. Should the coolant level go down, repeat topping-up until there is no more drop in the coolant level.
6. After directly filling the radiator, fill the reservoir to the maximum level.

7. Install and tighten radiator cap and start the engine. After idling for 2 to 3 minutes, stop the engine and reopen radiator cap. If the water level is lower, replenish.
   WARNING:
   When the coolant is heated to a high temperature, be sure not to loosen or remove the radiator cap. Otherwise you might get scalded by hot vapor or boiling water. To open the radiator cap, put a piece of thick cloth on the cap and loosen the cap slowly to reduce the pressure when the coolant has become cooler.
8. After tightening radiator cap, warm up the engine at about 2,000 rpm.
   Set heater adjustment to the highest temperature position, and let the coolant circulate also into heater water system.
9. Check to see the thermostat has opened through the needle position of water thermometer, conduct a 5 minutes idling again and stop the engine.
10. When the engine has been cooled, check filler neck for water level and replenish if required. Should extreme shortage of coolant is found, check the coolant system and reservoir tank hose for leakage.
11. Fill the coolant into the reservoir tank up to “MAX” line.



6B-4-1.tif

ANTI-FREEZE SOLUTION

- Relation between Mixing ratio and Freezing point

  Freezing temperature of the engine coolant varies with the ratio of anti-freeze solution in water.

  Proper mixing ratio can be determined by referring to the chart. Supplemental inhibitors or additives claiming to increase cooling capability that have not been specifically approved by Isuzu are not recommended for addition to the cooling system.

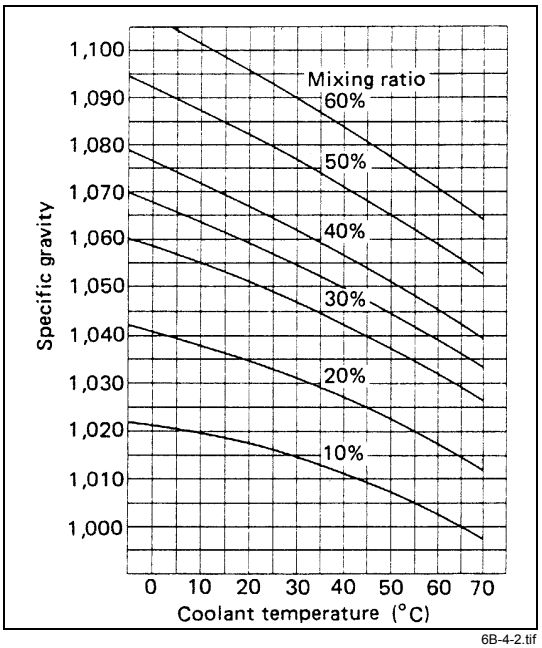
- Calculation of mixing ratio

$$\text{Mixing ratio} = \frac{\text{Anti-freeze solution (Lit/qt.)}}{\text{Anti-freeze solution (Lit/qt.)} + \text{Water (Lit/qt.)}}$$

Note: Anti-freeze solution + Water = 10 lit
Total cooling system capacity.

In case of 6.8 lit total cooling system capacity

Mixing ratio (%)	Anti-freeze solution: lit. (imp. qt./U.S. qt)	Water: lit. (imp. qt/U.S. qt)
0	0 0	10 (8.80/10.57)
5	0.5 (0.44/0.53)	9.5 (8.36/10.04)
10	1.0 (0.88/1.06)	9.0 (7.92/9.51)
15	1.5 (1.32/1.59)	8.5 (7.48/8.98)
20	2.0 (1.76/2.11)	8.0 (7.04/8.45)
25	2.5 (2.20/2.64)	7.5 (6.60/7.93)
30	3.0 (2.64/3.17)	7.0 (6.16/7.40)
35	3.5 (3.08/3.70)	6.5 (5.72/6.87)
40	4.0 (3.52/4.23)	6.0 (5.28/6.34)
45	4.5 (3.96/4.76)	5.5 (4.84/5.81)
50	5.0 (4.40/5.28)	5.0 (4.40/5.28)



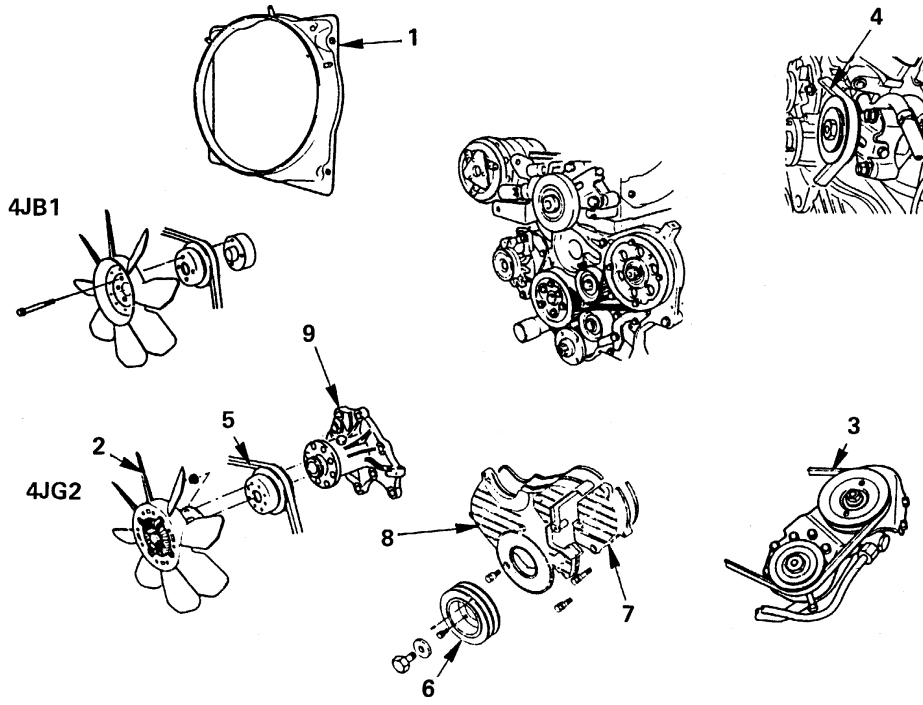
6B-4-2.tif

- Mixing ratio

  Check the specific gravity of engine coolant in the cooling system in temperature ranges from 0° to 50°C using a suction type hydrometer, then determine the mixing ratio of the coolant by referring to the table at left.

ON-VEHICLE SERVICE

WATER PUMP



Removal steps
1. Fan shoroud
2. Cooling fan Assembly
3. Power steering pump drive belt
4. A/C compressor drive belt
5. AC generator drive belt
6. Crankshaft damper pulley
7. Timing pulley upper cover
8. Timing pulley lower cover
9. Water pump Assembly

Installation steps
To install, follow the removal steps in the reverse order.

6B-5-1.tif

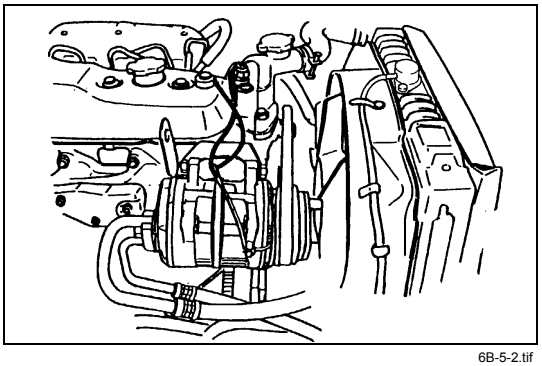
REMOVAL

Preparation:
- Disconnect battery ground cable.
- Drain coolant

1. Fan Shroud
- Remove the reservoir tank hose, bypass hose and fan guide.

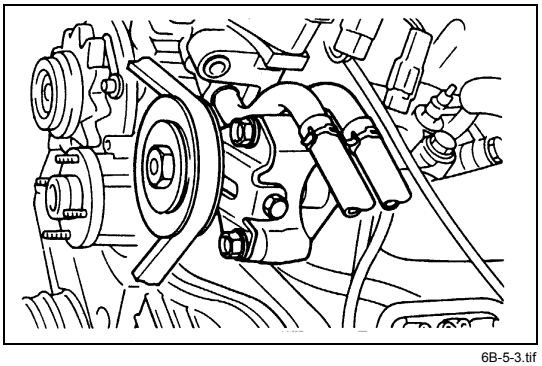
2. Cooling Fan Assembly
- Remove lock nut and take out cooling fan assembly.

3. Power Steering Pump Drive Belt
- Loosen the idler pulley lock nut and loosen adjust bolt, and remove the drive belt.

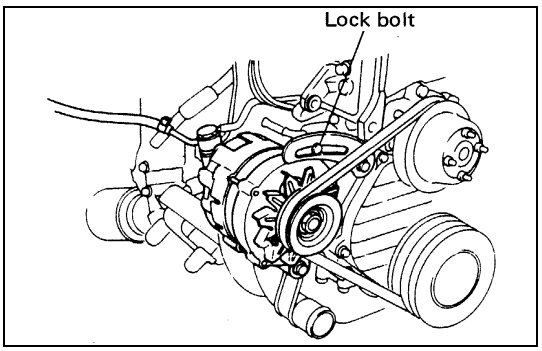


6B-5-2.tif

4. A/C Compressor Drive Belt
- Loosen A/C compressor idler pulley lock nut and adjust bolt and remove the drive belt.



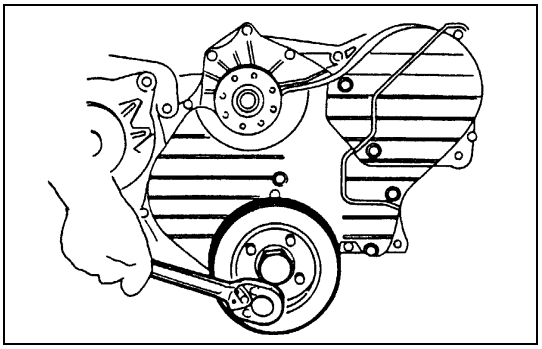
6B-5-3.tif



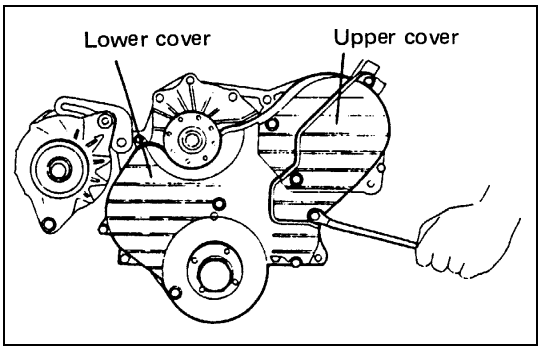
6B-6-1.tif

5. AC Generator Drive Belt

- Loosen AC Generator mounting bolt (under side) and adjust plate lock bolt, and remove the drive belt.


6B-6-2.tif

6. Crankshaft Damper Pulley



6B-6-3.tif

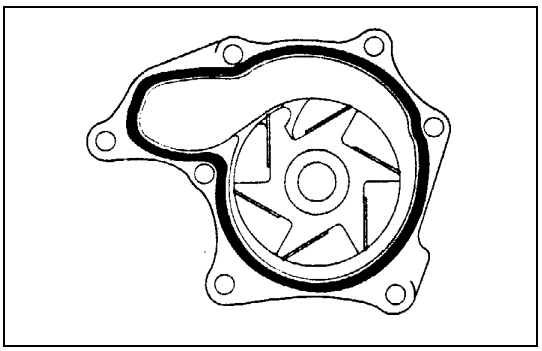
7. Timing Pulley Upper Cover
8. Timing Pulley Lower Cover
9. Water Pump Assembly

- Remove the O-ring

INSPECTION

Make necessary parts replacement if extreme wear or damage is found during inspection. Should any of the following problems occur, the entire water pump assembly must be replaced.

- Cracks in the coolant pump body
- Coolant leakage from the seal unit
- Play or abnormal noise in the bearing
- Cracks or corrosion in the impeller



6B-7-1.tif

INSTALLATION

9. Water Pump Assembly

- Set O-ring in water pump body groove.
- Install water pump assembly, and tighten to specified torque.

Pump Fixing Bolt Torque	N·m (Kg·m/lb·ft)
20 (2.0/14)	

8. Timing Pulley Lower Cover

- Install timing pulley lower cover, and tighten to specified torque.

Cover Fixing Bolts Torque	N·m (Kg·m/lb·in)
8 (0.8/69)	

7. Timing Pulley Upper Cover

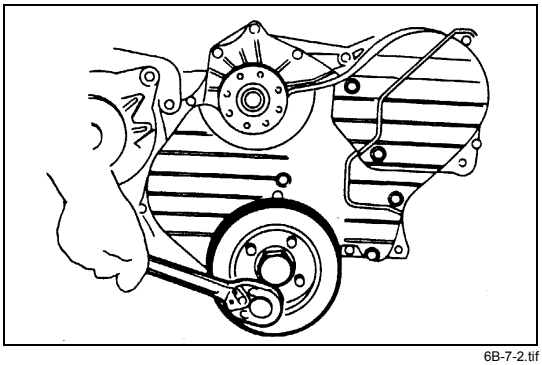
- Install timing upper cover, and tighten to specified torque.

Cover Fixing Bolts Torque	N·m (Kg·m/lb·in)
8 (0.8/69)	

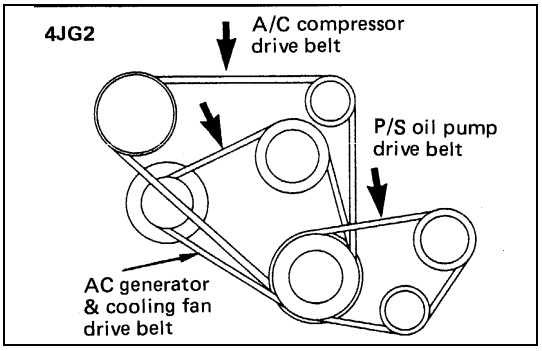
6. Crankshaft Damper Pulley

- Install crankshaft damper pulley, and tighten to specified torque.

Pulley Bolt Torque	N·m (Kg·m/lb·in)
19 (1.9/14)	



6B-7-2.tif



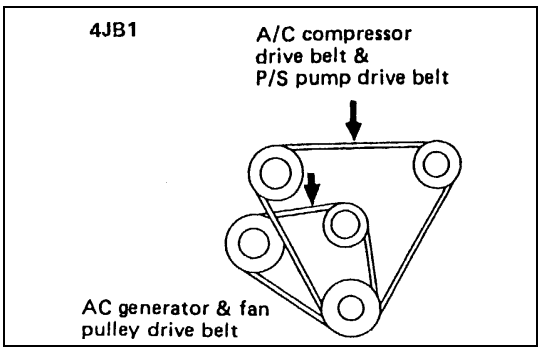
6B-7-3.tif

5. AC Generator Drive Belt
4. A/C Compressor Drive Belt
3. Power Steering Pump Drive Belt

- Install the drive belts and adjust belt
  Check drive belts for wear or damage, and replace with new ones as necessary. Check belts for tension, and adjust as necessary.
- Push the middle of belts with a force of 98 N (10 kg/22 lb) and check each bolt for deflection.
- Standard deflection

mm (in)

	Initial tension
AC Generator drive belt A/C compressor drive belt Power Steering drive belt	8 – 12 (0.31-0.47)



6B-8-1.tif

Generator Fixing Belt Torque	N·m (Kg·m/lb·ft)
40 (4.1/30)	

Adjust Plate Fixing Belt Torque	N·m (Kg·m/lb·ft)
19 (1.9/14)	

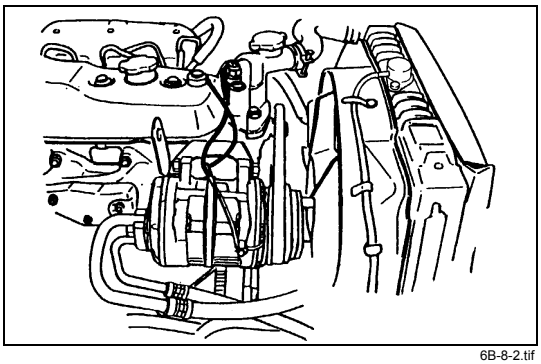
A/C Idler Pulley Lock Nut Torque	N·m (Kg·m/lb·ft)
27 (2.8/20)	

P/S Idler Pulley Lock Nut Torque	N·m (Kg·m/lb·ft)
27 (2.8/20)	

2. Cooling Fan Assembly

- Mount fan pulley and cooling fan assembly on the water pump and tighten to the specified torque.

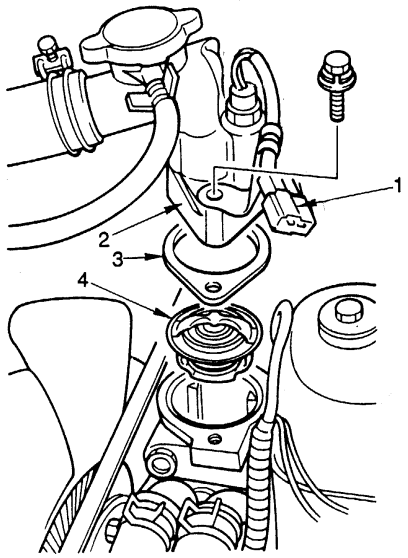
Fan Pulley Nut Torque	N·m (Kg·m/lb·in)
8 (0.8/69)	


6B-8-2.tif

1. Fan Shroud

- Install the fan shroud and reservoir tank hose and bypass hose.
- Connect the battery ground cable.
- Pour coolant.
- Start the engine and check coolant leakage.

THERMOSTAT



Removal steps
1. Switch harness
2. Outlet pipe
3. Gasket
4. Thermostat

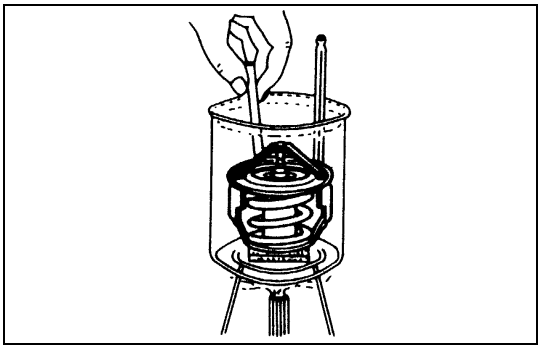
Installation steps
To install, follow the removal steps in the reverse order.

6B-9-1.tif

REMOVAL

Preparation:
- Disconnect battery ground cable.
- Drain coolant from the radiator and engine.

1. **Switch Harness**
2. **Outlet Pipe**
   - Remove mounting bolt and remove outlet pipe together with radiator hose.
3. **Gasket**
4. **Thermostat**



6B-9-2.tif

INSPECTION

Submerge the thermostat assembly in the water.
Place wooden blocks on the bottom of the water container.
Not to directly heat the thermostat.
Gradually increase the water temperature. Stir the water so that the entire water is same temperature.

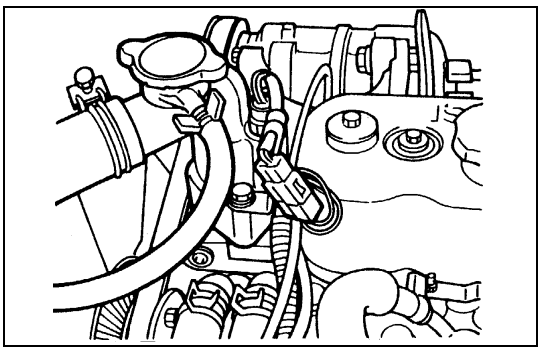
- Make sure that primary valve begins to open at the specified temperature.

Valve Opening Temperature	°C (°F)
82 (180)	

- Make sure that secondary valve opens fully at the specified temperature.

Valve Full Open Temperature	°C (°F)
95 (203)	

Make necessary repair and parts replacement if extreme wear or damage is found during inspection.


6B-10-1.tif

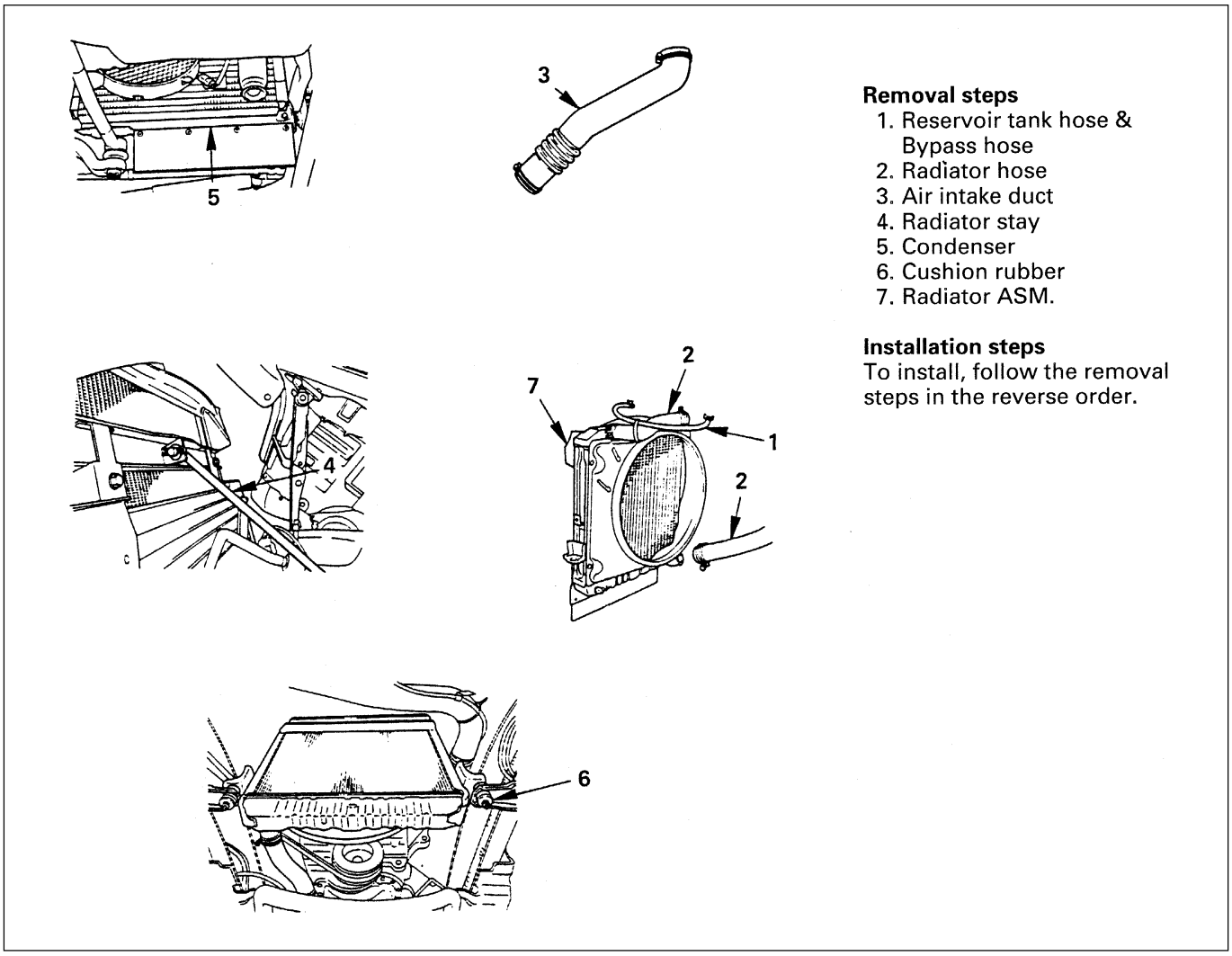
INSTALLATION

4. **Thermostat**
3. **Gasket**
2. **Outlet Pipe**
   - Connect outlet pipe and tighten bolts to the specified torque.

N·m (Kg·m/lb·ft)
19 (1.9/14)

1. **Switch Harness**
   - Install switch harness.
   - Install battery ground cable.
   - Pour coolant.
   - Start the engine and check coolant leakage.

RADIATOR



Removal steps
1. Reservoir tank hose & Bypass hose
2. Radiator hose
3. Air intake duct
4. Radiator stay
5. Condenser
6. Cushion rubber
7. Radiator ASM.

Installation steps
To install, follow the removal steps in the reverse order.

6B-11-1.tif

REMOVAL

Preparation:
- Disconnect battery ground cable.
- Loosen drain plug to drain coolant.

1. **Reservoir Tank Hose & Bypass Hose**
   - Disconnect the hose from radiator.
2. **Radiator Hose**
   - Disconnect lower hose and upper hose from the engine.
3. **Air Intake Duct**
4. **Radiator Stay**
5. **Condenser**
   - Remove the condenser from radiator and temporarily tighten the condenser to cab body front side, use the wire.
6. **Cushion Rubber**
   - Remove cushion rubbers on both sides of the bottom.

7. Radiator Assembly

- Remove upward the radiator assembly with hose, taking care not to damage the radiator core by fan blade.

INSPECTION

Radiator Valve

- Apply air pressure from filler neck using radiator cap tester and check the opening pressure of radiator valve. If the valve opening pressure is out of the standard value range, replace with a new radiator valve.

Radiator valve opening pressure	kPa (kg/cm^2/psi)
	93 - 123 (0.95 - 1.25/13.5 - 17.8)

- Remove the radiator valve and check a negative pressure valve as the center of the valve seat side. If the negative pressure valve does not work smoothly, clean or replace the radiator valve.

Radiator valve fixing torque	N·m (kg·m/lb ft)
	6 (0.6/4)

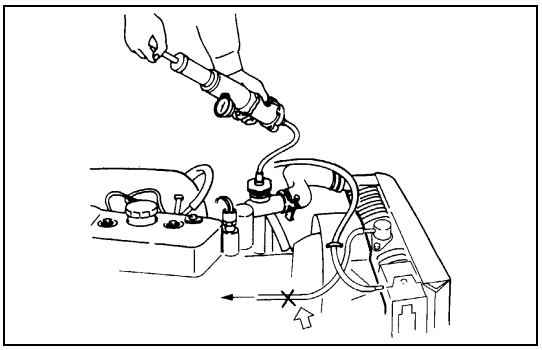
- Conduct cooling system leakage check after reinstalling the radiator valve.

Radiator Core

- Deformed radiator fins could reduce radiation effects, resulting in overheat. Straighten the fins. In such a case, take care not to damage the fin roots.
- Remove dust and other foreign materials.

Flushing the Radiator

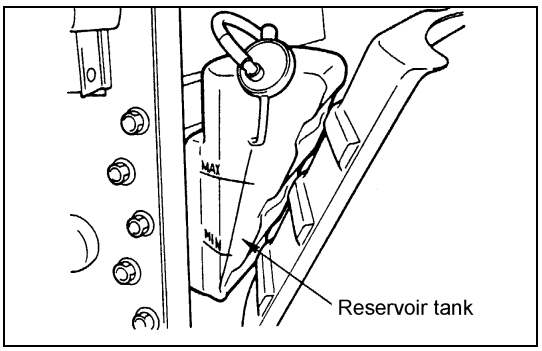
- Wash the inside of radiator and the coolant passage with water and neutral detergent. Remove all scales and rust.



6B-12-1.tif

Checking for Coolant Leakage

- Clog up the reserver tank hose carefully and check the cooling system for leakage with a radiator cap tester by applying an air pressure of 147 kPa (1.5 kg/cm^2/21 psi) from filler neck to inside the radiator.
- As the radiator upper tank is provided with a valve, the pressure fails to rise higher than the valve opening pressure unless the hose is clogged up.

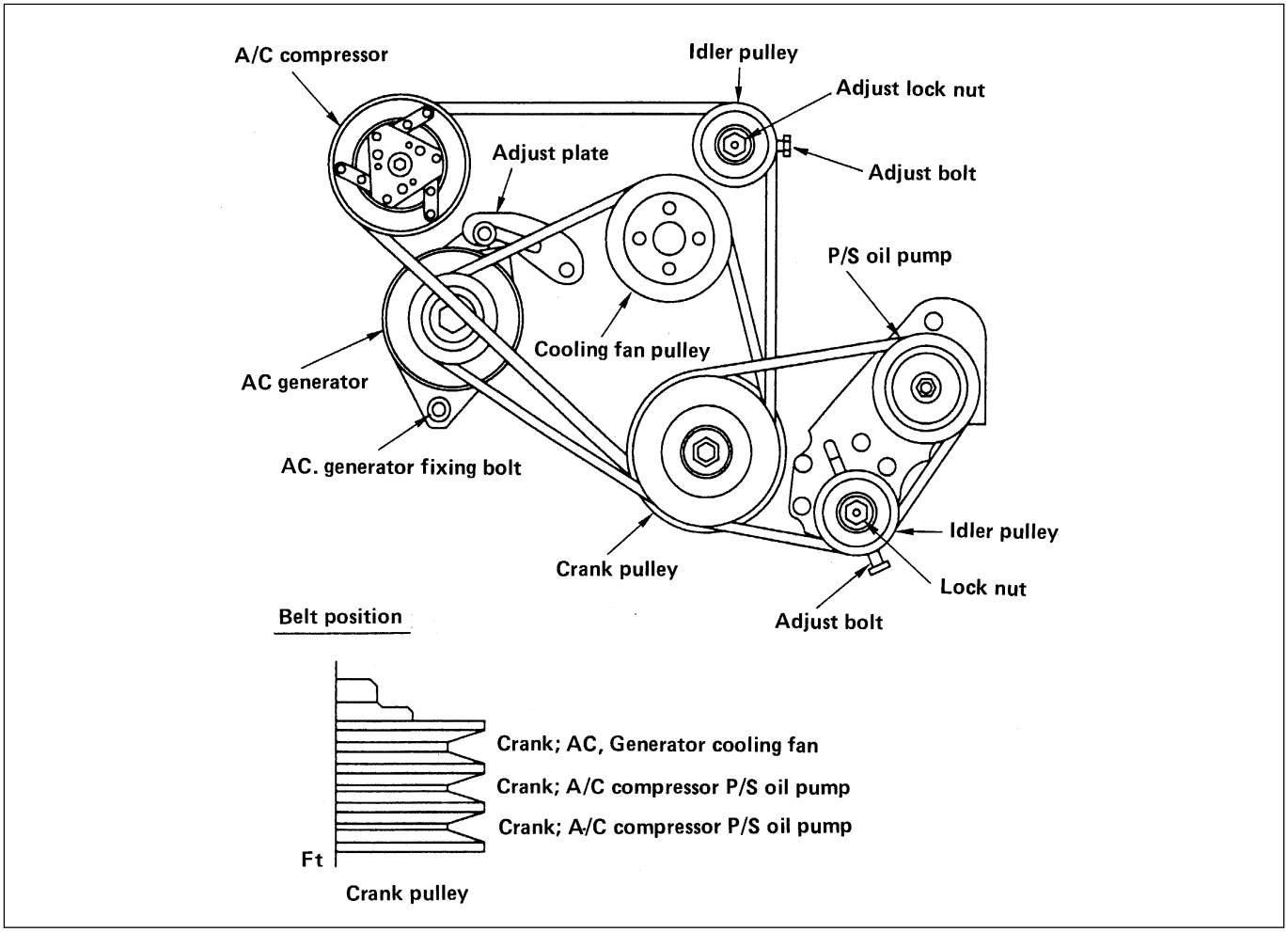


6B-13-1.tif

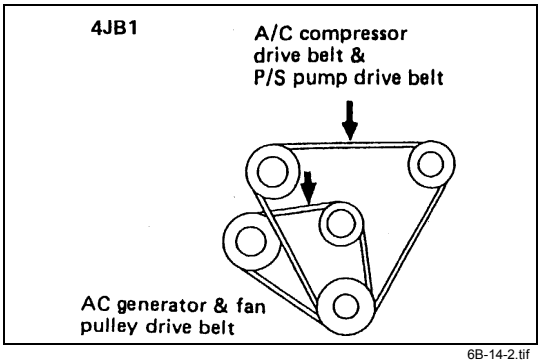
INSTALLATION

7. **Radiator Assembly**
   - Install the radiator
6. **Cushion Rubber**
   - Install cushion rubbers on both sides of radiator bottom.
   - Install radiator assembly with hose, taking care not to damage the radiator core by a fan blade.
5. **Condenser**
4. **Radiator Stay**
3. **Air Intake Duct**
   - Connect the Duct and tighten clip securely.
2. **Radiator Hose**
   - Connect inlet hose and outlet hose to the engine.
   - Connect battery ground cable.
   - Pour coolant
   - Pour coolant up to filler neck of radiator, and up to MAX mark of reservoir tank.
1. **Reservoir Tank Hose & Bypass Hose**
   - Start engine to warm up, and check for coolant level.

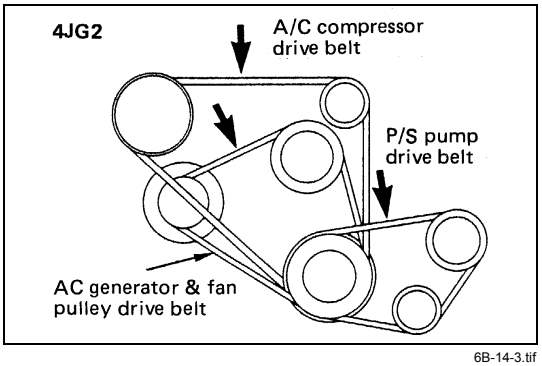
DRIVE BELT ADJUSTMENT



6B-14-1.tif



6B-14-2.tif



6B-14-3.tif

INSPECTION

Check drive belts for wear or damage, and replace with new ones as necessary. Check belts for tension, and adjust as necessary.

- Check drive belts tension.
- Push the middle of belts with a force of 98 N (10 kg/22 lb) and check each bolt for deflection.
- Standard deflection

mm (in)

	Tension at readjustment
AC generator & fan pulley drive belt A/C compressor drive belt P/S pump drive belt	8 ~ 12 (0.31 ~ 0.47)

TENSION ADJUSTMENT

1. Cooling Fan Pulley Belt

- With AC Generator mounting and lock bolts loose, adjust belt tension with adjuster's adjust bolt.

  Tighten bolt to the specified torque

Generator Fixing Bolt Torque	N·m (Kg·m/lb·ft)
40 (4.1/30)	

Adjust Plate Fixing Bolt Torque	N·m (Kg·m/lb·ft)
19 (1.9/14)	

2. P/S Oil Pump and A/C Compressor Pulley Belt

- With P/S pump lock bolt loose, adjust belt tension with adjust belt.

  Tighten lock nut to the specified torque.

Lock Nut Torque	N·m (Kg·m/lb·ft)
27 (2.8/20)	

SECTION 6C
ENGINE FUEL

CONTENTS

PAGE

General Description ..... 6C - 2
On-Vehicle Service ..... 6C - 7
- Fuel Filter Assembly ..... 6C - 7
- Fuel Filter Cartrige ..... 6C - 8
- Injection nozzle ..... 6C - 9
- Injection Pump Assembly (Gear Drive Type) ..... 6C - 26
- Injection Pump Assembly (Belt Drive Type) ..... 6C - 31
- Injection Timing Adjustment ..... 6C - 41
- Adjustment of Idling Speed ..... 6C - 42
- Injection Pump Data ..... 6C - 43
- Injection Volume and Governor Performance Diagram ..... 6C - 45
- Fuel Tank ..... 6C - 55
- Fuel Gauge Unit ..... 6C - 57

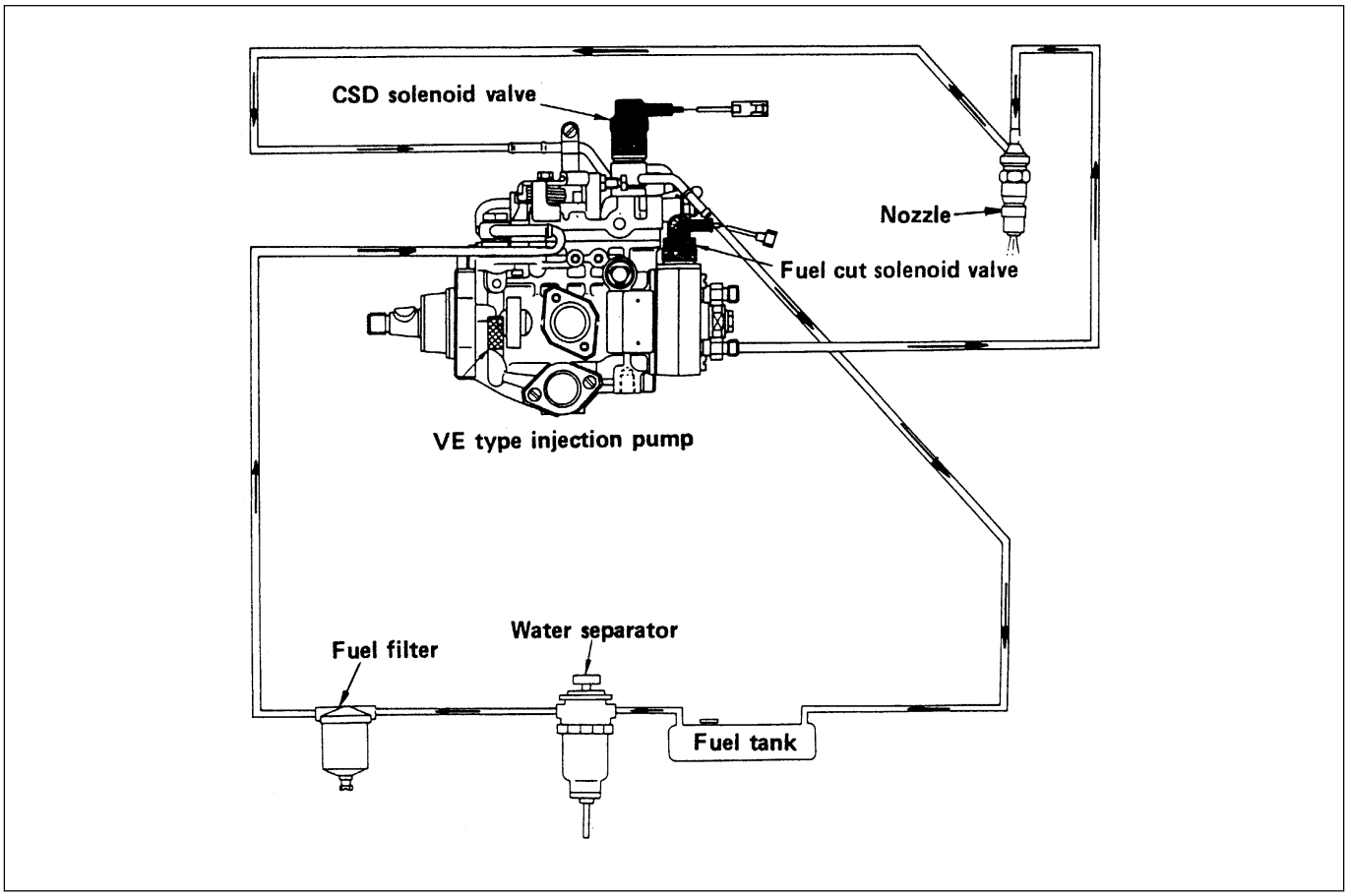
Accelerator Control ..... 6C - 58
- Accelerator Control Cable ..... 6C - 58
- Accelerator Pedal ..... 6C - 60
- Idling Control Cable ..... 6C - 62
- Air Cleaner Element ..... 6C - 64

GENERAL DESCRIPTION

When working on the fuel system, there are several things to keep in mind:

- Any time the fuel system is being worked on, disconnect the negative battery cable except for those tests where battery voltage is required.
- Always keep a dry chemical (Class B) fire extinguisher near the work area.
- Replace all pipes with the same pipe and fittings that were removed. Clean and inspect "O" rings. Replace where required.
- Always relieve the line pressure before servicing any fuel system components.
- Do not attempt repairs on the fuel system until you have read the instructions and checked the pictures relating to that repairs.

FUEL FLOW



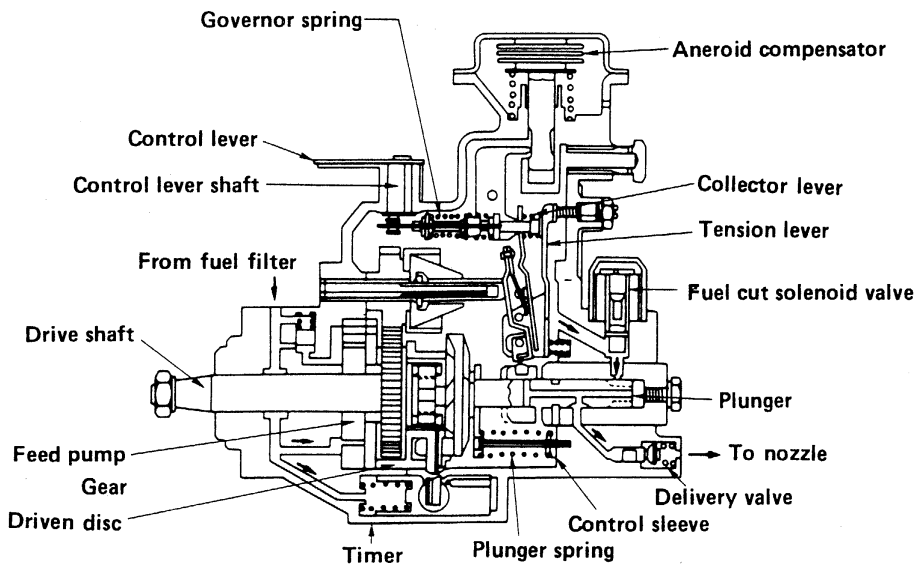
6C-2-1.tif

The fuel system consists of the fuel tank, the water separator, the fuel filter, the injection pump, and the injection nozzle.

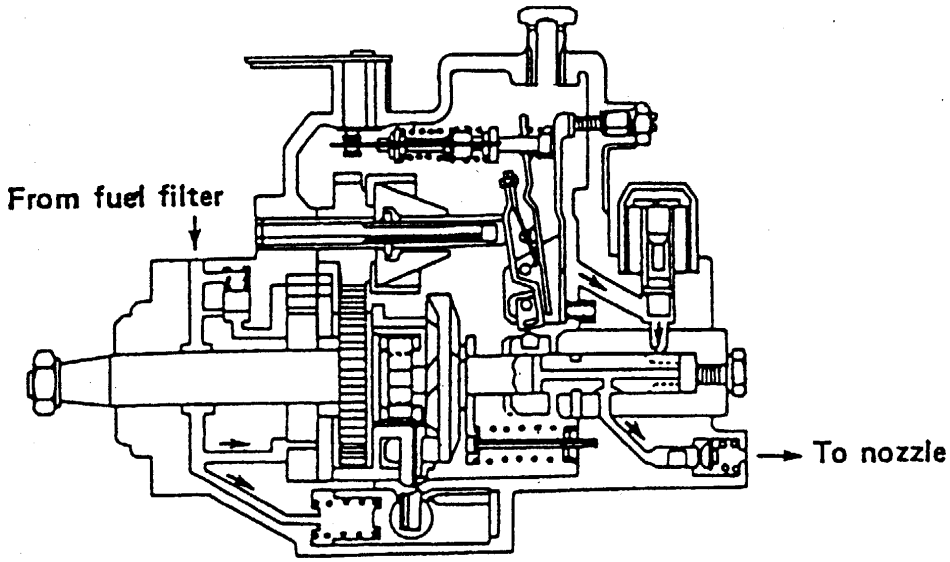
The fuel from the fuel tank passes through the water separator and the fuel filter where water particles and other foreign material are removed from the fuel.

Fuel, fed by the injection pump plunger, is delivered to the injection nozzle in the measured volume at the optimum timing for efficient engine operation.

INJECTION PUMP



6C-3-1.tif



6C-3-2.tif

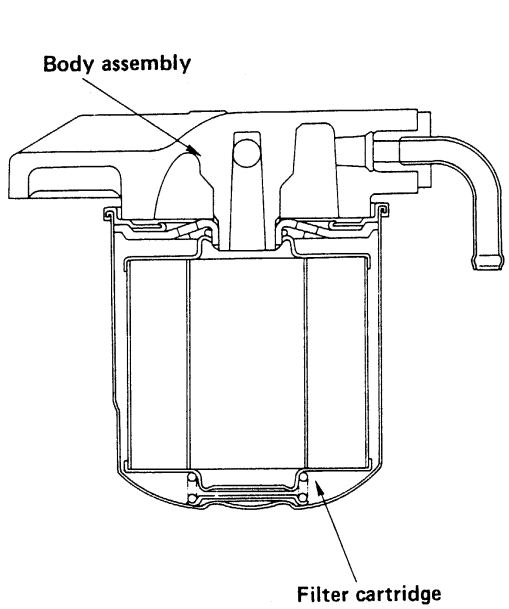
A Bosch Distributor Type Injection Pump is used. A single reciprocating/revolving plunger delivers the fuel uniformly to the injection nozzles, regardless of the number of cylinders.

The governor, the injection timer, and the feed pump are all contained in the injection pump housing.

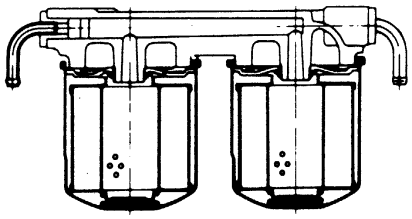
The injection pump is compact, light weight, and provides reliable high-speed operation.

An aneroid compensator is available as an option for vehicles to be operated at high altitudes. It adjusts the fuel and air mixing ratio.

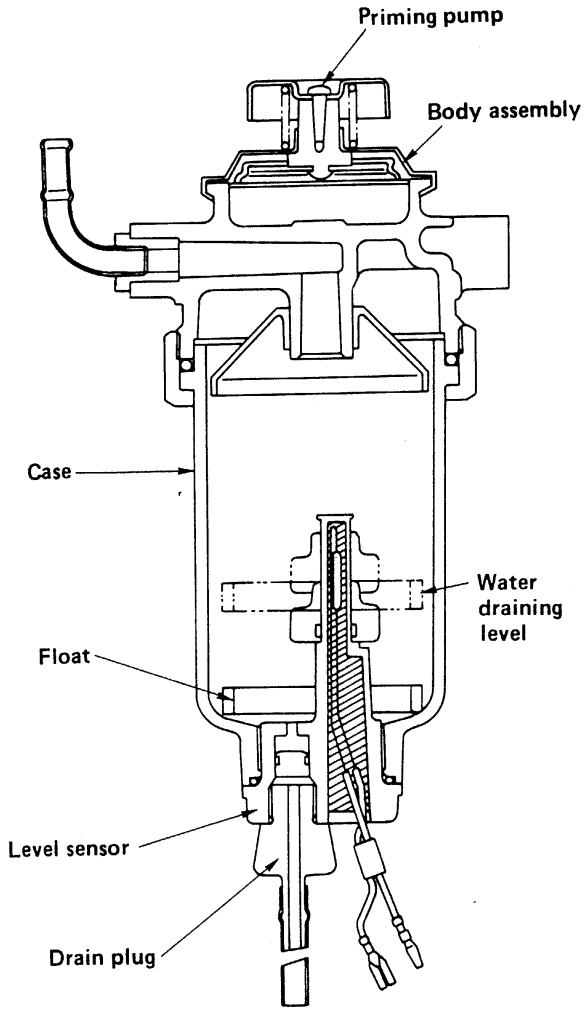
FUEL FILTER AND WATER SEPARATOR



Dual type



6C-4-1.tif



6C-4-2.tif

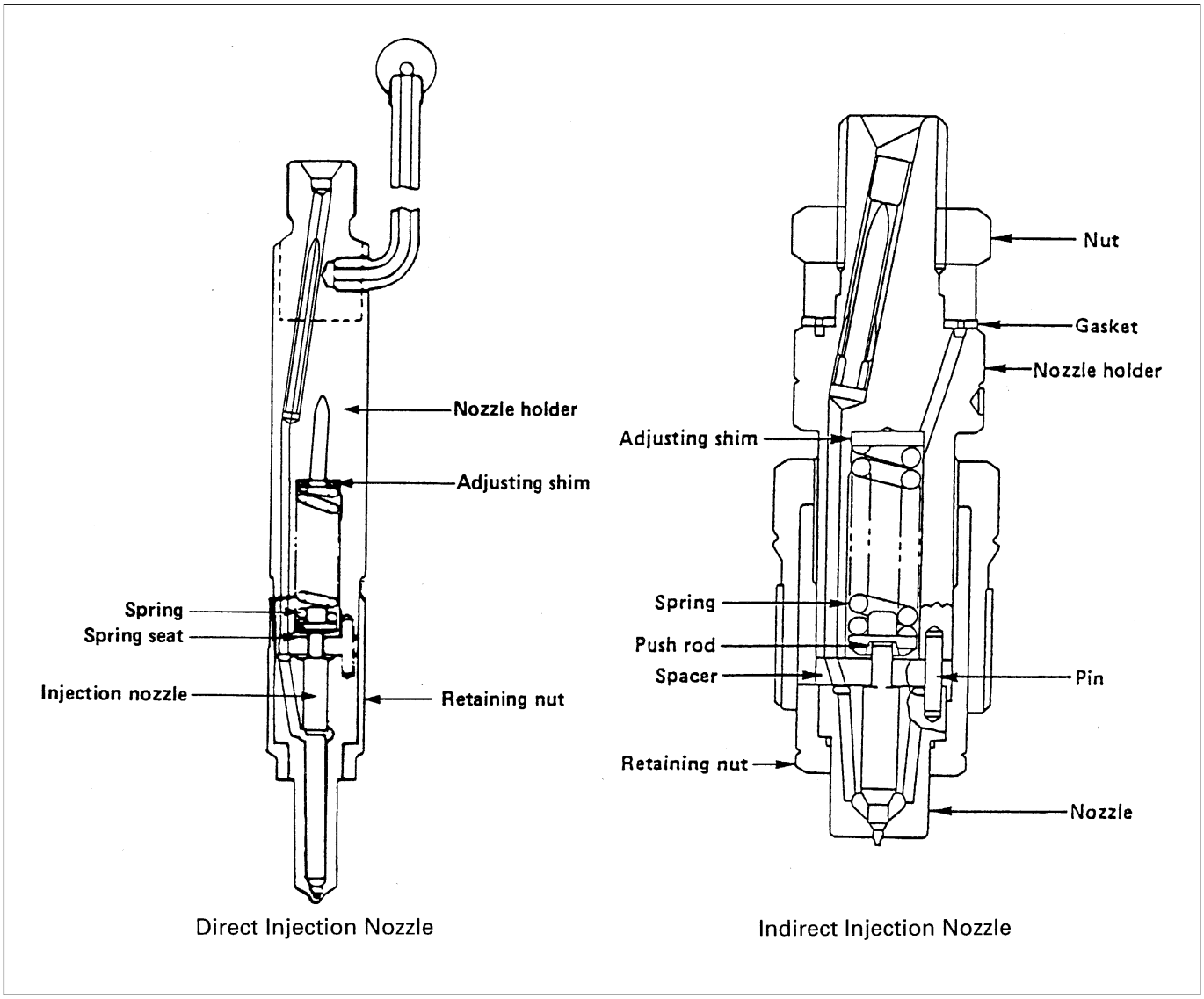
A cartridge type fuel filter and a water separator are used along with the VE type injection pump.

As the inside of the injection pump is lubricated by the fuel which it is pumping, the fuel must be perfectly clean. The fuel filter and the water separator remove water particles and other foreign material from the fuel before it reaches the injection pump.

The water separator has an internal float. When the float reaches the specified level, a warning light comes on to remind you to drain the water from the water separator.

A diaphragm type priming pump is installed at the top of the water separator. It is used during the water draining and the air bleeding procedures.

INJECTION NOZZLE



6C-5-1.tif

For 4J Series diesel engines, there are two types available: Direct injection engine (4JB1/4JB1T) and Indirect injection engine (4JG2). Accordingly, the injection nozzles to be used are different depending on the type of the engine and the combustion chamber.

The injection nozzle sprays pressurized fuel from the injection pump into the combustion chamber through the injection nozzle orifices.

4JB1 engines employ a hole type nozzle with four injection orifices. The nozzle is made up of the nozzle body and the needle valve assembly.

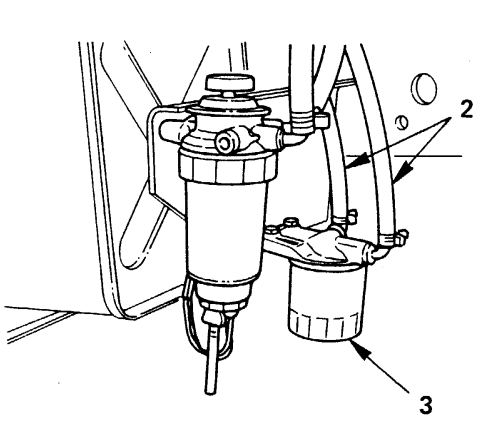
Pressurized fuel from the injection pump is sprayed by the injection nozzle into the combustion chamber through the nozzle body orifices.

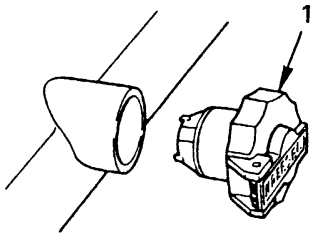
4JB1-TC Engine

The two-spring nozzle holder has been developed to reduce NOx (Nitrogen Oxides) and particulates from direct injection diesel engine exhaust.

ON-VEHICLE SERVICE

FUEL FILTER ASSEMBLY





Removal steps
1. Fuel filler cap
2. Fuel hose
3. Fuel filter assembly

Installation steps
To install, follow the removal steps in the reverse order.

6C-6-1.tif

REMOVAL

Preparation
- Disconnect battery ground cable.

1. Fuel Filler Cap

2. Fuel Hose
- Disconnect fuel hose from filter body.
  Plug the hose ends to prevent fuel spillage.

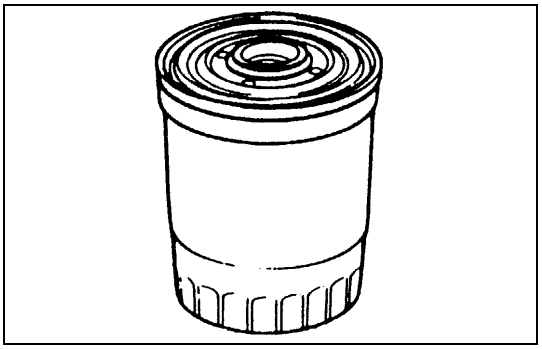
3. Fuel Filter Assembly
- Remove the fixing bolts on fuel filter bracket.

INSTALLATION

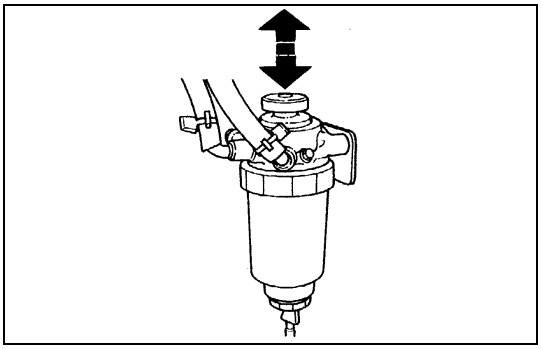
3. Fuel Filter Assembly
- Install the fuel filter bracket then tighten fixing bolt.

2. Fuel Hose
- Connect hoses to filter body.

1. Fuel Filler Cap
- Connect the battery ground cable.
- Feed fuel to the injection pump by means of the priming, and bleed the fuel system.



6C-7-1.tif



6C-7-2.tif

FUEL FILTER CARTRIDGE

REMOVAL

- Remove the cartridge using a filter wrench.
  Filter wrench: 5-8840-0253-0 (J-22700)

INSTALLATION

- Clean the cartridge mounting surface of filter body so that the cartridge can be securely.
  Apply engine oil thinly to new cartridge O-ring.
- To facilitate bleeding, fill the new cartridge with light oil.
- Tighten the cartridge until O-ring comes in contact with the sealing, taking care not to spill the light oil.
- Retighten 1/3~ 2/3 using a filter wrench.
  Filter wrench: 5-8840-0253-0 (J-22700)

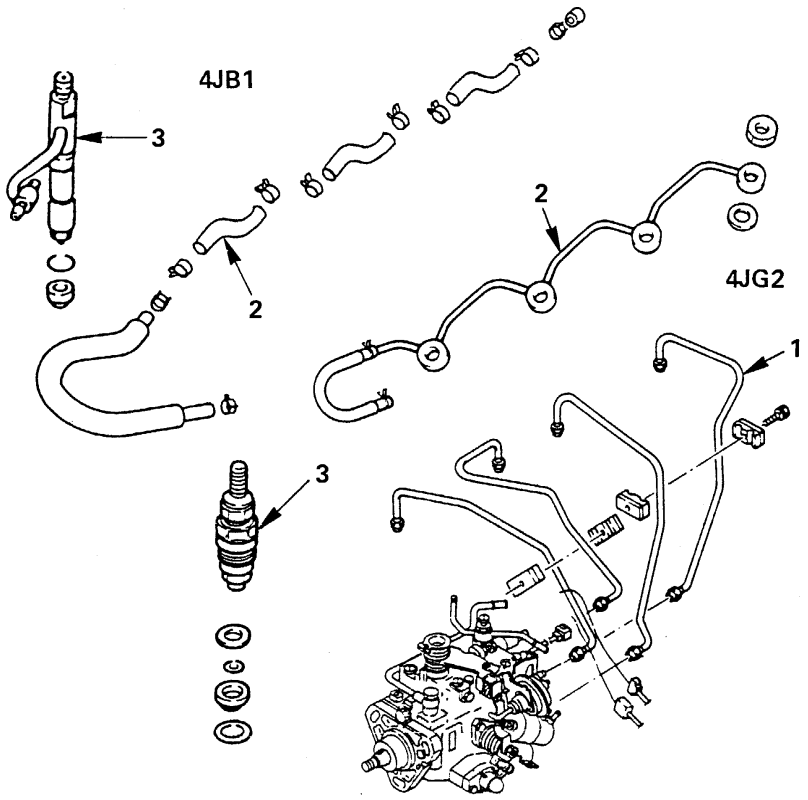
Bleeding

- Operate priming pump to send the air in the fuel system to the injection pump.
- Loosen injection pump bleeding plug, and operate the priming pump until no bubble is made.
- Tighten the bleeding plug.
- Start the engine, and if it is not started in 10 seconds or less, repeat the bleeding steps.
- Make sure of no fuel leakage, and tighten the priming pump.

Draining

- When the water in the sedimentor reaches the specified volume, warning light is actuated.
  In this case, follow the draining steps below.
- Set a vinyl hose over the drain plug.
- Loosen the drain plug.
- To drain the water, operate the priming pump several times.
- After draining, tighten the drain plug.
- Operate the priming pump several times to check for fuel leakage.
- Check and see the warning light is off.

INJECTION NOZZLE



Removal steps
1. Injection pipe
2. Leak off pipe or hose
3. Injection nozzle

Installation steps
To install, follow the removal steps in the reverse order.

6C-8-1.tif

REMOVAL

Preparation:
- Disconnect battery ground cable.

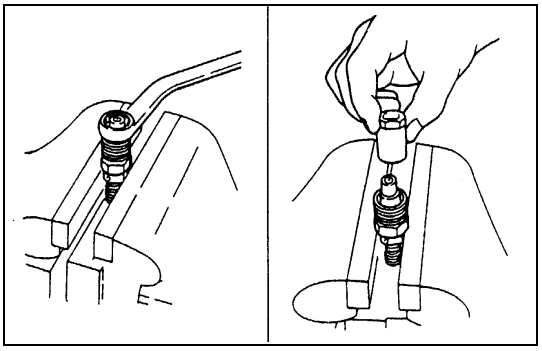
1. Injection Pipe
- Release injection pipe clip.
- Loosen the flare nut on the injection pump side.
- Loosen the flare nut on the injection nozzle side, disconnect and put aside the pipe.

2. Leak off Pipe or Hose

3. Injection Nozzle

INSPECTION

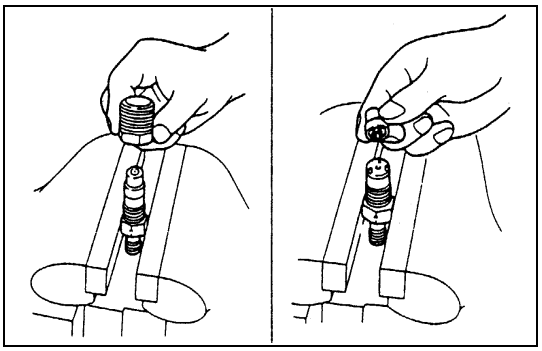
- Set the nozzle in a nozzle tester.
  Check there is no fuel leak in the nozzle seal when a fuel pressure of kg/cm^2 is applied.
  If there is leak, replace.



6C-9-1.tif

DISASSEMBLY (4JG2 Engine)

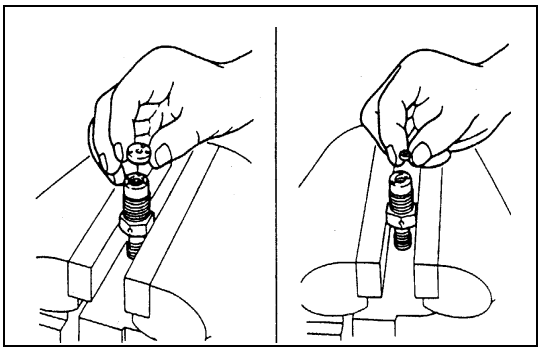
- Grip nozzle holder with a vise, loosen retaining nut and disassemble.
- Loosen holder nut and remove the nozzle.



6C-9-2.tif

CAUTION

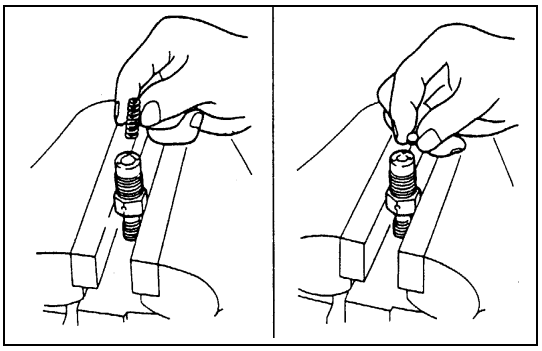
- Be careful not to damage the needle valve.
- Remove spacer, positioning pin, and push rod.
- Remove spring and adjusting shim.



6C-9-3.tif

CAUTION

- Wash all the parts removed and arrange them on a cylinder basis, care should be taken not to miss any parts.
- Soak the nozzle assembly in a parts receptacle filled with light oil.
- Care should be taken not to miss shim, if used.

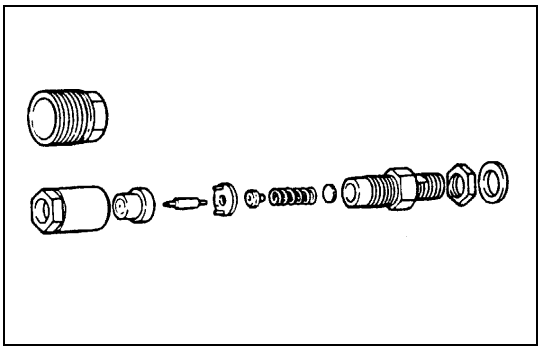


6C-9-4.tif

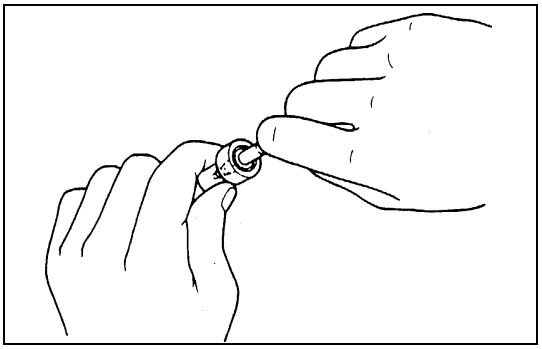
INSPECTION (4JG2 Engine)

Nozzle

- Soak the nozzle removed in clean light oil, wash nozzle body and needle valve separately, and check and see that the needle valve slide smoothly in the nozzle body.



6C-9-5.tif



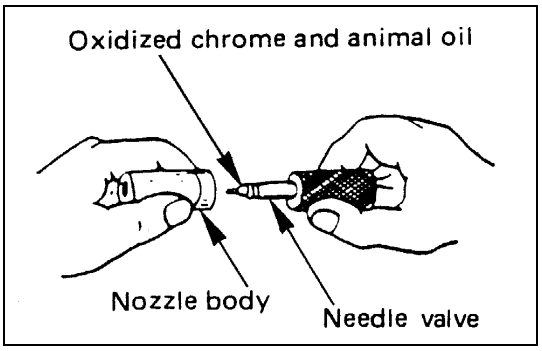
6C-10-1.tif

CAUTION

- If the needle valve does not slide smoothly repair or replace with a new nozzle assembly.

Nozzle lapping procedure

- Apply thinly a compound (Chrome oxide kneaded with an animal oil) to the seat of needle valve and lap.



6C-10-2.tif

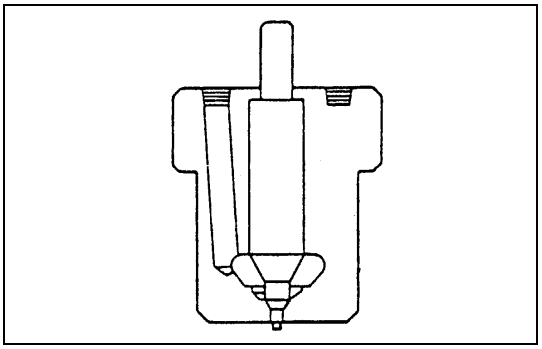
CAUTION

- Excess compound may cause worn needle valve, and be sure to wash out the compound after lapping.

Nozzle body & needle

- Check nozzle body and end for seizure.

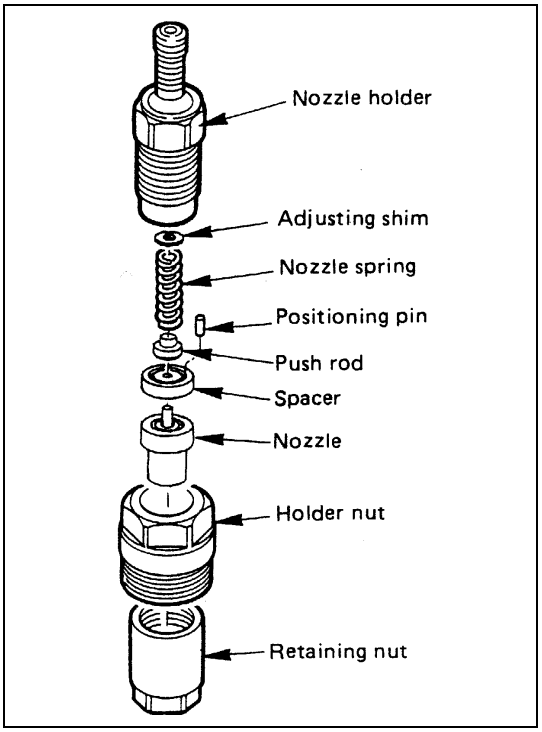
  If significantly seized, replace as a nozzle assembly basis. Also replace as a nozzle assembly basis, if needle valve end is deformed or seized.



6C-10-3.tif

CAUTION

- If either nozzle body or needle valve is faulty, replace with a new nozzle assembly.



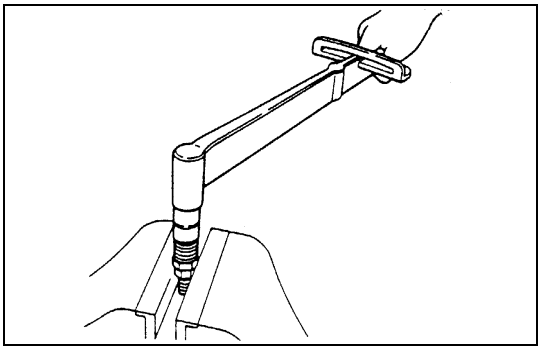
6C-10-4.tif

REASSEMBLY (4JG2 Engine)

To reassemble, follow the removal steps in the reverse order, noting the following point.

CAUTION

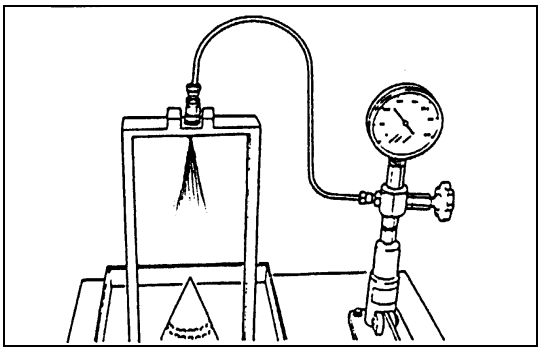
- Be careful to fit spacer because positioning pins are set off.



6C-11-1.tif

- Install retaining nut and tighten nut to the specified torque.

N·m (Kg·m/lb·ft)
39 (4.0/32)



6C-11-2.tif

ADJUSTMENT OF INJECTION OPENING PRESSURE (4JG2 Engine)

- Set nozzle holder assembly on a nozzle tester.
- Apply hydraulic pressure by operating tester handle, and make sure fuel cam be injected under the following pressure.

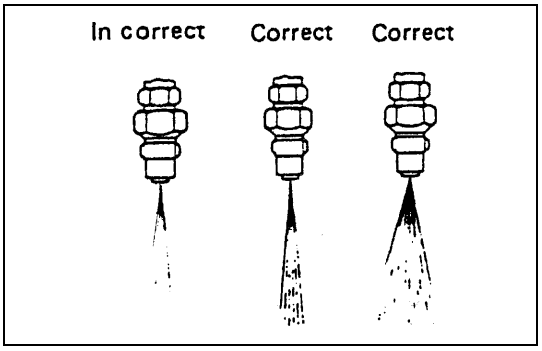
Kpa (Kg/cm^2/psi)
14,710 (150/2,133)

CAUTION

- If not injected under the specified pressure, adjust with adjusting shim.

Ref. Types are available in the 1.0 mm - 1.75 mm thickness range (on a 0.01 mm basis).

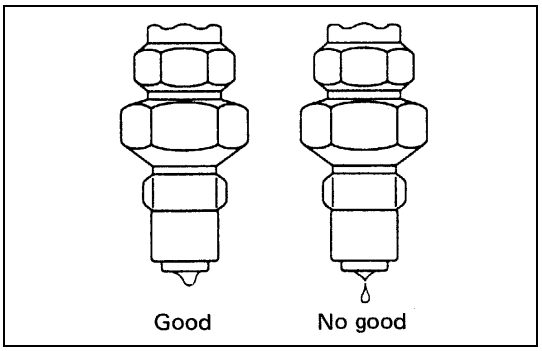
- Unless extremely deformed spray in seen, there is no problem.



6C-11-3.tif

CAUTION

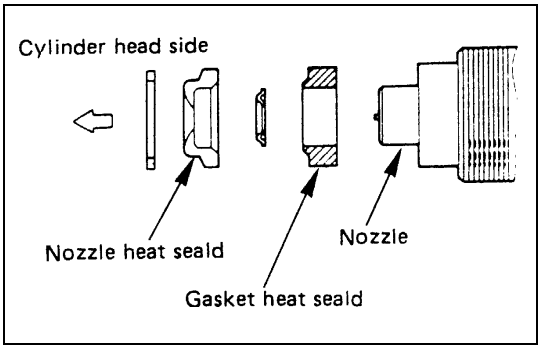
- The spray condition, when judged with a nozzle tester, is deemed as normal so long as the spray form is not excessively deformed.



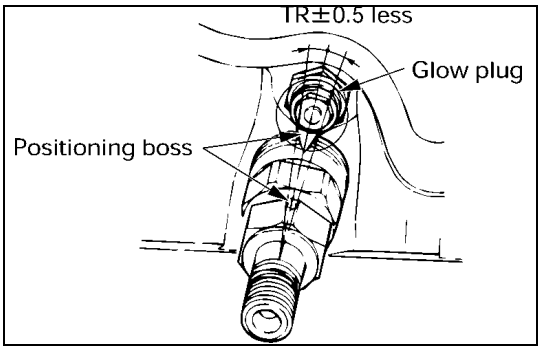
6C-11-4.tif

Oil tight test (4JG2 Engine)

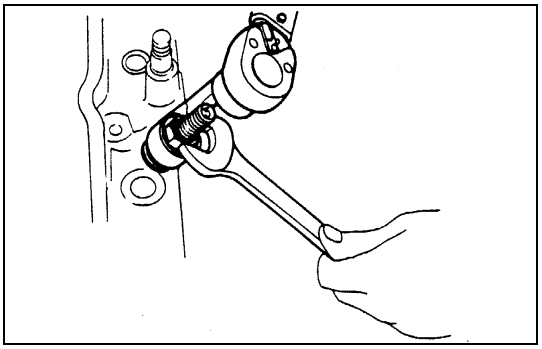
1) After completion of the adjustment of injection pressure, wipe off light oil at the tip of the nozzle with waste.
2) With pressure 1,961 Kpa (20 kg/cm^2/284 psi) less than the specified injection pressure applied, check to see if an oil drop trickles off the tip of the nozzle within 10 seconds after application of pressure. (There is no problem with the nozzle when oil gathers at the tip, but does not drop off.)
3) When an oil drop trickles, clean the nozzle thoroughly. Then reassemble it to check for any dropping of oil. When oil still drops, change it with a new one.



6C-12-1.tif



040LX016.tif



6C-12-3.tif

INSTALLATION (4JG2 Engine)

CAUTION

- Nozzle and assembling should be as illustrated.
- Use new heat shield and new corrugated washer.

3. Injection Nozzle (4JG2 only)

- Lightly tighten the holder nut to suck extent that the nozzle holder can turn one word and one word.
- Set positioning confirmation drilled hole (ϕ2) within a nozzle turning angle of ±5° against the cylinder head-side positioning boss.
- Apply a wrench as illustrated and tighten the holder nut to the specified torque using a special tool.

CAUTION

- **After tightening the holder nut, make sure that the drilled hole makes ±5° or smaller with the cylinder head-side positioning boss.**
- **When mounting leak off pipe, injection nozzle and pipe, clean then with air so that dust may not enter.**

Nozzle Fixing Torque	N·m (Kg·m/lb·ft)
64 (6.5/47)	

Wrench: nozzle holder 5-8840-0259-0

2. Leak Off Pipe

- Mount using a new copper washer
- Tighten nut to the specified torque.

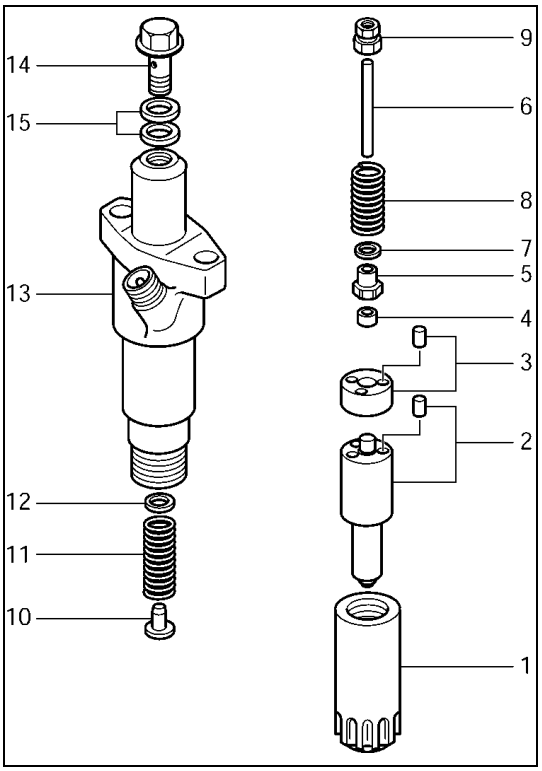
Pipe Nut Torque	N·m (Kg·m/lb·ft)
29 (3.0/22)	

1. Injection Pipe

- Connect injection pipe to nozzle holder.
- Tighten the injection pump side.

Sleeve Nut Torque	N·m (Kg·m/lb·ft)
29 (3.0/22)	

- Fit pipe clip in specified position.



080LX002.tif

4-1 Injection Nozzle (Two spring nozzle holder) (4JB1-TC only)

The two-spring nozzle holder has been developed to reduce NOx (Nitrogen Oxides) and particulates from direct injection diesel engine exhaust.

DISASSEMBLY

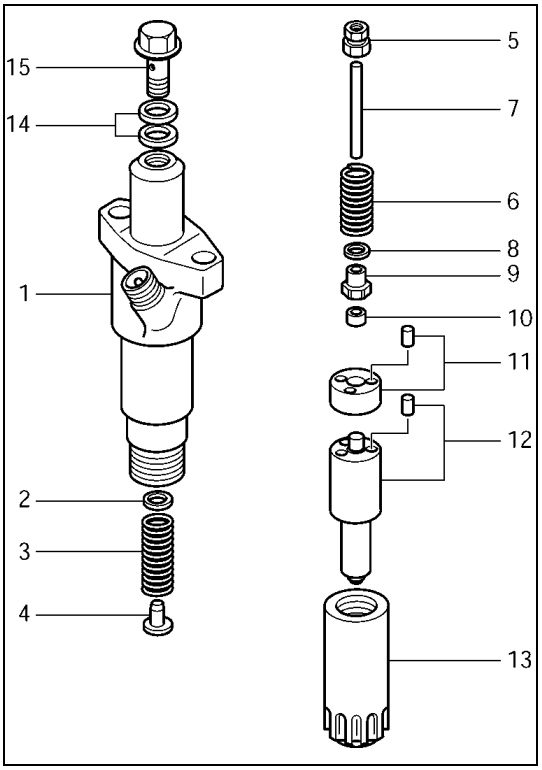
1. Retaining nut
2. Nozzle & pin
3. Spacer & pin
4. Lift piece
5. Spring seat
6. Push rod
7. Shim (Second nozzle opening pressure adjustment)
8. Second spring
9. Collar
10. Spring seat
11. First spring
12. Shim (First nozzle opening pressure adjustment)
13. Nozzle holder body
14. Eye bolt
15. Gasket

(1) Before disassembly remove carbon deposit from nozzle and nozzle holder using a wire brush and wash the outside nozzle holder assembly.

Caution:

Do not touch nozzle holes with the wire brush during cleaning it.

(2) Disassemble the nozzle holder assembly to numerical order.



080LX003.tif

REASSEMBLY AND OPENING PRESSURE ADJUSTMENT (4JB1-TC only)

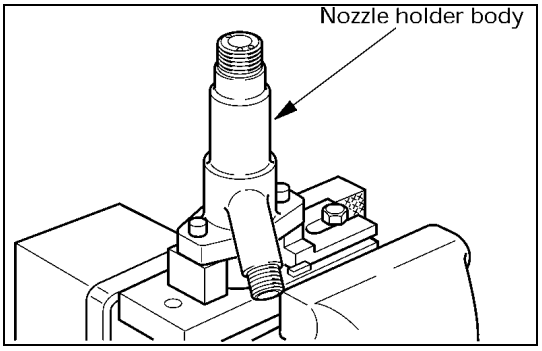
1. Nozzle holder body
2. Shim (First opening pressure adjustment)
3. First spring
4. Spring seat
5. Collar
6. Second spring
7. Push rod
8. Shim (Second opening pressure adjustment)
9. Spring seat
10. Lift piece
11. Spacer & pin
12. Nozzle & pin
13. Retaining nut
14. Gasket
15. Eye bolt

The nozzle holder is adjusted as the components are reassembled in the sequence above.

As adjustment of the two-spring nozzle holder is made in hundredths of a millimeter, clean the parts thoroughly in light oil to completely remove any dirt or foreign matter.

REASSEMBLY AND ADJUSTMENT PROCEDURE

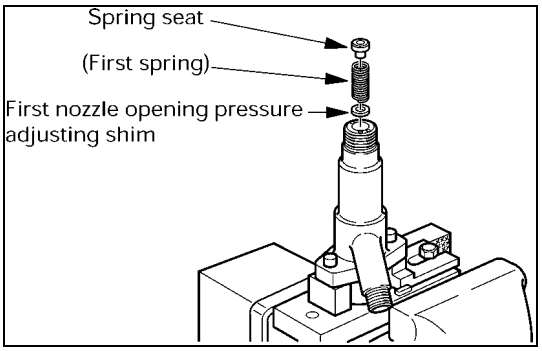
1	First nozzle opening pressure adjustment	Adjust the first nozzle opening pressure using the shim.
2	Full needle valve lift confirmation	Confirm the full needle valve lift in accordance with the closed method.
3	Pre-lift confirmation	Confirm pre-lift in accordance with the closed method. **CAUTION:** **If not as specified, replace the nozzle assembly, lift piece, pins and spacer using the nozzle service kit.**
4	Second nozzle opening pressure confirmation	Confirm the second nozzle opening pressure in accordance with the closed method.
5	Second nozzle opening pressure adjustment	Adjust the second nozzle opening pressure using the shim.
6	Final inspection	Confirm the condition of the fuel spray with the nozzle and nozzle holder assembled.



040MV015.tif

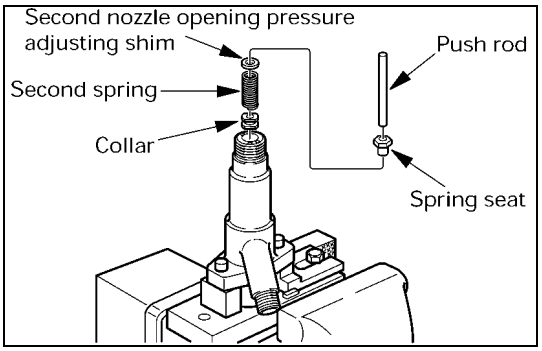
First nozzle opening pressure adjustment

1. Claim the nozzle holder in a vise.



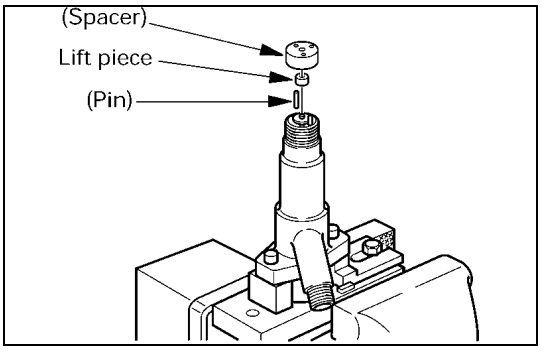
040MV016.tif

2. Install the shim, first spring and spring seat in the nozzle holder.



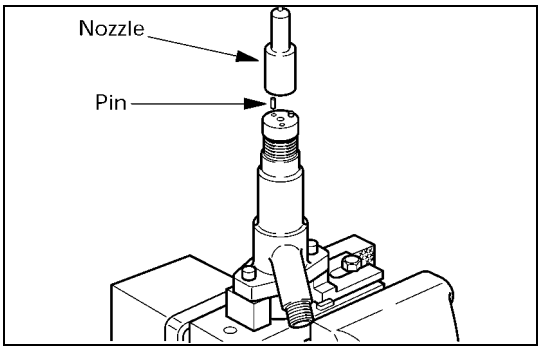
040MV017.tif

3. Install the collar, second spring, shim, spring seat and pushrod in the nozzle holder.



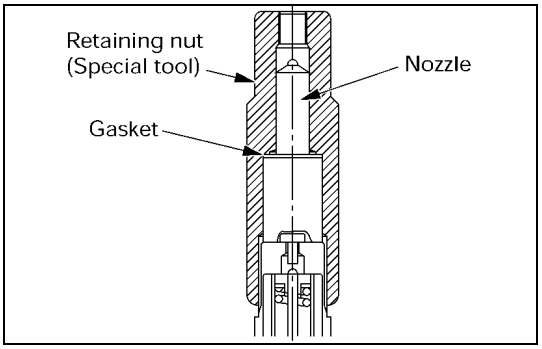
040MV018.tif

4. Install the pins, lift piece and spacer in the nozzle holder.



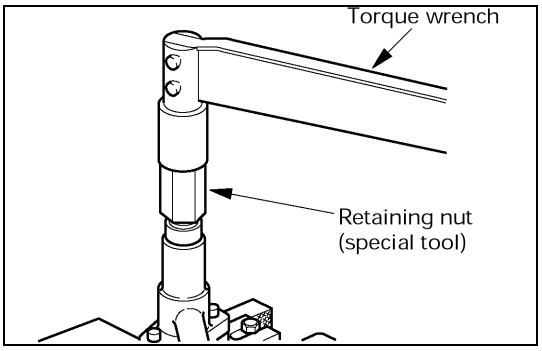
040MV019.tif

5. Install the pins in the spacer.
6. Install the nozzle on the spacer.



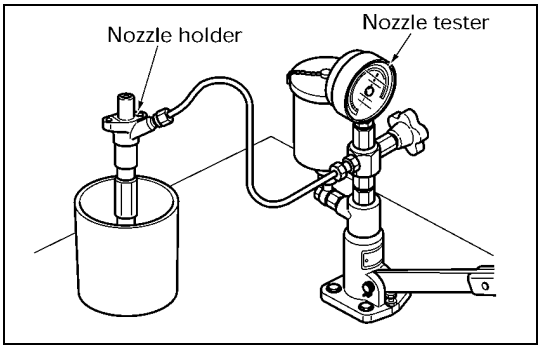
040MV010.tif

7. Hand-tighten the adjustment retaining nut together with the gasket to the nozzle holder.
   Retaining nut: 5-8677-7140-0
   Gasket: 5-8677-7139-0



040MV014-1.tif

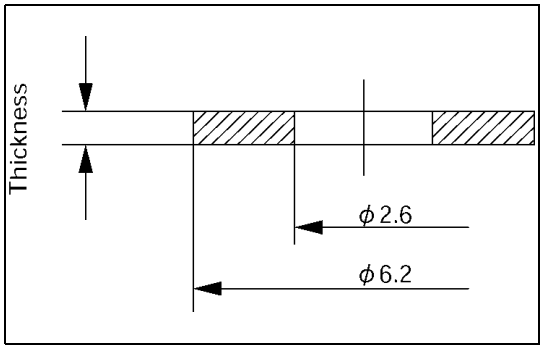
8. Tighten the adjustment retaining nut to the specified torque.
   Torque: 29 - 39 N·m (3.0 - 4.0 kg·m)



040MV030.tif

9. Set the nozzle holder to the nozzle tester.
10. Operate the nozzle tester and measure the first nozzle opening pressure.
11. If the first nozzle opening pressure is not as specified, disassemble the nozzle holder and replace the shim until the pressure is as specified.

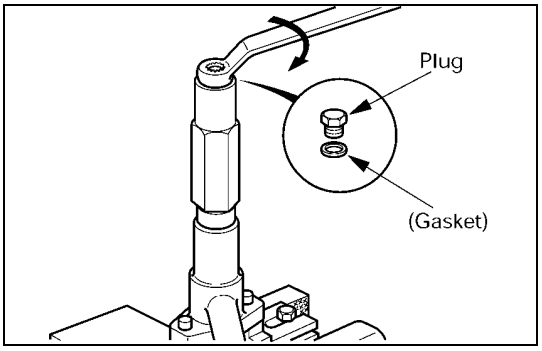
CAUTION:
Use a micrometer to measure shim thickness.



040LX010.tif

- First nozzle opening pressure adjusting shims

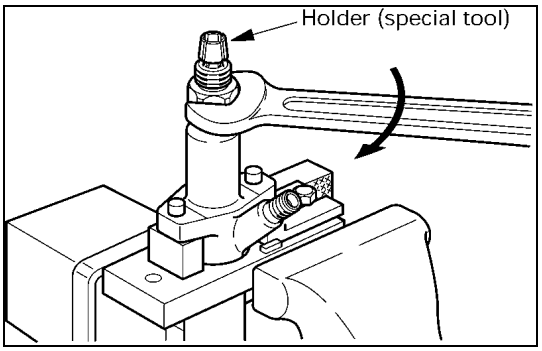
Parts No.	Thickness (mm)
1-1534-9042-0	0.40
1-1534-9043-0	0.50
1-1534-9044-0	0.52
1-1534-9045-0	0.54
1-1534-9046-0	0.56
1-1534-9047-0	0.58
1-1534-9048-0	0.60
1-1534-9049-0	0.70



040MV013.tif

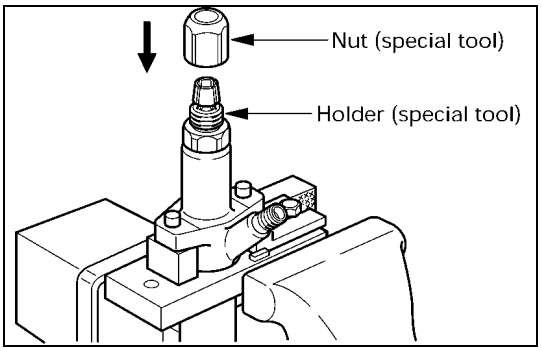
Full needle valve lift confirmation

1. Install the gasket and plug on the adjustment retaining nut.
   Gasket: 8-9722-7602-0
   Plug: 5-8677-7141-0



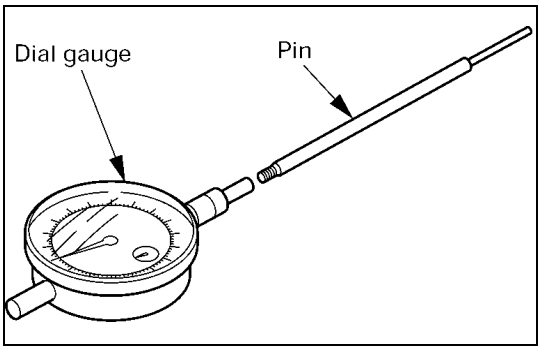
040MV012.tif

2. Position the nozzle holder with the nozzle facing down and install the dial gauge holder on the nozzle holder.
   Dial gauge holder: 5-8677-7142-0



040MV011.tif

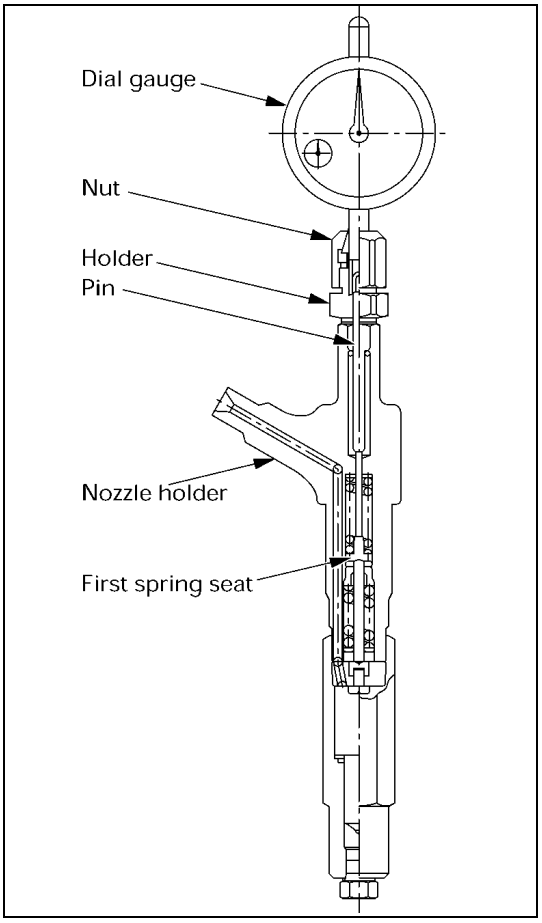
3. Install the nut on the dial gauge holder.
   Nut: 5-8677-7143-0



040MV029.tif

4. Install the pin to the dial gauge.

   Note:
   The lengths of the pins do not include the threaded portions.
   Pin (liter=100 mm): 5-8677-7144-0
   Dial gauge: 1-8531-7015-0

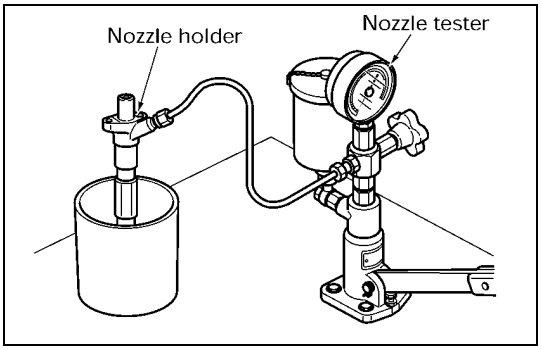


040MV009.tif

5. Secure the dial gauge to the nozzle holder using the nut so that the pin contacts the tip of the first spring seat.

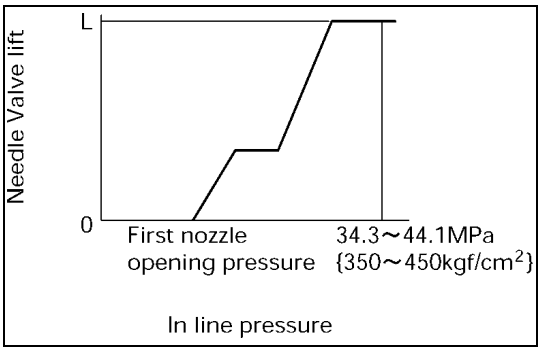
CAUTION:

- **Secure the dial gauge so that a stroke of 2 mm can be measured.**
- **Do not over-tighten the nut as the dial gauge shaft may jam. (Confirm from the dial gauge that the shaft moves smoothly.)**



040MV030.tif

6. Set the nozzle holder to the nozzle tester and put needle to zero on the dial gauge.
7. Operate the nozzle tester to bleed any air from inside the retaining nut and to confirm that no fuel leaks.

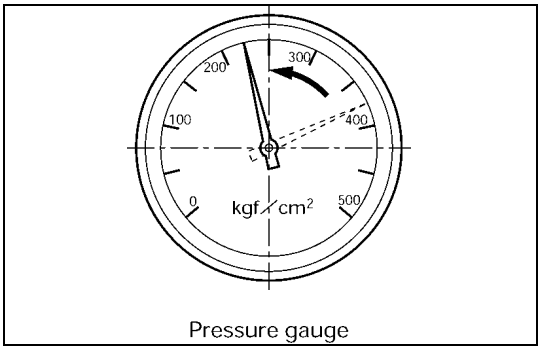


040MV008.tif

8. Operate the nozzle tester and increase the in-line pressure to 34.3 - 44.1 MPa (350 - 450 kg/cm^2) so that the nozzle's needle valve moves through its full lift. Record full lift 'L'. (Read dial gauge)

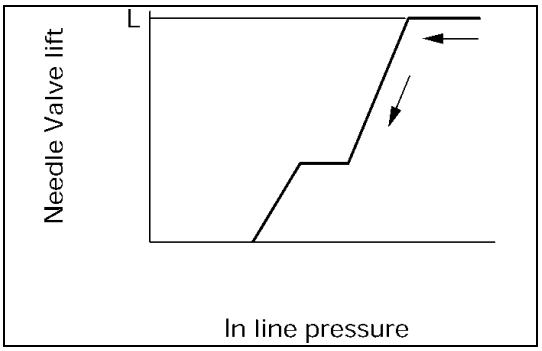
Note:

The above operation is used to determine whether the nozzle seat is worn and whether the nozzle assembly is in good condition.

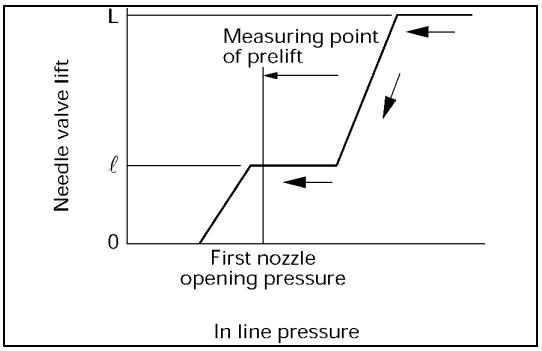


Pressure gauge

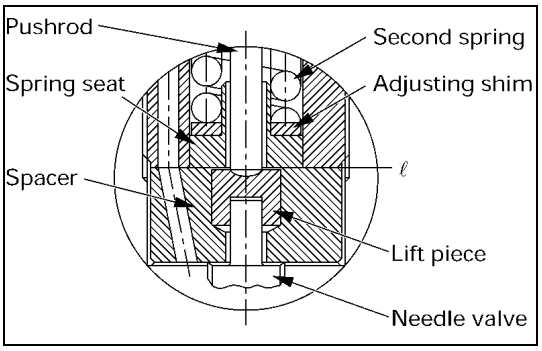
040MV007.tif



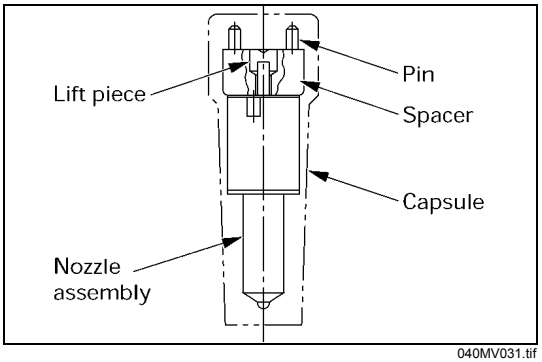
040MV006.tif



040MV025-1.tif



040MV005.tif



040MV031.tif

Pre-lift confirmation

1. With the needle valve at full lift, release the nozzle tester handle.

Note:

The in-line pressure will decrease and needle valve lift (as indicated on the dial gauge) will also decrease a little.

2. Read the needle valve lift 'liter' from the dial gauge indication (once the needle valve has descended when the second spring has stopped operating). Refer to the pre-lift measuring point for 'liter'.

Pre-lift measuring point:

Read the dial gauge at first nozzle opening pressure +approx 1 MPa (10 kg/cm^2).

Note:

This point can be found while the pressure is decreasing.

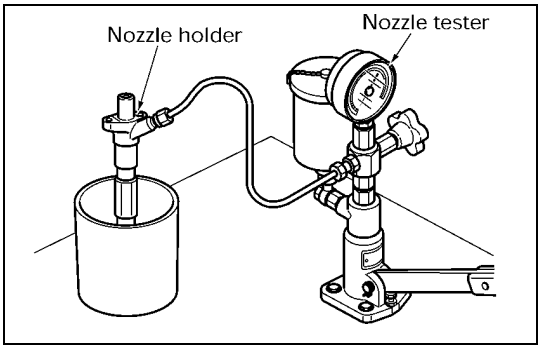
3. Confirm that pre-lift 'liter' is as specified.

Pre-lift	mm
0.04	

4. If pre-lift is not as specified, replace the pins, lift piece, spacer and nozzle assembly as a set with the service kit.

Service kit:

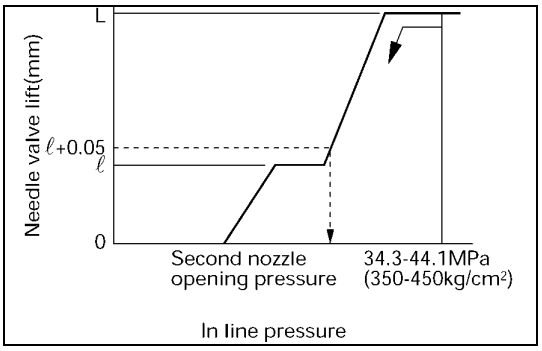
8-9720-3470-1



040MV030.tif

Second nozzle opening pressure confirmation

1. After pre-lift confirmation, operate the nozzle tester to increase in-line pressure to 34.3 - 44.1 MPa (350 - 450 kg/cm^2) so that the nozzle's needle valve moves through its full lift.

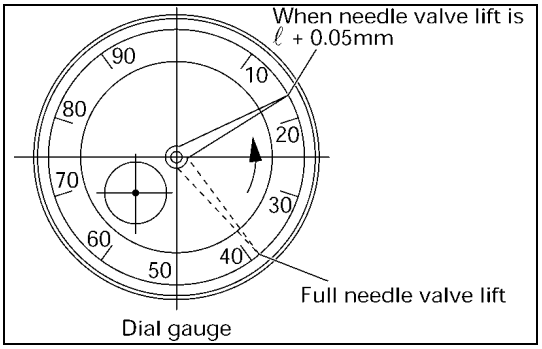


040MV022.tif

2. Release the nozzle tester handle so that in-line pressure decreases.

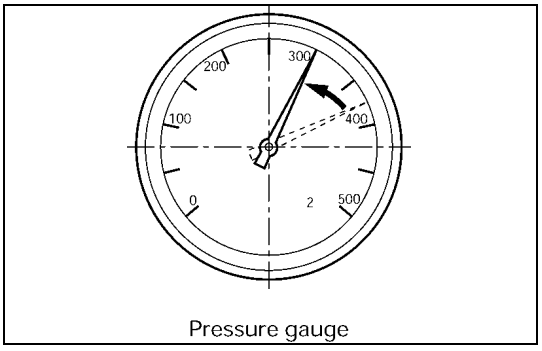
   Note:

   The in-line pressure will decrease and needle valve lift (as indicated on the dial gauge) will also decrease a little.

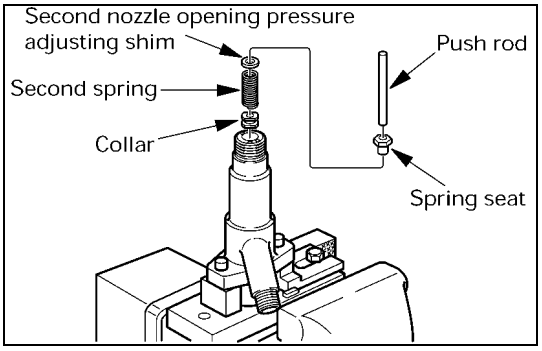


040MV024.tif

3. Then, read the pressure gauge indication (second nozzle opening pressure) the instant that the dial gauge indicates the specified needle valve lift (usually pre-lift liter + 0.05 mm).



040MV026.tif



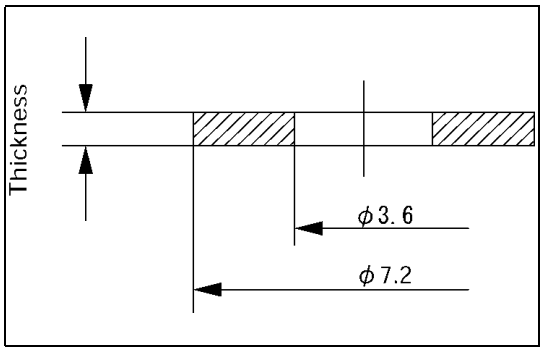
040MV017.tif

Second nozzle opening pressure adjustment

If the second nozzle opening pressure is not as specified, disassemble the nozzle from the nozzle holder and replace the shim until the pressure is as specified.

CAUTION:

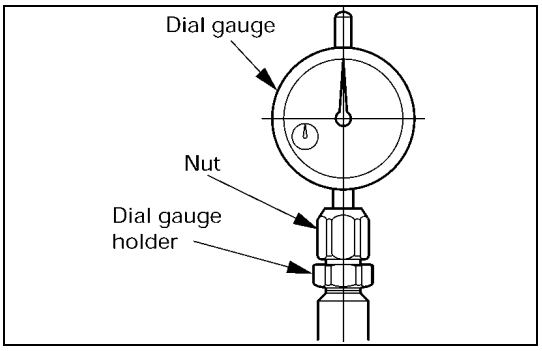
- **Because the second opening pressure changes when the first opening pressure changes, the second opening pressure must be adjusted when the first opening pressure changes.**
- **Use a micrometer to measure shim thickness.**



040LX009.tif

- Second nozzle opening pressure adjusting shims

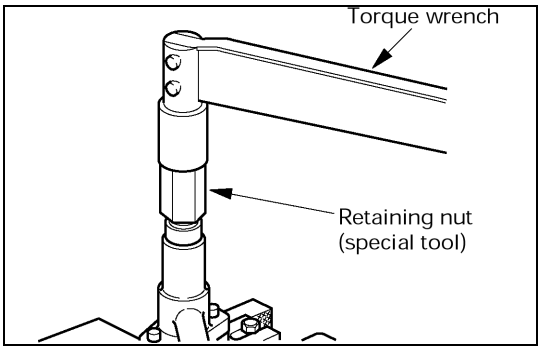
Part No.	Thickness (mm)
8-9711-6034-0	0.40
8-9711-6035-0	0.50
8-9711-6037-0	0.52
8-9711-6039-0	0.54
8-9711-6041-0	0.56
8-9711-6043-0	0.58
8-9711-6044-0	0.59



040MV028.tif

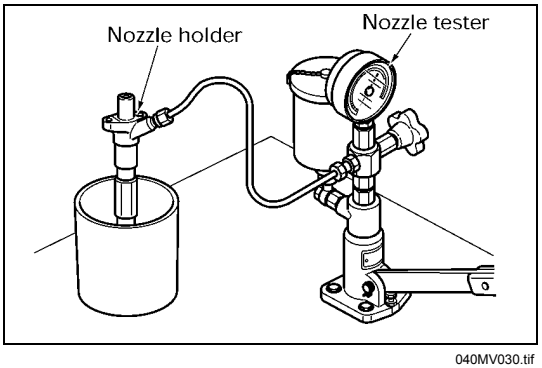
Final inspection

1. Remove the dial gauge, nut and dial gauge holder.



040MV014-1.tif

2. Remove the adjustment retaining nut and gasket.
3. Install the original retaining nut, confirm that the pins are inserted fully into the nozzle, and then hand-tighten the retaining nut. Then, tighten the original retaining nut to the specified torque.
   Torque: 59 - 79 N·m (6.0 - 8.0 kg·m)

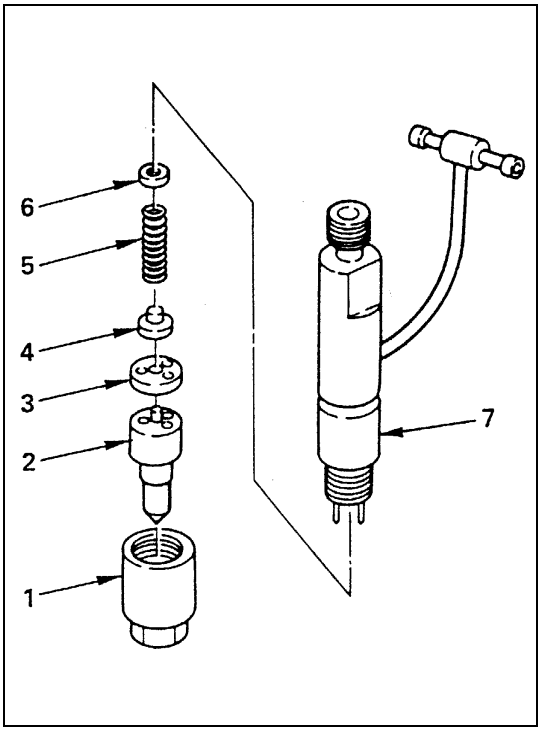


040MV030.tif

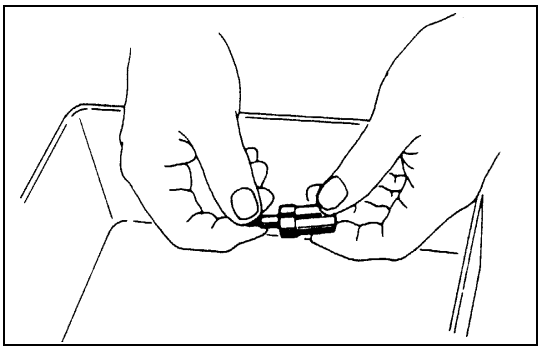
4. Set the nozzle holder to the nozzle tester and check first nozzle opening pressure, spray condition, seat oil tightness and each part for oil leaks.
5. When replacing the nozzle, replace the nozzle, lift piece, pins and spacer as a set with the nozzle service kit.

CAUTION:

Pre-lift will not be as specified if only the nozzle is replaced.



6C-22-1.tif



6C-22-2.tif

DISASSEMBLY (4JBI/4JB1T Engine)

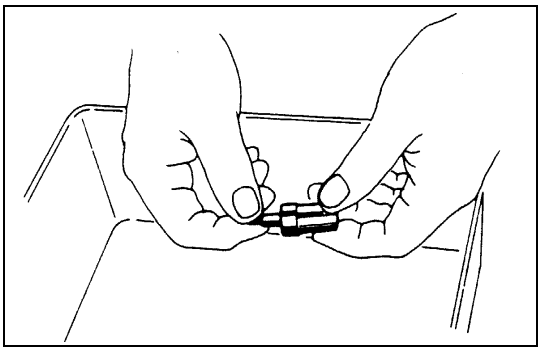
1. **Retaining Nut**
2. **Injection Nozzle**
   1) Remove the nozzle assemblies from the nozzle holders.

      Tag the nozzle assemblies and the nozzle holders to ensure that they are reinstalled in their original positions.

      The nozzle assembly and nozzle holder combinations must not be interchanged.
   2) Immerse the injection nozzle in a tool tray filled with clean diesel oil to protect them from dust.
3. **Spacer**
4. **Spring Seat**
5. **Spring**
6. **Adjusting Shim**
7. **Nozzle Holder**

INSPECTION AND REPAIR (4JB1/4JB1 T Engine)

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.

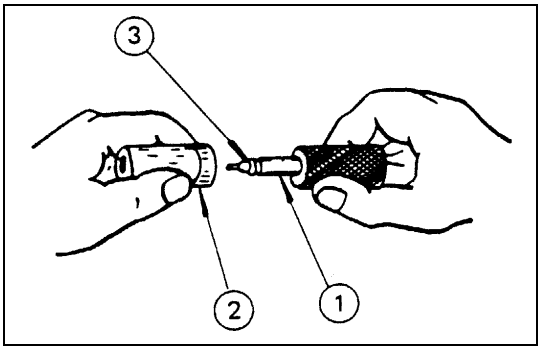


6C-22-3.tif

Inspection Nozzle Needle Inspection

1. Remove the needle from the nozzle body.
2. Carefully wash the nozzle needle and the nozzle body in clean diesel fuel.
3. Check that the nozzle needle moves smoothly inside the injection nozzle body.

   If the nozzle needle does not move smoothly, it must be repaired (See "Nozzle Lapping Procedure" belows).



6C-23-1.tif

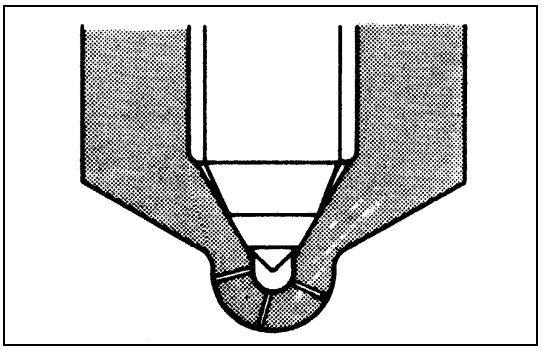
Nozzle Lapping Procedure

1. Lap the nozzle needle ① and the nozzle body ② by applying a compound of oxidized chrome and animal oil ③.

NOTE:

Do not apply an excessive amount of the oxidized chrome and animal oil compound to the injection needle valve seat area. Applying too much compound will cause the injection nozzle needle and the injection nozzle body cavity to wear excessively.

2. Carefully wash the needle valve and the nozzle body in clean diesel fuel after lapping.



6C-23-2.tif

Nozzle Body and Needle Valve Inspection

Check the nozzle body and the needle valve for damage and deformation.

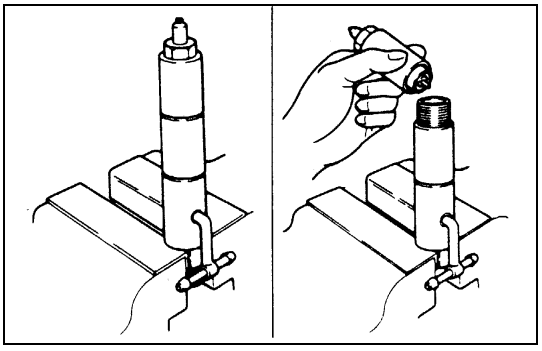
The nozzle and body assembly must be replaced if either of these two conditions are discovered during inspection.

Reassembly

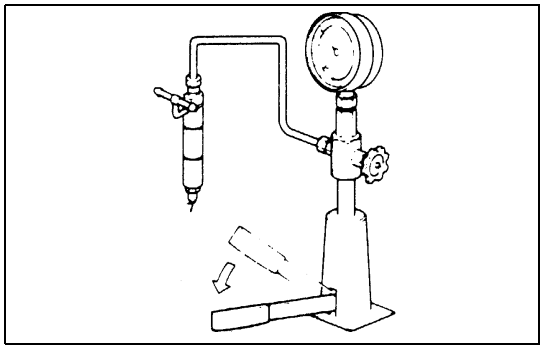
7. **Nozzle Holder**
6. **Adjusting Shim**
5. **Spring**
4. **Spring Seat**
3. **Spacer**
2. **Injection Nozzle**
1. **Retaining Nut**

Tighten the retaining nut to the specified torque.

N·m (Kg·m/lb·ft)
34 (3.5/25)



6C-23-3.tif



6C-24-1.tif

Injection Nozzle Adjustment

1) Attach the injection nozzle holder to the injection nozzle tester.
2) Apply pressure to the nozzle tester to check that the injection nozzle opens at the specified pressure.

kPa (kg/cm^2/psi)

18,142 (185/2630)

If the injection nozzle does not open at the specified pressure, install or remove the appropriate number of adjusting shims to adjust it.

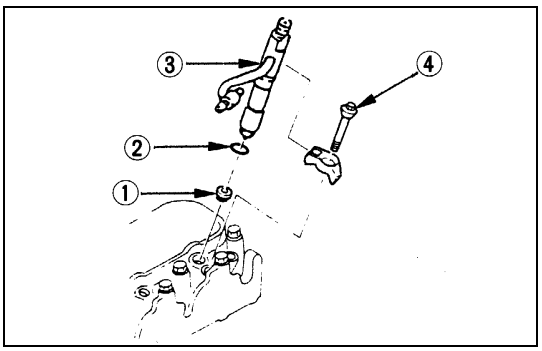
Adjusting Shim Availability	mm (in)
Range	0.50 - 1.50 (0.02 - 0.06)
Increment	0.025 (0.001)
Total No. of Shims	40

Removing or installing one shim will increase of decrease the nozzle opening pressure approximately 369.46 kPa (3.77 kg/cm^2/53.6 psi).

WARNING:

TEST FLUID FROM THE INJECTION NOZZLE WILL SPRAY OUT UNDER GREAT PRESSURE. IT CAN EASILY PUNCTURE A PRESON'S SKIN. KEEP YOUR HANDS AWAY FROM THE INJECTION NOZZLE TESTER AT ALL THE TIMES.

INSTALLATION (4JB1/4JB1T Engine)



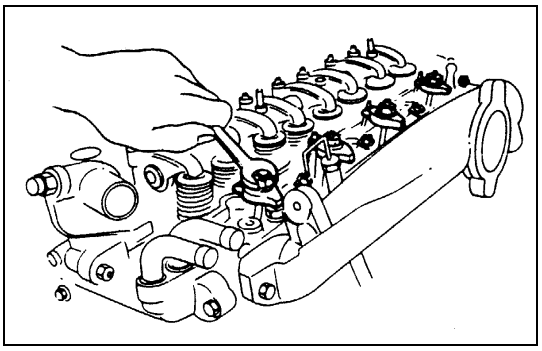
6C-24-2.tif

3. Injection Nozzle

1) Install the injection nozzle gasket ① and the O-ring ② to the injection nozzle holder ③.
   Be sure that the O-ring fits snugly in the injection nozzle groove.
2) Apply engine oil to the cylinder head nozzle holder hole.
3) Install the nozzle holder together with the nozzle holder bracket ④ to the cylinder head.

N·m (Kg·m/lb·ft)

37 (3.8/27)

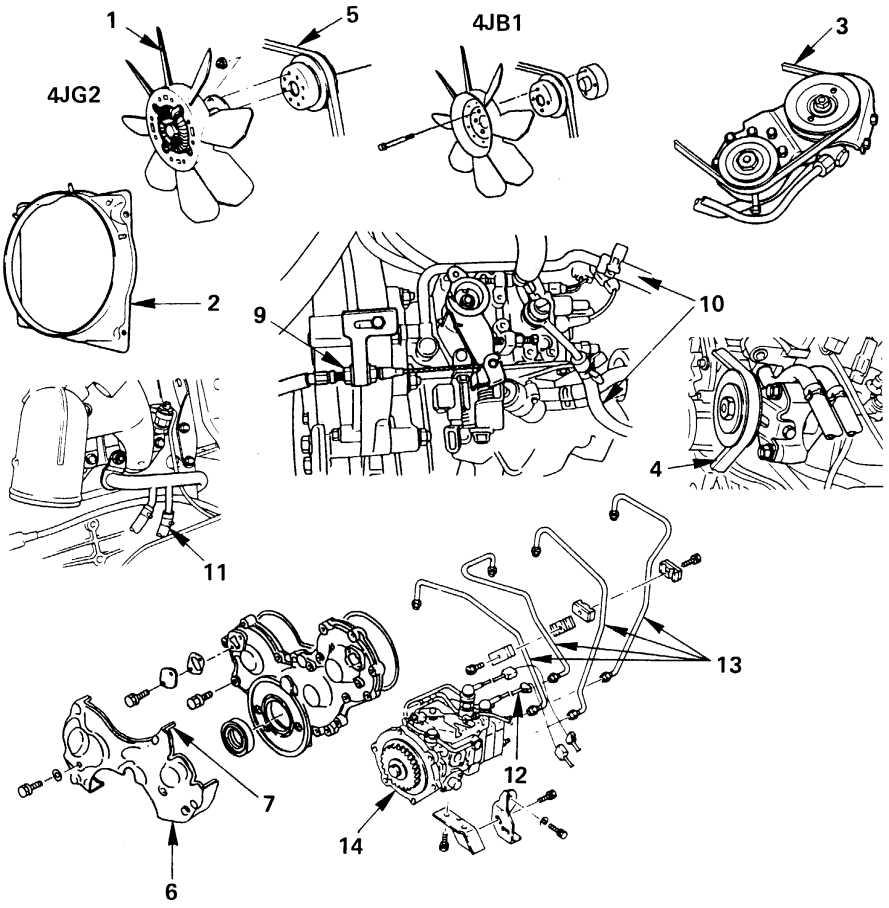


6C-24-3.tif

2. Leak Off Hose

1. Injection Pipe

INJECTION PUMP ASM (4JB1/4JB1T, 4JG2 Gear Drive Type)



Removal steps
1. Cooling fan ASM.
2. Fan Shroud
3. Power steering pump drive belt.
4. A/C compressor drive belt.
5. AC generator drive belt.
6. Noise shield cover.
7. Noise cover spacer
8. Air intake duct
9. Injection pump control cable
10. Fuel hose
11. CSD water hose
12. Injection pump harness
13. Injection pipe
14. Injection pump ASM.

Installation steps
To install, follow the removal steps in the reverse order.

6C-25-1.tif

REMOVAL

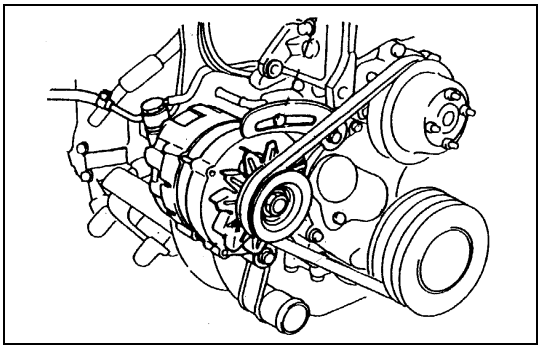
Preparation:
- Disconnect battery ground cable.
- Drain coolant.

1. Cooling Fan Assembly
- Remove clamp nut, and remove cooling fan assembly, distant pipe, and fan pulley.

2. Fan Shroud

3. Power Steering Pump Drive Belt (P/S Model)
- Loosen Power Steering pump mounting bolt and adjust bolt, and remove the drive belt.

4. A/C Compressor Drive Belt (A/C Model)
- Loosen A/C compressor idler pulley lock nut, adjust bolt and remove the drive belt.



6C-26-1.tif

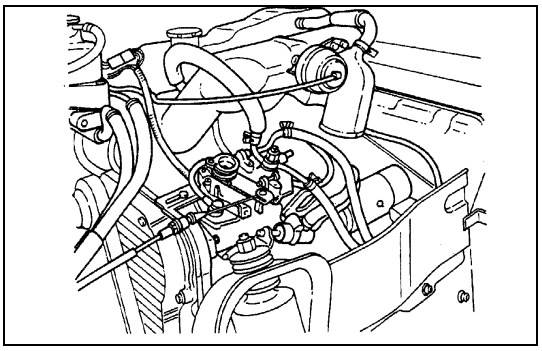
5. AC Generator Drive Belt

- Loosen AC generator mounting bolt (under side) and adjust plate lock bolt, and remove the drive belt.

6. Noise Shield Cover

7. Noise Cover Spacer

8. Air Intake Duct



6C-26-2.tif

9. Injection Pump Control Cable

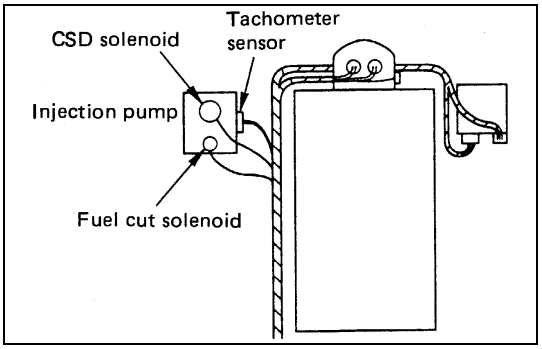
- Removal the control cable bracket bolt and remove the control lever side.

10. Fuel Hose

- Disconnect the fuel feed hose and fuel return hose.

11. CSD (Cold Starting Device) Water Hose

- Disconnect the water hose from injection pump side.



6C-26-3.tif

12. Injection Pump Harness

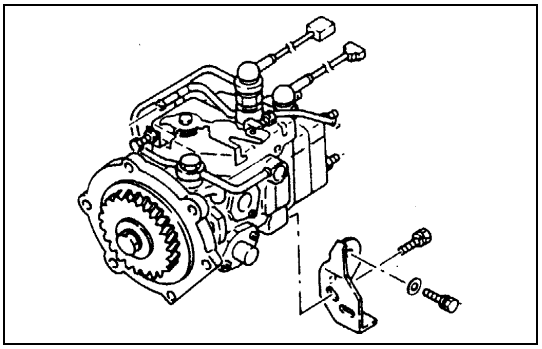
- Remove the tachometer sensor (with tachometer) CSD solenoid, fuel cut solenoid.

13. Injection Pipe

- Release pipe clip.
- Remove the flare nut on the pump side.
- Remove the flare nut on the injection nozzle side, and remove the injection pipe.

CAUTION

- Be sure to plug the injection nozzle holder and delivery holder to prevent the entry of foreign matter.



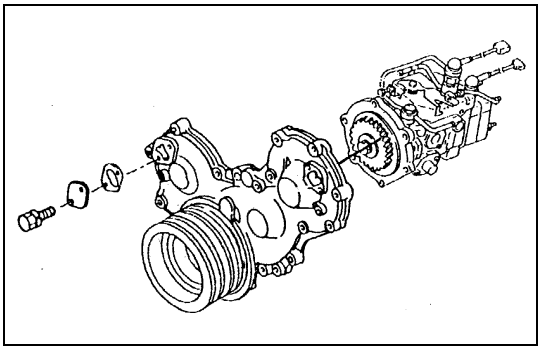
6C-26-4.tif

14. Injection Pump Assembly

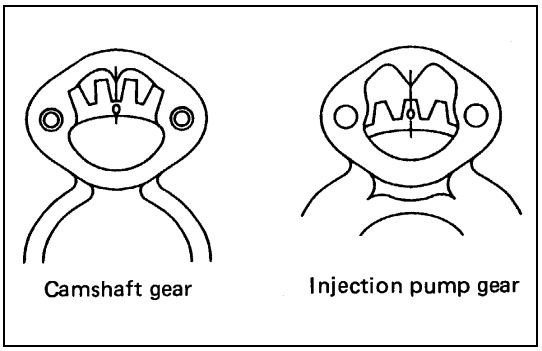
- Remove pump mounting nut
- Loosen injection pump rear bracket adjuster lock bolt.
- Remove the mounting bolt on the engine side, and pull out the pump from the engine.

NOTE:

Plug the injection pump delivery holder parts with the shipping caps (or the equivalent) to prevent the entry of foreign materials.



6C-27-1.tif



6C-27-2.tif

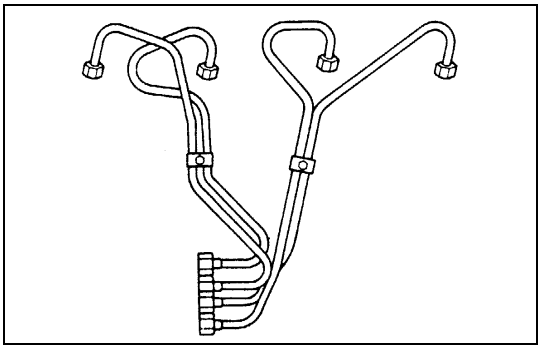
INSTALLATION

14. Injection Pump Assembly

1. Timing gear case a camshaft timing gear side c injection pump timing gear side check holde cover.
2. Turn the crankshaft clockwise to see the TDC mark of the crank pulley to the pointer, and then bring the No. 1 cylinder to the TDC on the compression stroke.
3. Look in through the check hole on the crankshaft timing gear side and check to see if the “O” mark on the timing gear is in line with the pointer of the check hole.
4. In the condition above with the injection pump gear mark “O” set to the pointer of the check hole, install the injection pump assembly.

- Install the injection pump fixing bolts and tighten them to the specified torque.

Pump Bolts Torque	N·m (Kg·m/lb·ft)
	15 (1.5/11)

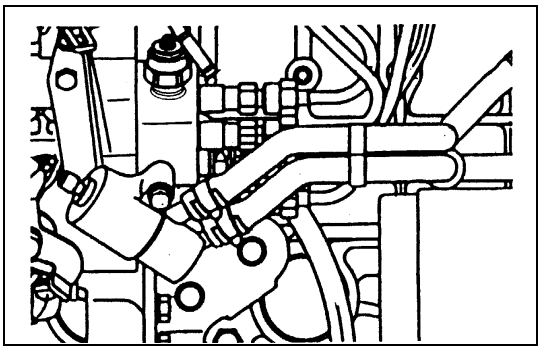


6C-27-3.tif

13. Injection Pipe

- Connect the pump side and nozzle side of the pipe, and tighten securely.
- Install clip where it was.

Sleeve Nut Torque	N·m (Kg·m/lb·ft)
	29 (3.0/22)



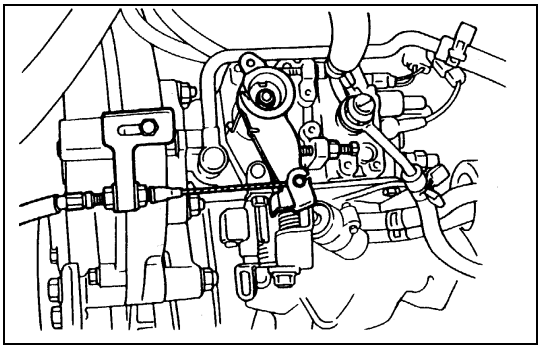
6C-27-4.tif

12. Injection Pump Harness

- Mount engine harness and connect it to switches.

11. CSD Water Hose

- Connect the water hose and tighten clip securely.



6C-28-1.tif

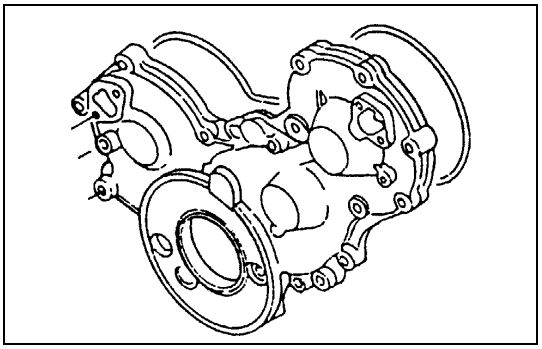
10. Fuel Hose

- Connect the fuel feed hose and fuel return hose.
- Connect the leak off hose.

9. Injection Pump Control Cable

1) Install the control wire to the engine control lever.
2) Hold the accelerator lever in the fully closed position and stretch the control cable in the direction indicated by the arrow to remove any slack.
3) Tighten the accelerator cable bracket bolt.

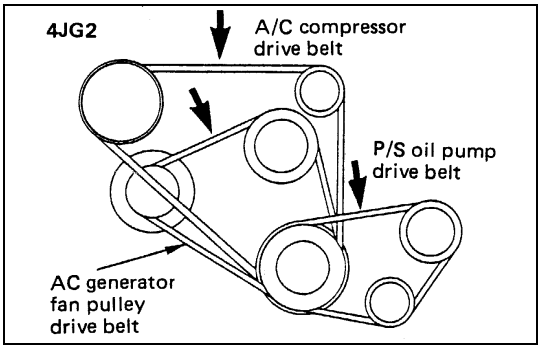
8. Air Intake Duct



6C-28-2.tif

7. Noise Cover Spacer

6. Noise Shield Cover



6C-28-3.tif

5. AC Generator Drive Belt

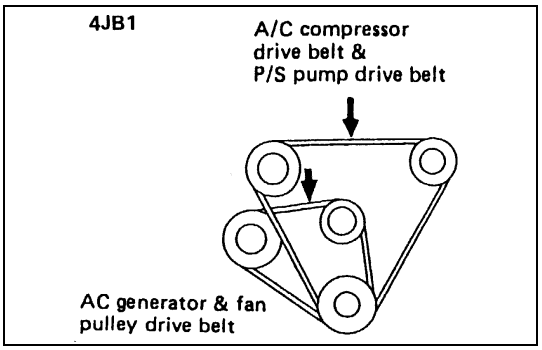
- Install AC generator drive belt and adjust belt tension.
- Depress the drive belt mid-portion with a 98 N (10 kg/22 lb) force.

Drive Belt Deflection	mm (in)
8 (0.31) - 10 (0.39)	

- Install fixing bolt and tighten bolts to the specified torque.

Generator Fixing Bolt	N·m (Kg·m/lb·ft)
40 (4.1/30)	

Adjust Plate Fixing Bolt	N·m (Kg·m/lb·ft)
19 (1.9/14)	



6C-28-4.tif

4. A/C Compressor Drive Belt (A/C Model)

- Install A/C compressor drive belt and adjust belt tension.
- Depress the drive belt mid-portion with a 98N (10 kg/22 lb) force.

Drive Belt Deflection	mm (in)
8 (0.31) - 10 (0.39)	

- Tighten the idler lock nut to the specified torque

N·m (Kg·m/lb·ft)
27 (2.8/20)

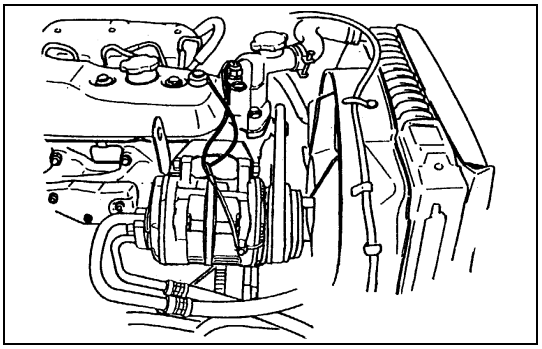
3. Power Steering Pump Drive Belt (P/S Model)

- Install P.S pump drive belt and adjust belt tension.
- Depress the drive belt mid-portion with a 98 N (10 kg/ 22 lb) force.

Drive Belt Deflection	mm (in)
8 (0.31) - 10 (0.39)	

- Tighten the idler lock nut to the specified torque.

N·m (Kg·m/lb·ft)
27 (2.8/20)



6C-29-1.tif

2. Fan Shroud

- Install the fan shroud and reservoir tank hose.

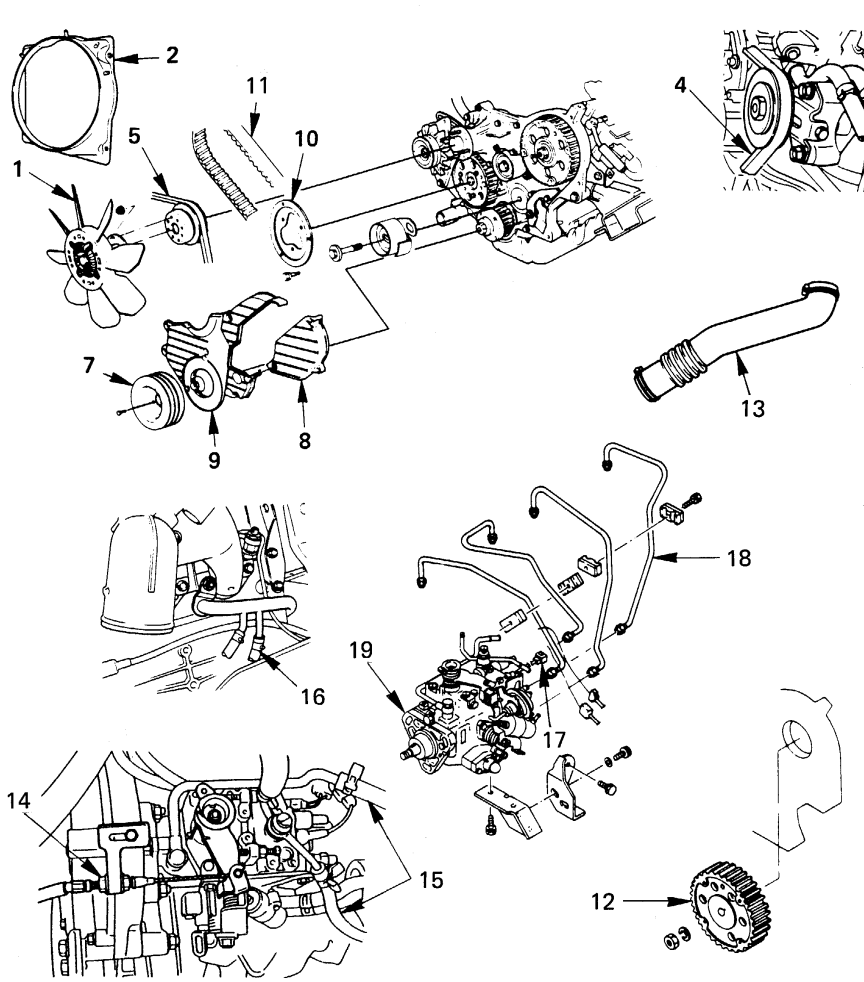
1. Cooling Fan Assembly

- Mount fan pulley, distance piece, and cooling fan assembly (in this order) on the water pump, and tighten to the specified torque.

N·m (Kg·m/lb·in)
8 (0.8/69)

- Connect battery ground cable.
- Pour coolant.

INJECTION PUMP ASSEMBLY (4JG2 Belt Drive Type)



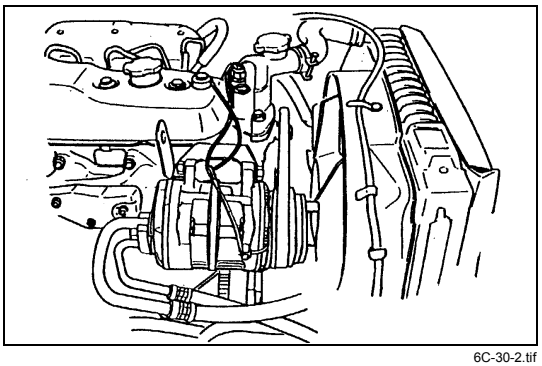
Removal steps

1. Cooling fan Assembly
2. Fan shroud
3. Power steering pump drive belt
4. A/C compressor drive belt
5. AC generator drive belt
6. Power steering pump & bracket Assembly
7. Crankshaft damper pulley
8. Timing pulley upper cover
9. Timing pulley lower cover
10. Flange; Camshaft pulley
11. Timing belt
12. Injection pump timing pulley
13. Air intake duct
14. Injection pump control cable
15. Fuel hose
16. CSD water hose
17. Injection pump hearness
18. Injection pipe
19. Injection pump Assembly

Installation steps

To install, follow the removal steps in the reverse order.

6C-30-1.tif



6C-30-2.tif

REMOVAL

Preparation:

- Disconnect battery ground cable.
- Drain coolant

1. Cooling Fan Assembly

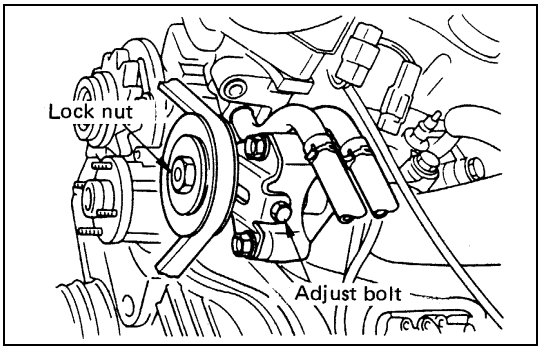
- Remove clamp nut, and remove cooling fan assembly, distant pipe, and fan pulley.

2. Fan Shroud

- Removal reservoir tank hose and fan shroud.

3. Power Steering Pump Drive Belt (P/S Model)

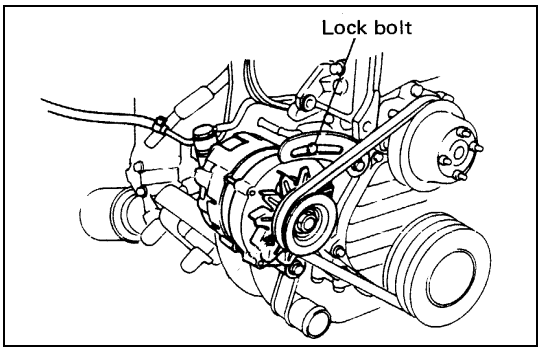
- Loosen power steering pump idle pulley lock nut and adjust bolt, and remove the drive belt.



6C-31-1.tif

4. A/C Compressor Drive Belt (A/C Model)

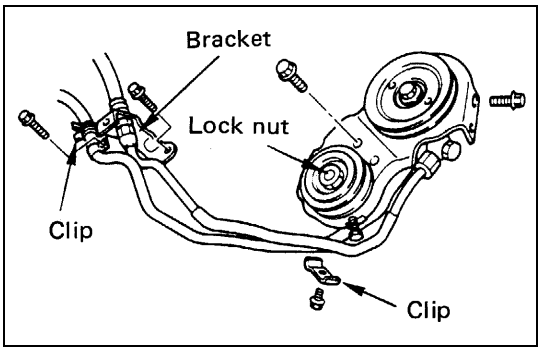
- Loosen A/C compressor idler pulley lock nut, adjust bolt, and remove the drive belt.



6C-31-2.tif

5. AC Generator Drive Belt

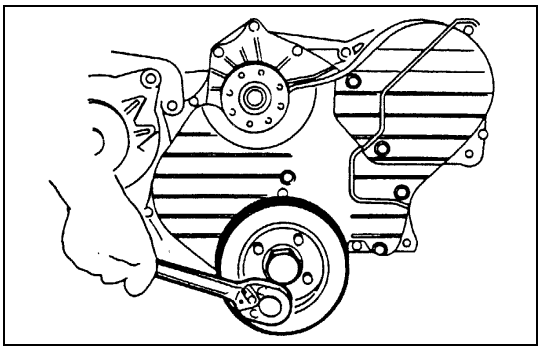
- Loosen AC generator mounting bolt (under side) and adjust plate lock bolt, and remove the drive belt.



6C-31-3.tif

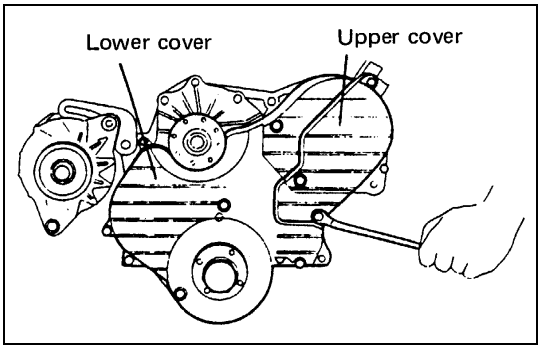
6. Power Steering Pump & Bracket Assembly (P/S Model)

- Loosen power steering oil pipe bracket and clip.
- Remove P/S pump bracket assembly and hang the P/S pump bracket assembly.



6C-31-4.tif

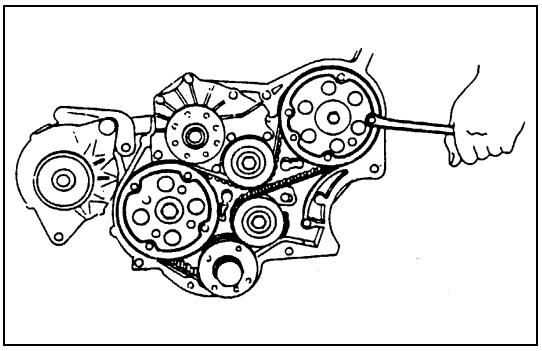
7. Crankshaft Dumper Pulley



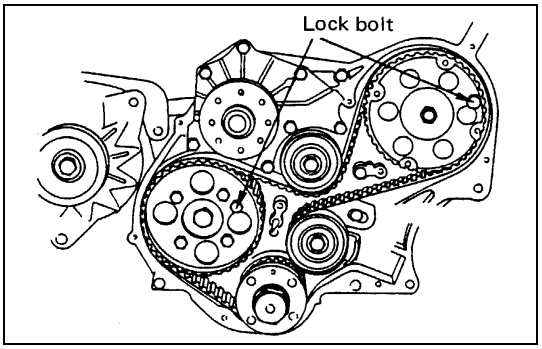
6C-32-1.tif

8. Timing Pulley Upper Cover

9. Timing Pulley Lower Cover


6C-32-2.tif

10. Flange; Camshaft Pulley

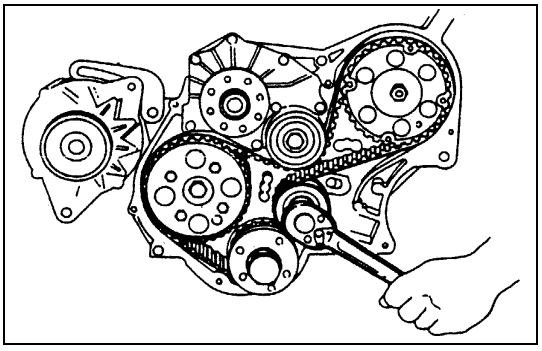


6C-32-3.tif

11. Timing Belt

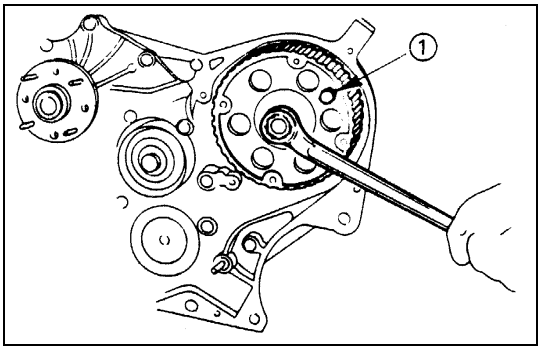
- Prepare a fixing bolt (M8 x 40, P=1.25)
- Turn crankshaft timing pulley in the normal direct pulley side mark to timing pulley housing side mark.
- Make sure that the camshaft pulley and injection timing pulley fixing bolt holes are set to each other. Then Fit in a fixing bolt and lightly tighten.
- No. 1 cylinder should be at top dead center.

  If the fixing bolt holes are not set (No. 4 cylinder is at top dead center) give another turn.
- Remove tensioner and timing belt.


6C-32-4.tif

WARNING

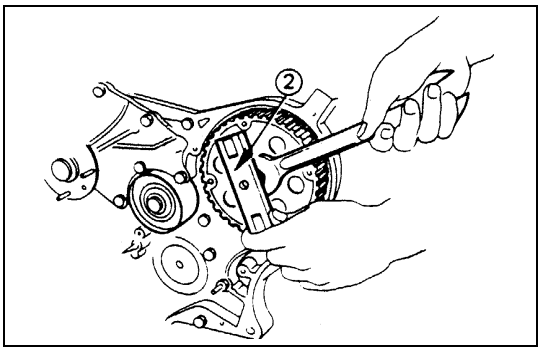
- **If crankshaft and camshaft and turned with timing belt being not mounted, piston and valve will interfere with each other. Therefore, the shafts must not be turned.**



6C-33-1.tif

12. Injection Pump Timing Pulley

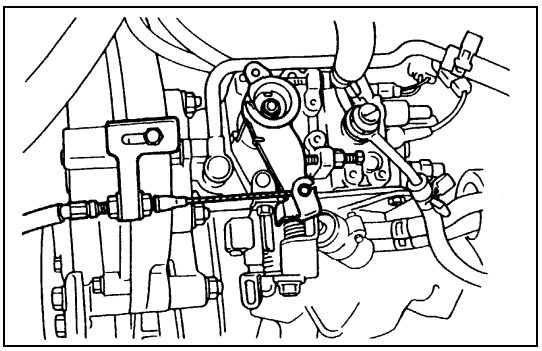
- Install the stopper bolt ① to the timing pulley to prevent it from turning.



6C-33-2.tif

- Use the timing pulley puller ② to remove the injection pump timing pulley.
  Timing Pulley Puller: 5-8840-0086-0
- Remove the stopper bolt.

13. Air Intake Duct



6C-33-3.tif

14. Injection Pump Control Cable

- Remove the control cable bracket bolt and remove the control lever side.

15. Fuel Hose

- Disconnect the fuel feed hose and fuel return hose.

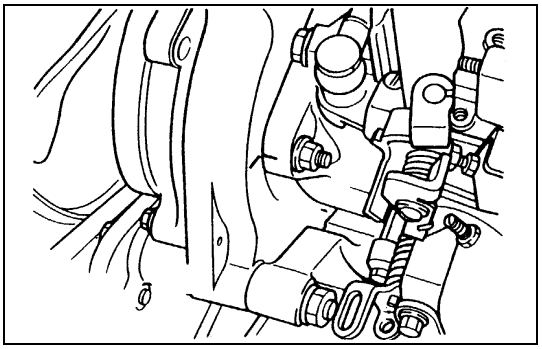
16. CSD Water Hose

17. Injection Pump Harness

18. Injection Pipe

19. Injection Pump Assembly

- Remove the pump bracket bolt engine side.
- Remove the adjust lock bolt.
- Remove the injection pump fixing bolt and take out injection pump.


6C-34-1.tif

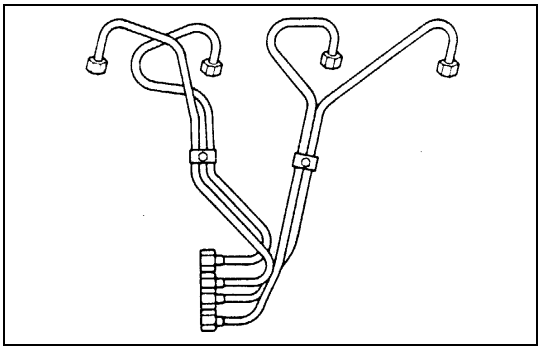
INSTALLATION

19. Injection Pump Assembly

- Put the timing pulley housing side and injection pump side setting marks together, and temporarily tighten.
- After adjusting injection timing retighten.
- Mount rear bracket on cylinder block and tighten to the specified torque.

	N·m (Kg·m/lb·ft)
	19 (1.9/14)

- Install adjust lock bolt and lightly tighten.
- After adjusting injection timing, retighten.


6C-34-2.tif

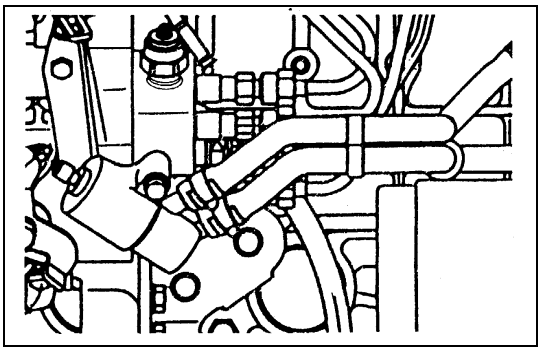
18. Injection Pipe

- Connect the pump side and nozzle side of the pipe, and tighten securely.
- Install clip where it was.

Sleeve Nut Torque	N·m (Kg·m/lb·ft)
	29 (3.0/22)

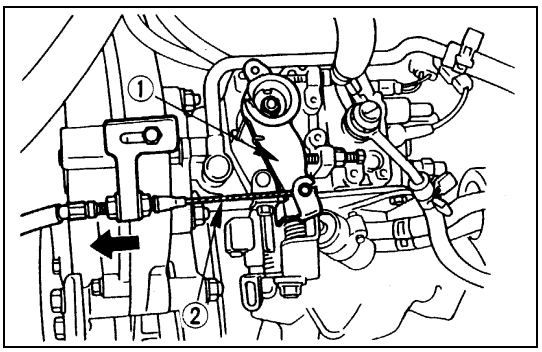
17. Injection Pump Harness

- Mount engine harness and connect it to switches.


6C-34-3.tif

16. CSD Water Hose

- Connect the water hose and tighten clip securely.



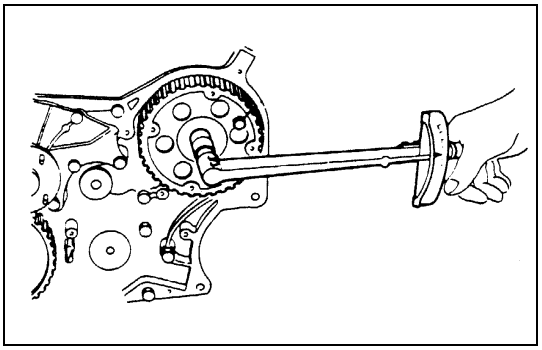
6C-34-4.tif

15. Fuel Hose

- Connect the fuel feed hose and fuel return hose.
- Connect the rear off hose.

14. Injection Pump Control Cable

1) Install the Control wire to the engine control lever.
2) Hold the accelerator lever ① in the fully closed position and stretch the control cable ② in the direction indicated by the arrow to remove any slack.
3) Tighten the accelerator cable bracket bolt.



6C-35-1.tif

13. Air Intake Duct

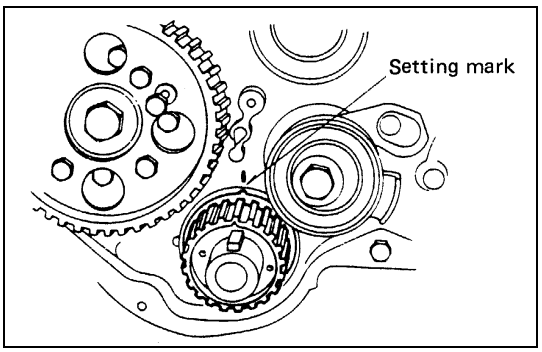
- Connect the air intake duct and tighten clip securely.

12. Injection Pump Timing Pulley

- Align the timing pulley with the pump shaft key.
- Install the stopper bolt to the timing pulley.
  This will prevent the timing pulley from moving.
- Tighten the timing pulley nut to the specified torque.

Injection Pump Timing Pulley Nut Torque N·m (Kg·m/lb·ft)
64 (6.5/47)

- Remove the stopper bolt from the injection timing pulley.



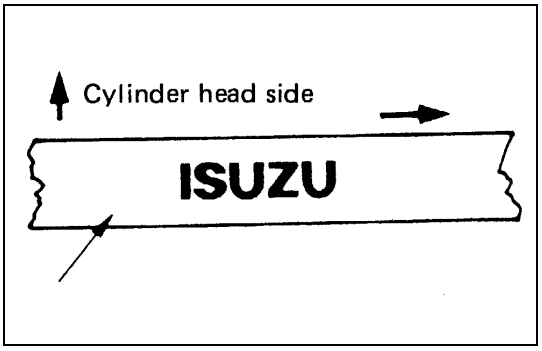
6C-35-2.tif

11. Timing Belt

- When removing the belt, make sure the marks on the bolt fixed camshaft, injection pulley and crankshaft timing pulley are set to each other.

CAUTION

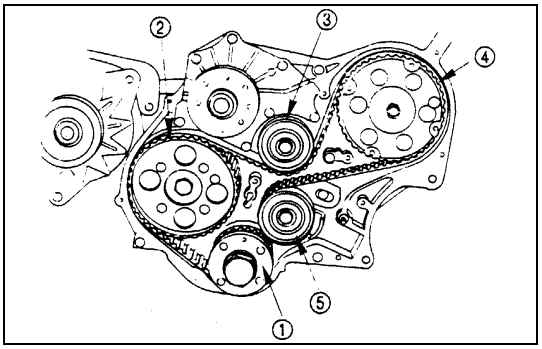
- Do not turn crankshaft because otherwise piston and valve will interfere with each other.



6C-35-3.tif

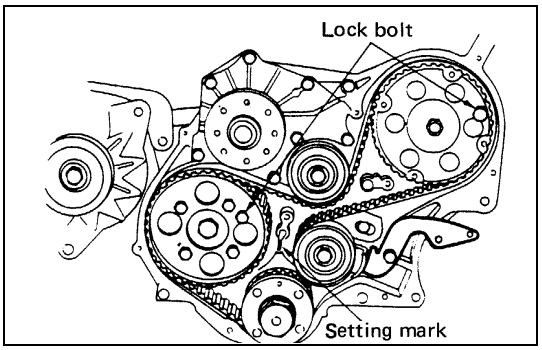
CAUTION

- For accurate mounting, be sure to mount the belt in the direction that letters on the belt are readable.



6C-36-1.tif

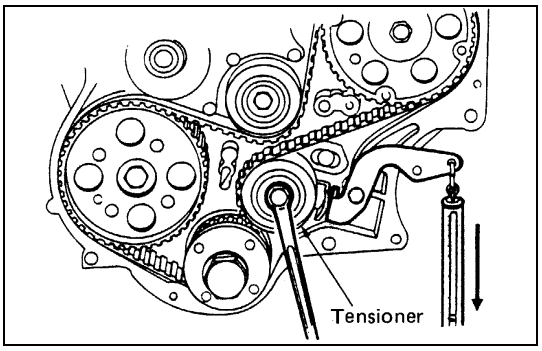
- Mount new timing belt on pulleys in the following steps.
  Crankshaft timing pulley ① camshaft
  Timing pulley.② Idle pulley ③ Injection
  Pump pulley ④ tensioner ⑤
- Set the belt on crankshaft timing pulley and hold with one hand.
- Stretch and pass the belt round each pulley with the other hand.
- After passing it round injection pump pulley, install tensioner while taking care not to slacken the belt.



6C-36-2.tif

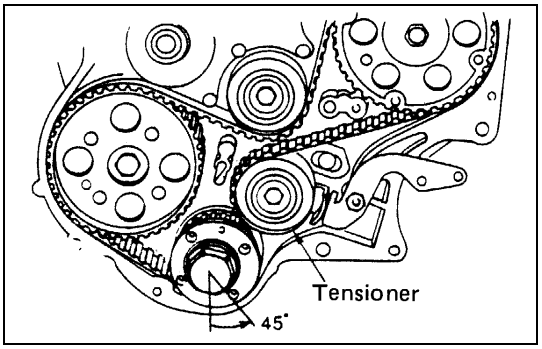
CAUTION

- On completion of belt passing, make sure that the setting mark on crankshaft timing pulley is set.
- If not set, reset the mark and repeat the belt passing.
- Remove tension adjust, lever mounting bolt, and loosen the fulcrum bolt to such extent that the lever is movable.
- Hung a spring balance from the end hole of tension adjust lever, and with the balance pulled down with 88 N (9Kg/20 lb)., loosen once the, tensioner mounting bolt and there retighten it.
- Turn the crankshaft by 45° counterclockwise to shift belt slackness on the tensioner.
- Again hand the spring balance from the end hole of tension adjust lever and pull it down with the specified force. Under this condition, loosen tensioner mounting bolt to absorb belt slackness and retighten is to specified torque.



6C-36-3.tif

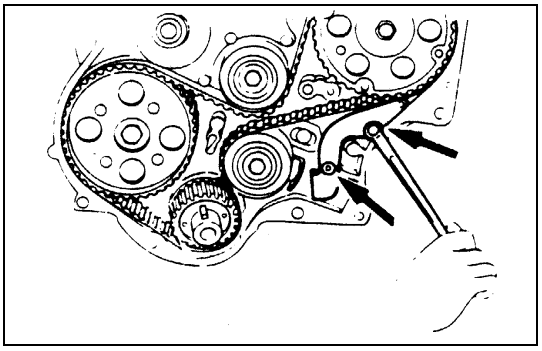
Belt Tension	N (Kg/lb)
98 ~ 118 (10 ~ 12/22 ~ 26)	



6C-36-4.tif

Bolt Torque	N·m (Kg·m/lb·ft)
76 (7.8/56)	

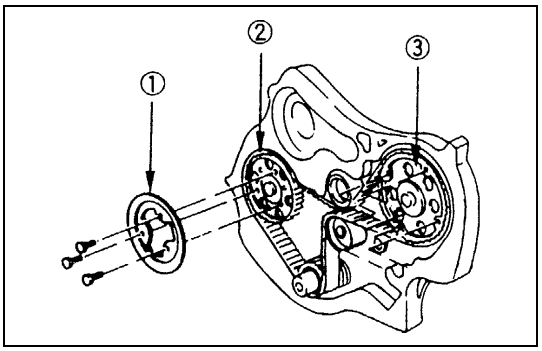
- Fix the tension adjust lever.



6C-37-1.tif

CAUTION

- In case where the timing belt has been replaced with the actuation of warning light, put off the light with change over switch on the reverse side of meter.
- Refer to Chassis Electrical in Seetion 8 .
- Tighten the tension adjusting lever nut and bolt.



6C-37-2.tif

10. Flange; Camshaft Pulley

- Install the timing pulley flange ① to the camshaft ②.
- Tighten the timing pulley flange bolts to the specified torque.

N·m (Kg·m/lb ft)
19 (1.9/14)

9. Timing Pulley Lower Cover

- Install timing pulley lower cover and tighten bolt to the specified torque.

N·m (Kg·m/lb in)
8 (0.8/69)

8. Timing Pulley Upper Cover

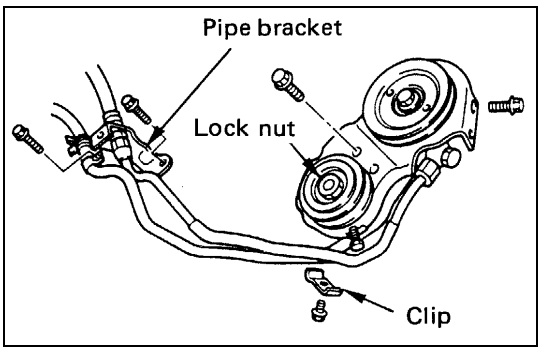
- Install timing pulley upper cover and tighten bolt to the specified torque.

N·m (Kg·m/lb in)
8 (0.8/69)

7. Crankshaft Damper Pulley

- Install crankshaft damper pulley and tighten bolt to the specified torque.

N·m (Kg·m/lb ft)
19 (1.9/14)



6C-37-3.tif

6. Power Steering Pump & Bracket Assembly (P/S Model)

- Install the pipe bracket, clip and tighten bolts to the specified torque.

Pipe bracket bolts	N·m (Kg·m/lb ft)
19 (1.9/14)	

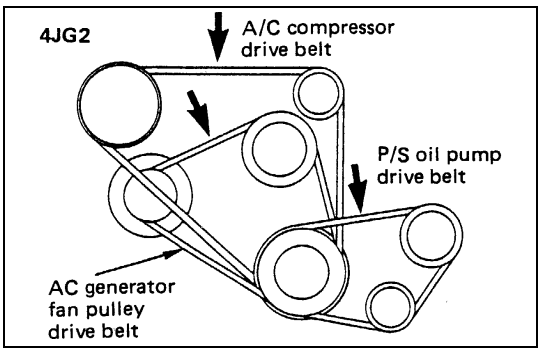
Pipe clip bolts	N·m (Kg·m/lb ft)
10 (1.0/7)	

- Install the Power Steering pump & bracket assembly.

10M bolts	N·m (Kg·m/lb ft)
	40 (4.1/30)

8M bolts	N·m (Kg·m/lb ft)
	19 (1.9/14)

Lock nut	N·m (Kg·m/lb ft)
	27 (2.8/20)



6C-38-1.tif

5. AC Generator Drive Belt

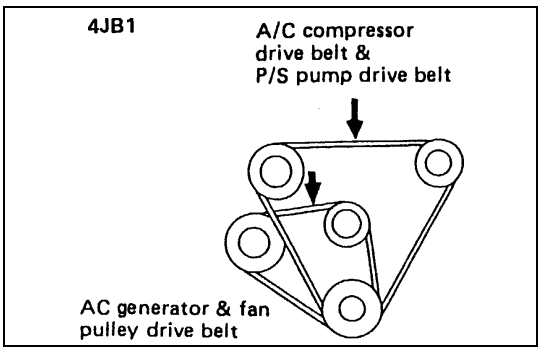
- Install AC generator drive belt and adjust belt tension.
- Depress the drive belt mid-portion with a 98N (10 kg/ 22 lb) force.

Drive Belt Deflection	mm (in)
	8 (0.31) - 10 (0.39)

- Install fixing bolt and tighten bolts to the specified torque.

Generator fixing Bolt	N·m (Kg·m/lb ft)
	40 (4.1/30)

Adjust Plate Fixing Bolt	N·m (Kg·m/lb ft)
	19 (1.9/14)



6C-38-2.tif

4. A/C Compressor Drive Belt (A/C Model)

- Install A/C compressor drive belt and adjust belt tension.
- Depress the drive belt mid-portion with a 98N (10 kg/22lb) force.

Drive Belt Deflection	mm (in)
	8 (0.31) - 10 (0.39)

- Tighten the idler lock nut to the specified torque.

	N·m (Kg·m/lb ft)
	27 (2.8/20)

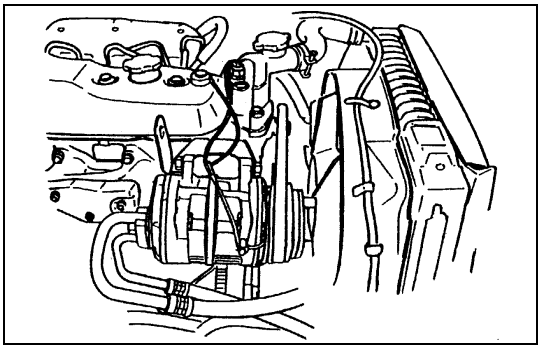
3. Power Steering Pump Drive Belt (P/S Model)

- Install power steering pump drive belt and adjust belt tension.
- Depress the drive belt mid-portion with a 98N (10 kg/22 lb) force.

Drive Belt Deflection	mm (in)
8 (0.31) - 10 (0.39)	

- Tighten the idler lock nut to the specified torque.

N·m (Kg·m/lb ft)
27 (2.8/20)



6C-39-1.tif

2. Fan Shroud

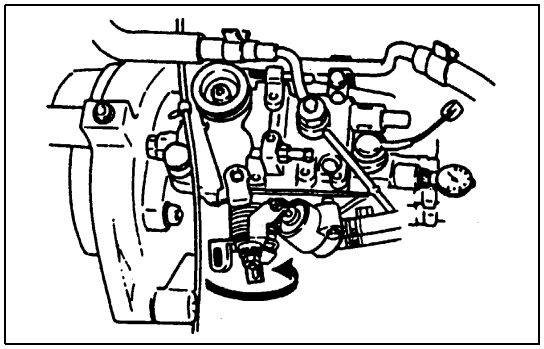
- Install the fan shroud and reservoir tank hose.

1. Cooling Fan Assembly

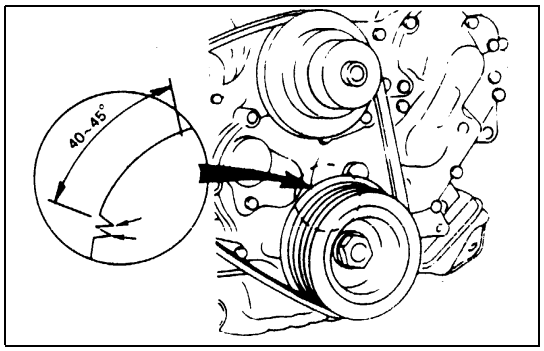
- Mount fan pulley, distance piece, and cooling fan assembly (in this order) on the water pump, and tighten to the specified torque.

N·m (Kg·m/lb in)
8 (0.8/69)

- Connect battery ground cable.
- Pour coolant.
- Start the engine and check coolant leakage.



6C-40-1.tif



6C-40-2.tif

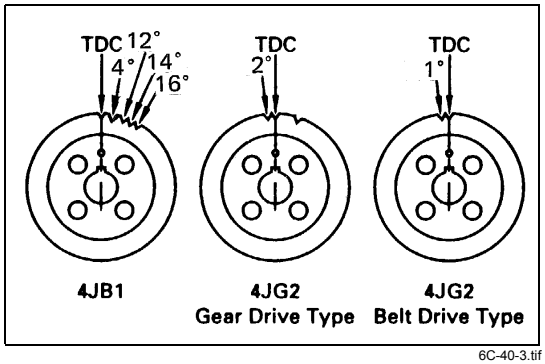
INJECTION TIMING ADJUSTMENT

- Set No. 1 cylinder to top dead center.
- Remove injection pump distributor head plug.
- Cancel wax CSD with the handle of a screw driver.
- Fit a dial gauge and set lift to 2 mm.

Measuring device: 5-8840-0145-0

- Set crankshaft damper pulley top dead center mark about 45° before top dead center from the pointer.
- Set dial gauge in the "0" position.
- Turn the crankshaft a little right wise and left wise and see if the pointer is stable in the "0" position.
- Turn the crankshaft in the normal direction and read the measuring device's indication at as follows.

4JB1	BTDC 14°, BTDC 12° ('91/ 542A)
4JB1T	BTDC11°
4JB1TC	BTDC4°
4JG2 (Belt Drive Type)	ATDC 1° ('91/ 542A) TDC 0° ('91/ 542B)
" (Gear Drive Type)	ATDC 2° ('91/ 542A)



6C-40-3.tif

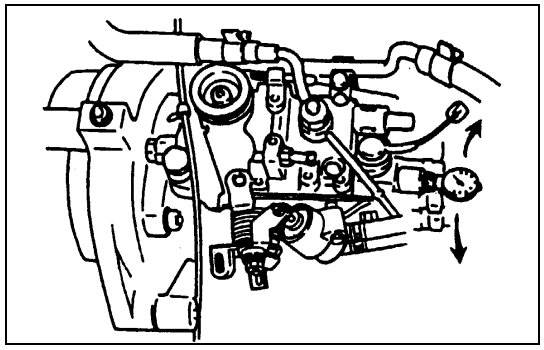
Measuring Device's Indication mm (in)

Standard	0.5 (0.0197)

- If it reads abnormal, loosen injection pump fixing nut and pump bracket adjust bolt, make adjustment by changing the pump mounting angle, and tighten the nut and bolt to the specified torque where the dial indicates the specified valve.

Pump fixing nut N·m (Kg·m/lb·ft)

24 (2.4/17)



6C-40-4.tif

Adjust bolt N·m (Kg·m/lb·ft)

19 (1.9/14)

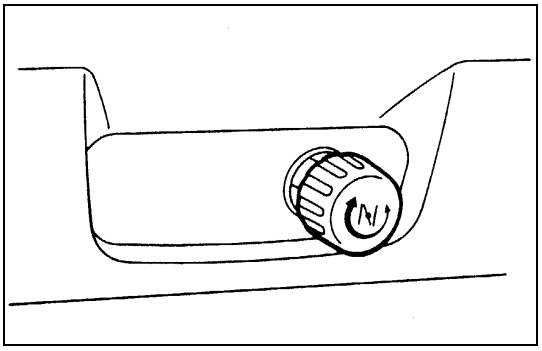
- Remove the measuring device and tighten the distributor head plug to the specified torque.

N·m (Kg·m/lb·ft)

17 (1.7/12)

CAUTION

- When installing the distributor head plug, be sure to use new copper washer.
- Connect injection pipe.
- Fit pipe clip where specified.

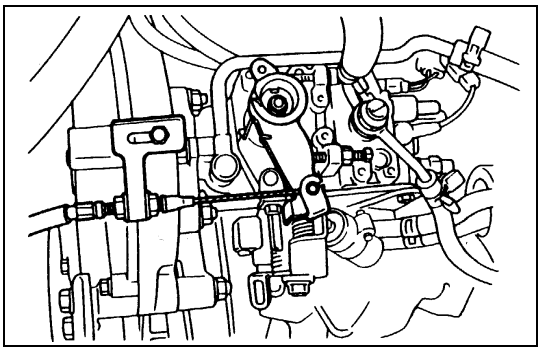


6C-41-1.tif

Adjustment of Idling Speed

1) Pull the parking brake and lock the wheels.
2) Set the transmission gear to the neutral position.
3) Start the engine and idle it until the water temperature gets to 70 to 80°C (158 to176°F).
4) Turn back the idling control button, and remove the control cable from the control lever (injection pump)
5) Set the engine tachometer.
6) Check the idling rotation.
   When the idling rotation is outside the range of the specified value, adjust it correctly.

Specified value (rpm) = 750 - 790 (4JB1)
700 - 740 (4JG2)



6C-41-2.tif

(1) Loosen the lock nut of the idling set bolt.
(2) Rotate the idling set bolt to set the idling rotation to the specified value.
(3) Tighten the lock knut to lock the set bolt.
(4) Check the tension of the control cable, and remove any slackening as required.

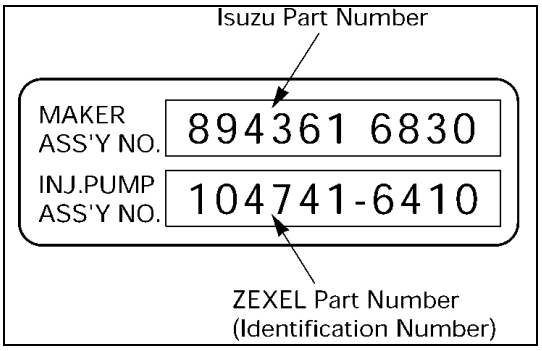
INJECTION PUMP DATA

TEST CONDITIONS

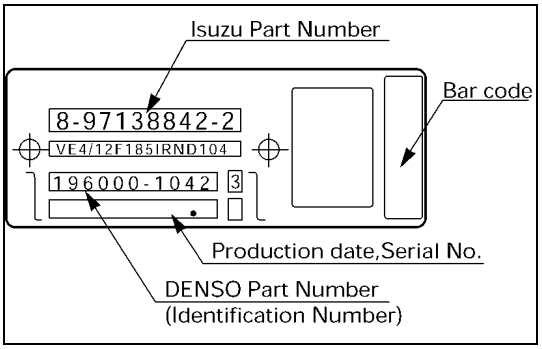
Items	Conditions					
Engine Type	4JB1(Gear)	4JG2(Belt) (For '91/542B) Euro 2	4JB1(Gear) (For '91/542A) Euro 1	4JG2(Gear) (For '91/542A) Euro 1	4JB1TC	4JB1T
Injection Nozzle						
ZEXEL Part Number	105780-0000	105780-0000		105780-0060	105780-0060	105780-0060
Bosch Type Number	DN12SD12T	DN12SD12		DN00SD1510		—
Injection Nozzle holder						
ZEXEL Part Number	105780-2080	105780-2080		105780-2150	105780-2150	105780-2150
Bosch Type Number	EF8511/9	EF8511/9		—	—	—
Injection Nozzle Opening Pressure MPa(kg/cm^2/psi)	14.7 (150 / 2,133)		13.0(133 / 1,891)			
Injection Line dimensions mm(in)						
Inside Diameter	2 (0.079)					
Outside Diameter	6 (0.236)					
Length	840 (33.1)		450 (17.7)			
Fuel delivery Pressure kPa(kg/cm2/psi)	20 (0.2 / 2.84)					
Test Fuel	SAE Standard Test Diesel Fuel (SAE967D) ISO Standard Test Diesel Fuel (ISO4113)					
Test Fuel Temperature °C (°F)	48 - 52 (118-126)					
Identification Numbers	104746-1230 104746-1240 104746-1250 104746-1260 104746-1270 104746-1280 104746-1290 104746-1370	196000-1042	104742-1451 104742-1461 104742-1471 104742-1480 104742-1490	104746-1222 104746-1211 4JG2 (Belt) (For +91/542A)	104746-6601 104766-6620	104746-6311 104746-6380 104746-6670

Note:

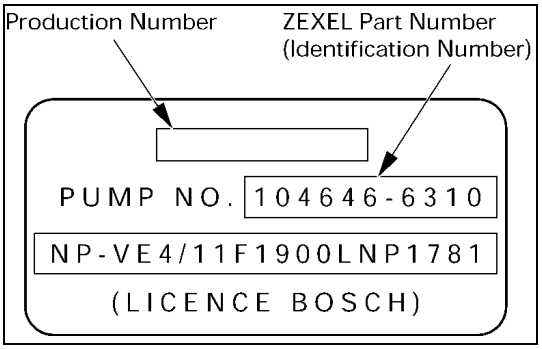
'91/542A ; Euro 1
'91/542B ; Euro 2



F06LV002.tif



F06LV001.tif



F06LW002.tif

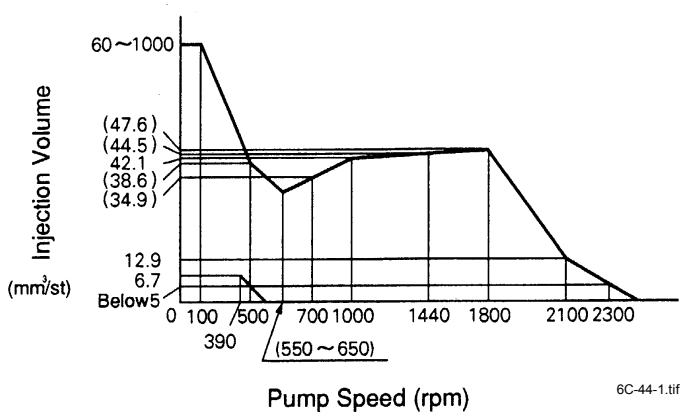
IDENTIFICATION PLATE AND NUMBER

Use the data following the injection pump identification number to adjust the injection volume.

INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

Engine ; 4JB1
Injection pump assembly No. ; 8943616830 (104741-6410)
8943616850 (104741-6430)

Injection volume adjustment

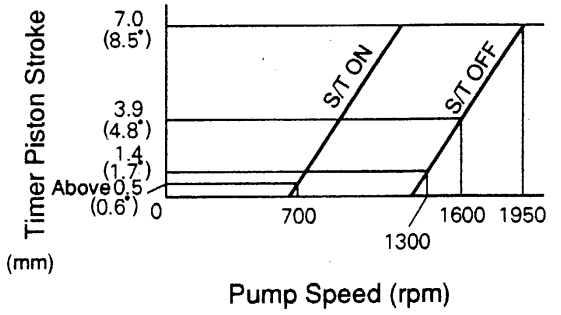


6C-44-1.tif

Adjustment specification of injection volume

Pump rotation rpm	Average injection quantity mm³/ST	Uneven amplitude mm³/ST	Oil temperature °C	Remarks
500	(38.6)		48±2	
700	34.9±2.5		50±2	
1000	42.1±1.0	4.0	50±2	Standard
1450	44.5±2.5		50±2	
1800	47.6±3.0		60±2	
2100	12.9±3.0	4.0	52±2	
390	6.7±3.0	2.0	48±2	
100	60 - 100		48±2	

Timer adjustment

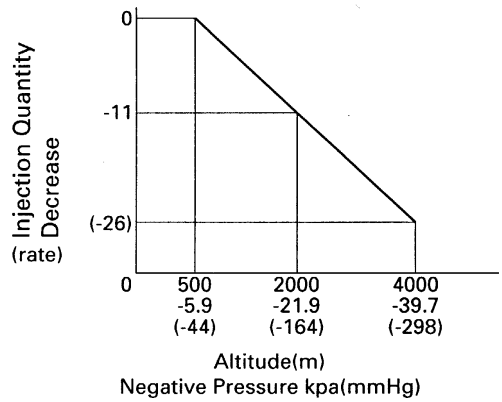


6C-44-2.tif

Adjustment specification of timer and pump case pressure

Pump rotation rpm	Timer piston stroke mm		Air pressure of pump kPa (kg/cm²)		Standard
	Solenoid timer		Solenoid timer		
	ON	OFF	ON	OFF	
700	Over 0.5	—	—	—	
1300	—	1.4±0.4	—	—	
1600	—	3.9±2	—	490±20 (5.0±0.2)	Standard
1950	—	7.0 $^{+0.4}_{-0.3}$	—	—	

Aneroid compensator adjustment



6C-44-3.tif

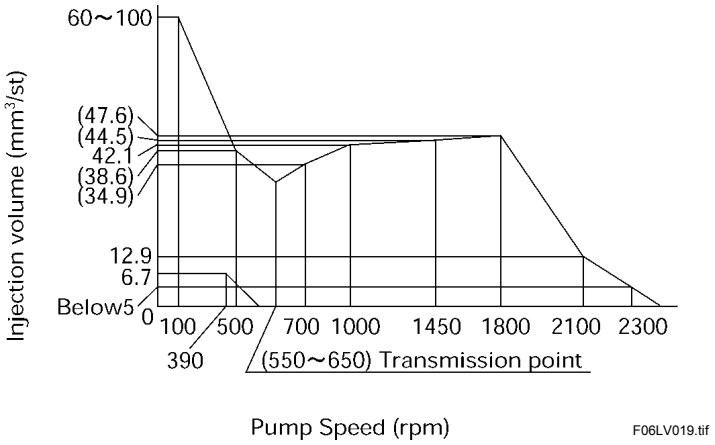
Adjustment specification of aneroid compensator

Pump rotation rpm	Altitude m	Air pressure difference kPa (mmHg)	Amount of reduction mm³/ST	Rate of reduction %
1000	0	0	0	0
	(500)	-5.9±3.3 (-44±3)	Inflation point	Inflation point
	2000	-21.9 (-164)	-4.6±1	-11±3

Engine ; 4JB1

Injection pump identification No. ; 104746-1230, 1240, 1250, 1260, 1280, 1290, 1370

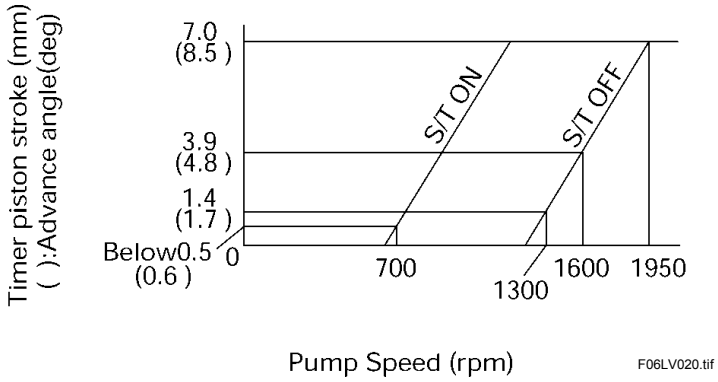
Injection volume adjustment



Adjustment specification of injection volume

Pump rotation (rpm)	Average injection quantity (mm^3/ST)	Uneven amplitude (mm^3/ST)	Oil temperature (°C)	Remarks
500	(38.6)		48±2	
700	34.9±2.5		50±2	
1000	42.1±1.0	4.0	50±2	Standard
1450	44.5±2.5		50±2	
1800	47.6±3.0		50±2	
2100	12.9±3.0	4.0	52±2	
390	6.7±2.0	2.0	48±2	
100	60 - 100		48±2	

Timer adjustment



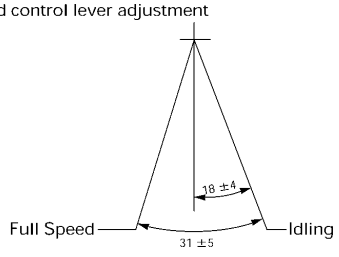
Adjustment specification of timer and pump case pressure

Pump rotation (rpm)	Timer piston stroke (mm)		At pressure of pump (MPa (kg/cm^2))		Standard
	Solenoid timer		Solenoid timer		
	ON	OFF	ON	OFF	
700	Over 0.5	—	—	—	
1300	—	1.4±0.4	—	—	
1600	—	3.9±2	—	0.49±0.02 (5.0±0.2)	Standard
1950	—	$7.0^{+0.4}_{-0.3}$	—	—	

Adjustment specification of aneroid compensator (For 104746-1230,14746-1280)

Pump rotation (rpm)	Altitude (m)	Air pressure difference kPa (mmHg)	Amount of reduction (mm^3/ST)	Rate of reduction (%)
1000	0	0	0	0
	(500)	-5.9±3.3 (-44±25)	Inflation point	Inflation point
	2000	-21.9 (-164)	-4.6±1	-11±3

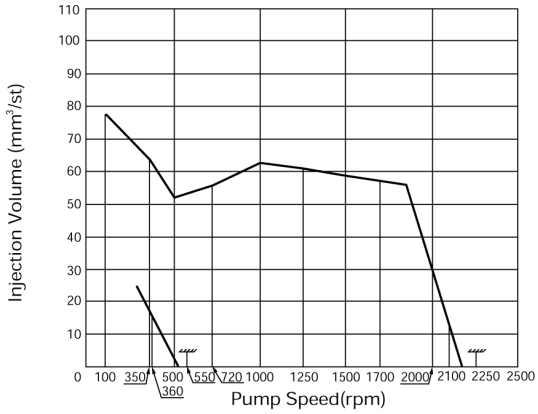
Speed control lever adjustment



Engine ; 4JG2 (For '91/542B) (Belt drive)

Injection pump assembly No. ; 897138-8422 (196000-1042)

Injection Volume

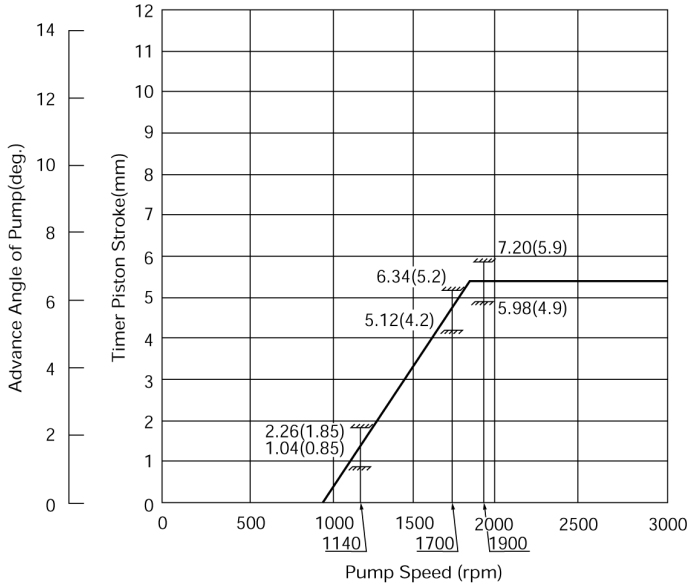


F06LV005.tif

Adjustment specification of injection volume

Pump rotation rpm	Average injection quantity mm³/ST	Uneven amplitude mm³/ST	Remarks
100	78±12		
350	64±6.0		
500	52±3.0		
720	55.9±3.4		
1000	62.6±1.0	4.0	
1250	60.9±3.5		
1700	574±3.5	4.0	
2100	13±5.0		
2250	Below 5.0		
360	15.9±3.0	2.5	
550	Below 3.0		

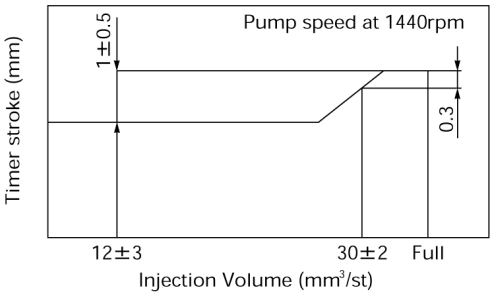
Timer adjustment



Indication timer stroke in parentheses.(mm)
The timer stroke 1mm=1.22 on camshaft.
1mm=2.44 on crankshaft.

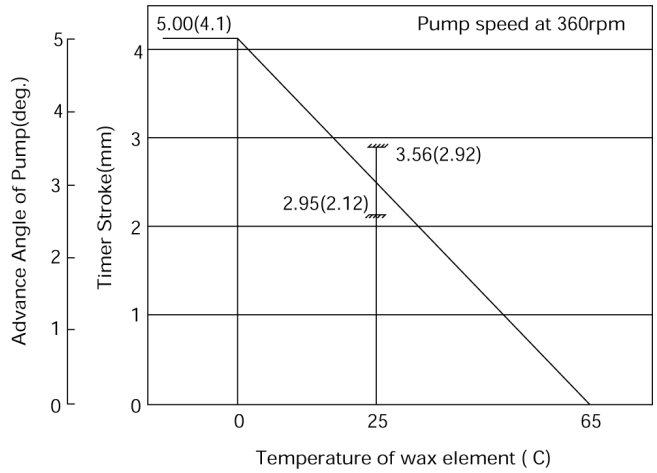
F06LV007.tif

Load timer adjustment



F06LV006.tif

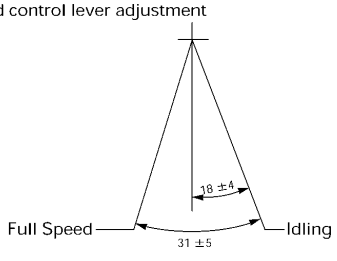
Cold start device adjustment



Indication timer stroke in parentheses.(mm)
The timer stroke 1mm=1.22 on camshaft.
The timer stroke 1mm=2.44 on crankshaft.

F06LV008.tif

Speed control lever adjustment

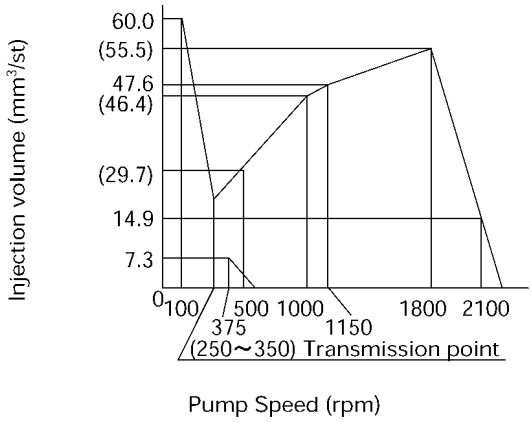


F06LV004.tif

Engine ; 4JB1 (For '91/542A) (Gear drive)

Injection pump identification No. ; 104742-1451, 1461, 1471

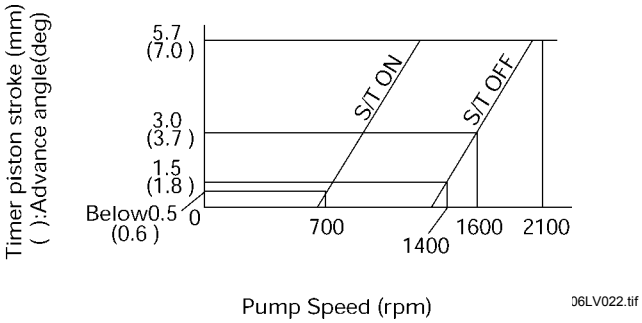
Injection volume adjustment



Adjustment specification of injection volume

Pump rotation (rpm)	Average injection quantity (mm^3/ST)	Uneven amplitude (mm^3/ST)	Oil temperature (°C)	Remarks
500	(29.7±4.5)		48±2	
1000	(46.4±3.5)		50±2	
1150	47.6±1.0	3.5	50±2	Standard
1800	$(55.5^{+0.4}_{-6.0})$		50±2	
2100	14.9±3.0	4.0	52±2	Standard
375	7.3±2.0	2.0	48±2	Standard
100	(60 - 100)		48±2	

Timer adjustment



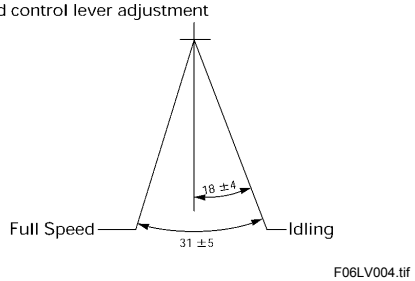
Adjustment specification of timer and pump case pressure

Pump rotation (rpm)	Timer piston stroke (mm)		At pressure of pump (MPa (kg/cm^2))		Remarks
	Solenoid timer		Solenoid timer		
	ON	OFF	ON	OFF	
700	Over 0.5	—	—	—	
1400	—	1.5±0.4	—	—	
1600	—	3.0±0.2	—	0.53±0.02 (5.4±0.2)	Standard
2100	—	$5.7^{+0.4}_{-0.3}$	—	—	

Adjustment specification of aneroid compensator (For 104742-1471)

Pump rotation (rpm)	Altitude (m)	Air pressure difference kPa (mmHg)	Amount of reduction (mm^3/ST)	Rate of reduction (%)
1150	0	0	0	0
	(500)	-5.9±3.3 (-44±25)	Inflation point	Inflation point
	2000	-21.9 (-164)	(-5.2±1.3)	(-11±3)

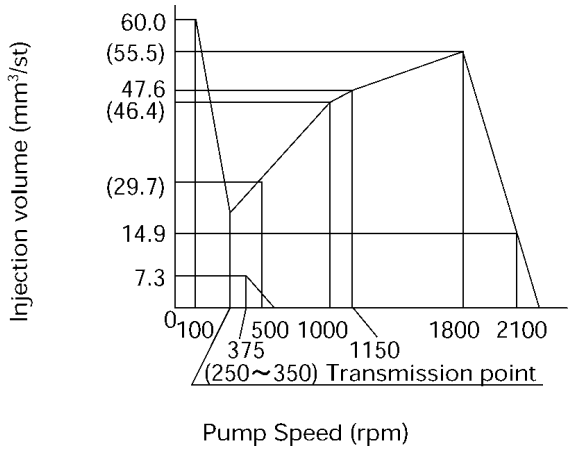
Speed control lever adjustment



Engine ; 4JB1 (For '91/542A) (Gear drive)

Injection pump identification No. ; 104742-1480, 1490

Injection volume adjustment

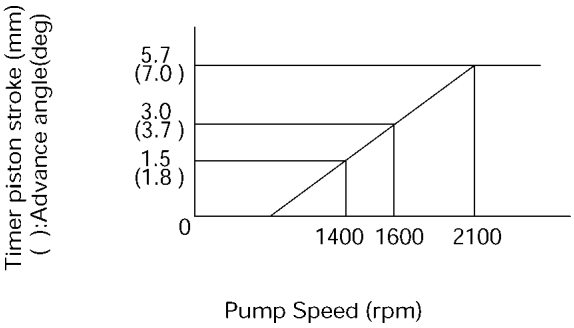


F06LV021.tif

Adjustment specification of injection volume

Pump rotation (rpm)	Average injection quantity (mm^3/ST)	Uneven amplitude (mm^3/ST)	Oil temperature (°C)	Remarks
500	(29.7±4.5)		48±2	
1000	(46.4±3.5)		50±2	
1150	47.6±1.0	3.5	50±2	Standard
1800	(55.5 $^{+0.4}_{-6.0}$)		50±2	
2100	14.9±3.0	4.0	52±2	Standard
375	7.3±2.0	2.0	48±2	Standard
100	(60 - 100)		48±2	

Timer adjustment

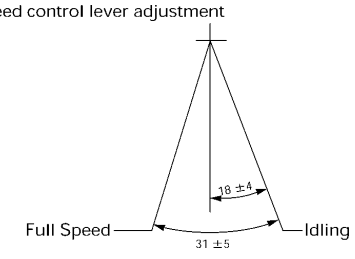


F06LV023.tif

Adjustment specification of timer and pump case pressure

Pump rotation (rpm)	Timer piston stroke (mm)	At pressure of pump (MPa (kg/cm^2))	Remarks
1400	(1.5±0.4)	—	
1600	3.0±0.2	0.53±0.02 (5.4±0.2)	Standard
2100	5.7 $^{+0.4}_{-0.3}$		

Speed control lever adjustment

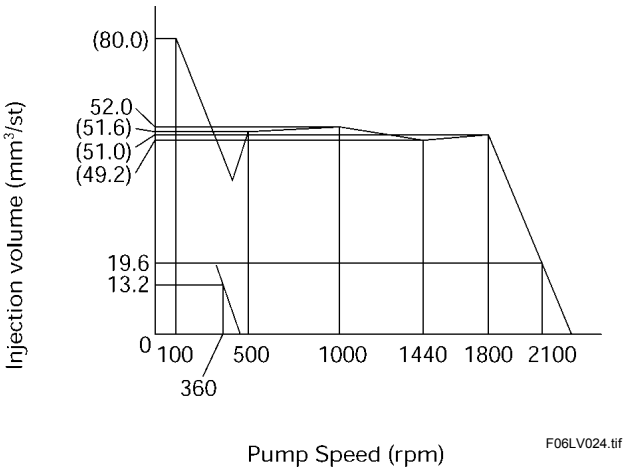


F06LV004.tif

Engine ; 4JG2 (For '91/542A) (Gear drive)

Injection pump identification No. ; 104746-1222

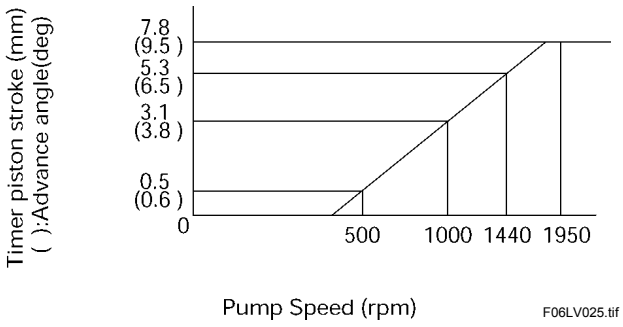
Injection volume adjustment



Adjustment specification of injection volume

Pump rotation (rpm)	Average injection quantity (mm^3/ST)	Uneven amplitude (mm^3/ST)	Oil temperature (°C)	Remarks
500	(51.6)		48±2	
1000	52.0±1.0		50±2	Standard
1440	(49.2)	3.5	50±2	
1800	(51.0)		50±2	
2100	19.6±3.0	5.5	52±2	
360	13.2±2.0	2.0	48±2	
100	(80 - 120)		48±2	

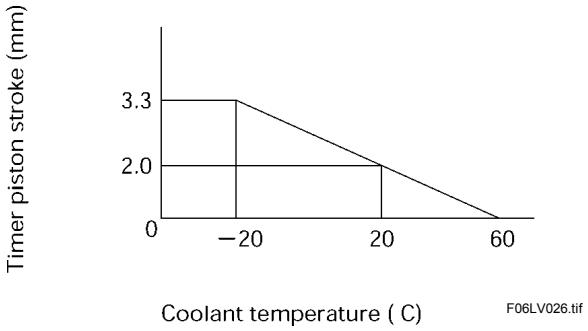
Timer adjustment



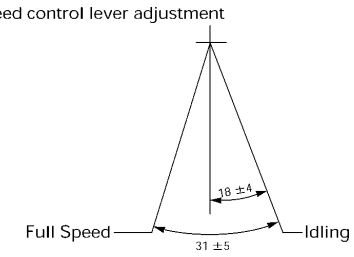
Adjustment specification of timer and pump case pressure

Pump rotation (rpm)	Timer piston stroke (mm)	At pressure of pump (MPa (kg/cm^2))	Remarks
500	$0.5^{+0.8}_{-0.4}$		
1000	3.1±0.2	0.402±0.029 (4.1±0.3)	Standard
1440	5.3±0.4		
1950	$7.8^{+0.4}_{-0.3}$		

Cold start device adjustment



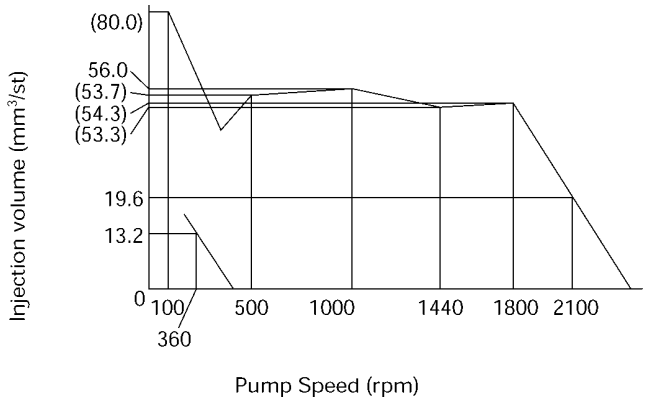
Speed control lever adjustment



Engine ; 4JG2 (For '91/542A) (Belt drive)

Injection pump identification No. ; 104746-1211

Injection volume adjustment

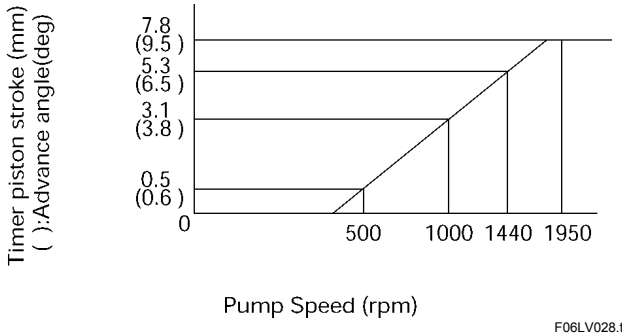


F06LV027.tif

Adjustment specification of injection volume

Pump rotation (rpm)	Average injection quantity (mm^3/ST)	Uneven amplitude (mm^3/ST)	Oil temperature (°C)	Remarks
500	(53.7)		48±2	
1000	56.0±1.0	3.5	50±2	Standard
1440	(53.3)		50±2	
1800	(54.3)		50±2	
2100	19.6±3.0	5.5	52±2	
360	13.2±2.0	2.0	48±2	
100	(80 - 120)		48±2	

Timer adjustment

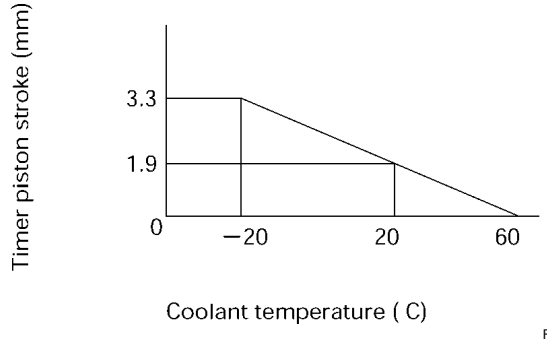


F06LV028.tif

Adjustment specification of timer and pump case pressure

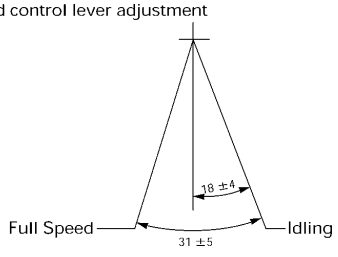
Pump rotation (rpm)	Timer piston stroke (mm)	At pressure of pump (MPa (kg/cm^2))	Remarks
500	$0.5^{+0.4}_{-0.3}$		
1000	3.1±0.2	0.402±0.029 (4.1±0.3)	Standard
1440	5.3±0.4		
1950	$7.8^{+0.8}_{-0.4}$		

Cold start device adjustment



F06LV029.tif

Speed control lever adjustment

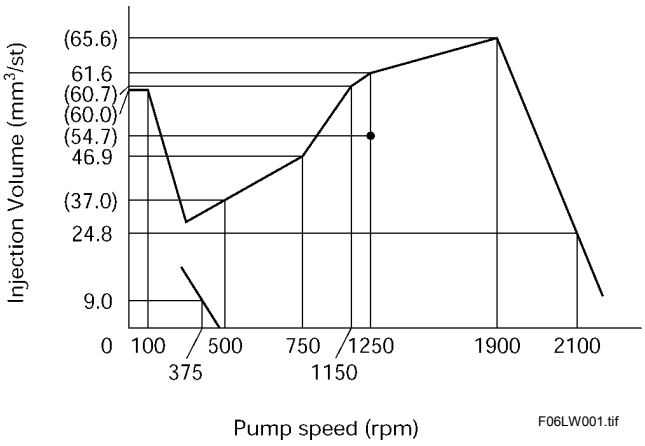


F06LV004.tif

Engine ; 4JB1T

Injection pump identification No. ; 104746-6311, 104746-6380

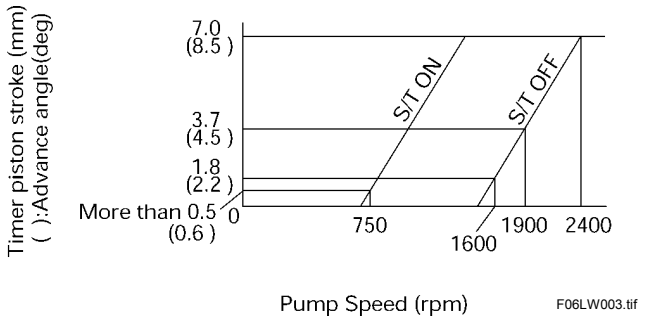
Injection volume adjustment



Adjustment specification of injection volume

Pump rotation (rpm)	Average injection quantity (mm^3/ST)	Uneven amplitude (mm^3/ST)	Boost pressure (kPa (kg/cm^2))	Oil temperature (°C)	Remarks
500	(37.0±4.0)	—	0	48±2	
750	46.9±1.0	3.5	33.3 (0.34)	50±2	Standard
1150	(60.7±3.5)	—	72.0 (0.73)	50±2	
1250	61.6±1.0	5.0	72.0 (0.73)	50±2	Standard
1250	(54.7±3.5)	—	0	50±2	
1900	(65.6±4.0)	—	72.0 (0.73)	50±2	
2100	24.8±3.0	4.5	72.0 (0.73)	52±2	Standard
375	9.0±2.0	2.0	0	48±2	Standard
100	60^{+40}_{-0}	—	0	48±2	

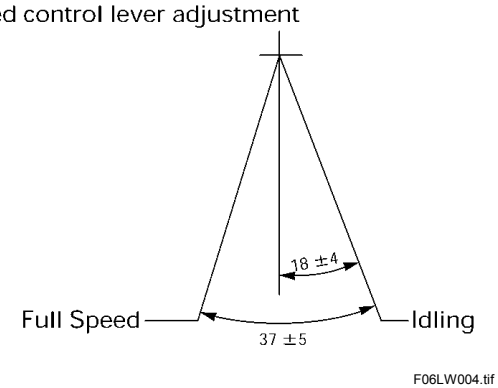
Timer adjustment



Adjustment specification of timer and pump case pressure

Pump rotation (rpm)	Timer piston stroke (mm)		At pressure of pump (MPa (kg/cm^2))		Boost Pressure kPa (kg/cm^2)	Remarks
	Solenoid timer		Solenoid timer			
	ON	OFF	ON	OFF		
750	Over 0.5	—	—	—	72.0 (0.73)	
1600	—	1.8±0.4	—	—	72.0 (0.73)	
1900	—	3.7±0.2	—	618 (6.3±0.2)	72.0 (0.73)	Standard
2400	—	$7.0^{+0.4}_{-0.3}$	—	—	72.0 (0.73)	

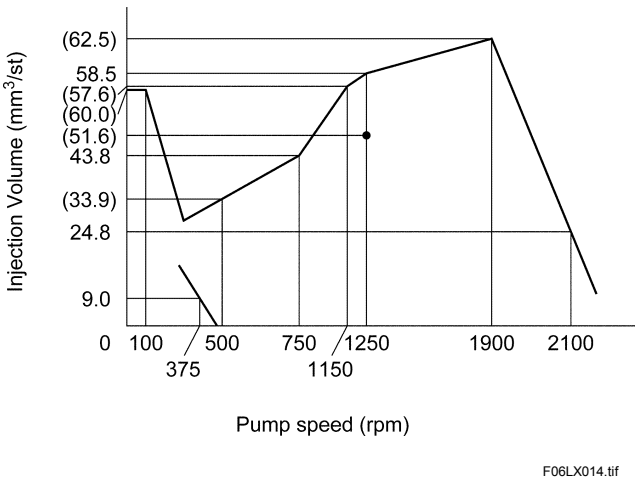
Speed control lever adjustment



Engine ; 4JB1T

Injection pump identification No. ; 104746-6670

Injection volume adjustment

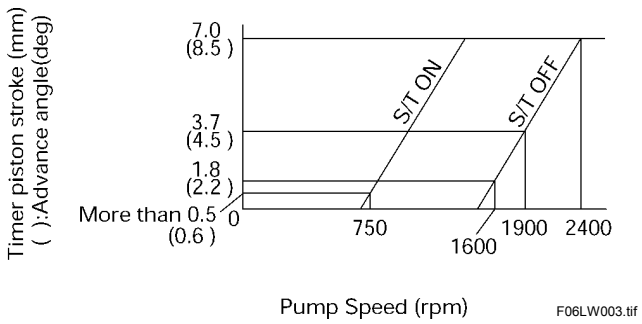


F06LX014.tif

Adjustment specification of injection volume

Pump rotation (rpm)	Average injection quantity (mm^3/ST)	Uneven amplitude (mm^3/ST)	Boost pressure (kPa (kg/cm^2))	Oil temperature (°C)	Remarks
500	(33.9±4.0)	—	0	48±2	
750	43.8±1.0	3.5	33.3 (0.34)	50±2	Standard
1150	(57.6±3.5)	—	72.0 (0.73)	50±2	
1250	58.5±1.0	5.0	72.0 (0.73)	50±2	Standard
1250	(51.6±3.5)	—	0	50±2	
1900	(62.5±4.0)	—	72.0 (0.73)	50±2	
2100	24.8±3.0	4.5	72.0 (0.73)	52±2	Standard
375	9.0±2.0	2.0	0	48±2	Standard
100	60^{+40}_{-0}	—	0	48±2	

Timer adjustment

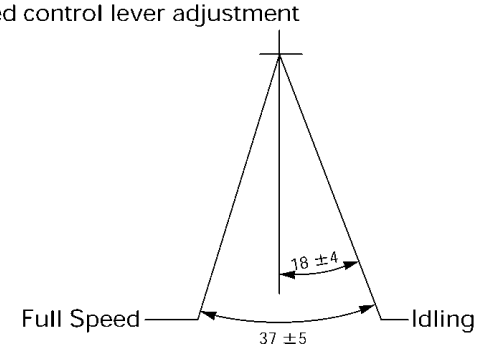


F06LW003.tif

Adjustment specification of timer and pump case pressure

Pump rotation (rpm)	Timer piston stroke (mm)		At pressure of pump (MPa (kg/cm^2))		Boost Pressure kPa (kg/cm^2)	Remarks
	Solenoid timer		Solenoid timer			
	ON	OFF	ON	OFF		
750	Over 0.5	—	—	—	72.0 (0.73)	
1600	—	1.8±0.4	—	—	72.0 (0.73)	
1900	—	3.7±0.2	—	618 (6.3±0.2)	72.0 (0.73)	Standard
2400	—	$7.0^{+0.4}_{-0.3}$	—	—	72.0 (0.73)	

Speed control lever adjustment

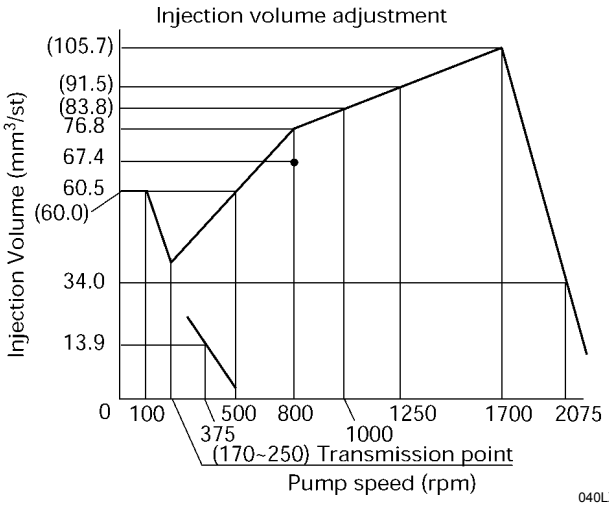


F06LW004.tif

Engine ; 4JB1TC

Injection pump identification No. ; 104746-6601

Injection volume adjustment

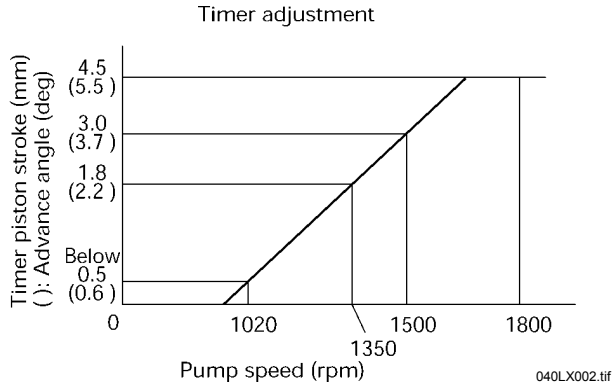


040LX001.tif

Adjustment specification of injection volume

Pump rotation (rpm)	Average injection quantity (mm^3/ST)	Uneven amplitude (mm^3/ST)	Boost pressure (kPa (kg/cm^2))	Oil temperature (°C)	Remarks
500	60.5±1.0	5.0	0	48±2	Standard
800	67.4±1.0	5.5	52.0 (0.531)	50±2	Standard
800	76.8±1.0	6.0	80.0 (0.821)	50±2	Standard
1000	(83.8±6.5)		80.0 (0.821)	50±2	
1250	(91.5±6.5)		80.0 (0.821)	50±2	
1700	(105.7±6.5)		80.0 (0.821)	50±2	
2075	34.0±3.0	7.0	80.0 (0.821)	52±2	Standard
375	13.9±2.0	2.0	0	48±2	Standard
100	60^{+40}_{-0}		0	48±2	

Timer adjustment



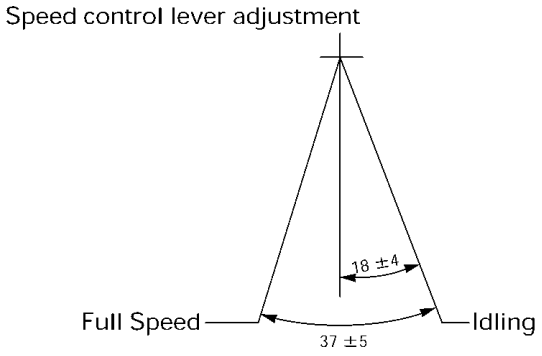
040LX002.tif

Adjustment specification of timer and pump case pressure

Pump rotation (rpm)	Timer piston stroke (mm)	At pressure of pump (MPa (kg/cm^2))	Boost Pressure kPa (kg/cm^2)	Remarks
1020	Below 0.5		80.0 (0.82)	
1350	1.8±0.2	471±29 (4.8±0.3)	80.0 (0.82)	Standard
1500	(3.0±0.4)		80.0 (0.82)	
1800	$4.5^{+0.4}_{-0.3}$		80.0 (0.82)	

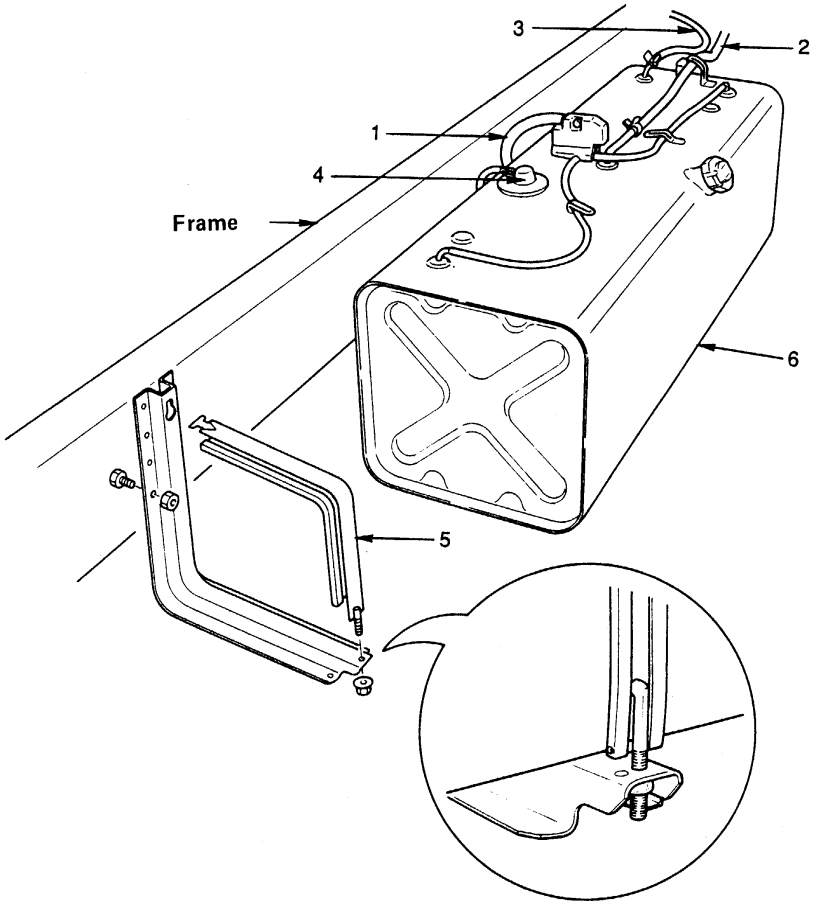
Potentiometer adjustment

Pump speed (r/min)	Out-put voltage (V)	Average injection quantity (mm^3/st)	Boost Pressure kPa (kg/cm^2)	Remarks
1080	3.56±0.03	27.5±2.0	0	Standard
375	(0.93±0.45)	13.9±2.0	0	Standard



F06LW004.tif

FUEL TANK



Removal steps
1. Evapo fuel hose
2. Fuel feed hose
3. Fuel return hose
4. Fuel gauge unit connector
5. Band
6. Fuel tank

Installation steps
To install, follow the removal steps in the reverse order.

6C-54-1.tif

REMOVAL

Preparation:
- Disconnect battery ground cable.
- Loosen fuel filler cap.
- Drain fuel from drain plug.
- After the drain fuel, tighten the drain plug to the specified torque.

N·m (Kg·m/lb·ft)

29 (3/22)

1. **Evapo Fuel Hose**
2. **Fuel Feed Hose**
3. **Fuel Return Hose**
   - Plug the hose to prevent fuel from getting spilt, and tie it to the frame with the plugged end up.
4. **Fuel Gauge Unit Connector**
   - Remove the connector of the fuel gauge.
5. **Band**
   - Remove the nut of the fuel tank fixing band, and then remove the band end on the frame side.

6. **Fuel Tank**
   - Pull out the fuel tank to the outside.

   Note:

   When it is not possible to pull out the fuel tank, remove the bracket and then draw out the fuel tank downward.

INSTALLATION

6. **Fuel Tank**

   Note:

   When the bracket was removed to take off the fuel tank, install the bracket to the frame and tighten it to the specified torque.

N·m (Kg·m/lb·ft)
55 (5.6/41)

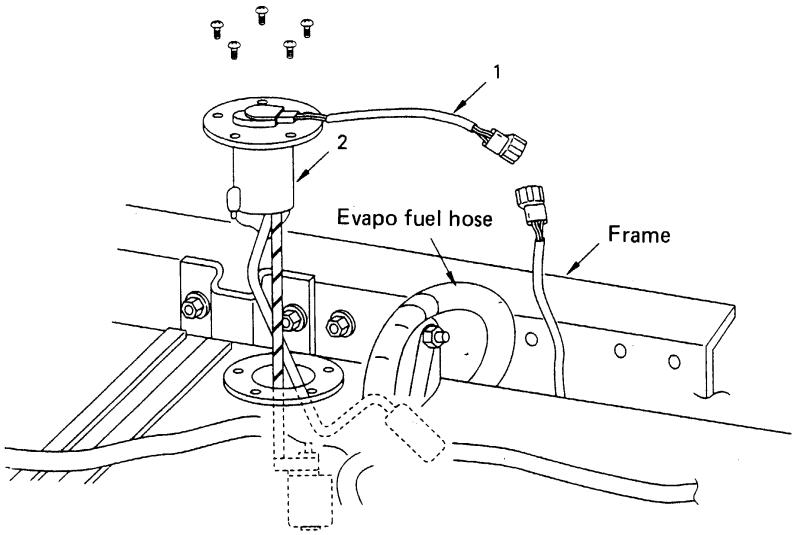
   When mounting the fuel tank on the bracket, be sure to place the packing section pasted on the fuel tank securely on the bracket.

5. **Band**
   - Tighten the band to the specified torque

N·m (Kg·m/lb·ft)
12 (1.2/104)

4. **Fuel Gauge Unit Connector**
   - Connect the fuel gauge unit connector.
3. **Fuel Return Hose**
2. **Fuel Feed Hose**
   - Set the hose to the pipe more than 25 mm (0.98 in) deep.
1. **Evapo Fuel Hose**
   - Fill the fuel to the fuel tank.
   - Connect battery ground cable.

FUEL GAUGE UNIT



Removal steps
1. Fuel gauge unit connector
2. Fuel gauge unit

Installation steps
To install follow the removal steps in the reverse order.

6C-56-1.tif

REMOVAL

Preparation: Disconnect Battery ground cable.

1. **Fuel Gauge Unit Connector**
   - Disconnect fuel gauge unit connector from fuel gauge unit.
2. **Fuel Gauge Unit**
   - Remove fuel gauge unit fixing screw and fuel gauge unit.

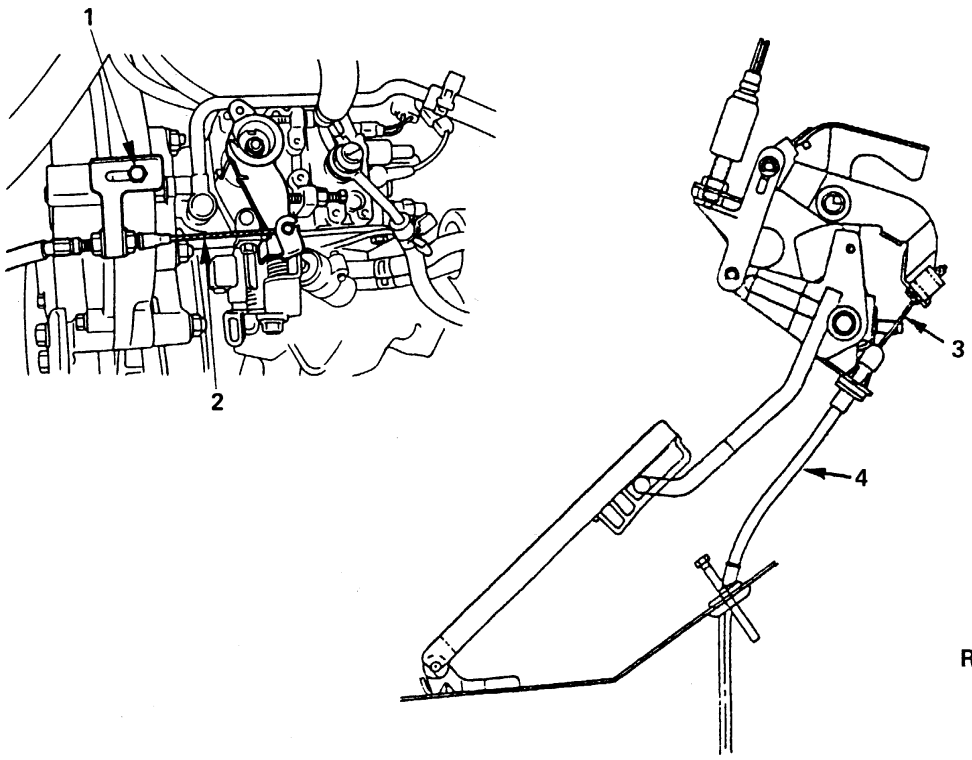
NOTE:
- After removing fuel gauge unit, cover fuel tank with waste to prevent any dust entering.

INSTALLATION

2. **Fuel Gauge Unit**
1. **Fuel Gauge Unit Connector**
   - Connect the wiring connector to the fuel gauge unit.

ACCELERATOR CONTROL

ACCELERATOR CONTROL CABLE



Removal steps
1. Adjust nut
2. Accelerator control wire
3. Accelerator control wire
4. Accelerator control cable

Installation steps
To install, follow the removal steps in the reverse order.

6C-57-1.tif

REMOVAL

1. **Adjust Nut**
   - Loosen the adjust nut on the cable bracket mounted on the inlet manifold.
2. **Accelerator Control Wire (Injection Pump Side)**
   - Remove the control wire from injection pump control lever.
3. **Accelerator Control Wire (Accelerator Pedal Side)**
   - Remove the accelerator control wire from accelerator pedal.
4. **Accelerator Control Cable**
   - Remove the cable clip from intake manifold duct.
   - Remove the cable clip from chassis frame.
   - Pull out the wire to the chassis side through the grommet hole of the floor board, and remove the control cable.

INSPECTION

Check the following items, and replace the control cable if any abnormality is found.

- The control cable should move smoothly.
- The control cable should not be bent or kinked.
- The control cable should be free of damage and corrosion.

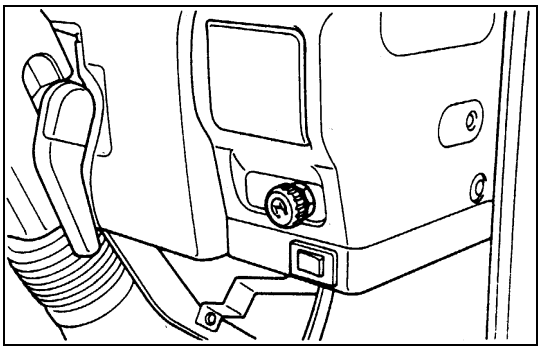
INSTALLATION

4. Accelerator Control Cable

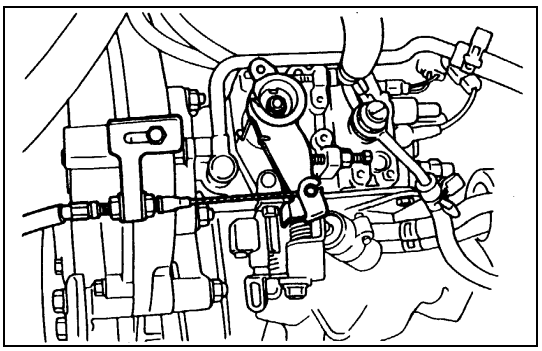
- Take care that the core wire of the cable does not get damaged or kinked.
- Pull the cable through the grommet hole from under the floor.
- Set the groove of the grommet securely into the floor panel.
- Lower the cab.

3. Accelerator Control Wire (Accelerator pedal side)

- Connect the accelerator control wire to the accelerator pedal.
- Check to see if the idling control knob is fully turned to the left.
- Tilt up the cab.



6C-58-1.tif



6C-58-2.tif

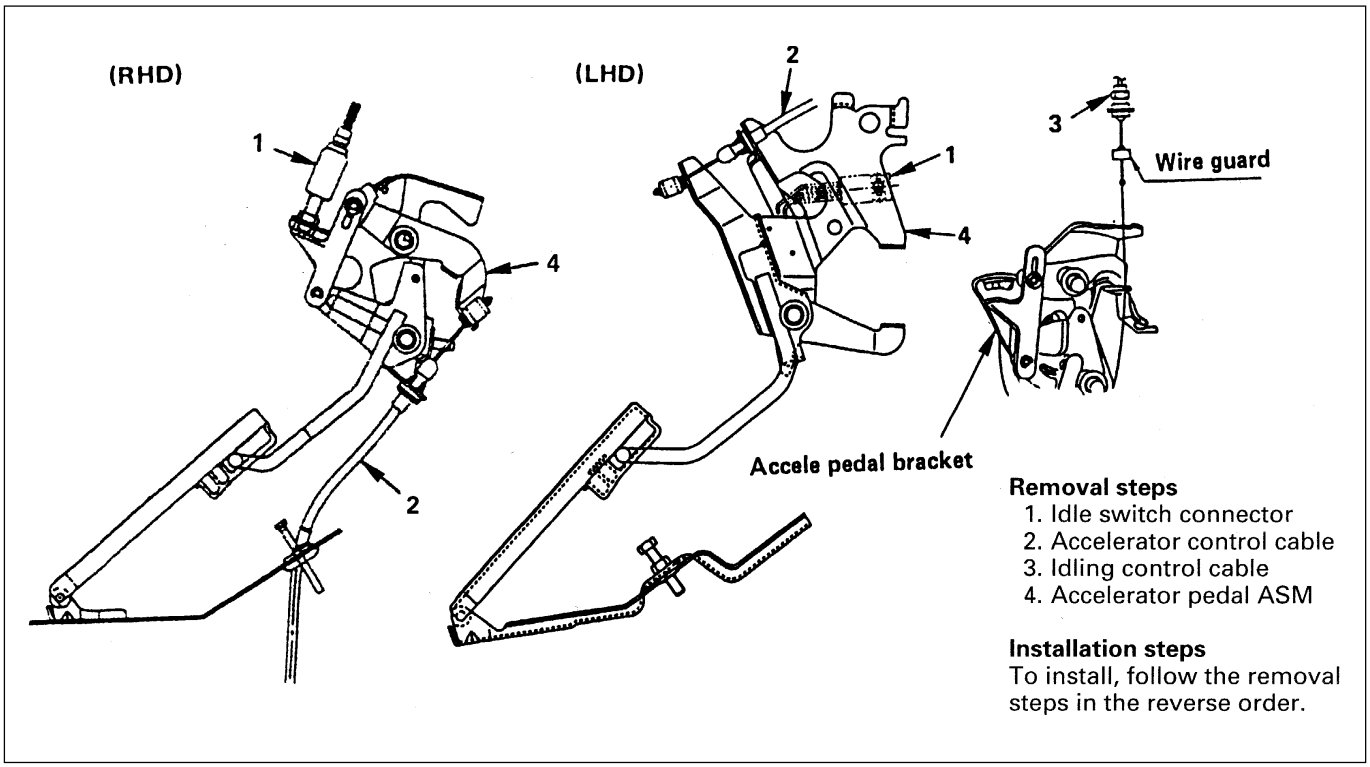
2. Accelerator Control Wire (Injection pump side)

- Install the tip end of the wire to the engine control lever.

1. Lock Bolt

- With the accelerator control lever attached to the stopper bolt, pull the cable lightly toward the front of the axis and fasten the cable bracket with the lock bolt.
- Check to see if the injection pump lever is at the idle position (with the lever in touch with the stopper bolt).
- Connect the battery ground cable.
- Lower the cab.
- Check to see if the accelerator pedal play is in the range of 5 ~ 10 mm above the pedal pad.
- Press down on the accelerator pedal fully, and check to see if the engine rotates at the maximum speed with the linkage in the smooth operation.
- In the operating range of the accelerator pedal, check to see if the accelerator pedal and the injection pump lever return without fail to their original positions respectively.

ACCELERATOR PEDAL



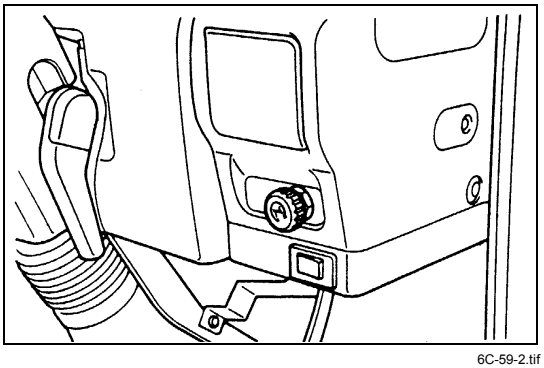
6C-59-1.tif

REMOVAL

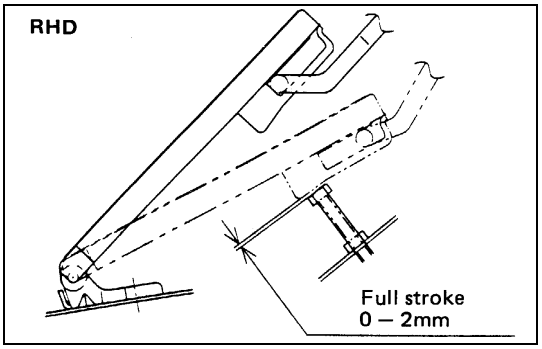
1. **Idle Switch Connector**
2. **Accelerator Control Cable**
   - Remove control cable from Accelerator pedal bracket.
3. **Idling Control Cable**
   - Remove control cable from accelerator pedal bracket.
4. **Accelerator Pedal Assembly**
   - Remove accelerator pedal assembly from brake pedal bracket.

INSTALLATION

4. **Accelerator Pedal Assembly**
   - Apply the sliding section with grease, and install it to the brake pedal bracket.
3. **Idling Control Cable**
   - Install the cable to the lever of the accelerator pedal bracket.
2. **Accelerator Control Cable**
   - After confirming that the idling control knob is fully turned to the left, install the accelerator control cable.
1. **Idle Switch Connector**



6C-59-2.tif

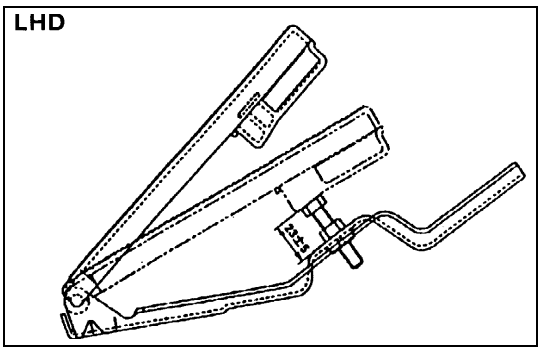


6C-60-1.tif

Adjustment of the press-down amount of the accelerator pedal

- After installing each cable, give a full stroke to the accelerator pedal while pushing the accelerator pedal pad by hand.
- Adjust the stopper bolt so that the clearance between the pedal pad stopper bolt and the back of the pad becomes 0 ~ 2 mm (0 ~0.079 in.), and tighten the lock nut to the specified torque.

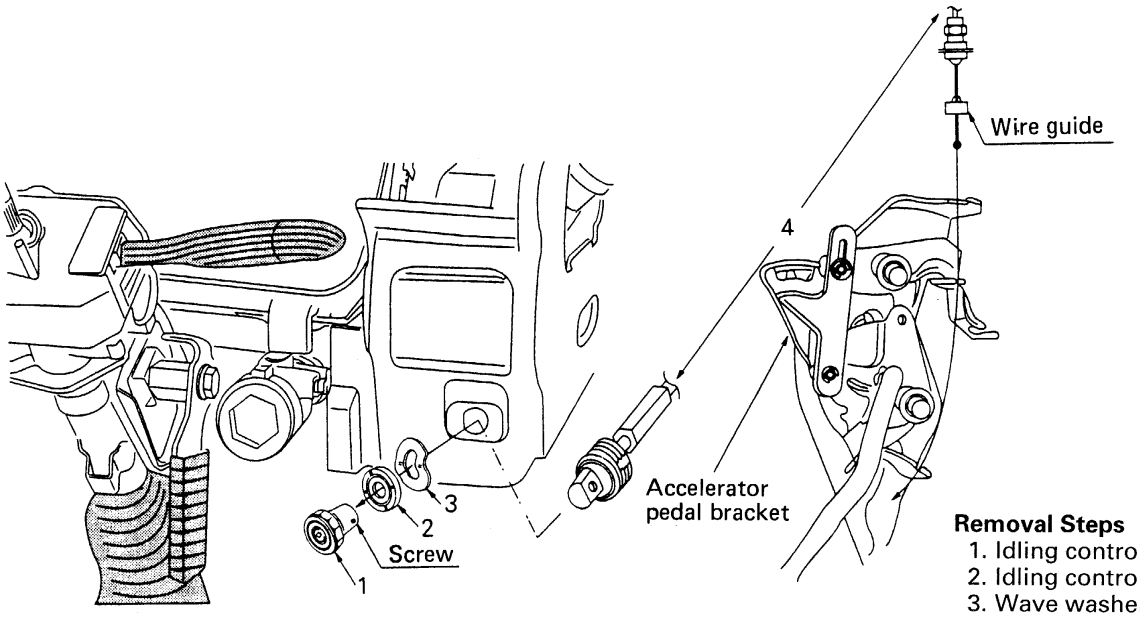
N·m (Kg·m/lb·ft)
7.4 (0.75/65)



6C-60-2.tif

- Check to see if the accelerator pedal play is in the range of 5 ~ 10 mm (0.2 ~ 0.4 in.) above the pedal pad.
- Press down on the accelerator pedal fully, and check to see if the engine rotates at the maximum speed with the linkage in the smooth operation.
- In the operating range of the accelerator pedal, check to see if the accelerator pedal and the injection pump lever return without fail to their original positions respectively.

IDLING CONTROL CABLE



Removal Steps
1. Idling control knob
2. Idling control cable nut
3. Wave washer
4. Idling control cable

Installation steps
To install, follow the removal steps in the reverse order.

6C-61-1.tif

REMOVAL

1. **Idling Control Knob**
   - Loosen the idling control knob screw and remove the knob from cable.
2. **Idling Control Cable Nut**
3. **Wave Washer**
4. **Idling Control Cable**
   - Remove control cable from accelerator pedal bracket.

INSTALLATION

4. **Idling Control Cable.**
   - Install Control Cable to Accelerator pedal bracket.
3. **Wave Washer**
2. **Idling Control Cable Nut**
   - Insert the idling control cable into the specified hole of the instrument panel.
   - Install the washer to the cable, and tighten it with the nut.

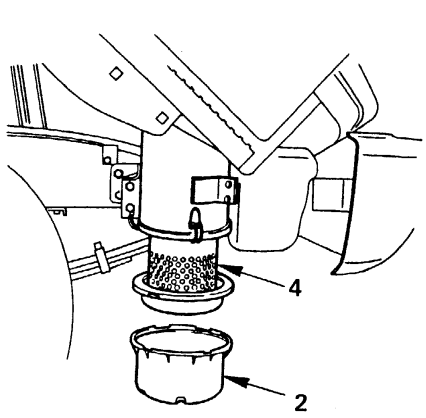
1. Idling Control Knob

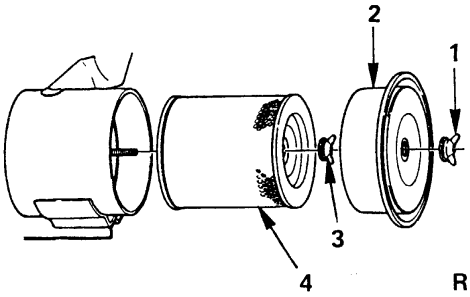
- Insert the idling control knob into the cable, and tighten the screw.

Inspection:

- With the idling control knob not in use, check to see if the injection pump lever is at the idle position (with the lever in contact with the stopper bolt).
- With the idling control knob turned fully to the right, check to see if the engine idles up to 1,500 rpm or more.

AIR CLEANER ELEMENT





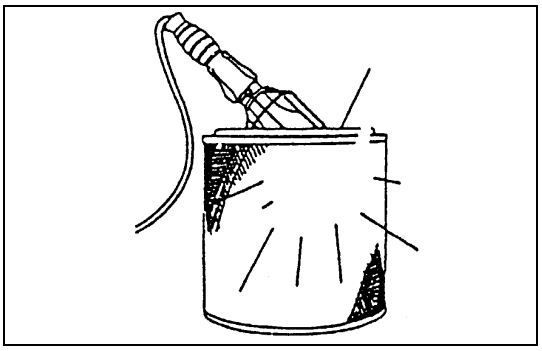
Removal steps
1. Cover wing nut
2. End cover
3. Filter wing nut
4. Air cleaner element

Installation steps
To install, follow the removal steps in the reverse order.

6C-63-1.tif

REMOVAL

1. **Cover Wing Nut**
2. **End Cover**
3. **Filter Wing Nut**
4. **Air Cleaner Element**



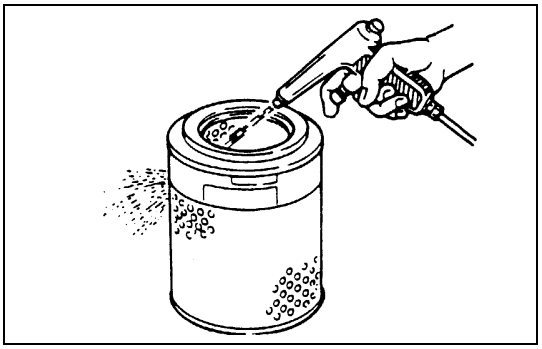
6C-63-2.tif

Clean

- Wipe out the inside of the Air Cleaner assembly.
- Wipe off the Cover

Inspection

- The air filter with a light for fears rears or holes.



6C-63-3.tif

Cleaning Method

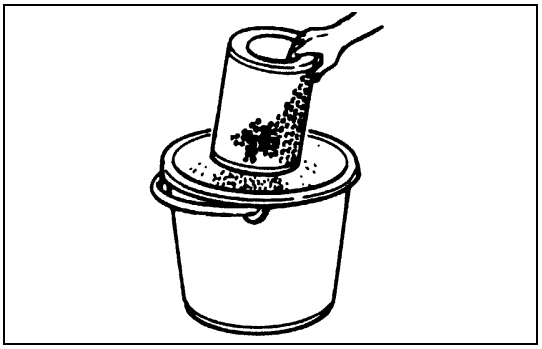
Dust Fouled Element

Rotate the element with your hand while applying compressed air to the inside of the element. This will blow the dust free.

Compressed air pressure	kPa (kg/cm^2/psi)
392 - 490 (4 - 5/57 - 71)	

CAUTION

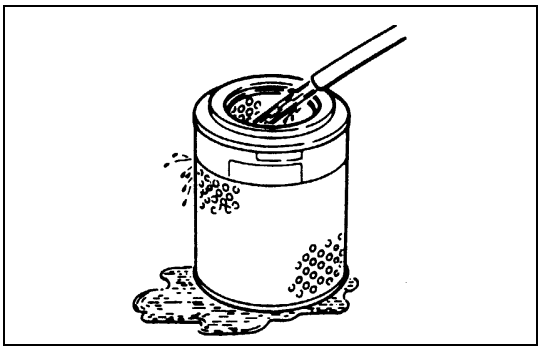
Do not bang the element against another object in an attempt to clean it. Damage to the element will result.



6C-64-1.tif

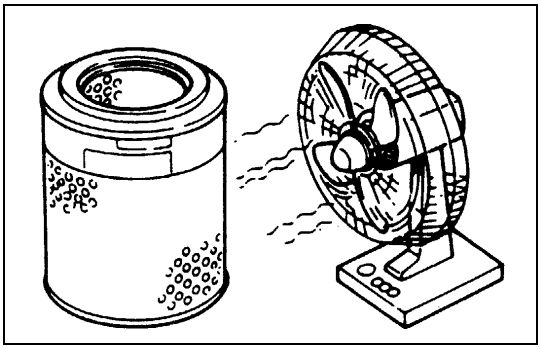
Carbon and Dust Fouled Element

1. Prepare a cleaning solution of Isuzu Genuine Element Cleaner (Donaldson D1400) diluted with water.
2. Submerge the element in the solution for twenty minutes.



6C-64-2.tif

3. Remove the element from the solution and rinse it well with running water.
   Water pressure must not exceed 274 Kpa
   (2.8 kg/cm^2 /40 psi).



6C-64-3.tif

4. Dry the element in a well ventilated area.
   An electric fan will hasten drying.

NOTE:

Do not use compressed air or an open flame to dry the element quickly. Damage to the element will result. It will usually take two or three days for the element to dry completely. Therefore, it is a good idea to have a spare on hand to use in the interim.

INSTALLATION

4. **Air Cleaner Element**
3. **Filter Wing Nut**
2. **End Cover**
1. **Cover Wing Nut**

MEMO

SECTION 6D
ENGINE ELECTRICAL

CONTENTS

	PAGE
Battery	6D1
Starting System	6D2
Charging System	6D3
QOS-II Preheating System	6D6
QOS-III Preheating System	6D7

SECTION 6D1
BATTERY

CONTENTS

	PAGE
General Description	6D1-2
Diagnosis	6D1-2
On-Vehicle Service	6D1-4
Battery Charging	6D1-4
Jump Starting	6D1-5
Removal and Installation of Battery	6D1-7
Main Data and Specifications	6D1-7

GENERAL DESCRIPTION

There are six battery fluid caps at the top of the battery. these are covered by a paper label.

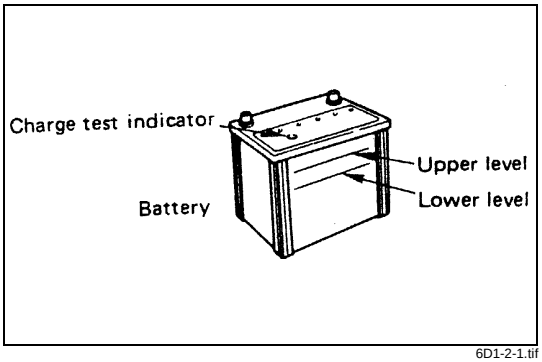
The battery is completely sealed except for the six small vent holes at the side. these vent holes permit the escape of small amounts of gas generated by the battery.

This type of battery has the following advantages over conventional batteries.

1. There is no need to add water during the entire service life of the battery.
2. The battery protects itself against overcharging. The battery will refuse to accept an excessive charge.

   (A conventional battery will accept an excessive charge, resulting in gassing and loss of battery fluid.)
3. The battery is much less vulnerable to self discharge than a conventional type battery.

DIAGNOSIS



6D1-2-1.tif

1. VISUAL INSPECTION

Inspect the battery for obvious physical damage, such as a cracked or broken case, which would permit electrolyte loss.

Replace the battery if obvious physical damage is discovered during inspection.

Check for any other physical damage and correct it as necessary. If not, proceed to Step 2.

2. FLUID LEVEL CHECK

The fluid level should be between the upper level line and lower level line on side of the battery.

a. CORRECT FLUID LEVEL - Charge the battery.
b. BELOW LOWER LEVEL - Replace battery.

3. VOLTAGE CHECK

(1) Put voltmeter test leads to battery terminals.
   a. VOLTAGE IS 12.4V OR ABOVE – Battery condition OK.
   b. VOLTAGE IS UNDER 12.4V - Go to procedure (2) below.

(2) Determine fast charge amperage from specification (See Main Data and Specifications in this section).

Fast charge battery for 30 minutes at amperage rate no higher than specified value.

Take voltage and amperage readings after charge.

   a. VOLTAGE IS ABOVE 16V AT BELOW 1/3 OF AMPERAGE RATE - Replace battery.
   b. VOLTMETER IS ABOVE 16V AT ABOVE 1/3 OF AMPERAGE RATE - Drop charging voltage to 15V and charge for 10 - 15 hours.
   c. VOLTAGE IS BETWEEN 12V AND 16V - Continue charging at the same rate for an additional 3-3.5 hours.
   d. VOLTAGE IS BELOW 12V - Replace battery.

4. LOAD TEST

(1) Connect a voltmeter and a battery load tester across the battery terminals.

(2) Apply 300 ampere load for 15 seconds to remove surface charge from the battery.

Remove load.

(3) Wait 15 seconds to let battery recover. Then apply specified load from specifications (See Main Data and Specifications in this section).

Read voltage after 15 seconds, then remove load.

a. VOLTAGE DOES NOT DROP BELOW THE MINIMUM LISTED IN FOLLOWING TABLE - The battery is good and should be returned to service.

b. VOLTAGE IS LESS THAN MINIMUM LISTED - Replace battery.

ESTIMATED TEMPERATURE		MINIMUM VOLTAGE
°F	°C	
70	21	9.6
60	16	9.5
50	10	9.4
40	4	9.3
30	-1	9.1
20	-7	8.9
10	-12	8.7
0	-18	8.5
The battery temperature must be estimated by feel and by the temperature the battery has been exposed to for the preceding few hours.		

ON-VEHICLE SERVICE

BATTERY CHARGING

Observe the following safety precautions when charging the battery:

1. Never attempt to charge the battery when the fluid level is below the lower level line on the side of the battery. In this case, the battery must be replaced.
2. Pay close attention to the battery during the charging procedure.

   Battery charging should be discontinued or the rate of charge reduced if the battery feels hot to the touch.

   Battery charging should be discontinued or the rate of charge reduced if the battery begins to gas or spew electrolyte from the vent holes.
3. In order to more easily view the hydrometer blue dot or ring, it may be necessary to jiggle or tilt the battery.
4. Battery temperature can have a great effect on battery charging capacity.
5. The sealed battery used on this vehicle may be either quick-charged or slow-charged in the same manner as other batteries.

   Whichever method you decide to use, be sure that you completely charge the battery. Never partially charge the battery.

JUMP STARTING

JUMP STARTING WITH AN AUXILIARY (BOOSTER) BATTERY

CAUTION:

Never push or tow the vehicle in an attempt to start it. Serious damage to the emission system as well as other vehicle parts will result.

Treat both the discharged battery and the booster battery with great care when using jumper cables. Carefully follow the jump starting procedure, being careful at all times to avoid sparking.

WARNING:

Failure to carefully follow the jump starting procedure could result in the following:

1. **Serious personal injury, particularly to your eyes.**
2. **Property damage from a battery explosion, battery acid, or an electrical fire.**
3. **Damage to the electronic components of one or both vehicles particularly.**

Never expose the battery to an open flame or electrical spark. Gas generated by the battery may catch fire or explode.

Remove any rings, watches, or other jewelry before working around the battery. Protect your eyes by wearing an approved set of goggles.

Never allow battery fluid to come in contact with your eyes or skin.

Never allow battery fluid to come in contact with fabrics or painted surfaces.

Battery fluid is a highly corrosive acid.

Should battery fluid come in contact with your eyes, skin, fabric, or a painted surface, immediately and thoroughly rinse the affected area with clean tap water.

Never allow metal tools or jumper cables to come in contact with the positive battery terminal, or any other metal surface of the vehicle. This will protect against a short circuit.

Always keep batteries out of the reach of young children.

JUMP STARTING PROCEDURE

1. Set the vehicle parking brake.

   If the vehicle is equipped with an automatic transmission, place the selector lever in the "PARK" position.

   If the vehicle is equipped with a manual transmission place the shift lever in the "NEUTRAL" position.

   Turn "OFF" the ignition.

   Turn "OFF" all lights and any other accessory requiring electrical power.
2. Look at the built-in hydrometer.

   If the indication area of the built-in hydrometer is completely clear, do not try to jump start.
3. Attach the other end of the same cable to the positive terminal of the discharged battery.

   Attach the end of one jumper cable to the positive terminal of the booster battery.

   Do not allow the vehicles to touch each other.

   This will cause a ground connection, effectively neutralizing the charging procedure.

   Be sure that the booster battery has a 12 volt rating.
4. Attach one end of the remaining cable to the negative terminal of the booster battery.

   Attach the other end of the same cable to a solid engine ground (such as the A/C compressor bracket or the generator mounting bracket) of the vehicle with the discharged battery.

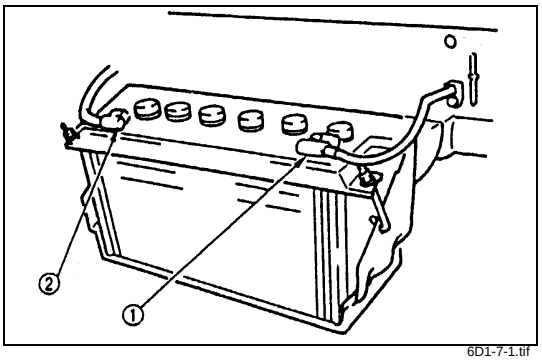
   This ground connection must be at least 450 mm (18 in) from the battery of the vehicle whose battery is being charged.

WARNING:

Never attach the end of the jumper cable directly to the negative terminal of the dead battery.

5. Start the engine of the vehicle with the good battery.
   Make sure that all unnecessary electrical accessories have been turned "OFF".
6. Start the engine of the vehicle with the dead battery.
7. To remove the jumper cables, follow the above directions in the reverse order.
   Be sure to first disconnect the negative cable from the vehicle with the discharged battery.

REMOVAL AND INSTALLATION OF THE BATTERY



6D1-7-1.tif

REMOVAL

1. All switches should be in the "OFF" position.
2. Disconnect the battery ground cable.
3. Disconnect the battery positive cable.
4. Disconnect the battery cable.

CAUTION:

It is important that the battery ground cable be disconnected first.

Disconnecting the battery positive cable first can result in a short circuit.

INSTALLATION

To install the battery, follow the removal procedure in the reverse order, noting the following points:

1. Make sure that the rod is hooked on the body side.

MAIN DATA AND SPECIFICATIONS

Model	(JIS)	115E41R-MF	130E41R-MF	95D31R-MF	80D26R-MF
Voltage	(V)	12	12	12	12
Cold-Cranking Performance	(Amp)	651	799	622	582
Reserve Capacity	(Min)	212	229	159	133
Load Test	(Amp)	325	400	310	290
Fast Charge Maximum Amperage	(Amp)	20	20	20	20
BCI Group No.		-	-	27	24
Overall Dimension L×W×H	(mm)	410×178×213	410×178×213	-	-

MEMO

SECTION 6D2

STARTING SYSTEM

CONTENTS

PAGE

General Description..... 6D2 - 1

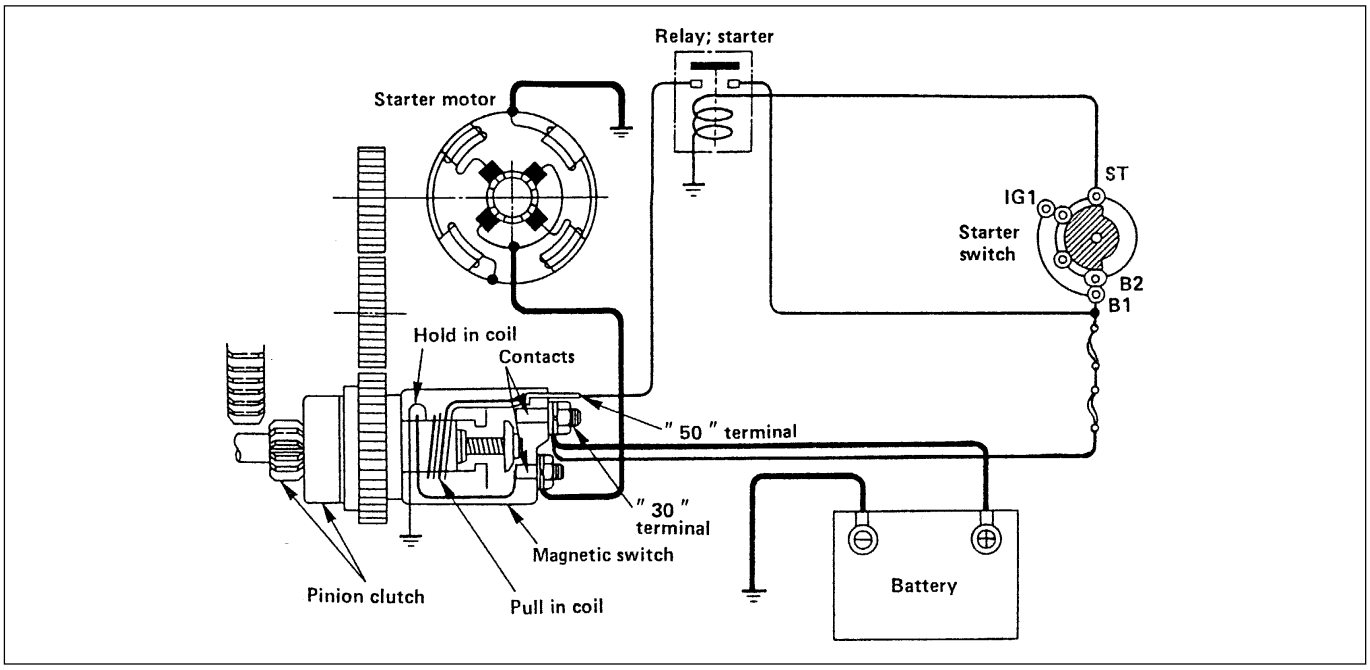
On-Vehicle Service..... 6D2 - 3

Unit Repair..... 6D2 - 5

GENERAL DESCRIPTION

STARTING CIRCUIT

The cranking system consists of a battery, starter, starter switch, starter relay, etc. and these main components are connected as shown in Figure. For details of the starting circuit.

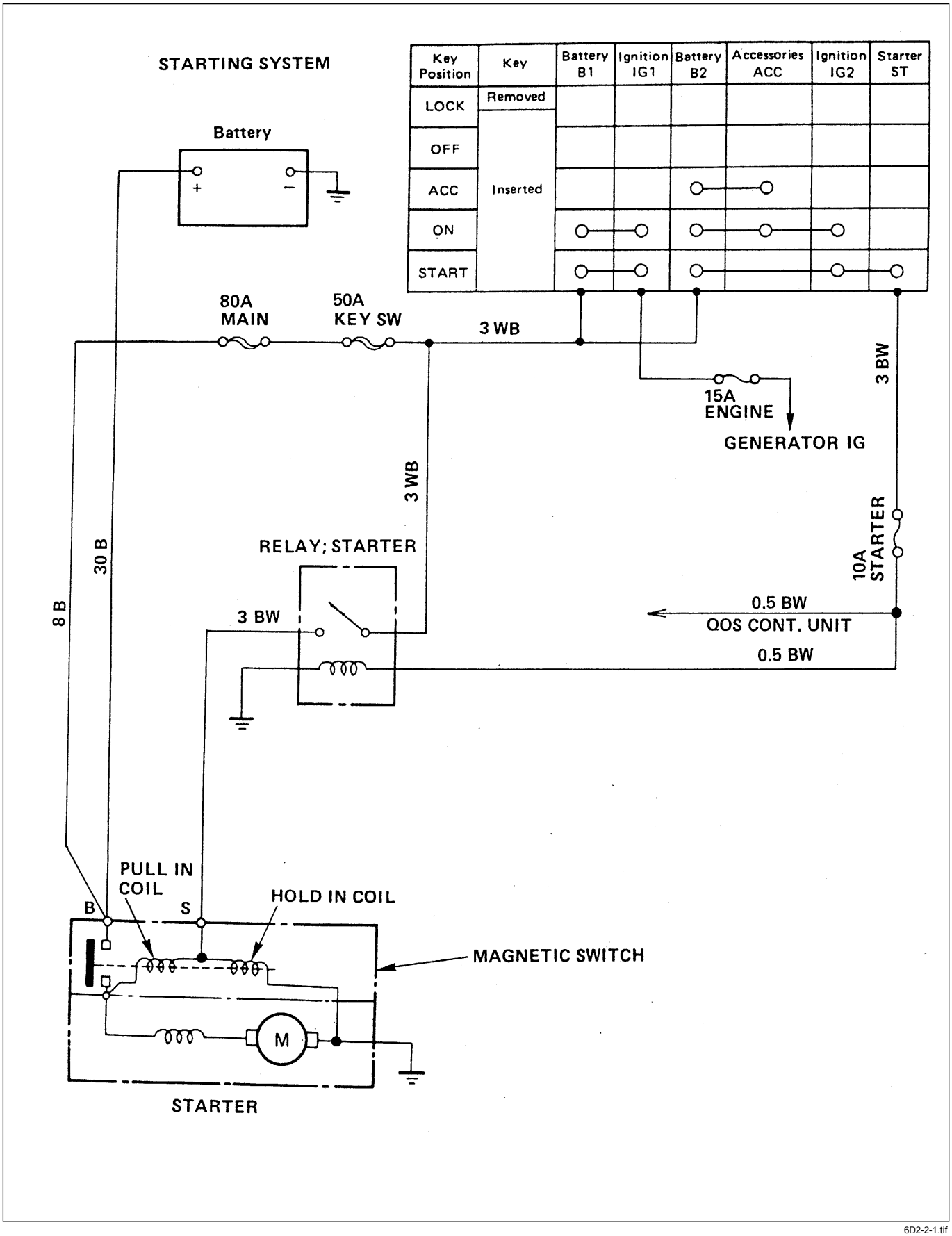


6D2-1-1.tif

STARTER

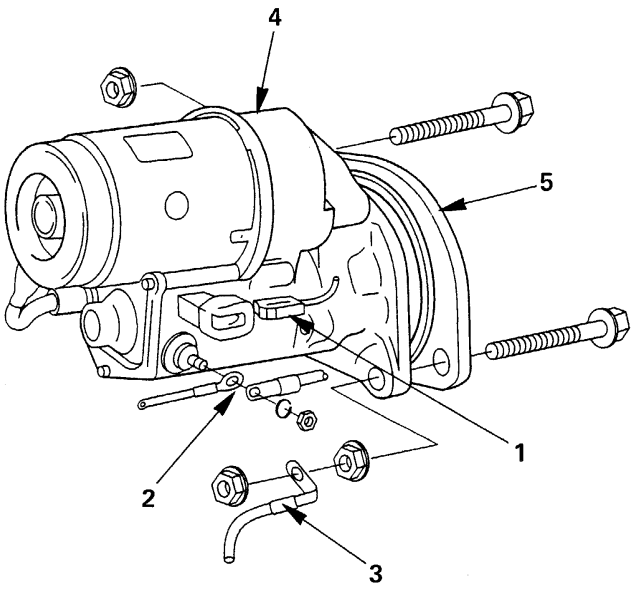
The starting system employs a magnetic type reduction starter in which the motor shaft is also used as a pinion shaft. When the starter switch is turned on, the contacts of magnetic switch are closed, and the armature rotates. At the same time, the plunger is attracted, and the pinion is pushed forward by the shift lever to mesh with ring gear. Then, the ring gear runs to start the engine. When the engine starts and the starter switch is turned off, the plunger returns, the pinion is disengaged from ring gear, and the armature stops rotation. When the engine speed is higher than the pinion, the pinion idles, so that the armature is not driven.

STARTING CIRCUIT



6D2-2-1.tif

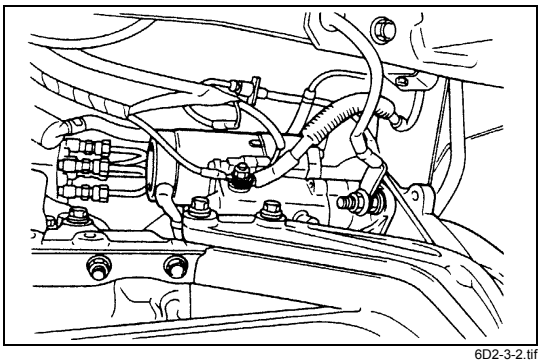
ON-VEHICLE SERVICE



Removal steps
1. 50 terminal
2. 30 terminal
3. Earth cable terminal
4. Starter ASM.
5. Spacer (4JB1, except cold area)

Installation steps
To install, follow the removal steps in the reverse order.

6D2-3-1.tif



6D2-3-2.tif

REMOVAL

Preparation
- Disconnect Battery Ground Cable.

1. **"50" Terminal**
2. **"30" Terminal**
3. **Earth Cable Terminal**
4. **Starter Assembly**
5. **Spacer (4JB1, Except cold area)**

INSTALLATION

5. **Spacer (4JB1, Except cold area)**
4. **Starter Assembly**
   - Tighten the fixing bolt and nut to the specified torque

Starter Bolts and Nuts Torque	N·m (Kg·m/lb·ft)
	81 (8.3 / 60)

3. **Earth Cable Terminal**
   - Connect the earth cable terminal.

2. "30" Terminal

- Connect the harness connector.

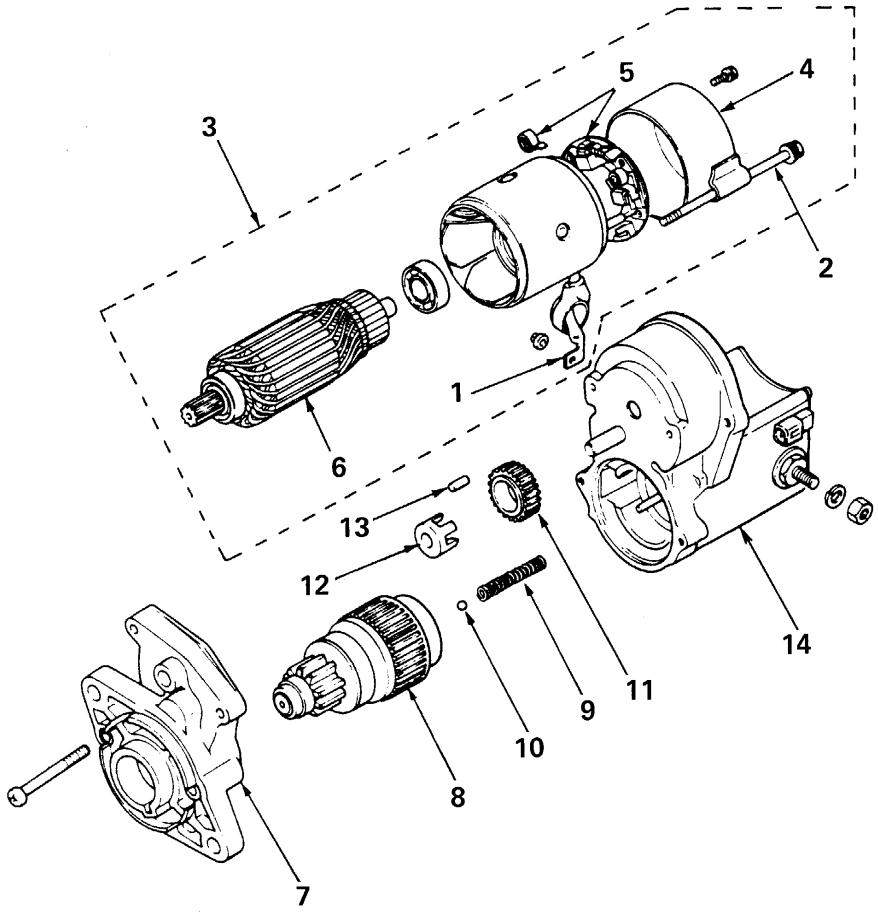
1. "50" Terminal

- Connect the battery cable terminal with starter switch harness terminal, then tighten nut to the specified torque.

Fixing Nut Torque	N·m (Kg·m/lb·in)
	9 (0.9/78)

- Connect the battery cable.

UNIT REPAIR



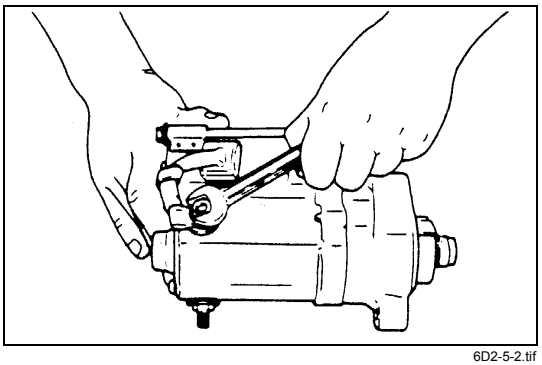
Disassembly steps

1. Lead wire
2. Through bolt
3. Yoke assembly
4. Cover yoke
5. Brush and brush holder
6. Armature
7. Drive side housing
8. Overrunning clutch
9. Return spring
10. Steel ball
11. Idle pinion
12. Retainer
13. Roller
14. Magnetic switch

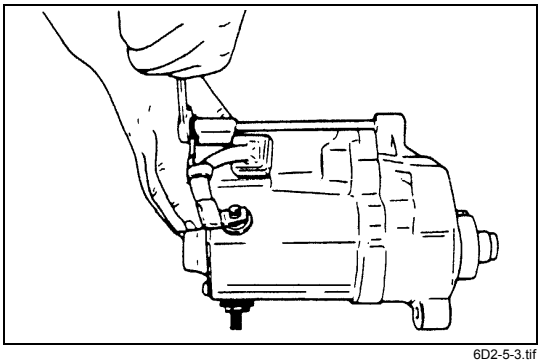
Reassembly steps

To reassembly, follow the disassembly steps in the reverse order.

6D2-5-1.tif



6D2-5-2.tif



6D2-5-3.tif

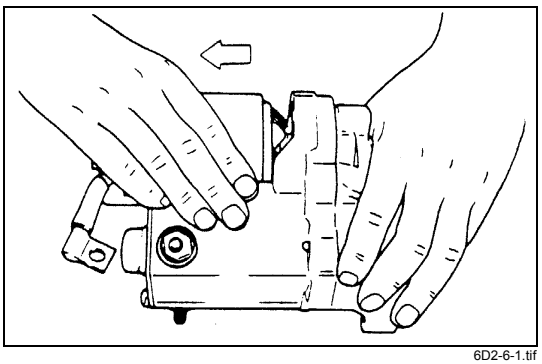
DISASSEMBLY

1. Lead Wire

Disconnect the lead wire from the magnetic switch.

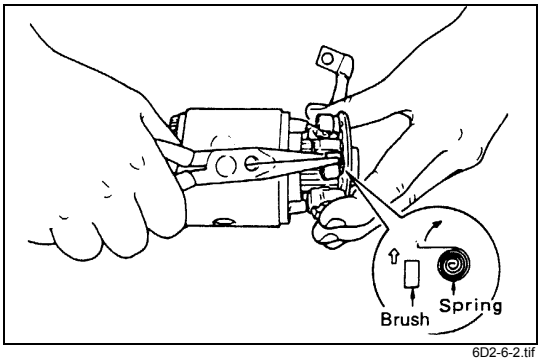
2. Through Bolt

Remove the through bolts from the yoke.



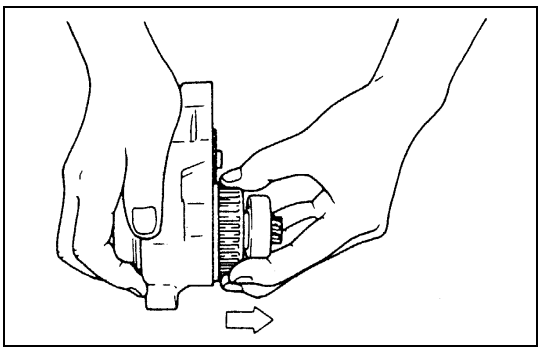
6D2-6-1.tif

3. **Yoke Assembly**
   Separate the yoke from the solenoid switch.
4. **Yoke Cover**



6D2-6-2.tif

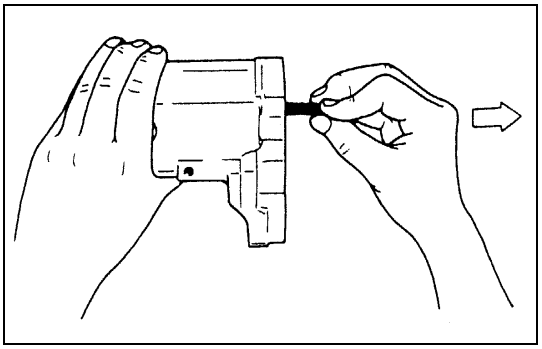
5. **Brush and Brush Holder**
   Remove (pull out) the brushes and the brush holder from the armature with a pair of long-nose pliers.
6. **Armature**
7. **Drive Side Housing**



6D2-7-1.tif

8. Overrunning Clutch

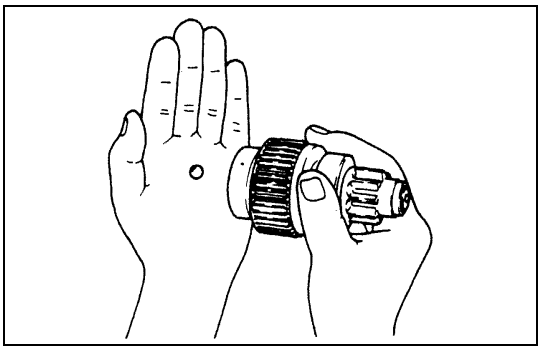
Remove the overrunning clutch from the housing.



6D2-7-2.tif

9. Return Spring

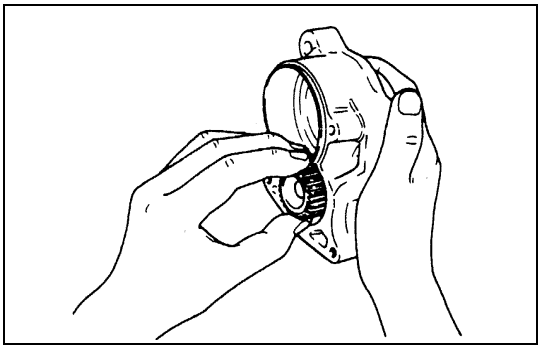
Remove the return spring from magnetic switch.



6D2-7-3.tif

10. Steel Ball

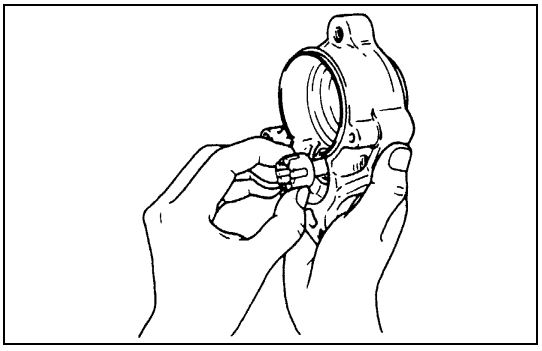
Remove the steel ball from the overrunning clutch.



6D2-7-4.tif

11. Idle Pinion

Remove the idle pinion from housing.



6D2-7-5.tif

12. Retainer

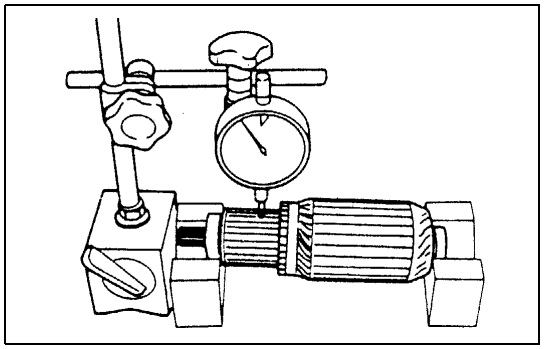
Remove the retainer from housing.

13. Roller

14. Magnetic Switch

INSPECTION AND REPAIR

Make necessary correction or parts replacement if wear, damage or any other abnormal condition are found through inspection.

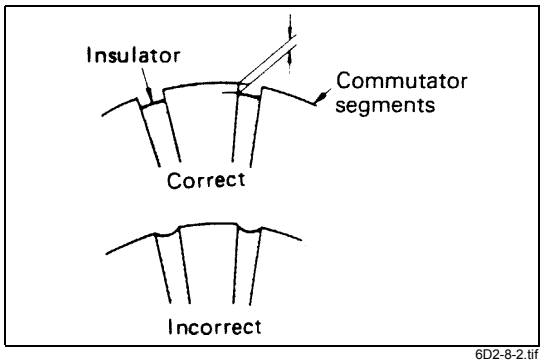

6D2-8-1.tif

ARMATURE

Check the commutator for run-out and replace if the amount of run-out exceeds the limit.

Run-out test mm (in.)

kw	Standard	Limit
2.2	0.02 (0.0008)	0.05 (0.0020)
2.0		

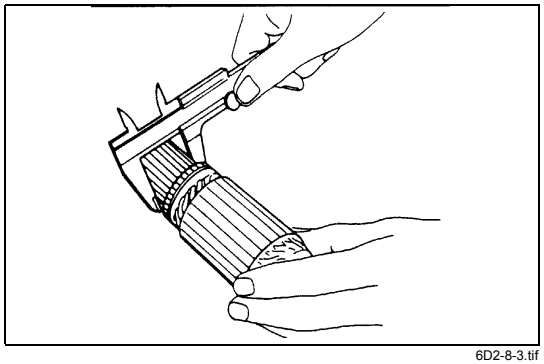


6D2-8-2.tif

Check the mica segment for wear.

Depth of mica segment mm (in.)

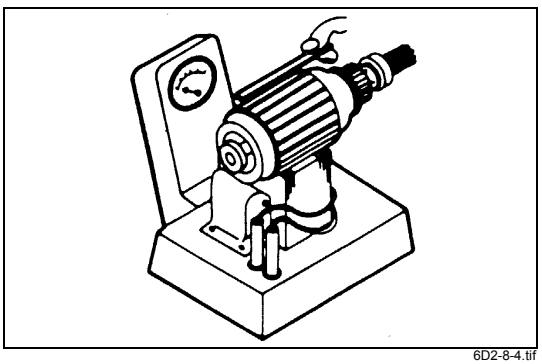
kw	Standard	Limit
2.2	0.7 - 0.9 (0.028 - 0.035)	0.20 (0.008)
2.0		


6D2-8-3.tif

Check the commutator outer diameter.

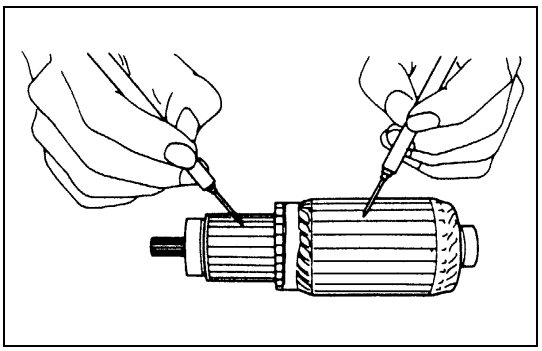
Commutator outer diameter mm (in.)

kw	Standard	Limit
2.2	35.00 (1.378)	34.00 (1.339)
2.0		


6D2-8-4.tif

Armature short circuit test

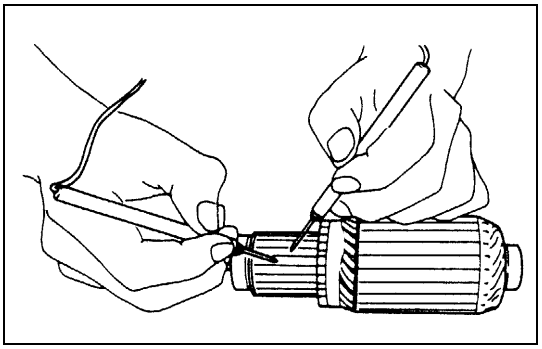
Check the armature for short circuit by placing it on a growler tester. Hold a piece of hacksaw blade against the armature core while slowly rotating the armature. A short-circuited armature will cause the blade to vibrate and to be attracted by the core. If the hacksaw blade is attracted or vibrates, the armature, is short circuited, and must be replaced.



6D2-9-1.tif

Armature ground test

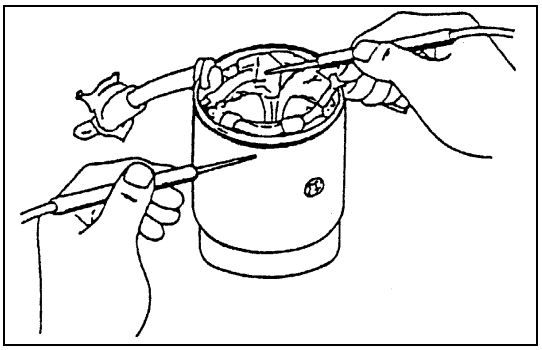
Touch one probe of a circuit tester to the commutator segment and the other to the armature core. There should be no continuity. If there is a continuity, the armature is grounded. Replace the armature if it is grounded.



6D2-9-2.tif

Armature continuity test

Connect the probes of a circuit tester across the 2 segments. There should be continuity at any test points. Replace if it is open-circuited.



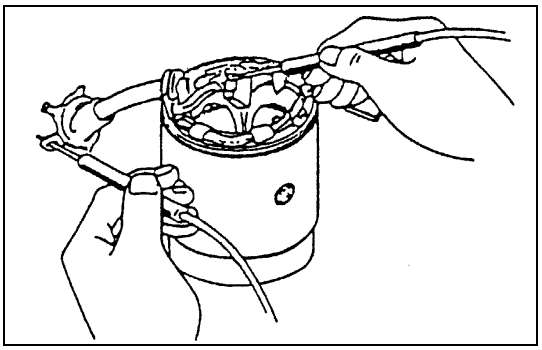
6D2-9-3.tif

YOKE

Field winding ground test

Using circuit tester, touch one probe to the field winding end or brush and the other to the bare surface of yoke body.

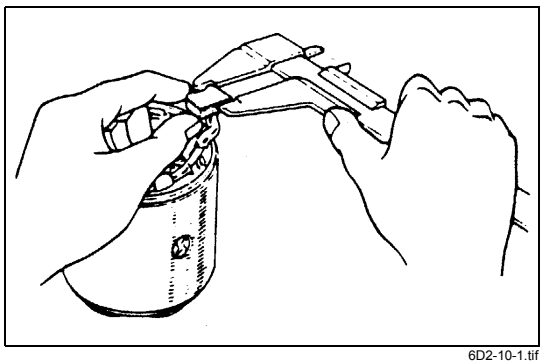
There should be no continuity. If the tester indicates a continuity, the field coil is grounded and yoke assembly should be replaced.



6D2-9-4.tif

Field winding continuity test

Using a circuit tester, touch one probe to the "C" terminal lead wire and the other to the brush. There should be continuity. Replace the yoke if it is open.



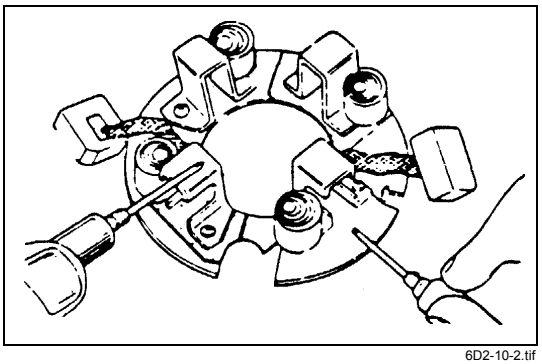
6D2-10-1.tif

BRUSH AND BRUSH HOLDER

Measure the brush length and replace if it is worn beyond the service limit.

Brush length mm (in.)

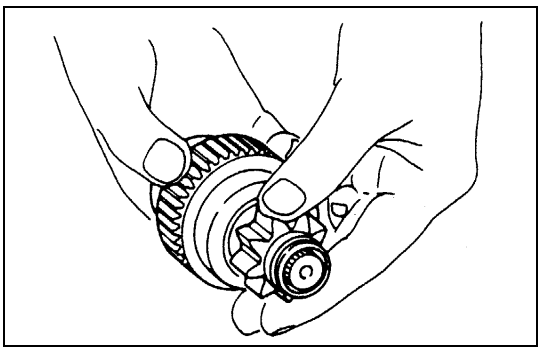
kw	Standard	Limit
2.2	14.5 (0.57)	10 (0.39)
2.0	16 (0.63)	



6D2-10-2.tif

Brush holder insulation test

Using a circuit tester, check the brush holder insulation. Touch one probe to the holder plate and the other to the positive brush holder. There should be no continuity.



6D2-10-3.tif

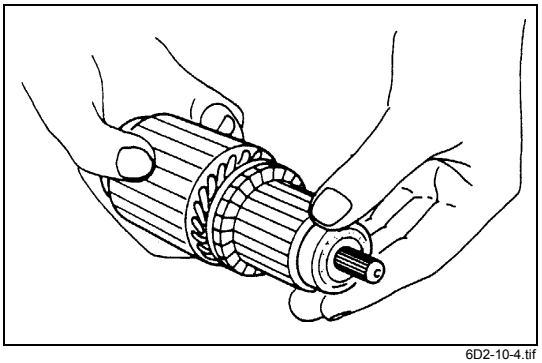
OVERRUNNING CLUTCH

Inspect the teeth of pinion for wear and damage.

Replace if it damaged.

Rotate the pinion in direction of rotation (clockwise).

It should rotate smoothly. But in opposite direction, it should be locked.



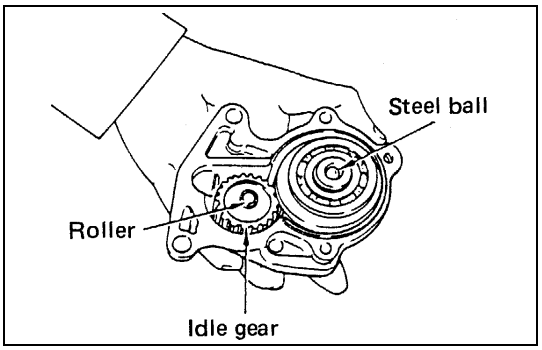
6D2-10-4.tif

BEARING

Check the bearings for wear and damage. If the bearings are noisy during operation, they should be replaceds.

REASSEMBLY

To install, follow the removal steps in the reverse order, noting the following points:



6D2-11-1.tif

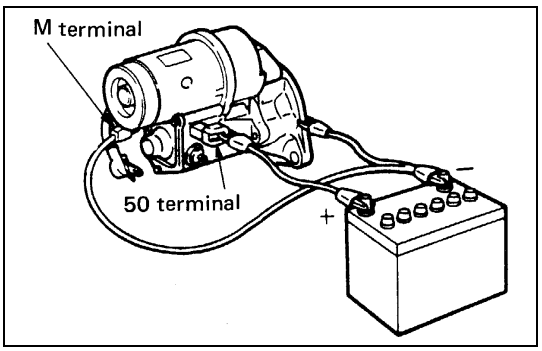
- Magnetic Switch
- Idle Gear
- Clutch assembly
- Housing

1) Install the clutch asm to the magnetic switch.
2) Install the idle gear and housing.

Note:

Do not fail to assemble the steel ball and the spring between the clutch and magnetic switch.

Assemble the roller to the idle gear in advance.



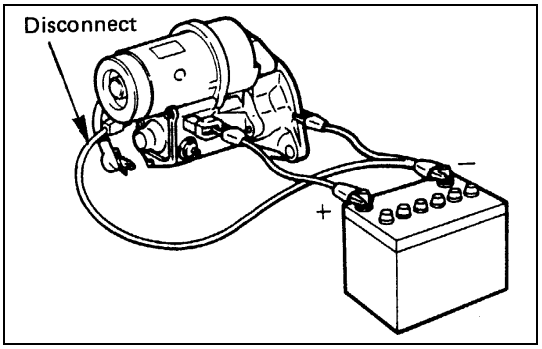
6D2-12-1.tif

MAGNETIC SWITCH

Temporarily connect the solenoid switch between the clutch and the housing and run the following tests. Complete each test within three to five seconds.

1. Pull-in test

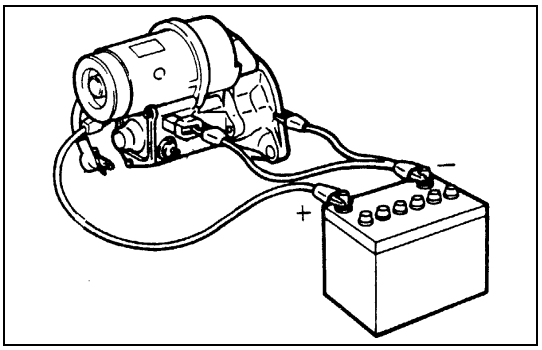
Connect the battery negative terminal with the solenoid switch body and the M terminal. When current is applied to the 50 terminal from the battery positive terminal, the pinion should flutter.



6D2-12-2.tif

2. Hold-in test

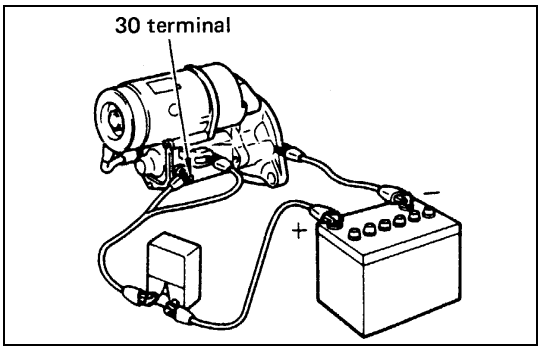
Disconnect the lead at the M terminal. The pinion should continue to flutter.



6D2-12-3.tif

3. Return test

Connect the battery negative terminal to the 50 terminal and the body. Connect the battery positive terminal to the M terminal. The pinion will flutter. When the lead to the 50 terminal is disconnected, the pinion should immediately return to its stationary positions.



6D2-12-4.tif

4. Current value

- Make connections as shown in the illustration, and measure the current value.

Standard = 120 A or less

Note:

For a battery, be sure to use one fully charged.

For lead wires, use thick ones since a large amount of current flows through them.

SECTION 6D3
CHARGING SYSTEM

CONTENTS

PAGE

General Description..... 6D3 - 1

Diagnosis..... 6D3 - 4

On-Vehicle Service ..... 6D3 - 5

Unit Repair..... 6D3 - 9

GENERAL DESCRIPTION

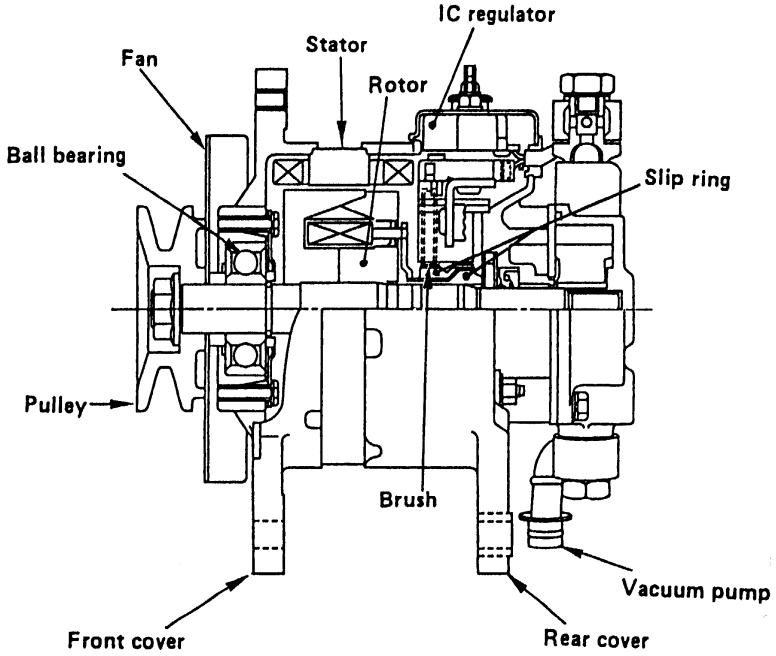
The charging system is the IC integral regulator charging system and its main components are connected as shown in Figure.

The regulator is a solid state type and it is mounted along with the brush holder assembly inside the generator installed on the rear end cover.

The generator does not require particular maintenance such as voltage adjustment. The rectifier connected to the stators coil has nine diodes to transform A.C. voltage into D.C. voltage. This D.C. voltage is connected to the output terminal of generator.

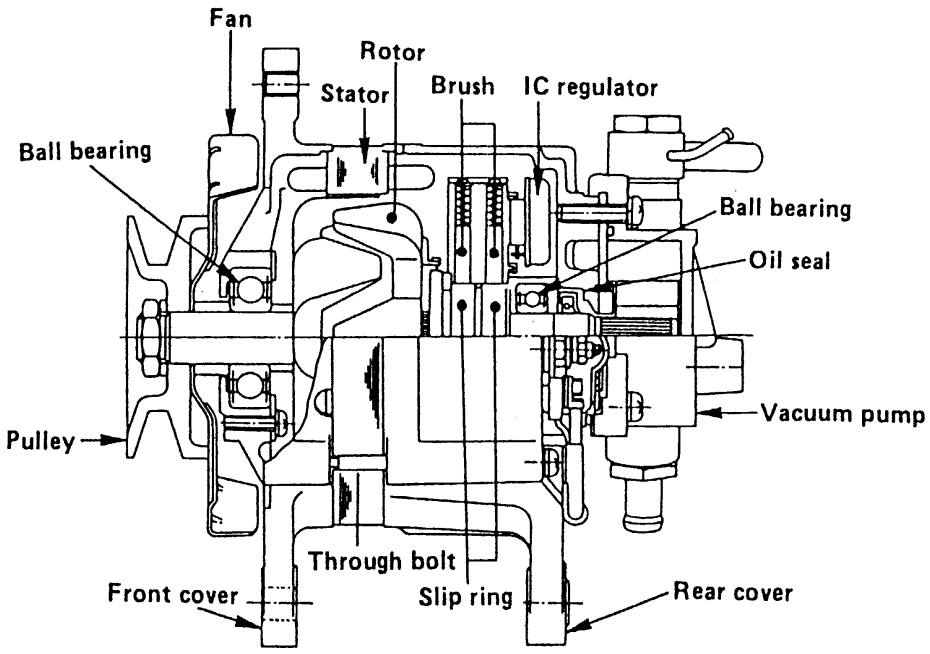
Generator

12V–40A



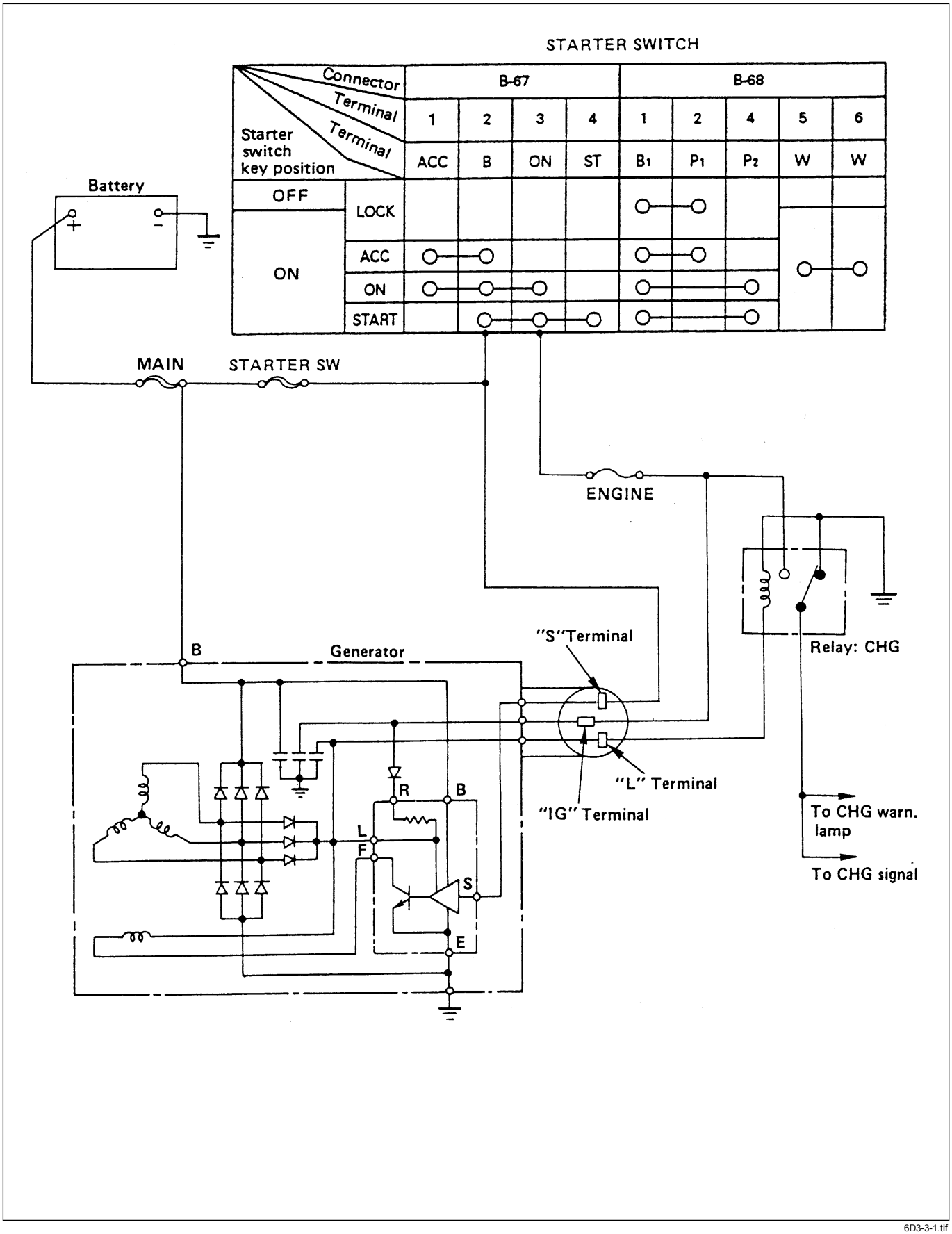
6D3-2-1.tif

12V–50A



6D3-2-2.tif

CHARGING CIRCUIT

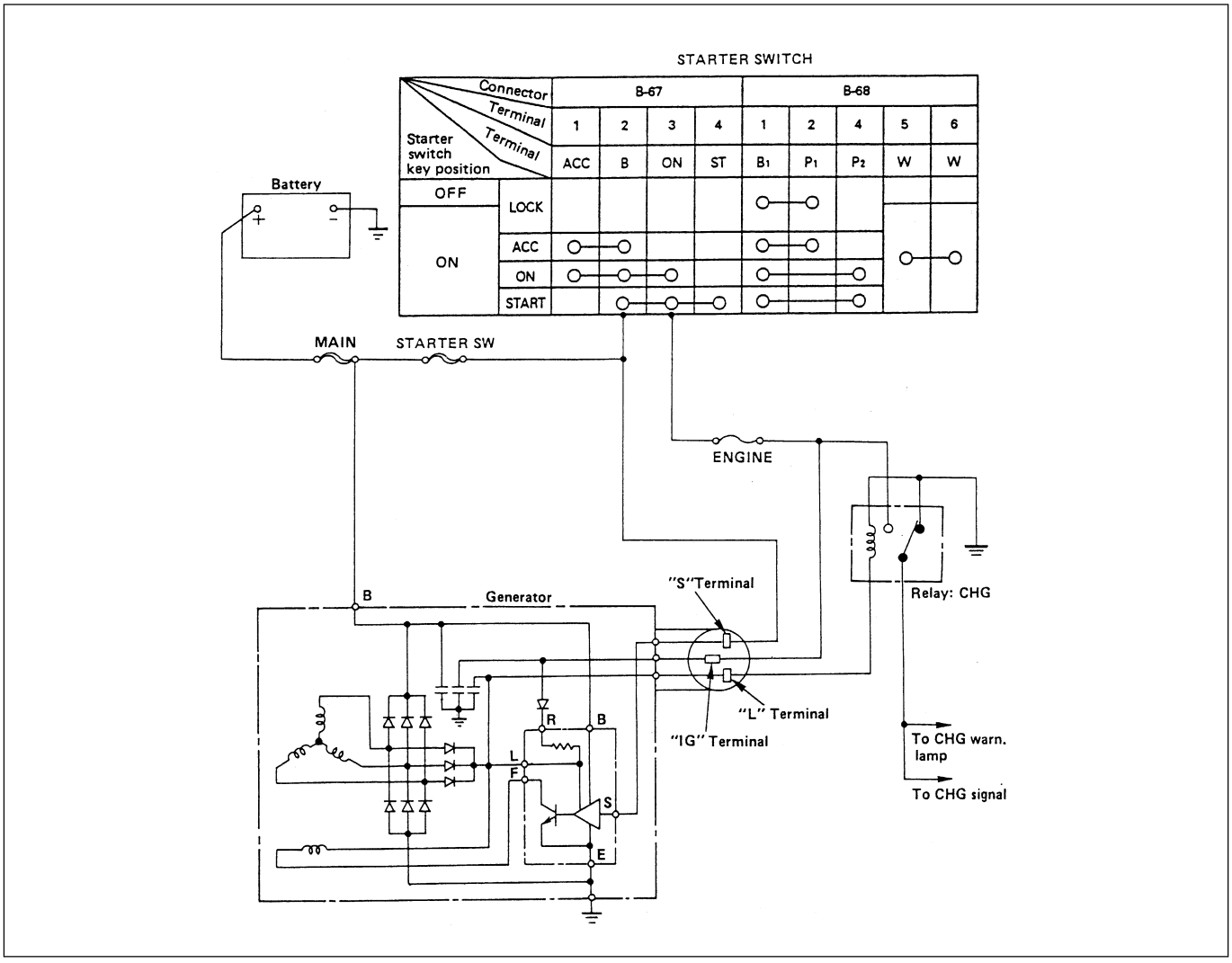


6D3-3-1.tif

DIAGNOSIS

GENERAL ON-VEHICLE INSPECTION

The operating condition of charging system is indicated by the charge warning lamp. The warning lamp comes on when the starter switch is turned on "ON" position. The charging system operates normally if the lamp goes off when the engine starts. If the warning lamp shows abnormality or if undercharged or overcharged battery condition is suspected, perform diagnosis by checking the charging system as follows:



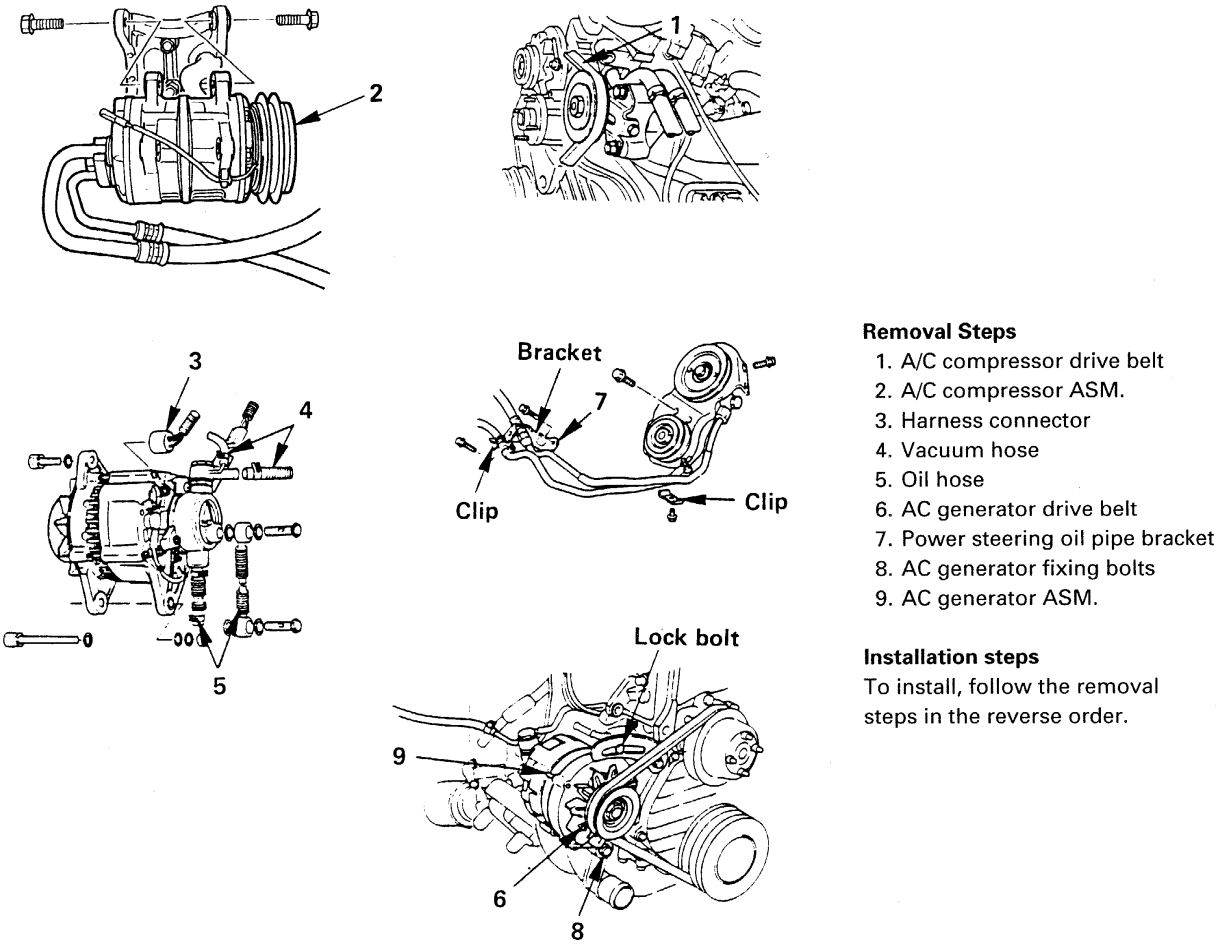
6D3-4-1.tif

1. Check visually the belt and wiring connector.
2. With the engine in stop status, turn the starter switch to "ON" position and observe the warning lamp.

- If lamp does not come on:
  Disconnect wiring connector from generator, and ground the terminal "L" on connector side.
- If lamp comes on:
  Repair or replace the generator.

ON-VEHICLE SERVICE

GENERATOR



Removal Steps

1. A/C compressor drive belt
2. A/C compressor ASM.
3. Harness connector
4. Vacuum hose
5. Oil hose
6. AC generator drive belt
7. Power steering oil pipe bracket
8. AC generator fixing bolts
9. AC generator ASM.

Installation steps

To install, follow the removal steps in the reverse order.

6D3-5-1.tif

REMOVAL

Preparation

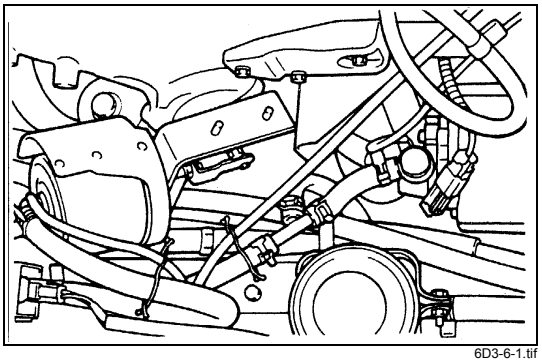
- Disconnect battery ground cable.

1. A/C Compressor Drive Belt (A/C Model)

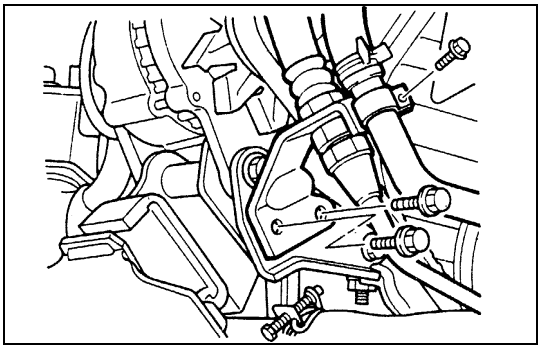
- Loosen the idler pulley lock nut
- Loosen the adjust bolt and remove the drive belt.

2. A/C Compressor Assembly (A/C Model)

- Disconnect the clutch harness connector.
- Remove the A/C compressor fixing bolts and temporarily tighten the A/C compressor to chassis frame side use the wire.


6D3-6-1.tif

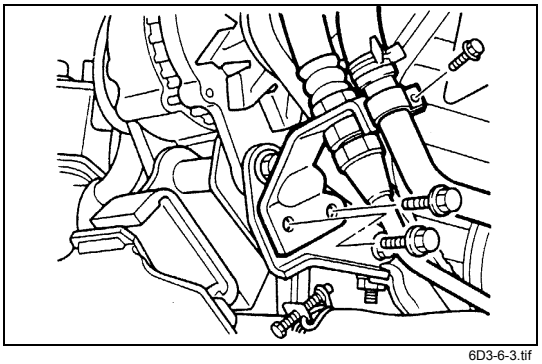
3. **Harness Connector (A/C Model)**
   - Disconnect the "L", "S", "IG" terminal.
   - Disconnect the "B" terminal.
4. **Vacuum Hose (EXH. Brake Model)**
   - Remove the vacuum hose to vacuum tank and exhaust actuator.
5. **Oil Hose**
   - Remove the oil hose from oil pan.
   - Remove the oil hose of vacuum pump side.
6. **AC Generator Drive Belt**
   - Loosen the adjust plate fixing bolt.
   - Remove the adjust bolt.
   - Loosen the AC Generator fixing bolt then remove the fan belt.


6D3-6-2.tif

7. **Power Steering Oil Pipe Bracket (P/S Model)**
   - Remove the oil pressure pipe bracket fixing bolt and pipe clip bolt.
   - Remove the oil suction pipe clip bolt.
8. **AC Generator Fixing Bolts**
9. **AC Generator Assembly**

INSTALLATION

9. **AC Generator Assembly**
   - Set the AC generator.
8. **AC Generator Fixing Bolts**
   - Temporary install the AC generator fixing bolt.


6D3-6-3.tif

7. **Power Steering Oil Pipe Bracket (P/S Model)**
   - Install the oil pipe bracket and tighten bolts to the specified torque.

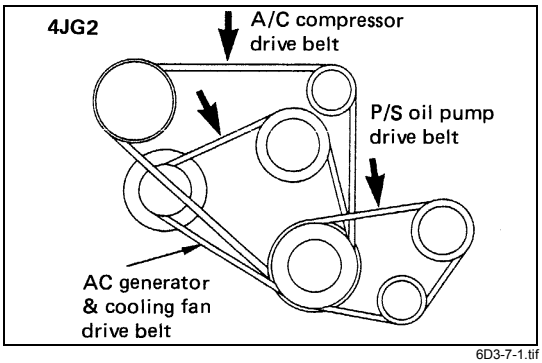
Pipe Bracket Bolt torque	N·m (kg·m/lb·ft)
	19 (1.9/14)

- Install the suction pipe clip bolt and tighten bolt to the specified torque.

Pipe Clip Bolt torque	N·m (kg·m/lb·in)
10 (1.0/87)	

- Install the pressure pipe and suction pipe clip bolt, then tighten bolt to the specified torque.

Pipe Clip Bolt Torque	N·m (kg·m/lb·in)
10 (1.0/87)	



6D3-7-1.tif

6. AC Generator Drive Belt

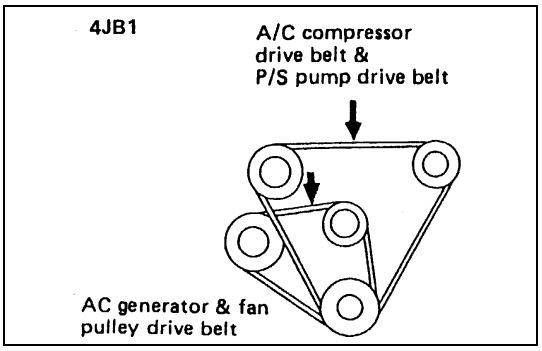
- Install the AC Generator drive belt and adjust belt tension.
- Depress the drive belt mid-portion with a 98N (10kg/22lb) force.

Drive Belt Deflection	mm (in)
8 (0.31) - 10 (0.39)	

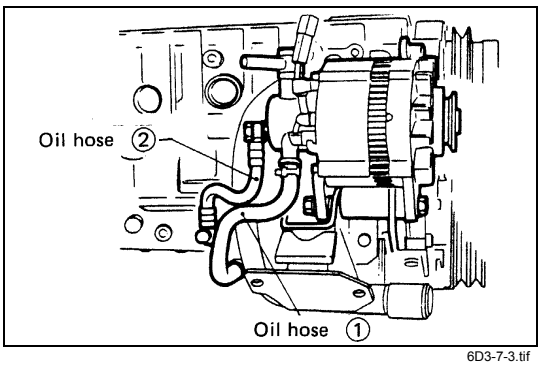
- Install the fixing bolt and tighten bolt to the specified torque.

Generator Fixing Bolt Torque	N·m (kg·m/lb·ft)
40 (4.1/30)	

Adjust Plate Fixing Bolt Torque	N·m (kg·m/lb·ft)
19 (1.9/14)	



6D3-7-2.tif



6D3-7-3.tif

5. Oil Hose

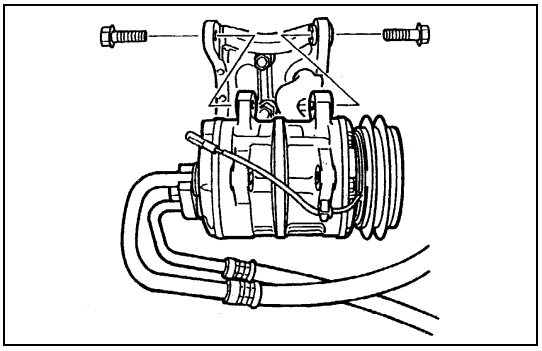
- Install the oil hose ① to vacuum pump.
- Install the oil hose ② to oil pan.

4. Vacuum Hose (EXH. Brake Model)

- Install the vacuum hose to vacuum tank and exhaust actuator.

3. Harness Connector (A/C Model)

- Connect the "L", "S", "IG" terminal and "B" terminal connectors.



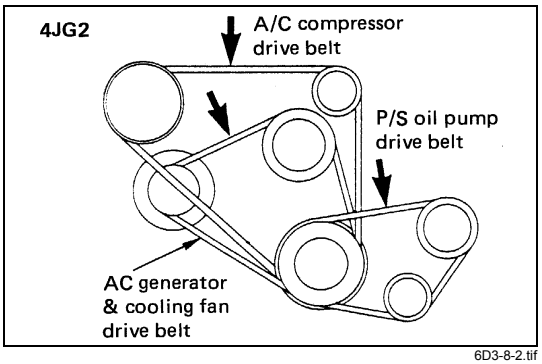
6D3-8-1.tif

2. A/C compressor Assembly (A/C Model)

- Install the compressor assembly and tighten bolts to the specified torque.

Compressor Bolt Torque	N·m (kg·m/lb·ft)
	19 (1.9/14)

- Connect the magnetic switch harness connector.



6D3-8-2.tif

1. A/C compressor Drive Belt (A/C Model)

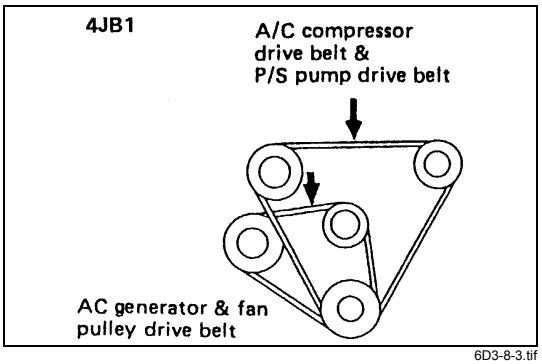
- Install A/C compressor drive belt and adjust belt tension.
- Depress the drive belt and mid-portion with a 98N (10 kg/ 22 lb) force.

Drive Belt Deflection	mm (in)
	8 (0.31) - 10 (0.39)

- Tighten the idler lock nut to the specified torque.

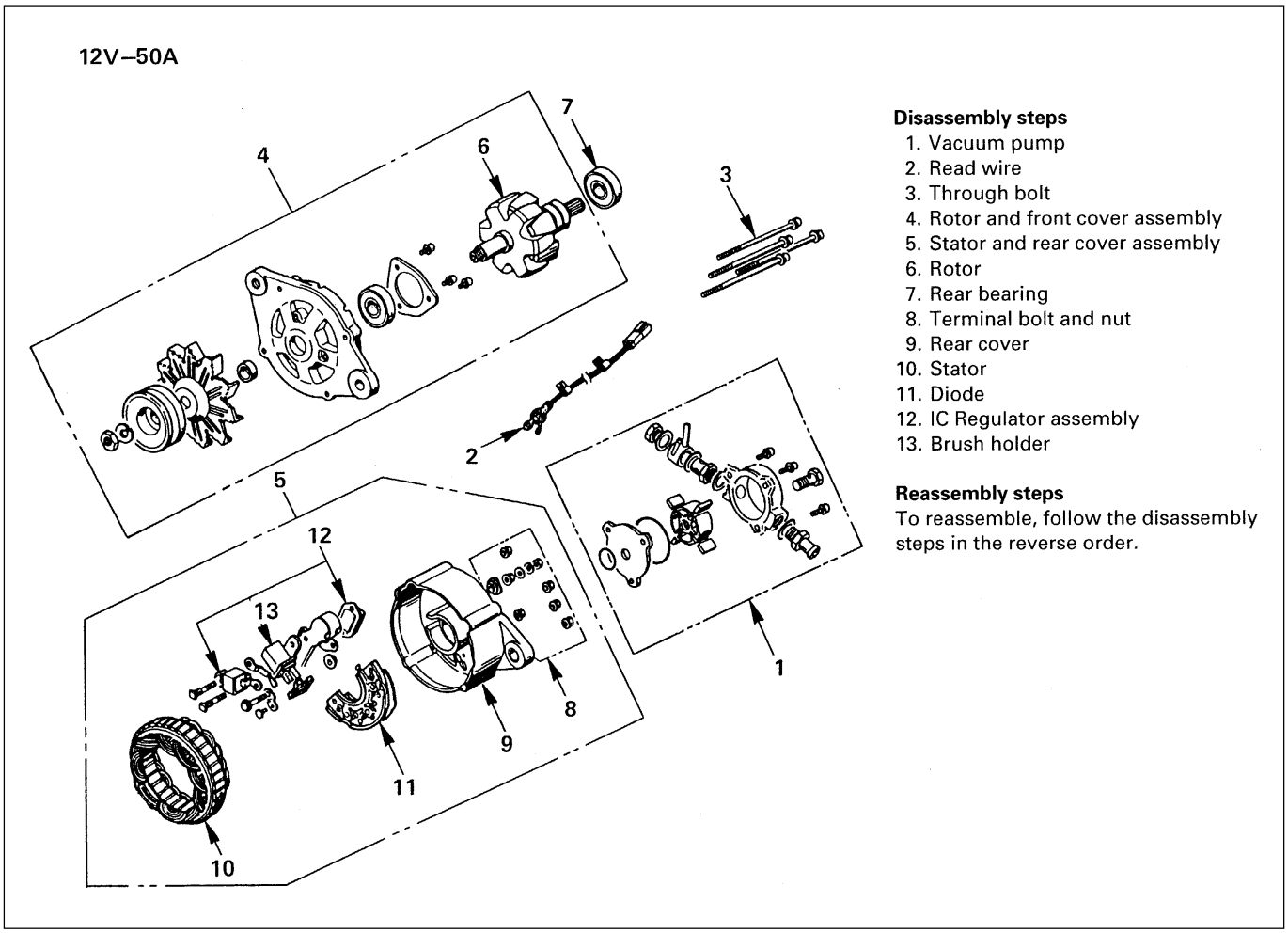
Idle Pulley Lock Nut Torque	N·m (kg·m/lb·ft)
	27 (2.8/20)

- Connect the battery ground cable.



6D3-8-3.tif

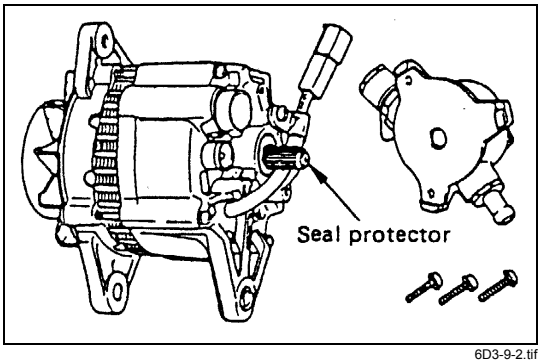
UNIT REPAIR



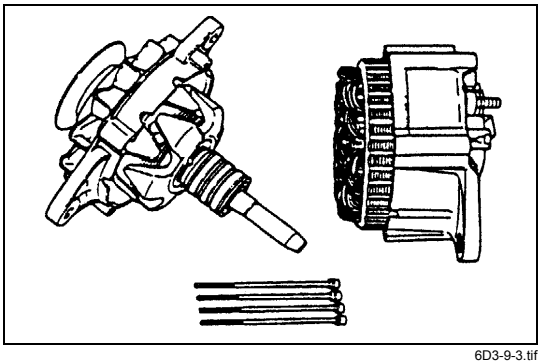
Disassembly steps
1. Vacuum pump
2. Read wire
3. Through bolt
4. Rotor and front cover assembly
5. Stator and rear cover assembly
6. Rotor
7. Rear bearing
8. Terminal bolt and nut
9. Rear cover
10. Stator
11. Diode
12. IC Regulator assembly
13. Brush holder

Reassembly steps
To reassemble, follow the disassembly steps in the reverse order.

6D3-9-1.tif



6D3-9-2.tif



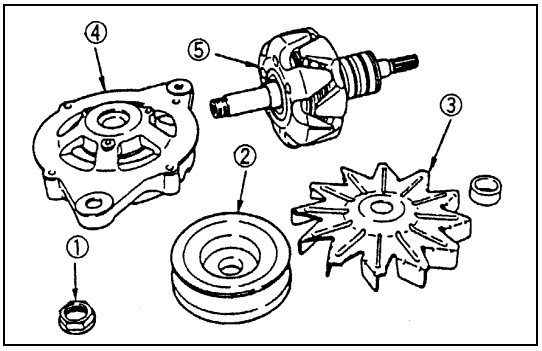
6D3-9-3.tif

DISASSEMBLY

1. **Vacuum Pump**
   - Dram fluid from discharged port.
   - Remove the vacuum pump fixing bolts. Hold the center plate and remove the vacuum pump horizontally in direction in line with the rotor shaft.
2. **Read Wire**
3. **Through Bolts**
4. **Rotor and Front Cover Assembly**
5. **Stator and Rear Cover Assembly**
   - Insert a driver into the clearance between the front cover and the stator core, and remove the assembly.

   NOTE:

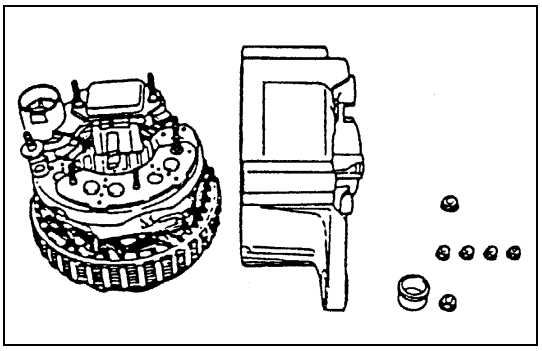
   Take care not to damage the stator coil with the driver. When the assembly will not come off, hold down the rear cover and hit the end face of the shaft gently with a plastic hammer to detach it.



6D3-10-1.tif

6. Rotor

- With the rotor gripped with a vise, remove the pulley nut ①, and then take off the pulley ②, fan ③, front cover ④ and the rotor ⑤.


6D3-10-2.tif

7. Rear Bearing

8. Terminal Bolt and Nut

9. Rear Cover

- Remove the nuts fixing the B terminal and diode holder.

  Separate the stator and rear cover.

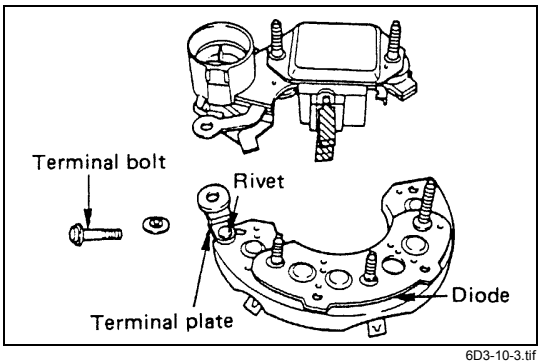
  Note the position of insulation washers to ensure reassembly into original position.

10. Stator

11. Diode

- Separate the diodes from the stator by melting away solder on stator coil and diode.

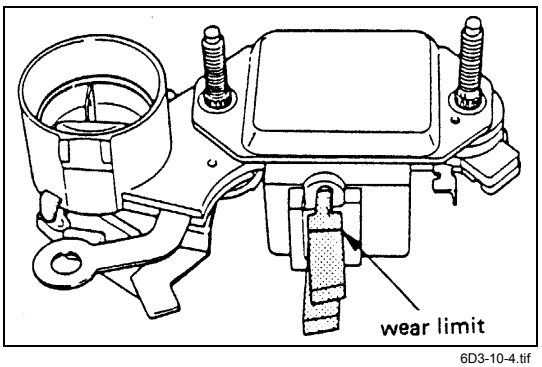
  When melting solder, hold the lead wire with long nose pliers to prevent heat from being transferred to the diodes.



6D3-10-3.tif

12. IC Regulator Assembly

- Separate the IC regulator from the diode by melting away solder on IC regulator holder plate and removing the nut.



6D3-10-4.tif

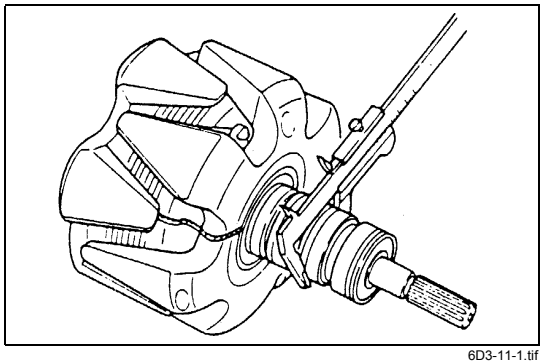
13. Brush Holder

- Remove the serrated bolts and melt away solder on IC regulator.
- Do not remove the serrated bolts unless the replacement of brush or condenser.

  To install, follow the removal steps in the reverse order.

INSPECTION AND REPAIR

Repair or replace necessary parts if extreme wear or damage is found during inspection.

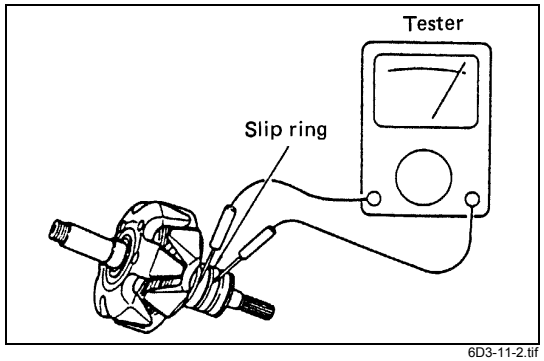

6D3-11-1.tif

ROTOR

1. Check the rotor slip ring surfaces for contamination and roughness. If rough, polish with #500-600 sandpaper.
2. Measure the slip ring diameter, and replace if it exceeds the limit.

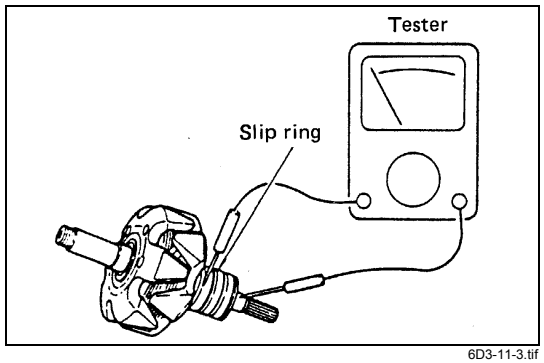
mm (in)

Standard	Limit
34.6 (1.36)	33.6 (1.32)



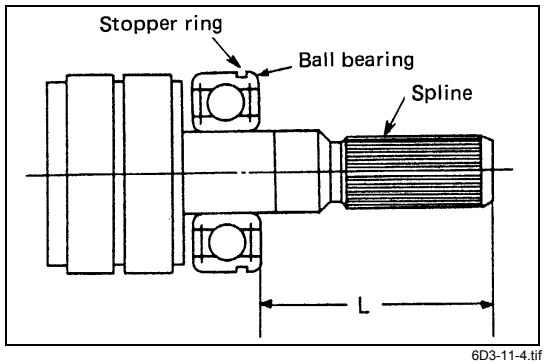
6D3-11-2.tif

3. Check for continuity between slip rings, and replace if there is no continuity.



6D3-11-3.tif

4. Check for continuity between slip ring and rotor core or slip ring and rotor shaft.
   In case of continuity, replace the rotor assembly.



6D3-11-4.tif

Rear Ball Bearing

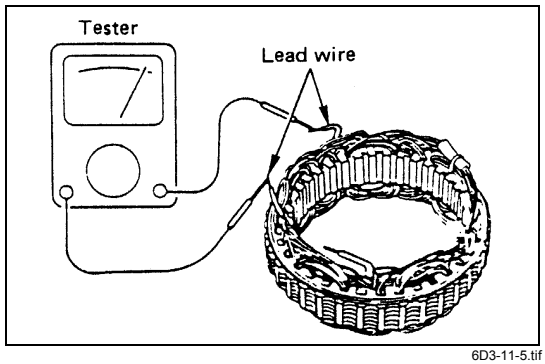
Check to see if the ball bearing rotates smoothly with no noises.

When it does not rotate smoothly or any noises are heard, replace it with a new one.

When installing the bearing, press it in with the stopper ring turned to the spline side, while pushing the bearing inner ring.

Bearing press-in measurement: L mm (in)

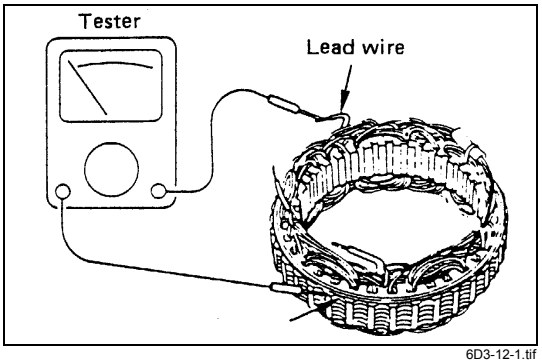
Standard	41.8 - 42.0 (1.64 - 1.65)



6D3-11-5.tif

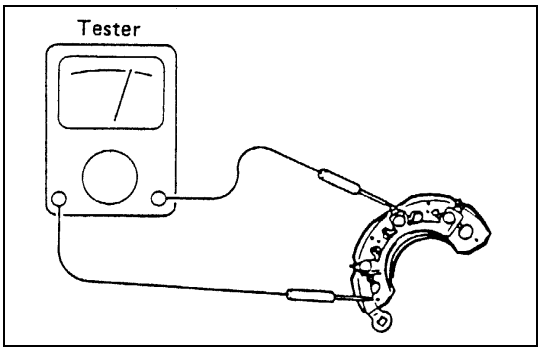
STATOR COIL

1. Check for continuity between respective phases.
   In case of no continuity, replace the stator.



6D3-12-1.tif

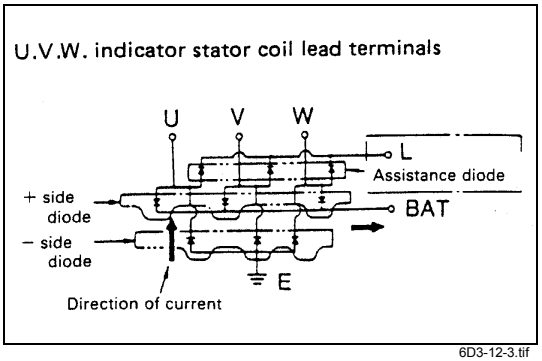
2. Check for continuity across one of the stator coils and stator core. If a continuity exists, replace the coil.



6D3-12-2.tif

DIODE

1. Check for continuity across the terminal (example: across BAT and U). If a continuity exists, the diode is in satisfactory condition. If no continuity exists the diode is defective.
2. Make a test with the polarities reversed. If no continuity exists, the diode is in satisfactory condition. If a continuity exists at any point, the diode is defective and should be replaced.
   Auxiliary diodes are not provided with the terminal and continuity test should be made across the terminals of the conventional diodes.



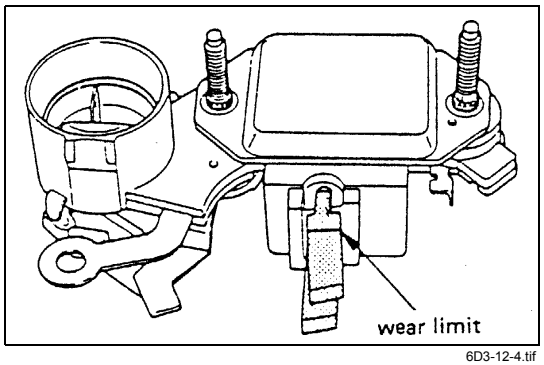
6D3-12-3.tif

⊖ side diode check

Across terminals		BAT (Positive side (+) diodes)	
	Tester pin	Positive side	Negative side
U.V.W	Positive side		No continuity
	Negative side	Continuity	

⊕ side diode check

Across terminals		E (Negative side (+) diodes)	
	Tester pin	Positive side	Negative side
U.V.W	Positive side		Continuity
	Negative side	No continuity	



6D3-12-4.tif

BRUSH

Measure length of brushes.
Brush length (L)

mm (in)

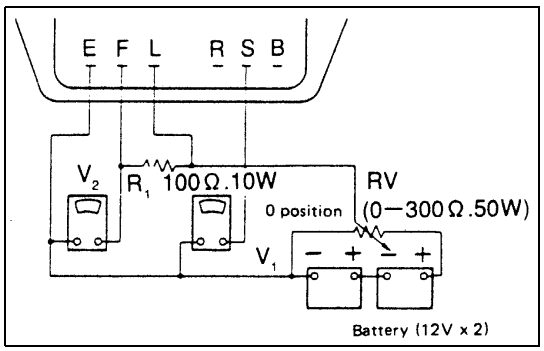
Standard	Limit
20 (0.79)	6 (0.24)

Brushes are provided with a line which indicates the limit of usage.

IC REGULATOR

Measuring instruments is necessary.

Take the following measurements with the instruments connected as shown in the illustration.



6D3-13-1.tif

V1 Voltage at BAT1 V

Standard	10 - 13

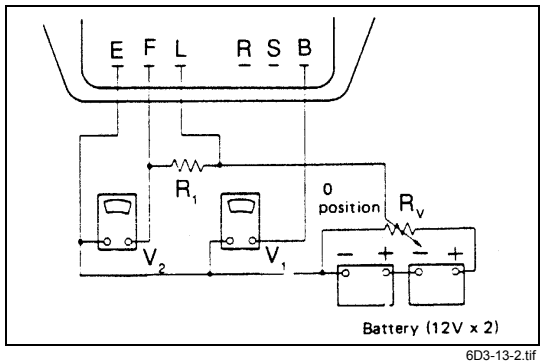
V2 Voltage across F-E V

Standard	Limit
2 or less	2 or more

Take measurement with `S' terminal disconnected.

V3 Measure the voltage at BAT1 - BAT2. V

Standard	20 - 26



6D3-13-2.tif

- Measurement the voltage across the E-F while varying resistance gradually from zero using variable resistor.
  Then check that voltage increases from 2V to 10 - 13.
  If increase in voltage is interrupted at any point, replace the regulator.
- V4 Measure the voltage across the intermediate tap on variable resistor and `E' terminal without actuating the variable resistor.

V

Standard voltage at 20°C (68°F)	14.0 - 14.9

If measured value deviates from the standard, replace the regulator.

Check the following with the instrument connected as illustrated.

Measure the voltage across the terminals B and E by gradually increasing voltage with variable resistor RV.

Check to see if voltage increases from lower than 2V to range from 10 to 13 volts.

If the voltage does not vary, the regulator is defective and should be replaced.

Check the voltage across the intermediate tap of the variable resistor and terminal E without actuating the variable resistor.

V

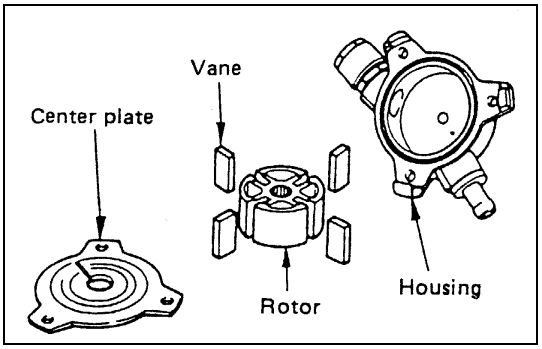
Standard voltage at 20°C (68°F)	14.5 - 16.9

If measured voltage deviates from the standard value, replace the regulator.

VACUUM PUMP

Visual check

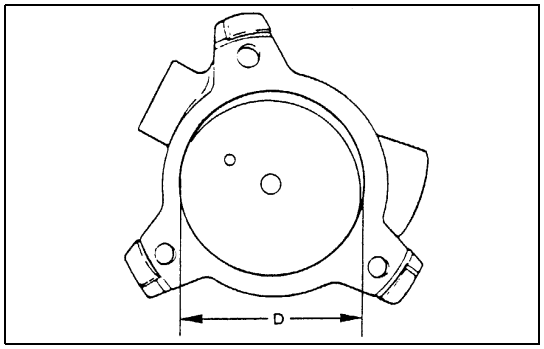
- Inspect the following parts for wear, damage or other abnormal conditions.



6D3-14-1.tif

Disassembly of Vacuum pump

- For the center plate, rotor and vane in the mentioned.



6D3-14-2.tif

Housing

- Measure the inside diameter of housing and place if it exceed the standard.

mm (in)

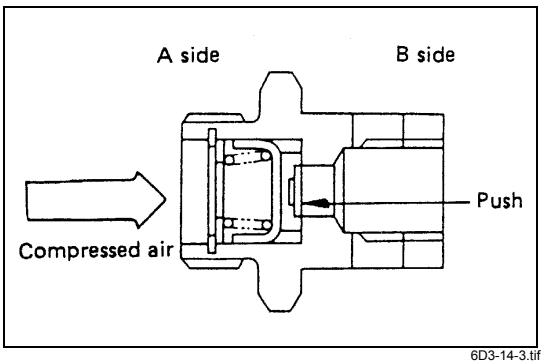
Standard	57.0 - 57.1 (2.244 - 2.248)

Vane

Measure the length of vanes

mm (in)

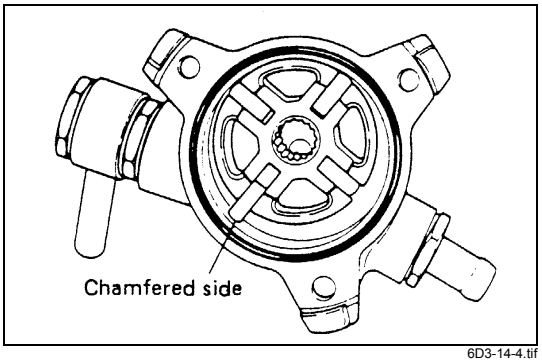
Standard	12.5 - 13.5 (0.492 - 0.531)



6D3-14-3.tif

Check Valve

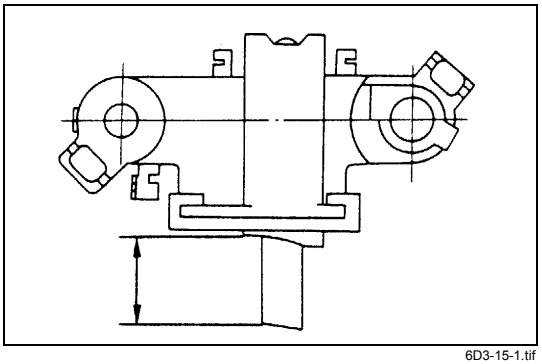
1. Apply a light pressure onto the "B" side of valve with a screw driver and check that valve operates smoothly.
2. Apply compressed air 1 - 5 kg/cm^2 onto "A" side of valve and check if there is air leak.

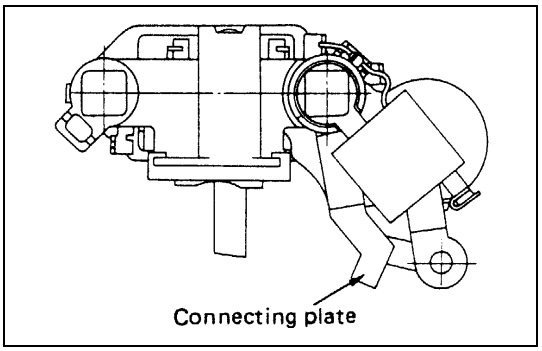


6D3-14-4.tif

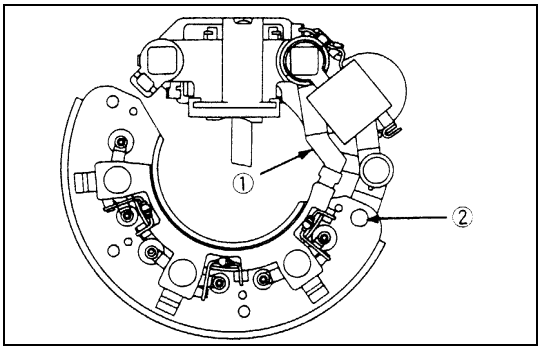
Reassembly of vacuum pump

1. Position the rotor, with the serrated boss turned up, on the center plate and housing.
   Align the holes in center plate and rotor.
2. Install vanes into slits in rotor.
   The vanes should be installed with chamfered side turned outward.
3. Install the O-ring and center plate

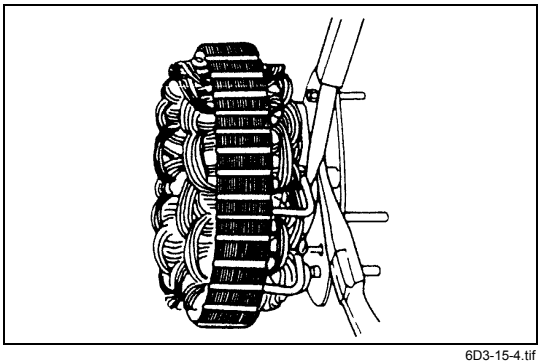

6D3-15-1.tif

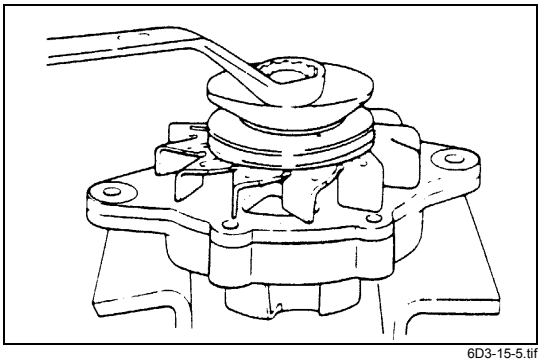


6D3-15-2.tif



6D3-15-3.tif


6D3-15-4.tif


6D3-15-5.tif

REASSEMBLY

13. Brush Holder

12. IC Regulator Assembly

- Hold the brush in the holder as shown in the illustration and solder the lead wire.
- Put the IC regulator on the brush holder and press the bolt.
  Bushing and connecting plate must be installed when pressing the bolt.

11. Diode

- Connect the terminals by fixing the rivet at 1 and soldering the terminal at 2.

10. Stator

- When connecting stator coil leads and diode leads using solder, use long-nose pliers and finish the work as quickly as possible to prevent the heat from being transferred to the diodes.

9. Rear Cover

8. Terminal Bolt and Nut

7. Rear Bearing

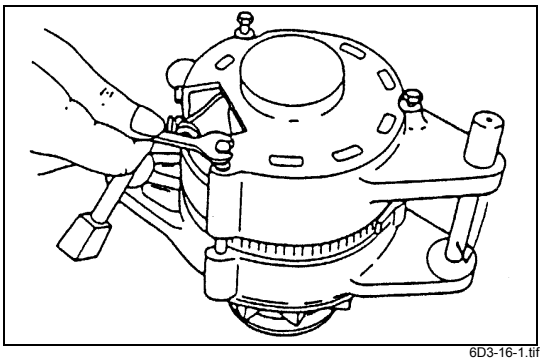
6. Rotor

- Cover vice with copper plates, clamp the rotor with the vice, and tighten nut to the specified torque.

Pulley Nut Torque	N·m (kg·m/lb·ft)
	90 (9.2/67)

5. Stator and Rear Cover Assembly

4. Rotor and Front Cover Assembly

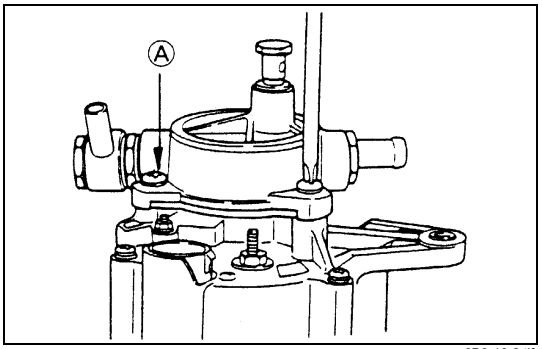


6D3-16-1.tif

3. Through Bolts

- Place guide bar through the holes in front cover and rear cover flange for alignment, then install the through bolts.
- Tighten the through bolts to the specified torque

Through Bolts Torque	N·m (kg·m/lb·in)
	3.5 (0.36/31)



6D3-16-2.tif

2. Read wire

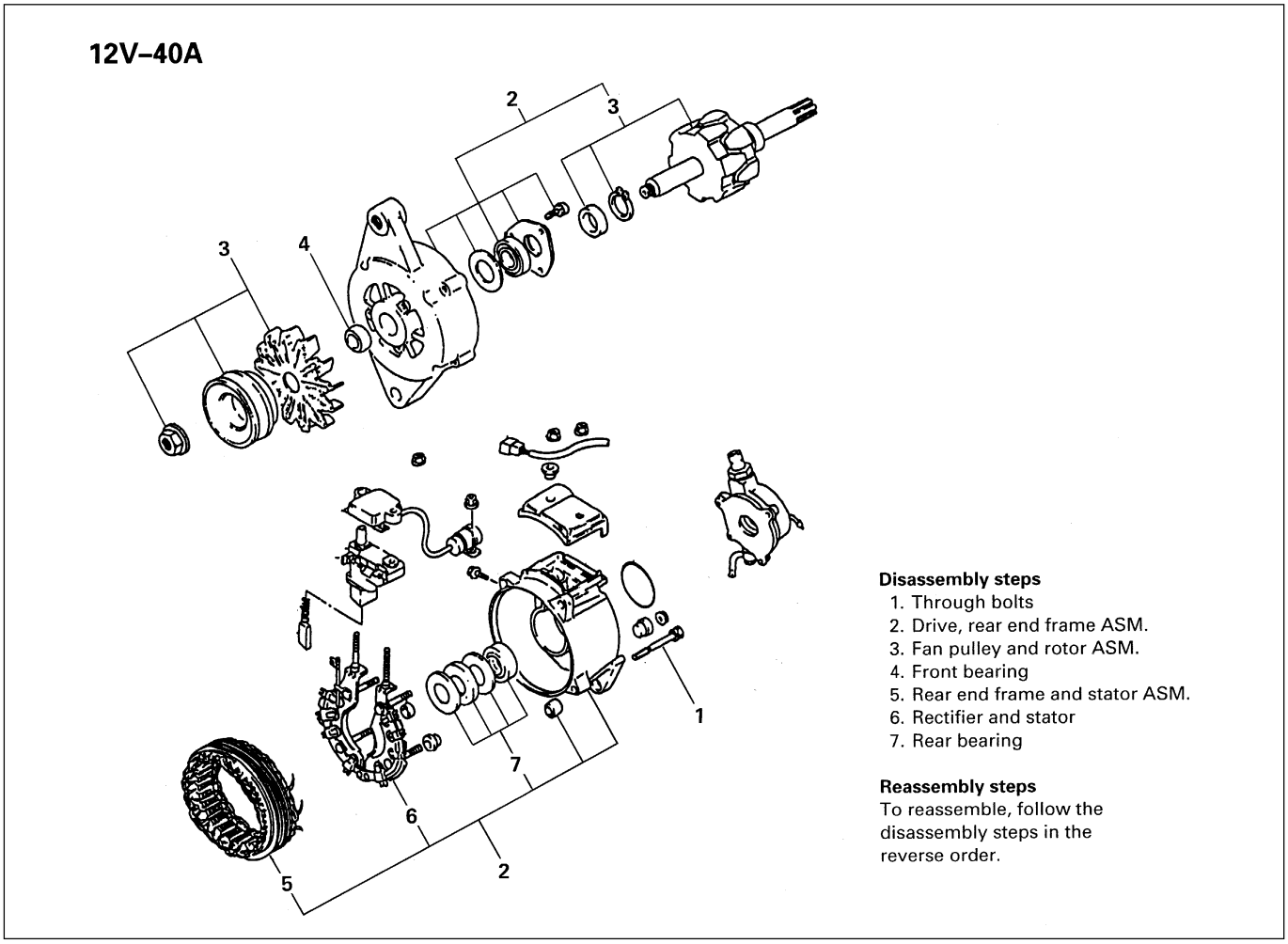
1. Vacuum Pump

- Install and mount the housing to the generator using 3 bolts.
- Pour engine oil (5 cc or so) in through the filler port, then check that generator pulley can be turned smoothly with hand.
- Tighten the pump fixing bolts to the specified torque.

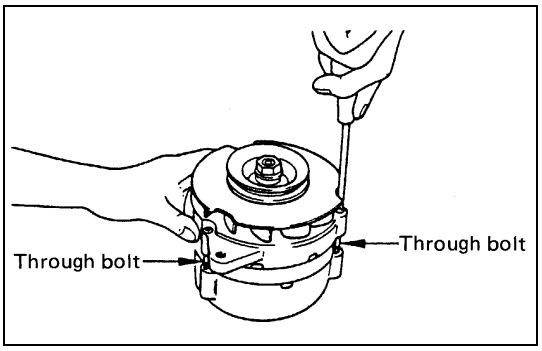
Pump Fixing Bolts Torque	N·m (kg·m/lb·in)
	3.5 (0.36/31)

- Pour engine oil (5 cc or so) throuh the filler port, and then check the pulley for smooth rotation.

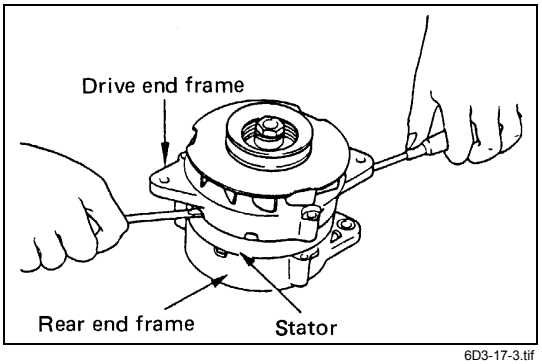
UNIT REPAIR



6D3-17-1.tif



6D3-17-2.tif



6D3-17-3.tif

DISASSEMBLY

1. Removal of Through Bolts

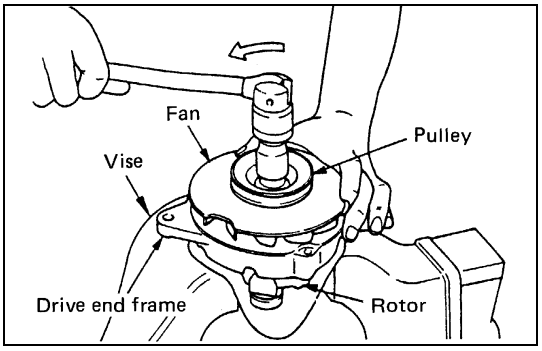
Remove the three through bolts.

2. Separation of Drive End Frame and Rear End Frame & Stator

As illustrated, put a screw-driver into the notched part of the drive end frame and separate the rear end frame and stator from the drive end frame.

NOTE:

Be careful not to put in a screw-driver to excess so as to prevent the stator coil from being scratched.



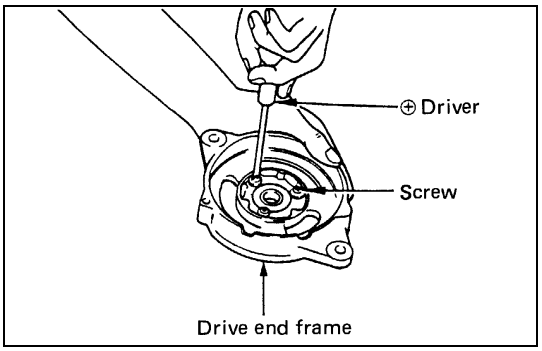
6D3-18-1.tif

3. Separation of Pulley, Fan, Drive End Frame, and Rotor

Fix the rotor in a lock vice, and after removing the lock nut separate the pulley, fan, drive end frame, and rotor.

NOTE:

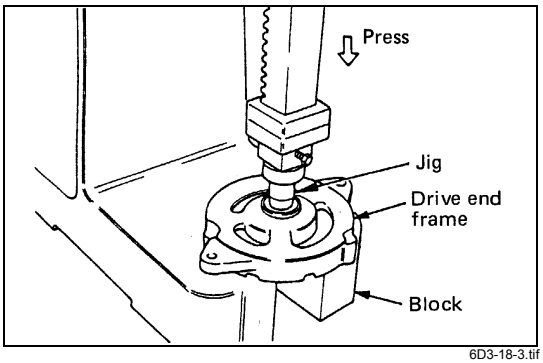
Be sure to fix the rotor through cloth in a vice.



6D3-18-2.tif

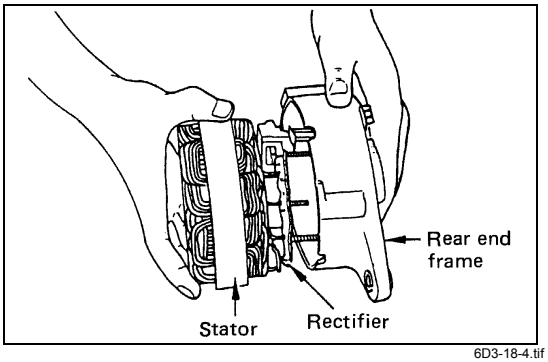
4. Removal of Bearing (on the Drive End Frame Side)

- Remove the ball bearing fixing screw.



6D3-18-3.tif

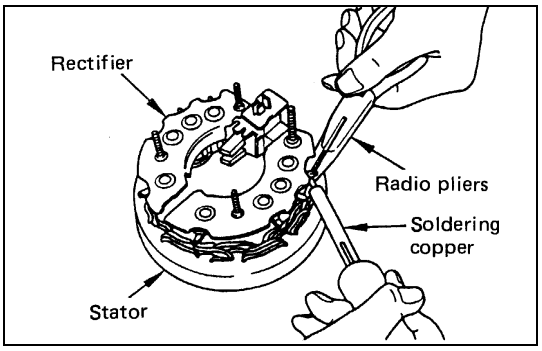
- As shows in the illustration, make the drive end frame parallel to a block, and then push out the bearing with a press through a jig.



6D3-18-4.tif

5. Separation of Rear End Frame and Rectifier & Stator

Remove the nuts M5 and M6, and separate the rectifier and stator from the rear end frame.



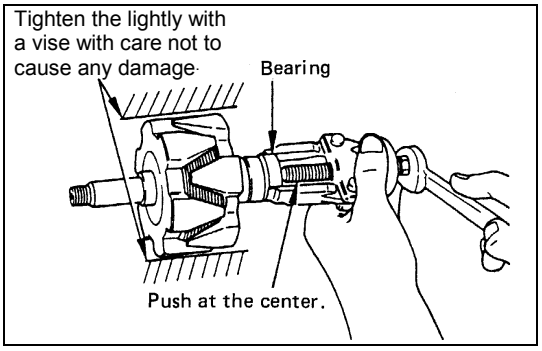
6D3-18-5.tif

6. Separation of Rectifier and Stator

Disconnect the stator lead wire from the rectifier by means of a soldering copper to separate the rectifier and stator from each other.

NOTE:

Since the rectifier a low resistance to heat, the work should be done quickly using radio pliers to absorb heat.



6D3-19-1.tif

7. Removal of Bearing (on the Rear Side) [Only for Replace.]

Take out the bearing with a puller.

Insert it to see whether replacement is needed.

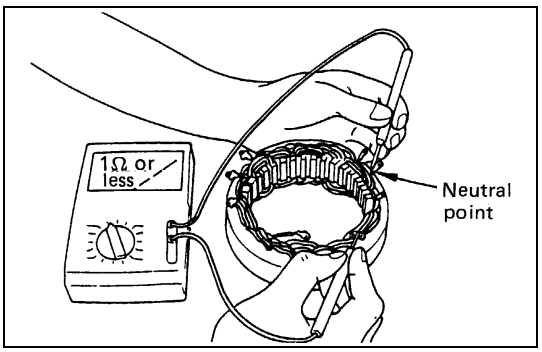
NOTE:

Conduct the bearing inspection mentioned below and determine whether or not the bearing be replaced.

INSPECTION AND REPAIR

NOTE:

Standard values and limits vary with alternators, and therefore, maintenance standards for each part should be followed.



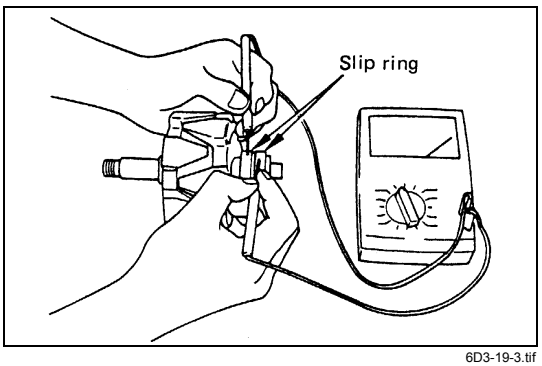
6D3-19-2.tif

1) Fan
   Check to see whether it is deformed.
2) Bearing
   Turn it by hand to check for smooth and noiseless turning.
3) Stator

- Resistance between phases (neutral point and each phase lead wire) should be 1Ω or less.
- Insulation resistance between the core and stator coil should be 0.1MΩ or more by a 500V megohmmeter.

NOTE:

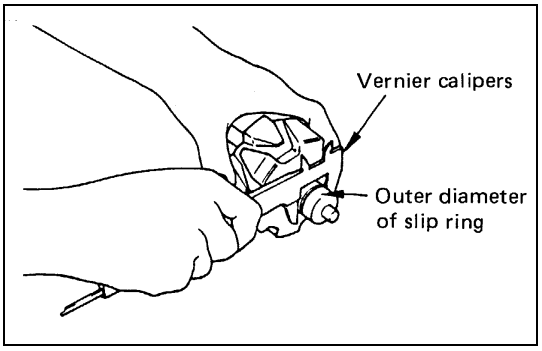
If there is no continuity, the connection of lead wire should be checked as the disconnected stator coil cannot be considered.



6D3-19-3.tif

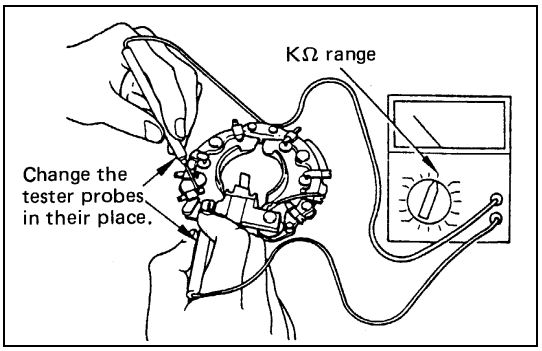
4) Rotor

- Resistance between slip rings as shows in the illustration, about 4Ω.
- Insulation resistance between slip ring and ball core: 0.1MΩ or more by 500V megohmmeter.
- Check slip rings for surface. If staind or rough, use sand paper (#300 - #500).



6D3-20-1.tif

In this case, the slip ring can be used until its outer diameter becomes 0.4mm shorter than the initial size.



6D3-20-2.tif

5) Rectifier

Conduct a rectifier continuity test using the KΩ range of a circuit tester.

Specifically, change polarity between the rectifier and holder fin, making sure that there continuity in either one direction only. (There should not be continuity in the other direction.)

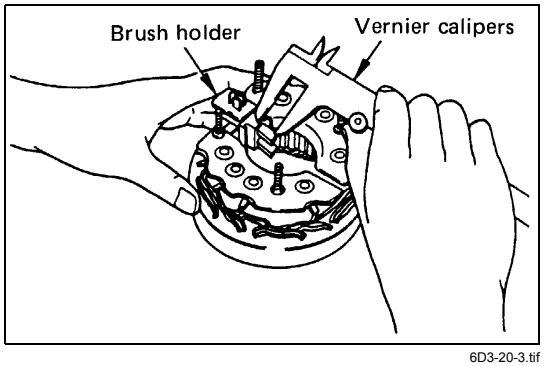
NOTE:

It is impossible to judge a rectifier by the resistance in the direction of easy flow. Because of diode's characteristics, the current in the direction of easy flow changes greatly depending on the power source voltage.

Therefore, a tester's indication varies depending on its type and resistance range variation.

Accordingly, it must be regarded as a criterion that there is a wide difference between the resistances easy flow and the other direction.

Never use a 500V megohmmeter for such a continuity test, since the rectifier may be damaged.



6D3-20-3.tif

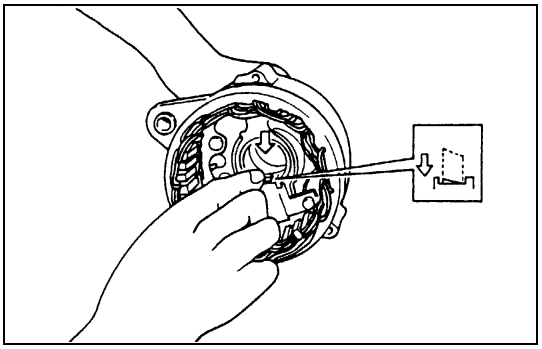
6) Brush

Measure the protruding length from the brush holder.

mm (in)

Standard	Limit
12.5 (0.492)	5.5 (0.217)

REASSEMBLY

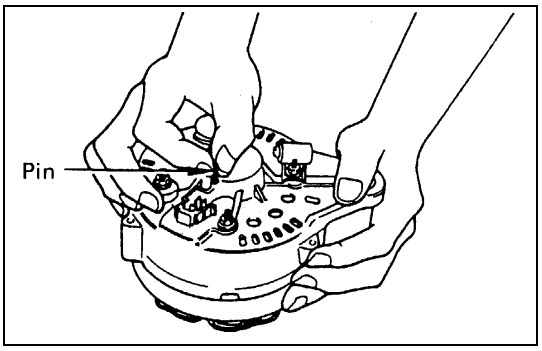


6D3-21-1.tif

Follow the same procedure as for disassembly in the opposite order, paying special attention to the following points:

- Brush

  When fitting a new brush, be sure to see it so that the free end of it is projecting 12.5mm (0.49 in) from the holder.

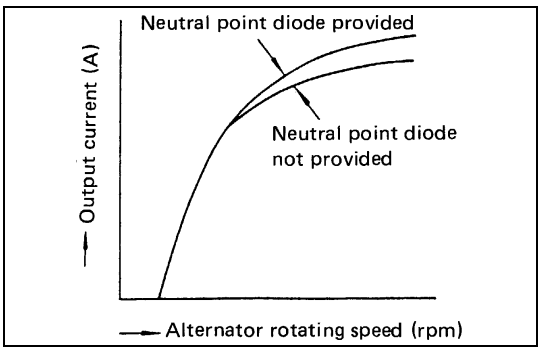


6D3-21-2.tif

- Rotor

  Be sure to fit it after brush is supported by the brush holder.

  Otherwise, the rotor cannot be fitted or the brush may be broken.



6D3-21-3.tif

Output Characteristic

As alternator speed increases, the output gradually increases as shows in the illustration.

In other words, when alternator speed exceeds a certain limit to cause to enlarge output current, supply capacity will further increase owing to the neutral point diodes.

MEMO

SECTION 6D6

QOSII PREHEATING SYSTEM (4JB1/4JB1T/4JB1TC ONLY)

CONTENTS

PAGE

General Description..... 6D6 - 1

System Diagram..... 6D6 - 2

Inspection on QOS II system Operation ..... 6D6 - 3

QOSII System Troubleshooting..... 6D6 - 4

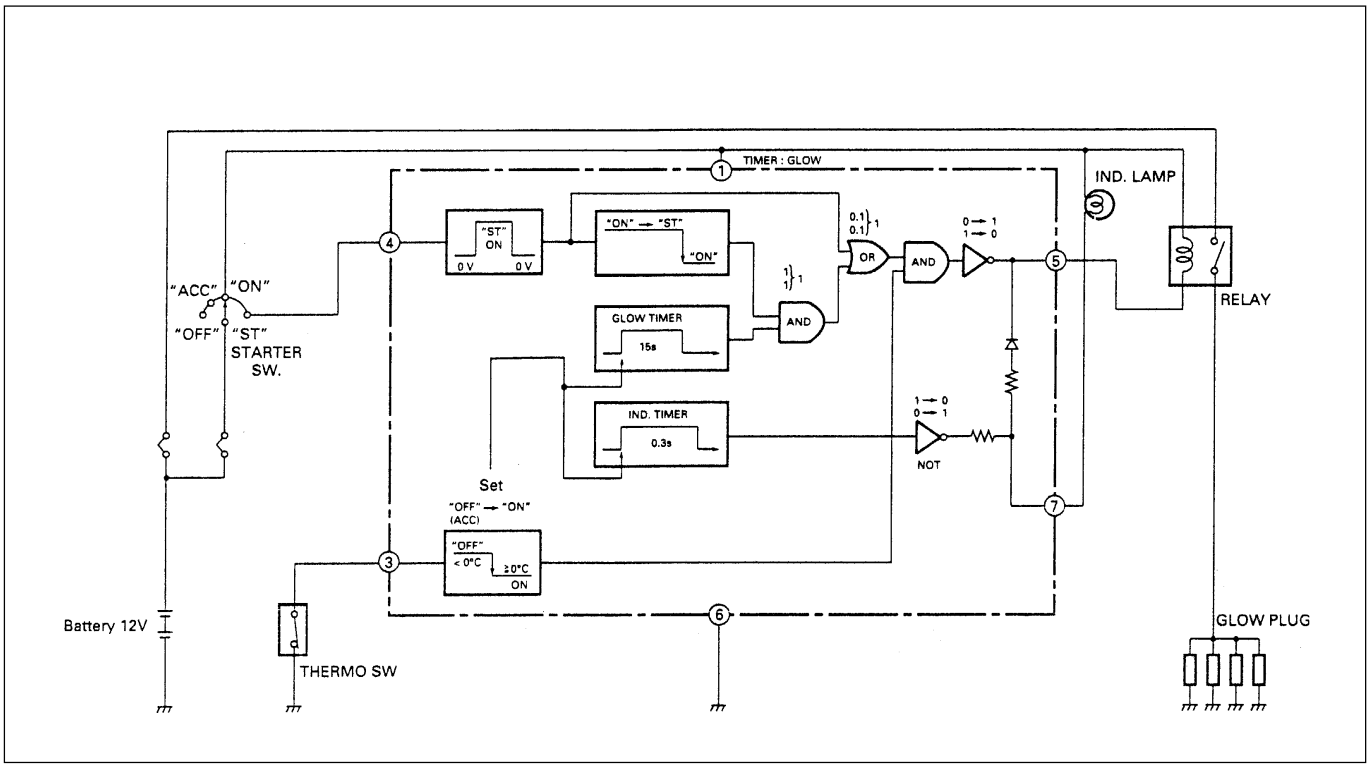
GENERAL DESCRIPTION

QOS II preheating system features a quick-on glow plug with thermometer control of the glowing time and the afterglow time function.

The system consists of a controller, indicator lamp, thermoswitch, relay, and glow plug (4 pcs).

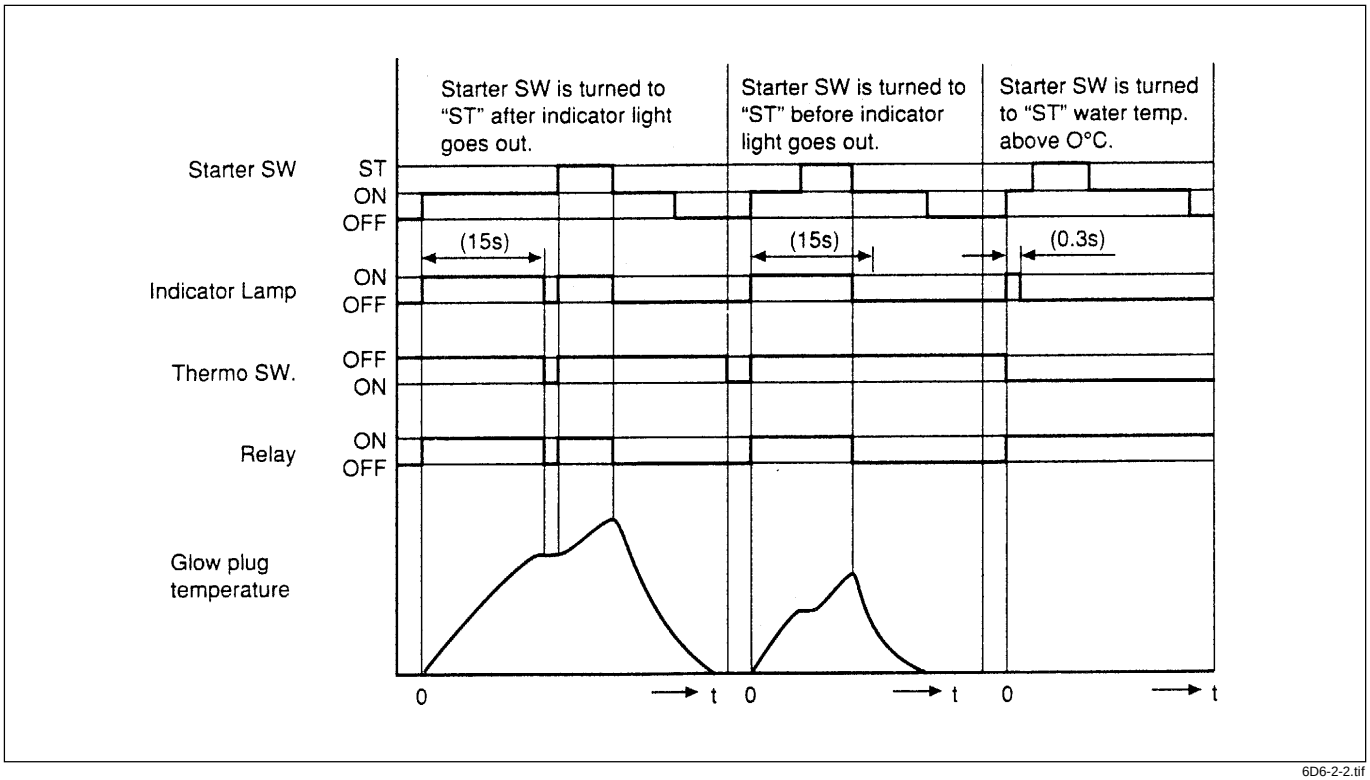
With the employment of the thermoswitch, the glow time changes according to the engine coolant temperature, thus allowing optimum starting conditions to be obtained.

SYSTEM DIAGRAM

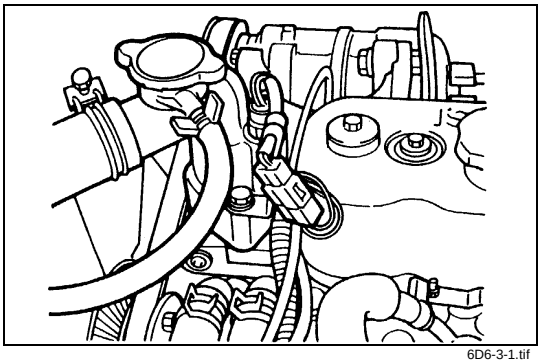


6D6-2-1.tif

QOS II Timing Chart

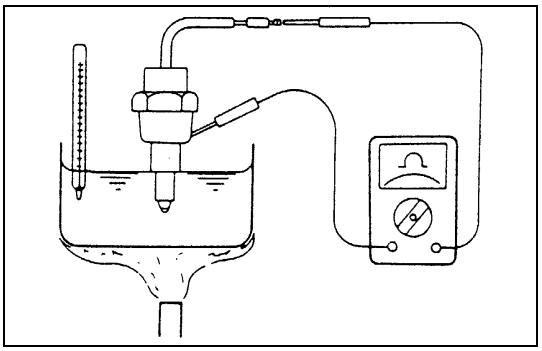


6D6-2-2.tif


6D6-3-1.tif

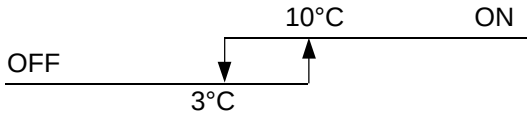
Inspection on QOSII System Operation
THERMO SWITCH

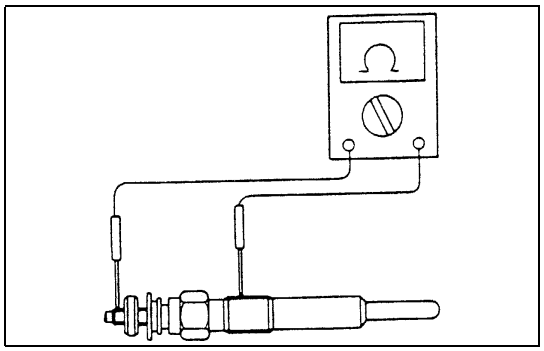
The thermo switch is located on the water outlet pipe.


6D6-3-2.tif

Use a circuit tester to check the thermo switch for continuity.

OFF→ON	: 7-13°C (44.6-55.4°F)
ON→OFF	: Below 3°C (37.4°F)



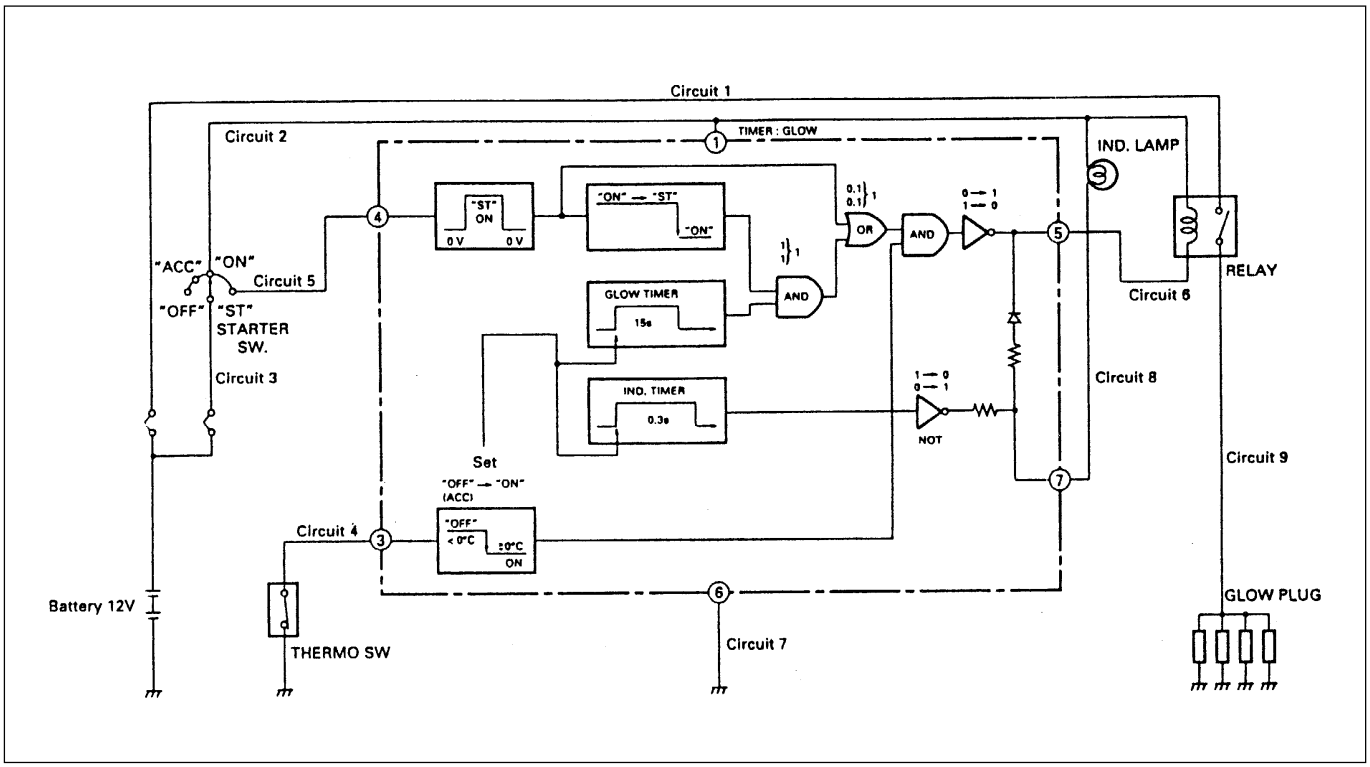

6D6-3-3.tif

GLOW PLUG

Use a circuit tester to test the glow plugs for continuity.

Glow Plug Resistance (Reference)	Ohms
Conventional model	Approximately 1.5
Quick on start model	Approximately 0.9

QOSII SYSTEM TROUBLESHOOTING



6D6-4-1.tif

Problems when the water temperature of the engine is 0°C below.

Condition	Cause	Circuit
Glow plug relay will not be lit.	Bad connection of FLW between battery and starter.	3
	Bad connection or disconnection of starter SW circuit	
	Bad connection or disconnection of Fuse No . 8 — Malfunction of other circuits occurred simultaneously.	2
	Bad starter awitch.	
	Bad connection of glow plug relay terminal.	1
	Disconnection of glow plug relay excitation coil.	
	Disconnection of circuit between glow plug relay and timer.	6
	Bad glow relay. (The main contact does not pass electricity.)	
	Bad connection of timer.	
	Bad timer.	
	Bad earth circuit of timer.	7
	Bad thermoswitch. (It remains ON even in water temperature below 0°C.)	
	Earth short-circuiting of thermo SW.	7

Condition	Cause	Circuit
Through glow plug relay turns ON, preheating is not done.	Bad connection of FLW between battery and glow relay.	1
	Bad connection or disconnection in preheating circuit of glow relay main contact terminal connector.	
	Bad connection between plug connector and preheating circuit	9
Glow plug relay turns ON, but does not go OFF.	Bad timer.	
	Bad timer. Short circuiting in circuit or earth between 5 terminal and glow relay.	6
	Bad glow relay.	
Indication lamp is not lit.	Bad timer.	
	Burning-out of light bulb.	8

Note: Circuit No. in rectangle is shown in the previous pre-heating chart.

2) Problems when the time water temperature of the engine is 0°C or above.

Condition	Cause	Circuit
Indicator lamp is not lit	Bad timer	
	Burning-out of bulb.	8
Turn glow relay ON.	Bad thermoswitch or disconnection of thermo SW circuit. (Indicator will light up for 3.5 seconds.)	4
	Bad timer.	
	Bad timer. Short-circuiting in circuit or earth between terminals 5 and glow relay.	

Note: Circuit No. in rectangle is shown in the previous pre-heating chart.

3) Burning-out of glow plug

When only one line is burned out, it has no effect on the start up of the engine. Even if one line is burned out, judging from the characteristics of the glow plug, the impressed voltage will change only slightly. Therefore, no judgment can be made by normal testing while the glow plug is installed. In order to check for disconnections and burn-outs, the glow plugs will have to be removed from the connectors and checked one by one for continuity.

MEMO

SECTION 6D7

QOSIII PREHEATING SYSTEM (4JG2 ONLY)

CONTENTS

PAGE

General Description..... 6D7 - 1

System Diagram..... 6D7 - 2

Inspection on QOS III system Operation ..... 6D7 - 5

GENERAL DESCRIPTION

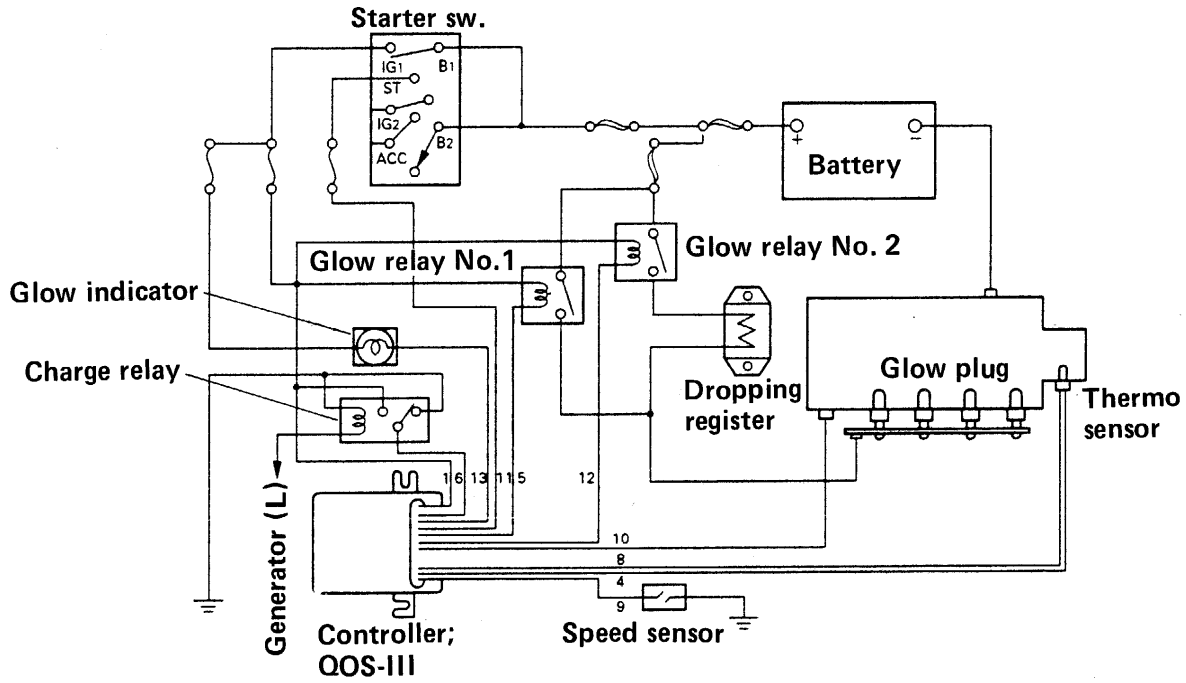
QOS III preheating system features a quick-on glow plug with thermometer control of the glowing time and the afterglow time function.

The system consists of a controller, indicator lamp, thermosensor, vehicle speedsensor, dropping resistor, relay (2 pcs), and temperature self-control type glow plug (4 pcs)

With the employment of the thermoswitch, the glow time changes according to the engine coolant temperature, thus allowing optimum starting conditions to be obtained.

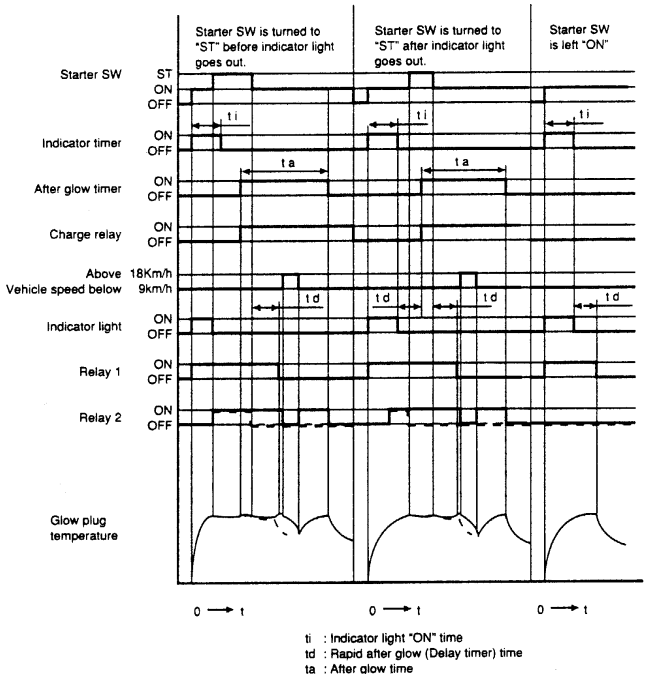
The afterglow time function is controlled by thermosensor, vehicle speed sensor, and the engine runstall sensor (charge relay).

SYSTEM DIAGRAM



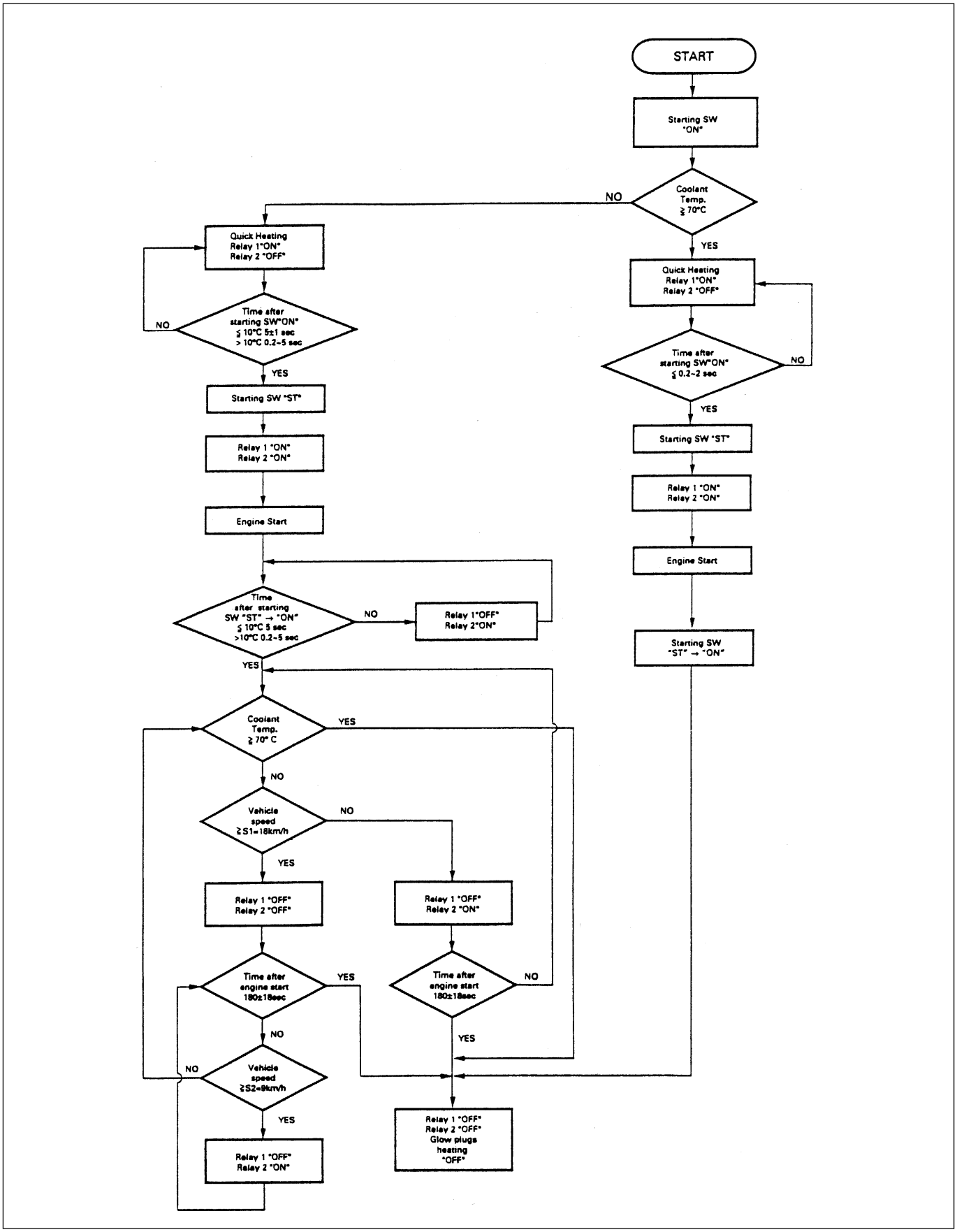
6D7-2-1.tif

QOS II Timing Chart



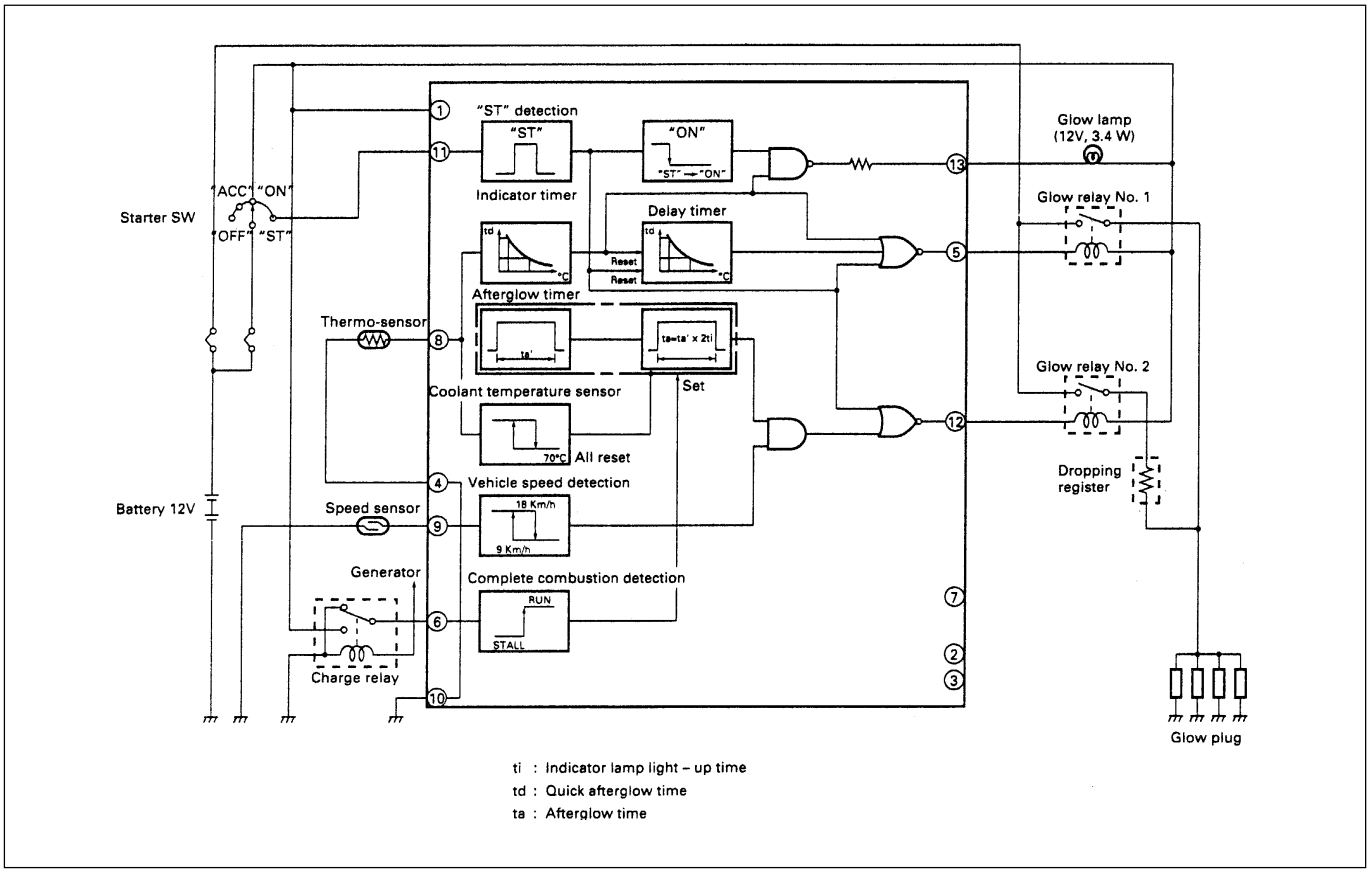
6D7-2-2.tif

QOS III FLOW CHART

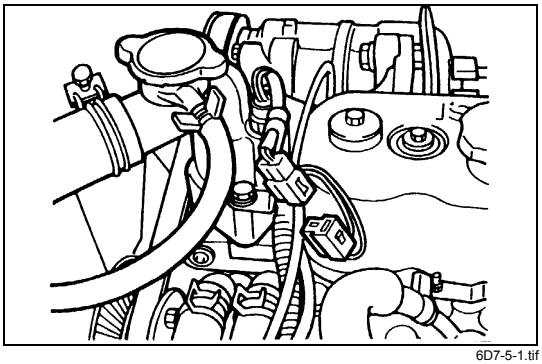


6D7-3-1.tif

QOS III BLOCK CHART



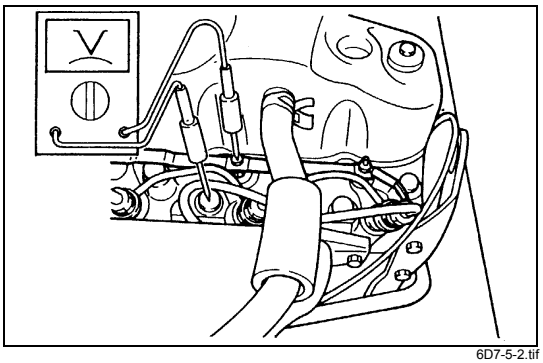
6D7-4-1.tif


6D7-5-1.tif

Inspection on QOSIII System Operation

I Inspection on Quick Heating Operation

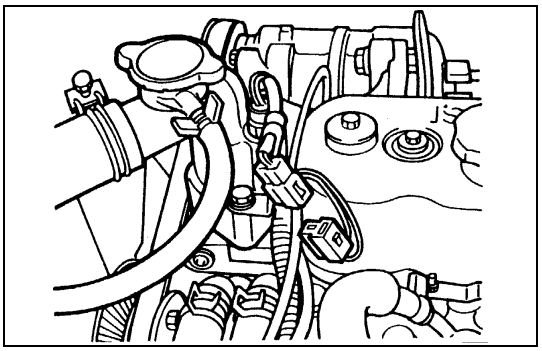
1. Disconnect thermo-sensor connection on the thermostat housing.


6D7-5-2.tif

2. Connect the circuit tester between glow plug and engine earth.
3. Inspect the following items with starter switch set to ON position (but do not start the engine).

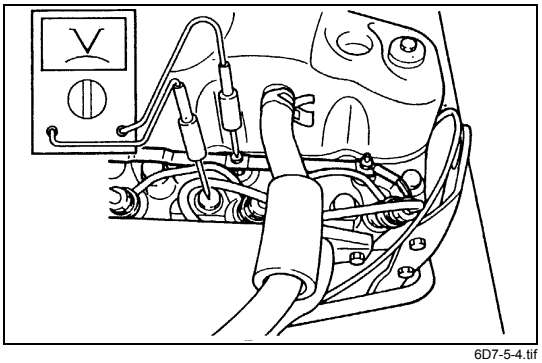
1) The glow indicator shall light for 1 ~ 6 sec.
2) The circuit tester shall indicate power supply voltage for 9 ~ 13 sec.

- If above specifications are not satisfied, inspect wire harness, glow relay and thermo-sensor. If satisfied, inspect glow plug.


6D7-5-3.tif

II Inspection on Quick Heating Afterglow Operation

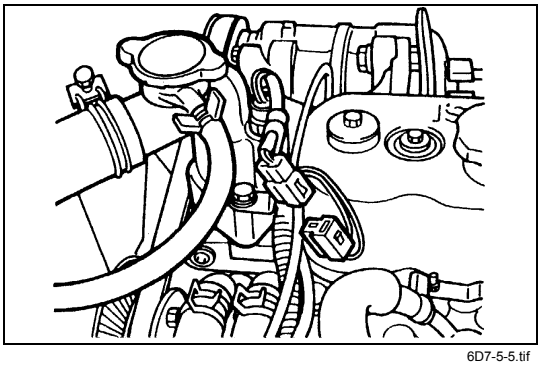
1. Disconnect thermo-sensor connection on the thermostat housing.


6D7-5-4.tif

2. Connect the circuit tester between glow plug and engine earth.
3. Inspect the following item with start the engine.

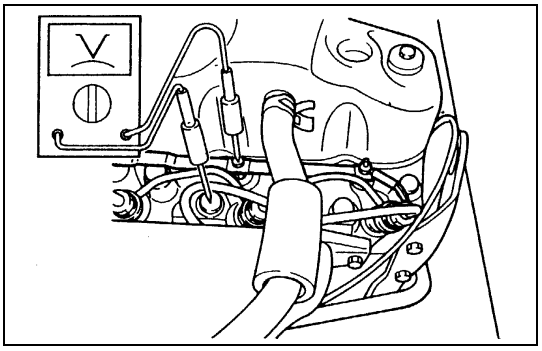
1) The circuit tester shall indicate power supply voltage for about 5 seconds.

- If above specification is not satisfied, inspect battery voltage, engine earth, wire harness and starter switch "st" signal to control unit.
  If satisfied, inspect wiring harness, engine earth and starter switch.


6D7-5-5.tif

III Inspection on Afterglow Operation

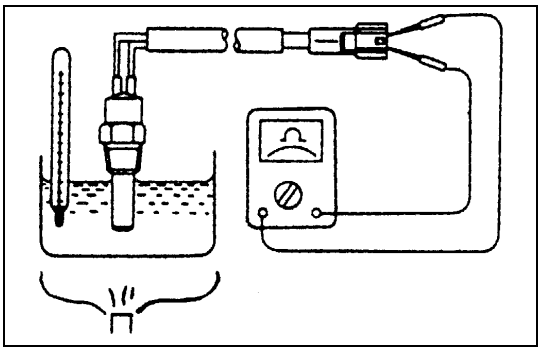
1. Disconnect thermo-sensor connection on the thermostat housing.


6D7-6-1.tif

2. Connect the circuit tester between glow plug and engine earth.
3. Inspect the following items with start the engine.

1) The circuit tester shall indicate about 7 volts after 360 seconds of engine start.

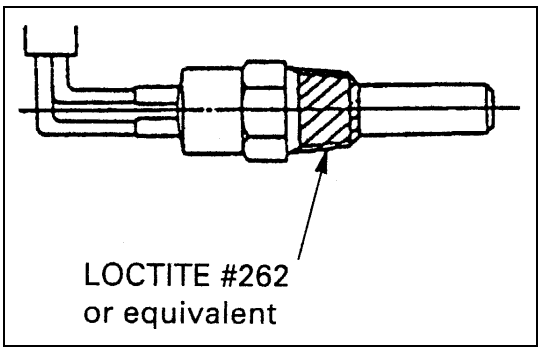
- If above specifications are not satisfied, inspect battery voltage, engine earth, wiring harness, glow plug, dropping resistor, relay No. 2 and charge relay.


6D7-6-2.tif

THERMO SENSOR

Measure the resistance depending on the water temperature as shown in the left figure. (Measuring range: 10°C ~ 50°C)

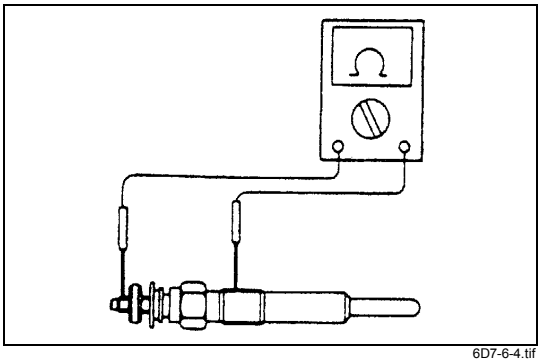
Temperature	Current (mA)	Resistance (KW)
20 ± 1	1.0	2.0 ~ 3.0
50 ± 1	1.0	0.68 ~ 1.0



6D7-6-3.tif

When installing the thermo sensor, apply sealant (Loctite #262 or equivalent) to narrowed portion in the left figure to prevent water leakage

Torque	N·m (kg·m/lb·in)
8 (0.8/69)	

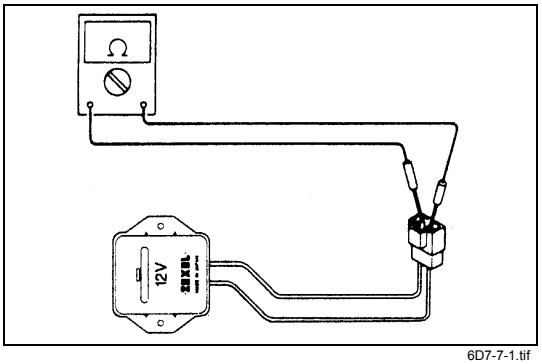

6D7-6-4.tif

GLOW PLUG

Inspect the resistance

Resistance at normal temperature	Ω
0.8 ~ 1.0	

Torque	N·m (kg·m/lb·ft)
23 (2.3/17)	

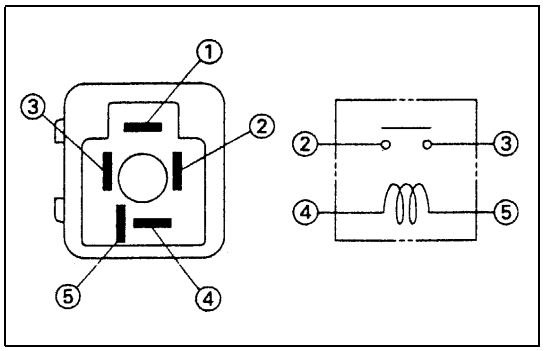


6D7-7-1.tif

DROPPING RESISTOR

Inspect the resistance

Resistance of normal ambient temperature	mΩ
225 ~ 255	



6D7-7-2.tif

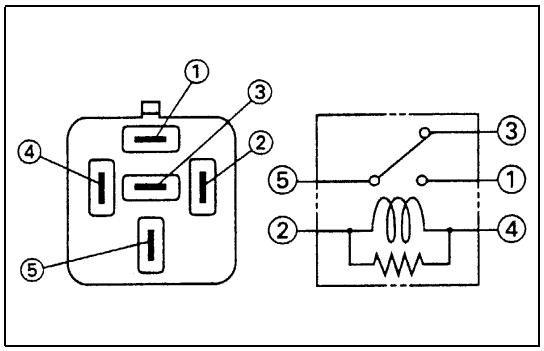
GLOW PLUG RELAY

Inspect the continuity

② - ③	No Continuity

If apply the battery voltage to terminal between ④ - ⑤

② - ③	Continuity



6D7-7-3.tif

CHARGE RELAY

Inspect the continuity

③ - ⑤	Continuity
① - ⑤	No Continuity

If apply the battery voltage to terminal between ② - ④

③ - ⑤	No Continuity
① - ⑤	Continuity

MEMO

SECTION 6E

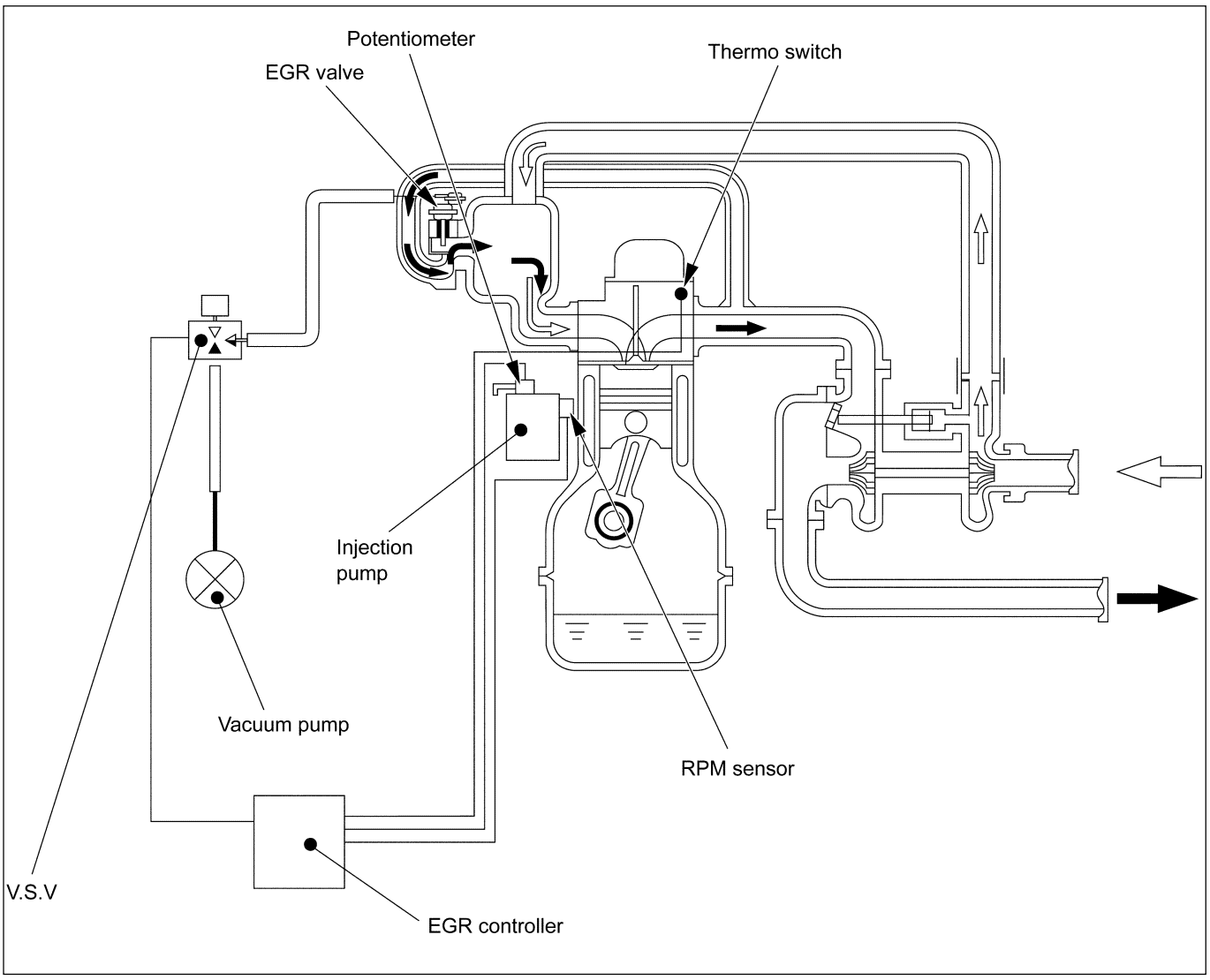
EXHAUST GAS RECIRCULATION (EGR) SYSTEM

CONTENTS

PAGE

General Description..... 6E -2
EGR System Wiring Diagram..... 6E -3
EGR System Operation ..... 6E -3
EGR System Check ..... 6E -4
Inspection..... 6E -5

GENERAL DESCRIPTION



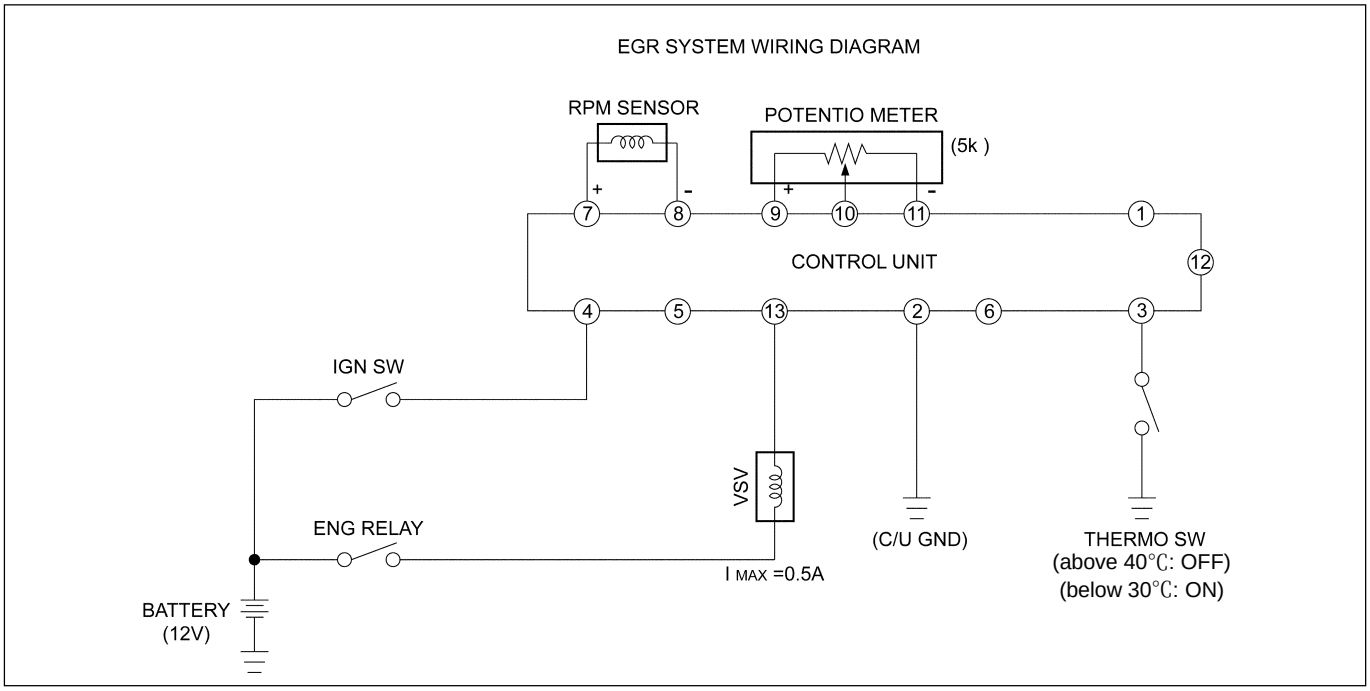
D06LX001.tif

This system controls the formation of NOx emission by recirculating the exhaust gas into the combustion chamber through the intake manifold.

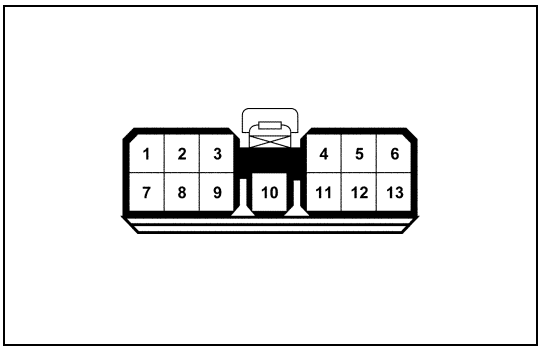
The EGR valve are controlled by VSV, also VSV are controlled by EGR controller according to signals from RPM sensor and Potentiometer.

The amount of EGR depends on the number of engine rotations and the opening of the accelerator.

EGR SYSTEM WIRING DIAGRAM



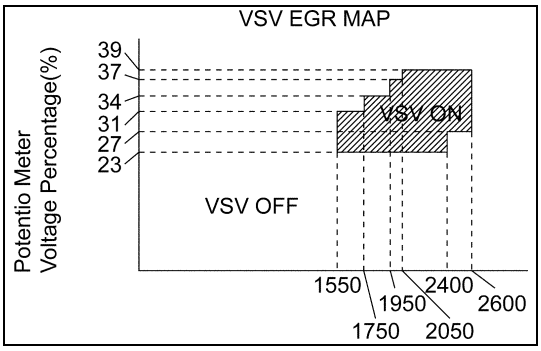
826LX007.tif



13-01.tif

1. CONNECTOR PIN ASSIGNMENT

No.	CONNECTOR NAME
1	-
2	Battery (-) c/u GND
3	Thermo Switch
4	Battery (+)
5	-
6	-
7	rpm Signal (+)
8	rpm Signal (-)
9	Potentio Meter (+)
10	Potentio Meter
11	Potentio Meter (-)
12	-
13	VSV



056LX016.tif

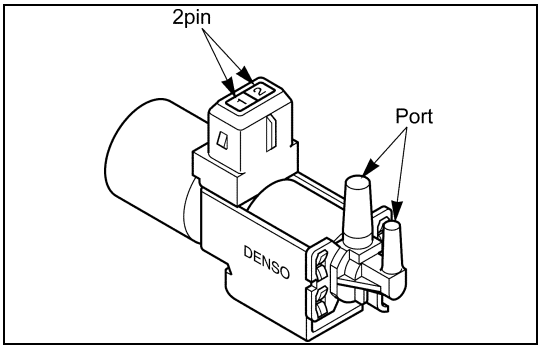
EGR SYSTEM OPERATION

1) On the input side of engine speed, there is provided a hysteresis of 50 rpm on the speed rising side.
2) It does not work until 70 sec, pass after engine start.
3) It does not work while the water temperature switch is on (30°C or lower).
4) While engine speed drops from 3,800 rpm or higher, it does not work for 25 sec.

Exhaust Gas Recirculation (EGR) System Check

Step	Action	Value (s)	Yes	No
1	Check the EGR valve for looseness. Is the EGR valve loose?	-	Go to Step 2	Go to Step 3
2	Tighten the EGR valve. Is the action complete?	-	Verify repair	-
3	1. Engine "OFF." 2. Ignition "ON." 3. Using test light to ground, check the EGR harness between the EGR valve and ignition feed. Does the test light illuminate?	-	Go to Step 5	Go to Step 4
4	Repair the EGR harness ignition feed. Was the problem corrected?	-	Verify repair	Go to Step 5
5	1. Remove the EGR valve. 2. Visually and physically inspect the EGR valve pintle, valve passages and adapter for excessive deposits, obstructions or any restrictions. Does the EGR valve have excessive deposits, obstructions or any restrictions?	-	Go to Step 6	Go to Step 7
6	Clean or replace EGR system components as necessary. Was the problem corrected?	-	Verify repair	Go to Step 7
7	1. Remove the EGR inlet and outlet pipes from the intake and exhaust manifolds. 2. Visually and physically inspect manifold EGR ports and EGR inlet and outlet pipes for blockage or restriction caused by excessive deposits or other damage. Do the manifold EGR ports or inlet and outlet pipes have excessive deposits, obstructions, or any restrictions?	-	Go to Step 8	EGR system working properly. No problem found.
8	Clean or replace EGR system components as necessary. Is the action complete?	-	Verify repair	-

INSPECTION



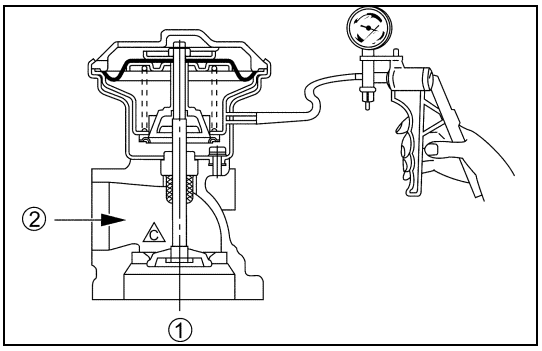
056LW026.tif

Vacuum Switch Valve (VSV)

Check the resistance between the VSV connector terminals using a circuit tester.

Cold Resistance: 37 - 44 (Ω) (for 12 volt)

Connect battery voltage between VSV connector terminals and make sure of the continuity between the ports.



056LW009.tif

EGR Valve

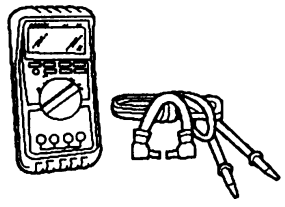
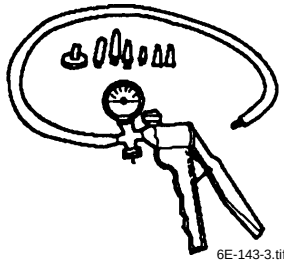
With negative pressure applied to the diaphragm chamber, make sure that the valve is smoothly actuated to make the area between (1) and (2) ventilated.

Startup: About -18.66±2.67 Kpa (-140±20 mmHg)

Check to see if EGR valve is normally actuated under the following conditions:

QWS off (After warming up)

Engine coolant temp: 80°C or higher

ILLUSTRATION	TOOL NO. TOOL NAME
 6E-143-1.tif	**5-8840-0366-0** High Impedance Multimeter (Digital Voltmeter-DVM)
 6E-143-3.tif	**5-8840-0279-0** Vacuum Pump with Gauge

MEMO

SECTION 6F

ENGINE EXHAUST

⚠ CAUTION:

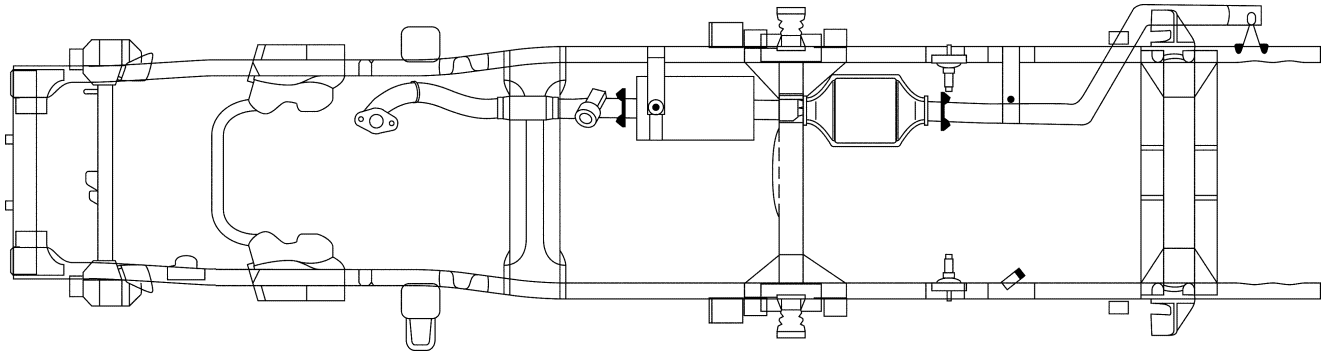
Exhaust system components must have enough clearance from the underbody to prevent overheating of the floor pan and possible damage to the passenger compartment, insulation and trim materials.

CONTENTS

	PAGE
General Description	6F - 2
Three Way Catalytic Converter	6F - 3
On-Vehicle Service	6F - 4
Front Exhaust Pipe	6F - 4
Exhaust Brake Unit	6F - 5
Inspection	6F - 5

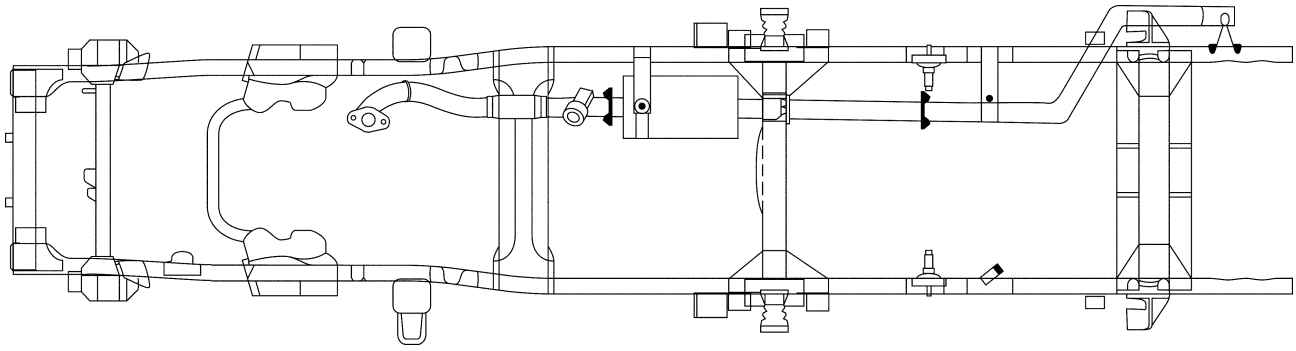
GENERAL DESCRIPTION

Model ’91/542B (Euro 2)



501LX002.tif

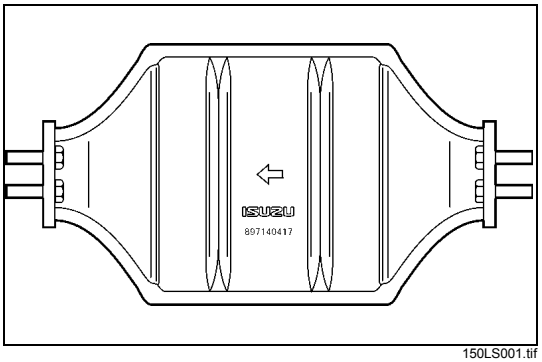
General Export



501LX003.tif

When inspecting or replacing exhaust system components, make sure there is adequate clearance from all points on the underbody to prevent overheating of the floor pan and possible damage to the passenger compartment insulation and trim materials.

Check complete exhaust system and nearby body areas and rear compartment lid for broken, damaged, missing or mispositioned parts, open seams, holes, loose connections or other deterioration which could permit exhaust fumes to seep into the rear compartment or passenger compartment. Dust or water in the rear compartment may be an indication of a problem in one of these areas. Any faulty areas should be corrected immediately.



150LS001.tif

THREE WAY CATALYTIC CONVERTER

The three way catalytic converter is an emission control device added to the exhaust system to reduce pollutants from the exhaust gas stream.

CAUTION:

- The catalytic converter requires the use of unleaded fuel only.

Periodic maintenance of the exhaust system is not required. If the vehicle is raised for other service, it is advisable to check the condition of the complete exhaust system.

A dual bed monolith catalytic converter is used in combination with three way catalytic converter.

Catalytic Types:

Three way (Reduction/Oxidation) catalyst

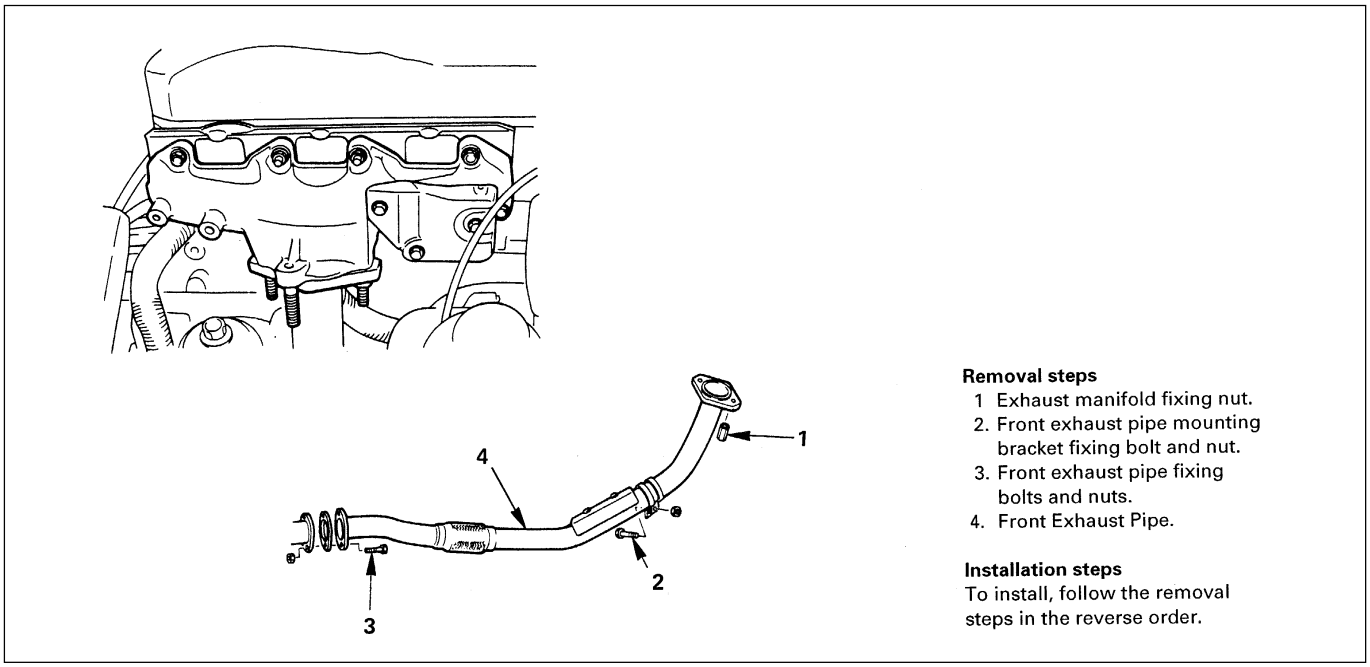
The catalyst coating on the three way (reduction) converter contains platinum and rhodium which lowers the levels of oxide of nitrogen (NOx) as well as hydrocarbons (HC) and carbon monoxide (Co).

ON-VEHICLE SERVICE

Rattles and noise vibrations in the exhaust system are usually caused by misalignment of parts. When aligning the system, leave all bolts or nuts loose until all parts are properly aligned; then tighten, working from front to rear.

1. Check connections for looseness or damage, especially for exhaust gas leakage.
2. Check clamps and rubbers for weakness, cracks or damage.
3. If any part of the converter heat shield is damaged or dented to the extent that it contacts the catalyst, repair or replace.
4. Check for dents or damage and for any holes or cracks caused by corrosion.

FRONT EXHAUST PIPE



Removal steps
1. Exhaust manifold fixing nut.
2. Front exhaust pipe mounting bracket fixing bolt and nut.
3. Front exhaust pipe fixing bolts and nuts.
4. Front Exhaust Pipe.

Installation steps
To install, follow the removal steps in the reverse order.

6F-6-1.tif

REMOVAL

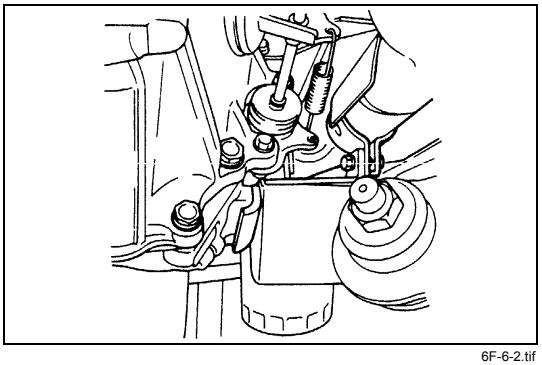
Preparation:
- Battery ground cable

1. Exhaust manifold fixing nuts.
- Remove two fixing nuts from exhaust manifold and front pipe.

2. Front exhaust pipe mounting bracket fixing bolt and nut.

3. Front exhaust pipe fixing bolts and nuts.
- Remove two bolts fixed from front pipe and center pipe.

4. Front exhaust pipe.
- Take out the exhaust pipe to another side.

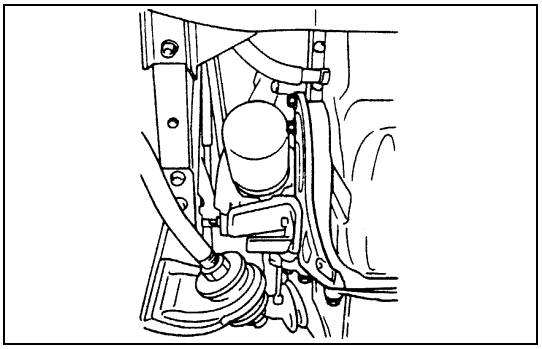


6F-6-2.tif

INSTALLATION

4. **Front exhaust pipe.**
3. **Front exhaust pipe fixing bolts and nuts.**
   - Tighten the fixing nuts to the specified torque

N·m (kg·m/lb·ft)
50 (5.1/37)



6F-7-1.tif

2. **Front exhaust pipe mounting bracket fixing bolt and nut.**
   - Tighten the fixing bolt to the specified torque

N·m (kg·m/lb·ft)
40 (4.1/30)

1. **Exhaust manifold fixing nuts**
   - Tighten the fixing nuts to the specified torque

N·m (kg·m/lb·ft)
69 (7/51)

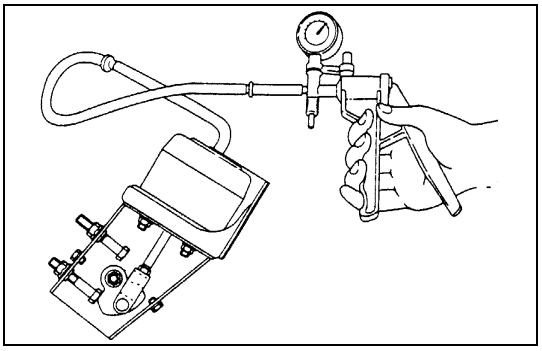
- Connect battery ground cable.
- After assembling each part, start the engine to check for any leakage of gas at each connection.

Exhaust Brake Unit

INSPECTION

Operational inspection

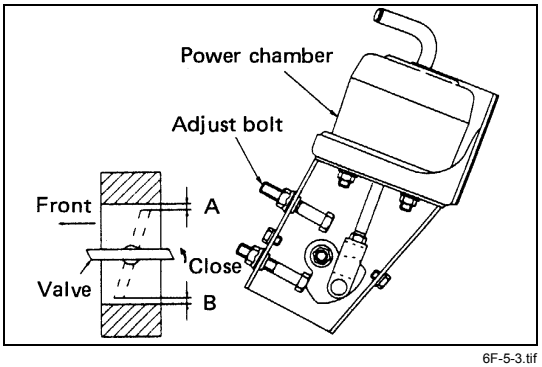
- With the engine idling, operate the exhaust brake to check for the sound of the valve hitting against the stopper.



6F-5-2.tif

Unit inspection

- Check to see if the exhaust valve opens and closes smoothly when the power chamber is applied with a negative pressure (400 mmHg - 700 mmHg) by the vacuum pump.



6F-5-3.tif

- Check to see if the clearance between the valve and the body is in the range of 0.1 mm - 0.2 mm (the minimum of 0.1 mm) on an average of the points “A” and “B” when the power chamber is applied with a negative pressure (650 mmHg - 700 mmHg) by the vacuum pump.

  When the clearance is outside this range, adjust the clearance with the adjust bolt.

MEMO

SECTION 6G

TURBOCHARGER

CONTENTS

PAGE

Turbocharger ..... 6G - 2
Main Data and Specifications ..... 6G - 2
General Description ..... 6G - 3
Identification of Unit ..... 6G - 4
Turbocharger Servicing ..... 6G - 4
Precautions ..... 6G - 4
Disassembly ..... 6G - 5
Inspection and Repair ..... 6G - 7
Reassembly ..... 6G - 9
IHI Service Net work ..... 6G -11

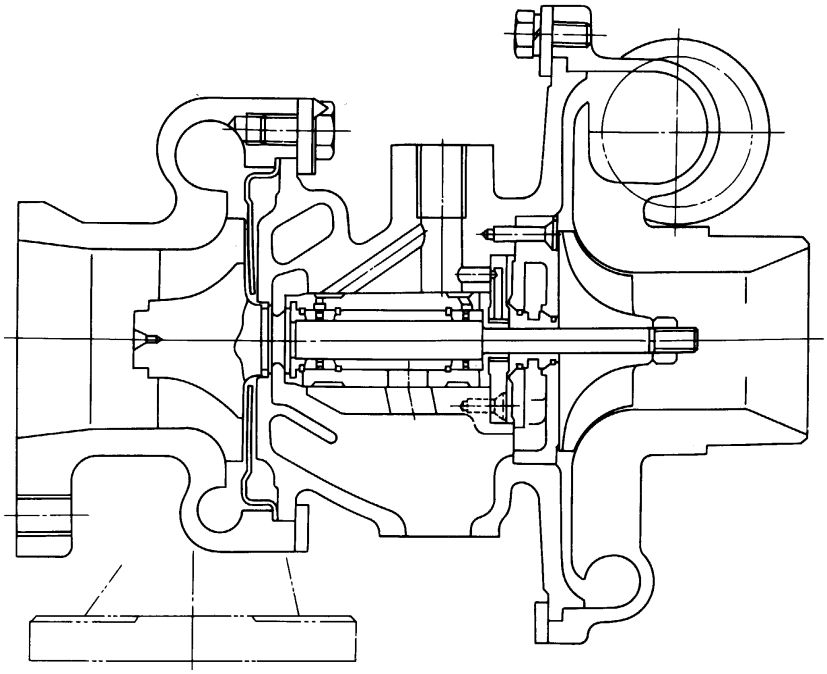
TURBOCHARGER

MAIN DATA AND SPECIFICATIONS

Model		IHI RHF 4H	IHI RHB 5
Turbine type		Mixed-flow	Radial-inflow
Compressor type		Centrifugal	
Maximum permissible speed	rpm	180,000	
Wastegate opening pressure	kPa (mmHg)	109 ± 4.4 (815 ± 33)	120 ± 4.8 (898 ± 36)
Weight	N (kg/lb)	41 (4.2/9.3)	45 (4.6/10.1)

IHI : Ishikawajima-Harima Heavy Industries., Ltd.

GENERAL DESCRIPTION



6G-3-1.tif

The turbocharger internal mechanism consists of the turbine wheel, the compressor wheel, and the radial bearings. These parts are supported by the bearing housing.

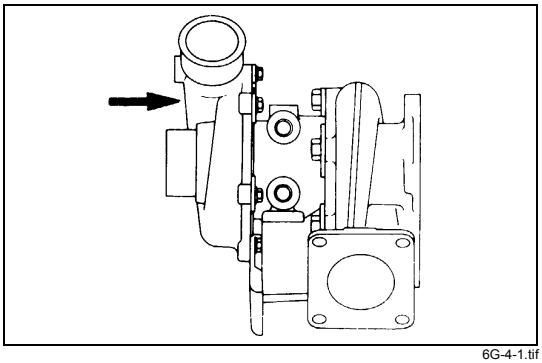
The turbocharger external mechanism consists of the compressor housing air intake port and the turbine housing air exhaust port.

The turbocharger increases air intake efficiency. This results in increased engine power, reduced fuel consumption, and minimal engine noise.

The turbocharger operates at very high speeds and temperatures. Part materials have been carefully selected and machined to extremely high precision.

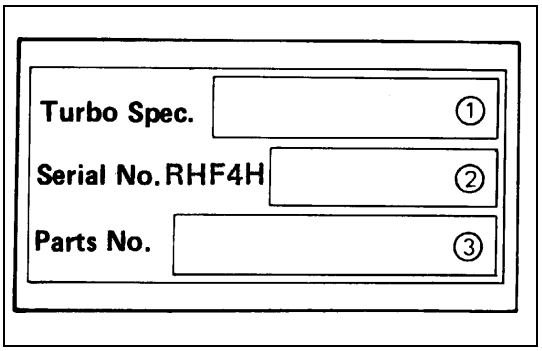
Turbocharger servicing requires great care and expertise.

If reduced performance is noted, check the engine for damage or wear. If there is no apparent engine damage or wear, trouble with the turbocharger is indicated.


6G-4-1.tif

IDENTIFICATION OF UNIT

The turbocharger nameplate gives the date of manufacture and other important information required to identify the unit when service inquiries are made.



6G-4-2.tif

The turbocharger nameplate has the following information stamped on it.

① Turbocharger Specification Number, Production Year and Month
② Production Date, Serial Number
③ ISUZU Parts Number

TURBOCHARGER SERVICING

1. Refer to TROUBLESHOOTING in this Manual to determine whether or not turbocharger repair or overhaul is required.
2. The following procedures should also be performed (either with the turbocharger on the vehicle or removed from the vehicle but not disassembled) to determine whether or not turbocharger repair or overhaul is required.
   * Visual checks
   * Clearance measurements
   * End play measurements

   Refer to INSPECTION AND REPAIR
3. The turbocharger compressor and turbine housing may be removed from the center housing and rotating assembly (CHRA) for further visual inspection.
   Refer to DISASSEMBLY and REASSEMBLY.

PRECAUTIONS

Turbocharger servicing requires great care and expertise.

Faulty turbocharger servicing procedures can result in serious damage to pistons, valves, cylinder liners, and other important engine parts.

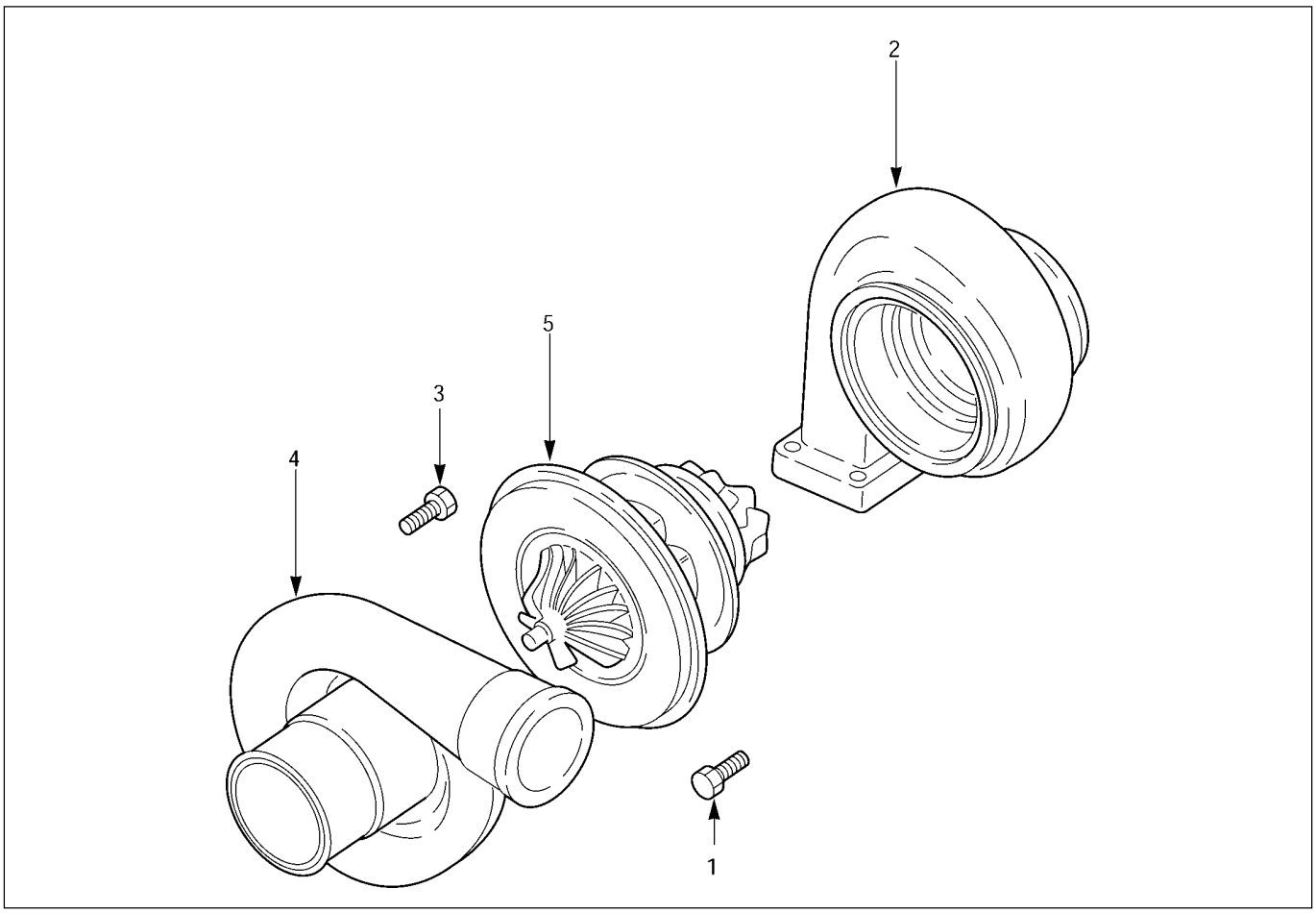
ISUZU does not recommended the performance of any servicing procedure not specified described in this Manual.

Contact your nearest IHI service facility to have the turbocharger assembly repaired or overhauled.

The identification plate and assembly number will be required by the service facility.

A list of IHI Turbocharger Service Network locations is given at the end of this Section.

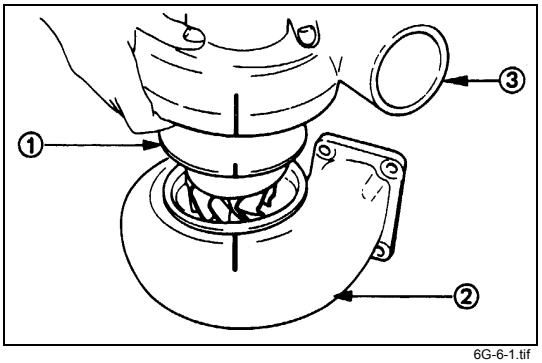
DISASSEMBLY



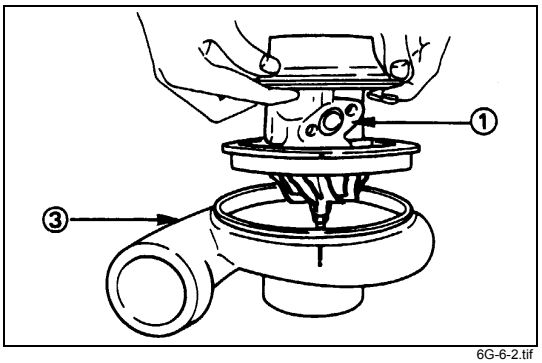
036LW001.tif

Disassembly Steps

1. Bolt
2. Turbine housing
3. Bolt
4. Compressor housing
5. Center housing and rotating assembly



6G-6-1.tif



6G-6-2.tif

Disassembly Steps

1. **Bolt**

   Apply a setting mark across the center housing and rotating assembly (1), the turbine housing (2), and the compressor housing (3).

2. **Turbine Housing**
3. **Bolt**
4. **Compressor Housing**
5. **Center Housing and Rotating Assembly**
   1) Loosen the bolts.
   2) Disassembly the parts.

      Handle the parts with extreme care.

      Be particularly careful not to damage the turbine wheel blades and the compressor wheel blades. Take care not to allow foreign material to enter the center housing.

NOTE:

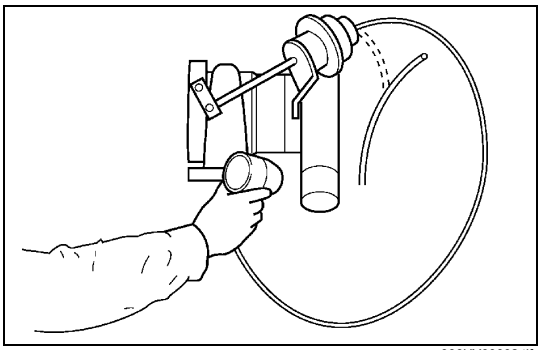
Disassembly and servicing of the center housing and rotating assembly is not recommended.

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.

Minor servicing operations are described in this Section. Contact the nearest IHI SERVICE FACILITY for major repairs and maintenance.

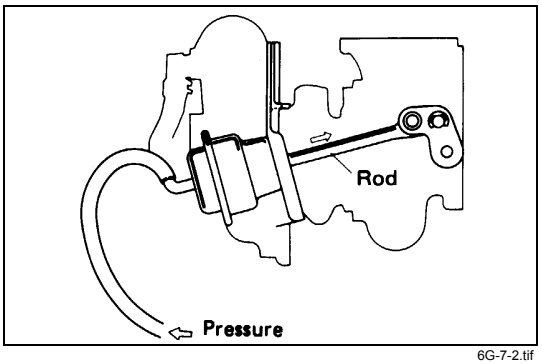
Refer to “IHI SERVICE NETWORK” at the end of this Section.



036HY00002.tif

Turbocharger pressure check

(1) Remove the waste gate control chamber connecting hose.
(2) Connect the pressure gauge.
(3) Start the engine and gradually increase the engine speed (the vehicle must be stationary with no load applied to the engine).
(4) Check to see that turbocharger pressure rises to approximately 500 mmHg.
Pressure Gauge : 5-8840-0075-0



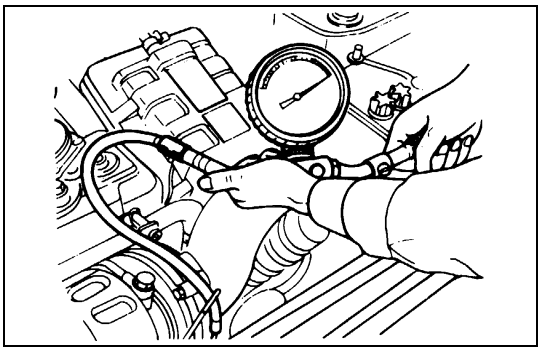
6G-7-2.tif

Waste gate operation check

(1) Remove the hose between the waste gate control chamber and the intake pipe.
(2) Connect the pressure gauge.
(3) Check to see that the rod begins to move when a pressure of approximately 665 mmHg is applied to the waste gate, control chamber.

NOTE:

Do not apply a pressure greater than 1467mmHg (196 kPa) to the waste gate during this check.

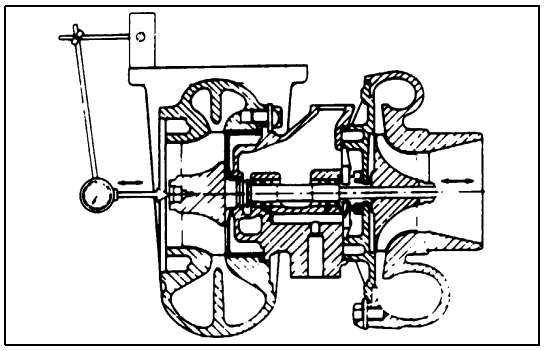


6G-7-3.tif

(4) Check to see the pressure required to move the control rod 2 mm is within the limits shown below.

Control Rod Operating Pressure	mmHg (kPa)
4JBIT (IHI RHB5)	898 ± 36 (120 ± 4.8)
4JBITC (IHI RHF4)	815 ± 33 (109 ± 4.4)

Important wheel shaft end play and bearing clearance standards and limits are included below for your reference.



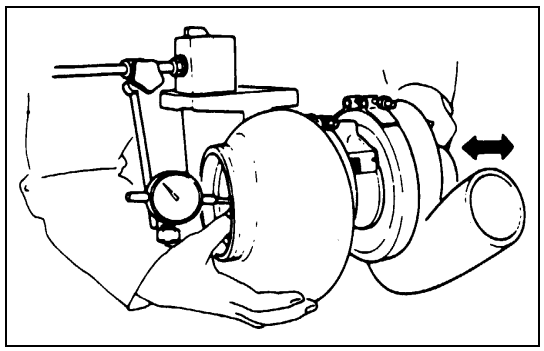
6G-8-1.tif

Wheel Shaft End Play

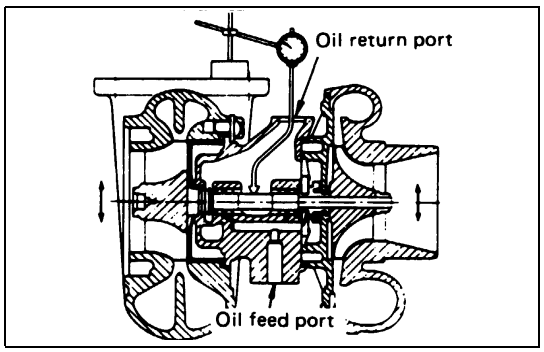
Use a dial indicator to measure the wheel shaft end play. Apply a force of 1.2 kg (2.6 lb/11.8N) alternately to the compressor wheel end and the turbine wheel end.

Wheel Shaft End Play mm (in)

Standard	Limit
0.02 - 0.08 (0.0008 - 0.0031)	0.09 (0.0035)



6G-8-2.tif



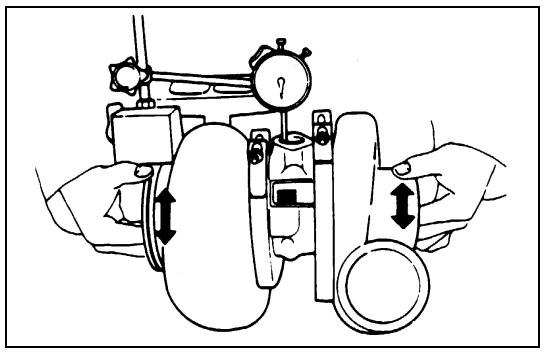
6G-8-3.tif

Wheel Shaft and Bearing Clearance

Use a dial indicator to measure the wheel shaft and bearing clearance.

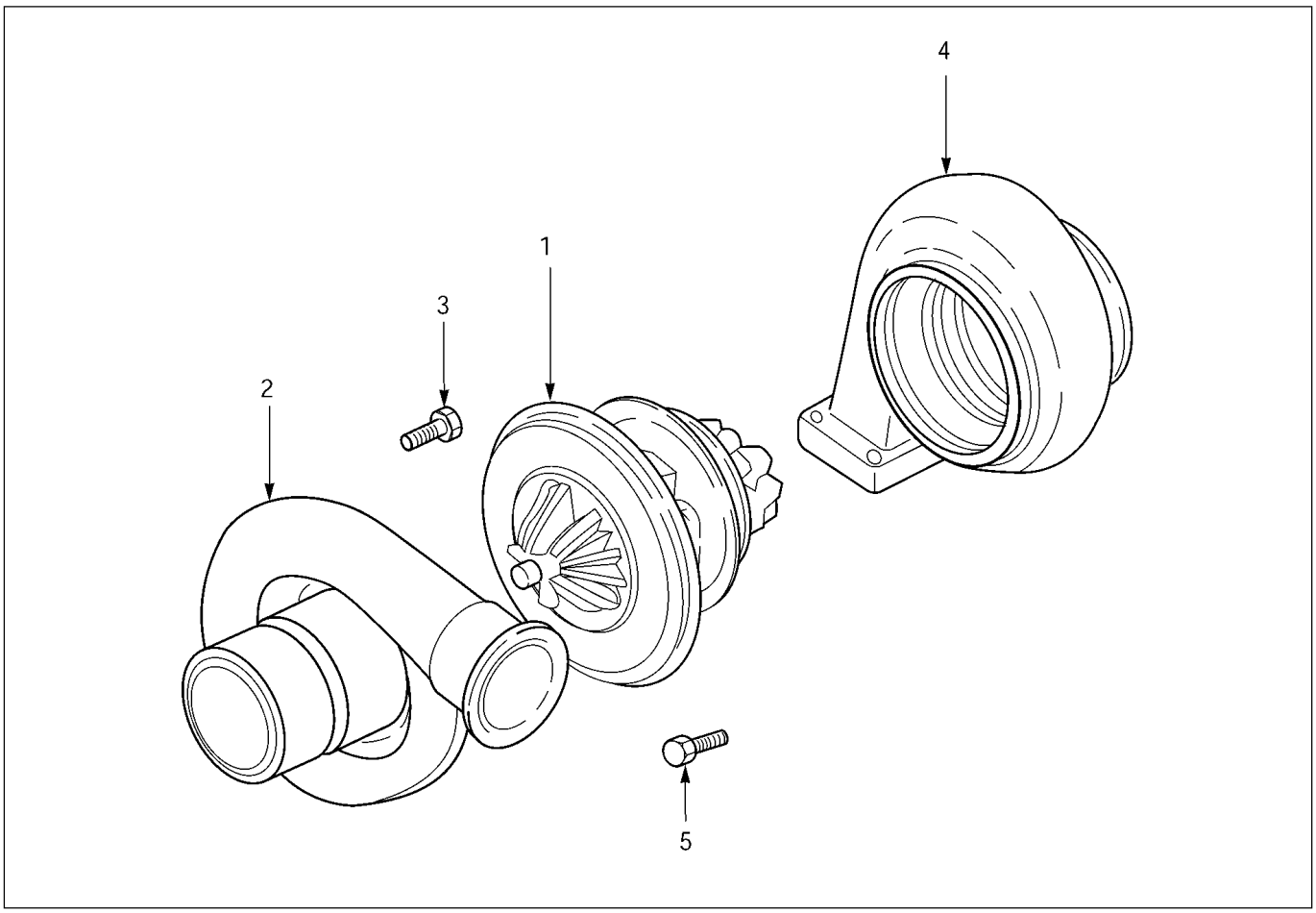
Wheel Shaft and Bearing Clearance mm (in)

Standard	Limit
0.07 - 0.12 (0.0028 - 0.0047)	0.16 (0.0063)



6G-8-4.tif

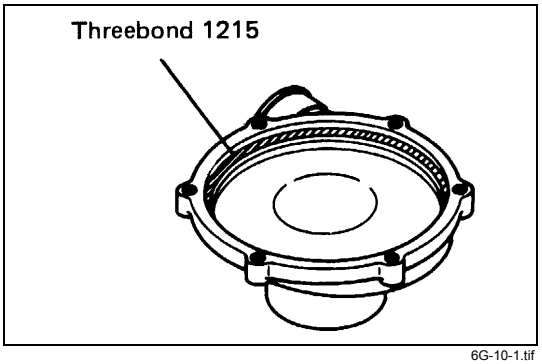
REASSEMBLY



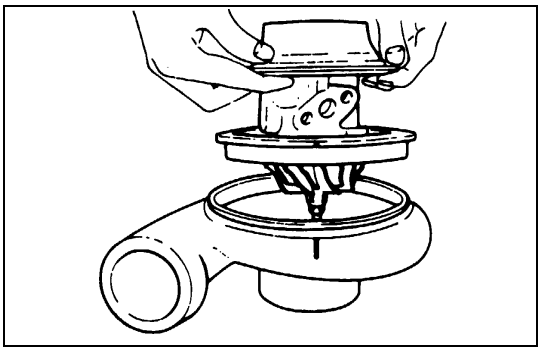
036LW002.tif

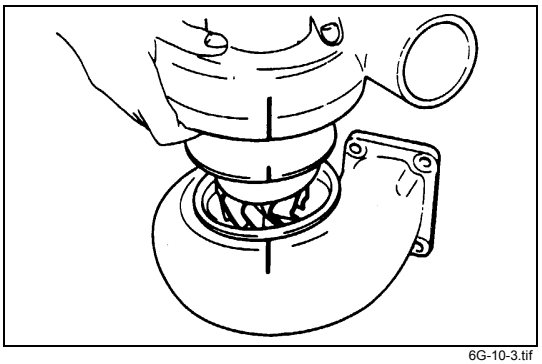
Reassembly Steps

1. Center housing and rotating assembly
2. Compressor housing
3. Bolt
4. Turbine housing
5. Bolt



6G-10-1.tif


6G-10-2.tif


6G-10-3.tif

Reassembly Steps

1. Center Housing and Rotating Assembly

2. Compressor Housing

3. Bolt

1) Apply Threebond 1215 or equivalent to flange surface of compressor housing shown in the illustration.
2) Align the setting marks (applied at disassembly) on the center housing and rotating assembly and the compressor housing.
   Handle the parts with extreme care to avoid damaging the compressor wheel blades.
3) Apply and anti-seizing agent (LOCTITE ANTISEIZE LUBRICANT or the equivalent) to the new bolt threads.
4) Install the new bolts to the compressor housing.
5) Tighten the bolts to the specified torque.

Compressor Housing Bolt Torque	N·m (kg·m/lb·ft)
	4.7 (0.5/3.5)

4. Turbine Housing

5. Lock Plate and Bolt

1) Align the setting marks (applied at disassembly) on the center housing and rotating assembly and the turbine housing.
   Handle the parts with extreme care to avoid damaging the trubine shaft wheel blade.
2) Apply and anti-seizing agent (LOCTITE ANTISEIZE LUBRICANT or the equivalent) to the bolt.
3) Tighten the bolt to the specified torque.

Turbine Housing Bolt Torque	N·m (kg·m/lb·ft)
	28.0 (2.85/20.6)

4) Check that the rotating assembly turns smoothly.

IHI SERVICE NETWORK

For inquiries relating to turbochargers, please contact your ISUZU distributor or the nearest IHI Turbocharger Service Facility.

HEADQUARTERS

ISHIKAWAJIMA HARIMA HEAVY INDUSTRIES CO., LTD.(IHI)

General Machinery Division
Tokyo Chuo Building 1-6-2 Marunouchi Chiyoda-ku
Tokyo 100-0005 JAPAN
TEL: 81-(3)-3286-2405 to 2407 (3 lines)
FAX: 81-(3)-3286-2430

CHINA

IHI BEIJING OFFICE

Room 705, China World Trade Center, No. 1 Jian Guo Men Wai Avenue
Beijing, People's Republic of CHINA
Beijing, People's Republic of CHINA
TEL: 86-(1)-505-4997, 0408
FAX: 86-(1)-505-4350
TLX: 210343 IHIPK CN

TAIWAN

IHI TAIPEI OFFICE

Room 1202, Chia Hsin Building, No. 96 Chung Shan
North Road, Section 2, Taipei, TAIWAN
TEL: 886-(2)-542-5520, 5521, 5523
FAX: 886-(2)-542-4362
TLX: 11320 IHICO

THAILAND

IHI BANGKOK OFFICE

8th Floor, Thaniya Building, 62 Silom Road, Bangkok, THAILAND
TEL: 66-(2)-236-3490, 7356, 9099
FAX: 66-(2)-236-7340
TLX: 82375 IHICO TH

MALAYSIA

IHI KUALA LUMPUR OFFICE

Letter Box No. 52, 22nd Floor, UBN Tower,
10 Jin. P. Ramlee 50250 Kuala Lumpur, MALAYSIA
TEL: 60-(3)-232-1255, 1271
FAX: 60-(3)-232-1418
TLX: IHI KLMA 20257

INDONESIA

IHI JAKARTA OFFICE

9th Floor, Skyline Building JI. M. H. Thamrin, No. 9, Jakarta, INDONESIA
TEL: 62-(21)-32-2147, 390-2211
FAX: 62-(21)-32-3273
TLX: 44175 IHIJKT

LG4J-WE-9491

You are requested to order this manual using the manual number that is shown above.

This manual is applicable for vehicles in all countries except the USA and Canada.

All rights reserved. This manual may not be reproduced in whole or in part, without the permission in writing of ISUZU MOTORS LIMITED.

Issued by

ISUZU MOTORS LIMITED

INTERNATIONAL SERVICE DEPARTMENT

Tokyo, Japan

First edition Jan., 1999 9001-12N-1

No. HGSTG-WE-661 PRINTED IN JAPAN

WORKSHOP MANUAL

NPR,NQR

AUTOMATIC TRANSMISSION

450-43LE

SECTION 7

ISUZU

ISUZU

International Service & Parts

Tokyo, Japan

NOTICE

Before using this Workshop Manual to assist you in performing vehicle service and maintenance operations, it is recommended that you carefully read and thoroughly understand the information contained in Section 0A under the headings "GENERAL REPAIR INSTRUCTIONS" and "HOW TO USE THIS MANUAL".

All material contained in this Manual is based on latest product information available at the time of publication.
All rights are reserved to make changes at any time without prior notice.

Applicable Model : NPR70,NQR70

This manual is applicable to 1999 year model and later vehicles.

THIS MANUAL INCLUDES THE FOLLOWING SECTIONS:

SECTION NO.	CONTENTS
7A 1	Construction and Function
7A 2	Diagnosis
7A 3	On-Vehicle Service
7A 4	Automatic Transmission Overhaul

SECTION 7A

AUTOMATIC TRANSMISSION

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size and strength (or stronger) may be used. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

CONTENTS

SUBJECT **PAGE**

Construction and Function 7A1
Diagnosis 7A2
On-Vehicle Service 7A3
Automatic Transmission Overhaul 7A4

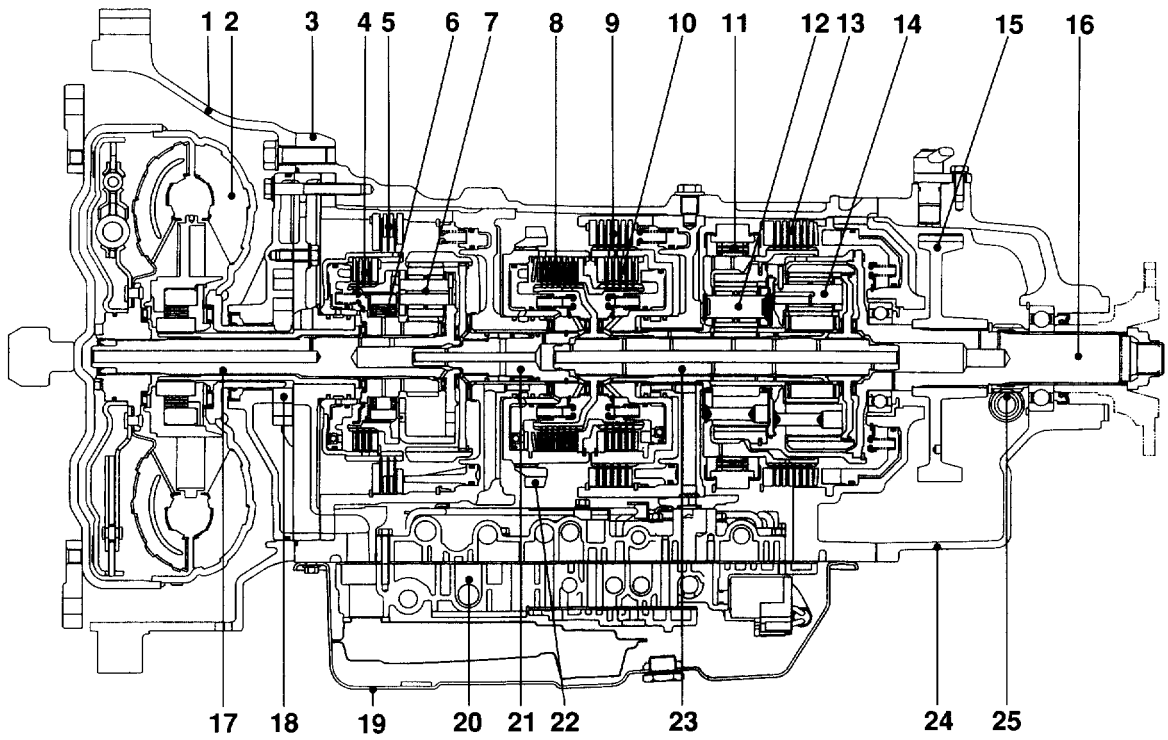
7A1 CONSTRUCTION AND FUNCTION

CONTENTS

SUBJECT	PAGE
Description	7A1- 3
Construction	7A1- 3
Transmission Serial Number	7A1- 4
Number Plate Location	7A1- 4
Component Location	7A1- 5
Structure and Function of Component	7A1- 6
Torque Converter	7A1- 6
Oil Pump	7A1- 6
Shaft	7A1- 7
Gear Shifting Mechanism	7A1- 8
Accumulator	7A1-16
Solenoid	7A1-17
Automatic Transmission Fluid (ATF) Thermosensor	7A1-18
Automatic Transmission Fluid (ATF) Temperature Switch	7A1-18
Inhibitor Switch (Neutral/Start Switch)	7A1-18
Kick-down Switch	7A1-19
Throttle Position Sensor	7A1-19
Vehicle Speed Sensor 1	7A1-20
Vehicle Speed Sensor 2	7A1-20
Engine Speed Sensor	7A1-21
Transmission Control Module (TCM)	7A1-21
Control Mechanism	7A1-22
Content of Function and Control	7A1-22
Control Item, Input and Output	7A1-23
Major Input/Output Component Function	7A1-24
Control Circuit Block Diagram	7A1-25
Circuit Diagram	7A1-26
Valve Operation	7A1-28
Valve Function	7A1-28
Valve Body Construction	7A1-30
Gear Train (Transmission Mechanism) Operation	7A1-31
Construction and Operation	7A1-31
Component Name and Function	7A1-32
Component and Their Operating Condition	7A1-32
N and P ranges	7A1-33
First Gear in D or 2 Range	7A1-34
Second Gear in D Range	7A1-35
Third Gear in D, 2, L Range	7A1-37
Overdrive Gear in D Range	7A1-39
Second Gear in 2 Range	7A1-40
First Gear in L Range	7A1-42
R Range	7A1-43

DESCRIPTION

CONSTRUCTION



1. Torque Converter Housing
2. Torque Converter
3. Transmission Case
4. Overdrive Direct Clutch
5. Overdrive Brake
6. Overdrive One-way Clutch
7. Overdrive Planetary Gear
8. Front Clutch
9. 2nd Brake
10. Rear Clutch
11. Front Planetary Gear
12. No.2 One-way Clutch
13. 1st and Reverse Brake
14. Rear Planetary Gear
15. Parking Lock Gear
16. Output Shaft
17. Overdrive Input Shaft
18. Oil Pump
19. Oil Pan
20. Valve Body
21. Input Shaft
22. PTO Drive Gear
23. Intermediate Shaft
24. Extension Housing
25. Speedometer Drive Gear

Figure 1. Construction of Automatic Transmission

The 450-43LE type automatic transmission is a four-speed automatic gear shift that is controlled electronically by the Transmission Control Module (TCM).

The TCM provides smooth and powerful driving performance by automatically selecting the optimum transmission characteristics and gear positions according to the accelerator (throttle) position, vehicle speed, and other conditions.

In an event of a malfunction of the vehicle speed sensor, throttle position sensor, solenoid or other components, it shifts to fail-safe control mode to maintain the drivability. In an event of a malfunction of the vehicle speed sensor, throttle position sensor, solenoid, engine rpm signal, etc., the TCM's self-diagnosis function allows faster troubleshooting to enhance the vehicle's serviceability.

The automatic transmission consists of the torque converter, oil pump, gear train, and valve bodies.

The torque converter is of the 3-element, 1-stage, and 2-phase type with a built-in lock-up clutch.

The gear train consists of 3 sets of multiple-plate clutches, 3 sets of multiple-plate brakes, 2 one-way clutches, and 3 sets of planetary gear each consisting of a sun gear, a pinion gear, and a ring gear.

TRANSMISSION SERIAL NUMBER

NUMBER PLATE LOCATION

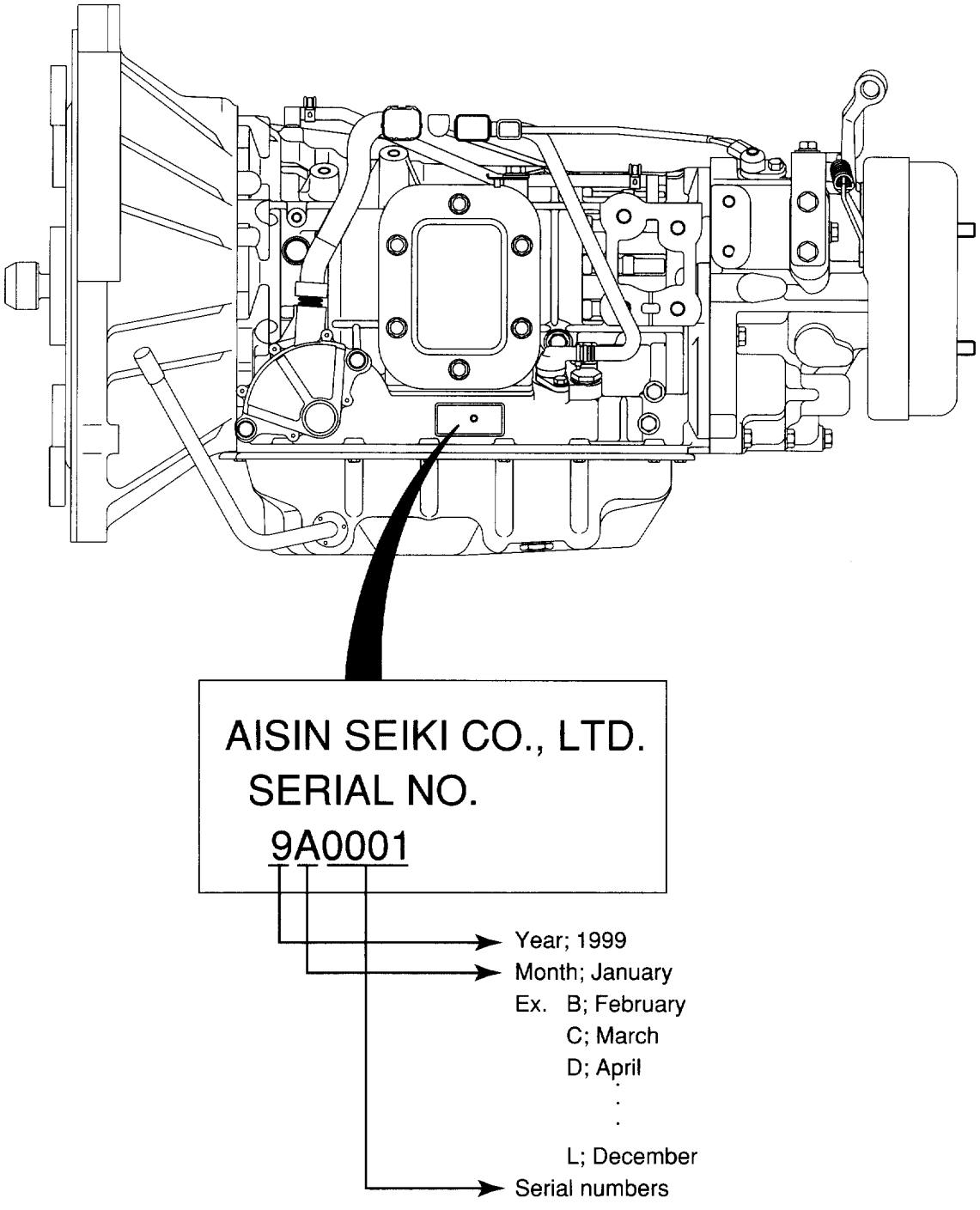
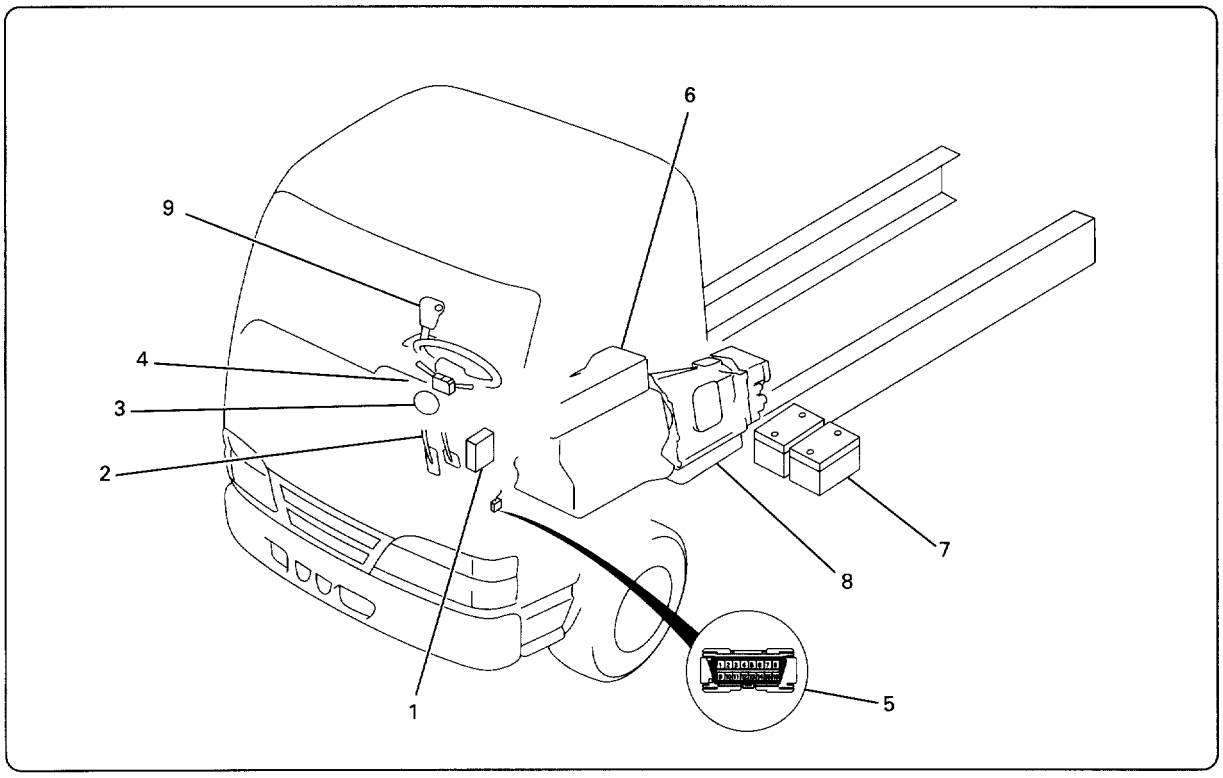


Figure 2. Number Plate Location

COMPONENT LOCATION



2. Pedal
- Throttle position sensor
- Kick down switch
- Brake switch

3. Speedometer
- Vehicle speed sensor-2

4. Instrument panel
- Exhaust brake switch

- Check trans light
- ATF temperature light

1. Transmission Control Module (TCM)

6. Engine
- Engine speed sensor
- Idle signal(from PCM)
- FICD signal

- Exhaust brake cut relay

7. Electrical source
- Ignition

8. Transmission
- No. 1 shift solenoid
- No. 2 shift solenoid
- Line pressure solenoid
- Lock-up solenoid
- Timing solenoid

- Vehicle speed sensor-1
- ATF thermosensor
- ATF thermo switch
- Inhibitor switch

5. Data link connector
- Diagnostic enable
- TECH 2

9. Control lever
- Overdrive OFF switch

: Signal direction

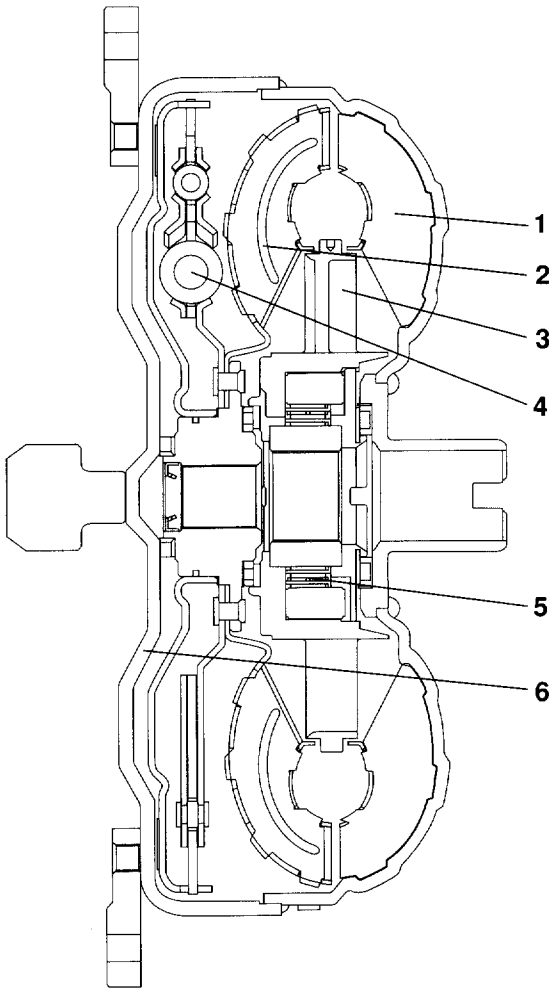
Figure 3. Component Location

STRUCTURE AND FUNCTION OF COMPONENT

TORQUE CONVERTER

(Figure 4)

- The torque converter transmits the engine torque to the transmission by way of oil (when the lock-up clutch is disengaged) or the lock-up piston (when the lock-up clutch is engaged).
- The torque converter is of the 3-element, 1-stage, and 2-phase type.
- "1-stage" means the output element consists of a single turbine runner.
  "2-phase" means the converter works as a torque converter against the pump impeller when the turbine runner speed is relatively low, and as a fluid coupling when the speed is high.



1. Pump Impeller
2. Turbine Runner
3. Stator
4. Lock-up Clutch
5. One-way Clutch
6. Converter Front Cover

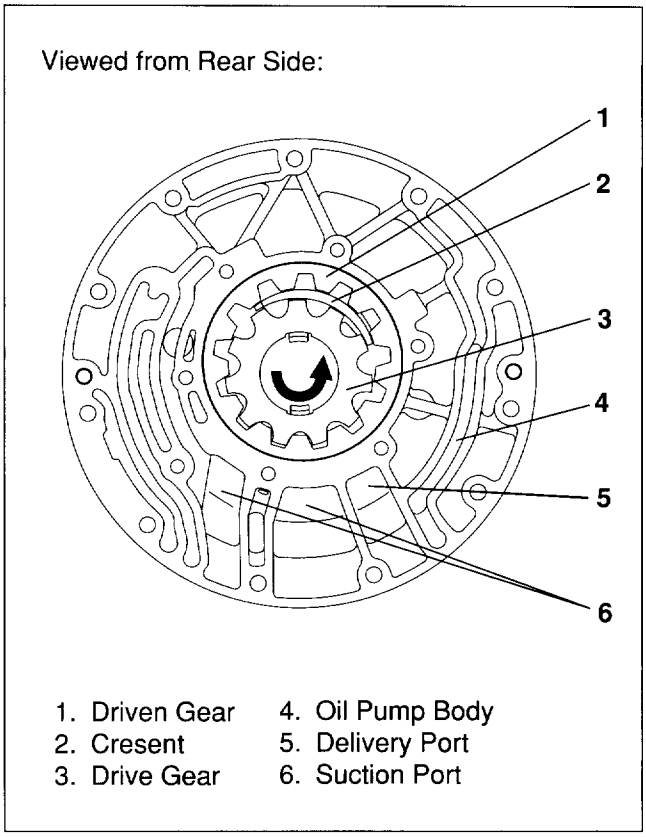
Figure 4. Torque Converter

OIL PUMP

(Figure 5)

Construction

- The oil pump is a high performance geared oil pump with a small number of teeth of a special profile.



1. Driven Gear
2. Cresent
3. Drive Gear
4. Oil Pump Body
5. Delivery Port
6. Suction Port

Figure 5. Construction of Oil Pump

Operation

- The drive gear is engaged with the extension sleeve of the torque converter. As it rotates in the direction of the arrow at the engine speed, the oil is drawn in and compressed before exiting from the delivery port.

SHAFT

(Figure 6)

Overdrive (O/D) input shaft

- The O/D input shaft (O/D planetary gear) is engaged with the turbine runner and the lock-up piston inside the torque converter. Therefore, the driving force of the engine reaching the torque converter is transmitted to the O/D planetary gear.
  The oil hole (A) inside the O/D input shaft serves as the torque converter operating pressure supply passage when the lock-up clutch is disengaged. It also serves as the lubricant supply passage to all parts.

Input shaft

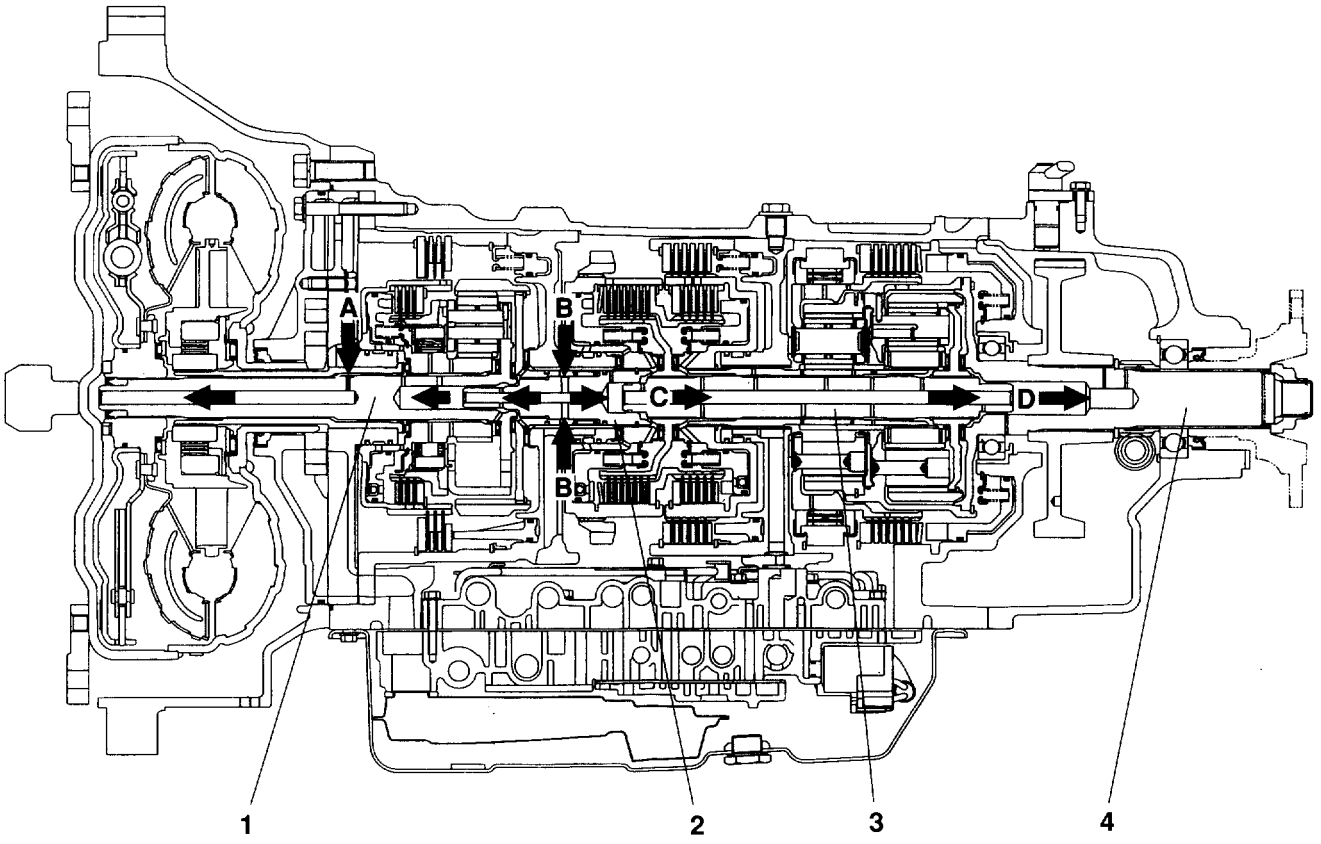
- The input shaft transmits the driving force from the O/D planetary gear to the front clutch.
  The oil hole (B) inside the input shaft is used to supply the oil, cooled by the oil cooler, to all parts as the lubricant.

Intermediate shaft

- The intermediate shaft transmits the driving force from the front clutch to the rear planetary gear.
  The oil passage (C) inside the intermediate shaft is used to supply the oil to all parts as the lubricant.

Output shaft

- The output shaft transmits the driving force reaching the front and rear planetary gears to the propeller shaft. The output shaft is engaged with the front planetary ring gear and the rear planetary carrier. The parking gear, which is used to fix the output shaft and detect rotation, is also engaged by way of spline.
  The oil passage (D) inside the output shaft is used to supply the lubricant to all parts.



1. Overdrive Input Shaft
2. Input Shaft
3. Intermediate Shaft
4. Output Shaft

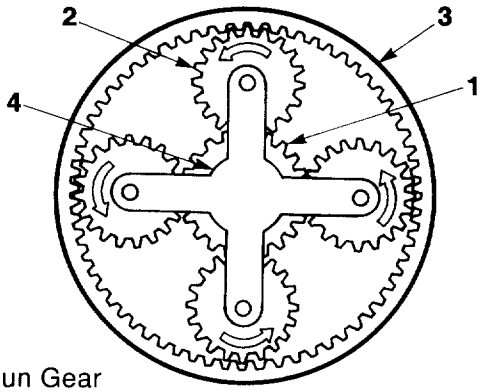
Figure 6. Shaft

GEAR SHIFTING MECHANISM

- The 450-43LE type transmission combines three sets of planetary gears, three sets of multi-plate clutches and multi-plate brakes, and two sets of one-way clutches to achieve forward (4 speeds) and backward (1 speed) gear shifting.

Principle of gear shifting

- The automatic transmission uses three sets of planetary gears unlike the parallel gears that are used in the manual transmission.
- Planetary gears have the advantage of a compact configuration because of the way they are constructed with a single central shaft (one axis).
- Also, unlike the manual transmission gears that require changing of gear mesh, the gear ratio of the planetary gears can be changed more easily by locking, releasing or rotating only some of their parts.
- A planetary gear is made up of a sun gear at its center and pinion gears each of which rotates about its own center and also along the sun gear.
- Also, since the pinion gears are further supported by the planetary carrier, they rotate as a unit in the same direction and at the same rate.
- As shown in the figure, each planetary gear is constructed of three elements; a sun gear, pinion gears, a ring gear, and a planetary carrier. Gear shifting is achieved by conditioning two of the three elements, namely the sun gear, internal gear, and the planetary carrier.
- The planetary gears are locked by the clutch, brake, and one-way clutch, according to the gear shifting.



1. Sun Gear
2. Pinion Gear
3. Ring Gear
4. Planetary Carrier

Figure 7. Planetary Gear

Overdrive Direct Clutch

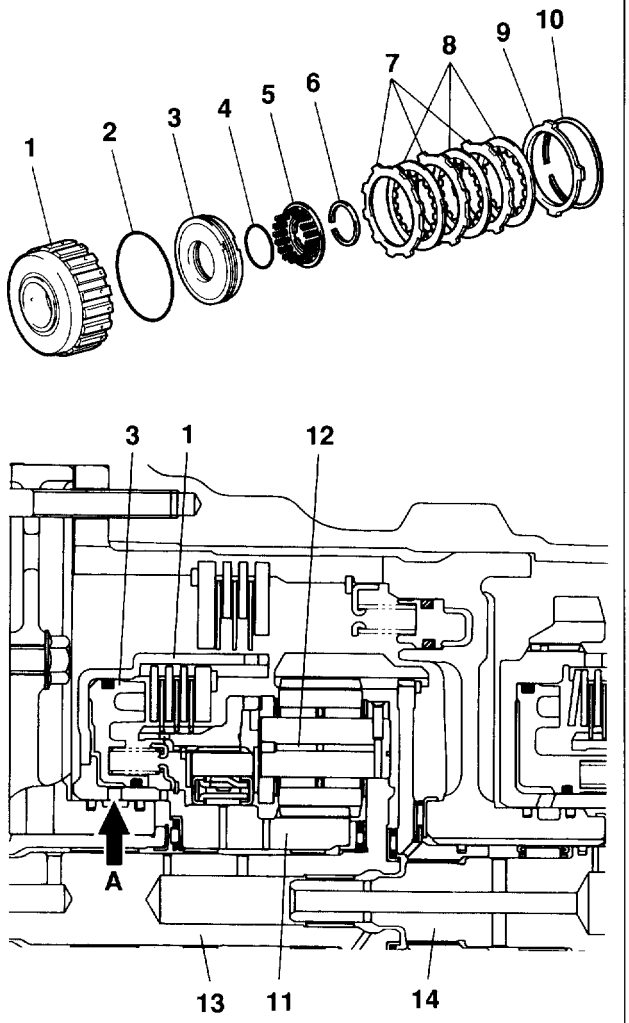
(Figure 8)

When engaged

- The operating pressure (A), switched by the control valve, acts on the O/D direct clutch piston (3) to connect the clutch disk (8) and clutch plate (7). This also connects the O/D sun gear (11) and O/D planetary carrier (12). As the result, the entire O/D planetary gear works as a unit to transmit the engine torque from the O/D input shaft (13) to the input shaft (14).

When disengaged

- Since the operating pressure is not sent to the O/D direct clutch piston (3) when disengaging it, the clutch piston is returned by the return spring (5).
- The clutch plate (7) separates from the clutch disk (8) cutting the power transmission.



1. O/D Direct Clutch Drum
2. O-ring
3. O/D Direct Clutch Piston
4. O-ring
5. O/D Direct Clutch Return Spring
6. Snap Ring
7. Clutch Plate
8. Clutch Disc
9. Clutch Flange
10. Snap Ring
11. O/D Planetary Sun Gear
12. O/D Planetary Carrier
13. O/D Input Shaft
14. Input Shaft

A. Operating Pressure

Figure 8. Overdrive Direct Clutch

Front Clutch

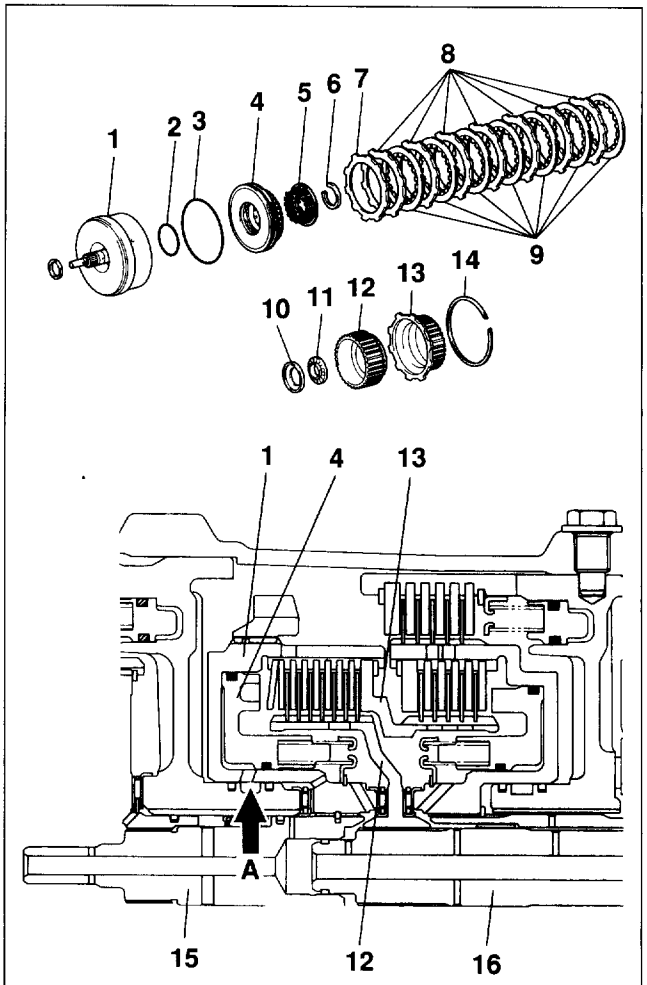
(Figure 9)

When engaged

- The operating pressure (A), switched by the control valve, acts on the front clutch piston (4) to connect the clutch disk (9) and clutch plate (8). As the result, the engine torque is transmitted from the input shaft (15) to the front clutch hub (12).

When disengaged

- Since the operating pressure is not sent to the front clutch piston (4) when disengaging it, the clutch piston is returned by the return spring (5).
- The clutch plate (8) separates from the clutch disk (9) cutting the power transmission.



1. Front Clutch Drum
2. O-ring
3. O-ring
4. Front Clutch Piston
5. Front Clutch Return Spring
6. Snap Ring
7. Clutch Cushion Plate
8. Clutch Plate
9. Clutch Disk
10. Thrust Bearing Race
11. Thrust Bearing
12. Front Clutch Hub
13. Rear Clutch Hub
14. Snap Ring
15. Input Shaft
16. Intermediate Shaft

A. Operating Pressure

Figure 9. Front Clutch

Rear Clutch

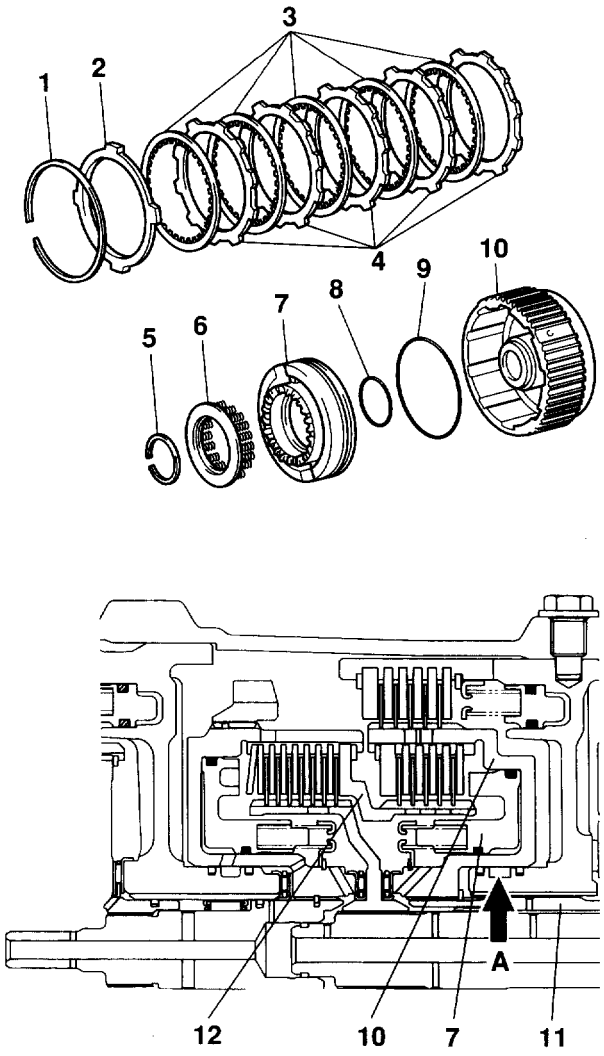
(Figure 10)

When engaged

- The operating pressure (A), switched by the control valve, acts on the rear clutch piston (7) to connect the clutch disk (3) and clutch plate (4). As the result, the engine torque is transmitted from the front clutch hub (12) to the front sun gear (11).

When disengaged

- Since the operating pressure is not sent to the rear clutch piston (7) when disengaging it, the clutch piston is returned by the return spring (6).
- The clutch plate (4) separates from the clutch disk (3) cutting the power transmission.



1. Snap Ring
2. Clutch Flange
3. Clutch Disk
4. Clutch Plate
5. Snap Ring
6. Rear Clutch Piston Return Spring
7. Rear Clutch Piston
8. O-ring
9. O-ring
10. Rear Clutch Drum
11. Front Planetary Sun Gear
12. Rear Clutch Hub

A. Operating Pressure

Figure 10. Rear Clutch

Overdrive Brake

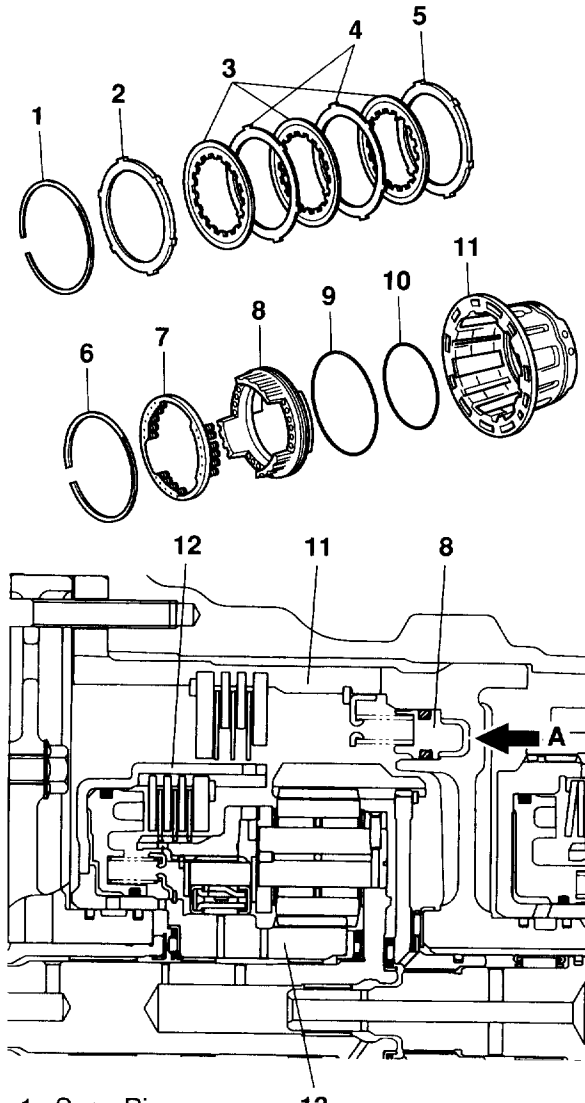
(Figure 11)

When engaged

- The operating pressure (A), switched by the control valve, acts on the O/D brake piston (8) to connect the clutch disk (3) and brake plate (4 and 5). This also locks the O/D direct clutch (12) to the O/D case (11). As the result, the O/D planetary sun gear (13) is locked in position.

When disengaged

- Since the operating pressure is not sent to the O/D brake piston (8) when disengaging it, the clutch piston is returned by the return spring (7).
- The brake plate (4 and 5) separates from the clutch disk (3) cutting the power transmission.



1. Snap Ring
2. Brake Flange
3. Clutch Disk
4. Brake Plate
5. Brake Plate
6. Snap Ring
7. O/D Brake Return Spring
8. O/D Brake Piston
9. O-ring
10. O-ring
11. O/D Case
12. O/D Direct Clutch
13. O/D Planetary Sun Gear

A. Operating Pressure

Figure 11. Overdrive Brake

2nd Brake

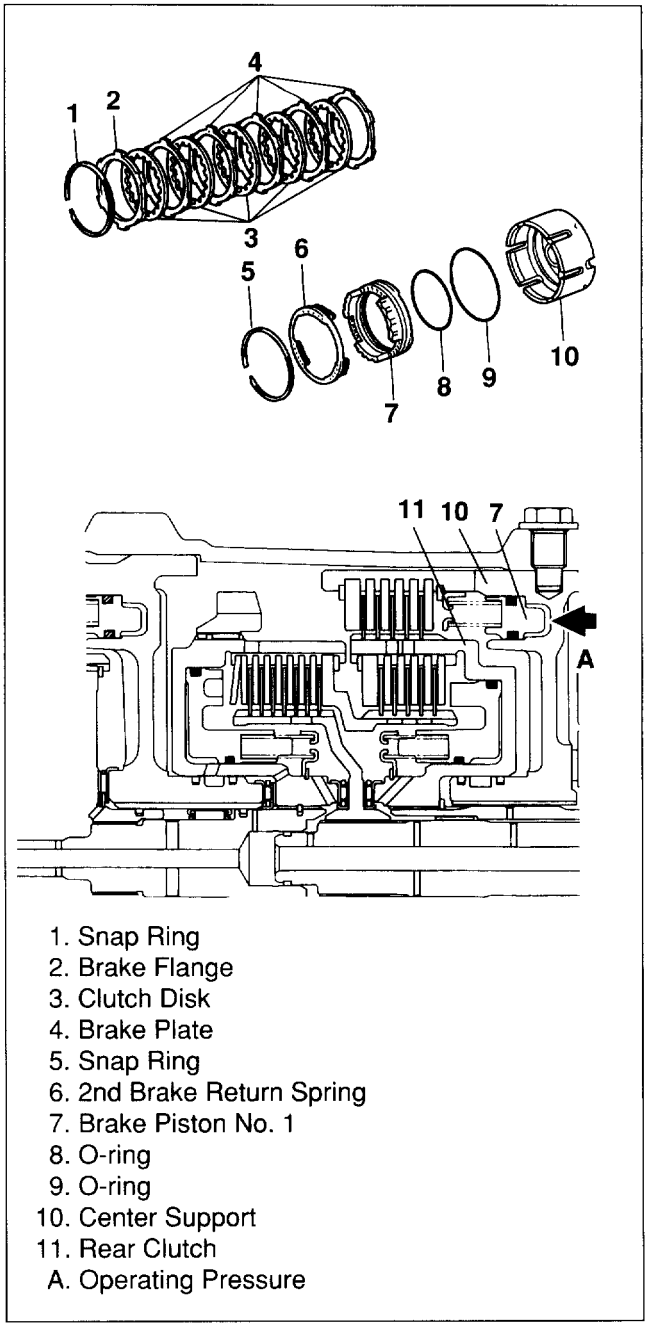
(Figure 12)

When engaged

- The operating pressure (A), switched by the control valve, acts on the brake piston No. 1 (7) to connect the clutch disk (3) and brake plate (4). This also locks the rear clutch (11) to the center support (10).

When disengaged

- Since the operating pressure is not sent to the brake piston No. 1 (7) when disengaging it, the brake piston is returned by the return spring (6).
- The brake plate (4) separates from the clutch disk (3) cutting the power transmission.



1. Snap Ring
2. Brake Flange
3. Clutch Disk
4. Brake Plate
5. Snap Ring
6. 2nd Brake Return Spring
7. Brake Piston No. 1
8. O-ring
9. O-ring
10. Center Support
11. Rear Clutch

A. Operating Pressure

Figure 12. 2nd Brake

1st and Reverse Brake

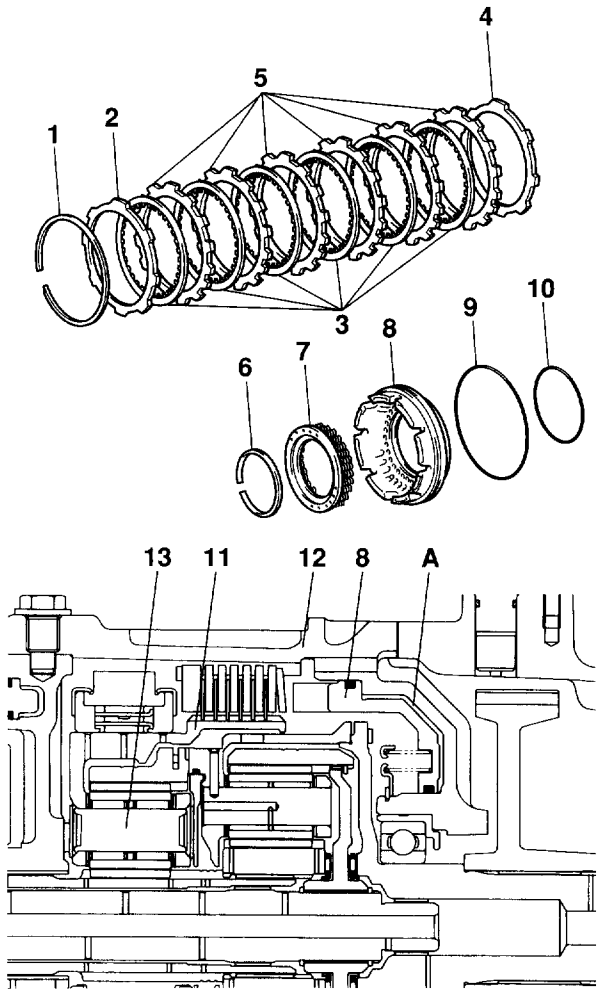
(Figure 13)

When engaged

- The operating pressure (A), switched by the control valve, acts on the 1st and reverse brake piston (8) to connect the clutch disk (3) and brake plate (5). This also locks the 1st and reverse brake hub (11) to the transmission case (12). As the result, the front planetary carrier (13) is locked in position.

When disengaged

- Since the operating pressure is not sent to the 1st and reverse brake piston (8) when disengaging it, the brake piston is returned by the return spring (7).
- The brake plate (5) separates from the clutch disk (3) cutting the power transmission.



1. Snap-Ring
2. Brake Flange
3. Clutch Disk
4. Brake Cushion Plate
5. Brake Plate
6. Snap Ring
7. 1st and Reverse Brake Return Spring
8. 1st and Reverse Brake Piston
9. O-ring
10. O-ring
11. 1st and Reverse Brake Hub
12. Transmission Case
13. Front Planetary Carrier

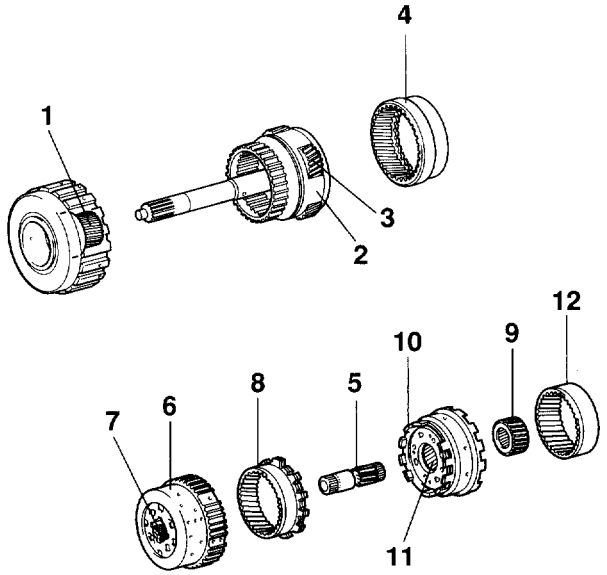
A. Operating Pressure

Figure 13. 1st and Reverse Brake

Planetary Gear

(Figure 14)

- Three sets of Simpson type planetary gears are used to achieve the total of five gear ratios including 4 forward and 1 backward ratios.



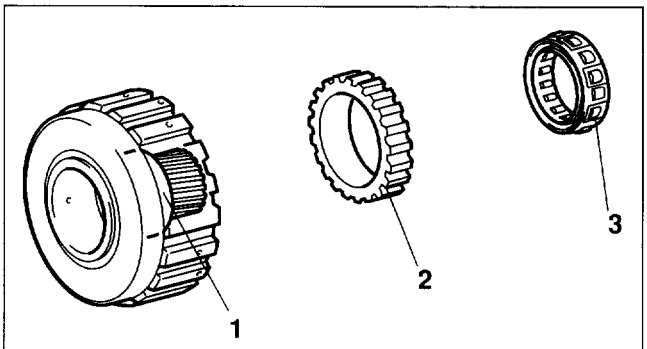
1. O/D Sun Gear
2. O/D Planetary Carrier
3. O/D Pinion Gear
4. O/D Ring Gear
5. Front Sun Gear
6. Front Planetary Carrier
7. Front Pinion Gear
8. Front Ring Gear
9. Rear Sun Gear
10. Rear Planetary Carrier
11. Rear Pinion Gear
12. Rear Ring Gear

Figure 14 Planetary Gear

Overdrive (O/D) One-way clutch

(Figure 15)

- The O/D one-way clutch is locked during acceleration in 1st, 2nd or 3rd speed to maintain the O/D sun gear fixed to the O/D planetary carrier.
- The O/D one-way clutch idles in 4th speed.



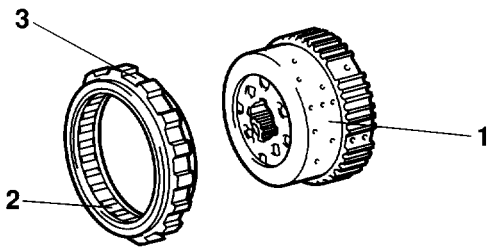
1. O/D Direct Clutch Drum and O/D One-way Clutch Inner Race
2. O/D One-way Clutch Outer Race
3. O/D One-way Clutch

Figure 15 O/D One-way Clutch

One-way Clutch No.2

(Figure 16)

- The one-way clutch No.2 is locked during acceleration in 1st speed to fix the front planetary carrier.
- It idles in 2nd, 3rd and 4th speeds.



1. Front Planetary Carrier and One-way Clutch No. 2 Inner Race
2. One-way Clutch No. 2
3. One-way Clutch No. 2 Outer Race

Figure 16 One-way Clutch No.2

ACCUMULATOR

- The accumulator helps a smooth increase of the operating pressure in the respective friction element to ease the gear shifting shock.
- During a gear shift, the accumulator control pressure regulated by the respective accumulator control valve is applied to the back of the accumulator to ease the gear shifting shock.

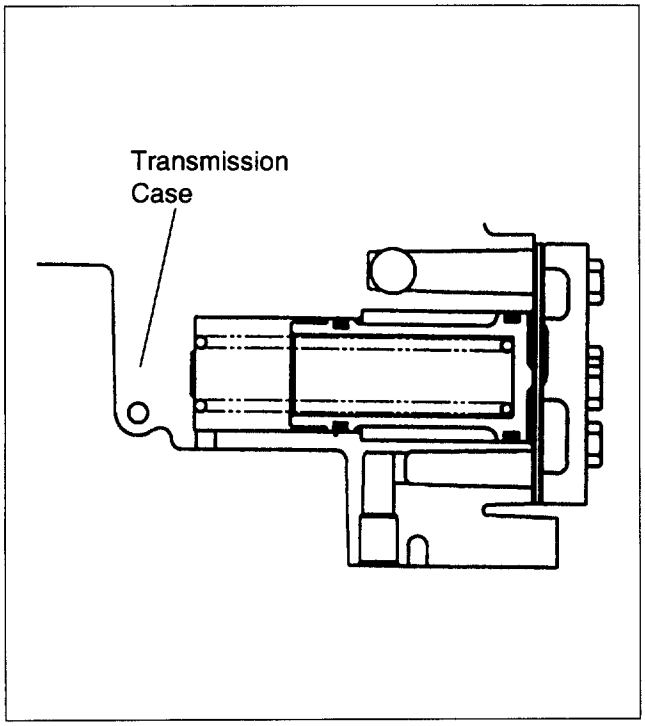


Figure 17. Front Clutch Accumulator

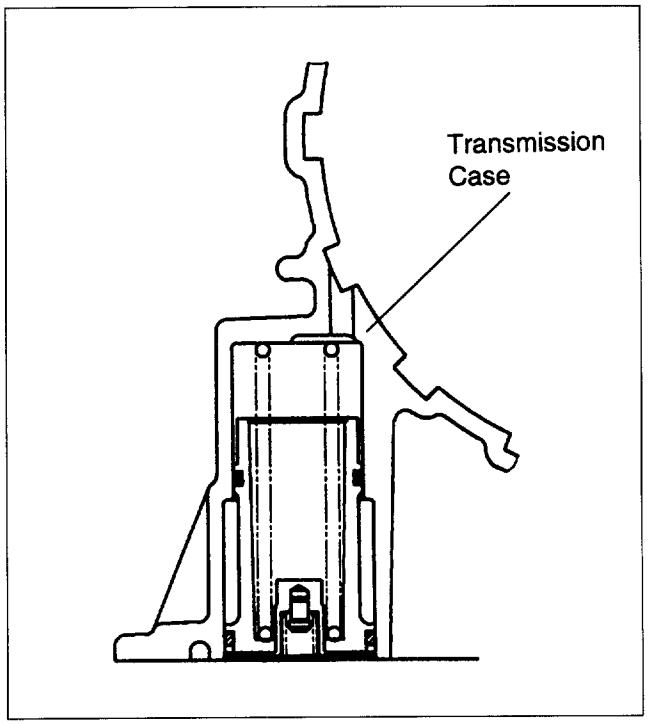


Figure 18. Rear Clutch Accumulator

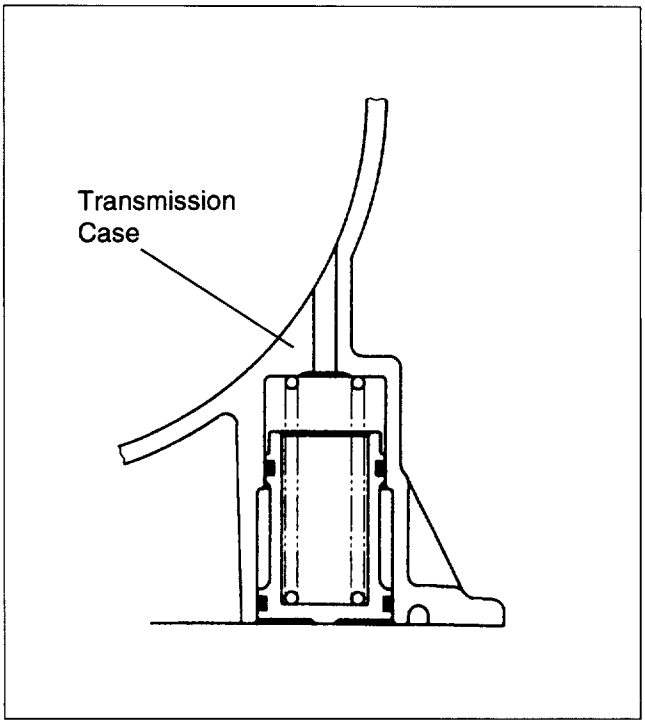


Figure 19. Overdrive Brake Accumulator

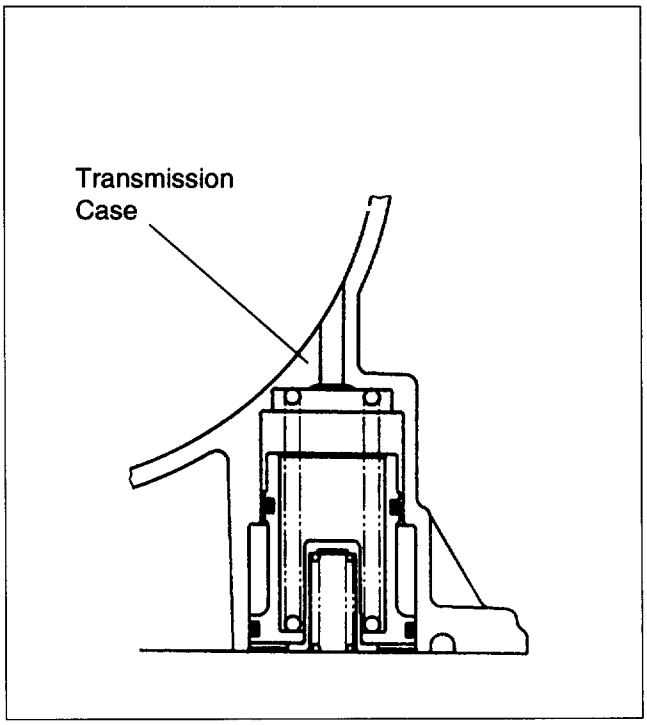


Figure 20. 2nd Brake Accumulator

SOLENOID

No.1 and No.2 Shift Solenoids

(Figure 21)

- These solenoids are fitted in the lower part of the valve body. They are turned on or off by a signal from the TCM to control the gear shifting.
- The ON/OFF combinations of the two solenoids are used to control the gear position as shown below.

Gear Position / Solenoid	1st gear	2nd gear	3rd gear	4th gear
No.1 shift solenoid	ON	ON	OFF	OFF
No.2 shift solenoid	OFF	ON	ON	OFF

Timing Solenoid

(Figure 21)

- This solenoid is fitted in the lower part of the valve body. It is turned on or off by a signal from the TCM to control the timing during 2nd and 3rd gear shifting.

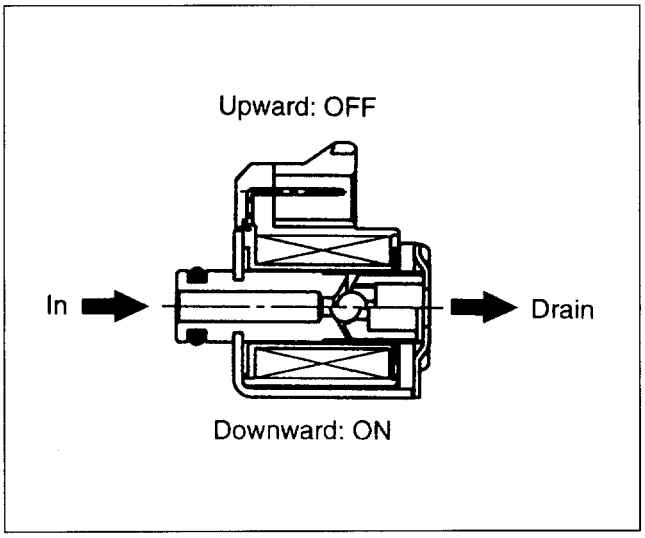


Figure 21. No.1, No.2 Shift Solenoids and Timing Solenoid

Lock-up solenoid

(Figure 22)

- This solenoid is fitted in the lower part of the valve body. It controls the lock-up oil pressure by a signal from the TCM according to the duty cycle.

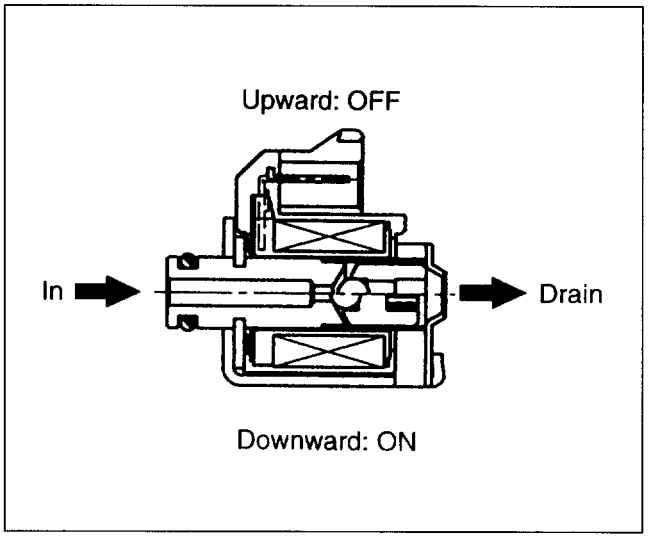


Figure 22. Lock-up Solenoid

Line Pressure Solenoid

(Figure 23)

- This solenoid is fitted in the upper part of the valve body and integrally consists of the electromagnetic component and the pressure regulating valve. It controls the line pressure by a signal from the TCM according to the electric current.

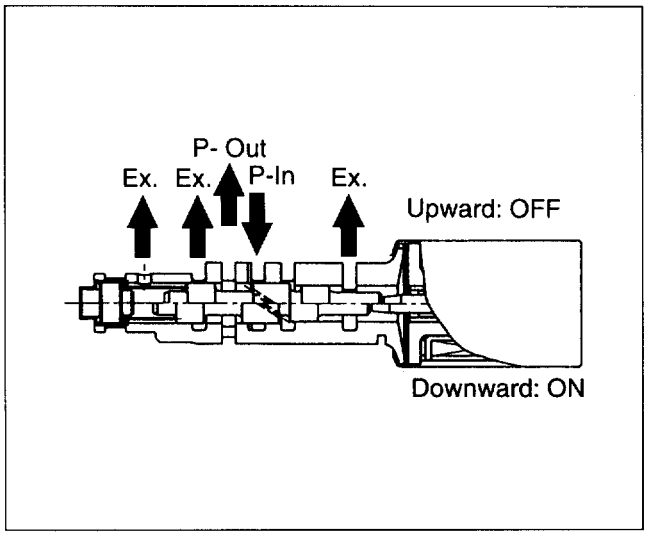


Figure 23. Line Pressure Solenoid

AUTOMATIC TRANSMISSION FLUID (ATF) THERMOSENSOR

- The sensor is fitted to the valve body in the transmission. It converts a change in temperature into a continuous electrical signal, which is sent to the transmission control module (TCM) (figure 24 and 25).

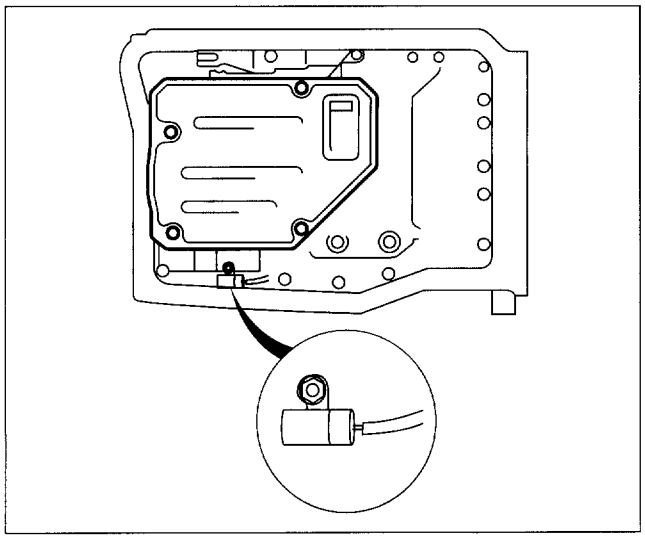
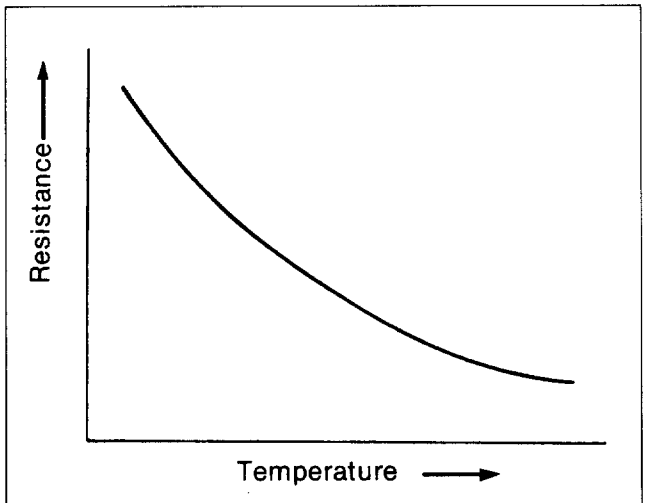


Figure 24. ATF Thermosensor



Temperature °C (°F)	Resistance Ω	Temperature °C (°F)	Resistance Ω
–30 (–22)	29613	70 (158)	433
–20 (–4.4)	16704	80 (176)	324
–10 (14)	9842	90 (194)	246
0 (32)	6028	100 (212)	190
10 (50)	3822	110 (230)	148
20 (68)	2500	120 (248)	117
30 (86)	1681	130 (266)	94
40 (104)	1160	140 (284)	76
50 (122)	819	150 (302)	62
60 (140)	590		

Figure 25. Output Characteristic of ATF Thermosensor

AUTOMATIC TRANSMISSION FLUID (ATF) TEMPERATURE SWITCH

- This switches fitted to the right side of the transmission case. It detects abnormal high temperature of the ATF to protect transmission (figure 26).

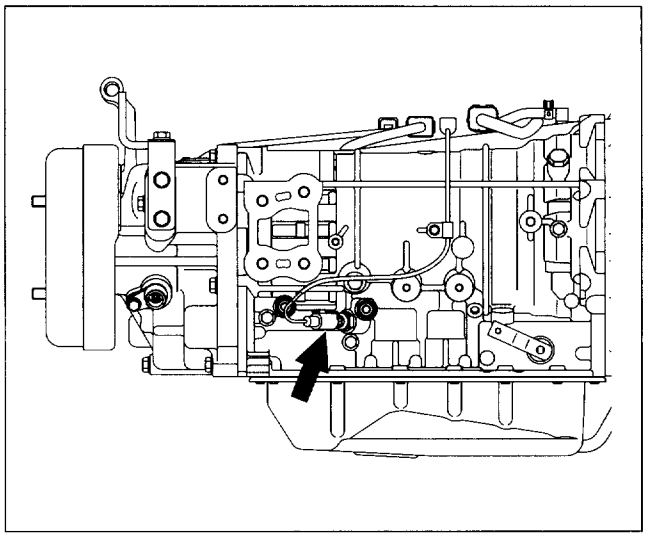


Figure 26. ATF Temperature Switch

INHIBITOR SWITCH (NEUTRAL/ START SWITCH)

(Figure 27)

- Inhibitor switch is attached to the right side of the transmission, and detects P, R, N, D, 2 and 1 range of selector lever.
- Inhibitor switch is set to be "ON" when selector lever is shifted to P, R, N, D, 2 and 1 range.
- Also, inhibitor switch is connected to starter switch circuit and makes engine-starting possible when selector lever is only P or N range.

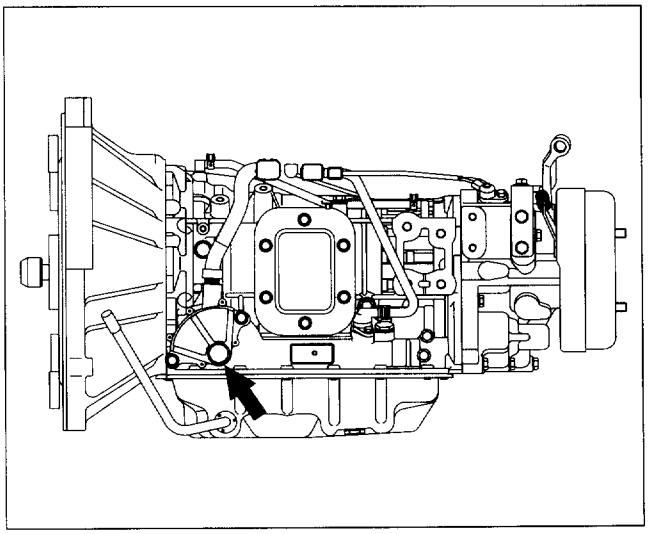


Figure 27. Inhibitor Switch

KICK-DOWN SWITCH

(Figure 28)

- The kick-down switch is fitted to the accelerator pedal. When the pedal is fully depressed, it sends an electrical signal to the transmission control module (TCM).

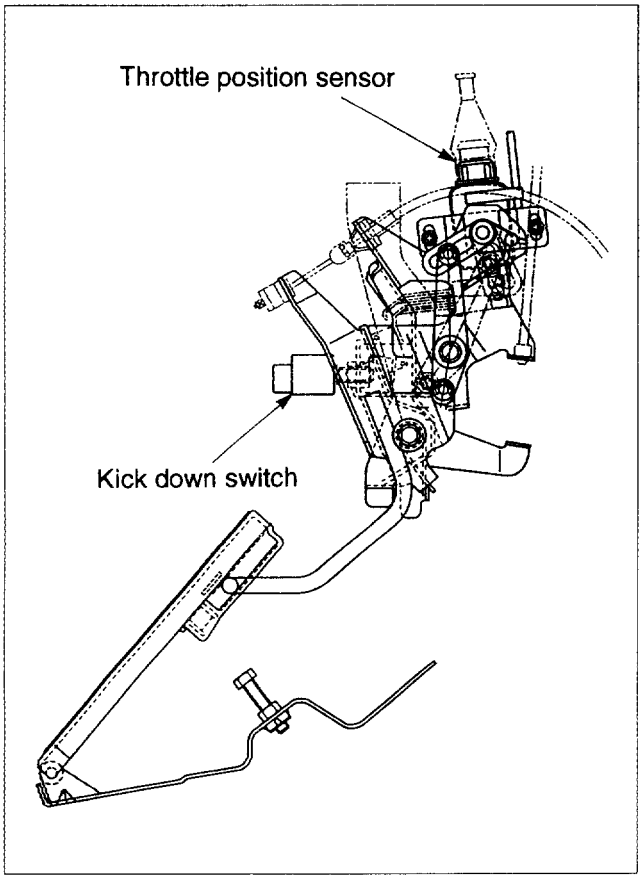


Figure 28. Kick-down Switch and Throttle Position Sensor

THROTTLE POSITION SENSOR

(Figure 28 and 29)

- The throttle position sensor is fitted to the accelerator pedal. It converts the physical throttle opening angle into a continuous electrical signal, to the TCM.
- The TCM detects the throttle opening angle and the speed at which the pedal is depressed by the electrical signal of the throttle position sensor having output characteristics as shown (figure 29).

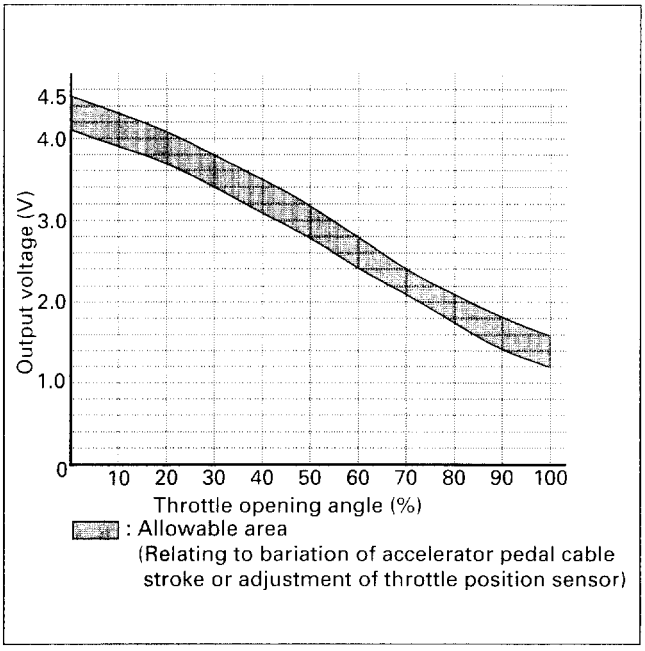


Figure 29. Output Characteristic of Throttle Position Sensor

VEHICLE SPEED SENSOR 2

(Fitted to the speedometer driven gear)

- The vehicle speed sensor 2 is fitted on the speedometer driven gear assembly.
- The number of pulses generated is four pulses (AC) per one rotation of the pinion shaft (figure 32).

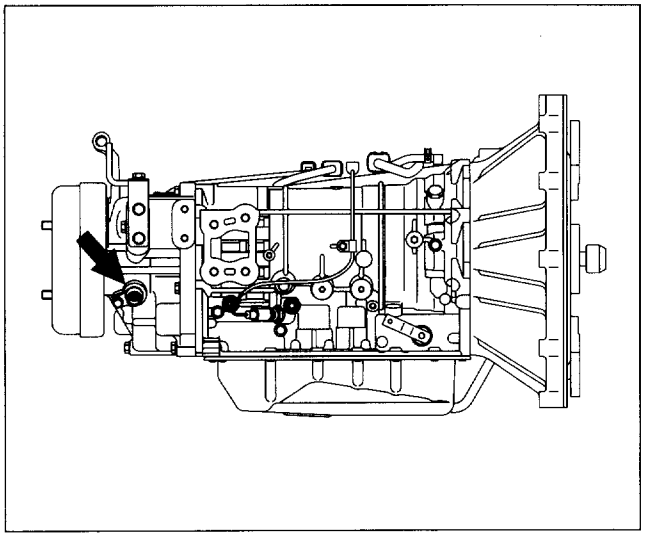


Figure 30. Vehicle Speed Sensor 2 Location

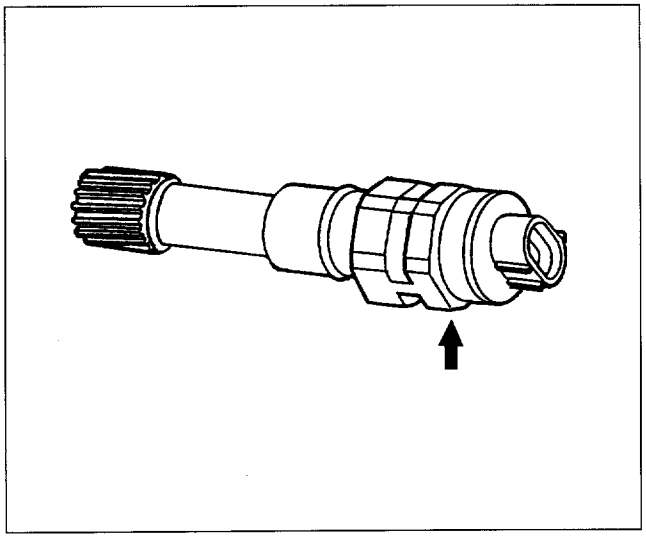


Figure 31. Vehicle Speed Sensor 2

VEHICLE SPEED SENSOR 1

(Fitted to the extension housing)

- This sensor detects the speed of revolution of the parking gear fitted to the output shaft, and generates a pulse (AC=Alternating Current) signal accordingly (figure 31).
- The pulse signal is sent to the transmission control module (TCM) where it is converted into the vehicle speed.
- Should the vehicle speed sensor 2 malfunction for any reason, the vehicle speed sensor 1 takes over control.

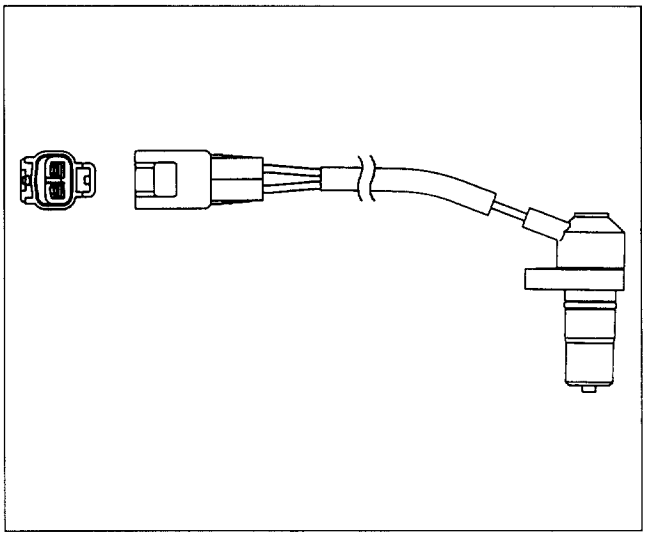


Figure 32. Vehicle Speed Sensor 1

ENGINE SPEED SENSOR

(Figure 33)

- The engine speed sensor fitted on the timing gear case.
- It detects the speed of revolution of the injection pump drive gear and generates a pulse (AC) signal accordingly.
- The pulse signal is sent to the TCM where it is converted into the engine revolution.

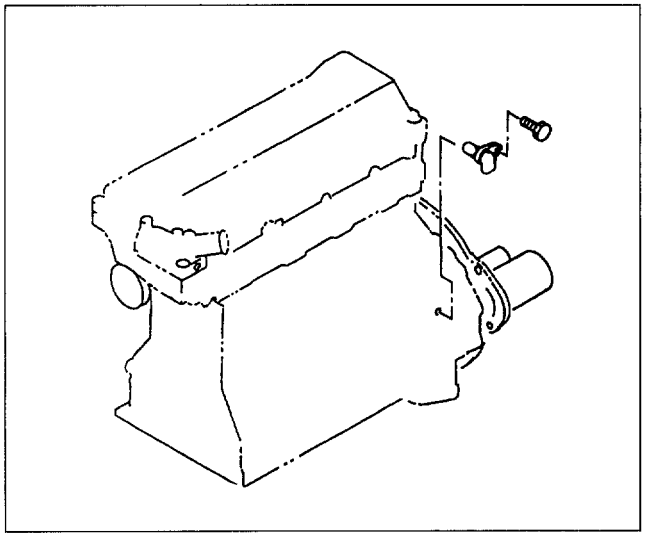


Figure 33. Engine Speed Sensor

TRANSMISSION CONTROL MODULE (TCM)

- The TCM is fitted under the meter cluster. It receives signals from various sensors and judges the running condition of the vehicle accordingly. It compares the result with programmed gear shifting parameters, lock-up operating parameters, etc., and sends signals to solenoids and controls them accordingly.
- It controls seven different items:

1. Line pressure
2. Gear shifting (including overdrive control)
3. Lock-up
4. Exhaust brake
5. "2-3" timing
6. Self-diagnosis
7. Fail-safe function

CONTROL MECHANISM

CONTENT OF FUNCTION AND CONTROL

Item	Description
Line pressure control	• The line pressure solenoid is controlled by the TCM, based on signals from inhibitor switch and those regarding vehicle speed, throttle opening angle, etc., to automatically control the pressure regulator. This keeps oil pump delivery pressure at an optimal line pressure for driving condition. • Line pressure parameters including line pressure for continuous driving and that for gear shifting are stored in the TCM's microcomputer and appropriate parameters are selected from time to time.
Gear shift control	• No. 1 and No. 2 shift solenoids are controlled by the TCM, based on signals from inhibitor switch and those regarding vehicle speed, throttle opening angle, etc., to automatically shift gears to an optimal pattern.
O/D up-shift inhibition control	• When O/D OFF switch is turned off or when the transmission fluid temperature is low, upshifting to D_4 speed (O/D) is prohibited.
Lock-up control	• When driving in D_4, D_3 and D_2 gear, TCM activates the lock-up solenoid based on vehicle speed, throttle opening angle and other signals to automatically control lock-up operation. • When transmission fluid temperature is low, the TCM prohibits lock-up operation.
Engine brake control	• The TCM activates the solenoid based on signals from inhibitor switch, and throttle position sensor to automatically control clutch operation. When exhaust brake is used, it increases line pressure to ensure sufficient clutch capacity.
Fail-safe function	• In case of malfunction of the vehicle speed sensor, throttle position sensor, all solenoids or inhibitor switch, TCM automatically begins fail-safe control to minimize effects on driving.
Self-diagnosis function	• In case of malfunction (with key switch turned on) in vehicle speed sensor, throttle position sensor, all solenoids, ATF thermosensor or engine RPM signal, check trans light at meter panel starts blinking to warn the driver. Malfunctioning system diagnostic trouble data is stored in the TCM and, when self-diagnosis start signal is received, the TCM causes the check trans light to blink in a special manner to indicate the diagnostic result.
Throttle learning control	• The varied throttle position sensor voltage is corrected within the TCM to ensure constant gear-shift control.
Serial data control	• TCM data (such as the vehicle and engine speed) is checked and actuator test controlled by sending signals from "Scan Tool" to the communication program incorporated in the TCM.
Exhaust brake control	• When vehicle speed is lower than regulated speed, while shifting or while lock-up operation, TCM cuts exhaust brake operation.

ATF: Automatic Transmission Fluid O/D: Overdrive TCM: Transmission Control Module

CONTROL ITEM, INPUT AND OUTPUT

Item \ Control Item			Shift control (Main)	Shift control (Exception)	Timing solenoid control	Lock-up	Line pressure control	Throttle learning control	Fail-safe	Self-diag.	Exhaust brake control
Input	Vehicle speed sensor 2	Fitted to Speedometer Driven gear	○	○	○	○	○	○	○	○	○
	Vehicle speed sensor 1 (*1)	Fitted to transmission	○	○	○	○	○	○	●	○	○
	Engine speed sensor				○	○		○	○	○	
	Idle signal (*2)							○		○	
	Kick-down switch (*2)							○		○	
	Throttle position sensor		○	○	○	○	○	○	●	○	
	ATF thermo switch		○			○					
	ATF thermosensor						○			○	
	Exhaust brake operation signal						○		○	○	○
	FICD						○	○			
	O/D OFF switch		○		○	○					
	Brake switch		○			○		○			
	Inhibitor switch		○	○	○	○	○	○	●	○	○
Output	No.1 shift solenoid		○	○					●	○	
	No.2 shift solenoid		○	○					●	○	
	Timing solenoid		○		○				●	○	
	Lock-up solenoid					○			○	○	
	Exhaust brake cancel signal								○	○	○
	Line pressure solenoid						○		●	○	
	Check trans indicator									○	

*1: Back-up for vehicle speed sensor 2
*2: Back-up for throttle position sensor
ATF : Automatic Transmission Fluid
O/D : Overdrive
● : Causes "Check Trans" light to flash.

FICD : First Idle Control Device

MAJOR INPUT/OUTPUT COMPONENT FUNCTION

Component			Function
Input	Vehicle speed sensor 1 (Fitted to transmission)		Detects output shaft revolution and sends RPM signal to TCM.
	Vehicle speed sensor 2 (Fitted to speedometer driven gear)		In case of malfunction of vehicle speed sensor 1 fitted to the transmission, a signal from this sensor (spare sensor) is used for continued control.
	Engine speed sensor		Detects engine revolution and sends signal to TCM.
	Idle signal (from ECM)		Detects when accelerator pedal is fully released and sends signal to TCM.
	Kick-down switch		This switch detects when the accelerator pedal is fully depressed and sends signal to TCM.
	Throttle position sensor		Fitted to accelerator pedal; detects throttle opening angle and pedal operating speed and sends signal to TCM.
	ATF thermo switch		Detects abnormal high temperature of ATF and sends signal to TCM.
	ATF thermosensor		Detects ATF temperature and sends signal to TCM.
	Exhaust brake operation signal		Detects whether exhaust brake is in use and sends signal to TCM.
	FICD operation signal		Detects whether FICD is in use and sends signal to TCM.
	O/D OFF switch		Detects O/D OFF switch ON or OFF position and sends signal to TCM.
	Brake switch		Detects when brake pedal is depressed and sends signal to TCM.
	Inhibitor switch		Detects select lever position and sends to TCM.
Computer	TCM		Judges necessary line pressure, gear shifting point, lock-up operation and engine brake based on electrical signals from switches and sensors and sends appropriate signals to solenoids.
Output	Solenoid	No.1 and No.2 shift solenoids	Selects appropriate gear shifting position for current driving condition based on signal from TCM.
		Timing solenoid	Controls the timing during 2nd and 3rd shifting based on signal from TCM.
		Lock-up solenoid	Regulates (decreases) lock-up pressure to appropriate level for current driving condition based on signal from TCM.
		Line pressure solenoid	Regulates (decreases) oil pump delivery pressure to the appropriate line pressure for current driving condition based on signal from TCM.
	Exhaust brake cancel signal		Cancel exhaust brake.
	Check trans light		Indicates transmission malfunction.
Input/ output	Scan Tool		Self-diagnosis (such as check of vehicle input/output values and actuator test) is performed by connecting TCM and "Scan Tool".

CONTROL CIRCUIT BLOCK DIAGRAM

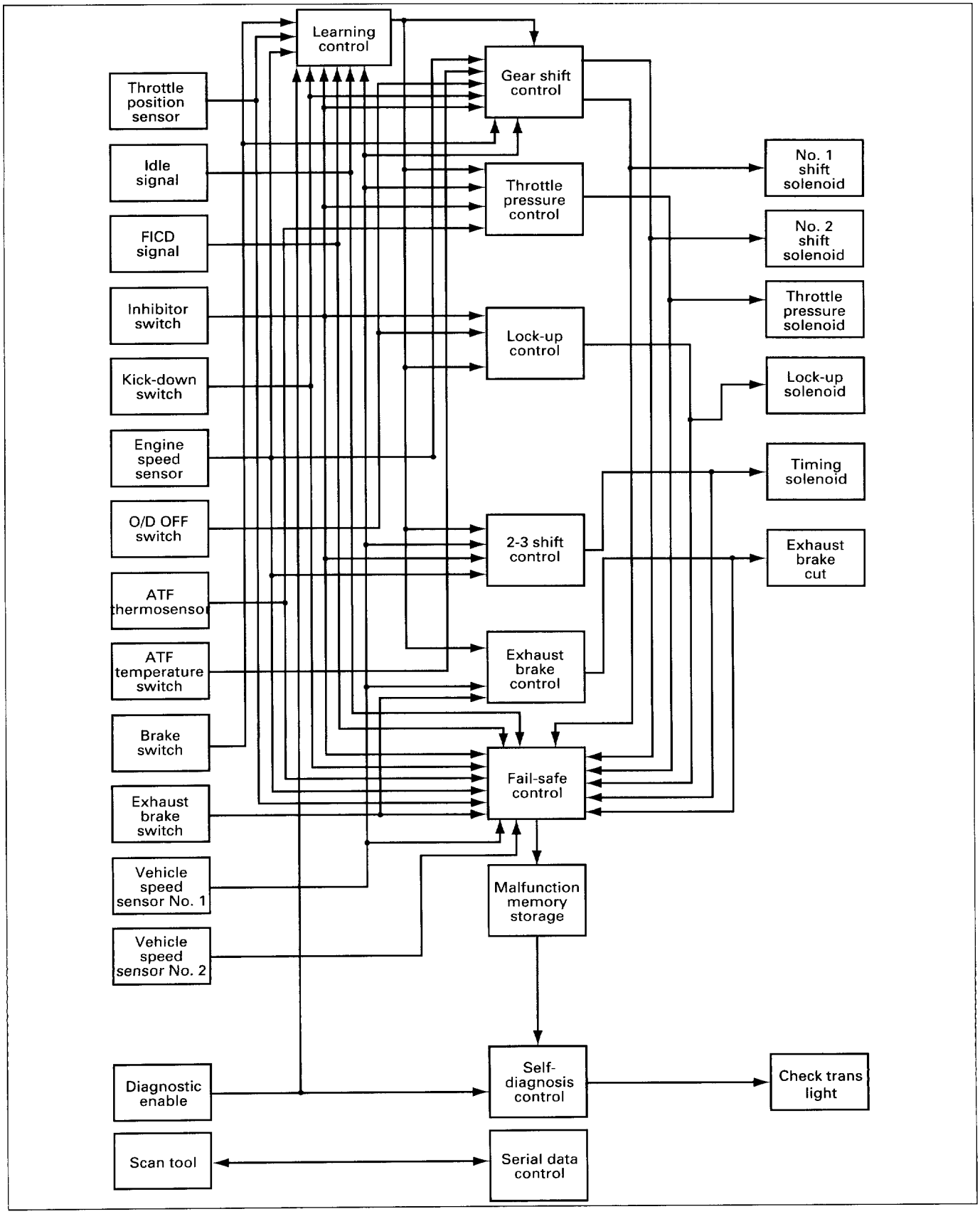


Figure 34. Control Circuit Block Diagram

CIRCUIT DIAGRAM(LHD model)

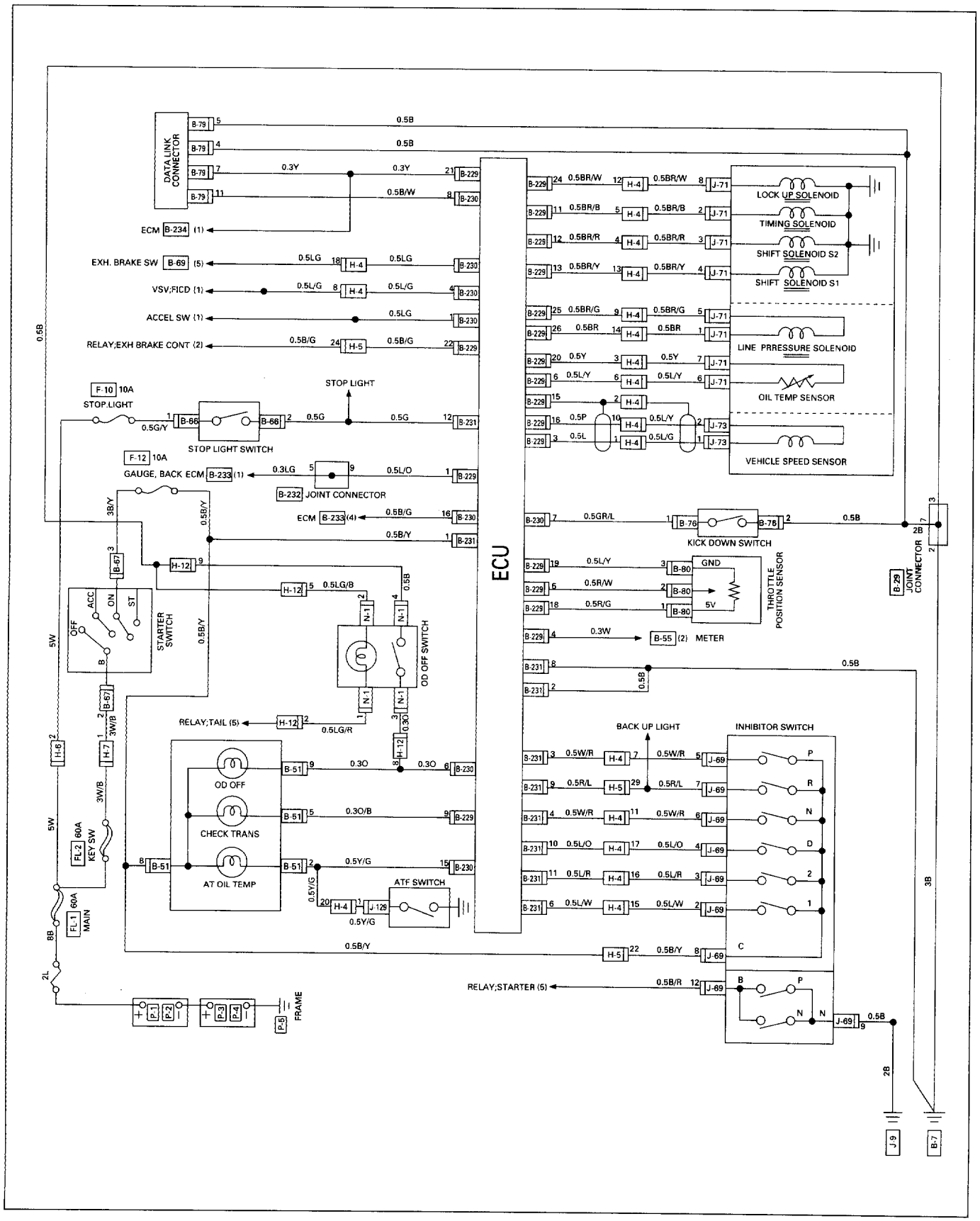


Figure 35-A. Circuit Diagram

CIRCUIT DIAGRAM(RHD model)

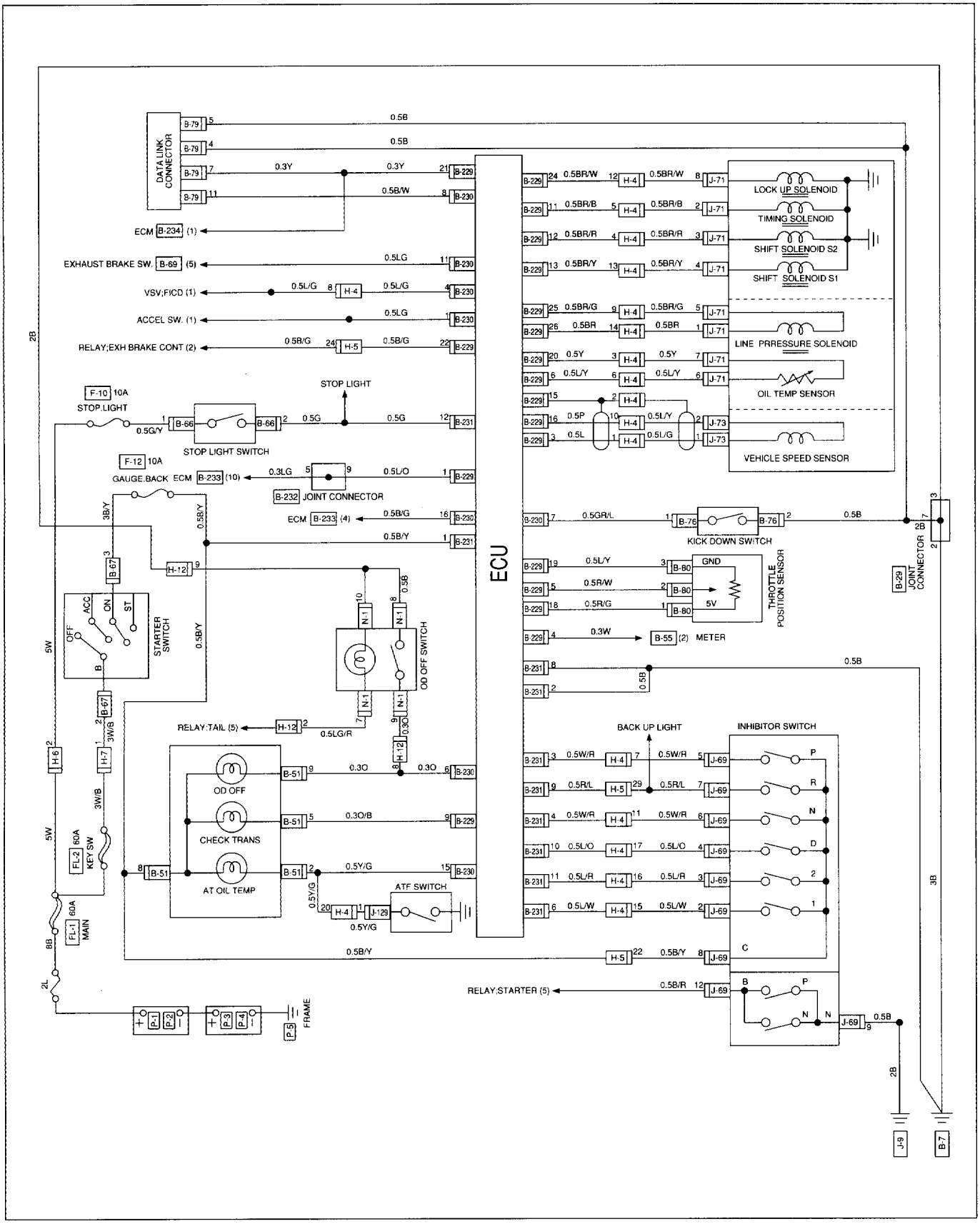


Figure 35-B. Circuit Diagram

VALVE OPERATION

VALVE FUNCTION

Upper Valve Body
(figure 36)

	Valve name	Function
(1)	• 2-3 shift valve	• Shifts between the 2nd and the 3rd gears.
(2)	• Reverse inhibitor valve	• When the gear is shifted to the R range when the vehicle is running forward at high speed, this valve provides the necessary solenoid output to prevent shifting to the reverse gear.
(3)	• Modulator valve	• Regulates the line pressure before it is supplied to the lock-up signal valve, orifice control valve, etc.
(4)	• Throttle valve	• Regulates the signal pressure (throttle pressure) to regulate the line pressure to the optimum level for the driving conditions.
(5)	• Secondary regulator valve	• Controls the oil pressure being sent from the primary regulator valve to the torque converter, and controls the pressure of the lubricant being supplied to all parts.
(6)	• Reducing valve	• Reduces the line pressure before it is supplied to the throttle valve.
(7)	• Lock-up signal valve	• Activates or deactivates the lock-up function.
(8)	• Accumulator control valve	• Lowers the back pressure of the accumulator to the low throttle opening angle, and acquires from line pressure the necessary accumulator control pressure for easing the gear shifting shock.
(9)	• Low coast modulator valve	• Regulates pressure from the line pressure to a low pressure to ease the gear shifting shock when shifting to the L range.
(10)	• Orifice control valve	• Switches the orifices to reduce the shock.
(11)	• Low inhibitor valve	• When the gear is shifted to the L range when driving at high speed, this valve shifts to the 3rd gear at the timing solenoid output.
(12)	• Check valve	• Switches the oil passage to the rear clutch (C2) between the D range and the R range.

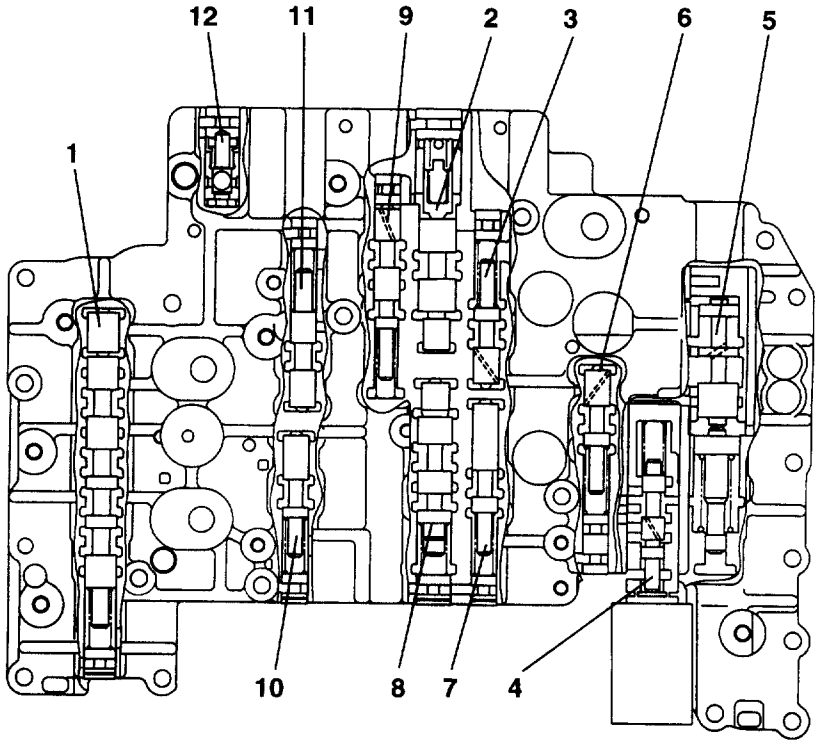
Lower Valve Body

(Figure 36)

	Valve name	Function
(1)	• Manual valve	• Switches the oil passage to the P, R, N, D, 2, or L range according to the select lever action.
(2)	• 1-2 shift valve	• Switches between the 1st and the 2nd gears.
(3)	• 3-4 shift valve	• Switches between the 3rd and the O/D gears.
(4)	• Pressure relief valve	• Regulates the supply pressure to the cooler to the low pressure.
(5)	• Primary regulator valve	• Controls the oil pressure (line pressure) reaching respective elements.
(6)	• Lock-up control valve	• Switches the flow of fluid being sent to the torque converter.
(7)	• C0 exhaust valve	• Eases the gear shifting shock when shifting from the 3rd to 2nd gears.
(8)	• 2-3 timing valve	• Optimizes the oil pressure switching timing to ease the shock when shifting from 2nd to the 3rd gears.
(9)	• Cut-back valve	• Causes the cut-back pressure to act upon the throttle valve to lower the line pressure.

VALVE BODY CONSTRUCTION

Upper Valve Body:
1. 2-3 Shift Valve
2. Reverse Inhibitor Valve
3. Modulator Valve
4. Throttle Valve
5. Secondary Regulator Valve
6. Reducing Valve
7. Lock-up Signal Valve
8. Accumulator Control Valve
9. Low Coast Modulator Valve
10. Orifice Control Valve
11. Low Inhibitor Valve
12. Check Valve



Lower Valve Body:
1. Manual Valve
2. 1-2 Shift Valve
3. 3-4 Shift Valve
4. Pressure Relief Valve
5. Primary Regulator Valve
6. Lock-up Control Valve
7. C0 Exhaust Valve
8. 2-3 Timing Valve
9. Cut-back Valve

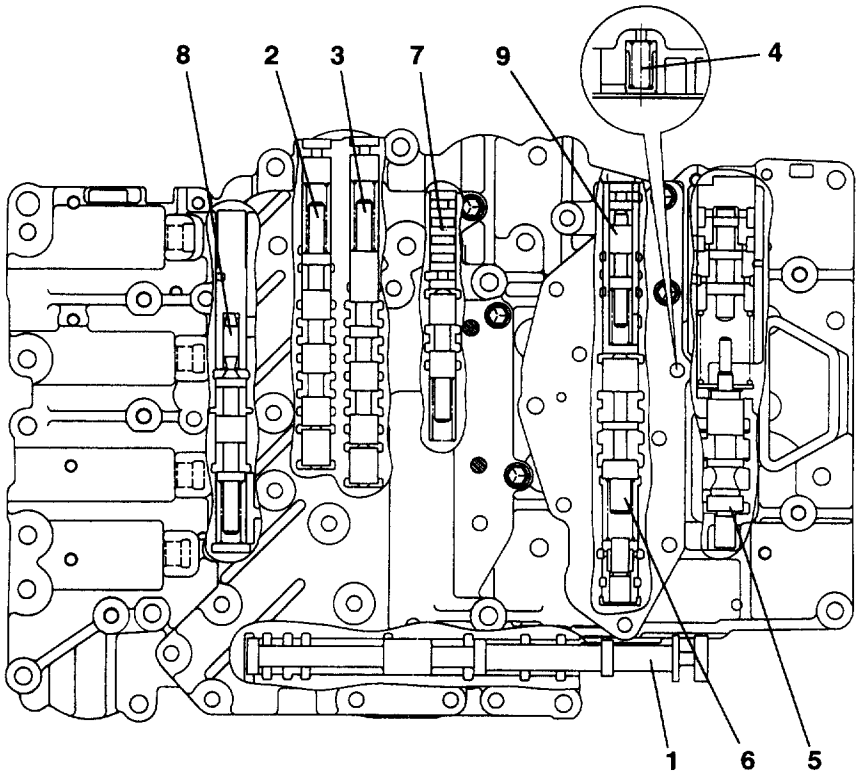
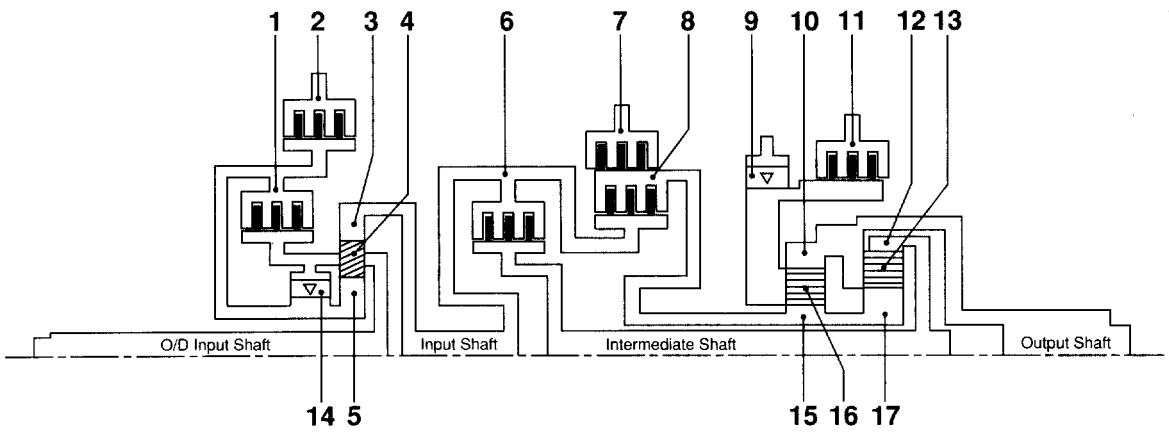


Figure 36. Valve Body Construction

GEAR TRAIN (TRANSMISSION MECHANISM) OPERATION

CONSTRUCTION AND OPERATION

The gear train consists of three pairs of planetary gears, three pairs of multi-plate clutches, three pairs of multi-plate brakes and two pairs of one-way clutches.



1. O/D Direct Clutch (C0)
2. O/D Brake (B0)
3. O/D Ring Gear
4. O/D Pinion Gear
5. O/D Sun Gear
6. Front Clutch (C1)
7. 2nd Brake (B1)
8. Rear Clutch (C2)
9. No. 2 One-way Clutch (F1)
10. Front Ring Gear
11. 1st and Reverse Brake (B2)
12. Rear Ring Gear
13. Rear Pinion Gear
14. O/D One-way Clutch (F0)
15. Front Sun Gear
16. Front Pinion Gear
17. Rear Sun Gear

Figure 37. Construction of Automatic Transmission

COMPONENT NAME AND FUNCTION

Component name	Symbol	Function
O/D direct clutch	C0	Connects O/D sun gear and O/D carrier.
Front clutch	C1	Transmit the engine torque from the input shaft to the intermediate shaft.
Rear clutch	C2	Transmit the engine torque from the front clutch hub to the front and rear planetary sun gear.
O/D brake	B0	Locks the O/D planetary sun gear.
2nd brake	B1	Locks the front and rear planetary sun gear.
1st & Rev. brake	B2	Locks the front planetary carrier.
O/D one-way clutch	F0	Locks the O/D sun gear and O/D planetary carrier during acceleration in 1st, 2nd or 3rd gear.
One-way clutch No.2	F1	Locks the front planetary carrier during acceleration in 1st gear.
No.1 shift solenoid No.2 shift solenoid	S1 S2	The ON/OFF combinations of the two solenoids are used to control the gear position.

COMPONENT AND THEIR OPERATING CONDITION

Shift position		C0	C1	C2	B0	B1	B2	F0	F1	S1	S2	Remarks
P					○					○		
R		○		○			○	●				
N					○					○		
D	1st	○	○					●	●	○		Automatic shift control 1 ⇔ 2 ⇔ 3 ⇔ 4
	2nd		○			○		●		○	○	
	3rd	○	○	○				●			○	
	O/D		○	○	○							
2	1st	○	○					●	●	○		Automatic shift control 1 ⇔ 2 ⇐ 3
	2nd	○	○			○		●		○	○	
	3rd	○	○	○				●			○	
L	1st	○	○				○	●	●	○		Fixed at 1st speed 1 ⇐ 2 ⇐ 3 (*)
	2nd	○	○			○		●		○	○	
	3rd	○	○	○				●			○	

○ - Engaged
● - Operative when accelerating
* - 3rd gear engaged when the timing solenoid is active

N AND P RANGES

N range

- The front clutch (C1) and the rear clutch (C2) are released. The torque from the input shaft is not transmitted to the output shaft.

P range

- As in the case of the N range above, the torque from the input shaft is not transmitted to the output shaft. The parking lock pawl, which is linked to the select lever, is engaged with the parking lock gear, which is directly coupled with the output shaft. The vehicle is locked as the result.

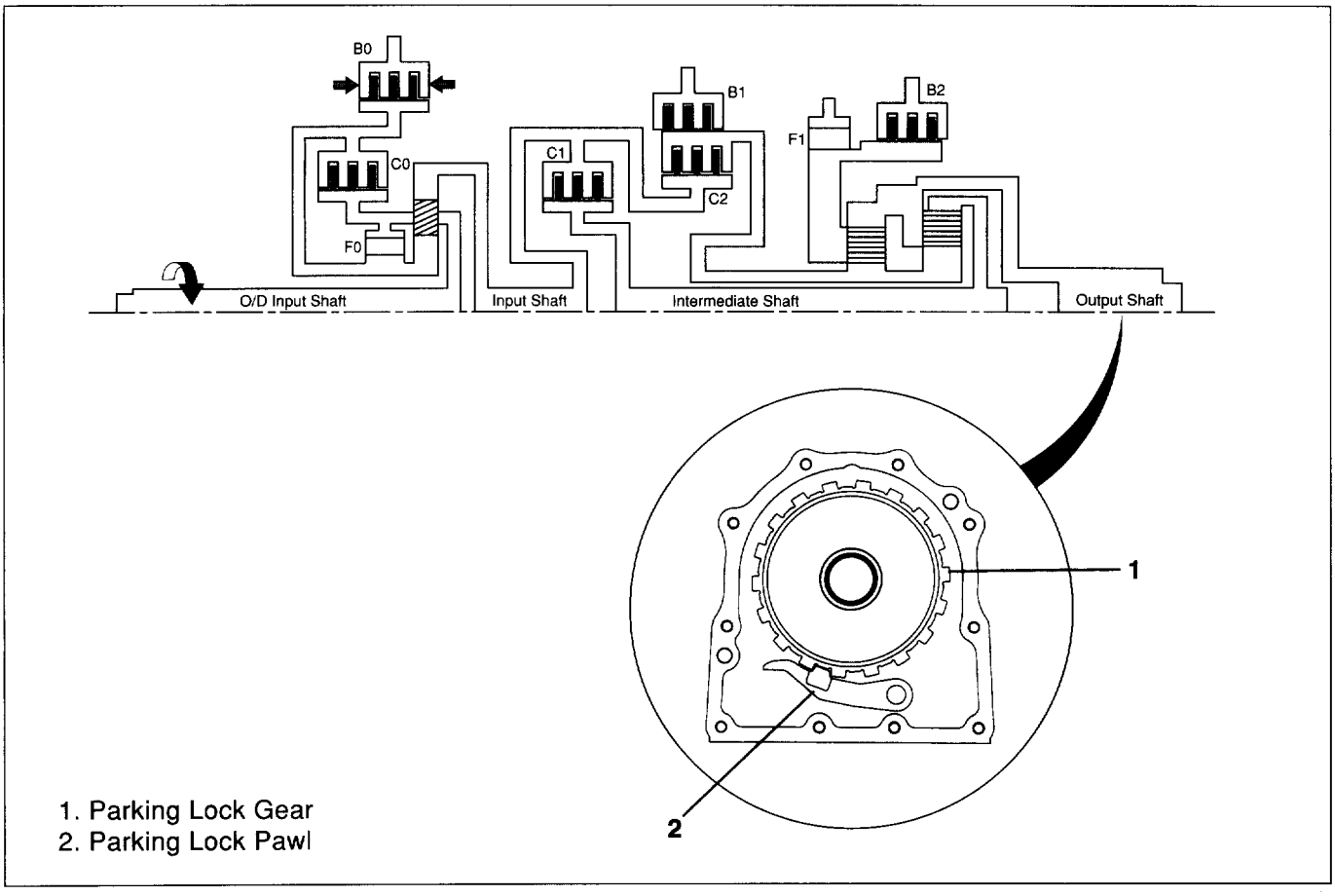


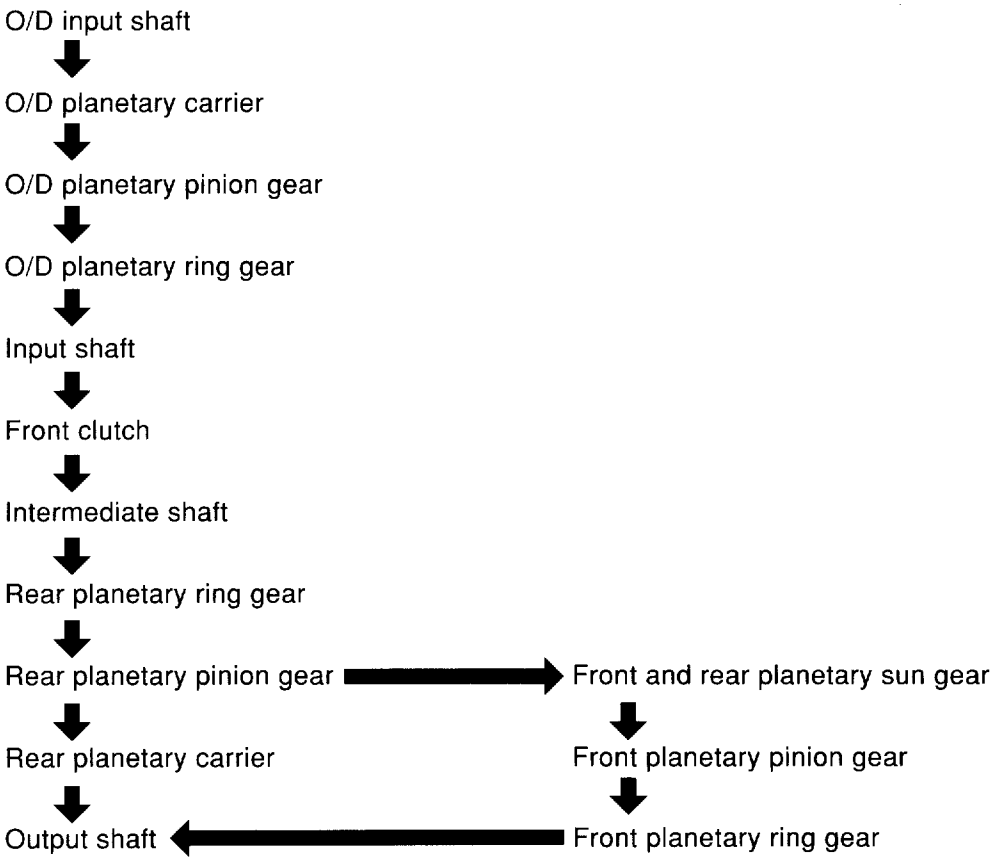
Figure 38. N and P Range

FIRST GEAR IN D OR 2 RANGE

The O/D direct clutch (C0), front clutch (C1), O/D one-way clutch (F0) and No.2 one-way clutch (F1) are activated to form the 1st gear. In the O/D planetary gear, the O/D direct clutch (C0) connects the O/D planetary carrier (O/D input shaft) to the O/D sun gear. This prevents the O/D pinion gear from turning so that the O/D planetary carrier transmits the driving force to the input shaft along with the O/D ring gear as a unit (direct coupling). When the O/D planetary carrier turns clockwise the O/D pinion gear tends to turn counterclockwise causing the O/D sun gear to turn clockwise. However, since it turns faster than the O/D planetary carrier, the O/D one-way clutch (F0) locks the O/D planetary carrier with the O/D sun gear. This prevents the O/D pinion gear from turning, as in the case when the O/D direct clutch (C0) is activated, so that the O/D planetary carrier transmit the driving force to the input shaft along with the O/D ring gear as a unit (direct coupling). The two-way transmission of the power helps to ease the load being applied to the O/D direct clutch (C0).

The clockwise rotational force of the input shaft is transmitted, by the front clutch (C1), from the intermediate shaft to the rear planetary ring gear and to the rear planetary pinion gear. Since the rear planetary carrier is stopped at this time due to the vehicle load, the rear sun gear receives the counterclockwise rotational force and transmits it to the front planetary pinion gear. This causes the front planetary carrier to turn counterclockwise. However, since the front planetary carrier is prevented from turning counterclockwise by the one-way clutch No.2 (F1), the pinion gear causes the front ring gear and the rear planetary carrier to turn clockwise so that the driving force is transmitted to the output shaft.
(Rotational direction is viewed from torque converter side)

Path of power transmission



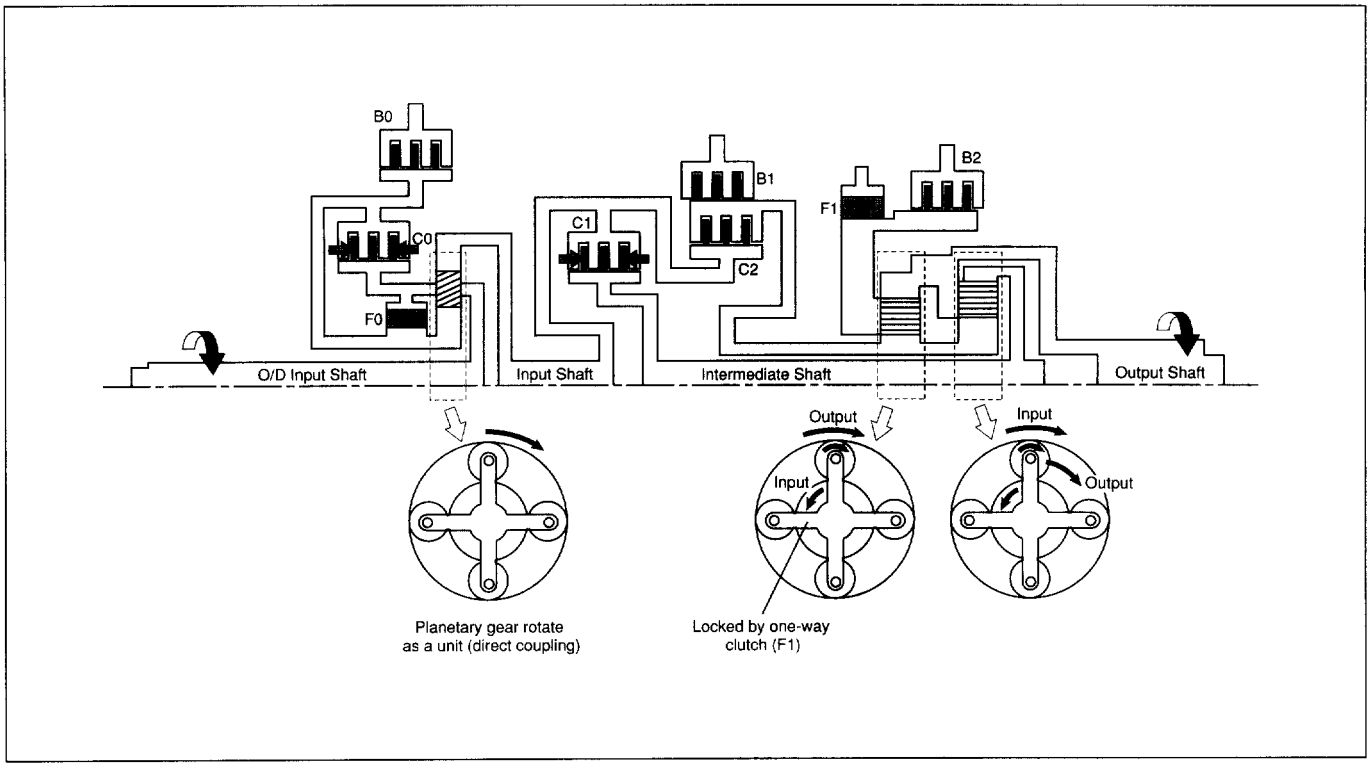


Figure 39. First Gear In D or 2 Range

SECOND GEAR IN D RANGE

The front clutch (C1), 2nd brake (B1), and O/D one-way clutch (F0) are activated to form the 2nd gear. In the 2nd gear, the rotational force of the input shaft caused by the O/D one-way clutch (F0) is transmitted from the intermediate shaft to the rear planetary ring gear and to the rear planetary pinion gear. At this time, the rear sun gear which is engaged with the pinion gear receives a counterclockwise rotational force. However, since it is prevented from turning by the 2nd brake (B1), the rotational force is not transmitted to the front planetary gear. It is transmitted via the rear pinion gear to the rear planetary carrier and to the output shaft.

Path of power transmission

O/D input shaft
↓
O/D planetary carrier
↓
O/D planetary pinion gear
↓
O/D planetary ring gear
↓
Input shaft
↓
Front clutch
↓
Intermediate shaft
↓
Rear planetary ring gear
↓
Rear planetary pinion gear
↓
Rear planetary carrier
↓
Output shaft

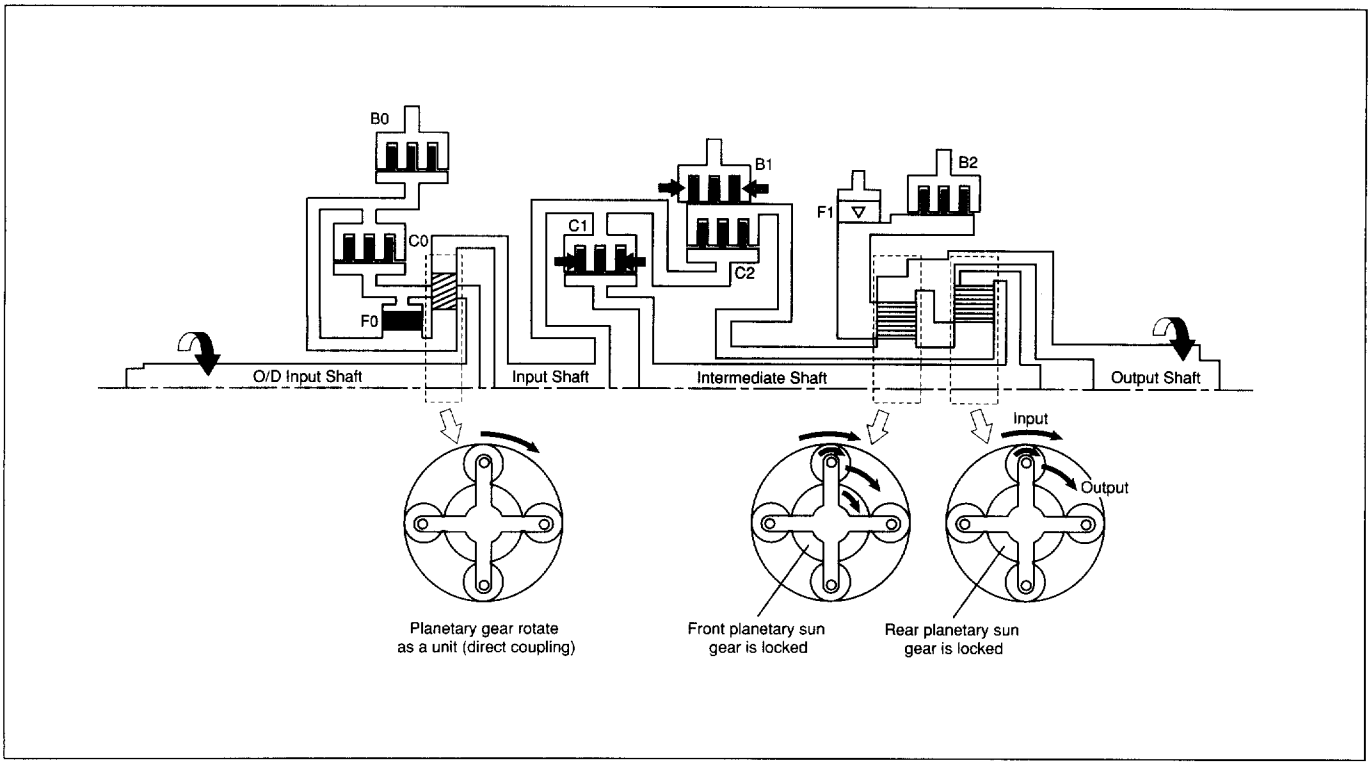
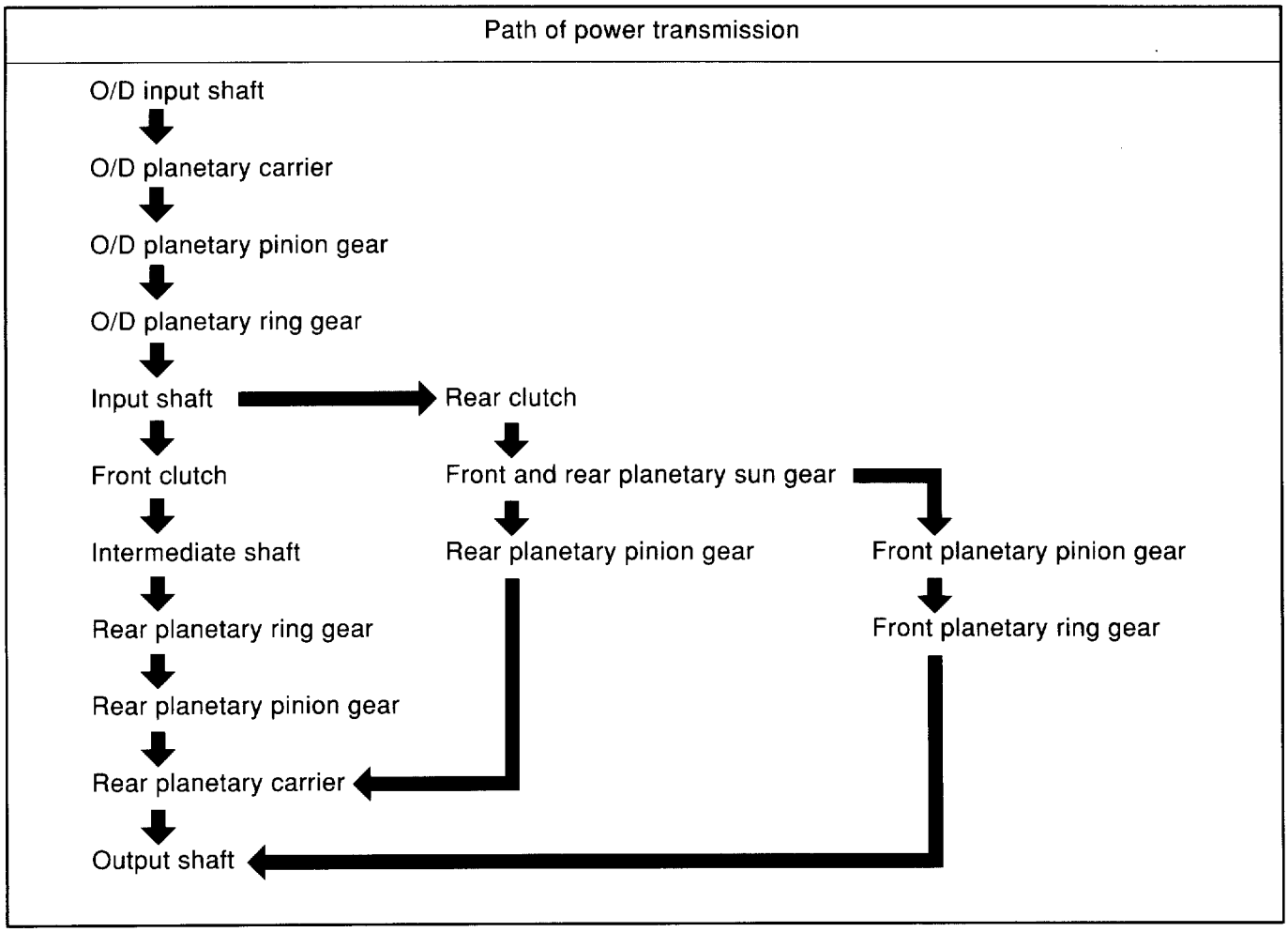


Figure 40. Second Gear in D Range

THIRD GEAR IN D, 2, L RANGE

The O/D direct clutch (C0), front clutch (C1), rear clutch (C2), and O/D one-way clutch (F0) are activated to form the 3rd gear. In the 3rd gear, the intermediate shat and the front and rear sun gears rotate in the same direction as a unit because of the front clutch (C1) and the rear clutch (C2). Therefore, the front and rear planetary pinion gears are locked so that the planetary gear turns as a unit. As the result, the rotational force of the input shaft is transmitted directly to the output shaft without being reduced.



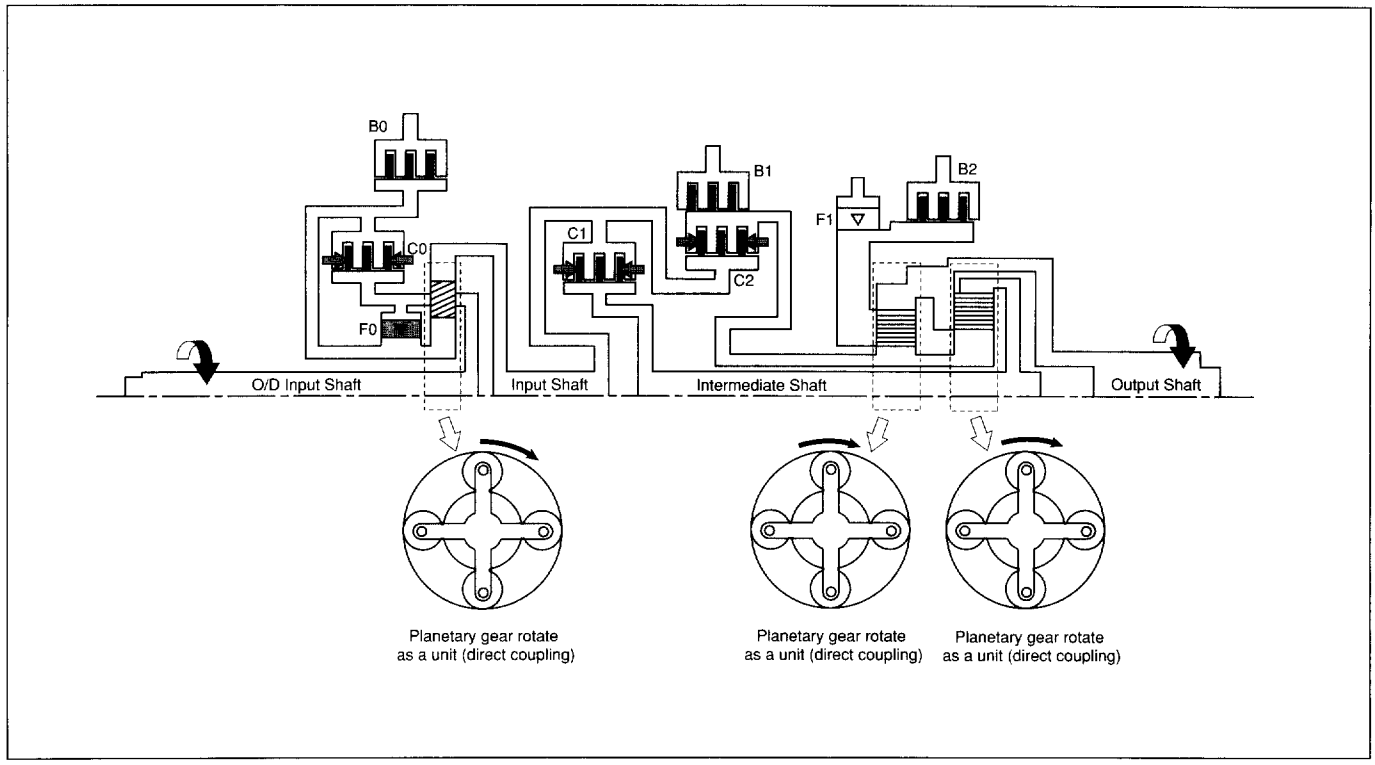
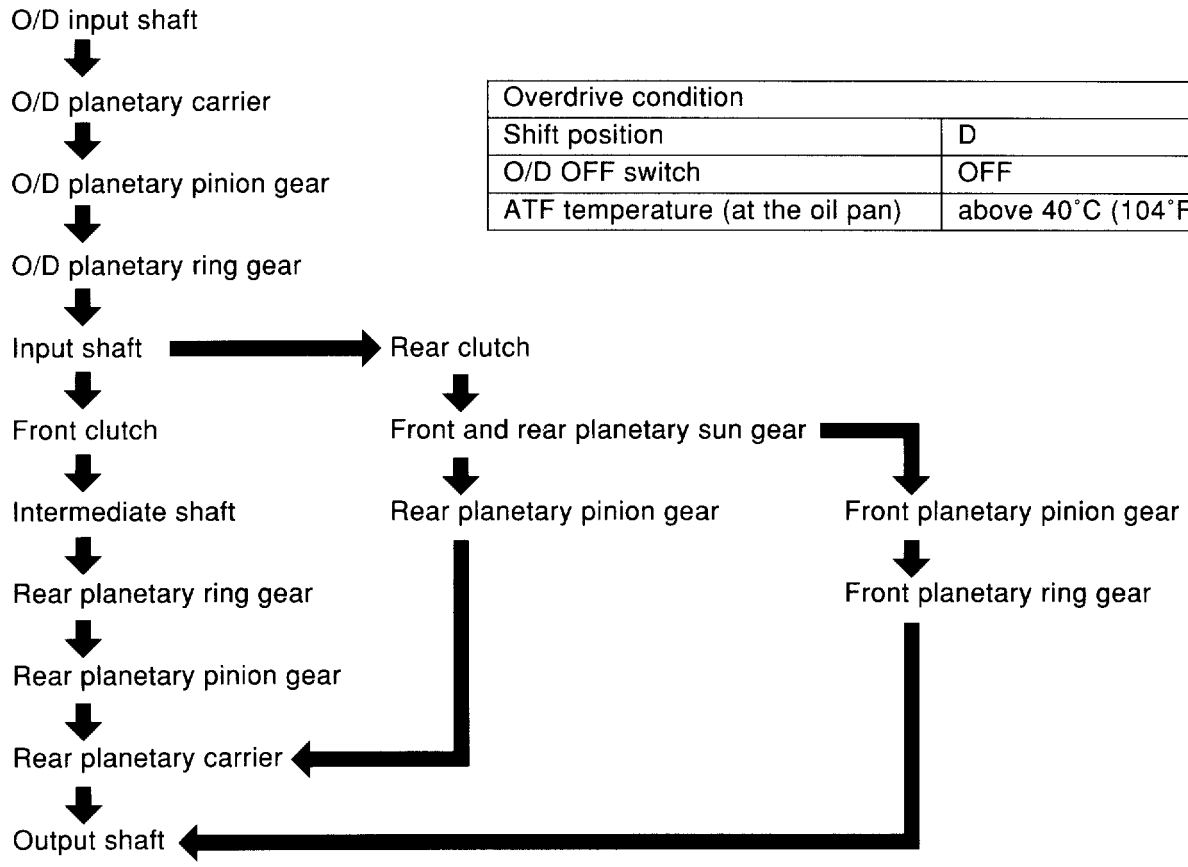


Figure 41. Third Gear in D, 2, L Range

OVERDRIVE GEAR IN D RANGE

When the overdrive conditions (shown in the table below) are met in the 3rd gear condition, the O/D direct clutch (C0) is released. At the same time, the O/D brake (B0) is activated to form the overdrive gear. In the overdrive gear, the O/D sun gear is locked by the O/D brake (B0). Therefore, the rotational force which is transmitted from the O/D input shaft to the O/D planetary carrier causes the O/D planetary pinion gear to turn about itself and revolve at the same time. This increases the speed of the O/D planetary ring gear (input shaft) and, as in the case of the 3rd gear, the rotational force of the input shaft is transmitted directly to the output shaft.

Path of power transmission



Overdrive condition	
Shift position	D
O/D OFF switch	OFF
ATF temperature (at the oil pan)	above 40°C (104°F)

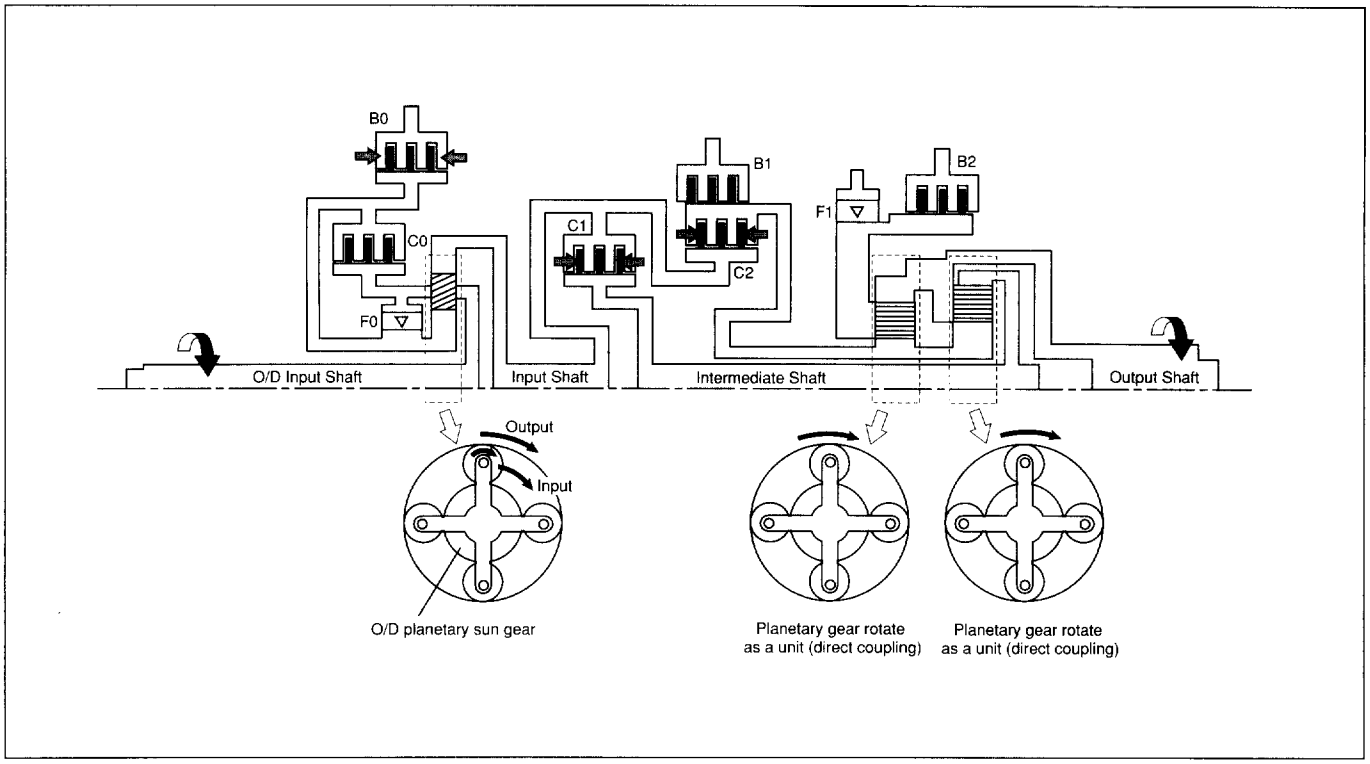


Figure 42. Overdrive Gear in D Range

SECOND GEAR IN 2 RANGE

The rotational force is transmitted in the same way as in the case of the 2nd gear in the D range with a few exceptions. The clockwise rotation of the O/D sun gear during the engine brake is prevented by the O/D direct clutch (C0). In other words, the rotational force is transmitted to the input shaft by the O/D one-way clutch (F0) when the vehicle is driven by the second gear in the D range. When the engine brake is applied, the counterclockwise rotational force of the O/D sun gear deactivates the O/D one-way clutch. The engine brake takes no effect as the O/D sun gear idles in this condition. For this reason, the O/D direct clutch (C0) is activated in the 2nd range to engage the O/D sun gear and the O/D planetary carrier so that the engine brake is effective.

Path of power transmission

O/D input shaft
↓
O/D planetary carrier
↓
O/D planetary pinion gear
↓
O/D planetary ring gear
↓
Input shaft
↓
Front clutch
↓
Intermediate shaft
↓
Rear planetary ring gear
↓
Rear planetary pinion gear
↓
Rear planetary carrier
↓
Output shaft

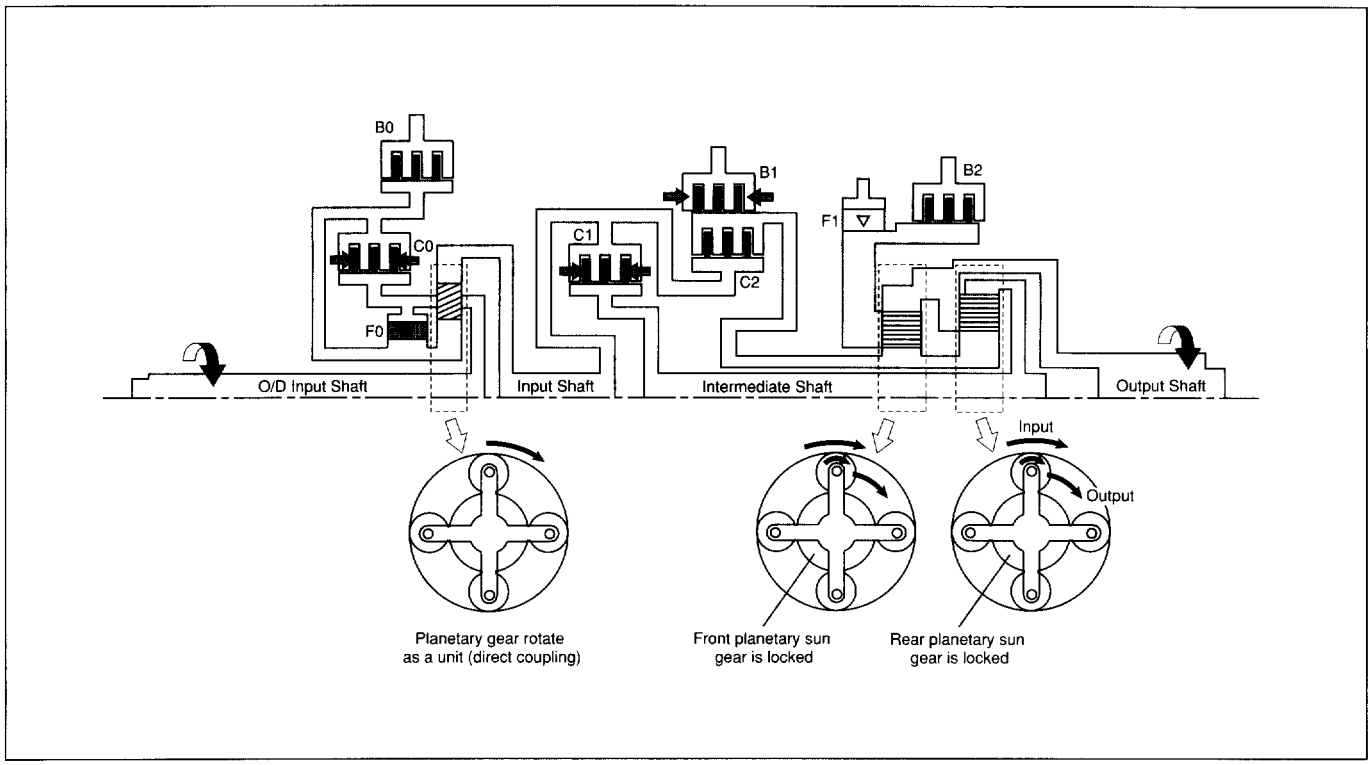
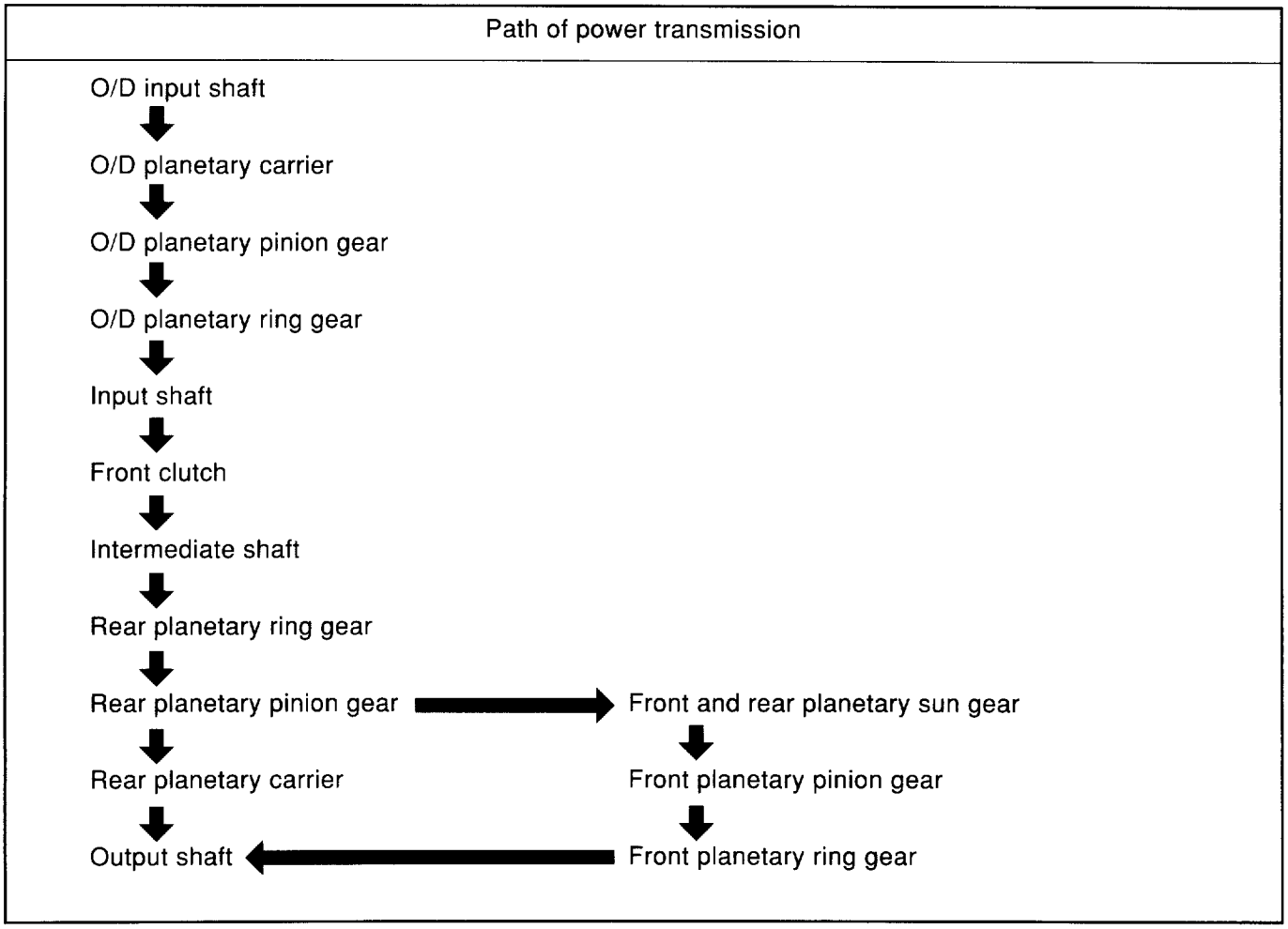


Figure 43. Second Gear in 2 Range

FIRST GEAR IN L RANGE

The rotational force is transmitted in the same way as in the case of the 1st gear in the D and 2nd ranges with a few exceptions. When the engine brake is applied, the clockwise rotation of the front planetary carrier is prevented by the 1st and reverse brake (B2). When the vehicle is driven by the 1st gear in the D or 2nd range, the counterclockwise rotation of the front planetary carrier is locked by the one-way clutch No.2 (F1) so that the rotational force is transmitted to the output shaft. When the engine brake is applied, however, a counter force deactivates the one-way clutch No.2 (F1). This causes the front planetary carrier to idle and the engine brake takes no effect. In the L range, the 1st and reverse brake (B2) is activated to lock the front planetary carrier so that the engine brake is effective.



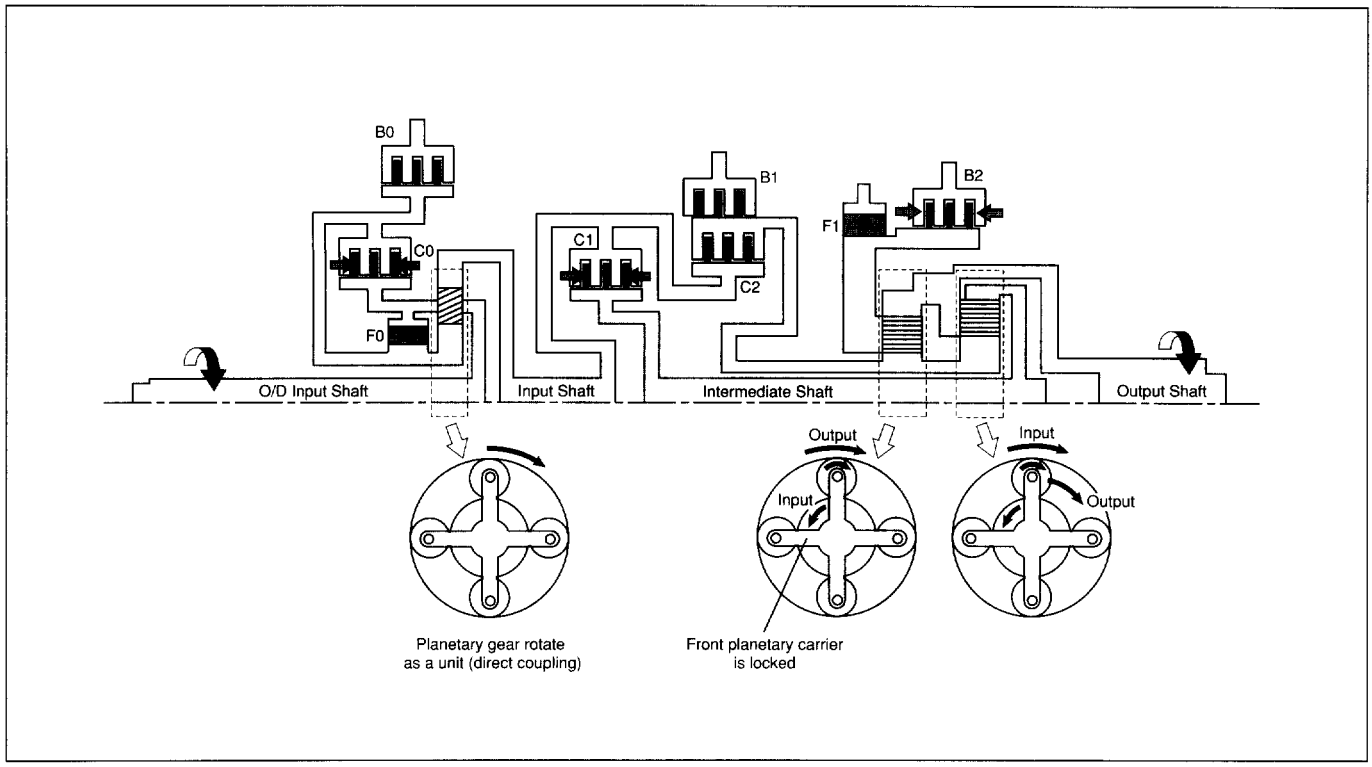


Figure 44. First Gear in 1 Range

R RANGE

In the R range, the O/D direct clutch (C0), O/D one-way clutch (F0), rear clutch (C2) and 1st and reverse brake (B2) are activated to form the reverse gear. The rotational force of the O/D input shaft is transmitted directly to the input shaft as does the 1st gear in the D or 2nd range. The rotational force of the input shaft is transmitted to the pinion gear of the front planetary gear as the rear clutch (C2) is active. However, since the front planetary carrier is locked by the 1st and reverse brake (B2), the rotational force of the sun gear is transmitted to the ring gear via the pinion gear so that the counterclockwise rotational force is transmitted to the output shaft.

Path of power transmission

O/D input shaft
↓
O/D planetary carrier
↓
O/D planetary pinion gear
↓
O/D planetary ring gear
↓
Input shaft
↓
Rear clutch
↓
Front planetary ring gear
↓
Front planetary pinion gear
↓
Front planetary carrier
↓
Output shaft

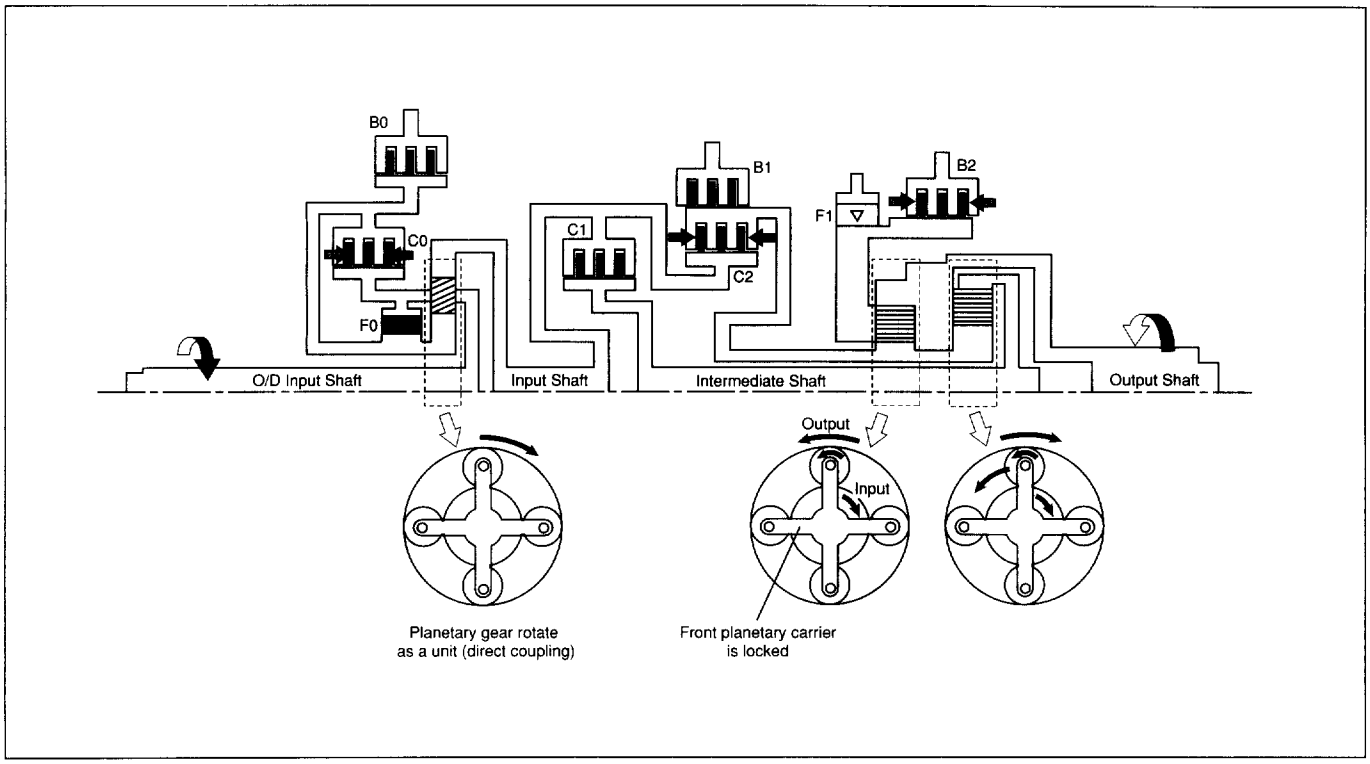


Figure 45. R Range

7A2 DIAGNOSIS

CONTENTS

SUBJECT	PAGE
Description	7A2- 2
Diagnosis Procedure	7A2- 2
Self Diagnosis	7A2- 3
Self Diagnosis Information	7A2- 3
Clearing Memory of the Diagnostic Trouble Code (DTC)	7A2- 6
Identification of Transmission Control Module (TCM)	7A2- 7
Diagnosis Based on Diagnostic Trouble Code (DTC)	7A2- 8
DTC 11 Vehicle Speed Sensor 1	7A2- 9
DTC 13 Engine Speed Sensor	7A2-11
DTC 15 Automatic Transmission Fluid (ATF) Thermosensor	7A2-13
DTC 17 Inhibitor Switch	7A2-15
DTC 21 Throttle Position Sensor	7A2-17
DTC 24 Vehicle Speed Sensor 2	7A2-20
DTC 31 No.1 Shift Solenoid	7A2-22
DTC 32 No.2 Shift Solenoid	7A2-24
DTC 33 Timing Solenoid	7A2-26
DTC 34 Lock-up Solenoid	7A2-28
DTC 35 Line Pressure Solenoid	7A2-30
DTC 37 Exhaust Brake Cut System	7A2-32
Diagnosis Based on Vehicle Condition	7A2-34
Inspection Based on Faulty Symptom	7A2-36
Wiring Diagram	7A2-52
Parts Location	7A2-54
Connector Configurations	7A2-55
Control Signal Inspection	7A2-57
Line Pressure Test	7A2-62
Stall Test	7A2-64
Road Test	7A2-65
Shift Point Diagram and Lock-up Point Diagram	7A2-65
Diagnosis by Using Scan Tool	7A2-69
Special Tools	7A2-73

DESCRIPTION

DIAGNOSIS PROCEDURE

When the automatic transmission is out of order, something is wrong with the mechanical system or the electrical system such as the hydraulic circuit, friction element and Transmission Control Module (TCM), and complicated phenomena may occur sometimes. So, at the time of diagnosis, perform the self-diagnosis function, a stall test, a line pressure test or a road test to reproduce such abnormal phenomena so as to fully understand what is out of order before starting inspection, adjustment or overhaul.

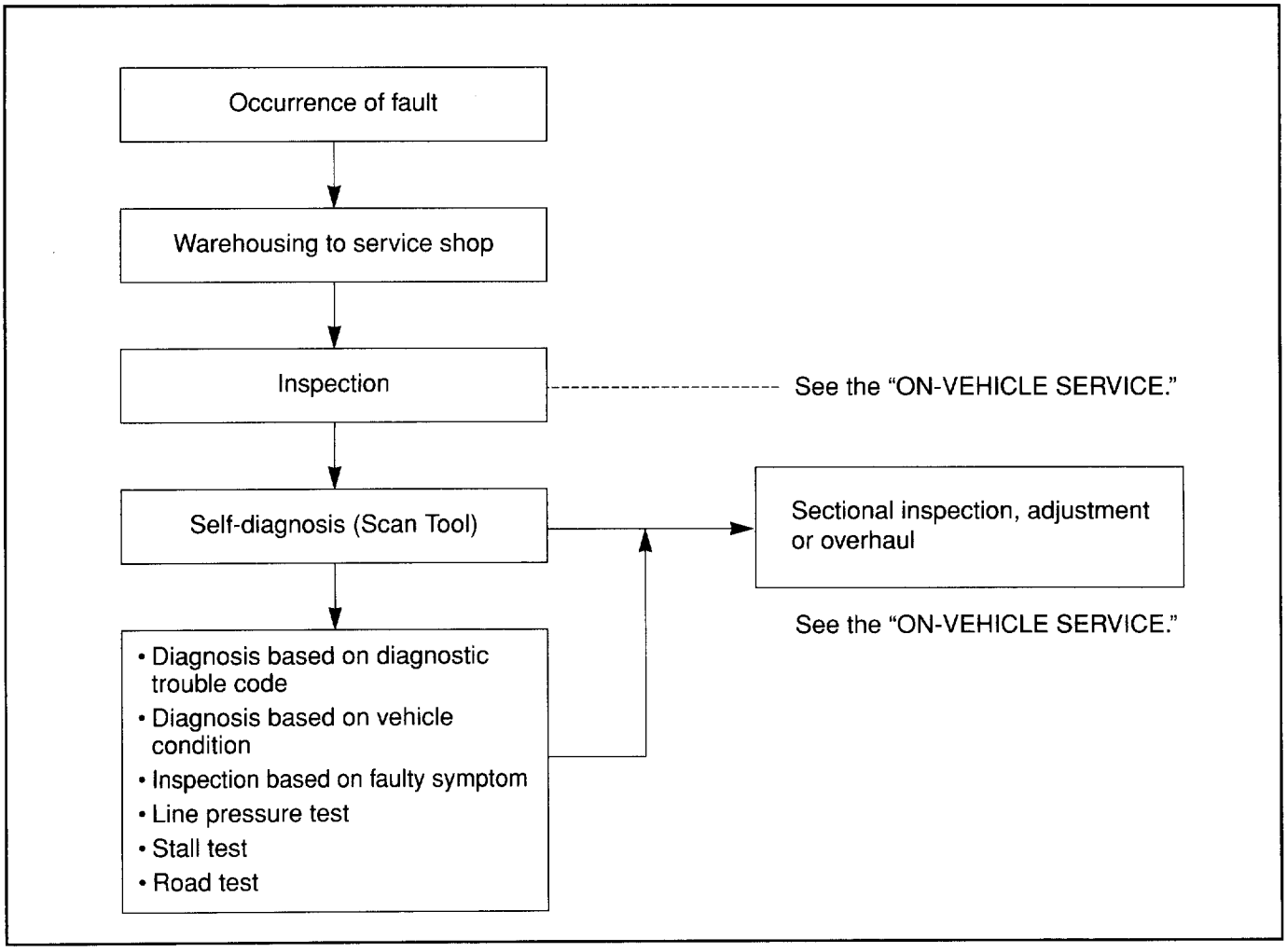


Figure 1. Diagnosis Procedure

SELF DIAGNOSIS

SELF DIAGNOSIS INFORMATION

The transmission control module of this system has the function of self diagnosis. If any trouble occurs in this system, the check trans light functions to inform operator of possible troubles related to the following 12 components.

1. Vehicle speed sensor-1
   (Installed on the Transmission)
2. Engine speed sensor
3. Automatic transmission fluid thermosensor
4. Inhibitor switch
5. Throttle position sensor
6. Vehicle speed sensor-2
   (Fitted on the speedometer driven gear)
7. No.1 shift solenoid
8. No.2 shift solenoid
9. Timing solenoid
10. Lock-up solenoid
11. Line pressure solenoid
12. Exhaust brake cut

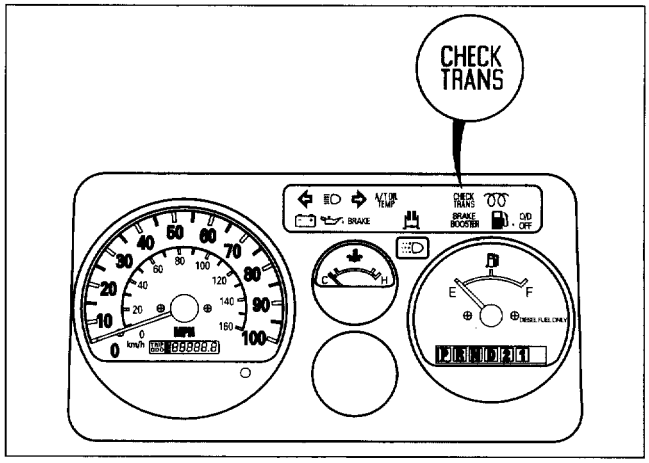


Figure 2. Check Trans Light

Indication of the Check Trans Light with the Key Switch Turned On (User Mode)

When the throttle position sensor, vehicle speed sensor, solenoids, etc., starts to malfunction when the vehicle is running (the key switch turned on), the check trans light blinks to warn the driver (figure 3).

- The check trans light begins to blink as soon as a problem occurs during driving, and keeps blinking until it is corrected.

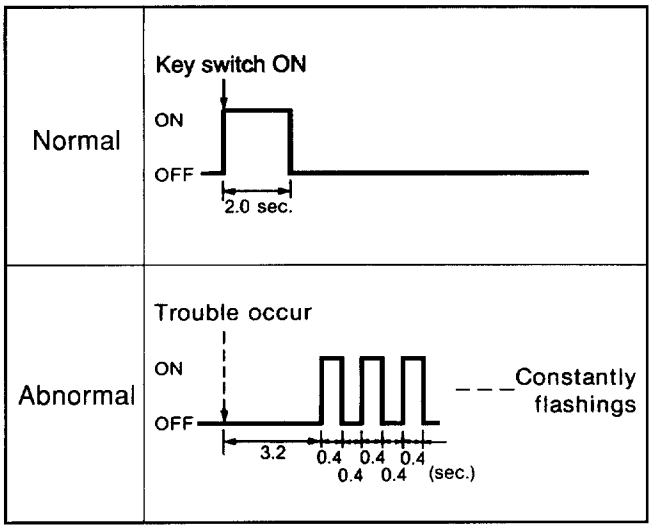


Figure 3. Check Trans Light Display

Indication of the Check Trans Light During Self-Diagnosis (Dealer Mode)

To help the mechanic locate the problem more easily, the check trans light blinks in different cycles. Each cycle represents one of the eleven possible sources of problem.

Indication of Self-Diagnostic Results

A diagnostic trouble code (DTC) registered in memory can be displayed by the connection of terminal 11 and 4 or 5 of the data link connector (DLC).

The DLC is the black 16-pin connector and it is tied to the support bracket locating under the brake and clutch fluid tank.

- When no problem exists, the display flashes "1" repeatedly (figure 4-A).
- When a malfunction exists, the appropriate DTC is displayed three times repeatedly (figure 4-B).
- When two or more DTCs are registered, they are all displayed three times repeatedly, one at a time, starting with the lowest code number (figure 4-C).

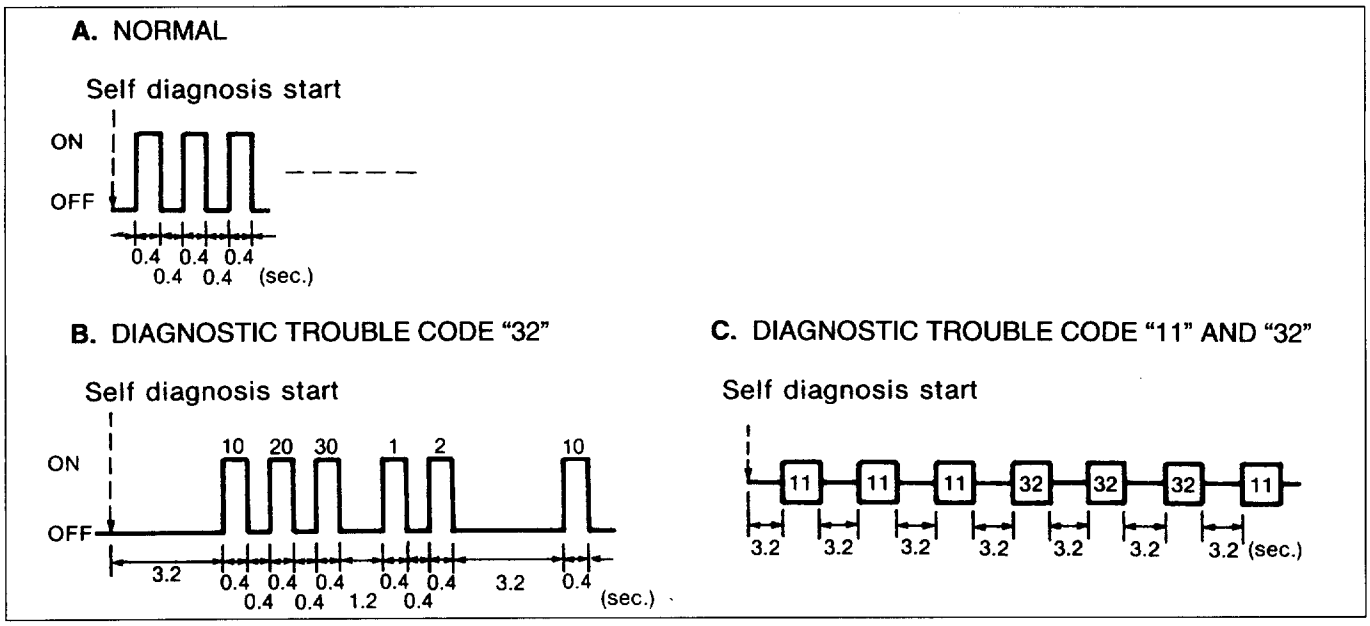


Figure 4. Self Diagnosis Display

Diagnostic Trouble Codes (DTC)

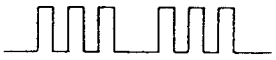
DTC No.	DISPLAY PATTERN	DIAGNOSED CONTENT	REFERENCE
11		Vehicle speed sensor 1 circuit open or shorted (Fitted to transmission)	7A2-9
13		Engine speed sensor circuit open or shorted	7A2-11
15		Automatic transmission fluid thermosensor circuit open	7A2-13
17		Inhibitor switch circuit open or shorted	7A2-15
21		Throttle position sensor circuit open or shorted	7A2-17
24		Vehicle speed sensor 2 circuit open or shorted (Built into speedometer)	7A2-20
31		No.1 shift solenoid (S1) circuit open or shorted	7A2-22
32		No.2 shift solenoid (S2) circuit open or shorted	7A2-24
33		Timing solenoid (ST) circuit open or shorted	7A2-26
34		Lock-up solenoid circuit open or shorted	7A2-28
35		Line pressure solenoid circuit open or shorted	7A2-30
37		Exhaust brake cut system circuit open or shorted	7A2-32

Figure 5. Diagnostic Trouble Code

CLEARING MEMORY OF THE DIAGNOSTIC TROUBLE CODE (DTC)

1) To clear the memory in TCM, use Tech-2 (Scan Tool).
2) To clear the memory in TCM without Tech-2, perform the following operation at once and keep more than 5 seconds.
   - Turn the key switch to ON position, but do not start the engine.
     (= No engine RPM/No vehicle speed)
   - Connect terminal 1 and 3 of the DLC.
     (= Self-diagnosis is started)
   - Select "N" (Neutral) range.
     (= "N" range signal is sent)
   - Depress brake pedal fully.
     (= Brake switch is ON)
   - Depress accelerator pedal fully.
     (= Kick-down switch is ON)

   If the memory is cleared normally in this procedure, the check trans light flashes rapidly ("ON"–0.2 sec, "OFF"–0.2 sec) for 10 seconds.

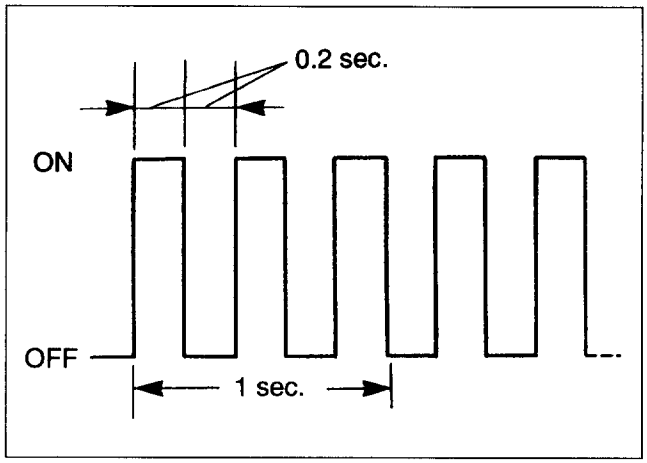


Figure 6. First Flashing Pattern After Clearing Memory

IDENTIFICATION OF TRANSMISSION CONTROL MODULE (TCM)

A: ISUZU part No. : 8972050330(LHD)
8972050340(RHD)
B: AISIN part No. : 86410-0423(LHD)
86410-0463(RHD)

C: Manufactured date
Ex. : 9 F 14

- 9 → Year ; 1999
- F → Month ; June
  A: January
  B: February
  :
  L: December
- 14 → Day

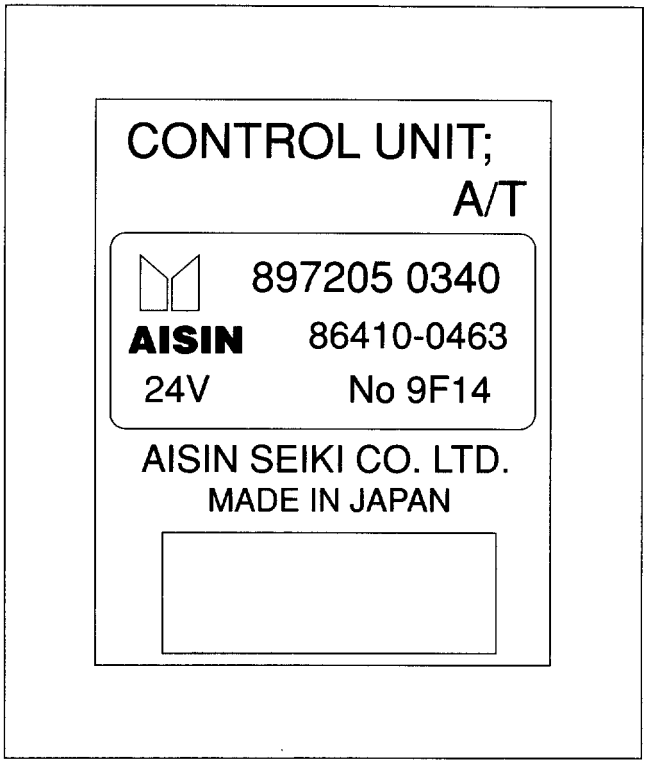
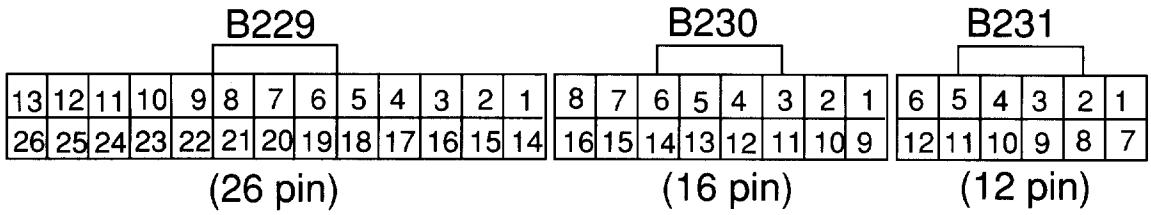


Figure 7. Identification of TCM

DIAGNOSIS BASED ON DIAGNOSTIC TROUBLE CODE (DTC)



Pin No.	Function
B231-1	Ignition signal
B231-2	Battery ground
B231-3	Shift position; P range signal
B231-4	Shift position; N range signal
B231-5	Not used
B231-6	Shift position; 1 range signal
B231-7	Not used
B231-8	Battery ground
B231-9	Shift position; R range signal
B231-10	Shift position; D range signal
B231-11	Shift position; 2 range signal
B231-12	Brake switch
B230-1	Exhaust brake signal
B230-2	Not used
B230-3	Not used
B230-4	Idle up signal
B230-5	Not used
B230-6	O/D OFF switch
B230-7	Kick-down switch
B230-8	Diagnostic enable signal
B230-9	Not used
B230-10	Not used
B230-11	Not used
B230-12	Not used
B230-13	Not used
B230-14	Not used
B230-15	ATF temperature switch
B230-16	Idle signal

Pin No.	Function
B229-1	Engine speed sensor
B229-2	Not used
B229-3	Vehicle speed sensor (Transmission/+)
B229-4	Vehicle speed sensor (Speedometer)
B229-5	Throttle position sensor
B229-6	ATF thermosensor (+)
B229-7	Not used
B229-8	Not used
B229-9	Check trans indicator light
B229-10	Not used
B229-11	Timing solenoid (ST)
B229-12	No.2 shift solenoid (S2)
B229-13	No.1 shift solenoid (S1)
B229-14	Not used
B229-15	Shield for No. B229-3
B229-16	Vehicle speed sensor (Transmission/–)
B229-17	Not used
B229-18	Throttle position sensor voltage
B229-19	Throttle position sensor ground
B229-20	ATF thermosensor (–)
B229-21	Serial data (Scan tool)
B229-22	Exhaust brake cut signal
B229-23	Not used
B229-24	Lock-up solenoid
B229-25	Line pressure solenoid (–)
B229-26	Line pressure solenoid (+)

Figure 8. TCM Connector Pin Layout

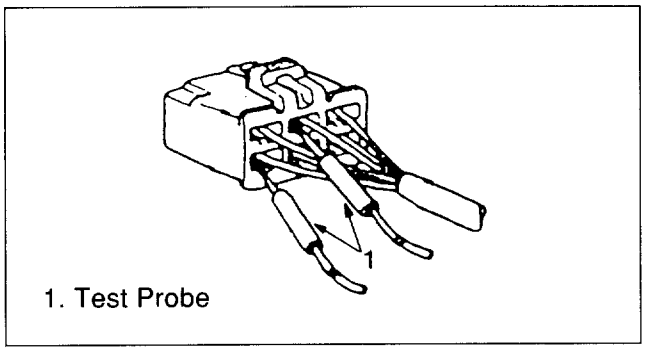


Figure 9. Connector Inspection

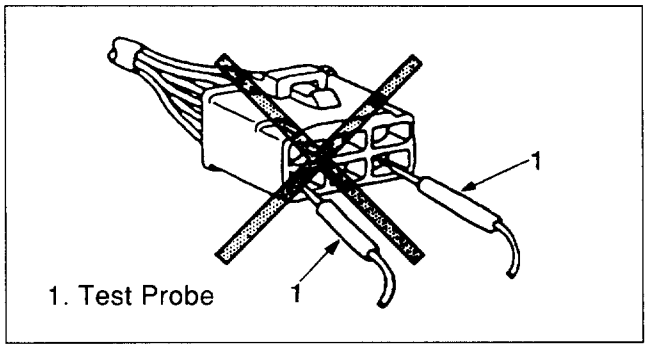


Figure 10. Connector Inspection

Connector Inspection

Use circuit tester to check the connector for continuity. Insert the test probes (1) from the connector wire side (figure 9).

CAUTION: Never insert the circuit tester test probes (1) into the connector open side to test the continuity (figure 10).
Broken or open connector terminals will result.

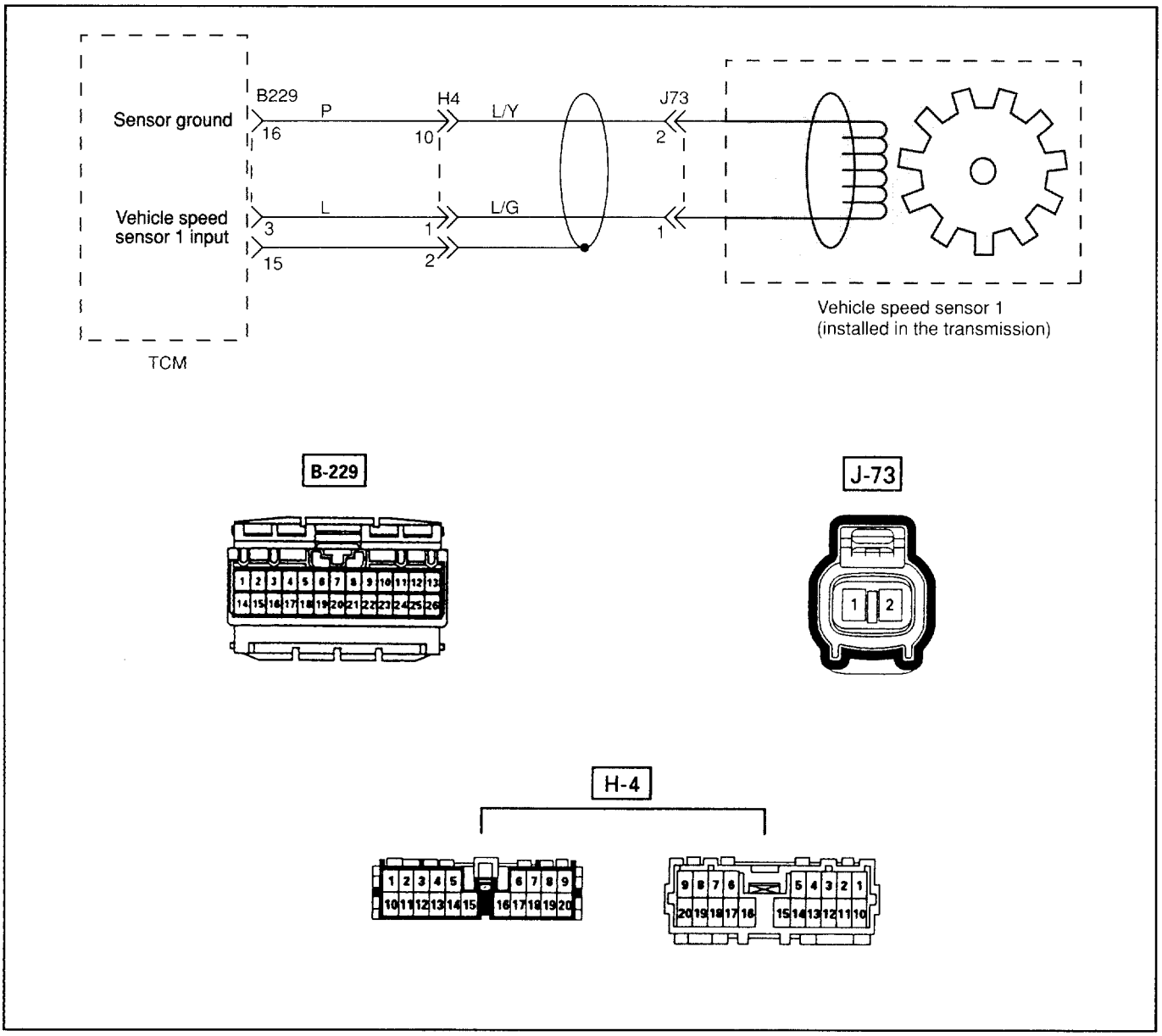
DIAGNOSTIC TROUBLE CODE (DTC) 11
VEHICLE SPEED SENSOR 1
(Wire Breaking/Short Circuit)

Explanation of Circuit: Vehicle speed information is sent from the vehicle speed sensor 1 to the Transmission Control Module (TCM). This sensor is provided in the transmission rear cover.
The vehicle speed sensor 1 is an electromagnetic pulse pickup type that generates a speed signal according to the revolution of the transmission output shaft (18 pulses at a single revolution of the output shaft). As a result, the sensor sends a sine wave signal to the TCM, which converts this sine wave signal (pulse voltage) into a km/h (mph) signal.

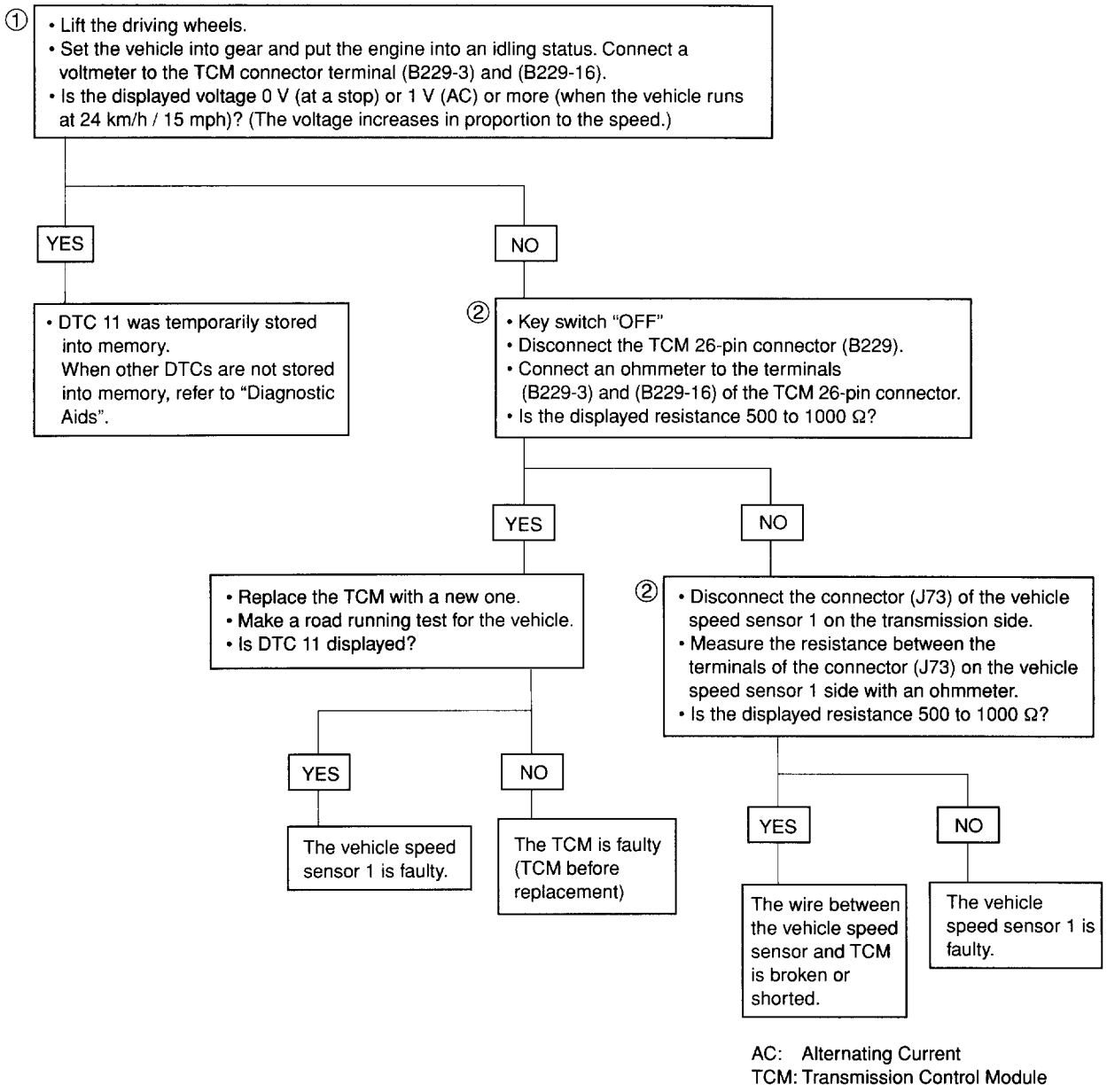
Explanation of Test: The following numbers correspond to the numbers enclosed with a circle in the diagnosis chart.
① When the vehicle is running, a speed signal is input from the vehicle speed sensor 1 into the TCM.
② At this test, the continuity of circuit wiring and the vehicle speed sensor 1 is checked.

Diagnostic Aids: A temporary failure may be caused by faulty connection, worn-away wire insulator or internal wire breaking of insulator. Check if any of the following conditions is provided in the TCM harness connector: Terminal positional shift, improper junction, lock damage, improper terminal shape or damage, faulty wire connection of terminal, and harness damage.

TCM Voltage Check: Refer to page 7A2-57.



DIAGNOSTIC TROUBLE CODE (DTC) 11
VEHICLE SPEED SENSOR 1
(Wire Breaking/Short Circuit)



AC: Alternating Current
TCM: Transmission Control Module

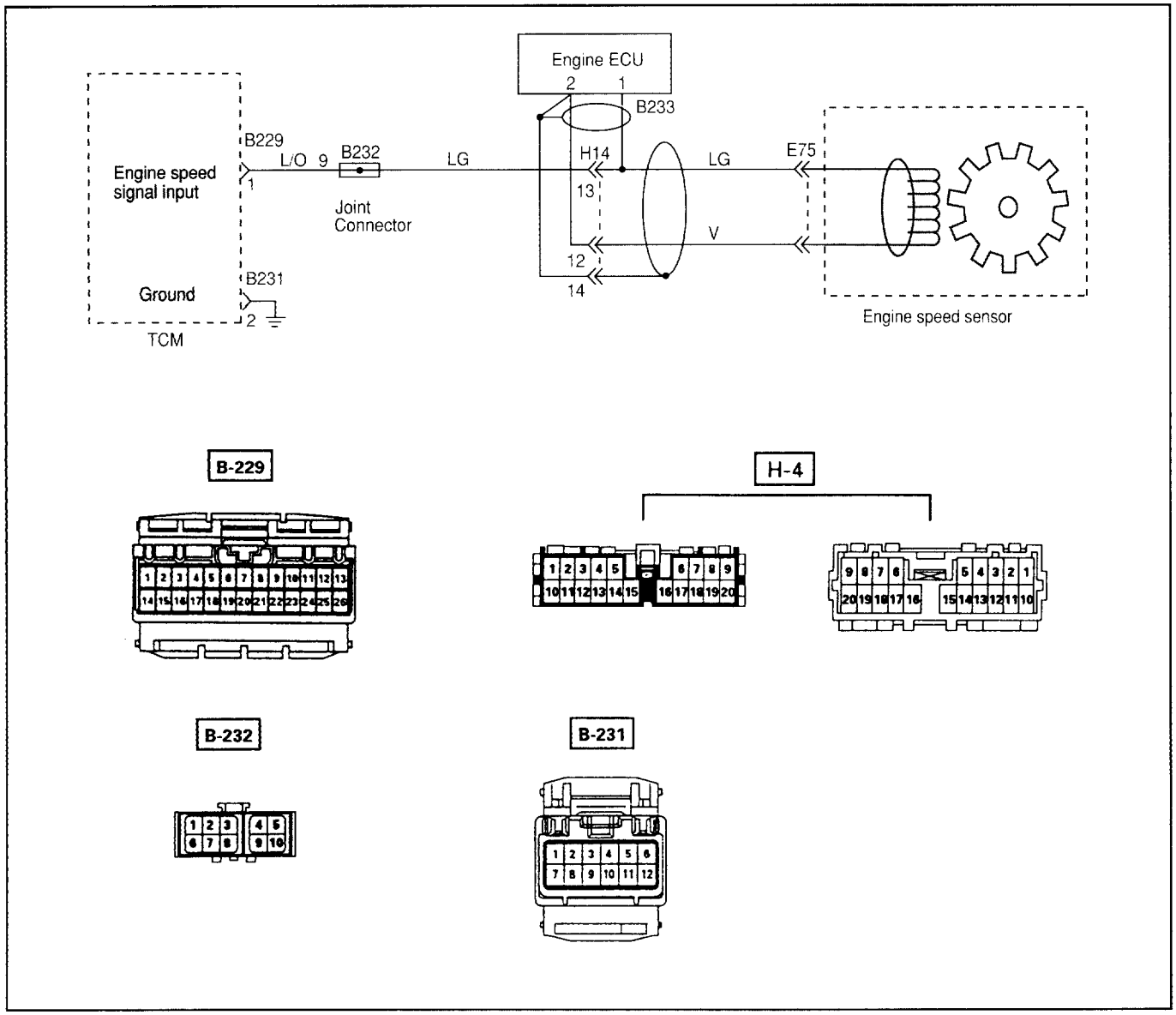
DIAGNOSTIC TROUBLE CODE (DTC) 13
ENGINE SPEED SENSOR
(Wire Breaking/Short Circuit)

Explanation of Circuit: Engine speed (RPM) signals are sent from the engine speed sensor to the Transmission Control Module (TCM).
The engine speed sensor is an electromagnetic pulse pickup type that generates signals when the fuel timing gear revolves (35 pulses at a single revolution of the timing gear).
The TCM converts these sine wave signals into engine speed (RPM) signals.

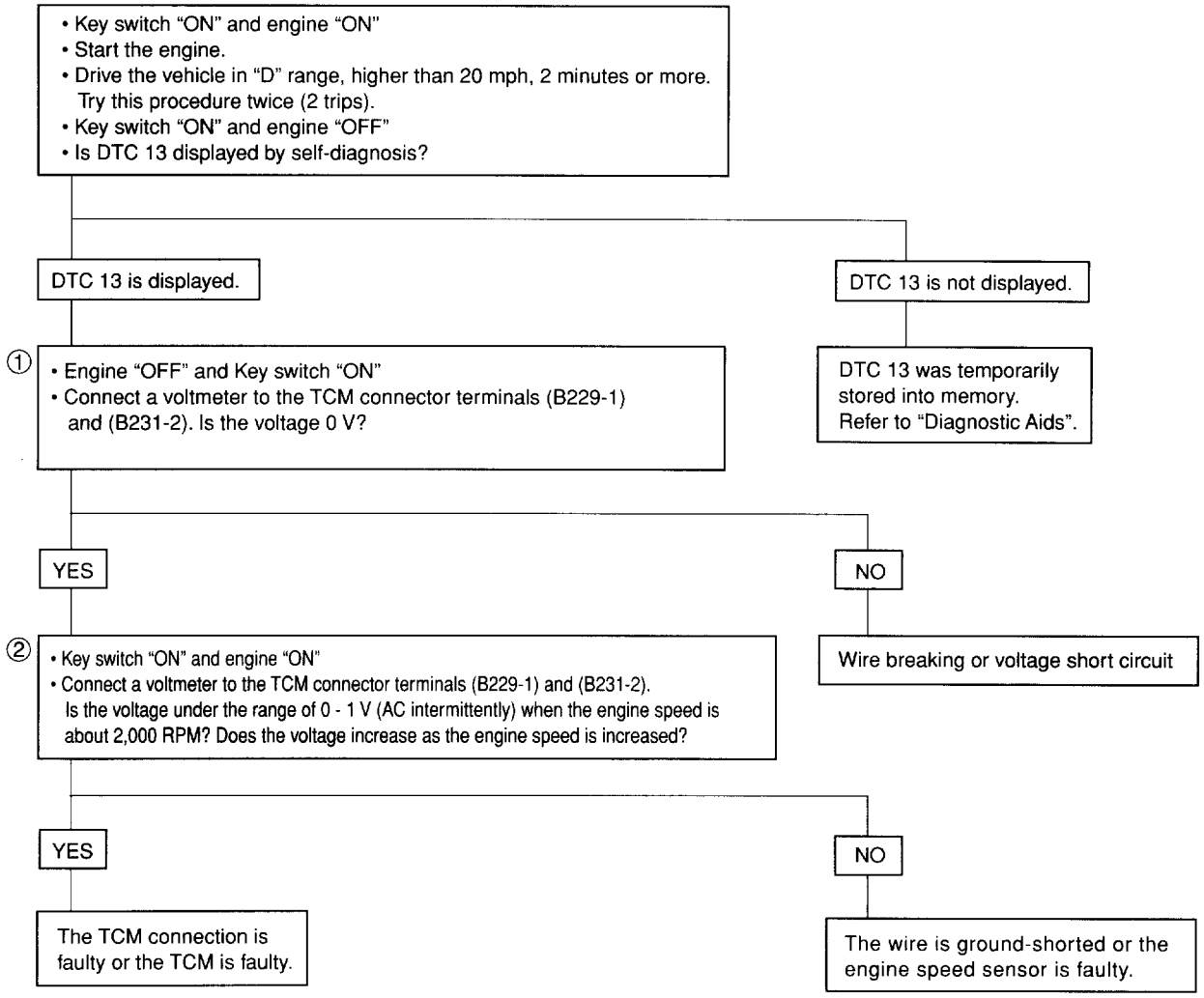
Explanation of Test: The following numbers correspond to the numbers enclosed with a circle in the diagnosis chart.
① Engine speed signals are input from the engine speed sensor into the TCM.
② When the engine speed is 2000 RPM, the voltage varies within the range of 0 to 1 V (AC intermittently).
The voltage increases in proportion to engine revolution speed.

Diagnostic Aids: A temporary failure may be caused by faulty connection, worn-away wire insulator or internal wire breaking of insulator. Check if any of the following conditions is provided in the TCM harness connector: Terminal positional shift, improper junction, lock damage, improper terminal shape or damage, faulty wire connection of terminal, and harness damage.

TCM Voltage Check: Refer to page 7A2-57.



DIAGNOSTIC TROUBLE CODE (DTC) 13
ENGINE SPEED SENSOR
(Wire Breaking/Short Circuit)



AC: Alternating Current
TCM: Transmission Control Module

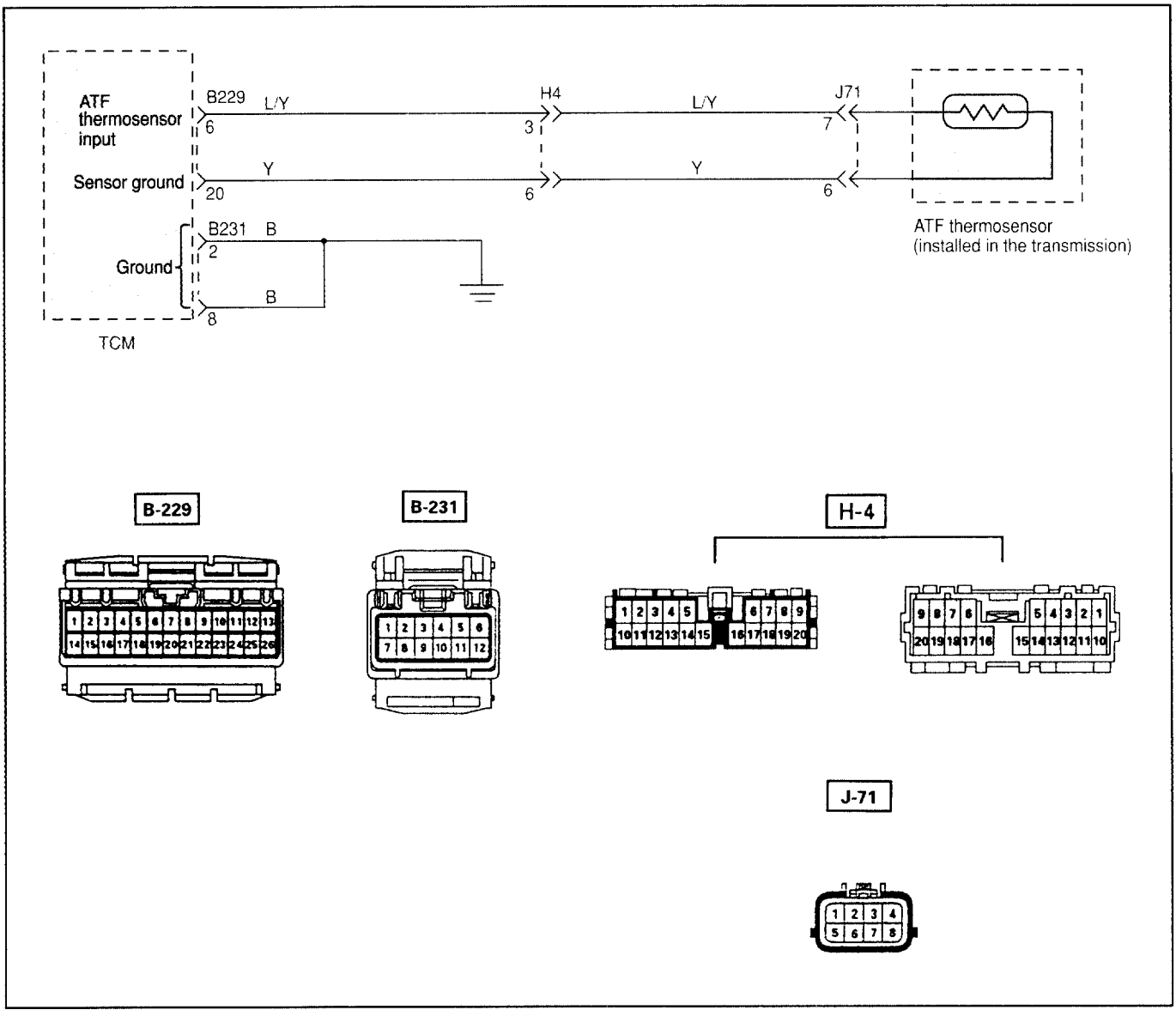
DIAGNOSTIC TROUBLE CODE (DTC) 15
AUTOMATIC TRANSMISSION FLUID (ATF) THERMOSENSOR
(Wire Breaking/Short Circuit or Voltage Drop)

Explanation of Circuit: The ATF thermosensor is a thermistor sensor that is installed in the transmission valve body and converts temperature changes into continuous electric signals, then outputs them to the Transmission Control Module (TCM). When the ATF temperature is low, the resistance of the sensor (thermistor) goes up, so that the voltage of the TCM signal becomes high.
As the ATF is gradually warmed, the resistance of the sensor goes down and the voltage becomes low. At the normal operating ATF temperature (80°C/176°F) of the transmission, the voltage of the TCM is about 0.4 V.

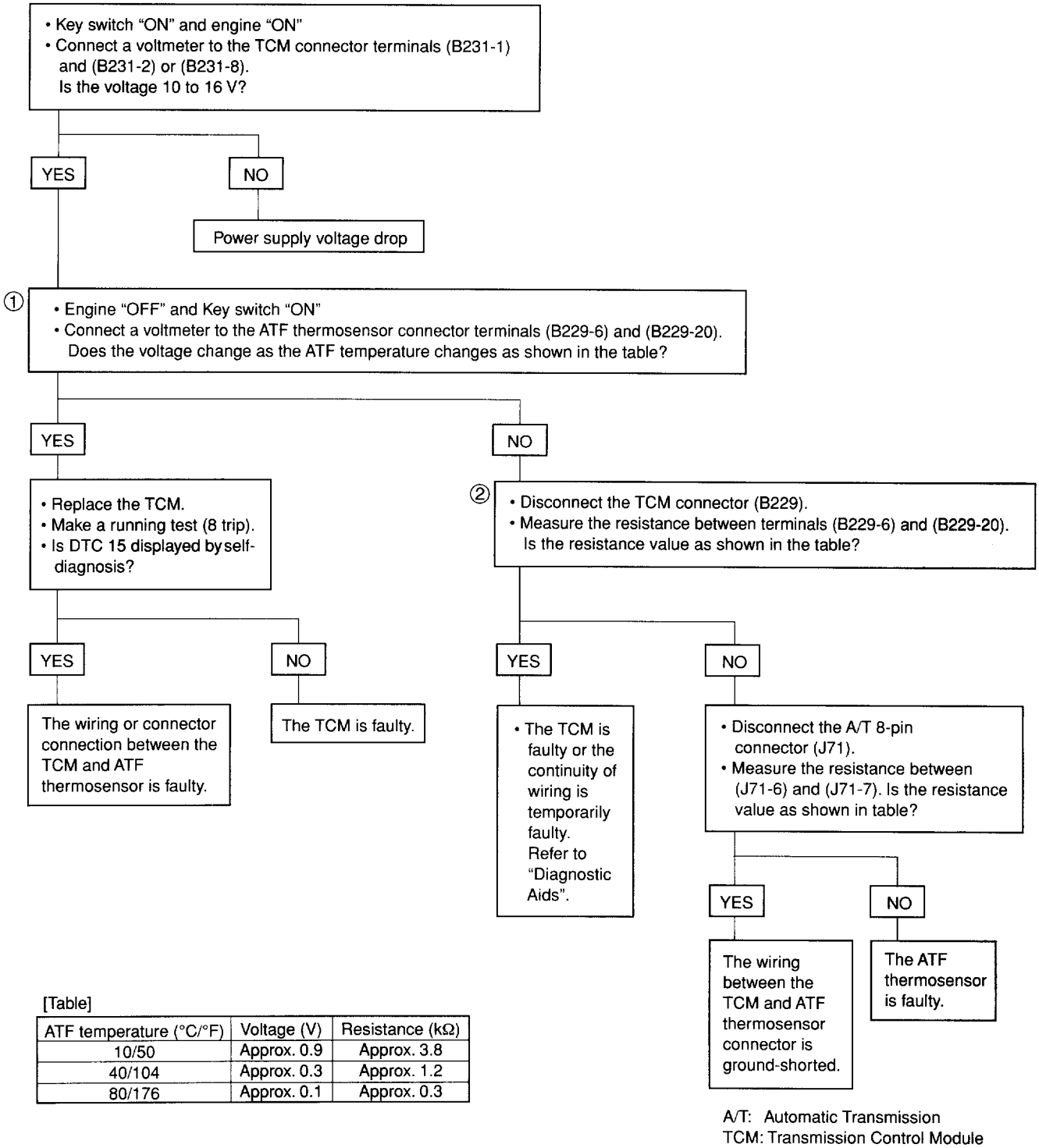
Explanation of Test: The following numbers correspond to the numbers enclosed with a circle in the diagnosis chart.
① Check that the voltage of the ATF thermosensor varies with ATF temperatures.
② Check that the resistance of the ATF thermosensor varies with ATF temperatures.

Diagnostic Aids: A temporary failure may be caused by faulty connection, worn-away wire insulator or internal wire breaking of insulator. Check if any of the following conditions is provided in the TCM harness connector: Terminal positional shift, improper junction, lock damage, improper terminal shape or damage, faulty wire connection of terminal, and harness damage.

TCM Voltage Check: Refer to pages 7A2-57.



DIAGNOSTIC TROUBLE CODE (DTC) 15 AUTOMATIC TRANSMISSION FLUID (ATF) THERMOSENSOR OR BATTERY BACK-UP VOLTAGE (Wire Breaking/Short Circuit or Voltage Drop)



[Table]

ATF temperature (°C/°F)	Voltage (V)	Resistance (kΩ)
10/50	Approx. 0.9	Approx. 3.8
40/104	Approx. 0.3	Approx. 1.2
80/176	Approx. 0.1	Approx. 0.3

A/T: Automatic Transmission
TCM: Transmission Control Module

DIAGNOSTIC TROUBLE CODE (DTC) 17
INHIBITOR SWITCH
(Wire Breaking or Multiplex Signal)

Explanation of Circuit: The inhibitor switch gives the signals related to the selector lever position (PRND21) to the Transmission Control Module (TCM). The inhibitor switch turns on when the select lever is shifted to the P, R, N, D, 2 or 1 range. The inhibitor switch, which is connected to the starter switch circuit, is available only when the select lever is in the P or N range.
The inhibitor switch is connected to the transmission manual shaft and installed in the transmission case.

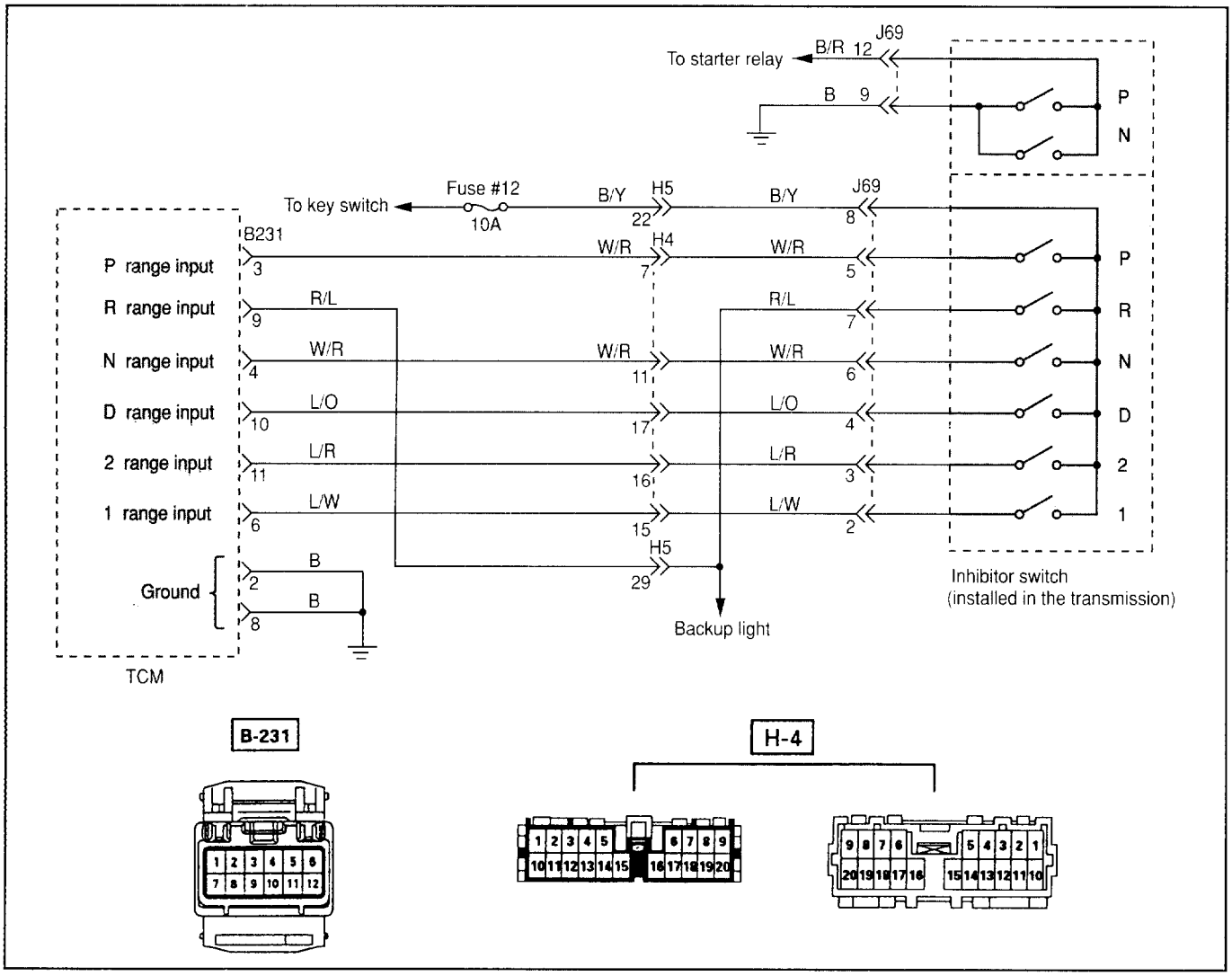
Explanation of Test: The following numbers correspond to the numbers enclosed with a circle in the diagnosis chart.

① It is judged whether the input signal received from the inhibitor switch by the TCM is proper or not.
② The power status of the inhibitor switch is checked.
③ The continuity between inhibitor switch terminals and the continuity of the wire connected to the solenoid are checked.

Diagnostic Aids: A temporary failure may be caused by faulty connection, worn-away wire insulator, internal wire breaking of insulator. Check if any of the following conditions is provided in the TCM harness connector: Terminal positional shift, improper junction, lock damage, improper terminal shape or damage, faulty wire connection of terminal, and harness damage.

CAUTION: Before continuing checking, adjust the shift linkage. After completion of the adjustment, clear DTCs and make a running test for the vehicle. Check that the trouble has been repaired by self-diagnosis.

TCM Voltage Check: Refer to pages 7A2-57.



DIAGNOSTIC TROUBLE CODE (DTC) 17
INHIBITOR SWITCH
(Wire Breaking or Multiplex Signal)

①
- Engine "OFF" and key switch "ON"
- Connect a voltmeter to the each terminal of the TCM connectors (B231) and grounding terminal (B231-2 or B231-8).
- Measure the voltage shifting the select lever to every position. (Comparison with Table 1)
- Is the displayed voltage at every position normal?

(Table 1)

⊖ Terminal	⊕ Terminal	Voltage (V)
B231-2 or B231-8	B231-3	10 - 16: P range 1 or less: Others than P range
	B231-9	10 - 16: R range 1 or less: Others than R range
	B231-4	10 - 16: N range 1 or less: Others than N range
	B231-10	10 - 16: D range 1 or less: Others than D range
	B231-11	10 - 16: 2 range 1 or less: Others than 2 range
	B231-6	10 - 16: 1 range 1 or less: Others than 1 range

YES

- Clear the memory.
- Make a running test. (greater than 30 sec)

Is DTC 17 displayed by self-diagnosis?

YES

The TCM is faulty or the continuity of wiring is temporarily faulty. Refer to "Diagnostic Aids".

NO

The continuity of wiring is temporarily faulty. Refer to "Diagnostic Aids".

NO

Is the displayed voltage at every position abnormal?

YES

②
- Check if there is any wire breaking in the fuse and wire connected to the connector terminal (J69-8) of the inhibitor switch.
- Check the adjusted condition of the inhibitor switch.
- If no fault is found, replace the inhibitor switch.

NO

③
- Disconnect the connectors (J69) of the inhibitor switch.
- Make a continuity check between inhibitor switch terminals with an ohmmeter. (Table 2) Is the result OK?

(Table 2)

Terminal / Range	J69 2	3	4	5	6	7	8	9	12
P				○			○	○	○
R						○	○		
N					○		○	○	○
D			○				○		
2		○					○		
1	○						○		

○—○ Continuity

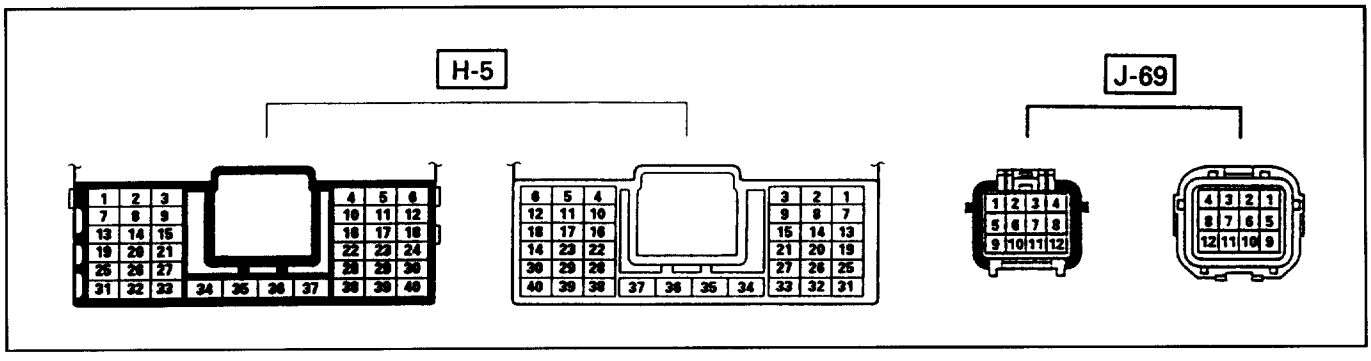
YES

Wire breaking or a short circuit between the TCM connector and the inhibitor switch connector.

NO

Replace the inhibitor switch.

TCM: Transmission Control Module



DIAGNOSTIC TROUBLE CODE (DTC) 21
THROTTLE POSITION (TP) SENSOR
(Wire Breaking/Short Circuit)

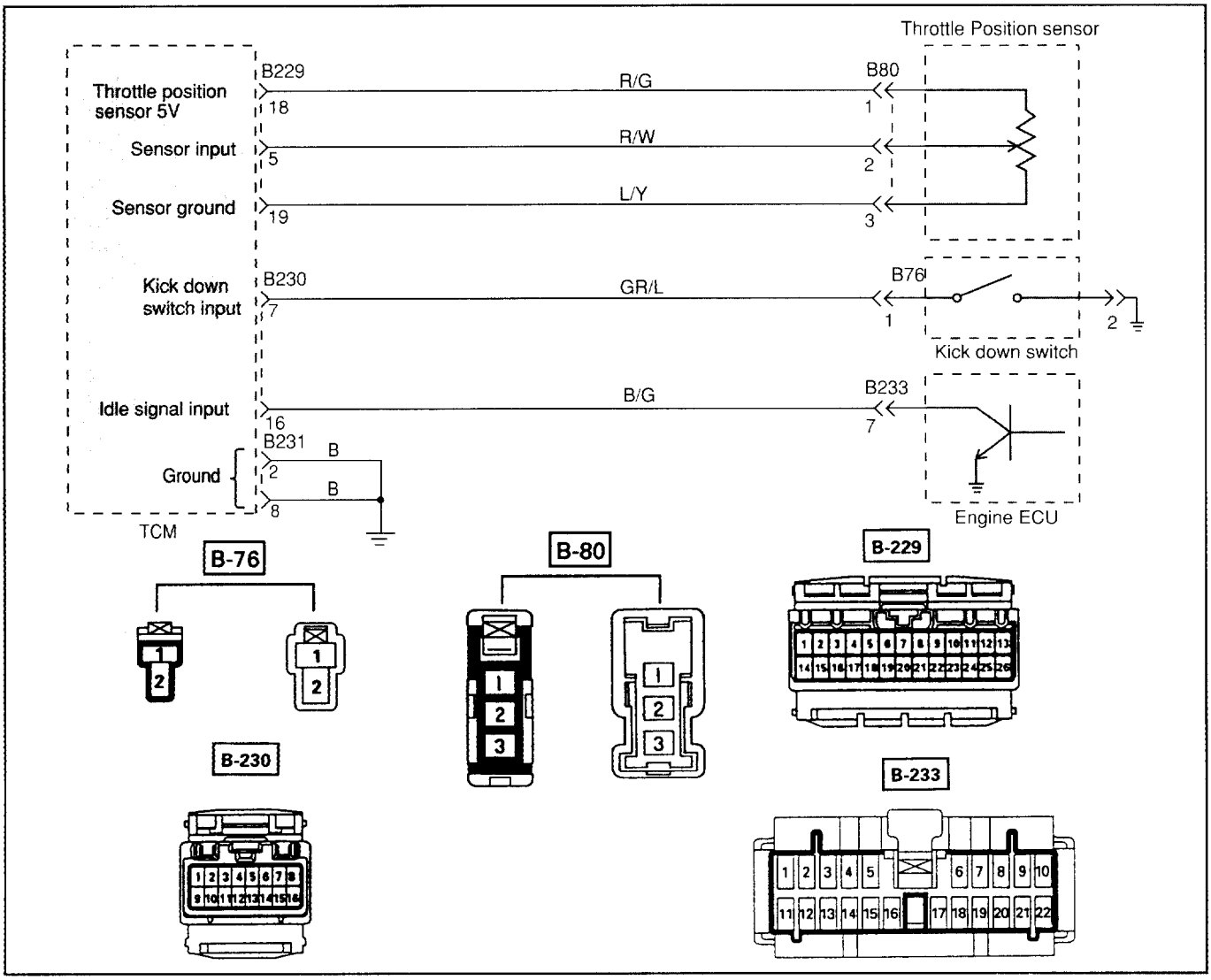
Explanation of Circuit: When the signal of the TP sensor installed in the accel pedal is supplied to the Transmission Control Module (TCM), the TCM judges the opening condition of the throttle.
The shift point of the transmission is determined by this opening condition of the throttle.

Explanation of Test: The following numbers correspond to the numbers enclosed with a circle in the diagnosis chart.

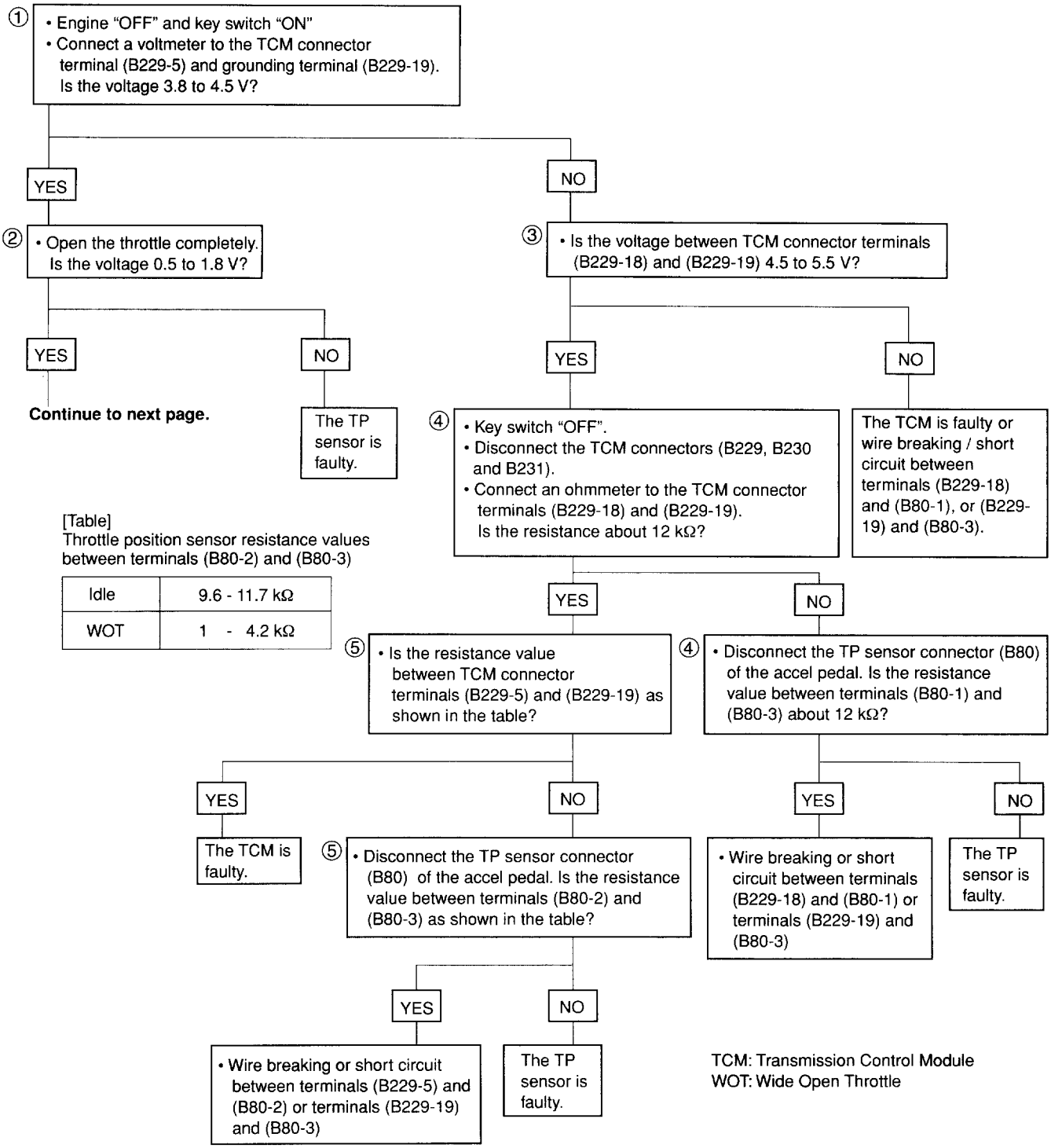
① Check that the throttle input voltage is 3.8 to 4.5 V.
② At this test, check that as the throttle opens, the voltage goes down and that the voltage reaches 1.0 to 2.2 V at the full open status.
③ Check the power supply voltage (4.5 - 5.5 V) of the TP sensor.
④ Check the resistance (about 12 kΩ) between the TP sensor power supply voltage terminal and grounding terminal.
⑤ Check the resistance (Idle: 9.6 - 11.7 kΩ, Wide open throttle: 1 - 42kΩ) between the TP sensor input terminal and grounding terminal.
⑥ Check that the kick down switch input voltage is 10 to 16 V.
⑦ Check that the idle signal input voltage is 10 to 16 V.

Diagnostic Aids: A temporary failure may be caused by faulty connection, worn-away wire insulator or internal wire breaking of insulator.
Check if any of the following conditions is provided in the TP sensor and TCM harness connector: Terminal positional shift, improper junction, lock damage, improper terminal shape or damage, faulty wire connection of terminal, and harness damage.

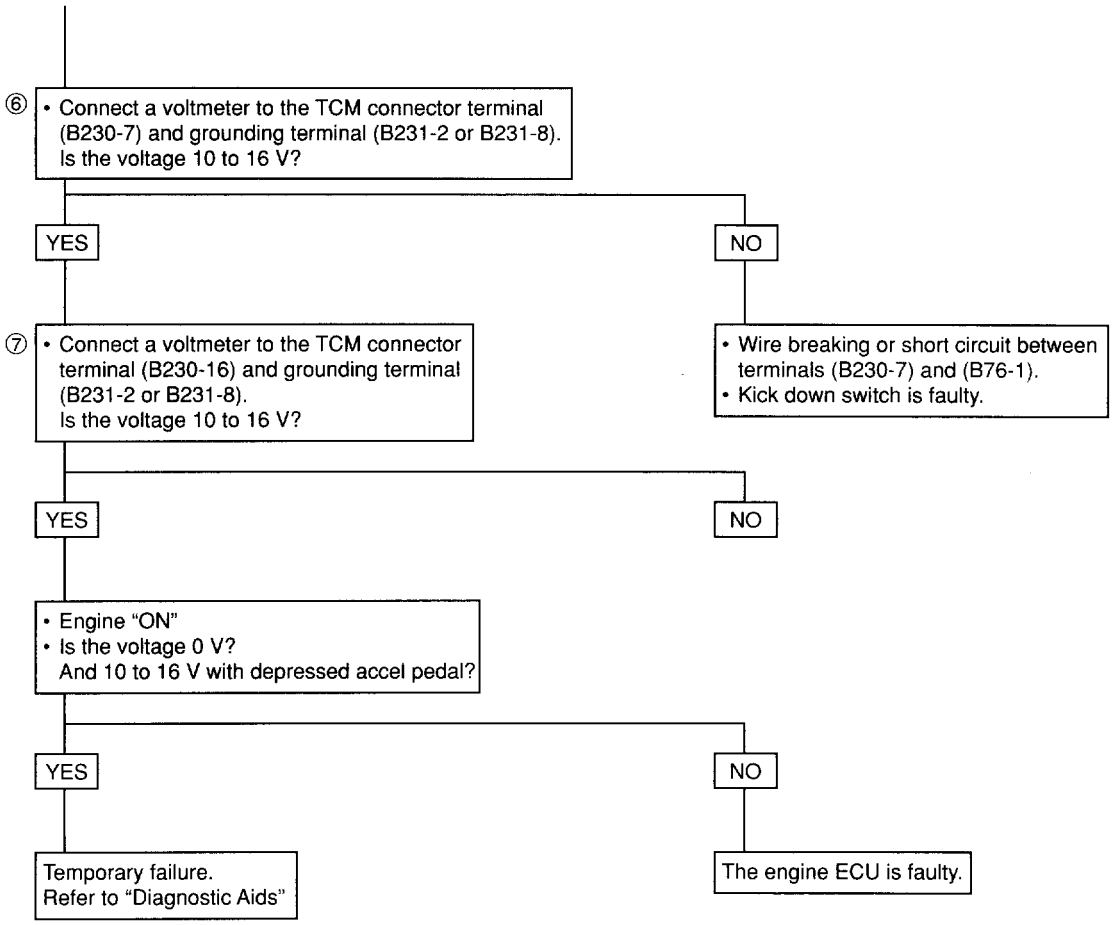
TCM Voltage Check: Refer to pages 7A2-57.



DIAGNOSTIC TROUBLE CODE (DTC) 21
THROTTLE POSITION (TP) SENSOR
(Wire Breaking/Short Circuit)



Continued


⑥
• Connect a voltmeter to the TCM connector terminal (B230-7) and grounding terminal (B231-2 or B231-8).
Is the voltage 10 to 16 V?
YES
NO
⑦
• Connect a voltmeter to the TCM connector terminal (B230-16) and grounding terminal (B231-2 or B231-8).
Is the voltage 10 to 16 V?
• Wire breaking or short circuit between terminals (B230-7) and (B76-1).
• Kick down switch is faulty.
YES
NO
• Engine "ON"
• Is the voltage 0 V?
And 10 to 16 V with depressed accel pedal?
YES
NO
Temporary failure.
Refer to "Diagnostic Aids"
The engine ECU is faulty.

DIAGNOSTIC TROUBLE CODE (DTC) 24
VEHICLE SPEED SENSOR 2
(Wire Breaking/Short Circuit)

Explanation of Circuit: Vehicle speed information is provided by the vehicle speed sensor 2 to the speedometer.
In the speedometer, the pulses of the speed sensor are converted to speed signals (pulses), and these signals are output to the Transmission Control Module (TCM). The TCM converts these pulse voltages to km/h (MPH) signals.

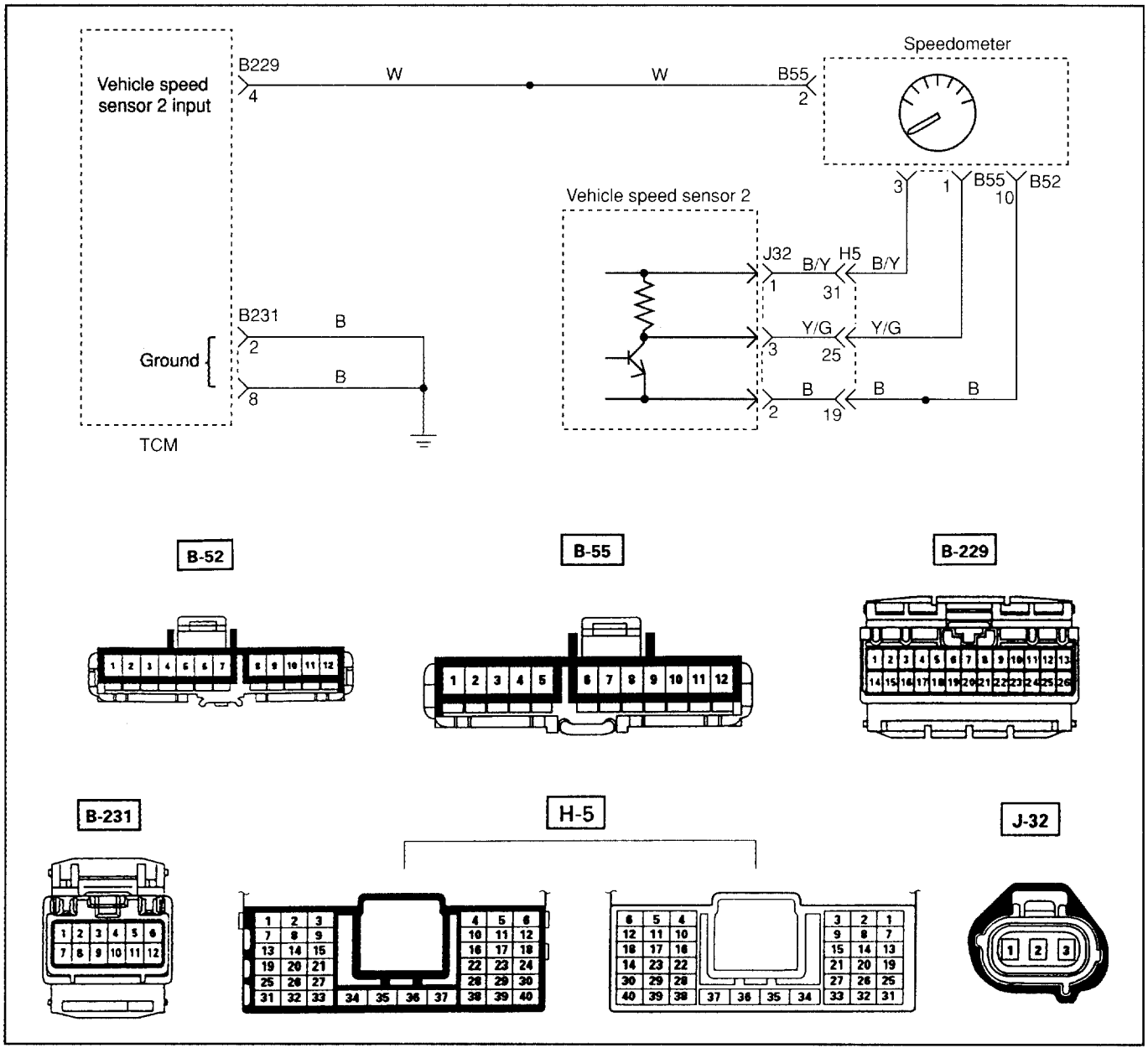
Explanation of Test: The following numbers correspond to the numbers enclosed with a circle in the diagnosis chart.

① The cause of DTC 24 setting is due to the operation fault of the speedometer.

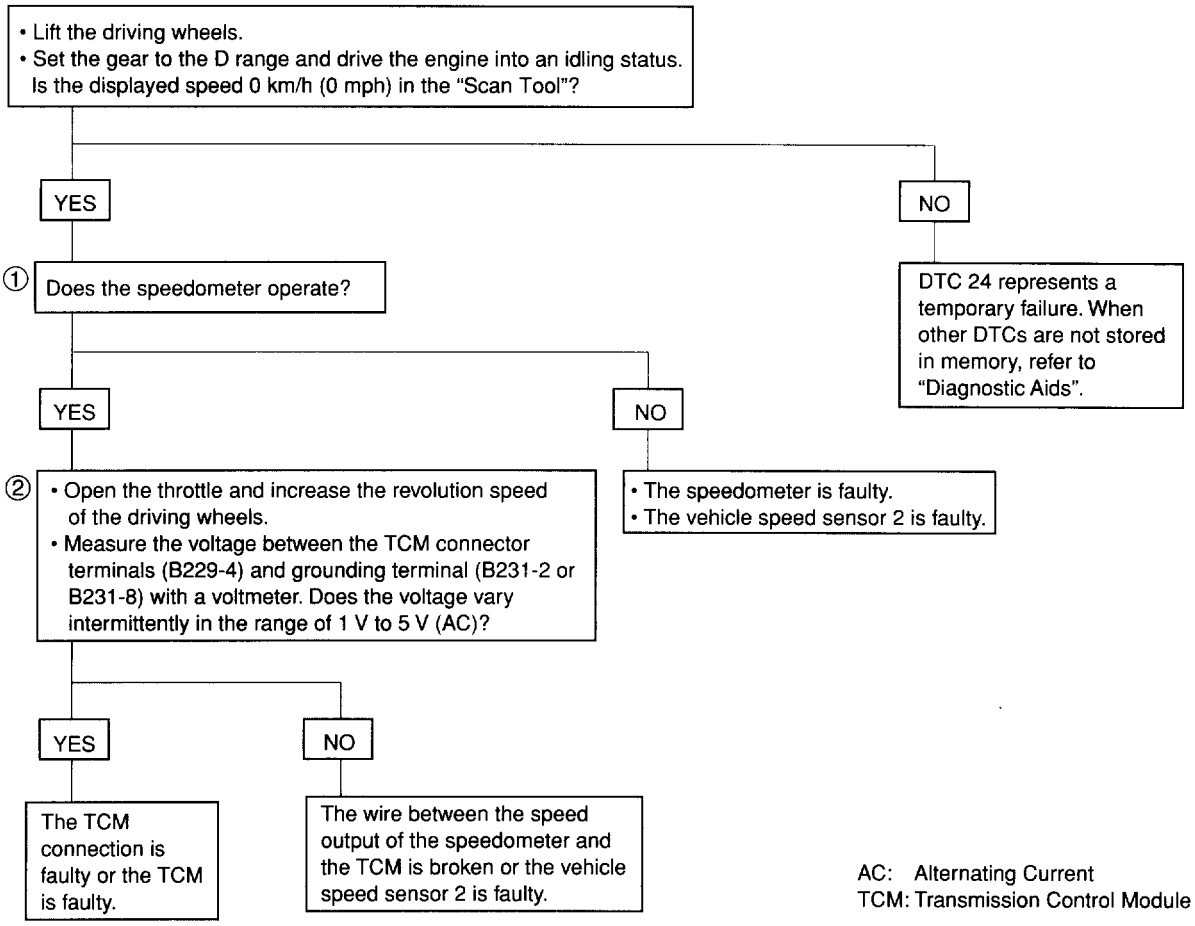
② Speed signals are output from the speedometer. The sensor power supply is given from the TCM.

Diagnostic Aids: A temporary failure may be caused by faulty connection, worn-away wire insulator or internal wire breaking of insulator. Check if any of the following conditions is provided in the output of the speedometer and the harness connector: Terminal positional shift, improper junction, lock damage, improper terminal shape or damage, faulty wire connection of terminal, and harness damage.

TCM Voltage Check: Refer to page 7A2-57.



DIAGNOSTIC TROUBLE CODE (DTC) 24
VEHICLE SPEED SENSOR 2
(Wire Breaking/Short Circuit)



AC: Alternating Current
TCM: Transmission Control Module

DIAGNOSTIC TROUBLE CODE (DTC) 31
No.1 SHIFT SOLENOID (S1)
(Wire Breaking/Short Circuit)

Explanation of Circuit: The No.1 shift solenoid (S1) changes the hydraulic route with the signals from the Transmission Control Module (TCM) according to the vehicle speed and the opening of the throttle in order to exert shift control. When the No.1 or No.2 shift solenoid (S1 or S2) fails, the hydraulic circuit is mechanically operated as a backup.

Explanation of Test: The following numbers correspond to the numbers enclosed with a circle in the diagnosis chart.

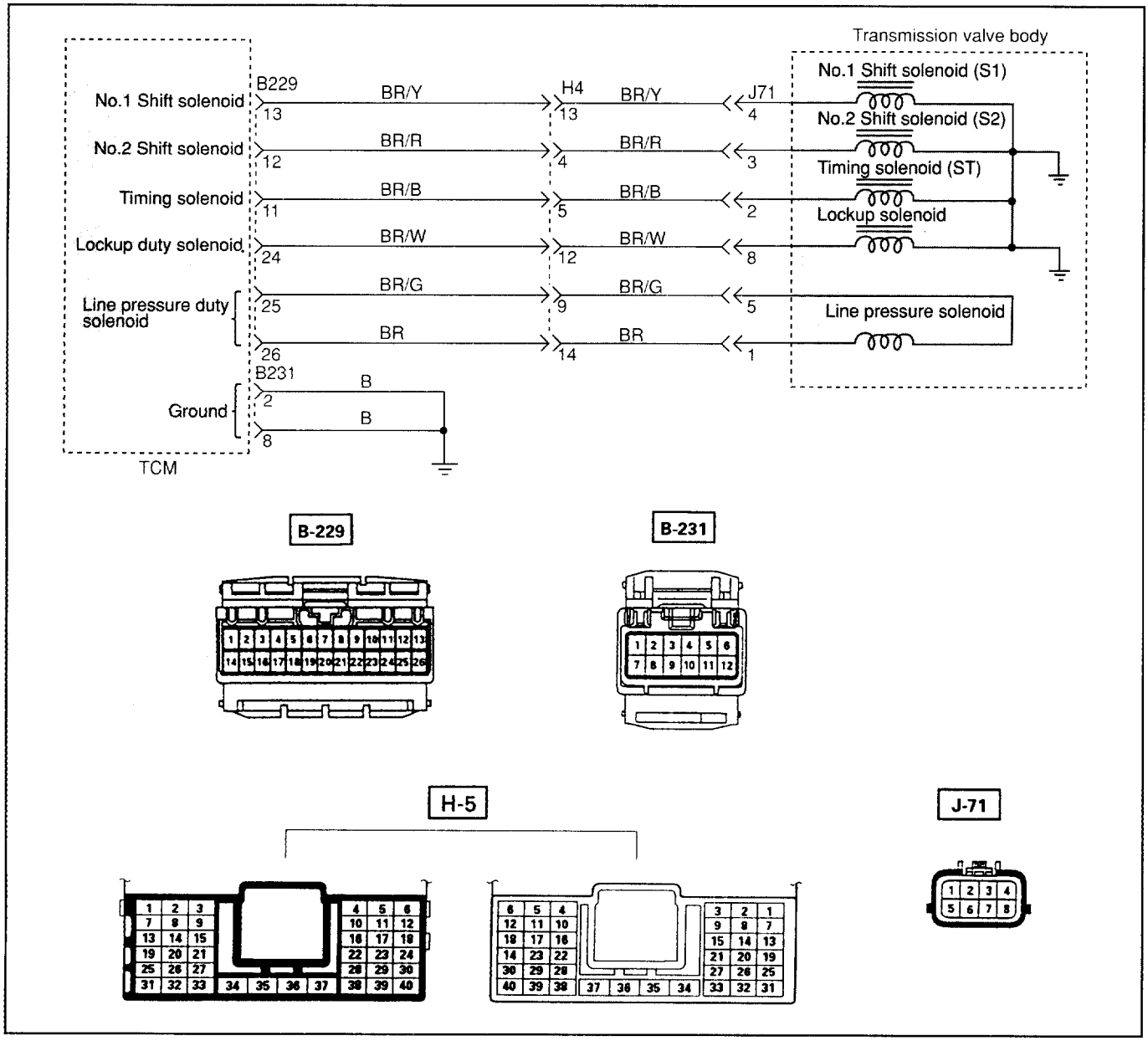
① When the key switch has been turned on, the voltage between the TCM terminals (B229-13) and (B231-2 or B231-8) is 10 to 16 V when it is measured with a voltmeter.

② When the driving wheels revolve with the 3rd gear, the voltage is 1 V or less.

③ The solenoid resistance is within the range of 10 to 20 Ω.

Diagnostic Aids: In case of faulty wire connection to the TCM terminal (B229-13), wire breaking or short circuit, DTC 31 is displayed.
A temporary failure may be cause by faulty connection, worn-away wire insulator or internal wire breaking of insulator.

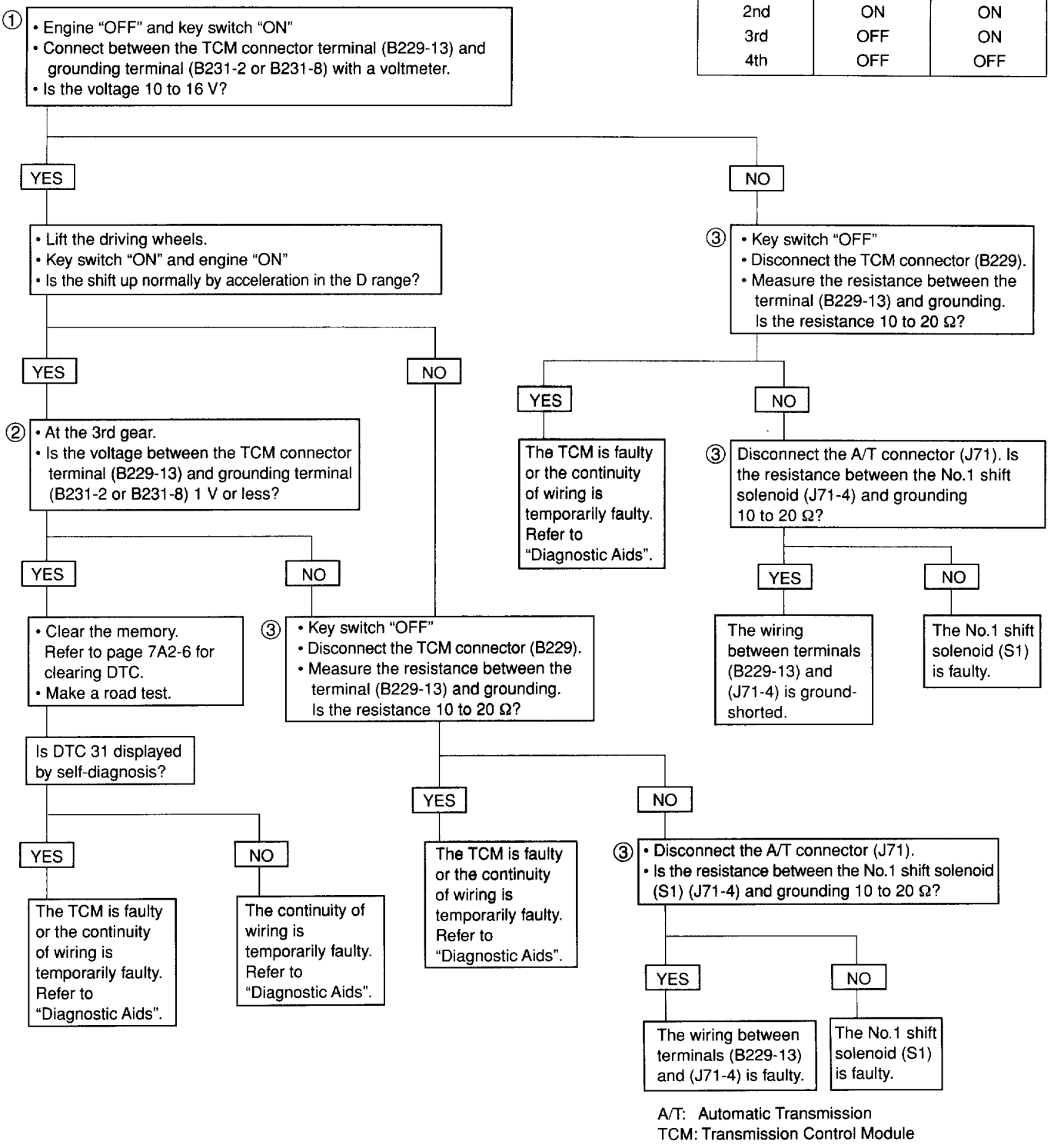
TCM Voltage Check: Refer to page 7A2-57.



DIAGNOSTIC TROUBLE CODE (DTC) 31
No.1 SHIFT SOLENOID (S1)
(Wire Breaking/Short Circuit)

Operating solenoid

Gear	S1	S2
1st	ON	OFF
2nd	ON	ON
3rd	OFF	ON
4th	OFF	OFF



A/T: Automatic Transmission
TCM: Transmission Control Module

DIAGNOSTIC TROUBLE CODE (DTC) 32
No.2 SHIFT SOLENOID (S2)
(Wire Breaking/Short Circuit)

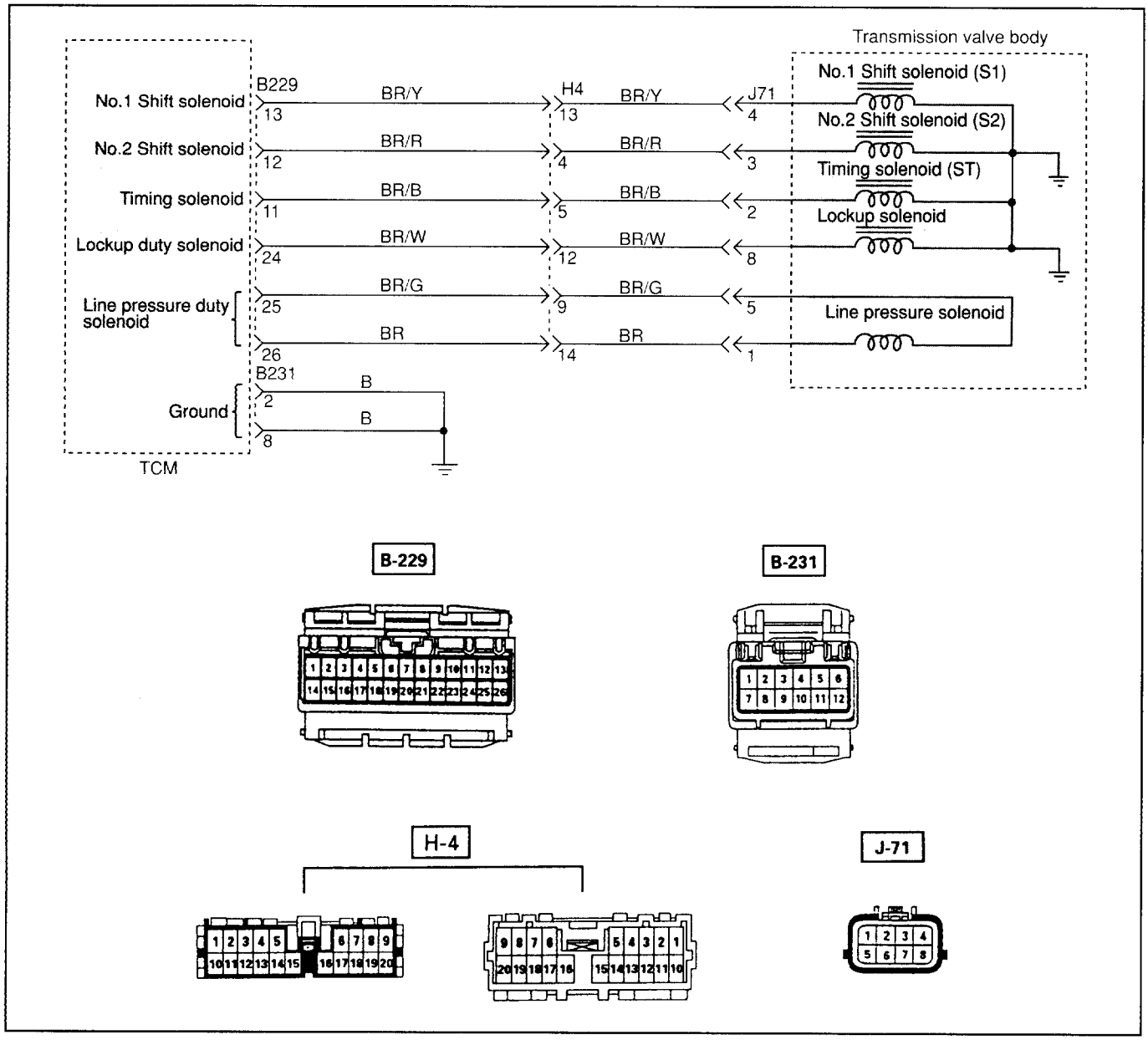
Explanation of Circuit: The No.2 shift solenoid (S2) changes the hydraulic route with the signals from the Transmission Control Module (TCM) according to the vehicle speed and the opening of the throttle in order to exert shift control.
When the No.1 or No.2 shift solenoid (S1 or S2) fails, the hydraulic circuit is mechanically operated as a backup.

Explanation of Test: The following numbers correspond to the numbers enclosed in a circle in the diagnosis chart.

① When the key switch has been turned on, the voltage between the TCM terminals (B229-12) and (B231-2 or B231-8) is 1V or less when it is measured with a voltmeter.
② When the driving wheels revolve with the 2nd gear, the voltage is 1 V or less.
③ The resistance of the solenoid is in the range of 10 to 20 Ω.

Diagnostic Aids: In case of faulty wire connection to the TCM terminal (B229-12), wire breaking or short circuit, DTC 32 is displayed.
A temporary failure may is caused by faulty connection, worn-away wire insulator, or internal wire breaking of insulator.

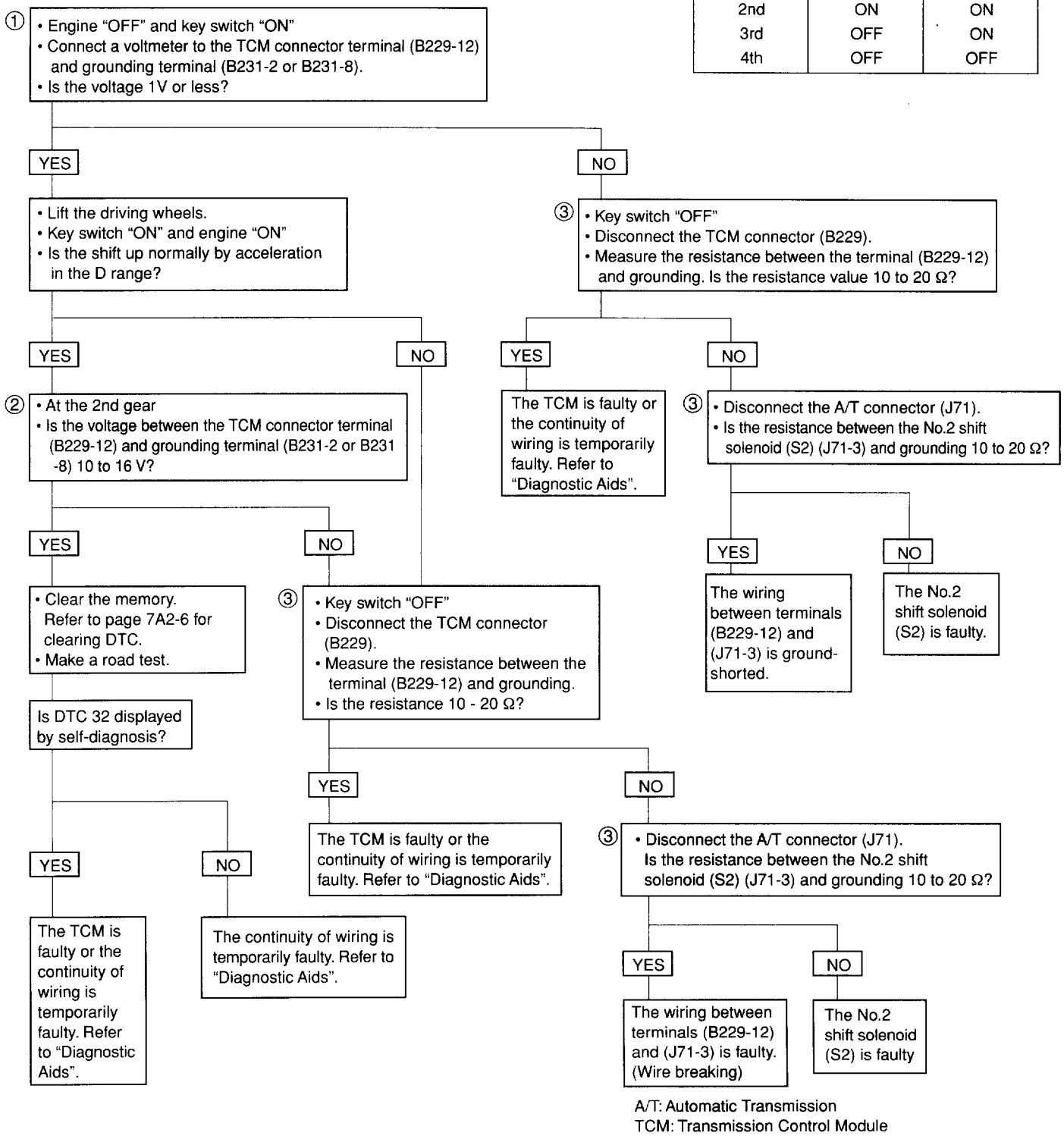
TCM Voltage Check: Refer to page 7A2-57.



DIAGNOSTIC TROUBLE CODE (DTC) 32
No.2 SHIFT SOLENOID (S2)
(Wire Breaking/Short Circuit)

Operating solenoid

Gear	S1	S2
1st	ON	OFF
2nd	ON	ON
3rd	OFF	ON
4th	OFF	OFF



A/T: Automatic Transmission
TCM: Transmission Control Module

DIAGNOSTIC TROUBLE CODE (DTC) 33
TIMING SOLENOID (ST)
(Wire Breaking/Short Circuit)

Explanation of Circuit: When shifting 1st to 2nd, 2nd to 3rd, or 3rd to 2nd, timing solenoid (ST) turns on. It controls the orifice of the 2nd brake (B0) and reduces the shift shock.

Explanation of Test: The following numbers correspond to the numbers enclosed with a circle in the diagnosis chart.

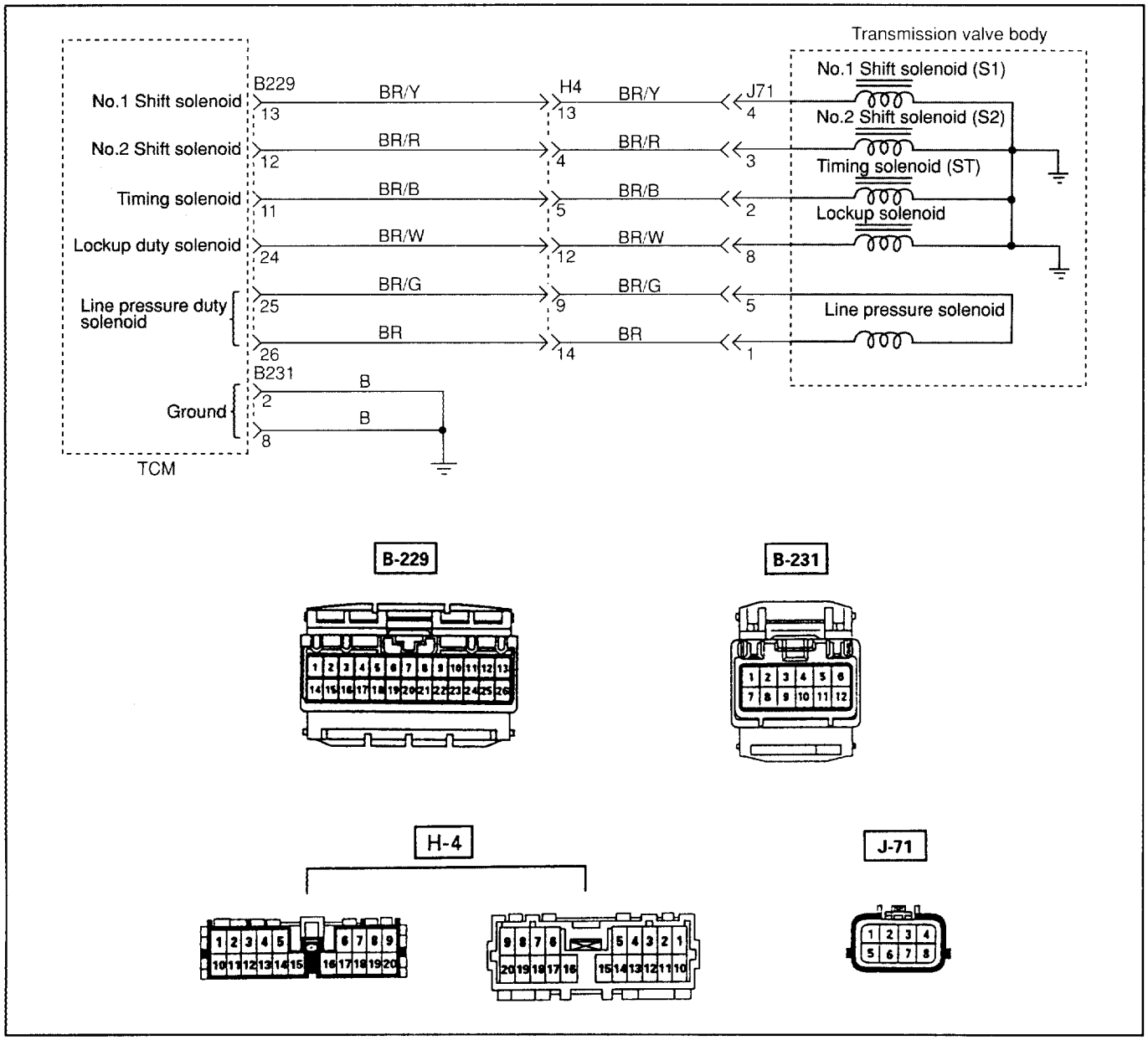
① When the timing solenoid (ST) is ON, the voltage between the TCM terminals (B229-11) and (B48-13 or B48-14) is 10 to 16 V.

② When the timing solenoid (ST) is OFF, the voltage between the TCM terminals (B229-11) and (B231-2 or B231-8) is 1 V or less.

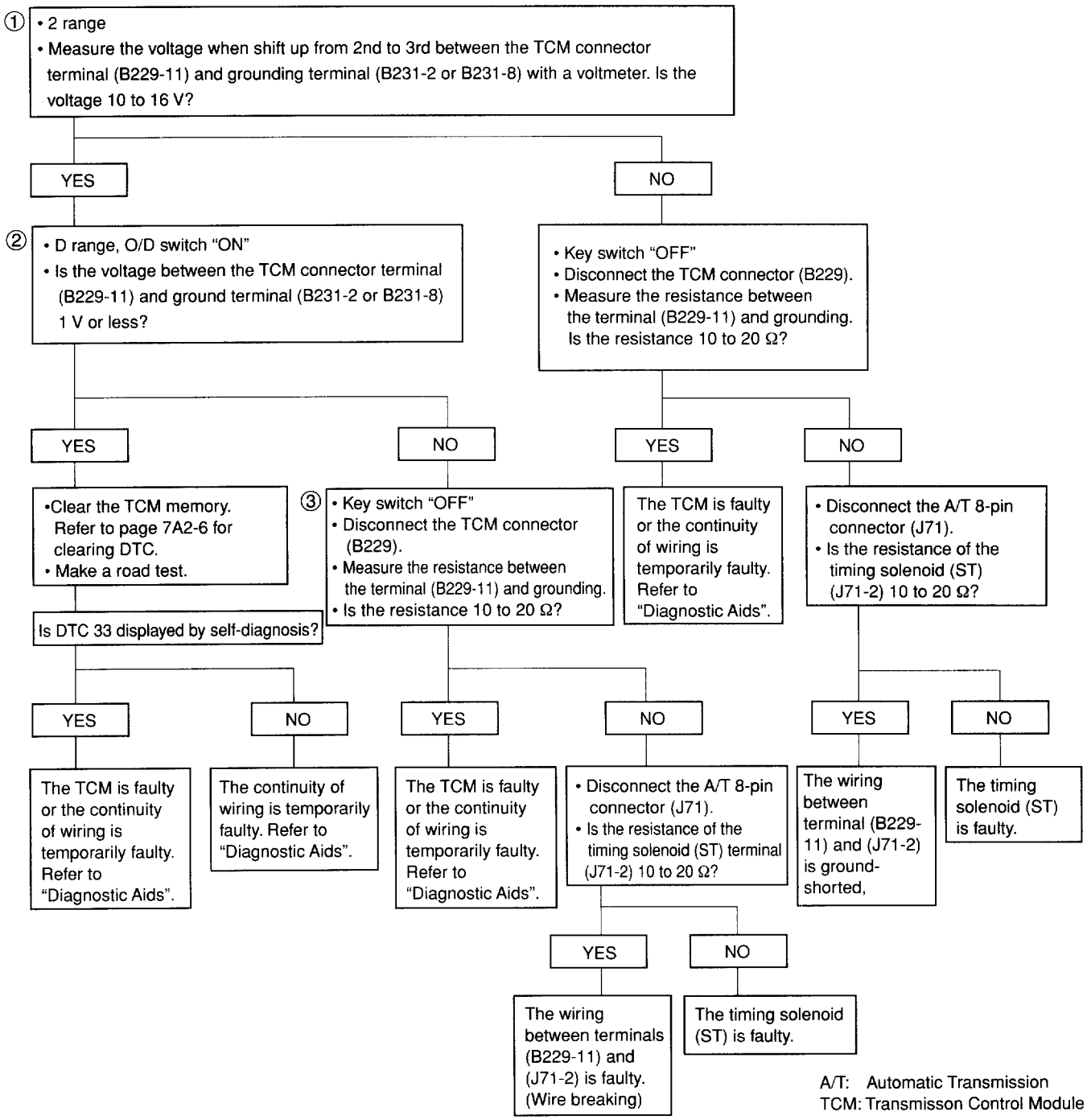
③ The resistance of the timing solenoid is 10 to 20 Ω.

Diagnostic Aids: In case of faulty wire connection to the TCM terminal (B229-11), wire breaking or short circuit, DTC 33 is displayed.
A temporary failure may be caused by faulty connection, worn-away wire insulator or internal wire breaking of insulator.

TCM Voltage Check: Refer to page 7A2-57.



DIAGNOSTIC TROUBLE CODE (DTC) 33
TIMING SOLENOID (ST)
(Wire Breaking/Short Circuit)



A/T: Automatic Transmission
TCM: Transmisson Control Module

DIAGNOSTIC TROUBLE CODE (DTC) 34
LOCK-UP SOLENOID
(Wire Breaking/Short Circuit)

Explanation of Circuit: The lock-up solenoid of the Torque Converter Clutch (TCC) aims at controlling the lock-up clutch when the vehicle runs.
This function can improve the fuel cost to almost the same extent as the manual transmission. The lock-up solenoid is put into battery voltage by the Transmission Control Module (TCM), so that the solenoid is actuated with the result of lock-up.

Explanation of Test: The following numbers correspond to the numbers enclosed with a circle in the diagnosis chart.

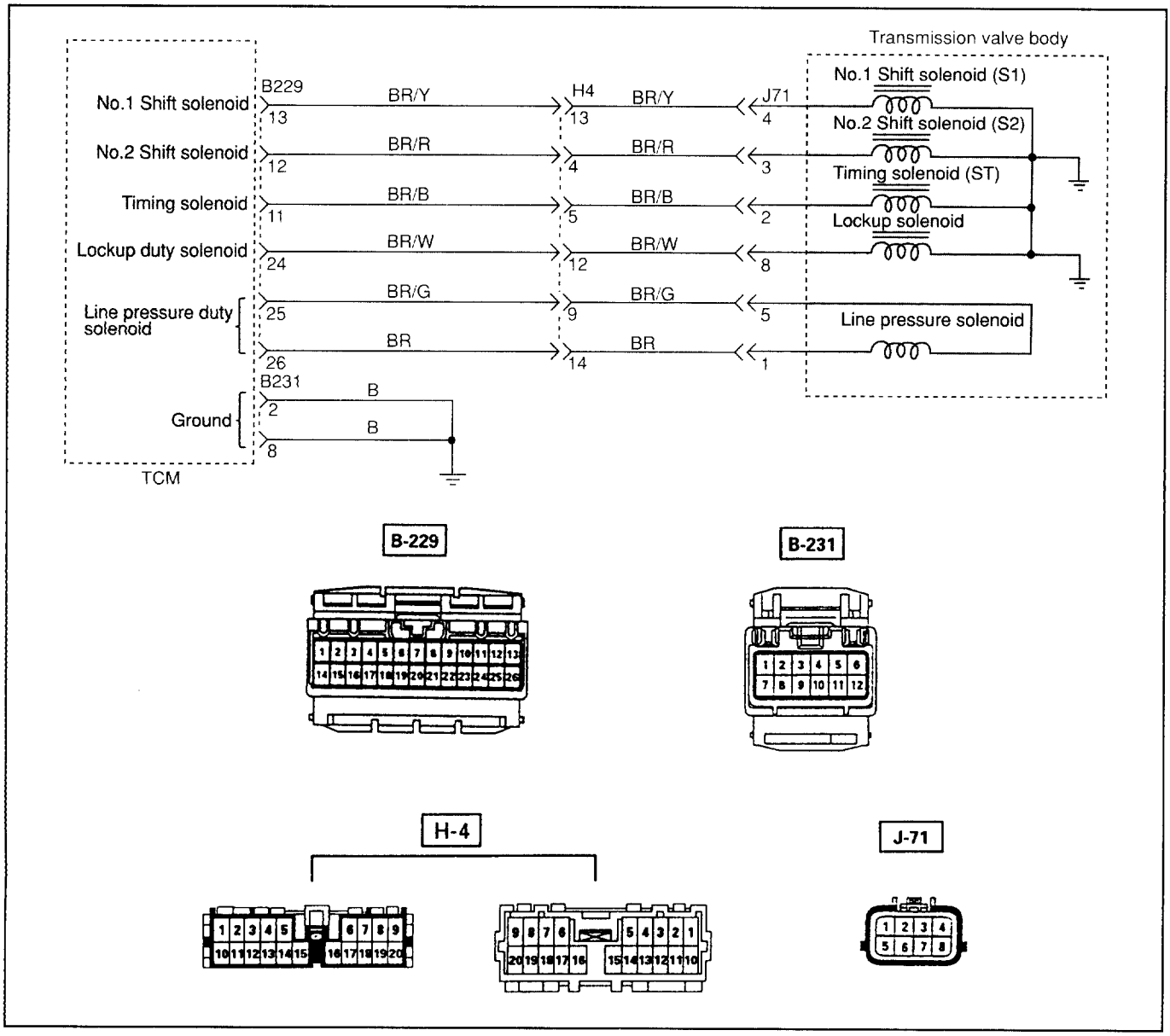
① When the key switch is ON, the voltage between the TCM connector terminals (B229-24) and (B231-2 or B231-8) is 1.0 V or less.

② When the 3rd gear in the D range and the Throttle Position (TP) sensor is about 50% at a higher speed than about 65 km/h (41 mph) at the final gear ratio 5.857, the TCM supplies 10 to 16 V, so that the lock-up duty solenoid is actuated with the result of lock-up.

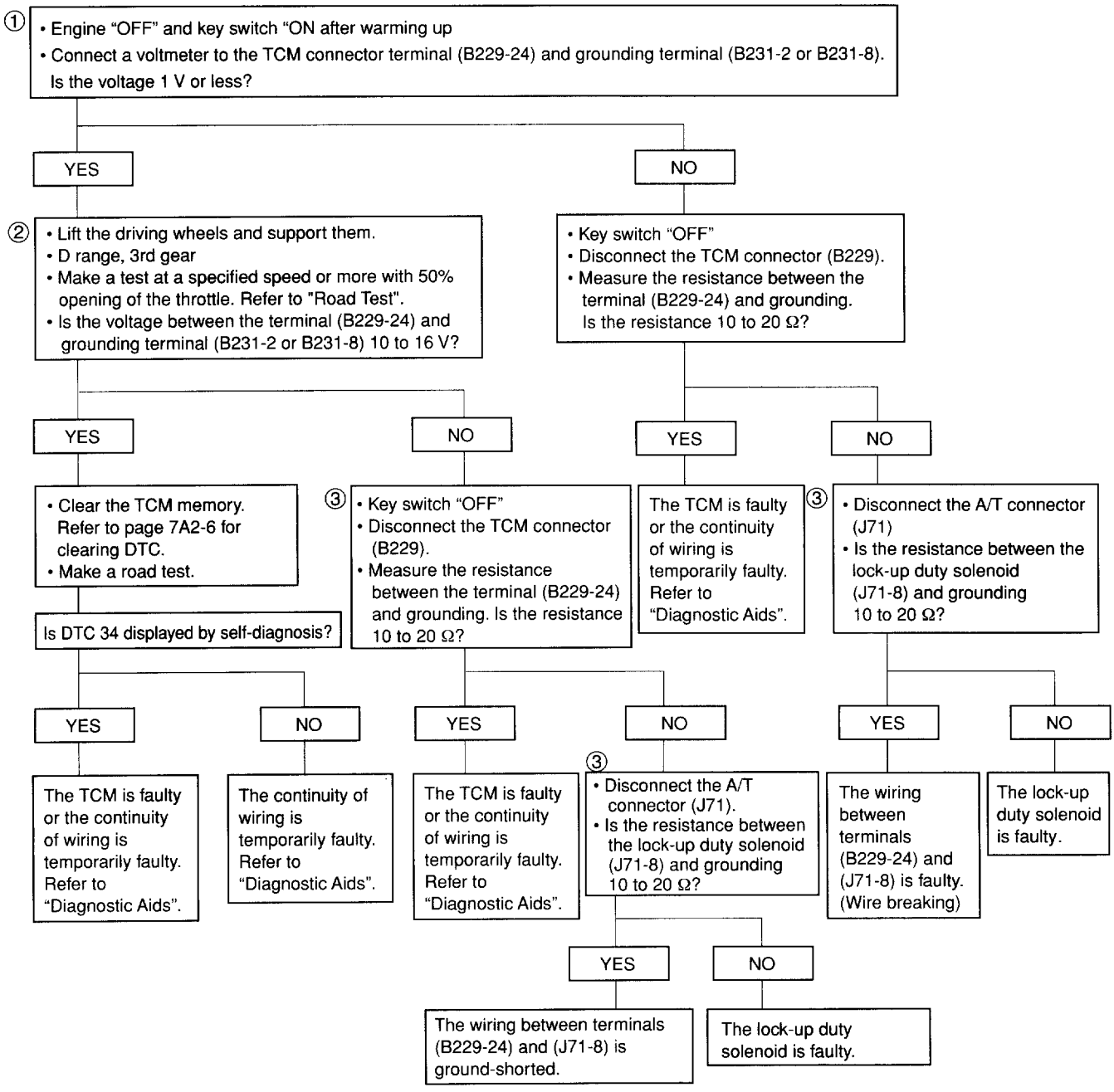
③ The resistance of the lock-up duty solenoid is 10 to 20 Ω.

Diagnostic Aids: In case of faulty wire connection to the TCM terminal (B229-24), wire breaking or short circuit, DTC 34 is displayed. A temporary failure may be caused by faulty connection, worn-away wire insulator or internal wire breaking of insulator.

TCM Voltage Check: Refer to page 7A2-57.



DIAGNOSTIC TROUBLE CODE (DTC) 34
LOCK-UP SOLENOID
(Wire Breaking/Short Circuit)



A/T: Automatic Transmission
TCM: Transmission Control Module

DIAGNOSTIC TROUBLE CODE (DTC) 35
LINE PRESSURE SOLENOID
(Wire Breaking/Short Circuit)

Explanation of Circuit: The Transmission Control Module (TCM) outputs signals to the line pressure duty solenoid to control the line pressure of the transmission. With the operation of this solenoid, the operation and shift of the hydraulic circuit in the transmission can be performed smoothly. The line pressure solenoid is controlled according to the inhibitor switch, vehicle speed and throttle position sensor signal.

Explanation of Test: The following numbers correspond to the numbers enclosed with a circle in the diagnosis chart.

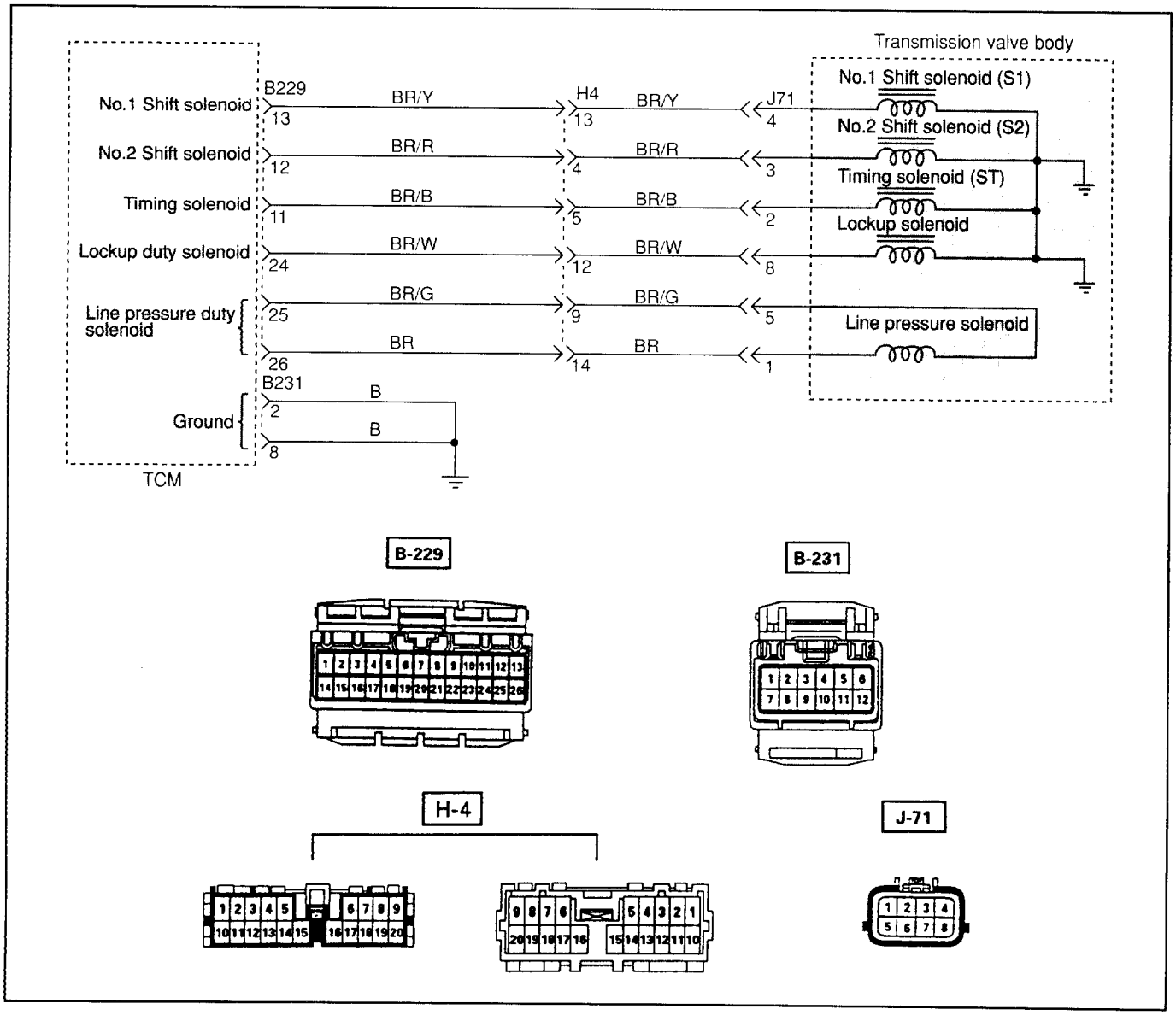
① When the key switch is ON, the voltage between TCM terminals (B229-26) and (B229-25) is 3.3 to 5.5 V.

② As the throttle opens gradually, the voltage between TCM terminals (B229-26) and (B229-25) goes down. (When the throttle is completely open, the voltage is 1.0 to 1.7 V)

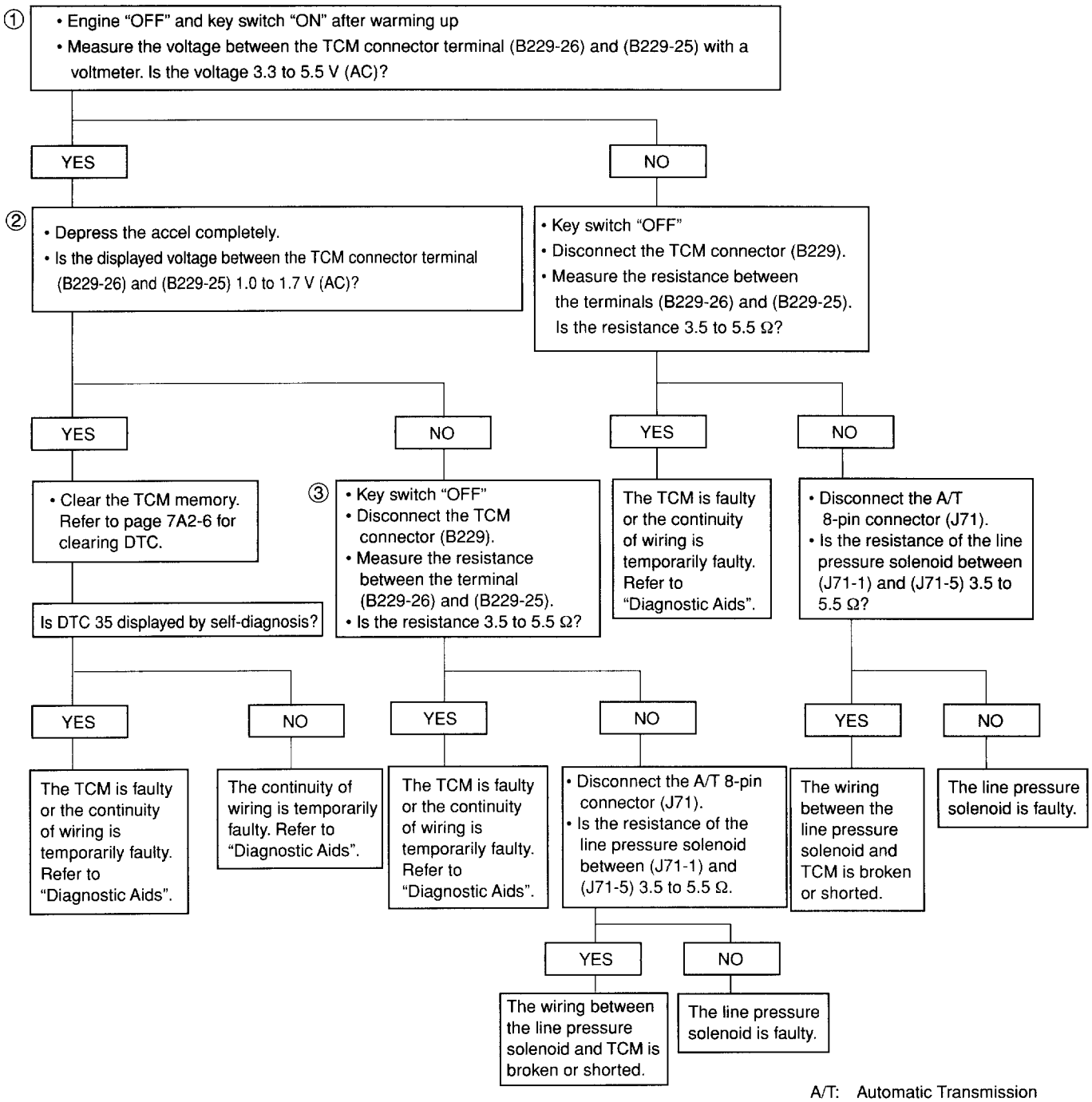
③ The resistance of the line pressure solenoid is 3.5 to 5.5 Ω.

Diagnostic Aids: In case of faulty wire connection to the TCM terminal (B229-26 or B229-25), wire breaking or short circuit, DTC 35 is displayed.
A temporary failure may be caused by faulty connection, worn-away wire insulator or internal wire breaking of insulator.

TCM Voltage Check: Refer to page 7A2-57.



DIAGNOSTIC TROUBLE CODE (DTC) 35
LINE PRESSURE SOLENOID
(Wire Breaking/Short Circuit)



A/T: Automatic Transmission
TCM: Transmission Control Module

DIAGNOSTIC TROUBLE CODE (DTC) 37
EXHAUST BRAKE CUT SYSTEM
(Wire Breaking/Short Circuit)

Explanation of Circuit: The TCM sends the exhaust brake cut signal, the exhaust brake cut relay acts on the exhaust brake magnetic valve to OFF when the selector position is "P", "N" range or when the vehicle speed is slow.
In addition, when the lock-up (ON →OFF) is activate, the TCM sends the exhaust brake cut signal instantaneously.

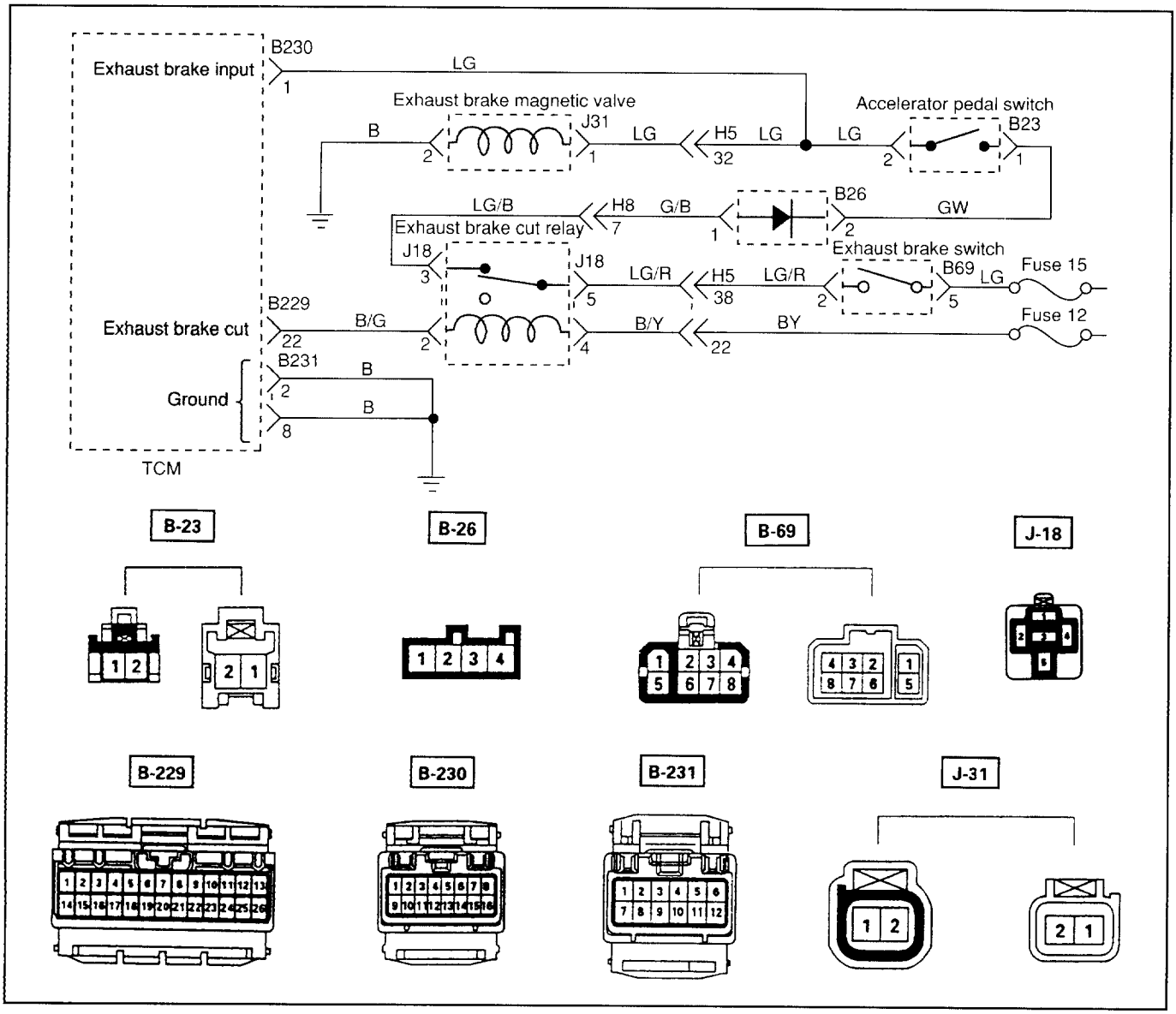
Explanation of Test: The following numbers correspond to the numbers enclosed with a circle in the diagnosis chart.

① When the exhaust brake cut relay is INACTIVE, the voltage between the TCM terminal (B229-22) and (B231-2 or B231-8) is 10 to 16 V.

② When the exhaust brake cut relay is ACTIVE, the voltage between the TCM terminal (B230-1) and grounding is 1V or less.

Diagnostic Aids: A temporary failure may be caused by faulty connection, worn-away wire insulator or internal wire breaking of insulator.
Check if any of the following conditions is provided in the TCM harness connector: Terminal positional shift, improper junction, lock damage, improper terminal shape or damage, faulty wire connection of terminal, and harness damage.

TCM Voltage Check: Refer to pages 7A2-57.



DIAGNOSTIC TROUBLE CODE (DTC) 37
EXHAUST BRAKE CUT SYSTEM
(Wire Breaking/Short Circuit)

① • Vehicle is running in "D" range at a speed of 6km/h (10 mph) or more.
• Exhaust brake switch is "ON".
• Measure the voltage between the TCM connector terminal (B229-22) and grounding terminal (B231-2 or B231-8) with a voltmeter. Is the voltage 10 to 16 V?

YES

② • Key switch "OFF"
• Connect a wire between the TCM connector terminal (B229 -22) and (B231-2 or B231-8)
• Shift "P" range. Engine "ON"
• Exhaust brake switch "ON"
• Measure the voltage between the TCM connector terminal (B230-1) and grounding. Is the voltage 1V or less?

YES

The TCM is faulty or the continuity of wiring is temporarily faulty. Refer to "Diagnostic Aids".

NO

• Key switch "OFF"
• Disconnect the exhaust brake cut relay
• Key switch "ON"
• Measure the voltage between the terminal (J18-3) and grounding. Is the voltage 1V or less?

YES

The exhaust brake cut relay is faulty.

NO

The wiring between the terminal (J18-3) and (B230-1) or magnetic valve is shorted to voltaged wire.

NO

• Key switch "OFF"
• Disconnect the exhaust brake cut relay.
• Key switch "ON"
• Measure the voltage between the terminal (J18-4) and grounding. Is the voltage 10 to 16V?

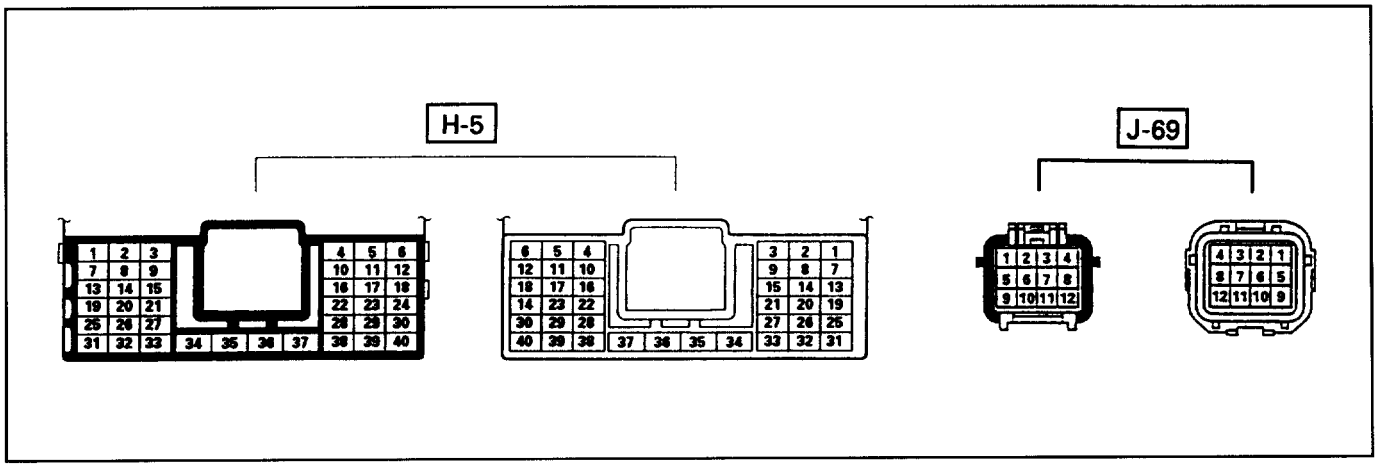
YES

The exhaust brake cut relay is faulty or the continuity of wiring is temporarily faulty. Refer to "Diagnostic Aids".

NO

Wire breaking or a short circuit between the fuse-12 and the terminal (J18-4) or the fuse-12 blow out.

A/T: Automatic Transmission
TCM: Transmission Control Module



DIAGNOSIS BASED ON VEHICLE CONDITION

ON-VEHICLE SERVICE ITEM

Faulty symptom \ Check position	ATF level and condition	Control linkage	Inhibitor switch	Throttle position sensor	Vehicle speed sensor	Engine speed sensor	Engine idling revolution	Line pressure solenoid	No.1 shift solenoid (S1)	No.2 shift solenoid (S2)	Timing solenoid (ST)	Lock-up solenoid	Starter circuit	O/D OFF switch	Exhaust brake switch	Idle signal	Kick-down switch	TCM	Torque converter
VEHICLE MOVEMENT																			
Vehicle does not run at "R"									1	1								2	
Vehicle does not move at every range	1	1						1											2
Vehicle moves at "P"		1																	
Parking gear does not release when selector is moved from "P"		1																	
Vehicle moves at "N"		1																	
ABNORMAL GEAR CHANGE																			
Does not upshift from 1st to 2nd		1	1		3					2								3	
Does not upshift from 2nd to 3rd		1	1		3				2									3	
Does not upshift from 3rd to 4th			1		3					2				3				3	
Does not downshift from 4th to 3rd					2					1								2	
Does not downshift from 3rd to 2nd					2				1									2	
Does not downshift from 2nd to 1st					2					1								2	
Engine overruns when shifting from 2nd to 3rd				1		3					2							3	
All shift points extremly high or low				1	2													2	
Kick-down fails				1	3				2	2								3	
Engine brake does not function at "L" range										1								2	
Engine brake does not function at "2" range									1	1								2	
Lock-up device does not function				1		3		1	2	2		2			3	3		3	4
Lock-up point extremly high or low				1	3							2						3	
EXCESSIVE SHOCK WHEN CHANGING GEARS																			
Excessive shock when selector is moved to "R" from "N", or "D" from "N"				1			2	1			2					2	2		
Excessive shock when upshifting from 1st to 2nd				1							2					3	3	3	
Excessive shock when upshifting from 2nd to 3rd				1		3										3	3	3	
Excessive shock when upshifting from 3rd to 4th				1												2	2		
Excessive shock when upshifting (all gear)				1												2	2		
Excessive shock when downshift from 4th to 3rd				1												2	2		
Excessive shock when downshift from 3rd to 2nd				1							2					3	3	3	
When lock-up				1	2														3
SLIPPAGE																			
When going forward and backward	1			1				1											2
When in reverse gear				1															
When in 1st gear				1															
When in 2nd gear				1															
When in 3nd gear				1															
When in 4th gear				1															
OTHERS																			
Engine will not srart in either "P" or "N"		1	1										2						
Engine can start in other than "P" or "N"		1	1																
Engine stalls when selector is moved from "P" or "N" to one of drive ranges							2					1							3
Automatic transmission unit overheating/ATF blows off from air breather pipe	1							1				3						3	4

Note: The numbers in the table denote the order of inspection.

1. Moveable parts that are dislocated easily or are hard to adjust.
2. Parts that are turned on and off.
3. Other parts that are controlled by electrical circuit.
4. Others.

OVERHAUL ITEM

Faulty symptom \ Check position	ATF thermosensor	Oil pump	O/D brake (B0)	2nd brake (B1)	1st & Rev. brake (B2)	O/D direct clutch (C0)	Front Clutch (C1)	Rear clutch (C2)	O/D one-way clutch (F0)	No.2 one-way clutch (F1)	Front planetary	Rear planetary	Parking linkage	Valve body assembly	B0 accumulator	C1 accumulator	B1 accumulator	C2 accumulator	Line pressure solenoid
VEHICLE MOVEMENT																			
Vehicle does not run at "D", "2", "L"							○												
Vehicle does not run at "R"					○			○											
Vehicle does not move at every range		○				○			○		○	○		○					
Vehicle moves at "P"													○						
Parking gear does not release when selector is moved from "P"													○						
Vehicle moves at "N"							○	○											
ABNORMAL GEAR CHANGE																			
Does not upshift from 1st to 2nd				○						○				○					
Does not upshift from 2nd to 3rd						○		○						○					
Does not upshift from 3rd to 4th	○		○											○					
Does not downshift from 4th to 3rd						○			○					○					
Does not downshift from 3rd to 2nd				○										○					
Does not downshift from 2nd to 1st						○				○				○					
Engine overruns when shifting from 2nd to 3rd								○						○					
All shift points extremly high or low																			
Kick-down fails														○					
Engine brake does not function at "L" range					○									○					
Engine brake does not function at "2" range						○													
Lock-up device does not function	○													○					○
Lock-up point extremly high or low														○					
EXCESSIVE SHOCK WHEN CHANGING GEARS																			
Excessive shock when selector is moved to "R" from "N"					○			○						○				○	
Excessive shock when selector is moved to "D" from "N"							○			○				○		○			
Excessive shock when selector is moved to "R" from "N", or "D" from "N"														○					○
Excessive shock when upshifting from 1st to 2nd				○										○			○		○
Excessive shock when upshifting from 2nd to 3rd						○		○						○				○	○
Excessive shock when upshifting from 3rd to 4th			○											○	○				○
Excessive shock when upshifting (all gear)	○						○							○					○
Excessive shock when downshift from 4th to 3rd						○			○					○					○
Excessive shock when downshift from 3rd to 2nd				○										○			○		○
When lock-up														○					○
SLIPPAGE																			
When going forward and backward		○							○										○
When in reverse gear					○			○											○
When in 1st gear							○			○									○
When in 2nd gear				○			○		○										○
When in 3nd gear							○	○											○
When in 4th gear			○				○	○											○
OTHERS																			
Engine will not srart in either "P" or "N"																			
Engine can start in other than "P" or "N"																			
Engine stalls when selector is moved from "P" or "N" to one of drive ranges														○					
Automatic transmission unit overheating/ATF blows off from air breather pipe		○	○	○			○	○						○					

INSPECTION BASED ON FAULTY SYMPTOM

This section details how to inspect or repair the following phenomena found in fault reproducing tests:

1. The vehicle does not move at every range.
2. The vehicle moves at the "N" range.
3. The gear cannot be changed.
4. Does not upshift from the 3rd to 4th.
5. The gear change is abnormal.
6. At acceleration, the engine races and slippage occurs.
7. The engine stalls when the selector lever is moved from the "P" or "N" to one of the drive ranges.
8. The ATF blows off from the air breather pipe during driving.
9. Engine brake does not function.

1	**The vehicle does not move at every range.**
Situations	When the accelerator is depressed while the selector lever is set in the drive range, the vehicle does not move, but the engine comes to rotate faster.
Causes	① The ATF is not sufficient. ② The selector lever has not been assembled nor adjusted correctly. ③ The throttle position sensor is defective or is not adjusted correctly. ④ The line pressure has dropped. ⑤ The powertrain slippage. ⑥ The control valve does not slide correctly. ⑦ The line pressure solenoid is defective. ⑧ The parking mechanism is defective.

Steps	Inspection		Corrective Measures
1–1	Is the ATF sufficient and in good order? (See Page 7A3-2) <Reference> • When the ATF is cloudy (pinkish), it contains some water.	YES	Proceed to the next step.
		NO	<Reference> • It is finally required to replace the transmission. The inside of the transmission is considered to be damaged, and the causes will be traced in the following step. If the ATF has become cloudy, replace the A/T and check the route (radiator, etc.) through which water has entered the A/T.
1–2	Is the self-diagnosis satisfactory? (See Page 7A2-3)	YES	Proceed to the next step.
		NO	When a DTC is shown, check the relevant section of the DTC. When the trouble cannot be fixed, replace the transmission.
1–3	Is the line pressure sufficient? (See Page 7A2-62) kPa (kg/cm²/PSI) Range / Idling pressure / Stall pressure D: 529-784 (5.4-8.0/77-114) / 990-1480 (10.1-15.1/144-215) R: 755-1127 (7.7-11.5/110-164) / 1401-2107 (14.3-21.5/203-306)	YES	Proceed to the next step.
		NO	Proceed to the Step 1–5.
1–4	Is the parking mechanism in good order? • The tires are locked when the selector lever is set in the "P" range. • When the brake is released with the selector lever set in other range than "P", the vehicle can be moved by being pushed.	YES	The powertrain inside the A/T is considered to be out of order. Replace the transmission.
		NO	The parking mechanism is considered to be out of order. Replace the transmission.
1–5	Does the selector lever move well?	YES	Proceed to the next step.
		NO	Adjust the selector lever.

A/T: Automatic Transmission ATF: Automatic Transmission Fluid DTC: Diagnostic Trouble Code

<table>
<tr><th>Steps</th><th>Inspection</th><th></th><th>Corrective Measures</th></tr>
<tr><td>1–6</td><td>Does the line pressure solenoid of the TCM output correct voltage? (See Page 7A2-58)
<table><tr><th>Terminals</th><th>Voltage (V)</th><th>Measuring Conditions</th></tr><tr><td rowspan="2">B229-26</td><td>3.3–5.5</td><td>When the throttle is completely closed.</td></tr><tr><td>1.0–1.7</td><td>When the throttle is fully open.</td></tr></table></td><td>YES</td><td>Replace the transmission.</td></tr>
<tr><td></td><td></td><td>NO</td><td>Measure the resistance values.
(See Page 7A3-14)
OK → Proceed to the next step.
NG → Check defective parts or the harness.</td></tr>
<tr><td>1–7</td><td>Are signals properly input to the throttle position sensor of the TCM? (See Page 7A2-58)
<table><tr><th>Terminals</th><th>Voltage (V)</th><th>Measuring Conditions</th></tr><tr><td rowspan="2">⊕ B229-5
↕
⊖ B229-19</td><td>4.1–4.5</td><td>Release the accelerator (to close the throttle completely).</td></tr><tr><td>0.8–1.6</td><td>Depress the accelerator fully (to open the throttle fully).</td></tr></table></td><td>YES</td><td>Replace the TCM.
Check the ATF, and when a sign of “Burn” or “Damage” is found inside the A/T, replace the A/T as well.</td></tr>
<tr><td></td><td></td><td>NO</td><td>Proceed to the next step.</td></tr>
<tr><td>1–8</td><td>Is the supply voltage of the throttle position sensor satisfactory? (See Page 7A2-59)
<table><tr><th>Terminals</th><th>Voltage (V)</th></tr><tr><td>⊕ ⊖
B229-18 ↔ B229-19</td><td>4.5–5.5</td></tr></table></td><td>YES</td><td>Check the throttle position sensor and the harness.
As the inside of the A/T is considered to be damaged, replace the transmission.</td></tr>
<tr><td></td><td></td><td>NO</td><td>Check the power circuit of the throttle position sensor.
When it is in order, replace the TCM.</td></tr>
</table>

A/T: Automatic Transmission ATF: Automatic Transmission Fluid TCM: Transmission Control Module

2	**The vehicle moves at the "N" range.**		
Situations	• The vehicle moves at the time of idling and accelerates when the accelerator is depressed with the selector lever set in the "N" range. • The vehicle does not drive with the selector lever set in the "R" range.		
Causes	① The selector lever has not been assembled nor adjusted correctly. ② The front clutch or the rear clutch has seized. ③ The manual valve has malfunctioned (the linkage has come off).		
Steps	**Inspection**		**Corrective Measures**
2–1	Does the selector lever work well?	YES	Proceed to the next step.
		NO	Adjust the selector lever, then proceed to the next step.
2–2	Can the trouble be fixed by conducting a road test? Do you recognize no abnormal phenomenon like "Slippage"?	YES	Proceed to the next step.
		NO	The inside of the A/T is considered to be damaged, so replace the A/T.
2–3	Is the stall revolution normal in a stall test? Stall revolution: 1600–1900 RPM	YES	The control linkage is defective, but the inside of the A/T is considered to be free of any fault.
		NO	Replace the A/T.

A/T: Automatic Transmission

3	**The gear cannot be changed.**		
Situations	• Gear changes from 1st to 2nd, from 2nd to 3rd and from 3rd to 4th are not possible, and the shift gear is fixed. • The gear changes at a time but not at other time.		
Causes	① The shift solenoids (No.1 and 2) are defective. ② The control valve does not slide properly. ③ The vehicle speed sensor 1 is defective. ④ Grounding is not correct. ⑤ The TCM is defective.		
Steps	**Inspection**		**Corrective Measures**
3–1	Is the self-diagnosis satisfactory? (See Page 7A2-3)	YES	Proceed to the next step.
		NO	A DTC appears Check the relevant DTC section.
3–2	Is the gear set to the 1st when the vehicle starts?	YES	Proceed to the Step 3–4.
		NO	Proceed to the next step.
3–3	Are the output voltages from the TCM to the No.1 and 2 shift solenoids (S1 and S2) satisfactory in the "4th (O/D)" range? (See Page 7A2-58 and 59)	YES	Proceed to the next step.
		NO	Measure the resistances of the shift solenoids No.1 and 2. (See Page 7A3-14) OK → Proceed to the Step 3–7. NG → Check the shift solenoids No.1, 2 and the harness.
3–4	Is the resistance of the vehicle speed sensor 1 satisfactory?	YES	Check wiring from the TCM to the vehicle speed sensor 1 and connection of the connector. Proceed next step.
		NO	Replace the vehicle speed sensor 1. Proceed to the next step.
3–5	Is the trouble is fixed when the TCM is replaced with a non-defective one?	YES	Replace the TCM.
		NO	Replace the A/T.

Solenoid	Terminal	Voltage (V)
No.1 (S1)	B229-13	12 : When driving at the D1 or D2 gear. 0 : When driving at the D3 or D4 gear.
No.2 (S2)	B229-12	12 : When driving at the D2 or D3 gear. 0 : When driving at the D1 or D4 gear.

Resistance (Ω)	560–680 (at 20°C)

A/T: Automatic Transmission ATF: Automatic Transmission Fluid DTC: Diagnostic Trouble Code O/D: Overdrive
TCM: Transmission Control Module

4	**Does not upshift from the 3rd to 4th.**		
Situations	• Even though the engine is accelerated and rotates faster, the gear does not shift to the 4th. • When the accelerator is released at the vehicle speed is over 60km/h (38mph) with the selector lever set in the "D" range, the gear is not set to 4th. ※ When the engine is cold (the ATF temperature is below 40°C/104°F), the gear is not set to the 4th (O/D).		
Causes	① The ATF thermosensor is defective. ② The No.1 and 2 shift solenoids are defective. ③ The control valve does not slide well. ④ The inhibitor switch is defective or is not adjusted correctly. ⑤ The vehicle speed sensor 1 is defective. ⑥ The O/D OFF switch is defective. ⑦ The grounding is not correct. ⑧ The TCM is defective.		
Steps	**Inspection**		**Corrective Measures**
4–1	Is the self-diagnosis satisfactory? (See Page 7A2-3)	YES	Proceed to the next step.
		NO	A DTC appears. Check the relevant DTC section.
4–2	Are the output voltages from the TCM to the No.1 and 2 shift solenoids (S1 and S2) satisfactory in the "4th (O/D)" range? (See Page 7A2-58 and 59)	YES	The inside of the A/T is considered to be defective. Check the ATF, and if internal parts have been burnt, replace the A/T.
		NO	Measure the resistances of the shift solenoids No.1 and 2. OK → Proceed to the next step. NG → Check defective parts and the harness.

Solenoid	Terminal	Voltage (V)
No.1 (S1)	B229-13	12 : When driving at the D1 or D2 gear. 0 : When driving at the D3 or D4 gear.
No.2 (S2)	B229-12	12 : When driving at the D2 or D3 gear. 0 : When driving at the D1 or D4 gear.

A/T: Automatic Transmission ATF: Automatic Transmission Fluid DTC: Diagnostic Trouble Code O/D: Overdrive
TCM: Transmission Control Module

<table>
<tr><th>Steps</th><th>Inspection</th><th></th><th>Corrective Measures</th></tr>
<tr><td>4–3</td><td>Are the voltages at the inhibitor switch and O/D OFF switch terminal of the TCM satisfactory?
(See Pages 7A2-60 and 61)
<table>
<tr><th>Terminal</th><th>Voltages (V)</th><th>Measuring Conditions</th></tr>
<tr><td rowspan="2">B231-3</td><td>10–16</td><td>“P” range</td></tr>
<tr><td>1 max.</td><td>Other than “P” range</td></tr>
<tr><td rowspan="2">B231-9</td><td>10–16</td><td>“R” range</td></tr>
<tr><td>1 max.</td><td>Other than “R” range</td></tr>
<tr><td rowspan="2">B231-4</td><td>10-16</td><td>“N” range</td></tr>
<tr><td>1 max.</td><td>Other than “N” range</td></tr>
<tr><td rowspan="2">B231-10</td><td>10–16</td><td>“D” range</td></tr>
<tr><td>1 max.</td><td>Other than “D” range</td></tr>
<tr><td rowspan="2">B231-11</td><td>10–16</td><td>“2” range</td></tr>
<tr><td>1 max.</td><td>Other than “2” range</td></tr>
<tr><td rowspan="2">B231-6</td><td>10–16</td><td>“1” range</td></tr>
<tr><td>1 max.</td><td>Other than “1” range</td></tr>
<tr><td rowspan="2">B230-6</td><td>10–16</td><td>O/D OFF switch “OFF”</td></tr>
<tr><td>1 max.</td><td>O/D OFF switch “ON”</td></tr>
</table></td><td>YES</td><td>Proceed to the next step.</td></tr>
<tr><td></td><td></td><td>NO</td><td>Check defective parts and the harness.
When the trouble is not fixed, return to the Step 4–2.</td></tr>
<tr><td>4–4</td><td>Is the resistance of the vehicle speed sensor 1 satisfactory?
<table>
<tr><td>Resistance (Ω)</td><td>560–680 (at 20°C)</td></tr>
</table></td><td>YES</td><td>Check wiring from the TCM to the vehicle speed sensor 1 and connection of the connector.
Proceed next step.</td></tr>
<tr><td></td><td></td><td>NO</td><td>Replace the vehicle speed sensor 1.
Proceed next step.</td></tr>
<tr><td>4–5</td><td>Is the potential difference between the ground terminal B231-2 or B231-8 of the TCM and the transmission case correct?
<table>
<tr><td>Potential difference</td><td>0V (when it is normal)</td></tr>
</table></td><td>YES</td><td>Replace the TCM.</td></tr>
<tr><td></td><td></td><td>NO</td><td>The grounding is considered not to be correct.
Check the grounding point.</td></tr>
</table>

O/D: Overdrive TCM: Transmission Control Module

5	**The gear change is abnormal.**		
Situations	• The gear change pattern is different from the drive pattern. Example) When the engine is accelerated by depress on the accelerator slowly, the 1st gear abruptly changes to the 4th gear.		
Causes	① The ATF is not sufficient. ② The grounding is not correct. ③ The throttle position sensor is defective or has not been adjusted correctly. ④ The vehicle speed sensor 1 is defective. ⑤ The TCM is defective. ⑥ The control valve does not slide well.		
Steps	**Inspection**		**Corrective Measures**
5–1	Is the ATF sufficient and in good order? (See Page 7A3-2) <Reference> • When the ATF is cloudy (pinkish), it contains water.	YES	Proceed to the next step.
		NO	<Reference> • It is finally required to disassemble and repair the A/T. The inside of the A/T is considered to be damaged. Proceed to the next step, and find causes of the trouble. When the ATF is cloudy, replace the A/T and check the route (radiator, etc.) through which water has entered the A/T.
5–2	Is the self-diagnosis satisfactory? (See Page 7A2-3)	YES	Proceed to the next step.
		NO	A DTC appears. Check the relevant DTC section.
5–3	Is the line pressure sufficient? (See Page 7A2-62) kPa (kg/cm²/PSI)	YES	Replace the A/T.
		NO	Proceed to the next step.
5–4	Does the selector lever work well?	YES	Proceed to the next step.
		NO	Adjust the selector lever.

Range	Idling pressure	Stall pressure
D	529-784 (5.4-8.0/77-114)	990-1480 (10.1-15.1/144-215)
R	755-1127 (7.7-11.5/110-164)	1401-2107 (14.3-21.5/203-306)

A/T: Automatic Transmission ATF: Automatic Transmission Fluid DTC: Diagnostic Trouble Code
TCM: Transmission Control Module

<table>
<tr><th>Steps</th><th>Inspection</th><th></th><th>Corrective Measures</th></tr>
<tr><td rowspan="2">5–5</td><td rowspan="2">Does the line pressure solenoid of the TCM output correct voltages? (See Page 7A2-59)
<table><tr><th>Terminals</th><th>Voltage (V)</th><th>Measuring Conditions</th></tr><tr><td rowspan="2">B229-26</td><td>3.3–5.5</td><td>When the throttle is completely closed.</td></tr><tr><td>1.0–1.7</td><td>When the throttle is fully open.</td></tr></table></td><td>YES</td><td>Replace the A/T.</td></tr>
<tr><td>NO</td><td>Proceed to the next step.</td></tr>
<tr><td rowspan="2">5–6</td><td rowspan="2">Are signals properly input to the throttle position sensor of the TCM? (See Page 7A2-58)
<table><tr><th>Terminals</th><th>Voltage (V)</th><th>Measuring Conditions</th></tr><tr><td rowspan="2">⊕ B229-5
˄
˅
⊖ B229-19</td><td>4.1–4.5</td><td>Release the accelerator (to close the throttle completely).</td></tr><tr><td>0.8–1.6</td><td>Depress the accelerator fully (to open the throttle fully).</td></tr></table></td><td>YES</td><td>Replace the TCM.
Check the ATF, and when a sign of “Burn” or “Damage” is found inside the A/T, replace the A/T as well.</td></tr>
<tr><td>NO</td><td>Proceed to the next step.</td></tr>
<tr><td rowspan="2">5–7</td><td rowspan="2">Is the supply voltage of the throttle position sensor satisfactory? (See Page 7A2-59)
<table><tr><th>Terminals</th><th>Voltage (V)</th><th>Measuring Condition</th></tr><tr><td>⊕ B229-18 ‹ › ⊖ B229-19</td><td>4.5–5.5</td><td>Key switch “ON”</td></tr></table></td><td>YES</td><td>As the inside of the A/T is considered to be damaged, replace the A/T.</td></tr>
<tr><td>NO</td><td>Check the power circuit of the throttle position sensor.
When it is in order, replace the TCM.</td></tr>
</table>

A/T: Automatic Transmission ATF: Automatic Transmission Fluid TCM: Transmission Control Module

6	**At acceleration, the engine races and slippage occurs.**
Situations	• When the accelerator is depressed to start driving, the engine rotates faster, but the speed does not increase. • Even if the accelerator is depressed for acceleration during a drive, only the engine rotates faster but the speed does not increase.
Causes	① The ATF is not sufficient. ② The selector lever has not been assembled or adjusted correctly. ③ The throttle position sensor is defective or has not been adjusted correctly. ④ The line pressure has dropped. ⑤ The powertrain slips. ⑥ The control valve does not slide well. ⑦ The line pressure solenoid is defective.

Steps	Inspection		Corrective Measures
6–1	Is the ATF sufficient and in good order? (See Page 7A3-2) <Reference> • When the ATF is cloudy (pinkish), water is contained in the ATF.	YES	Proceed to the next step.
		NO	<Reference> • It is finally required to disassemble and repair the A/T. The inside of the A/T is considered to be damaged. Proceed to the next step, and find causes of the trouble. When the ATF is cloudy, replace the A/T and check the route (radiator, etc.) through which water has entered the A/T.
6–2	Is the self-diagnosis satisfactory? (See Page 7A2-3)	YES	Proceed to the next step.
		NO	A DTC appears. Check the relevant DTC section.
6–3	Is the line pressure sufficient? kPa (kg/cm²/PSI) Range / Idling pressure / Stall pressure D: 529–784 (5.4-8.0/77-114) / 990–1480 (10.1-15.1/144-215) R: 755-1127 (7.7-11.5/110-164) / 1401-2107 (14.3-21.5/203-306)	YES	Replace the A/T.
		NO	Replace the selector lever. OK → Proceed to the next step. NG → Adjust or replace the selector lever.
6–4	Is the output voltage of the line pressure solenoid of the TCM satisfactory? (See Page 7A2-59) Terminals / Voltage (V) / Measuring Conditions B229-26: 3.3–5.5 / When the throttle is completely closed. B229-26: 1.0–1.7 / When the throttle is fully open.	YES	Replace the A/T.
		NO	Proceed to the next step.

A/T: Automatic Transmission ATF: Automatic Transmission Fluid DTC: Diagnostic Trouble Code
TCM: Transmission Control Module

<table>
<tr><th>Steps</th><th>Inspection</th><th></th><th>Corrective Measures</th></tr>
<tr><td>6–5</td><td>Are signals properly input to the throttle position sensor of the TCM? (See Page 7A2-58)
<table><tr><th>Terminals</th><th>Voltage (V)</th><th>Measuring Conditions</th></tr><tr><td rowspan="2">⊕ B229-5
↕
⊖ B229-19</td><td>4.1–4.5</td><td>Release the accelerator (to close the throttle completely).</td></tr><tr><td>0.8–1.6</td><td>Depress the accelerator fully (to open the throttle fully).</td></tr></table></td><td>YES</td><td>Replace the TCM.
Check the ATF, and when a sign of “Burn” or “Damage” is found inside the A/T, replace the A/T as well.</td></tr>
<tr><td></td><td></td><td>NO</td><td>Proceed to the next step.</td></tr>
<tr><td>6–6</td><td>Is the supply voltage of the throttle position sensor satisfactory? (See Page 7A2-59)
<table><tr><th>Terminals</th><th>Voltage (V)</th></tr><tr><td>⊕ B229-18 ↔ ⊖ B229-19</td><td>4.5–5.5</td></tr></table></td><td>YES</td><td>As the inside of the A/T is considered to be damaged, replace the A/T.</td></tr>
<tr><td></td><td></td><td>NO</td><td>Check the power circuit of the throttle position sensor.
When it is in order, replace the TCM.</td></tr>
</table>

A/T: Automatic Transmission ATF: Automatic Transmission Fluid TCM: Transmission Control Module

7	**The engine stalls when the selector lever is moved from the "P" or "N" to one of the drive ranges.**
Situations	• When the selector lever is changed from the "N" or "P" range to the drive range while the engine is idling, the engine stops immediately.
Causes	① The idling speed of the engine is slow. ② The control valve does not slide well. ③ The inhibitor switch is defective or has not been adjusted correctly. ④ The vehicle speed sensor 1 is defective. ⑤ The engine speed sensor is defective.

Steps	Inspection		Corrective Measures
7–1	Is the idling speed satisfactory? Idling speed : 775 - 825RPM	YES	Proceed to the next step.
		NO	Adjust the idling speed.
7–2	Is the trouble fixed when the connectors of Pin 12, Pin 16 and Pin 26 of the TCM are disconnected? Be sure to reset the connectors.	YES	Proceed to the next step.
		NO	Replace the A/T.
7–3	Are the voltages at the inhibitor switch and the vehicle speed sensor 1 of the TCM satisfactory? (See Pages 7A2-58 and 61)	YES	Proceed to the next step.
		NO	Check defective parts and the harness.

Terminal	Voltages (V)	Measuring Conditions
B231-3	10–16	"P" range
	1 max.	Other than "P" range
B231-9	10–16	"R" range
	1 max.	Other than "R" range
B231-4	10–16	"N" range
	1 max.	Other than "N" range
B231-10	10–16	"D" range
	1 max.	Other than "D" range
B231-11	10–16	"2" range
	1 max.	Other than "2" range
B231-6	10–16	"1" range
	1 max.	Other than "1" range
⊕ B229-3 ↕ ⊖ B229-16	0.35 (AC) min.	Vehicle speed of over 24km/h (15mph) (As the speed increases, the voltage increases continuously.)

AC: Alternating Current A/T: Automatic Transmission TCM: Transmission Control Module

<table>
<tr><th>Steps</th><th>Inspection</th><th></th><th>Corrective Measures</th></tr>
<tr><td rowspan="2">7–4</td><td colspan="2" rowspan="2">Are the voltage at the engine speed sensor terminal satisfactory? (See Page 7A2-58)
<table><tr><th>Terminal</th><th>Voltage (V)</th><th>Measuring conditions</th></tr><tr><td>B229-1</td><td>1 min.</td><td>The engine speed is 1000RPM approx.</td></tr></table></td><td>YES</td><td>Proceed to the next step.</td></tr>
<tr><td>NO</td><td>Check defective parts and the harness.</td></tr>
<tr><td rowspan="2">7–5</td><td colspan="2" rowspan="2">Is the potential difference between the ground terminal B229-3 or B229-16 of the TCM and the transmission case correct?
<table><tr><td>Potential difference</td><td>0V (when it is normal)</td></tr></table></td><td>YES</td><td>Replace the TCM.</td></tr>
<tr><td>NO</td><td>The grounding is considered not to be correct.
Check the grounding point.</td></tr>
</table>

TCM: Transmission Control Module

8	**The ATF blows off from the air breather pipe during driving.**		
Situations	• During a drive, ATF blows off from the air breather pipe.		
Causes	① The ATF is too much. ② Water enters the A/T from the outside.		
Steps	**Inspection**		**Corrective Measures**
8–1	Is the ATF at the proper level and in good order? (See Page 7A3-2) <Reference> • When the ATF is cloudy (pinkish), water is contained in the ATF.	YES	Proceed to the next step.
		NO	Adjust the ATF level when its condition is satisfactory but the level is too high. When its level is satisfactory but the condition is not, the inside of the A/T is considered to be damaged, so replace the A/T. When the ATF is cloudy, replace the A/T and check the route (radiator, etc.) through which water enters it.
8–2	Is the phenomenon improved during a drive after the ATF is adjusted to the "Low" level?	YES	Check the ATF while keeping it at the "Low" level. If the level rises, water is considered to have entered the A/T.
		NO	Replace the A/T.

A/T: Automatic Transmission ATF: Automatic Transmission Fluid

9	**Engine brake does not function.**		
Situations	• When the accelerator is released during a drive at an intermediate or high speed, the engine rotates at the idling speed and the vehicle drives free. • Also, when the accelerator is released during a drive at a low speed with the selector lever set in "2" or "1" range, the vehicle drives free.		
Causes	① The ATF is not sufficient. ② The powertrain slips. ③ The control valve does not slide well. ④ The throttle position sensor is defective or has not been adjusted correctly. ⑤ The O/D OFF switch is defective. ⑥ The inhibitor switch is defective or has not been adjusted correctly. ⑦ The vehicle speed sensor 1 is defective.		
Steps	**Inspection**		**Corrective Measures**
9–1	Is the ATF sufficient or in good order? (See Page 7A3-2) <Reference> • When the ATF is cloudy (pinkish), water is contained in the ATF.	YES	Proceed to the next step.
		NO	<Reference> • It is finally required to disassemble and repair the A/T. The inside of the A/T is considered to be damaged. Proceed to the next step, and find causes of the trouble. When the ATF is cloudy, check the route (radiator, etc.) through which water enter the ATF.
9–2	Is the self-diagnosis satisfactory? (See Page 7A2-3)	YES	Proceed to the next step.
		NO	A DTC appears. Check the relevant DTC section.
9–3	Does such a phenomenon occur as "At the time of acceleration, the engine races or the clutch slips"?	YES	The powertrain is considered to slip. Proceed to the Abnormal Phenomena 6 "At acceleration, the engine races and slippage occurs."
		NO	Proceed to the next step.
9–4	Is engine braking effective with the selector lever set in the "1" range?	YES	Proceed to the next step.
		NO	The inside of the A/T is considered to be defective. Check the ATF, and if internal parts seem to be burnt, replace the A/T.

A/T: Automatic Transmission ATF: Automatic Transmission Fluid DTC: Diagnostic Trouble Code O/D: Overdrive
TCM: Transmission Control Module

<table>
<tr><th>Steps</th><th>Inspection</th><th></th><th>Corrective Measures</th></tr>
<tr><td rowspan="2">9–5</td><td colspan="2" rowspan="2">Are voltages at the inhibitor switch, O/D OFF switch, throttle position sensor and vehicle speed sensor 1 terminal of the TCM are satisfactory?
(See Pages 7A2-58 and 61)
<table><tr><th>Terminal</th><th>Voltages (V)</th><th>Measuring Conditions</th></tr><tr><td rowspan="2">B231-3</td><td>10–16</td><td>“P” range</td></tr><tr><td>1 max.</td><td>Other than “P” range</td></tr><tr><td rowspan="2">B231-9</td><td>10–16</td><td>“R” range</td></tr><tr><td>1 max.</td><td>Other than “R” range</td></tr><tr><td rowspan="2">B231-4</td><td>10–16</td><td>“N” range</td></tr><tr><td>1 max.</td><td>Other than “N” range</td></tr><tr><td rowspan="2">B231-10</td><td>10–16</td><td>“D” range</td></tr><tr><td>1 max.</td><td>Other than “D” range</td></tr><tr><td rowspan="2">B231-11</td><td>10–16</td><td>“2” range</td></tr><tr><td>1 max.</td><td>Other than “2” range</td></tr><tr><td rowspan="2">B231-6</td><td>10–16</td><td>“1” range</td></tr><tr><td>1 max.</td><td>Other than “1” range</td></tr><tr><td rowspan="2">B230-6</td><td>10–16</td><td>O/D OFF switch “OFF”</td></tr><tr><td>1 max.</td><td>O/D OFF switch “ON”</td></tr><tr><td rowspan="2">⊕ B229-5
↕
⊖ B229-19</td><td>4.1–4.5</td><td>Release the accelerator (to close the throttle completely).</td></tr><tr><td>0.8–1.6</td><td>Depress the accelerator fully (to fully open the throttle).</td></tr><tr><td>⊕ B229-3
↕
⊖ B229-16</td><td>0.35 (AC) min.</td><td>Vehicle speed of over 24km/h (15mph)
(As the speed increases, the voltage increases continuously.)</td></tr></table></td><td>YES</td><td>Replace the TCM.</td></tr>
<tr><td>NO</td><td>Check defective parts and the harness.</td></tr>
</table>

AC: Alternating Current O/D: Overdrive TCM: Transmission Control Module

WIRING DIAGRAM

LHD model:

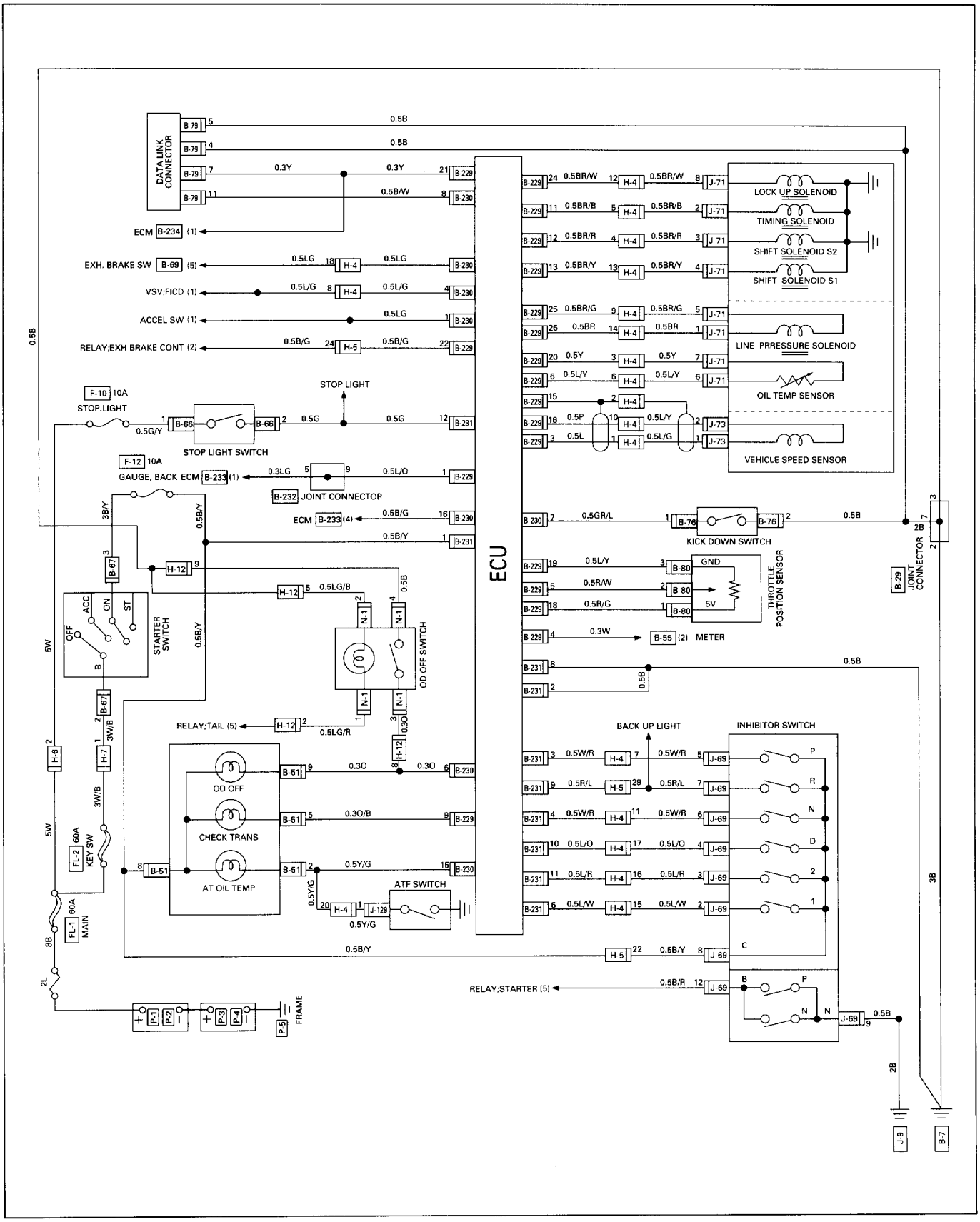


Figure 11-A. Wiring Diagram(LHD model)

RHD model:

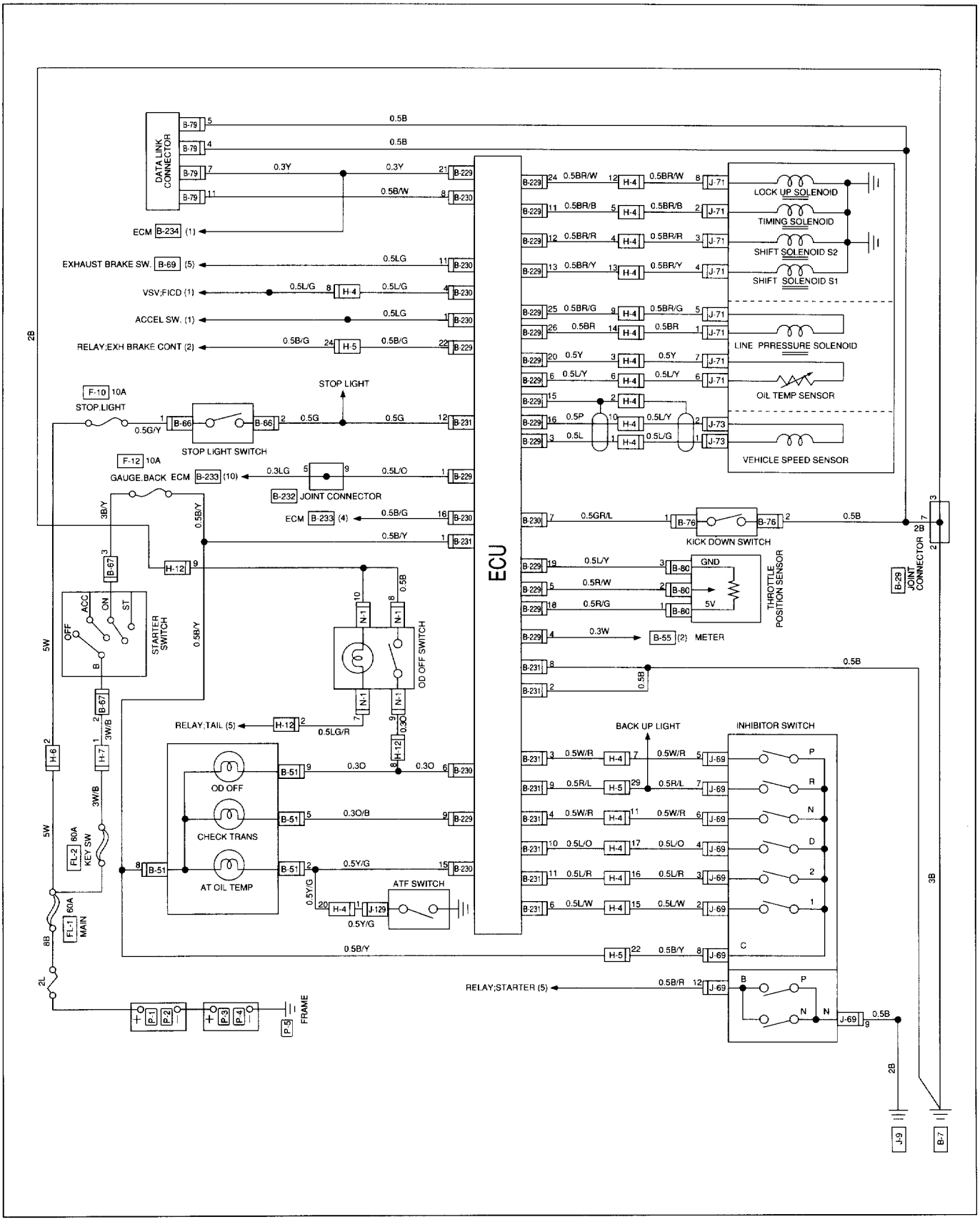


Figure 11-B. Wiring Diagram(RHD model)

PARTS LOCATION

This illustration is based on LHD model.

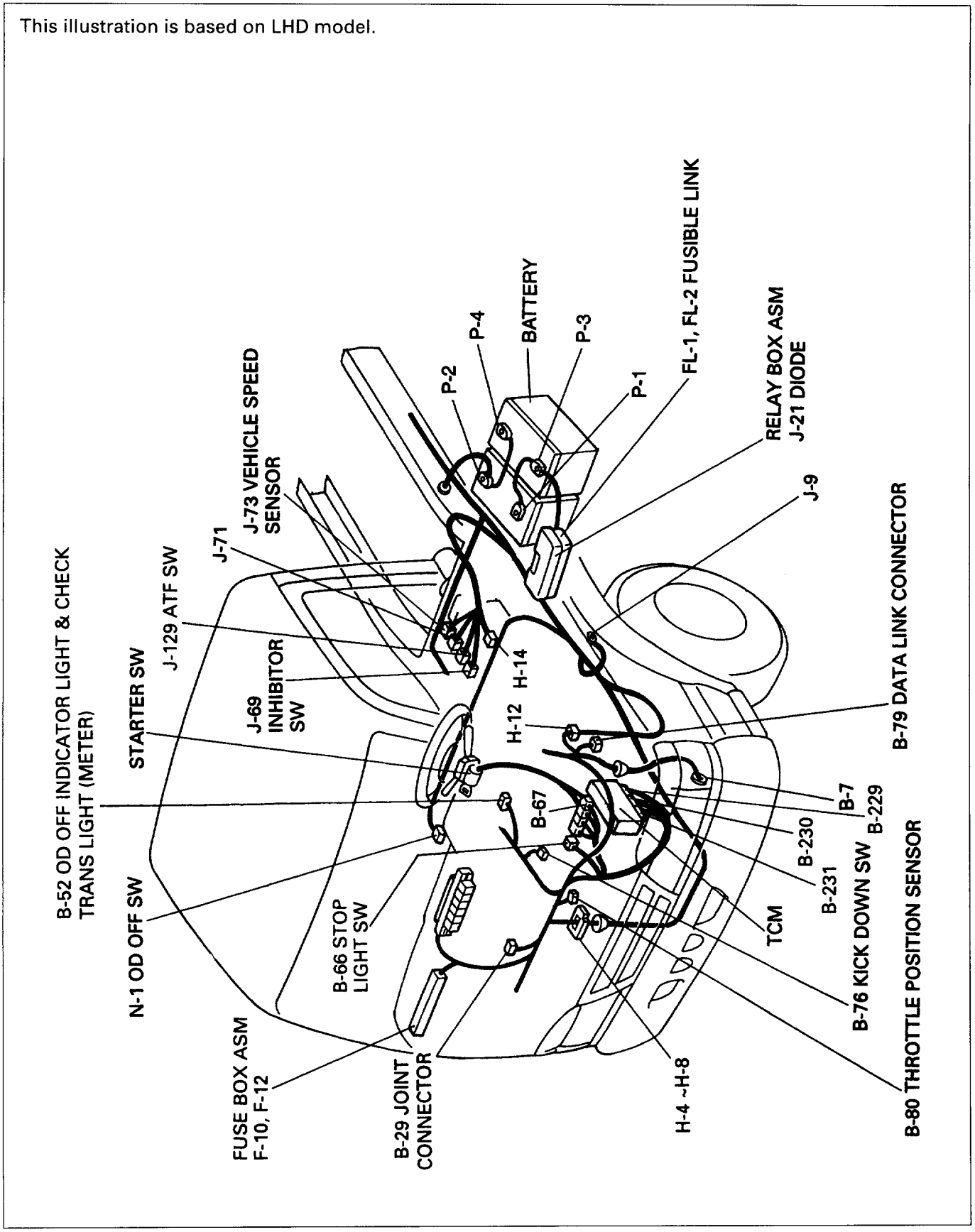


Figure 12. Parts Location

CONNECTOR CONFIGURATIONS (1)

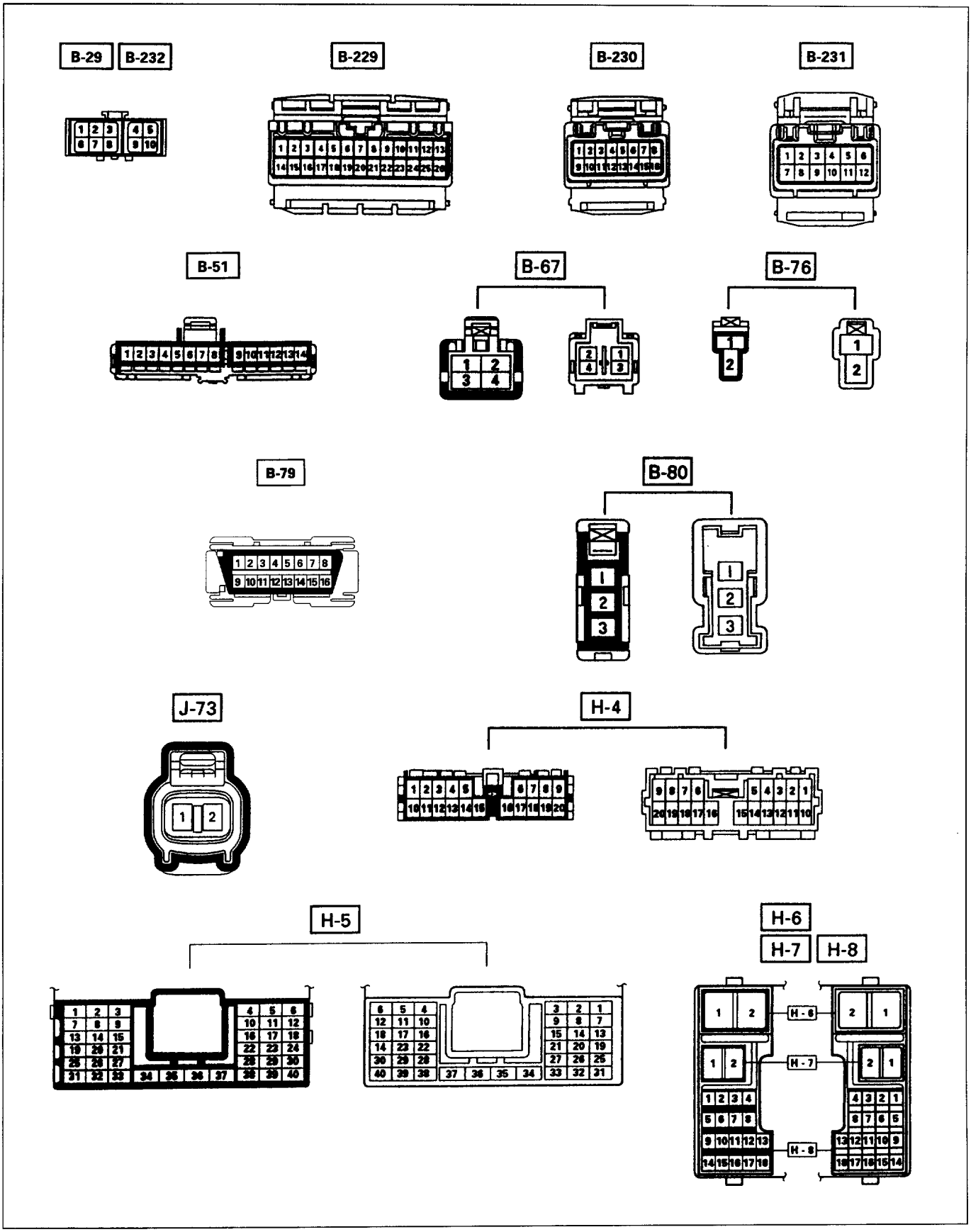


Figure 13. Connector Configurations (1)

CONNECTOR CONFIGURATIONS (2)

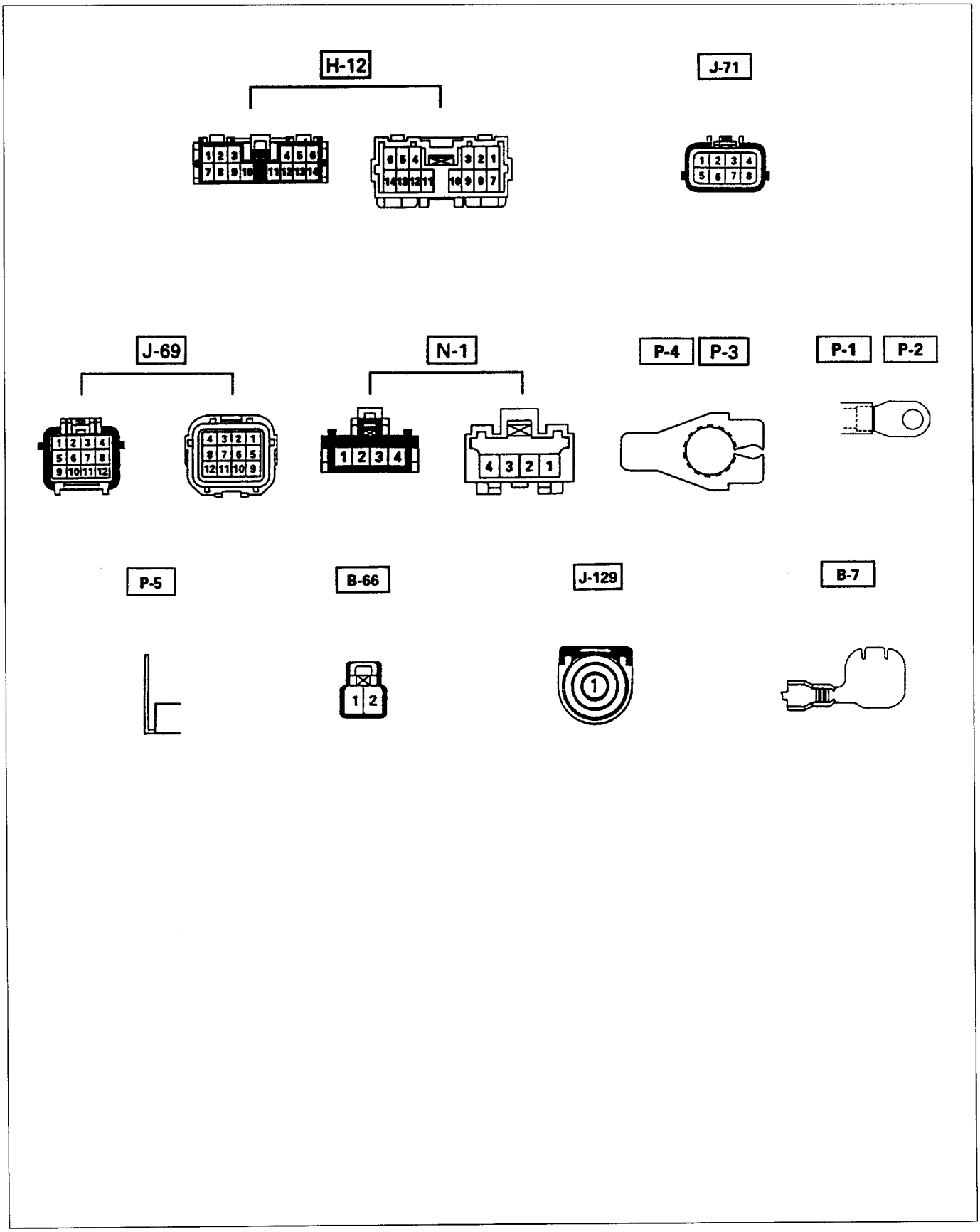


Figure 14. Connector Configurations (2)

CONTROL SIGNAL INSPECTION

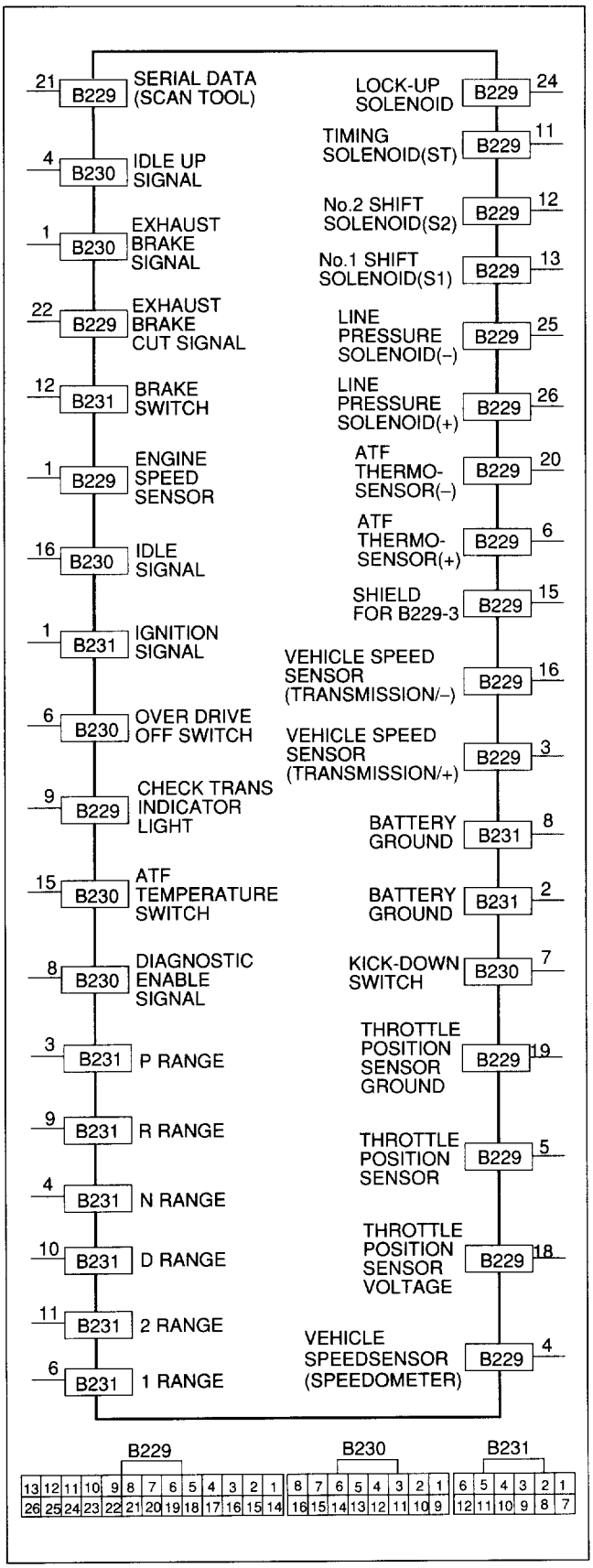


Figure 15. TCM Connector Pin

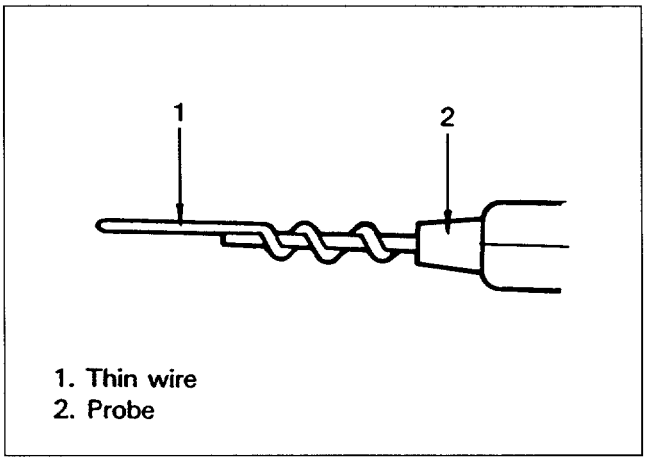
Control signal inspection is done to check for transmission and transmission control module (TCM) problems which cannot be detected by self diagnosis.
Additionally, it serves as a back-up check for self diagnosis.

Measure the voltage drop and make a continuity test for each of the sensors, solenoids, and switches.

If the voltage is within the specified range and continuity exists, that particular area of the TCM and automatic transmission assembly is normal.

If voltage deviation or lack of continuity is discovered, disconnect the applicable parts and check each of them individually.

This will allow you to determine the trouble location (TCM, automatic transmission unit, or another area of the vehicle).



1. Thin wire
2. Probe

Figure 16. Inspection Tool

Inspection Tool

Use a circuit tester to measure voltage and circuit continuity.

Refer to the following table for the specified voltage ranges.

TCM terminals are extremely small.

Wrap a piece of thin wire (1) around the probe of tester (2) (figure 16).

This will make measurement easier.

TCM Terminal No. (Wire Color)		Standard Voltage	Inspection Condition	Signal Type	Circuit
Tester (–)	Tester (+)				
B231-2 (B) or B231-8 (B)	B229-1 (L/O)	More than 1.0 (Intermittent AC)	At an engine speed of approx. 1,000 RPM	Input	Engine speed sensor
	B229-2	Not used	—	—	—
B229-16 (P)	B229-3 (L)	More than 0.35 (AC)	Vehicle speed 24 km/h (15 mph) (Voltage increases in proportion to the speed)	Input	Vehicle speed sensor (Transmission)
		0	Vehicle stopped		
B231-2 (B) or B231-8 (B)	B229-4 (L/G)	0–5	Vehicle moved at slowest possible speed at least 1 meter	Input	Vehicle speed sensor (SPEEDOMETER)
B229-19 (L/Y)	B229-5 (R/W)	4.1–4.5	Accelerator pedal fully closed	Input	Throttle position sensor
		0.8–1.6	Accelerator pedal fully opened		
B229-20 (Y)	B229-6 (L/Y)	0.9	ATF temp. approx. 10 °C (50 °F)	Input	ATF thermosensor
		0.3	ATF temp. approx. 40 °C (104 °F)		
B231-2 (B) or B231-8 (B)	B229-7	Not used	—	—	—
	B229-8	Not used	—	—	—
	B229-9 (O/B)	10–16	Normally state	Output	Check trans light
		Less than 3.0	In order to 2 seconds when after the key switch "ON"		
	B229-10	Not used	—	—	—
	B229-11 (R/B)	10–16	Shift up to 2nd or 3rd kick down to 1st	Output	Timing solenoid (ST)
		Less than 1.0	Normally state		
	B229-12 (BR/R)	10–16	Driving at "D2" and "D3" (No.2 shift solenoid (S2) "ON")	Output	No.2 shift solenoid (S2)
		Less than 1.0	Driving at "D1" and "D4" (No.2 shift solenoid (S2) "OFF")		

AC: Alternating Current ATF: Automatic Transmission Fluid TCM: Transmission Control Module

TCM Terminal No. (Wire Color)		Standard Voltage	Inspection Condition	Signal Type	Circuit
Tester (–)	Tester (+)				
B231-2 (B) or B231-8 (B)	B229-13 (BR/Y)	10–16	Driving at "D1" and "D2" (No.1 shift solenoid (S1) "ON")	Output	No.1 shift solenoid (S1)
		Less than 1.0	Driving at "D3" and "D4" (No.1 shift solenoid (S1) "OFF")		
	B229-14	Not used	—	—	—
	B229-15	—	—	—	Shield
	B229-17	Not used	—	—	—
B229-19 (L/Y)	B229-18 (R/G)	4.5–5.5	Key switch "ON"	Source	Throttle position sensor supply voltage
B231-2 (B) or B231-8 (B)	B229-21 (B/R)	—	—	—	"Scan Tool"
	B229-22 (B/G)	10–16	Vehicle speed 16 km/h (10 mph) selector "1" range	Output	Exhaust brake cut
		Less than 3.0	Selector "P" or "N" range		
	B229-23	Not used	—	—	—
	B229-24 (BR/W)	10–16	Lock-up "ON"	Output	Lock-up solenoid
		Less than 1.0	Lock-up "OFF"		
B229-25 (BR/G)	B229-26 (BR)	3.3–5.5 (AC)	Engine warmed up and stopped, Throttle fullly closed, key switch "ON"	Output	Line pressure duty solenoid
		1.0–1.7 (AC)	Engine warmed up and stopped, Throttle fullly opened, key switch "ON"		
B231-2 (B) or B231-8 (B)	B230-1 (LG)	10–16	Exhaust brake switch "ON"	Input	Exhaust brake
		Less than 1.0	Exhaust brake switch "OFF"		
	B230-2	Not used	—	—	—
	B230-3	Not used	—	—	—

TCM: Transmission Control Module

TCM Terminal No. (Wire Color)		Standard Voltage	Inspection Condition	Signal Type	Circuit
Tester (–)	Tester (+)				
B231-2 (B) or B231-8 (B)	B230-4 (L/G)	10–16	Air conditioner copmressor "ON"	Input	Engine idle up
		Less than 1.0	Air conditioner copmressor "OFF"		
	B230-5	Not used	—	—	—
	B230-6 (O)	10–16	O/D OFF switch "OFF"	Input	O/D OFF switch
		Less than 1.0	O/D OFF switch "ON"		
	B230-7 (GR/L)	10–16	Accelerator pedal "released"	Input	Kick down switch
		Less than 1.0	Accelerator pedal "depressed"		
	B230-8 (B/W)	10–16	Self diagnosis "OFF"	Input	Data link connector
		Less than 1.0	Self diagnosis "ON"		
	B230-9	Not used	—	—	—
	B230-10	Not used	—	—	—
	B230-11	Not used	—	—	—
	B230-12	Not used	—	—	—
	B230-13	Not used	—	—	—
	B230-14	Not used	—	—	—
	B230-15 (Y/G)	10–16	Normally state	Input	ATF thermo switch
		Less than 1.0	ATF temperature more than 147 °C		
	B230-16 (B/G)	10–16	Engine speed more than 880 RPM	Input	Idle signal
		Less than 1.0	Accelerator pedal full closed. Engine speed 400-880 RPM		

O/D: Overdrive TCM: Transmission Control Module

TCM Terminal No. (Wire Color)		Standard Voltage	Inspection Condition	Signal Type	Circuit
Tester (–)	Tester (+)				
B231-2 (B) or B231-8 (B)	B231-1 (BY)	10–16	Key switch "ON"	Source	Battery voltage
	B231-3 (W/R)	10–16	Selector "P" range	Input	"P" range switch
		Less than 1.0	Selector other than except "P" range		
	B231-4 (W/R)	10–16	Selector "N" range	Input	"N" range switch
		Less than 1.0	Selector other than except "N" range		
	B231-5	Not used	—	—	—
	B231-6 (L/W)	10–16	Selector "1" range	Input	"1" range switch
		Less than 1.0	Selector other than except "1" range		
	B231-7	Not used	—	—	—
	B231-9 (R/L)	10–16	Selector "R" range	Input	"R" range switch
		Less than 1.0	Selector other than except "R" range		
	B231-10 (L/O)	10–16	Selector "D" range	Input	"D" range switch
		Less than 1.0	Selector other than except "D" range		
	B231-11 (L/R)	10–16	Selector "2" range	Input	"2" range switch
		Less than 1.0	Selector other than except "2" range		
	B231-12 (G)	10–16	Stop light "ON"	Input	Stop light
		Less than 1.0	Stop light "OFF"		

TCM: Transmission Control Module

LINE PRESSURE TEST

The line pressure test checks oil pump and control valve pressure regulator valve function. It will also detect oil leakage.

CAUTION: The line pressure test always requires two persons with the first person checking the tire and tire stopper off the vehicle while the second person performs testing.

Line Pressure Test Procedure

1. Check the level of the engine coolant, the engine oil, and the automatic transmission fluid. Replenish if required.
2. Set the parking brake.
3. Place chocks at the front and rear of each tire.
4. Remove the pressure detection plug at the left side of the transmission.
5. Set a pressure gauge and adapter to the pressure detection plug hole.
   Tools Required:
   5-8840-0004-0 Pressure Gauge
   5-8840-2654-0 Adapter

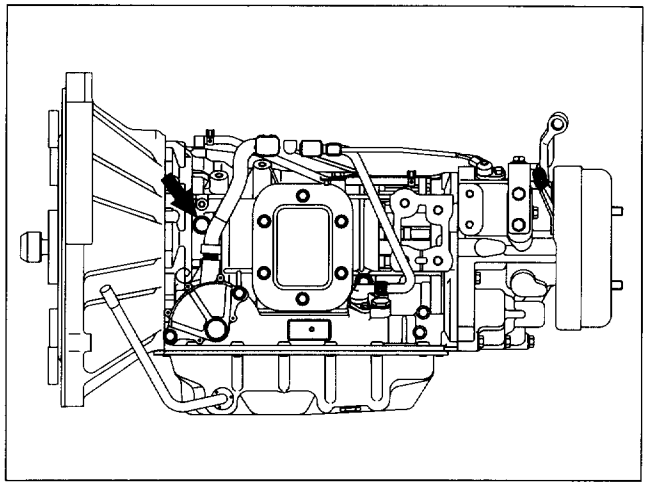


Figure 17. Detection Plug Hole

6. Start the engine and allow it to idle until the ATF temperature reaches 50–80°C (122–176°F) and check the idling rpm.
7. Hold the brake pedal down as far as it will go.
8. Place the selector in the "D" range.
9. Note the pressure gauge reading with the engine idling.
10. While depressing the accelerator pedal to the floor, quickly read the oil pressure at stalling rpm.

CAUTION: Release the accelerator pedal and stop the test if the rear wheels start to turn before the engine reaches the stalling rpm.

11. Repeat the test in the "R" range.

Measure

• Line Pressure kPa (kg/cm²/PSI)

Range	Engine Speed	
	Idling	Stalling
D	529–784 (5.4-8.0/77-114)	990–1480 (10.1-15.1/144-215)
R	755–1127 (7.7-11.5/110-164)	1401–2107 (14.3-21.5/203-306)

12. Install pressure detection plug to the transmission.
13. Tighten the pressure detection plug.

Tighten

• Detection Plug 27 N·m (2.8 kg·m/20 lb·ft)

Line Pressure Test Results	Probable Trouble Area
Line pressure is above the specified limit in all ranges	• Defective or poorly adjusted throttle position sensor • Sticking or short throttle pressure solenoid • Sticking regulator valve • Defective idle switch • Defective kick-down switch
Line pressure is below the specified limit in all ranges	• Poorly adjusted throttle position sensor • Sticking or short throttle pressure solenoid • Sticking regulator valve • Worn oil pump • Defective O/D direct clutch
Line pressure is below the specified limit in "D" ranges	• Oil leakage in "D" range line • Defective front clutch
Line pressure is below the specified limit in "R" ranges	• Oil leakage in "R" range line • Defective rear clutch • 1st and reverse brake malfunction

STALL TEST

The stall test allows you to check the transmission for internal abrasion and the one-way clutch for slippage. Torque converter performance can also be evaluated.

The stall test results together with the road test results will identify transmission components requiring servicing or adjustment.

CAUTION: When the clutch appears to be slipping in a road test, etc., or when the line pressure does not reach a preset value in a line pressure test, do not proceed to a stall test.

Stall Test Procedure

1. Set the parking brake.
2. Place chocks at the front and rear of each tire.
3. Check the level of the engine coolant, the engine oil, and the automatic transmission fluid. Replenish if required.
4. Start the engine and allow it to idle until the engine coolant temperature reaches 70–80°C (158–176°F).
5. Set a tachometer to the engine.
6. Hold the brake pedal down as far as it will go.
7. Place the selector in the "D" range.
8. Gradually push the accelerator pedal to the floor.
   The throttle will fully open.
   Note the engine speed at which the tachometer needle stabilizes.

   Measure

   - Stall speed 1,600–1,900 RPM

9. Release the accelerator pedal.
10. Place the selector in the "N" range.
11. Run the engine at 1,200 RPM for one minute. This will cool the transmission fluid.
12. Repeat Steps 6-11 for the "2", "1 ", and "R" ranges.

    CAUTION: Do not continuously run this test longer than 5 seconds so the transmission does not become overheated.

ROAD TEST

The road test should be performed by two people (one to drive and the other to note the required data) on a lightly traveled ordinary public road.

General Test Items

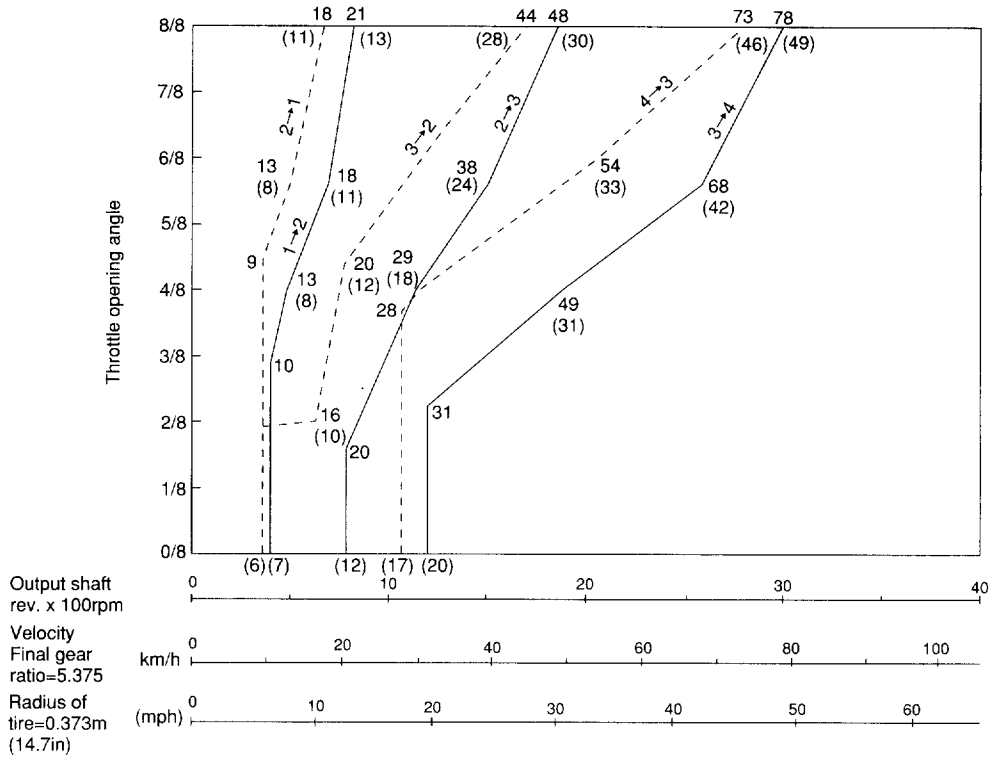
1. Compare the actual automatic shift speeds with the fixed shift schedule.
   a. Perform the diagnosis procedures.
   b. Note the actual shift up, shift down, and lock up speeds on the fixed shift schedule.
2. Check for shock or drag when the transmission shifts from one gear to another.
3. Check that the engine brake functions in the "2" and "1" ranges.
4. Check for abnormal noise or vibration.
   After completing the road test, make the necessary adjustments and repairs to the automatic transmission and related parts.

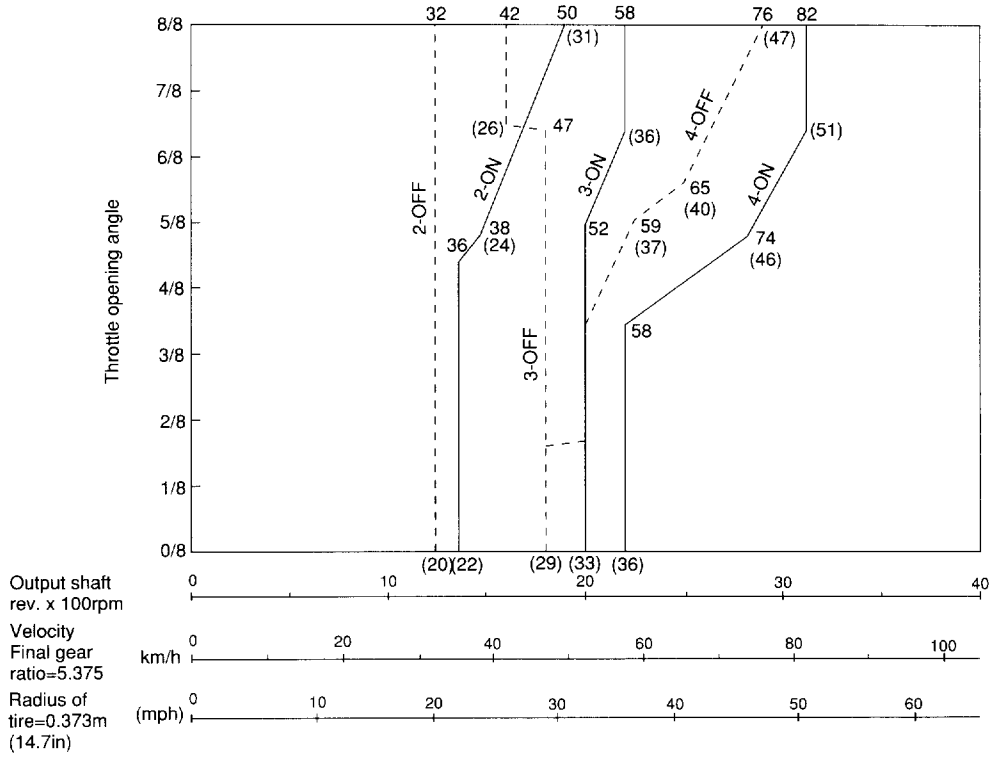
SHIFT POINT DIAGRAM AND LOCK-UP POINT DIAGRAM

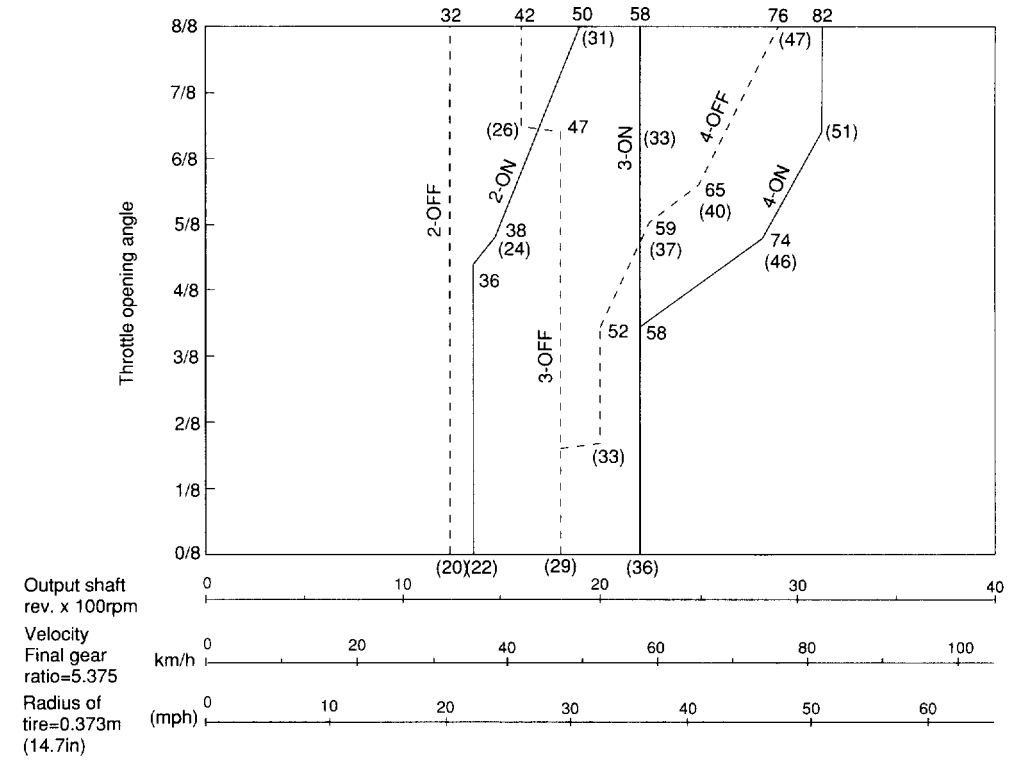
In the shift point diagram and the lock-up point diagram, figures indicate vehicle speeds (in km/h) for the final gear ratio of 5.375 and for the tire radius of 0.373m (215/85R16). And vehicle speeds (in km/h) for other final ratios can be obtained by multiplying figures in this diagram by following coefficients.

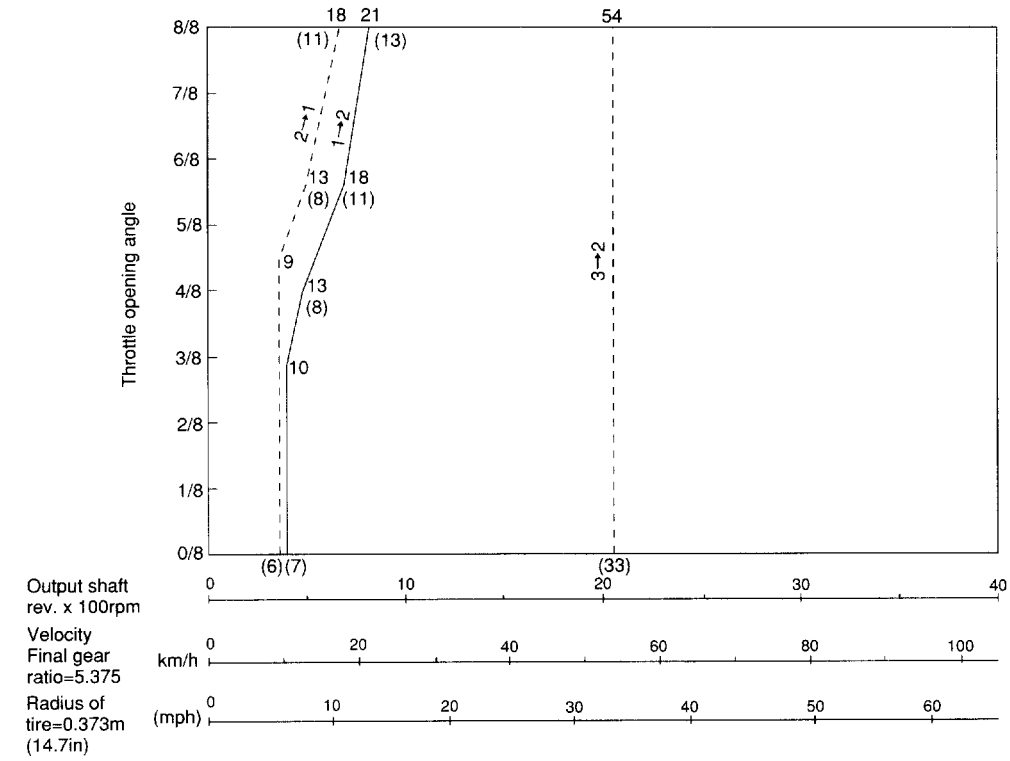
Final Gear Ratio	Tire	Radius	Coefficient
5.375 (43/8)	215/85R16	0.373m	1.000
5.375 (43/8)	215/75R16	0.352m	0.944
5.571(39/7)	7.50-16-10	0.382m	0.988
5.571(39/7)	215/75R17.5	0.373m	0.965

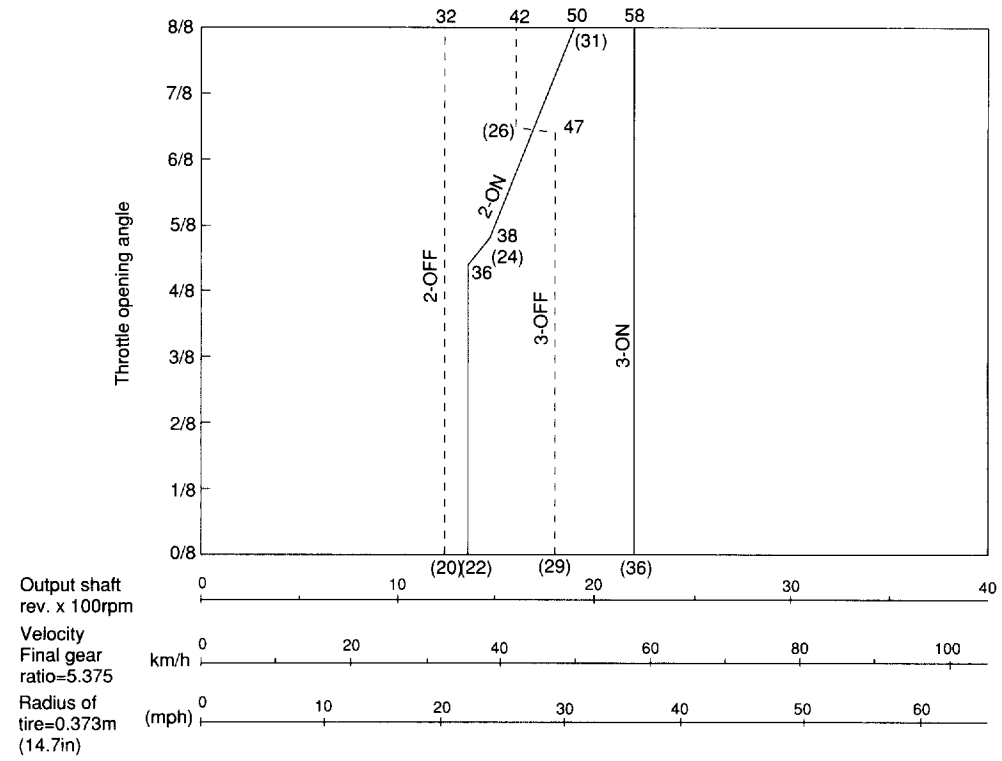
The tolerance to measured values is ±3km/h.

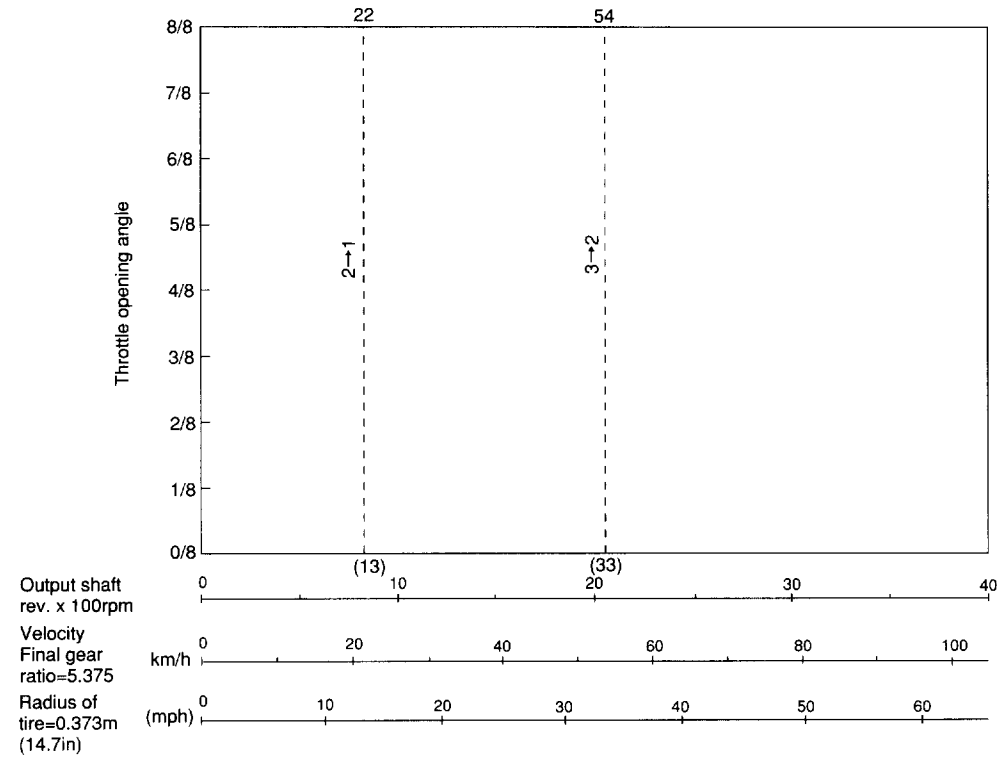
Range \ Diagram	Shift Point Diagram
"D"	

Range \ Diagram	Lock-up Point Diagram
"D" ("O/D off switch" "ON")	

Range \ Diagram	Lock-up Point Diagram
"D" (O/D off switch "OFF")	

Range \ Diagram	Shift Point Diagram
"2"	

Range \ Diagram	Lock-up Point Diagram
"2"	

Range \ Diagram	Shift Point Diagram
"1"	

DIAGNOSIS BY USING SCAN TOOL

TECH 2 SCAN TOOL

In this 450-43LE transmission, diagnosis can be perfomed for electrical faults by using the diagnosis equipment called "TECH 2".

When the check trans light blinks or when an electrical fault in the transmission may probably exist, check diagnostic trouble codes by using the "TECH 2".

For the operations of "TECH 2", refer to following instruction and the User Guide in the "TECH 2" kit.

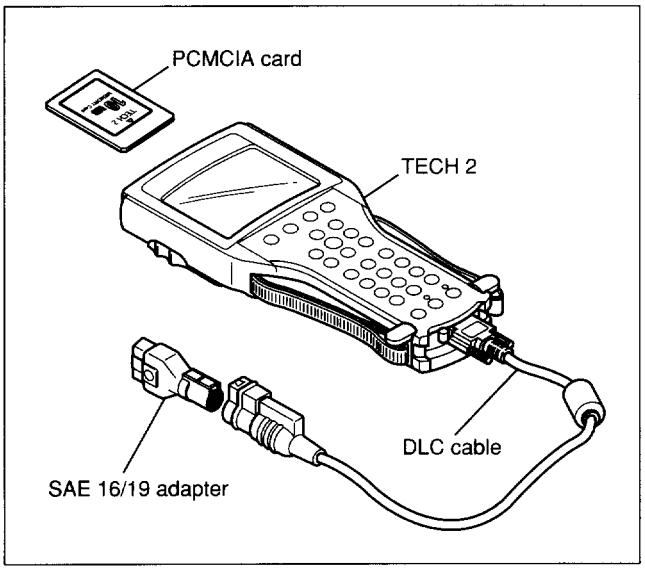


Figure 18. TECH 2 Scan Tool

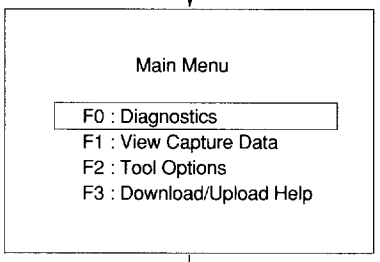
1. Before operating the Isuzu PCMCIA card with the TECH-2, the following steps must be performed:
   1) The Isuzu 99 System PCMCIA card inserts into the TECH-2.
   2) Connect the SAE 16/19 adapter to the DLC cable.
   3) Connect the DLC cable to the TECH-2.
   4) Make sure the vehicle ignition is off.
   5)Connect the TECH-2 SAE 16/19 adapter to the vehicle DLC
   The DLC is the black 16-pin connector and it is tied to the support bracket locating under the brake and clutch fluid tank.
   6) The vehicle ignition turns on.
   7) Push the "PWR(Power)" key.
   8) Verify the TECH-2 power up display.

Figure 19. TECH 2 Display(1)

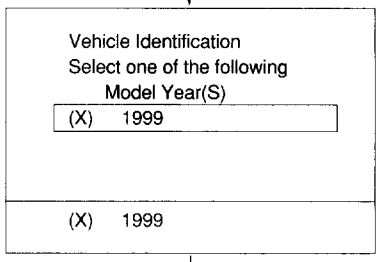
2. Follow the operating procedure below.

① Press "ENTER" key.

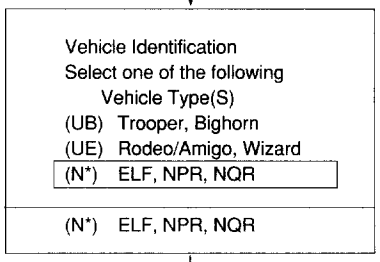
② Press "F0" key, or select "F0 Diagnostics" with selection key and press "ENTER" key.



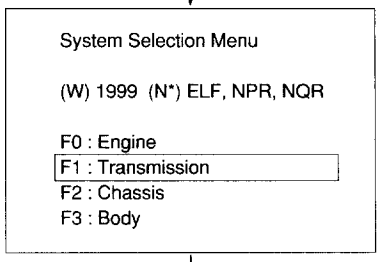
③ Select "(X) 1999" with selection key and press "ENTER" key.



④ Select "(N*) ELF, NPR, NQR" with selection key and press "ENTER" key.



⑤ Press "F1" key, or select "F1 Transmission" with selection key and press "ENTER" key.



Continue to next page.

Figure 20. TECH 2 Display (2)

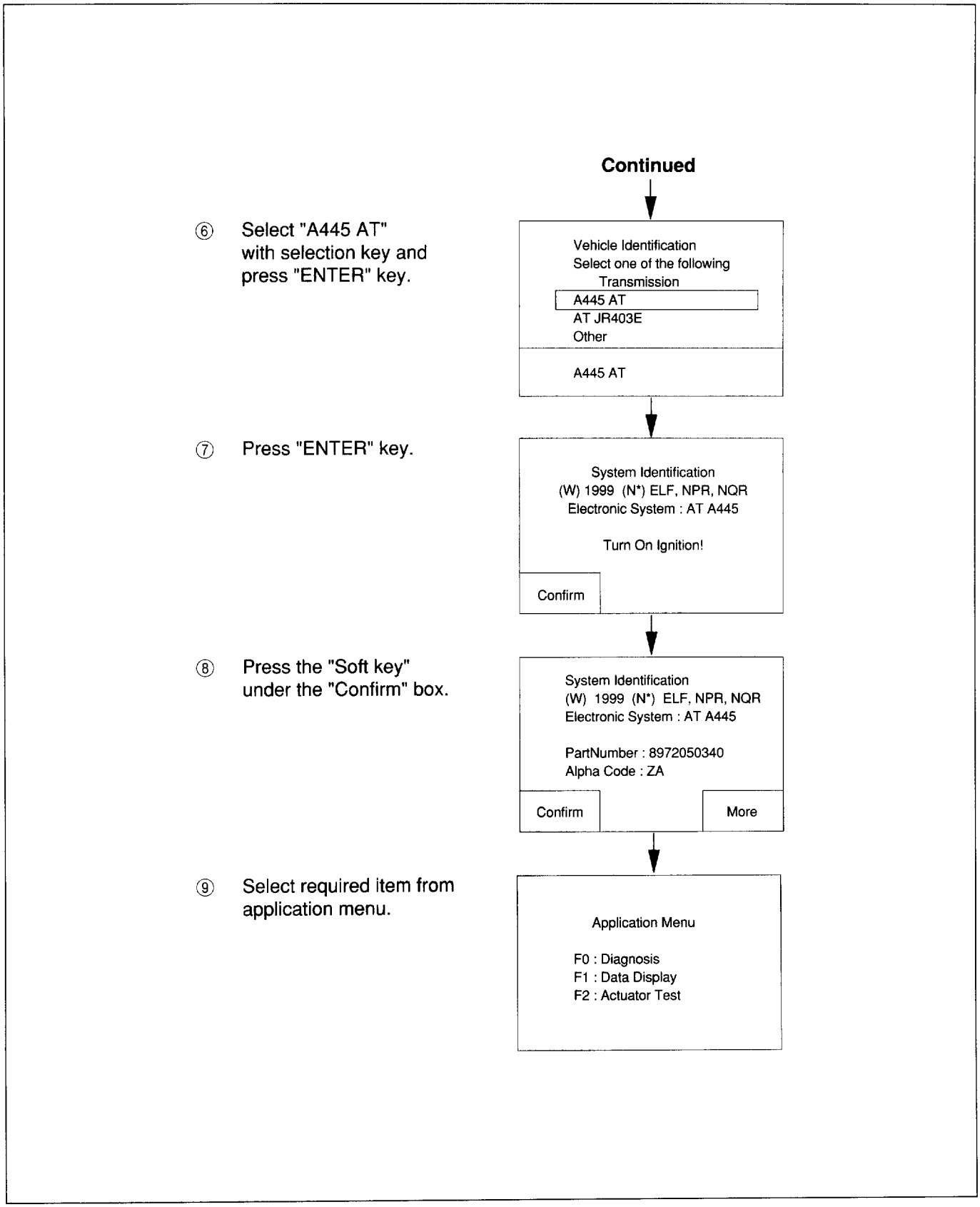
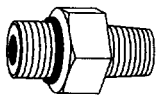


Figure 21. TECH 2 Display (3)

MODE F1: DATA DISPLAY

Item	Key switch ON Engine OFF	Engine running at idle
Current Gear	1	1
Selector Position	P	P
Vehicle Speed Sensor 1 (AT side)	0 km/h	0 km/h
Vehicle Speed Sensor 2 (Meter side)	0 km/h	0 km/h
Engine Speed	0 RPM	700-850 RPM
PC (Line Pressure) Solenoid Desired Current	1.00 A	1.00 A
PC (Line Pressure) Solenoid Actual Current	1.00 A	1.00 A
Engine Runtime	***sec	***sec
TPS (Throttle Position Sensor) Voltage	3.80-4.50V	3.80-4.50V
TPS (Throttle Position Sensor) Angle	0%	0%
ATF Temperature	**°C	**°C
ATF Temperature Sensor Voltage	**V	**V
Battery Voltage	10-16V	10-16V
Inhibitor Switch P	ON 12V	ON 12V
Inhibitor Switch R	OFF 0V	OFF 0V
Inhibitor Switch N	OFF 0V	OFF 0V
Inhibitor Switch D	OFF 0V	OFF 0V
Inhibitor Switch 2	OFF 0V	OFF 0V
Inhibitor Switch 1	OFF 0V	OFF 0V
OD OFF Switch	OFF 12V	OFF 12V
PTO Switch	OFF 0V	OFF 0V
Lock Up Duty (Solenoid)	0%	0%
Idle Signal	OFF 12V	ON 0V
Kick Down Switch	OFF 12V	OFF 12V
BTS Switch (Oil temp. Switch)	OFF 12V	OFF 12V
EXH. Brake Switch	OFF 0V	OFF 0V
Brake Switch	OFF 0V	OFF 0V
Diagnosis Switch	OPEN	OPEN
First Idle Control	OFF 0V	OFF 0V
QWS Switch	OFF 0V	OFF 0V
Shift Solenoid S1	ACTIVE 12V	ACTIVE 12V
Shift Solenoid S2	INACTIVE 0V	INACTIVE 0V
Shift Timing Solenoid ST	INACTIVE 0V	INACTIVE 0V
PTO Solenoid	INACTIVE 0V	INACTIVE 0V
Engine Overrun Warning	OFF 12V	OFF 12V
Transmission Check Light	OFF 12V	OFF 12V
Exhaust Brake Cut	ON 0V	ON 0V
QWS Cut	OFF 12V	OFF 12V

SPECIAL TOOLS

ILLUSTRATION	**TOOL NO.** TOOL NAME
	TECH 2 Scan Tool Kit
	5-8840-0004-0 **(J-29770-A)** Pressure Gauge
	**5-8840-2654-0** **(J-43407)** Adapter

7A3 ON-VEHICLE SERVICE

CONTENTS

SUBJECT	PAGE
Description	7A3- 2
Automatic Transmission Fluid (ATF)	7A3- 2
ATF Level	7A3- 2
ATF Change	7A3- 3
Transmission Control Module (TCM)	7A3- 3
Throttle Position Sensor and Kick-Down Switch	7A3- 4
Inhibitor Switch	7A3- 6
Vehicle Speed Sensor-1	7A3- 8
Vehicle Speed Sensor-2	7A3- 9
Automatic Transmission Fluid (ATF) Temperature Switch	7A3-10
Engine Speed Sensor	7A3-11
Overdrive OFF Switch	7A3-11
Oil Pan	7A3-12
Oil Filler Tube	7A3-13
Oil Strainer	7A3-14
Solenoids	7A3-14
Rear Cover Oil Seal	7A3-15
Vehicle Speed (Speedometer) Sensor Driven Gear	7A3-16
Control Lever Assembly	7A3-17
Control Cable	7A3-18
Transmission Assembly	7A3-20
Torque Converter	7A3-22
Specifications	7A3-23
Special Tools	7A3-23

DESCRIPTION

Before performing on-vehicle service on the automatic transmission, check that the engine idling speed and general engine condition are normal.

AUTOMATIC TRANSMISSION FLUID (ATF)

Inspect

Remove the transmission dipstick to check the condition of the ATF.

Clean the dipstick and look for gum or varnish.

Gum or varnish indicate scorching of the clutch and other parts.

The transmission control module, the transmission unit, and the vehicle must be carefully checked if gum or varnish is present.

ATF LEVEL

Inspect

CAUTION:

Steady the vehicle level on a flat road. Apply the parking brake and block the wheel.

- **An improper oil level (too high or too low) can cause trouble.**
- **Check the idle rpm before starting the level check.**
- **Keep the transmission fully warmed (ATF temperature: 70 - 80°C/ 150 - 176°F) during the check.**

1. Depress the brake pedal and start the engine.
2. With the engine idling, shift the gear slowly in every range from "P" to "L" ranges, and return to the "P" range (figure 1).
3. With the engine idling, remove the level gauge and apply compressed air to remove threads or other foreign items. Insert the level gauge, remove it again, and confirm that the oil level is within the "HOT" range (figure 2).

CAUTION:

- **When checking the oil level at low ATF temperatures (20 - 30°C/ 68 - 86°F) during oil change, etc., adjust the oil level so that it is within the "COLD" range (figure 3). Then, recheck the oil level in the fully warmed condition (70 - 80°C/ 150 - 176°F).**
- **Use the lower level if the oil level varies between the front and back of the level gauge.**

4. If the oil level is low, suspect oil leakage.

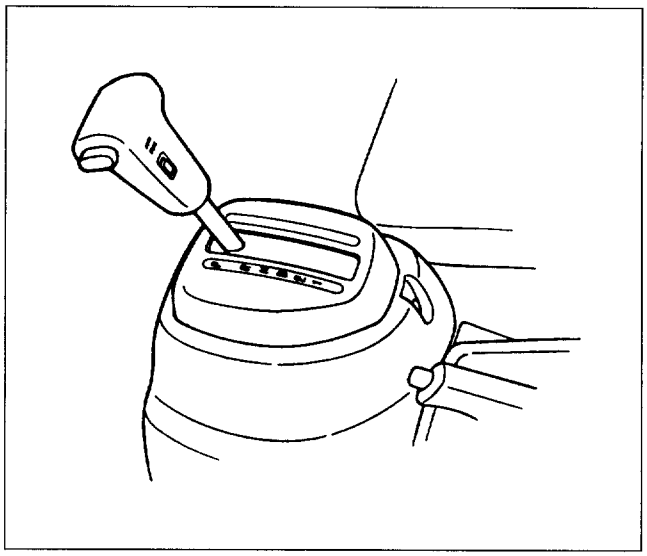


Figure 1. Moving Gear Selector

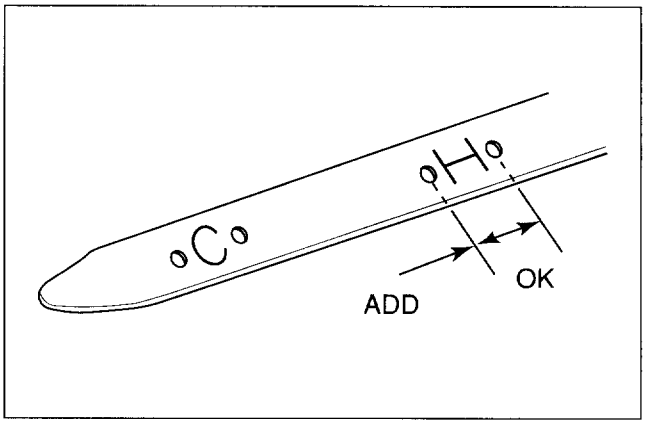


Figure 2. Hot ATF Level

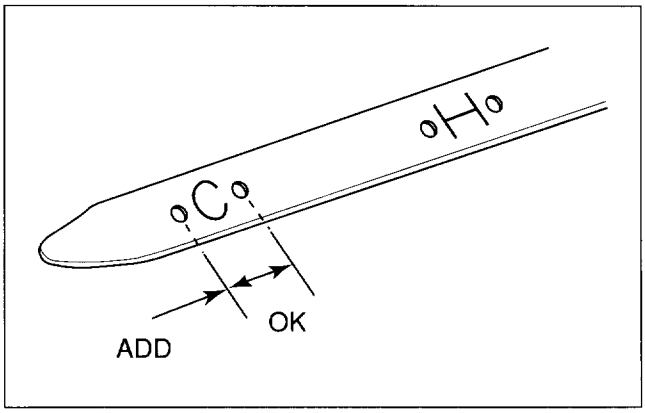


Figure 3. Cold ATF Level

AUTOMATIC TRANSMISSION FLUID (ATF) CHANGE

1. Start the engine and allow it to idle until the ATF reaches a temperature of 40–50°C (104–122°F).
2. Park the vehicle on level ground and block the wheels.
3. Stop the engine.
4. Raise vehicle and support with suitable safety stands.
5. Remove the drain plug from the oil pan and drain the ATF (approximately 4 liters).
6. Remove the oil pan.
7. Inspect the oil pan (details written below).
8. Install the oil pan.

NOTICE: Use new gasket. Clean the oil pan and magnet.

Tighten

- Oil pan bolts 7 N·m (0.7 kg·m / 61 lb·in)

9. Replace the gasket and install the drain plug.

Tighten

- Drain plug 27 N·m (2.8 kg·m / 20 lb·ft)

NOTICE: Do not reuse old washer (gasket). Clean the drain plug (especially the threaded section).

10. Remove the ATF filter element.
11. Install new ATF filter element.
12. Pour about 5 liters of new ATF. Then, add more ATF carefully as necessary using the level gage. Refer to "ATF LEVEL" previously in this section.

CAUTION: Keep the engine idle (do not stop it) during the oil level adjustment.

13. Remove the safety stands and wheel blocks.

Inspect

1. Check the drain plug tip for adhesion of foreign substances.
2. Check the drained ATF for color, smell and inclusion of foreign substances.
3. Check the oil pan bottom and magnet for adhesion of foreign substances.
   If a problem is discovered during those checks, the Automatic transmission must be overhauled.

TRANSMISSION CONTROL MODULE (TCM)

The TCM is located under the meter cluster (figure 4).

Remove or Disconnect

1. Block the wheels.
2. Negative battery cable.
3. Harness connectors (26 pin, 16 pin and 12 pin connectors).
4. Fixing nuts (1).
5. TCM (2).

Install or Connect

1. TCM.
2. Fixing nuts .
3. Harness Connectors.
4. Negative battery cable.
5. Remove the wheel blocks.

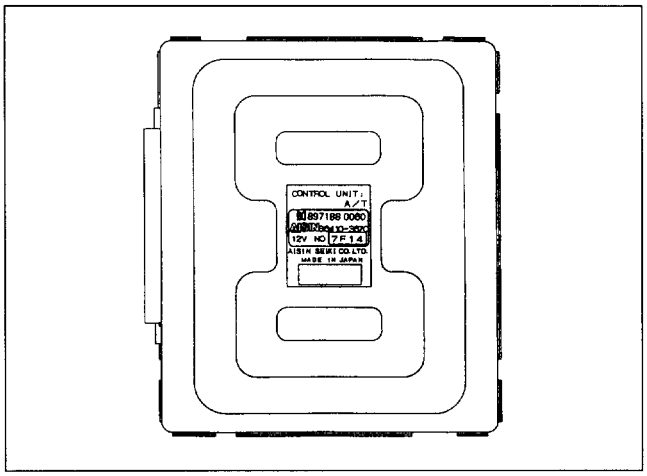
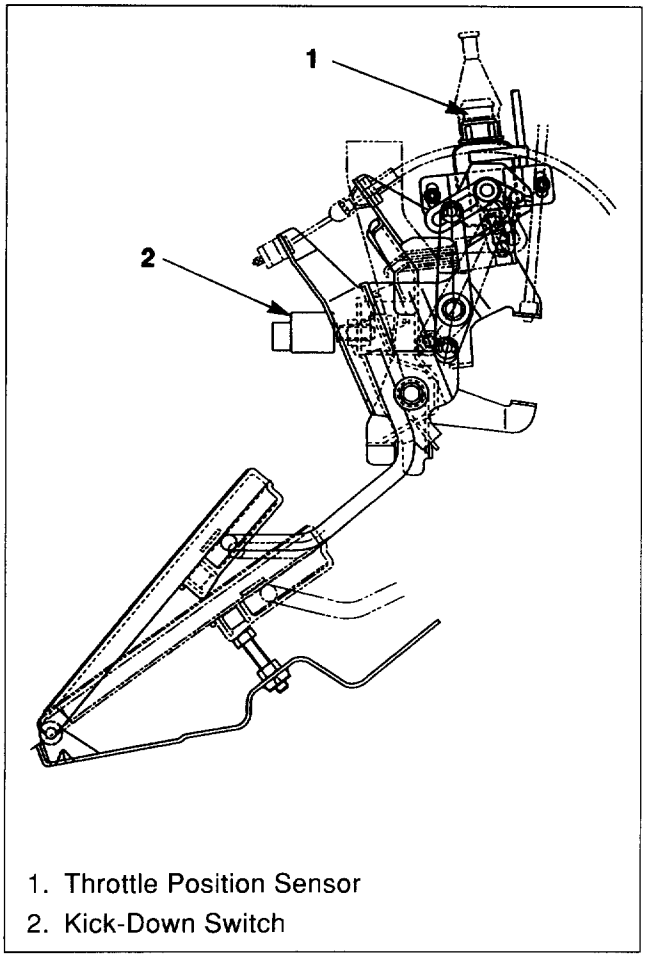


Figure 4. TCM

THROTTLE POSITION SENSOR AND KICK-DOWN SWITCH



1. Throttle Position Sensor
2. Kick-Down Switch

Figure 5. Throttle Position Sensor, Kick-Down Switch and Related Part

Throttle Position Sensor

The throttle position sensor is fitted to the accelerate linkage (figure 5).

The throttle position sensor should be adjusted under the following condition.

1. When shift shock is harsh.
2. When shift up is late.
3. When the following parts replaced.
   - Engine assembly or injection pump
   - Accelerator pedal
   - Throttle position sensor
   - Kick-down switch

Adjust (Figures 6 and 7)

Under the idling condition, set the throttle position sensor according to the following procedure:

1. Block the wheels.
2. Disconnect the battery negative cable.
3. Eliminate play of accelerator pedal cable.
4. Depress the accelerator pedal until injection pump side full open.
5. Adjust the stopper bolt that has no clearance.
6. Remove the throttle position sensor connectors.
7. Throttle position sensor terminals (5), (6), and (7).
   a. Apply 5 volts to the terminal (5).
   b. Measure the output voltage between the terminal(6) and (7) (Terminal (7) is ground).
   c. If the output voltage is 4.1 – 4.5 V, under the above condition, throttle position sensor setting is "OK".
   d. If the reading is beyond 4.1 – 4.5 V, loosen the throttle position sensor fixing bolts, and turn it right or left, so that the specified output voltage be obtained.
      After adjusting, tighten the throttle position sensor fixing bolts.

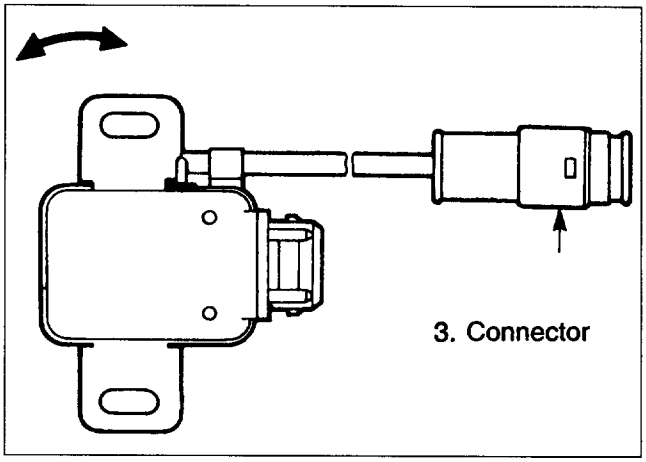


Figure 6. Throttle Position Sensor

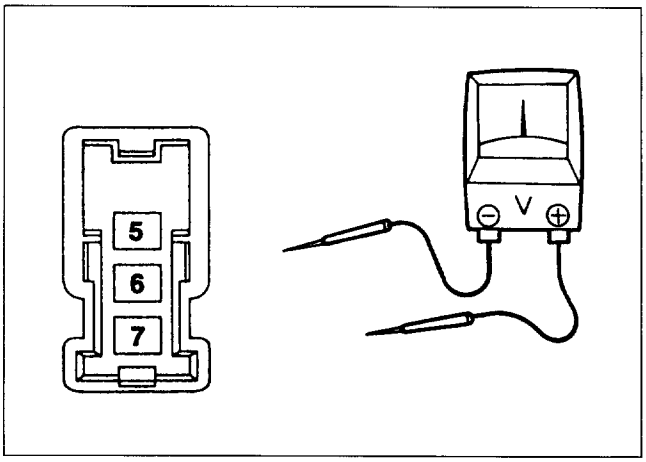


Figure 7. Throttle Position Sensor Connector

Re-learning of the Throttle Position Sensor Voltage

It need re-learning of the throttle position sensor voltage when following parts are replaced or adjusted.

- Engine assembly or injection pump
- Accelerator pedal, cable or linkage
- Throttle position sensor
- Kick-down switch

Clearing Memory of current Value of Throttle Position Sensor Voltage

To clear the memory, perform the following operation at once.

1. Turn the starter switch to ON position.
2. Turn the overdrive OFF switch to "ON" position.
3. Place the select lever in the "1" range.
4. Depress the accelerator pedal fully (= Kick-down switch is ON).
5. Depress the brake pedal (=Brake switch is ON).

If the memory is cleared normally in this procedure, the check trans light flashes 5 times.

Preparation

6. Disconnect FICD connector in order to inhibit it's operation.
7. Turn the starter switch to ON position.
8. Connect terminal 11 and 4 or 5 of the data link connector (DLC). The check trans light becomes flashing (0.4 seconds interval).
9. Place the select lever in the "P" range.

Learning voltage at full open position

10. Depress accelerator pedal by hand until injection pump side opens fully.
11. At the condition in step 10., depress brake pedal more than 3 seconds.
12. After check trans light changes from intermittent flashing → illuminate (3 seconds) → slow flashing 6 times → flashing again, then release the brake pedal. If check trans light does not change to illuminate (3 seconds), clear memory and try again from step 7.

Learning voltage at idle position

13. Start the engine.
14. Depress the accelerator pedal slowly 3 times. (The TCM try to search the point of idle position.)
15. Connect the FICD connector and remove the jumper wire from DLC connector.
    The flashing of check trans light will quits.
    NOTICE: In case of miss-operation, clear the memory and try again from step 6.

Confirmation of learning

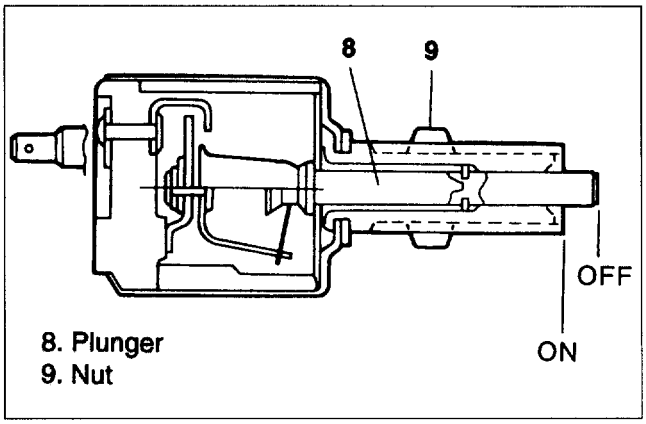
16. Stop the engine. Turn the starter switch to "ON" position, the check trans light becomes flashing again. Depress the accelerator pedal fully (=kick-down switch is ON) and release the pedal slowly.
    If the full open position voltage is out of specification or the TCM learns no value, the check trans light flash continuously. Clear the memory and try again from step 6. If the flashing is stopped, learning operation is completed.

Kick-Down Switch

The kick-down switch is fitted to the accelerator linkage (figure 5).

Adjust (Figure 8)

1. Depress the accelerator pedal by hand until injection pump side opens fully.
2. At the above condition, adjust the projection level of the kick-down switch, so that it may become "ON".
3. "Tick, Tick" sound indicates that the kick-down switch turns to "ON" condition.
4. Connect the battery negative cable.
5. Remove the wheel blocks.



8. Plunger
9. Nut

Figure 8. Kick-Down Switch

INHIBITOR SWITCH

The inhibitor switch is attached to the left side of the transmission.

Inspect (Figures 9, 10and 11)

1. Block the wheels.
2. Disconnect the negative battery cable.
3. Disconnect the control cable from the lever.
4. Remove the harness connector cover and disconnect the harness connectors (figure 11).
5. Use a ohmmeter to check the inhibitor switch continuity between the following terminals (figure 10).
6. Place the select lever in the "N" range (figure 9).

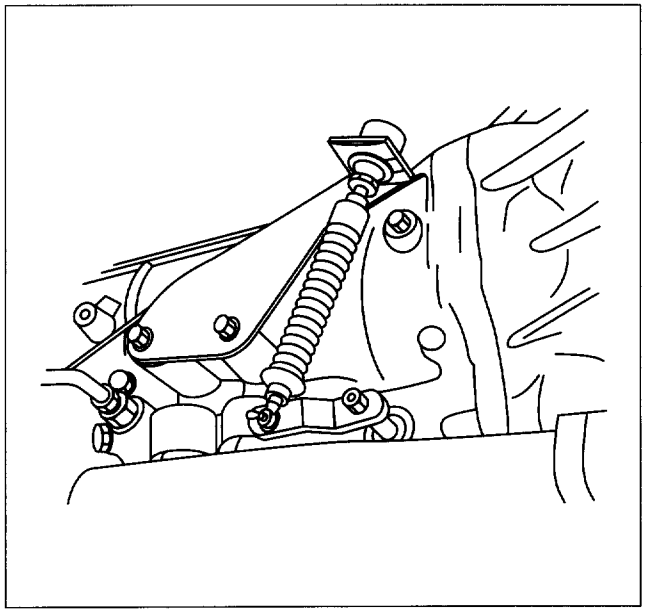


Figure 9. Selector Lever

7. Move the select lever to either side.
   Check the inhibitor switch continuity between the terminals shown in Step 5.
   The continuity readings should remain fairly steady as the select lever is moved.
   If there is no continuity or the continuity is intermittent, the inhibitor switch must be reinstalled correctly.
   After reinstallation, if there is still a problem with the inhibitor switch continuity, the switch must be replaced.
8. Connect the control cable to the lever.
9. Connect the harness connector and install the cover (figure 11).

	1	2	3	4	5	6	7	8	9
P				○			○	○	○
R						○	○		
N					○		○	○	○
D			○				○		
2		○					○		
1	○						○		

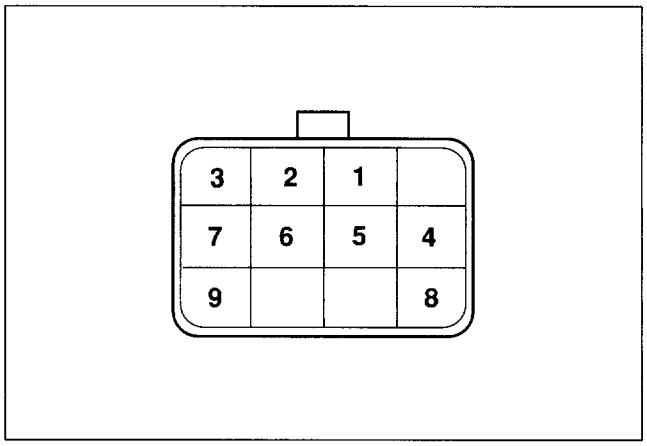


Figure 10. Inhibitor Switch Connector

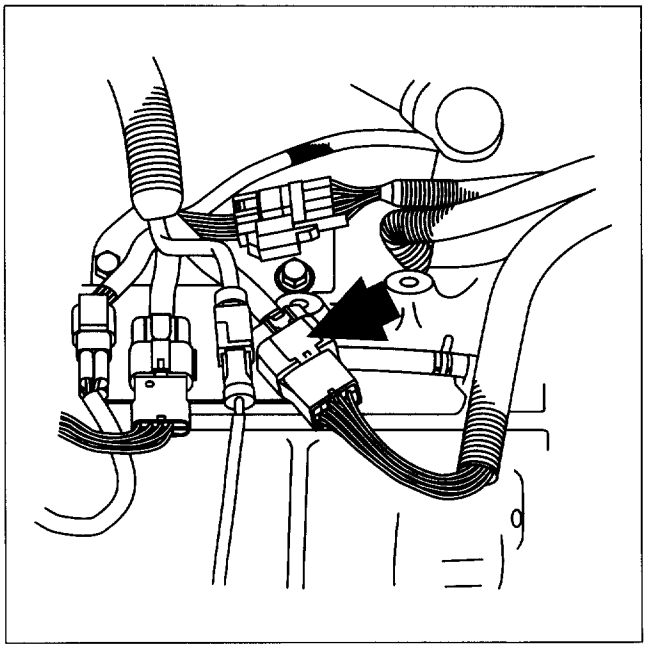


Figure 11. Harness Connector Location

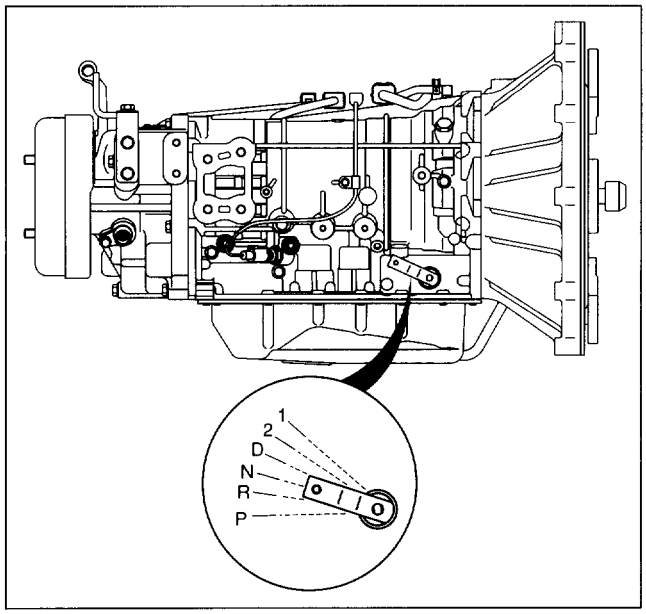


Figure 12. Moving Select Lever

Remove or Disconnect (Figure 13)

1. Nut retainer.
2. Loosen the nut.
3. Remove the inhibitor switch bolts.
4. Inhibitor switch from the transmission.

Install or Connect (Figures 13 and 14)

1. Place the select lever in the "N" range.
2. Assemble the inhibitor switch to the end of the shaft (A).

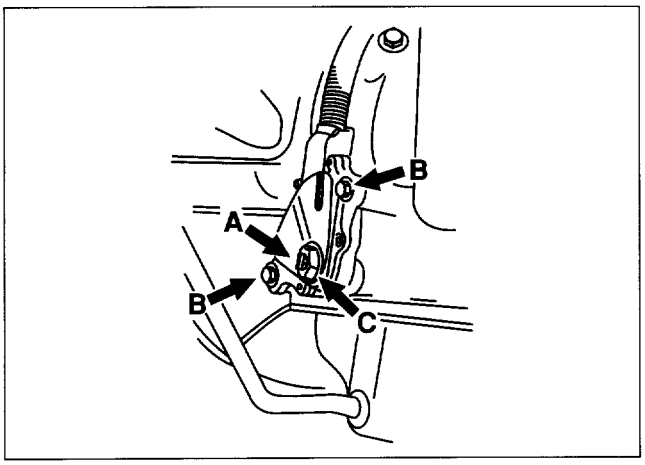


Figure 13. Inhibitor Switch

3. Temporarily tighten the inhibitor switch bolts (B).
4. Tighten the nut (C).

Tighten

- Inhibitor switch nut 7 N·m (0.7 kg·m / 61 lb·in)

5. Loosen the two temporarily tightened bolts and move the inhibitor switch as necessary to align the reference line (D) with the groove (E).

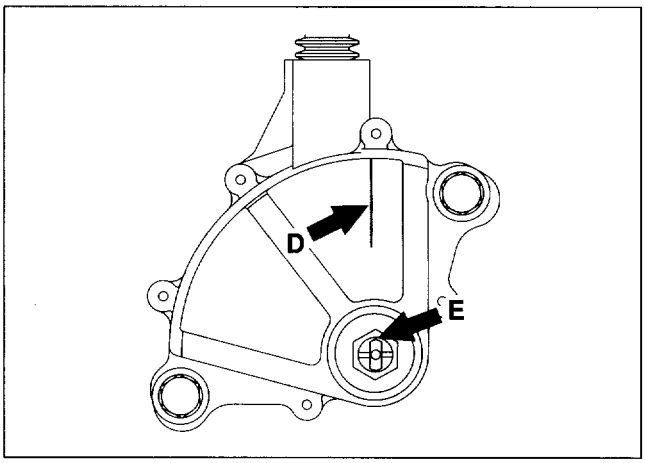


Figure 14. Adjusting Inhibitor Switch

6. Steadying the inhibitor switch with one hand, tighten the two bolts.

Tighten

- Inhibitor switch bolts 12.5 N·m (1.25 kg·m / 109 lb·in)

7. Bend the nut retainer of the inhibitor switch at two places.

VEHICLE SPEED SENSOR-2

Vehicle speed sensor-2 is attached on the speedometer driven gear assembly.

Inspect (Figure 15)

1. Block the wheels.
2. Disconnect the negative battery cable.
3. Disconnect the harness connector from vehicle speed sensor 2.
4. Connect the vehicle speed sensor connector terminal (1) to the battery (+) terminal and terminal (2) to the battery (-) terminal.
5. Connect a resistance of 1.3 kΩ to 1.5 kΩ (1.4 W or more) between terminals (1) and (3).

CAUTION: Be extremely careful not to connect the battery (+) terminal to the vehicle speed sensor terminal(3).
This may damage the vehicle speed sensor.

6. Rotate the shaft of the vehicle speed sensor slowly and measure the voltage at both ends with a digital voltmeter.

Measure

- The voltage, with one rotation of vehicle speed sensor shaft, fluctuates four times in the following range: 10 to 14 V ◄► 2V or less.

7. Replace the sensor when the result of inspection is found abnormal.

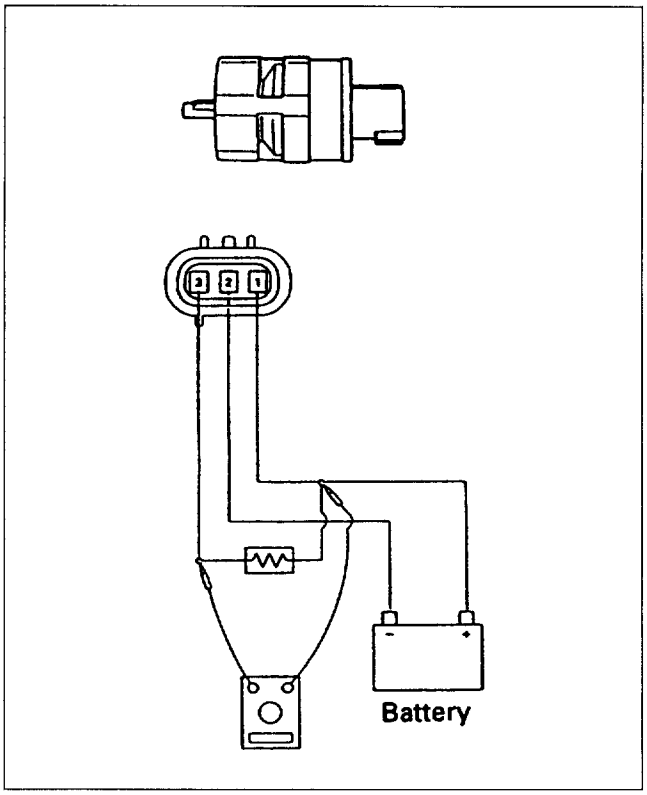


Figure 15. Vehicle Speed Sensor-2

Remove or Disconnect

1. Remove cover and clip.
2. Harness connector.
3. Vehicle speed sensor with key rod.

Install or Connect

1. Vehicle speed sensor with key rod.

Tighten

- Vehicle speed sensor 27 N·m (2.8 kg·m / 20 lb·ft)

2. Harness connector.
3. Cover and clip.
4. Negative battery cable.
5. Remove wheel blocks.

VEHICLE SPEED SENSOR-1

The vehicle speed sensor-1 is attached on the transmission rear cover (figure 17).

Inspect (Figure 16)

1. Block the wheels.
2. Disconnect the negative battery cable.
3. Disconnect the harness connector.
4. Use a ohmmeter to measure the resistance between terminals (1) and (2).

Measure

- Resistance 560 – 680 Ω at approx. 20°C (68°F)

5. If the measured value is outside the specified range, the vehicle speed sensor-1 must be replaced.

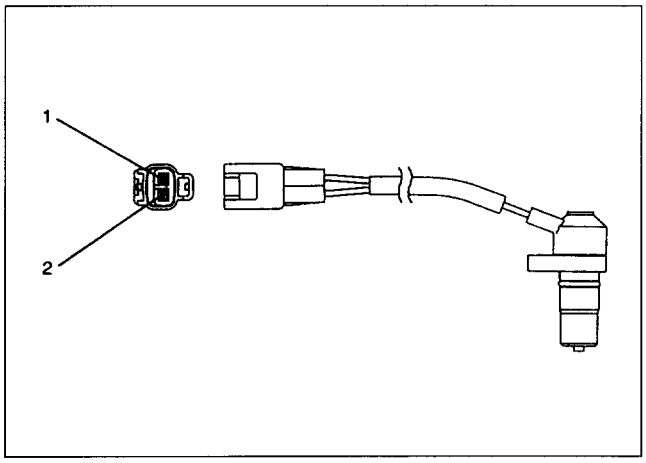


Figure 16. Vehicle Speed Sensor-1

Remove or Disconnect (Figure 17)

1. Support transmission with a transmission jack.
2. Remove the mount bolt (8 pcs) from the crossmember. Then lower the transmission assembly slightly.
3. Harness connector.
4. Fixing screw.
5. Vehicle speed sensor 2 from transmission rear cover.

Install or Connect (Figure 17)

1. Apply grease to the new O-ring then attach to the vehicle speed sensor.
2. Vehicle speed sensor to the rear cover.
3. Fixing screw.

Tighten

- Vehicle speed sensor screw 8 N·m (0.8 kg·m / 69 lb·in)

4. Harness connector.
5. Raise the transmission jack and install mount bolt.
6. Negative battery cable.
7. Remove the wheel blocks.

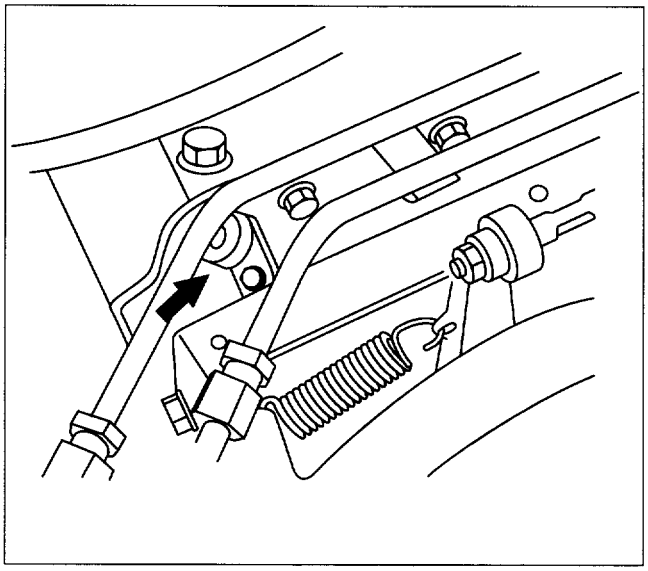


Figure 17. Vehicle Speed Sensor-1

AUTOMATIC TRANSMISSION FLUID (ATF) TEMPERATURE SWITCH

The ATF temperature switch fitted to the right side of the transmission (figure 18).

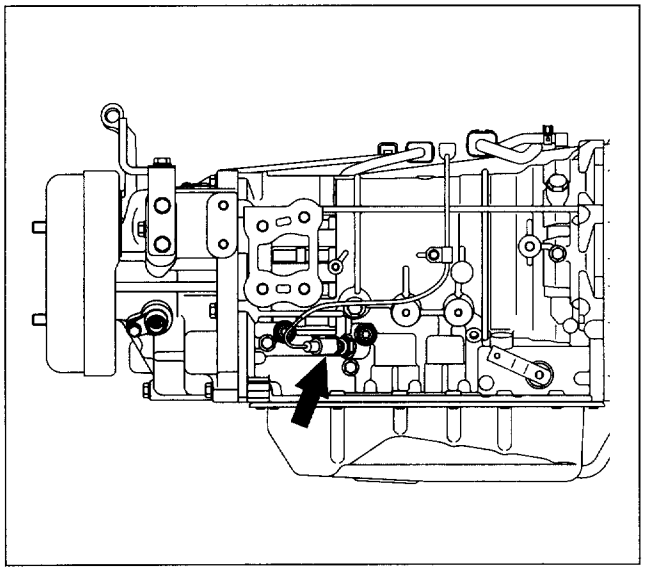


Figure 18. ATF Temperature Switch

Remove or Disconnect (Figure 18)

1. Harness connector and harness clip.
2. ATF temperature switch.

Inspect (Figure 19 and 20)

1. Heat ATF in a container and place the ATF temperature switch.
2. Check the electrical continuity between the switch terminal and the switch body.

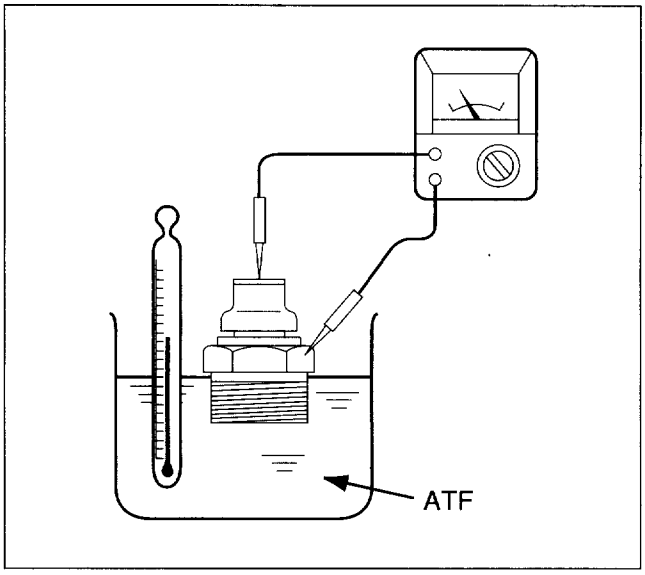


Figure 19. Testing the ATF Temperature Switch

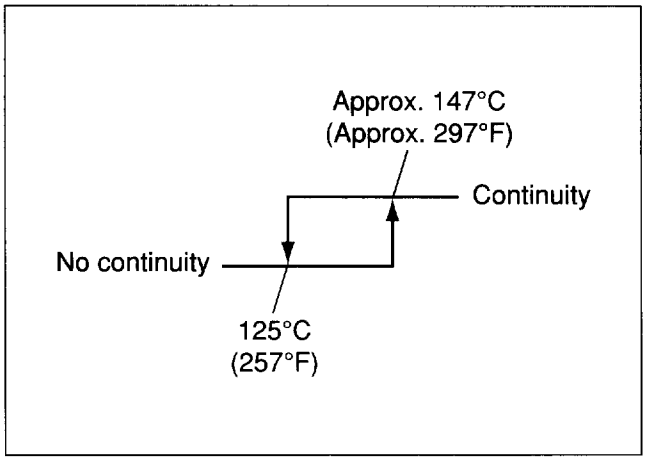


Figure 20. Continuity of the ATF Temperature Switch

Install or Connect (Figure 18)

1. ATF temperature switch.

Tighten

- ATF temperature switch 25 N·m (2.6 kg·m / 18 lb·ft)

2. Harness connector and harness clip.

ENGINE SPEED SENSOR

The engine speed sensor attached to left side of the flywheel housing (figure 21).

Inspect (Figure 22)

1. Block the wheels.
2. Disconnect the negative battery cable.
3. Use a ohmmeter to measure the resistance between terminal (1) and (2).

Measure

- Resistance 670 – 1000 Ω

4. Replace the sensor when the result of inspection is found abnormal.

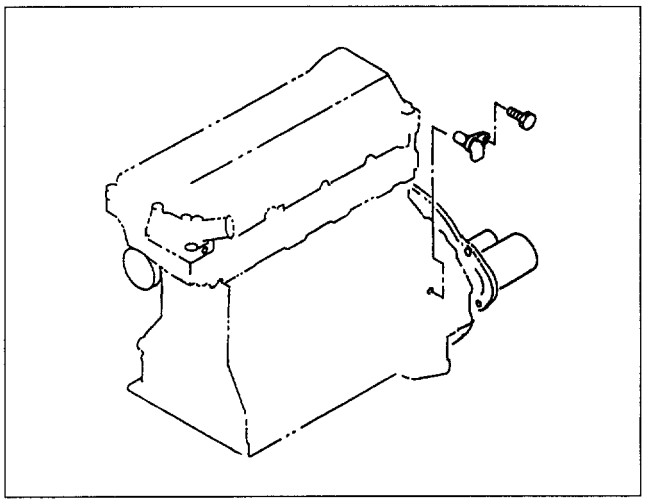


Figure 21. Engine Speed Sensor Location

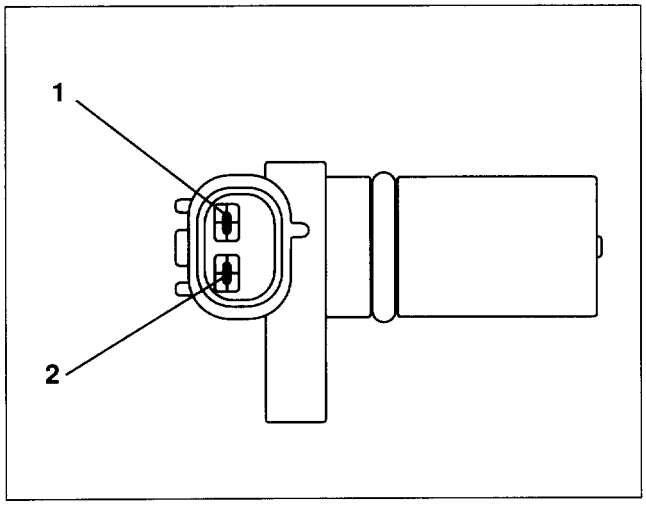


Figure 22. Engine Speed Sensor

Remove or Disconnect

1. Harness connector.
2. Engine speed sensor.

Install or Connect

1. Engine speed sensor.

Tighten

- Engine speed sensor 8 N·m (0.8 kg·m / 69 lb·in)

2. Harness connector.
3. Negative battery cable.
4. Remove wheel blocks.

OVERDRIVE OFF SWITCH

LHD model :

Inspect (Figure 23-A)

1. Block the wheels.
2. Disconnect the negative battery cable.
3. Remove the select lever cover
4. Disconnect the harness connector
5. Check continuity between terminals (3) and (4).
6. Replace the overdrive off switch when the result of inspection is found abnormal.
7. Connect the harness connector.
8. Connect negative battery cable.
9. Remove wheel blocks.

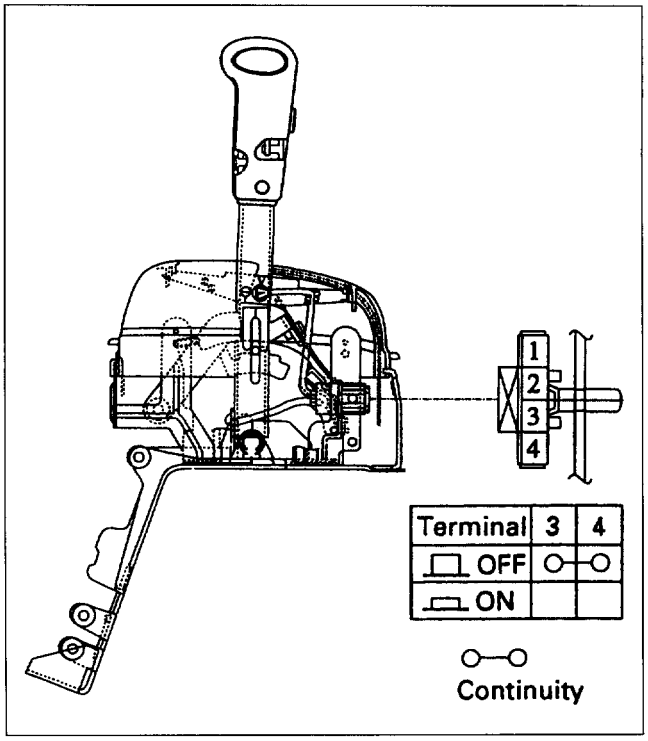


Figure 23-A. Overdrive OFF switch (LHD model)

RHD model :

Inspect (Figure 23-B)

1. Block the wheels.
2. Disconnect the negative battery cable.
3. Remove the select lever cover.
4. Disconnect the harness connector.
5. Check continuity between terminals (9) and (10).
6. Replace the overdrive off switch when the result of inspection is found abnormal.
7. Connect the harness connector.
8. Install the select lever cover.
9. Connect negative battery cable.
10. Remove wheel blocks.

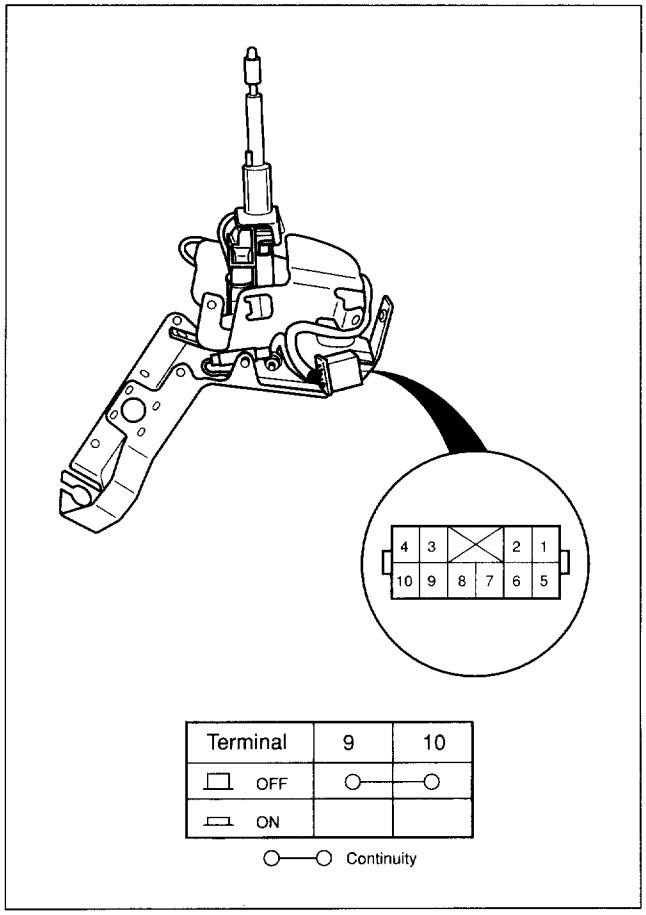


Figure 23-B. Overdrive OFF switch (RHD model)

OIL PAN

Remove or Disconnect

Tool Required:
5-8840-2153-0 Oil Pan Seal Cutter

1. Block the wheels.
2. Negative battery cable.
3. Raise vehicle and support with suitable safety stands.
4. Drain the Automatic Transmission Fluid (ATF). Refer to "ATF CHANGE" previously in this section.
5. Remove the oil pan bolts (20 pcs). Leave several bolts attached (2-3 pitch).
6. Insert an oil pan seal cutter from a corner of the oil pan and separate the oil pan (figure 24).

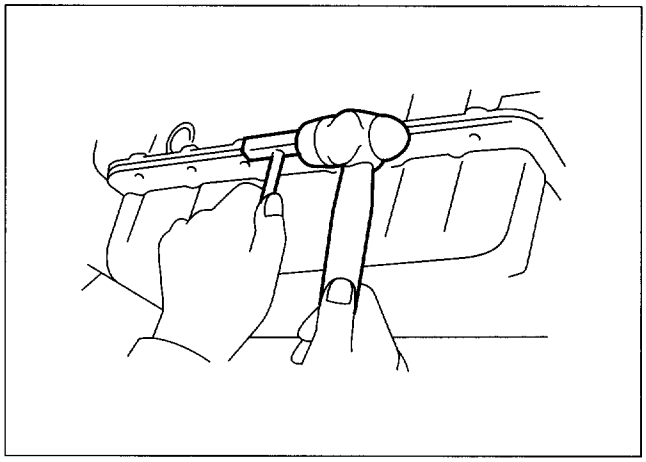


Figure 24. Oil Pan Seal Cutter

CAUTION:
Drive the oil pan cutter carefully. Do not deform the oil pan.
The oil pan cannot be emptied completely. Do not tilt.

Install or Connect

1. Clean the oil cleaner magnet and set it to the oil pan (figure 25).

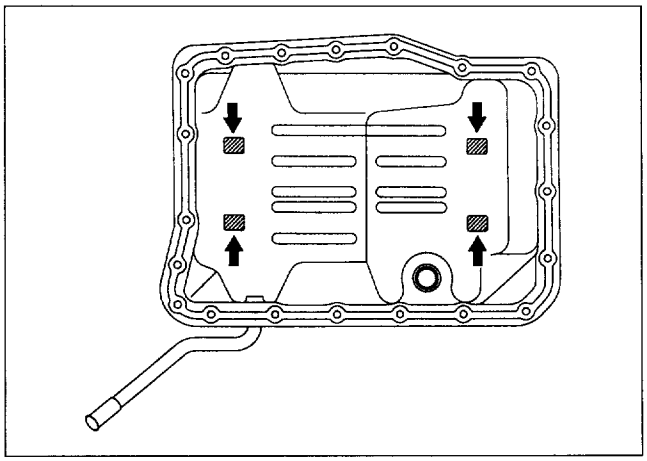


Figure 25. Magnet

2. Remove the sealant in the contact surface between the transmission case and the oil pan.

   CAUTION: Work carefully to keep the contact surface between the transmission case and the oil pan free of ATF.

3. Apply sealant (ThreeBond 1281B or equivalent) and attach the oil pan to the transmission case.

   CAUTION: The sealant must be 2-3 mm (0.03-0.12 in.) diameter without interruption. Assemble the oil pan within 10 minutes after the sealant is applied (figure 26).

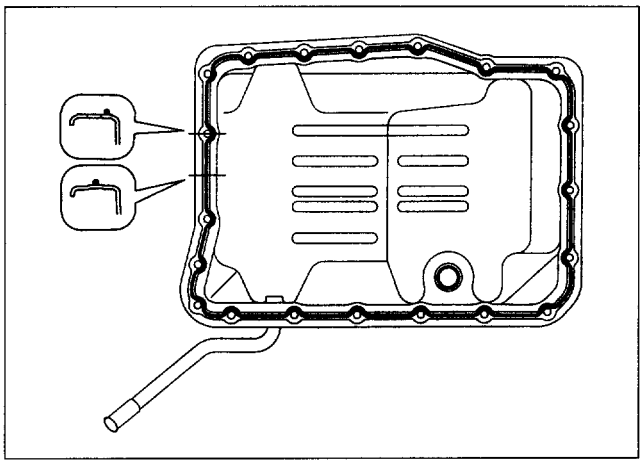


Figure 26. Sealant

4. Oil pan to the transmission case and tighten the oil pan bolts.

   Tighten

   - Oil pan bolts 7 N·m (0.7 kg·m / 61 lb·in)
   - Drain plug 27 N·m (2.8 kg·m / 20 lb·ft)

   CAUTION: Tighten the bolts evenly in several times.

5. Refill the transmission with new ATF. Refer to "ATF CHANGE".
6. Negative battery cable.
7. Remove safety stands.
8. Remove wheel blocks.

OIL FILLER TUBE

Remove or Disconnect (Figure 27)

1. Block the wheels.
2. Negative battery cable.
3. Remove the oil level gauge.
4. Remove the nut from bracket, then remove the oil filler tube with O-ring.

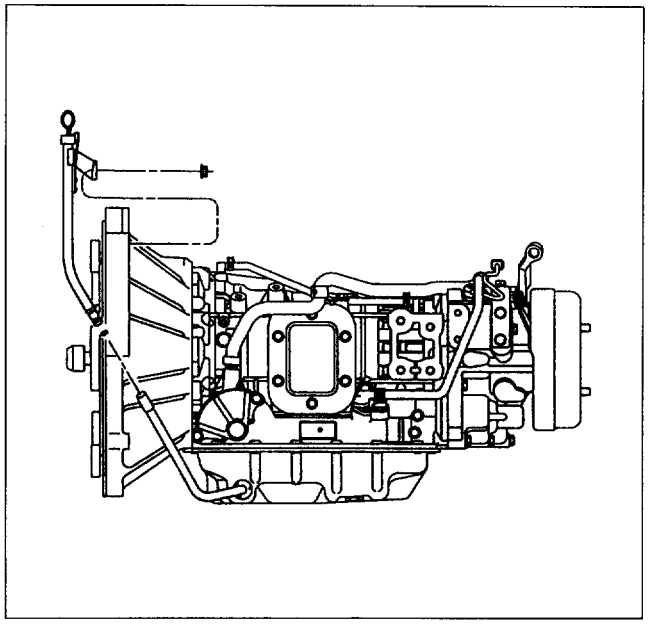


Figure 27. Oil Filler Tube

Install or Connect (Figure 27)

1. Oil filler tube with O-ring.

   Tighten

   - Oil filler tube nut 47 N·m (4.8 kg·m / 35 lb·ft)

2. Install level gauge.
3. Negative battery cable.
4. Remove wheel blocks.

OIL STRAINER

Remove or Disconnect (Figure 28)

1. Block the wheels.
2. Negative battery cable.
3. Raise vehicle and support with suitable safety stands.
4. Oil pan.
   Refer to "OIL PAN" previously in this section.
5. Oil strainer bolts (4 pcs), and then oil strainer.

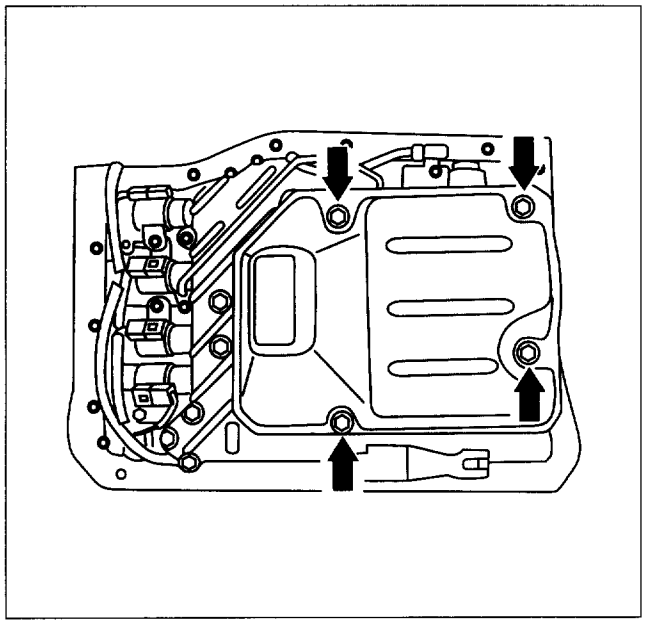


Figure 28. Oil Strainer

Inspect

Check oil pan bottom and oil strainer mesh for foreign substances (facing of clutches and metal flakes, etc.).

Install or Connect (Figure 28)

1. Oil strainer.

   Tighten

   - Oil strainer bolts 10 N·m (1.0 kg·m / 87 lb·in)

2. Oil pan.
   Refer to "OIL PAN" previously in this section.
3. Negative battery cable.
4. Remove safety stands.
5. Remove wheel blocks.

SOLENOIDS

Inspect

1. Block the wheels.
2. Disconnect the negative battery cable.
3. Oil pan.
   Refer to "OIL PAN" previously in this section.
4. Disconnect the connectors from the solenoids. Use the ohmmeter to measure the resistance of each solenoid.

   Measure

Solenoid	Resistance (Ω) (at approx. 20°C/68°F)
Timing solenoid	11 - 15
No. 1 Shift solenoid	
No. 2 Shift solenoid	
Lock-up solenoid	
Line pressure solenoid	3.7—4.1

Remove or Disconnect (Figure 29)

1. Loosen the bolts and remove the solenoids.

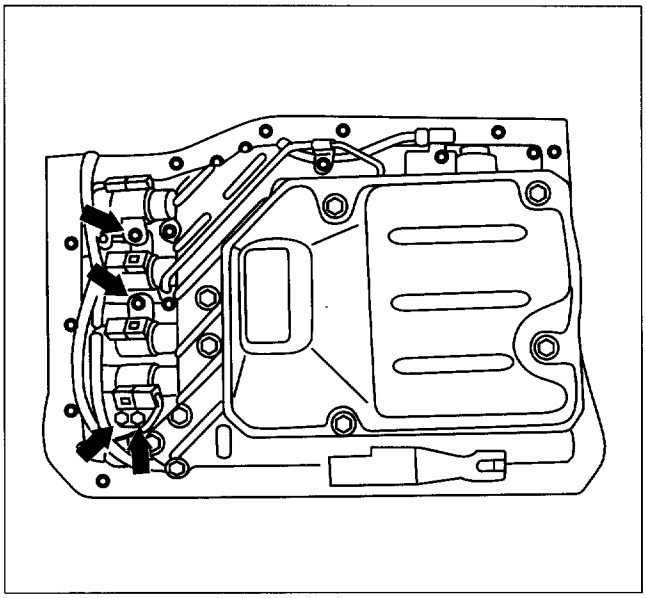


Figure 29. Solenoids

Install or Connect (Figure 29)

1. Install solenoids and tighten the bolts.

   Tighten

   - Solenoid bolts 10 N·m (1.0 kg·m / 87 lb·in)

REAR COVER OIL SEAL

Remove or Disconnect (Figure 30)

Tool Required:
5-8840-0027-0 Rear Oil Seal Remover
5-8840-0019-0 Sliding Hammer

1. Block the wheels.
2. Negative battery cable.
3. Raise vehicle and support with suitable safety stands.
4. Reference mark the flange yoke to the parking brake drum.
5. Propeller shaft.
7. Lock nut.
   Make sure to raise the caulking of the lock nut. Apply the parking brake or move the select lever to the "P" range to prevent the output shaft from turning.
8. Remove the O-ring using a screwdriver.
9. Release the parking brake and remove the parking brake drum.
10. Drive coupling from output shaft.
11. Remove parking brake assembly.
11. Remove the oil seal using oil seal remover.

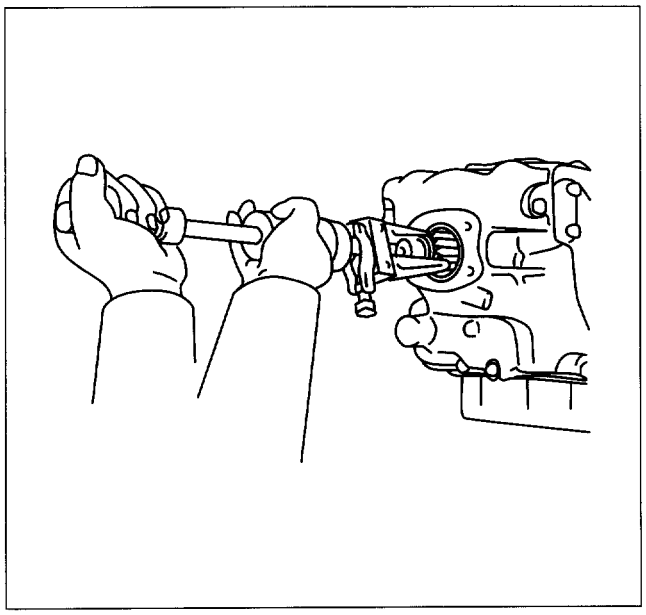


Figure 30. Rear Cover Oil Seal Removal

Install or Connect

Tool Required:
5-8840-2345-0 Rear Oil Seal Installer

1. Apply grease to the new oil seal lip.
2. Drive the oil seal to the rear cover end surface using oil seal installer (figure 31).

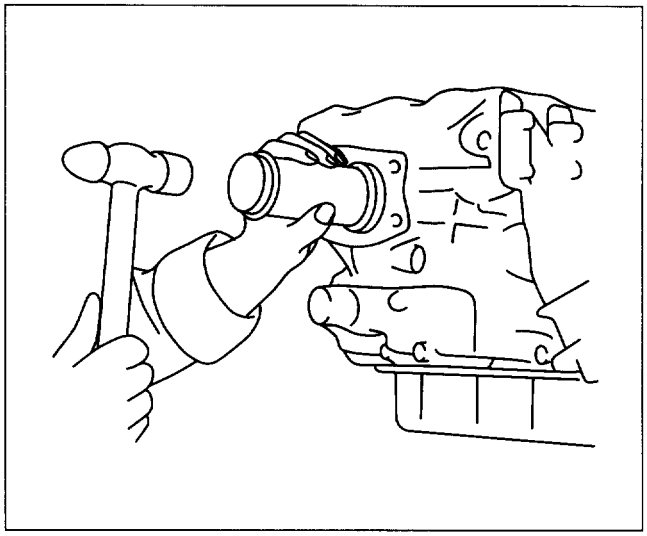


Figure 31. Rear Cover Oil Seal Installation

CAUTION: Drive the oil seal evenly. Take care not to damage or deform the oil seal.

3. Parking brake assembly.

Tighten

- Parking brake bolts 83 N·m (8.5 kg·m / 61 lb·ft)

4. Drive coupling to the output shaft.

CAUTION: Take care not to damage the oil seal lip .

5. Apply the parking brake or move the select lever to the "P" range to prevent the output shaft from turning.
6. New O-ring and new lock nut.

Tighten

- Driver coupling nut 170 N·m (17.3 kg·m / 125 lb·ft)

CAUTION: Always install a new lock nut. Never reuse the original coupling nut.

- Stake nut by chisel (figure 32).

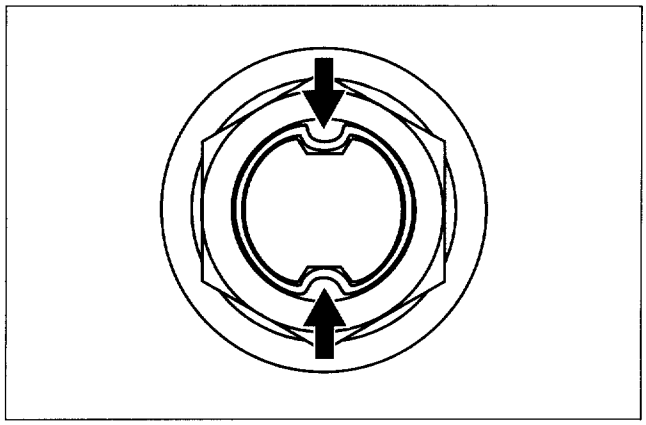


Figure 32. Lock Nut

7. Parking brake drum.
8. Line up reference mark and install propeller shaft to the driver coupling.

Tighten

- Propeller shaft nuts 102 N·m (10.4 kg·m / 75 lb·ft)

9. Negative battery cable.
10. Remove safety stands.
11. Remove wheel blocks.

VEHICLE SPEED (SPEEDOMETER) SENSOR DRIVEN GEAR

Remove or Disconnect (Figures 33 and 34)

1. Block the wheels.
2. Negative battery cable.
3. Raise vehicle and support with suitable safety stands.
4. Harness clip (1) and protector (2).

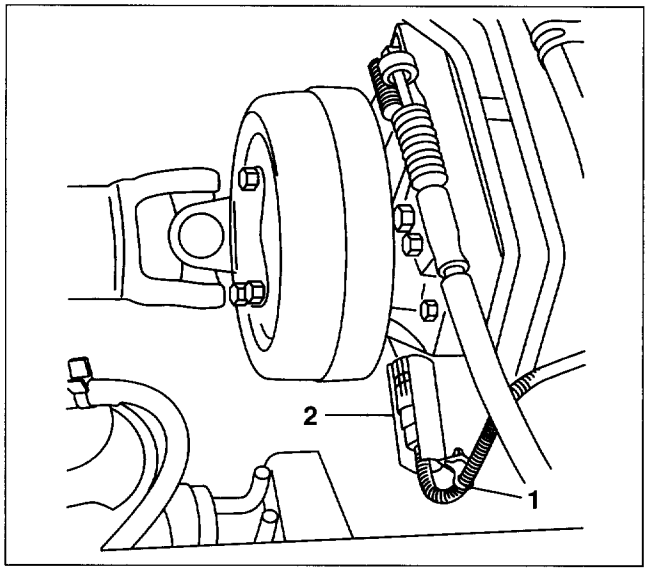


Figure 33. Vehicle Speed Sensor Connector

5. Wiring connector.
6. Vehicle speed sensor (3) with key rod.
7. Fixing bolt (4) and plate (5).
8. Driven gear assembly (6).
9. Remove clip (7) and disassemble driven gear assembly.

Install or Connect (Figures 33 and 34)

1. Driven gear assembly (6).
2. Install clip (7).
3. Plate (5) and fixing bolt (4).

Tighten

- Driven gear fixing bolt 12.5 N·m (1.25 kg·m / 109 lb·in)

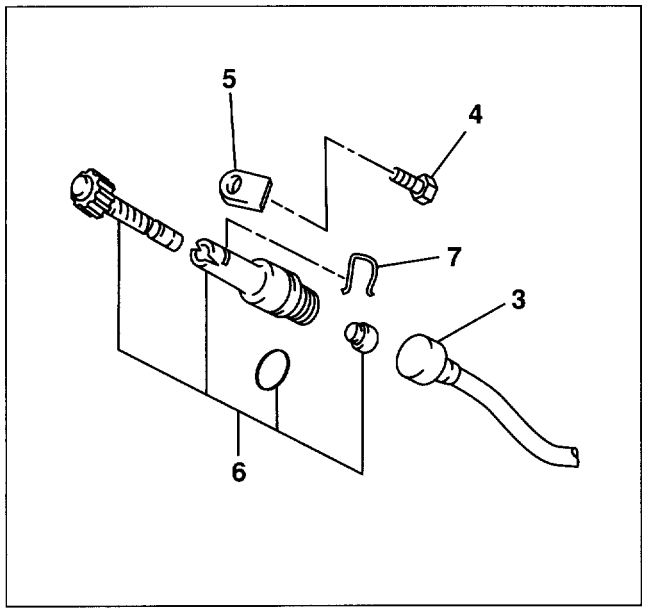


Figure 34. Vehicle Speed Sensor and Driven Gear Assembly

4. Vehicle speed sensor (3) with key rod.

Tighten

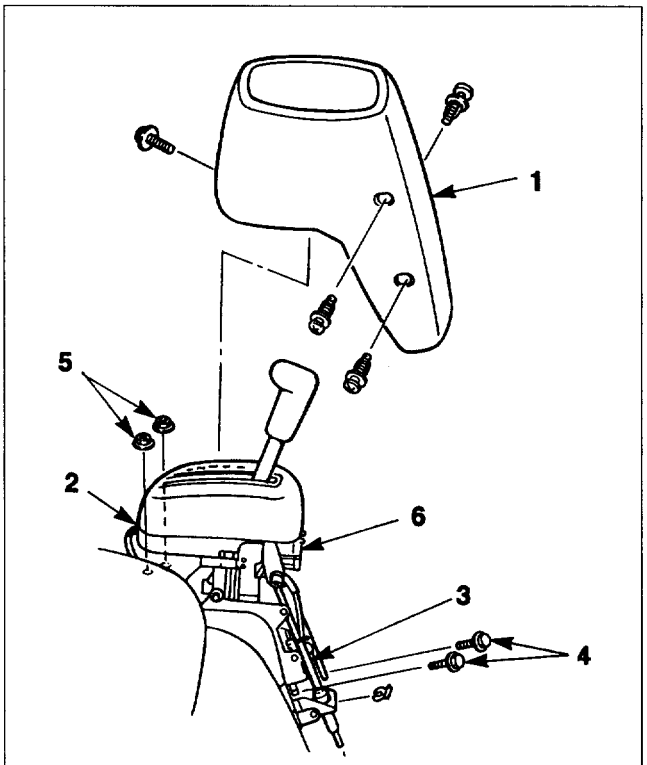
- Vehicle speed sensor 27 N·m (2.8 kg·m / 20 lb·ft)

5. Wiring connector.
6. Protector (2) and harness clip (1).
7. Negative battery cable.
8. Remove safety stands.
9. Remove wheel blocks.

CONTROL LEVER ASSEMBLY

Remove or Disconnect (Figure 35)

1. Block the wheels.
2. Negative battery cable.
3. Raise vehicle and support with suitable safety stands.
4. Control lever cover (1).
5. Harness connector (2).
6. Control cable (3) from control lever assembly .
7. Bolts (4) and nuts (5)
8. Control lever assembly (6).



1. Control Lever Cover
2. Harness Connector
3. Control Cable
4. Bolt
5. Nut
6. Control Lever Assembly

Figure 35. Control Lever Assembly

Install or Connect (Figure 35)

1. Control lever assembly (6).
2. Bolts (4) and nut (5).
3. Control cable (3) to the control lever assembly.

Adjust

- When connecting the control cable to the select lever, adjust the cable.
  Refer to "CONTROL CABLE" later in this section.

4. Harness connector (2).
5. Control lever cover (1).
6. Negative battery cable.
7. Remove safety stands.
8. Remove wheel blocks.

CONTROL CABLE

Check that the each control lever position matches the corresponding shift indicators ("P", "R", "N", "D", "2" and "1").
If the control lever positions and shift indicators do not match, the control cable must be adjusted.

Adjust (Figure 37)

- Disconnect the negative battery cable.
- Apply parking brake.

1. Remove the retaining pin.
2. Remove the cable rod and washer.
3. Put the control lever in the "N" position.
4. Put the transmission in the "N" range.
5. Move the control lever towards the "R" position until a slight resistance is felt.
   Do not move the lever fully into the "R" position.
6. Loosen the cable lock nuts.
7. Adjust the cable rod length by rotating the turn buckle.
8. Tighten the lock nuts.
9. Install the cable rod and washer to the control lever.
10. Install the new retaining pin
    - Install the negative battery cable.

Remove or Disconnect (Figures 36, 37 and 38)

- Disconnect the negative battery cable.
- Apply parking brake.

1. Remove the retaining pin.
2. Remove the cable rod and washer.
3. Remove the cable from rear bracket.
4. Remove the control lever cover.
5. Remove the clip.
6. Remove the snap pin and washer.
7. Remove the cable rod.
8. Remove the grommet assembly.
9. Remove the cable from the bracket.
10. Remove the clip bands.
11. Cable assembly.

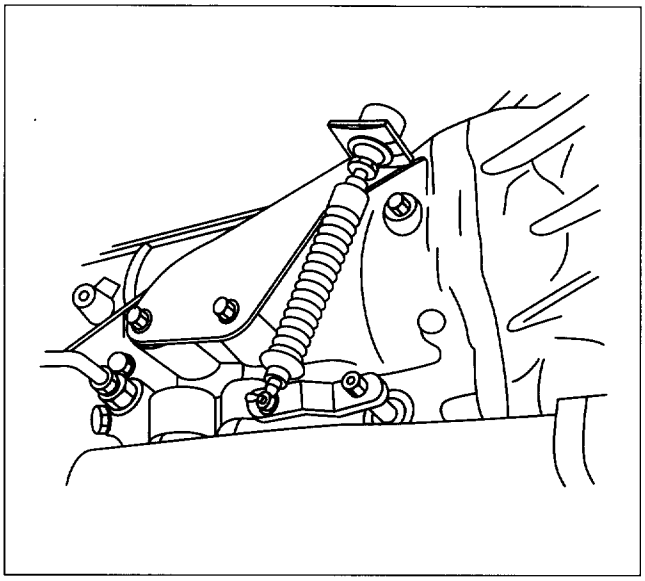


Figure 36. Control Cable (Transmission Side)

Install or Connect (Figures 36, 37 and 38)

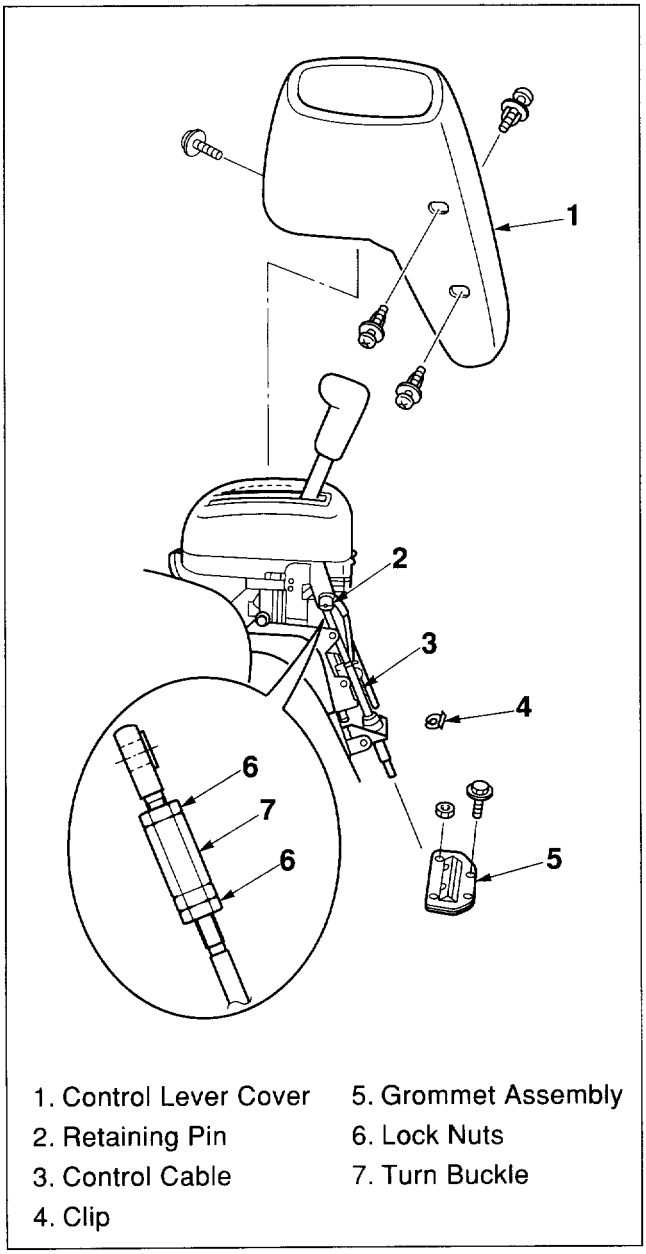
1. Install temporarily the control cable.

Important

- Never bend the cable to radius less than 450 mm (18 in) unless it is necessary to do so for wiring purposes. And never bend the cable to radius less than 180 mm (7 in) even during wiring.
- Install the cable carefully without unnecessary twisting of the cable boots.

2. Cable rod and washer to control lever.
3. New snap pin.
4. Cable to front bracket.
5. Clip.
6. Control lever cover.

7. Grommet assembly.
8. Put the control lever in the "N" position.
9. Put the transmission in "N" range.
10. Cable to rear bracket.
11. Clip.
12. Cable rod and washer to shift lever.
13. Clip bands.
    - Adjust the control cable.
    - Negative battery cable.



1. Control Lever Cover
2. Retaining Pin
3. Control Cable
4. Clip
5. Grommet Assembly
6. Lock Nuts
7. Turn Buckle

Figure 37. Control Cable (Cab Side)

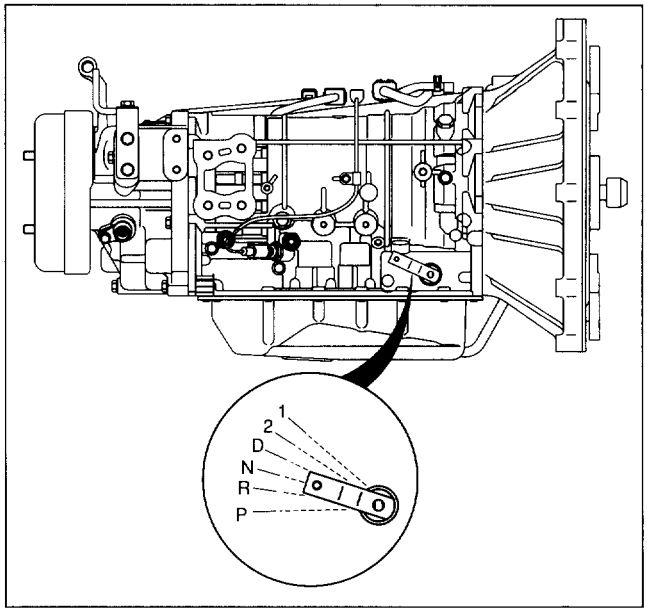


Figure 38. Shift Positions

TRANSMISSION ASSEMBLY

Remove or Disconnect (Figures 37, 38, 39, and 40)

1. Block the wheels.
2. Negative battery cable.
3. Raise vehicle and support with suitable safety stands.
4. Tilt the cab.
5. Oil filler tube with bracket.
6. Propeller shaft guard.
7. Center bearing bracket (If equipped).
8. Reference mark (2) the flange yoke (3) to the parking brake drum (4).

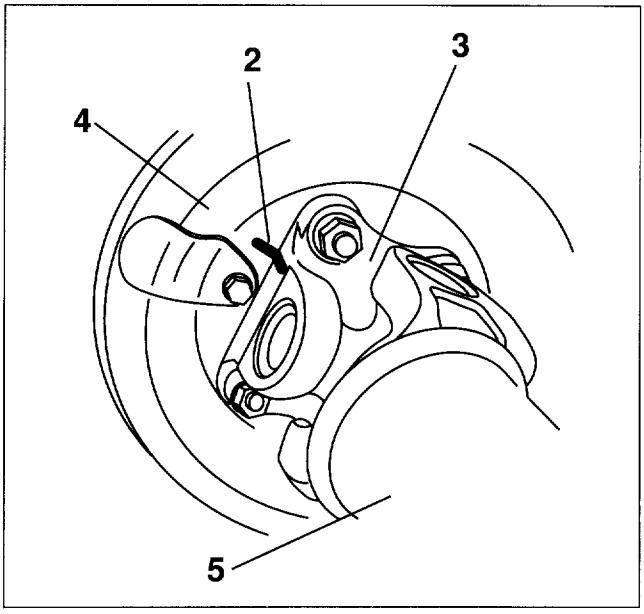


Figure 37. Propeller Shaft

9. Propeller shaft (5).
10. Starter assembly. Wire the starter assembly to frame.
11. Parking brake cable with bracket (figure 38).

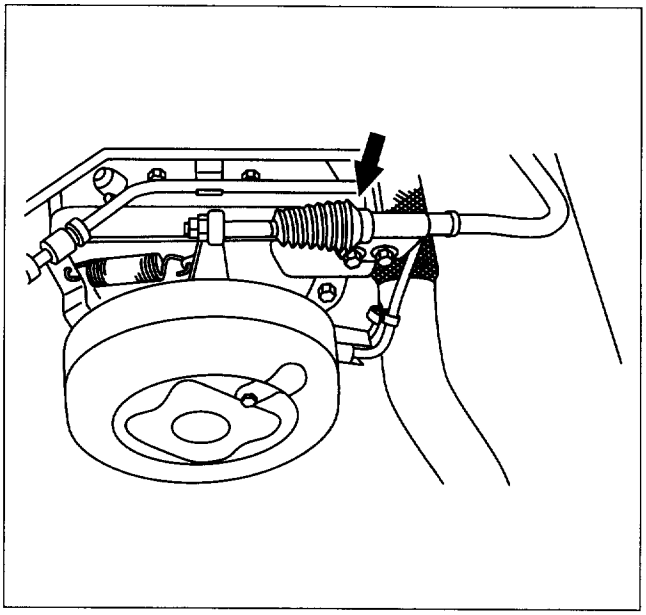


Figure 38. Parking Brake Cable

12. Harness connectors (figure 39).
    Remove the harness connector bracket (1) on the transmission. Then disconnect four connectors (inhibitor switch, solenoid, vehicle speed sensor 2 and ATF temperature switch).

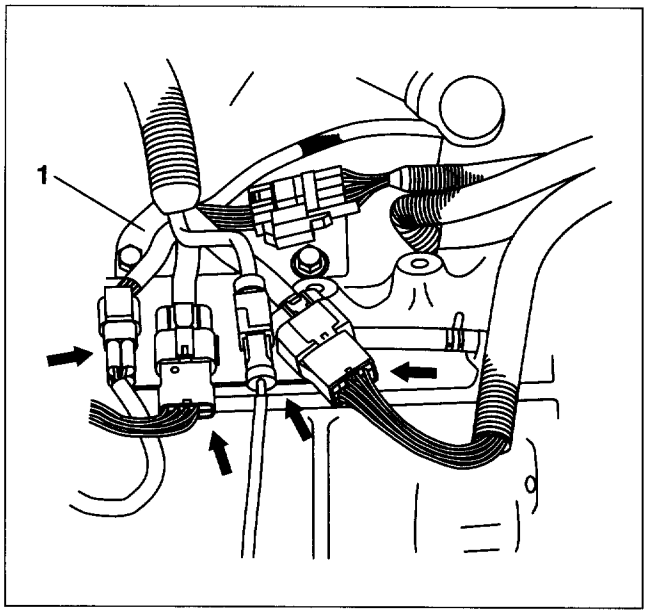


Figure 39. Harness Connector

13. Vehicle speed sensor 1.
14. Disconnect transmission fluid cooler lines above the transmission.
15. Control cable with bracket from transmission.
16. Exhaust pipe bracket.
17. Under cover from converter housing (figure 40).
18. Torque converter bolts (6pcs).

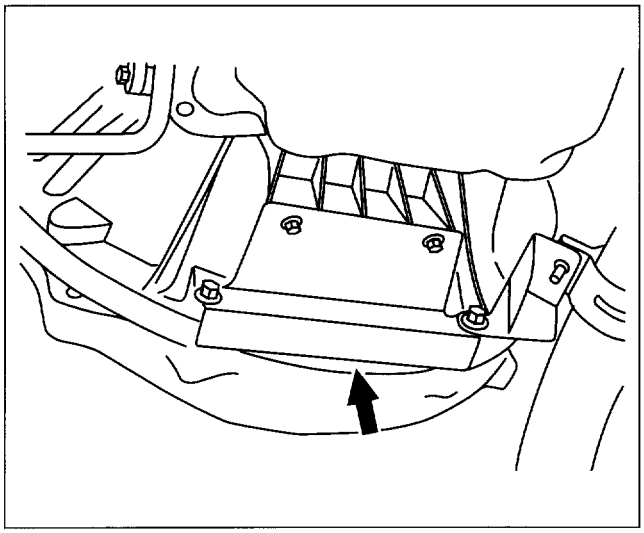


Figure 40. Under Cover

19. Support the transmission with a transmission jack.
20. Attach a lifting cable/chain to the engine.
21. Operate the hoist to slightly raise the engine and support it.
22. Torque converter housing to flywheel housing bolts.
23. Operate the hoist to slowly lower the engine. Hold the front end of the transmission higher than the rear end of the transmission. This will prevent the torque converter from falling from the transmission.
24. Lower the transmission jack.

Install or Connect
(Figures 37, 38, 39, and 40)

1. Set the transmission assembly on a transmission jack.
   - Hold the front end of the transmission higher than the rear end of the transmission.
   - This will prevent the torque converter from falling from the transmission.
2. Transmission to the flywheel housing.

Tighten

- Torque converter housing to flywheel housing fixing bolts 40 N·m (4.1 kg·m / 30 lb·ft).

3. Operate the hoist to slowly raise the engine and transmission assembly.
4. Torque converter to the flywheel.
   - By turning the flywheel.

Tighten

- Torque converter bolts 40 N·m (4.1 kg·m / 30 lb·ft)

NOTICE: Discard used bolts and install new ones.

6. Under cover (figure 40).

Tighten

- Under cover bolt 9 N·m (0.9 kg·m / 78 lb·in)

7. Exhaust pipe bracket.
8. Control cable and bracket to the transmission.
9. Adjust control cable.
   - Refer to "CONTROL CABLE" previously in this section.
10. Transmission fluid cooler line.

Tighten

- Cooler line joint connector 34 N·m (3.5 kg·m / 25lb·ft)

11. Vehicle speed sensor 1.
12. Harness connectors and bracket (figure 39).
13. Parking brake cable (figure 38).
    Adjust parking brake cable.
14. Starter assembly.
15. Propeller shaft to the driver coupling.
    - Line up reference mark (figure 37).

Tighten

- Propeller shaft bolts 102 N·m (10.4 kg·m / 75 lb·ft)

16. Center Bearing Bracket (If equipped).

Tighten

- Center bearing bracket bolts 40 N·m (4.1 kg·m / 30 lb·ft)

17. Propeller shaft guard.
18. Oil filler tube with bracket.
19. Negative battery cable.
20. Remove safety stands.
21. Remove wheel blocks.

TORQUE CONVERTER

Remove or Disconnect

1. Remove the transmission assembly from the vehicle.
2. Remove the torque converter from the torque converter housing.

Inspect

Whenever the transmission is replaced, inspect the torque converter and replace it if any of the following conditions exists:

- Line pressure is normal but a stalling test fails (idle in "D" or "R" range).
- Metallic sound is heard from the torque converter during a stall test or when in "N" range.
- The torque converter center piece is deformed.
- The extension sleeve is rusty, has a large vertical scratch, or is worn excessively.
- Debris of paper, bearing or foreign materials is found from the ATF in the torque converter.
- Check the one-way clutch of the torque converter by using the special tools (figure 41).

  Tool Required:

  5-8840-2168-0 One-way Clutch Test Tool

1. Set the pilot nut in the test tool to the wrench. Insert the wrench to stator shaft fitting face of the torque converter.
2. Insert stator stopper through the sleeve in converter and set it to cutaway portion of the sleeve.
3. If both direction of the one-way clutch are free, or turns counterclockwise and locks clockwise, torque converter should be replaced.
   The normal one-way clutch turns clockwise and locks counterclockwise.

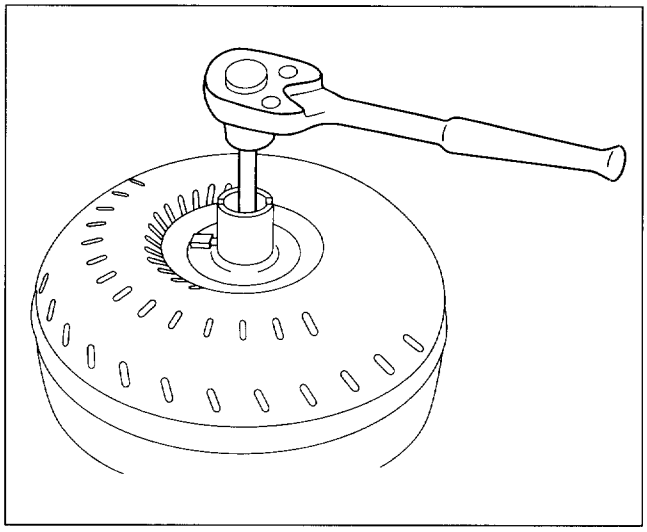


Figure 41. One-way Clutch Test

Install or Connect

1. Pour new ATF (approximately 2 liters) if a new torque converter is being installed.
2. Install the torque converter to the oil pump.
3. Measure the dimention A from the torque converter housing to the torque converter set block and confirm that the torque converter is inserted to the correct position (figure 42).

Measure

- Dimention A: 23.0 mm (0.91 in) or less

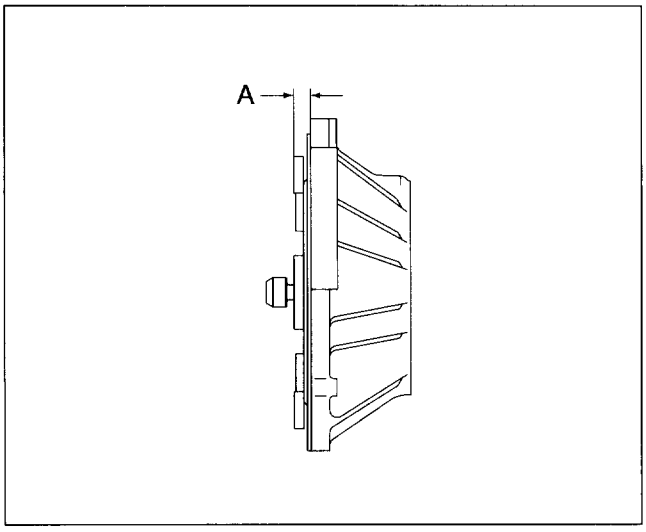


Figure 42. Torque Converter Installation Position

SPECIFICATIONS

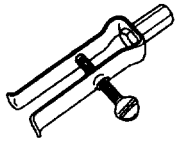
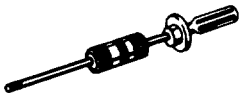
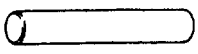
AUTOMATIC TRANSMISSION

Torque Converter Set Dimention .....23.0 mm (0.91 in) or less

FASTENER TORQUES

Oil Pan Bolt .....7 N·m (0.7 kg·m / 61 lb·ft)
Drain Plug.....27 N·m (2.8 kg·m / 20 lb·ft)
Inhibitor Switch Nut .....7 N·m (0.7 kg·m / 61 lb·ft)
Inhibitor Switch Bolt.....12.5 N·m (1.25 kg·m / 109 lb·ft)
Vehicle Speed Senser 2.....27 N·m (2.8 kg·m / 20 lb·ft)
Vehicle Speed Senser 1 Screw.....8 N·m (0.8 kg·m / 69 lb·ft)
ATF Temperature Switch .....25 N·m (2.5 kg·m / 28 lb·ft)
Oil Filler Tube Nut .....47 N·m (4.8 kg·m / 35 lb·ft)
Oil Strainer Bolts .....10 N·m (1.0 kg·m / 87 lb·ft)
Solenoid bolts.....10 N·m (1.0 kg·m / 87 lb·ft)
Driver Coupling Nut.....170 N·m (17.3 kg·m / 125 lb·ft)
Speed Meter Driven Gear Fixing Bolt.....12.5 N·m (1.25 kg·m / 109 lb·in)
Torque Converter Bolts .....40 N·m (4.1 kg·m / 30 lb·ft)
Under Cover Bolts .....9 N·m (0.9 kg·m / 78 lb·ft)
Cooler Line Joint Connectors .....34 N·m (3.5 kg·m / 25 lb·ft)

SPECIAL TOOLS

ILLUSTRATION	**TOOL NO.** TOOL NAME
	5-8840-2153-0 **(J-37228)** Oil Pan Seal Cutter
	**5-8840-0027-0** **(J-26941)** Rear Oil Seal Remover
	**5-8840-0019-0** **(J-23907)** Sliding Hammer
	**5-8840-2345-0** **(J-41736)** Rear Oil Seal Installer
 	5-8840-2168-0 **(J-35467)** One-way Clutch Test Tool

SECTION 7A4

AUTOMATIC TRANSMISSION OVERHAUL

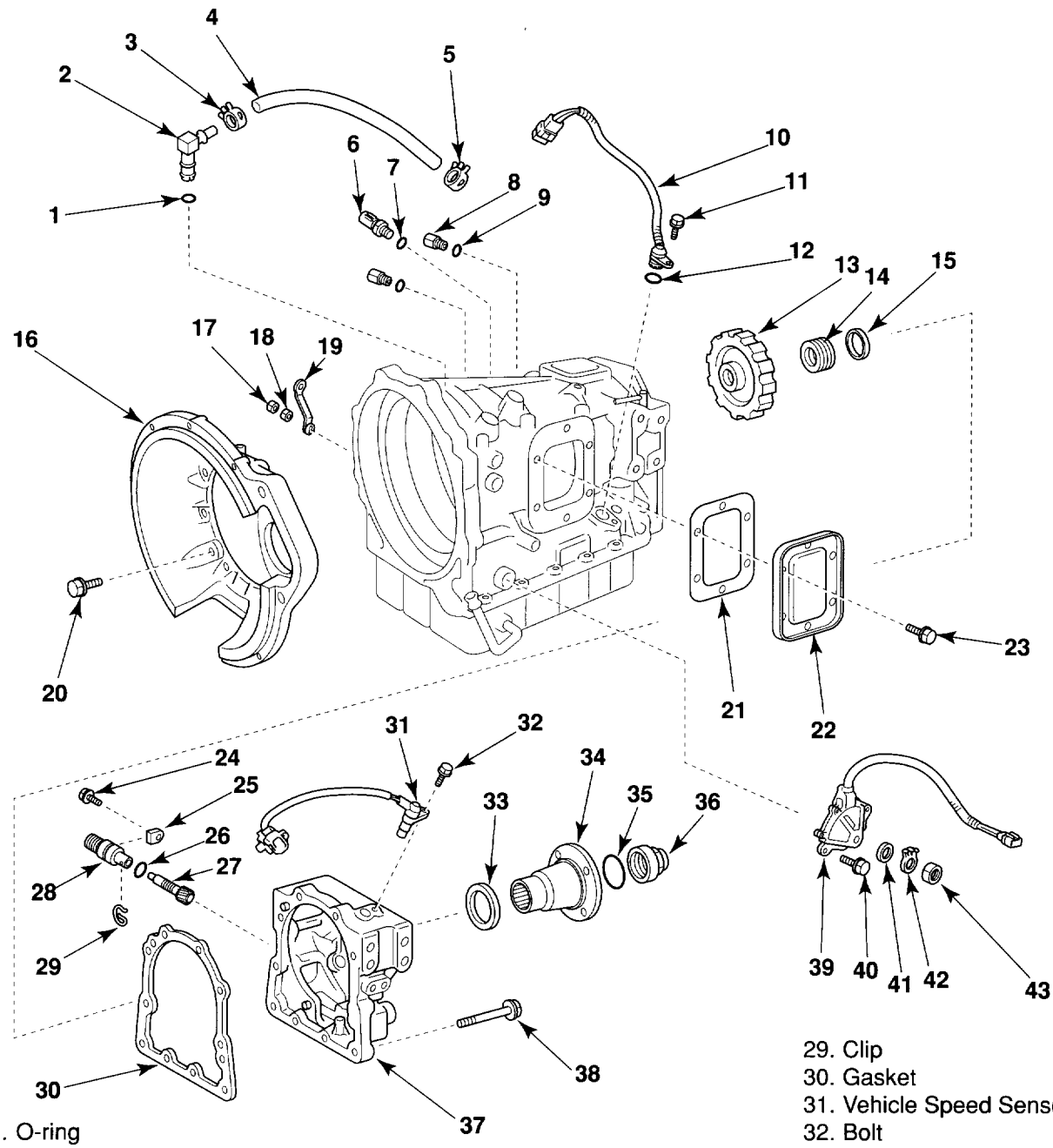
CONTENTS

SUBJECT	PAGE
GENERAL REPAIR INSTRUCTION	7A4-2
COMPONENT PARTS REMOVAL	7A4-3
OIL PUMP	7A4-18
OVERDRIVE PLANETARY GEAR AND DIRECT CLUTCH	7A4-22
OVERDRIVE BRAKE	7A4-32
FRONT CLUTCH	7A4-38
REAR CLUTCH	7A4-45
SECOND BRAKE	7A4-51
PLANETARY GEARS, ONE-WAY CLUTCH AND OUTPUT SHAFT	7A4-58
FIRST AND REVERSE BRAKE	7A4-67
VALVE BODY	7A4-73
EXTENSION HOUSING	7A4-81
COMPONENT PARTS INSTALLATION	7A4-85
SPECIFICATIONS	7A4-107
SPECIAL TOOLS	7A4-111

GENERAL REPAIR INSTRUCTIONS

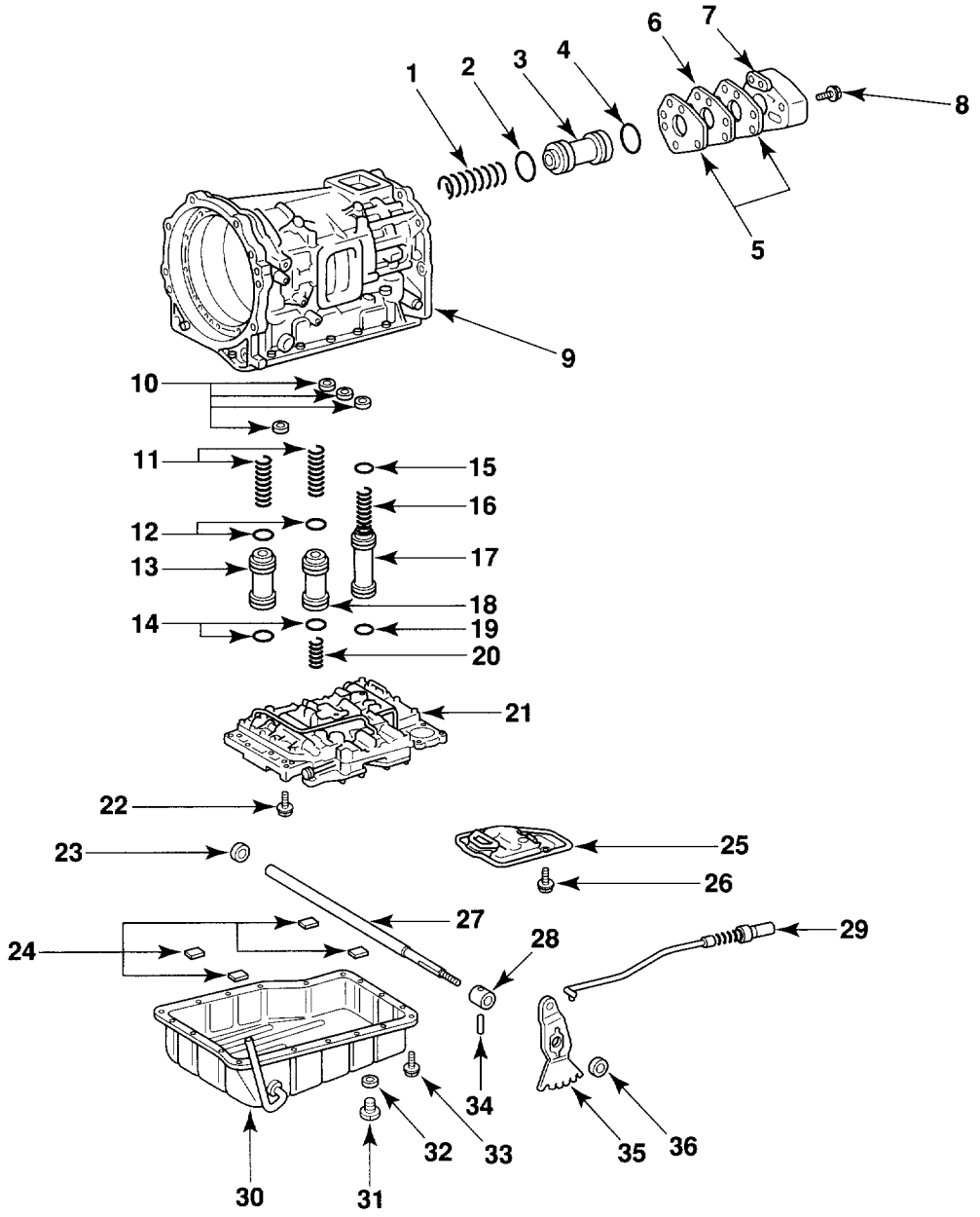
1. Before assembling, remove sand or mud etc. adhered to the outside of the transmission to prevent them from coming into the inside when disassembling or assembling.
2. Do not face the oil pan upward to avoid foreign particle coming in until oil pan is removed.
3. When disassembling the attaching the part made of light alloy such as a case, do not pry out with a screwdriver but tap with a plastic.
4. When disassembling or assembling, do it with bare hands or using vinyl grabs. To avoid lint coming in, do not use grabs or shop rug.
5. Ensure those disassembled parts are well organized and free from dust.
6. Before assembling, wash each disassembled part and all the water has evaporated, apply DEXRON®-III.Do not clean the aluminum or rubber part with alkaline agent. Never clean the rubber part of O-ring, gasket and oil seal, and clutch disc and brake disc with white gasoline.
7. Submerge the clutch disc and brake disc into DEXRON®-III before assembling. Especially a new disc should be submerged in for more than 15 minutes to pervade the oil into the lining.
8. Apply DEXRON®-III to the sliding and rotating surfaces and O-ring or oil seal ring, assemble them being carefully not to damage them.
9. Replace the damaged or deformed snap ring with a new one.
10. When placing a part in a vise,do not place it in a vise directly but use an aluminum plate.
11. Take a caution not to damage the contact surface of case, otherwise it causes fluid leakage. If damaged, replace the case with a new one.
12. Before applying sealant, clean off the adhered sealant on the sealing part, clean the sealing part with white gasoline.
13. Right after applying sealant, do not pour the fluid or drive the vehicle. Leave it for more than 2 hours.
14. Pay due attention when assembling those similar parts such as O-ring, snap ring, bearing and bearing race and not to lose a part.
15. When assembling oil seal ring, do not spread the ring ends as thick as more than necessary.
16. When assembling the thrust bearing, race and thrust washer, to prevent dropping off, a little amount of petroleum jelly in over haul gasket kit should be applied. Unless there is petroleum jelly, a little amount of Vaseline can be used.
17. Use fluid is DEXRON®-III.
18. Non - reusable parts:
    Always replace cotter pin, gaskets, O-rings and oil seals etc. with new ones.
19. Precoated parts are bolts and nuts, etc. that are coated with a sealant at the factory.
    a) If a precoated parts is retightened, loosened or caused to move in any way, it must be recoated with the specified adhesive.
    b) When reusing precoated parts, clean off the old adhesive and dry with compressed air. Then apply the specified adhesive to the bolt, nut or threads.
20. When necessary, use a sealer on gaskets to prevent leaks.
21. Carefully observe all specifications for bolt tightening torques. Always use a torque wrench.
22. Use of special tools and sealants may be required, depending on the nature of the repair. Be sure to use special tools and sealant where specified and follow the proper work procedure. A list of special tools and sealant can be found at the preparation of automatic transmission section.

COMPONENT PARTS REMOVAL



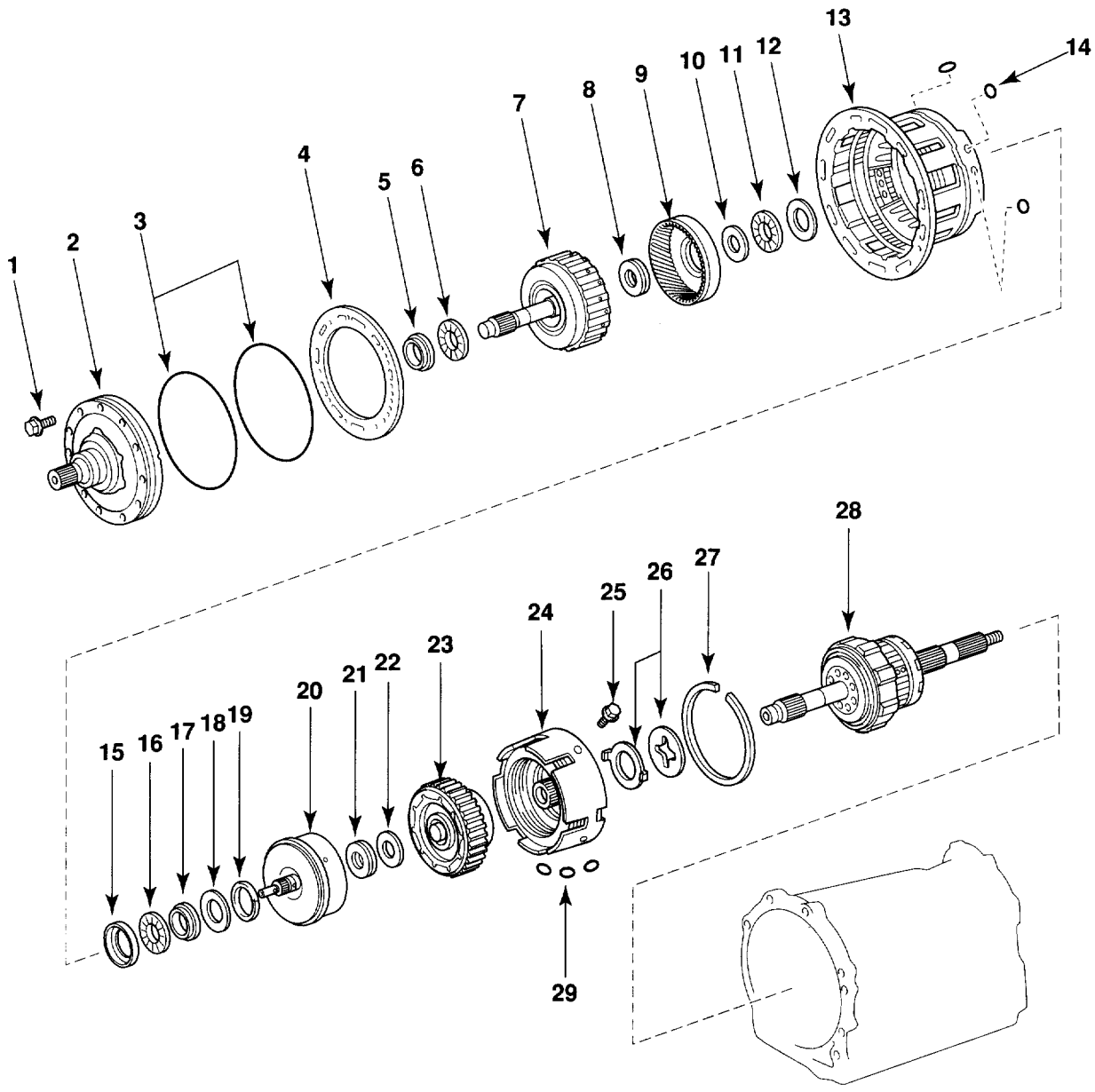
1. O-ring
2. Oil Cooler Union
3. Clip
4. Hose
5. Clip
6. ATF Temperature Switch
7. O-ring
8. Oil Cooler Union
9. O-ring
10. Transmission Solenoid Wire
11. Bolt
12. O-ring
13. Parking Lock Gear
14. Speedometer Drive Gear
15. Spacer
16. Torque Converter Housing
17. Nut
18. Nut
19. Control Shaft Lever
20. Bolt
21. Gasket
22. PTO Cover
23. Bolt
24. Bolt
25. Lock Plate
26. O-ring
27. Speedometer Driven Gear
28. Speedometer Sleeve
29. Clip
30. Gasket
31. Vehicle Speed Sensor 1
32. Bolt
33. Oil Seal
34. Companion Flange
35. O-ring
36. Lock Nut
37. Extension Housing
38. Bolt
39. Inhibitor Switch
40. Bolt
41. Grommet
42. Lock Washer
43. Nut

Figure 1. Component Parts (1)



1. Spring
2. O-ring
3. C1 Accumulator
4. O-ring
5. Gasket
6. Plate
7. Front Clutch Accumulator Cover
8. Bolt
9. Transmission Case
10. Center Support Apply Gasket
11. Spring
12. O-ring
13. B0 Accumulator Piston
14. O-ring
15. O-ring
16. Spring
17. C2 Accumulator Piston
18. B1 Accumulator Piston
19. O-ring
20. Spring
21. Valve Body Assembly
22. Bolt
23. Oil Seal
24. Magnet
25. Oil Strainer
26. Bolt
27. Manual Valve Lever Shaft
28. Spacer
29. parking Lock Rod
30. Oil Pan
31. Drain Plug
32. Gasket
33. Bolt
34. Pin
35. Manual Valve Lever
36. Oil Seal

Figure 2. Component Parts (2)



1. Bolt
2. Oil Pump
3. O-ring
4. Gasket
5. Race
6. Thrust Bearing
7. O/D Planetary Gear, O/D Direct Clutch and One-way Clutch Assembly
8. Thrust Bearing
9. O/D Ring Gear assembly
10. Race
11. Thrust Bearing
12. Race
13. O/D Case Assembly
14. O-ring
15. Race
16. Thrust Bearing
17. Race
18. Spacer
19. Oil Seal ring
20. Front Clutch Assembly
21. Thrust Bearing
22. Race
23. Rear Clutch Assembly
24. Center Support assembly
25. Bolt
26. Thrust Washer
27. Snap Ring
28. Planetary Gear, One-way Clutch and Output Shaft Assembly
29. O-ring

Figure 3. Component Parts (3)

Remove or Disconnect

Transmission Wiring
Disconnect the connectors, and remove the transmission wiring.

Breather Plug and Hose
1. Using 2 screwdrivers, pry out the breather plug and hose.

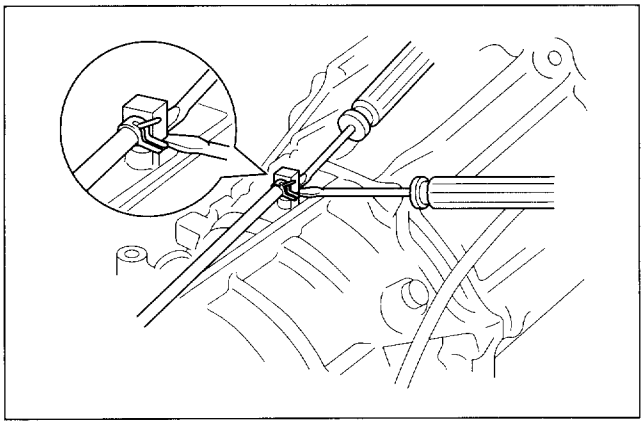


Figure 4. Breather Plug

2. Remove the O-ring from the breather plug.

Control Shaft Lever
Remove the 2 nuts and the lever.

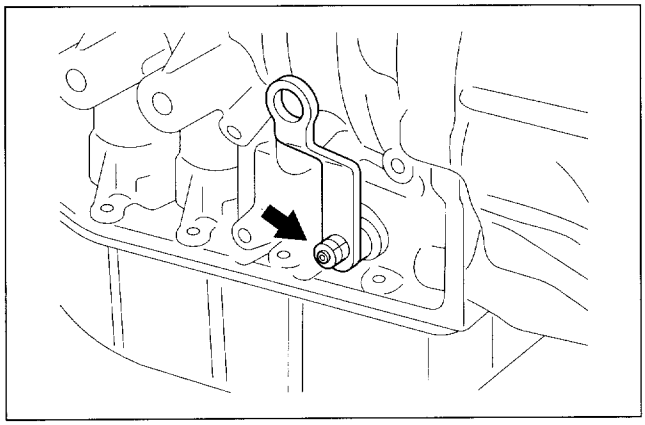


Figure 5. Control Shaft Lever

Inhibitor Switch
1. Unstake the lock washer.

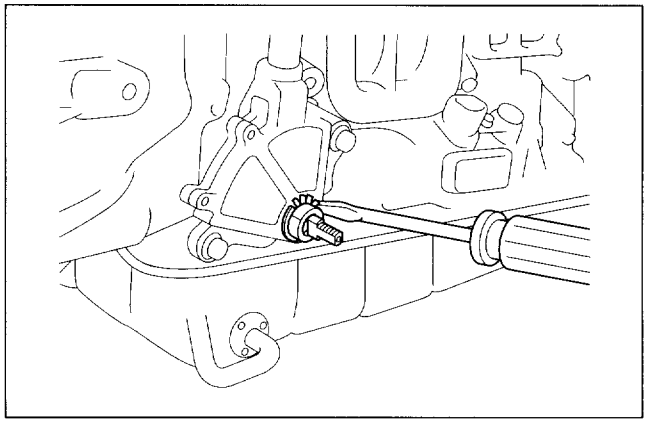


Figure 6. Lock Washer

2. Remove the nut, lock washer and grommet.
3. Remove the 2 bolts and inhibitor switch.

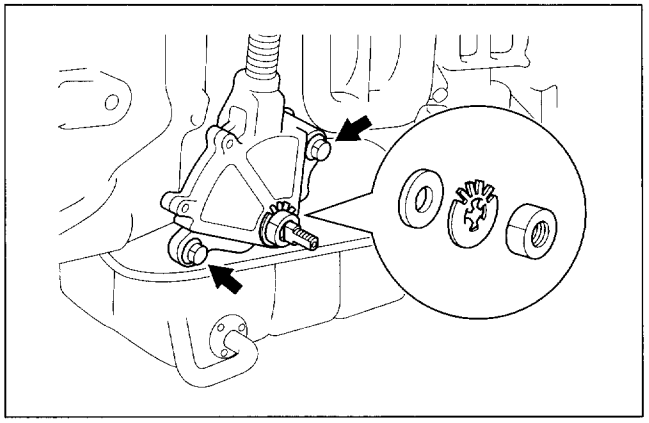


Figure 7. Inhibitor Switch Removal

ATF Temperature Switch
1. Remove the switch.
2. Remove the O-ring from the switch.

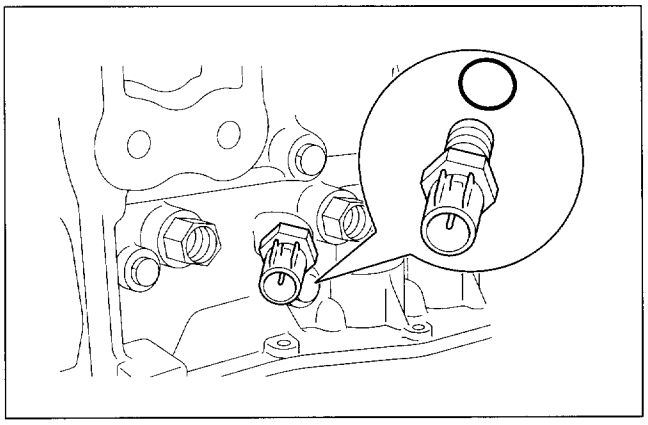


Figure 8. ATF Temperature Switch

Oil Cooler Unions
1. Remove the 2 unions.
2. Remove the O-ring from the both the unions.

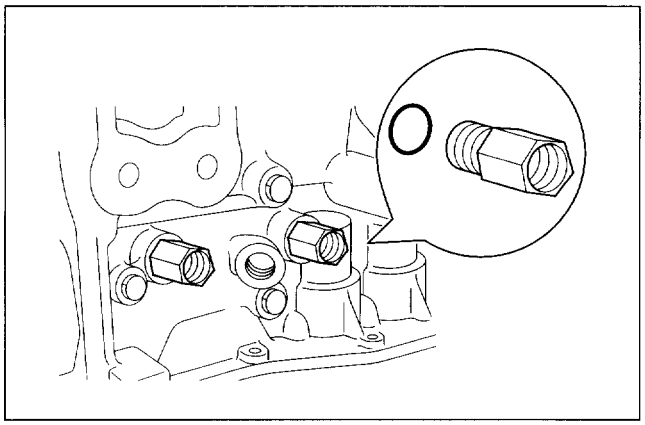


Figure 9. Oil Cooler Union

Torque Converter Housing

Remove the 8 bolts and torque converter housing.

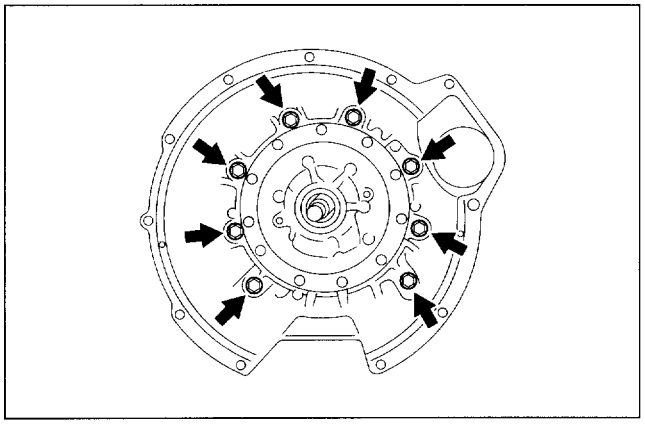


Figure 10. Torque Converter Housing

Vehicle Speed Sensor 1

1. Remove the bolt and the sensor.
2. Remove the O-ring from sensor.

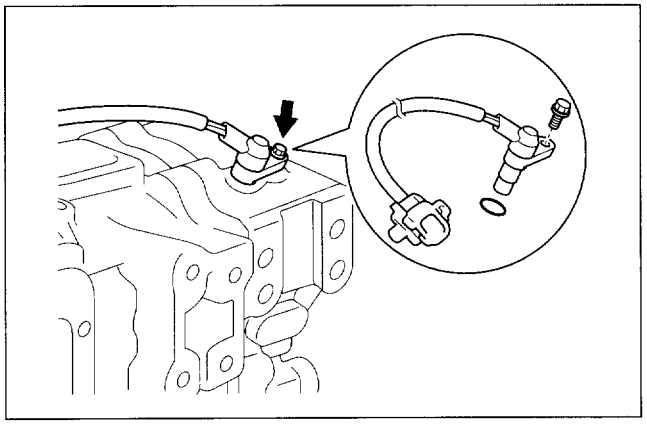


Figure 11. Vehicle Speed Sensor 1

Speedometer Driven Gear ASSY

1. Remove the lock bolt and plate.
2. Remove speedometer driven gear ASSY.
3. Remove the O-ring from the driven gear ASSY.

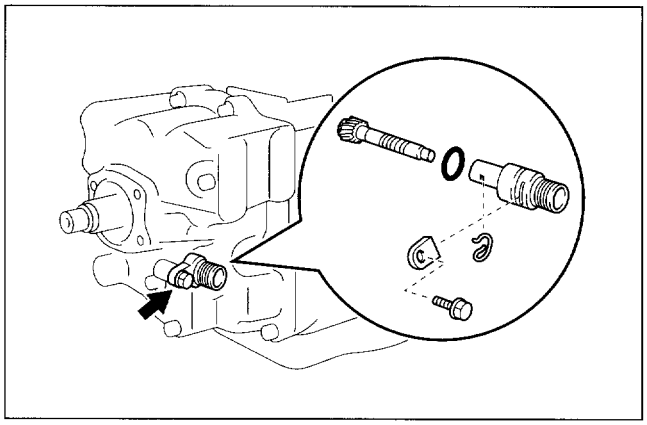


Figure 12. Speedometer Driven Gear ASSY

Extension Housing

1. Remove the 10 bolts.

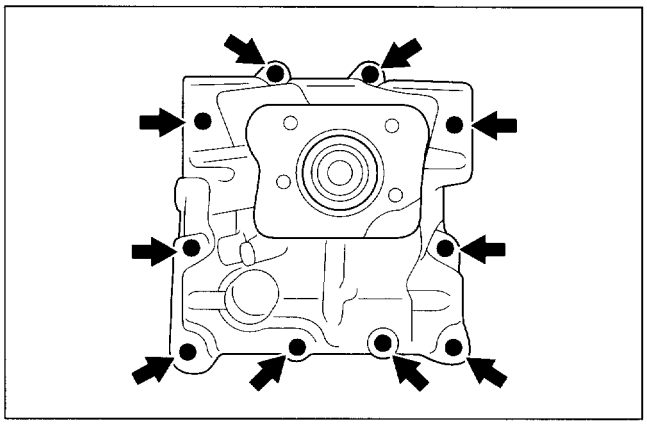


Figure 13. Extension Housing Bolt

2. Using a plastic hammer, remove the extension housing and gasket.

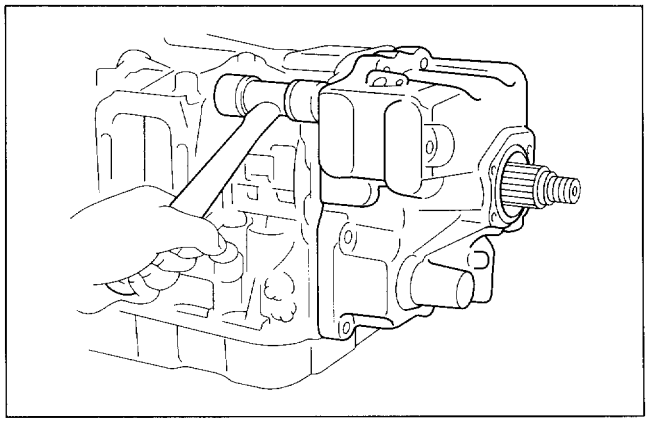


Figure 14. Extension Housing Removal

Speedometer Drive Gear and Spacer

Remove the spacer and speedometer drive gear from the output shaft.

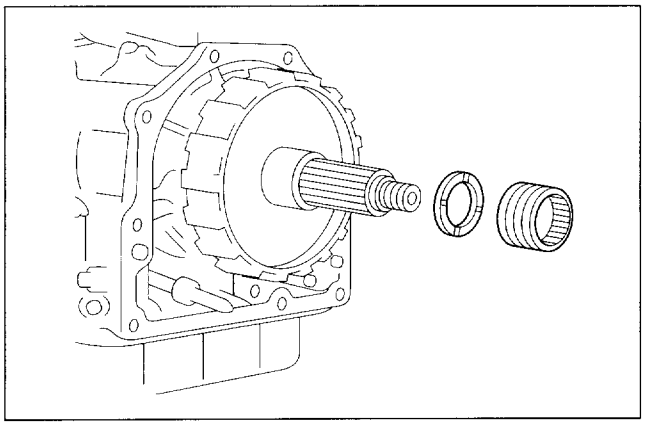


Figure 15. Speedometer Drive Gear

Parking Lock Gear

Remove the parking lock gear from the output shaft.

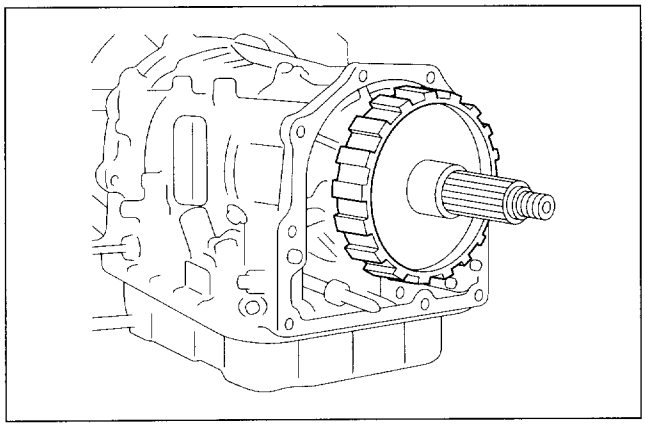


Figure 16. Parking Lock Gear

Oil Pan

NOTICE: Do not turn the transmission over as this will contaminate the valve body with any foreign matter at the bottom of the pan.

1. Remove the 20 bolts.

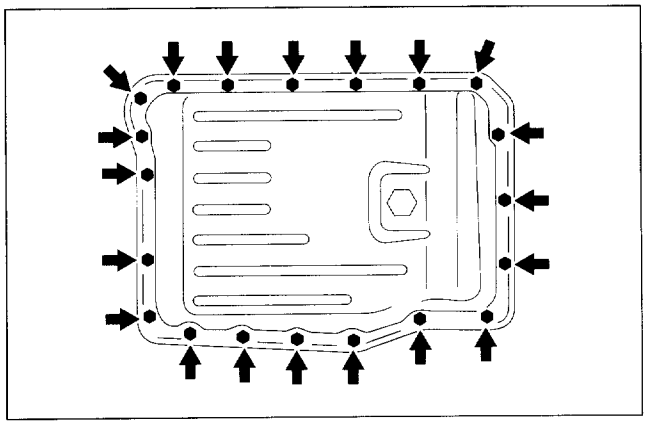


Figure 17. Oil Pan Bolt

2. Insert the blade of oil pan seal cutter between the transmission and oil pan, cut off applied sealer.
   Tool Required:
   5-8840-2153-0 Oil Pan Seal Cutter
   NOTICE:
   - **Be careful not to damage the oil pan flange.**
   - **Install several mounting bolts by tightening 2 to 3 pitches.**
   - **Do not tilt the oil pan as all the oil in the pan has not been drained.**

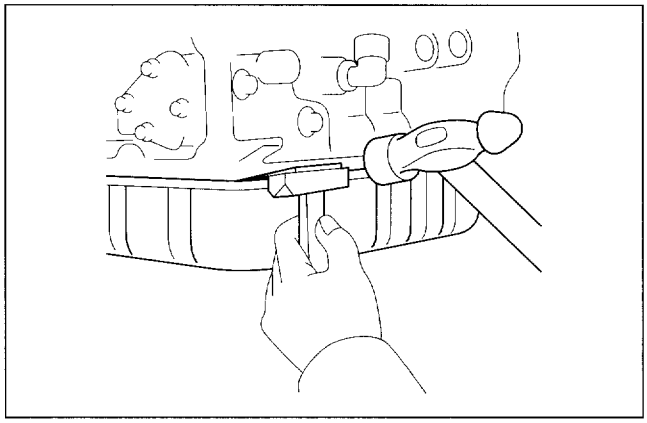


Figure 18. Oil Pan Removal

3. Examine particles in pan.
   Remove the magnets and use them to collect any steel particles.
   Carefully look at the foreign matter and particles in the pan and on the magnets to anticipate the type of wear you will find in the transmission:
   - Steel (magnetic): Bearing, gear, and clutch
   - Brass (non-magnetic): Bushing wear

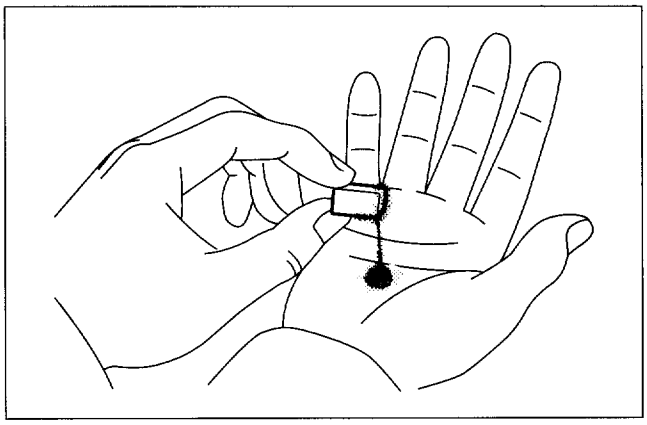


Figure 19. Particles

Oil Strainer

Remove the 4 bolts and oil strainer.

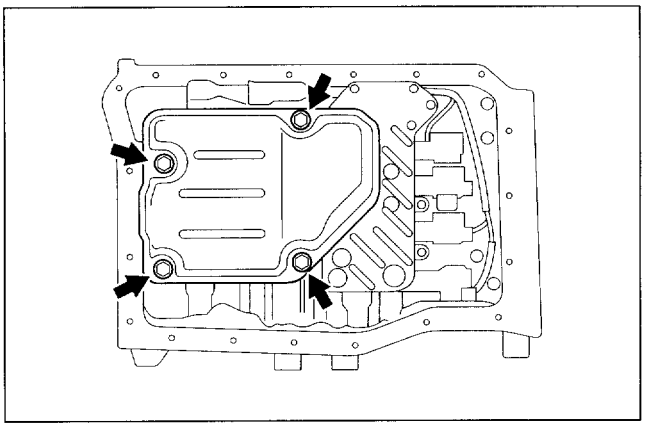


Figure 20. Oil Strainer

Solenoid Connectors

1. Disconnect the 4 connectors from the solenoids.
2. Disconnect the connector from the ATF temperature sensor.
3. Disconnect the connector from the line pressure solenoid.

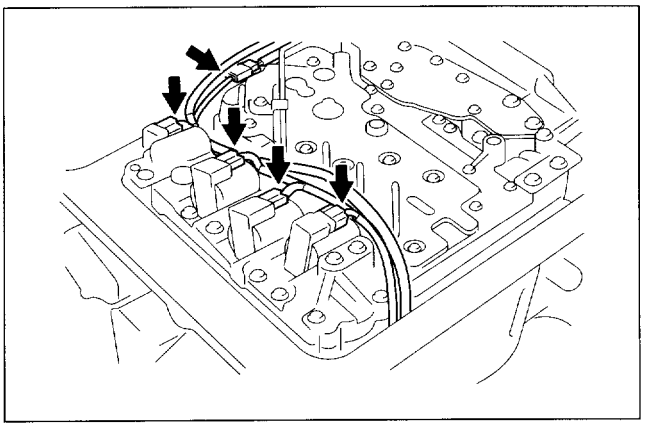


Figure 21. Solenoid Connectors

Valve Body

Remove the 21 bolts.

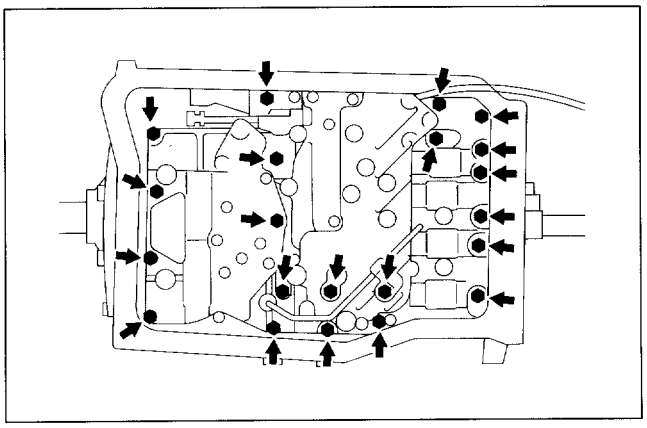


Figure 22. Valve Body Removal

Center Support Apply Gaskets

Remove the 4 apply gaskets.

NOTICE: Check the installation direction of apply gaskets.

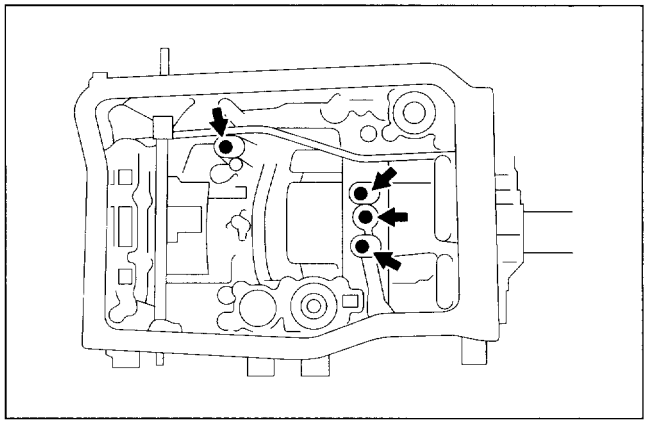


Figure 23. Center Support Apply Gasket

Solenoid Wiring

1. Remove the bolt and the solenoid wiring.
2. Remove the O-ring from it.

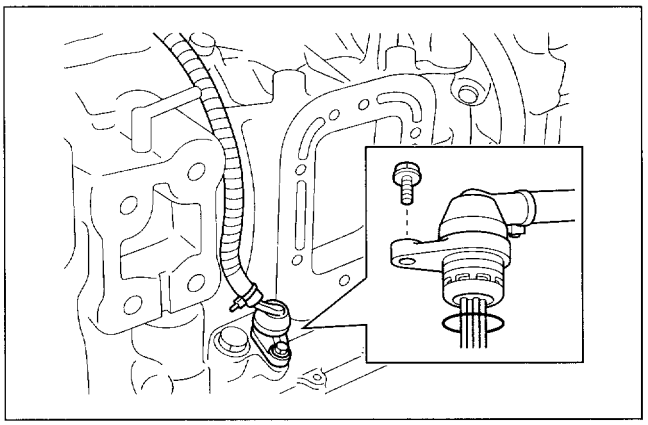


Figure 24. Solenoid Wiring Removal

C_1 Accumulator Piston and Spring

1. Remove the 4 bolts, front clutch accumulator cover, 2 gaskets and plate.

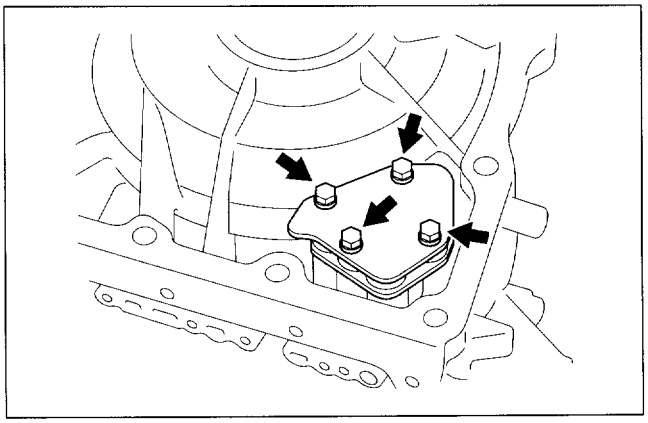


Figure 25. Front Clutch Accumulator Cover

2. Remove the accumulator piston and spring by applying compressed air 392–785 kPa (4–8 kg/cm², 57–114 psi) to the oil hole.
NOTICE: Cover the area around the piston with a shop rag as the piston and oil gush out.

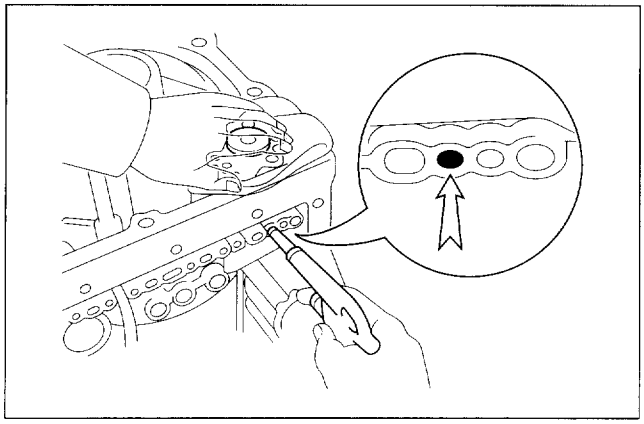


Figure 26. C_1 Accumulator Piston Removal

C_2 B_0 B_1 Accumulator Pistons And Springs

1. Remove the C_2 accumulator piston and spring by applying compressed air 392–785 kPa (4–8 kg/cm², 57–114 psi) to the oil hole.
NOTICE: Cover the area around the piston with a shop rag as the piston and oil gush out.

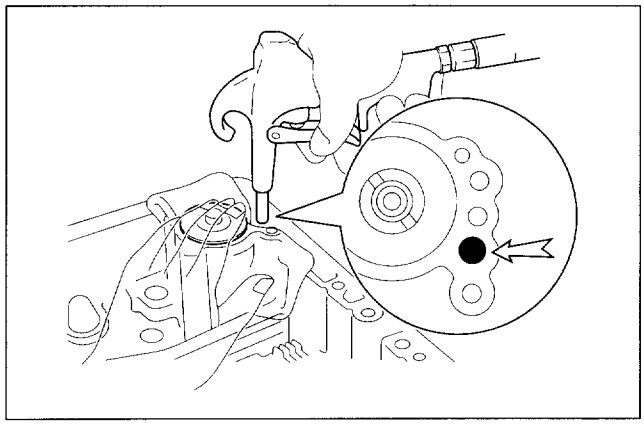


Figure 27. C_2 Accumulator Piston Removal

2. Remove the B_0 accumulator piston together with the B_1 accumulator piston by applying compressed air to the oil hole.

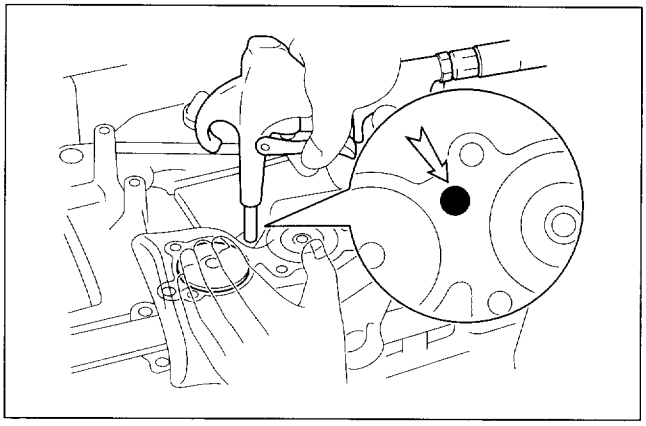


Figure 28. B_0/B_1 Accumulator Piston Removal

3. Remove the B_0 and B_1 accumulator pistons.
4. Remove the O-ring from the accumulator pistons.

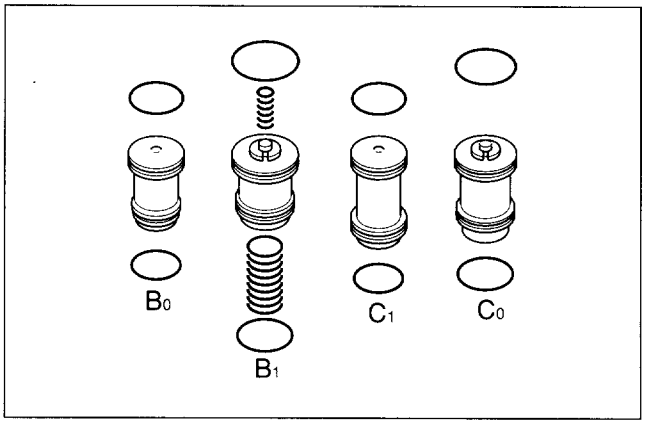


Figure 29. Accumulator Piston and O-ring

Manual Valve Lever, Shaft and Oil Seals

1. Using a screwdriver or chisel, cut off the spacer and remove it from the shaft.

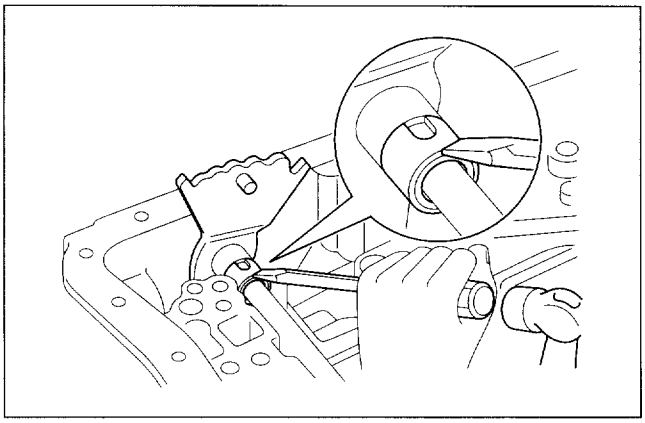


Figure 30. Spacer Removal

2. Using a pin punch, tap out the pin.
NOTICE: Do not drop the pin into the transmission case.

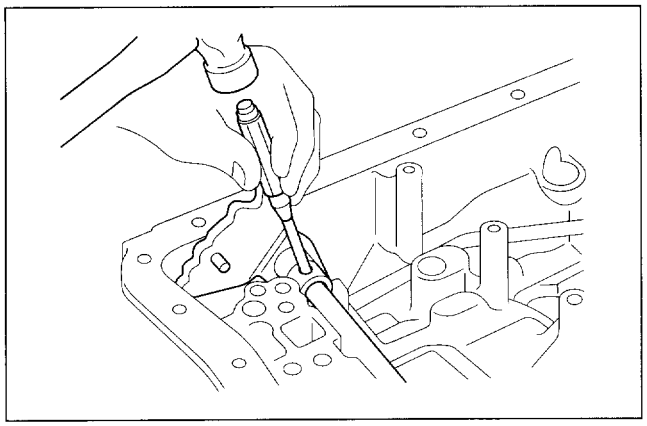


Figure 31. Spring Pin Removal

3. Pull the manual valve lever shaft out through the case, remove the manual valve lever, parking lock rod assembly, the 2 plate washers and wave washer.
4. Disconnect the parking lock rod from the manual valve lever.

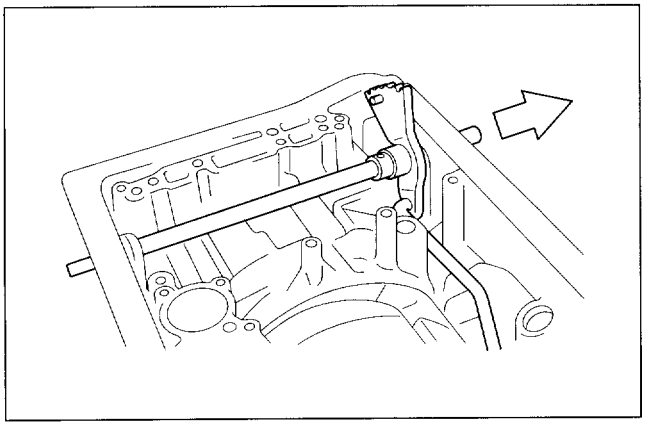


Figure 32. Manual Valve Lever Shaft Removal

5. Using a screwdriver, pry out the 2 oil seals.

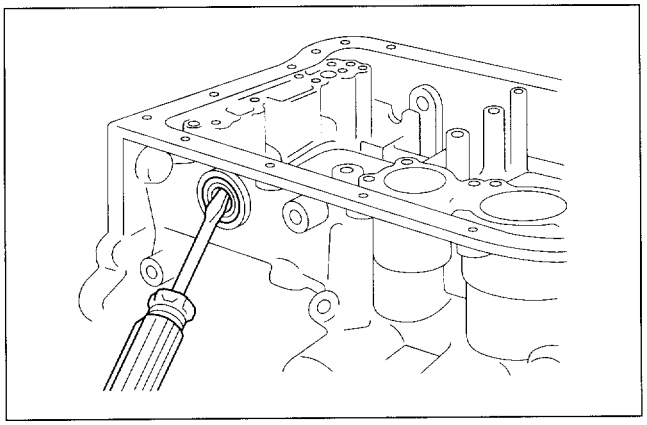


Figure 33. Oil Seal Removal

Thrust Clearance of Overdrive Input Shaft (Overdrive Planetary Gear)

1. Push the O/D input shaft toward the rear of the transmission by applying a force of 49–98 N (5–10 kg, 11.0–22.0 lb).

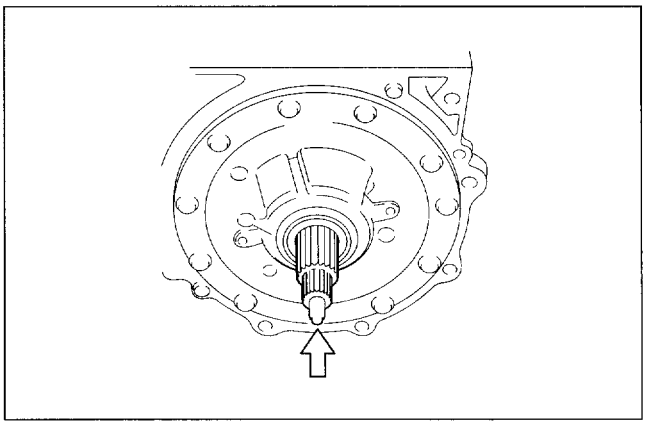


Figure 34. O/D Input Shaft

2. Using dial indicator, measure the thrust clearance of the input shaft.
Standard thrust clearance: 0.40–0.90 mm (0.0157–0.0354 in.)
Maximum thrust clearance: 0.90 mm (0.0354 in.)

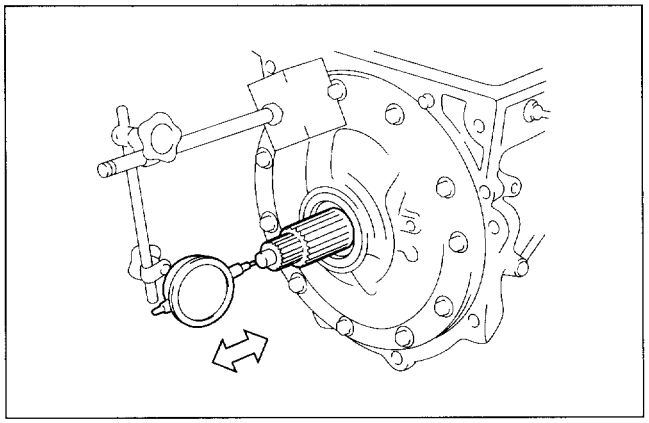


Figure 35. Thrust Clearance of Input Shaft

Oil Pump

1. Place matchmarks on the oil pump and transmission case.
2. Remove the 11 bolts holding the oil pump to the transmission case.

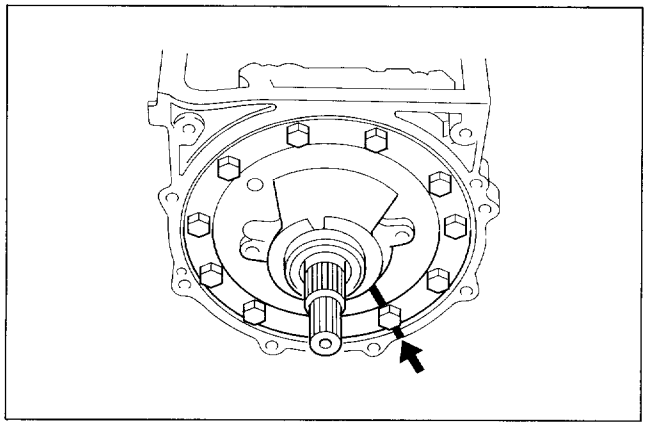


Figure 36. Matchmarks

3. Using oil pump remover, remove the oil pump and gasket.
   Tool Required:
   5-8840-2652-0 Oil Pump Remover
4. Remove the O-ring from the oil pump.

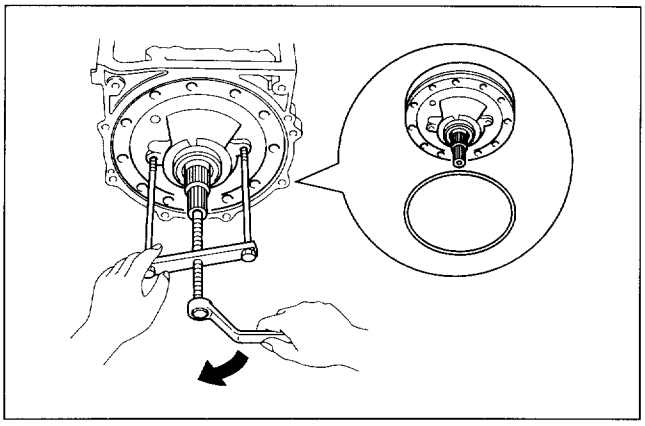


Figure 37. Oil Pump Remover

5. Remove the race and thrust bearing from the O/D direct clutch drum or oil pump.
6. Remove the O-ring from the transmission case.

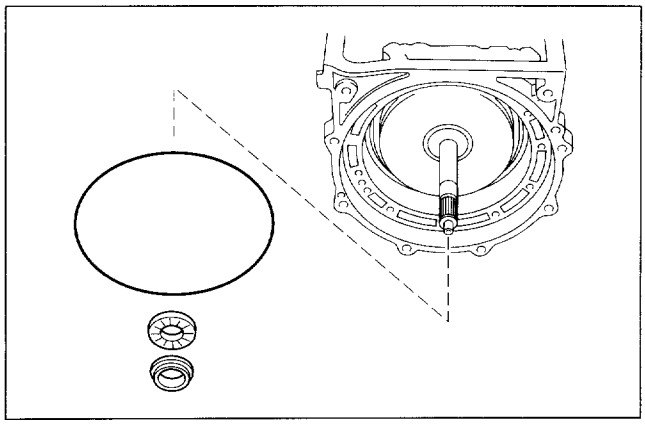


Figure 38. Race, Thrust Bearing and O-ring

Overdrive Planetary Gear, Overdrive Direct Clutch and One-Way Clutch Assembly

1. Place plate on the installation surface of the oil pump.
   Tool Required:
   5-8840-2647-0 Plate
2. Using calipers, measure the distance between the tops of plate and the clutch drum for assembly.
   NOTICE: Record the measured distance to keep it as a reference when assembling.

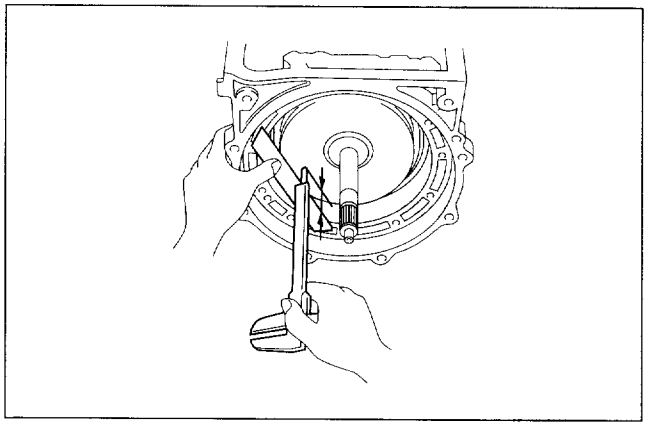


Figure 39. Measuring Distance

3. Remove the O/D planetary gear, direct clutch and one-way clutch assembly.

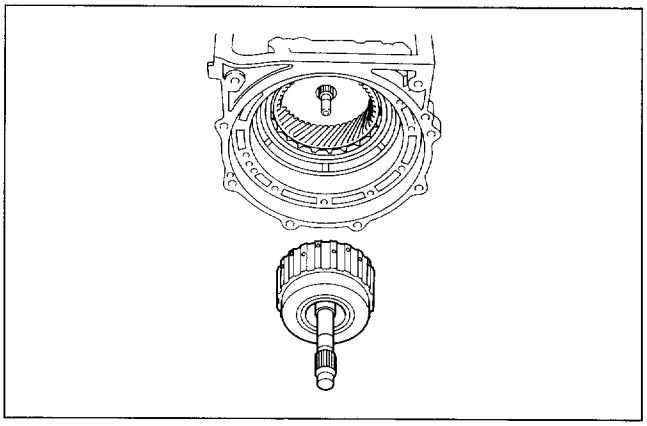


Figure 40. Clutch Assembly Removal

4. Remove the thrust bearing from the O/D planetary gear.

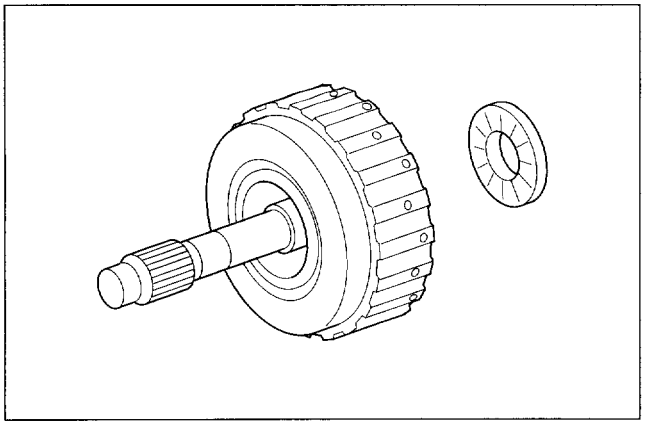


Figure 41. Thrust Bearing

Overdrive Planetary Ring Gear Assembly

1. Remove the ring gear assembly from the O/D case.

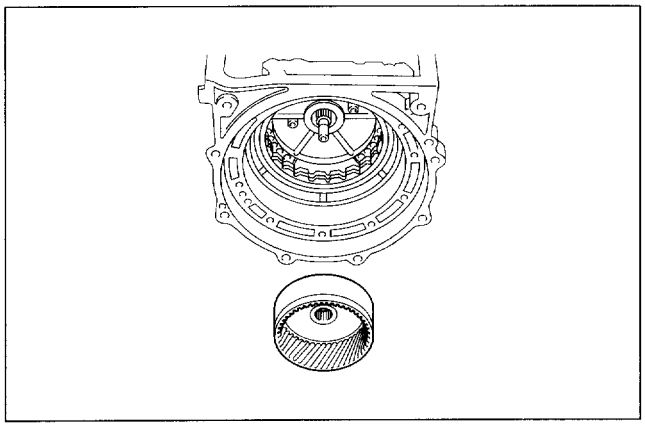


Figure 42. Ring Gear Removal

2. Remove the thrust bearing and the 2 races from the O/D case.

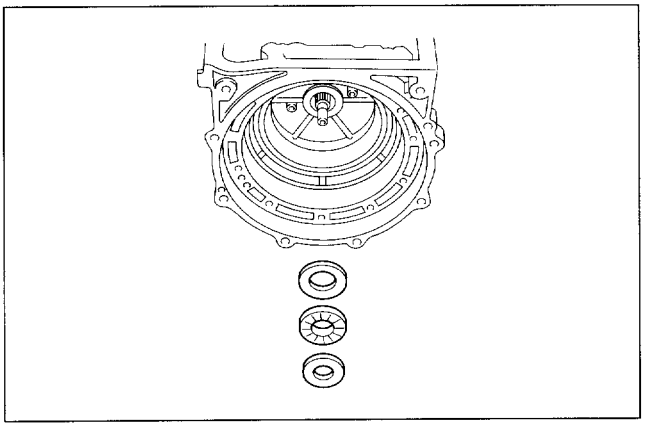


Figure 43. Thrust Bearing and Race

Thrust Clearance of Input Shaft (Front Clutch Drum)

1. Temporarily install the 3 bolts.

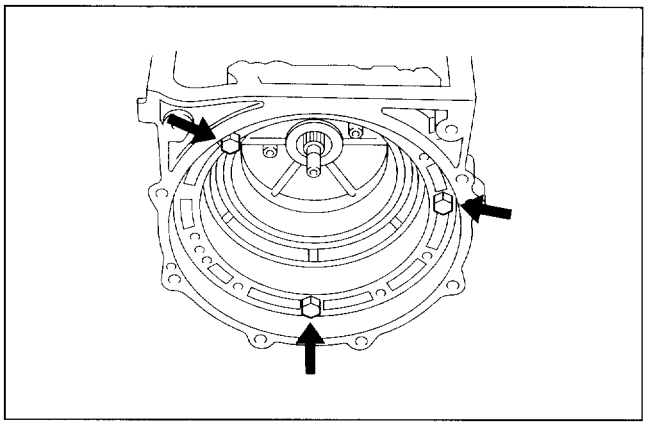


Figure 44. Bolt Installation

2. Push the transmission output shaft toward the front of the transmission by applying a force of 49–98 N (5–10 kg, 11.0–22.0 lb).
3. Push the O/D case toward the rear of the transmission by applying a force of 49–98 N (5–10 kg, 11.0–22.0 lb).

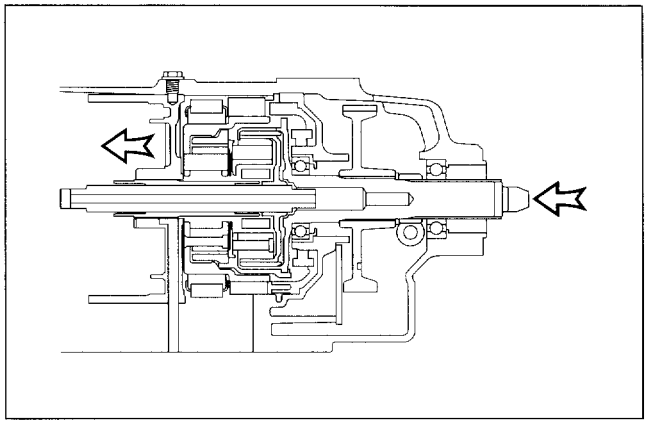


Figure 45. Trust Clearance

4. Using the extension bar and dial indicator, measure the thrust clearance of the input shaft.
   Tool Required:
   5-8840-2651-0 Extension Bar
   Standard thrust clearance: 0.30–0.70 mm (0.0118–0.0276 in.)
   Maximum thrust clearance: 0.70 mm (0.0276 in.)

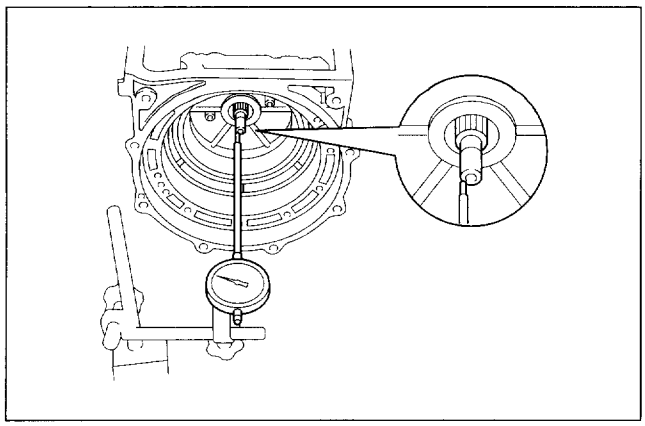


Figure 46. Measuring Clearance

Overdrive Case Assembly

1. Remove 3 bolts.

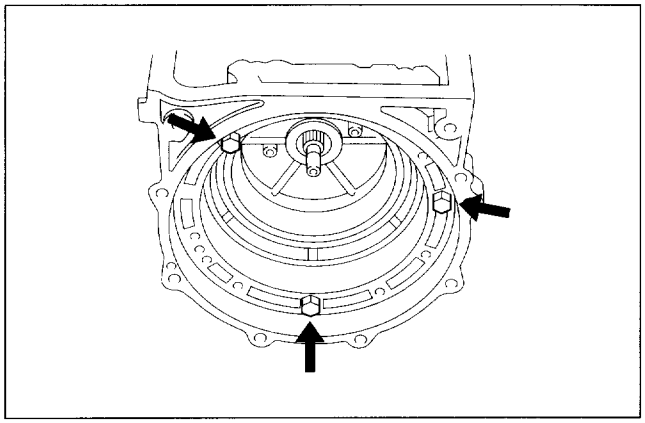


Figure 47.Bolt Removal

2. Using the oil pump remover, remove the O/D case assembly.
   Tool Required:
   5-8840-2652-0 Oil Pump Remover

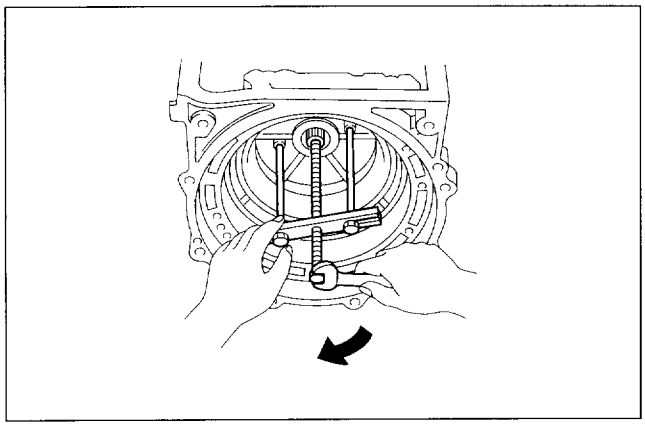


Figure 48. O/D Case Assy Removal

3. Remove the 3 O-rings from the oil holes of the O/D case.

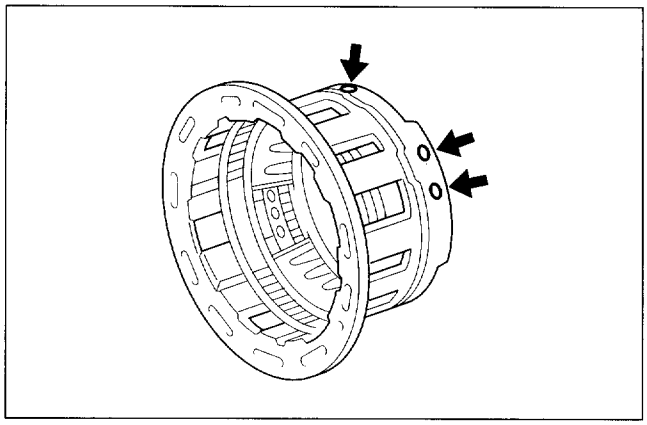


Figure 49. O-ring Location

Front Clutch Assembly

1. Place the plate, on the installation surface of the oil pump.
   Tool Required:
   5-8840-2647-0 Plate
2. Using calipers, measure the distance between the tops of the plate and the clutch drum for assembly.
   NOTICE: Record the measured distance to keep it as a reference when assembling.

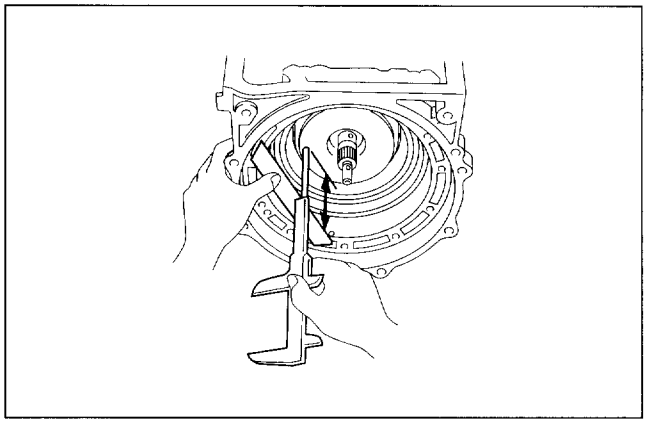


Figure 50. Measuring Distance

3. Remove the front clutch assembly.

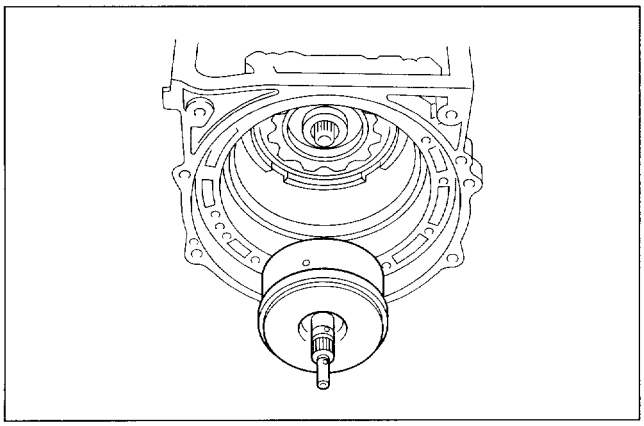


Figure 51. Front Clutch Assembly Removal

4. Using a screwdriver, remove the oil seal ring from the input shaft.

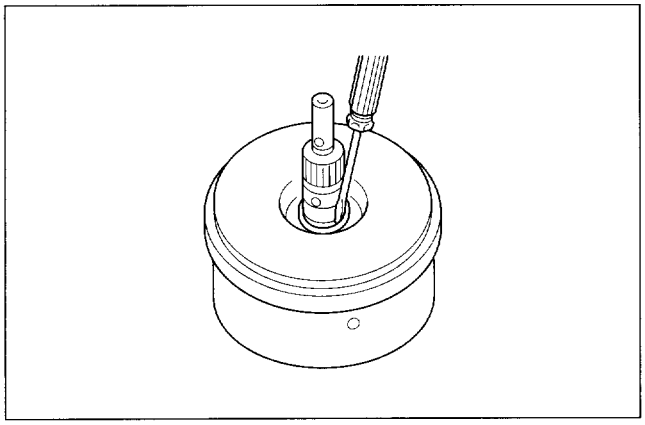


Figure 52. Oil Seal Removal

5. Remove the 2 races, thrust bearing and spacer from the front clutch drum.

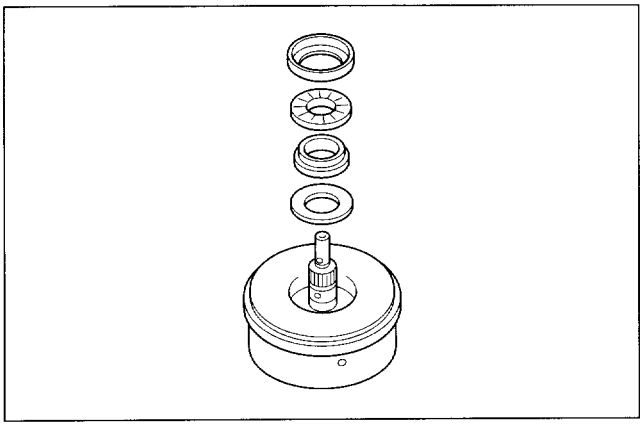


Figure 53. Race, Thrust Bearing and Spacer

6. Remove the thrust bearing and race from the rear clutch drum.

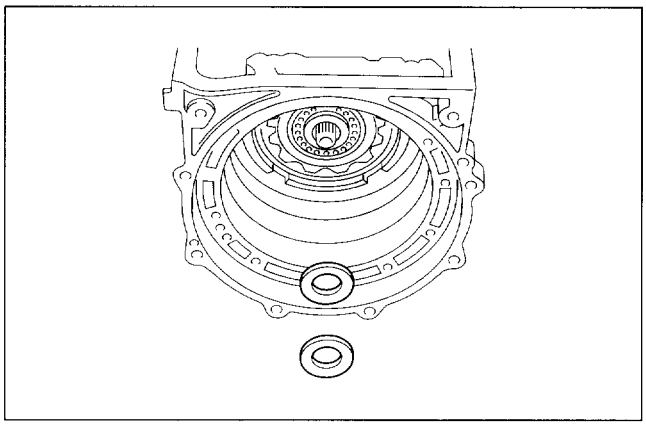


Figure 54. Thrust Bearing and Race

Rear Clutch Assembly

Install 2 wires into flukes of the clutch discs, and remove the rear clutch assembly.

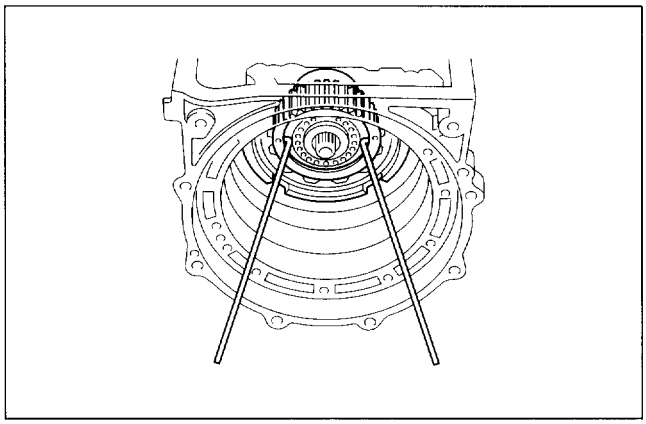


Figure 55. Rear Clutch Assembly Removal

Center Support Assembly

1. Push the transmission output shaft toward the front of the transmission by applying a force of 49–98 N (5–10 kg, 11.0–22.0 lb).
2. Push the center support toward the rear of the transmission by applying a force of 49–98 N (5–10 kg, 11.0–22.0 lb), then pull with the same amount of force.

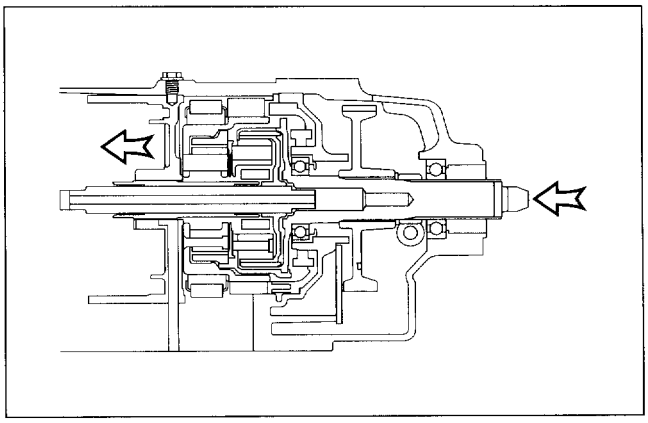


Figure 56. Thrust Clearance

3. Place the plate on the center support.
   Tool Required:
   5-8840-2647-0 Plate
4. Using calipers, measure distance (A) between the tops of the plate and the thrust washer on the front planetary gear.
5. Using calipers, measure the thickness (B) of the plate.

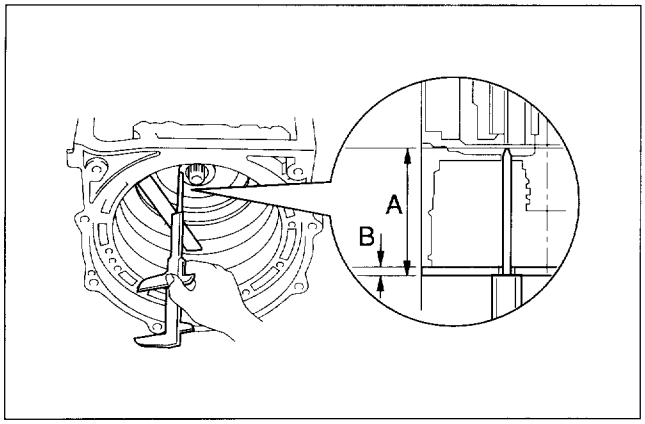


Figure 57. Measuring Distance

6. Remove the 3 center support set bolts.

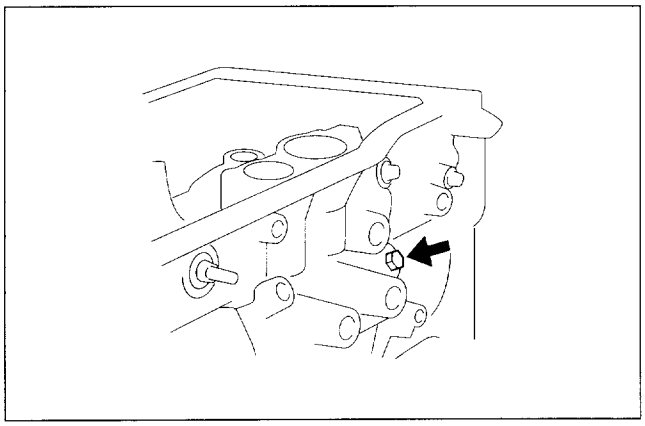


Figure 58. Center Support Bolt

7. Using the oil pump remover, remove the center support assembly.
   Tool Required:
   5-8840-2652-0 Oil Pump Remover

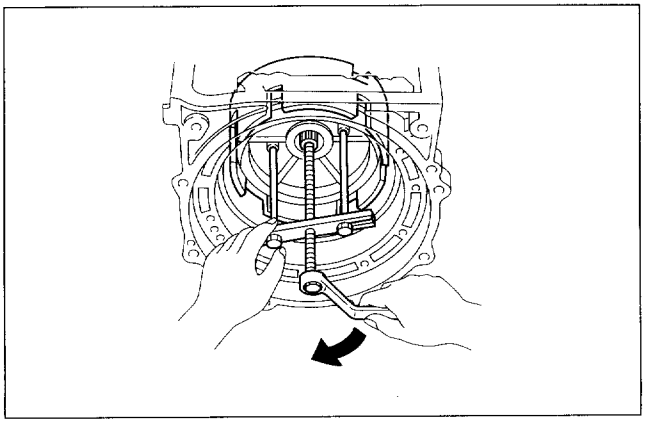


Figure 59. Center Support Assembly Removal

8. Turn over the center support together with the thrust washer, and place it on a flat surface.
9. Inserting the calipers into the thrsut washer hole, measure the distance (C) between it and the flat surface.
   Center support thrust clearance: A – (B + C)
   Standard thrust clearance: 0.30–0.70 mm (0.0118–0.0276 in.)
   Maximum thrust clearance: 0.90 mm (0.0354 in.)

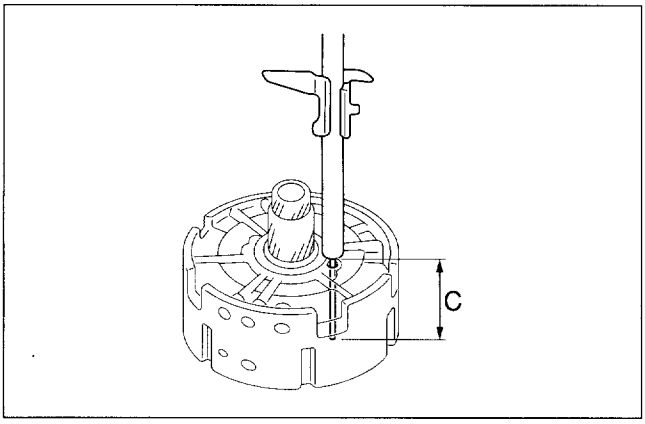


Figure 60. Measuring Distance

10. Remove the 3 O-rings from the center support.

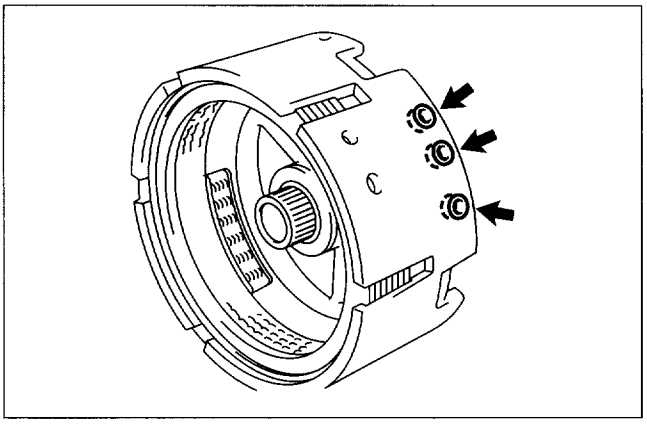


Figure 61. O-ring of Center Support

11. Remove the thrust washer from the center support.

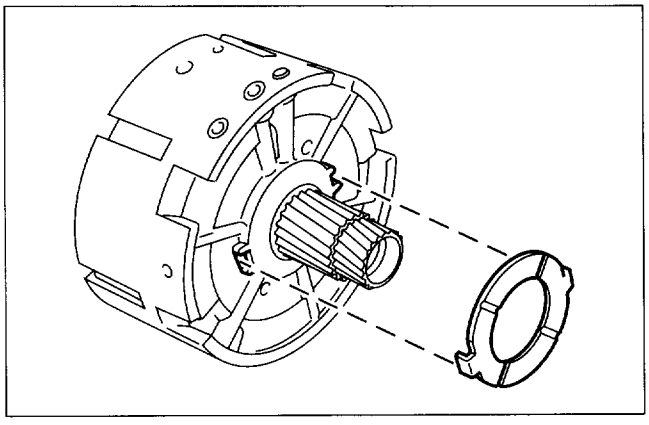


Figure 62. Thrust Washer

Planetary Gears, One-Way Clutch and Output Shaft Assembly

1. Remove the thrust washer from the planetary gear.

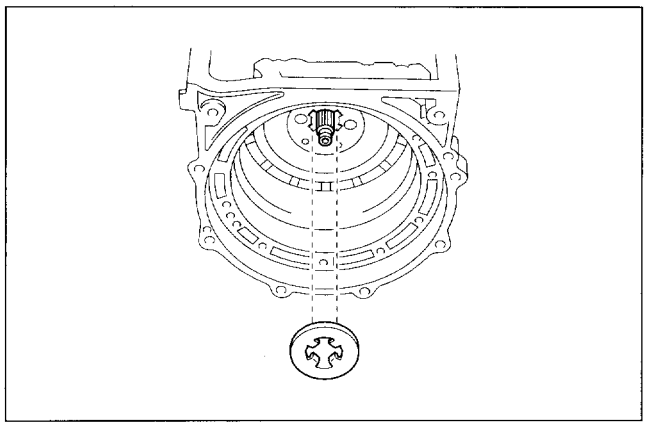


Figure 63. Thrust Washer

2. Using a screwdriver, remove the snap ring.

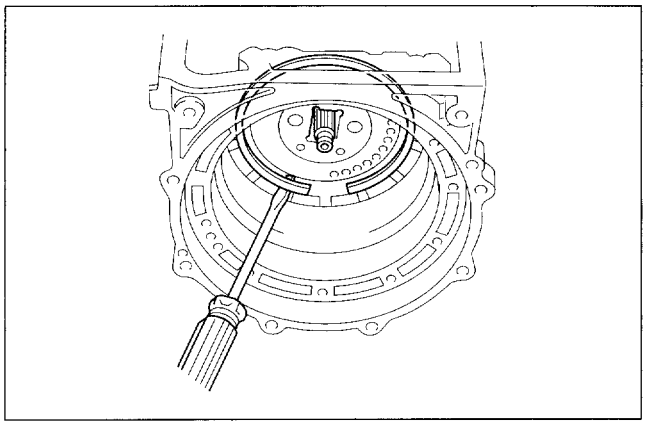


Figure 64. Snap Ring Removal

3. Remove the planetary gears, one-way clutch and output shaft assembly.

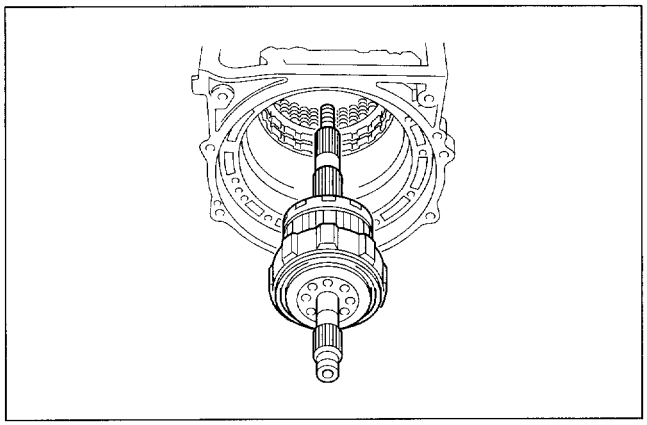


Figure 65. Output Shaft Assembly Removal

General Notes

The instructions here are organized so that you work on only one component group at a time. This will help avoid confusion from similar-looking parts of different subassemblies being on your workbench at the same time.

The component groups are inspected and repaired from the converter housing side.

As much as possible, complete the inspection, repair and assembly before proceeding to the next component group. If a component group can not be assembled because parts are being ordered, be sure to keep all parts of that group in a separate container while proceeding with disassembly, inspection, repair and assembly of other component groups.

Recommended fluid of the automatic transmission is DEXRON®-III.

GENERAL CLEANING NOTES:

1. All disassembled parts should be washed clean and any fluid passages and holes blown through with compressed air.
2. When using compressed air to dry parts, always aim away from yourself to prevent accidentally spraying automatic transmission fluid or kerosene on your face.
3. The recommended automatic transmission fluid or kerosene should be used for cleaning.

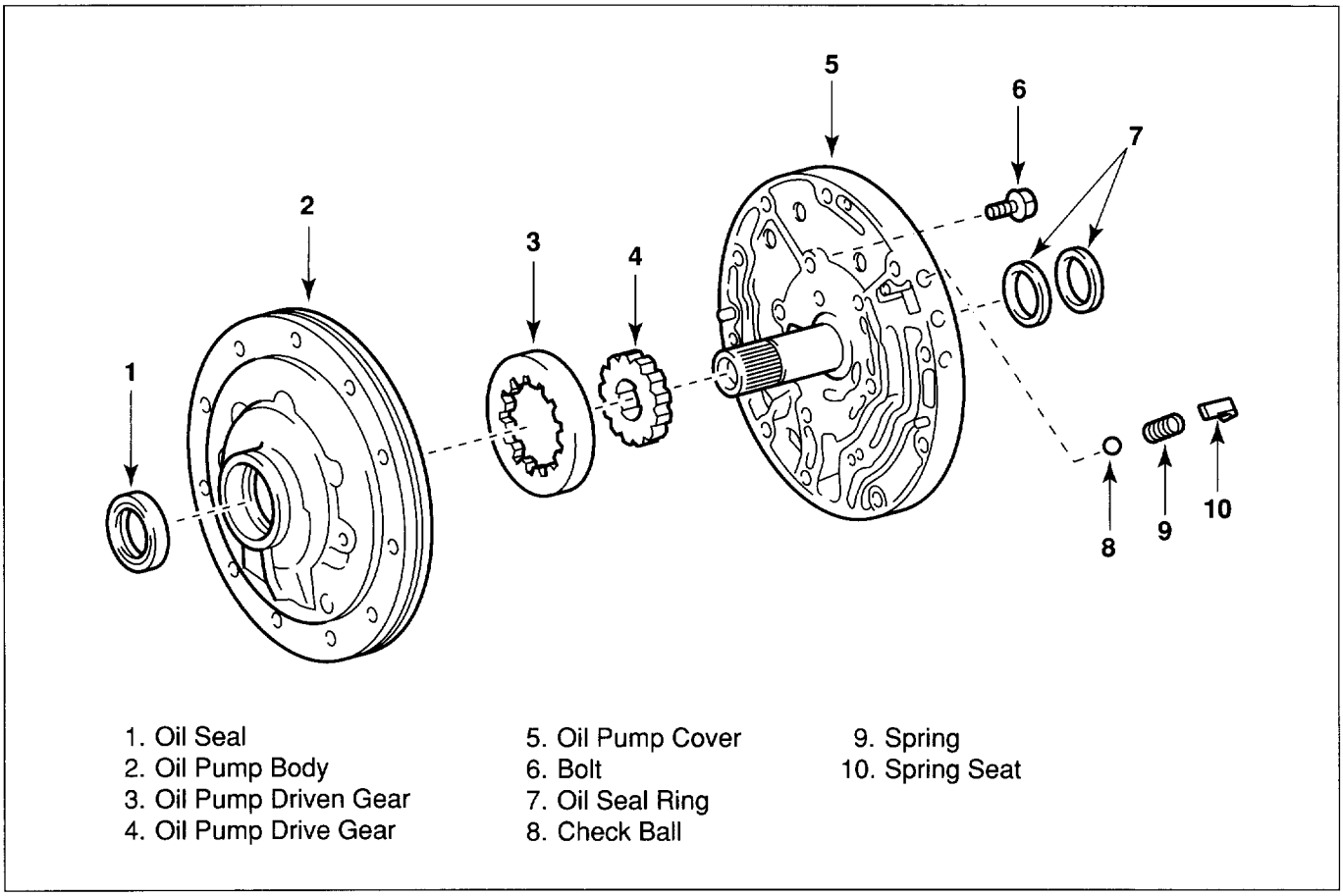
PARTS ARRANGEMENT:

1. After cleaning, the parts should be arranged in proper order to allow performing inspection, repairs, and reassembly with efficiency.
2. When disassembling a valve body, be sure to keep each valve together with the corresponding spring.
3. New disc for the brakes and clutches that are to be used for replacement must be soaked in transmission fluid for at least 15 minutes before assembly.

GENERAL ASSEMBLY:

1. All oil seal rings, clutch discs, clutch plates, rotating parts, and sliding surfaces should be coated with transmission fluid prior to reassembly.
2. All gaskets and rubber O-rings should be replaced.
3. Make sure that the ends of a snap ring are not aligned with one of the cutouts and are installed in the groove correctly.
4. If a worn bushing is to be replaced, the subassembly containing that bushing must also be replaced.
5. Check thrust bearings and races for wear or damage. Replace if necessary.
6. Use petroleum jelly to keep parts in place.

OIL PUMP



1. Oil Seal
2. Oil Pump Body
3. Oil Pump Driven Gear
4. Oil Pump Drive Gear
5. Oil Pump Cover
6. Bolt
7. Oil Seal Ring
8. Check Ball
9. Spring
10. Spring Seat

Figure 66. Oil Pump Assembly

Disassemble

1. Use torque converter as work stand.
   Make sure the drive gear rotates smoothly when installed to the torque converter.

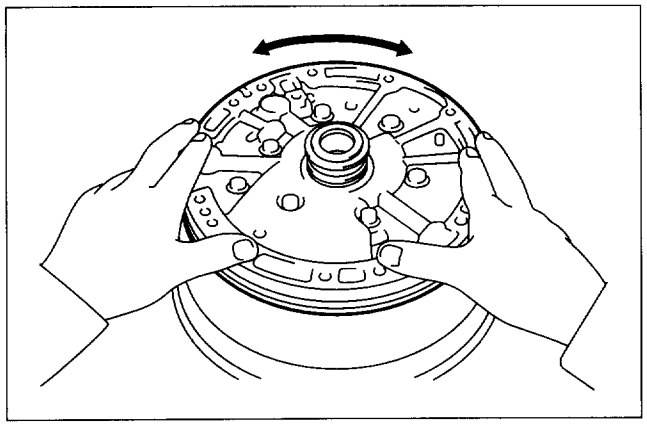


Figure 67. Drive Gear Rotation Check

2. Remove the 2 oil seal rings.

CAUTION:
- **Do not damage the oil seal rings and do not deform them unless necessary.**
- **Do not damage the claws on the oil seal rings.**

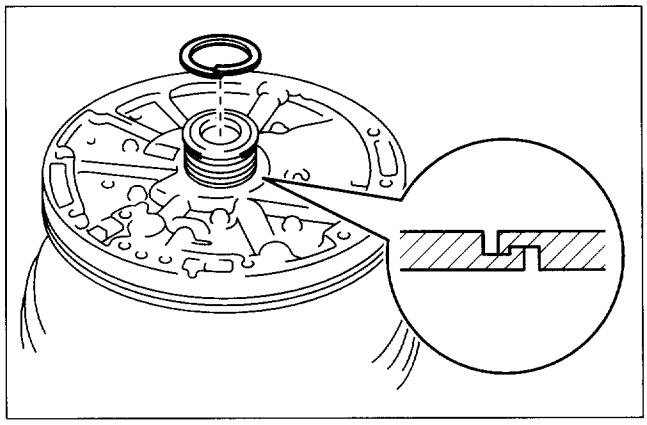


Figure 68. Oil Seal Removal

3. Using a screwdriver, compress the spring and remove the spring seat.
   Remove the spring and check ball.

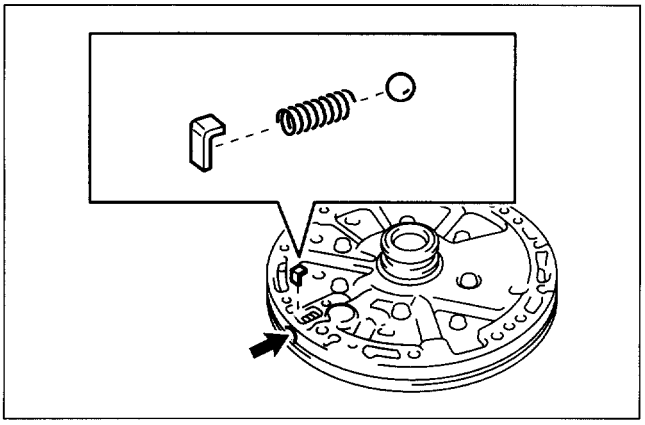


Figure 69. Check Ball Removal

4. Remove 7 bolts and pump cover.

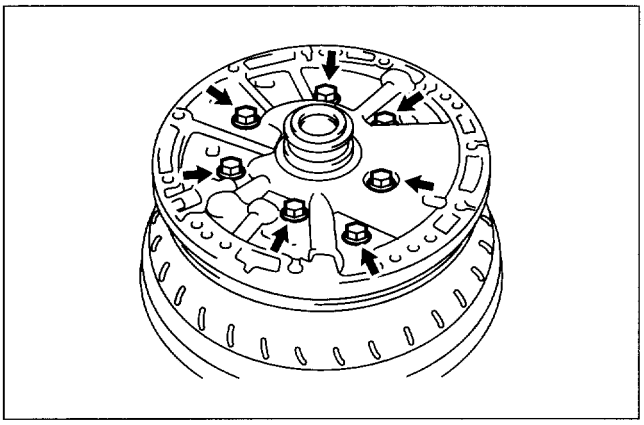


Figure 70. Pump Cover Removal

5. Using a screwdriver, pry off the oil seal.

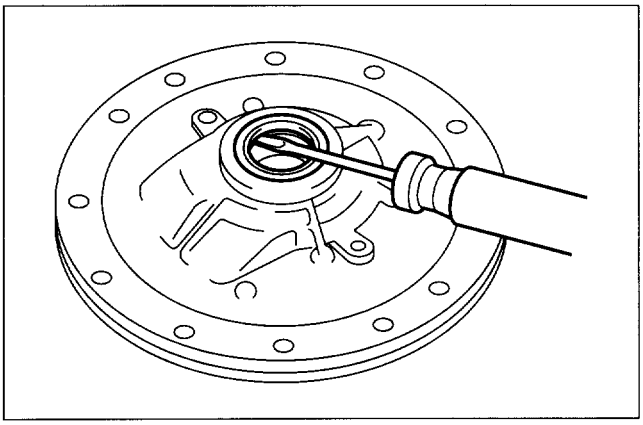


Figure 71. Oil Seal Removal

Inspect

1. Inspect bushing of oil pump body.
   Using a dial indicator, measure the inside diameter.
   Standard inside diameter: 42.050–42.075 mm (1.6555–1.6565 in.)
   Maximum inside diameter: 42.13 mm (1.6587 in.)
   NOTICE: Measure at several points and take the average value.
   If the inside diameter is greater than maximum, replace the oil pump assembly.

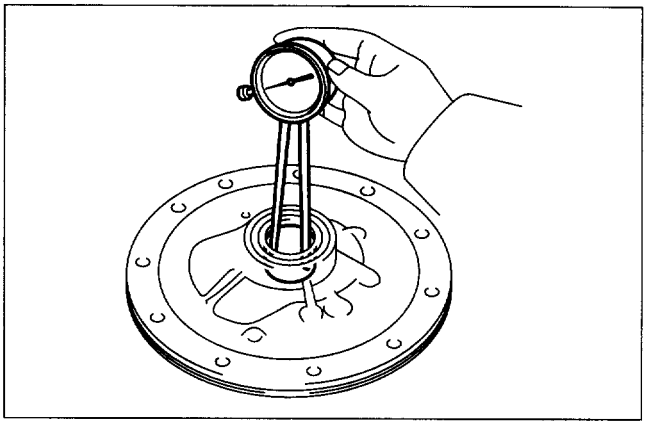


Figure 72. Bushing Inside Diameter Measurement

2. Inspect bushings of oil pump cover.
   Using a dial indicator, measure the inside diameter.
   Front bushing standard inside diameter: 24.000–24.021 mm (0.9449–0.9457 in.)
   Rear bushing standard inside diameter: 26.500–26.521 mm (1.0433–1.0441 in.)
   Front bushing maximum inside diameter: 24.07 mm (0.9476 in.)
   Rear bushing maximum inside diameter: 26.57 mm (1.0461 in.)
   NOTICE: Measure at several points and take the average value.
   If the inside diameter is greater than the maximum, replace the oil pump assembly.

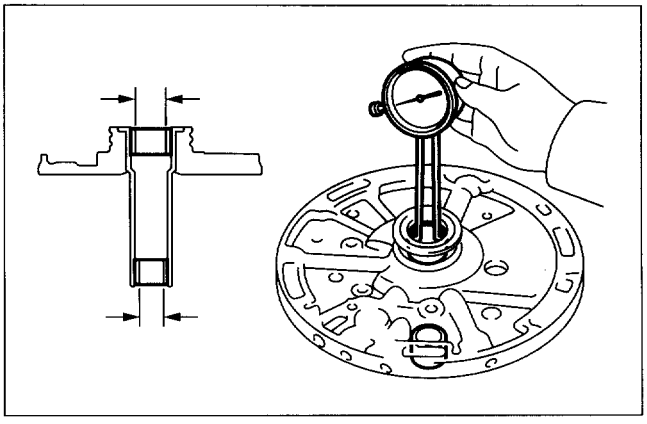


Figure 73. Bushing Inside Diameter Measurement

Assemble

1. Install oil seal.
   Coat the new oil seal with DEXRON®-III.
   Using installer, tap in a new oil seal.
   Tool Required:
   5-8840-2644-0 Oil Seal Installer
   The oil seal end should be flushed with the outer edge of the pump body.
   Apply grease to the oil seal lip.

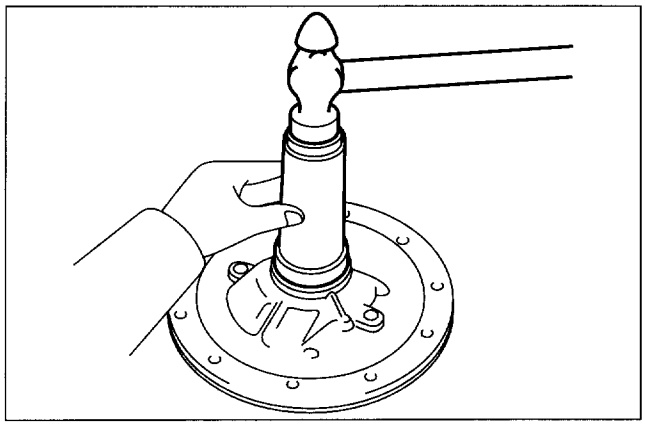


Figure 74. Oil Seal Installation

2. Install oil pump cover to oil pump body.
   Align the bolt holes of the oil pump body and cover.
   Install the pump cover with the 7 bolts.

Tighten

Torque: 21 N·m (2.1 kg·m, 15lb·ft)

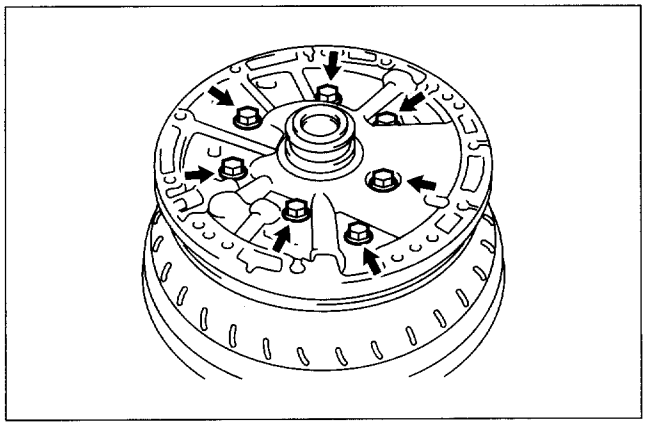


Figure 75. Oil Pump Cover Installation

3. Install the check ball and spring.
   Using a screwdriver, compress the spring and install the spring seat.

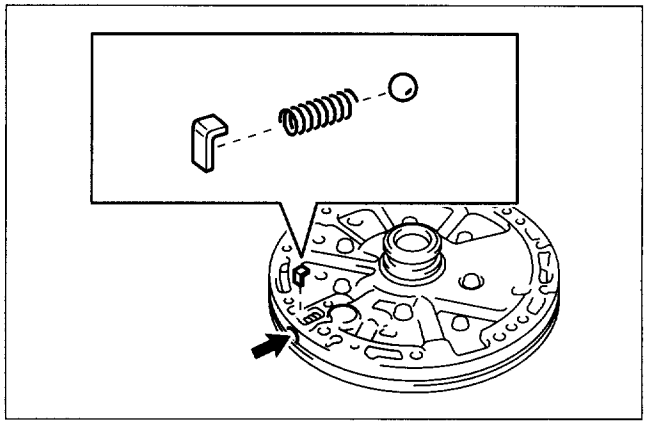


Figure 76. Check Ball Installation

4. Coat the 2 oil seal rings with ATF.
   Contract the oil seal rings, and install them onto the stator shaft.
   CAUTION:
   - **Do not spread the ring ends too much.**
   - **Do not damage the claws on the oil seal rings.**

   NOTICE:
   - **If the rings are damaged or deformed, replace them with new ones.**
   - **After installing the oil seal rings, check that they rotate smoothly.**

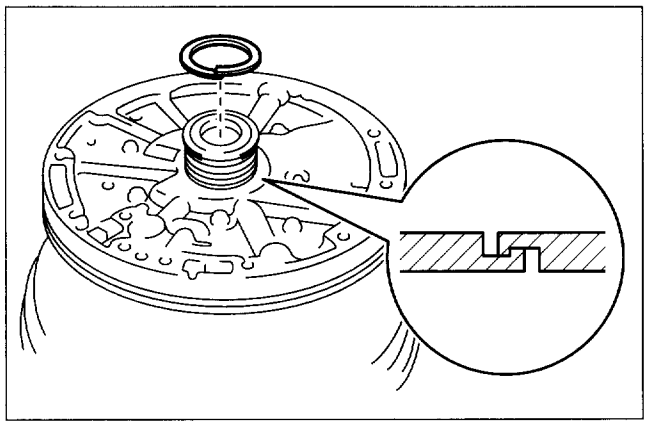


Figure 77. Oil Seal Installation

6. Check oil pump drive rotation.
   Make sure the drive gear rotates smoothly when installed to the torque converter.

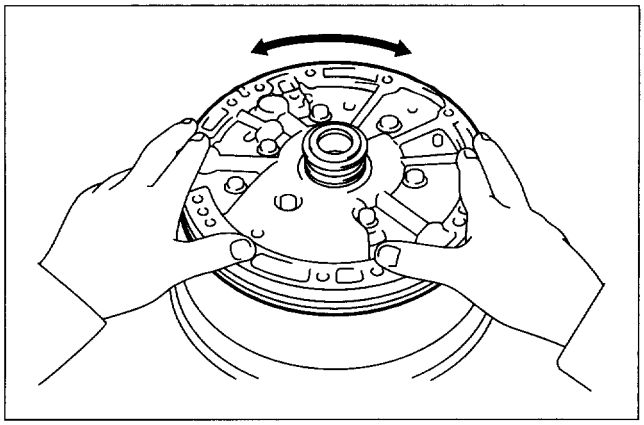
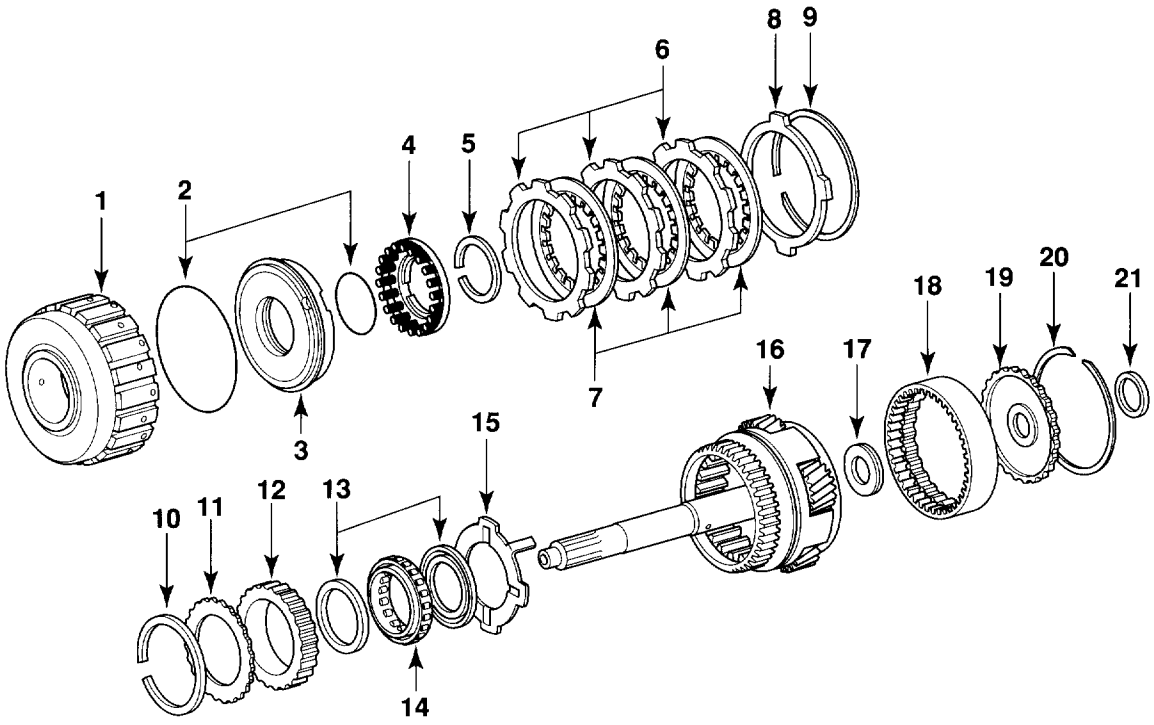


Figure 78. Drive Gear Rotation Check

OVERDRIVE PLANETARY GEAR AND DIRECT CLUTCH



1. O/D Direct Clutch Drum
2. O-ring
3. O/D Direct Clutch Piston
4. Piston Return Spring
5. Snap Ring
6. Plate
7. Disc
8. Flange
9. Snap Ring
10. Snap Ring
11. Thrust washer
12. One-way Clutch Outer Race
13. Retainer
14. One-way Clutch
15. Thrust Washer
16. O/D Planetary Gear
17. Thrust Washer
18. Planetary Ring Gear
19. Ring Gear Flange
20. Snap Ring
21. Oil Seal Ring

Figure 79. O/D Planetary Gear and Direct Clutch Assembly

Disassemble

1. Check operation of one-way clutch.
   Hold the O/D direct clutch drum and turn the input shaft.
   The input shaft should turn freely clockwise and should lock counterclockwise.

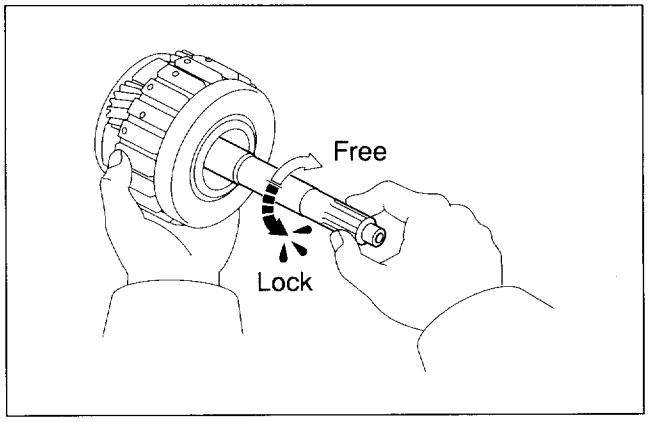


Figure 80. One-way Clutch Operation

2. Remove overdrive direct clutch assembly from overdrive planetary gear.

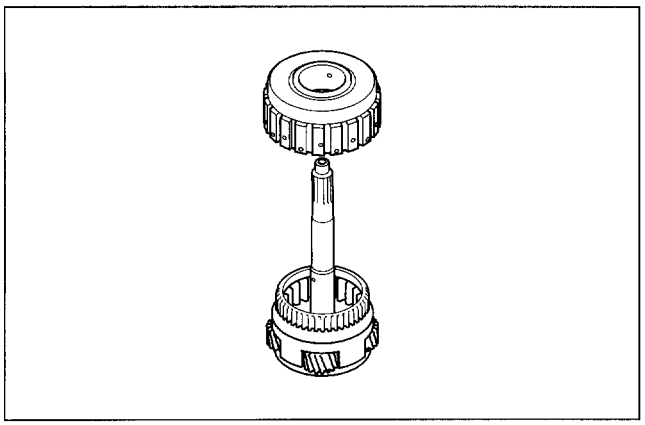


Figure 81. O/D Direct Clutch Removal

3. Check piston stroke of overdrive direct clutch.
Place the oil pump onto the torque converter, and then place the O/D direct clutch assembly onto the oil pump.

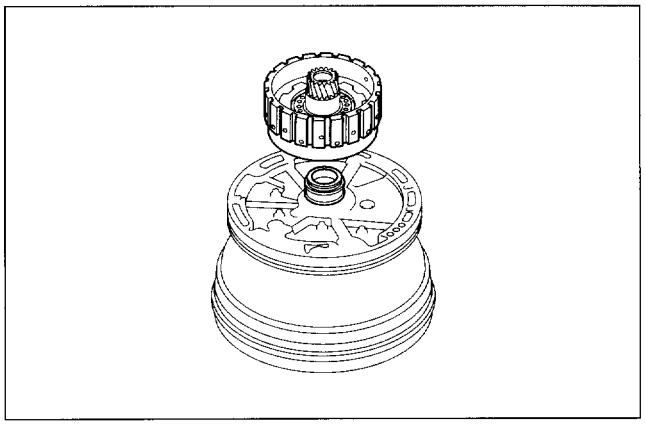


Figure 82. Piston Stroke Check (1)

Using No.1 measure terminal and a dial indicator, measure the piston stroke by applying and releasing compressed air 392–785 kPa (4–8 kg/cm², 57–114 psi).
Tool Required:
5-8840-2649-0 No.1 measure terminal
NOTICE:
- **Stand the measure terminal on the piston vertically.**
- **Ensure that the measure terminal does not touches other parts than the piston.**
- **Measure the stroke at more than 3 points.**

Piston stroke: 1.80–2.07 mm (0.0709–0.0815 in.)
If the piston stroke is not as specified, inspect the discs and the plates.

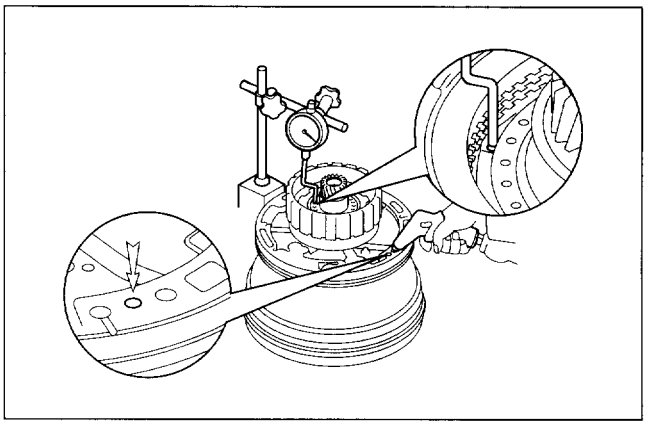


Figure 83. Piston Stroke Check (2)

4. Remove flange, plates and discs
Using a screwdriver, remove the snap ring.

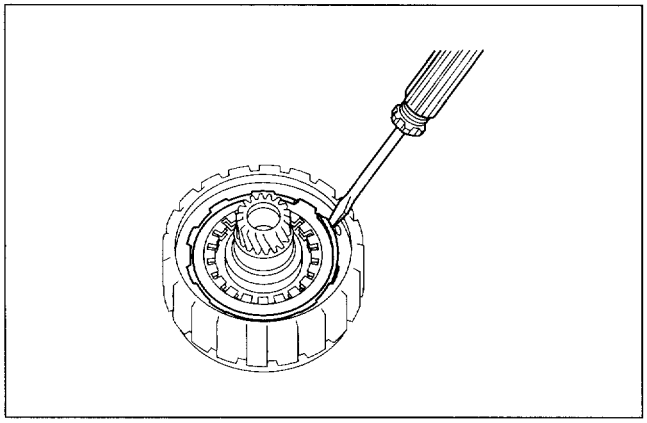


Figure 84. Snap Ring Removal

Remove the flange, 3 discs and 3 plates.

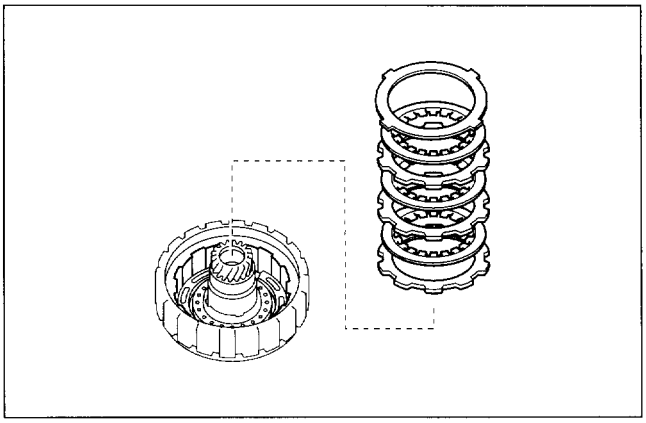


Figure 85. Disc and Plate Removal

5. Remove piston return spring.
Place No.2 piston spring compressor on the spring seat, and compress the return spring with a shop press.
Tool Required:
5-8840-2641-0 No.2 Piston Spring Compressor

NOTICE: Stop compressing the return spring at the position 1 to 2 mm away from the snap ring to prevent the spring sheet from being deformed.

Using snap ring pliers, remove the snap ring.

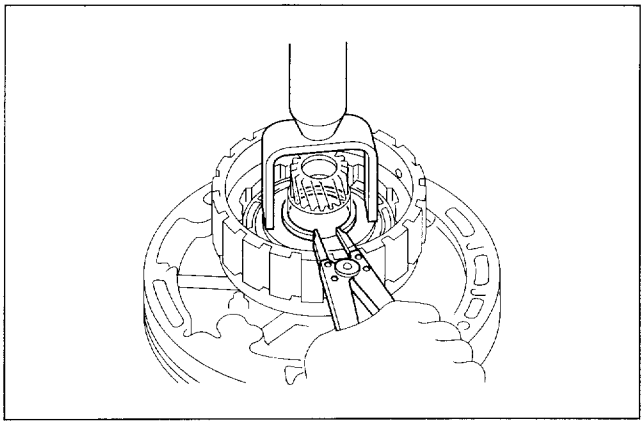


Figure 86. Piston Return Spring Removal (1)

6. Remove the piston return spring.

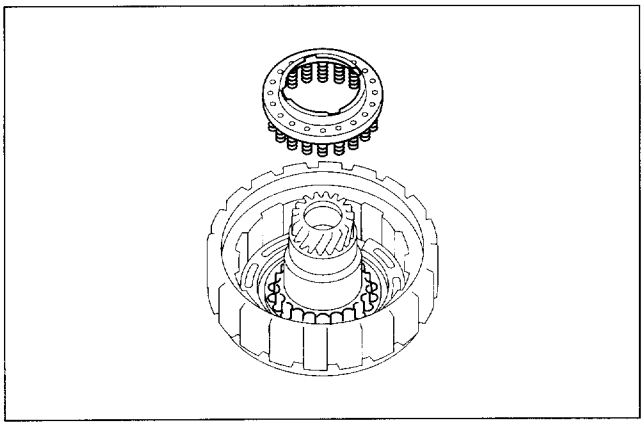


Figure 87. Piston Return Spring Removal (2)

7. Remove overdrive direct clutch piston.
   Place the oil pump onto the torque converter, and then place the O/D direct clutch onto the oil pump.
   Hold the clutch piston with hand, apply compressed air into the oil hole of the oil pump to remove the clutch piston.
   Remove the 2 O-rings from the clutch piston.

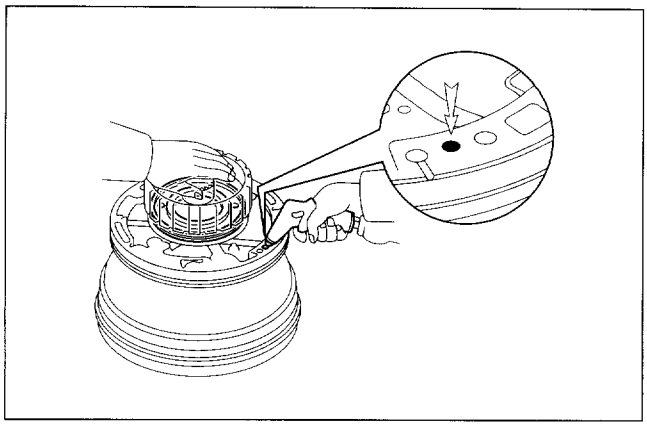


Figure 88. O/D Direct Clutch Piston Removal

8. Remove oil seal ring from ring gear flange.

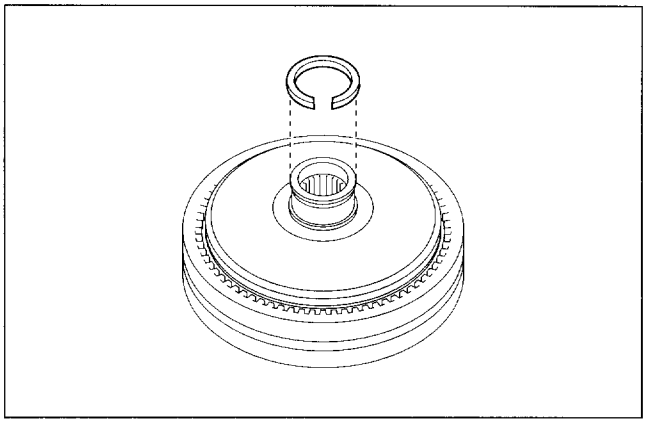


Figure 89. Oil Seal Ring Removal

9. Remove ring gear flange.
   Using a small screwdriver, remove the snap ring.

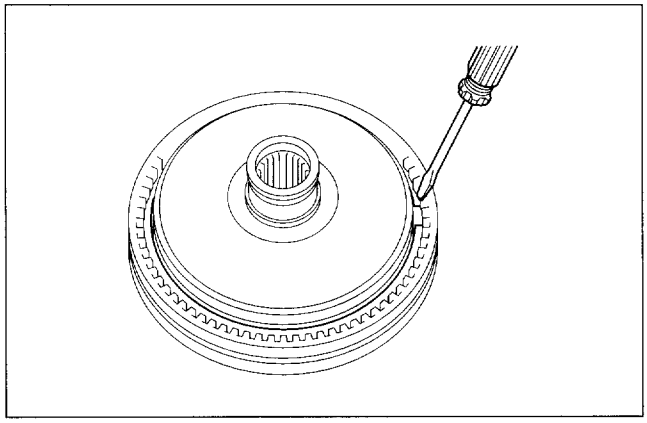


Figure 90. Snap Ring Removal

10. Remove the ring gear flange.

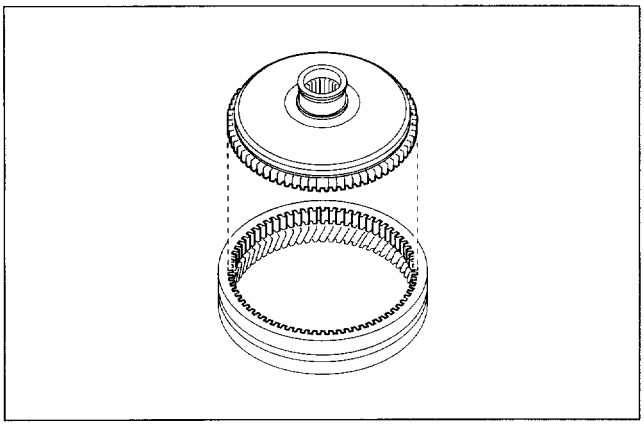


Figure 91. Ring Gear Flange Removal

11. Remove one-way clutch from overdrive planetary gear.
    Using small screwdriver, remove the snap ring.

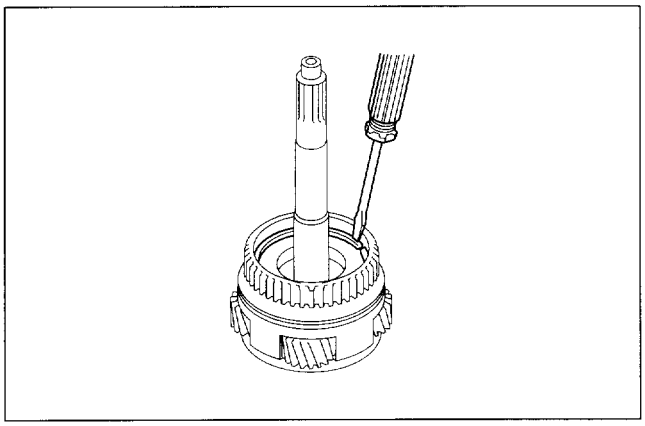


Figure 92. Snap Ring Removal

12. Remove the thrust washer.

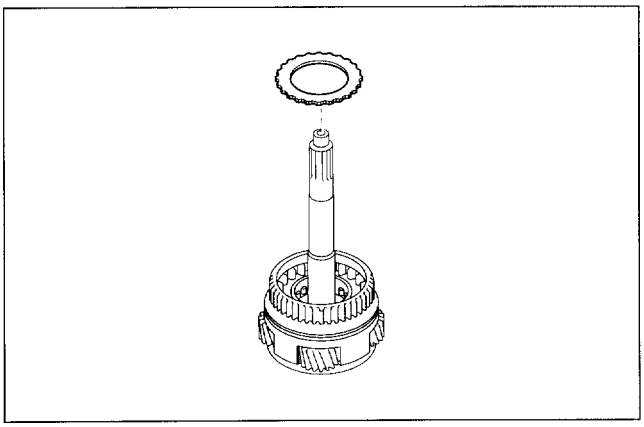


Figure 93. Thrust Washer Removal

13. Remove the one-way clutch together with the outer race.
    NOTICE: Check the installation direction of the one-way clutch.

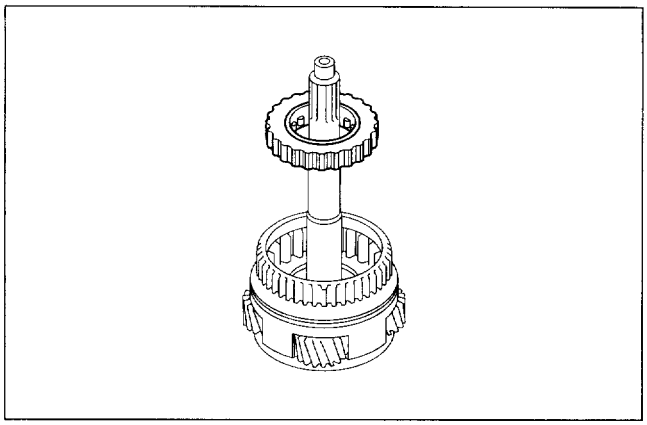


Figure 94. One-way Clutch and Outer Race Removal

14. Remove the thrust washer.
    NOTICE: Check the installation direction of the thrust washer.

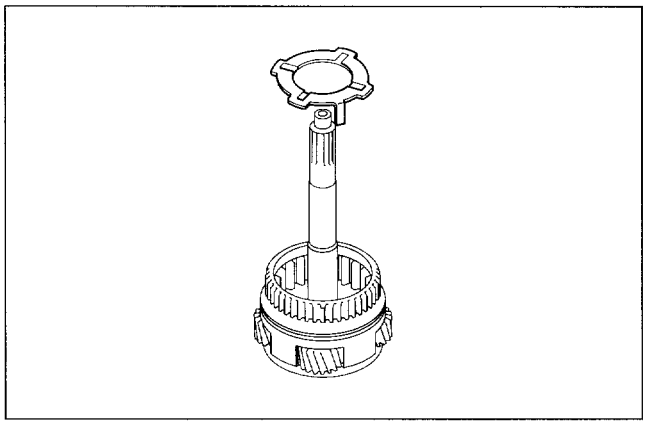


Figure 95. Thrust Washer Removal

15. Remove the one-way clutch from the outer race.
    NOTICE: Do not remove the upper and lower plates of the one-way clutch.

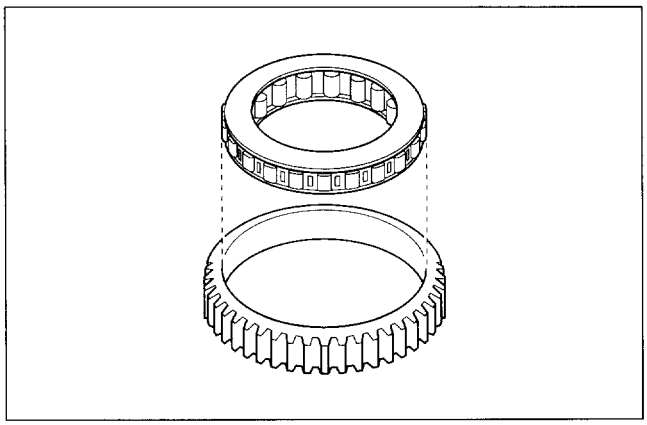


Figure 96. One-way Clutch Removal

Inspect

1. Inspect discs, plates and flange.
   Check to see if the sliding surface of the disc, plate and flange are worn or burnt. If necessary, replace them.
   NOTICE:
   - **If the lining of the disc is peeling off or discolored, or even if a part of the printed numbers are defaced, replace all discs.**
   - **Before assembling new discs, soak them in ATF for at least 15 minutes.**

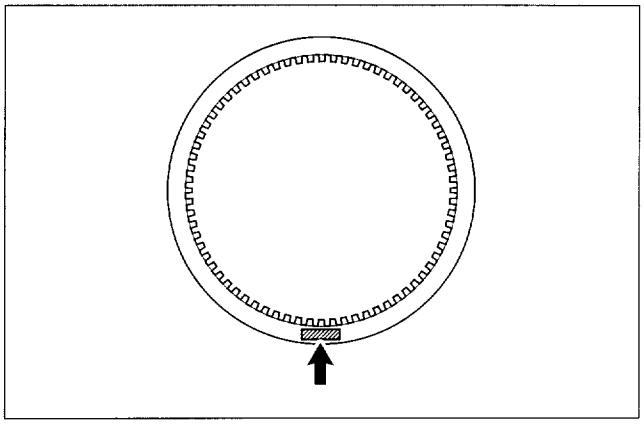


Figure 97. Disc Inspection

2. Inspect overdrive direct clutch piston.
   Check that check ball is free by shaking the piston.
   Check that the valve does not leak by applying low pressure compressed air.

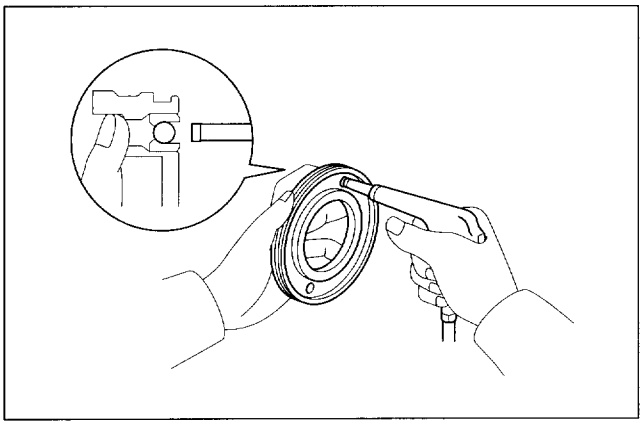


Figure 98. Valve Leakage Check

3. Inspect bushings of overdrive direct clutch drum.
   Using a dial indicator, measure the inside diameter.
   Standard inside diameter: 26.500–26.521 mm (1.0433–1.0441 in.)
   Maximum inside diameter: 26.57 mm (1.0461 in.)
   NOTICE: Measure at several points and take the average value.
   If the inside diameter is greater than maximum, replace the clutch drum.
   Inspect the bushing contacting surface of the planetary gear input shaft, when discoloration or damage on the surface is found, replace the planetary gear.

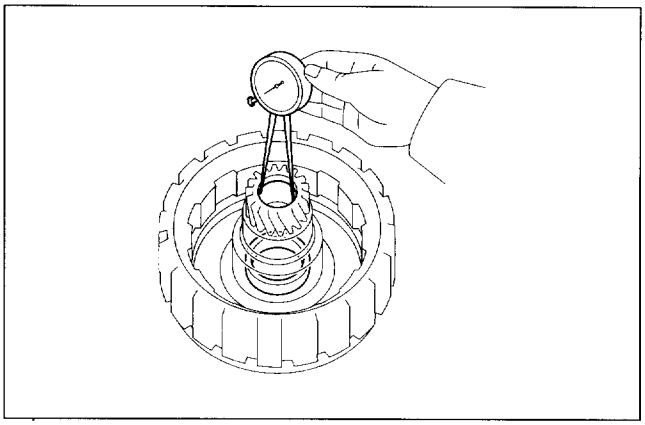


Figure 99. O/D Direct Clutch Drum Inspection

4. Inspect bushings of overdrive planetary gear.
   Using a dial indicator, measure the inside diameter.
   Standard inside diameter: 12.000–12.018 mm (0.4724–0.4731 in.)
   Maximum inside diameter: 12.070 mm (0.4752 in.)
   NOTICE: Measure at several points and take the average value.
   If the inside diameter is greater than maximum, replace the planetary gear.
   Inspect the bushing contacting surface of the front clutch drum input shaft, when discoloration or damage on the surface is found, replace the front clutch drum.

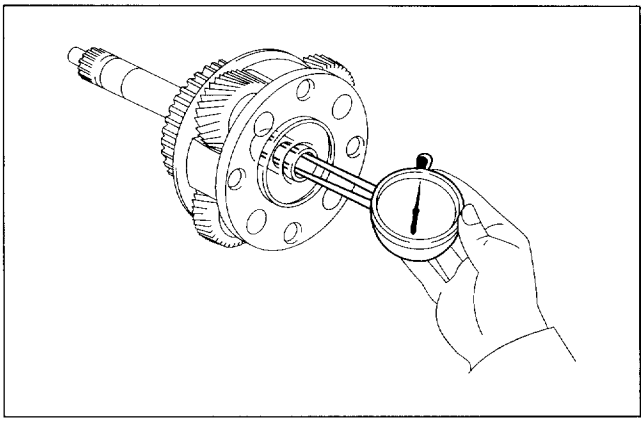


Figure 100. O/D Planetary Gear Inspection

5. Inspect planetary pinion gear thrust clearance. Using a feeler gauge, measure the clearance between the pinions and carrier.
   Standard clearance: 0.20–0.59 mm (0.0079–0.0232 in.)
   Maximum clearance: 0.80 mm (0.0315 in.)
   If the thrust clearance is greater than maximum, replace the planetary gear.

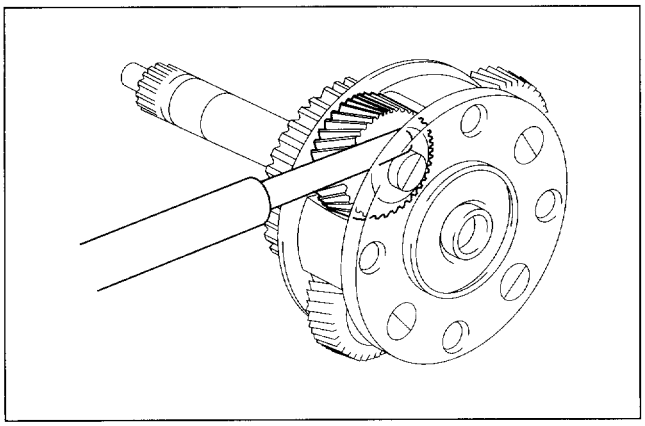


Figure 101. Thrust Clearance Check

Assemble

1. Install one-way clutch to overdrive planetary gear.
   a) Install the one-way clutch into the outer race.

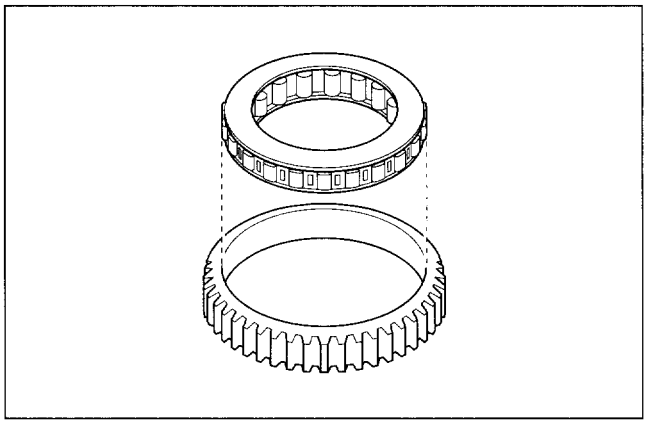


Figure 102. One-way Clutch Installation

   b) Install the thrust washer, facing the grooved side upward.

NOTICE: Insert the pin of thrust washer into holes in the O/D planetary gear.

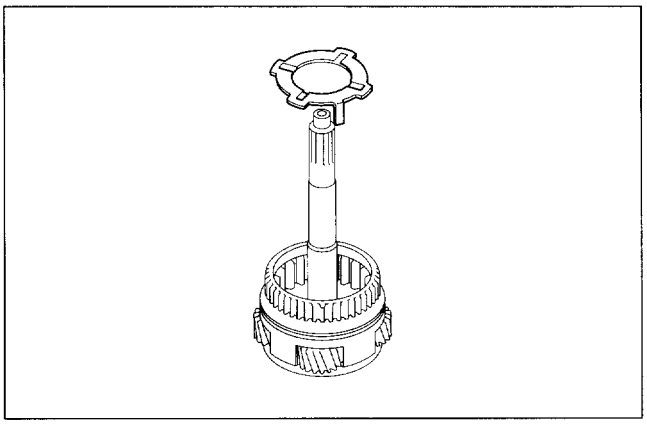


Figure 103. Thrust Washer Installation

   c) Install the one-way clutch and outer race assembly, facing the flanged side of the one-way clutch upward.

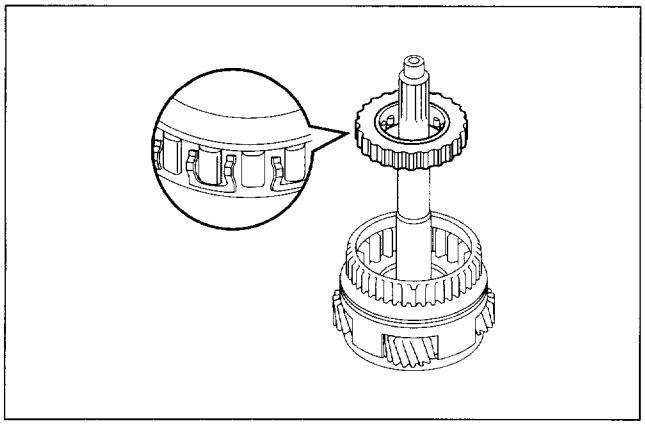


Figure 104. One-way Clutch Direction

d) Install the thrust washer.

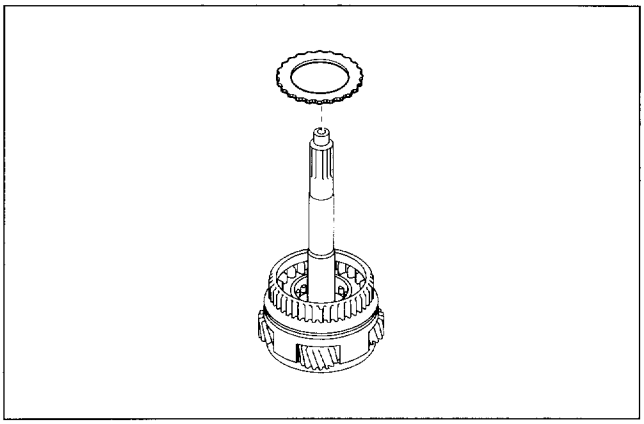


Figure 105. Thrust Washer Installation

e) Using a screwdriver, install the snap ring.

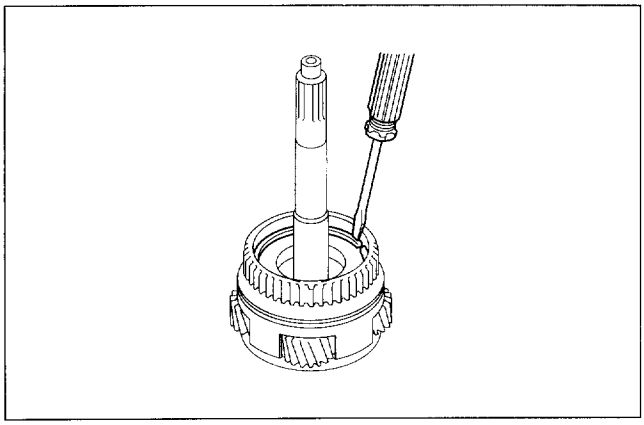


Figure 106. Snap Ring Installation

2. Install ring gear flange to overdrive planetary ring gear.
   a) Install the ring gear flange as shown.

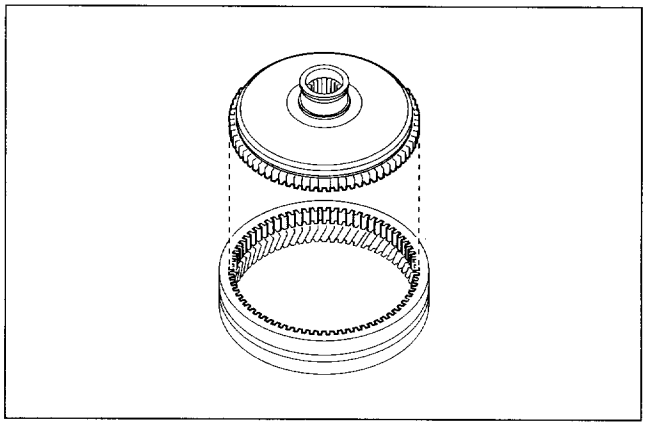


Figure 107. Ring Gear Flange Installation

b) Using a screwdriver, install the snap ring.

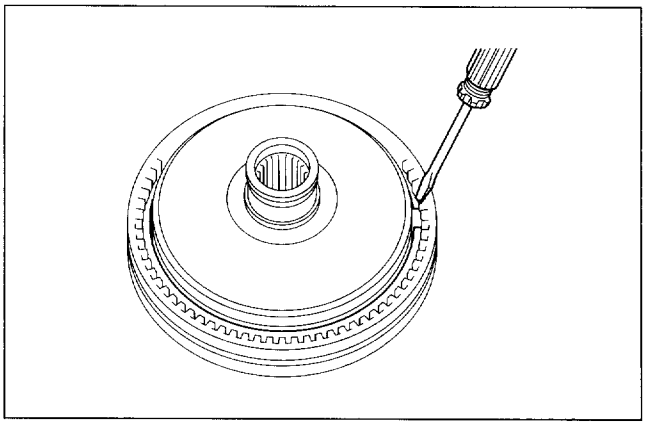


Figure 108. Snap Ring Installation

3. Install oil seal ring.
   Coat the oil seal ring with ATF, and install it to the ring gear flange, then sank it down by squeezing their ends together.
   CAUTION: Do not spread the ring ends more than necessary.
   NOTICE: After installing the oil seal ring, check that it moves smoothly.

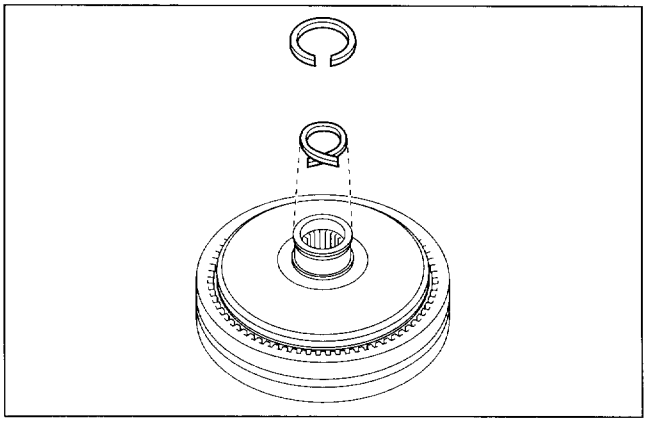


Figure 109. Oil Seal Ring Installation

4. Install overdrive direct clutch piston.
   a) Coat new O-rings with ATF, and install them on the clutch piston.

O-ring diameters mm (in.)

	Inside	Wire diameter
Inner side	64.1 (2.524)	2.6 (0.102)
Outer side	117.4 (4.6227)	3.1 (0.122)

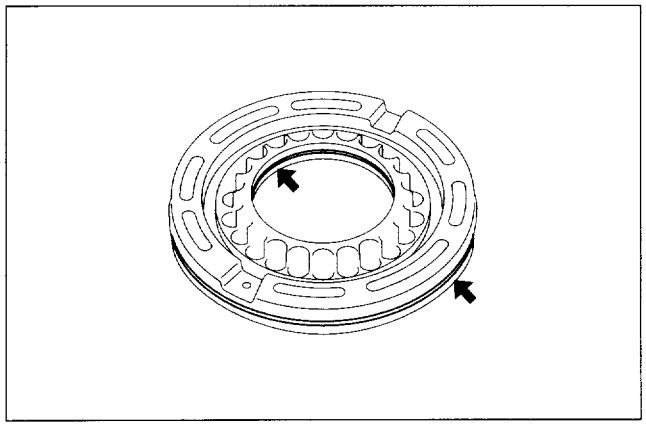


Figure 110. O-ring Location

   b) Push in the clutch piston into the clutch drum with both hands.

CAUTION: Be careful not to damage the O-rings.

NOTICE: Push in the piston uniformly.

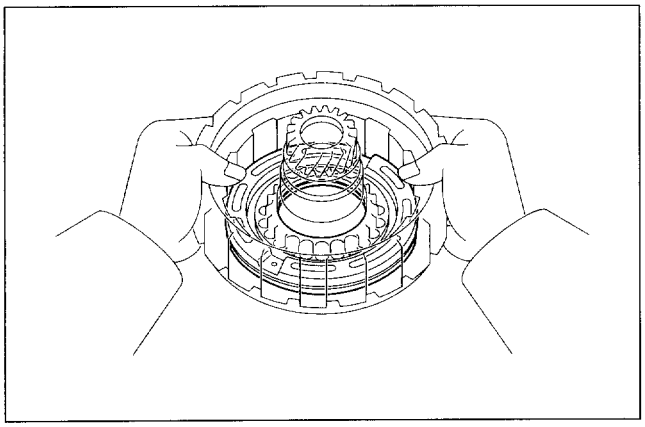


Figure 111. Clutch Piston Installation

5. Install piston return spring.
   a) Place the piston return spring on the clutch piston.

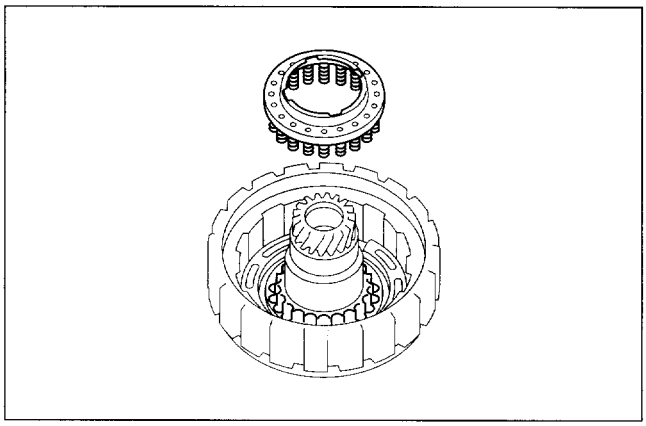


Figure 112. Return Spring Installation (1)

   b) Place No.2 piston spring compressor on the spring seat, and compress the return spring with a shop press.

Tool Required:
5-8840-2641-0 No.2 Piston Spring Compressor

NOTICE: Stop compressing the return spring at the position 1 to 2 mm away from the snap ring to prevent the spring sheet from being deformed.

   c) Using snap ring pliers, install the snap ring.

NOTICE: Be sure the end gap of the snap ring is not aligned with the spring retainer claw.

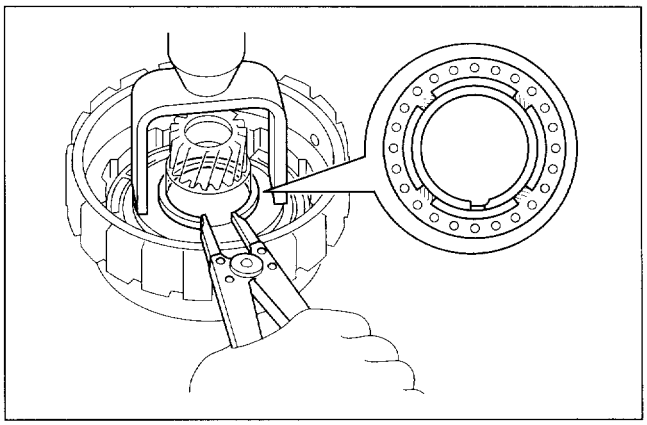


Figure 113. Return Spring Installation (2)

6. Install plates, discs and flange.
   a) Install the 3 plates and 3 discs in order:
   P = Plate D = Disc
   P – D – P – D – P – D

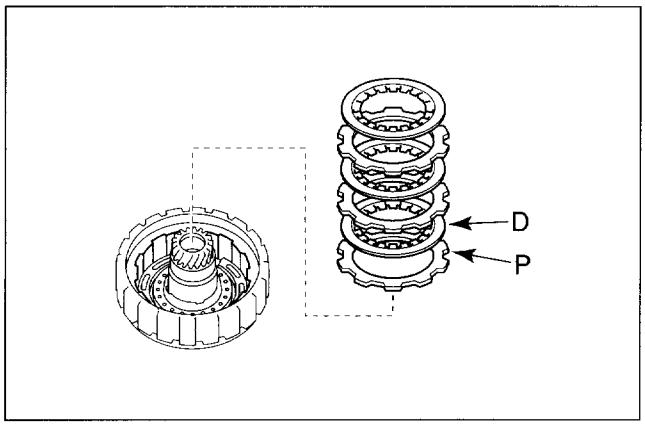


Figure 114. Plate and Disc Installation

b) Install the flange, facing the rounded edge upward.

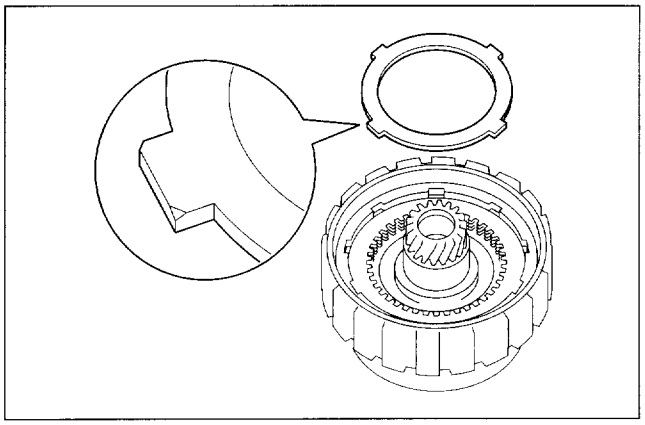


Figure 115. Flange Direction

c) Using a screwdriver, install the snap ring.
NOTICE: Be sure the end gap of the snap ring is not aligned with the cutout portion of the clutch drum.

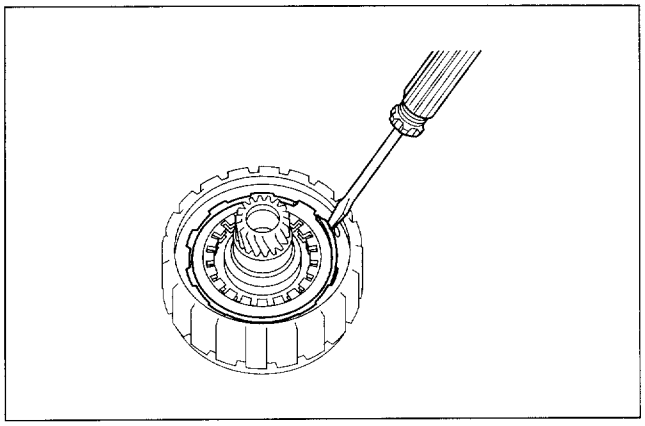


Figure 116. Snap Ring Installation

7. Check piston stroke of overdrive direct clutch.
   a) Place the oil pump onto the torque converter, and then place the O/D direct clutch assmebly onto the oil pump.

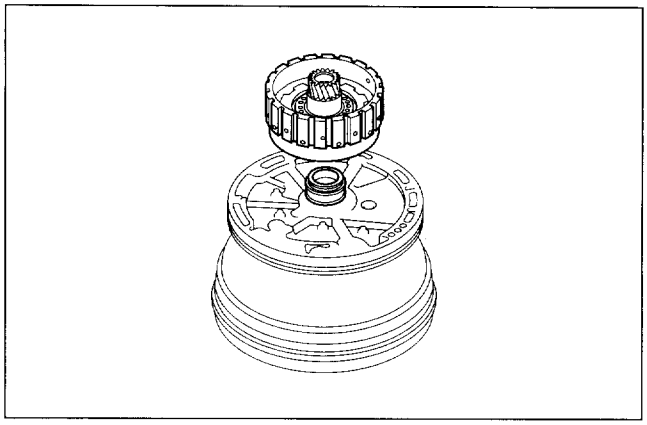


Figure 117. Piston Stroke Check (1)

b) Using No.1 measure terminal and a dial indicator, measure the piston stroke by applying and releasing compressed air 392–785 kPa (4–8 kg/cm², 57–114 psi).

Tool Required:
5-8840-2649-0 No.1 Measure Terminal

NOTICE:
- **Stand the measure terminal on the piston vertically.**
- **Ensure that the measure terminal does not touches other parts than the piston.**
- **Measure the stroke at more than 3 points.**

Piston stroke: 1.80–2.07 mm (0.0709–0.0815 in.)

If the piston stroke is less than specified, parts may have been assembled incorrectly, check and reassemble again.

If the piston stroke is not as specified, select another flange.

NOTICE: There are 4 different thicknesses for flange.

Flange thicknesses mm (in.)

No.	Thickness	No.	Thickness
A	4.6 (0.181)	C	4.94 (0.194)
B	4.77 (0.188)	D	5.11 (0.201)

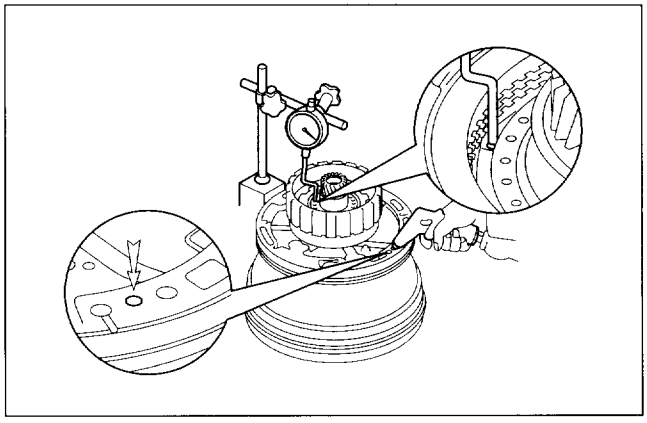


Figure 118. Piston Stroke Check (2)

8. Install overdrive direct clutch assembly.
   Install the direct clutch assembly onto the O/D planetary gear.
   NOTICE: Mesh the spline of the O/D planetary gear with the flukes of the discs by rotating and pushing the O/D direct clutch counterclockwise.

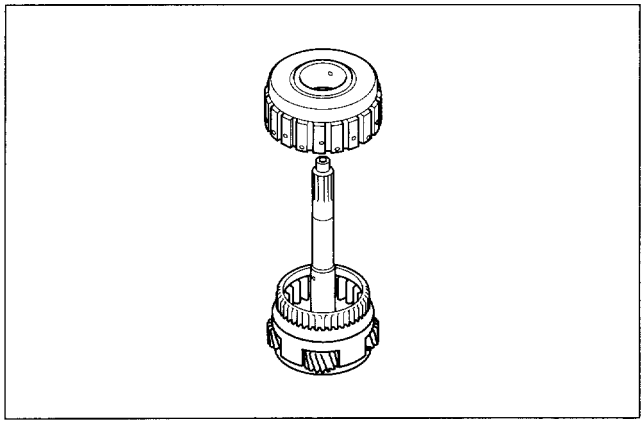


Figure 119. O/D Clutch Installation

9. Check operation of one-way clutch
   Hold the O/D direct clutch drum and turn the input shaft.
   The input shaft should turn freely clockwise and should lock counterclockwise.

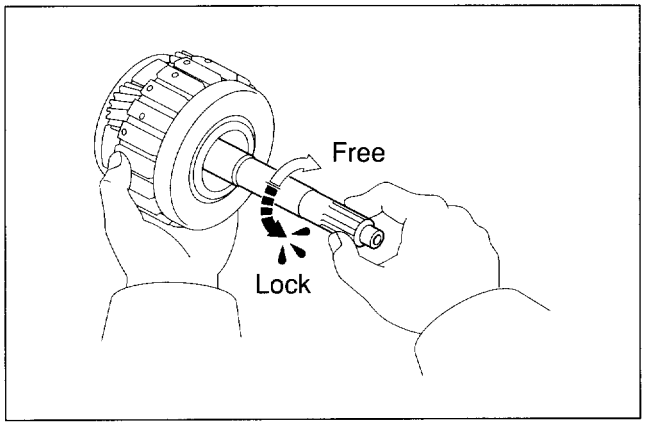
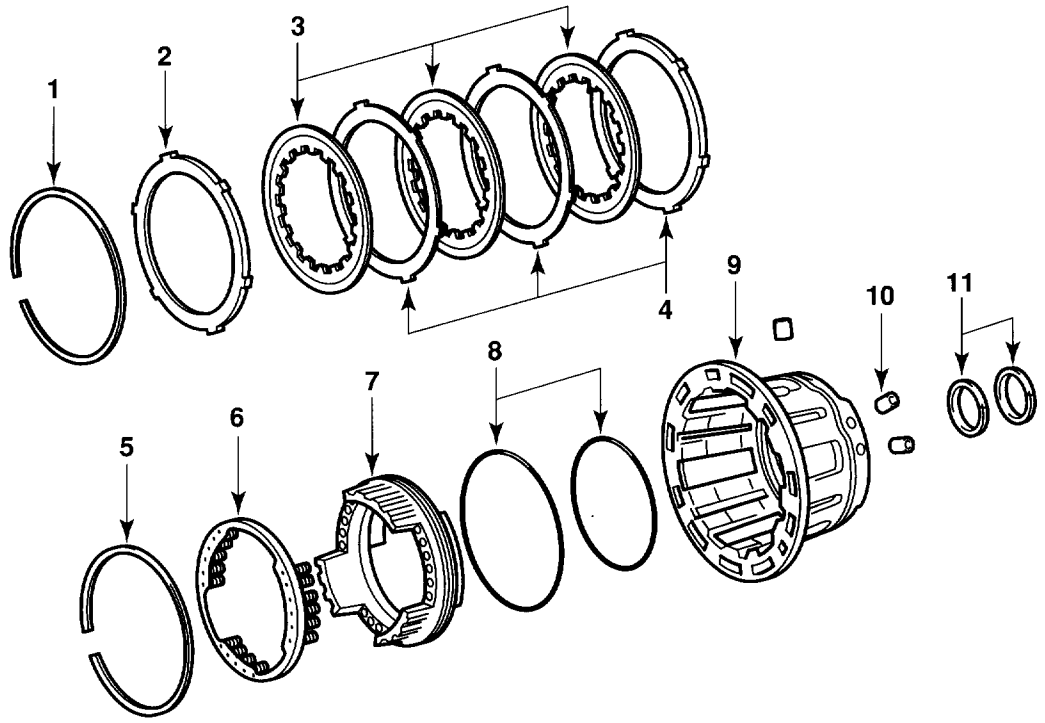


Figure 120. One-way Clutch Operation

OVERDRIVE BRAKE



1. Snap Ring
2. Flange
3. Disc
4. Plate
5. Snap Ring
6. Piston Return Spring
7. O/D Brake Piston
8. O-ring
9. O/D Case
10. Ring Retainer
11. Oil Seal Ring

Figure 121. O/D Brake Assembly

Disassemble

1. Check piston stroke of overdrive brake.
   a) Place the O/D case assembly onto the front clutch assembly.

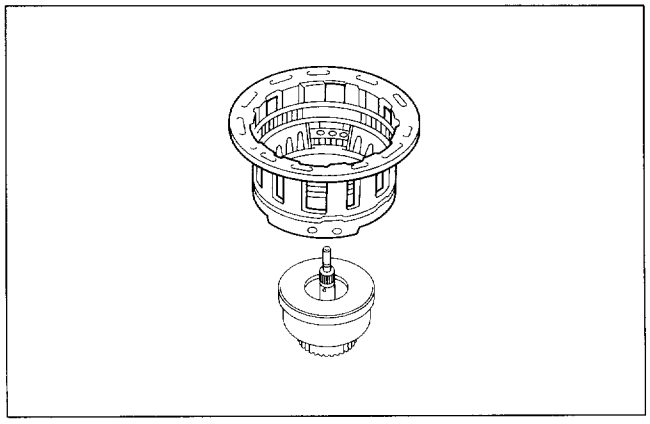


Figure 122. Piston Stroke Check (1)

b) Using No.2 measure terminal and a dial indicator, measure the piston stroke by applying and releasing compressed air 392–785 kPa (4–8 kg/cm², 57–114 psi).

Tool Required:
5-8840-2650-0 No.2 Measure Terminal

Piston stroke: 1.25–1.85 mm (0.0492–0.0728 in.)

NOTICE:
- **Stand the measure terminal on the piston vertically.**
- **Ensure that the measure terminal does not touches other parts than the piston.**
- **Measure the stroke at more than 3 points.**

If the piston stroke is not as specified, inspect the discs and plates.

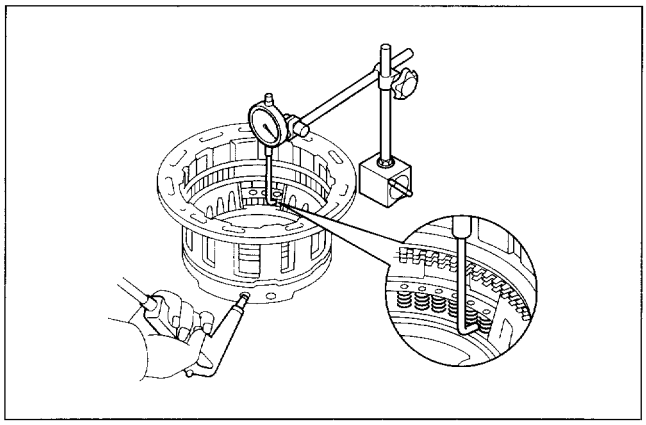


Figure 123. Piston Stroke Check (2)

2. Remove flange, discs and plates.
   a) Using a screwdriver, remove the snap ring.
   b) Remove the flange, 3 discs and 3 plates.

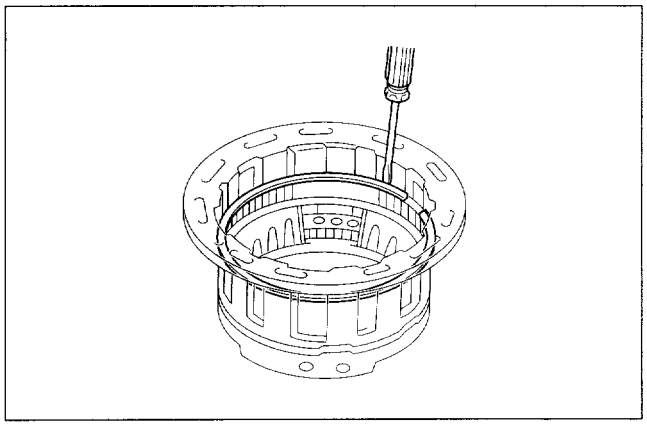


Figure 124. Snap Ring Removal

3. Remove piston return spring.
   a) Place No.3 piston spring compressor on the spring seat, and compress the return spring with a shop press.

   Tool Required:
   5-8840-2642-0 No.3 Piston Spring Compressor

   b) Using screwdriver, remove the snap ring.

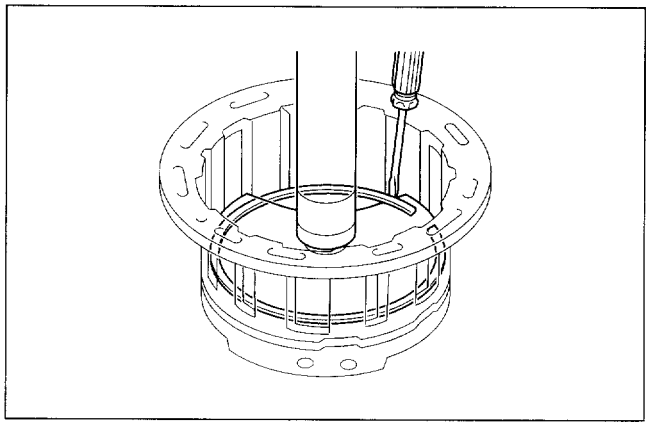


Figure 125. Return Spring Removal (1)

   c) Remove the return spring.

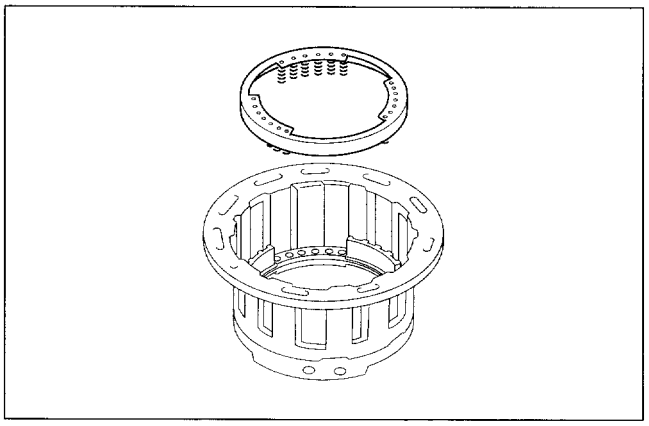


Figure 126. Return Spring Removal (2)

4. Remove overdrive brake piston
   Place the No.3 piston spring compressor on the brake piston.
   Hold piston spring compressor so it does not slant, and apply compressed air 392–785 kPa (4–8 kg/cm², 57–114 psi) into the oil hole of the O/D case to remove the brake piston.
   Remove the 2 O-rings from the brake piston.

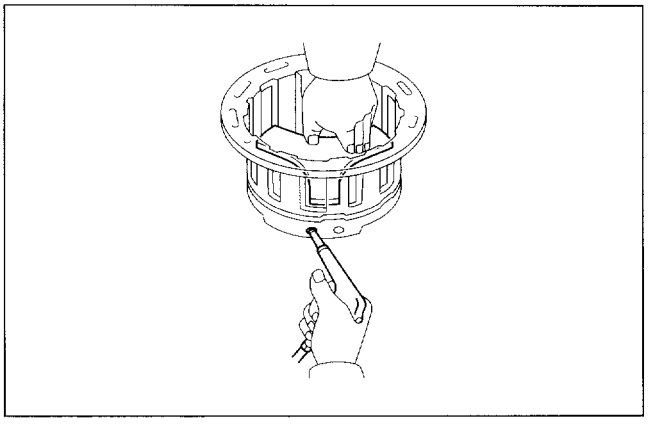


Figure 127. Brake Piston Removal

5. Remove the 2 oil seal rings from the O/D case.

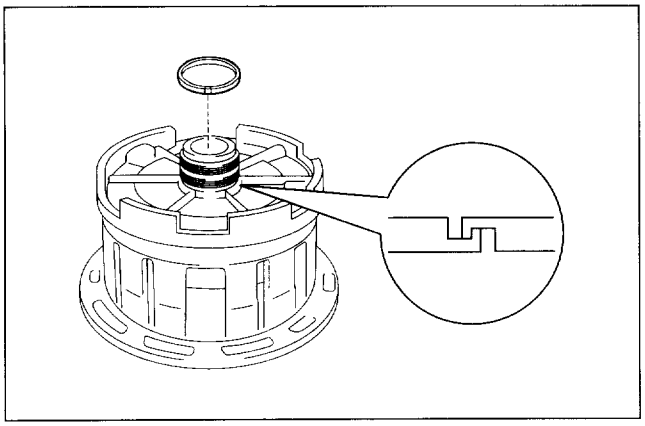


Figure 128. Oil Seal Ring Removal

6. Remove ring retainers.
   Using needle nose pliers, remove the 3 ring retainers from the oil holes of O/D case.

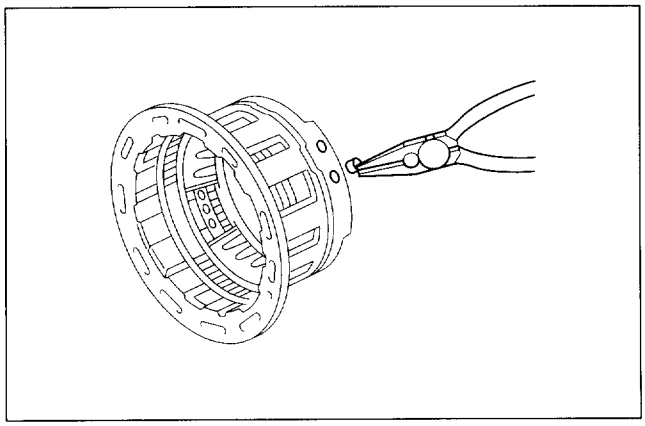


Figure 129. Ring Retainer Removal

Inspect

1. Inspect discs, plates and flange.
   Check to see if the sliding surface of the disc, plate and flange are worn or burnt. If necessary, replace them.
   NOTICE:
   - **If the lining of the disc is peeling off or discolored, or even if a part of the printed numbers are defaced, replace all discs.**
   - **Before assembling new discs, soak them in ATF for at least 15 minutes.**

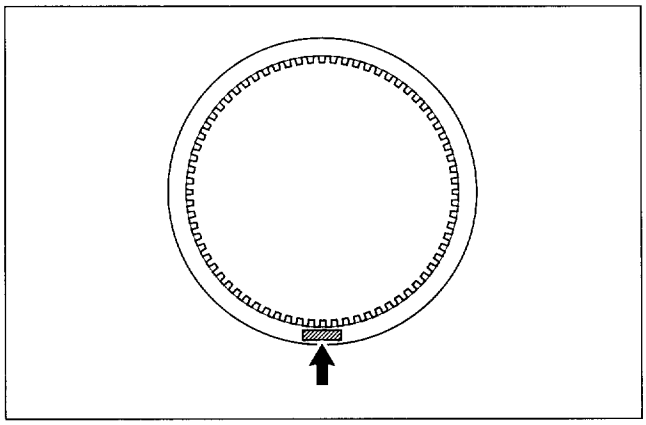


Figure 130. Disc Inspection

2. Inspect bushing of overdrive case.
   Using a dial indicator, measure the inside diameter.
   Standard inside diameter: 33.10–33.15 mm (1.3031–1.3051 in.)
   Maximum inside diameter: 33.20 mm (1.3071 in.)
   NOTICE: Measure at several points and take the average value.
   If the inside diameter is greater than maximum, replace the O/D case.
   Inspect the bushing contacting surface of the front clutch drum input shaft and the planetary ring gear flange, when discoloration or damage on the surface is found, replace the front clutch drum and planetary ring gear flange.

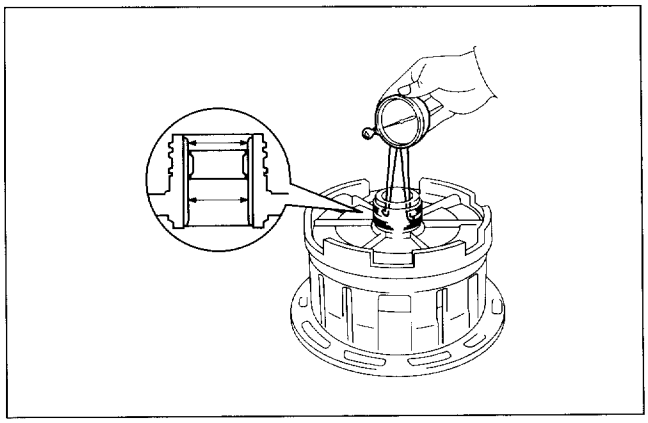


Figure 131. O/D Case Inspection

Assemble

1. Install ring retainers.
   Coat the new 3 ring retainers with ATF.
   Using needle nose pliers, install the 3 ring retainers into the oil holes of the O/D case.

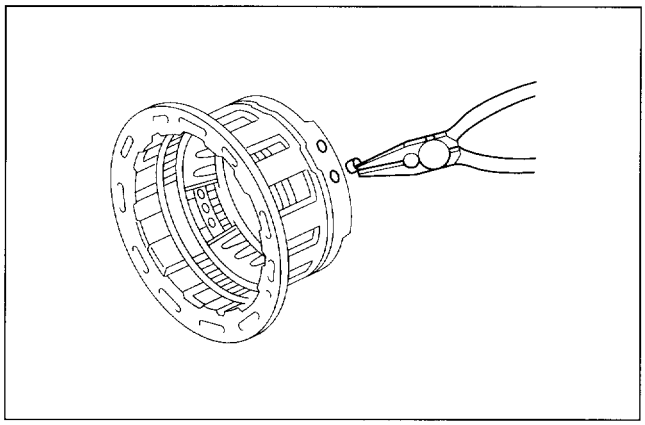


Figure 132. Ring Retainer Installation

2. Install oil seal rings.
   Coat the new 2 oil seal rings with ATF.
   Contract the oil seals, and install them onto the O/D case.
   CAUTION:
   - **Do not damage the claws on the oil seal rings.**
   - **Do not spread the ring ends more than necessary.**

   NOTICE: After installing the oil seal rings, check that they rotate smoothly.

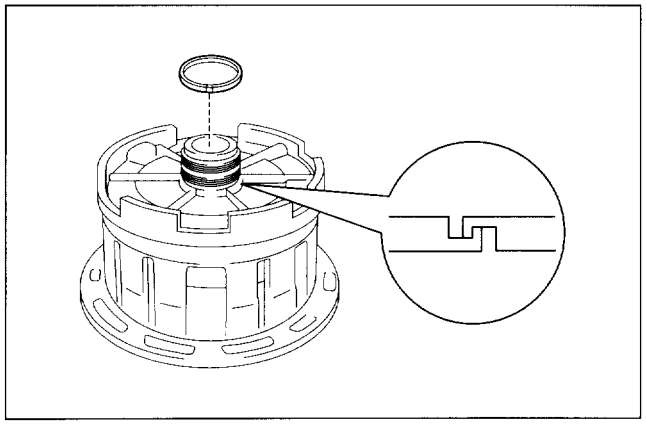


Figure 133. Oil Seal Ring Installation

3. Install overdrive brake piston.
   a) Coat new 2 O-rings with ATF, and install them on the brake piston.

O-ring diameters mm (in.)

	Inside	Wire diameter
Inner side	145.3 (5.7)	3.1 (0.1)
Outer side	163.7 (6.4)	3.1 (0.1)

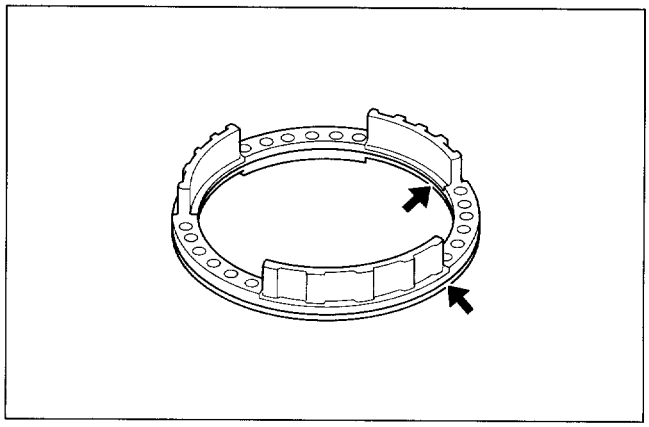


Figure 134. O-ring Location

   b) Align the protrusions of the brake piston with the grooves of the O/D case.
   c) Push in the brake piston into the O/D case with both hands.

   CAUTION: Be careful not to damage the O-rings.
   NOTICE: Push in the piston uniformly.

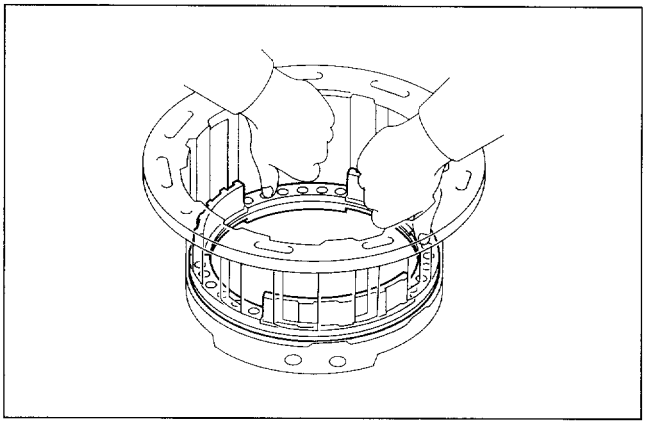


Figure 135. Brake Piston Installation

4. Install piston return spring.
   a) Place the return spring on the brake piston.

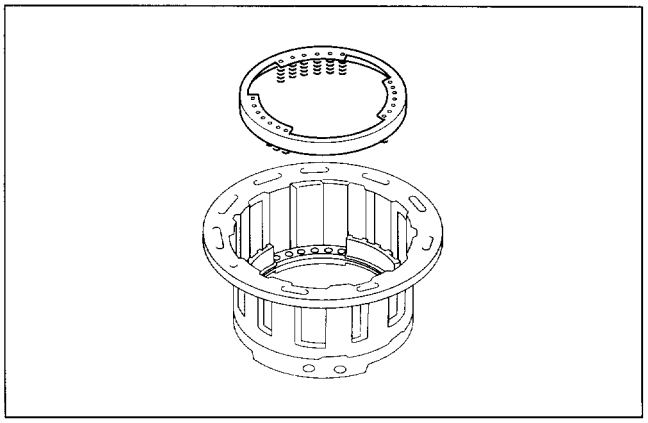


Figure 136. Return Spring Installation (1)

b) Place No.3 piston spring compressor on the spring on the spring seat, and compress the return spring with a shop press.

Tool Required:

5-8840-2642-0 No.3 Piston Spring Compressor

NOTICE: Stop compressing the return spring at the position 1 to 2 mm away from the snap ring to prevent the spring sheet from being deformed.

c) Using a screwdriver, install the snap ring.

NOTICE: Be sure the end gap of the snap ring is not aligned with the cutout portion of the O/D case.

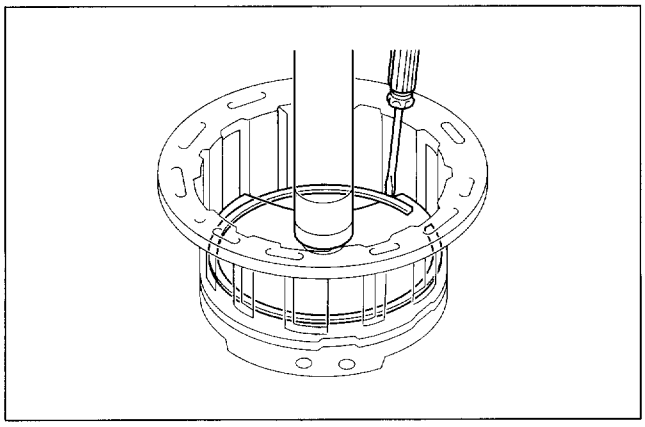


Figure 137. Return Spring Installation (2)

5. Install plates, discs and flange.
   a) Install the 3 plates and 3 discs in order:
      P = Plate D = Disc
      P – D – P – D – P – D

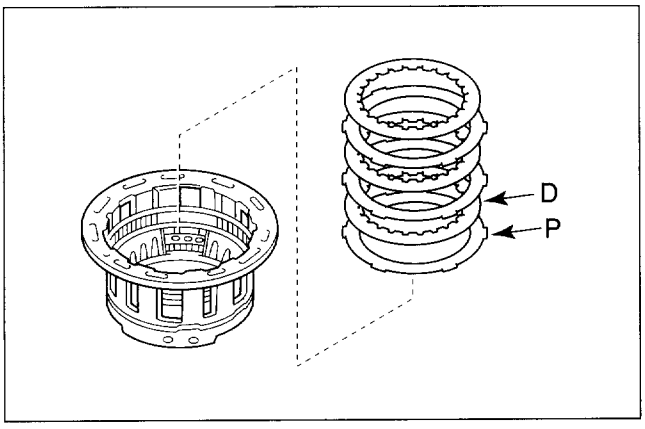


Figure 138. Plate, Disc and Flange Installation

   b) Install the flange, facing the rounded edge upward.

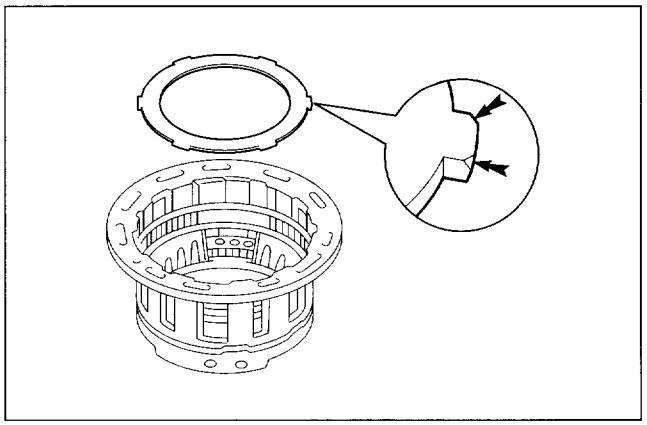


Figure 139. Flange Direction

   c) Using a screwdriver, install the snap ring.

NOTICE: Be sure the end gap of the snap ring is not aligned with the cutout portion of the O/D case.

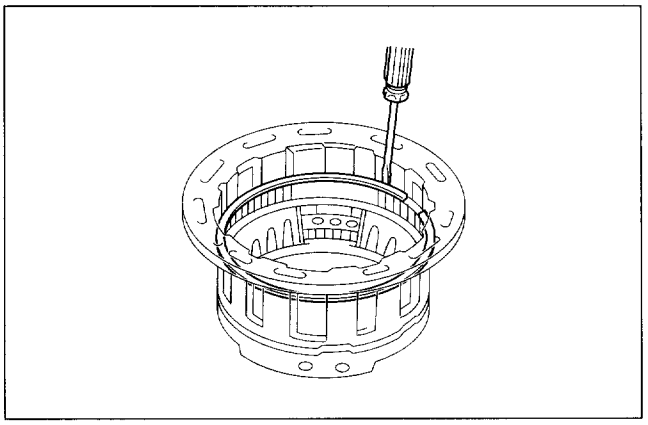


Figure 140. Snap Ring Installation

6. Check piston stroke of overdrive brake.
   a) Place the O/D case assembly onto the front clutch assembly.

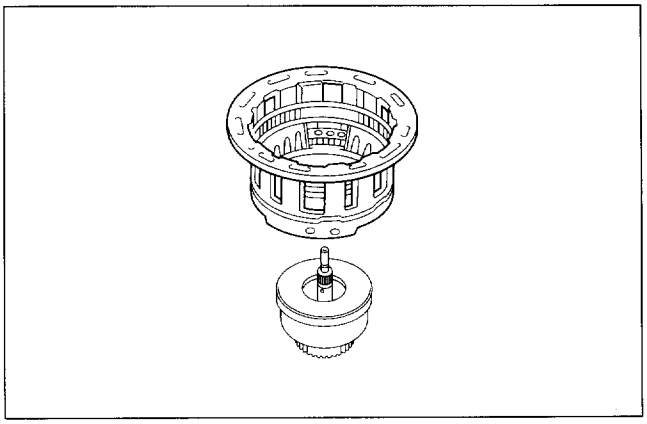


Figure 141. Piston Stroke Check (1)

b) Using No.2 measure terminal and a dial indicator, measure the piston stroke by applying and releasing compressed air 392–785 kPa (4–8 kg/cm², 57–114 psi).

Tool Required:
5-8840-2650-0 No.2 Measure Terminal

Piston stroke: 1.25–1.85 mm (0.0492–0.0728 in.)

NOTICE:

- **Stand the measure terminal on the piston vertically.**
- **Ensure that the measure terminal does not touches other parts than the piston.**
- **Measure the stroke at more than 3 points.**

If the piston stroke is less than specified, parts may have been assembled incorrectly, check and reassemble again.

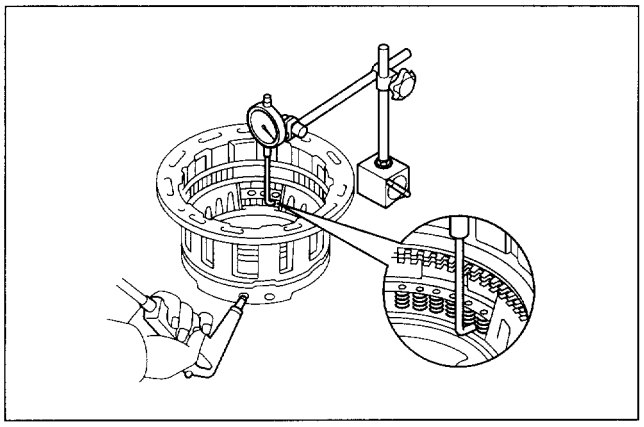
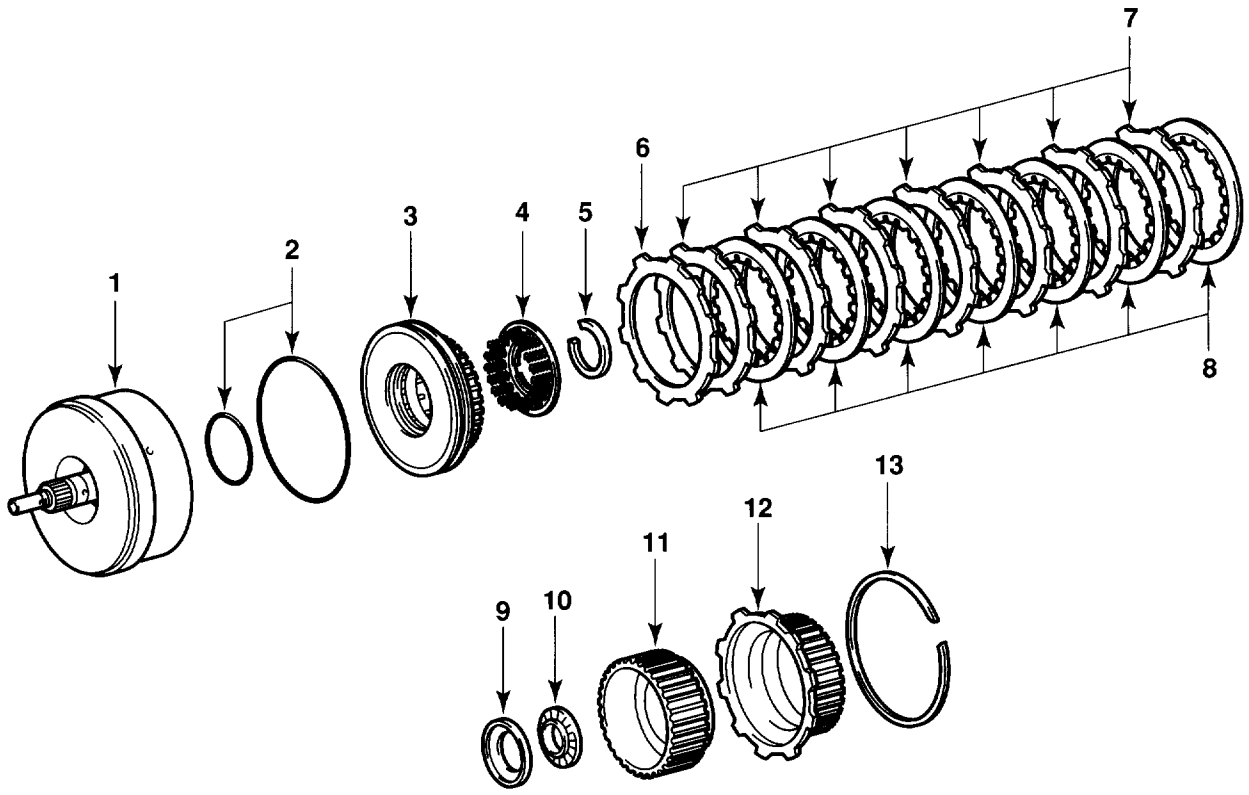


Figure 142. Piston Stroke Check (2)

FRONT CLUTCH



1. Front Clutch Drum
2. O-ring
3. Front Clutch Piston
4. Piston return Spring
5. Snap Ring
6. Cushion Plate
7. Plate
8. Disc
9. Race
10. Thrust Bearing
11. Front Clutch Hub
12. Rear Clutch Hub
13. Snap Ring

Figure 143. Front Clutch Assembly

Disassemble

1. Remove rear and front clutch hubs.
   a) Place the front clutch assembly onto the O/D case assembly.
   b) Using a screwdriver, remove the snap ring.
   c) Remove the rear clutch hub.

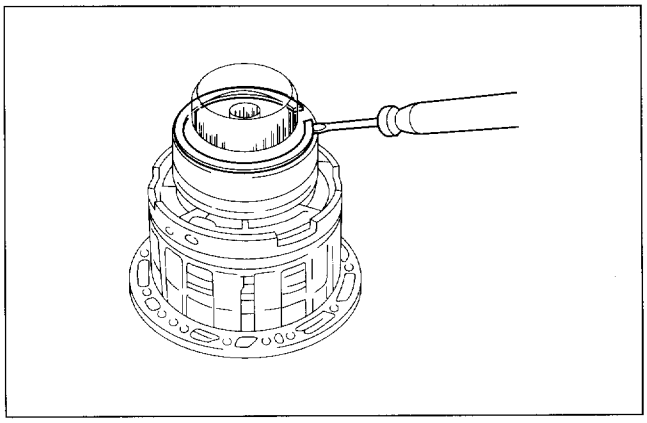


Figure 144. Snap Ring Removal

d) Remove the front clutch hub.

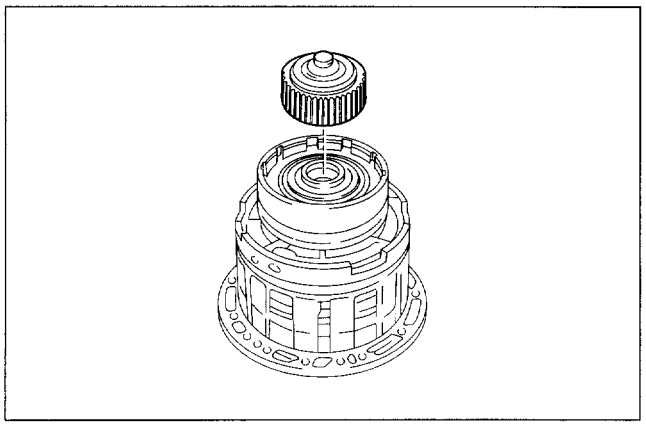


Figure 145. Front Clutch Hub Removal

e) Remove the race and thrust bearing.

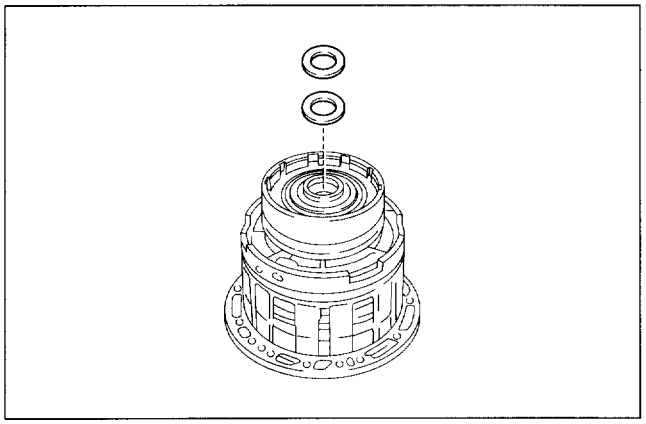


Figure 146. Race and Thrust Bearing Removal

2. Check piston stroke of front clutch.
   a) Install No.1 measure terminal to a dial indicator.
   Tool Required:
   5-8840-2649-0 No.1 Measure Terminal
   b) Place the assembled measure terminal and a dial indicator on the clutch piston.
   NOTICE:
   - **Stand the measure terminal on the piston vertically.**
   - **Ensure that the measure terminal does not touches other parts than the piston.**
   c) Install the rear clutch hub with the snap ring.
   NOTICE: Do not install the front clutch hub.

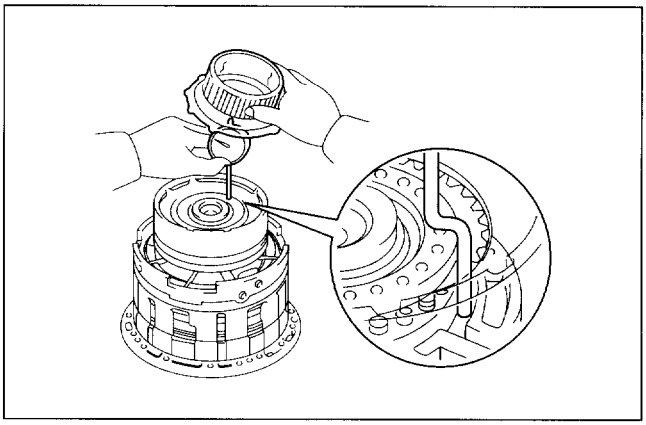


Figure 147. Piston Stroke Check (1)

   d) Using No.1 measure terminal and a dial indicator, measure the piston stroke by applying and releasing compressed air 392–785 kPa (4–8 kgf/cm², 57–114 psi).
   Tool Required:
   5-8840-2649-0 No.1 Measure Terminal
   Piston stroke: 3.93–4.23 mm (0.1547–0.1665 in.)
   NOTICE: Measure the stroke at more than 3 points. If the piston stroke is gretaer than specified, inspect the discs.

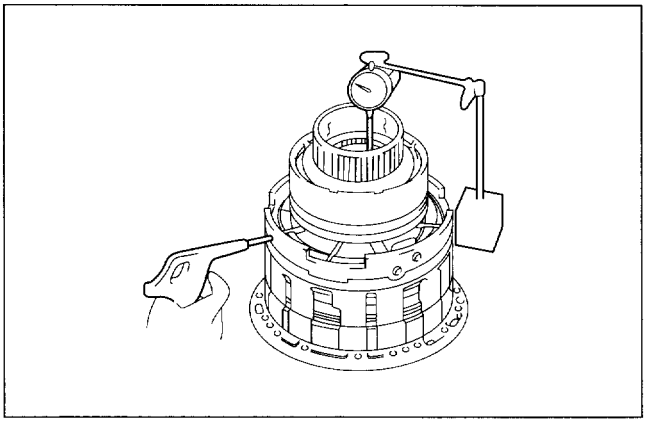


Figure 148. Piston Stroke Check (2)

3 Remove discs, plates and cushion plate.
   a) Remove the snap ring and rear clutch hub.

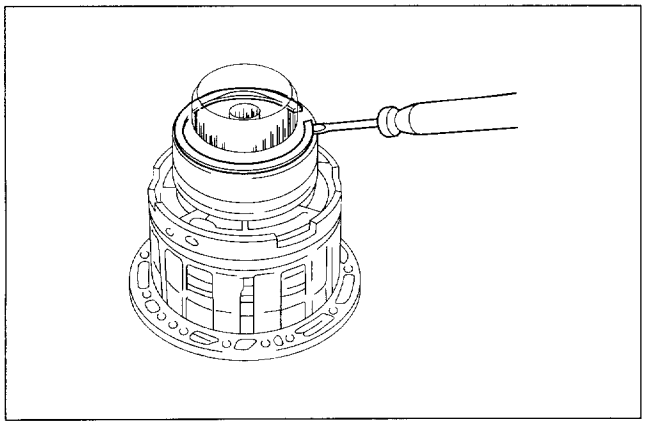


Figure 149. Rear Clutch Hub Removal

b) Remove the 7 discs, 7 plates and cushion plate.

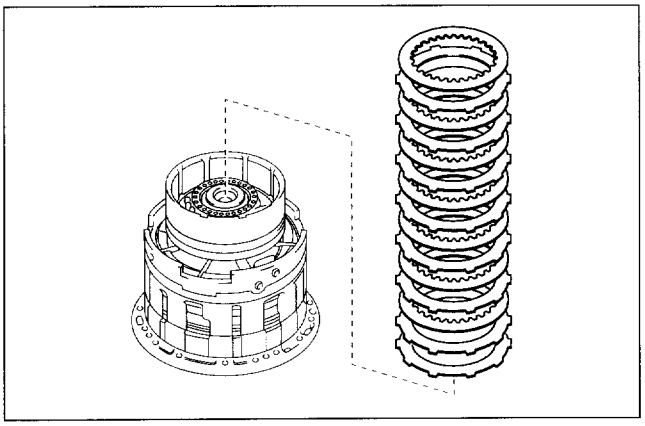


Figure 150. Disc and Plate Removal

4. Remove piston return springs.
   a) Place No.2 piston spring compressor on the spring seat, and compress the return springs with a shop press.

   NOTICE: Stop compressing the return spring at the position 1 to 2 mm away from the snap ring to prevent the spring sheet from being deformed.

   b) Using snap ring pliers, remove the snap ring.

   NOTICE: Do not damage the snap ring and do not deform them unless necessary.

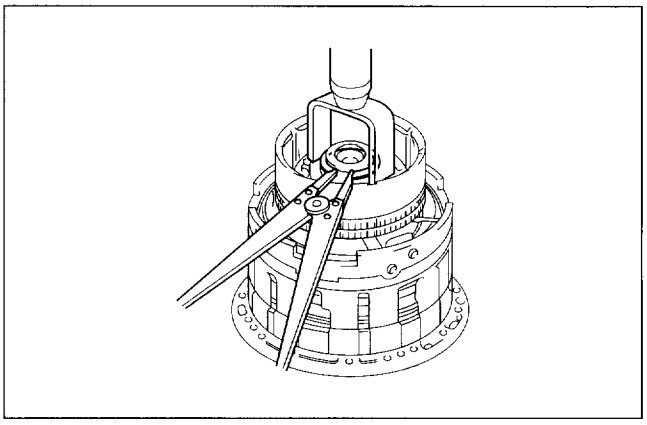


Figure 151. Piston Return Spring Removal

   c) Remove the piston return spring.
5. Remove front clutch piston.
   a) Holding the clutch piston by hand, apply compressed air 392–785 kPa (4–8 kgf/cm^2, 57–114 psi) into the oil hole of the O/D case to remove the clutch piston.
   b) Remove the 2 O-rings from the clutch piston.

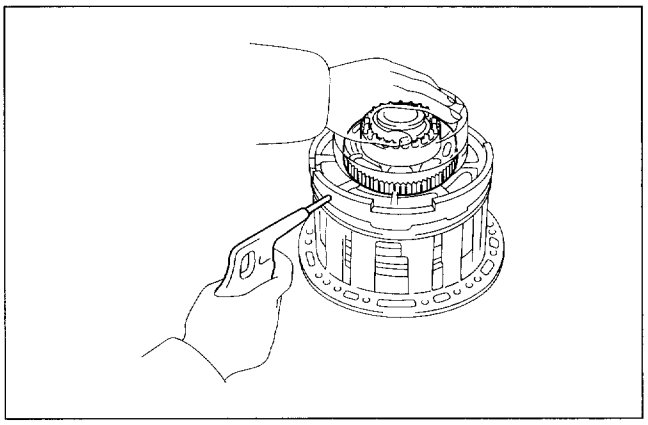


Figure 152. Front Clutch Piston Removal

Inspect

1. Inspect discs, plates and cushion plate.
   Check to see if the contacting surface of the disc, plate and cushion plate are worn or burnt. If necessary, replace them.
   NOTICE:
   - **If the lining of the disc is peeling off or discolored, or even if a parts of the printed numbers are defaced, replace all discs.**
   - **Before assembling new discs, soak them in ATF for at least 15 minutes.**

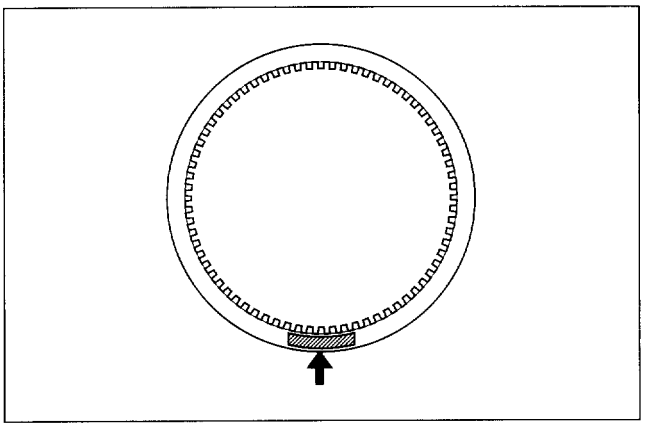


Figure 153. Disc Inspection

2. Inspect front clutch piston.
   a) Check that the check ball is free by shaking the piston.
   b) Check that the valve does not leak by applying compressed air 392–785 kPa (4–8 kgf/cm², 57–114 psi).

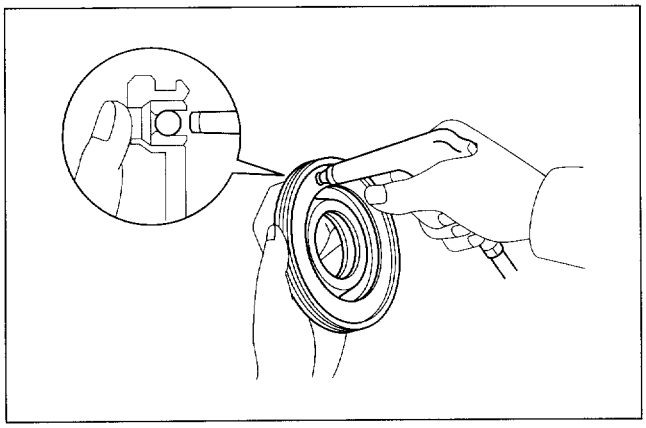


Figure 154. Front Clutch Piston Inspection

Assemble

1. Install front clutch piston.
   a. Place front clutch drum onto overdrive case assembly.

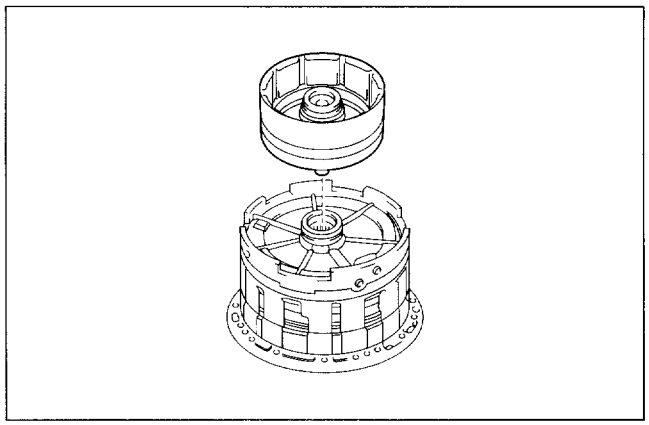


Figure 155. Front Clutch Piston Installation

   b) Coat new 2 O-rings with ATF, and install them on the clutch piston.

O-ring diameters mm (in.)

	Inside	Wire diameter
Inner side	62.9 (2.476)	2.6 (0.102)
Outer side	117.4 (4.622)	3.1 (0.122)

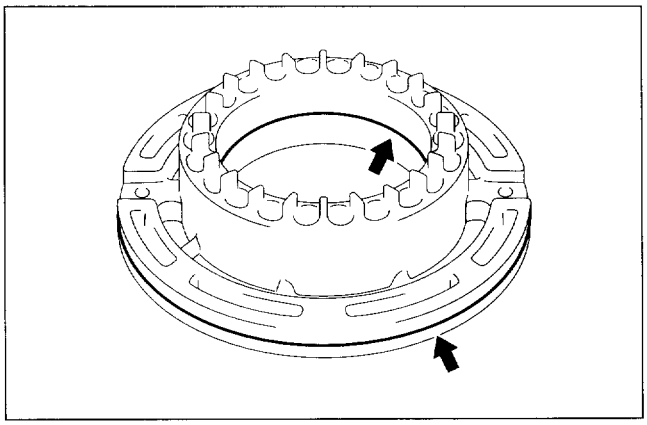


Figure 156. O-ring Location

   c) Push in the clutch piston into the clutch drum by both hands.

CAUTION: Be careful not to damage the O-rings.

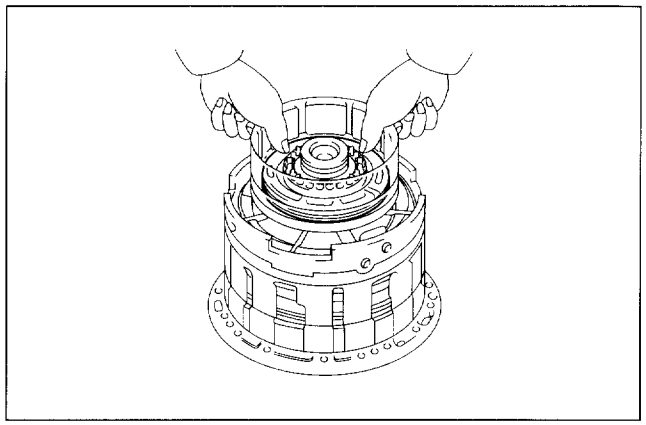


Figure 157. Clutch Piston Installation

2. Install piston return springs.
   a) Install the piston return spring on the clutch piston.

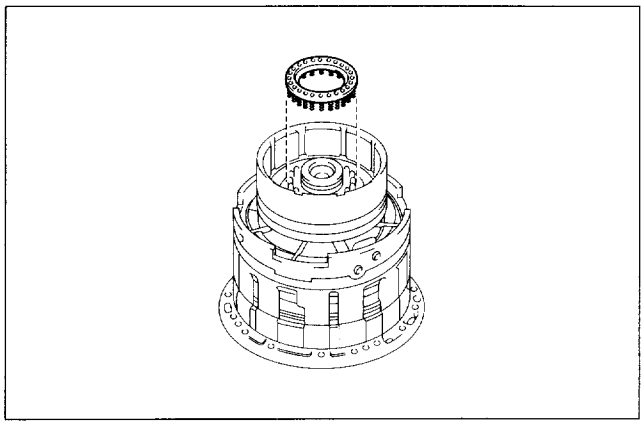


Figure 158. Piston Return Spring Installation (1)

   b) Place No.2 piston spring compressor on the spring seat, and compress the return springs with a shop press.

Tool Required:

5-8840-2641-0 No.2 Piston Spring Compressor

NOTICE: Stop compressing the return spring at the position 1 to 2 mm away from the snap ring to prevent the spring sheet from being deformed.

   c) Using snap ring pliers, install the snap ring.

NOTICE: Be sure the end gap of the ring is not aligned with the spring seat claw.

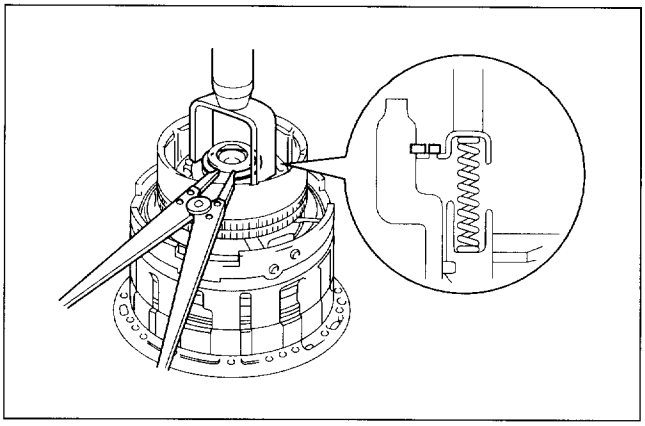


Figure 159. Piston Return Spring Installation (2)

3. Install cushion plate, plates and discs.
   a) Install the cushion plate, facing the rounded edge downward.

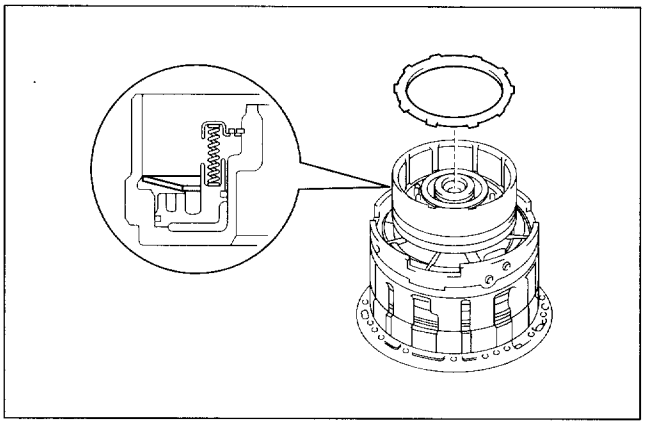


Figure 160. Cushion Plate Installation

   b) Install the 7 plates and 7 discs in order:
   P = Plate D = Disc
   P – D – P – D – P – D – P – D – P – D – P – D –Ⓟ– D

NOTICE: Ⓟ = This plate is used to adjust piston stroke.

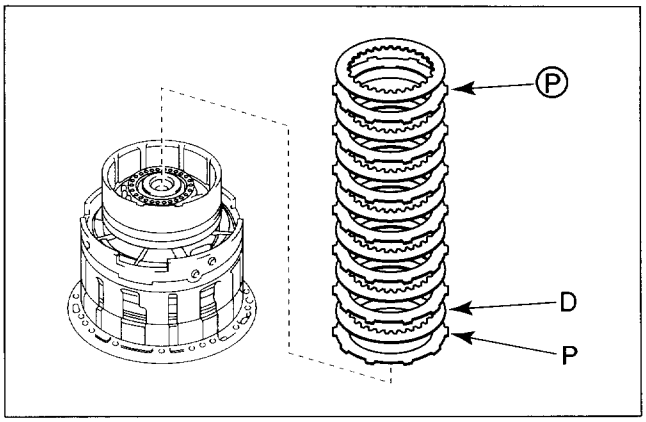


Figure 161. Plate and Disc Installation

4. Check piston stroke of front clutch.
   a) Install No.1 measure terminal to a dial indicator.
   Tool Required:
   5-8840-2649-0 No.1 Measure Terminal
   b) Place the assembled measure terminal and a dial indicator on the clutch piston.
   NOTICE:
   - **Stand the measure terminal on the piston vertically.**
   - **Ensure that the measure terminal does not touches other parts than the piston.**
   c) Install the rear clutch hub with the snap ring.
   NOTICE: Do not install the front clutch hub.

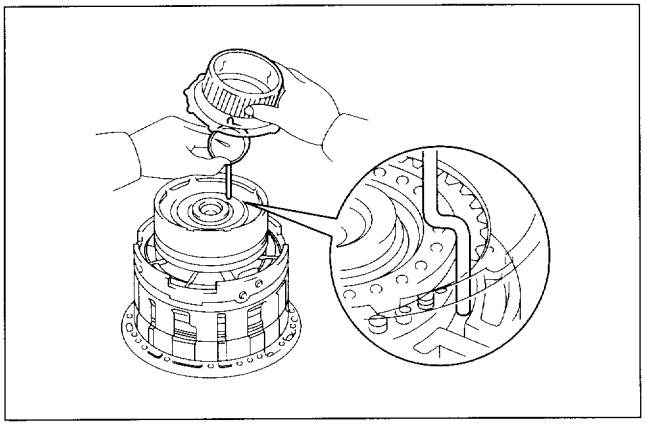


Figure 162. Piston Stroke Check (1)

   d) Using No.1 measure terminal and a dial indicator, measure the piston stroke by applying and releasing compressed air 392–785 kPa (4–8 kgf/cm², 57–114 psi).
   Piston stroke: 3.93–4.23 mm (0.1547–0.1665 in.)
   NOTICE: Measure the stroke at more than 3 points.
   If the piston stroke is less than specified, parts may have been assembled incorrectly, check and reassemble again.
   If the piston stroke is not as specified, select another plate.
   Plate thicknesses

Thickness mm (in.)	Thickness mm (in.)
1.8 (0.071)	2.2 (0.087)
2.0 (0.079)	2.4 (0.094)

   e) Remove the snap ring and rear clutch hub.

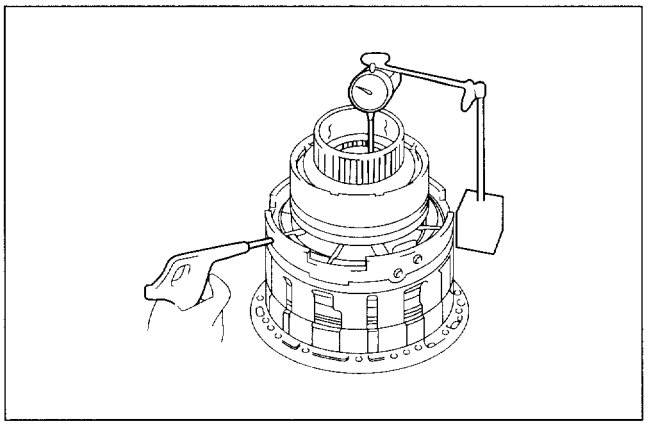


Figure 163. Piston Stroke Check (2)

5. Install front and rear clutch hubs.
   a) Coat the race and thrust bearing with petroleum jelly, and install them onto the front clutch drum.
   Race and bearing diameter

Diameter mm (in.)	Inside	Outside
Bearing	32.8 (1.291)	52.0 (2.047)
Race	37.0 (1.457)	52.0 (2.047)

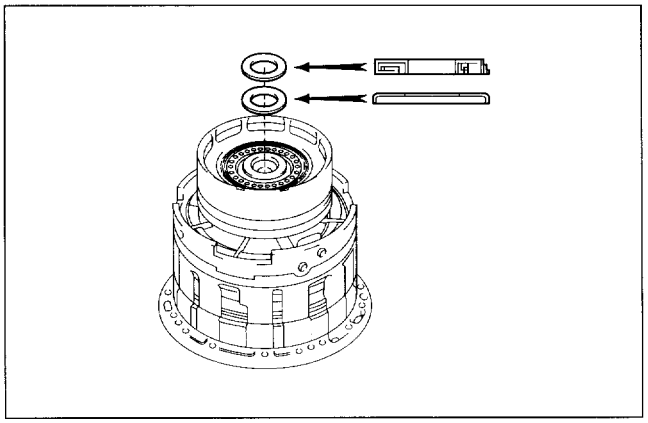


Figure 164. Bearing Installation

   b) Install the front clutch hub into the clutch drum.
   NOTICE: Mesh the spline of the front clutch hub with the flukes of the discs by rotating the front clutch hub clockwise or counterclockwise.

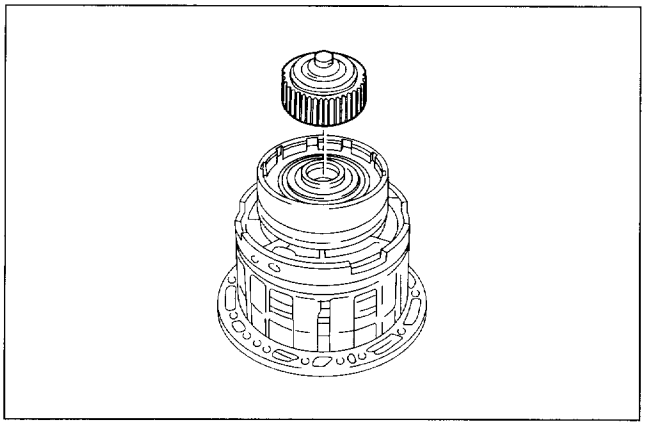


Figure 165. Front Clutch Hub Installation

c) Install the rear clutch hub onto the clutch drum.
d) Using a screwdriver, install the snap ring.

NOTICE: Be sure the end gap of the snap ring is not aligned with the cutout portion of the front clutch drum.

e) Remove the front clutch assembly from the O/D case.

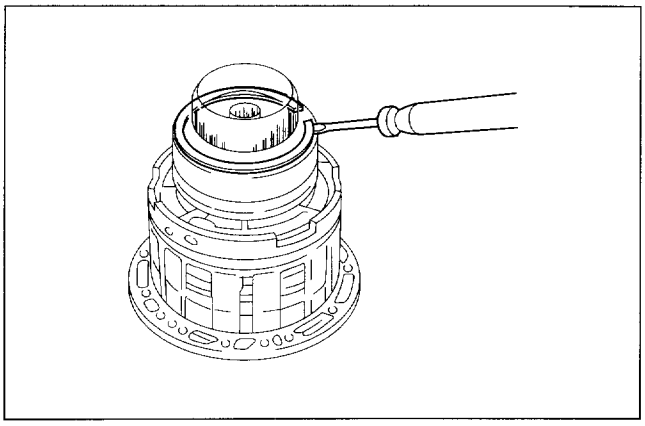
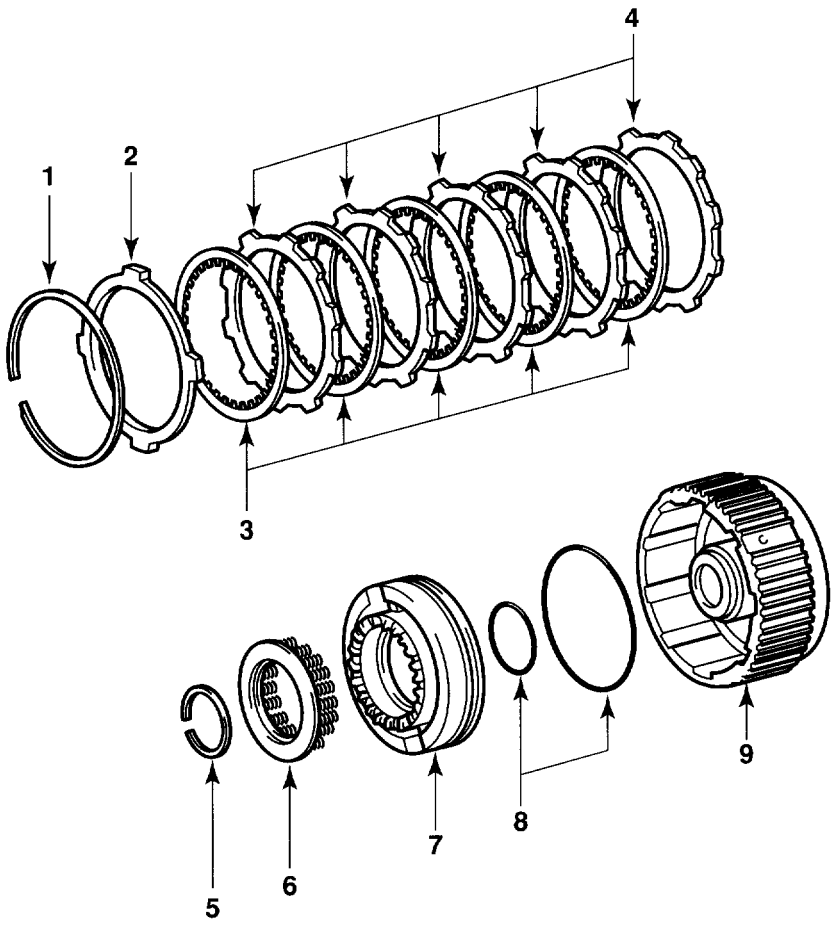


Figure 166. Rear Clutch Hub Installation

REAR CLUTCH



1. Snap Ring
2. Flange
3. Disc
4. Plate
5. Snap Ring
6. Piston Return Spring
7. Rear Clutch Piston
8. O-ring
9. Rear Clutch Drum

Figure 167. Rear Clutch Assembly

Disassemble

1. Check piston stroke of rear clutch.
   a) Place the center support assembly on wooden blocks.

   NOTICE: Provide clearance so that the sun gear does not touch the rear clutch drum.

   b) Place the rear clutch assembly into the center support assembly.

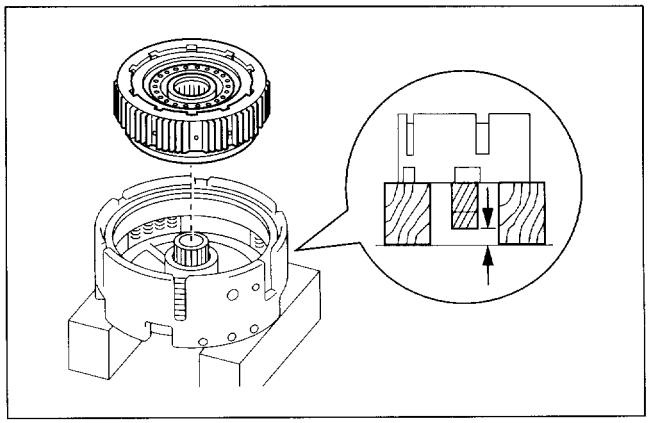


Figure 168. Piston Stroke Check (1)

Using No.1 measure terminal and a dial indicator, measure the piston stroke by applying and releasing the compressed air 392–785 kPa (4–8 kgf/cm², 57–114 psi).
Tool Required:
5-8840-2649-0 No.1 Measure Terminal
Piston stroke: 2.00–2.20 mm (0.0787–0.0866 in.)
NOTICE:
- **Stand the measure terminal on the piston vertically.**
- **Ensure that the measure terminal does not touches other parts than the piston.**
- **Measure the stroke at more than 3 points.**

If the piston stroke is greater than specified, inspect the discs.

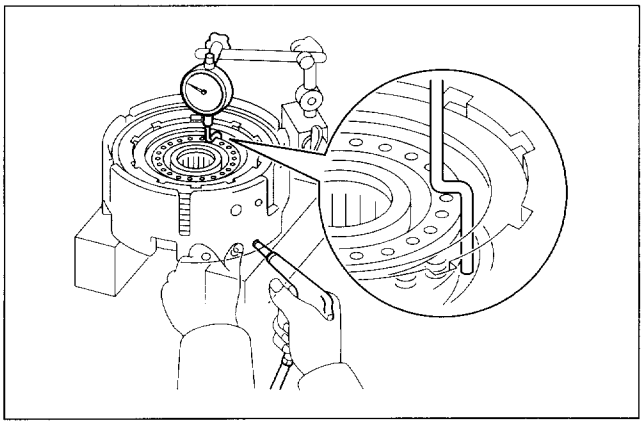


Figure 169. Piston Stroke Check (2)

2. Remove flange, discs and plates.
   a) Using a screwdriver, remove the snap ring.

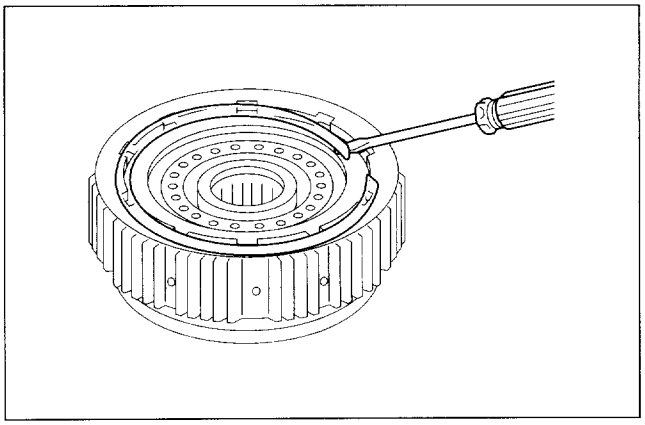


Figure 170. Snap Ring Removal

   b) Remove the flange, 5 discs and 5 plates.

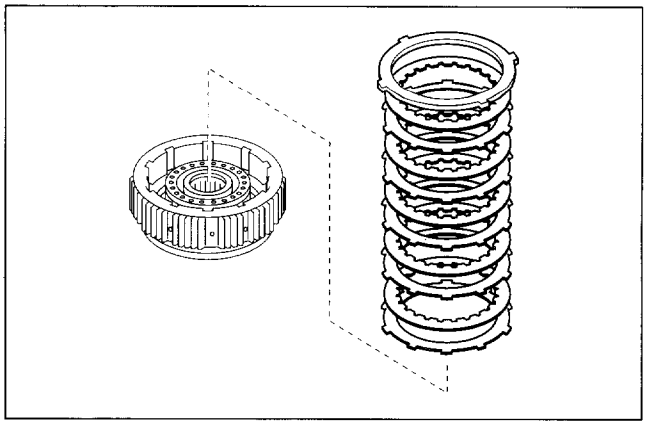


Figure 171. Flange, Disc and Plate Removal

3. Remove piston return spring.
   a) Place No.2 piston spring compressor on the spring seat, and compress the return spring with a shop press.
   Tool Required:
   5-8840-2641-0 No.2 Piston Spring Compressor
   NOTICE: Stop compressing the return spring at the position 1 to 2 mm away from the snap ring to prevent the spring sheet from being deformed.
   b) Using snap ring pliers, remove the snap ring.
   NOTICE: Do not damage the snap ring and do not defrom them unless necessary.

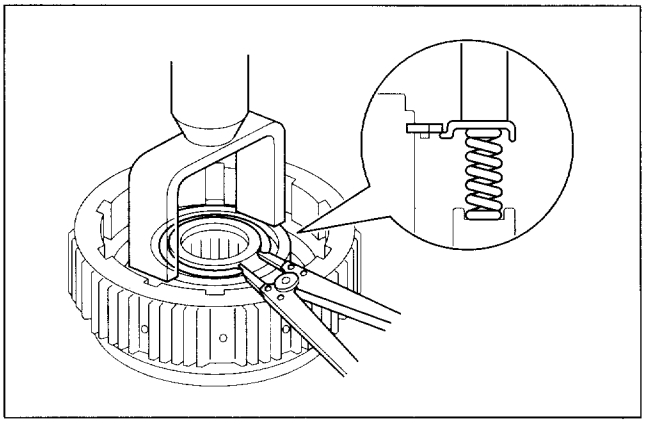


Figure 172. Piston Return Spring Removal

   c) Remove the piston return spring.

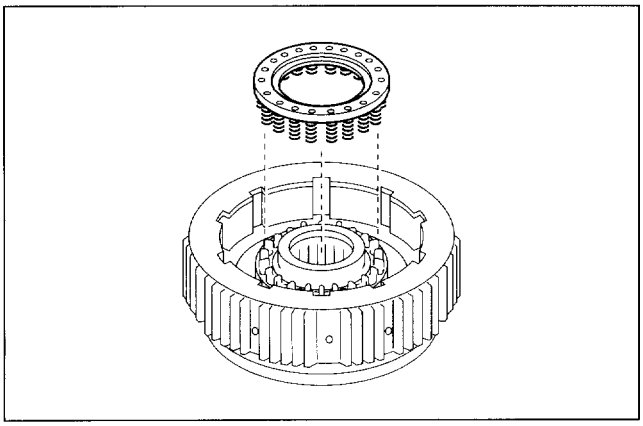


Figure 173. Piston Return Spring Removal (2)

4. Remove rear clutch piston.
   a) Place the center support assembly on wooden blocks.
   b) Place the rear clutch drum onto the center support assembly.
   c) Hold the piston with hand, apply compressed air 392–785 kPa (4–8 kgf/cm², 57–114 psi) into the oil hole of the center support to remove the clutch piston.
   d) Remove the 2 O-rings from the clutch piston.

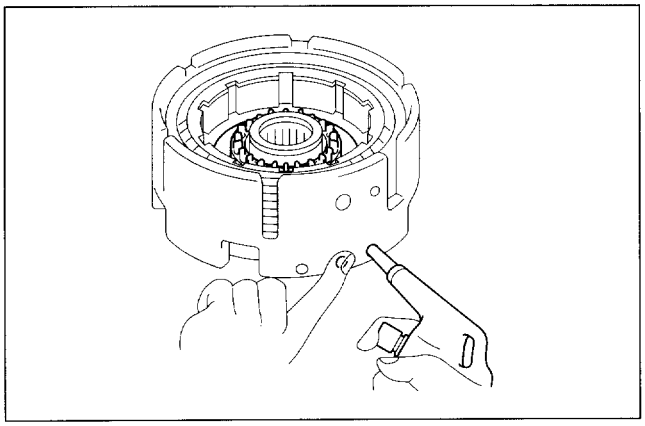


Figure 174. Rear Clutch Piston Removal

Inspect

1. Inspect discs, plates and flange.
   Check to see if the contacting surface of the disc, plate and flange are worn or burnt. If necessary, replace them.
   NOTICE:
   - **If the lining of the disc is peeling off or discolored, or even if a parts of the printed numbers are defaced, replace all discs.**
   - **Before assembling new discs, soak them in ATF for at least 15 minutes.**

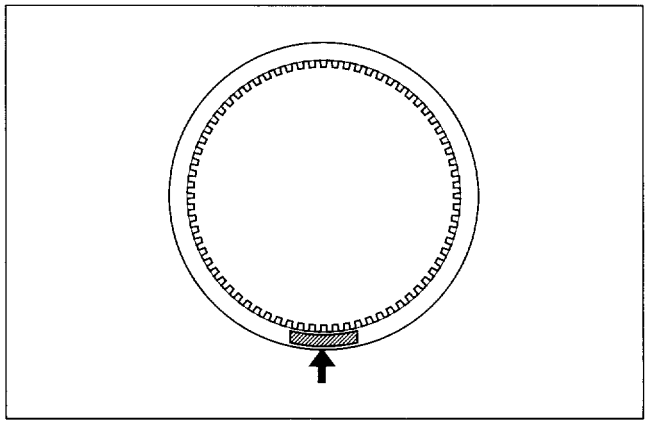


Figure 175. Disc Inspection

2. Inspect rear clutch piston.
   a) Check that check ball is free by shaking the piston.
   b) Check that the valve does not leak by applying low-pressure compressed air.

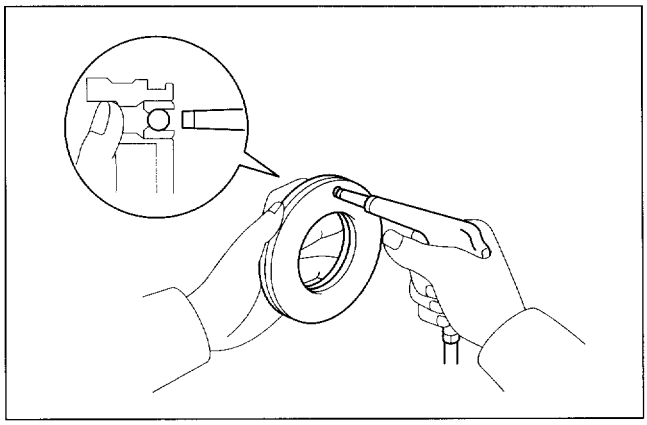


Figure 176. Rear Clutch Piston Check

Assemble

1. Install rear clutch piston.
   a) Coat new O-rings with ATF, and install them in the clutch drum.

O-ring diameters mm (in.)

	Inside	Wire diameter
Inner side	62.9 (2.4767)	2.6 (0.1024)
Outer side	109.7 (4.3189)	3.1 (0.1220)

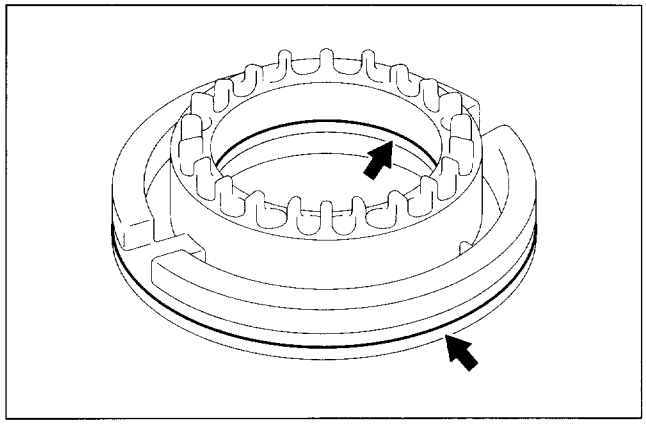


Figure 177. O-ring Location

   b) Push in the clutch piston into the clutch drum with both hands.

CAUTION: Be careful not to damage the O-rings.
NOTICE: Push in the piston uniformly.

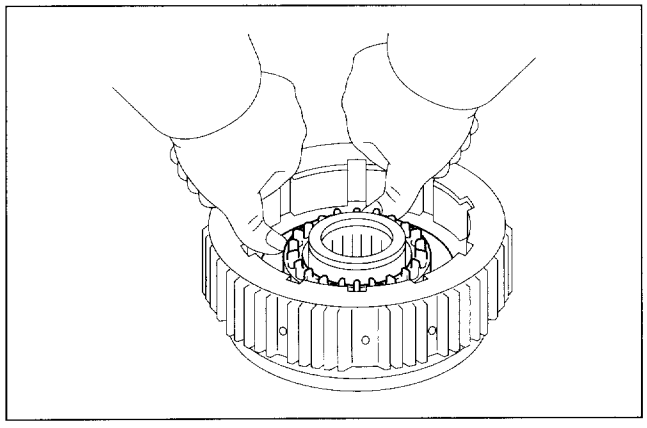


Figure 178. Clutch Piston Installation

2. Install piston return springs.
   a) Place the piston return spring on the clutch piston.

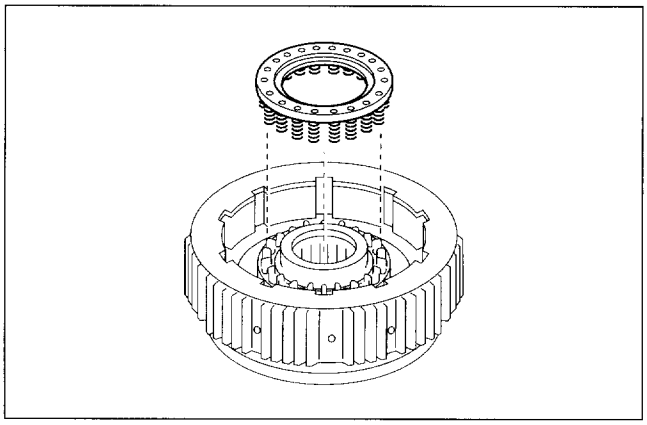


Figure 179. Piston Return Spring Installation (1)

   b) Place No.2 piston spring compressor on the spring seat, and compress the return spring with a shop press.

Tool Required:
5-8840-2641-0 No.2 Piston Spring Compressor

NOTICE: Stop compressing the return spring at the position 1 to 2 mm away from the snap ring to prevent the spring sheet from being deformed.

   c) Using snap ring pliers, install the snap ring.

NOTICE: Be sure the end gap of the snap ring is not aligned with the spring retainer claw.

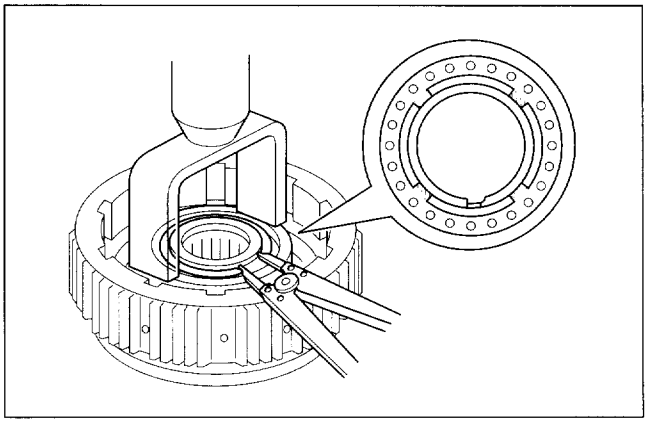


Figure 180. Piston Return Spring Installation (2)

3. Install plates, discs and flange.
   a) Install the 5 plates and 5 discs in order:
   P = Plate D = Disc
   P – D – P – D – P – D – P – D – P – D

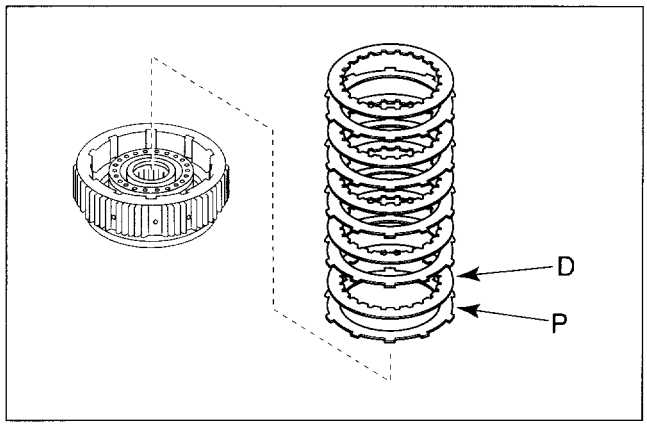


Figure 181. Plate and Disc Installation

b) Install the flange, facing the rounded edge upward.

NOTICE: If the flange is step-edged, install the flange with the step-edge, facing downward.

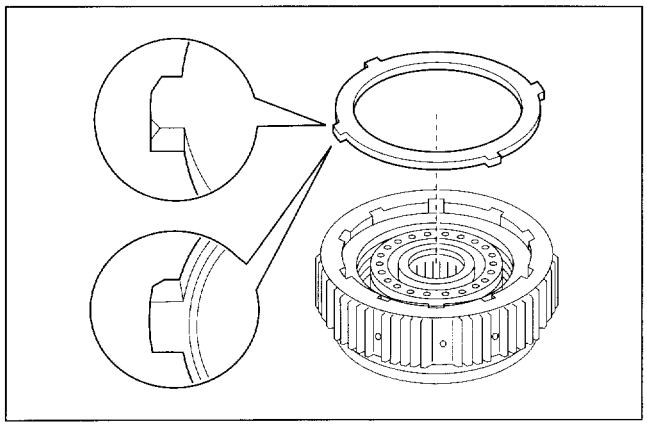


Figure 182. Flange Installation

c) Using a screwdriver, install the snap ring.

NOTICE: Be sure the end gap of the snap ring is not aligned with the cutout portion of the rear clutch drum.

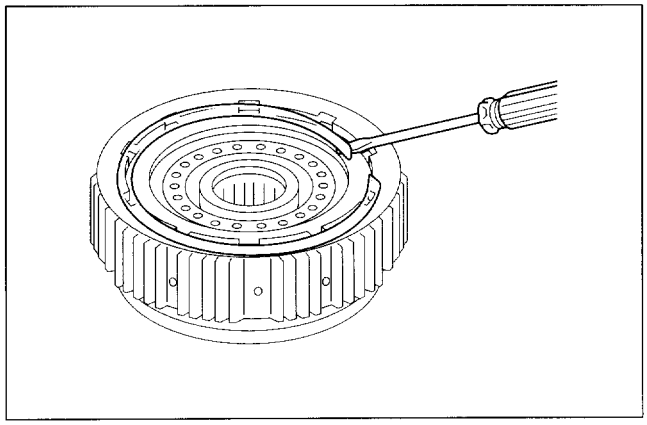


Figure 183. Snap Ring Installation

4. Check piston stroke of rear clutch.
   a) Place the center support assembly on wooden blocks.

   NOTICE: Provide clearance so that the sun gear does not touch the rear clutch drum.

   b) Place the rear clutch assembly onto the center support assembly.

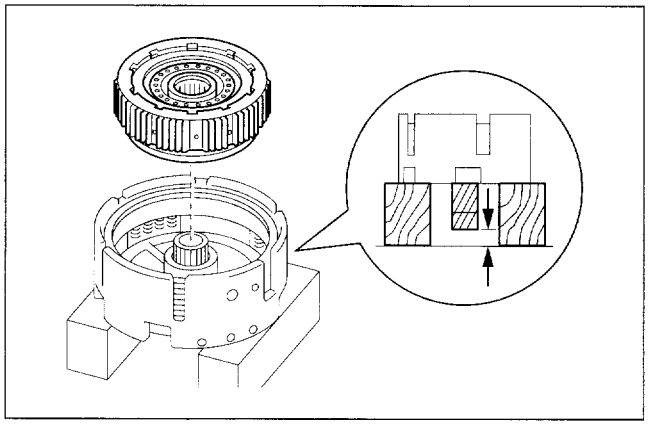


Figure 184. Piston Stroke Check (1)

c) Using No.1 measure terminal and a dial indicator, measure the piston stroke while applying and releasing compressed air 392–785 kPa (4–8 kgf/cm², 57–114 psi).

Tool Required:
5-8840-2649-0 No.1 Measure Terminal

Piston stroke: 2.00–2.20 mm (0.0787–0.0866 in.)

NOTICE:
- **Stand the measure terminal on the piston vertically.**
- **Ensure that the measure terminal does not touches other parts than the piston.**
- **Measure the stroke at more than 3 points.**

If the piston stroke is less than specified, parts may have been assembled incorrectly, check and reassemble again.

If the piston stroke is not as specified, select another flange.

Flange thicknesses

No.	Thickness mm (in.)	No.	Thickness mm (in.)
A	5.0 (0.197)	E	4.6 (0.181)
B	5.2 (0.205)	F	4.8 (0.189)

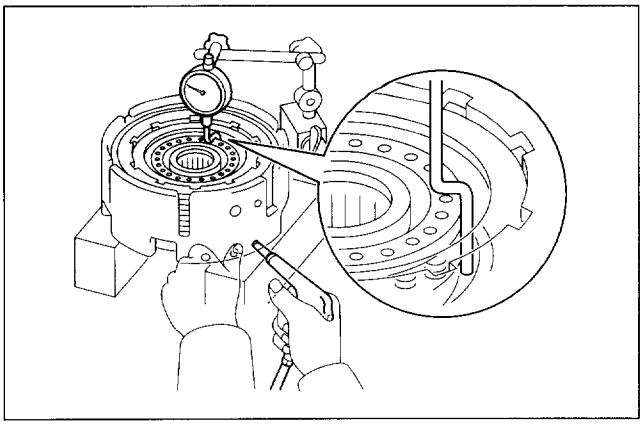
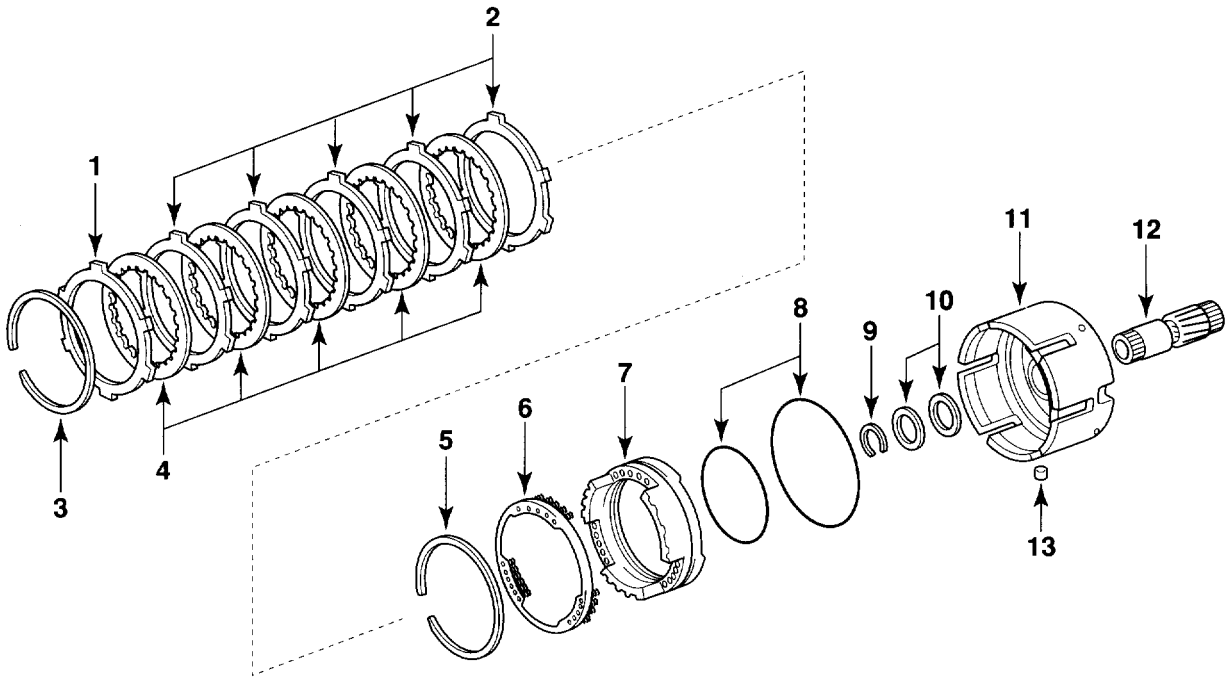


Figure 185. Piston Stroke Check (2)

SECOND BRAKE



1. Flange
2. Plate
3. Snap Ring
4. Disc
5. Snap Ring
6. Piston return Spring
7. Second Brake Piston
8. O-ring
9. Snap Ring
10. Oil Seal Ring
11. Center Support
12. Front Planetary Sun Gear
13. Retainer

Figure 186. Second Brake Assembly

Disassemble

1. Remove front planetary sun gear.
   a) Using snap ring pliers, remove the snap ring.

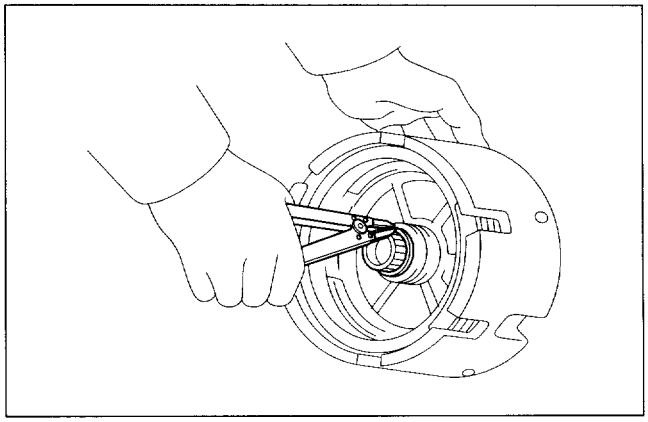


Figure 187. Sun Gear Removal

b) Remove the sun gear.

2. Check piston stroke of second brake.
   Using No.2 measure terminal and a dial indicator, measure the piston stroke by applying and releasing compressed air 392–785 kPa (4–8 kgf/cm², 57–114 psi).
   Tool Required:
   5-8840-2650-0 No.2 Measure Terminal
   Piston stroke: 1.86–2.06 mm (0.0732–0.0811 in.)
   NOTICE:
   - **Stand the measure terminal on the piston vertically.**
   - **Ensure that the measure terminal does not touches other parts than the piston.**
   - **Measure the stroke at more than 3 points.**

   If the piston stroke is greater than specified, inspect the discs.

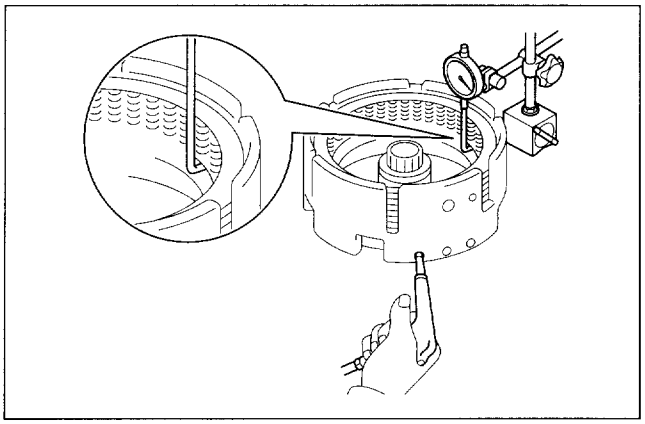


Figure 188. Piston Stroke Check

3. Remove flange, discs and plates.
   a) Using a screwdriver, remove the snap ring.

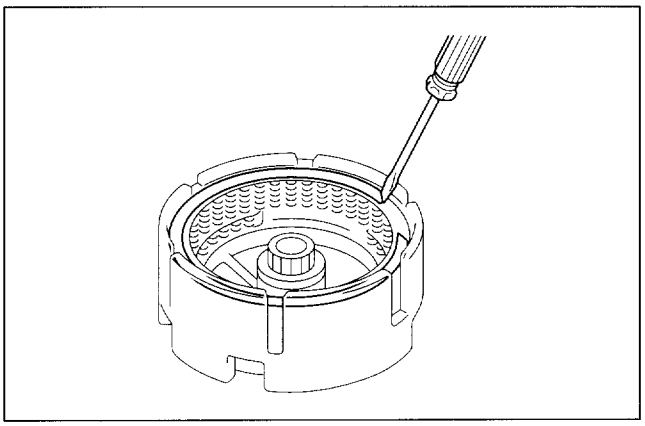


Figure 189. Snap Ring Removal

b) Remove the flange, 5 discs and 5 plates.

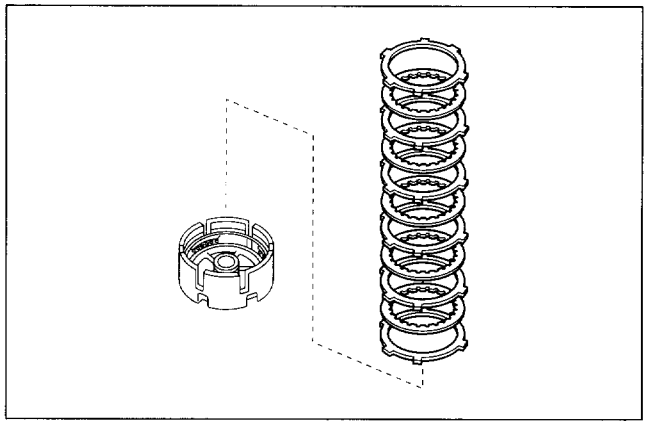


Figure 190. Flange, Disc and Plate Removal

4. Remove piston return spring.
   a) Place No.3 piston spring compressor on the spring seat, and compress the return spring with a shop press.
   Tool Required:
   5-8840-2642-0 No.3 Piston Spring Compressor
   NOTICE: Stop compressing the return spring at the position 1 to 2 mm away from the snap ring to prevent the spring sheet from being deformed.
   b) Using a screwdriver, remove the snap ring.

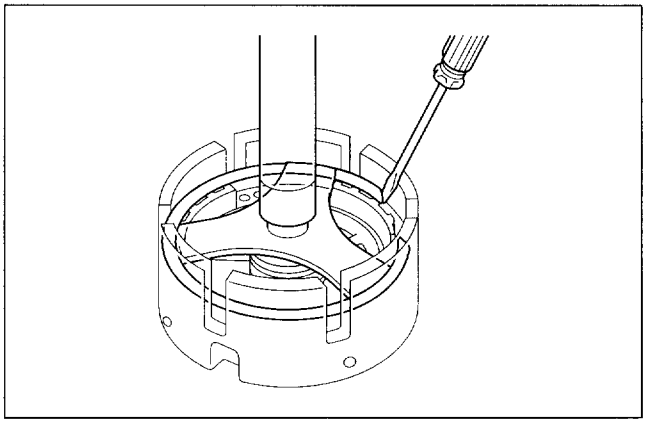


Figure 191. Return Spring Removal (1)

c) Remove the piston return spring.

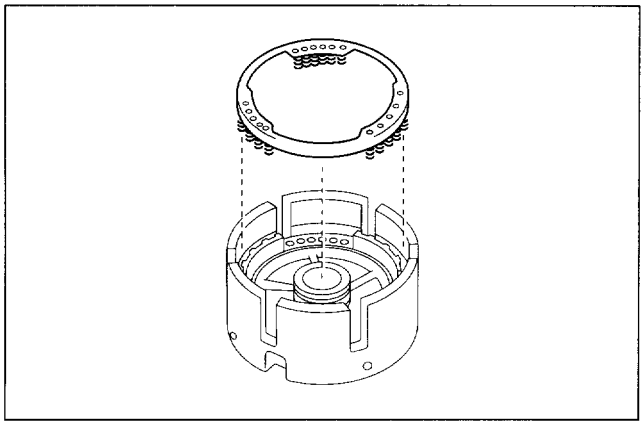


Figure 192. Return Spring Removal (2)

5. Remove second brake piston.
   a) Place the No.3 piston spring compressor on the brake piston.
   Tool Required:
   5-8840-2642-0 No.3 Piston Spring Compressor
   b) Hold the spring compressor so it does not slant, and apply compressed air 392–785 kPa (4–8 kg/cm², 57–114 psi) into the oil hole of the center support to remove the brake piston.
   c) Remove the 2 O-rings from the brake piston.

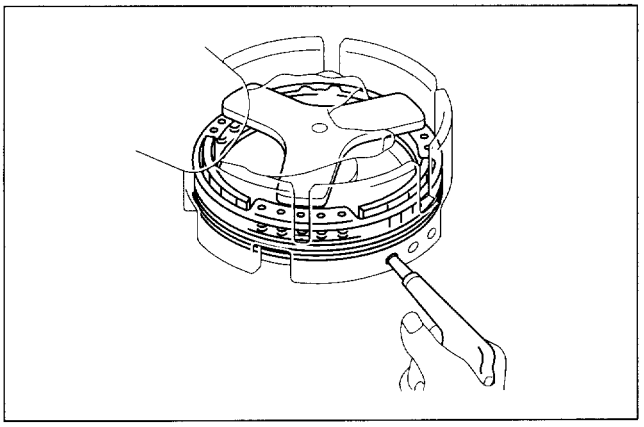


Figure 193. Piston Removal

6. Remove oil seal rings.
   Remove the 2 oil seal rings from the center support.
   CAUTION:
   - **Do not damage the oil seal rings and do not deform them unless necessary.**
   - **Do not damage the claws on the oil seal rings.**

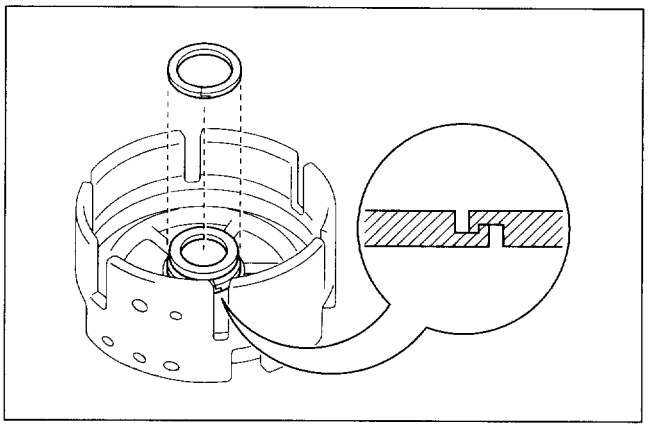


Figure 194. Oil Seal Removal

7. Remove ring retainers.
   Using needle nose pliers, remove the 3 ring retainers from the oil holes of the center support.

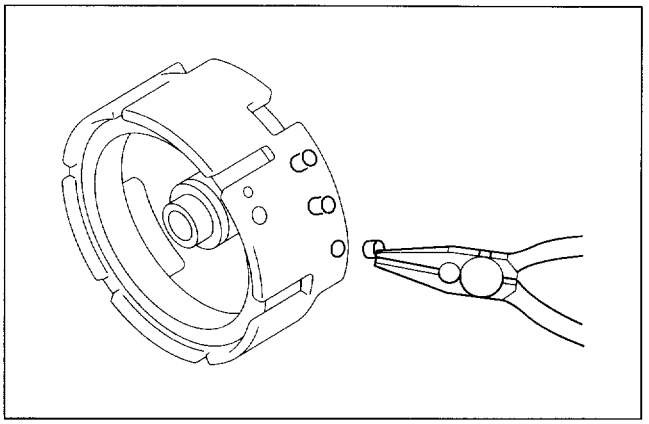


Figure 195. Ring Retainer Removal

Inspect

1. Inspect discs, plates and flange.
   Check to see if the contacting surface of the disc, plate and flange are worn or burnt. If necessary, replace them.
   NOTICE:
   - **If the lining of the disc is peeling off or discolored, or even if parts of the printed numbers are defaced, replace all discs.**
   - **Before assembling new discs, soak them in ATF for at least 15 minutes.**

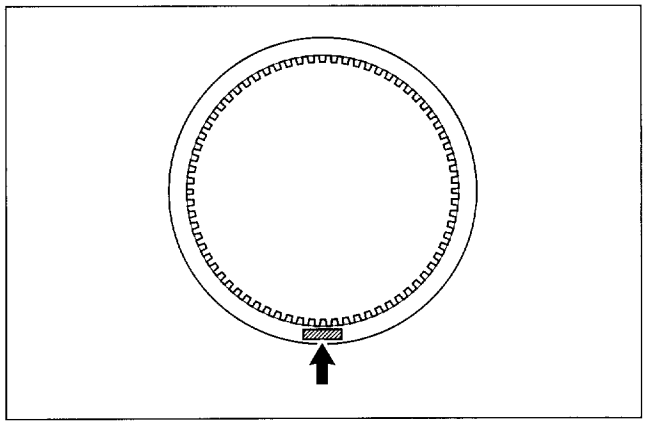


Figure 196. Disc Inspection

2. Inspect bushing of center support.
   Using a dial indicator, measure the inside diameter.
   Standrad inside diameter: 35.000–35.025 mm (1.3780–1.3789 in.)
   Maximum inside diameter: 35.08 mm (1.3811 in.)
   NOTICE: Measure at several points and take the average value.
   If the inside diameter is greater than the maximum, replace the center support.
   Inspect the bushing contacting surface of the front planetary sun gear, when discoloration or damage on the surface is found, replace the front planetary sun gear with a new one.

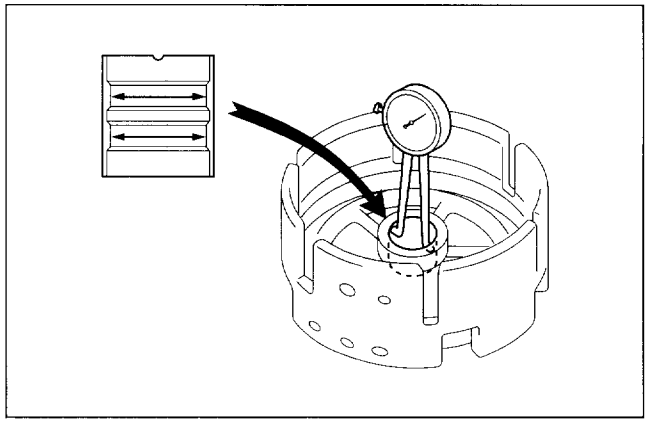


Figure 197. Bushing Inspection

3. Inspect bushings of front planetary sun gear.
   Using a dial indicator, measure the inside diameter.
   Standrad inside diameter: 25.500–25.521 mm (1.0039–1.0048 in.)
   Maximum inside diameter: 25.570 mm (1.0067 in.)
   NOTICE: Measure at several points and take the average value.
   If the inside diameter is greater than the maximum, replace the front planetary sun gear.
   Inspect the bushing contacting surface of the intermediate shaft, when discoloration or damage on the surface is found, replace the intermediate shaft with a new one.

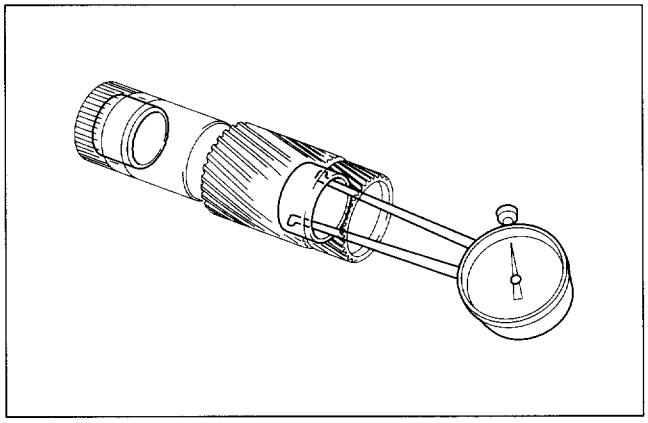


Figure 198. Sun Gear Bushing Inspection

Assemble

1. Install ring retainers.
   Using needle nose pliers, install the 3 ring retainers into the oil holes of the center support.

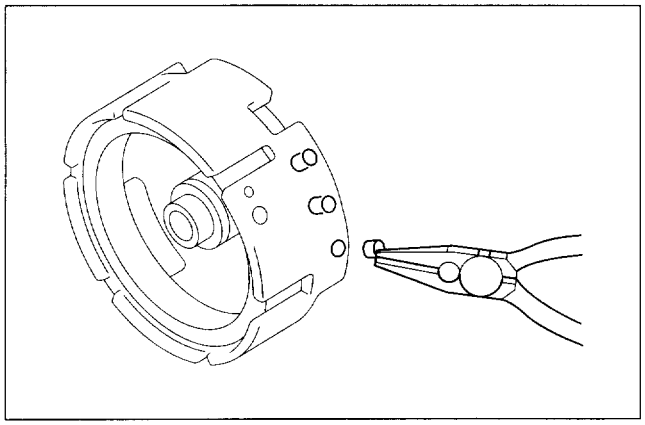


Figure 199. Ring Retainer Installation

2. Install oil seal rings.
   a) Coat the new 2 oil seal rings with ATF.
   b) Contract the oil seal rings, and install them onto the center support.

CAUTION:
- **Do not spread the ring ends more than necessary.**
- **Do not damage the claws on the oil seal rings.**

NOTICE:
- **If the oil seal rings are damaged or deformed, replace them with new ones.**
- **After installing the oil seal rings, check that they rotate smoothly.**

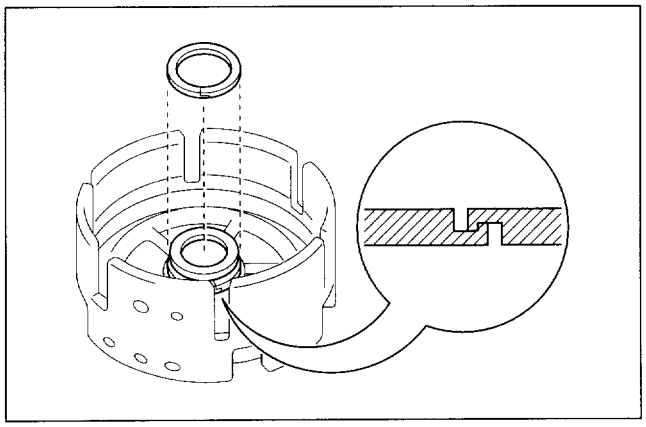


Figure 200. Seal Ring Installation

3. Install second brake piston.
   a) Coat the new 2 O-rings with ATF, and install them on the brake piston.

O-ring diameters mm (in.)

	Inside	Wire diameter
Inner side	145.3 (5.72047)	3.1 (0.12208)
Outer side	163.7 (6.44489)	3.1 (0.12208)

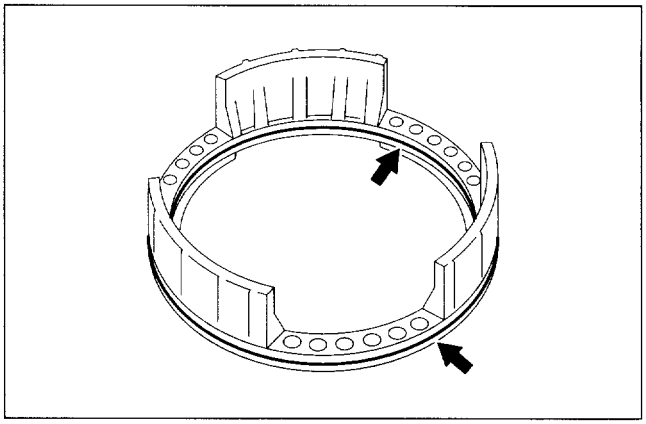


Figure 201. O-ring Installation

   b) Align the protrusions of the brake piston with the grooves of the center support.
   c) Push in the brake piston into the center support with both hands.

CAUTION:
- **Be careful not to damage the O-rings.**
- **Push in the piston uniformly.**

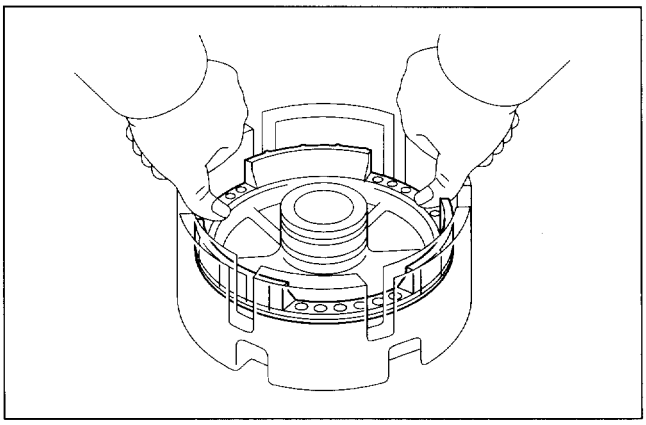


Figure 202. Piston Installation

4. Install piston return spring.
   a) Place the return spring on the brake piston.

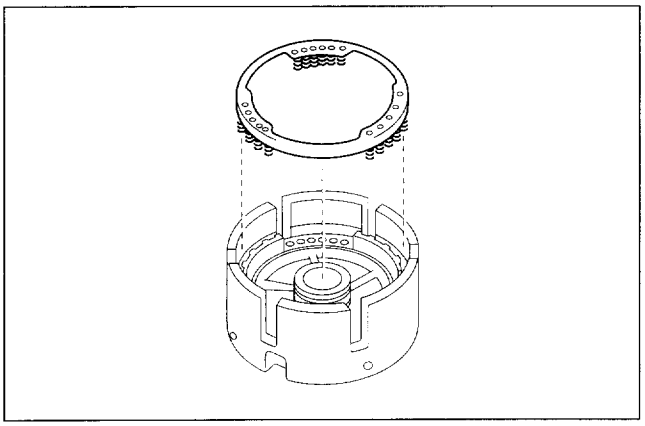


Figure 203. Return Spring Installation (1)

b) Place the No.3 piston spring compressor on the return spring, and compress the return spring with a shop press.

Tool Required:

5-8840-2642-0 No.3 Piston Spring Compressor

NOTICE: Stop compressing the return spring at the position 1 to 2 mm away from the snap ring to prevent the spring sheet from being deformed.

c) Using a screwdriver, install the new snap ring.

NOTICE: Be sure the end gap of the snap ring is not aligned with the cutout portion of the center support.

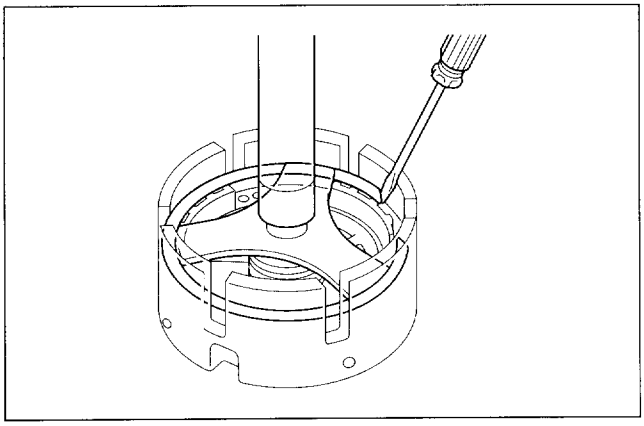


Figure 204. Return Spring Installation (2)

5. Install plates, discs and flange.
   a) Install the 5 plates and 5 discs in order:
      P = Plate D = Disc
      P – D – P – D – P – D – P – D – P – D

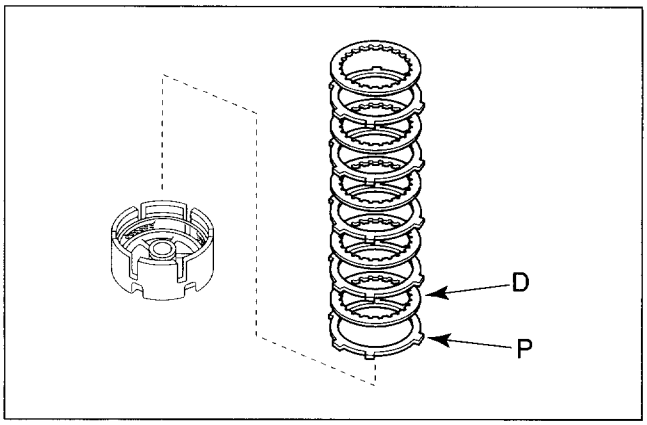


Figure 205. Plate and Disc Installation

b) Install the flange, facing the rounded edge upward.

NOTICE: If the flange is step-edged, install the flange with the step-edge, facing downward.

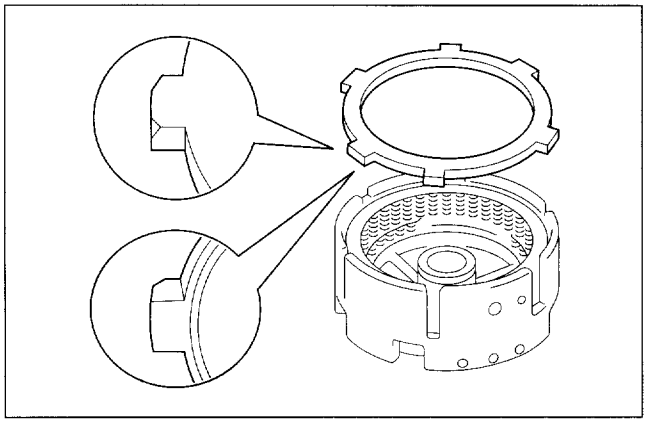


Figure 206. Flange Installation

c) Using a screwdriver, install the snap ring.

NOTICE: Be sure the end gap of the snap ring is not aligned the cutout portion of the center support.

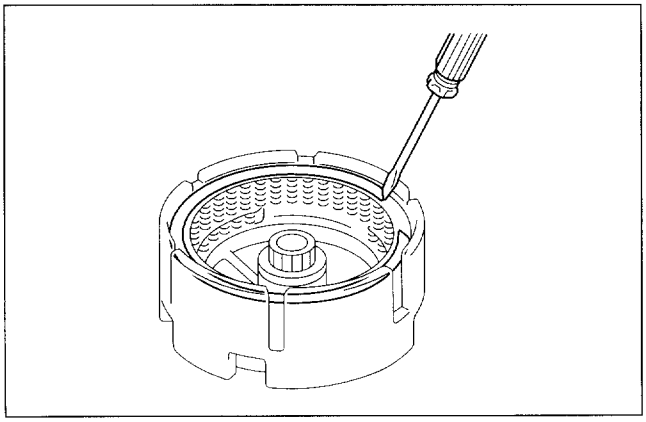


Figure 207. Snap Ring Installation

6. Check piston stroke of second brake.
   Using the No.2 measure terminal and a dial indicator, measure the piston stroke by applying and releasing compressed air 392–785 kPa (4–8 kg/cm², 57–114 psi).
   Piston stroke: 1.86–2.06 mm (0.0732–0.0811 in.)
   NOTICE:
   - **Stand the measure terminal on the piston vertically.**
   - **Ensure that the measure terminal does not touches other parts than the piston.**
   - **Measure the stroke at more than 3 points.**

   If the piston stroke is less than specified, parts may have been assembled incorrectly, check and reassemble again.
   If the piston stroke is not as specified, select another flange.
   Flange thicknesses

No.	Thickness mm (in.)	No.	Thickness mm (in.)
A	5.0 (0.197)	C	5.4 (0.213)
B	5.2 (0.205)	D	5.6 (0.220)

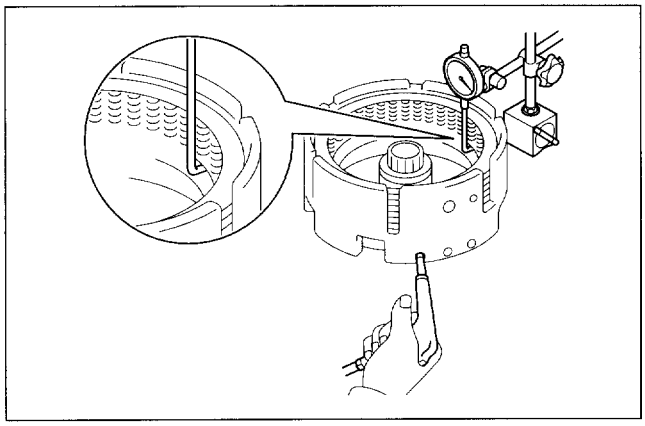


Figure 208. Piston Stroke Check

6. Install front planetary sun gear.
   a) Install the sun gear.
   b) Using snap ring pliers, install the snap ring.

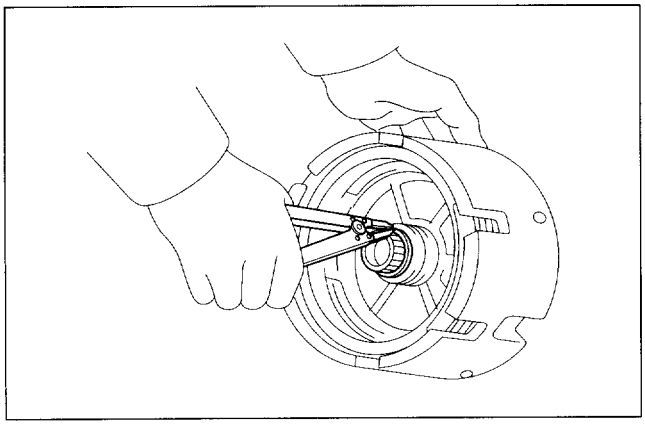
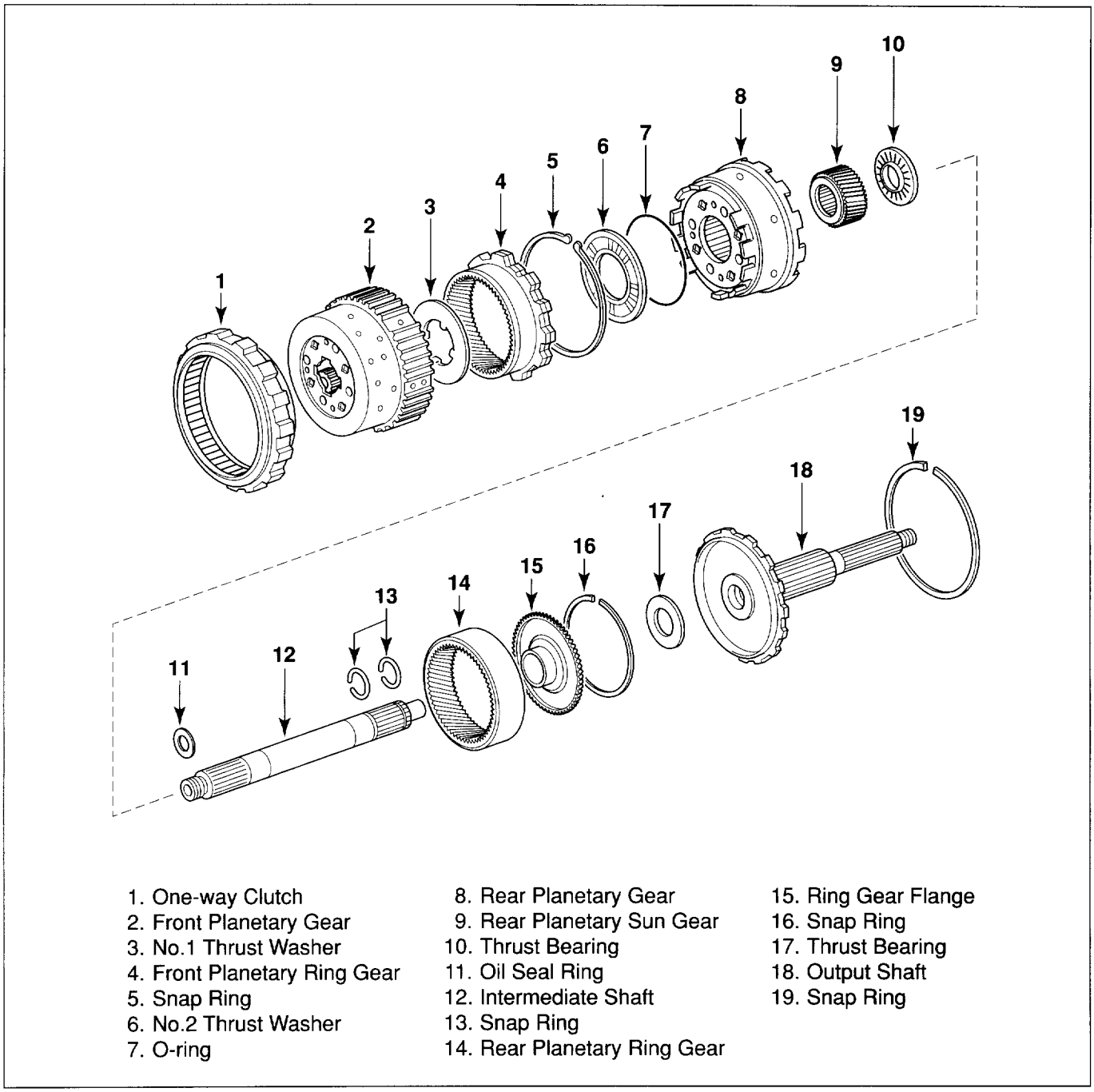


Figure 209. Sun Gear Installation

PLANETARY GEARS, ONE-WAY CLUTCH AND OUTPUT SHAFT



1. One-way Clutch
2. Front Planetary Gear
3. No.1 Thrust Washer
4. Front Planetary Ring Gear
5. Snap Ring
6. No.2 Thrust Washer
7. O-ring
8. Rear Planetary Gear
9. Rear Planetary Sun Gear
10. Thrust Bearing
11. Oil Seal Ring
12. Intermediate Shaft
13. Snap Ring
14. Rear Planetary Ring Gear
15. Ring Gear Flange
16. Snap Ring
17. Thrust Bearing
18. Output Shaft
19. Snap Ring

Figure 210. Planetary Gear, One-way Clutch and Output Shaft Assembly

Disassemble

1. Remove the rear planetary gear and output shaft assembly from the front planetary gear.

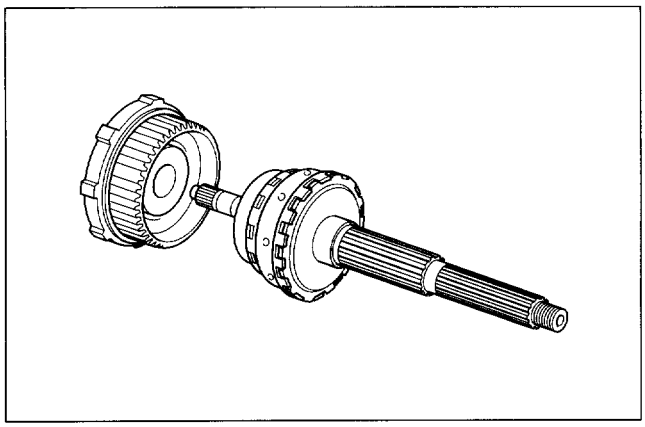


Figure 211. Rear Planetary Gear Removal

2. Remove No.1 rear thrust washer.
   Remove the thrust washer from the rear side of the front planetary gear.

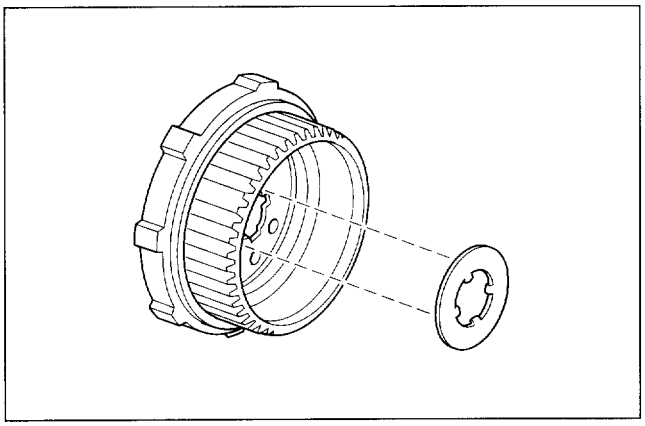


Figure 212. No.1 Thrust Washer Removal

3. Check operation of one-way clutch.
   Hold the one-way clutch outer race and turn the front planetary gear. The front planetary gear should turn freely counterclockwise and should lock clockwise.
   If operation is not as specified, replace the one-way clutch.

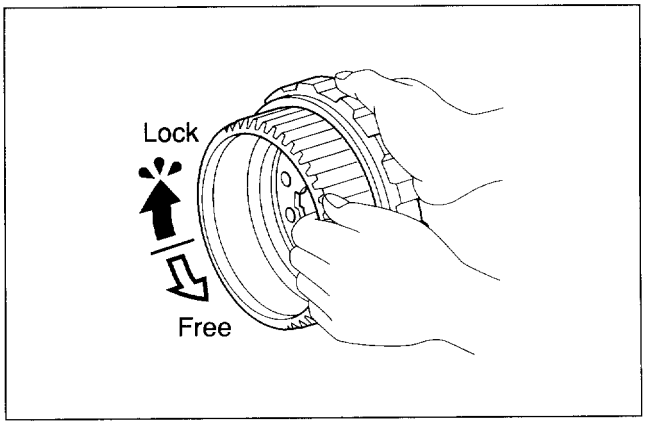


Figure 213. One-way Clutch Check

4. Remove the one-way clutch from the front planetary gear.

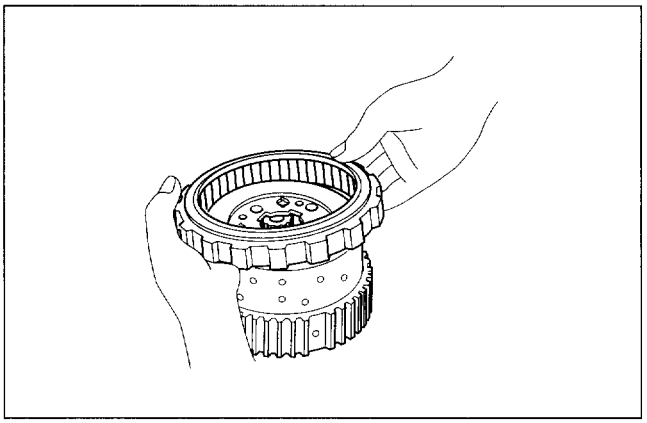


Figure 214. One-way Clutch Removal

5. Remove output shaft.
   a) Using a screwdriver, remove the snap ring.

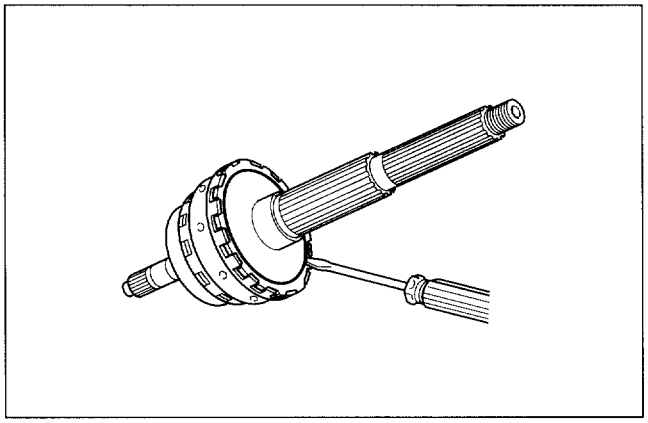


Figure 215. Output Shaft Removal (1)

   b) Remove the output shaft from the rear planetary gear.

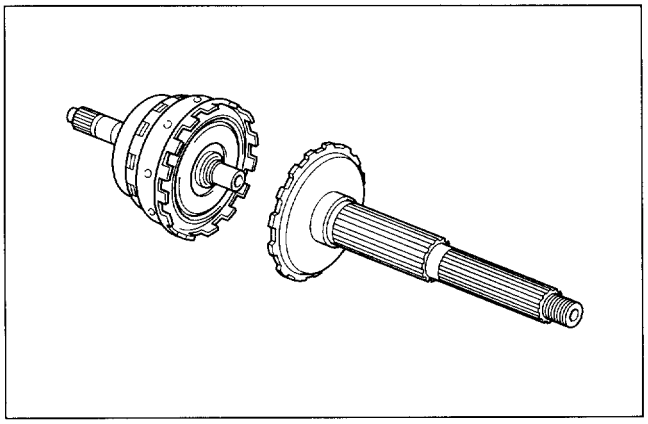


Figure 216. Output Shaft Removal (2)

   c) Remove the thrust bearing and race from the rear side of the ring gear flange.

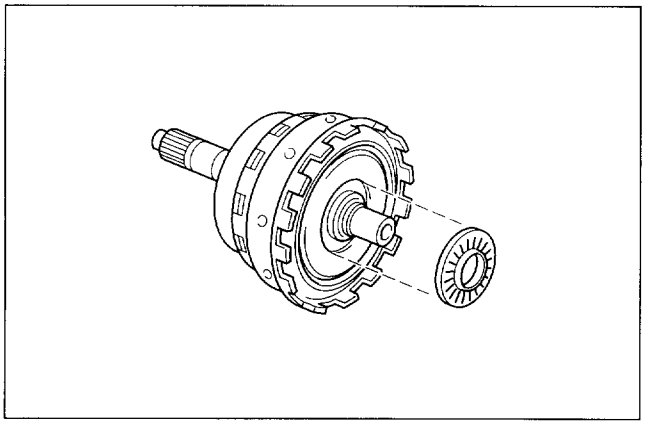


Figure 217. Thrust Bearing Removal

6. Remove rear planetary ring gear and intermediate shaft assembly.
   a) Remove the ring gear and intermediate shaft assembly from the rear planetary gear.

NOTICE: Do not drop the planetary sun gear.

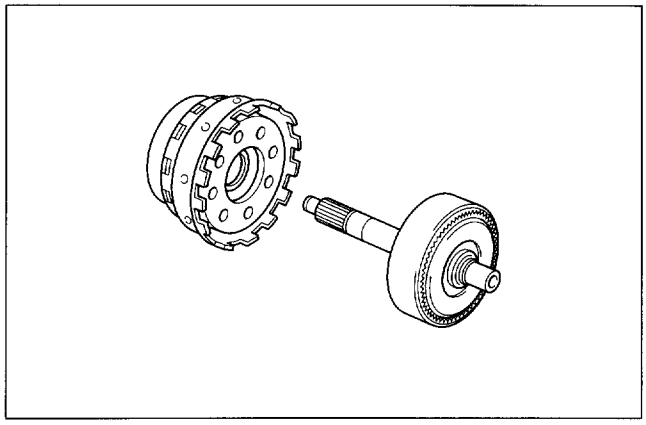


Figure 218. Ring Gear and Shaft Removal

   b) Remove the thrust bearing from the front side of the ring gear flange.

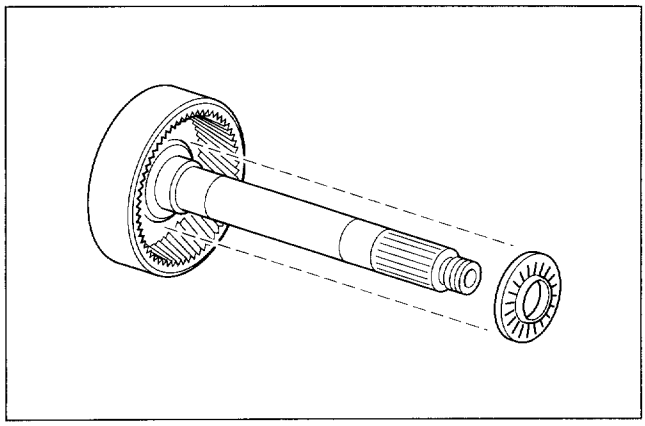


Figure 219. Thrust Bearing Removal

7. Remove the sun gear from the rear planetary gear.

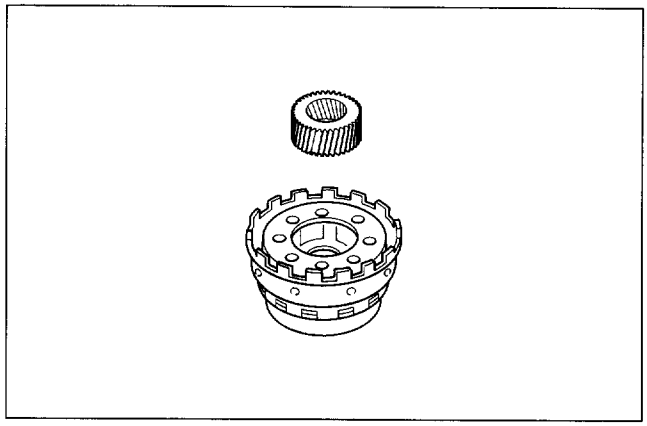


Figure 220. Sun Gear Removal

8. Remove oil seal ring.
   Using a small screwdriver, pry out the oil seal ring.

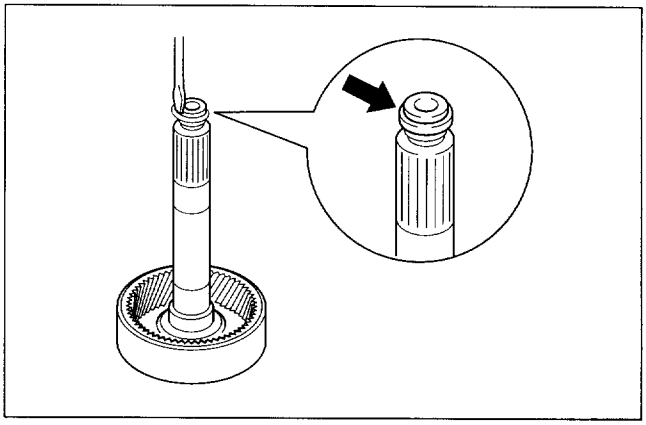


Figure 221. Oil Seal Ring Removal

9. Remove rear planetary ring gear and flange assembly.
   a) Using snap ring pliers, remove the snap ring from the rear side of the intermediate shaft.

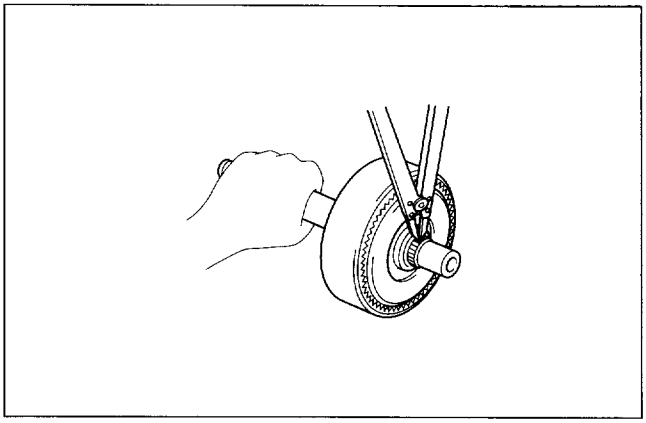


Figure 222. Snap Ring Removal

   b) Remove the ring gear and flange assembly from the intermediate shaft.

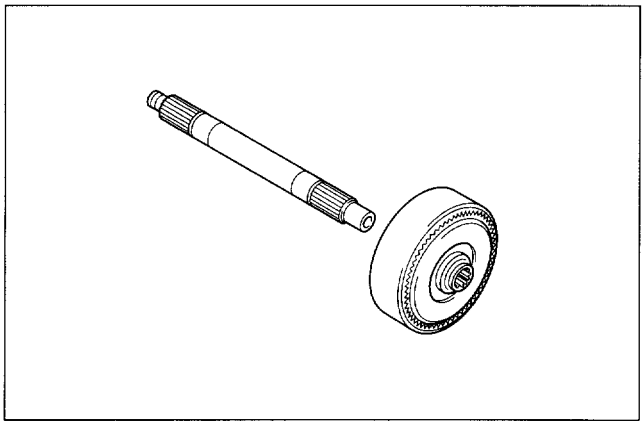


Figure 223. Ring Gear and Flange Removal

c) Using snap ring pliers, remove the snap ring from the front side of the intermediate shaft.

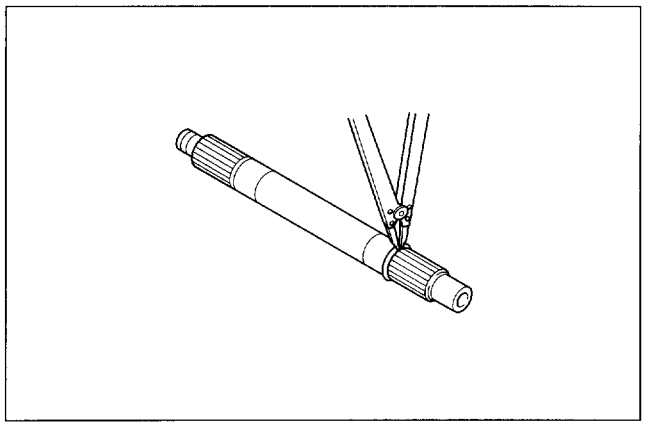


Figure 224. Snap Ring Removal

10. Remove rear planetary ring gear flange.
    a) Using a small screwdriver, remove the snap ring.

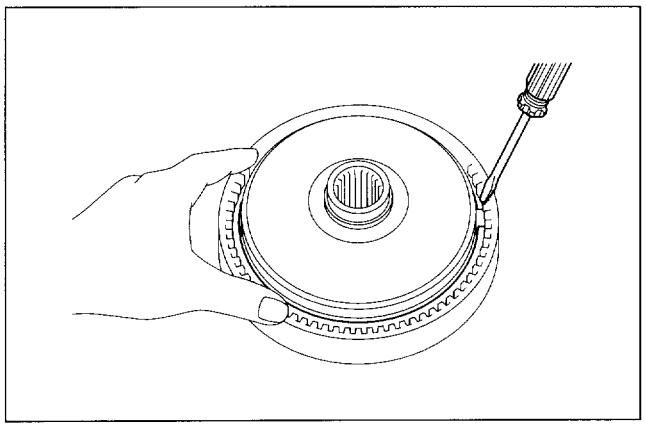


Figure 225. Ring Gear Flange Removal (1)

b) Remove the ring gear flange from the rear planetary ring gear.

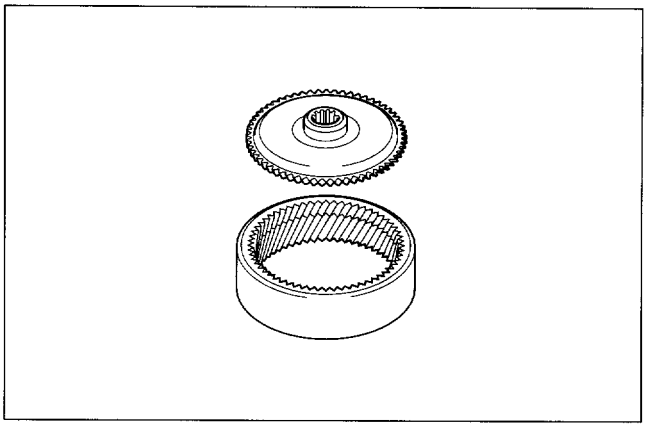


Figure 226. Ring Gear Flange Removal (2)

11. Remove front planetary ring gear.
    Using needle nose pliers, pry out the ring gear while compressing the snap ring.

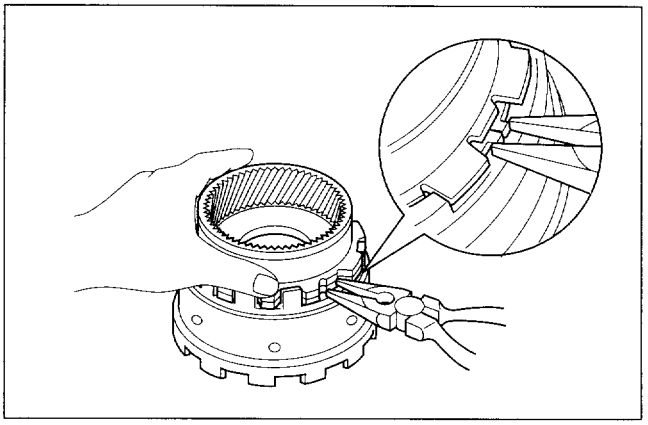


Figure 227. Ring Gear Removal

12. Using a screwdriver, remove the No.2 thrust washer from the rear planetary gear.
    CAUTION: Do not damage the No.2 thrust washer.

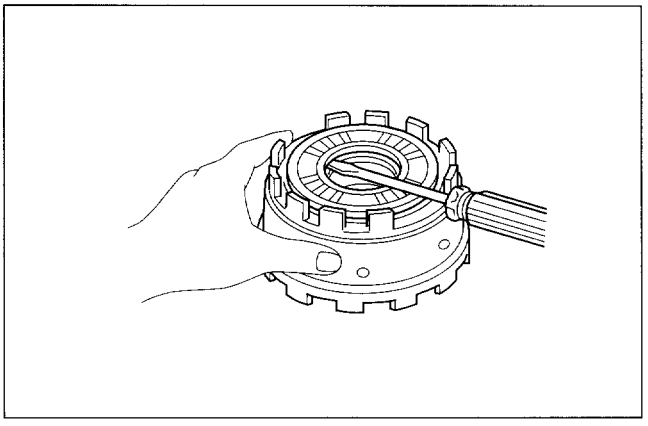


Figure 228. Thrust Washer Removal

13. Using a small screwdriver, remove the O-ring from the rear planetary gear.

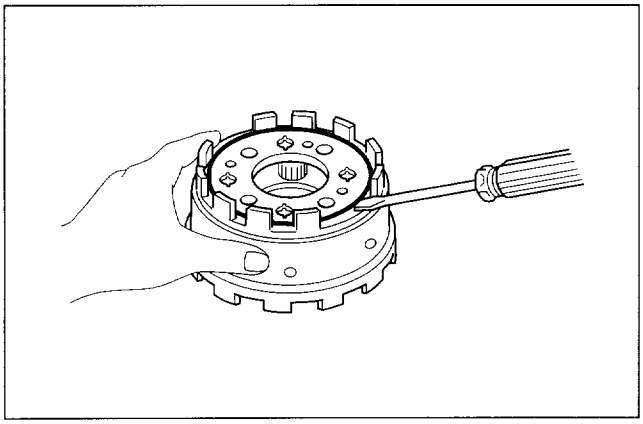


Figure 229. O-ring Removal

Inspect

1. Inspect bushing of output shaft.
   Using a dial indicator, measure the inside diameter.
   Standard inside diameter: 17.000–17.021 mm (0.6693–0.6701 in.)
   Maximum inside diameter: 17.07 mm (0.6720 in.)
   If the inside diameter is greater than maximum, replace the output shaft.
   Inspect the bushing contact surface of the intermediate shaft, when discoloration or damage on the surface is found, replace the intermediate shaft with a new one.

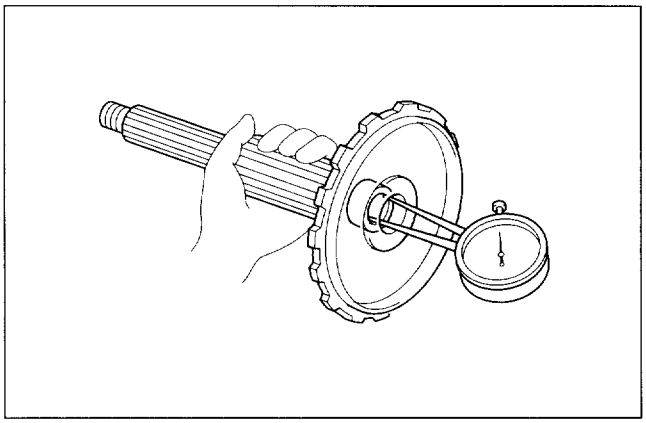


Figure 230. Bushing Inspection

2. Inspect planetary pinion gear thrust clearance.
   Using a feeler gauge, measure the thrust clearance between the pinions and carrier.
   Standrad clearance: 0.20–0.59 mm (0.0079–0.0232 in.)
   Maximum clearance: 0.75 mm (0.0295 in.)
   If the thrust clearance is greater than maximum, replace the planetary gear.

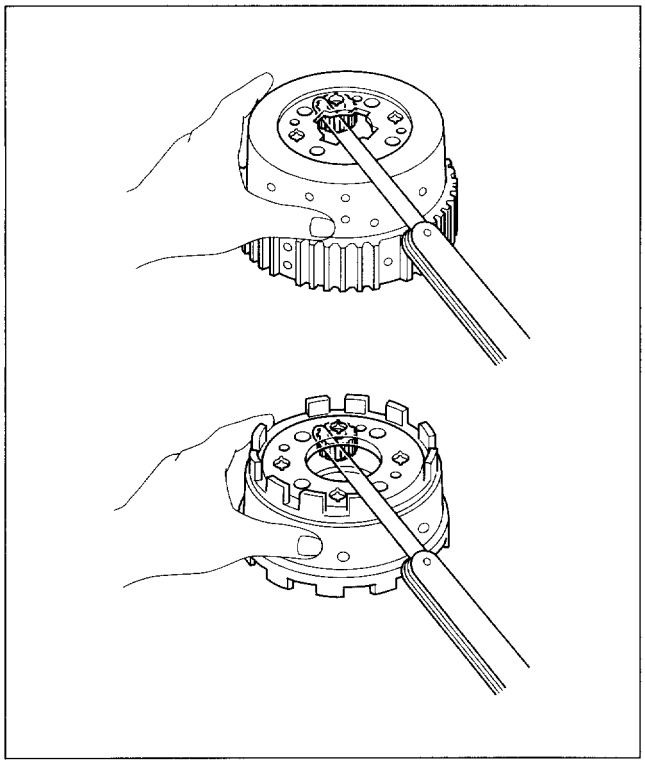


Figure 231. Thrust Clearance Inspection

Assemble

1. Install O-ring.
   Coat a new O-ring with ATF, and install it onto the rear planetary gear.
   CAUTION: Be careful not to damage the O-ring.

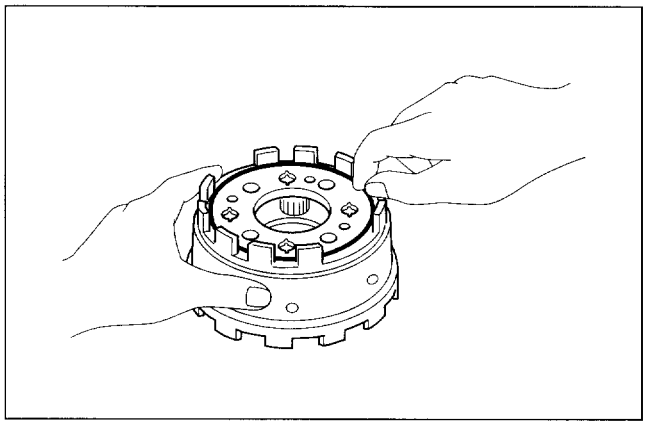


Figure 232. O-ring Installation

2. Install No.2 thrust washer.
   Coat the thrust washer with petroleum jelly, and install it onto the rear planetary gear.
   NOTICE: Securely fit the lips of the thrust washer into the holes of the rear planetary gear.

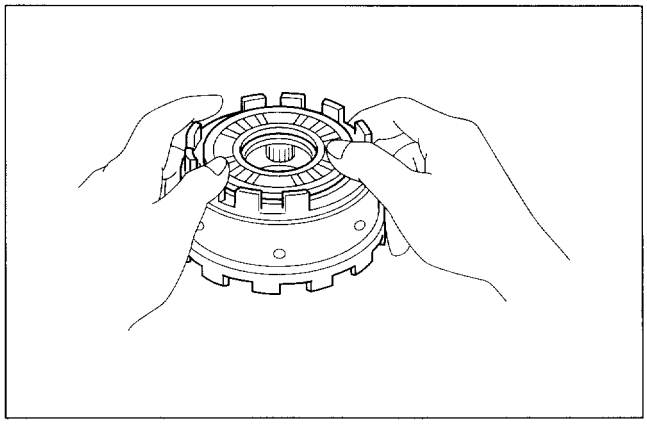


Figure 233. No.2 Thrust Washer Installation

3. Install front planetary ring gear.
   a) Align the snap ring end with the wide cutout portion of the rear planetary gear.
   b) Using needle nose pliers, compress the snap ring and then install the ring gear.
   c) Check that the snap ring is installed into the groove of the rear planetary gear.

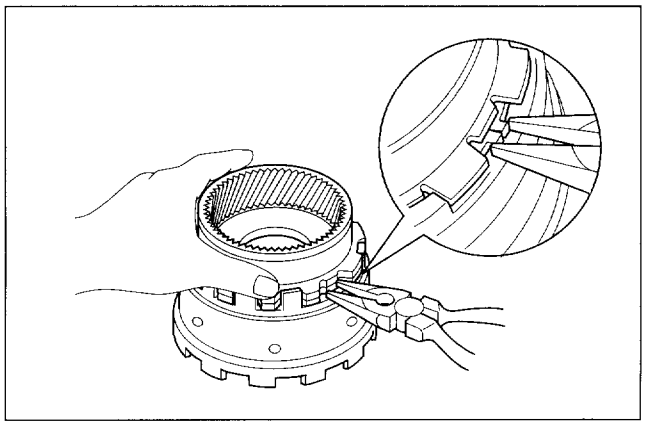


Figure 234. Ring Gear Installation

4. Install rear planetary ring gear flange.
   a) Install the ring gear flange to the rear planetary ring gear.

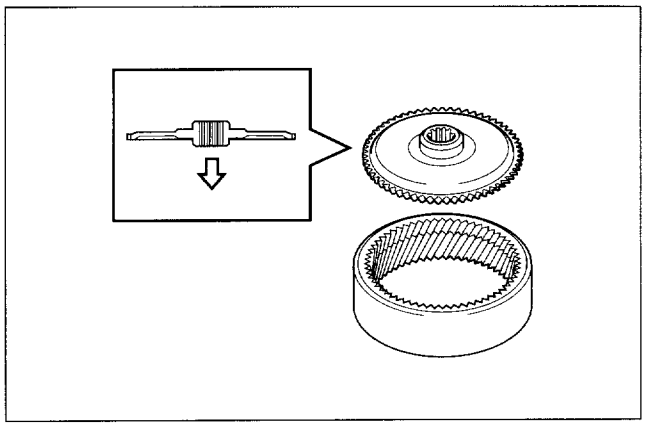


Figure 235. Ring Gear Flange Installation

   b) Using a small screwdriver, install the snap ring.

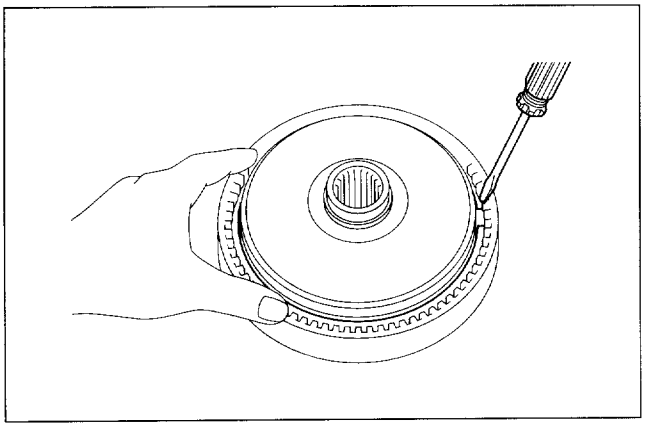


Figure 236. Snap Ring Installation

5. Install rear planetary ring gear and flange assembly.
   a) Using snap ring pliers, install the snap ring on the front side of the intermediate shaft.

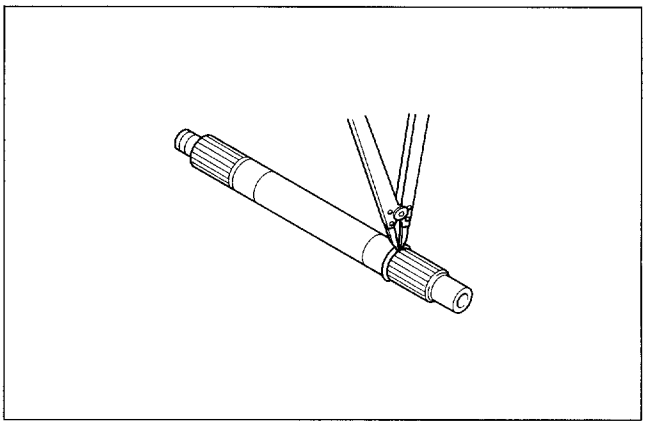


Figure 237. Snap Ring Installation

   b) Install the ring gear and flange assembly.
   c) Using snap ring pliers, install the snap ring on the rear side of the intermediate shaft.

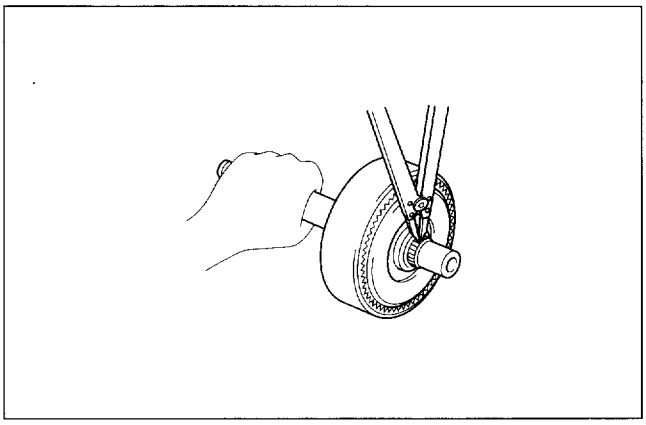


Figure 238. Snap Ring Installation

6. Install oil seal ring.
   Coat the new oil seal ring with ATF, and install it on the intermediate shaft.

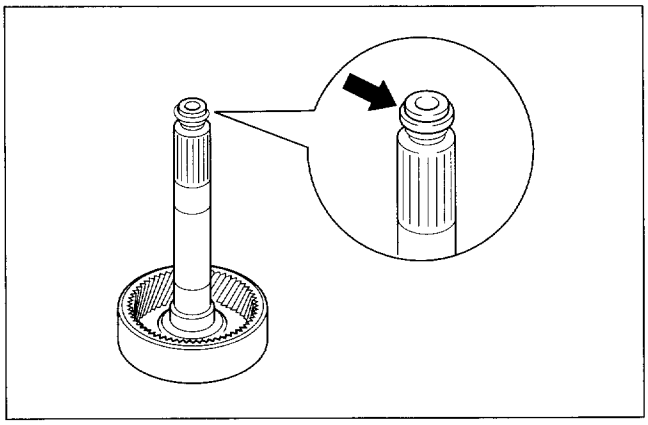


Figure 239. Oil Seal Ring Installation

7. Install rear planetary sun gear.
   Install the sun gear to the rear planetary gear.

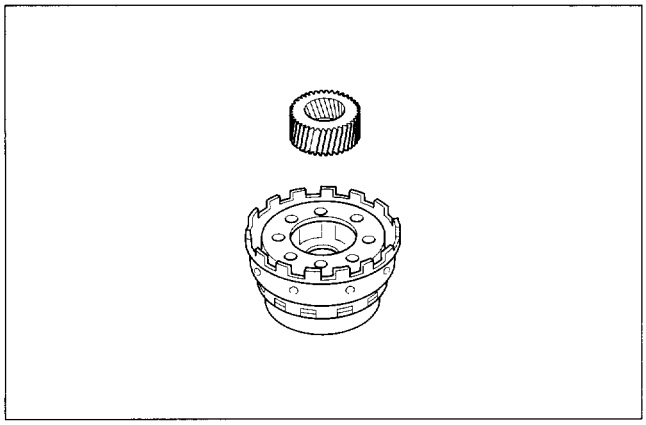


Figure 240. Sun Gear Installation

8. Install rear planetary ring gear and intermediate shaft assembly.
   a) Coat the thrust bearing with petroleum jelly.
   b) Install the thrust bearing onto the front side of the ring gear flange.

Thrust bearing diameter

Diameter mm (in.)	Inside	Outside
Bearing	32.8 (1.291)	53.2 (2.094)

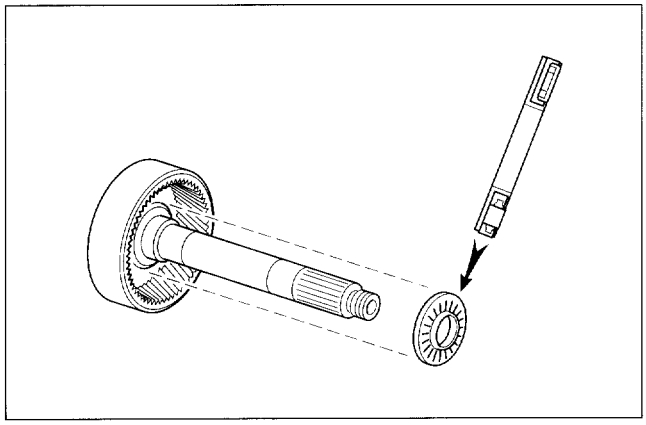


Figure 241. Thrust Bearing Installation

   c) Install the ring gear and intermediate shaft assembly to the rear planetary gear.

NOTICE: Do not drop the planetary sun gear.

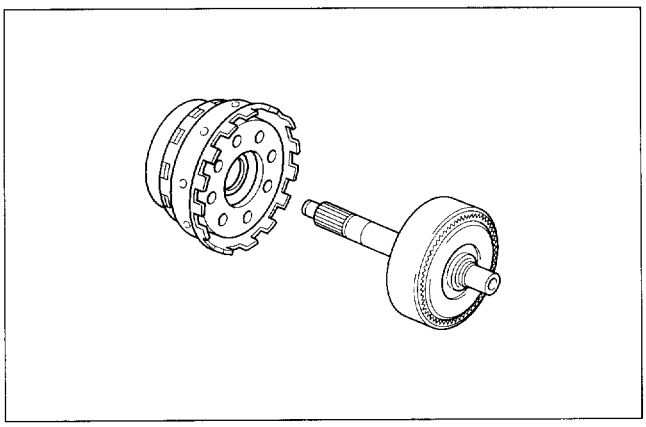


Figure 242. Ring Gear and Shaft Installation

9. Install output shaft.
   a) Coat the thrust bearing with petroleum jelly.
   b) Install the thrust bearing onto the rear side of the ring gear flange.

Thrust bearing diameter

Diameter mm (in.)	Inside	Outside
Bearing	32.8 (1.291)	53.2 (2.094)

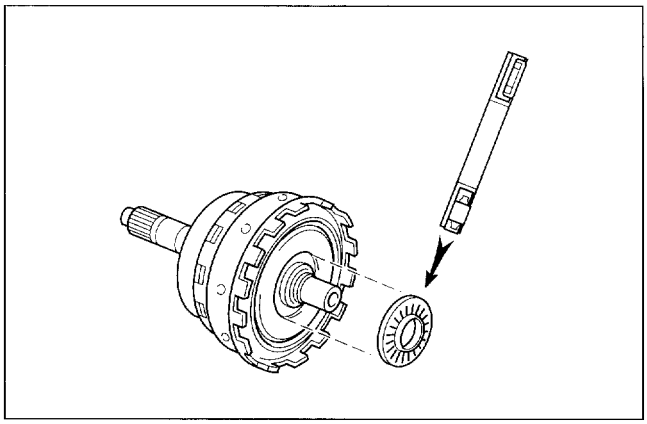


Figure 243. Thrust Bearing Installation

   c) Install the output shaft to the rear planetary gear.

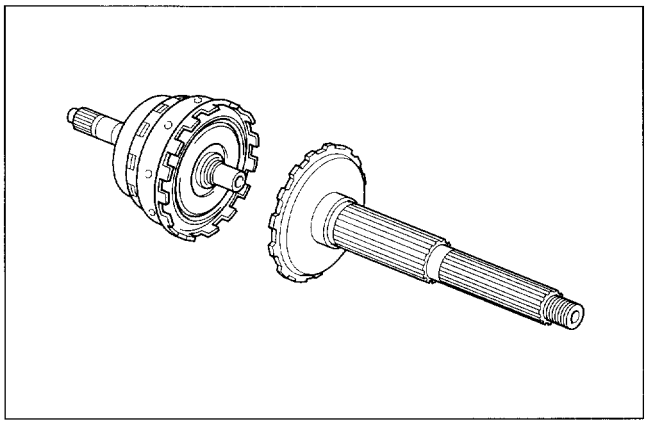


Figure 244. Output Shaft Installation

   d) Using a screwdriver, install the snap ring.

NOTICE: Be sure the end gap of the snap ring is not aligned with the cutout portion of the rear planetary gear.

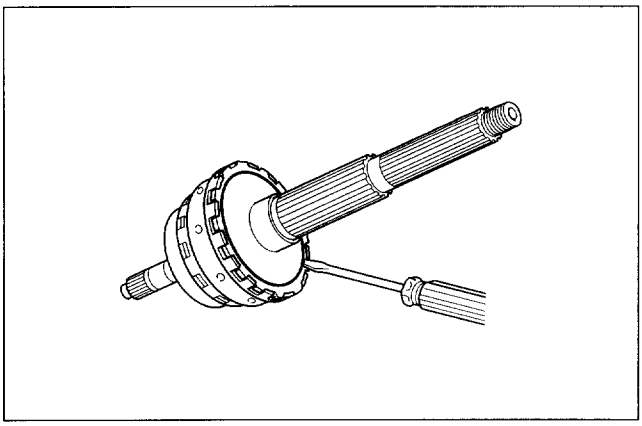


Figure 245. Snap Ring Installation

10. Install one-way clutch.
    a) Position the one-way clutch on the front planetary gear, facing the flanged side of the one-way clutch downward.
    b) Install the one-way clutch to the front planetary gear by rotating the one-way clutch counterclockwise.

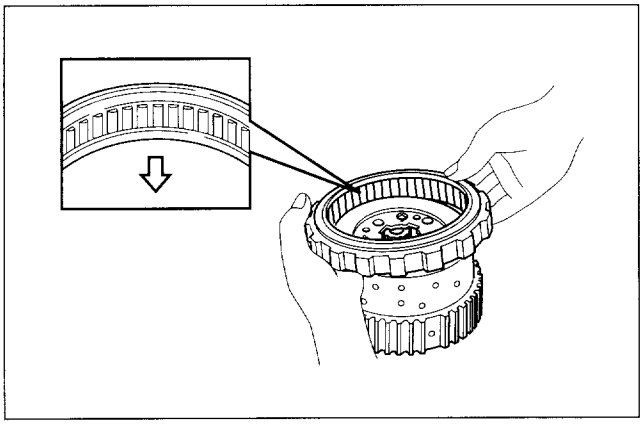


Figure 246. One-way Clutch Installation

11. Check operation of one-way clutch.
    Hold the one-way clutch outer race and turn the front planetary gear. The front planetary gear should turn freely counterclockwise and should lock clockwise.
    If operation is not as specified, replace the one-way clutch.

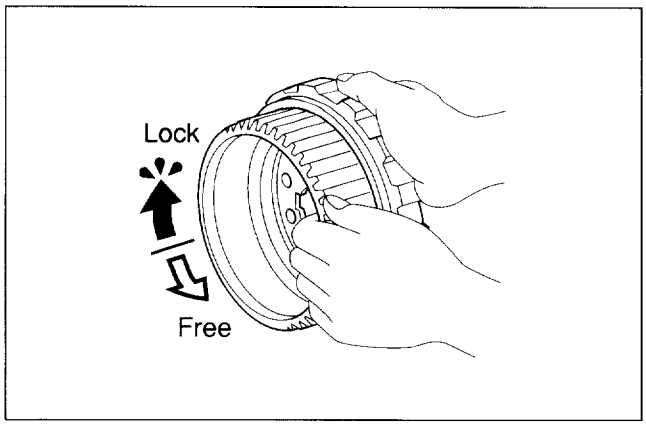


Figure 247. One-way Clutch Check

12. Install No.1 thrust washer.
    Coat the thrust washer with petroleum jelly, and install it onto the rear side of the front planetary gear.
    NOTICE: Securely fit the claws of the thrust washer into the grooves of the front planetary gear.

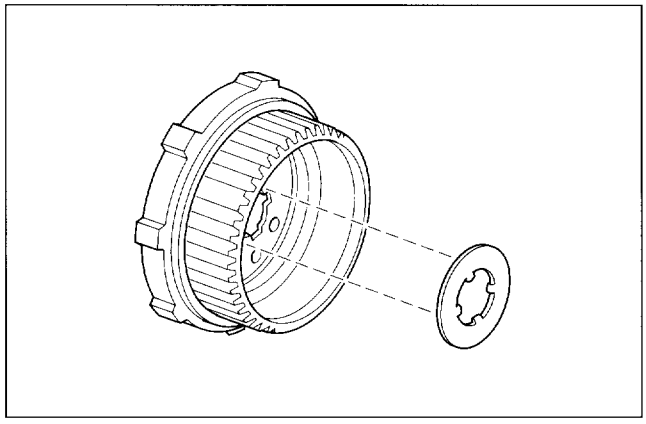


Figure 248. No.1 Thrust Washer Installation

13. Install the rear planetary gear and output shaft assembly to the front planetary gear.

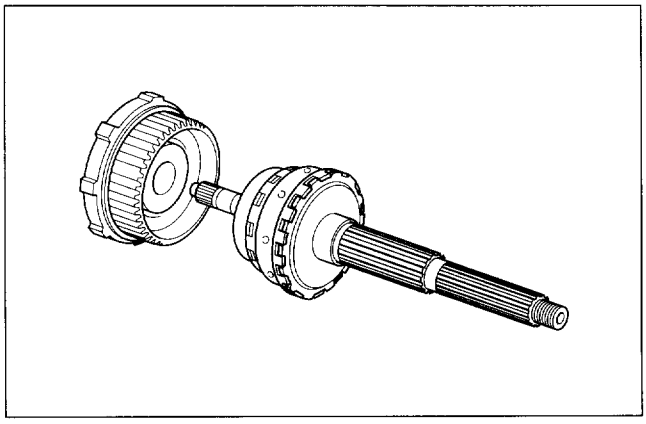
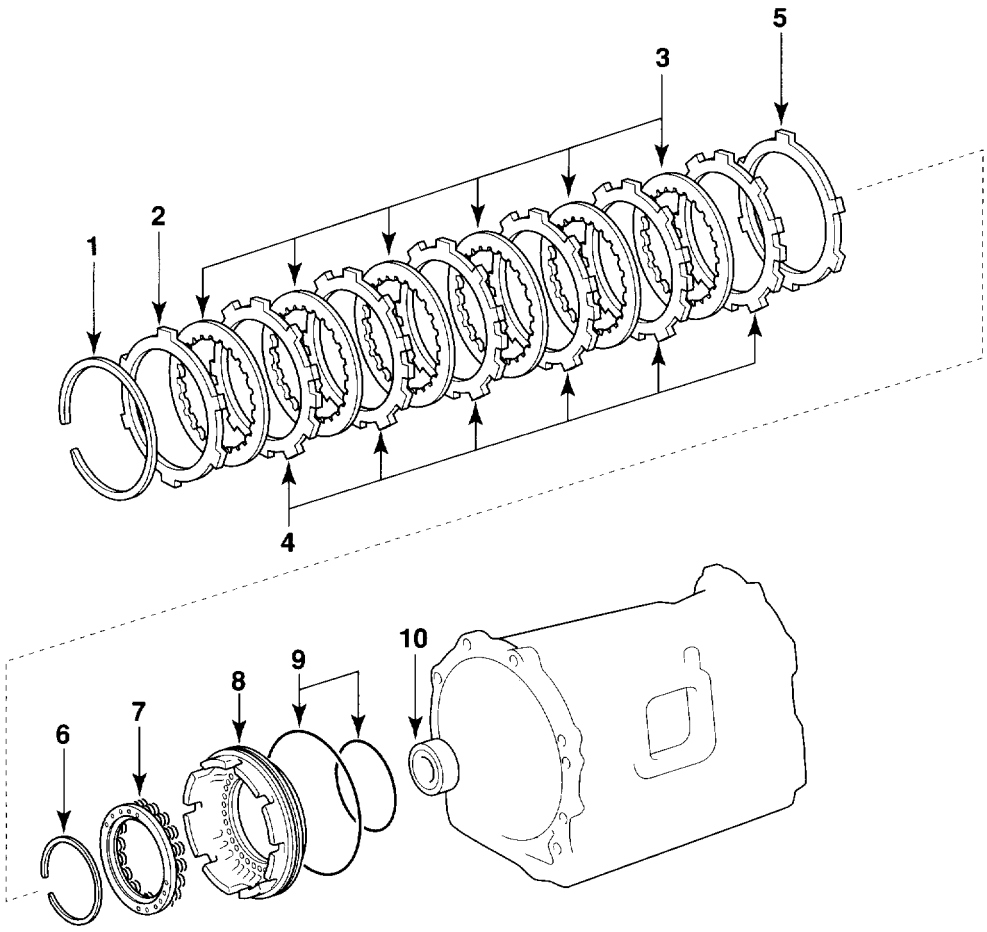


Figure 249. Planetary Gear and Shaft Installation

FIRST AND REVERSE BRAKE



1. Snap Ring
2. Flange
3. Disc
4. Plate
5. Cushion Plate
6. Snap Ring
7. Piston Return Spring
8. First and Reverse Brake Piston
9. O-ring
10. Output Shaft Front Bearing

Figure 250. First and Reverse Brake Assembly

Disassemble

1. Check piston stroke of first and reverse brake piston.
   a) Using the No.2 measure terminal and a dial indicator, measure the piston stroke by applying and releasing the compressed air 392–785 kPa (4–8 kg/cm², 57–114 psi).

   Tool Required:
   5-8840-2650-0 No.2 Measure Terminal

   Piston stroke: 3.30–3.80 mm (0.1299–0.1496 in.)

NOTICE:
- **Stand the measure terminal on the piston vertically.**
- **Ensure that the measure terminal does not touches other parts than the piston.**
- **Measure the stroke at more than 3 points.**

If the piston stroke is not as specified, inspect the discs.

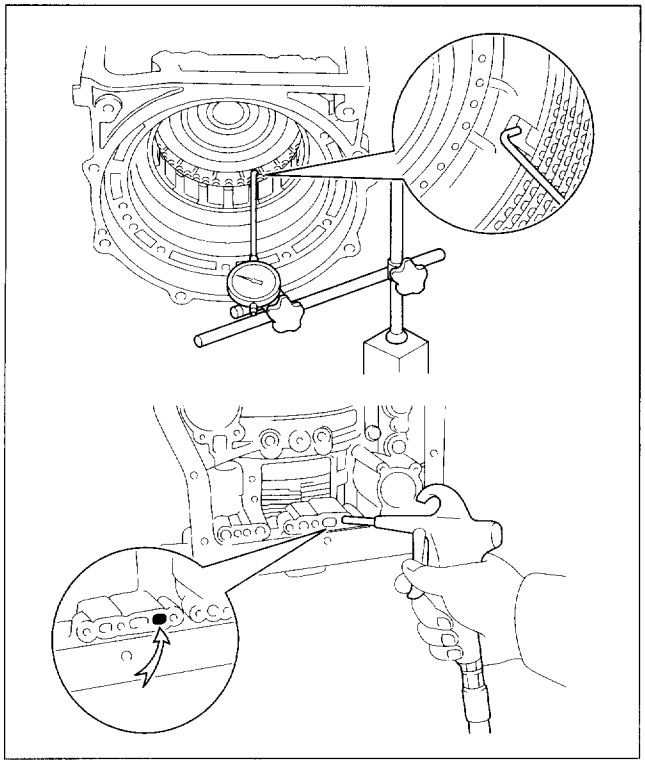


Figure 251. Piston Stroke Check

2. Remove flange, discs, plates and cushion plate.
   a) Using screwdriver, remove the snap ring.

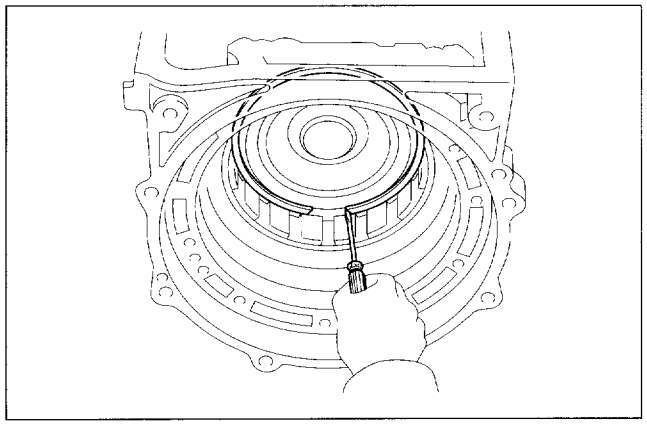


Figure 252. Snap Ring Removal

   b) Remove flange, 6 discs, 6 plates and cushion plate.

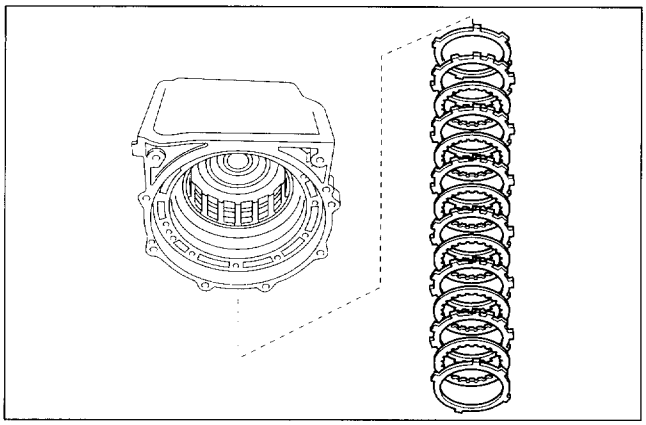


Figure 253. Flange, Disc, Plate and Cushion Plate

3. Remove piston return spring.
   a) Set the No.1 piston spring compressor on the spring retainer, and compress the return spring.

   Tool Required:

   5-8840-2643-0 No.1 Piston Spring Compressor

NOTICE: Stop compressing the return spring at the position 1 to 2 mm away from the snap ring to prevent the spring sheet from being deformed.

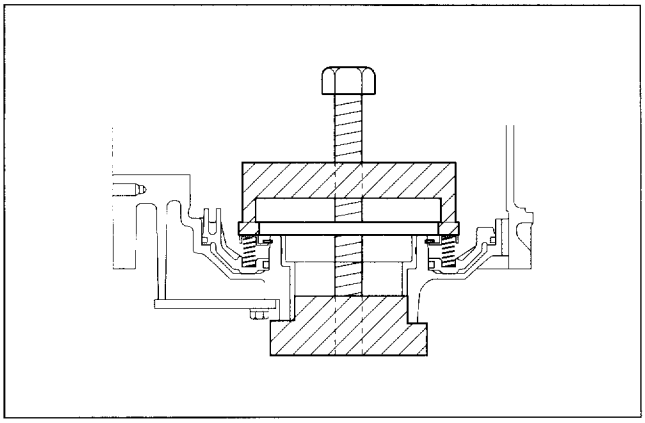


Figure 254. Return Spring Removal (1)

   b) Using a snap ring pilers, remove the snap ring.

CAUTION: Do not damage the snap ring and do not defrom them unless necessary.

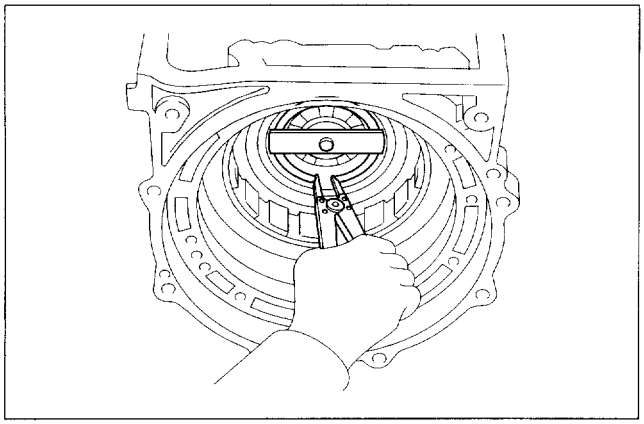


Figure 255. Return Spring Removal (2)

c) Remove the piston return spring.

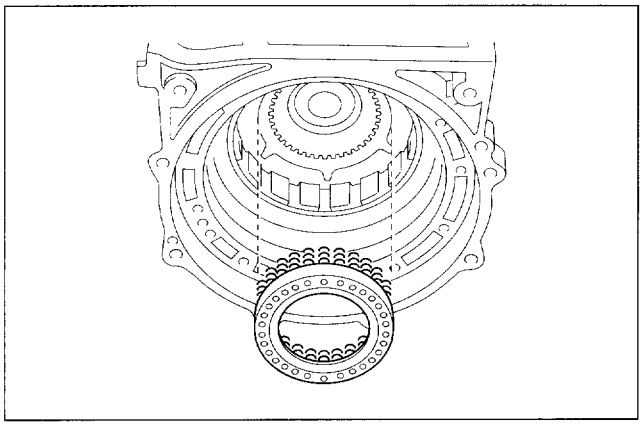


Figure 256. Return Spring Removal (3)

4. Remove first and reverse brake piston.
   a) Hold first and reverse brake piston with hand, remove first and reverse brake piston by applying compressed air 392–785 kPa (4–8 kg/cm², 57–114 psi) into the oil hole of the transmission case.
   b) Remove the 2 O-rings from brake piston.

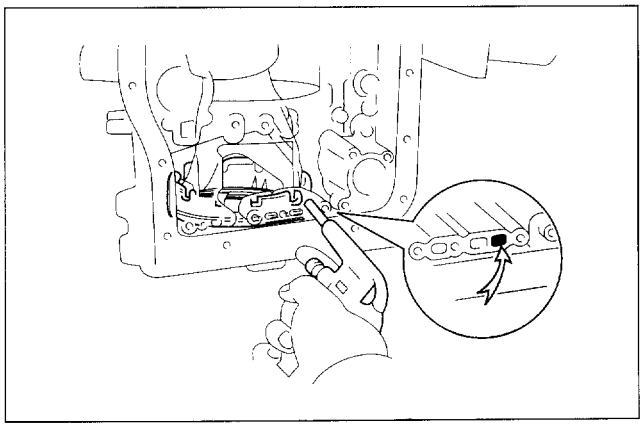


Figure 257. Brake Piston Removal

Inspect

Inspect discs, plates and cushion plate.
Check to see of the contacting surface of the disc, plate and flange are worn or burnt. If necessary, replace them.

NOTICE:

- **If the lining of the disc is peeling off or discolored, or even if a part of the printed numbers are defaced, replace all discs.**
- **Before assembling new discs, soak them in ATF for at least 15 minutes.**

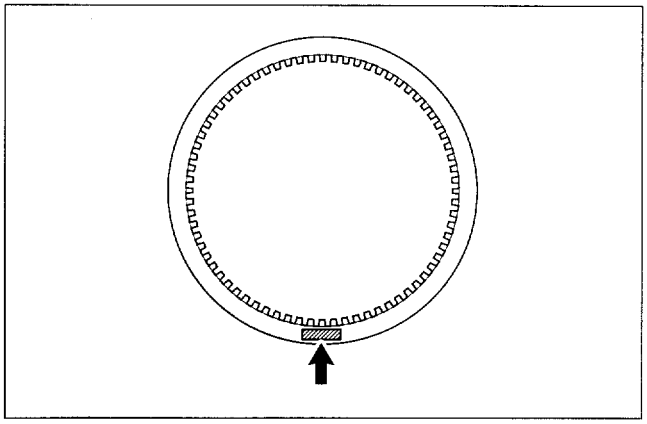


Figure 258. Disc Inspection

Output shaft front bearing replacement

1. Remove output shaft front bearing.
   Using oil seal installer (for oil pump), steel plate and a shop press, press out the bearing.
   Tool Required:
   5-8840-2644-0 Oil Seal Installer

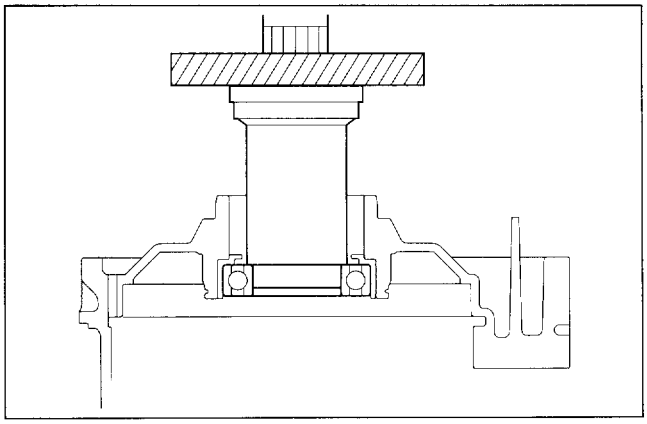


Figure 259. Bearing Replacement (1)

2. Install output shaft front bearing.
   a) Using the bearing installer, handle and a shop press, press in the new bearing.
   Tool Required:
   5-8840-2645-0 Handle
   5-8840-2646-0 Oil Seal Installer

b) Check that the bearing rotates smoothly.

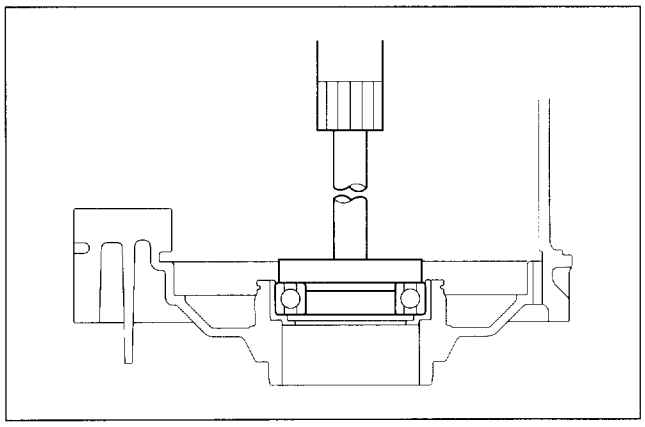


Figure 260. Bearing Replacement (2)

Reassemble

1. Install first and reverse brake piston.
   a) Coat the new 2 O-rings with ATF, and install them in the first and reverse brake piston.

O-ring diameter mm (in.)

	Inside	Wire diameter
Inner side	94.4 (3.7165)	3.1 (0.1221)
Outer side	163.7 (6.4449)	3.1 (0.1221)

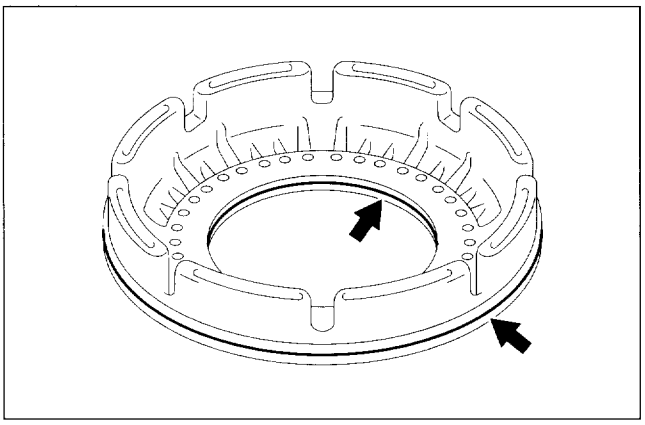


Figure 261. O-ring Location

   b) Using the No.1 piston spring compressor and the handle, push in the brake piston.

Tool Required:

5-8840-2643-0 No.1 Piston Spring Compressor
5-8840-2645-0 Handle

CAUTION: Be careful not to damage the O-ring.

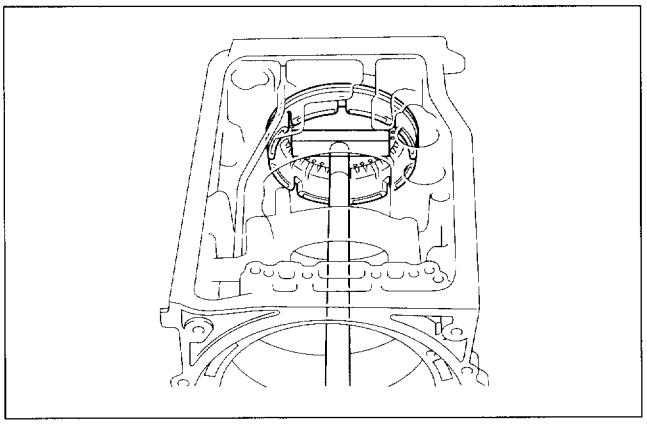


Figure 262. Brake Piston Installation

2. Install piston return spring.
   a) Place the return spring on the brake piston.

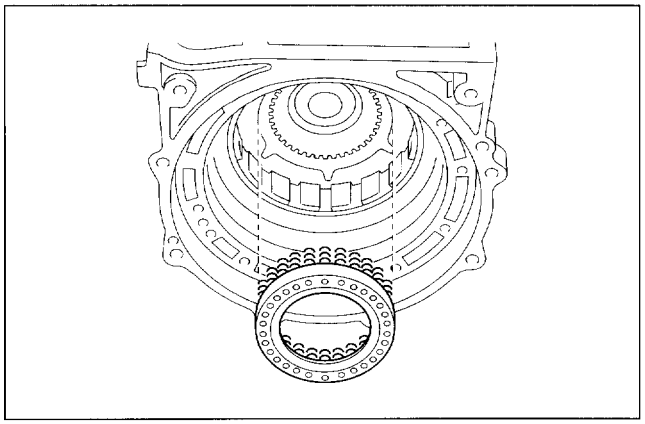


Figure 263. Return Spring Installation (1)

b) Using No.1 piston spring compressor, compress the return spring.

NOTICE: Stop compressing the return spring at the position 1 to 2 mm away from the snap ring to prevent the spring sheet from being deformed.

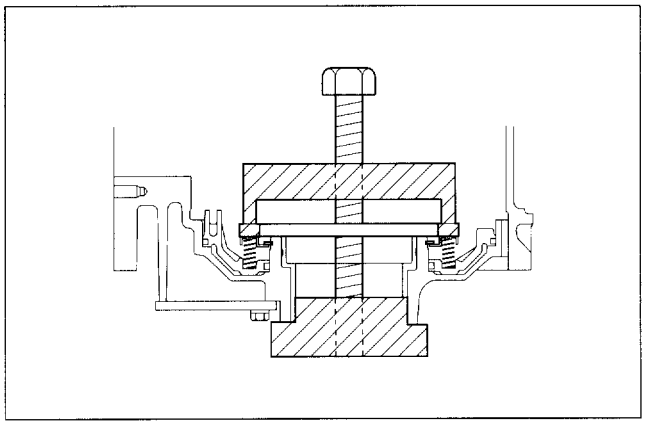


Figure 264. Return Spring Installation (2)

c) Using snap ring pliers, install the snap ring.

NOTICE: If the snap ring are damaged or deformed, replace it with a new one.

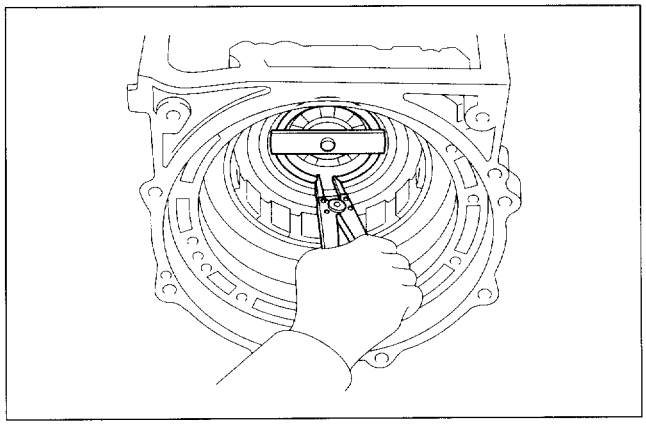


Figure 265. Return Spring Installation (3)

3. Install cushion plate, plates, discs and flange.
   a) Install the cushion plate, facing the rounded edge inward.

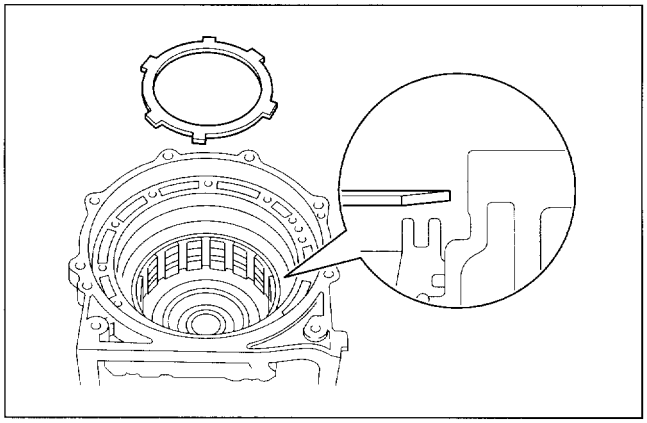


Figure 266. Cushion Plate Installation

b) Install the 6 plates and 6 discs in order:
P = Plate D = Disc
P – D – P – D – P – D – P – D – P – D

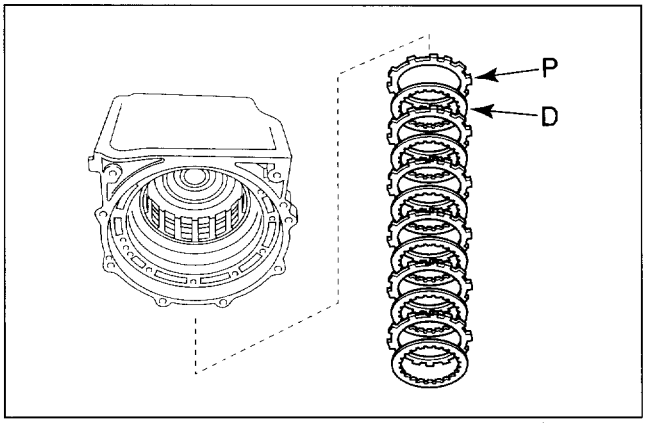


Figure 267. Plate and Disc Installation

c) Install the flange, facing the rounded edge outward.

NOTICE: If the flange is step-edged, install the flange with the step-edge, facing inward.

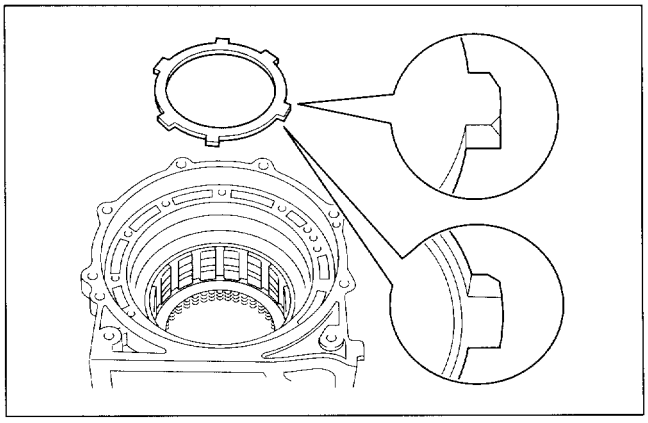


Figure 268. Flange Direction

d) Using screwdriver, install the snap ring.
NOTICE: Be sure the end of the snap ring is not aligned with the cutout portion of the transmission case.

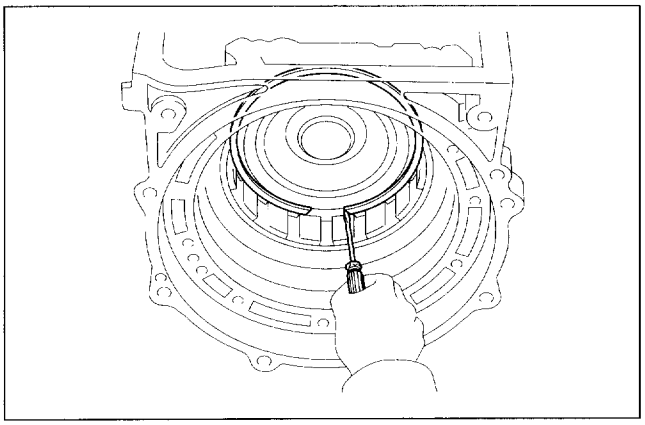


Figure 269. Snap Ring Installation

4. Check piston stroke of first and reverse brake.
   a) Using No.2 measure terminal and a dialindicator, measure the piston stroke by applying and releasing the compressed air 392–785 kPa (4–8 kg/cm², 57–114 psi).

   Tool Required:
   5-8840-2650-0 No.2 Measure Terminal

   Piston stroke: 3.3–3.8 mm (0.130–0.150 in.)

   NOTICE:
   - **Stand the measure terminal on the piston vertically.**
   - **Ensure that the measure terminal does not touches other parts than the piston.**
   - **Measure the stroke at more than 3 points.**

   If the piston stroke is less than specified, parts may have been assembled incorrectly, check and reassemble again.
   If the piston stroke is not as specified, select another flange.

Flange thickness mm (in.)

No.	Thickness
E	6.65 (0.2618)
F	7.05 (0.2776)
G	7.45 (0.2933)

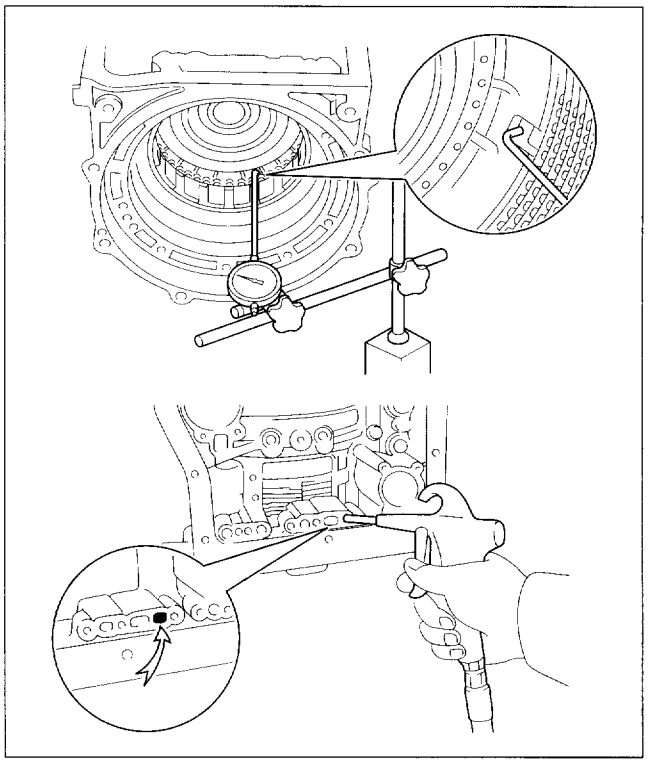
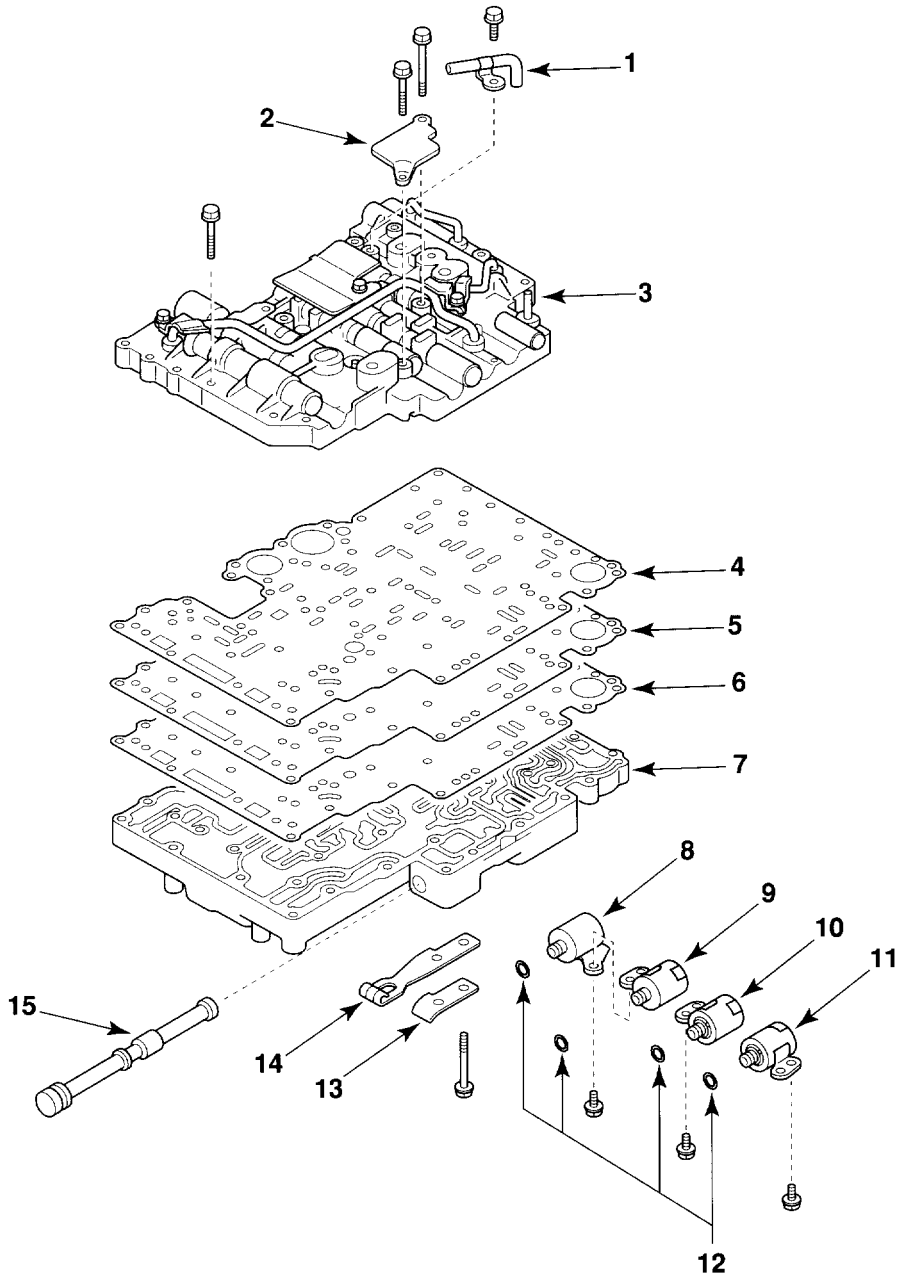


Figure 270. Piston Stroke Check

VALVE BODY



1. Drain Tube
2. Plate
3. Upper Valve Body
4. No.1 Gasket
5. Plate
6. No.2 Gasket
7. Lower Valve Body
8. Lock Up Solenoid
9. Timing Solenoid
10. No.2 Shift Solenoid
11. No.1 Shift Solenoid
12. O-ring
13. Spring Cover
14. Manual Detent Spring
15. Manual Valve

Figure 271. Valve Body Assembly

Disassemble

1. Remove the bolt and the drain tube.

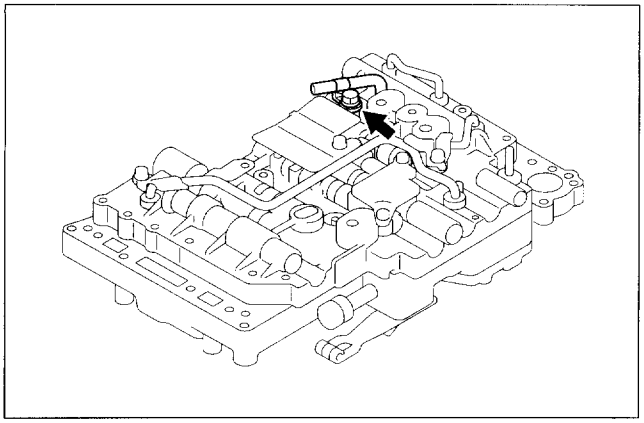


Figure 272. Drain Tube Removal

2. Remove the manual valve.

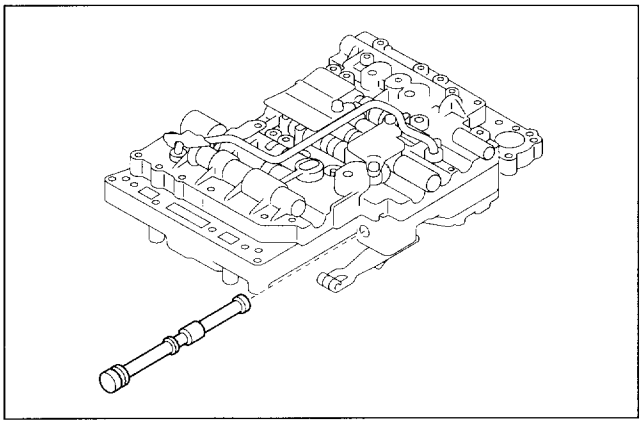


Figure 273. Manual Valve Removal

3. Remove manual detent spring.
   a) Turn over the valve body assembly.
   b) Remove the bolt, spring cover and detent spring.

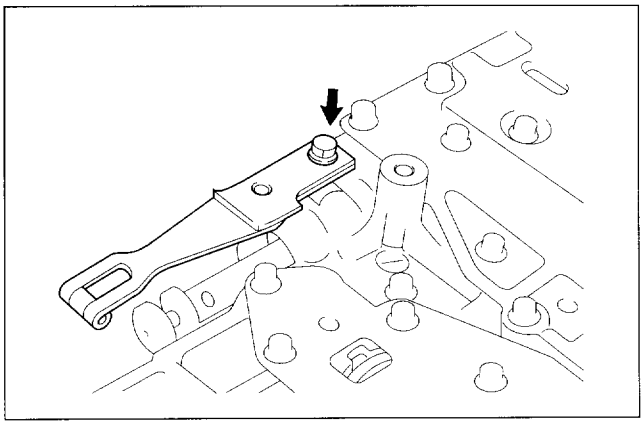


Figure 274. Detent Spring Removal

4. Remove 4 solenoid valves.
   a) Remove the 2 bolts, the No.1 and No.2 solenoids.
   b) Remove the 2 O-rings from them.

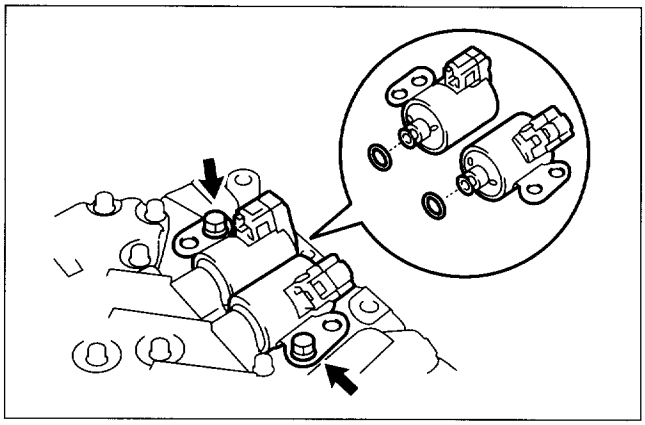


Figure 275. Solenoid Removal (1)

   c) Remove the bolt, the timing and lockup solenoids.
   d) Remove the 2 O-rings from them.

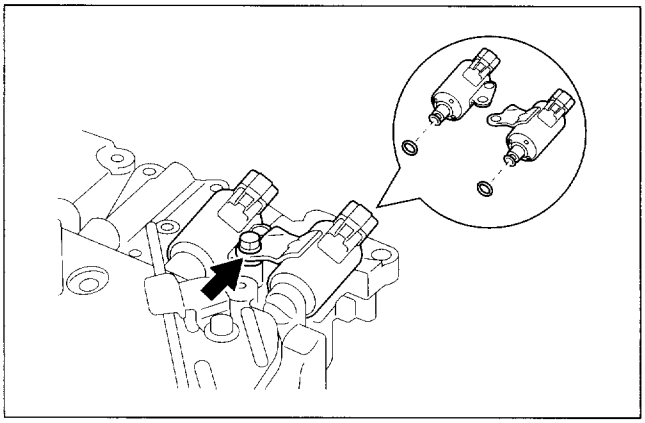


Figure 276. Solenoid Removal (2)

5. Separate upper and lower valve bodys.
   a) Remove the 12 bolts, and wave washers from the lower valve body.

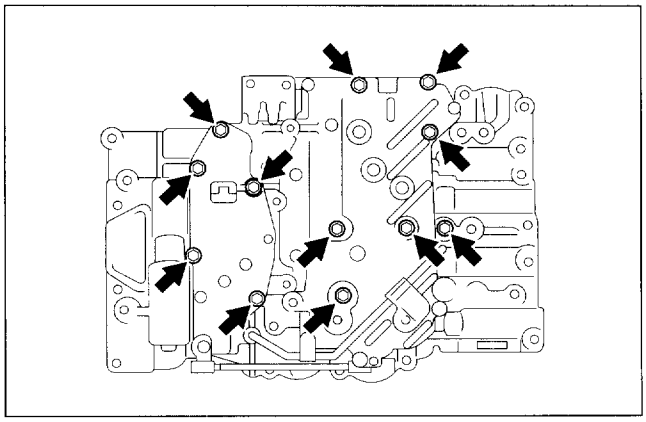


Figure 277. Lower Valve Body Bolts

b) Remove 2 bolts and plates.

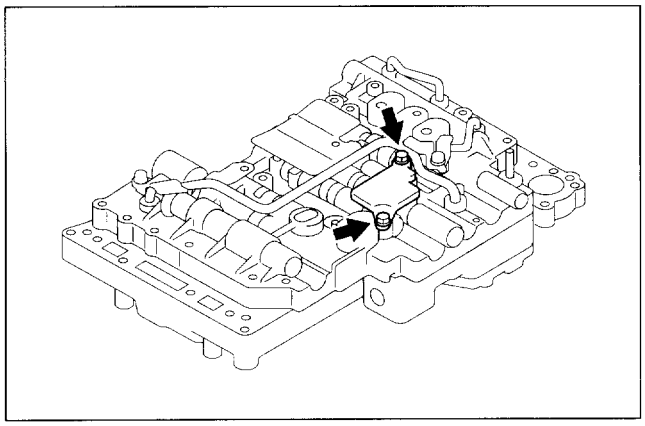


Figure 278. Plate Removal

c) Remove the 16 bolts from the upper valve body.

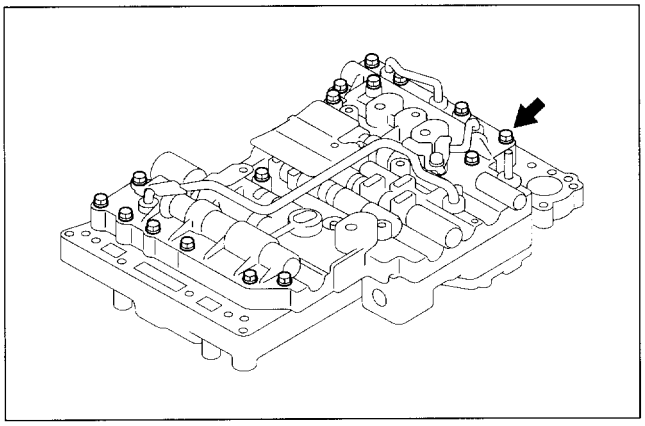


Figure 279. Upper Valve Body Bolts

d) Remove the upper valve body together with the 2 gaskets and plate.
e) Remove the 2 gaskets and plate from the upper valve body.

NOTICE: Be careful that the check balls, springs and check valves do not fall out from the lower valve body.

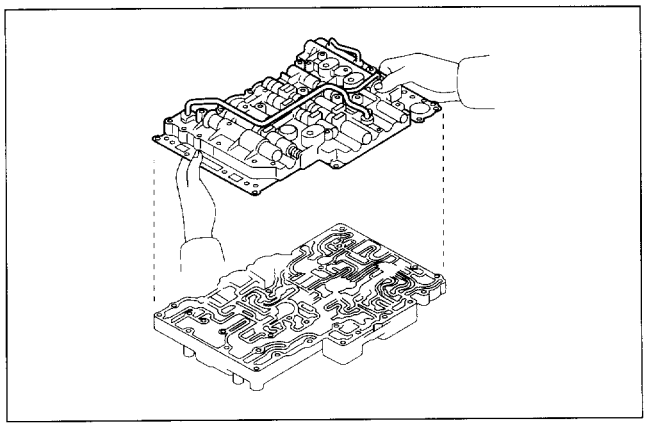
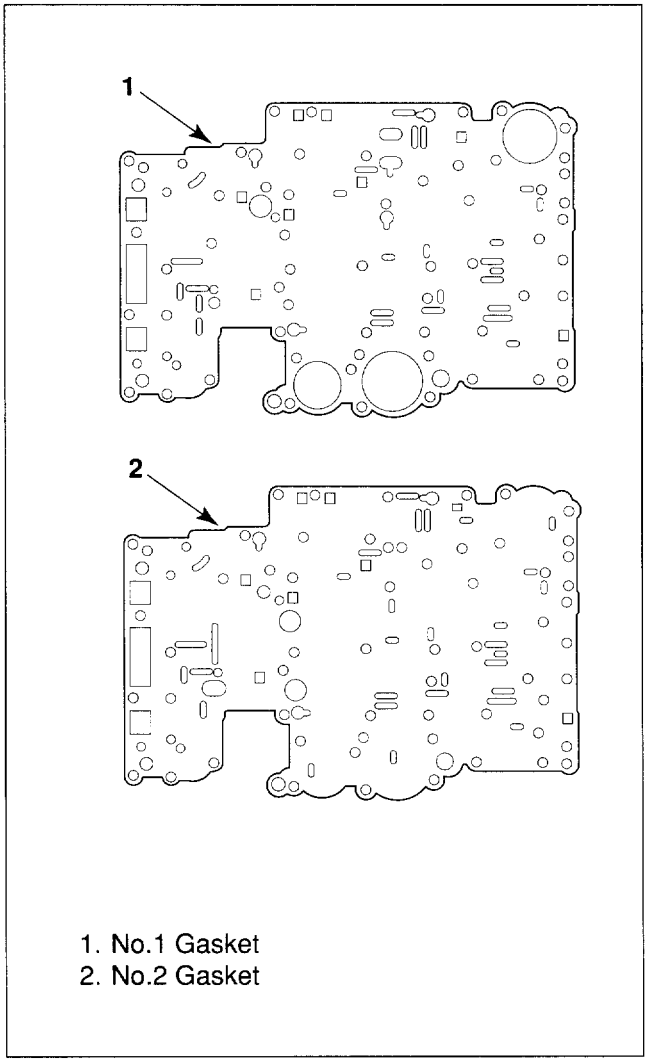


Figure 280. Upper Valve Body Removal

Assemble

1. Install valve body plate and gaskets.
NOTICE: If there is dirt on the valve body, wash the valve body clean and install it.



1. No.1 Gasket
2. No.2 Gasket

Figure 281. Gasket

a) Place a new No.1 gasket, plate and a new No.2 gasket on the lower valve body.

NOTICE: Since No.1 and No.2 gaskets look similar, use the illustrations above to differentiate between them.

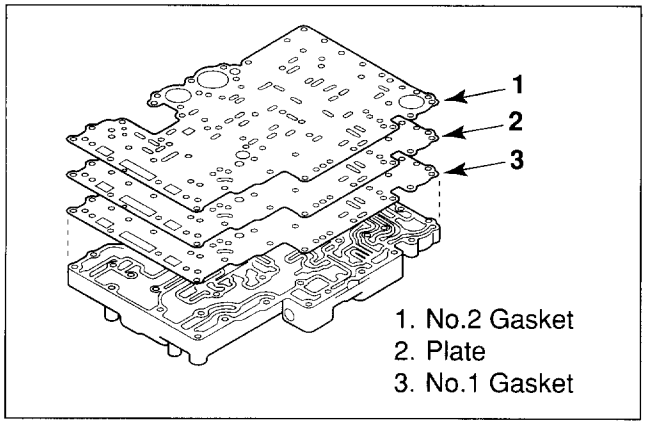


Figure 282. Gasket and Plate Installation

2. Install lower valve body.
   a) Turn over the valve body assembly together with the plate and 2 gaskets.
   NOTICE: Be careful that the check balls, check valve and spring do not fall out.
   b) Place the lower valve body on the upper valve body.

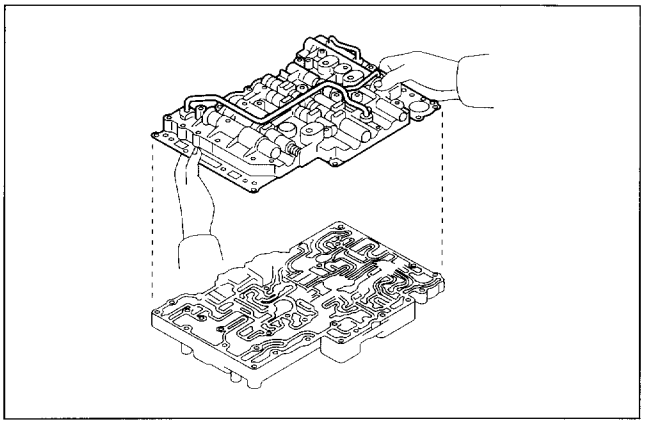


Figure 283. Lower Valve Body Installation

   c) Install the 2 bolts and 2 washers indicated as "C" in the illustration and tighten them temporarily.
   d) Install and tighten the rest of 10 bolts temporarily.

NOTICE: Each bolt length (mm) is indicated in the illustration.
Bolt length:
A 50 mm (1.97 in.)
B 42 mm (1.65 in.)
C 50 mm (1.97 in.) with washer
D 50 mm (1.97 in.)
E 53 mm (2.09 in.)

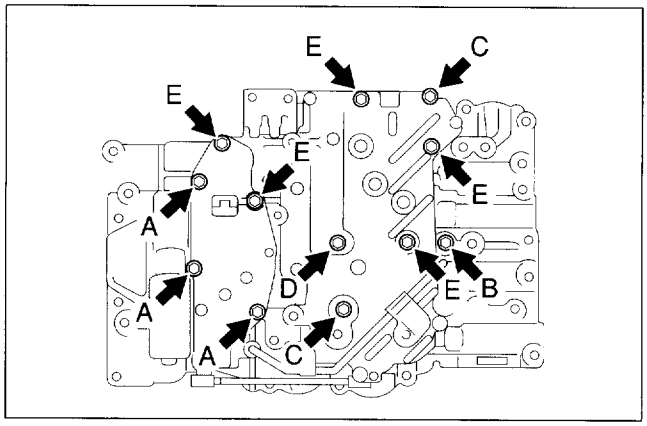


Figure 284. Lower Valve Body Bolts

3. Install upper valve body.
   a) Turn over the valve body assembly.
   b) Install the 2 bolts and 2 washers indicated as "C" in the illustration and tighten them temporarily.
   c) Install and tighten the rest of 14 bolts temporarily.

NOTICE: Each bolt length (mm) is indicated in the illustration.
Bolt length:
A 28 mm (1.10 in.)
B 32 mm (1.26 in.)
C 36 mm (1.42 in.) with washer
D 40 mm (1.57 in.)

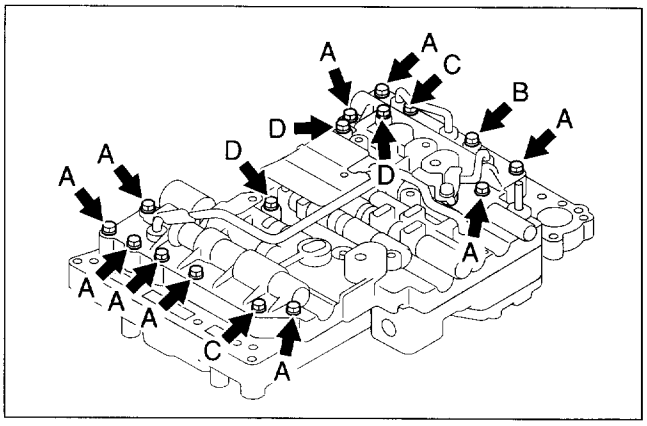


Figure 285. Upper Valve Body Bolts

4. Install the plate and tighten the 2 bolts temporarily.
NOTICE: Each bolt length (mm) is indicated in the illustration.
Bolt length:
A 42 mm (1.65 in.)
B 50 mm (1.97 in.)

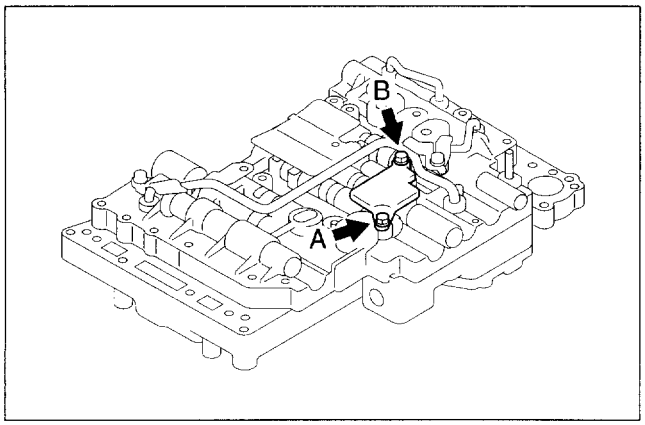


Figure 286. Plate Installation

5. Tighten bolts of upper and lower valve bodies.
   Upper side: Tighten the 16 bolts.

Tighten

Torque: 5.5 N·m (55 kg·cm, 48 lb·in)

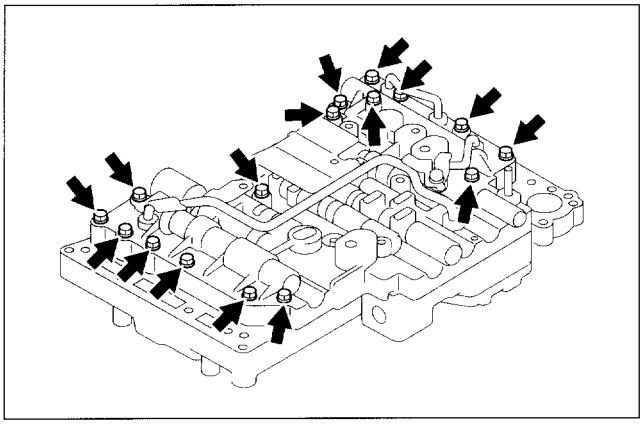


Figure 287. Upper Side Bolts

Lower side: Tighten the 12 bolts.

Tighten

Torque: 5.5 N·m (55 kg·cm, 48 lb·in)

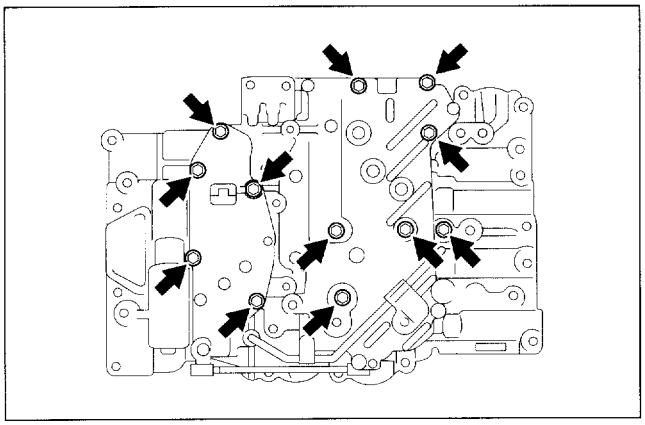


Figure 288. Lower Side Bolts

6. Install 4 solenoid valves.
   a) Coat the 2 O-rings with ATF, install them to the No.1 and No.2 solenoids.
   b) Install the No.1 and No.2 solenoids with the 2 bolts.

Tighten

Torque: 10 N·m (1.0 kg·m, 87 lb·in)

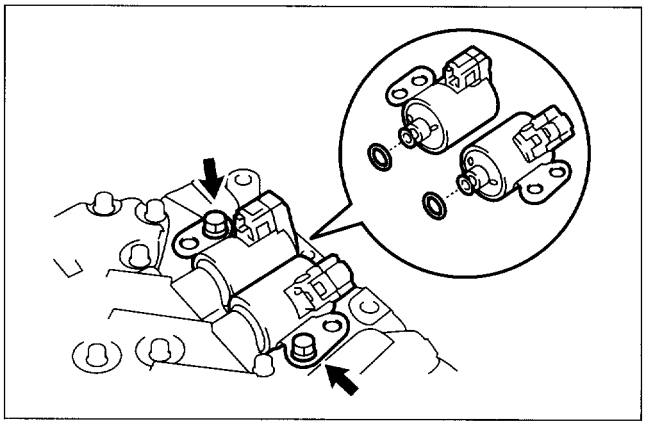


Figure 289. Solenoid Installation (1)

   c) Coat the 2 O-rings with ATF, install them to the timing and lockup solenoids.
   d) Install the timing and lockup solenoids.

Tighten

Torque: 10 N·m (1.0 kg·m, 87 lb·in)

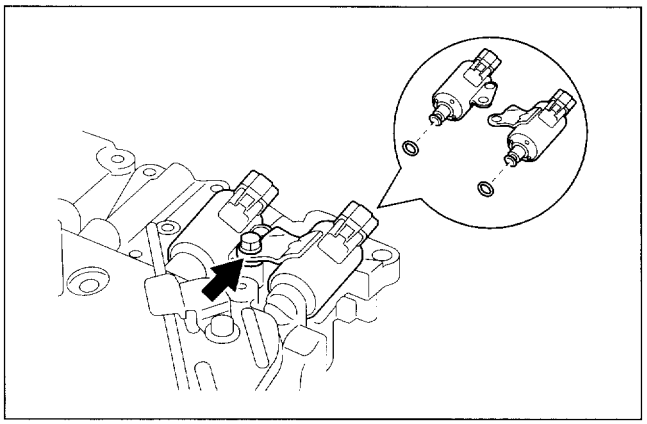


Figure 290. Solenoid Installation (2)

7. Install manual detent spring.
   Install the detent spring and cover with the bolt.

Tighten

Torque: 5.5 N·m (55 kg·cm, 48 lb·in)
NOTICE: Use the bolt which is 43 mm (1.69 in.) in length.

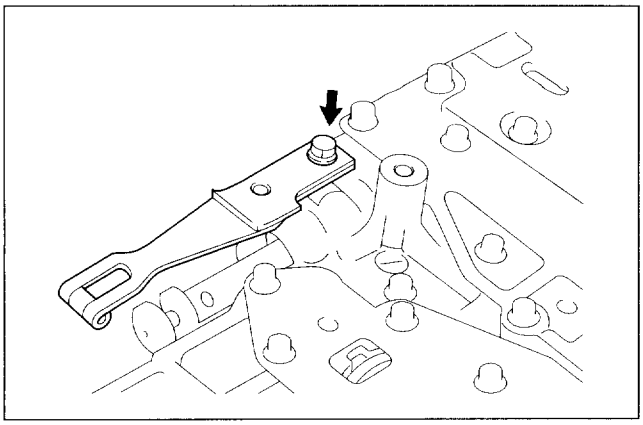


Figure 291. Detent Spring Installation

8. Install manual valve into the valve body.

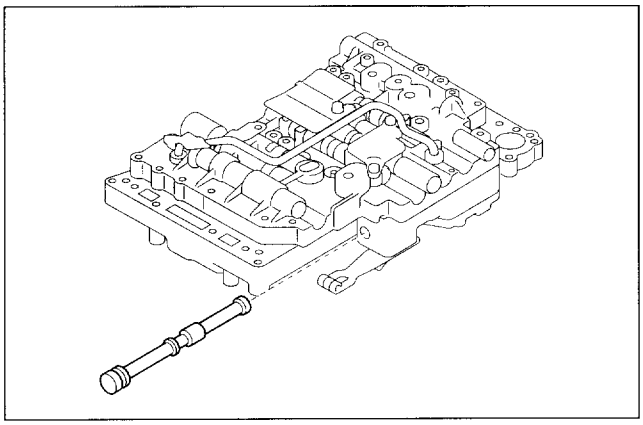


Figure 292. Manual Valve Installation

9. Install the drain tube.
   NOTICE: Use the bolt which is 10.5 mm (0.41 in.) in length.

   Tighten

   Torque: 5.5 N·m (55 kg·cm, 48 lb·in)

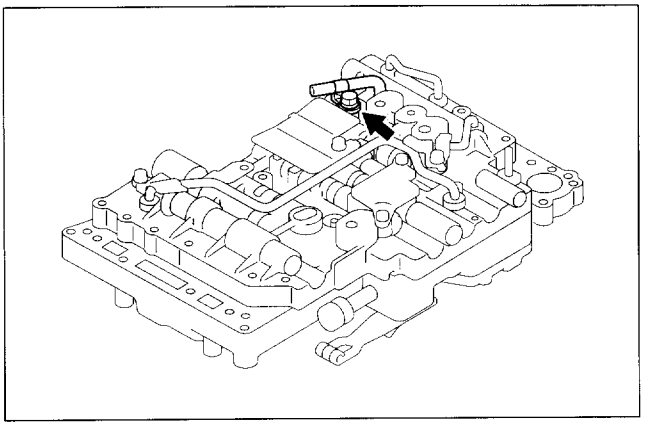
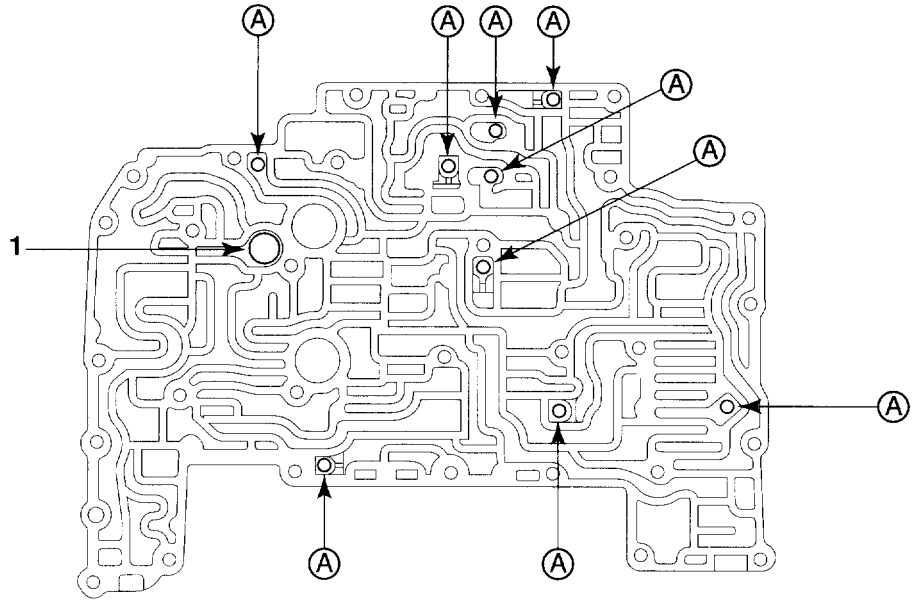


Figure 293. Drain Tube Installation

Upper Valve Body Parts Location

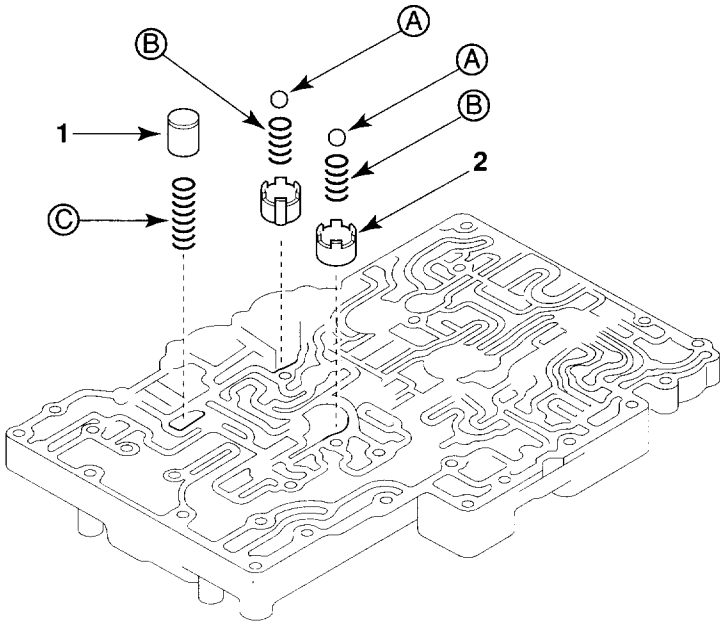


1. Strainer

Figure 294. Check Ball Location

Mark	Name	Diameter mm (in.)
Ⓐ	Check Ball	6.4 (0.252)

Lower Valve Body Parts Location



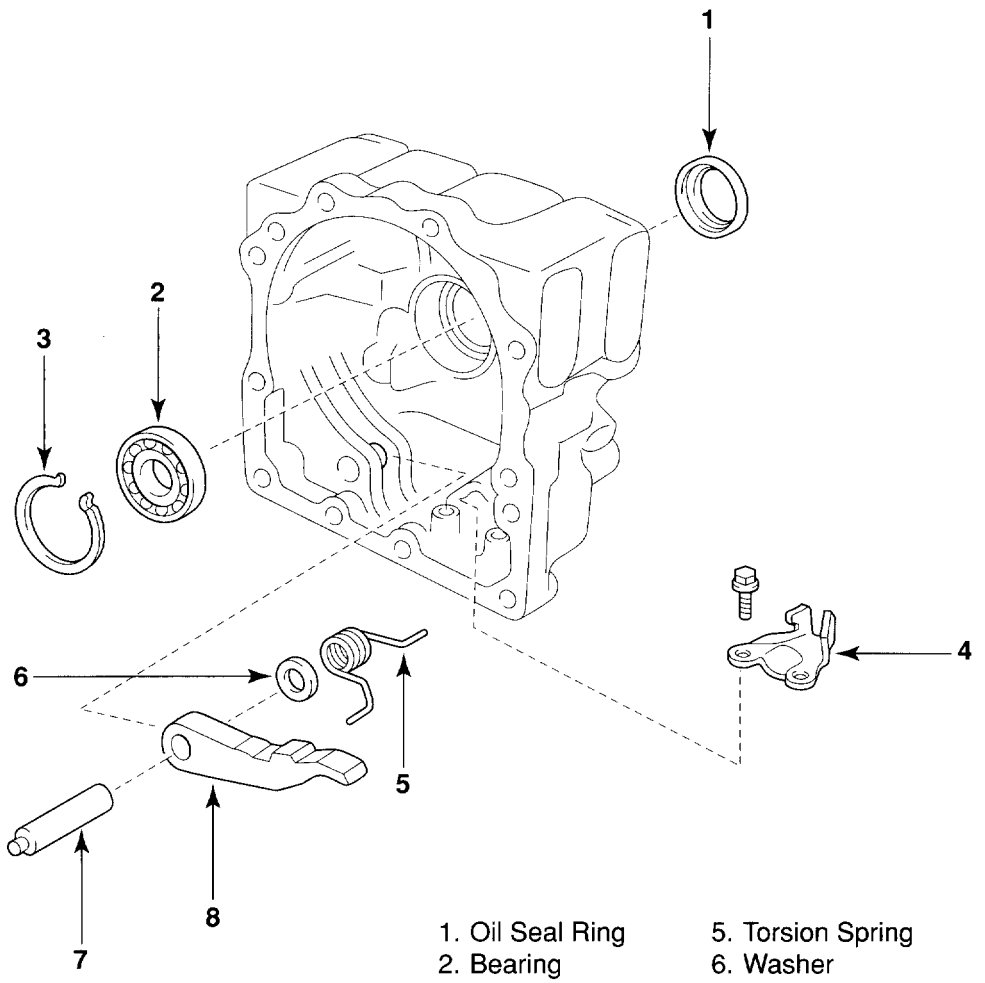
1. Pressure Relief Valve
2. Case

Figure 295. Parts Location

Mark	Name	Diameter mm (in.)
Ⓐ	Check Ball	8.7 (0.343)

Mark	Name (Color)	Free length / Outer Diameter mm (in.)	Total No. of Coils
Ⓑ	Check Ball (Pink)	14.0 / 9.8 (0.551 / 0.386)	8.0
Ⓒ	Pressure Relief Valve (White)	24.0 / 8.2 (0.945 / 0.323)	12.0

EXTENSION HOUSING



1. Oil Seal Ring
2. Bearing
3. Snap Ring
4. Bracket
5. Torsion Spring
6. Washer
7. Parking Lock Pawl Shaft
8. Parking Lock Pawl

Figure 296. Extension Housing Assembly

Disassemble

1. Remove the parking lock pawl shaft from the extension housing.

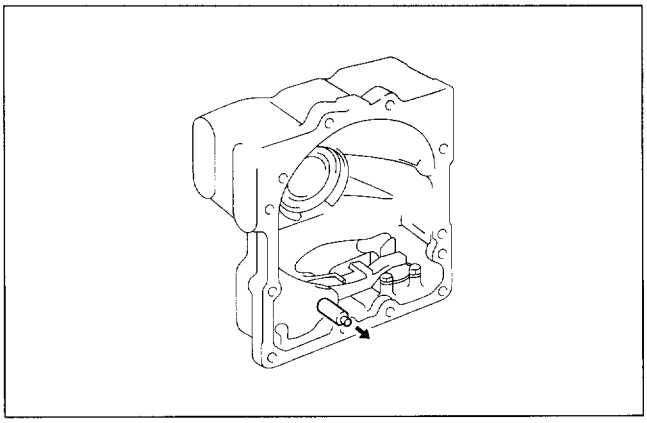


Figure 297. Shaft Removal

2. Remove parking lock pawl, torsion spring and plate washer.
   a) Remove the parking lock pawl.
   b) Remove the spring and plate washer.
   CAUTION: Do not damage the spring and do not deform it unless necessary.

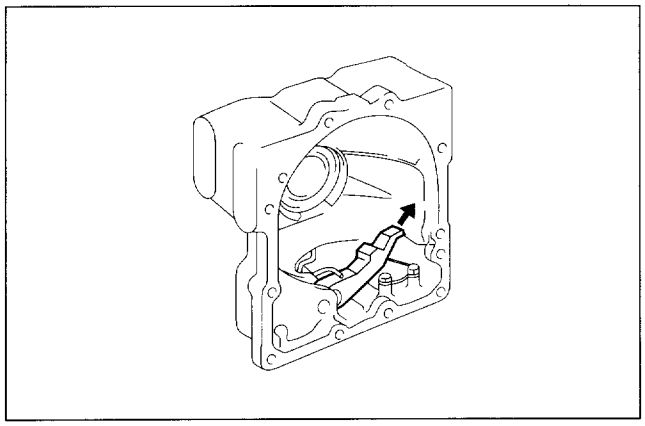


Figure 298. Parking Lock Pawl Removal

3. Remove the 2 bolts and parking lock pawl bracket.

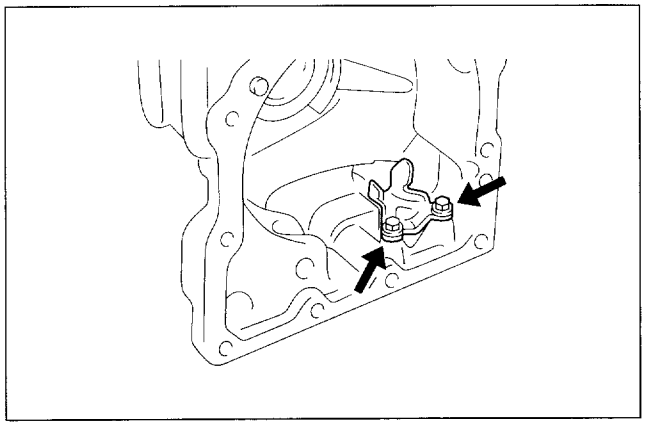


Figure 299. Bracket Removal

4. Using a screwdriver, remove the oil seal.

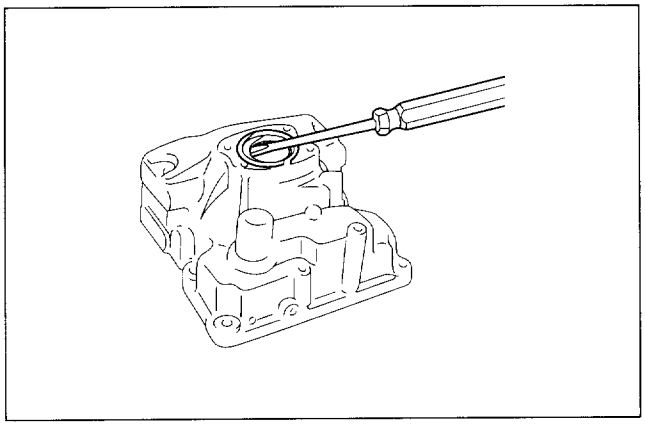


Figure 300. Oil Seal Removal

5. Remove bearing.
   a) Using a screwdriver, remove the snap ring.

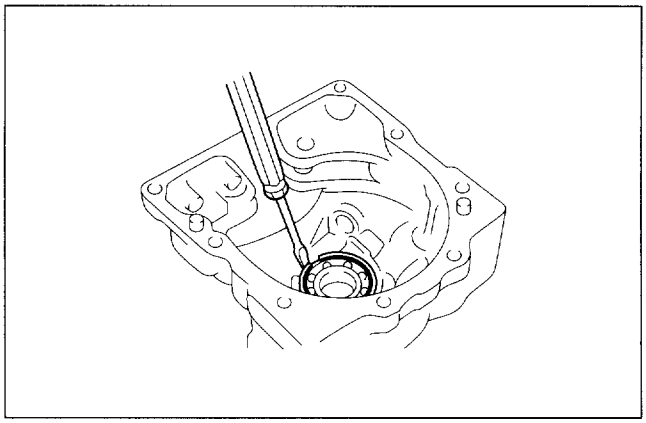


Figure 301. Bearing Removal (1)

   b) Using the rear bearing replacer and a shop press, press out the bearing.
   Tool Required:
   5-8840-2646-0 Rear Bearing Replacer

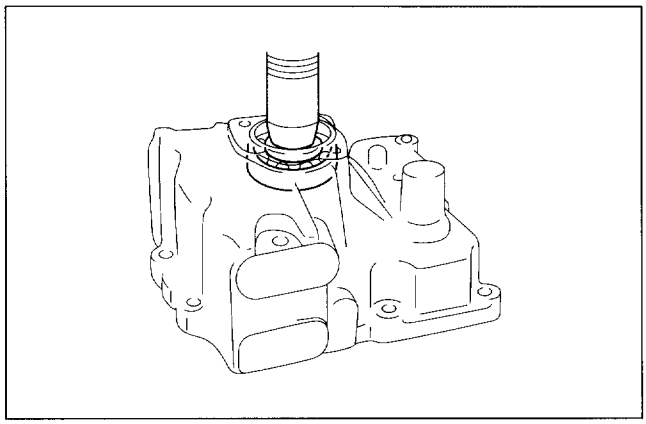


Figure 302. Bearing Removal (2)

Assemble

1. Install bearing.
   a) Using the rear bearing replacer, Oil seal (for lever shaft) installer and a shop press, press in the bearing.
   Tool Required:
   5-8840-2646-0 Rear Bearing Replacer
   5-8840-2653-0 Oil Seal (for lever shaft) Installer

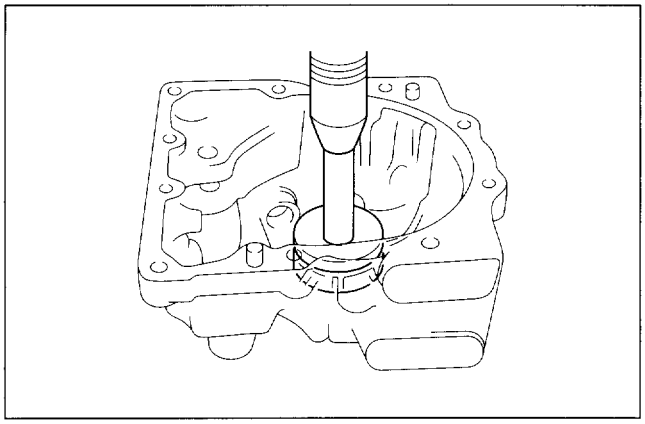


Figure 303. Bearing Installation

   b) Install the snap ring.

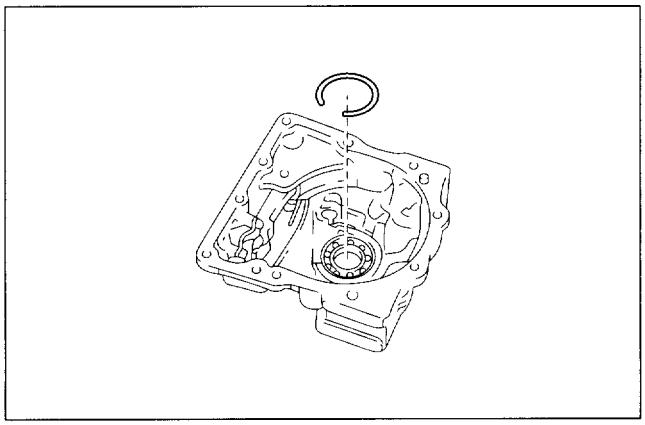


Figure 304. Snap Ring Installation

2. Using the oil seal installer and a hammer, install the oil seal.
   Tool Required:
   5-8840-2644-0 Oil Seal Installer

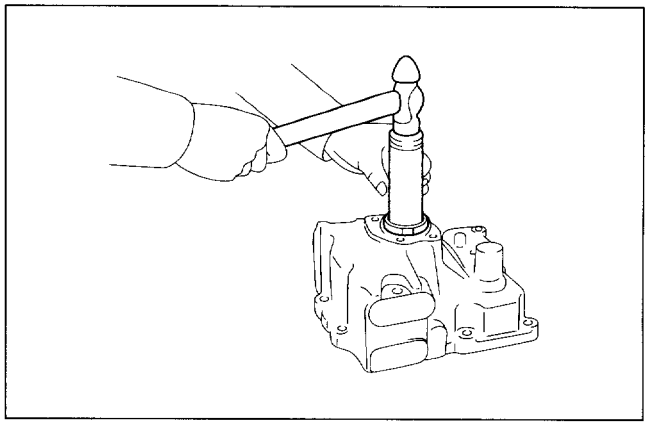


Figure 305. Oil Seal Installation

3. Install parking lock pawl bracket.
   a) Apply sealant (Three Bond 1344 or equivalent) to the threads of the 2 bolts.
   b) Temporarily install the bracket with the 2 bolts.
   NOTICE: These bolts are precoated bolt.

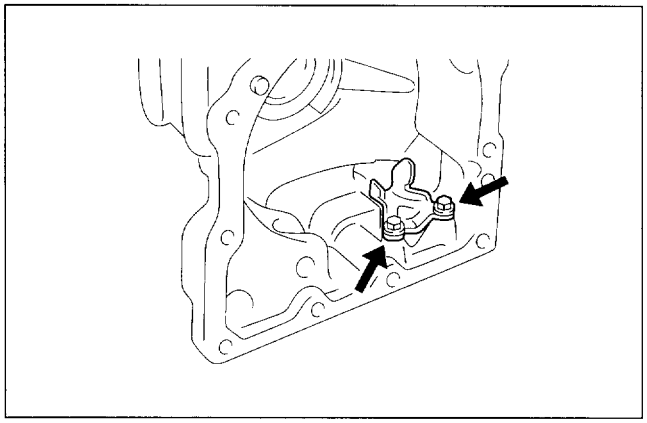


Figure 306. Bracket Installation (1)

   b) Using the plate and a calipers, set the bracket so that the distance between the extension housing surface and the top of the bracket tab is the standard distance.
   Standard distance
   = Total distance – Plate thickness
   Standard distance:
   49.76–49.86 mm (1.959–1.963 in.)
   c) Tighten the 2 bolts.

Tighten

Torque: 19 N·m (1.9 kg·m, 14 lb·ft)

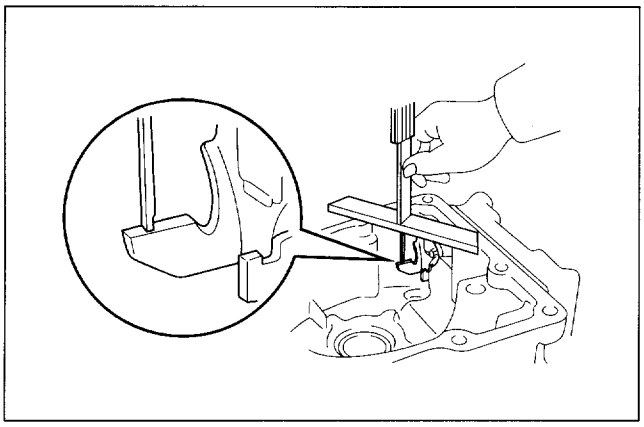


Figure 307. Bracket Installation (2)

4. Install parking lock pawl.
   a) Insert the torsion spring end to the hole of the extension housing.
   b) Install the parking lock pawl, shaft and plate washer.

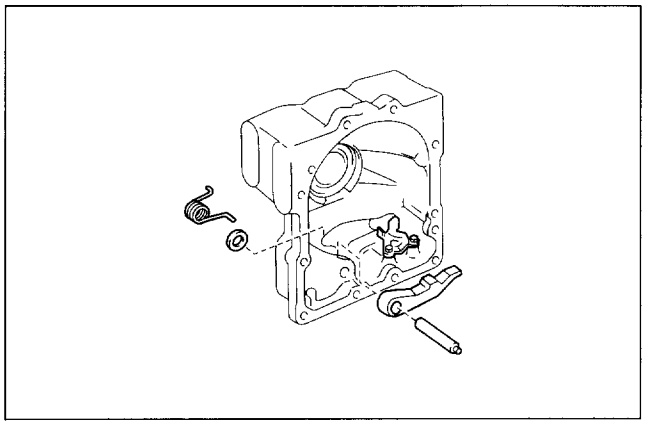


Figure 308. Parking Lock Pawl Installation

   c) Hook another spring end to the parking lock pawl.
   d) Make sure the parking lock pawl moves smoothly.

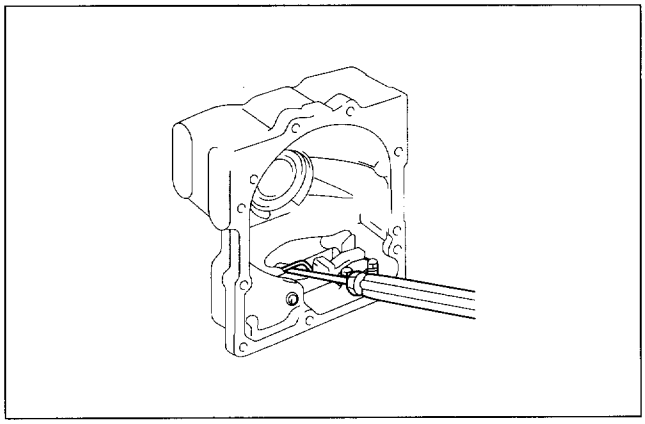


Figure 309. Spring Installation

COMPONENT PARTS INSTALLATION

Disassembly, inspection and assembly of each component group have been indicated in the preceding chapter. Before assembly, make sure again that all component groups are assembled correctly.
If something wrong is found in a certain component group during assembly, inspect and repair this group immediately.
Recommended ATF:
DEXRON®III

General Installation Notes:

1. The automatic transmission is composed of highly precision-finished parts, necessitating careful inspection before assembly because even a small nick could cause fluid leakage and affect performance.
2. Before assembling new clutch discs, soak them in automatic transmission fluid for at least 15 minutes.
   Apply automatic transmission fluid on sliding or rotating surfaces of parts before assembly.
4. Use petroleum jelly to keep small parts in their places.
5. Do not use adhesive cements on gaskets and similar parts.
6. When assembling the transmission, be sure to use new gaskets and O-rings.
7. Dry all parts with compressed air, never use shop rags.

Bearings and Races Location

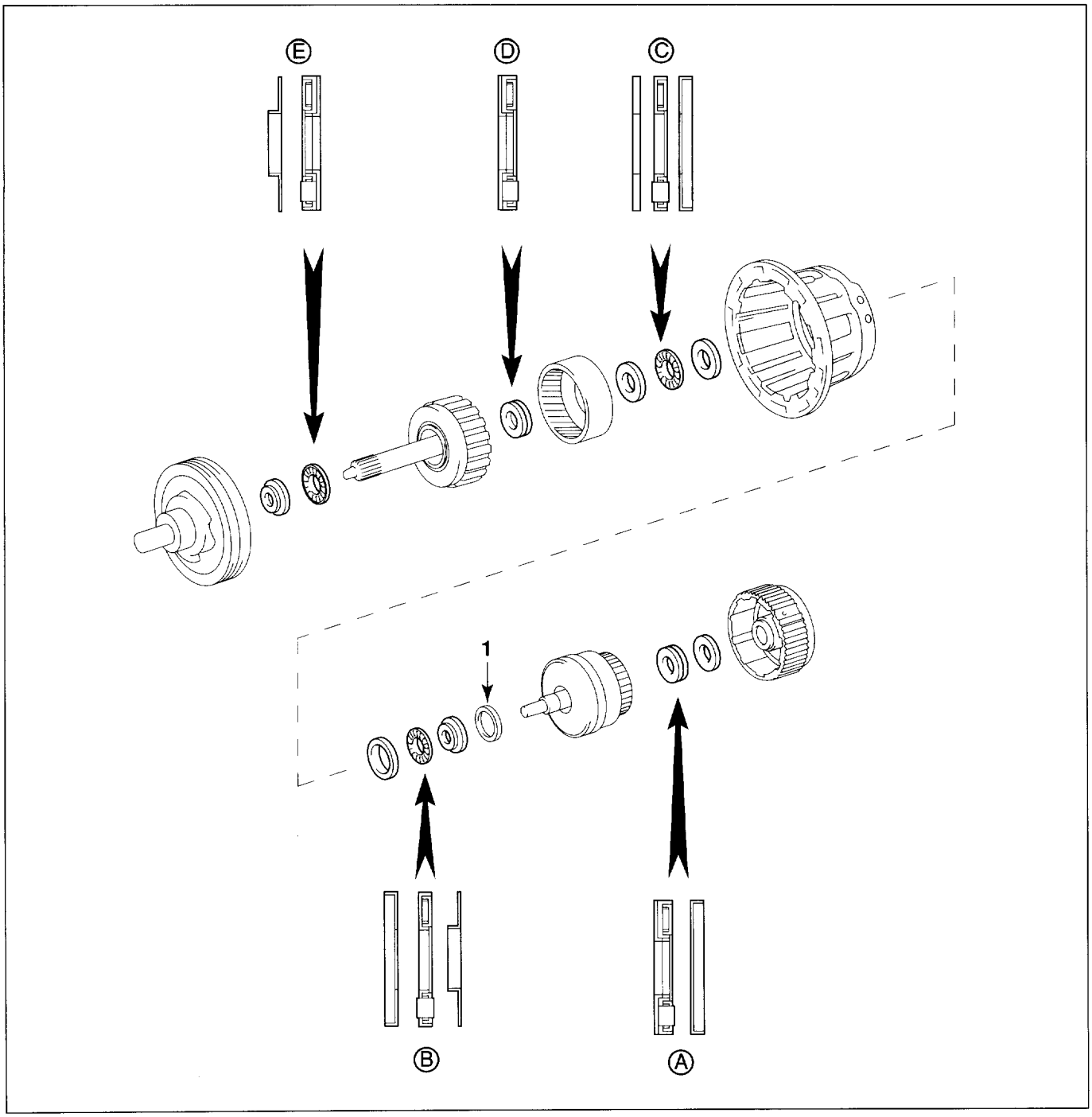


Figure 310. Bearing and Race Location

Mark	Thrust Bearing Diameter Inside/Outside mm (in.)	Front Race Diameter Inside/Outside mm (in.)	Rear Race Diameter Inside/Outside mm (in.)
Ⓐ	32.8 / 52.0 (1.291 / 2.047)	–	37.0 / 52.0 (1.457 / 2.047)
Ⓑ	34.7 / 52.0 (1.366 / 2.047)	37.0 / 52.0 (1.457 / 2.047)	32.8 / 50.4 (1.291 / 1.984)
Ⓒ	34.7 / 58.4 (1.366 / 2.299)	34.6 / 58.2 (1.362 / 2.291)	37.0 / 60.5 (1.457 / 2.382)
Ⓓ	23.2 / 42.0 (0.913 / 1.654)	–	–
Ⓔ	28.5 / 48.0 (1.122 / 1.819)	27.1 / 43.0 (1.067 / 1.693) 27.9 / 43.0 (1.098 / 1.693) 28.3 / 43.0 (1.114 / 1.693)	–

Install or Connect

Manual Valve Lever, Shaft and Oil Seals

1. Using the oil seal installer, tap in new 2 oil seals.
   Tool Required:
   5-8840-2653-0 Lever Shaft Oil Seal Installer
2. Apply multi purpose grease to the oil seal lip.

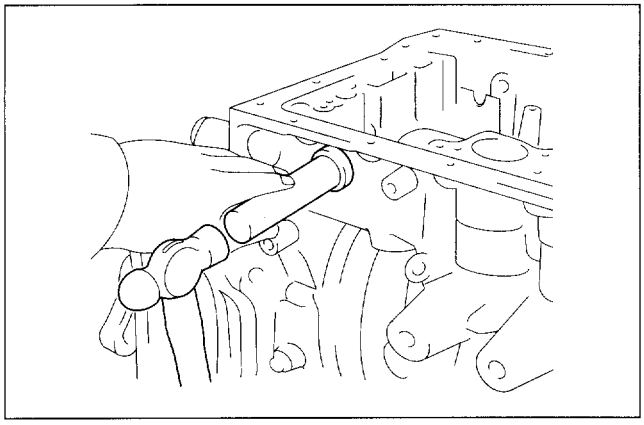


Figure 311. Oil Seal Installation

3. Install the new spacer to the manual valve lever.

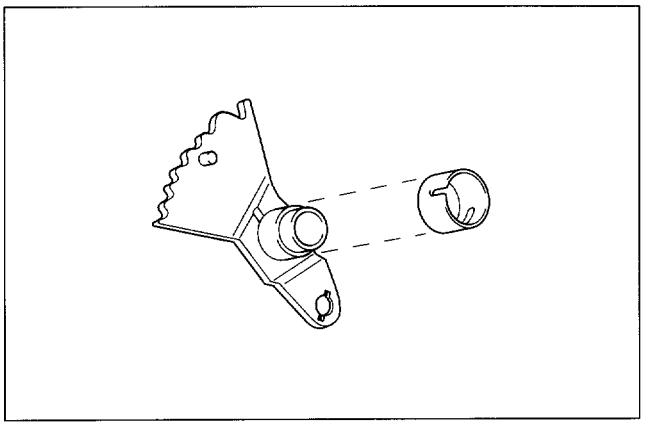


Figure 312. Spacer Installation

4. Connect the parking lock rod to the manual valve lever.

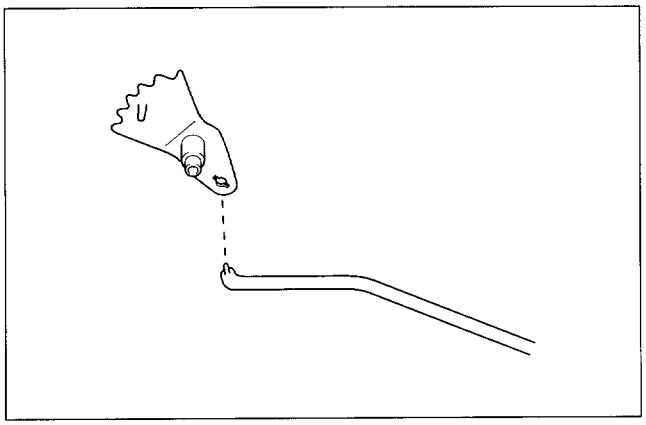


Figure 313. Manual Valve Lever Installation

5. Install the manual valve lever shaft to the transmission case through the manual valve lever.
   CAUTION: Be careful not to damage the oil seals.

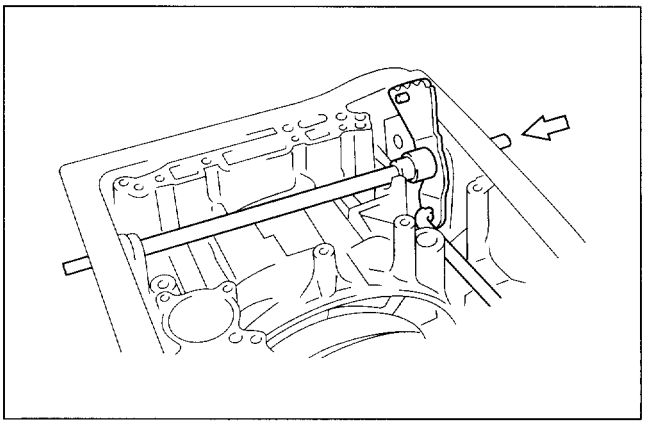


Figure 314. Lever Shaft Installation

6. Using a punch and hammer, tap in the pin with the slot at right angle to the shaft.

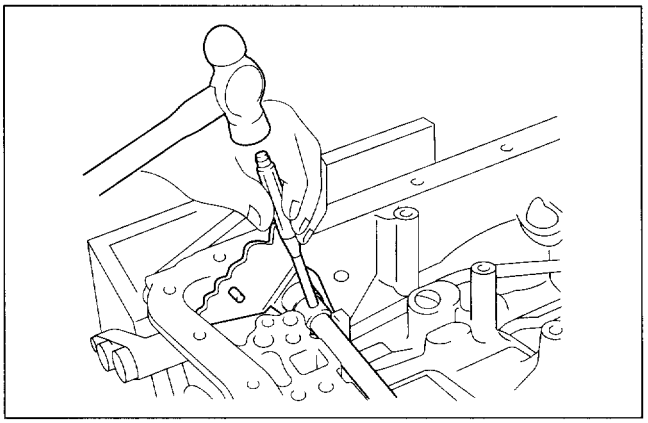


Figure 315. Pin Installation

7. Match the spacer hole to the lever calking hollow and calk the spacer to the lever.
8. Make sure the manual valve lever shaft turns smoothly.

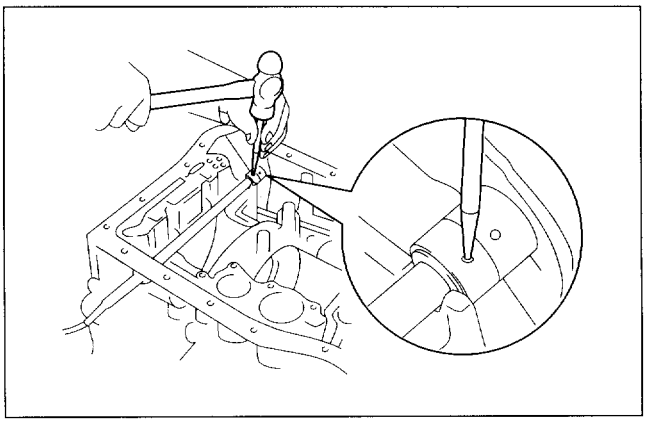


Figure 316. Spacer Calking

Planetary Gears, One-Way Clutch and Output Shaft Assembly

1. Place the transmission case on a cylinder.
2. Install the rear planetary gear and output shaft assembly to the transmission case.

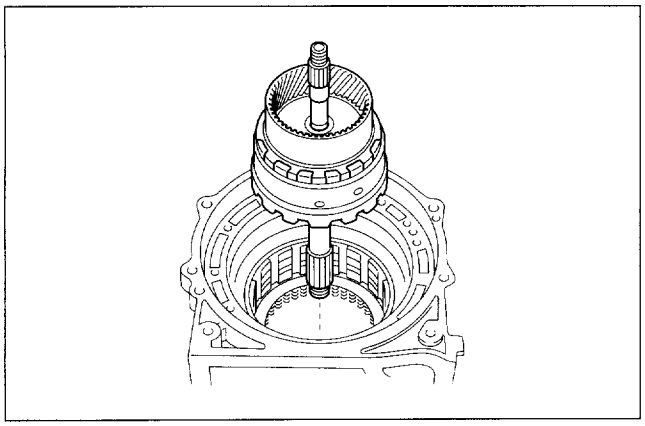


Figure 317. Output Shaft Assembly Installation

3. Temporarily install 2 bolts to the front planetary gear.
   NOTICE: Use two 6 mm (1 mm pitch) bolts. Do not screw more than 5 revolutions.
4. Align the spline of the one-way clutch assembly into the transmission case.
5. Install the front planetary gear and one-way clutch assembly into the transmission case.
   NOTICE:
   - **Mesh the spline of the front planetary gear with the flukes of the discs by rotating and pushing the front planetary gear clockwise.**
   - **If the front planetary gear will not rotate clockwise, check the installation of the one-way clutch.**

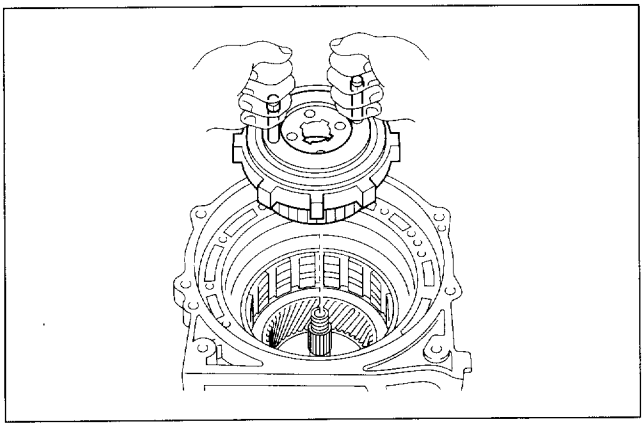


Figure 318. Front Planetary Gear Assembly Installation

6. Remove the 2 bolts from the front planetary gear.
7. Using a screwdriver, install the snap ring.
   NOTICE: Be sure the end of the snap ring is not aligned with the cutout portion of the transmission case.

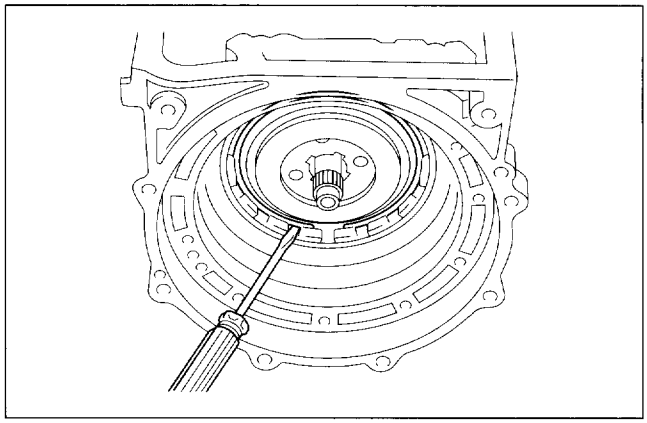


Figure 319. Snap Ring Installation

8. Coat the thrust washer with petroleum jelly, and install it onto the front planetary gear.
   NOTICE: Securely fit the claws of the thrust washer into the grooves of the front planetary gear.

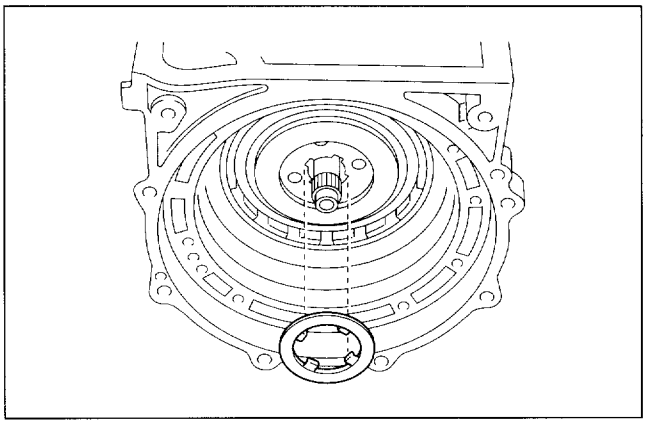


Figure 320. Thrust Washer Installation

Temporarily Install Center Support Assembly

1. Coat the thrust washer with petroleum jelly, and install it onto the rear side of the center support.
   NOTICE: Securely fit the claws of the thrust washer into the grooves of the center support.

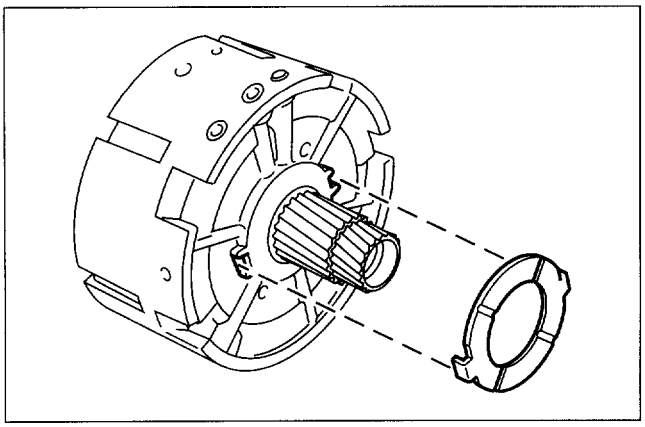


Figure 321. Thrust Washer Installation

2. Install oil pump remover (2 bolts) to the center support.
   Tool Required:
   5-8840-2652-0 Oil Pump Remover
3. Align the oil holes and bolt holes of the center support and transmission case.
4. Install the center support assembly into the transmission case.

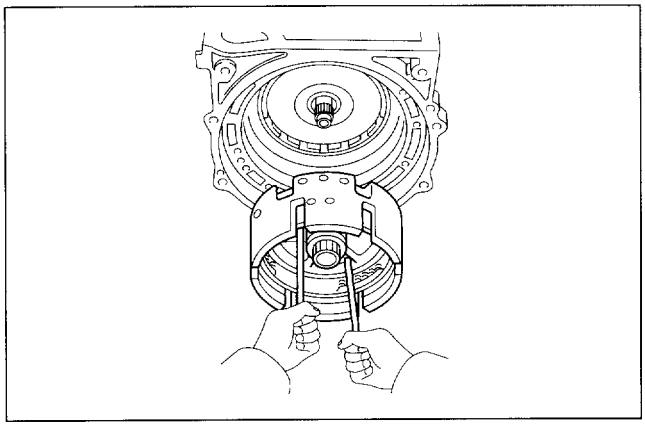


Figure 322. Center Support Installation

5. Install the 3 center support bolts.

Tighten

Torque: 25 N·m (2.5 kg·m, 18 lb·ft)

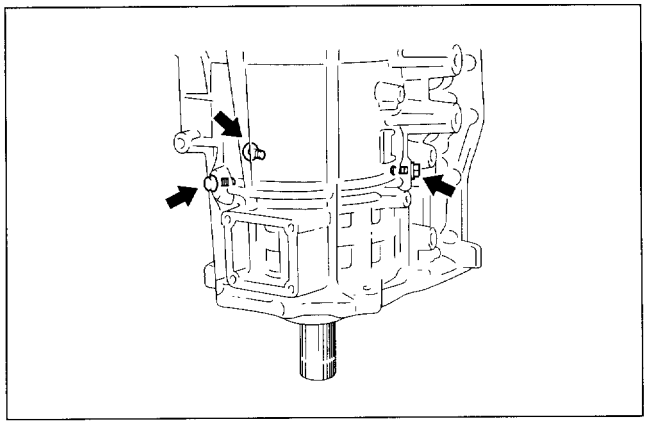


Figure 323. Center Support Bolt

Parking Lock Gear

Install the parking lock gear onto the output shaft.

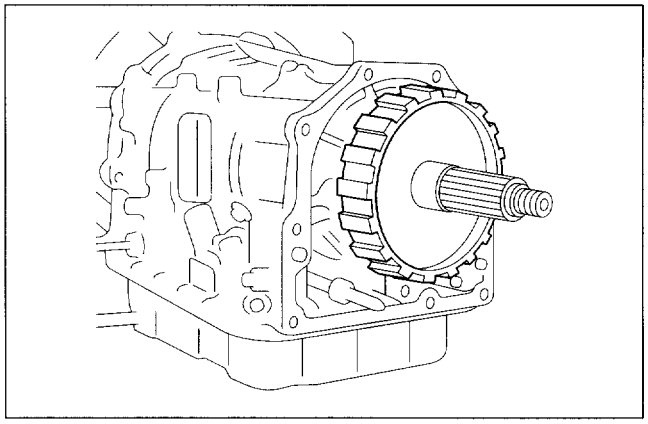


Figure 324. Parking Lock Gear Installation

Output Shaft Spacer and Speedometer Drive Gear

Install the spacer and speedometer drive gear onto the output shaft.

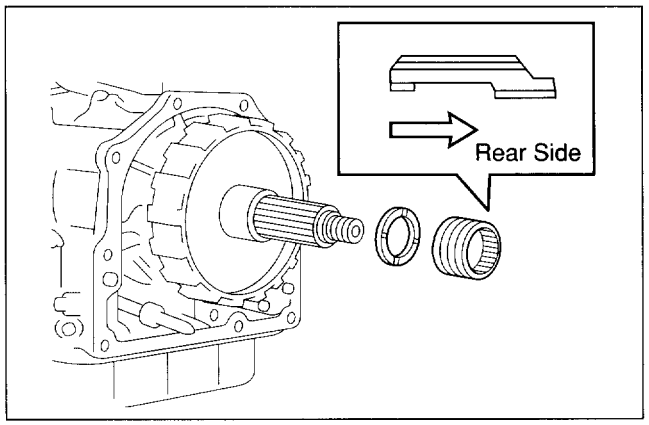


Figure 325. Speedometer Drive Gear Installation

Extension Housing

1. Place the new gasket on the transmission case.
2. Install the parking lock rod between the parking lock pawl and bracket, and attach the extension housing on the transmission case.

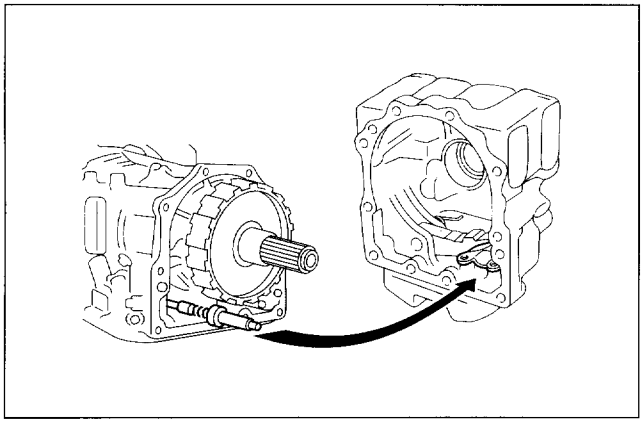


Figure 326. Extension Housing Installation

3. Apply sealant (Three Bond 1344, Loctite 572 or equivalent) to the thread of the 2 bolts.
4. Install the 2 bolts indicated by ☆ marks in the illustration and tighten them.
5. Install and tighten the 7 bolts.
   Bolt length:
   A 45 mm (1.77 in.)
   B 50 mm (1.97 in.)
   C 85 mm (3.35 in.)
   D 117 mm (4.61 in.)
   E 120 mm (4.72 in.)

Tighten

Torque: 37 N·m (3.8 kg·m, 27 lb·ft)

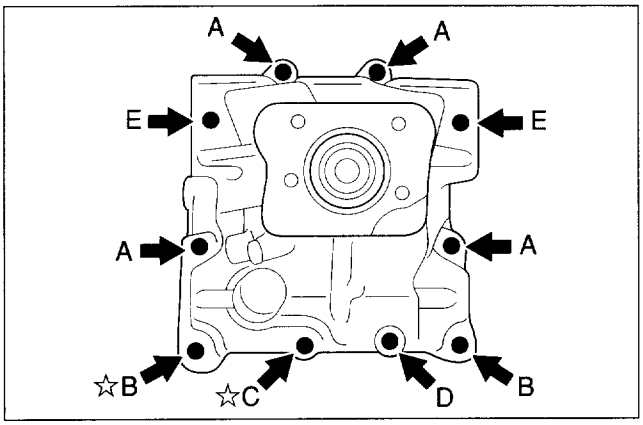


Figure 327. Extension Housing Bolts

Thrust Clearance of Center Support

1. Push the transmission output shaft toward the front of the transmission by applying a force of 49–89 N (5–10 kg, 11.0–22.0 lb).
2. Push the center support toward the rear of the transmission by applying a force of 49–89 N (5–10 kg, 11.0–22.0 lb), then pull with the same amount of force.

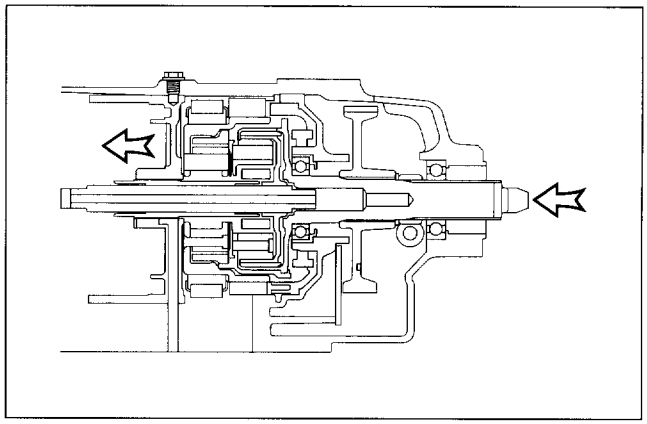


Figure 328. Thrust Clearance Adjustment (1)

3. Place the plate on the center support.
   Tool Required:
   5-8840-2647-0 Plate
4. Using calipers, measure distance (A) between the tops of the plate and the thrust washer on the front planetary gear.
5. Using calipers, measure thickness (B) of the plate.

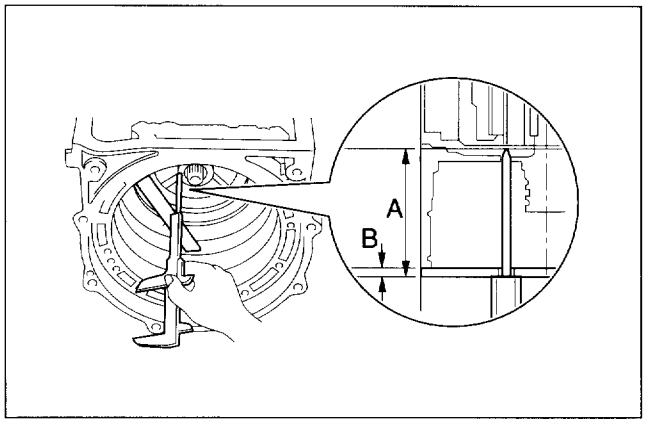


Figure 329. Thrust Clearance Adjustment (2)

6. Remove the 3 center support set bolts.

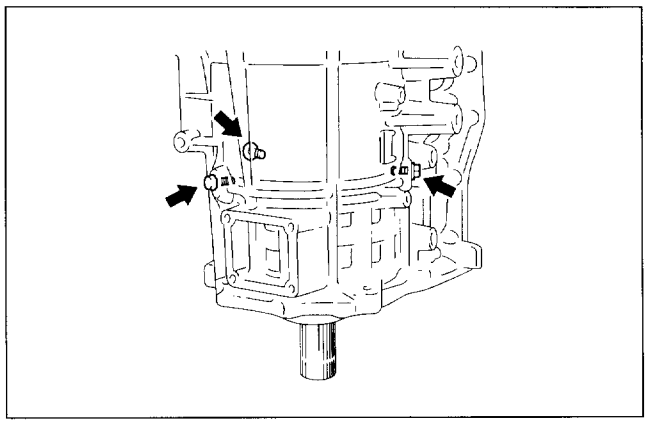


Figure 330. Thrust Clearance Adjustment (3)

7. Using the oil pump remover, remove the center support assembly from transmission case.
   Tool Required:
   5-8840-2652-0 Oil Pump Remover

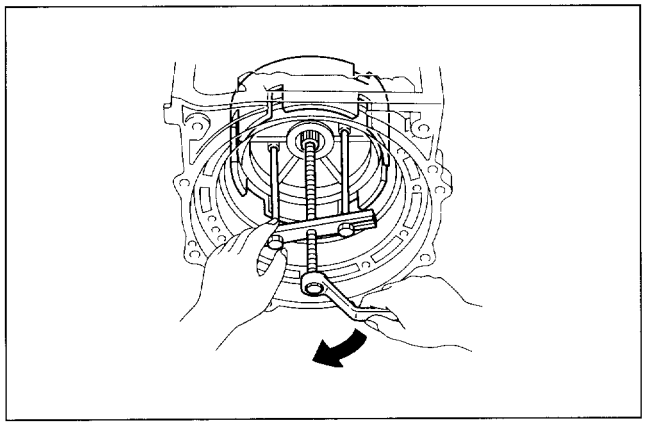


Figure 331. Thrust Clearance Adjustment (4)

8. Turn over the center support together with the thrust washer, and place it on a flat surface.
9. Inserting calipers into the thrust washer hole, measure the distance (C) between it and the flat surface.
   Center support thrust clearance: A – (B + C)
   Standard thrust clearance: 0.30–0.70 mm (0.0118–0.0276 in.)
   Maximum thrust clearance: 0.90 mm (0.0354 in.)

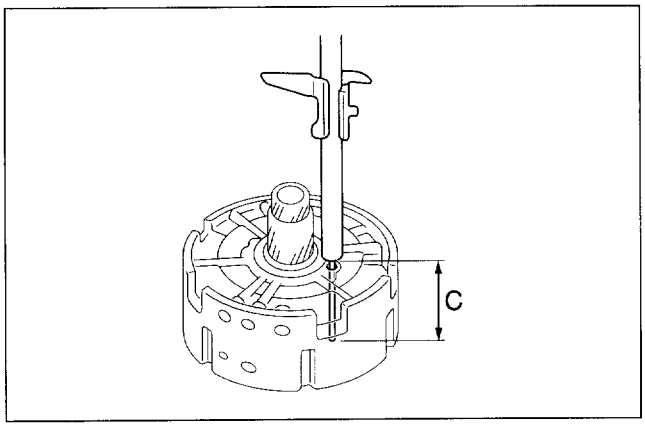


Figure 332. Thrust Clearance Adjustment (5)

If the thrust clearance is greater than the maximum, select and install a thrust washer.
Thrust washer thicknesses

Thickness mm (in.)	
1.5 (0.059)	1.8 (0.071)
2.1 (0.083)	2.4 (0.094)
2.7 (0.108)	

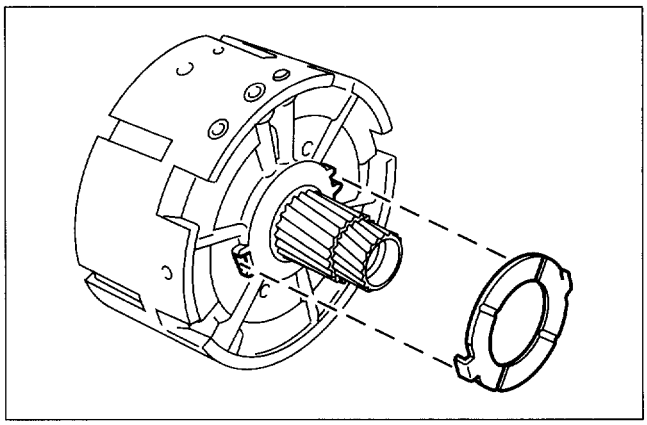


Figure 333. Thrust Clearance Adjustment (6)

Center Support Assembly Installation

1. Coat new 3 O-rings with ATF and install them to the oil holes of the center support.

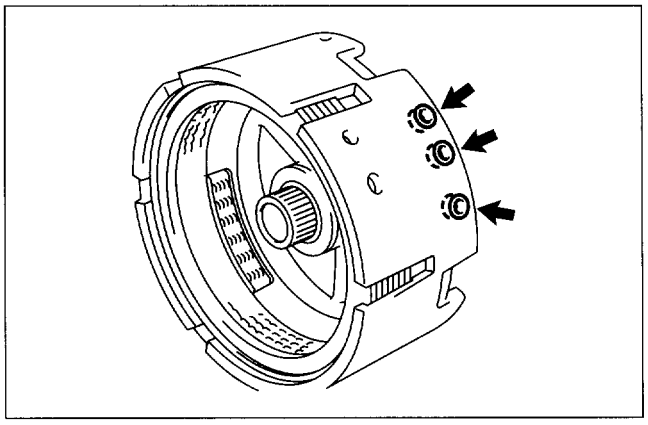


Figure 334. O-ring Installation

2. Install the oil pump remover (2 bolts) to the center support.
   Tool Required:
   5-8840-2652-0 Oil Pump Remover
3. Align the oil holes and bolt hole of the center support and transmission case.
4. Install the center support assembly into the transmission case.

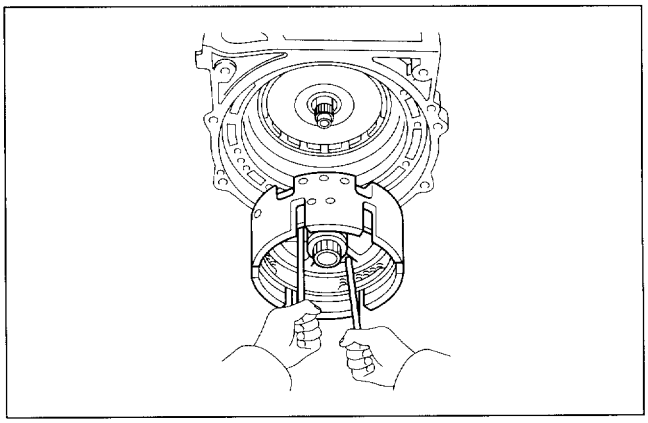


Figure 335. Center Support Installation

5. Apply sealant (Three Bond 1344, Loctite 572 or equivalent) to the threads of the center support set bolts.

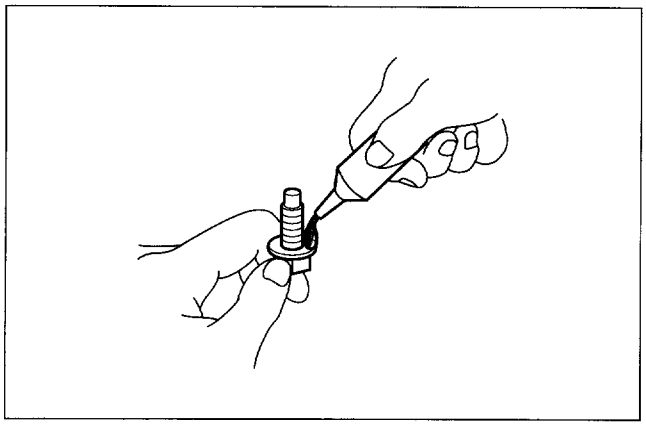


Figure 336. Sealant

6. Install the 3 center support set bolts.

Tighten

Torque: 25 N·m (2.6 kg·m, 19 lb·ft)

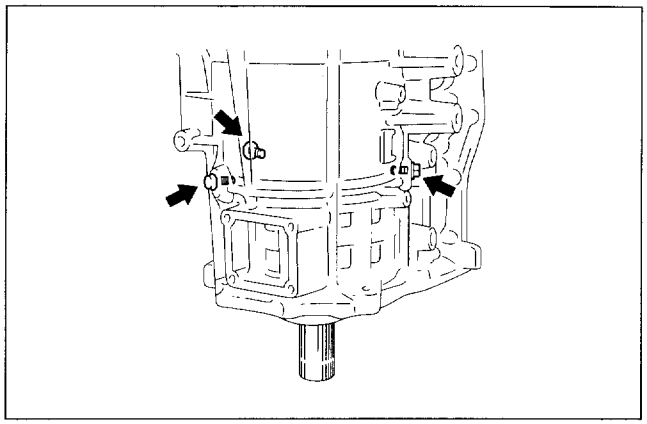


Figure 337. Center Support Bolt

Rear Clutch Assembly

Install the rear clutch assembly into the transmission case.

NOTICE: Mesh the spline of the rear clutch drum with the flukes of the discs by rotating and pushing the rear clutch drum clockwise or counterclockwise.

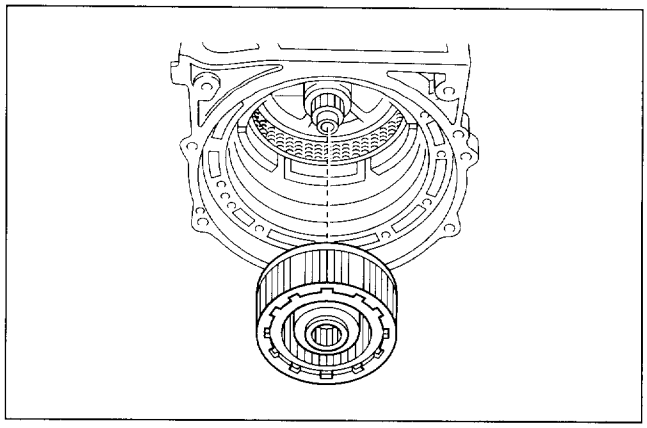


Figure 338. Rear Clutch Assembly Installation

Front Clutch Assembly

1. Coat the race with petroleum jelly, and install it onto the rear clutch drum.

Race diameter

Diameter mm (in.)	Inside	Outside
Race	37.0 (1.457)	52.0 (2.047)

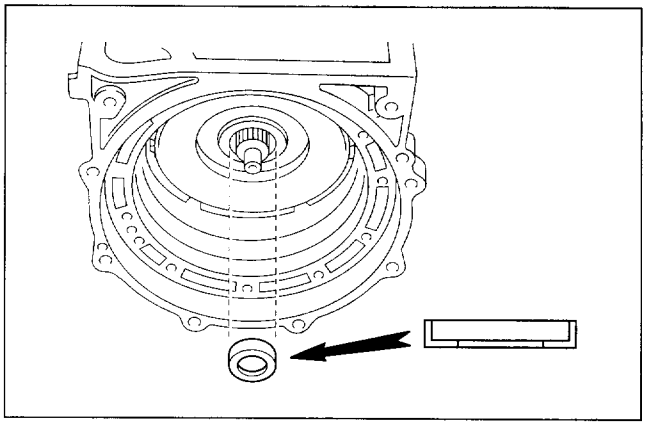


Figure 339. Race Installation

2. Coat the bearing with petroleum jelly, and install it onto the front clutch hub.

Bearing diameter

Diameter mm (in.)	Inside	Outside
Bearing	32.8 (1.291)	52.0 (2.047)

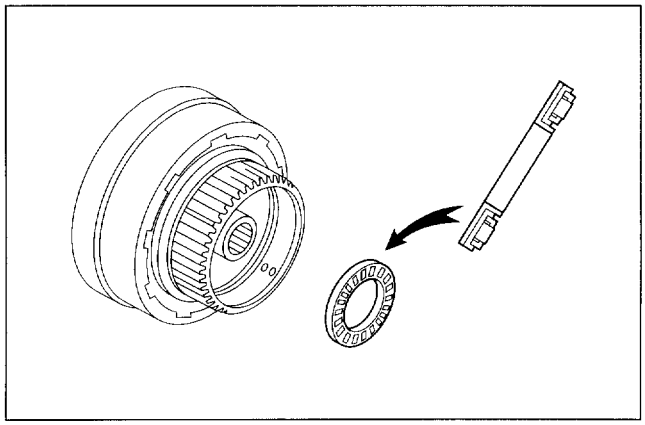


Figure 340. Bearing Installation

3. Coat the spacer, race and bearing with petroleum jelly, and install the spacer and them onto the front clutch drum.
Bearing and race diameter

Diameter mm (in.)	Inside	Outside
Bearing	34.7 (1.366)	52.0 (2.047)
Race (Rear)	32.8 (1.291)	50.4 (1.984)

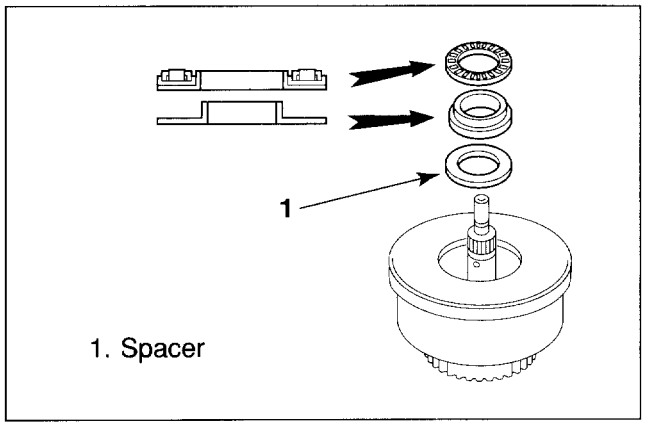


Figure 341. Bearing and Race Installation

4. Coat the new oil seal ring with ATF.
5. Install the oil seal ring to the clutch drum, then sank it down by squeezing their ends together.
CAUTION: Do not spread the ring seals more than necessary.

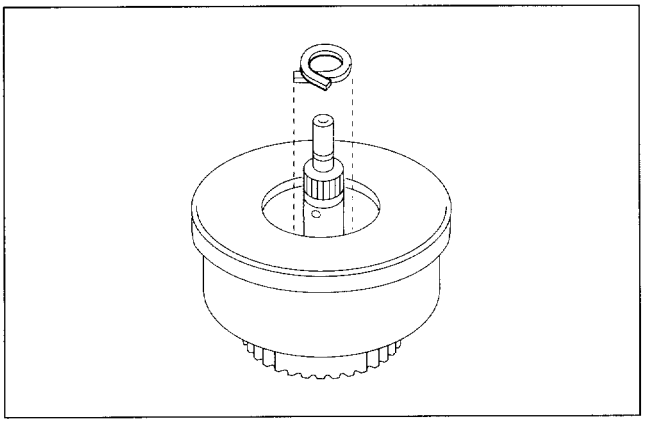


Figure 342. Oil Seal Ring Installation

6. Install the front clutch assembly into the rear clutch assembly.
NOTICE: Mesh the spline of the front clutch hub with the flukes of the discs by rotating and pushing the front clutch drum clockwise or counterclockwise.

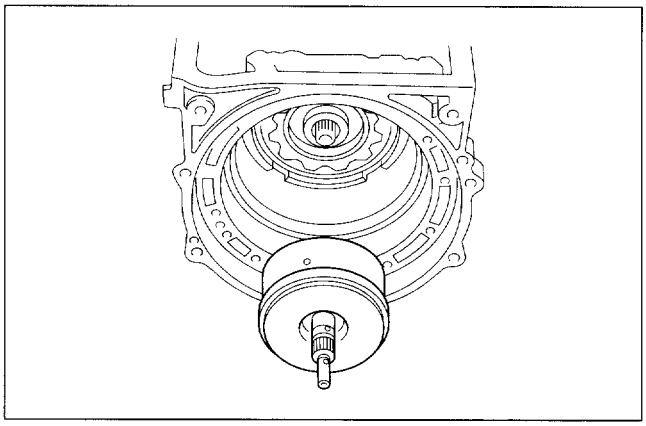


Figure 343. Front Clutch Assembly Installation

7. Place the plate on the installation surface of the oil pump.
Tool Required:
5-8840-2647-0 Plate
8. Using calipers, measure the distance between the tops of the plate and the clutch drum.
If the distance corresponds to that during disassembly, the front clutch assembly is installed correctly.

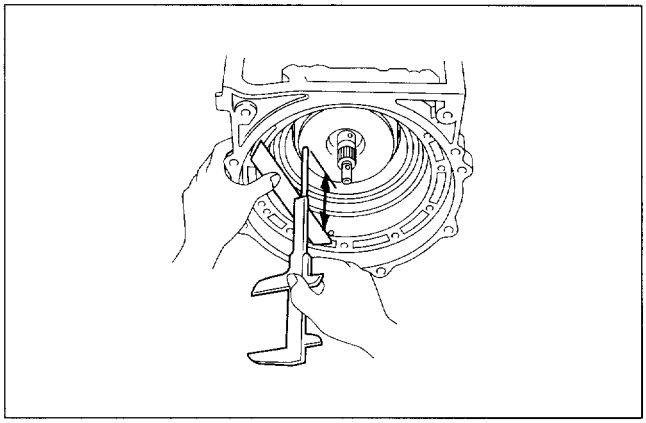


Figure 344. Correct Installation Check

Temporarily Install Overdrive Case Assembly

1. Coat the race with petroleum jelly, and install it into the O/D case.
Race diameter

Diameter mm (in.)	Inside	Outside
Race (Rear)	32.8 (1.291)	50.4 (1.984)

2. Install the oil pump remover (2 bolts) to the O/D case.
3. Align the oil holes and bolt holes of the O/D case and transmission case.

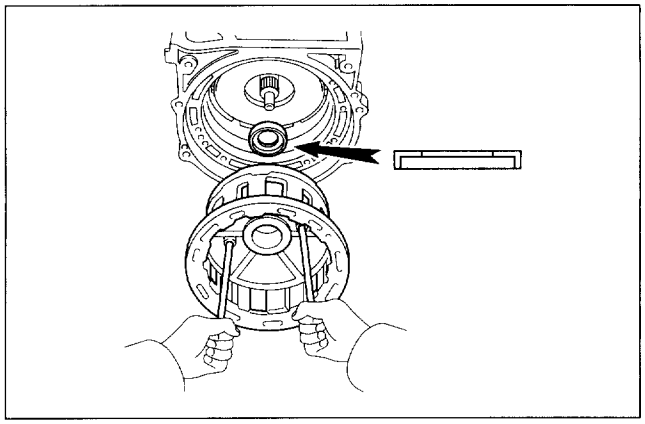


Figure 345. O/D Case Assembly Installation

3. Temporarily install the 3 bolts.

Tighten

Torque: 25 N·m (2.5 kg·m, 18 lb·ft)

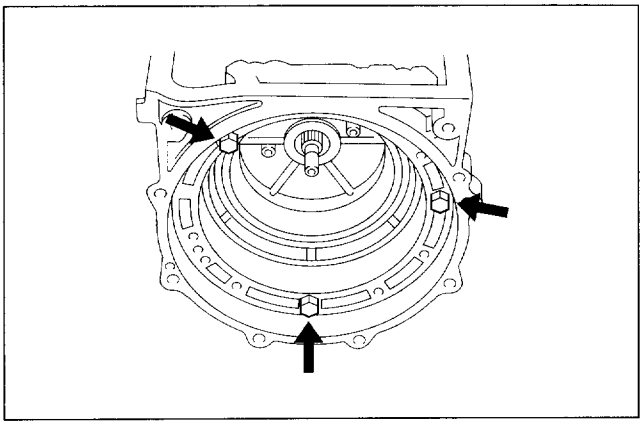


Figure 346. O/D Case Bolt

Thrust Clearance of Input Shaft (Front Clutch Drum)

1. Push the transmission output shaft toward the front of the transmission by applying a force of 49–98 N (5–10 kg, 11.0–22.0 lb).
2. Push the O/D case toward the rear of the transmission by applying a force of 49–98 N (5–10 kg, 11.0–22.0 lb).

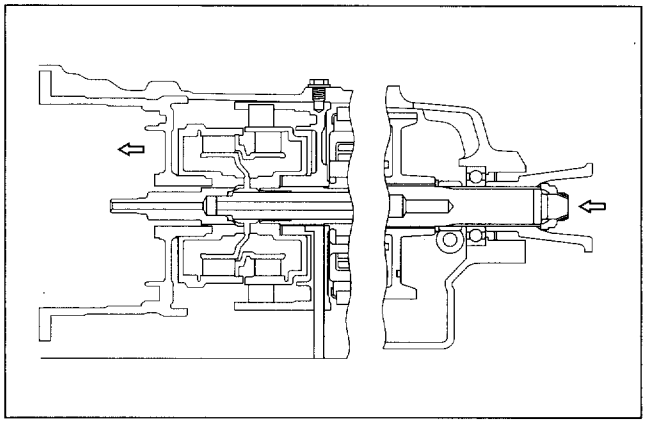


Figure 347. Thrust Clearance Adjustment (1)

3. Using the extension bar and a dial indicator, measure the thrust clearance of the input shaft.
   Tool Required:
   5-8840-2651-0 Extension Bar
   Standard thrust clearance: 0.30–0.70 mm (0.0118–0.0276 in.)
   Maximum thrust clearance: 0.70 mm (0.0276 in.)
   If the thrust clearance is greater than the maximum, adjust with a spacer.

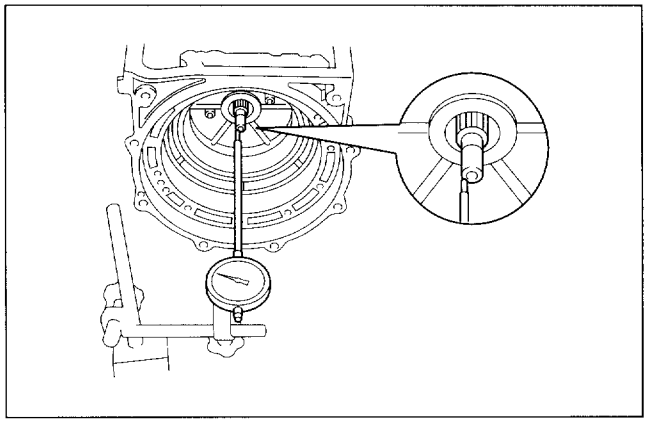


Figure 348. Thrust Clearance Adjustment (2)

4. Remove the 3 O/D case set bolts.

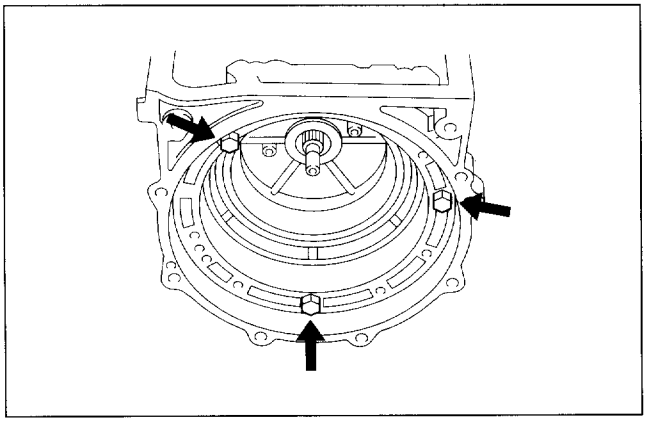


Figure 349. O/D Case Bolt

5. Using the oil pump remover, remove the O/D case assembly.
   Tool Required:
   5-8840-2652-0 Oil Pump Remover

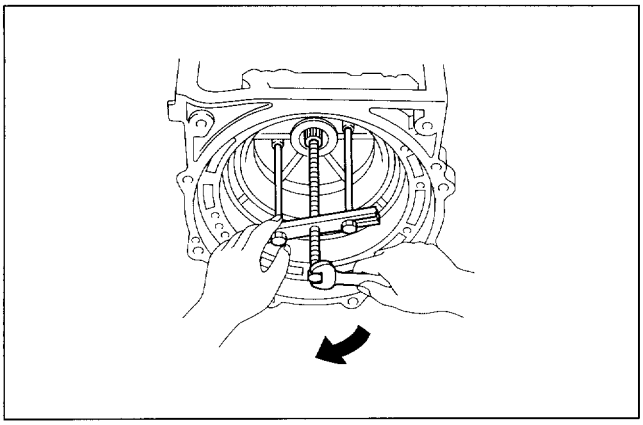


Figure 350. O/D Case Removal

6. Remove the thrust bearing, two races, and spacer from the front clutch drum or O/D case.
7. Select a spacer.

Spacer thicknesses

Thickness mm (in.)	
0.9 (0.035)	1.8 (0.071)
1.2 (0.047)	2.1 (0.083)
1.5 (0.059)	

8. Install the spacer, 2 races and bearing onto the front clutch drum.

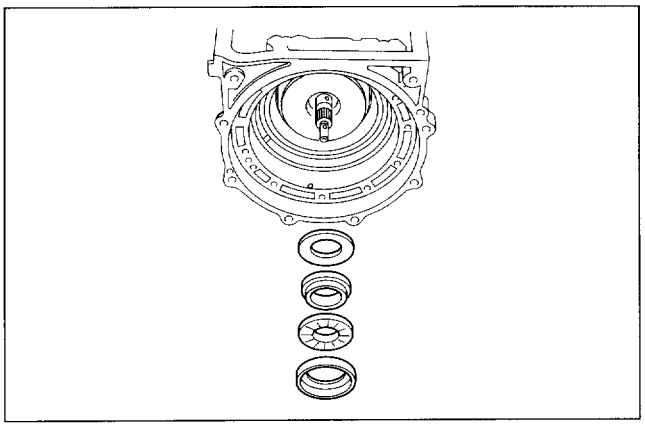


Figure 351. Race, Bearing and Spacer Installation

Overdrive Case Assembly Installation

1. Coat the new 3 O-rings with ATF, and install them to the oil holes of the O/D case.

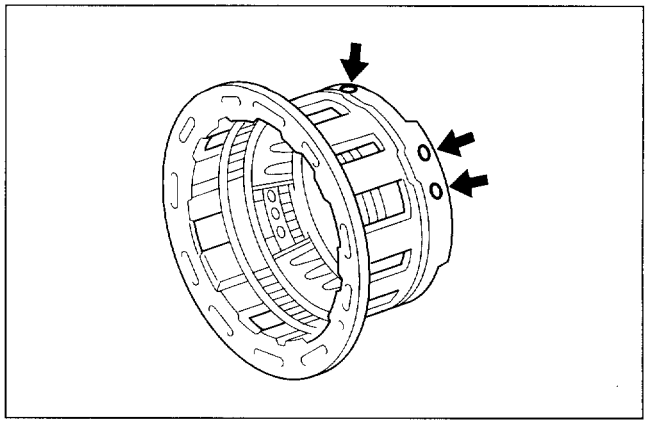


Figure 352. O-ring Installation

2. Install the oil pump remover (2 bolts) to the O/D case.
   Tool Required:
   5-8840-2652-0 Oil Pump Remover
3. Align the oil holes and bolt holes of the O/D case and transmission case.

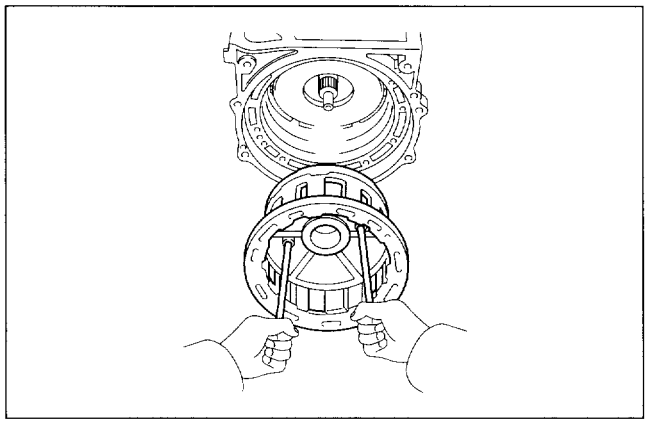


Figure 353. O/D Case Installation

Overdrive Ring Gear Assembly

1. Coat the race and bearing with petroleum jelly, and install them onto the O/D case.
   Race and bearing diameter

Diameter mm (in.)	Inside	Outside
Race	37.0 (1.457)	60.5 (2.382)
Bearing	34.7 (1.366)	58.4 (2.299)

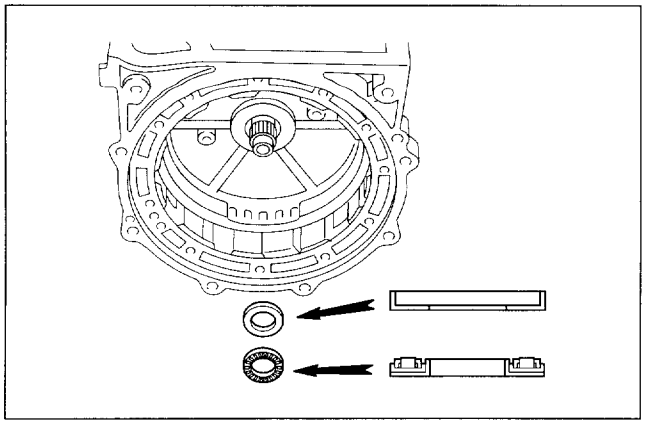


Figure 354. Race and Bearing Installation

2. Coat the race with petroleum jelly, and install it onto the ring gear flange.
Race diameter

Diameter mm (in.)	Inside	Outside
Race	34.6 (1.362)	58.2 (2.291)

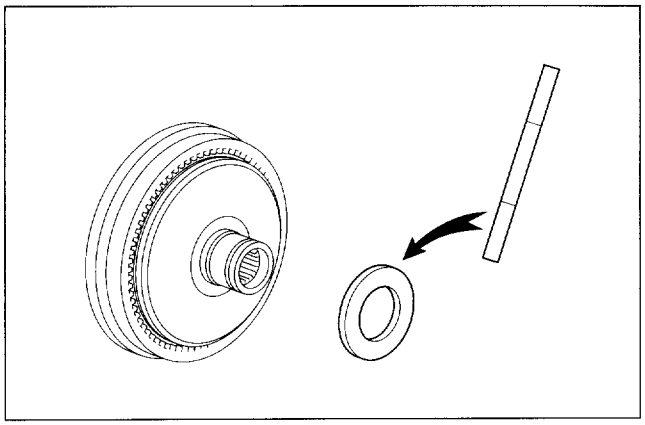


Figure 355. Race Installation

3. Install the ring gear assembly into the O/D case.

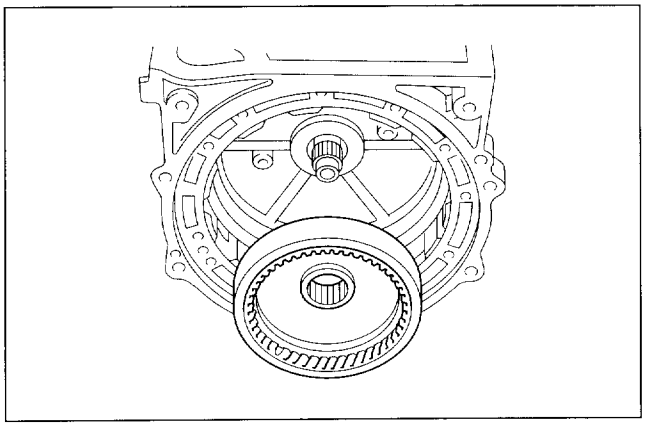


Figure 356. Ring Gear Assembly Installation

Overdrive Planetary Gear, Overdrive Direct Clutch and One-Way Clutch Assembly

1. Coat the 2 bearings with petroleum jelly, and install them onto the planetary gear.
Bearing diameters

Diameter mm (in.)	Inside	Outside
Bearing (A)	28.5 (1.122)	48.0 (1.889)
Bearing (B)	23.2 (0.913)	42.0 (1.654)

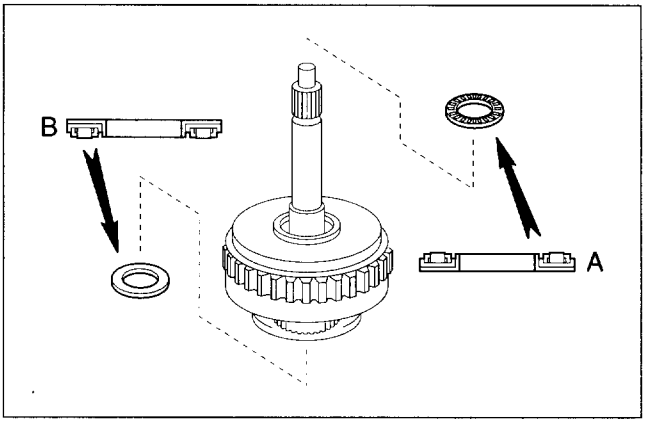


Figure 357. Bearing Installation

2. Install the planetery gear, direct clutch and one-way clutch assembly into transmission case.
NOTICE: Mesh the spline of the O/D direct clutch drum with the flukes of the discs by rotating and pushing the O/D direct clutch drum clockwise or counterclockwise.

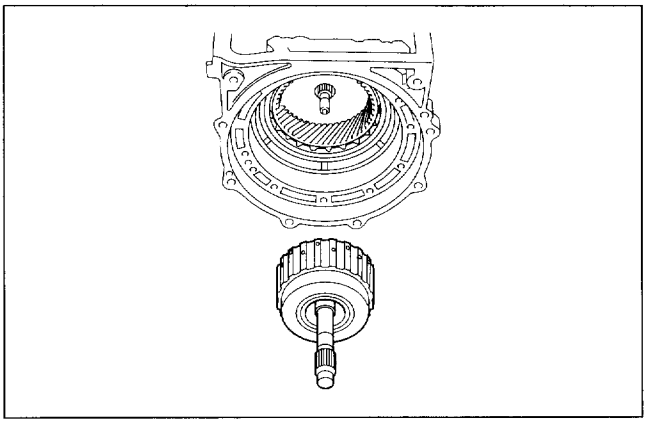


Figure 358. O/D Direct Clutch Assembly Installation

3. Place the plate on the installtion surface of the oil pump.
Tool Required:
5-8840-2647-0 Plate
4. Using calipers, measure the distance between the tops of the plate and the clutch drum.
If the distance corresponds to that during disassembly, the O/D planetary gear, O/D direct clutch and one-way clutch assembly are installed correctly.

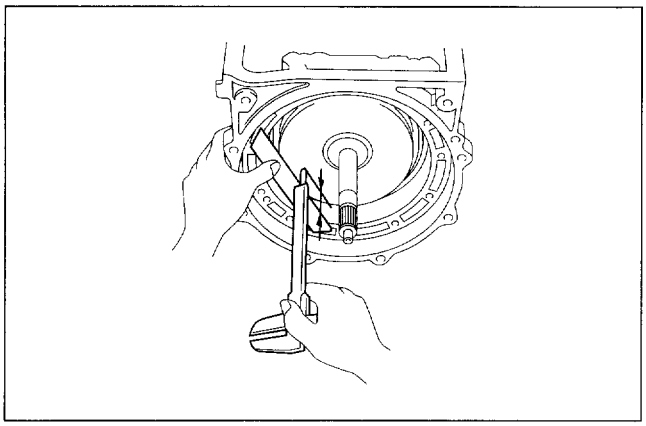


Figure 359. Correct Installation Check

Temporarily Install Oil Pump

1. Coat the race with petroleum jelly, and install it onto the oil pump.
   Race diameter (Reference)

Diameter mm (in.)	Inside	Outside
Race	27.1 (1.067)	43.0 (1.693)
	27.9 (1.098)	43.0 (1.693)
	28.3 (1.114)	43.0 (1.693)

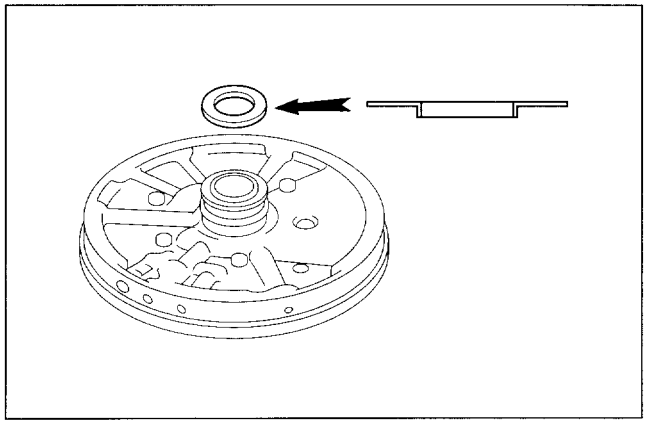


Figure 360. Race Installation

2. Place the gasket on the transmission case.

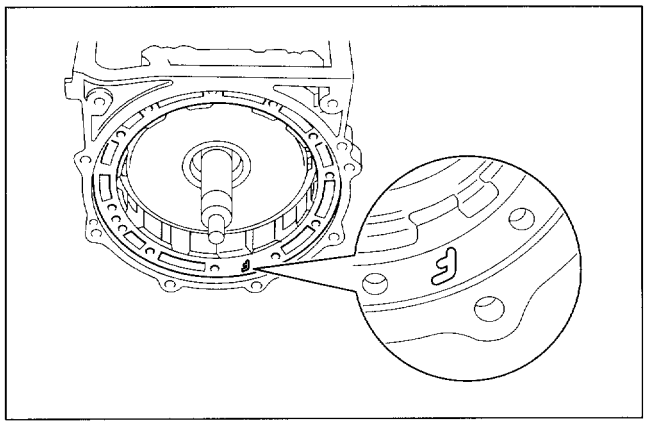


Figure 361. Gasket Installation

3. Align the bolt holes of the pump body and transmission case, and install it.

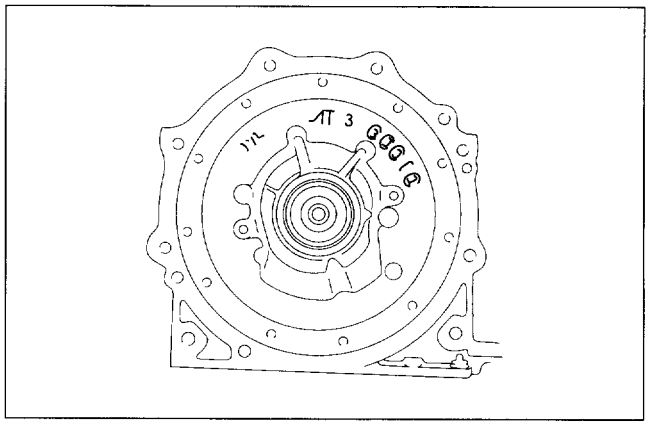


Figure 362. Oil Pump Installation (1)

4. Install a bolt to the matchmarked position, tighten all the 11 bolts temporarily, then tighten them completely a little at a time.

Tighten

Torque: 21 N·m (2.1 kg·m, 15 lb·ft)

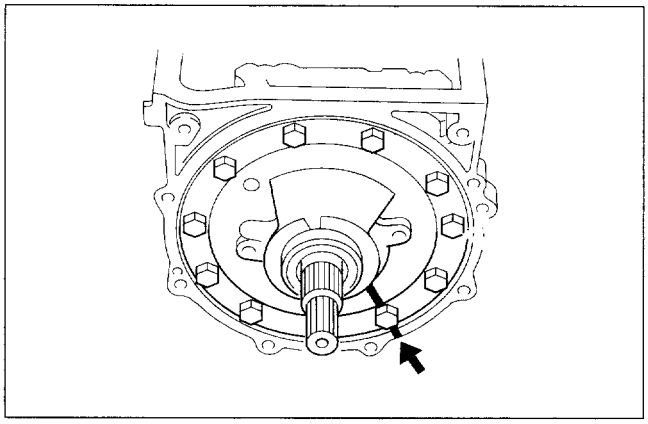


Figure 363. Oil Pump Installation (2)

Thrust Clearance of Overdrive Input Shaft (Overdrive Planetary Gear)

1. Push the O/D input shaft toward the rear of the transmission by applying a force of 49–98 N (5–10 kg, 11.0–22.0 lb).

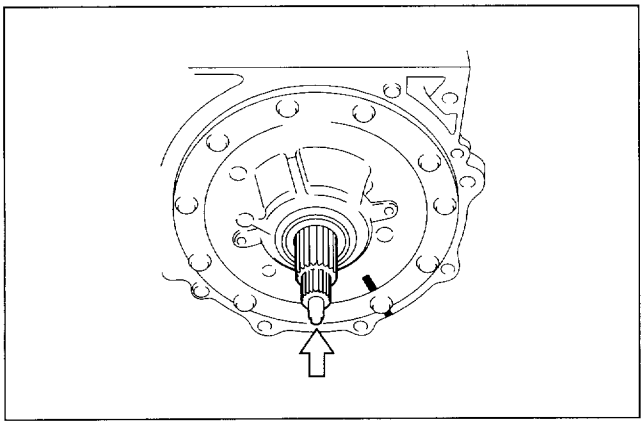


Figure 364. Thrust Clearance Adjustment (1)

2. Using a dial indicator, measure the thrust clearance of the input shaft.
   Standard thrust clearance: 0.40–0.90 mm (0.0157–0.0354 in.)
   Maximum thrust clearance: 0.90 mm (0.0354 in.)
   If the thrust clearance is greater than the maximum, adjust with a race.

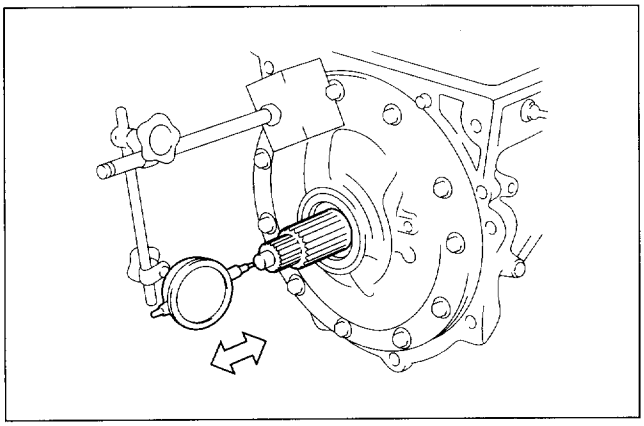


Figure 365. Thrust Clearance Adjustment (2)

3. Remove the 11 oil pump set bolts.

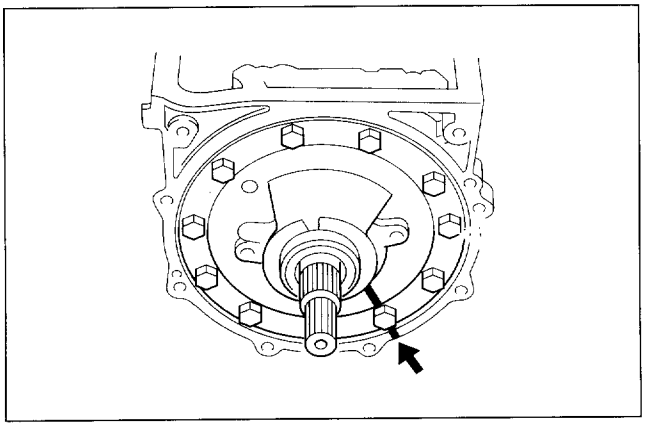


Figure 366. Oil Pump Bolt

4. Using the oil pump remover, remove the oil pump and gasket.
   Tool Required:
   5-8840-2652-0 Oil Pump Remover

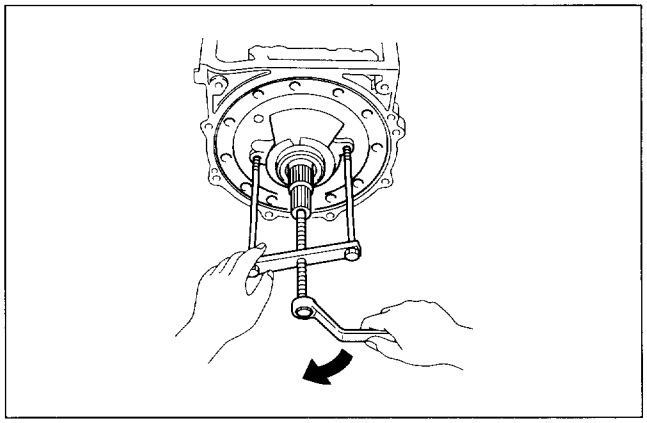


Figure 367. Oil Pump Removal

5. Remove the race from the oil pump cover.
6. Select a race.

Race thicknesses

Thickness mm (in.)	
0.8 (0.031)	1.4 (0.055)
1.0 (0.039)	

7. Coat the race with petroleum jelly, and install it onto the oil pump cover.

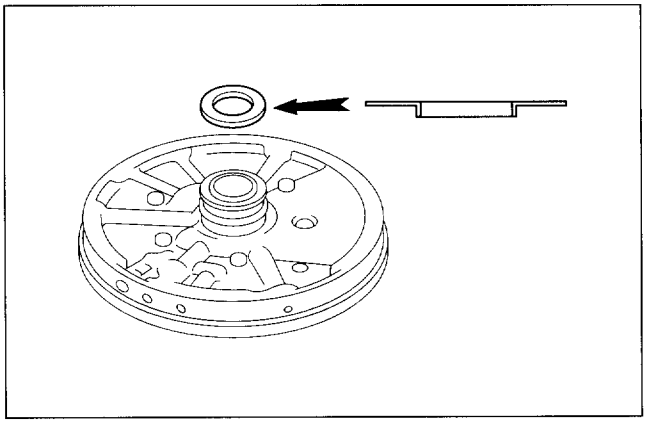


Figure 368. Race Installation

Oil Pump Installation

1. Place a new gasket on the transmission case.

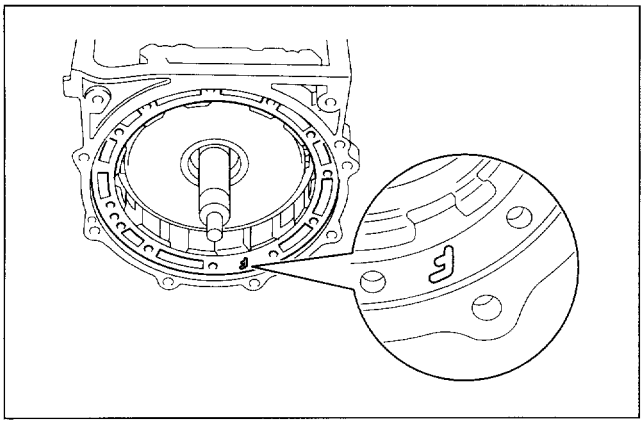


Figure 369. Gasket Installation

2. Align the bolt holes of the pump body and transmission case.

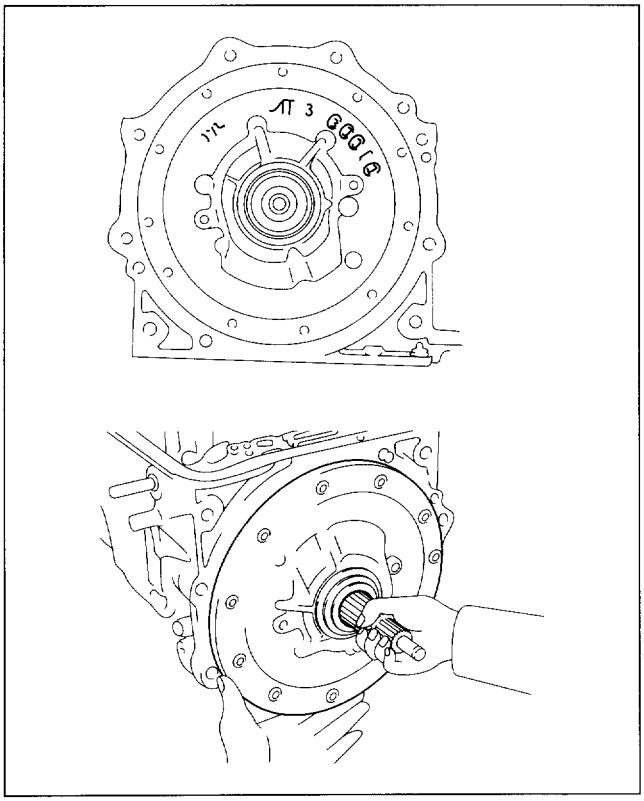


Figure 370. Oil Pump Installation (1)

3. Apply sealant (Three Bond 1344, Loctite 572 or equivalent) to the threads of the oil pump set bolts.

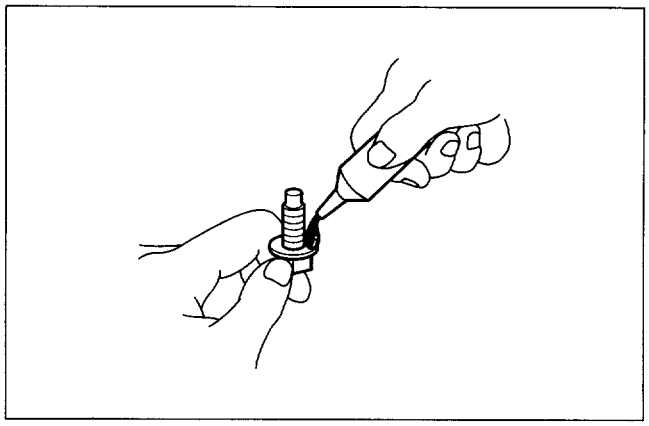


Figure 371. Sealant

4. Install a bolt to the matchmarked position, tighten all the 11 bolts temporarily, then tighten them completely a little at a time.

Tighten

Torque: 21 N·m (2.1 kg·m, 15 lb·ft)

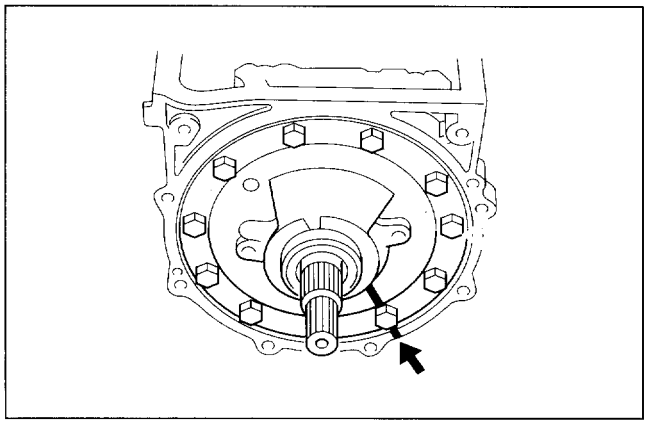


Figure 372. Oil Pump Installation (2)

5. Coat the new 2 O-rings with ATF, and install them to the oil pump body.
NOTICE: Be careful not to damage the O-rings.

O-ring diameters mm (in.)

	Inside	Thickness
O-ring (A)	241.6 (9.512)	3.1 (0.122)
O-ring (B)	250.0 (9.843)	2.7 (0.106)

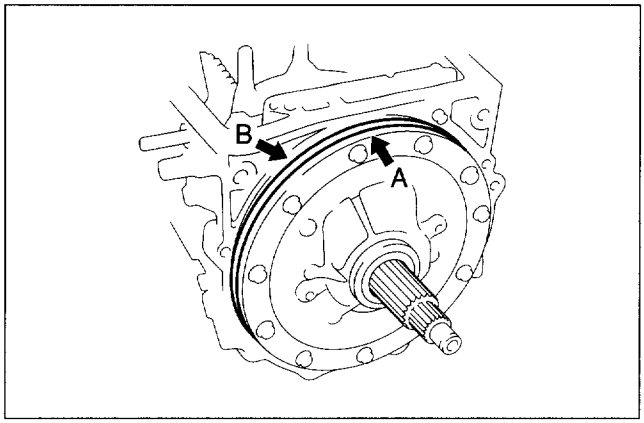


Figure 373. O-ring Installation

Accumulator Springs and Pistons

1. Coat the new 8 O-rings with ATF, and install them to the pistons.
   CAUTION: Be careful not to damage the O-rings.
   O-ring diameter mm (in.)

		Inside	Outside
B-0	A	29.9 (1.177)	2.6 (0.102)
	B	26.1 (1.028)	2.6 (0.102)
B-1	A	37.5 (1.476)	2.6 (0.102)
	B	29.9 (1.177)	2.6 (0.102)
C-1	A	28.5 (1.122)	2.6 (0.102)
	B	22.3 (0.878)	2.6 (0.102)
C-2	A	33.7 (1.327)	2.6 (0.102)
	B	28.5 (1.122)	2.6 (0.102)

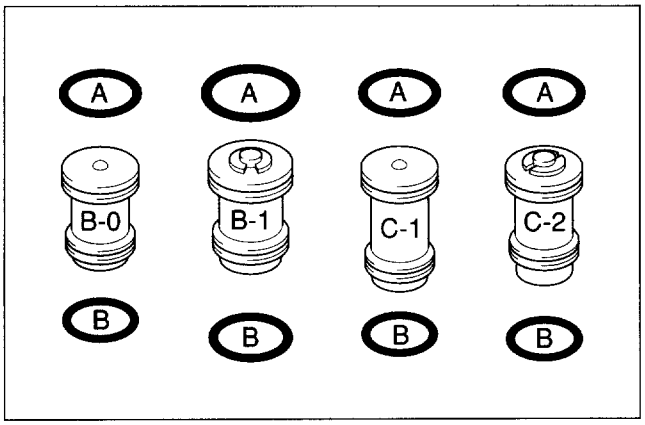


Figure 374. O-ring and Piston

2. Install the spring and accumulator pistons into the bore of the transmission case.
   Spring diameter mm (in.)

	C-1
Free length	93.3 (3.673)
Diameter	17.7 (0.697)
Color	Red

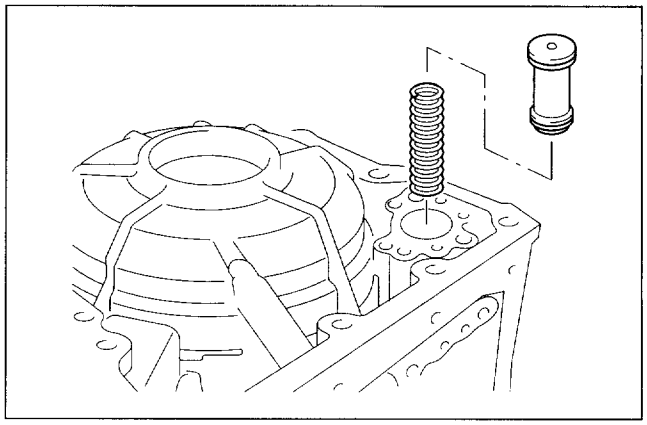


Figure 375. Accumulator Installation (1)

3. Place the new 2 gaskets, plate and accumulator on the transmission case.

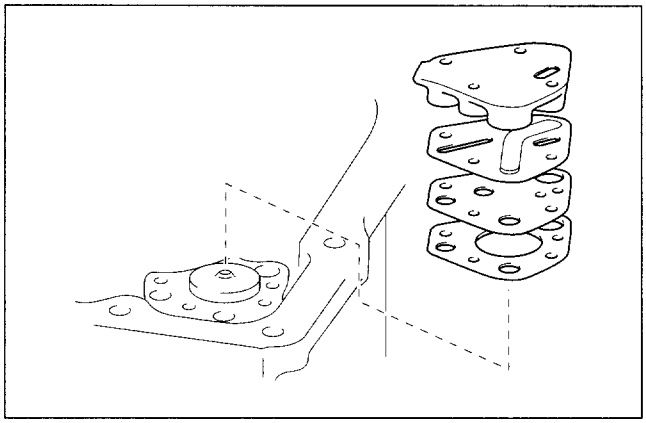


Figure 376. Plate Installation

4. Install the 4 bolts.

   Tighten

   Torque: 8 N·m (80 kg·cm, 69 lb·in)

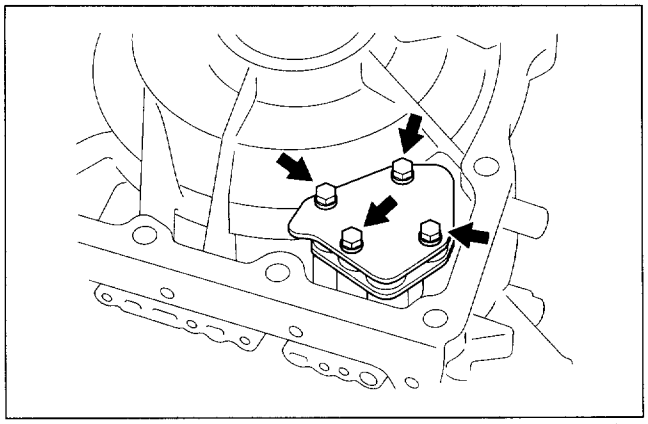


Figure 377. Bolt Installation

5. Install the 4 springs and accumulator pistons into the bore of the transmission case as shown.

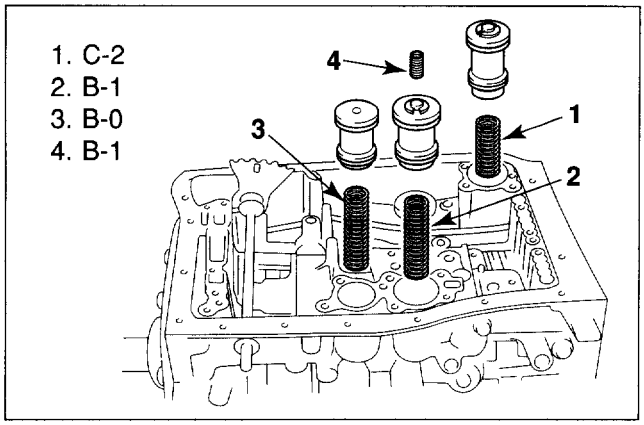


Figure 378. Accumulator Installation (2)

Spring diameter and free length mm (in.)

	Free length	Diameter	Color
B-0	67.9 (2.673)	21.1 (0.831)	White
B-1 (Upper)	30.4 (1.197)	11.0 (0.433)	Yellow
B-1 (Low)	66.0 (2.598)	25.1 (0.988)	Yellow
C-2	81.8 (3.220)	22.4 (0.882)	Beige

Center Support Apply Gasket

Coat the new gaskets with ATF, and install them, facing the pitted side toward the transmission case.

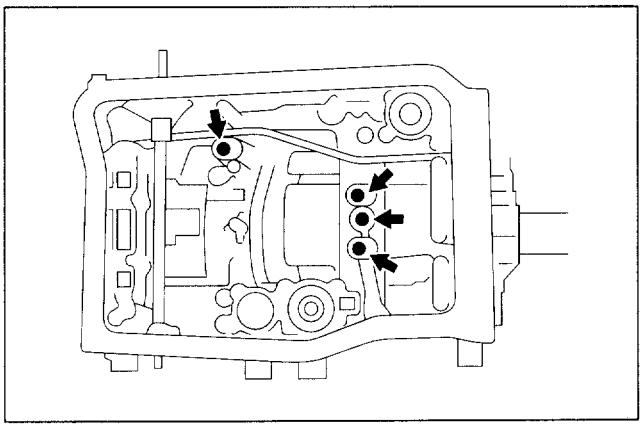


Figure 379. Gasket Installation

Solenoid Wiring

1. Coat a new O-ring with ATF, and install it to the wiring.

O-ring diameter mm (in.)

	Inside dimeter	Thickness
O-ring	17.8 (0.701)	2.4 (0.094)

CAUTION: Be careful not to damage the O-ring.

2. Install the solenoid wiring to the transmission case.

Tighten

Torque: 8 N·m (80 kg·cm, 69 lb·in)

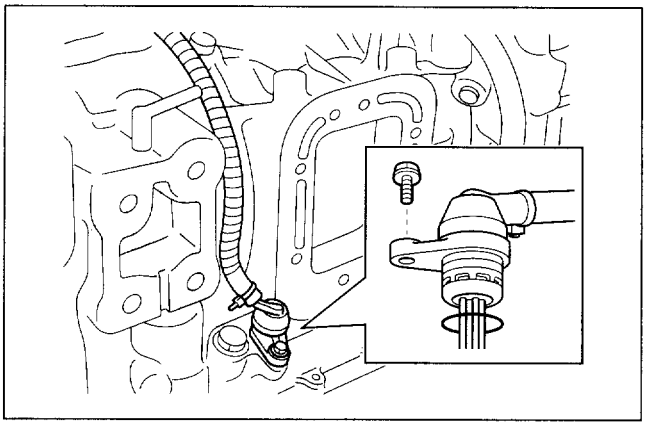


Figure 380. Solenoid Wiring

Valve Body

1. Align the groove of the manual valve with the pin of the manual valve lever.

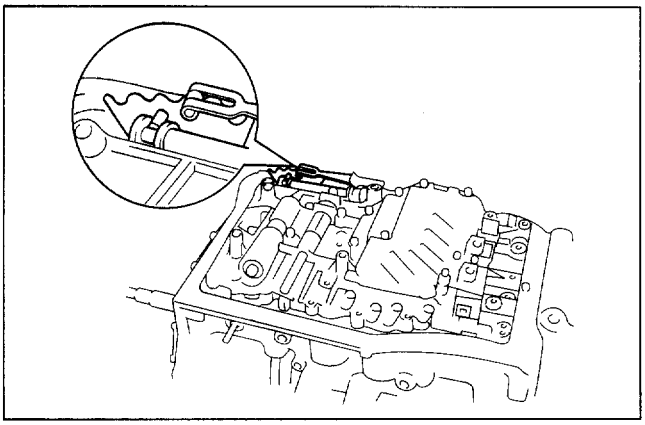


Figure 381. Valve Body Installation

2. Connect the line pressure solenoid connector.

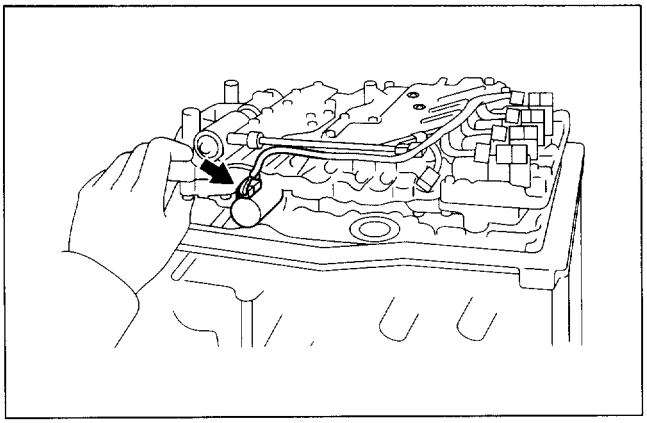


Figure 382. Solenoid Connector

3. Install the 2 bolts indicated by ☆ marks in the illustration and tighten them temporarily.
4. Install and tighten the rest of 19 bolts temporarily, then tighten all of them completely a little at a time.

Tighten

Torque: 10 N·m (1.0 kg·m, 77 lb·in)
NOTICE: Each bolt length is indicated in the illustration.
Bolt length:
A 22 mm (0.87 in.)
B 28 mm (1.10 in.)
C 32 mm (1.26 in.)
D 37.5 mm (1.48 in.)
E 40 mm (1.57 in.)
F 41 mm (1.61 in.)
G 45 mm (1.77 in.)
H 52 mm (2.05 in.)
I 57 mm (2.24 in.)

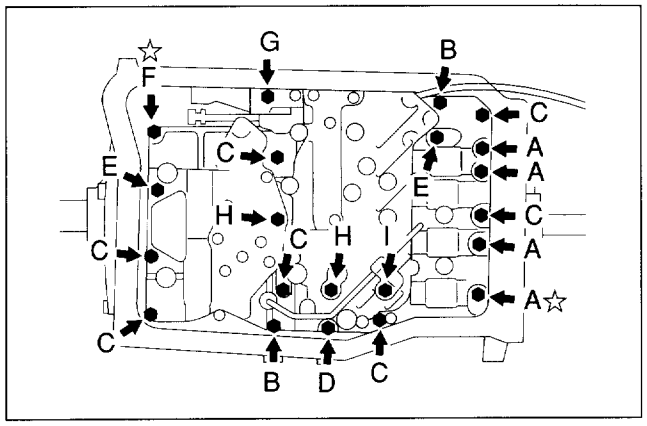


Figure 383. Valve Body Bolt

Solenoid and ATF Thermosensor Connectors
1. Connect the 4 connectors to the solenoids.
2. Connect the connector to the ATF thermosensor.

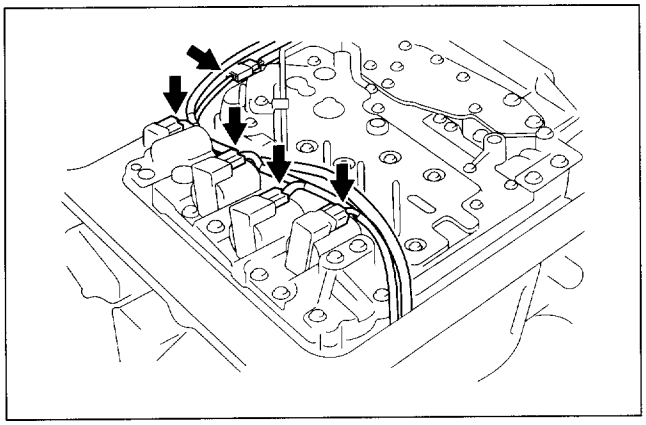


Figure 384. Solenoid Connector

Oil Strainer
Install the oil strainer with the 4 bolts.

Tighten

Torque: 10 N·m (1.0 kg·m, 87 lb·in)
Bolt length:
A 16 mm (0.63 in.)
B 32.4 mm (1.28 in.)

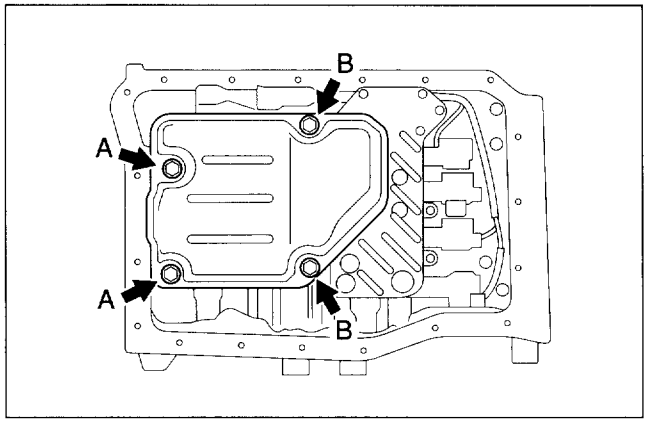


Figure 385. Oil Strainer Installation

Magnet in Pan
Install the 4 magnets in the oil pan as shown in the illustration.

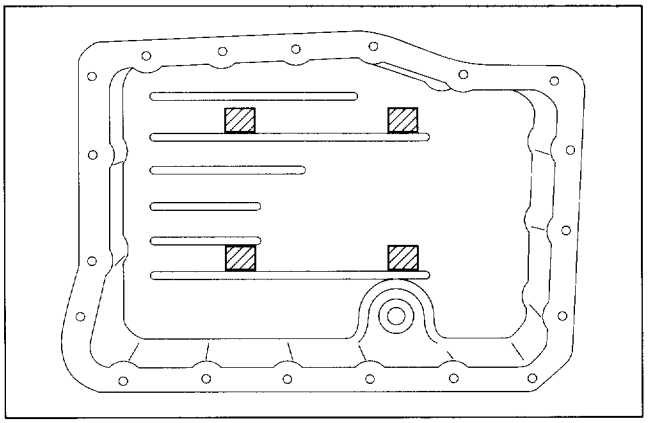


Figure 386. Magnet Installation

Oil Pan
1. Remove any sealants and be careful not to drop oil on the contacting surface of the transmission case and oil pan.
2. Apply sealants (Three Bond 1281 or equivalent) to the oil pan.

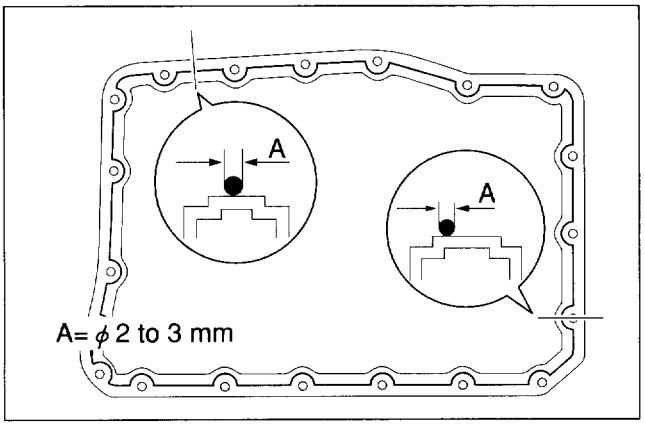


Figure 387. Sealant Application

3. Install and tighten the 20 bolts.

Tighten

Torque: 7 N·m (70 kg·cm, 61 lb·in)

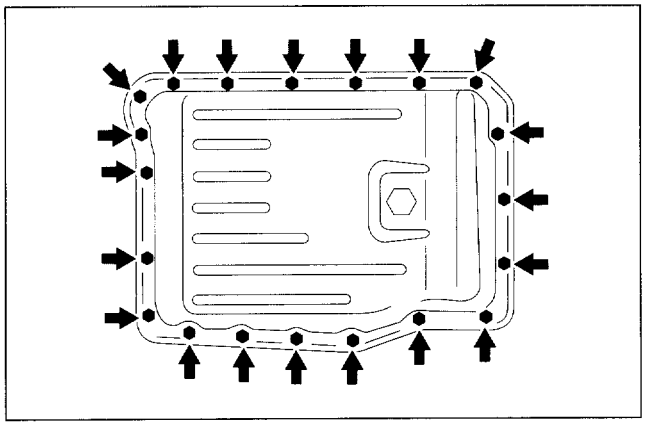


Figure 388. Oil Pan Installation

Torque Converter Housing

1. Install the torque converter housing with the 8 bolts.
   CAUTION: Be careful do not damage the 2 O-rings around the oil pump body when installing the torque converter housing.

Tighten

Torque: 64 N·m (6.5 kg·m, 47 lb·ft)
Bolt length:
A 35 mm (1.38 in.)
B 45 mm (1.77 in.)

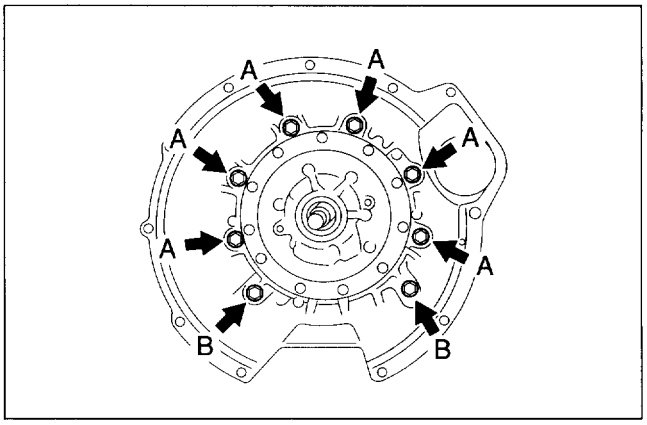


Figure 389. Torque Converter Housing Installation

Transmission PTO Cover

1. Apply sealant (Three Bond 1344, Loctite 572 or equivalent) to the thread of the PTO cover fixing bolt.
2. Install the transmission PTO cover and new gasket with 6 bolts.

Tighten

Torque: 15 N·m (1.5 kg·m, 11 lb·ft)

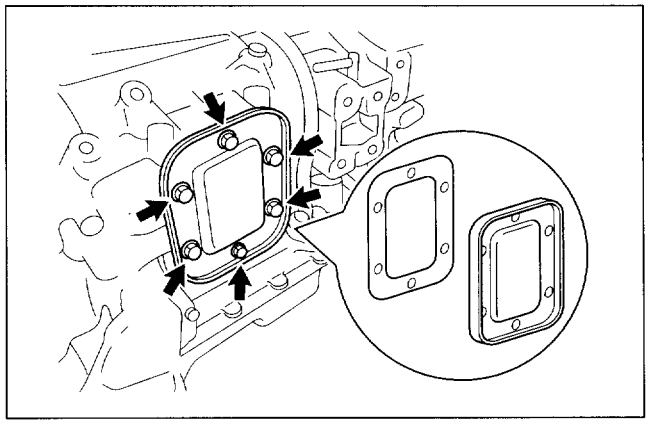


Figure 390. PTO Cover Installation

Vehicle Speed Sensor 1

1. Coat the new O-ring with ATF, and install it to the sensor.
   CAUTION: Be careful not to damage the O-ring.

O-ring diameter mm (in.)

	Inside	Thickness
O-ring	11.8 (0.465)	1.9 (0.075)

2. Install the speed sensor to the extension housing with the bolt.

Tighten

Torque: 8 N·m (80 kg·cm, 69 lb·in)

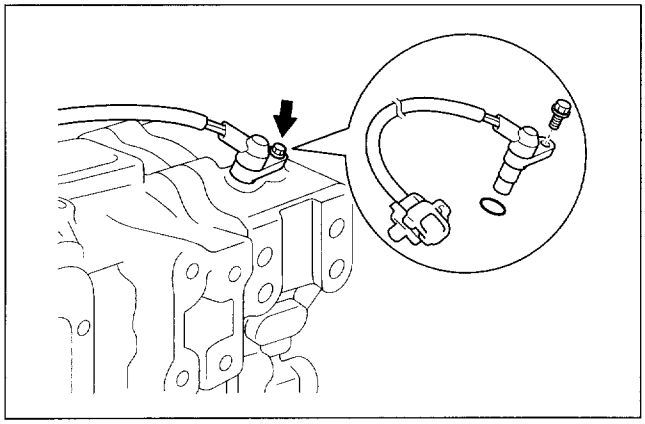


Figure 391. Vehicle Speed Sensor 1 Installation

Transmission Oil Cooler Unions

1. Coat the new 2 O-rings with ATF, and install them to each union.
   CAUTION: Be careful not to damage to the O-rings.
   O-ring diameters mm (in.)

	Inside	Wire diameter
O-rings	11.6 (0.457)	2.0 (0.079)

2. Install the 2 unions.

Tighten

Torque: 32 N·m (3.3 kg·m, 24 lb·ft)

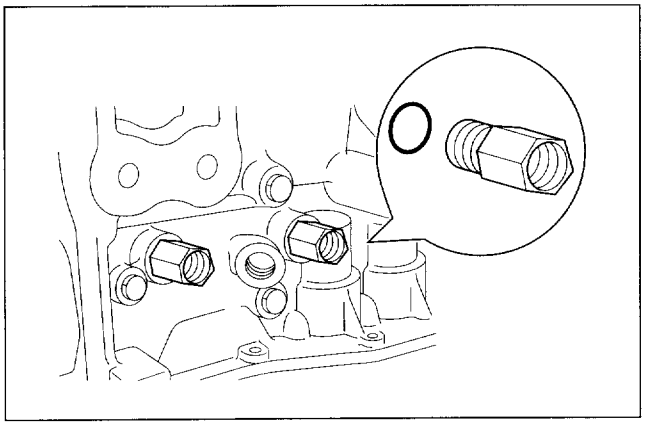


Figure 392. Cooler Union Installation

ATF Temperature Switch

1. Coat the new O-ring with ATF, and install it to the switch.
   CAUTION: Be careful not to damage to the O-ring.
   O-ring diameters mm (in.)

	Inside	Wire diameter
O-ring	13.8 (0.543)	1.9 (0.075)

2. Install the sensor to the transmission case.

Tighten

Torque: 25 N·m (2.5 kg·m, 18 lb·ft)

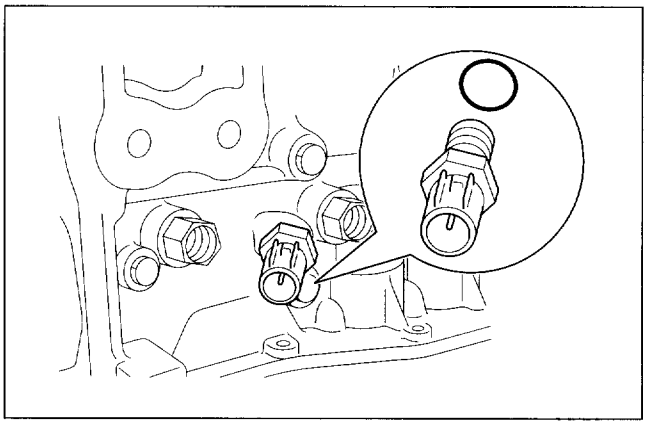


Figure 393. ATF Temerature Switch Installation

Inhibitor Switch

1. Temporarily install the inhibitor switch with the 2 bolts.
2. Install the gasket, a new lock washer and the nut.

Tighten

Torque: 7 N·m (70 kg·cm, 61 lb·in)

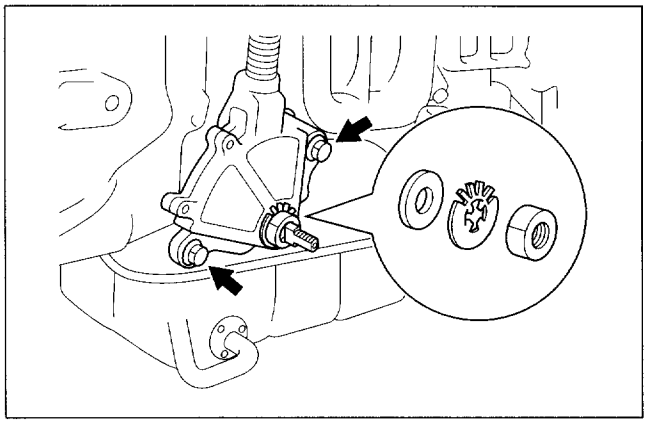


Figure 394. Inhibitor Switch Installation

3. Using a screwdriver, bend the tabs of the lock washer.
   NOTICE: Bend at least 2 of the lock washer tabs.

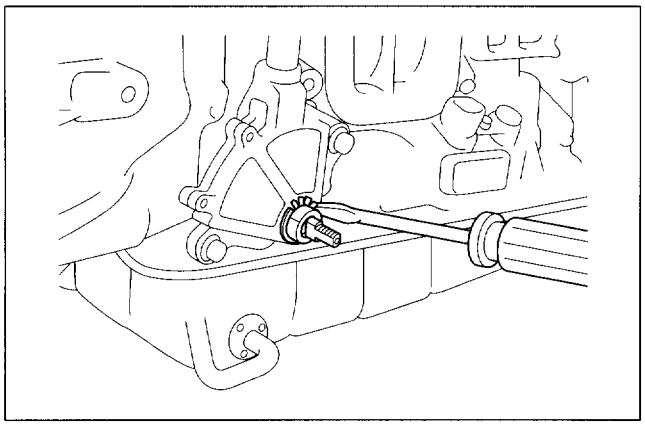


Figure 395. Lock Washer

4. Using the control shaft lever, fully turn the control shaft lever back and return 2 notches, it is now in neutral position.
5. Remove the control shaft lever.

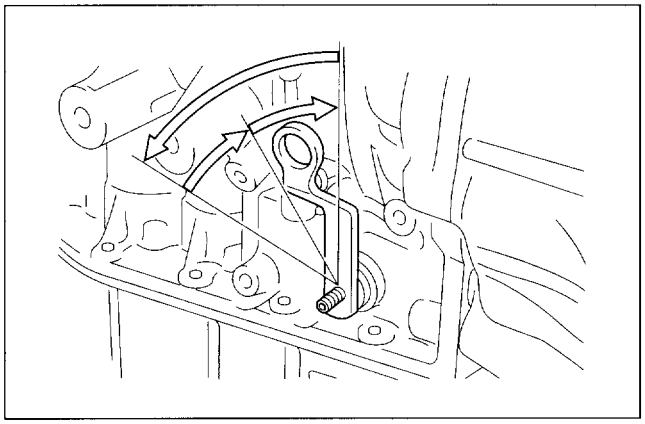


Figure 396. Control Shaft Lever

6. Align the neutral basic line with the switch groove and tighten the 2 bolts.

Tighten

Torque: 13 N·m (1.3 kg·m, 113 lb·in)

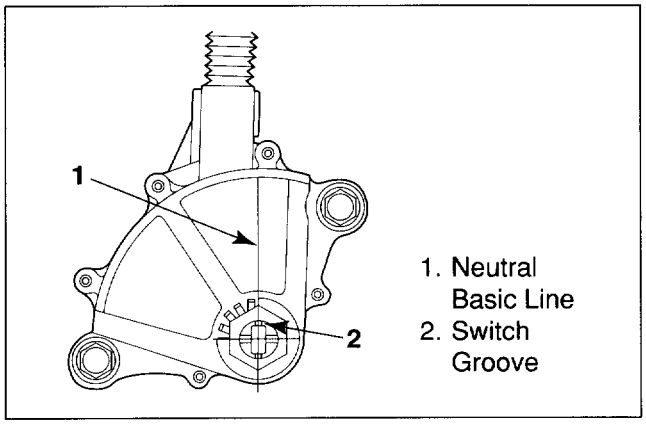


Figure 397. Newtral Basic Line

Control Shaft Lever

Tighten

Torque: 13 N·m (1.3 kg·m, 113 lb·in)

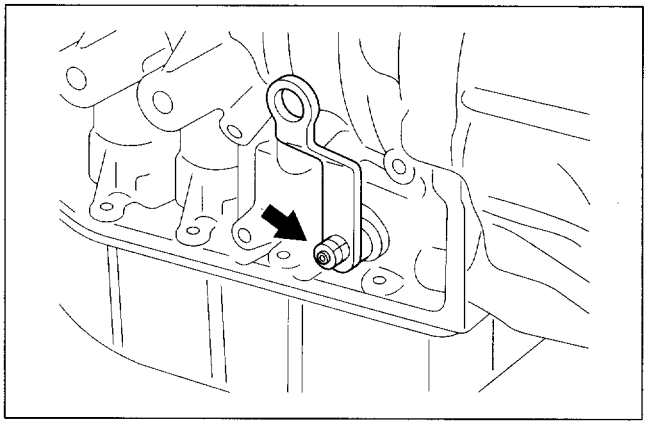


Figure 398. Control Shaft Lever

Breather Plug and Hose

1. Coat a new O-ring with ATF, and install it to breather plug.
2. Install the breather plug and hose.

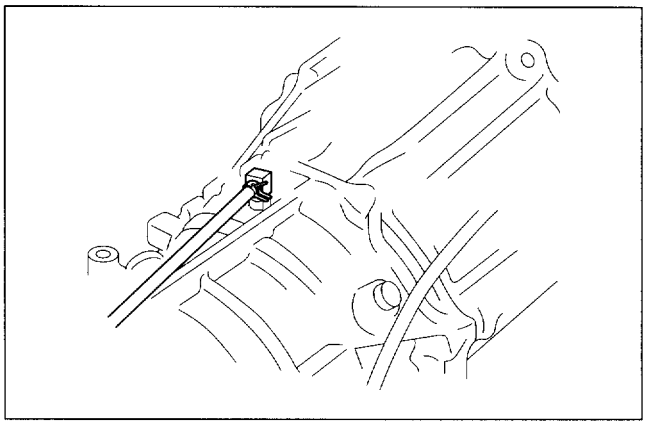


Figure 399. Breather Plug

Speedometer Driven Gear Assy

1. Coat the new O-ring with ATF, and install it to the speedometer sleeve.
   CAUTION: Be careful not to damage the O-ring.

O-ring diameter mm (in.)

	Inside	Wire diameter
O-ring	18.7 (0.736)	2.6 (0.102)

2. Install the speedometer driven gear to the speedometer sleeve with the clip.
3. Install the speedometer driven gear assembly to the extension housing with the bolt.

Tighten

Torque: 12 N·m (1.2 kg·m, 104 lb·in)

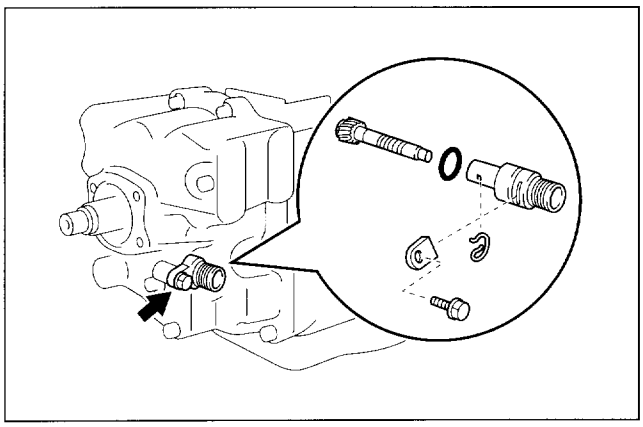


Figure 400. Speedometer Driven Gear Installation

SPECIFICATIONS

SERVICE DATA

Oil Pump	Pump body bushing inside diameter		STD	42.050 to 42.075 mm	1.6555 to 1.6565 in.
			Limit	42.13 mm	1.6587 in.
	Pump cover bushing inside diameter	Front	STD	24.000 to 24.021 mm	0.9449 to 0.9457 in.
			Limit	24.070 mm	1.9476 in.
		Rear	STD	26.500 to 26.521 mm	1.0433 to 1.0441 in.
			Limit	26.57 mm	1.0461 in.
O/D Planetary Gear and Direct Clutch	O/D input shaft thrust clearance (O/D planetary gear)		STD	0.40 to 0.90 mm	0.0157 to 0.0354 in.
			Limit	0.90 mm	0.0345 in.
	O/D input shaft thrust bearing race thickness			0.8 mm	0.031 in.
				1.0 mm	0.039 in.
				1.4 mm	0.055 in.
	O/D direct clutch flange thickness			4.6 mm	0.181 in.
				4.77 mm	0.188 in.
				4.94 mm	0.194 in.
				5.11 mm	0.201 in.
	Piston stroke			1.80 to 2.00 mm	0.0709 to 0.0787 in.
	O/D direct clutch drum bushing inside diameter		STD	26.500 to 26.521 mm	1.0433 to 1.0441 in.
			Limit	26.57 mm	1.0461 in.
	O/D planetary gear bushing inside diameter		STD	12.000 to 12.018 mm	0.4724 to 0.4731 in.
			Limit	12.07 mm	0.4752 in.
	Planetary piston gear thrust clearance		STD	0.20 to 0.59 mm	0.0079 to 0.0232 in.
			Limit	0.80 mm	0.315 in.
O/D Brake	Piston stroke			1.25 to 1.85 mm	0.0492 to 0.0728 in.
	O/D case bushing inside diameter		STD	33.100 to 33.150 mm	1.3031 to 1.305 in.
			Limit	32.20 mm	1.3071 in.
Front Clutch	Input shaft thrust clearance (forward clutch hub)		STD	0.30 to 0.70 mm	0.0118 to 0.0276 in.
			Limit	0.70 mm	0.0276 in.
	Input shaft spacer thickness			0.9 mm	0.035 in.
				1.2 mm	0.047 in.
				1.5 mm	0.059 in.
				1.8 mm	0.071 in.
				2.1 mm	0.083 in.
	Piston stroke			3.93 to 4.23 mm	0.1547 to 0.1665 in.
	Front clutch plate thickness			1.8 mm	0.071 in.
				2.0 mm	0.079 in.
				2.2 mm	0.084 in.
				2.4 mm	0.094 in.

Rear Clutch	Piston stroke		2.00 to 2.20 mm	0.0790 to 0.0866 in.
	Rear clutch flange thickness		4.6 mm	0.181 in.
			4.8 mm	0.189 in.
			5.0 mm	0.197 in.
			5.2 mm	0.205 in.
Second Brake	Center support thrust clearance	STD	0.30 to 0.70 mm	0.0118 to 0.0276 in.
		Limit	0.90 mm	0.0345 in.
	Center support thrust washer thickness		1.5 mm	0.059 in.
			1.8 mm	0.071 in.
			2.1 mm	0.083 in.
			2.4 mm	0.094 in.
			2.7 mm	0.106 in.
	Piston stroke		1.86 to 2.06 mm	0.0732 to 0.0811 in.
	Center support bushing inside diameter	STD	35.000 to 35.025 mm	1.3780 to 1.3789 in.
		Limit	35.08 mm	1.3811 in.
	Front planetary sun gear bushing inside diameter	STD	25.500 to 25.521 mm	1.0039 to 1.0048 in.
		Limit	25.57 mm	1.0067 in.
	Second brake flange thickness		5.0 mm	0.197 in.
			5.2 mm	0.205 in.
			5.4 mm	0.213 in.
			5.6 mm	0.220 in.
Planetary Gears, One-way Clutch and Output Shaft	Output shaft bushing inside diameter	STD	17.000 to 17.021 mm	0.6693 to 0.6701 in.
		Limit	17.07 mm	0.6720 in.
	Planetary pinion gear thrust clearance	STD	0.20 to 0.59 mm	0.0079 to 0.0232 in.
		Limit	0.75 mm	0.0295 in.
First and Reverse Brake	Piston stroke		3.3 to 3.8 mm	0.130 to 0.150 in.
	First and reverse brake flange thickness		6.65 mm	0.2618 in.
			7.05 mm	0.2776 in.
			7.45 mm	0.2933 in.
Parking Lock Pawl	Parking lock pawl bracket distance		49.76 to 49.86 mm	1.959 to 1.963 in.
Upper Valve Body	Check ball diameter		6.4 mm	0.252 in.
Lower Valve Body	Check ball diameter		8.7 mm	0.343 in.
	Check ball spring	Free length	14.0 mm	0.551 in.
		Outer diameter	9.8 mm	0.386 in.
	Pressure relief valve spring	Free length	24.0 mm	0.945 in.
		Outer diameter	8.2 mm	0.323 in.

Pistons and Springs Specifications

Mark	Piston diameter mm (in.)	Spring Free length / Outer Diameter mm (in.)	Spring Color
B_0	35.9 (1.413)	67.9 / 21.1 (2.673 / 0.831)	White
B_1	43.9 (1.728)	66.0 / 25.1 (2.598 / 0.988)	Yellow
		30.4 / 11.0 (1.197 / 0.433)	Yellow
C_1	34.4 (1.354)	93.3 / 17.7 (3.673 / 0.697)	Red
C_2	39.9 (1.571)	81.8 / 22.4 (3.220 / 0.882)	Beige

FASTENER TORQUES

Part tightened	N·m	lb·ft (lb·in)	kg·m (kg·cm)
Oil Pump cover x Oil pump body	21	15	2.1
Upper valve body x Lower valve body	5.5	4	55
Manual detent spring x Lower valve body	5.5	(47)	(55)
Parking lock pawl bracket x Extension housing	19	14	1.9
C_1 accumulator cover x Transmission case	8	(69)	(80)
Transmission case x Extension housing	37	27	3.8
Center support set bolt	25	18	2.5
Oil pan x Transmission case	7	(61)	(70)
Transmission case x Transmission housing	64	47	6.5
ATF temperature sensor x Transmission case	25	18	2.5
Oil cooler union x Transmission case	29	22	3.0
Inhibitor switch x Transmission case	12.5	(78)	(130)
Inhibitor switch x Manual valve shaft	7	(61)	(70)
Control shaft x Transmission case	12.5	(78)	(130)
Oil pump x Transmission case	25	18	2.5
Valve body x Transmission case	10	(87)	1.0
Solenoid valve x Valve body	10	(87)	1.0
Oil strainer x Valve body	10	(87)	1.0
Drain plug x Oil pan	27	20	2.8
Speedometer sleeve lock plate x Transmission case	12.5	(78)	(130)
Speed sensor x Transmission case	8	(69)	(80)
Solenoid wire x Transmission case	8	(69)	(80)
PTO cover x Transmission case	15	11	1.5

SPECIAL TOOLS

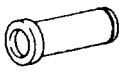
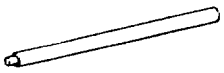
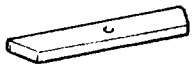
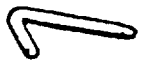
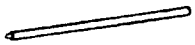
ILLUSTRATION	**TOOL NO.** TOOL NAME
	5-8840-2153-0 **(J-37228)** Oil Pan Seal Cutter
	5-8840-2641-0 **(J-44160)** No.2 Piston Spring Compressor
	5-8840-2642-0 **(J-44161)** No.3 Piston Spring Compressor
	5-8840-2643-0 **(J-44162)** No.1 Piston Spring Compressor
	**5-8840-2644-0** **(J-44163)** Oil Pump Oil Seal Installer
	**5-8840-2645-0** **(J-44164)** Handle
	5-8840-2646-0 **(J-44165)** Rear Bearing Installer

ILLUSTRATION	**TOOL NO.** TOOL NAME
	**5-8840-2647-0** **(J-44166)** Plate
	5-8840-2649-0 **(J-44167)** No.1 Measure Termial
	**5-8840-2650-0** **(J-44168)** No.2 Measure Termial
	**5-8840-2651-0** **(J-44169)** Extension Bar
	5-8840-2652-0 **(J-44170)** Oil Pump Remover
	5-8840-2653-0 **(J-44171)** Lever Shaft Oil Seal Installer

LG450-WE-9991

You are requested to order this manual using the manual number that is shown above.

This manual is applicable for vehicles in all countries except USA and Canada.

All rights reserved. This manual may not be reproduced in whole or in part, without the permission in writing of ISUZU MOTORS LIMITED

Issued by

ISUZU MOTORS LIMITED

INTERNATIONAL SERVICE DEPARTMENT

Tokyo,Japan

First edition Jan., 1999 9901-01N-3

NO.LG450-WE-9991 PRINTED IN JAPAN

WORKSHOP MANUAL

NKR · NPR · NQR

CAB AND CHASSIS ELECTRICAL

ANTI-LOCK BRAKE SYSTEM (ABS)

SUPPLEMENT

SECTION 8

ISUZU

ISUZU
International Service & Parts
Tokyo, Japan

FOREWORD

This workshop manual supplement contains information of anti-lock brake system for Medium Duty Steel Tilt Cab Vehicle (NKR · NPR · NQR). When used with the Medium Duty Truck Workshop Manual (Pub. No. LGBKR-WE-0101), complete service coverage is provided.

Keep this manual in a handy place for ready reference. If properly used, it will enable the technician to serve the owners of ISUZU vehicles.

CAUTION:

These vehicles contain parts dimensioned in the metric system as well as in the customary system. Some fasteners are metric and are very close in dimension to familiar customary fasteners in the inch system. It is important to note that, during any vehicle maintenance procedures, replacement fasteners must have the same measurements and strength as those removed, whether metric or customary. (Numbers on the heads of metric bolts and on surfaces of metric nuts indicate their strength. Customary bolts use radial lines for this purpose, while most customary nuts do not have strength markings.) Mismatched or incorrect fasteners can result in vehicle damage or malfunction, or possibly personal injury. Therefore, fasteners removed from the vehicle should be saved for re-use in the same location whenever possible. Where the fasteners are not satisfactory for re-use, care should be taken to select a replacement that matches the original. For information and assistance, see your Authorized Isuzu Medium Duty Vehicle dealer.

CAB AND CHASSIS ELECTRICAL

Service Precaution

CAUTION: When fasteners are removed, always reinstall them at the same location from which they were removed. If the fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size and strength (or stronger) may be used. Fasteners that are not reused, and those requiring thread locking compound, will be called out. The correct torque values must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

CONTENTS

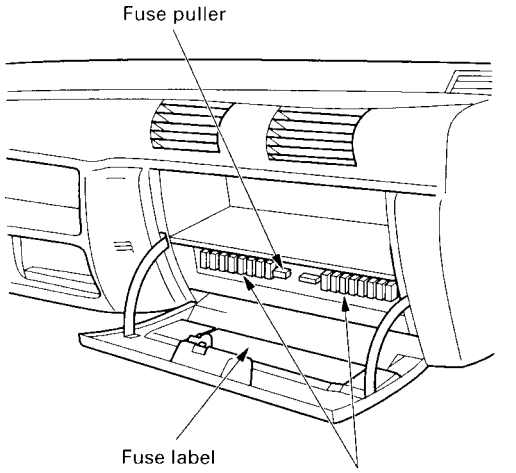
PAGE

Anti-lock Brake System ..... See Anti-lock Brake System (ABS) Workshop Manual (LGBRK-WE-0101)
General Information ..... See 1999 MY SECTION 8 Workshop Manual
Notes for Working on Electrical Items ..... See 1999 MY SECTION 8 Workshop Manual
Symbols and Abbreviations ..... See 1999 MY SECTION 8 Workshop Manual
Symbols ..... See 1999 MY SECTION 8 Workshop Manual
Abbreviations ..... See 1999 MY SECTION 8 Workshop Manual
Parts for Electrical Circuit ..... See 1999 MY SECTION 8 Workshop Manual
Wiring ..... See 1999 MY SECTION 8 Workshop Manual
Fuse and Fusible Link ..... See 1999 MY SECTION 8 Workshop Manual
Relay ..... See 1999 MY SECTION 8 Workshop Manual
Diode ..... See 1999 MY SECTION 8 Workshop Manual
Connector ..... See 1999 MY SECTION 8 Workshop Manual
Reading the Circuit Diagram ..... See 1999 MY SECTION 8 Workshop Manual
Connector Symbol ..... See 1999 MY SECTION 8 Workshop Manual
Joint Connector ..... See 1999 MY SECTION 8 Workshop Manual
Main Data and Specifications ..... See 1999 MY SECTION 8 Workshop Manual
Bulb Specifications ..... See 1999 MY SECTION 8 Workshop Manual
Fuse and Fusible Link Location 8-3
Fuse and Circuit Breaker 8-3
Fusible Link 8-4
Fuse Block Circuit 8-5
Reference Table of Fuse ..... See 1999 MY SECTION 8 Workshop Manual

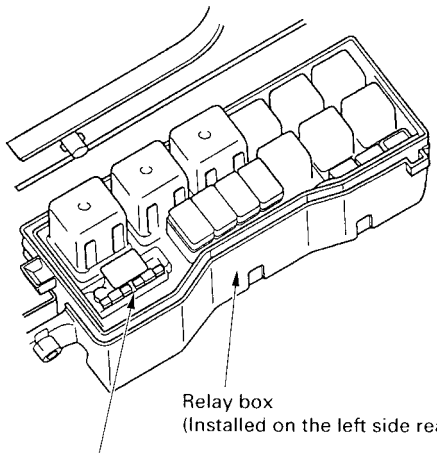
Relay Location **8-7**
Relay List **8-8**
Diode Location **8-9**
Reference Table of Grounding Point ..... **See 1999 MY SECTION 8 Workshop Manual**
Grounding Point Location ..... **See 1999 MY SECTION 8 Workshop Manual**
Cable Harness Routing ..... **See 1999 MY SECTION 8 Workshop Manual**
System Repair ..... **See 1999 MY SECTION 8 Workshop Manual**
Start and Charging ..... **See 1999 MY SECTION 8 Workshop Manual**
Engine Control Module ..... **See 1999 MY SECTION 8 Workshop Manual**
Engine Stop System ..... **See 1999 MY SECTION 8 Workshop Manual**
Headlight, D.R.L and Cornering Light ..... **See 1999 MY SECTION 8 Workshop Manual**
Clearance Light, Taillight, License Plate Light, ID Light and Illumination Light ..... **See 1999 MY SECTION 8 Workshop Manual**
Turn Signal Light, Hazard Warning Light and Stoplight ..... **See 1999 MY SECTION 8 Workshop Manual**
Horn and Backup Light ..... **See 1999 MY SECTION 8 Workshop Manual**
Dome Light and Cab Interior Light ..... **See 1999 MY SECTION 8 Workshop Manual**
Transmission Control Module (TCM) ..... **See 1999 MY SECTION 8 Workshop Manual**
Windshield Wiper and Washer ..... **See 1999 MY SECTION 8 Workshop Manual**
Audio and Cigarette Lighter ..... **See 1999 MY SECTION 8 Workshop Manual**
Meter and Warning/Indicator Light ..... **See 1999 MY SECTION 8 Workshop Manual**
Heater, Air Conditioning, Condenser Fan and Ceramic Heater ..... **See 1999 MY SECTION 8 Workshop Manual**
Service Terminal ..... **See 1999 MY SECTION 8 Workshop Manual**
ABS (Anti-lock Brake System) **8-10**
Parts Location **8-10**
Circuit Diagram **8-11**
Connector List **8-15**

Fuse And Fusible Link Location

Fuse And Circuit Breaker



Fuse(F-1 ~ F-20)



Fuse(F-21 , F-22)

FUSE LABEL-FOR 12Volt

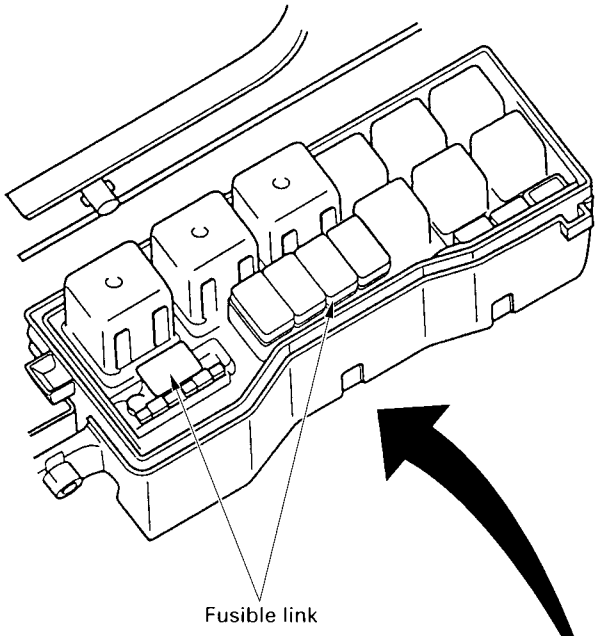
25A F-1	HEATER
10A F-2	AIR CON
10A F-3	STARTER
15A F-4	CIGAR LIGHTER
10A F-5	HEAD LIGHT (RH)
10A F-6	HEAD LIGHT (LH)
15A F-7	AUDIO, DOOR LOCK
15A F-8	HAZARD, HORN
15A F-9	TAIL LIGHT
10A F-10	FOG LIGHT
15A F-11	WIPER, WASHER
10A F-12	GAUGE, BACK
15A F-13	RR. HEATER
15A F-14	FUEL HEATER EXH. BRAKE
10A F-15	HDLP LEVELING
25A F-16	POWER WINDOW
10A F-17	STOP LIGHT
15A F-18	GENERATOR
10A F-19	TURN S/LIGNT
10A F-20	ENG. STOP

FUSE LABEL-FOR 24Volt

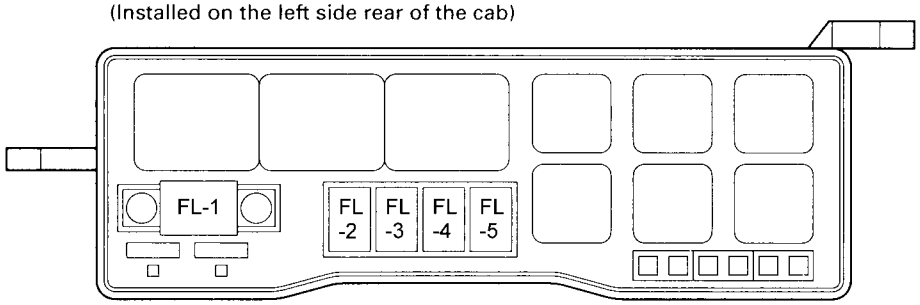
15A F-1	HEATER
– F-2	–
10A F-3	STARTER
15A F-4	CIGAR LIGHTER
10A F-5	HEAD LIGHT (RH)
10A F-6	HEAD LIGHT (LH)
15A F-7	AUDIO, DOOR LOCK
15A F-8	HAZARD, HORN
15A F-9	TAIL LIGHT
10A F-10	STOP LIGHT
15A F-11	WIPER, WASHER
10A F-12	GAUGE, BACK
10A F-13	ECU (IGN)
10A F-14	FUEL HEATER EXH. BRAKE
15A F-15	RR. HEATER
15A F-16	POWER WINDOW
10A F-17	ENG. STOP
10A F-18	HDLP LEVELING
10A F-19	TURN S/LIGNT
15A F-20	GENERATOR

10A F-21	MARKER LIGHT
15A F-22	CONDENSER FAN

Fusible Link

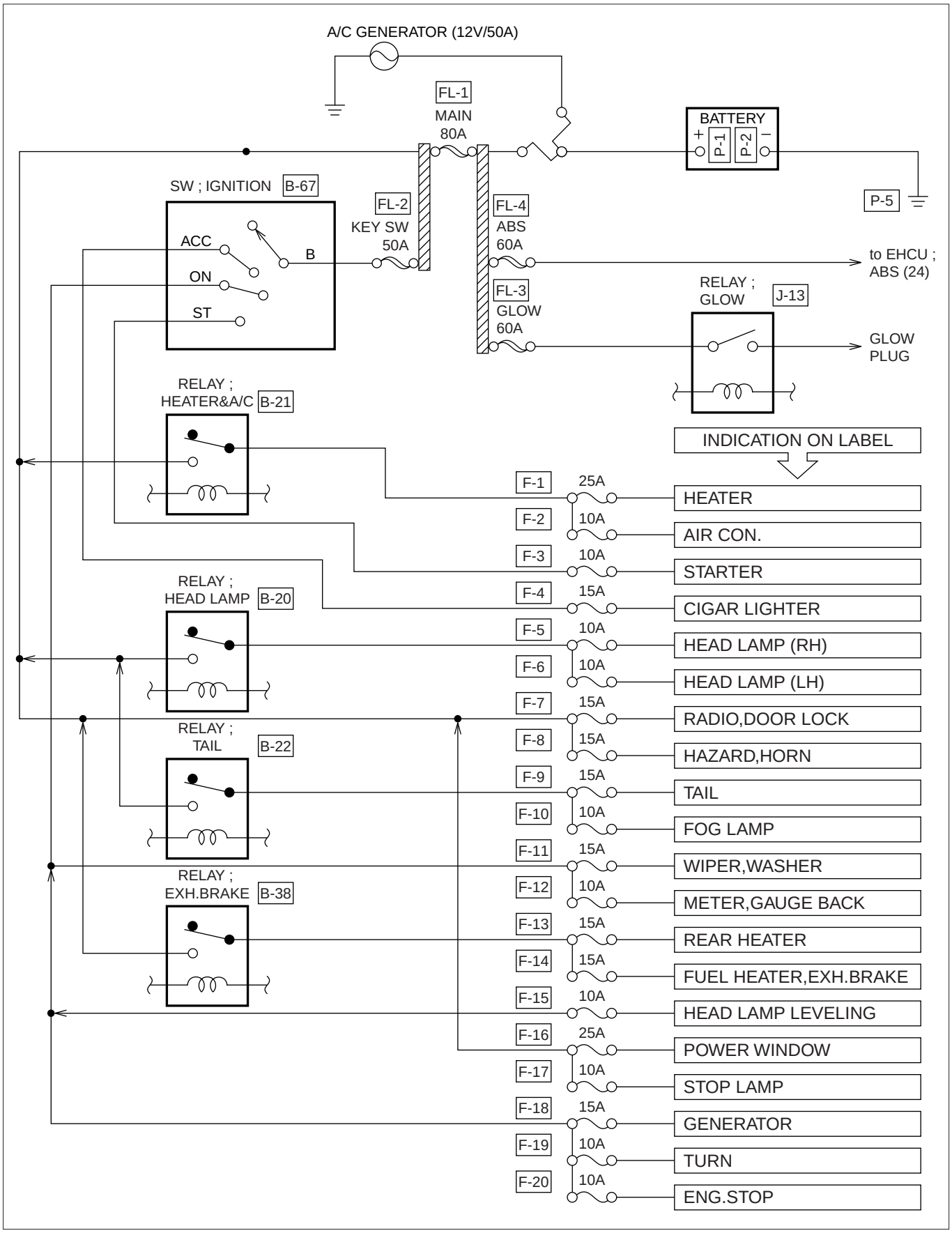


Relay box
(Installed on the left side rear of the cab)

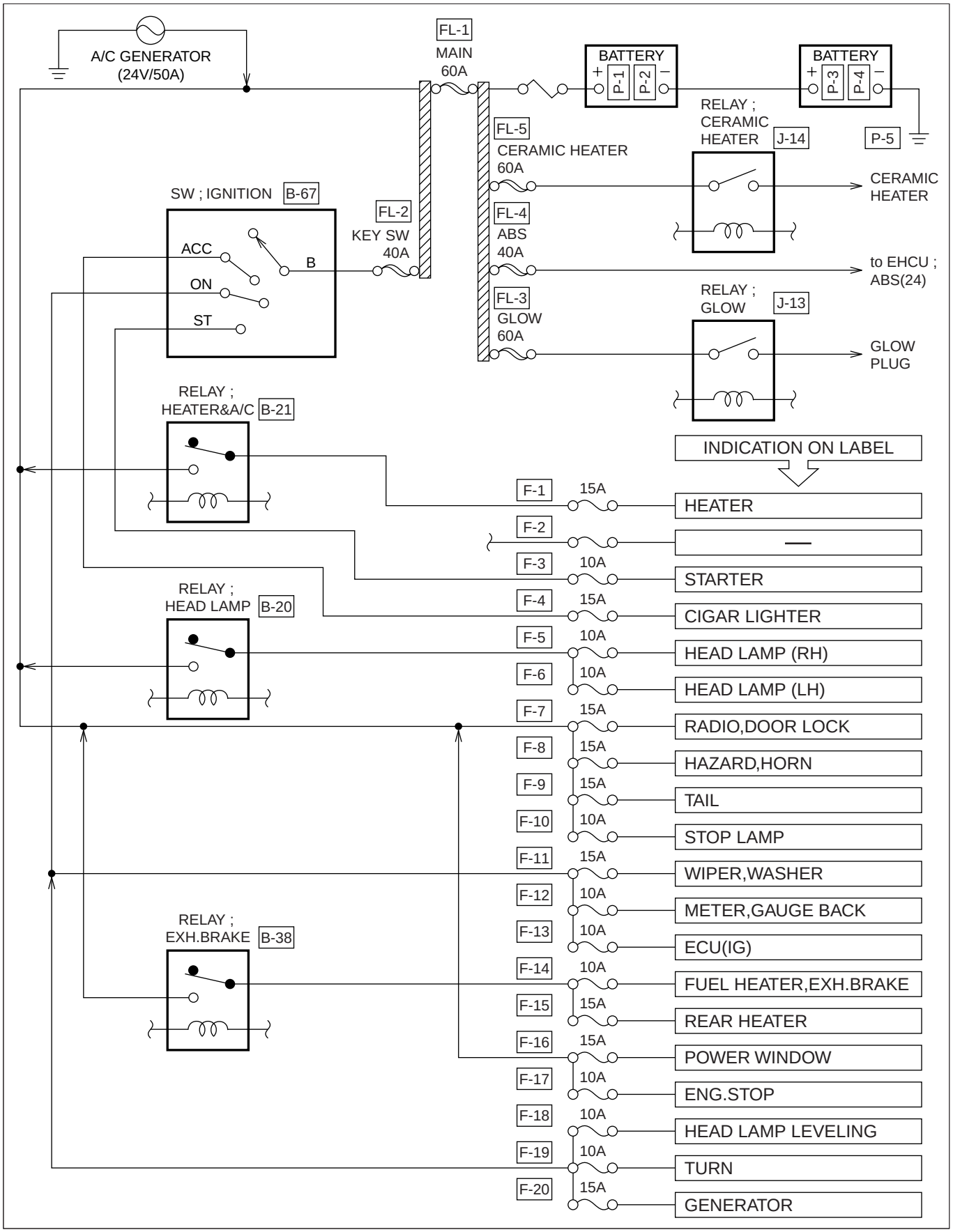


No.	Name	Capacity	Remarks
FL-1	MAIN	80A	12V
		60A	24V
FL-2	KEY SW	50A	12V
		60A	24V
FL-3	GLOW	60A	12V
		60A	24V
FL-4	ABS	60A	12V
		40A	24V
FL-5	-	-	12V
	CERAMIC HEATER	60A	24V

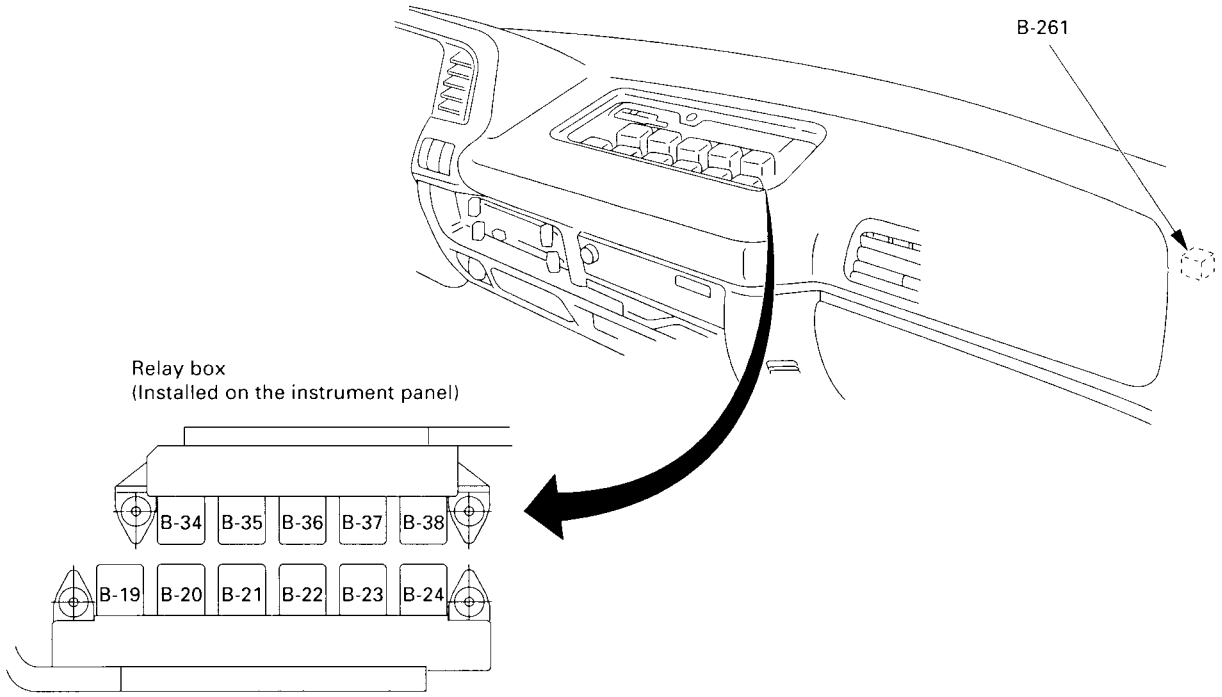
Fuse Block Circuit - FOR 12VOLT

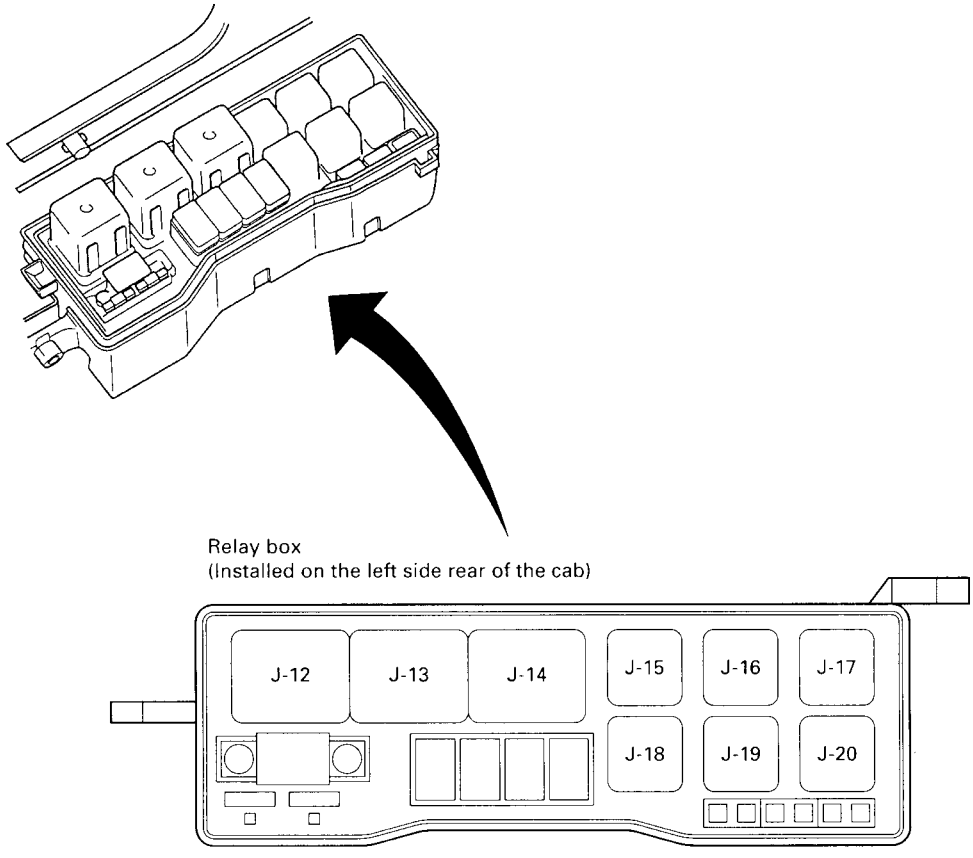


Fuse Block Circuit - FOR 24VOLT



Relay Location





Relay List

Connector No.	B-19	B-20	B-21	B-22	B-23
Relay name	Charge	Headlight	Heater & A/C	Tail	Dimmer

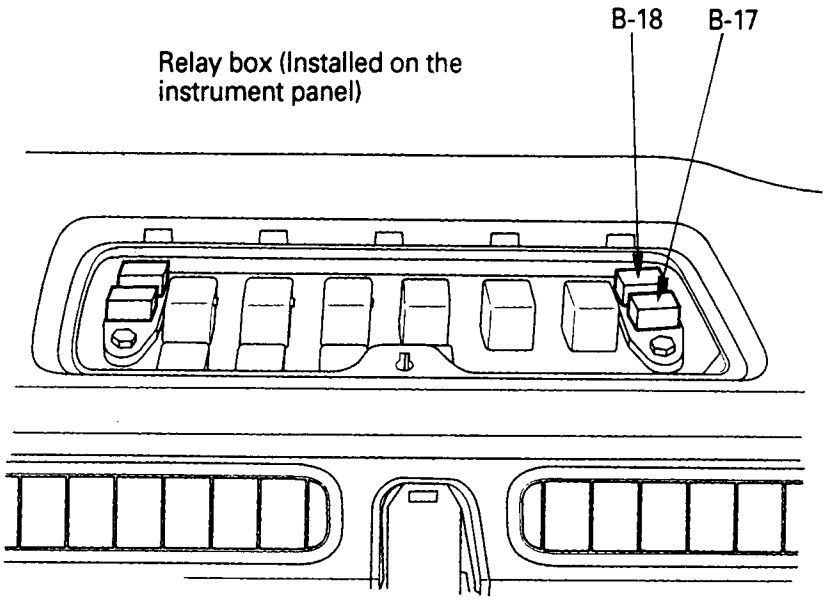
Connector No.	B-24	B-34	B-35	B-36	B-37
Relay name	Horn	Buzzer cansel	ABS. IND	Power window	A/C thermo

Connector No.	B-38	B-261
Relay name	Exh. Brake	Timing

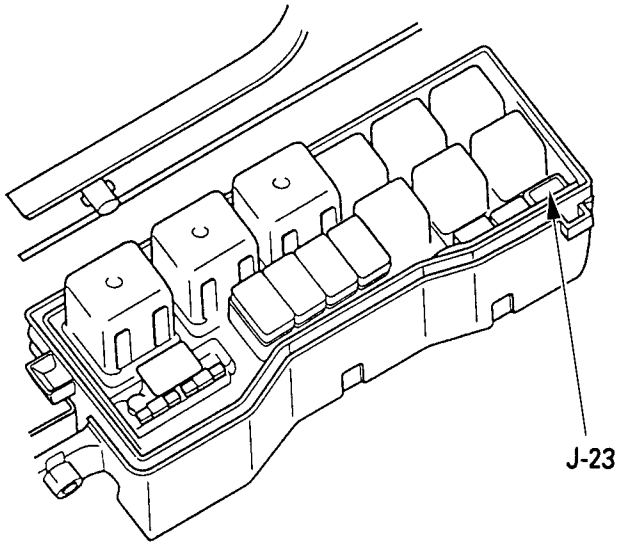
Connector No.	J-12	J-13	J-14	J-15	J-16
Relay name	Starter	Glow	C/HEATER	Eng. warm cut	Exh. brake cut

Connector No.	J-17	J-18	J-19	J-20
Relay name	Condenser fan	Exh. brake control	Rear fog	Marker lamp

Diode Location



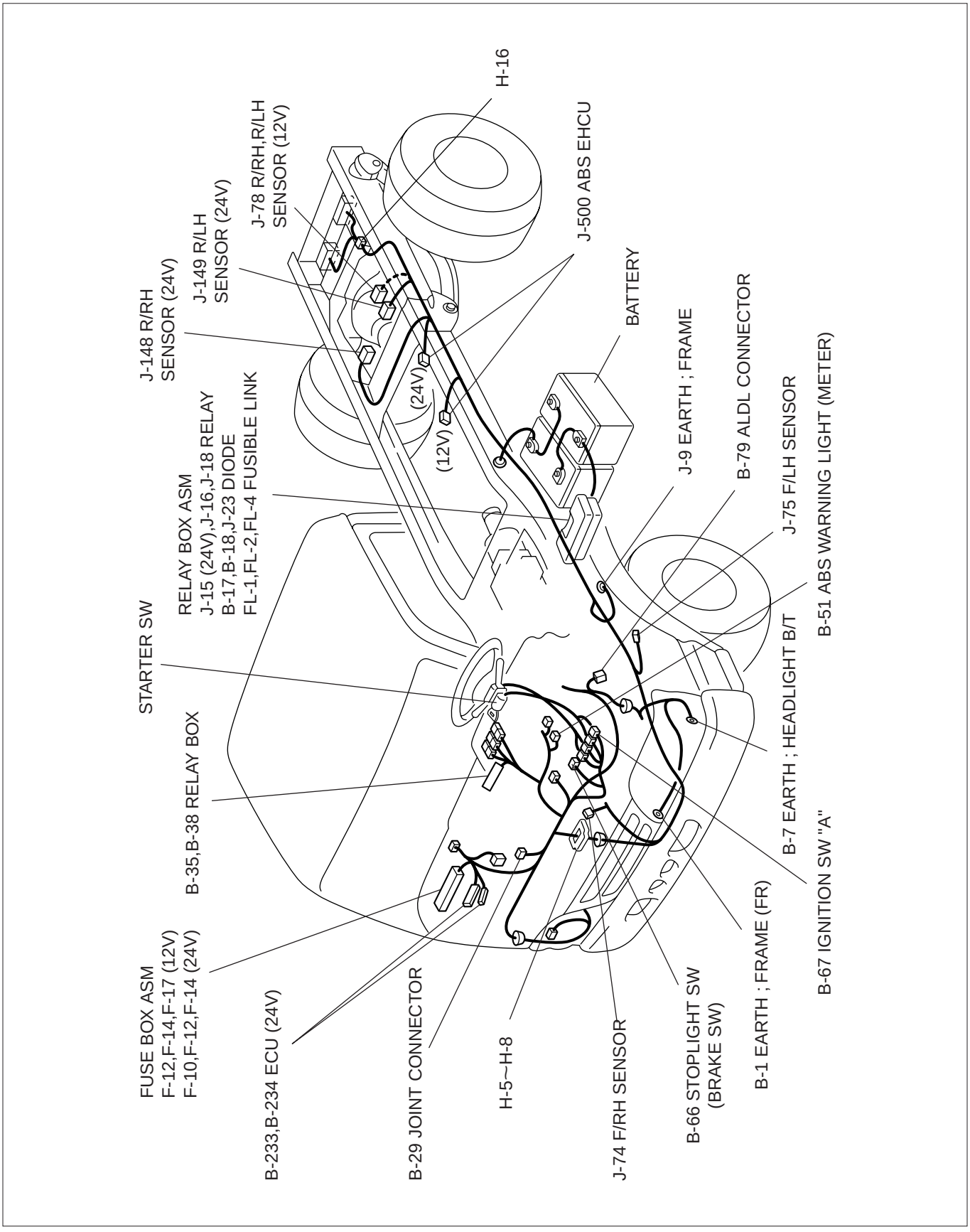
Relay box (Installed on the cab left side rear)



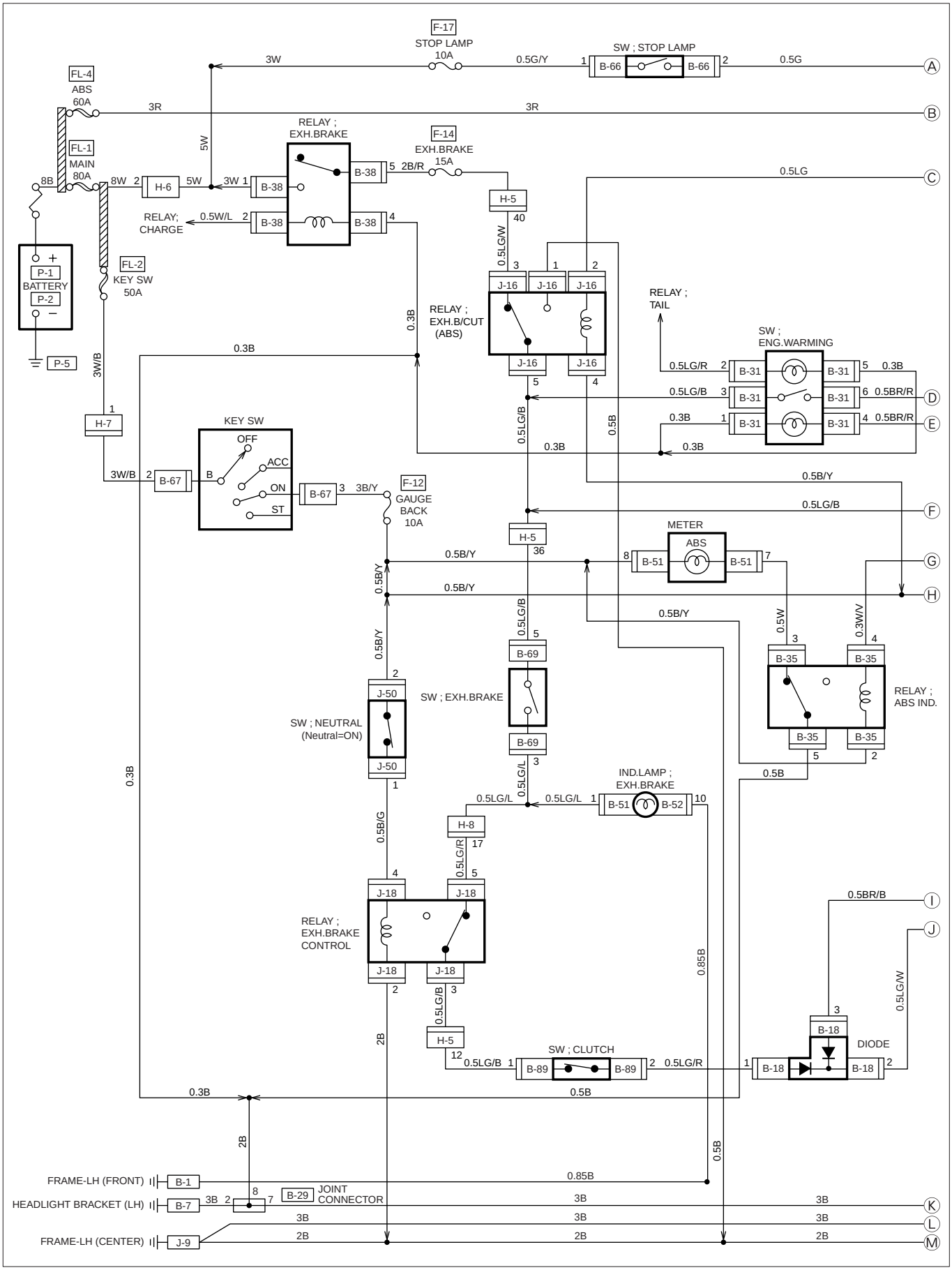
Connector No.	B-17	B-18	J-23
Usage	RELAY : THERMO A/C	SW : ACCEL	VSD : FICD

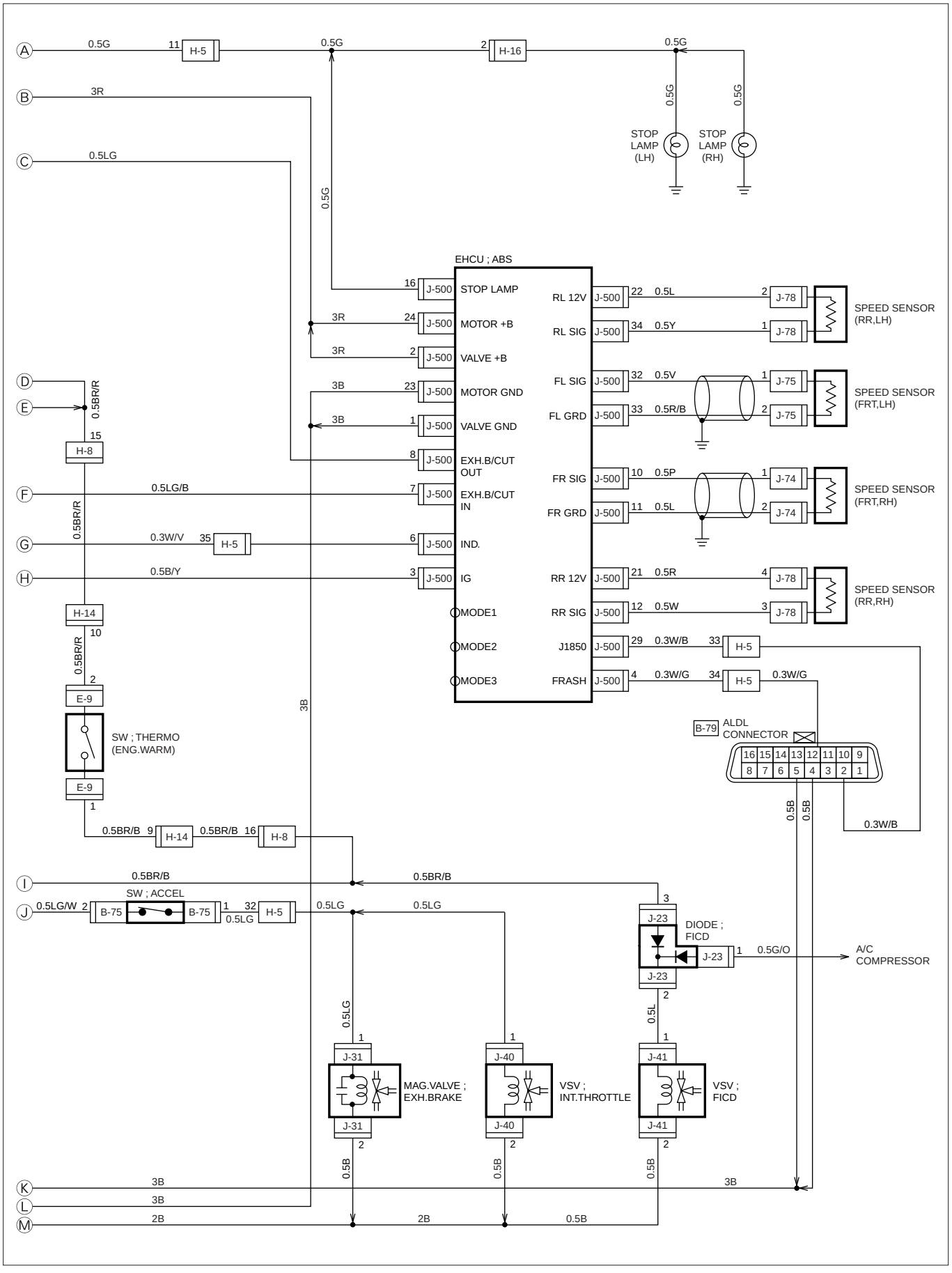
ABS (Anti-lock Brake System)

Parts Location

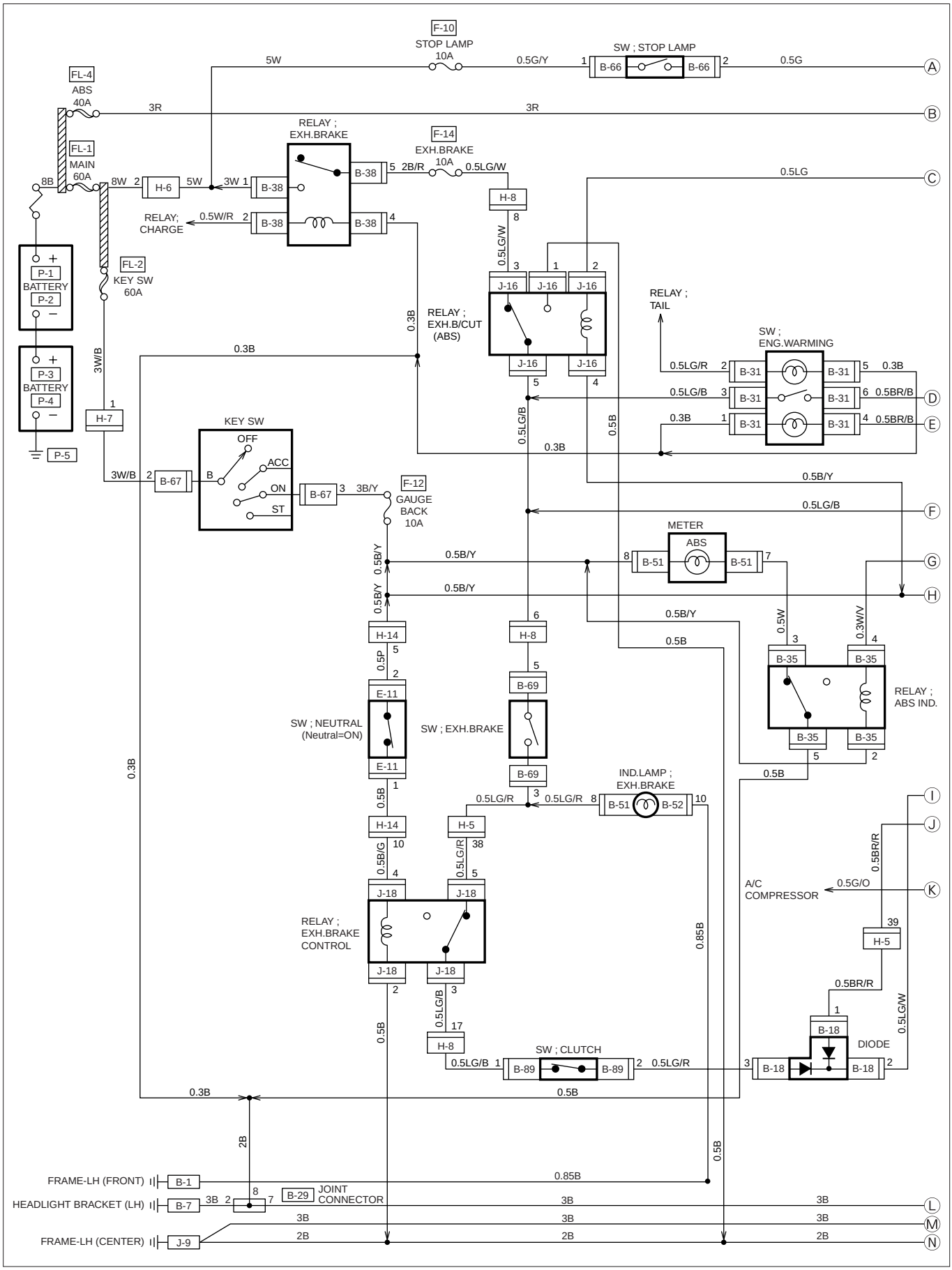


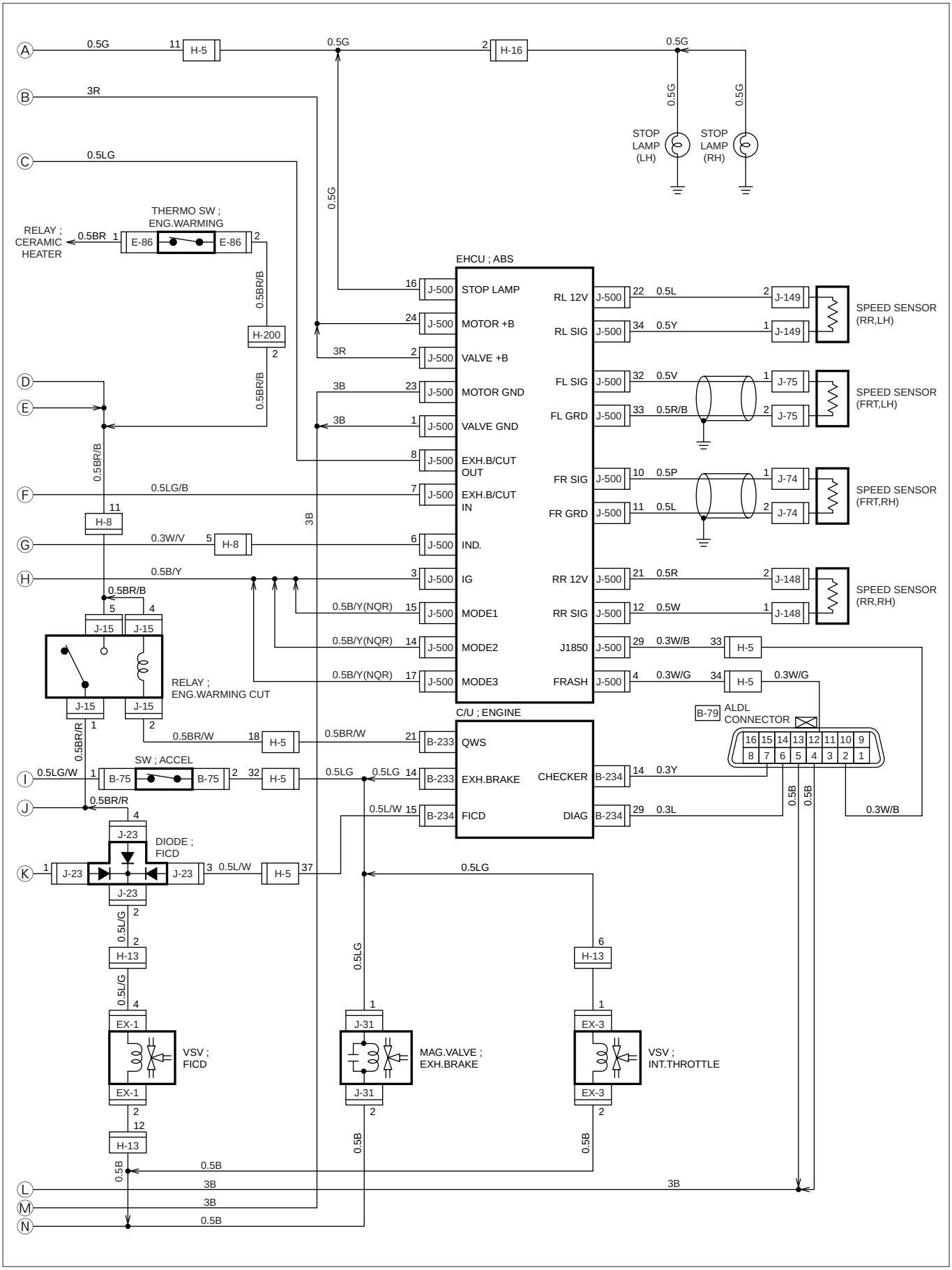
Circuit Diagram-FOR 12VOLT




A
0.5G
11
H-5
0.5G
2
H-16
0.5G
B
3R
C
0.5LG
0.5G
0.5G
0.5G
STOP LAMP (LH)
STOP LAMP (RH)
EHCU ; ABS
16
J-500
STOP LAMP
3R
24
J-500
MOTOR +B
3R
2
J-500
VALVE +B
3B
23
J-500
MOTOR GND
3B
1
J-500
VALVE GND
8
J-500
EXH.B/CUT OUT
7
J-500
EXH.B/CUT IN
6
J-500
IND.
3
J-500
IG
MODE1
MODE2
MODE3
RL 12V
RL SIG
FL SIG
FL GRD
FR SIG
FR GRD
RR 12V
RR SIG
J1850
FRASH
J-500
22
0.5L
34
0.5Y
32
0.5V
33
0.5R/B
10
0.5P
11
0.5L
21
0.5R
12
0.5W
29
0.3W/B
4
0.3W/G
J-78
J-75
J-74
SPEED SENSOR (RR,LH)
SPEED SENSOR (FRT,LH)
SPEED SENSOR (FRT,RH)
SPEED SENSOR (RR,RH)
D
E
0.5BR/R
15
H-8
F
0.5LG/B
0.5BR/R
G
0.3W/V
35
H-5
H
0.5B/Y
H-14
10
0.5BR/R
2
E-9
SW ; THERMO (ENG.WARM)
E-9
1
0.5BR/B
9
H-14
0.5BR/B
16
H-8
3B
B-79
ALDL CONNECTOR
16 15 14 13 12 11 10 9
8 7 6 5 4 3 2 1
0.5B
0.5B
0.3W/B
I
0.5BR/B
0.5BR/B
J
0.5LG/W
2
B-75
SW ; ACCEL
B-75
1
32
H-5
0.5LG
0.5LG
0.5LG
3
J-23
DIODE ; FICD
J-23
1
0.5G/O
A/C COMPRESSOR
J-23
2
0.5L
0.5LG
1
J-31
MAG.VALVE ; EXH.BRAKE
J-31
2
1
J-40
VSV ; INT.THROTTLE
J-40
2
1
J-41
VSV ; FICD
J-41
2
0.5B
0.5B
0.5B
K
3B
3B
L
3B
M
2B
2B
0.5B

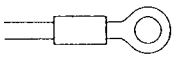
Circuit Diagram-FOR 24VOLT



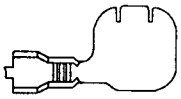

A
B
C
D
E
F
G
H
I
J
K
L
M
N
0.5G
11
H-5
2
H-16
3R
0.5LG
STOP LAMP (LH)
STOP LAMP (RH)
THERMO SW ; ENG.WARMING
RELAY ; CERAMIC HEATER
0.5BR
E-86
0.5BR/B
H-200
0.5BR/B
0.5BR/B
0.5LG/B
H-8
0.3W/V
0.5B/Y
0.5BR/B
J-15
RELAY ; ENG.WARMING CUT
0.5BR/R
0.5BR/W
SW ; ACCEL
0.5LG/W
B-75
0.5BR/R
DIODE ; FICD
J-23
0.5L/W
0.5L/G
H-13
EX-1
VSV ; FICD
0.5B
EHCU ; ABS
STOP LAMP
MOTOR +B
VALVE +B
MOTOR GND
VALVE GND
EXH.B/CUT OUT
EXH.B/CUT IN
IND.
IG
MODE1
MODE2
MODE3
RL 12V
RL SIG
FL SIG
FL GRD
FR SIG
FR GRD
RR 12V
RR SIG
J1850
FRASH
J-500
0.5L
0.5Y
0.5V
0.5R/B
0.5P
0.5R
0.5W
0.3W/B
0.3W/G
J-149
J-75
J-74
J-148
SPEED SENSOR (RR,LH)
SPEED SENSOR (FRT,LH)
SPEED SENSOR (FRT,RH)
SPEED SENSOR (RR,RH)
C/U ; ENGINE
QWS
EXH.BRAKE
FICD
CHECKER
DIAG
B-233
B-234
0.3Y
0.3L
B-79
ALDL CONNECTOR
16 15 14 13 12 11 10 9
8 7 6 5 4 3 2 1
0.5LG
J-31
MAG.VALVE ; EXH.BRAKE
EX-3
VSV ; INT.THROTTLE
3B

Connector List

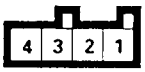
B-1



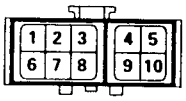
B-7



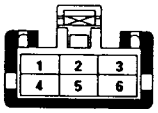
B-18



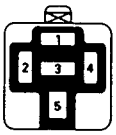
B-29



B-31

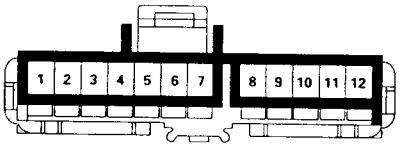


B-35 B-38



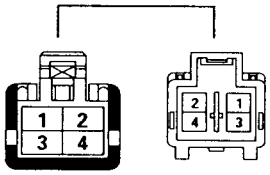
B-51

B-52

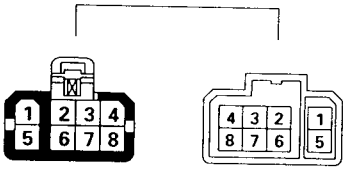


B-66

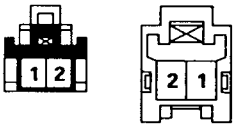
B-67



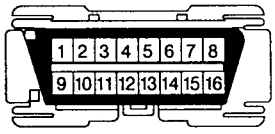
B-69



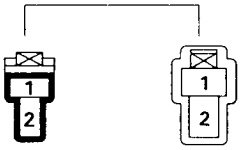
B-75



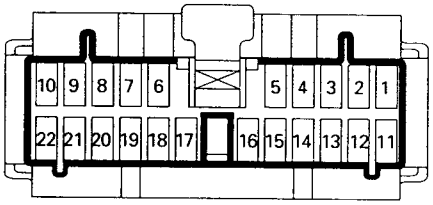
B-79



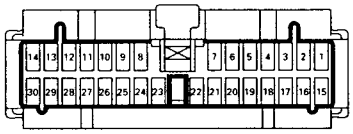
B-89



B-233 (24V)

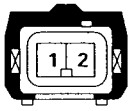


B-234 (24V)

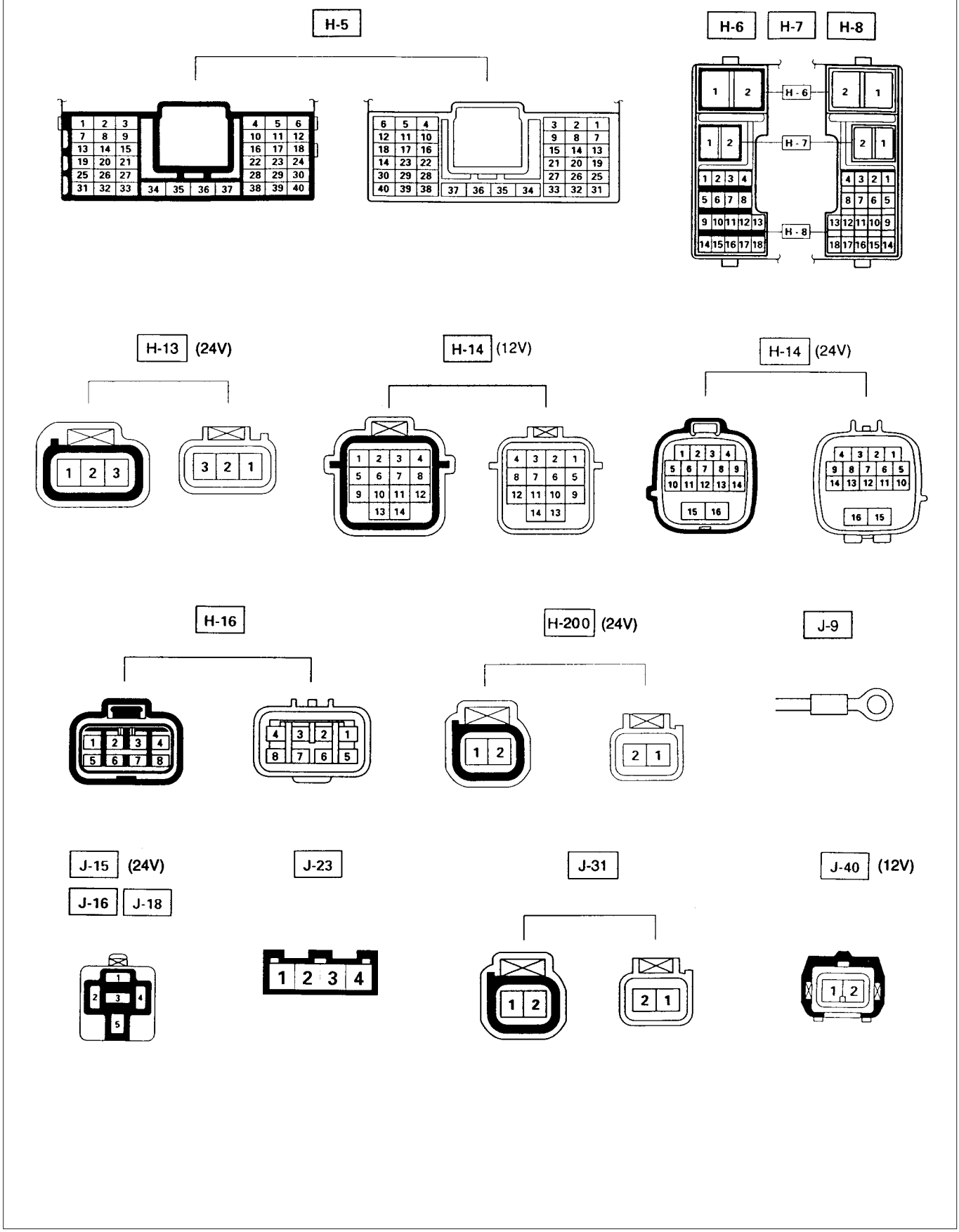


E-9 (12V)
E-11 E-86 (24V)

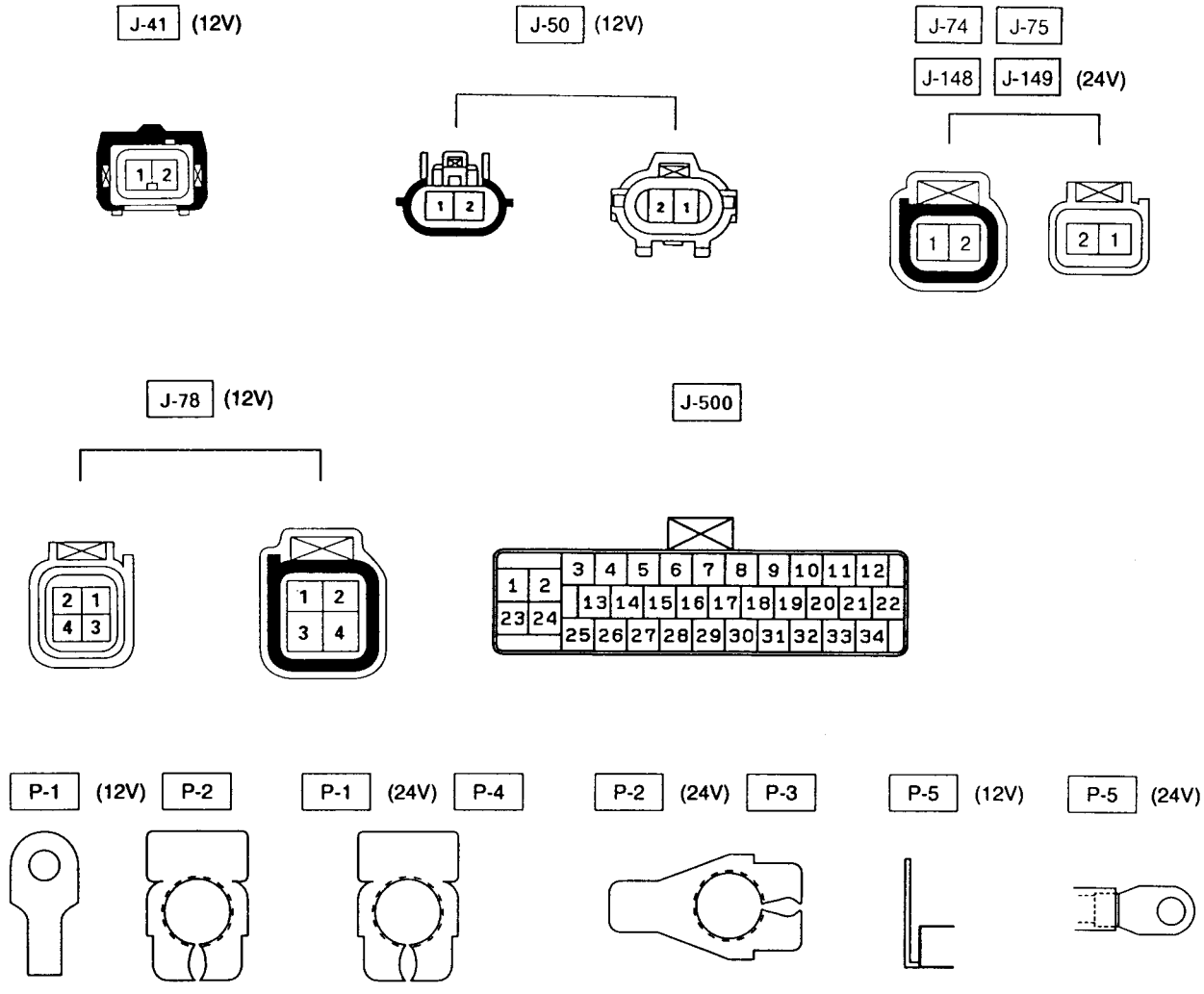
EX-1 EX-3 (24V)



Connector List



Connector List



LGBRK-AE-0108

You are requested to order this manual using the manual number that is shown above.

This manual is applicable for vehicles in all countries except the USA and Canada.

All rights reserved. This manual may not be reproduced in whole or in part, without the permission in writing of ISUZU MOTORS LIMITED.

Issued by

ISUZU MOTORS LIMITED

INTERNATIONAL SERVICE DEPARTMENT

Tokyo, Japan

First edition Jan., 2001

LGBRK-AE-0108 PRINTED IN JAPAN

WORKSHOP MANUAL

NKR · NPR · NQR

ANTI-LOCK BRAKE SYSTEM (ABS)

SECTION 5A4

ISUZU

ISUZU
International Service & Parts
Tokyo, Japan

SECTION 5A4

ANTI-LOCK BRAKE SYSTEM (ABS)

Service Precaution

CAUTION: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. ISUZU will call out those fasteners that require a replacement after removal. ISUZU will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (Paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

CONTENTS

PAGE

Service Precaution ..... 5A4 -1
General Description ..... 5A4 -5
System Components ..... 5A4 -6
Electronic Hydraulic Control Unit (EHCU) ..... 5A4 -6
Hydraulic Unit (HU) ..... 5A4 -6
ABS Warning Light ..... 5A4 -6
Wheel Speed Sensor ..... 5A4 -6
Normal and Anti-lock Braking ..... 5A4 -6
Brake Pedal Travel ..... 5A4 -7
Acronyms and Abbreviations ..... 5A4 -7
General Diagnosis ..... 5A4 -7
General Information ..... 5A4 -7
ABS Service Precautions ..... 5A4 -7
Computer System Service Precautions ..... 5A4 -7
General Service Precautions ..... 5A4 -8
Note on Intermittents ..... 5A4 -8
Test Driving ABS Complaint Vehicles ..... 5A4 -8
“ABS” Warning Light ..... 5A4 -8
Normal Operation ..... 5A4 -8
Basic Diagnostic Flow Chart ..... 5A4 -9
Basic Inspection Procedure ..... 5A4 -9

Tech 2 Scan Tool ..... 5A4 -10
Tech 2 Features ..... 5A4 -11
Getting Started ..... 5A4 -11
Operating Procedure (For Example) ..... 5A4 -12
DTC Modes ..... 5A4 -13
DTC Information Mode ..... 5A4 -13
Plotting Snapshot Graph ..... 5A4 -14
Plotting Graph Flow Chart (Plotting graph after obtaining vehicle information) ..... 5A4 -15
Flow Chart for Snapshot Replay (Plotting Graph) ..... 5A4 -16
Tech 2 Data Display ..... 5A4 -17
Special Function ..... 5A4 -17
EHCU Connector Pin-out Checks ..... 5A4 -21
Circuit Diagram ..... 5A4 -22
Connector List ..... 5A4 -26
Part Location ..... 5A4 -29
Symptom Diagnosis ..... 5A4 -30
Chart A-1 ABS Works Frequently But Vehicle Does Not Decelerate ..... 5A4 -30
Chart TA-1 ABS Works Frequently But Vehicle Does Not Decelerate (Use TECH 2) ..... 5A4 -30
Chart A-2 Uneven Braking Occurs While ABS Works ..... 5A4 -31
Chart A-3, TA-3 The Wheels Are Locked ..... 5A4 -31
Chart A-4 Brake Pedal Feed Is Abnormal ..... 5A4 -32
Chart A-5, TA-5 Braking Sound (From Hydraulic Unit) Is Heard While Not Braking ..... 5A4 -33
Diagnostic Trouble Codes ..... 5A4 -34
Diagnosis By “ABS” Warning Light Illumination Pattern ..... 5A4 -35
Diagnostic Trouble Codes (DTCs) ..... 5A4 -35
Chart B-1-1 With the key in the ON position (Before starting the engine). Warning light (W/L) is not activated. ..... 5A4 -39
Chart 1 (DTC 13/C0213) Vehicle Type Error ..... 5A4 -40
Chart 2 (DTC 14/C0214) Low Power Voltage of Rear Sensor or EHCU Abnormality ..... 5A4 -40
Chart 3 (DTC 15/C0215) Low Power Voltage OUT of Range ..... 5A4 -41
Chart 4 (DTC 25/C0225) Exhaust Brake Cut Circuit Abnormality ..... 5A4 -42
Chart 5 (DTC 33/C0233) Motor Drive Circuit Abnormality ..... 5A4 -42

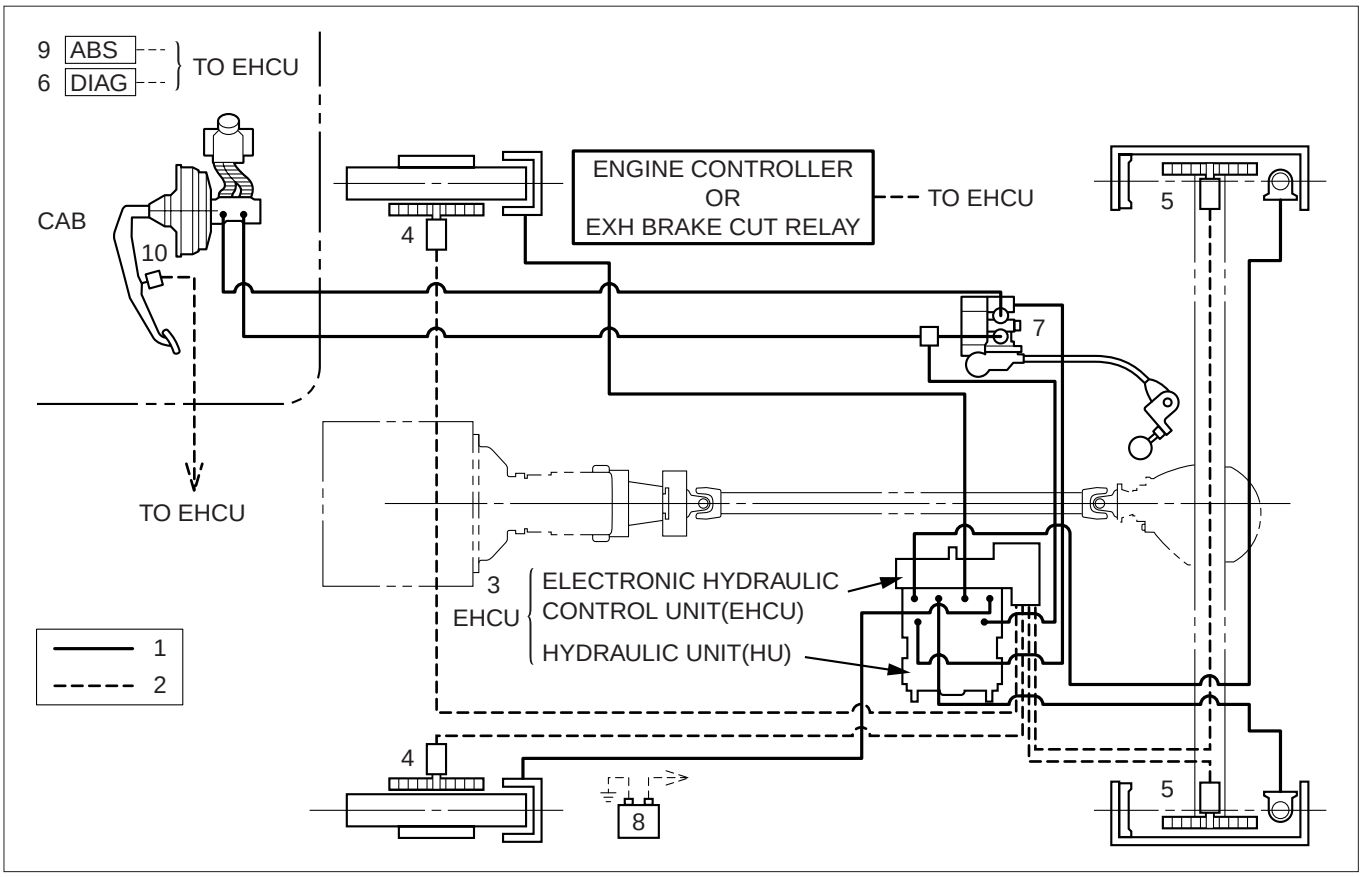
Chart 6 (DTC 34/C0234) Abnormal Motor Rotation ..... 5A4 -42
Chart 7 (DTC 41/C0241) Solenoid Valve Power Supply Abnormality ..... 5A4 -43
Chart 8 (DTC 43, 45/C0243, C0245) Solenoid Valve Circuit Abnormality ..... 5A4 -43
Chart 9 (DTC 51/C0251) FL Speed Sensor Circuit Abnormality ..... 5A4 -43
Chart 10 (DTC 52/C0252) FR Speed Sensor Circuit Abnormality ..... 5A4 -43
Chart 11 (DTC 53/C0253) RL Speed Sensor Circuit Abnormality ..... 5A4 -44
Chart 12 (DTC 54/C0254) RR Speed Sensor Circuit Abnormality ..... 5A4 -45
Chart 13 (DTC 61/C0261) Abnormal FL Speed Sensor Signal ..... 5A4 -46
Chart 14 (DTC 62/C0262) Abnormal FR Speed Sensor Signal ..... 5A4 -48
Chart 15 (DTC 63/C0263) Abnormal RL Speed Sensor Signal 5A4- 50
Chart 16 (DTC 64/C0264) Abnormal RR Speed Sensor Signal 5A4- 51
Chart 17 (DTC 65/C0265) Tire Size Error 5A4- 52
Unit Inspection Procedure 5A4- 53
Chart C-1-1 FL Speed Sensor Output Inspection Procedure 5A4- 53
Chart C-1-2 FR Speed Sensor Output Inspection Procedure 5A4- 54
Chart C-1-3 RL Speed Sensor Output Inspection Procedure 5A4- 55
Chart C-1-4 RR Speed Sensor Output Inspection Procedure 5A4- 57
Chart TC-1 Sensor Output Inspection Procedure (Use TECH 2) 5A4- 58
Electronic Hydraulic Control Unit (EHCU) 5A4- 59
Removal 5A4- 59
Installation 5A4- 59
Front Speed Sensor 5A4- 60
Front Speed Sensor and Associated Parts 5A4- 60
Removal 5A4- 60
Inspection and Repair 5A4- 60
Installation 5A4- 60
Front Speed Sensor Rotor 5A4- 61
Front Speed Sensor Rotor and Associated Parts 5A4- 61
Removal 5A4- 61
Inspection and Repair 5A4- 62
Installation 5A4- 62
Rear Speed Sensor 5A4- 63
Rear Speed Sensor and Associated Parts 5A4- 63
Removal 5A4- 64
Inspection and Repair 5A4- 64

Installation 5A4- 64
Rear Speed Sensor Rotor 5A4- 65
Rear Speed Sensor Rotor and Associated Parts 5A4- 65
Removal 5A4- 65
Inspection and Repair 5A4- 65
Installation 5A4- 65
Special Tools 5A4- 67

General Description

The Anti-lock Brake System (ABS) works on all four wheels. A combination of wheel speed sensor and Electronic Hydraulic Control Unit (EHCU) can determine when a wheel is about to stop turning and adjust brake pressure to maintain best braking.

This system helps the drive maintain greater control of the vehicle under heavy braking conditions.



Legend

(1) Hydraulic Line
(2) Electronic Line
(3) Electronic Hydraulic Control Unit (EHCU)
(4) Front Wheel Speed Sensor
(5) Rear Wheel Speed Sensor
(6) Diagnosis Connector
(7) Load Sensing Proportioning Valve (LSPV)
(8) Battery
(9) ABS Warning Light
(10) Brake Switch

System Components

The Anti-lock Brake System consists of a Electronic Hydraulic Control Unit (EHCU), four Wheel Speed Sensors and Warning Light.

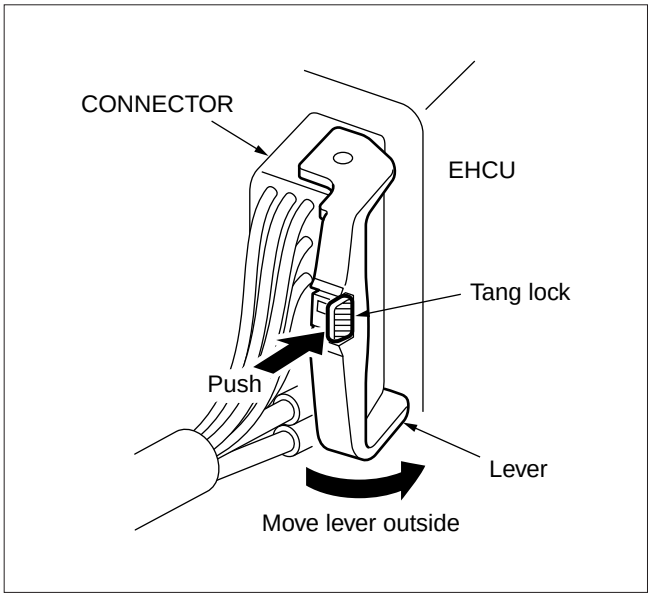
Electronic Hydraulic Control Unit (EHCU)

The EHCU consists of Electronic Brake Control Module (EBCM) and Hydraulic Unit (HU).

The EHCU is located at the frame side, in front of rear spring bracket.

The EHCU consists of ABS control circuits, fault detector, and a fail-safe. It drives the hydraulic unit according to the signal from each sensor, cancelling ABS to return to normal braking when a malfunction has occurred in the ABS.

The EHCU is self-diagnosing function which can indicate faulty circuits during diagnosis.



NOTE:

When disconnecting harness connector from EHCU, push the tang lock of the connector (▭ portion) and release the tang lock. Then move the lever.

Hydraulic Unit (HU)

It consists of a Motor, Plunger Pump, Solenoid Valves and Check Valve.

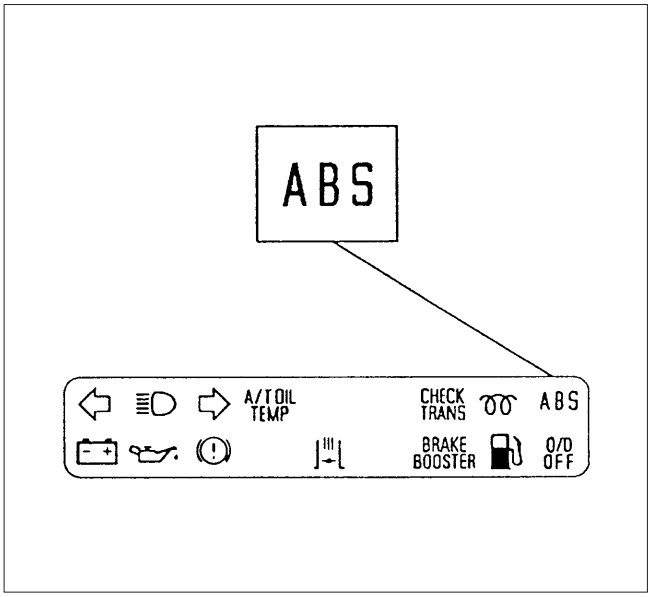
Solenoid Valves: Reduces or holds the caliper fluid pressure for each front disc brake or both rear drum brakes according to the signal sent from the EHCU.

Reservoir: Temporarily holds the brake fluid that returns from the front and rear wheel brake so that pressure of front wheel brake can be reduced smoothly.

Plunger Pump: Feeds the brake fluid held in the reservoir to the master cylinder.

Motor: Drives the pump according to the signal from EHCU. Check Valve: Controls the brake fluid flow.

ABS Warning Light



Vehicles equipped with the Anti-lock Brake System has an amber “ABS” warning light in the instrument panel. The “ABS” warning light will illuminate if a malfunction in the Anti-lock Brake System is detected by the Electronic Hydraulic Control Unit (EHCU). In case of an electronic malfunction, the EHCU will turn “ON” the “ABS” warning light and disable the Anti-lock braking function.

The “ABS” light will turn “ON” for 2 seconds after the ignition switch is to the “ON” position, and then will go out.

If the “ABS” light comes “ON” and stays “ON” while driving, the Anti-lock Brake System should be inspected for a malfunction according to the diagnosis procedure.

Wheel Speed Sensor

It consists of a sensor and a rotor. The sensor is attached to the knuckle on the front wheels and to the bracket on the brake back plate on the rear wheels. The front speed sensor is coil type and rear is Hall IC type.

The sensor rotors press-fitted to front and rear wheel hubs output pulse frequency depending on wheel rotation.

The speed sensors find vehicle speed from its frequency.

Normal and Anti-lock Braking

Under normal driving conditions, the Anti-lock Brake System functions the same as a standard power assisted brake system. However, with the detection of wheel lock-up, a slight bump or kick-back will be felt in the brake pedal. This pedal “bump” will be followed by a series of short pedal pulsations which occurs in rapid succession. The brake pedal pulsation will continue

until there is no longer a need for the anti-lock function or until the vehicle is stopped. A slight ticking or popping noise may be heard during brake applications when the Anti-lock features is being used.

When the Anti-lock feature is being used, the brake pedal may rise even as the brakes are being applied.

This is also normal. Maintaining a consist force on the pedal will provide the shortest stopping distance.

Brake Pedal Travel

Vehicles equipped with the Anti-lock Brake System may be stopped by applying normal force to the brake pedal. Although there is no need to push the pedal beyond the point where it stops or holds the vehicle, by applying more force the pedal will continue to travel toward the floor.

This extra brake pedal travel is normal.

Acronyms and Abbreviations

Several acronyms and abbreviations are commonly used throughout this section:

ABS

Anti-lock Brake System

CKT

Circuit

DLC

Data Link Connector

DTC

Diagnostic Trouble Code

DVM

Digital Volt Meter (High Impedance Multimeter)

EHCU

Electronic Hydraulic Control Unit

FL

Front Left

FR

Front Right

GEN

Generator

HU

Hydraulic Unit

MV

Millivolts

RL

Rear Left

RR

Rear Right

RPS

Revolution per Second

SW

Switch

VDC

Volts DC

VAC

Volts AC

W/L

Warning Light

WSS

Wheel Speed Sensor

General Diagnosis

General Information

ABS malfunction can be classified into two types, those which can be detected by the ABS warning light and those which can be detected as a vehicle abnormality by the driver.

In either case, locate the fault in accordance with the “BASIC DIAGNOSTIC FLOWCHART” and repair.

Please refer to Section 5A for the diagnosis of mechanical troubles such as brake noise, brake judder (brake pedal or vehicle vibration felt when braking), uneven braking, and parking brake trouble.

ABS Service Precautions

Required Tools and Items:

- Box Wrench
- Brake Fluid
- Special Tool

Some diagnosis procedures in this section require the installation of a special tool.

5-8840-0285-0 (J-39200) High Impedance Multimeter

When circuit measurements are requested, use a circuit tester with high impedance.

Computer System Service Precautions

The Anti-lock Brake System interfaces directly with the Electronic Hydraulic Control Unit (EHCU) which is a control computer that is similar in some regards to the Engine Control Module. These modules are designed to withstand normal current draws associated with vehicle operation. However, care must be taken to avoid overloading any of the EHCU circuits. In testing for opens or shorts, do not ground or apply voltage to any of the circuits unless instructed to do so by the appropriate diagnostic procedure. These circuits should only be tested with a high impedance multimeter 5-8840-0285-0 (J-39200) or special tools as described in this section. Power should never be removed or applied to any control module with the ignition in the “ON” position. Before removing or connecting battery cables, fuses or connectors, always turn the ignition switch to the “OFF” position.

General Service Precautions

The following are general precautions which should be observed when servicing and diagnosing the Anti-lock Brake System and/or other vehicle systems. Failure to observe these precautions may result in Anti-lock Brake System damage.

- If welding work is to be performed on the vehicle using an electric arc welder, the EHCU connector should be disconnected before the welding operation begins.
- The EHCU connector should never be connected or disconnected with the ignition "ON".
- The EHCU is not separately serviceable and must be replaced as assemblies. Do not disassemble any component which is designated as non-serviceable in this Section.
- If only rear wheels are rotated using jacks or drum tester, the system will diagnose a speed sensor malfunction and the "ABS" warning light will illuminate. But actually no trouble exists. After inspection stop the engine once and re-start it, then make sure that the "ABS" warning light does not illuminate.

If the battery has been discharged

The engine may stall if the battery has been completely discharged and the engine is started via jumper cables. This is because the Anti-lock Brake System (ABS) requires a large quantity of electricity. In this case, wait until the battery is recharged, or set the ABS to a non-operative state by removing the fuse for the ABS. After the battery has been recharged, stop the engine and install the ABS fuse. Start the engine again, and confirm that the ABS warning light does not light.

Note on Intermittents

As with virtually any electronic system, it is difficult to identify an intermittent failure. In such a case duplicating the system malfunction during a test drive or a good description of vehicle behavior from the customer may be helpful in locating a "most likely" failed component or circuit. The symptom diagnosis chart may also be useful in isolating the failure. Most intermittent problems are caused by faulty electrical connections or wiring. When an intermittent failure is encountered, check suspect circuits for:

- Suspected harness damage.
- Poor mating of connector halves or terminals not fully seated in the connector body (backed out).
- Improperly formed or damaged terminals.

Test Driving ABS Complaint Vehicles

In case that there has been an malfunction in the lighting pattern of "ABS" warning light, the fault can be located in accordance with the "DIAGNOSIS BY "ABS" WARNING LIGHT ILLUMINATION PATTERN". In case of such trouble as can be detected by the driver as a vehicle symptom, however, it is necessary to give a test drive following the test procedure mentioned below, thereby reproducing the symptom for trouble diagnosis on a symptom basis:

1. Start the engine and make sure that the "ABS" W/L goes OFF. If the W/L remains ON, it means that the Diagnostic Trouble Code (DTC) is stored. Therefore, read the code and locate the fault.
2. Start the vehicle and accelerate to about 30km/h (19 mph) or more.
3. Slowly brake and stop the vehicle completely.
4. Then restart the vehicle and accelerate to about 40 km/h (25 mph) or more.
5. Brake at a time so as to actuate the ABS and stop the vehicle.
6. Be cautious of abnormality during the test. If the W/L is actuated while driving, read the DTC and locate the fault.
7. If the abnormality is not reproduced by the test, make best efforts to reproduce the situation reported by the customer.
8. If the abnormality has been detected, repair in accordance with the "SYMPTOM DIAGNOSIS".

NOTE:

- Be sure to give a test drive on a wide, even road with little traffic.
- If an abnormality is detected, be sure to suspend the test and start trouble diagnosis at once.

"ABS" Warning Light

When ABS trouble occurs and actuates when possible the "ABS" warning light, the trouble code corresponding to the trouble is stored in the EHCU. Only the ordinary brake system is available when the ABS is turned OFF. When the "ABS" warning light is actuated, if the starter switch is set ON after setting it OFF once, the EHCU checks up on the entire system and, if there is no abnormality, judges ABS to work currently and the warning light works normally even though the trouble code is stored.

NOTE: Illumination of the "ABS" warning light indicates that anti-lock braking is no longer available. Power assisted braking without anti-lock control is still available.

Normal Operation

"ABS" Warning Light

When the ignition is first moved from "OFF" to "ON", the amber "ABS" warning light will turn "ON" for 2 seconds and will turn "OFF".

Basic Diagnostic Flow Chart

Step	Action	Yes	No
1	1. Customer complaint. 2. Questioning to customer. 3. Basic inspection (Refer to “Basic inspection procedure”) Using TECH 2?	Go to Step 2	Go to Step 3
2	Make sure of DTC by TROUBLE CODE. Is EHCU including DTC?	Go to Step 5	Go to Step 4
3	Check if the DTC is stored. Is EHCU including DTC?	Go to Step 5	Go to Step 4
4	Test drive. Is W/L lit?	Go to Step 5	Trouble diagnosis based on symptom (Refer to “SYMPTOM DIAGNOSIS”) Go to Step 5
5	1. Repair of faulty part. 2. Elimination of DTC. 3. Inspection of “ABS” W/L illumination pattern with ignition SW “ON”. 4. Test drive. Does repeat trouble?	Repeat the diagnosis of the symptom or DTC appears again Go to Step 1	Go to Step 6
6	1. Reconnect all components and ensure all components are properly mounted. 2. Clear diagnostic trouble code. Was this step finished?	Finished	Go to Step 6

Basic Inspection Procedure

1. Basic Inspection of Service Brake

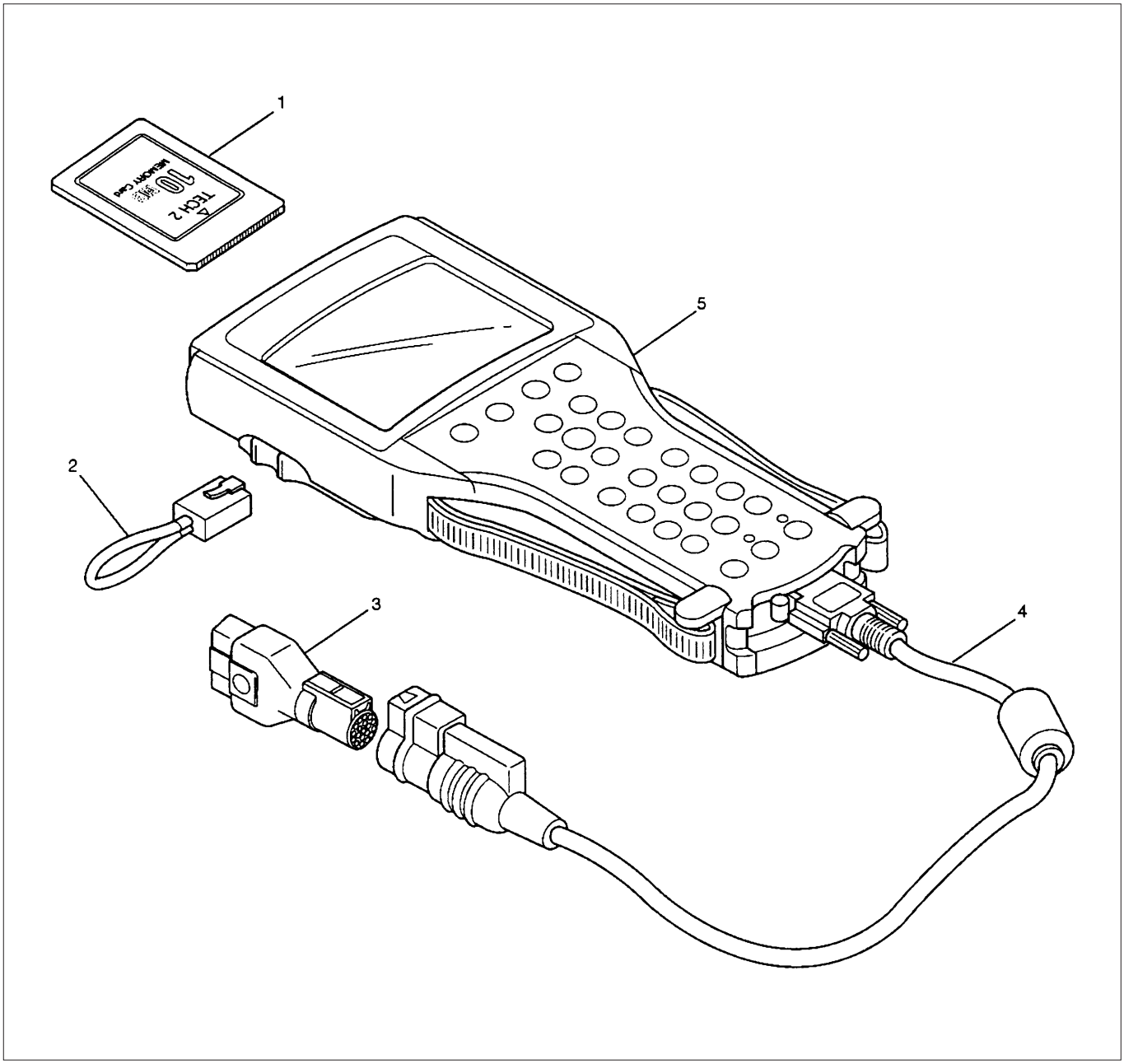
Step	Action	Yes	No
1	Is the fluid level normal?	Go to Step 2	Replenish with fluid. Go to Step 2
2	Does fluid leak?	Repair. Go to Step 3	Go to Step 3
3	Is the booster functioning normal?	Go to Step 4	Repair. Go to Step 4
4	Is the pad and rotor normal?	Go to Step 5	Repair. Go to Step 5
5	Reconnect all components and ensure all components are properly mounted. Was this step finished?	Finished	Go to Step 5

2. Ground Inspection

Step	Action	Yes	No
1	Are ABS-related ground points ok?	Go to Step 2	Repair. Go to Step 2
2	Reconnect all components and ensure all components are properly mounted. Was this step finished?	Finished	Go to Step 2

Tech 2 Scan Tool

From 98 MY, Isuzu dealer service departments are recommended to use Tech 2. Please refer to Tech 2 scan tool user guide.



Legend

(1) PCMCIA Card
(2) RS 232 Loop Back Connector
(3) SAE 16/19 Adapter
(4) DLC Cable
(5) Tech-2

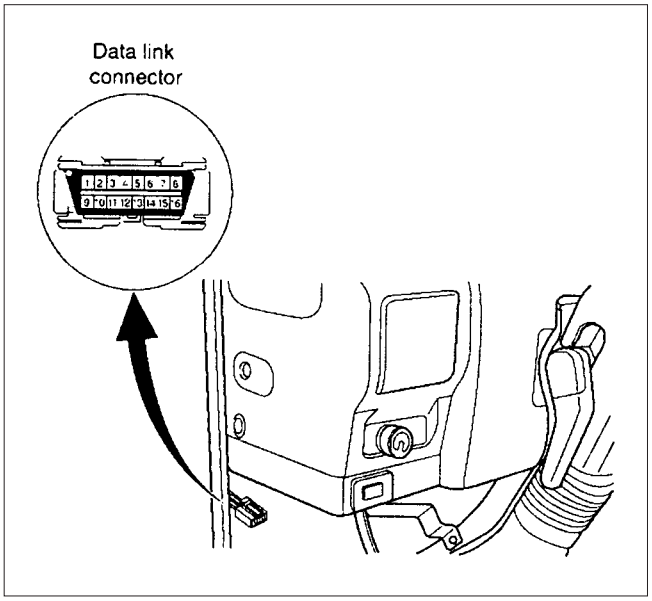
Tech 2 Features

1. Tech 2 is a 12 volt system. Do not apply 24 volt.
2. After connecting and/or installing the Vehicle Communications Interface (VCI) module, PCMCIA card and DLC connector to the Tech 2, connect the tool to the vehicle DLC.
3. Make sure the Tech 2 is powered OFF when removing or installing the PCMCIA card.
4. The PCMCIA card has a capacity of 10 Megabytes which is 10 times greater than the memory of the Tech 1 Mass Storage Cartridge.
5. The Tech 2 has the capability of two snapshots.
6. The PCMCIA card is sensitive to magnetism and static electricity, so care should be taken in the handling of the card.
7. The Tech 2 can plot a graph when replaying a snapshot.
8. Always return to the Main Menu by pressing the EXIT key several times before shutting down.
9. To clear Diagnostic Trouble Codes (DTCs), open Application Menu and press “F1: Clear DTC Info”.

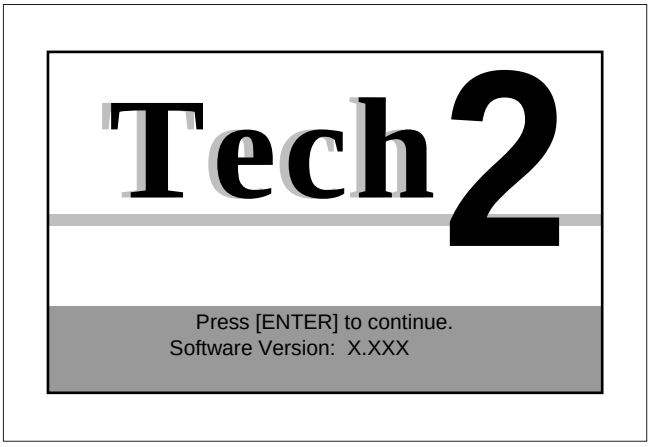
Getting Started

- Before operating the Isuzu PCMCIA card with the Tech 2, the following steps must be performed:

1. The Isuzu 2000 Model Year System PCMCIA card (1) inserts into the Tech 2 (5).
2. Connect the SAE 16/19 adapter (3) to the DLC cable (4).
3. Connect the DLC cable to the Tech 2 (5).
4. Make sure the vehicle ignition is off.
5. Connect the Tech 2 SAE 16/19 adapter to the vehicle DLC.



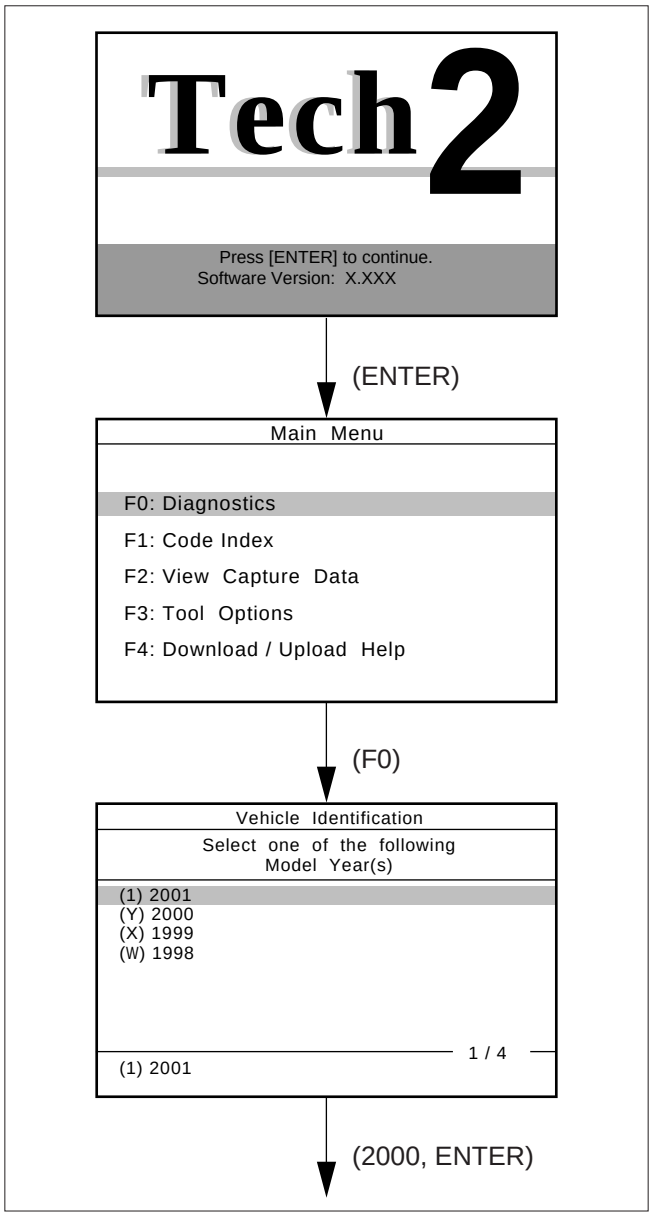
6. Turn on the vehicle ignition.
7. Power the Tech 2 ON and verify the Tech 2 power up display.

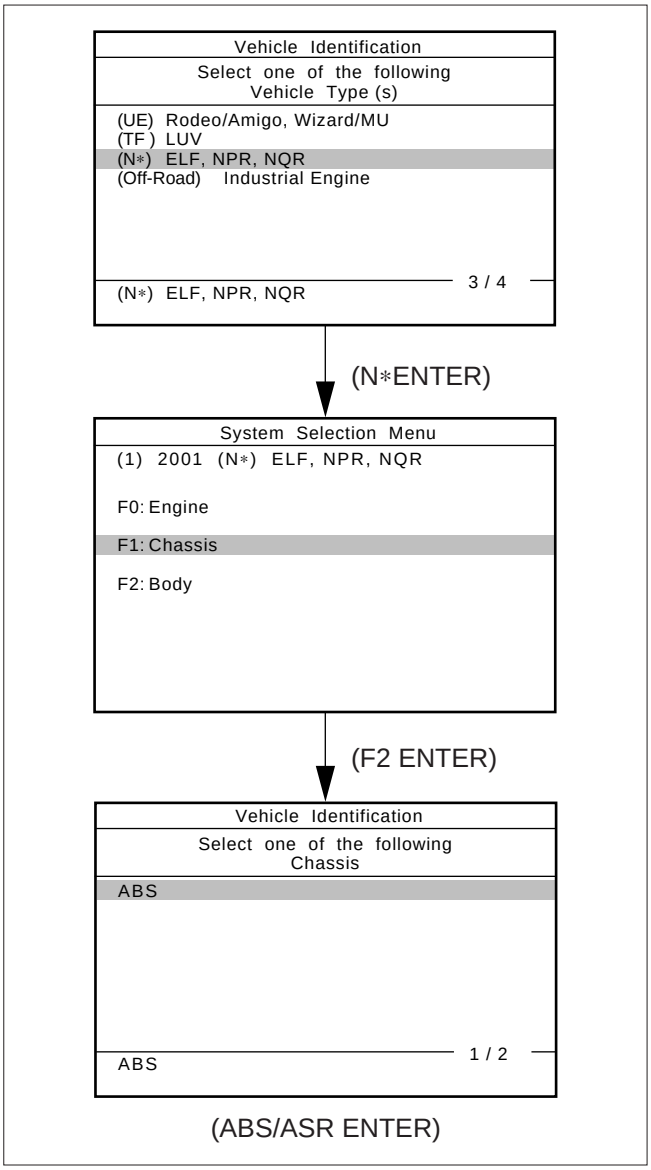


NOTE: The RS232 Loop back connector is only to use for diagnosis of Tech 2. Refer to user guide of the Tech 2.

Operating Procedure (For Example)

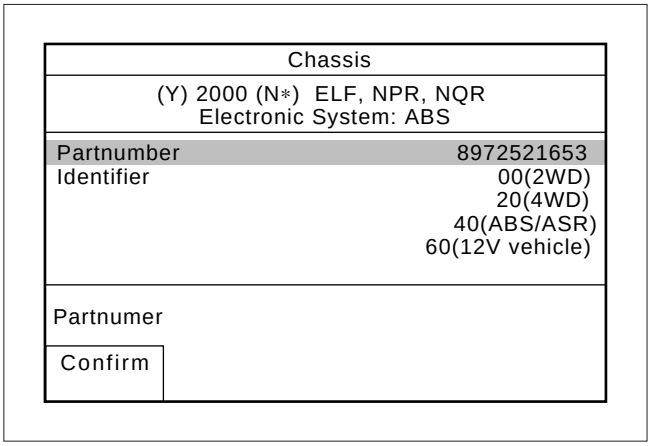
The power up screen is displayed when you power up the tester with the Isuzu systems PCMCIA card. Follow the operating procedure below.



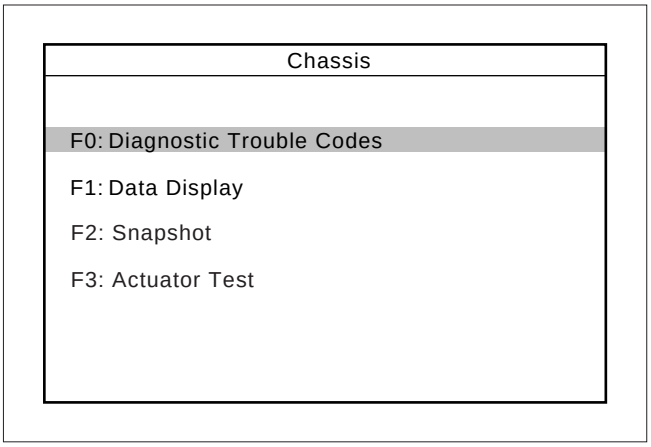


Menu

- The following table shows which functions are used for the available equipment versions.

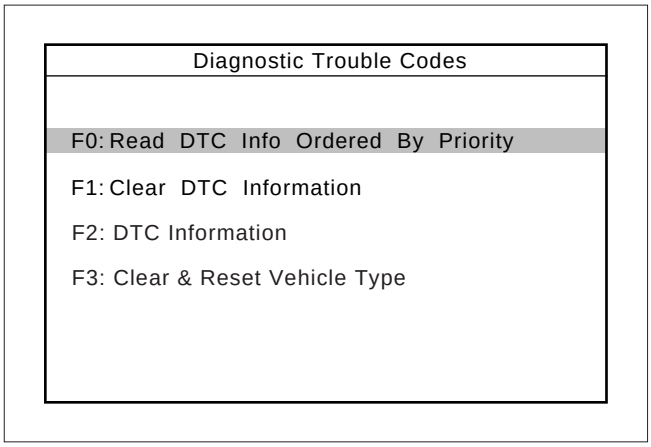


DTC Modes



There are two options available in Tech 2 DTC mode to display the enhanced information available. After selecting DTC, the following menu appears.

- DTC Info
- Clear Info



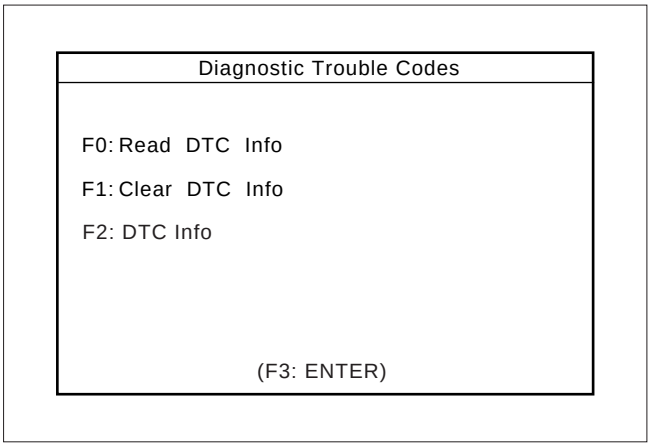
The following is a brief description of each of the sub menus in DTC Info and DTC. The order in which they appear here is alphabetical and not necessarily the way they will appear on the Tech 2.

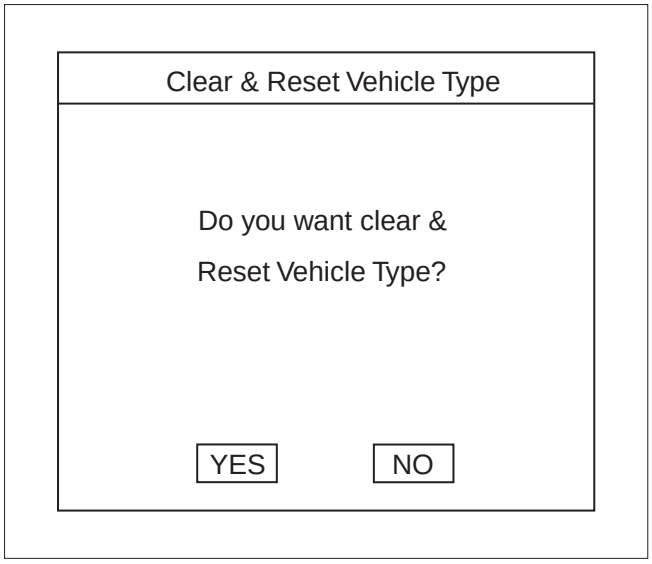
DTC Information Mode

Use the DTC info mode to search for a specific type of stored DTC information. There are two choices. The service manual may instruct the techinician to test for DTCs in a certain manner. Always follow published service procedures.

When CODE “13” is displayed (Vehicle Type Error)

Step	Action	Value(s)	Yes	No
1	Check harness. Is it okay?	-	Erase vehicle type with TECH 2 and reread harness information.	Replace the harness.





YES: Clear vehicle type and reread vehicle harness information.

NO: Return

DTC Status

Current Diagnostic Trouble Codes

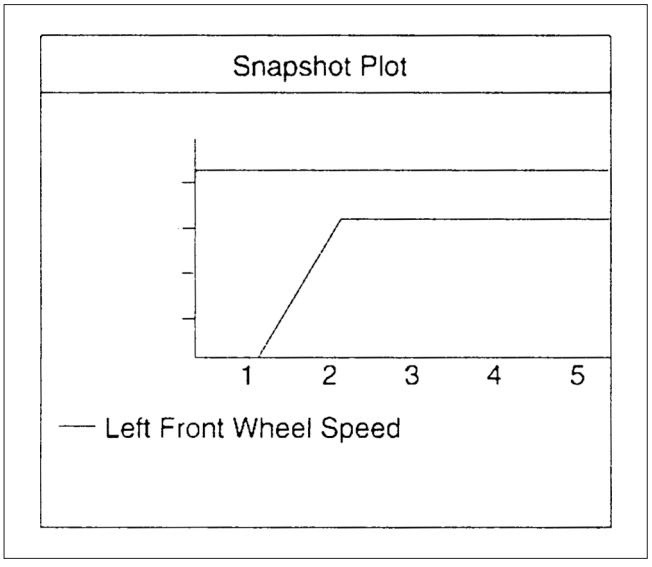
This selection will display all DTCs that have failed during the present ignition cycle.

History Diagnostic Trouble Codes

This selection will display only DTCs that are stored in the EHCU’s history memory.

Plotting Snapshot Graph

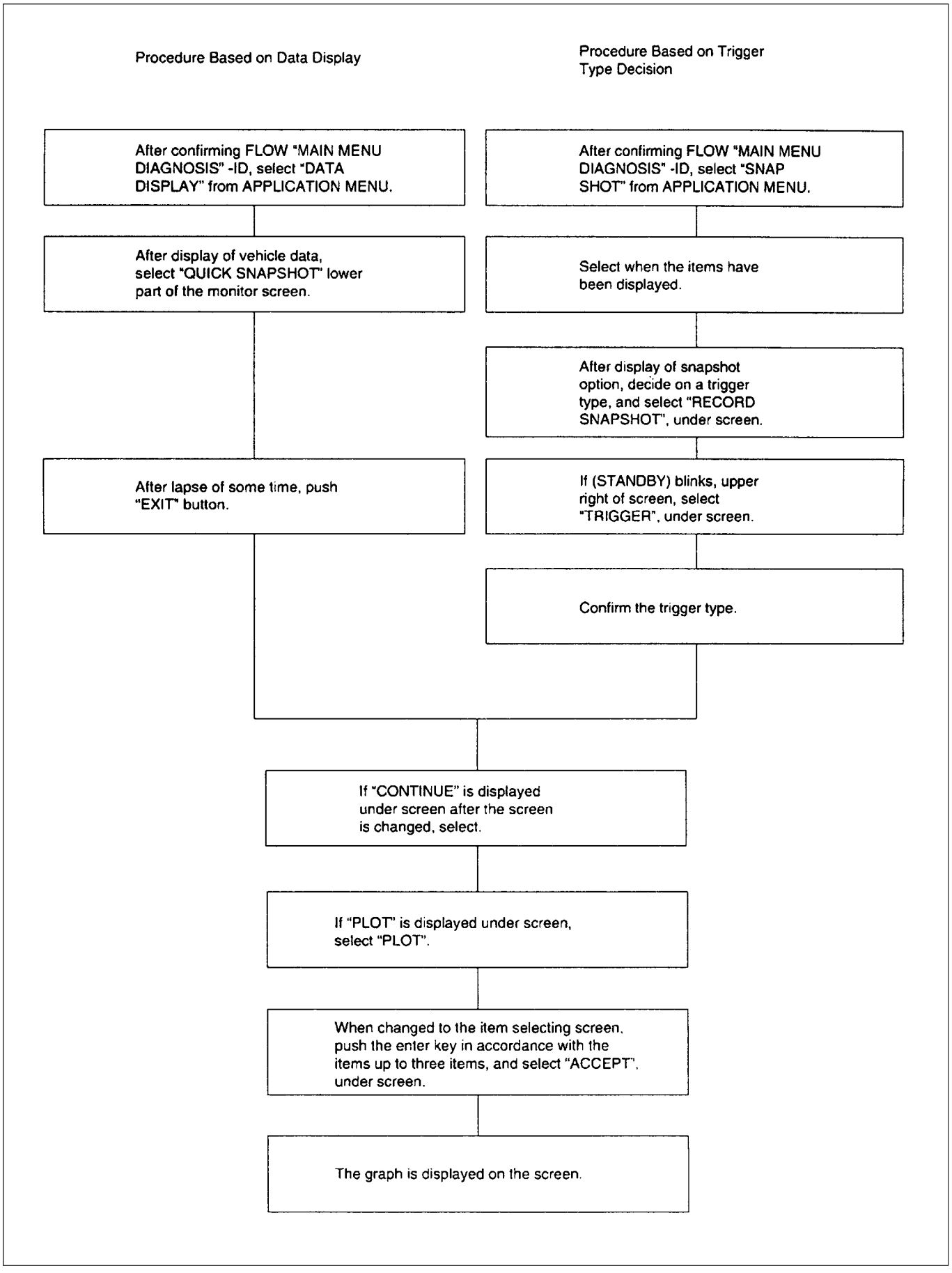
This test selects several necessary items from the data list to plot graphs and makes data comparison on a long term basis. This test can check ABS performance and defect by graphing wheel speed differences between right and left sides, and front and rear sides obtained from the ABS data list menu.



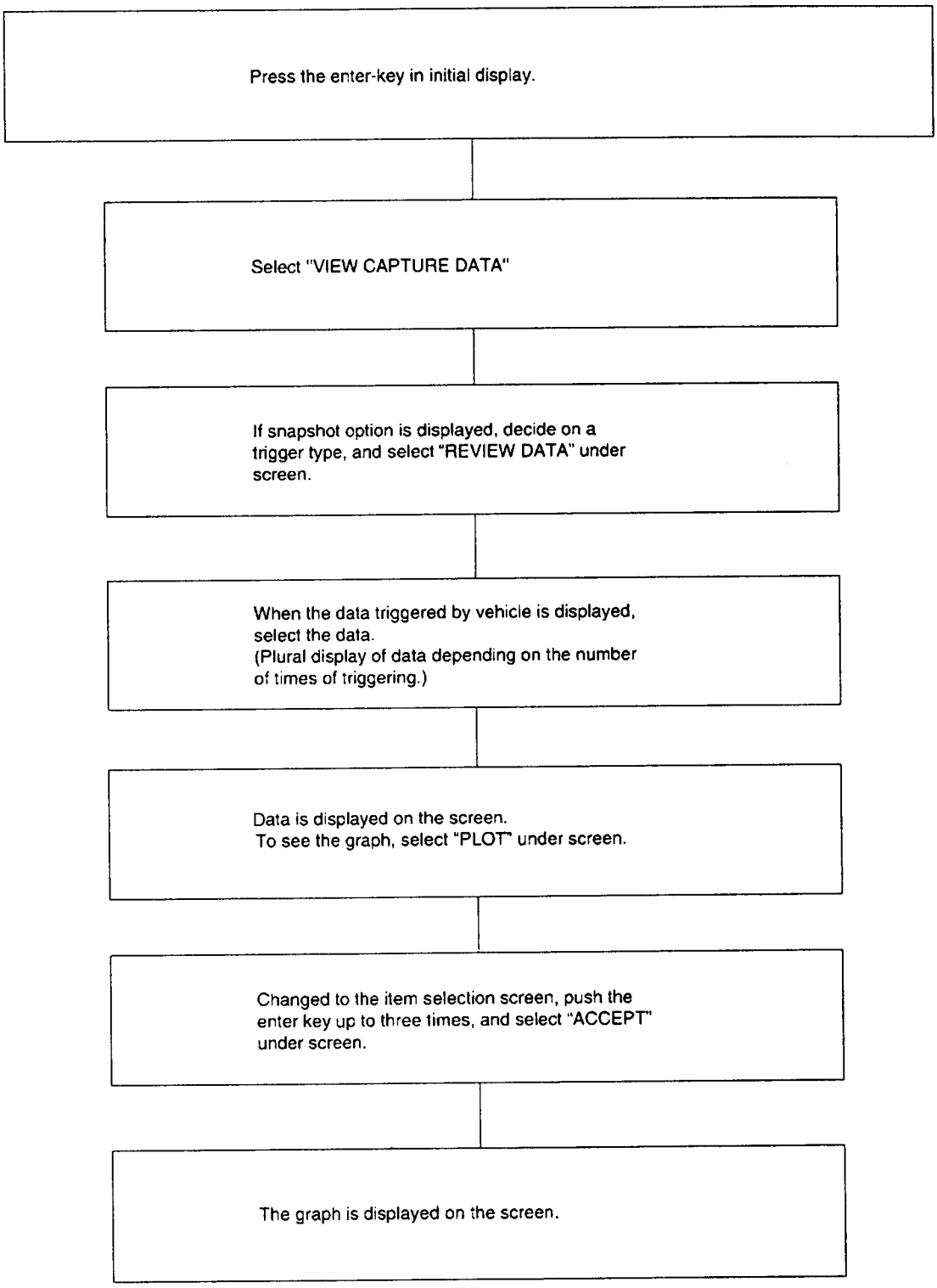
For trouble diagnosis, you can collect graphic data (snap shot) directly from the vehicle.

You can replay the snapshot data as needed. Therefore, accurate diagnosis is possible, even though the vehicle is not available.

Plotting Graph Flow Chart (Plotting graph after obtaining vehicle information)



Flow Chart for Snapshot Replay (Plotting Graph)



Tech 2 Data Display

Use the Tech 2 data Values only after the ABS Diagnostic System Check has been completed, no DTC(s) were noted, and you have determined that the on-board diagnostics are functioning properly. Tech 2 values from a properly-running engine may be used for comparison with the engine you are diagnosing.

ABS Data

Ignition SW is “ON” position.

(For example)

F1; ABS DATA

Left Front Wheel Speed	2 mph
Right Front Wheel Speed	2 mph
Left Rear Wheel Speed	2 mph
Right Rear Wheel Speed	2 mph
Brake Switch Status	OFF
ABS Lamp Command	OFF
ABS Pump Motor	OFF
LR Release Valve Command	OFF
LR Hold Valve Command	OFF
RR Release Valve Command	OFF
RR Hold Valve Command	OFF
LF Release Valve Command	OFF
LF Hold Valve Command	OFF
RF Release Valve Command	OFF
RF Hold Valve Command	OFF
LR Release Valve Feed back	OFF
LR Hold Valve Feed back	OFF
RR Release Valve Feed back	OFF
RR Hold Valve Feed back	OFF
LF Release Valve Feed back	OFF
LF Hold Valve Feed back	OFF
RF Hold Valve Feed back	OFF
RF Release Valve Feed back	OFF
Battery Voltage	12～16V

Select Items | DTC | Quick Snapshot | More

Special Function

There are 12 different menus available for this test. The state of each circuit can be tested by using these menus. Especially when DTC cannot be detected, a faulty circuit can be diagnosed by testing each circuit by means of these menus.

Even when DTC has been detected, the circuit tests using these menus could help discriminate between a mechanical trouble and an electrical trouble.

In all cases test condition; Engine stops with the key turned to the “ON” position. To be more specific, the test is conducted with the brake pedal stepped on after stepping once and releasing.

- Engine: Stop
- Ignition SW: ON
- Brake Pedal: ON-OFF-ON

If the Ignition SW was turned OFF or communication was lost, make sure to apply the brake pedal ON-OFF-ON once again and then continue the test.

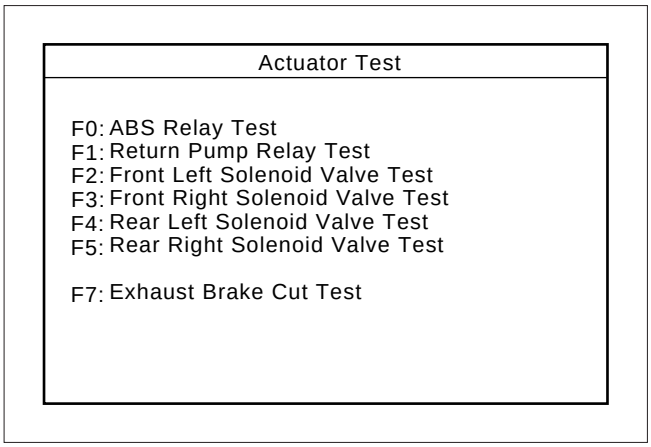
Actuator Test

F0: ABS Relay Test
F1: Return Pump Relay Test
F2: Front Left Solenoid Valve Test
F3: Front Right Solenoid Valve Test
F4: Rear Left Solenoid Valve Test
F5: Rear Right Solenoid Valve Test
F6: ABS Check Light Test
F7: Exhaust Brake Cut Test

ABS Warning Lamp

Test condition: Engine stops with the key turned to the "ON" position. To be more specific, the test is conducted with the brake pedal stepped on after stepping once and releasing.

- The circuit is normal if the warning light in the meter panel comes on and goes out in accordance with Tech 2's instruction.

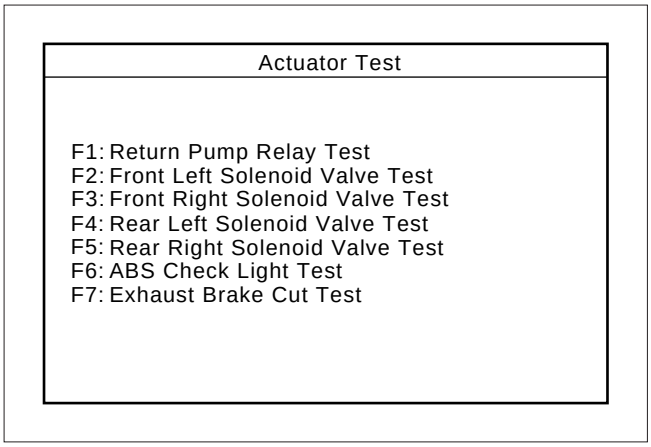


ABS Relay

Test condition: Engine stops with the key turned to the "ON" position. To be more specific, the test is conducted with the brake pedal stepped on after stepping once and releasing.

Make sure of the working sound of the ABS relay.

The circuit is normal if the working sound of the ABS relay is made in accordance with Tech 2's instruction.

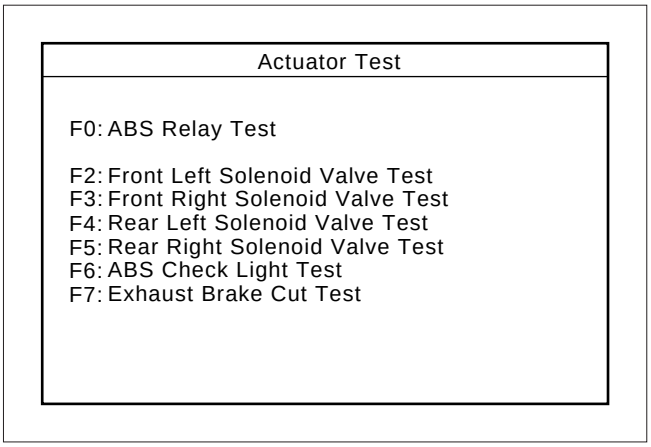


ABS Motor

Test condition: Engine stops with the key turned to the "ON" position. To be more specific, the test is conducted with the brake pedal stepped on after stepping once and releasing.

Make sure of the working sound of the ABS motor.

The circuit is normal if the working sound of the ABS motor is made in accordance with Tech 2's instruction.

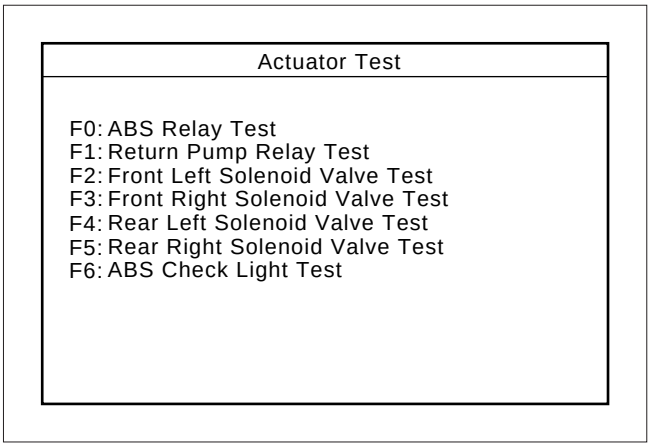


Exhaust Brake Cut Relay

Test condition: Engine stops with the key turned to the "ON" position. To be more specific, the test is conducted with the brake pedal stepped on after stepping once and releasing.

Make sure of the working sound of the exhaust brake cut relay.

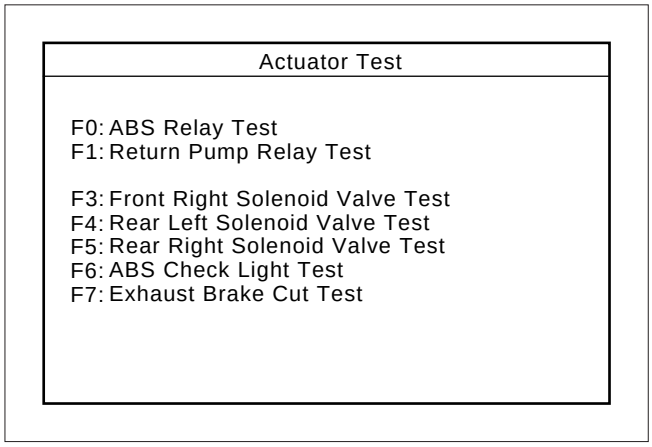
The circuit is normal if the working sound of the exhaust brake cut relay is made in accordance with Tech 2's instruction.



Hold Valve Test

Purpose: The purpose of this test is to detect brake pipe and valve line harness wire wrong connections and valve trouble.

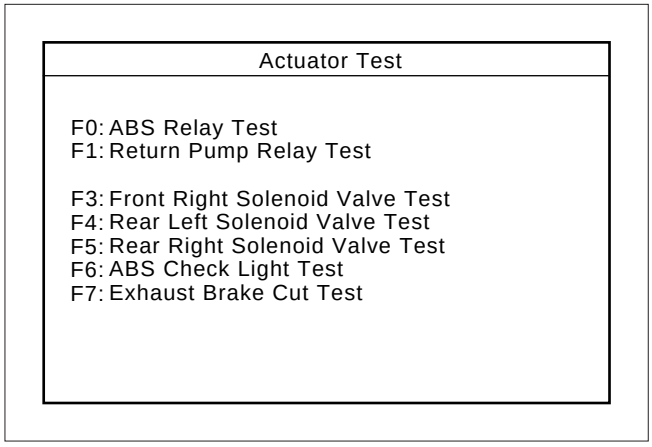
This test will help you confirm the result of your repair service including the removal/reinstallation of brake pipe, valve line harness and valve.



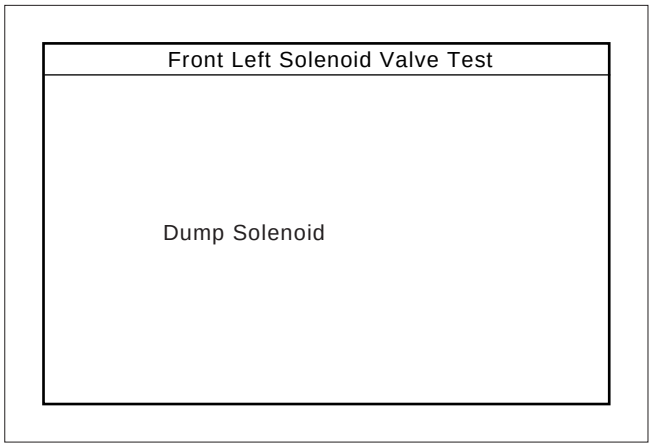
Test conditions: The ignition key is the “ON” position with the four wheels lifted up. The brake pedal is stepped on, released and stepped on again with the parking brake released.

Test procedure:

1. Connect Tech 2 with the vehicle, and select Special Function from the menus.
2. Select a Hold Valve Menu from the Special Function Menus.



Select a Iso Solenoid
from the Front Left Solenoid Valve Test Function Menus.



3. Press the Hold Valve “ON” Soft Key with the brake pedal stepped on.
4. Release the brake pedal.
5. Make sure that the Hold Valve “ON” aimed at by Tech 2 and the wheel locked position are the same. If different, check brake pipe, valve line harness wiring and H/UNIT. Repair is needed if abnormality is found.
6. Conduct Step 2 through Step 5 above on all the four wheels.

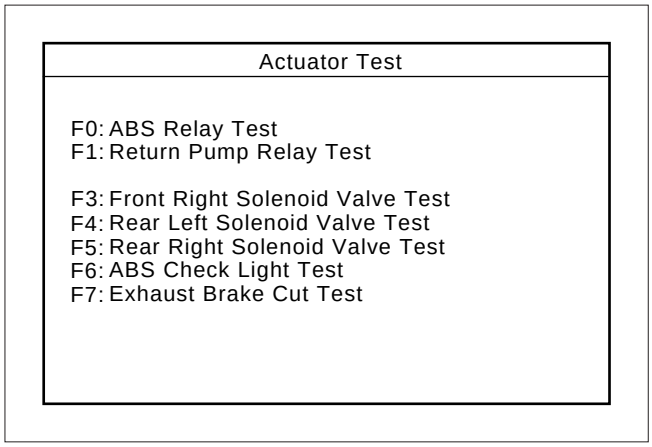
CAUTION: When conducting this test, please observe the following cautions.

1. **Do not start the engine without fail.**
2. **Lift up the vehicle at the level floor.**
   - **Secure a clearance from the floor surface enough to allow the lifted tire to rotate.**
3. **Maintain the lift up.**
4. **Wipe the floor surface to remove water and oil so that the surface may become unslippery.**
5. **Do not load the vehicle.**
   - **When lifting up the vehicle, be sure to observe the lifting up points. Refer to vehicle lifting points in 0A section.**

Release Valve Test

Purpose: The purpose of this test is to detect brake pipe and valve line harness wire wrong connections and valve trouble.

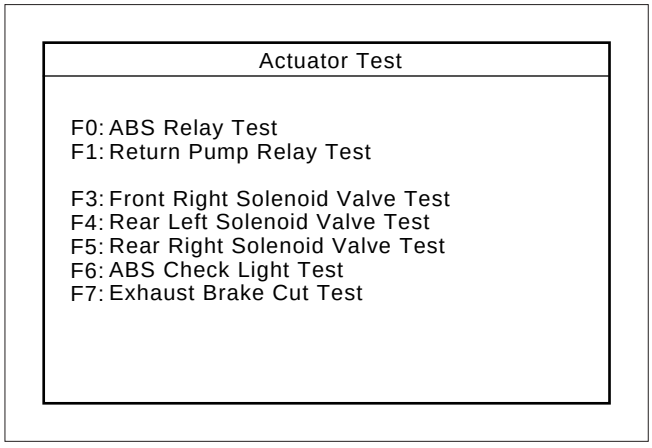
This test will help you confirm the result of your repair service including the removal/reinstallation of brake pipe, valve line harness and valve.



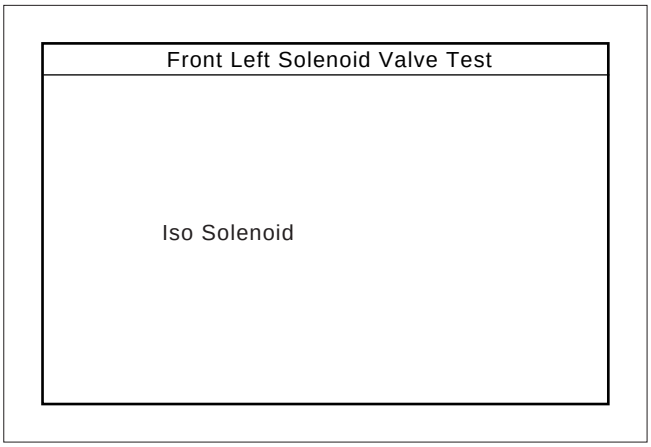
Test conditions: The ignition key is in the “ON” position with the four wheels lifted up. The brake pedal is stepped on, released and stepped on again with the parking brake released.

Test procedure:

1. Connect Tech 2 with the vehicle, and select Special Function from the menus.
2. Select a Release Valve Menu from the Special Function Menus.



Select a Dump Solenoid
from the Front Left Solenoid Valve Test Function Menus.



3. Press the Release Valve “ON” Soft Key with the brake pedal stepped on.
4. Make sure that the Release Valve “ON” aimed at by Tech 2 and the wheel released position are the same. If different, check brake pipe, valve line harness wiring and H/UNIT. Repair is needed if abnormality is found.
5. Conduct Step 2 through Step 5 above on all the four wheels.

CAUTION: When conducting this test, please observe the following cautions.

1. Do not start the engine without fail.
2. Lift up the vehicle at the level floor.
- **Secure a clearance from the floor surface enough to allow the lifted tire to rotate.**

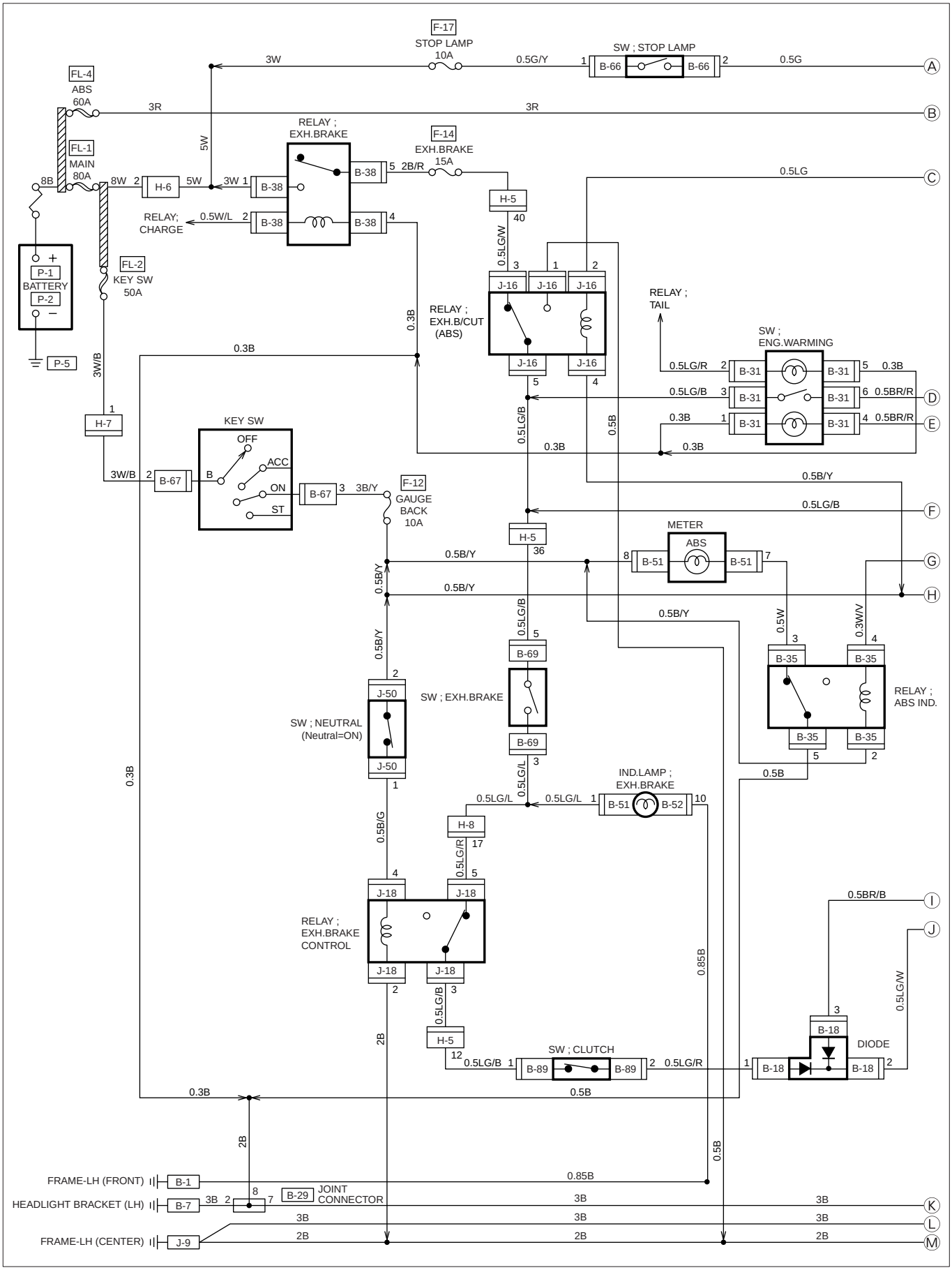
3. Maintain the lift up.
4. Wipe the floor surface to remove water and oil so that the surface may become unslippery.
5. Do not load the vehicle.
- **When lifting up the vehicle, be sure to observe the lifting up points. Refer to vehicle lifting points in 0A section.**

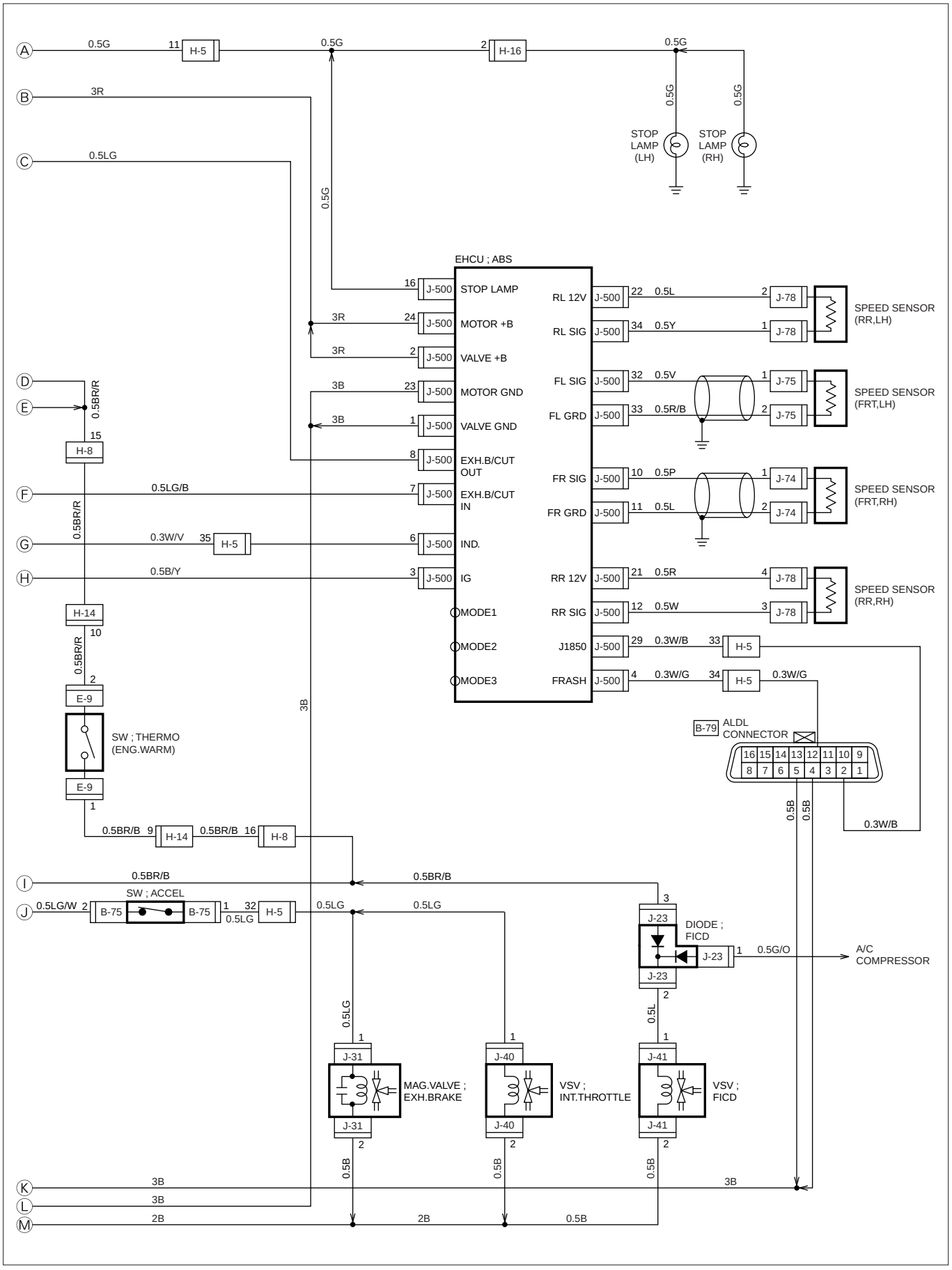
EHCU Connector Pin-out Checks

- Disconnect EHCU.
- Perform checks with high impedance digital multimeter 5-8840-0285-0 (J-39200) or equivalent.

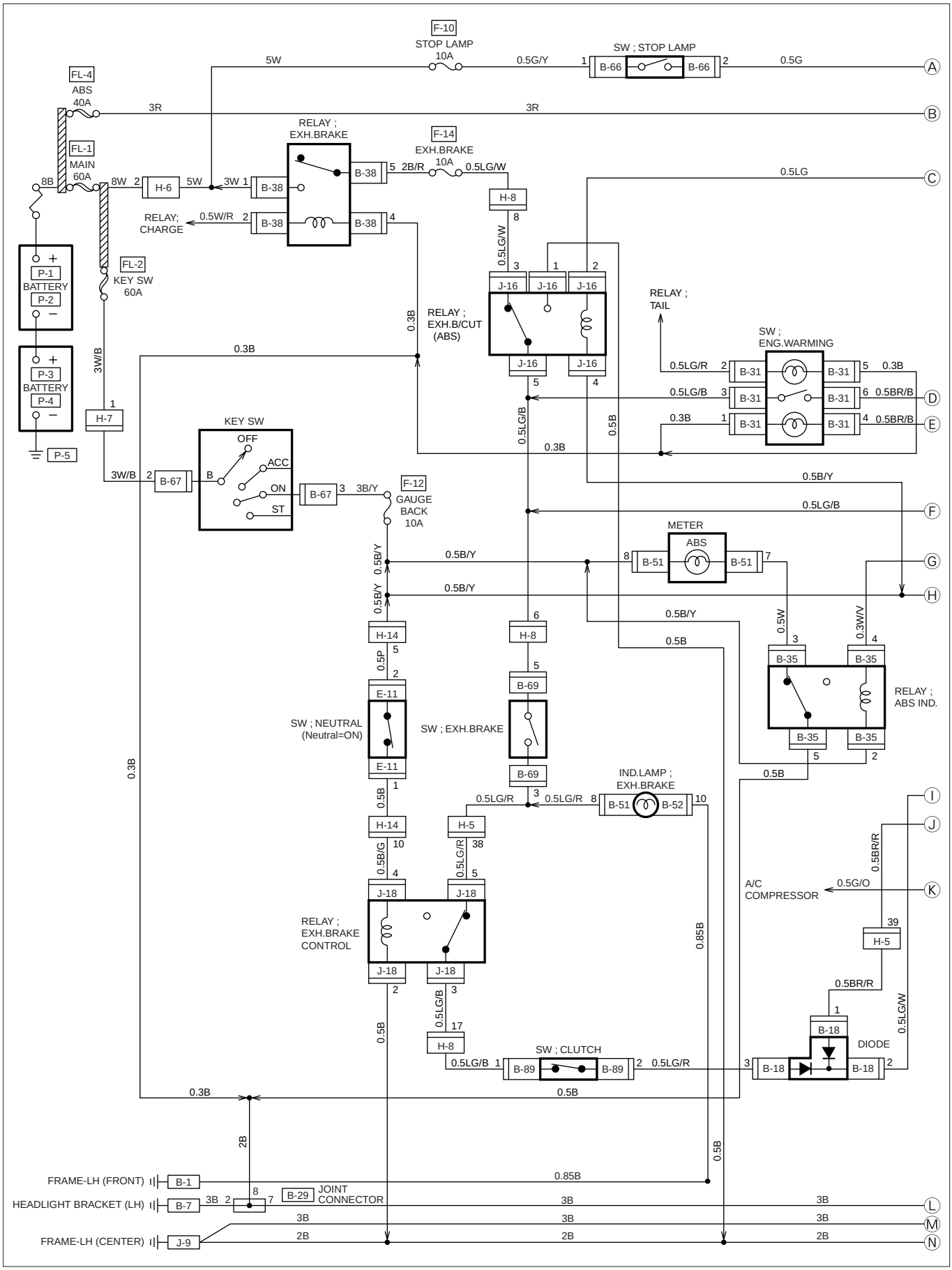
No.	Circuit to be Tested	Key Switch Position	Multimeter Scale/Range	Measure between Pin	Nominal Value (24V Battery Vehicle)	Note
1	EHCU Power Circuit	OFF	VDC	3(+)-1(-)	0-0.3V	
		ON	VDC	3(+)-1(-)	9.5-16.5V (16.5-34V)	
		OFF	VDC	2(+)-1(-)	9.5-16.5V (16.5-34V)	
		OFF	VDC	24(+)-1(-)	9.5-16.5V (16.5-34V)	
2	EHCU Ground Circuit	OFF	Ω	1(+)-GND	Less than 0.01 Ω	
		OFF	Ω	23(+)-GND	Less than 0.01 Ω	
3	EXHIN Circuit	ON	VDC	7(+)-1(-)	9.5-16.5V (16.5-34V)	Engine Run
4	EXHOUT Circuit	ON	VDC	8(+)-1(-)	9.5-16.5V (16.5-34V)	
		OFF	VDC	8(+)-1(-)	0-0.3V	
5	Brake Switch Signal Circuit	OFF	VDC	16(+)-1(-)	0-0.3V	
		OFF	VDC	16(+)-1(-)	9.5-16.5V (16.5-34V)	Apply Brake Pedal
6	ABS W/L Circuit	ON	VDC	6(+)-1(-)	9.5-16.5V (16.5-34V)	
		OFF	VDC	6(+)-1(-)	0-0.3V	
7	FL Speed Sensor	OFF	kΩ	10(+)-11(-)	1-2kΩ	
		OFF	kΩ	10(+)-1(-)	More than 1000kΩ	
		OFF	VDC	10(+)-11(-)	More than 200mV	Turn Wheel at 0.5RPS
8	FR Speed Sensor	OFF	kΩ	32(+)-33(-)	1-2kΩ	
		OFF	kΩ	32(+)-1(-)	More than 1000kΩ	
		OFF	VDC	32(+)-33(-)	More than 200mV	Turn Wheel at 0.5RPS

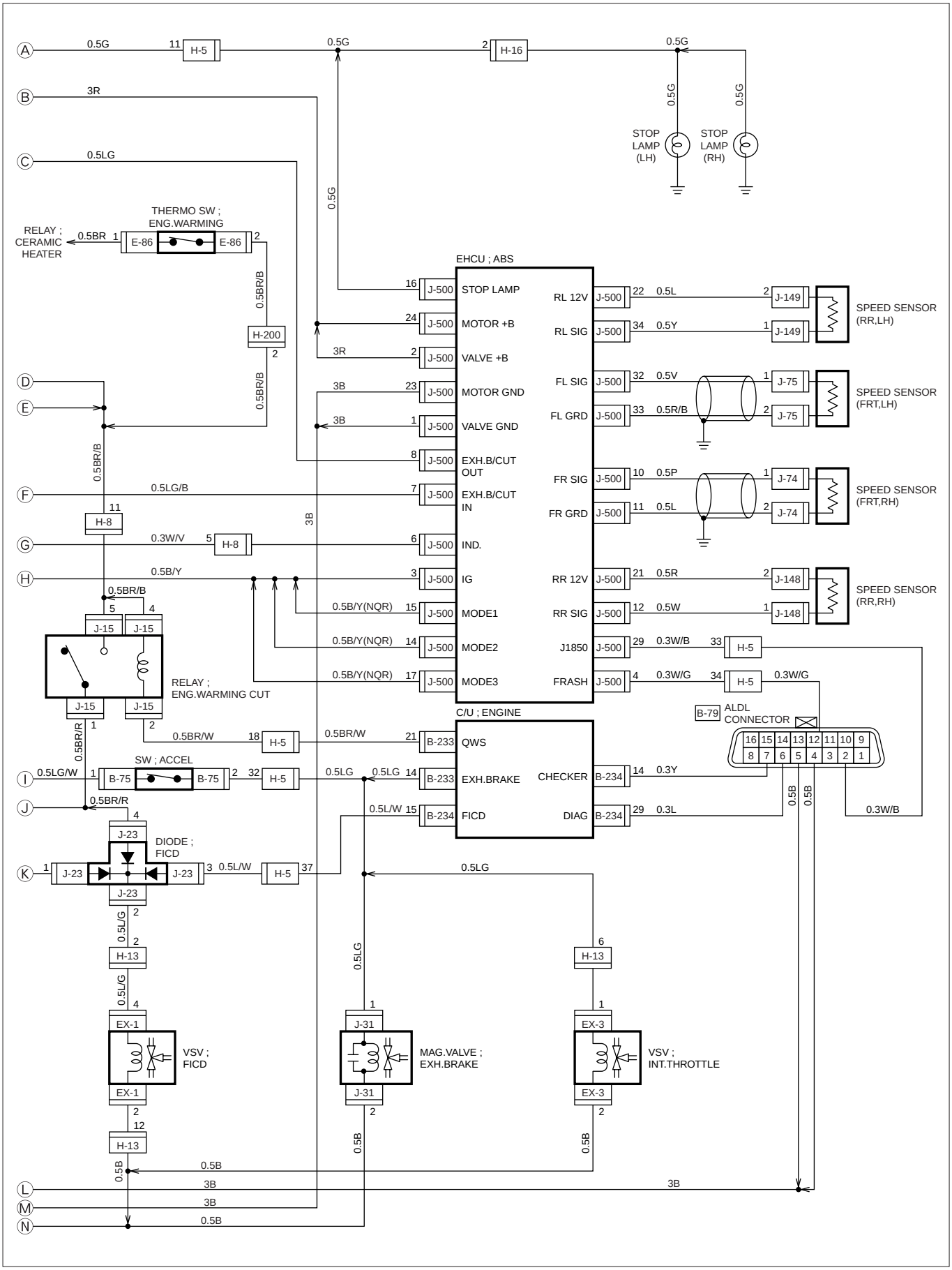
Circuit Diagram-FOR 12VOLT



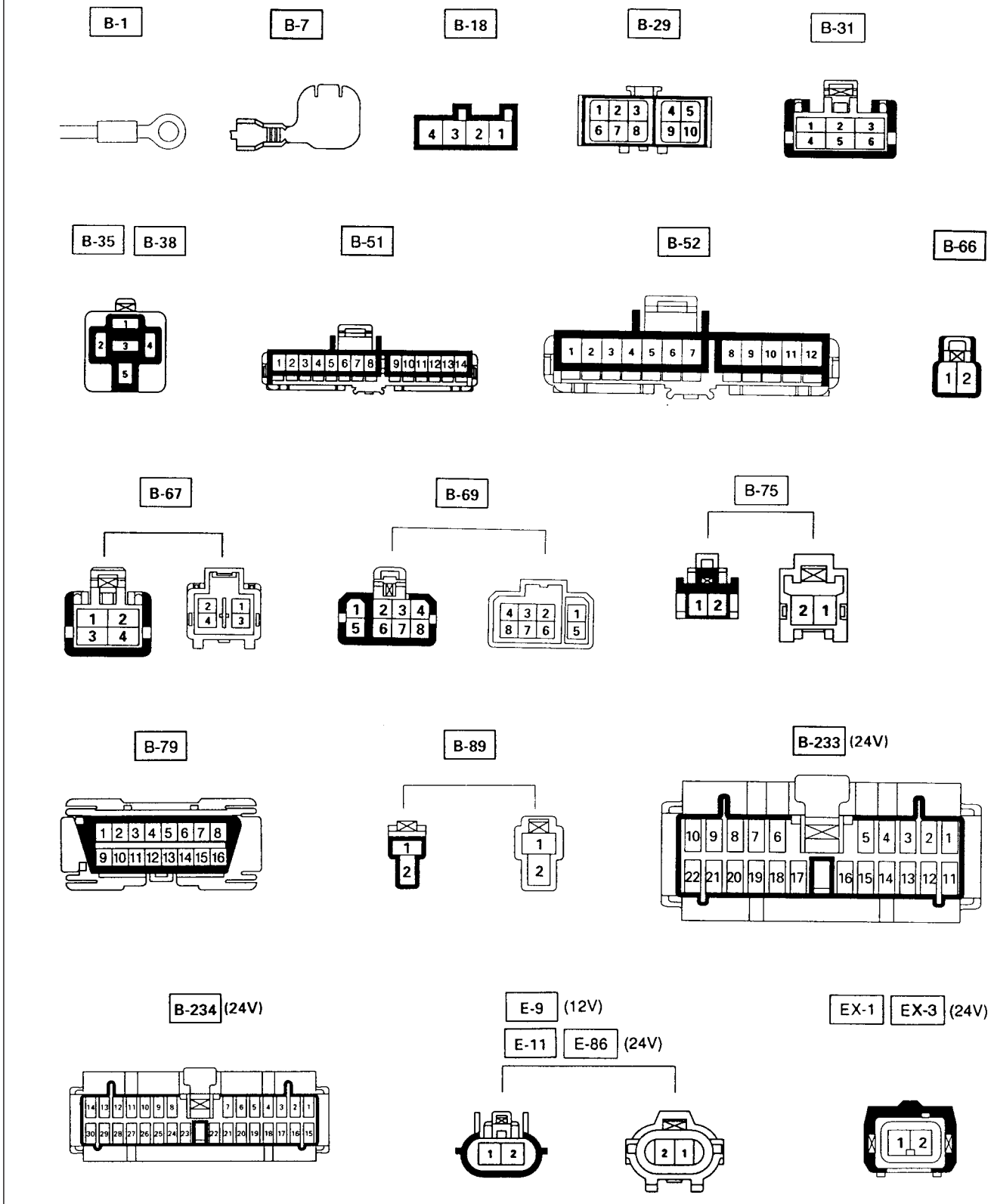

A
0.5G
11
H-5
0.5G
2
H-16
0.5G
B
3R
C
0.5LG
0.5G
0.5G
STOP LAMP (LH)
STOP LAMP (RH)
EHCU ; ABS
16
J-500
STOP LAMP
3R
24
MOTOR +B
3R
2
VALVE +B
3B
23
MOTOR GND
3B
1
VALVE GND
8
EXH.B/CUT OUT
7
EXH.B/CUT IN
6
IND.
3
IG
MODE1
MODE2
MODE3
RL 12V
RL SIG
FL SIG
FL GRD
FR SIG
FR GRD
RR 12V
RR SIG
J1850
FRASH
22
0.5L
34
0.5Y
32
0.5V
33
0.5R/B
10
0.5P
11
0.5L
21
0.5R
12
0.5W
29
0.3W/B
4
0.3W/G
J-78
J-75
J-74
SPEED SENSOR (RR,LH)
SPEED SENSOR (FRT,LH)
SPEED SENSOR (FRT,RH)
SPEED SENSOR (RR,RH)
D
E
0.5BR/R
15
H-8
F
0.5LG/B
0.5BR/R
G
0.3W/V
35
H-5
H
0.5B/Y
H-14
10
0.5BR/R
2
E-9
SW ; THERMO (ENG.WARM)
E-9
1
0.5BR/B
9
H-14
0.5BR/B
16
H-8
3B
B-79
ALDL CONNECTOR
16 15 14 13 12 11 10 9
8 7 6 5 4 3 2 1
0.5B
0.5B
0.3W/B
I
0.5BR/B
0.5BR/B
J
0.5LG/W
2
B-75
SW ; ACCEL
B-75
1
32
H-5
0.5LG
0.5LG
0.5LG
3
J-23
DIODE ; FICD
J-23
1
0.5G/O
A/C COMPRESSOR
J-23
2
0.5L
0.5LG
1
J-31
MAG.VALVE ; EXH.BRAKE
J-31
2
1
J-40
VSV ; INT.THROTTLE
J-40
2
1
J-41
VSV ; FICD
J-41
2
0.5B
0.5B
0.5B
K
3B
3B
L
3B
M
2B
2B
0.5B

Circuit Diagram-FOR 24VOLT



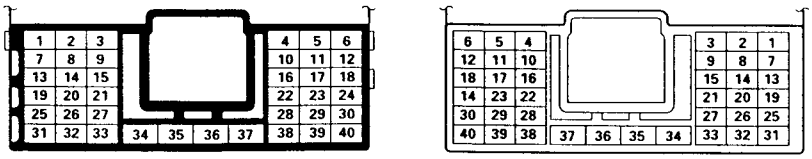

A
0.5G
11
H-5
0.5G
2
H-16
0.5G
B
3R
0.5G
0.5G
STOP LAMP (LH)
STOP LAMP (RH)
C
0.5LG
THERMO SW ; ENG.WARMING
RELAY ; CERAMIC HEATER
0.5BR
1
E-86
E-86
2
0.5BR/B
H-200
2
0.5BR/B
D
E
0.5BR/B
F
0.5LG/B
11
H-8
3B
G
0.3W/V
5
H-8
H
0.5B/Y
0.5BR/B
5
4
J-15
J-15
RELAY ; ENG.WARMING CUT
J-15
J-15
1
2
0.5BR/R
0.5BR/W
18
H-5
I
0.5LG/W
1
SW ; ACCEL
B-75
B-75
2
32
H-5
J
0.5BR/R
4
J-23
DIODE ; FICD
K
1
J-23
J-23
3
0.5L/W
H-5
37
J-23
2
0.5L/G
2
H-13
0.5L/G
4
EX-1
VSV ; FICD
EX-1
2
12
H-13
0.5B
L
M
N
EHCU ; ABS
16
J-500
STOP LAMP
24
J-500
MOTOR +B
3R
2
J-500
VALVE +B
3B
23
J-500
MOTOR GND
3B
1
J-500
VALVE GND
8
J-500
EXH.B/CUT OUT
7
J-500
EXH.B/CUT IN
6
J-500
IND.
3
J-500
IG
0.5B/Y(NQR)
15
J-500
MODE1
0.5B/Y(NQR)
14
J-500
MODE2
0.5B/Y(NQR)
17
J-500
MODE3
RL 12V
J-500
22
0.5L
2
J-149
RL SIG
J-500
34
0.5Y
1
J-149
SPEED SENSOR (RR,LH)
FL SIG
J-500
32
0.5V
1
J-75
FL GRD
J-500
33
0.5R/B
2
J-75
SPEED SENSOR (FRT,LH)
FR SIG
J-500
10
0.5P
1
J-74
FR GRD
J-500
11
0.5L
2
J-74
SPEED SENSOR (FRT,RH)
RR 12V
J-500
21
0.5R
2
J-148
RR SIG
J-500
12
0.5W
1
J-148
SPEED SENSOR (RR,RH)
J1850
J-500
29
0.3W/B
33
H-5
FRASH
J-500
4
0.3W/G
34
H-5
0.3W/G
B-79
ALDL CONNECTOR
16 15 14 13 12 11 10 9
8 7 6 5 4 3 2 1
C/U ; ENGINE
21
B-233
QWS
14
B-233
EXH.BRAKE
CHECKER
B-234
14
0.3Y
15
B-234
FICD
DIAG
B-234
29
0.3L
0.5B
0.5B
0.3W/B
0.5LG
0.5LG
0.5LG
6
H-13
0.5LG
1
J-31
MAG.VALVE ; EXH.BRAKE
J-31
2
0.5B
1
EX-3
VSV ; INT.THROTTLE
EX-3
2
0.5B
0.5B
0.5B
3B
3B
0.5B
3B

Connector List

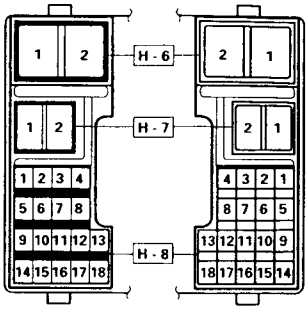


Connector List

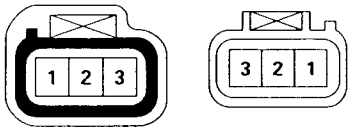
H-5



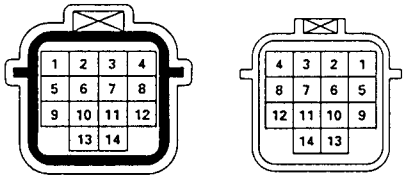
H-6 H-7 H-8



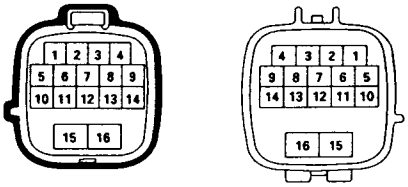
H-13 (24V)



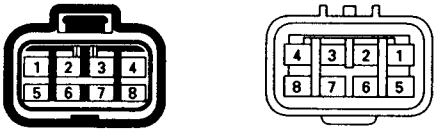
H-14 (12V)



H-14 (24V)

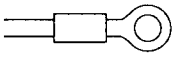


H-16



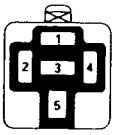
H-200 (24V)

J-9



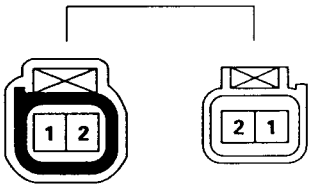
J-15 (24V)

J-16 J-18



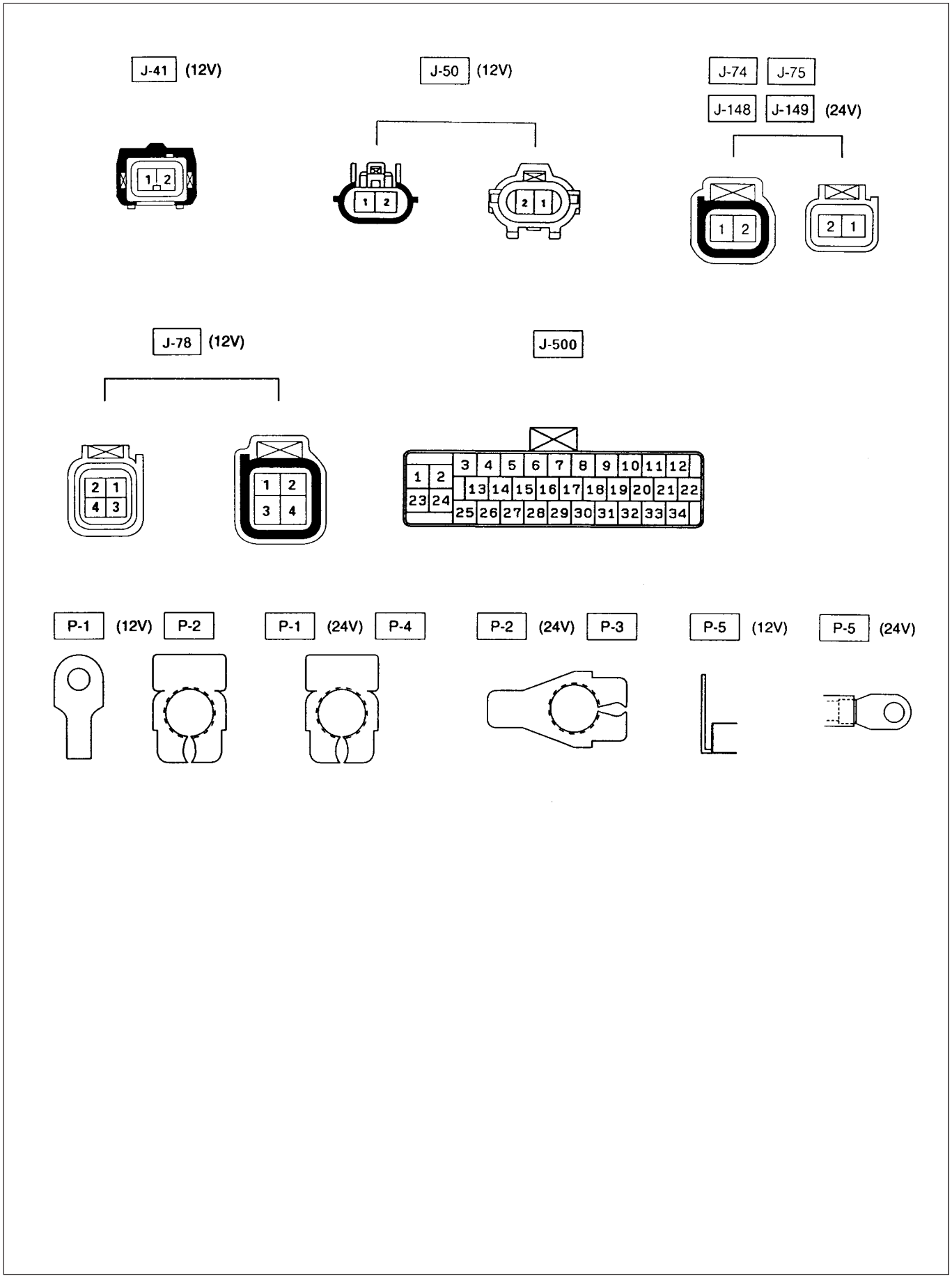
J-23

J-31

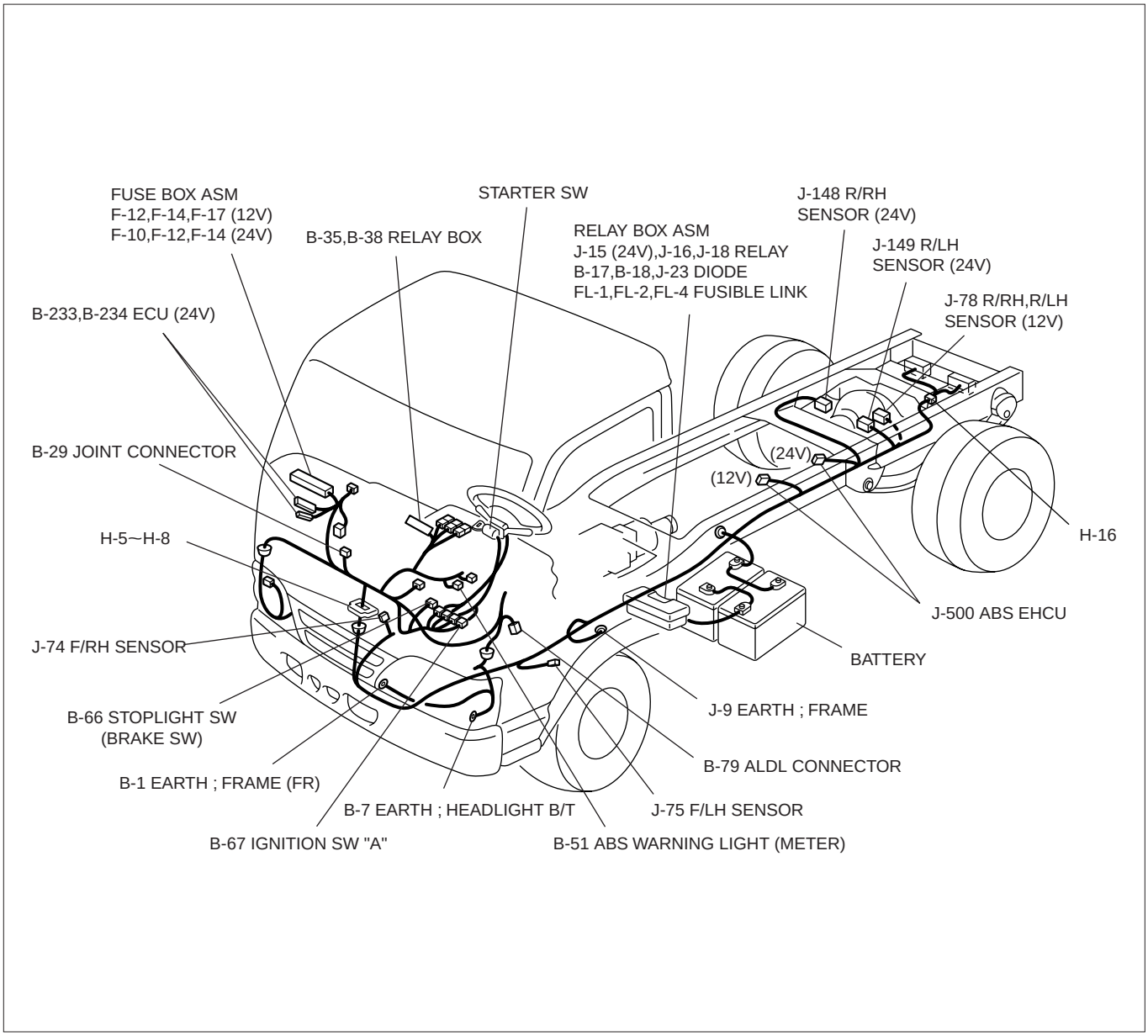


J-40 (12V)

Connector List



Part Location



Symptom Diagnosis

The symptoms that cannot be indicated by the warning light can be divided in the following five categories:

1. ABS works frequently but vehicle does not decelerate.
2. Uneven braking occurs while ABS works.
3. The wheels lock during braking.
4. Brake pedal feel is abnormal
5. Braking sound (from Hydraulic Unit) is heard while not braking.

These are all attributable to problems which cannot be detected by EHCU self-diagnosis. Use the customer complaint and a test to determine which symptom is present. Then follow the appropriate flow chart listed below.

No.	Symptom	Diagnostic Flow Charts	
		Without TECH 2	With TECH 2
1	ABS works frequently but vehicle does not decelerate.	Chart A-1	Chart TA-1
2	Uneven braking occurs while ABS works.	Chart A-2	Chart TA-2
3	The wheels are locked.	Chart A-3	Chart TA-3
4	Brake pedal feel is abnormal.	Chart A-4	-
5	Braking sound (from Hydraulic Unit) is heard while not braking.	Chart A-5	Chart TA-5

Chart A-1 ABS Works Frequently But Vehicle Does Not Decelerate

Step	Action	Yes	No
1	Is braking force distribution normal between the front and rear of the vehicle?	Go to Step 2	Repair brake parts. Go to Step 6
2	Are axle parts installed normally?	Go to Step 3	Repair axle parts. Go to Step 6
3	Is there play in each wheel speed sensor?	Go to Step 4	Repair wheel speed sensor. Go to Step 6
4	Is there damage, or powdered iron sticking to each wheel speed sensor/sensor rotor?	Go to Step 5	Replace sensor or sensor rotor. Go to Step 6
5	Is the output of each wheel speed sensor normal? (Refer to chart C-1 or TC-1)	Replace EHCU. Go to Step 6	Replace wheel speed sensor or repair harness. Go to Step 6
6	Reconnect all components and ensure all components are properly mounted. Was this step finished?	Repeat the “Basic diagnostic flow chart.”	Go to Step 6

Chart TA-1 ABS Works Frequently But Vehicle Does Not Decelerate (Use TECH 2)

Step	Action	Yes	No
1	1. Connect TECH 2. 2. WHEEL SENSORS make sure of the output conditions of each sensor. Is the output of each sensor normal?	Go to Step 2	Replace wheel speed sensor. Go to Step 3
2	Return to Chart A-1. Was the Chart A-1 finished?	Go to Step 3	Go to Step 2
3	Reconnect all components, ensure all components are properly mounted. Was this step finished?	Repeat the “Basic diagnostic flow chart.”	Go to Step 3

Chart A-2 Uneven Braking Occurs While ABS Works

Step	Action	Yes	No
1	Is there play in each sensor?	Go to Step 2	Repair. Go to Step 5
2	Damage or powdered iron sticking to each sensor/sensor rotor?	Go to Step 3	Repair. Go to Step 5
3	Is the output of each sensor normal? (Refer to chart C-1 or TC-1)	Go to Step 4	Replace sensor or repair harness. Go to Step 5
4	Is brake pipe connecting order correct?	Replace EHCU. Go to Step 5	Reconnect brake pipe correctly. Go to Step 5
5	Reconnect all components, ensure all components are properly mounted. Was this step finished?	Repeat the “Basic diagnostic flow chart.”	Go to Step 5

Chart A-3, TA-3 The Wheels Are Locked

Step	Action	Yes	No
1	Is ABS working?	Go to Step 2	Go to Step 4
2	Is vehicle speed under 10 km/h (6mph)?	Go to Step 3	Normal.
3	Is sensor output normal? (Chart C-1 or TC-1)	Go to Step 4	Replace sensor or repair harness. Go to Step 5
4	Is hydraulic unit grounded properly?	Replace hydraulic unit. Go to Step 5	Correct. Go to Step 5
5	Reconnect all components, ensure all components are properly mounted. Was this step finished?	Repeat the “Basic diagnostic flow chart.”	Go to Step 5

Chart A-4 Brake Pedal Feed Is Abnormal

Step	Action	Yes	No
1	Is the stop light actuated when the brake pedal is depressed?	Go to Step 2	Go to Step 3
2	1. Turn the key off. 2. Disconnect EHCU connector. 3. Measure the voltage between J-500 EHCU connector terminals 16 and 1, when brake pedal is depressed. Is the voltage between 9 - 16 V?	Go to Step 4	Harness NG between brake SW and EHCU. Go to Step 7
3	Is stop light fuse 12V: F-17, 24V: F-10 normal?	Go to Step 5	Replace fuse 12V: F-17, 24V: F-10. Go to Step 7
4	Is there continuity between J-500 EHCU connector terminal 1 to body ground?	Go to Step 6	Repair body grounded harness. Go to Step 7
5	Is the brake SW normal?	Repair stop light harness. Go to Step 7	Replace brake SW. Go to Step 7
6	Is the check harness/connector for suspended disconnection?	Hydraulic system leakage or air entry Go to Step 7	Repair harness. Go to Step 7
7	Reconnect all components, ensure all components are properly mounted. Was this step finished?	Repeat the “Basic and diagnostic flow chart.”	Go to Step 7

Chart A-5, TA-5 Braking Sound (From Hydraulic Unit) Is Heard While Not Braking

Step	Action	Yes	No
1	Is this the first time the vehicle is being driven after starting the engine?	It is self checking sound. Normal.	Go to Step 2
2	Is vehicle speed under 10 km/h (6 mph)?	It is self checking sound. Normal.	Go to Step 3
3	Check for the following condition: • At the time of shift down or clutch operation. • At the time of low μ drive (ice or snow road) or rough road drive. • At the time of high-speed turn. • At the time of passing curb. • At the time of operating electrical equipment switches. • At the time of racing the engine. Did it occur under any one condition above?	ABS may sometime be actuated even when brake pedal is not applied.	Go to Step 4
4	Is there play in each sensor/wheel speed sensor rotor?	Go to Step 5	Repair. Go to Step 7
5	Damage or powdered iron sticking to each sensor/wheel speed sensor rotor?	Repair. Go to Step 7	Go to Step 6
6	Is each sensor output normal? (Refer to chart C-1 or TC-1).	Check harness/connector for suspected disconnection. If no disconnection is found, replace EHCU. Go to Step 7	Repair. Go to Step 7
7	Reconnect all components, ensure all components are properly mounted. Was this step finished?	Repeat the “Basic diagnostic flow chart.”	Go to Step 7

Diagnostic Trouble Codes

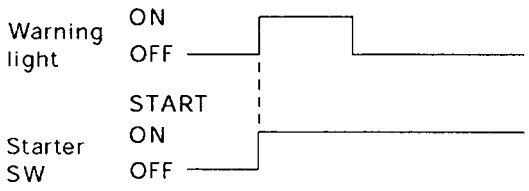
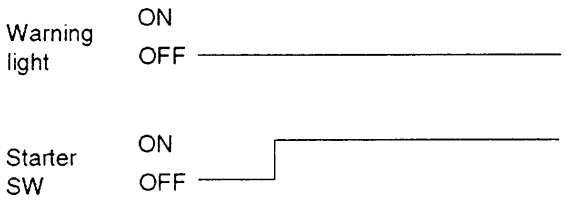
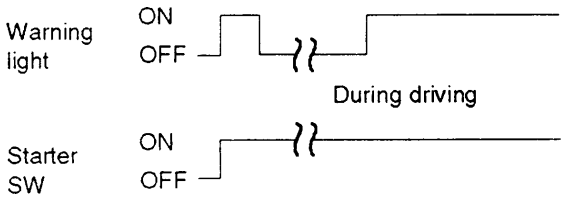
Choose and trace an appropriate flowchart by the numbers listed below to find fault and repair.

Code		Diagnosis	Item (except Wiring)	Chart No.
Flash out	Serial Communications			
12	-	Normal	-	-
13	C0213	Vehicle Type Error	EHCU	1
14	C0214	Low Power Voltage of Rear Sensor or ECU Abnormality	EHCU	2
15	C0215	Low Power Voltage	EHCU	3
25	C0225	Exhaust Brake Cut Circuit Abnormality	Relay or EHCU	4
33	C0233	Motor Drive Circuit Abnormality	EHCU	5
34	C0234	Abnormal Motor Rotation	EHCU	6
41	C0241	Solenoid Valve Power Supply Abnormality	EHCU	7
43	C0243	Solenoid Valve Circuit Abnormality	EHCU	8
45	C0245	Solenoid Valve Circuit Abnormality		
51	C0251	FL Speed Sensor Circuit Abnormality	Sensor, EHCU	9
52	C0252	FR Speed Sensor Circuit Abnormality		10
53	C0253	RL Speed Sensor Circuit Abnormality		11
54	C0254	RR Speed Sensor Circuit Abnormality		12
61	C0261	Abnormal FL Speed Sensor Signal		13
62	C0262	Abnormal FR Speed Sensor Signal		14
63	C0263	Abnormal RL Speed Sensor Signal		15
64	C0264	Abnormal RR Speed Sensor Signal		16
65	C0265	Tire Size Error	Tire, Sensor, EHCU	17

*** Important: DTC 20 (Reference Voltage High) cannot be indicated by Tech 2. DTC 20 can be indicated and confirmed by flashing using Diagnosis Switch.**

Diagnosis BY "ABS" Warning Light Illumination Pattern

In the event that there is abnormality in the "ABS" warning light illumination pattern while the key is in the ON position or if the warning light is actuated during driving, trouble should be diagnosed on a illumination pattern basis as follows:

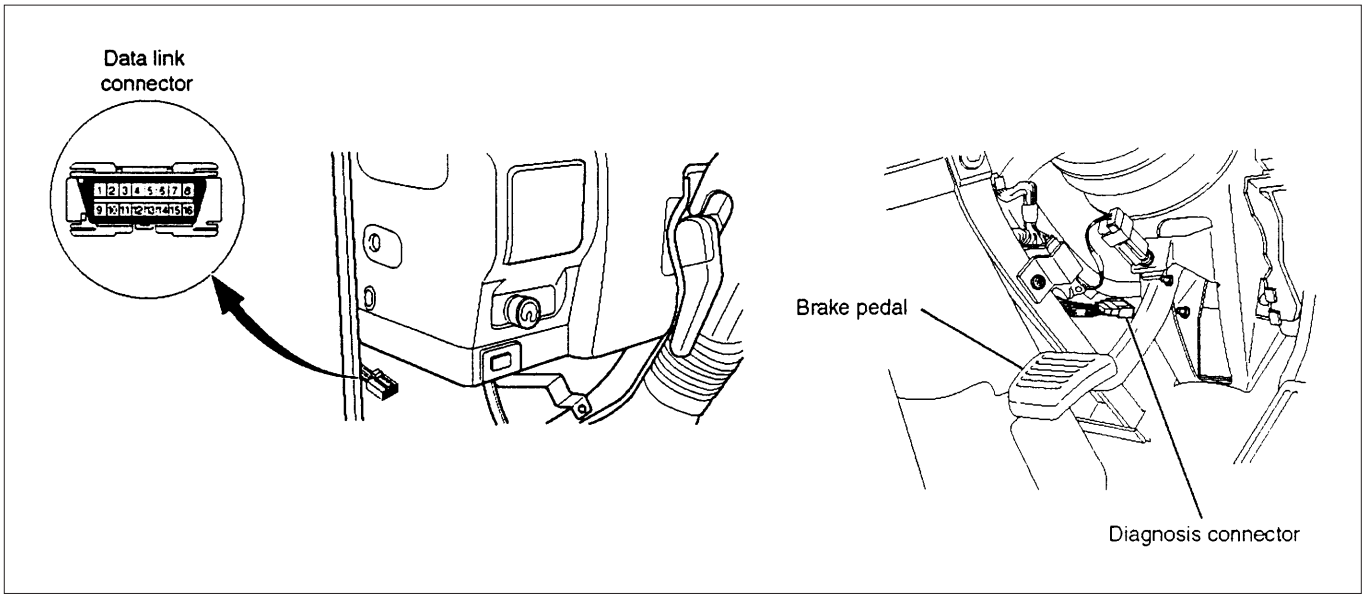
No.	Condition	"ABS" Warning Light Illumination Pattern	Diagnostic
1	Warning light is actuated normally		Normal
2	Warning light is not lit		Warning light lighting circuit trouble→Go to Chart B-1
3	Warning light is actuated while driving		Diagnostic trouble codes are stored. Display diagnostic trouble codes and diagnose on a code basis according to the flow charts.

Diagnostic Trouble Codes (DTCs)

When the warning light in the meter remains ON, the EHCU stores the fault identification and disables the ABS.

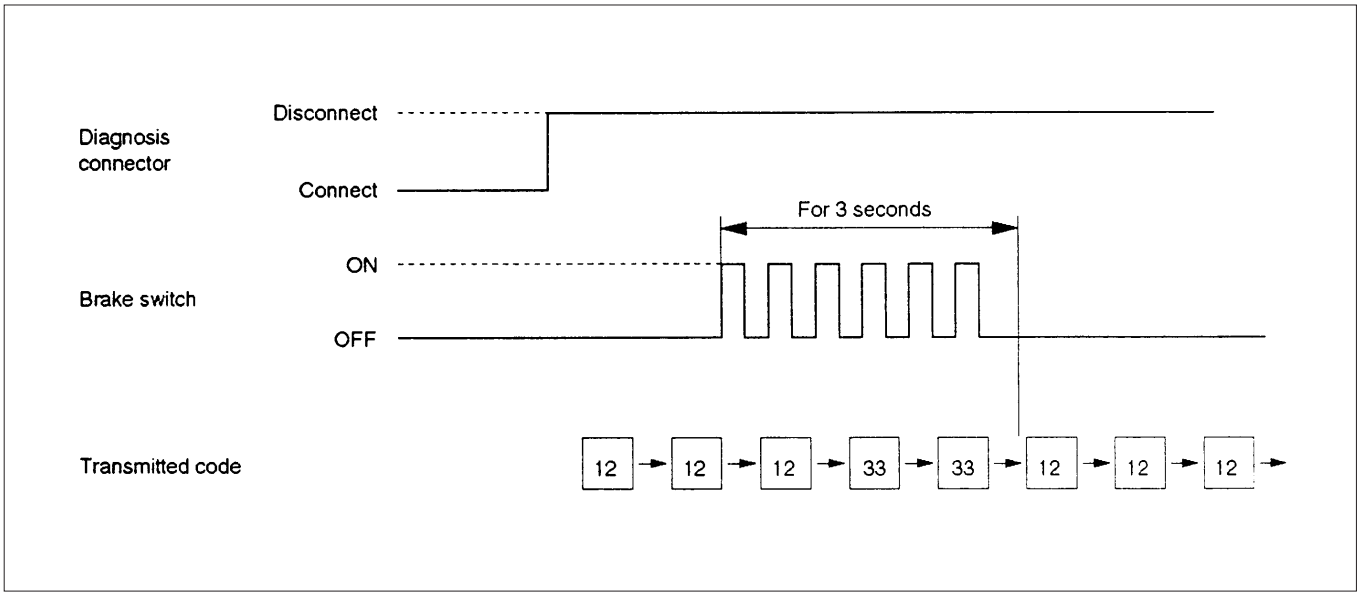
1. How to start DTC display:
   - Confirm that the vehicle has come to a complete stop (with the wheels standing still) and that the brake pedal is not depressed. (Unless these two conditions are satisfied, DTC display cannot be started.)
   - With the key switch OFF and short B-79 diagnosis connector terminal 12 to ground. Then turn the key switch ON.
   - DTCs can be displayed also by TECH 2.

The DLC (for Tech 2) is located behind the driver side lower cluster panel

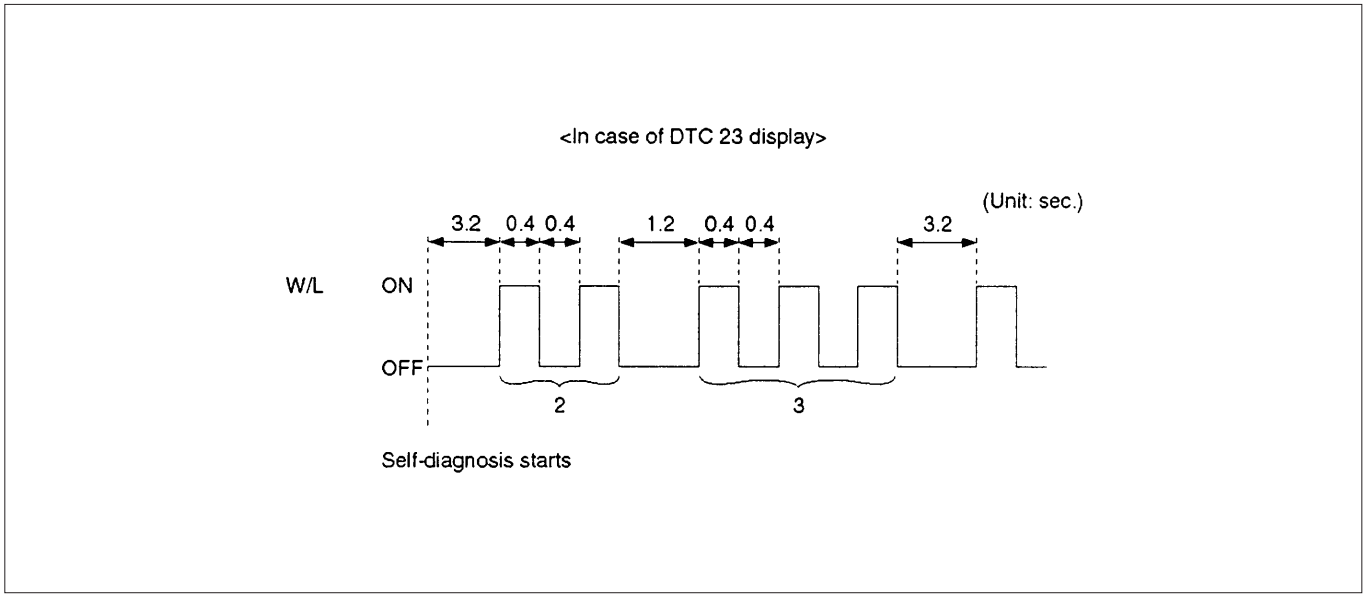


2. DTC display:
   - DTC is displayed by blinking warning light.
   - Double-digit display.
   - First, normal DTC 12 is displayed three times and then any other DTCs are displayed three times. (If no other DTCs have been stored, the display of DTC 12 will be repeated.)

3. How to erase code:
   - Conduct brake switch ON/OFF operation 6 or more times within 3 seconds of self-diagnosis startup.
   - The code cannot be erased if more than 3 seconds have passed since self-diagnosis startup, or if self-diagnosis has started with brake switched on (brake pedal depressed).
   - DTCs can be erased also by Tech 2.

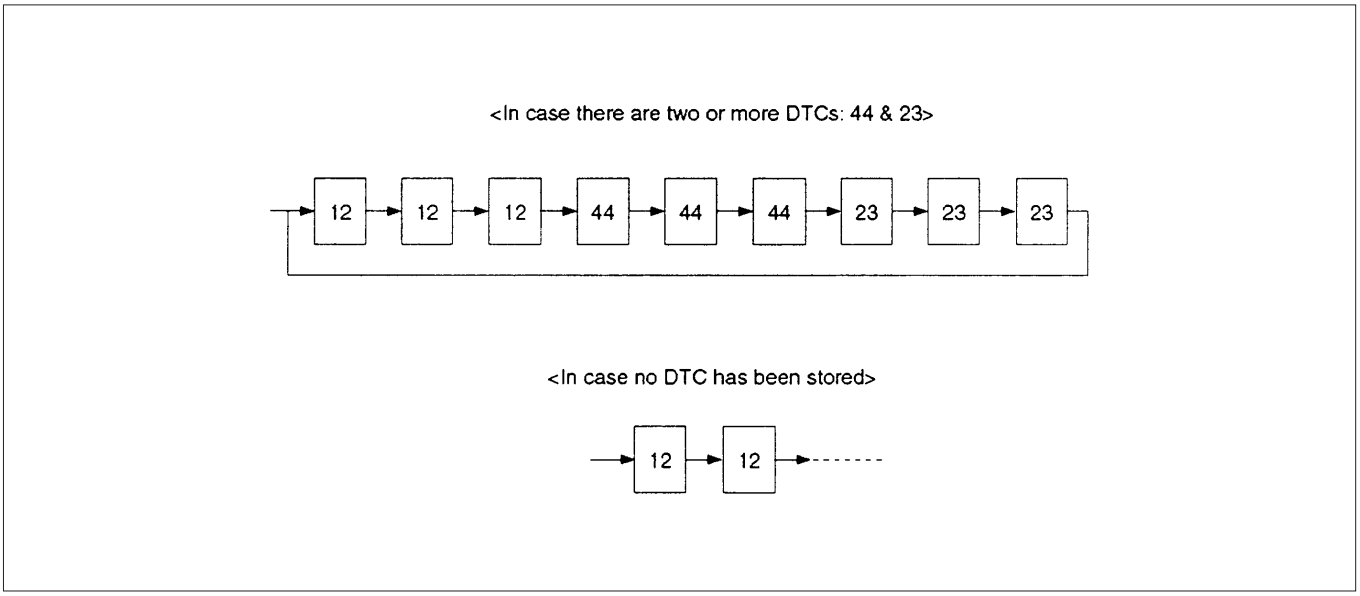


4. An example of DTC display
   Display of DTC 23



After displaying DTC 12 three times, one DTC after another is displayed, starting with the most recent one. (However, display is discontinued after about 5 minutes.)

The DTC 12 is displayed repeatedly. (display is discontinued after about 5 minutes)



5. How to display vehicle model:
   1) Turn the key switch OFF.
   2) Short the diagnosis connector terminal 12 to ground.
   3) Slightly push the brake pedal.
   4) Turn the key switch ON.
   5) ABS warning light illuminates.
   6) Illuminating number of times indicates the vehicle model.

Vehicle model	Illuminating number of times
NKR, NPR	1
NQR	8

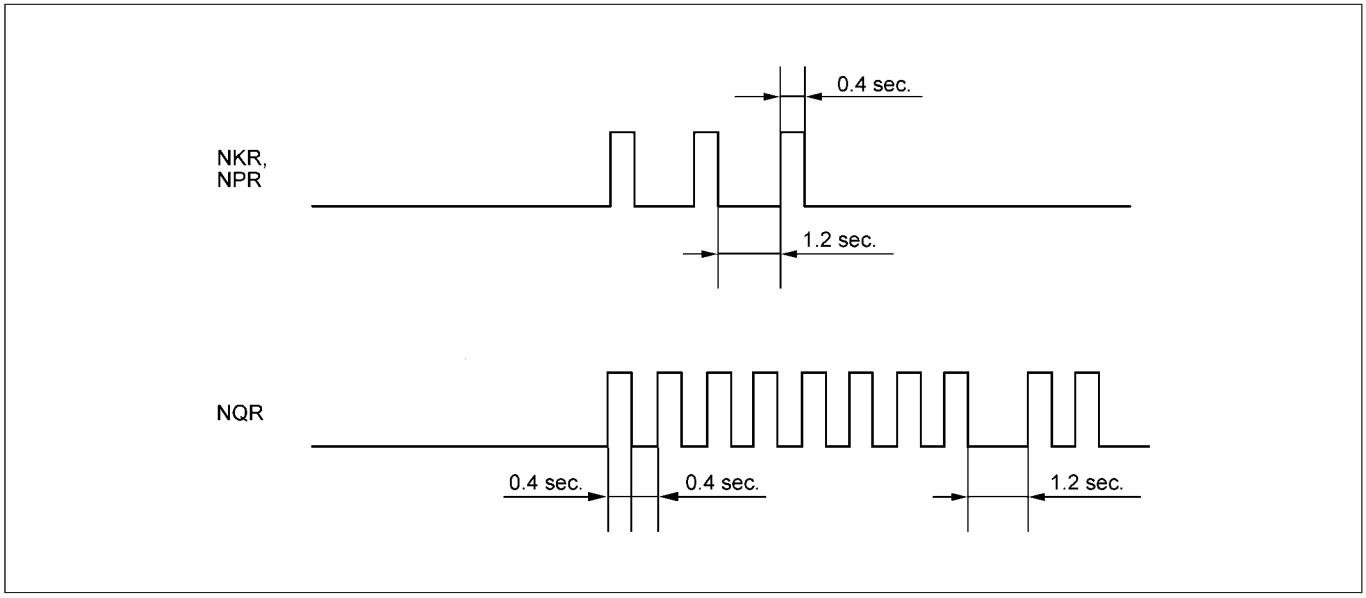


Chart B-1-1 With the key in the ON position (Before starting the engine). Warning light (W/L) is not activated.

Step	Action	Value(s)	Yes	No
1	Is W/L fuse F-12 disconnected?	-	Go to Step 5	Go to Step 2
2	Is W/L burnt out?	-	Go to Step 6	Go to Step 3
3	1. Turn the key off. 2. Disconnect EHCU connectors. 3. Turn the key on. 4. Using DVM, measure the voltage between J-500 EHCU connector terminals 6 and 1. Does the DVM display a voltage within the specified value?	12V: 9.5-16.5V 24V: 16.5-34V	Go to Step 4	Go to Step 7
4	Check the continuity between J-500 EHCU connector terminal 1 and body ground. Is there continuity?	-	Go to Step 9	Go to Step 8
5	Replace the fuse. Is action complete?	-	Go to Step 10	-
6	Replace the W/L bulb. Is action complete?	-	Go to Step 10	-
7	Locate and repair open circuit, poor connection or short circuit in the ignition feed circuit. Is action complete?	-	Go to Step 10	-
8	Locate and repair open circuit, poor connection or short circuit in the ground circuit. Is action complete?	-	Go to Step 10	-
9	1. Check the harness for suspected disconnection. 2. If no fault found, replace the EHCU. Is action complete?	-	Go to Step 10	-
10	1. Reconnect all components, ensure all components are properly mounted. 2. Clear diagnostic trouble code. Was this step finished?	-	Go to “Basic diagnostic flow chart.”	-

Chart 1 (DTC13/C0213) Vehicle Type Error

Step	Action	Value(s)	Yes	No
1	1. Disconnect EHCU connector. 2. Turn the key on. 3. Measure the voltage at terminal 14, 15, and 17.	NQR: All terminal battery voltage NKR, NPR: All terminal 0V	Go to Step 2	Go to Step 5
2	1. Turn the key off and connect EHCU. 2. Connect the TECH 2. 3. Clear the vehicle type. 4. Does the warning light turn off?	-	Go to Step 3	Replace the EHCU. Go to Step 3
3	Confirm the vehicle type. Is the vehicle type okay?	-	Go to Step 4	Replace the EHCU. Repeat Step 3
4	Clear the DTC.	-	Troubleshooting completed.	-
5	Repair harness. Does the warning light turn off?	-	Go to Step 3	Replace the EHCU. Go to Step 3

Chart 2 (DTC14/C0214) Low Power Voltage of Rear Sensor or EHCU Abnormality

Step	Action	Value(s)	Yes	No
1	Perform chart 11 and 12.	-	Go to Step 2	Go to Step 1
2	1. Turn the key off. 2. Disconnect the EHCU connector. 3. Measure continuity between the body ground and J-500 connector terminal 1, 23. Is there continuity?	-	Go to Step 3	Go to Step 4
3	1. Connect the EHCU connector. 2. Clear DTC. 3. Turn the key from off to on and perform diagnosis procedure. Does the DTC repeat?	-	Go to Step 5	Go to Step 6
4	Repair the open/short circuit or malfunction at connection of connector. Is this step completed?	-	Go to Step 6	-
5	Replace the EHCU. Is this step completed?	-	Go to Step 6	-
6	1. Install all parts. Verify each part is properly installed. 2. Clear DTC. Is this step completed?	-	Go to “Basic diagnostic flow chart”.	Go to Step 6

Chart 3 (DTC15/C0215) EHCU Voltage OUT of Range

Step	Action	Value(s)	Yes	No
1	Is the battery voltage okay?	-	Go to Step 2	Go to Step 5
2	1. Turn the key off. 2. Disconnect the EHCU connector. 3. Start the engine. 4. Measure voltage between J-500 connector terminal 2 and J-500 connector terminal 1, 23. Is the voltage within the specified value?	12 V vehicle: 10-16 V 24 V vehicle: 17-33.5 V	Go to Step 3	Go to Step 6
3	Locate the malfunction of connection in the circuit. Is the circuit malfunction specified?	-	Go to Step 4	Go to Step 8
4	Repair the malfunction and perform diagnosis procedure. Does the DTC repeat?	-	Go to Step 7	Go to Step 8
5	Charge or replace the battery. Is this step completed?	-	Go to Step 8	-
6	Repair open/short circuit or malfunction at connection of connector between J-500 connector terminal 2 and fusible link FL-4. Is this step completed?	-	Go to Step 8	-
7	Replace the EHCU. Is this step completed?	-	Go to Step 8	-
8	1. Install all parts. Verify each part is properly installed. 2. Clear DTC. Is this step completed?	-	Go to “Basic diagnostec flow chart”.	Go to Step 8

Chart 4 (DTC25/C0225) Exhaust Brake Cut Circuit Abnormality

Step	Action	Value(s)	Yes	No
1	1. Disconnect EHCU connector. 2. Start the engine. 3. Measure voltage between EHCU terminals 8 and 1. Is the voltage within the specified value?	12 V vehicle: More than 5 V 24 V vehicle: More than 10 V	Go to Step 2	Go to Step 4
2	Measure voltage between EHCU terminals 7 and 1. Is the voltage within the specified value?	12 V vehicle: More than 5 V 24 V vehicle: More than 10 V	Go to Step 3	Go to Step 6
3	Short EHCU terminal 8 to 1. Is the voltage at EHCU terminal 7 less than 1.5 V?	-	Replace the EHCU.	Replace the exhaust brake cut relay.
4	Measure resistance of the exhaust brake cut relay coil.	12 V vehicle: 60-120 ohms 24 V vehicle: 210-310 ohms	Go to Step 5	Replace the exhaust brake cut relay.
5	Measure voltage at coil power side of relay box connector. (key at on position) Is the voltage within the specified value?	12 V vehicle: 10-16 V 24 V vehicle: 20-32 V	Check harness between EHCU terminal 8 and exhaust brake cut relay. Repair as necessary.	Repair harness and/or power line.
6	Turn the exhaust brake switch on. Does the exhaust brake indicator light turn on?	-	Repair harness of EHCU terminal 7.	Go to exhaust brake diagnosis procedure.

Chart 5 (DTC33/C0233) Motor Drive Circuit Abnormality

Step	Action	Value(s)	Yes	No
1	1. Disconnect EHCU connector. 2. Measure voltage between EHCU terminals 24 and 1. Is the voltage within the specified value?	12 V vehicle: 10-16 V 24 V vehicle: 20-32 V	Go to Step 2	Go to Step 3
2	Measure continuity between EHCU terminals 23 and 1. Is there continuity?	-	Replace the EHCU.	Repair the harness.
3	Check the ABS fusible link (12V: 60A, 24V: 40A). Is it okay?	-	Repair the harness.	Replace the ABS fusible link (12V: 60A, 24V: 40A).

Chart 6 (DTC 34/C0234) Abnormal Motor Rotation

- Replace EHCU.

Chart 7 (DTC41/C0241) Solenoid Valve Power Supply Abnormality

Step	Action	Value(s)	Yes	No
1	1. Disconnect EHCU connector. 2. Measure voltage between EHCU terminals 2 and 1. Is the voltage within the specified value?	12 V vehicle: 10-16 V 24 V vehicle: 20-32 V	Replace the EHCU.	Go to Step 2
2	Check the ABS fusible link (12V: 60A, 24V: 40A). Is it okay?	-	Repair the harness.	Replace the ABS fusible link (12V: 60A, 24V: 40A).

Chart 8 (DTC 43, 45/C0243, C0245) Solenoid Valve Circuit Abnormality

- Replace EHCU.

Chart 9 (DTC51/C0251) FL Speed Sensor Circuit Abnormality

Step	Action	Value(s)	Yes	No
1	1. Disconnect EHCU connector. 2. Measure resistance between EHCU terminals 32 and 33. Is the resistance within the specified value?	1-2 k ohms	Replace the EHCU.	Go to Step 2
2	1. Disconnect the FL speed sensor connector. 2. Measure the FL speed sensor resistance. Is the resistance okay?	-	Repair the harness.	Replace the FL speed sensor.

Chart 10 (DTC52/C0252) FR Speed Sensor Circuit Abnormality

Step	Action	Value(s)	Yes	No
1	1. Disconnect EHCU connector. 2. Measure resistance between EHCU terminals 10 and 11. Is the resistance within the specified value?	1-2 k ohms	Replace the EHCU.	Go to Step 2
2	1. Disconnect the FR speed sensor connector. 2. Measure the FR speed sensor resistance. Is the resistance okay?	-	Repair the harness.	Replace the FR speed sensor.

Chart 11 (DTC53/C0253) RL Speed Sensor Circuit Abnormality

Step	Action	Value(s)	Yes	No
1	1. Disconnect EHCU connector. 2. Disconnect RL speed sensor connector. 3. Measure continuity between EHCU terminal 22 and positive side of chassis harness connector connected to RL speed sensor. Is there continuity?	-	Go to Step 2	Repair the harness.
2	Measure continuity between EHCU terminals 22 and 1. Is there continuity?	-	Go to Step 3	Repair the harness.
3	1. Start the engine. 2. Measure voltage between EHCU terminals 22 and 1. Is the voltage within the specified value?	Less than 2 V	Go to Step 4	Repair the harness.
4	Measure continuity between EHCU terminal 34 and positive side of chassis harness connector connected to RL speed sensor. Is there continuity?	-	Go to Step 5	Repair the harness.
5	Measure continuity between EHCU terminals 34 and 1. Is there continuity?	-	Go to Step 6	Repair the harness.
6	1. Start the engine. 2. Measure voltage between EHCU terminals 34 and 1. Is the voltage within the specified value?	Less than 2 V	Go to Step 7	Repair the harness.
7	Check the RL speed sensor (Refer to chart C-1-3 or TC-1). Does the DVM display a voltage within the specified value?	0.2-4.5 V	Replace the EHCU.	Replace the RL speed sensor.

Chart 12 (DTC54/C0254) RR Speed Sensor Circuit Abnormality

Step	Action	Value(s)	Yes	No
1	1. Disconnect EHCU connector. 2. Disconnect RR speed sensor connector. 3. Measure continuity between EHCU terminal 21 and positive side of chassis harness connector connected to RR speed sensor. Is there continuity?	-	Go to Step 2	Repair the harness.
2	Measure continuity between EHCU terminals 21 and 1. Is there continuity?	-	Go to Step 3	Repair the harness.
3	1. Start the engine. 2. Measure voltage between EHCU terminals 21 and 1. Is the voltage within the specified value?	Less than 2 V	Go to Step 4	Repair the harness.
4	Measure continuity between EHCU terminal 12 and positive side of chassis harness connector connected to RR speed sensor. Is there continuity?	-	Go to Step 5	Repair the harness.
5	Measure continuity between EHCU terminals 12 and 1. Is there continuity?	-	Go to Step 6	Repair the harness.
6	1. Start the engine. 2. Measure voltage between EHCU terminals 12 and 1. Is the voltage within the specified value?	Less than 2 V	Go to Step 7	Repair the harness.
7	Check the RR speed sensor (Refer to chart c-1-4 or TC-1). Does the DVM display a voltage within the specified value?	0.2-4.5 V	Replace the EHCU.	Replace the RR speed sensor.

Chart 13 (DTC 61/C0261) Abnormal FL Speed Sensor Signal

Step	Action	Value(s)	Yes	No
1	Is there play in the FL wheel bearing?	-	Go to Step 10	Go to Step 2
2	Is there play in the FL speed sensor/sensor rotor?	-	Go to Step 11	Go to Step 3
3	Is there powdered iron sticking to FL speed sensor/sensor rotor?	-	Go to Step 12	Go to Step 4
4	Check the FL speed sensor. (Refer to Chart C-1-1 or TC-1) Is the FL sensor output normal?	-	Go to Step 5	Go to Step 8
5	Is there a broken tooth or indentation in the sensor rotor?	-	Go to Step 13	Go to Step 6
6	Using DVM, measure the resistance between J-500 EHCU connector terminal 33 and ground. Does the DVM display a resistance within the specified value?	1000 k ohms or more	Go to Step 7	Go to Step 9
7	1. Clear diagnostic trouble code. 2. Test drive and perform system self-check. Does repeat trouble?	-	Go to Step 18	Go to Step 16
8	Is there damage or indentation in the speed sensor?	-	Go to Step 14	Go to Step 15
9	1. Disconnect FL sensor connector. 2. Using DVM, measure the resistance between J-75 sensor connector terminal 2 and ground. Does the DVM display a resistance within the specified value?	1000 k ohms or more	Go to Step 17	Go to Step 14
10	Adjust wheel bearing preload. Is action complete?	-	Go to Step 19	-
11	Repair or replace speed sensor/sensor rotor. Is action complete?	-	Go to Step 19	-
12	Repair speed sensor/sensor rotor. Is action complete?	-	Go to Step 19	-
13	Replace sensor rotor. Is action complete?	-	Go to Step 19	-
14	Replace FL speed sensor. Is action complete?	-	Go to Step 19	-
15	Check the FL speed sensor circuit. Refer to Chart 9. Is action complete?	-	Verify repair	
16	Check for a poor connection and an open circuit on the harness between EHCU and sensor connectors. Refer to “Note on Intermittents” described in earlier this section. Is action complete?	-	Go to Step 19	-

Step	Action	Value(s)	Yes	No
17	1. Locate open circuit, poor connection or short circuit on the harness between EHCU and sensor connectors. 2. Repair the harness. Is action complete?	-	Go to Step 19	Go to Step 19
18	Replace EHCU. Is action complete?	-	Go to Step 19	-
19	1. Reconnect all components, ensure all components are properly mounted. 2. Clear diagnostic trouble code. Was this step finished?	-	Go to “Basic diagnostic flow chart.”	Go to Step 19

Chart 14 (DTC 62/C0262) Abnormal FR Speed Sensor Signal

Step	Action	Value(s)	Yes	No
1	Is there play in the FR wheel bearing?	-	Go to Step 10	Go to Step 2
2	Is there play in the FR speed sensor/sensor rotor?	-	Go to Step 11	Go to Step 3
3	Is there powdered iron sticking to FR speed sensor/sensor rotor?	-	Go to Step 12	Go to Step 4
4	Check the FR speed sensor. (Refer to Chart C-1-2 or TC-1) Is the FR sensor output normal?	-	Go to Step 5	Go to Step 8
5	Is there a broken tooth or indentation in the sensor rotor?	-	Go to Step 13	Go to Step 6
6	Using DVM, measure the resistance between J-500 EHCU connector terminal 11 and ground. Does the DVM display a resistance within the specified value?	1000 k ohms or more	Go to Step 7	Go to Step 9
7	1. Clear diagnostic trouble code. 2. Test drive and perform system self-check. Does repeat trouble?	-	Go to Step 18	Go to Step 16
8	Is there damage or indentation in the speed sensor?	-	Go to Step 14	Go to Step 15
9	1. Disconnect FR sensor connector. 2. Using DVM, measure the resistance between J-74 sensor connector terminal 2 and ground. Does the DVM display a resistance within the specified value?	1000 k ohms or more	Go to Step 17	Go to Step 14
10	Adjust wheel bearing preload. Is action complete?	-	Go to Step 19	-
11	Repair or replace speed sensor/sensor rotor. Is action complete?	-	Go to Step 19	-
12	Repair speed sensor/sensor rotor. Is action complete?	-	Go to Step 19	-
13	Replace sensor rotor. Is action complete?	-	Go to Step 19	-
14	Replace FR speed sensor. Is action complete?	-	Go to Step 19	-
15	Check the FR speed sensor circuit. Refer to Chart 10. Is action complete?	-	Verify repair	-
16	Check for a poor connection and an open circuit on the harness between EHCU and sensor connectors. Refer to “Note on Intermittents” described in earlier this section. Is action complete?	-	Go to Step 19	-

Step	Action	Value(s)	Yes	No
17	1. Locate open circuit, poor connection or short circuit on the harness between EHCU and sensor connectors. 2. Repair the harness. Is action complete?	-	Go to Step 19	Go to Step 19
18	Replace EHCU. Is action complete?	-	Go to Step 19	-
19	1. Reconnect all components, ensure all components are properly mounted. 2. Clear diagnostic trouble code. Was this step finished?	-	Go to “Basic diagnostic flow chart.”	Go to Step 19

Chart 15 (DTC 63/C0263) Abnormal RL Speed Sensor Signal

Step	Action	Value(s)	Yes	No
1	Is there play in the RL wheel bearing?	-	Go to Step 8	Go to Step 2
2	Is there play in the RL speed sensor/sensor rotor?	-	Go to Step 9	Go to Step 3
3	Is there powdered iron sticking to RL speed sensor/sensor rotor?	-	Go to Step 10	Go to Step 4
4	Check the RL speed sensor. (Refer to Chart C-1-3 or TC-1) Is the RL sensor output normal?	-	Go to Step 5	Go to Step 7
5	Is there a broken tooth or indentation in the sensor rotor?	-	Go to Step 11	Go to Step 6
6	1. Clear diagnostic trouble code. 2. Test drive and perform system self-check. Does repeat trouble?	-	Go to Step 15	Go to Step 14
7	Is there damage or indentation in the speed sensor?	-	Go to Step 12	Go to Step 13
8	Adjust wheel bearing preload. Is action complete?	-	Go to Step 16	-
9	Repair or replace speed sensor/sensor rotor. Is action complete?	-	Go to Step 16	-
10	Repair speed sensor/sensor rotor. Is action complete?	-	Go to Step 16	-
11	Replace sensor rotor. Is action complete?	-	Go to Step 16	-
12	Replace RL speed sensor. Is action complete?	-	Go to Step 16	-
13	Check the RL speed sensor circuit. Refer to Chart 11. Is action complete?	-	Verify repair	-
14	Check for a poor connection and an open circuit on the harness between EHCU and sensor connectors. Refer to “Note on Intermittents” described in earlier this section. Is action complete?	-	Go to Step 16	-
15	Replace EHCU. Is action complete?	-	Go to Step 16	-
16	1. Reconnect all components, ensure all components are properly mounted. 2. Clear diagnostic trouble code. Was this step finished?	-	Go to “Basic diagnostic flow chart.”	Go to Step 16

Chart 16 (DTC 64/C0264) Abnormal RR Speed Sensor Signal

Step	Action	Value(s)	Yes	No
1	Is there play in the RR wheel bearing?	-	Go to Step 8	Go to Step 2
2	Is there play in the RR speed sensor/sensor rotor?	-	Go to Step 9	Go to Step 3
3	Is there powdered iron sticking to RR speed sensor/sensor rotor?	-	Go to Step 10	Go to Step 4
4	Check the RR speed sensor. (Refer to Chart C-1-4 or TC-1) Is the RR sensor output normal?	-	Go to Step 5	Go to Step 7
5	Is there a broken tooth or indentation in the sensor rotor?	-	Go to Step 11	Go to Step 6
6	1. Clear diagnostic trouble code. 2. Test drive and perform system self-check. Does repeat trouble?	-	Go to Step 15	Go to Step 14
7	Is there damage or indentation in the speed sensor?	-	Go to Step 12	Go to Step 13
8	Adjust wheel bearing preload. Is action complete?	-	Go to Step 16	-
9	Repair or replace speed sensor/sensor rotor. Is action complete?	-	Go to Step 16	-
10	Repair speed sensor/sensor rotor. Is action complete?	-	Go to Step 16	-
11	Replace sensor rotor. Is action complete?	-	Go to Step 16	-
12	Replace RR speed sensor. Is action complete?	-	Go to Step 16	-
13	Check the RR speed sensor circuit. Refer to Chart 12. Is action complete?	-	Verify repair	-
14	Check for a poor connection and an open circuit on the harness between EHCU and sensor connectors. Refer to “Note on Intermittents” described in earlier this section. Is action complete?	-	Go to Step 16	-
15	Replace EHCU. Is action complete?	-	Go to Step 16	-
16	1. Reconnect all components, ensure all components are properly mounted. 2. Clear diagnostic trouble code. Was this step finished?	-	Go to “Basic diagnostic flow chart.”	Go to Step 16

Chart 17 (DTC65/C0265) Tire Size Error

Step	Action	Value(s)	Yes	No
1	Does the tire size match the vehicle specification?	-	Go to Step 2	Replace the abnormal tire.
2	Check wear and inflation of the tire. Are they okay?	-	Go to Step 3	Repair or replace the abnormal tire.
3	Are the sensor rotors normal?	-	Go to Step 4	Replace the abnormal sensor rotor.
4	Test run the vehicle. Does the malfunction repeat.	-	Replace the EHCU.	Recheck the DTC.

Unit Inspection Procedure

This section describes the following inspection procedures referred to during "SYMPTOM DIAGNOSIS" and "DIAGNOSIS BY 'ABS' WARNING LIGHT ILLUMINATION PATTERN":

	without TECH 2	with TECH 2
Speed Sensor Output Inspection	Chart C-1-1 to C-1-4	Chart TC-1

Chart C-1-1 FL Speed Sensor Output Inspection Procedure

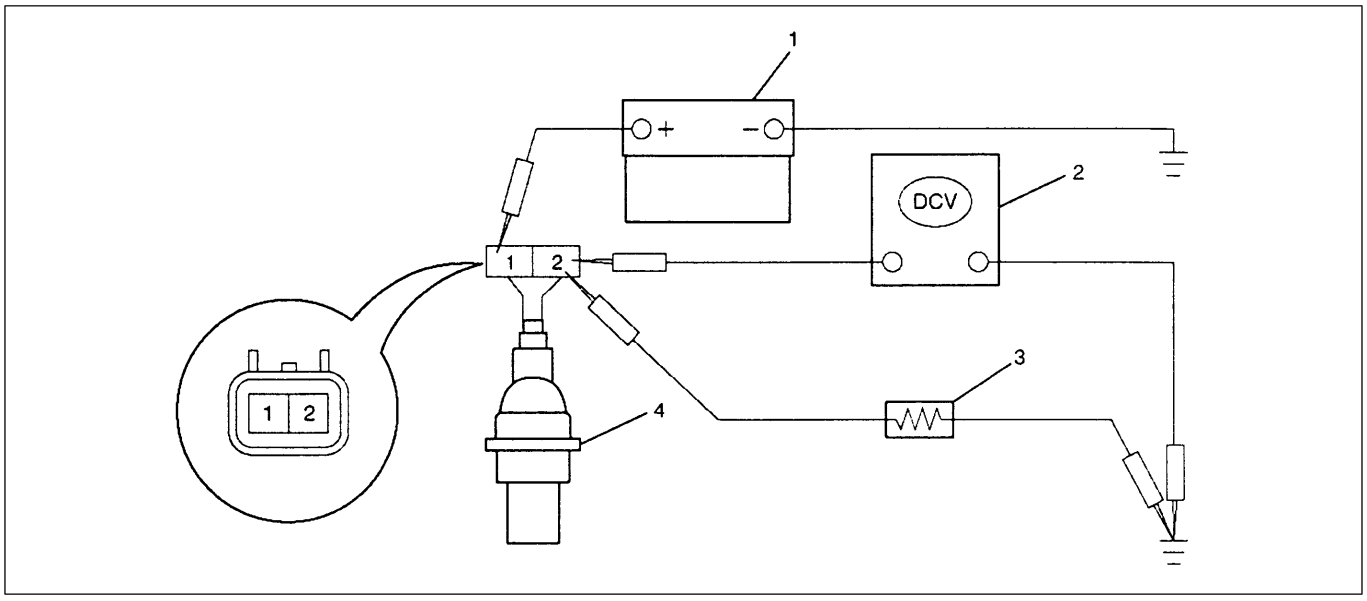
Step	Action	Value(s)	Yes	No
1	1. Turn the key off. 2. Disconnect EHCU connector. 3. Jack up the vehicle, with all wheels off the ground. 4. Measure the AC voltage between J-500 EHCU connector terminals 32 and 33 while turning FL wheel at a speed of 0.5 RPS. Does the DVM display a voltage within the specified value?	200 mV or more	Go to Step 5	Go to Step 2
2	1. Disconnect FL sensor connector. 2. Using DVM, measure the resistance between J-75 sensor connector terminals 1 and 2. Does the DVM display a resistance within the specified value?	1.0-2.0 k ohms	Go to Step 4	Go to Step 3
3	1. Locate open circuit, poor connection or short circuit on the harness between EHCU and sensor connectors. 2. Repair the harness. Is action complete?	-	Go to Step 5	-
4	Replace FL sensor. Is action complete?	-	Go to Step 5	-
5	1. Reconnect all components, ensure all components are properly mounted. 2. Clear diagnostic trouble code. Was this step finished?	-	Go to "Basic diagnostic flow chart."	Go to Step 5

Chart C-1-2 FR Speed Sensor Output Inspection Procedure

Step	Action	Value(s)	Yes	No
1	1. Turn the key off. 2. Disconnect EHCU connector. 3. Jack up the vehicle, with all wheels off the ground. 4. Measure the AC voltage between J-500 EHCU connector terminals 10 and 11 while turning FR wheel at a speed of 0.5 RPS. Does the DVM display a voltage within the specified value?	200 mV or more	Go to Step 5	Go to Step 2
2	1. Disconnect FR sensor connector. 2. Using DVM, measure the resistance between J-74 sensor connector terminals 1 and 2. Does the DVM display a resistance within the specified value?	1.0-2.0 k ohms	Go to Step 4	Go to Step 3
3	1. Locate open circuit, poor connection or short circuit on the harness between EHCU and sensor connectors. 2. Repair the harness. Is action complete?	-	Go to Step 5	-
4	Replace FR sensor. Is action complete?	-	Go to Step 5	-
5	1. Reconnect all components, ensure all components are properly mounted. 2. Clear diagnostic trouble code. Was this step finished?	-	Go to “Basic diagnostic flow chart.”	Go to Step 5

Chart C-1-3 RL Speed Sensor Output Inspection Procedure

Step	Action	Value(s)	Yes	No
1	1. Turn the key off. 2. Disconnect EHCU connector. 3. Jack up the vehicle, with all wheels off the ground. 4. Connect a 120 ohms resistor between J-500 EHCU connector terminal 22 and ground. Apply voltage of 12V to EHCU connector terminal 22. 5. Using DVM, measure the DC voltage between J-500 connector terminal 22 and ground while turning RL wheel at a speed of 0.5 RPS. Does the DVM display a voltage within the specified value?	0.2-4.5V	Go to Step 5	Go to Step 2
2	1. Turn the key off. 2. Disconnect RL sensor connector. 3. Connect a 120 ohms resistor between sensor connector terminal 2 (sensor side) and ground. 4. Apply 12V voltage at sensor connector terminal 1 (sensor side). 5. Using DVM, measure the DC voltage between sensor connector terminal 2 (sensor side) and ground while turning RL wheel at a speed of 0.5 RPS. Does the DVM display a voltage within the specified value?	0.2-4.5V	Go to Step 3	Go to Step 4
3	1. Locate open circuit, poor connection short circuit on the harness between EHCU and sensor connectors. 2. Repair the harness. Is action complete?	-	Go to Step 5	-
4	Replace RL sensor. Is action complete?	-	Go to Step 5	-
5	1. Reconnect all components, ensure all components are properly mounted. 2. Clear diagnostic trouble code. Was this step finished?	-	Go to “Basic diagnostic flow chart.”	Go to Step 5

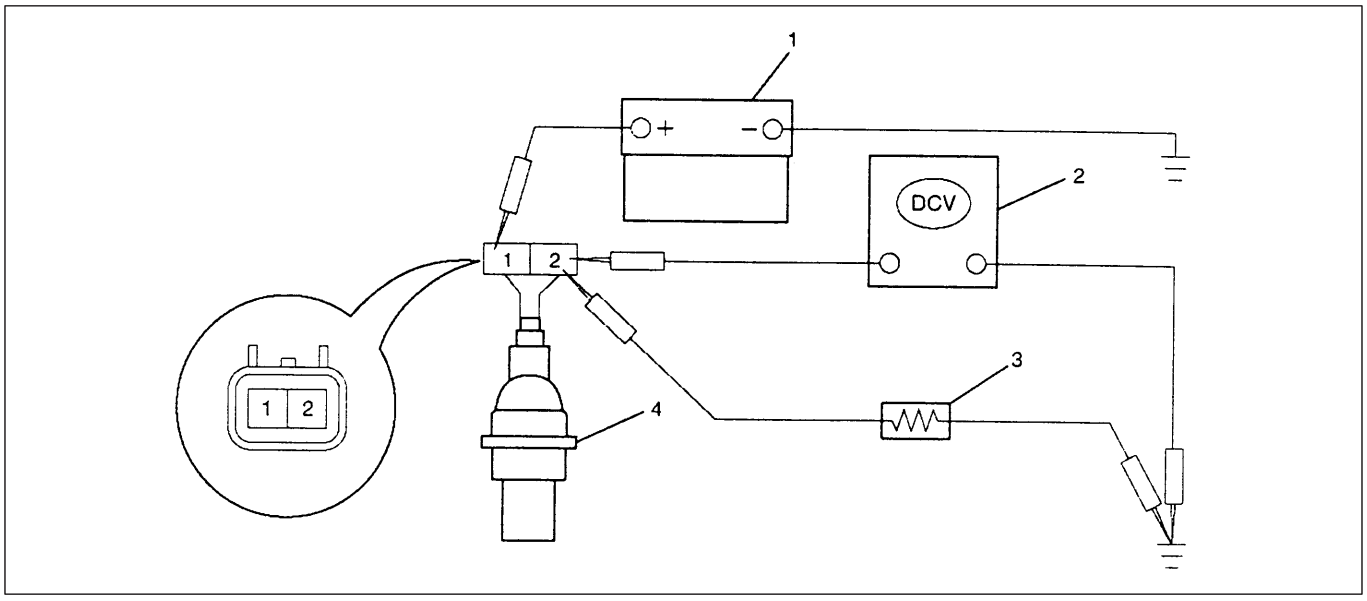


Legend

(1) Battery
(2) DVM
(3) Resistor
(4) Speed Sensor

Chart C-1-4 RR Speed Sensor Output Inspection Procedure

Step	Action	Value(s)	Yes	No
1	1. Turn the key off. 2. Disconnect EHCU connector. 3. Jack up the vehicle, with all wheels off the ground. 4. Connect a 120 ohms resistor between J-500 EHCU connector terminal 21 and ground. 5. Using DVM, measure the DC voltage between J-500 connector terminal 21 and ground while turning RR wheel at a speed of 0.5 RPS. Does the DVM display a voltage within the specified value?	0.2-4.5V	Go to Step 5	Go to Step 3
2	1. Turn the key off. 2. Disconnect RR sensor connector. 3. Connect a 120 ohms resistor between sensor connector terminal 2 (sensor side) and ground. 4. Apply 12V voltage at sensor connector terminal 1 (sensor side). 5. Using DVM, measure the DC voltage between sensor connector terminal 2 (sensor side) and ground while turning RR wheel at a speed of 0.5 RPS. Does the DVM display a voltage within the specified value?	0.2-4.5V	Go to Step 3	Go to Step 4
3	1. Locate open circuit, poor connection short circuit on the harness between EHCU and sensor connectors. 2. Repair the harness. Is action complete?	-	Go to Step 5	-
4	Replace RR sensor. Is action complete?	-	Go to Step 5	-
5	1. Reconnect all components, ensure all components are properly mounted. 2. Clear diagnostic trouble code. Was this step finished?	-	Go to “Basic diagnostic flow chart.”	Go to Step 5



Legend

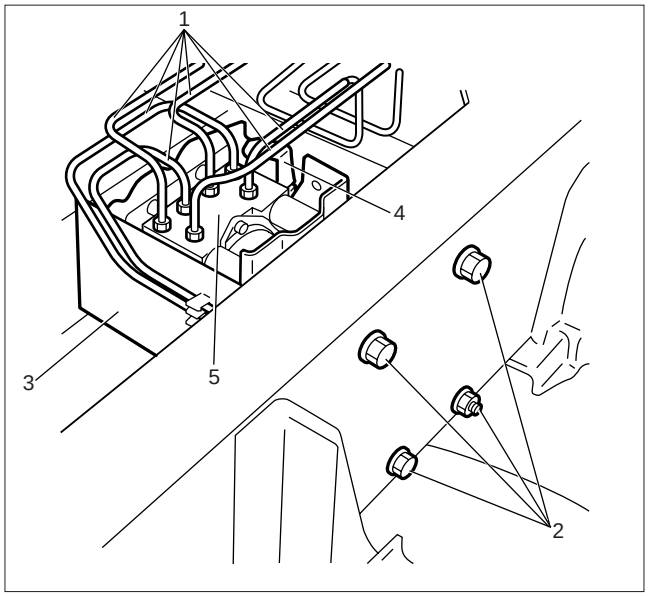
(1) Battery
(2) DVM
(3) Resistor
(4) Speed Sensor

Chart TC-1 Sensor Output Inspection Procedure (Use TECH 2)

Step	Action	Yes	No
1	1. Connect TECH 2. 2. Check the minimum speed of each sensor by WHEEL SENSORS. Is the sensor speed more than 5km/h (3mph)?	Go to Step 2	Go to Step 6
2	Check the sensor harness for suspected disconnection (check while shaking harness/connector). Is the sensor harness connection normal?	Replace speed sensor. Go to Step 3	Repair. Go to Step 3
3	Check the minimum speed of each sensor by WHEEL SENSORS. Is the sensor speed more than 5 km/h (3mph)?	Go to Step 4	Go to Step 6
4	Check the sensor rotor. Is the sensor rotor normal?	Go to Step 5	Replace sensor rotor. Go to Step 5
5	Check the minimum speed of each sensor by WHEEL SENSORS. Is sensor speed more than 5 km/h (3 mph)?	Repair harness or connector between EHCU and speed sensor. Go to Step 6	Go to Step 6
6	Reconnect all components, ensure all components are properly mounted. Was this step finished?	Repeat the “Basic diagnostic flow chart.”	Go to Step 6

Electronic Hydraulic Control Unit (EHCU)

Removal



Legend

(1) Brake Pipe
(2) EHCU Bracket Fix Bolt & Nut
(3) EHCU Bracket
(4) Harness Connector
(5) EHCU

1. Disconnect battery ground cable.
2. Disconnect brake pipes.
3. Remove EHCU bracket fix bolts & nut.
4. Remove EHCU bracket.
5. Remove EHCU.

Installation

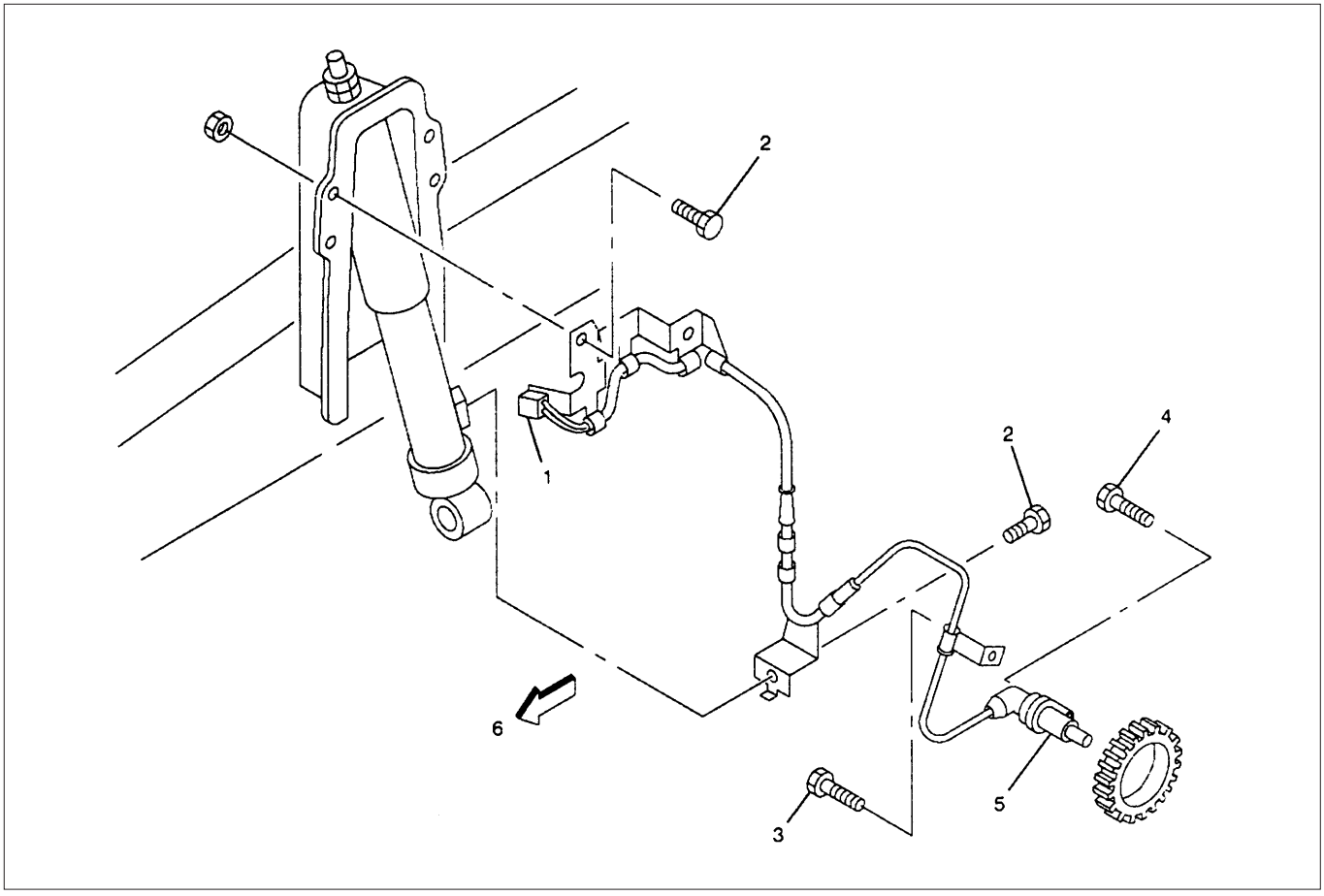
To install, follow the removal steps in the reverse order, noting the following points.

NOTE:

- If welding work is to be performed on the vehicle using an electric arc welder, the EHCU should be removed from the vehicle before the welding operation begins.
- Do not put a radio equipment etc, that emits strong radio wave near the EHCU.
- Do not wet the control unit. If wetted, wipe off water immediately and dry it fully.
- Never loosen any screw on the control unit.
- Do not paint the control unit.
- Prevent possible electrostatic discharge damage.
- Do not touch the control unit pin type terminal with a metalic tip of a screwdriver or tester.
- Do not apply voltage to the terminal.

Front Speed Sensor

Front Speed Sensor and Associated Parts



Legend

(1) Speed Sensor Connector
(2) Sensor Cable Fixing Bolt
(3) Sensor Cable Fixing Bolt
(4) Sensor Fixing Bolt
(5) Speed Sensor
(6) Front

Removal

1. Remove speed sensor connector.
2. Remove sensor cable fixing bolts.
3. Remove the speed sensor fixing bolt.
4. Remove speed sensor.

Inspection and Repair

1. Check the speed sensor pole piece for presence of foreign materials; remove any dirt, etc.
2. Check the pole piece for damage; replace speed sensor if necessary.
3. Check the speed sensor cable for short or open circuit, and replace with a new one if necessary. To check for cable short or open, bend or stretch the cable while checking for continuity.

Installation

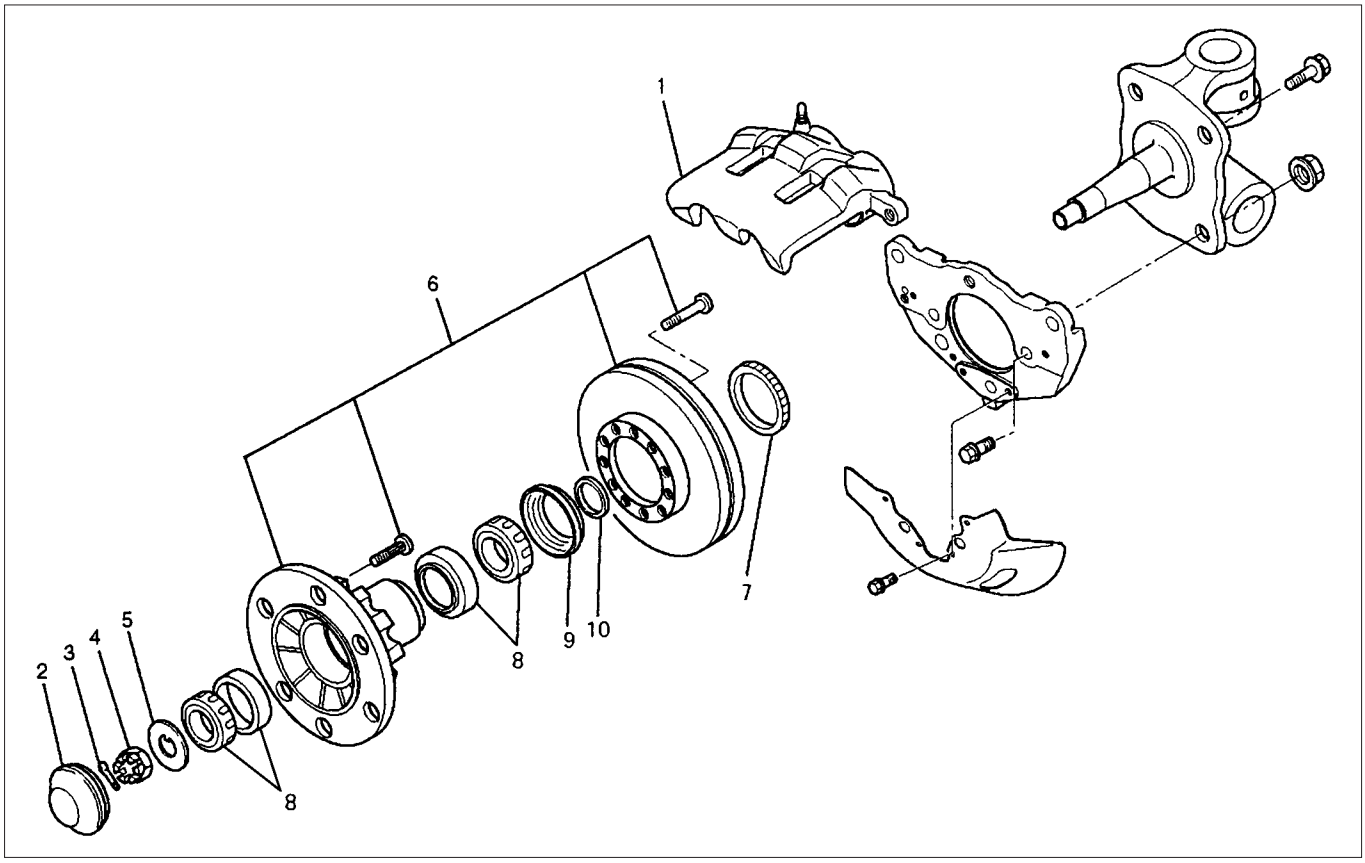
1. Install speed sensor and take care not to hit the speed sensor pole piece during installation.
2. Install speed sensor fixing bolt and tighten the fixing bolt to the specified torque.
   Torque: 22 N·m (2.2kgf·m/16lb·ft)
3. Install speed sensor cable fixing bolts and tighten the fixing bolt to the specified torque.
   Torque
   Bolts (2): 22 N·m (2.2kgf·m/16lb·ft)
   Bolts (3): 45 N·m (4.6kgf·m/33lb·ft)

NOTE: Confirm that a white or yellow line marked on the cable is not twisted when connecting the speed sensor cable.

4. Connect speed sensor connector.

Front Speed Sensor Rotor

Front Speed Sensor Rotor and Associated Parts

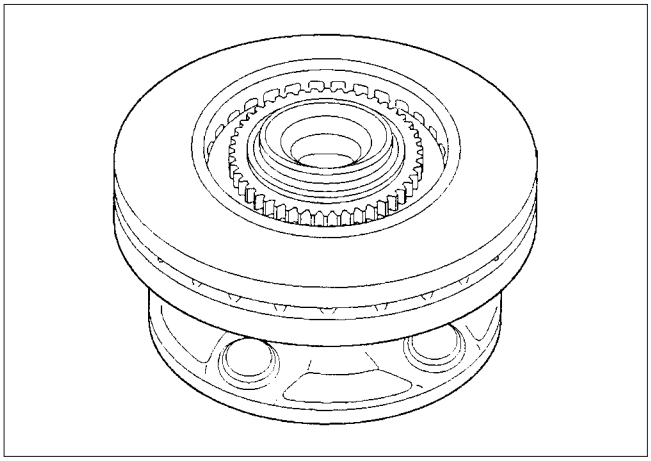


Legend

(1) Disk Brake Assembly
(2) Hub Cap
(3) Cotter Pin
(4) Hub Nut
(5) Washer
(6) Hub and Disc Assembly
(7) Speed Sensor Rotor
(8) Inner Bearing and Outer Bearing
(9) Oil Seal
(10) Spacer

Removal

1. Remove disc brake assembly and support the caliper assembly so that the brake hose is not stretched or damaged.
2. Remove hub cap.
3. Remove cotter pin and hub nut.
4. Remove washer.
5. Remove hub and disc assembly.



6. Remove speed sensor rotor.
7. Remove inner bearing, oil seal spacer.

Inspection and Repair

1. Check the speed sensor rotor for damage including tooth chipping, and if damaged, replace the speed sensor rotor.

Installation

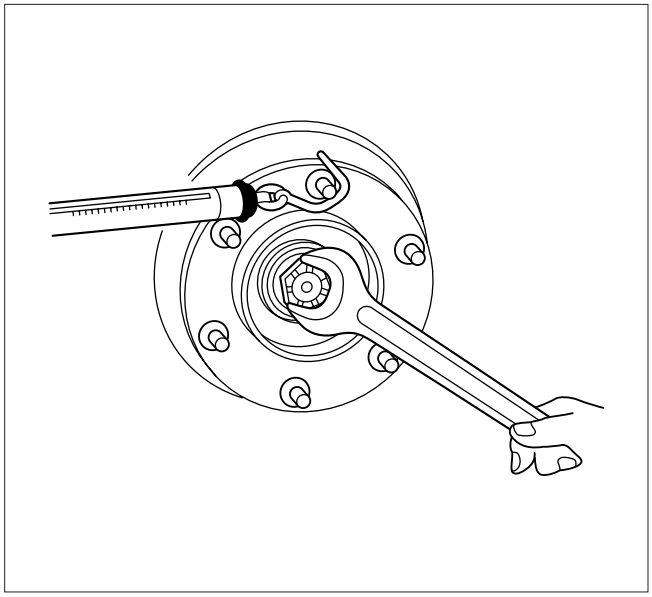
1. Using a bench press, install speed sensor rotor.
2. Install spacer onto the knuckle spindle.
3. Apply grease into the outer and inner bearings and install bearings in the hub.
4. Install oil seal into hub and disc assembly and install hub and disc assembly on to the knuckle spindle.

Preload Adjustment

Adjust the wheel bearing as follows:

1. Tighten the nut until you are unable to manually rotate the hub and disc assembly.
2. Loosen the nut.
3. Attach a spring balancer to one stud. Gradually retighten the nut until the hub and disc assembly bearing is adjusted to the specified preload.

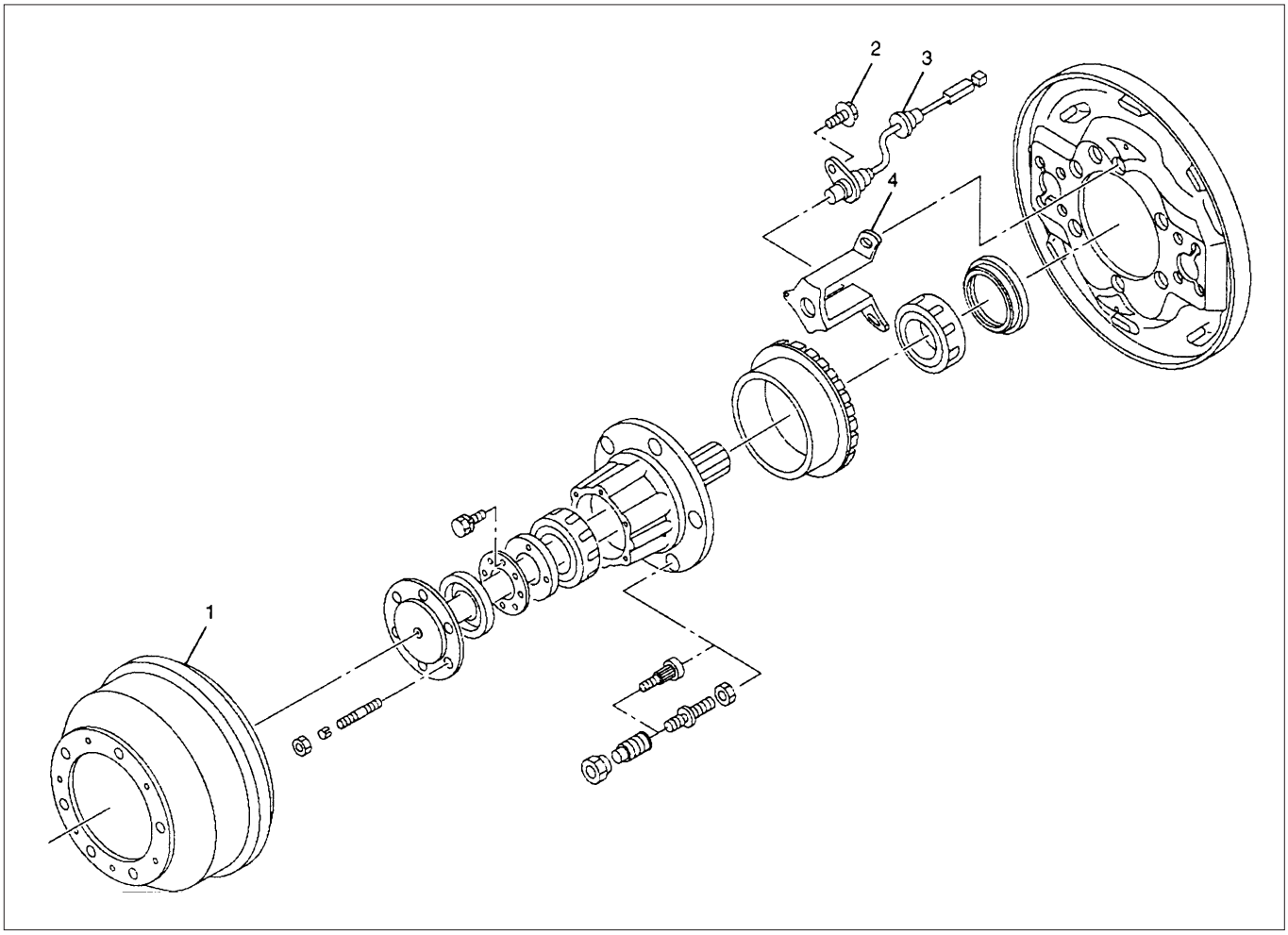
- Hub bearing preload
  New Hub Bearing 9.8-24.5N (1-2.5kgf/2.2-5.5lbf)
  Reused Hub Bearing 4.9-19.6N (0.5-2kgf/1.1-4.4lbf)



4. Install a cotter pin through the nut and knuckle and bend it over.
   - If the notch in the nut does not line up with the cotter pin hole in the knuckle, tighten the nut until it does. Do not loosen the nut to line up a notch and the knuckle hole.
5. Apply grease into the hub cap and install it.
   - 0.4N (40g/0.09lbf)
6. Install the disc brake assembly and tighten two bolts to the specified torque.
   - **Torque: 221 N·m (22.5kgf·m/163lb·ft)**

Rear Speed Sensor

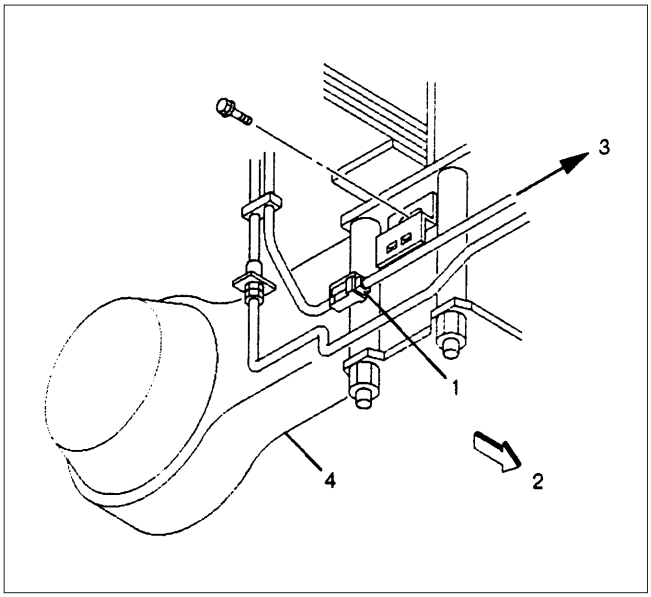
Rear Speed Sensor and Associated Parts



Legend

(1) Brake Drum
(2) Speed Sensor Fixing Bolt
(3) Speed Sensor
(4) Speed Sensor Bracket

Removal



Legend

(1) Speed Sensor Connector
(2) Front
(3) Speed Sensor
(4) Rear Axle

1. Disconnect speed sensor connector.
2. Remove brake drum.
3. Remove speed sensor fixing bolt.
4. Remove speed sensor.
5. Remove speed sensor bracket.

Inspection and Repair

1. Check the speed sensor for presence of foreign materials; remove any dirt, etc.
2. Check the speed sensor for damage, and replace the speed sensor if necessary.
3. Check the speed sensor harness for a short or an open, and replace with a new one if necessary. To check for harness short or open, bend or stretch the cable while checking for continuity.

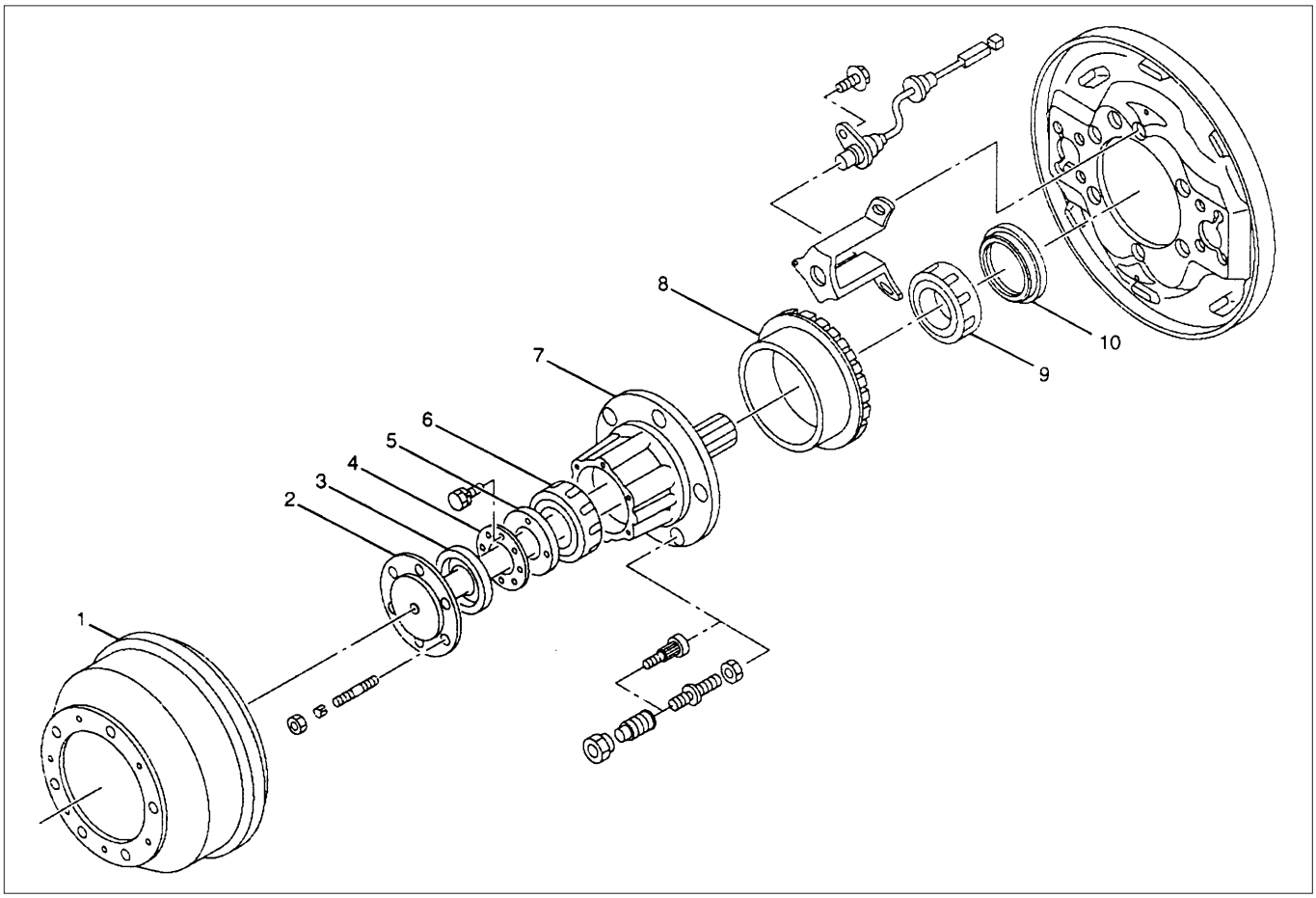
Installation

1. Install speed sensor bracket and tighten the nut to the specified torque.
   Torque:
   GVW Range 12,000 lbs. and 14,500 lbs. model 108 N·m (11kgf·m/80lb·ft)
   GVW Range 17,950 lbs. model 157 N·m (16kgf·m/116lb·ft)
2. Install the speed sensor and take care not to hit the speed sensor during installation.
3. Install the speed sensor fixing bolt and tighten it to the specified torque.
   Torque: 18 N·m (1.8kgf·m/13lb·ft)
4. Install brake drum and tighten bolts to the specified torque.
   Torque: 13 N·m (1.3kgf·m/9.5lb·ft)
5. Connect speed sensor connector.

NOTE: Confirm that the harness is not twisted when connecting the speed sensor connector.

Rear Speed Sensor Rotor

Rear Speed Sensor Rotor and Associated Parts



Legend

(1) Brake Drum
(2) Axle Shaft
(3) Outer Oil Seal
(4) Lock Washer
(5) Bearing Nut
(6) Outer Bearing
(7) Rear Hub
(8) Speed Sensor Rotor
(9) Inner Bearing
(10) Inner Oil Seal

Removal

1. Remove brake drum.
2. Remove axle shaft.
3. Remove outer oil seal, using a screwdriver.
4. Remove lock washer.
5. Remove bearing nut with a hub bearing nut wrench.
6. Remove hub assembly from axle case.
7. Remove outer bearing from hub assembly.
8. Remove speed sensor rotor from hub assembly.
9. Remove inner bearing and inner oil seal from axle case.

Inspection and Repair

1. Check the speed sensor rotor for damage including tooth chipping. If damaged, replace speed sensor rotor.

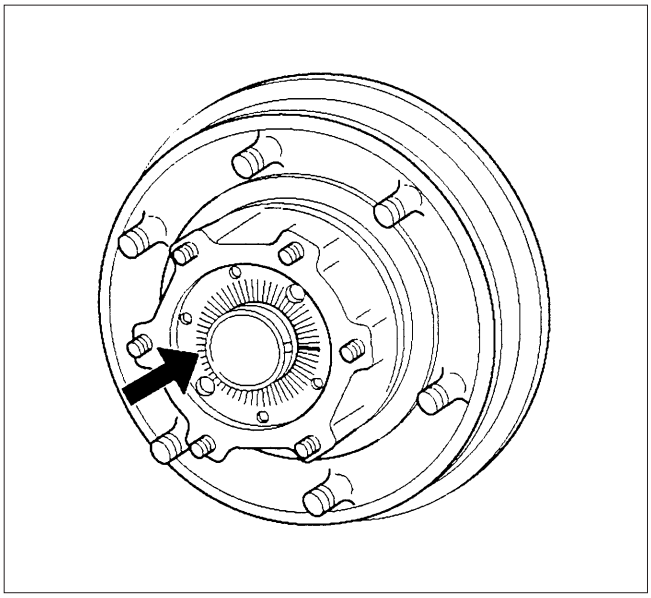
Installation

1. Using a bench press, install speed sensor rotor.

NOTE: Do not reuse the sensor rotor.

2. Install spacer on to the axle case.
3. Apply grease into the outer and inner bearings and install bearings in the hub.
4. Install outer oil seal into hub.

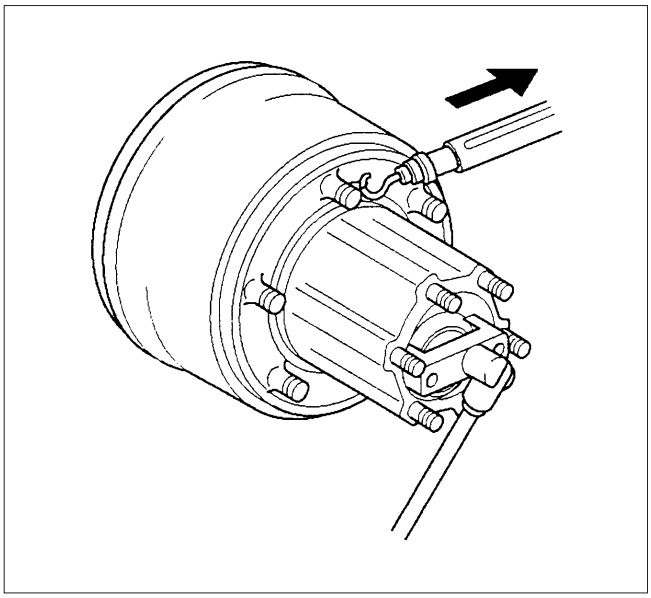
5. Install hub assembly onto the axle case.



6. Set the lock nut with the notched line facing out.

Preload Adjustment

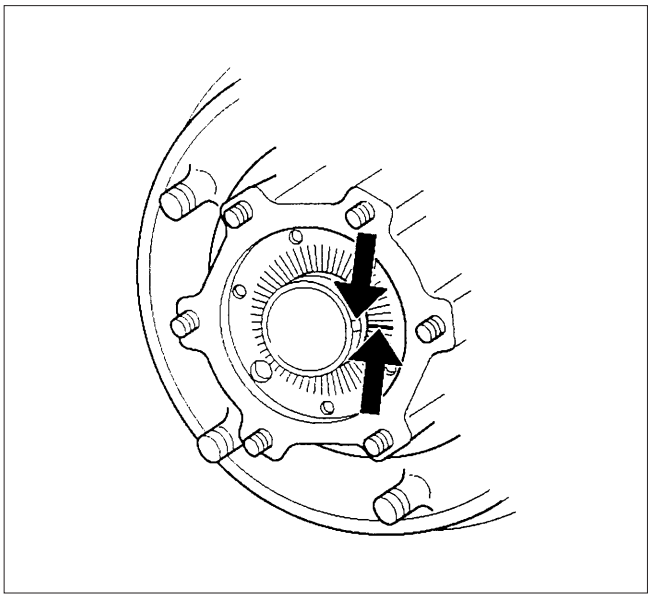
1) Turn the hub to the left and right several times to establish bearing conformity.
2) Use the bearing nut wrench to tighten the bearing nut until the hub can not be manually rotated.
3) Loosen the bearing nut until hub rotates easily.



4) Set the spring balancer to the wheel pin in the position shown in the illustration.
5) Measure the hub bearing preload by carefully pulling on the spring balancer and noting the indicator reading.

Hub Bearing Preload (At Wheel Pin)
42-52 N (4.3-5.3kgf/9.4-11.6lbf)

6) Rotate the hub several times to the right and left.
7) Measure the bearing preload a second time.

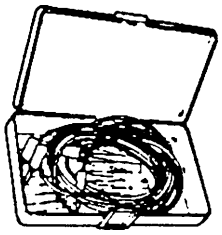
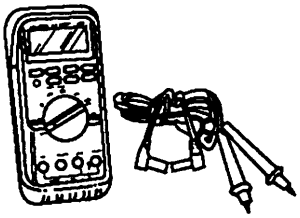
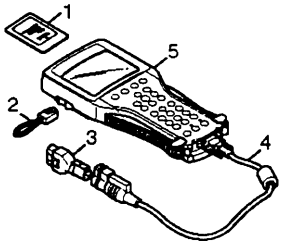


8) Align the axle case groove with the closest bearing nut slit.

NOTE: If it is difficult to align the axle case and bearing nut, slightly tighten the bearing nut.

7. Install the lock washer with the lock washer tabs inserted to the axle case grooves.
   Install the lock bolts to prevent the bearing nut from loosening.
   Check that the lock washer tabs are inserted to the axle case grooves.
8. Apply grease to the outer oil seal lip inner and outer circumferences and install outer oil seal.
9. Clean the axle shaft.
   Apply gear oil to the axle shaft spline.
   Insert the axle shaft into the axle case.
   Take care not to damage the oil seal.
10. Tighten the axle shaft nuts to the specified torque a little at a time.
    Torque: 46 N·m (4.7kgf·m/34lb·ft)
11. Install brake drum.

Special Tools

ILLUSTRATION	TOOL NO. TOOL NAME
	**5-8840-0385-0** **(J-35616)** Connector test adapter kit
	**5-8840-0285-0** **(J-39200)** High impedance multimeter
	(1) PCMCIA Card (2) RS232 Loop Back Connector (3) SAE 16/19 Adapter (4) DLC Cable (5) Tech 2

LGBRK-WE-0101

You are requested to order this manual using the manual number that is shown above.

This manual is applicable for vehicles in all countries except the USA and Canada.

All rights reserved. This manual may not be reproduced in whole or in part, without the permission in writing of ISUZU MOTORS LIMITED.

Issued by

ISUZU MOTORS LIMITED

INTERNATIONAL SERVICE DEPARTMENT

Tokyo, Japan

First edition Jan., 2001

LGBRK-WE-0101 PRINTED IN JAPAN

WORKSHOP MANUAL

NHR, NKR, NPR, NQR, NPS

BRAKES

SECTION 5

ISUZU

International Service & Parts
Tokyo, Japan

NOTICE

Before using this Workshop Manual to assist you in performing vehicle service and maintenance operations, it is recommended that you carefully read and thoroughly understand the information contained in Section-0A under the headings "GENERAL REPAIR INSTRUCTIONS" and "HOW TO USE THIS MANUAL".

**All material contained in this Manual is based on latest product information available at the time of publication.
All rights are reserved to make changes at any time without prior notice.**

Applicable Model

N Series		
NHR55	NPR58	NPS66
NHR69	NPR59	NPS71
NKR55	NPR65	NQR66
NKR58	NPR66	NQR70
NKR66	NPR69	NQR71
NKR69	NPR70	
NPR55	NPR71	

This manual is applicable to 1994 year model and later vehicles.

THIS MANUAL INCLUDES THE FOLLOWING SECTIONS:

SECTION NO.	CONTENTS
00	Service Information
5A	Hydraulic Brakes
5B	—
5C	Parking Brakes
5D	—
5E	Exhaust Brake

SECTION 00
SERVICE INFORMATION

CONTENTS

	PAGE
Troubleshooting	00- 3
Main Data and Specifications	00- 15
Service Standard	00- 82
Servicing	00- 83
Fixing Torque	00- 94
Special Tools	00-105

MEMO

TROUBLESHOOTING

CONTENTS

PAGE

Brake System 00- 4
Hydraulic Booster 00- 8
Brake Lining 00-11
Brake Drum 00-12
Exhaust Brake 00-13
Parking Brakes 00-14
Hydromaster 00-14

BRAKE SYSTEM

PROBLEM	POSSIBLE CAUSE	CORRECTION
No Brakes	1. Restricted tubing or hose. 2. Brakes out of adjustment. 3. No fluid.	1. Replace defective parts. 2. Adjust.
Insufficient Brakes	1. Pedal improperly adjusted. 2. Worn linings/pads or drum/discs. 3. Plugged, crimped, restricted lines or hoses.	1. Adjust. 2. Replace as necessary. 3. Repair or replace.
Slow Brake Application	1. Pedal binding. 2. Wheel cylinder piston sticking. 3. Restriction in the lines. 4. Worn linings/pads or drums/discs.	1. Lubricate pivot pin, clean-check for foreign objects. 2. Repair the wheel cylinder. 3. Remove the restriction or replace the line. 4. Replace as necessary.
Uneven Braking (Front or Rear Brakes not Working)	1. Damaged hydraulic lines. 2. No brake fluid at the master cylinder. 3. Safety valve not opened.	1. Repair or replace. 2. Check for plugged, kinked or damaged hose to the reservoir. 3. Correct.
Wet Weather: Brakes Grab or won't Hold	1. Linings too sensitive to water. 2. Dirty brakes. 3. Bent mounting plate – opening. 4. Scored drums/discs.	1. Replace in axle sets. 2. Clean out. 3. Replace. 4. Machine in pairs. Replace if necessary.
Brakes Squeak	1. Mounting plate bent or shoes twisted. 2. Metallic particles or dust imbedded in the lining. 3. Lining rivets loose or lining not held tightly against the shoe at the ends. 4. Drums distorted tampered, or not square. 5. Incorrect lining/pad. 6. Mixed size linings. 7. Weak or broken return spring. 8. Loose wheel bearings. 9. Loose mounting plate, drum, wheel cylinder. 10. Linings/pads located wrong on the shoes. 11. Linings/pads worn out. 12. Lining glazed. 13. Cracked or threaded drums/discs.	1. Replace damaged parts. 2. Replace the linings/pads in axle sets. 3. Replace the rivets and/or tighten the lining by riveting. 4. Machine or replace drums/discs. 5. Replace the linings/pads in axle sets. 6. Use all standard or oversize linings in a brake. 7. Replace the return spring. 8. Tighten to the proper setting. 9. Tighten. 10. Install the linings correctly. 11. Reline the brakes. 12. Replace. 13. Replace in axle pairs.
Brakes Chatter	1. Incorrect lining/pad to drum/disc clearance. 2. Loose mounting plate. 3. Grease, fluid, road dust on the lining pad. 4. Weak or broken return spring. 5. Loose wheel bearings. 6. Drums out-of-round.	1. Adjust to specification. 2. Tighten securely. 3. Clean or reline. 4. Replace the return spring. 5. Readjust. 6. Machine the drums in axle sets.

BRAKE SYSTEM (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Brakes Chatter (Cont.)	7. Discs warped. 8. Cocked or distorted shoes. 9. Distorted, tapered, or barrel-shaped drums. 10. Incorrect lining/pad material. 11. Linings/pads worn out. 12. Lining loose on the shoes. 13. Foreign material imbedded in the linings/pads. 14. Cracked or threaded drums/discs.	7. Machine the discs in axle sets. 8. Straighten or replace. 9. Machine drums in pairs. Replace if necessary. 10. Reline with correct linings/pads. 11. Reline the brake. 12. Rerivet the linings to the shoes. Replace if necessary. Check for damaged or distorted shoes. 13. Replace the linings/pads in axle sets. 14. Replace in axle pairs.
Shoe Click	1. Return spring weak. 2. Shoe bent.	1. Replace the spring. 2. Straighten or replace.
Noise and Chatter Squealing, clicking, or scraping sound upon brake application	1. Bent, damaged or incorrect shoes. 2. Worn out lining/pad. 3. Foreign material embedded in the lining/pad. 4. Broken shoe return spring. 5. Cracked or threaded drums/discs (lathe marks).	1. Replace with the correct shoes and lining. Always replace in axle sets. 2. Replace the shoes and lining/pad in axle sets. 3. Replace the shoes and lining/pad in axle sets. 4. Replace the return spring. 5. Replace the drums/discs in axle sets.
Pulls to One Side	1. Grease or fluid soaked lining/pad. 2. Loose wheel bearings, loose (or distorted) mounting plate on the rear or front axle or loose spring bolts. 3. Linings/pads not of the recommended kind. 4. Tires not properly or evenly inflated or unequal wear of tread. Different tread non-skid design. 5. Water, mud, etc., in the brakes. 6. Wheel cylinder sticking. 7. Weak or broken shoe return spring. 8. Out-of-round drums or different sized drums on the same axle. 9. Brake dragging. 10. Weak chassis springs, loose U-bolts, loose steering gear, etc. 11. Loose steering. 12. Unequal camber. 13. Restricted brake line or hose.	1. Replace in axle sets. 2. Adjust the wheel bearing, tighten (or replace) the mounting plate to the axle and tighten the spring bolts. 3. Install recommended linings/pads. Install the shoes correctly. 4. Inflate the tires to recommended pressures. Rearrange the tires so that a pair of non-skid tread surfaces of similar design and equal wear will be installed on the front wheels, and another pair with like tread will be installed on the rear wheels. 5. Remove any foreign material from all of the brake parts and inside of the drums. 6. Repair or replace the wheel cylinder. 7. Check the spring-replace distorted, open coiled, or cracked spring. 8. Refinish or replace the drums in axle pairs. 9. Check for loose lining. Adjust. (Refer to "DRAGGING BRAKES".) 10. Replace the spring, tighten the U-bolts, adjust the steering gear, etc. 11. Repair and adjust. 12. Adjust to "Specifications". 13. Check for soft hose or damaged lines. Replace as necessary.

BRAKE SYSTEM (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Pulls to One Side (Cont.)	14. Wheel cylinder size different on opposite sides. 15. Loose kingpin. 16. Distorted, damaged, or scored drum/disc. 17. Front end alignment. 18. Excessively worn lining/pad. 19. Uneven adjustment of brake lining clearance. 20. Water/wet linings.	14. Replace with correct cylinders. 15. Replace the kingpins or bushing. 16. Refinish the drums/discs in axle pairs. Replace if necessary. 17. Align the front end. 18. Replace in axle sets. 19. Adjust the brake lining clearance in all wheels. 20. Apply the brakes a few times while moving at a slow speed to dry the linings.
One Wheel Locks	1. Gummy lining/pad. 2. Tire tread slick. 3. Brake adjustment not correct. 4. Restricted brake line or hoses. 5. Incorrect linings/pads. 6. Grease or fluid soaked lining/pads. 7. Foreign material in the brakes.	1. Replace in axle sets. 2. Match up tire treads from side to side. 3. Adjust the brakes. 4. Check for soft hoses or damaged lines. Replace as necessary. 5. Replace. Linings/pads must be the same on the axle. 6. Replace in axle sets. 7. Remove the material.
Light Pedal Pressure-Brakes too Severe (Grabby Brakes)	1. Brake adjustment not correct. 2. Loose mounting plate on the front axle. 3. A small amount of grease or fluid on the lining/pad. 4. Incorrect lining/pad. 5. Wheel bearings loose. 6. Lining loose on the shoe. 7. Excessive dust and dirt in the drum. 8. Out-of-round drum.	1. Adjust the brakes. 2. Tighten the plates. 3. Replace the linings/pads. 4. Install factory specified linings/pads. 5. Adjust the wheel bearings. 6. Replace the lining or the shoe and lining. 7. Clean and sand the drums and linings. 8. Turn the drums in pairs or replace.
Low Pedal or Pedal Goes to Floor	1. Excessive clearance between the linings and drum. 2. Pedal stop not adjusted, or missing. 3. Weak break hose. 4. Leaking wheel cylinder. 5. Air in the hydraulic system. 6. Improper brake fluid (low boiling point). 7. Low fluid level. 8. Bent or distorted brake shoes. 9. Leaks at hydraulic line connections.	1. Adjust the brakes. 2. Adjust or install the pedal stop. 3. Replace with new hose. 4. Clean and rebuild. 5. Bleed the hydraulic system. 6. Flush the sytem and refill with recommended brake fluid. 7. Fill the reservoir with brake fluid; check for leaks and bleed system. 8. Replace in axle sets. 9. Check for hydraulic leaks and repair.

BRAKE SYSTEM (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Slow Brake Release	1. Foot pedal binding. 2. Restriction in the line. 3. Weak shoe return spring.	1. Lubricate the pivot pin; clean-check for foreign objects. 2. Remove the restriction or replace line. 3. Replace the spring.
Poor Assist or Loss of Assist	1. Low brake fluid level. 2. Air in the hydraulic system. 3. Weak brake hose. 4. Loss of vacuum. 5. No brake fluid at the master cylinder.	1. Fill the reservoir to the proper level. Bleed the system. 2. Locate the source of the air leak and repair. Bleed the system. 3. Replace. 4. Inspect for vacuum leaks or malfunctioning pump. Repair or replace as necessary. 5. Check for plugged, kinked, or damaged hose to the reservoir.
Brake Fade	1. Incorrect lining/pad. 2. Poor lining/pad contact. 3. Thin drum. 4. Dragging brakes. 5. All conditions listed under "PULLS TO ONE SIDE".	1. Replace with recommended lining/pad. 2. Grind the lining/pad to the proper radius; adjust. 3. Replace the drum. 4. Adjust. 5. All corrections listed under "PULLS TO ONE SIDE".
All Brakes Drag when Adjustment is Known to be Correct	1. Pedal does not return to stop. 2. Improper fluid. 3. Use of incorrect rubber parts.	1. Lubricate the pedal linkage; adjust the pedal. 2. Replace rubber parts and fill with the recommended brake fluid. 3. Install the proper parts.
One Wheel Drags	1. Weak or broken shoe return spring. 2. Brake shoe to drum clearance too small. 3. Loose wheel bearings. 4. Wheel cylinder piston cups swollen and distorted or piston stuck. 5. Pistons sticking in the wheel cylinder. 6. Drum out-of-round. 7. Disc warped. 8. Restricted brake line or hose. 9. Distorted shoe. 10. Defective lining/pad. 11. Loose or bent mounting plate. 12. Loose calipers.	1. Replace the return spring. 2. Adjust to specification. 3. Adjust or replace the wheel bearings. 4. Rebuild the cylinders. Flush the hydraulic system and fill with recommended fluid. 5. Clean or replace the pistons; clean the cylinder bore. 6. Machine the drum. 7. Machine the disc. 8. Check for soft hoses or damaged lines. Replace as necessary. 9. Replace. 10. Replace with the recommended lining/pad. 11. Tighten the fasteners; replace the plate. 12. Tighten the fasteners.

BRAKE SYSTEM (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Dragging Brakes	1. Improper fluid. 2. Brake pedal adjustment incorrect. 3. Incorrect shoe return spring. 4. Brake pedal linkage interference or binding. 5. Incorrect lining/pad. 6. All conditions listed under "ONE WHEEL DRAGS".	1. Flush the hydraulic system and fill with recommended brake fluid, and replace rubber components. 2. Adjust the pedal. 3. Replace the shoe return spring. 4. Free the linkage and lubricate. 5. Replace the linings/pads. 6. All corrections under "ONE WHEEL DRAGS".

HYDRAULIC BOOSTER

PROBLEM	POSSIBLE CAUSE	CORRECTION
Large force pressing on the brake pedal (boosting insufficient)	1. Booster operation insufficient • Large internal leakage • Sticking of the spool valve • Insufficient sliding around the input and output rods	• With the engine on, press the brake pedal repeatedly, and confirm the presence of manual operation. With regard to manual operation, turn the engine off, and judge whether the pedal is as stiff and its play is as small as when the pedal is pressed repeatedly ten times or more. • When there is manual operation, the hydro boost assembly is replaced.
Brake dragging	1. Bad dimensions of the booster • The amount of protrusion of the output rod is large	• Confirm whether the amount of protrusion of the output rod (the distance from surface of the master cylinder attachment flange to the end of the rod) is no greater than 18.2 mm. • If the above dimension is outside the range, replace the hydro boost assembly.
	2. Bad pedal circumference attachment dimensions • Clevis position dimension is large	• Confirm whether the clevis position dimension (the distance from surface of the vehicle attachment flange to the center of the clevis center) is in the range 109 ± 1mm. • If the above dimension is outside the range, loosen the lock nut and adjust the clevis position dimension to be inside the above range. After making this adjustment, be sure to securely tighten the lock nut and to do a stop lamp switch reconfirmation.
	3. Booster return is bad • Input-output rod circumference sticks • Bad spool valve operation	• With the engine on, repeatedly press the brake pedal and confirm the pedal return state. • If the pedal does not return, replace the hydro boost assembly as necessary.

HYDRAULIC BOOSTER (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Oil leakage	1. Hydro boost assembly external leakage • Leakage from the seal material	• If the oil leakage is caused by looseness in the piping connections, retighten the connections. • If there is oil leakage from the connections of the accumulator, replace the affected seals of the connections with new seals. • If there is any oil leakage from parts other than the above that are included in the hydro boost assembly, replace the hydro boost assembly or the repair setting parts (accumulator).
Bad brake operation (lack of smoothness in operation)	1. Poor operation of the booster • Input-output rod circumference sticks • Bad spool valve operation	• With the engine on, repeatedly press the brake pedal and confirm the pedal operation state. • If there is sticking or some other abnormality in the pedal operation, replace the hydro boost assembly as necessary.
Abnormal brake noise (when pressing the pedal)	1. Air in the hydraulic booster lines	• With the engine running, check the amount of hydraulic flud remaining in the reserve tank for the hydraulic booster. • If low, add fluid (Besco ATF III) and bleed to remove air as necessary before starting the engine. Operate the pump and repeatedly step on the pedal to confirm the gear noise (caused by cavitation).
	2. Water in the hydraulic fluid	• Check the color of the hydraulic fluid in the reserve tank for the hydraulic booster (normal: purple, abnormal: milky white). • If the hydraulic fluid is milky white, change the fluid (Besco ATF III) and bleed to remove air as necessary before starting the engine. Operate the pump and strongly press the pedal until reaching full boost range to confirm the gear noise (caused by cavitation). The length of time to keep the pedal pressed all the way down is no more than five seconds.
No pedal boosting effect immediately after turning the engine off	1. Faulty charge valve • Gas leaking from the accumulator • Leakage inside the charge valve	• Keep the engine running for more than 10 seconds. Turn off the engine, and within 60 seconds, step on the pedal once to confirm boosting effect. Boosting effect means the same pedal effort if the engine was running. • If boosting effect does not exist, either the hydraulic booster assembly or the accumulator may need to be replaced.

HYDRAULIC BOOSTER (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Warnng buzzer continuously sounds	1. Faulty hydraulic booster assembly • Faulty pressure switch • Leakage inside the charge valve	• Confirm that the electric devices (pressure switch, relay, buzzer, etc.) are working correctly. • If all are working correctly, pump the brake pedal at least 10 times after turning the engine off to reduce pressure in the hydraulic booster. Start the engine, and if the vehicle has a manual transmission, release the parking brake (with an automatic, put it in Drive). Check to see if the alarm stops within ten seconds (if it does, the electrical devices are working properly). • When testing the electrical devices, always keep your foot on the brake pedal with just enough pressure to prevent the vehicle from moving. If the alarm does not stop, the hydraulic booster assembly may have to be replaced.
Charge operation remains in effect	1. Bad charge valve operation • Bad valve switching operation	• Turn the engine on, and without pressing the brake pedal, check whether any charging sound continues, such as the sound of the fluid. • If it continues and will not stop, replace the hydro boost assembly as necessary.

NOTES

1. When the brake pedal is operated after the engine is turned off and the oil pump stops, during a few operations a fluid sound due to the flow of high-pressure oil or a sound of movement by the charge spool may be produced, but this sound is not abnormal; it merely indicates that boosting by the accumulator (accumulator operation) is proceeding normally.
   Also, a similar fluid sound is produced during quick operation of the brake pedal even if the engine is on, but this too is normal.
2. If the pressure of the oil in the accumulator drops with operation of the brake pedal after the engine is turned off or when the engine has been off for a long time, then immediately after the engine is turned on, fluid sound during charge valve operation or switching sound when charging ends will be produced, but this sound is not abnormal; it merely indicates that the accumulator is being normally charged.
   Also, a similar charging operation sometimes occurs and sound is sometimes produced when the pressure inside the accumulator drops even when the engine is on and charging has ended, due to such causes as rapid operation of the brake pedal, internal leakage that is too slight to affect brake performance, or a change in temperature; this too is normal.
3. When the brake pedal is pressed strongly as far as the booster full load region while the engine is on, sometimes sound is produced by the flow of hydraulic oil discharged from the oil pump, but this is not abnormal. Also, pressing the pedal in as far as this booster full load region can cause a significant increase in the oil temperature inside the oil pump and can lead to a failure, so keep the pedal pressed for no longer than 5 seconds.

BRAKE LINING

PROBLEM	POSSIBLE CAUSE	CORRECTION
Poor Contact at the Center of Shoe	1. Bell-mouthed drum. 2. Distorted mounting plate. 3. Bent brake shoe. 4. Undersize linings. 5. Loose wheel bearing.	1-5. Repair or replace as required.
Unequal Wear on the Shoes in the Same Brake	1. Brake linings not a balanced set. 2. Sticking wheel cylinder piston.	1-2. Repair or replace as required.
Material at the Center of the Shoe Excessively Thin	1. Undersize linings. 2. Oversize drum.	1-2. Repair or replace as required.
Lining Tapered across the Width	1. Bell-mouthed drum. 2. Bent shoe. 3. Distorted mounting plate.	1-3. Repair or replace as required.
Lining Worn at One End	Bent mounting plate.	Repair or replace as required.
Linings Glazed	1. Grease on lining. 2. Wrong type lining for service involved.	1-2. Repair or replace as required.
Rivets Tear Loose	1. Improper set rivet. 2. Improper setting of the rivet. 3. Enlarged rivet holes in the shoe.	1-3. Repair or replace as required.
Unequal Wear Opposite Brakes, Same Axle	1. Weak shoe return spring. 2. Obstructed hydraulic line. 3. Stuck wheel cylinder piston. 4. Brake drum surface in poor condition. 5. Loose wheel bearing.	1-5. Repair or replace as required.
Linings at Scored	1. Scored drum. 2. Abrasive material between the lining and drum.	1-2. Repair or replace as required.
Cracks at Rivet Holes	1. Wrong type rivets. 2. Rivets not properly set. 3. Dirt or rust on the shoe table. 4. Wrong size lining.	1-4. Repair or replace as required.
Elongation of the Rivet Holes	1. Loose rivets. 2. Wrong size rivets.	1-2. Repair or replace as required.
Wear on the Edge of the Lining	1. Wrong width lining. 2. Holes improperly drilled. 3. Loose wheel bearing. 4. Bent shoe.	1-4. Repair or replace as required.
Groove on the Edge of the Lining	1. Lining too wide. 2. Worn drum.	1-2. Repair or replace as required.

BRAKE DRUM

PROBLEM	POSSIBLE CAUSE	CORRECTION
Brake Drum Heat Checked in Spots	1. Out-of-round brake drum. 2. Eccentric mounting of the drum. 3. Loose wheel bearing.	1-3. Repair or replace as required.
Drum Uniformly Heat Checked	1. Improper friction materials. 2. Overworked brake. 3. Driver abuse.	1-3. Repair or replace as required.
Excessive Scoring of the Drum	1. Improper friction materials. 2. Overworked brake. 3. Abrasive material between the lining and drum. 4. Soft drum. 5. Bent or warped shoe.	1-5. Repair or replace as required.
Excessive Drum Cracks	1. Drive abuse. 2. Weak drum. 3. Wrong friction material. 4. Overworked brake.	1-4. Repair or replace as required.

EXHAUST BRAKE

PROBLEM	POSSIBLE CAUSE	CORRECTION
Exhaust Brake does not Operate	1. Blown fuse. 2. Improperly adjusted or faulty accelerator or clutch switches. 3. Poor connections or corroded terminals at switches or control valve. 4. Improperly adjusted or seized exhaust brake valve. 5. Vacuum lines kinked, restricted, or plugged with ice. 6. Seized vacuum chamber. 7. Valve linkage broken. 8. Chamber or control valve jammed with ice. 9. Faulty control valve. Valve should open when approximate battery(s) voltage is applied to terminals. 10. Faulty vacuum chamber. 11. Broken wire in wiring harness.	1. Replace. 2. Adjust or replace. 3. Clean or replace. 4. Adjust, or repair. 5. Repair. 6. Repair. 7. Repair. 8. Melt ice, Drain lines of water. 9. Replace. 10. Replace. 11. Repair.
Exhaust Brake Slow to Operate	1. Tighten exhaust brake valve or linkage. 2. Improperly adjsuted accelerator or clutch switches.	1. Free up and lubricate. 2. Adjust.
Weak Braking Action	1. Improperly adjusted or tight exhaust brake valve. 2. Tight linkage. 3. Vacuum lines kinked or partially plugged with ice. 4. Leaking fittings at vacuum lines. 5. Leaky vacuum chamber.	1. Free up and/or adjust. Lubricate as needed. 2. Free up and lubricate. 3. Repair. 4. Tighten. 5. Replace.
Exhaust Brake will not Shut Off (Exhaust Brake Control Switch "Off")	1. Seized exhaust brake valve or linkage. 2. Control valve or chamber jammed with ice. 3. Short in wiring harness (approximate battery(s) voltage at control solenoid regardless of control switch position. 4. Faulty control switch.	1. Free up and lubricate. 2. Melt ice and drain lines. 3. Repair. 4. Replace.
Exhaust Brake "On Continuously when Exhaust Brake Control Switch is "On" (not Controlled by Clutch or Accelerator Switches)	1. Improperly adjusted clutch or accelerator switches. 2. Switches improperly wired. 3. Short in wiring harness.	1. Adjust. 2. Check wiring against wiring diagram. Repair as needed. 3. Repair.
Engine Overheats or Loses Power	1. Engine brake valve stuck partially closed. 2. Engine brake valve adjusted so that it is partially closed.	1. Free up and lubricate or replace. 2. Adjust.

PARKING BRAKES

INSUFFICIENT BRAKING FORCE

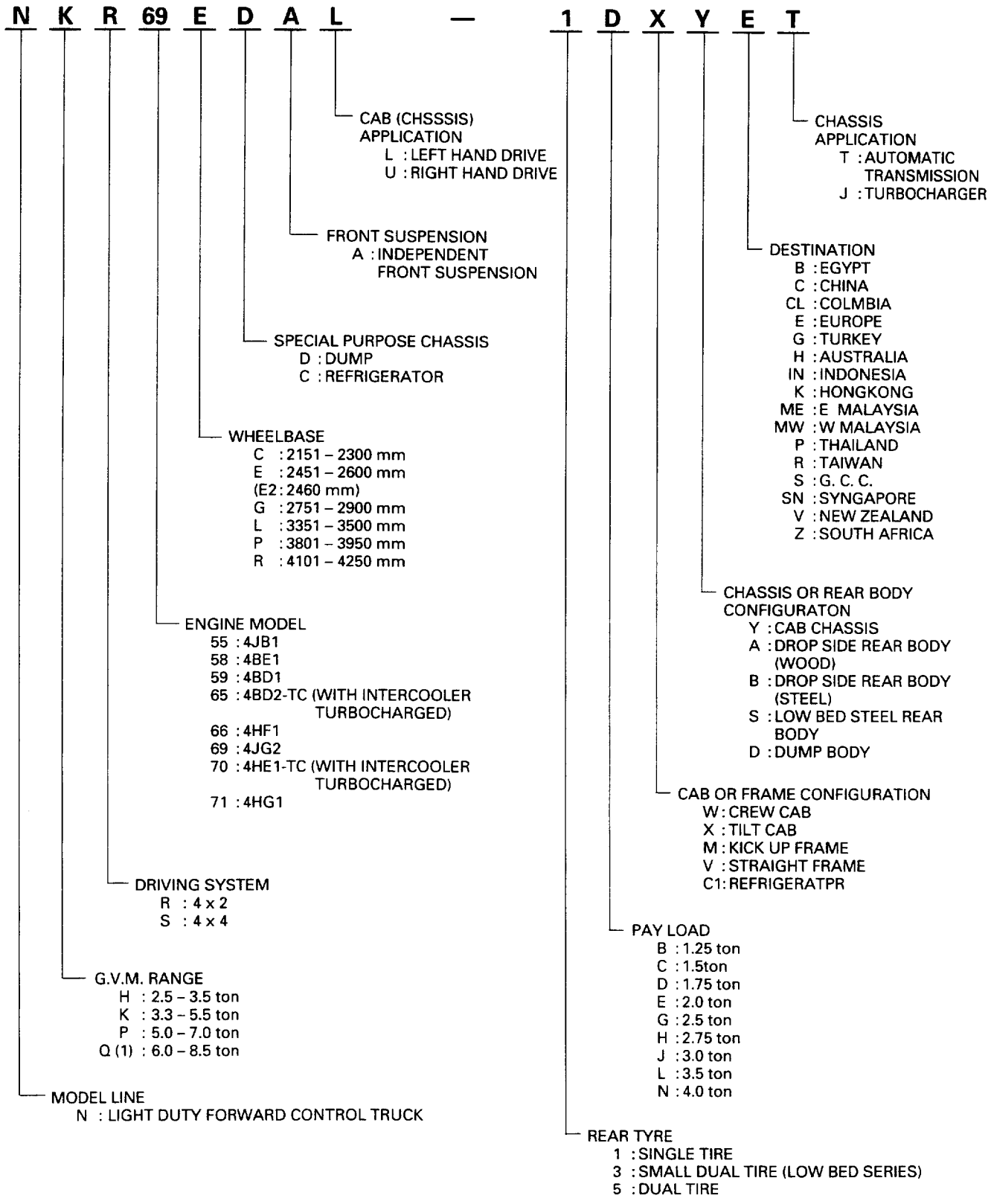
PROBLEM	POSSIBLE CAUSE	CORRECTION
Brake lining and drum clearance	Clearance between the brake lining and the brake drum excessive	Adjust the brake lining and the brake drum clearance
Brake lining	Brake lining worn out	Replace the brake lining
Camshaft	Camshaft worn out	Replace the camshaft
Control wire	Control wire stretched	Adjust the control wire length or replace the control wire

HYDROMASTER

PROBLEM	POSSIBLE CAUSE	CORRECTION
Insufficient Braking Power	1. Hydraulic piston retainer deteriorated (brake fluid leakage). 2. Relay piston cup deteriorated (brake fluid leakage). 3. Air leakage from between the piston plate and the cylinder shell. 4. Clearance between the poppet valve and the body excessive.	1. Replace the hydraulic piston retainer. 2. Replace the relay piston cup. 3. Replace the piston plate rubber gasket 4. Replace the poppet valve.

MAIN DATA AND SPECIFICATIONS

MODEL DEDIGNATION (EXPLANATION ONLY)



FRONT BRAKES (NHR 1994 – 1997)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	FRONT BRAKE																					
		DISC BRAKE								DRUM BRAKE													
		WHEEL CYL.		DISC				PAD		Type		WHEEL CYL.			DRUM			LINING					
		Inside dia. (in)		Thickness (mm)		Outside dia. (mm)		Thickness (mm)		2L	D2L	Inside dia. (in)			Inside dia. (mm)			Thickness (mm)			Width (mm)		
		2+1/8	2	30	35	265	282	12.0	14.0			1+1/8	1+1/16	1+3/16	279.4	300	320	6.0	9.6	11.0	60	75	100
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	NHR55EU -1CB		–	–		–		–		○		○			○			○			○		
2	NHR55EU -1CY		–	–		–		–		○		○			○			○			○		
3	NHR55EU -1CYIN		–	–		–		–		○		○			○			○			○		
4	NHR55EU -ICYMW		–	–		–		–		○		○			○			○			○		
5	NHR55EU -1CYZ		–	–		–		–		○		○			○			○			○		
6	NHR55EAU-1CBK		○	○		○		○		–		–			–			–			–		
7	NHR55EAU-1CYK		○	○		○		○		–		–			–			–			–		
6a	NHR55EU -1CBK		–	–		–		–		○		○			○			○			○		
7a	NHR55EU -1CYK		–	–		–		–		○		○			○			○			○		
8	NHR55EU -3CB		–	–		–		–		○		○			○			○			○		
9	NHR55EU -3CBSN		–	–		–		–		○		○			○			○			○		
10	NHR55EAU-3CBK		○	○		○		○		–		–			–			–			–		
10a	NHR55EU -3CBK		–	–		–		–		○		○			○			○			○		
11	NHR55EU -1BWS		–	–		–		–		○		○			○			○			○		
12	NHR55EU -1BWSSK		–	–		–		–		○		○			○			○			○		
13	NHR55EAU-1BWSK		○	○		○		○		–		–			–			–			–		
13a	NHR55EU -1BWSK		–	–		–		–		○		○			○			○			○		
14	NHR55EL -1CBS		–	–		–		–		○		○			○			○			○		
15	NHR55EL -1CY		–	–		–		–		○		○			○			○			○		
16	NHR55EAL -1CBC		○	○		○		○		–		–			–			–			–		
17	NHR55EL -3CB		–	–		–		–		○		○			○			○			○		
18	NHP55EL -1BWS		–	–		–		–		○		○			○			○			○		
19	NHR55EL -1BWSS		–	–		–		–		○		○			○			○			○		
20	NHR55EAL -1BWSC		○	○		○		○		–		–			–			–			–		

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	REAR BRAKE																	PARKING BRAKE				BRAKE CONTROL					
		DRUM BRAKE																										
		TYPE		WHEEL CYL.				DRUM				LINING							DRUM		LINING		MASTER CYL.					
		D2L(W/O AUTO)	D2L(W AUTO)	Inside dia. (in)				Inside dia. (mm)				Thickness (mm)				Width (mm)			Inside dia. (mm)		Width (mm)		Inside dia. (in)			DSPV	LSPV	EBXHAAKUEST
				7/8	1	1 + 3/16	1 + 5/16	228.6	279.4	300	320	4.9	6.0	9.6	11.0	60	75	100	178	190	35	45	1 + 1/16	1 + 1/8	1 + 1/4			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
1	NHR55EU -1CB	○	–	○				–	○			–	○			○	–		○		○		○			△		△
2	NHR55EU -1CY	○	–	○				–	○			–	○			○	–		○		○		○			–		△
3	NHR55EU -1CYIN	○	–	○				–	○			–	○			○	–		○		○		○			–		△
4	NHR55EU -1CYMW	○	–	○				–	○			–	○			○	–		○		○		○			△		△
5	NHR55EU -1CYZ	○	–	○				–	○			–	○			○	–		○		○		○			○		△
6	NHR55EAU-1CBK	–	○	○				–	○			–	○			○	–		○		○		○			△		△
7	NHR55EAU-1CYK	–	○	○				–	○			–	○			○	–		○		○		○			–		△
6a	NHR55EU -1CBK	○	–	○				–	○			–	○			○	–		○		○		○			△		△
7a	NHR55EU -1CYK	○	–	○				–	○			–	○			○	–		○		○		○			–		△
8	NHR55EU -3CB	○	–	○				○	–			○	–			–	○		○		○		○			△		△
9	NHR55EU -3CBSN	○	–	○				○	–			○	–			–	○		○		○		○			△		△
10	NHR55EAU-3CBK	–	○	○				○	–			○	–			–	○		○		○		○			△		△
10a	NHR55EU -3CBK	○	–	○				○	–			○	–			–	○		○		○		○			△		△
11	NHR55EU -1BWS	○	–	○				–	○			–	○			○	–		○		○		○			△		△
12	NHR55EU -1BWSSN	○	–	○				–	○			–	○			○	–		○		○		○			△		△
13	NHR55EAU-1BWSK	–	○	○				–	○			–	○			○	–		○		○		○			△		△
13a	NHR55EU -1BWSK	○	–	○				–	○			–	○			○	–		○		○		○			△		△
14	NHR55EL -1CBS	○	–	○				–	○			–	○			○	–		○		○		○			△		△
15	NHR55EL -1CY	○	–	○				–	○			–	○			○	–		○		○		○			–		△
16	NHR55EAL -1CBC	–	○	○				–	○			–	○			○	–		○		○		○			○		○
17	NHR55EL -3CB	○	–	○				○	–			○	–			–	○		○		○		○			△		△
18	NHR55EL -1BWS	○	–	○				–	○			–	○			○	–		○		○		○			△		△
19	NHR55EL -1BWSS	○	–	○				–	○			–	○			○	–		○		○		○			△		△
20	NHR55EAL -1BWSC	–	○	○				–	○			–	○			○	–		○		○		○			○		△

FRONT BRAKES (NHR 1998)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	FRONT BRAKE																									
		DISC BRAKE										DRUM BRAKE															
		WHEEL CYL.			DISC				PAD		Type		WHEEL CYL.				DRUM			LINING						
		Inside dia. (in)			Thickness (mm)		Outside dia. (mm)			Thickness (mm)			Inside dia. (in)				Inside dia. (mm)			Thickness (mm)			Width (mm)			
		2 + 1 / 8	2 + 2	2 + 1 / 4	35	42	265	282	310	14.0	13.0	2L	D2L	1 + 1 / 8	1 + 3 / 16	1 + 5 / 16	1 + 3 / 8	279.4	300	320	6.9	9.6	11.0	60	75	100	120
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	NHR55EU -1CB											○		○				○			○			○			
2	NHR55EU -1CY											○		○				○			○			○			
3	NHR55EU -1CYIN											○		○				○			○			○			
4	NHR69EU -1CBK											○		○				○			○			○			
5	NHR69EU -1CYK											○		○				○			○			○			
6	NHR55EU -1BWS											○		○				○			○			○			
7	NHR55EU -1BWSSN											○		○				○			○			○			
8	NHR69EU -1BWSK											○		○				○			○			○			
9	NHR55EU -3CB											○		○				○			○			○			
10	NHR55EU -3CBSN											○		○				○			○			○			
11	NHR69EU -3CBK											○		○				○			○			○			
12	NHR55EL -1CBS											○		○				○			○			○			
13	NHR55EL -1CY											○		○				○			○			○			
14	NHR55EL -1BWS											○		○				○			○			○			
16	NHR55EL -3CB											○		○				○			○			○			

REAR BRAKES (NHR 1998)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	REAR BRAKE																			PARKING BRAKE				BRAKE CONTROL							
		DRUM BRAKE																														
		TYPE		WHEEL CYL.					DRUM				LINING								DRUM.				LINING				MASTER CYL.							
				Inside dia. (in)					Inside dia. (mm)				Thickness (mm)				Width (mm)				Inside dia. (mm)				Width (mm)				Inside dia. (in)							
		D2L (W/O AUTO)	D2L (W AUTO)	7/8	1	1+3/16	1+5/16	1+3/8	228.6	279.4	300	320	4.9	6.0	9.6	11.0	60	75	100	120	178	190	203	254	35	45	50	60	1+1/16	1+1/8	1+1/4	1+3/8	DSPV	LSPV	EXHAUST BRAKE	HYDROMASTER	HBB
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
1	NHR55EU -1CB	○	—	○					—	○							○	—			○				○				○				△		△		
2	NHR55EU -1CY	○	—	○					—	○							○	—			○				○				○				—		△		
3	NHR55EU -1CYIN	○	—	○					—	○							○	—			○				○				○				—		△		
4	NHR69EU -1CBK	○	—	○					—	○							○	—			○				○				○				△		△		
5	NHR69EU -1CYK	○	—	○					—	○							○	—			○				○				○				—		△		
6	NHR55EU -1BWS	○	—	○					—	○							○	—			○				○				○				△		△		
7	NHR55EU -1BWSSN	○	—	○					—	○							○	—			○				○				○				△		△		
8	NHR69EU -1BWSK	○	—	○					—	○							○	—			○				○				○				△		△		
9	NHR55EU -3CB	○	—	○					○	—							—	○			○				○				○				△		△		
10	NHR55EU -3CBSN	○	—	○					○	—							—	○			○				○				○				△		△		
11	NHR69EU -3CBK	○	—	○					○	—							—	○			○				○				○				△		△		
12	NHR55EL -1CBS	○	—	○					—	○							○	—			○				○				○				△		△		
13	NHR55EL -1CY	○	—	○					—	○							○	—			○				○				○				—		△		
14	NHR55EL -1BWS	○	—	○					—	○							○	—			○				○				○				△		△		
16	NHR55EL -3CB	○	—	○					○	—							—	○			○				○				○				△		△		

FRONT BRAKES (NKR 1994 – 1997)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	FRONT BRAKE																					
		DISC BRAKE								DRUM BRAKE													
		WHEEL CYL.		DISC				PAD		Type		WHEEL CYL.			DRUM		LINING						
		Inside dia. (in)		Thickness (mm)		Outside dia. (mm)		Thickness (mm)				Inside dia. (in)			Inside dia. (mm)		Thickness (mm)				Width (mm)		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
		2 + 1 / 8	2	3 0	3 5	2 6 5	2 8 2	1 2 . 0	1 4 . 0	2 L	D 2 L	1 + 1 / 8	1 + 1 / 16	1 + 1 / 16	2 7 9 . 4	3 0 0	3 2 0	6 . 0	9 . 6	1 1 . 0	6 0	7 5	1 0 0
1	NKR55EU -1EY		–		–	–	–		–	○	–	○	–			○	–	○	–			○	
2	NKR55EU -1EYV		–		–	–	–		–	○	–	○	–			○	–	○	–			○	
3	NKR55EU -1EA		–		–	–	–		–	○	–	○	–			○	–	○	–			○	
4	NKR55EU -1EXYP		–		–	–	–		–	○	–	○	–			○	–	○	–			○	
5	NKR58EU -1EXY		–		–	–	–		–	○	–	○	–			○	–	○	–			○	
6	NKR58EU -1EXA		–		–	–	–		–	○	–	○	–			○	–	○	–			○	
7a	NKR58EU -1EXYH		–		–	–	–		–	○	–	○	–			○	–	○	–			○	
8	NKR55E2U -5HY		–		–	–	–		–	○	–	○	–			○	–	○	–			○	
9	NKR55E2U -5HYK		–		–	–	–		–	○	–	○	–			○	–	○	–			○	
9a	NKR55E2U -5HXYP		–		–	–	–		–	○	–	○	–			○	–	○	–			○	
10	NKR58E2U -5HY		–		–	–	–		–	○	–	○	–			○	–	○	–			○	
11	NKR58E2U -5HYV		–		–	–	–		–	○	–	○	–			○	–	○	–			○	
12	NKR58E2U -5HXY		–		–	–	–		–	○	–	○	–			○	–	○	–			○	
13	NKR58E2U -5HXC1Y		–		–	–	–		–	○	–	○	–			○	–	○	–			○	
14	NKR58E2U -5HXYP		–		–	–	–		–	○	–	○	–			○	–	○	–			○	
14a	NKR58E2U -5EXYH		–		–	–	–		–	○	–	○	–			○	–	○	–			○	
15	NKR58EDU -5EMXD		–		–	–	–		–	–	○	○	–			○	–	○	–			○	
16	NKR58EDU -5EMXDY		–		–	–	–		–	–	○	○	–			○	–	○	–			○	
17	NKR17LU -5HXYZ		–		–	–	–		–	○	–	○		–		○	–	○	–			○	
18	NKR55LU -5HY		–		–	–	–		–	○	–	○		–		○	–	○	–			○	
19	NKR55LU -5HXY		–		–	–	–		–	○	–	○		–		○	–	○	–			○	
20	NKR55LU -5HA		–		–	–	–		–	○	–	○		–		○	–	○	–			○	
21	NKR55LU -5HXA		–		–	–	–		–	○	–	○		–		○	–	○	–			○	
22	NKR55LU -5HYK		–		–	–	–		–	○	–	○		–		○	–	○	–			○	

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	REAR BRAKE																	PARKING BRAKE				BRAKE CONTROL					
		DRUM BRAKE																										
		TYPE		WHEEL CYL.				DRUM				LINING							DRUM		LINING		MASTER CYL.					
				Inside dia. (in)				Inside dia. (mm)				Thickness (mm)				Width (mm)			Inside dia. (mm)		Width (mm)		Inside dia. (in)					
		D2LW/O AUTO	D2LW AUTO	7/8	1	1+3/16	1+5/16	228.6	279.4	300	320	4.9	6.0	9.6	11.0	60	75	100	178	190	35	45	1+1/16	1+1/8	1+1/4	DSPV	LSPV	EBXHAAKUEST
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
1	NKR55EU -1EY	○	–	○	–	–		–		○	–	–	○	–			○		○	–	○	–		○		–	–	△
2	NKR55EU -1EYV	○	–	○	–	–		–		○	–	–	○	–			○		○	–	○	–		○		–	–	△
3	NKR55EU -1EA	○	–	○	△	–		–		○	–	–	○	–			○		○	–	○	–		○		△	–	△
4	NKR55EU -1EXYP	○	–	○	–	–		–		○	–	–	○	–			○		○	–	○	–		○		–	–	△
5	NKR58EU -1EXY	○	–	○	–	–		–		○	–	–	○	–			○		–	○	–	○		○		–	–	△
6	NKR58EU -1EXA	○	–	○	△	–		–		○	–	–	○	–			○		–	○	–	○		○		△	–	△
7a	NKR58EU -1EXYH	○	–	–	○	–		–		○	–	–	○	–			○		–	○	–	○		○		–	○	△
8	NKR55E2U -5HY	○	–	–	○	–		–		○	–	–	○	–			○		○	–	○	–		○		–	–	△
9	NKR55E2U -5HYK	○	–	–	○	–		–		○	–	–	○	–			○		○	–	○	–		○		–	–	△
9a	NKR55E2U -5HXYP	○	–	–	○	–		–		○	–	–	○	–			○		○	–	○	–		○		–	–	△
10	NKR58E2U -5HY	○	–	–	○	–		–		○	–	–	○	–			○		–	○	–	○		○		–	–	△
11	NKR58E2U -5HYV	○	–	–	○	–		–		○	–	–	○	–			○		–	○	–	○		○		–	–	△
12	NKR58E2U -5HXY	○	–	–	○	–		–		○	–	–	○	–			○		–	○	–	○		○		–	–	△
13	NKR58E2U -5HXC1Y	○	–	–	○	–		–		○	–	–	○	–			○		–	○	–	○		○		–	–	△
14	NKR58E2U -5HXYP	○	–	–	○	–		–		○	–	–	○	–			○		–	○	–	○		○		–	–	△
14a	NKR58E2U -5EXYH	○	–	–	○	–		–		○	–	–	○	–			○		–	○	–	○		○		–	○	△
15	NKR58EDU -5EMXD	○	–	–	○	–		–		○	–	–	○	–			○		–	○	–	○		○		–	–	△
16	NKR58EDU -5EMXDY	○	–	–	○	–		–		○	–	–	○	–			○		–	○	–	○		○		–	–	△
17	NKR17LU -5HXYZ	○	–	–	○	–		–		○	–	–	○	–			○		○	–	○	–		○		○	–	–
18	NKR55LU -5HY	○	–	–	○	–		–		○	–	–	○	–			○		○	–	○	–		○		–	–	△
19	NKR55LU -5HXY	○	–	–	○	–		–		○	–	–	○	–			○		○	–	○	–		○		–	–	△
20	NKR55LU -5HA	○	–	–	○	–		–		○	–	–	○	–			○		○	–	○	–		○		–	–	△
21	NKR55LU -5HXA	○	–	–	○	–		–		○	–	–	○	–			○		○	–	○	–		○		–	–	△
22	NKR55LU -5HYK	○	–	–	○	–		–		○	–	–	○	–			○		○	–	○	–		○		–	–	△

FRONT BRAKES (NKR 1994 – 1997)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	FRONT BRAKE																					
		DISC BRAKE								DRUM BRAKE													
		WHEEL CYL.		DISC				PAD		Type		WHEEL CYL.			DRUM			LINING					
		Inside dia. (in)		Thickness (mm)		Outside dia. (mm)		Thickness (mm)		2L	D2L	Inside dia. (in)			Inside dia. (mm)			Thickness (mm)			Width (mm)		
		2+1/8	2	30	35	265	282	12.0	14.0			1+1/8	1+1/16	1+3/16	279.4	300	320	6.0	9.6	11.0	60	75	100
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
23	NKR58LU -5HXY		–		–	–	–		–	○	–	○		–		○	–	○	–			○	
24	NKR58LU -5HYV		–		–	–	–		–	○	–	○		–		○	–	○	–			○	
25	NKR58LU -5HA		–		–	–	–		–	○	–	○		–		○	–	○	–			○	
26	NKR58LU -5HXA		–		–	–	–		–	○	–	○		–		○	–	○	–			○	
27	NKR58LU -5HXYMW		–		–	–	–		–	○	–	○		–		○	–	○	–			○	
28	NKR58LU -5HXYP		–		–	–	–		–	○	–	○		–		○	–	○	–			○	
29	NKR58LU -5HXYIN		–		–	–	–		–	○	–	○		–		○	–	○	–			○	
30	NKR66LU -5LXYIN		–		–	–	–		–	–	○	–		○		–	○	–	○			○	
31	NKR55EU -3EXY		–		–	–	–		–	○	–	○		–		○	–	○	–			○	
32a	NKR58EU -3EXYH		–		–	–	–		–	○	–	○		–		○	–	○	–			○	
33	NKR55EU -1DWY		–		–	–	–		–	○	–	○				○	–	○	–			○	
34	NKR55EU -1DWYV		–		–	–	–		–	○	–	○				○	–	○	–			○	
35	NKR55EU -1DWS		–		–	–	–		–	○	–	○				○	–	○	–			○	
36	NKR55LU -5GWYK		–		–	–	–		–	○	–	○				○	–	○	–			○	
37	NKR58LU -5GWY		–		–	–	–		–	○	–	○				○	–	○	–			○	
38	NKR58LU -5GWYV		–		–	–	–		–	○	–	○				○	–	○	–			○	
39	NKR55EL -1EY		–		–	–	–		–	○	–	○				○	–	○	–			○	
40	NKR55EL -1EXY		–		–	–	–		–	○	–	○				○	–	○	–			○	
41	NKR55EL -1EA		–		–	–	–		–	○	–	○				○	–	○	–			○	
41a	NKR55EL -1EXYG		–		–	–	–		–	○	–	○				○	–	○	–			○	
42	NKR55EL -1EAC		–		–	–	–		–	○	–	○				○	–	○	–			○	
42a	NKR55EL -1EXAC		–		–	–	–		–	○	–	○				○	–	○	–			○	
43	NKR55EAL-1EYB		○		○	○	–		○	–	–	–				–	–	–	–			–	
44	NKR58EL -1EY		–		–	–	–		–	○	–	○				○	–	○	–			○	

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	REAR BRAKE																	PARKING BRAKE				BRAKE CONTROL					
		DRUM BRAKE																										
		TYPE		WHEEL CYL.				DRUM				LINING							DRUM		LINING		MASTER CYL.					
				Inside dia. (in)				Inside dia. (mm)				Thickness (mm)				Width (mm)			Inside dia. (mm)		Width (mm)		Inside dia. (in)					
		D 2 L (W/O AUTO)	D 2 L (W AUTO)	7/8	1	1+3/16	1+5/16	228.6	279.4	300	320	4.9	6.0	9.6	11.0	60	75	100	178	190	35	45	1+1/16	1+1/8	1+1/4	DSPV	LSPV	EBXRHAAKUEST
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
23	NKR58LU -5HXY	○	–	–	○	–		–		○	–	–	○	–			○		–	○	–	○		○		–	–	△
24	NKR58LU -5HYV	○	–	–	○	–		–		○	–	–	○	–			○		–	○	–	○		○		–	–	△
25	NKR58LU -5HA	○	–	–	○	–		–		○	–	–	○	–			○		–	○	–	○		○		–	–	△
26	NKR58LU -5HXA	○	–	–	○	–		–		○	–	–	○	–			○		–	○	–	○		○		–	–	△
27	NKR58LU -5HXYMW	○	–	–	○	–		–		○	–	–	○	–			○		–	○	–	○		○		–	–	△
28	NKR58LU -5HXYP	○	–	–	○	–		–		○	–	–	○	–			○		–	○	–	○		○		–	–	△
29	NKR58LU -5HXYIN	○	–	–	○	–		–		○	–	–	○	–			○		–	○	–	○		○		–	–	△
30	NKR66LU -5LXYIN	○	–	–	–	○		–		–	○	–	–	○			○			○		○			○	–	–	△
31	NKR55EU -3EXY	○	–	–	○	–		○		–	–	○	–	–			○		○	–	○	–		○		–	–	△
32a	NKR58EU -3EXYH	○	–	–	○	–		○		–	–	○	–	–			○		–	○	–	○		○		–	○	△
33	NKR55EU -1DWY	○	–	○	–	–		–		○	–	–	○	–			○		○	–	○	–		○		–	–	△
34	NKR55EU -1DWYV	○	–	○	–	–		–		○	–	–	○	–			○		○	–	○	–		○		–	–	△
35	NKR55EU -1DWS	○	–	○	△	–		–		○	–	–	○	–			○		○	–	○	–		○		△	–	△
36	NKR55LU -5GWYK	○	–	–	○	–		–		○	–	–	○	–			○		○	–	○	–		○		–	–	△
37	NKR58LU -5GWY	○	–	–	○	–		–		○	–	–	○	–			○		–	○	–	○		○		–	–	△
38	NKR58LU -5GWYV	○	–	–	○	–		–		○	–	–	○	–			○		–	○	–	○		○		–	–	△
39	NKR55EL -1EY	○	–	○	–	–		–		○	–	–	○	–			○		○	–	○	–		○		–	–	△
40	NKR55EL -1EXY	○	–	○	–	–		–		○	–	–	○	–			○		○	–	○	–		○		–	–	△
41	NKR55EL -1EA	○	–	○	△	–		–		○	–	–	○	–			○		○	–	○	–		○		△	–	△
41a	NKR55EL -1EXYG	○	–	○	–	–		–		○	–	–	○	–			○		○	–	○	–		○		–	–	△
42	NKR55EL -1EAC	○	–	–	○	–		–		○	–	–	○	–			○		○	–	○	–		○		○	–	△
42a	NKR55EL -1EXAC	○	–	–	○	–		–		○	–	–	○	–			○		○	–	○	–		○		○	–	△
43	NKR55EAL -1EYB	–	○	○	–	–		–		○	–	–	○	–			○		○	–	○	–		○		–	–	△
44	NKR58EL -1EY	○	–	○	–	–		–		○	–	–	○	–			○		–	○	–	○		○		–	–	△

FRONT BRAKES (NKR 1994 – 1997)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	FRONT BRAKE																					
		DISC BRAKE								DRUM BRAKE													
		WHEEL CYL.		DISC				PAD		Type		WHEEL CYL.			DRUM			LINING					
		Inside dia. (in)		Thickness (mm)		Outside dia. (mm)		Thickness (mm)		2L	D2L	Inside dia. (in)			Inside dia. (mm)			Thickness (mm)			Width (mm)		
		2 + 1/8	2	30	35	265	282	12.0	14.0			1 + 1/8	1 + 1/16	1 + 3/16	279.4	300	320	6.0	9.6	11.0	60	75	100
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
45	NKR58EL -1EXY		–		–	–	–		–	○	–	○				○	–	○	–			○	
46	NKR58EL -1EXA		–		–	–	–		–	○	–	○				○	–	○	–			○	
47	NKR69EL -1EXYR		–		–	–	–		–	○	–	○				○	–	○	–			○	
48	NKR69EAL-1DXYE		○		○	○	–		○	–	–	–				–	–	–	–			–	
49	NKR55E2L-5HY		–		–	–	–		–	○	–	○	–			○	–	○	–			○	
49a	NKR55E2L-5HXYG		–		–	–	–		–	○	–	○	–			○	–	○	–			○	
50	NKR58E2L-5HY		–		–	–	–		–	○	–	○	–			○	–	○	–			○	
51	NKR58E2L-5HXY		–		–	–	–		–	○	–	○	–			○	–	○	–			○	
52	NKR58E2L-5HXA		–		–	–	–		–	○	–	○	–			○	–	○	–			○	
53	NKR58E2L-5HXYS		–		–	–	–		–	○	–	○	–			○	–	○	–			○	
53a	NKR58E2L-5HXAS		–		–	–	–		–	○	–	○	–			○	–	○	–			○	
54	NKR58E2L-5HXC1Y		–		–	–	–		–	○	–	○	–			○	–	○	–			○	
55	NKR58EDL-5EMXD		–		–	–	–		–	–	○	○	–			○	–	○	–			○	
56	NKR58EDL-5EMXDY		–		–	–	–		–	–	○	○	–			○	–	○	–			○	
57	NKR58EDL-5EMXDS		–		–	–	–		–	–	○	○	–			○	–	○	–			○	
58	NKR66E2L-5HXYR		–		–	–	–		–	○	–	○	–			–	○	–	○			○	
59	NKR55LL -5HY		–		–	–	–		–	○	–	○		–		○	–	○	–			○	
60	NKR55LL -5HA		–		–	–	–		–	○	–	○		–		○	–	○	–			○	
61	NKR55LL -5HXY		–		–	–	–		–	○	–	○		–		○	–	○	–			○	
62	NKR55LL -5HYC		–		–	–	–		–	○	–	○		–		○	–	○	–			○	
63	NKR55LL -5HAC		–		–	–	–		–	○	–	○		–		○	–	○	–			○	
62a	NKR55LL -5HXYC		–		–	–	–		–	○	–	○		–		○	–	○	–			○	
63a	NKR55LL -5HXAC		–		–	–	–		–	○	–	○		–		○	–	○	–			○	
64	NKR58LL -5HY		–		–	–	–		–	○	–	○		–		○	–	○	–			○	
65	NKR58LL -5HXY		–		–	–	–		–	○	–	○		–		○	–	○	–			○	

REAR BRAKES (NKR 1994 – 1997)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	REAR BRAKE																	PARKING BRAKE				BRAKE CONTROL					
		DRUM BRAKE																										
		TYPE		WHEEL CYL.				DRUM				LINING							DRUM		LINING		MASTER CYL.					
				Inside dia. (in)				Inside dia. (mm)				Thickness (mm)				Width (mm)			Inside dia. (mm)		Width (mm)		Inside dia. (in)					
		D2L (W/O AUTO)	D2L (W AUTO)	7/8	1	1+3/16	1+5/16	228.6	279.4	300	320	4.9	6.0	9.6	11.0	60	75	100	178	190	35	45	1+1/16	1+1/8	1+1/4	DSPV	LSPV	EBXHAAKUEST
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
45	NKR58EL -1EXY	○	–	○	–	–		–		○	–	–	○	–			○		–	○	–	○		○		–	–	△
46	NKR58EL -1EXA	○	–	○	△	–		–		○	–	–	○	–			○		–	○	–	○		○		△	–	△
47	NKR69EL -1EXYR	○	–	○	–	–		–		○	–	–	○	–			○		○	–	○	–		○		–	–	△
48	NKR69EAL-1DXYE	–	○	–	○	–		–		○	–	–	○	–			○		○	–	○	–		○		–	○	○
49	NKR55E2L -5HY	○	–	–	○			–		○	–		○	–			○		○	–	○	–		○		–	–	△
49a	NKR55E2L -5HXYG	○	–	–	○			–		○	–		○	–			○		○	–	○	–		○		–	–	△
50	NKR58E2L -5HY	○	–	–	○			–		○	–		○	–			○		–	○	–	○		○		–	–	△
51	NKR58E2L -5HXY	○	–	–	○			–		○	–		○	–			○		–	○	–	○		○		–	–	△
52	NKR58E2L -5HXA	○	–	–	○			–		○	–		○	–			○		–	○	–	○		○		△	–	△
53	NKR58E2L -5HXYS	○	–	–	○			–		○	–		○	–			○		–	○	–	○		○		–	–	△
53a	NKR58E2L -5HXAS	○	–	–	○			–		○	–		○	–			○		–	○	–	○		○		△	–	△
54	NKR58E2L -5HXC1Y	○	–	–	○			–		○	–		○	–			○		–	○	–	○		○		–	–	△
55	NKR58EDL-5EMXD	○	–	–	○			–		○	–		○	–			○		–	○	–	○		○		–	–	△
56	NKR58EDL-5EMXDY	○	–	–	○			–		○	–		○	–			○		–	○	–	○		○		–	–	△
57	NKR58EDL-5EMXDS	○	–	–	○			–		○	–		○	–			○		–	○	–	○		○		–	–	△
58	NKR66E2L -5HXYR	○	–	–	○			–		–	○		–	○			○		–	○	–	○		○		–	–	△
59	NKR55LL -5HY	○	–	–	○			–		○	–	–	○	–			○		○	–	○	–		○		–	–	△
60	NKR55LL -5HA	○	–	–	○			–		○	–	–	○	–			○		○	–	○	–		○		–	–	△
61	NKR55LL -5HXY	○	–	–	○			–		○	–	–	○	–			○		○	–	○	–		○		–	–	△
62	NKR55LL -5HYC	○	–	–	○			–		○	–	–	○	–			○		○	–	○	–		○		–	–	○
63	NKR55LL -5HAC	○	–	–	○			–		○	–	–	○	–			○		○	–	○	–		○		–	–	○
62a	NKR55LL -5HXYC	○	–	–	○			–		○	–	–	○	–			○		○	–	○	–		○		–	–	○
63a	NKR55LL -5HXAC	○	–	–	○			–		○	–	–	○	–			○		○	–	○	–		○		–	–	○
64	NKR58LL -5HY	○	–	–	○			–		○	–	–	○	–			○		–	○	–	○		○		–	–	△
65	NKR58LL -5HXY	○	–	–	○			–		○	–	–	○	–			○		–	○	–	○		○		–	–	△

FRONT BRAKES (NKR 1994 – 1997)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	FRONT BRAKE																					
		DISC BRAKE								DRUM BRAKE													
		WHEEL CYL.		DISC				PAD		Type		WHEEL CYL.			DRUM			LINING					
		Inside dia. (in)		Thickness (mm)		Outside dia. (mm)		Thickness (mm)				Inside dia. (in)			Inside dia. (mm)			Thickness (mm)			Width (mm)		
		2 + 1/8	2	30	35	265	282	12.0	14.0	2L	D2L	1 + 1/8	1 + 1/16	1 + 3/16	279.4	300	320	6.0	9.6	11.0	60	75	100
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
66	NKR58LL -5HXA		–		–	–	–		–	○	–	○		–		○	–	○	–			○	
67	NKR58LL -5HXYS		–		–	–	–		–	○	–	○		–		○	–	○	–			○	
68	NKR58LL -5HXAS		–		–	–	–		–	○	–	○		–		○	–	○	–			○	
69	NKR66LL -5HXYR		–		–	–	–		–	○	–	○		–		–	○	–	○			○	
70	NKR66LL -5LXYC		–		–	–	–		–	–	○	–		○		–	○	–	○			○	
71	NKR69LL -5DXYE	○	–		○	–	○		○	–	–	–		–		–	–	–	–			–	
72	NKR69LL -5HXYE	○	–		○	–	○		○	–	–	–		–		–	–	–	–			–	
73	NKR55EL -3EXY		–		–	–	–		–	○	–	○				○		○				○	
74	NKR69EL -3EXYR		–		–	–	–		–	○	–	○				○		○				○	
75	NKR55EL -1DWY		–		–	–	–		–	○	–	○				○	–	○	–			○	
76	NKR55EL -1DWS		–		–	–	–		–	○	–	○				○	–	○	–			○	
77	NKR55EL -1DWSC		–		–	–	–		–	○	–	○				○	–	○	–			○	
78	NKR58LL -5GWY		–		–	–	–		–	○	–	○				○	–	○				○	
79	NKR58LL -5GWYC		–		–	–	–		–	○	–	○				○	–	○				○	

REAR BRAKES (NKR 1994 – 1997)

—	Not available
○	Standard
△	Factory option
	Non

		REAR BRAKE																	PARKING BRAKE				BRAKE CONTROL					
		DRUM BRAKE																										
		TYPE		WHEEL CYL.				DRUM				LINING							DRUM		LINING		MASTER CYL.					
				Inside dia. (in)				Inside dia. (mm)				Thickness (mm)				Width (mm)			Inside dia. (mm)		Width (mm)		Inside dia. (in)					
		D2L (W/O AUTO)	D2L (W AUTO)	7/8	1	1 + 3/16	1 + 5/16	228.6	279.4	300	320	4.9	6.0	9.6	11.0	60	75	100	178	190	35	45	1 + 1/16	1 + 1/8	1 + 1/4	DSPV	LSPV	EBXHAAKUEST
No.	Models	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
66	NKR58LL-5HXA	○	–	–	○			–		○	–	–	○	–			○		–	○	–	○		○		–	–	△
67	NKR58LL-5HXYS	○	–	–	○			–		○	–	–	○	–			○		–	○	–	○		○		–	–	△
68	NKR58LL-5HXAS	○	–	–	○			–		○	–	–	○	–			○		–	○	–	○		○		–	–	△
69	NKR66LL-5HXYR	○	–	–	○			–		–	○	–	–	○			○		–	○	–	○		○		–	–	△
70	NKR66LL-5LXYC	○	–	–	○			–		–	○	–	–	○			○		–	○	–	○			○	–	–	○
71	NKR69LL-5DXYE	–	○	–	○			–		–	○	–	–	○			○		○	–	○	–		○		–	○	○
72	NKR69LL-5HXYE	–	○	–	○			–		–	○	–	–	○			○		○	–	○	–		○		–	○	○
73	NKR55EL-3EXY	○	–	–	○			○		–	–	○	–	–			○		○	–	○	–		○		–	–	△
74	NKR69EL-3EXYR	○	–	–	○			○		–	–	○	–	–			○		○	–	○	–		○		–	–	△
75	NKR55EL-1DWY	○	–	○	–			–		○	–	–	○	–			○		○	–	○	–		○		–	–	△
76	NKR55EL-1DWS	○	–	○	△			–		○	–	–	○	–			○		○	–	○	–		○		△	–	△
77	NKR55EL-1DWSC	○	–	–	○			–		○	–	–	○	–			○		○	–	○	–		○		○	–	△
78	NKR58LL-5GWY	○	–	–	○			–		○	–	–	○	–			○		–	○	–	○		○		–	–	△
79	NKR58LL-5GWYC	○	–	–	○			–		○	–	–	○	–			○		–	○	–	○		○		–	–	○

FRONT BRAKES (NKR 1998)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	FRONT BRAKE																									
		DISC BRAKE										DRUM BRAKE															
		WHEEL CYL.			DISC				PAD		Type		WHEEL CYL.				DRUM			LINING						
		Inside dia. (in)			Thickness (mm)		Outside dia. (mm)			Thickness (mm)			Inside dia. (in)				Inside dia. (mm)			Thickness (mm)			Width (mm)			
		2 + 1 / 8	2 + 2	2 + 1 / 4	35	42	265	282	310	14.0	13.0	2L	D2L	1 + 1 / 8	1 + 3 / 16	1 + 5 / 16	1 + 3 / 8	279.4	300	320	6.9	9.6	11.0	60	75	100	120
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	NKR55EU -1EXY						—	○	○	—					○	—	○		—		—	—		—		—	
2	NKR55EU -1EXA						—	○	—	○				—	○	—	○		—		—	—		—		—	
3	NKR55EU -1EXYP						○	—	○	—				○	—	—	○		—		—	—		—		—	
4	NKR58EU -1EXY						○	—	○	—				○	—	—	○		—		—	—		—		—	
5	NKR55EU -1EXYJ						○	—	○	—				—	○	—	○		—		—	—		—		—	
6	NKR66EU -1EXYH						—	○	—	○				—	○	—	○		—		—	—		—		—	
7	NKR69EAL-1DXYUK						—	○	—	○				—	○	—	○		—		—	—		—		—	
8	NKR55E2U-5HXY						—	○	—	○				—	○	—	○		—		—	—		—		—	
9	NKR69E2U-5HYK						—	○	—	○				—	○	—	○		—		—	—		—		—	
10	NKR55E2U-5HXYP						—	○	—	○				—	○	—	○		—		—	—		—		—	
12	NKR58E2U-5HXY						—	○	—	○				—	○	—	○		—		—	—		—		—	
15	NKR66E2U-5EXYH						—	○	—	○				—	○	—	○		—		—	—		—		—	
16	NKR58EDL-5EMXD						—	○	—	○					○	○	—		—		—	—		—		—	
17	NKR55LU -5HXYZJ						—	○	○	—					○	—	○		—		—	—		—		—	
18	NKR55LU -5HXYJ						—	○	—	○					○	—	○		—		—	—		—		—	
19	NKR55LU -5HXY						—	○	—	○					○	—	○		—		—	—		—		—	
20	NKR55LU -5HXA						—	○	—	○					○	—	○		—		—	—		—		—	
21	NKR69LU -5HYK						—	○	—	○					○	—	○		—		—	—		—		—	
22	NKR58LU -5HXY						—	—	—	—					—	—	—		○		—	○		○		○	
24	NKR58LU -5HXA						—	○	—	○					○	—	○		—		—	—		—		—	
25	NKR58LU -5HYIN						—	○	—	○					○	—	○		—		—	—		—		—	
26	NKR66LU -5LXYP						—	○	—	○					○	—	○		—		—	—		—		—	
27	NKR66LU -5LYIN						—	○	—	○					○	—	○		—		—	—		—		—	
28	NKR55EU -3EXY						—	○	—	○					○	—	○		—		—	—		—		—	

REAR BRAKES (NKR 1998)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	REAR BRAKE																								PARKING BRAKE				BRAKE CONTROL								
		DRUM BRAKE																																				
		TYPE		WHEEL CYL.					DRUM				LINING								DRUM				LINING				MASTER CYL.									
		D 2 L (W/O AUTO)	D 2 L (W AUTO)	Inside dia. (in)					Inside dia. (mm)				Thickness (mm)				Width (mm)				Inside dia. (mm)				Width (mm)				Inside dia. (in)				DSPV	LSPV	EXHAUST BRAKE	HYDROMASTER	HBB
				7/8	1	1+3/16	1+5/16	1+3/8	228.6	279.4	300	320	4.9	6.0	9.6	11.0	60	75	100	120	178	190	203	254	35	45	50	60	1+1/16	1+1/8	1+1/4	1+3/8					
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
1	NKR55EU -1EXY	○	—	○	—	—			—		○	—	—	○	—			○			○	—			○	—				○			—	—	△		
2	NKR55EU -1EXA	○	—	—	○	—			—		○	—	—	○	—			○			○	—			○	—				○			△	—	△		
3	NKR55EU -1EXYP	○	—	○	—	—			—		○	—	—	○	—			○			○	—			○	—				○			—	—	△		
4	NKR58EU -1EXY	○	—	—	○	—			—		○	—	—	○	—			○			—	○			—	○				○			—	—	△		
5	NKR55EU -1EXYJ	○	—	○	—	—			—		○	—	—	○	—			○			○	—			○	—				○			△	—	△		
6	NKR66EU -1EXYH	—	○	—	○	—			—		○	—	—	○	—			○			○	—			○	—				○			—	○	△		
7	NKR69EAL-1DXYUK	○	—	○	—	—			—		○	—	—	○	—			○			—	○			—	○				○			—	○	○		
8	NKR55E2U-5HXY	○	—	—	○	—			—		○	—	—	○	—			○			○	—			○	—				○			—	—	△		
9	NKR69E2U-5HYK	○	—	—	○	—			—		○	—	—	○	—			○			○	—			○	—				○			—	—	△		
10	NKR55E2U-5HXYP	○	—	—	○	—			—		○	—	—	○	—			○			○	—			○	—				○			—	—	△		
12	NKR58E2U-5HXY	○	—	—	○	—			—		○	—	—	○	—			○			—	○			—	○				○			—	—	△		
15	NKR66E2U-5EXYH	○	—	—	○	—			—		○	—	—	○	—			○			—	○			—	○				○			—	○	△		
16	NKR58EDL-5EMXD	○	—	—	○	—			—		○	—	—	○	—			○			—	○			—	○				○			—	—	△		
17	NKR55LU -5HXYZJ	○	—	—	○	—			—		○	—	—	○	—			○			○	—			○	—				○			○	—	△		
18	NKR55LU -5HXYJ	○	—	—	○	—			—		○	—	—	○	—			○			○	—			○	—				○			—	—	△		
19	NKR55LU -5HXY	○	—	—	○	—			—		○	—	—	○	—			○			○	—			○	—				○			—	—	△		
20	NKR55LU -5HXA	○	—	—	○	—			—		○	—	—	○	—			○			○	—			○	—				○			—	—	△		
21	NKR69LU -5HYK	○	—	—	○	—			—		○	—	—	○	—			○			○	—			○	—				○			—	—	△		
22	NKR58LU -5HXY	○	—	—	○	—			—		○	—	—	○	—			○			—	○			—	○				○			—	—	△		
24	NKR58LU -5HXA	○	—	—	○	—			—		○	—	—	○	—			○			—	○			—	○				○			—	—	△		
25	NKR58LU -5HYIN	○	—	—	○	—			—		—	○	—	—	○			○			—	○			—	○				○			—	—	△		
26	NKR66LU -5LXYP	○	—	—	—	○			—		—	○	—	—	○			○				○				○				—	○		—	—	△		
27	NKR66LU -5LYIN	○	—	—	—	○			—		—	○	—	—	○				○			○				○				—	○		—	—	△		
28	NKR55EU -3EXY	○	—	—	○	—			○		—	—	○	—	—			○			○	—			○	—				○			—	—	△		

FRONT BRAKES (NKR 1998)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	FRONT BRAKE																								
		DISC BRAKE										DRUM BRAKE														
		WHEEL CYL.			DISC				PAD		Type		WHEEL CYL.				DRUM			LINING						
		Inside dia. (in)			Thickness (mm)		Outside dia. (mm)			Thickness (mm)			Inside dia. (in)				Inside dia. (mm)			Thickness (mm)			Width (mm)			
		2+1/8	2+2	2+1/4	35	42	265	282	310	14.0	13.0	2L	D2L	1+1/8	1+3/16	1+5/16	1+3/8	279.4	300	320	6.9	9.6	11.0	60	75	100	120
No.	Models	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
29	NKR66EU -3EXYH						—	○	—	○					○	—	○		—		—	—		—		—	
30	NKR55EU -1DWY		—		—		—	—		—		○	—	○					○	—	○	—					
31	NKR55EU -1DWS		—		—		—	—		—		○	—	○					○	—	○	—					
32	NKR69LU -5GWYK		—		—		—	—		—		○	—	○					○	—	○	—					
33	NKR58LU -5GWY		—		—		—	—		—		○	—	○					○	—	○	—					
34	NKR55EL -1EY		—		—		—	—		—		○	—	○					○	—	○	—					
35	NKR55EL -1EXY		—		—		—	—		—		○	—	○					○	—	○	—					
36	NKR55EL -1EXYJ		—		—		—	—		—		○	—	○					○	—	○	—			○		
37	NKR55EL -1EXA		—		—		—	—		—		○	—	○					○	—	○	—					
38	NKR55EL -1EXYG		—		—		—	—		—		○	—	○					○	—	○	—					
39A	NKR55EL -1EAC		—		—		—	—		—		○	—	○					○	—	○	—					
42	NKR58EL -1EXY		—		—		—	—		—		○	—	○					○	—	○	—			○		
43	NKR69EL -1EXYR		—		—		—	—		—		○	—	○					○	—	○	—			○		
44	NKR69EAL-1DXYE		○		○		○	—		○		—	—	—					—	—	—	—			—		
45	NKR55E2L-5HXY		—		—		—	—		—		○	—	○					○	—	○	—			○		
45A	NKR55E2L-5HXYCL		—		—		—	—		—																	
47	NKR55E2L-5HXYG		—		—		—	—		—		○	—	○					○	—	○	—			○		
49	NKR58E2L-5HXY		—		—		—	—		—		○	—	○					○	—	○	—			○		
50	NKR58E2L-5HXA		—		—		—	—		—		○	—	○					○	—	○	—			○		
51	NKR58E2L-5HXYS		—		—		—	—		—		○	—	○					○	—	○	—			○		
52	NKR58E2L-5HXAS		—		—		—	—		—		○	—	○					○	—	○	—			○		
53	NKR58EDL-5EMXD		—		—		—	—		—		—	○	○					○	—	○	—			○		
54	NKR58EDL-5EMXDS		—		—		—	—		—		—	○	○					○	—	○	—			○		
55	NKR66E2L-5HXYR		—		—		—	—		—		○		○					—	○	—	○			○		

REAR BRAKES (NKR 1998)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	REAR BRAKE																		PARKING BRAKE				BRAKE CONTROL								
		DRUM BRAKE																														
		TYPE		WHEEL CYL.					DRUM				LINING								DRUM				LINING				MASTER CYL.						
		D 2 L (W/O AUTO)	D 2 L (W AUTO)	Inside dia. (in)					Inside dia. (mm)				Thickness (mm)				Width (mm)				Inside dia. (mm)				Width (mm)				Inside dia. (in)				DSPV	LSPV	EXHAUST BRAKE	HYDROMASTER	HBB
				7/8	1	1 + 3/16	1 + 5/16	1 + 3/8	228.6	279.4	300	320	4.9	6.0	9.6	11.0	60	75	100	120	178	190	203	254	35	45	50	60	1 + 1/16	1 + 1/8	1 + 1/4	1 + 3/8					
No.	Models	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
29	NKR66EU -3EXYH	○	—	—	○	—			—		○	—	—	○	—			○			—	○			—	○				○			—	○	△		
30	NKR55EU -1DWY	○	—	○	—	—			—		○	—	—	○	—			○			○	—			○	—				○			—	—	△		
31	NKR55EU -1DWS	○	—	—	○	—			—		○	—	—	○	—			○			○	—			○	—				○			△	—	△		
32	NKR69LU -5GWYK	○	—	—	○	—			—		○	—	—	○	—			○			○	—			○	—				○			—	—	△		
33	NKR58LU -5GWY	○	—	—	○	—			—		○	—	—	○	—			○			—	○			—	○				○			—	—	△		
34	NKR55EL -1EY	○	—	○	—	—			—		○	—	—	○	—			○			○	—			○	—				○			—	—	△		
35	NKR55EL -1EXY	○	—	○	—	—			—		○	—	—	○	—			○			○	—			○	—				○			—	—	△		
36	NKR55EL -1EXYJ	○	—	○	—	—			—		○	—	—	○	—			○			○	—			○	—				○			—	—	△		
37	NKR55EL -1EXA	○	—	—	○	—			—		○	—	—	○	—			○			○	—			○	—				○			△	—	△		
38	NKR55EL -1EXYG	○	—	○	—	—			—		○	—	—	○	—			○			○	—			○	—				○			—	—	△		
39A	NKR55EL -1EAC	○	—	—	○	—			—		○	—	—	○	—			○			○	—			○	—				○			○	—	△		
42	NKR58EL -1EXY	—	○	—	○	—			—		○	—	—	○	—			○			○	—			○	—				○			—	○	△		
43	NKR69EL -1EXYR	○	—	○	—	—			—		○	—	—	○	—			○			—	○			—	○				○			—	—	△		
44	NKR69EAL-1DXYE	○	—	○	—	—			—		○	—	—	○	—			○			○	—			○	—				○			—	○	○		
45	NKR55E2L-5HXY	○	—	—	○				—		○	—	—	○	—			○			—	○			—	○				○			—	—	△		
45A	NKR55E2L-5HXYCL	○	—	—	○				—		○	—						○			○	—			○	—				○			—	—	△		
47	NKR55E2L-5HXYG	○	—	—	○				—		○	—	—	○	—			○			○	—			○	—				○			—	—	△		
49	NKR58E2L-5HXY	○	—	—	○				—		○	—	—	○	—			○			—	○			—	○				○			—	—	△		
50	NKR58E2L-5HXA	○	—	—	○				—		○	—	—	○	—			○			—	○			—	○				○			P	—	△		
51	NKR58E2L-5HXYS	○	—	—	○				—		○	—	—	○	—			○			—	○			—	○				○			—	—	△		
52	NKR58E2L-5HXAS	○	—	—	○				—		○	—	—	○	—			○			—	○			—	○				○			P	—	△		
53	NKR58EDL-5EMXD	○	—	—	○				—		○	—	—	○	—			○			—	○			—	○				○			—	—	△		
54	NKR58EDL-5EMXDS	○	—	—	○				—		○	—	—	○	—			○			—	○			—	○				○			—	—	△		
55	NKR66E2L-5HXYR	○	—	—	○				—		—	○	—	—	○			○			—	○			—	○				○			—	—	△		

FRONT BRAKES (NKR 1998)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	FRONT BRAKE																									
		DISC BRAKE										DRUM BRAKE															
		WHEEL CYL.			DISC				PAD		Type		WHEEL CYL.				DRUM			LINING						
		Inside dia. (in)			Thickness (mm)		Outside dia. (mm)			Thickness (mm)			Inside dia. (in)				Inside dia. (mm)			Thickness (mm)			Width (mm)			
		2+1/8	2+2	2+1/4	35	42	265	282	310	14.0	13.0	2L	D2L	1+1/8	1+3/16	1+5/16	1+3/8	279.4	300	320	6.9	9.6	11.0	60	75	100	120
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
56	NKR66E2L-5HXFYR		—		—		—	—	—	—		○		○						○		○			○		
57	NKR55LL -5HXA	—	—		—		—	—		—		○	—	○					○	—	○	—			○		
58	NKR55LL -5HXY	—	—		—		—	—		—		○	—	○	—				○	—	○	—			○		
59	NKR55LL -5HXYJ	—	—		—		—	—		—		○	—	○	—				○	—	○	—			○		
60	NKR69LL -5HXYCH	—	—		—		—	—		—		○	—	○	—				○	—	○	—			○		
63	NKR55LL -5EAC	—	—		—		—	—		—		○	—	○	—				○	—	○	—			○		
65	NKR55LL -5HXYCJ	—	—		—		—	—		—		○	—	○	—				○	—	○	—			○		
66	NKR55LL -5HXAC	—	—		—		—	—		—		○	—	○	—				○	—	○	—			○		
67	NKR55LL -5HXACJ	—	—		—		—	—		—		○	—	○	—				○	—	○	—			○		
69	NKR55LL -5HACJ	—	—		—		—	—		—		○	—	○	—				○	—	○	—			○		
70	NKR58LL -5HXY	—	—		—		—	—		—		○	—	○	—				○	—	○	—			○		
71	NKR58LL -5HXA	—	—		—		—	—		—		○	—	○	—				○	—	○	—			○		
72	NKR58LL -5HXYS	—	—		—		—	—		—		○	—	○	—				○	—	○	—			○		
73	NKR58LL -5HXAS	—	—		—		—	—		—		○	—	○	—				○	—	○	—			○		
74	NKR66LL -5HXYR	—	—		—		—	—		—		○	—	○	—				—	○	—	○			○		
77	NKR69LL -5DXYE	○	—		○		—	○		○		—	—	—	—				—	—	—	—			—		
78	NKR69LL -5HXYE	○	—		○		—	○		○		—	—	—	—				—	—	—	—			—		
78A	NKR69LL -5HXYBR	—	—		—		—	—		—		○	—	○	—				○	—	○	—			○		
79	NKR55EL -3EXY		—		—		—	—		—		○	—	○					○		○				○		
80	NKR69EL -3EXYR		—		—		—	—		—		○	—	○					○		○				○		
81	NKR55EL -1DWSC		—		—		—	—		—		○	—	○					○	—	○	—			○		
82A	NKR58LL -5GWYS		—		—		—	—		—																	
84	NKR58GL -5JXY		—		—		—	—		—		○	—	○					○	—	○	—			○		

REAR BRAKES (NKR 1998)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	REAR BRAKE																		PARKING BRAKE								BRAKE CONTROL								
		DRUM BRAKE																																		
		TYPE		WHEEL CYL.					DRUM				LINING								DRUM				LINING				MASTER CYL.								
		D2L (W/O AUTO)	D2L (W AUTO)	Inside dia. (in)					Inside dia. (mm)				Thickness (mm)				Width (mm)				Inside dia. (mm)				Width (mm)				Inside dia. (in)				DSPV	LSPV	EXHAUST BRAKE	HYDROMASTER	HBB
				7/8	1	1+3/16	1+5/16	1+3/8	228.6	279.4	300	320	4.9	6.0	9.6	11.0	60	75	100	120	178	190	203	254	35	45	50	60	1+1/16	1+1/8	1+1/4	1+3/8					
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
56	NKR66E2L-5HXFYR	○	—	—	○				—		—	○	—	—	○			○			—	○			—	○				○			—	—	△		
57	NKR55LL -5HXA	○	—	—	○	—			—		○	—	—	○	—			○			○	—			○	—				○			—	—	△		
58	NKR55LL -5HXY	○	—	—	○	—			—		○	—	—	○	—			○			○	—			○	—				○			—	—	△		
59	NKR55LL -5HXYJ	○	—	—	○	—			—		○	—	—	○	—			○			○	—			○	—				○			—	—	△		
60	NKR69LL -5HXYCH	○	—	—	○	—			—		○	—	—	○	—			○			○	—			○	—				○			—	—	△		
63	NKR55LL -5EAC	○	—	—	○	—			—		○	—	—	○	—			○			○	—			○	—				○			—	—	○		
65	NKR55LL -5HXYCJ	○	—	—	○	—			—		○	—	—	○	—			○			○	—			○	—				○			—	—	○		
66	NKR55LL -5HXAC	○	—	—	○	—			—		○	—	—	○	—			○			○	—			○	—				○			—	—	○		
67	NKR55LL -5HXACJ	○	—	—	○	—			—		○	—	—	○	—			○			○	—			○	—				○			—	—	○		
69	NKR55LL -5HACJ	○	—	—	○	—			—		○	—	—	○	—			○			○	—			○	—				○			—	—	○		
70	NKR58LL -5HXY	○	—	—	○	—			—		○	—	—	○	—			○			—	○			—	○				○			—	—	△		
71	NKR58LL -5HXA	○	—	—	○	—			—		○	—	—	○	—			○			—	○			—	○				○			—	—	△		
72	NKR58LL -5HXYS	○	—	—	○	—			—		○	—	—	○	—			○			—	○			—	○				○			—	—	△		
73	NKR58LL -5HXAS	○	—	—	○	—			—		○	—	—	○	—			○			—	○			—	○				○			—	—	△		
74	NKR66LL -5HXYR	○	—	—	○				—		—	○	—	○	—			○			—	○			—	○				○			—	—	△		
77	NKR69LL -5DXYE	—	○	—	○	—			—		—	○	—	—	○			○			○	—			○	—				○			—	○	○		
78	NKR69LL -5HXYE	—	○	—	○	—			—		—	○	—	—	○			○			○	—			○	—				○			—	○	○		
78A	NKR69LL -5HXYBR	○	—	—	○	—			—		○	—	—	○	—			○			○	—			○	—				○			—	○	△		
79	NKR55EL -3EXY	○	—	—	○				○		—	—	○	—				○			○	—			○	—				○			—	—	△		
80	NKR69EL -3EXYR	○	—	—	○				○		—	—	○	—				○			○	—			○	—				○			—	—	△		
81	NKR55EL -1DWSC	○	—	—	○				—		○	—	—	—				○			○	—			○	—				○			○	—	△		
82A	NKR58LL -5GWYS	○	—	—	○						○							○				○				○				○			—	—	△		
84	NKR58GL -5JXY	○	—	—	○				—		○	—	—	○	—			○			—	○			—	○				○			—	—	△		

FRONT BRAKES (NPR 1994 – 1997)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	FRONT BRAKE																					
		DISC BRAKE								DRUM BRAKE													
		WHEEL CYL.		DISC				PAD		Type		WHEEL CYL.			DRUM			LINING					
		Inside dia. (in)		Thickness (mm)		Outside dia. (mm)		Thickness (mm)		2L	D2L	Inside dia. (in)			Inside dia. (mm)			Thickness (mm)			Width (mm)		
		2 + 1/8	2	30	35	265	282	12.0	14.0			1 + 1/8	1 + 1/16	1 + 3/16	279.4	300	320	6.0	9.6	11.0	60	75	100
1	NPR58GU -5EXYH	–			–		–		–	○	–	○		–			○		○	–		○	–
2	NPR58GU -5JXY	–			–		–		–	○	–	○		–			○		○	–		○	–
3	NPR58GU -5JXYSN	–			–		–		–	○	–	○		–			○		○	–		○	–
4	NPR66GU -5JXYK	–			–		–		–	○	–	○		–			○		○	–		○	–
5	NPR66GDU-5LX	–			–		–		–	–	○	–		○			○		–	○		–	○
6	NPR66GU -5LXY	–			–		–		–	○	–	–		○			○		–	○		–	○
7	NPR66GU -5LXYK	–			–		–		–	○	–	–		○			○		–	○		–	○
8	NPR66GU -5LXYSN	–			–		–		–	○	–	–		○			○		–	○		–	○
9	NPR69GU -5DXYE	○			○		○		○	–	–	–		–			–		–	–		–	–
10	NPR58LU -5EXYH	–			–		–		–	○		○		–			○		○	–		○	
11	NPR58LU -5JXYH	–			–		–		–	○		○		–			○		○	–		○	
12	NPR58LU -5JXA	–			–		–		–	○		○		–			○		○	–		○	
13	NPR58LU -5JXY	–			–		–		–	○		○		–			○		○	–		○	
14	NPR58LU -5JXYME	–			–		–		–	○		○		–			○		○	–		○	
15	NPR58LU -5JXYMW	–			–		–		–	○		○		–			○		○	–		○	
16	NPR58LU -5JXYSN	–			–		–		–	○		○		–			○		○	–		○	
17	NPR58LU -5JXYV	–			–		–		–	○		○		–			○		○	–		○	
18	NPR66LU -5EXYHT	○			○		○		○	–		–		–			–		–	–		–	
18a	NPR66LU -5JXYHT	○			○		○		○	–		–		–			–		–	–		–	
19a	NPR66LU -5JXYH	–			–		–		–	○		○		–			○		○	–		○	
19	NPR66LU -5JXYK	–			–		–		–	○		○		–			○		○	–		○	
20	NPR66LU -5LXA	–			–		–		–	○		–		○			○		–	○		–	○
21	NPR66LU -5LXY	–			–		–		–	○		–		○			○		–	○		–	○
22	NPR66LU -5LXYH	–			–		–		–	○		–		○			○		–	○		–	○
23	NPR66LU -5LXYIN	–			–		–		–	○		–		○			○		–	○		–	○

REAR BRAKES (NPR 1994 – 1997)

—	Not available
○	Standard
△	Factory option
	Non

		REAR BRAKE																PARKING BRAKE				BRAKE CONTROL					
		DRUM BRAKE																									
		TYPE		WHEEL CYL.				DRUM				LINING							DRUM		LINING		MASTER CYL.					
				Inside dia. (in)				Inside dia. (mm)				Thickness (mm)				Width (mm)			Inside dia. (mm)		Width (mm)		Inside dia. (in)					
		D 2 L (W/O AUTO)	D 2 L (W AUTO)	7/8	1	1 + 3/16	1 + 5/16	228.6	279.4	300	320	4.9	6.0	9.6	11.0	60	75	100	178	190	35	45	1 + 1/16	1 + 1/8	1 + 1/4	DSPV	LSPV	EBXRHAAKUEST
No.	Models	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
1	NPR58GU -5EXYH	○	–		○		–				○			○	–		○	–	–	○	–	○		○	–	–	○	○
2	NPR58GU -5JXY	○	–		○		–				○			○	–		○	–	–	○	–	○		○	–	–	–	○
3	NPR58GU -5JXYSN	○	–		○		–				○			○	–		○	–	–	○	–	○		○	–	–	–	○
4	NPR66GU -5JXYK	○	–		○		–				○			○	–		○	–	–	○	–	○		○	–	–	–	△
5	NPR66GDU-5LX	○	–		–	○	–				○			–	○		–	○	–	○	–	○		–	○	–	–	○
6	NPR66GU -5LXY	○	–		–	○	–				○			–	○		–	○	–	○	–	○		–	○	–	–	○
7	NPR66GU -5LXYK	○	–		–	○	–				○			–	○		–	○	–	○	–	○		–	○	–	–	△
8	NPR66GU -5LXYSN	○	–		–	○	–				○			–	○		–	○	–	○	–	○		–	○	–	–	○
9	NPR69GU -5DXYE	–	○		○		–				○			○	–		○	–	○	–	○	–		○	–	–	○	○
10	NPR58LU -5EXYH	○	–		○		–				○			○	–		○	–	–	○	–	○		○	–	–	○	○
11	NPR58LU -5JXYH	○	–		○		–				○			○	–		○	–	–	○	–	○		○	–	–	○	○
12	NPR58LU -5JXA	○	–		○		–				○			○	–		○	–	–	○	–	○		○	–	–	–	○
13	NPR58LU -5JXY	○	–		○		–				○			○	–		○	–	–	○	–	○		○	–	–	–	○
14	NPR58LU -5JXYME	○	–		○		–				○			○	–		○	–	–	○	–	○		○	–	–	–	○
15	NPR58LU -5JXYMW	○	–		○		–				○			○	–		○	–	–	○	–	○		○	–	–	–	○
16	NPR58LU -5JXYSN	○	–		○		–				○			○	–		○	–	–	○	–	○		○	–	–	–	○
17	NPR58LU -5JXYV	○	–		○		–				○			○	–		○	–	–	○	–	○		○	–	–	–	○
18	NPR66LU -5EXYHT	–	○		–	○	–				○			–	○		–	○	–	○	–	–		–	○	–	○	○
18a	NPR66LU -5JXYHT	–	○		–	○	–				○			–	○		–	○	–	○	–	–		–	○	–	○	○
19a	NPR66LU -5JXYH	○	–		○		–				○			○	–		○	–	–	○	–	○		○	–	–	○	○
19	NPR66LU -5JXYK	○	–		○		–				○			○	–		○	–	–	○	–	○		○	–	–	–	△
20	NPR66LU -5LXA	○	–		–	○	–				○			–	○		–	○	–	○	–	○		–	○	–	–	○
21	NPR66LU -5LXY	○	–		–	○	–				○			–	○		–	○	–	○	–	○		–	○	–	–	○
22	NPR66LU -5LXYH	○	–		–	○	–				○			–	○		–	○	–	○	–	○		–	○	–	○	○
23	NPR66LU -5LXYIN	○	–		–	○	–				○			–	○		–	○	–	○	–	○		–	○	–	–	○

FRONT BRAKES (NPR 1994 – 1997)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	FRONT BRAKE																				
		DISC BRAKE								DRUM BRAKE												
		WHEEL CYL.		DISC				PAD		Type		WHEEL CYL.			DRUM			LINING				
		Inside dia. (in)		Thickness (mm)		Outside dia. (mm)		Thickness (mm)		2L	D2L	Inside dia. (in)			Inside dia. (mm)			Thickness (mm)			Width (mm)		
		2+1/8	2	30	35	265	282	12.0	14.0			1+1/8	1+1/16	1+3/16	279.4	300	320	6.0	9.6	11.0	60	75	100
1		2		3		4		5		6		7			8			9			10		
24	NPR66LU -5LXYK	–			–		–		–	○		–		○			○		–	○		–	○
25	NPR66LU -5LXYP	–			–		–		–	○		–		○			○		–	○		–	○
26	NPR66LU -5LXYSN	–			–		–		–	○		–		○			○		–	○		–	○
27	NPR99LU -5JXYZ	–			–		–		–	○		○		–			○		○	–		○	–
28	NPR69LU -5DXYE	○			○		○		○	–		–		–			–		–	–		–	–
29	NPR69LU -5HXYE	○			○		○		○	–		–		–			–		–	–		–	–
30	NPR65LU -5JXKYEJ	○			○		○		○	–		–		–			–		–	–		–	–
31	NPR58PU -5JXA	–			–		–		–	○			○	–			○		○	–		○	–
32	NPR58PU -5JXY	–			–		–		–	○			○	–			○		○	–		○	–
33	NPR58PU -5JXYSN	–			–		–		–	○			○	–			○		○	–		○	–
34	NPR66PU -5JXYK	–			–		–		–	○			○	–			○		○	–		○	–
35	NPR66PU -5LXA	–			–		–		–	○			–	○			○		–	○		–	○
36	NPR66PU -5LXY	–			–		–		–	○			–	○			○		–	○		–	○
37	NPR66PU -5LXYK	–			–		–		–	○			–	○			○		–	○		–	○
38	NPR66PU -5LXYH	–			–		–		–	○			–	○			○		–	○		–	○
39	NPR66PU -5LXYME	–			–		–		–	○			–	○			○		–	○		–	○
40	NPR66PU -5LXYMW	–			–		–		–	○			–	○			○		–	○		–	○
41	NPR66PU -5LXYP	–			–		–		–	○			–	○			○		–	○		–	○
42	NPR66PU -5LXYSN	–			–		–		–	○			–	○			○		–	○		–	○
43a	NPR99PU -5JXYZ	–			–		–		–	○		○	–	–			○		○	–		○	–
43	NPR99PU -5LXYZ	–			–		–		–	○			–	○			○		–	○		–	○
44	NPR59PU -5LXYHJ	–			–		–		–	○			–	○			○		–	○		–	○
45	NPR59PU -5LXYVJ	–			–		–		–	○			–	○			○		–	○		–	○
46	NPR58LU -5HWYH	–			–		–		–	○		○					○		○			○	
47	NPR58LU -5HWYSN	–			–		–		–	○		○					○		○			○	

REAR BRAKES (NPR 1994 – 1997)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	REAR BRAKE																PARKING BRAKE				BRAKE CONTROL					
		DRUM BRAKE																									
		TYPE		WHEEL CYL.				DRUM				LINING							DRUM		LINING		MASTER CYL.					
				Inside dia. (in)				Inside dia. (mm)				Thickness (mm)				Width (mm)			Inside dia. (mm)		Width (mm)		Inside dia. (in)					
		D 2 L (W/O AUTO)	D 2 L (W AUTO)	7/8	1	1 + 3/16	1 + 5/16	228.6	279.4	300	320	4.9	6.0	9.6	11.0	60	75	100	178	190	35	45	1 + 1/16	1 + 1/8	1 + 1/4	DSPV	LSPV	EBXHAAKUEST
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
24	NPR66LU -5LXYK	○	–		–	○	–				○			–	○		–	○	–	○	–	○		–	○	–	–	△
25	NPR66LU -5LXYP	○	–		–		○				○			–	○		–	○	–	○	–	○		–	○	–	–	○
26	NPR66LU -5LXYSN	○	–		–	○	–				○			–	○		–	○	–	○	–	○		–	○	–	–	○
27	NPR99LU -5JXYZ	○	–		○		–				○			○	–		○	–	–	○	–	○		○	–	–	○	○
28	NPR69LU -5DXYE	–	○		○		–				○			○	–		○	–	○	–	○	–		○	–	–	○	○
29	NPR69LU -5HXYE	–	○		○		–				○			○	–		○	–	○	–	○	–		○	–	–	○	○
30	NPR65LU -5JXYEJ	–	○		–	○	–				○			–	○		–	○	–	○	–	○		–	○	–	○	○
31	NPR58PU -5JXA	○	–		○		–				○			○	–		○	–	–	○	–	○		○	–	–	–	○
32	NPR58PU -5JXY	○	–		○		–				○			○	–		○	–	–	○	–	○		○	–	–	–	○
33	NPR58PU -5JXYSN	○	–		○		–				○			○	–		○	–	–	○	–	○		○	–	–	–	○
34	NPR66PU -5JXYK	○	–		○		–				○			○	–		○	–	–	○	–	○		○	–	–	–	△
35	NPR66PU -5LXA	○	–		–	○	–				○			–	○		–	○	–	○	–	○		–	○	–	–	○
36	NPR66PU -5LXY	○	–		–	○	–				○			–	○		–	○	–	○	–	○		–	○	–	–	○
37	NPR66PU -5LXYK	○	–		–	○	–				○			–	○		–	○	–	○	–	○		–	○	–	–	△
38	NPR66PU -5LXYH	○	–		–	○	–				○			–	○		–	○	–	○	–	○		–	○	–	○	○
39	NPR66PU -5LXYME	○	–		–	○	–				○			–	○		–	○	–	○	–	○		–	○	–	–	○
40	NPR66PU -5LXYMW	○	–		–	○	–				○			–	○		–	○	–	○	–	○		–	○	–	–	○
41	NPR66PU -5LXYP	○	–		–	○	–				○			–	○		–	○	–	○	–	○		–	○	–	–	○
42	NPR66PU -5LXYSN	○	–		–	○	–				○			–	○		–	○	–	○	–	○		–	○	–	–	○
43a	NPR99PU -5JXYZ	○	–		○		–				○			○	–		○	–	–	○	–	○		○	–	–	○	○
43	NPR99PU -5LXYZ	○	–		–	○	–				○			–	○		–	○	–	○	–	○		–	○	–	–	○
44	NPR59PU -5LXYHJ	○	–		–	○	–				○			–	○		–	○	–	○	–	○		–	○	–	○	○
45	NPR59PU -5LXYVJ	○	–		–	○	–				○			–	○		–	○	–	○	–	○		–	○	–	–	○
46	NPR58LU -5HWYH	○	–		○	–	–				○			○	–		○	–		○		○		○	–	–	○	○
47	NPR58LU -5HWYSN	○	–		○	–	–				○			○	–		○	–		○		○		○	–	–	–	○

FRONT BRAKES (NPR 1994 – 1997)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	FRONT BRAKE																					
		DISC BRAKE								DRUM BRAKE													
		WHEEL CYL.		DISC				PAD		Type		WHEEL CYL.			DRUM			LINING					
		Inside dia. (in)		Thickness (mm)		Outside dia. (mm)		Thickness (mm)		2L	D2L	Inside dia. (in)			Inside dia. (mm)			Thickness (mm)			Width (mm)		
		2+1/8	2	30	35	265	282	12.0	14.0			1+1/8	1+1/16	1+3/16	279.4	300	320	6.0	9.6	11.0	60	75	100
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
48	NPR66LU -5HWYK	–			–		–		–	○		○					○		○			○	
49	NPR66PU -5LWYK	–			–		–		–	○				○			○			○			○
50	NPS66LU -5JXYH	–			–		–		–		○			○			○		○			○	
51	NPR58GL -5JXY	–			–		–		–	○	–	○		–			○		○	–		○	–
52	NPR58GL -5JXYS	–			–		–		–	○	–	○		–			○		○	–		○	–
53	NPR66GDL -5LX	–			–		–		–	–	○	–		○			○		–	○		–	○
54	NPR66GL -5LXY	–			–		–		–	○	–	–		○			○		–	○		–	○
55	NPR66GL -5LXYS	–			–		–		–	○	–	–		○			○		–	○		–	○
56	NPR66GL -5LXYR	–			–		–		–	○	–	–		○			○		–	○		–	○
57	NPR59GL -5LXYRJ	–			–		–		–	○	–	–		○			○		–	○		–	○
58	NPR58LL -5JXA	–			–		–		–	○		○		–			○		○	–		○	–
59	NPR58LL -5JXY	–			–		–		–	○		○		–			○		○	–		○	–
60	NPR58LL -5JXAC	–			–		–		–	○		○		–			○		○	–		○	–
61	NPR58LL -5JXYC	–			–		–		–	○		○		–			○		○	–		○	–
62	NPR58LL -5JXAS	–			–		–		–	○		○		–			○		○	–		○	–
63	NPR58LL -5JXYS	–			–		–		–	○		○		–			○		○	–		○	–
64	NPR66LL -5JXYR	–			–		–		–	○		○		–			○		○	–		○	–
65	NPR66LL -5LXA	–			–		–		–	○		–		○			○		–	○		–	○
66	NPR66LL -5LXY	–			–		–		–	○		–		○			○		–	○		–	○
67	NPR66LL -5LXAC	–			–		–		–	○		–		○			○		–	○		–	○
68	NPR66LL -5LXYC	–			–		–		–	○		–		○			○		–	○		–	○
69	NPR66LL -5LXAS	–			–		–		–	○		–		○			○		–	○		–	○
70	NPR66LL -5LXYS	–			–		–		–	○		–		○			○		–	○		–	○
71	NPR66LL -5LXYR	–			–		–		–	○		–		○			○		–	○		–	○
72	NPR66LL -5LXYCL	–			–		–		–	○		–		○			○		–	○		–	○

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	REAR BRAKE																	PARKING BRAKE				BRAKE CONTROL					
		DRUM BRAKE																										
		TYPE		WHEEL CYL.				DRUM				LINING							DRUM		LINING		MASTER CYL.					
				Inside dia. (in)				Inside dia. (mm)				Thickness (mm)				Width (mm)			Inside dia. (mm)		Width (mm)		Inside dia. (in)					
		D2LW/O AUTO	D2LW AUTO	7/8	1	1 + 3/16	1 + 5/16	228.6	279.4	300	320	4.9	6.0	9.6	11.0	60	75	100	178	190	35	45	1 + 1/16	1 + 1/8	1 + 1/4	DSPV	LSPV	EBXRHAAKUEST
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
48	NPR66LU -5HWYK	○	–		○	–	–				○			○	–		○	–		○		○		○	–	–	–	△
49	NPR66PU -5LWYK	○	–		–	○	–				○			–	○		–	○		○		○		–	○	–	–	△
50	NPS66LU -5JXYH	○	–		–	–	○				○			–	○		–	○		○		○		–	○	–	○	○
51	NPR58GL -5JXY	○	–		○		–				○			○	–		○	–		○		○		○	–	–	–	○
52	NPR58GL -5JXYS	○	–		○		–				○			○	–		○	–		○		○		○	–	–	–	○
53	NPR66GDL-5LX	○	–		–	○	–				○			–	○		–	○		○		○		–	○	–	–	○
54	NPR66GL -5LXY	○	–		–	○	–				○			–	○		–	○		○		○		–	○	–	–	○
55	NPR66GL -5LXYS	○	–		–	○	–				○			–	○		–	○		○		○		–	○	–	–	○
56	NPR66GL -5LXYR	○	–		–	○	–				○			–	○		–	○		○		○		–	○	–	–	○
57	NPR59GL -5LXYRJ	○	–		–	○	–				○			–	○		–	○		○		○		–	○	–	–	○
58	NPR58LL -5JXA	○	–		○		–				○			○	–		○	–		○		○		○	–	–	–	○
59	NPR58LL -5JXY	○	–		○		–				○			○	–		○	–		○		○		○	–	–	–	○
60	NPR58LL -5JXAC	○	–		○		–				○			○	–		○	–		○		○		○	–	–	–	○
61	NPR58LL -5JXYC	○	–		○		–				○			○	–		○	–		○		○		○	–	–	–	○
62	NPR58LL -5JXAS	○	–		○		–				○			○	–		○	–		○		○		○	–	–	–	○
63	NPR58LL -5JXYS	○	–		○		–				○			○	–		○	–		○		○		○	–	–	–	○
64	NPR66LL -5JXYR	○	–		○		–				○			○	–		○	–		○		○		○	–	–	–	○
65	NPR66LL -5LXA	○	–		–	○	–				○			–	○		–	○		○		○		–	○	–	–	○
66	NPR66LL -5LXY	○	–		–	○	–				○			–	○		–	○		○		○		–	○	–	–	○
67	NPR66LL -5LXAC	○	–		–	○	–				○			–	○		–	○		○		○		–	○	–	–	○
68	NPR66LL -5LXYC	○	–		–	○	–				○			–	○		–	○		○		○		–	○	–	–	○
69	NPR66LL -5LXAS	○	–		–	○	–				○			–	○		–	○		○		○		–	○	–	–	○
70	NPR66LL -5LXYS	○	–		–	○	–				○			–	○		–	○		○		○		–	○	–	–	○
71	NPR66LL -5LXYR	○	–		–	○	–				○			–	○		–	○		○		○		–	○	–	–	○
72	NPR66LL -5LXYCL	○	–		–	○	–				○			–	○		–	○		○		○		–	○	–	–	○

FRONT BRAKES (NPR 1994 – 1997)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	FRONT BRAKE																				
		DISC BRAKE								DRUM BRAKE												
		WHEEL CYL.		DISC				PAD		Type		WHEEL CYL.			DRUM			LINING				
		Inside dia. (in)		Thickness (mm)		Outside dia. (mm)		Thickness (mm)		2L	D2L	Inside dia. (in)			Inside dia. (mm)			Thickness (mm)			Width (mm)		
		2+1/8	2	30	35	265	282	12.0	14.0			1+1/8	1+1/16	1+3/16	279.4	300	320	6.0	9.6	11.0	60	75	100
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
73	NPR66LL -5LXYG	–			–		–		–	○		–		○			○		–	○		–	○
74	NPR69LL -5DXYE	○			○		○		○	–		–		–			–		–	–		–	–
75	NPR69LL -5HXYE	○			○		○		○	–		–		–			–		–	–		–	–
76	NPR59LL -5LXYCLJ	–			–		–		–	○		–		○			○		–	○		–	○
77	NPR59LL -5LXYRJ	–			–		–		–	○		–		○			○		–	○		–	○
78	NPR58PL -5JXA	–			–		–		–	○		○		–			○		○	–		○	–
79	NPR58PL -5JXY	–			–		–		–	○		○		–			○		○	–		○	–
80	NPR66PL -5LXA	–			–		–		–	○		–		○			○		–	○		–	○
81	NPR66PL -5LXY	–			–		–		–	○		–		○			○		–	○		–	○
82	NPR66PL -5LXAC	–			–		–		–	○		–		○			○		–	○		–	○
83	NPR66PL -5LXYC	–			–		–		–	○		–		○			○		–	○		–	○
84	NPR66PL -5LXAS	–			–		–		–	○		–		○			○		–	○		–	○
85	NPR66PL -5LXYS	–			–		–		–	○		–		○			○		–	○		–	○
86	NPR66PL -5LXYR	–			–		–		–	○		–		○			○		–	○		–	○
87	NPR65PL -5JXYEJ	○			○		○		○	–		–		–			–		–	–		–	–
88	NPR59PL -5LXYRJ	–			–		–		–	○		–		○			○		–	○		–	○
89	NPR58LL -5HWYC	–			–		–		–	○		○		–			○		○	–		○	–

REAR BRAKES (NPR 1994 – 1997)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	REAR BRAKE																	PARKING BRAKE				BRAKE CONTROL					
		DRUM BRAKE																										
		TYPE		WHEEL CYL.				DRUM				LINING							DRUM		LINING		MASTER CYL.					
				Inside dia. (in)				Inside dia. (mm)				Thickness (mm)				Width (mm)			Inside dia. (mm)		Width (mm)		Inside dia. (in)					
		D2LL (W/O AUTO)	D2LL (W AUTO)	7/8	1	1 + 3/16	1 + 5/16	228.6	279.4	300	320	4.9	6.0	9.6	11.0	60	75	100	178	190	35	45	1 + 1/16	1 + 1/8	1 + 1/4	DSPV	LSPV	EBXRHAAKUEST
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
73	NPR66LL -5LXYG	○	–		–	○	–				○			–	○		–	○		○		○		–	○	–	–	○
74	NPR69LL -5DXYE	–	○		○		–				○			○	–		○	–		○		○		○	–	–	○	○
75	NPR69LL -5HXYE	–	○		○		–				○			○	–		○	–		○		○		○	–	–	○	○
76	NPR59LL -5LXYCLJ	○	–		–		○				○			–	○		–	○		○		○		–	○	–	–	○
77	NPR59LL -5LXYRJ	○	–		–		○				○			–	○		–	○		○		○		–	○	–	–	○
78	NPR58PL -5JXA	○	–		○		–				○			○	–		○	–		○		○		○	–	–	–	○
79	NPR58PL -5JXY	○	–		○		–				○			○	–		○	–		○		○		○	–	–	–	○
80	NPR66PL -5LXA	○	–		–	○	–				○			–	○		–	○		○		○		–	○	–	–	○
81	NPR66PL -5LXY	○	–		–	○	–				○			–	○		–	○		○		○		–	○	–	–	○
82	NPR66PL -5LXAC	○	–		–	○	–				○			–	○		–	○		○		○		–	○	–	–	○
83	NPR66PL -5LXYC	○	–		–	○	–				○			–	○		–	○		○		○		–	○	–	–	○
84	NPR66PL -5LXAS	○	–		–	○	–				○			–	○		–	○		○		○		–	○	–	–	○
85	NPR66PL -5LXYS	○	–		–	○	–				○			–	○		–	○		○		○		–	○	–	–	○
86	NPR66PL -5LXYR	○	–		–	○	–				○			–	○		–	○		○		○		–	○	–	–	○
87	NPR65PL -5JXYEJ	–	○		–	○	–				○			–	○		–	○		○		○		–	○	–	○	○
88	NPR59PL -5LXYRJ	○	–		–	○	–				○			–	○		–	○		○		○		–	○	–	–	○
89	NPR58LL -5HWYC	○	–		○		–				○			○	–		○	–		○		○		○	–	–	–	○

FRONT BRAKES (NQR 1994 – 1997)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	FRONT BRAKE																					
		DISC BRAKE								DRUM BRAKE													
		WHEEL CYL.		DISC				PAD		Type		WHEEL CYL.				DRUM			LINING				
		Inside dia. (in)		Thickness (mm)		Outside dia. (mm)		Thickness (mm)		2 L	D 2 L	Inside dia. (in)				Inside dia. (mm)			Thickness (mm)			Width (mm)		
		2 + 1 / 8	2	30	35	265	282	12.0	14.0			1 + 1 / 8	1 + 1 / 16	1 + 3 / 16	1 + 3 / 8	279.4	300	320	6.0	9.6	11.0	75	100	120
1	NQR66LU -5NVXY	–			–		–		–	○				○	△			○			○		–	○
2	NQR66PU -5NVXY	–			–		–		–	○		–	–	○	△			○			○	–	–	○
3	NQR66LL -5NVXY	–			–		–		–	○				○	△			○			○	–	–	○
4	NQR66PL -5NVXY	–			–		–		–	○				○	△			○		–	○	–	–	○
5	NQR66RU -5NVXY	–			–		–		–	○				○	△			○			○			○
6	NQR66RL -5NVXY	–			–		–		–	○				○	△			○			○			○
7	NQR66LU -5NVXYP	–			–		–		–	○				–	○			○			○			○
8	NQR66RU -5NVXYP	–			–		–		–	○				–	○			○			○			○

REAR BRAKES (NQR 1994 – 1997)

—	Not available
○	Standard
△	Factory option
	Non

		REAR BRAKE																	PARKING BRAKE				BRAKE CONTROL							
		DRUM BRAKE																												
		TYPE		WHEEL CYL.					DRUM				LINING						DRUM		LINING		MASTER CYL.							
		D 2 L (W/O AUTO)	D 2 L (W AUTO)	Inside dia. (in)					Inside dia. (mm)				Thickness (mm)				Width (mm)			Inside dia. (mm)		Width (mm)		Inside dia. (in)				DSPV	LSPV	EBXRHAAKUEST	HYDROMASTER
				7/8	1	1 + 3/16	1 + 5/16	1 + 3/8	228.6	279.4	300	320	4.9	6.0	9.6	11.0	75	100	120	178	190	35	45	1 + 1/16	1 + 1/8	1 + 1/4	1S + I3N/G8LE				
No.	Models	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	NQR66LU-5NVXY	○	–		–	–	○	△				○			–	○	–	–	○	–	○	–	○		–	○	△	–	–	○	△
2	NQR66PU-5NVXY	○	–		–	–	○	△				○			–	○	–	–	○	–	○		○			○	△	–	–	○	△
3	NQR66LL-5NVXY	○	–		–	–	○	△				○				○		–	○		○		○			○	△	–	–	○	△
4	NQR66PL-5NVXY	○	–		–	–	○	△				○			–	○	–	–	○		○		○		–	○	△	–	–	○	△
5	NQR66RU-5NVXY	○	–		–	–	○	△				○				○			○		○		○			○	△	–	–	○	△
6	NQR66RL-5NVXY	○	–		–	–	○	△				○				○			○		○		○			○	△	–	–	○	△
7	NQR66LU-5NVXYP	○	–		–	–	–	○				○				○			○		○		○			–	○	–	–	○	○
8	NQR66RU-5NVXYP	○	–		–	–	–	○				○				○			○		○		○			–	○	–	–	○	○

FRONT BRAKES (NPR-NQR 1998)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	FRONT BRAKE																									
		DISC BRAKE										DRUM BRAKE															
		WHEEL CYL.			DISC				PAD		Type		WHEEL CYL.				DRUM			LINING						
		Inside dia. (in)			Thickness (mm)		Outside dia. (mm)		Thickness (mm)		2L	D2L	Inside dia. (in)				Inside dia. (mm)			Thickness (mm)			Width (mm)			
		2+1/8	2+2	2+1/4	35	42	265	282	310	14.0	13.0			1+1/8	1+3/16	1+5/16	1+3/8	279.4	300	320	6.9	9.6	11.0	60	75	100	120
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	NPR58GU -5JXY											○	—	○	—		—			○		○	—		○	—	—
2	NPR66GU -5EXYH											○	—	○	—		—			○		○	—		○	—	—
3	NPR66GU -5JXYSN											○	—	○	—		—			○		○	—		○	—	—
4	NPR66GDU-5LX											—	○	—	○		—			○		—	○		—	○	—
5	NPR66GU -5LXY											○	—	—	○		—			○		—	○		—	○	—
6	NPR65GU -5JXYKJ											○	—	○	—		—			○		○	—		○	—	—
7	NPR65GU -5LXYKJ											○	—	—	○		—			○		—	○		—	○	—
8	NPR58LU -5JXA											○		○	—		—			○		○	—		○	—	—
9	NPR58LU -5JXY											○		○	—		—			○		○	—		○	—	—
12	NPR66LBU-5JVXY											○		○	—		—			○		○	—		○	—	—
13	NPR66LU -5LXA											○		—	○		—			○		—	○		—	○	—
14	NPR66LU -5LXY											○		—	○		—			○		—	○		—	○	—
15	NPR66LU -5LXYP											○		—	○		—			○		—	○		—	○	—
16	NPR66LU -5JVXYZ											○		○	—		—			○		○	—		○	—	—
17	NPR66LU -5EVXYH											○		○	—		—			○		○	—		○	—	—
18	NPR71LU -5JVXYH											○		○	—		—			○		○	—		○	—	—
19	NPR71LU -5JVXYHT	○			○			○		○																	
20	NPR71LU -5LVXYH											○		—	○		—			○		—	○		—	○	—
21	NQR71LU -5NVXY											○		—	—	○	△			○		—	○		—	—	○
22	NQR66LU -5NVXYP											○		—	—		○			○		—	○		—	—	○
23	NPR69LU -5DXYIR	○			○			○		○																	
24	NPR69LU -5HXYIR	○			○			○		○																	
25	NPR65LU -5JXYIRJ	○			○			○		○																	
26	NPR65LU -5JXYUKJ	○			○			○		○																	

REAR BRAKES (NPR-NQR 1998)

—	Not available
○	Standard
△	Factory option
	Non

		REAR BRAKE																							PARKING BRAKE				BRAKE CONTROL					
		DRUM BRAKE																																
		TYPE		WHEEL CYL.					DRUM				LINING								DRUM				LINING				MASTER CYL.						
				Inside dia. (in)					Inside dia. (mm)				Thickness (mm)				Width (mm)				Inside dia. (mm)				Width (mm)				Inside dia. (in)						
		D2L (W/O AUTO)	D2L (W AUTO)	7/8	1	1+3/16	1+5/16	1+3/8	228.6	279.4	300	320	4.9	6.0	9.6	11.0	60	75	100	120	178	190	203	254	35	45	50	60	1+1/16	1+1/8	1+1/4	1+3/8	DSPV	LSPV	EXHAUST BRAKE	HYDROMASTER	HBB
No.	Models	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
1	NPR58GU -5JXY	○	—		○	—	—	—				○			○	—		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
2	NPR66GU -5EXYH	○	—		○	—	—	—				○			○	—		○	—	—	—	○	—	—	—	○	—	—		○	—	—		○	○	—	—
3	NPR66GU -5JXYSN	○	—		○	—	—	—				○			○	—		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
4	NPR66GDU-5LX	○	—		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
5	NPR66GU -5LXY	○	—		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
6	NPR65GU -5JXYKJ	○	—		○	—	—	—				○			○	—		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	△	—	—
7	NPR65GU -5LXYKJ	○	—		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	△	—	—
8	NPR58LU -5JXA	○	—		○	—	—	—				○			○	—		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
9	NPR58LU -5JXY	○	—		○	—	—	—				○			○	—		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
12	NPR66LBU-5JVXY	○	—		○	—	—	—				○			○	—		○	—	—	—	○	—	—	—	○	—	—		○	—	—		○	○	—	—
13	NPR66LU -5LXA	○	—		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
14	NPR66LU -5LXY	○	—		—	○	—	—				○			○	—		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
15	NPR66LU -5LXYP	○	—		—	○	—	—				○			○	—		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
16	NPR66LU -5JVXYZ	○	—		○	—	—	—				○			○	—		○	—	—	—	○	—	—	—	○	—	—		○	—	—		○	○	—	—
17	NPR66LU -5EVXYH	○	—		○	—	—	—				○			○	—		○	—	—	—	○	—	—	—	○	—	—		○	—	—		○	○	—	—
18	NPR71LU -5JVXYH	○	—		○	—	—	—				○			○	—		○	—	—	—	○	—	—	—	○	—	—		○	—	—		○	○	—	—
19	NPR71LU -5JVXYHT	○	○		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		○	—	—		○	○	—	—
20	NPR71LU -5LVXYH	○	—		—	—	○	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		○	○	—	—
21	NQR71LU -5NVXY	○	—		—	—	○	△				○			—	○		—	—	○	—	○	—	—	—	○	—	—		—	○	△		—	○	△	—
22	NQR66LU -5NVXYP	○	—		—	—	△	○				○			—	○		—	—	○	—	○	—	—	—	○	—	—		—	—	○		—	○	○	—
23	NPR69LU -5DXYIR	○	○		○	—	—	—				○			○	—		○	—	—	○	—	—	—	○	—	—	—		○	—	—		○	○	—	—
24	NPR69LU -5HXYIR	○	○		○	—	—	—				○			○	—		○	—	—	○	—	—	—	○	—	—	—		○	—	—		○	○	—	—
25	NPR65LU -5JXYIRJ	○	○		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		○	○	—	—
26	NPR65LU -5JXYUKJ	○	○		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		○	○	—	—

FRONT BRAKES (NPR·NQR 1998)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	FRONT BRAKE																									
		DISC BRAKE										DRUM BRAKE															
		WHEEL CYL.			DISC				PAD		Type		WHEEL CYL.				DRUM			LINING						
		Inside dia. (in)			Thickness (mm)		Outside dia. (mm)			Thickness (mm)			Inside dia. (in)				Inside dia. (mm)			Thickness (mm)			Width (mm)			
		2 + 1/8	2 + 2	2 + 1/4	35	42	265	282	310	14.0	13.0	2L	D2L	1 + 1/8	1 + 3/16	1 + 5/16	1 + 3/8	279.4	300	320	6.9	9.6	11.0	60	75	100	120
No.	Models	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
27	NPR65LU -5JXYKJ											○		○	—		—			○		○	—		○	—	—
28	NPR65LU -5LXYKJ											○		—	○		—					—	○		—	○	—
29	NQR70LU -5LVXYIRJ			○		○			○		○																
30	NQR70LU-5LVXYUKJ			○		○			○		○																
31	NPR58PU -5JXA											○		○			—			○		○	—		○	—	—
32	NPR58PU -5JXY											○		○	—		—			○		○	—		○	—	—
33	NPR66PU -5JXYSN											○		○	—		—			○		○	—		○	—	—
34	NPR66PBU-5JVXY											○		○	—		—			○		○	—		○	—	—
35	NPR66PU -5LXA											○		—	○		—			○		—	○		—	○	—
36	NPR66PU -5LXY											○		—	○		—			○		—	○		—	○	—
37	NPR71PU -5LVXYH											○	—	—	○		—			○		—	○		—	○	—
38	NPR66PU -5LXYP											○		—	—		—			○		—	○		—	○	—
39	NQR71PU -5NVXY											○	—	—	—	○	△			○		—	○		—	—	○
41	NPR66PU -5LVXYZ											○		—	○		—			○		—	○		—	○	—
44	NPR65PU -5LXYVJ											○	—	—	○		—			○		—	○		—	○	—
45	NPR65PU -5JXYUKJ	○			○			○		○		○		○	—		—			○		○	—		○	—	—
46	NPR65PU -5JXYKJ											○	—	○	—		—			○		○	—		○	—	—
47	NPR65PU -5LXYKJ											○	—	—	○		—			○		—	○		—	○	—
48	NQR70PU-5LVXYUKJ			○		○					○																
49	NQR70PU -5NVXYHJ											○	—	—	—	○	—			○		—	○				○
50	NQR70PU -5NVXYKJ											○	—	—	—	○	—			○		—	○		—	—	○
51	NQR70PU -5NVXYVJ											○	—	—	—	○	—			○		—	○				○
52	NPR71LU -5HWYH											○	—	○	—		—			○		○	—		○	—	—
53	NPR66LU -5HWYSN											○	—	○	—		—			○		○	—		○	—	—

REAR BRAKES (NPR·NQR 1998)

—	Not available
○	Standard
△	Factory option
	Non

		REAR BRAKE																				PARKING BRAKE				BRAKE CONTROL								
		DRUM BRAKE																																
		TYPE		WHEEL CYL.					DRUM				LINING									DRUM				LINING				MASTER CYL.								
				Inside dia. (in)					Inside dia. (mm)				Thickness (mm)				Width (mm)					Inside dia. (mm)				Width (mm)				Inside dia. (in)								
No.	Models	D2L (W/O AUTO)	D2L (W AUTO)	7/8	1	1+3/16	1+5/16	1+3/8	228.6	279.4	300	320	4.9	6.0	9.6	11.0	60	75	100	120	178	190	203	254	35	45	50	60	1+1/16	1+1/8	1+1/4	1+3/8	DSPV	LSPV	EXHAUST BRAKE	HYDROMASTER	HBB
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
27	NPR65LU -5JXYKJ	○	—		○	—	—	—				○			—	○		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	△	—	—
28	NPR65LU -5LXYKJ	○	—		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	△	—	—
29	NQR70LU -5LVXYIRJ	○	○		—	—	○	—				○			—	○		—	—	○	—	—	—	○	—	—	—	○		—	—	○		○	○	—	○
30	NQR70LU-5LVXYUKJ	○	○		—	—	○	—				○			—	○		—	—	○	—	—	—	○	—	—	—	○		—	—	○		○	○	—	○
31	NPR58PU -5JXA	○	—		○	—	—	—				○			○	—		○	—	—	—	○	—	—	—	○	—	—	—	○	—	—		—	○	—	—
32	NPR58PU -5JXY	○	—		○	—	—	—				○			○	—		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
33	NPR66PU -5JXYSN	○	—		○	—	—	—				○			○	—		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
34	NPR66PBU-5JVXY	○	—		○	—	—	—				○			○	—		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
35	NPR66PU -5LXA	○	—		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
36	NPR66PU -5LXY	○	—		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
37	NPR71PU -5LVXYH	○	—		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		○	○	—	—
38	NPR66PU -5LXYP	○	—		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
39	NQR71PU -5NVXY	○	—		—	—	○	△				○			—	○		—	—	○	—	○	—	—	—	○	—	—		—	○	△		—	○	△	—
41	NPR66PU -5LVXYZ	○	—		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		○	○	—	—
44	NPR65PU -5LXYVJ	○	—		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
45	NPR65PU -5JXYUKJ	○	○		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		○	○	—	—
46	NPR65PU -5JXYKJ	○	—		○	—	—	—				○			○	—		○	—	—	—	○	—	—	—	○	—	—		○	—	—				—	—
47	NPR65PU -5LXYKJ	○	—		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
48	NQR70PU-5LVXYUKJ	○	○		—	—	○	—				○			—	○		—	—	○	—	—	—	○	—	—	—	○		—	—	○		○	○	—	○
49	NQR70PU -5NVXYHJ	○	—		—	—	○	—				○			—	○		—	—	○	—	—	—	○	—	—	—	○		—	—	○		○	○	—	○
50	NQR70PU -5NVXYKJ	○	—		—	—	○	—				○			—	○		—	—	○	—	—	—	○	—	—	—	○		—	—	○		—	○	—	○
51	NQR70PU -5NVXYVJ	○	—		—	—	○	—				○			—	○		—	—	○	—	—	—	○	—	—	—	○		—	—	○		—	○	—	○
52	NPR71LU -5HWYH	○	—		○	—	○	—				○			○	—		○	—	—	—	○	—	—	—	○	—	—		○	—	—		○	○	—	—
53	NPR66LU -5HWYSN	○	—		○	—	○	—				○			○	—		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—

FRONT BRAKES (NPR-NQR 1998)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	FRONT BRAKE																									
		DISC BRAKE										DRUM BRAKE															
		WHEEL CYL.			DISC					PAD		Type		WHEEL CYL.				DRUM			LINING						
		Inside dia. (in)			Thickness (mm)		Outside dia. (mm)			Thickness (mm)		2L	D2L	Inside dia. (in)				Inside dia. (mm)			Thickness (mm)			Width (mm)			
		2+1/8	2+2	2+1/4	35	42	265	282	310	14.0	13.0			1+1/8	1+3/16	1+5/16	1+3/8	279.4	300	320	6.9	9.6	11.0	60	75	100	120
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
54	NQR71RU -5NVXY											○	—	—	—	○	△			○		—	○		—	—	○
55	NQR66RU -5NVXYP											○	—	—	—		○			○		—	○		—	—	○
56	NQR70RU-5NVXYHJ											○	—	—	—	○	—			○		—	○		—	—	○
57	NQR70RU-5NVXYZJ											○	—	—	—	○	—			○		—	○		—	—	○
58	NQR70TU-5LVXYUKJ			○		○					○		—		—		—										
59	NQR70TU -5NVXYHJ											○	—	—	—	○	—			○		—	○		—	—	○
60	NQR70TU -5NVXYKJ											○	—	—	—	○	—			○		—	○		—	—	○
61	NQR70TU -5NVXYVJ											○	—	—	—	○	—			○		—	○		—	—	○
62	NPS71LU -5NVXYVJ											—	○	—	○	—	—			○		○	—		○	—	—
63	NPR58GL -5JXY											○	—	○	—	—	—			○		○	—		○	—	—
64	NPR66GDL-5LX											—	○	—	○	—	—			○		—	○		—	○	—
65	NPR66GL -5LXY											○	—	—	○	—	—			○		—	○		—	○	—
66	NPR66GL -5LXYR											○	—	—	○	—	—			○		—	○		—	○	—
67	NPR60GL -5DXYE	○			○			○		○																	
68	NPR58LL -5JXA											○	—	○	—	—	—			○		○	—		○	—	—
69	NPR58LL -5JXY											○	—	○	—	—	—			○		○	—		○	—	—
70	NPR58LL -5JXAC											○	—	○	—	—	—			○		○	—		○	—	—
71	NPR58LL -5JXYC											○		○	—	—	—			○		○	—		○	—	—
72	NPR58LL -5JXAS											○		○	—	—	—			○		○	—		○	—	—
73	NPR58LL -5JXYS											○		○	—	—	—			○		○	—		○	—	—
74	NPR66LL -5JXYR											○		○	—	—	—			○		○	—		○	—	—
75	NPR66LBL-5JVXY											○		○	—	—	—			○		○	—		○	—	—
76	NPR66LL -5LXA											○		—	○	—	—			○		—	○		—	○	—
77	NPR66LL -5LXY											○		—	○	—	—			○		—	○		—	○	—

REAR BRAKES (NPR-NQR 1998)

—	Not available
○	Standard
△	Factory option
	Non

		REAR BRAKE																							PARKING BRAKE				BRAKE CONTROL					
		DRUM BRAKE																																
		TYPE		WHEEL CYL.					DRUM				LINING								DRUM				LINING				MASTER CYL.						
				Inside dia. (in)					Inside dia. (mm)				Thickness (mm)				Width (mm)				Inside dia. (mm)				Width (mm)				Inside dia. (in)						
		D2L (W/O AUTO)	D2L (W AUTO)	7/8	1	1+3/16	1+5/16	1+3/8	228.6	279.4	300	320	4.9	6.0	9.6	11.0	60	75	100	120	178	190	203	254	35	45	50	60	1+1/16	1+1/8	1+1/4	1+3/8	DSPV	LSPV	EXHAUST BRAKE	HYDROMASTER	HBB
No.	Models	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
54	NQR71RU -5NVXY	○	—		—	—	○	△				○			—	○		—	—	○	—	○	—	—	—	○	—	—		—	—	○		—	○	○	—
55	NQR66RU -5NVXYP	○	—		—	—	△	○				○			—	○		—	—	○	—	○	—	—	—	○	—	—		—	○	△		—	○	△	—
56	NQR70RU-5NVXYHJ	○	—		—	—	○	—				○			—	○		—	—	○	—	—	○	—	—	—	○	—		—	—	○		○	○	—	○
57	NQR70RU-5NVXYZJ	○	—		—	—	○	—				○			—	○		—	—	○	—	—	—	○	—	—	—	○		—	—	○		○	○	—	○
58	NQR70TU-5LVXYUKJ	○	○		—	—	○	—				○			—	○		—	—	○	—	—	—	○	—	—	—	○		—	—	○		○	○	—	○
59	NQR70TU -5NVXYHJ	○	—		—	—	○	—				○			—	○		—	—	○	—	—	○	—	—	—	○	—		—	—	○		○	○	—	○
60	NQR70TU -5NVXYKJ	○	—		—	—	○	—				○			—	○		—	—	○	—	—	○	—	—	—	○	—		—	—	○		—	△	—	○
61	NQR70TU -5NVXYVJ	○	—		—	—	○	—				○			—	○		—	—	○	—	—	○	—	—	—	○	—		—	—	○		—	○	—	○
62	NPS71LU -5NVXYVJ	○	—		—	—	○	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		○	○	—	—
63	NPR58GL -5JXY	○	—		○	—	—	—				○			○	—		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
64	NPR66GDL-5LX	○	—		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
65	NPR66GL -5LXY	○	—		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
66	NPR66GL -5LXYR	○	—		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
67	NPR60GL -5DXYE	○	○		○	—	—	—				○			○	—		○	—	—	○	—	—	—	○	—	—	—		○	—	—		○	○	—	—
68	NPR58LL -5JXA	○	—		○	—	—	—				○			○	—		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
69	NPR58LL -5JXY	○	—		○	—	—	—				○			○	—		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
70	NPR58LL -5JXAC	○	—		○	—	—	—				○			○	—		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
71	NPR58LL -5JXYC	○	—		○	—	—	—				○			○	—		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
72	NPR58LL -5JXAS	○	—		○	—	—	—				○			○	—		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
73	NPR58LL -5JXYS	○	—		○	—	—	—				○			○	—		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
74	NPR66LL -5JXYR	○	—		○	—	—	—				○			○	—		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
75	NPR66LBL-5JVXY	○	—		○	—	—	—				○			○	—		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
76	NPR66LL -5LXA	○	—			○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
77	NPR66LL -5LXY	○	—			○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—

FRONT BRAKES (NPR-NQR 1998)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	FRONT BRAKE																								
		DISC BRAKE										DRUM BRAKE														
		WHEEL CYL.			DISC				PAD		Type		WHEEL CYL.				DRUM			LINING						
		Inside dia. (in)			Thickness (mm)		Outside dia. (mm)			Thickness (mm)			Inside dia. (in)				Inside dia. (mm)			Thickness (mm)			Width (mm)			
		2 + 1 / 8	2 + 2	2 + 1 / 4	35	42	265	282	310	14.0	13.0	2L	D2L	1 + 1 / 8	1 + 3 / 16	1 + 5 / 16	1 + 3 / 8	279.4	300	320	6.9	9.6	11.0	60	75	100	120
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
78	NPR66LL -5LY											○		—	○	—	—	—		○		—	○		—	○	—
79	NPR66LL -5LXAC											○		—	○	—	—	—		○		—	○		—	○	—
80	NPR66LL -5LXYC											○		—	○	—	—	—		○		—	○		—	○	—
81	NPR66LL -5LXAS											○		—	○	—	—	—		○		—	○		—	○	—
82	NPR66LL -5LXYA											○		—	○	—	—			○		—	○		—	○	—
83	NPR66LL -5LXYR											○		—	○	—	—			○		—	○		—	○	—
84	NPR66LL -5LXYG											○		—	○	—	—			○		—	○		—	○	—
85	NPR66LL -5LVXYBR											○		—	○	—	—			○		—	○		—	○	—
86	NQR71LL -5NVXY											○		—	○	○	△					—	○		—	—	○
87	NPR69LL -5DXYE	○			○			○		○																	
88	NPR69LL -5HXYE	○			○		○			○																	
89	NPR69LL -5HXYIS	○			○		○			○																	
91	NPR65LL -5JXYISJ	○			○		○			○																	
92	NPR65LL -5JXYISTJ	○			○		○			○																	
93	NPR65LL -5JXYEJ	○			○		○			○																	
94	NPR65LL -5LXYJ											○		—	○	—	—			○		—	○		—	○	—
95	NPR65LL -5LXYRJ											○		—	○	—	—			○		—	○		—	○	—
96	NPR65LL-5LVXYCLJ											○		—	○	—	—			○		—	○		—	○	—
97	NQR70LL -5LVXYEJ			○		○			○		○																
98	NQR70LL-5NVXYBRJ											○		—	—	○	—			○		—	—		—	—	○
99	NPR58PL -5JXA											○		○	—	—	—			○		○	—		○	—	—
100	NPR58PL -5JXY											○		○	—	—	—			○		○	—		○	—	—
101	NPR66PL -5JXYR											○		○	—	—	—			○		○	—		○	—	—
102	NPR66PL -5JVXY											○		○	—	—	—			○		○					

REAR BRAKES (NPR·NQR 1998)

—	Not available
○	Standard
△	Factory option
	Non

		REAR BRAKE																									PARKING BRAKE				BRAKE CONTROL					
		DRUM BRAKE																																		
		TYPE		WHEEL CYL.					DRUM				LINING								DRUM				LINING				MASTER CYL.								
				Inside dia. (in)					Inside dia. (mm)				Thickness (mm)				Width (mm)				Inside dia. (mm)				Width (mm)				Inside dia. (in)								
No.	Models	D2L (W/O AUTO)	D2L (W AUTO)	7/8	1	1+3/16	1+5/16	1+3/8	228.6	279.4	300	320	4.9	6.0	9.6	11.0	60	75	100	120	178	190	203	254	35	45	50	60	1+1/16	1+1/8	1+1/4	1+3/8	DSPV	LSPV	EXHAUST BRAKE	HYDROMASTER	HBB
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
78	NPR66LL -5LY	○	—		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
79	NPR66LL -5LXAC	○	—		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
80	NPR66LL -5LXYC	○	—		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
81	NPR66LL -5LXAS	○	—		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
82	NPR66LL -5LXYA	○	—		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
83	NPR66LL -5LXYR	○	—		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
84	NPR66LL -5LXYG	○	—		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
85	NPR66LL -5LVXYBR	○	—		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		○	○	—	—
86	NQR71LL -5NVXY	○	—		—	—	○	△				○			—	○		—	—	○	—	○	—	—	—	○	—	—		—	○	△		—	○	△	—
87	NPR69LL -5DXYE	○	○		○	—	—	—				○			○	—		○	—	—	○	—	—	—	○	—	—	—		○	—	—		○	○	—	—
88	NPR69LL -5HXYE	○	○		○	—	—	—				○			○	—		○	—	—	○	—	—	—	○	—	—	—		○	—	—		○	○	—	—
89	NPR69LL -5HXYIS	○	○		○	—	—	—				○			○	—		○	—	—	○	—	—	—	○	—	—	—		○	—	—		○	○	—	—
91	NPR65LL -5JXYISJ	○	○		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		○	○	—	—
92	NPR65LL -5JXYISTJ	○	○		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		○	○	—	—
93	NPR65LL -5JXYEJ	○	○		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		○	○	—	—
94	NPR65LL -5LXYJ	○	—		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
95	NPR65LL -5LXYRJ	○	—		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
96	NPR65LL-5LVXYCLJ	○	—		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
97	NQR70LL -5LVXYEJ	○	○		—	—	○	—				○			—	○		—	—	○	—	—	—	○	—	—	—	○		—	—	○		○	○	—	○
98	NQR70LL-5NVXYBRJ	○	—		—	—	○	—				○			—	○		—	—	○	—	—	—	○	—	—	—	○		—	—	○		○	○	—	○
99	NPR58PL -5JXA	○	—		○	—	—	—				○			○	—		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
100	NPR58PL -5JXY	○	—		○	—	—	—				○			○	—		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
101	NPR66PL -5JXYR	○	—		○	—	—	—				○			○	—		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
102	NPR66PL -5JVXY	○	—		○	—	—	—				○			○	—		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—

FRONT BRAKES (NPR-NQR 1998)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	FRONT BRAKE																									
		DISC BRAKE										DRUM BRAKE															
		WHEEL CYL.			DISC				PAD		Type		WHEEL CYL.				DRUM			LINING						
		Inside dia. (in)			Thickness (mm)		Outside dia. (mm)			Thickness (mm)			Inside dia. (in)				Inside dia. (mm)			Thickness (mm)			Width (mm)			
		2 + 1 / 8	2 + 2	2 + 1 / 4	35	42	265	282	310	14.0	13.0	2L	D2L	1 + 1 / 8	1 + 3 / 16	1 + 5 / 16	1 + 3 / 8	279.4	300	320	6.9	9.6	11.0	60	75	100	120
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
103	NPR66PL -5LXA											○		—	○	—	—			○		—	○		—	○	—
104	NPR66PL -5LXY											○		—	○	—	—			○		—	○		—	○	—
105	NPR66PL -5LXAC											○		—	○	—	—			○		—	○		—	○	—
106	NPR66PL -5LXYC											○		—	○	—	—			○		—	○		—	○	—
107	NPR66PL -5LXAS											○		—	○	—	—			○		—	○		—	○	—
108	NPR66PL -5LXYS											○		—	○	—	—			○		—	○		—	○	—
109	NPR66PL -5LXYR											○		—	○	—	—			○		—	○		—	○	—
110	NPR66PL -5LVXYBR											○		—	○	—	—			○		—	○		—	○	—
111	NQR66PL -5NVXA											○		—	—	○	△			○		—	○		—	—	○
112	NQR71PL -5NVXY											○		—	—	○	△			○		—	○		—	—	○
113	NPR65PL -5JXYEJ	○			○			○		○																	
114	NPR65PL -5JXYISJ	○			○			○		○																	
116	NPR65PL -5JXYISTJ	○			○			○		○																	
117	NPR65PL -5JXYJ											○		—	○	—	—						○		—	○	—
118	NPR65PL -5LXYRJ											○		—	○	—	—			○			○		—	○	—
119	NPR65PL-5LVXYCLJ											○		—	○	—	—			○			○		—	○	—
120	NQR70PL -5LVXYEJ			○		○					○																
121	NQR70PL-5NVXYBRJ											○		—	—	○	—			○			○		—	—	○
122	NQR70PL-5NVXYCLJ											○		—	—	○	—			○			○		—	—	○
123	NQR70PL -5NVXYRJ											○		—	—	○	—			○			○		—	—	○
124	NPR58LL -5HWYC																										
125	NQR71RL -5NVXY											○			—	○	△			○			○		—	—	○
126	NQR70TL -5LVXYEJ			○		○					○																
127	NQR70TL-5NVXYISJ			○		○					○																

REAR BRAKES (NPR-NQR 1998)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	REAR BRAKE																																
		DRUM BRAKE																																
		TYPE			WHEEL CYL.					DRUM				LINING								PARKING BRAKE								BRAKE CONTROL				
		D2L (W/O AUTO)	D2L (W AUTO)		Inside dia. (in)					Inside dia. (mm)				Thickness (mm)				Width (mm)				Inside dia. (mm)				Width (mm)				Inside dia. (in)				DSPV	LSPV	EXHAUST BRAKE	HYDROMASTER	HBB
					7/8	1	1+3/16	1+5/16	1+3/8	228.6	279.4	300	320	4.9	6.0	9.6	11.0	60	75	100	120	178	190	203	254	35	45	50	60	1+1/16	1+1/8	1+1/4	1+3/8					
No.	Models	1	2		4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
103	NPR66PL -5LXA	○	—		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
104	NPR66PL -5LXY	○	—		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
105	NPR66PL -5LXAC	○	—		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
106	NPR66PL -5LXYC	○	—		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
107	NPR66PL -5LXAS	○	—		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
108	NPR66PL -5LXYS	○	—		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
109	NPR66PL -5LXYR	○	—		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
110	NPR66PL -5LVXYBR	○	—		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		○	○	—	—
111	NQR66PL -5NVXA	○	—		—	—	○	—				○			—	○		—	—	○	—	○	—	—	—	○	—	—		—	○	△		—	○	△	—
112	NQR71PL -5NVXY	○	—		—	—	○	△				○			—	○		—	—	○	—	○	—	—	—	○	—	—		—	○	△		—	○	△	—
113	NPR65PL -5JXYEJ	○	○		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		○	○	—	—
114	NPR65PL -5JXYISJ	○	○		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		○	○	—	—
116	NPR65PL -5JXYISTJ	○	○		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		○	○	—	—
117	NPR65PL -5JXYJ	○	—		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
118	NPR65PL -5LXYRJ	○	—		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
119	NPR65PL-5LVXYCLJ	○	—		—	○	—	—				○			—	○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
120	NQR70PL -5LVXYEJ	○	—		—	—	○	—				○			—	○		—	—	○	—	—	—	○	—	—	—	○		—	—	○		○	○	—	○
121	NQR70PL-5NVXYBRJ	○	—		—	—	○	—				○			—	○		—	—	○	—	○	—	○	—	○	—	○		—	—	○		○	○	—	○
122	NQR70PL-5NVXYCLJ	○	—		—	—	○	—				○			—	○		—	—	○	—	—	○	—	—	—	○	—		—	—	○		—	○	—	○
123	NQR70PL -5NVXYRJ	○	—		—	—	○	—				○			—	○		—	—	○	—	—	○	—	—	—	○	—		—	—	○		—	○	—	○
124	NPR58LL -5HWYC																			—	—	○	—	—	—	○	—	—	—	○	—	—		—	○	—	—
125	NQR71RL -5NVXY	○	—		—	—	○	△				○			—	○		—	—	○	—	○	—	—	—	○	—	—	—	—	○	△		—	○	△	—
126	NQR70TL -5LVXYEJ	○	○		—	—	○	—				○			—	○		—	—	○	—	—	—	○	—	—	—	○		—	—	○		○	○	—	○
127	NQR70TL-5NVXYISJ	○	○		—	—	○	—				○			—	○		—	—	○	—	—	○	—	—	—	○	—		—	—	○		○	○	—	○

FRONT BRAKES (NPR·NQR 1998)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	FRONT BRAKE																								
		DISC BRAKE										DRUM BRAKE														
		WHEEL CYL.			DISC				PAD		Type		WHEEL CYL.				DRUM			LINING					
		Inside dia. (in)			Thickness (mm)		Outside dia. (mm)			Thickness (mm)			Inside dia. (in)				Inside dia. (mm)			Thickness (mm)			Width (mm)			
		2+1/8	2+2	2+1/4	35	42	265	282	310	14.0	13.0	2L	D2L	1+1/8	1+3/16	1+5/16	1+3/8	279.4	300	320	6.9	9.6	11.0	60	75	100	120
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
128	NQR70TL-5NVXYBRJ											○				○				○			○				○
129	NQR70TL-5NVXYCLJ											○				○				○			○				○
130	NQR70TL-5NVXYRJ											○				○				○			○				○
	NPR70GU -5JVXYKJ											○	—	○	—		—			○		○	—		○	—	—
	NPR70GU -5LVXYKJ											○	—	—	○		—			○		—	○		—	○	—
	NPR66LU -5JXY											○		○	—		—			○		○	—		○	—	—
	NPR70PU -5JVXYKJ											○	—	○	—		—			○		○	—		○	—	—
	NPR70PU -5LVXYKJ											○	—	—	○		—			○		—	○		—	○	—
	NPR65LU -5HWYK											○	—	○	—		—			○		○	—		○	—	—
	NQR70RU -5NVXYVJ											○	—	—	—	○	—			○		—	○		—	—	○
	NQR70RU -5NVXYKJ											○	—	—	—	○	—			○		—	○		—	—	○
	NPR65LL -5DXYEJ	○			○		○			○																	
	NQR70PL-5NVXYGJ													—	—	○	—			○					—	—	○
	NPR65LL -5HWYISJ	○			○			○		○																	

REAR BRAKES (NPR·NQR 1998)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	REAR BRAKE																			PARKING BRAKE				BRAKE CONTROL								
		DRUM BRAKE																																
		TYPE		WHEEL CYL.					DRUM				LINING								DRUM				LINING				MASTER CYL.								
				Inside dia. (in)					Inside dia. (mm)				Thickness (mm)				Width (mm)				Inside dia. (mm)				Width (mm)				Inside dia. (in)								
		D2L (W/O AUTO)	D2L (W AUTO)	7/8	1	1+3/16	1+5/16	1+3/8	228.6	279.4	300	320	4.9	6.0	9.6	11.0	60	75	100	120	178	190	203	254	35	45	50	60	1+1/16	1+1/8	1+1/4	1+3/8	DSPV	LSPV	EXHAUST BRAKE	HYDROMASTER	HBB
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
127	NQR70TL-5NVXYBRJ	○	—		—		○	—				○			—	○		—	—	○	—	—	—	○	—	—	—	○		—	—	○		○	○	—	○
128	NQR70TL-5NVXYCLJ	○	—		—	—	○	—				○			—	○		—	—	○	—	—	○	—	—	—	○	—		—	—	○		—	○	—	○
129	NQR70TL-5NVXYRJ	○	—		—	—	○	—				○			—	○		—	—	○	—	—	○	—	—	—	○	—		—	—	○		—	○	—	○
130	NPR70GU -5JVXYKJ	○	—		○	—	—	—				○			○	—		○	—	—	—	—	○	—	—	—	○	—		○	—	—		—		—	—
	NPR70GU -5LVXYKJ	○	—		—	○	—	—				○			—	○		—	○	—	—	—	○	—	—	—	○	—		—	○	—		—		—	—
	NPR66LU -5JXY	○	—		○	○	—	—				○			○	—		○	—	—			—	—	—	○	—	—		○	—	—		—	○	—	—
	NPR70PU -5JVXYKJ	○	—		○	—	—	—				○			○	—		○	—	—	—	—	○	—	—	—	○	—		○	—	—		—		—	—
	NPR70PU -5LVXYKJ	○	—		—	—	—	—				○			—	○		—	○	—	—	—	○	—	—	—	○	—		—	○	—		—		—	—
	NPR65LU -5HWYK	○	—		○	○	—	—				○			○	—		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—		—	—
	NQR70RU -5NVXYVJ	○	—		—	—	○	—				○			—	○		—	—	○	—	—	○	—	—	—	○	—		—	—	○		—	○	—	○
	NQR70RU -5NVXYKJ	○	—		—	—	○	—				○			—	○		—	—	○	—	—	○	—	—	—	○	—		—	—	○		—		—	○
	NPR65LL -5DXYEJ	○	○		○	—	—	—				○			○	—		○	—	—	—	○	—	—	—	○	—	—		○	—	—		○	○	—	—
	NQR70PL -5NVXYGJ	○	—		—	—	○	—				○			—	○		—	—	—	—	—	○	—	—	—	○	—		—	—	○		—	○	—	—
	NPR65LL -5HWYISJ	○	○		—	○	—	—				○			—	○		—	○	○	—	○	—	—	—	○	—	—		—	○	—		○	○	—	—

FRONT BRAKES (NHR 1999)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	FRONT BRAKE																								
		DISC BRAKE											DRUM BRAKE													
		WHEEL CYL.			DISC						PAD		Type		WHEEL CYL.			DRUM.			LINING					
		Inside dia. (in)			Thickness (mm)			Outside dia. (mm)			Thickness (mm)				Inside dia. (in)			Inside dia. (mm)			Thickness (mm)			Width (mm)			
		2 + 1 / 8	2 + 2	2 + 1 / 4	35	40	42	265	293	310	14.0	13.0	2L	D2L	1 + 1 / 8	1 + 3 / 16	1 + 3 / 8	279.4	300	320	6.0	9.6	11.0	60	75	100	120
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	NHR55EU-1CB												○		○			○			○			○			
2	NHR55EU-1CY												○		○			○			○			○			
3	NHR55EU-1CYIN												○		○			○			○			○			
4	NHR69EU-1CBK												○		○			○			○			○			
5	NHR69EU-1CYK												○		○			○			○			○			
6	NHR55EU-1BWS												○		○			○			○			○			
7	NHR69EU-1BWSSN												○		○			○			○			○			
8	NHR69EU-1BWSK												○		○			○			○			○			
9	NHR55EU-3CB												○		○			○			○			○			
10	NHR69EU-3CBSN												○		○			○			○			○			
11	NHR69EU-3CBK												○		○			○			○			○			
12	NHR55EL-1CBS												○		○			○			○			○			
13	NHR55EL-1CY												○		○			○			○			○			
14	NHR55EL-1BWS												○		○			○			○			○			
15	NHR55EL-3CBS												○		○			○			○			○			
16	NHR55EL-3CYS												○		○			○			○			○			
17	NHR55EL-3CB												○		○			○			○			○			
18	NHR55EL-1CYS												○		○			○			○			○			
19	NHR55EL-1CYCL												○		○			○			○			○			

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	REAR BRAKE																		PARKING BRAKE				BRAKE CONTROL								
		DRUM BRAKE																														
		TYPE		WHEEL CYL.					DRUM				LINING								DRUM				LINING				MASTER CYL.						
				Inside dia. (in)					Inside dia. (mm)				Thickness (mm)				Width (mm)				Inside dia. (mm)				Width (mm)				Inside dia. (in)						
		D2L (W/O AUTO)	D2L (W AUTO)	7/8	1	1+3/16	1+5/16	1+3/8	228.6	279.4	300	320	4.9	6.0	9.6	11.0	60	75	100	120	178	190	203	254	35	45	50	60	1+1/16	1+1/8	1+1/4	1+3/8	DSPV	LSPV	EXHAUST BRAKE	HYDROMASTER	HBB
No.	Models	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
1	NHR55EU-1CB	○		○					—	○				○			○	—			○				○				○				△		△		
2	NHR55EU-1CY	○		○					—	○				○			○	—			○				○				○				—		△		
3	NHR55EU-1CYIN	○		○					—	○				○			○	—			○				○				○				—		△		
4	NHR69EU-1CBK	○		○					—	○				○			○	—			○				○				○				△		△		
5	NHR69EU-1CYK	○		○					—	○				○			○	—			○				○				○				—		△		
6	NHR55EU-1BWS	○		○					—	○				○			○	—			○				○				○				△		△		
7	NHR69EU-1BWSSN	○		○					—	○				○			○	—			○				○				○				△		△		
8	NHR69EU-1BWSK	○		○					—	○				○			○	—			○				○				○				△		△		
9	NHR55EU-3CB	○		○					○	—			○				—	○			○				○				○				△		△		
10	NHR69EU-3CBSN	○		○					○	—			○				—	○			○				○				○				△		△		
11	NHR69EU-3CBK	○		○					○	—			○				—	○			○				○				○				△		△		
12	NHR55EL-1CBS	○		○					—	○				○			○	—			○				○				○				△		△		
13	NHR55EL-1CY	○		○					—	○				○			○	—			○				○				○				—		△		
14	NHR55EL-1BWS	○		○					—	○				○			○	—			○				○				○				△		△		
15	NHR55EL-3CBS	○		○					○	—				○			—	○			○				○				○				△		△		
16	NHR55EL-3CYS	○		○					○	—				○			—	○			○				○				○				—		△		
17	NHR55EL-3CB	○		○					○	—			○				—	○			○				○				○				△		△		
18	NHR55EL-1CYS	○		○					—	○			○				○	—			○				○				○				—		△		
19	NHR55EL-1CYCL	○		○					—	○			○				○	—			○				○				○				—		△		

FRONT BRAKES (NKR 1999)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	FRONT BRAKE																				
		DISC BRAKE									DRUM BRAKE											
		WHEEL CYL.			DISC						Type		WHEEL CYL.			DRUM.			LINING			
		Inside dia. (in)			Thickness (mm)			Outside dia. (mm)			2L	D2L	Inside dia. (in)			Inside dia. (mm)			Width (mm)			
		2+1/8	2+2	2+1/4	35	40	42	265	293	310			1+1/8	1+3/16	1+3/8	279.4	300	320	60	75	100	120
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	NKR55EU-1EXY	—	—		—	—		—	—		○	—	○	—			○	—		○		
2	NKR55EU-1EXA	—	—		—	—		—	—		○	—	○	—			○	—		○		
3	NKR55EU-1EXYP	—	—		—	—		—	—		○	—	○	—			○	—		○		
4	NKR55EU-1EXYJ	—	—		—	—		—	—		○	—	○	—			○	—		○		
5	NKR69EAU-1DXYUK	—	○		○	—		○	—		—	—	—	—			—	—		—		
*6	NKR55EAU-1DXYUKJ	—	○		○	—		○	—		—	—	—	—			—	—		—		
*7	NKR66EU-1EXY2	—	—		—	—		—	—		○	—	○	—			○	—		○		
8	NKR66EU-1EXYH	—	—		—	—		—	—		○	—	○	—			○	—		○		
9	NKR55EU-1DWY	—	—		—	—		—	—		○	—	○	—			○	—		○		
10	NKR55EU-1DWS	—	—		—	—		—	—		○	—	○	—			○	—		○		
11	NKR55E2U-5HXY	—	—		—	—		—	—		○	—	○	—			○	—		○		
12	NKR55E2U-5HXYP	—	—		—	—		—	—		○	—	○	—			○	—		○		
13	NKR69E2U-5HYK	—	—		—	—		—	—		○	—	○	—			○	—		○		
*14	NKR66E2U-5HXY2	—	—		—	—		—	—		○	—	○	—			○	—		○		
*15	NKR66EDU-5EMXD2	—	—		—	—		—	—		—	○	○	—			○	—		○		
16	NKR66E2U-5EXYH	—	—		—	—		—	—		○	—	○	—			—	○		○		
*17	NKR66LU-5EXYH	—	—		—	—		—	—		○	—	○	—			—	○		○		
18	NKR55LU-5HXY	—	—		—	—		—	—		○	—	○	—			○	—		○		
19	NKR55LU-5HXA	—	—		—	—		—	—		○	—	○	—			○	—		○		
20	NKR55LU-5HXYJ	—	—		—	—		—	—		○	—	○	—			○	—		○		
21	NKR55LU-5HXYZJ	—	—		—	—		—	—		○	—	○	—			○	—		○		
22	NKR69LU-5HYK	—	—		—	—		—	—		○	—	○	—			○	—		○		
*23	NKR66LU-5HXY2	—	—		—	—		—	—		○	—	○	—			○	—		○		
*24	NKR66LU-5HXA2	—	—		—	—		—	—		○	—	○	—			○	—		○		

REAR BRAKES (NKR 1999)

—	Not available
○	Standard
△	Factory option
	Non

		REAR BRAKE																						PARKING BRAKE				BRAKE CONTROL						
		DRUM BRAKE																																
		Type		WHEEL CYL.					DRUM.				LINING				DRUM				LINING				MASTER CYL.										
				Inside dia. (in)					Inside dia. (mm)				Width (mm)				Inside dia. (mm)				Width (mm)				Inside dia. (in)										
		D2L (W/O AUTO)	D2L (W AUTO)	7/8	1	1+3/16	1+5/16	1+3/8	228.6	279.4	300	320	60	75	100	120	178	190	203	254	35	45	50	60	1+1/16	1+1/8	1+1/4	1+3/8	DSPV	LSPV	EXHAUST BRAKE	HYDROMASTER	HBB
No.	Models	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
1	NKR55EU-1EXY	○	—	○	—	—			—		○	—		○	—		○	—			○	—				○			—	—	△		
2	NKR55EU-1EXA	○	—	○	—	—			—		○	—		○	—		○	—			○	—				○			△	—	△		
3	NKR55EU-1EXYP	○	—	○	—	—			—		○	—		○	—		○	—			○	—				○			—	—	△		
4	NKR55EU-1EXYJ	○	—	○	—	—			—		○	—		○	—		○	—			○	—				○			—	—	△		
5	NKR69EAU-1DXYUK	—	○	—	○	—			—		○	—		○	—		○	—			○	—				○			—	○	○		
*6	NKR55EAU-1DXYUKJ	—	○	—	○	—			—		○	—		○	—		○	—			○	—				○			—	○	○		
*7	NKR66EU-1EXY2	○	—	○	—	—			—		○	—		○	—		—	○			—	○				○			—	—	△		
8	NKR66EU-1EXYH	○	—	○	—	—			—		○	—		○	—		—	○			—	○				○			—	○	△		
9	NKR55EU-1DWY	○	—	○	—	—			—		○	—		○	—		○	—			○	—				○			—	—	△		
10	NKR55EU-1DWS	○	—	○	—	—			—		○	—		○	—		○	—			○	—				○			△	—	△		
11	NKR55E2U-5HXY	○	—	—	○	—			—		○	—		○	—		○	—			○	—				○			—	—	△		
12	NKR55E2U-5HXYP	○	—	—	○	—			—		○	—		○	—		○	—			○	—				○			—	—	△		
13	NKR69E2U-5HYK	○	—	—	○	—			—		○	—		○	—		○	—			○	—				○			—	—	△		
*14	NKR66E2U-5HXY2	○	—	—	○	—			—		○	—		○	—		—	○			—	○				○			—	—	△		
*15	NKR66EDU-5EMXD2	○	—	—	○	—			—		○	—		○	—		—	○			—	○				○			—	—	△		
16	NKR66E2U-5EXYH	○	—	—	○	—			—		—	○		○	—		—	○			—	○				○			—	○	△		
*17	NKR66LU-5EXYH	○	—	—	○	—			—		—	○		○	—		—	○			—	○				○			—	○	△		
18	NKR55LU-5HXY	○	—	—	○	—			—		○	—		○	—		○	—			○	—				○			—	—	△		
19	NKR55LU-5HXA	○	—	—	○	—			—		○	—		○	—		○	—			○	—				○			—	—	△		
20	NKR55LU-5HXYJ	○	—	—	○	—			—		○	—		○	—		○	—			○	—				○			—	—	△		
21	NKR55LU-5HXYZJ	○	—	—	○	—			—		○	—		○	—		○	—			○	—				○			○	—	△		
22	NKR69LU-5HYK	○	—	—	○	—			—		○	—		○	—		○	—			○	—				○			—	—	△		
*23	NKR66LU-5HXY2	○	—	—	○	—			—		○	—		○	—		—	○			—	○				○			—	—	△		
*24	NKR66LU-5HXA2	○	—	—	○	—			—		○	—		○	—		—	○			—	○				○			—	—	△		

FRONT BRAKES (NKR 1999)

—	Not available
○	Standard
△	Factory option
	Non

		FRONT BRAKE																			
		DISC BRAKE									DRUM BRAKE										
		WHEEL CYL.			DISC						Type		WHEEL CYL.			DRUM.			LINING			
		Inside dia. (in)			Thickness (mm)			Outside dia. (mm)			2 L	D 2 L	Inside dia. (in)			Inside dia. (mm)			Width (mm)			
		2 + 1 / 8	2 + 2	2 + 1 / 4	35	40	42	265	293	310			1 + 1 / 8	1 + 3 / 16	1 + 3 / 8	279.4	300	320	60	75	100	120
No.	Models	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
*25	NKR66LU-5HYIN2	—	—		—	—		—			○	—	○	—			—	○		○	—	
26	NKR66LU-5LXYP	—	—		—	—		—			○	—	—	○			—	○		○	—	
27	NKR66LU-5LYIN	—	—		—	—		—			○	—	—	○			—	○		—	○	
28	NKR69LU-5GWYK	—	—		—	—		—			○	—	○	—			○	—		○	—	
*29	NKR66LU-5GWY2	—	—		—	—		—			○	—	○	—			○	—		○	—	
30	NKR55EU-3EXY	—	—		—	—		—			○	—	○	—			○	—		○	—	
31	NKR66EU-3EXYH	—	—		—	—		—			○	—	○	—			○	—		○	—	
32	NKR55EL-1EY	—	—		—	—		—			○	—	○	—			○	—		○	—	
33	NKR55EL-1EXY	—	—		—	—		—			○	—	○	—			○	—		○	—	
34	NKR55EL-1EXA	—	—		—	—		—			○	—	○	—			○	—		○	—	
35	NKR55EL-1EXYG	—	—		—	—		—			○	—	○	—			○	—		○	—	
36	NKR55EL-1EAC	—	—		—	—		—			○	—	○	—			○	—		○	—	
37	NKR55EL-1EXYJ	—	—		—	—		—			○	—	○	—			○	—		○	—	
38	NKR69EL-1EXYR	—	—		—	—		—			○	—	○	—			○	—		○	—	
39	NKR69EAL-1DXYE	—	○		○	—		○			—	—	—	—			—	—		—	—	
40	NKR55EAL-1DXYEJ	—	○		○	—		○			—	—	—	—			—	—		—	—	
*41	NKR69EAL-1DXYBR	—	○		○	—		○			—	—	—	—			—	—		—	—	
*42	NKR66EL-1EXY2	—	—		—	—		—			○	—	○	—			○	—		○	—	
*43	NKR55EL-1DWSC	—	—		—	—		—			○	—	○	—			○	—		○	—	
44	NKR55E2L-5HXY	—	—		—	—		—			○	—	○	—			○	—		○	—	
45	NKR55E2L-5HXYG	—	—		—	—		—			○	—	○	—			○	—		○	—	
46	NKR55E2L-5HXYCL	—	—		—	—		—			○	—	○	—			○	—		○	—	
47	NKR66E2L-5HXY2	—	—		—	—		—			○	—	○	—			○	—		○	—	
48	NKR66E2L-5HXA2	—	—		—	—		—			○	—	○	—			○	—		○	—	

REAR BRAKES (NKR 1999)

—	Not available
○	Standard
△	Factory option
	Non

		REAR BRAKE																						PARKING BRAKE				BRAKE CONTROL					
		DRUM BRAKE																															
		Type		WHEEL CYL.					DRUM.				LINING				DRUM				LINING				MASTER CYL.								
		D2L (W/O AUTO)	D2L (W AUTO)	Inside dia. (in)					Inside dia. (mm)				Width (mm)				Inside dia. (mm)				Width (mm)				Inside dia. (in)				DSPV	LSPV	EXHAUST BRAKE	HYDROMASTER	HBB
				7/8	1	1+3/16	1+5/16	1+3/8	228.6	279.4	300	320	60	75	100	120	178	190	203	254	35	45	50	60	1+1/16	1+1/8	1+1/4	1+3/8					
No.	Models	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
*25	NKR66LU-5HYIN2	○	—	—	○	—			—		—	○		○	—		—	○			—	○				○			—	—	△		
26	NKR66LU-5LXYP	○	—	—	—	○			—		—	○		○	—			○			—	○				—	○		—	—	△		
27	NKR66LU-5LYIN	○	—	—	—	○			—		—	○		—	○			○			—	○				—	○		—	—	△		
28	NKR69LU-5GWYK	○	—	—	○	—			—		○	—		○	—		○	—			○	—				○			—	—	△		
*29	NKR66LU-5GWY2	○	—	—	○	—			—		○	—		○	—		—	○			—	○				○			—	—	△		
30	NKR55EU-3EXY	○	—	—	○	—			○		—	—		○	—		○	—			○	—				○			—	—	△		
31	NKR66EU-3EXYH	○	—	—	○	—			○		—	—		○	—		—	○			—	○				○			—	○	△		
32	NKR55EL-1EY	○	—	○	—	—			—		○	—		○	—		○	—			○	—				○			—	—	△		
33	NKR55EL-1EXY	○	—	○	—	—			—		○	—		○	—		○	—			○	—				○			—	—	△		
34	NKR55EL-1EXA	○	—	○	—	—			—		○	—		○	—		○	—			○	—				○			△	—	△		
35	NKR55EL-1EXYG	○	—	○	—	—			—		○	—		○	—		○	—			○	—				○			—	—	△		
36	NKR55EL-1EAC	○	—	—	○	—			—		○	—		○	—		○	—			○	—				○			○	—	○		
37	NKR55EL-1EXYJ	○	—	○	—	—			—		○	—		○	—		○	—			○	—				○			—	—	△		
38	NKR69EL-1EXYR	○	—	○	—	—			—		○	—		○	—		○	—			○	—				○			—	—	△		
39	NKR69EAL-1DXYE	—	○	—	○	—			—		○	—		○	—		○	—			○	—				○			—	○	○		
40	NKR55EAL-1DXYEJ	—	○	—	○	—			—		○	—		○	—		○	—			○	—				○			—	○	○		
*41	NKR69EAL-1DXYBR	—	○	—	○	—			—		○	—		○	—		○	—			○	—				○			—	○	△		
*42	NKR66EL-1EXY2	○	—	○	—	—			—		○	—		○	—		—	○			—	○				○			—	—	△		
*43	NKR55EL-1DWSC	○	—	—	○	—			—		○	—		○	—		○	—			○	—				○			○	—	△		
44	NKR55E2L-5HXY	○	—	—	○	—			—		○	—		○	—		○	—			○	—				○			—	—	△		
45	NKR55E2L-5HXYG	○	—	—	○	—			—		○	—		○	—		○	—			○	—				○			—	—	△		
46	NKR55E2L-5HXYCL	○	—	—	○	—			—		○	—		○	—		○	—			○	—				○			—	—	△		
47	NKR66E2L-5HXY2	○	—	—	○	—			—		○	—		○	—		—	○			—	○				○			—	—	△		
48	NKR66E2L-5HXA2	○	—	—	○	—			—		○	—		○	—		—	○			—	○				○			△	—	△		

FRONT BRAKES (NKR 1998)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	FRONT BRAKE																				
		DISC BRAKE									DRUM BRAKE											
		WHEEL CYL.			DISC						Type		WHEEL CYL.			DRUM.			LINING			
		Inside dia. (in)			Thickness (mm)			Outside dia. (mm)					Inside dia. (in)			Inside dia. (mm)			Width (mm)			
		2 + 1 / 8	2 + 2	2 + 1 / 4	35	40	42	265	293	310	2L	D2L	1 + 1 / 8	1 + 3 / 16	1 + 3 / 8	279.4	300	320	60	75	100	120
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
*49	NKR66E2L-5HXYS2	—	—		—	—		—	—		○	—	○	—			○	—		○	—	
*50	NKR66E2L-5HXAS2	—	—		—	—		—	—		○	—	○	—			○	—		○	—	
*51	NKR66EDL-5EMXD2	—	—		—	—		—	—		—	○	○	—			○	—		○	—	
*52	NKR66EDL-5EMXDS2	—	—		—	—		—	—		—	○	○	—			○	—		○	—	
*53	NKR66E2L-5HXYR	—	—		—	—		—	—		○	—	○	—			—	○		○	—	
54	NKR66E2L-5HXFYR	—	—		—	—		—	—		○	—	○	—			—	○		○	—	
55	NKR66GL-5JXY2	—	—		—	—		—	—		○	—	○	—			—	○		○	—	
*56	NKR55LL-5EAC	—	—		—	—		—	—		○	—	○	—			○	—		○	—	
57	NKR55LL-5HXY	—	—		—	—		—	—		○	—	○	—			○	—		○	—	
58	NKR55LL-5HXA	—	—		—	—		—	—		○	—	○	—			○	—		○	—	
59	NKR55LL-5HAC	—	—		—	—		—	—				○	—			○	—		○	—	
60	NKR55LL-5HXYCLJ	—	—		—	—		—	—		○	—	○	—			○	—		○	—	
*61	NKR55LL-5HXYJ	—	—		—	—		—	—		○	—	○	—			○	—		○	—	
62	NKR55LL-5HACJ	—	—		—	—		—	—		○	—	○	—			○	—		○	—	
63	NKR55LL-5HXYCJ	—	—		—	—		—	—		○	—	○	—			○	—		○	—	
64	NKR55LL-5HXACJ	—	—		—	—		—	—		○	—	○	—			○	—		○	—	
65	NKR69LL-5DXYE	○	—		—	○		—	○		—	—	—	—			—	—		—	—	
66	NKR55LL-5DXYEJ	○	—		—	○		—	○		—	—	—	—			—	—		—	—	
*67	NKR69LL-5HXYE	○	—		—	○		—	○		—	—	—	—			—	—		—	—	
68	NKR55LL-5HXYEJ	○	—		—	○		—	○		—	—	—	—			—	—		—	—	
*69	NKR69LL-5HXYCH	—	—		—	—		—	—		○	—	○	—			○	—		○	—	
*70	NKR69LL-5HXYBR	—	—		—	—		—	—		○	—	○	—			—	○		○	—	
71	NKR66LL-5HXY2	—	—		—	—		—	—		○	—	○	—			—	—		○	—	
72	NKR66LL-5HXA2	—	—		—	—		—	—		○	—	○	—			—	—		○	—	

REAR BRAKES (NKR 1998)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	REAR BRAKE																						PARKING BRAKE				BRAKE CONTROL					
		DRUM BRAKE																															
		Type		WHEEL CYL.					DRUM.				LINING				DRUM				LINING				MASTER CYL.									
				Inside dia. (in)					Inside dia. (mm)				Width (mm)				Inside dia. (mm)				Width (mm)				Inside dia. (in)									
		D2L (W/O AUTO)	D2L (W AUTO)	7/8	1	1+3/16	1+5/16	1+3/8	228.6	279.4	300	320	60	75	100	120	178	190	203	254	35	45	50	60	1+1/16	1+1/8	1+1/4	1+3/8	DSPV	LSPV	EXHAUST BRAKE	HYDROMASTER	HBB
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
*49	NKR66E2L-5HXYS2	○	—	—	○	—			—		○	—		○	—		—	○			—	○				○			—	—	△		
*50	NKR66E2L-5HXAS2	○	—	—	○	—			—		○	—		○	—		—	○			—	○				○			△	—	△		
*51	NKR66EDL-5EMXD2	○	—	—	○	—			—		○	—		○	—		—	○			—	○				○			—	—	△		
*52	NKR66EDL-5EMXDS2	○	—	—	○	—			—		○	—		○	—		—	○			—	○				○			—	—	△		
*53	NKR66E2L-5HXYR	○	—	—	○	—			—		—	○		○	—		—	○			—	○				○			—	—	△		
54	NKR66E2L-5HXFYR	○	—	—	○	—			—		—	○		○	—		—	○			—	○				○			—	—	△		
55	NKR66GL-5JXY2	○	—	—	—	○			—		—	○		○	—		—	○			—	○				○			—	—	△		
*56	NKR55LL-5EAC	○	—	—	○	—			—		○	—		○	—		○	—			○	—				○			—	—	○		
57	NKR55LL-5HXY	○	—	—	○	—			—		○	—		○	—		○	—			○	—				○			—	—	△		
58	NKR55LL-5HXA	○	—	—	○	—			—		○	—		○	—		○	—			○	—				○			—	—	△		
59	NKR55LL-5HAC	○	—	—	○	—			—		○	—		○	—		○	—			○	—				○			—	—	○		
60	NKR55LL-5HXYCLJ	○	—	—	○	—			—		○	—		○	—		○	—			○	—				○			—	—	△		
*61	NKR55LL-5HXYJ	○	—	—	○	—			—		○	—		○	—		○	—			○	—				○			—	—	△		
62	NKR55LL-5HACJ	○	—	—	○	—			—		○	—		○	—		○	—			○	—				○			—	—	○		
63	NKR55LL-5HXYCJ	○	—	—	○	—			—		○	—		○	—		○	—			○	—				○			—	—	○		
64	NKR55LL-5HXACJ	○	—	—	○	—			—		○	—		○	—		○	—			○	—				○			—	—	○		
65	NKR69LL-5DXYE	—	○	—	○	—			—		—	○		○	—		○	—			○	—				○			—	○	○		
66	NKR55LL-5DXYEJ	—	○	—	○	—			—		—	○		○	—		○	—			○	—				○			—	○	○		
*67	NKR69LL-5HXYE	—	○	—	○	—			—		—	○		○	—		○	—			○	—				○			—	○	○		
68	NKR55LL-5HXYEJ	—	○	—	○	—			—		—	○		○	—		○	—			○	—				○			—	○	○		
*69	NKR69LL-5HXYCH	○	—	—	○	—			—		○	—		○	—		○	—			○	—				○			—	—	△		
*70	NKR69LL-5HXYBR	○	—	—	○	—			—		—	○		○	—		○	—			○	—				○			—	○	△		
71	NKR66LL-5HXY2	○	—	—	○	—			—		○	—		○	—		—	○			—	○				○			—	—	△		
72	NKR66LL-5HXA2	○	—	—	○	—			—		○	—		○	—		—	○			—	○				○			—	—	△		

FRONT BRAKES (NKR 1999)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	FRONT BRAKE																				
		DISC BRAKE									DRUM BRAKE											
		WHEEL CYL.			DISC						Type		WHEEL CYL.			DRUM.			LINING			
		Inside dia. (in)			Thickness (mm)			Outside dia. (mm)			2 L	D 2 L	Inside dia. (in)			Inside dia. (mm)			Width (mm)			
		2 + 1 / 8	2 + 2	2 + 1 / 4	35	40	42	265	293	310			1 + 1 / 8	1 + 3 / 16	1 + 3 / 8	279.4	300	320	60	75	100	120
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
*73	NKR66LL-5HXYS2	—	—		—	—		—	—		○	—	○	—		○	—			○	—	
*74	NKR66LL-5HXAS2	—	—		—	—		—	—		○	—	○	—		○	—			○	—	
*75	NKR66LL-5HXYR	—	—		—	—		—	—		○	—	○	—		—	○			○	—	
*76	NKR66LL-5JXY2	—	—		—	—		—	—		○	—	○	—		—	○			○	—	
77	NKR55LL-5GWAC	—	—		—	—		—	—		○	—	○	—		○	—			○	—	
78	NKR66LL-5GWYS2	—	—		—	—		—	—		○	—	○	—		○	—			○	—	
*79	NKR55EL-3EXY	—	—		—	—		—	—		○	—	○	—		○	—			○	—	
80	NKR69EL-3EXYR	—	—		—	—		—	—		○	—	○	—		○	—			○	—	
81	NKR66LL-5HXY	—	—		—	—		—	—		○	—	○	—		—	○			○	—	
82	NKR55LL-5HXYCHJ	—	—		—	—		—	—		○	—	○	—		○	—			○	—	
*83	NKR69EL-1EXYCH	—	—		—	—		—	—		○	—	○	—		○	—			○	—	
84	NKR66LL-5GWY2	—	—		—	—		—	—		○	—	○	—		○	—			○	—	

REAR BRAKES (NKR 1999)

—	Not available
○	Standard
△	Factory option
	Non

		REAR BRAKE																						PARKING BRAKE				BRAKE CONTROL								
		DRUM BRAKE																																		
		Type		WHEEL CYL.					DRUM.				LINING				DRUM				LINING				MASTER CYL.												
				Inside dia. (in)					Inside dia. (mm)				Width (mm)				Inside dia. (mm)				Width (mm)				Inside dia. (in)				DSPV	LSPV	EXHAUST BRAKE	HYDROMASTER	HBB				
		D2L (W/O AUTO)	D2L (W AUTO)	7/8	1	1+3/16	1+5/16	1+3/8	228.6	279.4	300	320	60	75	100	120	178	190	203	254	35	45	50	60	1+1/16	1+1/8	1+1/4	1+3/8									
No.	Models	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32				
*73	NKR66LL-5HXYS2	○	—	—	○	—			—		○	—		○	—		—	○			—	○				○			—	—	△						
*74	NKR66LL-5HXAS2	○	—	—	○	—			—		○	—		○	—		—	○			—	○				○			—	—	△						
*75	NKR66LL-5HXYR	○	—	—	○	—			—		—	○		○	—		—	○			—	○				○			—	—	△						
*76	NKR66LL-5JXY2	○	—	—	—	○			—		—	○		○	—		—	○			—	○				○			—	—	△						
77	NKR55LL-5GWAC	○	—	—	○	—			—		○	—		○	—		○	—			○	—				○			—	—	○						
78	NKR66LL-5GWYS2	○	—	—	○	—					○	—		○	—		—	○			—	○				○			—	—	△						
*79	NKR55EL-3EXY	○	—	—	○	—			○		—	—		○	—		○	—			○	—				○			—	—	△						
80	NKR69EL-3EXYR	○	—	—	○	—			○		—	—		○	—		○	—			○	—				○			—	—	△						
81	NKR66LL-5HXY	○	—	—	○	—			—		—	○		○	—		—	○			—	○				○			—	—	△						
82	NKR55LL-5HXYCHJ	○	—	—	○	—			—		○	—		○	—		○	—			○	—				○			—	—	△						
*83	NKR69EL-1EXYCH	○	—	○	—	—			—		○	—		○	—		○	—			○	—				○			—	—	△						
84	NKR66LL-5GWY2	○	—	—	○	—					○	—		○	—		—	○			—	○				○			—	—	△						

FRONT BRAKES (NPR·NQR 1999)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	FRONT BRAKE																				
		DISC BRAKE									DRUM BRAKE											
		WHEEL CYL.			DISC						Type		WHEEL CYL.			DRUM.			LINING			
		Inside dia. (in)			Thickness (mm)			Outside dia. (mm)			2 L	D 2 L	Inside dia. (in)			Inside dia. (mm)			Width (mm)			
		2 + 1 / 8	2 + 2	2 + 1 / 4	35	40	42	265	293	310			1 + 1 / 8	1 + 3 / 16	1 + 3 / 8	279.4	300	320	60	75	100	120
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
*1	NPR66GU-5JXY2	—		—		—	—		—	—	○	—	○	—	—			○		○	—	—
2	NPR66GU-5EXYH	—		—		—	—		—	—	○	—	○	—	—			○		○	—	—
3	NPR66GU-5JXYSN	—		—		—	—		—	—	○	—	○	—	—			○		○	—	—
4	NPR66GDU-5LX	—		—		—	—		—	—	—	○	—	○	—			○		—	○	—
5	NPR66GU-5LXY	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
6	NPR70GU-5JXYKJ2	—		—		—	—		—	—	○	—	○	—	—			○		○	—	—
7	NPR70GU-5LXYKJ2	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
*8	NPR70GU-5LXYKTJ	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
9	NPR70GU-5LXYSNTJ	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
*10	NQR70GU-5NXYKTJ	—		—		—	—		—	—	○	—	—	—	○			○		—	—	○
*11	NPR69LU-5DXYIR	○		—		○	—		○	—	—	—	—	—	—			—		—	—	—
*12	NPR55LU-5DXYIRJ	○		—		○	—		○	—	—	—	—	—	—			—		—	—	—
*13	NPR69LU-5HXYIR	○		—		○	—		○	—	—	—	—	—	—			—		—	—	—
14	NPR55LU-5HXYIRJ	○		—		○	—		○	—	—	—	—	—	—			—		—	—	—
*15	NPR66LU-5EVXYH	—		—		—	—		—	—	○	—	○	—	—			○		○	—	—
16	NPR66LU-5JXA2	—		—		—	—		—	—	○	—	○	—	—			○		○	—	—
*17	NPR66LU-5JXY2	—		—		—	—		—	—	○	—	○	—	—			○		○	—	—
18	NPR66LU-5JXASN	—		—		—	—		—	—	○	—	○	—	—			○		○	—	—
*19	NPR66LU-5JXYSN	—		—		—	—		—	—	○	—	○	—	—			○		○	—	—
*20	NPR66LU-5JXYV	—		—		—	—		—	—	○	—	○	—	—			○		○	—	—
21	NPR66LBU-5JVXY	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
22	NPR66LU-5JVXYZ	—		—		—	—		—	—	○	—	○	—	—			○		○	—	—
23	NPR66LU-5LXA	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
24	NPR66LU-5LXY	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—

REAR BRAKES (NPR-NQR 1999)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	REAR BRAKE																						PARKING BRAKE				BRAKE CONTROL				
		DRUM BRAKE																														
		Type		WHEEL CYL.					DRUM.				LINING				DRUM				LINING				MASTER CYL.								
		D2L (W/O AUTO)	D2L (W AUTO)	Inside dia. (in)					Inside dia. (mm)				Width (mm)				Inside dia. (mm)				Width (mm)				Inside dia. (in)				DSPV	LSPV	EXHAUST BRAKE	HYDROMASTER	HBB
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
				7/8	1	1+3/16	1+5/16	1+3/8	228.6	279.4	300	320	60	75	100	120	178	190	203	254	35	45	50	60	1+1/16	1+1/8	1+1/4	1+3/8					
*1	NPR66GU-5JXY2	○	—		○	—	—	—				○		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
2	NPR66GU-5EXYH	○	—		○	—	—	—				○		○	—	—	—	○	—	—	—	○	—	—		○	—	—		○	○	—	—
3	NPR66GU-5JXYSN	○	—		○	—	—	—				○		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
4	NPR66GDU-5LX	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
5	NPR66GU-5LXY	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
6	NPR70GU-5JXYKJ2	○	—		○	—	—	—				○		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
7	NPR70GU-5LXYKJ2	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
*8	NPR70GU-5LXYKTJ	○	—		—	○	—	—				○		—	○	—	—	—	○	—	—	—	○	—		—	○	—		—	○	—	—
9	NPR70GU-5LXYSNTJ	○	—		—	○	—	—				○		—	○	—	—	—	○	—	—	—	○	—		—	○	—		—	○	—	—
*10	NQR70GU-5NXYKTJ	○	—		—	—	—	○				○		—	—	○	—	—	○	—	—	—	○	—		—	—	○		—	○	—	○
*11	NPR69LU-5DXYIR	—	○		○	—	—	—				○		○	—	—	○	—	—	—	○	—	—	—		○	—	—		○	○	—	—
*12	NPR55LU-5DXYIRJ	—	○		○	—	—	—				○		○	—	—	○	—	—	—	○	—	—	—		○	—	—		○	○	—	—
*13	NPR69LU-5HXYIR	—	○		○	—	—	—				○		○	—	—	○	—	—	—	○	—	—	—		○	—	—		○	○	—	—
14	NPR55LU-5HXYIRJ	—	○		○	—	—	—				○		○	—	—	○	—	—	—	○	—	—	—		○	—	—		○	○	—	—
*15	NPR66LU-5EVXYH	○	—		○	—	—	—				○		○	—	—	—	○	—	—	—	○	—	—		○	—	—		○	○	—	—
16	NPR66LU-5JXA2	○	—		○	—	—	—				○		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
*17	NPR66LU-5JXY2	○	—		○	—	—	—				○		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
18	NPR66LU-5JXASN	○	—		○	—	—	—				○		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
*19	NPR66LU-5JXYSN	○	—		○	—	—	—				○		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
*20	NPR66LU-5JXYV	○	—		○	—	—	—				○		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
21	NPR66LBU-5JVXY	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
22	NPR66LU-5JVXYZ	○	—		○	—	—	—				○		○	—	—	—	○	—	—	—	○	—	—		○	—	—		○	○	—	—
23	NPR66LU-5LXA	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
24	NPR66LU-5LXY	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—

FRONT BRAKES (NPR-NQR 1999)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	FRONT BRAKE																				
		DISC BRAKE									DRUM BRAKE											
		WHEEL CYL.			DISC						Type		WHEEL CYL.			DRUM.			LINING			
		Inside dia. (in)			Thickness (mm)			Outside dia. (mm)			2 L	D 2 L	Inside dia. (in)			Inside dia. (mm)			Width (mm)			
		2 + 1 / 8	2 + 2	2 + 1 / 4	3 5	4 0	4 2	2 6 5	2 9 3	3 1 0			1 + 1 / 8	1 + 3 / 16	1 + 3 / 8	2 7 9 . 4	3 0 0	3 2 0	6 0	7 5	1 0 0	1 2 0
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
25	NPR66LU-5LVXYZ	—		—		—	—		—	—	○		—	○	—			○		—	○	—
26	NPR66LU-5LXYP	—		—		—	—		—	—	○		—	○	—			○		—	○	—
27	NQR66LU-5NVXYP	—		—		—	—		—	—	○	—	—	—	○			○		—	—	○
*28	NPR71LU-5JVXYH	—		—		—	—		—	—	○	—	○	—	—			○		○	—	—
29	NPR71LU-5JVXYHT	○		—		○	—		○	—	—	—	—	—	—			—		—	—	—
30	NPR71LU-5LVXYH	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
31	NQR71LU-5NVXY	—		—		—	—		—	—	○	—	—	—	○			○		—	—	○
32	NPR70LU-5JXYIRJ2	○		—		○	—		○	—	—	—	—	—	—			—		—	—	—
33	NPR70LU-5JXYUKJ2	○		—		○	—		○	—	—	—	—	—	—			—		—	—	—
34	NPR70LU-5JXYKJ2	—		—		—	—		—	—	○	—	○	—	—			○		○	—	—
*35	NPR70LU-5LXYKJ2	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
*36	NPR70LU-5LXYKTJ	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
37	NPR70LU-5LXYSNTJ	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
*38	NQR70LU-5LXYIRJ	—		○		—	○		—	○	—		—	—	—			—		—	—	—
39	NQR70LU-5LXYUKJ	—		○		—	○		—	○	—		—	—	—			—		—	—	—
*40	NQR70LU-5NXYKTJ	—		—		—	—		—	—	○	—	—	—	○			○		—	—	○
*41	NPR66LU-5HWYSN	—		—		—	—		—	—	○	—	○	—	—			○		○	—	—
*42	NPR71LU-5HWYH	—		—		—	—		—	—	○	—	○	—	—			○		○	—	—
43	NPR70LU-5HWYKJ2	—		—		—	—		—	—	○	—	○	—	—			○		○	—	—
44	NPR66PU-5JXA2	—		—		—	—		—	—	○	—	○	—	—			○		○	—	—
*45	NPR66PU-5JXY2	—		—		—	—		—	—	○	—	○	—	—			○		○	—	—
46	NPR66PU-5JXYSN	—		—		—	—		—	—	○	—	○	—	—			○		○	—	—
47	NPR66PBU-5JVXY	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
*48	NPR66PU-5LXA	—		—		—	—		—	—	○		—	○	—			○		—	○	—

REAR BRAKES (NPR-NQR 1999)

—	Not available
○	Standard
△	Factory option
	Non

		REAR BRAKE																						PARKING BRAKE				BRAKE CONTROL							
		DRUM BRAKE																																	
		Type		WHEEL CYL.					DRUM.				LINING				DRUM				LINING				MASTER CYL.										
				Inside dia. (in)					Inside dia. (mm)				Width (mm)				Inside dia. (mm)				Width (mm)				Inside dia. (in)										
		D2L (W/O AUTO)	D2L (W AUTO)	7/8	1	1+3/16	1+5/16	1+3/8	228.6	279.4	300	320	60	75	100	120	178	190	203	254	35	45	50	60	1+1/16	1+1/8	1+1/4	1+3/8	DSPV	LSPV	EXHAUST BRAKE	HYDROMASTER	HBB
No.	Models	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
25	NPR66LU-5LVXYZ	○	—		—	—	○	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		○	○	—	—
26	NPR66LU-5LXYP	○	—		—	—	○	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
27	NQR66LU-5NVXYP	○	—		—	—	—	○				○		—	—	○	—	○	—	—	—	○	—	—		—	—	○		—	○	○	—
*28	NPR71LU-5JVXYH	○	—		○	—	—	—				○		○	—	—	—	○	—	—	—	○	—	—		○	—	—		○	○	—	—
29	NPR71LU-5JVXYHT	—	○		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		○	○	—	—
30	NPR71LU-5LVXYH	○	—		—	—	○	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		○	○	—	—
31	NQR71LU-5NVXY	○	—		—	—	○	△				○		—	—	○	—	○	—	—	—	○	—	—		—	○	△		—	○	△	—
32	NPR70LU-5JXYIRJ2	—	○		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		○	○	—	—
33	NPR70LU-5JXYUKJ2	—	○		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		○	○	—	—
34	NPR70LU-5JXYKJ2	○	—		○	—	—	—				○		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
*35	NPR70LU-5LXYKJ2	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
*36	NPR70LU-5LXYKTJ	○	—		—	○	—	—				○		—	○	—	—	—	○	—	—	—	○	—		—	○	—		—	○	—	—
37	NPR70LU-5LXYSNTJ	○	—		—	○	—	—				○		—	○	—	—	—	○	—	—	—	○	—		—	○	—		—	○	—	—
*38	NQR70LU-5LXYIRJ	—	○		—	—	○	—				○		—	—	○	—	—	—	○	—	—	—	○		—	—	○		○	○	—	○
39	NQR70LU-5LXYUKJ	—	○		—	—	○	—				○		—	—	○	—	—	—	○	—	—	—	○		—	—	○		○	○	—	○
*40	NQR70LU-5NXYKTJ	○	—		—	—	—	○				○		—	—	○	—	—	○	—	—	—	○	—		—	—	○		—	○	—	○
*41	NPR66LU-5HWYSN	○	—		○	—	—	—				○		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
*42	NPR71LU-5HWYH	○	—		○	—	—	—				○		○	—	—	—	○	—	—	—	○	—	—		○	—	—		○	○	—	—
43	NPR70LU-5HWYKJ2	○	—		○	—	—	—				○		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
44	NPR66PU-5JXA2	○	—		○	—	—	—				○		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
*45	NPR66PU-5JXY2	○	—		○	—	—	—				○		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
46	NPR66PU-5JXYSN	○	—		○	—	—	—				○		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
47	NPR66PBU-5JVXY	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
*48	NPR66PU-5LXA	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—

FRONT BRAKES (NPR-NQR 1999)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	FRONT BRAKE																			
		DISC BRAKE									DRUM BRAKE										
		WHEEL CYL.			DISC						Type		WHEEL CYL.			DRUM.			LINING		
		Inside dia. (in)			Thickness (mm)			Outside dia. (mm)			2 L	D 2 L	Inside dia. (in)			Inside dia. (mm)			Width (mm)		
		2 + 1 / 8	2 + 2	2 + 1 / 4	35	40	42	265	293	310			1 + 1 / 8	1 + 3 / 16	1 + 3 / 8	279.4	300	320	60	75	100	120
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
*49	NPR66PU-5LXY	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
*50	NPR66PU-5LVXYZ	—		—		—	—		—	—	○		—	○	—			○		—	○	—
*51	NPR66PU-5LXYP	—		—		—	—		—	—	○		—	○	—			○		—	○	—
52	NPR71PU-5LVXYH	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
53	NPR71PU-5LXYVJ	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
54	NQR71PU-5NVXY	—		—		—	—		—	—	○	—	—	○	△			○		—	—	○
55	NPR70PU-5JXYUKJ2	○		—		○	—		○	—	—	—	—	—	—			—		—	—	—
56	NPR70PU-5JXYKJ2	—		—		—	—		—	—	○	—	○	—	—			○		○	—	—
57	NPR70PU-5LXYKJ2	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
58	NPR70PU-5LXYKTJ	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
*59	NPR70PU-5LXYSNTJ	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
60	NQR70PU-5LXYUKJ	—		○		—	○		—	○	—	—	—	—	—			—		—	—	—
*61	NQR70PU-5NXYKJ	—		—		—	—		—	—	○	—	—	—	○			○		—	—	○
62	NQR70PU-5NXYKTJ	—		—		—	—		—	—	○	—	—	—	○			○		—	—	○
*63	NQR66RU-5NVXYP	—		—		—	—		—	—	○	—	—	—	○			○		—	—	○
64	NQR71RU-5NVXY	—		—		—	—		—	—	○	—	—	○	△			○		—	—	○
*65	NQR70RU-5LXYUKJ	—		○		—	○		—	○	—	—	—	—	—			—		—	—	—
*66	NQR70RU-5NXYHJ	—		—		—	—		—	—	○	—	—	—	○			○		—	—	○
*67	NQR70RU-5NXYZJ	—		—		—	—		—	—	○	—	—	—	○			○		—	—	○
*68	NQR70RU-5NXYVJ	—		—		—	—		—	—	○	—	—	—	○			○		—	—	○
69	NQR70RU-5NXYKJ	—		—		—	—		—	—	○	—	—	—	○			○		—	—	○
*70	NQR70TU-5LXYUKJ	—		○		—	○		—	○	—	—	—	—	—			—		—	—	—
71	NQR70TU-5NXYKJ	—		—		—	—		—	—	○	—	—	—	○			○		—	—	○
72	NPS71LU-5JXYH	—		—		—	—		—	—	—	○	—	○	—			○		○	—	—

REAR BRAKES (NPR-NQR 1999)

—	Not available
○	Standard
△	Factory option
	Non

		REAR BRAKE																						PARKING BRAKE				BRAKE CONTROL				
		DRUM BRAKE																														
		Type		WHEEL CYL.					DRUM.				LINING				DRUM				LINING				MASTER CYL.								
		D2L (W/O AUTO)	D2L (W AUTO)	Inside dia. (in)					Inside dia. (mm)				Width (mm)				Inside dia. (mm)				Width (mm)				Inside dia. (in)				DSPV	LSPV	EXHAUST BRAKE	HYDROMASTER	HBB
				7/8	1	1+3/16	1+5/16	1+3/8	228.6	279.4	300	320	60	75	100	120	178	190	203	254	35	45	50	60	1+1/16	1+1/8	1+1/4	1+3/8					
No.	Models	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
*49	NPR66PU-5LXY	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
*50	NPR66PU-5LVXYZ	○	—		—	—	○	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		○	○	—	—
*51	NPR66PU-5LXYP	○	—		—	—	○					○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
52	NPR71PU-5LVXYH	○	—		—	—	○	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		○	○	—	—
53	NPR71PU-5LXYVJ	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
54	NQR71PU-5NVXY	○	—		—	—	○	△				○		—	—	○	—	○	—	—	—	○	—	—		—	○	△		—	○	△	—
55	NPR70PU-5JXYUKJ2	—	○		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		○	○	—	—
56	NPR70PU-5JXYKJ2	○	—		○	—	—	—				○		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
57	NPR70PU-5LXYKJ2	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
58	NPR70PU-5LXYKTJ	○	—		—	○	—	—				○		—	○	—	—	—	○	—	—	—	○	—		—	○	—		—	○	—	—
*59	NPR70PU-5LXYSNTJ	○	—		—	○	—	—				○		—	○	—	—	—	○	—	—	—	○	—		—	○	—		—	○	—	—
60	NQR70PU-5LXYUKJ	—	○		—	—	○	—				○		—	—	○	—	—	—	○	—	—	—	○		—	—	○		○	○	—	○
*61	NQR70PU-5NXYKJ	○	—		—	—	—	○				○		—	—	○	—	—	○	—	—	—	○	—		—	—	○		—	○	—	○
62	NQR70PU-5NXYKTJ	○	—		—	—	—	○				○		—	—	○	—	—	○	—	—	—	○	—		—	—	○		—	○	—	○
*63	NQR66RU-5NVXYP	○	—		—	—	—	○				○		—	—	○	—	○	—	—	—	○	—	—		—	—	○		—	○	○	—
64	NQR71RU-5NVXY	○	—		—	—	○	△				○		—	—	○	—	○	—	—	—	○	—	—		—	○	△		—	○	△	—
*65	NQR70RU-5LXYUKJ	—	○		—	—	○	—				○		—	—	○	—	—	—	○	—	—	—	○		—	—	○		○	○	—	○
*66	NQR70RU-5NXYHJ	○	—		—	—	—	○				○		—	—	○	—	—	○	—	—	—	○	—		—	—	○		○	○	—	○
*67	NQR70RU-5NXYZJ	○	—		—	—	—	○				○		—	—	○	—	—	—	○	—	—	—	○		—	—	○		○	○	—	○
*68	NQR70RU-5NXYVJ	○	—		—	—	—	○				○		—	—	○	—	—	○	—	—	—	○	—		—	—	○		—	○	—	○
69	NQR70RU-5NXYKJ	○	—		—	—	—	○				○		—	—	○	—	—	○	—	—	—	○	—		—	—	○		—	○	—	○
*70	NQR70TU-5LXYUKJ	—	○		—	—	○	—				○		—	—	○	—	—	—	○	—	—	—	○		—	—	○		○	○	—	○
71	NQR70TU-5NXYKJ	○	—		—	—	—	○				○		—	—	○	—	—	○	—	—	—	○	—		—	—	○		—	○	—	○
72	NPS71LU-5JXYH	○	—		—	—	○	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		○	○	—	—

FRONT BRAKES (NPR-NQR 1999)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	FRONT BRAKE																			
		DISC BRAKE									DRUM BRAKE										
		WHEEL CYL.			DISC						Type		WHEEL CYL.			DRUM.			LINING		
		Inside dia. (in)			Thickness (mm)			Outside dia. (mm)			2L	D2L	Inside dia. (in)			Inside dia. (mm)			Width (mm)		
		2+1/8	2+2	2+1/4	35	40	42	265	293	310			1+1/8	1+3/16	1+3/8	279.4	300	320	60	75	100	120
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
73	NPR69GL-5DXYE	○		—		○	—		○	—	—	—	—	—	—			—		—	—	—
*74	NPR55GL-5DXYEJ	○		—		○	—		○	—	—	—	—	—	—			—		—	—	—
75	NPR66GL-5JXY2	—		—		—	—		—	—	○	—	○	—	—			○		○	—	—
76	NPR66GDL-5LX	—		—		—	—		—	—	—	○	—	○	—			○		—	○	—
77	NPR66GL-5LXY	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
*78	NPT66GL-5LXYS	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
79	NPR70GL-5JXYEJ2	○		—		○	—		○	—	—	—	—	—	—			—		—	—	—
*80	NPR66GL-5LXYR	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
81	NPR70GL-5LXYRJ2	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
82	NPR69LL-5DXYE	○		—		○	—		○	—	—	—	—	—	—			—		—	—	—
*83	NPR55LL-5DXYEJ	○		—		○	—		○	—	—	—	—	—	—			—		—	—	—
*84	NPR69LL-5HXYE	○		—		○	—		○	—	—	—	—	—	—			—		—	—	—
85	NPR55LL-5HXYEJ	○		—		○	—		○	—	—	—	—	—	—			—		—	—	—
86	NPR55LL-5HXYISJ	○		—		○	—		○	—	—	—	—	—	—			—		—	—	—
87	NPR66LL-5JXA2	—		—		—	—		—	—	○	—	○	—	—			○		○	—	—
88	NPR66LL-5JXY2	—		—		—	—		—	—	○	—	○	—	—			○		○	—	—
89	NPR66LL-5JXAC2	—		—		—	—		—	—	○	—	○	—	—			○		○	—	—
*90	NPR66LL-5JXYC2	—		—		—	—		—	—	○	—	○	—	—			○		○	—	—
91	NPR66LL-5JXAS2	—		—		—	—		—	—	○	—	○	—	—			○		○	—	—
*92	NPR66LL-5JXYS2	—		—		—	—		—	—	○	—	○	—	—			○		○	—	—
93	NPR66LL-5JXYR	—		—		—	—		—	—	○	—	○	—	—			○		○	—	—
*94	NPR70LL-5JXYRJ2	—		—		—	—		—	—	○	—	○	—	—			○		○	—	—
95	NPR66LBL-5JVXY	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
*96	NPR66LL-5LXA	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—

REAR BRAKES (NPR-NQR 1999)

—	Not available
○	Standard
△	Factory option
	Non

		REAR BRAKE																						PARKING BRAKE				BRAKE CONTROL				
		DRUM BRAKE																														
		Type		WHEEL CYL.					DRUM.				LINING				DRUM				LINING				MASTER CYL.								
				Inside dia. (in)					Inside dia. (mm)				Width (mm)				Inside dia. (mm)				Width (mm)				Inside dia. (in)								
		D2L (W/O AUTO)	D2L (W AUTO)	7/8	1	1+3/16	1+5/16	1+3/8	228.6	279.4	300	320	60	75	100	120	178	190	203	254	35	45	50	60	1+1/16	1+1/8	1+1/4	1+3/8	DSPV	LSPV	EXHAUST BRAKE	HYDROMASTER	HBB
No.	Models	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
73	NPR69GL-5DXYE	—	○		○	—	—	—				○		○	—	—	○	—	—	—	○	—	—	—		○	—	—		○	○	—	—
*74	NPR55GL-5DXYEJ	—	○		○	—	—	—				○		○	—	—	○	—	—	—	○	—	—	—		○	—	—		○	○	—	—
75	NPR66GL-5JXY2	○	—		○	—	—	—				○		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
76	NPR66GDL-5LX	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
77	NPR66GL-5LXY	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
*78	NPT66GL-5LXYS	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
79	NPR70GL-5JXYEJ2	—	○		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		○	○	—	—
*80	NPR66GL-5LXYR	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
81	NPR70GL-5LXYRJ2	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
82	NPR69LL-5DXYE	—	○		○	—	—	—				○		○	—	—	○	—	—	—	○	—	—	—		○	—	—		○	○	—	—
*83	NPR55LL-5DXYEJ	—	○		○	—	—	—				○		○	—	—	○	—	—	—	○	—	—	—		○	—	—		○	○	—	—
*84	NPR69LL-5HXYE	—	○		○	—	—	—				○		○	—	—	○	—	—	—	○	—	—	—		○	—	—		○	○	—	—
85	NPR55LL-5HXYEJ	—	○		○	—	—	—				○		○	—	—	○	—	—	—	○	—	—	—		○	—	—		○	○	—	—
86	NPR55LL-5HXYISJ	—	○		○	—	—	—				○		○	—	—	○	—	—	—	○	—	—	—		○	—	—		○	○	—	—
87	NPR66LL-5JXA2	○	—		○	—	—	—				○		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
88	NPR66LL-5JXY2	○	—		○	—	—	—				○		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
89	NPR66LL-5JXAC2	○	—		○	—	—	—				○		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
*90	NPR66LL-5JXYC2	○	—		○	—	—	—				○		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
91	NPR66LL-5JXAS2	○	—		○	—	—	—				○		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
*92	NPR66LL-5JXYS2	○	—		○	—	—	—				○		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
93	NPR66LL-5JXYR	○	—		○	—	—	—				○		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
*94	NPR70LL-5JXYRJ2	○	—		○	—	—	—				○		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
95	NPR66LBL-5JVXY	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
*96	NPR66LL-5LXA	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—

FRONT BRAKES (NPR·NQR 1999)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	FRONT BRAKE																			
		DISC BRAKE									DRUM BRAKE										
		WHEEL CYL.			DISC						Type		WHEEL CYL.			DRUM.			LINING		
		Inside dia. (in)			Thickness (mm)			Outside dia. (mm)					Inside dia. (in)			Inside dia. (mm)			Width (mm)		
		2 + 1 / 8	2 + 2	2 + 1 / 4	35	40	42	265	293	310	2L	D2L	1 + 1 / 8	1 + 3 / 16	1 + 3 / 8	279.4	300	320	60	75	100	120
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
* 97	NPR66LL-5LXY	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
* 98	NPR66LL-5LY	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
* 99	NPR66LL-5LXAC	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
*100	NPR66LL-5LXYC	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
*101	NPR66LL-5LXAS	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
*102	NPR66LL-5LXYS	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
*103	NPR66LL-5LXYR	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
104	NPR66LL-5LXYG	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
105	NPR71LL-5LVXYBRJ	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
*106	NQR71LL-5NVXY	—		—		—	—		—	—	○	—	—	○	△			○		—	—	○
107	NPR70LL-5JXYISJ2	○		—		○	—		○	—	—	—	—	—	—			—		—	—	—
108	NPR70LL-5JXYISTJ	○		—		○	—		○	—	—	—	—	—	—			—		—	—	—
109	NPR70LL-5JXYEJ2	○		—		○	—		○	—	—	—	—	—	—			—		—	—	—
110	NPR71LL-5LVXYJ	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
111	NPR70LL-5LXYRJ2	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
112	NPR71LL-5LVXYCLJ	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
113	NQR70LL-5LXYEJ	—		○		—	○		—	○	—	—	—	—	—			—		—	—	—
114	NQR70LL-5LYXJ	—		—		—	—		—	—	○		—	—	○			○		—	—	○
115	NQR70LL-5LYXJT	—		—		—	—		—	—	○		—	—	○			○		—	—	○
116	NQR70LL-5NXYBRJ	—		—		—	—		—	—	○	—	—	—	○			○		—	—	○
*117	NPR70LL-5HWYISJ2	○		—		○	—		○	—	—	—	—	—	—			—		—	—	—
118	NPR70LL-5HWYISTJ	○		—		○	—		○	—	—	—	—	—	—			—		—	—	—
*119	NPR66PL-5JXA2	—		—		—	—		—	—	○	—	○	—	—			○		○	—	—
*120	NPR66PL-5JXY2	—		—		—	—		—	—	○	—	○	—	—			○		○	—	—

REAR BRAKES (NPR-NQR 1999)

—	Not available
○	Standard
△	Factory option
	Non

		REAR BRAKE																						PARKING BRAKE				BRAKE CONTROL				
		DRUM BRAKE																														
		Type		WHEEL CYL.					DRUM.				LINING				DRUM				LINING				MASTER CYL.								
				Inside dia. (in)					Inside dia. (mm)				Width (mm)				Inside dia. (mm)				Width (mm)				Inside dia. (in)								
		D2L (W/O AUTO)	D2L (W AUTO)	7/8	1	1+3/16	1+5/16	1+3/8	228.6	279.4	300	320	60	75	100	120	178	190	203	254	35	45	50	60	1+1/16	1+1/8	1+1/4	1+3/8	DSPV	LSPV	EXHAUST BRAKE	HYDROMASTER	HBB
No.	Models	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
* 97	NPR66LL-5LXY	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
* 98	NPR66LL-5LY	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
* 99	NPR66LL-5LXAC	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
*100	NPR66LL-5LXYC	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
*101	NPR66LL-5LXAS	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
*102	NPR66LL-5LXYS	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
*103	NPR66LL-5LXYR	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
104	NPR66LL-5LXYG	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
105	NPR71LL-5LVXYBRJ	○	—		—	—	○	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		○	○	—	—
*106	NQR71LL-5NVXY	○	—		—	—	○	△				○		—	—	○	—	○	—	—	—	○	—	—		—	○	△		—	○	△	—
107	NPR70LL-5JXYISJ2	—	○		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		○	○	—	—
108	NPR70LL-5JXYISTJ	—	○		—	○	—	—				○		—	○	—	—	—	○	—	—	—	○	—		—	○	—		○	○	—	—
109	NPR70LL-5JXYEJ2	—	○		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		○	○	—	—
110	NPR71LL-5LVXYJ	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
111	NPR70LL-5LXYRJ2	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
112	NPR71LL-5LVXYCLJ	○	—		—	—	○	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
113	NQR70LL-5LXYEJ	—	○		—	—	○	—				○		—	—	○	—	—	—	○	—	—	—	○		—	—	○		○	○	—	○
114	NQR70LL-5LYXJ	○	—					○				○		—	—	○	—	—	○	—	—	—	○	—		—	—	○		—	○		○
115	NQR70LL-5LYXJT	○	—					○				○		—	—	○	—	—	○	—	—	—	○	—		—	—	○		—	○		○
116	NQR70LL-5NXYBRJ	○	—		—	—	—	○				○		—	—	○	—	—	—	○	—	—	—	○		—	—	○		○	○	—	○
*117	NPR70LL-5HWYISJ2	—	○		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		○	○	—	—
118	NPR70LL-5HWYISTJ	—	○		—	○	—	—				○		—	○	—	—	—	○	—	—	—	○	—		—	○	—		○	○	—	—
*119	NPR66PL-5JXA2	○	—		○	—	—	—				○		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
*120	NPR66PL-5JXY2	○	—		○	—	—	—				○		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—

FRONT BRAKES (NPR-NQR 1999)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	FRONT BRAKE																				
		DISC BRAKE									DRUM BRAKE											
		WHEEL CYL.			DISC						Type		WHEEL CYL.			DRUM.			LINING			
		Inside dia. (in)			Thickness (mm)			Outside dia. (mm)					Inside dia. (in)			Inside dia. (mm)			Width (mm)			
		2 + 1 / 8	2 + 2	2 + 1 / 4	35	40	42	265	293	310	2 L	D 2 L	1 + 1 / 8	1 + 3 / 16	1 + 3 / 8	279.4	300	320	60	75	100	120
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
*121	NPR66PL-5JXYR	—		—		—	—		—	—	○	—	○	—	—			○		○	—	—
*122	NPR70PL-5JXYRJ2	—		—		—	—		—	—	○	—	○	—	—			○		○	—	—
*123	NPR66PBL-5JVXY	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
*124	NPR66PL-5LXA	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
125	NPR66PL-5LXY	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
126	NPR66PL-5LXAC	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
*127	NPR66PL-5LXYC	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
*128	NPR66PL-5LXAS	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
*129	NPR66PL-5LXYS	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
*130	NPR66PL-5LXYR	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
*131	NPR71PL-5LVXYBRJ	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
*132	NQR66PL-5NVXA	—		—		—	—		—	—	○	—	—	○	△			○		—	—	○
*133	NQR71PL-5NVXY	—		—		—	—		—	—	○	—	—	○	△			○		—	—	○
134	NPR70PL-5JXYEJ2	○		—		○	—		○	—	—	—	—	—	—			—		—	—	—
135	NPR70PL-5JXYISJ2	○		—		○	—		○	—	—	—	—	—	—			—		—	—	—
*136	NPR70PL-5JXYISTJ	○		—		○	—		○	—	—	—	—	—	—			—		—	—	—
137	NPR71PL-5LVXYJ	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
138	NPR70PL-5LXYRJ2	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
139	NPR71PL-5LVXYCLJ	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
140	NPR70PL-5LXYCHJ2	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
141	NQR70PL-5LXYEJ	—		○		—	○		○	—	—	—	—	—	—			—		—	—	—
142	NQR70PL-5LYXJ	—		—		—	—		—	—	○	—	—	—	○			○		—	—	○
143	NQR70PL-5LYXJT	—		—		—	—		—	—	○	—	—	—	○			○		—	○	○
144	NQR70PL-5NXYBRJ	—		—		—	—		—	—	○	—	—	—	○			○		—	○	○

REAR BRAKES (NPR-NQR 1999)

—	Not available
○	Standard
△	Factory option
	Non

		REAR BRAKE																														
		DRUM BRAKE																														
		Type		WHEEL CYL.					DRUM.				LINING				DRUM				LINING				MASTER CYL.								
				Inside dia. (in)					Inside dia. (mm)				Width (mm)				Inside dia. (mm)				Width (mm)				Inside dia. (in)								
		D2L (W/O AUTO)	D2L (W AUTO)	7/8	1	1+3/16	1+5/16	1+3/8	228.6	279.4	300	320	60	75	100	120	178	190	203	254	35	45	50	60	1+1/16	1+1/8	1+1/4	1+3/8	DSPV	LSPV	EXHAUST BRAKE	HYDROMASTER	HBB
No.	Models	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
*121	NPR66PL-5JXYR	○	—		○	—	—	—				○		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
*122	NPR70PL-5JXYRJ2	○	—		○	—	—	—				○		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
*123	NPR66PBL-5JVXY	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
*124	NPR66PL-5LXA	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
125	NPR66PL-5LXY	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
126	NPR66PL-5LXAC	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
*127	NPR66PL-5LXYC	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
*128	NPR66PL-5LXAS	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
*129	NPR66PL-5LXYS	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
*130	NPR66PL-5LXYR	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
*131	NPR71PL-5LVXYBRJ	○	—		—	—	○	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		○	○	—	—
*132	NQR66PL-5NVXA	○	—		—	—	○	△				○		—	—	○	—	○	—	—	—	○	—	—		—	○	△		—	○	△	—
*133	NQR71PL-5NVXY	○	—		—	—	○	△				○		—	—	○	—	○	—	—	—	○	—	—		—	○	△		—	○	△	—
134	NPR70PL-5JXYEJ2	—	○		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		○	○	—	—
135	NPR70PL-5JXYISJ2	—	○		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		○	○	—	—
*136	NPR70PL-5JXYISTJ	—	○		—	○	—	—				○		—	○	—	—	—	○	—	—	—	○	—		—	○	—		○	○	—	—
137	NPR71PL-5LVXYJ	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
138	NPR70PL-5LXYRJ2	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
139	NPR71PL-5LVXYCLJ	○	—		—	—	○	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
140	NPR70PL-5LXYCHJ2	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
141	NQR70PL-5LXYEJ	—	○		—	—	○	—				○		—	—	○	—	—	—	○	—	—	—	○		—	—	○		○	○	—	○
142	NQR70PL-5LYXJ	○	—					○				○		—	—	○	—	—	○	—	—	—	○	—		—	—	○		—	○		○
143	NQR70PL-5LYXJT	○	—					○				○		—	—	○	—	—	○	—	—	—	○	—		—	—	○		—	○		○
144	NQR70PL-5NXYBRJ	○	—		—	—	—	○				○		—	—	○	—	—	—	○	—	—	—	○		—	—	○		○	○	—	○

FRONT BRAKES (NPR-NQR 1999)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	FRONT BRAKE																				
		DISC BRAKE									DRUM BRAKE											
		WHEEL CYL.			DISC						Type		WHEEL CYL.			DRUM.			LINING			
		Inside dia. (in)			Thickness (mm)			Outside dia. (mm)			2 L	D 2 L	Inside dia. (in)			Inside dia. (mm)			Width (mm)			
		2 + 1 / 8	2 + 2	2 + 1 / 4	35	40	42	265	293	310			1 + 1 / 8	1 + 3 / 16	1 + 3 / 8	279.4	300	320	60	75	100	120
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
*145	NQR70PL-5NXYCLJ	—		—		—	—		—	—	○	—	—	—	○			○		—	—	○
146	NQR70PL-5NXYCHJ	—		—		—	—		—	—	○	—	—	—	○			○		—	—	○
147	NQR70PL-5NXYRJ	—		—		—	—		—	—	○	—	—	—	○			○		—	—	○
148	NQR70PL-5NXYGJ	—		—		—	—		—	—	○	—	—	—	○			○		—	—	○
149	NQR71RL-5NVXY	—		—		—	—		—	—	○	—	—	○	△			○		—	—	○
*150	NQR70RL-5LXYEJ	—		○		—	○		—	○	—	—	—	—	—			—		—	—	○
*151	NQR70RL-5LYXJ	—		—		—	—		—	—	○	—	—	—	○			○		—	—	○
*152	NQR70RL-5LYXJT	—		—		—	—		—	—	○	—	—	—	○			○		—	—	○
*153	NQR70RL-5NXYBRJ	—		—		—	—		—	—	○	—	—	—	○			○		—	—	○
*154	NQR70RL-5NXYCLJ	—		—		—	—		—	—	○	—	—	—	○			○		—	—	○
*155	NQR70RL-5NXYCHJ	—		—		—	—		—	—	○	—	—	—	○			○		—	—	○
156	NQR70RL-5NXYRJ	—		—		—	—		—	—	○	—	—	—	○			○		—	—	○
*157	NQR70TL-5LXYEJ	—		○		—	○		—	○	—	—	—	—	—			—		—	—	—
158	NQR70TL-5LXYISJ	—		○		—	○		—	○	—	—	—	—	—			—		—	—	—
*159	NQR71PL-5NVXYS	—		—		—	—		—	—	○	—	—	○	△			○		—	—	○
*160	NPR71PL-5LVXYCHJ	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
*161	NPR71GL-5JXYBRJ	—		—		—	—		—	—	○	—	○	—	—			○		○	—	—
162	NPR71LL-5JXYBRJ	—		—		—	—		—	—	○	—	○	—	—			○		○	—	—
*163	NPR71PL-5JXYBRJ	—		—		—	—		—	—	○	—	○	—	—			○		○	—	—
*164	NQR71RL-5NVXYS	—		—		—	—		—	—	○	—	—	○	△			○		—	—	○
167	NPR71GU-5JVXYKJ	—		—		—	—		—	—	○	—	○	—	—			○		○	—	—
*168	NPR71LU-5LVXYKJ	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—
169	NPR71PU-5JVXYKJ	—		—		—	—		—	—	○	—	○	—	—			○		○	—	—
170	NPR71PU-5LVXYKJ	—		—		—	—		—	—	○	—	—	○	—			○		—	○	—

REAR BRAKES (NPR-NQR 1999)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	REAR BRAKE																						PARKING BRAKE				BRAKE CONTROL				
		DRUM BRAKE																														
		Type		WHEEL CYL.					DRUM.				LINING				DRUM				LINING				MASTER CYL.								
				Inside dia. (in)					Inside dia. (mm)				Width (mm)				Inside dia. (mm)				Width (mm)				Inside dia. (in)								
		D2L (W/O AUTO)	D2L (W AUTO)	7/8	1	1+3/16	1+5/16	1+3/8	228.6	279.4	300	320	60	75	100	120	178	190	203	254	35	45	50	60	1+1/16	1+1/8	1+1/4	1+3/8	DSPV	LSPV	EXHAUST BRAKE	HYDROMASTER	HBB
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
*145	NQR70PL-5NXYCLJ	○	—		—	—	—	○				○		—	—	○	—	—	○	—	—	—	○	—		—	—	○		—	○	—	○
146	NQR70PL-5NXYCHJ	○	—		—	—	—	○				○		—	—	○	—	—	○	—	—	—	○	—		—	—	○		—	○	—	○
147	NQR70PL-5NXYRJ	○	—		—	—	—	○				○		—	—	○	—	—	○	—	—	—	○	—		—	—	○		—	○	—	○
148	NQR70PL-5NXYGJ	○	—		—	—	—	○				○		—	—	○	—	—	○	—	—	—	○	—		—	—	○		—	○	—	○
149	NQR71RL-5NVXY	○	—		—	—	○	△				○		—	—	○	—	○	—	—	—	○	—	—		—	○	△		—	○	△	—
*150	NQR70RL-5LXYEJ	—	○		—	—	○	—				○		—	—	○	—	—	—	○	—	—	—	○		—	—	○		○	○	—	○
*151	NQR70RL-5LYXJ	○	—					○				○		—	—	○	—	—	○	—	—	—	○	—		—	—	○		—	○		○
*152	NQR70RL-5LYXJT	○	—					○				○		—	—	○	—	—	○	—	—	—	○	—		—	—	○		—	○		○
*153	NQR70RL-5NXYBRJ	○	—		—	—	—	○				○		—	—	○	—	—	—	○	—	—	—	○		—	—	○		○	○	—	○
*154	NQR70RL-5NXYCLJ	○	—					○				○		—	—	○	—	—	○	—	—	—	○	—		—	—	○		—	○	—	○
*155	NQR70RL-5NXYCHJ	○	—					○				○		—	—	○	—	—	○	—	—	—	○	—		—	—	○		—	○	—	○
156	NQR70RL-5NXYRJ	○	—		—	—	—	○				○		—	—	○	—	—	○	—	—	—	○	—		—	—	○		—	○	—	○
*157	NQR70TL-5LXYEJ	—	○		—	—	○	—				○		—	—	○	—	—	—	○	—	—	—	○		—	—	○		○	○	—	○
158	NQR70TL-5LXYISJ	—	○		—	—	○	—				○		—	—	○	—	—	—	○	—	—	—	○		—	—	○		○	○	—	○
*159	NQR71PL-5NVXYS	○	—		—	—	○	△				○		—	—	○	—	○	—	—	—	○	—	—		—	○	△		—	○	△	—
*160	NPR71PL-5LVXYCHJ	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
*161	NPR71GL-5JXYBRJ	○	—		○	—	—	—				○		○	—	—	—	○	—	—	—	○	—	—		○	—	—		○	○	—	—
162	NPR71LL-5JXYBRJ	○	—		○	—	—	—				○		○	—	—	—	○	—	—	—	○	—	—		○	—	—		○	○	—	—
*163	NPR71PL-5JXYBRJ	○	—		○	—	—	—				○		○	—	—	—	○	—	—	—	○	—	—		○	—	—		○	○	—	—
*164	NQR71RL-5NVXYS	○	—		—	—	○	△				○		—	—	○	—	○	—	—	—	○	—	—		—	○	△		—	○	△	—
167	NPR71GU-5JVXYKJ	○	—		○	—	—	—				○		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
*168	NPR71LU-5LVXYKJ	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
169	NPR71PU-5JVXYKJ	○	—		○	—	—	—				○		○	—	—	—	○	—	—	—	○	—	—		○	—	—		—	○	—	—
170	NPR71PU-5LVXYKJ	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—

FRONT BRAKES (NPR·NQR 1999)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	FRONT BRAKE																				
		DISC BRAKE									DRUM BRAKE											
		WHEEL CYL.			DISC						Type		WHEEL CYL.			DRUM.			LINING			
		Inside dia. (in)			Thickness (mm)			Outside dia. (mm)					Inside dia. (in)			Inside dia. (mm)			Width (mm)			
		2 + 1 / 8	2 + 2	2 + 1 / 4	35	40	42	265	293	310	2L	D2L	1 + 1 / 8	1 + 3 / 16	1 + 3 / 8	279.4	300	320	60	75	100	120
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
171	NPR70LU-5HWYIRJ2	○		—		○	—		○	—	—	—	—	—	—			—		—	—	—
*172	NQR66RU-5NVXY	—		—		—	—		—	—	○	—	—	○	△			○		—	—	○
173	NPR66GDL-5LXS	—		—		—	—		—	—	—	○	—	○	—			○		—	○	—
*174	NPR70GU-5JXYUKJ2	○		—		○	—		○	—	—	—	—	—	—			—		—	—	—
*175	NQR70LL-5LXYISJ	—		○		—	○		—	○	—	—	—	—	—			—		—	—	—
176	NQR70PL-5LXYISJ	—		○		—	○		—	○	—	—	—	—	—			—		—	—	—
177	NQR70RL-5LXYISJ	—		○		—	○		—	○	—	—	—	—	—			—		—	—	—

REAR BRAKES (NPR-NQR 1999)

—	Not available
○	Standard
△	Factory option
	Non

No.	Models	REAR BRAKE																						PARKING BRAKE				BRAKE CONTROL				
		DRUM BRAKE																														
		Type		WHEEL CYL.					DRUM.				LINING				DRUM				LINING				MASTER CYL.								
				Inside dia. (in)					Inside dia. (mm)				Width (mm)				Inside dia. (mm)				Width (mm)				Inside dia. (in)								
		D2L (W/O AUTO)	D2L (W AUTO)	7/8	1	1+3/16	1+5/16	1+3/8	228.6	279.4	300	320	60	75	100	120	178	190	203	254	35	45	50	60	1+1/16	1+1/8	1+1/4	1+3/8	DSPV	LSPV	EXHAUST BRAKE	HYDROMASTER	HBB
No.	Models	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
171	NPR70LU-5HWYIRJ2	—	○		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		○	○	—	—
*172	NQR66RU-5NVXY	○	—		—	—	○	△				○		—	—	○	—	○	—	—	—	○	—	—		—	○	△		—	○	△	—
173	NPR66GDL-5LXS	○	—		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		—	○	—	—
*174	NPR70GU-5JXYUKJ2	—	○		—	○	—	—				○		—	○	—	—	○	—	—	—	○	—	—		—	○	—		○	○	—	—
*175	NQR70LL-5LXYISJ	—	○		—	—	○	—				○		—	—	○	—	—	—	○	—	—	—	○		—	—	○		○	○	—	○
176	NQR70PL-5LXYISJ	—	○		—	—	○	—				○		—	—	○	—	—	—	○	—	—	—	○		—	—	○		○	○	—	○
177	NQR70RL-5LXYISJ	—	○		—	—	○	—				○		—	—	○	—	—	—	○	—	—	—	○		—	—	○		○	○	—	○

SERVICE STANDARD

ITEMS		SERVICE STANDARD	SERVICE LIMIT
FRONT DISC BRAKE ASSEMBLY			
Pad Thickness (φ265mm)	mm (in)	12.0 (0.472)	1.0 (0.039)
Pad Thickness (φ282mm)	mm (in)	14.0 (0.551)	1.0 (0.039)
Pad Thickness (φ293&φ310mm)	mm (in)	13.0 (0.510)	1.0 (0.039)
Piston and Cylinder Clearance	mm (in)	0.08 – 0.18 (0.0031 – 0.0071)	0.23 (0.0091)
Disc Lateral Run out	mm (in)	0.13 (0.005) or less	–
Disc Maximum Parallelism	mm (in)	0.02 (0.0008)	–
Disc Thickness (φ265mm)	mm (in)	30.0 (1.181)	28.5 (1.122)
Disc Thickness (φ282mm)	mm (in)	35.0 (1.378)	32.0 (1.260)
Disc Thickness (φ293mm)	mm (in)	40.0 (1.575)	37.0 (1.457)
Disc Thickness (φ310mm)	mm (in)	42.0 (1.654)	39.0 (1.535)
FRONT DRUM BRAKE ASSEMBLY			
Brake Drum Inside Diameter	mm (in)	279.4 (11.00)	281.0 (11.06)
		300.0 (11.81)	301.5 (11.87)
		320.0 (12.60)	321.5 (12.66)
Brake Drum Run-out	mm (in)	0.13 (0.005) or less	–
Brake Lining Thickness or Rivet Depth	mm (in)	–	1.0 (0.039)
Wheel Cylinder and Piston Clearance	mm (in)	–	0.15 (0.006)
REAR DRUM BRAKE ASSEMBLY			
Brake Drum Inside Diameter	mm (in)	228.6 (9.00)	230.0 (9.06)
		279.4 (11.00)	281.0 (11.06)
		300.0 (11.81)	301.5 (11.87)
		320.0 (12.60)	321.5 (12.66)
Brake Drum Run-out	mm (in)	0.13 (0.005) or less	–
Brake Lining Thickness or Rivet Depth	mm (in)	–	1.0 (0.039)
Wheel Cylinder and Piston Clearance	mm (in)	–	0.15 (0.006)
BRAKE PEDAL AND CONTROL			
Master Cylinder and Piston Clearance		0.11 – 0.195 (0.004 – 0.008)	0.22 (0.009)
	mm (in)	0.09 (0.0035)	0.14 (0.0055)
Safety Valve; Piston and Cylinder Body Clearance	mm (in)	–	0.17 (0.0067)
Hydromaster; Poppet Valve Body and Seat Clearance	mm (in)	1.4 - 2.6 (0.055 - 0.102)	–
Hydromaster; Hydraulic Piston and Cylinder Clearance	mm (in)	–	0.15 (0.0059)
Hydromaster; Relay Valve Piston and Fitting Clearance	mm (in)	–	0.1 (0.0039)
PARKING BRAKE			
Brake Drum Inside Diameter	mm (in)	178.0 (7.01)	179.0 (7.05)
		190.0 (7.48)	191.0 (7.52)
Brake Drum Run-out	mm (in)	0.05 (0.002) or less	–
Brake Lining Thickness	mm (in)	–	1.0 (0.039)
EXHAUST BRAKE			
Butterfly Valve and Body Clearance			
(4HF1 Engine)	mm (in)	0.4 – 0.6 (0.016 – 0.024)	–
(Other Engine)	mm (in)	0.1 – 0.2 (0.004 – 0.008)	–

SERVICING

CONTENTS

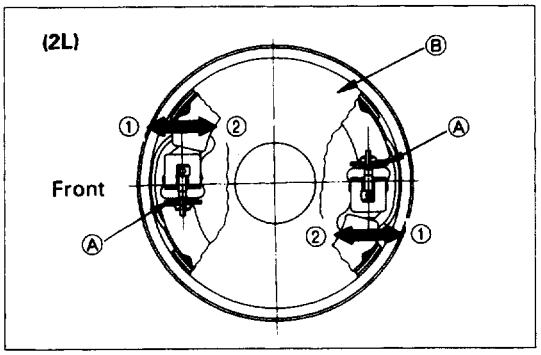
PAGE

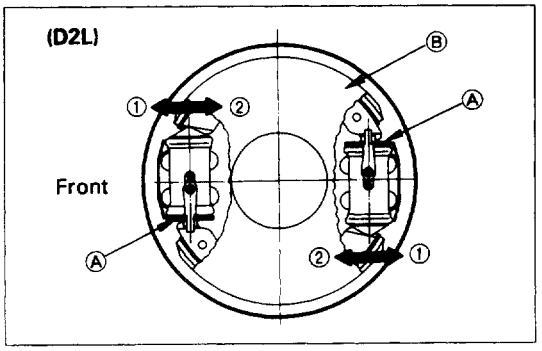
Service Brakes 00-84
- Wheel Brake Adjustment 00-84
- Brake Pedal Adjustment 00-85
- Brake Bleeding 00-87
- Hydraulic Booster Line Bleeding 00-89

Parking Brake 00-92
- Parking Brake Adjustment 00-92

SERVICE BRAKES

Wheel Brake Adjustment





Brake Lining Clearance Adjustment (2L and D2L)

Without auto-adjuster type

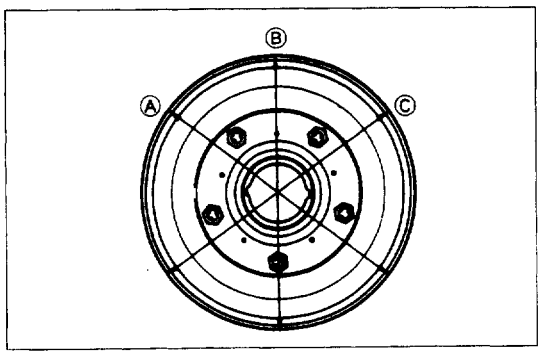
1. Chock the wheels not being adjusted.
2. Jack up the axle until the wheels can be turned freely.
3. Manually shake the wheel to check for excessive play.
4. Remove the grommet fitted to one of the brake drum cover adjuster holes.
5. Insert a screwdriver into the adjuster hole.
   Manually rotate the wheel while turning the adjuster Ⓐ in the direction of the arrow 1 until resistance is felt at the wheel.
6. Back off the adjuster Ⓐ in the direction of the arrow 2 the specified number of notches.

Specified Notched

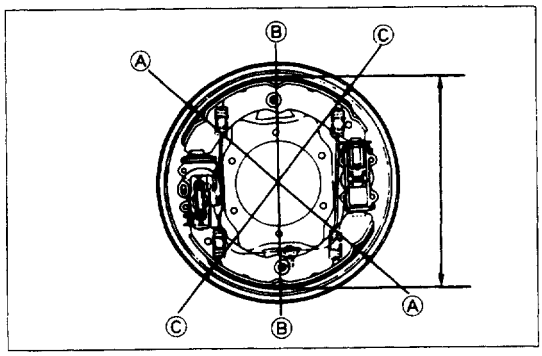
Front Rear	5 – 6

7. Install the grommet to the adjuster hole.
8. Repeat Steps 4 through 7 on the other wheels.
9. Lower the vehicle to the ground.

With auto-adjuster type



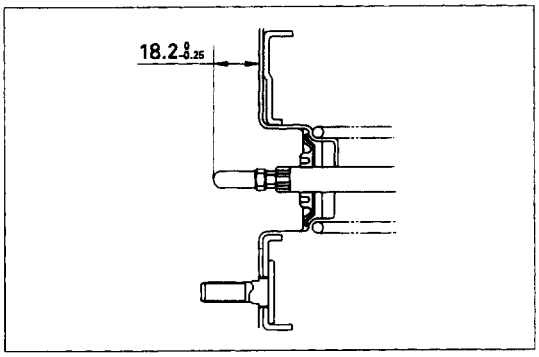
1. Measure the internal diameter of the brake drum.
   - Take measurement of the distance at Ⓐ, Ⓑ and Ⓒ points.



2. Measure the external diameter of the brake shoe.
   - Take measurement of the distance at Ⓐ, Ⓑ and Ⓒ points.
3. Turn the adjuster gear so that the difference between the internal diameter of the brake drum and the external diameter of the brake shoe becomes 0.6 mm.

4. Step on the brake hard while turning the brake drum in the forward direction, or while driving forward.

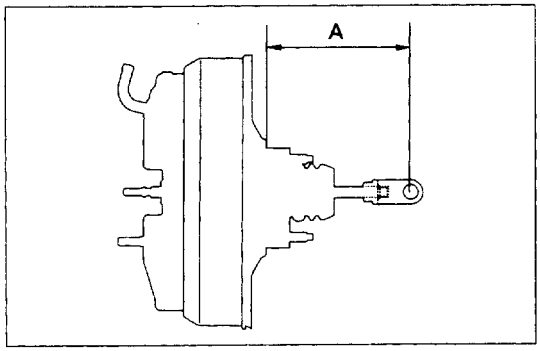
Brake Pedal Adjustment



Brake Pedal Height and Free Play Adjustment

Vacuum Booster (Master Vac) Type:

The height of push rod should be adjusted so that the distance from its master cylinder mounting surface to end measures 18.2mm (0.717 in).

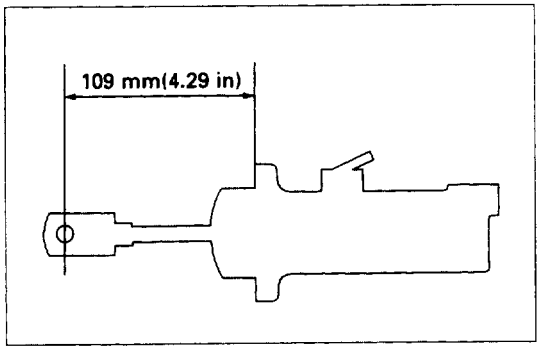


For push rod length adjustment, the distance from the center of crevis pin hole to brake pedal bracket mounting surface should be set at 109 mm (4.291 in); without spacer, 129 mm (5.079 in); with spacer.

When fixed under this condition, there is no need to adjust the height of brake pedal from floor and free play.

Note:

- **As vacuume booster (Master Vac) is undetachable type, it should be replaced as an assembly if does not work well.**
- **Be sure to adjust the stop light switch.**



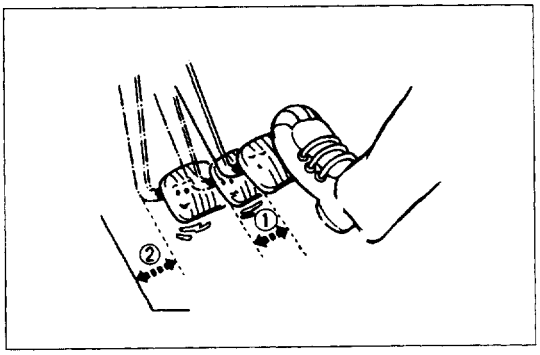
Hydromaster Type:

For push rod length adjustment, the distance from the center of crevis pin hole to brake pedal bracket mounting surface shoud be set at 109 mm (4.29 in).

When fixed under this condition, there is no need to adjust the height of brake pedal from floor and free play.

Note:

- **Be sure to adjust the stop light switch.**



Brake pedal free play and allowance

Standard value: mm (in)

① Free play: 4 to 7 (0.16 to 0.28)

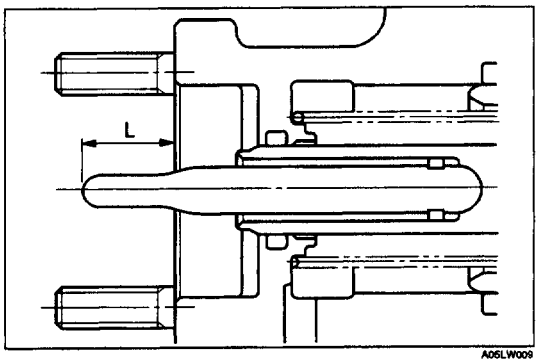
1 to 3 (0.04 to 0.12)...Hydromaster type

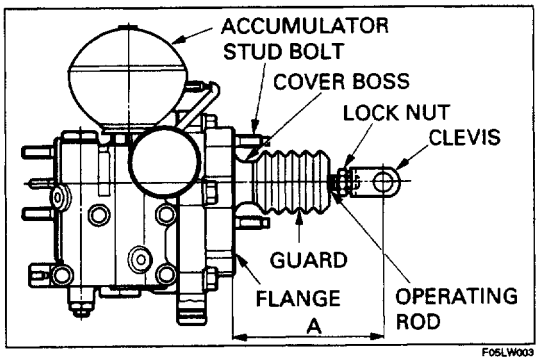
② Allowance:

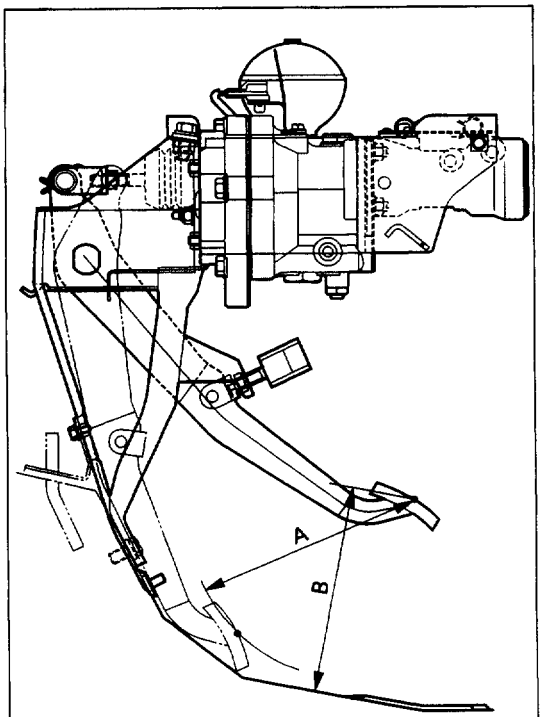
mm (in)

NHR	Front Disc Brake Model		40 (1.57)
	Front Drum Brake Model		50 (1.97)
NKR	Front Disc Brake Model		40 (1.57)
	Front Drum Brake Model	GVM 6.5 ton	40 (1.57)
		Except GVM 6.5 ton	60 (2.36)
NPR NQR	Front Disc Brake Model		40 (1.57)
	Front Drum Brake Model	Less than GVM 7.0 ton	60 (2.36)
		GVM 7.0 ton or more	40 (1.57)
NQR	Hydromaster Model		50 (1.97)
NPS			40 (1.57)

(When depressed with force of the 50 kg (110 lbs).)







Hydraulic Booster Type

Push Rod Length

- Use a scale to measure the push rod length (push rod to flange face clearance).
  Push Rod Length "L" to 17.95 – 18.2 mm (0.707 – 0.717 in).
  If the push rod length is not equal to the specification, the hydraulic booster assembly must be replaced.

Operating Rod Length

1. Loosen the jam nut at the stop lamp switch.
2. Loosen the jam nut on the hydraulic booster operating rod
3. Turn the operating rod until the distance from the centre of clevis pin hole to mounting surface of the brake pedal bracket should be set at 109 ± 1 mm (4.29 ± 0.04 in).
   When fixed under this condition, there is no need to adjust the brake pedal height and free play.
4. Tighten the operating rod jam nut.

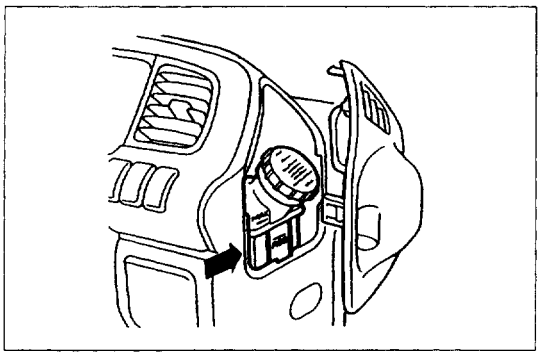
Jam Nut	N·m(kg·m / lb·ft)
	20 (2.0 / 14)

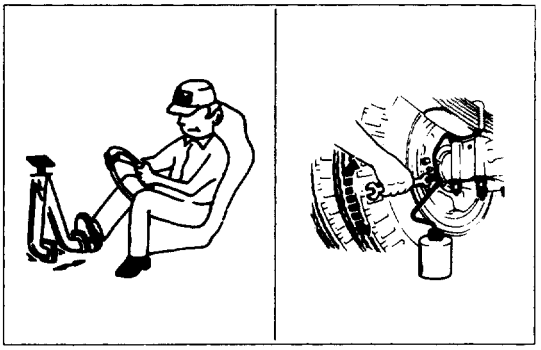
5. Stop lamp switch so that the end of the switch threaded portion contacts the brake pedal, then back-off the switch 1/2 turn.

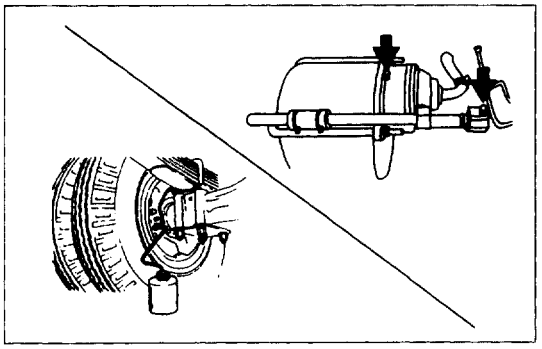
Stop Lamp Switch Lock Nut	N·m(kg·m / lb·ft)
	20 (2.0 / 14)

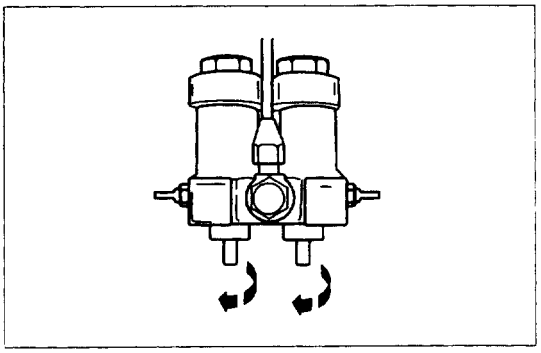
6. Check brake pedal operation to be sure it's operating properly.

- Measure the brake pedal free play, after reducing the pressure of the hydraulic oil in the accumulator by pedal operations at least 10 times with engine off.
  Brake pedal normal play is between 21 – 24 mm (0.83 – 0.94 in).
- Pressing the brake pedal with a force of 294 N (66 lb) with the engine on, the clearance between the brake pedal and floor panel is more than 35 mm (1.4 in).
- Brake pedal height "B" is 167 mm (6.58 in) (reference)
- Brake pedal travel "A" is between 180 ± 5 mm (7.09 ± 0.2 in) (reference).









Brake Bleeding

Brake Bleeding Precautions

Air in the brake hydraulic circuit will result in dangerous reduced braking efficiency.

The brake hydraulic circuit must be bled whenever the vehicle has been operated with the reservoir brake fluid level at an excessively low level or any time the brake pipes have been disconnected in the course of brake servicing.

The brake bleeding procedure requires the cooperative action of two men.

Brake Bleeding Procedure

Bleed the brake hydraulic circuit in the following sequence.

LHD

Right-hand rear wheel → DSPV or LSPV (If so equipped) → Right-hand front wheel → Left-hand front wheel → Hydromaster (If so equipped)

RHD

Right-hand rear wheel → DSPV or LSPV (If so equipped) → Left-hand front wheel → Right-hand front wheel → Hydromaster (If so equipped)

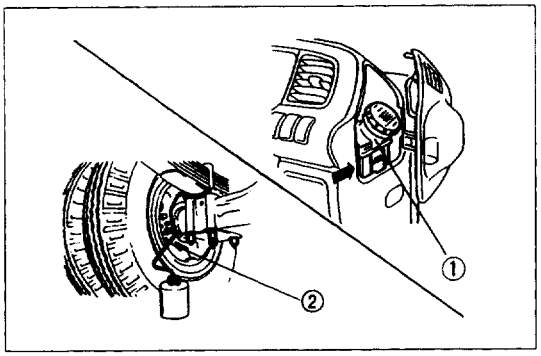
1. Check to make sure that the service area is well ventilated.

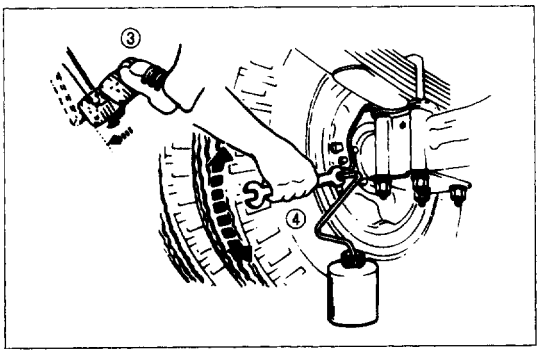
   Start the engine and allow it to run until the vacuum pressure rises sufficiently.

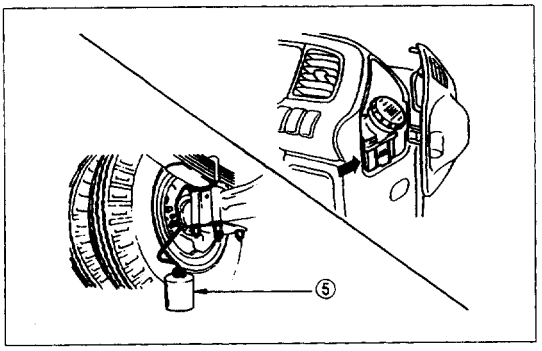
Notes:

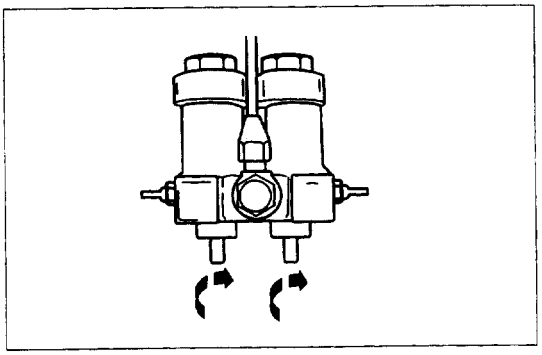
Brake booster (master-vac or hydromaster) will be adversely effected if bleeding operation is performed without running engine.

If the vehicles is equipped with hydromaster, turn the bleeder valves on the safety valves counterclockwise (on front and rear brake circiuts) until they are brought into light contact with the stoppers.









2. Fill the brake fluid reservoir ① up to the "MAX" level with clean brake fluid.

   It may be necessary to replenish the brake fluid reservoir several times during the bleeding procedure to maintain the required level of brake fluid.

Note:

Pour the brake fluid carefully so as not to produce air bubbles.

3. Remove the right hand rear wheel cylinder bleeder screw rubber cap and wipe it clean.
4. Connect one end of a vinyl tube ② to the bleeder screw.
5. Insert the other end of the vinyl tube into a transparent container approximately 1/3 full of brake fluid.
6. Pump the brake pedal ③ several times and hold it depressed.
7. Loosen the bleeder screw ④ approximately 1/2 of a turn.

   This will release the brake fluid with air bubbles into the transparent container ⑤.
8. When the brake fluid being released into the transparent container is completely free of air bubbles, retighten the bleeder screw ④.
9. Slowly release the brake pedal.
10. Replace the bleeder screw rubber cap.

Notes:

- **Be sure to maintain the brake fluid reservoir level at ll times during the bleeding procedure. Replenish the brake fluid as required.**

11. Repeat Steps 3 through 10 for each bleeder screws as mentioned before.

Notes:

If the vehicle is equipped with hydromaster, securely tighten the bleeder valve on the safety valves. If this operation is omitted, the brakes will be held in normal function but the safety valves will be held out of service.

Hydraulic Booster Line Bleeding

Bleeding Precautions

After removing the hydro boost assembly or piping and making repairs, do not run the vehicle until you perform the below-described air bleeding and then verify that everything is normal, including hydro boost boosting and accumulator operation.

Bleeding Procedure

1. Attach the hydro boost and the master cylinder to the vehicle and connect the piping.
2. Fill the hydro boost reservoir with hydraulic oil between its minimum and maximum range.
3. Turn the engine on for about 5 seconds.
4. Then turn the engine off and check the quantity of hydraulic oil in the reservoir.
5. If the hydraulic oil is below the minimum, pour in more hydraulic oil so that it is in the range from minimum to maximum.
6. Repeat the above steps 2 – 5 until there is no foaming or change in the level of the hydraulic oil in the reservoir. But if the hydraulic oil foams during the above steps, let it stand for a while, wait for the foam to dissipate, then continue the work.
7. With the engine on, repeatedly press the brake pedal slowly about five times.
8. Then turn the engine off and check the quantity of hydraulic oil in the reservoir. If the hydraulic oil is below the minimum, once again pour in more hydraulic oil so that it is in the range from minimum to maximum.
9. Leaving the engine off, repeatedly press the brake pedal at least ten times.
10. Verify that there is no foam or change in the level of the hydraulic oil in the reservoir. If any foam remains, let it stand for a while, wait for the foam to dissipate, then repeat the above steps 7 – 9.
11. If it is necessary at this time to bleed out the air from the brake fluid pressure system, such as the master cylinder or the wheel cylinder, be sure to first complete step 10 above and make sure that the engine is on.
12. With the engine on, strongly press the brake pedal as far as the booster full load region slowly and repeatedly about 30 times, (for 1 – 3 seconds each time). When doing so, do not keep the pedal at the full load region (no longer than 1 second).
13. Then turn the engine off and repeatedly press the brake pedal at least 10 times.
14. Check the state of the hydraulic oil in the reservoir, and if there is no foaming or change in the level of the oil, the operation of bleeding the air out is considered completed. If any foam remains, let it stand for a while, wait for the foam to dissipate, then repeat the above steps 12 – 13.

Notes:

Precautions when bleeding the air from the brake fluid pressure system
When doing air bleeding of the brake fluid pressure system, such as the master cylinder or wheel cylinder, verify that the air has been bled out of the hydro boost, and make sure that the engine is on.
Be aware that if air bleeding of the brake fluid system is to be done with the engine off, air bleeding cannot be done.
If air bleeding of the brake fluid pressure system is to be done at the same time as air bleeding of the hydro boost, do so when the operation of the above hydro boost air bleeding method 10 has been complete.

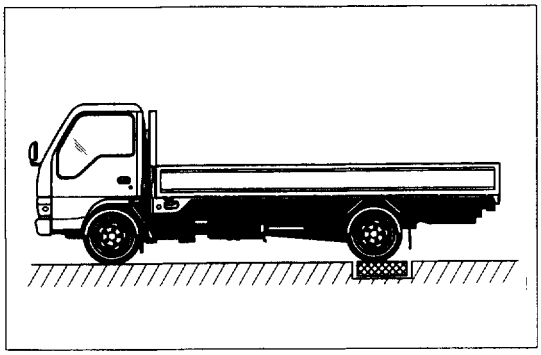
Supply Parts Replacement

1. The hydro boost is a precision part that operates with high-pressure hydraulic oil. Never remove any parts from the hydro boost except replacement parts. Trouble may occur if a part other than a replacement part is removed and a non-matching part is included or the assembly is bad. For example, misoperation may occur and the brake becomes ineffective, or a bad seal may allow high-temperature hydraulic oil under high pressure to spatter and cause a burn.
2. The hydraulic oil to be used for the hydra boost is ATF DEXRON® III. Using any other hydraulic oil could adversely affect the rubber parts and cause poor operation or oil leakage.
   In particular, the hydraulic oil for the hydro boost is quite different from the brake fluid that is used in the master cylinder.
   Be careful that hydro boost parts do not come into contact with the brake fluid for the master cylinder, and that master cylinder parts do not come into contact with the hydraulic oil for the hydro boost. Any mixing together of the hydraulic oil for the hydro boost and the brake fluid for the master cylinder could cause degradation such as the swelling of rubber parts, brake failure due to oil leakage or bad operation, or a serious mishap such as a vehicle fire caused by brake friction.
3. Operation of the pump while the engine is on will cause the hydro boost hydraulic oil to get hot. In particular, frequent repeated operation of the brake will sometimes increase the temperature of the hydraulic oil in the hydro boost assembly to 100°C or more. Be careful in handling.
   When performing work such as removing the hydro boost assembly from the vehicle, before starting the work, first turn the engine off, wait 30 minutes, and verify that the temperature has cooled off.
4. Even when a long time passes after the engine is turned off, the high-pressure hydraulic oil in the accumulator of the hydro boost remains stored under pressure.

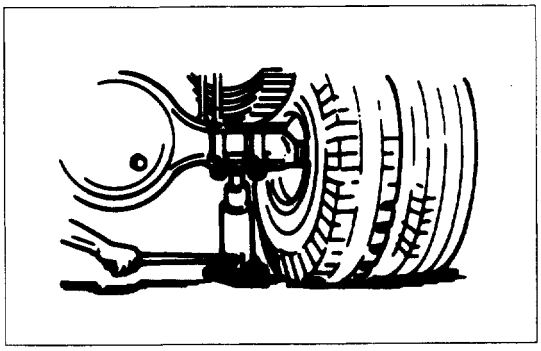
Before removing the hydro boost assembly or piping, be sure to repeatedly press the brake pedal at least ten times with the engine off, and make sure the pressure of the hydraulic oil in the accumulator has been reduced to atmospheric pressure before doing the work.
In particular, when removing the replacement-part accumulator from the hydro boost assembly, the hydraulic oil may spatter if it remains stored under high pressure inside the accumulator, so be careful of this.

PARKING BRAKE

Parking Brake Adjustment

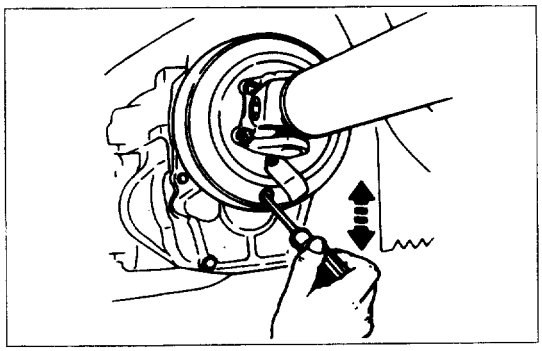


Before beginning to adjust the parking brake, park the vehicle on a level surface, chock all of the wheels, and place the parking brake lever in the released (off) position.



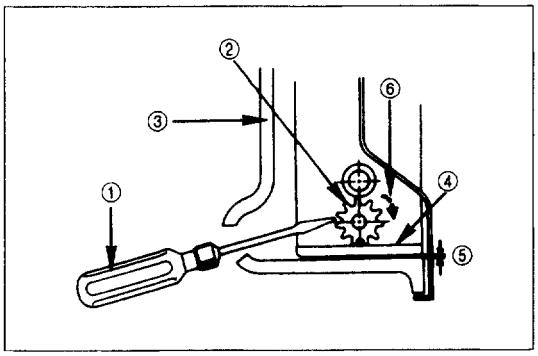
Parking Brake Lining Clearance Adjustment

1. Jack up the rear axle until the wheels can be turned freely.
2. Remove one of the two check hole covers from the parking brake drum.
3. Rotate the brake drum to align the check hole with the adjusting screw.
4. More the camshaft lever from side to side several times to center the brake shoes.



5. Insert a screwdriver into the check hole and rotate the adjusting screw by pushing it upward.

   Continue doing this until the brake shoes begin to drag on the drum.
6. Back off the adjusting screw the specified number of notches.

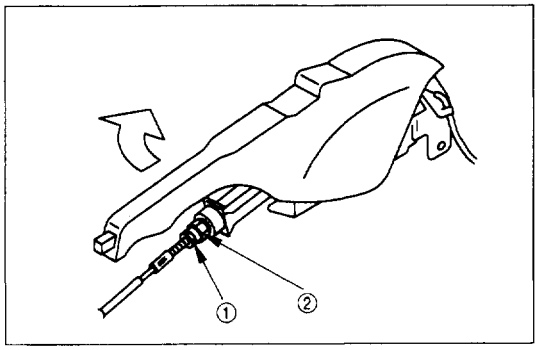


Adjusting Screw Notches and Clearance

Notches	Clearance mm (in)
30	0.75 (0.029)

1 Screwdriver
2 Adjusting screw
3 Brake drum
4 Brake shoe
5 Clearance
6 Direction of brake shoe expansion

7. Reinstall the check hole cover.
8. Lower the rear wheels to the floor.



Parking Brake Lever Travel Adjustment

1. Fully set the parking brake lever and release it several times.
   Leave the parking brake lever in the released position.
2. Loosen the parking brake control wire lock nut ①.
3. Turn the adjuster ② to adjust the lever travel to the specified notches.

Parking brake lever travel at 15 kg (33 lbs/147 N) notches

5 to 8

4. Retighten the control wire lock nut 1.
5. Check the parking brake lever travel (measured in notches).

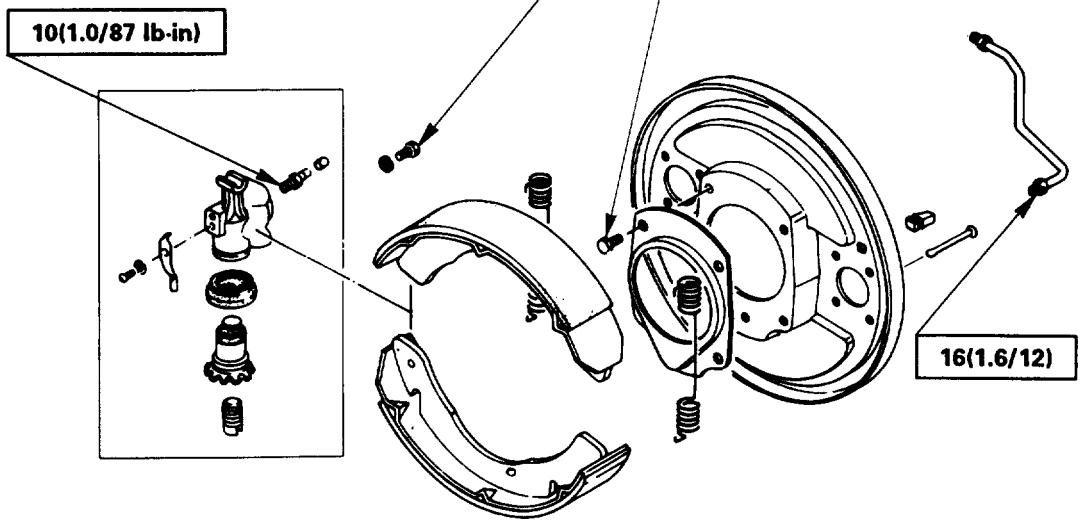
FIXING TORQUE

Front Wheel Brake (NHR·NKR·NPR·NQR)

N·m (kg·m/lb·ft)

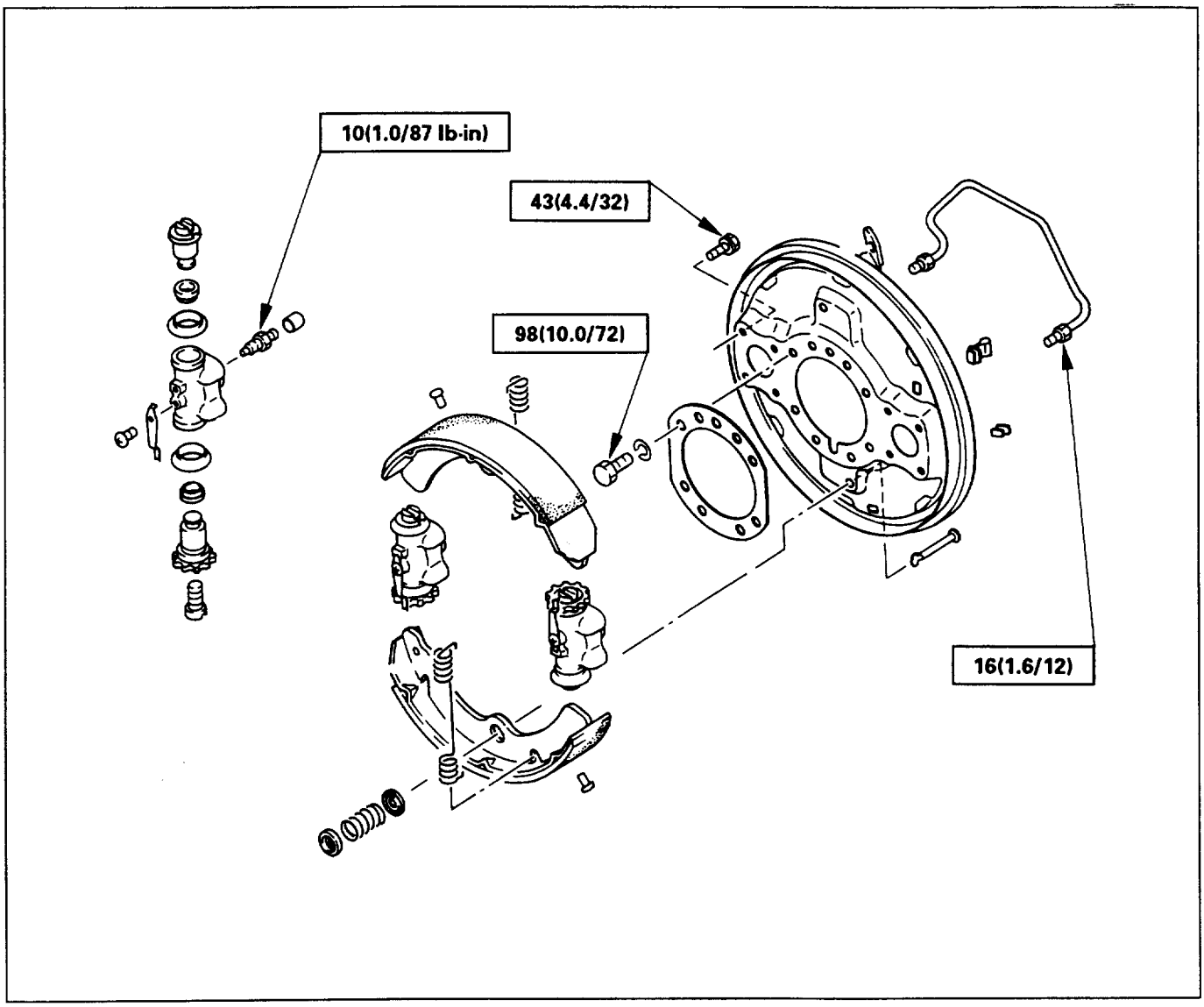
Drum Inside Dia. mm (in)	Lining Width mm (in)	Fixing Torque
279.4 (11.00)	60 (2.36)	27 (2.8 / 20)
300.0 (11.81)	75 (2.95)	34 (3.5 / 25)
320.0 (12.60)		43 (4.4 / 32)
320.0 (12.60)	100 (3.94)	74 (7.5 / 54)
320.0 (12.60)	120 (4.72)	94 (9.5 / 69)

Lining Width mm (in)	Fixing Torque
60 (2.36)	69 (7.0 / 51)
75 (2.95)	
100 (3.94)	
120 (4.72)	157 (16.0 / 116)



Front Wheel Brake (NPS66)

N·m (kg·m/lb·ft)



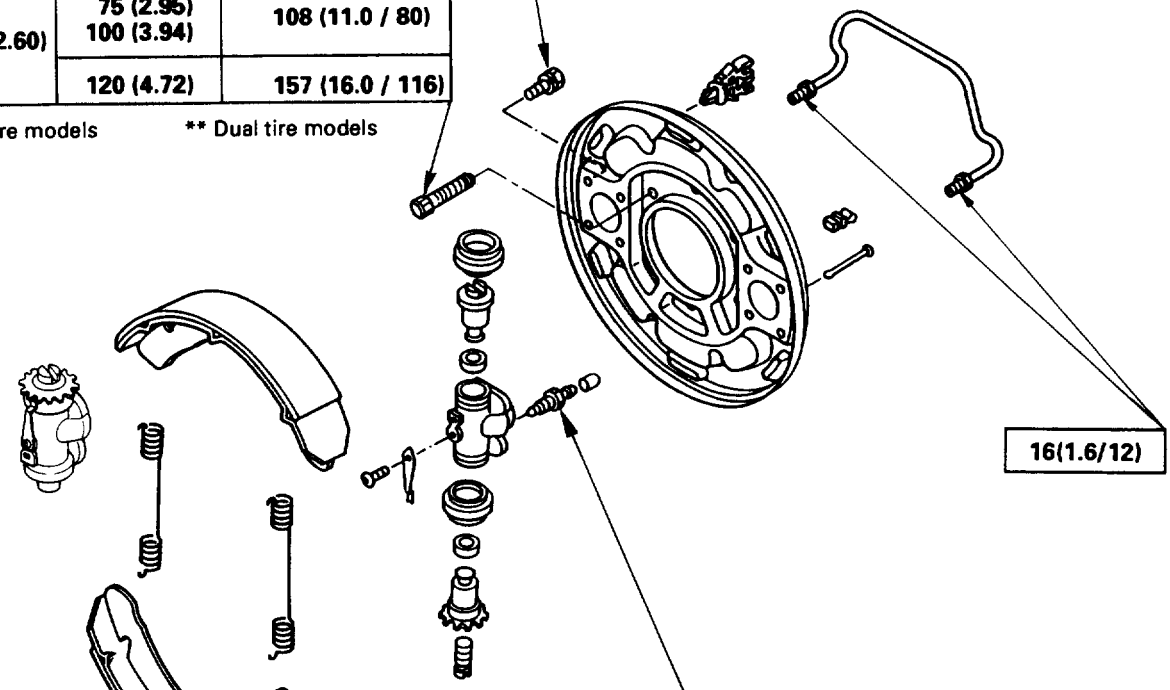
Rear Wheel Brake

N·m (kg·m/lb·ft)

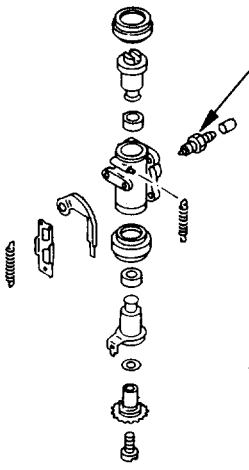
Drum Inside Dia. mm (in)	Lining Width mm (in)	—
228.6 (9.00)	75 (2.95)	108 (11.0 / 80)
279.4 (11.00)	60 (2.36)	74 (7.5 / 54)
300.0 (11.81)	75 (2.95)	* 44 (4.5 / 33) **108 (11.0 / 80)
320.0 (12.60)	75 (2.95) 100 (3.94)	108 (11.0 / 80)
	120 (4.72)	157 (16.0 / 116)

*Single Tire models ** Dual tire models

Drum Inside Dia. mm (in)	Lining Width mm (in)	—
228.6 (9.00)	75 (2.95)	34 (3.5 / 25)
279.4 (11.00)	60 (2.36)	27 (2.8 / 20)
300.0 (11.81)	75 (2.95)	34 (3.5 / 25)
320.0 (12.60)	75 (2.95)	43 (4.4 / 32)
	100 (3.94)	94 (9.6 / 69)
	120 (4.72)	94 (9.6 / 69)



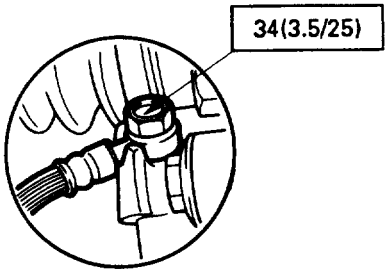
(Without Auto-Adjuster)



(With Auto-Adjuster)

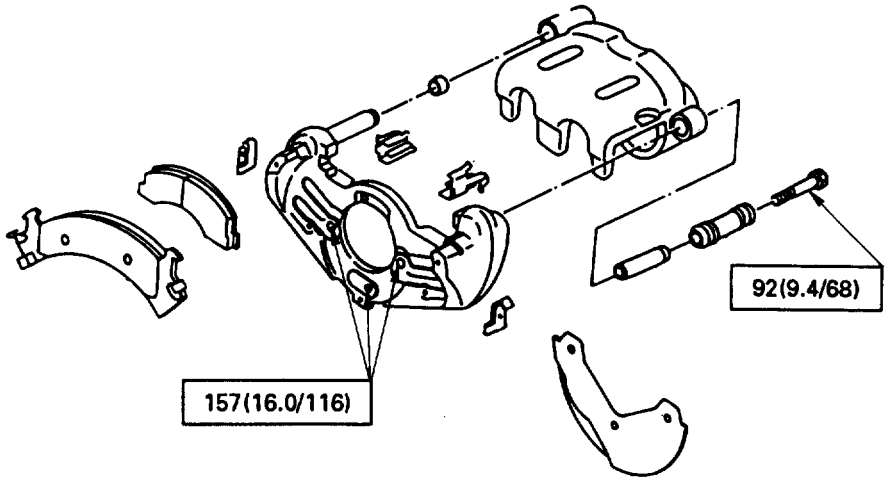
Front Disc Brake (NHR·NKR·NPR)

N·m (kg·m/lb·ft)

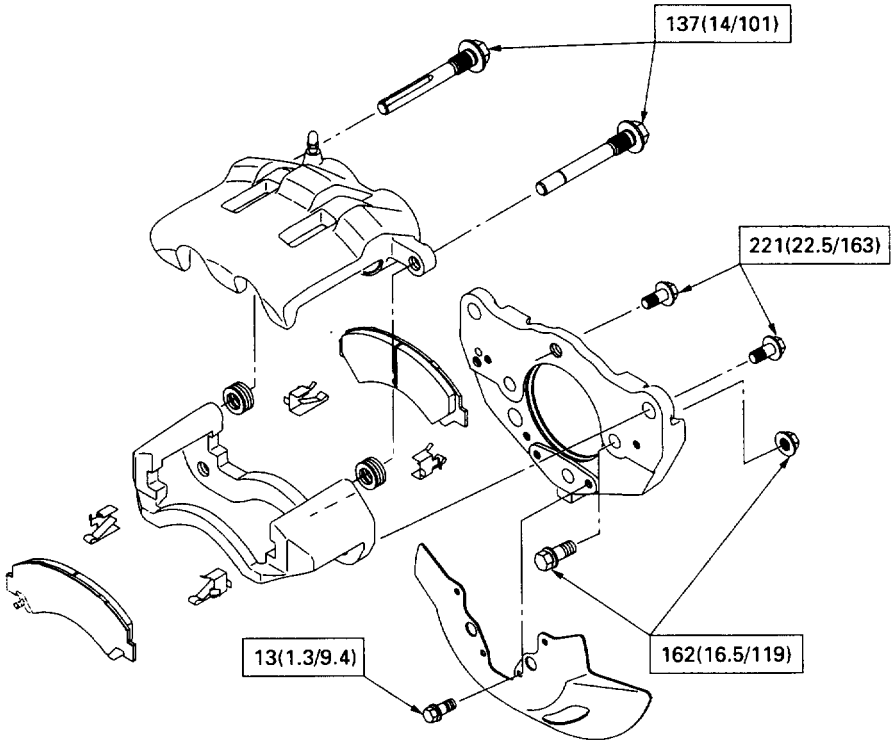


Leaf Spring Suspension Models (Rigid Axle Type)

ϕ 282 mm



ϕ 310 mm

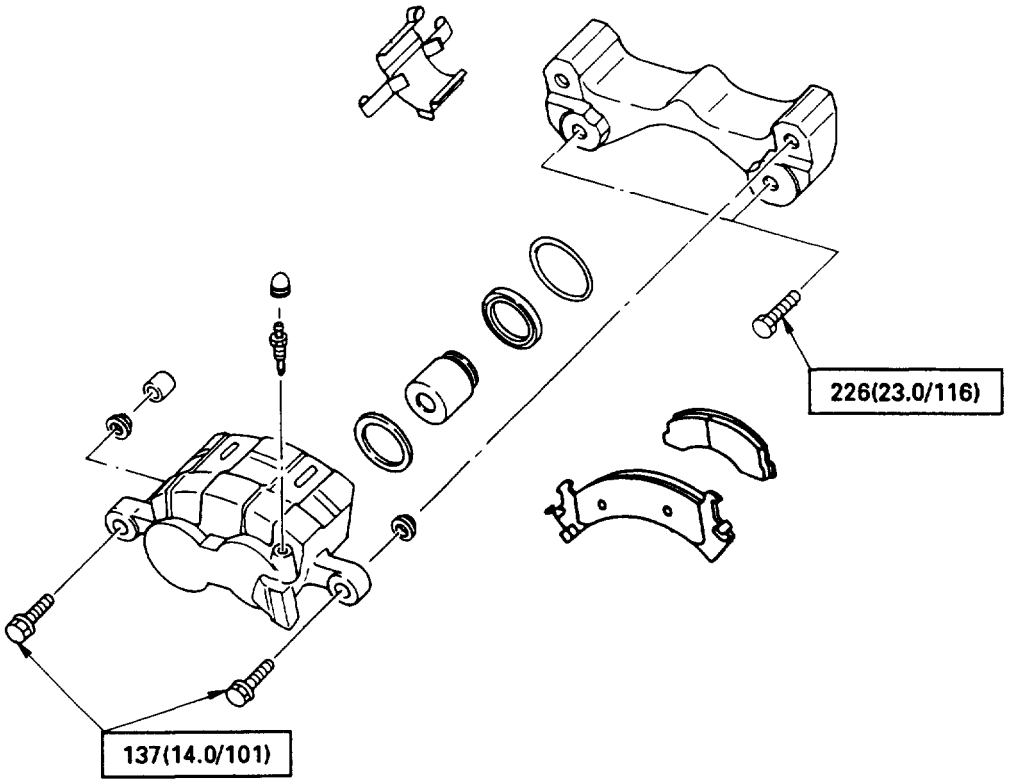


302LV013

Front Disc Brake (NHR·NKR·NPR)

N·m (kg·m/lb·ft)

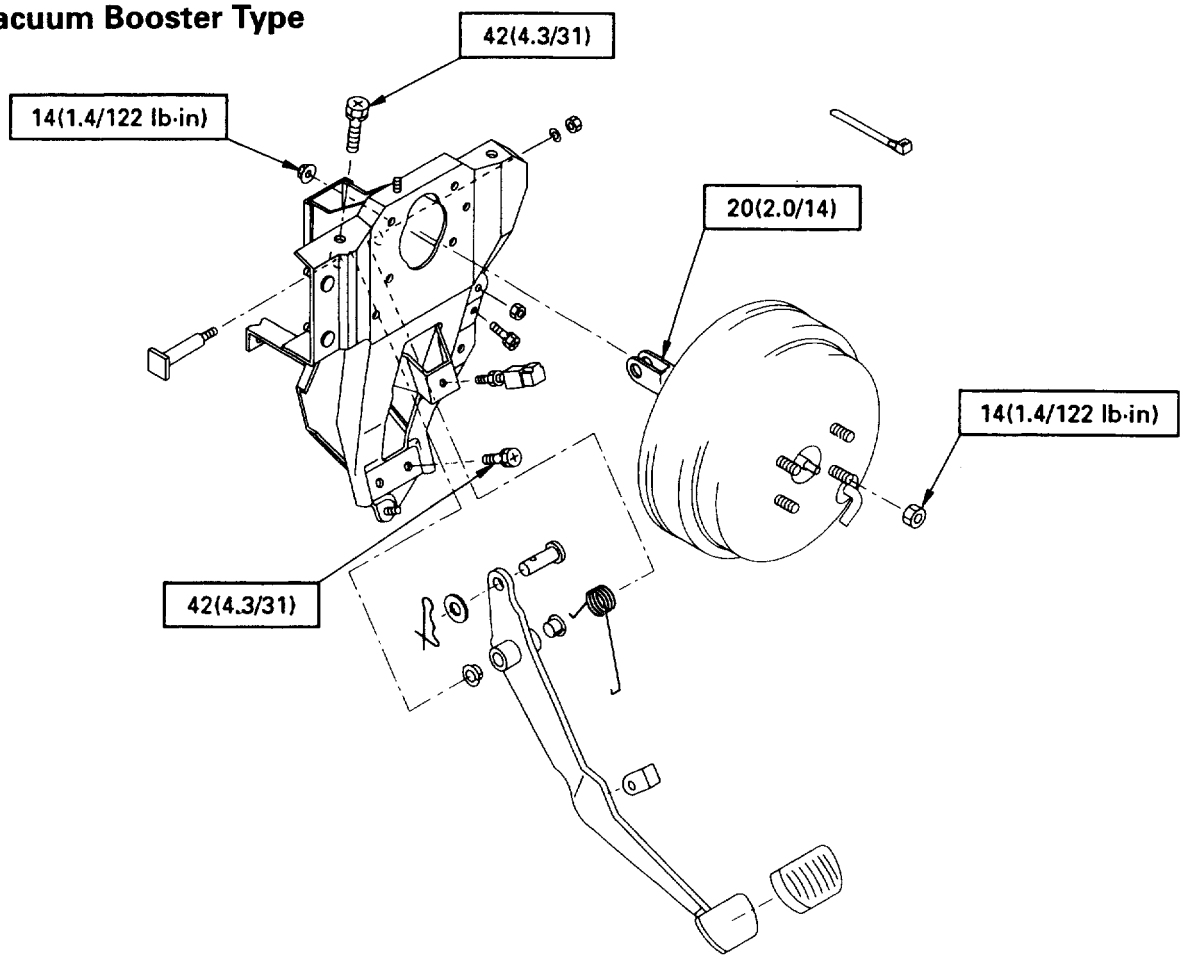
Independent Suspension Models



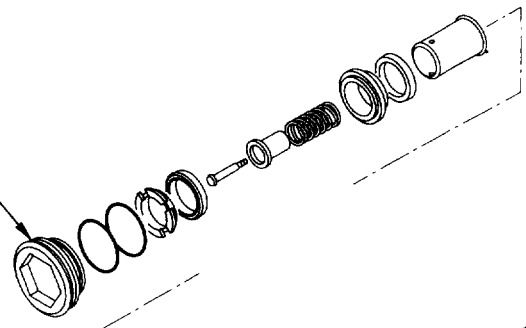
Brake Pedal and Control

N·m (kg·m/lb·ft)

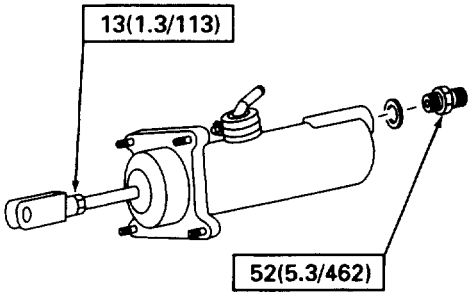
Vacuum Booster Type

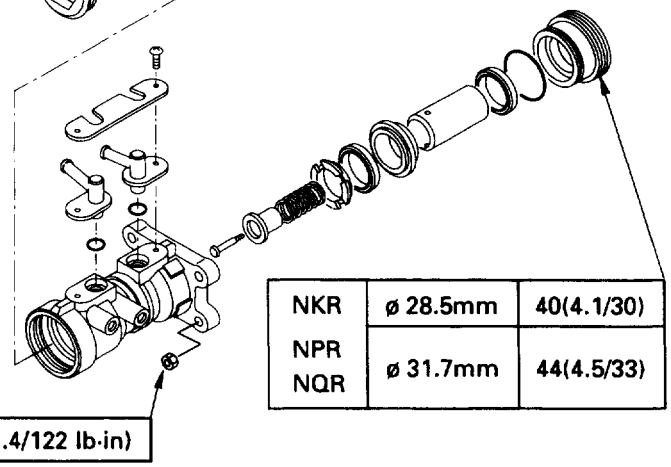


NKR	ø 28.5mm	40(4.1/30)
NPR NQR	ø 31.7mm	44(4.5/33)



NQR with Hydromaster

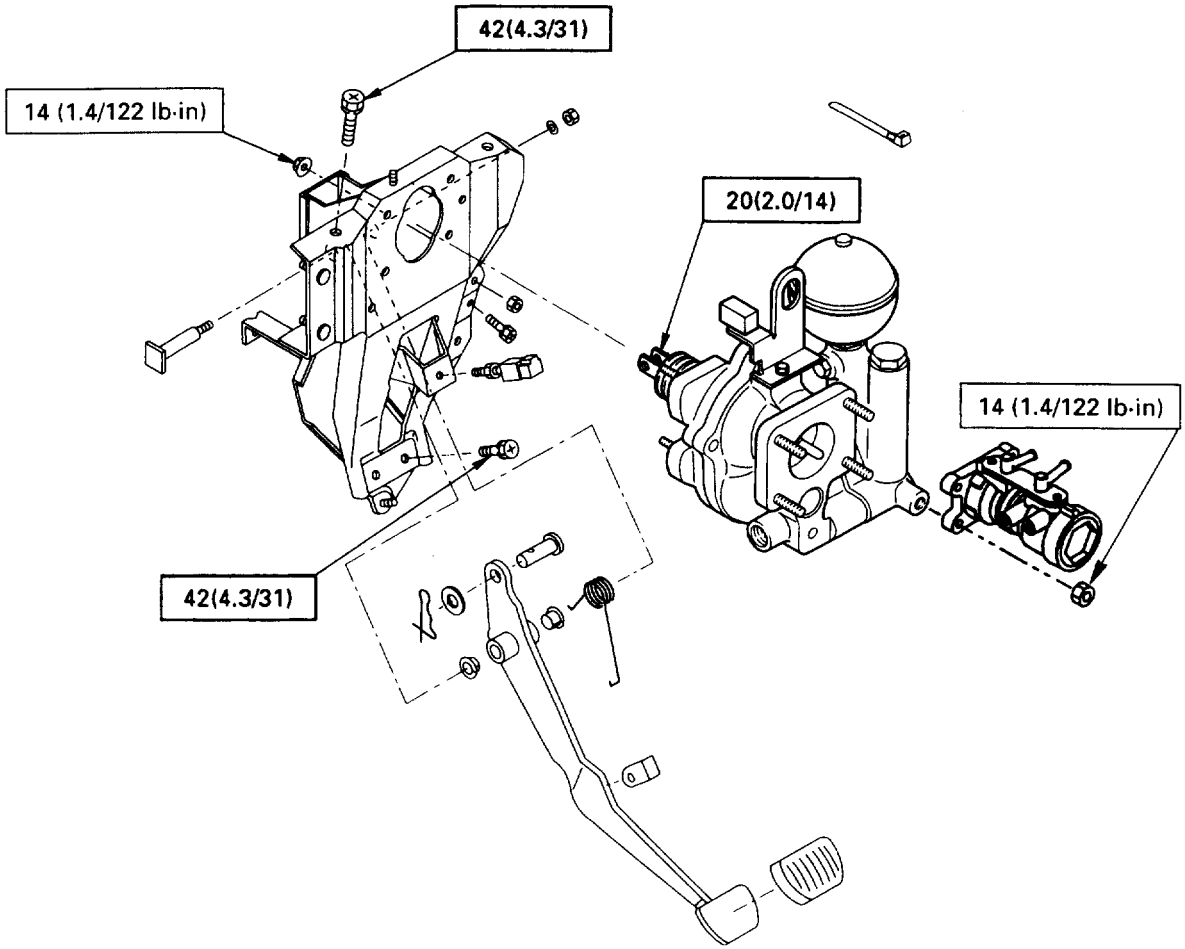




NKR	ø 28.5mm	40(4.1/30)
NPR NQR	ø 31.7mm	44(4.5/33)

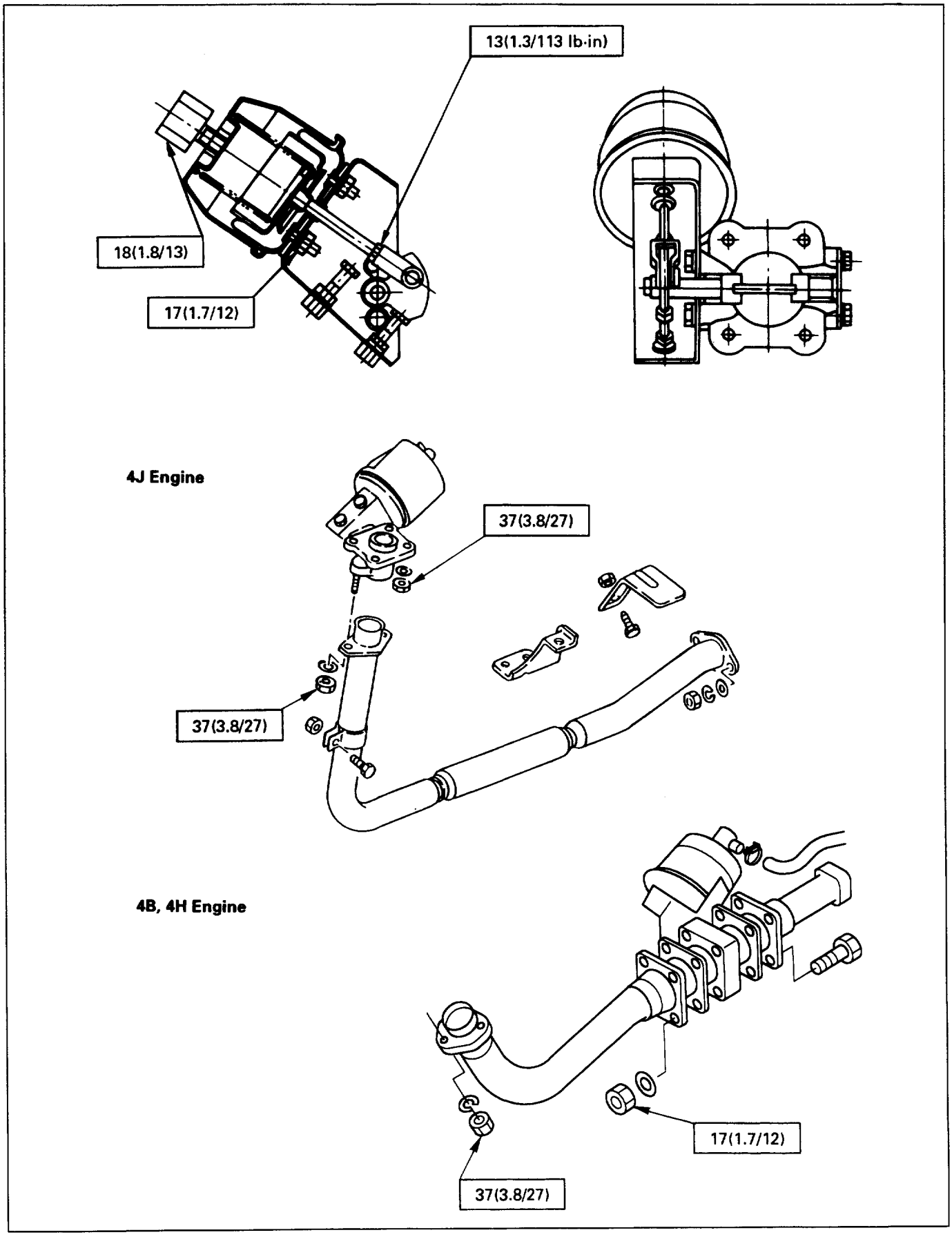
N·m (kg·m/lb·ft)

Hydraulic Booster Type



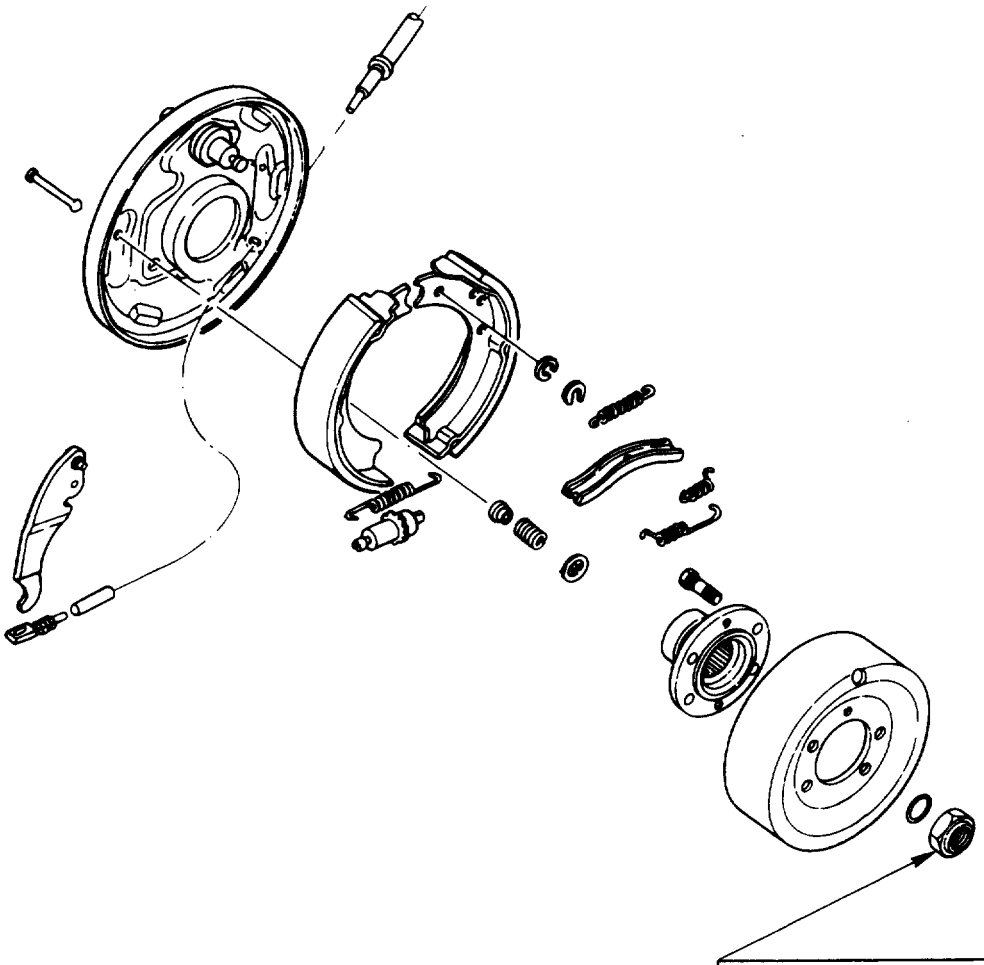
Exhaust Brake

N·m (kg·m/lb·ft)



Parking Brake Drum

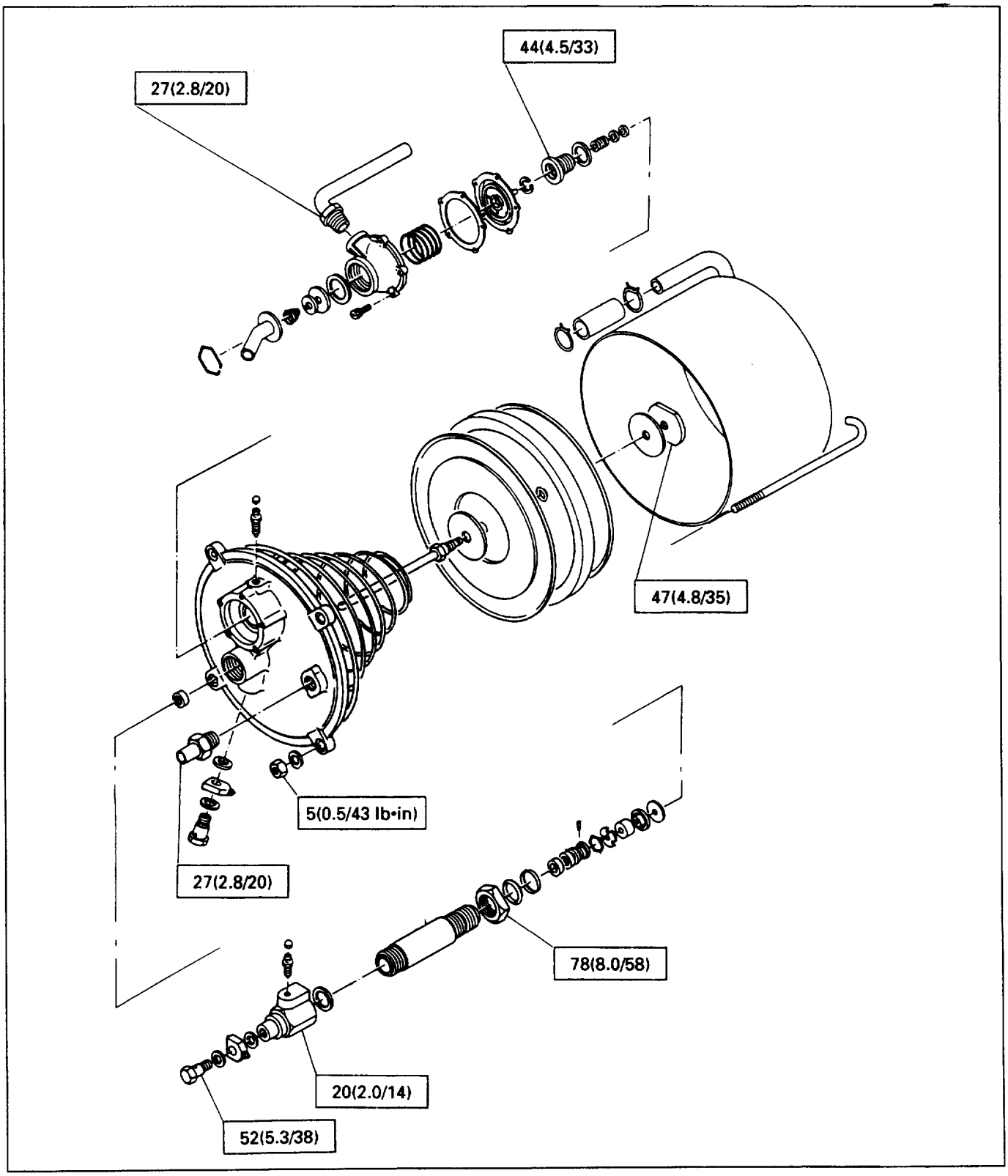
N·m (kg·m/lb·ft)



MSA, MSB, MXA (M/T)	226 (23.0/166)
MBP (M/T)	588 (60/434)
JR403E (AT)	123 (12.5/90)

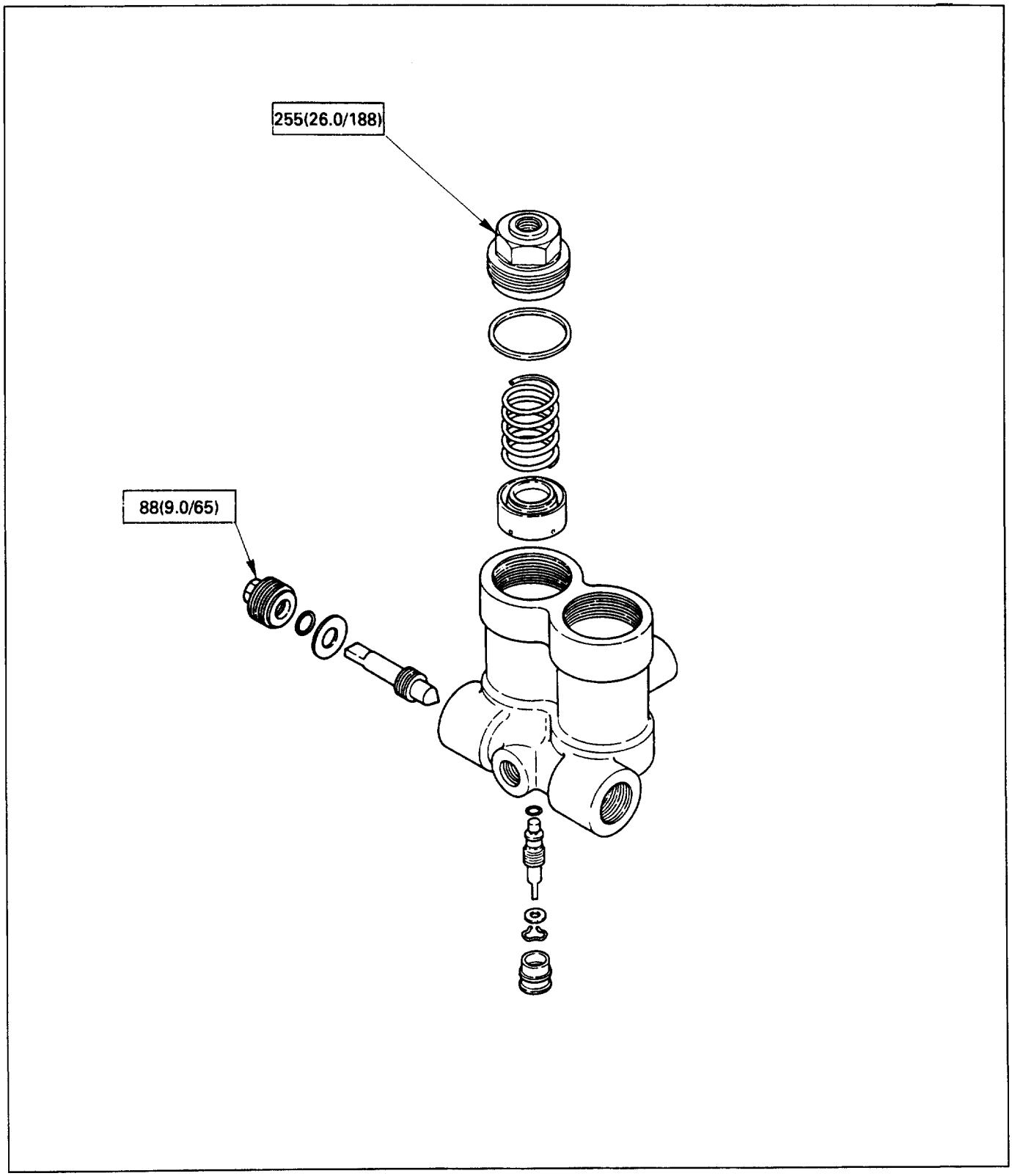
Hydromaster

N·m (kg·m/lb·ft)

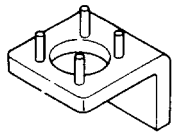
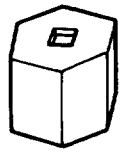
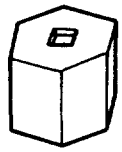
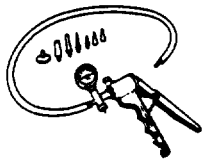
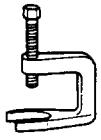
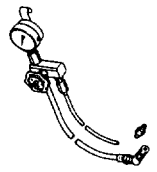


Safety Valve

N·m (kg·m/lb·ft)



SPECIAL TOOLS

ILLUSTRATION	PART NO. ISUZU	PART NAME	SERVICE BRAKE	EXHAUST BRAKE
	5-8840-2371-0	Master Cylinder Support plate	●	—
	5-8840-2370-0	Wrench (Cylinder inside diameter 31.7 ø)	●	—
	5-8840-2369-0	Wrench (Cylinder inside diameter 28.5 ø)	●	—
	5-8840-0279-0	Vacuum pump	—	●
	5-8840-2215-0	Remover: steering wheel	●	—
	5-8840-2190-0	Pressure Gauge: brake fluid	●	—

SECTION 5A
HYDRAULIC BRAKES

CONTENTS

PAGE

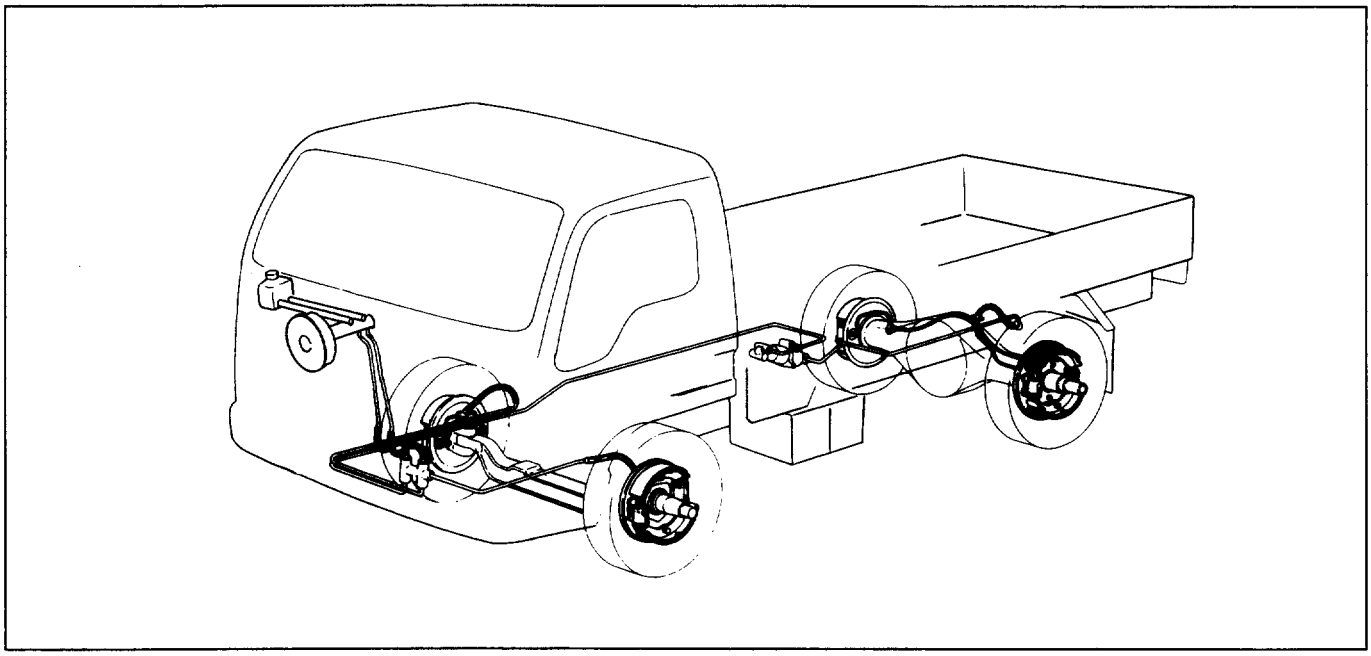
General Description . . . . . 5A - 4
On-vehicle Service . . . . . 5A - 20
Front Disc Brake Assembly . . . . . 5A - 20
Leaf Spring Suspension Models (ϕ282mm) . . . . . 5A - 20
Removal . . . . . 5A - 20
Inspection and Repair . . . . . 5A - 22
Installation . . . . . 5A - 24
Front Disc Brake Pad Replacement . . . . . 5A - 28
Leaf Spring Suspension Models (ϕ293 & ϕ310mm) . . . . . 5A - 29
Removal . . . . . 5A - 29
Inspection and Repair . . . . . 5A - 31
Installation . . . . . 5A - 33
Front Disc Brake Pad Replacement . . . . . 5A - 37
Independent Suspension Models (NHR and NKR) . . . . . 5A - 38
Removal . . . . . 5A - 38
Inspection and Repair . . . . . 5A - 41
Installation . . . . . 5A - 43
Front Drum Brake Assembly . . . . . 5A - 45
Two Leading and Dual Two Leading . . . . . 5A - 45
Removal . . . . . 5A - 45
Inspection and Repair . . . . . 5A - 48
Installation . . . . . 5A - 50
Rear Drum Brake Assembly . . . . . 5A - 54
Removal . . . . . 5A - 54
Inspection and Repair . . . . . 5A - 57
Installation . . . . . 5A - 59

Brake Pedal and Control ..... 5A - 63
Brake Vacuum Booster and Brake Pedal Assembly ..... 5A - 63
Removal ..... 5A - 63
Installation ..... 5A - 66
Master Cylinder Assembly ..... 5A - 70
Removal ..... 5A - 70
Installation ..... 5A - 72
Hydraulic Booster and Brake Pedal Assembly ..... 5A - 74
Removal ..... 5A - 74
Installation ..... 5A - 77
Hydraulic Booster ..... 5A - 79
Removal ..... 5A - 79
Installation ..... 5A - 81
Accumulator and O-ring Replacement ..... 5A - 83
Clevis and Lock Nut Replacement ..... 5A - 85
Guard Replacement ..... 5A - 86
Load Sensing Proportioning Valve ..... 5A - 87
Removal ..... 5A - 87
Installation ..... 5A - 88
Load Sensing Proportioning Valve Adjustment ..... 5A - 89
Deceleration Sensing Proportioning Valve ..... 5A - 92
Unit Repair ..... 5A - 93
Wheel Cylinder Assembly ..... 5A - 93
Disassembly ..... 5A - 93
Inspection and Repair ..... 5A - 94
Reassembly ..... 5A - 95
Wheel Cylinder Assembly (Without Auto-adjuster) ..... 5A - 97
Disassembly ..... 5A - 97
Inspection and Repair ..... 5A - 98
Reassembly ..... 5A - 99
Wheel Cylinder Assembly (With Auto-adjuster) ..... 5A - 101
Disassembly ..... 5A - 101
Inspection and Repair ..... 5A - 102
Reassembly ..... 5A - 103

Master Cylinder Assembly (NHR) . . . . . 5A - 107
Disassembly . . . . . 5A - 107
Inspection and Repair . . . . . 5A - 108
Reassembly . . . . . 5A - 109
Master Cylinder Assembly (NKR•NPR•NQR without Hydromaster) . . . . . 5A - 111
Disassembly . . . . . 5A - 111
Inspection and Repair . . . . . 5A - 113
Reassembly . . . . . 5A - 114
Master Cylinder Assembly (NQR with Hydromaster) . . . . . 5A - 118
Disassembly . . . . . 5A - 118
Inspection and Repair . . . . . 5A - 119
Reassembly . . . . . 5A - 120
Hydromaster . . . . . 5A - 122
Safety Valve . . . . . 5A - 144

GENERAL DESCRIPTION

Hydraulic Brake System

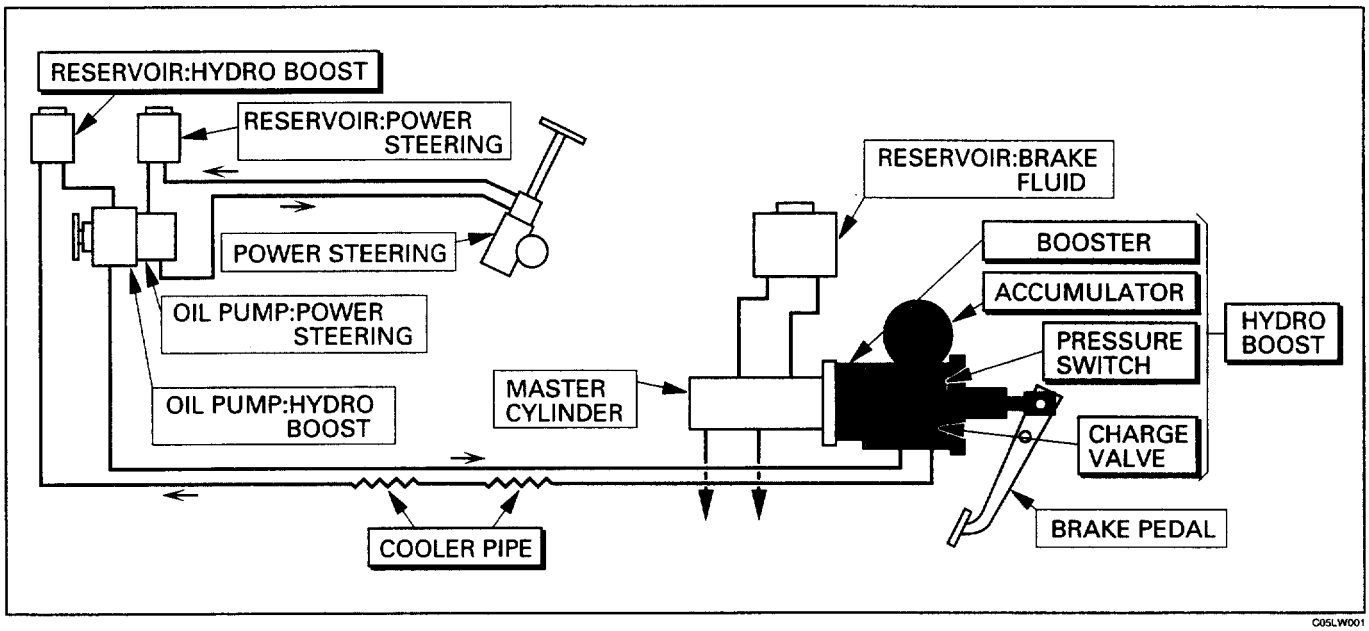


The brake system has dual hydraulic circuit with vacuum booster (Master-vac).

The master cylinders and the wheel cylinders at the front and rear of the vehicle are connected by steel piping and flexible hoses.

The vacuum booster is connected to the vacuum pump the through the vacuum tank. This provides the most effective vacuum assist.

Hydraulic Booster Brake System



The Hydro Boost system, which functions as a brake force boosting device that allows the brake to be operated with less force than otherwise, includes the Hydro Boost, which has the booster, accumulator, charge valve, and pressure switch in an integrated structure, a reservoir, and a cooler pipe.

Functions of the main constituent parts

Booster:	Controls the hydraulic oil ejected from the oil pump and amplifies the force on the pedal.
Accumulator:	Accumulates the hydraulic oil under pressure for the boosting operation after the pump stops.
Charge valve:	Performs switching operation and feeds the hydraulic oil to the accumulator when the accumulator oil pressure declines.
Pressure switch:	Detects that the accumulator oil pressure has declined to the warning set pressure and operates the warning buzzer.
Oil pump:	Is driven by the engine rotation and feeds the hydraulic oil to the hydro boost through the piping.
Reservoir:	The pump stores the hydraulic oil for doing suction and expulsion.
Cooler pipe:	Located before the radiator, facilitates heat radiation of the hydraulic oil in the system piping, and inhibits an increase in the temperature of the oil.

Other units relating to this system include, as shown in the figure, the power steering, the pump and reservoir for the power steering, the master cylinder, which receives the output of the hydro boost and activates the brake, the reservoir for the master cylinder, and the brake pedal that activates the booster.

The master cylinder is integrally bolted to the booster of the hydro boost. The pump for the power steering is integrated as a tandem pump that shares the hydro boost pump and the drive unit. But as systems, the hydro boost and the power steering are independent of each other, and their reservoirs are separate as well.

Booster assembly

The hydraulic booster is a device that applies force to the master cylinder when the brake pedal is applied. The fluid flowing through the booster head is controlled by brake pedal movement.

The hydraulic booster cylinder rod attaches to a piston that connects with the spool valve, This assembly moves when brake pedal pressure is applied. The spool valve restricts fluid flow and builds pressure on one side of the piston. The pressure overcomes the return spring and moves the piston to a balanced position. As the piston moves, it pushes the cylinder rod and applies pressure to the master cylinder.

A relief valve inside the pump limits the pressure to 11,770 kPa (1670 psi). This pressure level provides good braking without damaging the brake pipes or hoses. When actuated, the relief valve allows fluid to bypass the piston.

Fluid and fluid handling

This system uses no special fluids. However, care must be taken to use the correct fluids. The master cylinder and brake system uses brake fluid, while the hydraulic brake booster pump uses power steering fluid.

Substandard or contaminated fluid

NOTICE: Hydraulic brake systems use two distinct and incompatible fluids. Power steering fluid is used in the hydraulic booster brake system. Brake fluid is used in the master cylinder and brake pipes to the wheels. Be extremely careful when selecting brake system fluids or seal damage can result. Refer to SECTION 0B to select the correct fluid.

NOTICE: Do not reuse brake system fluids. Do not mix power steering fluid with brake fluid. Swelling and deterioration of rubber parts can result from fluid contamination. The can lead to reduced brake performance and the eventual loss of braking capability.

Contaminated fluid causes swelling and deterioration of rubber parts that can lead to reduced brake performance and the eventual loss of braking capability. Check the condition of the fluid at regular intervals and note any unusual consistency, color, and sings of contaminants in the fluid. Do not reuse brake system fluids. Always discard used fluids. Do not mix power steering fluid with hydraulic brake fluid. If contamination occurs, flush the hydraulic booster system with clean power steering fluid.

Booster components bench servicing should be done in a clean work area separated from the brake servicing area. Wash hands before changing between brake or booster work areas. Do not use the same containers for fluids.

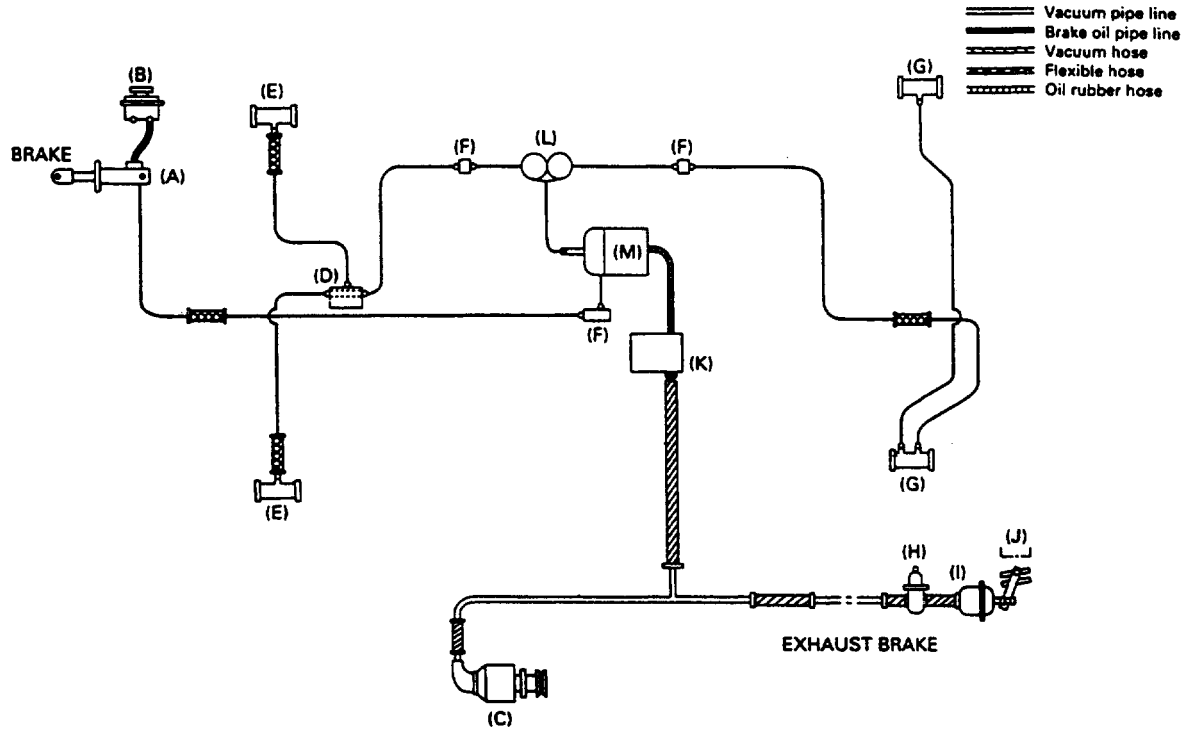
Flushing the hydraulic booster system

Flushing is required when dirt, sludge, or water is found in the system. Flushing involves running clean fluid through the system until the draining fluid appears the same as clean fluid.

Contaminated fluid in the booster system can cause rubber parts to deteriorate.

The hydraulic booster system should be cleaned and flushed when the hydraulic pump is replaced. Metal shavings from a worn hydraulic pump often contaminate the system. Pipes and hoses should be removed and blown clean of all metal shavings.

Hydraulic Brake System (NQR with Hydromaster)

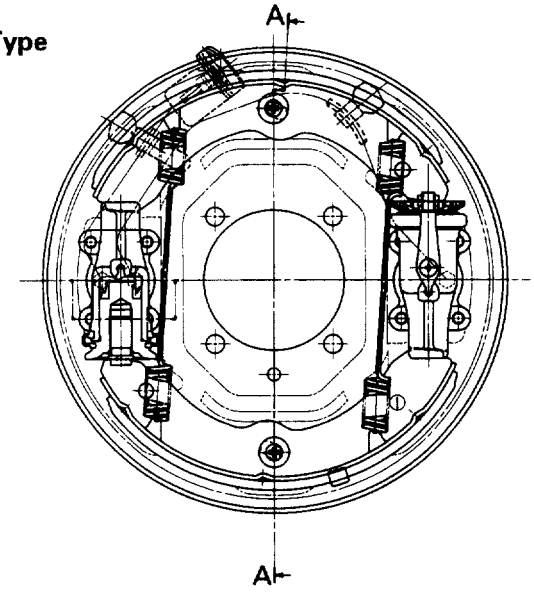


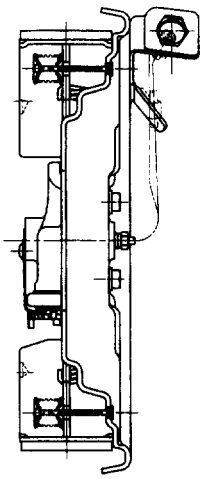
(A) Master cylinder (B) Oil tank (C) Vacuum pump (D) 3-way connector
(E) Front wheel cylinder (F) 2-way connector (G) Rear wheel cylinder
(H) Magnetic valve (I) Power chamber (J) Exhaust valve (K) Vacuum tank
(L) Safety valve (M) Hydromaster

This brake system uses a single hydraulic circuit with a hydromaster and safety valve.
The brake master cylinder and wheel cylinders are connected by steel pipe and flexible hoses through the hydromaster and safety valve.
To provide the maximum vacuum assist, the hydromaster is connected to the vacuum pump through the vacuum tank.

Front Drum Brake

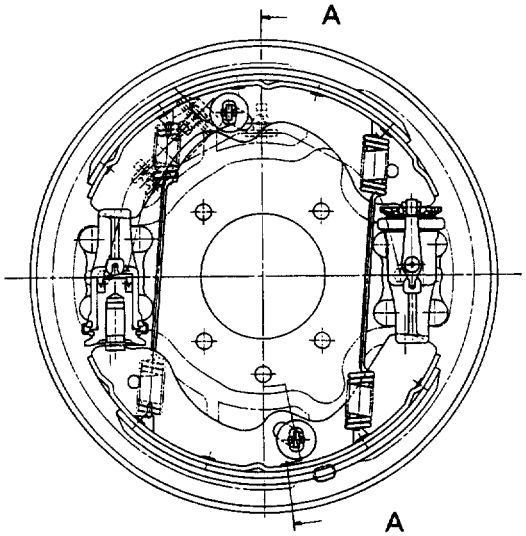
Drum Inside Diameter
279.4 & 300 mm – 2L Type

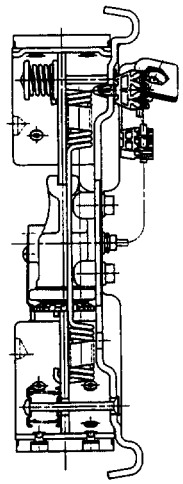




Section A-A

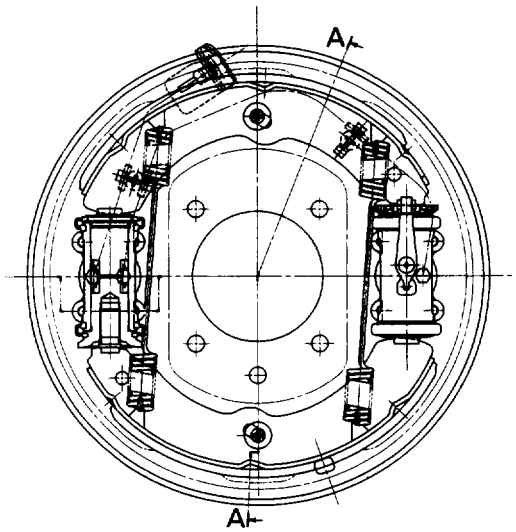
Drum Inside Diameter
320 mm – 2L Type

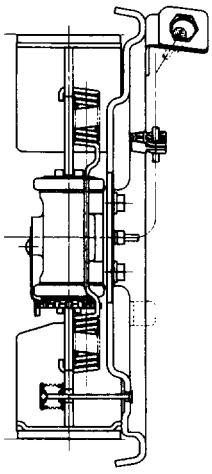




Section A-A

Drum Inside Diameter
300 mm – D2L Type

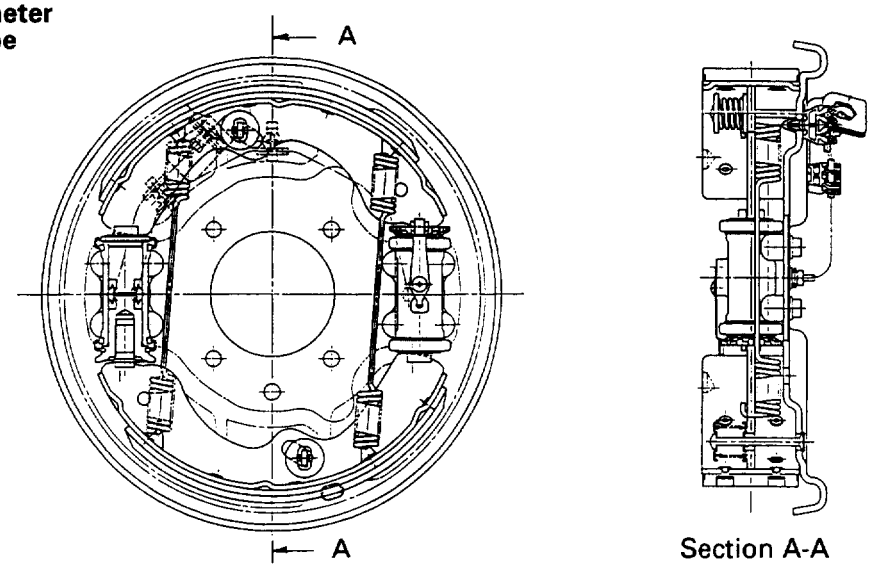




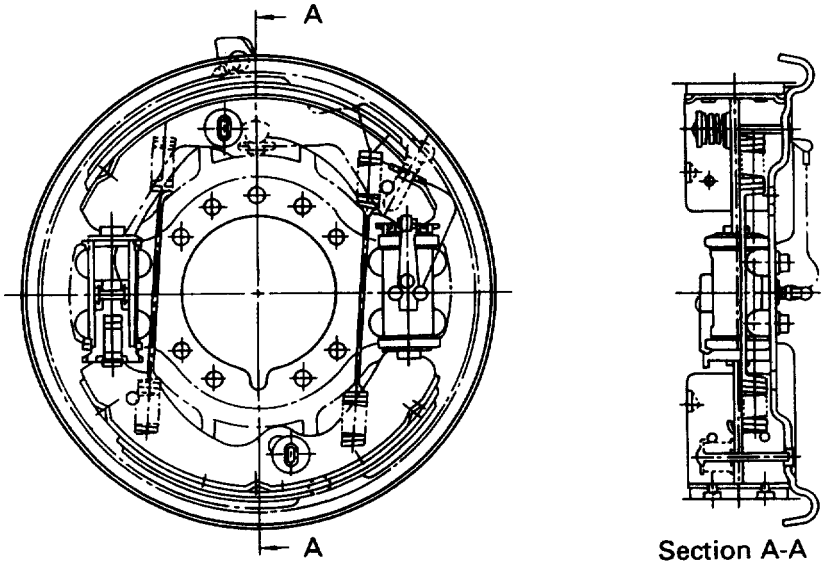
Section A-A

Front Drum Brake

Drum Inside Diameter
320mm – D2L Type

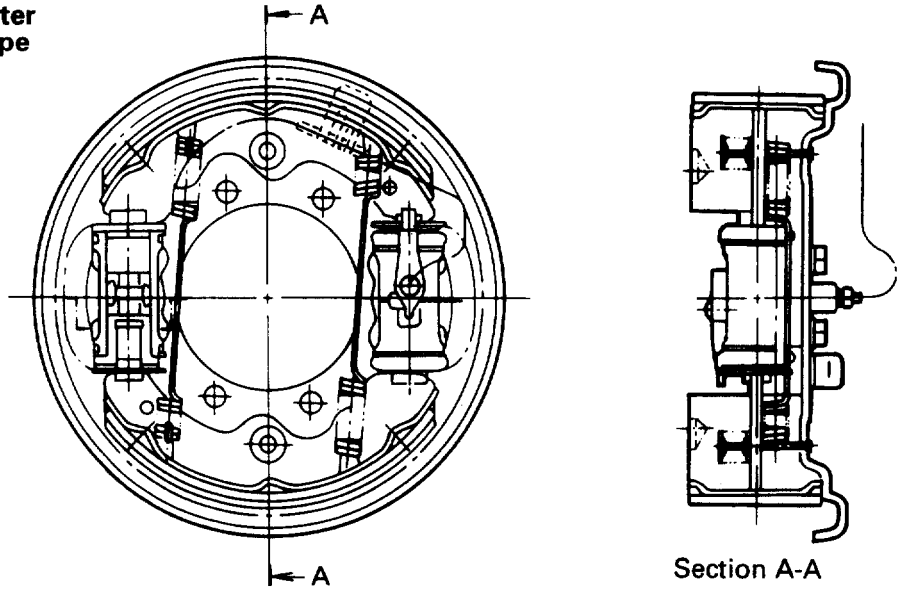


NPS66

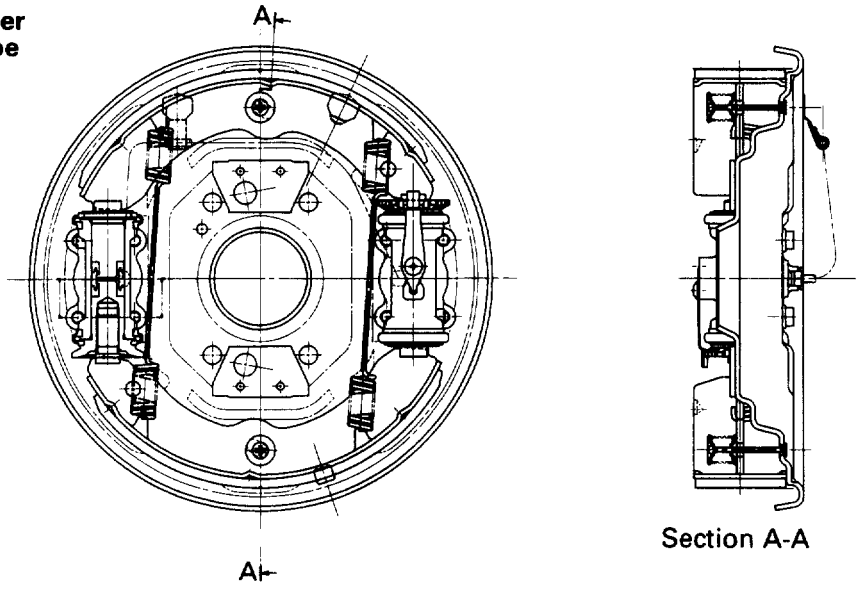


Rear Drum Brake (Manual Adjuster Type)

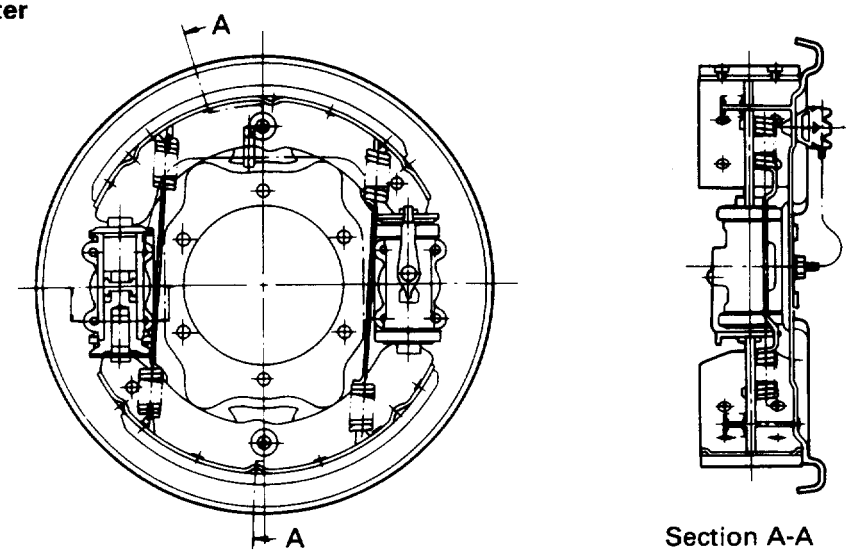
Drum Inside Diameter
228.6 mm – D2L Type



Drum Inside Diameter
279.4 mm – D2L Type

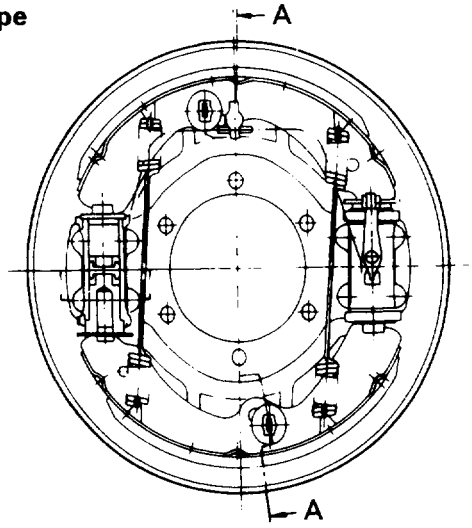


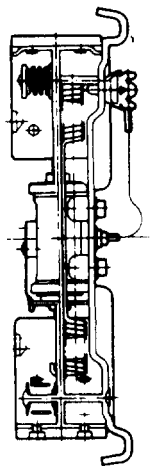
Drum Inside Diameter
300 mm – D2L Type



Rear Drum Brake (Manual Adjuster Type)

Drum Inside Diameter
320 mm – D2L Type

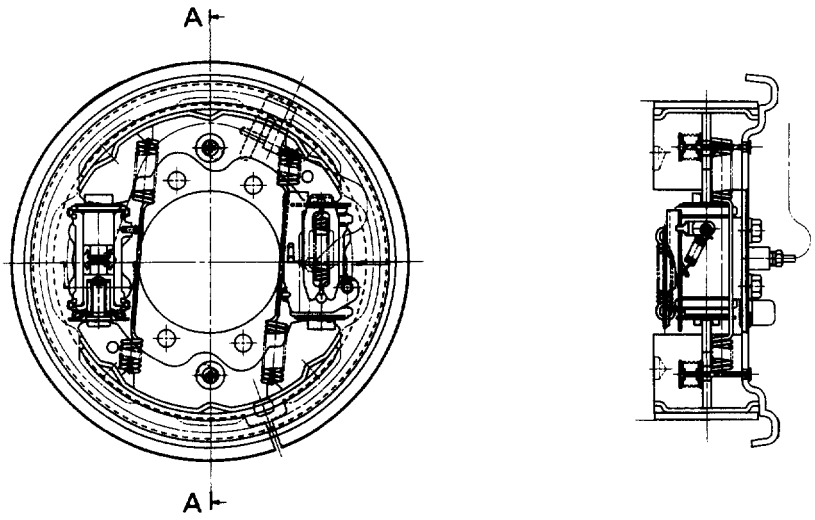




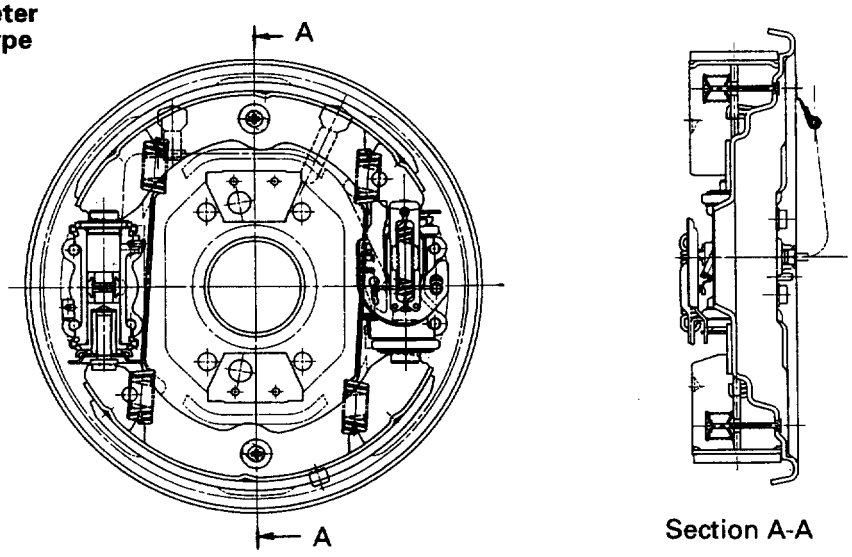
Section A-A

Rear Drum Brake (Auto-adjuster Type)

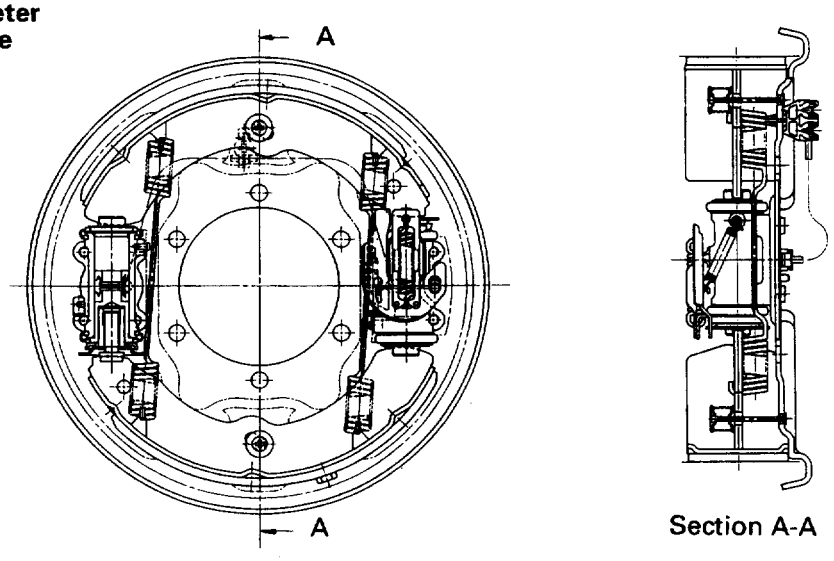
Drum Inside Diameter
228.6 mm – D2L Type



Drum Inside Diameter
279.6 mm – D2L Type

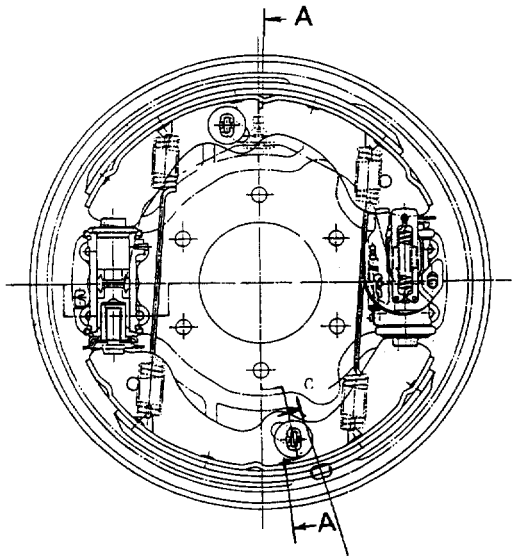


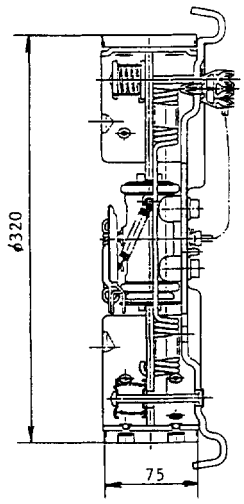
Drum Inside Diameter
300 mm – D2L Type



Rear Drum Brake (Auto-adjuster Type)

Drum Inside Diameter
320 mm – D2L Type





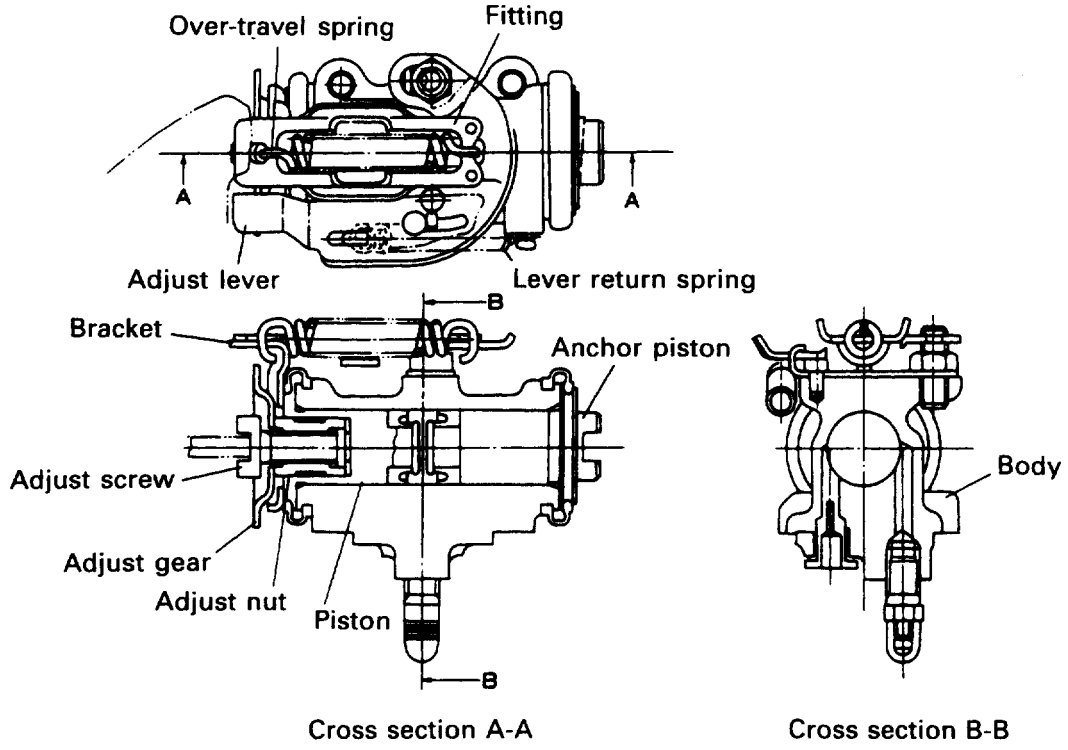
Section A-A

The dual two leading shoe type brake eliminates the problem of weaker braking force on reverse stops common to two leading shoe type brakes while maintaining the many advantages of this type of brake.

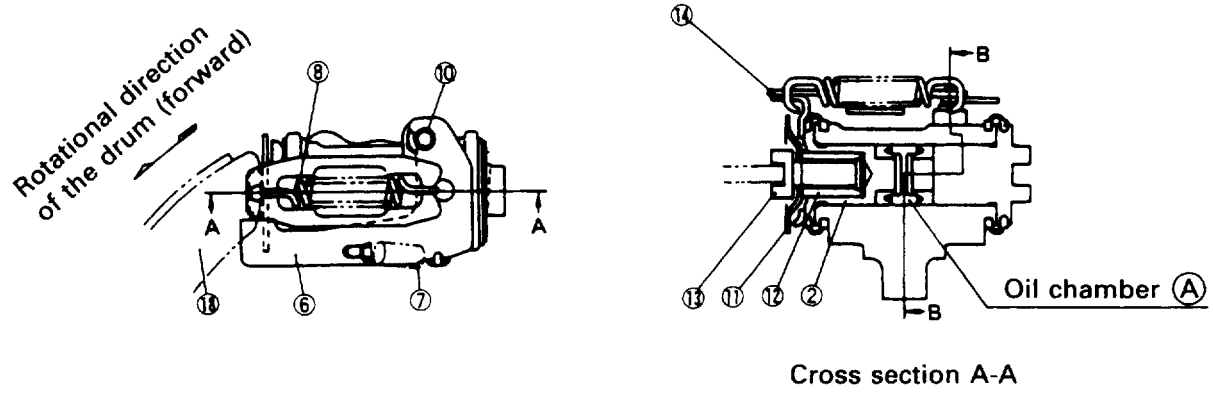
This combination of two leading shoes provides nearly equal braking force. This prevents an uneven load distribution on the wheel hub bearings.

This type of brake is widely used on the rear wheels of many vehicles.

Auto-Adjuster



Operation of Auto-adjuster



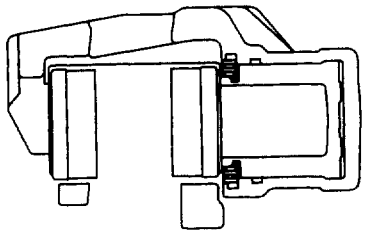
The entire auto-adjust mechanism is incorporated into the wheel assembly, and the adjust operation is carried out only when in the forward movement. The operation of the auto-adjuster is as follows:

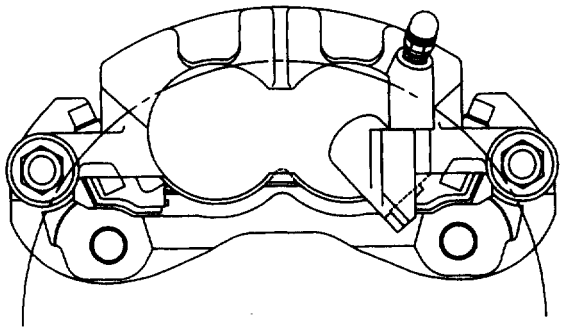
- When fluid pressure is applied to the oil chamber Ⓐ, the piston, which is resistant to the over-travel spring installed between the bracket ⑭ and the adjust lever ⑥, is forced out to the brake shoe ⑱ side. (The piston and bracket are welded into a monolithic construction.)
- When force delivered by the over-travel spring ⑱ is intensified as the piston ② moves, the balance maintained with the lever return spring ⑦ installed between the adjust lever ⑥ and lever pin ⑩ is destroyed, and the adjust lever ⑥ with the lever pin ⑩ as a pivot, rotates the adjust gear ⑪ in the rotational direction.

- When the shoe clearance (clearance between the brake shoe and the brake drum) gets to the specified value, the adjust lever ⑥ adjusts the shoe clearance by driving one gear tooth or more of the adjust gear ⑪ in the rotational direction through the force of the over-travel spring ⑧.
- When the brake shoe ⑱ comes into contact with the brake drum, the frictional force generated between the adjust screw ⑬ and the adjust nut ⑫ gets larger, and the adjust gear ⑪ cannot be rotated by the force of the over-travel spring ⑧. (The adjust gear and the adjust nut are welded into a monolithic construction.) That is, the automatic adjustment of the shoe clearance is carried out until the brake shoe comes in touch with brake drum. However, over adjust can be avoided since this automatic adjustment will not be performed for the increased amount of the piston shift caused by the deformation of the drum and shoe after their contact.
- When the fluid pressure is released from the oil chamber Ⓐ, the force by which the lever return spring ⑦ rotates the adjust gear ⑥ adversely gets weaker than the frictional force generated between the adjust screw ⑬ and the adjust nut ⑫, therefore, the adjust lever ⑥ slides on the adjust gear ⑪ to get back to its former state before operation and this operation is completed with the adjust gear ⑪ left in the state in the rotational direction into which it has been driven.

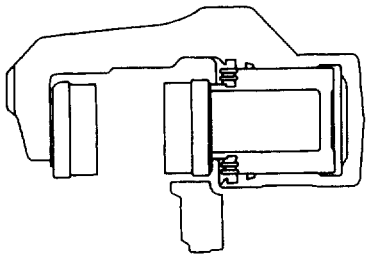
Front Disc Brake

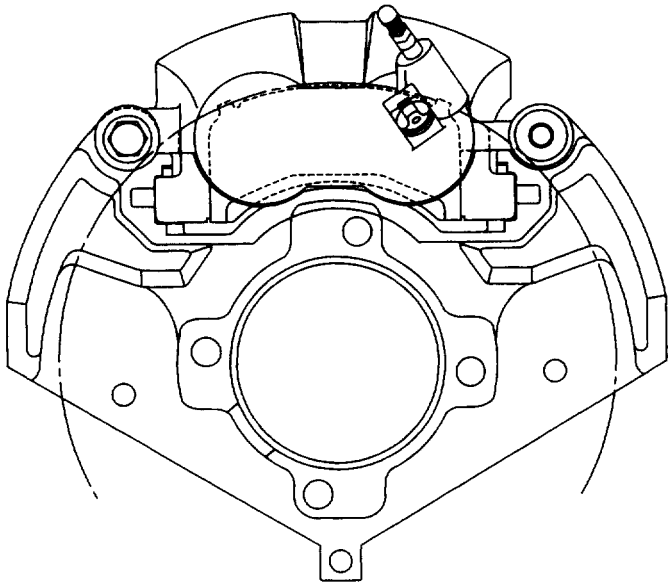
Independent Suspension Models





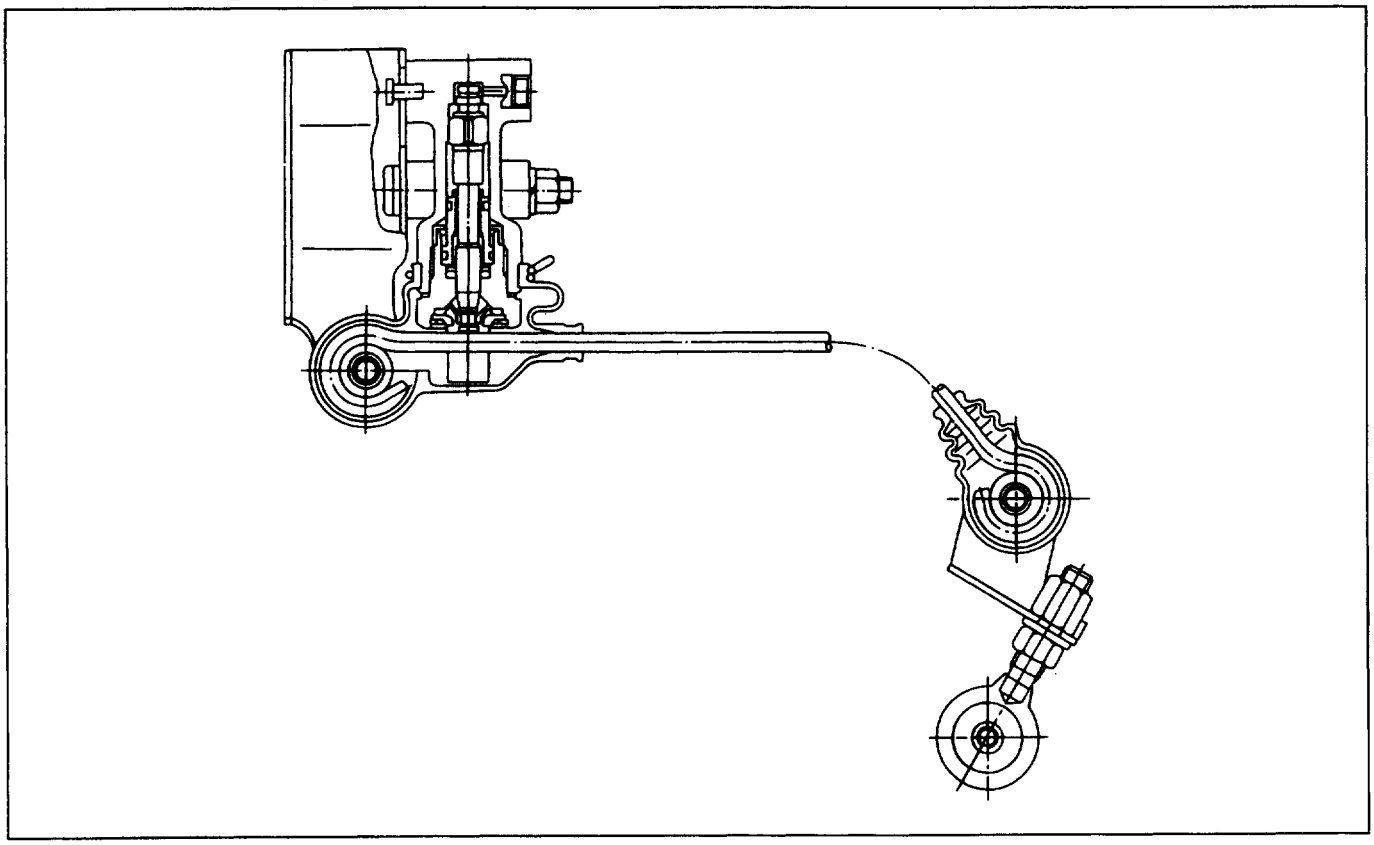
Leaf Spring Suspension Models (Rigid Axle Type)



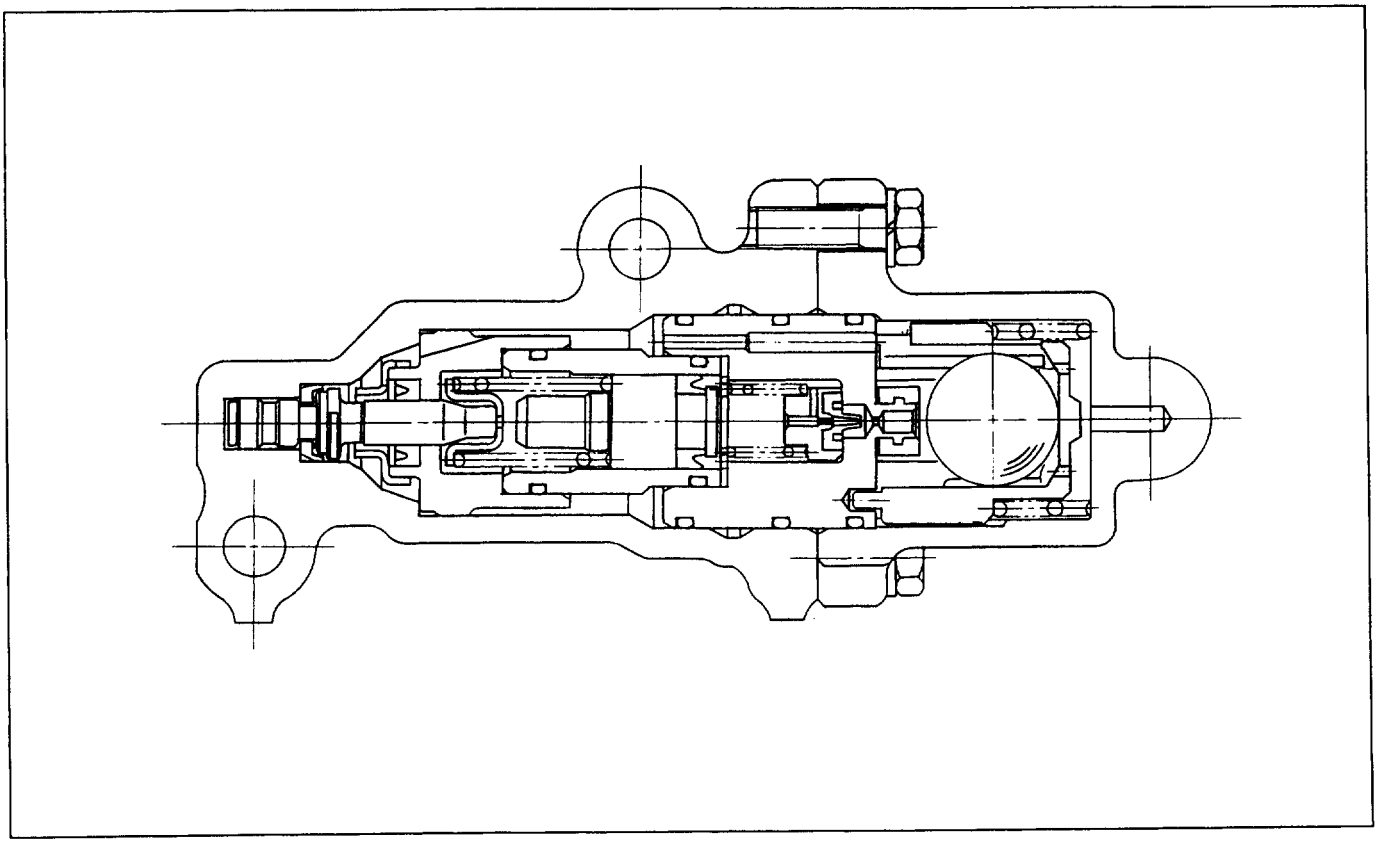


The disc brake assembly consists of a caliper, piston, disc, pad assembly and support bracket. The caliper assembly has two bores and is mounted to the support bracket with 2 mounting bolts. The support bracket allows the caliper to move laterally against the disc. The caliper is a one-piece casting with the inboard side containing the piston bore. A square cut rubber seal is located in a groove in the piston bore which provides the hydraulic seal between the piston and the cylinder wall.

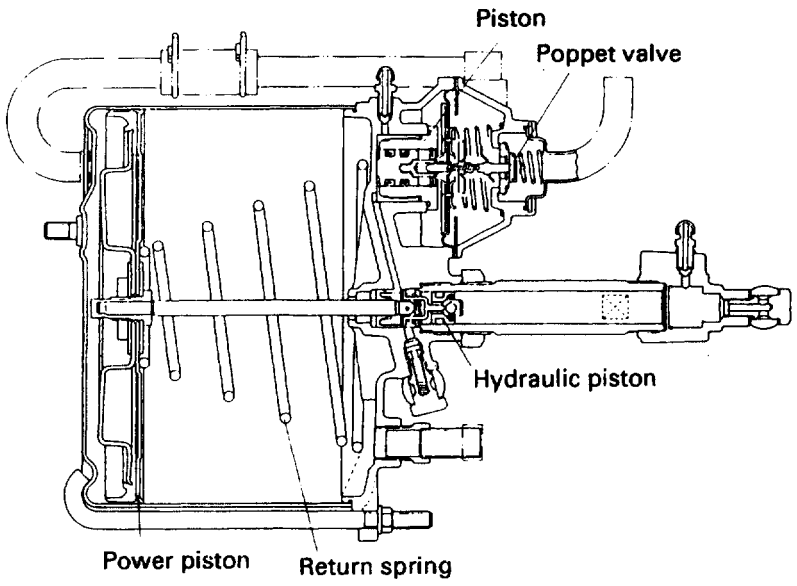
Load Sensing Proportioning Valve (LSPV)



Decerelation Sensing Proportioning Valve (DSPV)



Hydromaster



The hydromaster consists of cylinder shell, power piston, return spring, valve body assembly, and hydraulic piston.

The hydromaster is a vacuum servo unit designed to multiply hydraulic braking force on the vehicle.

It is similar to a Master-Vac in that it utilizes the difference between the atmospheric pressure and a negative pressure to provide a servo action.

The braking force of a conventional hydraulic system is directly proportional to the foot pressure applied to the brake pedal.

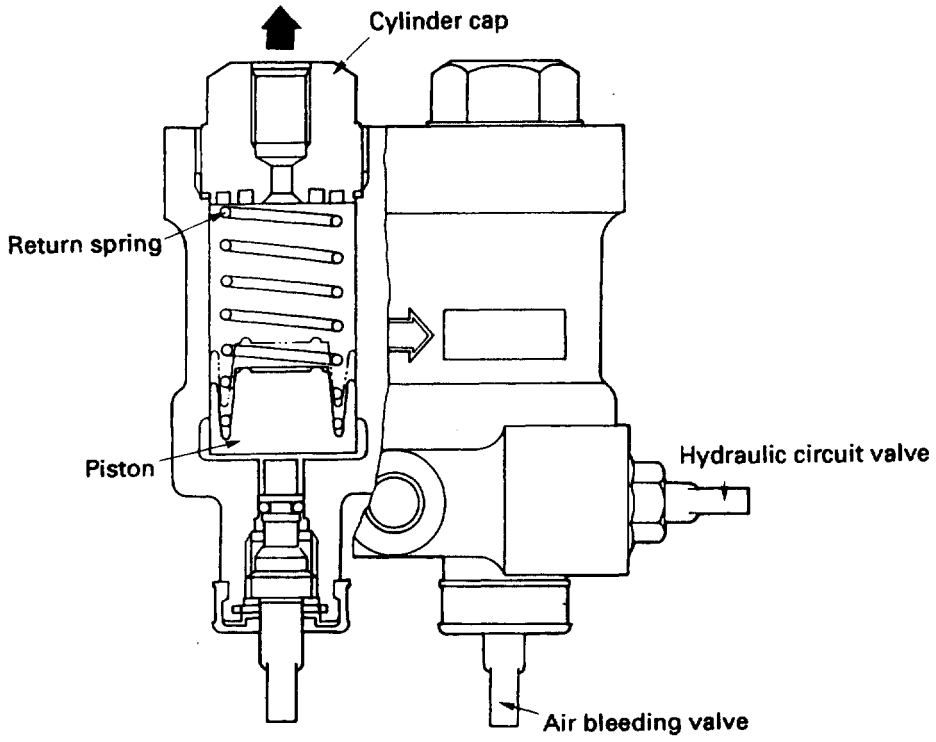
Hydromaster equipped hydraulic systems multiply the hydraulic pressure applied to the wheel cylinders when the brake pedal is depressed. This ensures braking power at all times and greatly relieves vehicle operator fatigue.

should the hydromaster fail, normal hydraulic brake function will not be affected. The brake system will function without the servo action.

Earlier hydromaster designs used negative pressure produced by the throttle valve and delivered through the ejector.

More recent designs use negative pressure produced by the vacuum pump for greater reliability.

Safety Valve



The brake safety valve consists of cylinder body, piston, return spring, cylinder cup, hydraulic circuit valve and air bleeding valve.

The brake safety valve maintains brake function in the event of hydraulic circuit failure.

There are a pair of safety valves (one for the front brake hydraulic circuit and the other for the rear brake hydraulic circuit) in the pipe line behind the brake hydromaster. Pumping the brake pedal will cause the hydraulic circuits to exert braking force should hydraulic system failure occurs because of the following reasons:

* Damaged brake pipe or brake hose.
* Worn or damaged wheel cylinder and/or piston cups

If one of the hydraulic systems fail, the safety valve on the failed side will close to maintain hydraulic pressure. Sufficient braking force will remain to bring the vehicle to a safety stop.

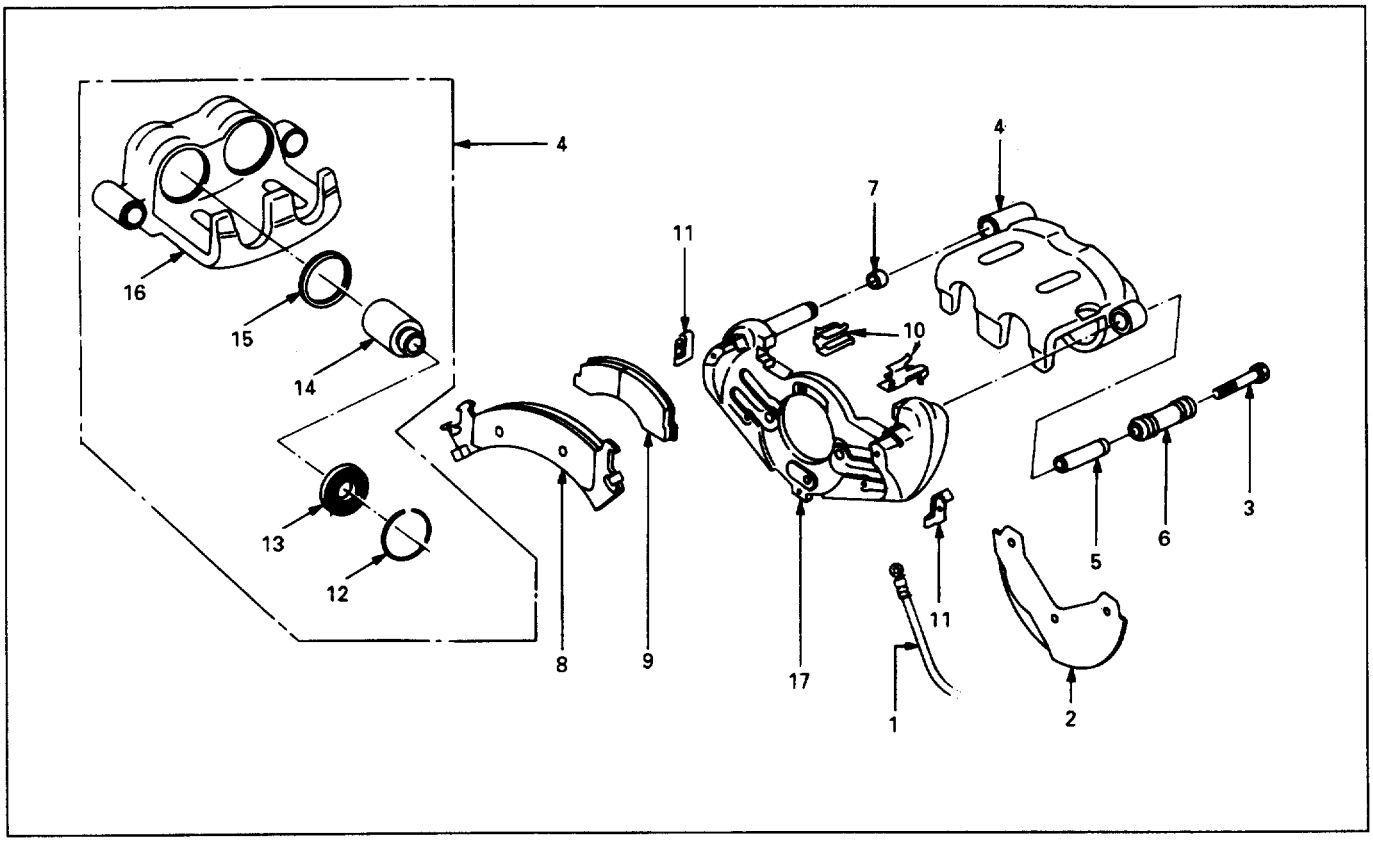
After stopping the vehicle, close the safety valve shut-off valve on the failed hydraulic circuit.

ON-VEHICLE SERVICE

FRONT DISC BRAKE ASSEMBLY

LEAF SPRING SUSPENSION MODELS (ϕ282mm)

REMOVAL

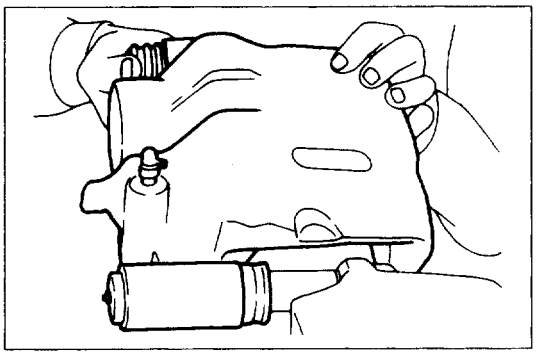


Removal Steps

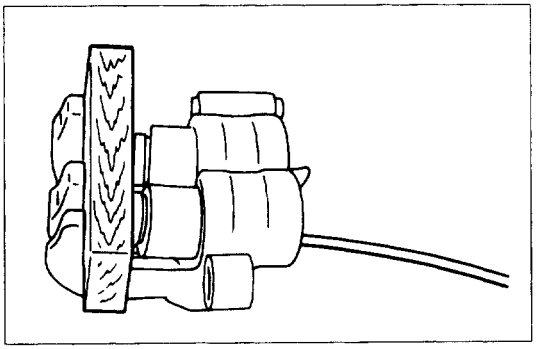
1. Flexible hose
2. Dust shield
3. Lock pin bolt
4. Caliper assembly
5. Sleeve
6. Sleeve boot
7. Lock Pin boot
8. Outer pad
9. Inner pad
10. Inner pad clip
11. Outer pad clip
12. Boot ring
13. Piston boot
14. Piston
15. Piston seal
16. Body assembly
17. Support assembly

Removal Steps

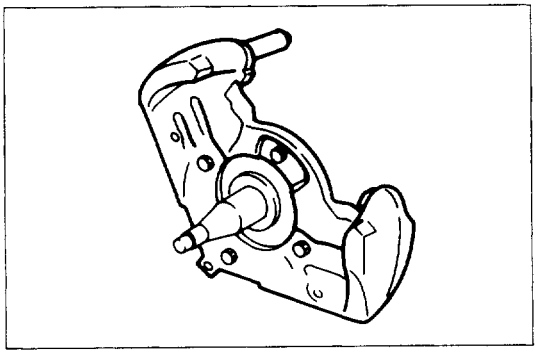
1. **Flexible Hose**
2. **Dust Shield**
3. **Lock Pin Bolt**
4. **Caliper Assembly**
   Slide the caliper assembly free from the inside



5. **Sleeve**
6. **Sleeve Boot**
7. **Lock Pin Boot**
8. **Outer Pad**
9. **Inner Pad**
10. **Inner Pad clip**
11. **Outer Pad clip**
12. **Boot Ring**
13. **Piston Boot**
14. **Piston**
    1. Place a piece of wood across the body assembly to prevent piston damage.
    2. Apply approximately 196 kPa (2.0 kg/cm^2, 28.4 psi) of compressed air to the body assembly oil port to remove the pistons.

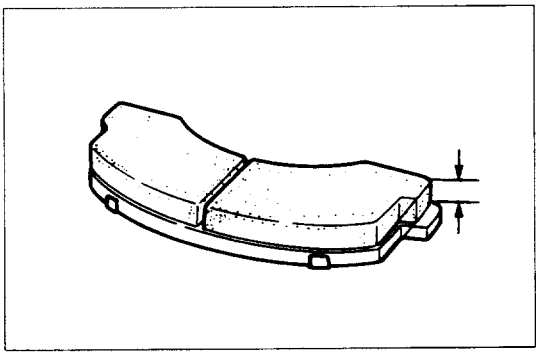


15. **Piston Seal**
16. **Body Assembly**
17. **Support Assembly**
    1. Remove the hub and disc before removing the support assembly.
       Refer to "Hub and Disc."



INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.



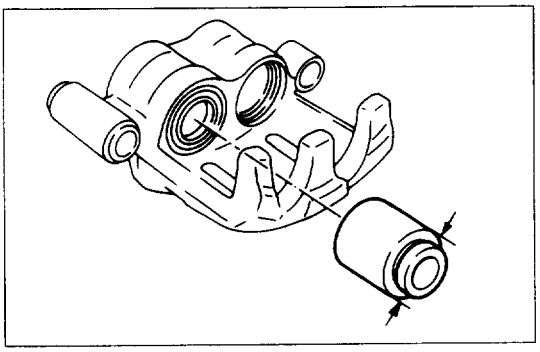
Inner and Outer Pad

Use a vernier caliper to measure the inner pad and outer pad thickness.

Pad Thickness mm(in)

Standard	Limit
14 (0.551)	1 (0.039)

If the measured value is less than the specified limit, the pads must be replaced with the repair pad kit.



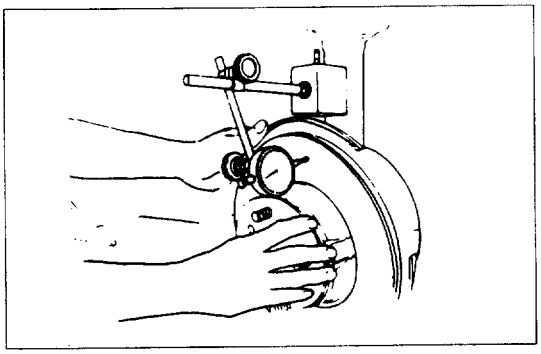
Piston and Cylinder Clearance

1. Use a micrometer to measure the piston diameter.
2. Use an inside dial indicator to measure the cylinder bore.
3. Calculate the piston and cylinder clearance.

Piston and Cylinder Clearance mm(in)

Standard	Limit
0.08 – 0.18 (0.0031 – 0.0071)	0.23 (0.0091)

If the clearance exceeds the specified limit, the piston and/or the body assembly must be replaced along with the repair seal kit.

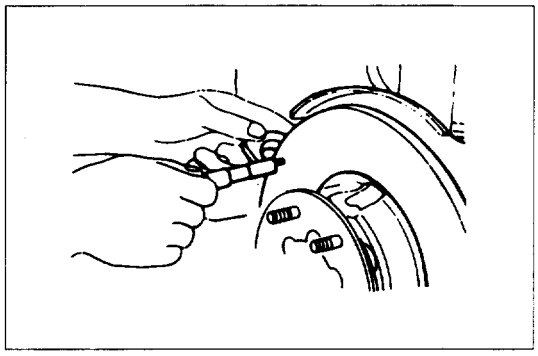


Disc

Lateral Runout

1. Adjust the wheel bearing correctly.
   Refer to "Front Axle" in Section 4.
2. Attach a dial indicator to some portion of the suspension so that the stem contacts the disc face about 29 mm (1.14 in) from the disc edge.
3. Move the disc one complete rotation.
   The lateral runout should not exceed 0.13 mm (0.005 in)

Maximum runout mm (in)	0.13 (0.005)



Parallelism and thickness

Parallelism is the measurement of the thickness of the disc at four or more points around the circumference of the disc. All measurement must be made at 29 mm (1.14 in) from the edge of the disc.

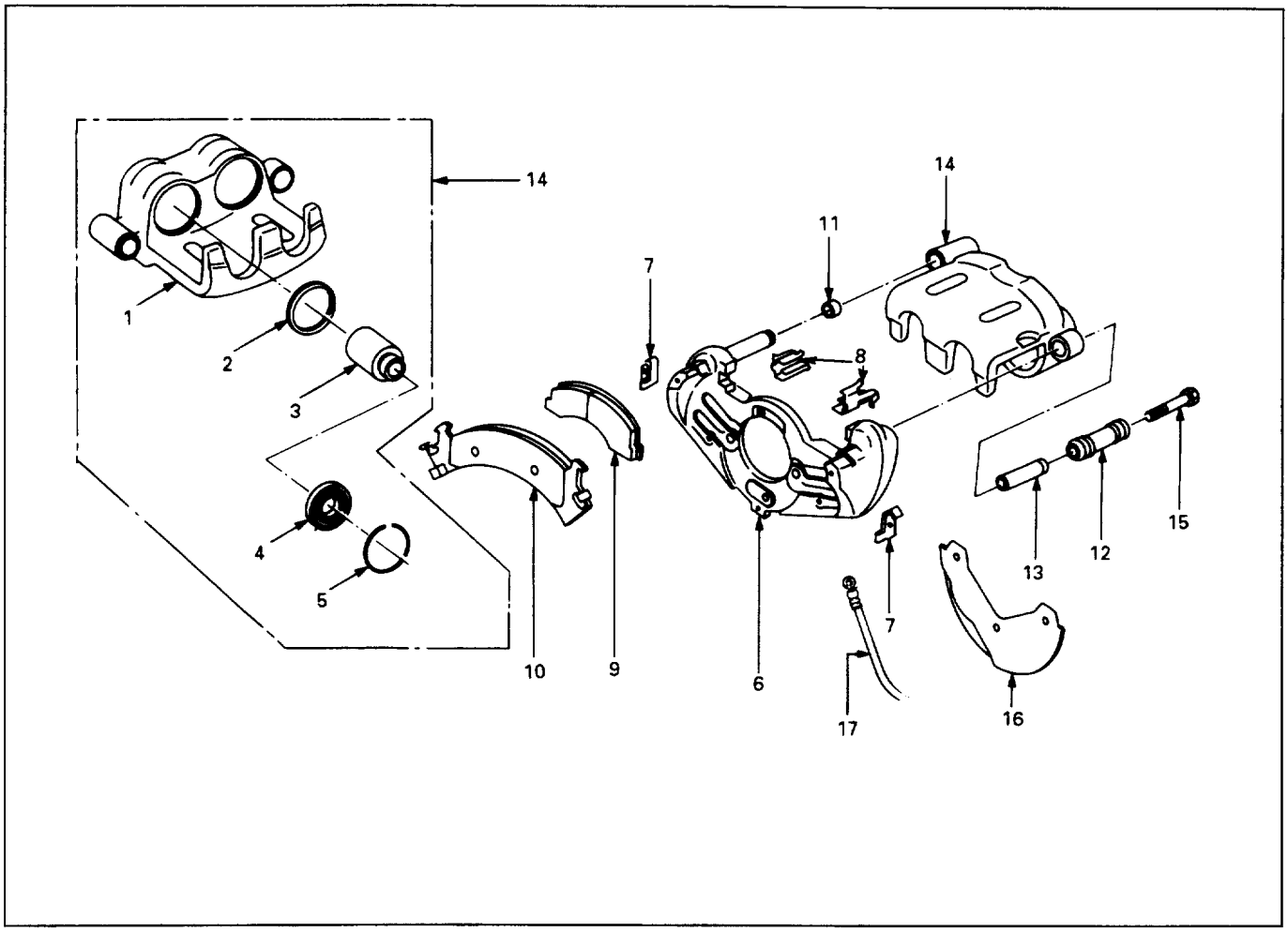
The disc thickness must not vary more than 0.010 mm (0.0004 in) from point to point.

Maximum parallelism	mm (in)	0.02 (0.0008)

Disc Thickness — mm (in)

Standard	Limit
35.0 (1.378)	32.0 (1.260)

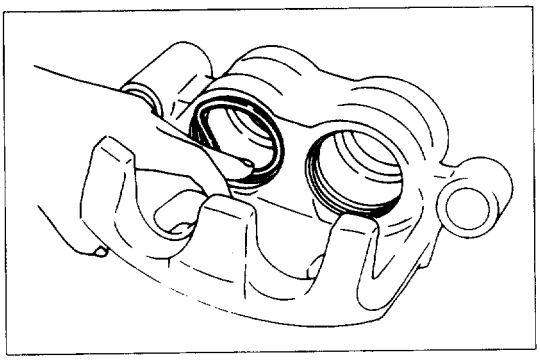
INSTALLATION



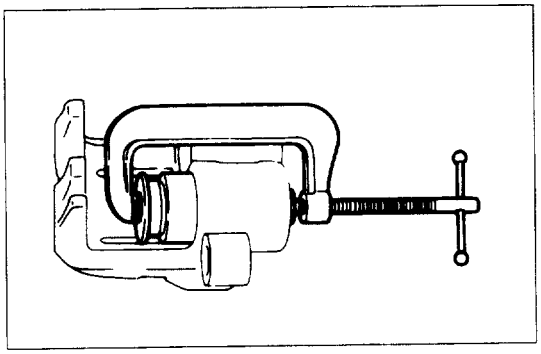
Installation Steps

1. Body assembly
2. Piston seal
3. Piston
4. Piston boot
5. Boot ring
6. Support assembly
7. Outer pad clip
8. Inner pad clip
9. Inner pad
10. Outer pad
11. Lock pin boot
12. Sleeve boot
13. Sleeve
14. Caliper assembly
15. Lock pin bolt
16. Dust shield
17. Flexible hose

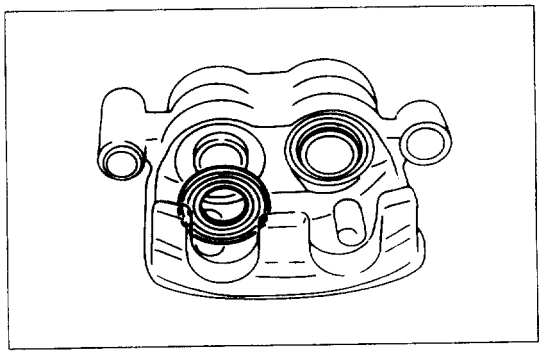
Installation steps

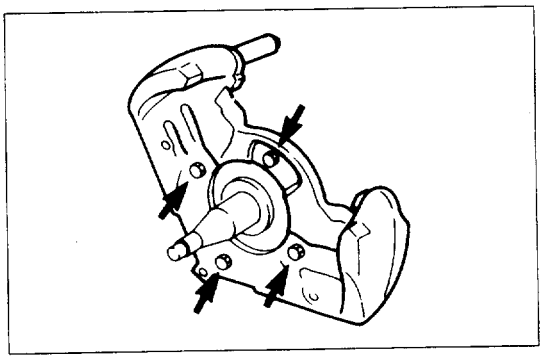


1. **Body Assembly**
2. **Piston Seal**
   1. Apply rubber grease to the piston seal.
      The rubber grease is included in the seal kit.
   2. Install the piston seal to the cylinder bore groove.



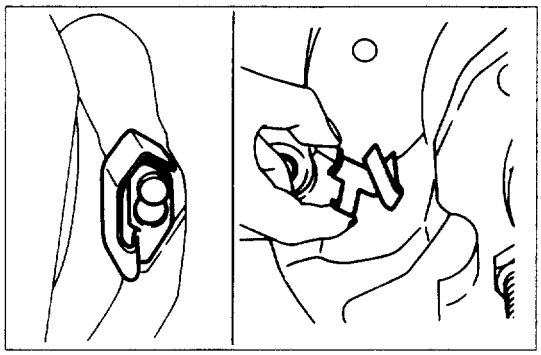
3. **Piston**
4. **Piston Boot**
5. **Boot Ring**
   1. Apply brake oil to the piston outer circumference.
   2. Use a hand vise to install the pistons to the cylinder.
   3. Apply special grease to the piston.
      This will prevent cylinder and piston corrosion.
   4. Install the piston boot outer lip to the cylinder bore groove.
      Install the piston boot inner lip to the piston groove.
      Handle the piston boot carefully.
   5. Install the boot ring to the cylinder bore groove.
      The boot ring must be completely installed to the groove.





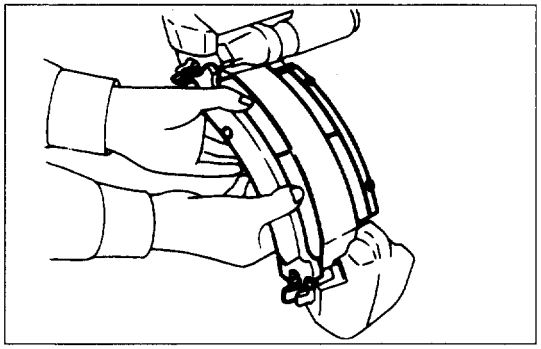
6. **Support Assembly**
   1. Install the support assembly to the knuckle.
   2. Tighten the fixing nuts to the specified torque.

Fixing Nut Torque	N·m (kg·m/lb·ft)
	157 (16.0 / 116)



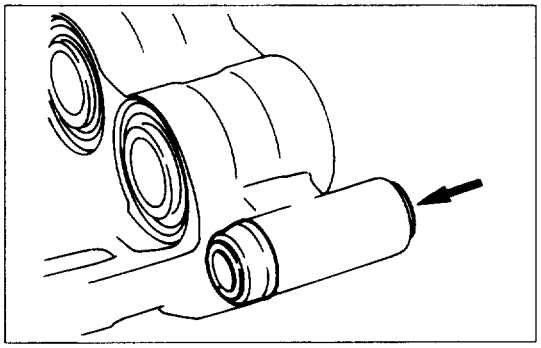
7. **Outer Pad Clip**
8. **Inner Pad Clip**

   Be sure that the clips are completely installed to the support assembly.



9. **Inner Pad**
10. **Outer Pad**

    Install the inner pad and the outer pad to the support assembly.



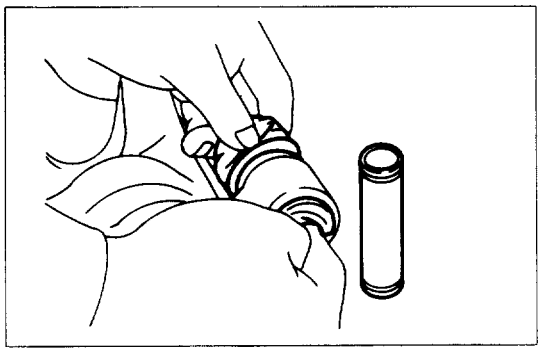
11. **Lock Pin Boot**

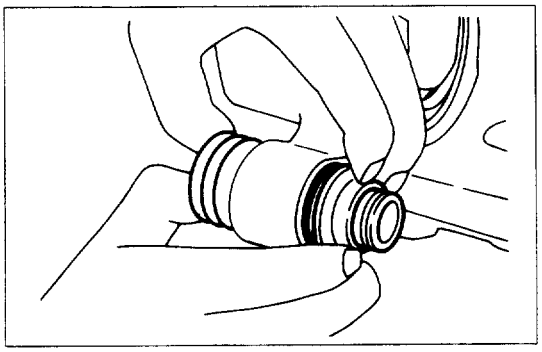
    1) Apply approximately 1 g (0.035 oz) of special grease to the pin boot bore.

       This will prevent pin corrosion.

       The special grease is included in the seal kit.
    2) Install the pin boot lip to the support assembly.

       The other pin boot lip will be installed to the caliper assembly groove after installation of the caliper assembly.



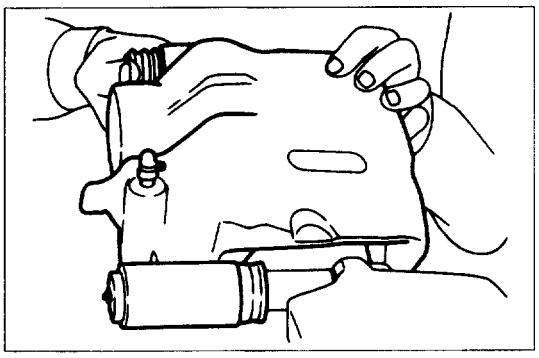


12. **Sleeve Boot**
13. **Sleeve**

    1) Apply approximately 1 g (0.035 oz) of special grease to the sleeve boot bore.

       This will prevent sleeve corrosion.

       The special grease is included in the seal kit.
    2) Install the sleeve boot to the caliper assembly.
    3) Install the sleeve to the sleeve boot.
    4) Install the sleeve boot lips to the sleeve grooves.

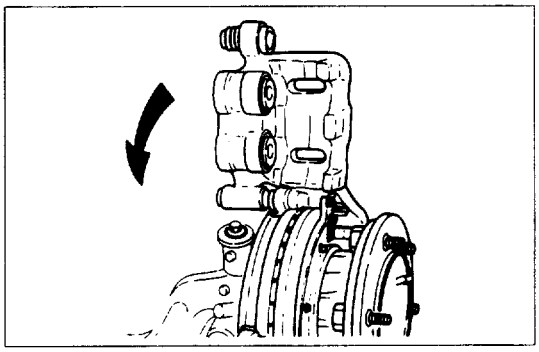


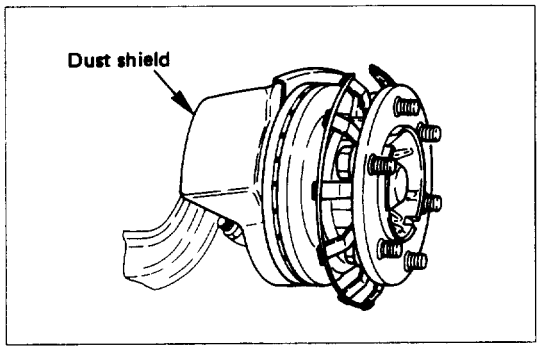
14. Caliper Assembly

15. Lock Pin Bolt

1. Install the caliper assembly to the support assembly guide pin from the inside.
2. Install the pin boot lip to the guide pin groove.
3. Return the caliper assembly to its original position. Take care not to pinch the sleeve boot.
4. Tighten the lock pin bolt to the specified torque.

Lock Pin Bolt Torque	N·m (kg·m/lb·ft)
92 (9.4 / 68)	

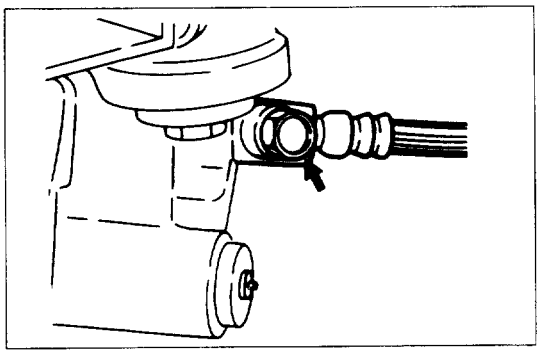




16. Dust Shield

Tighten the dust shield fixing bolts to the specified torque.

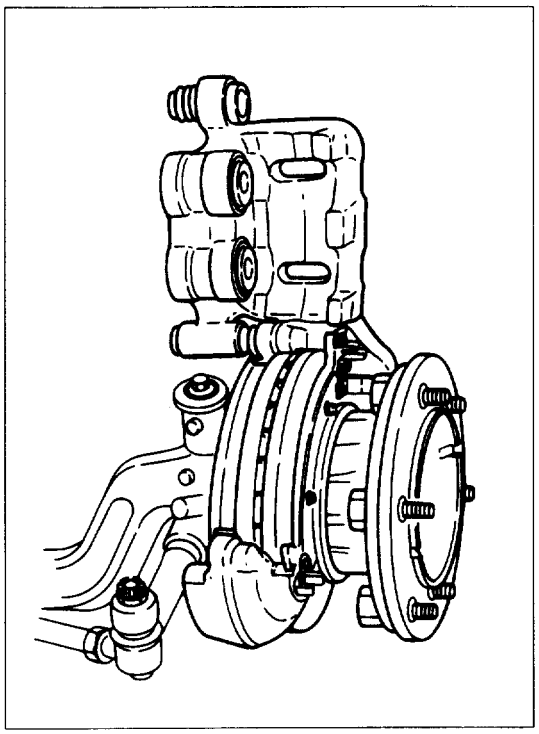
Dust Shield Fixing Bolt Torque	N·m (kg·m/lb·ft)
37 (3.8 / 27)	

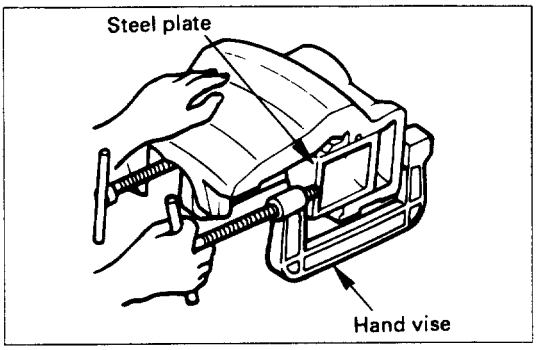


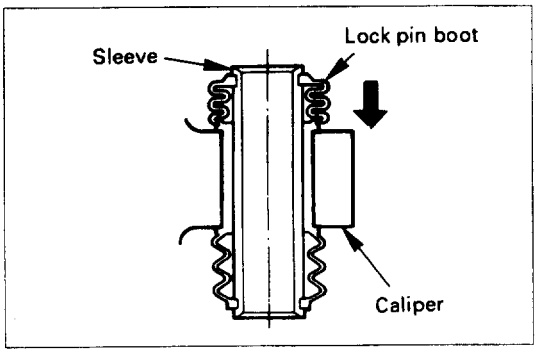
17. Flexible Hose

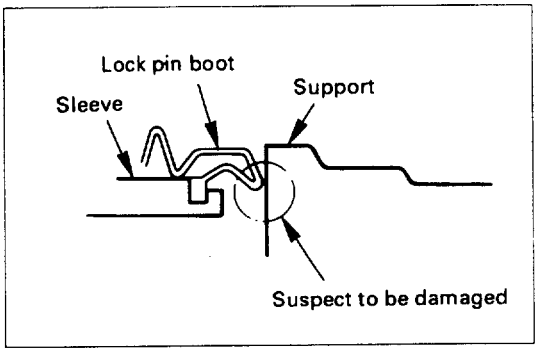
Tighten the flexible hose bolt to the specified torque.

Flexible Hose Bolt Torque	N·m (kg·m/lb·ft)
34 (3.5 / 25)	









Front Disc Brake Pad Replacement

Use the following procedure to replace the front disc brake pads.

1. Loosen and remove the lock pin bolt from the lower side of the caliper.
2. Turn the caliper assembly up and wire it to the frame firmly so that the hose is not stretched.

NOTE:

Do not disconnect the brake hose.

3. Remove the pad assembly with clips and install the new pads along with new clips.

NOTE:

Be careful not to assemble the inner and outer pad reversely.

Keep the rotor face away from the brake oil or grease.

4. Use a hand vise to push the piston backward until it reaches the cylinder bottom, as the piston was pushed forward by the distance where the pad worn.

NOTE:

When using a hand vise, push the piston at its center.

5. Before returning the caliper assembly to its original position, adjust the sleeve position to keep some clearance between support plate and sleeve end, so that the lock pin boot may not be wedged.

NOTE:

Do not allow the foreign matters to get in the sleeve.

6. Install the lock pin into the support plate by turning the caliper carefully so that the piston boot and lock pin boot may not be wedged.

NOTE:

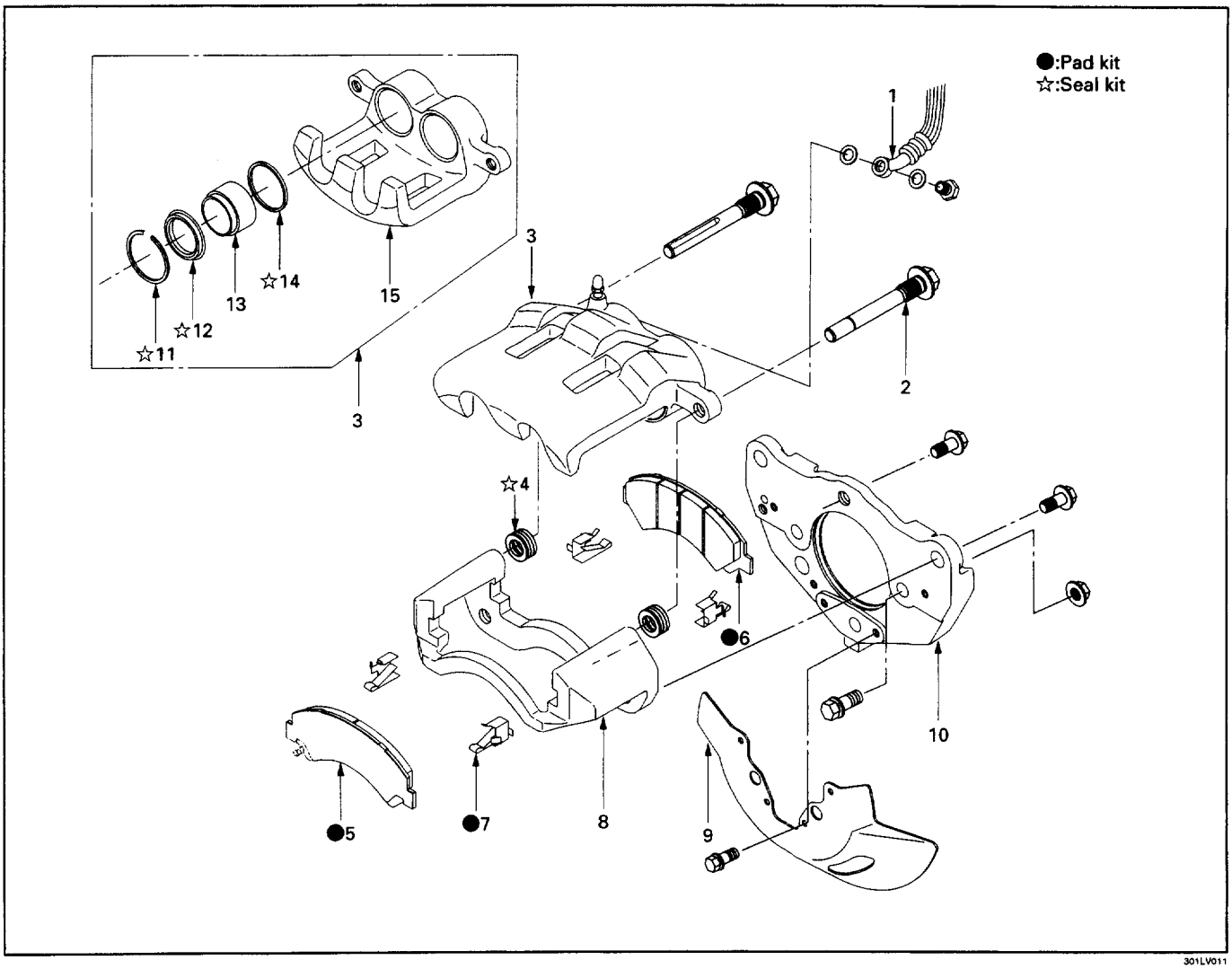
After assembling the caliper assembly, make sure that the piston boot and lock pin boot fitted correctly, and not damaged.

7. Tighten the lock pin bolt to the specified torque.

Lock Pin Bolt Torque	N·m (kg·m/lb·ft)
	92(9.4 / 68)

LEAF SPRING SUSPENSION MODELS (ϕ293 & ϕ310mm)

REMOVAL



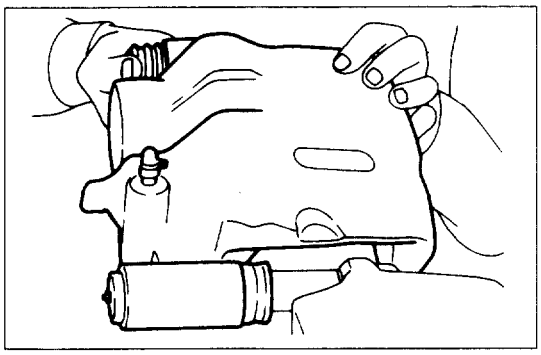
Removal Steps

1. Flexible hose
2. Lock pin bolt
3. Caliper assembly
4. Pin boot
5. Outer pad
6. Inner pad
7. Pad clip
8. Support assembly
9. Wind guide
10. Adapter
11. Boot ring
12. Piston boot
13. Pisotn
14. Piston seal
15. Body assembly

Removal Steps

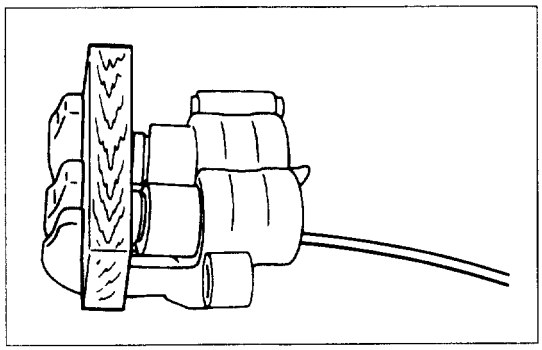
1. **Flexible Hose**
2. **Lock Pin Bolt**
3. **Caliper Assembly**

   Slide the caliper assembly free from the inside



4. **Pin Boot**
5. **Outer Pad**
6. **Inner Pad**
7. **Pad Clip**
8. **Support Assembly**
9. **Wind Guide**
   - Remove the hub and disc before removing the support assembly.

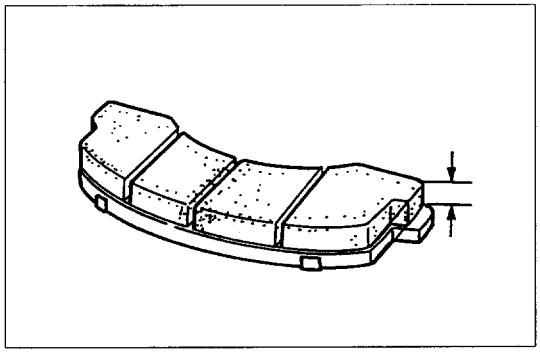
     Refer to "Hub and Disc."
10. **Adapter**
11. **Boot Ring**
12. **Piston Boot**
13. **Piston**
    1. Place a piece of wood across the body assembly to prevent piston damage.
    2. Apply approximately 196 kPa (2.0 kg/cm^2, 28.4 psi) of compressed air to the body assembly oil port to remove the pistons.



14. **Piston Seal**
15. **Body Assembly**

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.



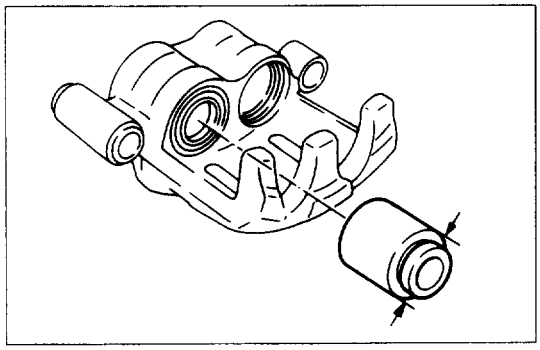
Inner and Outer Pad

Use a vernier caliper to measure the inner pad and outer pad thickness.

Pad Thickness mm(in)

Standard	Limit
13 (0.51)	1 (0.039)

If the measured value is less than the specified limit, the pads must be replaced with the repair pad kit.



Piston and Cylinder Clearance

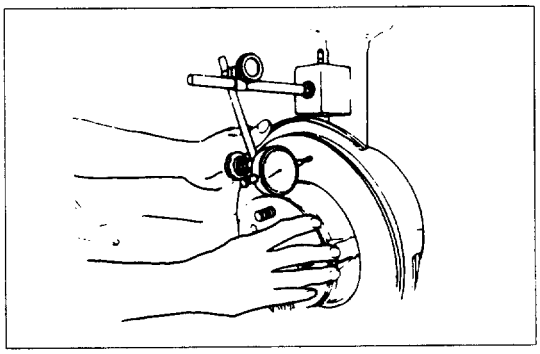
1. Use a micrometer to measure the piston diameter.
2. Use an inside dial indicator to measure the cylinder bore.
3. Calculate the piston and cylinder clearance.

Piston and Cylinder Clearance mm(in)

Standard	Limit
0.08 – 0.18 (0.0031 – 0.0071)	0.23 (0.0091)

If the clearance exceeds the specified limit, the piston and/or the body assembly must be replaced along with the repair seal kit.

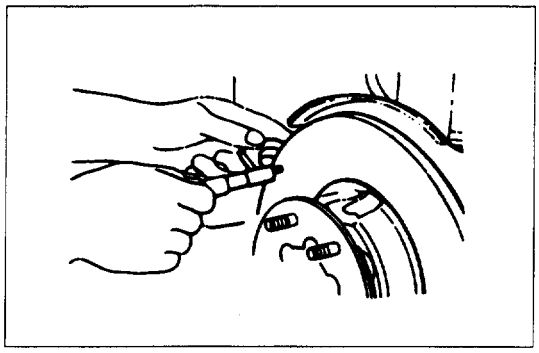
Disc



Lateral Runout

1. Adjust the wheel bearing correctly.
   Refer to "Front Axle" in Section 4.
2. Attach a dial indicator to some portion of the suspension so that the stem contacts the disc face about 29 mm (1.14 in) from the disc edge.
3. Move the disc one complete rotation.
   The lateral runout should not exceed 0.13 mm (0.005 in)

Maximum runout mm (in)	0.13 (0.005)



Parallelism and thickness

Parallelism is the measurement of the thickness of the disc at four or more points around the circumference of the disc. All measurement must be made at 29 mm (1.14 in) from the edge of the disc.

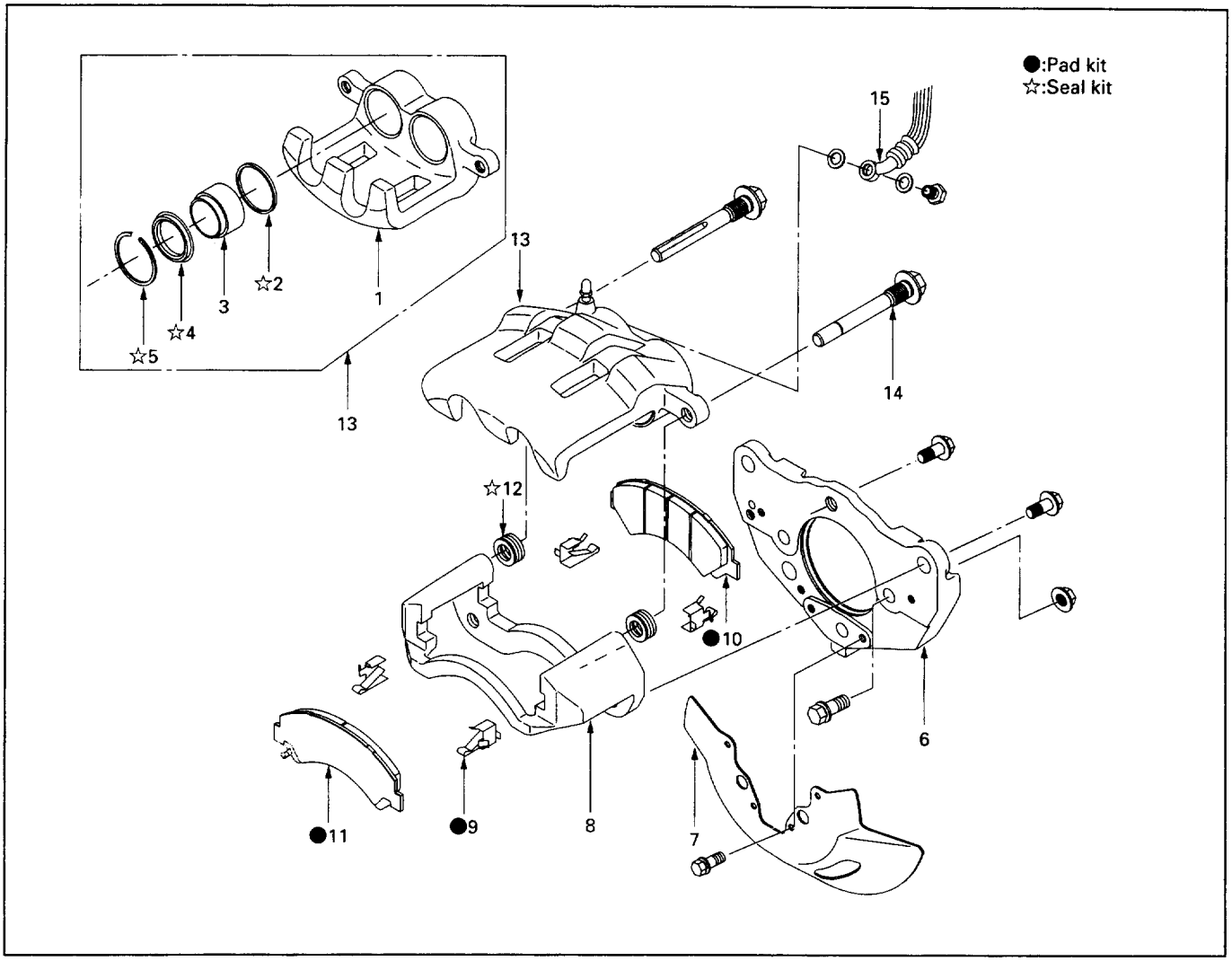
The disc thickness must not vary more than 0.010 mm (0.0004 in) from point to point.

Maximum parallelism	mm (in)	0.02 (0.0008)

Disc Thickness mm (in)

	Standard	Limit
ϕ310mm	42.0 (1.654)	39.0 (1.535)
ϕ293mm	40.0 (1.575)	37.0 (1.457)

INSTALLATION

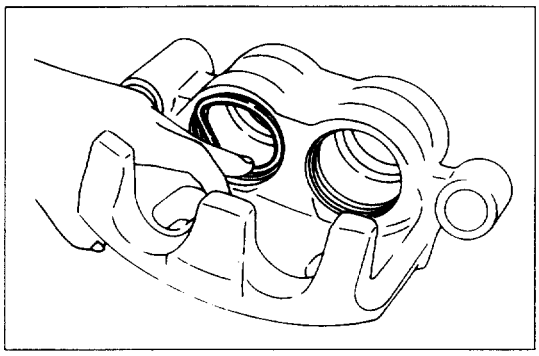


301LV012

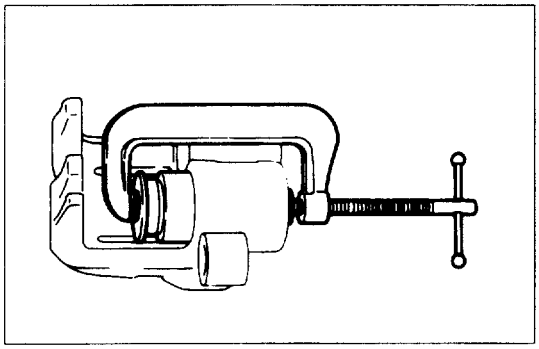
Installation Steps

1. Body assembly
2. Piston seal
3. Piston
4. Piston boot
5. Boot ring
6. Adapter
7. Wind guide
8. Support assembly
9. Pad clip
10. Inner pad
11. Outer pad
12. Pin boot
13. Caliper assembly
14. Lock pin bolt
15. Flexible hose

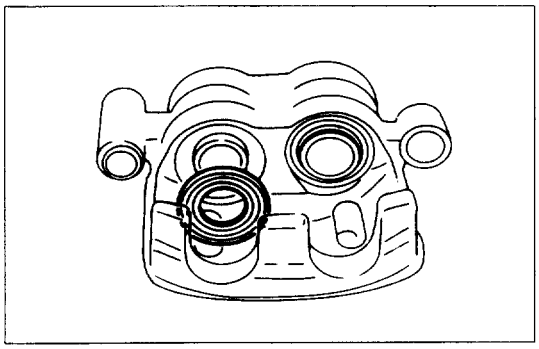
Installation steps

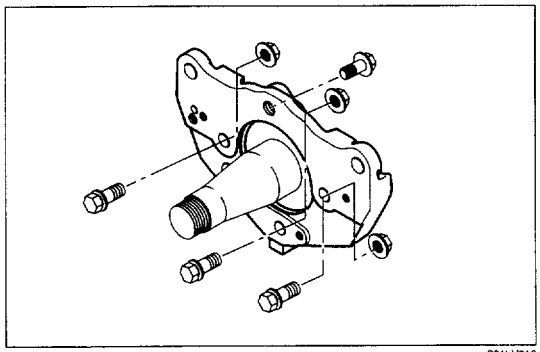


1. **Body Assembly**
2. **Piston Seal**
   1. Apply rubber grease to the piston seal.
      The rubber grease is included in the seal kit.
   2. Install the piston seal to the cylinder bore groove.



3. **Piston**
4. **Piston Boot**
5. **Boot Ring**
   1. Apply brake oil to the piston outer circumference.
   2. Use a hand vise to install the pistons to the cylinder.
   3. Apply special grease to the piston.
      This will prevent cylinder and piston corrosion.
   4. Install the piston boot outer lip to the cylinder bore groove.
      Install the piston boot inner lip to the piston groove.
      Handle the piston boot carefully.
   5. Install the boot ring to the cylinder bore groove.
      The boot ring must be completely installed to the groove.

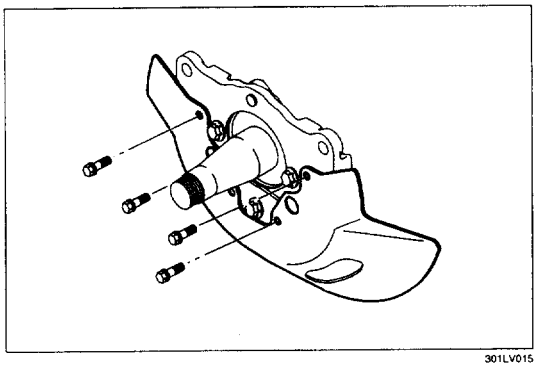




301LV016

6. **Adapter**
   1. Install the adapter to the knuckle.
   2. Tighten the fixing bolts and nuts to the specified torque.

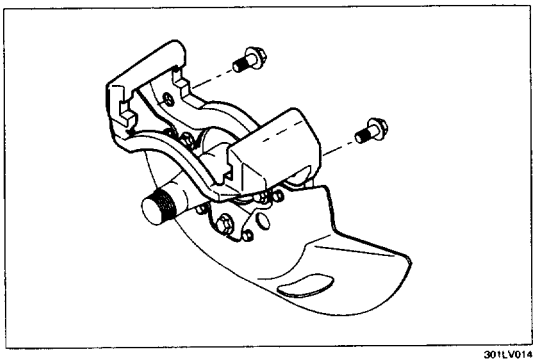
Fixing Nut Torque	N·m (kg·m/lb·ft)
	162 (16.5 / 119)



7. Wind Guide

Tighten the wind guide fixing bolts to the specified torque.

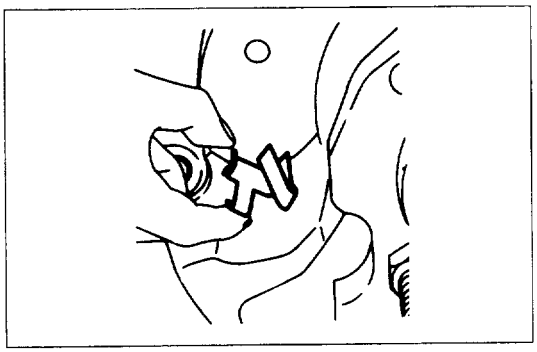
Wind Guide Fixing Bolt Torque	N·m (kg·m/lb·in)
13 (1.3 / 113)	



8. Support Assembly

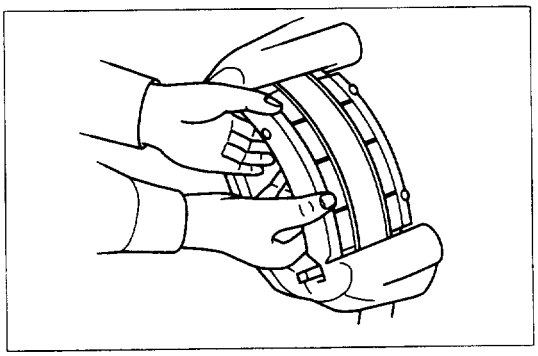
Tighten the support assembly fixing bolts to the specified torque.

Support Assembly Fixing Bolt Torque	N·m (kg·m/lb·ft)
221 (22.5 / 163)	



9. Pad Clip

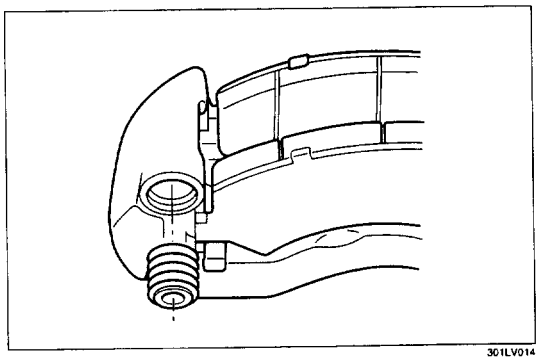
Be sure that the clips are completely installed to the support assembly.



10. Inner Pad

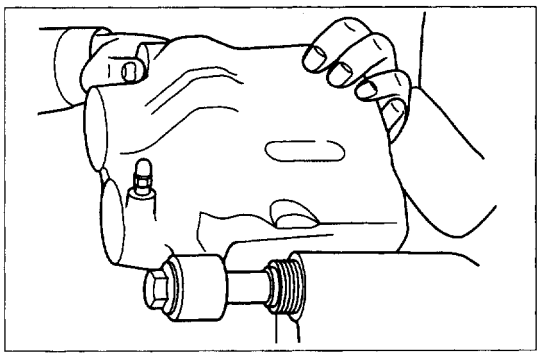
11. Outer Pad

Install the inner pad and the outer pad to the support assembly.



12. Pin Boot

1) Apply approximately 1 g (0.035 oz) of special grease to the pin boot bore and pin boss bore of support.
   This will prevent pin corrosion.
   The special grease is included in the seal kit.
2) Install the pin boot to the support assembly.

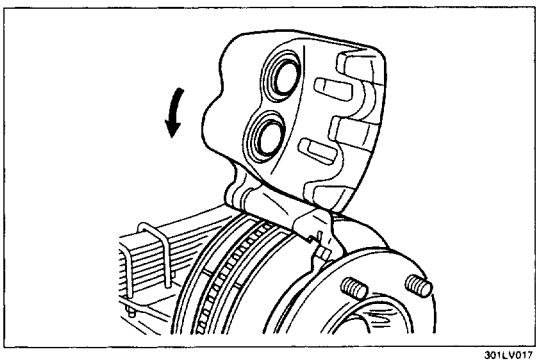


13. Caliper Assembly

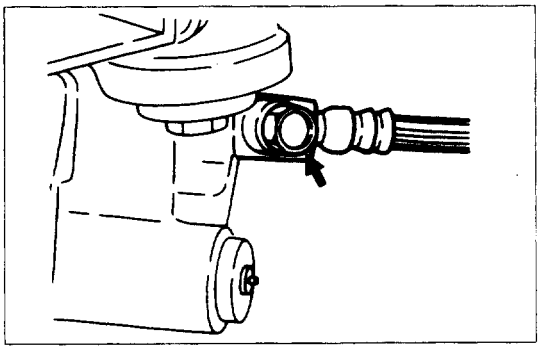
14. Lock Pin Bolt

1. Install the caliper assembly to the support assembly guide pin from the inside.
2. Return the caliper assembly to its original position.
   Take care not to pinch the sleeve boot.
3. Tighten the lock pin bolt to the specified torque.

Lock Pin Bolt Torque	N·m (kg·m/lb·ft)
	137 (14 / 101)



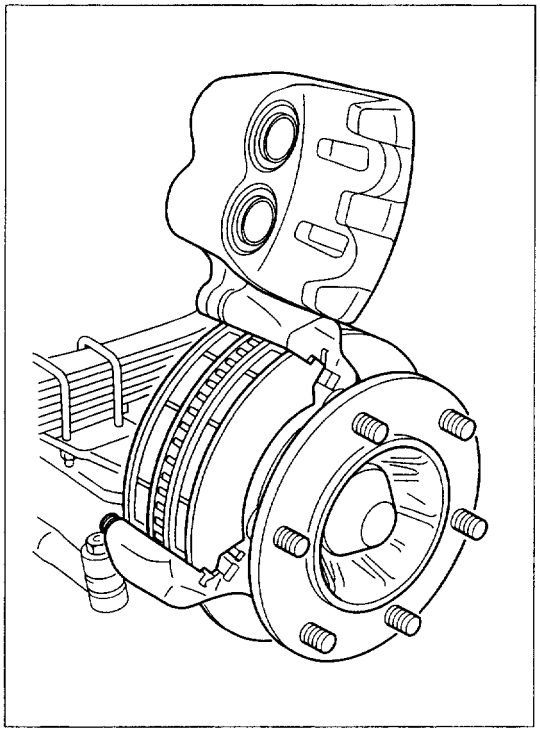
301LV017

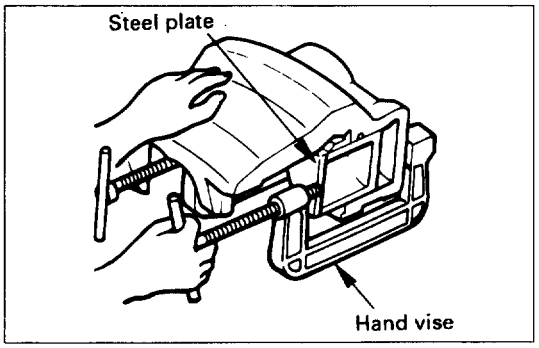


15. Flexible Hose

Tighten the flexible hose bolt to the specified torque.

Flexible Hose Bolt Torque	N·m (kg·m/lb·ft)
	34 (3.5 / 25)





Front Disc Brake Pad Replacement

Use the following procedure to replace the front disc brake pads.

1. Loosen and remove the lock pin bolt from the lower side of the caliper.
2. Turn the caliper assembly up and wire it to the frame firmly so that the hose is not stretched.

NOTE:

Do not disconnect the brake hose.

3. Remove the pad assembly with clips and install the new pads along with new clips.

NOTE:

Be careful not to assemble the inner and outer pad reversely.

Keep the rotor face away from the brake oil or grease.

4. Use a hand vise to push the piston backward until it reaches the cylinder bottom, as the piston was pushed forward by the distance where the pad worn.

NOTE:

When using a hand vise, push the piston at its center.

NOTE:

Do not allow the foreign matters to get in the sleeve.

5. Install the lock pin into the support plate by turning the caliper carefully so that the piston boot and pin boot may not be wedged.

NOTE:

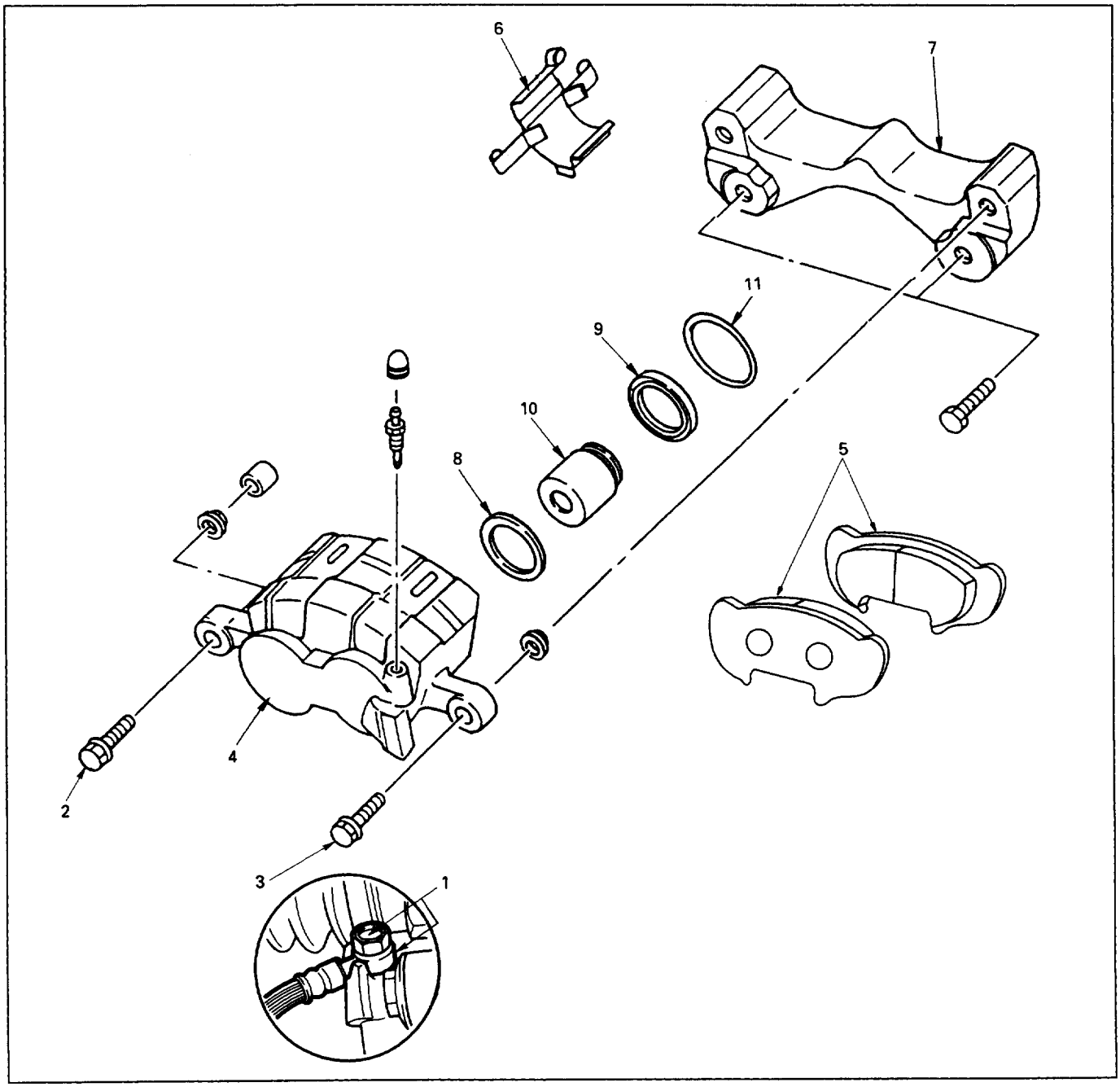
After assembling the caliper assembly, make sure that the piston boot and pin boot fitted correctly, and not damaged.

6. Tighten the lock pin bolt to the specified torque.

Lock Pin Bolt Torque	N·m (kg·m/lb·ft)
	137 (14 / 101)

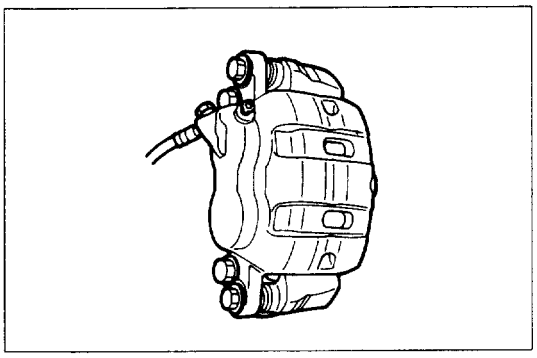
INDEPENDENT SUSPENSION MODELS (NHR AND NKR)

REMOVAL



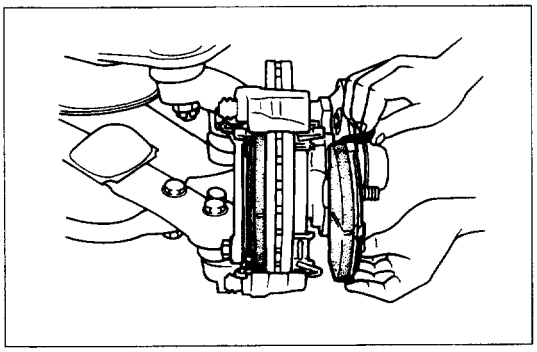
Removal Steps

1. Joint bolt and flexible hose
2. Lock pin bolt
3. Guide pin bolt
4. Caliper assembly
5. Pad
6. Pad clip
7. Support assembly
8. Boot ring
9. Piston boot
10. Piston
11. Piston seal

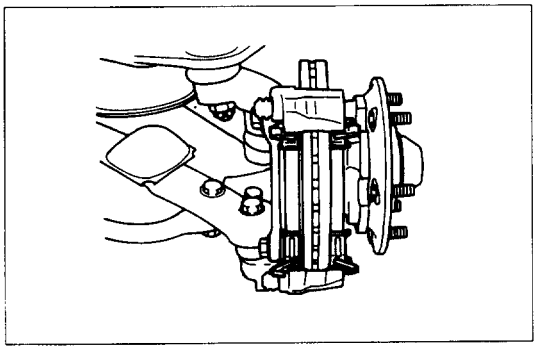


Removal Steps

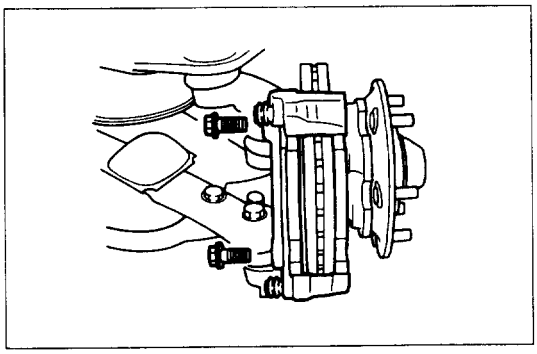
1. Joint Bolt and Flexible Hose
2. Lock Pin Bolt
3. Guide Pin Bolt
4. Caliper Assembly



5. Pad

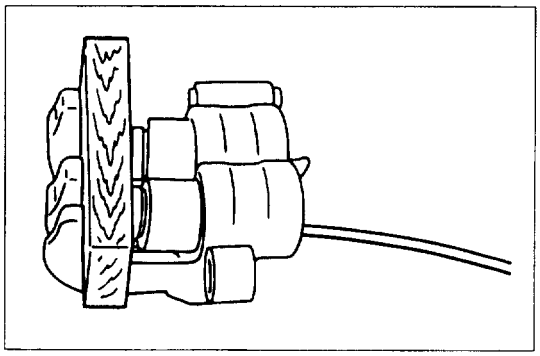


6. Pad Clip



7. Support Assembly

8. Boot Ring
9. Piston Boot



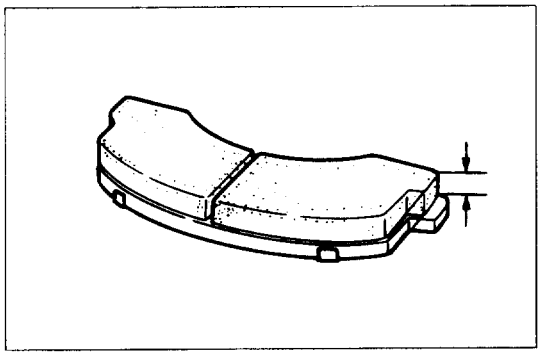
10. Piston

1. Place a piece of wood across the body assembly to prevent piston damage.
2. Apply approximately 196 kPa (2kg/cm^2, 28.4 psi) of compressed air to the body assembly oil port to remove the pistons.

11. Piston Seal

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.



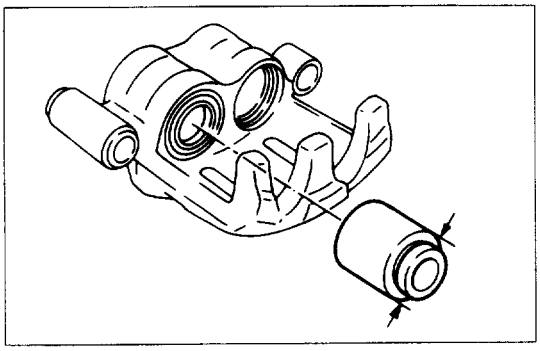
Pad

Use a vernier caliper to measure the pad thickness.

Pad Thickness mm(in)

Models	Standard	Limit
NHR	12 (0.472)	1 (0.039)
NKR	14 (0.551)	1 (0.039)

If the measured value is less than the specified limit, the pads must be replaced with the repair pad kit.



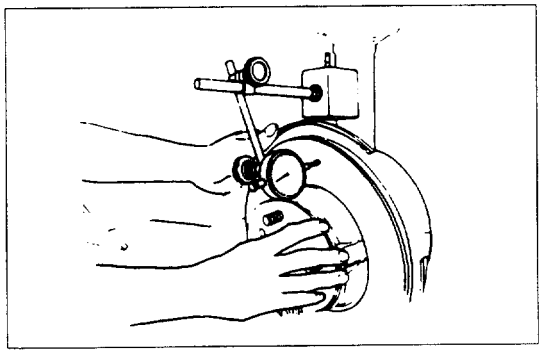
Piston and Cylinder Clearance

1. Use a micrometer to measure the piston diameter.
2. Use an inside dial indicator to measure the cylinder bore.
3. Calculate the piston and cylinder clearance.

Piston and Cylinder Clearance mm(in)

Standard	Limit
0.08 – 0.18 (0.0031 – 0.0071)	0.23 (0.0091)

If the clearance exceeds the specified limit, the piston and/or the body assembly must be replaced along with the repair seal kit.

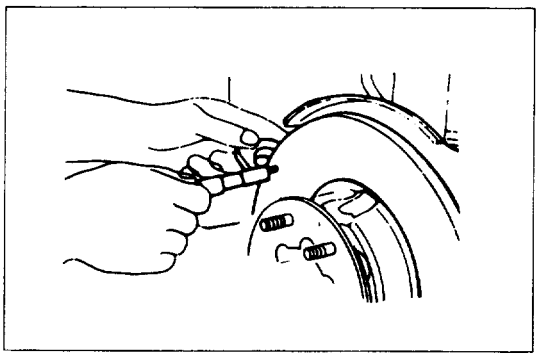


Disc

Lateral Runout

1. Adjust the wheel bearing correctly.
   Refer to "Front Axle" in Section 4.
2. Attach a dial indicator to some portion of the suspension so that the stem contacts the disc face about 29 mm (1.14 in) from the disc edge.
3. Move the disc one complete rotation.
   The lateral runout should not exceed 0.13 mm (0.005 in)

Maximum runout	mm (in)	0.13 (0.005)



Parallelism and thickness

Parallelism is the measurement of the thickness of the disc at four or more points around the circumference of the disc. All measurement must be made at 29 mm (1.14 in) from the edge of the disc.

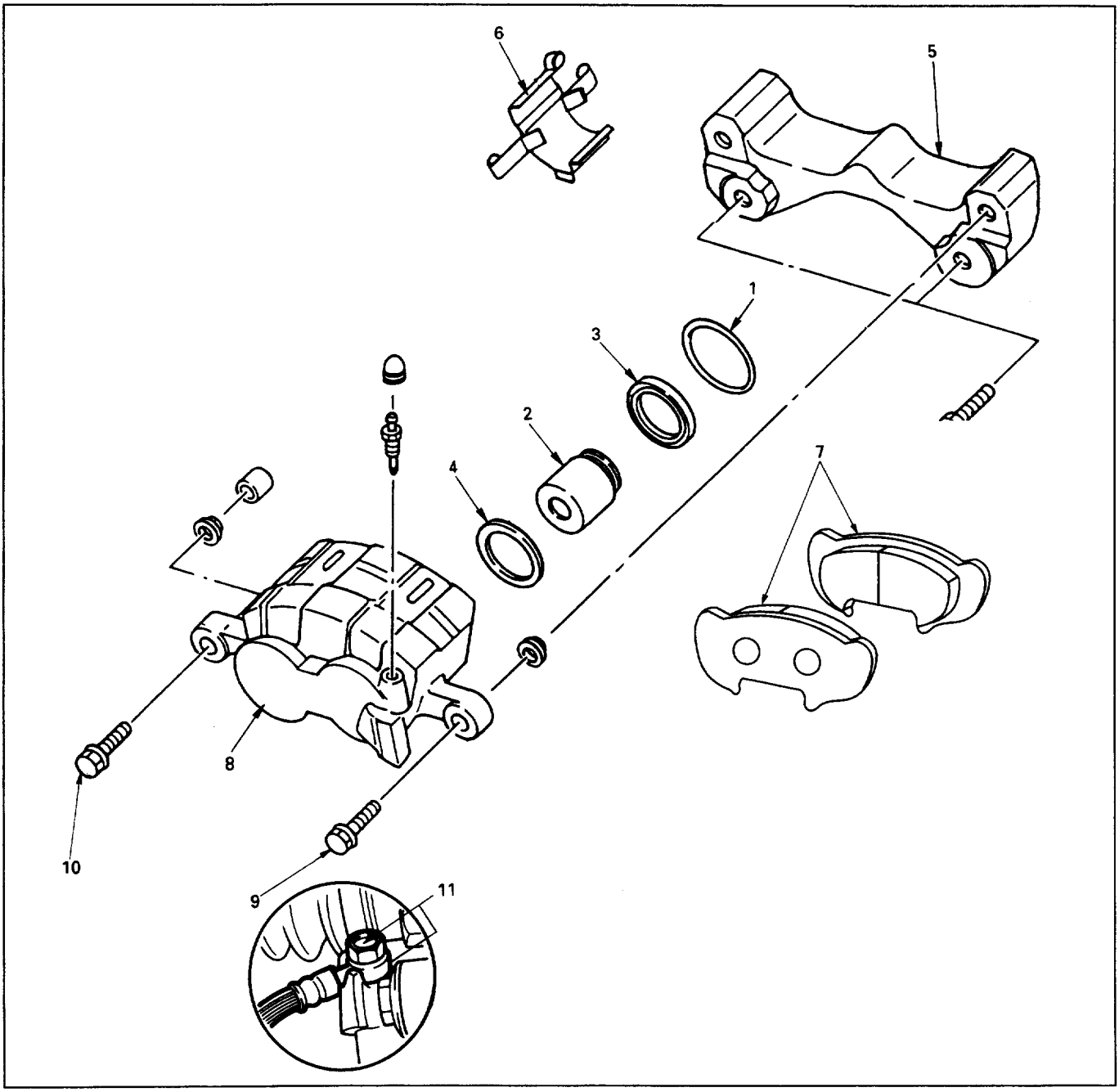
The disc thickness must not vary more than 0.010 mm (0.0004 in) from the point to point.

Maximum parallelism	mm (in)	0.02 (0.0008)

Disc Thickness mm (in)

Models	Standard	Limit
NHR	30.0 (1.181)	28.5 (1.122)
NKR	35.0 (1.378)	32.0 (1.260)

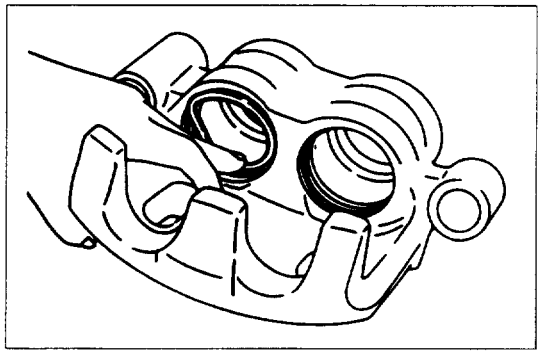
INSTALLATION



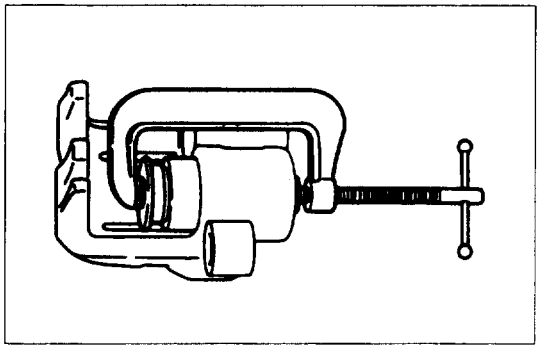
Installation Steps

1. Piston seal
2. Piston
3. Piston boot
4. Boot ring
5. Support Assembly
6. Pad clip
7. Pad
8. Caliper assembly
9. Guide pin bolt
10. Lock pin bolt
11. Joint bolt and flexible hose

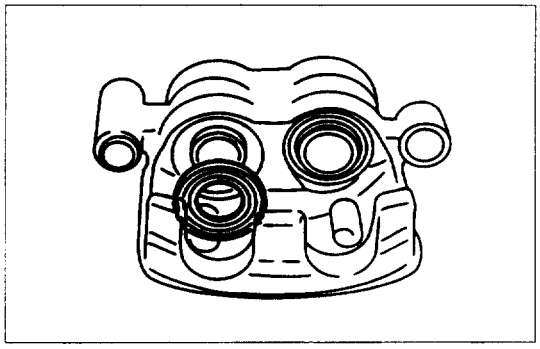
Installation steps



1. **Piston Seal**
   1. Apply rubber grease to the piston seal.
      The rubber grease is included in the seal kit.
   2. Install the piston seal to the cylinder bore groove.



2. **Piston**
3. **Piston Boot**
4. **Boot Ring**
   1. Apply brake oil to the piston outer circumference.
   2. Use a hand vise to install the pistons to the cylinder.
   3. Apply special grease to the piston.
      This will prevent cylinder and piston corrosion.
   4. Install the piston boot outer lip to the cylinder bore groove.
      Install the piston boot inner lip to the piston groove.
      Handle the piston boot carefully.
   5. Install the boot ring to the cylinder bore groove.
      The boot ring must be completely installed to the groove.



5. **Support Assembly**

Support Assembly Bolt Torque	N·m (kg·m/lb·ft)
226 (23.0 / 116)	

6. **Pad Clip**
7. **Pad**
8. **Caliper Assembly**
9. **Guide Pin Bolt**
10. **Lock Pin Bolt**

Guide Pin Bolt/Lock Pin Bolt Torque	N·m (kg·m/lb·ft)
137 (14.0 / 101)	

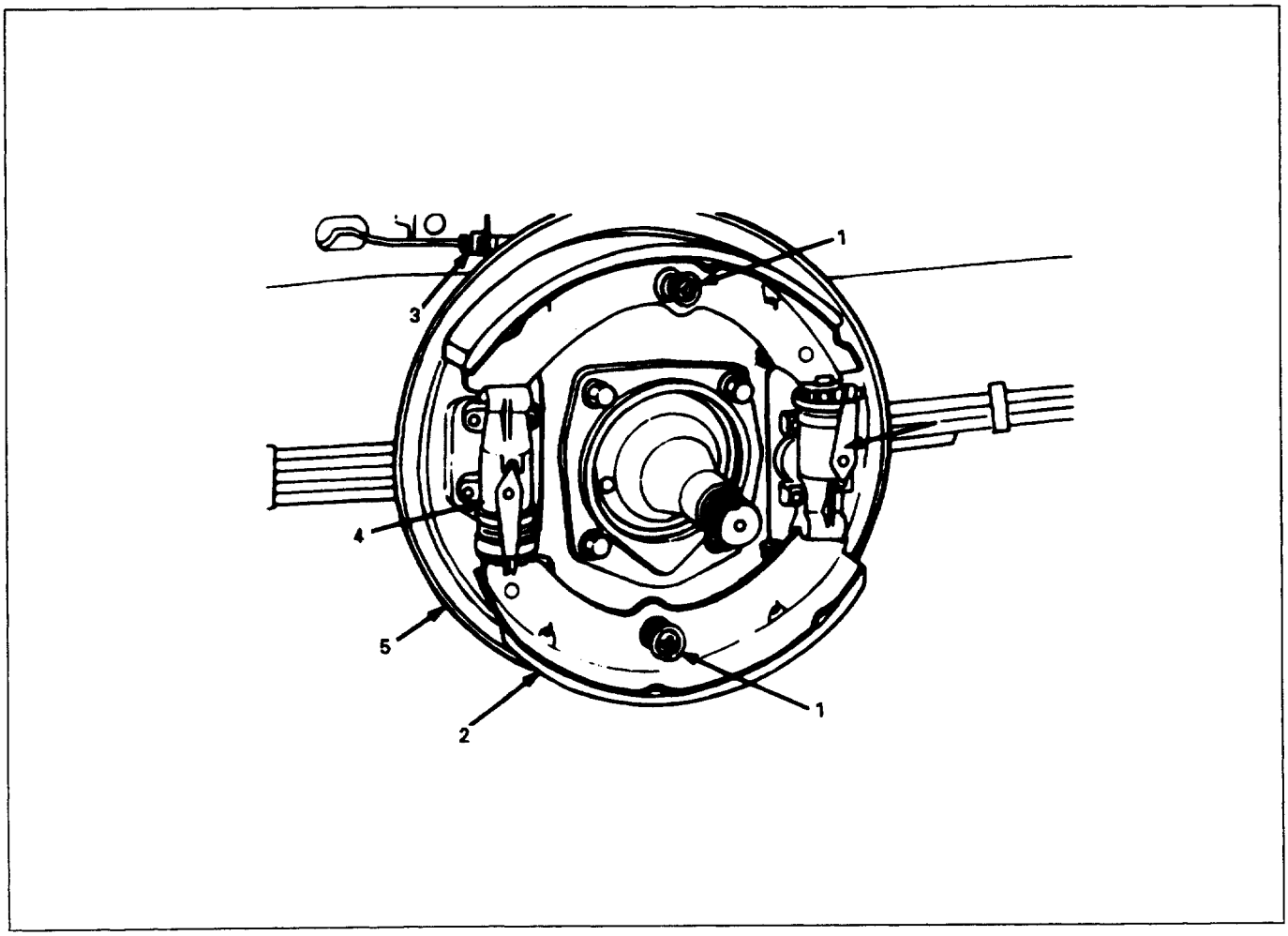
11. **Joint Bolt and Flexible Hose**

Joint Bolt Torque	N·m (kg·m/lb·ft)
34 (3.5 / 25)	

FRONT DRUM BRAKE ASSEMBLY

REMOVAL

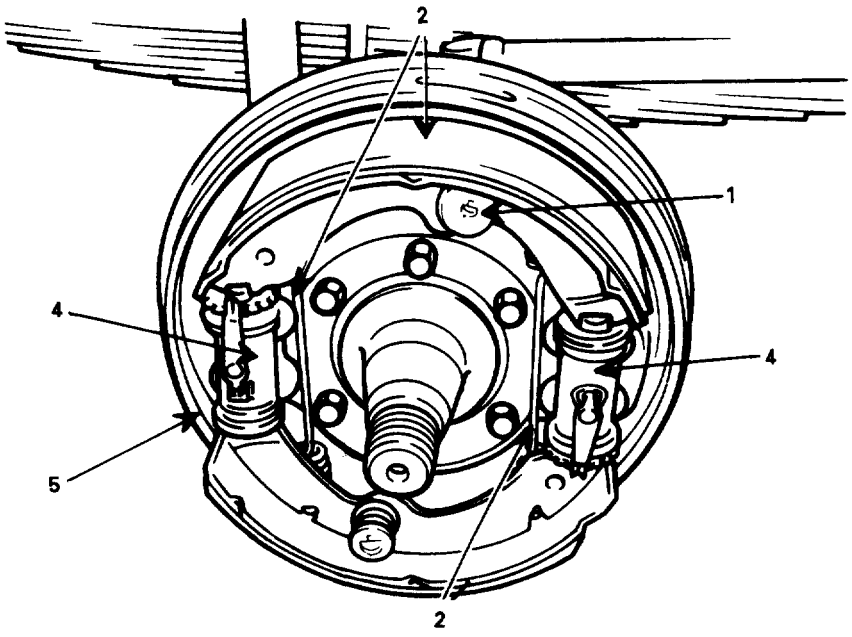
Two Leading Type



Removal Steps

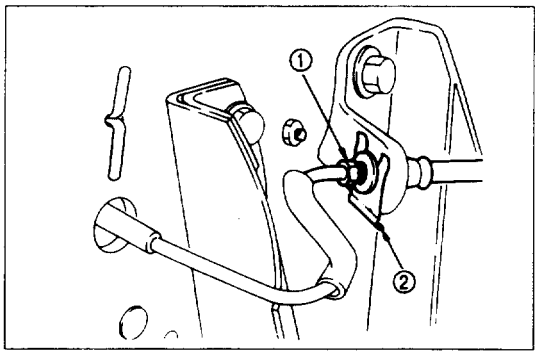
1. Shoe holding spring, cup and pin
2. Brake shoe and return spring
3. Brake flexible hose and pipe
4. Wheel cylinder assembly
5. Back plate and oil shield cover

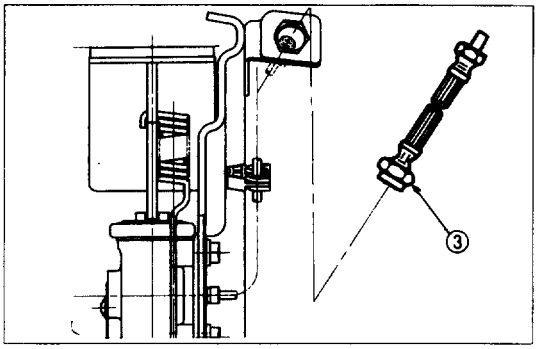
Dual Two Leading Type



Removal Steps

1. Shoe holding spring, cup and pin
2. Brake shoe and return spring
3. Brake flexible hose and pipe
4. Wheel cylinder assembly
5. Back plate and oil shield cover





Removal Steps

1. **Shoe Holding Spring, Cup and Pin**
2. **Brake Shoe and Return Spring**
3. **Brake flexible Hose and Pipe**
   1 Place a tray beneath the flexible hose to receive the brake fluid.
   2 Loosen the union nut ①.
   3 Remove the clip ② and loosen the hose end ③ from the pipe to remove the flexible hose.

   NOTE:

   Take care not to twist the piping and the flexible hose.

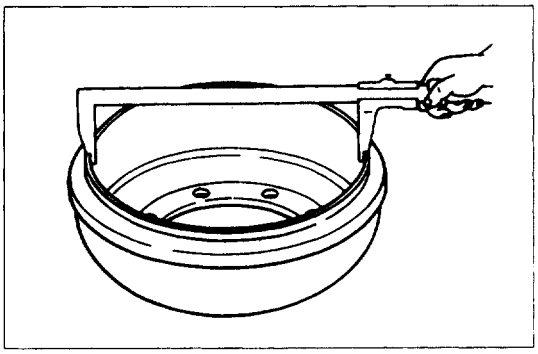
4. **Wheel Cylinder Assembly**
5. **Back Plate and Oil Shield Cover**

   Store all of the removed parts in a clean part tray.

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.

Brake Drum



Brake Drum Inside Diameter

Visually inspect the brake drum for excessive wear and scoring.

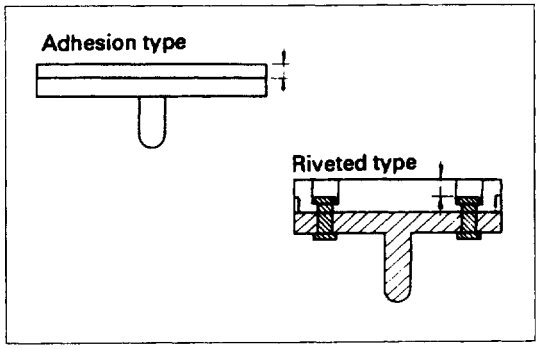
If the brake drum is scored or worn, lathed to the specified limit.

Use a vernier caliper to measure the brake drum inside diameter.

Brake Drum Inside Diameter mm (in)

Drum size	Standard	Limit
279.4	279.4 (11.00)	281.0 (11.06)
300.0	300.0 (11.81)	301.5 (11.87)
320.0	320.0 (12.60)	321.5 (12.66)
Out of round	0.13 (0.005) or less	—

Brake Lining



Brake Lining Thickness Measurement

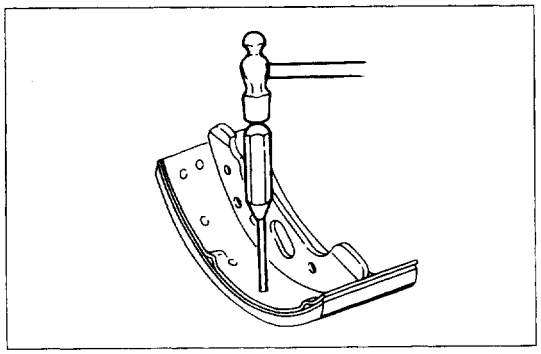
Use a vernier caliper to measure the brake lining thickness or the rivet depth.

If the measured value is less than the specified limit, the brake shoe assembly and/or the lining must be replaced.

Brake Lining Thickness or Rivet Depth mm (in)

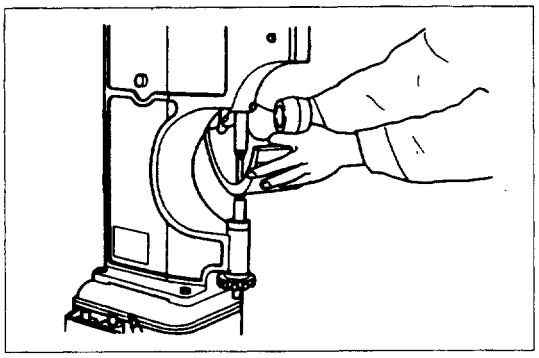
Limit	1.0 (0.039)

Brake Lining Replacement



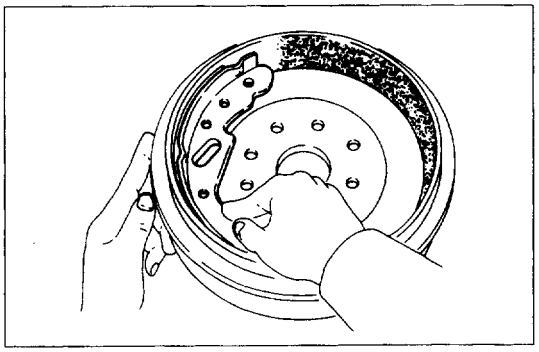
Brake Lining Removal (Riveted type only)

1. Remove the rivet caulking portions with a hammer and chisel.
2. Remove the rivets with a hammer and punch.
3. Inspect the brake shoe for cracking.



Brake Lining Installation (Riveted type only)

1. Install the brake lining the rivets to the brake shoe.
2. Place the brake shoe assembly in the air hydraulic riveter.
3. Use the air hydraulic riveter to set and caulk each of the rivets.
4. Start riveting at the center of lining and work towards the ends.



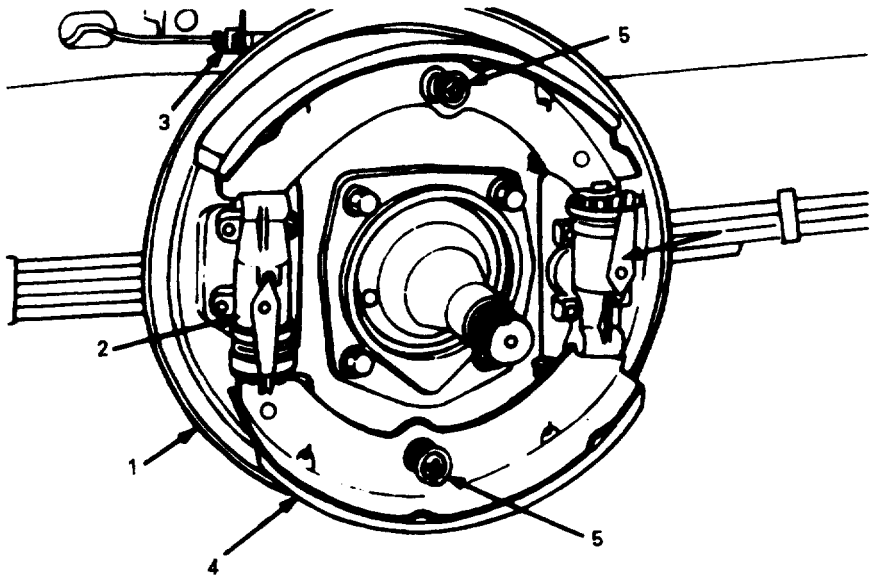
Brake Lining and Drum Contact

1. Apply chalk powder to the entire inside brake drum surface.
2. Place the brake shoe assembly in the inside brake drum.
3. Move the brake shoe assembly around the inside brake drum.

   Check for uniform contact between the brake lining and the brake drum.
4. Correct any areas having poor contact with sandpaper.
5. Repeat Steps 1 through 4 until the contact between the brake lining and the brake drum is perfect.

INSTALLATION

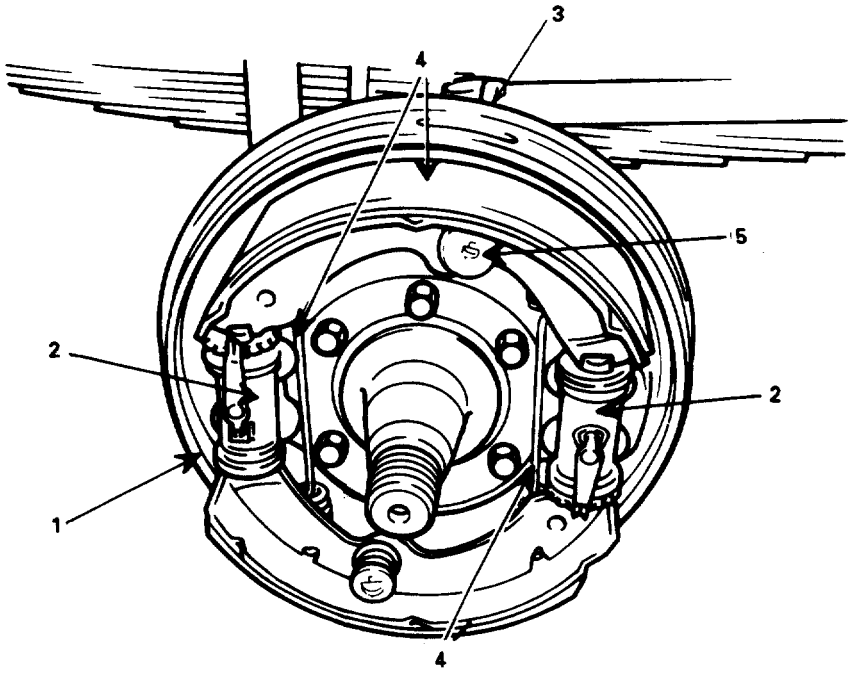
Two Leading Type



Installation Steps

1. Back plate and oil shield cover
2. Wheel cylinder assembly
3. Brake flexible hose and pipe
4. Brake shoe and return spring
5. Shoe holding spring, cup and pin

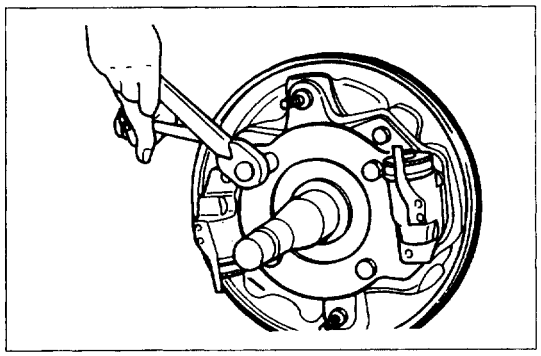
Dual Two Leading Type



Installation Steps

1. Back plate and oil shield cover
2. Wheel cylinder assembly
3. Brake flexible hose and pipe
4. Brake shoe and return spring
5. Shoe holding spring, cup and pin

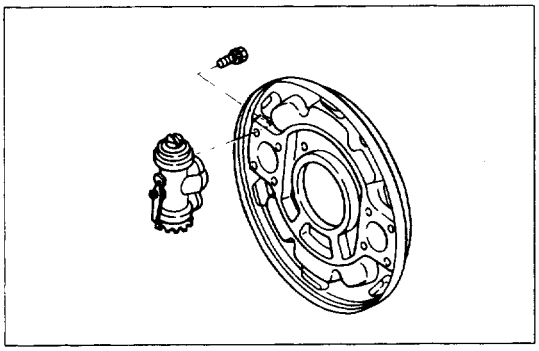
Installation Steps



1. **Back Plate and Oil Shield cover**

Tighten the back plate and oil shield cover bolts to the specified torque.

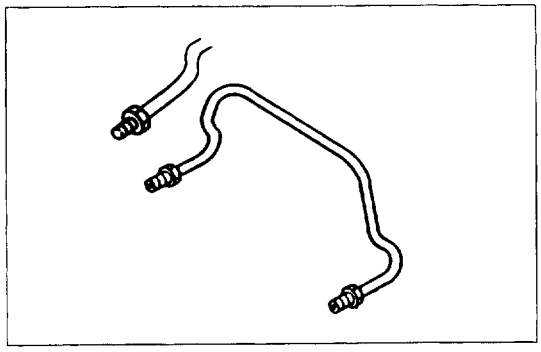
Back Plate and Oil Shield Cover Bolt Torque	N·m (kg·m/lb·ft)
NPS model	98 (10.0 / 72)
NQR model	157 (16.0 / 116)
Others	69 (7.0 / 51)



2. **Wheel Cylinder Assembly**

Tighten the wheel cylinder assembly bolts to the specified torque.

Wheel Cylinder Assembly Bolt Torque		N·m (kg·m/lb·ft)
Drum Inside Dia. mm (in)	Lining Width mm (in)	
279.4 (11.00)	60 (2.36)	27 (2.8 / 20)
300.0 (11.81)	75 (2.95)	34 (3.5 / 25)
320.0 (12.60)		43 (4.4 / 32)
320.0 (12.60)	100 (3.94)	74 (7.5 / 54)
320.0 (12.60)	120 (4.72)	94 (9.6 / 69)



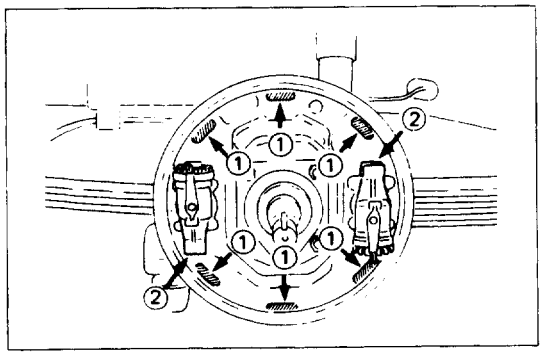
3. **Brake Flexible Hose and Pipe**

Tighten the brake pipe flare nuts to the specified torque

Brake Pipe Flare Nut Torque	N·m (kg·m/lb·ft)
16 (1.6 / 12)	

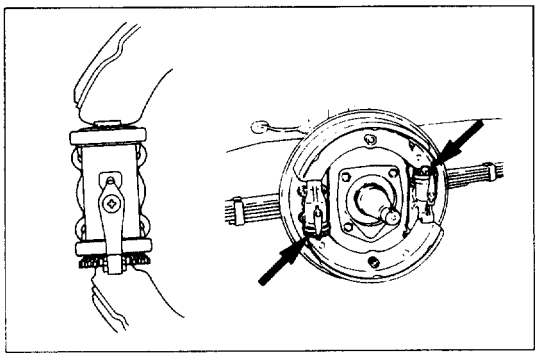
Note:

Take care not to twist the piping and the flexible hose.

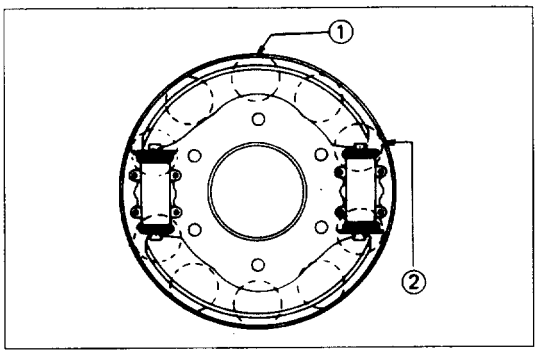


4. **Brake Shoe and Return Spring (Two Leading Type)**

1. Before setting the brake shoes, apply a thin coat of molybdenum disulfide grease to the back plate portions ① contacting the brake shoe edge as shown in the illustrations.
2. Apply a coat of molybdenum disulfide grease to the wheel cylinder parts contacting the brake shoe ②.

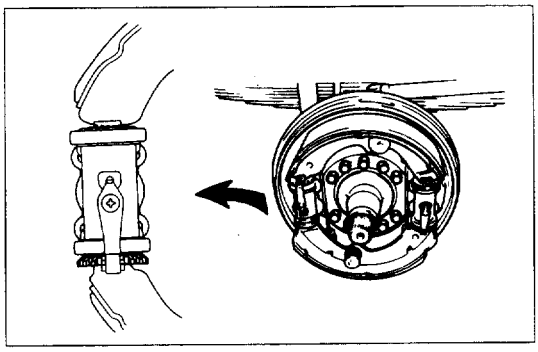


3. Set the brake shoe assembly to the cylinder adjusting screw at the brake shoe small angle end.
   Do not install it at the round end to the adjusting screw.
4. Install the brake shoes and the return springs to the wheel cylinders.
   Keep the lining surface clean.

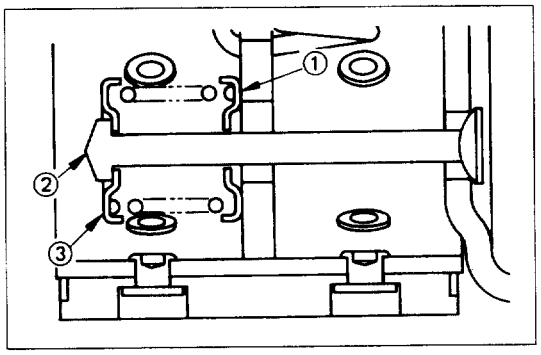


4. Brake Shoe and Return Spring (Dual Two Leading Type)

1. Before setting the brake shoes, apply a thin coat of molybdenum disulfide grease to the back plate portions ① contacting the brake shoe edge as shown in the illustrations.
2. Apply a coat of molybdenum disulfide grease to the wheel cylinder parts contacting the brake shoe ②.



3. Set the brake shoe assembly to the cylinder adjusting screw at the brake shoe small angle end.
   Do not install it at the round end to the adjusting screw.
4. Install the brake shoes and the return springs to the wheel cylinders.
   Keep the brake lining clean.



5. Shoe Holding Spring, Cup and Pin

1. Before installing the holding pin.
   Apply a coat of molybdenum disulfide grease to the holding cup seating faces ① contacting the brake shoe.

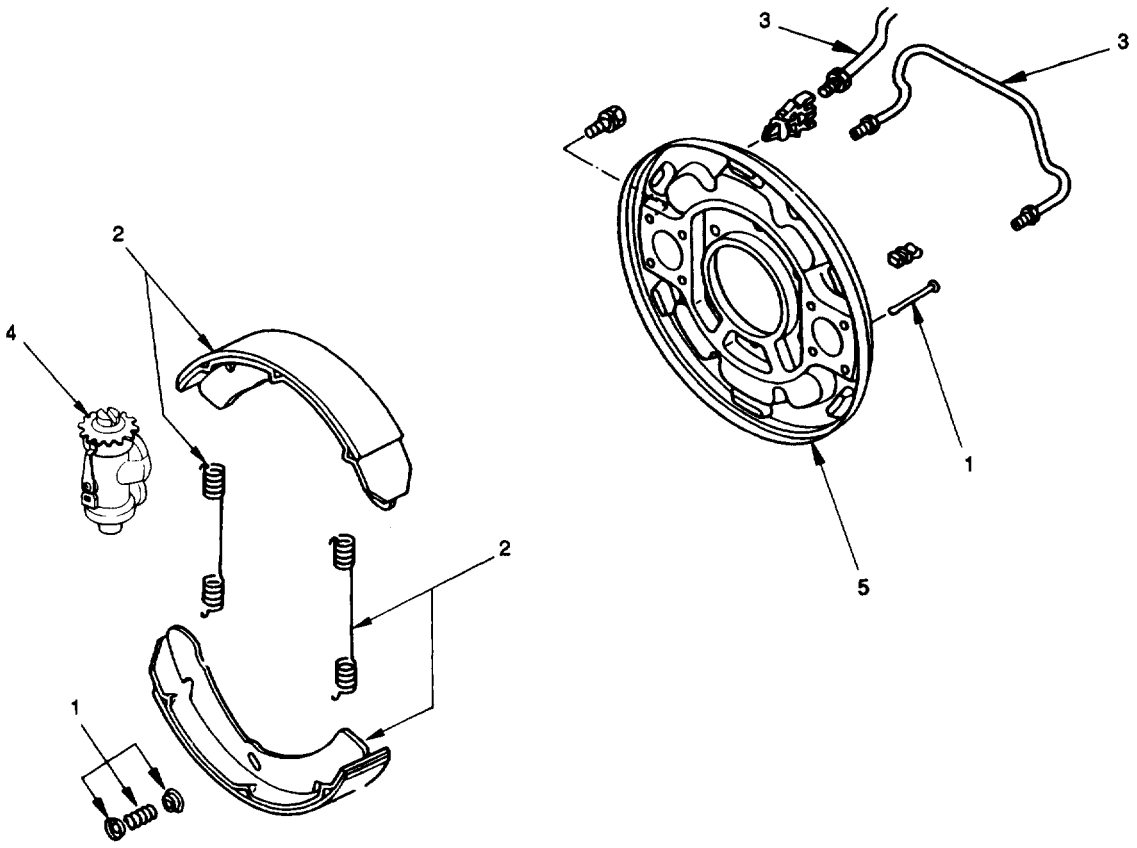
2. After installation of the pins, cups and the springs, make sure the pin ② seats to the cup ③ properly.

After assembly, adjust the lining clearance and air bleeding the brake, referring to the paragraph on servicing.

REAR DRUM BRAKE ASSEMBLY

REMOVAL

These removal steps are based on the without auto-adjuster type brake



Removal Steps

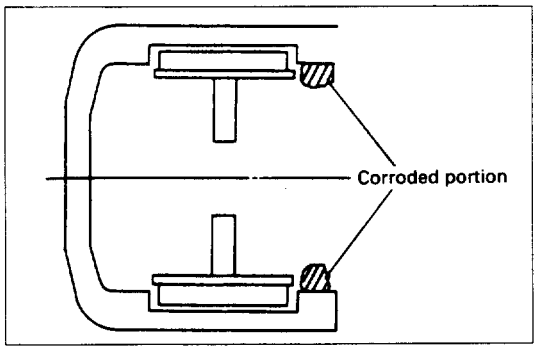
1. Shoe holding spring, cup and pin
2. Brake shoe and return spring
3. Brake pipe
4. Wheel cylinder assembly
5. Back plate

Removal Steps

1. **Shoe Holding Spring, Cup and Pin**
2. **Brake Shoe Return Spring**
3. **Brake Pipe**
4. **Wheel Cylinder Assembly**
5. **Back Plate**

   Store all of the removed parts in a clean part tray.

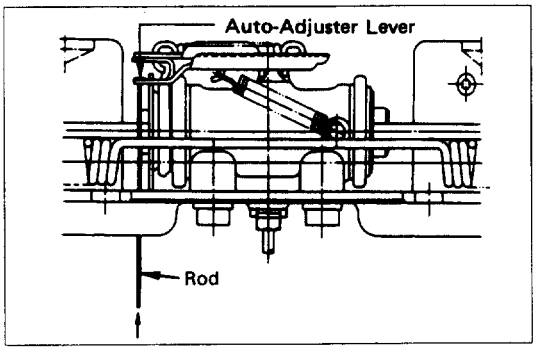
BRAKE DRUM REMOVAL (WITH AUTO-ADJUSTER)



Removal Procedure

If the brake drum has step wear or the brake drum edge is corroded, it will be difficult to remove the brake drum.

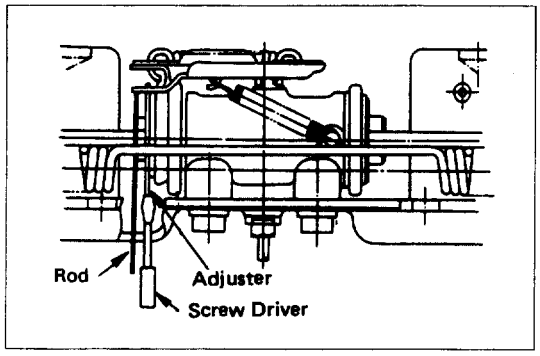
The following procedure will make brake drum removal easier.



Drum Inside Diameter 228.6 mm (9.0 in)

1. Remove the rubber covers from the brake lining clearance adjusting hole and auto-adjuster lever release hole.
2. Push up the auto-adjuster lever with a long drift or a suitable rod

   (Outside diameter: 4 mm (0.15 in) length: 80 mm (3.1 in)



3. Hold the auto-adjuster lever stationary.
   Use a screwdriver to rotate adjusters at back of the brake to provide clearance between lining and drum.

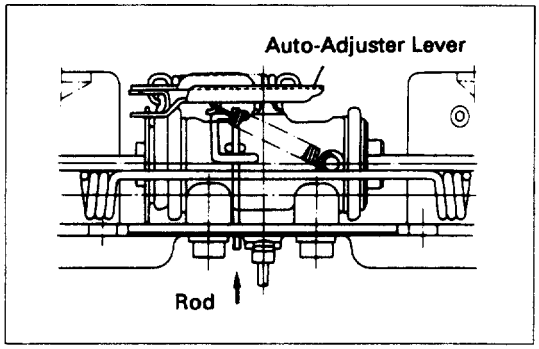
NOTE:

Be sure to push up the auto-adjuster lever (Step 2).

Failure to do so will result in damage to the teeth of the auto-adjuster lever.

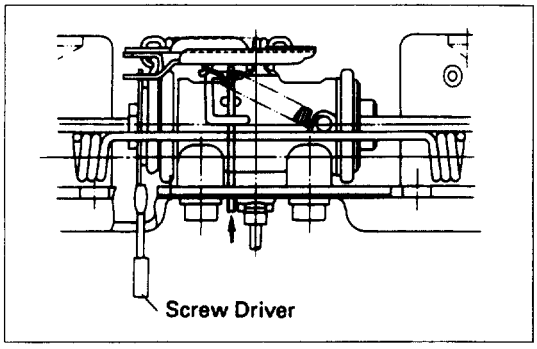
Take care not to damage the rubber boot with the bar or the screwdriver.

4. Remove the brake drum.



Drum Inside diameter 279.4 mm (11.0 in), 300.0 mm (11.81 in) and 320.0 mm (12.60 in)

1. Push the rod to push up the auto-adjuster lever.



2. Remove the rubber cover from the brake lining clearance adjusting hole.
3. Hold the auto-adjuster lever stationary.
   Use a screwdriver to rotate adjusters at back of the brake to provide clearance between lining and drum.

NOTE:

Be sure to push up the auto-adjuster lever (Step 1).

Failure to do so will result in damage to the teeth of the auto-adjuster lever.

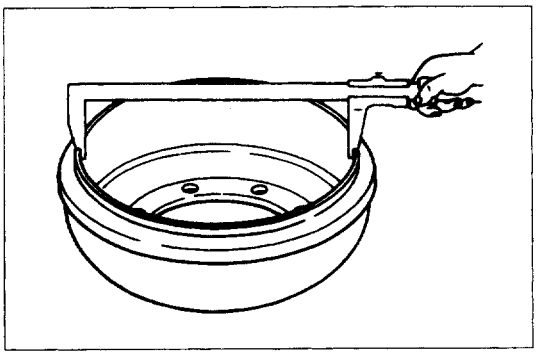
Take care not to damage the rubber boot with the bar or the screwdriver.

4. Remove the brake drum.

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.

Brake Drum



Brake Drum Inside Diameter

Visually inspect the brake drum for excessive wear and scoring.

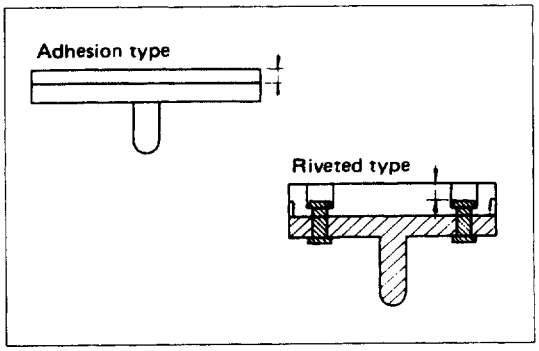
If the brake drum is scored or worn, lathed to the specified limit.

Use a vernier caliper to measure the brake drum inside diameter.

Brake Drum Inside Diameter mm (in)

Drum size	Standard	Limit
228.6	228.6 (9.00)	230.0 (9.06)
279.4	279.4 (11.00)	281.0 (11.06)
300.0	300.0 (11.81)	301.5 (11.87)
320.0	320.0 (12.60)	321.5 (12.66)
Out of round	0.13 (0.005) or less	

Brake Lining



Brake Lining Thickness Measurement

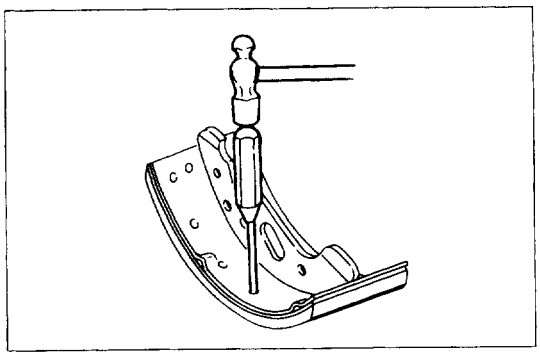
Use a vernier caliper to measure the brake lining thickness or the rivet depth.

If the measured value is less than the specified limit, the brake shoe assembly and/or the lining must be replaced.

Brake Lining Thickness or Rivet Depth mm (in)

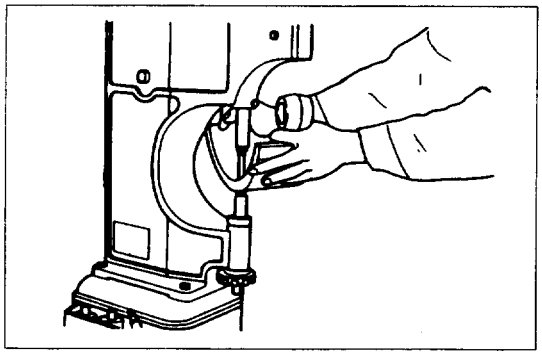
Limit	1.0 (0.039)

Brake Lining Replacement



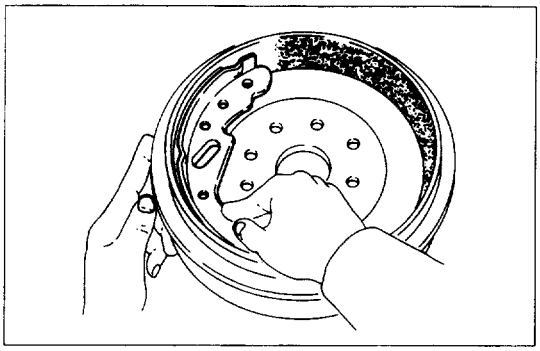
Brake Lining Removal (Riveted type only)

1. Remove the rivet caulking portions with a hammer and chisel.
2. Remove the rivets with a hammer and punch.
3. Inspect the brake shoe for cracking.



Brake Lining Installation (Riveted type only)

1. Install the brake lining and the rivets to the brake shoe.
2. Place the brake shoe assembly in the air hydraulic riveter.
3. Use the air hydraulic riveter to set and caulk each of the rivets.
4. Start riveting at the center of lining and work towards the ends.



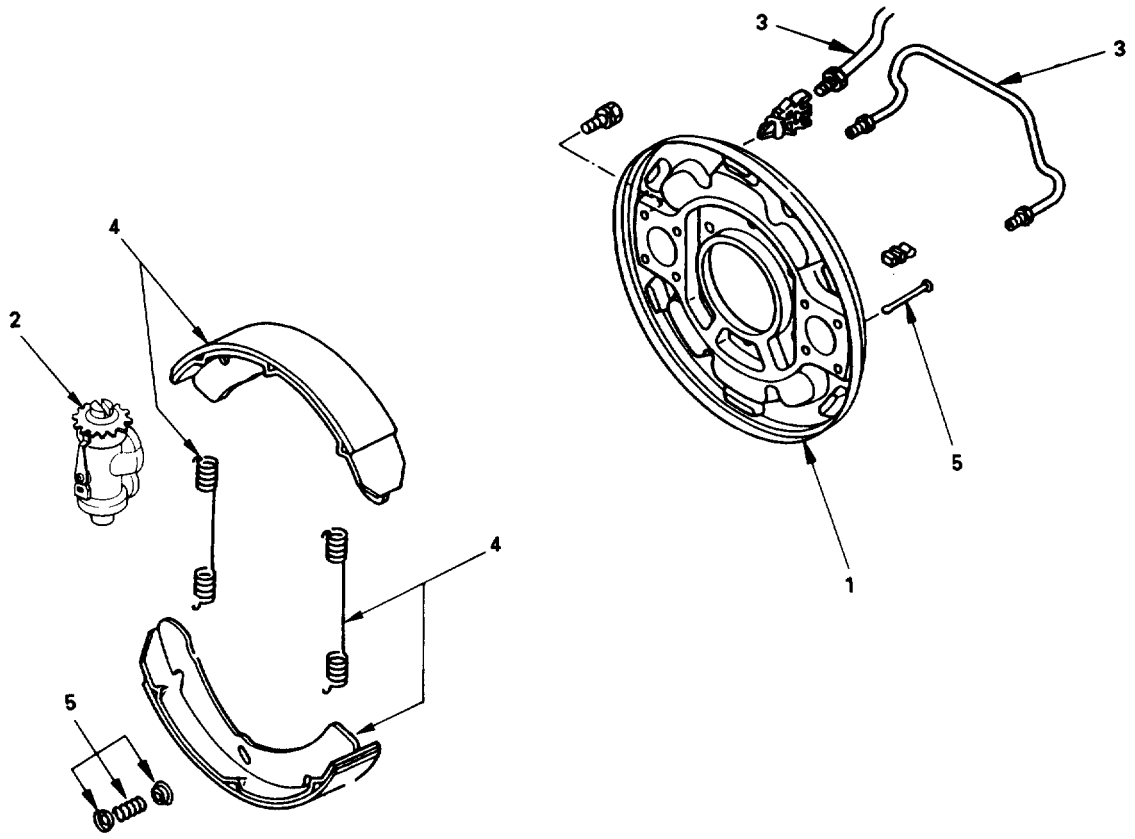
Brake Lining and Drum Contact

1. Apply chalk powder to the entire inside brake drum surface.
2. Place the brake shoe assembly in the inside brake drum.
3. Move the brake shoe assembly around the inside brake drum.

   Check for uniform contact between the brake lining and the brake drum.
4. Correct any areas having poor contact with sandpaper.
5. Repeat Steps 1 through 4 until the contact between the brake lining and the brake drum is perfect.

INSTALLATION

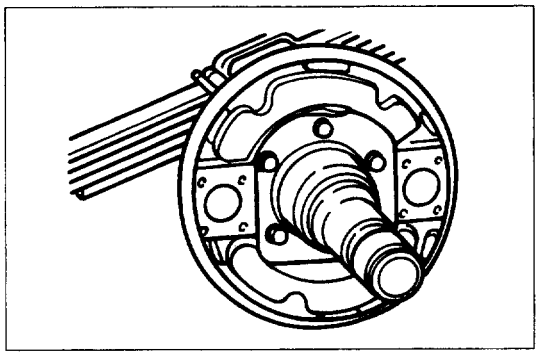
These installation steps are based on the without auto-adjuster type brake



Installation Steps

1. Back plate
2. Wheel cylinder assembly
3. Brake pipe
4. Brake shoe and return spring
5. Shoe holding spring, cup and pin

Installation Steps

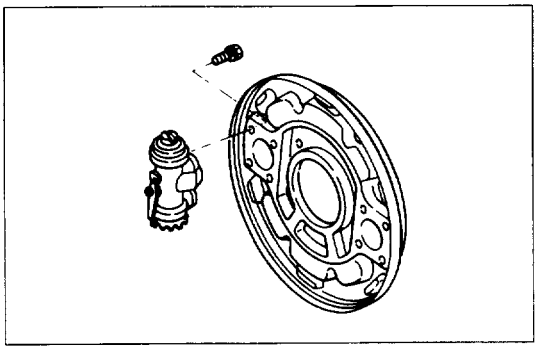


1. **Back Plate**

Tighten the back plate bolts to the specified torque.

Back Plate Bolt Torque		N·m (kg·m/lb·ft)
Drum Inside Dia. mm (in)	Lining Width mm (in)	
228.6 (9.00)	75 (2.95)	108 (11.0 / 80)
279.4 (11.00)	60 (2.36)	74 (7.5 / 54)
300.0 (11.81)	75 (2.95)	* 44 (4.5 / 33) **108 (11.0 / 80)
320.0 (12.60)	75 (2.95)	43 (4.4 / 32)
	100 (3.94)	94 (9.6 / 69)
	120 (4.72)	94 (9.6 / 69)

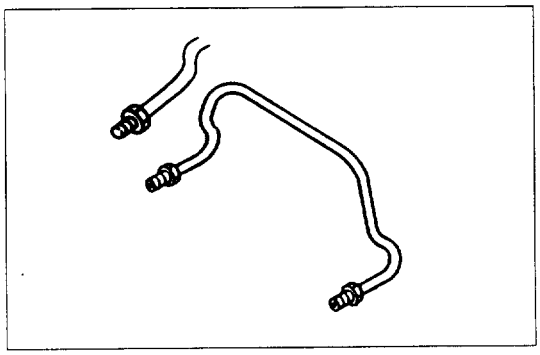
*Single Tire models **Dual Tire models



2. **Wheel Cylinder Assembly**

Tighten the wheel cylinder assembly bolts to the specified torque.

Wheel Cylinder Assembly Bolt Torque		N·m (kg·m/lb·ft)
Drum Inside Dia. mm (in)	Lining Width mm (in)	
228.6 (9.00)	75 (2.95)	34 (3.5 / 25)
279.4 (11.00)	60 (2.36)	27 (2.8 / 20)
300.0 (11.81)	75 (2.95)	34 (3.5 / 25)
320.0 (12.60)	75 (2.95)	43 (4.4 / 32)
	100 (3.94)	94 (9.6 / 69)
	120 (4.72)	94 (9.6 / 69)



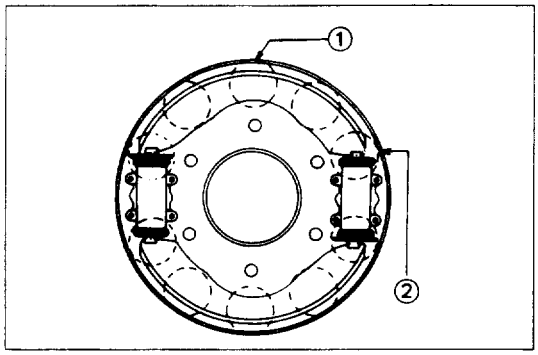
3. **Brake Pipe**

Tighten the brake pipe flare nuts to the specified torque

Brake Pipe Flare Nut Torque	N·m (kg·m/lb·ft)
16 (1.6 / 12)	

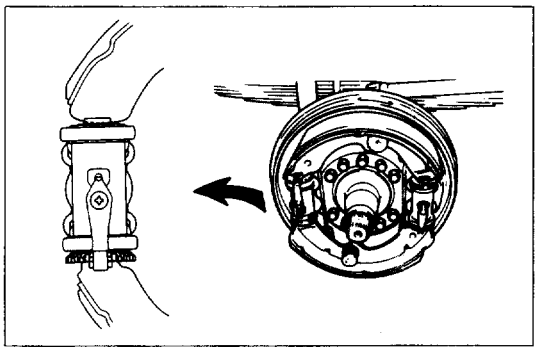
NOTE:

Take care not to twist the piping.

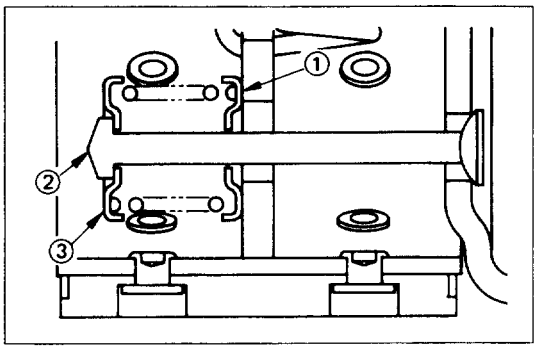


4. Brake Shoe and Return Spring

1. Before setting the brake shoes, apply a thin coat of molybdenum disulfide grease to the back plate portions ① contacting the brake shoe edge as shown in the illustrations.
2. Apply a coat of molybdenum disulfide grease to the wheel cylinder parts contacting the brake shoe ②.



3. Set the brake shoe assembly to the cylinder adjusting screw at the brake shoe small angle end.
   Do not install it at the round end.
4. Install the brake shoes and the return springs to the wheel cylinders.
   Keep the brake lining clean.

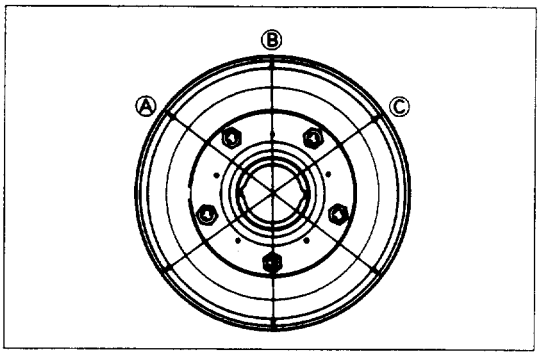


5. Shoe Holding Spring, Cup and Pin

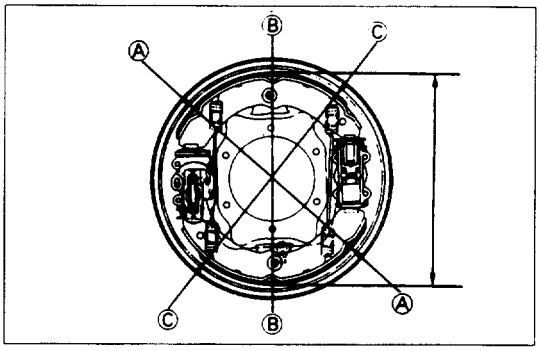
1. Before installing the holding pin.
   Apply a coat of molybdenum disulfide grease to the holding cup seating faces ① contacting the brake shoe.

2. After installation of the pins, cups and the springs, make sure the pin ② seats to the cup ③ properly.

BRAKE DRUM INSTALLATION



1. Measure the internal diameter of the brake drum.
   - Take measurement of the distance at Ⓐ, Ⓑ and Ⓒ points.

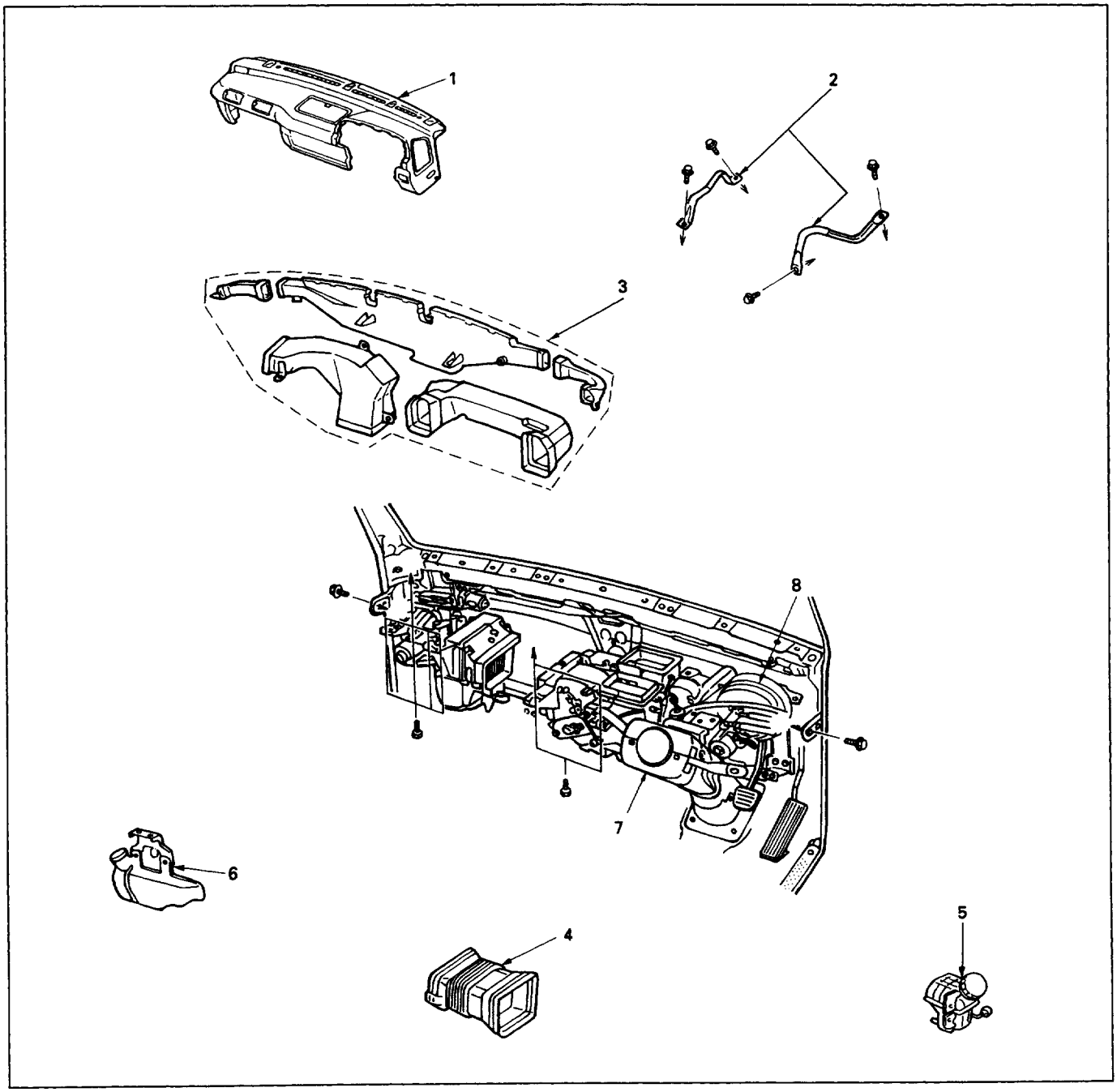


2. Measure the external diameter of the brake shoe.
   - Take measurement of the distance at Ⓐ, Ⓑ and Ⓒ points.
3. Turn the adjuster gear so that the difference between the internal diameter of the brake drum and the internal diameter of the brake shoe becomes 0.6 mm.
4. Install the brake drum.

BRAKE PEDAL AND CONTROL

BRAKE VACUUM BOOSTER AND BRAKE PEDAL ASSEMBLY

REMOVAL



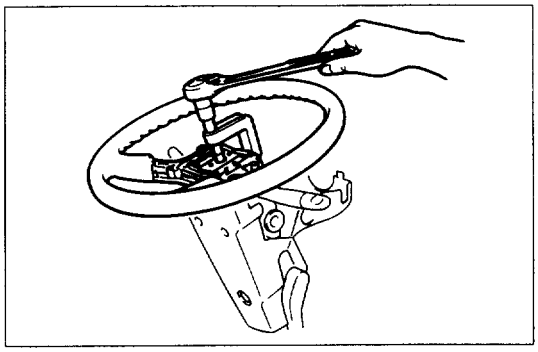
Removal Steps

1. Instrument panel
2. Stay
3. Defroster nozzle and vent duct
4. Center duct (NPR model only)
5. Brake and clutch fluid reservoir
6. Windshield washer tank
7. Steering cowl assembly
8. Vacuum booster and brake pedal assembly

Removal Steps

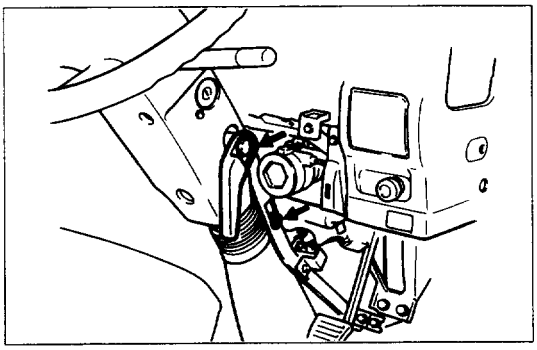
1. **Instrument Panel**
2. **Stay**
3. **Defroster Nozzle and Vent Duct**
4. **Center Duct (NPR model only)**
5. **Brake and Clutch Fluid Reservoir**
6. **Windshield Washer Tank**

   For the removal procedure for above, refer to Section 2 Frame and Cab Workshop Manual.

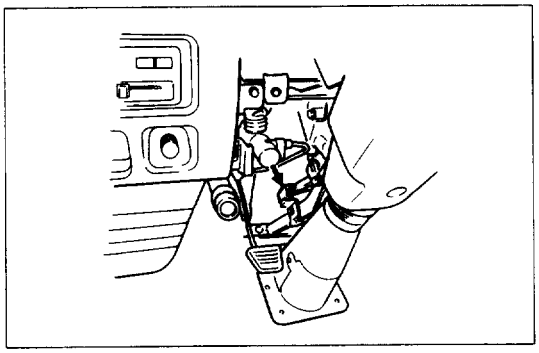


7. **Steering Cowl Assembly**

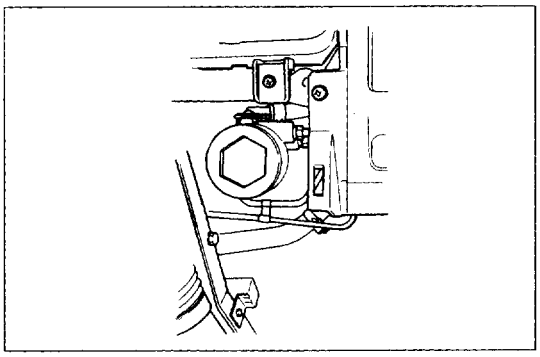
   Wheel remover: 5-8840-2215-0



Remove the tilt lever and steering cowl



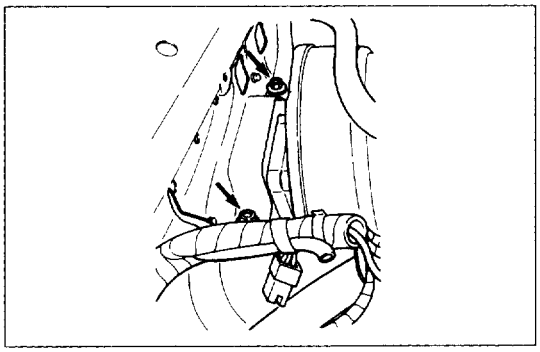
Disconnect the wire harness connectors.

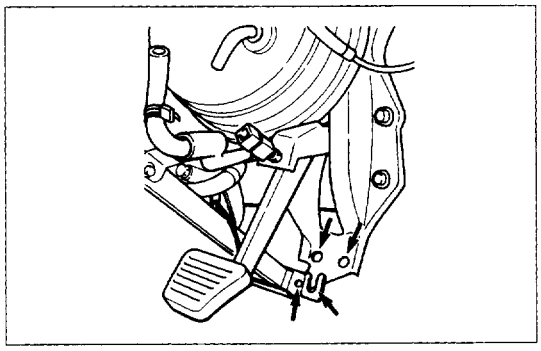


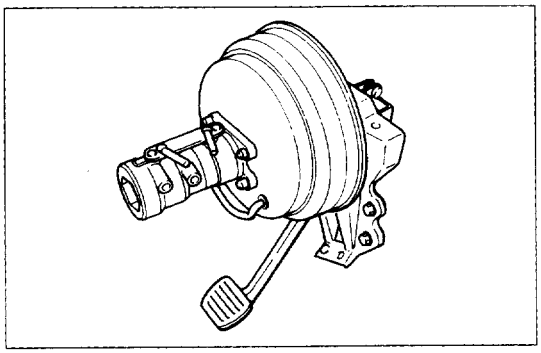
8. Vacuum Booster and Brake Pedal Assembly

1. Disconnect the brake pipes and hoses.
2. Plug or cover the brake rubber hoses, pipes and the master cylinder brake fluid ports to prevent brake fluid spillage.

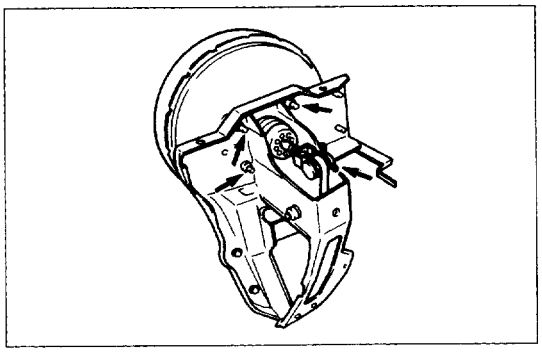
   If brake fluid spillage occurs, wipe it up immediately.
3. Remove the brake pedal bracket fixing bolts and vacuum booster (except hydromaster type) and brake pedal assembly.





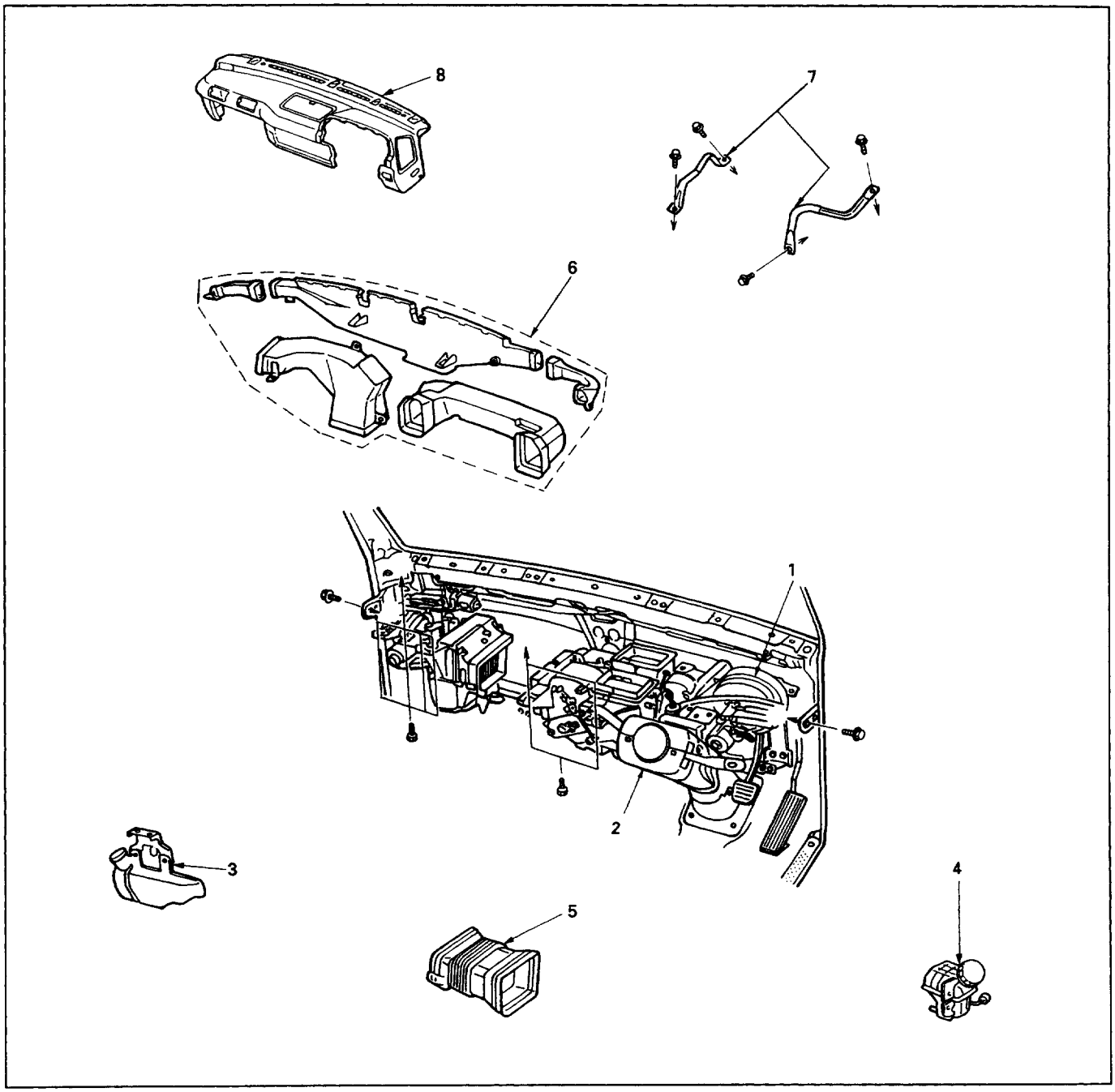


3. Remove the brake pedal and master cylinder.



4. Remove the vacuum booster assembly from brake pedal assembly (except hydromaster type).

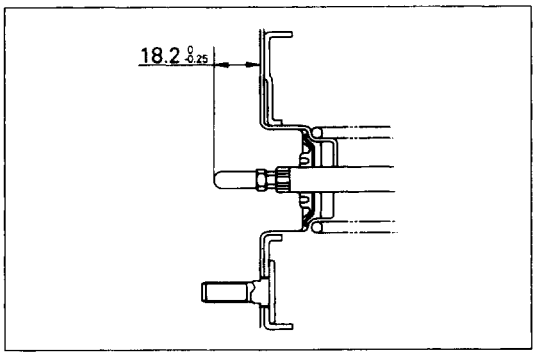
INSTALLATION



Installation Steps

1. Vacuum booster and brake pedal assembly
2. Steering cowl assembly
3. Windshield washer tank
4. Brake and clutch fluid reservoir
5. Center duct (NPR model only)
6. Defroster nozzle and vent duct
7. Stay
8. Instrument panel

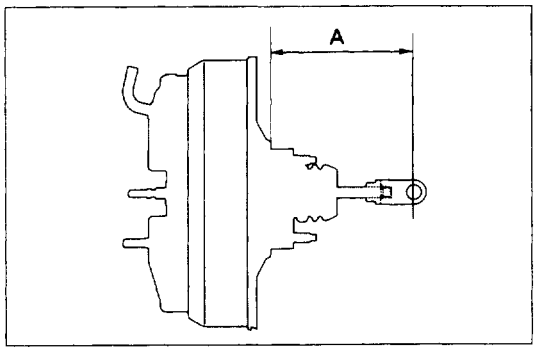
Installation steps



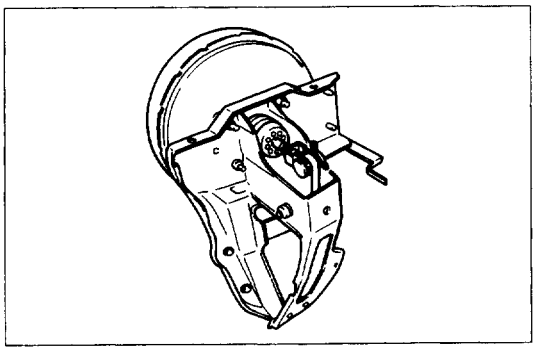
1. Vacuum Booster and Brake Pedal Assembly

Vacuum Booster (Master Vac) type:

1. Vacuum booster cannot be overhauled. If it is found faulty, replace its assembly with a new one.
2. Make necessary adjustment, so that distance between end of push rod and flange face is adjusted to 18.2 mm (0.717 in) in condition of vacuum applying.

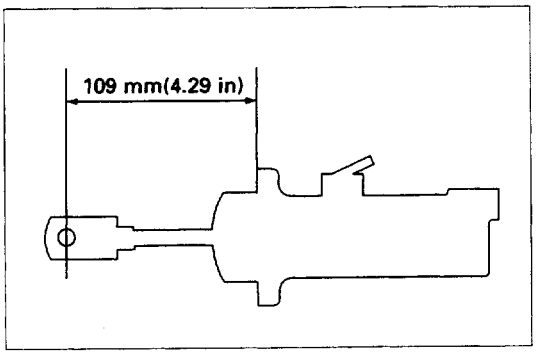


3. Push rod length Ⓐ is measured from the center of the clevis pin hole to the mounting surface of the brake pedal bracket. Adjusted to 109 mm (4.291 in); without spacer, 129 mm (5.079 in); with spacer and tighten the lock nut. When fixed under this condition, there is no need to adjust the height of brake pedal from floor and free play.



4. Install the vacuum booster to brake pedal assembly.
   - Adjust the clearance between the tip of threaded portion of the stop light switch and the pedal arm to 0.5 - 1.0 mm (0.02 - 0.04 in.).
5. Tighten the vacuum booster bolts to the specified torque.

Vacuum Booster Bolt	N·m (kg·m/lb·in)
	14 (1.4 / 122)



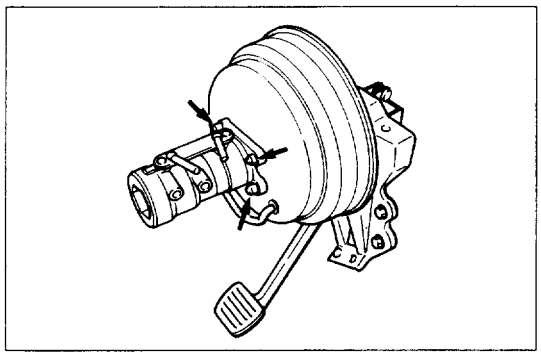
Hydromaster type:

Make necessary adjustment, so that distance between center of the clevis pin hole to the mounting surface of the master cylinder body is adjusted to 109 mm (4.29 in). Then tighten the lock nut.

When fixed under this condition, there is no need to adjust the height of brake pedal from floor and free play.

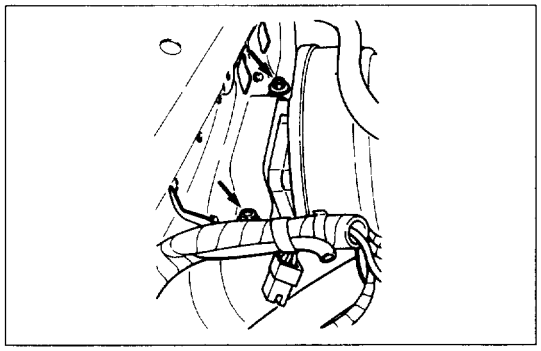
Push the brake pedal by hand to eliminate the free play between the push rod and the piston.

Under this condition, turn the stop light switch counterclockwise until the tip of the threaded portion contacts the brake pedal. Then back off the switch 1/4 - 3/4 turn.



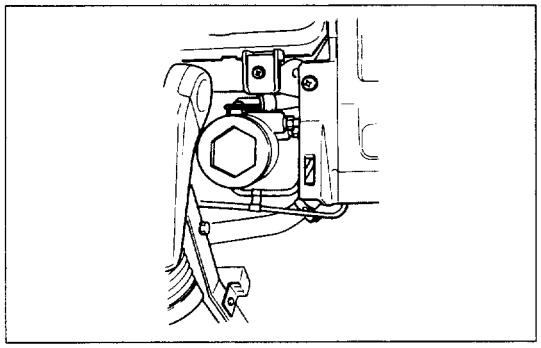
6. Install the master cylinder assembly to vacuum booster or brake pedal assembly.
7. Tighten the master cylinder nut to the specified torque.

Master Cylinder Bolt	N·m (kg·m/lb·in)
	14 (1.4 / 122)

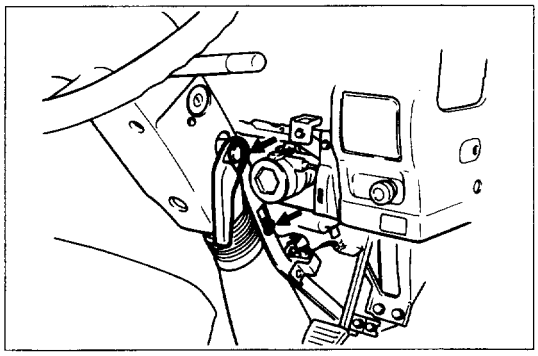


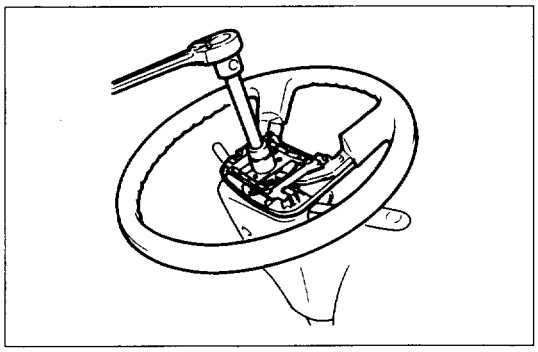
8. Install the vacuum booster and brake pedal assembly

Vacuum Booster and Brake Pedal Assembly Bolt	N·m (kg·m/lb·ft)
	42 (4.3 / 32)



9. Connect the brake hoses and pipes.





2. Steering Cowl Assembly

1. Connect the wire harness connectors.
2. Install the steering cowl

Steering Cowl Bolt	N·m (kg·m/lb·in)
14 (1.4 / 122)	

3. Install the tilt lever

Tilt Lever Bolt	N·m (kg·m/lb·ft)
45 (4.6 / 33)	

4. Steering wheel

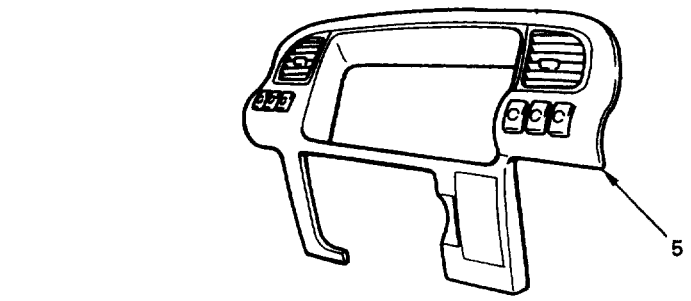
Steering Wheel Nut	N·m (kg·m/lb·ft)
49 (5.0 / 36)	

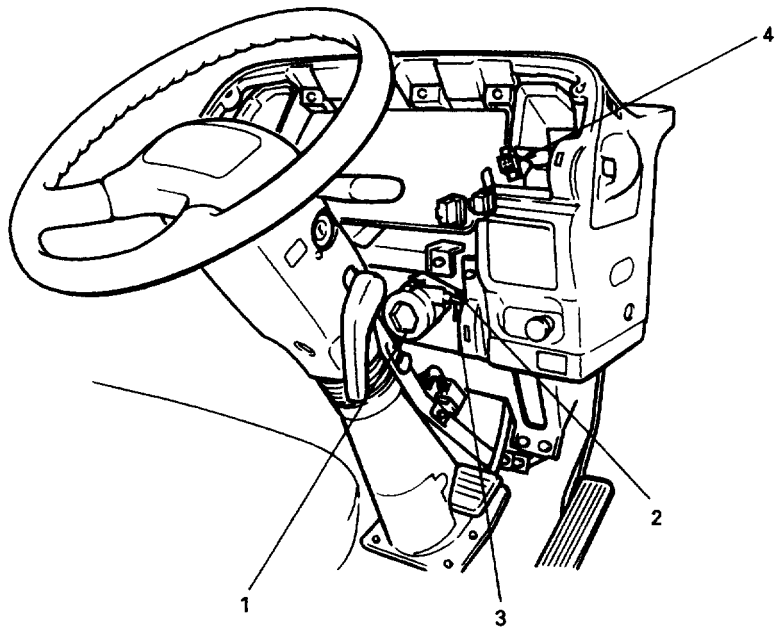
3. **Windshield Washer Tank**
4. **Brake and Clutch Fluid Reservoir**
5. **Center Duct (NPR model only)**
6. **Defroster Nozzle and Vent Duct**
7. **Stay**
8. **Instrument Panel**

For the installation procedure for above, refer to Section 2 Frame and Cab Workshop Manual.

MASTER CYLINDER ASSEMBLY

REMOVAL





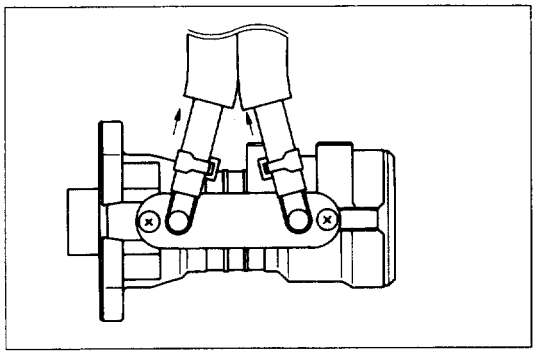
Removal Steps

1. Meter cluster
2. Switch connector
3. Brake pipe
4. Brake hose
5. Master cylinder

Removal Steps

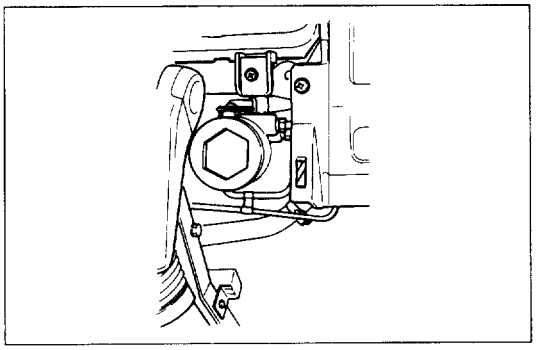
1. **Meter Cluster**
2. **Switch connector**

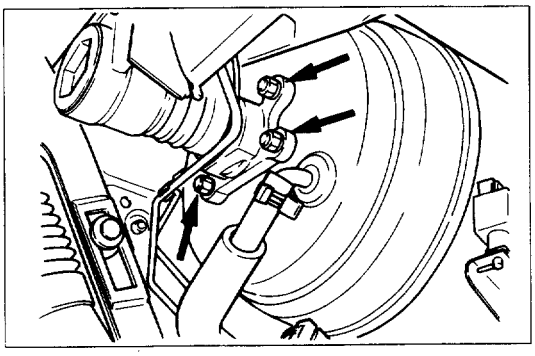
   For the removal procedure for above, refer to Section 2 Frame and Cab Workshop Manual.



3. **Brake Pipe**
4. **Brake Hose**
   1. Disconnect the brake pipes and hoses.
   2. Plug or cover the brake rubber hoses, pipes and the master cylinder brake fluid ports to prevent brake fluid spillage.

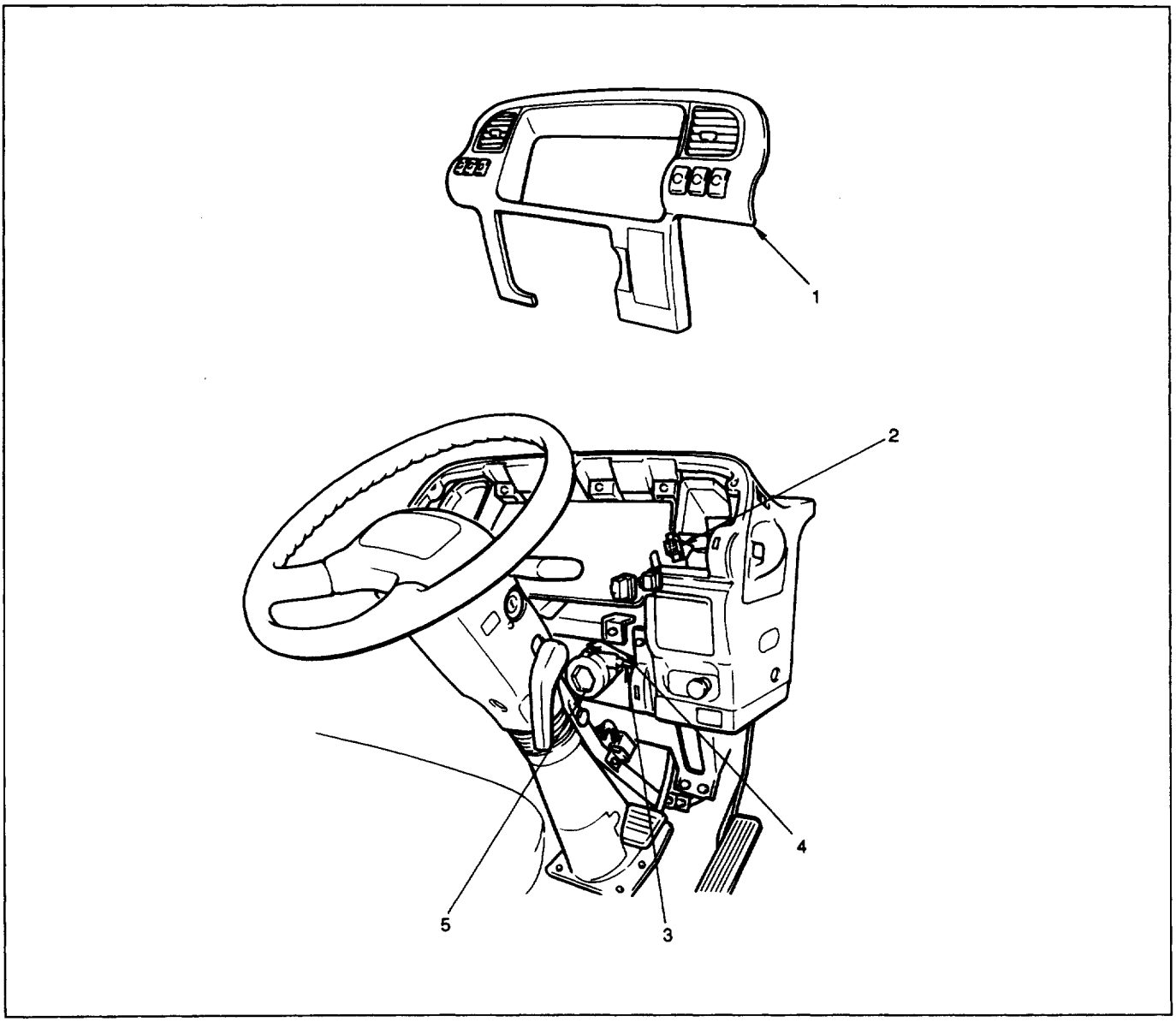
      If brake fluid spillage occurs, wipe it up immediately.





5. **Master Cylinder**

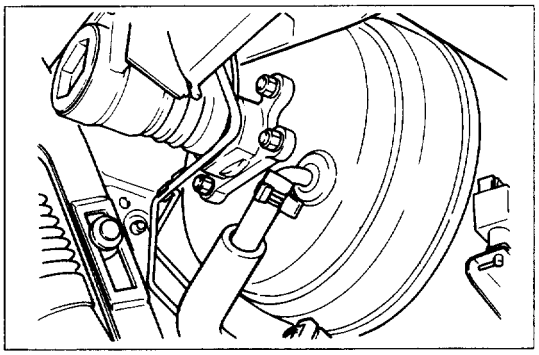
INSTALLATION



Installation Steps

1. Master cylinder
2. Brake hose
3. Brake pipe
4. Switch connector
5. Meter cluster

Installation Steps



1. **Master Cylinder**
   1. Install the master cylinder assembly to the vacuum booster or brake pedal assembly.
   2. Tighten the nuts to the specified torque

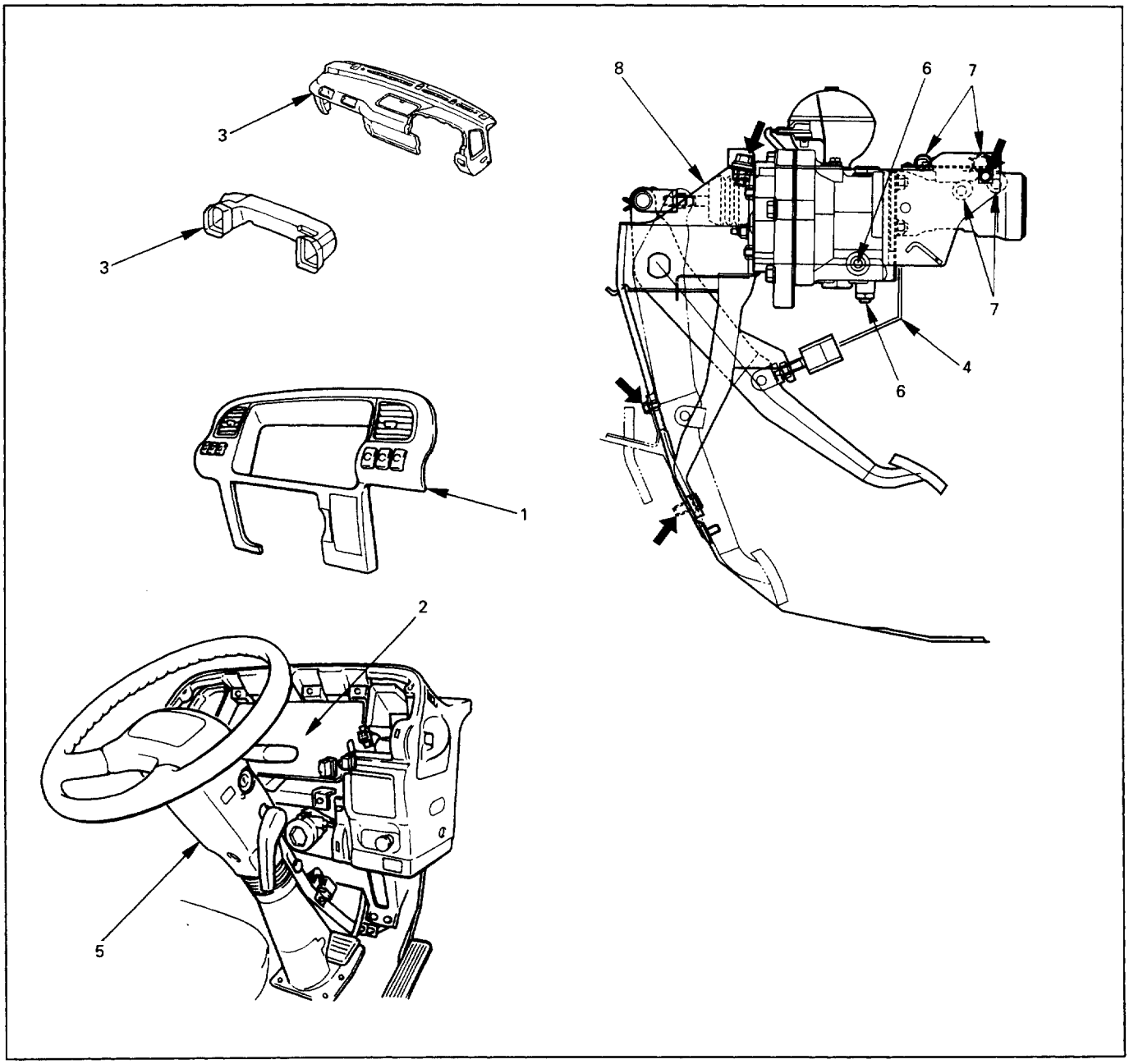
   Master Cylinder Assembly

Nut Torque	N·m (kg·m/lb·in)
14 (1.4 / 122)	

2. **Brake Hose**
3. **Brake Pipe**
4. **Switch Connector**
5. **Meter Cluster**

HYDRAULIC BOOSTER AND BRAKE PEDAL ASSEMBLY

REMOVAL



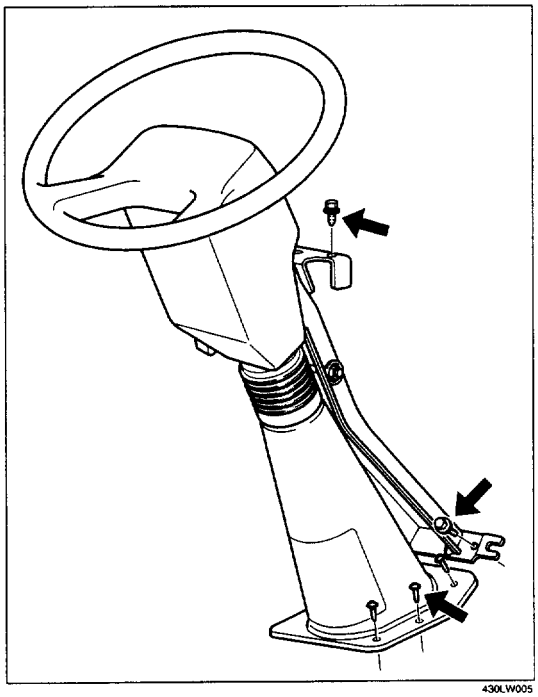
Removal Steps

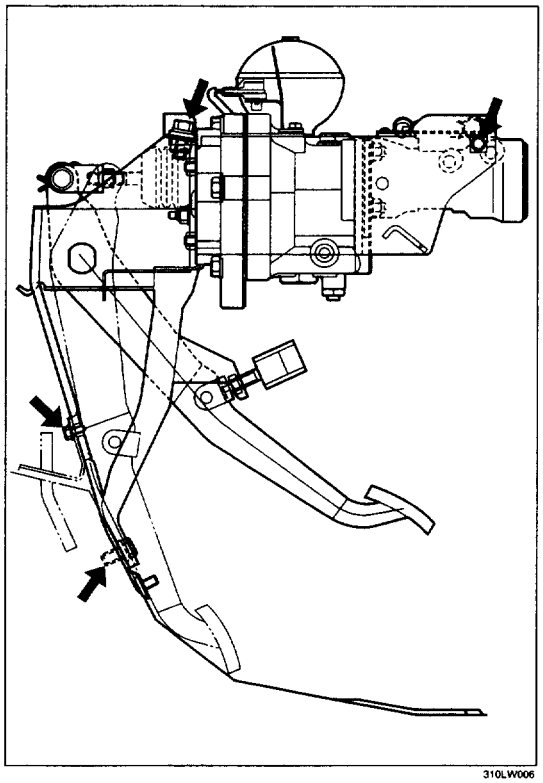
1. Meter cluster
2. Meter
3. Instrument panel and duct
4. Heat protector
5. Steering wheel and column assembly
6. ATF pipe
7. Brake pipe and hose
8. Brake pedal assembly with master cylinder and hydraulic booster

Removal Steps

- Block the vehicle wheels and apply the parking brake.
- Battery ground cable.
- By brake pedal operation with the engine off, reduce the pressure of the hydraulic oil in the accumulator, and after confirming that the temperature of the hydro boost assembly has been reduced, remove the hydro boost assembly from the vehicle.

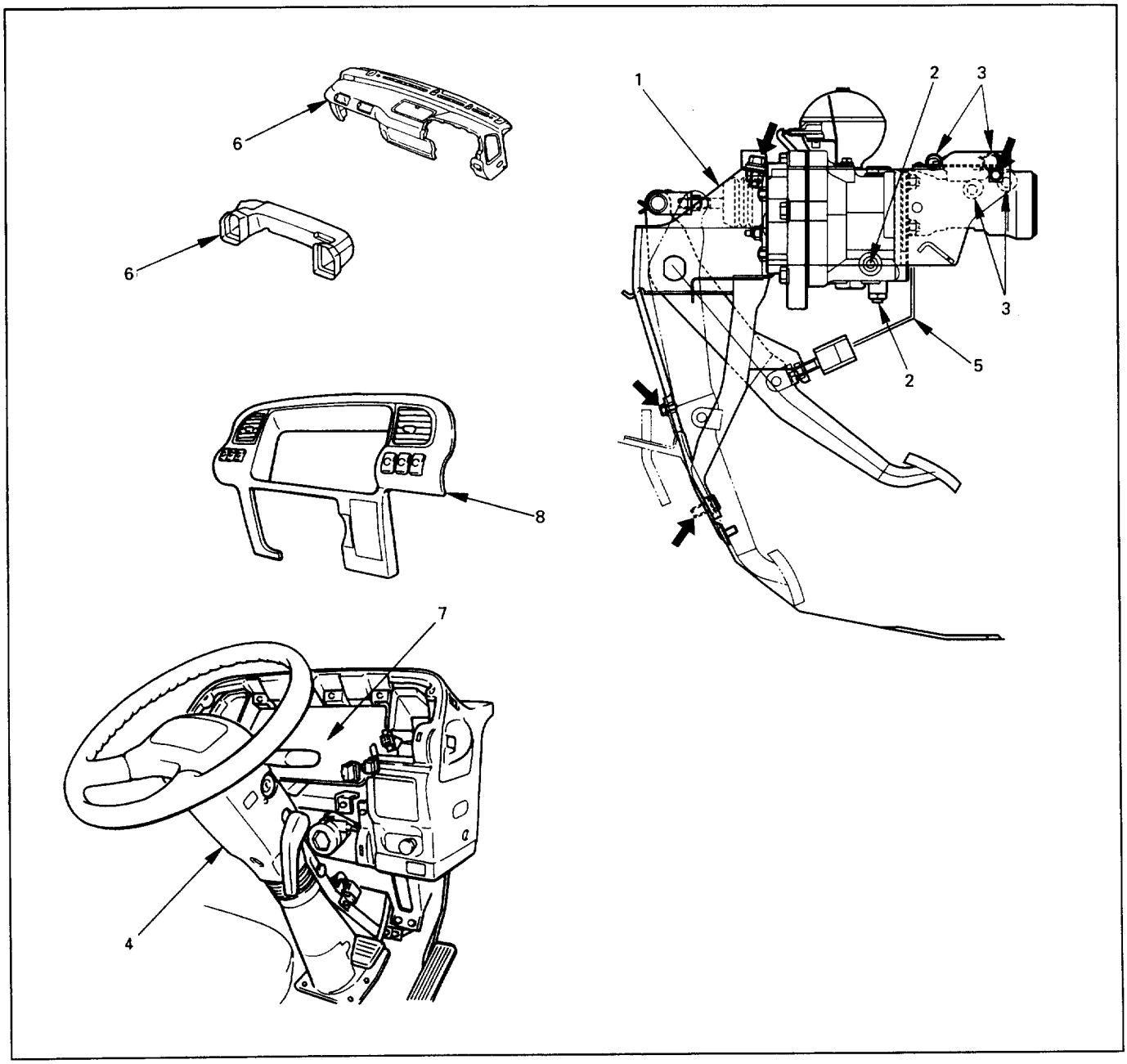
1. Remove meter cluster.
2. Remove meter assembly and harness connector.
3. Remove instrument panel assembly and ventilation duct.
4. Remove heat protector under the hydraulic booster.
5. Steering wheel and column assembly.
   - Remove inspection window and mark steering worm shaft and U-joint yoke.
     Remove key bolt and nut.
   - Remove screws: boots to floor.
   - Remove bolts and nuts: support bracket to floor.
   - Remove bolts: steering column bracket to instrument reinforcement assembly.
   - Remove bolts: steering column bracket to brake pedal bracket.
6. ATF pipe: inlet and outlet.
   - Disconnect pipes from the booster.
7. Brake pipe and hose: front and rear.
   - Disconnect pipes and hoses from the brake master cylinder.





8. Brake pedal assembly with master cylinder and hydraulic booster
   - Remove accel pedal bracket.
   - Remove brake pedal assembly mounting bolts.
   - Remove radiator grille and disconnect ATF inlet pipe from flexible hose in front of the radiator. Remove ATF inlet pipe.
   - Remove brake pedal assembly.

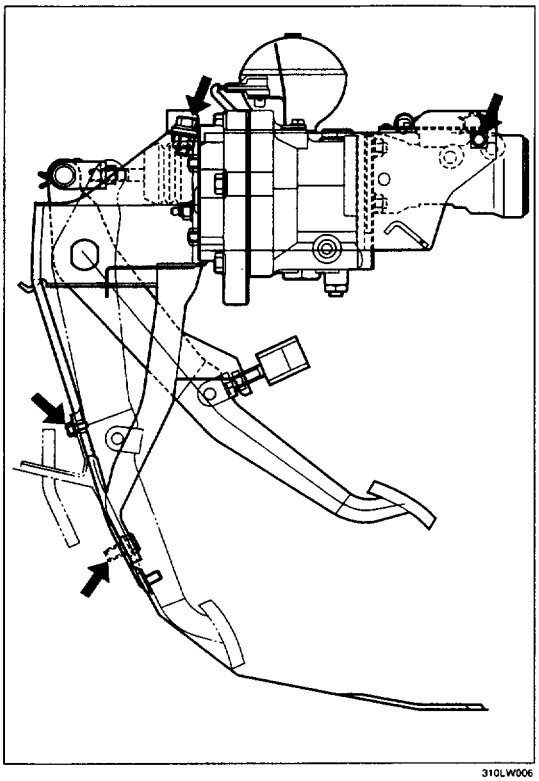
INSTALLATION



Installation Steps

1. Brake pedal assembly with master cylinder and hydraulic booster
2. ATF pipe
3. Brake pipe and hose
4. Steering wheel and column assembly
5. Heat protector
6. Instrument panel and duct
7. Meter
8. Meter cluster

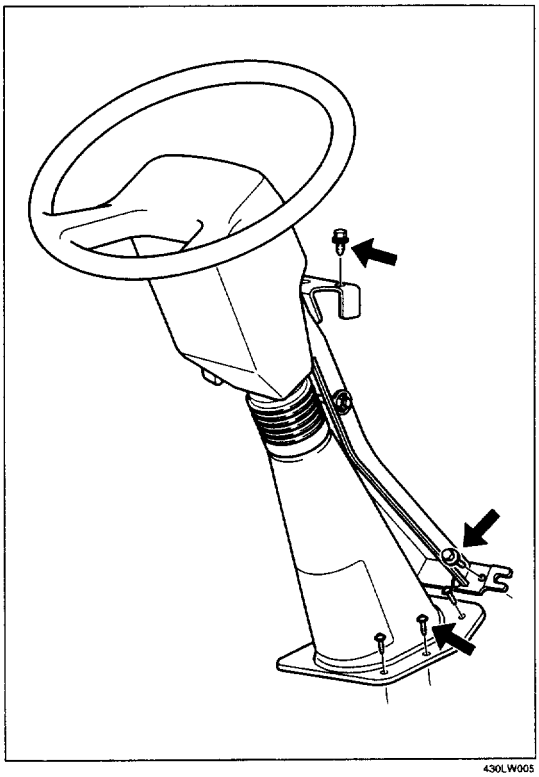
Installation Steps



1. **Brake Pedal Assembly with Master Cylinder and Hydraulic Booster**
   - Set ATF inlet pipe and install brake pedal assembly.

M10 mounting bolts	N·m (kg·m/lb·ft)
	42 (4.3 / 32)

   - Connect ATF inlet pipe with flexible hose.
   - Install accel pedal bracket.
   - Install radiator grille.
2. **ATF Pipe**
   - Install ATF pipes to hydraulic booster.
3. **Brake Pipe and Hose**
   - Install master cylinder hydraulic lines to master cylinder.



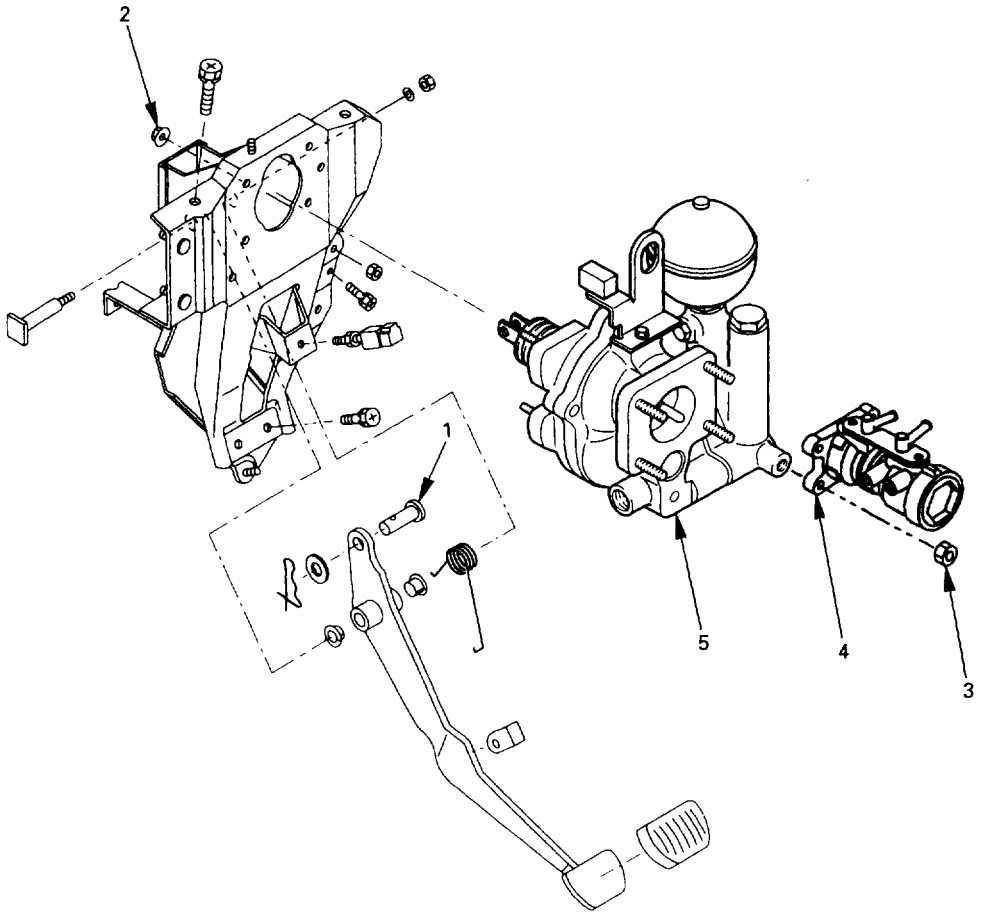
4. **Steering Wheel and Column Assembly**
   - Set steering wheel and column assembly.
   - Install mounting bolts, nuts and screws to body.
   - Install key bolt and nut.

Key Bolt	N·m (kg·m/lb·ft)
	38 (3.9 / 28)

   - Install inspection window.
5. **Heat Protector**
   - Install hydraulic booster heat protector.
6. **Instrument Panel and Duct**
   - Install ventilation duct and instrument panel assembly.
7. **Meter**
   - Install meter assembly and harness connector.
8. **Meter Cluster**
   - Install meter cluster.
9. Battery ground cable.
10. After attaching it to the vehicle, always replenish with new hydraulic oil (Besco ATF III), and completely release the air from the hydro boost.
11. Bleed brake lines.
12. Release the parking brake and remove the wheel blocks.

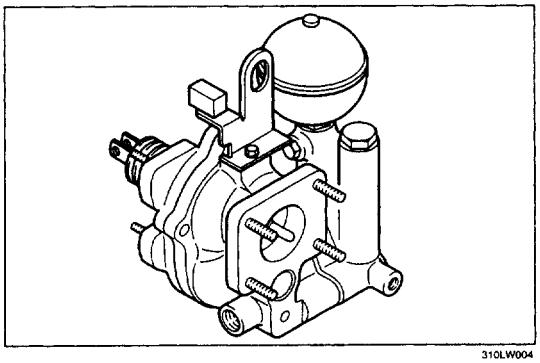
HYDRAULIC BOOSTER

REMOVAL



Removal Steps

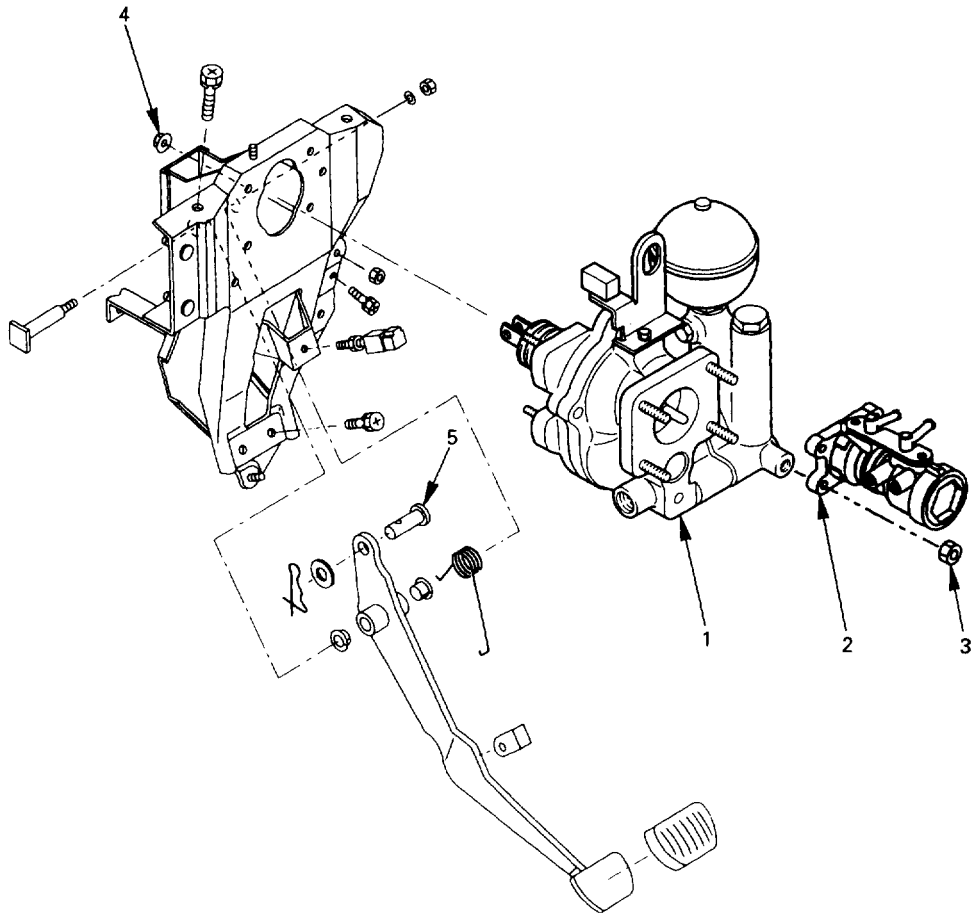
1. Clevis pin
2. Hydraulic booster nut
3. Master cylinder nut
4. Master cylinder
5. Hydraulic booster



Removal Steps

1. **Clevis Pin**
2. **Hydraulic Booster Nut**
   - Four hydraulic booster mounting nuts at pedal bracket.
   - Remove master cylinder with hydraulic booster.
3. **Master Cylinder Nut**
   - Four nuts retaining master cylinder to hydraulic booster.
4. **Master Cylinder**
5. **Hydraulic Booster**

INSTALLATION



Installation Steps

1. Hydraulic booster
2. Master cylinder
3. Master cylinder nut
4. Hydraulic booster nut
5. Clevis pin

Installation Steps

1. **Hydraulic Booster**
2. **Master Cylinder Assembly**
3. **Master Cylinder Nut**

Master Cylinder Nut Torque	N·m (kg·m/lb·in)
	14 (1.4 / 122)

4. **Hydraulic Booster Nut**
   - Four hydraulic booster mounting nuts to pedal bracket.

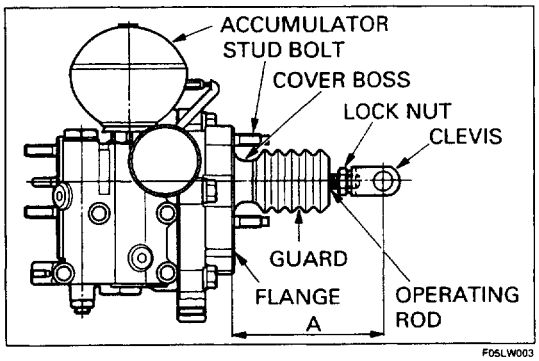
Hydraulic Booster Nut Torque	N·m (kg·m/lb·in)
	14 (1.4 / 122)

5. **Clevis Pin**
   - Connect hydraulic booster clevis to brake pedal, and install clevis pin.

Accumulator and O-ring replacement

Removal Steps

- Block the vehicle and apply the parking brake.
- Battery ground cable.
- Reduce the pressure of the hydraulic oil in the accumulator by brake pedal operation with the engine off, and after confirming that the temperature of the hydro boost assembly has been reduced, remove the hydro boost assembly from the vehicle.
  1. Remove meter cluster.
  2. Remove meter assembly and harness connector.
  3. Remove ventilation duct.
  4. Using an oil filter wrench, remove accumulator and O-ring.

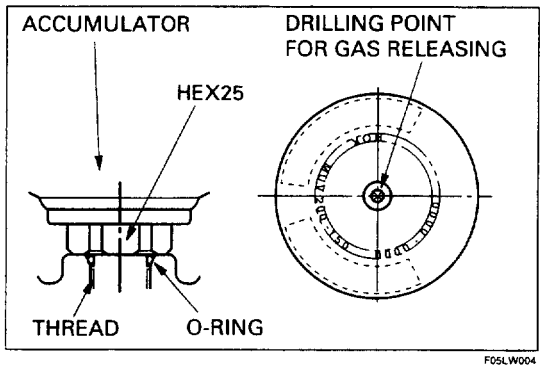


Installation Steps

1. Verify that there is no foreign matter adhering to the screw part of the accumulator or to the attachment part on the booster side.
2. Put an O-ring coated with new hydraulic oil (ATF DEXRON®-III) into the screw part of the accumulator, being careful not to damage it.
   Always use a new O-ring.
3. Using an oil filter wrench, hold the accumulator shell fixed, and tighten it via the wrench to the specified torque.

Accumulator	N·m (kg·m/lb·ft)
	29 (3.0 / 22)

4. Install ventilation duct.
5. Connect harness connector and install meter assembly.
6. Install meter cluster.
7. Battery ground cable.
8. After attaching it to the vehicle, always replenish with new hydraulic oil (ATF DEXRON®-III), and completely release the air from the hydro boost.
9. Release the parking brake and remove the wheel blocks.



NOTE:

How to dispose of the accumulator
To dispose of the accumulator, drill a hole in the position shown in the diagram according to the indications printed on the accumulator, completely release the nitrogen gas sealed inside the accumulator, then dispose of the accumulator.
Concerning disposal with the hydro boost assembly as well, dispose of it after first letting out all the nitrogen gas inside the accumulator, by the above method.

Clevis and Lock Nut Replacement

Removal Steps

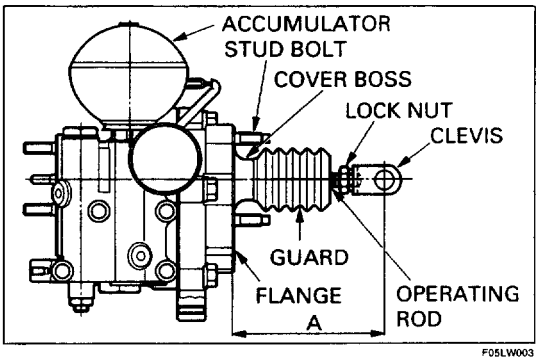
1. Remove hydraulic booster assembly.
   Refer to "Removal steps" of HYDRAULIC BOOSTER in this section.
2. Secure the hydro boost assembly to the jig using the four stud bolts on the surface of the flange for attachment to the vehicle.
3. Being careful not to exert any off-center load on the operating rod, loosen the lock nut and remove the clevis and lock nut.

Installation Steps

1. Screw the lock nut and then the clevis onto the operating rod.
2. Adjust so that the booster clevis position dimension (the dimension A in the diagram: the distance to the center of the clevis hole from the surface of the flange for attachment to the vehicle) is 109 ± 1 mm, and tighten the lock nut with the prescribed torque.

Prescribed tightening torque	N·m (kg·m/lb·ft)
	20 (2.0 / 14)

   When tightening the lock nut, be careful not to deform the clevis.
3. Attach the hydro boost assembly to the vehicle. Refer to "Installation Steps" of HYDRAULIC BOOSTER in this section.



Guard Replacement

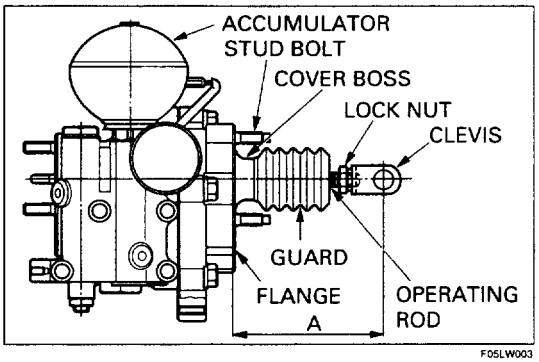
Removal Steps

1. Remove hydraulic booster assembly.
   Refer to "Removal steps" of HYDRAULIC BOOSTER in this section.
2. Secure the hydro boost assembly to the jig using the four stud bolts on the surface of the flange for attachment to the vehicle.
3. Being careful not to exert any off-center load on the operating rod, loosen the lock nut and remove the clevis and lock nut.
4. Remove the guard from the cover boss anchoring groove and from the operating rod anchoring groove, and pull it out.

Installation Steps

1. With a dry cloth, clean well the cover boss anchoring groove and the operating rod anchoring groove, and verify that no foreign matter is present.
2. Insert from the large diameter hole side of the guard end-face into the operating rod outside diameter part, assemble the small diameter hole part of the guard end-face into the anchoring groove of the operating rod, then assemble the large diameter hole part securely into the anchoring groove of the boss of the cover.
3. Screw the lock nut and then the clevis onto the operating rod.
4. Adjust so that the booster clevis position dimension (the dimension A in the diagram: the distance to the center of the clevis hole from the surface of the flange for attachment to the vehicle) is 109 ± 1 mm, and tighten the lock nut with the prescribed torque. When tightening the lock nut, be careful not to deform the clevis.

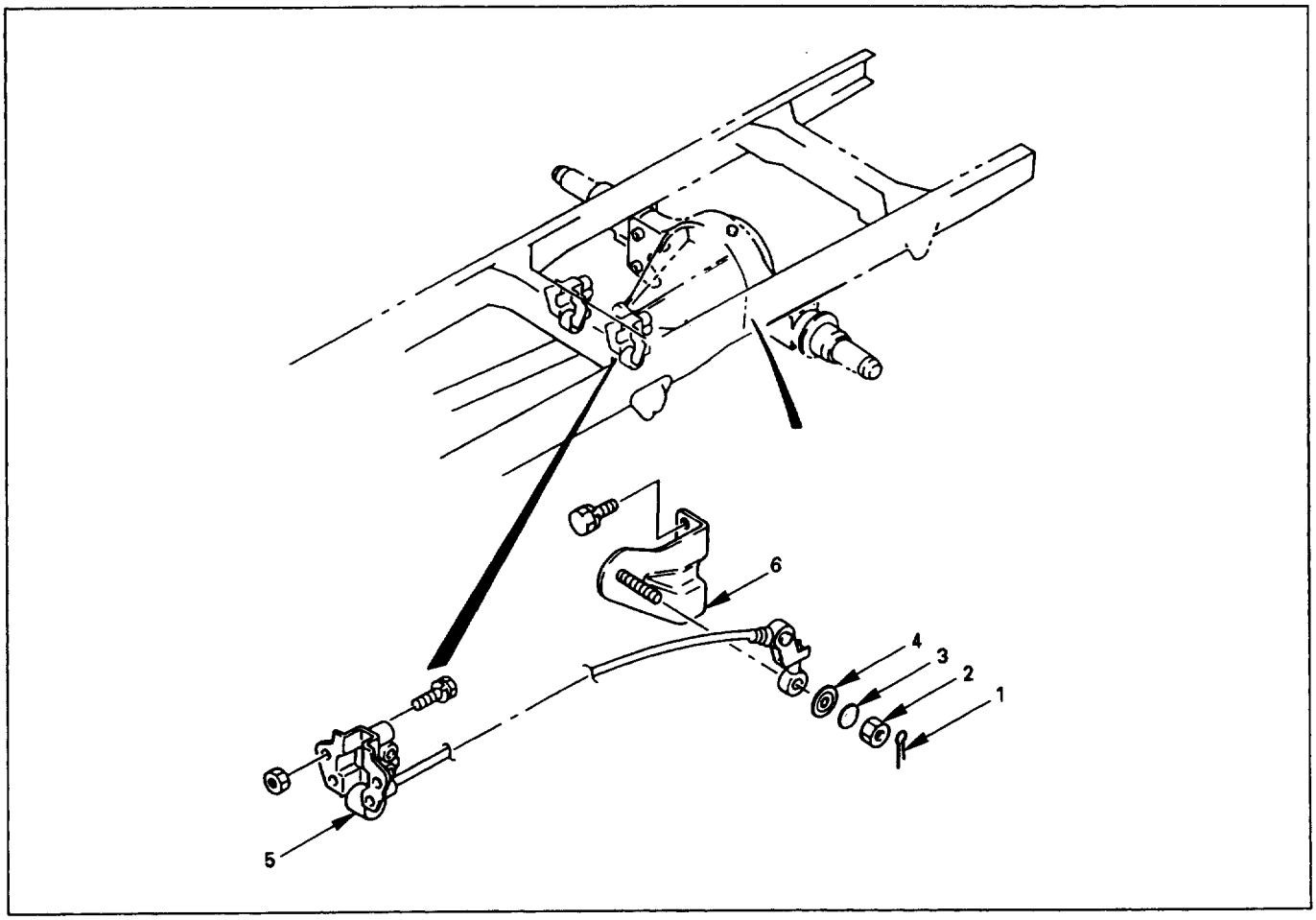
Prescribed tightening torque	N·m (kg·m/lb·ft)
20 (2.0 / 14)	



5. Attach the hydro boost assembly to the vehicle. Refer to "Installation Steps" of HYDRAULIC BOOSTER in this section.

LOAD SENSING PROPORTIONING VALVE

REMOVAL



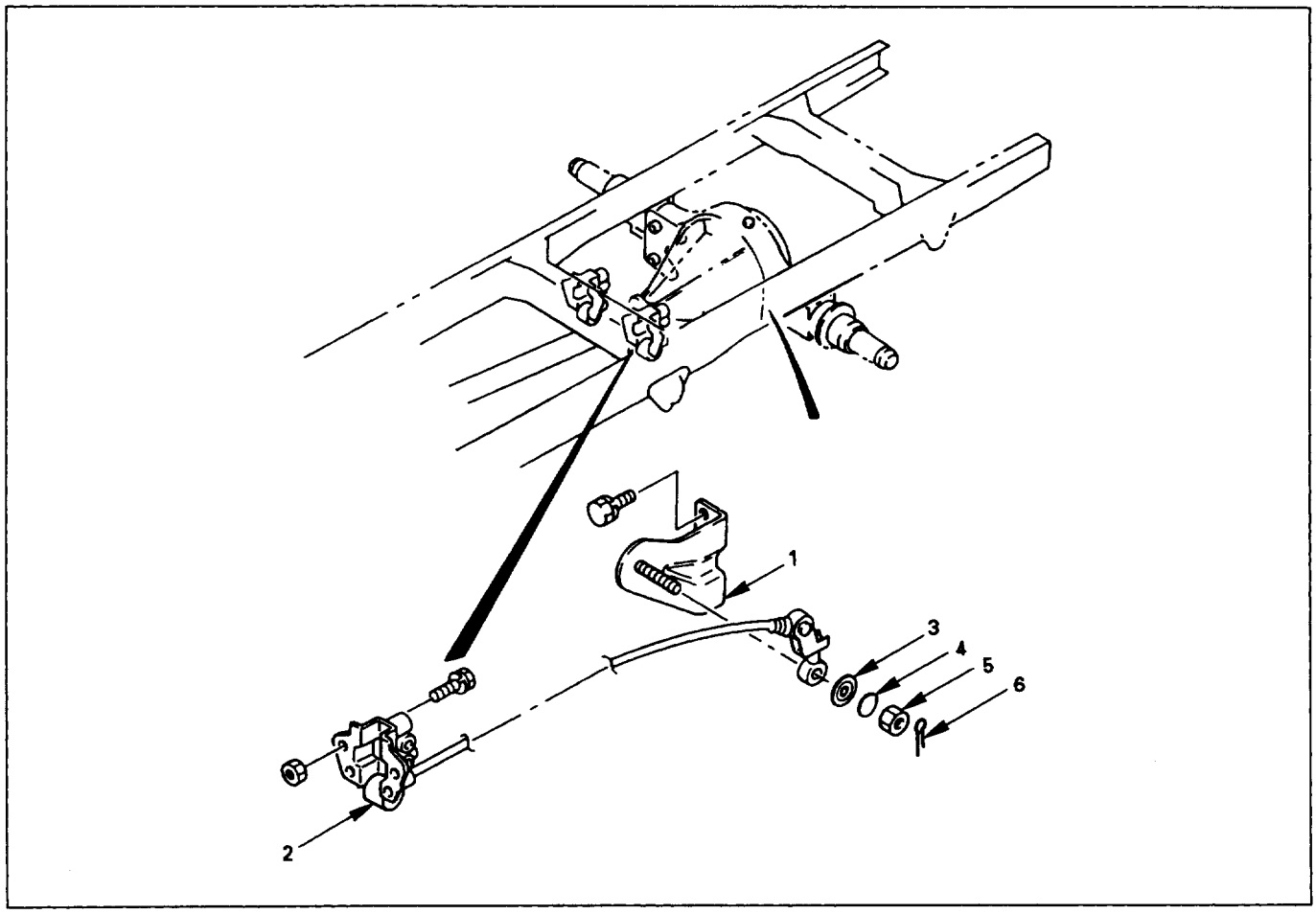
Removal Steps

1. Cotter pin
2. Nut
3. Washer
4. Retainer
5. Load sensing proportioning valve
6. Bracket

Removal Steps

1. Cotter Pin
2. Nut
3. Washer
4. Retainer
5. Load Sensing Proportioning Valve
6. Bracket

INSTALLATION



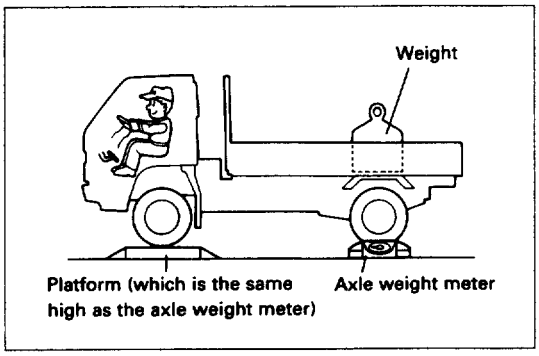
Installation Steps

1. Bracket
2. Load sensing proportioning valve
3. Retainer
4. Washer
5. Nut
6. Cotter pin

Installation Steps

To install, follow the removal steps in the reverse order.

LOAD SENSING PROPORTIONING VALVE (L.S.V.) ADJUSTMENT



1. Fluid Pressure Measurement

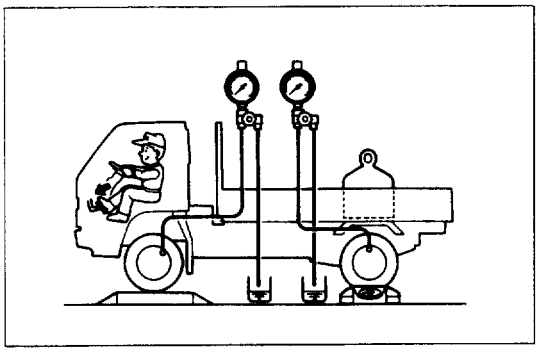
1) Rear axle weight adjustment

With an axle weight meter, adjust the rear axle weight with a person sitting in the driver's seat and a weight loaded in the rear body.

N (kg/lb)

Adjustment value	Ⓐ

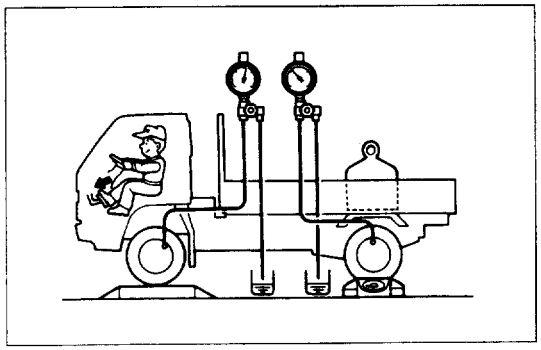
For Ⓐ refer to the adjustment standard table on page 5A-91.



2) Installation of a fluid pressure gauge

Remove the air bleeder of the left hand wheel front and rear brakes. Bleed air out of the fluid pressure gauge with the measurement hose of the fluid pressure gauge installed.

Pressure Tester: Brake oil (Fluid pressure gauge)
5-8840-2190-0



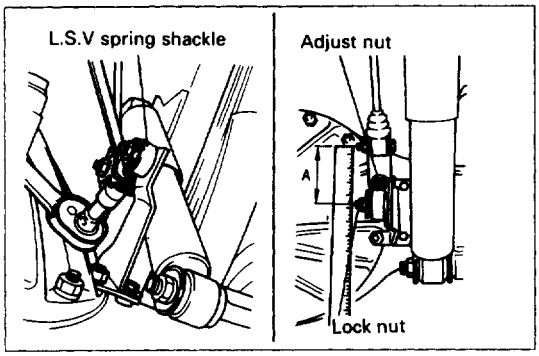
3) Rear wheel cylinder fluid pressure measurement

Step on the brake pedal until the fluid pressure of the front wheel cylinder gets to 80 kg/cm^2 (7845 kpa), and check the rear wheel cylinder fluid pressure. (Read the value of the front wheel cylinder fluid pressure 2 seconds after the measurement. When measuring the L.S.V fluid pressure, keep the brake pedal pressed down without stepping it down twice or releasing it.)

Rear Wheel Cylinder Fluid Pressure kpa (kg/cm^2)

Standard	Ⓑ

For Ⓑ refer to the adjustment standard table on page 5A-91.



2. Oil Pressure Adjustment

1) L.S.V spring shackle adjustment

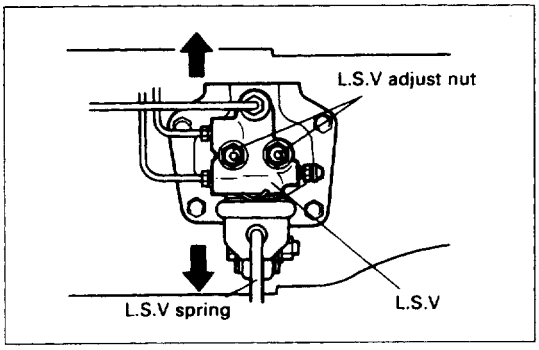
Loosen the adjust nut of the L.S.V spring shackle, and adjust the length of the L.S.V spring shackle. When the oil pressure is insufficient, turn the adjust nut clockwise to extend the span "A". When the oil pressure is too high, turn the adjust nut counterclockwise to reduce the span "A".

mm (in)

Item	Span adjusted
Standard of span "A"	78 (3.07)
Range adjustable	72 – 84 (2.83 – 3.31)

After adjustment, tighten the lock nut securely and install the cotter pin.

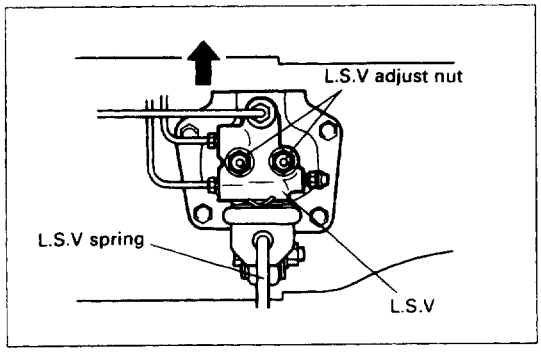
Lock Nut Torque	N·m (kg·m/lb·in)
Max. 10 (1.0 / 87)	



2) L.S.V adjustment

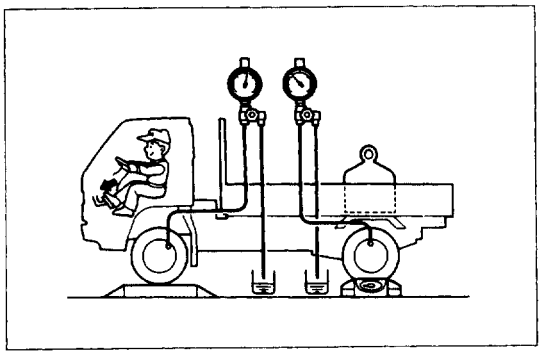
When the adjustment cannot be done with the L.S.V spring shackle, loosen the L.S.V adjust nut (2 pcs.) and adjust the oil pressure to the standard value by sliding the L.S.V up and down. After the L.S.V adjustment, readjust the length of the L.S.V spring shackle.

L.S.V Adjust Nut Torque	N·m (kg·m/lb·in)
13 (1.3 113)	



3. Unit Inspection of L.S.V

1) Loosen the L.S.V adjust nut (2 pcs.). And then lift the L.S.V up fully and tighten it up tentatively so that the L.S.V spring will not move.



2) Under the same conditions as 1) above, check the rear wheel cylinder fluid pressure.

Standard	
Master cylinder fluid pressure kPa(kg/cm^2)	Rear fluid pressure kPa(kg/cm^2)
2942 (30)	Ⓒ
7845 (80)	Ⓓ

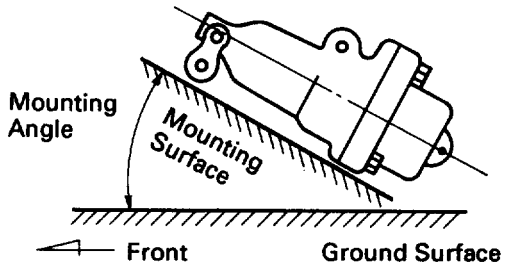
For Ⓒ and Ⓓ refer to the adjustment standard table on page 5A-91.

Load Sensing Proportioning Valve Adjustment Standard Table

Models	Ⓐ kg	Ⓑ kg/cm²	Ⓒ kg/cm²	Ⓓ kg/cm²
NKR69EAL–1DXYE	1000	37.6±6	14.7±2	19.7±3.5
NKR69LL –5DXYE	1000	37.6±6	14.7±2	19.7±3.5
NKR69LL –5HXYE	1000	37.6±6	14.7±2	19.7±3.5
NPR69LU –5DXYE	1000	37.6±6	14.7±2	19.7±3.5
NPR69LL –5DXYE	1000	37.6±6	14.7±2	19.7±3.5
NPR69LU –5HXYE	1000	51.3±6	17.3±2	29.8±3.5
NPR69LL –5HXYE	1000	51.3±6	17.3±2	29.8±3.5
NPR65LU –5JXYEJ	1500	51.3±6	17.3±2	29.8±3.5
NPR65PL –5JXYEJ	1500	51.3±6	17.3±2	29.8±3.5
NPR66LU –5JXYHT	1300	51.3±6	17.3±2	29.8±3.5
NKR58EU –3EXYH	700	37.6±6	14.7±2	19.7±3.5
NKR58EU –1EXYH	700	37.6±6	14.7±2	19.7±3.5
NKR58E2U–5EXYH	700	37.6±6	14.7±2	19.7±3.5
NPR58GU –5EXYH	1100	51.3±6	17.3±2	29.8±3.5
NPR58LU –5EXYH	1100	51.3±6	17.3±2	29.8±3.5
NPR58LU –5HWYH	1100	51.3±6	17.3±2	29.8±3.5
NPR66LU –5JXYH	1100	51.3±6	17.3±2	29.8±3.5
NPR58LU –5JXYH	1100	51.3±6	17.3±2	29.8±3.5
NPR99LU –5JXYZ	900	51.3±6	17.3±2	29.8±3.5
NPR99PU –5JXYZ	900	51.3±6	17.3±2	29.8±3.5
NPR99PU –5LXYZ	1300	51.3±6	17.3±2	29.8±3.5
NPR59PU –5LXYHJ	1300	51.3±6	17.3±2	29.8±3.5
NPR66LU –5LXYH	1300	51.3±6	17.3±2	29.8±3.5
NPR66PU –5LXYH	1300	51.3±6	17.3±2	29.8±3.5
NPS66LU –5JXYH	1800	51.3±6	17.3±2	29.8±3.5

Deceleration Sensing Proportioning Valve

DSPV Mounting Angle



Models			Mounting Angle
NHR	Front Disc Brake		12° 00′ ±45′
	Front Drum Brake	Flat-low Model	12° 00′ ±45′
		Except Flat-low Model	9° 30′ ±45′
NKR			12° 30′ ±45′

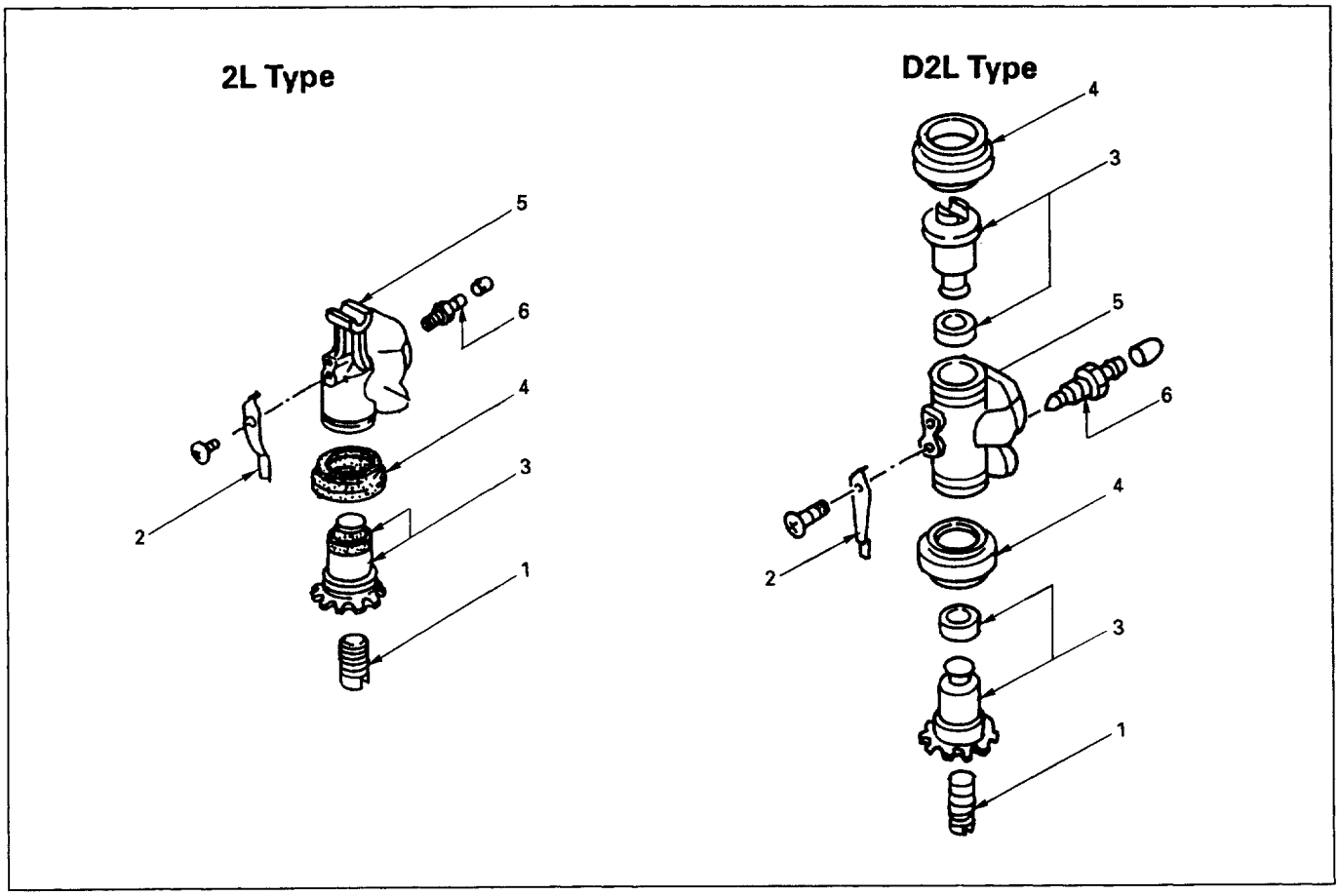
Conduct the following inspections, and if any abnormality is found, replace.

Condition	Procedure	Judgement
As installed in the vehicle	Measure braking force to make sure of normality.	If no braking force, adherence of ball (deceleration sensing) to seal is suspected.
	Bleed air also from the DSPV side of breather.	If no brake fluid does not come out, the same trouble as above is suspected.
	Check fluid leakage.	No problem, if there is no leak.
	Check mounting angle. (Refer to the table.)	If installed at an abnormal angle, though rare, specified braking force is unobtainable or DSPV does not work.
As not installed in the vehicle	Incling DSPV back and forth to see if the ball moves insides.	No problem, if a ball sound is heard from within.

UNIT REPAIR

WHEEL CYLINDER ASSEMBLY

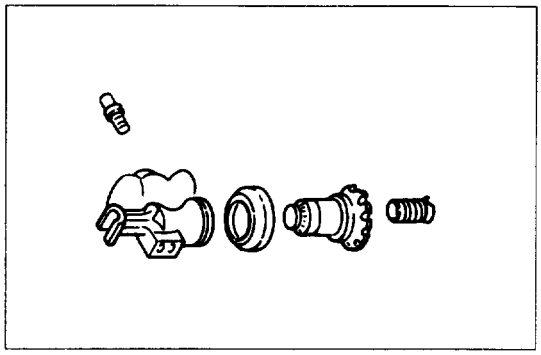
DISASSEMBLY

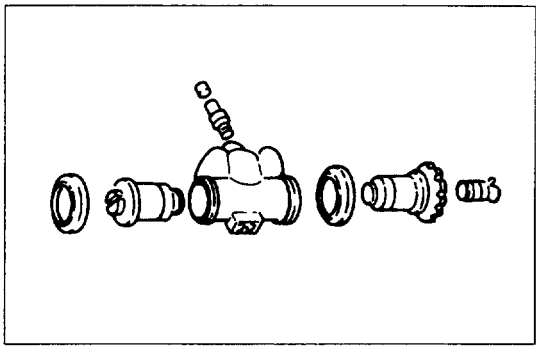


Disassembly Steps

1. Adjusting screw
2. Lock plate
3. Piston assembly
4. Boot
5. Wheel cylinder body
6. Bleeder screw

Disassembly Steps



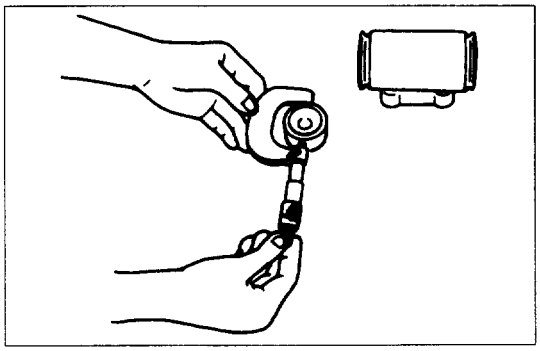


1. **Adjusting Screw**
2. **Lock Plate**
3. **Piston Assembly**
4. **Boot**
5. **Wheel Cylinder Body**
6. **Bleeder Screw**

   Store all of the removal parts in a clean part tray.

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.



Wheel Cylinder Assembly

Wheel Cylinder and Piston Clearance

1. Use a micrometer to measure the piston diameter,
2. Use an inside dial indicator to measure the cylinder bore.
3. Calculate the clearance between the wheel cylinder and the piston.

   If the clearance exceeds the specified limit, the piston and/or wheel cylinder body must be replaced.

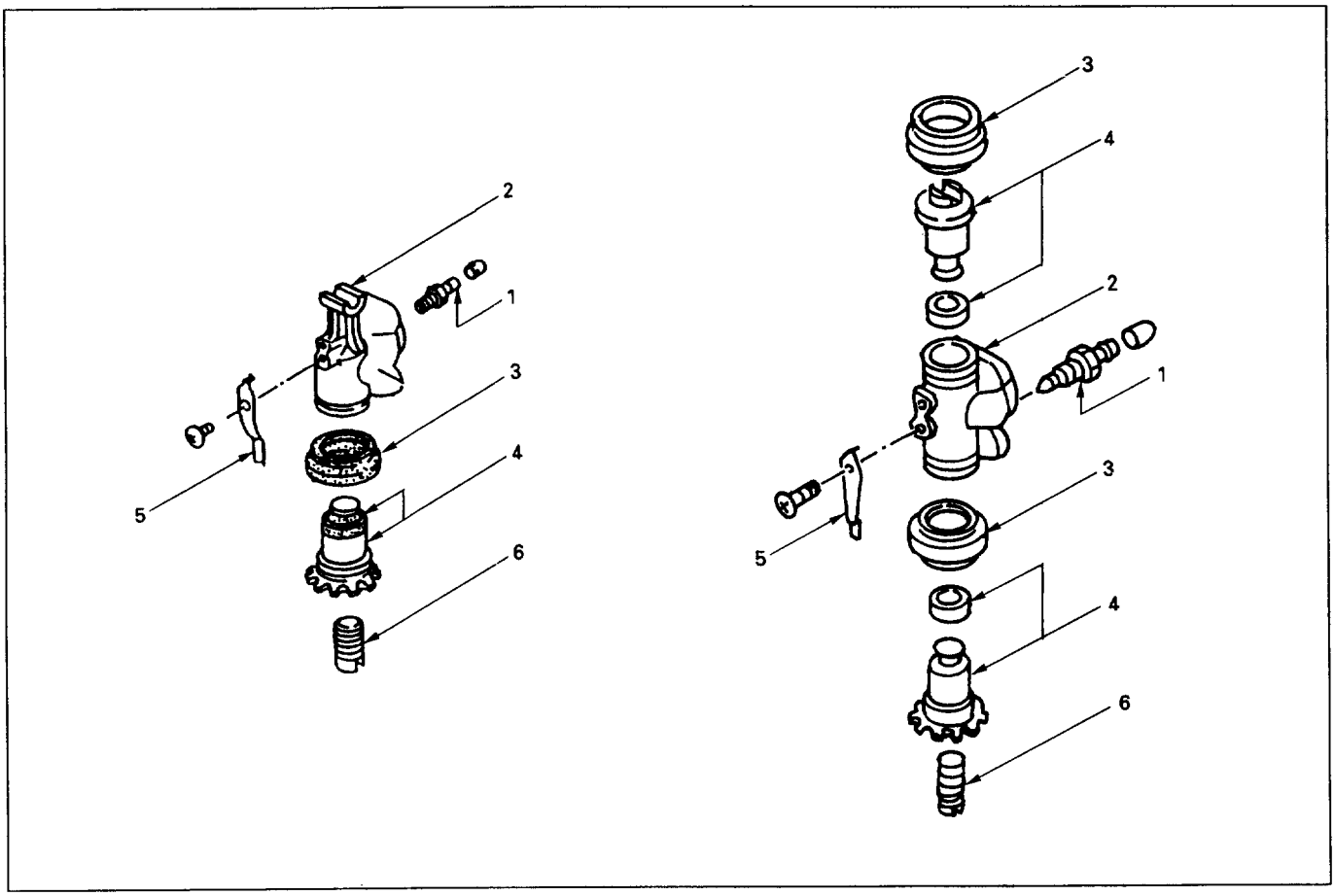
Wheel Cylinder and Piston Clearance mm (in)

Wheel Cylinder size	Limit
26.99 (1.063) 28.57 (1.125) 30.16 (1.188) 34.93 (1.375)	0.15 (0.006)

When the wheel cylinder disassembled, the repair kit (piston cup and boot) must be replaced.

REASSEMBLY

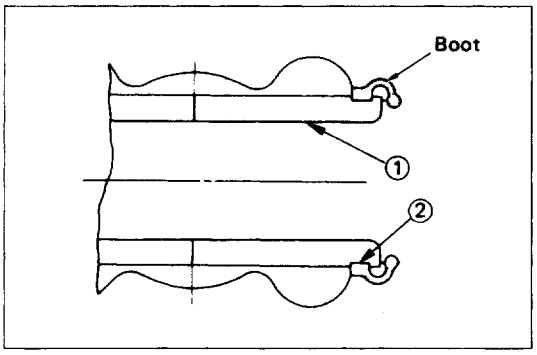
Wheel Cylinder Assembly



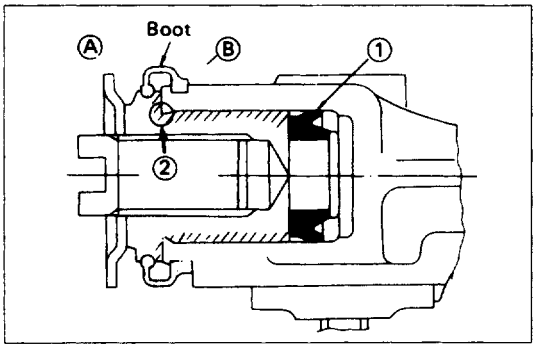
Reassembly Steps

1. Bleeder screw
2. Wheel cylinder body
3. Boot
4. Piston assembly
5. Lock plate
6. Adjusting screw

Reassembly Steps



1. **Bleeder Screw**
2. **Wheel Cylinder Body**
   1. Apply a coat of rubber grease to the cylinder body bore ① and the grooves for the boots ②.
   2. Fit the boot edge securely into the mating groove of the cylinder body.



3. **Boot**
4. **Piston Assembly**
   1. Apply a coat of rubber grease to the piston cups and the pistons.

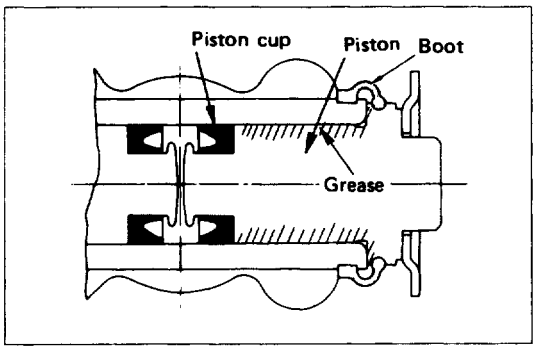
      Be sure to lubricate the entire cylinder body bore with the rubber grease.
   2. Install the piston assembly to the cylinder.

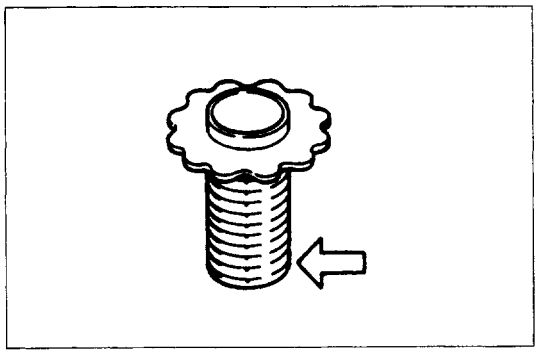
NOTE:

After installation of the piston assembly into the cylinder body bore, fit the boot edge securely into the mating groove of the piston.

Make sure that the two boot edges firmly sealed into the grooves.

Be careful not to damage the piston cups and the boots.



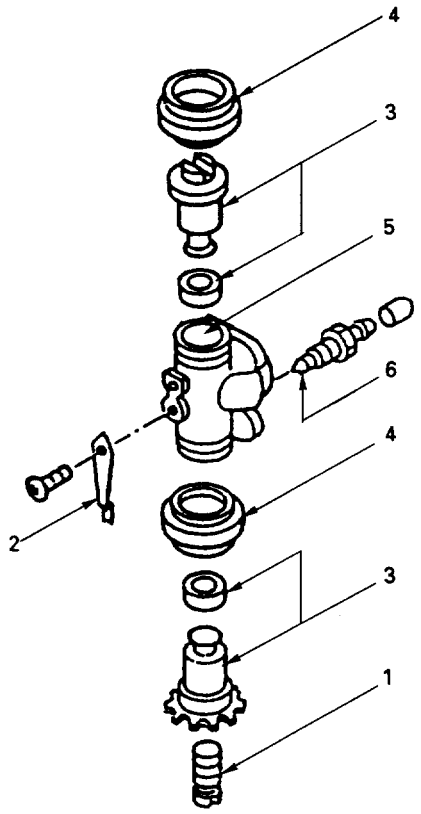


5. **Lock Plate**
6. **Adjusting Screw**

   Apply a coat of molybdenum disulfide grease to the adjusting screw slit and threads.

WHEEL CYLINDER ASSEMBLY (WITHOUT AUTO-ADJUSTER)

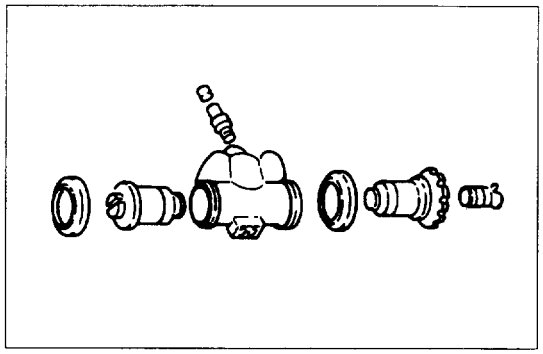
DISASSEMBLY



Disassembly Steps

1. Adjusting screw
2. Lock plate
3. Piston assembly
4. Boot
5. Wheel cylinder body
6. Bleeder screw

Disassembly Steps

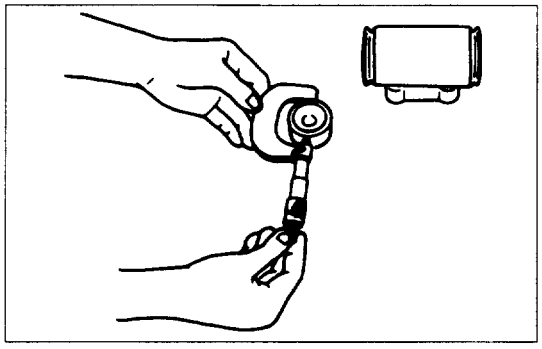


1. **Adjusting Screw**
2. **Lock Plate**
3. **Piston Assembly**
4. **Boot**
5. **Wheel Cylinder Body**
6. **Bleeder Screw**

   Store all of the removal parts in a clean part tray.

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.



Wheel Cylinder Assembly

Wheel Cylinder and Piston Clearance

1. Use a micrometer to measure the piston diameter,
2. Use an inside dial indicator to measure the cylinder bore.
3. Calculate the clearance between the wheel cylinder and the piston.

   If the clearance exceeds the specified limit, the piston and/or wheel cylinder body must be replaced.

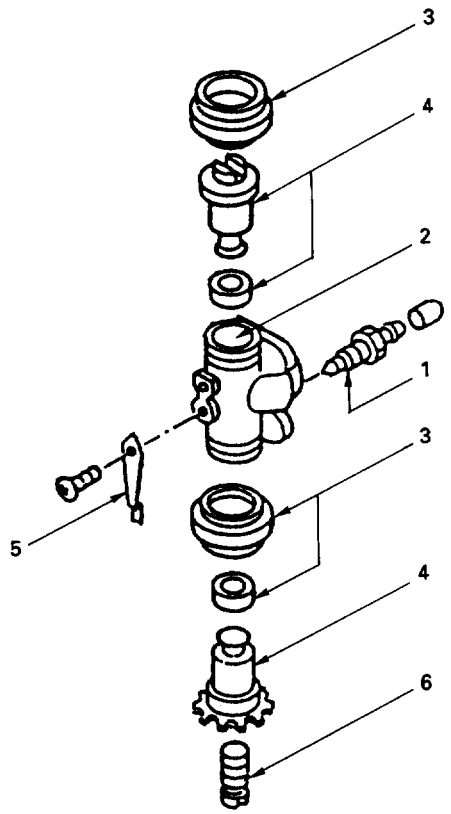
Wheel Cylinder and Piston Clearance mm (in)

Wheel Cylinder size	Limit
22.22 (0.875) 25.40 (1.000) 30.16 (1.188) 33.33 (1.312)	0.15 (0.006)

When the wheel cylinder disassembled, the repair kit (piston cup and boot) must be replaced.

REASSEMBLY

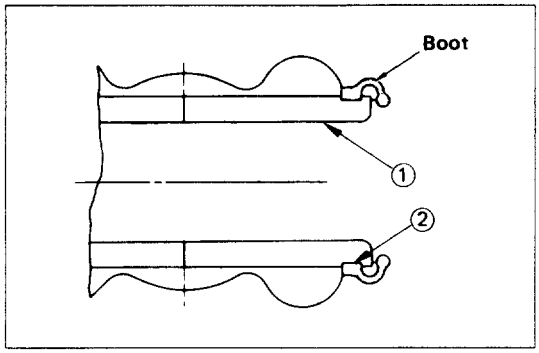
Wheel Cylinder Assembly (Without Auto-adjuster)



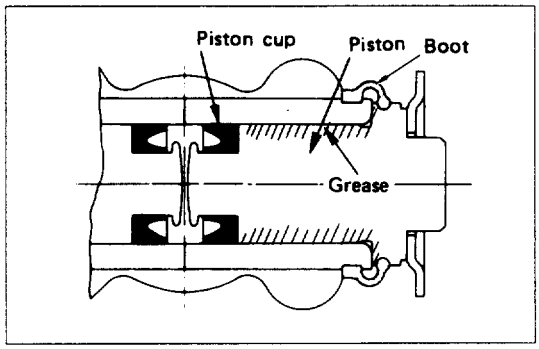
Reassembly Steps

1. Bleeder screw
2. Wheel cylinder body
3. Boot
4. Piston assembly
5. Lock plate
6. Adjusting screw

Reassembly Steps



1. **Bleeder Screw**
2. **Wheel Cylinder Body**
   1. Apply a coat of rubber grease to the cylinder body bore ① and the grooves for the boots ②.
   2. Fit the boot edge securely into the mating groove of the cylinder body.



3. **Boot**
4. **Piston Assembly**
   1. Apply a coat of rubber grease to the piston cups and the pistons.

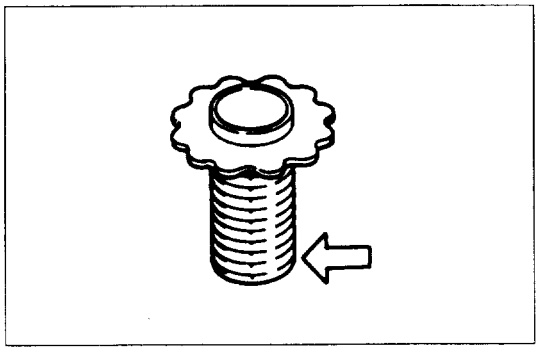
      Be sure to lubricate the entire cylinder body bore with the rubber grease.
   2. Install the piston assembly to the cylinder.

   NOTE:

   After installation of the piston assembly into the cylinder body bore, fit the boot edge securely into the mating groove of the piston.

   Make sure that the two boot edges firmly sealed into the grooves.

   Be careful not to damage the piston cups and the boots.

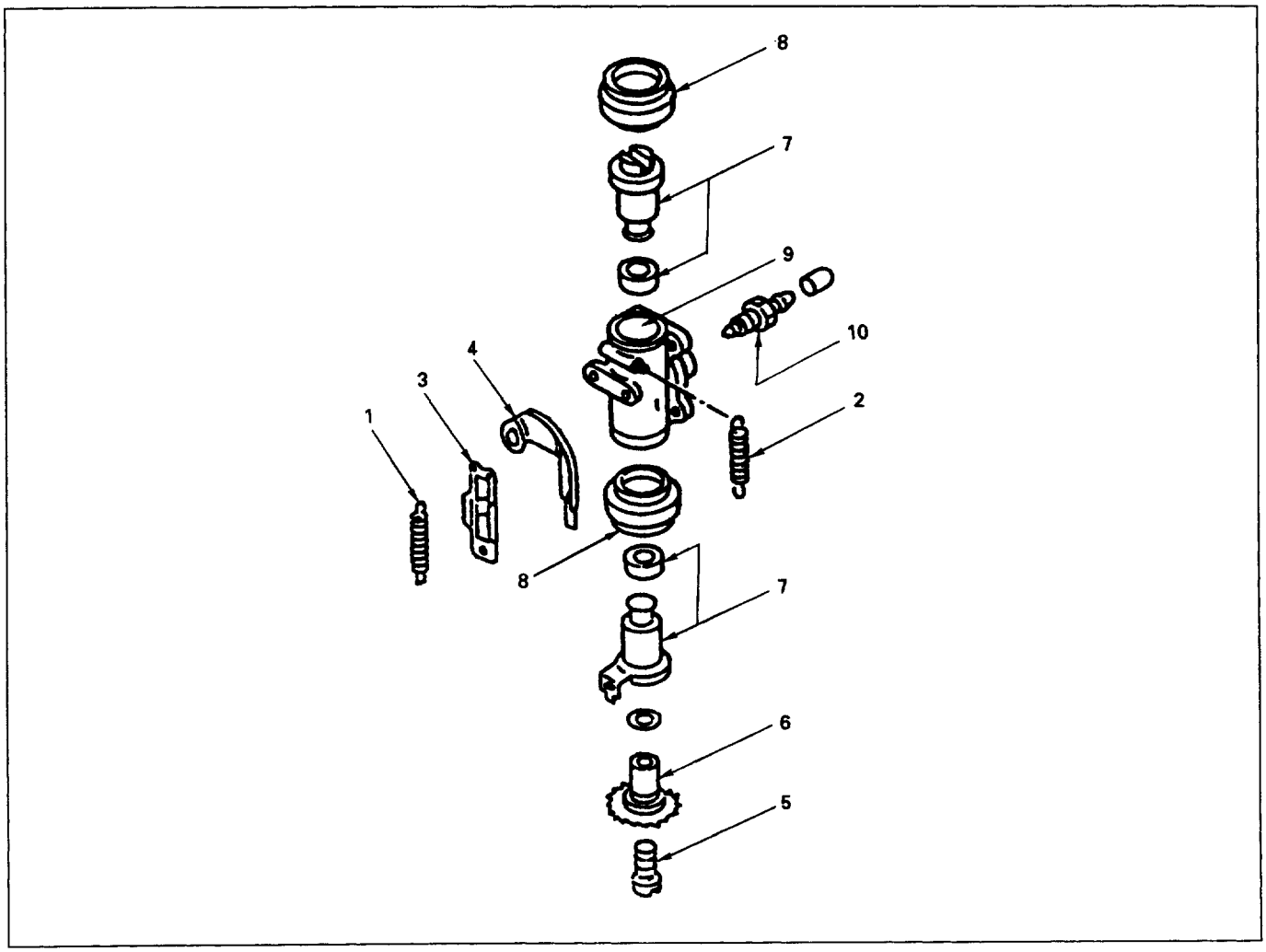


5. **Lock Plate**
6. **Adjusting Screw**

   Apply a coat of molybdenum disulfide grease to the adjusting screw slit and threads.

WHEEL CYLINDER ASSEMBLY (WITH AUTO-ADJUSTER)

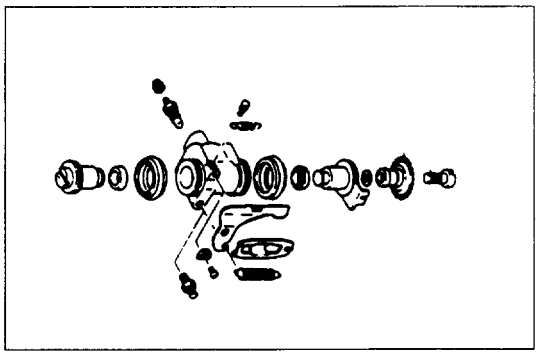
DISASSEMBLY



Disassembly Steps

1. Overtravel spring
2. Return spring
3. Fitting
4. Adjuster lever
5. Adjusting screw
6. Adjuster gear
7. Piston assembly
8. Boot
9. Wheel cylinder body
10. Bleeder screw

Disassembly Steps

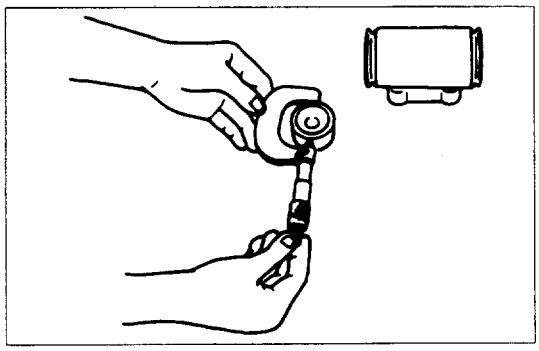


1. **Overtravel Spring**
2. **Return Spring**
3. **Fitting**
4. **Adjuster Lever**
5. **Adjusting Screw**
6. **Adjuster Gear**
7. **Piston Assembly**
8. **Boot**
9. **Wheel Cylinder Body**
10. **Bleeder Screw**

    Store all of the removed parts in a clean part tray.

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.



Wheel Cylinder Assembly

Wheel Cylinder and Piston Clearance

1. Use a micrometer to measure the piston diameter,
2. Use an inside dial indicator to measure the cylinder bore.
3. Calculate the clearance between the wheel cylinder and the piston.

   If the clearance exceeds the specified limit, the piston and/or wheel cylinder body must be replaced.

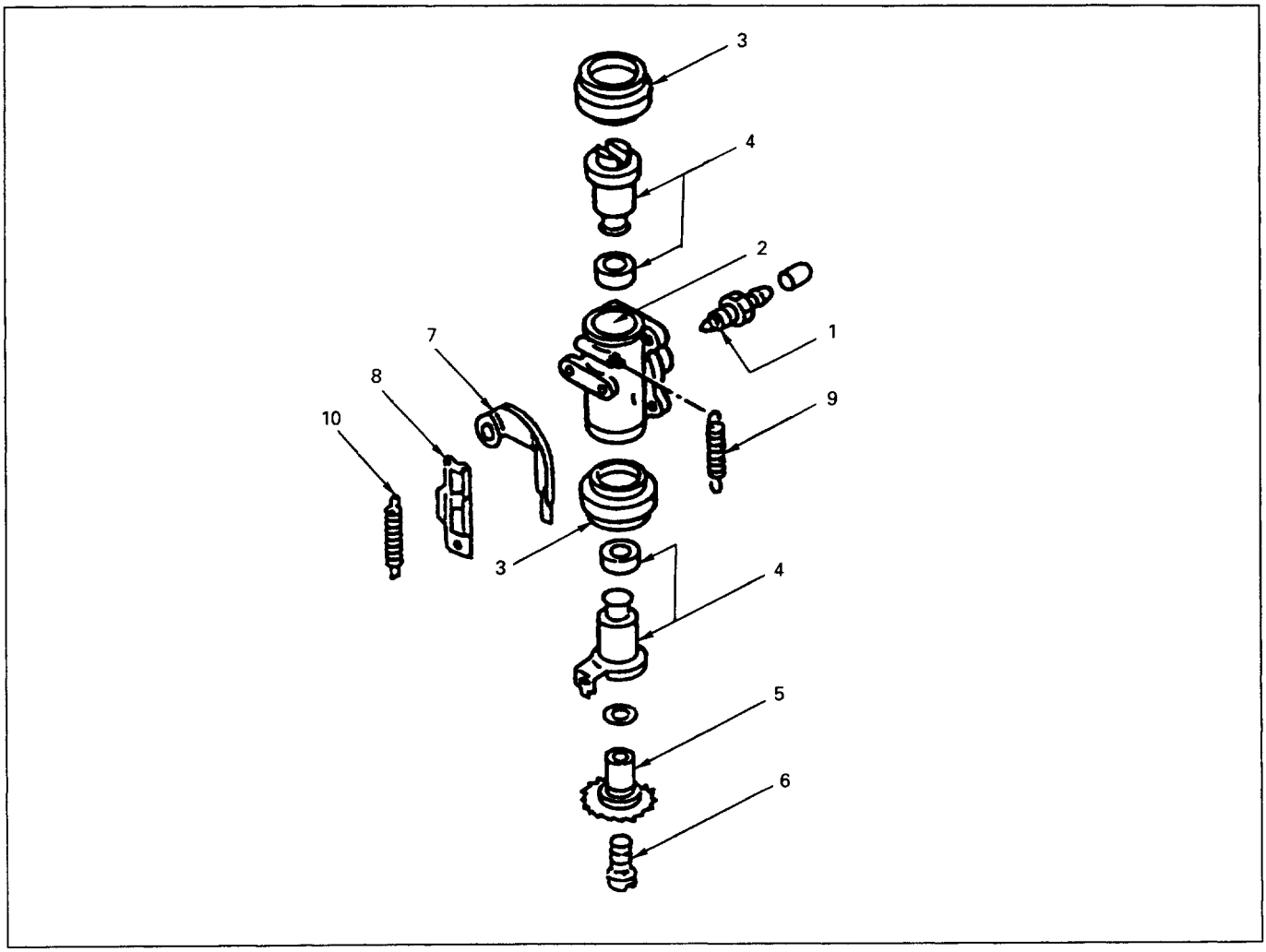
Wheel Cylinder and Piston Clearance mm (in)

Wheel Cylinder size	Limit
22.2 (0.875) 25.4 (1.000)	0.15 (0.006)

When the wheel cylinder disassembled, the repair kit (piston cup and boot) must be replaced.

REASSEMBLY

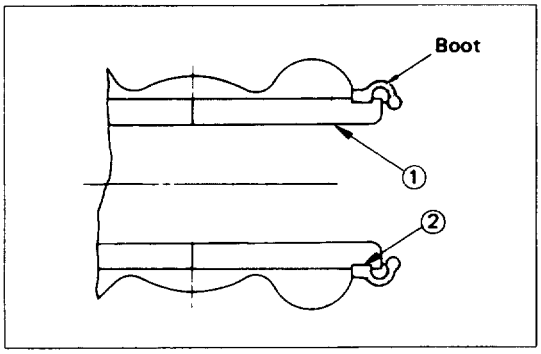
Wheel Cylinder Assembly (With Auto-adjuster)



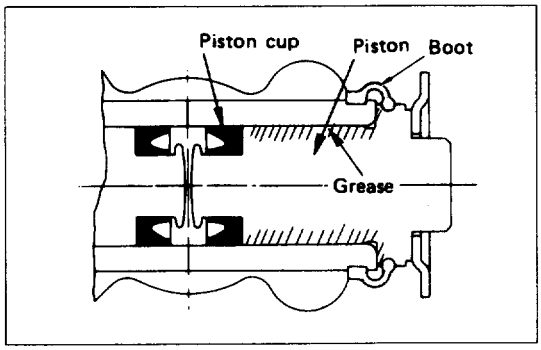
Reassembly Steps

1. Bleeder screw
2. Wheel cylinder body
3. Boot
4. Piston assembly
5. Adjuster gear
6. Adjusting screw
7. Adjuster lever
8. Fitting
9. Overtravel spring
10. Return spring

Reassembly Steps



1. **Bleeder Screw**
2. **Wheel Cylinder Body**
   1. Apply a coat of rubber grease to the cylinder body bore ① and the grooves for the boots ②.
   2. Fit the boot edge securely into the mating groove of the cylinder body.



3. **Boot**
4. **Piston Assembly**
   1. Apply a coat of rubber grease to the piston cups and the pistons.

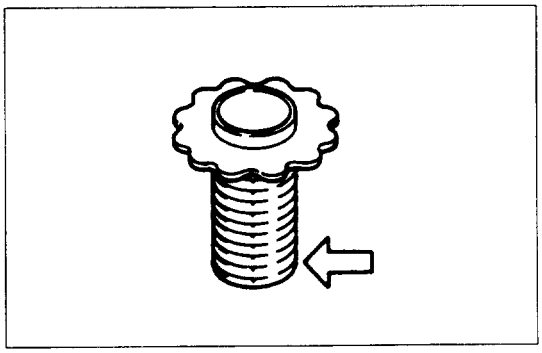
      Be sure to lubricate the entire cylinder body bore with the rubber grease.
   2. Install the piston assembly to the cylinder.

   NOTE:

   After installation of the piston assembly into the cylinder body bore, fit the boot edge securely into the mating groove of the piston.

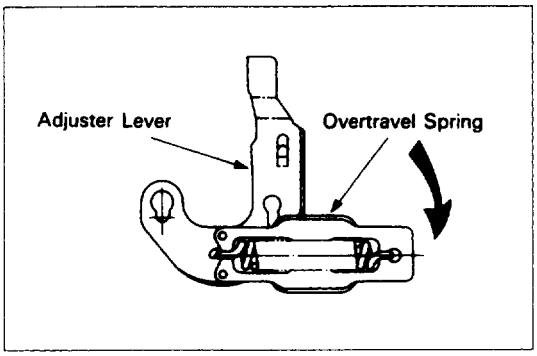
   Make sure that the two boot edges firmly sealed into the grooves.

   Be careful not to damage the piston cups and the boots.

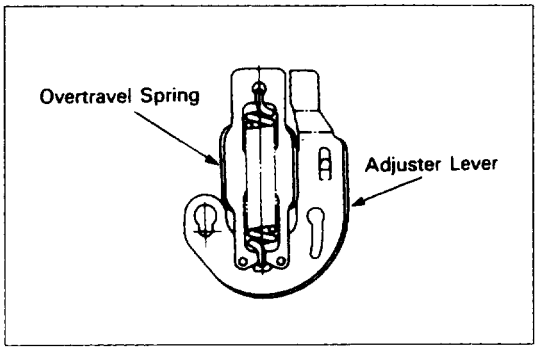


5. **Adjuster Gear**
6. **Adjusting Screw**

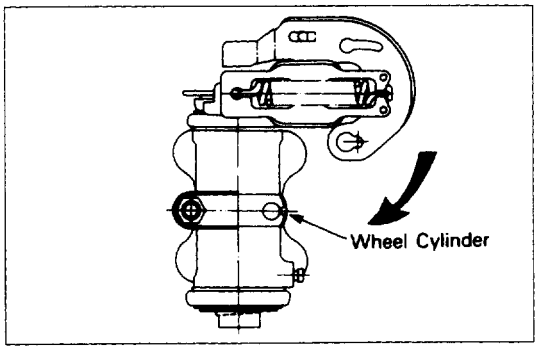
   Apply a coat of molybdenum disulfide grease to the adjusting screw slit and threads.



7. **Adjuster Lever**
8. **Fitting**
9. **Overtravel Spring**
   1) Hook one end of the overtravel spring to the adjuster lever hole as shown in the illustration.
   2) Hook the other end of the overtravel spring to the fitting slot.



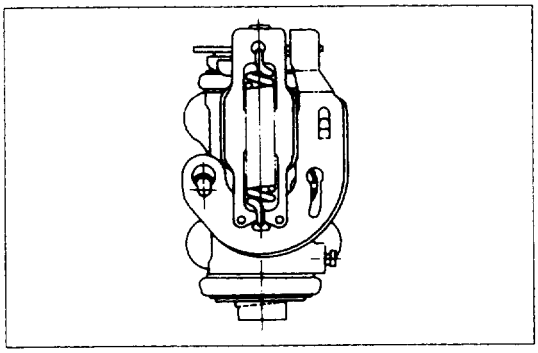
3) Turn the overtravel spring 90 degrees counterclockwise as shown in the illustrations.



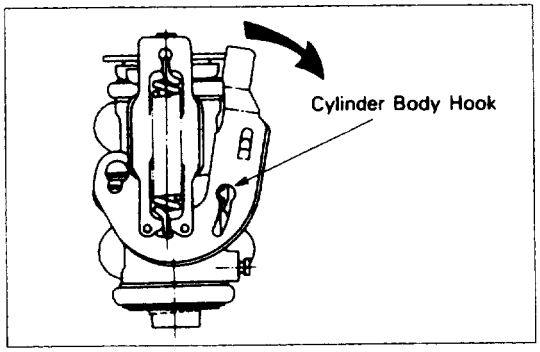
(Wheel Cylinder Body)

Install the adjuster lever and the overtravel spring to the wheel cylinder body.

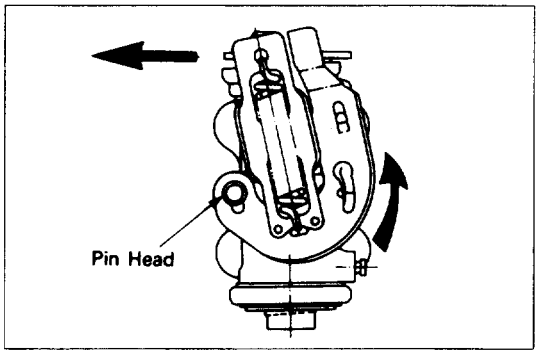
1) Hook the overtravel spring fitting slot side to the wheel cylinder body bracket hole.



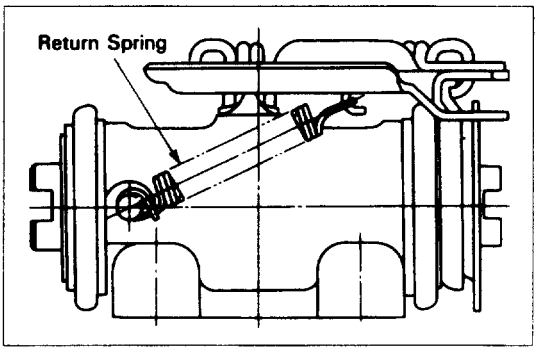
2) Turn the adjuster lever and the overtravel spring 90 degrees clockwise as shown in the illustration.



3) Turn the adjuster lever slightly clockwise to attach the adjuster lever hole to the wheel cylinder body hook.



4) Push the wheel cylinder body and bracket to the left as shown in the illustration.
5) Turn the adjuster lever counterclockwise to install the pin head through the adjuster lever hole.

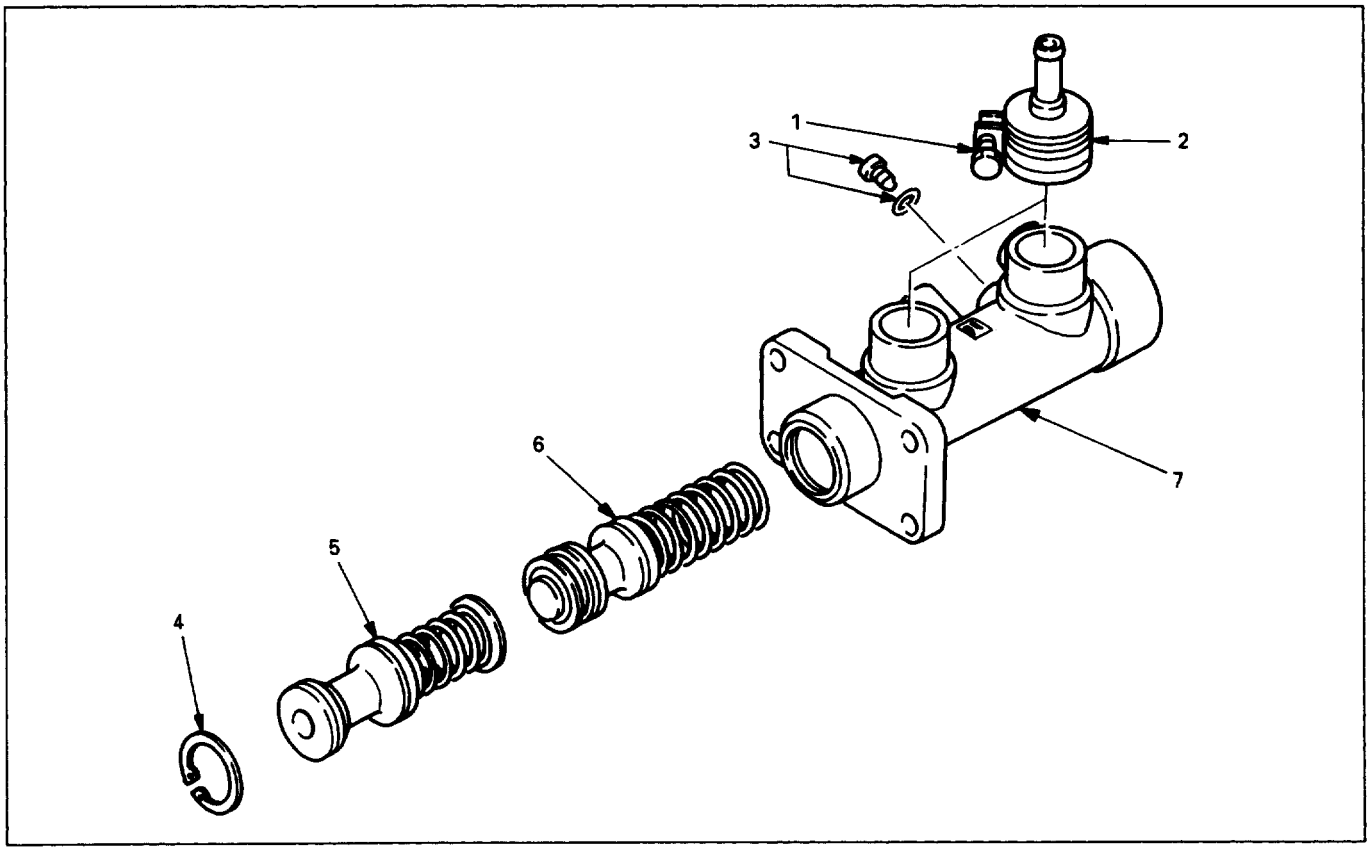


10. Return Spring

Hook the return spring to the wheel cylinder body pin.

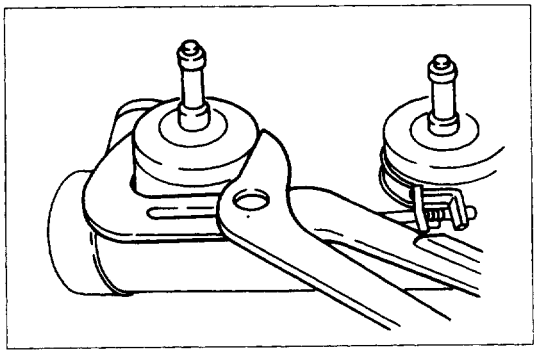
MASTER CYLINDER ASSEMBLY (NHR)

DISASSEMBLY



Disassembly Steps

1. Hose clamp
2. Hose joint
3. Stopper screw and gasket
4. Snap ring
5. Primary piston assembly
6. Secondary piston assembly
7. Cylinder body



Disassembly Steps

1. **Hose Clamp**
2. **Hose Joint**

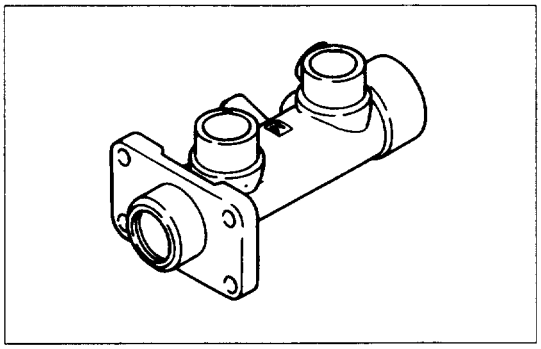
   Use a pair of pliers to remove the hose joint.

   Take care not to damage the hose joint and the cylinder body.

3. **Stopper Screw and Gasket**
4. **Snap Ring**
5. **Primary Piston Assembly**
6. **Secondary Piston Assembly**
7. **Cylinder Body**

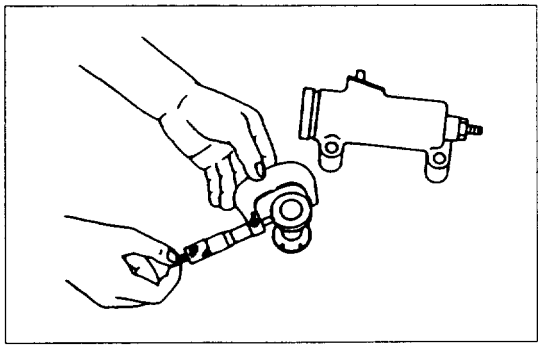
INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.



Cylinder Body

Visually check that the master cylinder bore, for scuf or scratch, if these conditions are presented, the cylinder body must be replaced.



Piston

Piston and Master Cylinder Clearance

1. Use a micrometer to measure the piston diameter.
2. Use an inside dial indicator to measure the cylinder bore.
3. Calculate the clearance between the wheel cylinder and the piston.

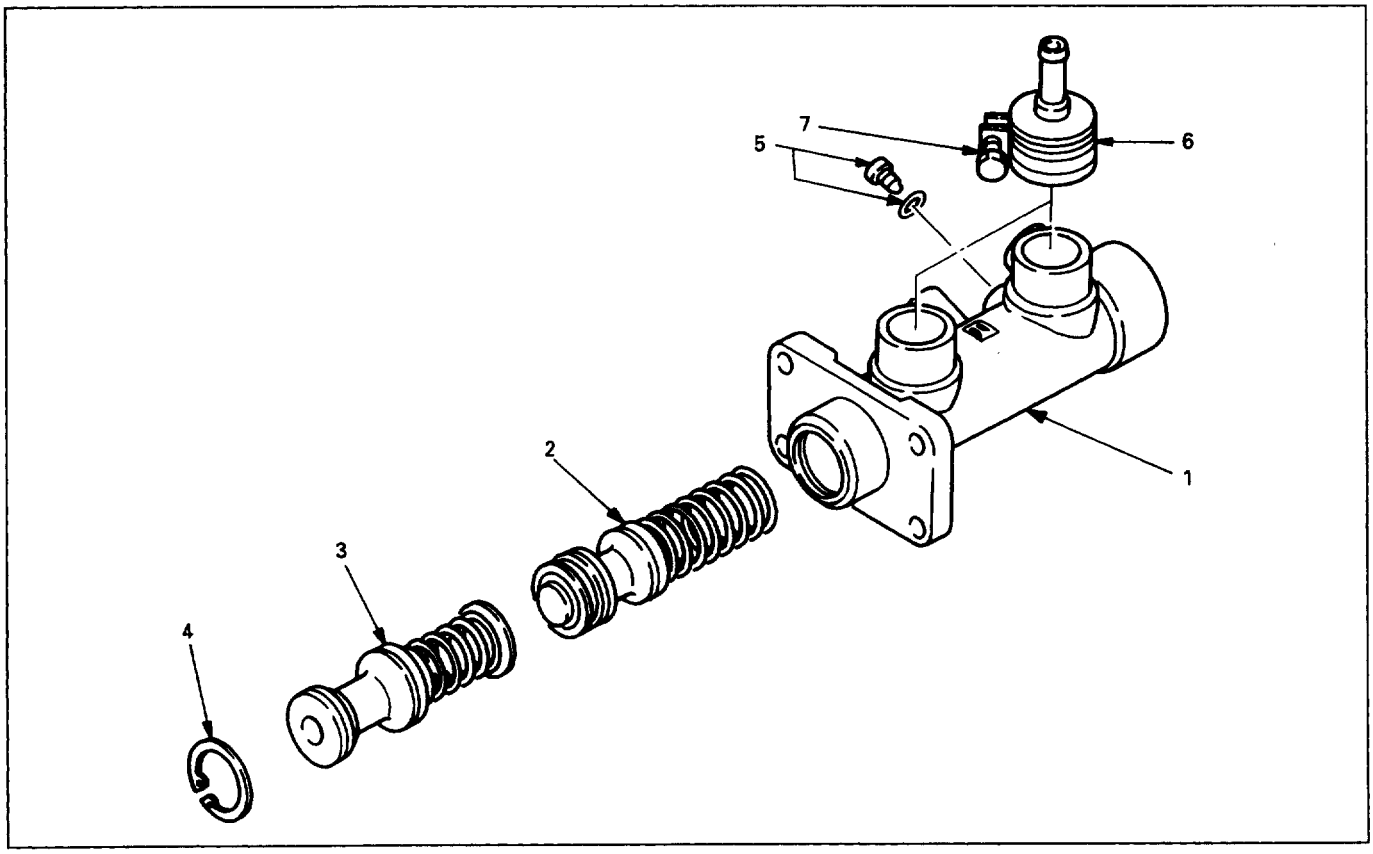
   If the clearance exceeds the specified limit, the piston assembly must be replaced.

Piston and Master Cylinder Clearance mm(in)

Standard	Limit
0.11 – 0.195 (0.004 – 0.008)	0.22 (0.009)

REASSEMBLY

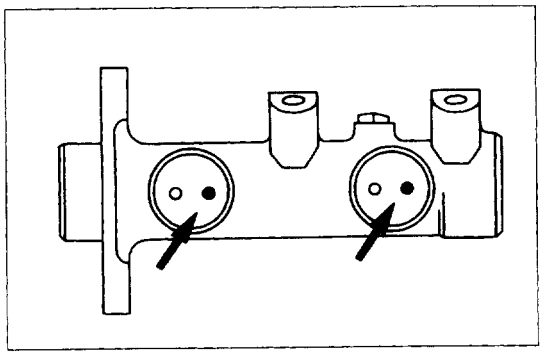
Master Cylinder Assembly (NHR)



Reassembly Steps

1. Cylinder body
2. Secondary piston assembly
3. Primary piston assembly
4. Snap ring
5. Stopper screw and gasket
6. Hose joint
7. Hose clamp

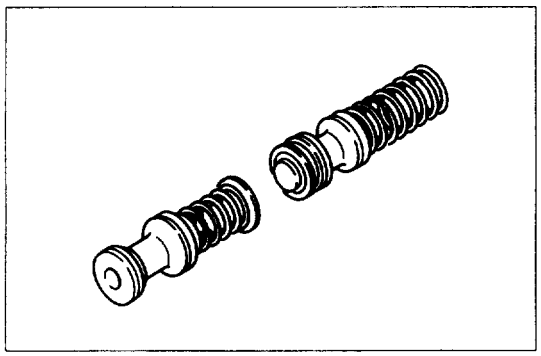
Reassembly Steps



1. **Cylinder Body**

   Clean the cylinder body and blow the return ports with compressed air.

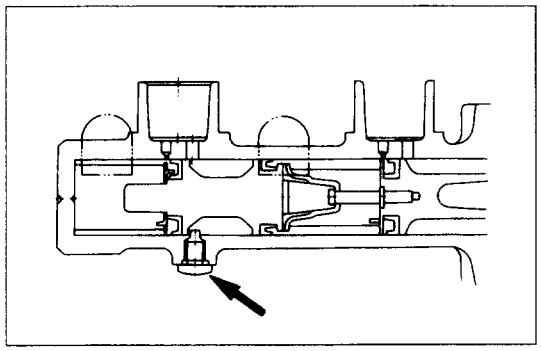
   Do not allow the return ports clogged with any foreign material.



2. **Secondary Piston Assembly**
3. **Primary Piston Assembly**
   1. Rinse the piston assembly in clean brake fluid.
   2. Install the piston assembly to the master cylinder.

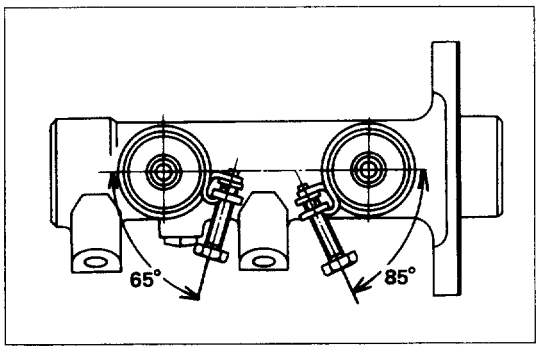
Note:

Take care not to scratch the primary and secondary cups when installing the piston assembly.



4. **Snap Ring**
5. **Stopper Screw and Gasket**
   1. Slide the piston until the oil cavity of the secondary piston dears the stopper bolt hole.
   2. Install the stopper screw and tighten it to the specified torque.

Stopper Screw Torque	N·m (kg·m/lb·ft)
	27 (2.8 / 20)

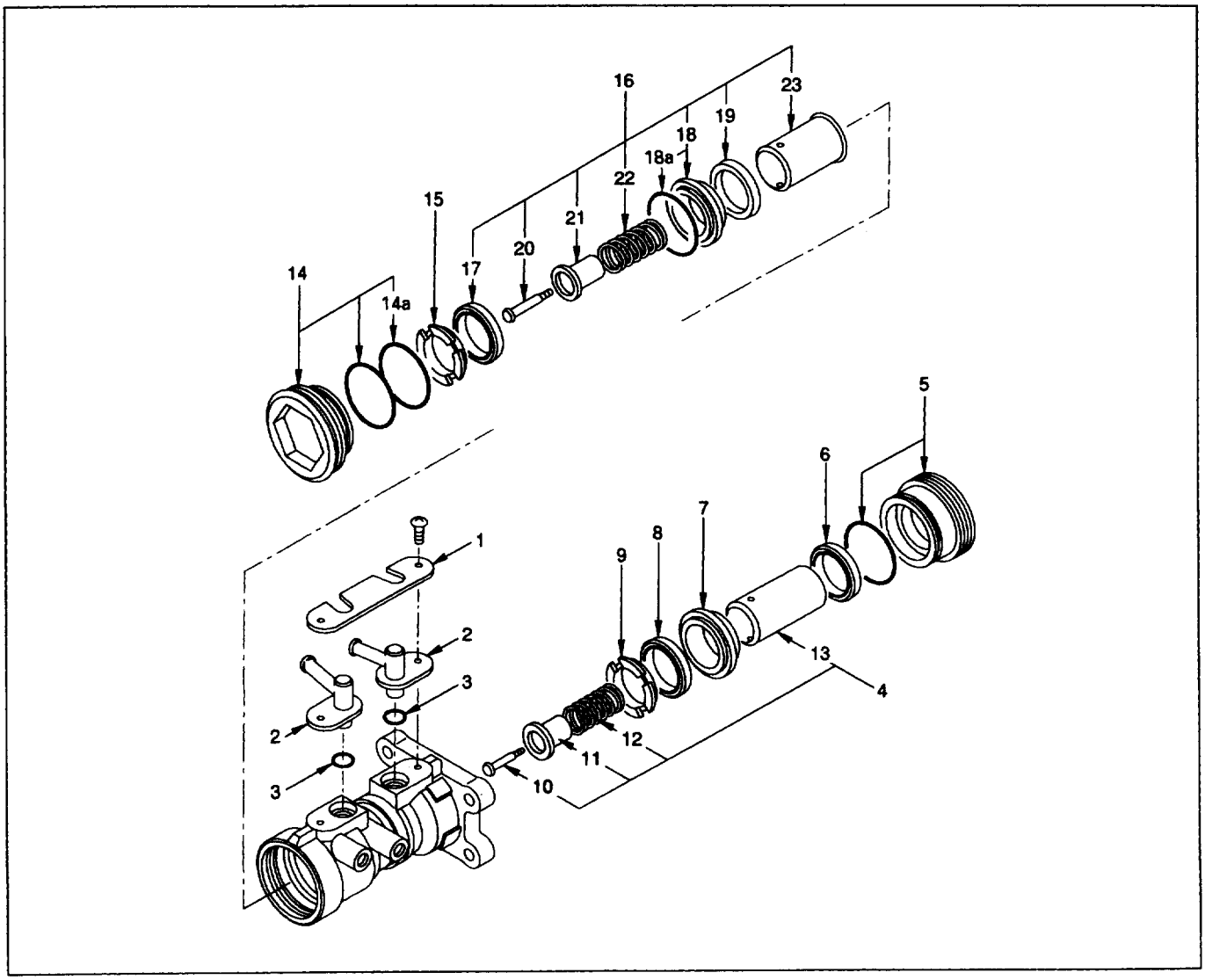


6. **Hose Joint**
7. **Hose Clamp**
   1. Set the clamp in position.
   2. Dip the hose joint in hot water (60° – 80C) for several minutes.
   3. Take out of the hose joint and blow off water immediately and completely.
   4. Fit the hose joint to the cylinder body.
   5. Align the position of the clamp screw as shown in the illustration.
   6. Tighten the clamp screw to the specified torque.

Clamp Screw Torque	N·m (kg·m/lb·in)
	2 (0.2 / 17)

MASTER CYLINDER ASSEMBLY (NKR·NPR·NQR·NPS WITHOUT HYDROMASTER)

DISASSEMBLY



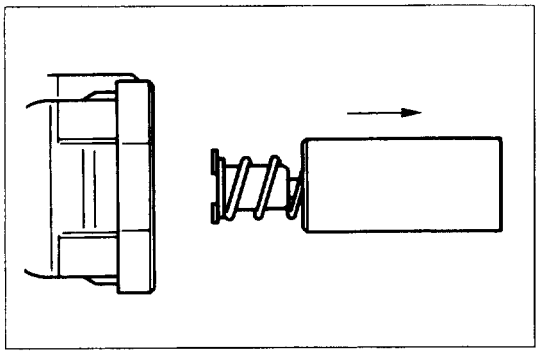
Disassembly Steps

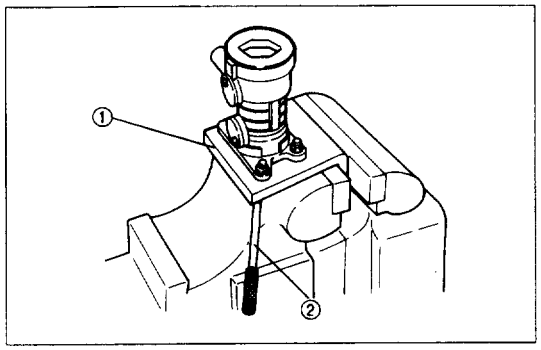
1. Holder plate
2. Hose joint
3. O-ring
4. Primary piston assembly
5. Plug and O-ring
6. Secondary cup
7. Bushing
8. Primary cup
9. Supporter
10. Screw
11. Spring retainer
12. Primary piston spring
13. Primary piston
14. Plug and O-ring
14a. O-ring (RHYTHM make only)
15. Supporter
16. Secondary piston assembly
17. Primary cup
18. Bushing
18a. O-ring (NABCO make only)
19. Secondary cup
20. Screw
21. Spring retainer
22. Secondary piston spring
23. Secondary piston

Disassembly Steps

1. **Holder Plate**
2. **Hose Joint**
3. **O-ring**
4. **Primary Piston Assembly**

   Draw out Piston by hand so that it may not be damaged.



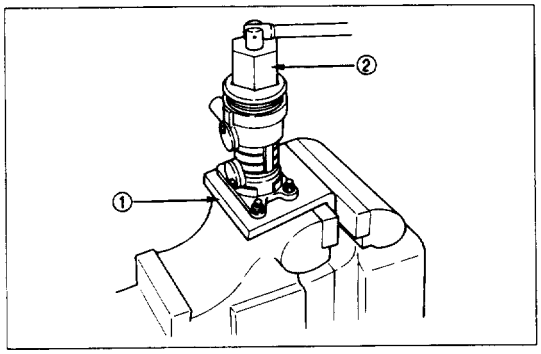


5. **Plug and O-ring**

   Install master cylinder on a support plate ①, fix the support in a vice, and loosen plug using a wrench ②.

   Support plate : 5-8840-2371-0
   Wrench : 5-8840-2370-0
   (Master cylinder inside dia. 31.7 mm)
   Wrench : 5-8840-2369-0
   (Master cylinder inside dia. 28.5 mm)

6. **Secondary Cup**
7. **Bushing**
8. **Primary Cup**
9. **Supporter**
10. **Screw**
11. **Spring Retainer**
12. **Primary Piston Spring**
13. **Primary Piston**



14. **Plug and O-ring**

14a. **O-ring (RHYTHM make only)**

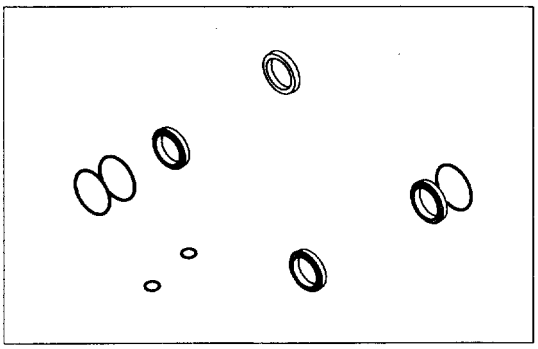
   Install master cylinder on a support plate ①, fix the support in a vice, and loosen plug using a wrench ②.

   Support plate : 5-8840-2371-0
   Wrench : 5-8840-2370-0
   (Master cylinder inside dia. 31.7 mm)
   Wrench : 5-8840-2369-0
   (Master cylinder inside dia. 28.5 mm)

15. **Supporter**
16. **Secondary Piston Assembly**
17. **Primary Cup**
18. **Bushing**
18a. **O-ring (NABCO make only)**
19. **Secondary Cup**
20. **Screw**
21. **Spring Retainer**
22. **Secondary Piston Spring**
23. **Secondary Piston**

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.



Cup and O-ring

1. Wash each part with brake oil and check for wear, deterioration, and damage.
2. Replace the parts shown on the left (Cups and O-rings).

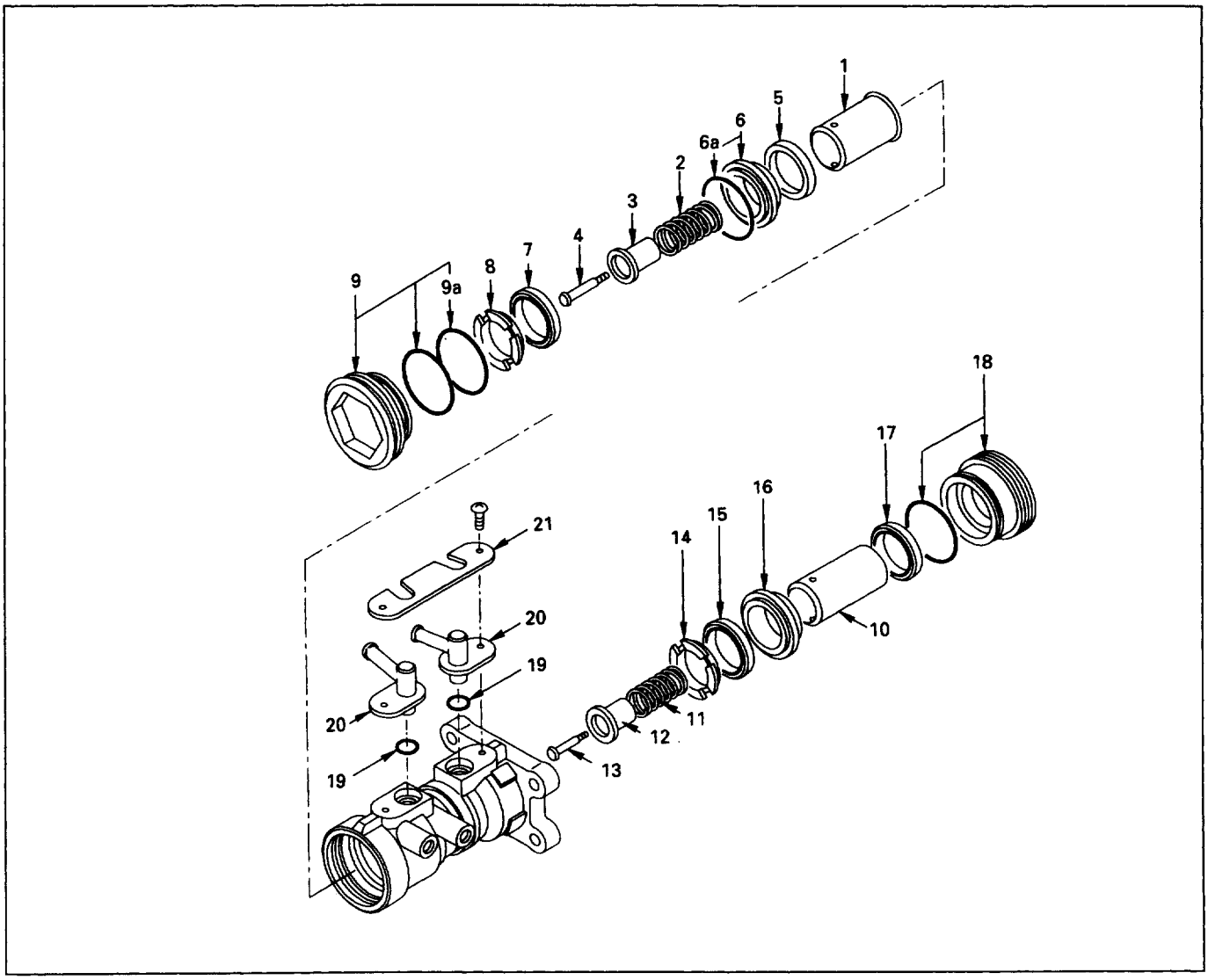
Note:

Master cylinder is available in two makes, RHYTHM and NABCO.

When ordering master cylinder parts, please make sure by master cylinder body mark which make your master cylinder is.

REASSEMBLY

Master Cylinder Assembly (NKR·NPR·NQR without Hydromaster)

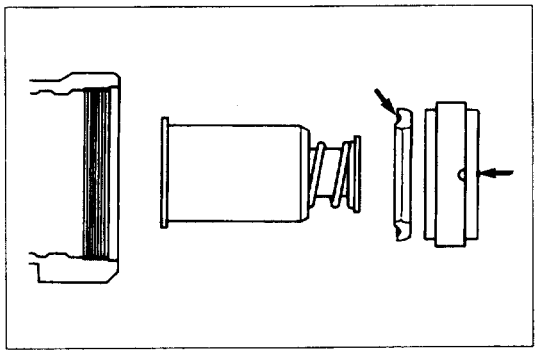


Reassembly Steps

1. Secondary piston
2. Secondary piston spring
3. Spring retainer
4. Screw
5. Secondary cup
6. Bushing
6a. O-ring (NABCO make only)
7. Primary cup
8. Supporter
9. Plug and O-ring
9a. O-ring (RHYTHM make only)
10. Primary piston
11. Primary piston spring
12. Spring retainer
13. Screw
14. Supporter
15. Primary cup
16. Bushing
17. Secondary cup
18. Plug and O-ring
19. O-ring
20. Hose joint
21. Holder plate

Reassembly Steps

1. **Secondary Piston**
2. **Secondary Piston Spring**
3. **Spring Retainer**
4. **Screw**

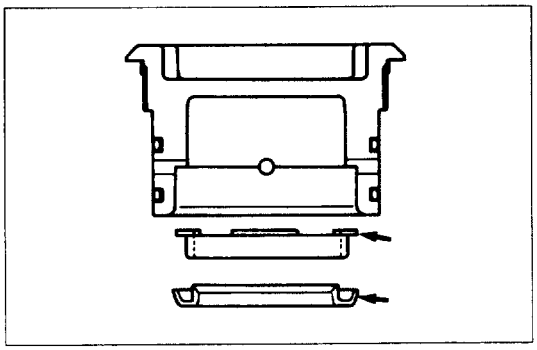


5. **Secondary Cup**
6. **Bushing**

Combine secondary cup and bushing with secondary piston as indicated as arrows, and push the assembly in until bushing comes into contact with cylinder body step.

6a. O-ring (NABCO make only)

Install the O-ring to the bushing.



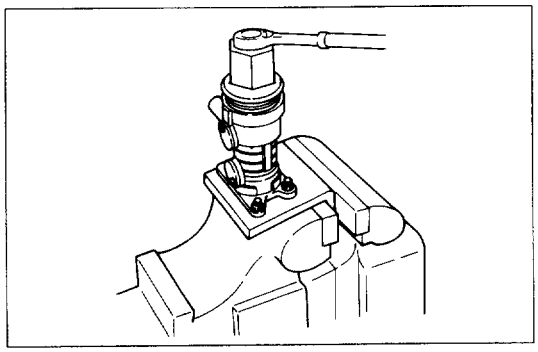
7. **Primary Cup**
8. **Supporter**
9. **Plug and O-ring**

9a. O-ring (RHYTHM make only)

Combine primary cup and supporter with plug as indicated by arrows.

Then tighten plug to specified tightening torque.

Plug Torque		N·m (kg·m/lb·ft)
Master Cylinder Inside dia. (mm)	28.5	40 (4.1 / 30)
	31.7	44 (4.5 / 33)

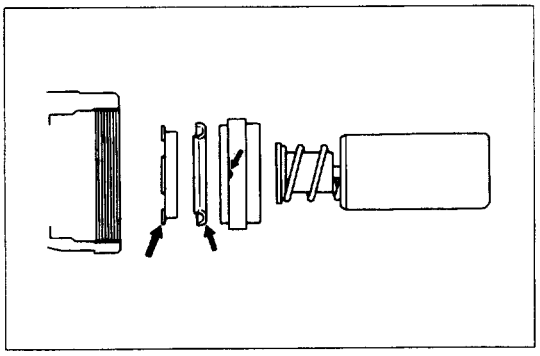


Support plate : 5-8840-2371-0
Wrench : 5-8840-2370-0
(Master cylinder inside dia. 31.7mm)
Wrench : 5-8840-2369-0
(Master cylinder inside dia. 28.5mm)

Note:

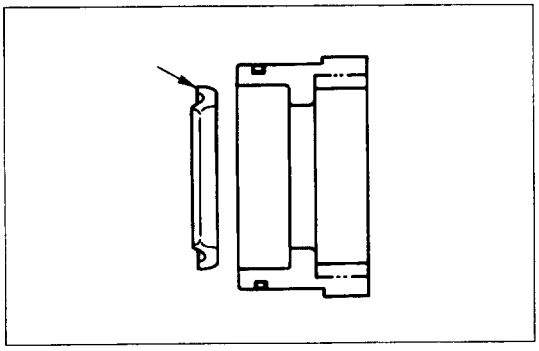
If plug tightened to specified torque is found floating from cylinder body.

Plug should be disassembled again and check for abnormal parts fitting. Then reassemble.



10. **Primary Piston**
11. **Primary Piston Spring**
12. **Spring Retainer**
13. **Screw**
14. **Supporter**
15. **Primary Cup**
16. **Bushing**

1. Combined the parts of primary piston as indicated by arrows.
   Then push the assembly in until bushing comes into contact with the step in cylinder body.
2. Draw out primary piston alone taking care not to be let bushing get out of the step.



17. **Secondary Cup**
18. **Plug and O-ring**

Combine secondary cup with plug as indicated by arrow, and tighten to specified tightening torque

Plug Torque		N·m (kg·m/lb·ft)
Master Cylinder Inside dia. (mm)	28.5	40 (4.1 / 30)
	31.7	44 (4.5 / 33)

Support date : 5-8840-2371-0
Wrench : 5-8840-2370-0
(Master cylinder inside dia. 31.7mm)
Wrench : 5-8840-2369-0
(Master cylinder inside dia. 28.5mm)

Note:

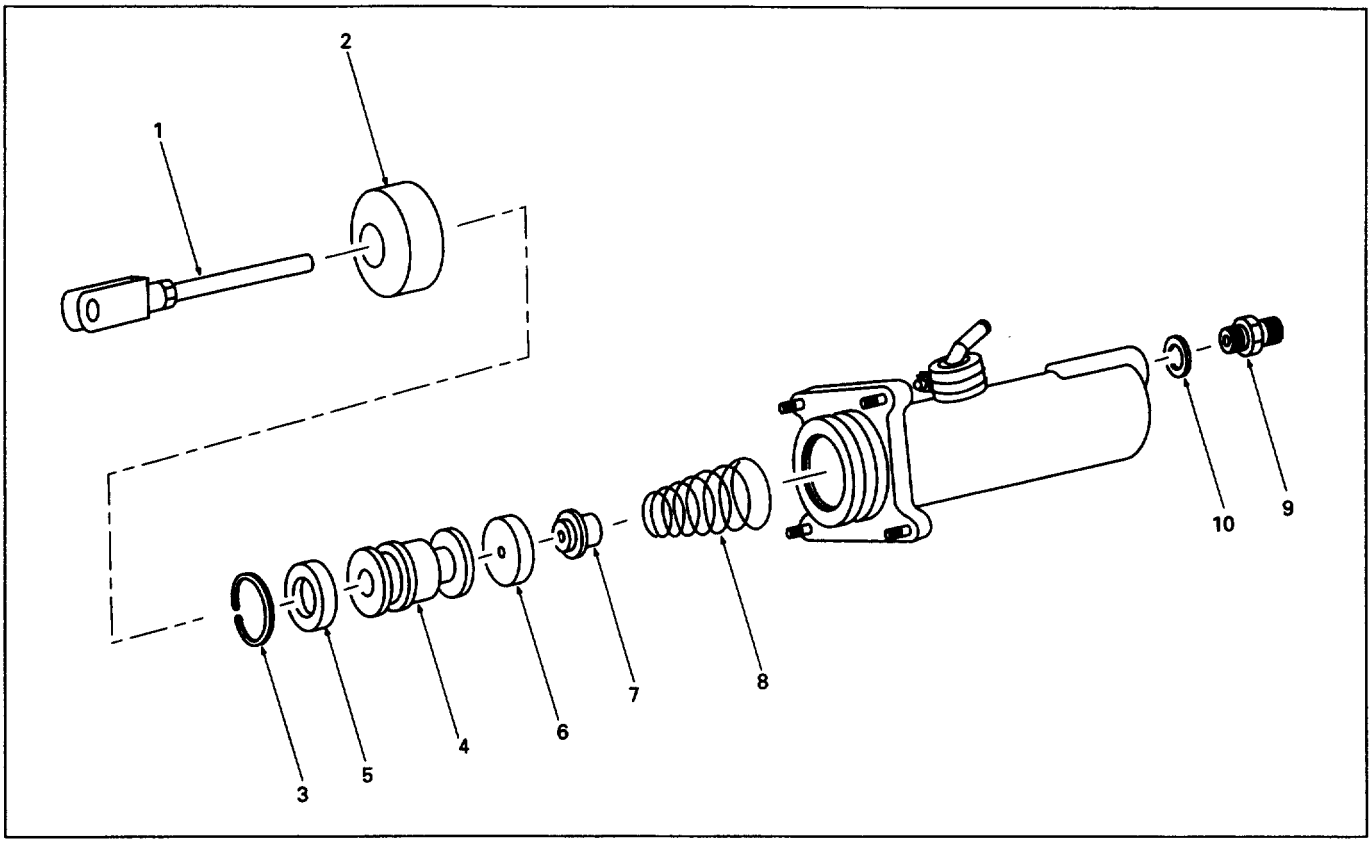
If plug tightened to specified torque is found floating from cylinder body.

Plug should be disassembled again and check for abnormal parts fitting. Then reassemble.

19. O-ring
20. Hose Joint
21. Holder Plate

MASTER CYLINDER ASSEMBLY (NQR WITH HYDROMASTER)

DISASSEMBLY



Disassembly Steps

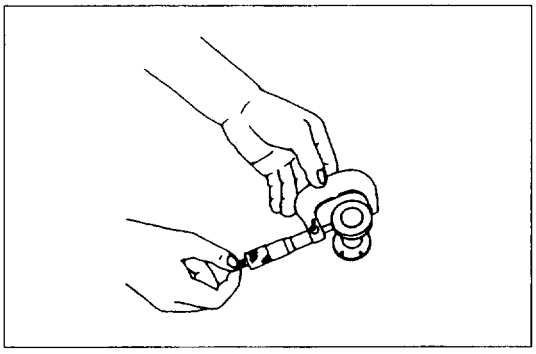
1. Push rod
2. Dust cover
3. Snap ring
4. Piston
5. Secondary cup
6. Primary cup
7. Cup filler
8. Return spring
9. Joint
10. Gasket

Disassembly Steps

1. **Push Rod**
2. **Dust Cover**
3. **Snap Ring**
4. **Piston**
5. **Secondary Cup**
6. **Primary Cup**
7. **Cup Filler**
8. **Return Spring**
9. **Joint**
10. **Gasket**

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.



Piston and Master Cylinder Clearance

1. Use a micrometer to measure the piston diameter.
2. Use an inside dial indicator to measure the cylinder bore.
3. Calculate the clearance between the cylinder and the piston.

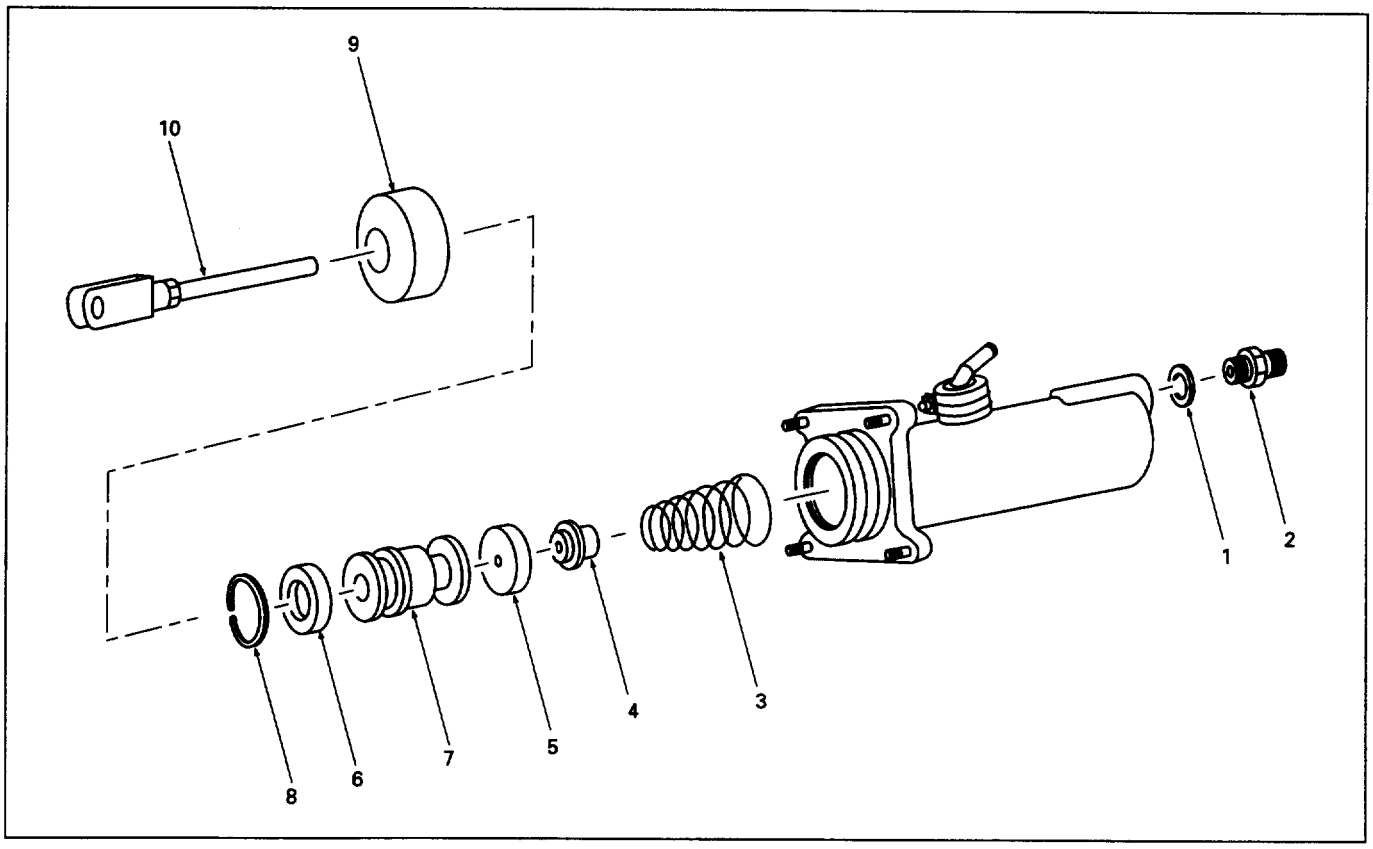
   If the cleareance exceeds the specified limit, the piston must be replaced.

Piston and Master Cylinder Clearance mm(in)

Standard	Limit
0.09 (0.0035)	0.14 (0.0055)

REASSEMBLY

Master Cylinder Assembly (NQR with Hydromaster)

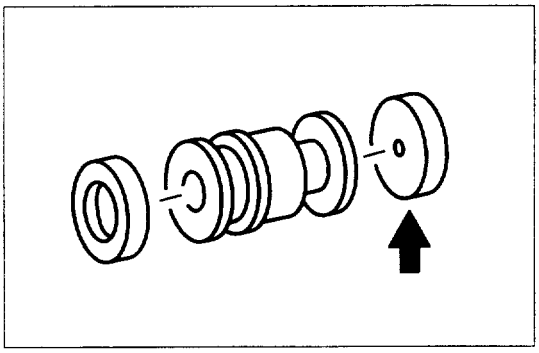


Reassembly Steps

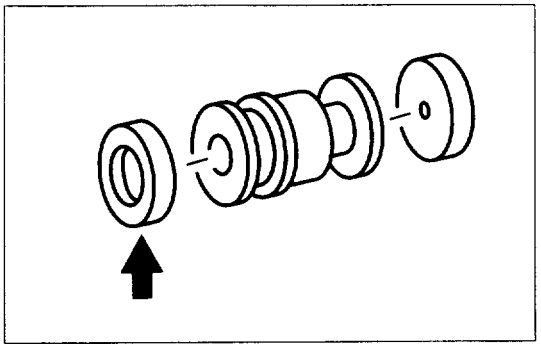
1. Gasket
2. Joint
3. Return spring
4. Cup filler
5. Primary cup
6. Secondary cup
7. Piston
8. Snap ring
9. Dust cover
10. Push rod

Reassembly Steps

1. **Gasket**
2. **Joint**
3. **Return Spring**
4. **Cup Filler**
5. **Primary Cup**
   1. Rinse the primary cup in clean brake fluid.



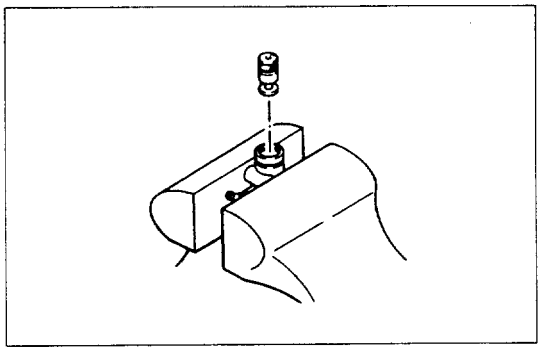
6. **Secondary Cup**
   1. Rinse the secondary cup in clean brake fluid.
   2. Install the secondary cup to the piston.



7. **Piston**
   1. Rinse the piston assembly in clean brake fluid.
   2. Install the piston assembly to the master cylinder.

   Note:

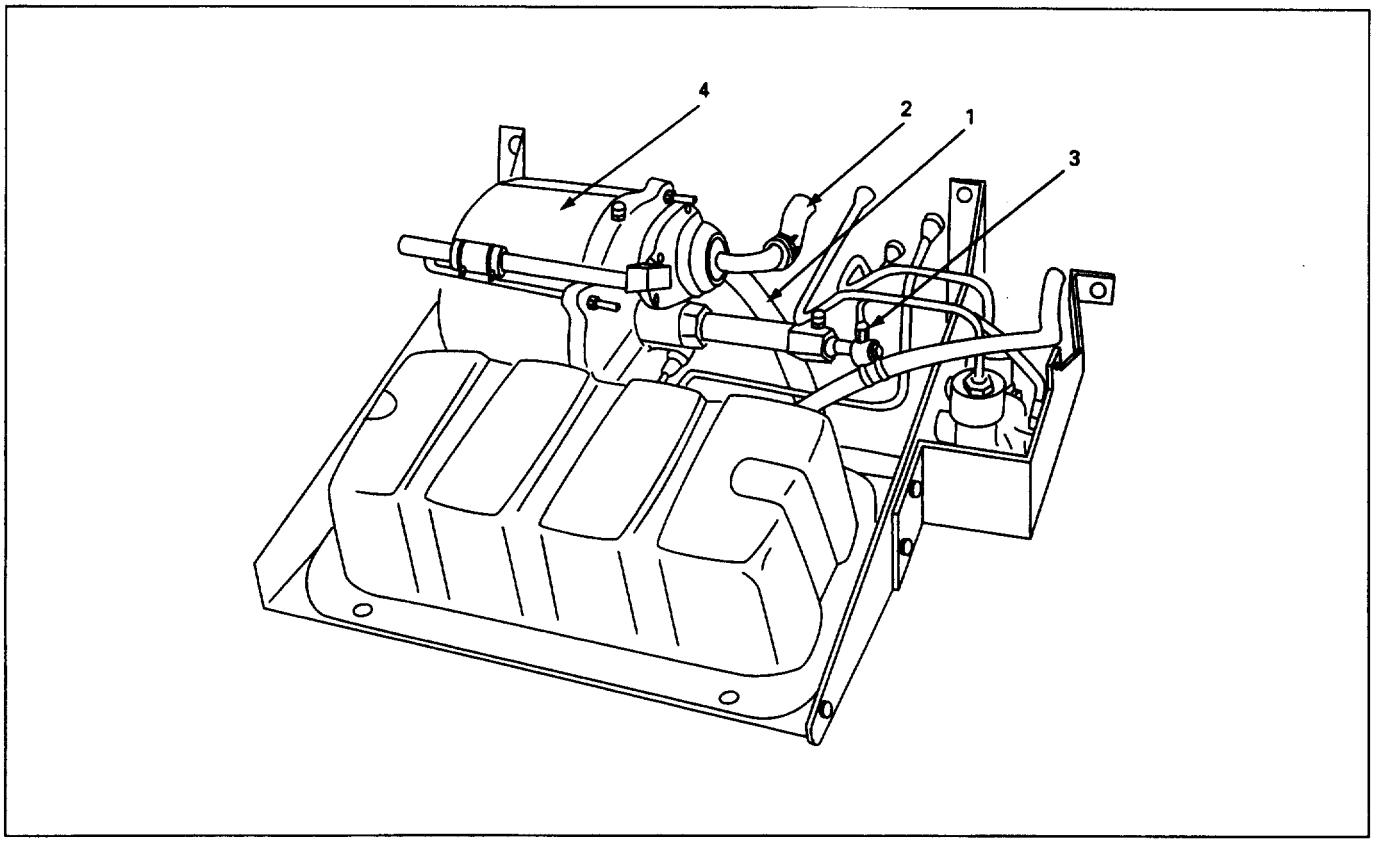
   Take care not to scratch the primary and secondary cups when installing the piston assembly.



8. **Snap Ring**
9. **Dust Cover**
10. **Push Rod**

HYDROMASTER

REMOVAL



Removal Steps

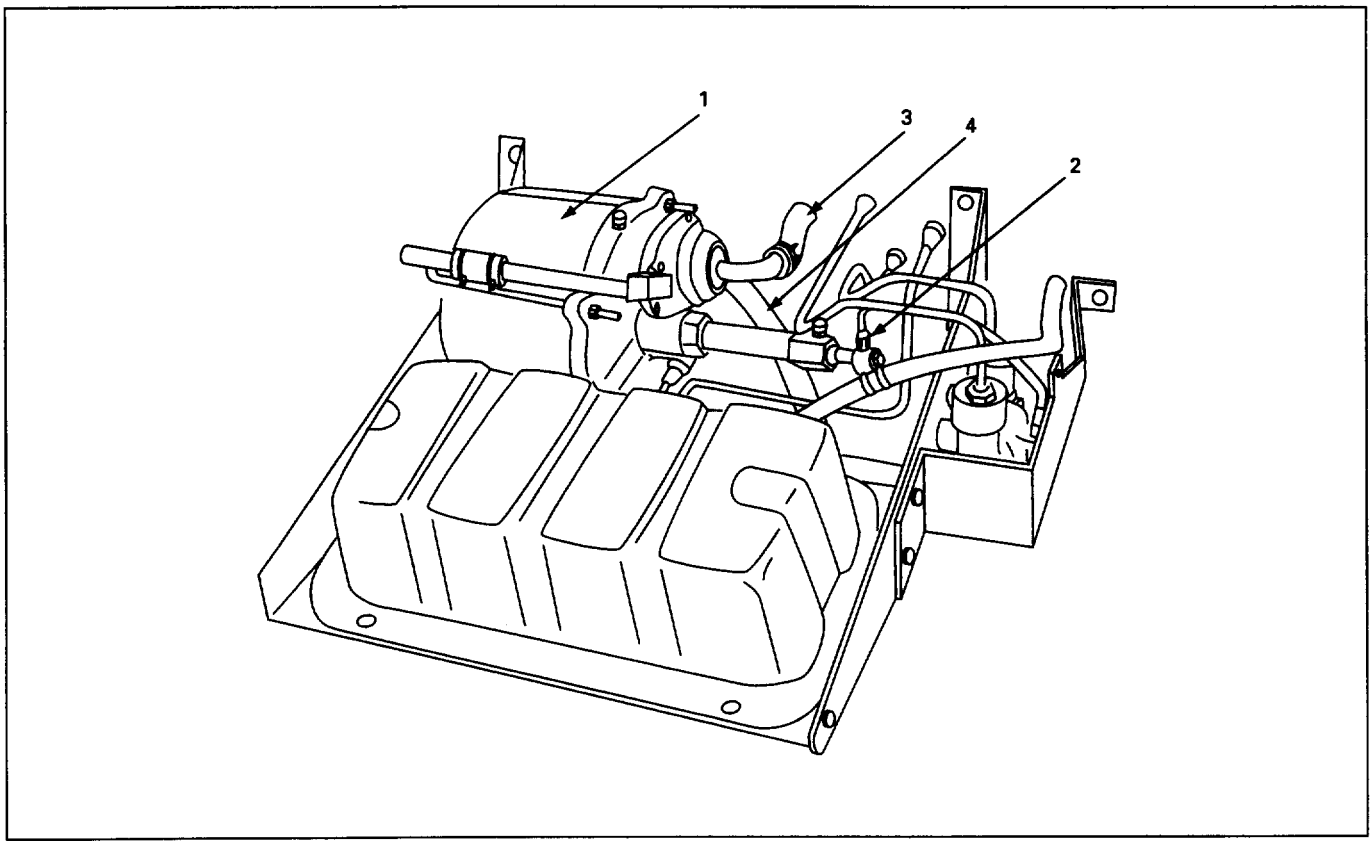
1. Vacuum hose
2. Air hose
3. Brake pipe
4. Hydromaster

Removal Steps

1. **Vacuum Hose**
2. **Air Hose**
3. **Brake Pipe**

   Plug or cover the removed hoses and the brake pipe to prevent brake fluid leakage and the entry of foreign material.
4. **Hydromaster**

INSTALLATION



Installation Steps

1. Hydromaster
2. Brake pipe
3. Air hose
4. Vacuum hose

Installation Steps

1. **Hydromaster**
2. **Brake Pipe**
3. **Air Hose**
4. **Vacuum Hose**

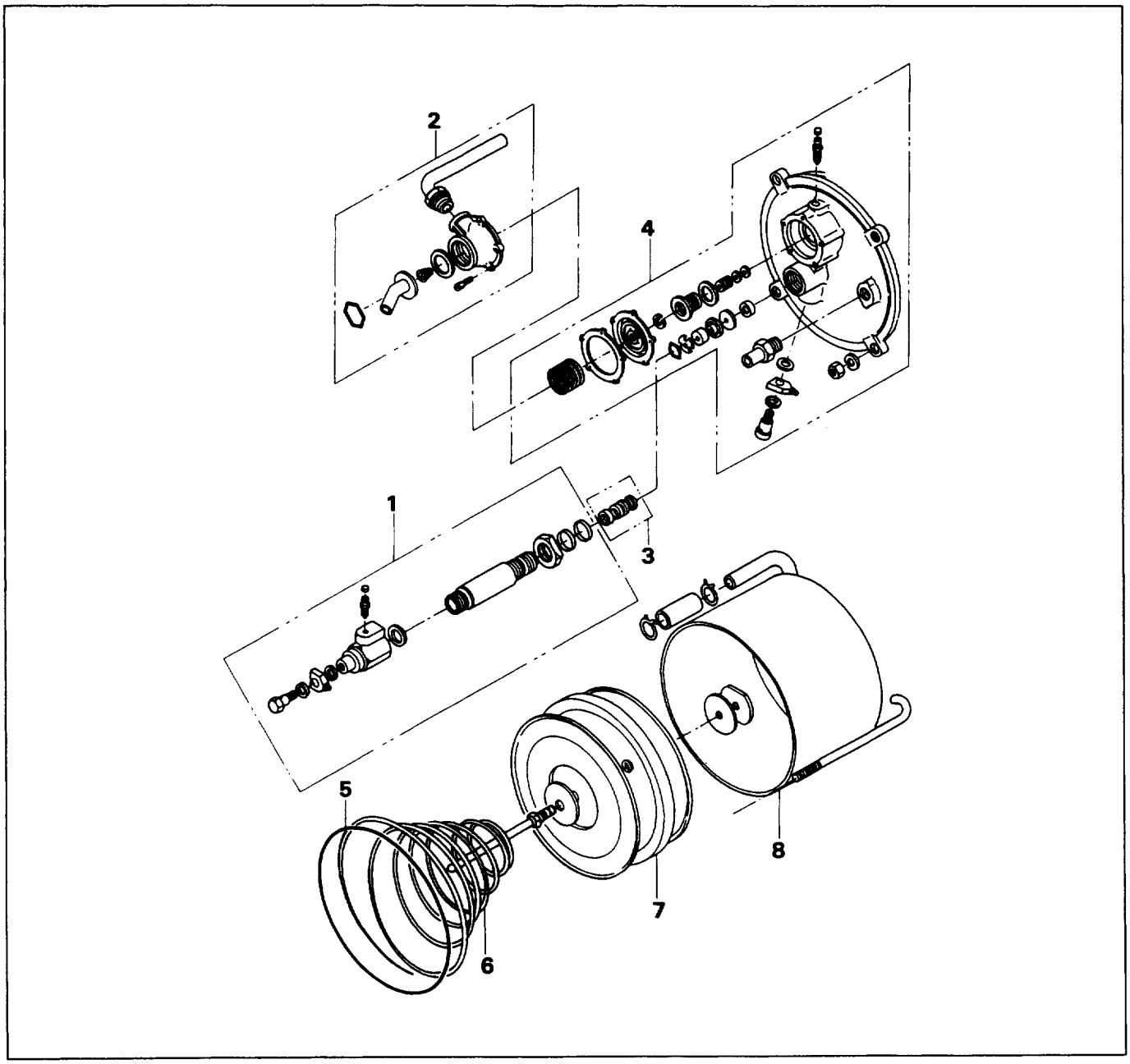
   Bleed the brake hydraulic circuit after installing the hydromaster.

   Refer to "SERVICING" in SECTION 00 (Service Information) for the brake bleeding procedure.

UNIT REPAIR

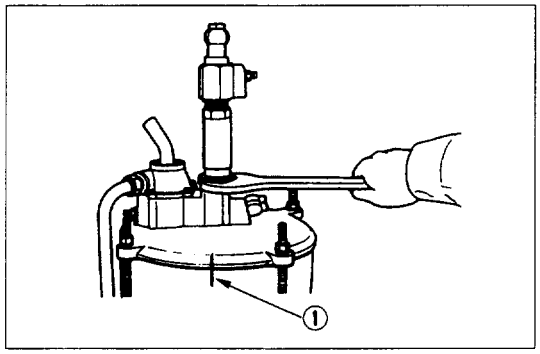
DISASSEMBLY

Hydromaster Assembly



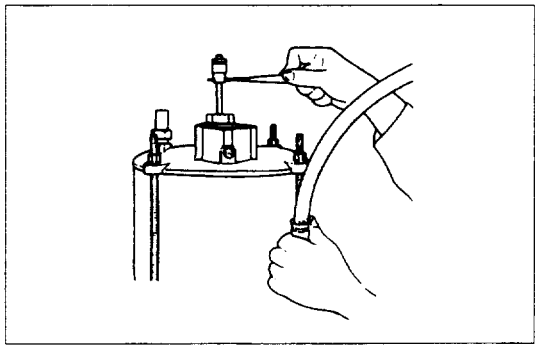
Disassembly Steps

1. Hydraulic cylinder assembly
2. Valve body assembly
3. Hydraulic piston assembly
4. End plate assembly
5. O-ring
6. Return spring
7. Power piston assembly
8. Cylinder shell



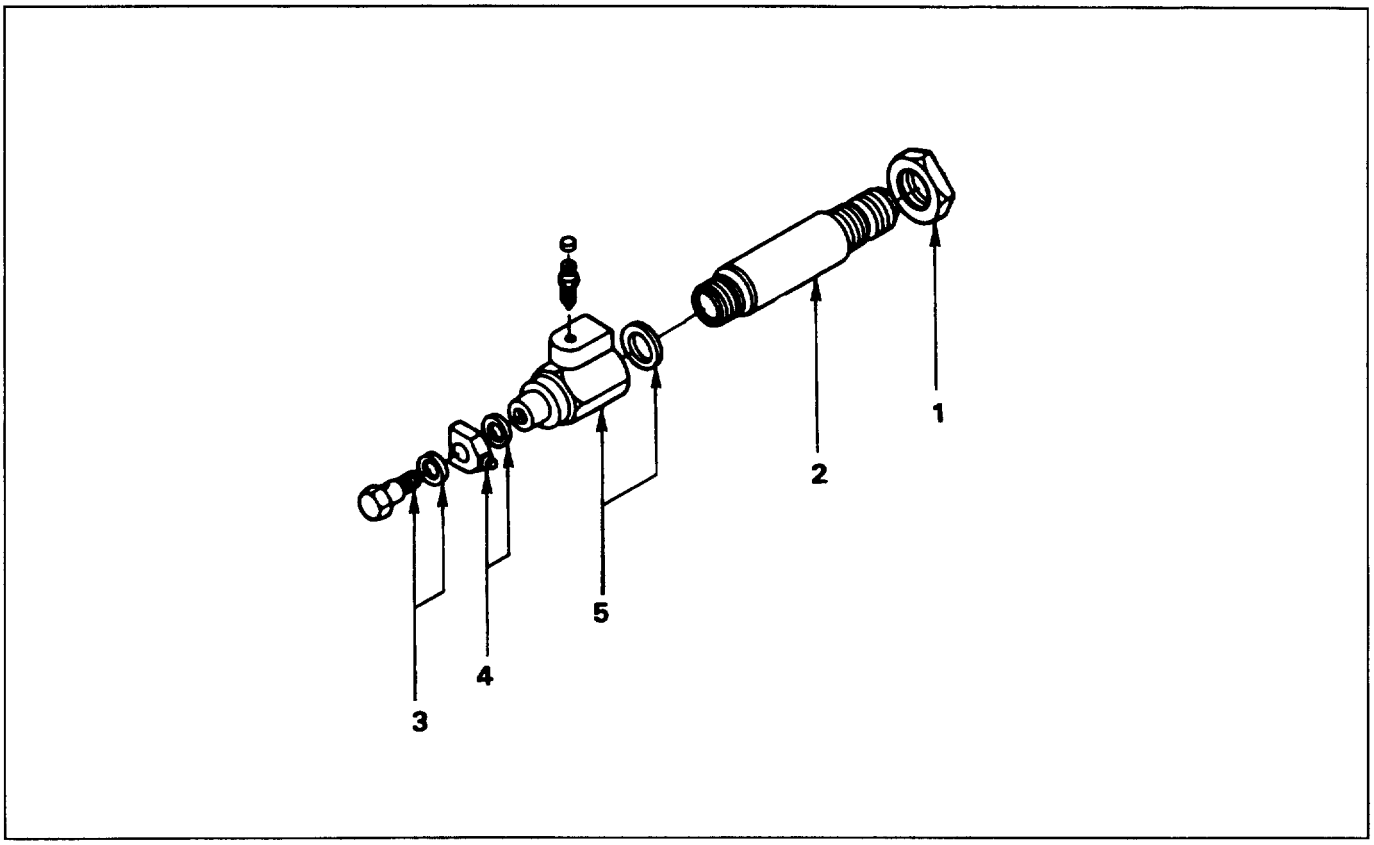
Disassembly Steps

1. **Hydraulic Cylinder Assembly**
   1. Apply a setting mark ① to the cylinder shell and the end plate before disassembling the hydromaster.
   2. Use a 41mm hex wrench to loosen the lock nut and remove the hydraulic cylinder assembly.



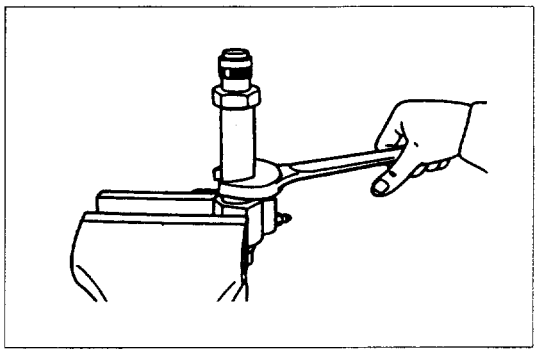
2. **Valve Body Assembly**
3. **Hydraulic Piston Assembly**
   1. Apply compressed air from the control pipe to the hydromaster raise the push rod.
   2. Remove the straight pin.
   3. Remove the hydraulic piston from the push rod.
   4. Stop the compressed air.
4. **End Plate Assembly**
5. **O-ring**
6. **Return Spring**
7. **Power Piston Assembly**
8. **Cylinder Shell**

Hydromaster Cylinder and Piston Assembly



Disassembly Steps

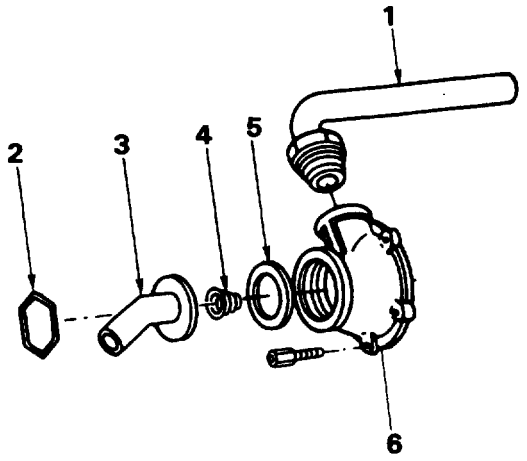
1. Lock nut
2. Cylinder
3. Eye bolt
4. Eye connector
5. Cap and gasket



Disassembly Steps

1. **Lock Nut**
2. **Cylinder**
3. **Eye Bolt**
4. **Eye Connector**
5. **Cap and Gasket**
   1. Clamp the cap in a vise.
   2. Use a wrench to remove the cylinder from the cap. Apply the wrench to the hex portion of the cylinder.

Valve Body Assembly



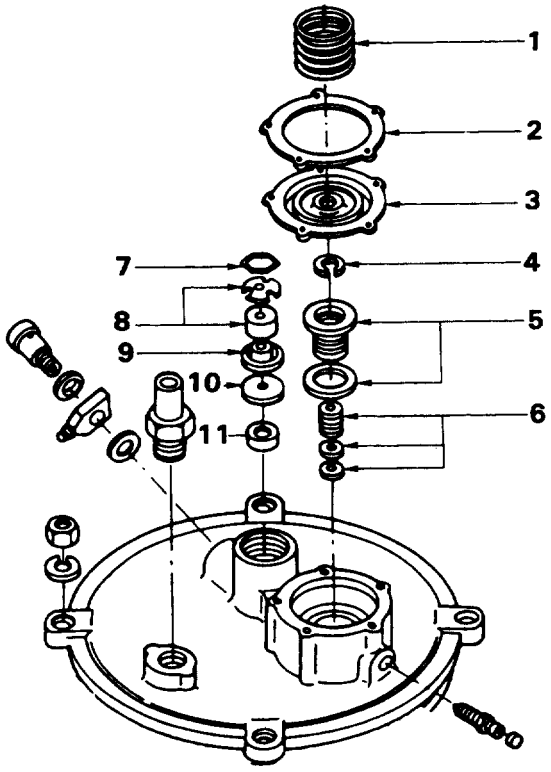
Disassembly Steps

1. Elbow
2. Retaining ring
3. Pipe
4. Spring
5. Washer
6. Valve body

Disassembly Steps

1. **Elbow**
2. **Retaining Ring**
3. **Pipe**
4. **Spring**
5. **Washer**
6. **Valve Body**

End Plate Assembly

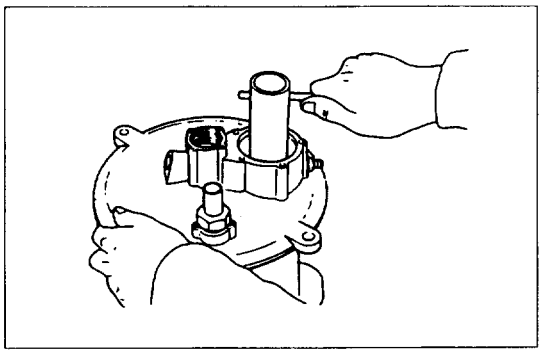


Disassembly Steps

1. Spring
2. Gasket
3. Diaphragm assembly
4. Retaining ring
5. Fitting
6. Relay valve piston assembly
7. Retaining ring
8. Retainer
9. Cup gasket
10. Washer
11. Oil seal

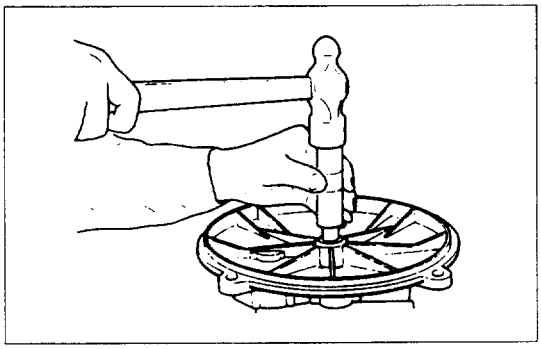
Disassembly Steps

1. **Spring**
2. **Gasket**
3. **Diaphragm Assembly**
4. **Retaining Ring**
5. **Fitting**
   1. Clamp the end plate assembly.
   2. Use a box wrench to remove the fitting.

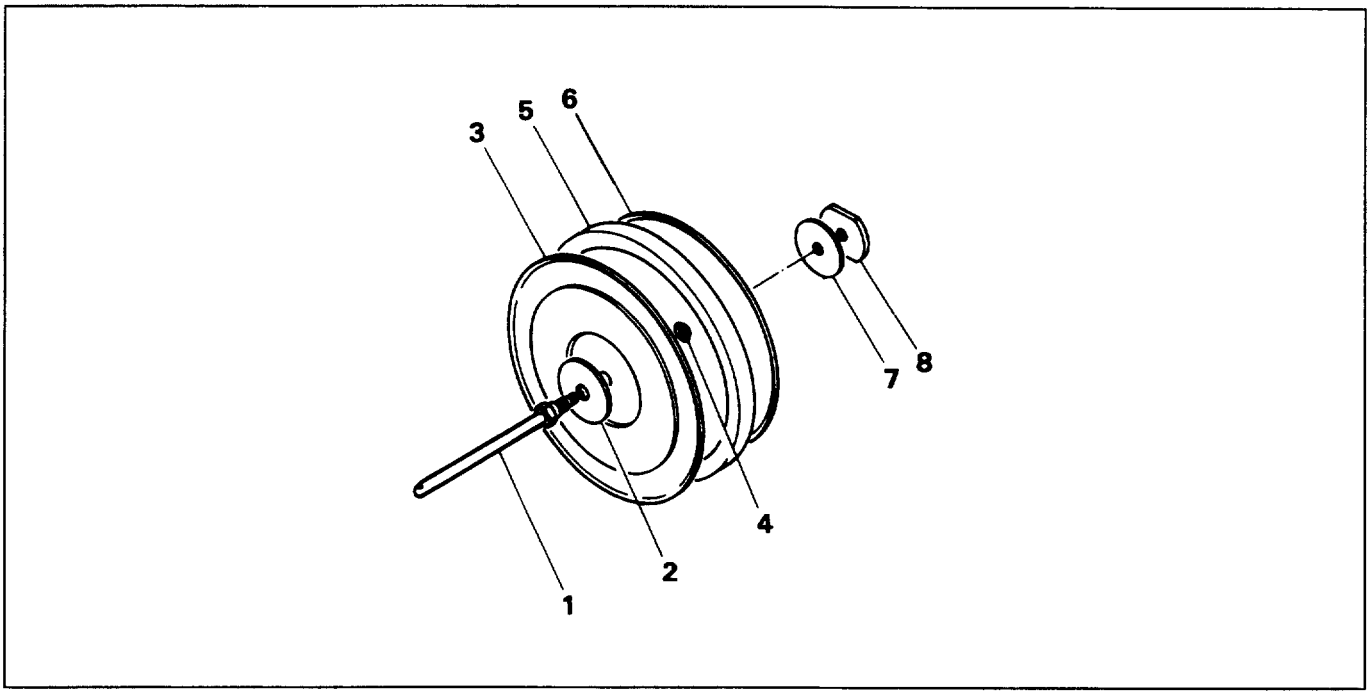


6. **Relay Valve Piston Assembly**
7. **Retaining Ring**
8. **Retainer**
9. **Cup Gasket**
10. **Washer**
11. **Oil Seal**
    1. Clamp the end plate assembly.
    2. Use an oil seal replacer and a hammer to remove the oil seal from the cylinder shell.

       Take care not to scratch the end plate inner surface.

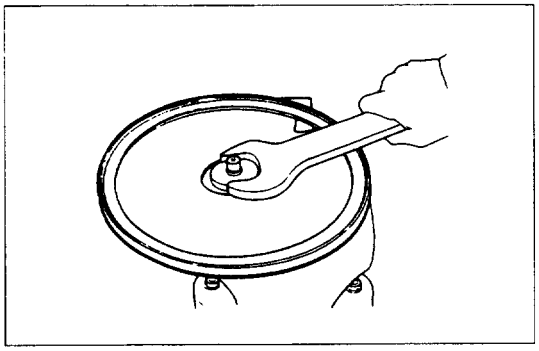


Power Piston Assembly



Disassembly Steps

1. Nut
2. Washer
3. Plate
4. Gasket
5. Gasket
6. Plate
7. Washer
8. Push rod



Disassembly Steps

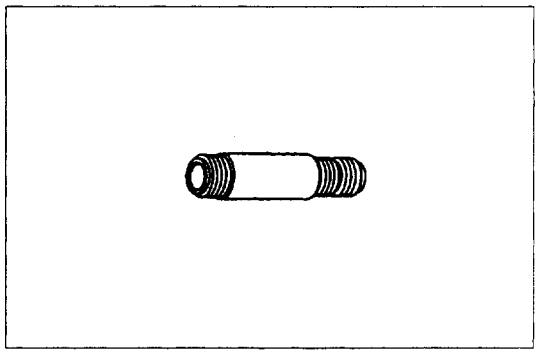
1. **Nut**

   Use a wrench to loosen the nut.

2. **Washer**
3. **Plate**
4. **Gasket**
5. **Gasket**
6. **Plate**
7. **Washer**
8. **Push Rod**

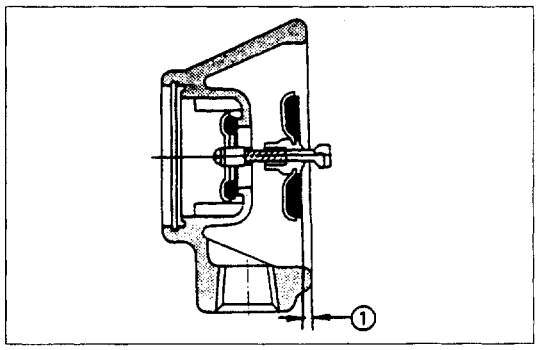
INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.



Cylinder

Visually inspect the cylinder bore for corrosion and other damage.

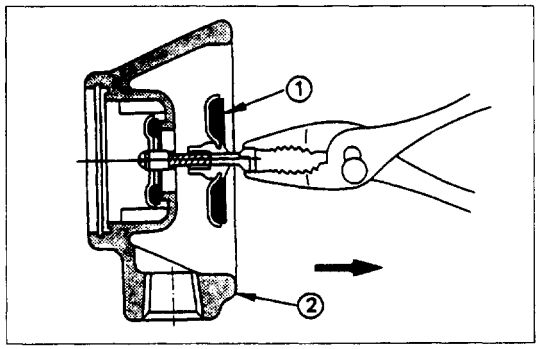


Poppet Valve

1. Visually inspect the rubber seal surface for exessive wear and damage.
2. Measure the poppet valve body and seat clearance.

Poppet Valve Body and Seat Clearance	mm (in)
Standard	1.4 - 2.6 (0.055 - 0.102)

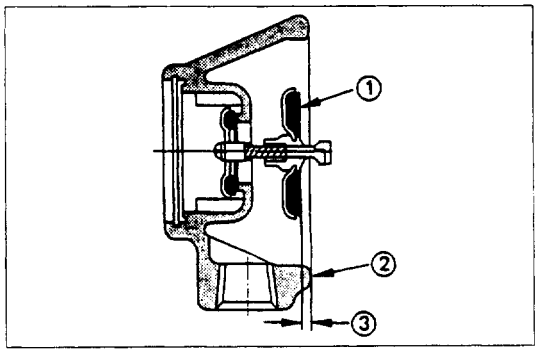
If the measured value is exeeds the specified standard, the poppet valve must be replaced.



Poppet Valve Replacement

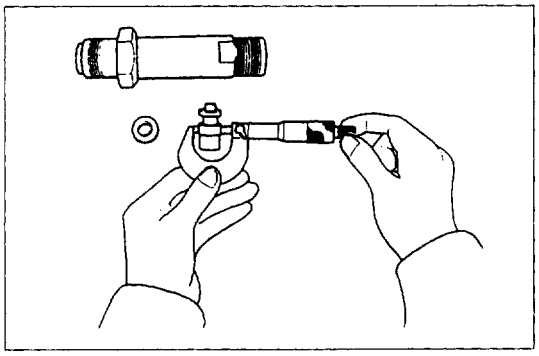
Poppet Valve Removal

Use a pliers to pull out the poppet valve ① from the valve body assembly ②.



Poppet Valve Instllation

1. Install the poppet valve ① to the valve body assembly ②.
2. Use a scale to measure the poppet valve body and seat clearance ③.
3. Caulk the poppet valve.

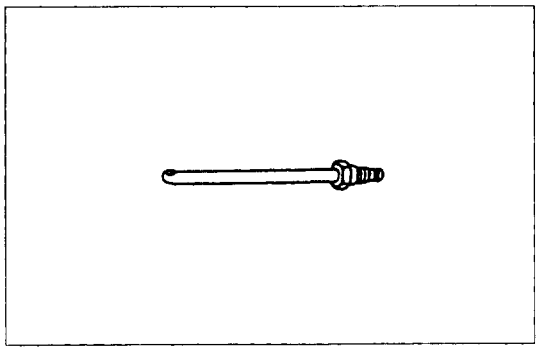


Hydraulic Piston

1. Use a micrometer to measure the hydraulic piston diameter.
2. Use an inside dial indicator to measure the cylinder bore.
3. Calculate the clearance between the cylinder and the piston.

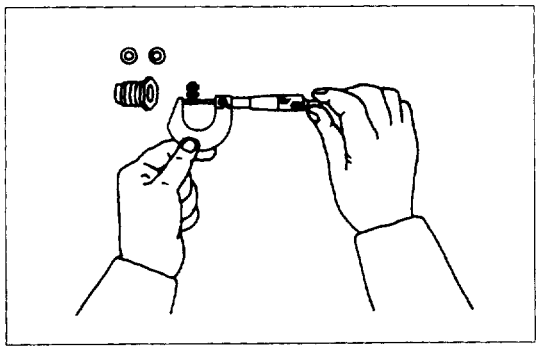
Cylinder and Piston clearance	mm (in)
Limit	0.15 (0.006)

If the clearance exceeds the specified limit, the cylinder and the piston liner must be replaced.



Push Rod

Visually inspect the push rod for corrosion and other damage.



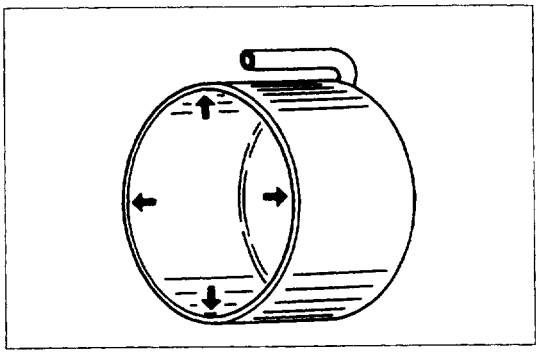
Fitting

Relay Valve Piston Assembly

1. Visually inspect the fitting inside surface for corrosion and other damage.
2. Use a micrometer to measure the relay valve piston diameter.
3. Use an inside dial indicator to measure the fitting inside diameter.
4. Calculate the clearance between the fitting and the piston.

Fitting and Piston clearance	mm (in)
Limit	0.1 (0.0039)

If the clearance exceeds the specified limit, the fitting and the piston must be replaced.

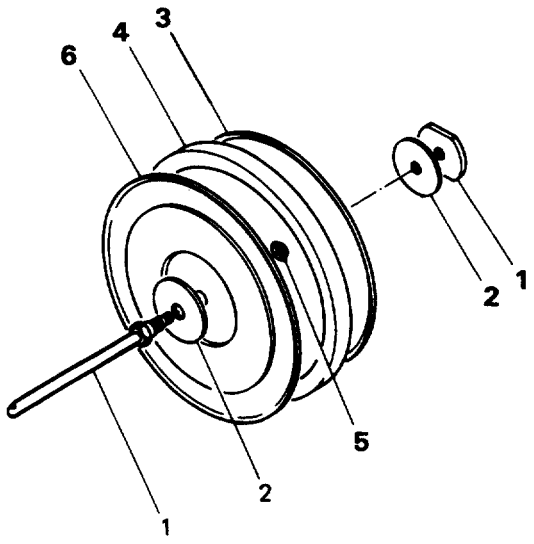


Cylinder Shell

Visually inspect the Cylinder shell bore for corrosion and other damage.

REASSEMBLY

Power Piston Assembly

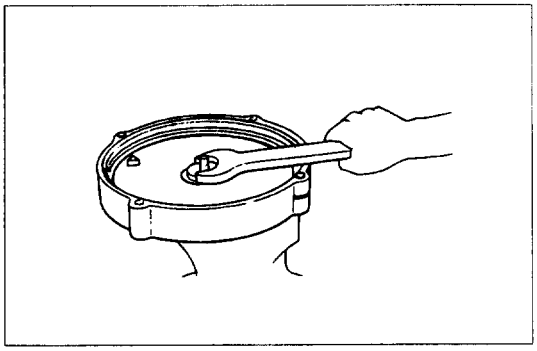


Reassembly Steps

1. Push rod
2. Washer
3. Plate
4. Gasket
5. Gasket
6. Plate
7. Washer
8. Nut

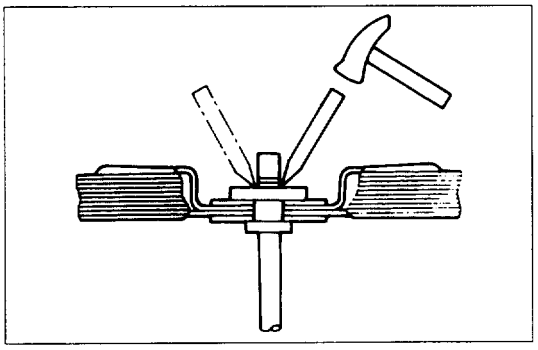
Reassembly Steps

1. **Push Rod**
2. **Washer**
3. **Plate**
4. **Gasket**
5. **Gasket**
6. **Plate**
7. **Washer**
8. **Nut**



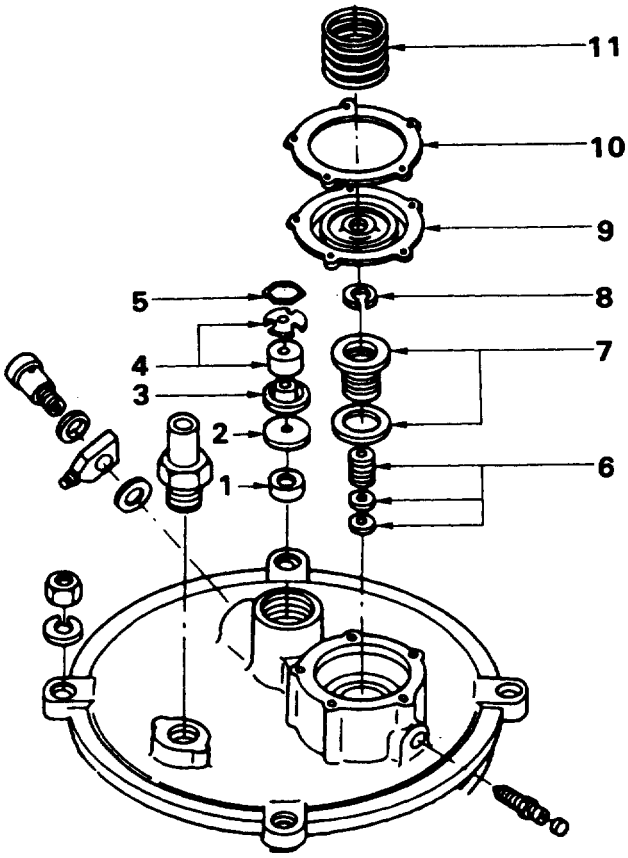
1. Clamp the push rod in a vice.
2. Use a wrench to tighten the lock nut to the specified torque.

Lock Nut Torque	N·m (kg·m/lb·ft)
	24.5 (2.5/18.1)



3. Caulk the lock nut at two positions to prevent from loosening.

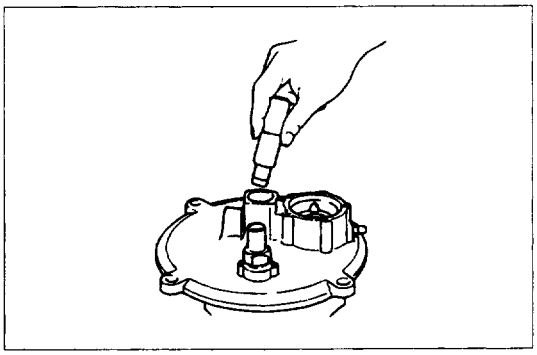
End Plate Assembly



Reassembly Steps

1. Oil seal
2. Washer
3. Cup gasket
4. Retainer
5. Retaining ring
6. Relay valve piston assembly
7. Fitting
8. Retaining ring
9. Diaphragm assembly
10. Gasket
11. Spring

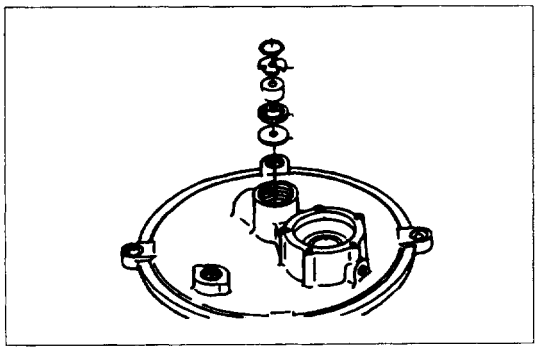
Reassembly Steps



1. **Oil Seal**
   1. Apply a coat of silicon grease to the oil seal lip.
   2. Use an oil seal replacer and a hammer to install the oil seal.

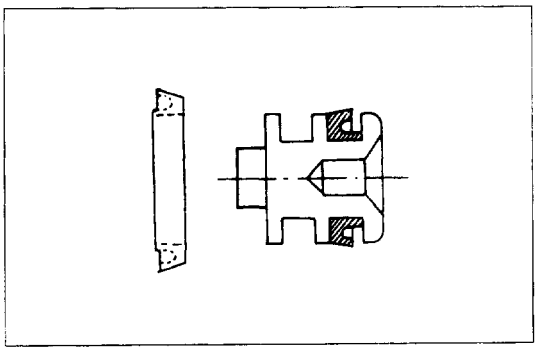
      The oil seal lip must be facing the end plate.

2. **Washer**
3. **Cup Gasket**
4. **Retainer**



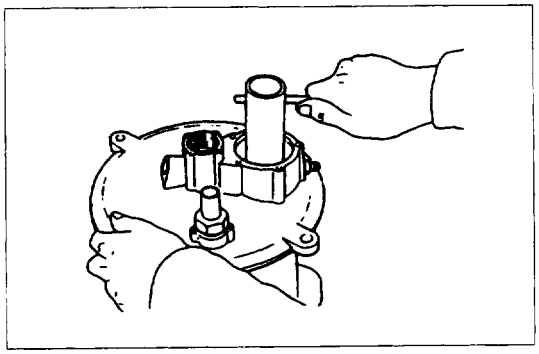
5. **Retaining Ring**
   1. Install the washer, the cup gasket, and the retainer.
   2. Fix the washer, the cup gasket, and the retainer with the retaining ring.

      The side of the washer having wider chamfer must be facing up.



6. **Relay Valve Piston Assembly**
   1. Apply a coat of vacuum cylinder oil to the piston.
   2. Rinse the piston cup in clean brake fluid.
   3. Install the piston cup to the piston.
   4. Install the relay valve piston assembly to the fitting.

      The piston hole must be facing the retaining ring.

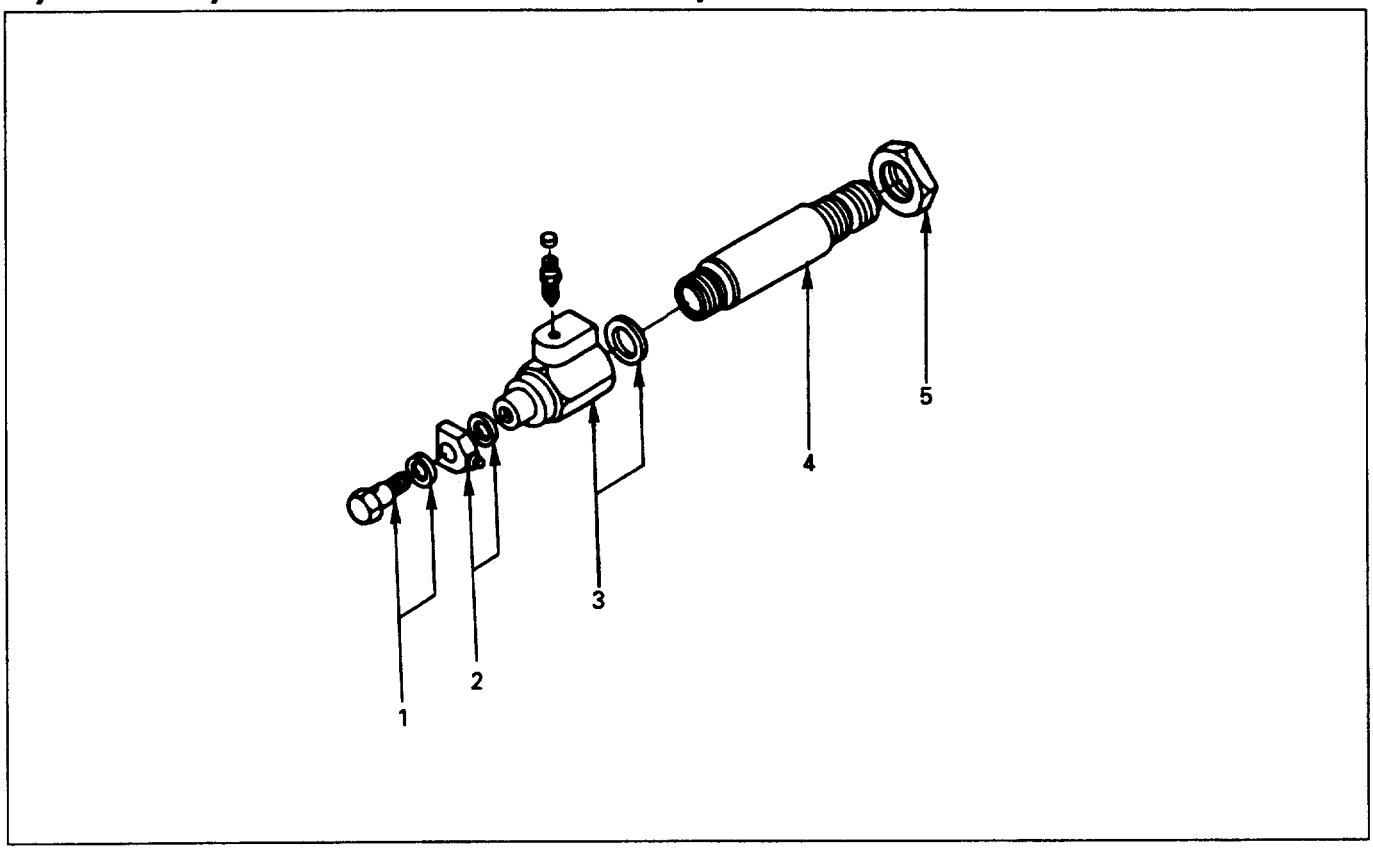


7. **Fitting**

   Use a box wrench to tighten the fitting to the specified torque.

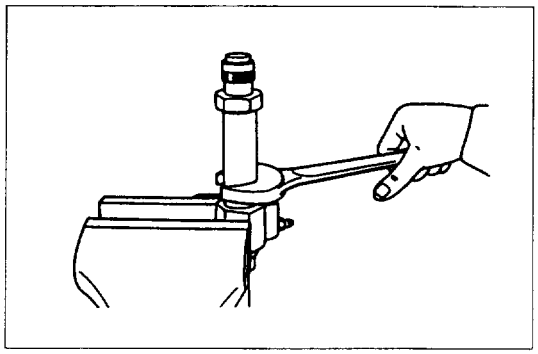
Fitting torque	N·m (kg·m/lb·ft)
	44.1 (4.5/32.6)

Hydraulic Cylinder and Piston Assembly



Reassembly Steps

1. Eye bolt
2. Eye connector
3. Cup and gasket
4. Cylinder
5. Lock nut



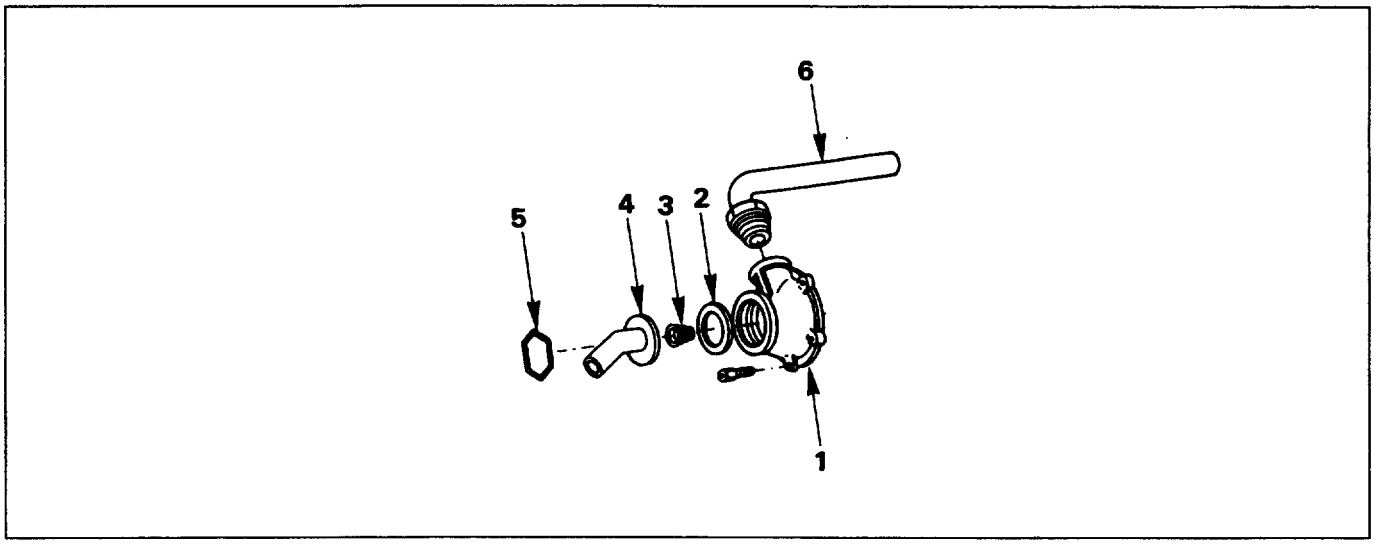
Reassembly Steps

1. **Eye Bolt**
2. **Eye Connector**
3. **Cup and Gasket**
4. **Cylinder**
   1. Clamp the cap in a vase.
   2. Install the gasket and the cylindert to the cup.
   3. Tighten the cylinder to the specified torque.

Cylinder torque	N·m (kg·m/lb·ft)
	112.7 (11.5/ 83.2)

5. **Lock Nut**

Valve Body Assembly



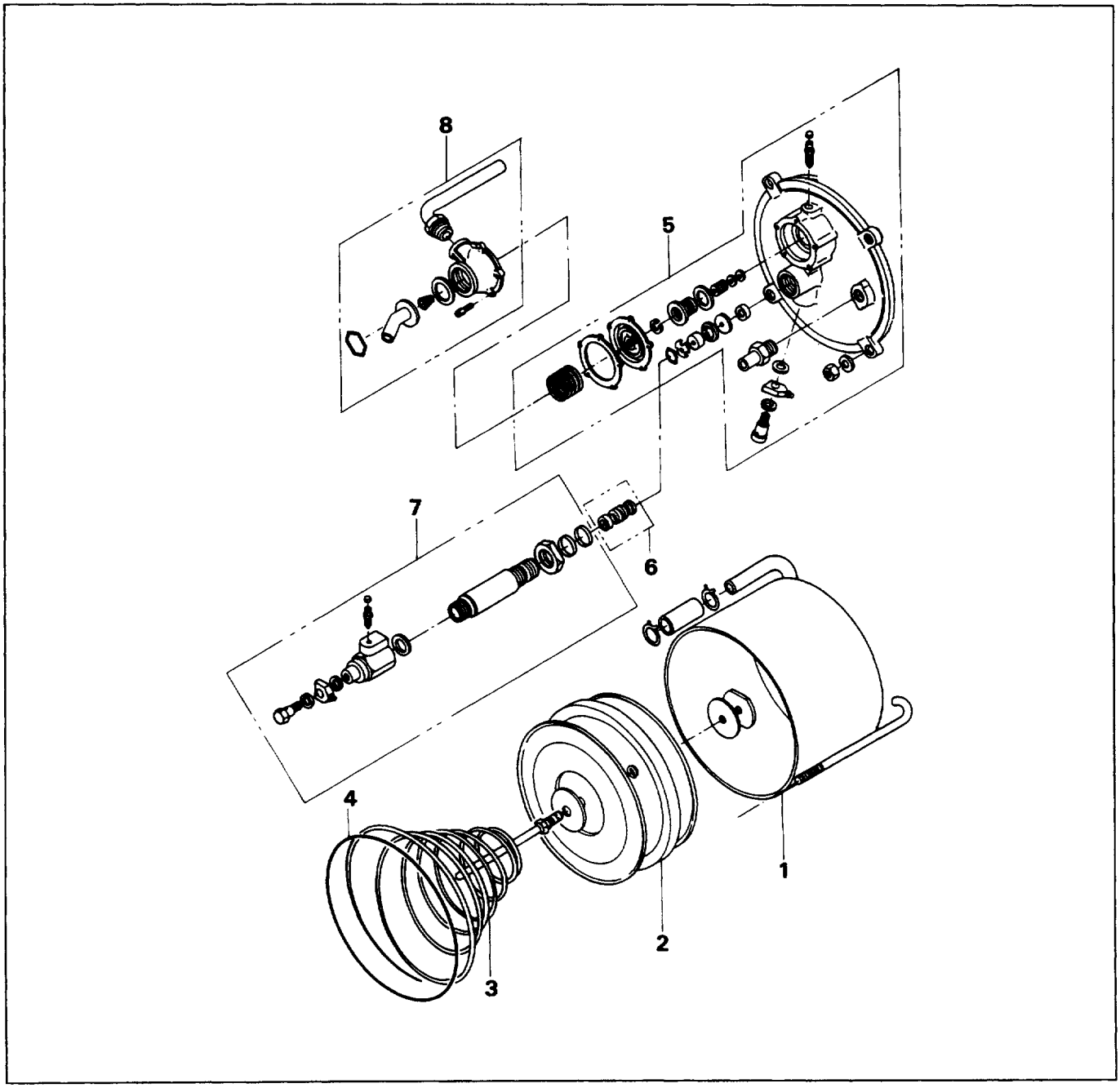
Reassembly Steps

1. Valve body
2. Washer
3. Spring
4. Pipe
5. Retaining ring
6. Elbow

Reassembly Steps

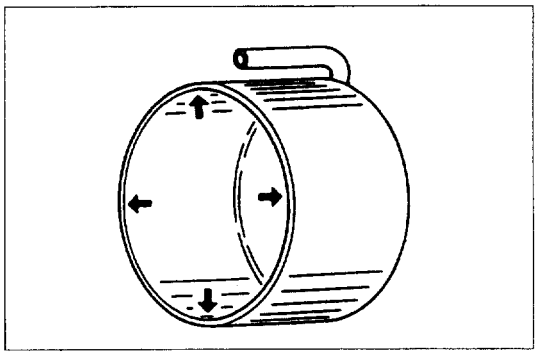
1. **Valve Body**
2. **Washer**
3. **Spring**
4. **Pipe**
5. **Retaining Ring**
6. **Elbow**

Hydromaster Assembly



Reassembly Steps

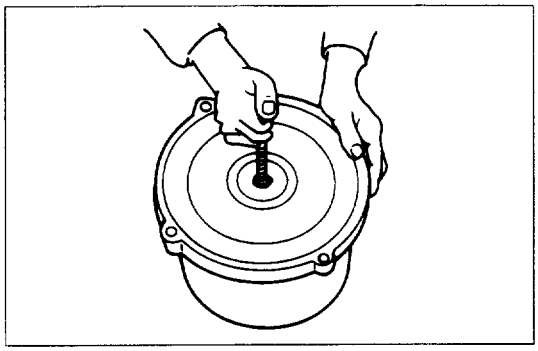
1. Cylinder shell
2. Power piston assembly
3. Return spring
4. O-ring
5. End plate assembly
6. Hydraulic piston assembly
7. Hydraulic cylinder assembly
8. Valve body assembly



Reassembly Steps

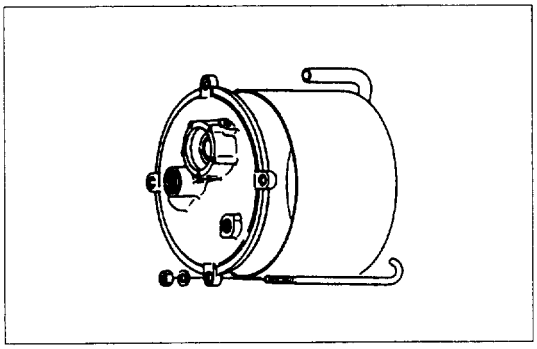
1. **Cylinder Shell**
   1. Clean the cylinder shell bore.
   2. Apply a coat of Airmaster paste to the entire cylinder shell bore.

      This will allow the piston to move smoothly and will prevent rust formation.



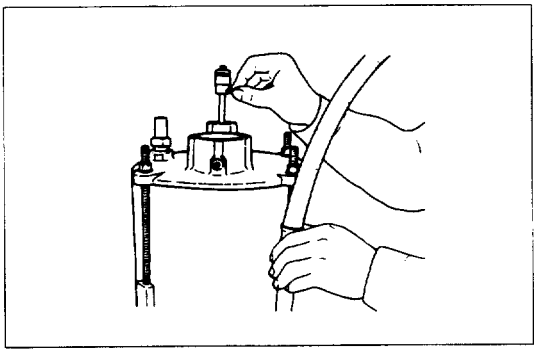
2. **Power Piston Assembly**
   1. Apply a coat of Airmaster paste to the entire outside circumference of the power piston assembly.
   2. Install the power piston assembly to the cylinder shell.

      Take care not to scratch the rubber gasket.

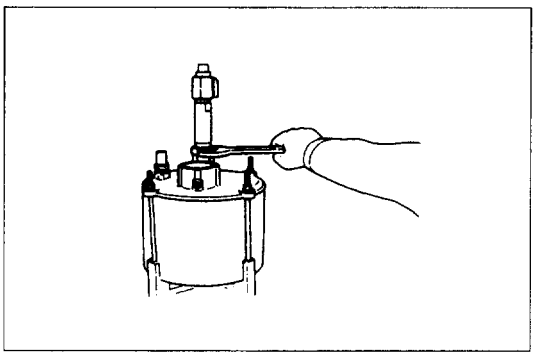


3. **Return Spring**
4. **O-ring**
5. **End Plate Assembly**
   1. Apply a coat of Airmaster paste to the O-ring.
   2. Align the setting marks applied to the cylinder shell and the end plate assembly.
   3. Tighten the end plate assembly to the specified torque.

End Plate Assembly Torque	N·m (kg·m/lb·ft)
	6.86 (0.7/ 5.1)



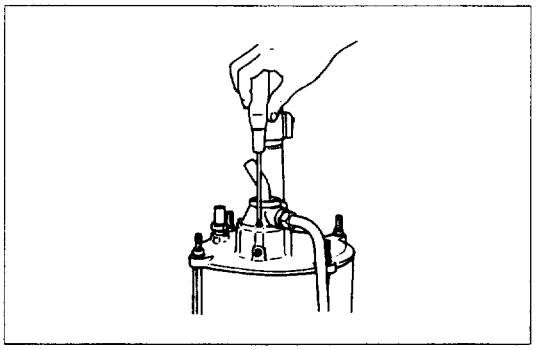
6. **Hydrolic Piston Assembly**
   1. Apply compressed air from the control pipe to the hydromaster to raise the push rod.
   2. Install the hydraulic piston assembly to the push rod.
   3. Install the pin to fix the hydraulic piston assembly and the push rod.
   4. Stop the compressed air.
   5. Check that the hydraulic piston is correctly seated at the end plate.



7. Hydraulic Cylinder Assembly

1. Install the hydraulic cylinder assembly to the end plate assembly.
2. Tighten the lock nut to the specified torque.
   The air bleeder must be facing up.

Fitting Torque	N·m (kg·m/lb·ft)
	63.7 (6.5/ 47.0)

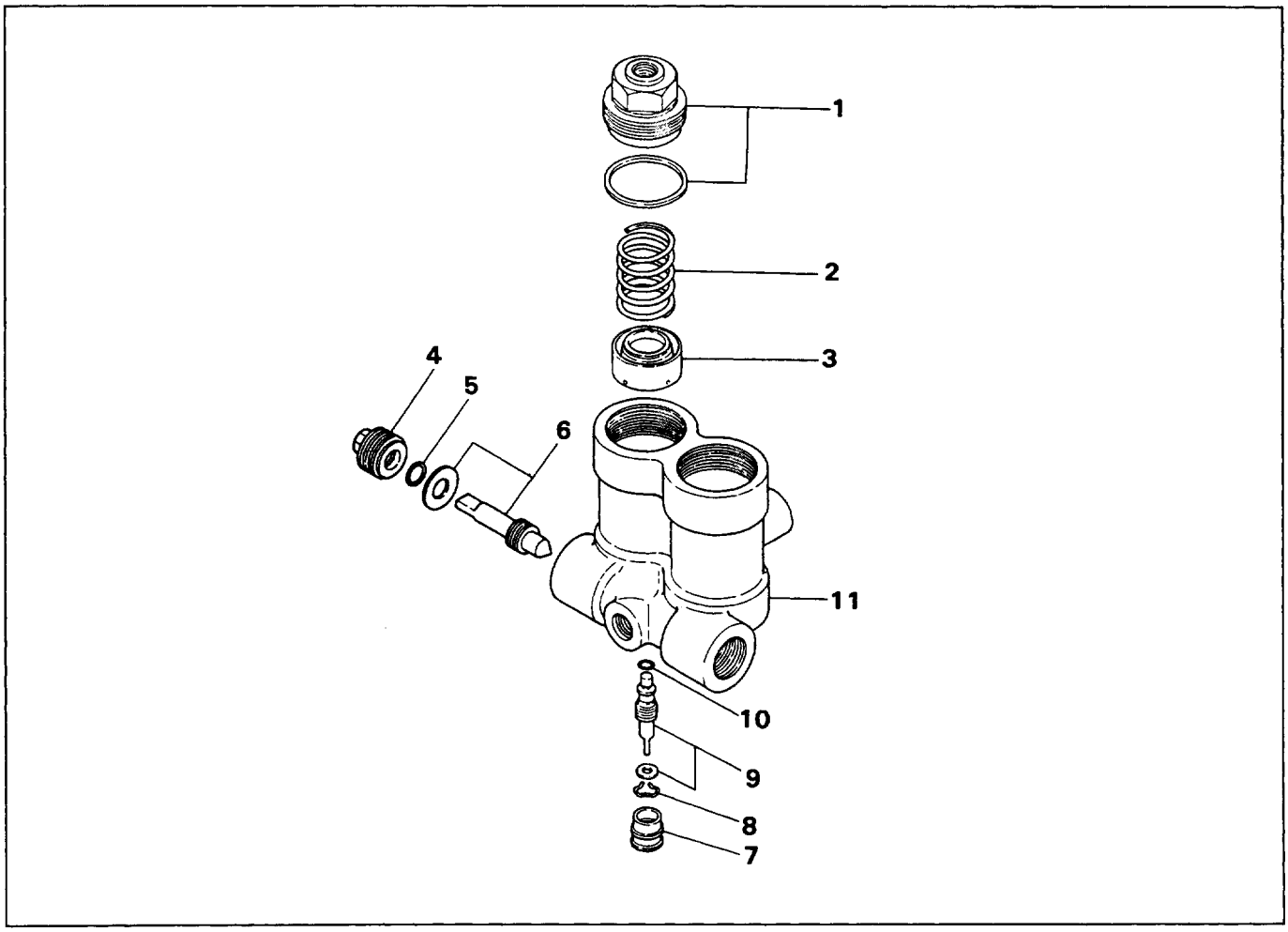


8. Valve Body Assembly

Install the valve body to the end plate.
The valve body pipe must be facing the control tube.

SAFETY VALVE

DISASSEMBLY



Disassembly Steps

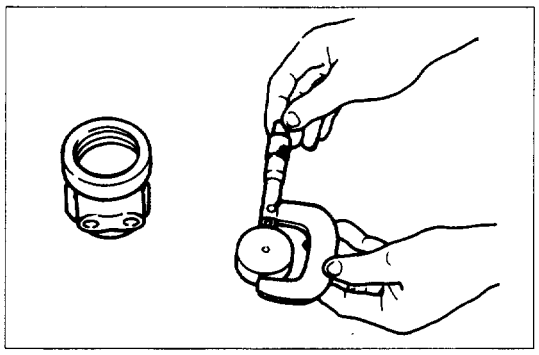
1. Cylinder cap
2. Spring
3. Piston
4. Nut; check bolt
5. O-ring
6. Check bolt
7. Boot
8. Snap ring
9. Air bleeding bolt
10. O-ring
11. Cylinder body

Disassembly Steps

1. Cylinder Cap
2. Spring
3. Piston
4. Nut; Check Bolt
5. O-ring
6. Check Bolt
7. Boot
8. Snap Ring
9. Air Bleeding Bolt
10. O-ring

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.



Piston and Cylinder Body Clearance

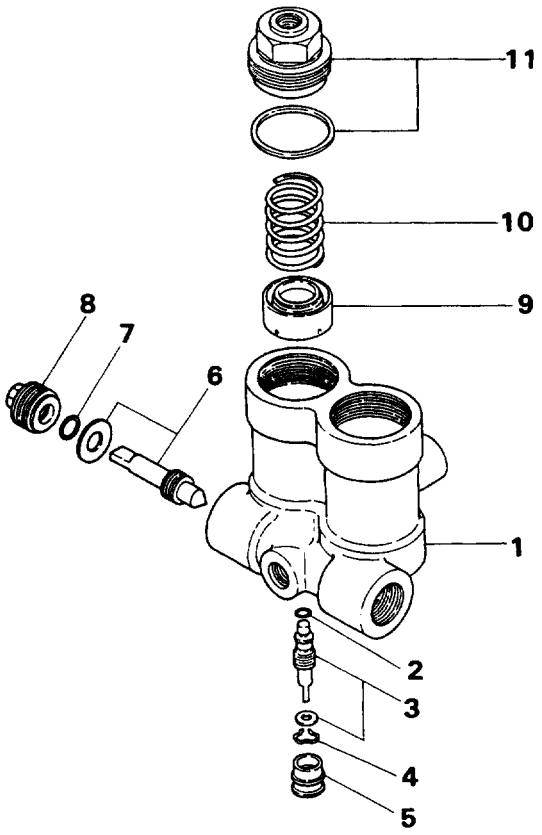
1. Use a micrometer to measure the piston diameter.
2. Use an inside dial indicator to measure the cylinder body bore.
3. Calculate the clearance between the piston and the cylinder body bore.

   If the clearance exceeds the specified limit, the safety valve must be replaced as an assembly.

Piston and Cylinder Body Clealance mm (in)

Limit	0.17 (0.0067)

REASSEMBLY



Reassembly Steps

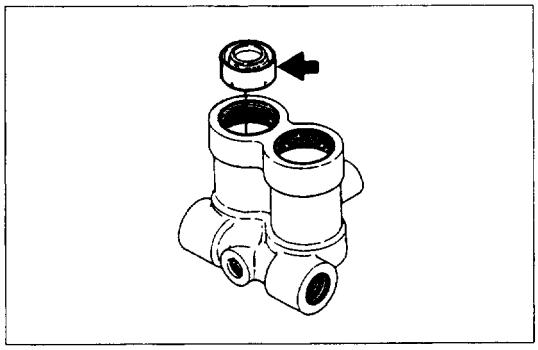
1. Cylinder Body
2. O-ring
3. Air Bleeding Bolt
4. Snap Ring
5. Boot
6. Check Bolt
7. O-ring
8. Nut; Check Bolt
9. Piston
10. Spring
11. Cylinder Cap

Reassembly Steps

1. **Cylinder Body**
2. **O-ring**
3. **Air Bleeding Bolt**
4. **Snap Ring**
5. **Boot**
6. **Check Bolt**
7. **O-ring**
8. **Nut; Check Bolt**

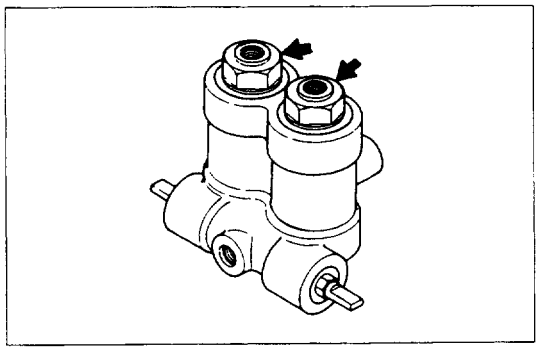
Tighten the nuts to specified torque.

Nut Torque	N·m (kg·m/lb·ft)
	88 (9.0/65)



9. **Piston**

Apply brake fluid to the piston and cylinder body bore before installing the piston.



10. **Cylinder Cap**

Tighten the cylinder caps to specified torque.

Cylinder Cap Torque	N·m (kg·m/lb·ft)
	255 (26.0/188)

SECTION 5C
PARKING BRAKES

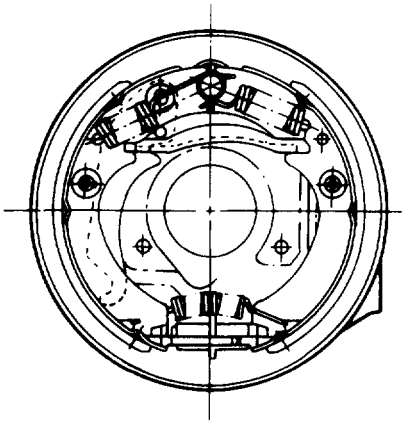
CONTENTS

	PAGE
General Description	5C- 2
On-Vehicle Service	5C- 3
Removal	5C- 3
Installation	5C- 5
Unit Repair [178 mm, 190 mm Type]	5C- 9
Disassembly	5C- 9
Inspection and Repair	5C-11
Reassembly	5C-13
Unit Repair [203 mm, 254 mm Type]	5C-15
Disassembly	5C-15
Inspection and Repair	5C-17
Reassembly	5C-18

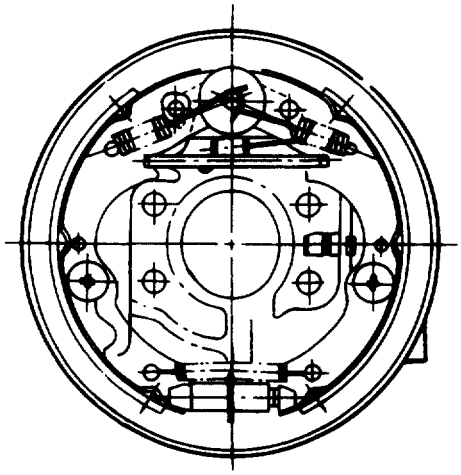
GENERAL DESCRIPTION

Parking Brake Assembly

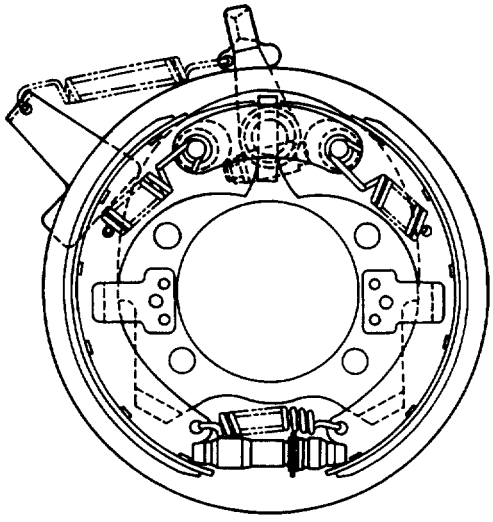
178 mm Type



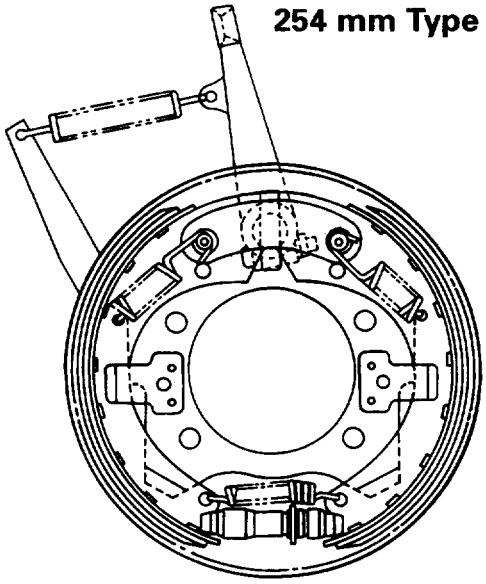
190 mm Type



203 mm Type



254 mm Type



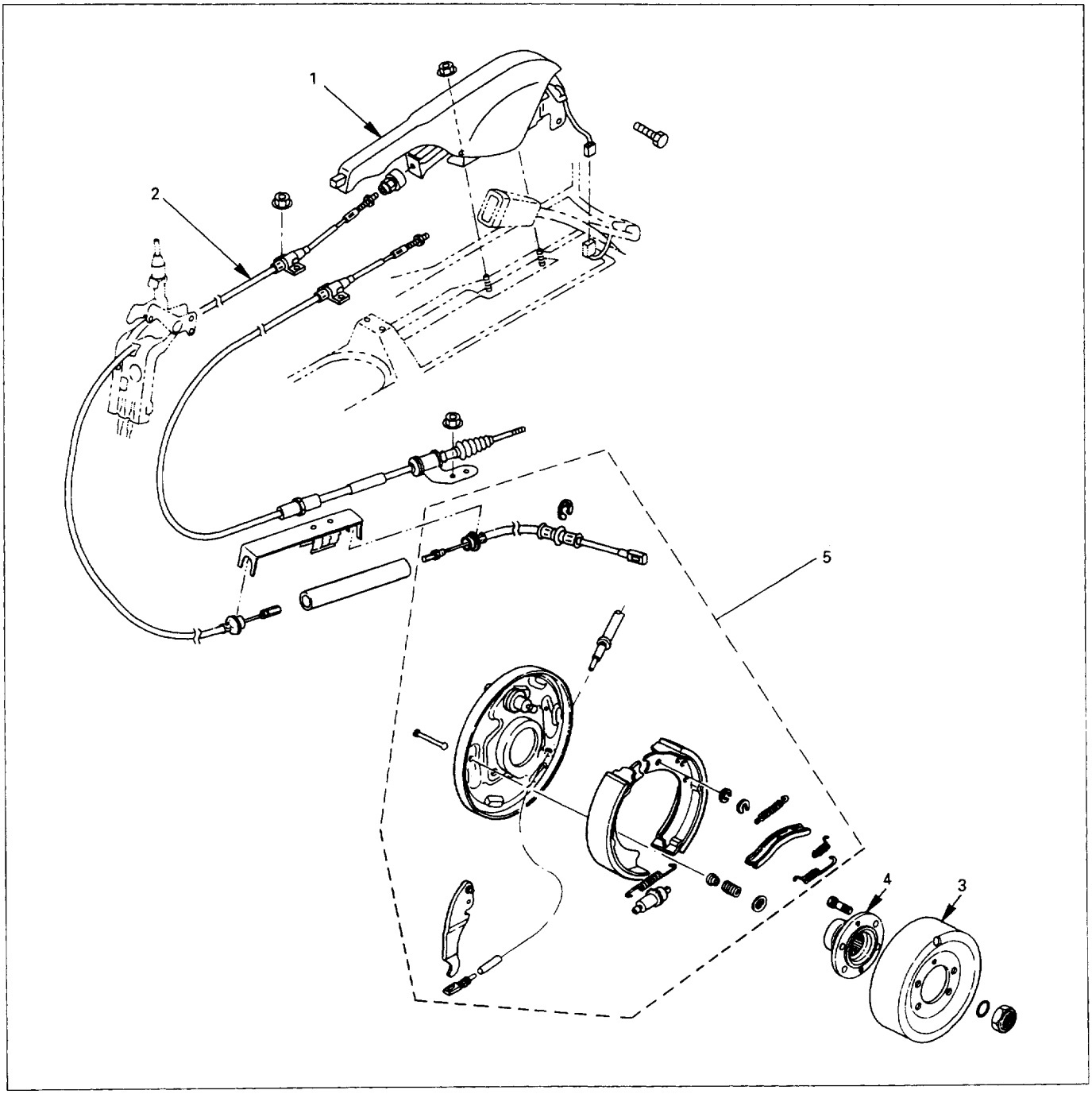
The parking brake is a mechanically operated internal- expanding type drum brake. It is mounted on the rear of the transmission case.

The control cable is routed into the vehicle cab where it is connected to the parking brake lever.

ON-VEHICLE SERVICE

REMOVAL

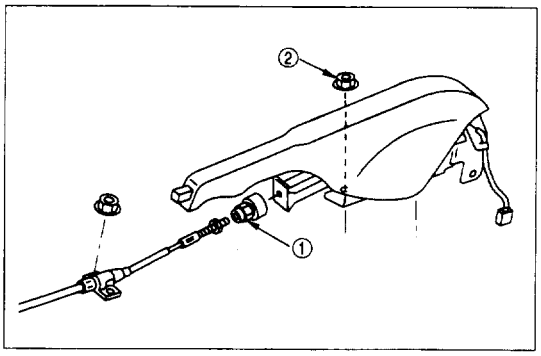
Parking Brake System Replacement



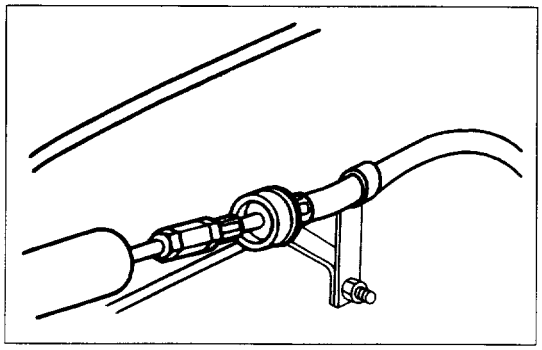
Removal Steps

1. Parking brake lever assembly
2. Parking brake cable front
3. Brake drum
4. Drive coupling
5. Parking brake assembly

Removal Steps



1. **Parking Brake Lever Assembly**
   1. Loosen the adjusting nut ① to disconnect the parking brake cable from the lever.
   2. Loosen the retaining nut ② to remove the parking brake assembly.



2. **Parking Brake Cable Front**
   1. Remove the clip ① and move the cover ② towards the front end of the vehicle.
   2. Remove the connecting bracket and move the cover towards the vehicle front.

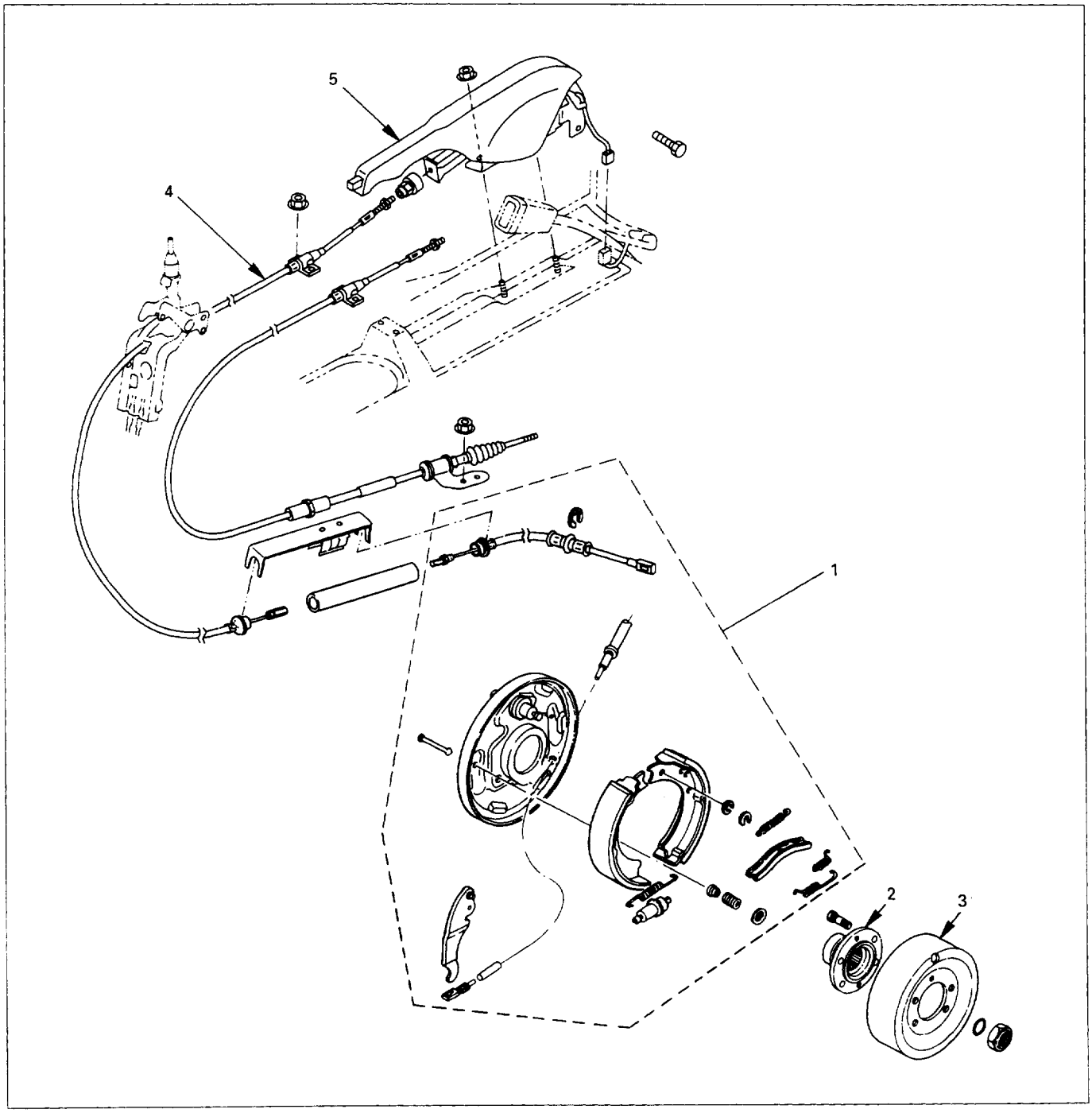
      Loosen and remove the nut connecting the front cable to the rear cable.

3. **Brake Drum**
4. **Drive Coupling**

   Refer to "Transmission Removal and Installation" in Section 7.
5. **Parking Brake Assembly**

INSTALLATION

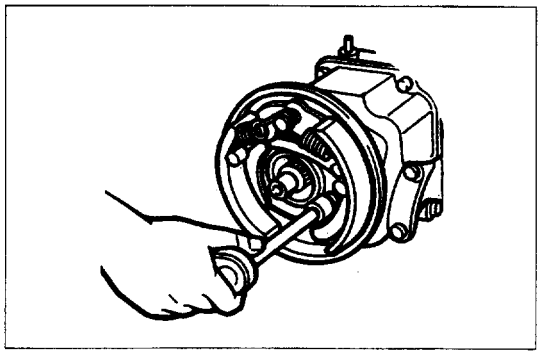
Parking Brake System Replacement



Installation Steps

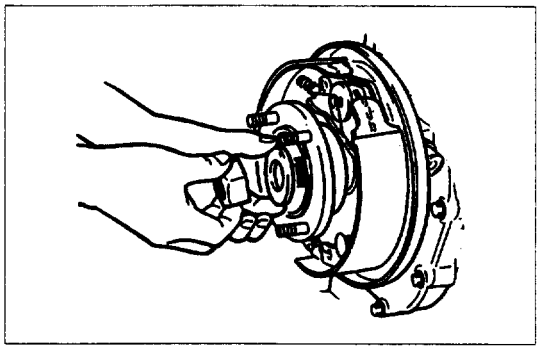
1. Parking brake assembly
2. Drive coupling
3. Brake drum
4. Parking brake cable front
5. Parking brake lever assembly

Installation Steps



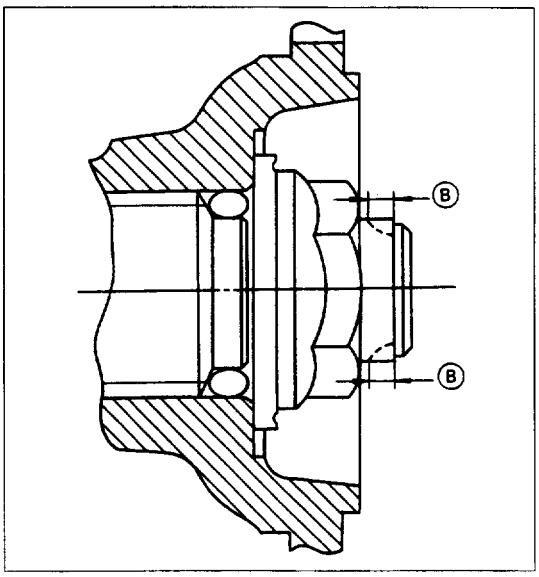
1. **Parking Brake Assembly**

Parking Brake Fixing Bolt Torque		N·m (kg·m/lb·ft)
JR403E (A/T) MSA, MXA,	—	83 (8.5 / 61)
MSB	M12 Nut	113 (11.5 / 83)
	M8 Bolt	25 (2.6 / 19)
MBP	—	123 (12.5 / 90)



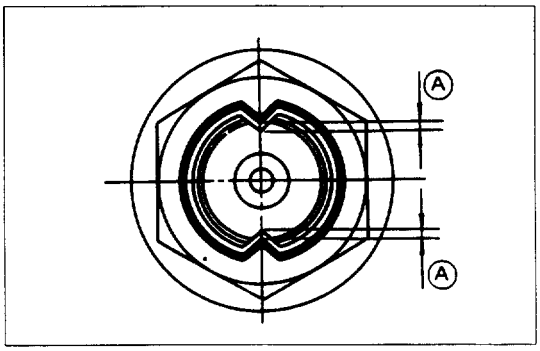
2. **Drive Coupling**
   1. After tightening the parking brake fixing bolts to the transmission, install the coupling driver, new O-ring, conical spring (Except A/T) and new lock nut.
   2. The grooved side of conical spring should be faced to the lock nut.

Drive Coupling Lock Nut Torque	N·m (kg·m/lb·ft)
MSA, MSB, MXA	226 (23.0 / 166)
JR403E (A/T)	284 (29.0 / 210)
MBP	588 (60 / 434)



   3. Align the lock nut with the V-shaped groove at the tip of the main shaft, and caulk the nut lip portion at two spots with a chisel. (Round edge 1 mm x 60g)

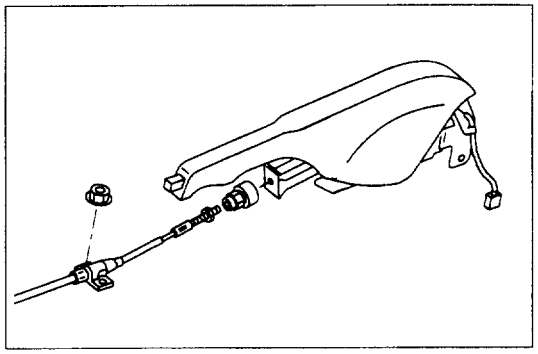
As shown in the illustration, be sure to caulk the nut lip so that the clearance between the V-shaped groove portion at the tip of the main shaft and the caulked nut lip Ⓐ is less than 1.5 mm (0.06 in.), and the caulking length Ⓑ is 5 mm (0.2 in.) or more.



NOTE:

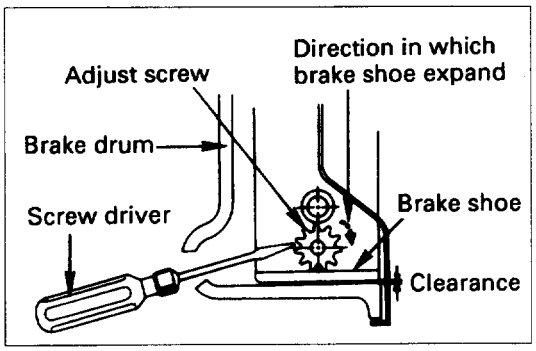
Be sure to confirm that there is no crack at the caulked portion of the nut after caulking.

3. **Brake Drum**
4. **Parking Brake cable Front**



5. **Parking Brake Lever Assembly**
   Install the parking brake cable to the brake lever.

Parking Brake Adjustment

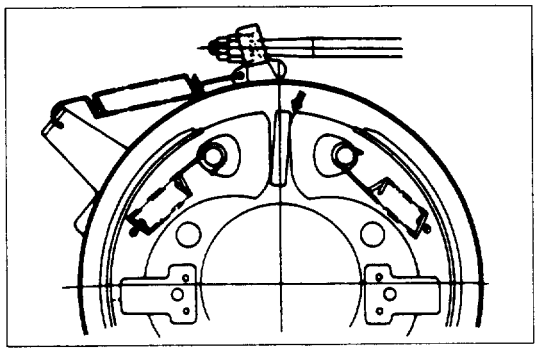


Brake Shoe Clearance Adjustment

1. Move the lever from side to side 3 or 4 times to properly center the brake shoes.
2. With a screw driver turn adjuster upward until the brake drum drags.
3. Back off the adjusting screw the specified number of notches.

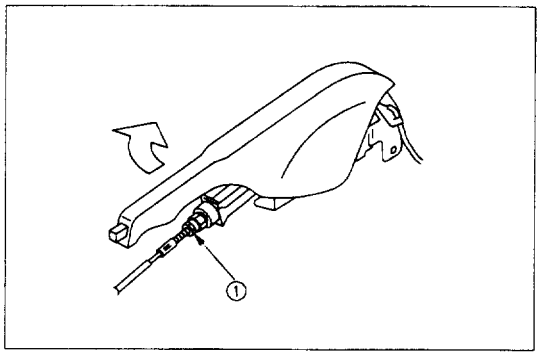
Adjusting Screw Notches and Clearance

Brake Type	Notches	Clearance mm(in)
178 mm, 190 mm	30	0.75 (0.029)
203 mm, 254 mm	8	0.23 (0.009)



Cam Clearance [203 mm, 254 mm Type]

When connecting cable with cam shaft lever, use adjust nut in order to make the clearance 0 mm (0 in) between cam and shoe, then lock adjust nut with lock nut.



Parking Brake Lever Travel Adjustment

1. Fully set the parking brake lever and release it several times.

   Leave the parking brake lever in the released position.
2. Loosen the parking brake cable lock nut ①.
3. Turn the adjuster ② to adjust the lever travel to the specified notches.

Parking brake lever travel at 147N (15kg/33lbs) notches.

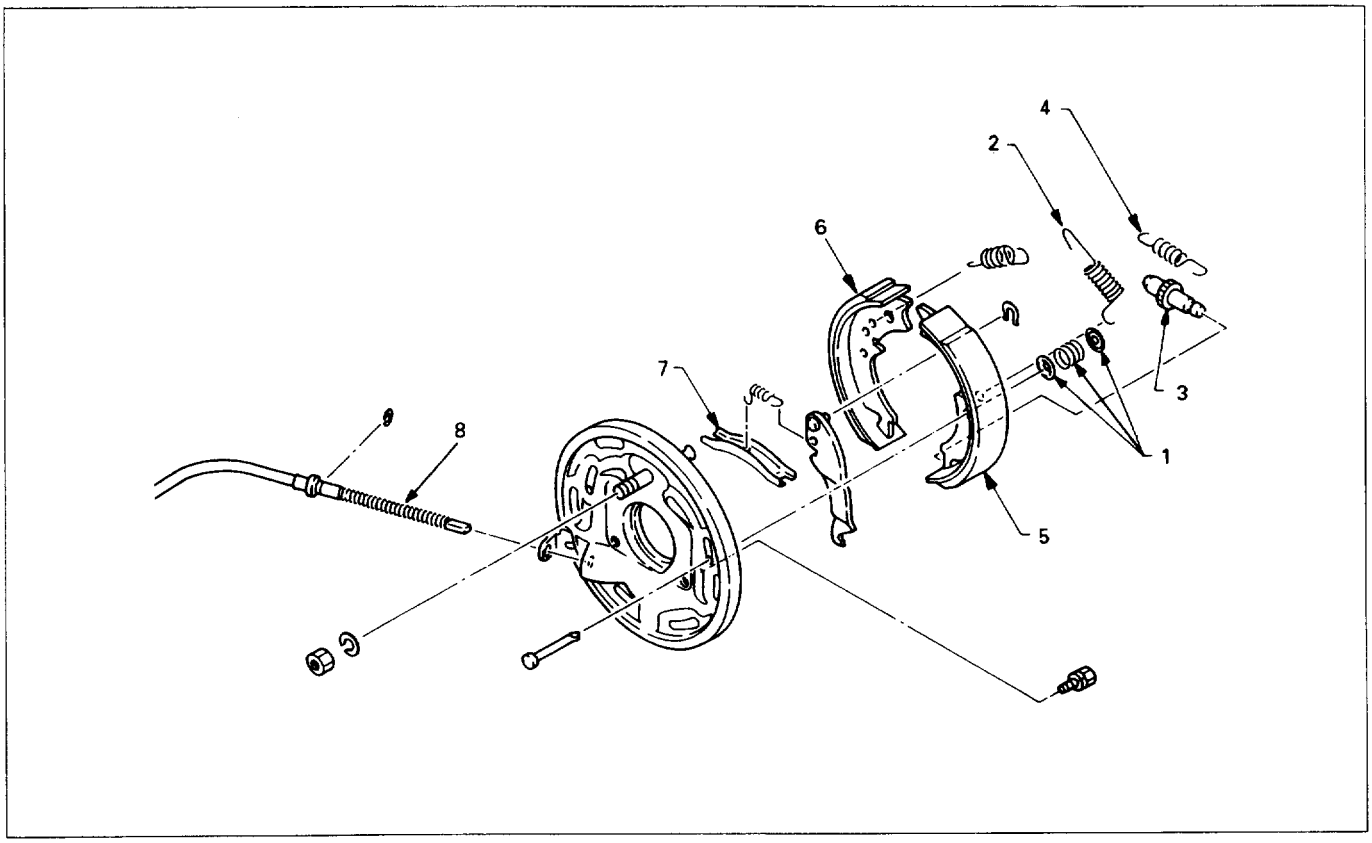
5 - 8

4. Retighten the cable lock nut ①.
5. Check the parking brake lever travel (measured in notches).

UNIT REPAIR [178 MM, 190MM TYPE]

DISASSEMBLY

Parking Brake Assembly



Disassembly Steps

1. Holding spring
2. Return spring
3. Adjuster assembly
4. Spring; adjuster
5. Secondary brake shoe assembly with lever
6. Primary brake shoe assembly
7. Strut
8. Parking cable rear

Disassembly Steps

1. Holding Spring
2. Return Spring
3. Adjuster Assembly
4. Spring; Adjuster
5. Secondary Brake Shoe Assembly
6. Primary Brake Shoe Assembly
7. Strut
8. Parking Cable Rear

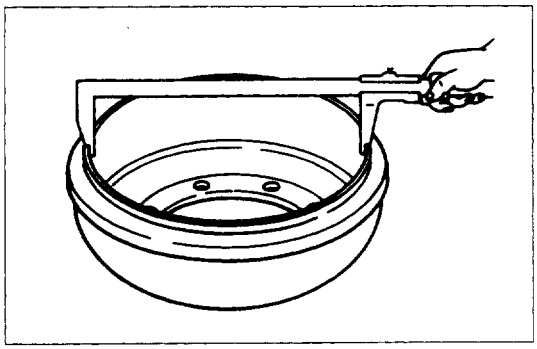
INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.

Brake drum
Brake linings
Return spring
Parking brake lever assembly
Parking brake inner cable

Visual check

Inspect the following parts for wear, corrosion, scuffs, scratches, deterioration or other abnormal conditions.



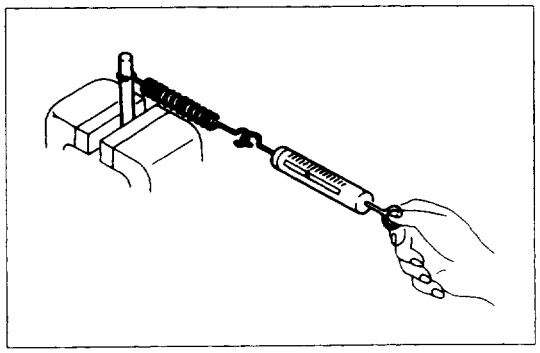
Brake Drum

Use a vernier caliper to measure the brake drum inside diameter.

If the measured value exceeds the specified limit, the brake drum must be replaced.

Brake Drum Inside Diameter mm(in)

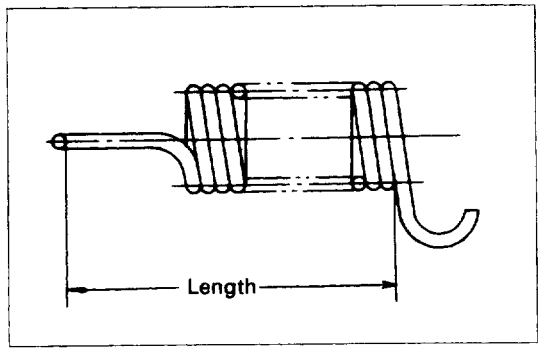
	Standard	Limit
Inside diameter	178 (7.01) 190 (7.48)	179 (7.05) 191 (7.52)
Out of round	0.05 (0.0020) or less	–



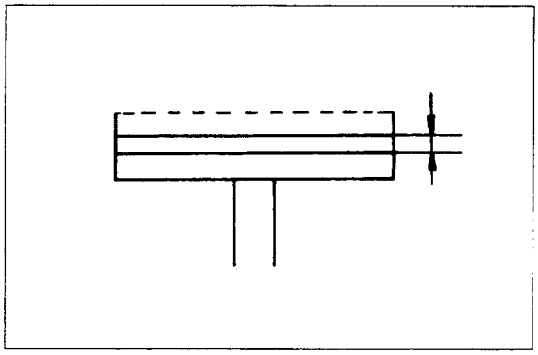
Return Spring

Use a spring balancer to measure the return spring set load.

If the variation exceeds 10% of the specified value, the return spring must be replaced.



		Drum inside dia, mm(in)	
		178 (7.01)	190 (7.48)
Free length: mm(in)	Primary Secondary	62 (2.44) 49 (1.93)	62.1 (2.44)
Set length: mm(in)	Primary Secondary	70 (2.76) 57 (2.24)	67.1 (2.64)
Set load; kg(lb./N)	Primary	10.8 - 13.2 (23.8 - 29.1/ 105.9 - 129.5)	5.4 - 6.6 (1.9 - 14.6/ 53 - 65.7)
	Secondary	9.0 - 11.0 (19.8 - 24.3/ 88.3 - 107.8)	



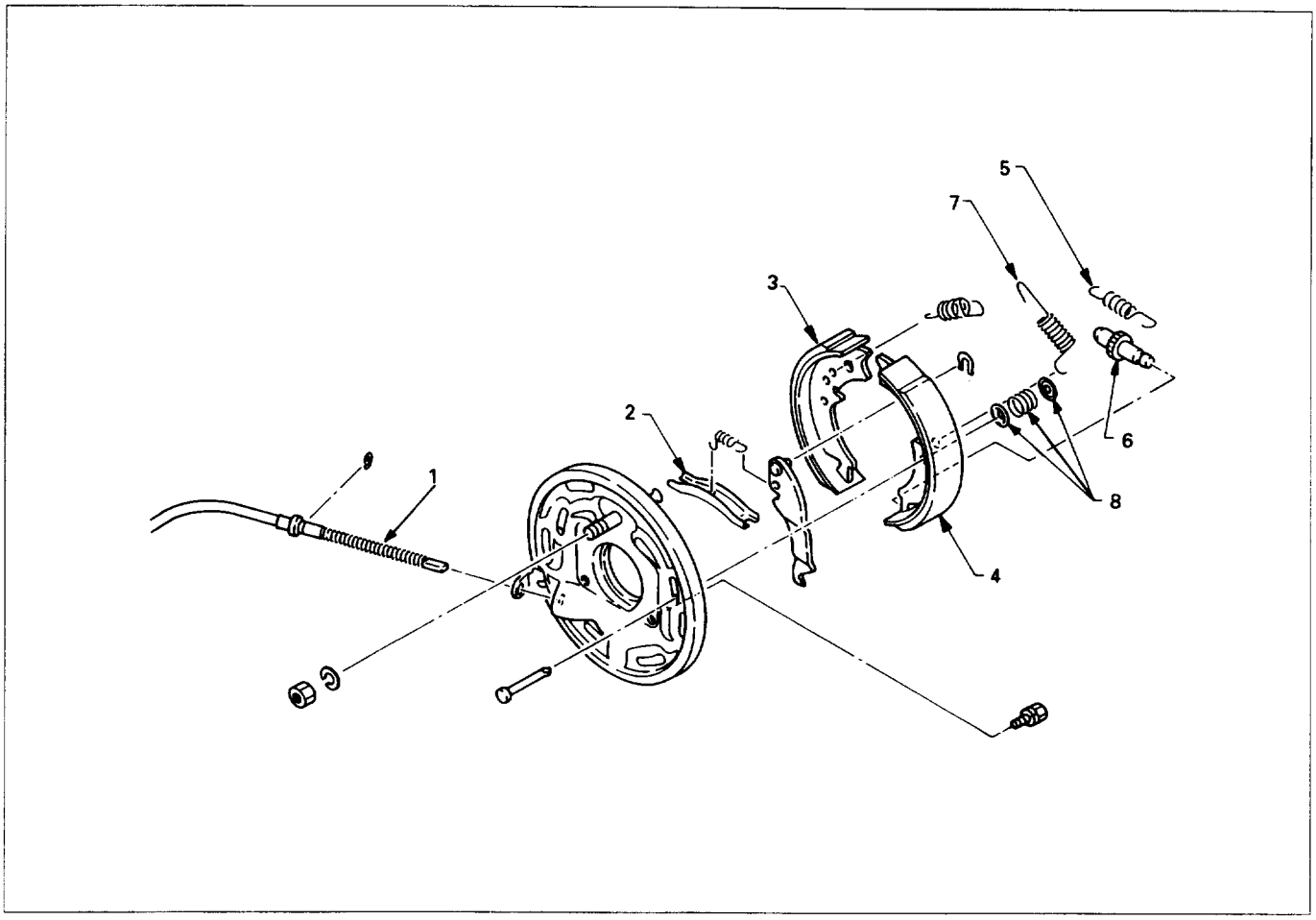
Brake Lining Thickness

Use a vernier caliper to measure the brake lining thickness.

If the measured value is less than the specified limit, the brake shoe assembly must be replaced.

Brake Lining Thickness	mm(in)
Limit	1.0 (0.039)

REASSEMBLY



Reassembly Steps

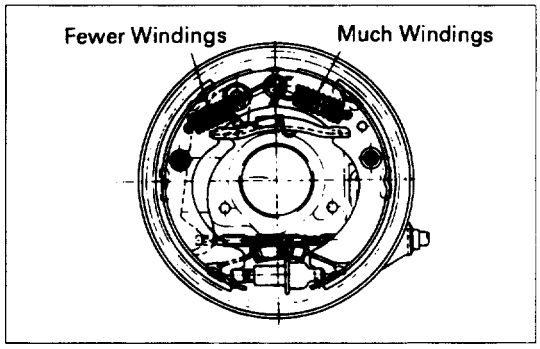
1. Parking cable rear
2. Strut
3. Primary brake shoe assembly
4. Secondary brake shoe assembly
5. Spring; adjuster
6. Adjuster assembly
7. Return spring
8. Holding spring

Reassembly Steps

1. **Parking Cable Rear**
2. **Strut**
3. **Primary Brake Shoe Assembly**
4. **Secondary Brake Shoe Assembly**

Install the brake shoes by fitting them properly into slot in the adjuster and strut.

5. **Spring; Adjuster**
6. **Adjuster Assembly**
7. **Return Spring**



Drum inside diameter 178ø only

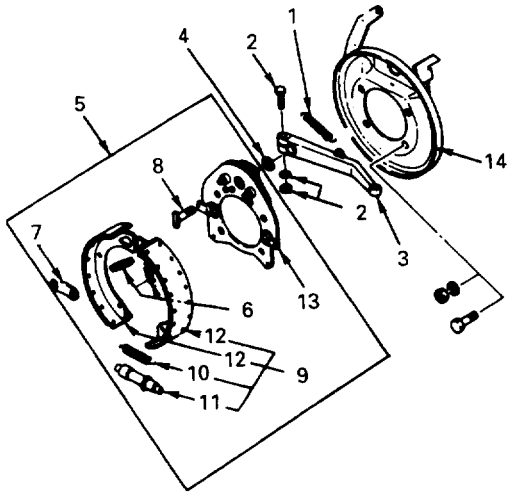
Attach the return spring bauing fewer windings at the primary side as illustrated.

8. **Holding Spring**

UNIT REPAIR [203 MM, 254MM TYPE]

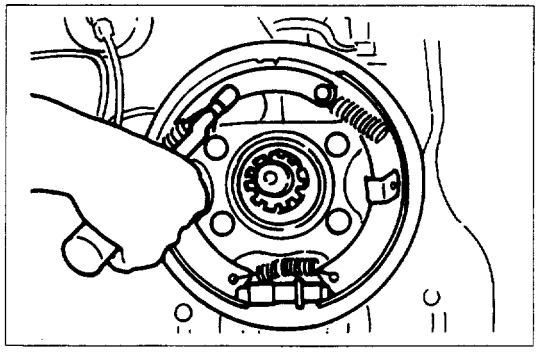
DISASSEMBLY

Parking Brake Assembly



Disassembly Steps

1. Spring
2. Nut, spring washer and bolt
3. Lever
4. Washer
5. Brake shoe and support plate
6. Return spring
7. Anchor pin brace
8. Camshaft
9. Brake shoe assembly
10. Spring: adjuster
11. Adjusting screw
12. Brake shoe
13. Support plate
14. Dust cover



Disassembly Steps

1. Spring
2. Nut, Spring Washer and Bolt
3. Lever
4. Washer
5. Brake Shoe and Support Plate
6. Return Spring
   Remover: 9-8523-1554-0
7. Anchor Pin Brace
8. Camshaft
9. Brake Shoe Assembly
10. Spring: adjuster
11. Adjusting Screw
12. Brake Shoe
13. Support Plate
14. Dust Cover

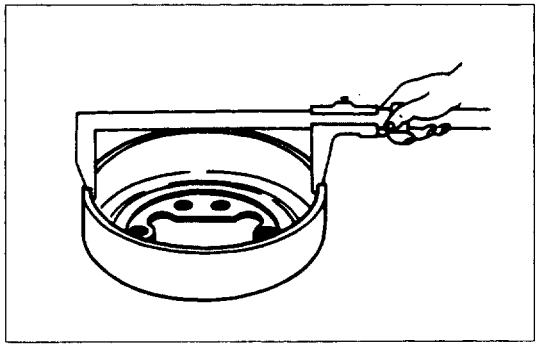
INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.

Brake drum
Brake linings
Return spring
Parking brake lever assembly
Parking brake inner cable

Visual check

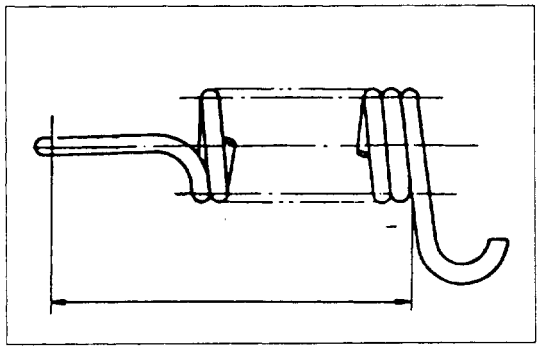
Inspect the following parts for wear, corrosion, scuffs, scratches, deterioration or other abnormal conditions.



Brake Drum

mm(in)

	Standard	Limit
Brake drum size inside diameter	203 (8.00)	205 (8.07)
	254 (10.0)	256 (10.08)
Uneven wear and or score	Run out 0.05 (0.002) or less	

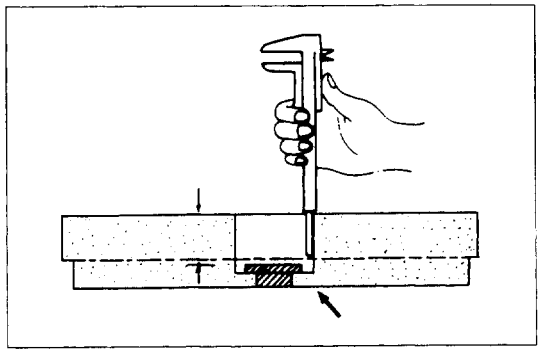


Return Spring

mm(in)

Brake drum size		203 (8.00)	254 (10.0)
Free length		49.9 (1.965)	68 (2.677)
Set load	N	147	181
	(kg / lb)	(15 / 33.07)	(18.5 / 40.79)
Set length		57.5 (2.264)	75 (2.953)

Note: A/T . . . Automatic Transmission



Brake Lining

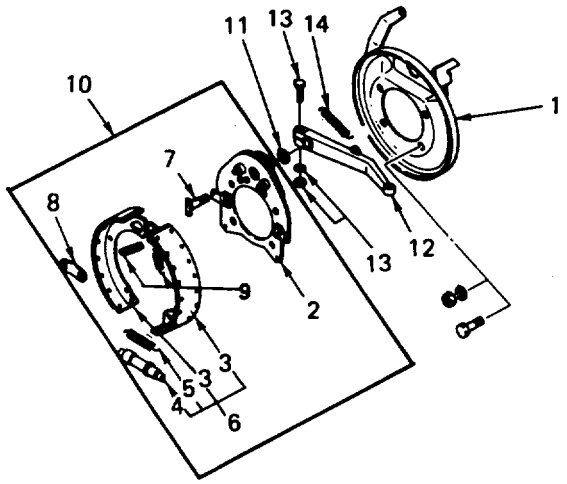
Clearance to Rivet Head [254 mm Type] mm(in)

Limit	0.5 (0.0197)

Brake Lining Thickness [203 mm Type] mm(in)

Limit	1.0 (0.039)

REASSEMBLY



Reassembly Steps

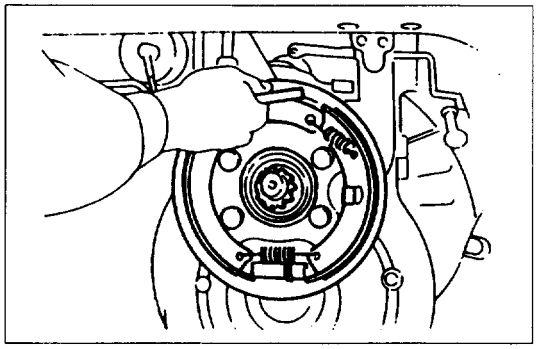
1. Dust cover
2. Support plate
3. Brake shoe
4. Adjusting screw
5. Spring: adjuster
6. Brake shoe assembly
7. Camshaft
8. Anchor pin brace
9. Return spring
10. Brake shoe and support plate
11. Washer
12. Lever
13. Bolt, spring washer and nut
14. Spring

Reassembly Steps

1. **Duct Cover**
2. **Support Plate**

Bolt Torque	N·m (kg·m / lb·ft)
	123 (12.5 / 90)

3. **Brake Shoe**
4. **Adjusting Screw**
5. **Spring: adjuster**
6. **Brake Shoe Assembly**
7. **Camshaft**
8. **Anchor Pin Brace**
9. **Spring**



Spring installer: 9-8523-1554-0

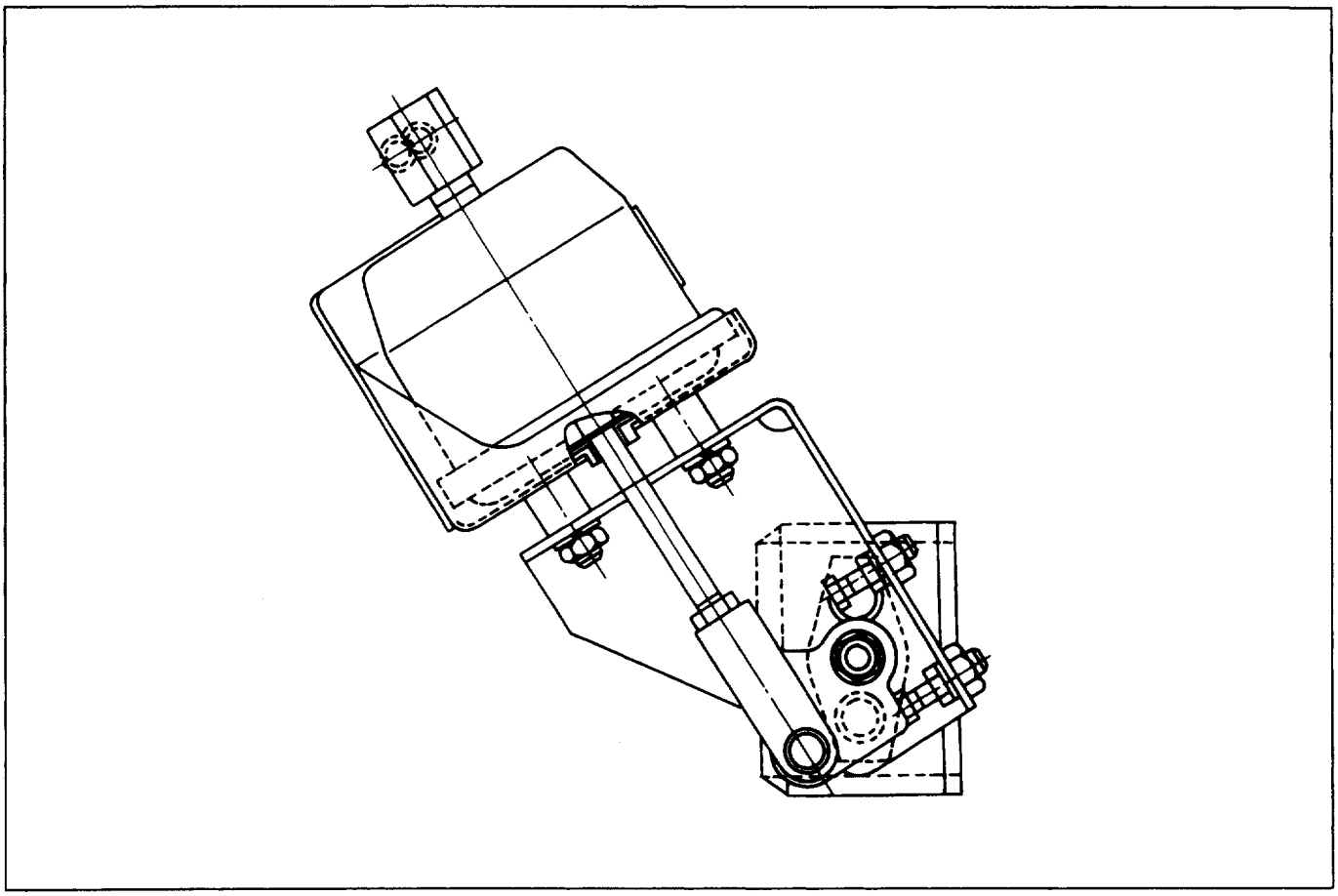
10. **Brake Shoe and Support Plate**
11. **Washer**
12. **Lever**
13. **Bolt, Spring Washer and Nut**
14. **Spring**

SECTION 5E
EXHAUST BRAKE

CONTENTS

	PAGE
General Description	5E-2
On-Vehicle Service	5E-3
Removal	5E-3
Installation	5E-4
Unit Repair	5E-6
Disassembly	5E-6
Inspection and Repair	5E-7
Reassembly	5E-8

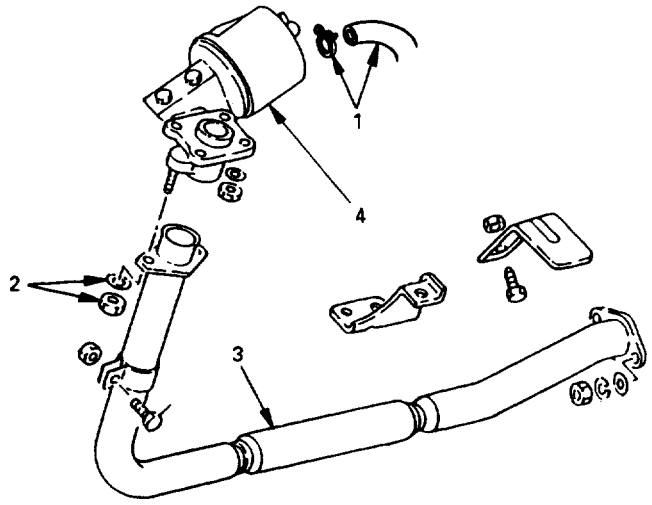
GENERAL DESCRIPTION



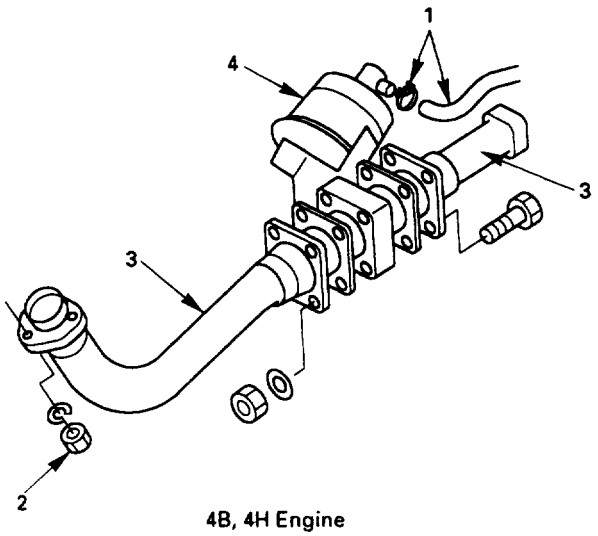
ON-VEHICLE SERVICE

REMOVAL

Exhaust Brake Assembly



4J Engine



4B, 4H Engine

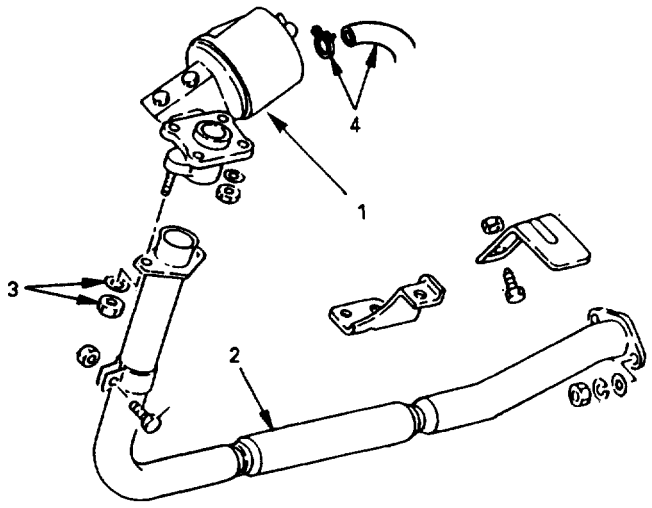
Removal Steps

1. Vacuum hose and clip
2. Flange nut
3. Exhaust pipe
4. Exhaust brake unit

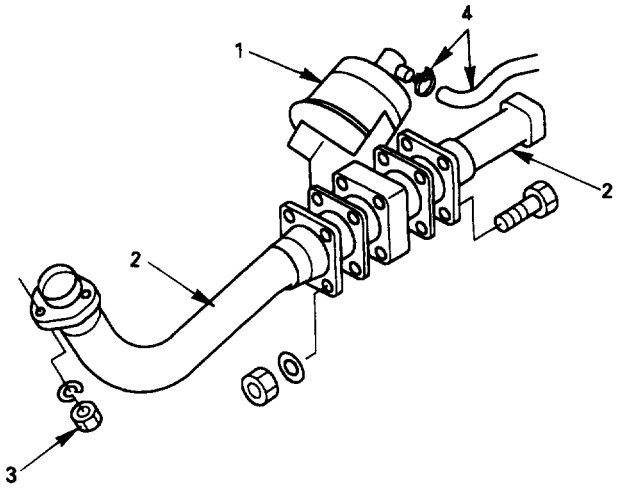
Removal Steps

1. **Vacuum Hose and Clip**
2. **Nut**
3. **Exhaust Pipe**
4. **Exhaust Brake Unit**

INSTALLATION



4J Engine

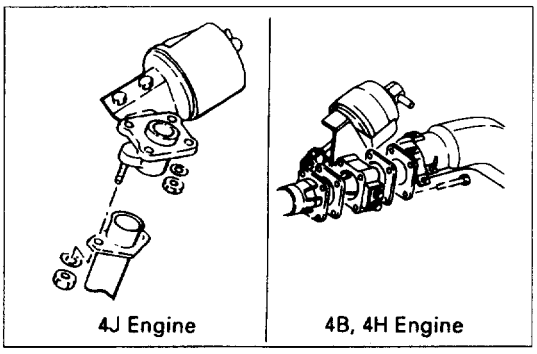


4B, 4H Engine

Installation Steps

1. Exhaust brake unit
2. Exhaust pipe
3. Flange nut
4. Vacuum hose and clip

Installation Steps

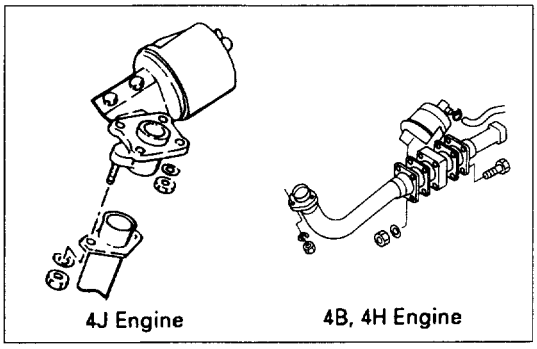


1. **Exhaust Brake Unit**

   Tighten the brake unit fixing nuts and/or bolts to the specified torque.

   Exhaust Brake Unit Fixing Nut and Bolt — N·m (kg·m/lb·ft)

4J Engine	4B, 4H Engine
37 (3.8/27)	17 (1.7 / 12)



2. **Exhaust Pipe**
3. **Flange Nut**

   Tighten the exhaust pipe flange nuts for the exhaust manifold to the specified torque.

   Flange Nut Torque — N·m (kg·m/lb·ft)

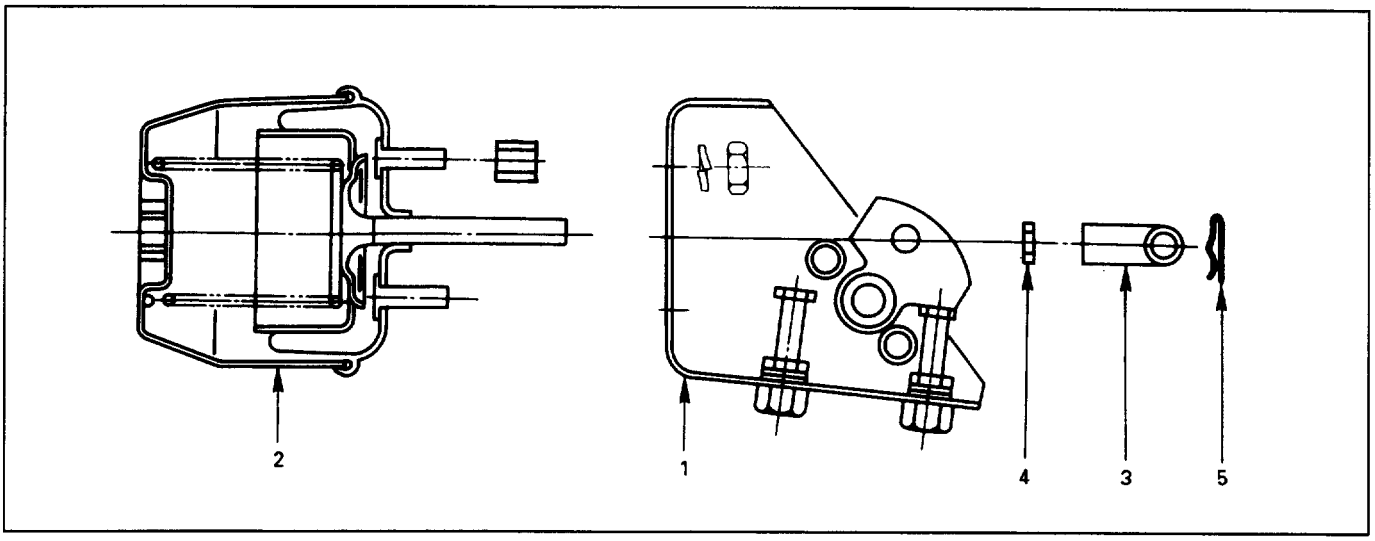
4J, 4B Engine	4H Engine
37 (3.8 / 27)	67 (6.8 / 49)

4. **Vacuum Hose and Clip**

UNIT REPAIR

DISASSEMBLY

Exhaust Brake Unit



Disassembly Steps

1. Cotter pin
2. Lock nut
3. Clevis joint
4. Power chamber
5. Exhaust valve assembly

Disassembly Steps

1. **Cotter Pin**
2. **Lock Nut**
3. **Clevis Joint**
4. **Power Chamber**
5. **Exhaust Valve Assembly**

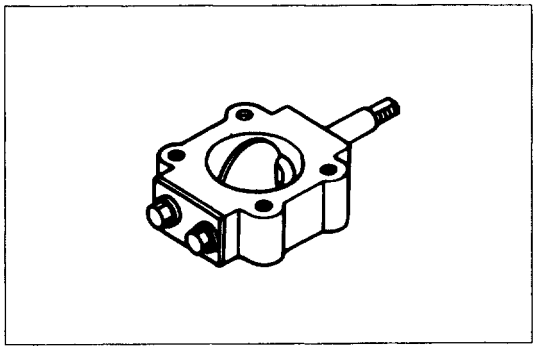
INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.

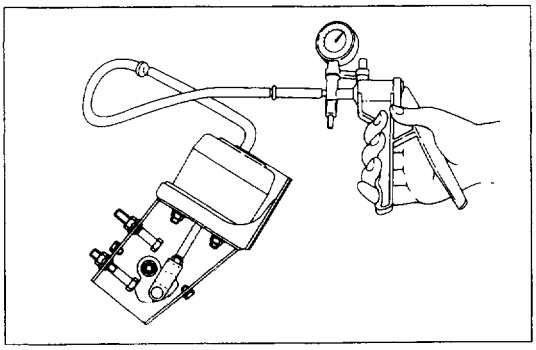
Visual Inspection

Visually inspect the following parts for excessive wear and damage.

If excessive wear or damage is discovered during inspection, the part(s) must be replaced.



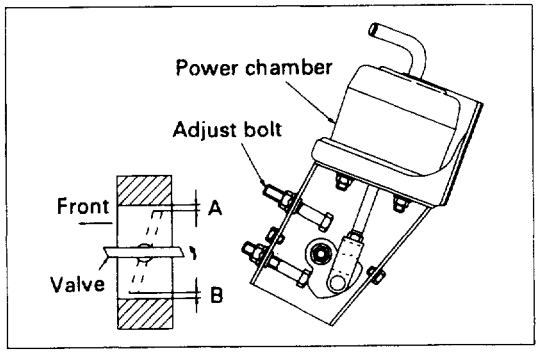
Exhaust brake valve
Exhaust brake shaft
Butterfly valve
Bushings
Power chamber



Power Chamber

(3) Power Chamber

The exhaust brake valve should operate smoothly when the negative pressure (400 mmHg to 700 mmHg) is applied to the power chamber via the vacuum pump.

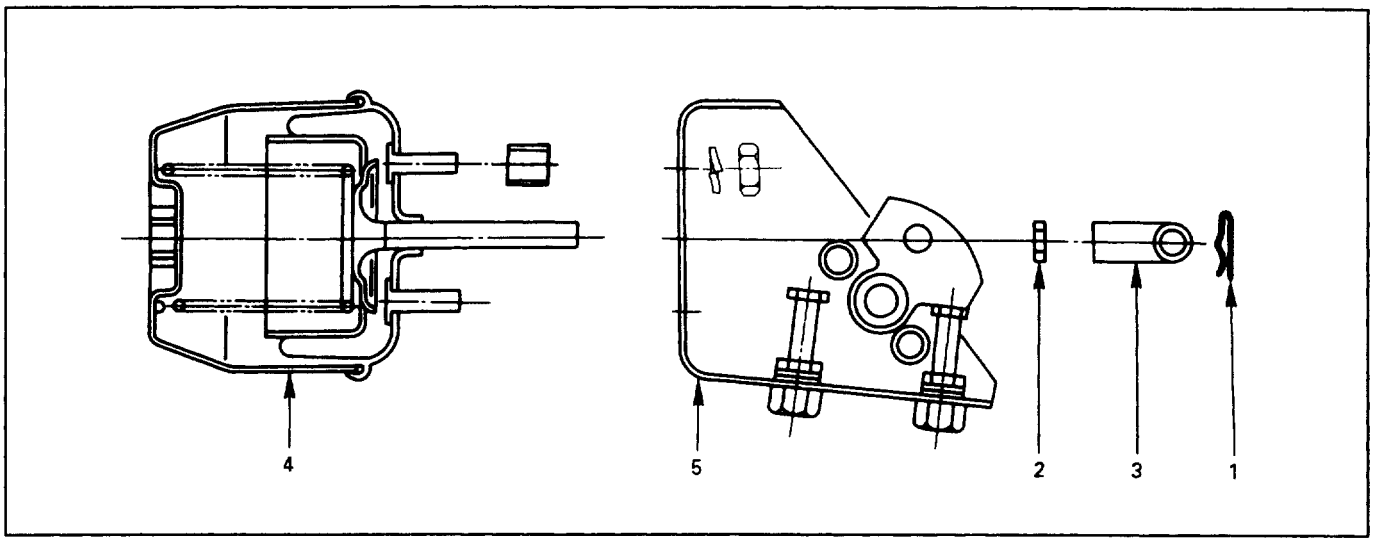


(4) At the points "A" and "B", the average clearance between the valve and the vehicle body should be as mentioned in the following table when the negative pressure (650 mmHg to 700 mmHg) is applied to the power chamber via the vacuum pump.

Clearance Between Valve and Body mm (in)

	Standard
4HF1 Engine	0.4 – 0.6 (0.016 – 0.024)
Others	0.1 – 0.2 (0.004 – 0.008)

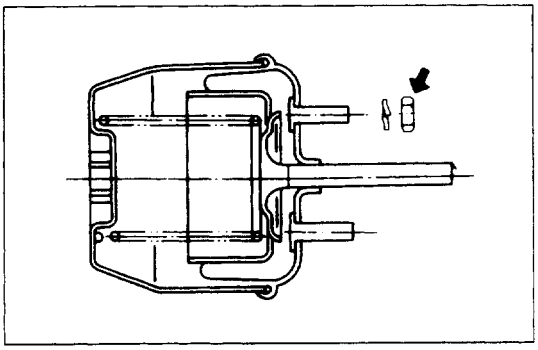
REASSEMBLY



Reassembly Steps

1. Exhaust valve assembly
2. Power chamber
3. Lock nut
4. Clevis joint
5. Cotter pin

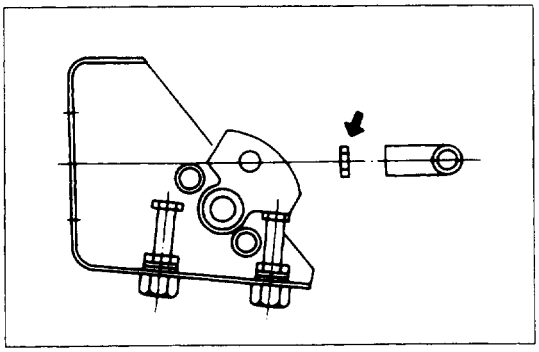
Reassembly Steps



1. Exhaust Valve Assembly

2. Power Chamber

Power Chamber Fixing Nut Torque	N·m (kg·m/lb·ft)
17 (1.7 / 12)	



3. Lock Nut

Lock Nut Torque	N·m (kg·m/lb·in)
13 (1.3 / 113)	

4. Clevis Joint

5. Cotter Pin

LGBRK-WE-481

You are requested to order this manual using the manual number that is shown above.

This manual is applicable for vehicles in all countries except the USA and Canada.

All rights reserved. This manual may not be reproduced in whole or in part, without the permission in writing of ISUZU MOTORS LIMITED.

Issued by

ISUZU MOTORS LIMITED

INTERNATIONAL SERVICE DEPARTMENT

Tokyo, Japan

First edition Feb., 1998 8010-15K-0.2

No.LGBRK-WE-481 PRINTED IN JAPAN

WORKSHOP MANUAL

NHR · NKR · NPR · NQR

CAB AND CHASSIS ELECTRICAL

SECTION 8

ISUZU

ISUZU

International Service & Parts
Tokyo, Japan

NOTICE

Before using this Workshop Manual to assist you in performing vehicle service and maintenance operations, it is recommended that you carefully read and thoroughly understand the information contained in Section 0A under the headings "GENERAL REPAIR INSTRUCTIONS" and "HOW TO USE THIS MANUAL".

All material contained in this Manual is based on latest product information available at the time of publication.
All rights are reserved to make changes at any time without prior notice.

Applicable Model

N-Series		
NHR55	NPR55	NPR71
NKR55	NPR66	NQR66
NKR66	NPR69	NQR70
NKR69	NPR70	NQR71

THIS MANUAL INCLUDES THE FOLLOWING SECTIONS:

SECTION NO.	CONTENTS
8	CAB AND CHASSIS ELECTRICAL

SECTION 8

CAB AND CHASSIS ELECTRICAL

CAUTION:

When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size and strength (or stronger) may be used. Fasteners that are not reused, and those requiring thread locking compound, will be called out. The correct torque values must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

CONTENTS

PAGE

General Information . . . . . 8 – 3
Notes for Working on Electrical Items . . . . . 8 – 3
Symbols and Abbreviations . . . . . 8 – 9
Symbols . . . . . 8 – 9
Abbreviations . . . . . 8 – 10
Parts for Electrical Circuit . . . . . 8 – 11
Wiring . . . . . 8 – 11
Fuse, Fusible Link and Circuit Breaker . . . . . 8 – 12
Relay . . . . . 8 – 13
Diode . . . . . 8 – 15
Connector . . . . . 8 – 16
Reading the Circuit Diagram . . . . . 8 – 18
Connector Symbol . . . . . 8 – 20
Joint Connector . . . . . 8 – 20
Main Data and Specifications . . . . . 8 – 21
Bulb Specifications . . . . . 8 – 21
Fuse, Circuit Breaker and Fusible Link Location . . . . . 8 – 23
Fuse Block Circuit . . . . . 8 – 26
Reference Table of Fuse and Circuit Breaker . . . . . 8 – 30
Relay Location . . . . . 8 – 32
Diode Location . . . . . 8 – 35
Reference Table of Grounding Point . . . . . 8 – 36
Grounding Point Location . . . . . 8 – 37

PAGE

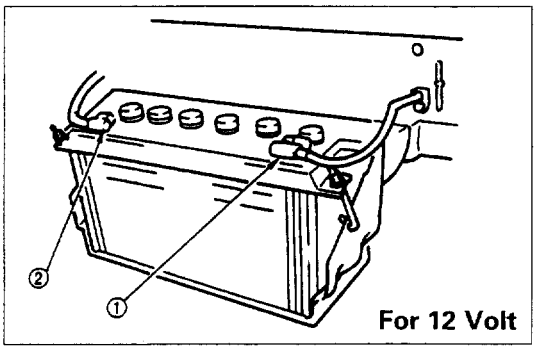
Cable Harness Routing . . . . . 8 – 38
System Repair . . . . . 8 – 41
Start and Charging . . . . . 8 – 41
QOS (Quick on Start) System . . . . . 8 – 49
Exhaust Brake System . . . . . 8 – 63
Exhaust Brake System and Engine Control System (70TC) . . . . . 8 – 74
Engine Stop System . . . . . 8 – 80
Headlight, Fog Light, Rear Fog Light, and Cornering Light . . . . . 8 – 86
Headlight Leveling . . . . . 8 – 110
Clearance Light, Taillight, License Plate Light and Illumination Light . . . . . 8 – 120
Turn Signal Light, Hazard Warning Light and Stoplight . . . . . 8 – 134
Horn, Backup Light and Backup Buzzer . . . . . 8 – 146
Dome Light and Key Remind Buzzer . . . . . 8 – 160
Power Door Lock . . . . . 8 – 168
Power Window . . . . . 8 – 180
A/T ECU (ELECTRONIC CONTROL UNIT) . . . . . 8 – 196
Windshield Wiper and Washer . . . . . 8 – 201
Audio and Cigar Lighter . . . . . 8 – 222
Meter and Warning/Indicator Light . . . . . 8 – 233
Heater and Air Conditioning . . . . . 8 – 280
Fuel Heater and Rear Heater . . . . . 8 – 288

GENERAL INFORMATION

The chassis electrical system is of 12-volt specifications with a negative ground polarity.
Wire sizes are appropriate to respective circuits, and classified by color. (The classification of harnesses by color is shown on the circuit diagram for ease of harness identification.)
The wire size is determined by load capacity and the length of wire required.
The vehicle harnesses are: body harness, floor harness, engine harness, frame front harness, frame rear harness, rear body harness, dome light harness, door harness and battery cable.
The harnesses are protected either by tape or corrugated tube, depending on harness location.
The circuit for each system consists of the power source, wire, fuse, relay switch, load parts and ground, all of which are shown on the circuit diagram.
In this manual, each electrical device is classified by system. For major parts shown on the circuit based on the circuit diagram for each system, a summary, diagnosis of troubles, inspection and removal and installation procedures are detailed.

NOTES FOR WORKING ON ELECTRICAL ITEMS

BATTERY CABLE



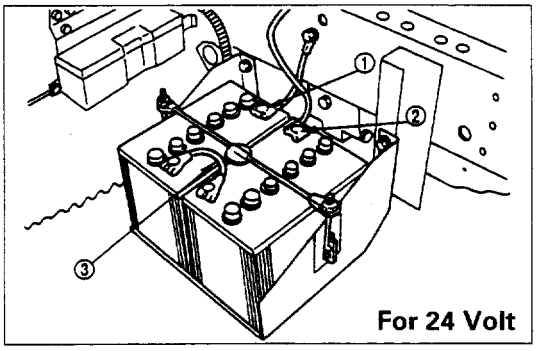
For 12 Volt

Disconnecting the Battery Cable

1) All switches should be in the "OFF" position.
2) Disconnect the battery ground cable.
3) Disconnect the battery positive cable
4) Disconnect the battery cable ③

CAUTION:

It is important that the battery ground cable be disconnected first.
Disconnecting the battery positive cable first can result in a short circuit.



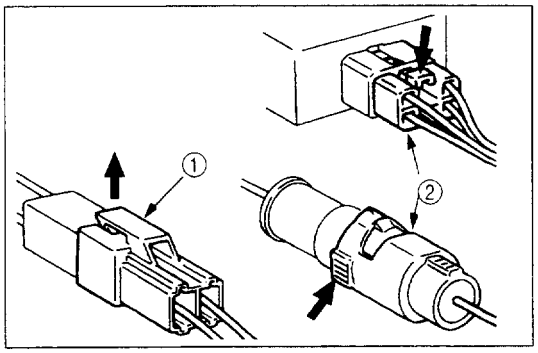
For 24 Volt

Connecting the Battery Cable

Follow the disconnecting procedure in the reverse order.

CAUTION:

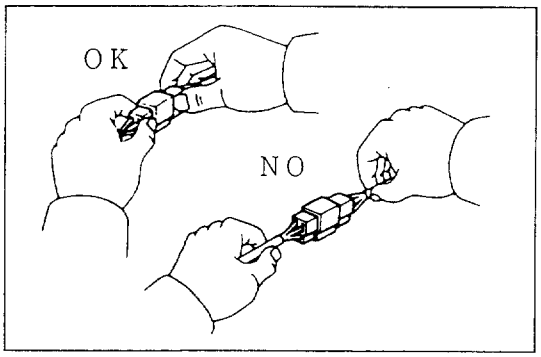
Clean the battery terminal and apply a light coat of grease to prevent terminal corrosion.



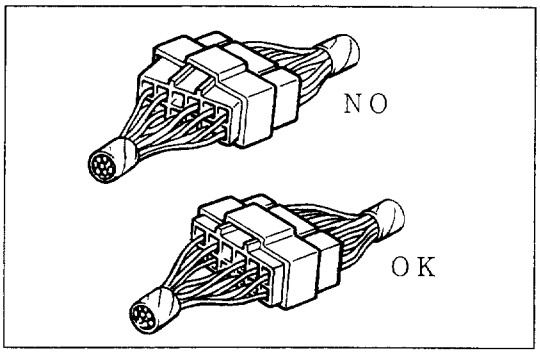
Connector Handling

Disconnecting The Connectors

Some connectors have a tang lock to hold the connectors together during vehicle operation.
Some tang locks are released by pulling them towards you ①.
Other tang locks are released by pressing them forward ②.
Determine which type of tang lock is on the connector being handled.
Firmly grasp both sides (male and female) of the connector.
Release the tang lock and carefully pull the two halves of the connector apart.

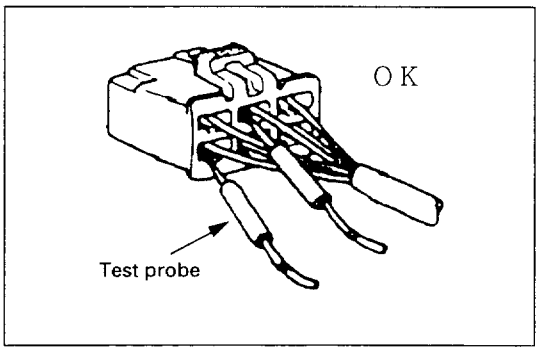


Never pull on the wires to separate the connectors. This will result in wire breakage.



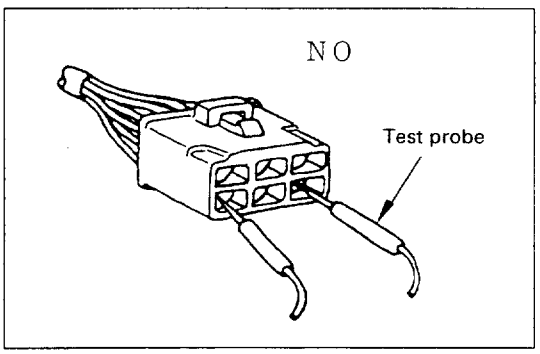
Connecting the Connector

Firmly grasp both sides (male and female) of the connector. Be sure that the connector pins and pin holes match. Be sure that both sides of the connector are aligned with each other. Firmly but carefully push the two sides of the connector together until a distinct click is heard.

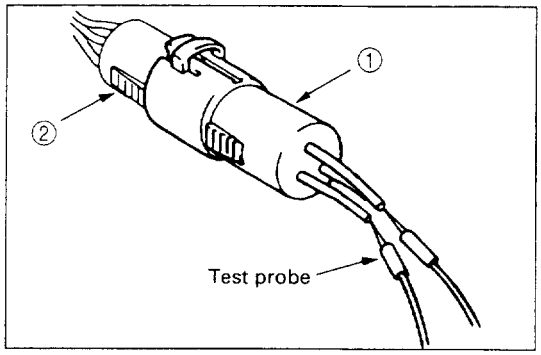


Connector Inspection

Use a circuit tester to check the connector for continuity. Insert the test probes from the connector wire side.

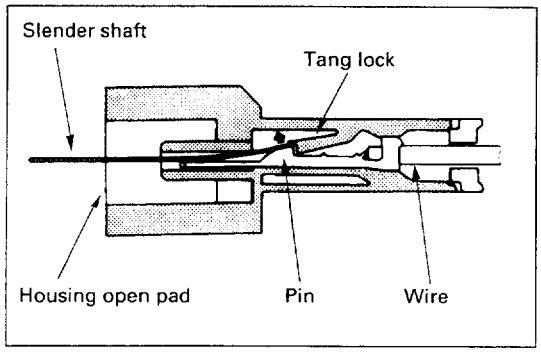


Never insert the circuit tester test probes into the connector open end to test the continuity. Broken or open connector terminals will result.



Waterproof Connector Inspection

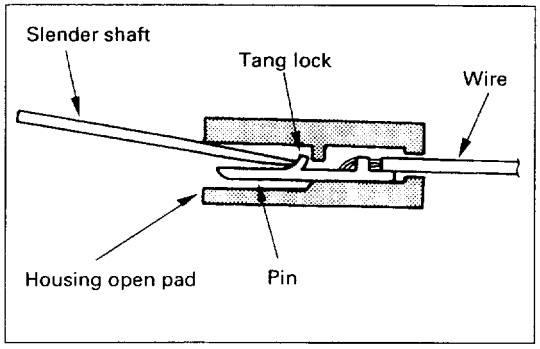
It is not possible to insert the test probes into the connector wire side of a waterproof connector. Use one side of a connector ① with its wires cut to make the test. Connect the test connector ② to the connector to be tested. Connect the test probes to the cut wires to check the connector continuity.



Connector Pin Removal

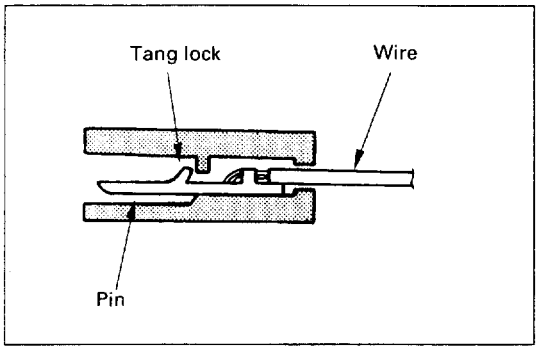
Connector Housing Tang Lock Type

1) Insert a slender shaft into the connector housing open end.
2) Push the tang lock up (in the direction of the arrow in the illustration). Pull the wire with pin free from the wire side of the connector.



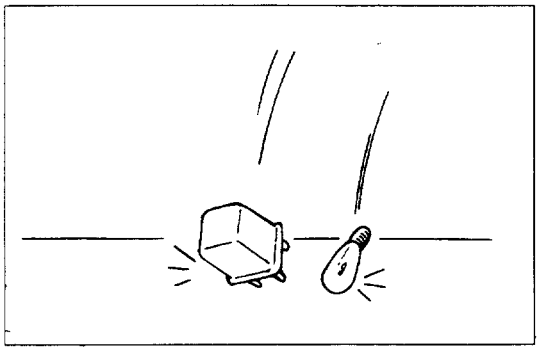
Pin Tang Lock Type

1) Insert a slender shaft into the connector housing open end.
2) Push the tang lock flat (toward the wire side of the connector). Pull the wire with pin free from the wire side of the connector.



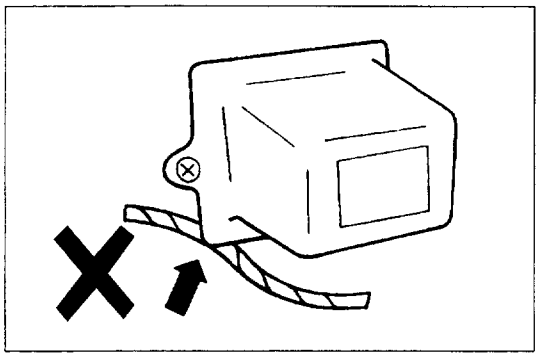
Connector Pin Insertion

1) Check that the tang lock is fully up.
2) Insert the pin from the connector wire side. Push the pin in until the tang lock closes firmly.
3) Gently pull on the wires to make sure that the connector pin is firmly set in place.



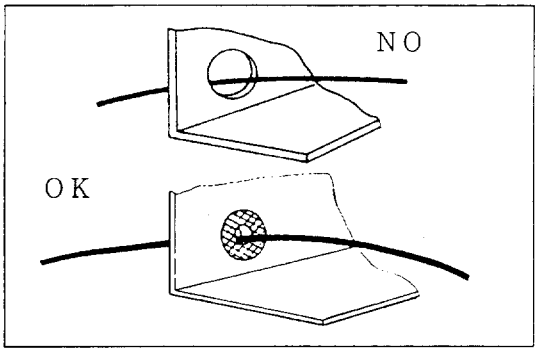
Parts Handling

Be careful when handling electrical parts. They should not be dropped or thrown, because short circuit or other damage may result.

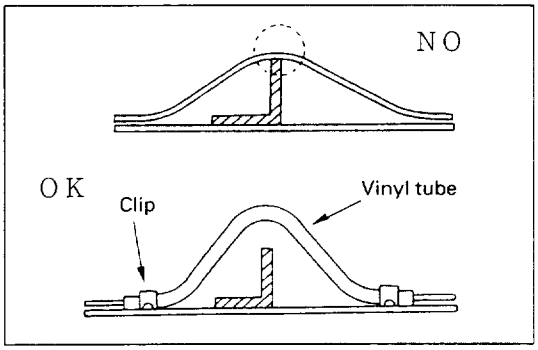


Cable Harness

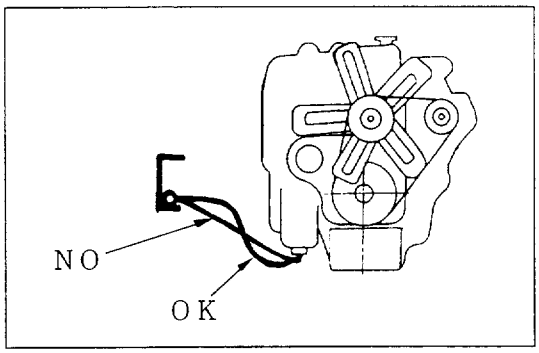
When installing the parts, be careful not to pinch or wedge the wiring harness.
All electrical connections must be kept clean and tight.



Use a grommet or guard tube to protect the wiring harness from contacting a sharp edge or surface.



Position the wiring harness with a enough clearance from the other parts and guard the wiring harness with a vinyl tube and clips to avoid direct contact.



The wiring harness between engine and chassis should be long enough to prevent chafing or damage due to various vibrations.

SPLICING WIRE

1. **Open the Harness**

   If the harness is taped, remove the tape. To avoid wire insulation damage, use a sewing "seam ripper" (available from sewing supply stores) to cut open the harness.
   If the harness has a block plastic conduit, simply pull out the desired wire.

2. **Cut the wire**

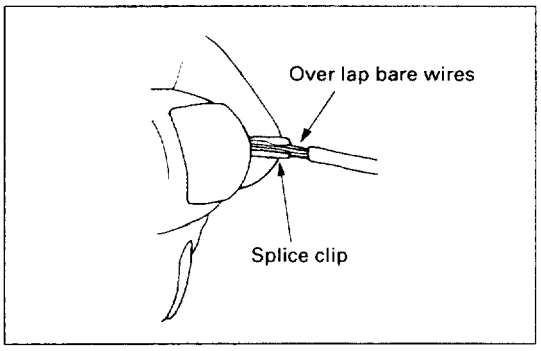
   Begin by cutting as little wire off the harness as possible. You may need the extra length of wire later if you decide to cut more wire off to change the location of a splice. You may have to adjust splice locations to make certain that each splice is at least 1-2/2" (40 mm) away from other splices, harness branches, or connectors.

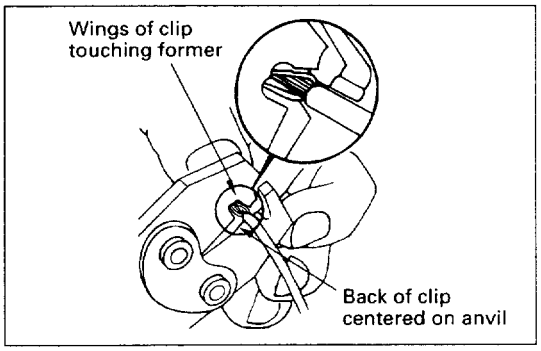
3. **Strip the insulation**

   When replacing a wire, use a wire of the same size as the original wire. Check the stripped wire for nicks or cut stands. If the wire is damaged, repeat the procedure on a new section of wire. The two stripped wire ends should be equal in length.

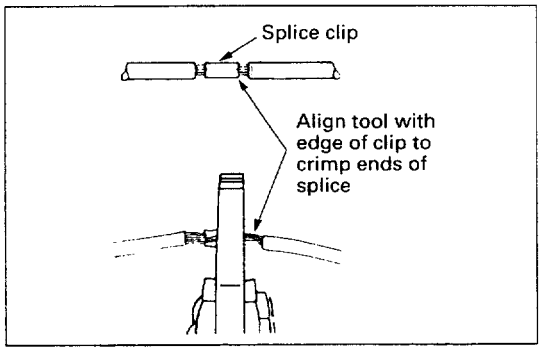
4. **Crimp the Wires**

   Select the proper clip to secure the splice. To determine the proper clip size for the wire being spliced, follow the directions included with your clips. Select the correct anvil on the crimper. (On most crimpers your choice is limited to either a small or large anvil.) Overlap the two stripped wire ends and hold them between your thumb and forefinger. Then, center the splice clip under the stripped wires and hold it in place.



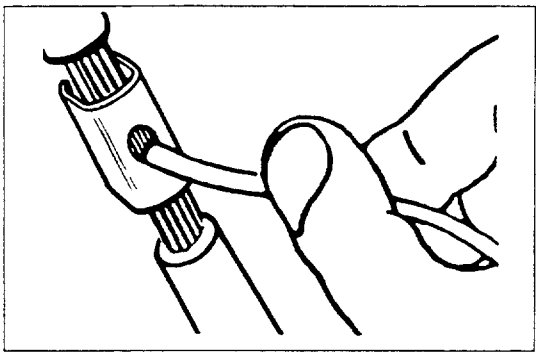


- Open the crimping tool to its full width and rest one handle on a firm flat surface.
- Center the back of the splice clip on the proper anvil and close the crimping tool to the point where the back of the splice clip touches the wings of the clip.
- Make sure that the clip and wires are still in the correct position. Then, apply steady pressure until the crimping tool closes.



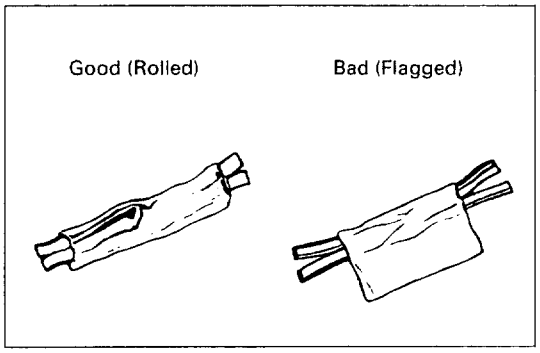
Before crimping the ends of the clip, be sure that:
- The wires extend beyond the clip in each direction.
- No strands of wire are cut loose, and
- No insulation is caught under the clip.

Crimp the splice again, once on each end. Do not let the crimping tool extend beyond the edge of the clip or you may damage or nick the wires.



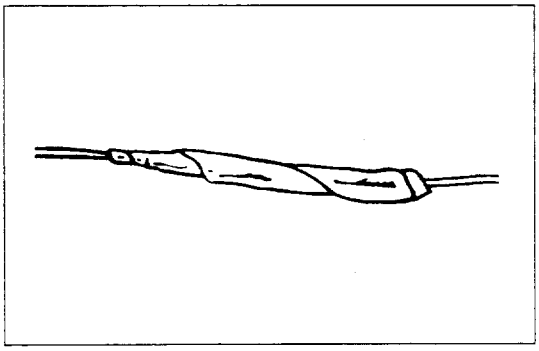
5. Solder

Apply 60/40 rosin core solder to the opening in the back of the clip. Follow the manufacturer's instructions for the solder equipment you are using.



6. Tape the Splice

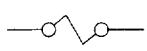
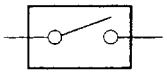
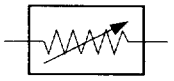
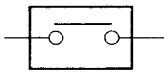
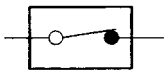
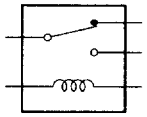
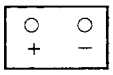
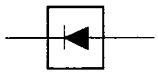
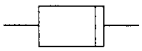
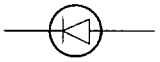
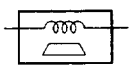
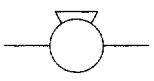
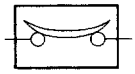
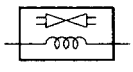
Center and roll the splicing tape. The tape should cover the entire splice. Roll on enough tape to duplicate the thickness of the insulation on the existing wires. Do not flag the tape. Flagged tape may not provide enough insulation, and the flagged ends will tangle with the other wires in the harness.



If the wire does not belong in a conduit or other harness covering, tape the wire again. Use a winding motion to cover the first piece of tape.

SYMBOLS AND ABBREVIATIONS

SYMBOLS

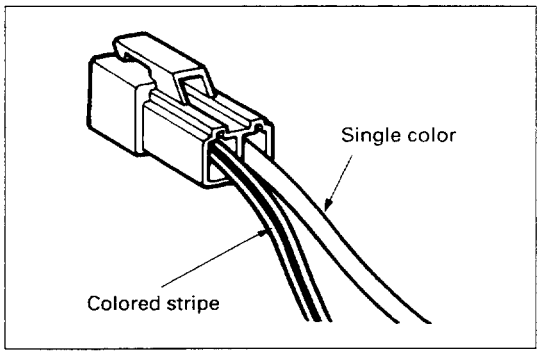
Symbol	Meaning of Symbol	Symbol	Meaning of Symbol
	Fuse		Bulb
	Fusible link		Double filament bulb
	Fusible link wire		Motor
	Switch		Variable register Rheostat
	Switch		Coil (inductor), solenoid, magnetic valve
	Switch (Normal close type)		Relay
	Contact wiring		
	Battery		
	Diode		Connector
	Electronic Parts		Light emitting diode
	Resistor		Reed switch
	Speaker		Condenser
	Buzzer		Horn
	Circuit breaker		Vacuum switching valve

ABBREVIATIONS

Abbreviation	Meaning of Abbreviation	Abbreviation	Meaning of Abbreviation
A	Ampere (S)	kW	kilowatt
ABS	Anti-lock brake system	LH	Left hand
ASM	Assembly	LWB	Long wheel base
AC	Alternating current	M/T	Manual transmission
A/C	Air conditioner	OD	Over drive
ACC	Accessories	OPT	Option
A/T	Automatic transmission	QOS	Quick on start
C/B	Circuit breaker	RH	Right hand
CSD	Cold start device	RR	Rear
DIS	Direct ignition system	RWAL	Rear wheel anti-lock brake system
EBCM	Electronic brake control module	ST	Start
ECGI	Electronic control gasoline injection	STD	Standard
ECM	Electronic control module	SW	Switch
ECU	Electronic control unit	SWB	Short wheel base
EFE	Early fuel evaporation	TCM	Transmission control module
4A/T	4-speed automatic transmission	3A/T	3-speed automatic transmission
4X4	Four-wheel drive	V	Volt
FL	Fusible link	VSV	Vacuum switching valve
FRT	Front	W	Watt (S)
H/L	Headlight	WOT	Wide open throttle
IC	Integrated circuit	W/	With
IG	Ignition	W/O	Without

PARTS FOR ELECTRICAL CIRCUIT

WIRING



Wire Color

All wires have color-coded insulation.
Wires belonging to a system's main harness will have a single color. Wires belonging to a system's sub-circuits will have a colored stripe. Striped wires use the following code to show wire size and colors.

Example: 0.5 G / R
- R: Red (Stripe color)
- G: Green (Base color)
- 0.5: Wire size (0.5 mm2)

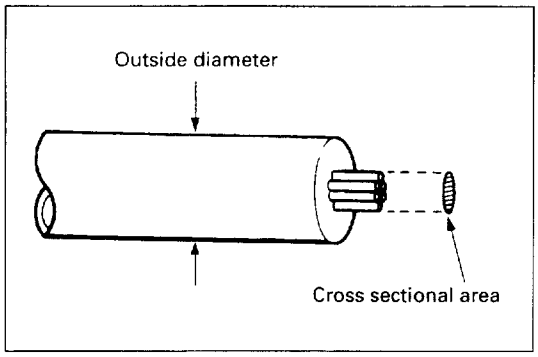
Abbreviations are used to indicate wire color within a circuit diagram.
Refer to the following table.

Wire Color Coding

Color-Coding	Meaning	Color-coding	Meaning
B	Black	BR	Brown
W	White	LG	Light green
R	Red	GR	Grey
G	Green	P	Pink
Y	Yellow	LB	Light blue
L	Blue	V	Violet
O	Orange		

Distinction of Circuit by Wire Base Color

Base color	Circuits	Base color	Circuits
B	Starter circuit	Y	Instrument circuit
W	Charging circuit	L, O, BR, LG, GR, P, LB, V	Other circuit
R	Lighting circuit		
G	Signal circuits		



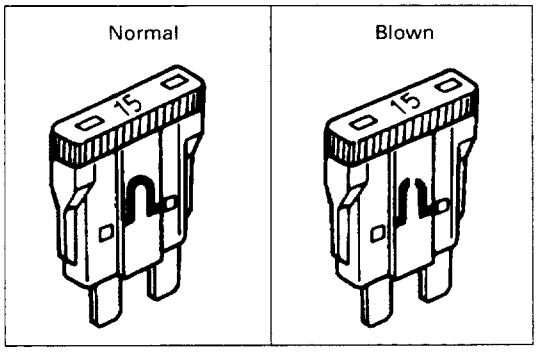
Wire Size

The size of wire used in a circuit is determined by the amount of current (amperage), the length of the circuit, and the voltage drop allowed. The following wire size and load capacity, shown below, are specified by AWG (American Wire Gauge) (Nominal size means approximate cross sectional area).

Wire Size Table

Nominal size	Cross sectional area (mm^2)	Outside diameter (mm)	Allowable current (A)	AWG size (cross reference)
0.3	0.372	1.8	9	22
0.5	0.563	2.0	12	20
0.85	0.885	2.2	16	18
1.25	1.287	2.5	21	16
2	2.091	2.9	28	14
3	3.296	3.6	37.5	12
5	5.227	4.4	53	10
8	7.952	5.5	67	8
15	13.36	7.0	75	6
20	20.61	8.2	97	4

FUSE, FUSIBLE LINK AND CIRCUIT BREAKER



FUSE

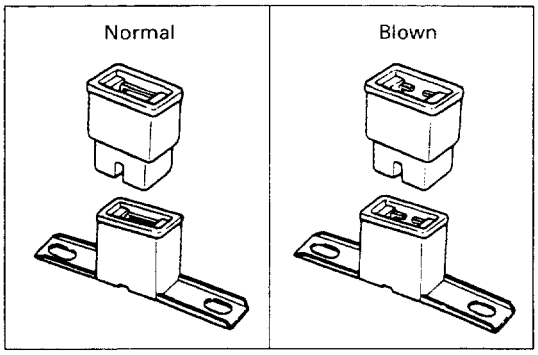
Fuses are the most common form of circuit protection used in vehicle wiring. A fuse is a thin piece of wire or strip of metal encases in a glass or plastic housing. It is wired in series with the circuit it protects. When there is an overload of current in a circuit, such as a short of a ground, the wire or metal strip is designed to burn out and interrupt the flow of current. This prevents a surge of high current from reaching and damaging other components in the circuit.

Determine the cause of the overloaded before replacing the fuse.

The replacement fuse must have the same amperage specifications as the original fuse.

Never replace a blown fuse with a fuse of a different amperage specification.

Doing so can result in an electrical fire or other serious circuit damage. A blown fuse is easily identified.



FUSIBLE LINK

The fusible link is primarily used to protect circuits where high amounts of current flow and where is would not be practical to use a fuse. For example, the starter circuit. When a current overload occurs, the fusible link melts open and interrupts the flow of current so as to prevent the rest of the wiring harness from burning.

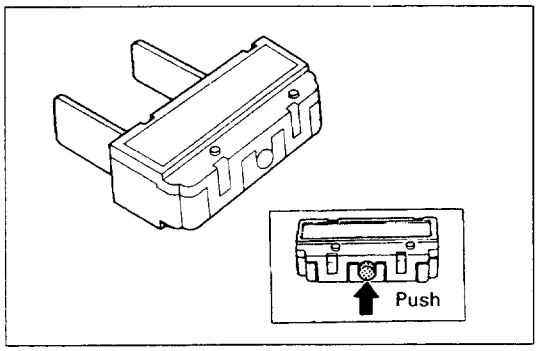
Determine the cause of the overload before replacing the fusible link. The replacement fusible link must have the same amperage specification as the original fusible link.

Never replace a blown fusible link with fusible link of a different amperage specification. Doing so can result in an electrical fire or other serious circuit damage.

A blown fusible link is easily identified.

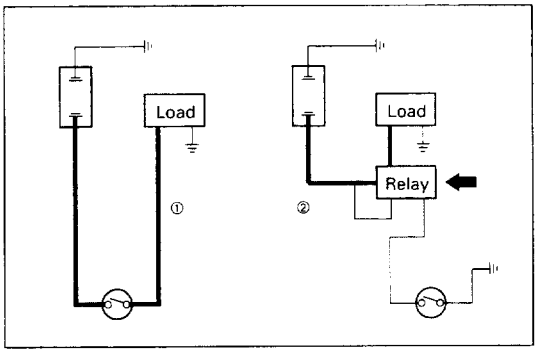
Fusible Link Specifications

Type	Rating	Case Color	Maximum Circuit Current (A)
Connector	30A	Pink	15
Connector	40A	Green	20
Bolted	50A	Red	25
Bolted	60A	Yellow	30
Bolted	80A	Black	40



CIRCUIT BREAKER

The circuit breaker is a protective device designed to open the circuit when a current load is in excess of rated breaker capacity. If there is a short or other type of overload condition in the circuit, the excessive current will open the circuit between the circuit breaker terminals. The reset knob pops out when the circuit is open. Push the reset knob in place to restore the circuit after repairing it.



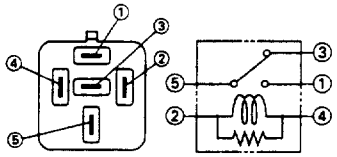
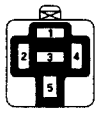
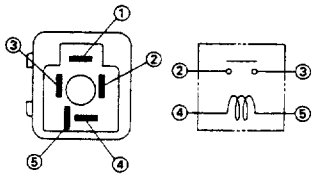
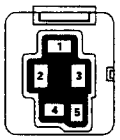
RELAY

Battery and load location may require that a switch be placed some distance from either component. This means a longer wire and a higher voltage drop ①.

The installation of a relay between the battery and the load reduces the voltage drop ②.

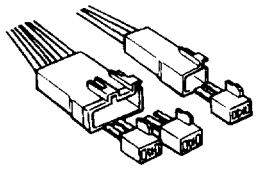
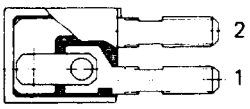
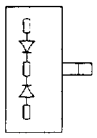
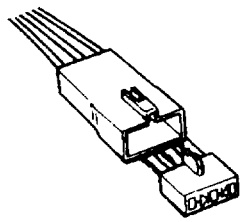
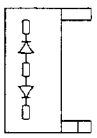
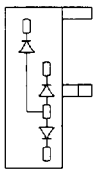
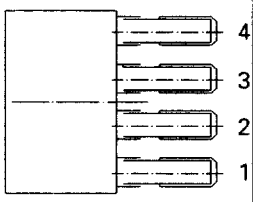
Because the switch controls the relay, amperage through the switch can be reduced.

RELAY SPECIFICATION, CONFIGURATION AND INSPECTION

<table>
<tr><th>Name/ Color</th><th>Rated voltage/Coil resistance</th><th>Internal circuit</th><th>Name/ Color</th><th>Rated voltage/Coil resistance</th><th>Internal circuit</th></tr>
<tr><td>MR5C (1T)/ Black</td><td>12V/ Approx. 90Ω Minimum operating voltage: 7V at 25°C (77°F)</td><td rowspan="4"> 
 
(connector face)</td><td rowspan="2">MR82C/ White label</td><td rowspan="2">12V/ Approx. 23Ω Minimum operating voltage: 7V at 20°C (68°F)</td><td rowspan="4"> 
 
(connector face)</td></tr>
<tr><td>MR5C (1T)/ Brown</td><td>12V/ Approx. 90Ω Minimum operating voltage: 10.5V at 25°C (77°F)</td></tr>
<tr><td>MR5C (1T)/ Green</td><td>24V/ Approx. 266Ω Minimum operating voltage: 16V at 25°C (77°F)</td><td rowspan="2">MR82C/ Green label</td><td rowspan="2">24V/ Approx. 100Ω Minimum operating voltage: 16V at 20°C (68°F)</td></tr>
<tr><td>MR5C (1T)/ Grey</td><td>24V/ Approx. 266Ω Minimum operating voltage: 20V at 25°C (77°F)</td></tr>
<tr><td rowspan="4">Inspection</td><td>The way / Result</td><td>Check to see if there is any continuity between the relay terminals.</td><td rowspan="4">Inspection</td><td>The way / Result</td><td>Check to see if there is any continuity between the relay terminals.</td></tr>
<tr><td>Normal</td><td>(When no voltage is applied relay terminals ②-④)
③-⑤ ··· continuity
①-⑤ ···No continuity
Inspection</td><td>Normal</td><td>(When no voltage is applied relay terminals ④-⑤)
②-③ ··· No continuity</td></tr>
<tr><td>Abnormal</td><td>(When minimum operating voltage is applied relay terminals between ②-④)
③-⑤ ··· continuity
①-⑤ ··· No continuity</td><td>Abnormal</td><td>(When minimum operating voltage is applied relay terminals between ④-⑤)
②-③ ··· No continuity</td></tr>
<tr><td>Normal</td><td>(When minimum operating voltage is applied relay terminals between ②-④)
③-⑤ ··· No continuity
①-⑤ ··· continuity</td><td>Normal</td><td>(When minimum operating voltage is applied relay terminals between ④-⑤)
②-③ ··· continuity</td></tr>
</table>

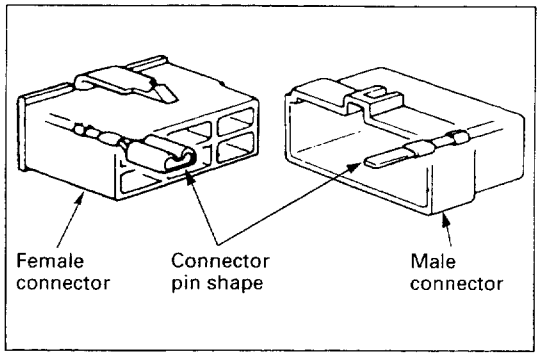
DIODE

DIODE SPECIFICATIONS AND CONFIGURATIONS

<table>
<tr><th>SHAPE</th><th>MARK/
COLOR</th><th>CONSTRUCTION</th><th>CHECKING (THERE SHOULD BE CONTINUITY IN EITHER A OR B WHEN A CIRCUIT TESTER IS CONNECTED WITH DIODE TERMINAL)</th></tr>
<tr><td rowspan="3">  </td><td>
BLACK</td><td>  </td><td>
<table>
<tr><td colspan="2">TERMINAL NO.</td><td></td><td>2</td><td>1</td></tr>
<tr><td rowspan="2">CONNECTION PATTERN</td><td>A</td><td></td><td>⊕</td><td>⊖</td></tr>
<tr><td>B</td><td></td><td>⊖</td><td>⊕</td></tr>
</table>
</td></tr>
<tr><td> 
BLACK</td><td rowspan="3"></td><td>
<table>
<tr><td colspan="2">TERMINAL NO.</td><td></td><td>3</td><td>2</td><td>1</td></tr>
<tr><td rowspan="4">CONNECTION PATTERN</td><td rowspan="2">A</td><td>⊖</td><td>⊕</td><td></td></tr>
<tr><td></td><td>⊕</td><td>⊖</td></tr>
<tr><td rowspan="2">B</td><td>⊕</td><td>⊖</td><td></td></tr>
<tr><td></td><td>⊖</td><td>⊕</td></tr>
</table>
</td></tr>
<tr><td rowspan="2">  </td><td> 
BLACK</td><td>
<table>
<tr><td colspan="2">TERMINAL NO.</td><td></td><td>3</td><td>2</td><td>1</td></tr>
<tr><td rowspan="4">CONNECTION PATTERN</td><td rowspan="2">A</td><td>⊖</td><td>⊕</td><td></td></tr>
<tr><td></td><td>⊕</td><td>⊖</td></tr>
<tr><td rowspan="2">B</td><td>⊕</td><td>⊖</td><td></td></tr>
<tr><td></td><td>⊖</td><td>⊕</td></tr>
</table>
</td></tr>
<tr><td> 
BLACK</td><td>  </td><td>
<table>
<tr><td colspan="2">TERMINAL NO.</td><td></td><td>4</td><td>3</td><td>2</td><td>1</td></tr>
<tr><td rowspan="6">CONNECTION PATTERN</td><td rowspan="3">A</td><td></td><td></td><td>⊕</td><td>⊖</td></tr>
<tr><td></td><td>⊖</td><td>⊕</td><td></td></tr>
<tr><td>⊖</td><td></td><td>⊕</td><td></td></tr>
<tr><td rowspan="3">B</td><td></td><td></td><td>⊖</td><td>⊕</td></tr>
<tr><td></td><td>⊕</td><td>⊖</td><td></td></tr>
<tr><td>⊕</td><td></td><td>⊖</td><td></td></tr>
</table>
</td></tr>
</table>

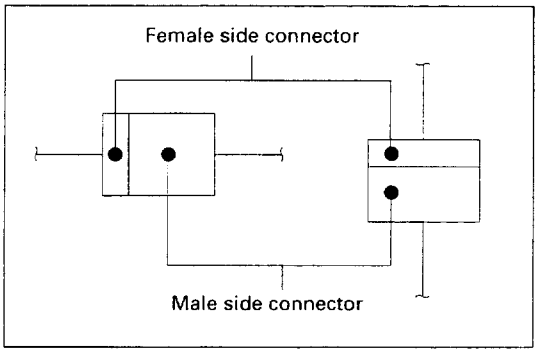
MAXIMUM RATING (Temp. =25°C)

Items	Rating	Remarks
Peak reverse voltage	400V	
Transient peak reverse voltage	500V	
Average output current	1.5A	Temp. = 40°C
Working ambient temperature	-30°C~80°C	
Storage temperature	-40°C~100°C	

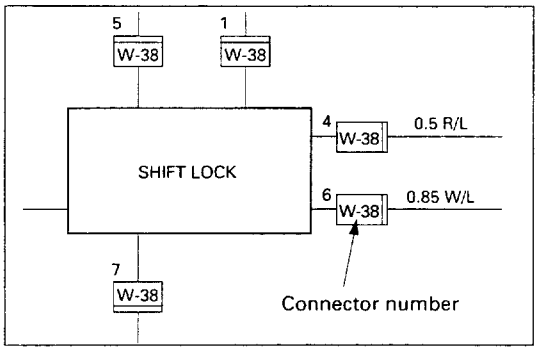


CONNECTOR

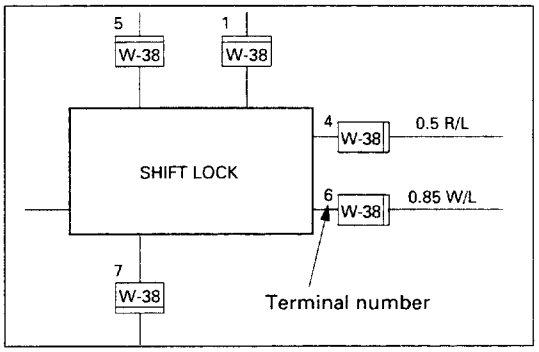
The connector pin shape determines whether the connector is male or female.
The connector housing configuration does not determine whether a connector is male or female.



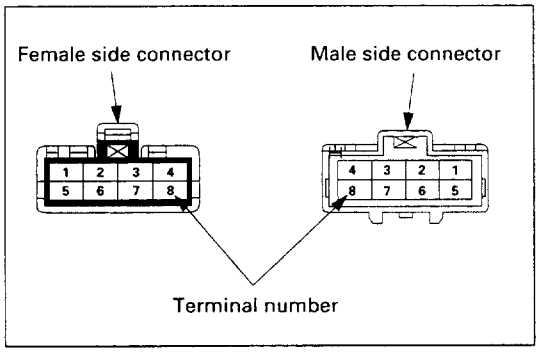
The symbol illustrated in the figure is used as connector, in the circuit of this section.



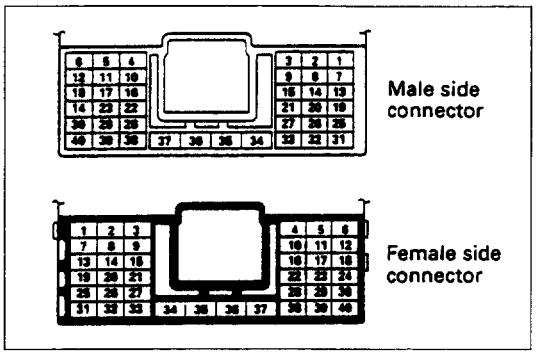
Connector is identified with a number.



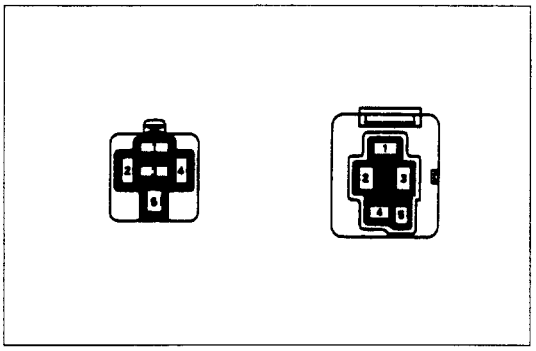
The applicable terminal number is shown for each connector.



Connector terminal numbers are clearly shown.
Male side connector terminal numbers are in sequence from upper right to lower left.
Female side connector terminal numbers are in sequence from upper left to lower right.



NOTE:
For those connectors on which specific terminal numbers or symbols are shown (such as ECM), the terminal numbers or symbols are used in the circuit diagram, irrespective of the above rule.



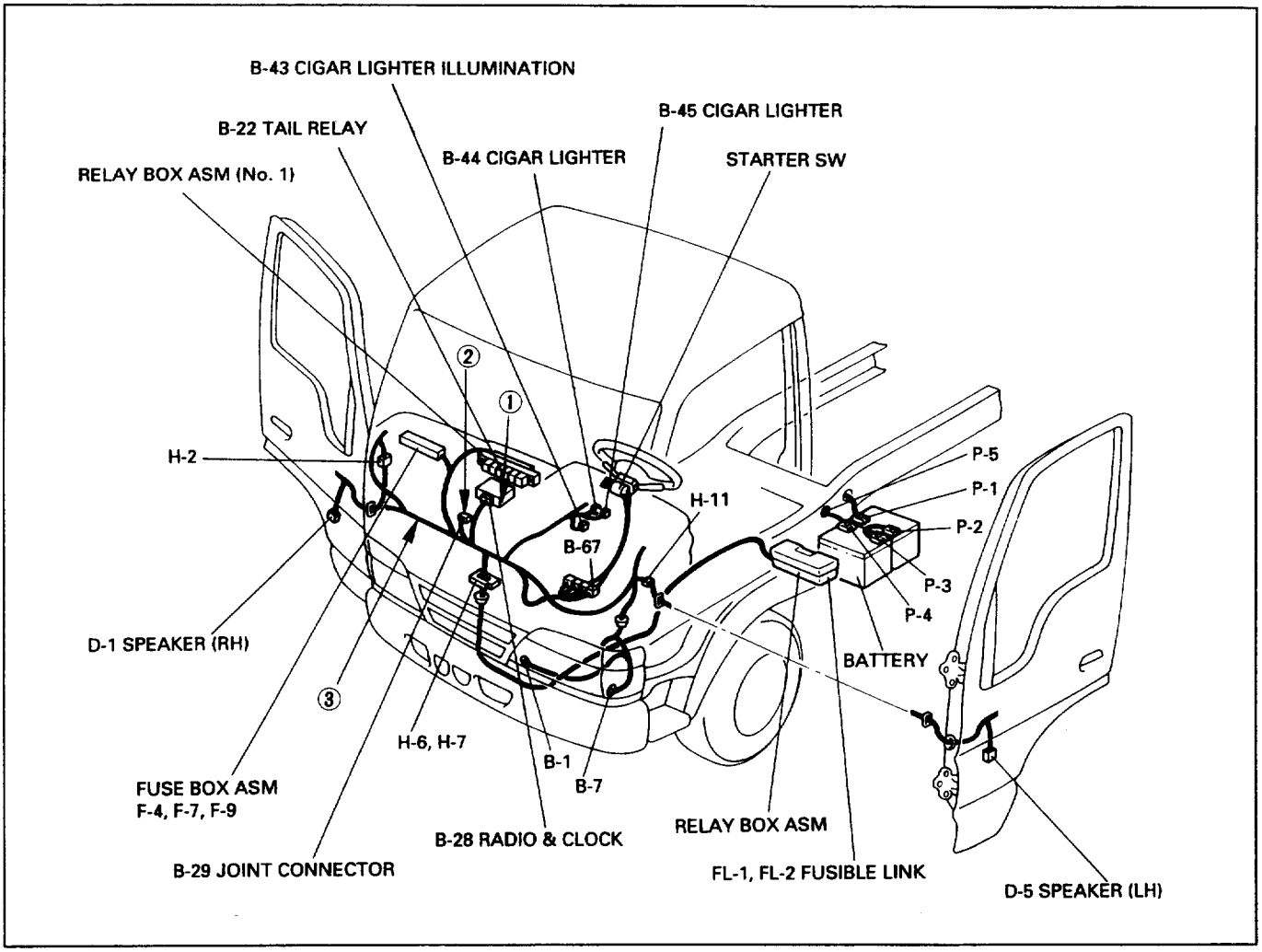
The connectors used for relays have their own terminal number assignment, irrespective of the above rule.

READING THE CIRCUIT DIAGRAM

In this manual, each system has its own parts location illustration, circuit diagram and connector configuration used in the circuit diagram.

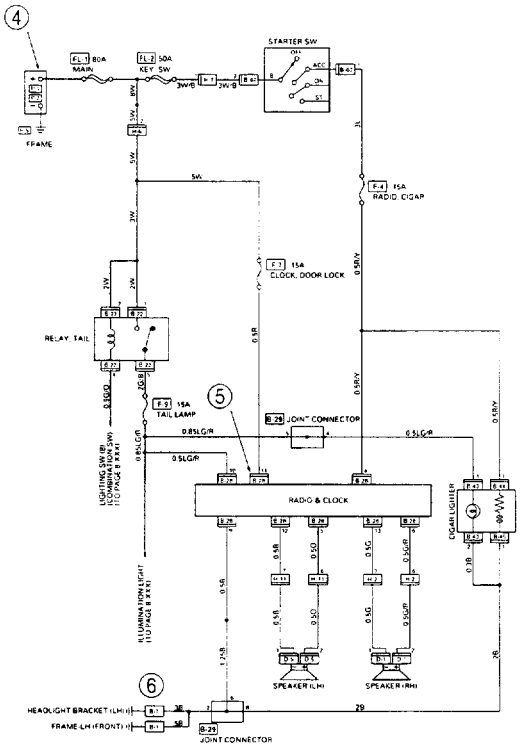
PARTS LOCATION

The parts location shows the location of the parts ① and the connector ② used in each harness routing ③.



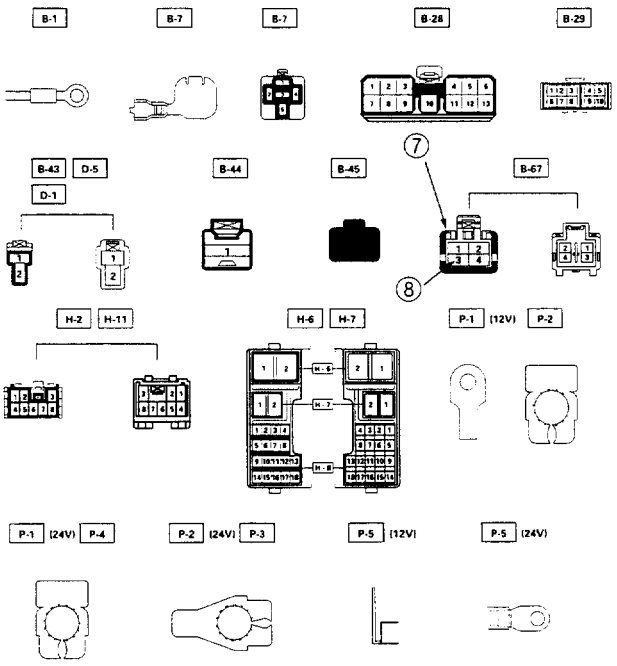
CIRCUIT DIAGRAM

The circuit diagram shows the power supply ④ the load or loads ⑤ and the grounding point(s) ⑥.



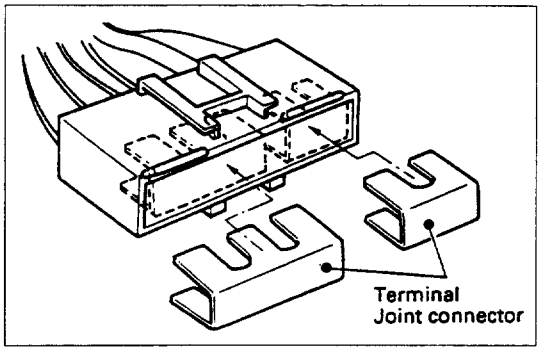
CONNECTOR LIST

The connector list shows each connectors' configuration ⑦ and the pin number ⑧.



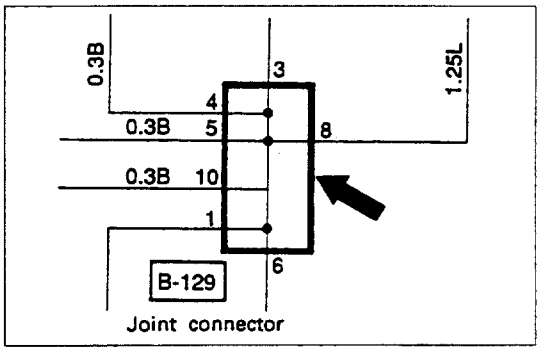
CONNECTOR SYMBOL

Connector Symbol	Harness name	Connector Symbol	Harness name
B	Body harness	L	Dome Light harness
D	Door harness	N	Floor harness (LH & RH)
E	Engine harness	P	Battery harness
H	For joint between harnesses	R	Rear body harness
J	Frame front & frame rear harness		



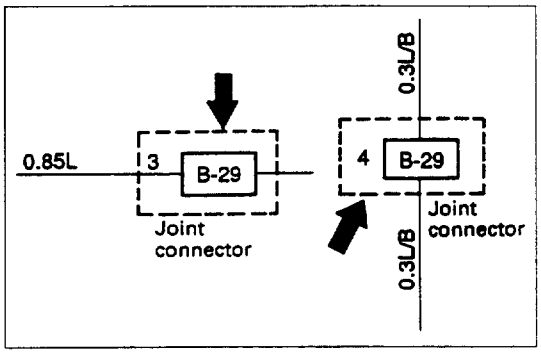
JOINT CONNECTOR

This connector has the structure of plural number of terminals collectively connected inside the connector.



How to show joint connector in the circuit diagram

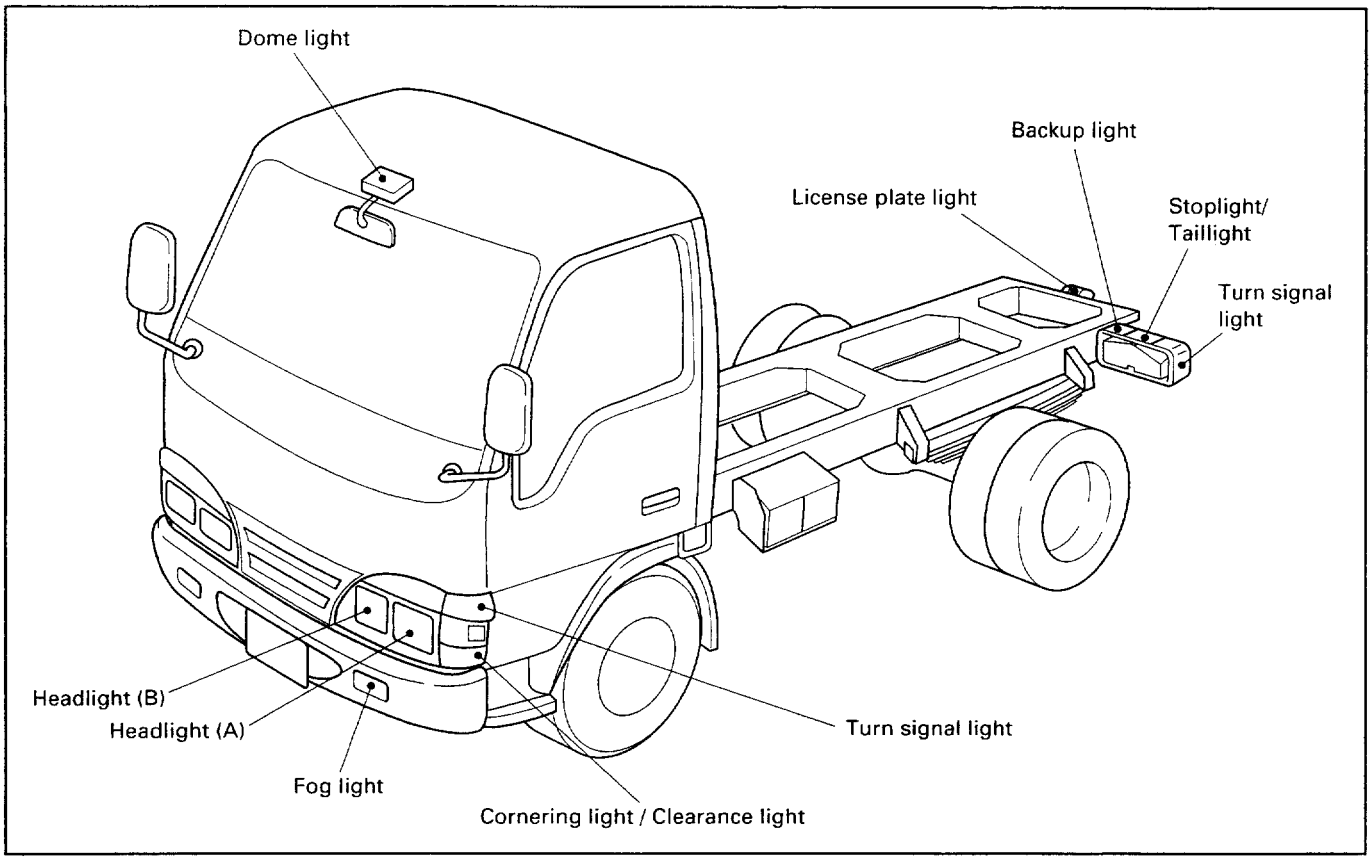
1. When joint connector can be shown as actual circuit diagram.



2. When one joint connector must be shown from different angles in the circuit diagram.

MAIN DATA AND SPECIFICATIONS

BULB SPECIFICATIONS

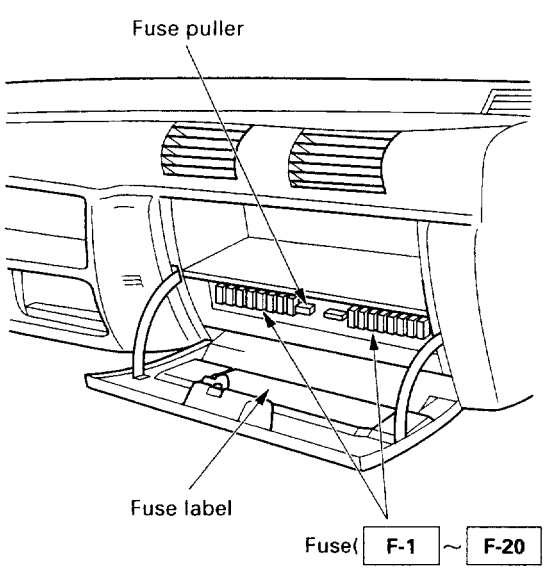


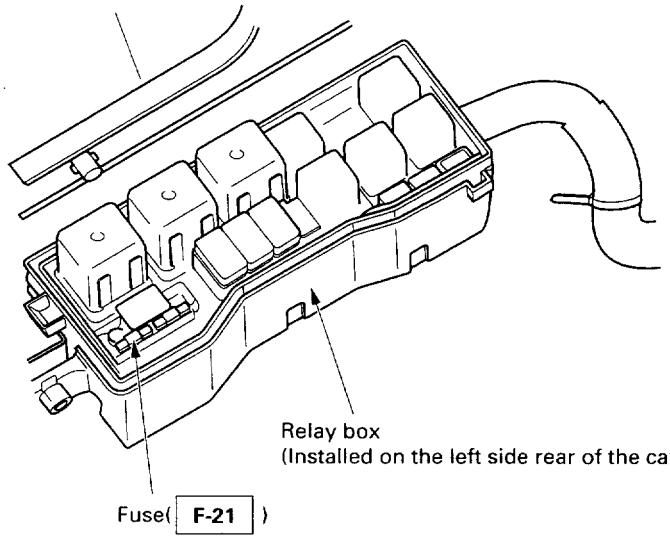
Light Name			Rated Power	No. of Bulb	Lens Color	Remarks
Headlight	Rectangular type	A	45W/40W	2	Clear	12V
		B	45W	2		
		A	55W/50W	2		24V
		B	55W	2		
Front combination light	Turn signal light		21W	2	Amber	12V
			25W			24V
	Cornering light/ Clearance light		27W/8W	2	Clear	12V
			30W/10W			24V
Fog light	Front		55W	2	Clear	12V
						24V
	Rear		21W	1	Red	12V
REAR combination light	Stoplight/Taillight		21W/5W	2	Red	12V
			25W/10W			24V
	Turn signal light		21W	2	Amber	12V
			25W			24V
	Backup light		21W	2	Clear	12V
			25W			24V
License plate light			10W	1	Clear	12V
			12W			24V

Light Name			Rated Power	No. of Bulb	Lens Color	Remarks
Dome light			10W	1	White	12V
			12W			24V
Indicator/ Warning Light (In the meter assembly)	Glow		2W	1		12V
			1.8W			24V
	Engine oil pressure		2W	1		12V
			1.8W			24V
	Fuel sedimenter		2W	1		12V
			1.8W			24V
	Brake fluid level / Parking brake		2W	1		12V
			1.8W			24V
	Charge		2W	1		12V
			1.8W			24V
	Exhaust brake		2W	1		12V
	High beam		2W	1		12V
			1.8W			24V
	Turn signal		2W	1		12V
			1.8W			24V
	Fuel level		2W	1		12V
			1.8W			24V
	Seat belt		2W	1		12V
			1.8W			24V
	Hazard warning		2W	1		12V
Illumination	Illumination light for meter assembly		2W	1		12V
			1.8W			24V
	Hazard warning Switch		2W	1		12V
			1.8W			24V
	Dome light switch		2W	1		12V
			1.8W			24V
	Front fog light switch		2W	1		12V
			1.8W			24V
	Rear fog light switch	For indicator	60mA	1		12V
		For illumination	60mA	1		
	Cigar lighter		1.4W	1		12V
			1.8W			24V
	Heater bezel		1.4W	1		
	Ashtray		1.4W	1		

FUSE AND FUSIBLE LINK LOCATION

FUSE AND CIRCUIT BREAKER





826LX010

FUSE LABEL-FOR 12Volt

25A ①	HEATER
10A ②	AIR CON
10A ③	STARTER
15A ④	AUDIO CIGAR LIGHTER
10A ⑤	HEAD LIGHT (RH)
10A ⑥	HEAD LIGHT (LH)
15A ⑦	POWER DOOR LOCK
15A ⑧	HAZARD, HORN
15A ⑨	TAIL LIGHT
10A ⑩	FOG LIGHT
15A ⑪	WIPER, WASHER
10A ⑫	GAUGE, BACK
15A ⑬	RR. HEATER ECU (IGN)
15A ⑭	FUEL HEATER EXH. BRAKE
10A ⑮	HDLP LEVELING ECU (BAT)
25A ⑯	POWER WINDOW
10A ⑰	STOP LIGHT
15A ⑱	GENERATOR
10A ⑲	TURN S/LIGHT
10A ⑳	ENG. STOP

FUSE LABEL-FOR 24Volt

15A ①	AIR CON HEATER
②	—
10A ③	STARTER
15A ④	AUDIO CIGAR LIGHTER
10A ⑤	HEAD LIGHT (RH)
10A ⑥	HEAD LIGHT (LH)
15A ⑦	POWER DOOR LOCK
15A ⑧	HAZARD, HORN
15A ⑨	TAIL, LIGHT
10A ⑩	STOP LIGHT
15A ⑪	WIPER, WASHER
10A ⑫	GAUGE, BACK
10A ⑬	FUEL HEATER EXH. BRAKE
15A ⑭	RR. HEATER
15A ⑮	POWER WINDOW
10A ⑯	ECU (BAT)
10A ⑰	ENG. STOP
10A ⑱	ECU (IGN)
10A ⑲	TURN S/LIGHT
15A ⑳	GENERATOR

10A F-21	MARKER LIGHT

NOTE:
The fuse numbers ① ~ ⑳ indicated on the fuse labels are expressed as F-1 ~ F-20 in the circuit diagrams of this manual.

FUSE AND CIRCUIT BREAKER

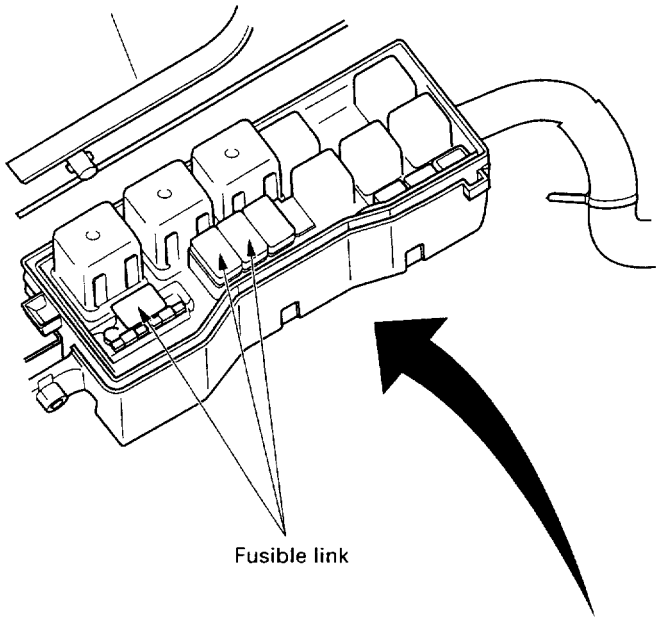
FUSE LABEL-FOR 24Volt MITICS

15A ①	AIR CON HEATER
②	—
10A ③	STARTER
15A ④	AUDIO CIGAR LIGHTER
10A ⑤	HEAD LIGHT (RH)
10A ⑥	HEAD LIGHT (LH)
15A ⑦	POWER DOOR LOCK
15A ⑧	HAZARD, HORN
15A ⑨	TAIL LIGHT
10A ⑩	STOP LIGHT
15A ⑪	WIPER, WASHER
10A ⑫	GAUGE, BACK
10A ⑬	ECU (IGN)
10A ⑭	FUEL HEATER EXH. BRAKE
15A ⑮	RR. HEATER
15A ⑯	POWER WINDOW
10A ⑰	ENG. STOP
10A ⑱	HDLP LEVELING
10A ⑲	TURN S/LIGHT
15A ⑳	GENERATOR

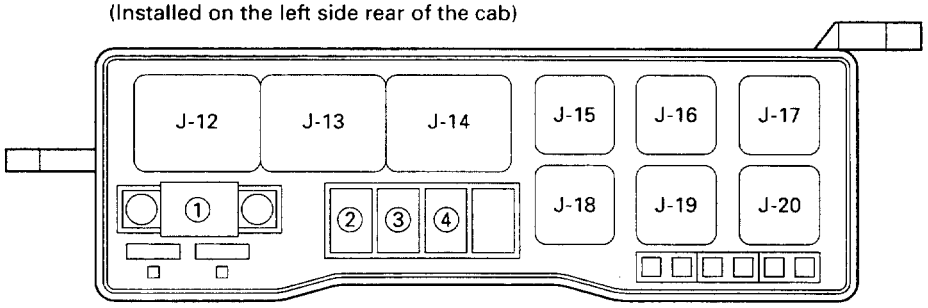
FUSE LABEL-FOR 12Volt (70, 71)

25A ①	HEATER
10A ②	AIR CON
10A ③	STARTER
15A ④	AUDIO CIGAR LIGHTER
10A ⑤	HEAD LIGHT (RH)
10A ⑥	HEAD LIGHT (LH)
15A ⑦	POWER DOOR LOCK
15A ⑧	HAZARD, HORN
15A ⑨	TAIL LIGHT
10A ⑩	FOG LIGHT
15A ⑪	WIPER, WASHER
10A ⑫	GAUGE, BACK
10A ⑬	ECU (IGN)
10A ⑭	EXH. BRAKE
10A ⑮	ECU (BAT)
25A ⑯	POWER WINDOW
10A ⑰	STOP LIGHT
15A ⑱	GENERATOR
10A ⑲	TURN S/LIGHT
10A ⑳	ENG. STOP

FUSIBLE LINK



Relay box
(Installed on the left side rear of the cab)

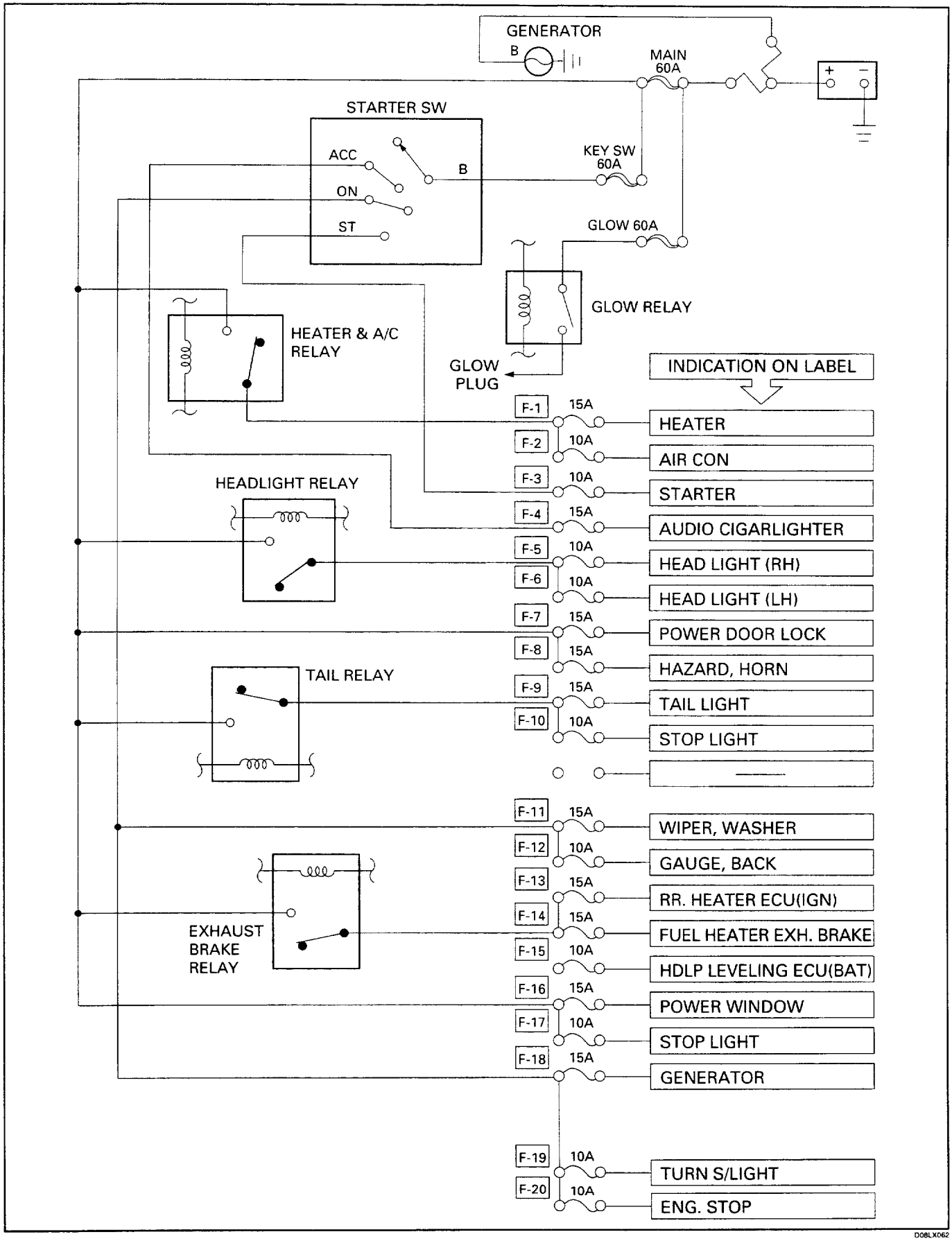


No.	Name	Capacity	Remarks
①	MAIN	80A	12V
		60A	24V
②	KEY SW	50A	12V
		60A	24V
③	GLOW	60A	12V
		60A	24V

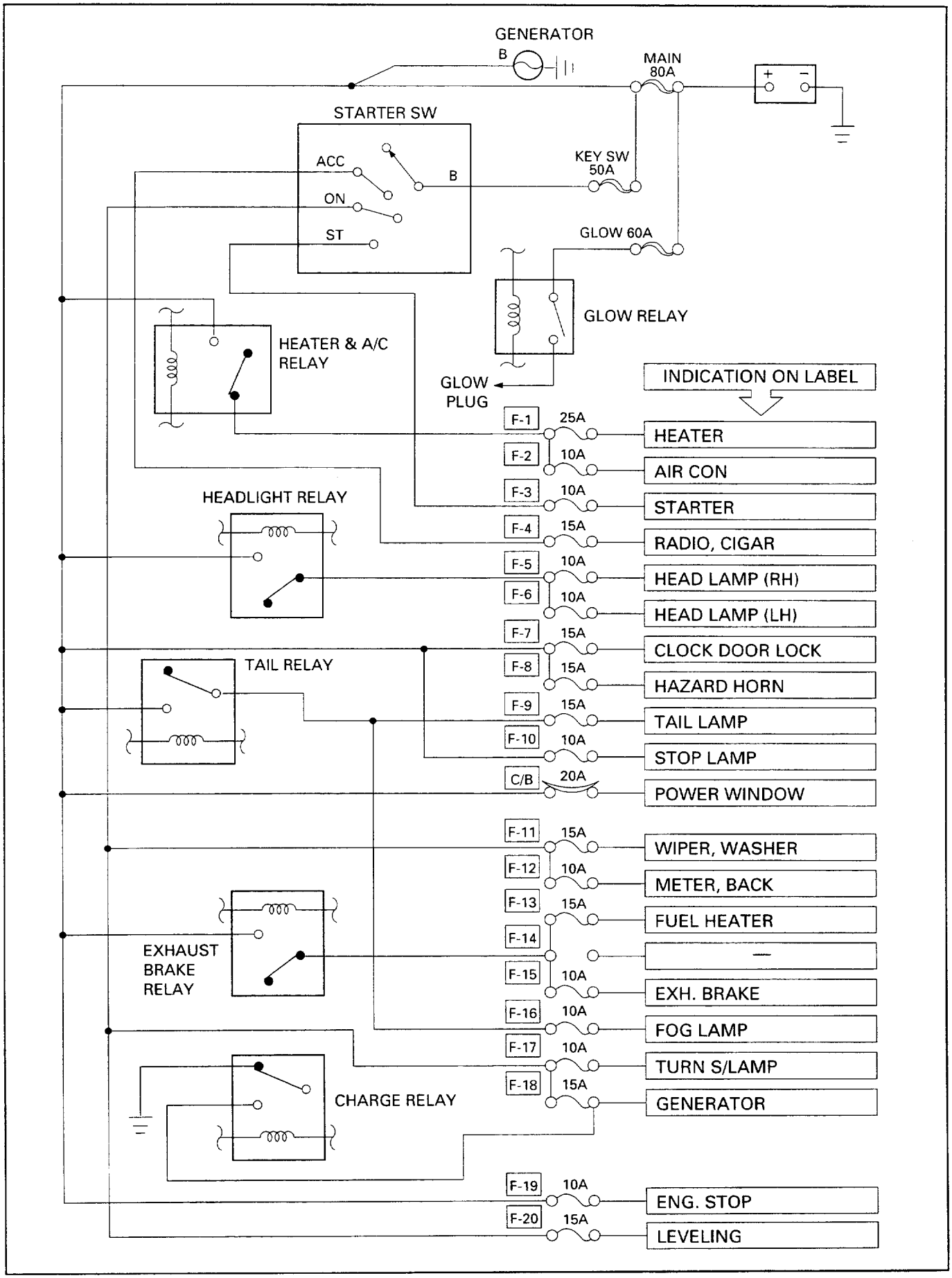
826LX011

FUSE BLOCK CIRCUIT

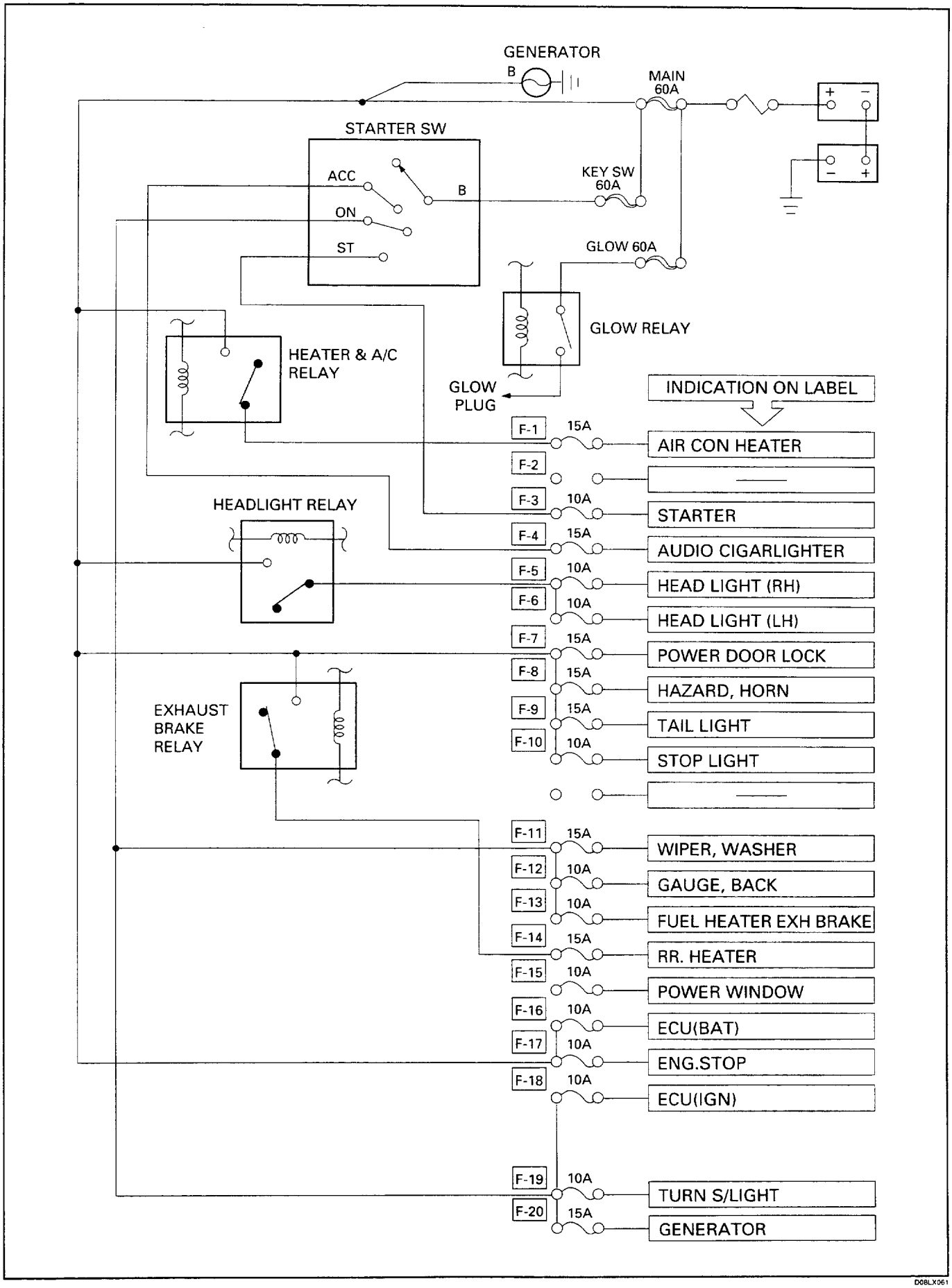
FOR 12VOLT-NHR55·NKR55



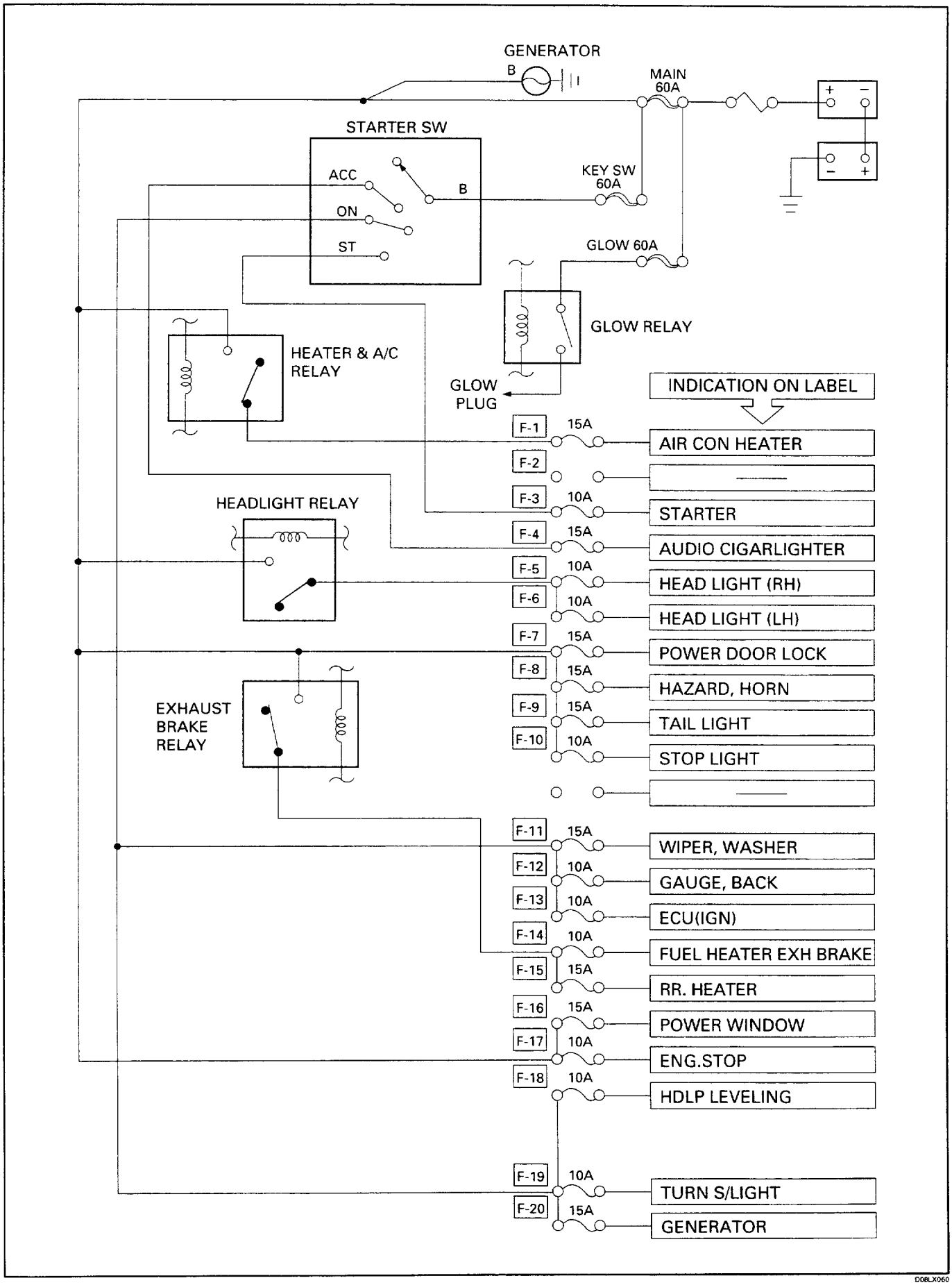
FOR 12VOLT-NPR70·NQR70



FOR 24VOLT-NKR66·NPR66·NQR66·NPR71·NQR71



FOR 24VOLT-NPR70·NQR70



D08LX060

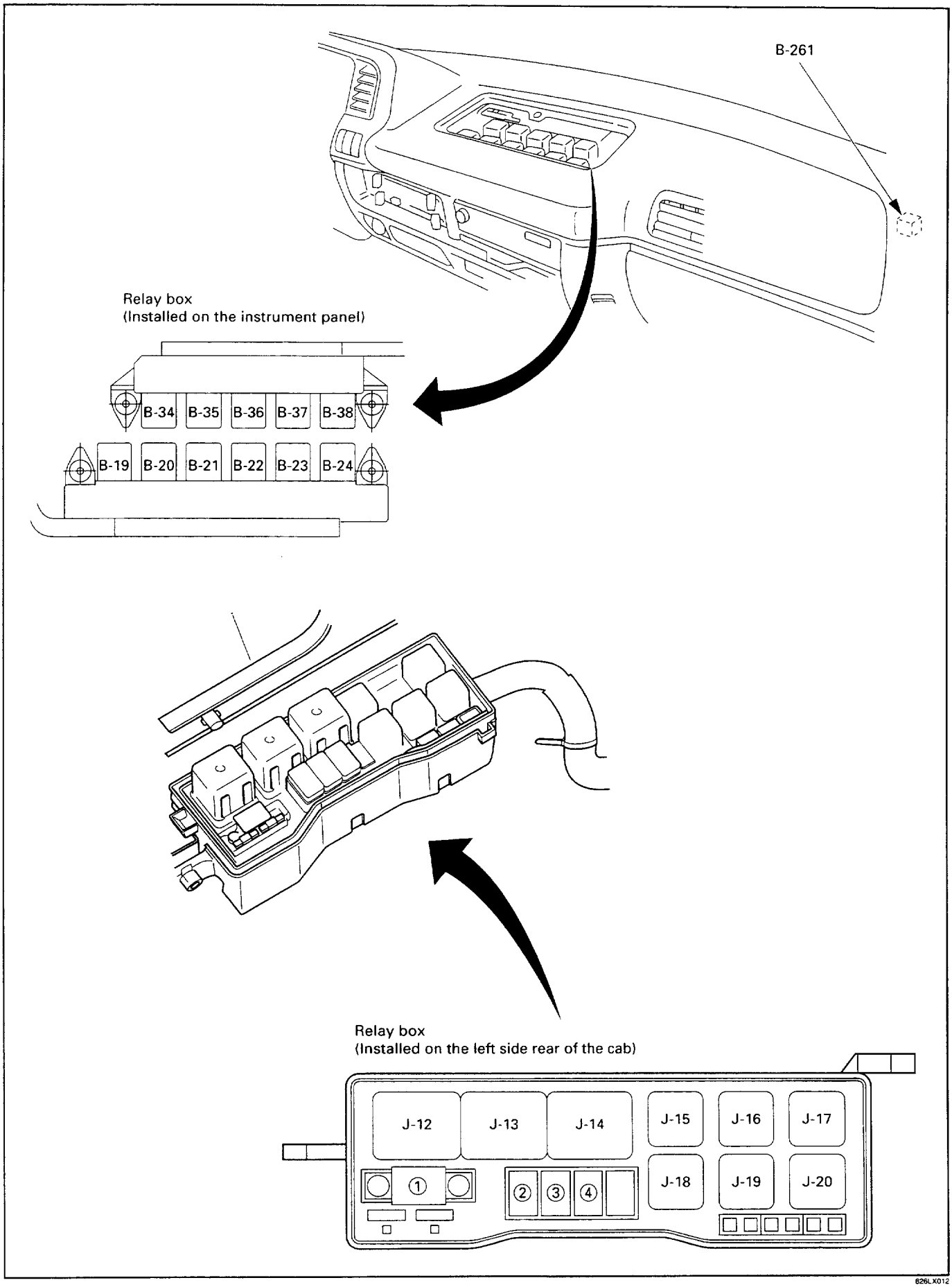
REFERENCE TABLE OF FUSE AND CIRCUIT BREAKER

FUSE

Fuse No.	Capacity	Indication on label	Main parts (Load)
F-1	25A (12V)	HEATER, AIR CON	Blower motor, Blower resistor, Fan switch
	15A (24V)		Blower motor, Blower resistor, Fan switch, A/C switch, A/C thermo relay, Pressure switch, A/C cut relay, Thermo switch (A/C cut), VSV: FICD, Electronic thermostat
F-2	10A (12V)	AIR CON	A/C switch, A/C thermo relay, Pressure switch, Magnetic clutch, VSV: FICD, Electronic thermostat
F-3	10A	STARTER	Starter relay, Inhibitor switch, QOSII controller, QOSIII controller
F-4	15A	RADIO, CIGAR	Cigar lighter, Radio
F-5	10A	HEAD LIGHT (RH)	Headlight (RH), Dimmer relay, High beam indicator light
F-6	10A	HEAD LIGHT (LH)	Headlight (LH), Dimmer relay, Cornering light relay, Cornering light, Cornering light switch
F-7	15A	CLOCK, DOOR LOCK	Radio & clock, Dome light switch, Dome light, Door switch (RH & LH), Door lock switch, Door lock actuator, Door lock controller, Speedometer, Key cylinder switch, Key remind buzzer
F-8	15A	HAZARD, HORN	Hazard warning switch, Horn, Horn relay, Horn switch, Flasher unit
F-9	15A	TAIL, FOG LIGHT	Tail relay, Illumination light(s), Fog light switch, Fog light, Lighting switch, Rear fog light switch, Rear fog light relay, Clearance light(s), Tail light(s), Rear fog light
F-10	10A	STOP LIGHT	Stoplight switch, Stoplight
F-11	15A	WIPER, WASHER	Wiper & Washer switch, Wiper motor, Washer motor, Intermittent relay
F-12	10A	METER, BACK	Exhaust brake control relay, CSD Relay, Key remind buzzer, Backup light switch, Backup light, Inhibitor Switch, Neutral switch, Starter relay, QOS II controller, QOS III controller, Glow relay, Glow-1 relay, Glow-2 relay, Glow indicator (Meter), Coolant temperature gauge, Thermo unit, vehicle speed sensor (Installed on the meter assembly & Transmission), Meter assembly, Power window relay, Cornering light relay

Fuse No.	Capacity	Indication on label	Main parts (Load)
F-13	15A (12V)	FUEL HEATER	Fuel heater
	10A (24V)		
F-14	15A	REAR HEATER	Rear heater, Rear heater switch
F-15	10A	EXH. BRAKE	Exhaust brake switch, Exhaust brake control relay, Exhaust brake magnetic valve, Clutch switch, Accel switch
F-16	10A (12V)	FOG LIGHT	Fog light switch, Fog light
	10A (24V)	ECU (IGN)	
F-17	10A	TURN S/LIGHT	Flasher unit, Front turn signal light, Rear turn signal light, Turn signal light switch, Hazard warning switch
F-18	15A	GENERATOR	Generator, Charge relay, QOSIII controller
F-19	10A	ENG. STOP	Engine stop motor, Fuel cut solenoid
F-20	10A (12V)	LEVELING	Headlight leveling switch, Headlight leveling motor (actuator)
F-21	15A	MARKER LIGHT	Marker light, Marker light relay

RELAY LOCATION



RELAY LIST

○ standard △ option

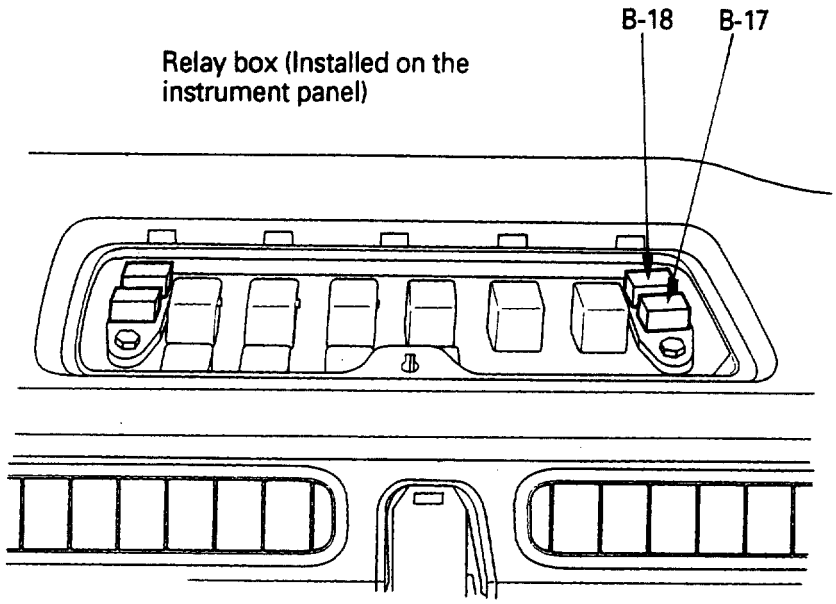
Voltage	Model \ Name / Connector No.	B-9 Inter-mittent	B-19 Charge	B-20 Head-light	B-21 Heater & AIR CON.	B-22 Tail	B-23 Dimmer
12V	NHR 55	△	○	○	○	○	○
	NKR 55	△	○	○	○	○	○
	NKR 69	△	○	○	○	○	○
	NPR 65	△	○	○	○	○	○
	NPR 69	△	○	○	○	○	○
24V	NKR 58	△	○	○	○	○	○
	NKR 66	△	○	○	○	○	○
	NPR 58	△	○	○	○	○	○
	NPR 66	△	○	○	○	○	○
	NQR 66	△	○	○	○	○	○
	NQR 71	△	○	○	○	○	○

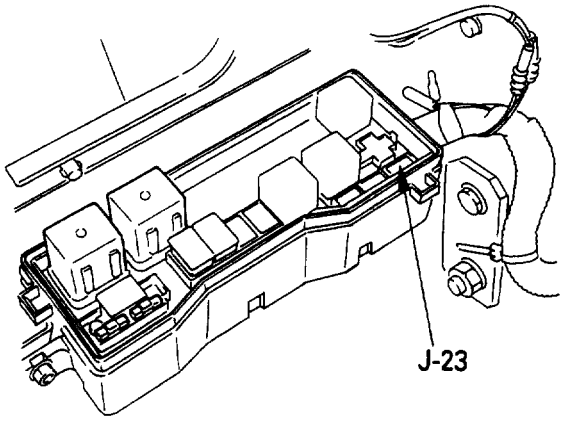
Voltage	Model \ Name / Connector No.	B-24 Horn	B-34 (EUROPE) Rear fog	B-35 (EXCEPT EUROPE) Cornering light	B-36 Power window	B-37 A/C Thermo
12V	NHR 55	○	—	○	○	△
	NKR 55	○	—	○	○	△
	NKR 69	○	○	○	○	△
	NPR 65	○	○	○	○	△
	NPR 69	○	○	—	○	△
24V	NKR 58	○	—	○	○	△
	NKR 66	○	—	○	○	△
	NPR 58	○	—	○	○	△
	NPR 66	○	—	○	○	△
	NQR 66	○	—	○	○	△
	NQR 71	○	—	○	○	△

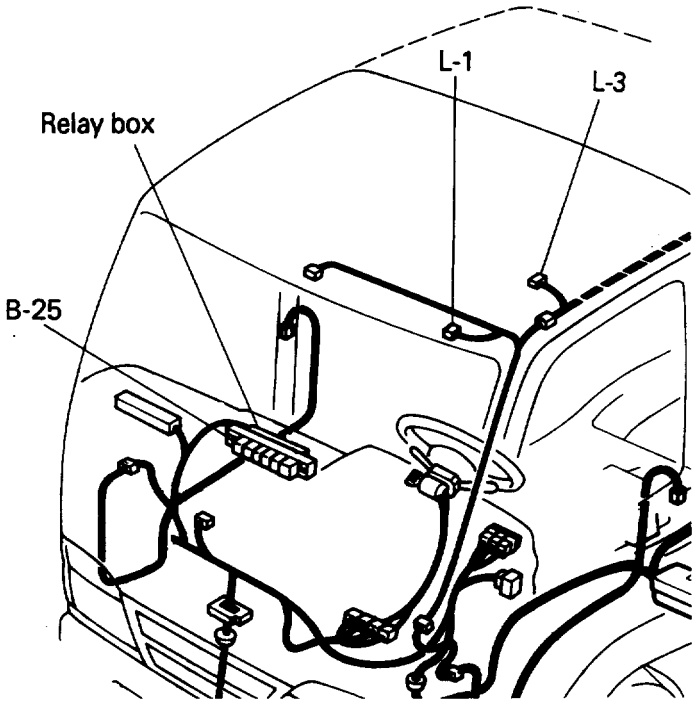
Voltage	Model \ Name / Connector No.	B-38 Exh. brake	J-12 Starter	J-13 Glow	J-13 Glow-1	J-14 Glow-2	J-16 CSD
12V	NHR 55	△	○	○	—	—	○
	NKR 55	△	○	○	—	—	○
	NKR 69	○	○	—	○	○	—
	NPR 65	○	○	—	○	○	—
	NPR 69	○	○	—	○	○	—
24V	NKR 58	○	○	○	—	—	—
	NKR 66	○	○	○	—	—	—
	NPR 58	○	○	○	—	—	—
	NPR 66	○	○	○	—	—	—
	NQR 66	○	○	○	—	—	—
	NQR 71	○	○	○	—	—	—

Voltage \ Connector No. / Name / Model	J-18	J-19	J-20
	Exh. brake control	A/C cut	Marker light
12V	NHR 55	○	—	—
	NKR 55	○	—	—
	NKR 69	○	—	○
	NPR 65	○	—	○
	NPR 69	○	—	○
24V	NKR 58	○	○	—
	NKR 66	○	—	—
	NPR 58	○	○	—
	NPR 66	○	—	—
	NQR 66	○	—	—
	NQR 71	○	—	—

DIODE LOCATION







Connector No.	B-17	B-18	B-25	J-23	L-1	L-3
Usage	A/C Door switch	Lighting	QOS-III	VSV: FICD	Dome light	Dome light

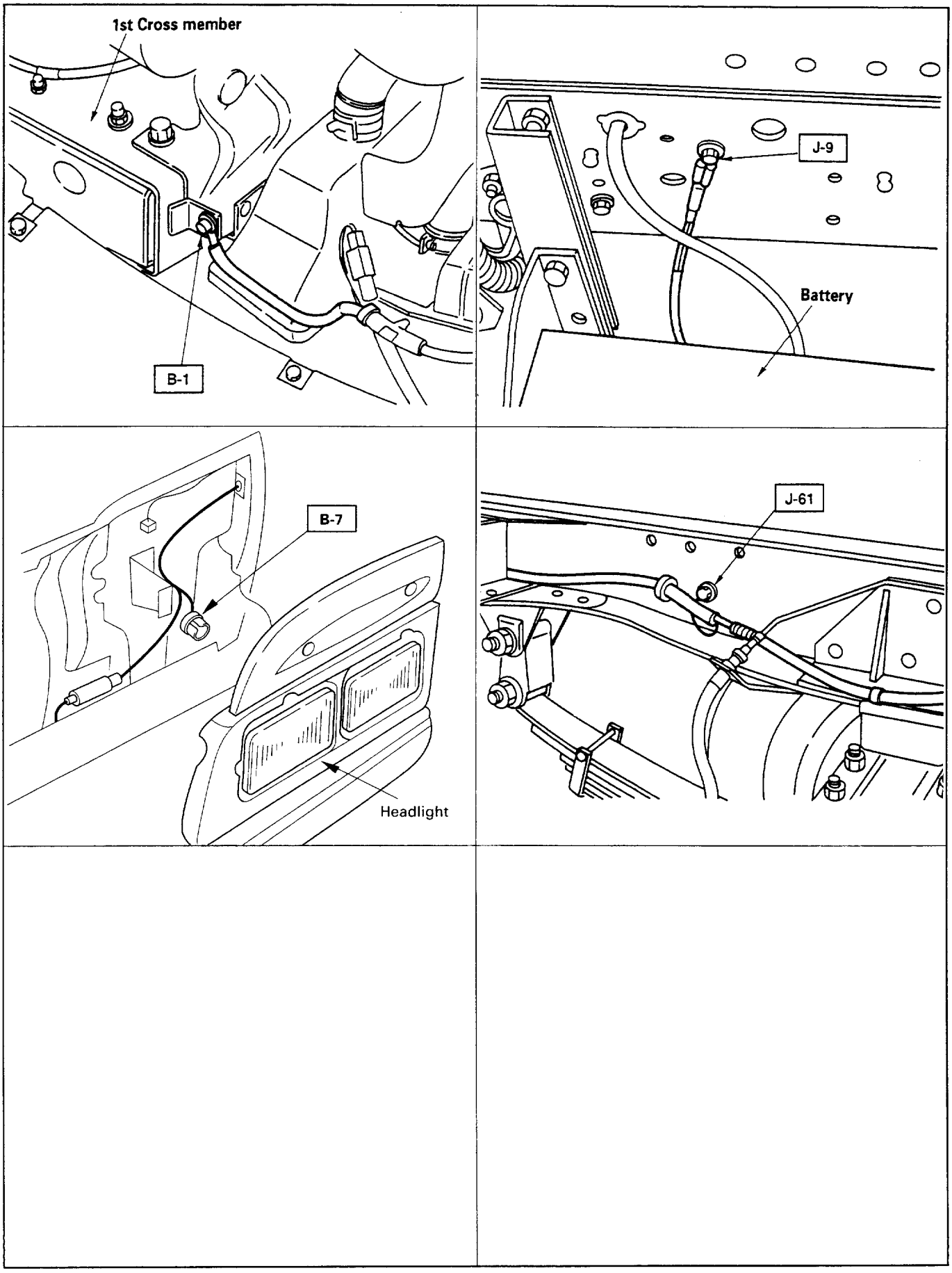
REFERENCE TABLE OF GROUNDING POINT

Note:

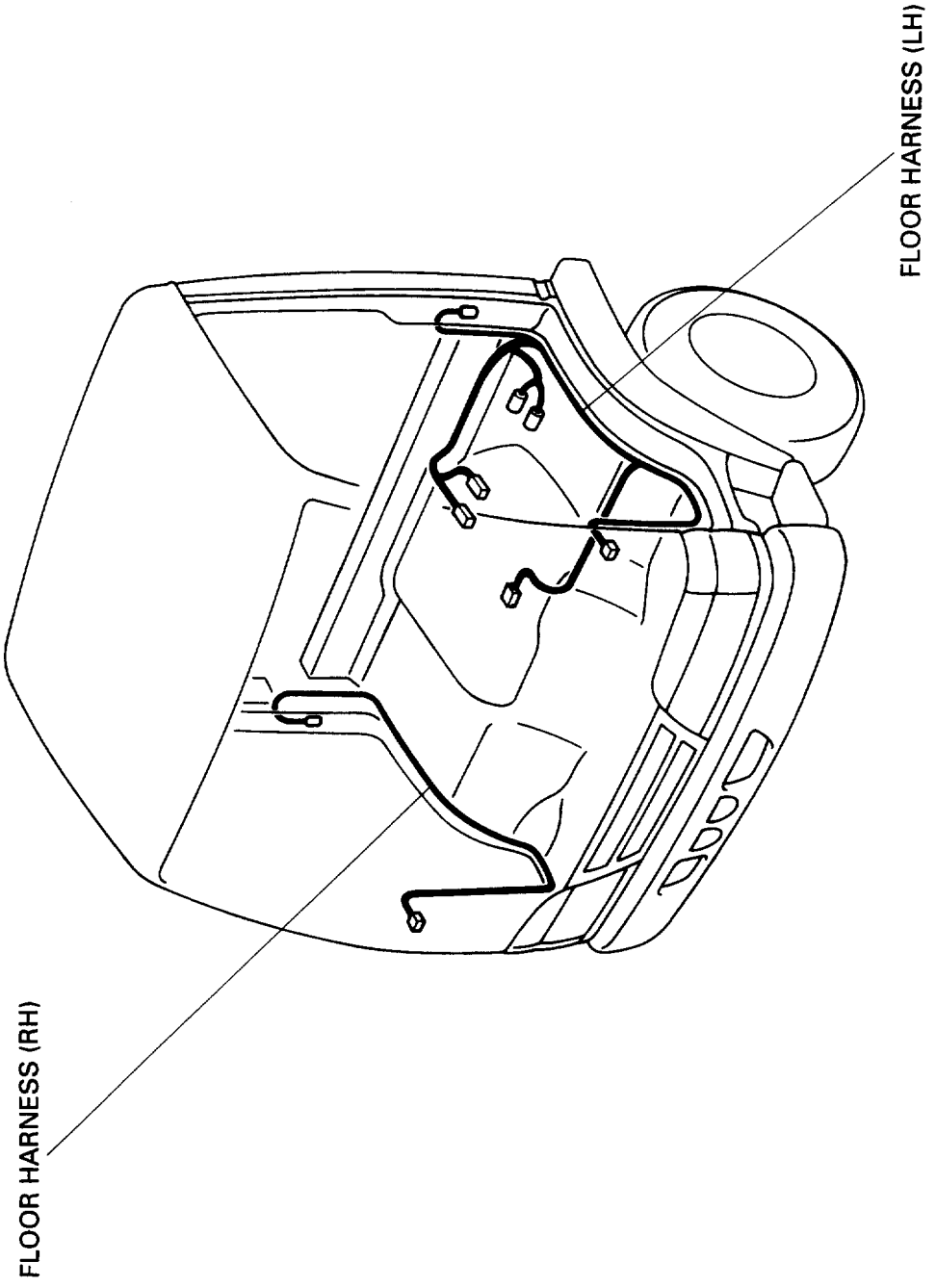
Abnormal phenomena of electrical components are considered resulted from defective grounding. In repair, be sure to inspect grounding points and to tighten all fastening parts surrounding the grounding points.

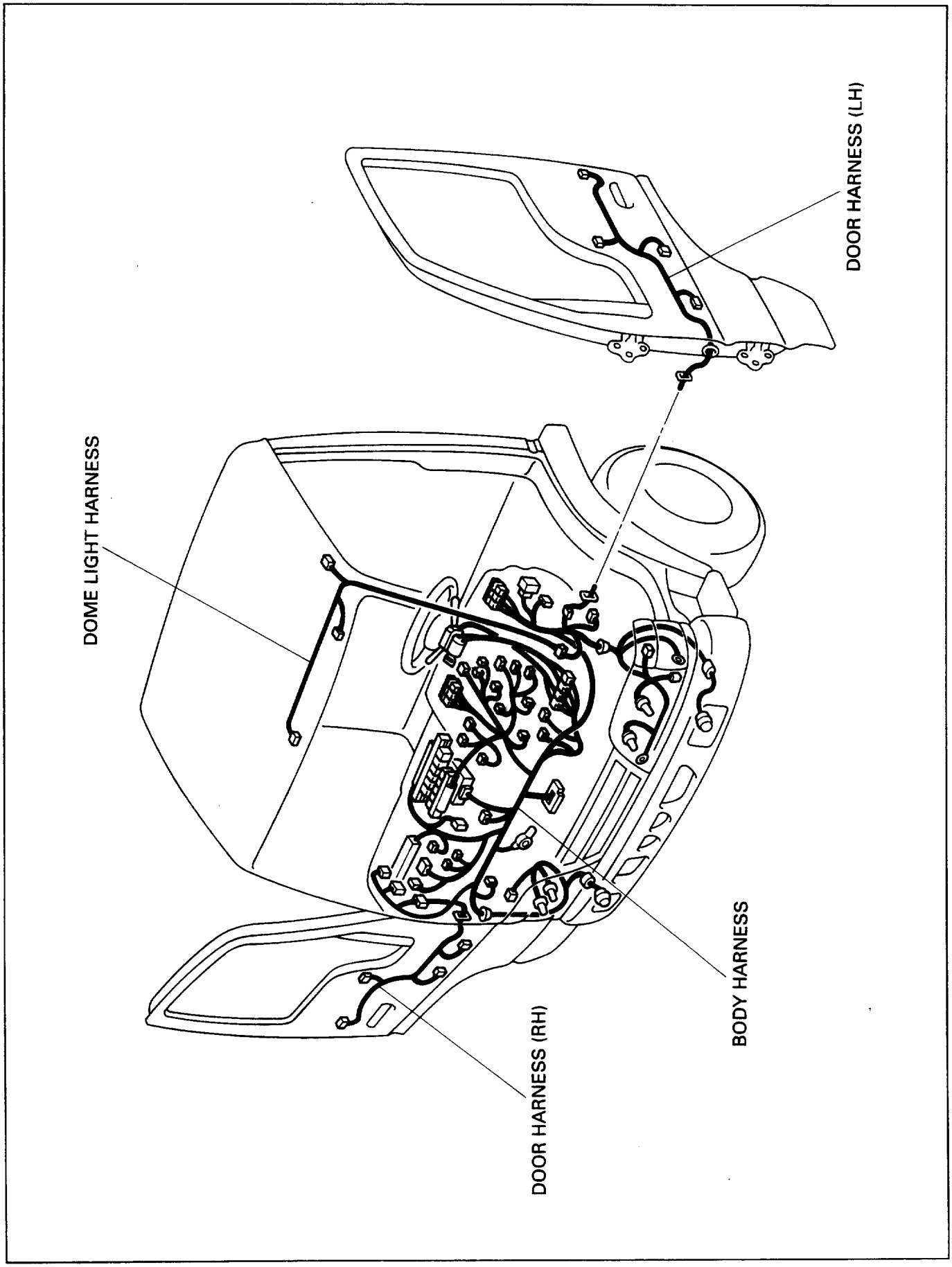
Connector No.	Cable harness name	Location	Main parts (Load)
B-1	Body harness	Frame-LH (FRT)	Vehicle speed sensor, QOS-III Control unit, Turn signal indicator light, Meter, High beam indicator light
B-7		Headlight bracket-LH	Charge relay, Exhaust brake relay, QOS II control unit, QOS III control unit, Dome light switch, Key remind and back up buzzer, Meter, Brake fluid switch, Tail relay, Cornering light switch, Cornering light, Cornering light relay, Fog light switch, Fog light, Dimmer relay, Door lock switch, Door lock relay, Power window switch (RH), Power window relay, Stoplight switch, Mirror switch, Wiper motor, Washer motor intermittent relay, Radio, Cigar lighter, Heater & A/C relay, Fan Switch, Horn relay, Rear heater switch, Rear heater, Radio & clock, Cigar lighter, Fan switch, Blower resistor, A/C Switch, Blower motor, Electronic thermostat, Accel switch, Door lock switch, Door lock controller, Headlight leveling switch, Headlight leveling motor, Power window relay, Power window switch, QOS III control unit
J-9	Frame front harness	Frame-LH (CTR)	Marker light relay, Marker light, Water sedimenter switch, Fuel tank unit, Starter relay,Neutral switch, Fuelheater, Pressure switch, A/C thermo relay, VSV: FICD, Exhaust brake control relay, Exhaust brake magnetic valve, Accel switch, Clutch switch, VSV: intake throttle, Engine stop motor
J-61	Frame rear harness	Frame-LH (RR)	License plate light, Taillight, Rear fog light, Rear turn signal light, Stoplight, Stoplight Switch, Backup light

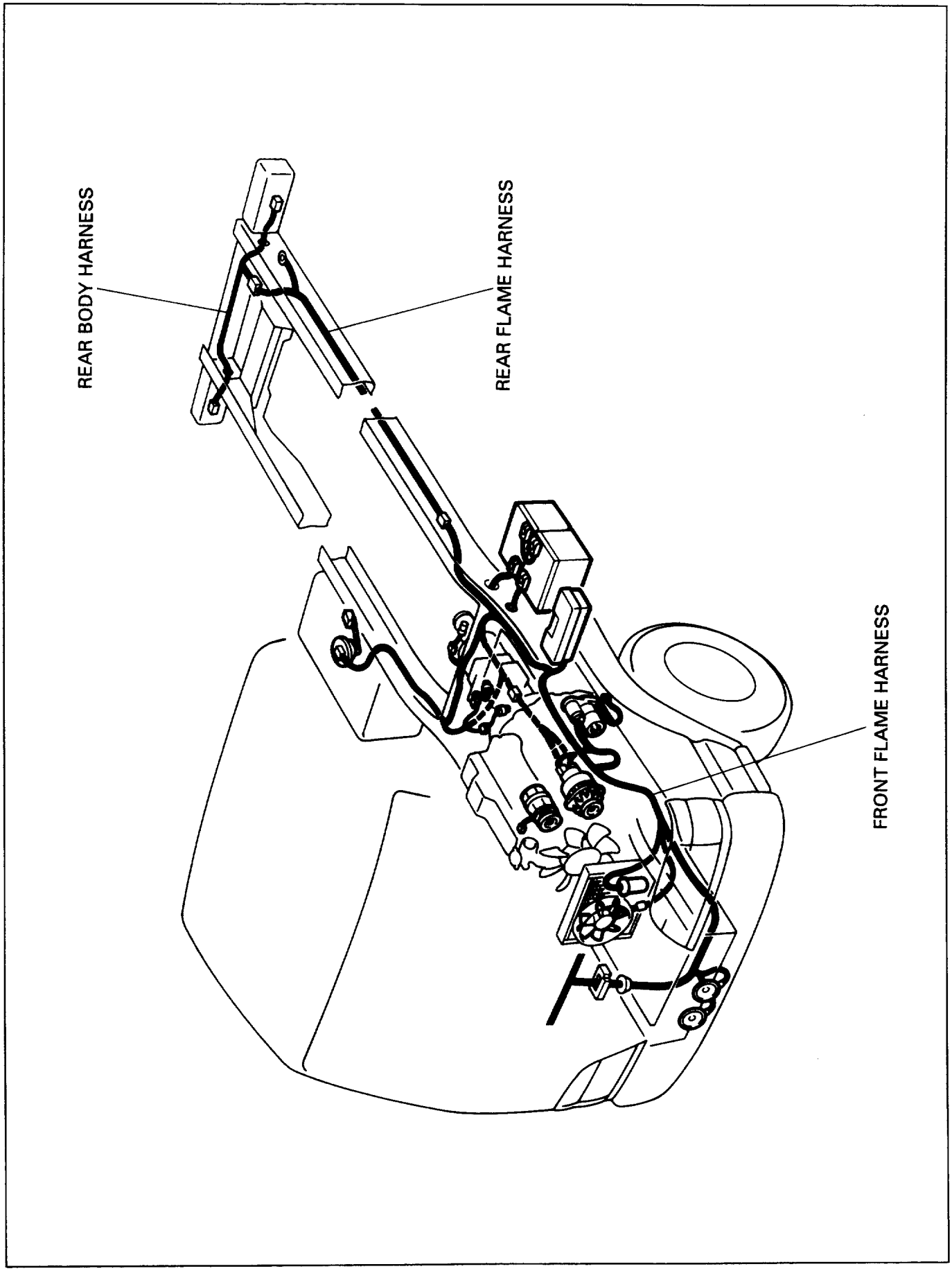
GROUNDING POINT LOCATION



CABLE HARNESS ROUTING




DOME LIGHT HARNESS
DOOR HARNESS (LH)
DOOR HARNESS (RH)
BODY HARNESS


REAR BODY HARNESS
REAR FLAME HARNESS
FRONT FLAME HARNESS

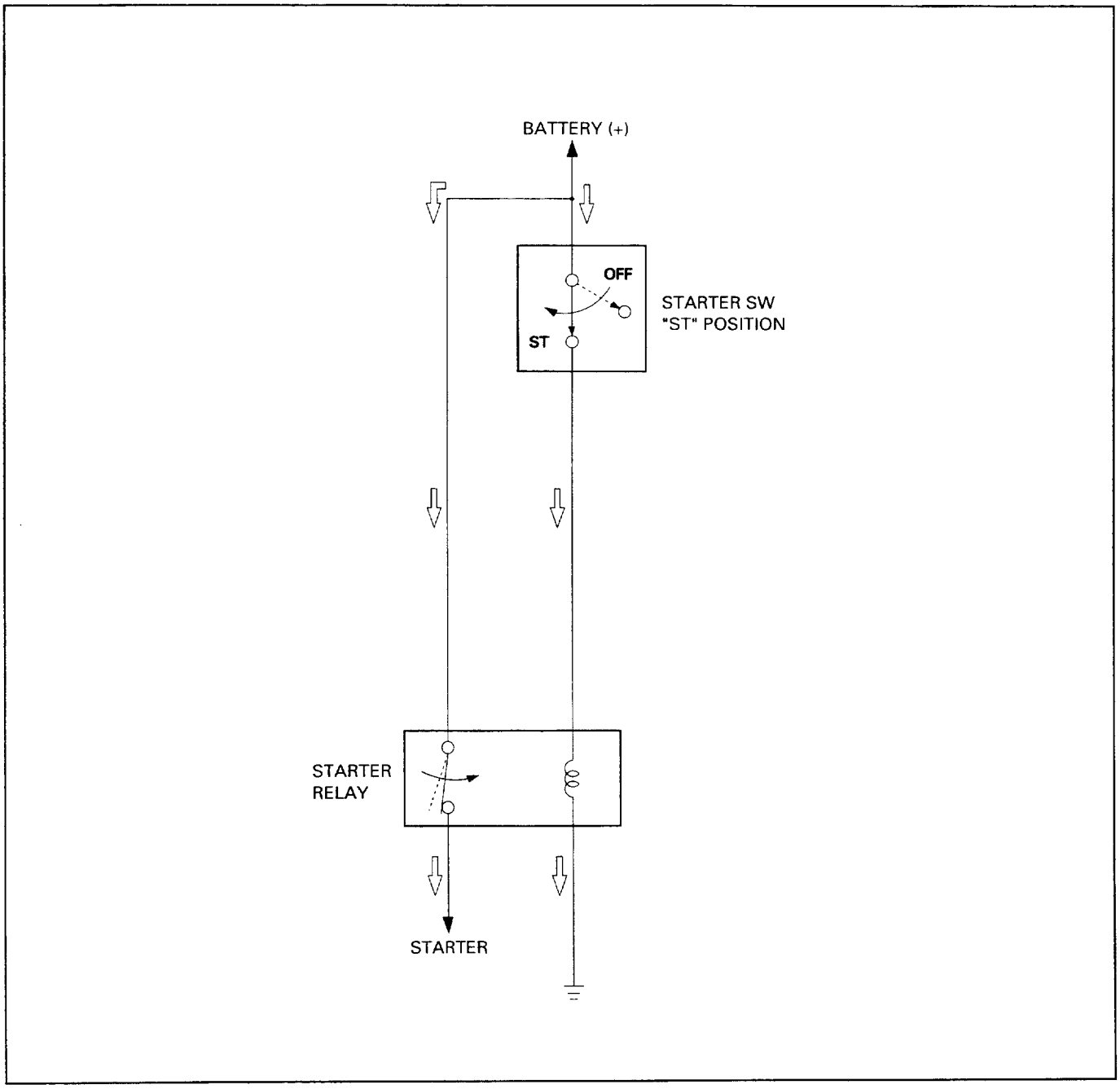
SYSTEM REPAIR

START AND CHARGING

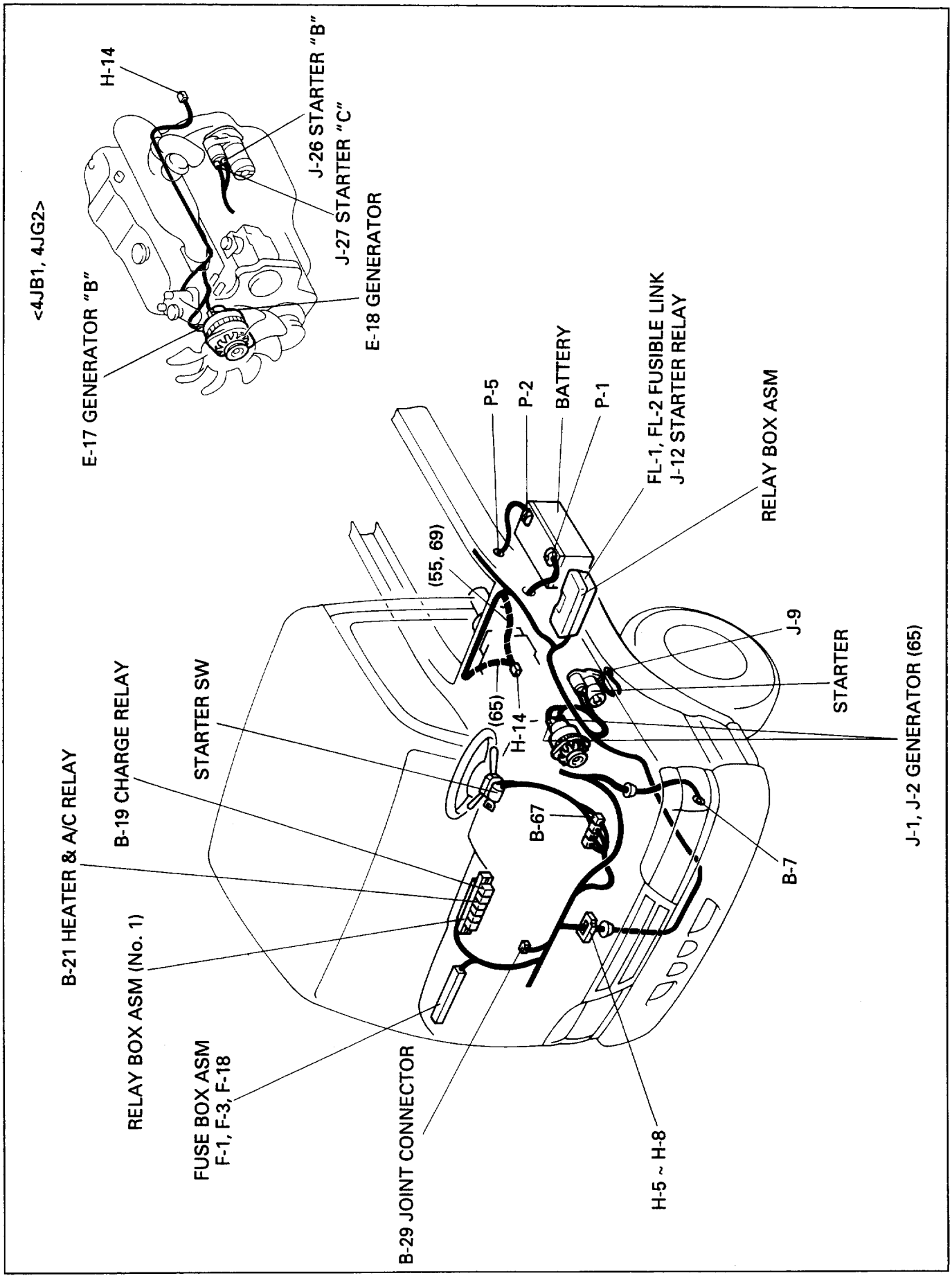
GENERAL DESCRIPTION

The system consists of the starter switch, starter, AC generator, starter relay, charge relay and heater and A/C relay. When the starter SW is set to the "ST" position, the battery voltage is applied to the starter solenoid coil through the starter relay to start the starter.

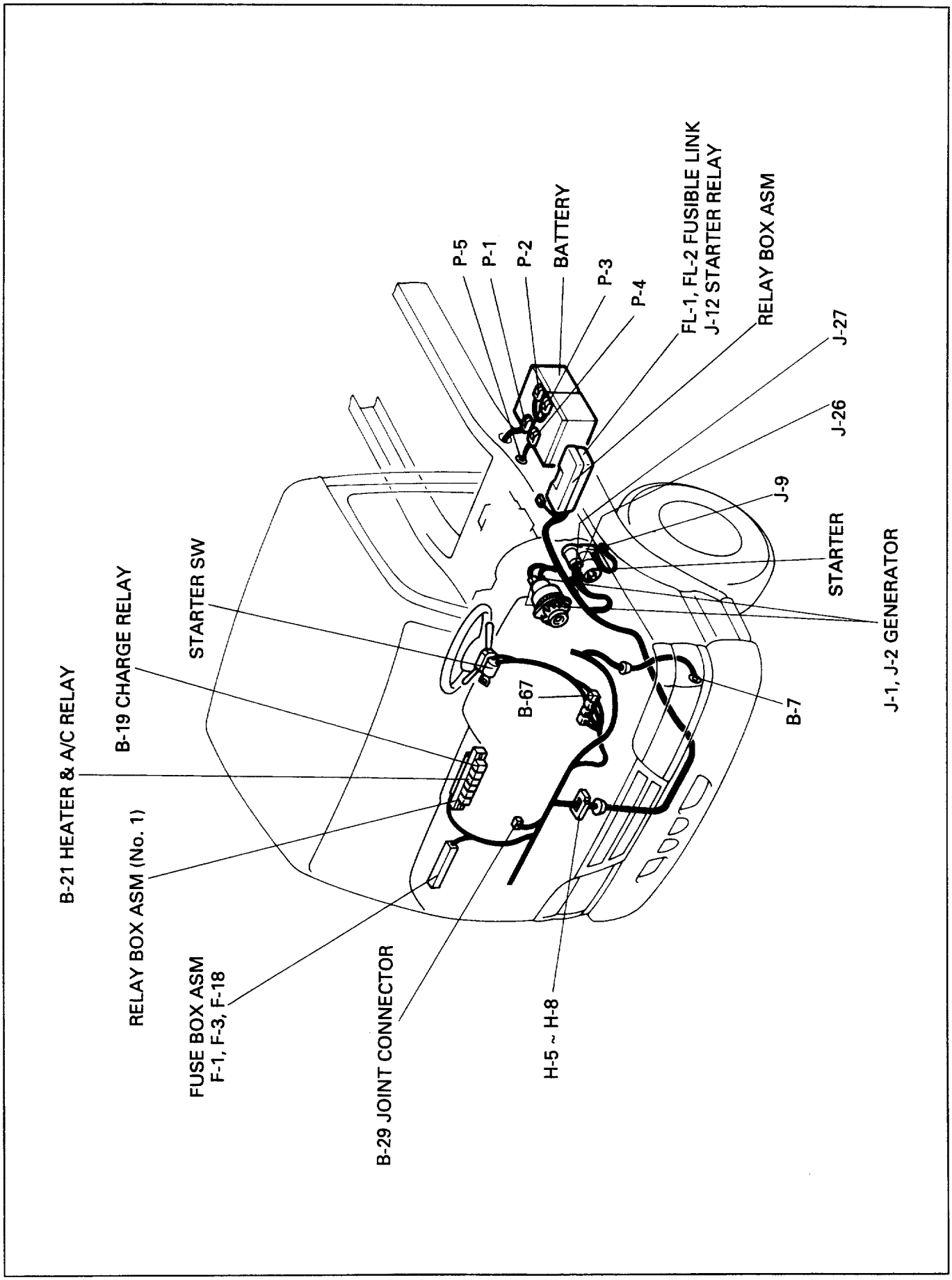
STARTING CIRCUIT



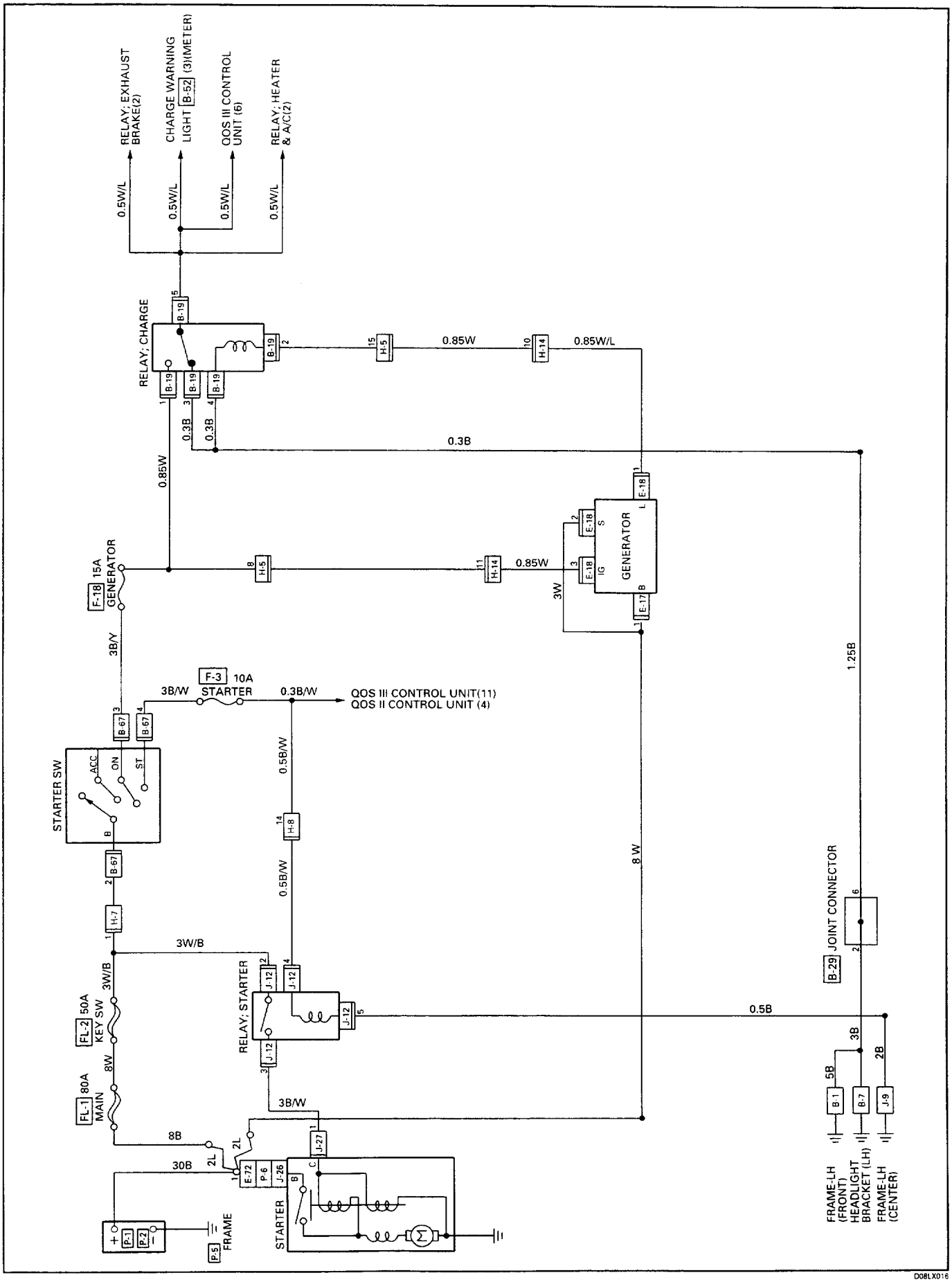
PARTS LOCATION - FOR 12 VOLT



PARTS LOCATION - FOR 24 VOLT



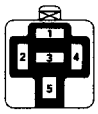
CIRCUIT DIAGRAM - FOR 4J TYPE ENGINE



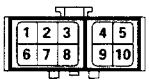
D08LX016

CONNECTOR LIST - FOR 12 VOLT

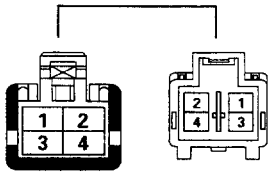
B-19



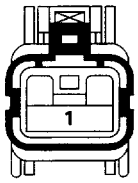
B-29



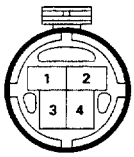
B-67



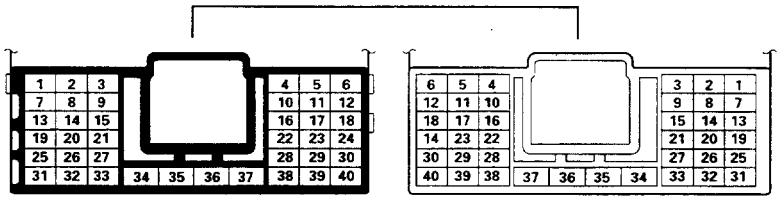
E-17



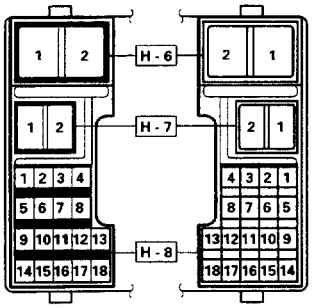
E-18



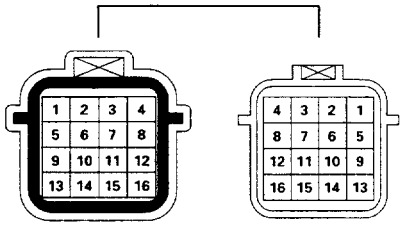
H-5



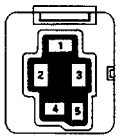
H-6 H-7 H-8



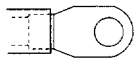
H-14



J-12

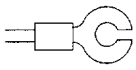


J-26 P-6

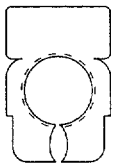


J-27

J-27 (65)

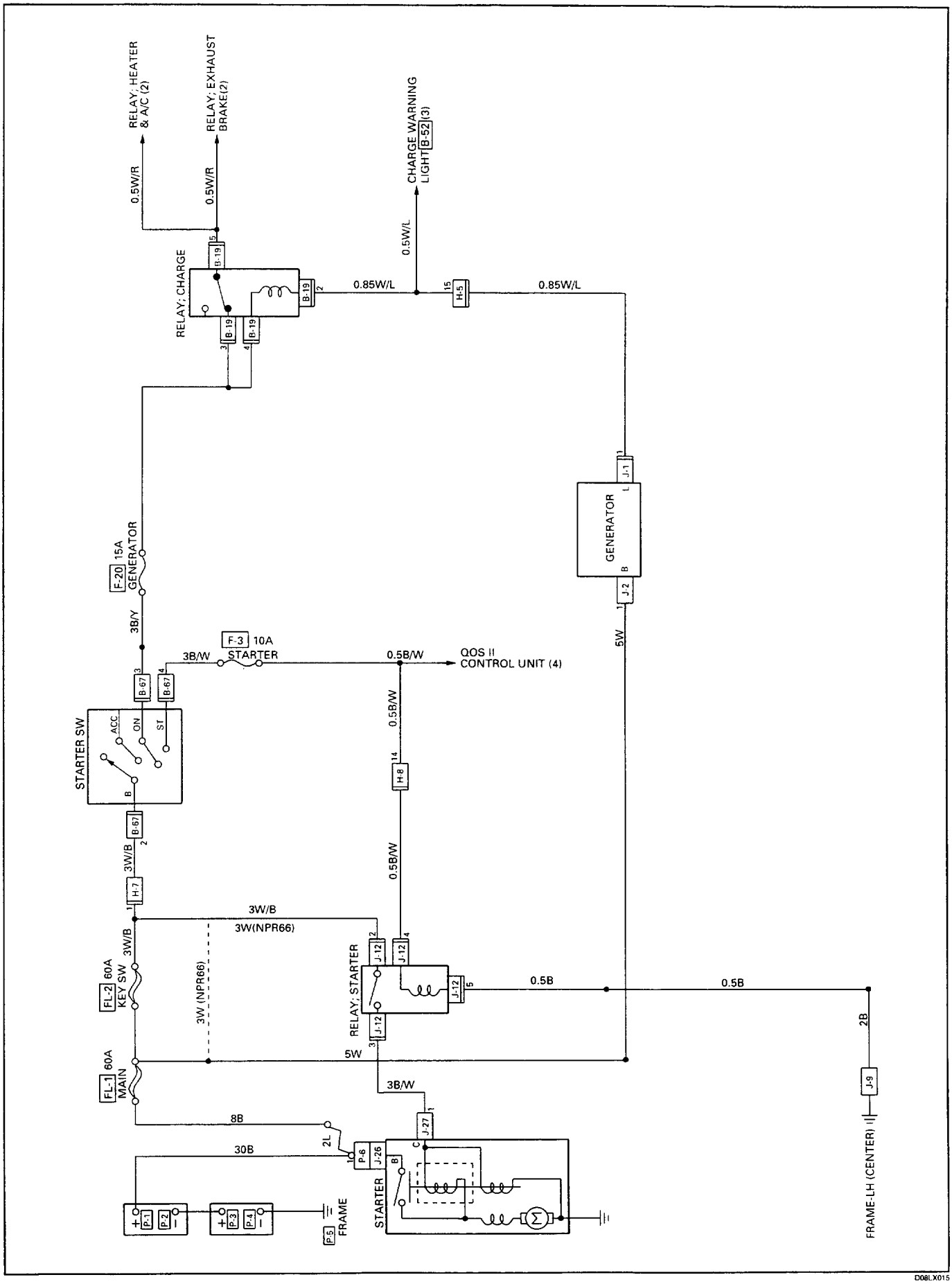


P-1 P-2



P-5

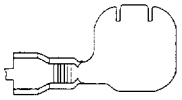
CIRCUIT DIAGRAM - FOR 4H TYPE ENGINE



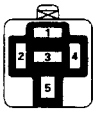
D08LX015

CONNECTOR LIST - FOR 24 VOLT

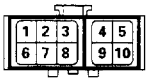
B-7



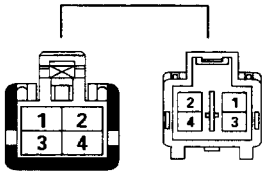
B-19



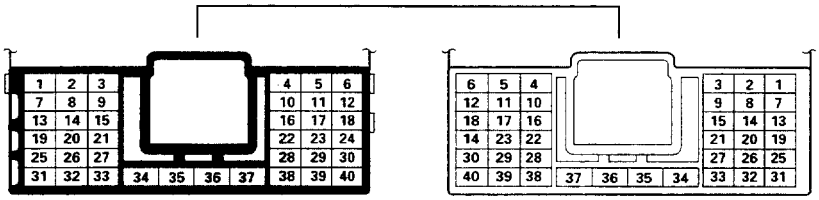
B-29



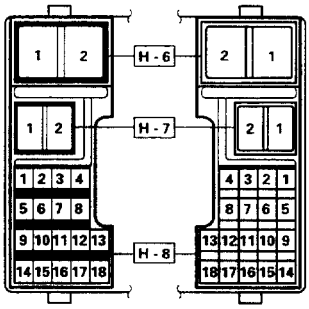
B-67



H-5

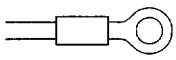


H-6 H-7 H-8

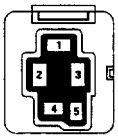


J-1

J-2 J-9

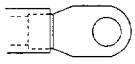


J-12

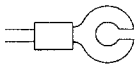


J-26 P-6 (N*R58)

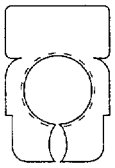
P-5



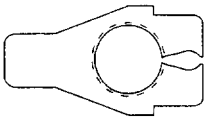
J-27



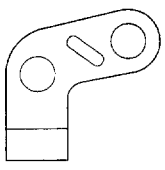
P-1 P-4

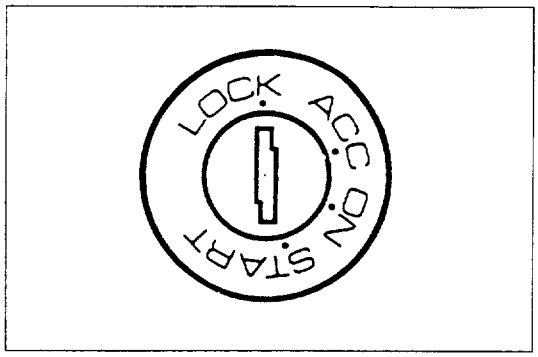


P-2 P-3



P-6 (N*R66)



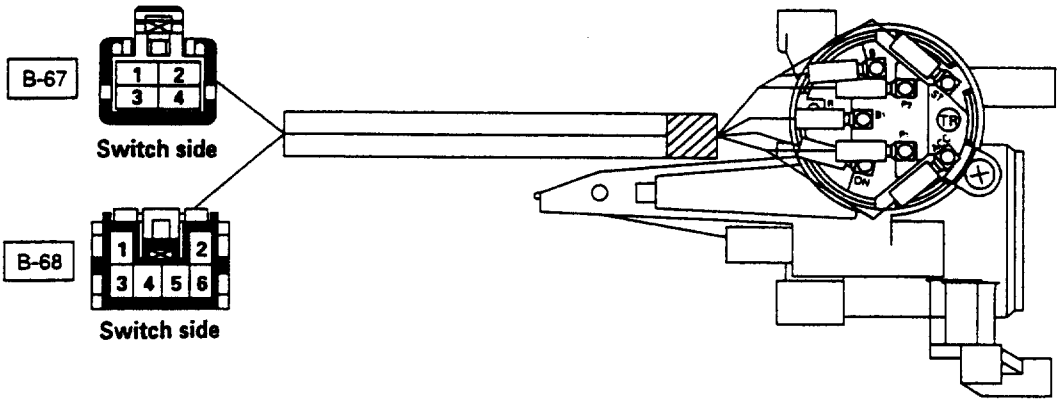


STARTER SWITCH

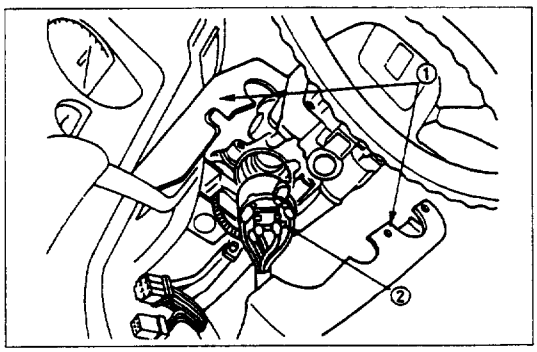
The starter switch positions are LOCK, ACC, ON and START. Turning the starter key to these positions a circuit for starting the engine, the operation of accessories, or stop the engine.

INSPECTION

Check the continuity between the starter switch connector terminals.
Repair or replace the switch when the result of inspection is found abnormal.



Connector No.		B-67				B-68				
Starter SW key position / Terminal No.		1	2	3	4	1	2	4	5	6
		ACC	B	ON	ST	B1	P1	P2	W	W
Removed	LOCK					○—○				
Inserted	ACC	○—○				○—○				
	ON	○—○	○—○			○	○	○	○—○	
	START		○—○	○—○		○	○	○		



REMOVAL

Preparation:
Disconnect the battery ground cable.

1. **Steering Cowl**
   Remove four screws and take off the steering cowl.
2. **Starter Switch**
   1) Disconnect the connector.
   2) Remove the screw.

QOS (QUICK ON START) SYSTEM

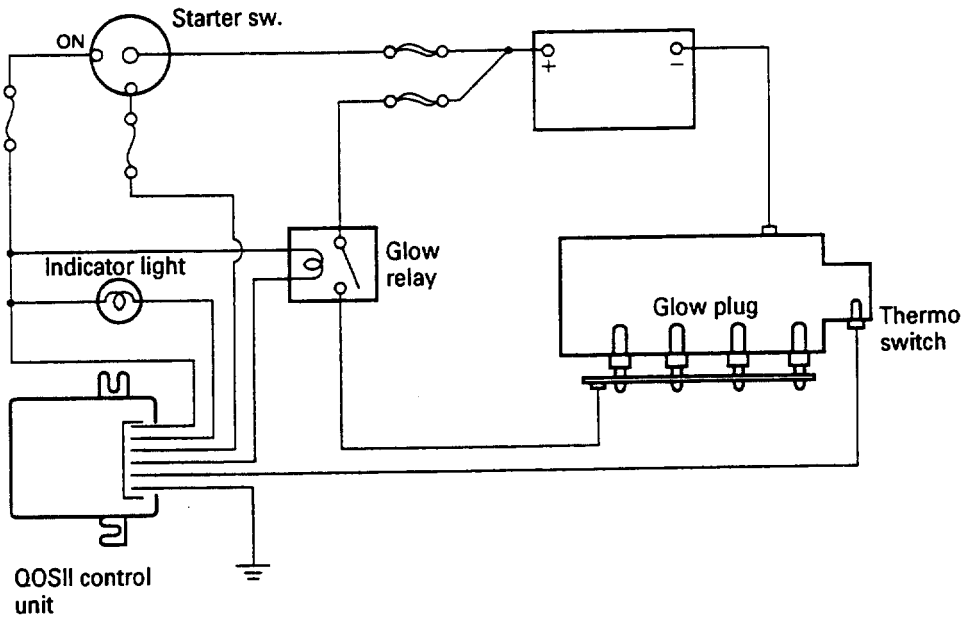
QOSII: 4BE1, 4HF1 AND 4JB1 MODEL ENGINE

GENERAL DESCRIPTION

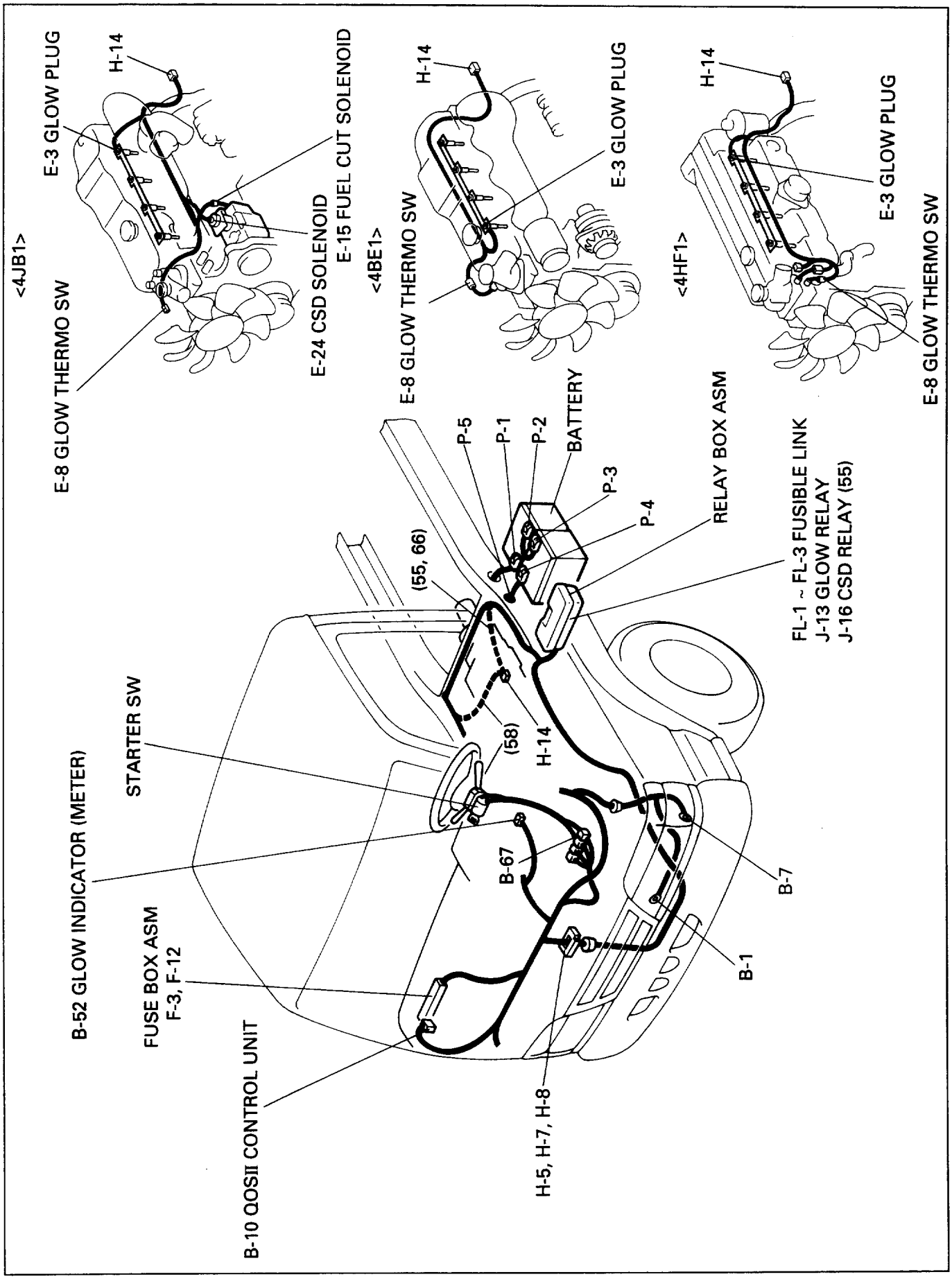
The circuit consists of starter switch, QOSII control unit, glow relay, thermo switch, glow plug, fuel cut solenoid, CSD relay, CSD solenoid and glow indicator light.
The QOS-II controller controls are glow plug relay by the ON or OFF signal of QOS thermo switch. Immediately when the starter switch turns "ON", the glow plug relay indicator light turns on to start preheating.
The engine should be started after the indicator light is off. However, the glow plug relay keeps preheating for a fixed period even after the indicator light turns off. When the fixed time is over, QOS-II controller performs to switch the glow plug relay off to stop preheating.
For details, refer to 6D6 "PREHEATING SYSTEM".

SYSTEM CIRCUIT

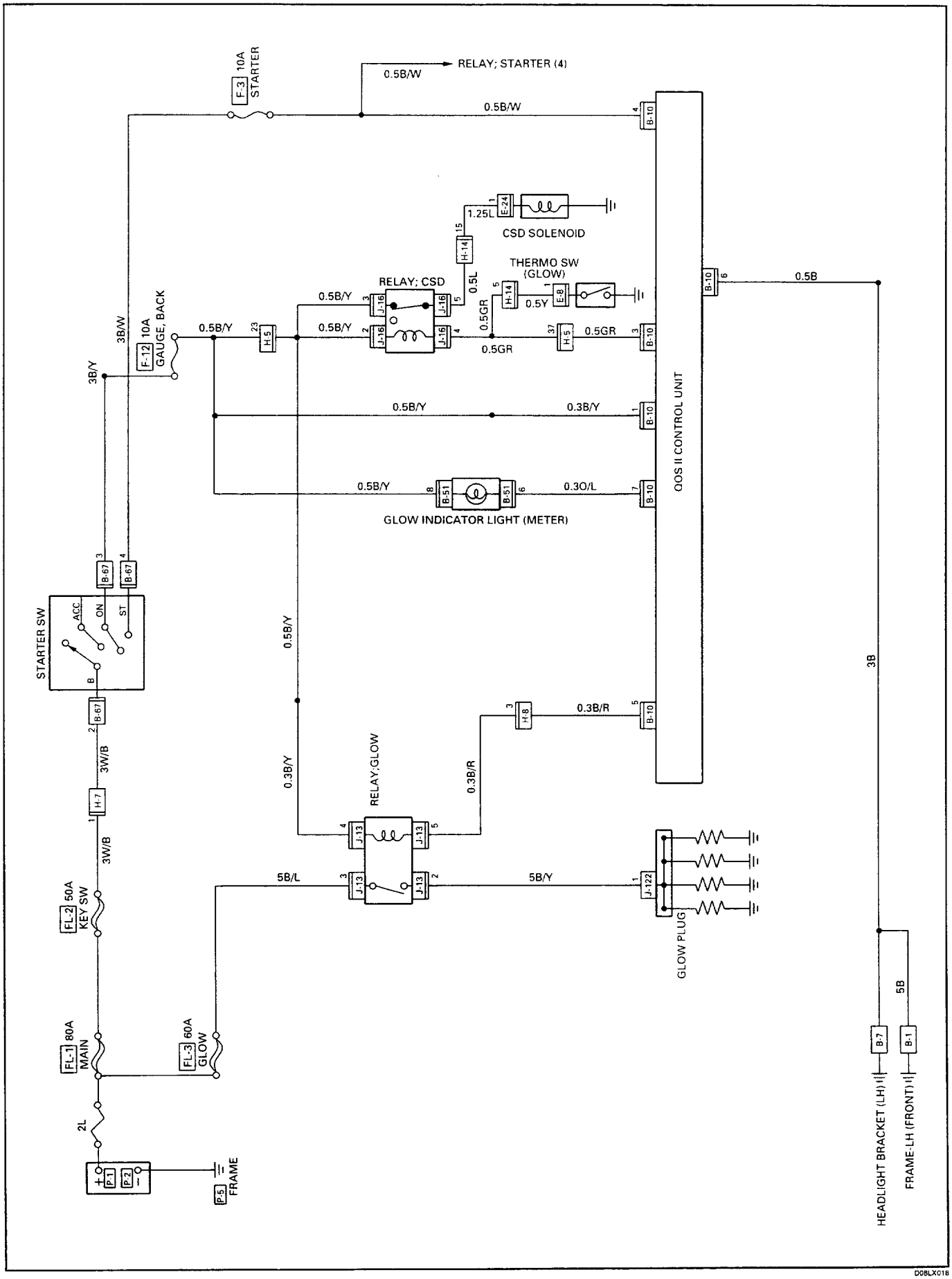
This illustration is based on N*R 58•66•55



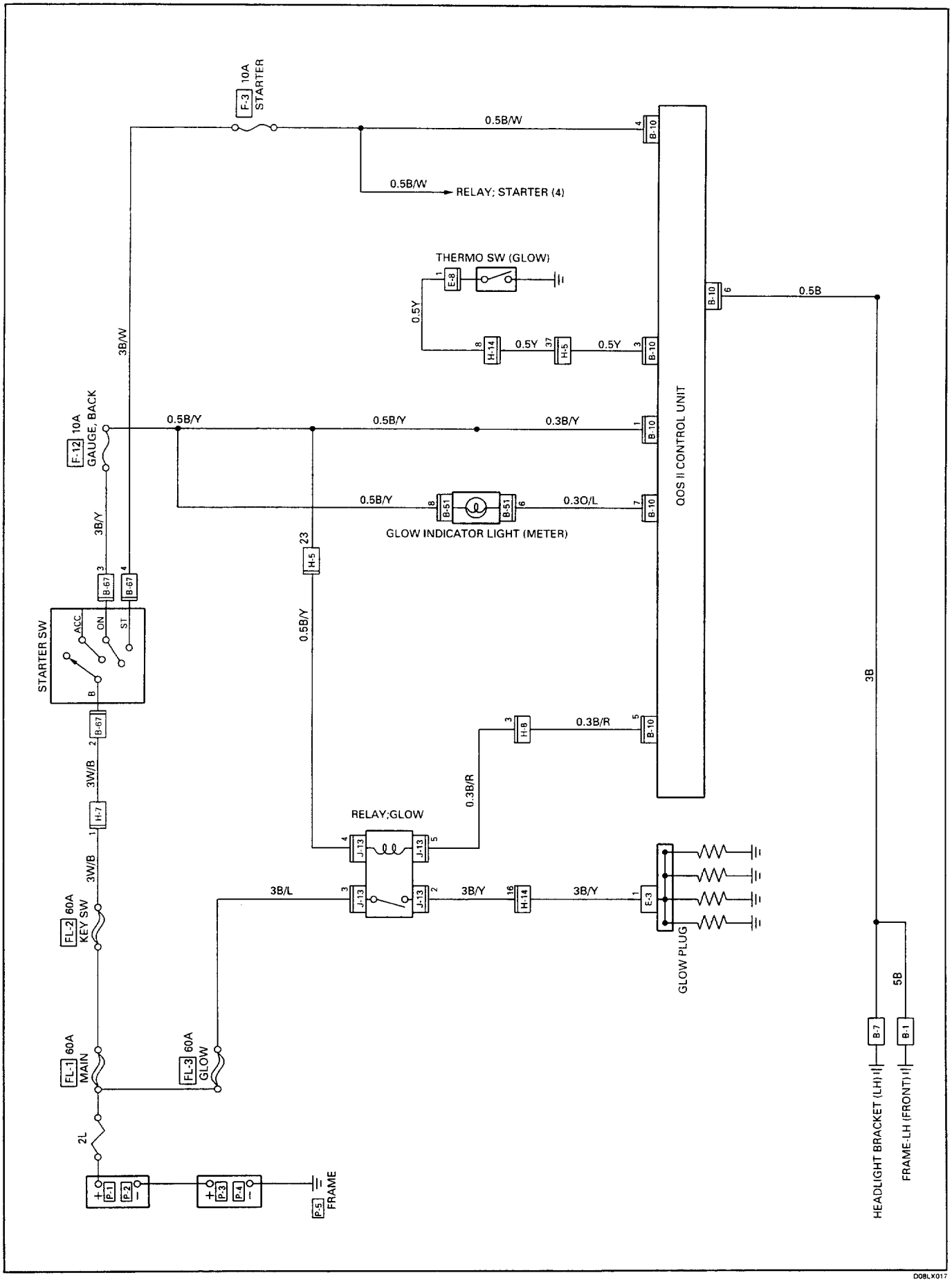
PARTS LOCATION



CIRCUIT DIAGRAM - NHR55 · NKR55



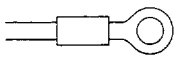
CIRCUIT DIAGRAM - NKR66 · NPR66 · NQR66



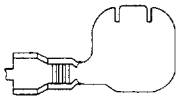
D08LX017

CONNECTOR LIST

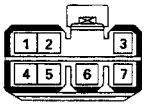
B-1



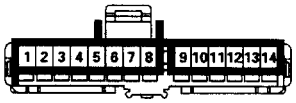
B-7



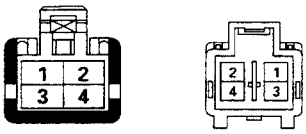
B-10



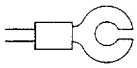
B-51



B-67

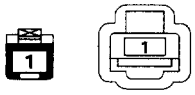


E-3

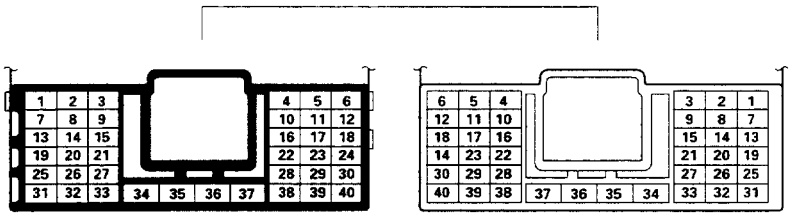


E-8

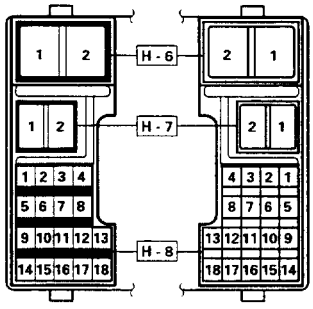
E-15 E-24



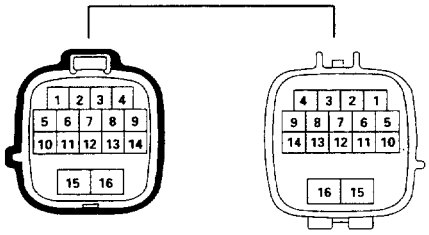
H-5



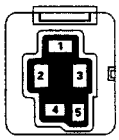
H-7 H-8



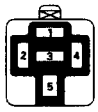
H-14 (4H type ENGINE)



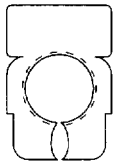
J-13



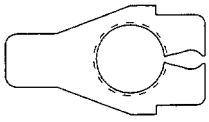
J-16



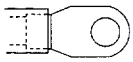
P-1 P-4



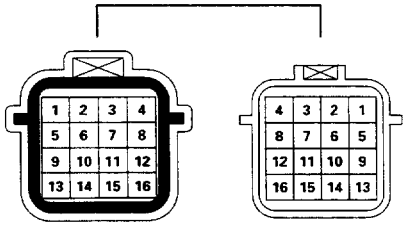
P-2 P-3



P-5



H-14 (4J type ENGINE)

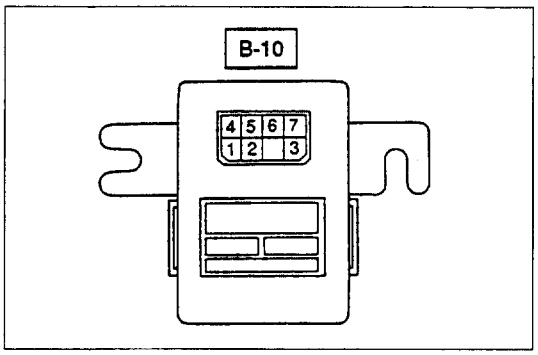


STARTER SWITCH

Refer to "START AND CHARGING" in this section.

GLOW INDICATOR LIGHT THERMO SWITCH

Refer to "METER AND WARNING/INDICATOR LIGHT" in this section.



QOSII CONTROL UNIT

Terminal No.	Connected to
1	Starter switch (ON)
2	—
3	Thermo switch
4	Starter switch (ST)
5	Glow relay
6	Ground
7	Glow indicator (Meter)

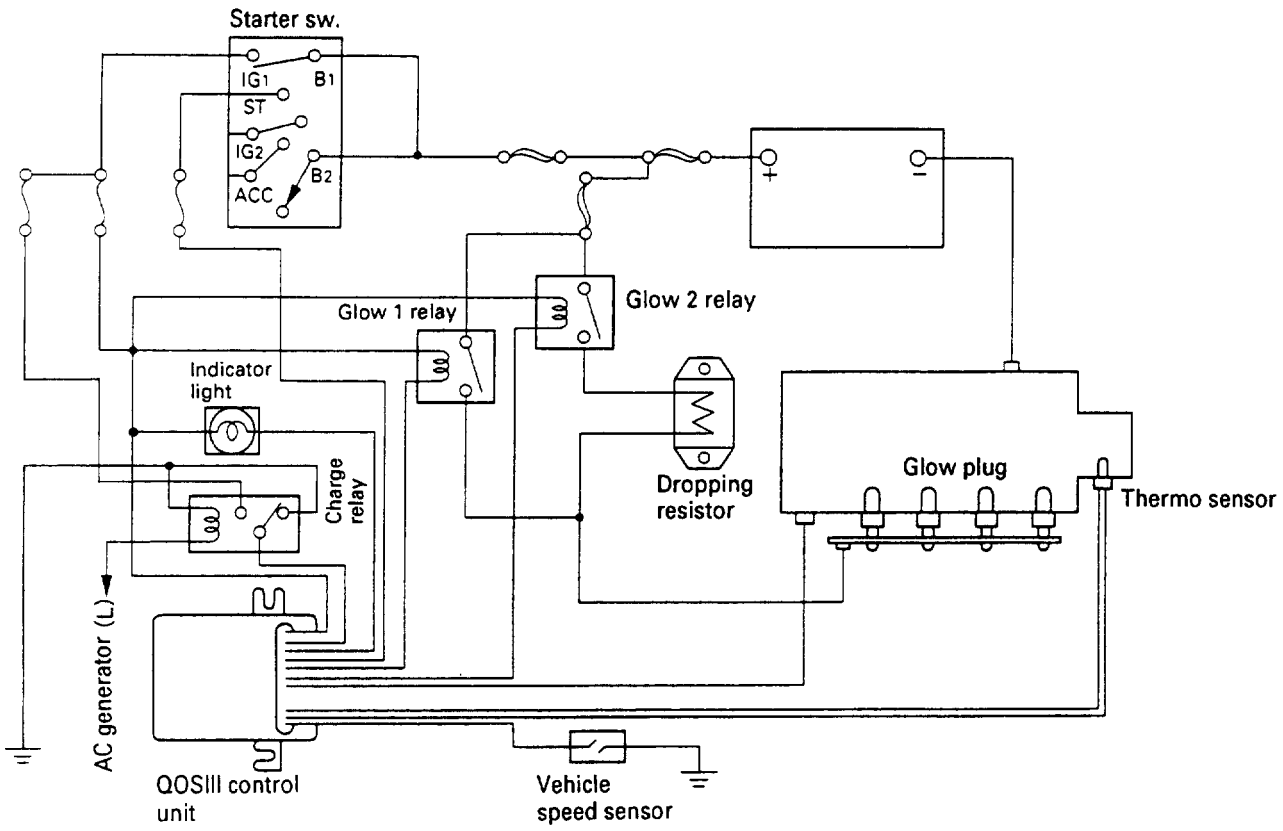
QOSIII - 4BD2-TC AND 4JG2 ENGINE MODEL

GENERAL DESCRIPTION

The system consists of starter switch, QOS III control unit, glow relay, charge relay, fuel cut solenoid, dropping resistor, thermo sensor, glow plug, engine speed sensor, accel switch and glow indicator light.
Perceiving the engine coolant temperature when the engine started, the thermo sensor varies the glowing time to always get the most suitable condition for engine starting.
The indicator timer starts to operate as soon as the starter switch turns to "ON" position, and the indicator light turns on and keeps lit until the glow plugs have been heated to the level ready for the engine starting, when the indicator light is off.
For details, refer to section 6D6 "PREHEATING SYSTEM".

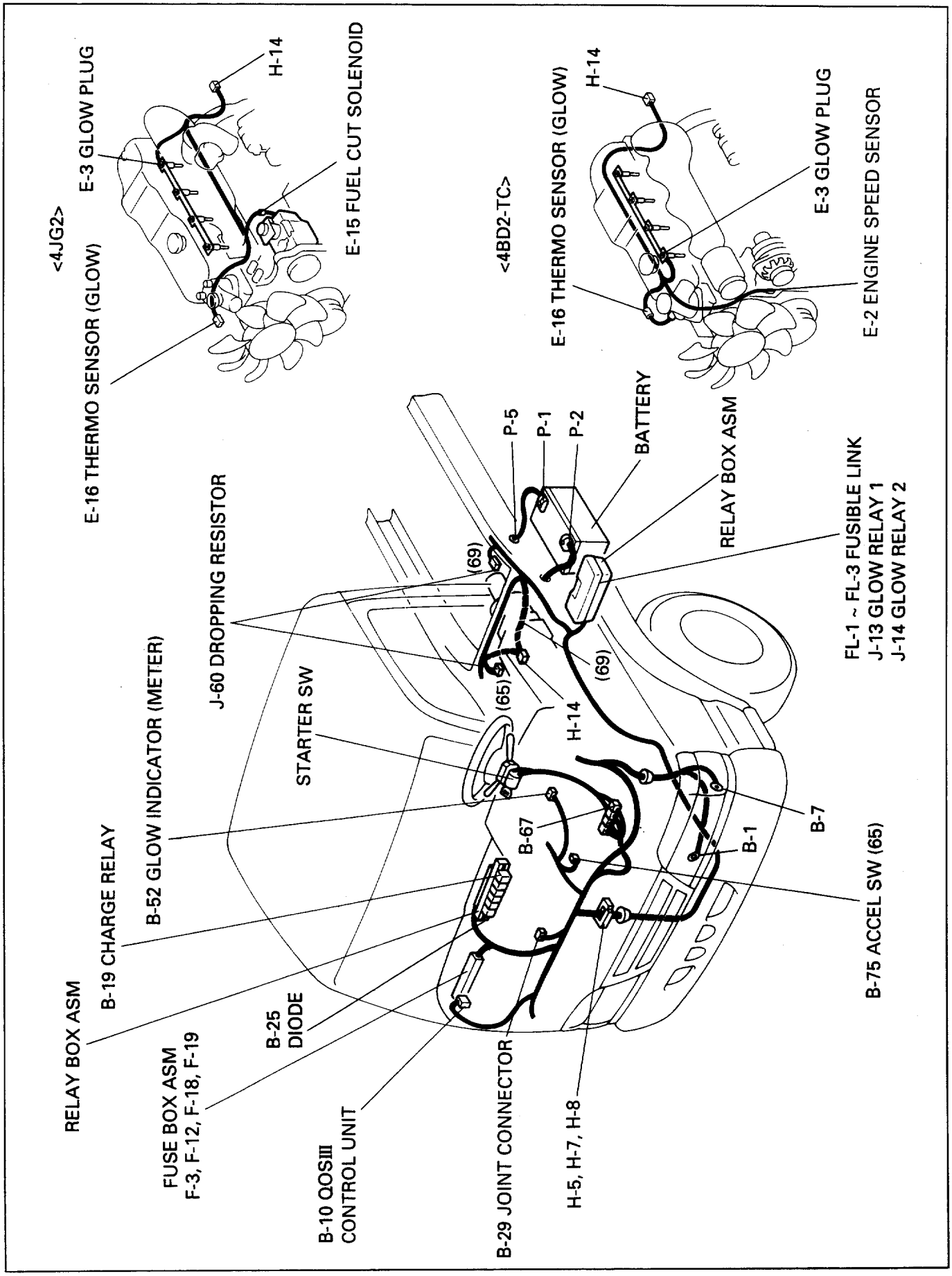
SYSTEM CIRCUIT

This illustration is based on N*R 69

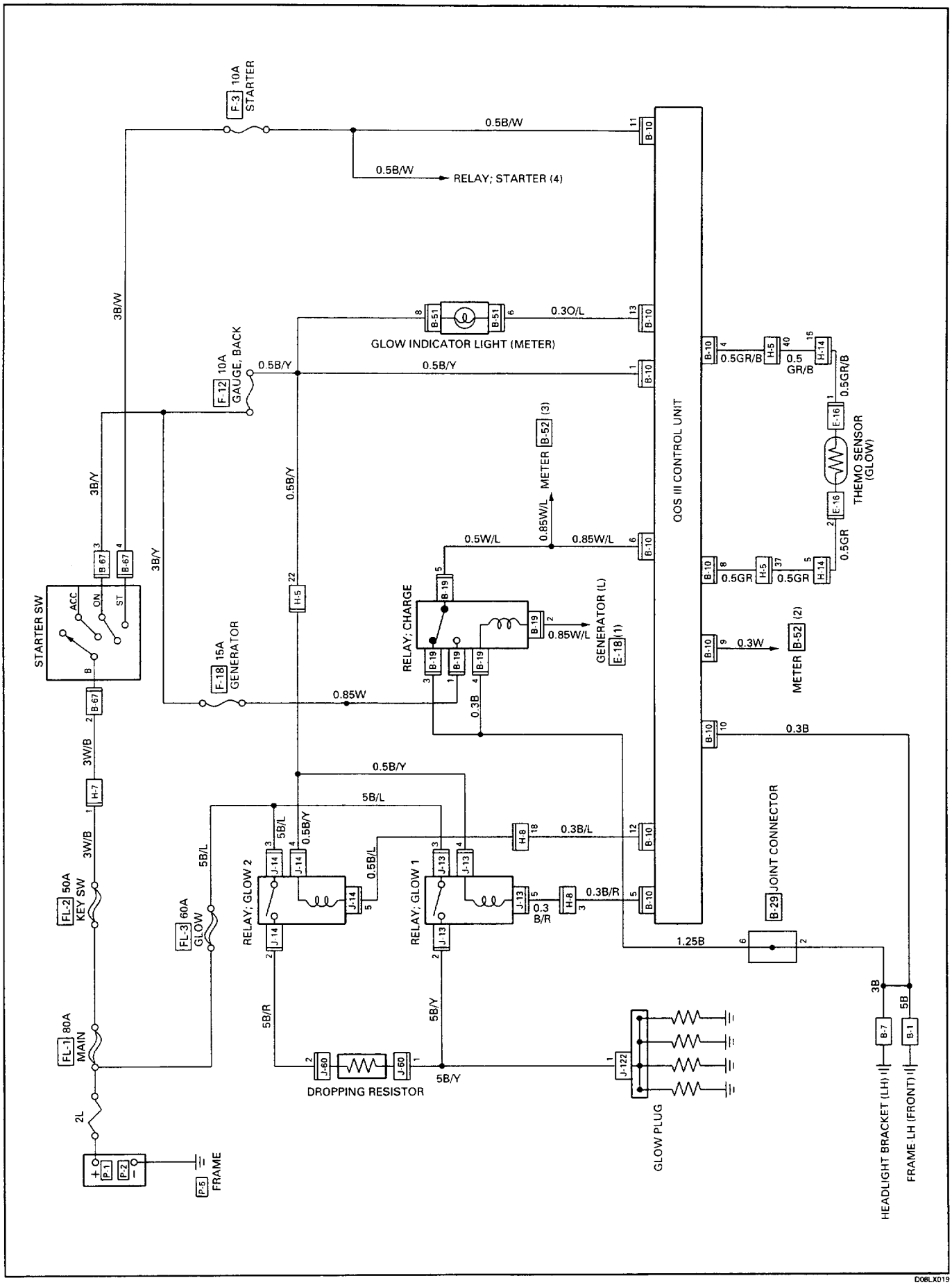


MEMO

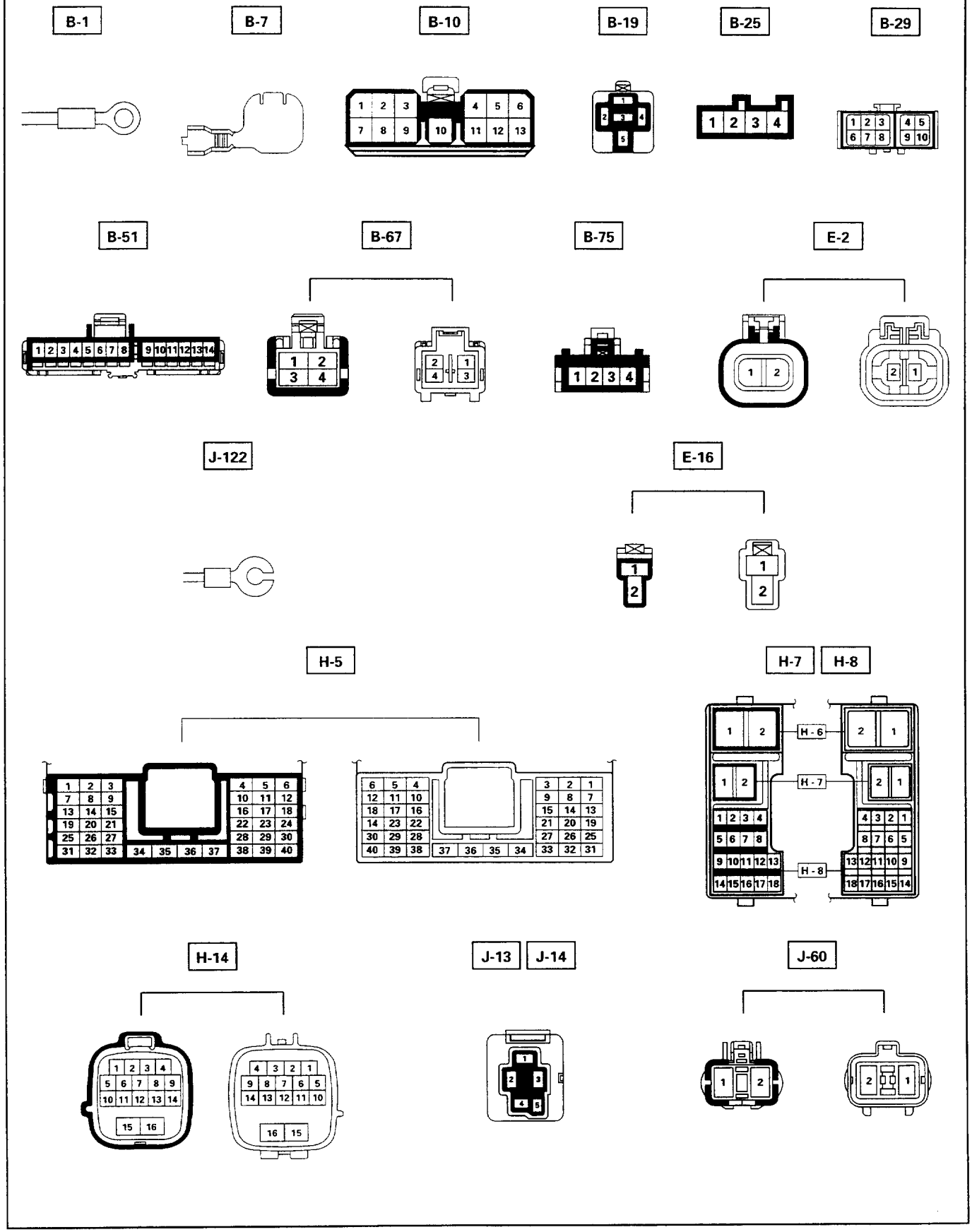
PARTS LOCATION



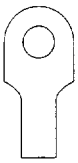
CIRCUIT DIAGRAM - NKR69 · NPR69



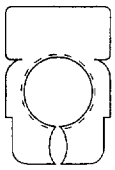
CONNECTOR LIST



P-1



P-2



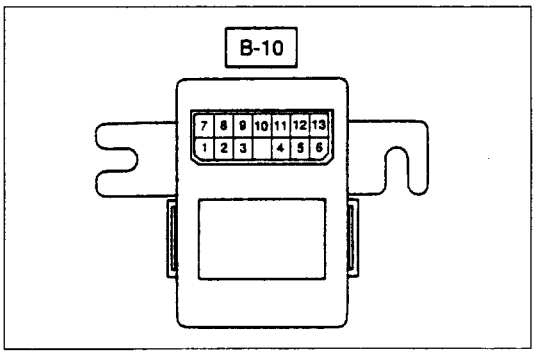
P-5

STARTER SWITCH

Refer to "START AND CHARGING" in this section.

GLOW INDICATOR LIGHT

Refer to "METER AND WARNING/INDICATOR LIGHT" in this section.



QOSIII CONTROL UNIT

Terminal No.	Connected to
1	Starter switch (ON)
2	Accel switch (NPR65)
3	Engine speed sensor (NPR65)
4	Thermo sensor (–)
5	Glow 1 relay
6	Charge relay
7	Accel switch (NPR65)
8	Thermo sensor (+)
9	Meter
10	Ground
11	Starter switch (ST)
12	Glow 2 relay
13	Glow indicator (Meter)

MEMO

EXHAUST BRAKE SYSTEM

GENERAL DESCRIPTION

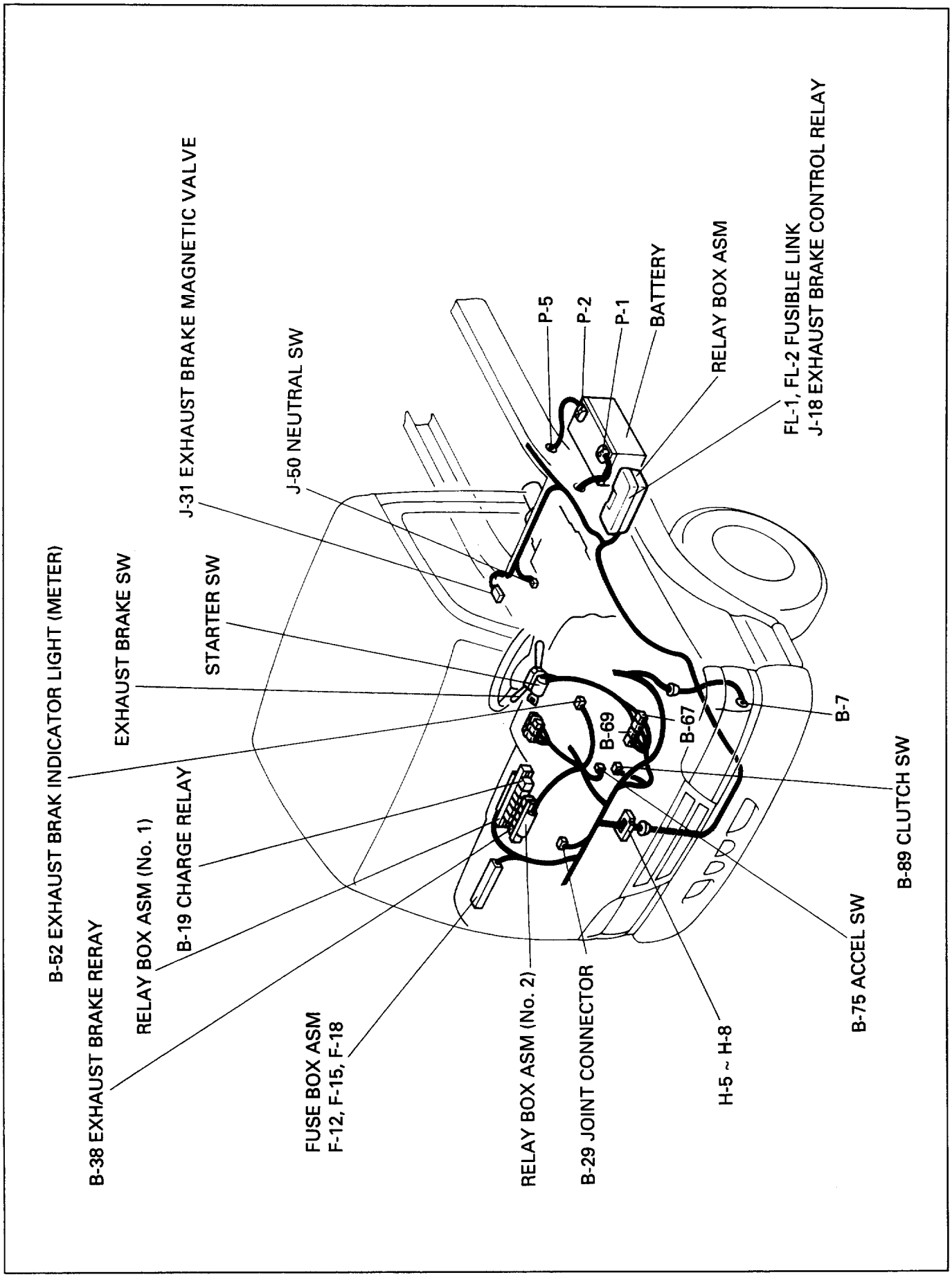
This circuit consists of starter switch, exhaust brake switch (combination switch), accelerator switch, clutch switch, vacuum switching valve, neutral switch and relay.

Exhaust brake is a system to increase exhaust pressure by means of squeezing exhaust gas from engine and exert engine brake.

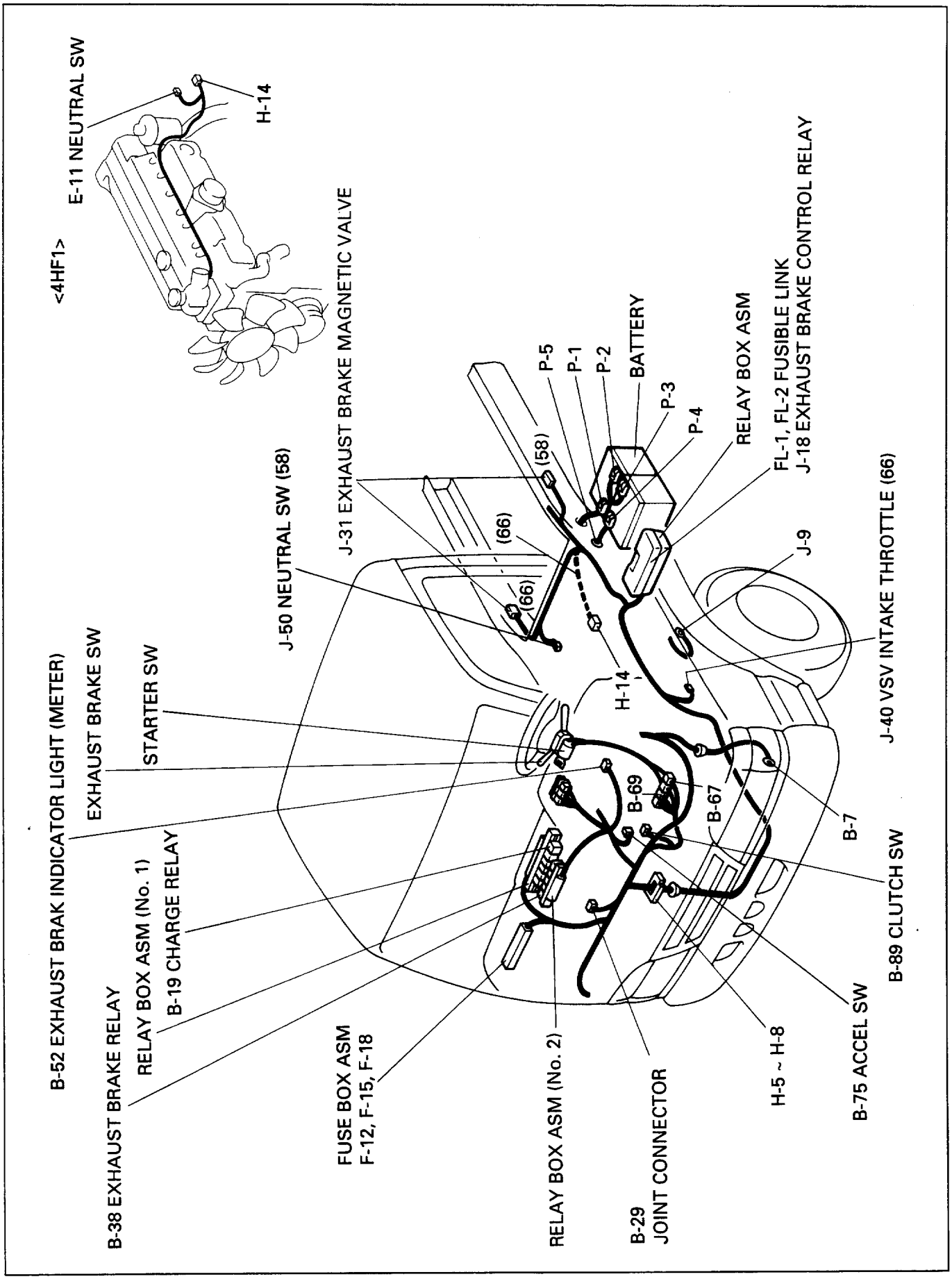
Turn the exhaust brake SW on, and the exhaust brake valve starts to work by the function of the magnetic valve to enable the exhaust bake to operate, when the exhaust brake indicator light will be on.

When either the accelerator pedal or the clutch pedal is depressed while driving, the switch of the depressed pedal will turn off, subsequently the exhaust braking will stop working.

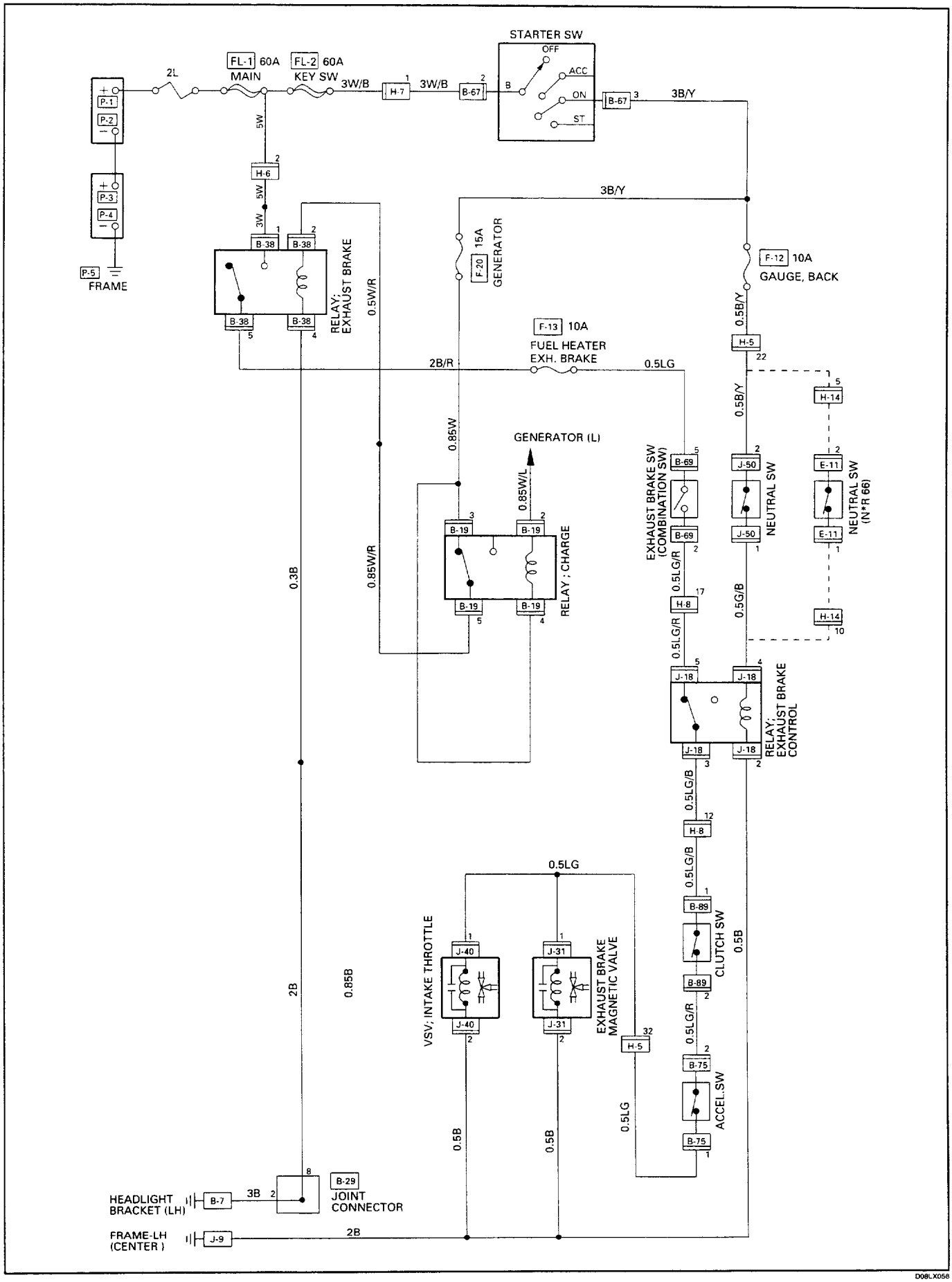
PARTS LOCATION - NHR55 · NKR55 · NPR69



PARTS LOCATION - NKR66 · NPR58 · NPR66 · NQR66

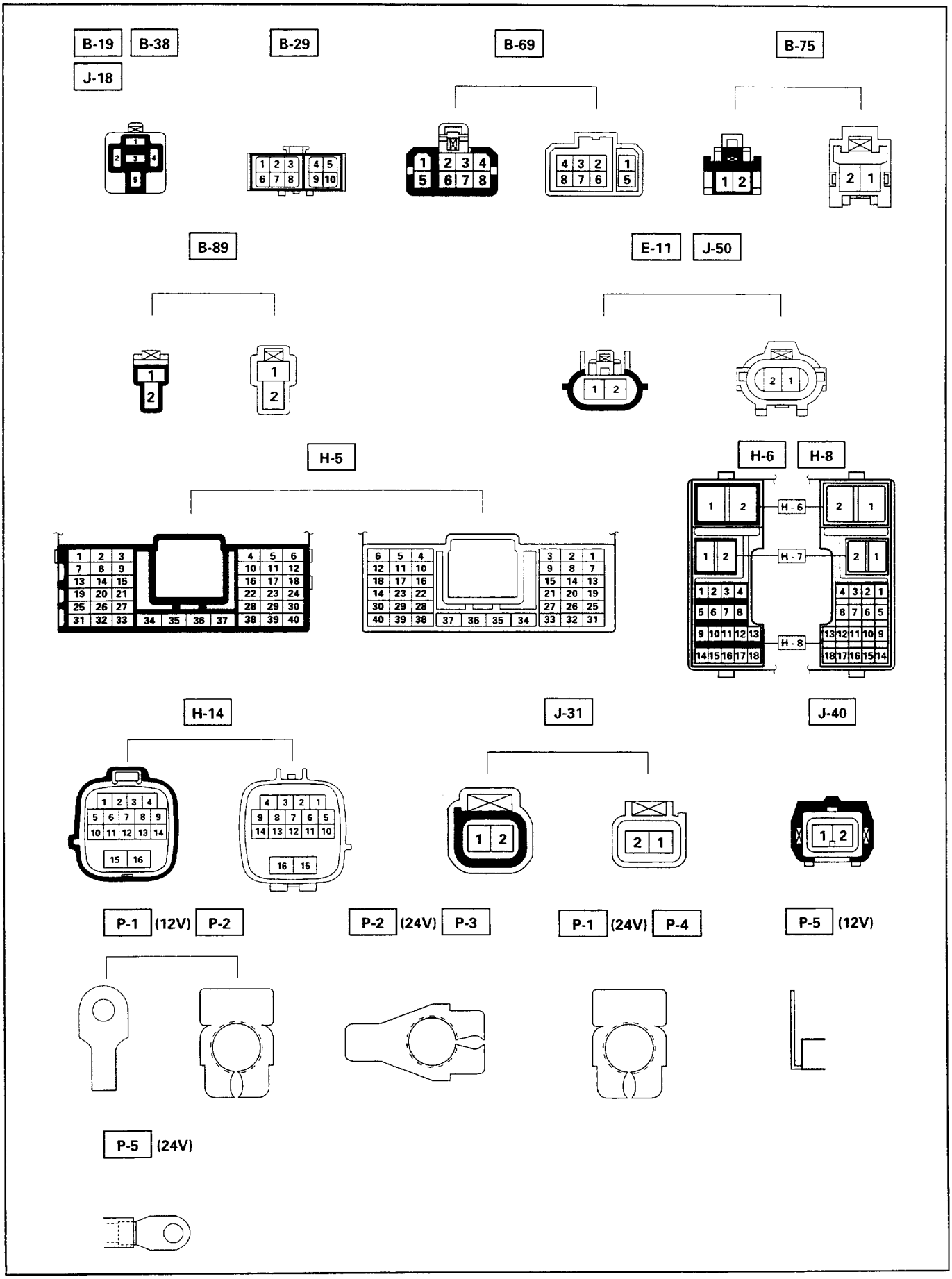


CIRCUIT DIAGRAM - NHR55 · NKR55 · NKR66 · NPR66 · NQR71



D08LX058

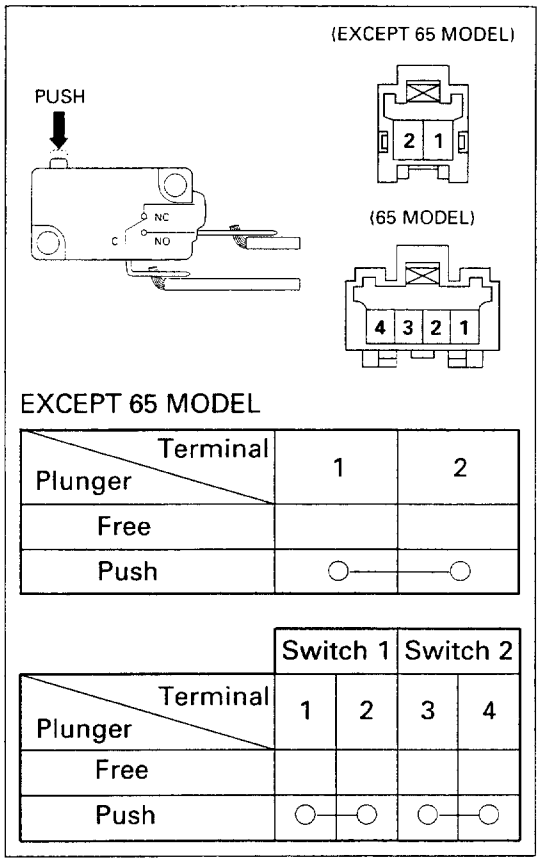
CONNECTOR LIST



NEUTRAL SWITCH
STARTER RELAY
CHARGE RELAY
STARTER SWITCH

Refer to "START AND CHARGING" in this section.

ACCEL SWITCH



EXCEPT 65 MODEL

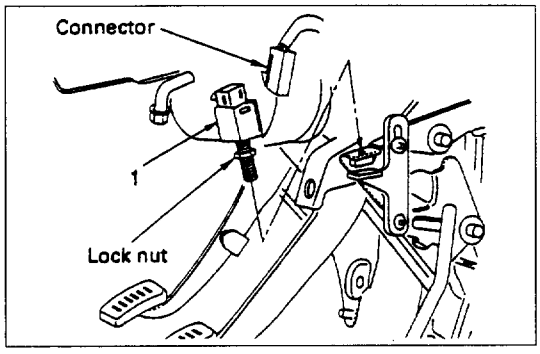
Terminal / Plunger	1	2
Free		
Push	○——	——○

	Switch 1		Switch 2	
Terminal / Plunger	1	2	3	4
Free				
Push	○—○		○—○	

INSPECTION

1. Check the continuity between the switch connector terminals.
2. Check to see if switch plunger operate smoothly.

Repair or replace the accel switch when result of inspection is found abnormal.



REMOVAL

Preparation:
Disconnect the battery ground cable.

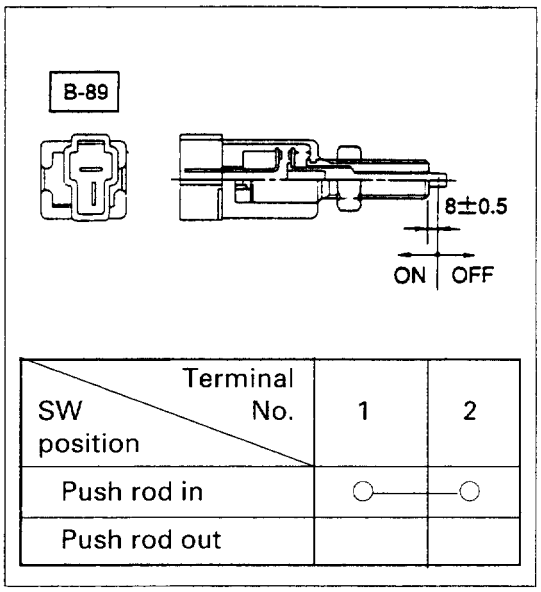
1. **Accel Switch**
   1) Disconnect the connector.
   2) Remove the two screws.

INSTALLATION

To install, follow the removal steps in the reverse order, noting the following points.

1) Check to see if the accel pedal has been returned by the return spring to the specified position.

CLUTCH SWITCH

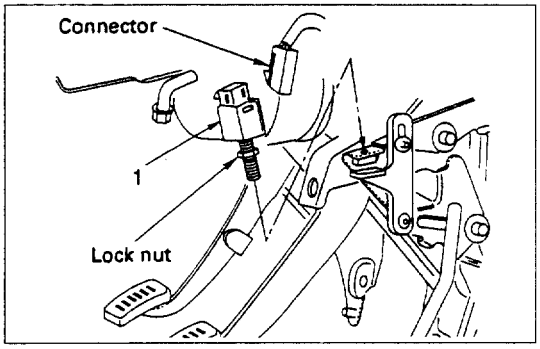


SW position \ Terminal No.	1	2
Push rod in	○	○
Push rod out		

INSPECTION

1. Check the continuity between the switch connector terminals.
2. Check to see if switch push rod operate smoothly.

   Repair or replace the switch when result of inspection is found abnormal.



REMOVAL

Preparation:
Disconnect the battery ground cable.

1. **Clutch Switch**
   1) Disconnect the connector.
   2) Loosen the lock nut of the switch.
   3) Remove the switch by turning it.

INSTALLATION

To install, follow the removal steps in the reverse order, noting the following points.

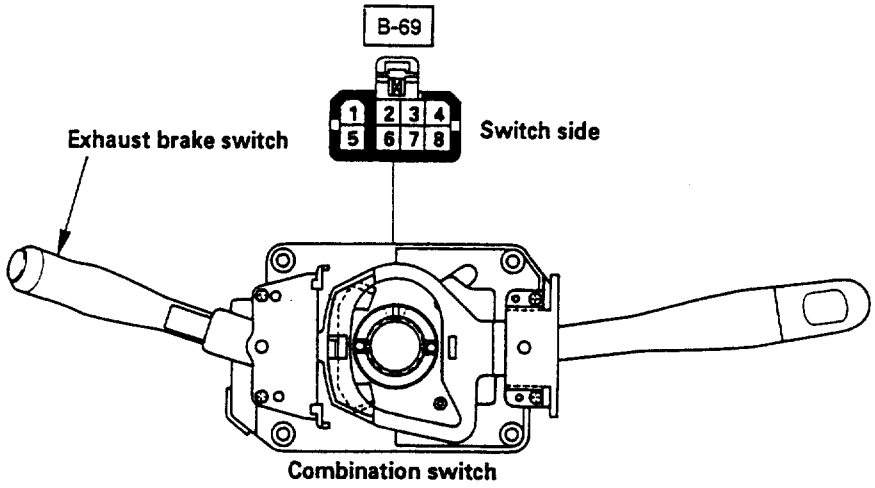
1) Check to see if the clutch pedal has been returned by the return spring to the specified position.
2) Turn the clutch switch clockwise until the tip of the threaded portion of the switch contacts the pedal arm.
3) Tighten the lock nut to the specified torque.

Lock nut torque	N·m (kg·cm/lb·in)
	13 (130/113)

EXHAUST BRAKE SWITCH

INSPECTION

Check the continuity between the terminals of the exhaust brake switch.
Repair or replace the switch when the result of inspection is found abnormal.



SW position \ Terminal No.	2	5
ON	○——	——○
OFF		

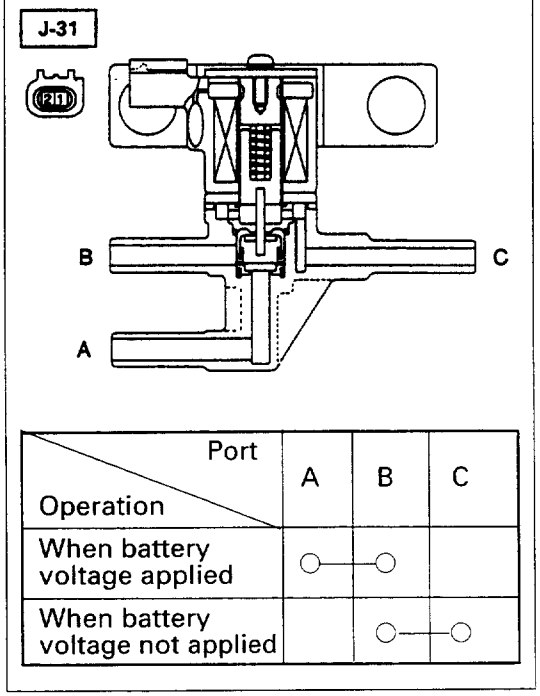
REMOVAL AND INSTALLATION

Refer to "HEADLIGHT, FOG LIGHT AND CORNERING LIGHT" in this section.

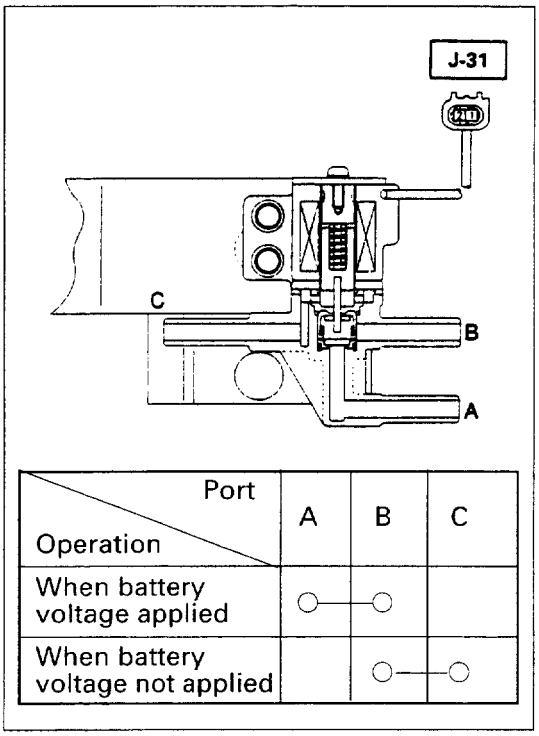
EXHAUST BRAKE MAGNETIC VALVE (4JG2 engine)

INSPECTION

Connect the magnetic valve connector terminal No.1 to the battery (+) terminal and terminal No. 2 to the (-) terminal and then check the continuity among each port.
Repair or replace the magnetic valve when the result of inspection is found abnormal.



Operation \ Port	A	B	C
When battery voltage applied	○——	——○	
When battery voltage not applied		○——	——○

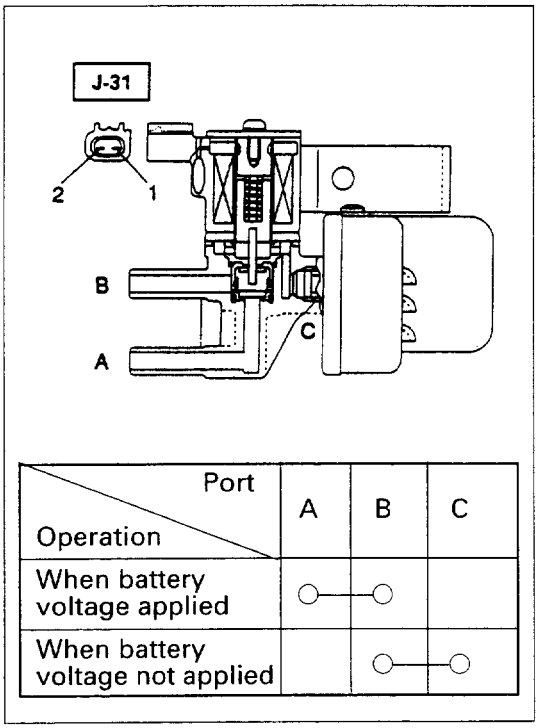


Operation \ Port	A	B	C
When battery voltage applied	○—○		
When battery voltage not applied		○—○	

EXHAUST BRAKE MAGNETIC VALVE (4B Series engine)

INSPECTION

Connect the magnetic valve connector terminal No. 1 to the battery (+) terminal and terminal No. 2 to the (-) terminal and then check the continuity among each port.



Operation \ Port	A	B	C
When battery voltage applied	○—○		
When battery voltage not applied		○—○	

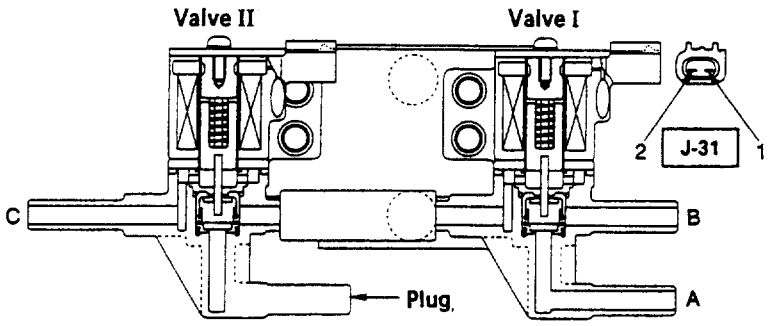
EXHAUST BRAKE MAGNETIC VALVE (4JG2, 4H Series engine)

INSPECTION

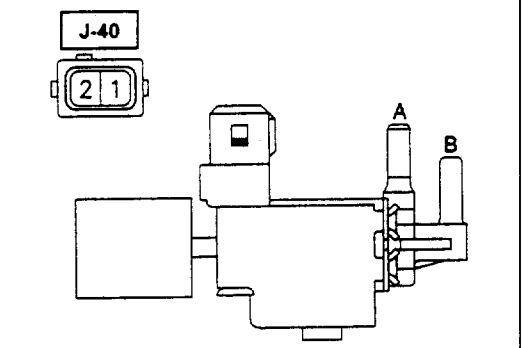
Connect the magnetic valve connector terminal No. 1 to the battery (+) terminal and terminal No. 2 to the (-) terminal and then check the continuity among each port.

EXHAUST BRAKE MAGNETIC VALVE (4H Series engine)
AIR EXHAUST MAGNETIC VALVE (4H Series engine)

Connect the magnetic valve connector terminal No. 1 to the battery (+) terminal and terminal No. 2 to the (-) terminal and then check the continuity among each port.



Operation		Port		
Valve I	Valve II	A	B	C
Battery voltage not applied	Battery voltage not applied		○—○	
Battery voltage applied	Battery voltage not applied	○—○		
Battery voltage not applied	Battery voltage applied			
Battery voltage applied	Battery voltage applied	○—○		



Operation \ Port	A	B
When battery voltage applied	○—○	
When battery voltage not applied		

VACUUM SWITCHING VALVE: INTAKE THROTTLE (4H Series engine)

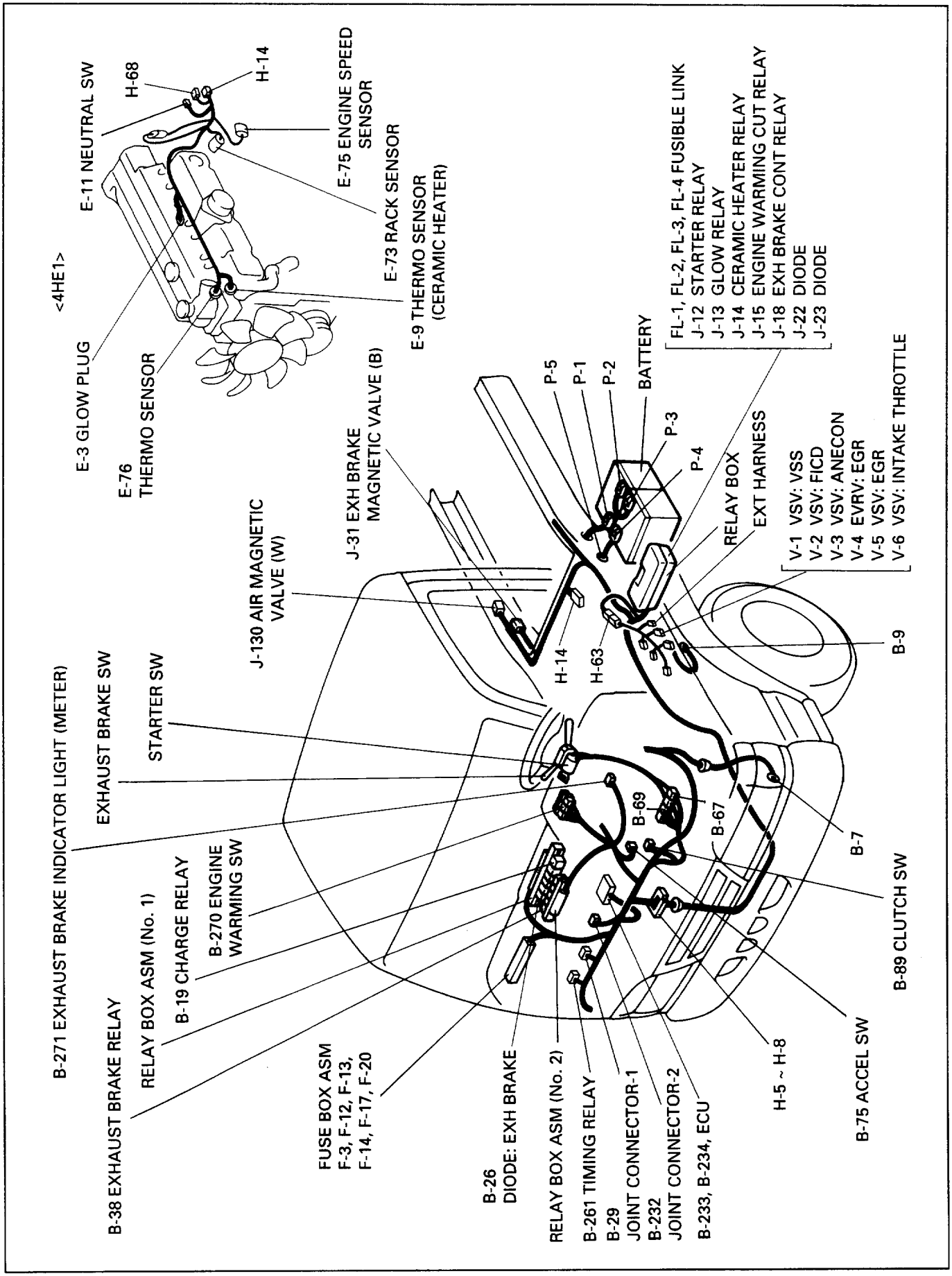
INSPECTION

Connect the magnetic valve connector terminal No. 1 to the battery (+) terminal and terminal No. 2 to the (-) terminal and then check the continuity among each port.
Repair or replace the vacuum switching valve when the result of inspection is found abnormal.

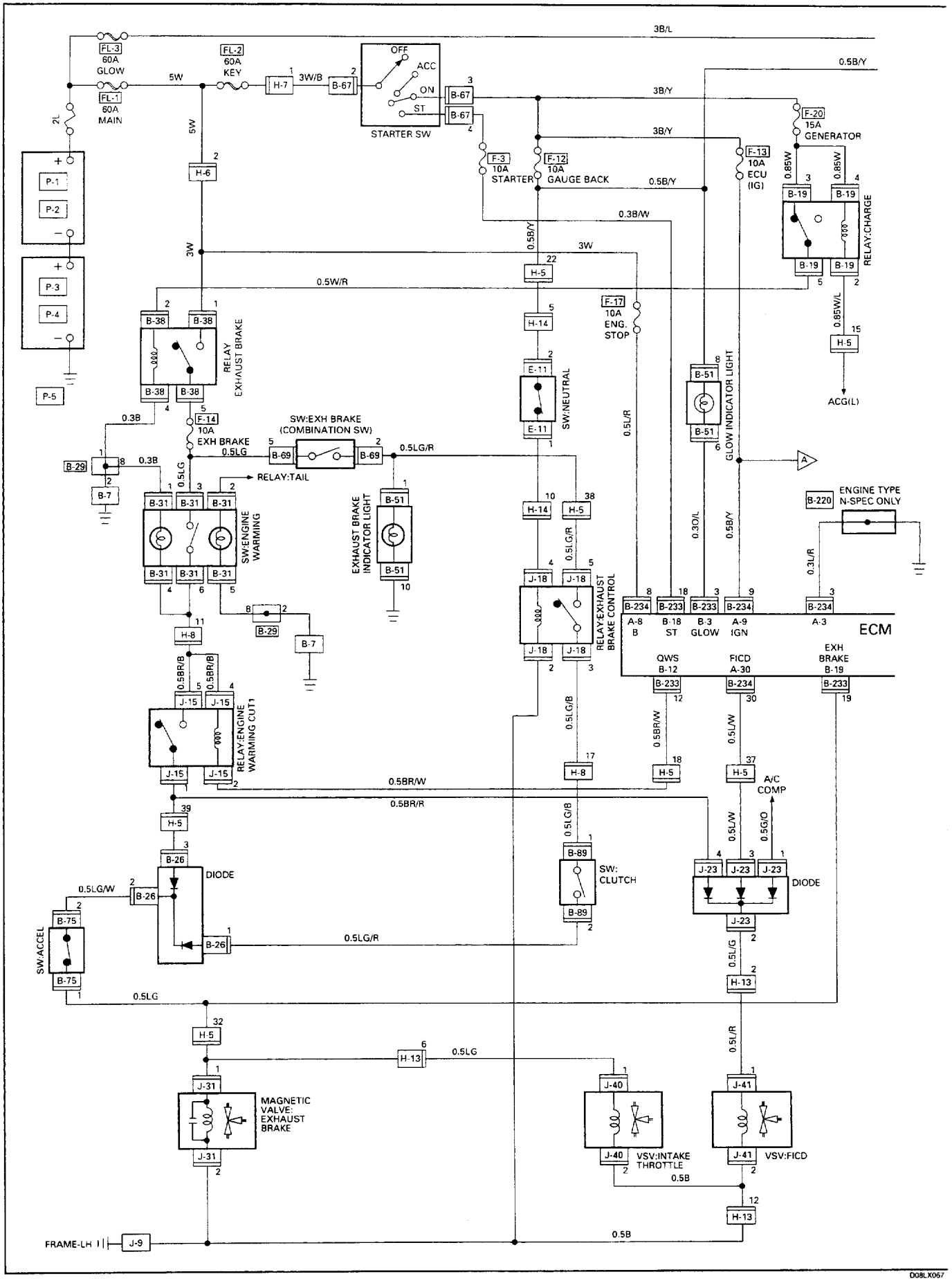
MEMO

EXHAUST BRAKE SYSTEM AND ENGINE CONTROL

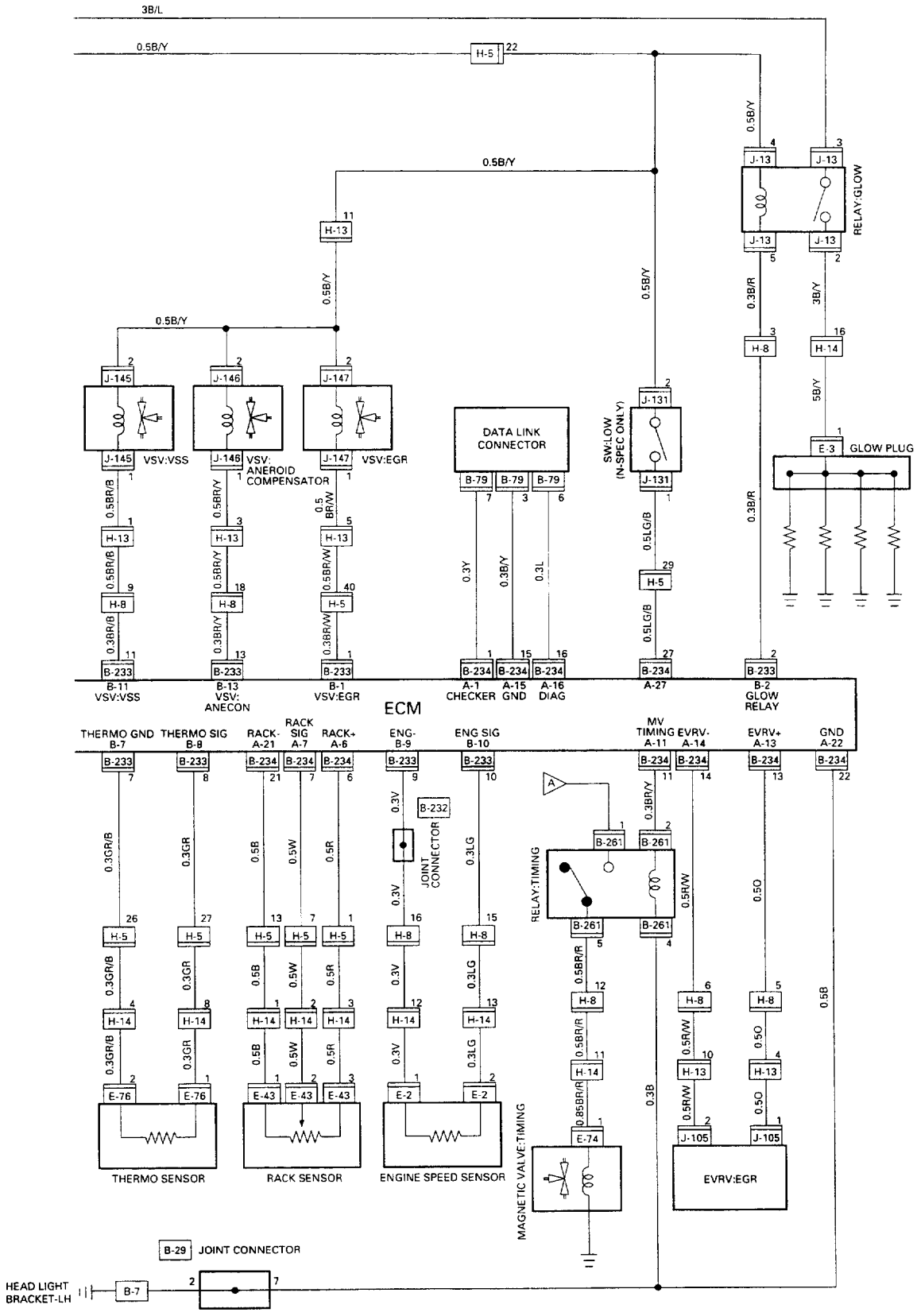
PARTS LOCATION - NPR70TC · NQR70TC



CIRCUIT DIAGRAM FOR 24 VOLT - NPR70TC · NQR70TC

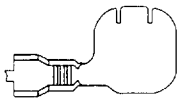


CIRCUIT DIAGRAM FOR 24 VOLT - NPR70TC · NQR70TC

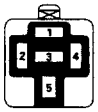


CONNECTOR LIST

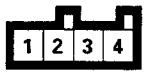
B-7



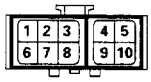
B-19 B-38



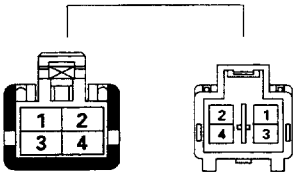
B-26



B-29



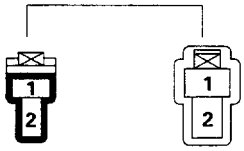
B-67



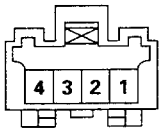
B-69

B-75

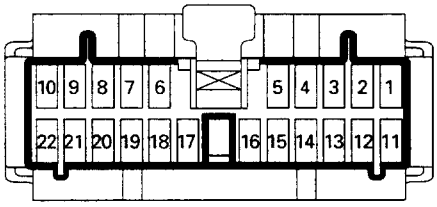
B-89



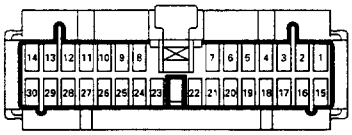
B-220



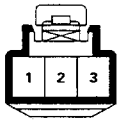
B-233



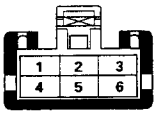
B-234



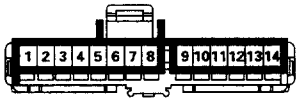
B-237



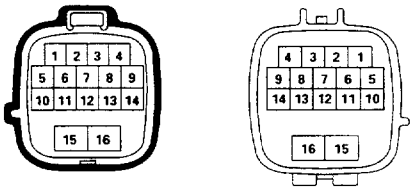
B-234



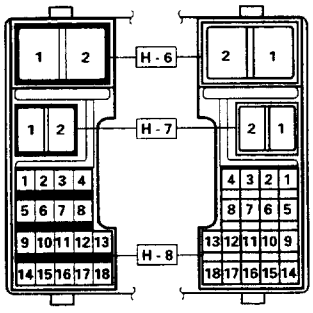
B-51



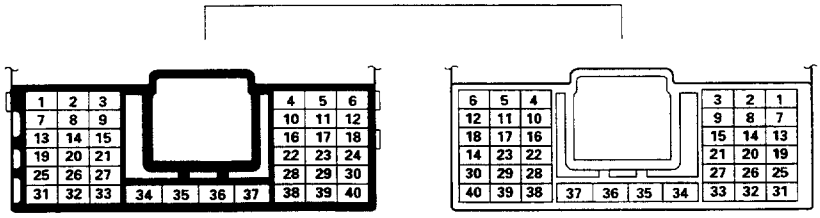
H-14



H-6 H-7 H-8

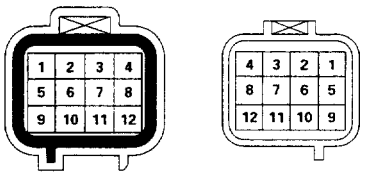


H-5

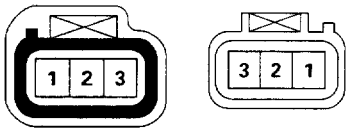


CONNECTOR LIST

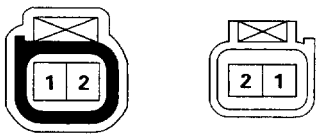
H-63



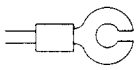
H-68



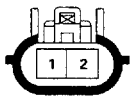
H-68



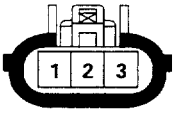
E-3



E-9 E-11

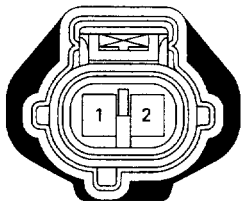


E-73

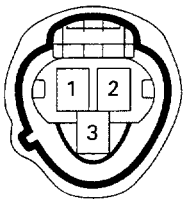


E-74

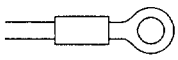
E-75



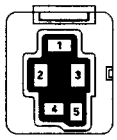
E-76



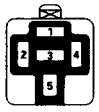
J-9



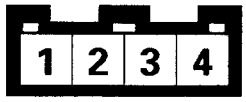
J-13 J-14



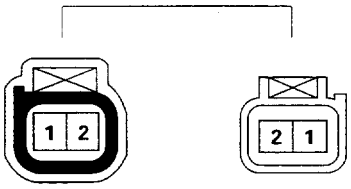
J-15 J-18



J-21 J-22 J-23



J-31 J-130 J-131



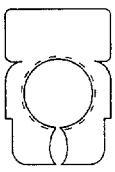
V-1 V-3

V-2 V-6

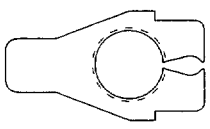
V-4

V-5

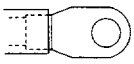
P-1 P-4



P-2 P-3



P-5



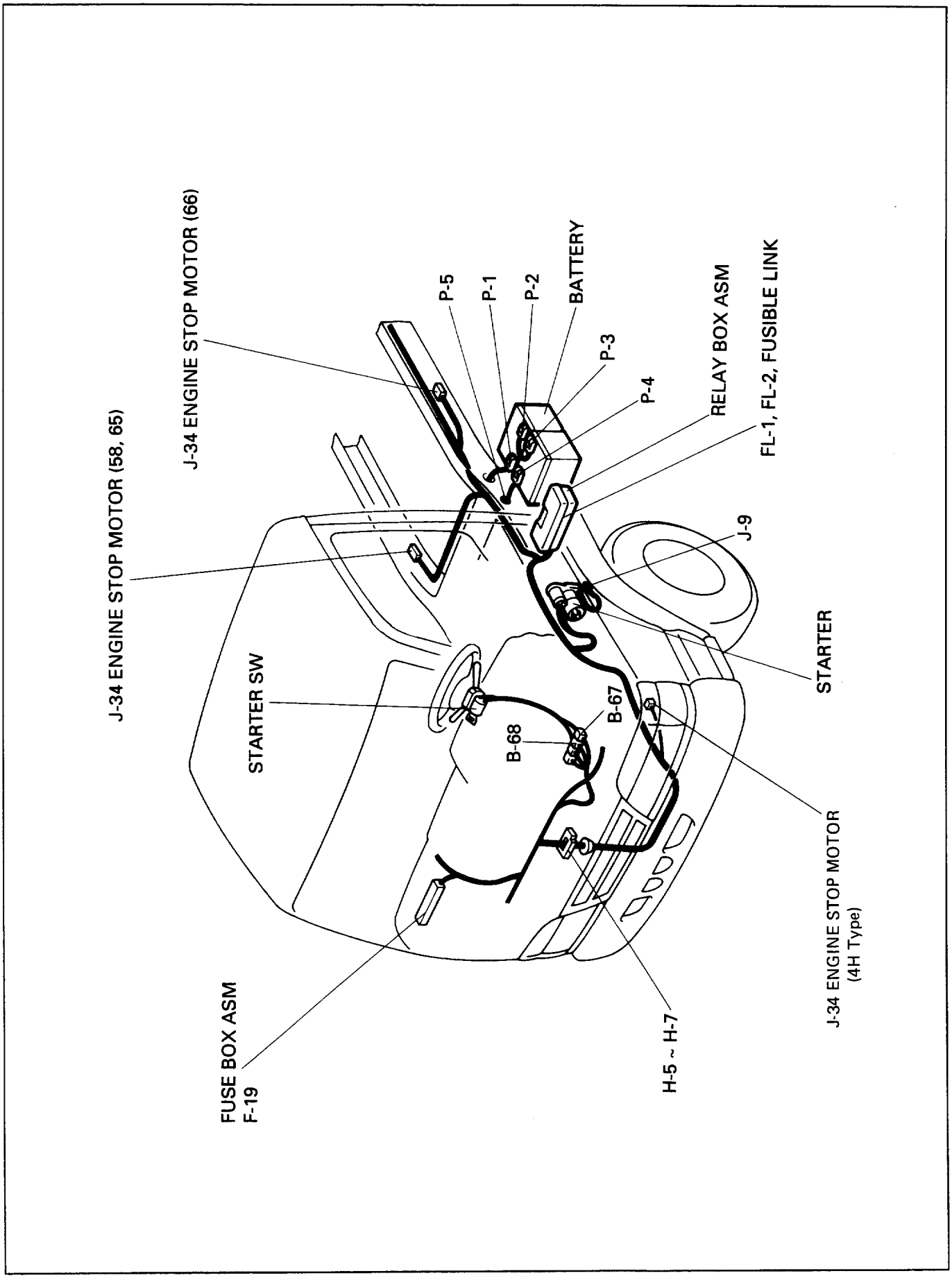
ENGINE STOP SYSTEM

GENERAL DESCRIPTION

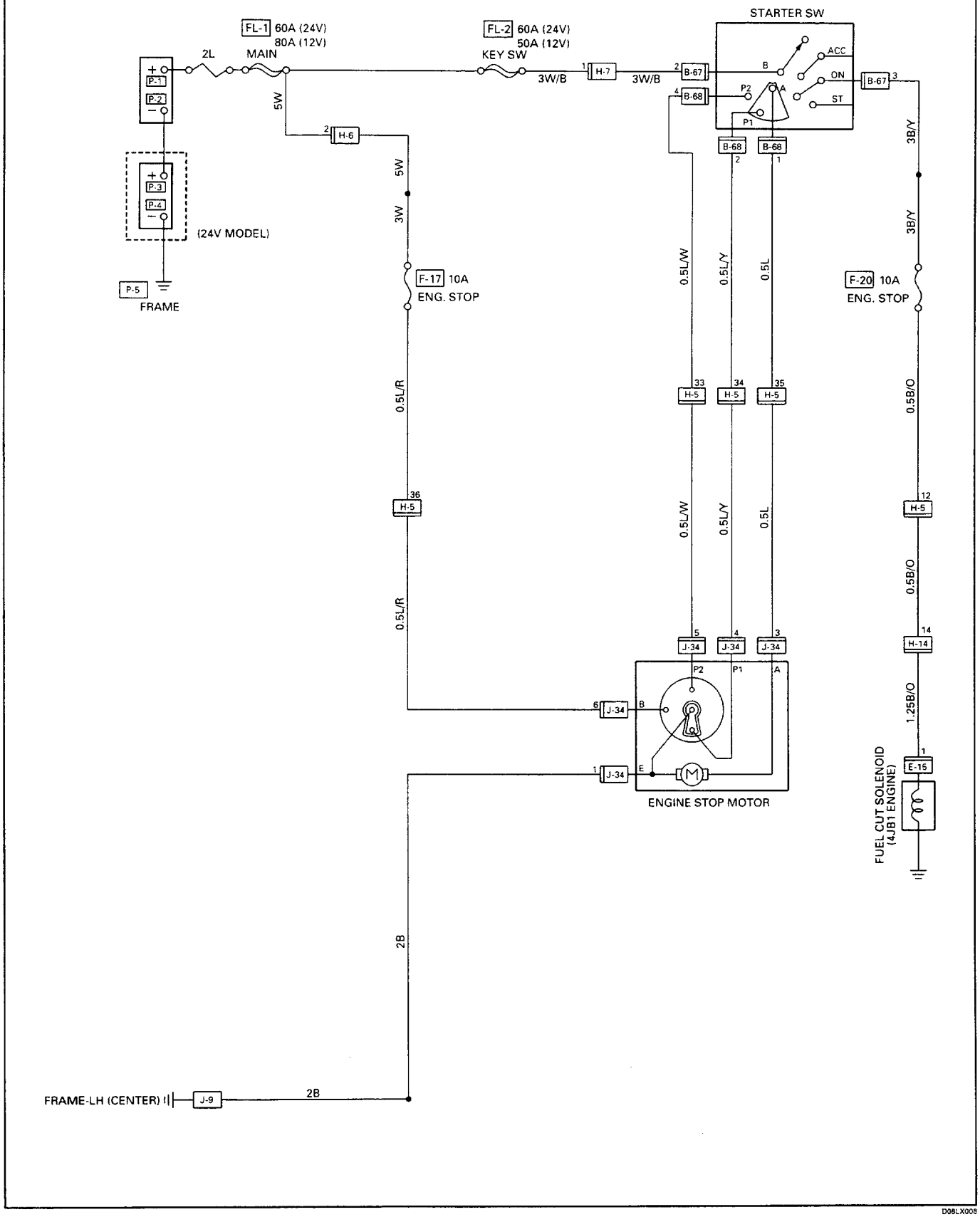
The circuit consists of starter switch and engine stop motor.
The engine stop mechanism aims at shut-off of fuel supply.
available are motor type and solenoid type depending on the types of the engine mounted.
Motor type is forcible pull the injection pump control rack to the direction of fuel supply reduction by means of engine stop motor, thus shutting it off.
Solenoid type is to have the starter switch turn from "ON" position to "OFF", so that the solenoid valve fitted to the injection pump closes to shut off the fuel circuit.

Engine stop system	Engine model
Motor type	4HF1, 4HG1
Solenoid type	4JB1

PARTS LOCATION



CIRCUIT DIAGRAM

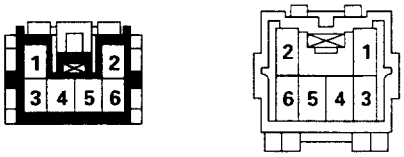


D08LX008

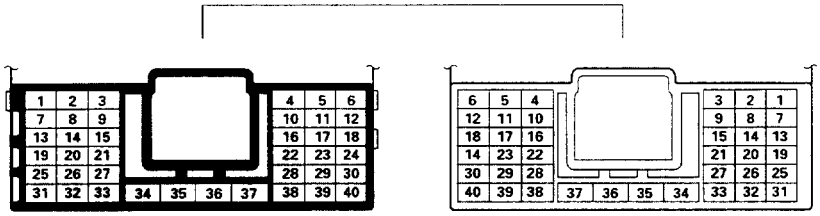
CONNECTOR LIST

B-67

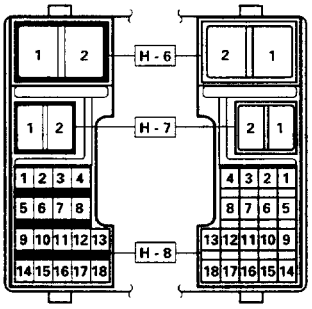
B-68



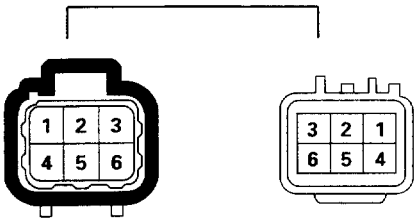
H-5



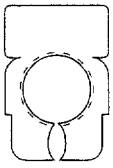
H-6 H-7



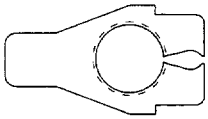
J-34



P-1 P-4

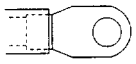


P-2 P-3

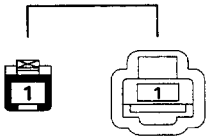


P-5 (12V)

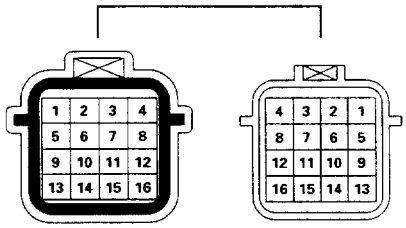
P-5 (24V)



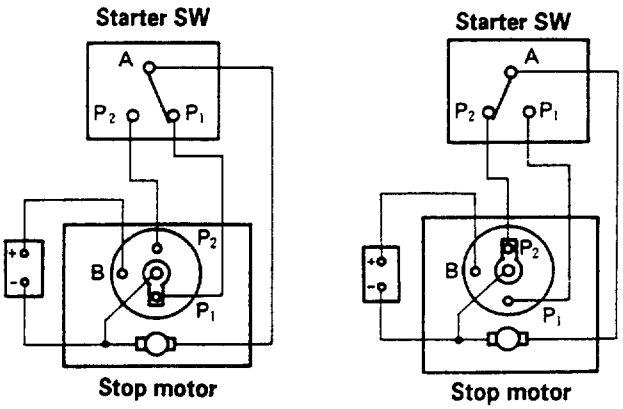
E-15



H-14



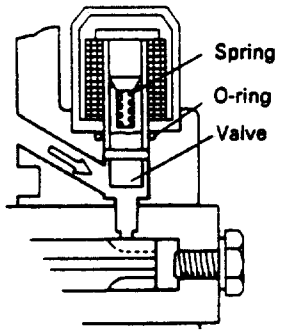
FUNCTION OF ENGINE STOP MOTOR



Turn the starter switch from "ACC" position to "ON", and the engine stop motor will turn by 180 degress (from 0° to 180°) so that the stop motor's electrode will be in potential equal to that of the starter switch for the stop.

Turn the starter switch from "ON" position to "ACC" or "LOCK", and then the stop motor will rotate by 180 degree (from 180° to 360°) and crease operating.

Connector No. / Terminal No. / Starter SW key position	B-68			Stop motor	Stop lever position
	A	P1	P2		
	1	2	4		
LOCK	○	○		0° (360°)	Stop
ACC	○	○			
ACC → ON				0° → 180°	Stop → Run
ON	○		○	180°	Stop
START	○		○		
ON → ACC → LOCK				0° → 360°	Stop → Run



Key position	Solenoid valve
LOCK	Close
ACC	
ON	Open
START	

SOLENOID TYPE

STARTER SWITCH AND SOLENOID VALVE

Turn the starter switch from "ON" position to "OFF", and then the solenoid valve fitted to the injection pump closes to cut off the fuel circuit.

MEMO

HEADLIGHT, FOG LIGHT, REAR FOG LIGHT AND CORNERING LIGHT

GENERAL DESCRIPTION

The circuit consists of headlight, fog light, Cornering light, starter switch, Combination switch (Lighting switch, dimmer · passing switch, cornering light switch), fog light switch, rear fog light switch, rear fog light, high beam indicator light and relay.

When the lighting SW is turned on by setting it at headlight position, the lighting relay is actuated to turn on the headlight. The optical axis of the headlight can be turned up or down by operating the dimmer SW while headlight is on.

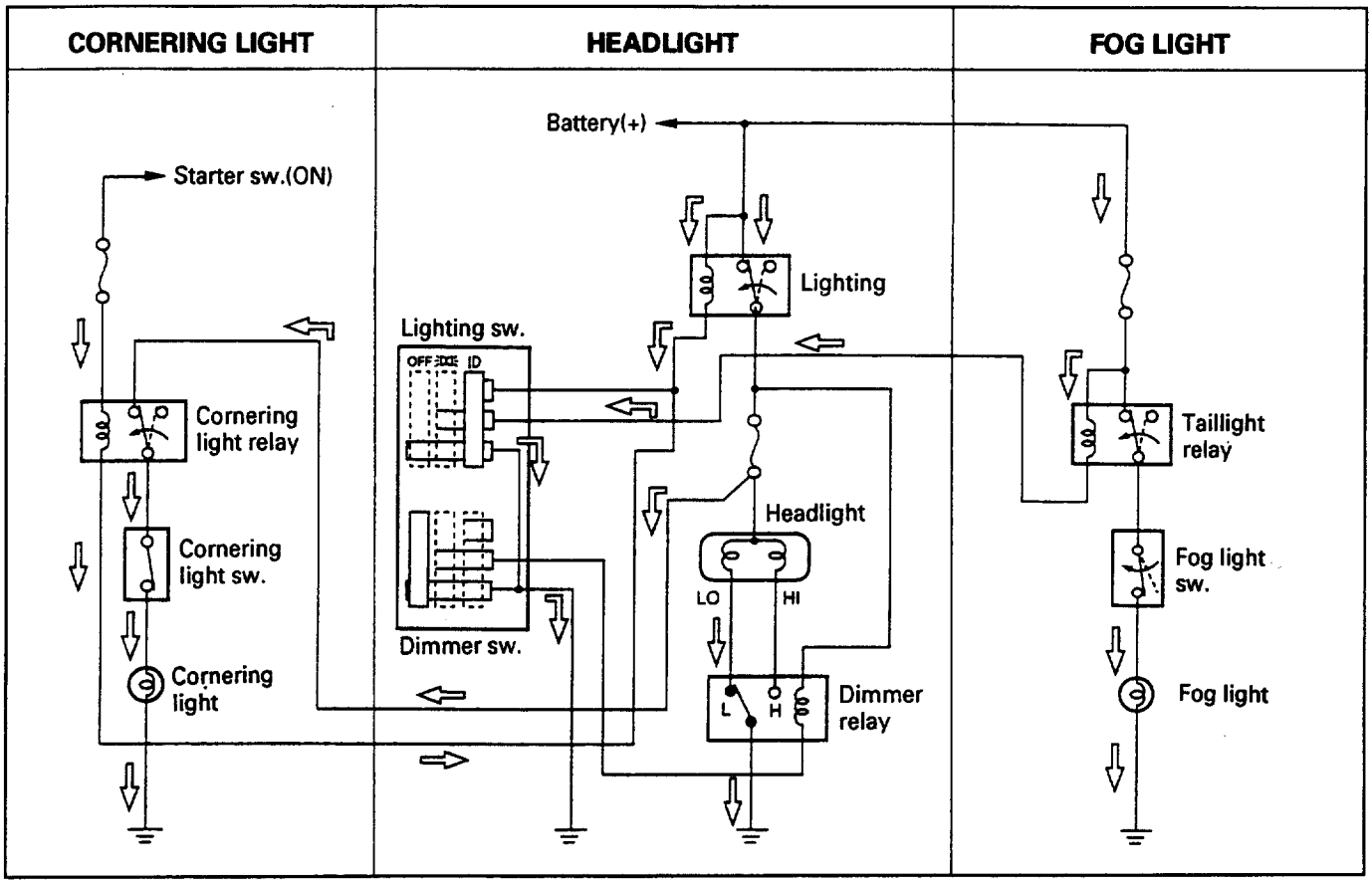
The passing SW is independent of the lighting SW, and the optical axis of the passing light can be turned up only while the switch lever is pulled up and held in this state.

Fog light turns on by switching it to "ON" position to activate relay only while lighting SW is on.

Rear fog light turns on by switching it to "ON" position to activate relay only while lighting switch is at headlight position.

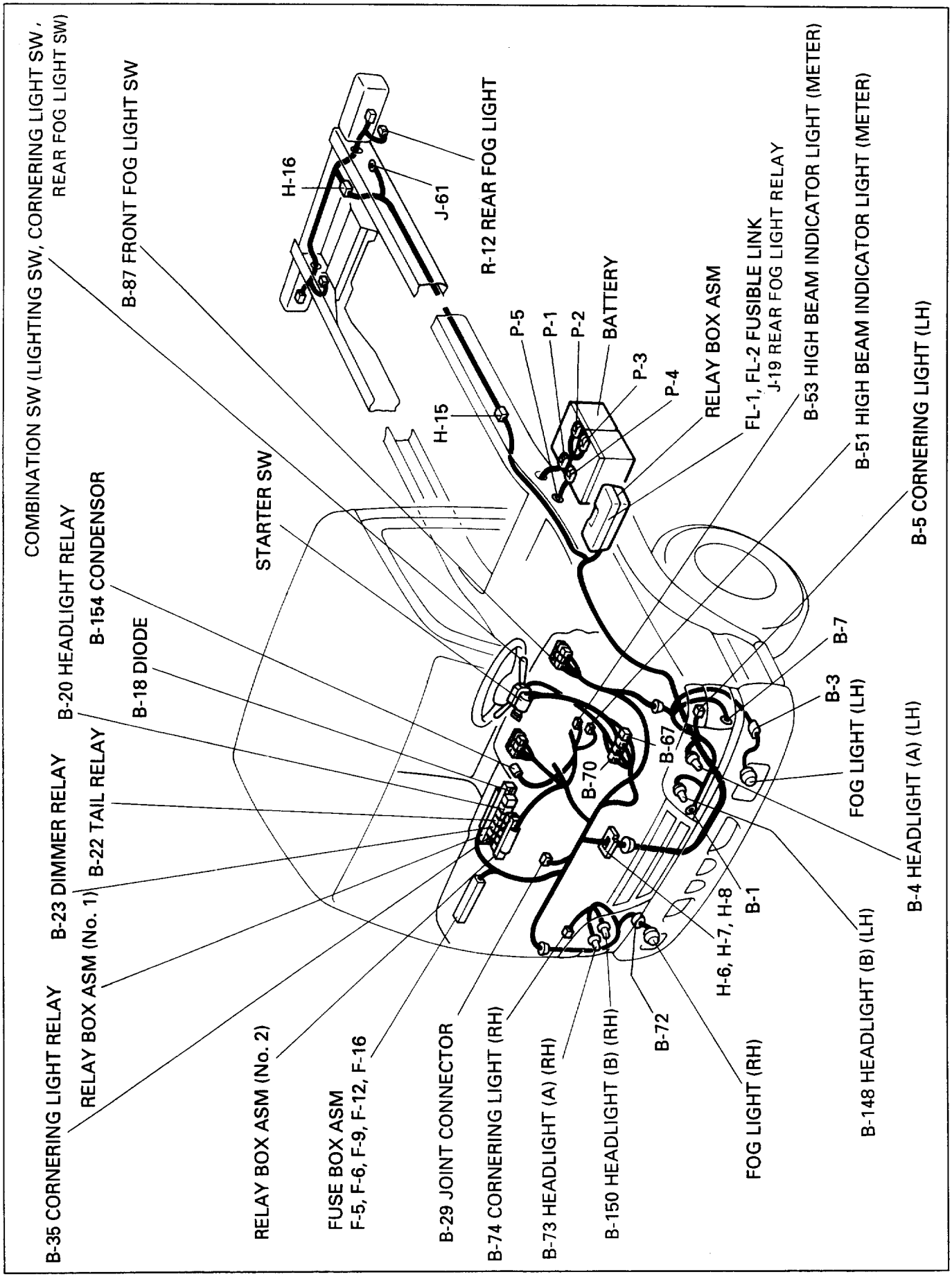
When the headlight is on, turn the turn-signal switch left or right, and then the cornering switch built in the combination switch turns on, followed by the cornering light turning on.

LIGHTING CIRCUIT

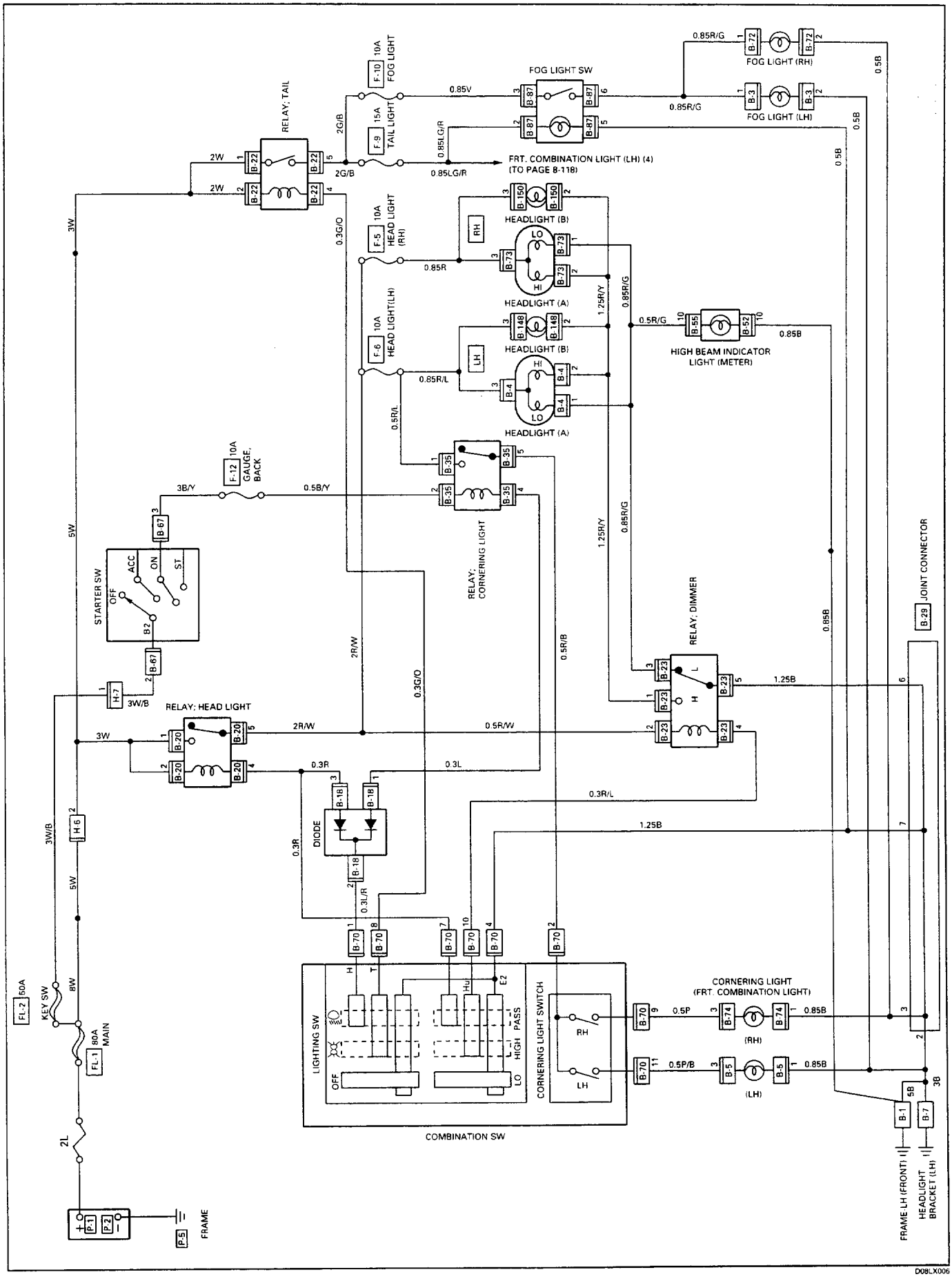


NOTE: Arrow marks "⇨" indicate the direction of current

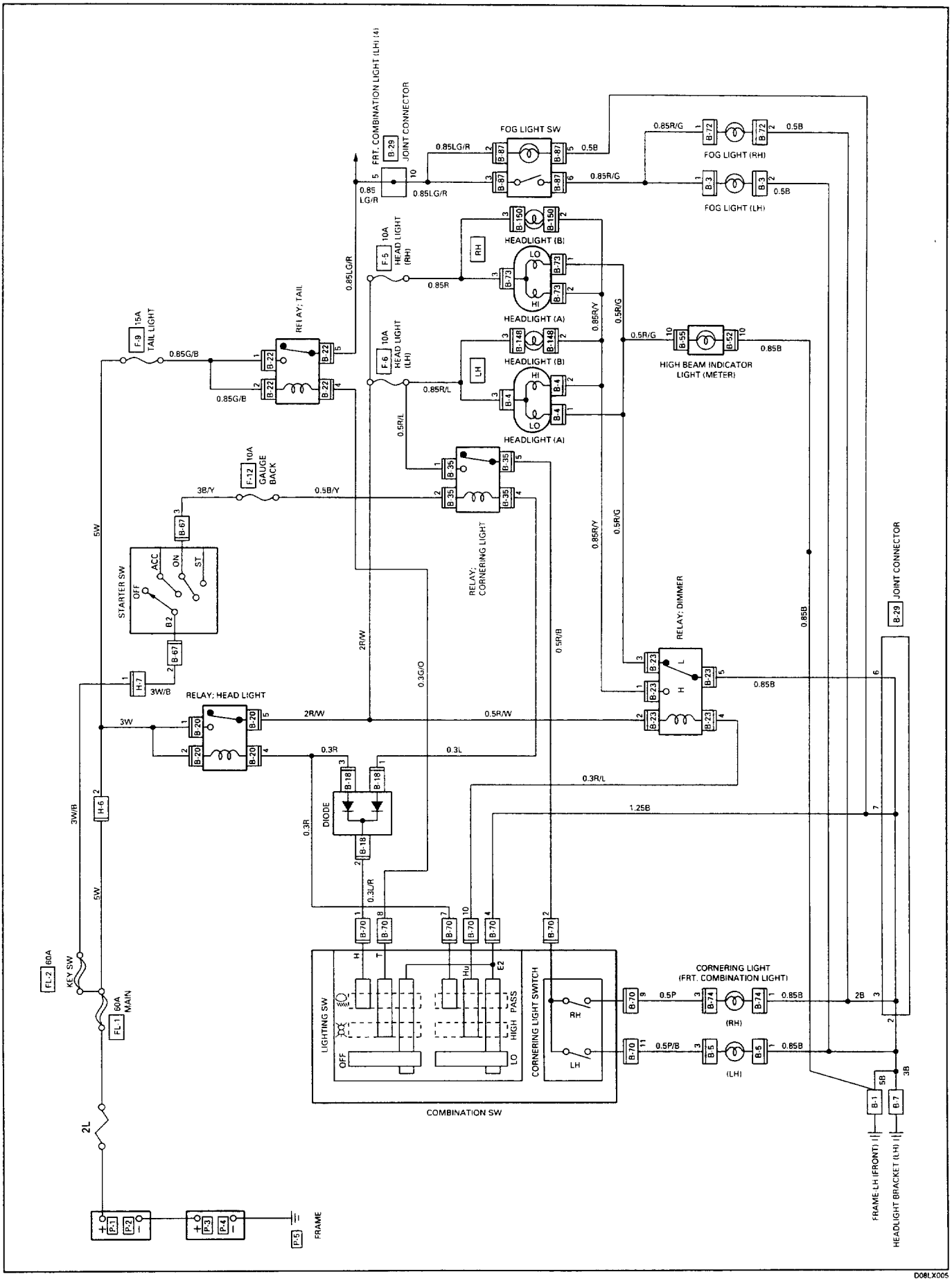
PARTS LOCATION



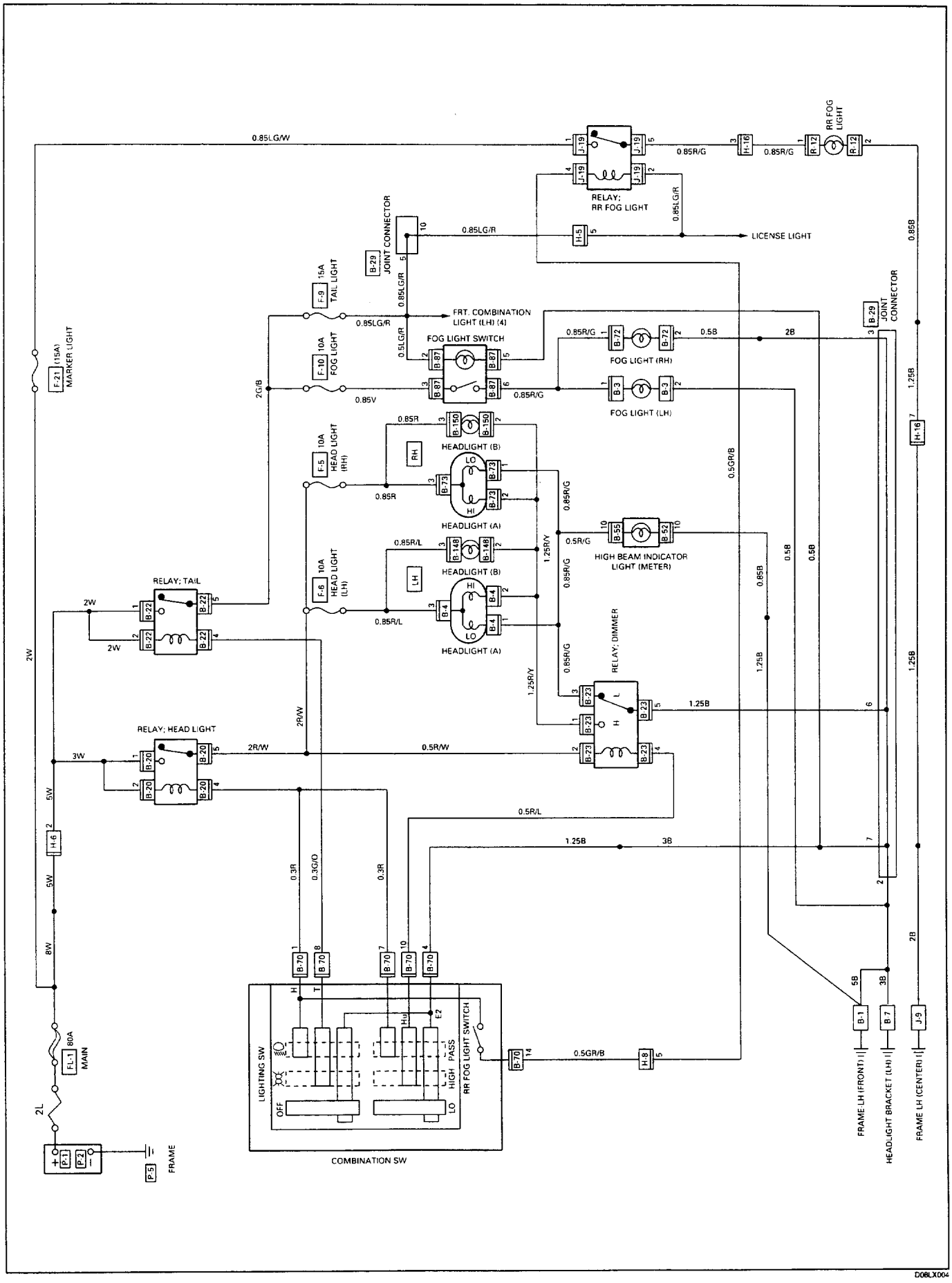
CIRCUIT DIAGRAM - FOR 12 VOLT



CIRCUIT DIAGRAM - FOR 24 VOLT

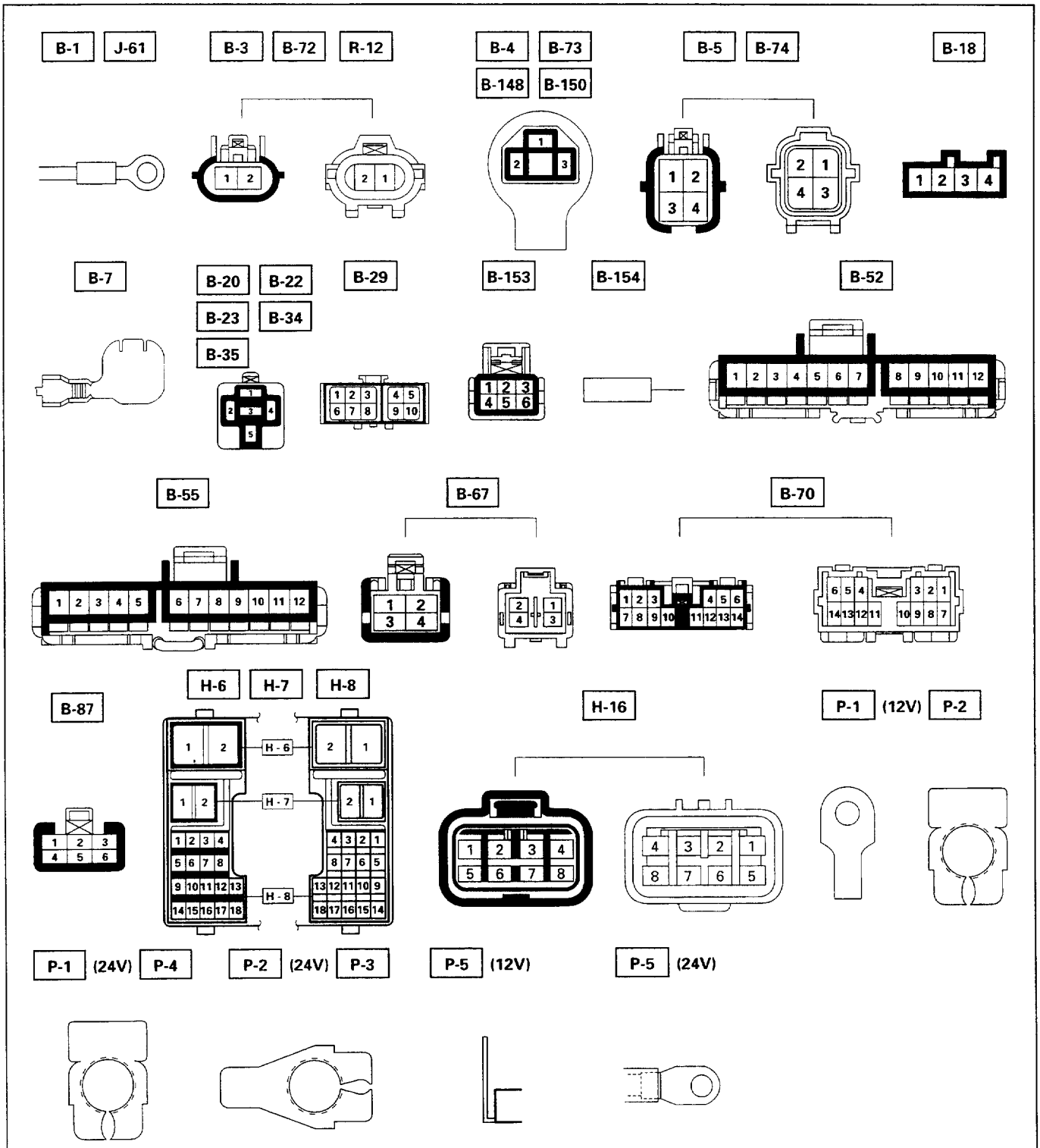


CIRCUIT DIAGRAM - FOR EUROPE



D08LX004

CONNECTOR LIST



DIAGNOSIS

QUICK CHART FOR CHECK POINT

1. HEADLIGHT

Check point / Trouble mode	Fuse F-5 (10A)	Fuse F-6 (10A)	Headlight relay	Lighting SW	Dimmer · passing SW	Dimmer relay	Headlight bulb LH	Headlight bulb RH	Cable harness
1-1. Both Headlights inoperative			○ (1)	○ (3)					○ (2)
1-2. Headlight on the left (or right) side inoperative	○ (1)	○ ((1))							○ (2)
1-3. Headlight in low-beam inoperative						○ (1)			○ (2)
1-4. Headlight in high-beam inoperative						○ (1)			○ (2)
1-5. Headlight on the left (or right) side in low (or high)-beam inoperative							○ (1)	○ ((1))	○ (2)
1-6. Headlight beam does not change					○ (1)	○ (2)			○ (3)
1-7. Headlights remain on when the lighting switch turned off			○ (1)	○ (2)					○ (3)
1-8. Headlights come on with the lighting SW at the clearance light position				○ (1)					

NOTE: Figure in parenthesis "( )" indicates the order of inspection.

2. FOG LIGHT

Check point / Trouble mode	Fuse F-9 (15A):24V F-10(15A):12V	Taillight relay	Fog light SW	Fog light bulb LH	Fog light bulb RH	Cable harness
2-1. Both fog lights inoperative (while lighting switch is on)	○ (1)	○ (2)	○ (3)			○ (4)
2-2. Fog light on the left (or right) side inoperative (while lighting switch is on)				○ (1)	○ ((1))	○ (2)
2-3. Fog lights remains on		○ (1)	○ (2)			○ (3)

NOTE: Figure in parenthesis "( )" indicates the order of inspection.

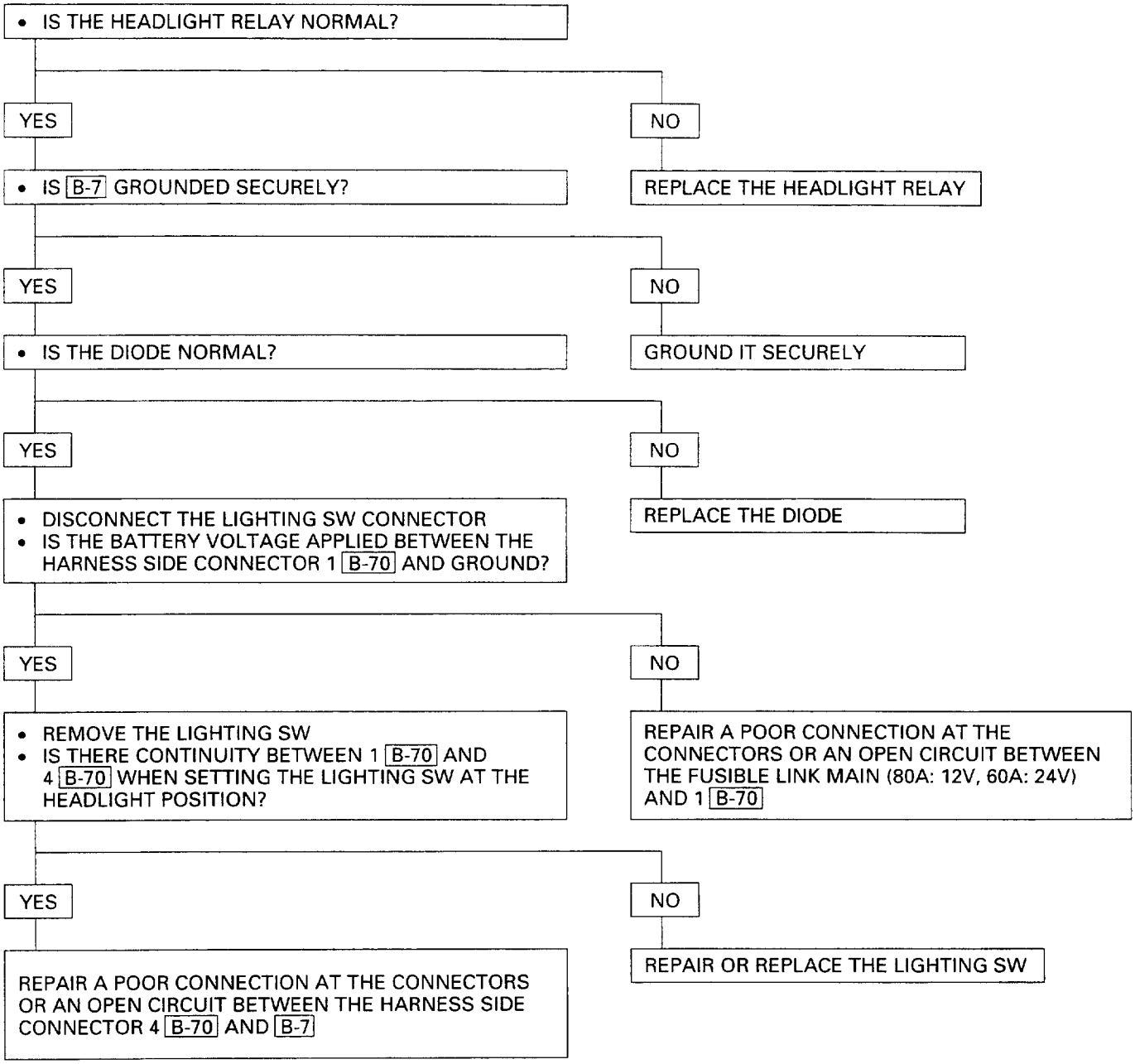
3. CORNERING LIGHT

Trouble mode \ Check point	Fuse F-6 (10A)	Fuse F-12 (10A)	Cornering light SW	Cornering light bulb	Cornering light relay	Cable harness
3-1. Both cornering lights inoperative	○ (2)	○ (1)	○ (5)		○ (3)	○ (4)
3-2. Cornering light on the left (or right) side inoperative			○ (2)	○ (1)		○ (3)
3-3. Cornering light remains on even when steering wheel is in the straight ahead position.			○ (1)			

4. REAR FOG LIGHT

Trouble mode \ Check point	Fuse F-21 (15A)	Rear fog light SW	Rear fog light relay	Rear fog light bulb	Cable harness
4-1. Rear fog light inoperative (while headlight is ON)	○ (2)	○ (4)	○ (3)	○ (1)	○ (5)

1-1. BOTH HEADLIGHTS INOPERATIVE



1-2. HEADLIGHT ON THE LEFT (OR RIGHT) SIDE INOPERATIVE

- IS THE FUSE F-6 OR F-5 (10A) NORMAL?

YES

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN FUSE F-6 (10A) AND 3 B-4 (OR 3 B-148) OR FUSE F-5 (10A) AND 3 B-73 (OR 3 B-150)

NO

REPLACE THE FUSE

1-3. HEADLIGHTS IN LOW-BEAM INOPERATIVE

- IS THE DIMMER RELAY NORMAL?

YES

REPAIR A POOR CONNECTION AT THE CONNECTOR OR AN OPEN CIRCUIT BETWEEN 1 B-4 AND 3 B-23

NO

REPLACE THE RELAY

1-4. HEADLIGHT IN HIGH-BEAM INOPERATIVE

- IS THE DIMMER RELAY NORMAL?

YES

- DISCONNECT THE DIMMER · PASSING SW CONNECTOR
- IS THERE ANY CONTINUITY BETWEEN SW SIDE CONNECTOR 4 B-70 AND 10 B-70 WHEN THE SW IS AT HIGH-BEAM POSITION?

NO

REPLACE THE RELAY

YES

- DISCONNECT THE HEADLIGHT RELAY
- IS THERE ANY CONTINUITY BETWEEN CHASSIS SIDE CONNECTOR 10 B-70 AND 5 B-20 ?

NO

REPAIR OR REPLACE THE SW

YES

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN 1 B-23 AND 2 B-74

NO

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN 10 B-70 AND 5 B-20

1-5. HEADLIGHT ON THE LEFT (OR RIGHT) SIDE IN LOW (OR HIGH)-BEAM INOPERATIVE

- IS THE BULB NORMAL?

YES

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT
[LOW BEAM]
BETWEEN 1 B-4 (OR 1 B-73) AND 3 B-23
[HIGH BEAM]
BETWEEN 2 B-4 (OR 2 B-73) AND 1 B-23

NO

REPLACE THE BULB

1-6. HEADLIGHT BEAM DOES NOT CHANGE

- IS THE DIMMER RELAY NORMAL?

YES

- DOES THE DIMMER · PASSING SW LEVER OPERATE SMOOTHLY AND SECURELY?

YES

- DISCONNECT THE DIMMER · PASSING SWITCH CONNECTOR (COMBINATION SW).
- CHECK IF THERE IS CONTINUITY BETWEEN 4 B-70 AND 10 B-70

DIMMER SW
"LO" POSITION.....NO CONTINUITY
"HI" POSITION.....CONTINUITY

NO

REPAIR OR REPLACE THE DIMMER · PASSING SW (COMBINATION SW)

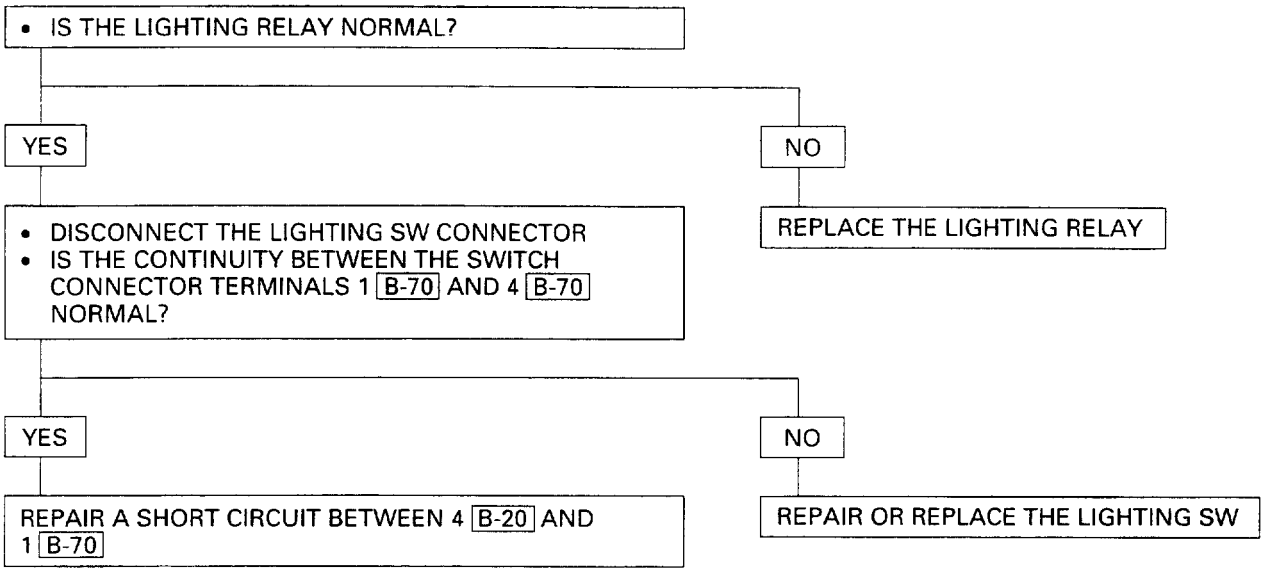
NO

REPAIR OR REPLACE THE DIMMER · PASSING SW

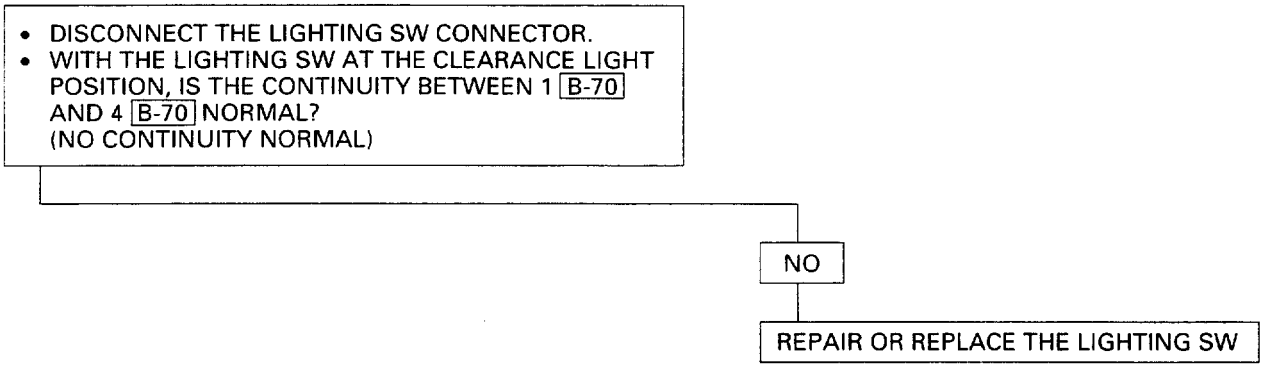
NO

REPLACE THE RELAY

1-7. HEADLIGHTS REMAIN ON WHEN THE LIGHTING SW IS TURNED OFF

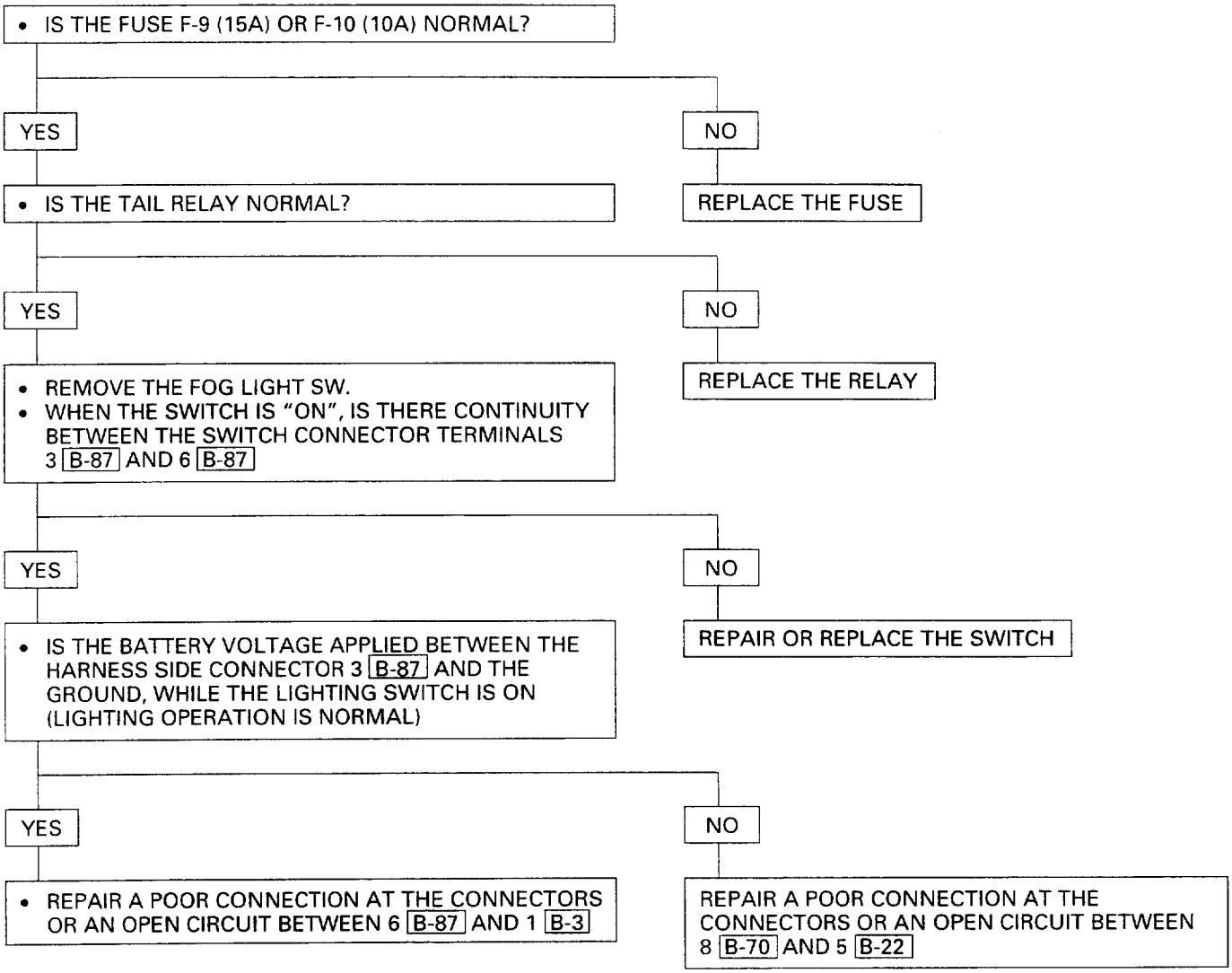


1-8. HEADLIGHT COME ON WITH THE LIGHTING SW AT THE CLEARANCE LIGHT POSITION



2. FOG LIGHT

2-1. BOTH FOG LIGHT INOPERATIVE (WHILE LIGHTING SWITCH IS ON)



2-2. FOG LIGHT ON THE LEFT (OR RIGHT) SIDE INOPERATIVE (WHILE LIGHTING SWITCH IS ON)

- IS THE BULB NORMAL?

YES

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN 2 [B-3] AND [B-7] (2 [B-72] AND [B-7])

NO

REPLACE THE BULB

NOTE: FIGURES IN PARENTHESIS "( )" INDICATE PLACE OF INSPECTION FOR THE FOG LIGHT ON THE RIGHT.

2-3. FOG LIGHTS REMAINS ON

- DO THE TAILLIGHTS GO OFF?

YES

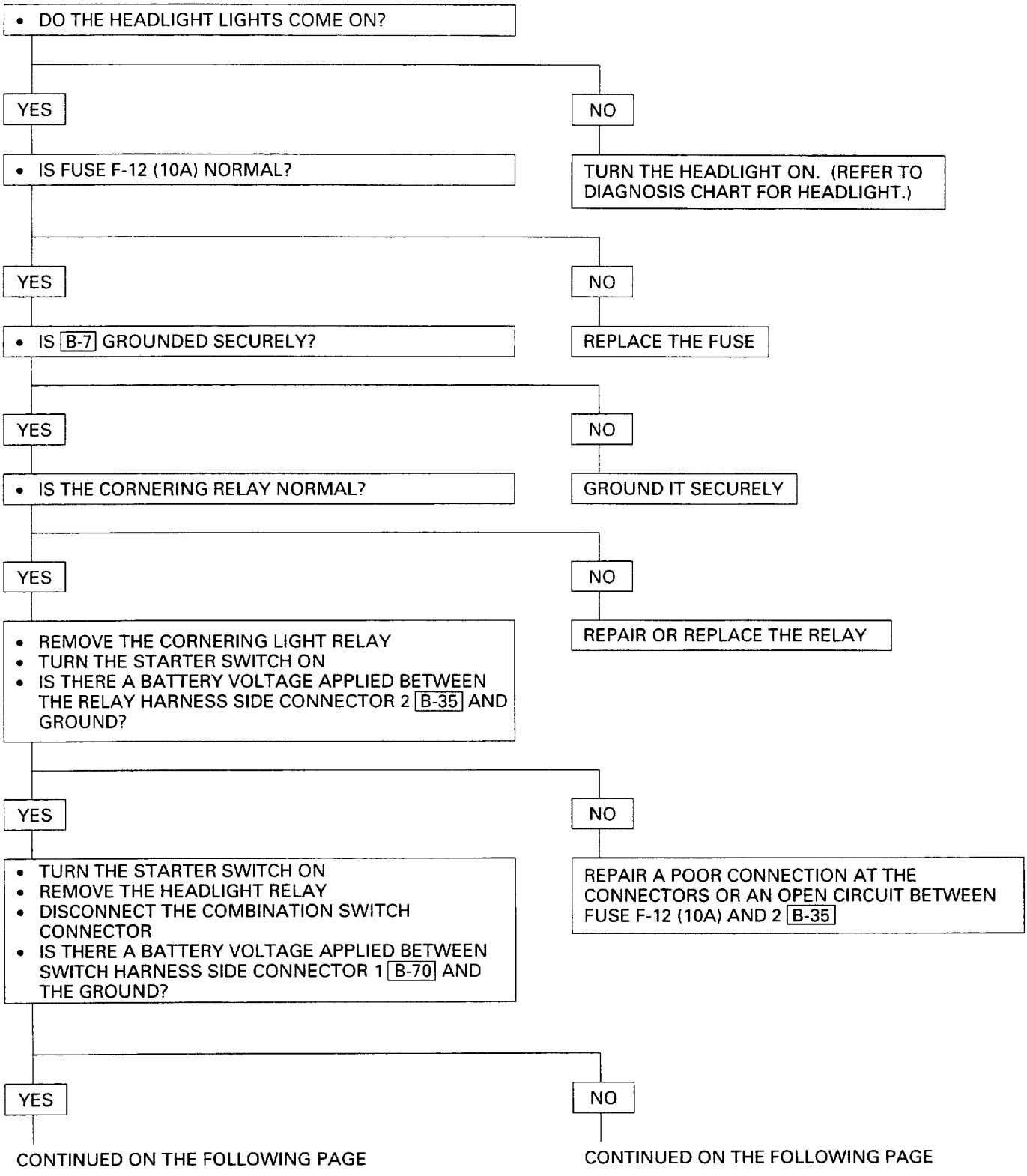
REPAIR OR REPLACE THE FOG LIGHT SWITCH

NO

REPLACE THE TAIL RELAY?

3. CORNERING LIGHT

3-1. BOTH CORNERING LIGHTS INOPERATIVE



CONTINUED FROM THE PREVIOUS PAGE

- IS THERE ANY CONTINUITY BETWEEN THE SWITCH CONNECTORS 2 [B-70] AND 11 [B-70] (WHEN TURNING LEFT) OR 2 [B-70] AND 9 [B-70] (WHEN TURNING RIGHT) RESPECTIVELY?

YES

REPAIR A POOR CONNECTION OR AN OPEN CIRCUIT BETWEEN THE HARNESS SIDE CONNECTORS 5 [B-35] AND 2 [B-70]

NO

REPAIR OR REPLACE THE SWITCH

CONTINUED FROM THE PREVIOUS PAGE

REPAIR A POOR CONNECTION OR A OPEN CIRCUIT AT THE CONNECTOR BETWEEN 4 [B-35] AND 1 [B-70]

3-2. CORNERING LIGHT ON THE LEFT (OR RIGHT) SIDE INOPERATIVE

- IS THE CORNERING LIGHT BULB ON THE LEFT (OR RIGHT) NORMAL?

YES

- DISCONNECT THE COMBINATION SWITCH CONNECTOR
- IS THERE ANY CONTINUITY BETWEEN THE SWITCH CONNECTOR TERMINALS 2 [B-70] AND 11 [B-70] (IN TURNING LEFT) (2 [B-70] – 9 [B-70]: IN TURNING RIGHT)

NO

REPLACE THE BULB

YES

- IS THERE ANY CONTINUITY BETWEEN THE CORNERING LIGHT SWITCH HARNESS SIDE CONNECTOR TERMINALS 11 [B-70] AND 3 [B-5] (9 [B-70] AND 3 [B-74])?

NO

REPAIR OR REPLACE THE CORNERING LIGHT SWITCH

YES

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN 1 [B-5] AND [B-7] OR 1 [B-74] AND [B-7]

NO

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN 11 [B-70] AND 3 [B-5] (9 [B-70] AND 3 [B-74]

NOTE: FIGURES IN PARENTHESIS "( )" INDICATE PLACE OF INSPECTION FOR THE CORNERING LIGHT ON THE RIGHT.

3-3. CORNERING LIGHT REMAINS ON EVEN WHEN STEERING WHEEL IS IN STRAIGHT AHEAD POSITION

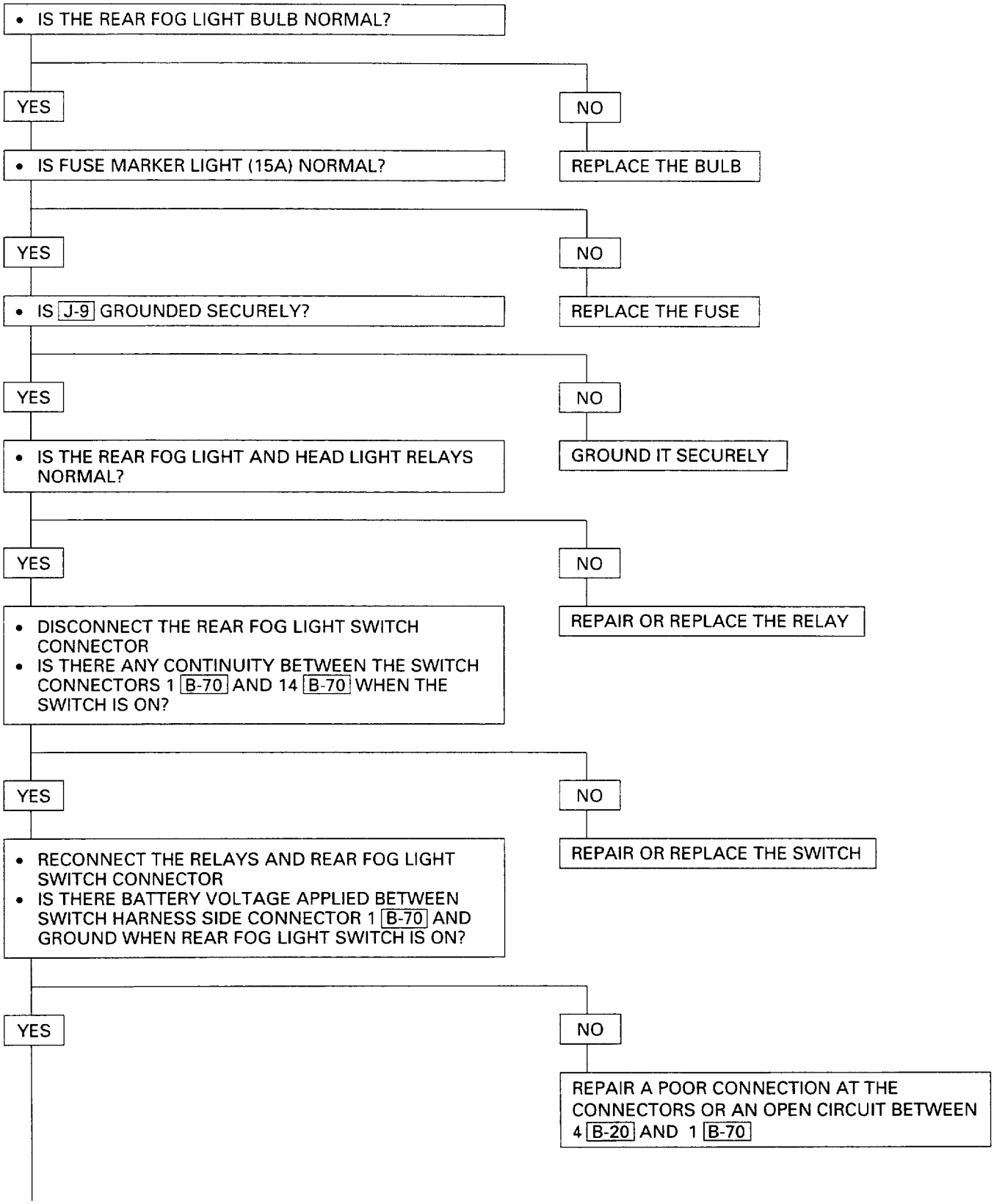
- DOES THE CORNERING LIGHT SWITCH OPERATE SMOOTHLY

NO

REPAIR OR REPLACE THE CORNERING LIGHT SWITCH (COMBINATION SWITCH)

4. REAR FOG LIGHT

4-1. REAR FOG LIGHT INOPERATIVE (WHILE HEADLIGHT IS ON)



CONTINUED ON THE FOLLOWING PAGE

CONTINUED FROM THE PREVIOUS PAGE

- SET THE REAR FOG LIGHT SWITCH TO ON POSITION
- IS THERE BATTERY VOLTAGE APPLIED BOTH BETWEEN REAR FOG LIGHT RELAY HARNESS SIDE CONNECTOR 4 [J-19] AND GROUND, AND 1 [J-19] AND GROUND?

YES

- DISCONNECT THE REAR FOG LIGHT CONNECTOR
- IS THERE BATTERY VOLTAGE APPLIED BETWEEN REAR FOG LIGHT HARNESS SIDE CONNECTOR 1 [R-12] AND GROUND WHEN REAR FOG LIGHT SWITCH IS ON?

YES

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN 2 [R-12] AND [J-9] (GROUND)

NO

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN 1 [R-12] AND 5 [J-19]

NO

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN FUSE MERKER LIGHT (15A) AND 1 [J-19] AND 14 [B-70] AND 4 [J-19]

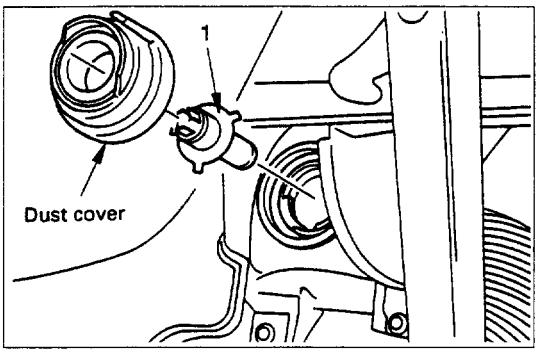
STARTER SWITCH

Refer to "START AND CHARGING" in this section.

HIGH BEAM INDICATOR LIGHT

Refer to "METER AND WARNING/INDICATOR LIGHT" in this section.

HEADLIGHT BULB



REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Headlight Bulb**
   1) Tilt up the cab.
   2) Disconnect the connector.
   3) Remove the dust cover.
   4) Remove the bulb by loosen the clip.

NOTE:

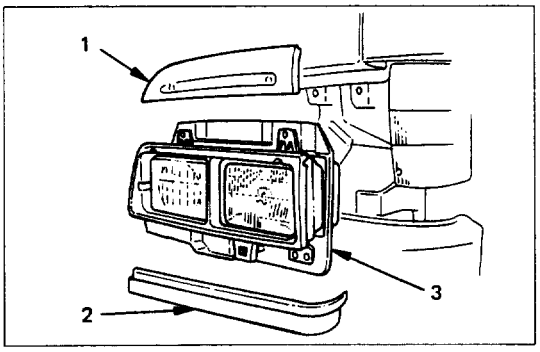
In case of non-tilt type cab, and depending on the equipment fitted, above removal is not applied.

In such a case, the bulbs can be removed after headlight and fog light assembly is removed. (Refer to HEADLIGHT ASSEMBLY in this section.

INSTALLATION

To install, follow the removal steps in the reverse order.

HEADLIGHT ASSEMBLY



REMOVAL

Preparation:

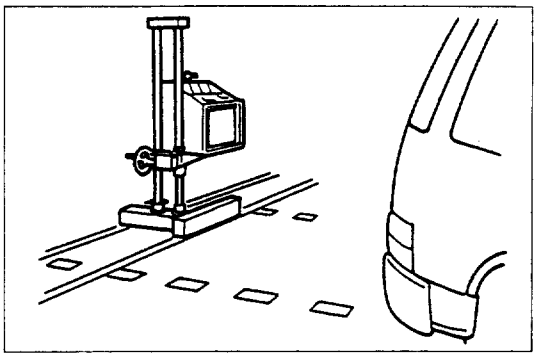
Disconnect the battery ground cable.

1. **Dummy lens**
   - Remove two screws.
2. **Lower cover**
   - Pull the lower cover to disconnect the clips.
3. **Headlight assembly**
   - Remove the fixing screws.
   - Disconnect the connectors.

INSTALLATION

To install, follow the removal steps in the reverse order, noting the following point.

1. After installing the headlight assembly, be sure to adjust the headlight aim.

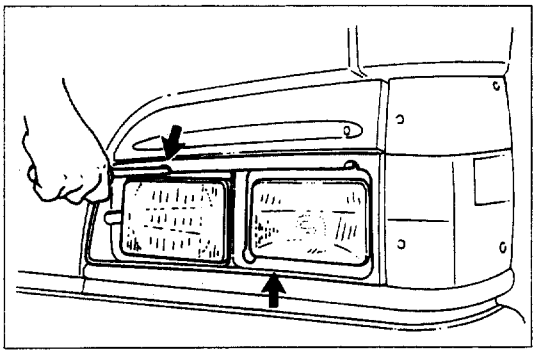


AIMING OF HEADLIGHT

Preparation:

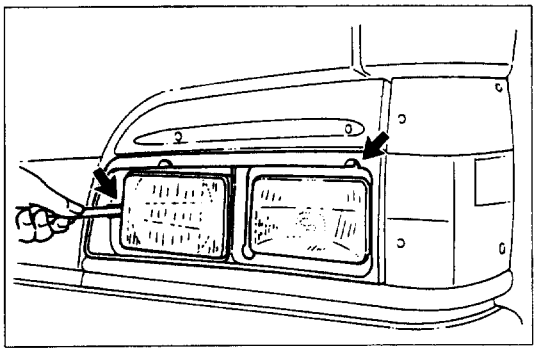
Place the unloaded vehicle on a level surface and check to see if the inflation pressure of the tires is correct, the lenses are clean, and the battery is sufficiently charged. Adjust the aim with the headlight tester.

When adjusting, follow the procedure of the tester manufacturer's.



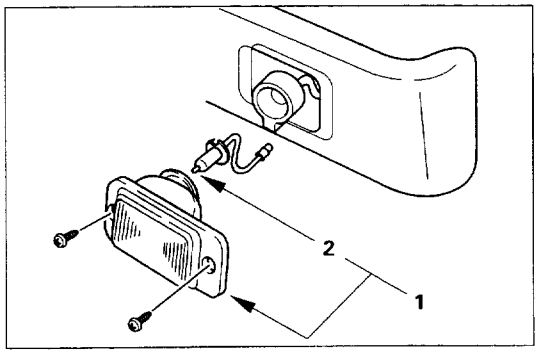
VERTICAL ADJUSTMENT

Use a screwdriver for vertical adjustment.



HORIZONTAL ADJUSTMENT

Use a screwdriver for horizontal adjustment.



FRT FOG LIGHT BULB

REMOVAL

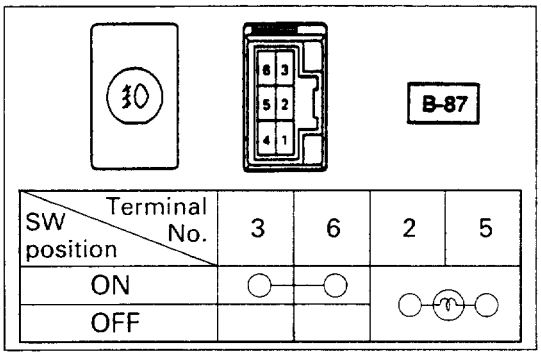
Preparation:

Disconnect the battery ground cable.

1. **Fog Light Assembly**
   - Remove the two screws.
   - Disconnect the connector.
2. **Bulb**

INSTALLATION

To install, follow the removal steps in the reverse order.

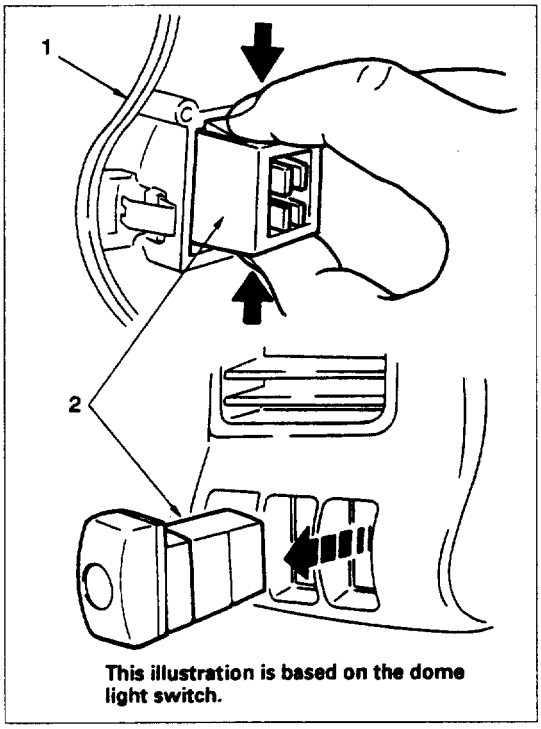


FOG LIGHT SWITCH

INSPECTION

Check the continuity between the connector terminals while operating the switch.

Replace the switch when the result of inspection is found abnormal.



This illustration is based on the dome light switch.

REMOVAL

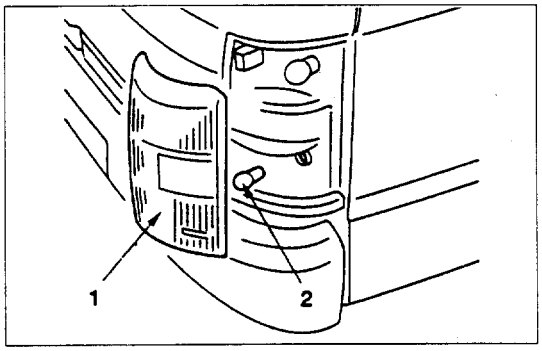
Preparaion:

Disconnect the battery ground cable.

1. **Meter Cluster**
   Refer to "METER AND WARNING/INDICATOR LIGHT" in this section.
2. **Fog Light Switch**
   Release the lock pushing the switch from the back side of the meter cluster.

INSTALLATION

To install, follow the removal steps in the reverse order.



CORNERING LIGHT/BULB

REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Front Combination Light Lens**
   Remove four screws.
2. **Bulb**

INSTALLATION

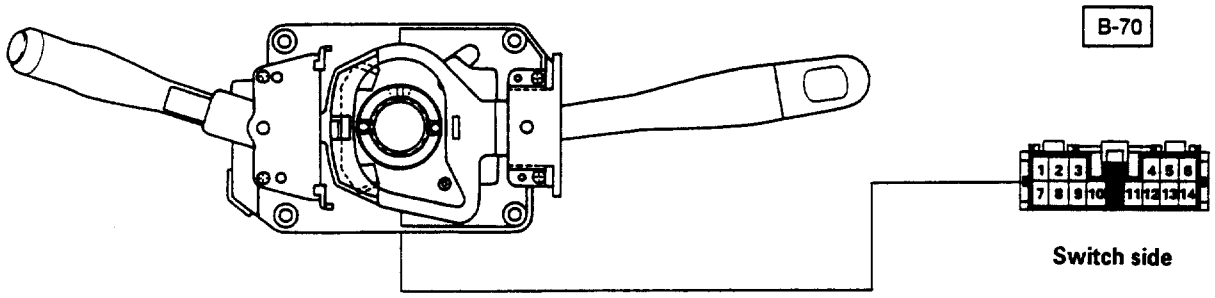
To install, follow the removal steps in the reverse order.

COMBINATION SWITCH (LIGHTING SWITCH, DIMMER-PASSING SWITCH, CORNERING LIGHT SWITCH AND REAR FOG LIGHT SWITCH)

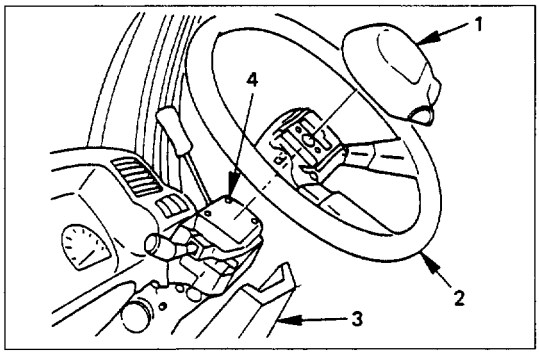
INSPECTION

Check the continuity between the connector terminals while operating the switch.

Replace the switch when the result of inspection is found abnormal.



SW position \ Terminal No.		1	2	4	5	7	8	9	10	11	12	13	14
Lighting SW		○		○			○						
				○			○						
	REAR FOG SW	○		○			○						○
	OFF												
Dimmer-passing SW	High beam			○					○				
	Passing			○		○			○				
Cornering light SW	Turning left		○							○			
	Neutral												
	Turning right		○					○					



REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Horn Pad**
   1) Hold the horn pad and pull it upward.
2. **Steering Wheel**
   1) Remove the steering shaft nut.
   2) Remove the steering wheel by using steering wheel remover.

      (Refer to Section 3D "STEERING COLUMN" for steering wheel removal steps.)
3. **Steering Cowl**

   Remove four screws
4. **Combination Switch**
   1) Remove four screws.
   2) Disconnect the connector.

INSTALLATION

To install, follow the removal steps in the reverse order, noting the following point.

1. Tighten the steering shaft nut to the specified torque.

Shaft nut torque	N·m (kg·m/lb·ft)
	49 (5/36)

HEADLIGHT LEVELING

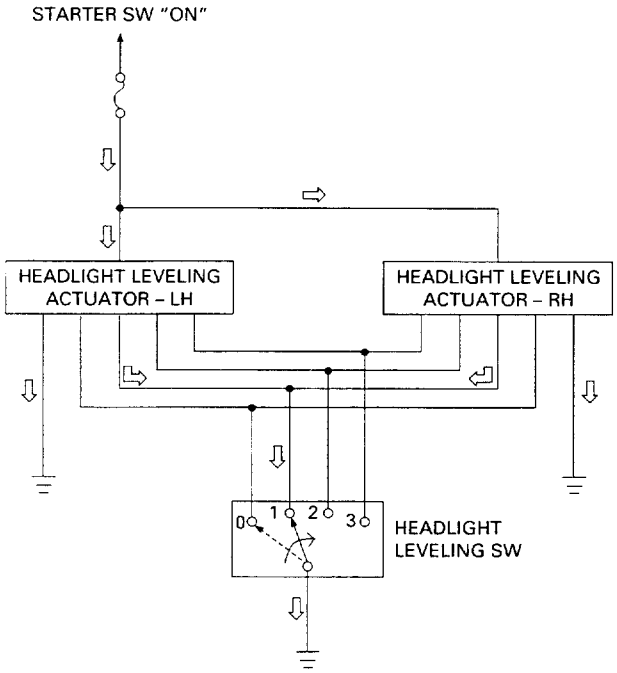
GENERAL DESCRIPTION

The circuit consists of starter SW, headlight leveling SW and headlight leveling actuator.

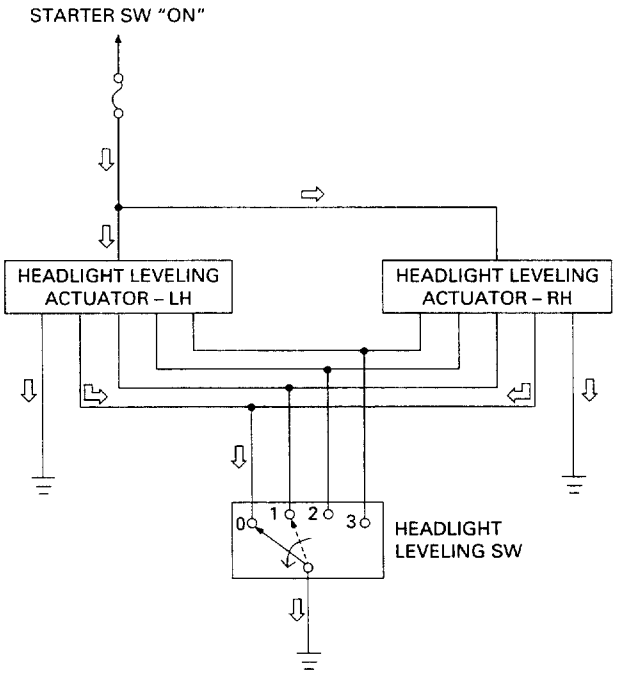
When the headlight leveling SW is operated with the starter SW at ON position, the actuator is operated to change the angle of the optical axis of the headlight.

OPERATION OF THE CIRCUIT

1. When headlight leveling SW is turned to "1" position

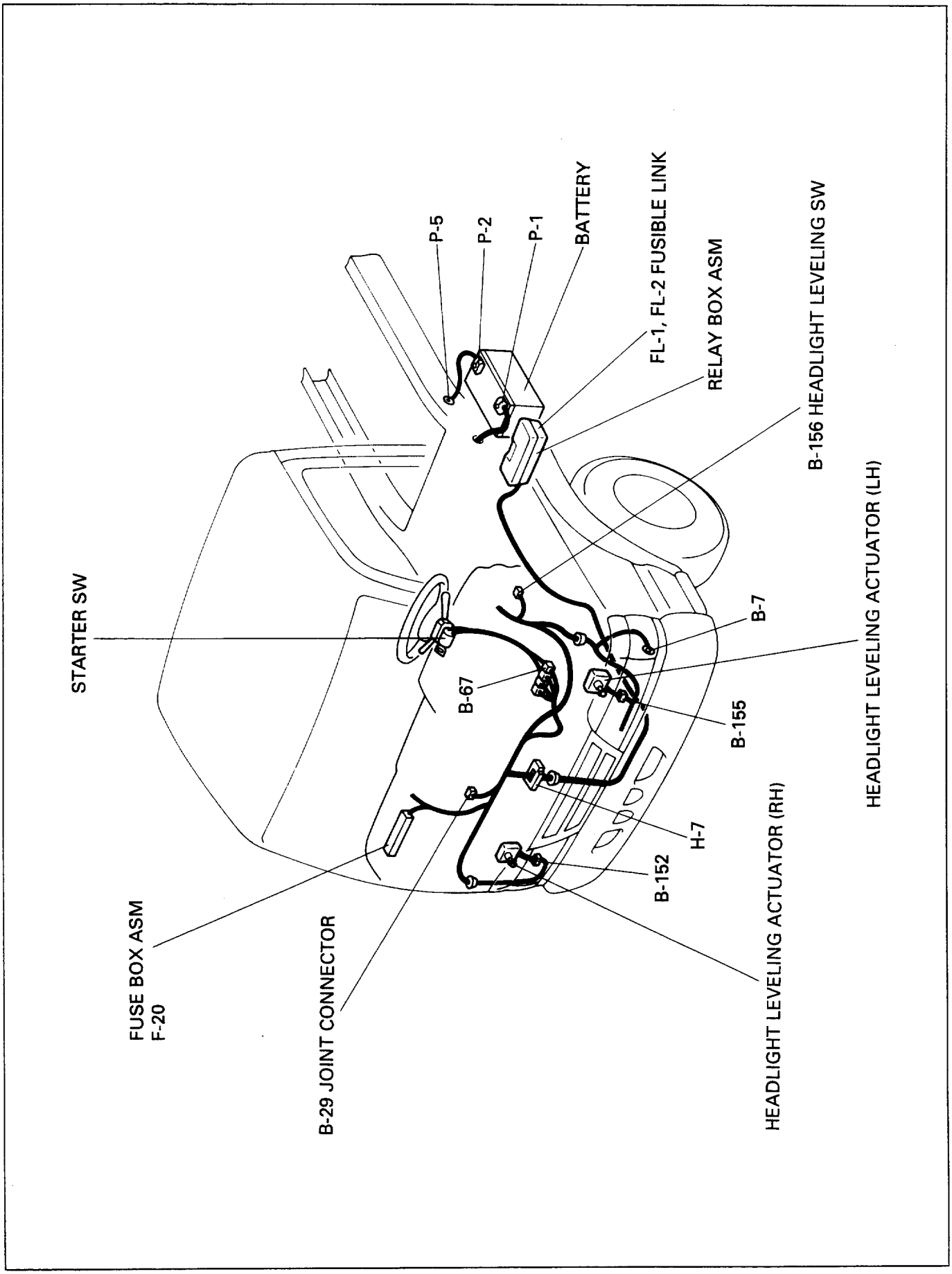


2. When headlight leveling SW is turned to "0" position

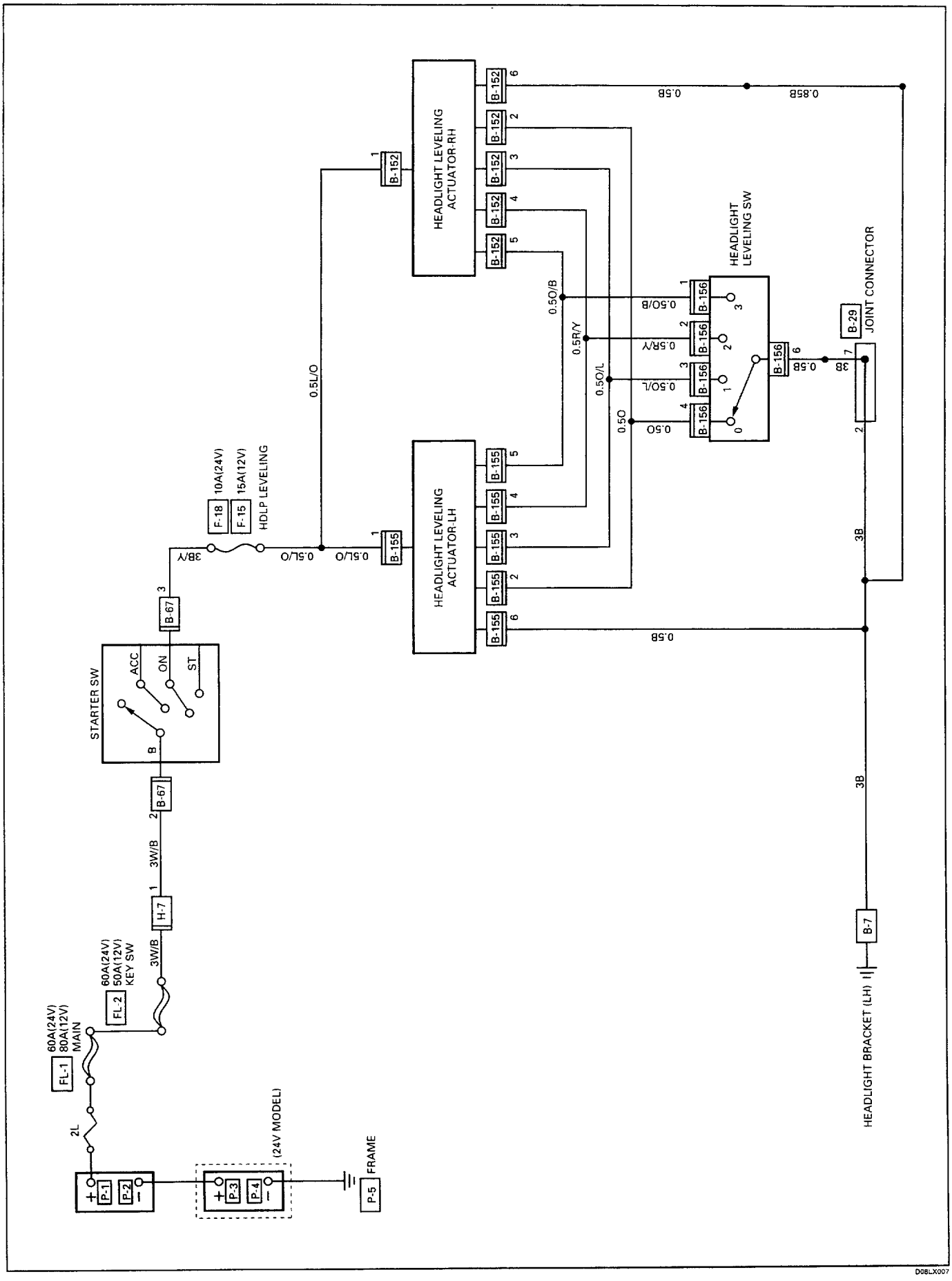


NOTE: Arrow marks "⟹" indicate the direction of current

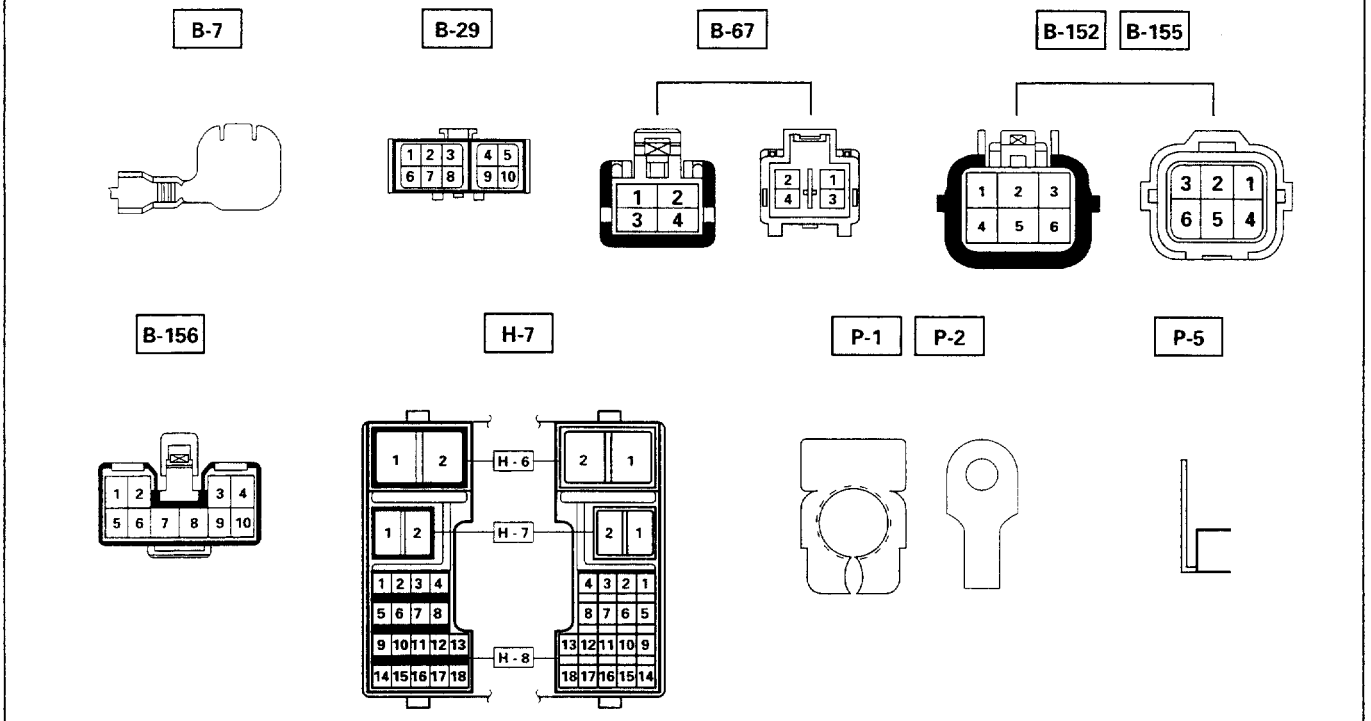
PARTS LOCATION



CIRCUIT DIAGRAM



CONNECTOR LIST

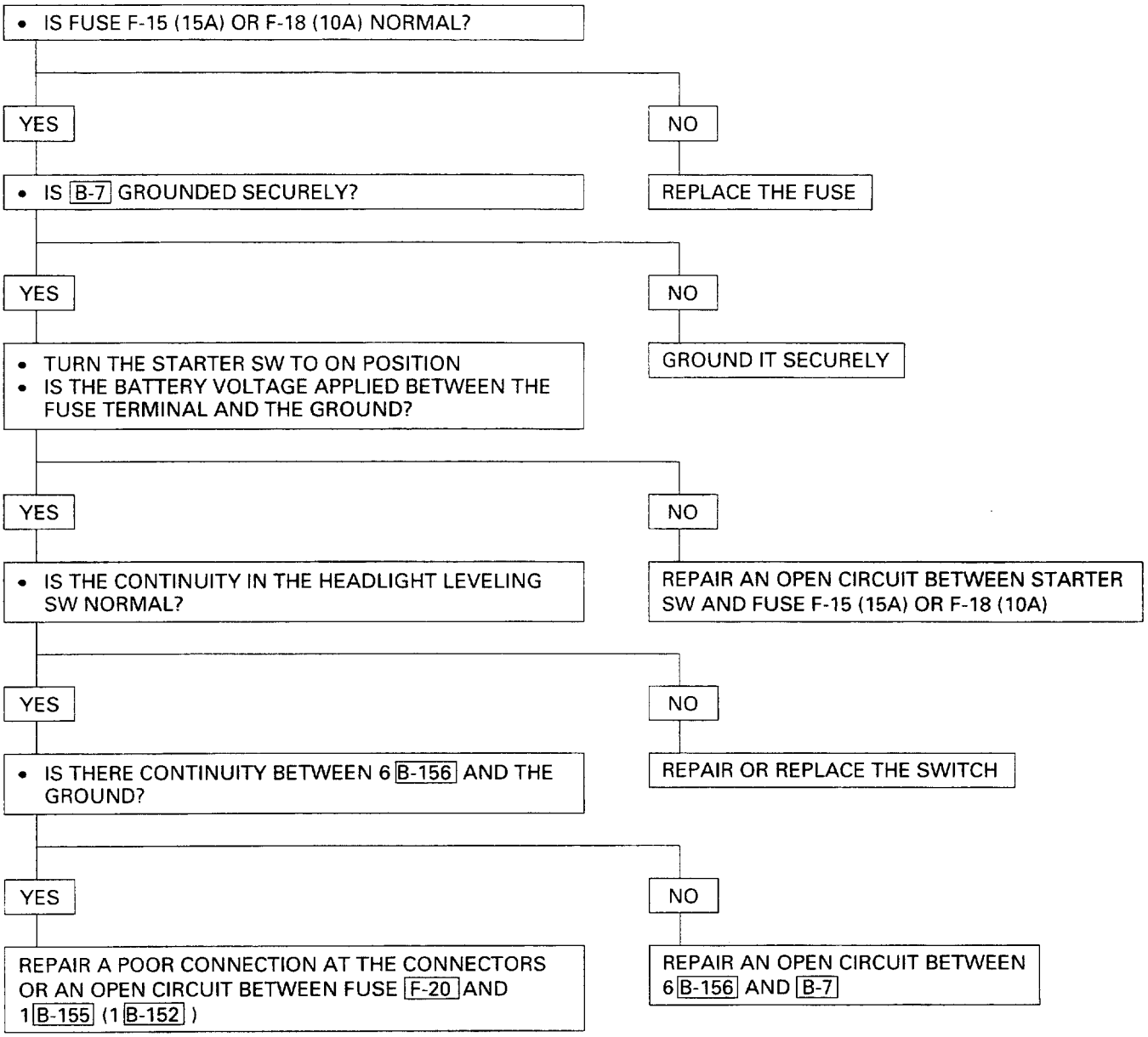


DIAGNOSIS

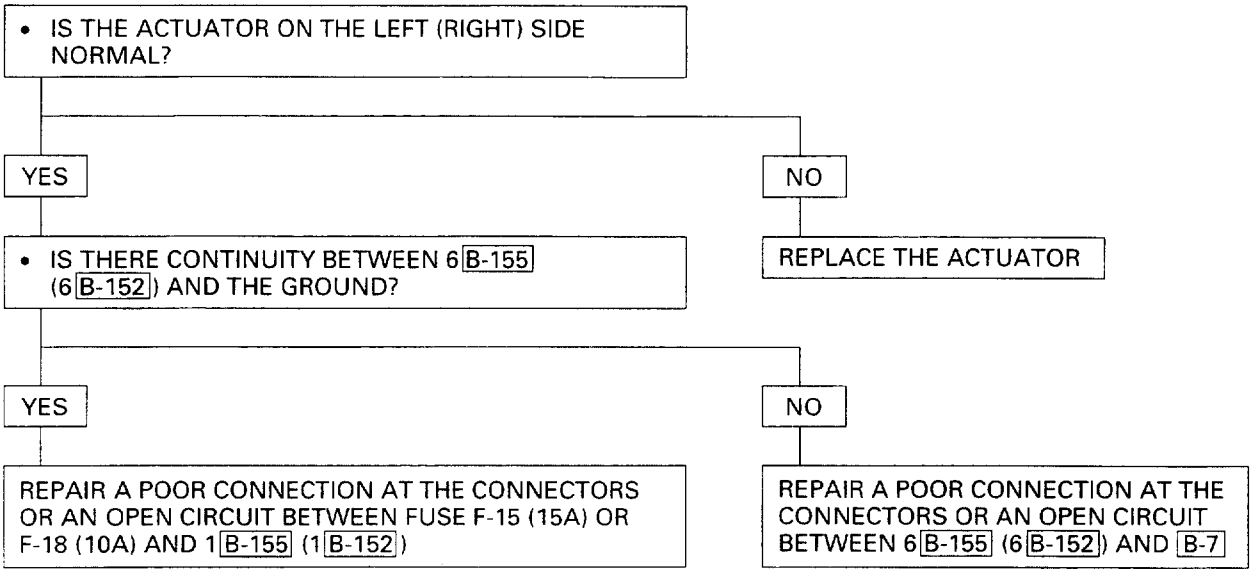
QUICK CHART FOR CHECK POINTS

Trouble mode \ Check point	Fuse F-18 (10A):24V F-15 (15A):12V	Headlight leveling switch	Headlight leveling actuator	Cable harness
1. Both actuators inoperative	○	○		○
2. Actuator on the left (right) side inoperative			○	○
3. When leveling SW is turned to a certain position, actuator inoperative		○	○	○

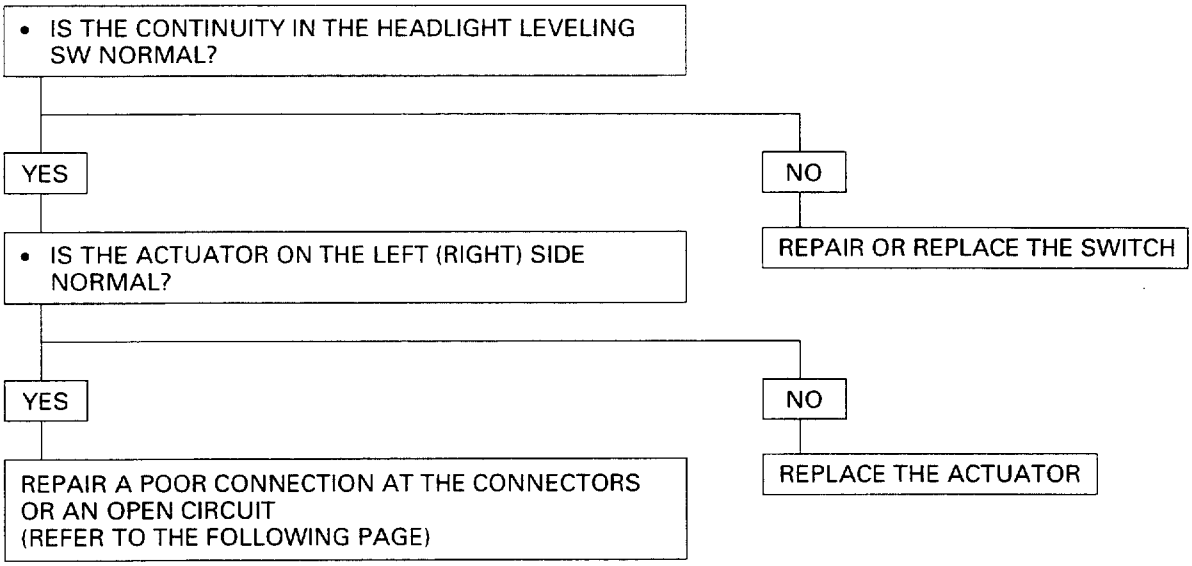
1. BOTH ACTUATORS INOPERATIVE



2. ACTUATOR ON THE LEFT (RIGHT) SIDE INOPERATIVE



3. WHEN HEADLIGHT LEVELING SW IS TURNED TO A CERTAIN POSITION, ACTUATOR INOPERATIVE



Inspect and repair the circuit that is corresponding to the headlight leveling switch position where the actuator becomes inoperative.

Actuator – LH

Headlight leveling SW position	Circuit
1	Between 3 B-156 and 3 B-155
2	Between 2 B-156 and 4 B-155
3	Between 1 B-156 and 5 B-155
0	Between 4 B-156 and 2 B-155

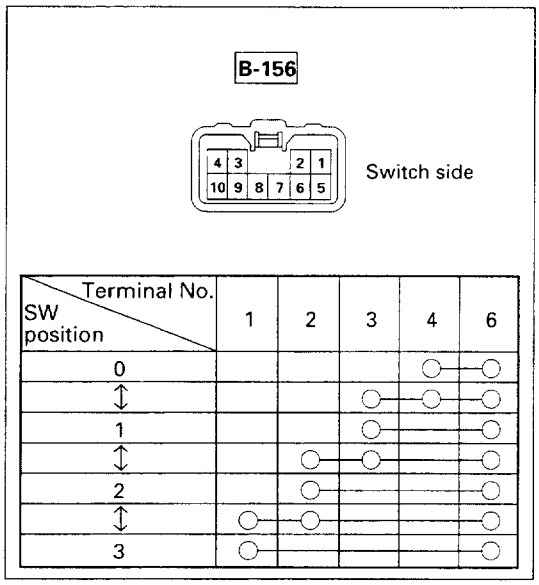
Actuator – RH

Headlight leveling SW position	Circuit
1	Between 3 B-156 and 3 B-152
2	Between 2 B-156 and 4 B-152
3	Between 1 B-156 and 5 B-152
0	Between 4 B-156 and 2 B-152

STARTER SWITCH

Refer to "START AND CHARGING" in this manual.

HEADLIGHT LEVELING SWITCH

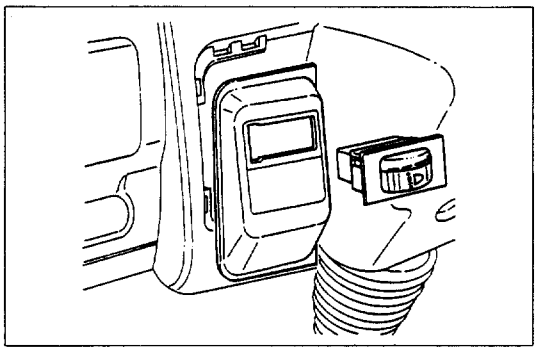


SW position \ Terminal No.	1	2	3	4	6
0				○	○
↕			○	○	○
1			○		○
↕		○	○		○
2		○			○
↕	○	○			○
3	○				○

INSPECTION

Check the continuity between the switch connector terminals.

Repair or replace the switch when the result of inspection is found abnormal.



REMOVAL

Preparation:

Disconnect the battery ground cable.

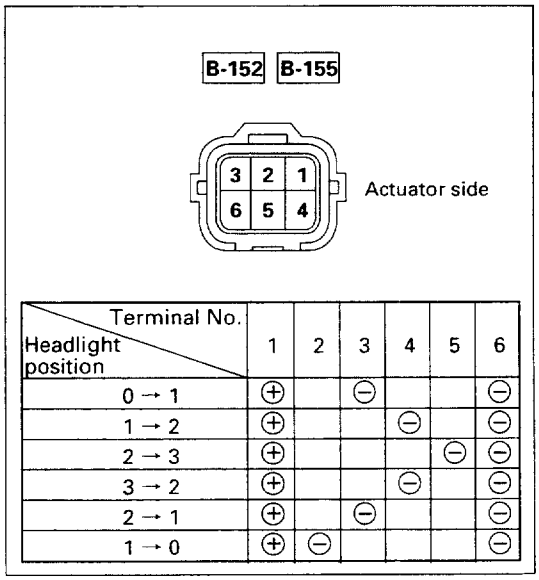
1. **Switch Bezel**
2. **Headlight Leveling Switch**

Disconnect the connector.

INSTALLATION

To install, follow the removal steps in the reverse order.

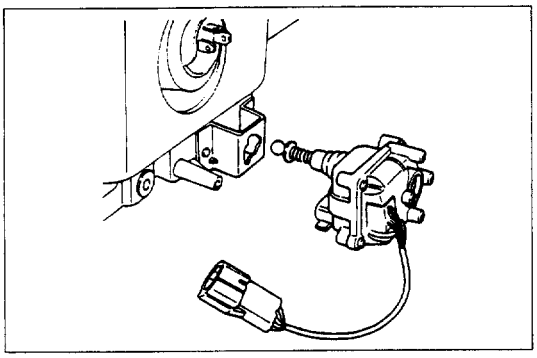
HEADLIGHT LEVELING ACTUATOR



Headlight position \ Terminal No.	1	2	3	4	5	6
0 → 1	⊕		⊖			⊖
1 → 2	⊕			⊖		⊖
2 → 3	⊕				⊖	⊖
3 → 2	⊕			⊖		⊖
2 → 1	⊕		⊖			⊖
1 → 0	⊕	⊖				⊖

INSPECTION

Apply the battery voltage to the connector terminals and check its function.



REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Headlight Assembly**

   Refer to HEADLIGHT ASSEMBLY removal steps in this manual.

2. **Headlight Leveling Actuator**
   1) Disconnect the connector.
   2) Remove the screw.

INSTALLATION

To install, follow the removal steps in the reverse order, noting the following point.

1. After installing the headlight leveling actuator and headlight assembly, be sure to adjust the headlight aim.

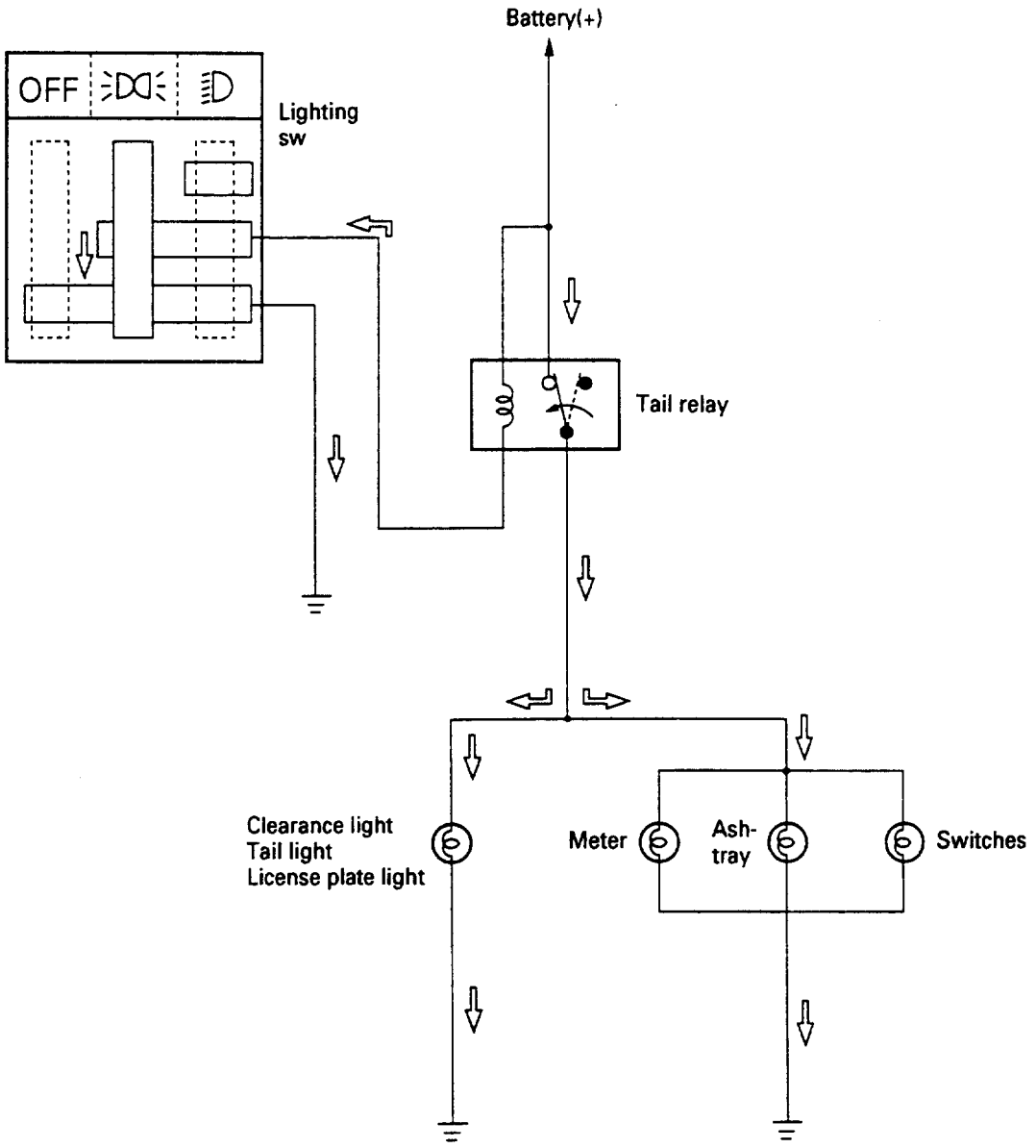
CLEARANCE LIGHT, TAILLIGHT, LICENSE PLATE LIGHT AND ILLUMINATION LIGHT

GENERAL DESCRIPTION

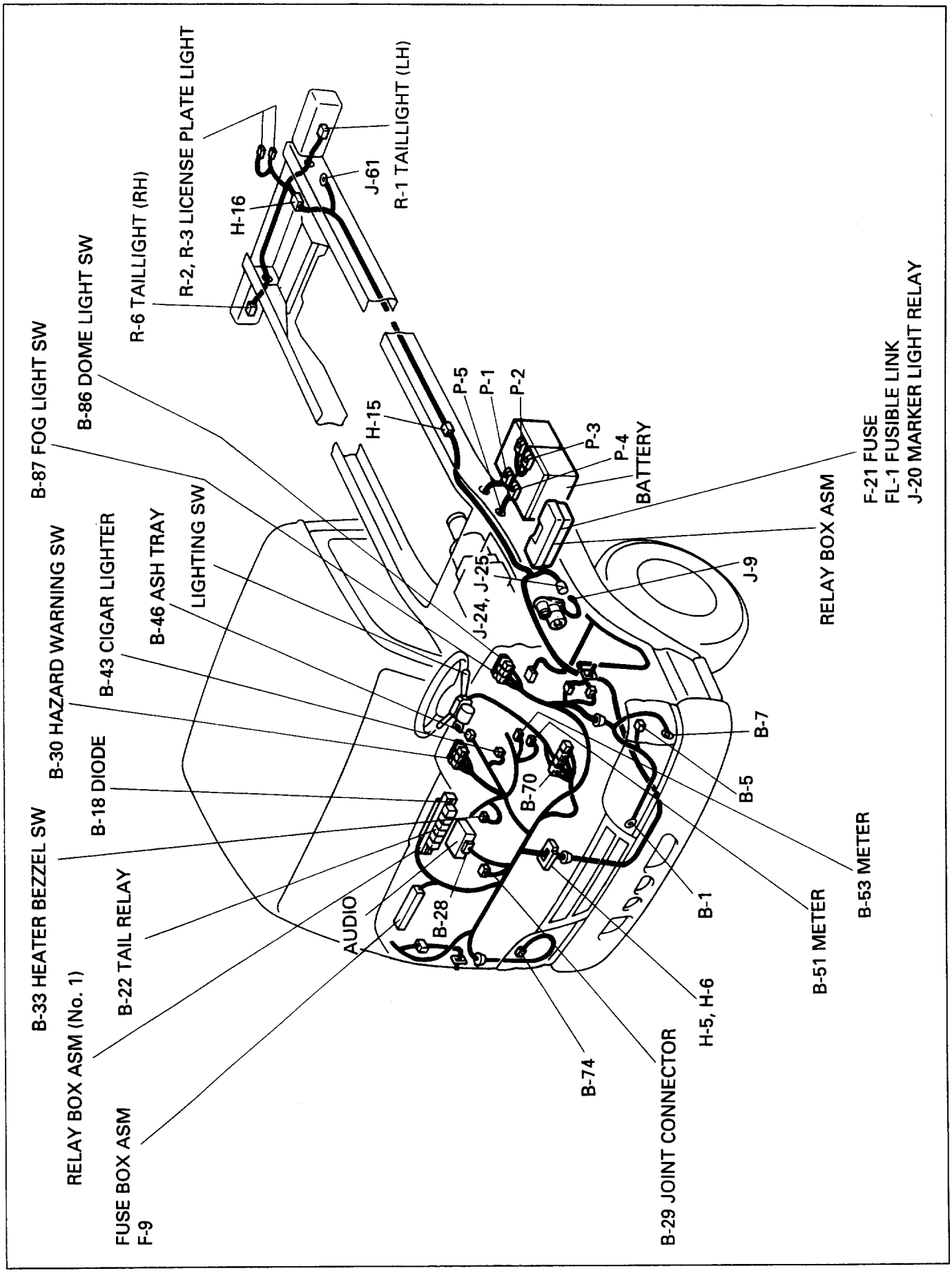
The circuit consists of the lighting switch, clearance light, taillight, license plate light and the illumination light for each of switch, meter and ashtray.

All these lights come on when the lighting switch are turned on with the switch to either clearance or headlight position.

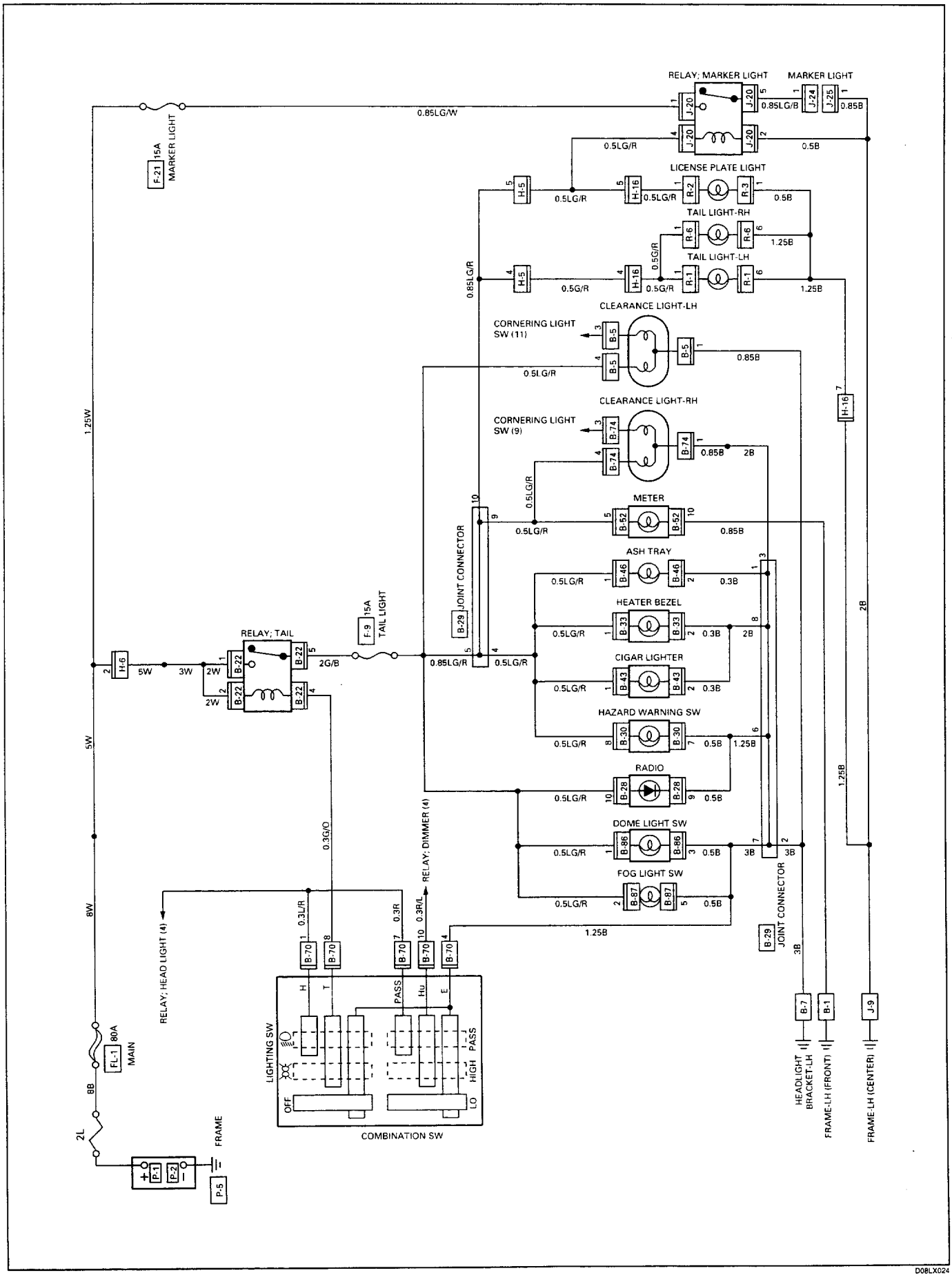
LIGHTING CIRCUIT



PARTS LOCATION

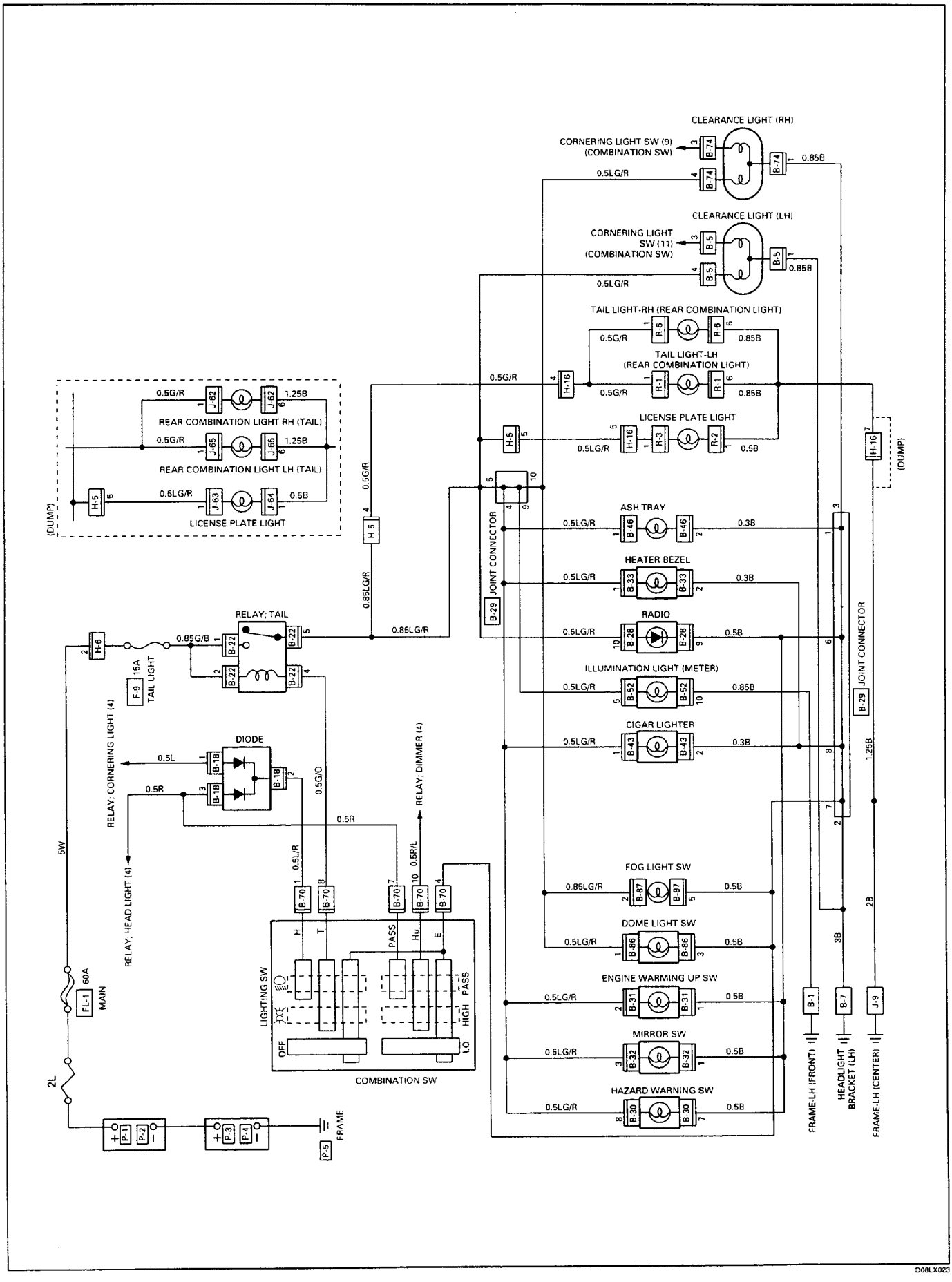


CIRCUIT DIAGRAM – FOR 12 VOLT



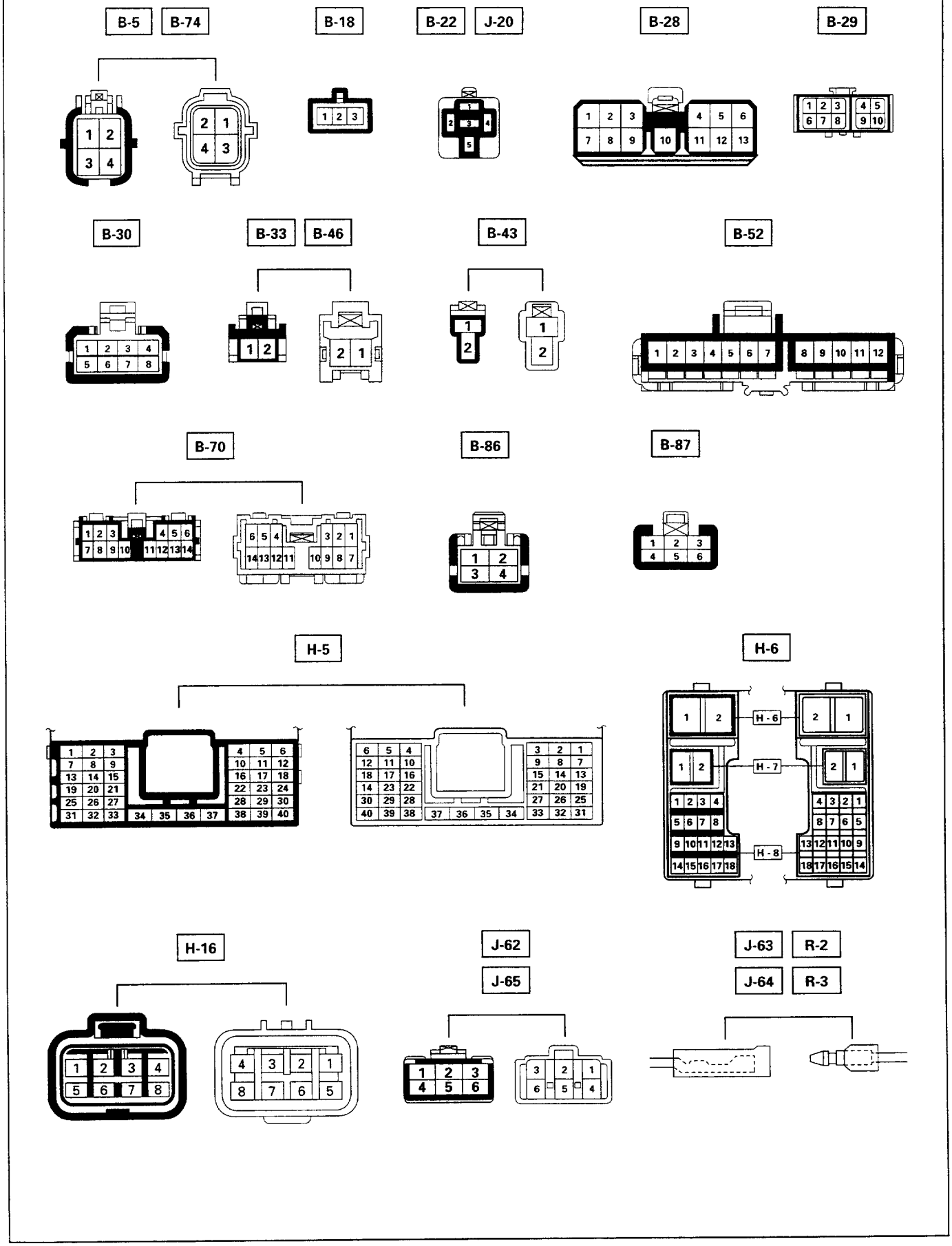
D08LX024

CIRCUIT DIAGRAM – FOR 24 VOLT



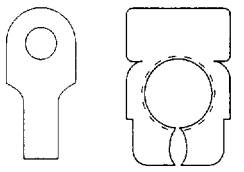
D08LX023

CONNECTOR LIST

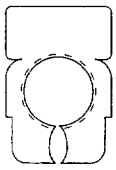


CONNECTOR LIST

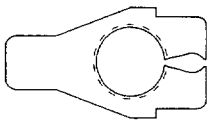
P-1 (12V) P-2



P-1 (24V) P-4

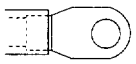


P-2 (24V) P-3

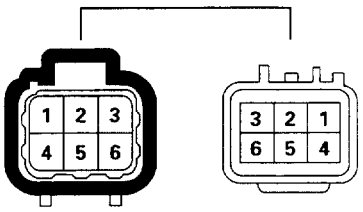


P-5 (12V)

P-5 (24V)



R-1 R-6



DIAGNOSIS

QUICK CHART FOR CHECK POINT

Trouble mode \ Check point	Fuse		Lighting SW	Taillight bulb	Clearance light bulb	License plate light bulb	Marker light relay	Cable harness
	F-9 (15A)	F-21 (15A)						
1. Both clearance lights inoperative	○ (1)		○ (3)		○ (2)			○ (4)
2. Clearance light on the left (or right) side inoperative					○ (1)			○ (2)
3. Both taillights inoperative	○ (1)		○ (2)					○ (3)
4. Taillight on the left (or right) side inoperative				○ (1)				○ (2)
5. License plate light inoperative						○ (1)		○ (2)
6. Marker light inoperative		○ (1)					○ (2)	○ (3)

NOTE: Figure in parenthesis "( )" indicates the order of inspection.

1. BOTH CLEARANCE LIGHTS INOPERATIVE

- ARE BOTH TAILLIGHT OPERATIVE?
  - NO → TURN TAILLIGHT ON (REFER TO TAILLIGHT DIAGNOSIS IN THIS SECTION)
  - YES → IS B-7 SECURELY GROUNDED?
    - NO → GROUND IT SECURELY
    - YES → • TURN THE LIGHTING SWITCH TO ≫D≪ OR ≫D POSITION
      • IS THERE BATTERY VOLTAGE APPLIED TO CLEARANCE LIGHT CONNECTOR 4 B-5 (4 B-74) AND GROUND.
      - NO → REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN FUSE F-9 (15A) AND 4 B-5 (4 B-74)
      - YES → REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN CLEARANCE LIGHT CONNECTOR TERMINAL 1 B-5 (1 B-74) AND B-7

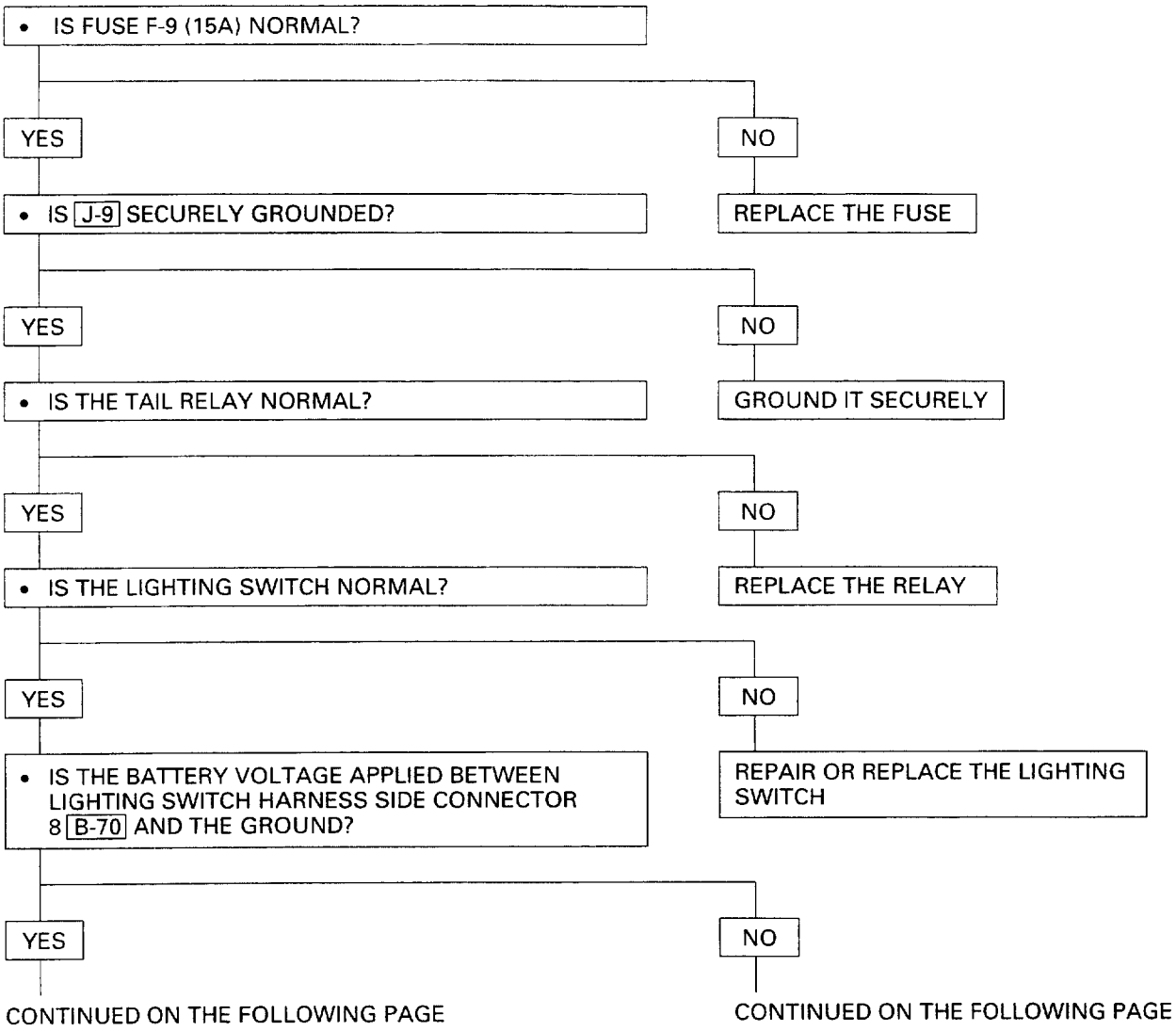
NOTE: FIGURE IN PARENTHESIS "( )" INDICATES PLACE OF INSPECTION FOR CLEARANCE LIGHT ON THE RIGHT SIDE.

2. CLEARANCE LIGHT ON THE LEFT (OR RIGHT) SIDE INOPERATIVE

- IS THE CLEARANCE LIGHT BULB ON THE LEFT (OR RIGHT) SIDE NORMAL?
  - NO → REPLACE THE BULB
  - YES → • IS THERE ANY CONTINUITY BETWEEN THE HARNESS SIDE CONNECTOR 5 B-22 AND 4 B-5 (OR 4 B-74 ?)
    - NO → REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT IN THE CIRCUIT
    - YES → • REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN 1 B-5 (1 B-74) AND B-7

NOTE: FIGURE IN PARENTHESIS "( )" INDICATES PLACE OF INSPECTION FOR CLEARANCE LIGHT ON THE RIGHT SIDE.

3. BOTH TAILLIGHTS INOPERATIVE



CONTINUED FROM THE PREVIOUS PAGE

- TURN THE LIGHTING SWITCH TO ≫DC≪ OR ≫D POSITION
- IS THERE BATTERY VOLTAGE APPLIED TO 4 [H-16] AND GROUND

YES

- REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN LIGHTING SWITCH HARNESS SIDE CONNECTORS 7 [H-16] AND [J-9]

CONTINUED FROM THE PREVIOUS PAGE

NO

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN FUSE F-9 (15A) AND 8 [B-70]

NO

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN TAILLIGHT RELAY CONNECTORS 5 [B-22] AND 4 [H-16]

4. TAILLIGHT ON THE LEFT (OR RIGHT) SIDE INOPERATIVE

- IS TAILLIGHT BULB ON THE LEFT (OR RIGHT) SIDE NORMAL?

YES

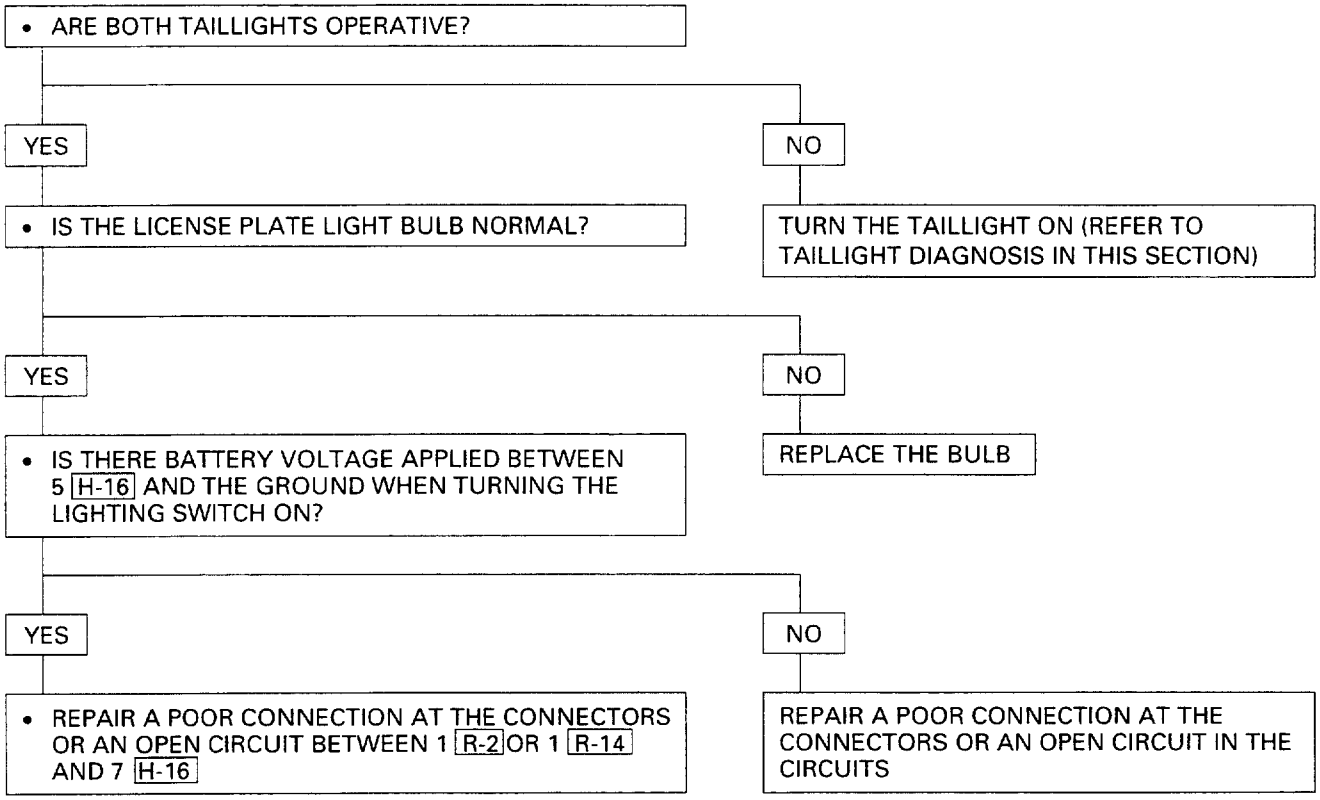
- REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN CONNECTOR TERMINAL 4 [H-16] AND TAILLIGHT CONNECTOR 1 [R-1] (1 [R-6])

NO

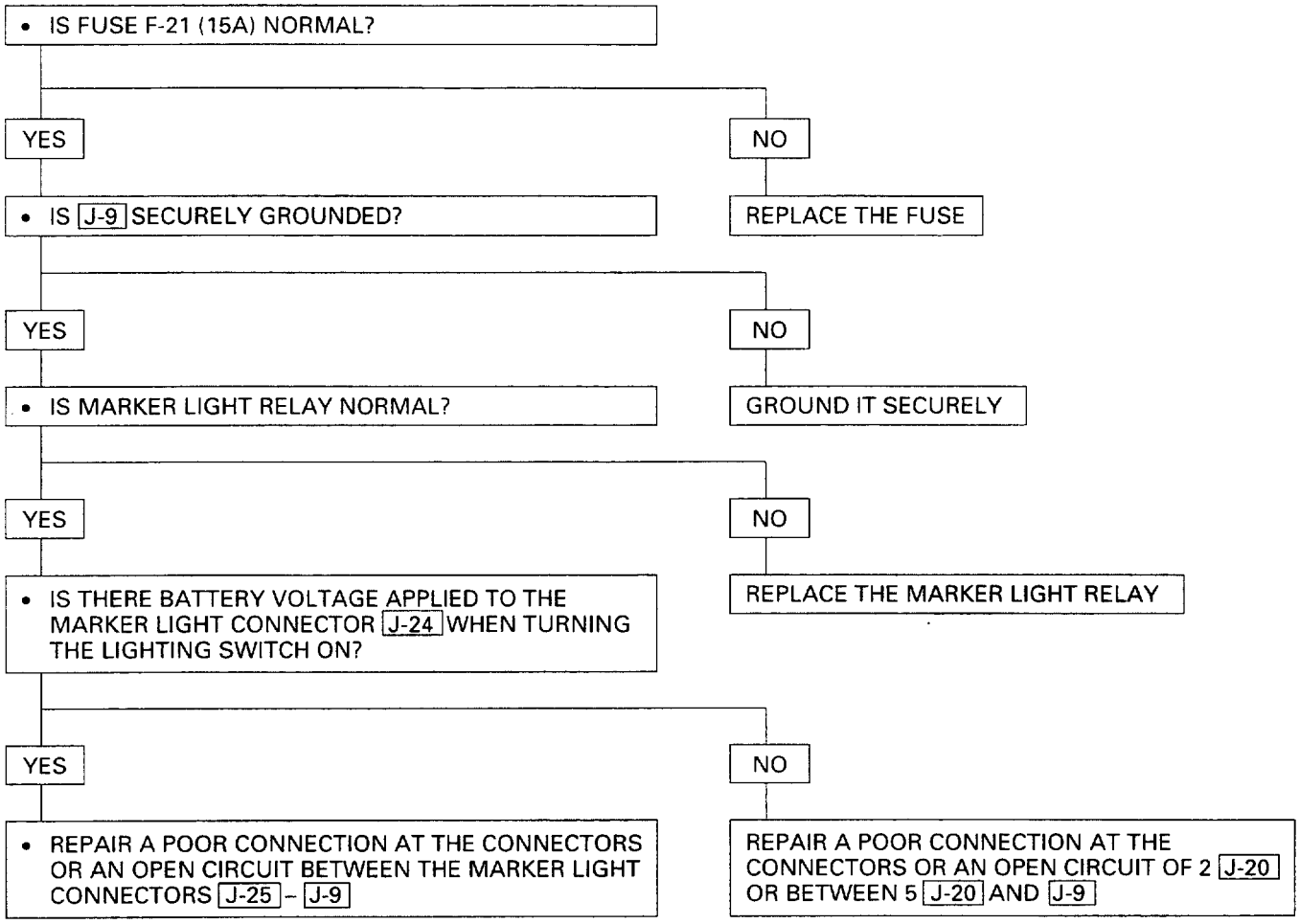
REPLACE THE BULB

NOTE: FIGURE IN PARENTHESIS "( )" INDICATES PLACE OF INSPECTION FOR TAILLIGHT ON THE RIGHT SIDE.

5. LICENSE PLATE LIGHT INOPERATIVE

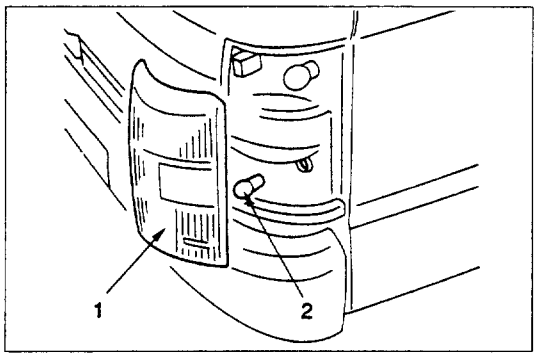


6. MARKER LIGHT INOPERATIVE



LIGHTING SWITCH

Refer to "HEADLIGHT, FOG LIGHT AND CORNERING LIGHT" in this section.



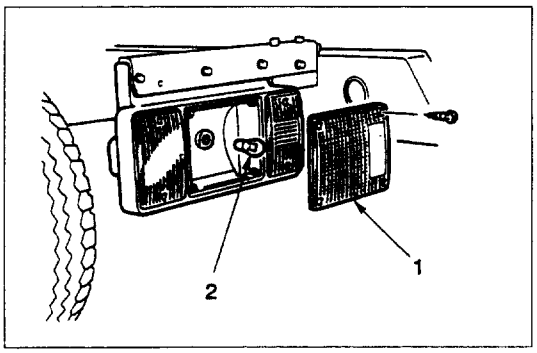
CLEARANCE LIGHT/BULB

REMOVAL

1. **Front Combination Light Lens**
   1) Remove four screws.
2. **Bulb**

INSTALLATION

To install, follow the removal steps in the reverse order.



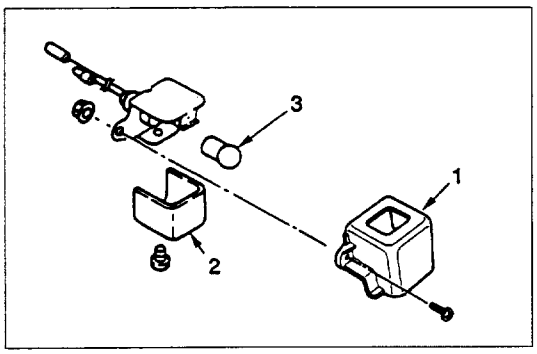
TAILLIGHT BULB

REMOVAL

1. **Lens**
2. **Bulb**

INSTALLATION

To install, follow the removal steps in the reverse order.



LICENSE PLATE LIGHT BULB

REMOVAL

1. **Cover**
2. **Lens**
3. **Bulb**

INSTALLATION

To install, follow the removal steps in the reverse order.

MEMO

TURN SIGNAL LIGHT, HAZARD WARNING LIGHT, AND STOPLIGHT

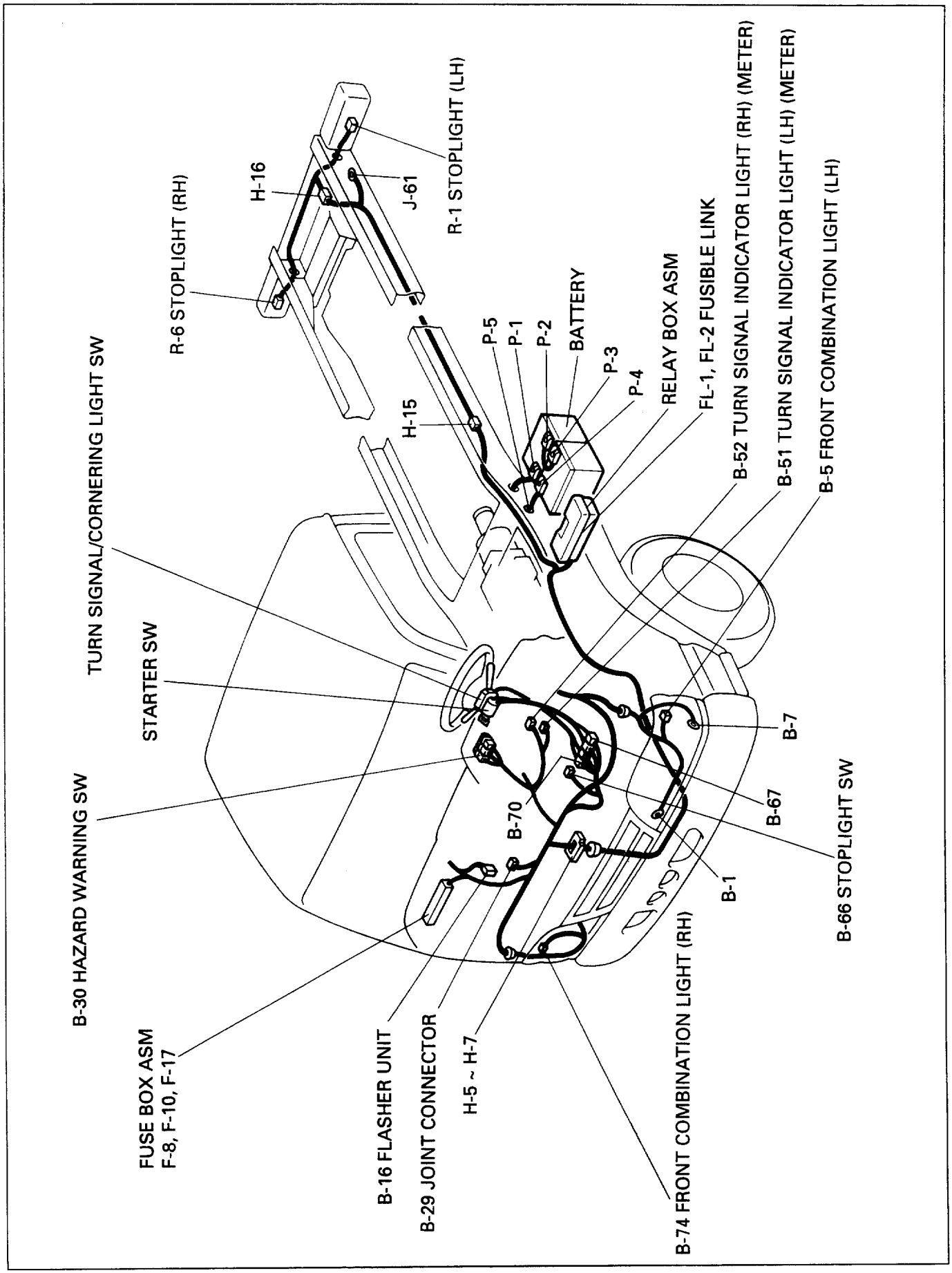
GENERAL DESCRIPTION

The circuit consists of the starter switch, turn signal light (front and rear), turn signal light switch, hazard warning light, flasher unit, stoplight and stoplight switch.

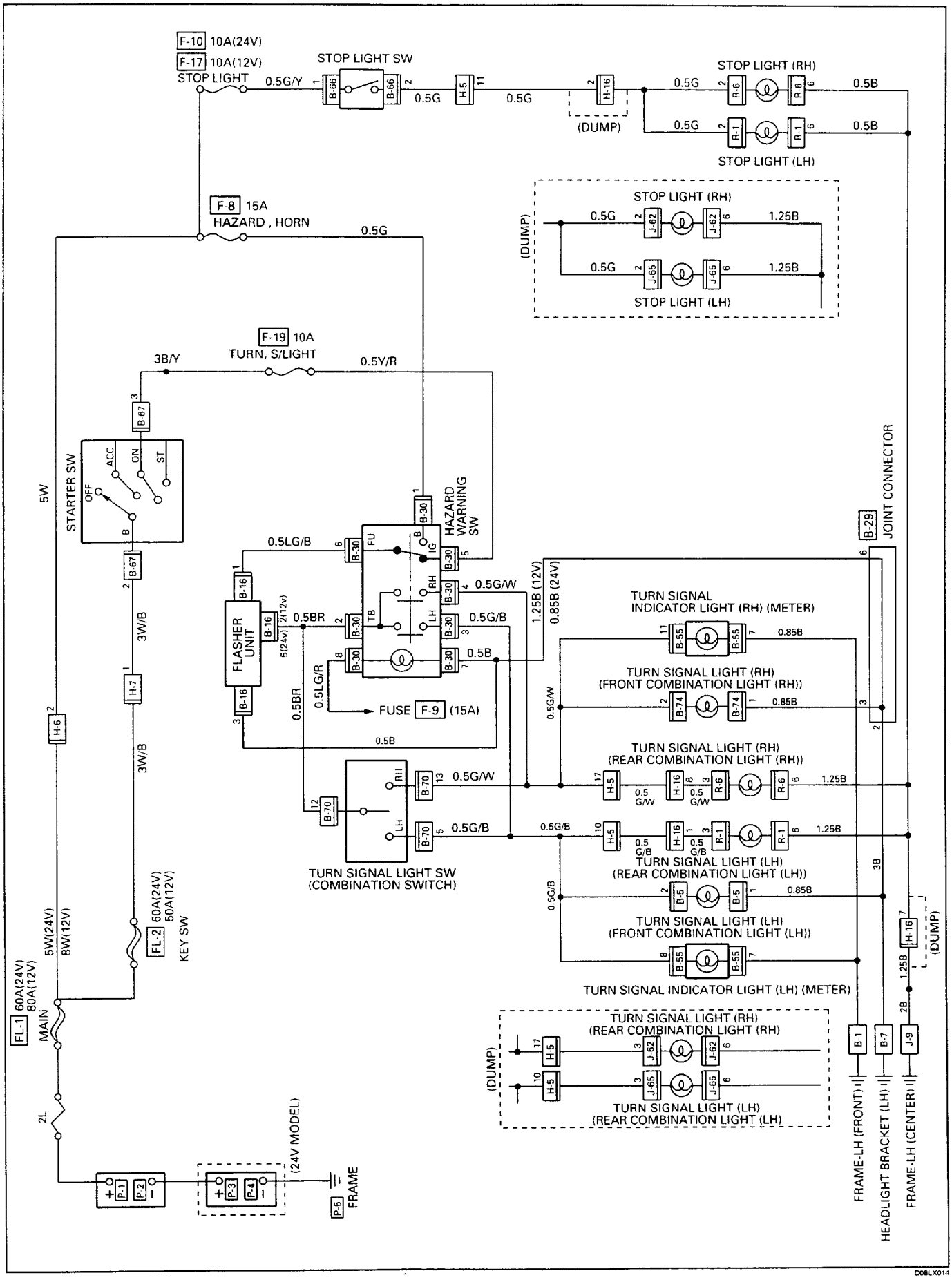
When turning on the respective switches with the starter switch on, the turn signal light will operate. When the turn signal light is flashing, the indicator light in the meter also start flashing. When the hazard warning switch is turned on, the current flows to the flasher unit through the hazard warning switch to cause the hazard warning light to flash, independent of the position of the starter switch. At the same time, the indicator lights in the meter also start flashing.

The stoplight switch will turn on and the light comes on once the brake pedal is depressed, independent of the position of the starter switch.

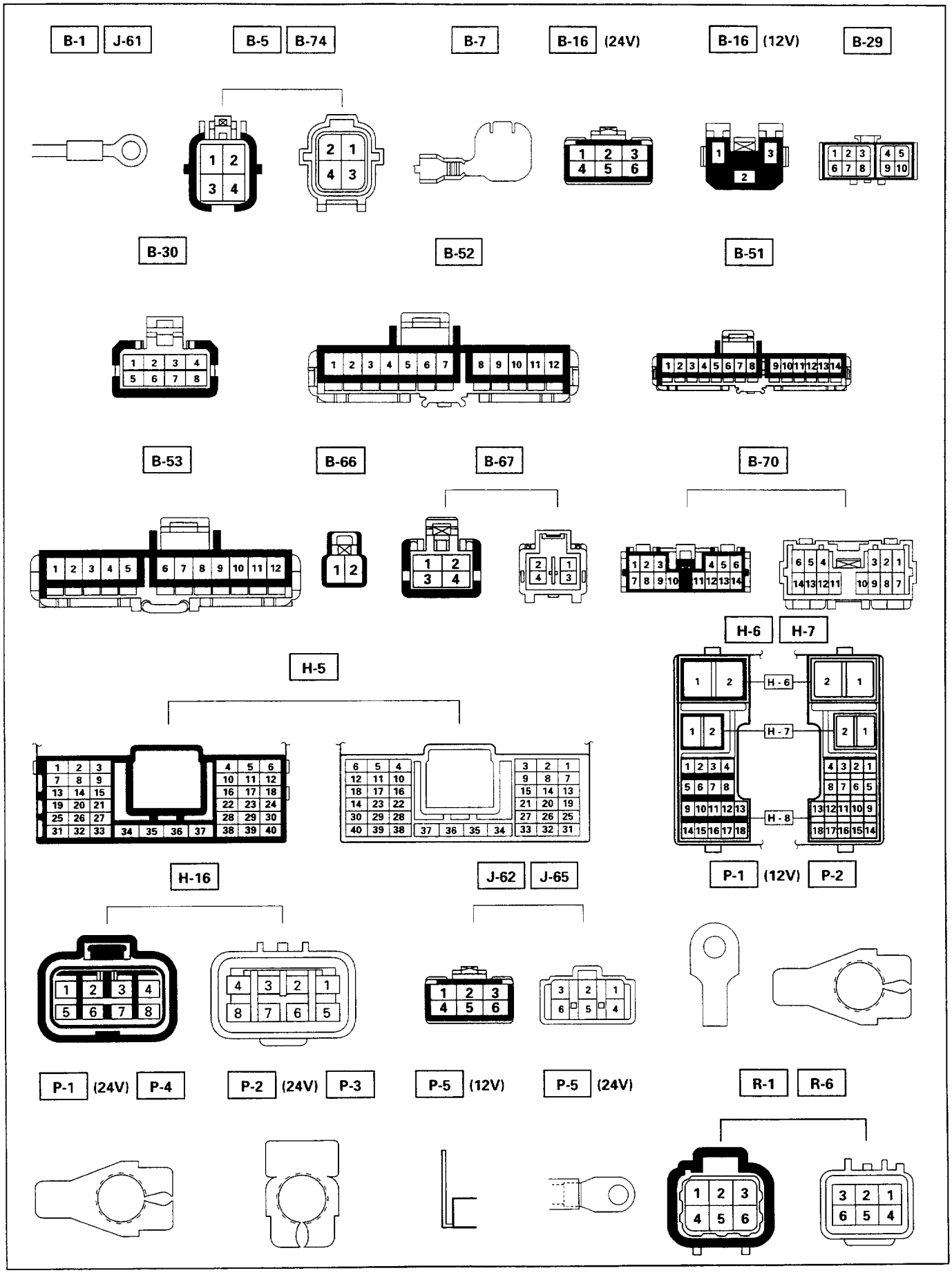
PARTS LOCATION



CIRCUIT DIAGRAM



CONNECTOR LIST



DIAGNOSIS

QUICK CHART FOR CHECK POINT

1. TURN SIGNAL LIGHT, HAZARD WARNING LIGHT

Check point / Trouble mode	Fuse		Turn signal light SW	Hazard warning light SW	Flasher unit	Turn signal light bult	Cable harness
	F-8 (15A)	F-19 (10A)					
1-1. Turn signal lights inoperative		○ (1)	○ (3)		○ (2)		○ (4)
1-2. Turn signal lights flashes too quickly						○ (1)	○ (2)
1-3. Hazard warning lights inoperative	○ (1)			○ (2)			

NOTE: Figure in parenthesis "( )" indicates the order of inspection.

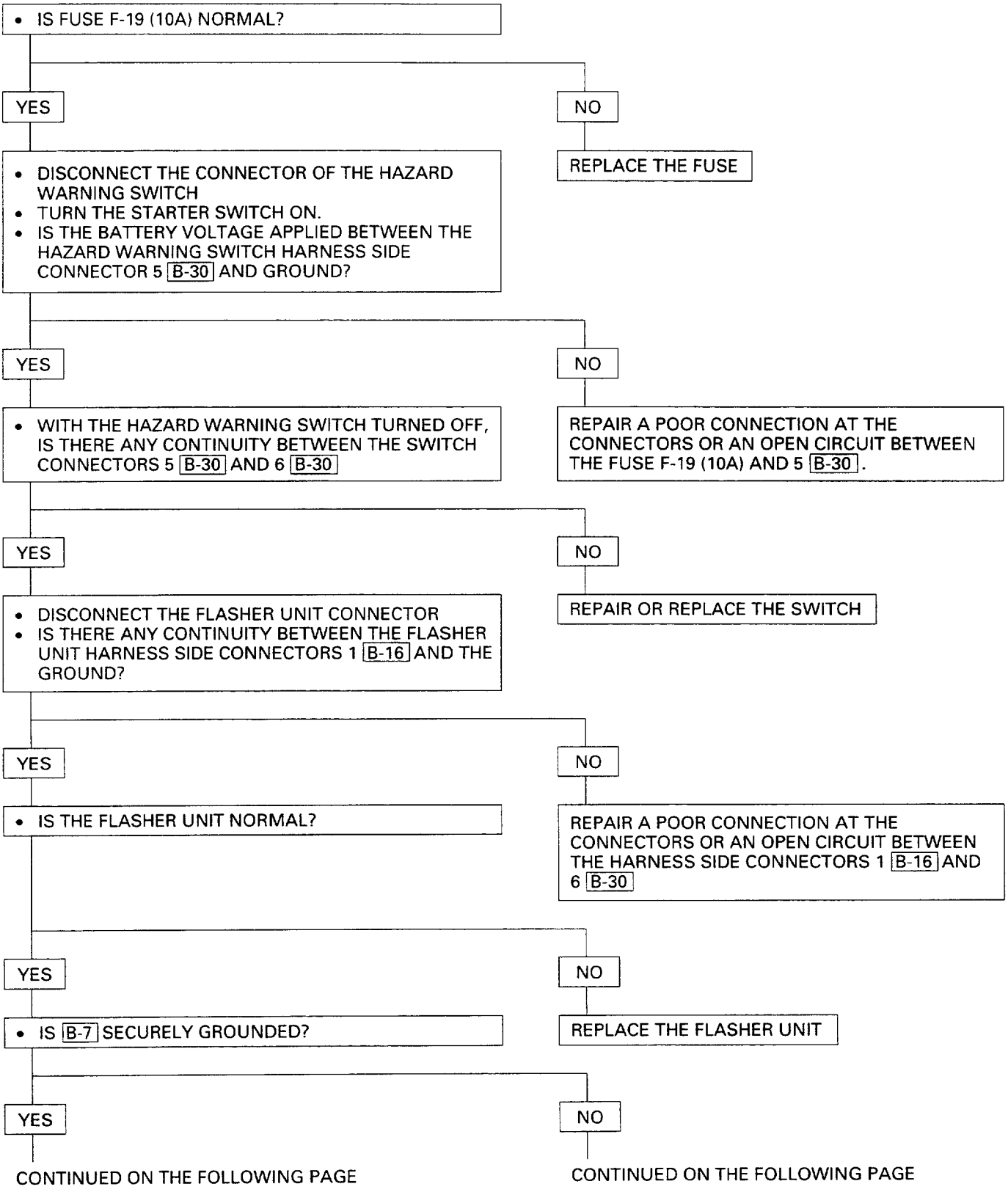
2. STOPLIGHT

Check point / Trouble mode	Fuse F-10(10A):24V F-17(10A):12V	Stoplight SW	Stoplight bulb	Cable harness
2-1. Both stoplights inoperative	○ (1)	○ (2)		○ (3)
2-2. Stoplight on the left (or right) side inoperative			○ (1)	○ (2)

NOTE: Figure in parenthesis "( )" indicates the order of inspection.

1. TURN SIGNAL LIGHT, HAZARD WARNING LIGHT

1-1. TURN SIGNAL LIGHTS INOPERATIVE



CONTINUED FROM THE PREVIOUS PAGE

- IS THERE ANY CONTINUITY BETWEEN THE HARNESS SIDE CONNECTORS 3 [B-16] AND [B-7] ?

YES

- DISCONNECT THE COMBINATION SWITCH CONNECTOR
- IS THERE ANY CONTINUITY BETWEEN THE SWITCH CONNECTORS 5 [B-70] AND 12 [B-70] (WHEN TURNING LEFT), 13 [B-70] AND 12 [B-70] (WHEN TURNING RIGHT) RESPECTIVELY?

YES

- REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN THE HARNESS SIDE CONNECTORS 2 [B-16] (12V), 5 [B-16] (24V) AND 12 [B-70]

CONTINUED FROM THE PREVIOUS PAGE

GROUND IT SECURELY

NO

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN THE CIRCUIT

NO

REPAIR OR REPLACE THE SWITCH

1-2. TURN SIGNAL LIGHTS FLASHES TOO QUICKLY

- DOES ANY TURN SIGNAL LIGHT REMAIN UNLIGHTED?

YES

DISCONNECT AND REINSTALL THE BULB, OR REPLACE IT, OR REPAIR AN OPEN CIRCUIT IN THE CIRCUIT OF THE INOPERATIVE BULB, OR CHECK THE GROUND

1-3. HAZARD WARNING LIGHTS INOPERATIVE

- IS FUSE F-8 (15A) NORMAL?
  - NO → REPLACE THE FUSE
  - YES → • DOES THE HAZARD WARNING LIGHT SWITCH FUNCTION NORMALLY?
    - NO → REPLACE THE HAZARD WARNING LIGHT SWITCH
    - YES → • REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN FUSE F-8 (15A) AND 1 [B-30]

2. STOPLIGHT

2-1. BOTH STOPLIGHTS INOPERATIVE

- IS FUSE F-10 (10A) OR F-17 (10A) NORMAL?
  - NO → REPLACE THE FUSE
  - YES → • IS [J-9] GROUNDED SECURELY?
    - NO → GROUND IT SECURELY
    - YES → • IS BATTERY VOLTAGE APPLIED TO THE 1 [B-66] OF THE STOPLIGHT SW?
      - NO → REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN THE FUSE F-10 (10A) OR F-17 (10A) AND 1 [B-66]
      - YES → • IS STOPLIGHT SWITCH IS NORMALLY?
        - NO → CONTINUED ON THE FOLLOWING PAGE
        - YES → CONTINUED ON THE FOLLOWING PAGE

CONTINUED FROM THE PREVIOUS PAGE

- DOES THE PUSH ROD OF THE STOPLIGHT SW OPERATE SMOOTHLY?

YES

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN 2 [B-66] AND [J-9]

CONTINUED FROM THE PREVIOUS PAGE

NO

REPLACE THE STOPLIGHT SW

2-2. STOPLIGHT ON THE LEFT (OR RIGHT)SIDE INOPERATIVE

- IS THE STOPLIGHT BULB ON THE LEFT (OR RIGHT) SIDE NORMAL?

YES

- IS THERE CONTINUITY BETWEEN THE STOPLIGHT CONNECTOR 2 [J-65] AND 11 [H-5] OR 2 [R-1] AND 2 [H-16] (2 [J-62] AND 11 [H-5] OR 2 [R-6] AND 2 [H-16])

YES

- REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN THE STOPLIGHT CONNECTOR 6 [J-65] AND [J-9] OR 6 [R-1] AND 7 [H-16] (6 [J-62] AND [J-9] OR 6 [R-6] AND 7 [H-16])

NO

REPLACE THE BULB

NO

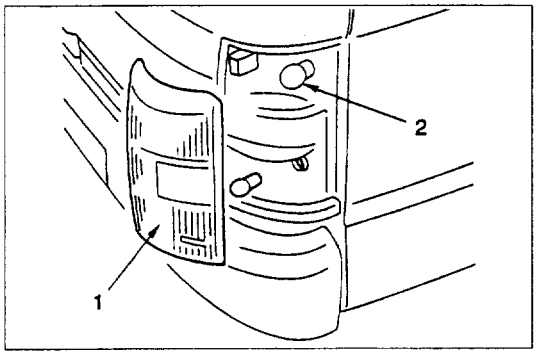
REPAIR A POOR CONNECTION AT CONNECTORS OR AN OPEN CIRCUIT

NOTE: FIGURE IN PARENTHESIS "( )" INDICATE THE PLACE OF INSPECTION FOR THE RIGHT SIDE STOPLIGHT.

STARTER SWITCH

Refer to "START AND CHARGING" in this section.

FRONT TURN SIGNAL LIGHT/BULB



REMOVAL

Preparation:

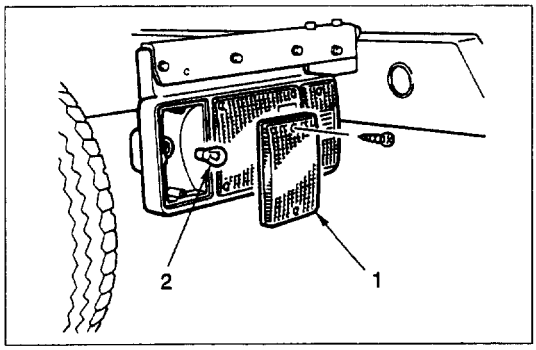
Disconnect the battery ground cable.

1. **Front Combination Light Lens**
   Remove four screws.
2. **Bulb**

INSTALLATION

To install, follow the removal steps in the reverse order.

REAR TURN SIGNAL LIGHT/BULB



REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Lens**
2. **Bulb**

INSTALLATION

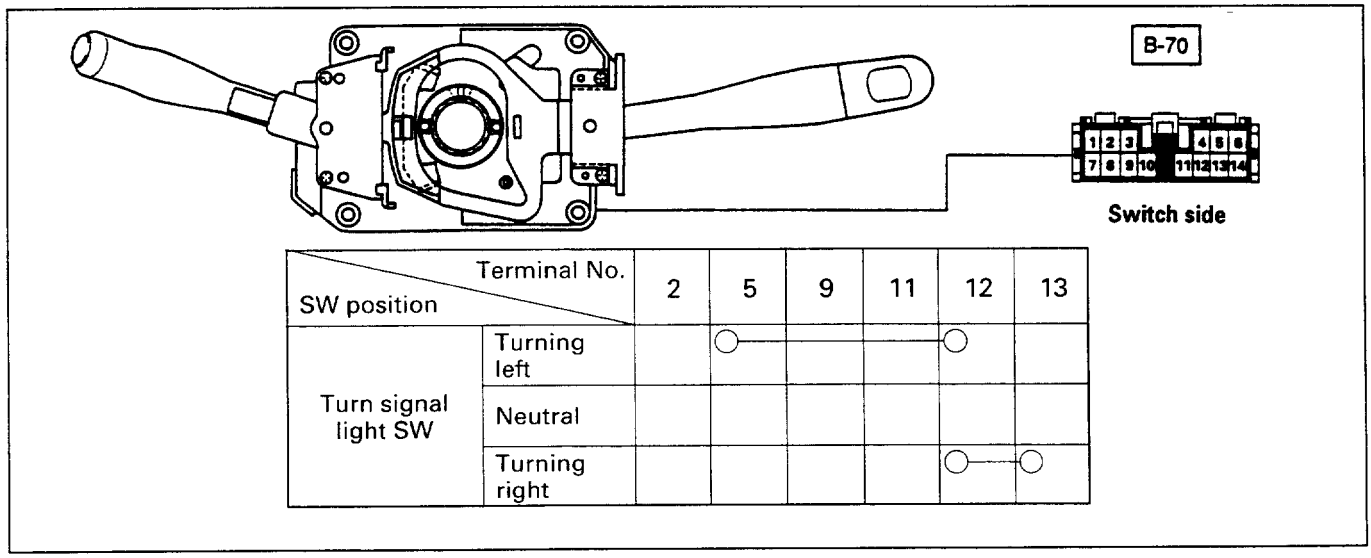
To install, follow the removal steps in the reverse order.

TURN SIGNAL LIGHT SWITCH (COMBINATION SWITCH)

INSPECTION

Check the continuity between the terminals of the turn signal light switch.

Repair or replace the switch when the result of inspection is found abnormal.

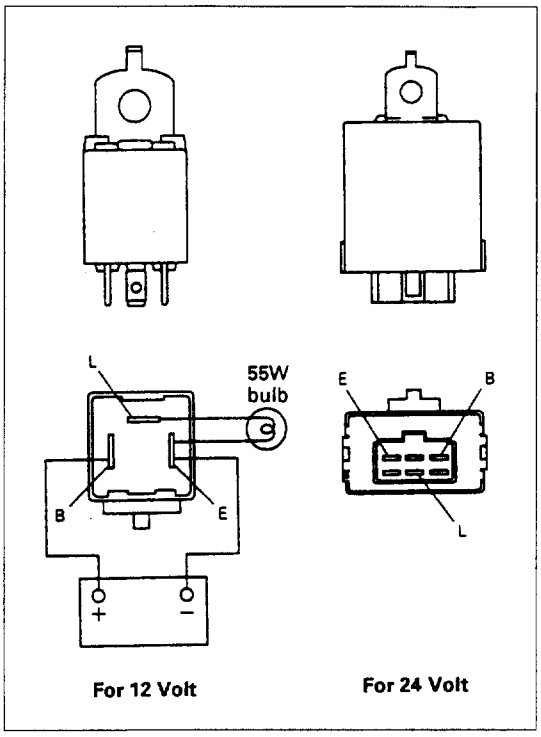


SW position \ Terminal No.		2	5	9	11	12	13
Turn signal light SW	Turning left		○			○	
	Neutral						
	Turning right					○	○

REMOVAL AND INSTALLATION

Refer to "HEADLIGHT, FOG LIGHT AND CORNERING LIGHT" in this section.

FLASHER UNIT



INSPECTION

When a 55W bulb is connected to the unit side terminals "L" and "E" while connecting the battery (+) terminal to terminal "B", and the battery (–) terminal to terminal "E" does the bulb light on and off?

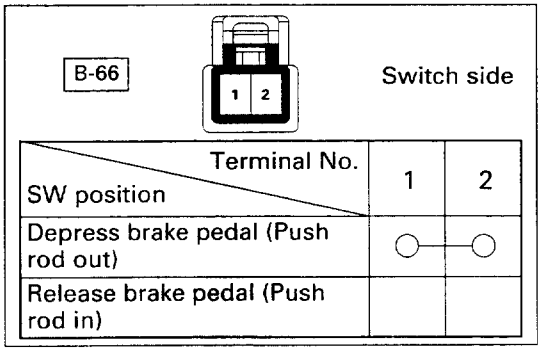
Replace the unit when the result of inspection is found abnormal.

STOPLIGHT BULB

REMOVAL AND INSTALLATION

Refer to "CLEARANCE LIGHT, TAILLIGHT, LICENSE PLATE LIGHT AND ILLUMINATION LIGHT" for TAILLIGHT BULB removal and installation steps in this section.

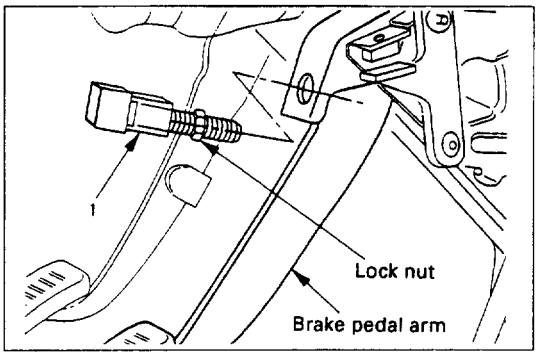
STOPLIGHT SWITCH



INSPECTION

1) Check to see if the stoplight switch is installed correctly to the specified position. Adjust the position when the result of the inspection is found abnormal.
2) Check to see if there is any continuity between the terminals of the stoplight switch.

   Replace the switch when the result of inspection is found abnormal.

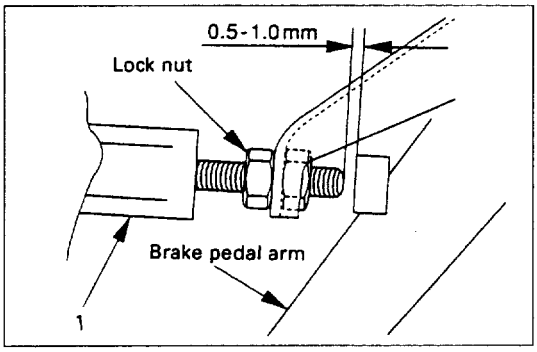


REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Stoplight Switch**
   1) Disconnect the connector.
   2) Loosen the lock nut of the switch.
   3) Remove the switch by turning it.

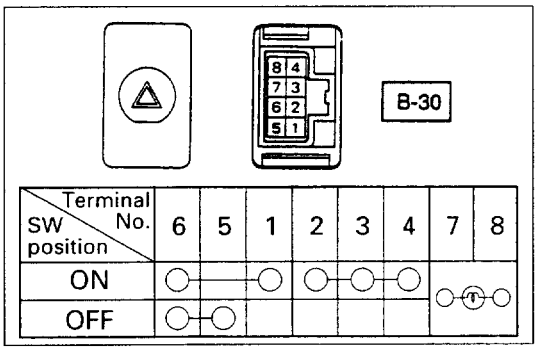


INSTALLATION

To install, follow the removal steps in the reverse order, noting the following points.

1) Check to see if the brake pedal has been returned by the return spring to the specified position.
2) Turn the stoplight switch clockwise until the tip of the threaded portion of the switch contacts the pedal arm.
3) Turn the switch counterclockwise until the space between the tip of the threaded portion and the pedal arm is 0.5 to 1.0mm (0.02 – 0.04in.)

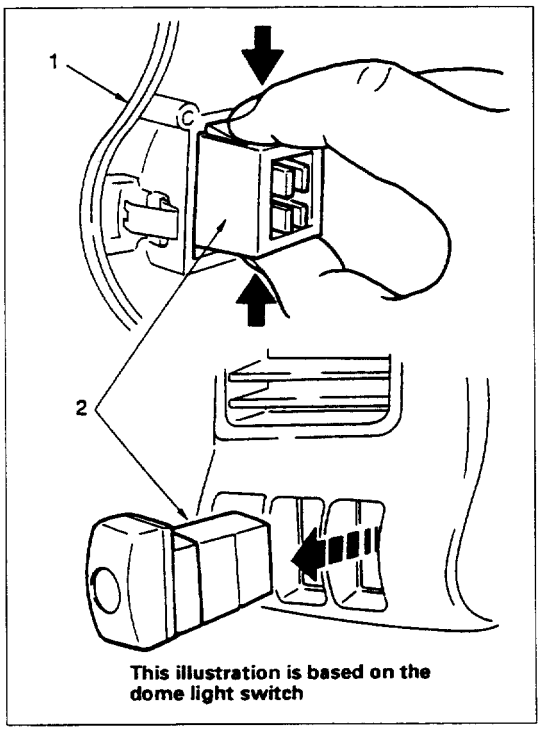
HAZARD WARNING SWITCH



INSPECTION

Check the continuity between the terminals of the hazard warning switch.

Repair or replace the switch when the result of inspection is found abnormal.



REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Meter cluster**

   Refer to the "METER AND WARNING/INDICATOR LIGHT" in this section.
2. **Hazard Warning Switch**

   Release the lock pushing the switch from the back side of the meter cluster.

INSTALLATION

To install, follow the removal steps in the reverse order noting the following point.

1. Push the switch with your fingers until locks securely.

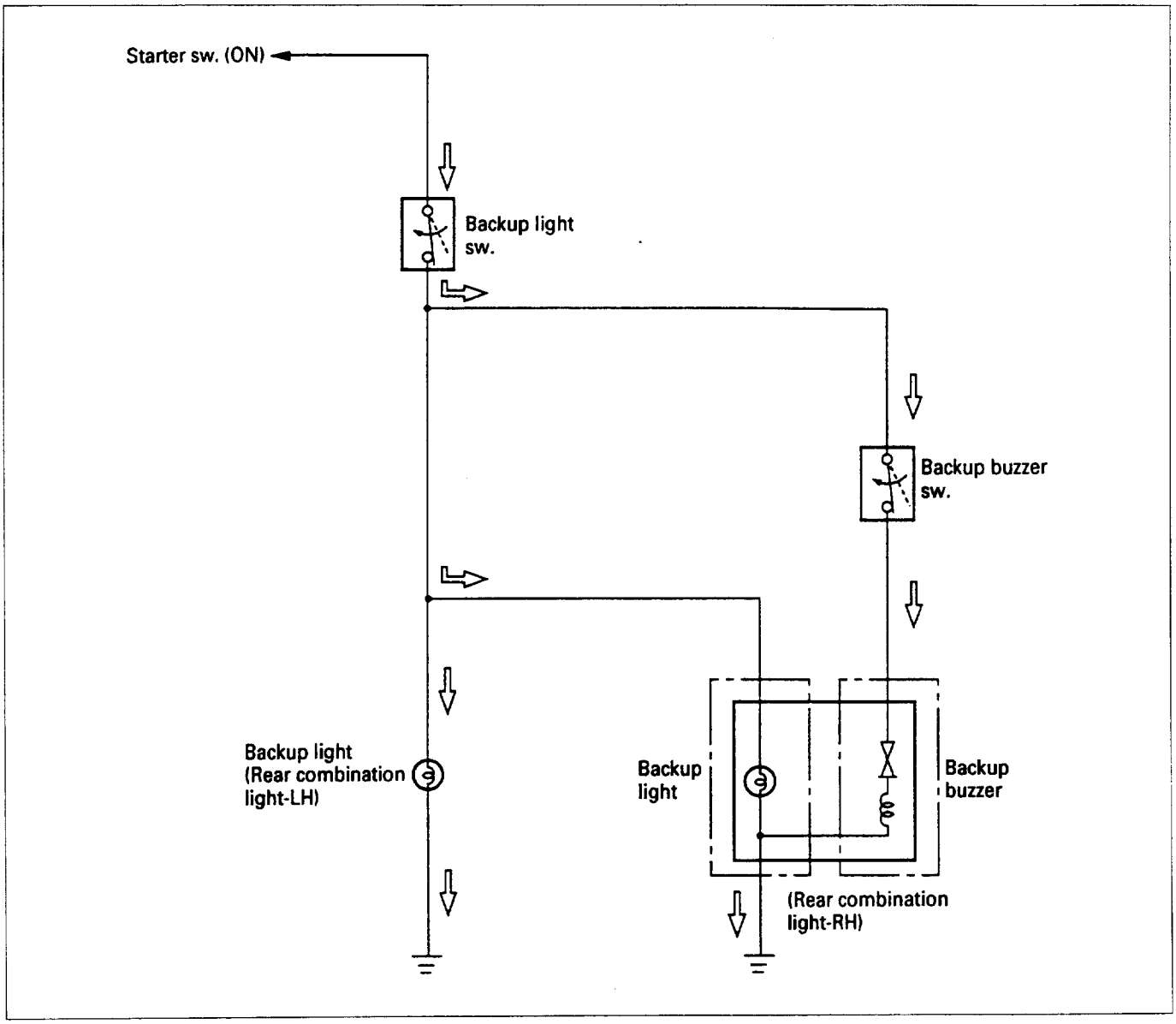
HORN, BACKUP LIGHT AND BACKUP BUZZER

GENERAL DESCRIPTION

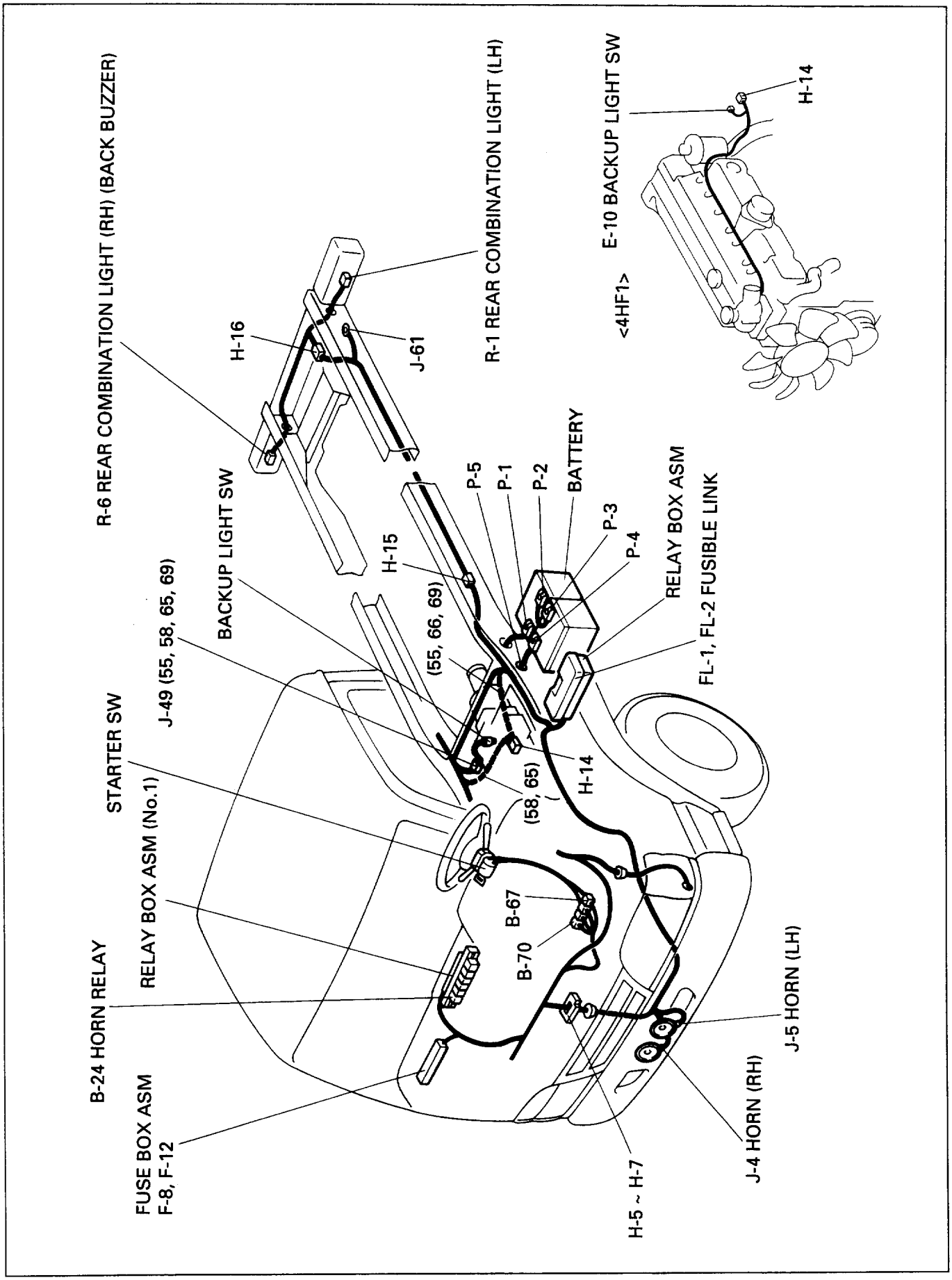
The circuit consists of the starter switch, horn, horn switch, backup light (Rear combination light), backup light switch, back buzzer and the relay.

When the horn switch is turned on independent of the position of the starter switch, the relay is activated to sound the horn. When the backup light switch turns on with the starter switch on, the backup light will operate.

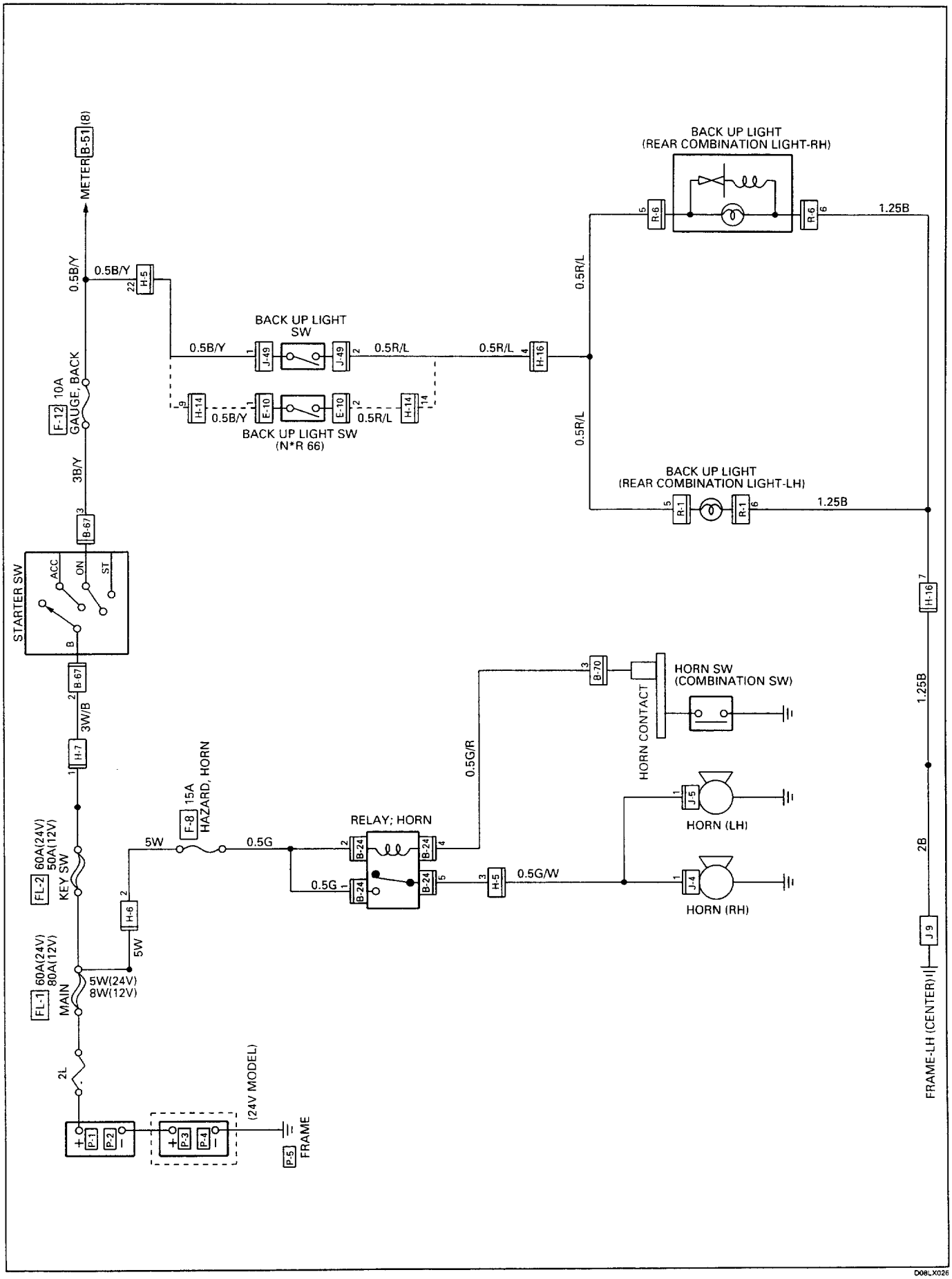
BACKUP LIGHT AND BACKUP BUZZER CIRCUIT



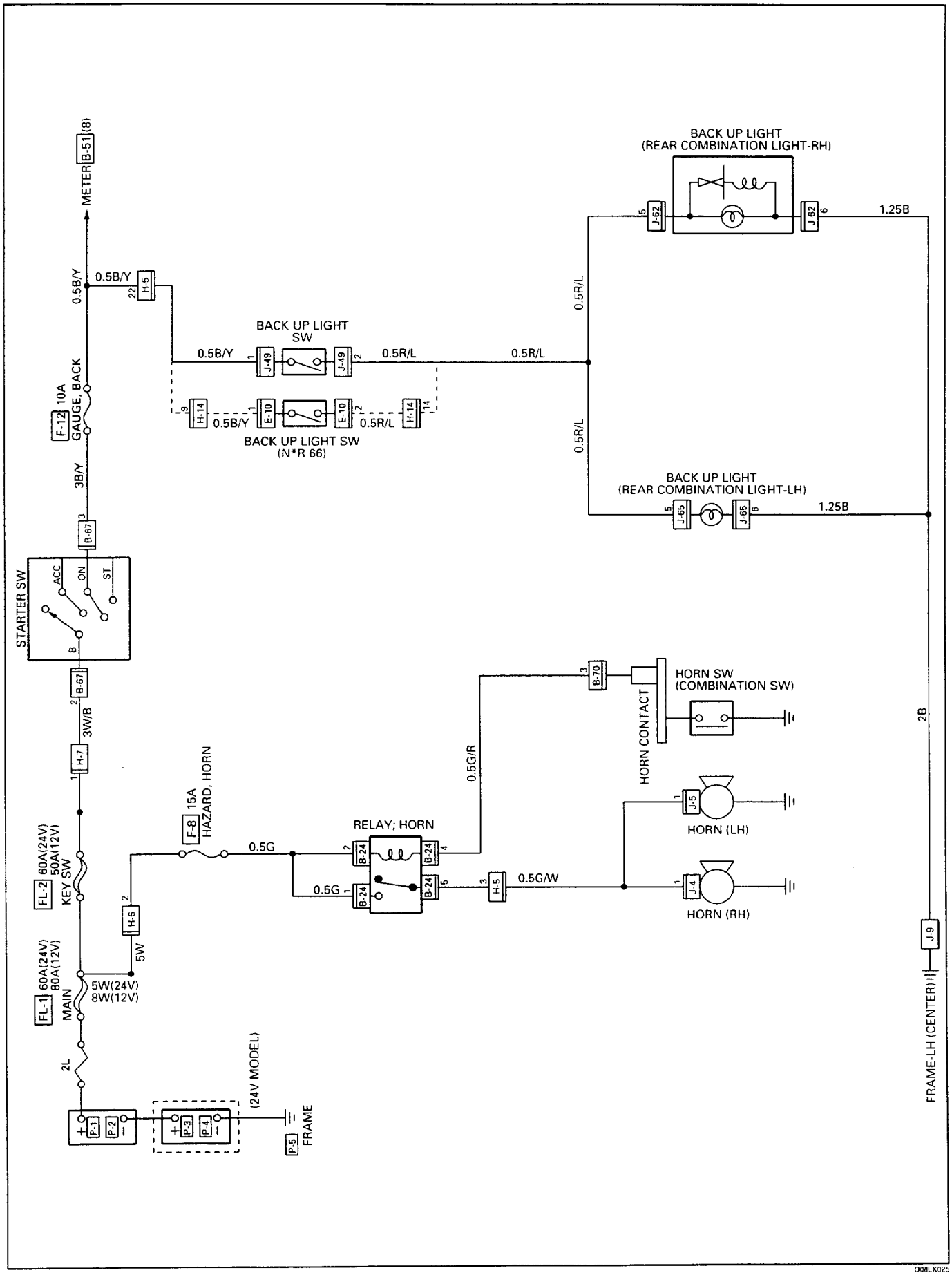
PARTS LOCATION



CIRCUIT DIAGRAM

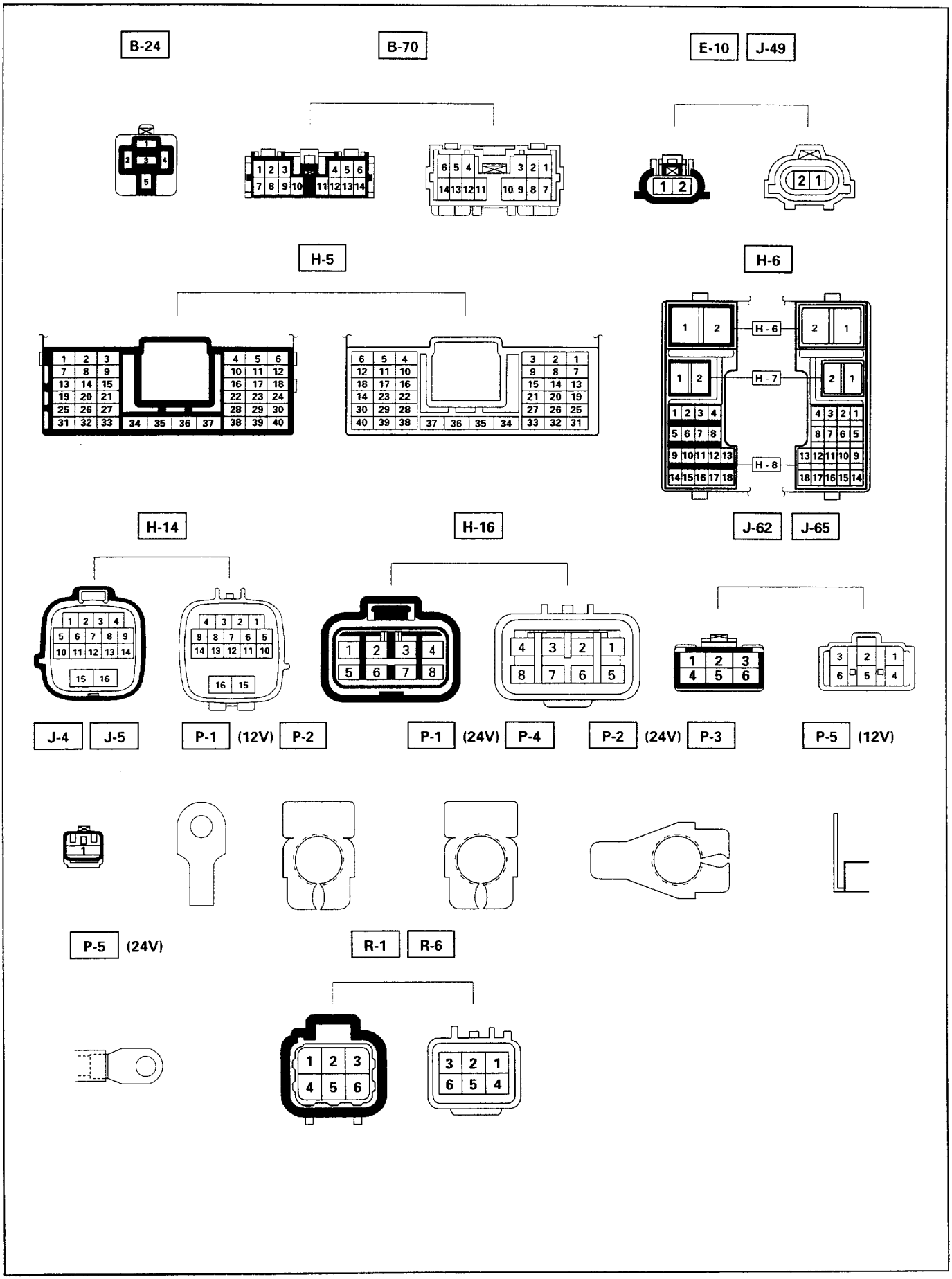


CIRCUIT DIAGRAM – FOR DUMP



D08LX025

CONNECTOR LIST



DIAGNOSIS

QUICK CHART FOR CHECK POINT

1. HORN

Trouble mode \ Check point	Fuse F-8 (15A)	Horn	Horn SW	Horn relay	Horn contact	Cable harness
1-1. Horn does not sound	○ (1)	○ (4)	○ (6)	○ (2)	○ (5)	○ (3)
1-2. Horn does not shut off			○ (2)	○ (1)		○ (3)

NOTE: Figure in parenthesis "( )" indicates the order of inspection.

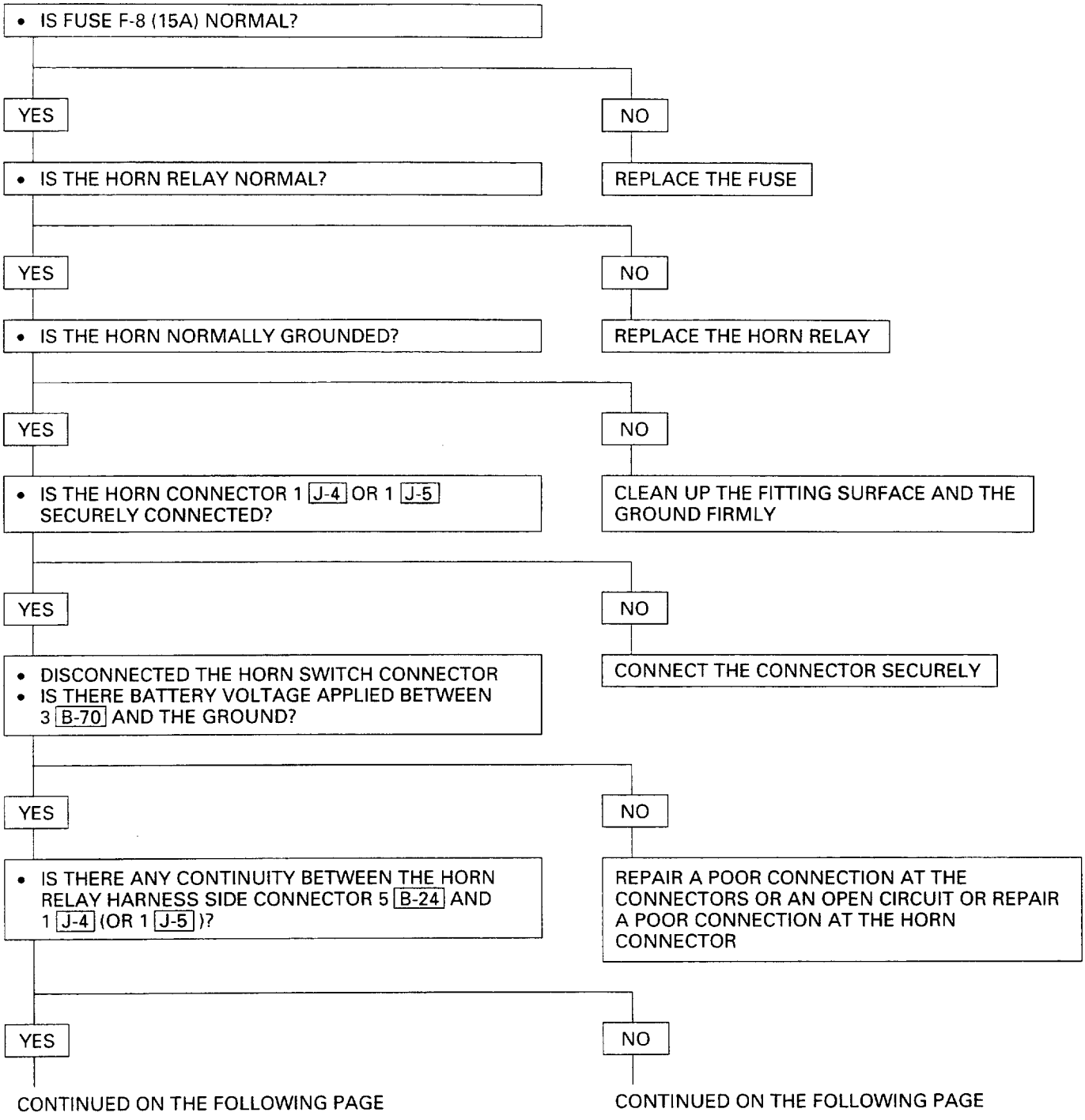
2. BACKUP LIGHT

Trouble mode \ Check point	Fuse F-12 (10A)	Backup light SW (Inhibitor SW)	Backup light bulb	Backup buzzer	Cable harness
2-1. Both backup lights inoperative	○ (1)	○ (3)			○ (2)
2-2. Backup light on the left (or right) side inoperative			○ (1)		○ (2)
2-3. Backup light remains on		○ (1)			

NOTE: Figure in parenthesis "( )" indicates the order of inspection.

1. HORN

1-1. HORN DOES NOT SOUND



CONTINUED FROM THE PREVIOUS PAGE

- DOES THE HORN SOUND WHEN CONNECTING THE BATTERY (+) TERMINAL TO THE HORN CONNECTOR 1 [J-4] (1 [J-5]), AND (–) TERMINAL TO THE HORN BRACKET?

NO

PEPLACE THE HORN

CONTINUED FROM THE PREVIOUS PAGE

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT IN THE CIRCUIT

1-2. HORN DOES NOT SHUT OFF

- IS THE HORN RELAY NORMAL?

YES

- REMOVE THE HORN SW
- IS THE MOVABLE PORTION OF THE HORN SW ALWAYS OUT OF CONTACT WITH THE GROUND BRACKET?

YES

REPAIR A SHORT CIRCUIT BETWEEN HORN RELAY HARNESS SIDE CONNECTOR 4 [B-24] AND 3 [B-70]

NO

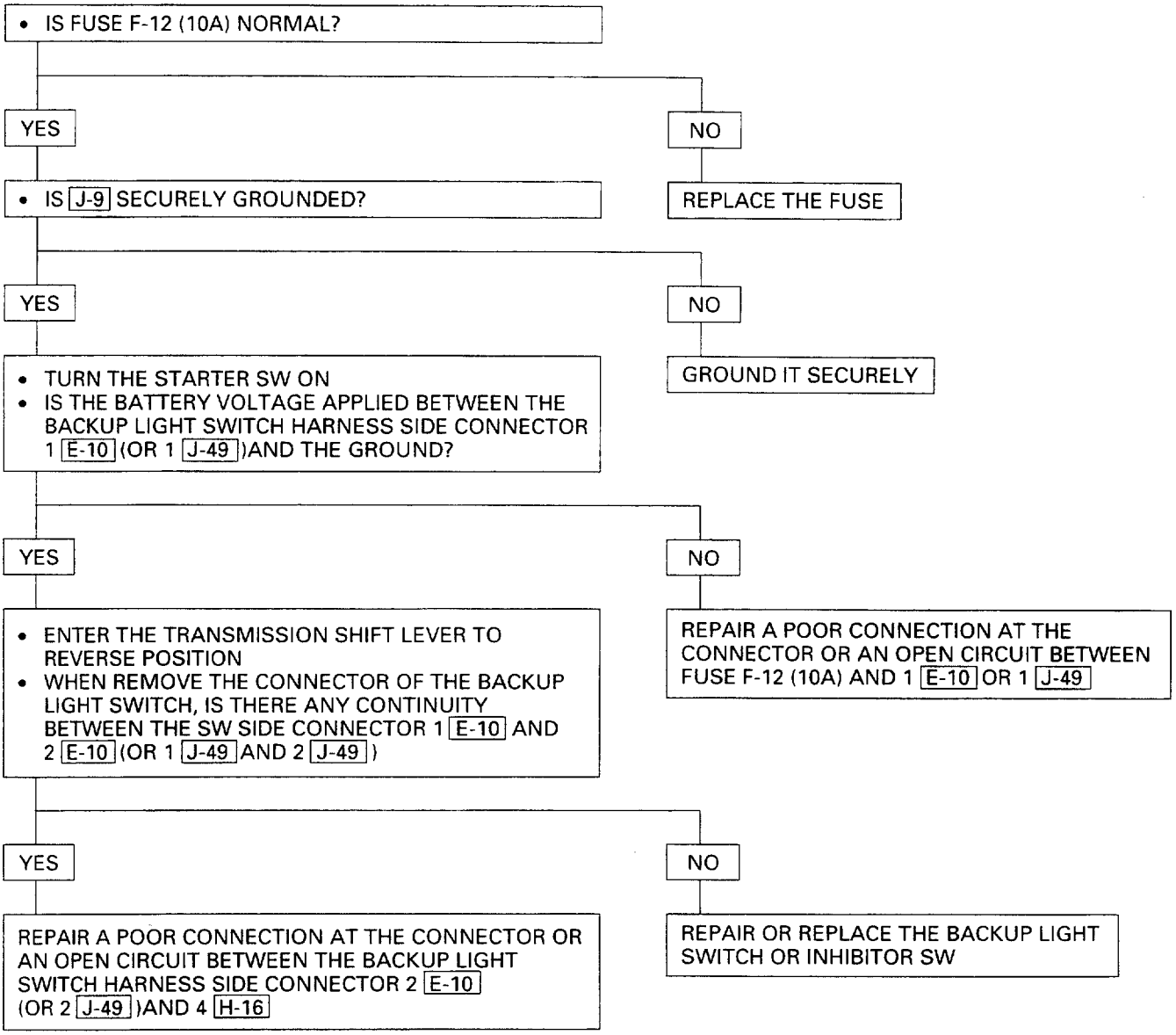
REPAIR OR REPLACE THE HORN SW

NO

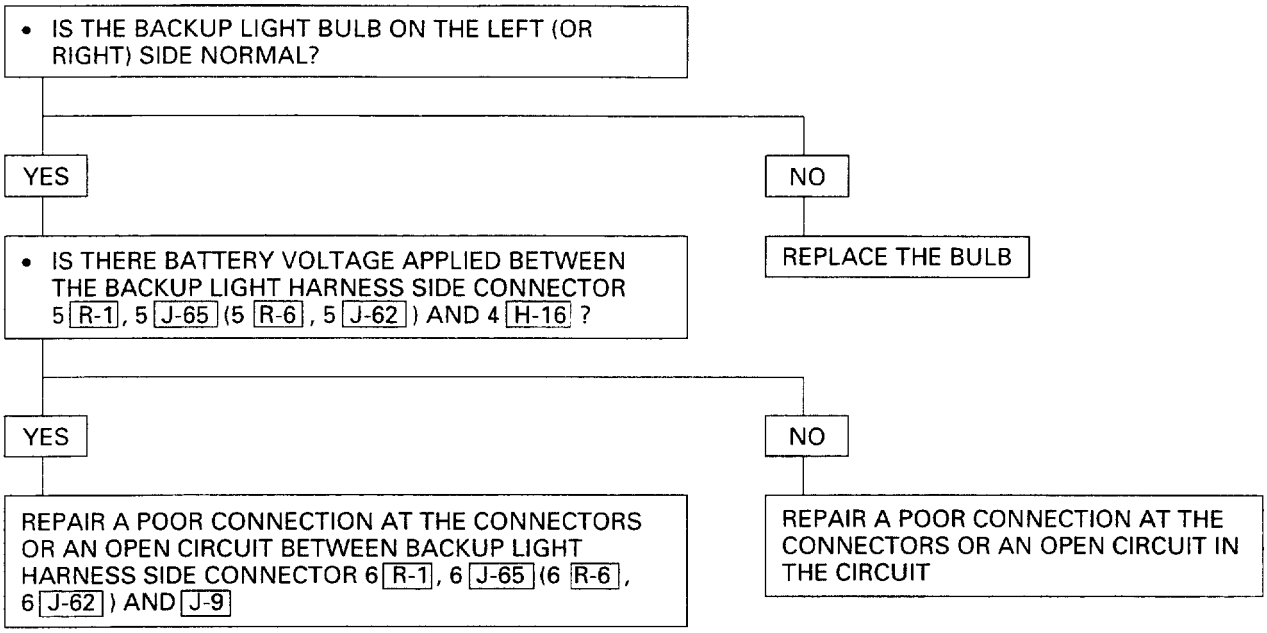
REPLACE THE HORN RELAY

2. BACKUP LIGHT

2-1. BACKUP LIGHTS INOPERATIVE



2-2. BACKUP LIGHT ON THE LEFT (OR RIGHT)SIDE INOPERATIVE



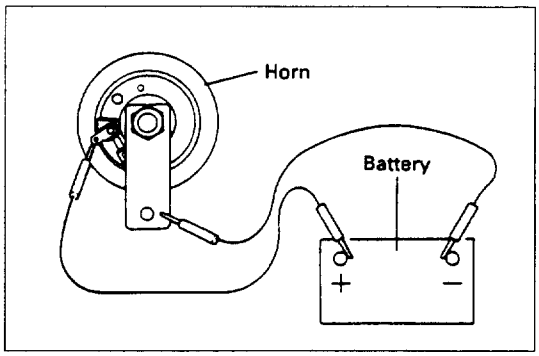
2-3. BACKUP LIGHT REMAINS ON

REPAIR OR REPLACE THE BACKUP LIGHT SW OR INHIBITOR SW

STARTER SWITCH

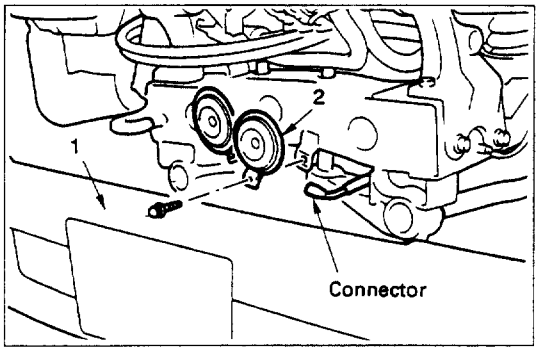
Refer to "START AND CHARGING" in this section.

HORN



INSPECTION

Check to see if horn sound when a battery voltage between horn terminal and the fixing bracket. Repair or replace the horn when the result of inspection is found abnormal.



REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Bumper**

   Refer to "BUMPER" in section 2B.

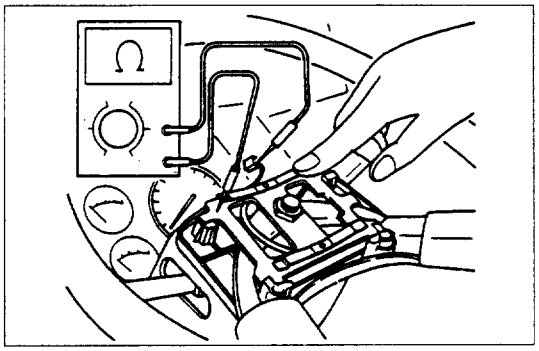
2. **Horn**

   Disconnect the connector.

INSTALLATION

To install, follow the removal steps in the reverse order.

HORN SWITCH

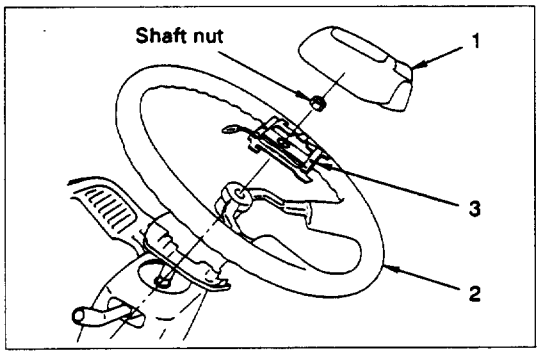


INSPECTION

With the contact point of the horn switch pressed to the switch bracket, check the continuity between the connector terminal and the bracket of the switch.

Check the contact condition between horn contact of the combination switch and contact plate of steering wheel.

Repair or replace the switch when the result of inspection is found abnormal.



REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Horn Pad**

   1) Hold the horn pad and pull it upward.

2. **Steering Wheel**

   1) Remove the steering shaft nut.
   2) Remove the steering wheel by using steering wheel remover.

      (Refer to Section 3D "STEERING COLUMN" for steering wheel removal steps.)

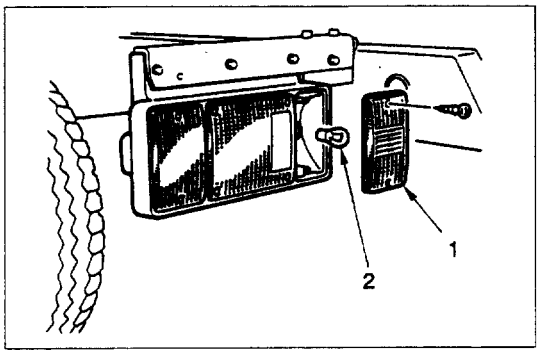
3. **Horn Switch**

INSTALLATION

To install, follow the removal steps in the reverse order, noting the following point.

1. Tighten the steering shaft nut to the specified torque

Shaft nut torque	N·m (kg·m/lb·ft)
	49 (5/36)



BACKUP LIGHT BULB

REMOVAL

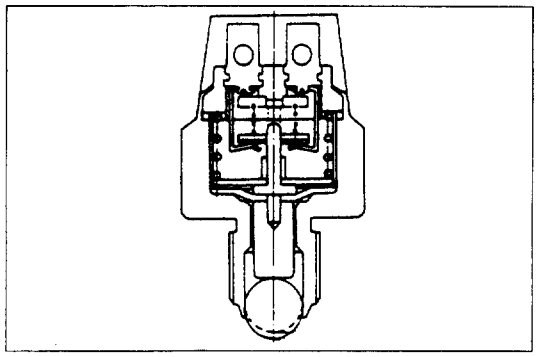
Preparation:

Disconnect the battery ground cable.

1. **Lens**
2. **Bulb**

INSTALLATION

To install, follow the removal steps in the reverse order.



BACKUP LIGHT SWITCH

INSPECTION

1. With the switch installed to the transmission, check the continuity between the terminals of the switch connectors.

   When the continuity is found between the terminals only with the switch shifted to the reverse position, the switch is normal.
2. When the result of the above inspection is found abnormal, remove the switch from the transmission and conduct a test on the switch alone.

   If the continuity appears between the connector terminals when the ball of the switch is released, the switch is normal. (When the ball is pushed, the continuity disappears.)
3. If there is no continuity with the switch installed to the transmission, even though the switch is found to be normal, then adjust the stroke of the switch by changing the thickness of the switch gasket.

REMOVAL

Preparation:

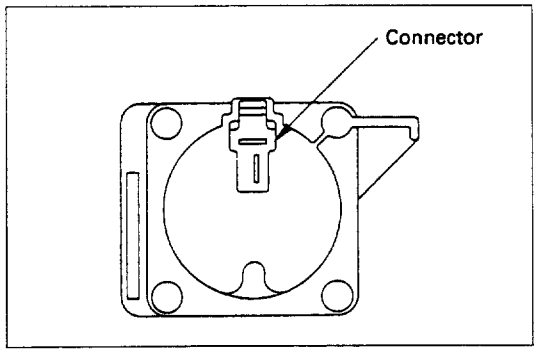
Disconnect the battery ground cable.

1. **Backup Light Switch**
   1) Disconnect the connectors.
   2) Remove the switch by turning it counterclockwise.

INSTALLATION

1. **Backup Light Switch**

Apply liquid gasket to the screw portion of the switch to prevent oil leak.

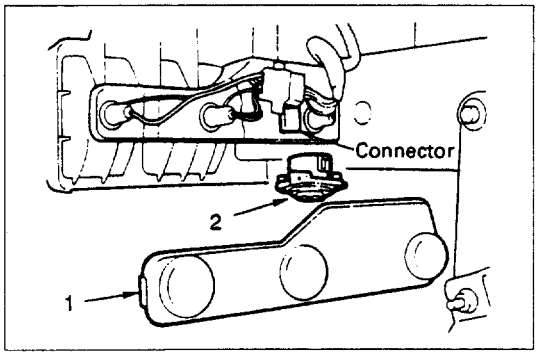


BACKUP BUZZER

INSPECTION

Apply battery voltage to the backup buzzer connector to check the buzzer sound.

Repair or replace the buzzer when the result of inspection is found abnormal.



REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Rear Combination Light Cover**
2. **Backup Buzzer**
   1) Remove the rear combination light connector fixing screw.
   2) Remove buzzer fixing screw.
   3) Disconnect the connector.

INSTALLATION

To install, follow the removal steps in the reverse order.

DOME LIGHT AND KEY REMIND BUZZER

GENERAL DESCRIPTION

The circuit consists of the starter switch, dome light, dome light switch, door switch, backup light switch and the key remind buzzer.

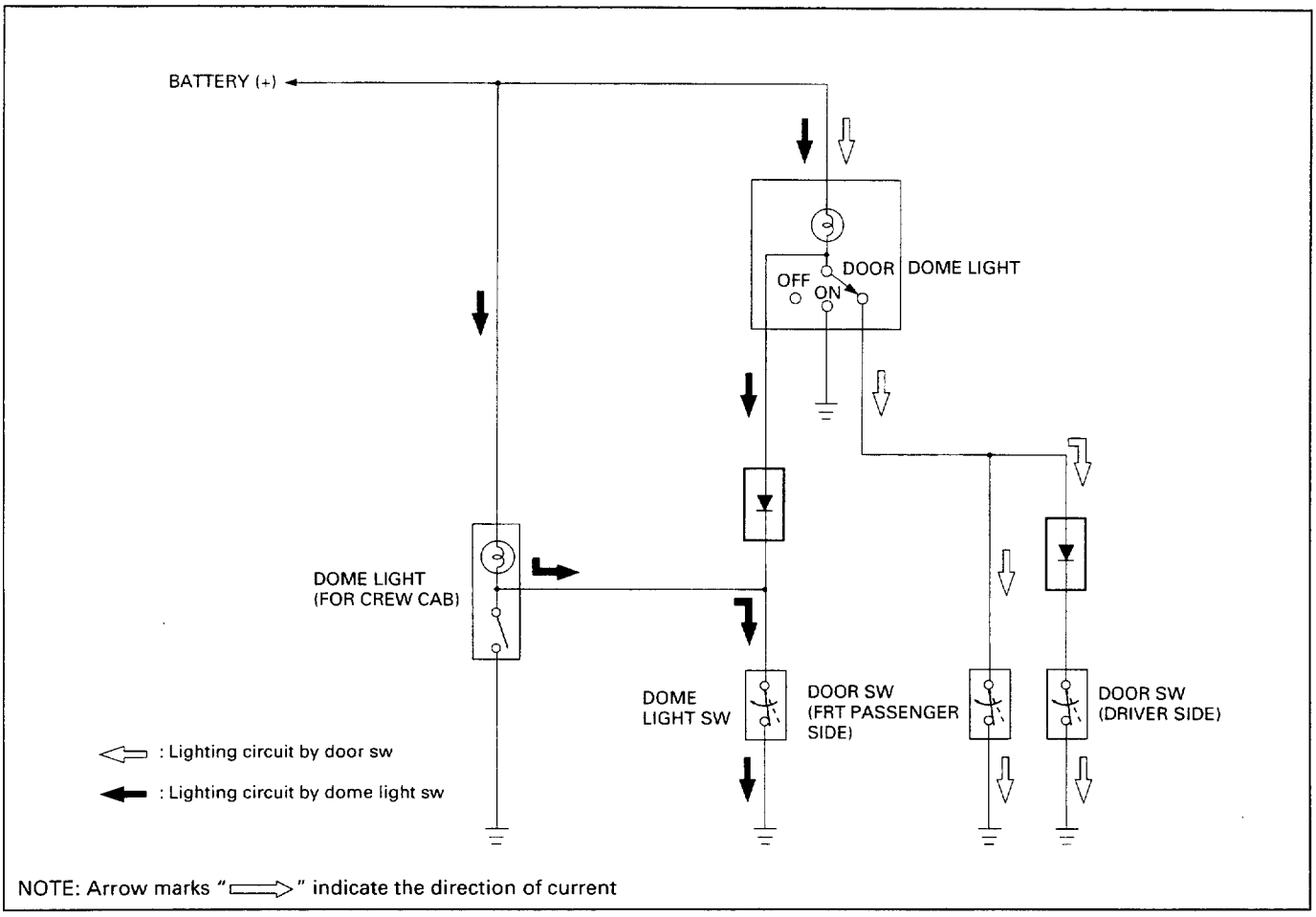
The dome light lights up when the left or right side door is opened with the switch set at the door mode. It can be lit by operating ON or OFF of the dome light switch.

The dome light can be lit by respective switch independent of the position of the starter switch.

By operating the dome light switch fitted on the instrument panel, the dome light can be lit indpendent of the switch position of dome light.

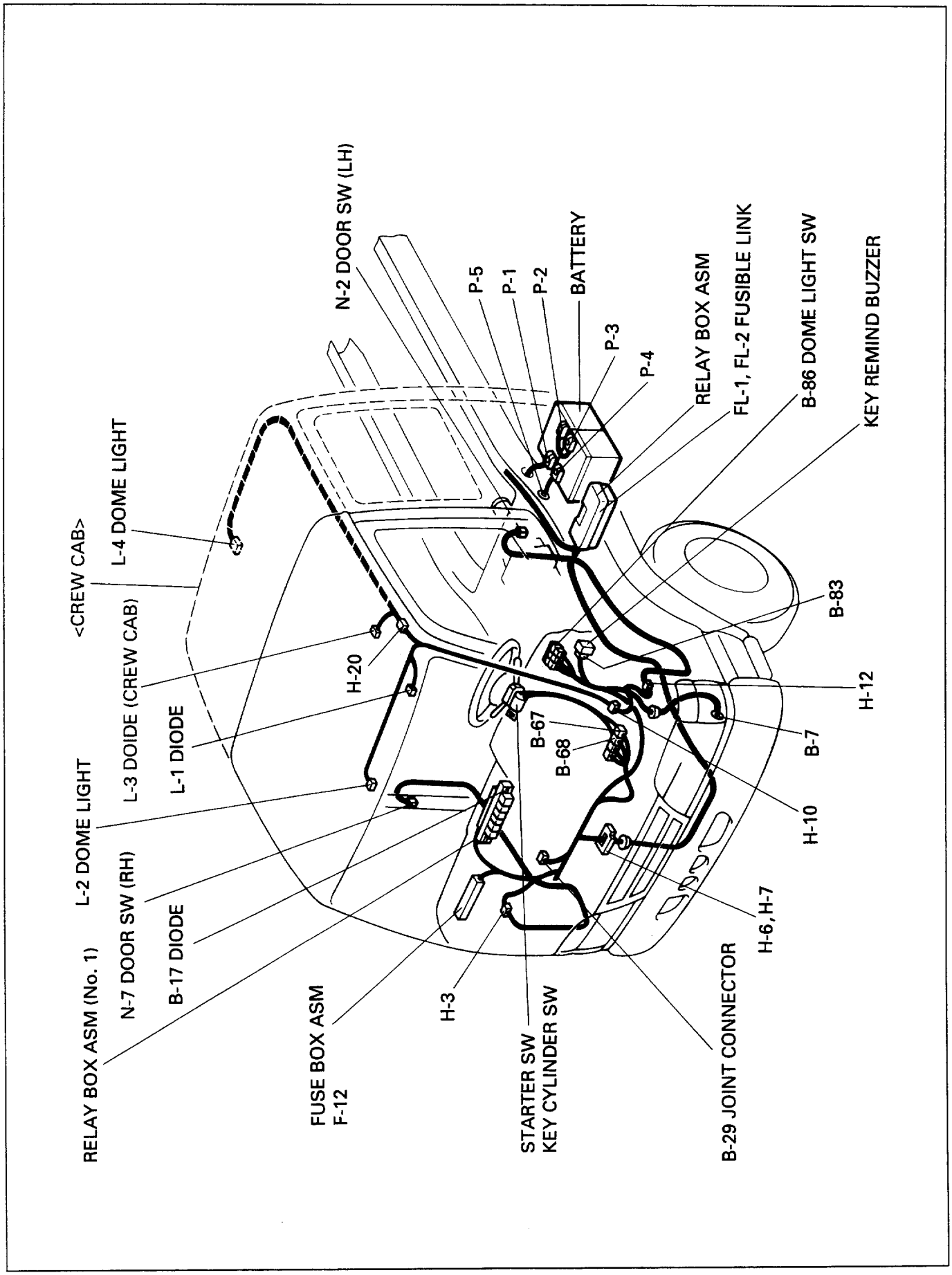
Key remind buzzer sounds to remind the driver of leaving the key in the starter switch when opening the driver's side door.

LIGHTING CIRCUIT

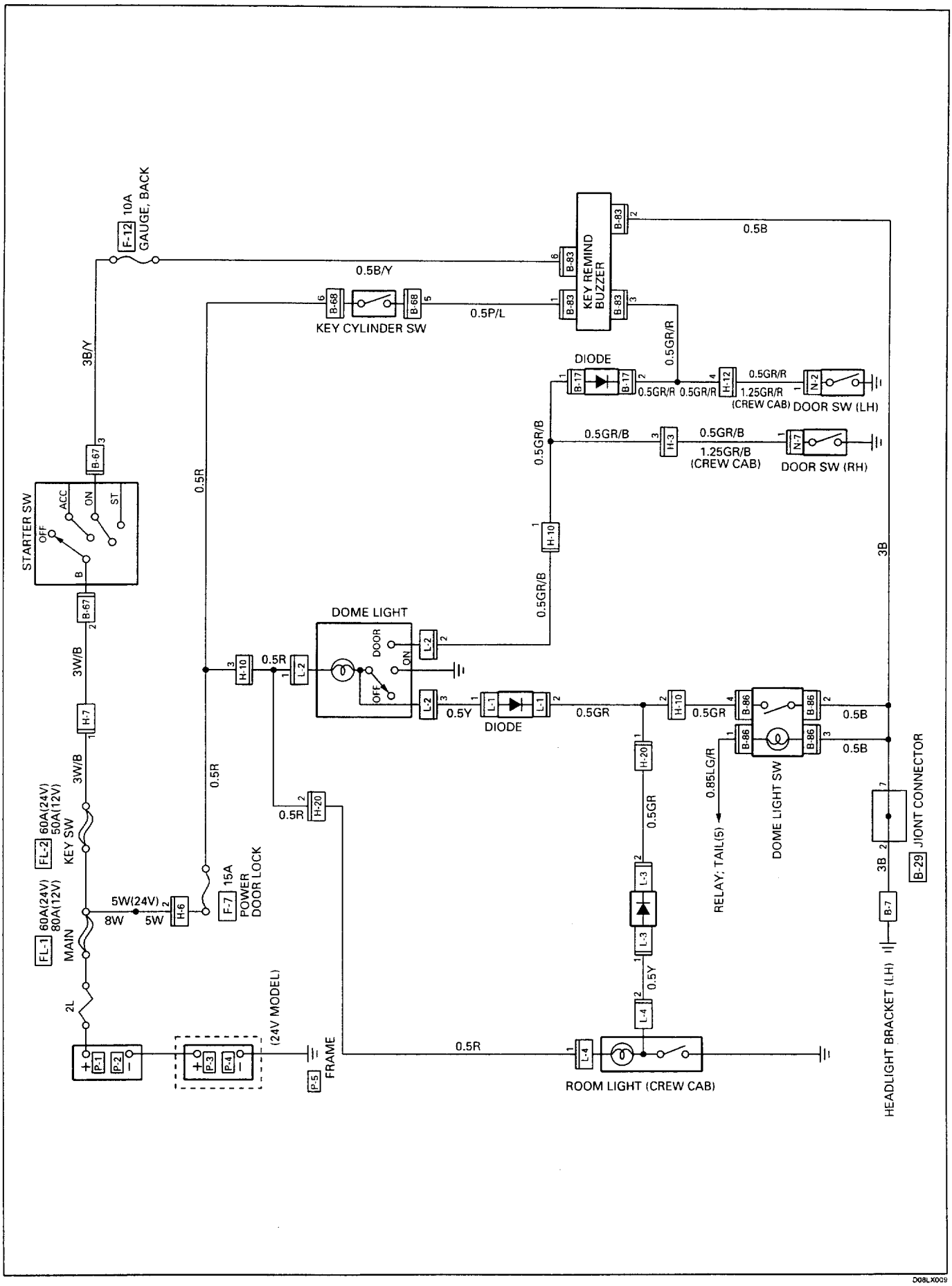


NOTE: Arrow marks "⇨" indicate the direction of current

PARTS LOCATION

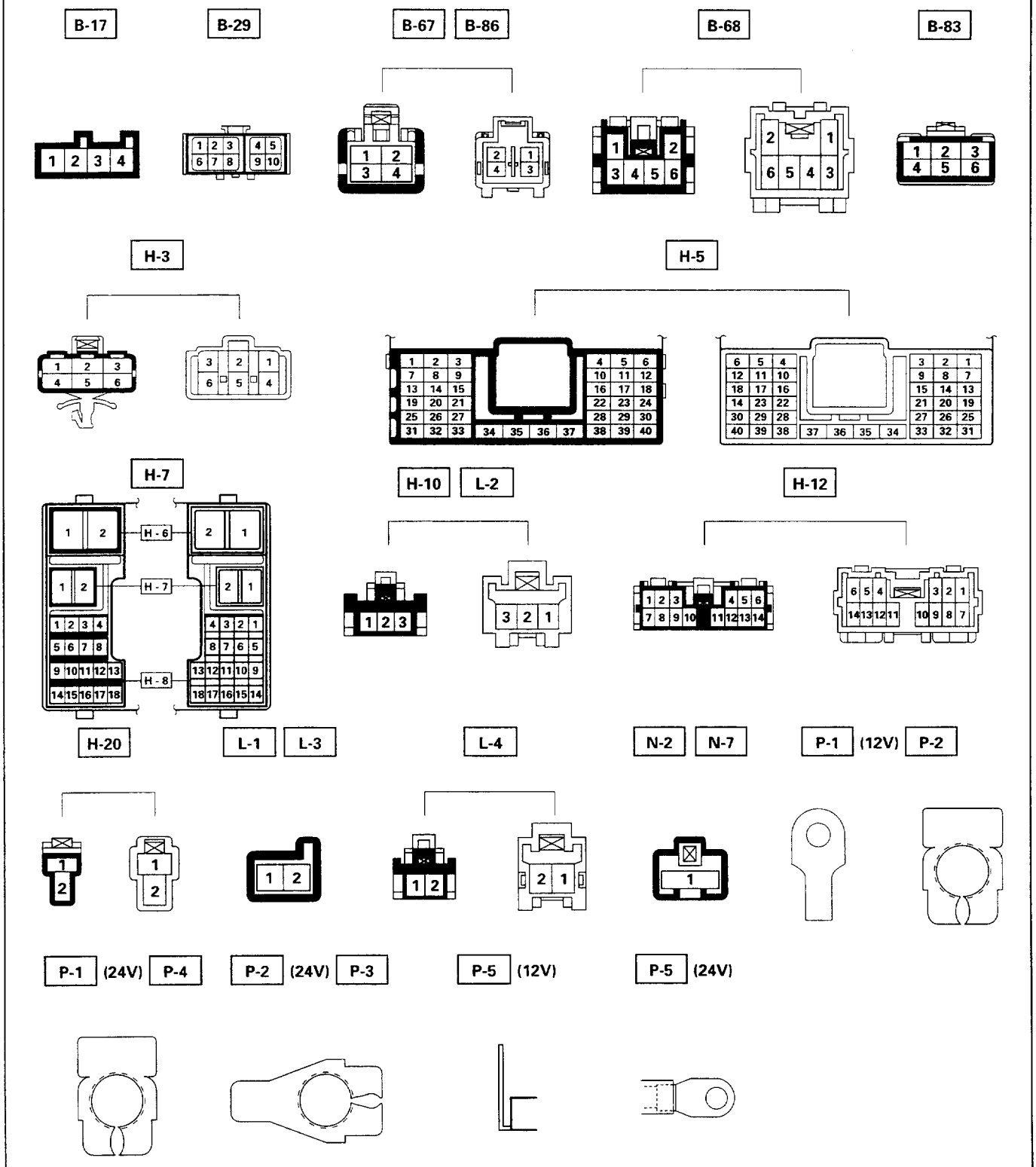


CIRCUIT DIAGRAM DOME LIGHT AND KEY REMIND BUZZER



D08LX009

CONNECTOR LIST

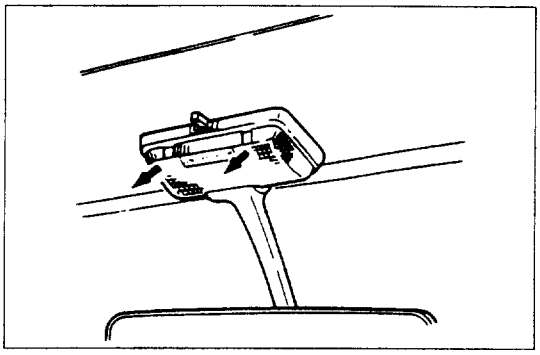


STARTER SWITCH
KEY CYLINDER SWITCH

Refer to "START AND CHARGING" in this section.

BACKUP LIGHT SWITCH

Refer to "HORN, BACKUP LIGHT AND BACKUP BUZZER" in this section.



DOME LIGHT BULB

REMOVAL

Preparation:

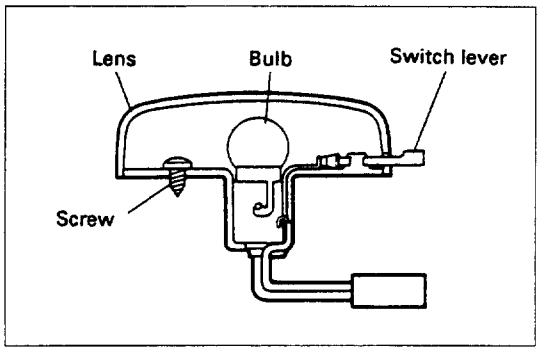
Disconnect the battery ground cable.

1. **Lens**

   Hold the lens and pull it downward.
2. **Bulb**

INSTALLATION

To install, follow the removal steps in the reverse order.



DOME LIGHT BULB (FOR CREW CAB)

REMOVAL

Preparation:

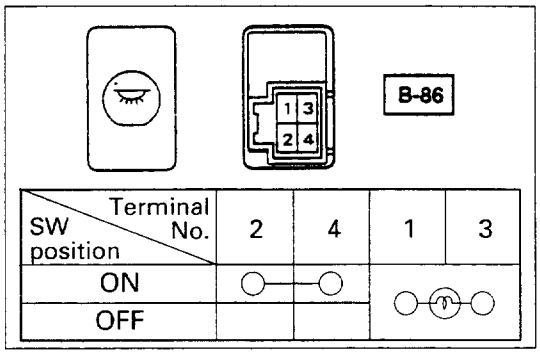
Disconnect the battery ground cable.

1. **Lens**

   Hold the lens and pull it down.
2. **Bulb**

INSTALLATION

To install, follow the removal steps in the reverse order.



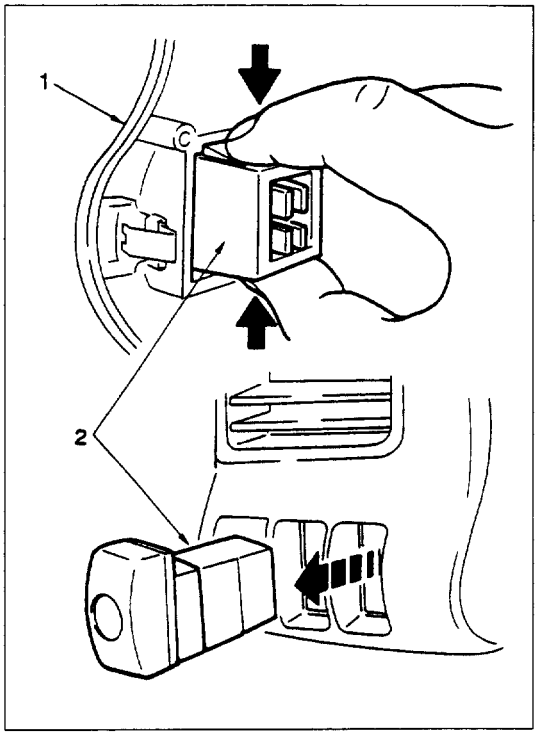
SW position \ Terminal No.	2	4	1	3
ON	○	○		
OFF			○	○

DOME LIGHT SWITCH

INSPECTION

Check the continuity between the dome light switch connector terminals.

Repair or replace the switch when the result of inspection is found abnormal.



REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Meter cluster**

   Refer to the "METER AND WARNING/INDICATOR LIGHT" in this section.

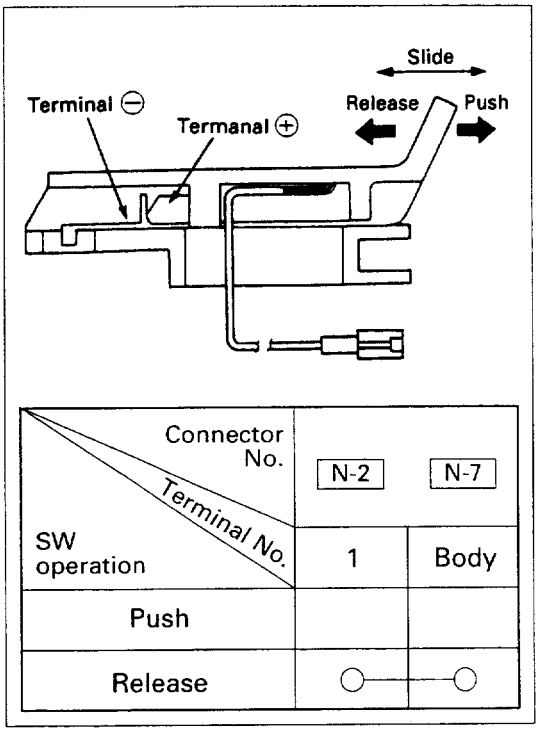
2. **Dome Light Switch**

   Release the lock pushing the switch from the back side of the meter cluster.

INSTALLATION

To install, follow the removal steps in the reverse order noting the following point.

1. Push the switch with your fingers until locks securely.



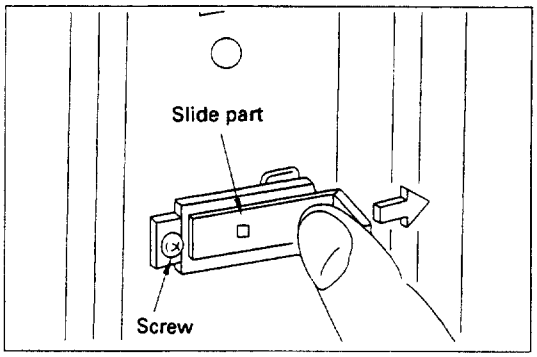
SW operation \ Terminal No. / Connector No.	N-2	N-7
	1	Body
Push		
Release	○	○

DOOR SWITCH

INSPECTION

Check to see if there is any continuity between the terminals and the body while operating the door switch.

Repair or replace the switch, when the result of inspection is found abnormal.



REMOVAL

Preparation:

Disconnect the battery ground cable.

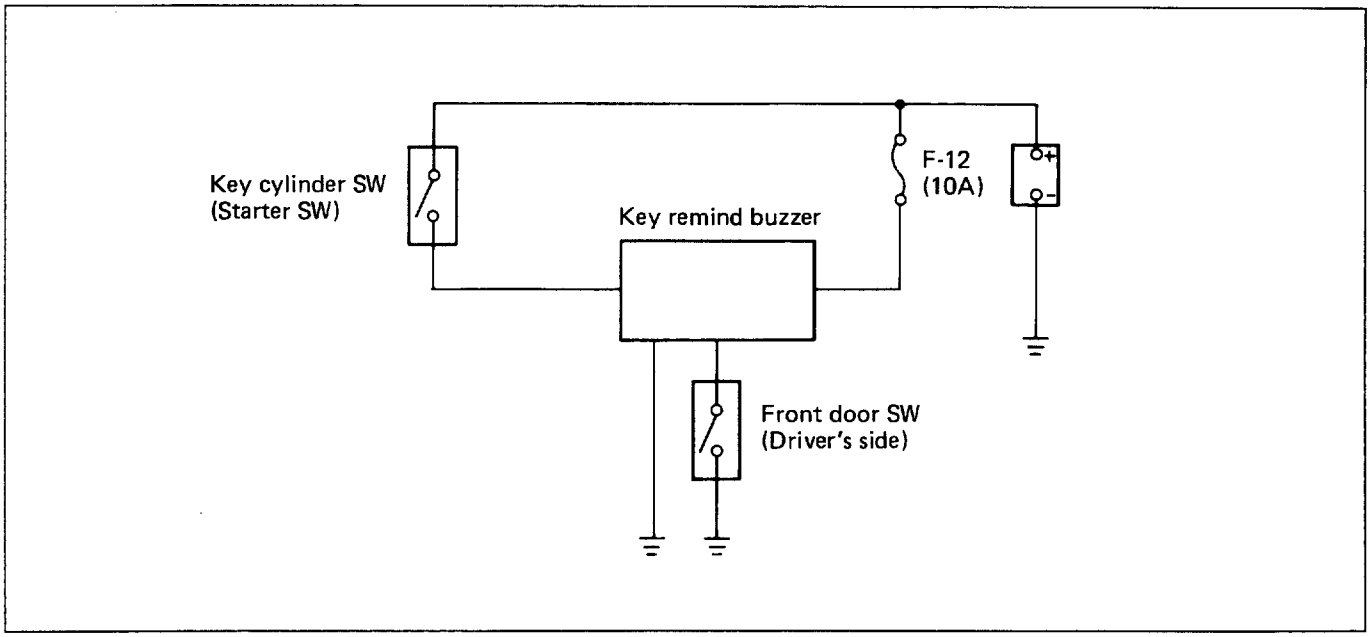
1. **Door Switch**
   1) Remove the screw.
   2) Disconnect the connector of the switch.

INSTALLATION

To install, follow the removal steps in the reverse order.

KEY REMIND BUZZER

The key remind buzzer sounds to remind the driver to remove the starter key from the starter switch when front driver side door is opened (Front driver side door switch is on).



INSPECTION OF THE BUZZER CIRCUIT

Disconnect the key remind buzzer connector, measure the continuity and voltage between the harness side connector terminals.

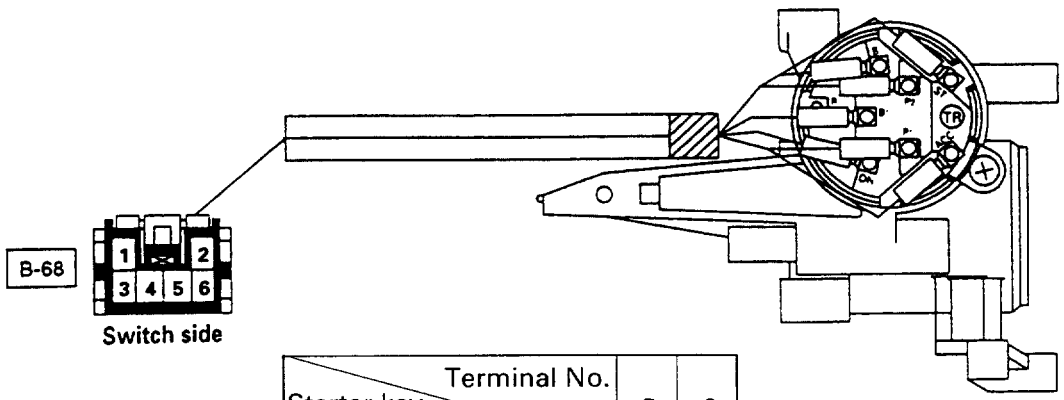
Terminal No.	Wire color	Connected to	Item to be checked	Connecting terminal	Checking conditions	Standard
2	B	Ground	Continuity	2-Ground	–	Continuity
1	P/L	Ground	Voltage	1-Ground	Starter key inserted	Approx. battery voltage
					Starter key removed	0V
3	GR/R	Ground	Continuity	3-Ground	Front driver's side door "OPEN"	Continuity
					Front driver's side door "CLOSE"	No Continuity
6	B/Y	Fuse F-12 (10A)	Voltage	6-Ground	· Starter SW ON	Approx. battery voltage

KEY CYLINDER SWITCH (STARTER SWITCH)

INSPECTION

Check to see if there is any continuity between the connector terminals of the key cylinder switch.

Repair or replace the switch when the result of inspection is found abnormal.



Starter key position \ Terminal No.		5	6
LOCK	Key removed		
OFF	Key inserted	○	○
ACC			
ON			
START			

POWER DOOR LOCK

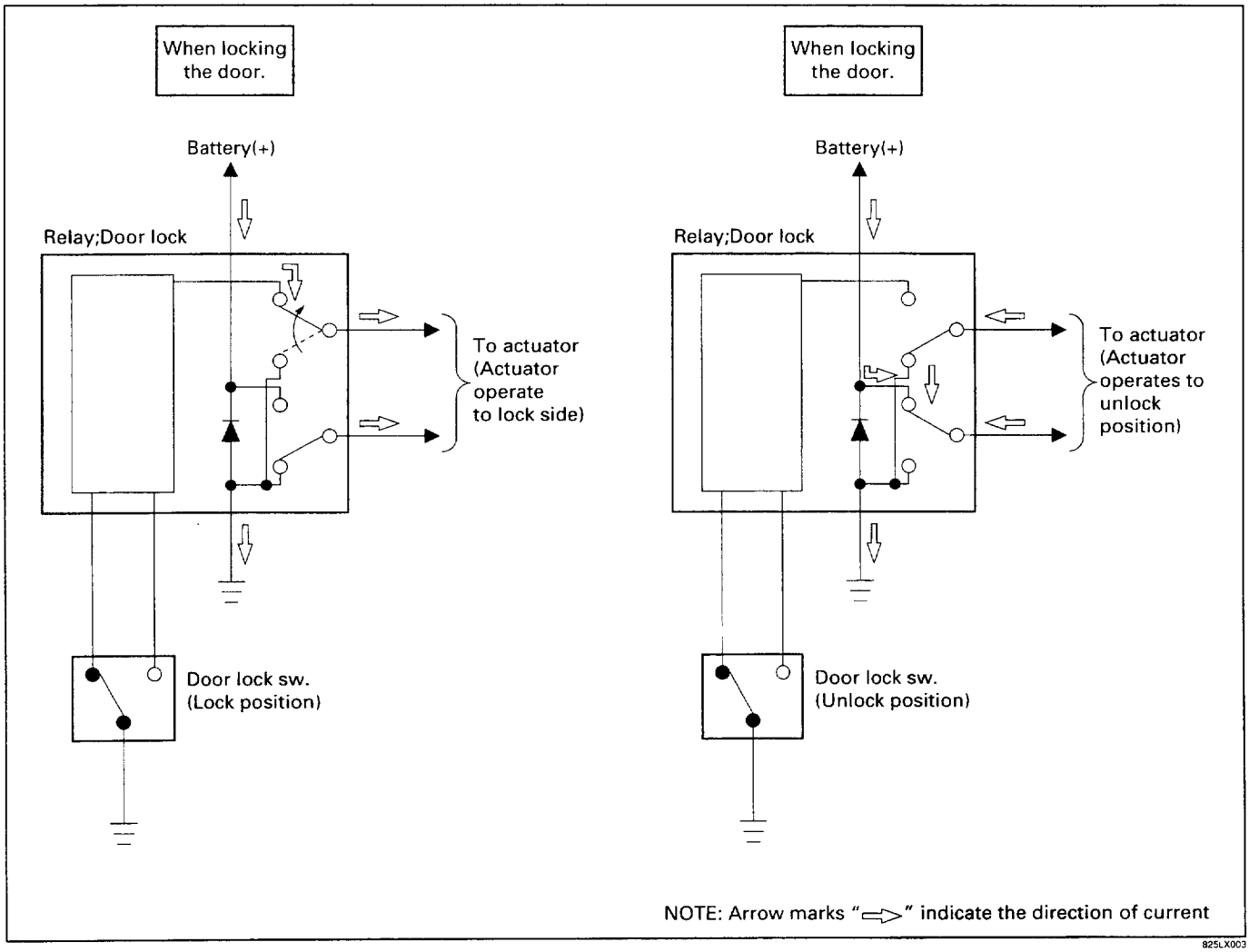
GENERAL DESCRIPTION

The circuit consists of the door lock switch, actuator for the front passenger door, rear doors and the door lock controller.

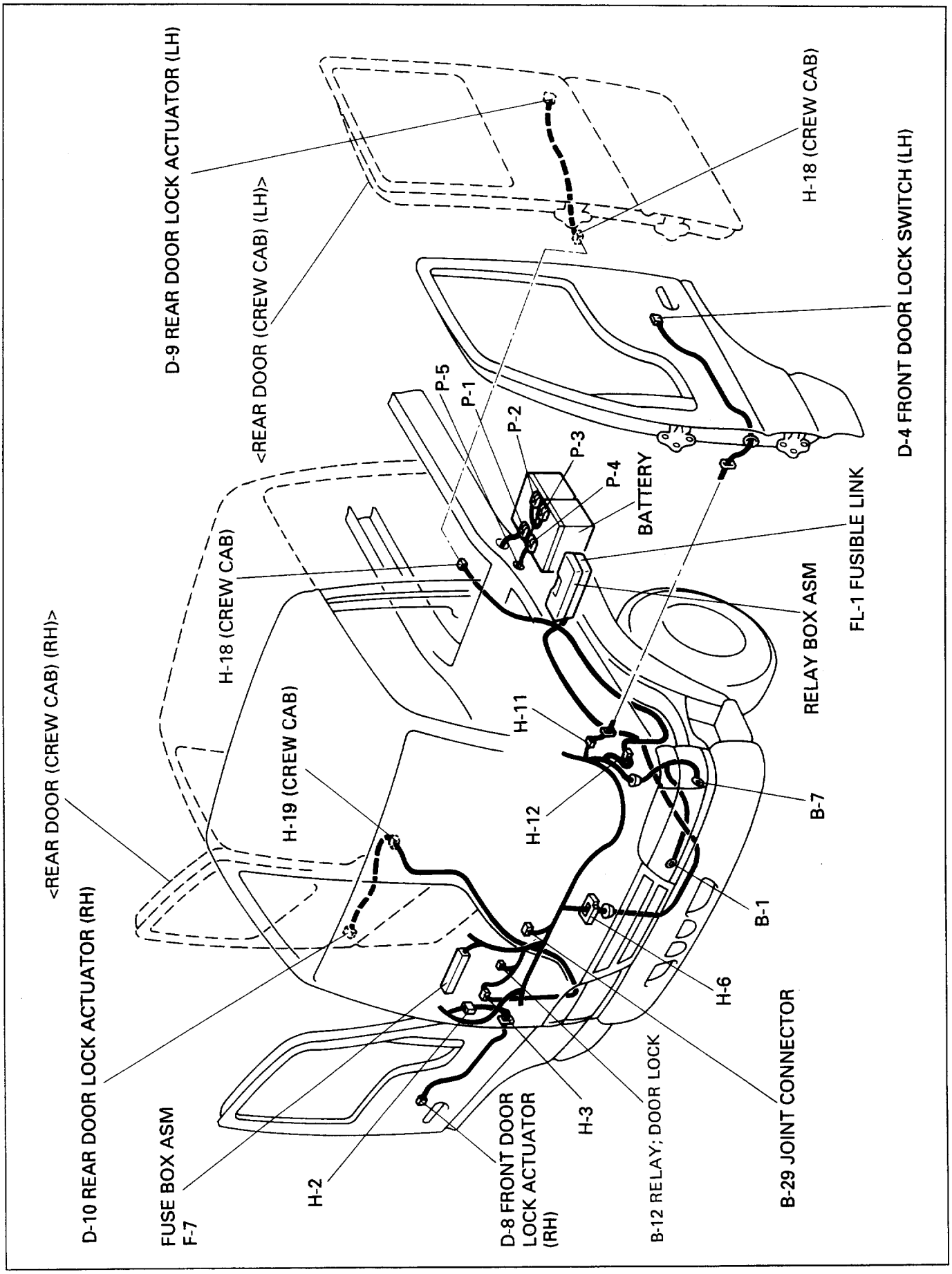
The door lock controller is always provided with battery voltage. The key or the inside lock knob on the driver's door can activate the lock mechanism of all the doors.

When the driver's door lock switch is turned on, current flows for about one second to the door lock actuator of each door connected in parallel with the controller to activates the actuator to lock and unlock the doors.

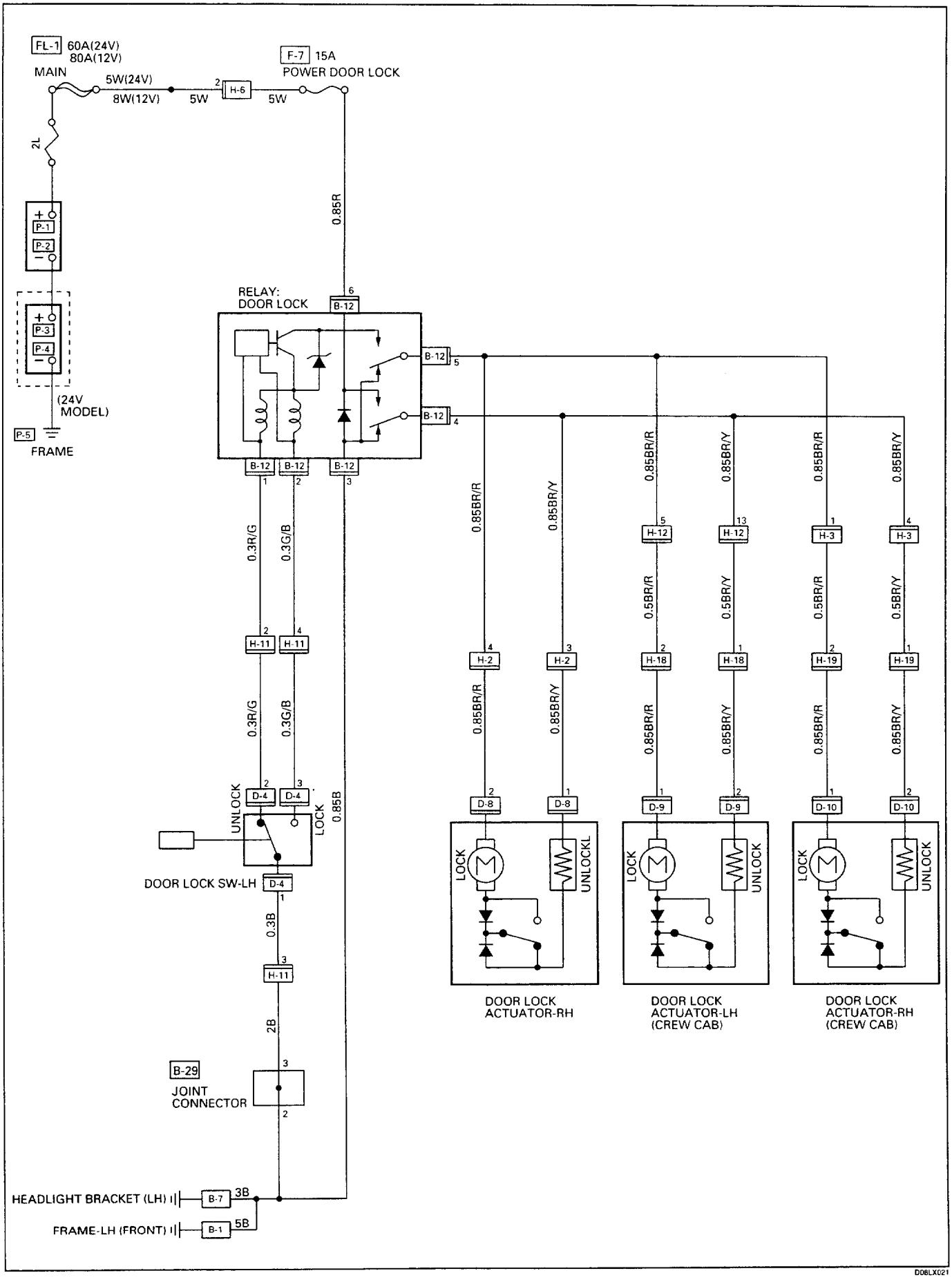
OPERATION OF DOOR LOCK CONTROLLER



PARTS LOCATION

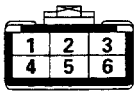


CIRCUIT DIAGRAM

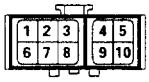


CONNECTOR LIST

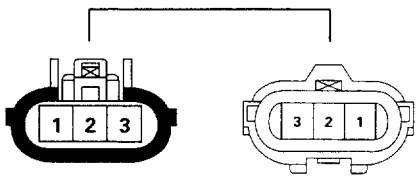
B-12



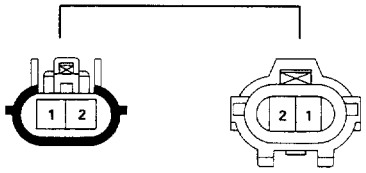
B-29



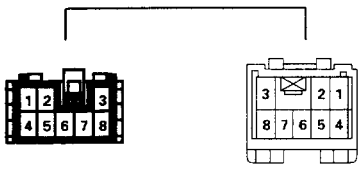
D-4



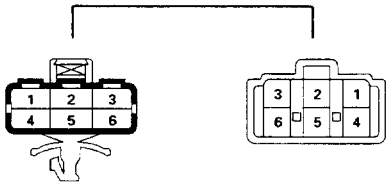
D-8 D-9 D-10
H-18 H-19



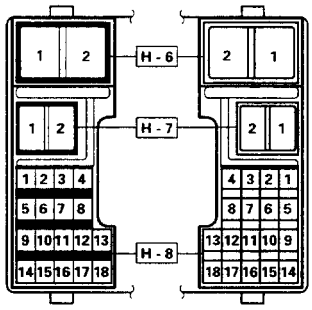
H-2 H-11



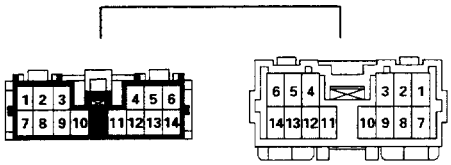
H-3



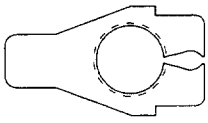
H-6



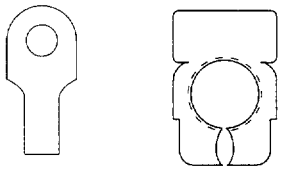
H-12



P-2 (24V) P-3

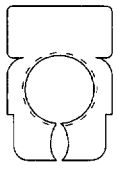


P-1 (12V) P-2

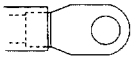


P-5 (12V)

P-1 (24V) P-4



P-5 (24V)



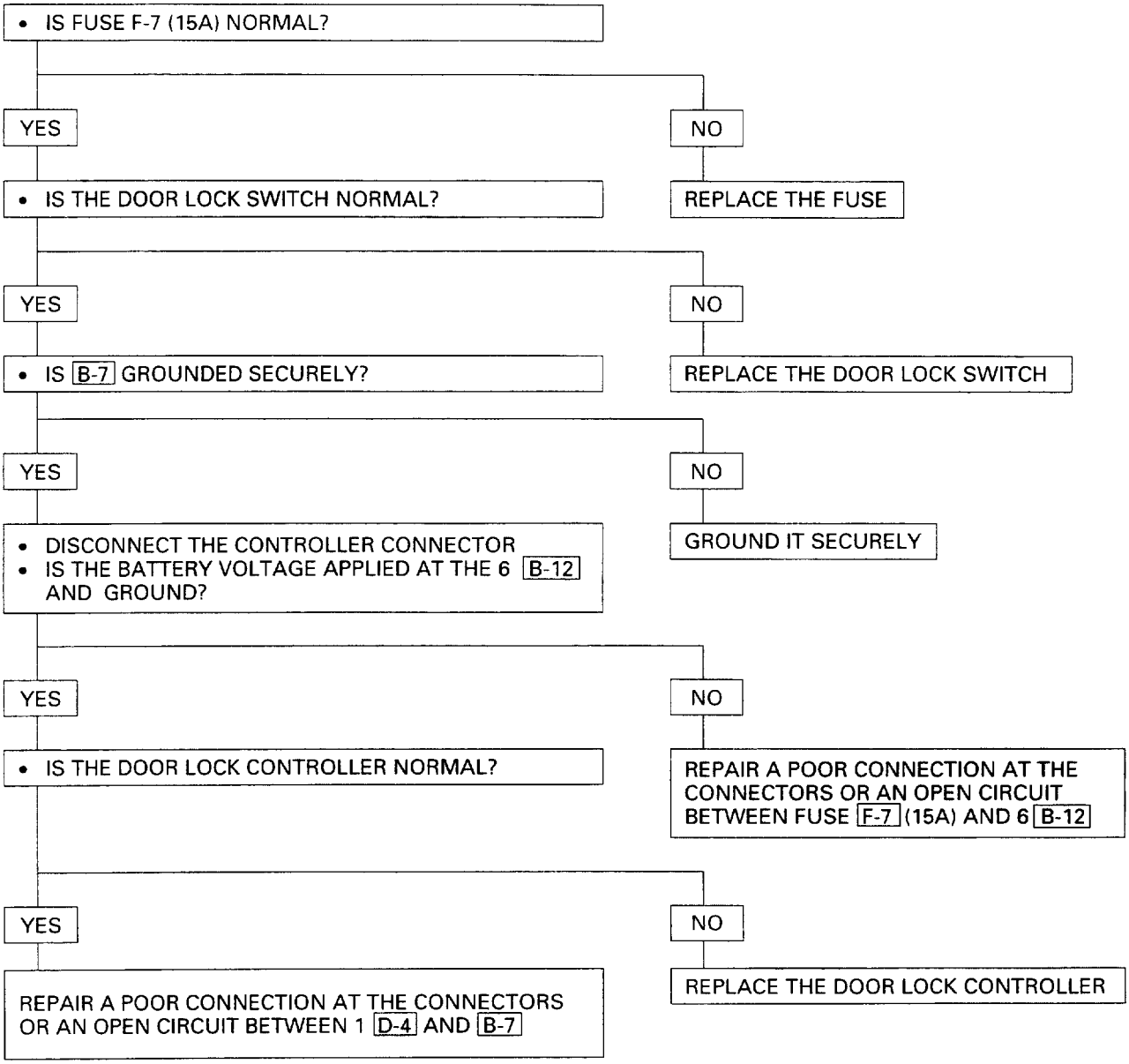
DIAGNOSIS

QUICK CHART FOR CHECK POINT

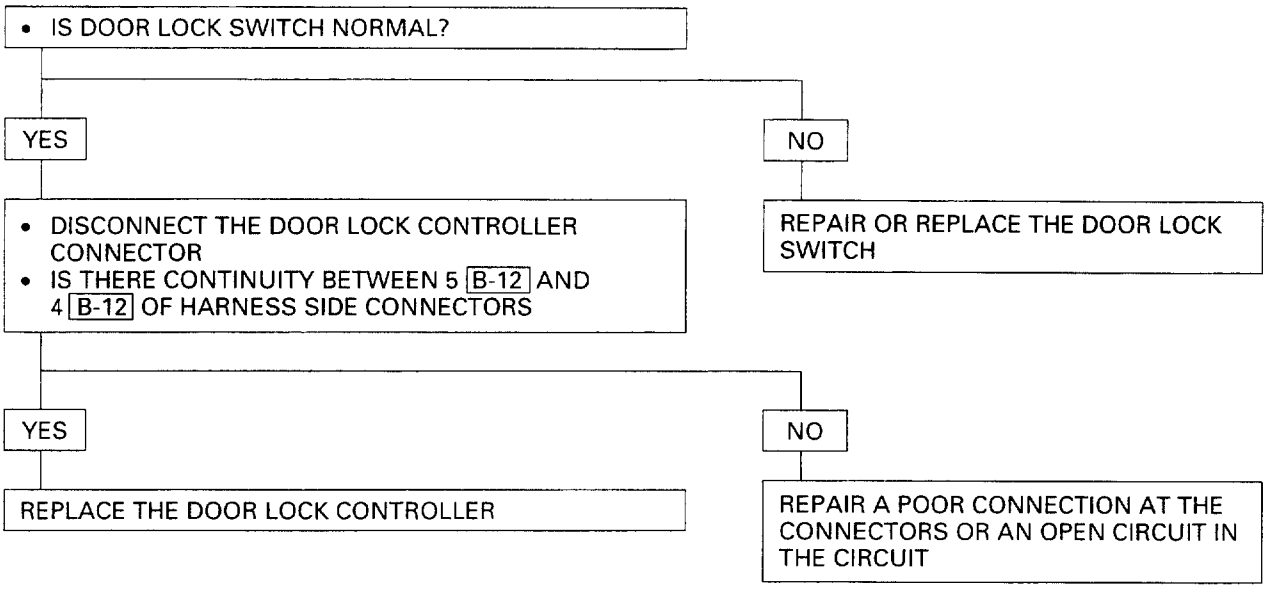
Trouble mode \ Check point	Fuse F-7 (15A)	Door lock controller	Door lock sw (Driver side)	Door lock actuator			
				Front (Passen-ger side)	Rear (RH)	Rear (LH)	Cable harness
1. All the doors do not lock and unlock	○ (1)	○ (2)					○ (3)
2. All the doors do not get locked (or unlocked)		○ (1)					○ (2)
3. Driver side door does not get locked (or unlocked)			○ (1)				○ (2)
4. Front passenger side door does not get locked (or unlocked)				○ (1)			○ (2)
5. Rear door-RH side does not get locked (or unlocked)					○ (1)		○ (2)
6. Rear door-LH side does not get locked (or unlocked)						○ (1)	○ (2)

NOTE: Figure in parenthesis "( )" indicates the order of inspection.

1. ALL THE DOORS DO NOT LOCK AND UNLOCK



2. ALL THE DOORS DO NOT GET LOCKED (OR UNLOCKED)



3. DRIVER SIDE DOOR DOES NOT GET LOCKED (OR UNLOCKED)

REPLACE THE DOOR LOCK SWITCH

4. FRT PASSENGER SIDE DOOR DOES NOT GET LOCKED (OR UNLOCKED)
5. RR DOOR-RH SIDE DOES NOT GET LOCKED (OR UNLOCKED)
6. RR DOOR-LH SIDE DOES NOT GET LOCKED (OR UNLOCKED)

REPLACE THE DOOR LOCK ACTUATOR

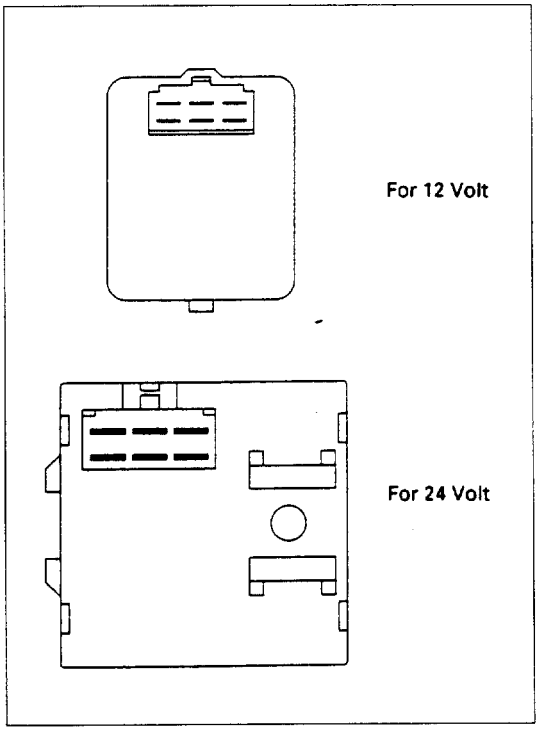
INSPECTION OF THE DOOR LOCK CIRCUIT

Check the voltage and the continuity between the controller harness side connector terminals.

B-12

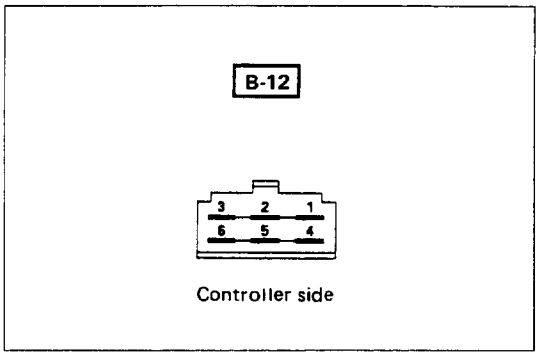
Harness side

Terminal No.	Wire color	Connected to	Item to be checked	Connecting terminal	Checking conditions		Standard
1	R/G	Door lock SW (Unlock)	Continuity (Resistance)	1-Ground	Driver seat side door	Unlock	Continuity
						Lock	No continuity
2	G/B	Door lock SW (Lock)		2-Ground	Driver seat side door	Unlock	No continuity
						Lock	Continuity
3	B	Ground		3-Ground	–		Continuity
4	BR/Y	Actuator (Unlock)		4-5	–		Continuity (There is some resistance)
5	BR/R	Actuator (Lock)		5-4	–		Continuity (There is some resistance)
6	R	Fuse F-7 (15A)	Voltage	6-Ground	–		Battery voltage



DOOR LOCK RELAY

The door lock controller sends out to each door lock actuator the lock/unlock signals received from door lock switch of driver seat side.



INSPECTION

Remove the connector of the door lock controller, and check the continuity and the voltage between the controller side connector terminals.

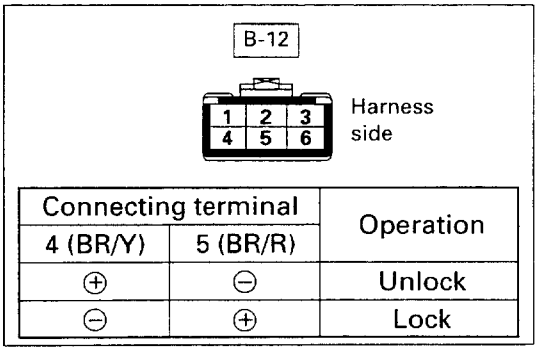
(Connect the ⊕ terminal of the battery to 6 B-12 and the ⊖ terminal to 3 B-12)

3 B-12 – 5 B-12 .....Continuity
3 B-12 – 4 B-12 .....Continuity

(Then, ground 2 B-12)
5 B-12 .....Voltage for approx. 1 second

(Disconnect the ground of 2 B-12, and ground 1 B-12 .)
4 B-12 .....Voltage for approx. 1 second

Replace the controller when the result of inspection is found abnormal.

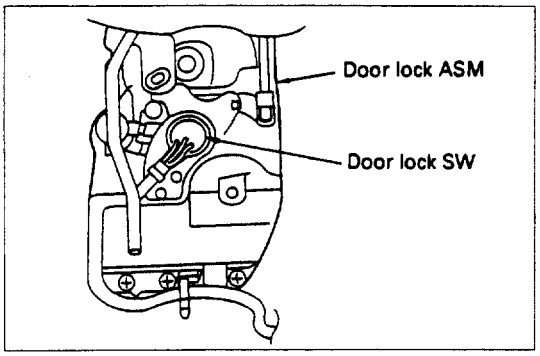


Connecting terminal		Operation
4 (BR/Y)	5 (BR/R)	
⊕	⊖	Unlock
⊖	⊕	Lock

DOOR LOCK OPERATION TEST

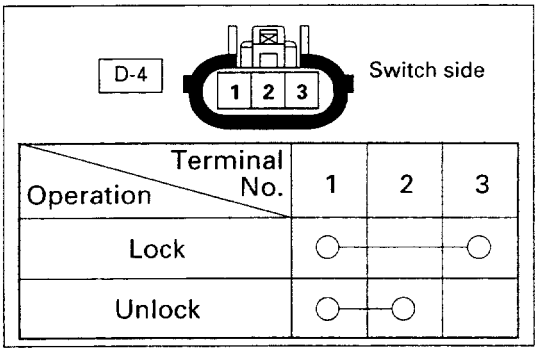
After confirming that there is continuity between the harness side connector terminals 4 B-12 and 5 B-12 of the door lock controller, apply battery voltage to each of the terminals to conduct the operation test.

When the door lock will not operate, check the door lock actuator for any trouble.



DOOR LOCK SWITCH (DRIVER SEAT SIDE)

The door lock switch on the driver's door is connected with the door lock cylinder and the inside lock knob with a rod. The switch sends lock/unlock signals to the door lock controller.



Operation \ Terminal No.	1	2	3
Lock	○		○
Unlock	○	○	

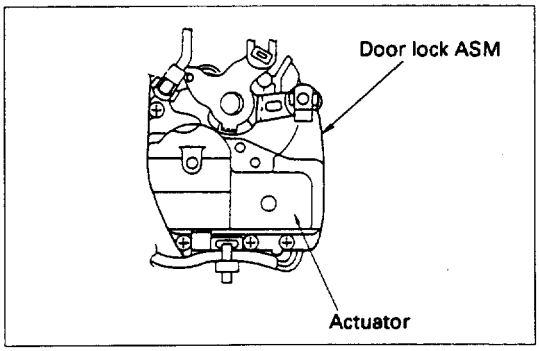
INSPECTION

Check to see if there is any continuity between the connector terminals of the door lock switch.

Replace the switch when the result of inspection is found abnormal.

REMOVAL AND INSTALLATION

Refer to Section 10 "CAB" for "DOOR LOCK ASSEMBLY (front and rear)".



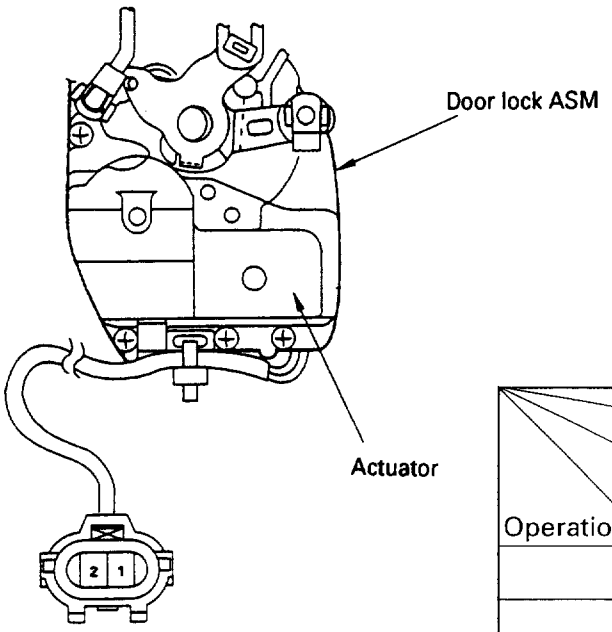
DOOR LOCK ACTUATOR

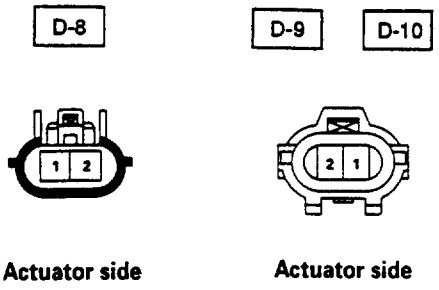
Receiving forward or reverse current from the door lock controller, the door lock actuator locks or unlocks the door with the rod connected to the door lock mechanism.

INSPECTION OF THE DOOR LOCK ACTUATOR

Apply the battery voltage to the connector terminals of the door lock actuator to check the operation.

When the door lock actuator is checked on the vehicle and there is no continuity, and when the door lock actuator itself is checked and no trouble is found, check the circuit between the door lock actuator and the door lock controller for any failure.





Door	FRT Passenger		RR-LH		RR-RH	
Connector No.	D-8		D-9		D-10	
Operation \ Terminal No.	1	2	1	2	1	2
Lock	⊖	⊕	⊕	⊖	⊕	⊖
Unlock	⊕	⊖	⊖	⊕	⊖	⊕

REMOVAL AND INSTALLATION

Refer to Section 10 "CAB" for "DOOR LOCK ASSEMBLY (Front and rear)".

MEMO

POWER WINDOW

GENERAL DESCRIPTION

The circuit consist of the starter switch, power window switch for each of the windows and power window motor.

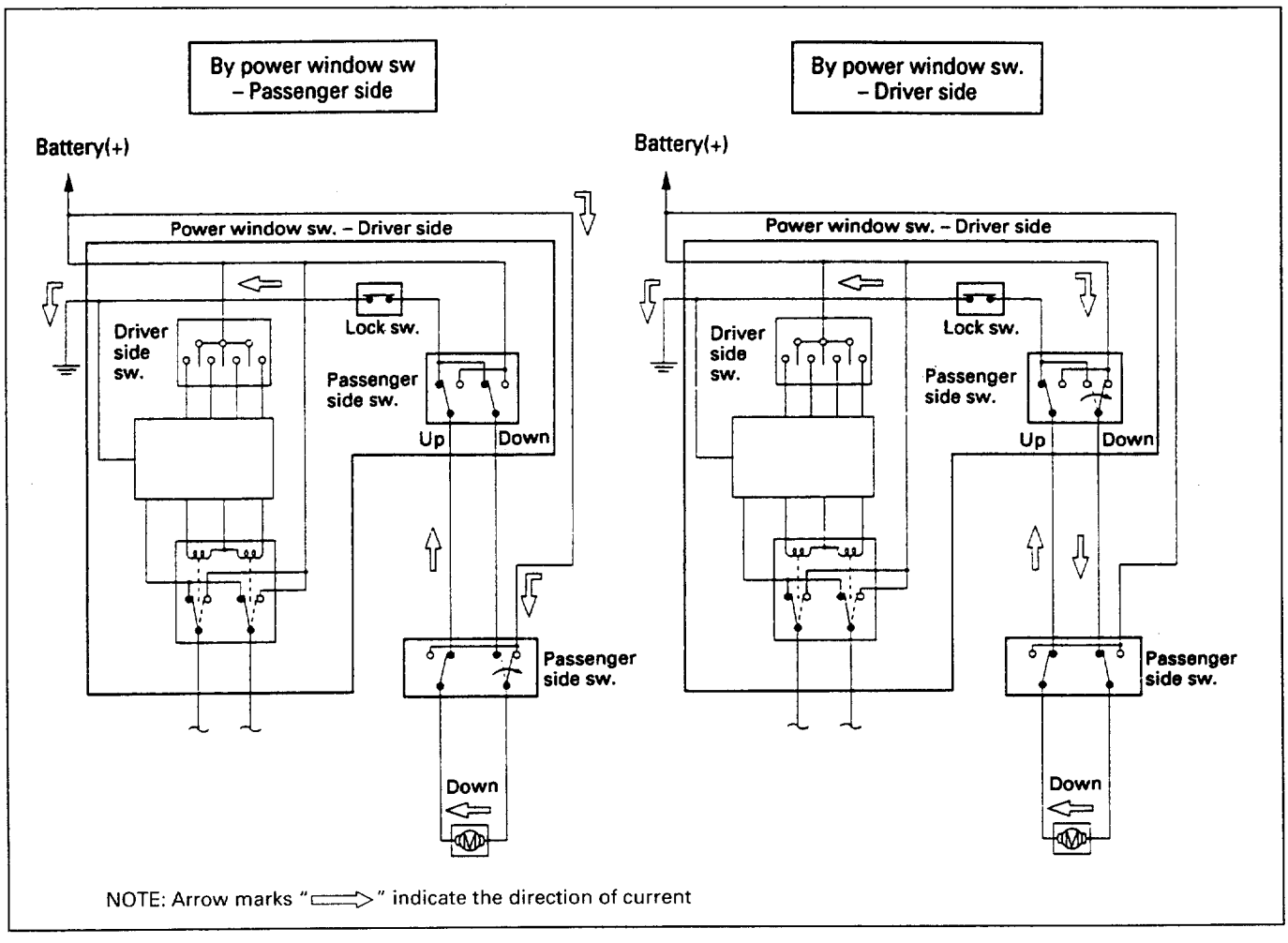
When the starter switch is turned on, the battery voltage is applied to each of the power window switches through the circuit breaker and the power window relay on the circuit.

By operating the switches of each window to select "UP" or "DOWN", the revolving direction of the power window motor changes to open or close the window.

The driver's power window switch has a built-in one-touch operating circuit which allows to automatically open the window by operating the switch to the AUTO position.

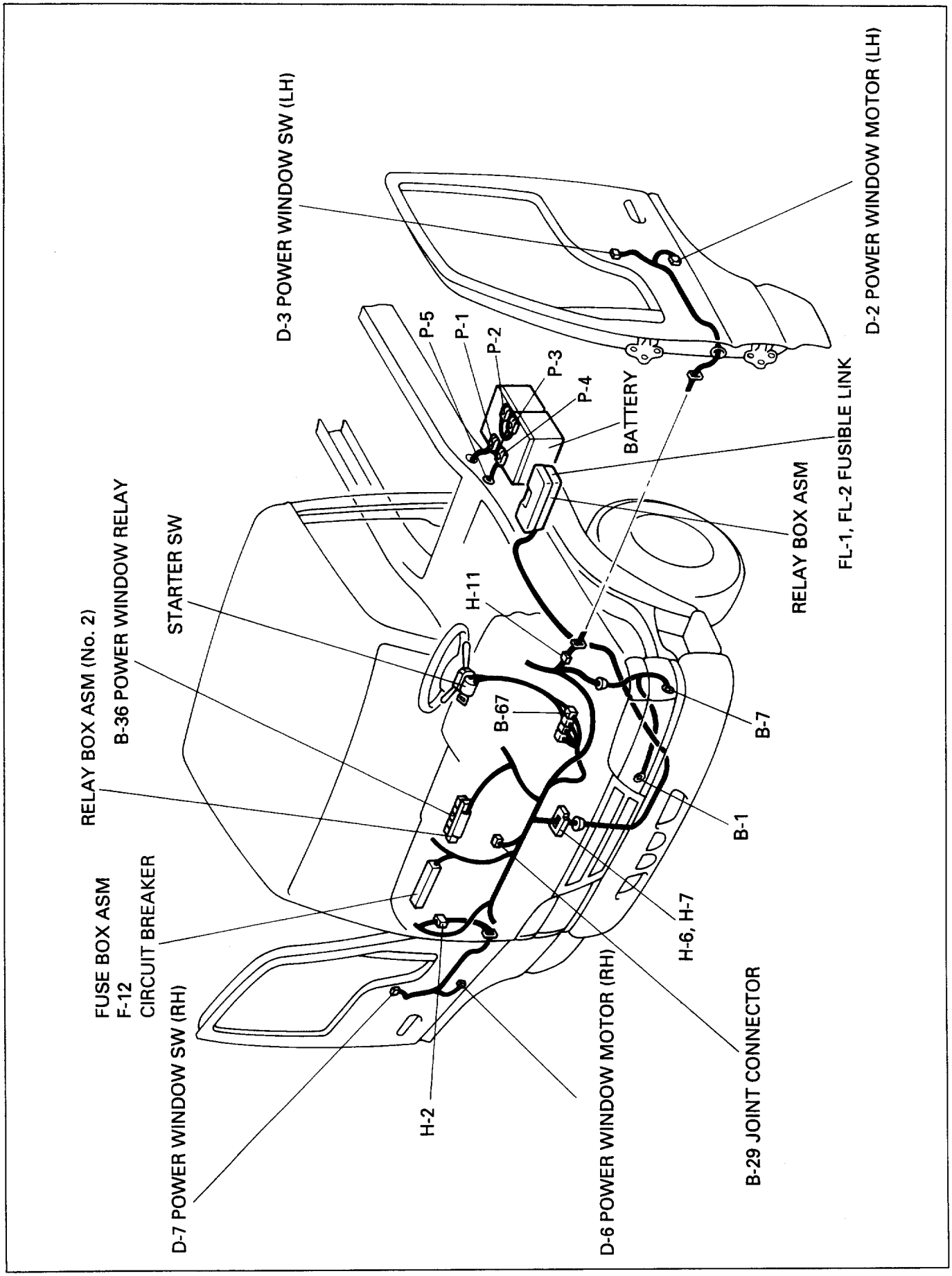
When the driver's power lock switch at the driver side is depressed, the power source to the passenger's power window switches will be shut off and passenger's side power window motor will not operate if the switch is operated.

OPERATION OF PASSENGER SIDE WINDOW

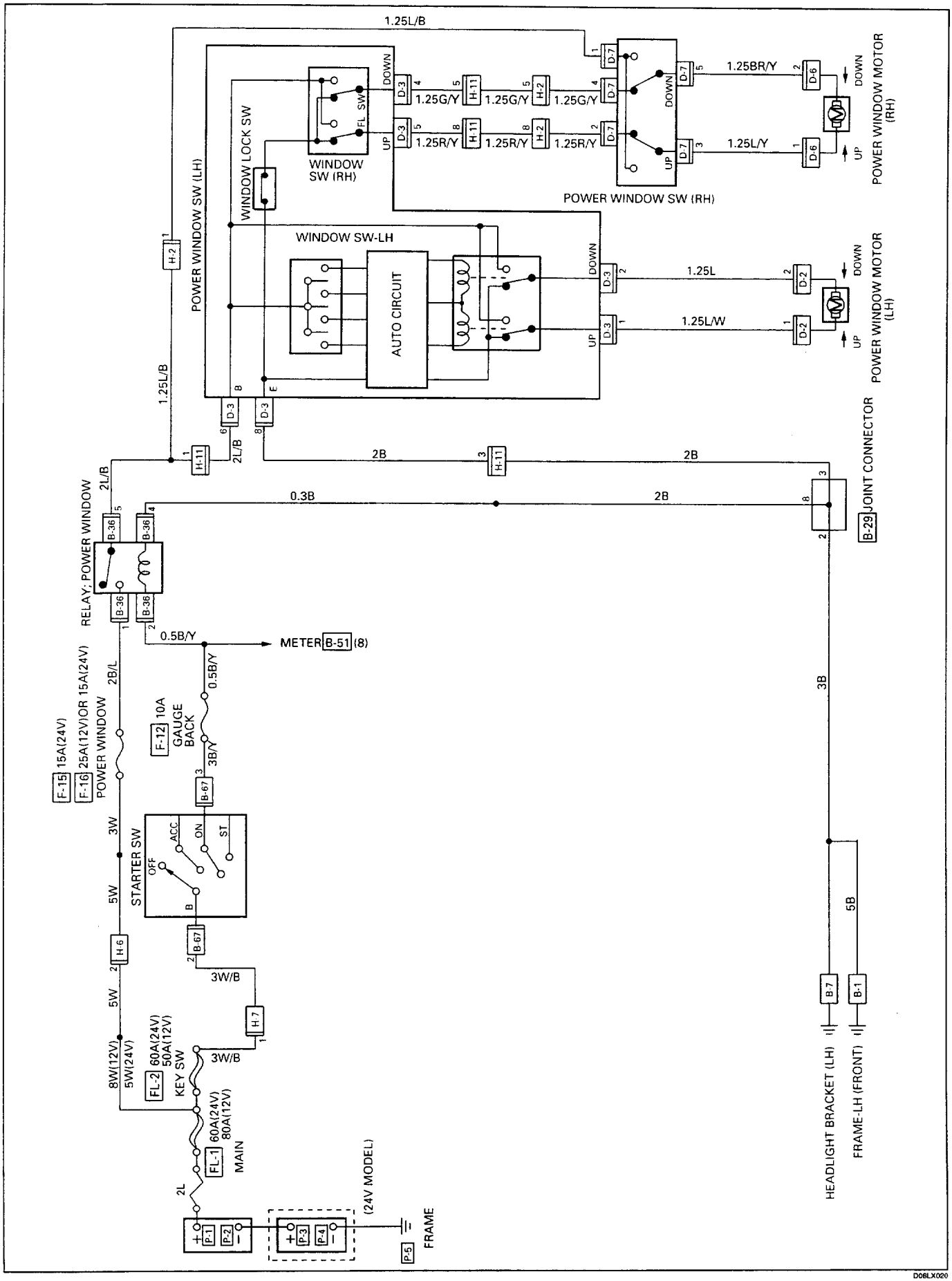


NOTE: Arrow marks "⟹" indicate the direction of current

PARTS LOCATION

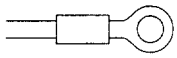


CIRCUIT DIAGRAM

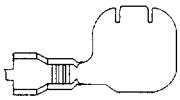


CONNECTOR LIST

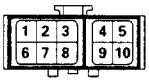
B-1



B-7

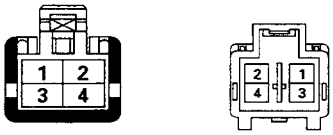


B-29

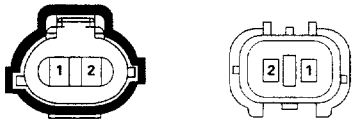


B-36

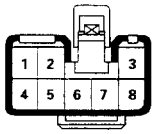
B-67



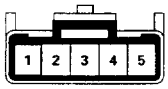
D-2 D-6



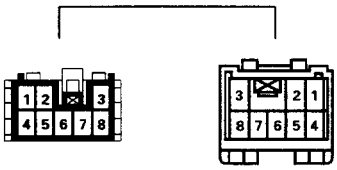
D-3



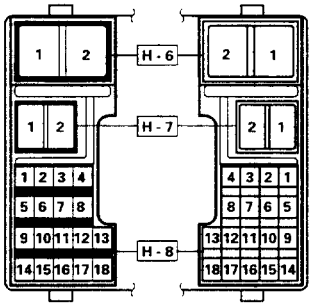
D-7



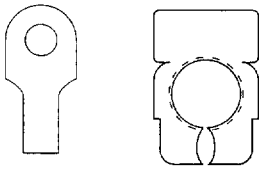
H-2 H-11



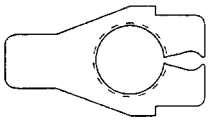
H-6 H-7



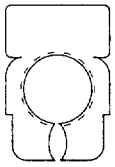
P-1 (12V) P-2



P-1 (24V) P-4

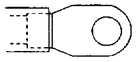


P-2 (24V) P-3



P-5 (12V)

P-5 (24V)



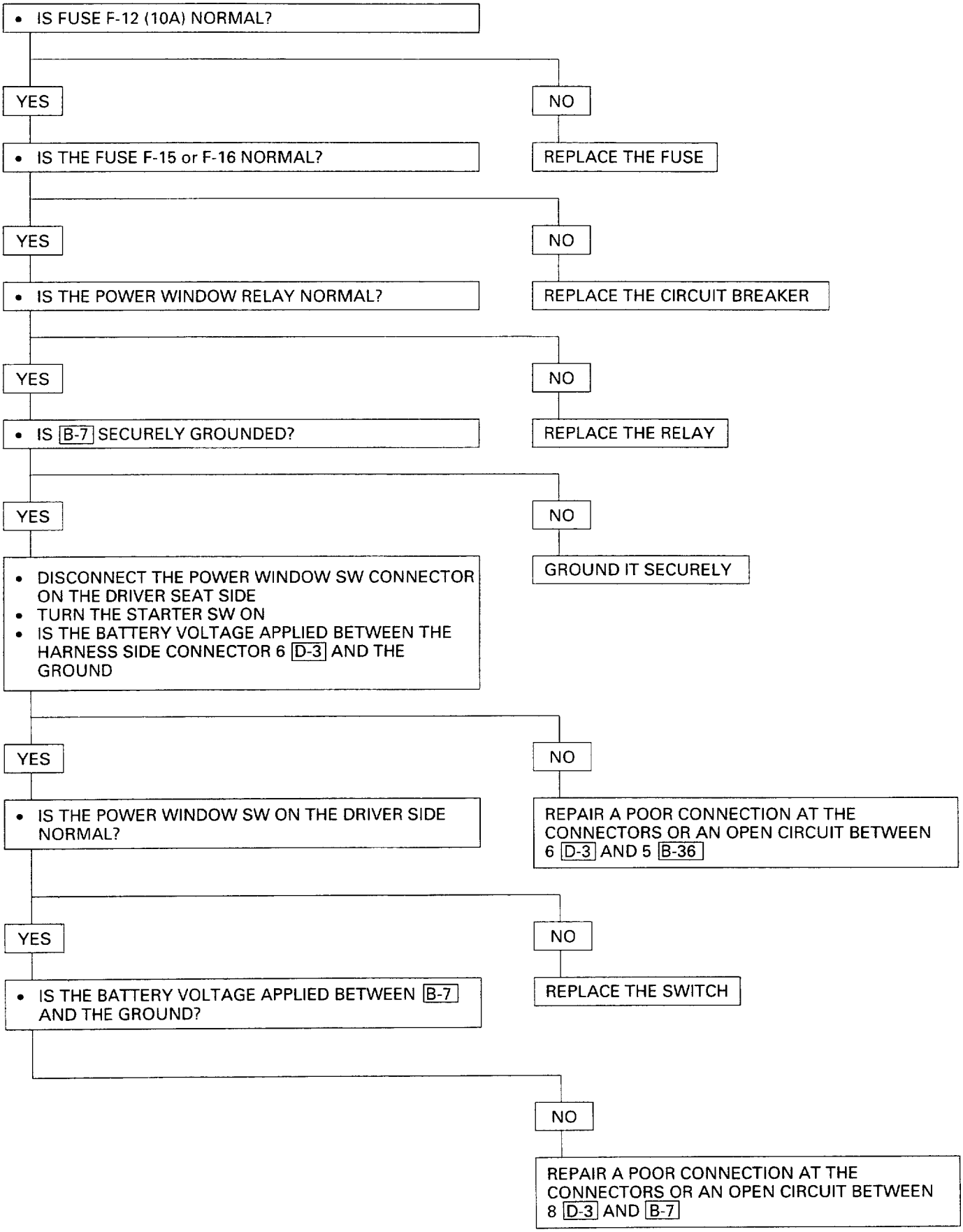
DIAGNOSIS

QUICK CHART FOR CHECK POINT

Trouble mode \ Check point	Fuse F-12 (10A)	F-15 (15A) F-16 (25A, 15A)	Power window relay	Power window SW		Power window motor		Cable harness
				Driver side	Passen-ger side	Driver side	Passen-ger side	
All windows do not operate	○ (1)	○ (2)	○ (3)	○ (5)				○ (4)
Lock SW does not function				○ (1)				
Driver side window								
Window does not operate				○ (1)		○ (2)		○ (3)
One-touch operation does not operate				○ (1)				
Window operates in only one direction				○ (1)				
Front passenger side window								
Window does not operate				○ (2)	○ (1)		○ (3)	○ (4)
Window does not operate when operating the driver side SW				○ (1)				○ (2)
Window does not operate when operating the passenger side SW					○ (1)			○ (2)
Window operates in only one direction when operating the driver side SW				○ (1)				○ (2)
Window operates in only one direction when operating the passenger side SW				○ (2)	○ (1)			

NOTE: Figure in parenthesis "( )" indicates the order of inspection.

ALL WINDOWS DO NOT OPERATE



LOCK SW DOES NOT FUNCTION

REPAIR OR REPLACE THE POWER WINDOW SW ON THE DRIVER SEAT SIDE

WINDOW ON THE DRIVER SIDE DOES NOT OPERATE

- IS THE POWER WINDOW SWITCH ON THE DRIVER SEAT SIDE NORMAL?

YES

- DISCONNECT THE CONNECTOR OF THE POWER WINDOW MOTOR ON THE DRIVER SEAT SIDE
- WHEN CONNECTING THE MOTOR CONNECTOR 1 [D-2] TO THE BATTERY (+) TERMINAL AND 2 [D-2] TO THE (–) TERMINAL, DOES THE MOTOR ROTATE IN THE "UP" DIRECTION OF THE WINDOW (OR WHEN CONNECTING 2 [D-2] TO THE (+) TERMINAL AND 1 [D-2] TO THE (–) TERMINAL, DOES THE MOTOR ROTATE IN THE "DOWN" DIRECTION OF THE WINDOW?

YES

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN HARNESS SIDE CONNECTOR TERMINALS 1 [D-3] AND POWER WINDOW MOTOR 1 [D-2] OR 2 [D-3] AND 2 [D-2]

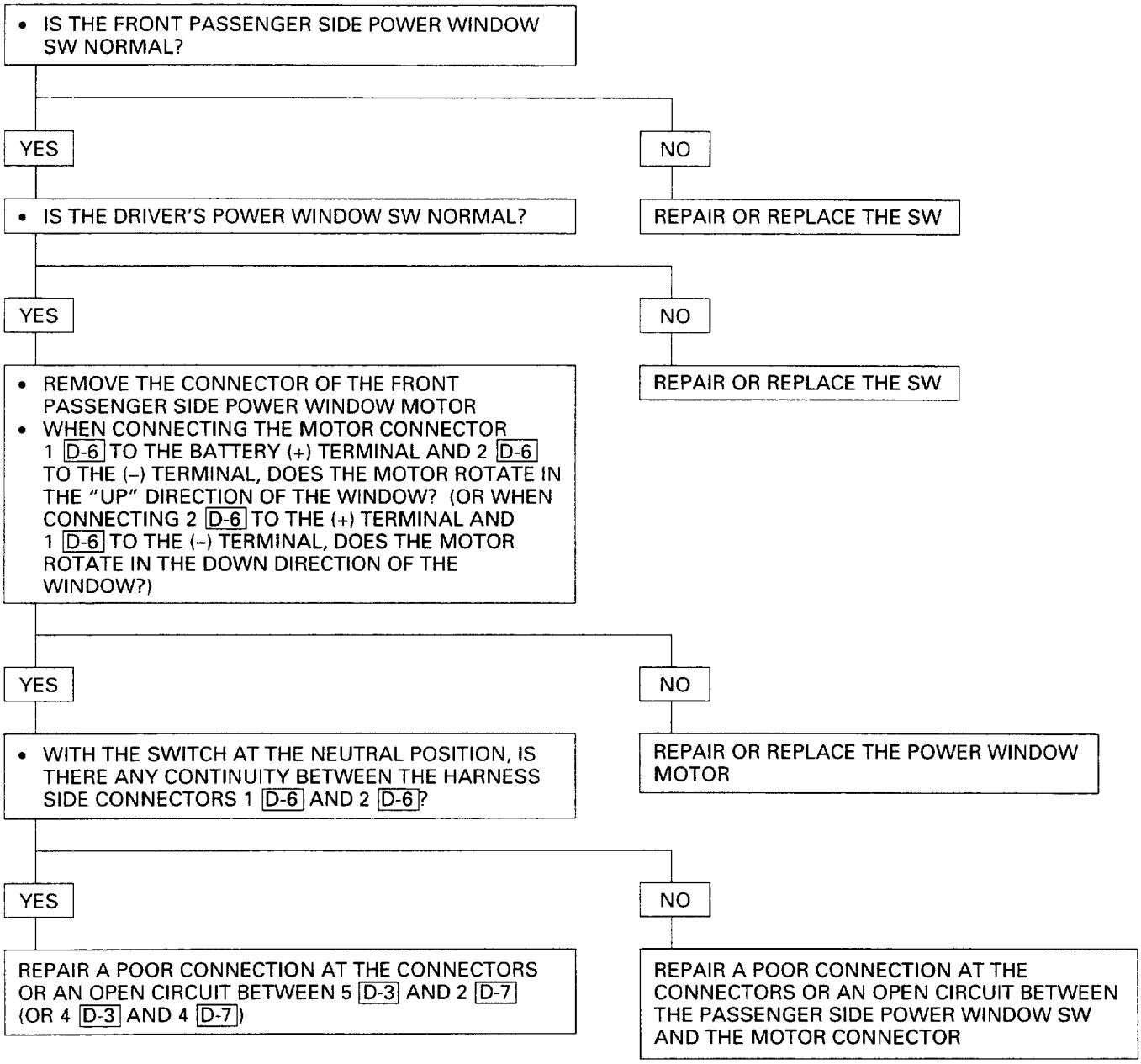
NO

REPAIR OR REPLACE THE POWER WINDOW MOTOR

NO

REPLACE THE POWER WINDOW SWITCH ON THE DRIVER SEAT SIDE

WINDOW ON THE FRONT PASSENGER SIDE DOES NOT OPERATE



STARTER SWITCH

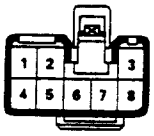
Refer to "START AND CHARGING" in this section.

POWER WINDOW SWITCH-DRIVER SIDE

CIRCUIT INSPECTION

Disconnect the switch connectors to check the voltage and the continuity between the harness side connector terminals.

D-3



Harness side

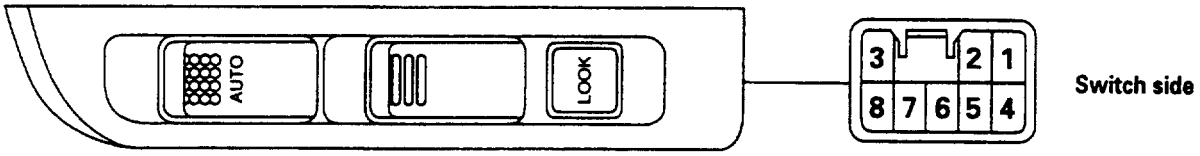
Terminal No.	Wire color	Connected to	Item to be checked	Connecting terminal	Checking conditions	Standard
1	L/W	Driver seat side motor	Continuity (resistance)	1-2	–	Continuity
2	L					
4	G/Y	Passenger side power window SW		4-5		
5	R/Y			5-4		
6	L/B	Power window relay	Voltage	6-Ground	Starter SW "ON"	Battery voltage
8	B	Ground	Continuity (resistance)	8-Ground	–	Continuity

INSPECTION

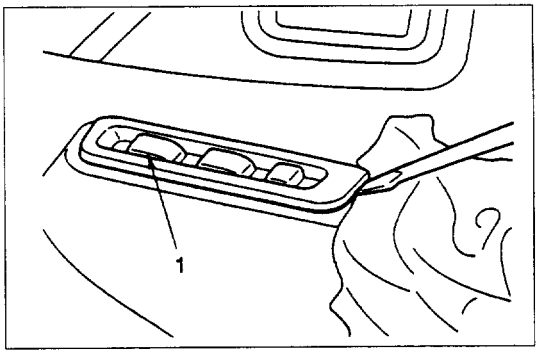
Check the continuity between the connector terminals of the switch.

Repair or replace the switch when the result of inspection is found abnormal.

D-3



Window		Driver side				Passenger side			
SW position / Terminal No.		6	1	2	8	6	5	4	8
UP		○—○		○—○		○—○		○—○	
OFF			○—○		○—○		○—○		○—○
DOWN		○—○		○—○		○—○		○—○	
LOCK	UP	○—○		○—○		○—○			
	OFF		○—○		○—○			○—○	
	DOWN	○—○			○—○		○—○		



REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Switch**
   1) Insert the screw driver to the cut off portion to remove the switch.
   2) Disconnect the connector

INSTALLATION

To install, follow the removal steps in the reverse order.

POWER WINDOW SWITCH-PASSENGER SIDE

CIRCUIT INSPECTION

Disconnect the switch connectors to check the voltage and the continuity between the harness side connector terminals

D-7

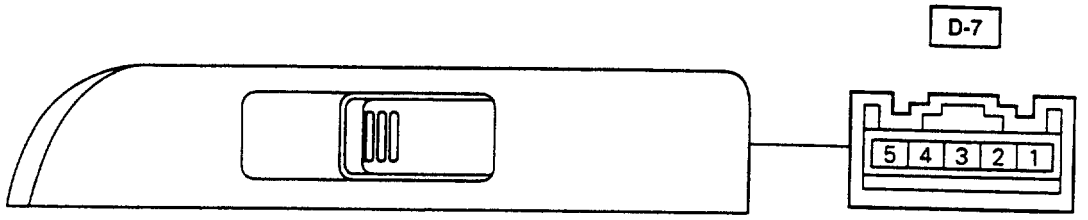
Harness side

Terminal No.	Wire color	Connected to	Item to be checked	Connecting terminal	Checking conditions	Standard
1	L/B	Power window relay	Voltage	1-Ground	· Turn "ON" the starter SW	Battery voltage
2	R/Y	Driver side SW	Continuity (Resistance)	2-Ground	· Turn "OFF" the passenger side SW at the driver side SW	Continuity
			Voltage	2-Ground	· Turn "ON" the starter SW · Turn to "UP" the passenger side SW at the driver side SW	Battery voltage
3	L/Y	Passenge side motor	Continuity (Resistance)	3-5	–	Continuity
4	G/Y	Driver side SW	Continuity (Resistance)	4-Ground	· Turn "OFF" the passenger side SW at the driver side SW	Continuity
			Voltage	4-Ground	· Turn "ON" the starter SW · Turn to "DOWN" the passenger side SW at the driver side SW	Battery voltage
5	BR/Y	Passenger side motor	Continuity (Resistance)	5-3	–	Continuity

INSPECTION

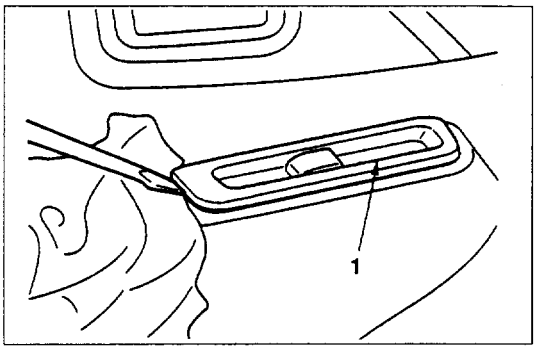
Check the continuity between the connector terminals of the switch.

Repair or replace the switch when the result of inspection is found abnormal.



Switch side

SW position \ Terminal No.	1	2	4	3	5
UP	○		○	○	○
OFF		○	○	○	○
DOWN	○	○		○	○



REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Switch**
   1) Insert the screw driver to the cut off portion to remove the switch.
   2) Disconnect the connector.

INSTALLATION

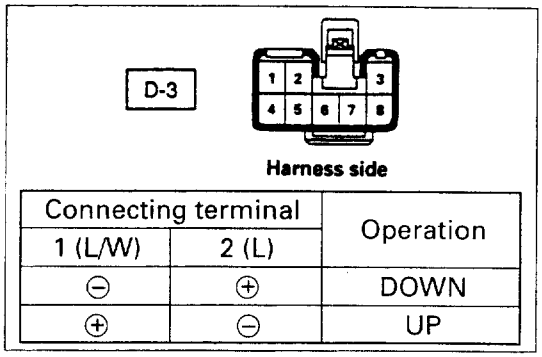
To install, follow the removal steps in the reverse order.

DRIVER SEAT SIDE POWER WINDOW MOTOR

INSPECTION

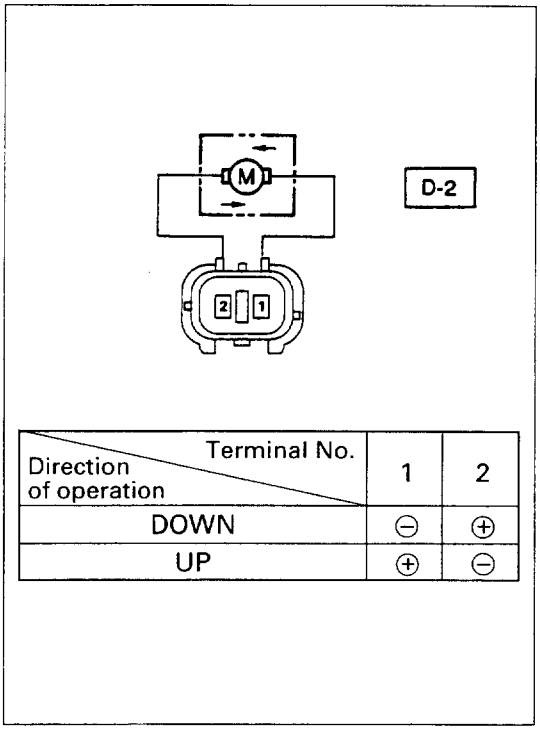
Before checking to see if the motor functions correctly, be sure to check the circuit through the connector D-3 of the driver's power window switch.

If the motor does not operate smoothly, either the motor or the circuit between the switch and the motor is defective.



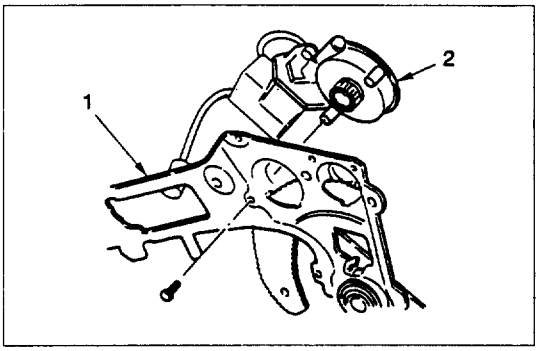
Connecting terminal		Operation
1 (L/W)	2 (L)	
⊖	⊕	DOWN
⊕	⊖	UP

1. **Circuit inspection of the driver side window switch**
   Disconnect the switch connector and apply battery voltage to the harness side connector terminals to check its function.



Direction of operation \ Terminal No.	1	2
DOWN	⊖	⊕
UP	⊕	⊖

2. **Inspection of the driver seat side motor**
   Remove the motor connector and apply battery voltage to the motor side connector terminals to check its function.
   Replace the motor when the result of inspection is found abnormal.



REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Window Regulator Assembly**
   Refer to Section 10 "BODY" for Window Regulator and Glass.
2. **Power Window Motor**
   Remove three screws.

INSTALLATION

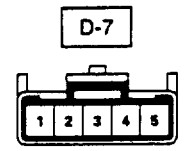
To install, follow the removal steps in the reverse order.

FRONT PASSENGER SEAT SIDE POWER WINDOW MOTOR

INSPECTION

Before checking to see if the motor functions correctly, be sure to check the circuit through the front passenger's switch connector D-7 and the driver's power window switch connector D-3.

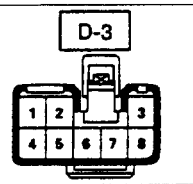
If the motor does not operate smoothly, either the motor or the circuit between the switch and the motor is defective.



Connecting terminal		Direction of operation
3 (L/Y)	5 (BR/Y)	
⊖	⊕	DOWN
⊕	⊖	UP

1. Circuit inspection of the front passenger seat side window

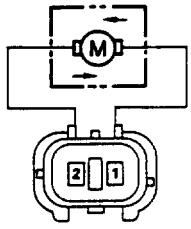
Disconnect the switch connector and apply battery voltage to the harness side connector terminals to check its function.



Connecting terminal		Direction of operation
4 (G/Y)	5 (R/Y)	
⊕	⊖	DOWN
⊖	⊕	UP

2. Circuit inspection of the driver seat side switch

Disconnect the switch connector and apply battery voltage to the harness side connector terminals to check its function.

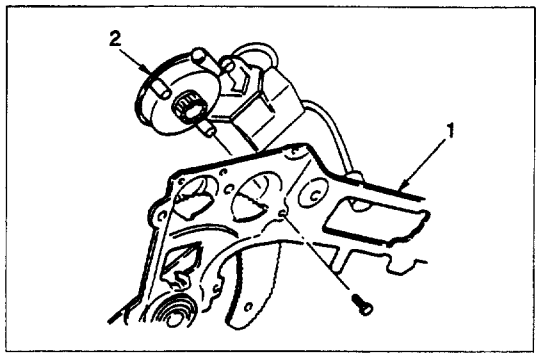


Direction of operation \ Terminal No.	1	2
DOWN	⊖	⊕
UP	⊕	⊖

3. Inspection of the front passenger window motor

Disconnect the motor connector and apply battery voltage to the motor side connector terminals to check its function.

Repair or replace the motor when the result of inspection is found abnormal.



REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Window Regulator Assembly**
   Refer to Section 10 "BODY" for Window Regulator and Glass.
2. **Power Window Motor**
   Remove three screws.

INSTALLATION

To install, follow the removal steps in the reverse order.

MEMO

A/T ECU (ELECTRONIC CONTROL UNIT)

GENERAL DESCRIPTION

The circuit consists of the starter switch ECU, pattern select switch, inhibitor switch, kickdown switch, idle switch, tacho sensor, vehicle speed sensor, throttle sensor, full throttle switch, dropping resistor OD switch and the relay.

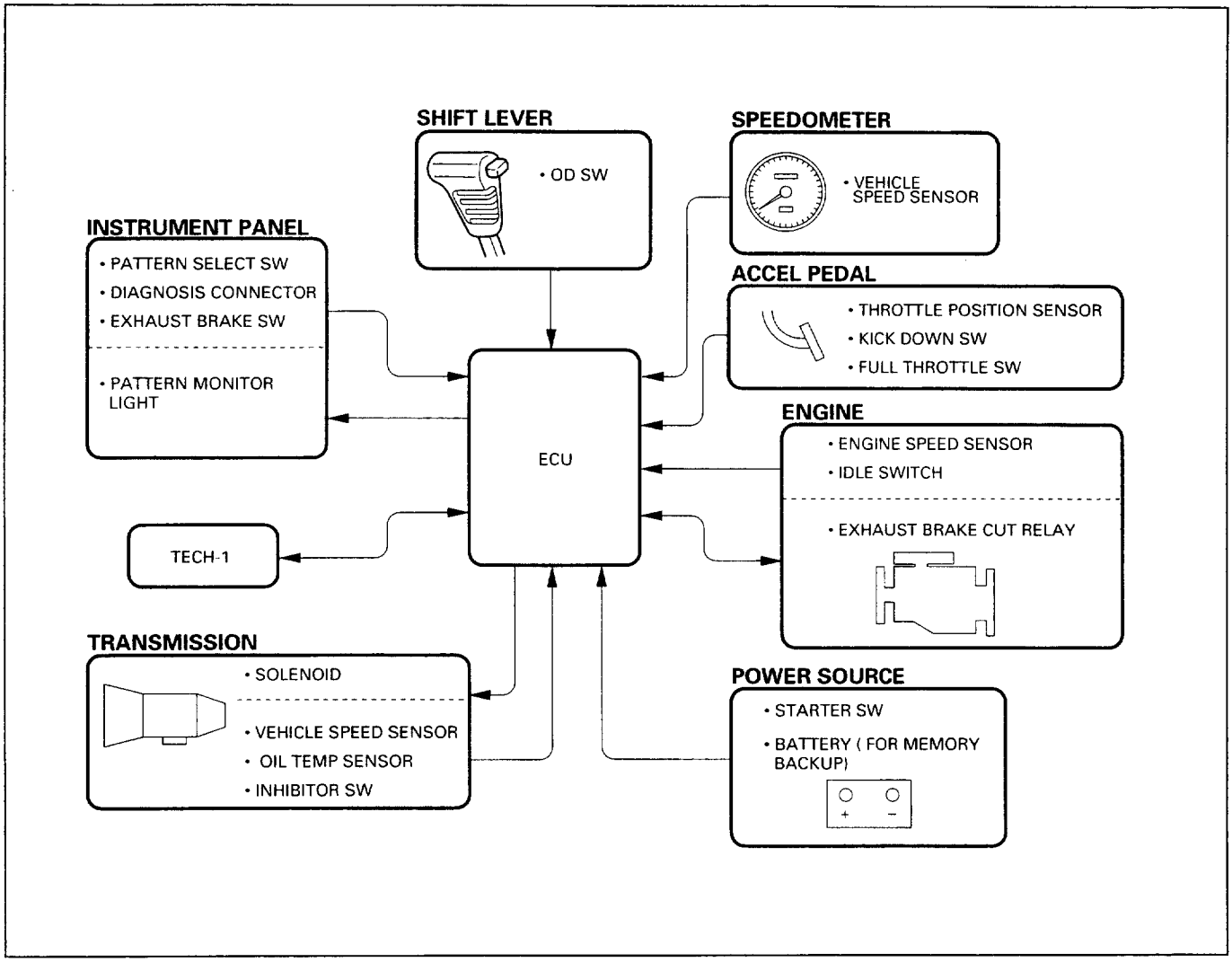
ECU, the key component of A/T ECU, judges where to shift speed and where to lock up shifting by the electric signals delivered from each one of the switches and sensors, and send controlling signals to respective solenoids.

The controllable items are speed shift pattern, speed shift, lock-up, oil pressure for each line and exhaust brake operative timing.

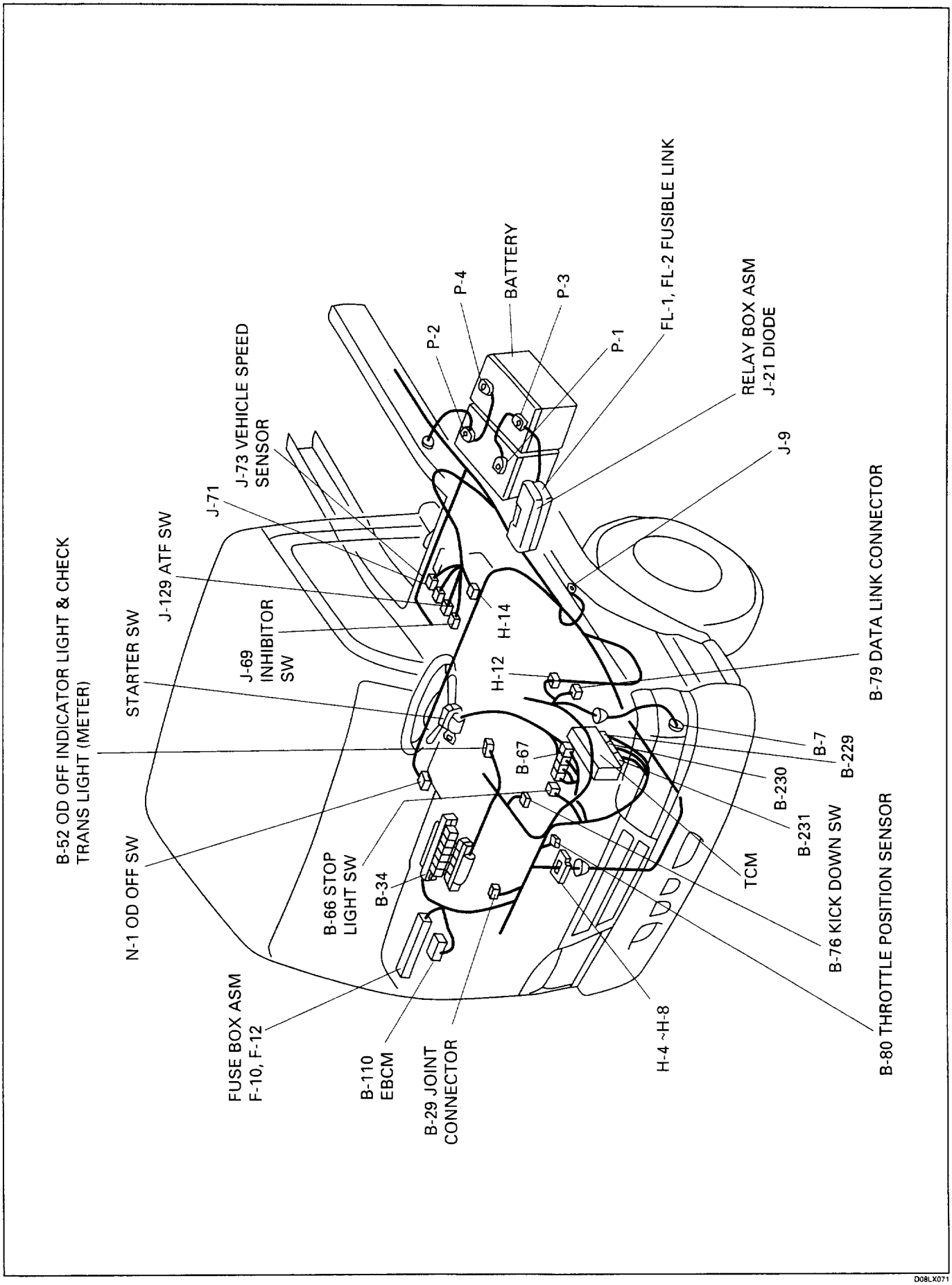
ECU also has TECH-1 diagnosis controlling function.

For details, refer to section 1A1 and 7A2 "AUTOMATIC TRANSMISSION".

ECU OUTPUT AND INPUT DIAGRAM

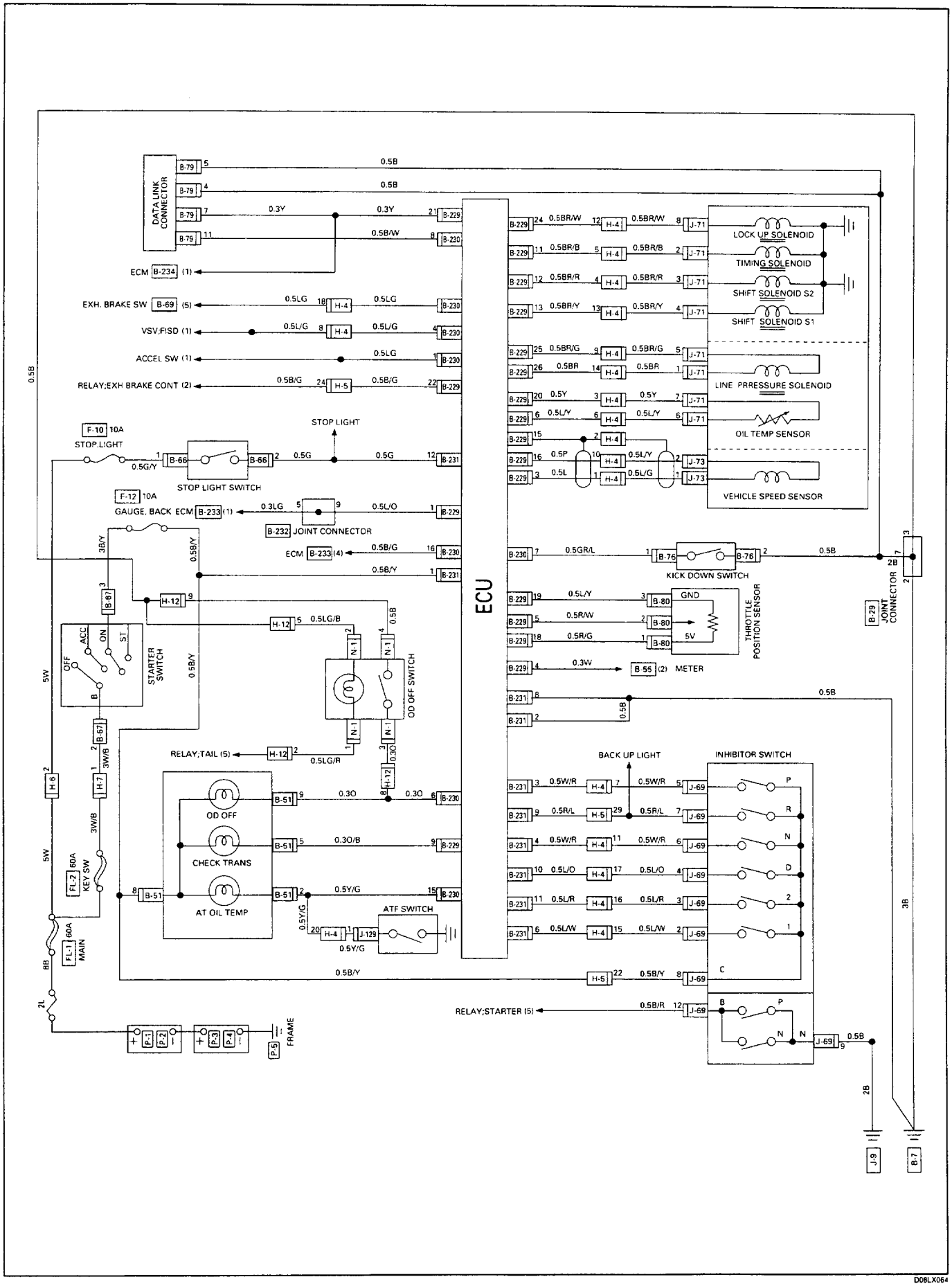


PARTS LOCATION



D08LX071

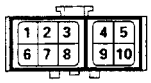
CIRCUIT DIAGRAM



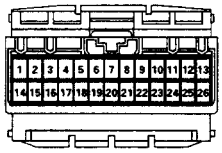
D08LX064

CONNECTOR LIST

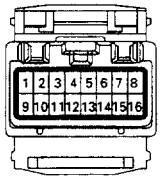
B-29 B-232



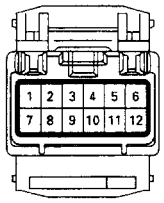
B-229



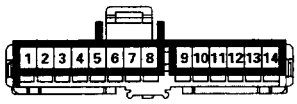
B-230



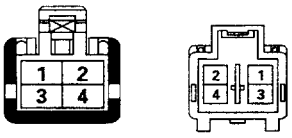
B-231



B-51

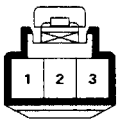


B-67

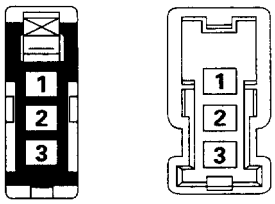


B-76

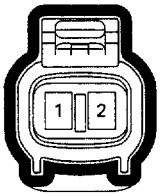
B-79



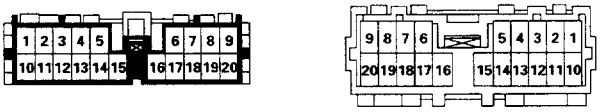
B-80



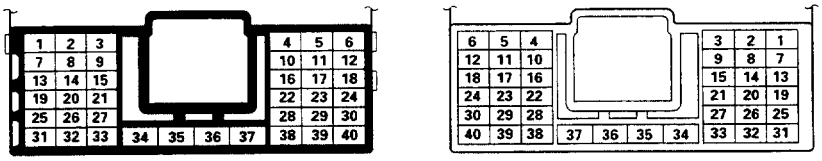
J-73



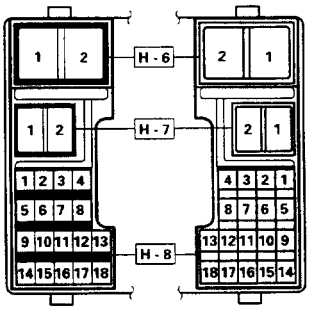
H-4



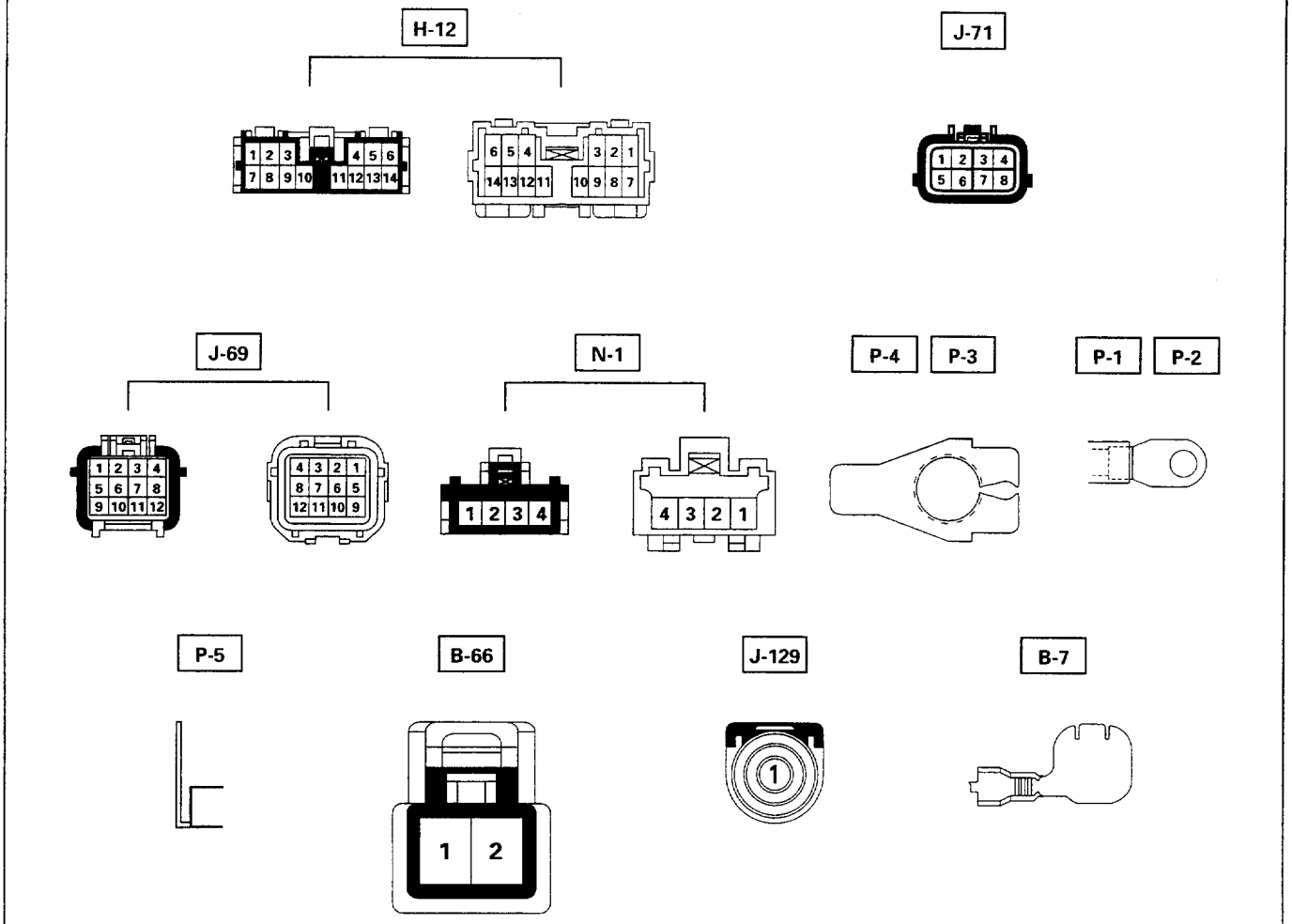
H-5



H-6 H-7 H-8



CONNECTOR LIST



WINDSHIELD WIPER AND WASHER

GENERAL DESCRIPTION

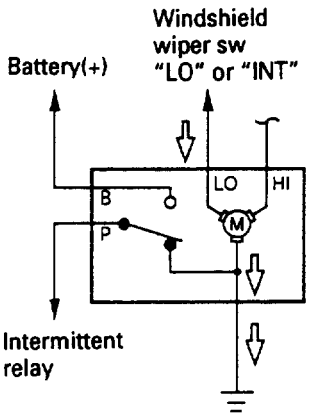
The circuit consists of the starter switch, windshield wiper & washer switch, wiper motor, washer motor and the intermittent relay.

When the wiper & washer switch is turned on with starter switch on, the battery voltage is applied to the wiper motor to activate the wiper.

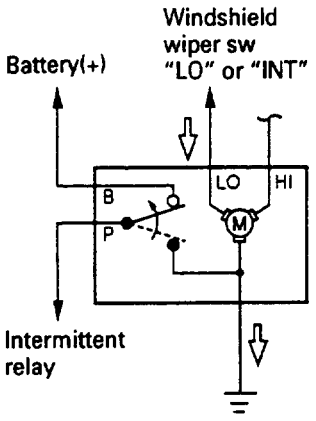
The washer motor squirts glass cleaning fluid while the washer switch is being pushed. The intermittent relay is used to control motion of the wiper.

OPERATION OF WINDSHIELD WIPER MOTOR (When wiper "LO" or "INT" position)

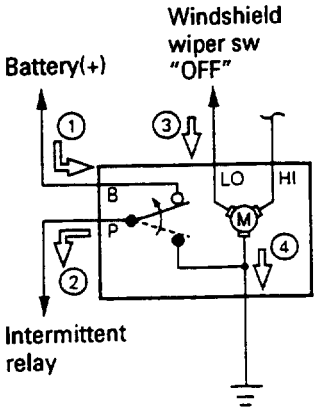
1. Condition of wiper switch is "LO"or "INT"position (Wiper motor is starting to operate)



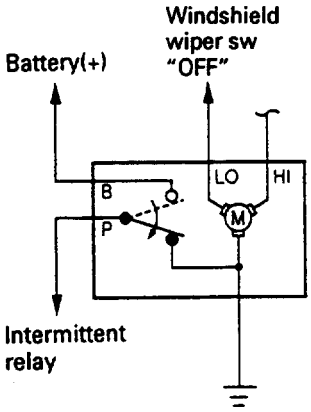
2. Condition of wiper motor is operating



3. Condition of wiper switch is just "OFF" (Wiper motor is still operating until auto-stop position)

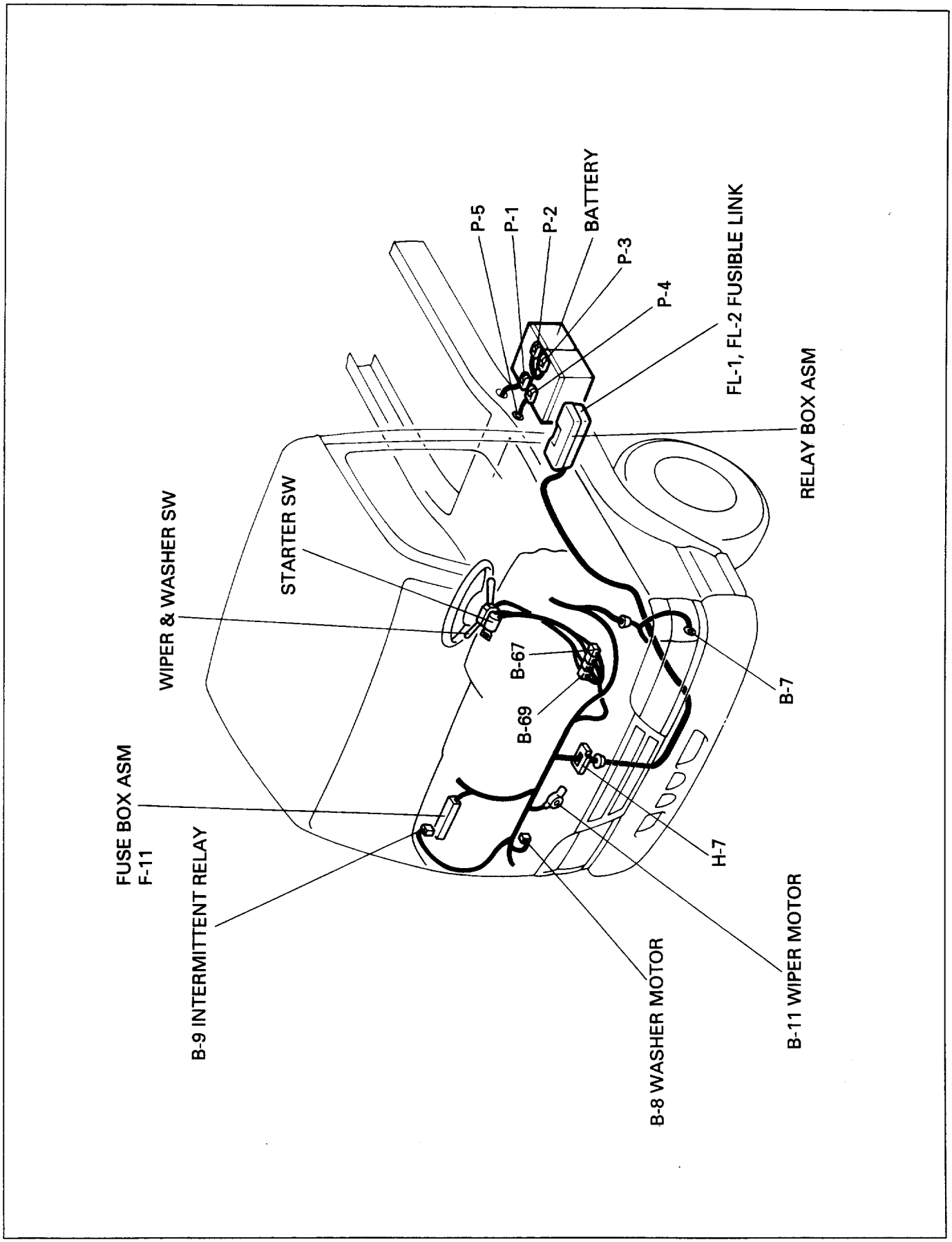


4. Wiper motor stops at auto-stop position

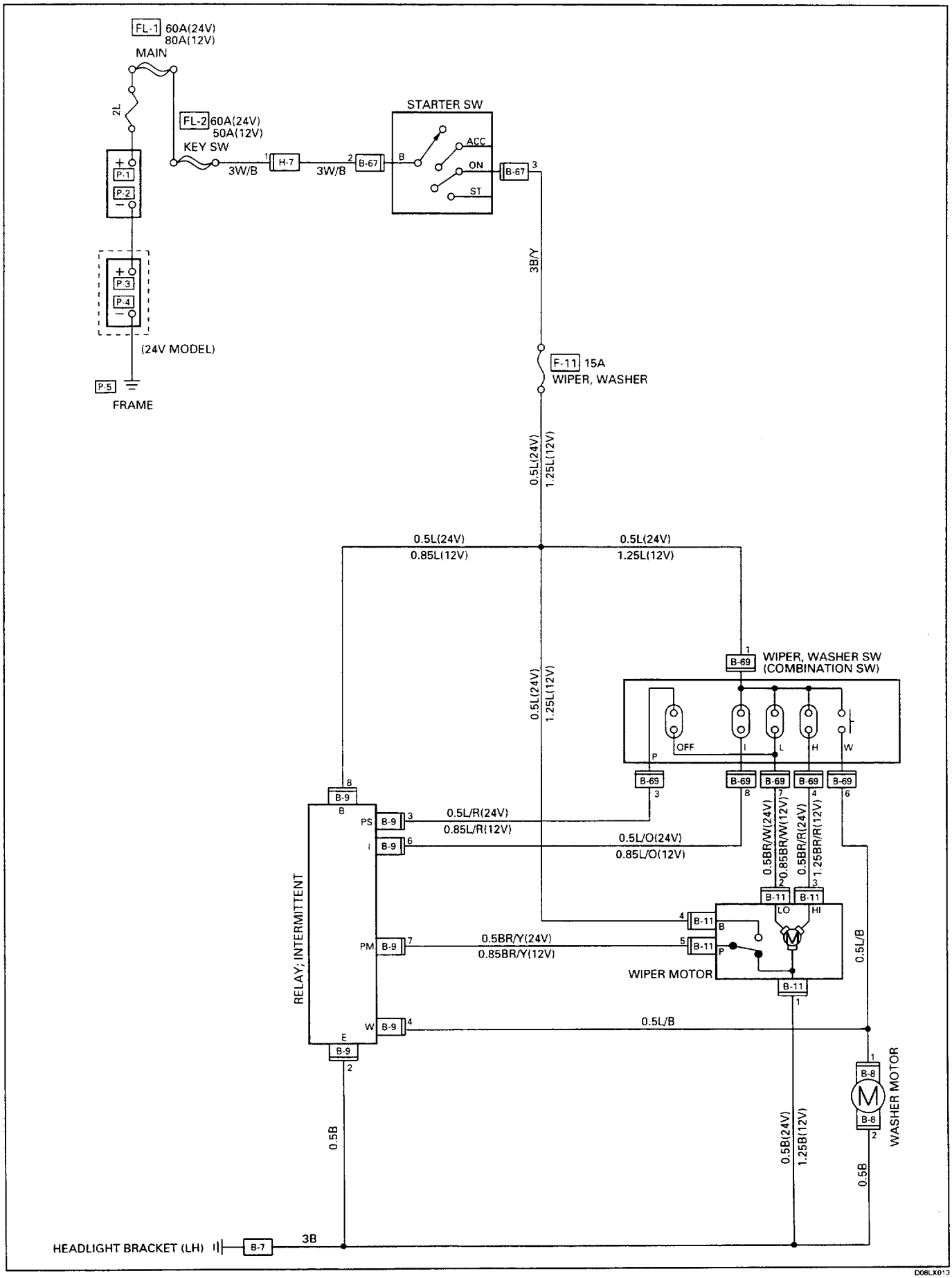


NOTE: Arrow marks "⇨"indicate the direction of current

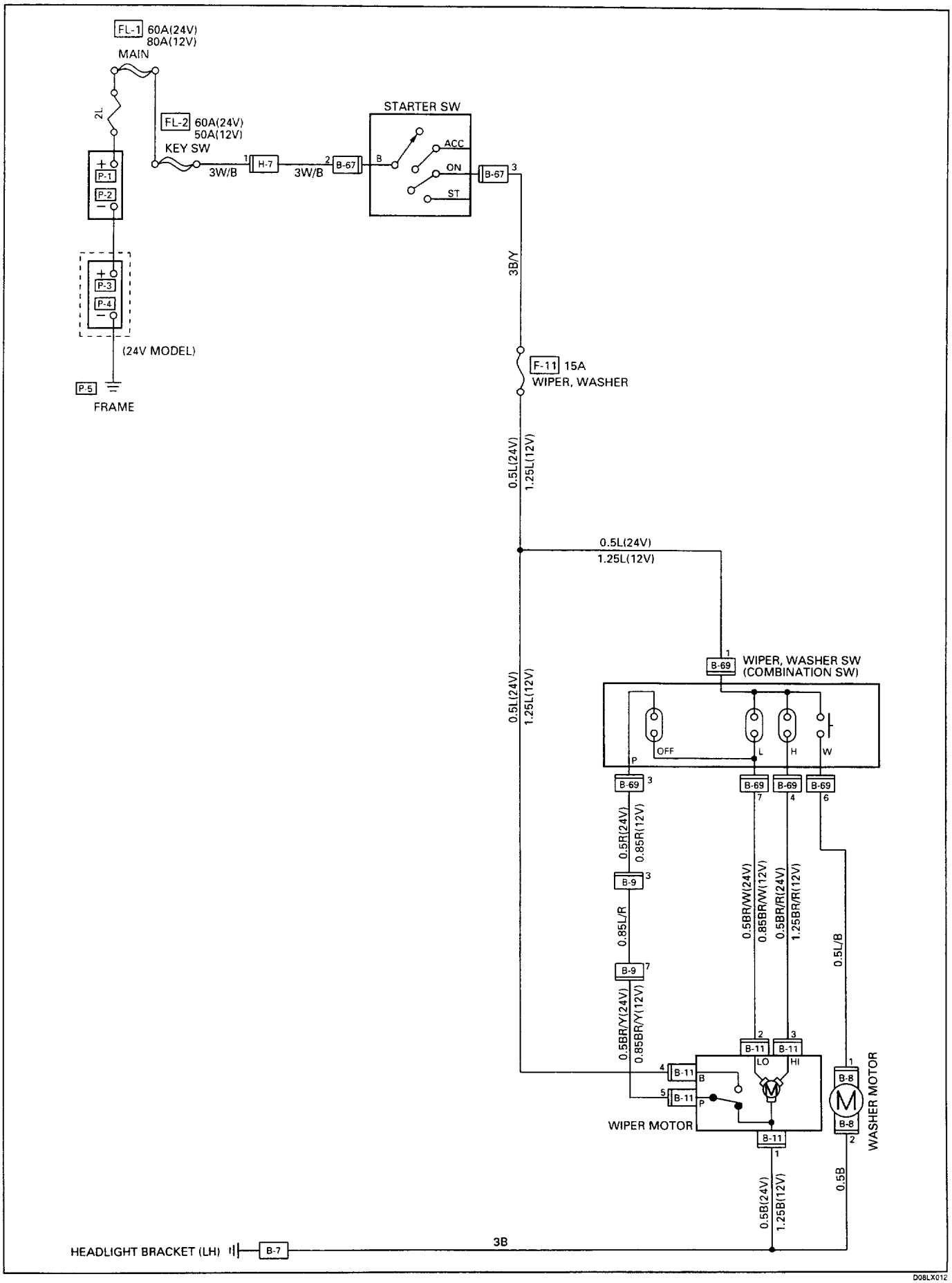
PARTS LOCATION



CIRCUIT DIAGRAM – W/INTERMITTENT

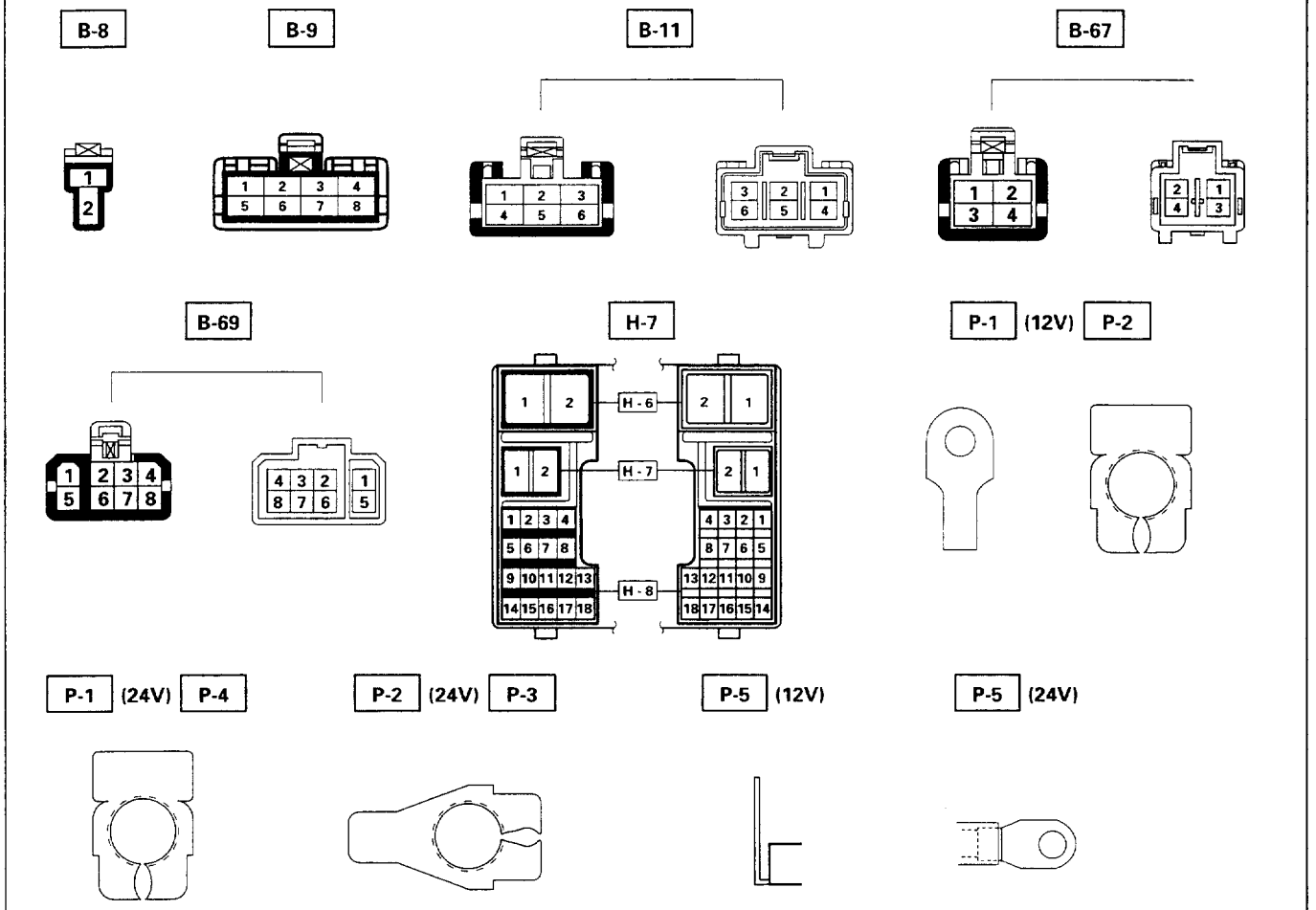


CIRCUIT DIAGRAM – W/O INTERMITTENT



D08LX012

CONNECTOR LIST



DIAGNOSIS

QUICK CHART FOR CHECK POINT

1.WINDSHEILD WIPER AND WASHER

Check point / Trouble mode	Fuse F-11 (15A)	Wiper & washer SW	Inter-mittent relay	Wiper motor	washer moter	cable harness
1. Windshield wiper does not operate at any switch position	○ (1)	○ (3)		○ (4)		○ (2)
2. Windshield wiper does not operate at "INT" position		○ (1)	○ (3)			○ (2)
3. Windshield wiper does not operate at "LO" position		○ (1)		○ (3)		○ (2)
4. Windshield wiper does not operate at "HI" position		○ (1)		○ (2)		○ (3)
5. Auto-stop function of the windshield wiper motor does not operate		○ (1)	○ (4)	○ (2)		○ (3)
6. Rotation of the windshield wiper motor does not stop		○ (1)		○ (2)		
7. Windshield washer motor does not operate		○ (1)			○ (3)	○ (2)

NOTE: Figure in parenthesis "( )" indicates the order of inspection.

1. WINDSHIELD WIPER DOES NOT OPERATE AT ANY SWITCH POSITION

- IS FUSE F-11 (15A) NORMAL?

YES

- DISCONNECT THE CONNECTOR OF THE WINDSHIELD WIPER & WASHER SWITCH
- TURN THE STARTER SWITCH ON
- IS THE BATTERY VOLTAGE APPLIED BETWEEN THE SWITCH HARNESS SIDE CONNECTOR 1 [B-69] AND THE GROUND?

YES

- IS CONTINUITY IN THE WINDSHIELD WIPER & WASHER SWITCH NORMAL?

YES

- IS [B-7] GROUNDED SECURELY?

YES

- DISCONNECT THE CONNECTOR OF THE WINDSHIELD WIPER MOTOR WITH THE MOTOR CONNECTOR 2 [B-11] CONNECTED TO THE BATTERY (+) TERMINAL, AND THE CONNECTOR 1 [B-11] TO THE (–) TERMINAL, DOES THE MOTOR ROTATE AT A LOW SPEED?
- AND WITH THE CONNECTOR 3 [B-11] CONNECTED TO THE (+) TERMINAL, DOES THE MOTOR ROTATE AT A HIGH SPEED?

YES

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN 1 [B-11] AND [B-7]

NO

REPAIR OR REPLACE THE WINDSHIELD WIPER MOTOR

NO

GROUND IT SECURELY

NO

REPAIR OR REPLACE THE SWITCH

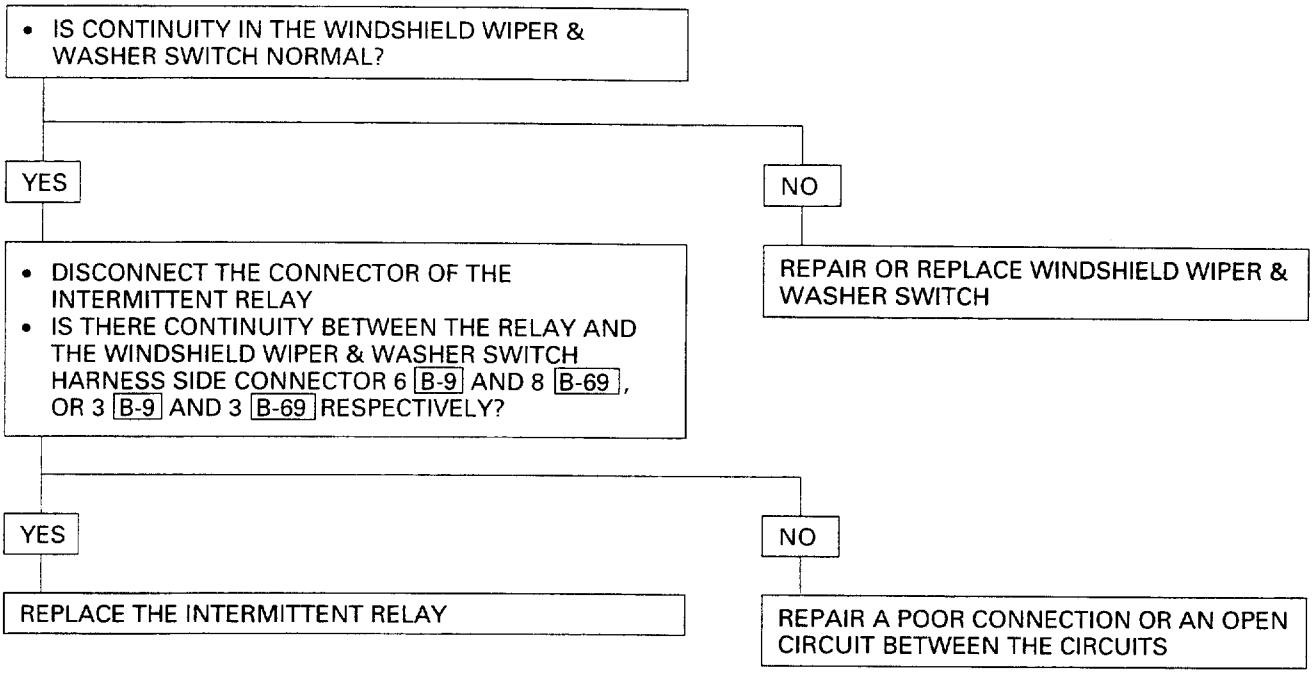
NO

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN THE FUSE F-11 (15A) AND 1 [B-69]

NO

REPLACE THE FUSE

2. WINDSHIELD WIPER DOES NOT OPERATE AT "INT" POSITION



3. WINDSHIELD WIPER DOES NOT OPERATE AT "LO" POSITION

- IS CONTINUITY IN THE WINDSHIELD WIPER & WASHER SWITCH NORMAL?

YES

- DISCONNECT THE WINDSHIELD WIPER MOTOR CONNECTOR
- CONNECT THE BATTERY (+) TERMINAL TO THE WINDSHIELD WIPER MOTOR CONNECTOR 2 [B-11] AND THE (–) TERMINAL TO 1 [B-11]
- DOES THE MOTOR ROTATE AT A LOW SPEED?

YES

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN THE CONNECTORS 7 [B-69] AND 2 [B-11]

NO

REPAIR OR REPLACE THE WINDSHIELD WIPER MOTOR

NO

REPAIR OR REPLACE THE WINDSHIELD WIPER & WASHER SWITCH

4. WINDSHIELD WIPER DOES NOT OPERATE AT "HI" POSITION

- IS CONTINUITY IN THE WINDSHIELD WIPER AND WASHER SWITCH NORMAL?

YES

- DISCONNECT THE WINDSHIELD WIPER MOTOR CONNECTOR
- CONNECT THE BATTERY (+) TERMINAL TO THE WINDSHIELD WIPER MOTOR CONNECTOR 3 [B-11] AND THE (–) TERMINAL TO 1 [B-11]
- DOES THE MOTOR ROTATE AT A HIGH SPEED?

YES

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN 4 [B-69] AND 3 [B-11]

NO

REPAIR OR REPLACE THE WINDSHIELD WIPER MOTOR

NO

REPAIR OR REPLACE THE WINDSHIELD WIPER & WASHER SWITCH

5. AUTO-STOP FUNCTION OF THE WINDSHIELD WIPER MOTOR DOES NOT OPERATE

- IS CONTINUITY IN THE WINDSHIELD WIPER AND WASHER SWITCH NORMAL?

YES

- DISCONNECT THE CONNECTOR OF THE WINDSHIELD WIPER MOTOR
- CONNECT THE MOTOR CONNECTOR 2 [B-11] TO THE BATTERY (+) TERMINAL, AND 1 [B-11] TO THE BATTERY (–) TERMINAL, AND THEN CHANGE THE CONNECTION OF THE BATTERY (+) TERMINAL TO THE CONNECTOR 4 [B-11] WHILE ROTATING THE MOTOR AT A LOW SPEED
- WHEN CONNECTING THE CONNECTOR TERMINALS 2 [B-11] AND 5 [B-11] IN THIS CONDITION, DOES THE MOTOR STOP AT AUTO STOP POSITION?

YES

- TURN THE STARTER SWITCH ON
- IS THERE BATTERY VOLTAGE APPLIED BETWEEN THE WINDSHIELD WIPER MOTOR HARNESS SIDE CONNECTOR TERMINAL 4 [B-11] AND GROUND?

YES

- DISCONNECT THE CONNECTOR OF THE WINDSHIELD INTERMITTENT RELAY
- IS THERE CONTINUITY BETWEEN THE RELAY HARNESS SIDE CONNECTOR 7 [B-9] AND THE WINDSHIELD WIPER MOTOR HARNESS SIDE CONNECTOR 5 [B-11] ?

YES

REPLACE THE WINDSHIELD INTERMITTENT RELAY

NO

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN THE CIRCUITS

NO

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN THE FUSE F-11 (15A) AND 4 [B-11]

NO

REPAIR OR REPLACE THE WINDSHIELD WIPER MOTOR

NO

REPAIR OR REPLACE THE WINDSHIELD WIPER & WASHER SWITCH

6. ROTATION OF THE WINDSHIELD WIPER MOTOR DOES NOT STOP

- IS CONTINUITY IN THE WINDSHIELD WIPER & WASHER SWITCH NORMAL?

NO → REPAIR OR REPLACE THE WINDSHIELD WIPER & WASHER SWITCH

YES

- THE MOMENT THE WINDSHIELD WIPER COMES TO AUTO-STOP POSITION, TURN THE STARTER SWITCH OFF.
  (ALTERNATIVELY, CONNECT THE BATTERY (+) TERMINAL TO THE WINDSHIELD WIPER MOTOR CONNECTORS 2 [B-11] AND THE (–) TERMINAL TO 1 [B-11], AND THEN MOVE THE WINDSHIELD WIPER MOTOR TO AUTO-STOP POSITION AND STOP IT

YES

CONFIRM CONTINUITY BETWEEN THE WINDSHIELD WIPER MOTOR SIDE CONNECTOR TERMINALS 4 [B-11] AND 5 [B-11], AND REPAIR OR REPLACE THE MOTOR

7. WINDSHIELD WASHER MOTOR DOES NOT OPERATE

- IS CONTINUITY IN THE WINDSHIELD WIPER & WASHER SWITCH NORMAL?

YES

- TURN THE STARTER SWITCH ON
- IS THE BATTERY VOLTAGE APPLIED BETWEEN THE WINDSHIELD WIPER & WASHER SWITCH HARNESS SIDE CONNECTOR TERMINAL 1 [B-69] AND THE GROUND?

YES

- DISCONNECT THE CONNECTOR OF THE WINDSHIELD WASHER MOTOR
- TURN THE STARTER SWITCH ON
- WITH THE WASHER BUTTON OF THE WINDSHIELD WIPER & WASHER SWITCH DEPRESSED, IS THE BATTERY VOLTAGE APPLIED BETWEEN THE WASHER MOTOR HARNESS SIDE CONNECTOR TERMINAL 1 [B-8] AND THE GROUND?

YES

- IS [B-7] GROUNDED SECURELY?

YES

- CONNECT THE MOTOR SIDE CONNECTOR 1 [B-8] OF THE WINDSHIELD WASHER MOTOR TO THE BATTERY (+) TERMINAL, AND THE CONNECTOR 2 [B-8] TO THE (–) TERMINAL
- DOES THE MOTOR ROTATE?

YES

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN 2 [B-8] AND [B-7]

NO

REPAIR OR REPLACE THE WINDSHIELD WASHER MOTOR

NO

GROUND IT SECURELY

NO

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN 1 [B-8] AND 6 [B-69]

NO

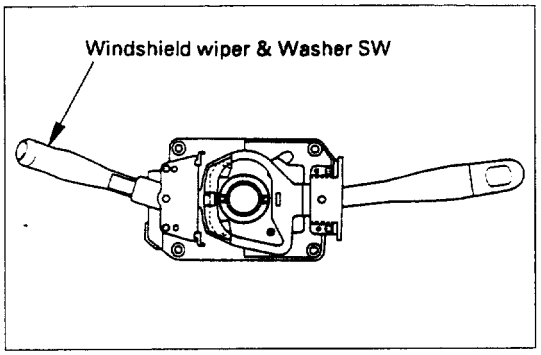
REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN FUSE F-11 (15A) AND 1 [B-69]

NO

REPAIR OR REPLACE THE WINDSHIELD WIPER & WASHER SWITCH

STARTER SWITCH

Refer to "START AND CHARGING" in this section.



WINDSHIELD WIPER & WASHER SWITCH

With the starter switch on, the windshield wiper and washer switch controls the start and stop operation as well as the change of operating speeds.

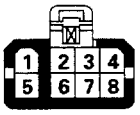
Both the windshield washer motor and the wiper motor jointly operate while the washer button is pushed.

INSPECTION

Check the continuity between the connector terminals of the switch.

Repair or replace the switch when the result of inspection is found abnormal.

B-69

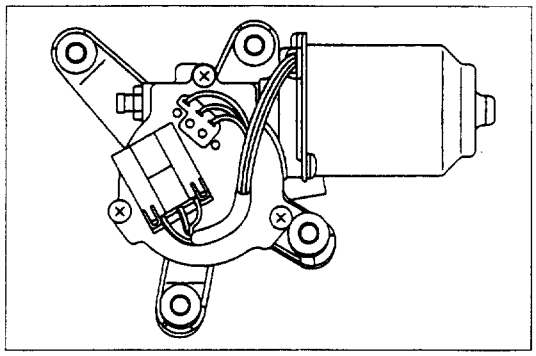


Switch side

Washer SW	Wiper SW	Terminal No.					
		3	7	1	4	8	6
OFF	OFF	○	○				
	INT	○	○	○		○	
	LO		○	○			
	HI			○	○		
ON	MIST,OFF INT,LO,HI			○			○

REMOVAL AND INSPECTION

Refer to "HEADLIGHT, FOG LIGHT AND CORNERING LIGHT" in this section.



WINDSHIELD WIPER MOTOR

INSPECTION

1. **Operation in low speed**

   With the motor connector terminal 2 [B-11] connected to the battery (+) terminal and the connector 1 [B-11] to the (–) terminal, check to see if the motor rotates in low speed.

2. **Operation in high speed**

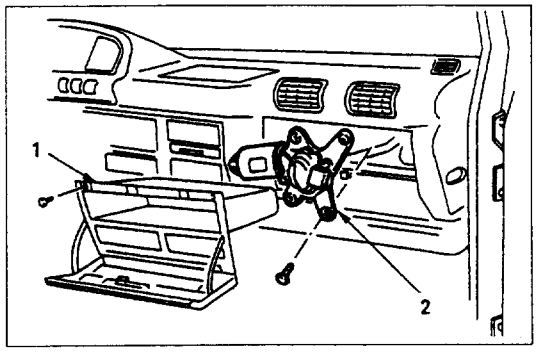
   With the motor connector terminal 3 [B-11] connected to the battery (+) terminal and the connector 1 [B-11] to the (–) terminal, check to see if the motor rotates in low speed.

3. **Stop operation**

   After stopping the windshield wiper in the position on the way by confirming the operation at the low speed in item No. 1.

   When the connectors 2 [B-11] and 5 [B-11] are connected, while connecting the motor connector terminal 4 [B-11] to the battery (+) terminal, check to see, if the motor rotates at low speed and stops at the auto-stop position.

   Repair or replace the motor when the results of the above inspections are found abnormal.



REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Glove Box**

   Refer to "GLOVE BOX" of section 10 "BODY".

2. **Windshield Wiper Motor**

   1) Disconnect the connector.
   2) Remove four screws.
   3) Remove the ball joint between crank arm and wiper link.

INSTALLATION

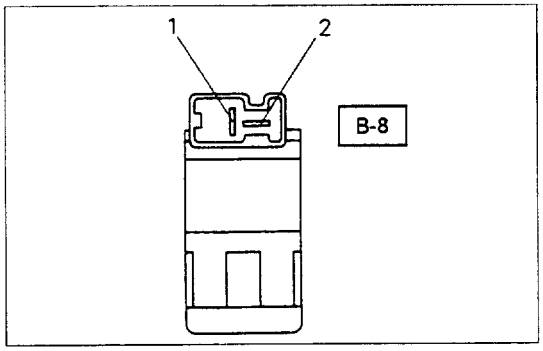
To install, follow the removal steps in the reverse order, noting the following points.

- Windshield Wiper Motor

  When the crank arm is removed from the windshield wiper motor, tighten the motor shaft nut with the specified torque.

Shaft nut torque	N·m (kg·cm/lb·in)
17 (170/147)	

- Temporarily fit the motor by using one of the four wiper motor fixing screws.
- Put the crank arm ball joint in the wiper link hole and fix them together while pulling the wiper link.

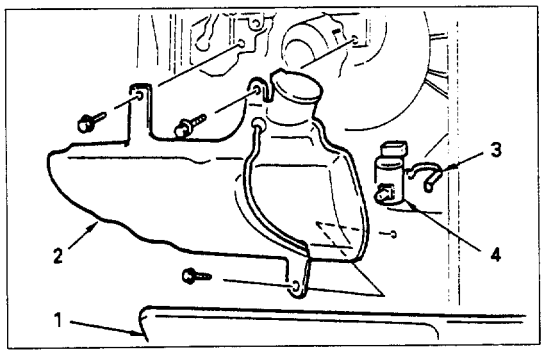


WINDSHIELD WASHER MOTOR

INSPECTION

With the battery (+) terminal connected to the washer motor connector terminal 1 B-8 and the (–) terminal to the connector 2 B-8 , check to see if the cleaning fluid pushes out.

Replace the tank/motor when the result of inspection is found abnormal.



REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Instrument Panel Under Cover**

   Refer to "INSTRUMENT PANEL" of section 10 "CAB".
2. **Washer Tank**
   1) Disconnect the washer motor connector.
   2) Disconnect the washer hose.
   3) Remove three fixing screws.
3. **Clip Band**
4. **Windshield Washer Motor**

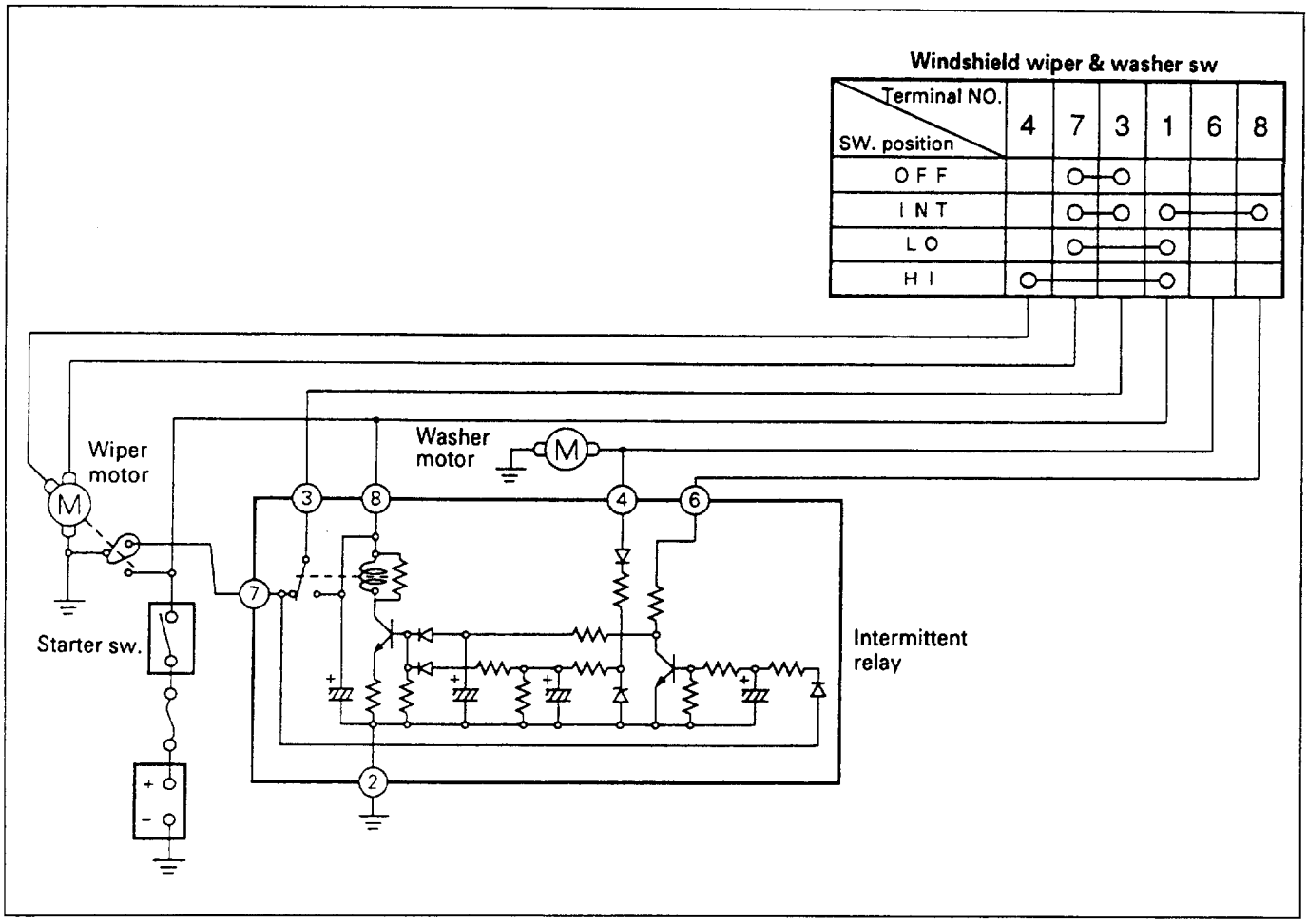
   Hold the motor and pull it out from the washer tank.

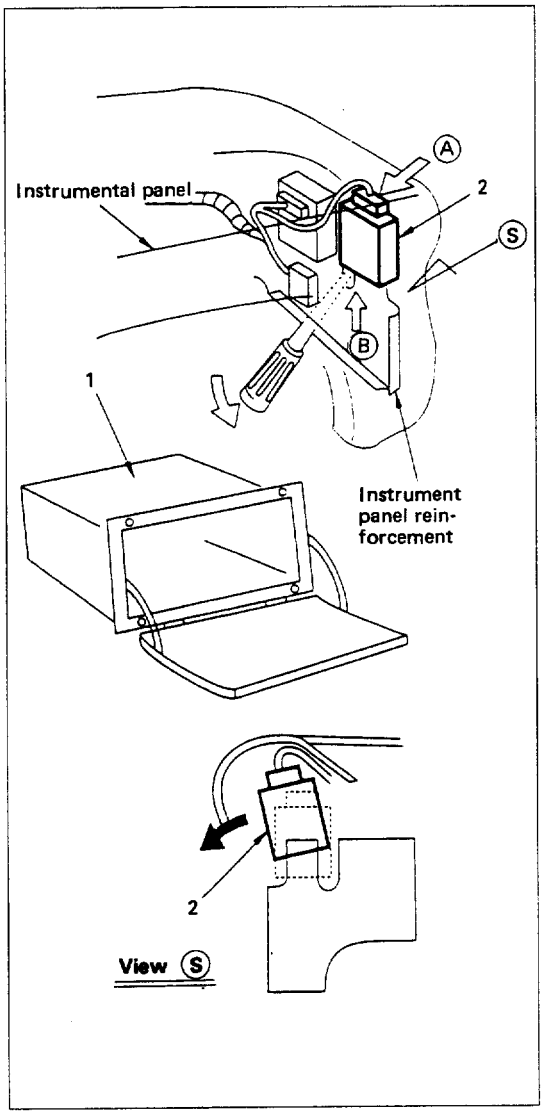
INSTALLATION

To install, follow the removal steps in the reverse order.

INTERMITTENT RELAY

CIRCUIT DIAGRAM





REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Glove Box**

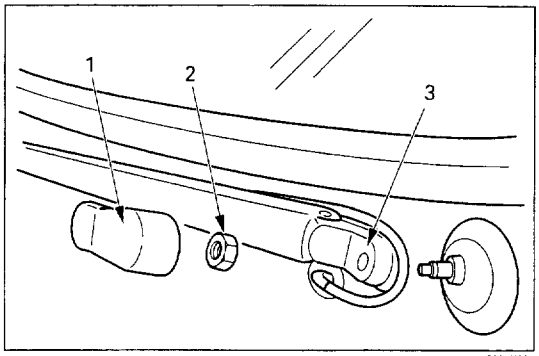
   Open the lid and remove the four screws.

2. **Intermittent Relay**

   1) Press Ⓐ position with your finger and pry up Ⓑ position with the tip of a screw-driver.
   2) When the relay moves up by about 2/3 of its size, tilt and take off the relay to avoid interference with the instrument panel.
   3) Disconnect the connector.

INSTALLATION

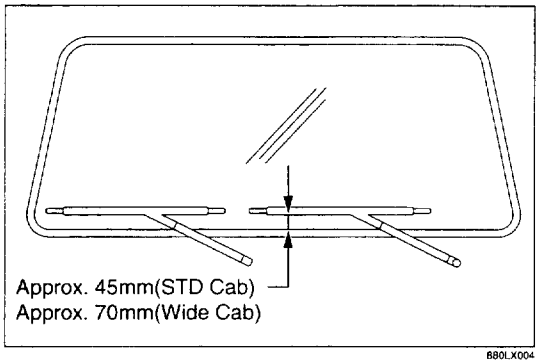
To install, follow the removal steps in the reverse order.



WINDSHIELD WIPER ARM/BLADE

REMOVAL

1. **Cover**
2. **Wiper Arm Nut**
3. **Wiper Arm/Blade**



INSTALLATION

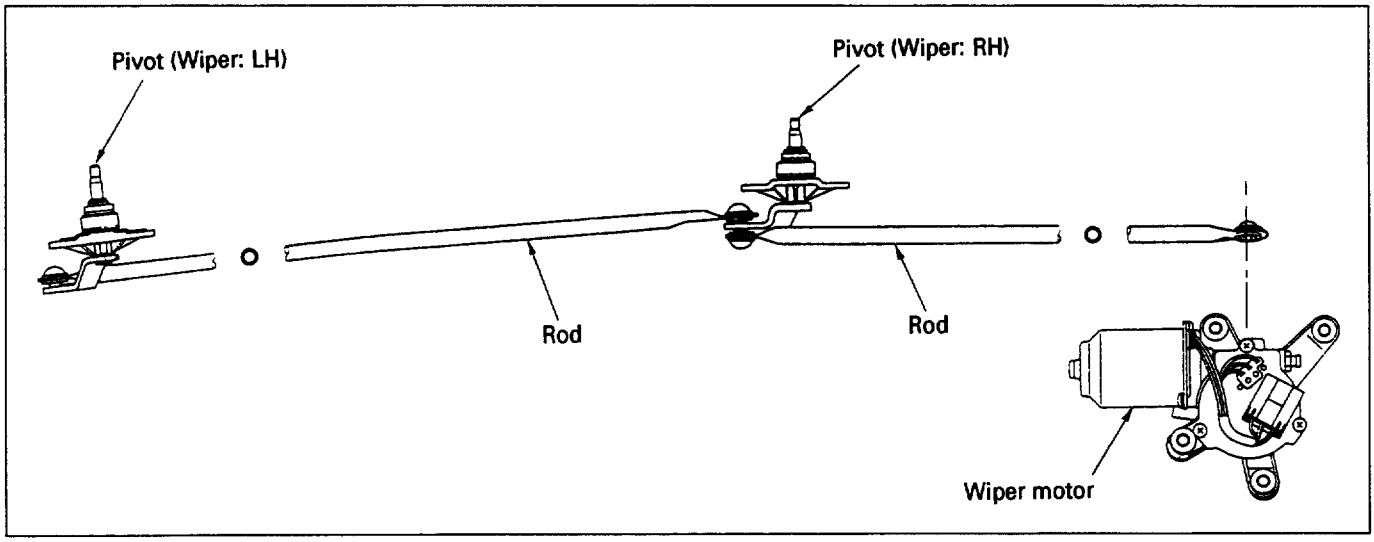
To install, follow the removal steps in the reverse order, noting the following points.

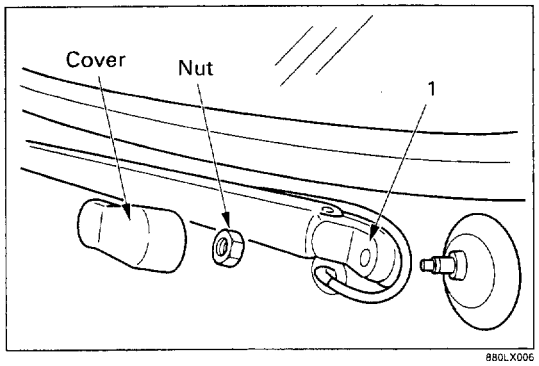
1) Before installing the wiper arm/blade to the shaft, confirm that the motor stops at the auto-stop position.
2) Set the wiper arm/blade so that the tips of both blades are positioned as shown in the illustration.
3) Tighten the wiper arm nut to the specified torque.

Wiper arm nut torque	N·m (kg·cm/lb·in)
	17 (170/147)

WINDSHIELD WIPER LINKAGE

LOCATION OF ROD AND PIVOT



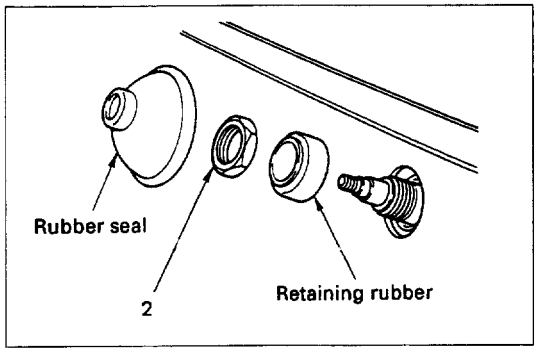


REMOVAL

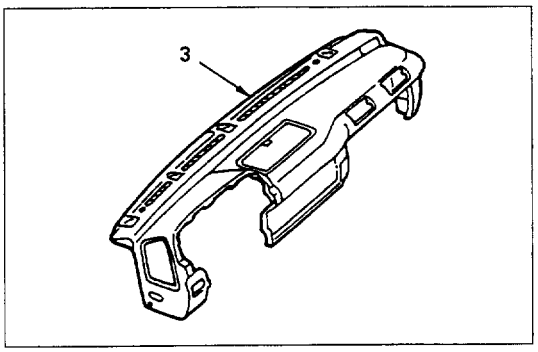
Preparation:

Disconnect the battery ground cable.

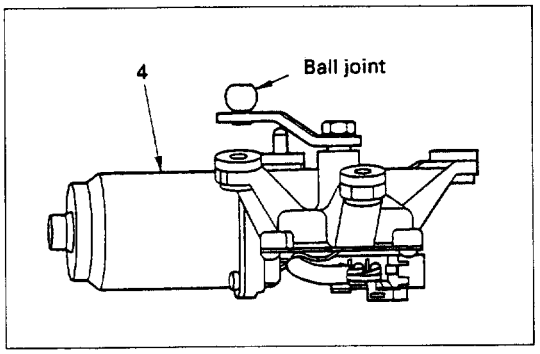
1. **Wiper Arm & Blade**
   Remove the cover, nut and wiper arm & blade.



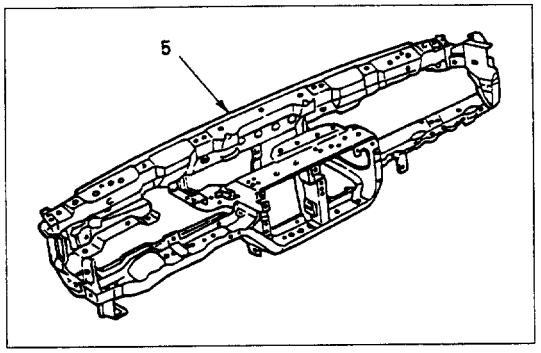
2. **Pivot Nut**
   Remove the rubber seal, nut and retaining rubber.



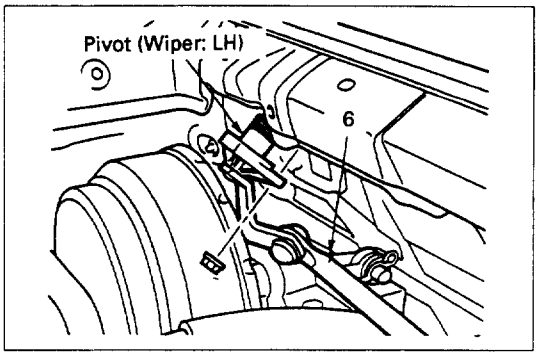
3. **Instrument Panel Assembly**
   Refer to "INSTRUMENT PANEL" of section 10 "CAB".



4. **Wiper Motor**
   1) Remove four screws.
   2) Disconnect the ball joint between the crank arm and the wiper link.

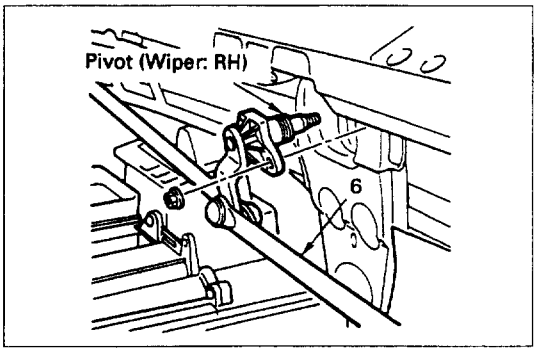


5. **Instrument Panel Reinforcement**
   Refer to "INSTRUMENT PANEL" of section 10 "CAB".



6. **Wiper Link Assembly**

Remove two retaining nut from right hand side of pivot.



Remove two retaining nut from left hand side of pivot.

INSTALLATION

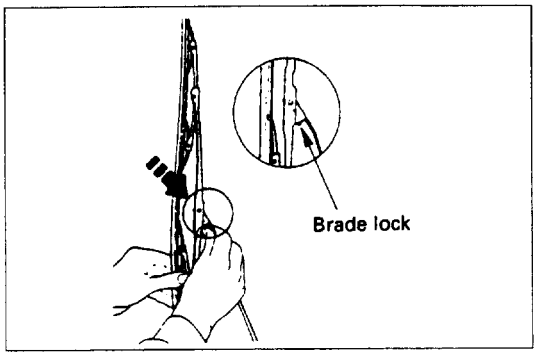
To install, follow the removal steps in the reverse order, noting the following points.

- Temporarily fit the wiper motor by using one of the four wiper motor fixing screw.
- Put the crank arm ball joint in the wiper link hole and fix them together while pulling the wiper link.
- Fit the motor with four screws.
- Tighten the pivot nut with the specified torque.

Pivot nut torque	N·m (kg·cm/lb·in)
8 (80/70)	

- Tighten the wiper arm nut with the specified torque

Wiper arm nut torque	N·m (kg·cm/lb·in)
17 (170/147)	



WIPER BLADE RUBBER

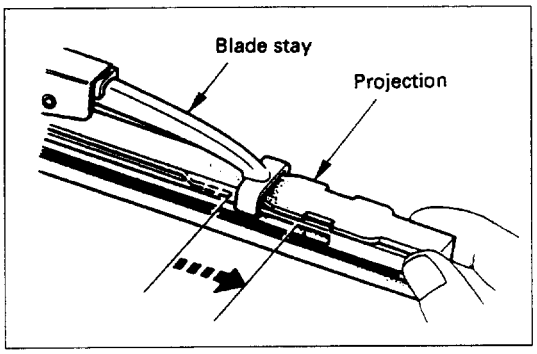
REMOVAL

1. **Wiper Blade**

   Push the wiper blade lock while pulling the wiper blade in the arrow direction.

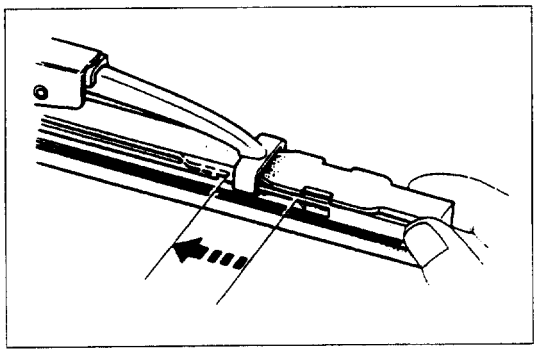
   NOTE:

   When the wiper blade has been removed, wrap the tip of the wiper arm with cloth, to avoid damaging the glass.



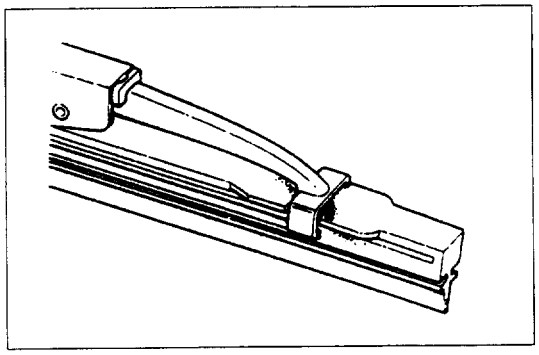
2. **Wiper Blade Rubber**
   1) Pull the end of rubber and remove the projection from the click of the blade stay.
   2) Pull the rubber out in the same direction.

INSTALLATION



2. **Wiper Blade Rubber**

   Install the click of the blade stay in the groove of the new rubber and slide it in. Complete installation by pushing the click.



Finally, check that the click of the stay has caught in the hole of the rubber.

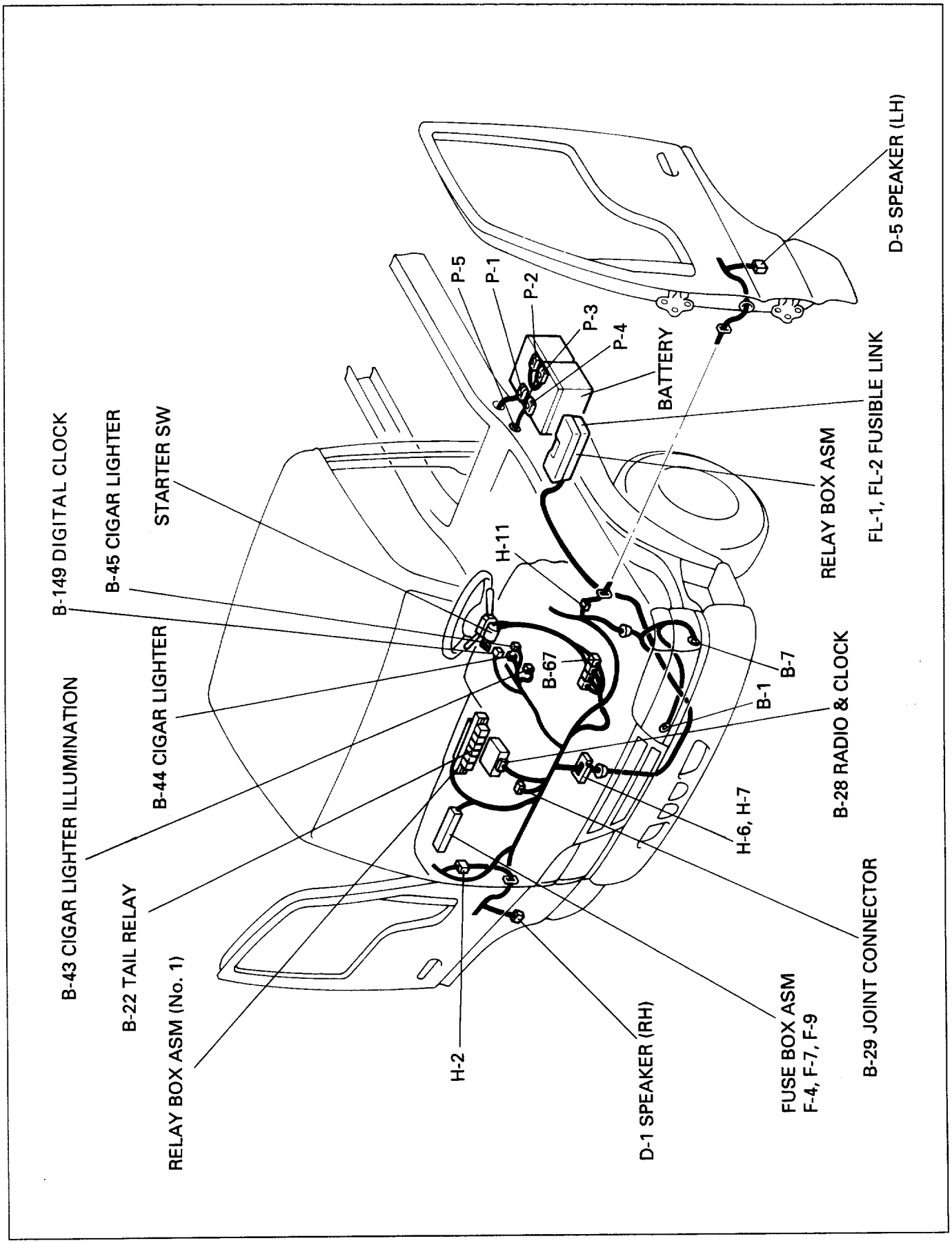
1. **Wiper Blade**

AUDIO AND CIGAR LIGHTER

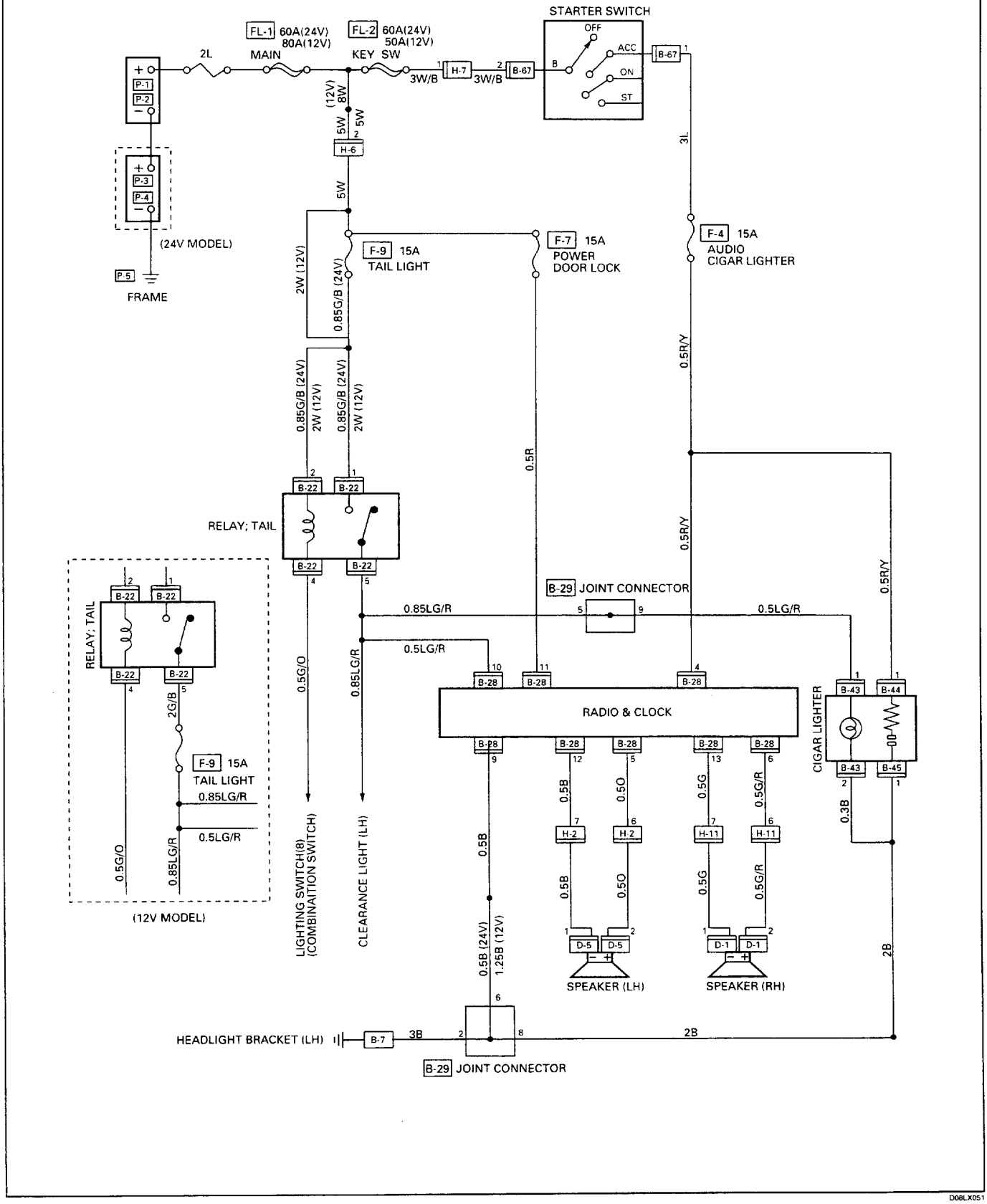
GENERAL DESCRIPTION

The circuit consists of the starter switch, radio, cigar lighter and the relay.
The audio circuit is designed for the current to flow through the receiver circuit when the radio switch is turned on with the starter switch in "ACC" or "ON". Current runs through the memory circuit of the audio regardless of the position of the starter switch.
When the cigar lighter is pushed in with the starter switch at either "ACC" or "ON" position, a circuit is formed in the cigar lighter case to heat the lighter coil. The cigar lighter is spring back to its original position after the lighter coil is heated.

PARTS LOCATION

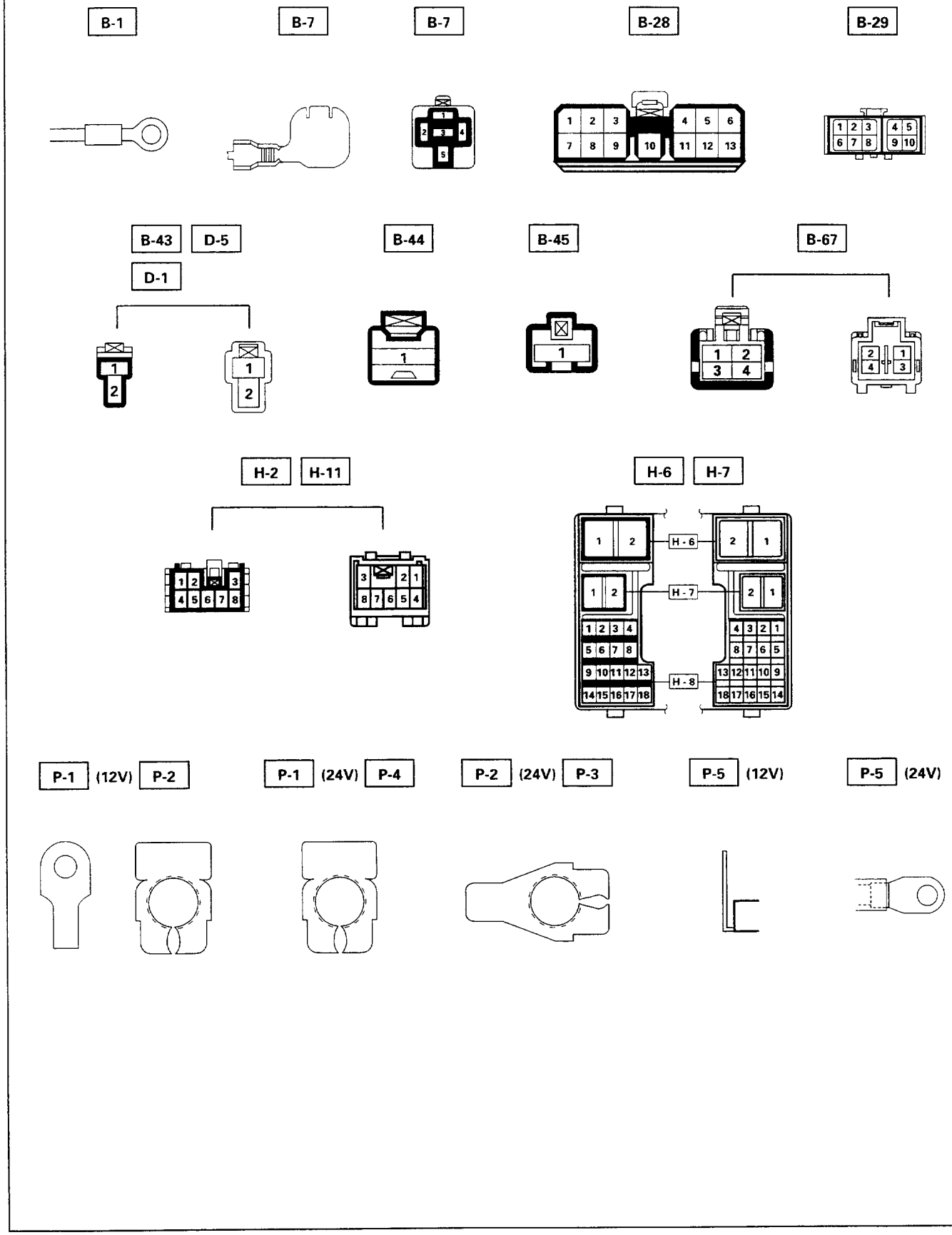


CIRCUIT DIAGRAM



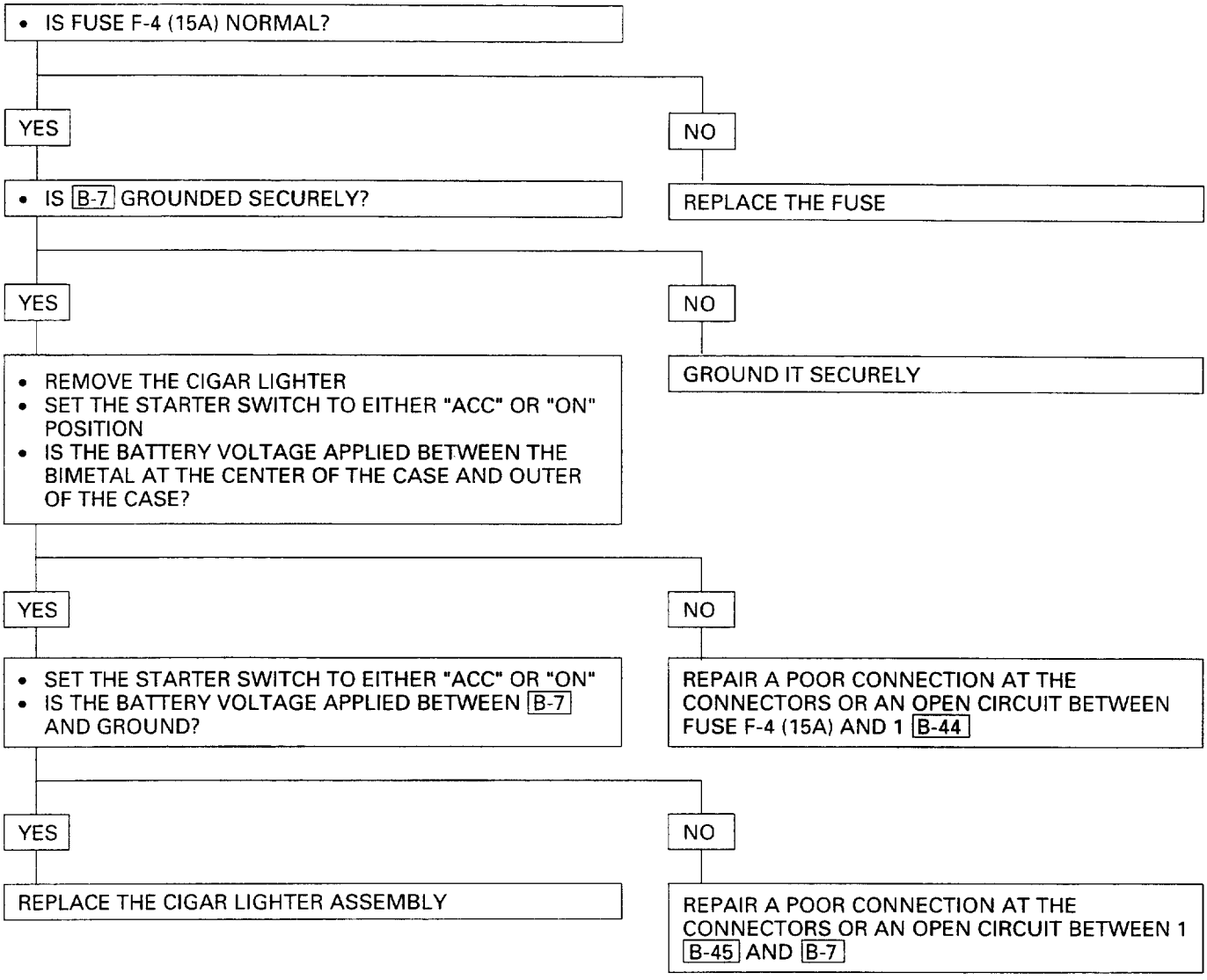
D08LX051

CONNECTOR LIST

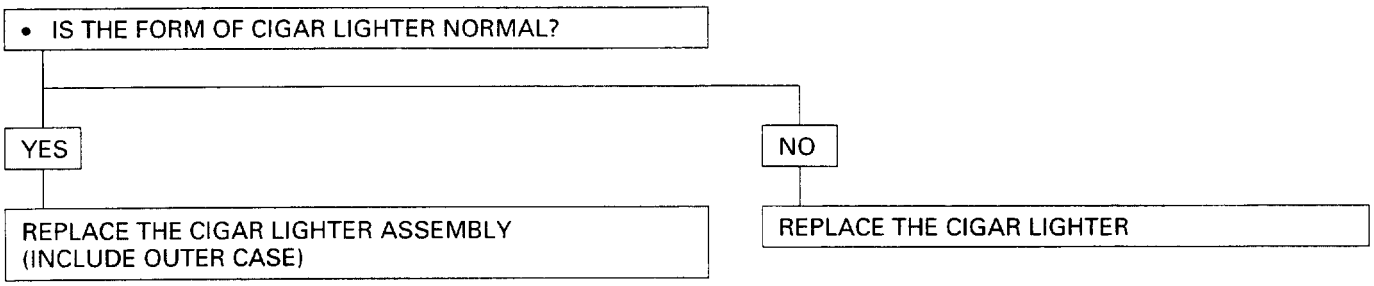


DIAGNOSIS

1. CIGAR LIGHTER DOES NOT HEAT SUFFICIENTLY



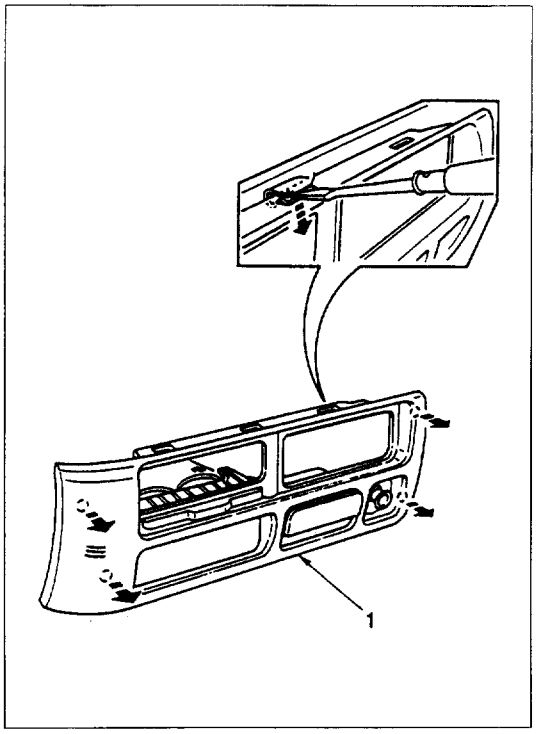
2. THE CIGAR LIGHTER DOES NOT SPRING OUT AFTER BEING HEATED



STARTER SWITCH

Refer to "START AND CHARGING" in this section.

RADIO



REMOVAL

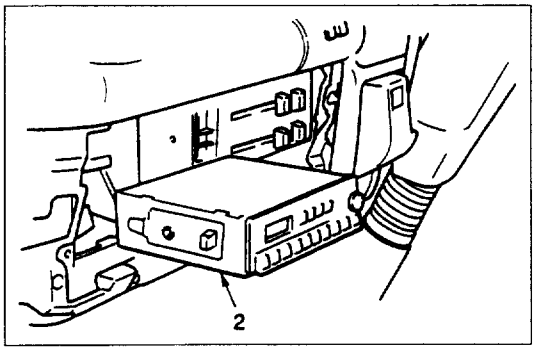
Preparation:

Disconnect the battery ground cable.

1. **Center Cluster**
   1) Pull it to remove. Pry off three clips by the tip of screwdriver.
   2) Remove the cigar lighter power source and its illumination connector.

Note:

To remove the center cluster, do not force to pry off three clips at upper portion of the center cluster.

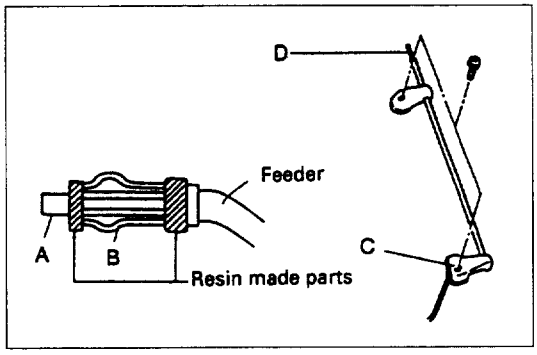


2. **Radio**
   1) Remove two radio fixing screws.
   2) Disconnect the connector and feeder plug.

INSTALLATION

To install, follow the removal steps in the reverse order.

ANTENNA



INSPECTION

The metal A is connected to the pole D at the top of the antenna through the core of the feeder.

The metal B is fitted in the feeder shielding the core, and grounded at the screw C to avoid the core hampered by noise.

Defective grounding would cause noise.

In checking, measure the following three points with the circuit tester in the range of "resistence x 1 (Ω)"

Between A and B

No continuity (No reading at the indicator) → Normal

Continuity (A bite in the feeder. The core grounded) → Lower reception

Between B and C

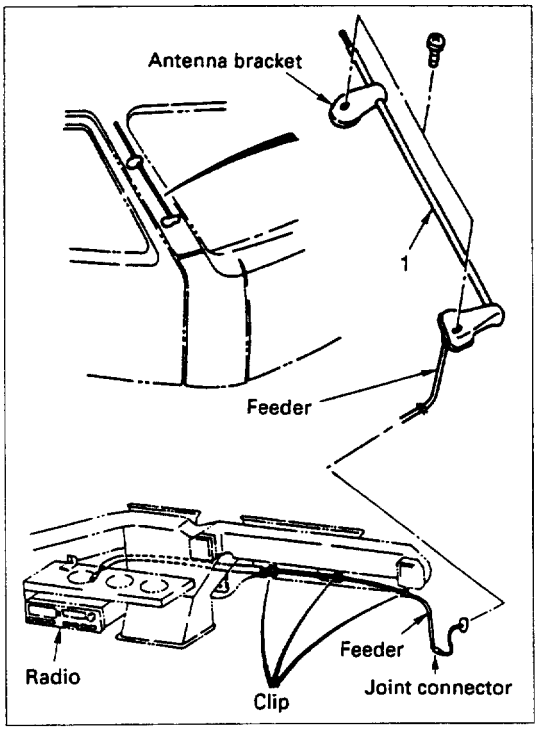
Continuity (Indicator reading: 0Ω) → Normal.

No continuity (Shielded core disconnected or defective grounding at the screw → Hampered by noise)

Between A and D

Continuity or no continuity

There are some antenna feeders and relay feeders with a condenser built in their connections. Measuring resistance between the two points does not result in correct judgment. Connect temporarily another normal antenna to the radio and check to see if its reception is audible. Most antenna now available are slide type. Rust at the screw C and the cab panel where grounded would lead no continuity, followed by lower reception. Keep this portion clean to avoid rust.



REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Antenna**
   1) Disconnect the joint connector.
   2) Remove the upper and lower side antenna bracket.
   3) Pull out the antenna feeder.

NOTE:

For easier fitting, tie the lead wire to the end of the antenna feeder in advance.

INSTALLATION

To install, follow the removal steps in the reverse order.

SPEAKER

INSPECTION

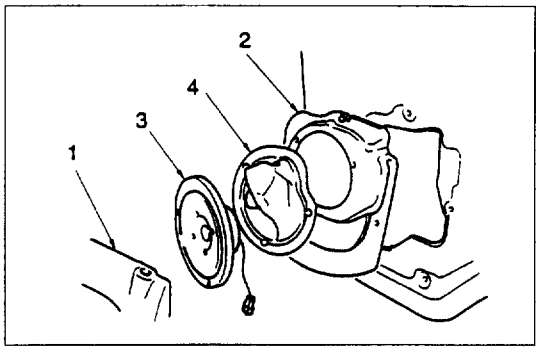
1. With the circuit tester set to the range of x 1 (Ω), connect the circuit tester probes (red and black) to the (+) and (–) terminals of the speaker.
2. When the speaker is normal, a low buzzing sound is heard.
3. When the speaker is defective, no sound is heard.

   However, the distortion or chattering of the sound cannot be identified.

   When the speaker is installed to the vehicle, disconnect the connectors before checking.

   When no sound is heard, the following are considered as the cause.

- The speaker wiring is disconnected at the speaker terminals.
- The speaker body is defective.
- There is an open circuit somewhere in the speaker harness on the vehicle side.
- The speaker harness on the vehicle side is grounded or caught up.



REMOVAL

Preparation:

Disconnect the battery ground cable.

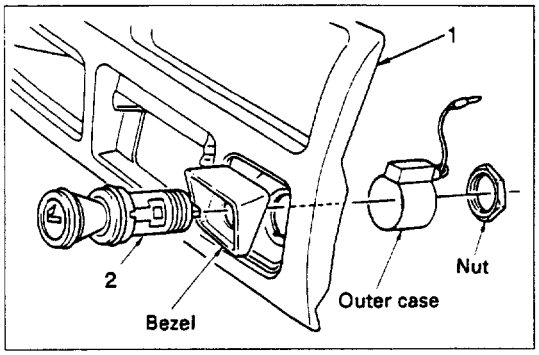
1. **Door Pad**

   Refer to "FRONT DOOR TRIM PAD" of section 10 "BODY"
2. **Speaker Panel**

   Disconnect the speaker connector.
3. **Speaker**
4. **Water proof sheet**

INSTALLATION

To install, follow the removal steps in the reverse order.



CIGAR LIGHTER

REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Center Cluster**

   Refer to "RADIO" in this section.

2. **Cigar Lighter Assembly**

   Remove the nut, then remove cigar lighter assembly, bezel and outer case.

INSTALLATION

To install, follow the removal steps in the reverse order.

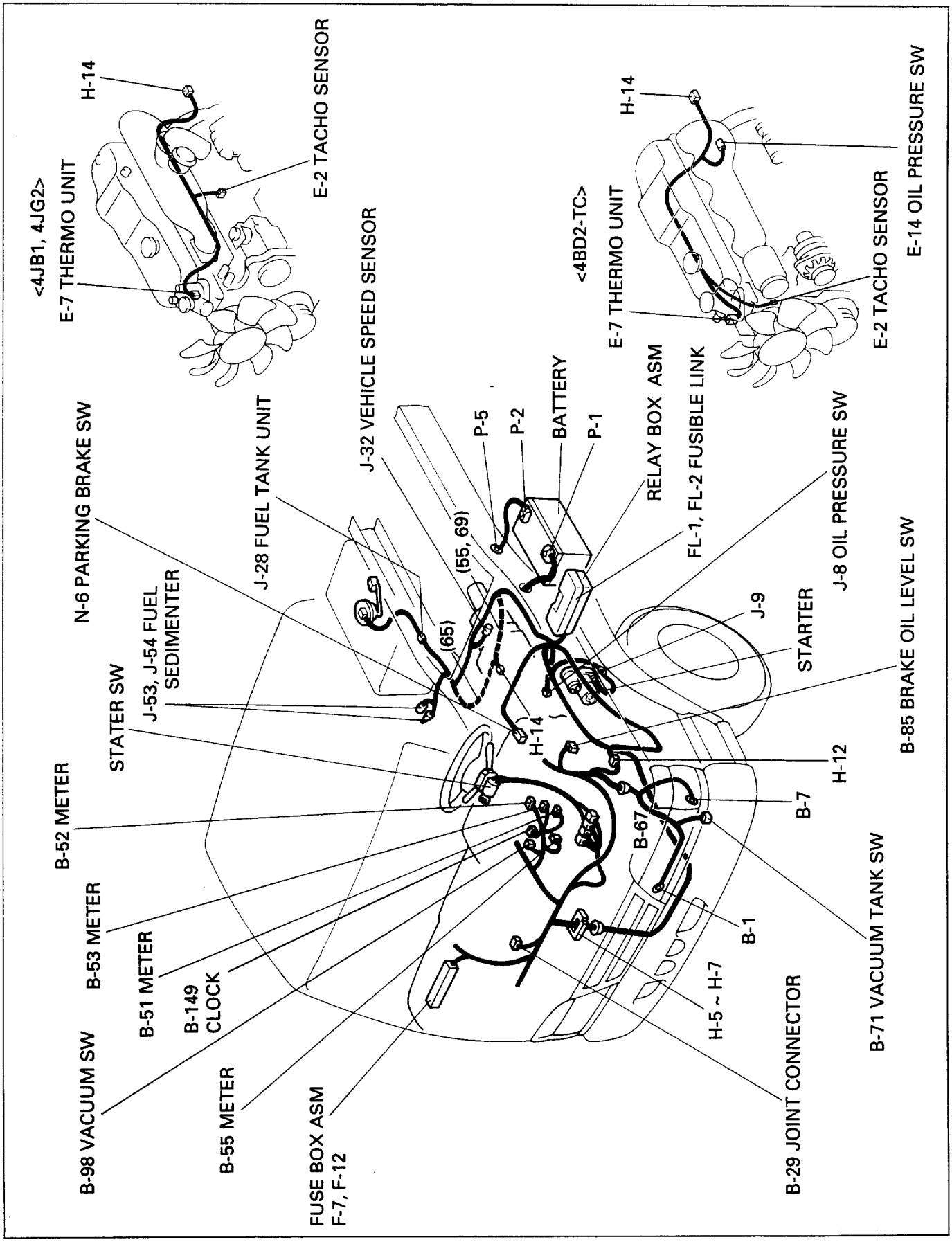
MEMO

METER AND WARNING/INDICATOR LIGHT

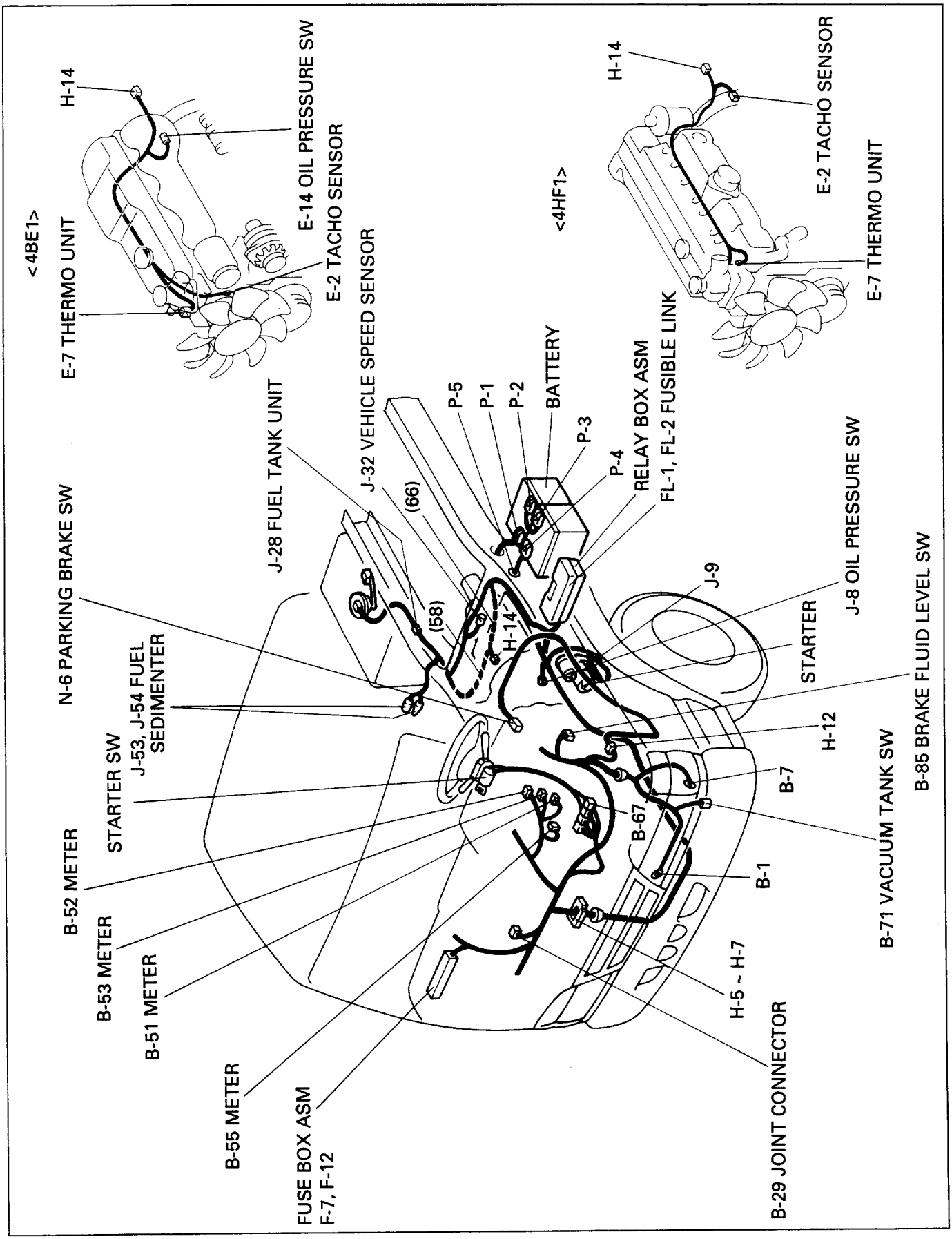
GENERAL DESCRIPTION

The circuit consists of the starter switch, meter assembly, vacuum tank switch, seat belt switch, oil pressure switch, fuel sedimentor switch, brake fluid switch, parking brake switch, vehicle speed sensor, fuel tank unit, thermo unit and engine speed sensor.
The meter assembly contains the speedometer, tachometer, fuel meter, thermometer and the warning/indicator light.
The meter warning/indicator lights and their bulb sockets are a unit, they are installed from the back of the speedometer assembly.

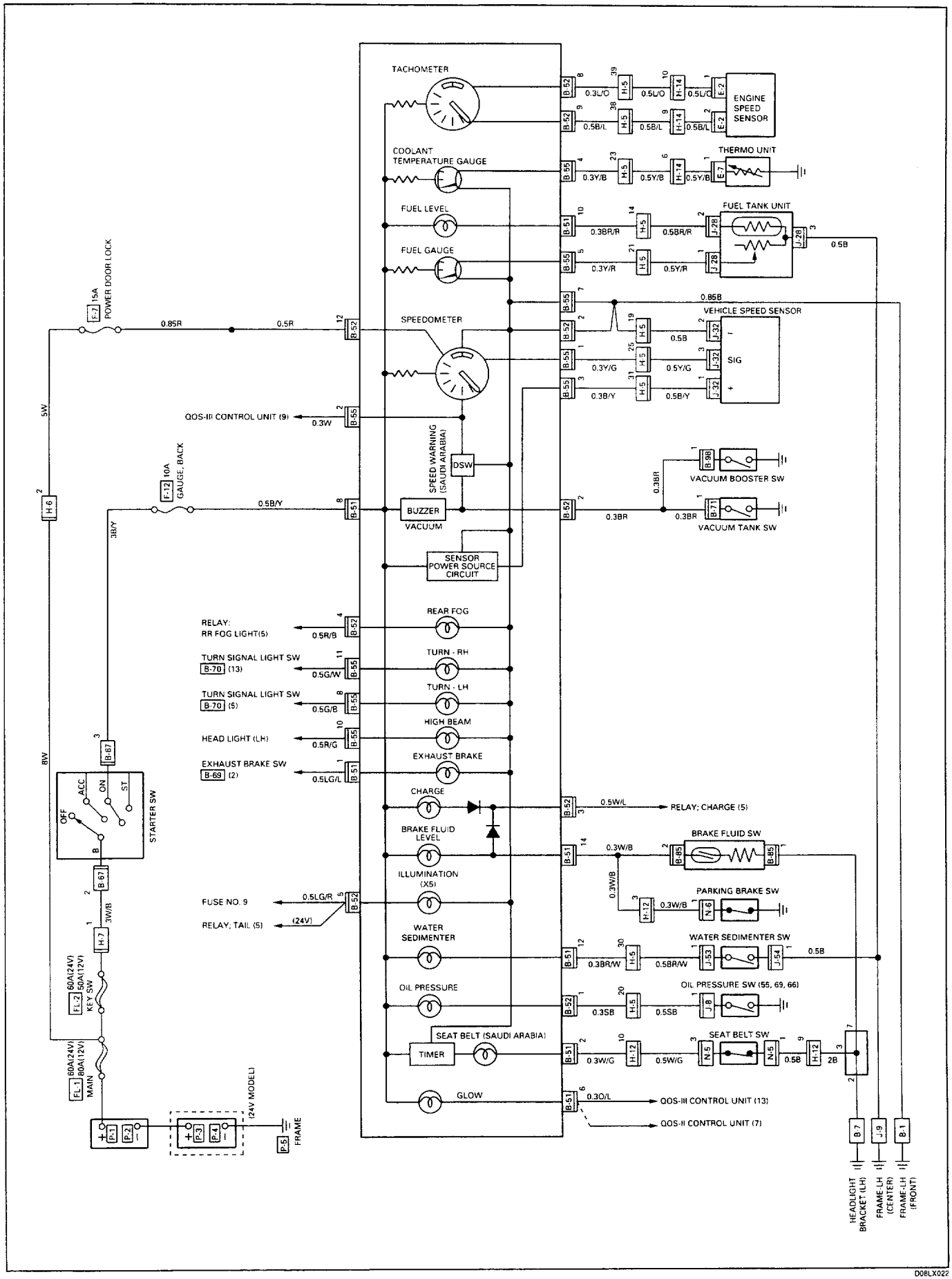
PARTS LOCATION – FOR 12 VOLT



PARTS LOCATION – FOR 24 VOLT

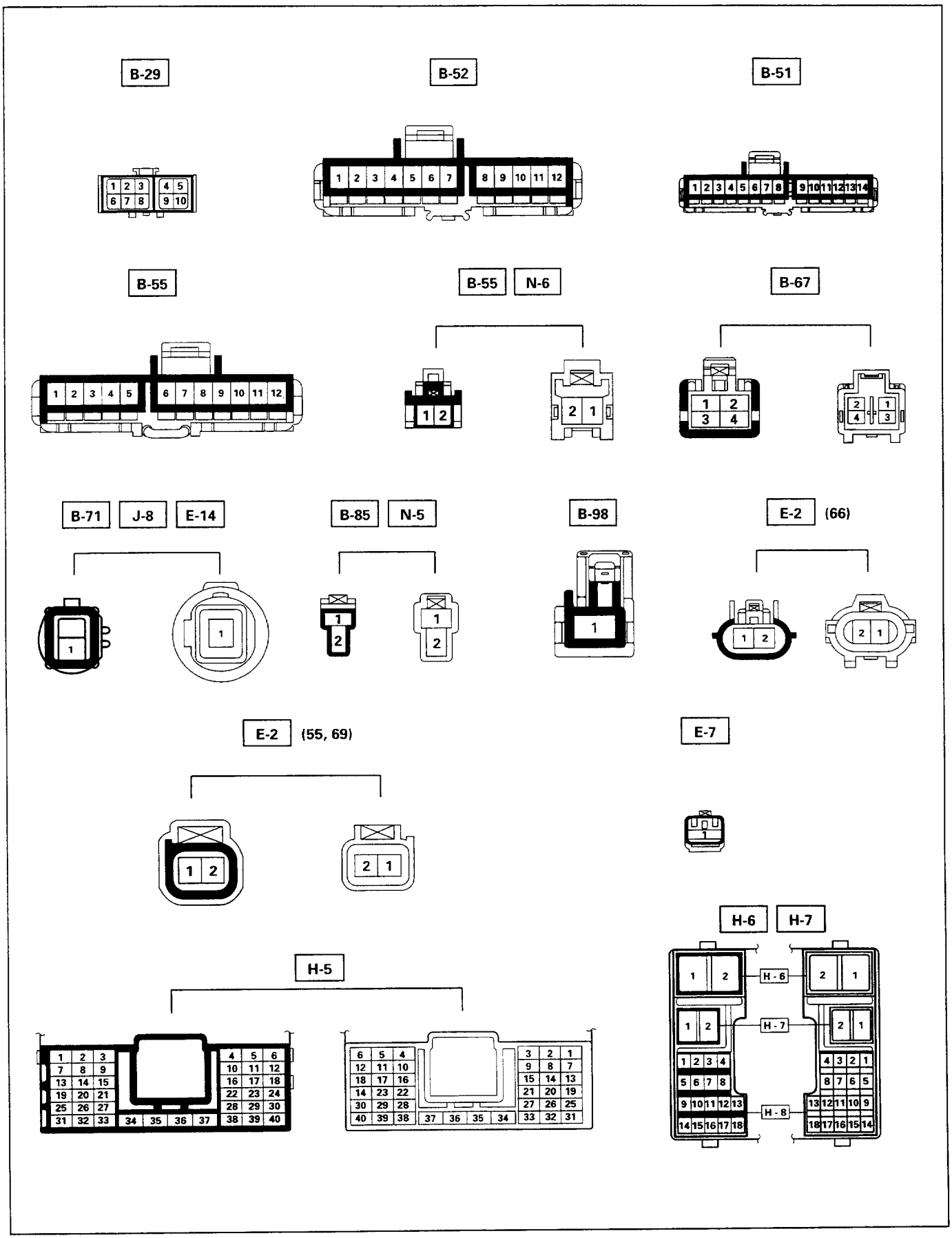


CIRCUIT DIAGRAM

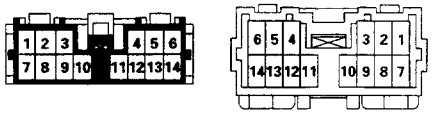


D08LX022

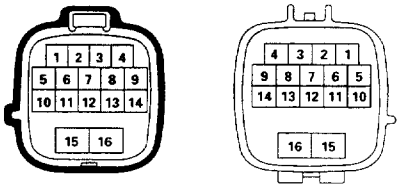
CONNECTOR LIST



H-12

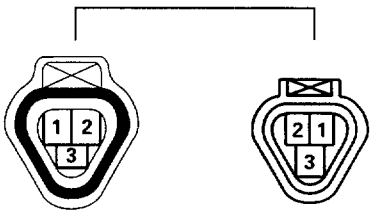


H-14

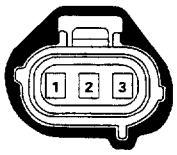


J-53 J-54 E-13

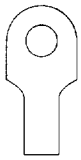
J-28



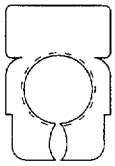
J-32



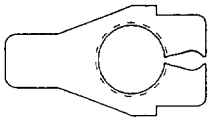
P-1 (12V)



P-1 P-4

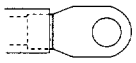


P-2 P-3

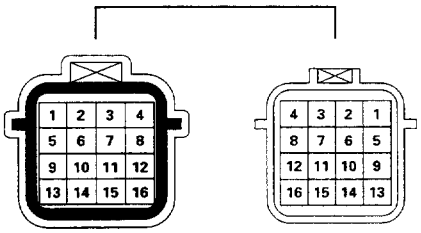


P-5 (12V)

P-5



H-14



J-8 (FOR 4J type ENGINE)

DIAGNOSIS

QUICK CHART FOR CHECK POINT

1. SPEEDOMETER

Trouble mode \ Check point	Speedometer	Vehicle speed sensor	Cable harness
1-1 Speedometer and odometer do not function	○ (3)	○ (1)	○ (2)
1-2 Speedometer does not function (odometer is normal)	○ (1)		
1-3 Odometer does not function (Speedometer is normal)	○ (1)		
1-4 Speedometer needle fluctuates (May be wide fluctuation)	○ (3)	○ (1)	○ (2)
1-5 Speedometer needle jumps erratically	○ (3)	○ (1)	○ (2)

NOTE: Figure in parenthesis "( )" indicates the order of inspection.

2. TACHOMETER

Trouble mode \ Check point	Tachometer	Engine speed sensor	Cable harness
2-1 Tachometer does not function	○ (3)	○ (1)	○ (2)
2-2 Tachometer needle fluctuates (May be wide fluctuation)	○ (3)	○ (1)	○ (2)
2-3 Tachometer needle jumps erratically	○ (3)	○ (1)	○ (2)

NOTE: Figure in parenthesis "( )" indicates the order of inspection.

3. COOLANT TEMPERATURE GAUGE

Trouble mode \ Check point	Meter ASM	Thermo-meter	Thermo unit	Thermo stat	Cable harness
3-1 Coolant temperature gauge needle does not move	○ (3)	○ (4)	○ (2)		○ (1)
3-2 Coolant temperature gauge reading is too low (or high)	○ (4)	○ (5)	○ (3)	○ (1)	○ (2)
3-3 Needle overshoots (or goes up to the "H" range)	○ (3)	○ (4)	○ (1)		○ (2)

NOTE: Figure in parenthesis "( )" indicates the order of inspection.

4. FUEL GAUGE

Trouble mode \ Check point	Meter ASM	Fuel gauge	Fuel tank unit	Cable harness
4-1 Fuel gauge needle does not move	○ (3)	○ (4)	○ (2)	○ (1)
4-2 Even when the tank is filled up with fuel, the needle does not reach "F"	○ (3)	○ (4)	○ (2)	○ (1)
4-3 When the tank is not full of fuel, the needle overshoots (or goes to "F")	○ (3)	○ (4)	○ (2)	○ (1)

NOTE: Figure in parenthesis "( )" indicates the order of inspection.

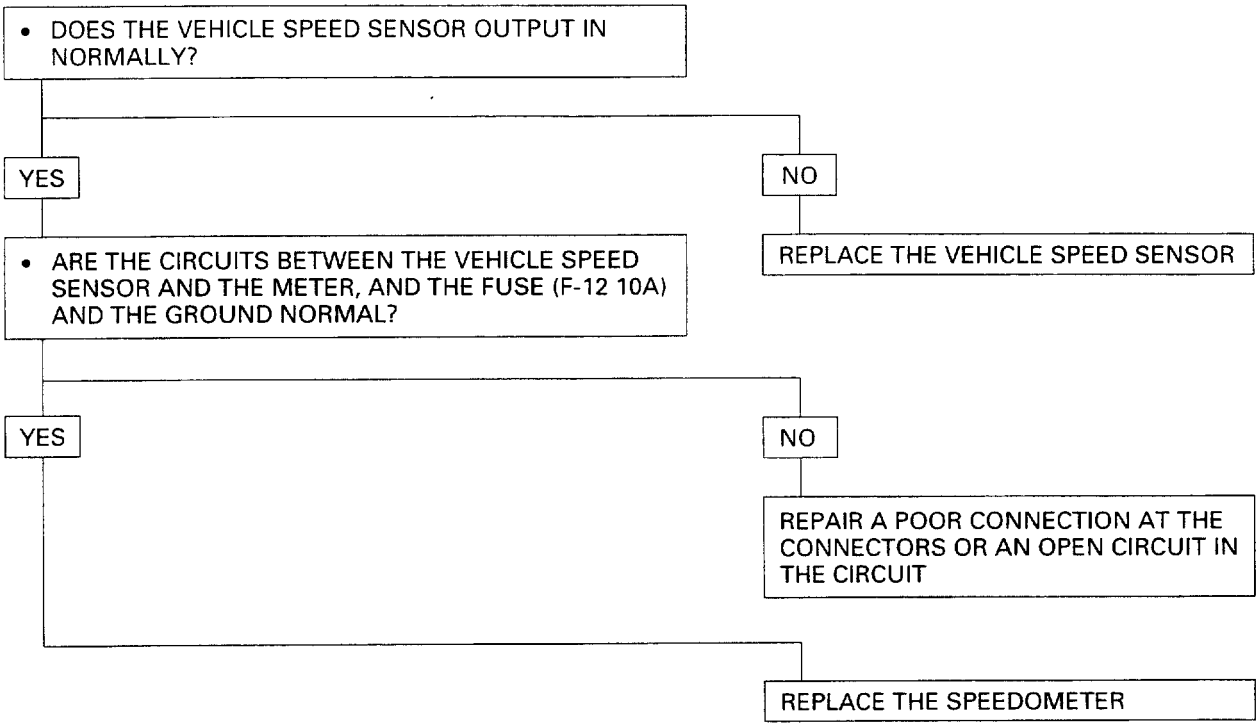
5. WARNING/INDICATOR LIGHT

Trouble mode \ Check point	Light bulb	Parking brake SW	Brake fluid SW	Oil pressure SW	Fuel tank unit	Vacuum SW	4WD SW	Sedimentor SW	Seat belt SW	Cable harness
5-1 When the parking brake lever is pulled, the indicator light does not light up.	○ (2)	○ (1)								○ (3)
5-2 Even when the parking brake lever is released, the indicator light does not go off.		○ (1)								○ (2)
5-3 While the engine operating, the oil pressure warning light does not go off.				○ (2)						○ (1)
5-4 Even when the tank is full with fuel, the fuel warning light lights up.					○ (1)					○ (2)
5-5 Even when the tank is empty, the low fuel warning light does not light up.	○ (1)				○ (2)					○ (3)
5-6 Even when the float in the water sedimenter goes up above the drain warning level, the indicator light does not light up.	○ (2)							○ (1)		○ (3)
5-7 Even when the brake fluid is lower than specified level, the level warning light does not light up.	○ (1)		○ (2)							○ (3)
5-8 Even when the vacuum tank is empty vacuum warning buzzer does not sound						○ (1)				○ (2)

NOTE: Figure in parenthesis "( )" indicates the order of inspection.

1. SPEEDOMETER

1-1. SPEEDOMETER AND ODOMETER DO NOT FUNCTION



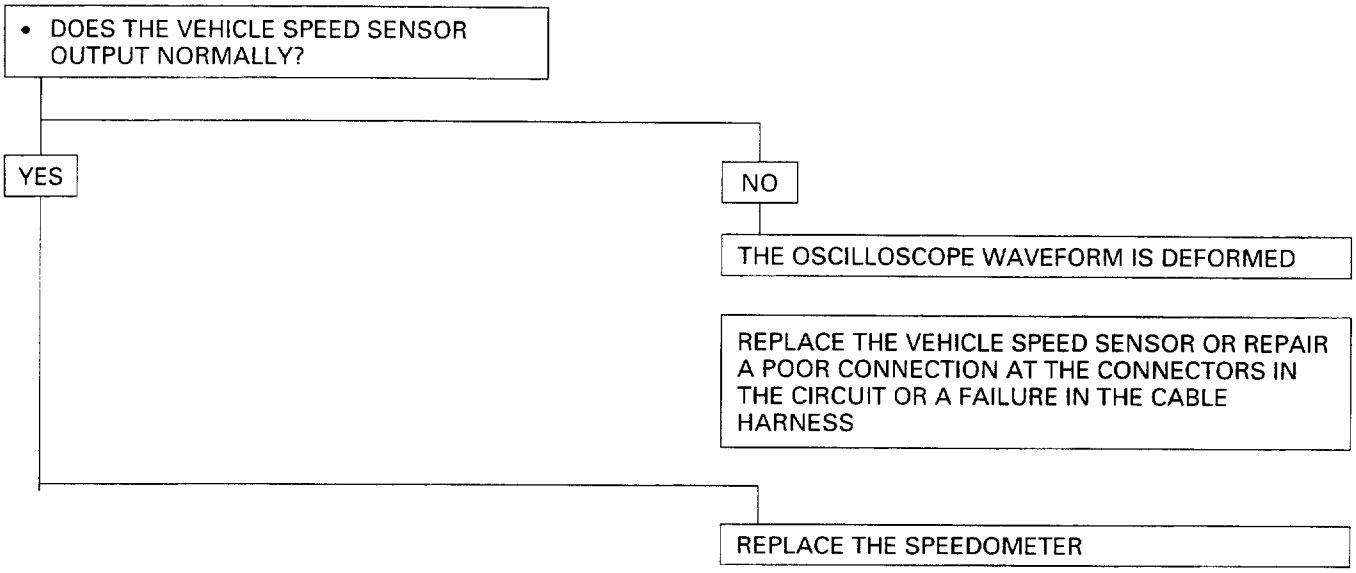
1-2. SPEEDOMETER DOES NOT FUNCTION (ODOMETER IS NORMAL)

REPLACE THE SPEEDOMETER ASSEMBLY

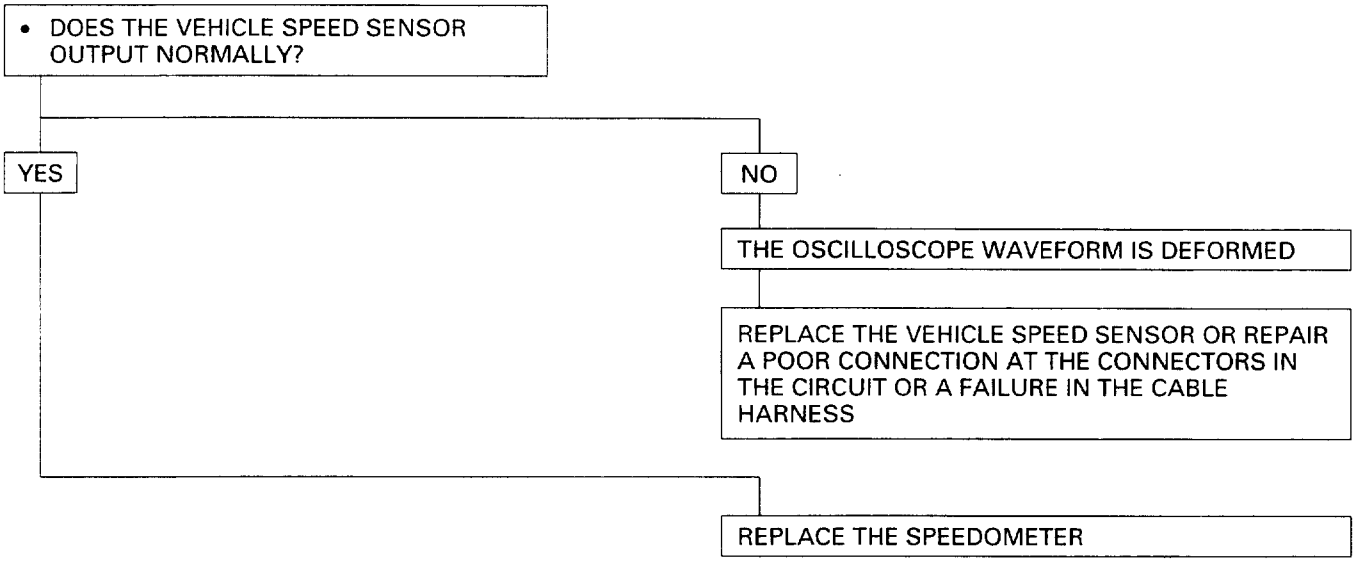
1-3. ODOMETER DOES NOT FUNCTION (SPEEDOMETER IS NORMAL)

REPLACE THE SPEEDOMETER ASSEMBLY

1-4. SPEEDOMETER NEEDLE FLUCTUATES (MAY BE WIDE FLUCTUATION)

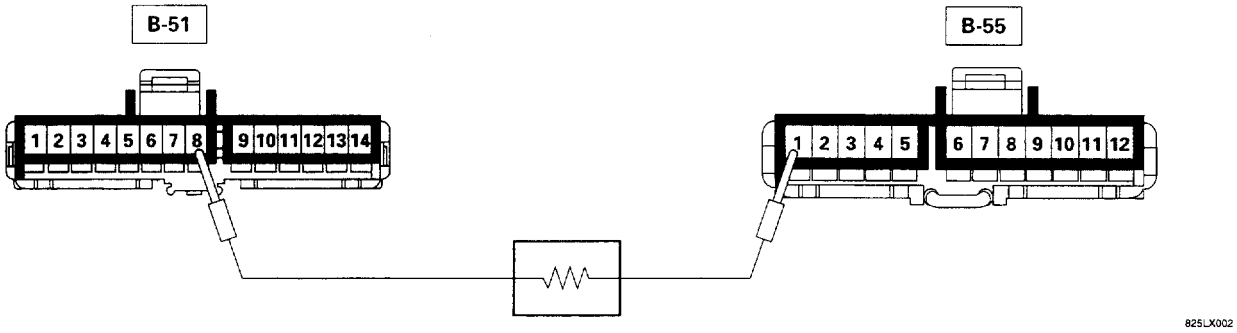


1-5. SPEEDOMETER NEEDLE JUMPS ERRATICALLY

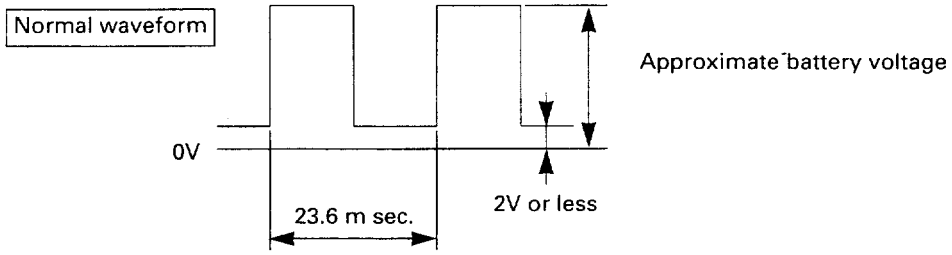


Inspection of waveform by oscilloscope

1. Connect a resistance of 1.3 to 5k ohm (1.4W or more) between the harness side connectors 8 B-51 and 1 B-55 of the meter.

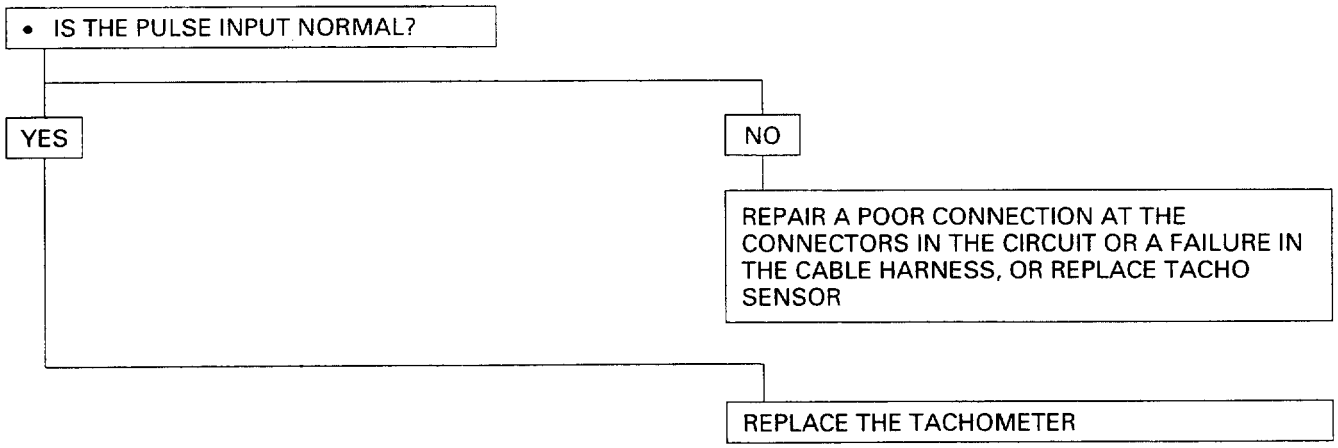


2. Install a speedometer tester.
2. Turn on the starter SW.
3. Check the waveform at the time when the vehicle speed is at 60 Km (37 mph)

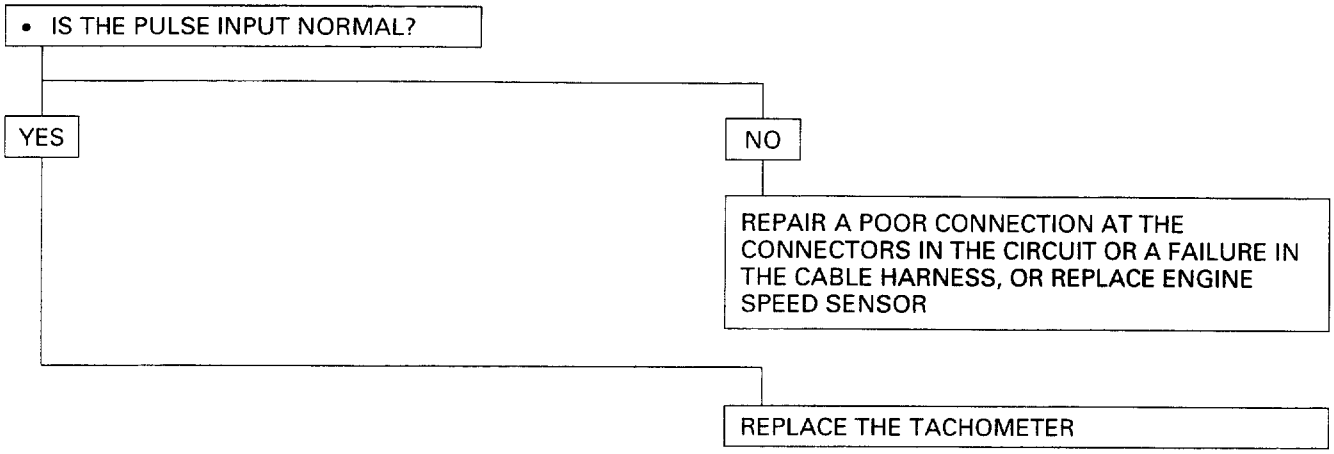


2. TACHOMETER

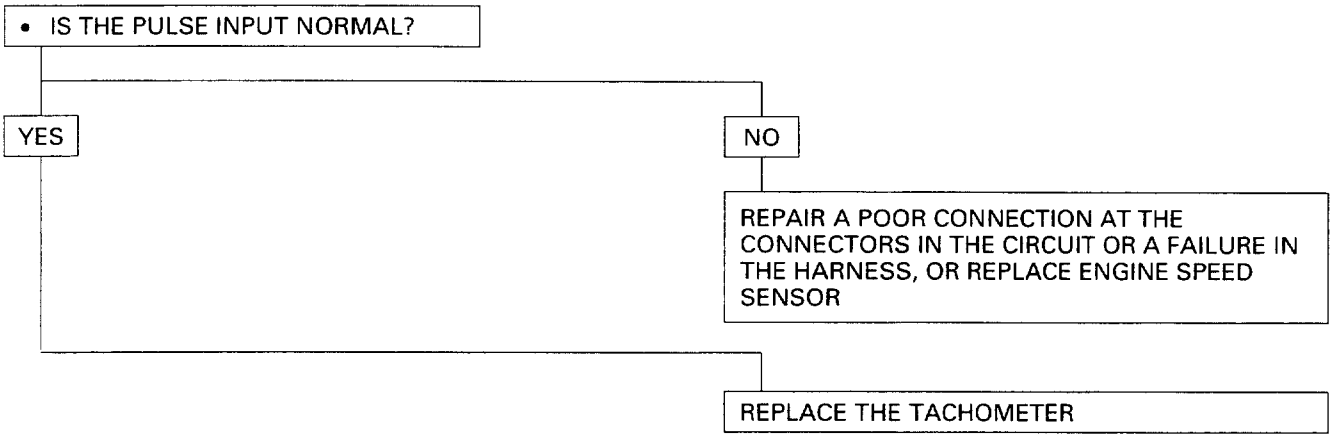
2-1. TACHOMETER DOES NOT FUNCTION



2-2 TACHOMETER NEEDLE FLUCTUATES (MAY BE WIDE FLUCTUATION)

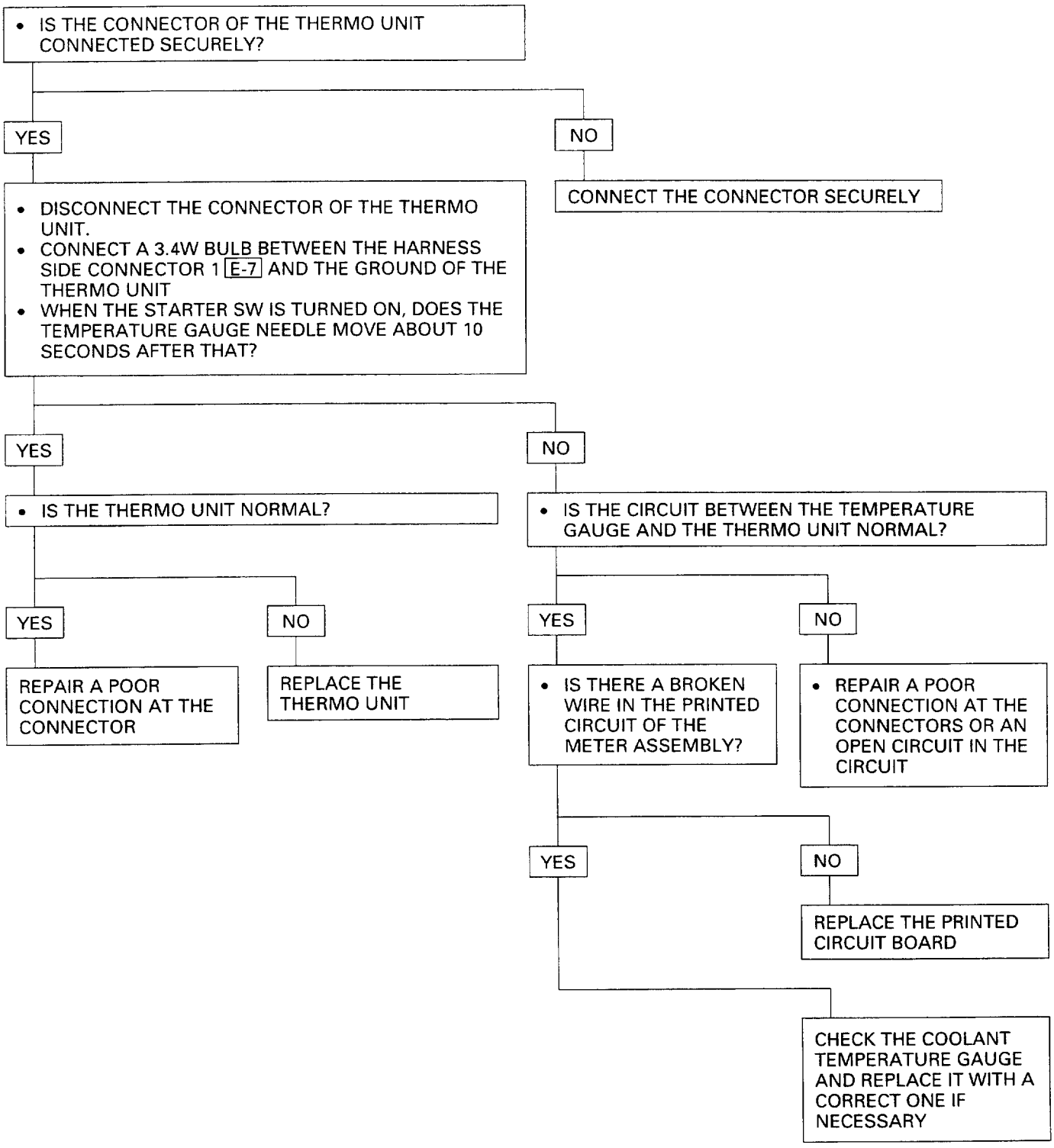


2-3 TACHOMETER NEEDLE JUMPS ERRATICALLY

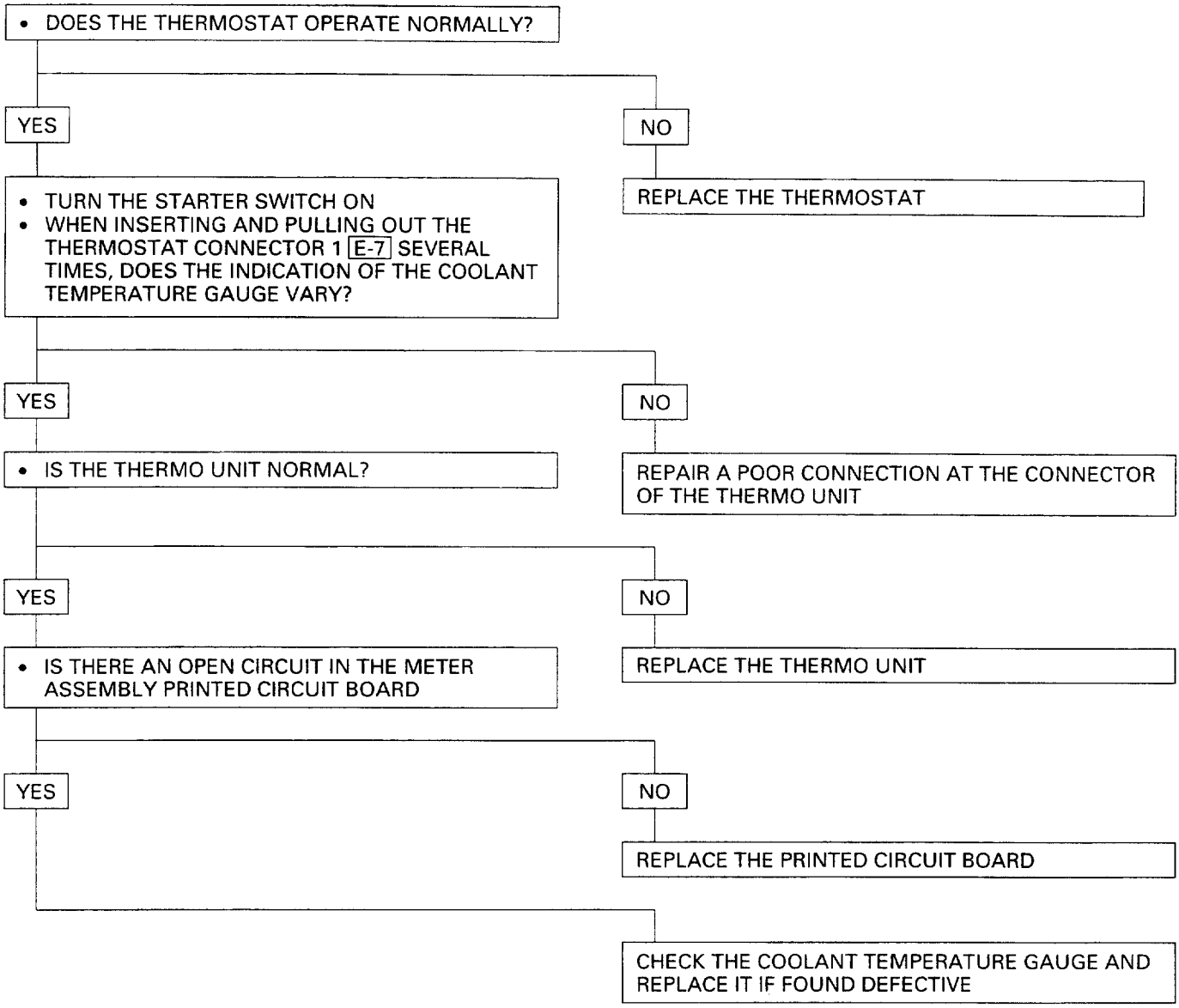


3. COOLANT TEMPERATURE GAUGE

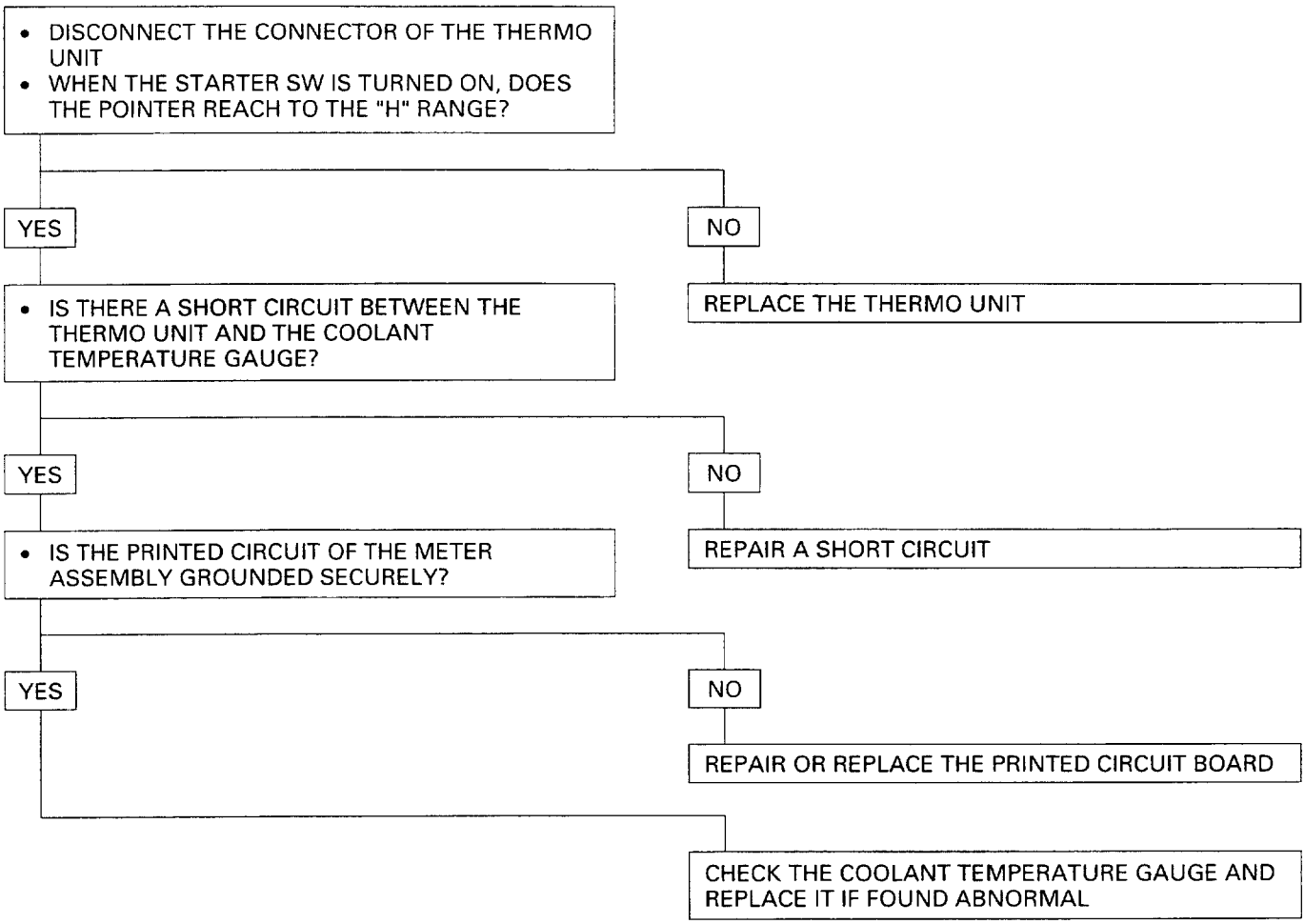
3-1 COOLANT TEMPERATURE GAUGE NEEDLE DOES NOT MOVE



3-2 COOLANT TEMPERATURE GAUGE READING IS TOO LOW (OR HIGH)

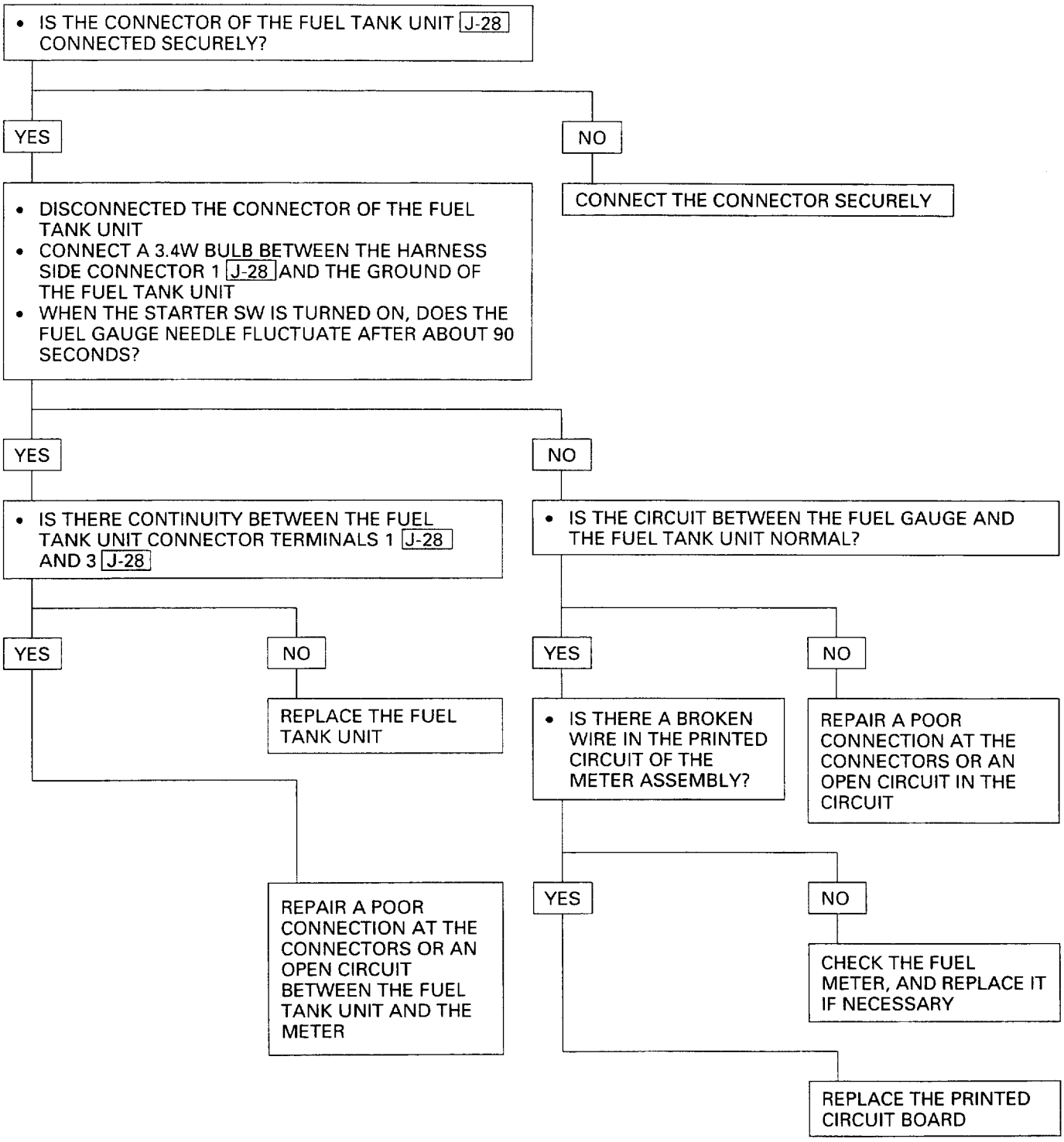


3-3 NEEDLE OVERSHOOTS (OR GOES UP TO THE "H" RANGE)

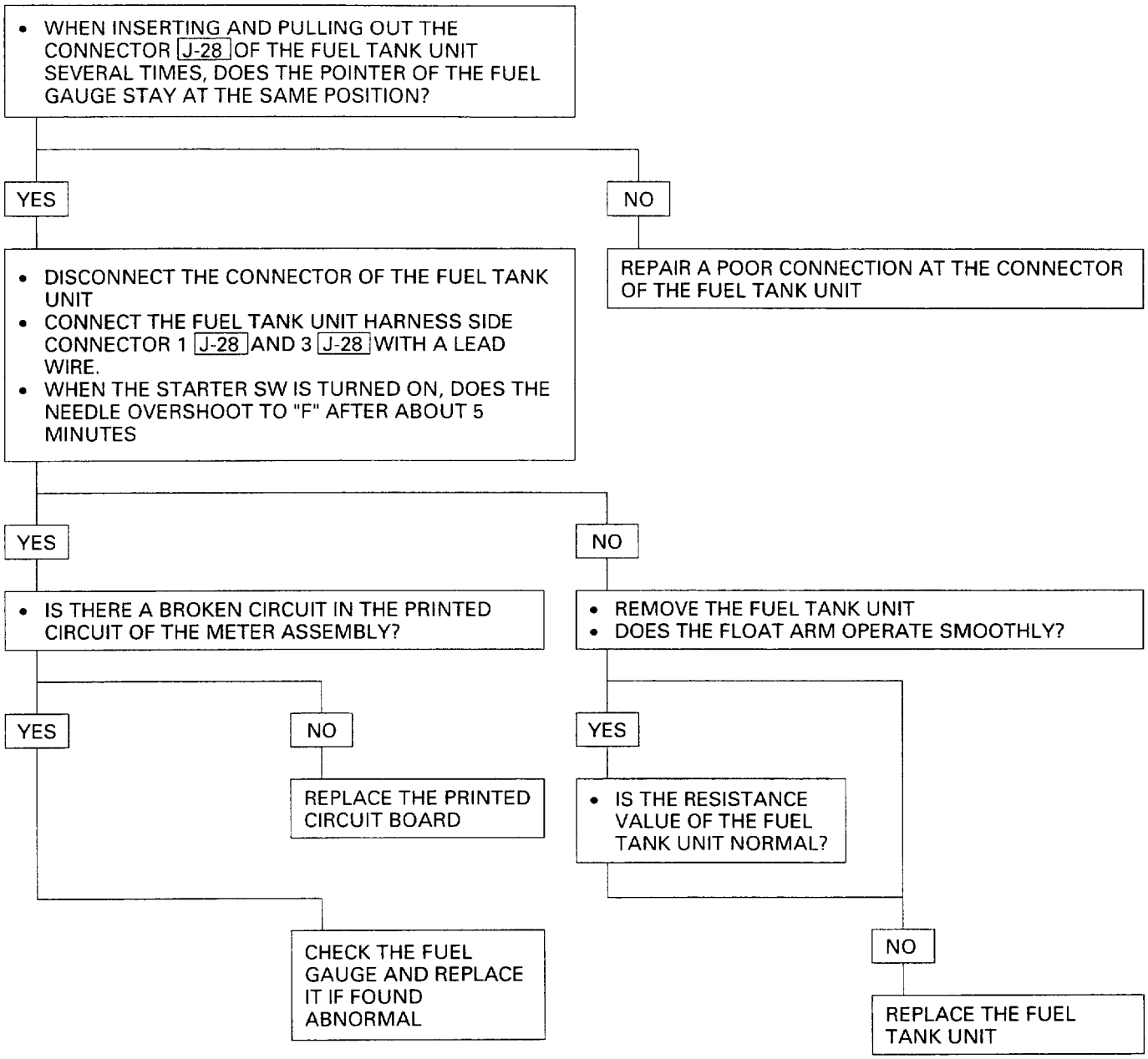


4. FUEL GAUGE

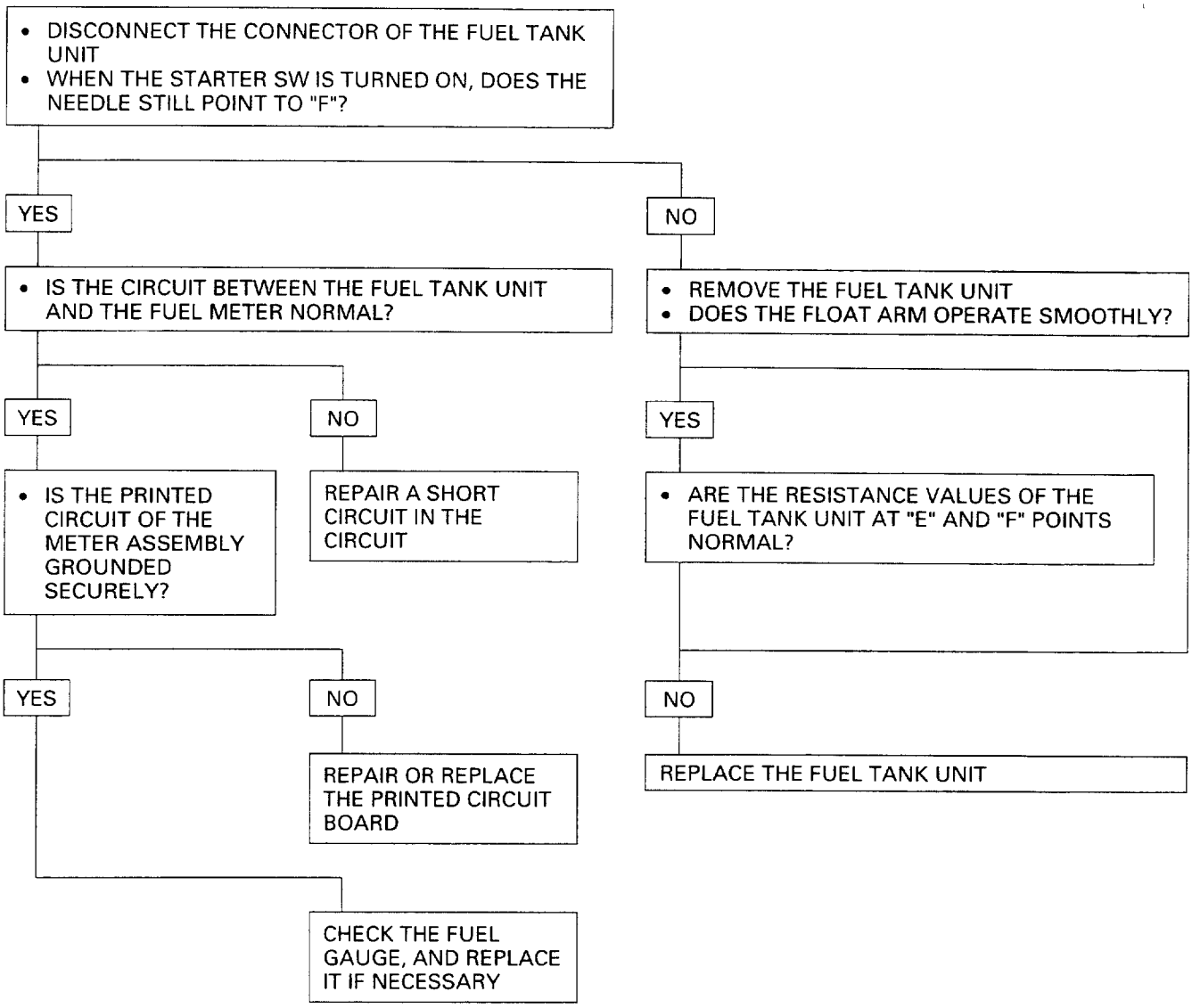
4-1. FUEL GAUGE NEEDLE DOES NOT MOVE



4-2 EVEN WHEN THE TANK IS FILLED UP WITH FUEL,THE NEEDLE DOES NOT REACH "F"

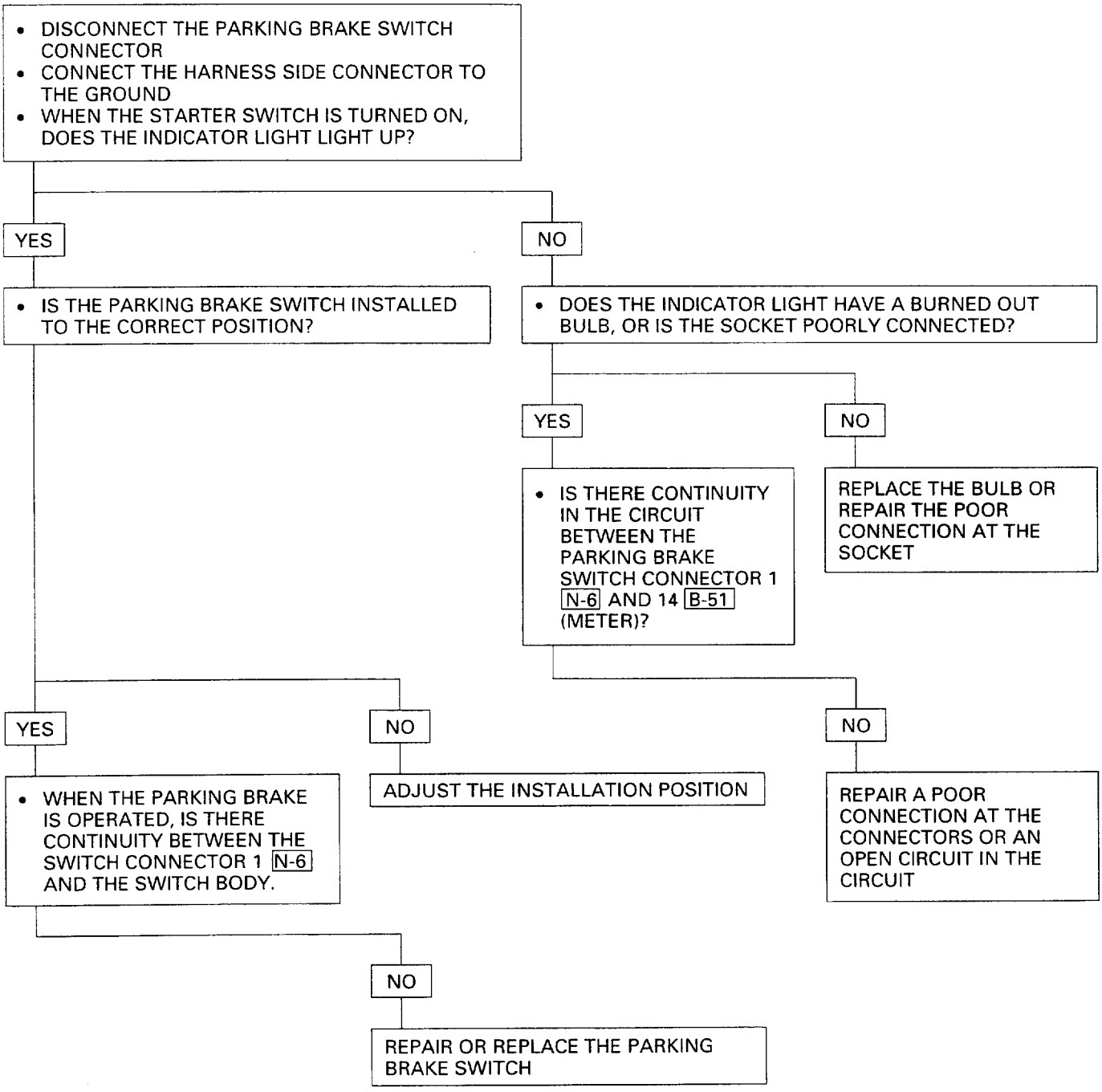


4-3 WHEN THE TANK IS NOT FULL OF FUEL, THE NEEDLE OVERSHOOTS (OR GOES UP TO "F")



5. WARNING/INDICATOR LIGHT

5-1 WHEN THE PARKING BRAKE LEVER IS PULLED, THE INDICATOR LIGHT DOES NOT LIGHT UP



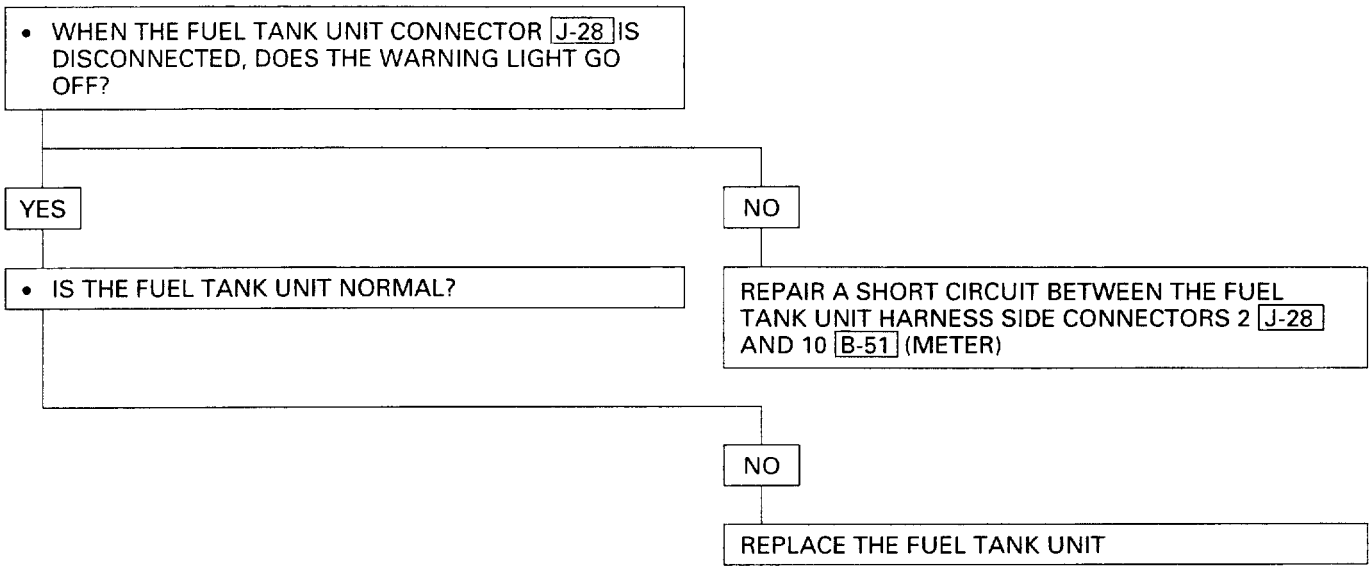
5-2 EVEN WHEN THE PARKING BRAKE LEVER IS RELEASED THE INDICATOR LIGHT DOES NOT GO OFF

- IS THE PARKING BRAKE SWITCH INSTALLED TO THE CORRECT POSITION, AND DOES IT OPERATE NORMALLY?
  - NO → ADJUST THE SWITCH INSTALLATION POSITION, OR REPAIR OR REPLACE THE SWITCH
  - YES →
- WHEN THE PARKING BRAKE SWITCH CONNECTOR [N-6] DISCONNECTED, DOES THE INDICATOR LIGHT GO OFF?
  - NO → REPAIR A SHORT CIRCUIT BETWEEN THE PARKING BRAKE SWITCH CONNECTOR 1 [N-6] AND 14 [B-51]
  - YES →

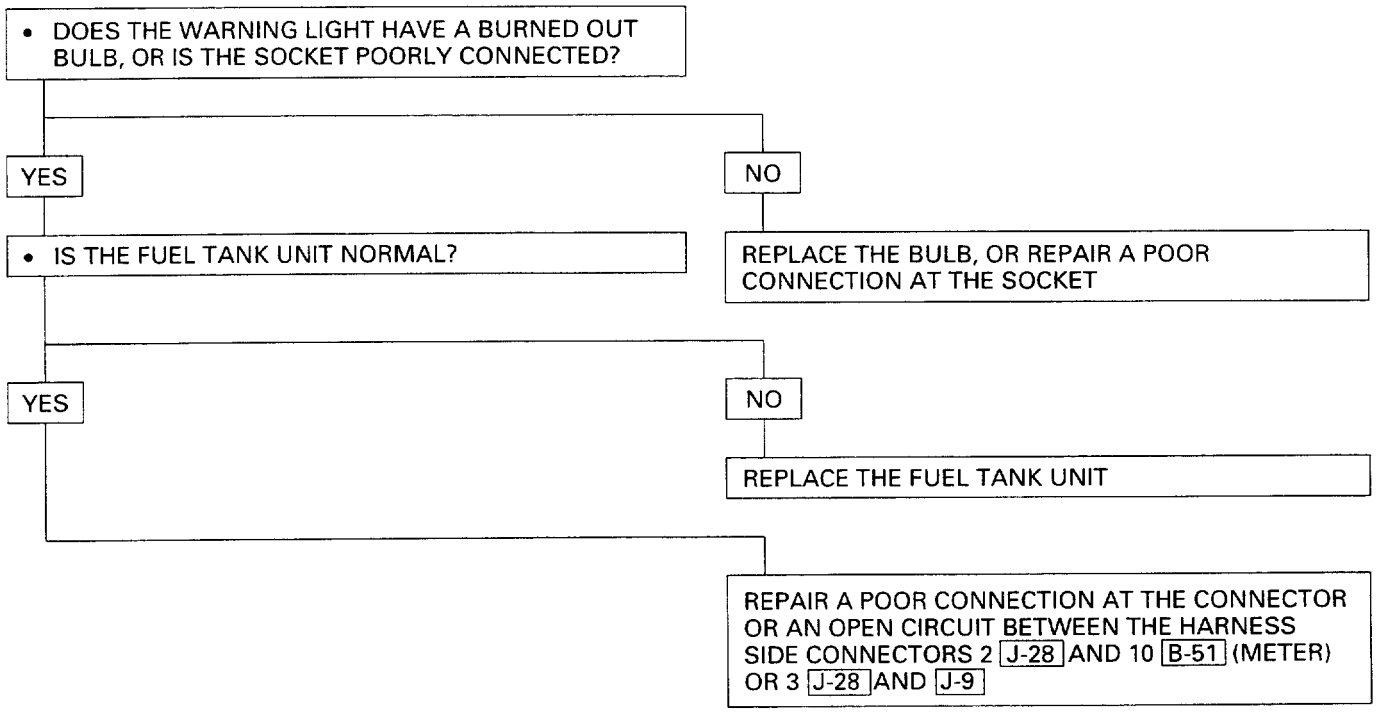
5-3 WHILE THE ENGINE IS OPERATING, THE OIL PRESSURE WARNING LIGHT DOES NOT GO OFF

- IS THE ENGINE OIL PRESSURE NORMAL?
  - NO → REFER TO THE "ENGINE" SECTION
  - YES →
- WITH THE OIL PRESSURE SWITCH CONNECTOR [J-8] DISCONNECTED, DOES THE WARNING LIGHT GO OFF?
  - NO → REPAIR A SHORT CIRCUIT BETWEEN 1 [J-8] AND 1 [B-52] (METER)
  - YES →
- WHILE THE ENGINE IS OPERATING, IS THERE CONTINUITY BETWEEN THE OIL PRESSURE SWITCH CONNECTOR [J-8] AND THE BODY GROUND?
  - NO → REPLACE THE OIL PRESSURE SWITCH
  - YES →

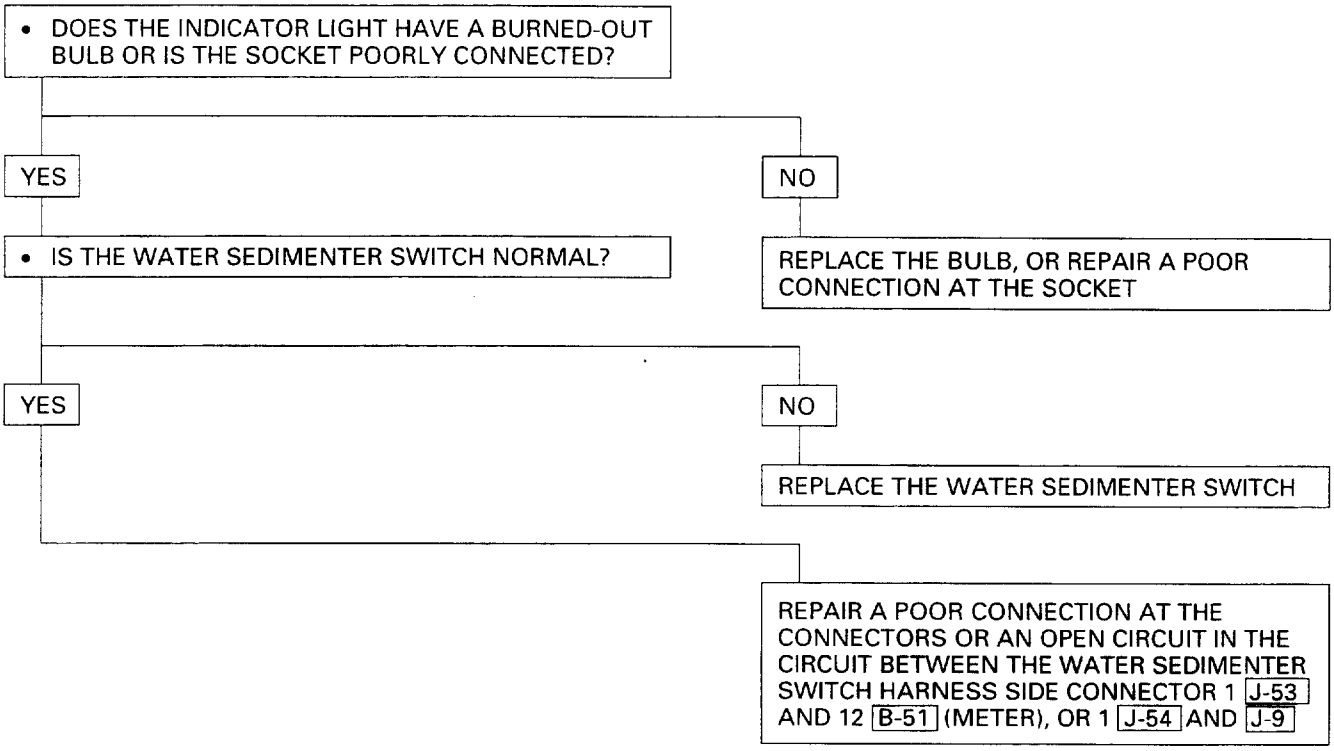
5-4 EVEN WHEN THE FUEL TANK IS FULL WITH FUEL, THE FUEL WARNING LIGHT LIGHTS UP



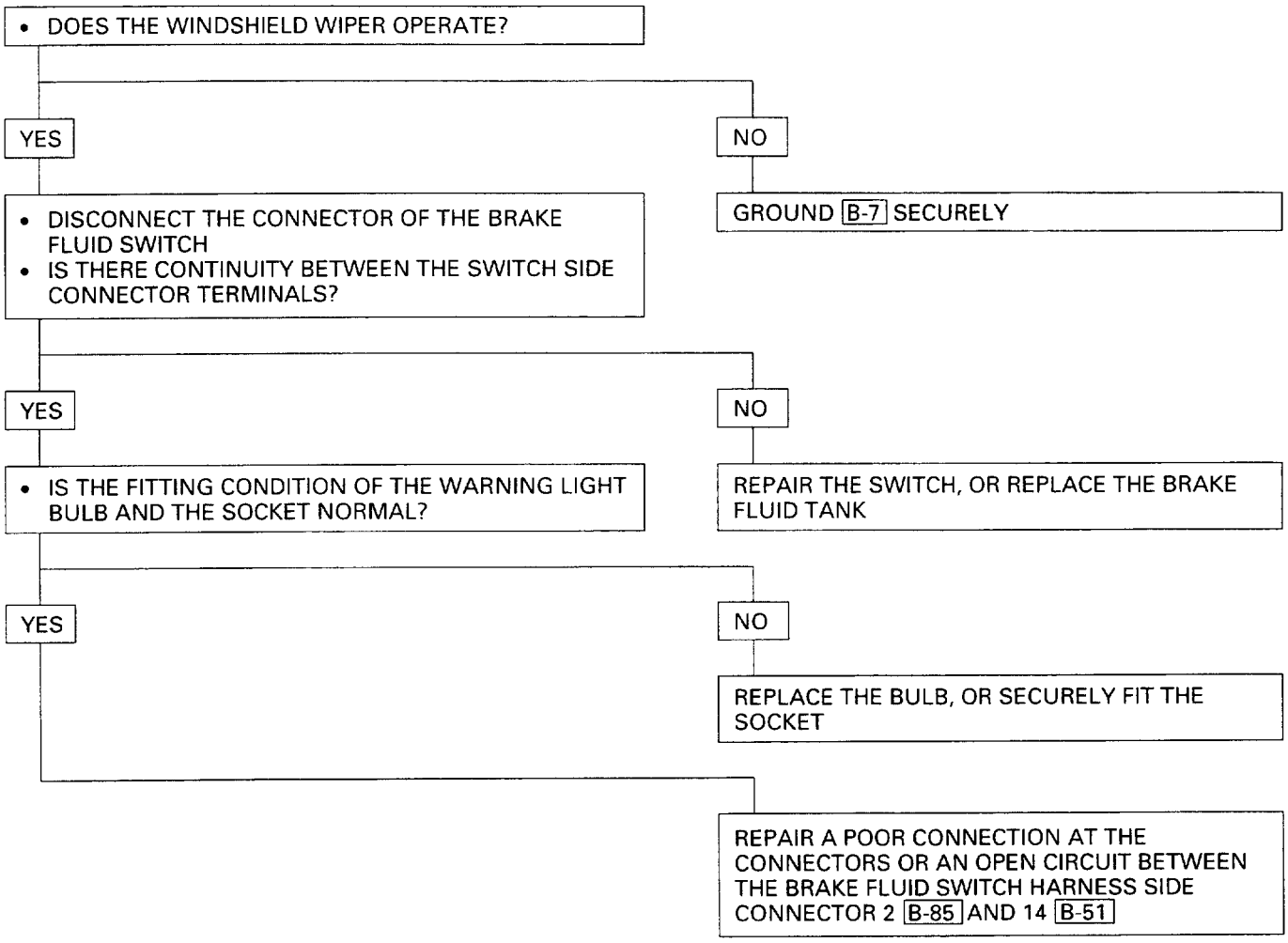
5-5 EVEN WHEN THE FUEL TANK IS EMPTY, THE LOW FUEL WARNING LIGHT DOES NOT LIGHT UP



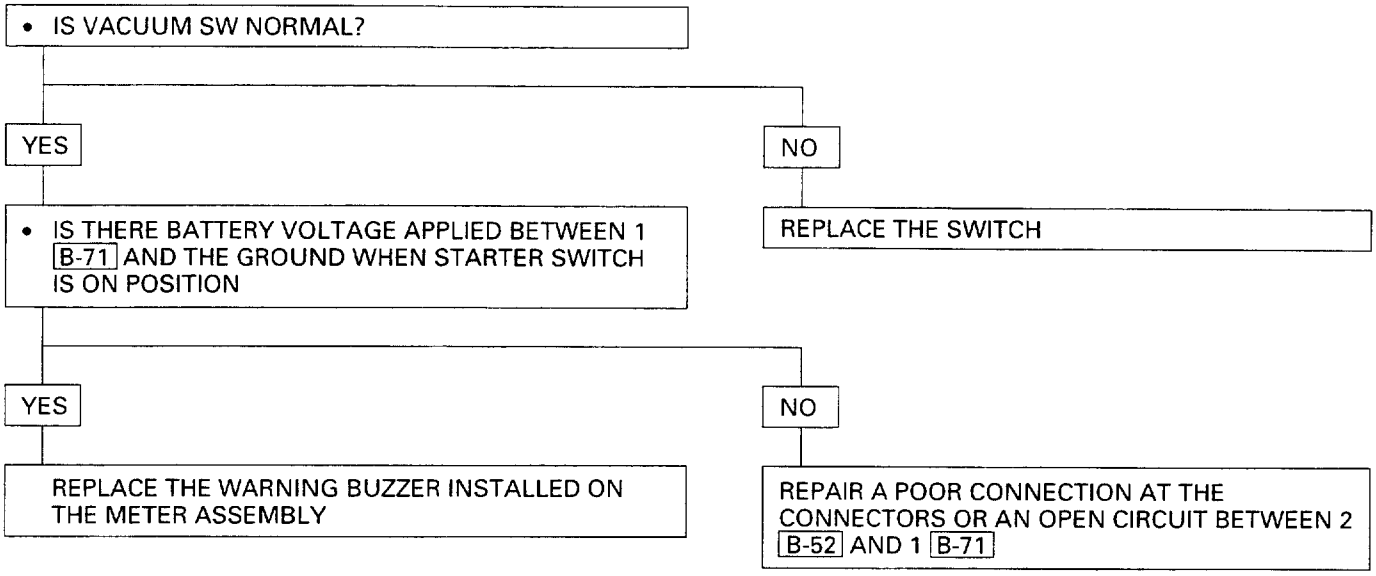
5-6 EVEN WHEN THE FLOAT IN THE WATER SEDIMENTER GOES UP ABOVE THE DRAIN WARNING LEVEL, THE INDICATOR LIGHT DOES NOT LIGHT UP



5-7 EVEN WHEN THE BRAKE FLUID IS LOWER THAN SPECIFIED LEVEL, THE LEVEL WARNING LIGHT DOES NOT LIGHT UP



5-8 VACUUM WARNING BUZZER DOES NOT SOUND



STARTER SWITCH

Refer to "START AND CHARGING" in this section.

TURN SIGNAL LIGHT SWITCH

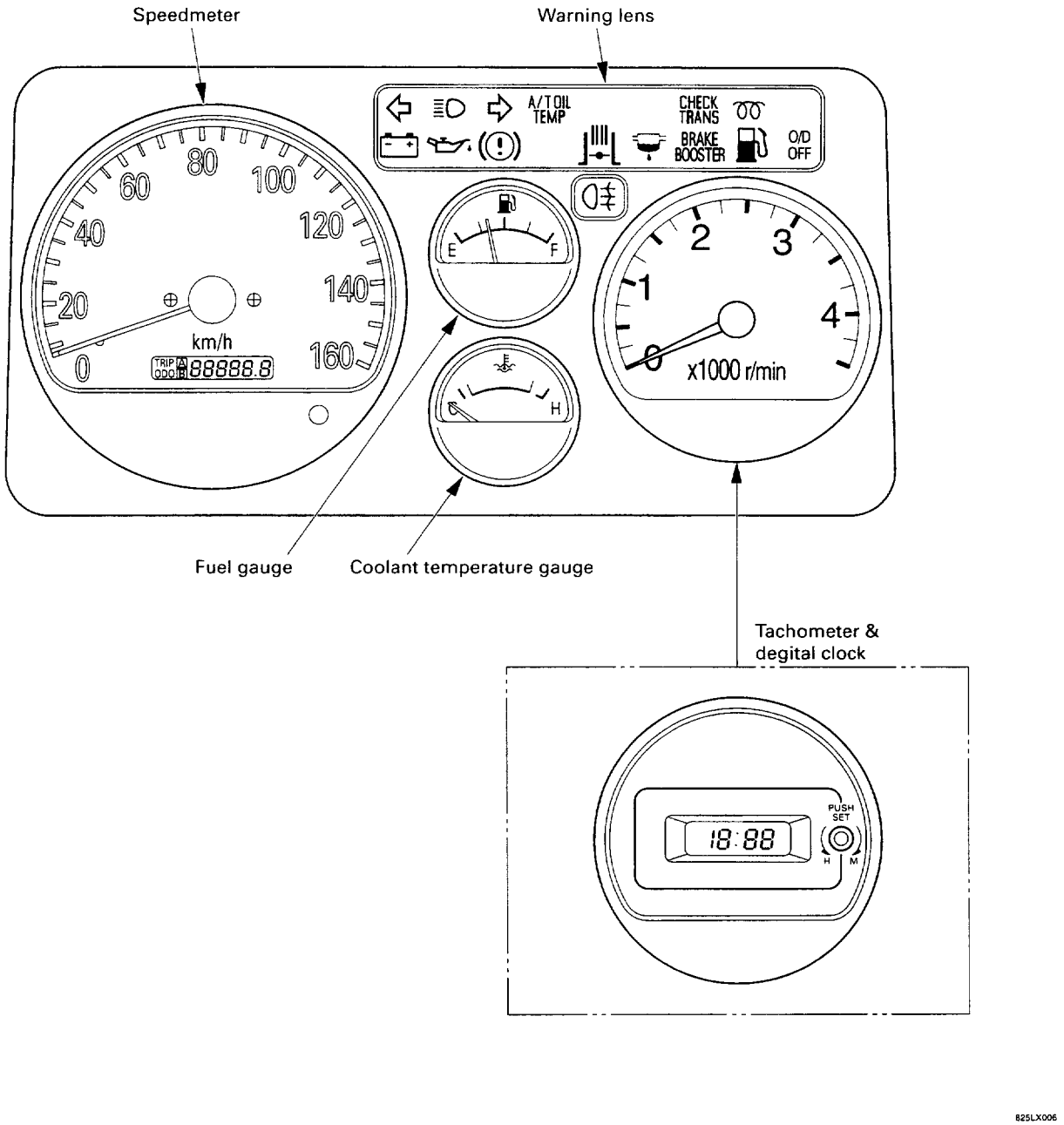
Refer to "TURN SIGNAL LIGHT, HAZARD WARNING LIGHT AND STOPLIGHT" in this section.

EXHAUST BRAKE SWITCH

Refer to "EXHAUST BRAKE" in this section.

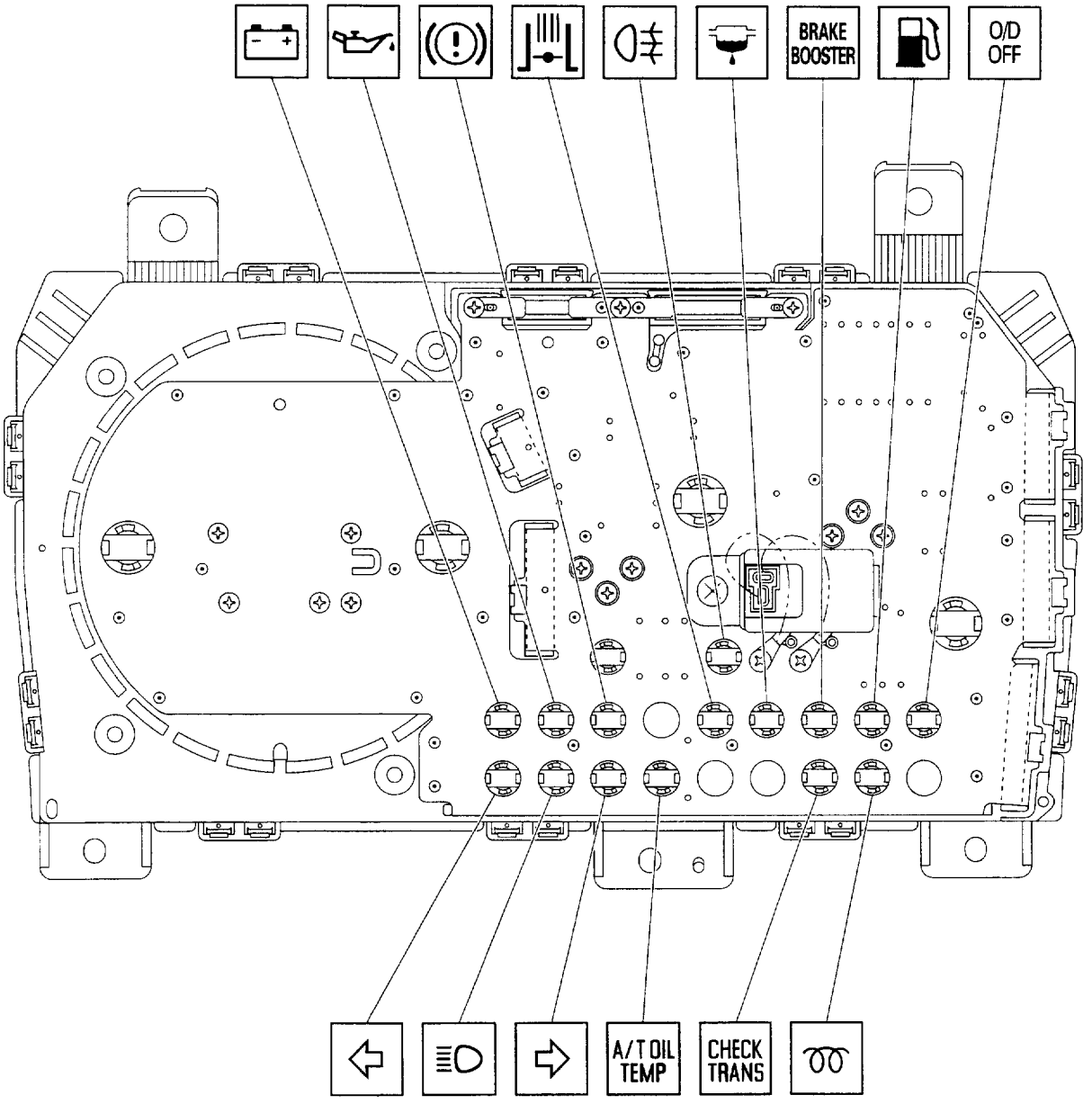
METER ASSEMBLY

LAYOUT FOR GAUGES, WARNING, INDICATOR AND ILLUMINATION LIGHTS



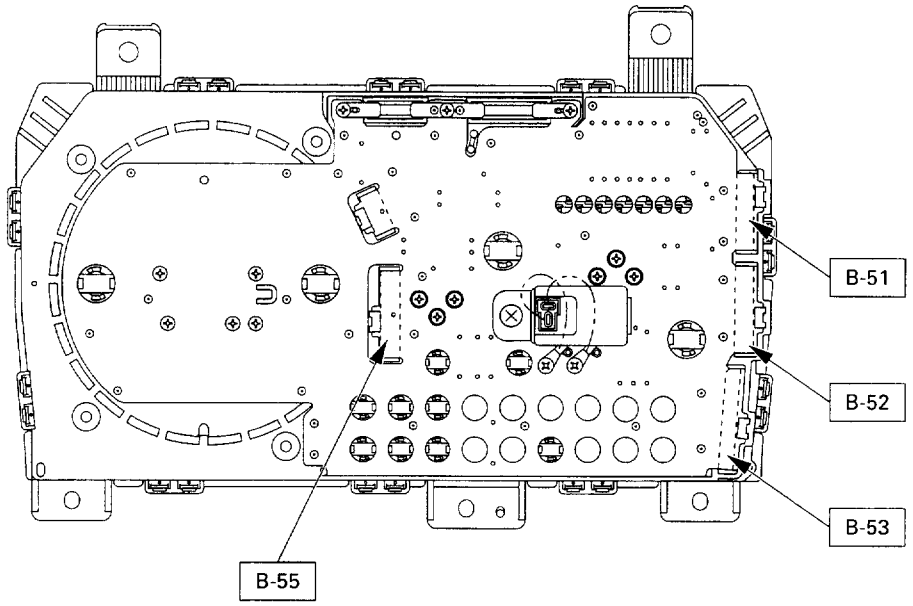
NOTE: The calibration and the red zone of tachometer are various depending on the models fitted.

BULB LOCATION FOR WARNING LENS



825LX005

TABLE FOR METER CONNECTOR TERMINAL CONNECTIONS



B-53

Terminal No.	Connected to	Terminal No.	Connected to
1	—	6	A/T Shift indicator D4
2	Ground	7	A/T Shift indicator D3
3	A/T Shift indicator P	8	A/T Shift indicator 2
4	A/T Shift indicator R	9	A/T Shift indicator 1
5	A/T Shift indicator N	10	Illumination (+)

B-51

Terminal No.	Connected to
1	Exh. Brake
2	—
3	—
4	—
5	Check trans
6	Glow
7	—
8	IGN (F-12) (+)
9	o/d off
10	Fuel low
11	—
12	Sedimentor
13	Low coolant
14	Brake

B-55

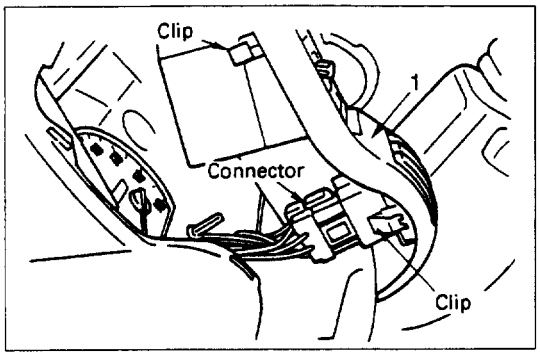
Terminal No.	Connected to
1	Speed pulse input
2	—
3	Power output (sensor)
4	ECT unit (GAGE)
5	Fuel tank unit (GAGE)
6	—
7	Ground
8	Turn signal (LH)
9	—
10	Beam (+) (F-7)
11	Turn signal (RH)
12	—

B-52

Terminal No.	Connected to
1	Oil pressure
2	Vacuum SW
3	Charge
4	Parking
5	Illumination (+)
6	—
7	—
8	Signal (tacho)
9	Ground (tacho)
10	Ground
11	—
12	+B (F-8)

ECT - Engine Coolant Temperature

825LX004

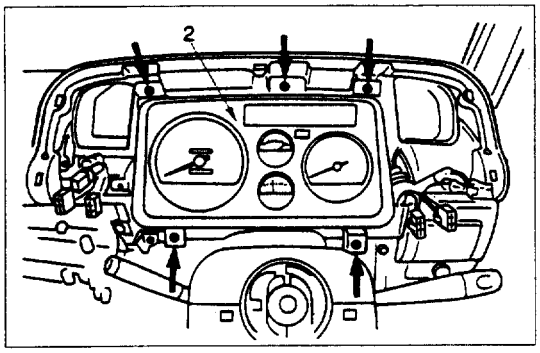


REMOVAL

Preparation:

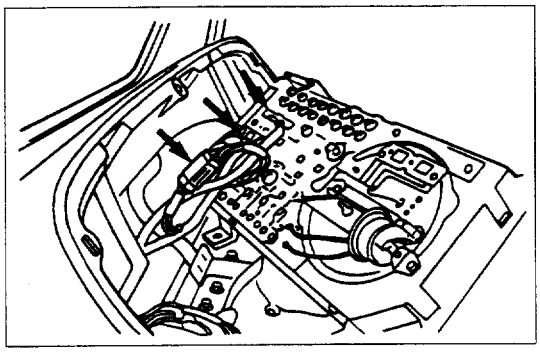
Disconnect the battery ground cable.

1. **Meter Cluster**



2. **Meter Assembly**

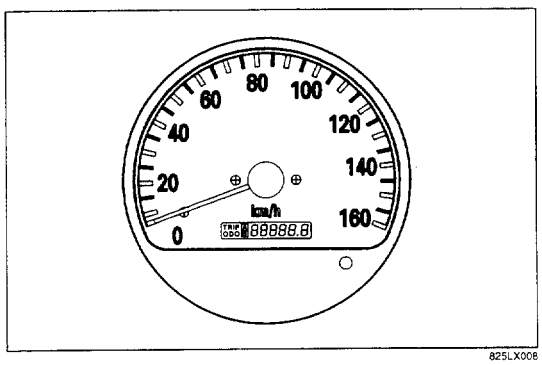
   Remove the five screws.



Disconnect the meter connectors.

INSTALLATION

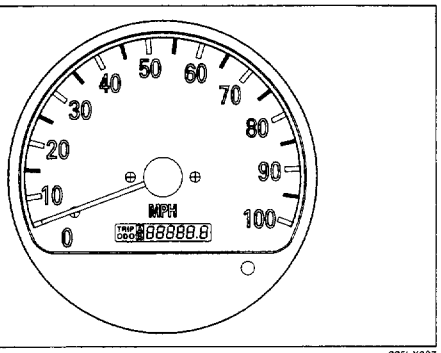
To install, follow the removal steps in the reverse order.



SPEEDOMETER

The speedometer is made up of the cross coil type ammeter (movement) that displays indications, the stepper motor that drives and adds up the odometer and trip meter, and the driving circuit (printed circuit board) that makes exchanges between the pulse signals and the current.

Tester display speed	Meter display parmissible level
20 km/h	17.5 – 22.5 km/h
40	37.5 – 42.5
60	57.5 – 62.5
80	77.5 – 82.5
100	97.6 – 103.4
120	117.6 – 123.4
140	137.6 – 143.4



825LX007

Tester display speed	Meter display parmissible level
20 MPH	18.3 – 21.7 MPH
40	38.3 – 41.7
60	58.3 – 61.7
80	78.8 – 82.8

ON-VEHICLE SERVICE

Check the meter display accuracy and the operation of the odometer with the speedometer tester.

NOTE:

Inappropriate tire inflation may affect the accuracy of the odometer.

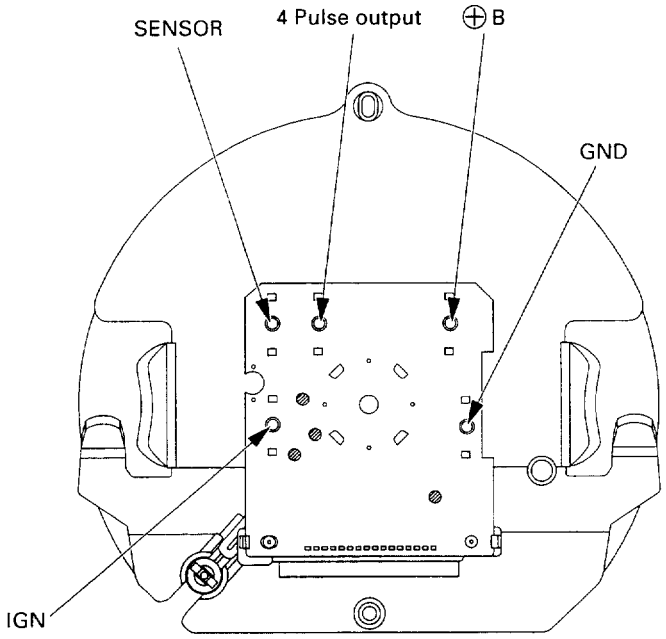
(To conduct this test, refer to the tester manufacturer's instruction manual.)

Since the meter display permissible levels above are specifications solely for the meter, they are to be used as reference values when conducting on-vehicle service.

INDIVIDUAL INSPECTION

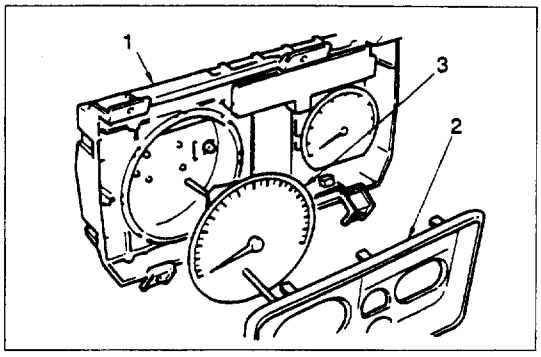
Remove the speedometer from the meter assembly and measure the resistance and the current consumption between each terminal.

Replace the speedometer when the result of inspection is found abnormal.



Terminal symbol	Resistance value
IGN-GND	58 ± 20kΩ
SEN-GND	70 ± 20kΩ
4P-GND	∞

825LW022



REMOVAL

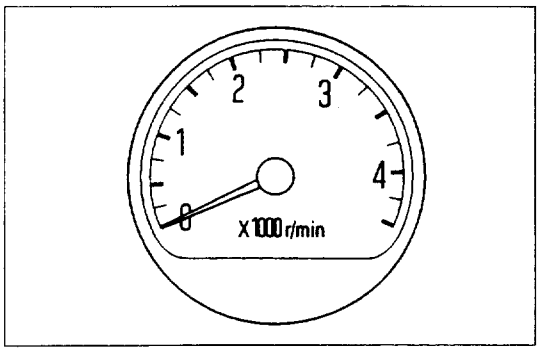
Preparation:

Disconnect the battery ground cable.

1. **Meter Assembly**
   Refer to "METER ASSEMBLY" in this section.
2. **Meter Glass**
   Remove it by pushing the catches with your finger.
3. **Speedometer**
   Remove four screws securing the meter at the back side.

INSTALLATION

To install, follow the removal steps in the reverse order.



TACHOMETER

The tachometer is made up of the cross coil type ammeter (movement) that displays indications, and the drive circuit (printed board) that makes exchange between the pulse signals and the current.

Tester display speed	Meter display parmissible level
500	400 – 500
1000	800 – 1050
2000	1800 – 2050
3000	2800 – 3050
4000	3800 – 4050

ON-VEHICLE SERVICE INSPECTION

1. Set up the tune-up tester to the engine.
2. Start the engine and compare the readings displayed by the tachometer and the tester.
   When the difference between these two readings differs largely from the specified value, replace it with a correct one.

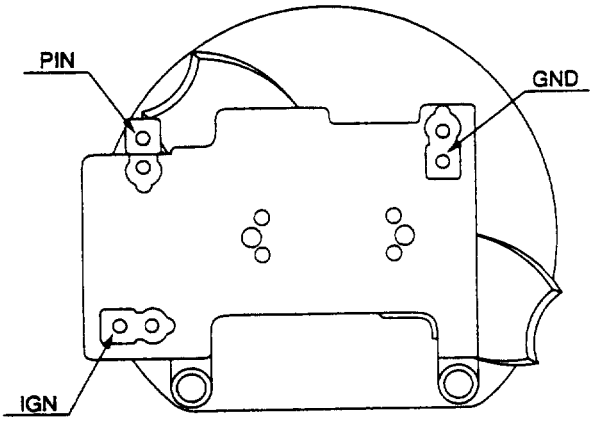
NOTE:

Since the meter display permissible levels above are specifications solely for the meter, they are to be used as reference values when conducting on-vehicle inspection.

INDIVIDUAL INSPECTION

Remove the tachometer from the meter assembly and measure the resistance value and the current consumption between each terminals.

Replace the tachometer when the result of inspection is found abnormal.



Tachometer (Back side)

1. Resistance value

Use the analog type circuit tester. (Range: 1K)

For 12 Volt tachometer

Tester terminal / Terminal symbol	Red (+)	Black (–)	Black (–)	Red (+)
IGN–GND	IGN	GND	IGN	GND
	∞		30 ± 5kΩ	
PIN–GND	PIN	GND	PIN	GND
	33 ± 5kΩ		500~1000kΩ	

For 24 Vol tachometer

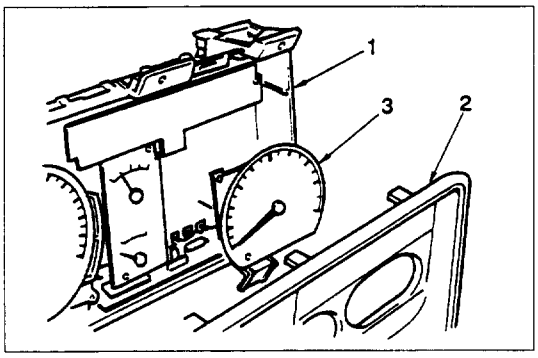
Tester terminal / Terminal symbol	Red (+)	Black (–)	Black (–)	Red (+)
IGN–GND	IGN	GND	IGN	GND
	∞		30 ± 5kΩ	
PIN–GND	PIN	GND	PIN	GND
	33 ± 5kΩ		500~1000kΩ	

2. Current value

Use the analog type circuit tester.

Since the current consumption fluctuates as the power voltage varies, check to be sure that the voltage applied is 12 ± 1V or 24 ± V.

Voltage	Connecting terminal	Current consumption	Remarks
12Volt	IGN–GND	12 ± 1V (when 12 ± 1V applied)	No signal input
24Volt		24 ± 1V (when 24 ± 1V applied)	No signal input



REMOVAL

Preparation:

Disconnect the battery ground cable.

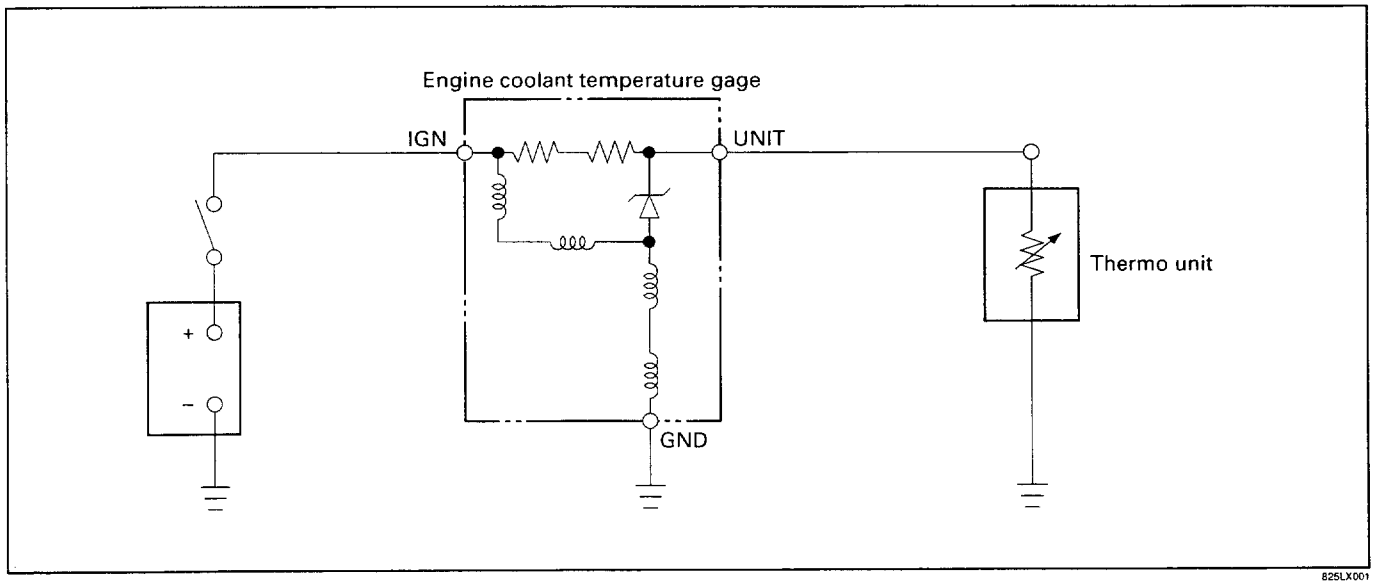
1. **Meter Assembly**
   Refer to "METER ASSEMBLY" in this section.
2. **Meter Glass**
   Remove it by pushing the catches with your finger.
3. **Tachometer**
   Remove three screws securing the meter at the back side.

INSTALLATION

To install, follow the removal steps in the reverse order.

COOLANT TEMPERATURE GAUGE

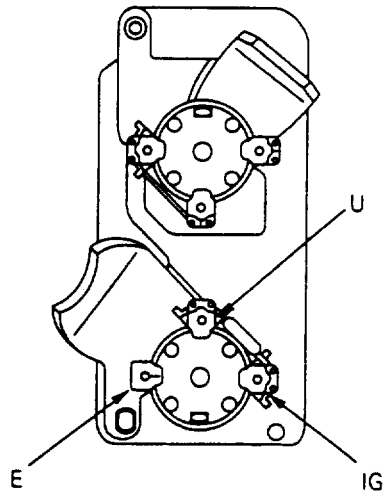
CIRCUIT DIAGRAM



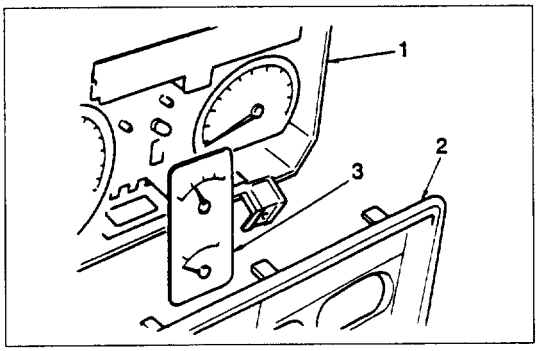
INSPECTION

Remove the coolant temperature gauge from the meter assembly, and measure the resistance value between each terminal.

Replace the coolant temperature gauge when the result of inspection is found abnormal.



Terminal symbol	Resistance value
IG–U	169Ω ± 10%
U–E	333Ω ± 10%
IG–E	242Ω ± 10%



REMOVAL

Preparation:

Disconnect the battery ground cable.

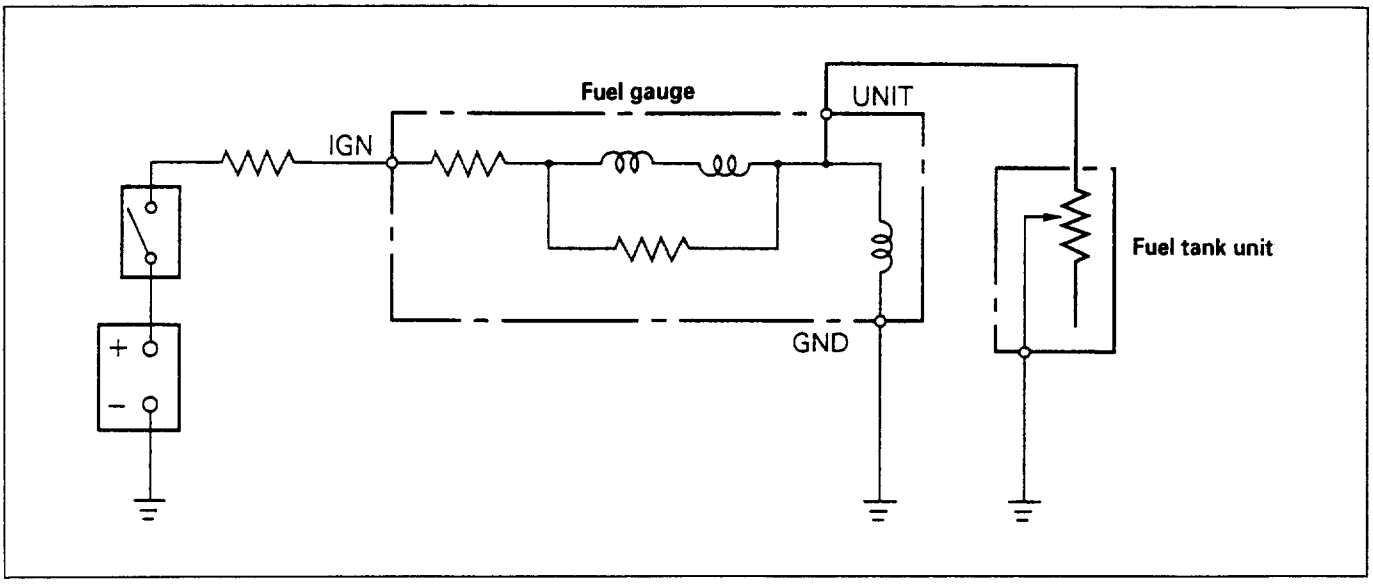
1. **Meter Assembly**
   Refer to "METER ASSEMBLY" in this section.
2. **Meter Glass**
   Remove it by pushing the catches with your finger.
3. **Coolant Temperature Gauge**
   Remove six screws securing the meter at the back side.

INSTALLATION

To install, follow the removal steps in the reverse order.

FUEL GAUGE

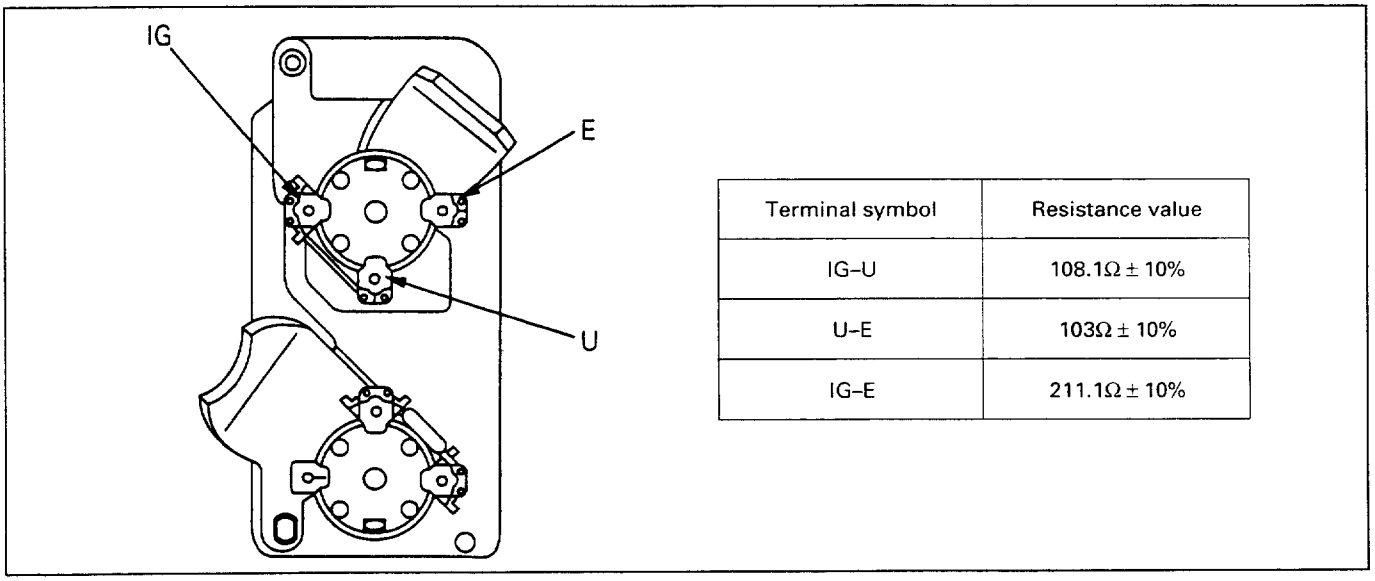
CIRCUIT DIAGRAM



INSPECTION

Remove the fuel gauge from the meter assembly, and measure the resistance value between each terminal.

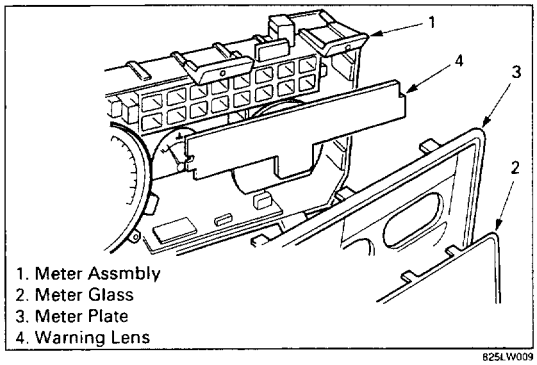
Replace the meter when the result of inspection is found abnormal.



Terminal symbol	Resistance value
IG–U	108.1Ω ± 10%
U–E	103Ω ± 10%
IG–E	211.1Ω ± 10%

REMOVAL AND INSTALLATION

Refer to the "COOLANT TEMPERATURE GAUGE" in this section.



1. Meter Assmbly
2. Meter Glass
3. Meter Plate
4. Warning Lens

WARNING LENS

REMOVAL

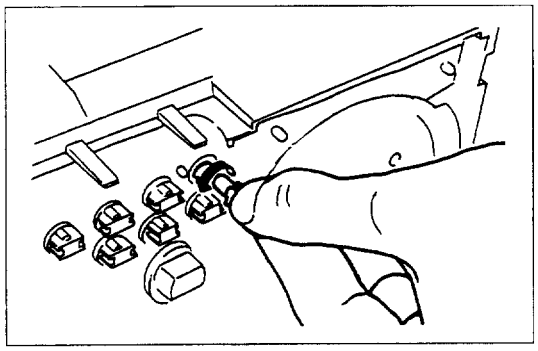
Preparation:

Disconnect the battery ground cable.

1. **Meter Assembly**
   Refer to "METER ASSEMBLY" in this section.
2. **Meter Glass**
   Remove it by pushing the catches with your finger.
3. **Meter Plate**
   Remove it by pushing the catches with your finger.
4. **Warning Lens**

INSTALLATION

To install, follow the removal steps in the reverse order.



WARNING LIGHT BULB, INDICATOR LIGHT BULB AND ILLUMINATION LIGHT BULB.

REMOVAL

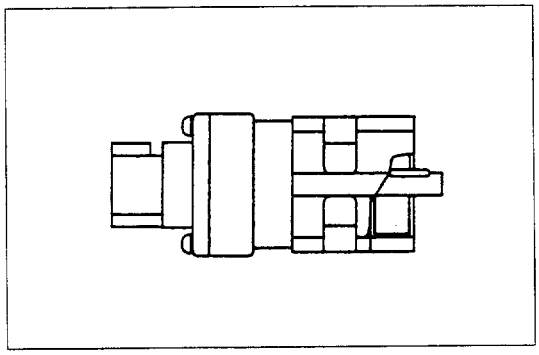
Preparation:

Disconnect the battery ground cable.

1. **Meter Assembly**
   Refer to "METER ASSEMBLY" in this section.
2. **Socket and Bulb**
   Hold the bulb socket by hand and rotate it counterclockwise to remove them from the meter body.
3. **Bulb**
   Pull out the bulb from the socket.

INSTALLATION

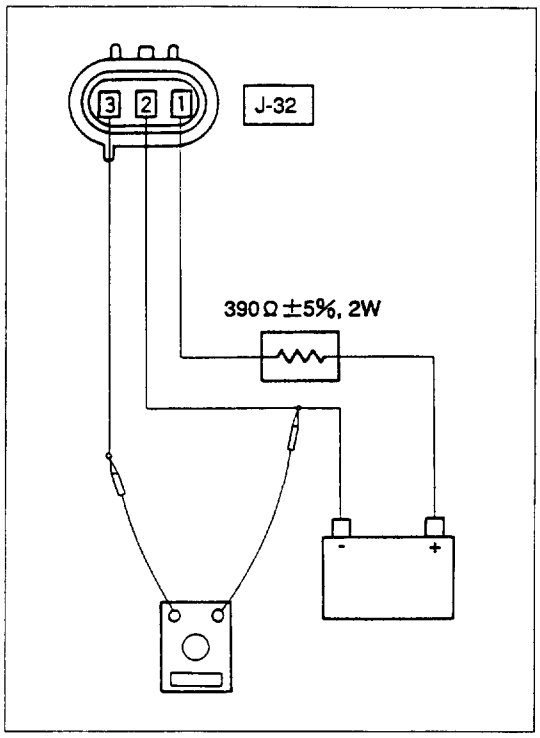
To install, follow the removal steps in the reverse order.



VEHICLE SPEED SENSOR

The vechicle speed sensor is installed on the rear portion of the transmission or transfer case.

The number of pulses generated is four pulses per one rotation of the pinion shaft.



INSPECTION

1. Connect a resistance of 390Ω ± 5%, 2W between connector terminal 1 J-32 and battery (+) terminal and connect the connector terminal 2 J-32 to the battery (–) terminal.

CAUTION

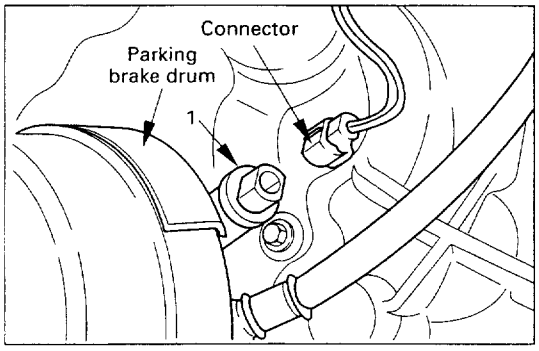
Be extremely careful not to connect the battery (+) terminal to the connector 3 J-32.

This may damage the vehicle speed sensor.

2. Rotate the shaft of the vehicle speed sensor slowly and measure the voltage between 3 J-32 and 2 J-32 with a digital tester.

The voltage, with one rotation of shaft, fluctuates four times in the following range: 10 to 14V ↔ 24 or less.

Replace the sensor when the result of inspection is found abnormal.



REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Vehicle Speed Sensor**

Disconnect the connector.

INSTALLATION

1. Tighten the vehicle speed sensor to the specified torque.

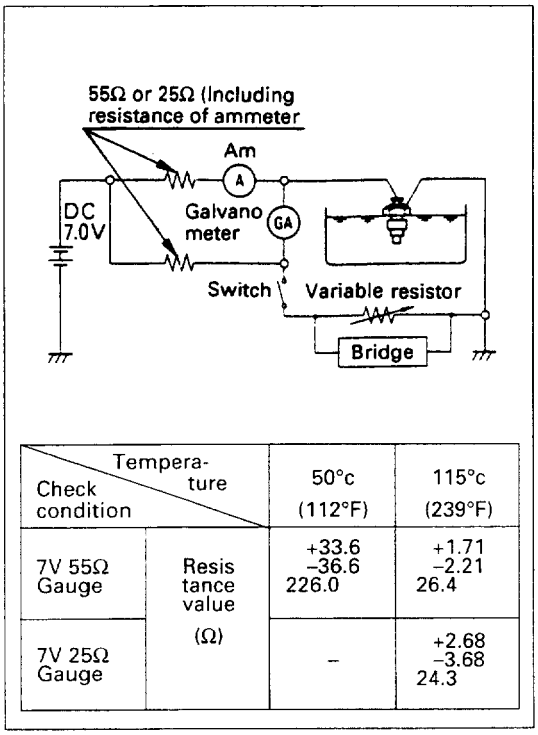
Vehicle speed sensor torque	N·m (kg·cm/lb·ft)
	25 (2.5/18)

CAUTION:

Tightening must be made at the hexagonal part of the sensor.

To tighten the connector itself would cause damage.

THERMO UNIT



Check condition \ Temperature		50°c (112°F)	115°c (239°F)
7V 55Ω Gauge	Resistance value (Ω)	+33.6 −36.6 226.0	+1.71 −2.21 26.4
7V 25Ω Gauge		–	+2.68 −3.68 24.3

INSPECTION

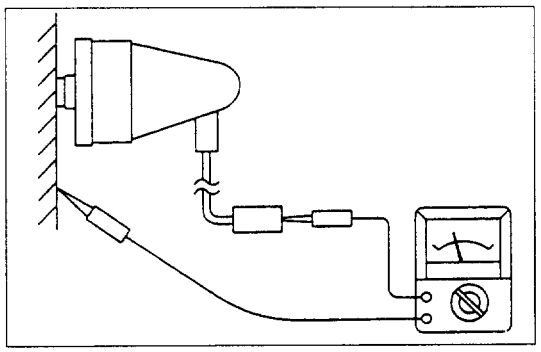
The thermo unit is thermistor type and must be inspected under the conditions as shown in the left chart.

1. Put the deviation of the galvanometer to 0 by using the variable resistor, switch the thermo unit off and then measure the resistance of the resistor through the bridge.

   Confirm that the resistance is continuously variable in any other points than those shown in the left chart.
2. Dip the thermo unit into 80 – 90°C (176 – 194°F) water and confirm that there is no bubble continuously coming out of inside of the unit.

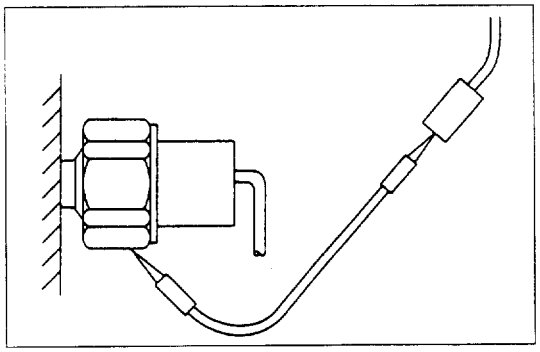
   Replace the unit when the result of inspection is found abnormal.

OIL PRESSURE SWITCH



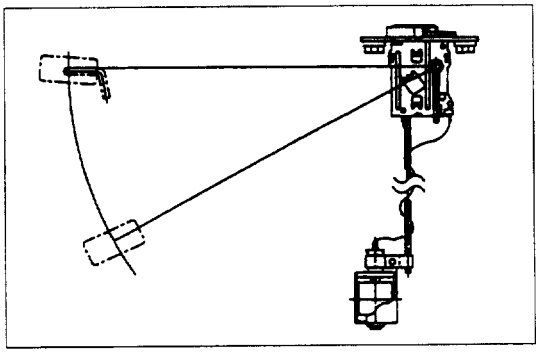
INSPECTION

Check the continuity between the switch terminal and the body ground with the starter switch is OFF position. Replace the switch when the result of inspection is found abnormal.



CIRCUIT INSPECTION

1. Start the engine
2. When disconnecting the oil pressure switch connector then connecting the harness side connector to the ground, check to see if the oil pressure warning light lights up. When the light will not light up, check the circuit between the meter and the oil pressure switch, and repair an open circuit if necessary.



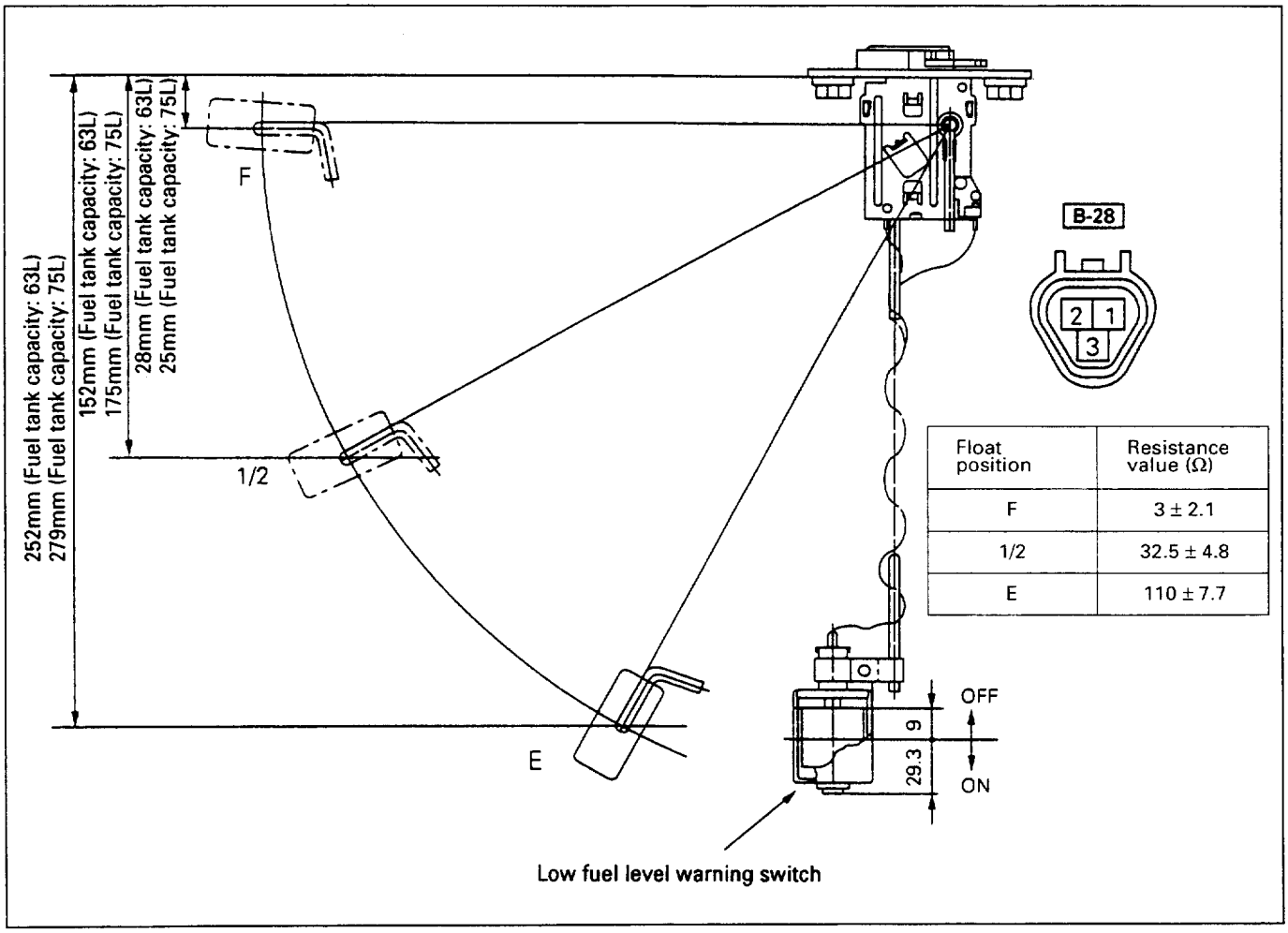
FUEL TANK UNIT

The tank unit varies the internal resistance according to the float position (fluid level) to operate the fuel meter needle. Also available is the build-in switch type to warn the driver of low fuel level (about 5 liters left in the tank) by illuminating the fuel warning light.

INSPECTION

(Level Switch type of warn low fuel level)

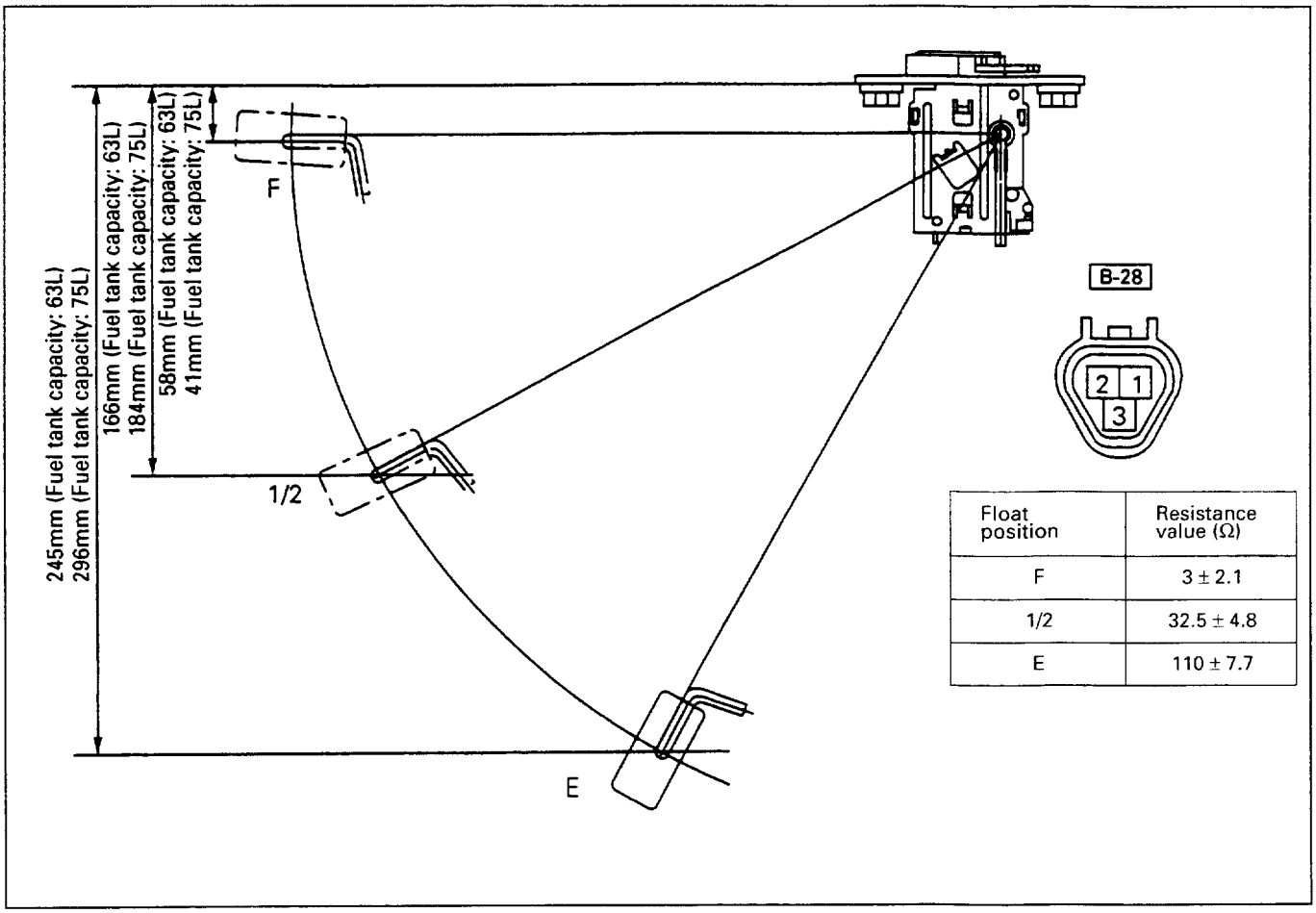
1. Check the resistance between the connector terminals 1 J-28 and 3 J-28 while shifting the float from "E" to "F" point.
2. Check if the low fuel warning switch turns on and off at the specified positions. If found defective, replace the fuel tank unit.



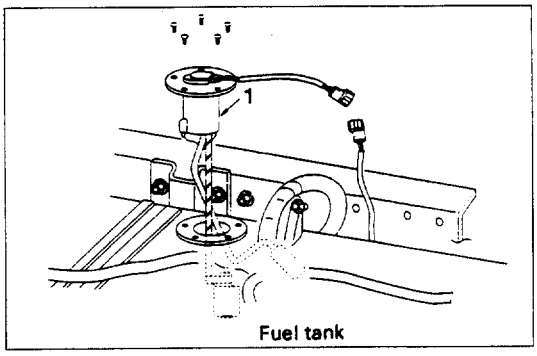
Float position	Resistance value (Ω)
F	3 ± 2.1
1/2	32.5 ± 4.8
E	110 ± 7.7

(Float type of warn low fuel level)

1. Check the resistance between the connector terminals 1 J-28 and 3 J-28 while shifting the float from "E" to "F" point.
2. Check if the low fuel warning light turns on when the float is at "E" position. If found defective replace the fuel tank unit.



Float position	Resistance value (Ω)
F	3 ± 2.1
1/2	32.5 ± 4.8
E	110 ± 7.7



REMOVAL

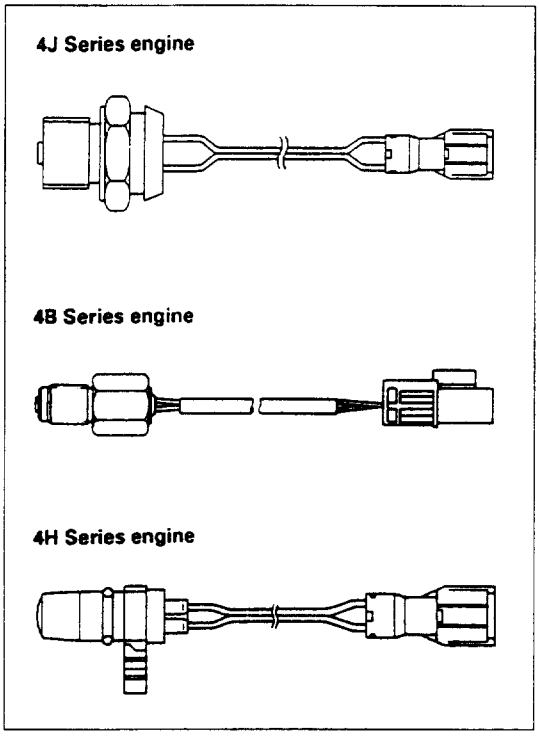
Preparation:

Disconnect the battery ground cable.

1. **Fuel Tank Unit**
   1) Disconnect the connector.
   2) Remove five screws.

INSTALLATION

To install, follow the removal steps in the reverse order.



ENGINE SPEED SENSOR

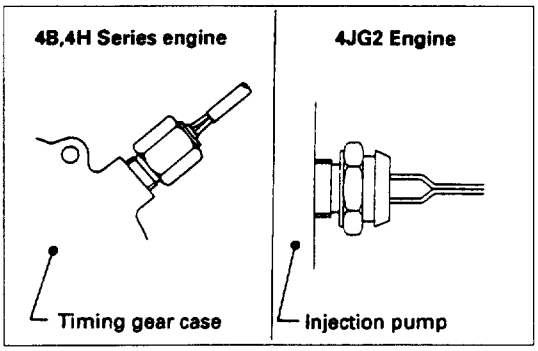
INSPECTION

Measure the resistance value between the engine speed sensor connector terminals.

Replace the engine speed sensor when the result of inspection is found abnormal.

4J Series engine = 1.36 – 1.86 KΩ

4H Series engine = 0.57 – 0.86 KΩ



REMOVAL

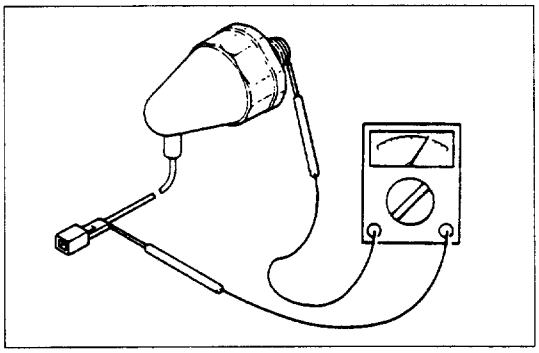
Preparation:

Disconnect the battery ground cable.

1. **Engine Speed Sensor**
   1) Disconnect the connector.
   2) Remove the engine speed sensor.

INSTALLATION

To install, follow the removal steps in the reverse order.



VACUUM SWITCH

INSPECTION

When the pressure value is below 250 ± 30mm Hg (33.3 ± 4.0 kPa), check to see if there is continuity between the terminal and the ground. If no continuity, replace the switch with a normal one.

REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Vacuum Switch**
   1) Disconnect the connector.
   2) Remove the vacuum switch.

INSTALLATION

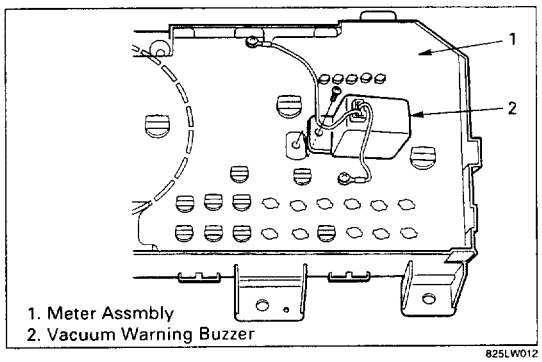
Apply liquid gasket to the screw portion of the switch to prevent vacuum leak.

VACUUM WARNING BUZZER

INSPECTION

Apply battery voltage to the buzzer connector terminals to check the buzzer sound.

Replace the buzzer when the result of inspection is found abnormal.



1. Meter Assmbly
2. Vacuum Warning Buzzer

825LW012

REMOVAL

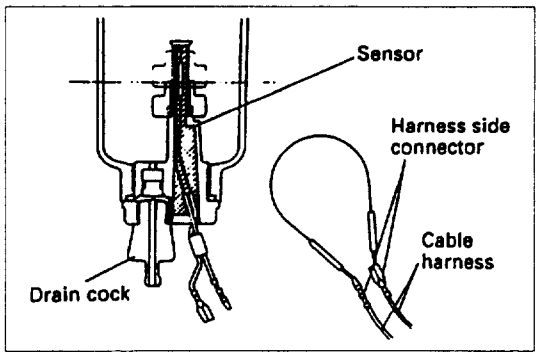
Preparation:

Disconnect the battery ground cable.

1. **Meter Assembly**
   Refer to "METER ASSEMBLY" in this section.
2. **Vacuum Warning Buzzer**
   1) Disconnect the connector.
   2) Remove the buzzer fixing screw.

INSTALLATION

To install, follow the removal steps in the reverse order.

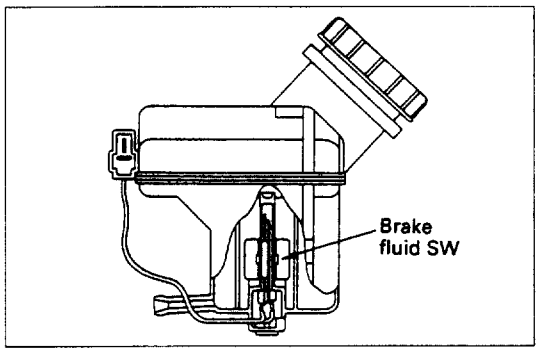


WATER SEDIMENTER SWITCH

INSPECTION

1. When the float in the water sedimenter is above the drain warning level, confirm if there is continuity between the switch connector terminals.
2. Turn the starter switch on, disconnect the water sedimenter connector and connect the harness side connector terminals. Then confirm that the sedimenter warning light turns on.

   If found defective, replace the switch or repair a poor connection or an open circuit between the connector terminals.



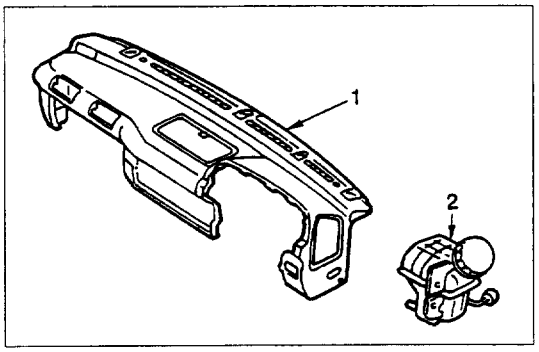
BRAKE FLUID SWITCH

INSPECTION

1. Confirm there is continuity between the switch connector terminals when the brake fluid in the tank is between 60 – 75 cc level.
2. Turn the switch on, disconnect the brake fluid switch connector and connect the harness side connector terminals.

   Then confirm that brake warning light turns on.

   If found defective, replace the tank, or repair a poor connection or an open circuit between the connector terminals.



REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Instrument Panel Assembly**

   Refer to "INSTRUMENT PANEL" of section 10 "CAB".
2. **Brake Fluid Tank (Brake Fluid Switch)**
   1) Disconnect the switch connector.
   2) Remove four fixing nuts.
   3) Drain brake fluid in the tank.
   4) Disconnect the tubes.

CAUTION:

Be very careful not to allow the brake fluid to come in contact with painted surfaces or resin parts surfaces.

INSTALLATION

To install, follow the removal steps in the reverse order, noting the following points.

1. Bleed the air from brake and clutch fluid pipe line.
2. Check to see if the brake fluid level in the tank with-in specified level.
3. Check to see if brake warning light comes on when starter switch is turned on and then warning light go off after the engine running.

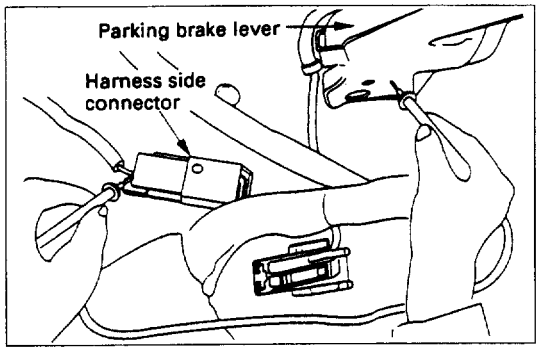
PARKING BRAKE INDICATOR LIGHT

The parking brake indicator light is connected in series with the parking brake switch installed to the parking brake lever bracket.

The light comes on when the parking brake lever is pulled, and goes out when the parking brake lever is fully released.

NOTE:

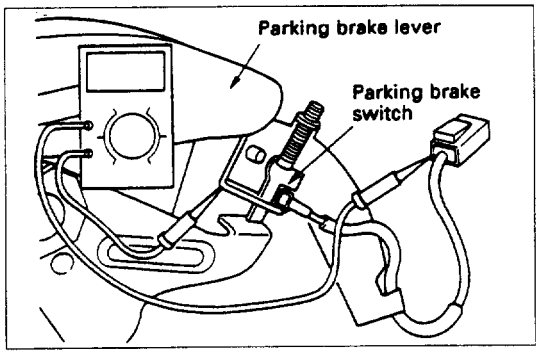
The parking brake indicator light illuminates to warn the driver that the parking brake is on. This light does not indicate the condition of the operability of the parking brake.



CIRCUIT INSPECTION

1. Disconnect the parking brake switch connector.
2. Connect the harness side connector terminal to the ground.
3. Check to see if the indicator light comes on with the starter switch "ON".

   Check the bulb or the harness when the result of inspection is found abnormal.



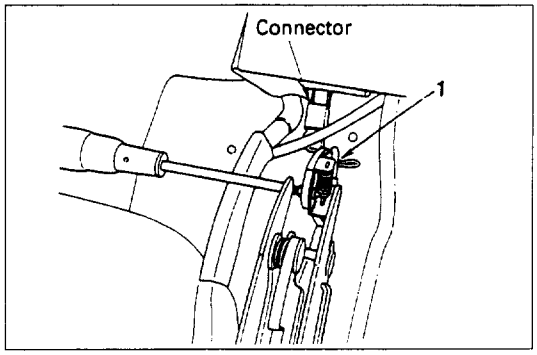
PARKING BRAKE SWITCH

INSPECTION

1. Disconnect the parking brake switch connector.
2. Check to see if there is any continuity between the switch terminal and the body ground with the circuit tester connected between them.

When parking brake applied	Continuity
When parking brake released	No continuity

Repair the parking brake switch or replace it when the result of inspection is found abnormal.



REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Parking Brake Switch**
   1) Disconnect the connector.
   2) Remove the fixing screw.

INSTALLATION

To install, follow the removal steps in the reverse order.

MEMO

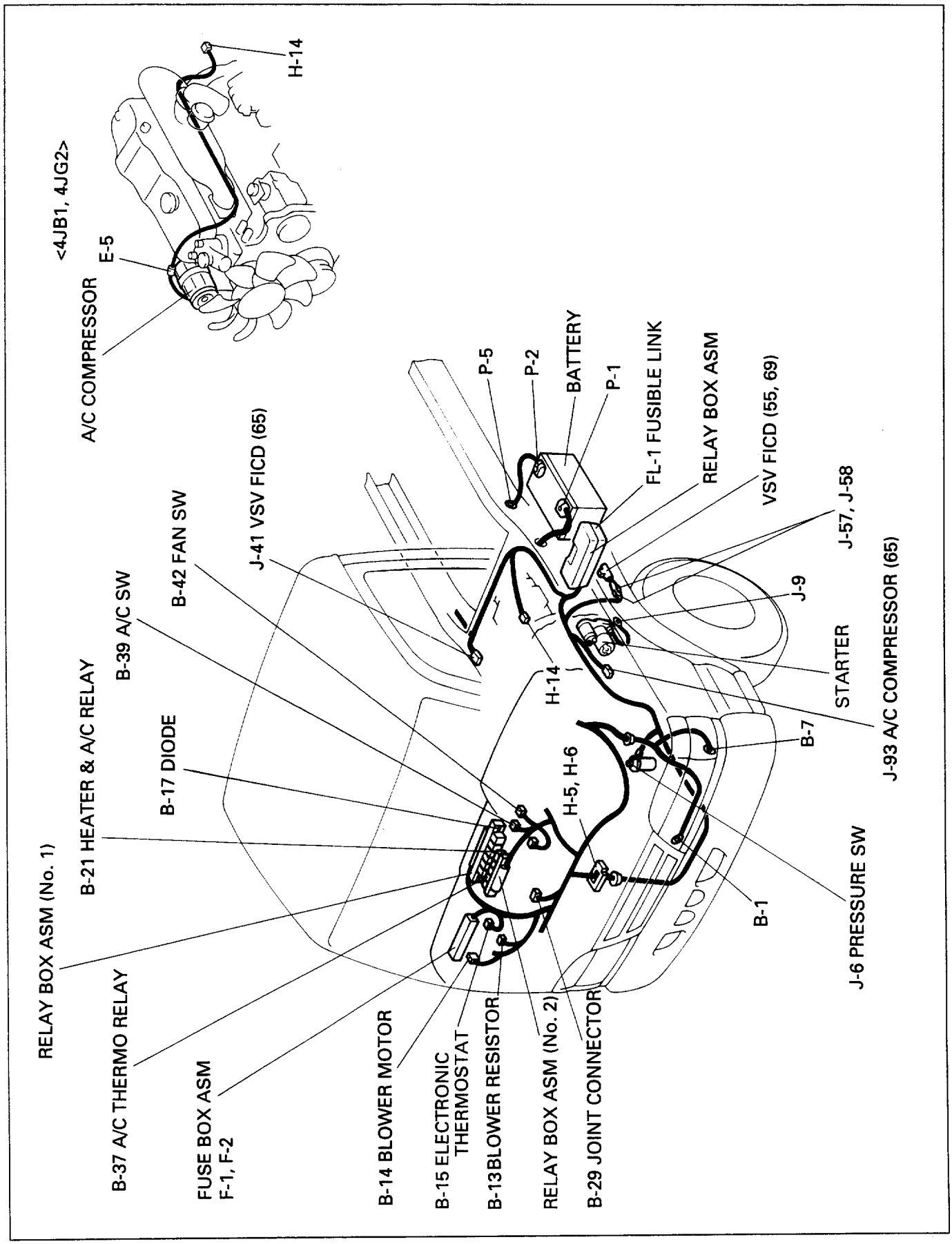
HEATER AND AIR CONDITIONING

GENERAL DESCRIPTION

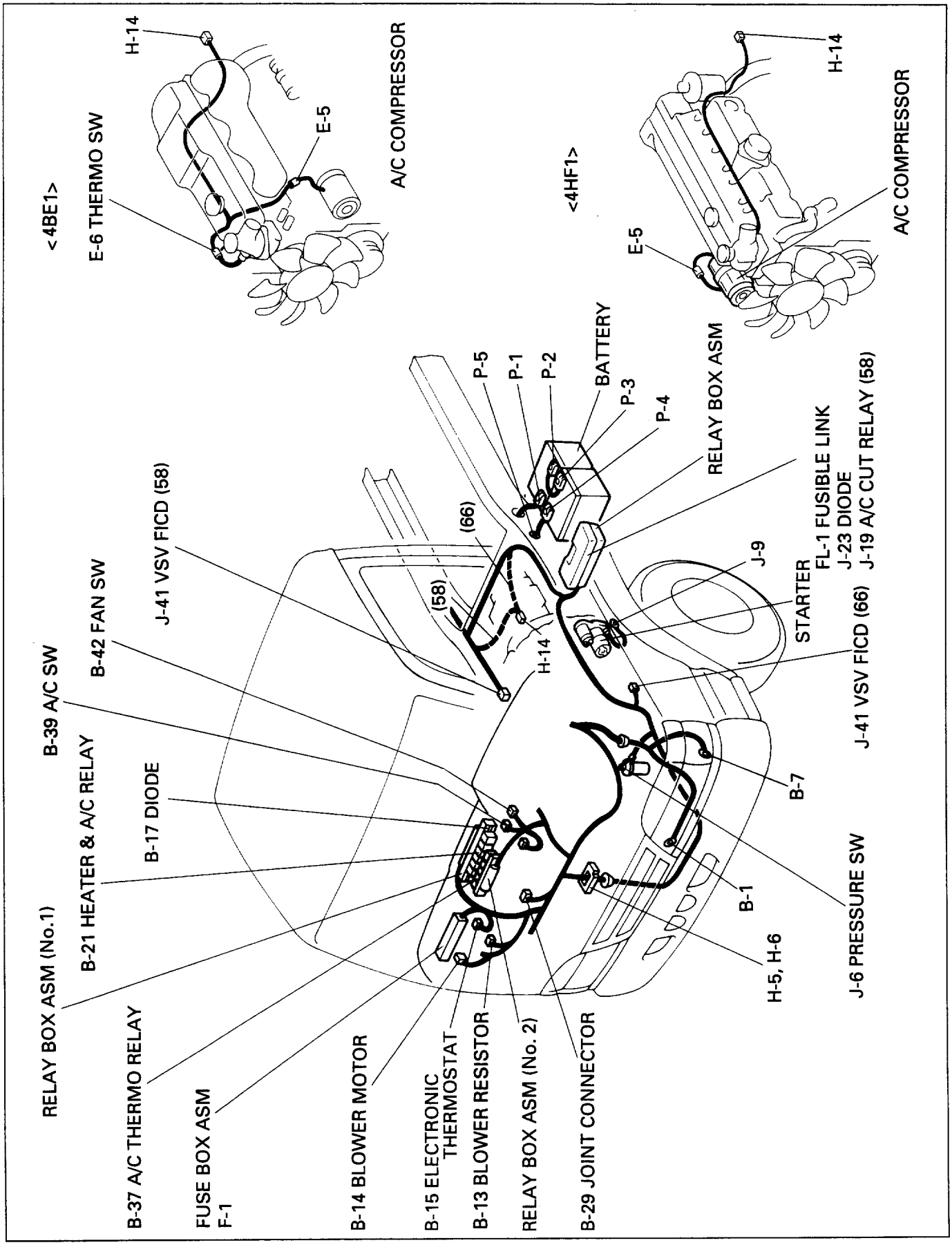
The air conditioning consists of compressor, evaporator, condenser, A/C switch, fan switch, etc. When the engine is rotating, the A/C starts to work with both the A/C and fan switches "ON", followed by the engagement of the magnetic clutch. It stops to work when either the fan switch or the A/C switch turns "OFF". In addition to the switches, the A/C has the function of temporary stop of its operation by the sensing system in the A/C cycle, such as:

- sensing abnormal rise of the refrigerant pressure by means of the pressure switch.
- sensing temperature of the blowing-off air by means of the thermo switch preventing the evaporator from freezing.
- sensing the coolant temperature by the thermo switch (available for limited models only).

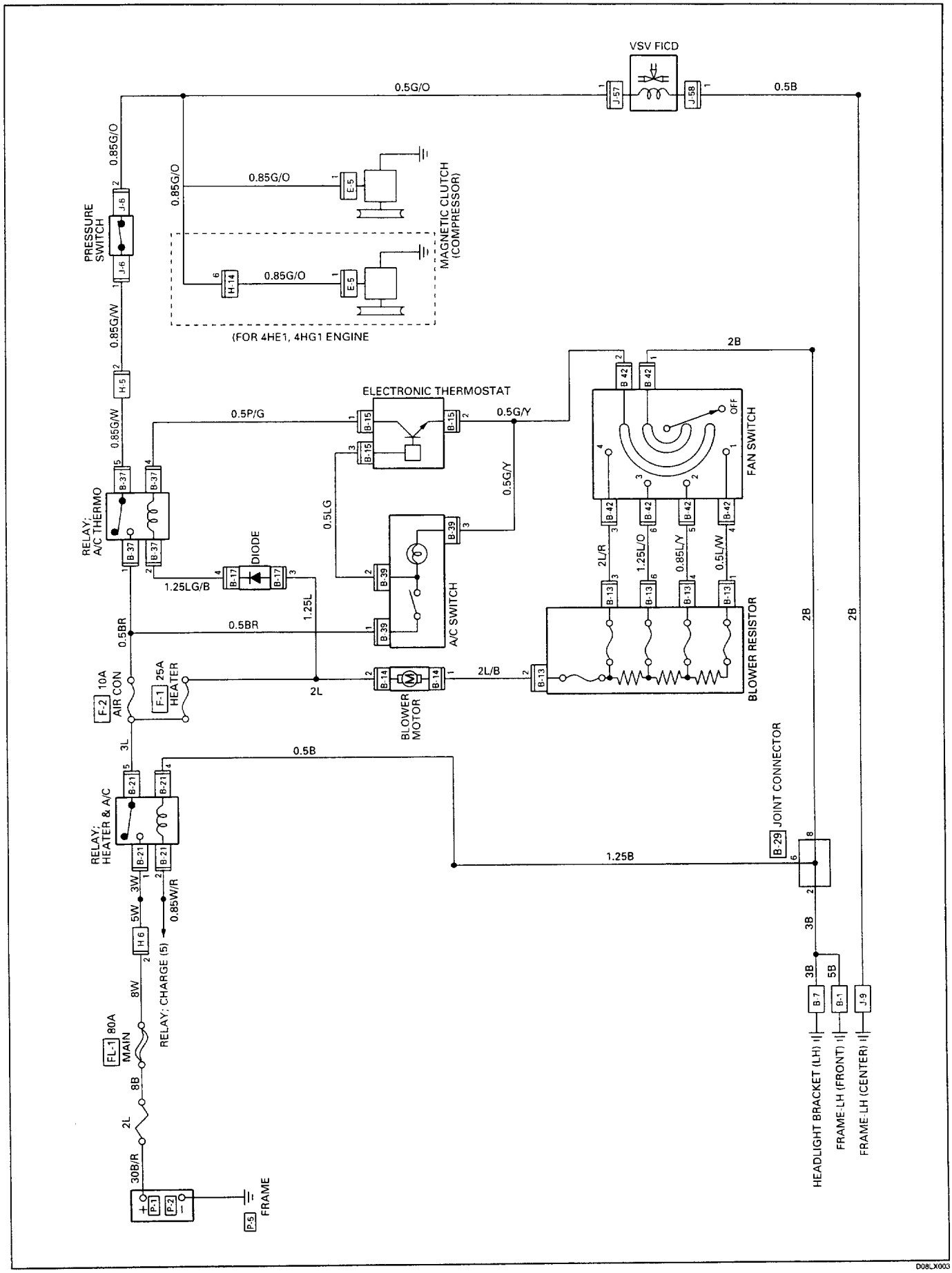
PARTS LOCATION – FOR 12 VOLT



PARTS LOCATION – FOR 24 VOLT

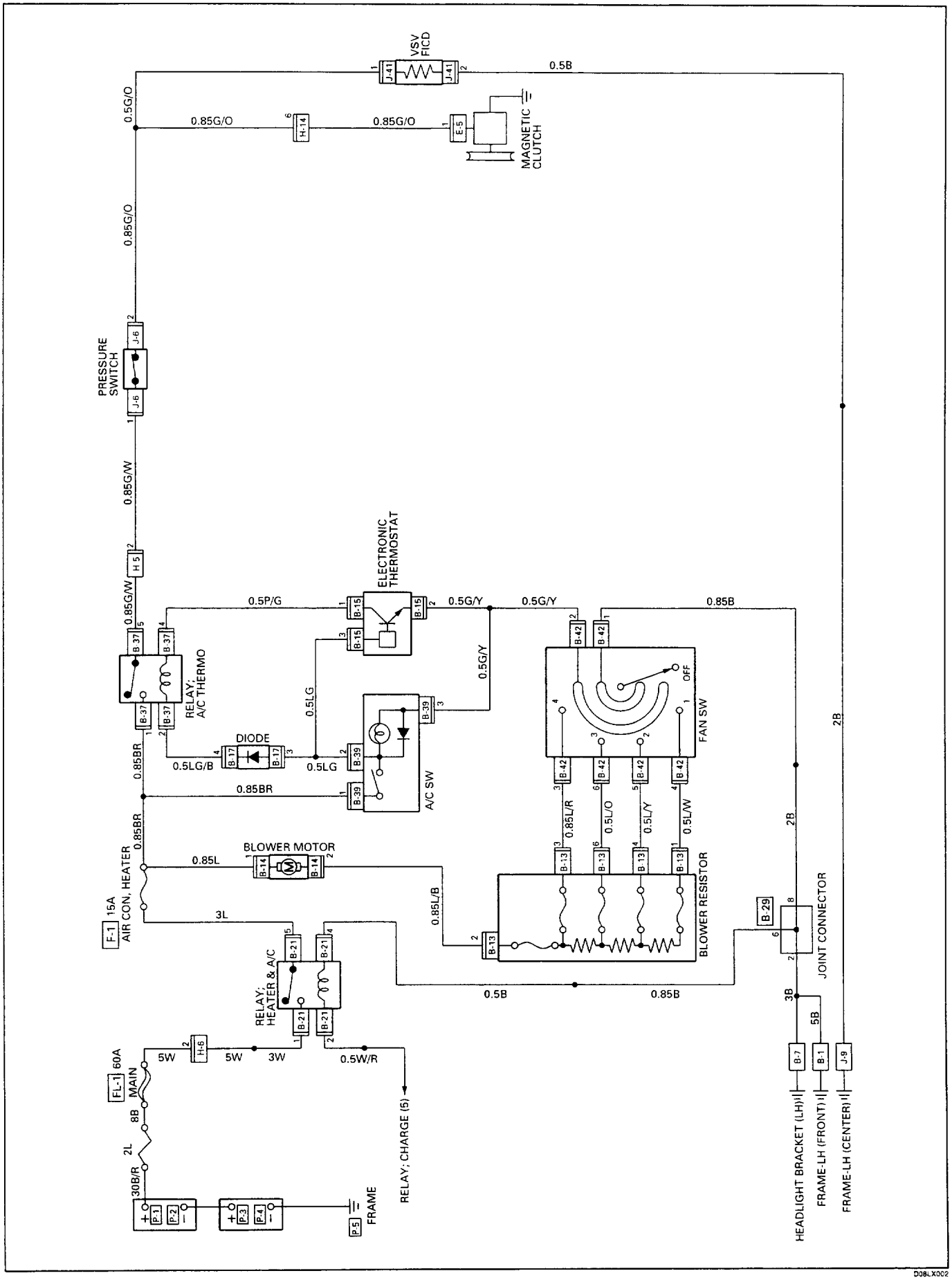


CIRCUIT DIAGRAM – FOR 12 VOLT

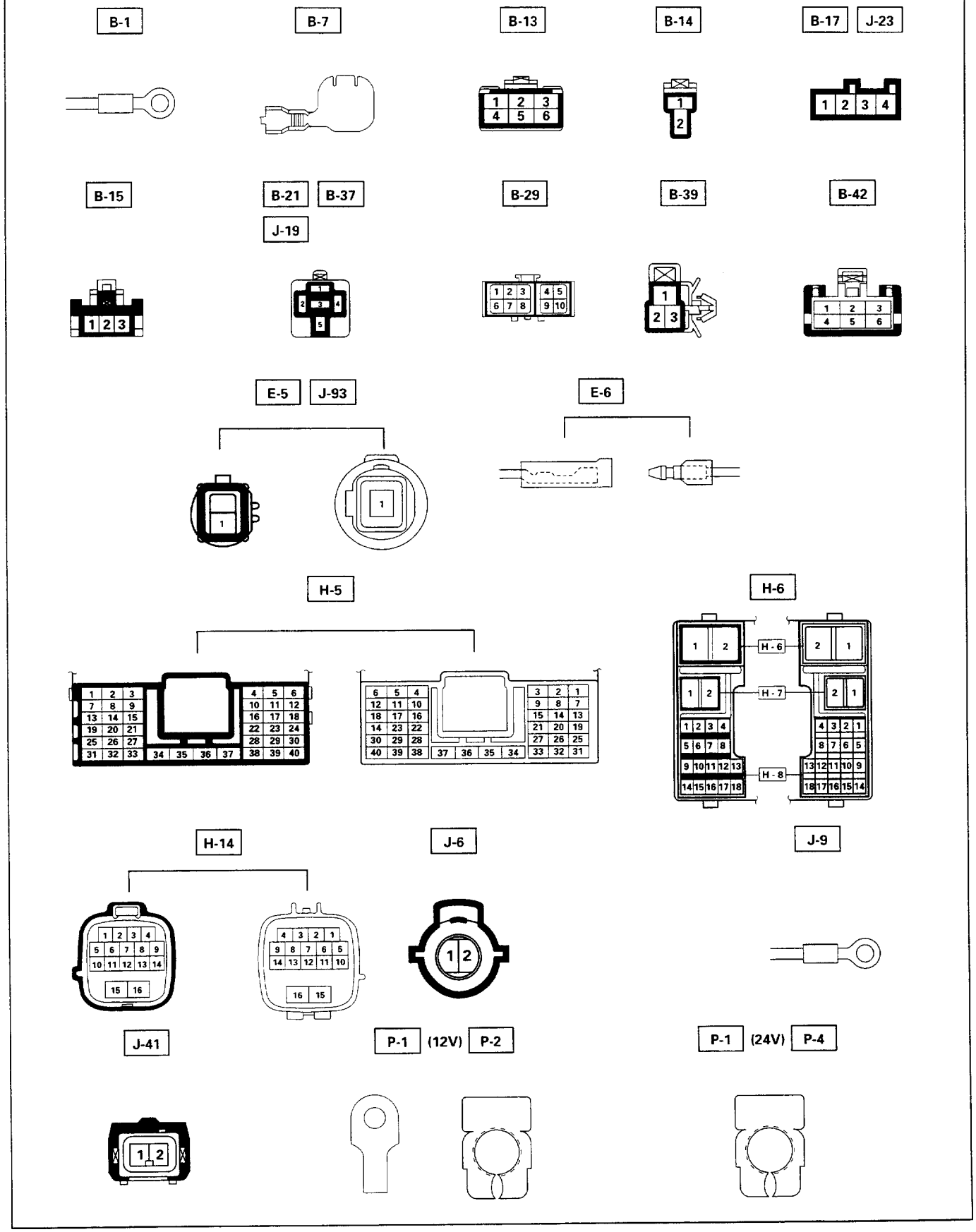


D08LX003

CIRCUIT DIAGRAM – FOR 24 VOLT – NKR66 • NPR66 • NQR66

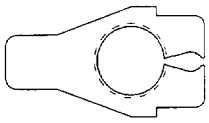


CONNECTOR LIST



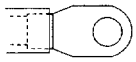
CONNECTOR LIST

P-2 (24V) P-3



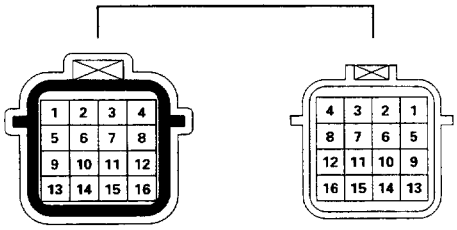
P-5 (12V)

P-5 (24V)



B-17 J-23

H-14



MEMO

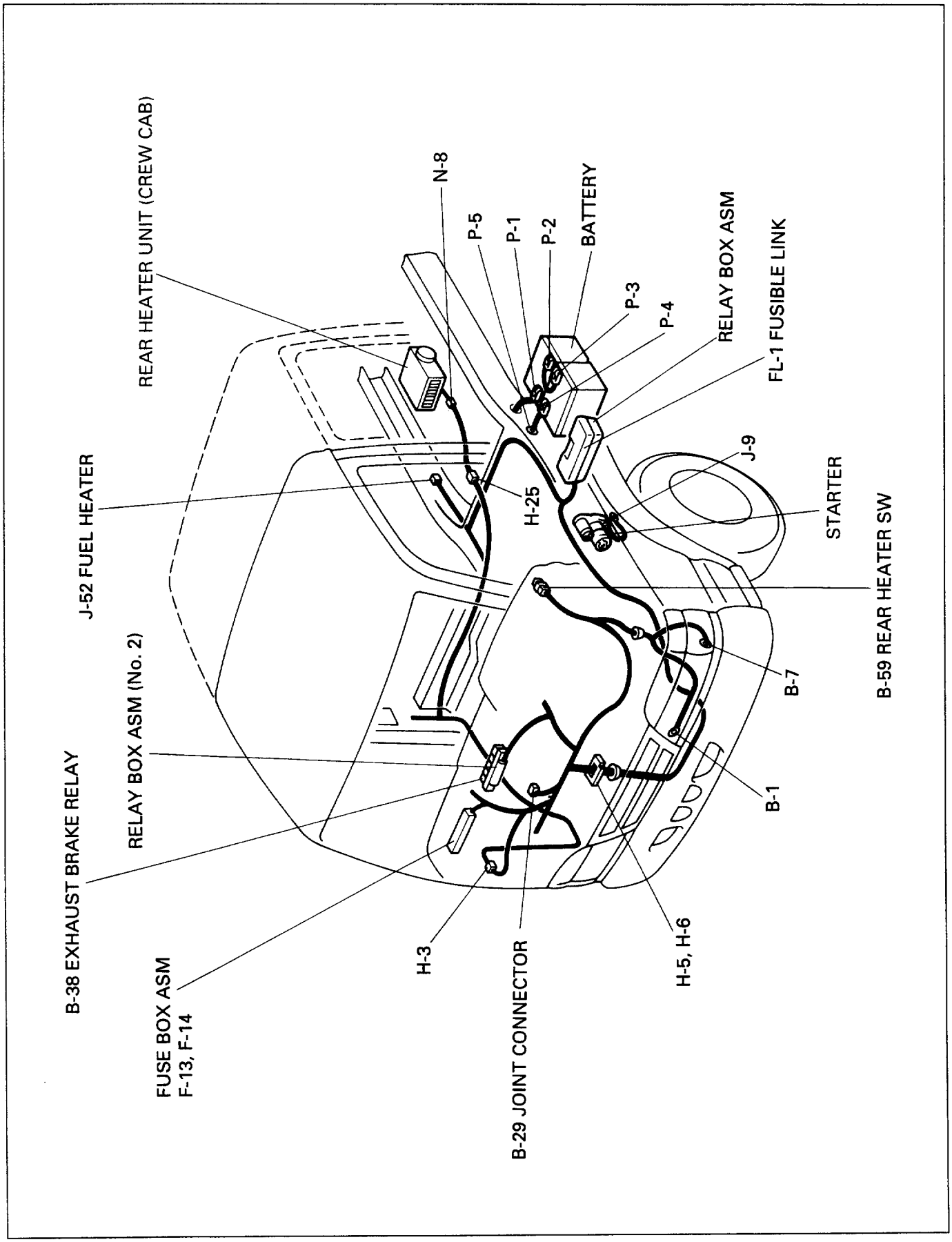
FUEL HEATER AND REAR HEATER

GENERAL DESCRIPTION

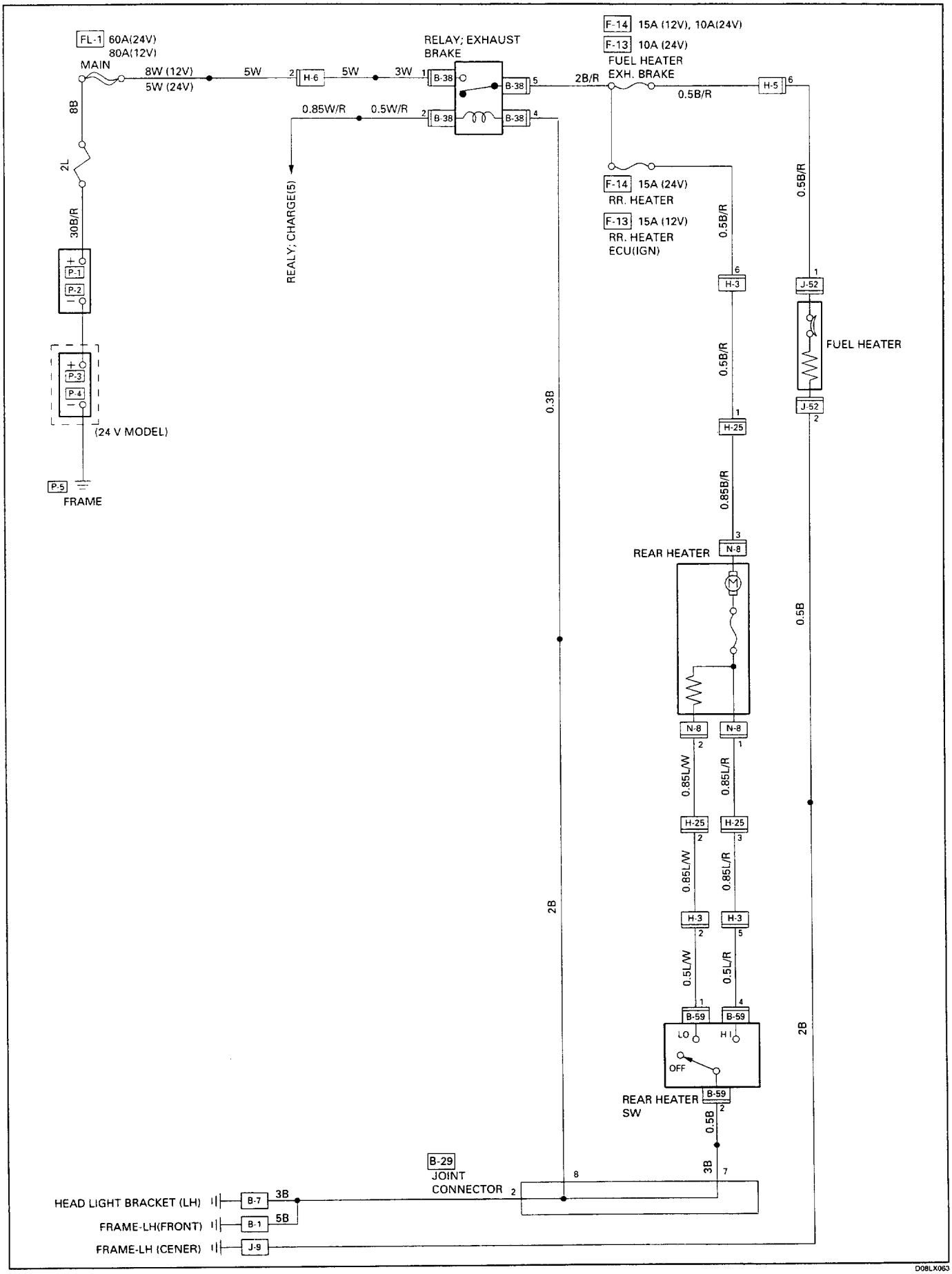
The circuit consists of fuel heater, rear heater, rear heater switch and the exhaust brake relay.

The fuel heater circuit is always in "ON" position when the generator is charging and its temperature is automatically controlled by the circuit breaker built in the fuel heater.

PARTS LOCATION

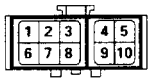


CIRCUIT DIAGRAM

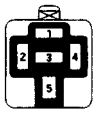


CONNECTOR LIST

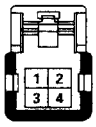
B-29



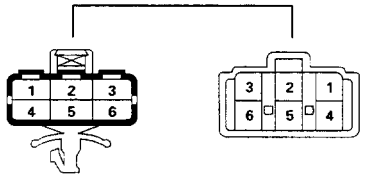
B-38



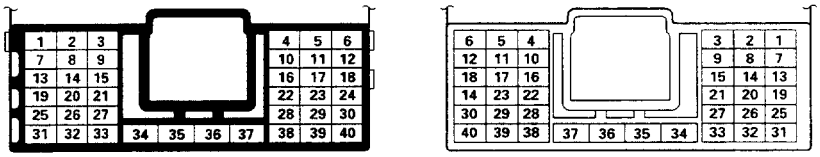
B-59



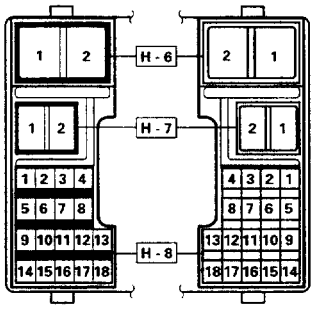
H-3



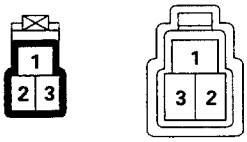
H-5



H-6



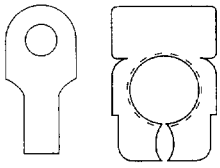
H-25



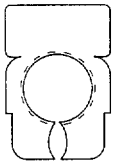
J-52

N-8

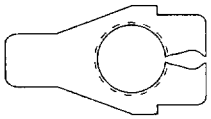
P-1 (12V) P-2



P-1 (24V) P-4

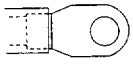


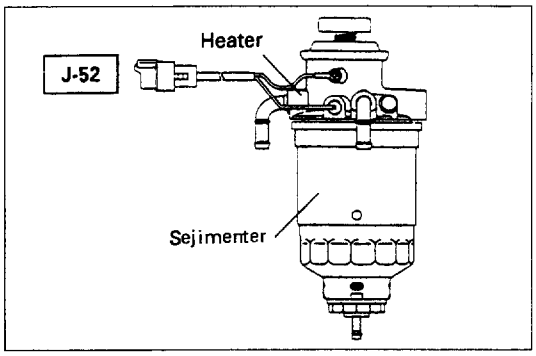
P-2 (24V) P-3



P-5 (12V)

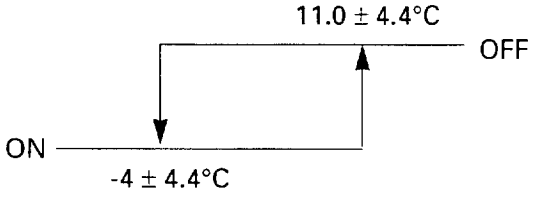
P-5 (24V)

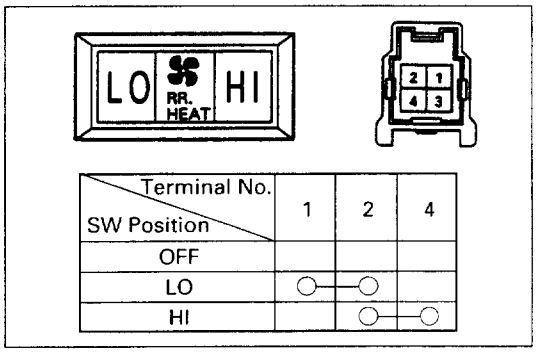




FUEL HEATER

Characteristic of fuel heater





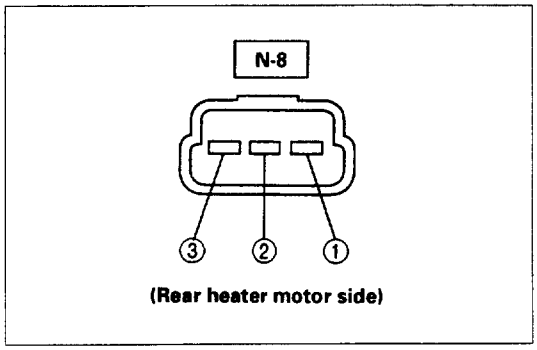
Terminal No. / SW Position	1	2	4
OFF			
LO	○	○	
HI		○	○

REAR HEATER SWITCH

INSPECTION

Check the continuity between the connector terminals while operating the switch.

Replace the switch when the result of inspection is found abnormal.



REAR HEATER MOTOR

INSPECTION

Disconnect the rear heater connector.

Connect the battery positive terminal to the NO.3 terminal of the rear heater motor side connector and negative to the NO.2. Check to see if rear heater motor operates low-speed correctly.

Connect the battery positive terminal to the NO.3 terminal of the rear heater motor side connector and negative to the NO.1. Check to see if rear heater motor operates high-speed correctly.

Replace the rear heater motor when the result of inspection is found abnormal.

LGCEL-WE-9981LH

You are requested to order this manual using the manual number that is shown above.

This manual is applicable for vehicles in all countries except the USA and Canada.

All rights reserved. This manual may not be reproduced in whole or in part, without the permission in writing of ISUZU MOTORS LIMITED.

Issued by

ISUZU MOTORS LIMITED

INTERNATIONAL SERVICE DEPARTMENT

Tokyo, Japan

First edition Jan., 1999 9009-02K-0.2

LGCEL-WE-9981LH PRINTED IN JAPAN

WORKSHOP MANUAL

NHR · NKR · NPR · NQR · NPS

CAB AND CHASSIS ELECTRICAL

SECTION 8

ISUZU

ISUZU

International Service & Parts

Tokyo, Japan

NOTICE

Before using this Workshop Manual to assist you in performing vehicle service and maintenance operations, it is recommended that you carefully read and thoroughly understand the information contained in Section 0A under the headings "GENERAL REPAIR INSTRUCTIONS" and "HOW TO USE THIS MANUAL".

All material contained in this Manual is based on latest product information available at the time of publication.
All rights are reserved to make changes at any time without prior notice.

Applicable Model

N-Series		
NHR55	NPR66	NPS71
NHR69	NPR69	NQR66
NKR55	NPR70	NQR70
NKR66	NPR71	NQR71
NKR69		

THIS MANUAL INCLUDES THE FOLLOWING SECTIONS:

SECTION NO.	CONTENTS
8	CAB AND CHASSIS ELECTRICAL

SECTION 8

CAB AND CHASSIS ELECTRICAL

CAUTION:

When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size and strength (or stronger) may be used. Fasteners that are not reused, and those requiring thread locking compound, will be called out. The correct torque values must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

CONTENTS

PAGE

General Information . . . . . 8 – 3
Notes for Working on Electrical Items . . . . . 8 – 3
Symbols and Abbreviations . . . . . 8 – 9
Symbols . . . . . 8 – 9
Abbreviations . . . . . 8 –10
Parts for Electrical Circuit . . . . . 8 –11
Wiring . . . . . 8 –11
Fuse, Fusible Link and Circuit Breaker . . . . . 8 –12
Relay . . . . . 8 –13
Diode . . . . . 8 –15
Connector . . . . . 8 –16
Reading the Circuit Diagram . . . . . 8 –18
Connector Symbol . . . . . 8 –20
Joint Connector . . . . . 8 –20
Main Data and Specifications . . . . . 8 –21
Bulb Specifications . . . . . 8 –21
Fuse and Fusible Link Location . . . . . 8 –24
Fuse Block Circuit . . . . . 8 –27
Reference Table of Fuse and Circuit Breaker . . . . . 8 –30
Relay Location . . . . . 8 –32
Diode Location . . . . . 8 –35
Reference Table of Grounding Point . . . . . 8 –36
Grounding Point Location . . . . . 8 –38

PAGE

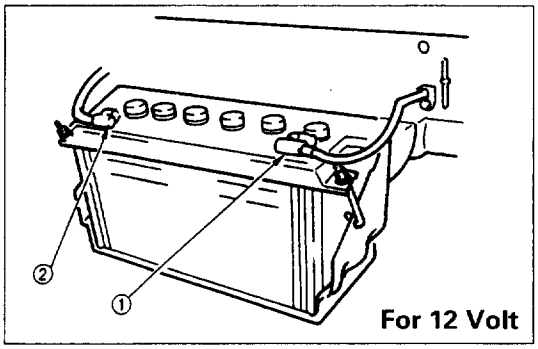
Cable Harness Routing . . . . . 8 – 39
System Repair . . . . . 8 – 42
Start and Charging . . . . . 8 – 42
QOS (Quick on Start) System . . . . . 8 – 50
Exhaust Brake System . . . . . 8 – 62
Exhaust Brake System and Engine Control System (70TC) . . . . . 8 – 76
Engine Stop System . . . . . 8 – 82
Headlight, Fog Light, Rear Fog Light, and Cornering Light . . . . . 8 – 88
Headlight Leveling . . . . . 8 –112
Clearance Light, Taillight, License Plate Light and Illumination Light . . . . . 8 –122
Turn Signal Light, Hazard Warning Light and Stoplight . . . . . 8 –135
Horn, Backup Light and Backup Buzzer . . . . . 8 –147
Dome Light and Backup Buzzer . . . . . 8 –160
Power Door Lock . . . . . 8 –170
Power Window . . . . . 8 –181
A/T ECU (Electronic Control Unit) . . . . . 8 –196
Windshield Wiper and Washer . . . . . 8 –204
Audio and Cigar Lighter . . . . . 8 –224
Meter and Warning/Indicator Light . . . . . 8 –234
Heater and Air Conditioning . . . . . 8 –282
Fuel Heater and Rear Heater . . . . . 8 –290
4WD Transfer (Vacuum Control) . . . . . 8 –295

GENERAL INFORMATION

The chassis electrical system is of 12-volt specifications with a negative ground polarity.
Wire sizes are appropriate to respective circuits, and classified by color. (The classification of harnesses by color is shown on the circuit diagram for ease of harness identification.)
The wire size is determined by load capacity and the length of wire required.
The vehicle harnesses are: body harness, floor harness, engine harness, frame front harness, frame rear harness, rear body harness, dome light harness, door harness and battery cable.
The harnesses are protected either by tape or corrugated tube, depending on harness location.
The circuit for each system consists of the power source, wire, fuse, relay switch, load parts and ground, all of which are shown on the circuit diagram.
In this manual, each electrical device is classified by system. For major parts shown on the circuit based on the circuit diagram for each system, a summary, diagnosis of troubles, inspection and removal and installation procedures are detailed.

NOTES FOR WORKING ON ELECTRICAL ITEMS

BATTERY CABLE



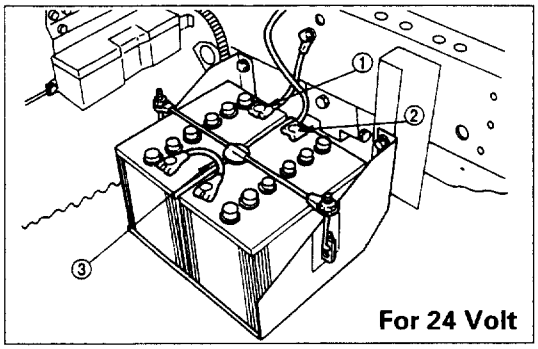
For 12 Volt

Disconnecting the Battery Cable

1) All switches should be in the "OFF" position.
2) Disconnect the battery ground cable.
3) Disconnect the battery positive cable
4) Disconnect the battery cable ③

CAUTION:

It is important that the battery ground cable be disconnected first.
Disconnecting the battery positive cable first can result in a short circuit.



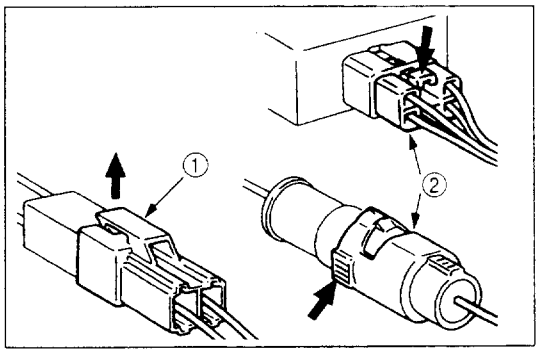
For 24 Volt

Connecting the Battery Cable

Follow the disconnecting procedure in the reverse order.

CAUTION:

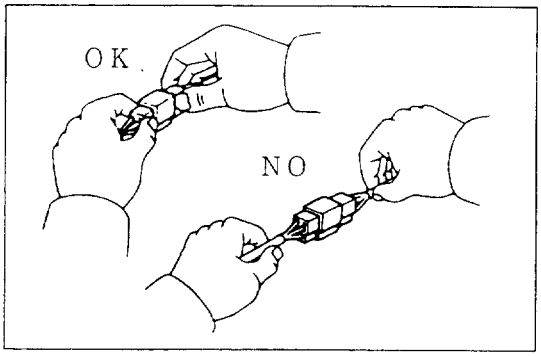
Clean the battery terminal and apply a light coat of grease to prevent terminal corrosion.



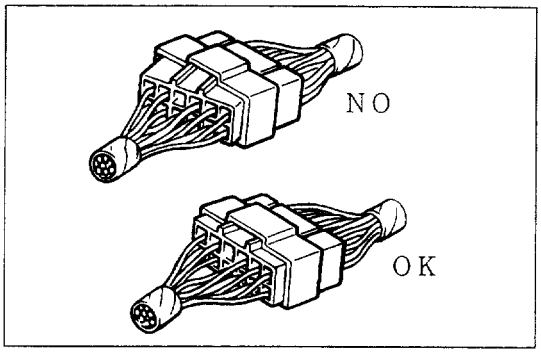
Connector Handling

Disconnecting The Connectors

Some connectors have a tang lock to hold the connectors together during vehicle operation.
Some tang locks are released by pulling them towards you ①.
Other tang locks are released by pressing them forward ②.
Determine which type of tang lock is on the connector being handled.
Firmly grasp both sides (male and female) of the connector.
Release the tang lock and carefully pull the two halves of the connector apart.

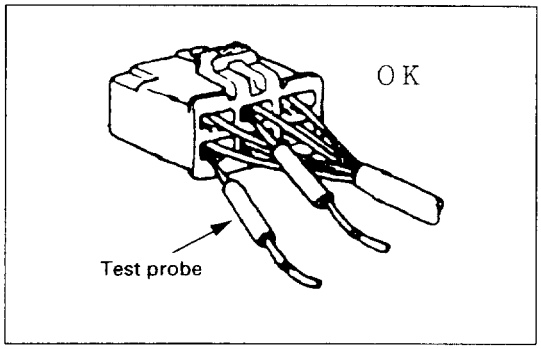


Never pull on the wires to separate the connectors. This will result in wire breakage.



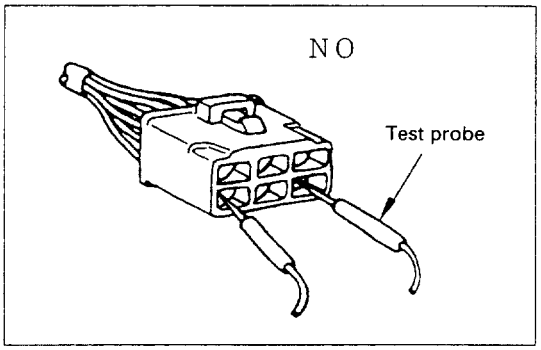
Connecting the Connector

Firmly grasp both sides (male and female) of the connector. Be sure that the connector pins and pin holes match. Be sure that both sides of the connector are aligned with each other. Firmly but carefully push the two sides of the connector together until a distinct click is heard.

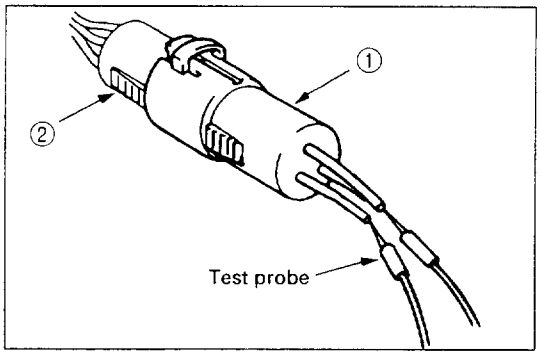


Connector Inspection

Use a circuit tester to check the connector for continuity. Insert the test probes from the connector wire side.

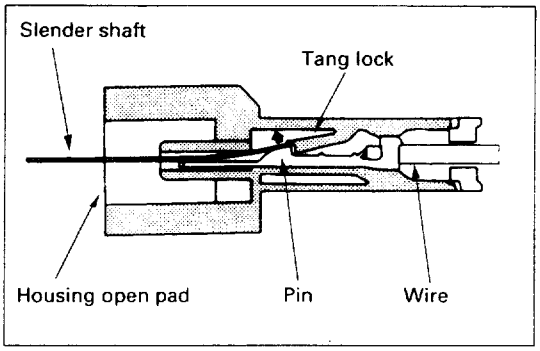


Never insert the circuit tester test probes into the connector open end to test the continuity. Broken or open connector terminals will result.



Waterproof Connector Inspection

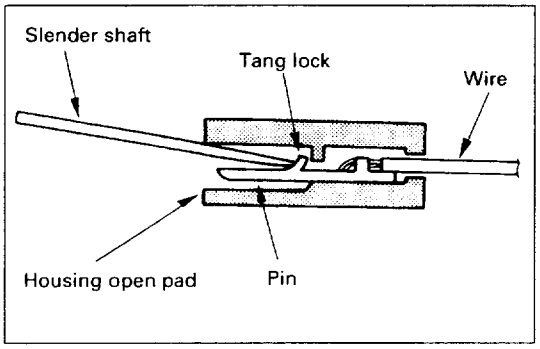
It is not possible to insert the test probes into the connector wire side of a waterproof connector. Use one side of a connector ① with its wires cut to make the test. Connect the test connector ② to the connector to be tested. Connect the test probes to the cut wires to check the connector continuity.



Connector Pin Removal

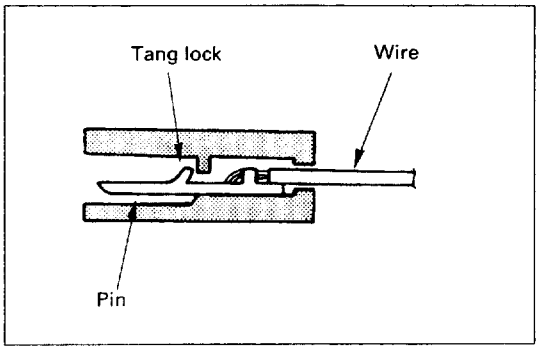
Connector Housing Tang Lock Type

1) Insert a slender shaft into the connector housing open end.
2) Push the tang lock up (in the direction of the arrow in the illustration). Pull the wire with pin free from the wire side of the connector.



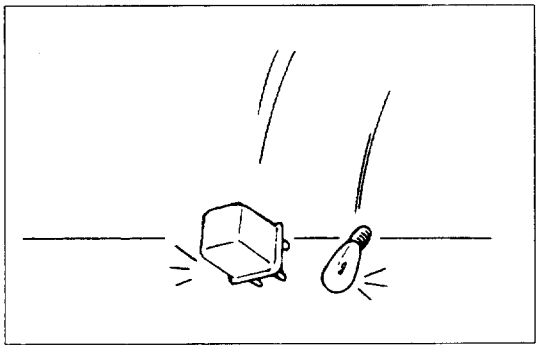
Pin Tang Lock Type

1) Insert a slender shaft into the connector housing open end.
2) Push the tang lock flat (toward the wire side of the connector). Pull the wire with pin free from the wire side of the connector.



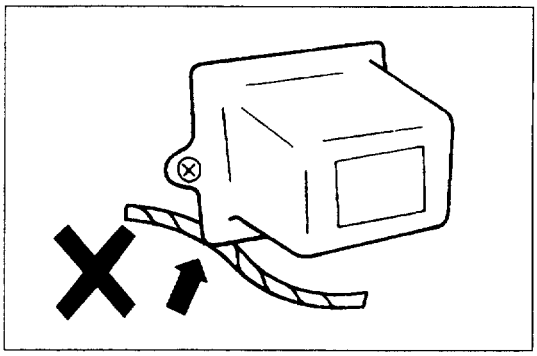
Connector Pin Insertion

1) Check that the tang lock is fully up.
2) Insert the pin from the connector wire side. Push the pin in until the tang lock closes firmly.
3) Gently pull on the wires to make sure that the connector pin is firmly set in place.



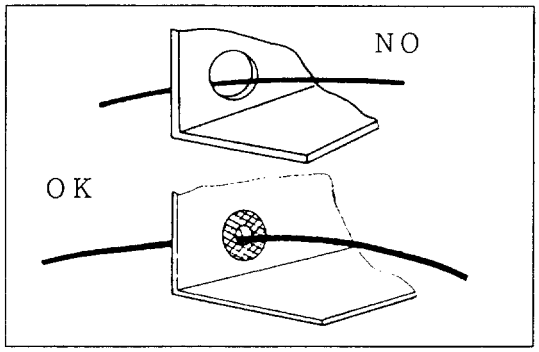
Parts Handling

Be careful when handling electrical parts. They should not be dropped or thrown, because short circuit or other damage may result.

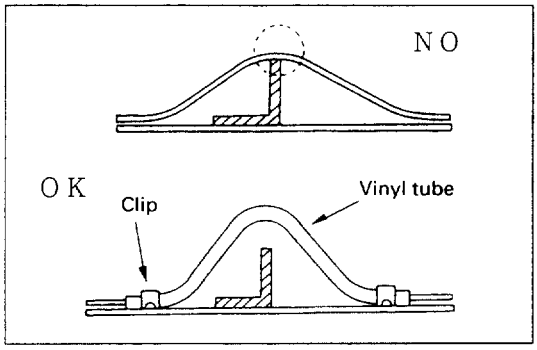


Cable Harness

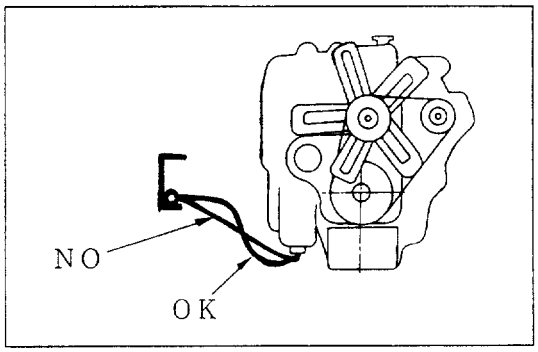
When installing the parts, be careful not to pinch or wedge the wiring harness.
All electrical connections must be kept clean and tight.



Use a grommet or guard tube to protect the wiring harness from contacting a sharp edge or surface.



Position the wiring harness with a enough clearance from the other parts and guard the wiring harness with a vinyl tube and clips to avoid direct contact.



The wiring harness between engine and chassis should be long enough to prevent chafing or damage due to various vibrations.

SPLICING WIRE

1. **Open the Harness**

   If the harness is taped, remove the tape. To avoid wire insulation damage, use a sewing "seam ripper" (available from sewing supply stores) to cut open the harness.
   If the harness has a block plastic conduit, simply pull out the desired wire.

2. **Cut the wire**

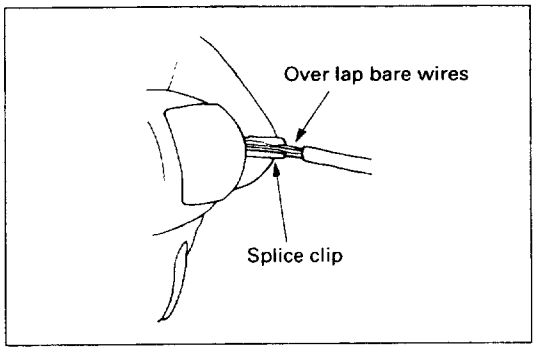
   Begin by cutting as little wire off the harness as possible. You may need the extra length of wire later if you decide to cut more wire off to change the location of a splice. You may have to adjust splice locations to make certain that each splice is at least 1-2/2" (40 mm) away from other splices, harness branches, or connectors.

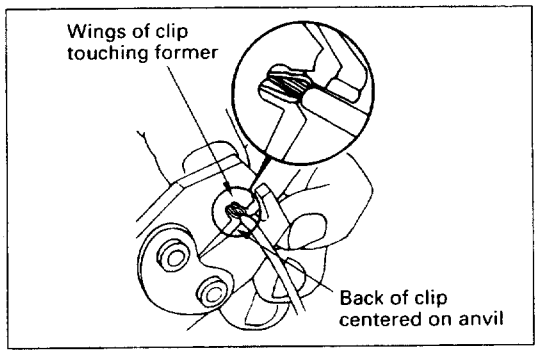
3. **Strip the insulation**

   When replacing a wire, use a wire of the same size as the original wire. Check the stripped wire for nicks or cut stands. If the wire is damaged, repeat the procedure on a new section of wire. The two stripped wire ends should be equal in length.

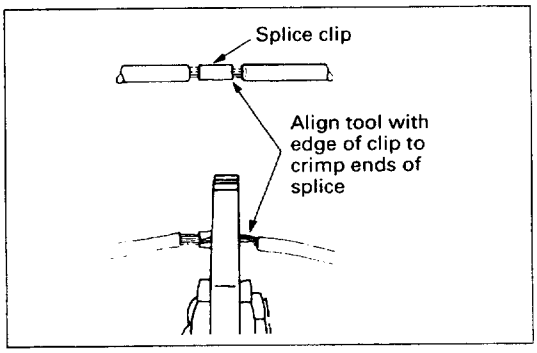
4. **Crimp the Wires**

   Select the proper clip to secure the splice. To determine the proper clip size for the wire being spliced, follow the directions included with your clips. Select the correct anvil on the crimper. (On most crimpers your choice is limited to either a small or large anvil.) Overlap the two stripped wire ends and hold them between your thumb and forefinger. Then, center the splice clip under the stripped wires and hold it in place.



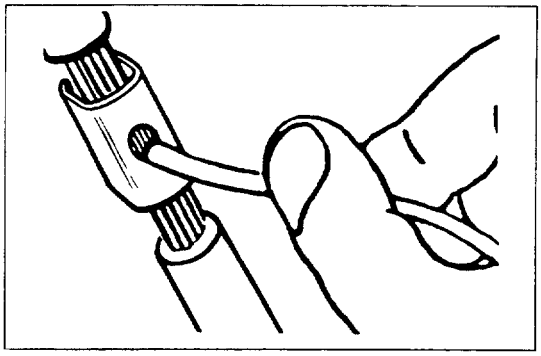


- Open the crimping tool to its full width and rest one handle on a firm flat surface.
- Center the back of the splice clip on the proper anvil and close the crimping tool to the point where the back of the splice clip touches the wings of the clip.
- Make sure that the clip and wires are still in the correct position. Then, apply steady pressure until the crimping tool closes.



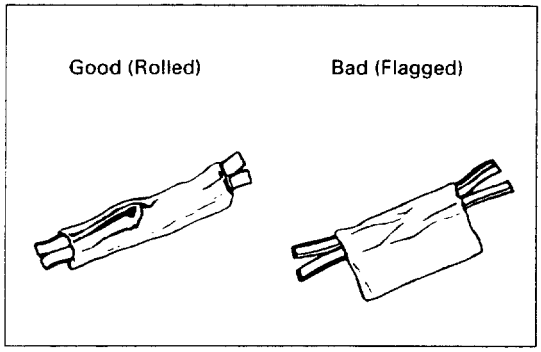
Before crimping the ends of the clip, be sure that:
- The wires extend beyond the clip in each direction.
- No strands of wire are cut loose, and
- No insulation is caught under the clip.

Crimp the splice again, once on each end. Do not let the crimping tool extend beyond the edge of the clip or you may damage or nick the wires.



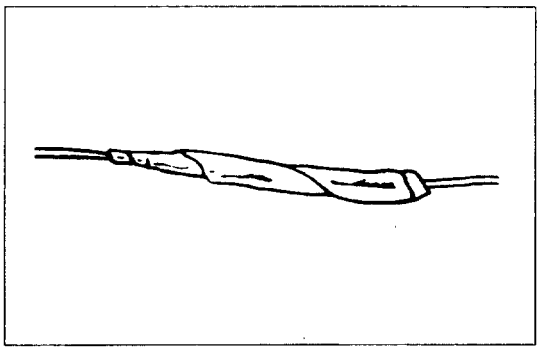
5. **Solder**

Apply 60/40 rosin core solder to the opening in the back of the clip. Follow the manufacturer's instructions for the solder equipment you are using.



6. **Tape the Splice**

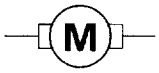
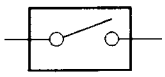
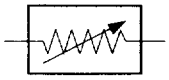
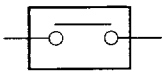
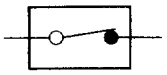
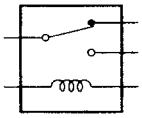
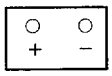
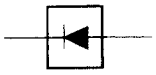
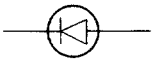
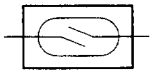
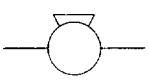
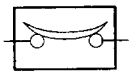
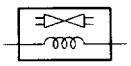
Center and roll the splicing tape. The tape should cover the entire splice. Roll on enough tape to duplicate the thickness of the insulation on the existing wires. Do not flag the tape. Flagged tape may not provide enough insulation, and the flagged ends will tangle with the other wires in the harness.



If the wire does not belong in a conduit or other harness covering, tape the wire again. Use a winding motion to cover the first piece of tape.

SYMBOLS AND ABBREVIATIONS

SYMBOLS

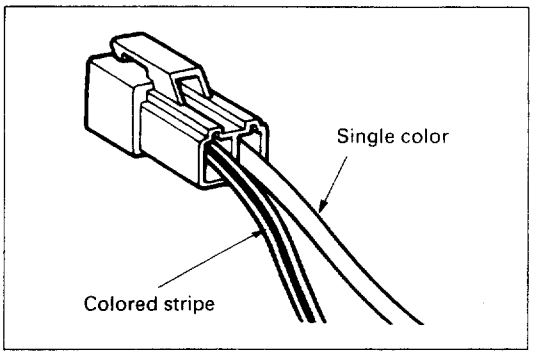
Symbol	Meaning of Symbol	Symbol	Meaning of Symbol
	Fuse		Bulb
	Fusible link		Double filament bulb
	Fusible link wire		Motor
	Switch		Variable register Rheostat
	Switch		Coil (inductor), solenoid, magnetic valve
	Switch (Normal close type)		Relay
	Contact wiring		
	Battery		
	Diode		Connector
	Electronic Parts		Light emitting diode
	Resistor		Reed switch
	Speaker		Condenser
	Buzzer		Horn
	Circuit breaker		Vacuum switching valve

ABBREVIATIONS

Abbreviation	Meaning of Abbreviation	Abbreviation	Meaning of Abbreviation
A	Ampere (S)	kW	kilowatt
ABS	Anti-lock brake system	LH	Left hand
ASM	Assembly	LWB	Long wheel base
AC	Alternating current	M/T	Manual transmission
A/C	Air conditioner	OD	Over drive
ACC	Accessories	OPT	Option
A/T	Automatic transmission	QOS	Quick on start
C/B	Circuit breaker	RH	Right hand
CSD	Cold start device	RR	Rear
DIS	Direct ignition system	RWAL	Rear wheel anti-lock brake system
EBCM	Electronic brake control module	ST	Start
ECGI	Electronic control gasoline injection	STD	Standard
ECM	Electronic control module	SW	Switch
ECU	Electronic control unit	SWB	Short wheel base
EFE	Early fuel evaporation	TCM	Transmission control module
4A/T	4-speed automatic transmission	3A/T	3-speed automatic transmission
4X4	Four-wheel drive	V	Volt
FL	Fusible link	VSV	Vacuum switching valve
FRT	Front	W	Watt (S)
H/L	Headlight	WOT	Wide open throttle
IC	Integrated circuit	W/	With
IG	Ignition	W/O	Without

PARTS FOR ELECTRICAL CIRCUIT

WIRING



Wire Color

All wires have color-coded insulation.
Wires belonging to a system's main harness will have a single color. Wires belonging to a system's sub-circuits will have a colored stripe. Striped wires use the following code to show wire size and colors.

Example: 0.5 G / R

- R — Red (Stripe color)
- G — Green (Base color)
- 0.5 — Wire size (0.5 mm2)

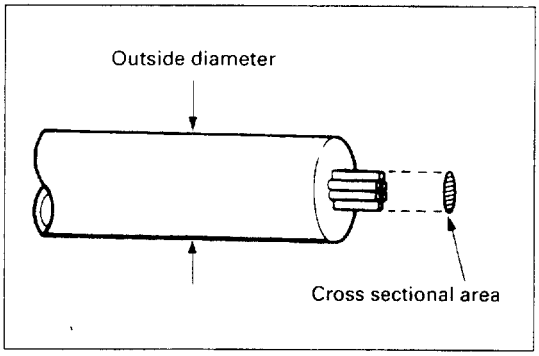
Abbreviations are used to indicate wire color within a circuit diagram.
Refer to the following table.

Wire Color Coding

Color-Coding	Meaning	Color-coding	Meaning
B	Black	BR	Brown
W	White	LG	Light green
R	Red	GR	Grey
G	Green	P	Pink
Y	Yellow	LB	Light blue
L	Blue	V	Violet
O	Orange		

Distinction of Circuit by Wire Base Color

Base color	Circuits	Base color	Circuits
B	Starter circuit	Y	Instrument circuit
W	Charging circuit	L, O, BR, LG, GR, P, LB, V	Other circuit
R	Lighting circuit		
G	Signal circuits		



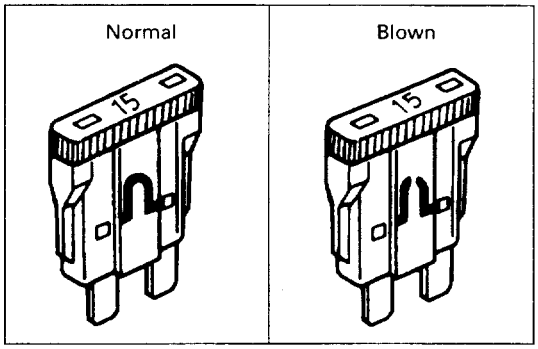
Wire Size

The size of wire used in a circuit is determined by the amount of current (amperage), the length of the circuit, and the voltage drop allowed. The following wire size and load capacity, shown below, are specified by AWG (American Wire Gauge) (Nominal size means approximate cross sectional area).

Wire Size Table

Nominal size	Cross sectional area (mm^2)	Outside diameter (mm)	Allowable current (A)	AWG size (cross reference)
0.3	0.372	1.8	9	22
0.5	0.563	2.0	12	20
0.85	0.885	2.2	16	18
1.25	1.287	2.5	21	16
2	2.091	2.9	28	14
3	3.296	3.6	37.5	12
5	5.227	4.4	53	10
8	7.952	5.5	67	8
15	13.36	7.0	75	6
20	20.61	8.2	97	4

FUSE, FUSIBLE LINK AND CIRCUIT BREAKER



FUSE

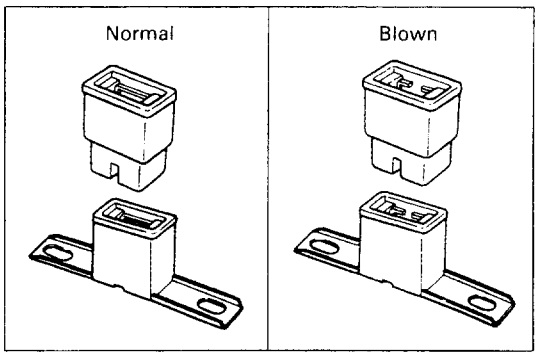
Fuses are the most common form of circuit protection used in vehicle wiring. A fuse is a thin piece of wire or strip of metal encases in a glass or plastic housing. It is wired in series with the circuit it protects. When there is an overload of current in a circuit, such as a short of a ground, the wire or metal strip is designed to burn out and interrupt the flow of current. This prevents a surge of high current from reaching and damaging other components in the circuit.

Determine the cause of the overloaded before replacing the fuse.

The replacement fuse must have the same amperage specifications as the original fuse.

Never replace a blown fuse with a fuse of a different amperage specification.

Doing so can result in an electrical fire or other serious circuit damage. A blown fuse is easily



FUSIBLE LINK

The fusible link is primarily used to protect circuits where high amounts of current flow and where is would not be practical to use a fuse. For example, the starter circuit. When a current overload occurs, the fusible link melts open and interrupts the flow of current so as to prevent the rest of the wiring harness from burning.

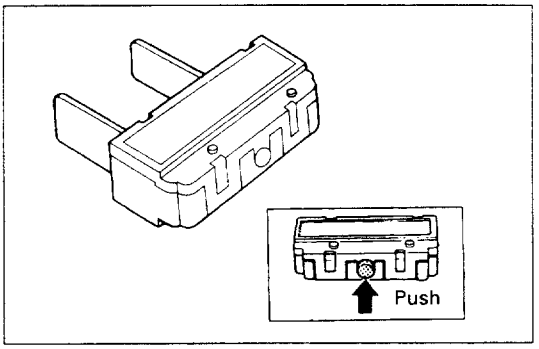
Determine the cause of the overload before replacing the fusible link. The replacement fusible link must have the same amperage specification as the original fusible link.

Never replace a blown fusible link with fusible link of a different amperage specification. Doing so can result in an electrical fire or other serious circuit damage.

A blown fusible link is easily identified.

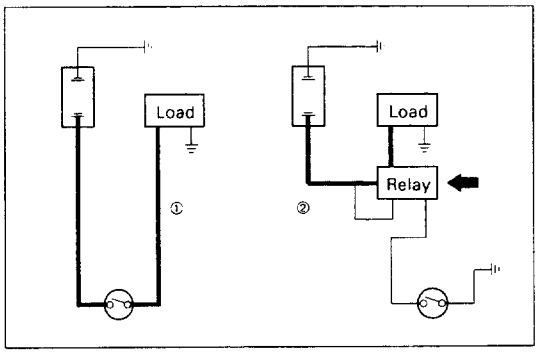
Fusible Link Specifications

Type	Rating	Case Color	Maximum Circuit Current (A)
Connector	30A	Pink	15
Connector	40A	Green	20
Bolted	50A	Red	25
Bolted	60A	Yellow	30
Bolted	80A	Black	40



CIRCUIT BREAKER

The circuit breaker is a protective device designed to open the circuit when a current load is in excess of rated breaker capacity. If there is a short or other type of overload condition in the circuit, the excessive current will open the circuit between the circuit breaker terminals. The reset knob pops out when the circuit is open. Push the reset knob in place to restore the circuit after repairing it.



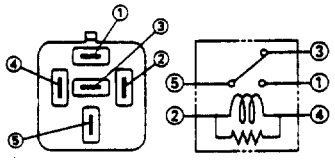
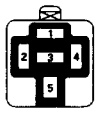
RELAY

Battery and load location may require that a switch be placed some distance from either component. This means a longer wire and a higher voltage drop ①.

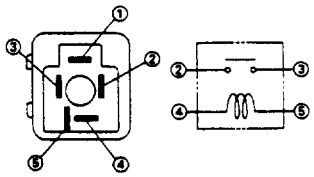
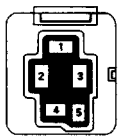
The installation of a relay between the battery and the load reduces the voltage drop ②.

Because the switch controls the relay, amperage through the switch can be reduced.

RELAY SPECIFICATION, CONFIGURATION AND INSPECTION

Name/ Color	Rated voltage/Coil resistance	Internal circuit
MR5C (1T)/ Black	12V/ Approx. 90Ω Minimum operating voltage: 7V at 25°C (77°F)	  (connector face)
MR5C (1T)/ Brown	12V/ Approx. 90Ω Minimum operating voltage: 10.5V at 25°C (77°F)	
MR5C (1T)/ Green	24V/ Approx. 266Ω Minimum operating voltage: 16V at 25°C (77°F)	
MR5C (1T)/ Grey	24V/ Approx. 266Ω Minimum operating voltage: 20V at 25°C (77°F)	

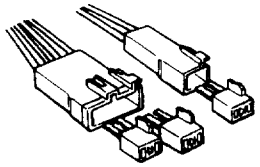
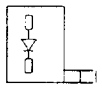
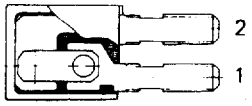
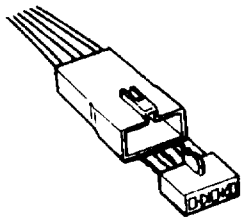
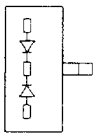
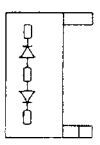
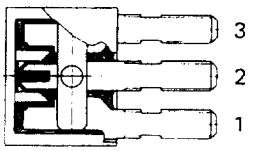
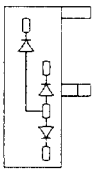
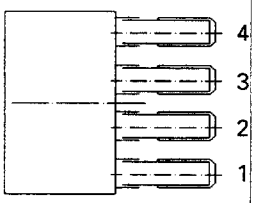
Inspection	The way / Result	Check to see if there is any continuity between the relay terminals.
	Normal	(When no voltage is applied relay terminals ②-④) ③-⑤ ··· continuity ①-⑤ ···No continuity Inspection
	Abnormal	(When minimum operating voltage is applied relay terminals between ②-④) ③-⑤ ··· continuity ①-⑤ ··· No continuity
	Normal	(When minimum operating voltage is applied relay terminals between ②-④) ③-⑤ ··· No continuity ①-⑤ ··· continuity

Name/ Color	Rated voltage/Coil resistance	Internal circuit
MR82C/ White label	12V/ Approx. 23Ω Minimum operating voltage: 7V at 20°C (68°F)	  (connector face)
MR82C/ Green label	24V/ Approx. 100Ω Minimum operating voltage: 16V at 20°C (68°F)	

Inspection	The way / Result	Check to see if there is any continuity between the relay terminals.
	Normal	(When no voltage is applied relay terminals ④-⑤) ②-③ ··· No continuity
	Abnormal	(When minimum operating voltage is applied relay terminals between ④-⑤) ②-③ ··· No continuity
	Normal	(When minimum operating voltage is applied relay terminals between ④-⑤) ②-③ ··· continuity

DIODE

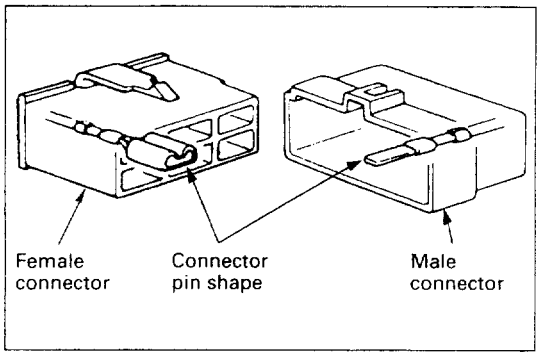
DIODE SPECIFICATIONS AND CONFIGURATIONS

SHAPE	MARK/ COLOR	CONSTRUCTION	CHECKING (THERE SHOULD BE CONTINUITY IN EITHER A OR B WHEN A CIRCUIT TESTER IS CONNECTED WITH DIODE TERMINAL)
	 BLACK	 2 1	TERMINAL NO. 2 1 CONNECTION PATTERN A: ⊕ ⊖ CONNECTION PATTERN B: ⊖ ⊕
	 BLACK		TERMINAL NO. 3 2 1 CONNECTION PATTERN A: ⊖ ⊕ ; ⊕ ⊖ CONNECTION PATTERN B: ⊕ ⊖ ; ⊖ ⊕
	 BLACK	 3 2 1	TERMINAL NO. 3 2 1 CONNECTION PATTERN A: ⊖ ⊕ ; ⊕ ⊖ CONNECTION PATTERN B: ⊕ ⊖ ; ⊖ ⊕
	 BLACK	 4 3 2 1	TERMINAL NO. 4 3 2 1 CONNECTION PATTERN A: ⊕ ⊖ ; ⊖ ⊕ ⊕ ; ⊖ ⊕ CONNECTION PATTERN B: ⊖ ⊕ ; ⊕ ⊖ ⊖ ; ⊕ ⊖

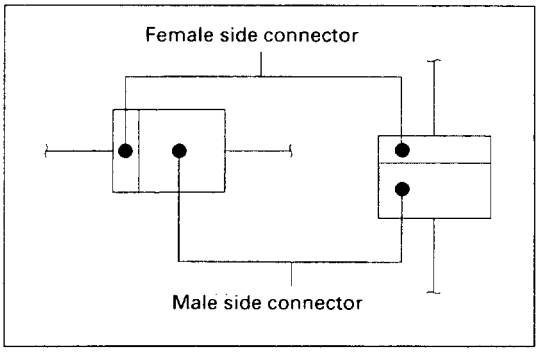
MAXIMUM RATING (Temp. =25°C)

Items	Rating	Remarks
Peak reverse voltage	400V	
Transient peak reverse voltage	500V	
Average output current	1.5A	Temp. = 40°C
Working ambient temperature	–30°C~80°C	
Storage temperature	–40°C~100°C	

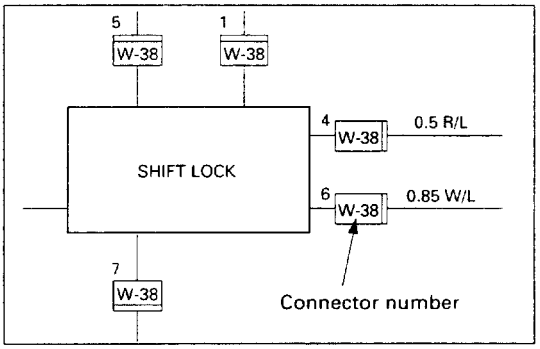
CONNECTOR



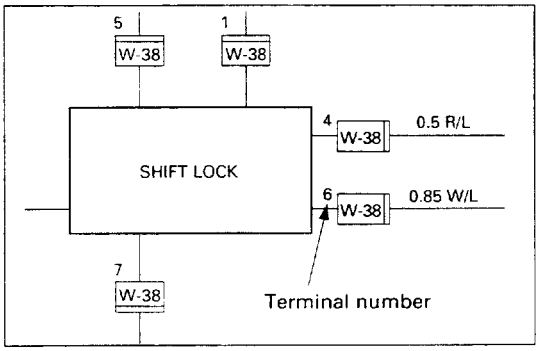
The connector pin shape determines whether the connector is male or female.
The connector housing configuration does not determine whether a connector is male or female.



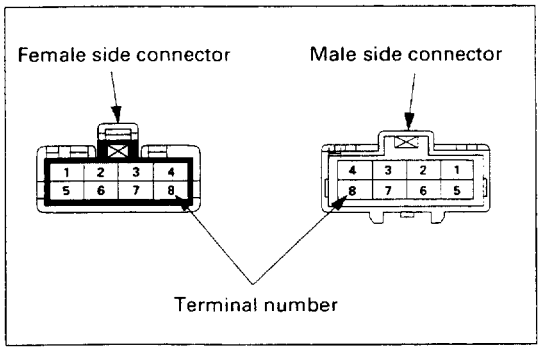
The symbol illustrated in the figure is used as connector, in the circuit of this section.



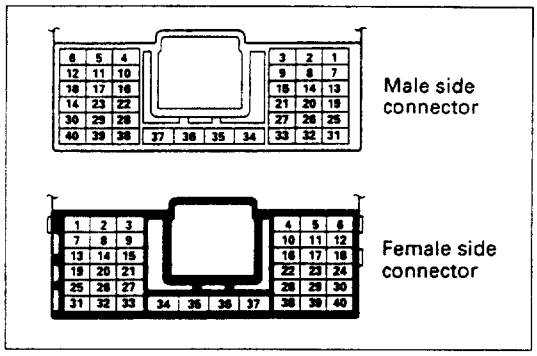
Connector is identified with a number.



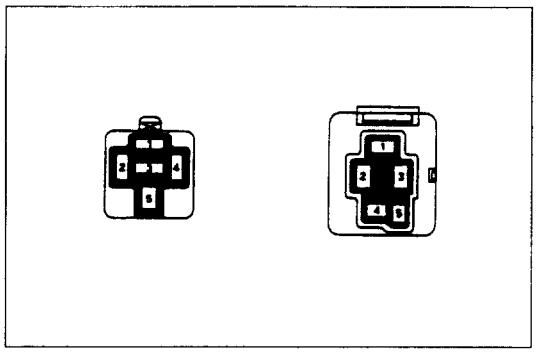
The applicable terminal number is shown for each connector.



Connector terminal numbers are clearly shown.
Male side connector terminal numbers are in sequence from upper right to lower left.
Female side connector terminal numbers are in sequence from upper left to lower right.



NOTE:
For those connectors on which specific terminal numbers or symbols are shown (such as ECM), the terminal numbers or symbols are used in the circuit diagram, irrespective of the above rule.



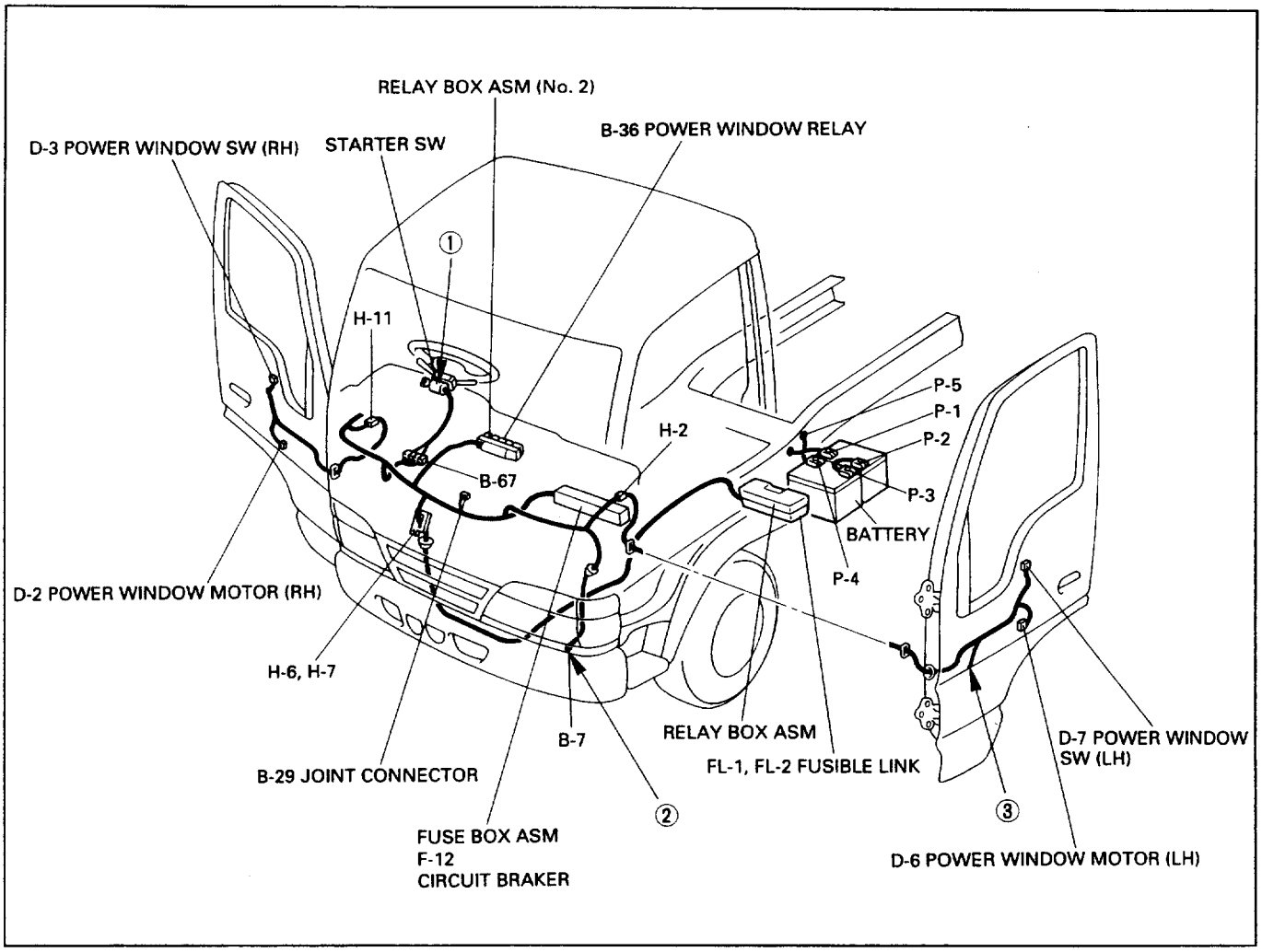
The connectors used for relays have their own terminal number assignment, irrespective of the above rule.

READING THE CIRCUIT DIAGRAM

In this manual, each system has its own parts location illustration, circuit diagram and connector configuration used in the circuit diagram.

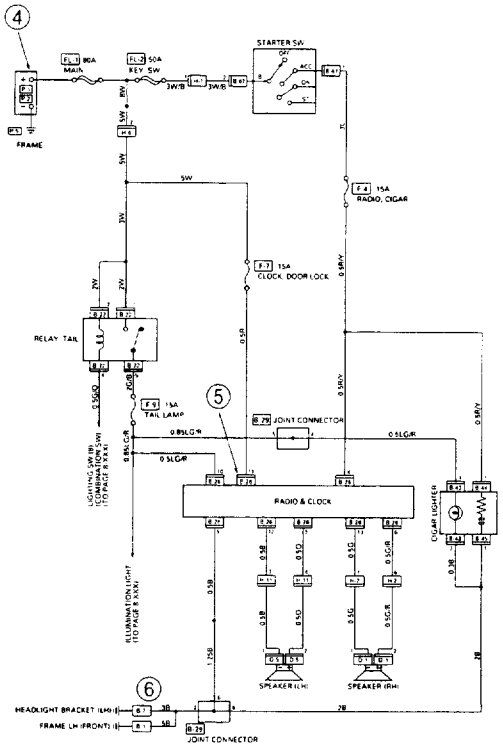
PARTS LOCATION

The parts location shows the location of the parts ① and the connector ② used in each harness routing ③.



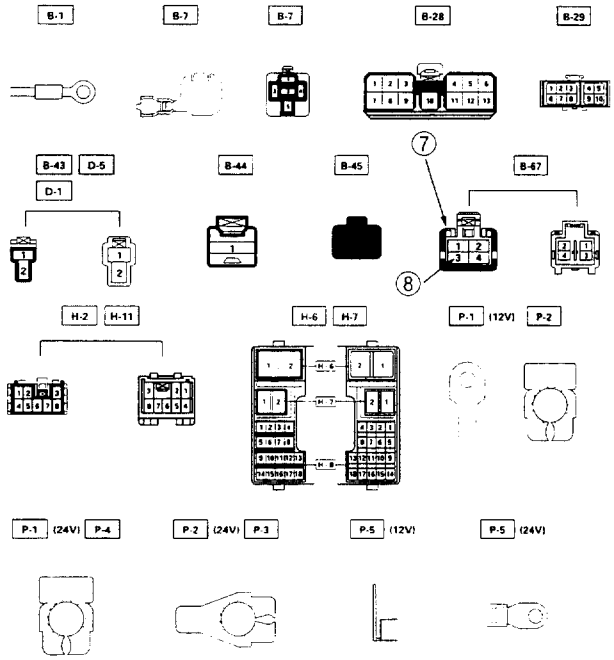
CIRCUIT DIAGRAM

The circuit diagram shows the power supply ④ the load or loads ⑤ and the grounding point(s) ⑥.



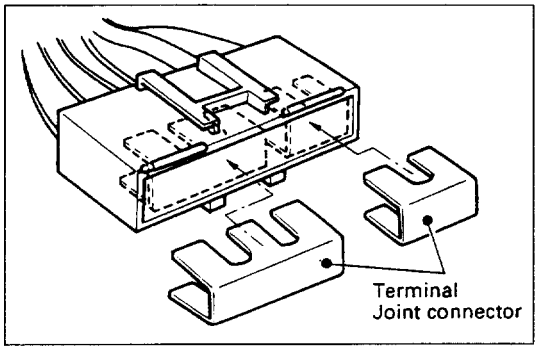
CONNECTOR LIST

The connector list shows each connectors' configuration ⑦ and the pin number ⑧.



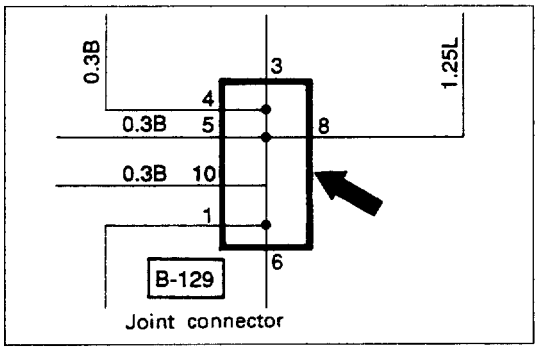
CONNECTOR SYMBOL

Connector Symbol	Harness name	Connector Symbol	Harness name
B	Body harness	L	Dome Light harness
D	Door harness	N	Floor harness (LH & RH)
E	Engine harness	P	Battery harness
H	For joint between harnesses	R	Rear body harness
J	Frame front & frame rear harness		



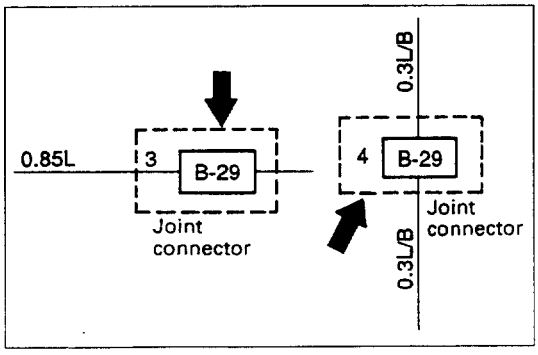
JOINT CONNECTOR

This connector has the structure of plural number of terminals collectively connected inside the connector.



How to show joint connector in the circuit diagram

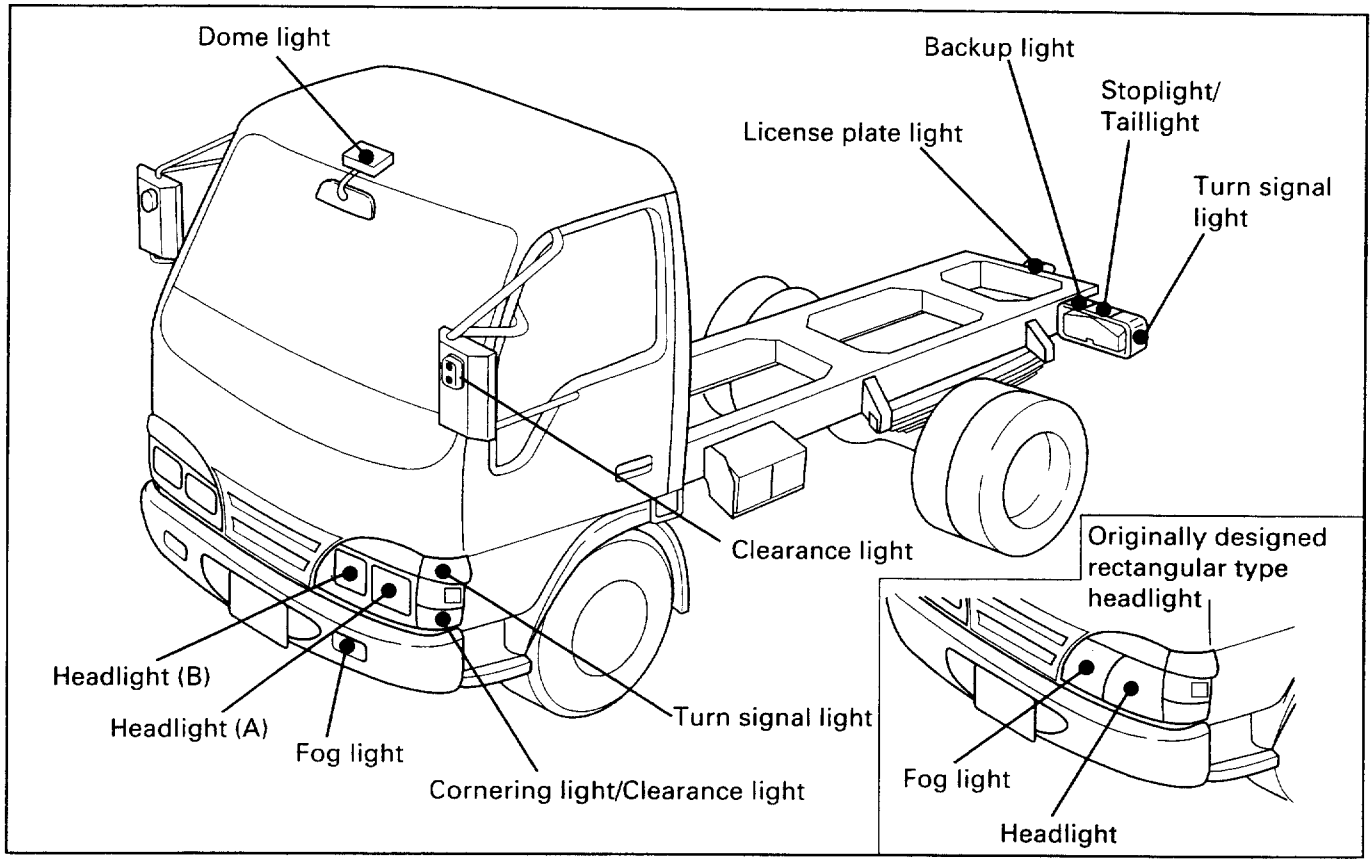
1. When joint connector can be shown as actual circuit diagram.



2. When one joint connector must be shown from different angles in the circuit diagram.

MAIN DATA AND SPECIFICATIONS

BULB SPECIFICATIONS



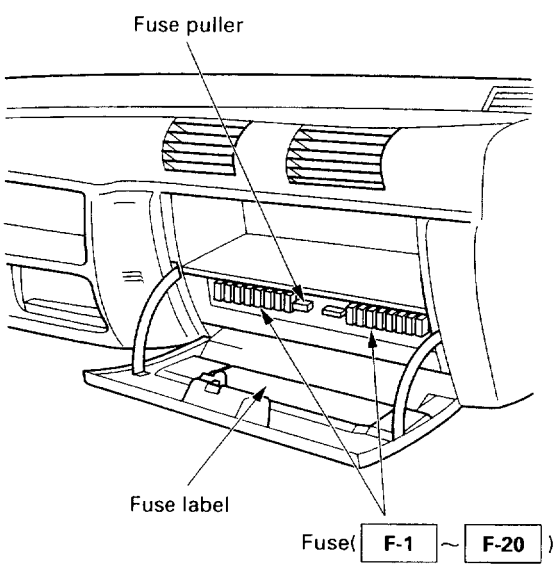
Light Name			Rated Power	No. of Bulb	Lens Color	Remarks
Headlight	Rectangular type	A	45W/40W	2	Clear	12V
		B	45W	2		
		A	55W/50W	2		24V
		B	55W	2		
	Originally designed rectangular type		60W/55W	2	Clear	12V
			75W/70W			24V
Front combination light	Turn signal light		21W	2	Amber	12V
			25W			24V
	Cornering light/ Clearance light		27W/8W	2	Clear	12V
			30W/10W			24V
Fog light	Front		55W	2	Clear	12V
						24V
	Rear		21W	1	Red	12V
Rear combination light	Stoplight/Taillight		21W/5W	2	Red	12V
			25W/10W			24V
	Turn signal light		21W	2	Amber	12V
			25W			24V
	Backup light		21W	2	Clear	12V
			25W			24V

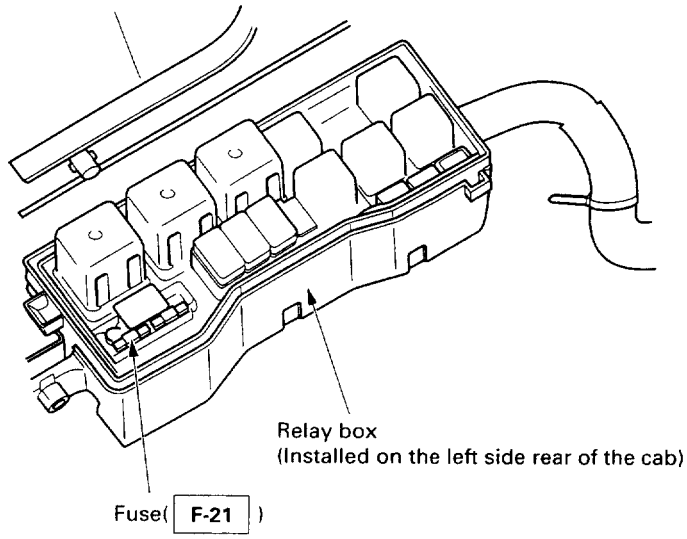
Light Name			Rated Power	No. of Bulb	Lens Color	Remarks
License plate light			10W	1	Clear	12V
			12W			24V
Dome light			10W	1	White	12V
			12W			24V
Clearance light (Fitted on the outside mirror)			5W	2	Clear	24V
Indicator/ Warning Light (In the meter assembly)	Glow		2W	1		12V
			1.8W			24V
	OD OFF		2W	1		12V
			1.8W			24V
	A/T OIL TEMP		2W	1		12V
			1.8W			24V
	4WD		1.8W	1		24V
	UNLADEN		1.8W	1		24V
	Engine oil pressure		2W	1		12V
			1.8W			24V
	Fuel sedimenter		2W	1		12V
			1.8W			24V
	Brake fluid level / Parking brake		2W	1		12V
			1.8W			24V
	Charge		2W	1		12V
			1.8W			24V
	Exhaust brake		2W	1		12V
	High beam		2W	1		12V
			1.8W			24V
	Turn signal		2W	1		12V
			1.8W			24V
	Fuel level		2W	1		12V
			1.8W			24V
	Hazard		2W	1		12V
Illumination	Illumination light for meter assembly		2W	1		12V
			1.8W			24V
	Hazard warning Switch		2W	1		12V
			1.8W			24V
	Dome light switch		2W	1		12V
			1.8W			24V
	Front fog light switch		2W	1		12V
			1.8W			24V
	Rear fog light switch	For indicator	60mA	1		12V
		For illumination	60mA	1		
	Cigar lighter		1.4W	1		12V
			1.8W			24V
	Heater bezel		1.4W	1		

Light Name		Rated Power	No. of Bulb	Lens Color	Remarks
Illumination	Ashtray	1.4W	1		
	4WD Switch	40mA	1		24V
	Pattern select switch (UNLADEN)	40mA	1		24V
	OD Switch	1.8W	1		24V

FUSE AND FUSIBLE LINK LOCATION

FUSE AND CIRCUIT BREAKER





826LX010

FUSE LABEL-FOR 12Volt

25A ①	HEATER
10A ②	AIR CON
10A ③	STARTER
15A ④	AUDIO CIGAR LIGHTER
10A ⑤	HEAD LIGHT (RH)
10A ⑥	HEAD LIGHT (LH)
15A ⑦	POWER DOOR LOCK
15A ⑧	HAZARD, HORN
15A ⑨	TAIL LIGHT
10A ⑩	FOG LIGHT
15A ⑪	WIPER, WASHER
10A ⑫	GAUGE BACK
15A ⑬	RR. HEATER ECU (IGN)
15A ⑭	FUEL HEATER EXH. BRAKE
10A ⑮	HDLP LEVELING ECU (BAT)
25A ⑯	POWER WINDOW
10A ⑰	STOP LIGHT
15A ⑱	GENERATOR
10A ⑲	TURN S/LIGHT
10A ⑳	ENG. STOP

FUSE LABEL-FOR 24Volt

15A ①	AIR CON HEATER
②	—
10A ③	STARTER
15A ④	AUDIO CIGAR LIGHTER
10A ⑤	HEAD LIGHT (RH)
10A ⑥	HEAD LIGHT (LH)
15A ⑦	POWER DOOR LOCK
15A ⑧	HAZARD, HORN
15A ⑨	TAIL LIGHT
10A ⑩	STOP LIGHT
15A ⑪	WIPER, WASHER
10A ⑫	GAUGE BACK
10A ⑬	FUEL HEATER EXH. BRAKE
15A ⑭	RR. HEATER
15A ⑮	POWER WINDOW
10A ⑯	ECU (BAT)
10A ⑰	ENG. STOP
10A ⑱	ECU (IGN)
10A ⑲	TURN S/LIGHT
15A ⑳	GENERATOR

15A F-21	MARKER LIGHT

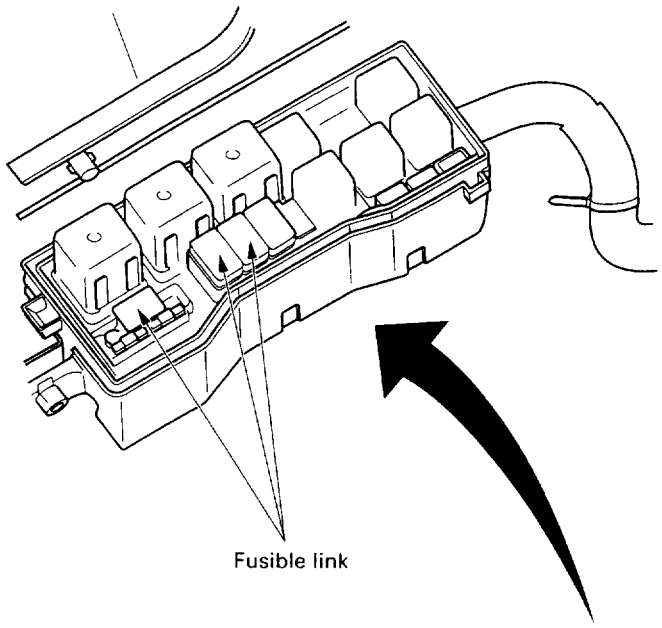
NOTE:
The fuse numbers ① ~ ⑳ indicated on the fuse labels are expressed as F-1 ~ F-20 in the circuit diagrams of this manual.

FUSE AND CIRCUIT BREAKER

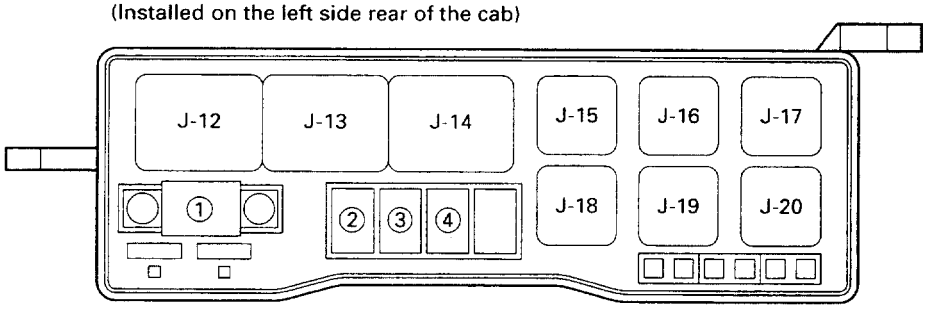
FUSE LABEL-FOR 24Volt MITICS

15A ①	AIR CON HEATER
②	—
10A ③	STARTER
15A ④	AUDIO CIGAR LIGHTER
10A ⑤	HEAD LIGHT (RH)
10A ⑥	HEAD LIGHT (LH)
15A ⑦	POWER DOOR LOCK
15A ⑧	HAZARD, HORN
15A ⑨	TAIL LIGHT
10A ⑩	STOP LIGHT
15A ⑪	WIPER, WASHER
10A ⑫	GAUGE BACK
10A ⑬	ECU (IGN)
10A ⑭	FUEL HEATER EXH. BRAKE
15A ⑮	RR. HEATER
15A ⑯	POWER WINDOW
10A ⑰	ENG. STOP
10A ⑱	HDLP LEVELING
10A ⑲	TURN S/LIGHT
15A ⑳	GENERATOR

FUSIBLE LINK



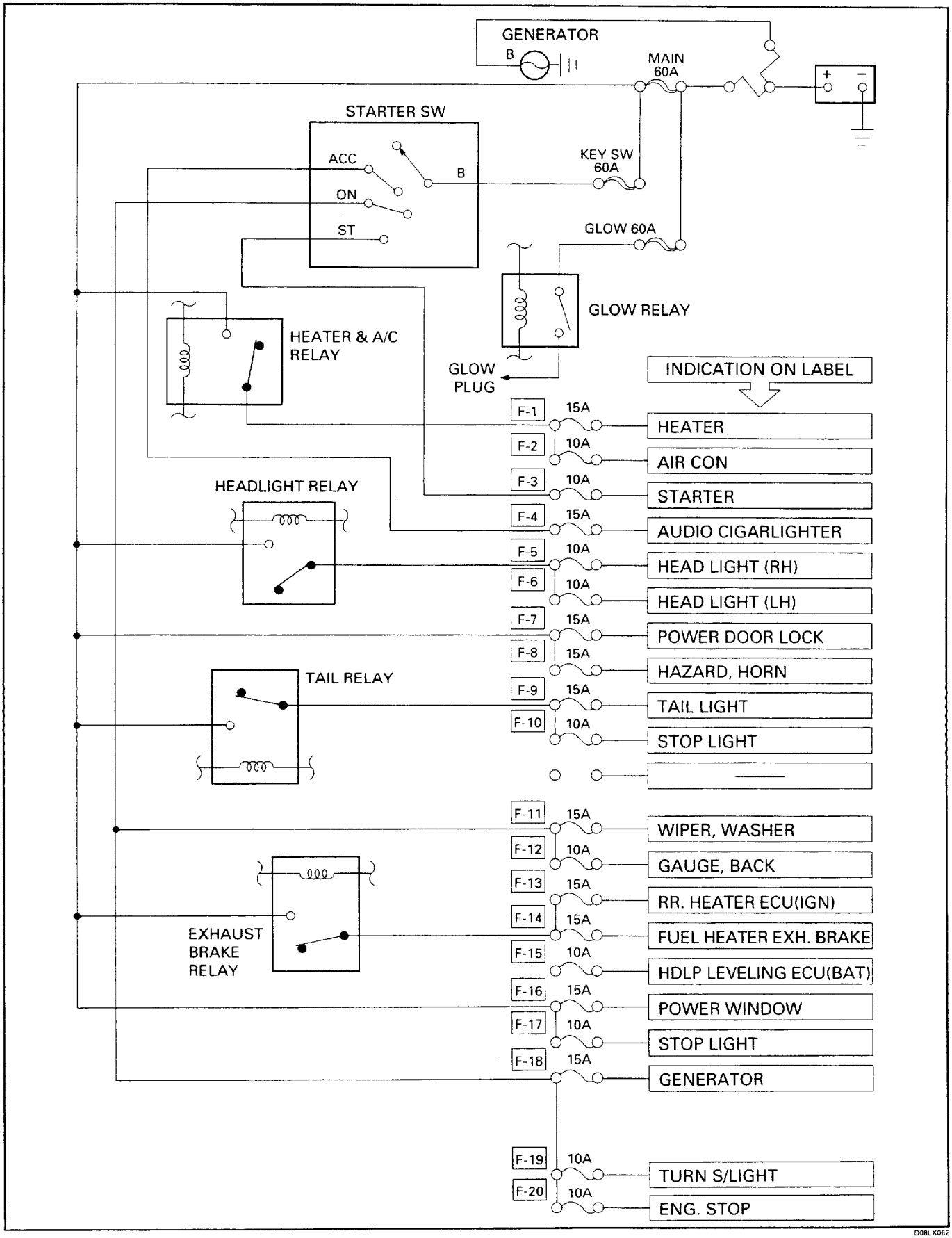
Relay box
(Installed on the left side rear of the cab)



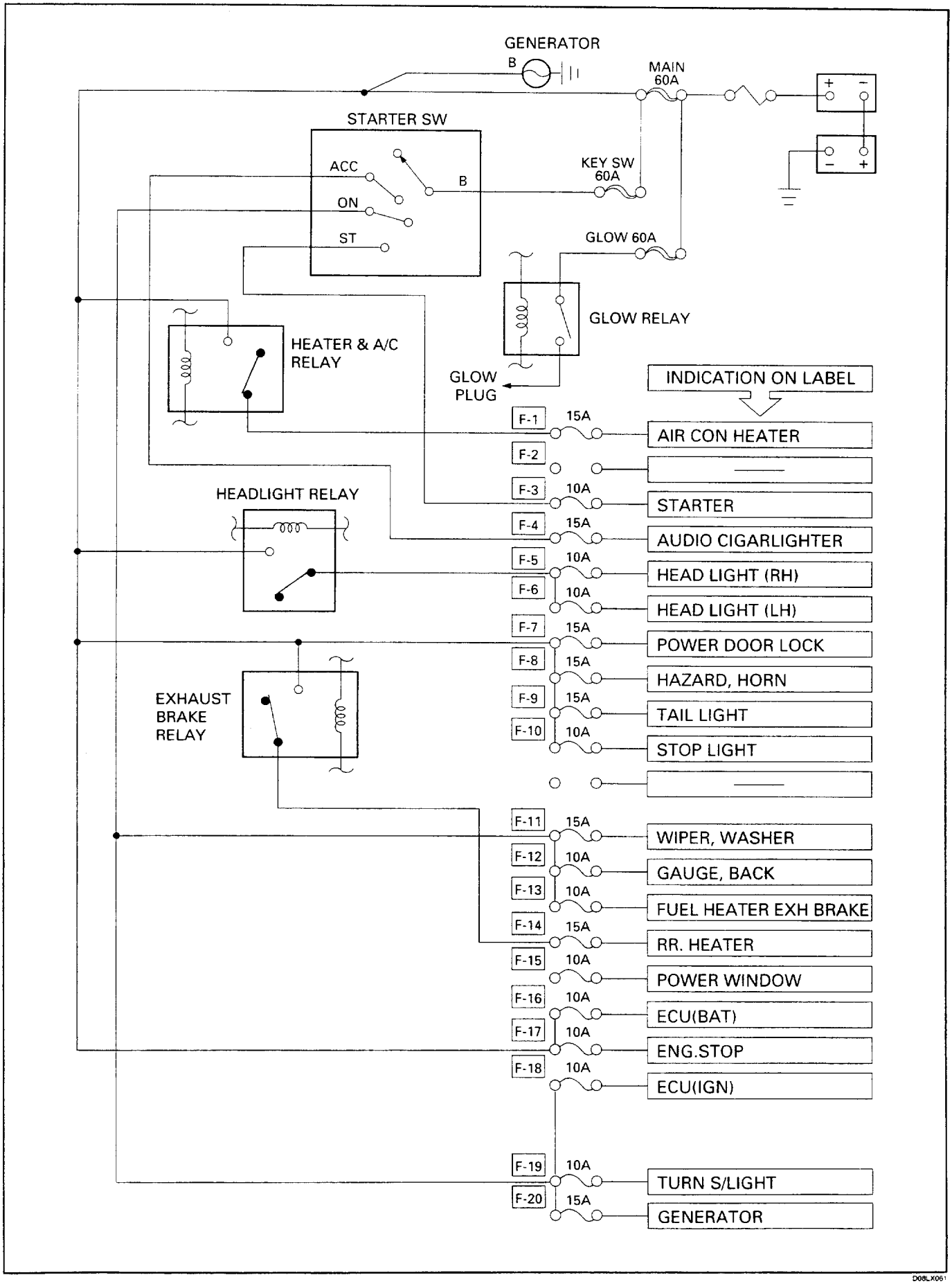
No.	Name	Capacity	Remarks
①	MAIN	80A	12V
		60A	24V
②	KEY SW	50A	12V
		40A	24V
		60A	24V (70T.TC)
③	GLOW	60A	12V
		60A	24V
④	CERAMIC/H	60A	24V (70TC)

FUSE BLOCK CIRCUIT

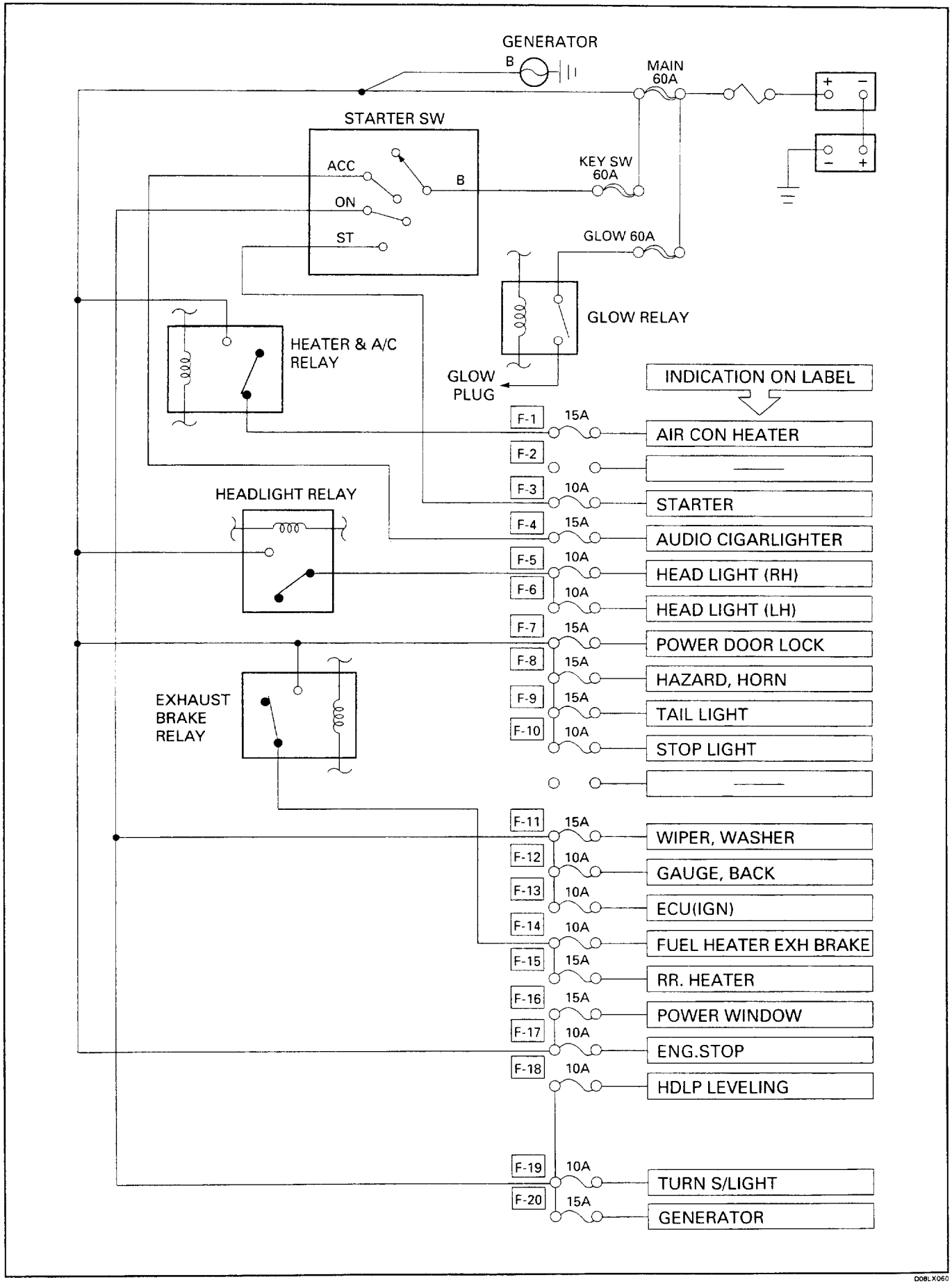
FOR 12VOLT-NHR55·NKR55·NPR69



FOR 24VOLT-NPR66·NQR66·NPS71·NPR71·NQR71



FOR 24VOLT-NPR70TC·NQR70TC



D08LX060

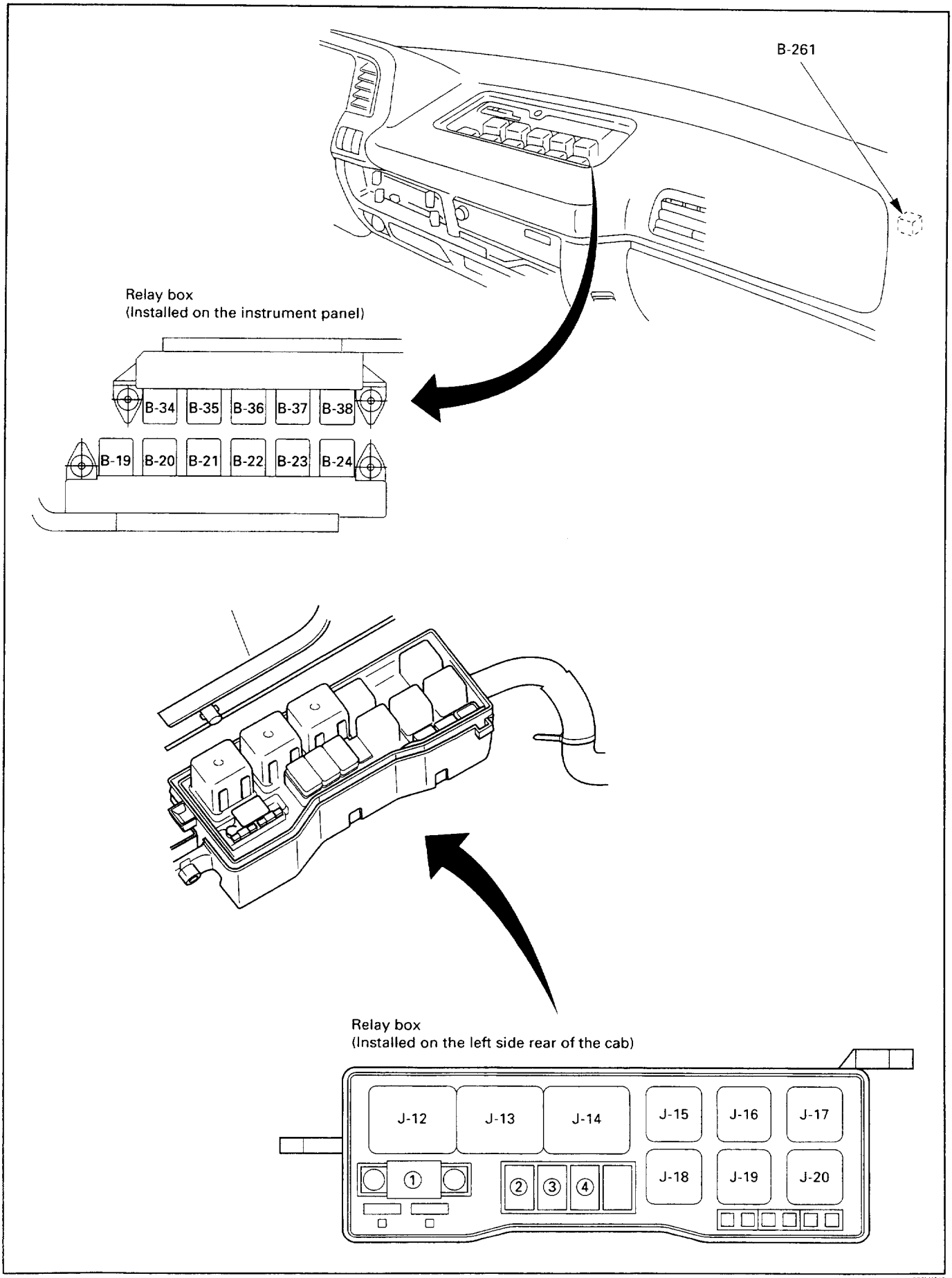
REFERENCE TABLE OF FUSE AND CIRCUIT BREAKER

FUSE

Fuse No.	Capacity	Indication on label	Main parts (Load)
F-1	25A (12V)	HEATER, AIR CON	Blower motor, Blower resistor, Fan switch, A/C thermo relay, Electronic thermostat
	15A (24V)		Blower motor, Blower resistor, Fan switch, A/C switch, A/C thermo relay, Pressure switch, A/C cut relay, Thermo switch (A/C cut), VSV: FICD, Electronic thermostat
F-2	10A (12V)	AIR CON	A/C switch, A/C thermo relay, Pressure switch, Magnetic clutch, VSV: FICD, Electronic thermostat,
F-3	10A	STARTER	Starter relay, Inhibitor switch, QOSII controller, QOSIII controller
F-4	15A	RADIO, CIGAR	Cigar lighter, Radio
F-5	10A	HEAD LAMP (RH)	Headlight (RH), Dimmer relay
F-6	10A	HEAD LAMP (LH)	Headlight (LH), Dimmer relay, Cornering light relay, Cornering right
F-7	15A	CLOCK, DOOR LOCK	Radio & clock, Dome light switch, Dome light, Door switch (RH & LH), Backup buzzer, Door lock switch, Door lock relay, Door lock actuator, Door lock controller, speedometer
F-8	15A	HAZARD, HORN	Hazard warning switch, Horn, Horn relay, Horn switch, Flasher unit
F-9	15A	TAIL, FOG LAMP	Tail relay, Illumination light(s), Fog light switch, Fog light, Lighting switch, Rear fog light switch, Rear fog light relay
F-10	10A	STOP LAMP	Stoplight switch, Stoplight, Shift lock controller
F-11	15A	WIPER, WASHER	Wiper & Washer switch, Wiper motor, Washer motor, Intermittent relay
F-12	10A	METER, BACK	Exhaust brake control relay, A/T ECU, OD OFF indicator, UNLADEN indicator, CSD Relay, Backup buzzer, Backup light switch, Backup light, Inhibitor Switch, Neutral switch, Starter relay, QOS II controller, QOS III controller, Glow relay, Glow-1 relay, Glow-2 relay, Glow indicator (Meter), Coolant temperature gauge, Thermo unit, vehicle speed sensor (Installed on the meter assembly & Transmission), Meter assembly, Power window relay, Cornering light relay, 4WD switch, 4WD relay, 4WD detective switch, VSV: transfer control (2WD & 4WD)

Fuse No.	Capacity	Indication on label	Main parts (Load)
F-13	15A (12V)	FUEL HEATER	Fuel heater
	10A (24V)		
F-14	15A	REAR HEATER	Rear heater, Rear heater switch
F-15	10A	EXH. BRAKE	Exhaust brake switch, Exhaust brake control relay, Exhaust brake magnetic valve, Clutch switch, Accel switch
F-16	10A (12V)	FOG LAMP	Fog light switch, Fog light
	10A (24V)	ECU (IGN)	ECU, shift lock controller
F-17	10A	TURN S/LAMP	Flasher unit, Front turn signal light, Rear turn signal light, Turn signal light switch
F-18	15A	GENERATOR	Generator, Charge relay, QOSIII controller
F-19	10A	ENG. STOP	Engine stop motor, Fuel cut solenoid
F-20	10A (12V)	LEVELING	Headlight leveling switch, Headlight leveling motor (Actuator)
F-21	15A	MARKER LAMP	Marker light, Marker light relay

RELAY LOCATION



RELAY LIST

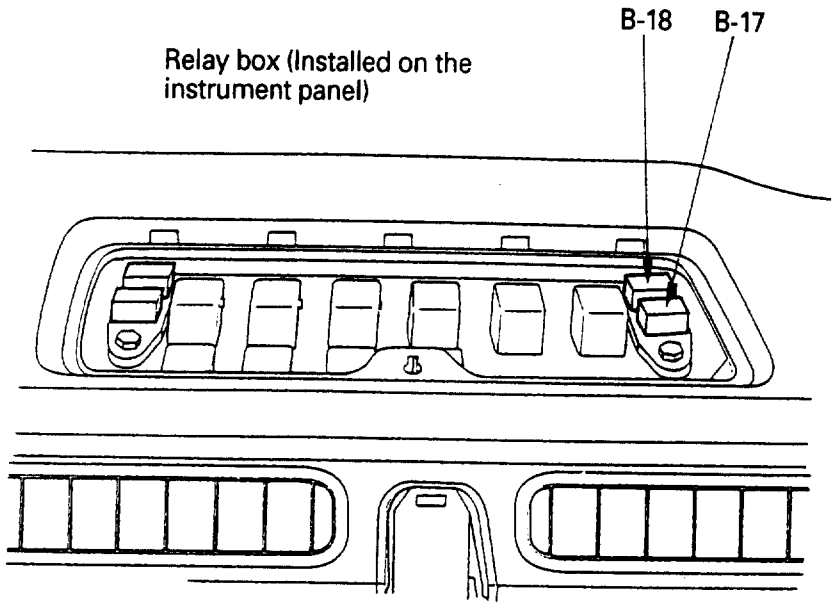
Voltage	Model \ Connector No. / Name	B-9 Inter-mittent	B-19 Charge	B-20 Head-light	B-21 Heater & AIR CON.	B-22 Tail	B-23 Dimmer
12V	NHR 55	○	○	○	○	○	○
	NKR 55	○	○	○	○	○	○
	NPR 69	○	○	○	○	○	○
24V	NKR 66	○	○	○	○	○	○
	NKS 66	○	○	○	○	○	○
	NPR 66	○	○	○	○	○	○
	NQR 70	○	○	○	○	○	○
	NPS 66	○	○	○	○	○	○

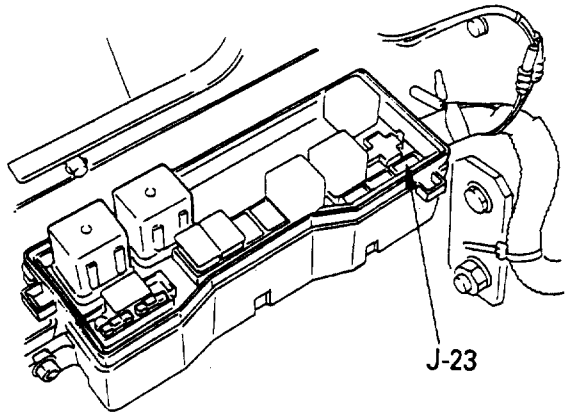
Voltage	Model \ Connector No. / Name	B-24 Horn	B-34 Rear fog	B-35 Corner-ing light	B-35 RR Fog	B-36 Power window	B-37 A/C Thermo
12V	NHR 55	○	—	○	—	○	○
	NKR 55	○	—	○	—	○	○
	NPR 69	○	○	—	○	○	○
24V	NKR 66	○	—	○	—	○	○
	NKS 66	○	—	○	—	○	○
	NPR 66	○	—	○	—	○	○
	NQR 70	○	—	○	—	○	○
	NPS 66	○	—	○	—	○	○

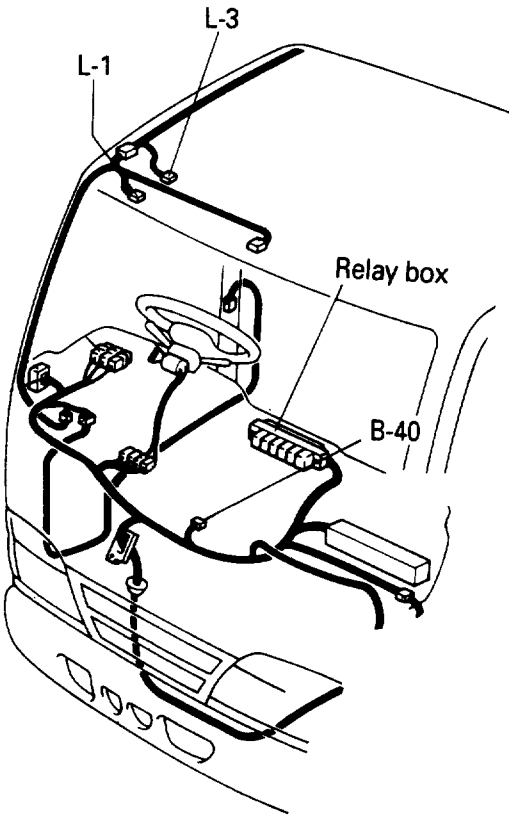
Voltage	Model \ Connector No. / Name	B-38 Exh. brake	J-12 Starter	J-13 Glow	J-13 Glow-1	J-14 Glow-2	J-16 CSD
12V	NHR 55	○	○	○	—	—	○
	NKR 55	○	○	○	—	—	○
	NPR 69	○	○	—	○	○	—
24V	NKR 66	○	○	○	—	—	—
	NKS 66	○	○	○	—	—	—
	NPR 66	○	○	○	—	—	—
	NQR 70	○	○	○	—	—	—
	NPS 66	○	○	○	—	—	—

Voltage	Model \ Connector No. / Name	J-18 Exh. brake control	J-19 4WD	J-19 A/C cut	J-20 Marker light
12V	NHR 55	○	—	—	—
	NKR 55	○	—	—	—
	NPR 69	○	—	—	○
24V	NKR 66	○	—	—	—
	NKS 66	○	○	—	—
	NPR 66	○	—	—	—
	NQR 70	○	—	—	—
	NPS 66	○	○	—	—

DIODE LOCATION







Connector No.	B-17	B-18	B-40	J-23	L-1	L-3
Usage	QOSIII, Lighting	Dome light, A/C	4A/T ECU	VSV: FICD	Dome light	Dome light

REFERENCE TABLE OF GROUNDING POINT

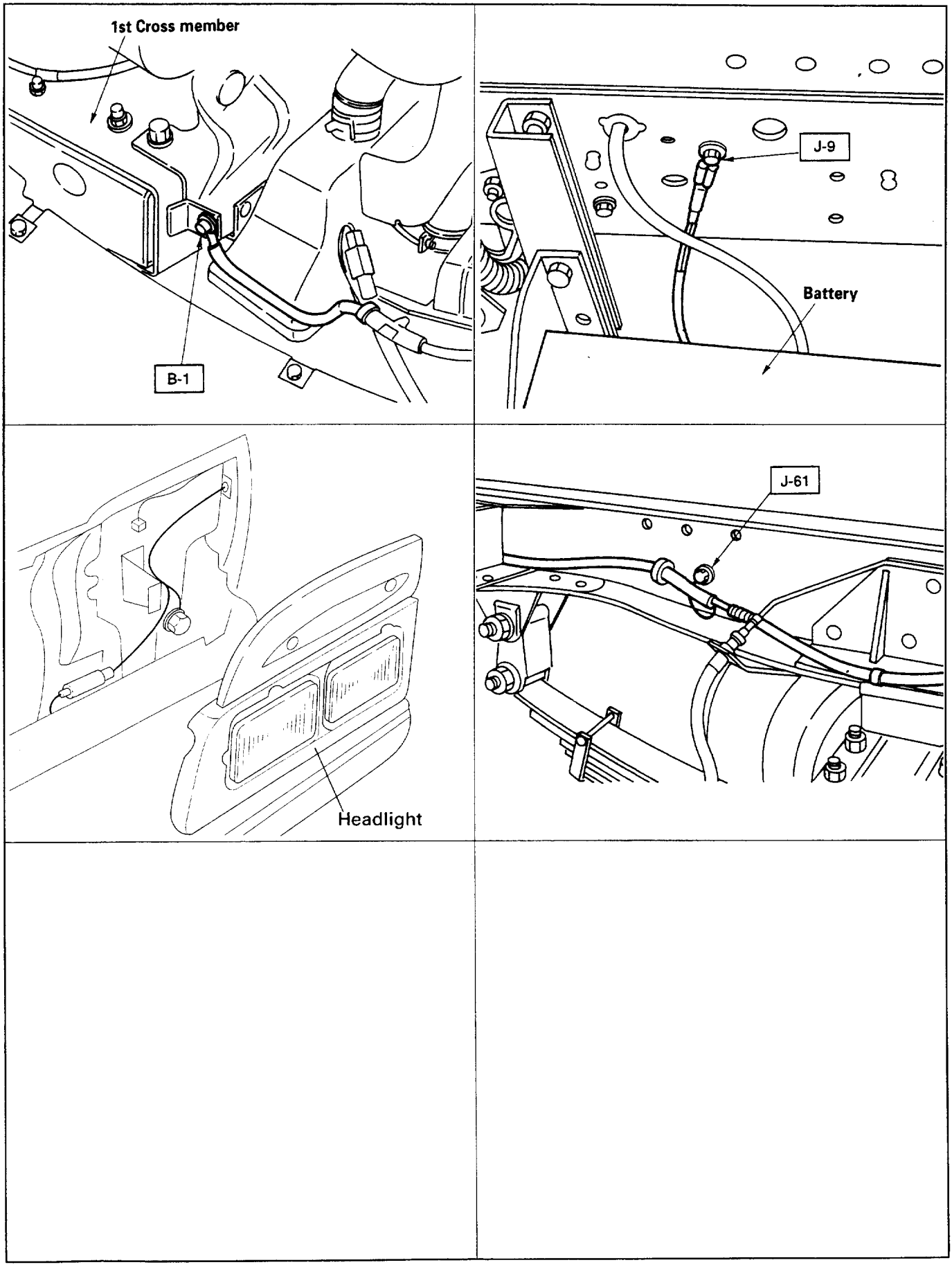
Note:

Abnormal phenomena of electrical components are considered resulted from defective grounding. In repair, be sure to inspect grounding points and to tighten all fastening parts surrounding the grounding points.

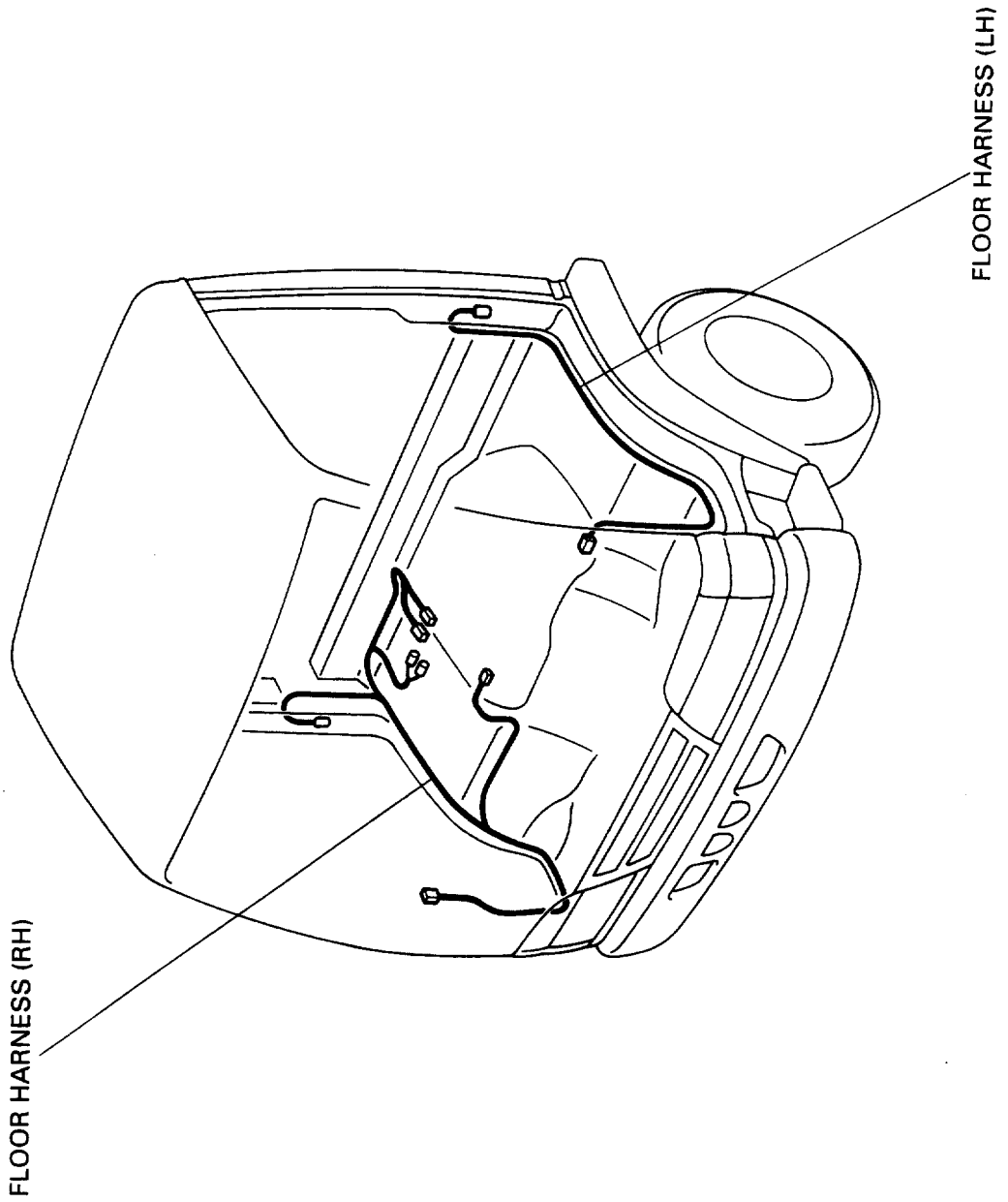
Connector No.	Cable harness name	Location	Main parts (Load)
B-1	Body harness	Frame-LH (FRT)	Vehicle speed sensor, Heater & A/C relay, Fan switch, Ceramic heater relay, Ceramic heater thermo relay, Meter, High beam indicator light
B-7		Headlight bracket-LH	Charge relay, Exhaust brake relay, QOS II control unit, QOS III control unit, OD Switch, OD OFF relay, Dome light switch, Key remind and back up buzzer, Meter, Brake fluid switch, Tail relay, Cornering light switch, Cornering light, Cornering light relay, Fog light switch, Fog light, Dimmer relay, Door lock switch, Door lock relay, Power window switch (RH), Power window relay, Stoplight switch, Mirror switch, Wiper motor, Washer motor intermittent relay, ECU, Pattern select switch, Kickdown switch, Shift indicator, Shift lock controller, Radio, Cigar lighter, Heater & A/C relay, Fan Switch, Ceramic heater relay, Ceramic heater thermo relay, ALDL connector (ECU), Vehicle speed sensor, Horn relay Rear heater switch, Rear heater, Radio & clock, Cigar lighter, Fan switch, Blower resistor, A/C Switch, Blower motor, Electronic thermostat, Accel switch, QOS II control unit, Door lock switch, Door lock controller, Headlight levering switch, Headlight levering motor, 4WD Switch, Shift lock controller, Power window relay, Power window switch, QOS III control unit, 4 A/T ECU, Pattern select switch
J-9	Frame front harness	Frame-LH (CTR)	Marker light relay, Marker light, Water sedimenter switch, Fuel tank unit, Starter relay, Inhibitor switch, 4WD switch, VSV; Transfer control (2WD & 4WD), 4WD detective switch, 4WD relay, Neutral switch, Fuel heater, Pressure switch, A/C thermo relay, VSV: FICD, Exhaust brake control relay, Exhaust brake magnetic valve, Accel switch, Clutch switch, VSV: intake throttle, Engine stop motor,

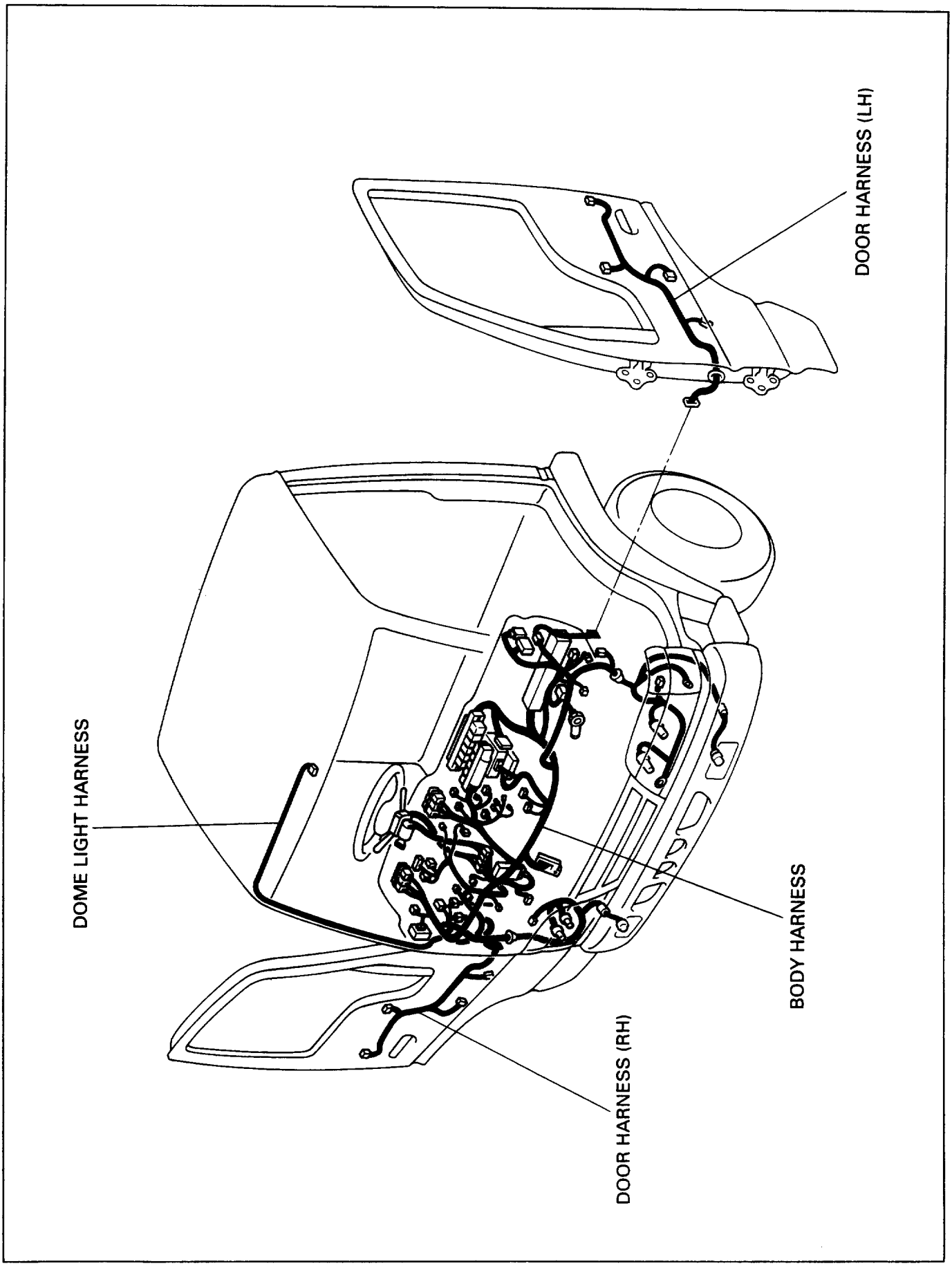
Connector No.	Cable harness name	Location	Main parts (Load)
J-61	Frame rear harness	Frame-LH (RR)	License plate light, Taillight, Rear fog light, Rear turn signal light, Stoplight, Stoplight Switch, License plate light, Backup light

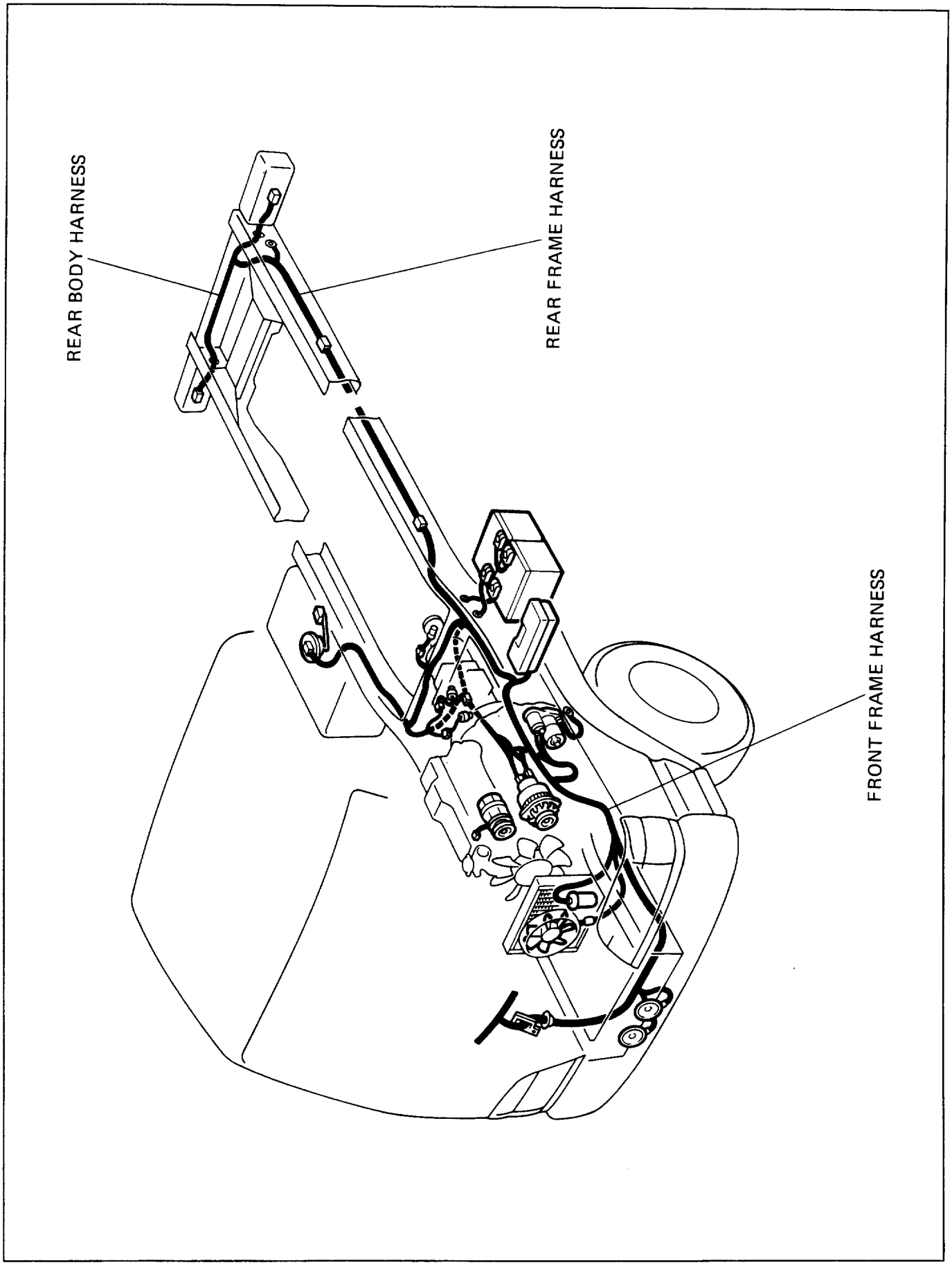
GROUNDING POINT LOCATION



CABLE HARNESS ROUTING




DOME LIGHT HARNESS
DOOR HARNESS (LH)
BODY HARNESS
DOOR HARNESS (RH)


REAR BODY HARNESS
REAR FRAME HARNESS
FRONT FRAME HARNESS

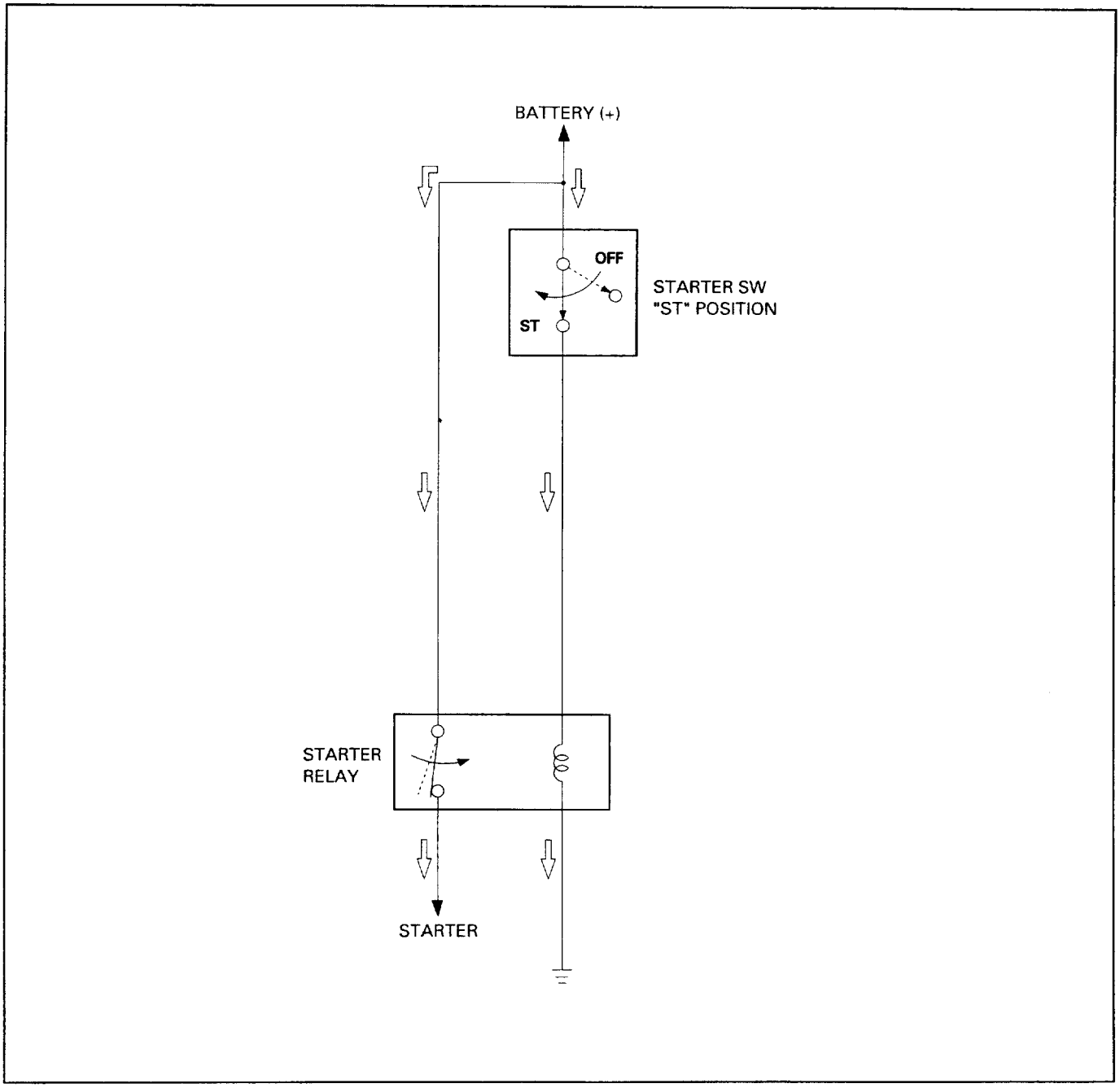
SYSTEM REPAIR

START AND CHARGING

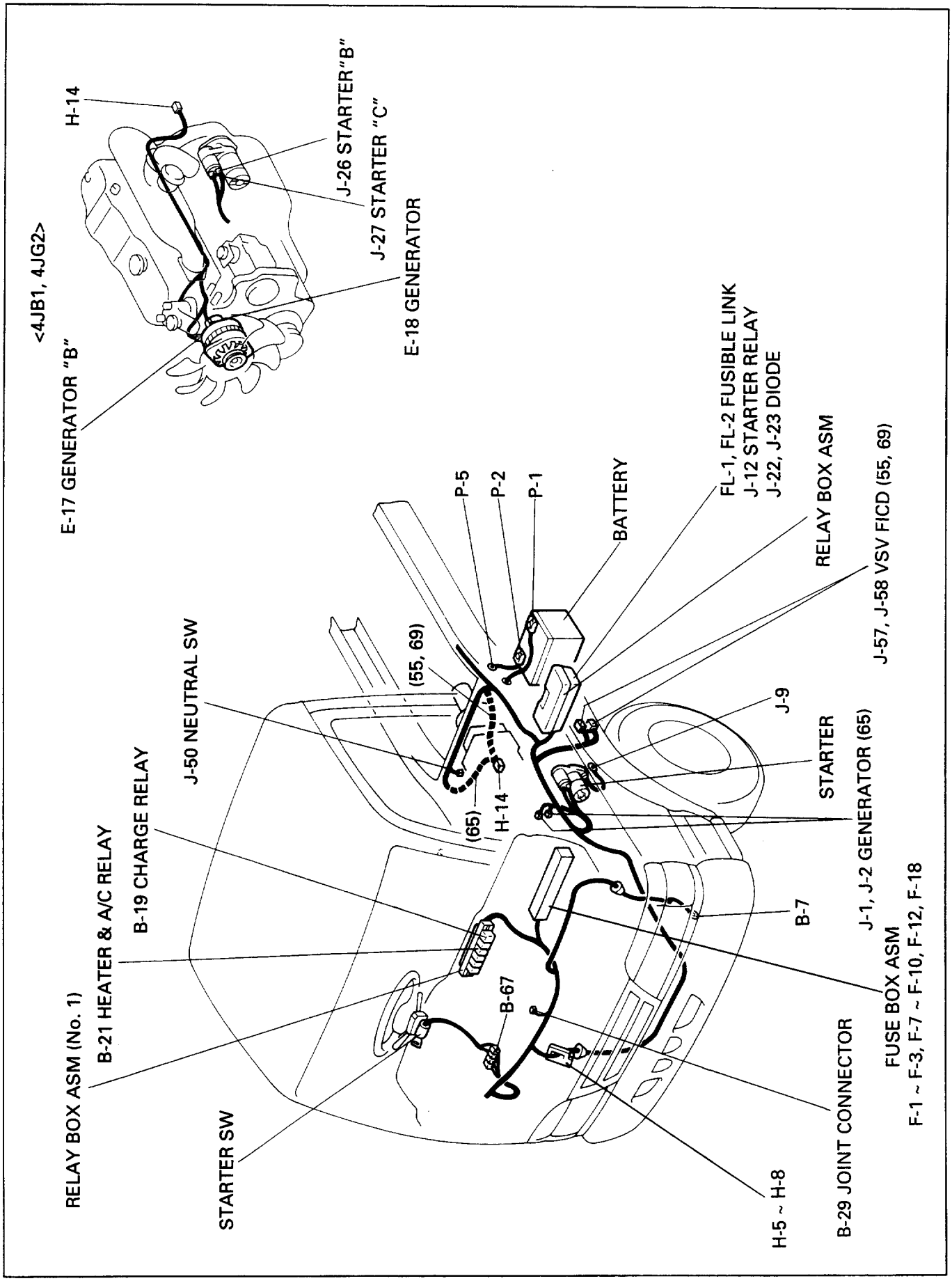
GENERAL DESCRIPTION

The system consists of the starter switch, starter, AC generator, starter relay, charge relay, heater and A/C relay, inhibitor switch and neutral switch. When the starter SW is set to the "ST" position, the battery voltage is applied to the starter solenoid coil through the starter relay to start the starter.

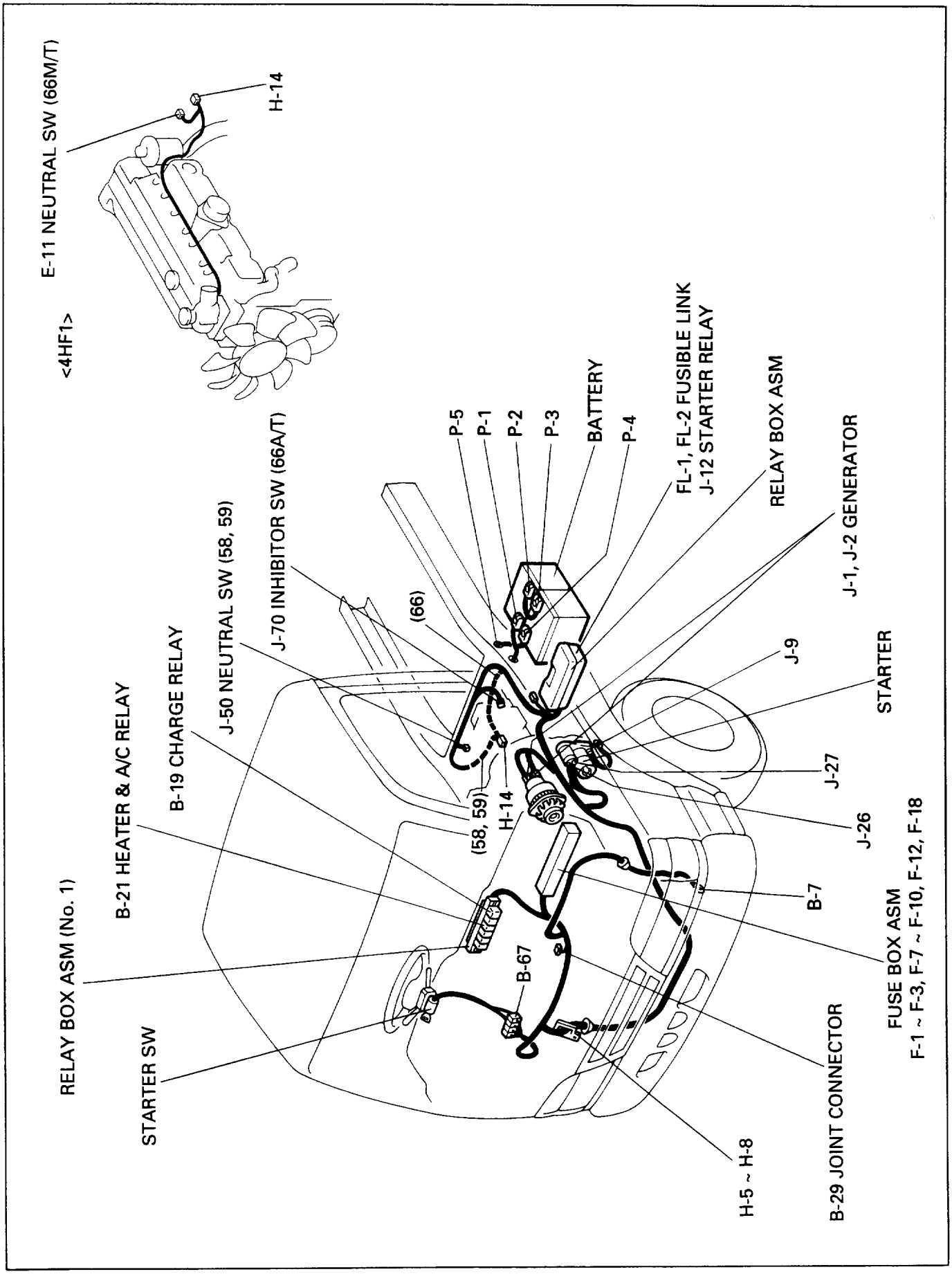
STARTING CIRCUIT



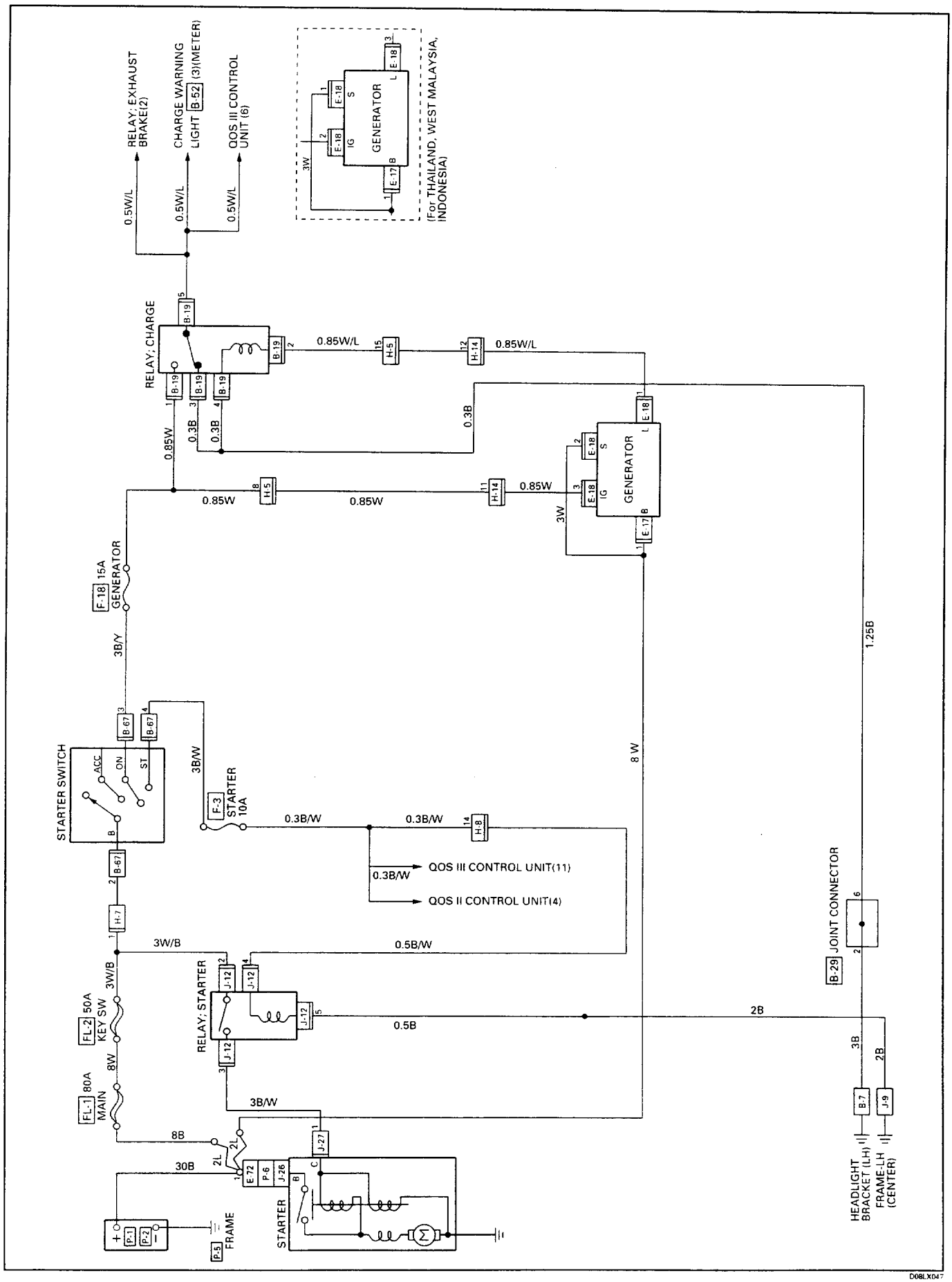
PARTS LOCATION - FOR 12 VOLT



PARTS LOCATION - FOR 24 VOLT

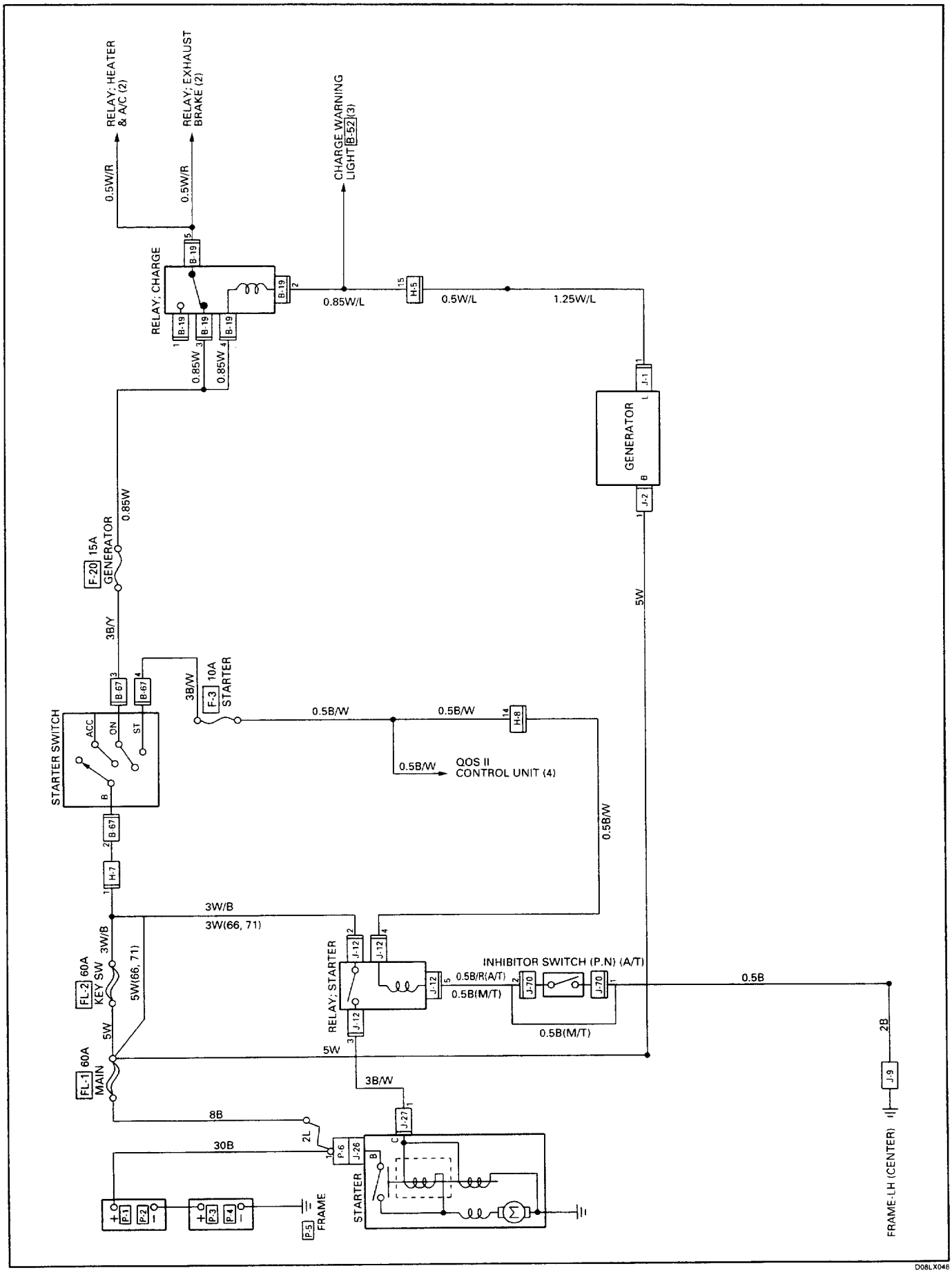


CIRCUIT DIAGRAM - FOR 12 VOLT



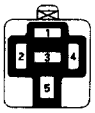
D08LX047

CIRCUIT DIAGRAM - FOR 24 VOLT

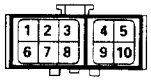


CONNECTOR LIST

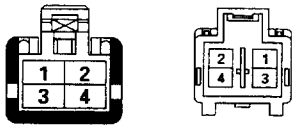
B-19



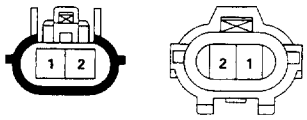
B-29



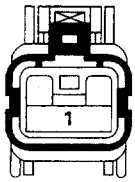
B-67



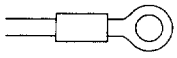
E-11 J-70



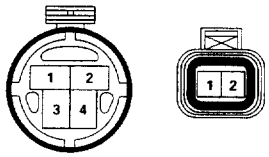
E-17



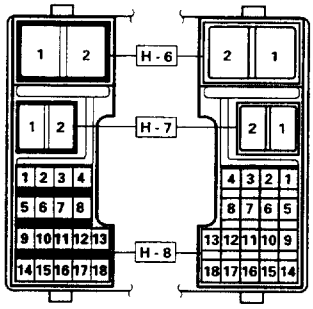
E-17 J-2



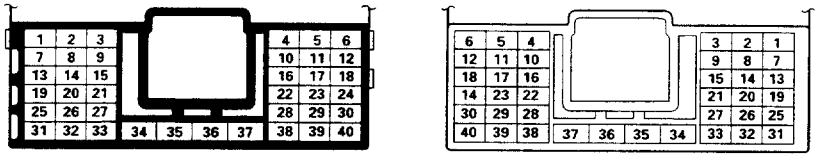
E-18 J-1



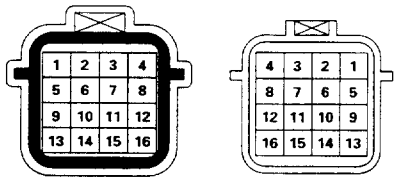
H-7 H-8



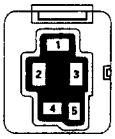
H-5



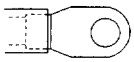
H-14



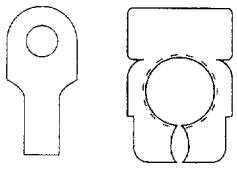
J-12



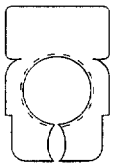
J-26 P-6 (Except 66)
P-5 (24V)



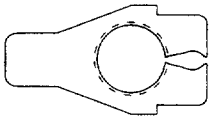
P-1 (12V) P-2



P-1 (24V) P-4

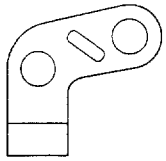


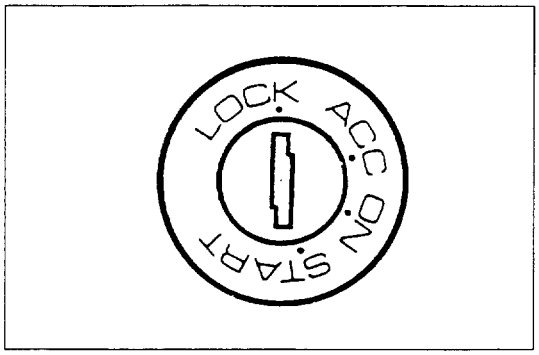
P-2 (24V) P-3



P-5 (12V)

P-6 (Except 66)



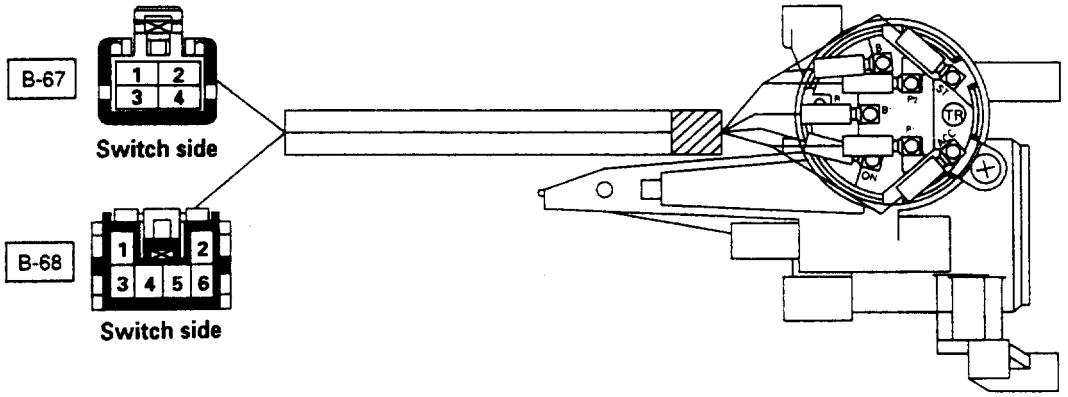


STARTER SWITCH

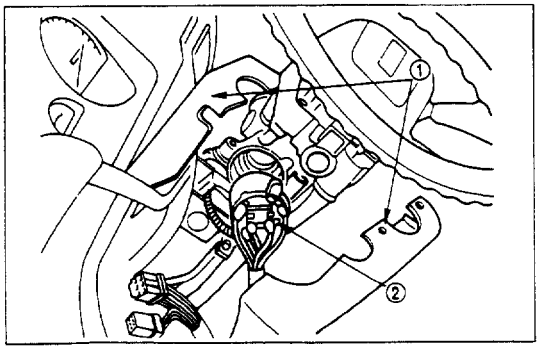
The starter switch positions are LOCK, ACC, ON and START. Turning the starter key to these positions a circuit for starting the engine, the operation of accessories, or stop the engine.

INSPECTION

Check the continuity between the starter switch connector terminals.
Repair or replace the switch when the result of inspection is found abnormal.



Connector No. / Terminal No. / Starter SW key position		B-67				B-68				
		1	2	3	4	1	2	4	5	6
		ACC	B	ON	ST	B1	P1	P2	W	W
Removed	LOCK					○—○				
Inserted	ACC	○—○				○—○				
	ON	○—○	○	○		○		○	○—○	
	START		○	○	○	○		○		



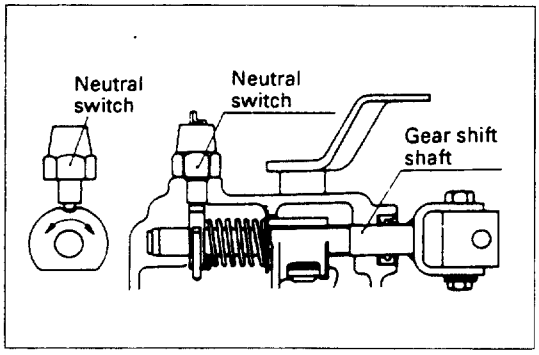
REMOVAL

Preparation:
Disconnect the battery ground cable.

1. **Steering Cowl**
   Remove four screws and take off the steering cowl.
2. **Starter Switch**
   1) Disconnect the connector.
   2) Remove the screw.

INSTALLATION

To install, follow the removal steps in the reverse order.



NEUTRAL SWITCH

INSPECTION

Check to see if there is any continuity between the switch terminals.
Replace the switch when the result of inspection is found abnormal.

QOS (QUICK ON START) SYSTEM

QOSII: 4HF1 AND 4JB1 MODEL ENGINE

GENERAL DESCRIPTION

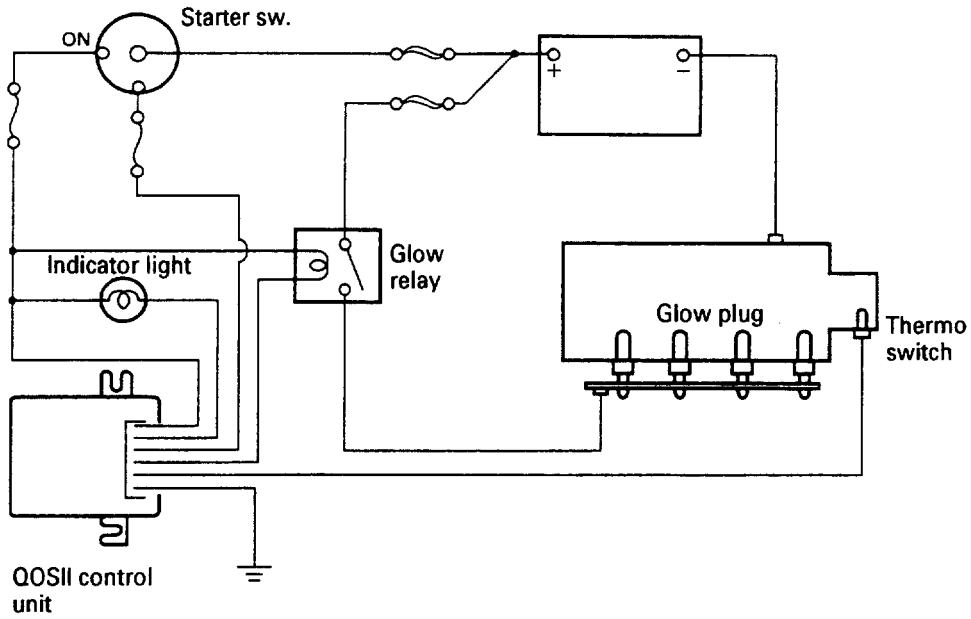
The circuit consists of starter switch, QOSII control unit, glow relay, thermo switch, glow plug fuel cut solenoid, CSD relay, CSD solenoid and glow indicator light.

The QOS-II controller controls are glow plug relay by the ON or OFF signal of QOS thermo switch. Immediately when the starter switch turns "ON", the glow plug relay indicator light turns on to start preheating.

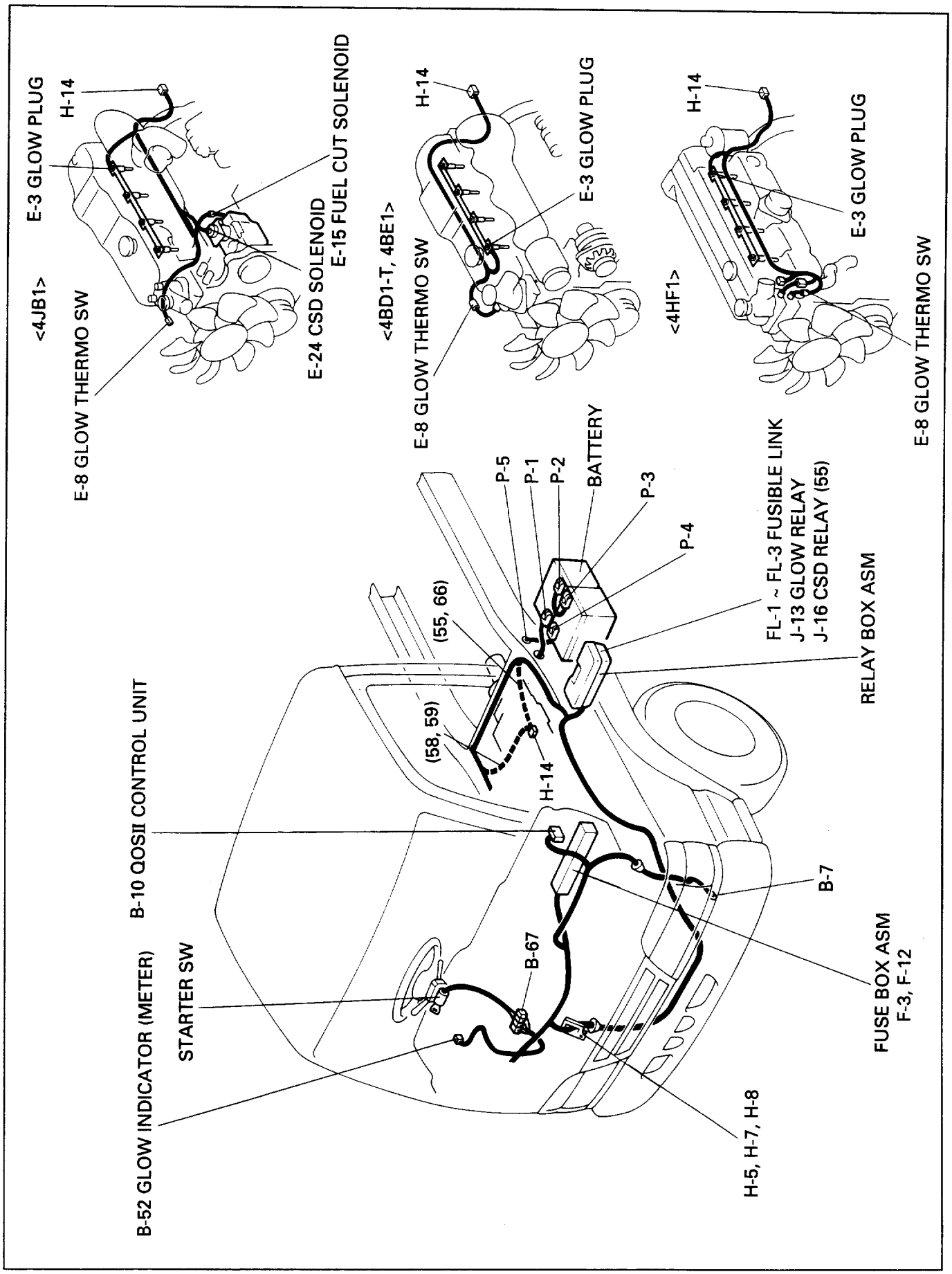
The engine should be started after the indicator light is off. However, the glow plug relay keeps preheating for a fixed period even after the indicator light turns off. When the fixed time is over, QOS-II controller performs to switch the glow plug relay off to stop preheating.

For details, refer to 6D6 "PREHEATING SYSTEM".

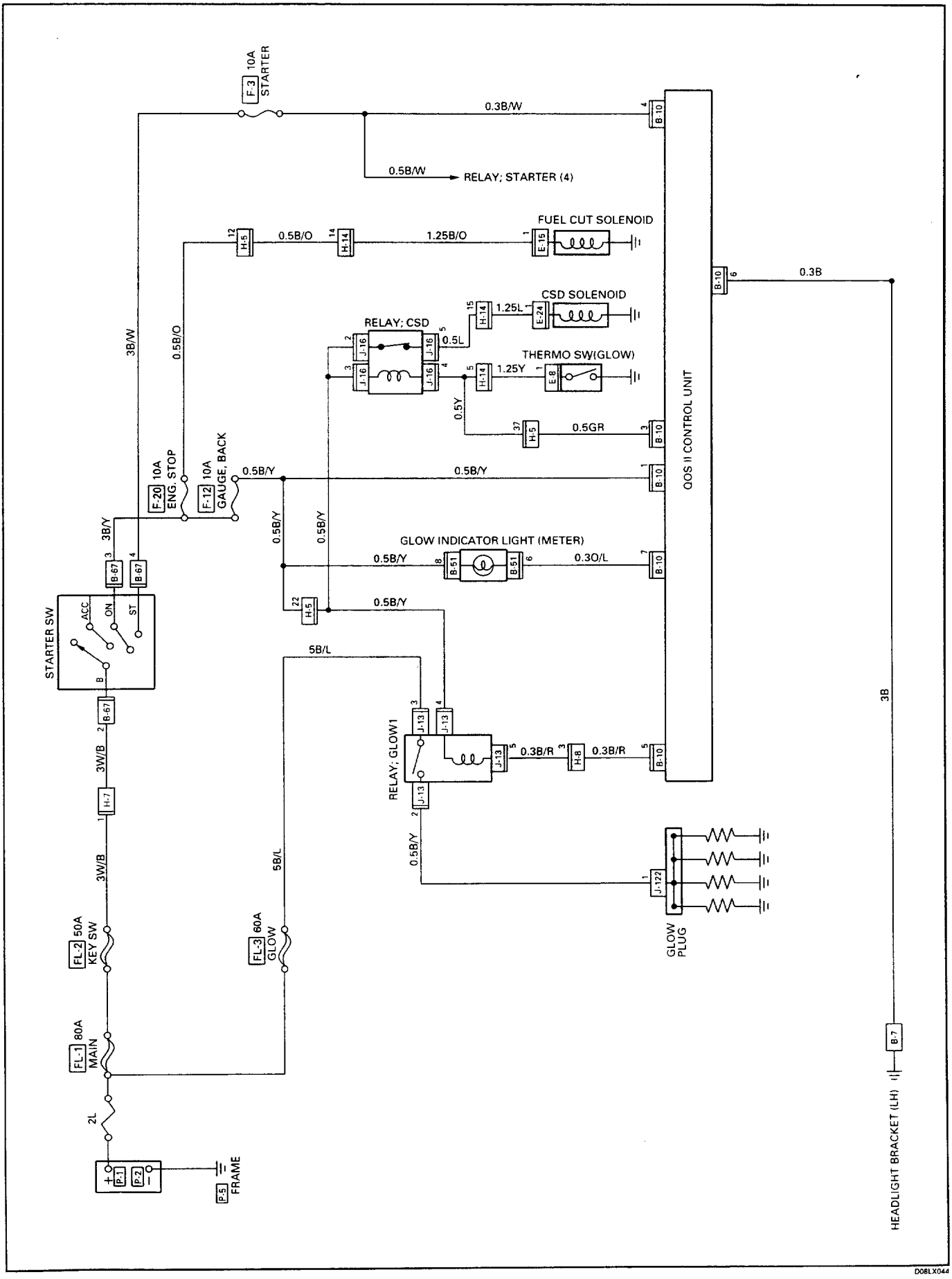
SYSTEM CIRCUIT



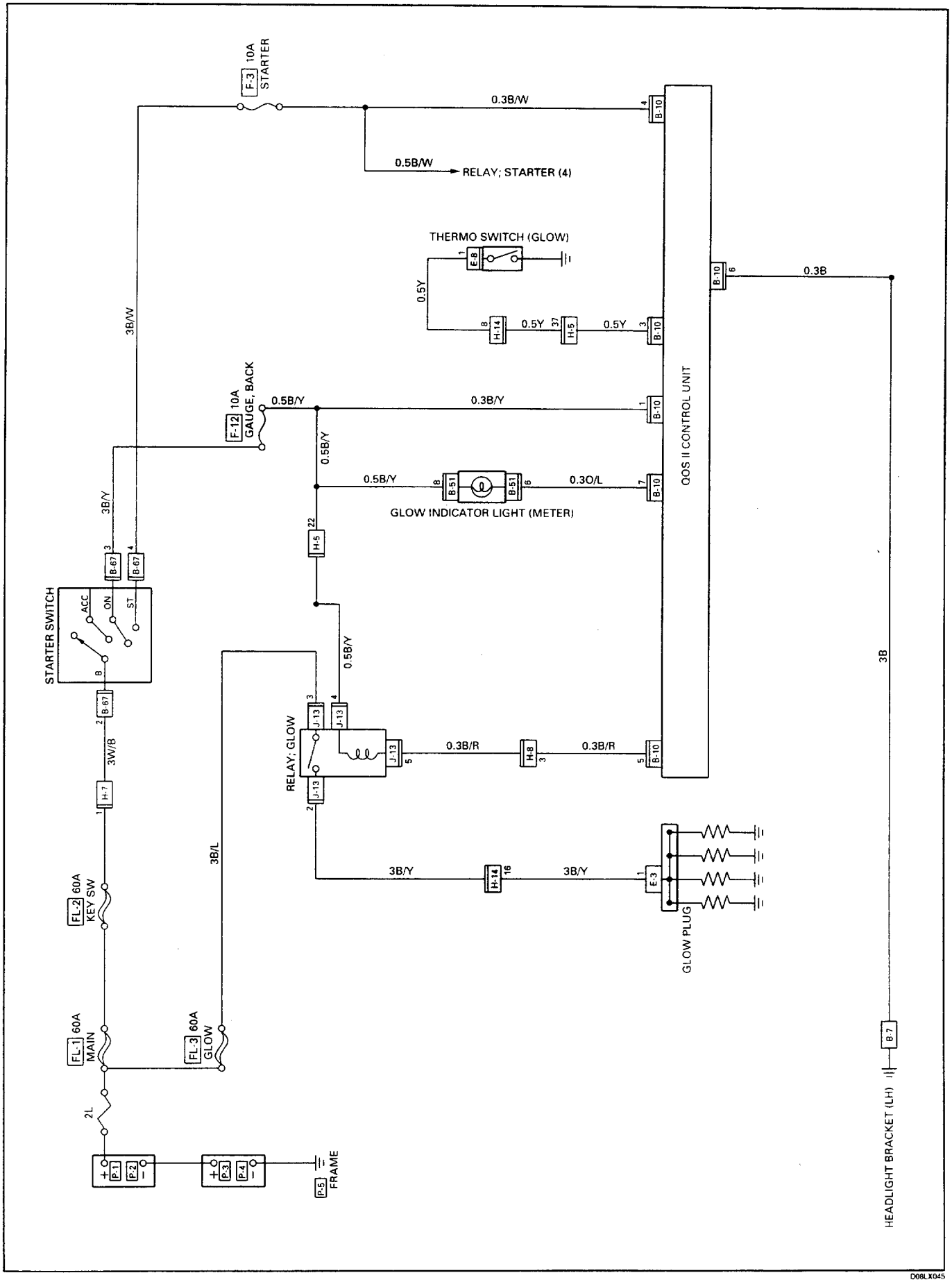
PARTS LOCATION



CIRCUIT DIAGRAM - NHR55 · NKR55

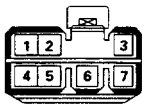


CIRCUIT DIAGRAM - NKR58 · NPR58 · NPR59 · NKR66 · NPR66 · NQR66 · NPS66

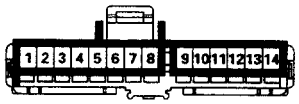


CONNECTOR LIST

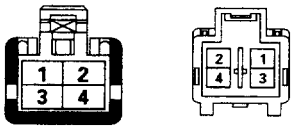
B-10



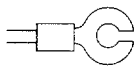
B-51



B-67



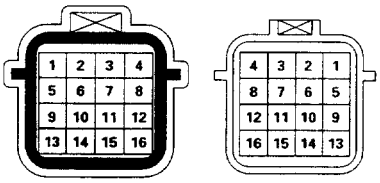
E-3



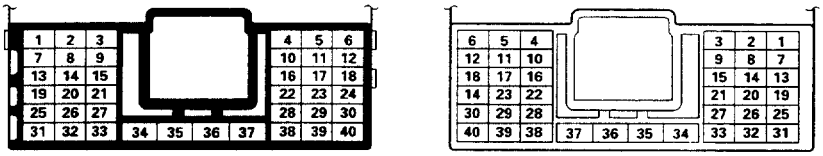
E-8

E-24

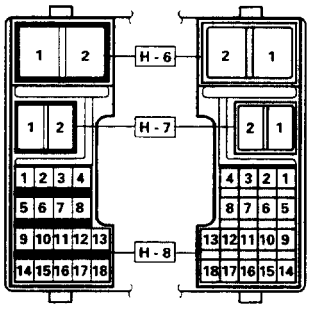
H-14



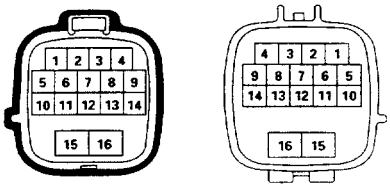
H-5



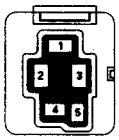
H-7 H-8



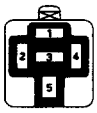
H-14 (4HF1)



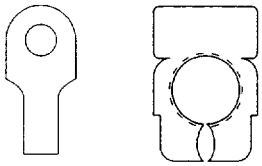
J-13 J-14



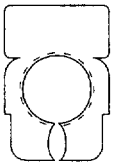
J-16



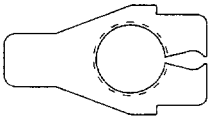
P-1 (12V) P-2



P-1 (24V) P-4

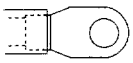


P-2 (24V) P-3



P-5 (12V)

P-5 (24V)

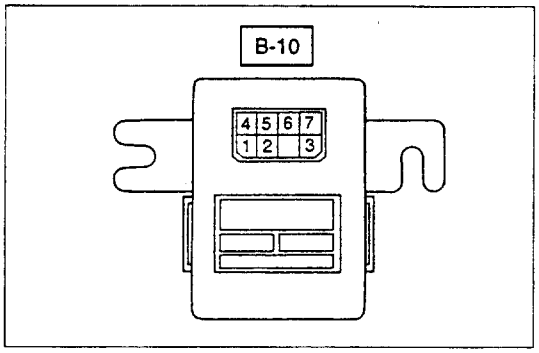


STARTER SWITCH

Refer to "START AND CHARGING" in this section.

GLOW INDICATOR LIGHT THERMO SWITCH

Refer to "METER AND WARNING/INDICATOR LIGHT" in this section.



QOSII CONTROL UNIT

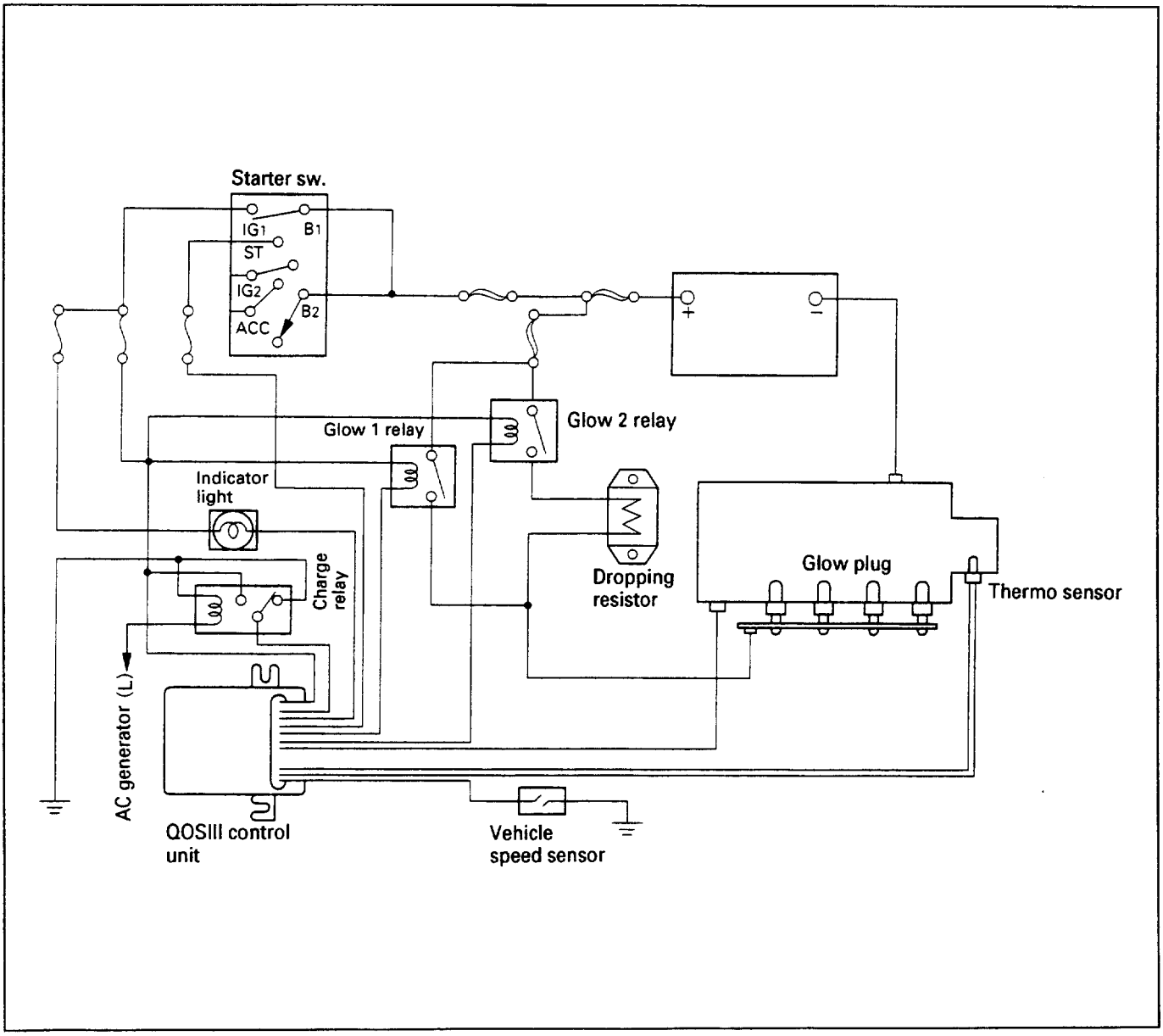
Terminal No.	Connected to
1	Starter switch (ON)
2	—
3	Thermo switch
4	Starter switch (ST)
5	Glow relay
6	Ground
7	Glow indicator (Meter)

QOSIII - 4JG2 ENGINE MODEL

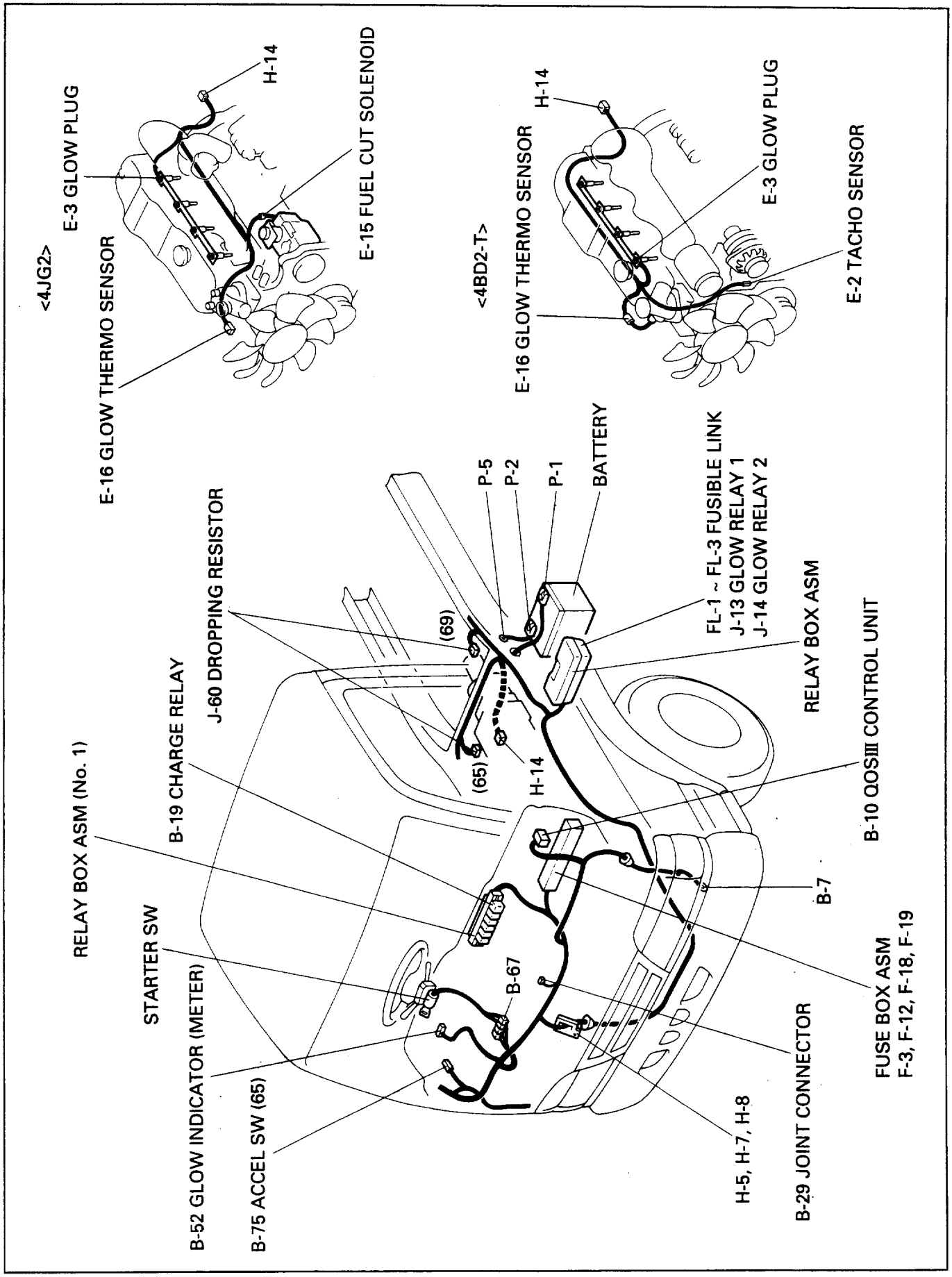
GENERAL DESCRIPTION

The system consists of starter switch, QOS III control unit, glow relay, charge relay, fuel cut solenoid, dropping resistor, thermo sensor, glow plug, engine speed sensor, accel switch and glow indicator light.
Perceiving the engine coolant temperature when the engine started, the thermo sensor varies the glowing time to always get the most suitable condition for engine starting.
The indicator timer starts to operate as soon as the starter switch turns to "ON" position, and the indicator light turns on and keeps lit until the glow plugs have been heated to the level ready for the engine starting, when the indicator light is off.
For details, refer to section 6D6 "PREHEATING SYSTEM".

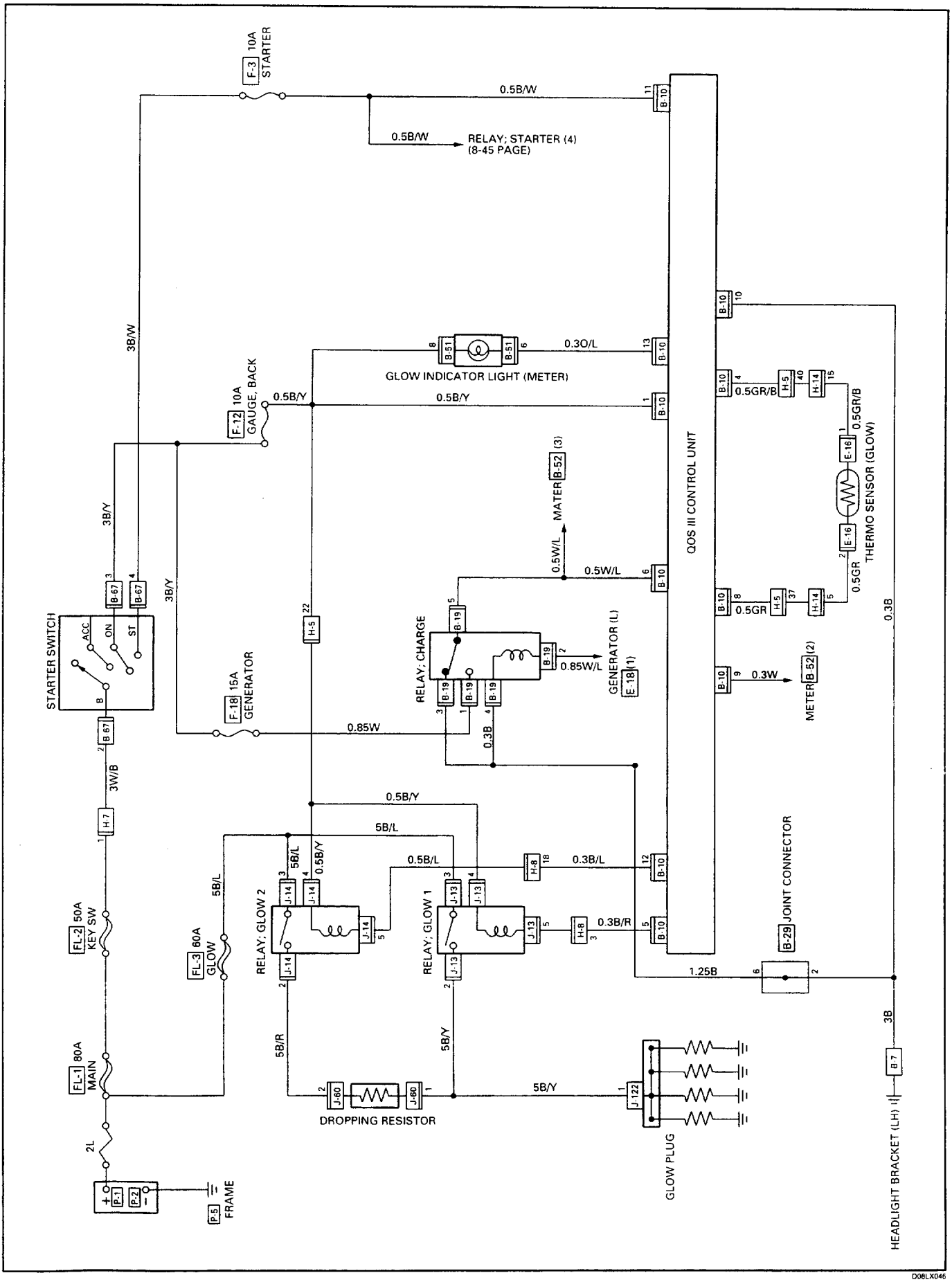
SYSTEM CIRCUIT



PARTS LOCATION



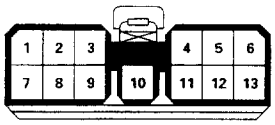
CIRCUIT DIAGRAM - NPR69



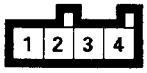
D08LX046

CONNECTOR LIST

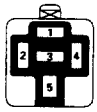
B-10



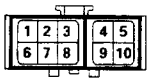
B-17



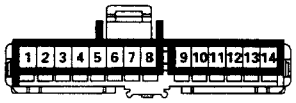
B-19



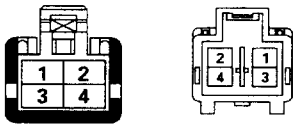
B-29



B-51

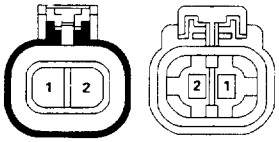


B-67

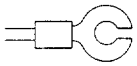


B-75

E-2



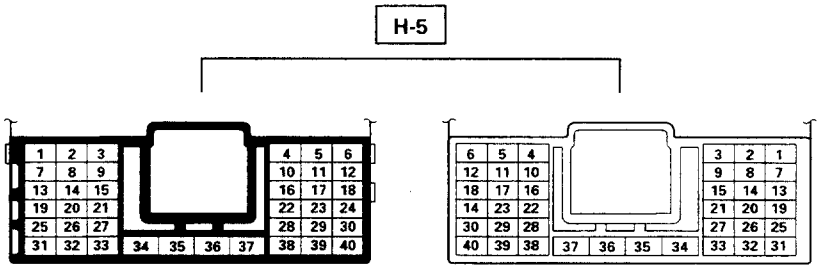
E-3 J-122

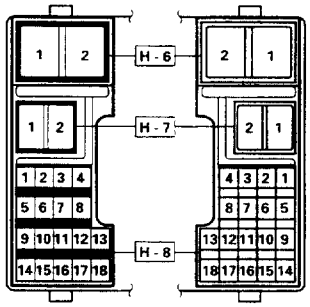


E-16

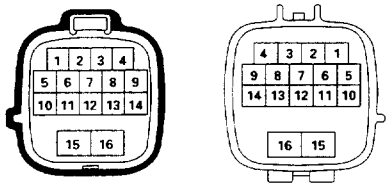
H-7 H-8

H-5

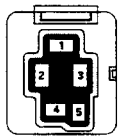




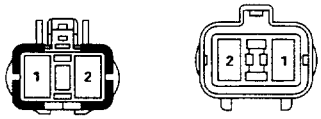
H-14



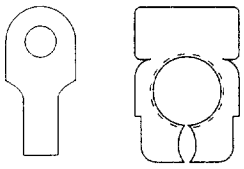
J-13 J-14



J-60



P-1 P-2



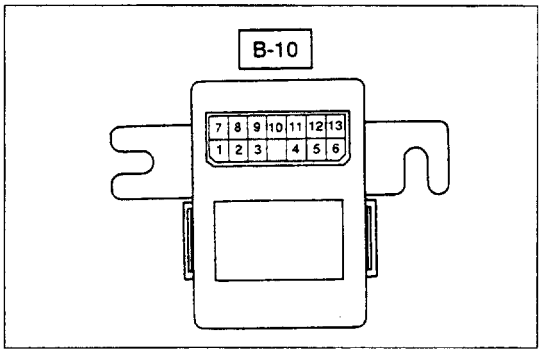
P-5

STARTER SWITCH

Refer to "START AND CHARGING" in this section.

GLOW INDICATOR LIGHT

Refer to "METER AND WARNING/INDICATOR LIGHT" in this section.



QOSIII CONTROL UNIT

Terminal No.	Connected to
1	Starter switch (ON)
2	—
3	Engine speed sensor (NPR65)
4	Thermo sensor (–)
5	Glow 1 relay
6	Charge relay
7	—
8	Thermo sensor (+)
9	Meter
10	Ground
11	Starter switch (ST)
12	Glow 2 relay
13	Glow indicator (Meter)

MEMO

EXHAUST BRAKE SYSTEM

GENERAL DESCRIPTION

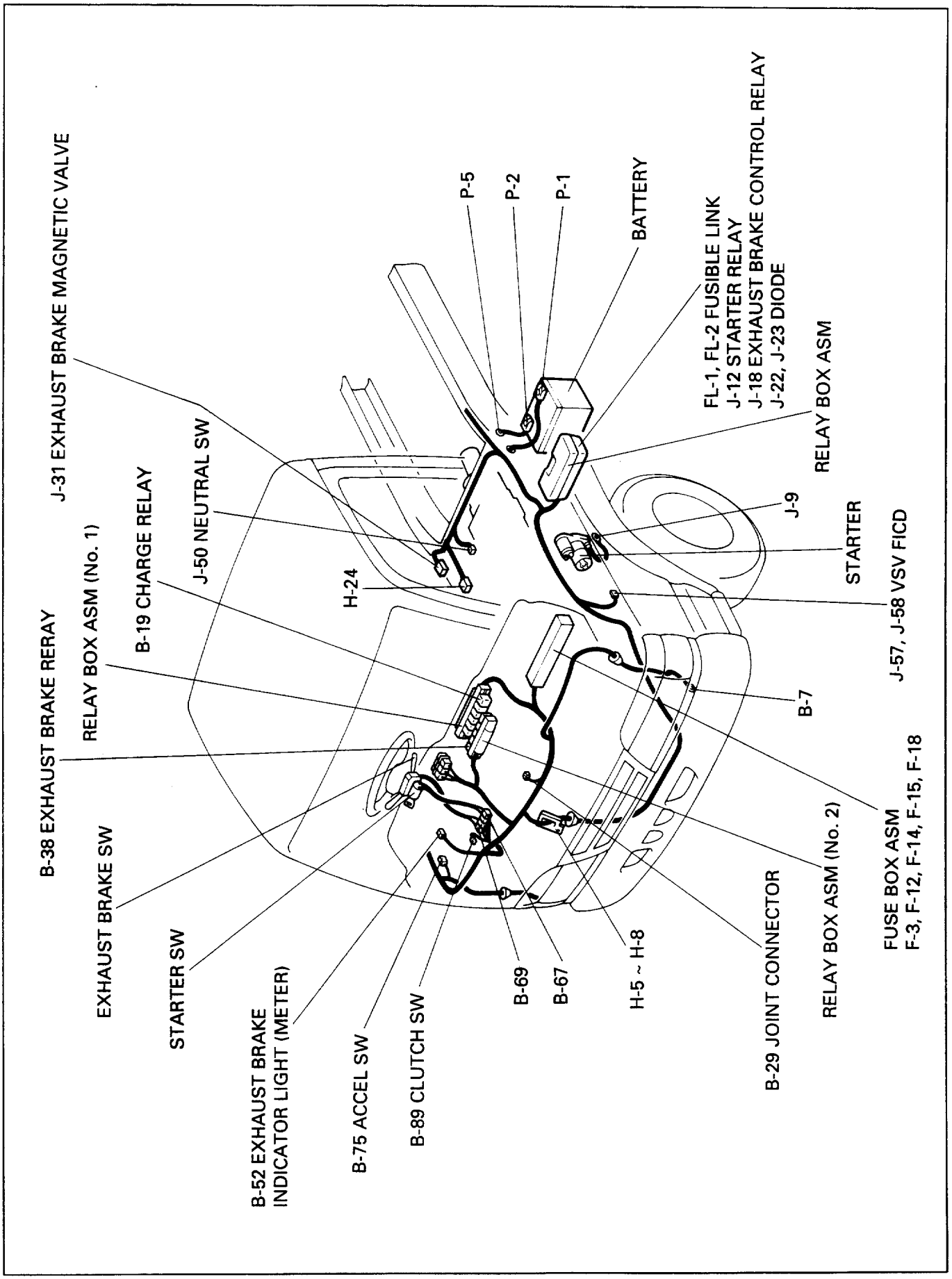
This circuit consists of starter switch, exhaust brake switch (combination switch), accelerator switch, clutch switch, vacuum switching valve, neutral switch and relay.

Exhaust brake is a system to increase exhaust pressure by means of squeezing exhaust gas from engine and exert engine brake.

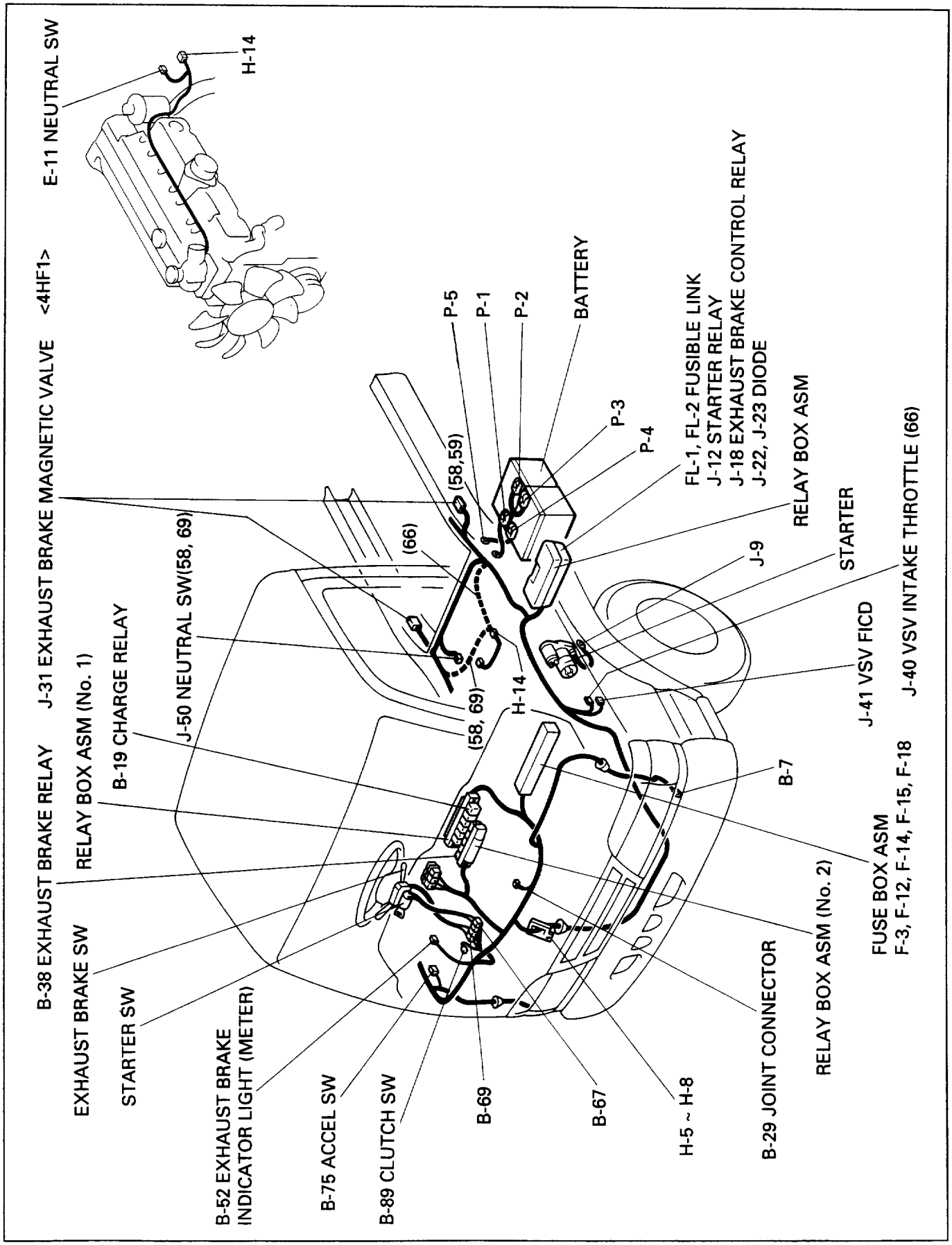
Turn the exhaust brake SW on, and the exhaust brake valve starts to work by the function of the magnetic valve to enable the exhaust bake to operate, when the exhaust brake indicator light will be on.

When either the accelerator pedal or the clutch pedal is depressed while driving, the switch of the depressed pedal will turn off, subsequently the exhaust braking will stop working.

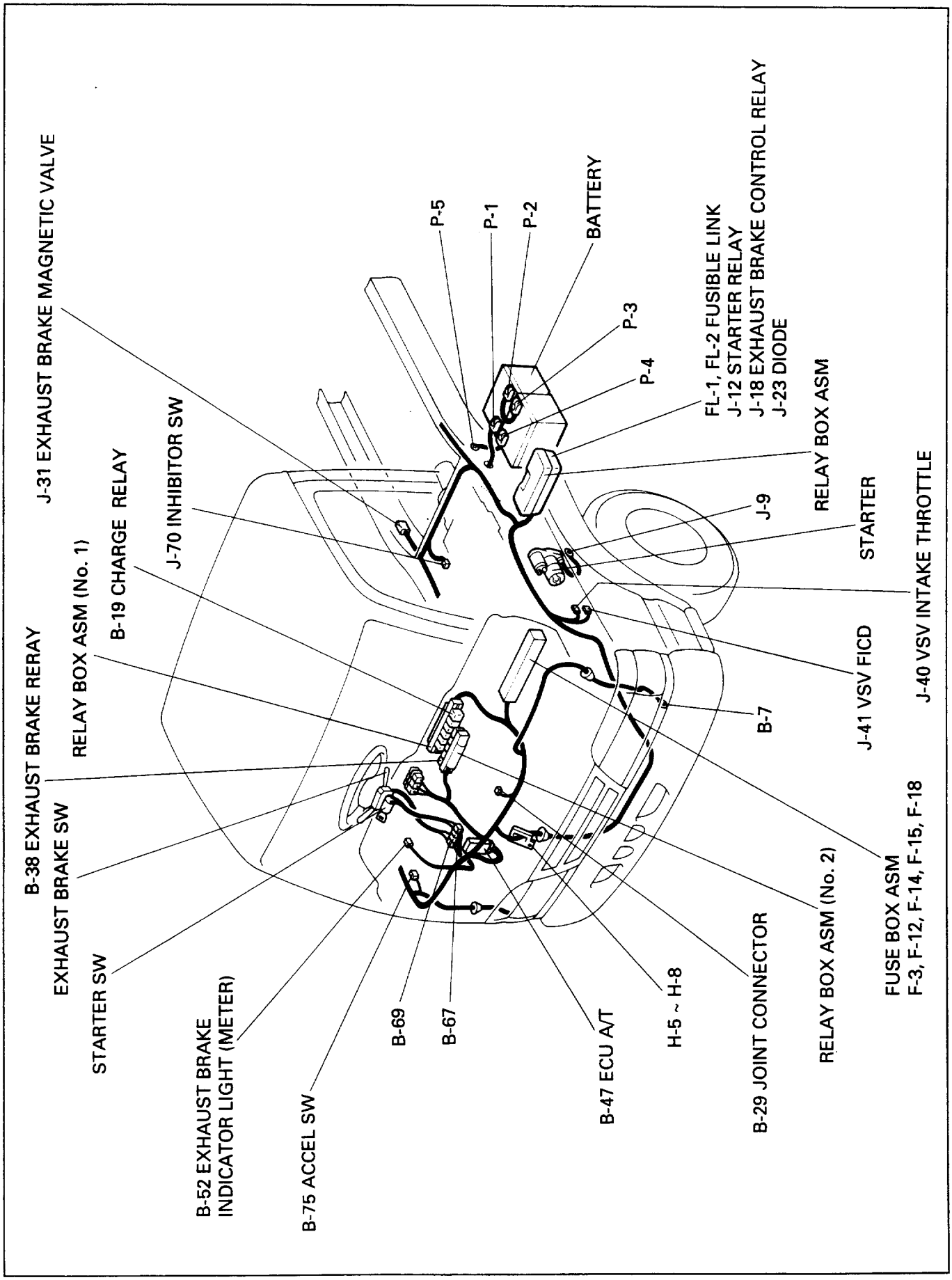
PARTS LOCATION - NHR55 · NKR55 · NPR69



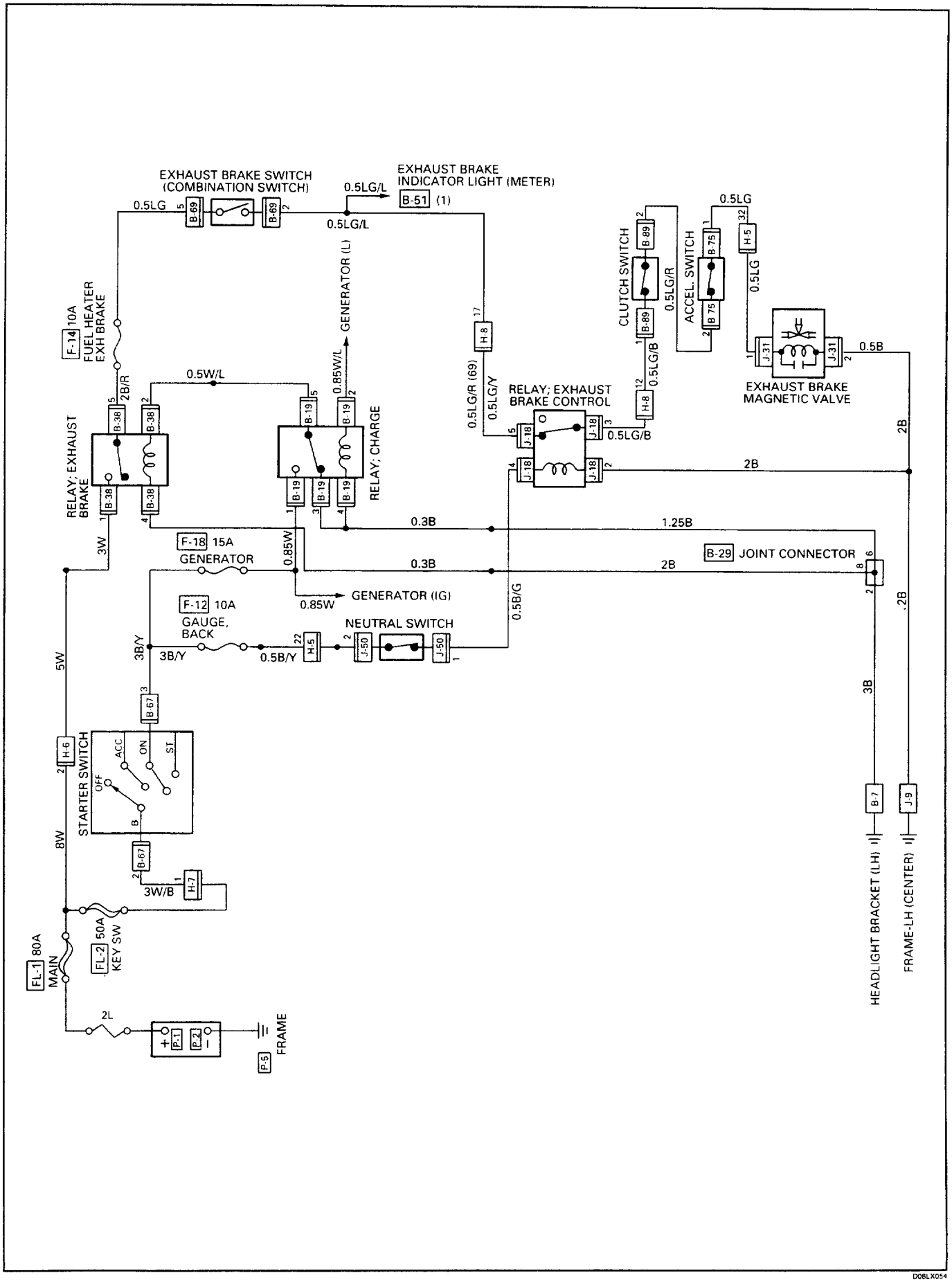
PARTS LOCATION - NKR66(M/T) · NPR66(M/T) · NQR66(M/T) · NPS66(M/T) · NPR70 · NPR71



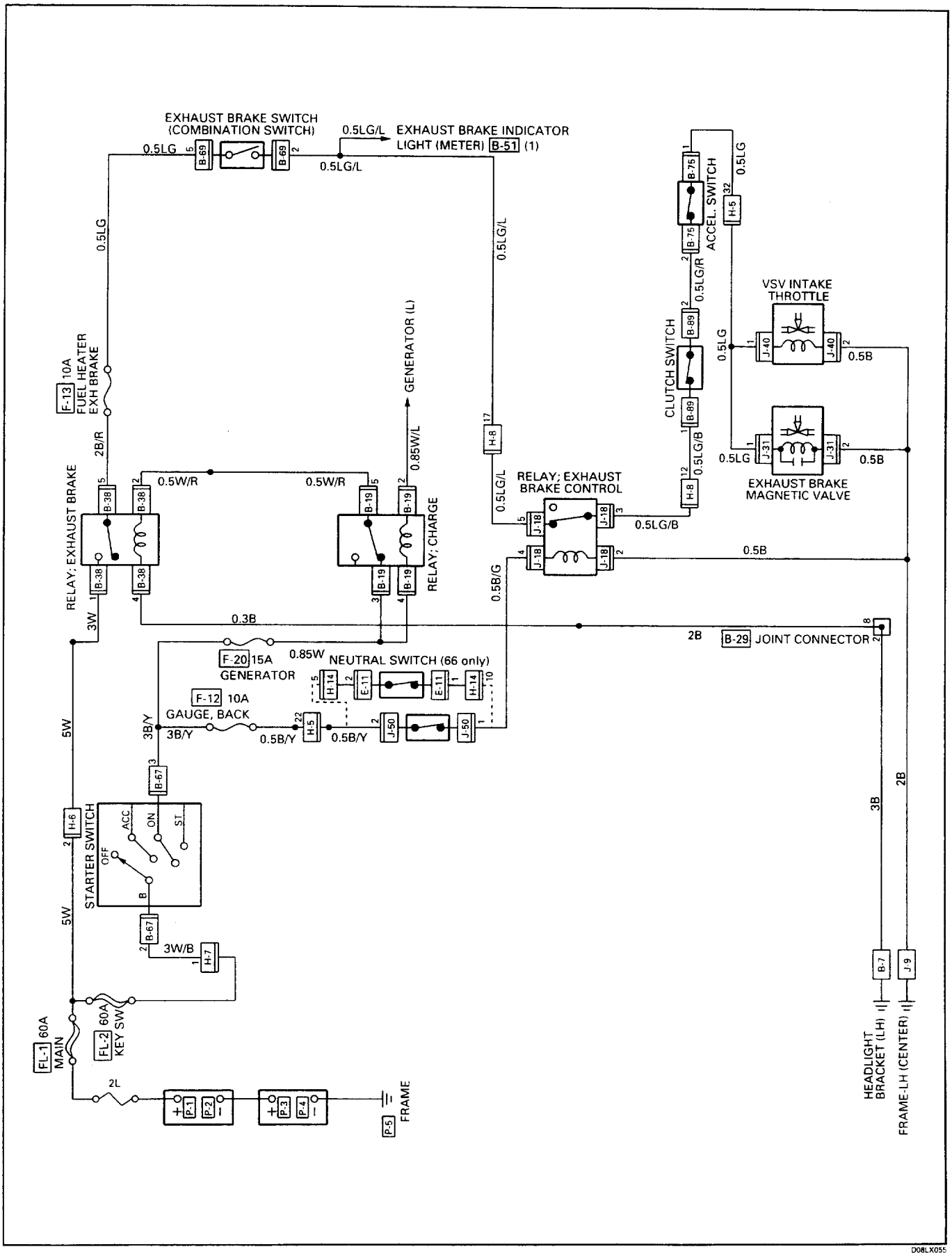
PARTS LOCATION - NPR66 . . . A/T



CIRCUIT DIAGRAM - NHR55 · NKR55 · NPR69

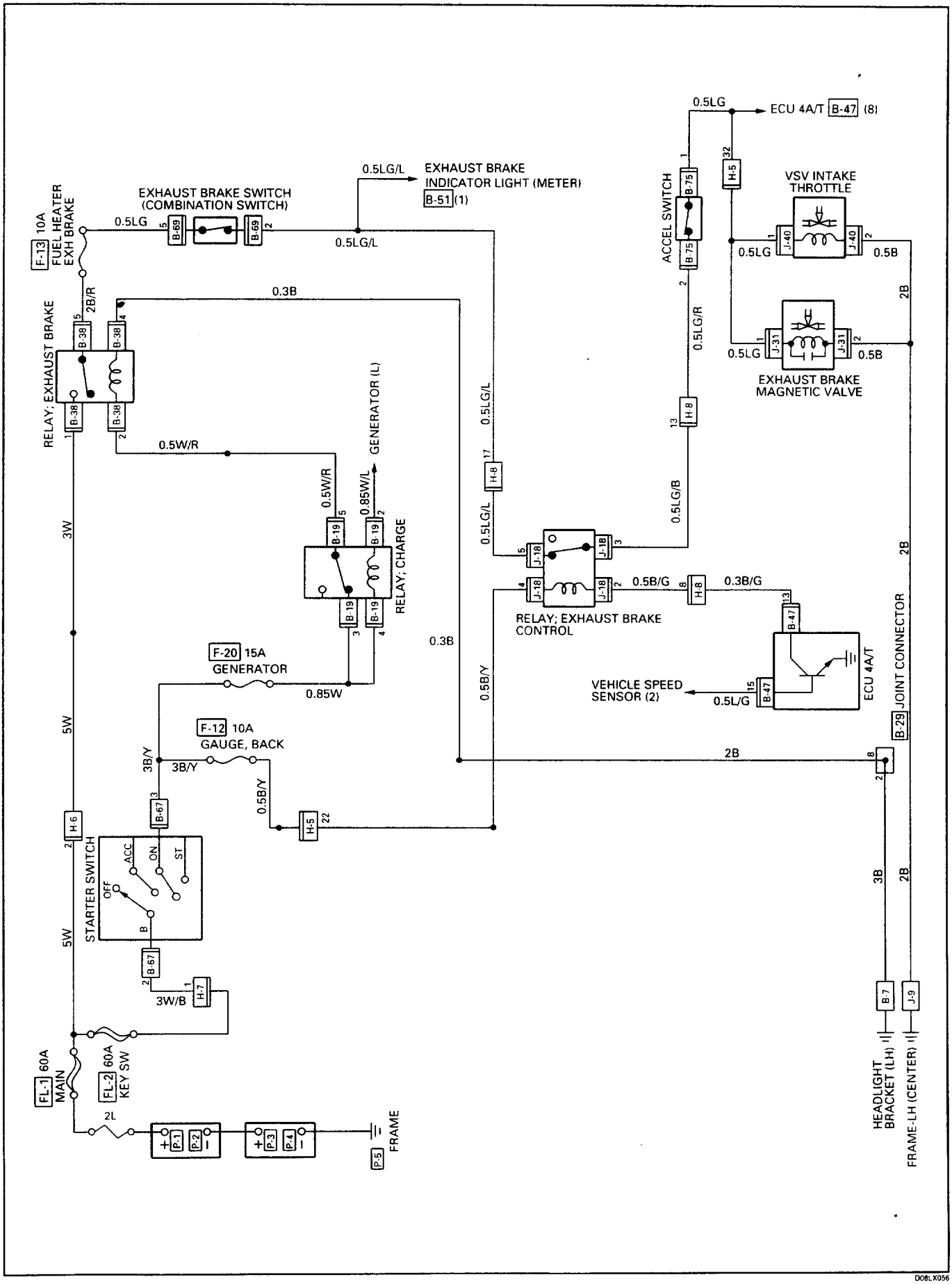


CIRCUIT DIAGRAM - NKR66(M/T) · NPR66(M/T) · NQR66(M/T) · NPS66(M/T) · NPR70 · NPR71



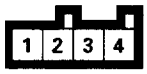
D08LX055

CIRCUIT DIAGRAM - NPR66 . . . A/T

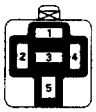


CONNECTOR LIST

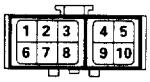
B-17



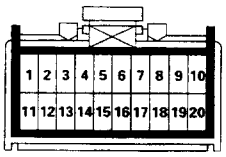
B-19 J-18 B-38



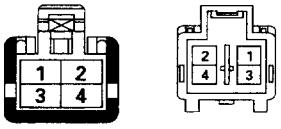
B-29



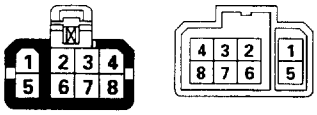
B-47



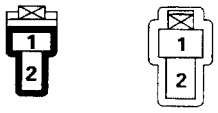
B-67



B-69

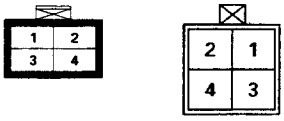


B-75



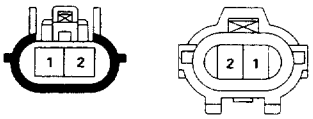
B-75

B-75

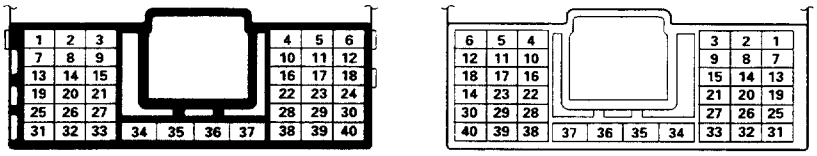


B-89

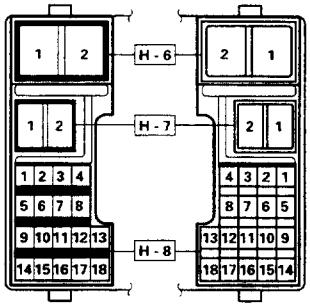
E-11 J-50 J-70



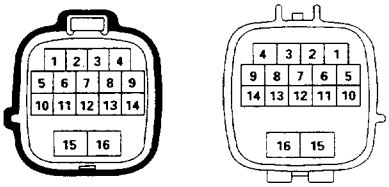
H-5



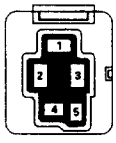
H-6 H-8 H-7



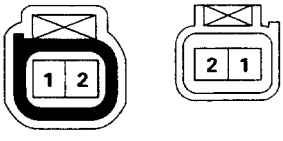
H-14



J-12



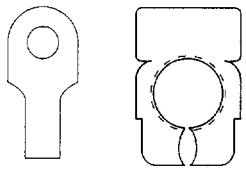
J-31



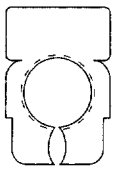
J-40

CONNECTOR LIST

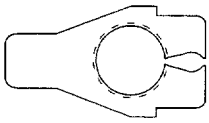
P-1 (12V) P-2



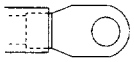
P-1 (24V) P-4



P-2 (24V) P-3



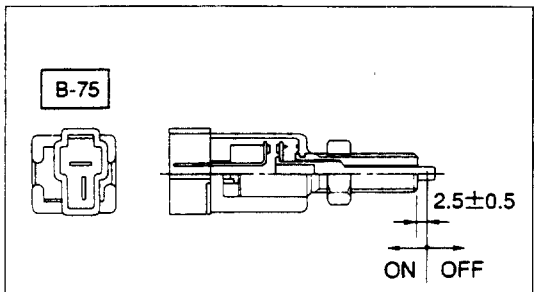
P-5 (24V)



P-5 (12V)

NEUTRAL SWITCH
STARTER RELAY
CHARGE RELAY
STARTER SWITCH

Refer to "START AND CHARGING" in this section.



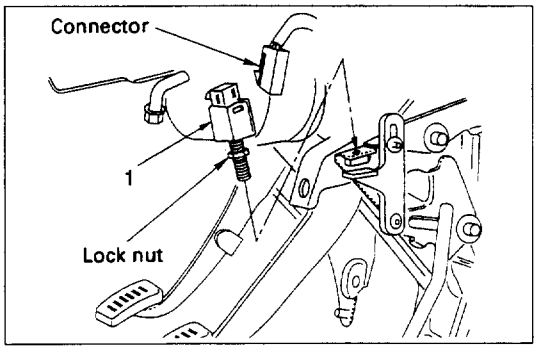
SW position \ Terminal No.	1	2
Push rod in	○	○
Push rod out		

ACCEL SWITCH
(2-Pole type connector)

INSPECTION

1. Check the continuity between the switch connector terminals.
2. Check to see if switch push rod operate smoothly.

Repair or replace the accel switch when result of inspection is found abnormal.



REMOVAL

Preparation:
Disconnect the battery ground cable.

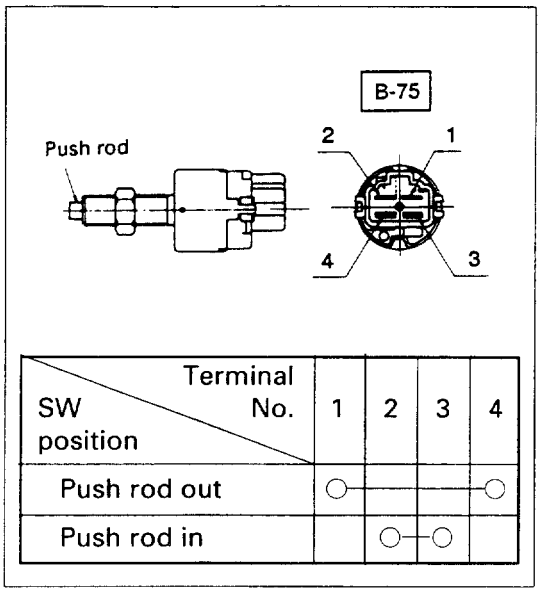
1. **Accel Switch**
   1) Disconnect the connector.
   2) Loosen the lock nut of the switch.
   3) Remove the switch by turnng it.

INSTALLATION

To install, follow the removal steps in the reverse order, noting the following points.

1) Check to see if the accel pedal has been returned by the return spring to the specified position.
2) Turn the accel switch clockwise until the tip of the threaded portion of the switch contacts the pedal arm.
3) Tighten the lock nut to the specified torque.

Lock nut torque	N·m (kg·cm/lb·in)
	13 (130 / 113)



SW position \ Terminal No.	1	2	3	4
Push rod out	○			○
Push rod in		○	○	

(4 - Pole type connector)

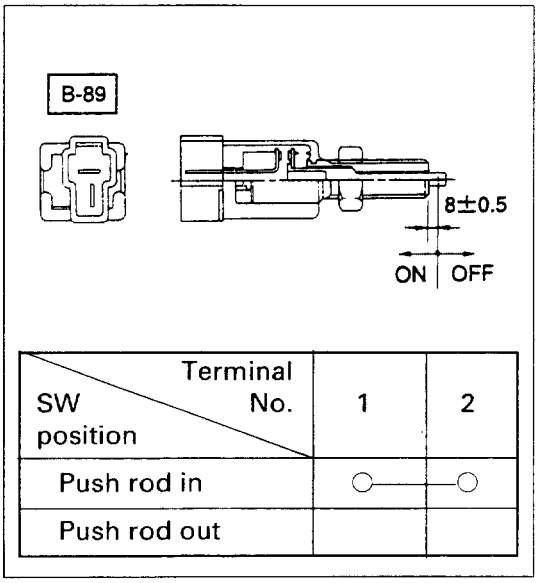
INSPECTION

1. Check the continuity between the switch connector terminals.
2. Check to see if switch push rod operate smoothly.

Repair or replace the switch when result of inspection is found abnormal.

REMOVAL AND INSTALLATION

Refer to "ACCEL SWITCH (2-POLE TYPE CONNECTOR)" in this section.



SW position \ Terminal No.	1	2
Push rod in	○	○
Push rod out		

CLUTCH SWITCH

INSPECTION

1. Check the continuity between the switch connector terminals.
2. Check to see if switch push rod operate smoothly.

Repair or replace the switch when result of inspection is found abnormal.

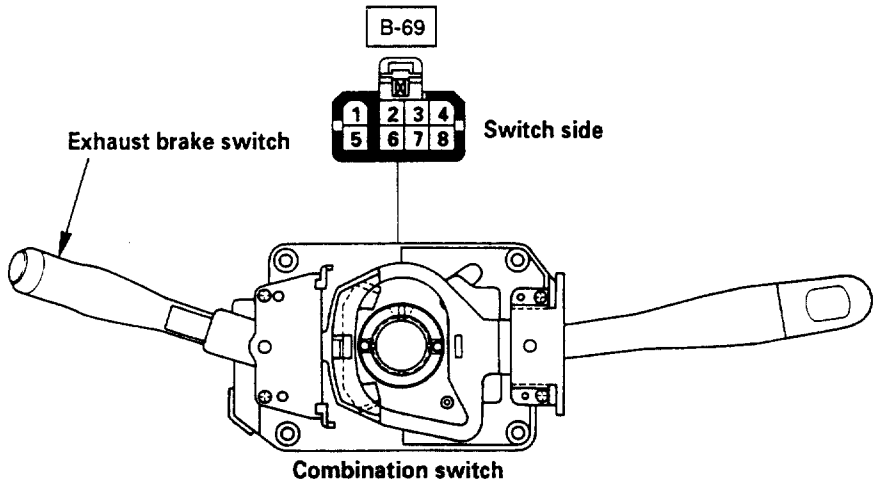
REMOVAL AND INSTALLATION

Refer to "ACCEL SWITCH (2-POLE TYPE CONNECTOR)" in this section.

EXHAUST BRAKE SWITCH

INSPECTION

Check the continuity between the terminals of the exhaust brake switch.
Repair or replace the switch when the result of inspection is found abnormal.



Terminal / SW position / No.	2	5
ON	○	○
OFF		

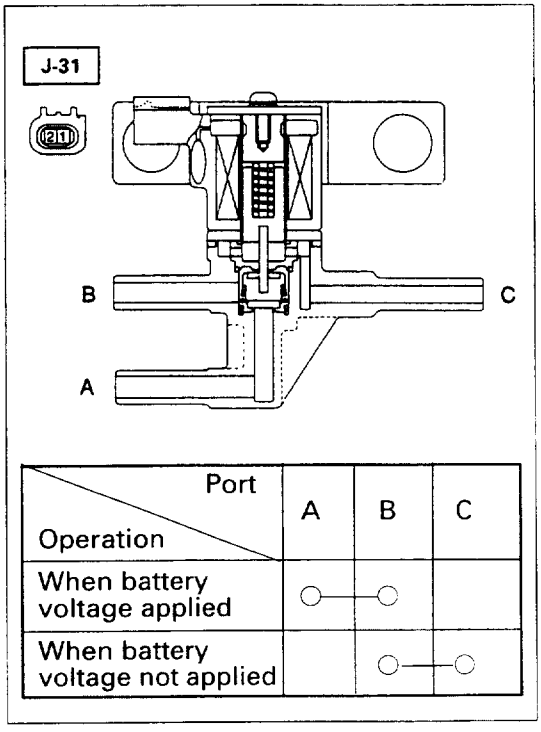
REMOVAL AND INSTALLATION

Refer to "HEADLIGHT, FOG LIGHT AND CORNERING LIGHT" in this section.

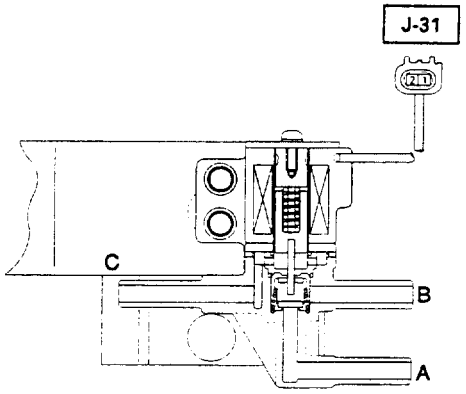
EXHAUST BRAKE MAGNETIC VALVE (4JG2 engine)

INSPECTION

Connect the magnetic valve connector terminal No.1 to the battery (+) terminal and terminal No. 2 to the (-) terminal and then check the continuity among each port.
Repair or replace the magnetic valve when the result of inspection is found abnormal.



Port / Operation	A	B	C
When battery voltage applied	○	○	
When battery voltage not applied		○	○

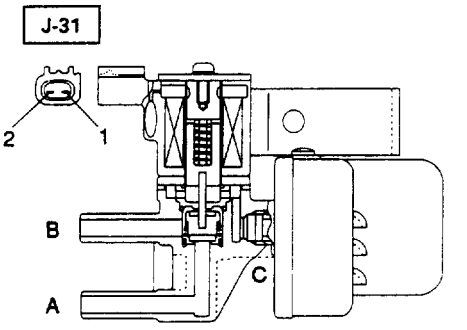


Operation \ Port	A	B	C
When battery voltage applied	○—○		
When battery voltage not applied		○—○	

EXHAUST BRAKE MAGNETIC VALVE (4B Series engine)

INSPECTION

Connect the magnetic valve connector terminal No. 1 to the battery (+) terminal and terminal No. 2 to the (-) terminal and then check the continuity among each port.



Operation \ Port	A	B	C
When battery voltage applied	○—○		
When battery voltage not applied		○—○	

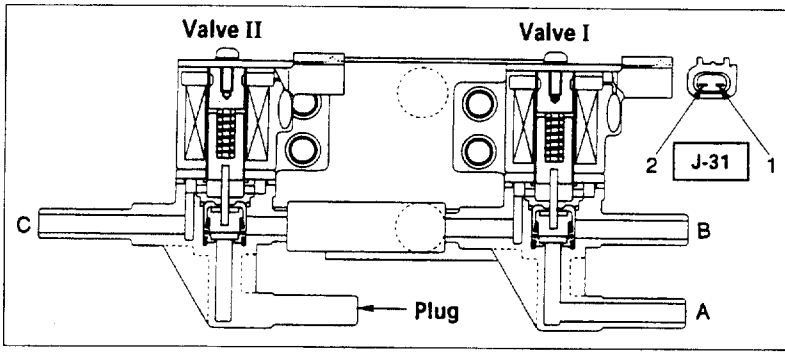
EXHAUST BRAKE MAGNETIC VALVE (4JG2, 4H Series engine)

INSPECTION

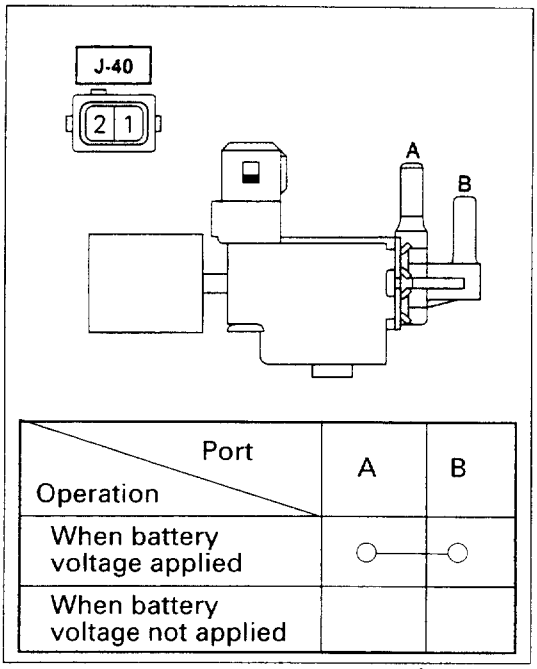
Connect the magnetic valve connector terminal No. 1 to the battery (+) terminal and terminal No. 2 to the (-) terminal and then check the continuity among each port.

EXHAUST BRAKE MAGNETIC VALVE (4H Series engine)
AIR EXHAUST MAGNETIC VALVE (4H Series engine)

Connect the magnetic valve connector terminal No. 1 to the battery (+) terminal and terminal No. 2 to the (-) terminal and then check the continuity among each port.



Operation		Port		
Valve I	Valve II	A	B	C
Battery voltage not applied	Battery voltage not applied		○—○	
Battery voltage applied	Battery voltage not applied	○—○		
Battery voltage not applied	Battery voltage applied			
Battery voltage applied	Battery voltage applied	○—○		



Operation \ Port	A	B
When battery voltage applied	○—○	
When battery voltage not applied		

VACUUM SWITCHING VALVE: INTAKE THROTTLE (4H Series engine)

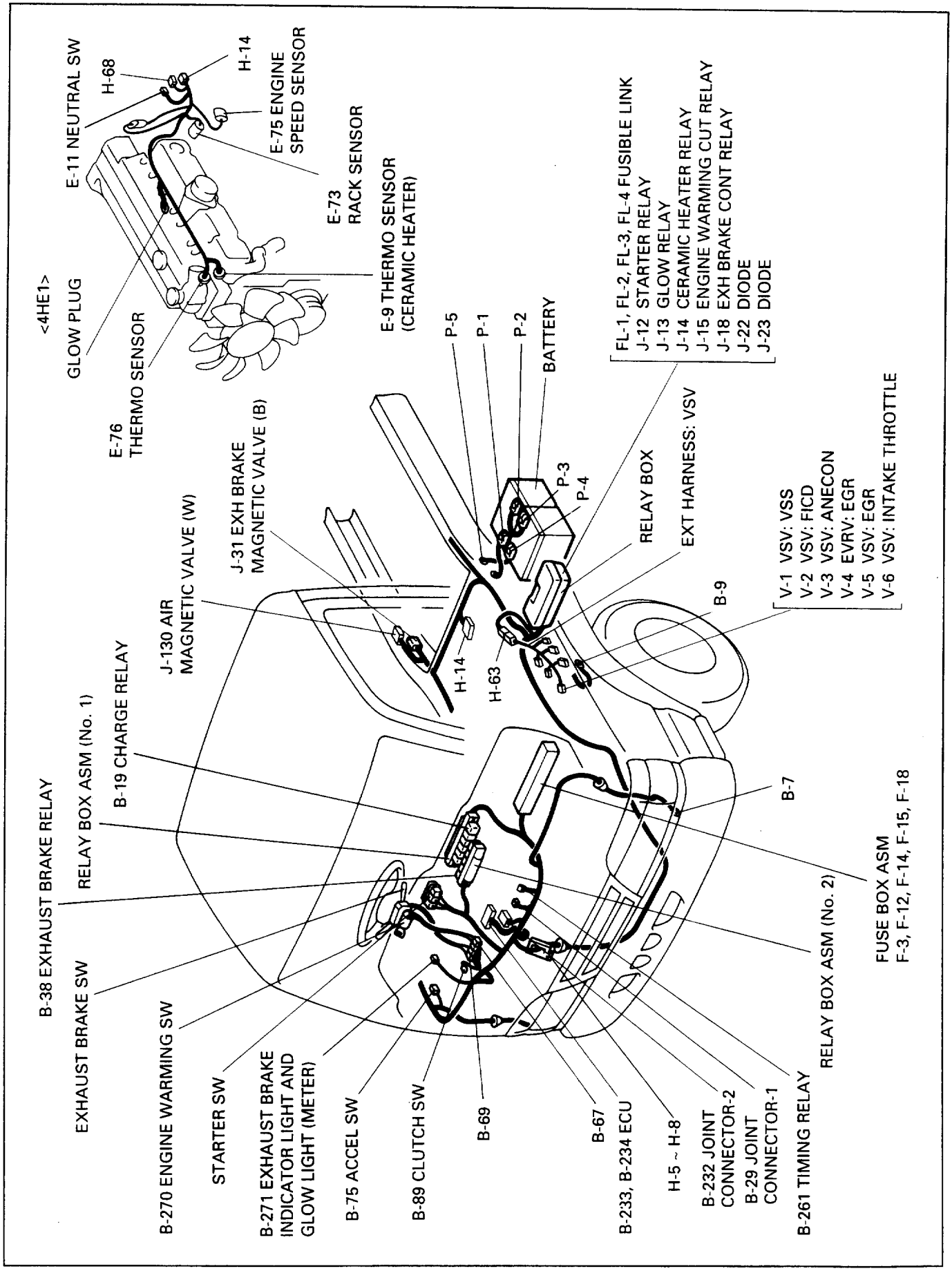
INSPECTION

Connect the magnetic valve connector terminal No. 1 to the battery (+) terminal and terminal No. 2 to the (-) terminal and then check the continuity among each port.

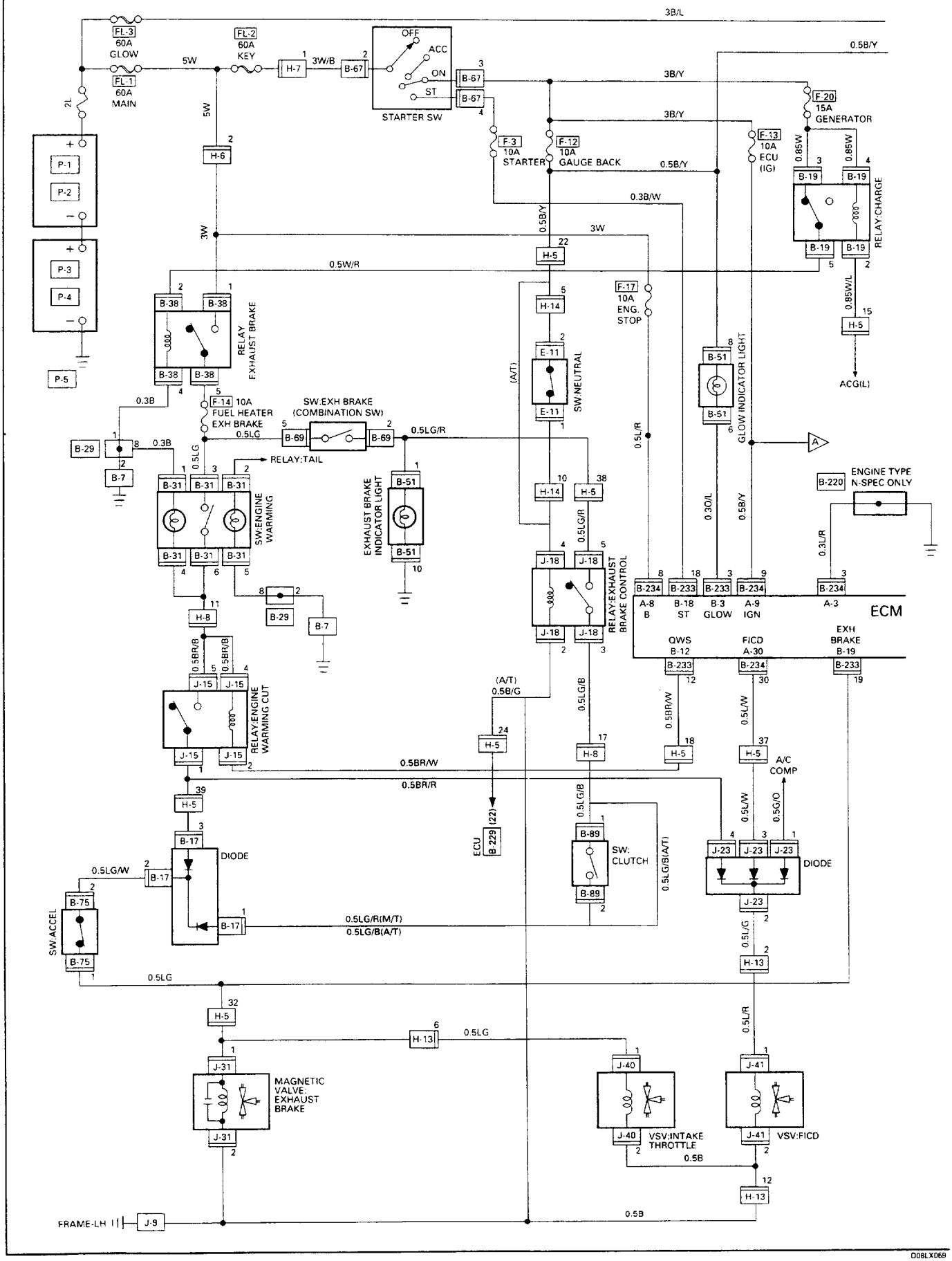
Repair or replace the vacuum switching valve when the result of inspection is found abnormal.

EXHAUST BRAKE SYSTEM AND ENGINE CONTROL

PARTS LOCATION - NPR70TC · NQR70TC

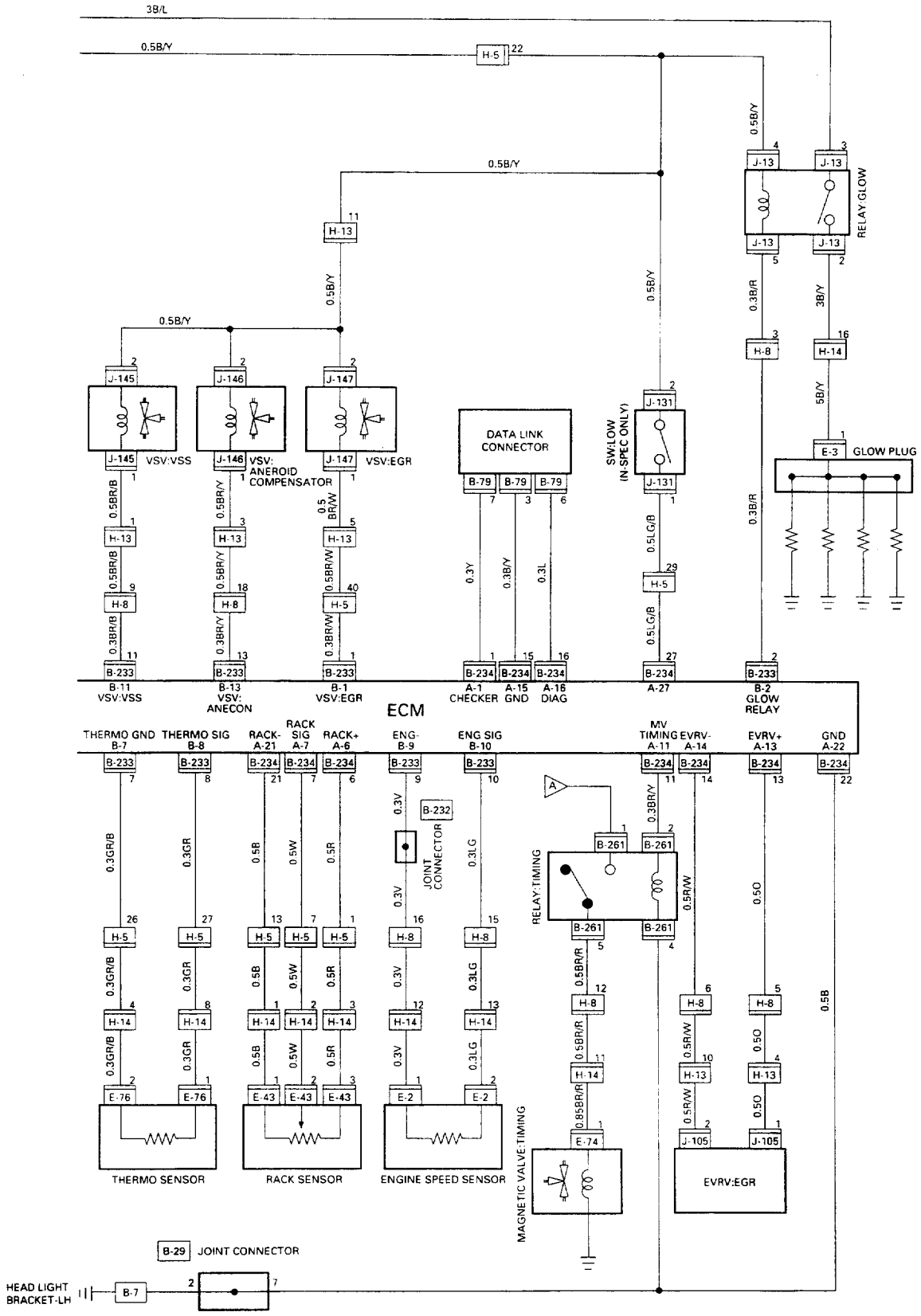


CIRCUIT DIAGRAM FOR 24 VOLT - NPR70TC · NQR70TC



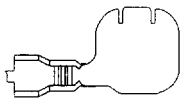
D08LX069

CIRCUIT DIAGRAM FOR 24 VOLT - NPR70TC · NQR70TC

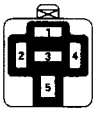


CONNECTOR LIST

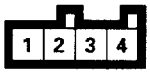
B-7



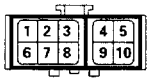
B-19 B-38



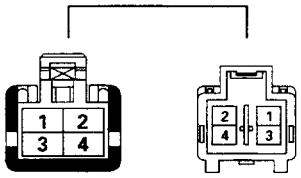
B-26



B-29



B-67

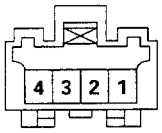


B-69

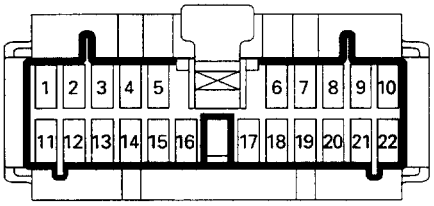
B-75

B-89

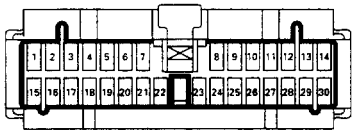
B-220



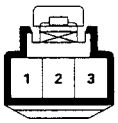
B-233



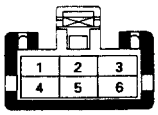
B-234



B-237

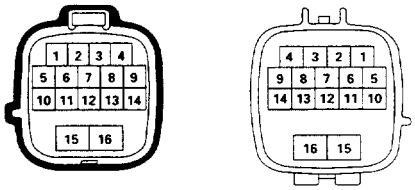


B-234

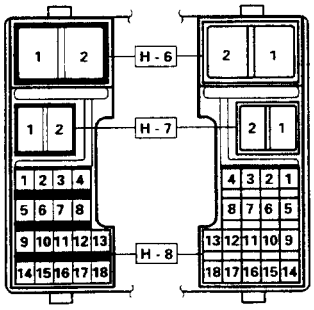


B-51

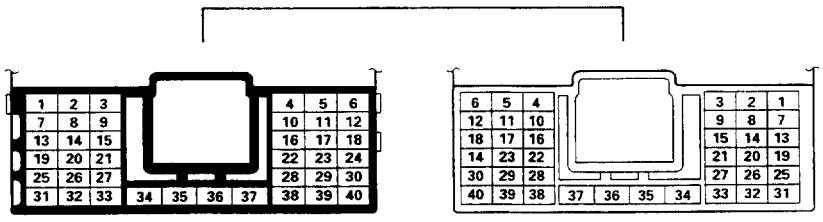
H-14



H-6 H-7 H-8

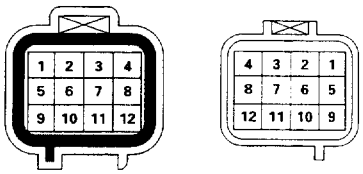


H-5

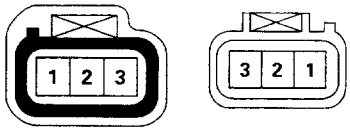


CONNECTOR LIST

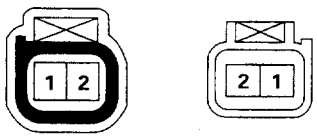
H-63



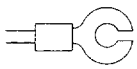
H-68



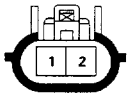
H-68



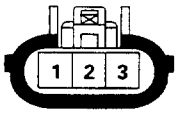
E-3



E-9 E-11

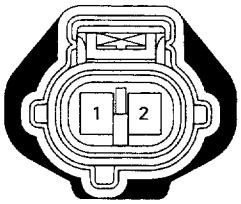


E-73

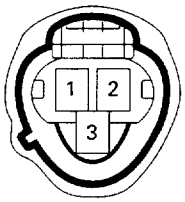


E-74

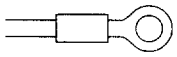
E-75



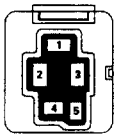
E-76



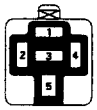
J-9



J-13 J-14

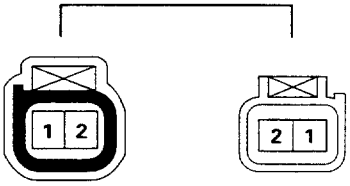


J-15 J-18



J-21 J-22 J-23

J-31 J-130 J-131



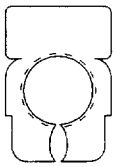
V-1 V-3

V-2 V-6

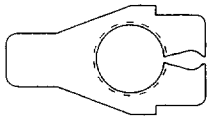
V-4

V-5

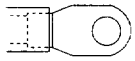
P-1 P-4



P-2 P-3



P-5



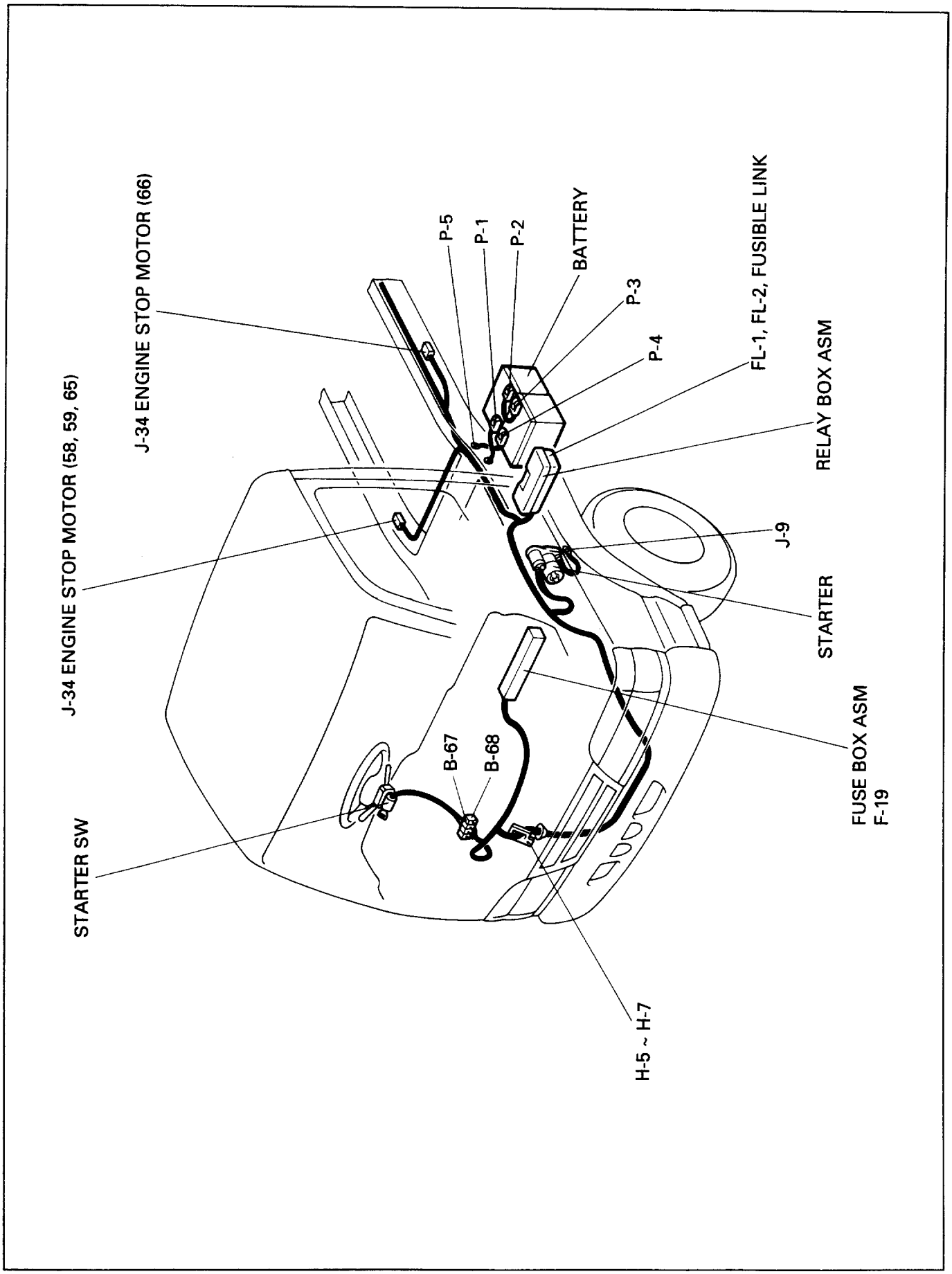
ENGINE STOP SYSTEM

GENERAL DESCRIPTION

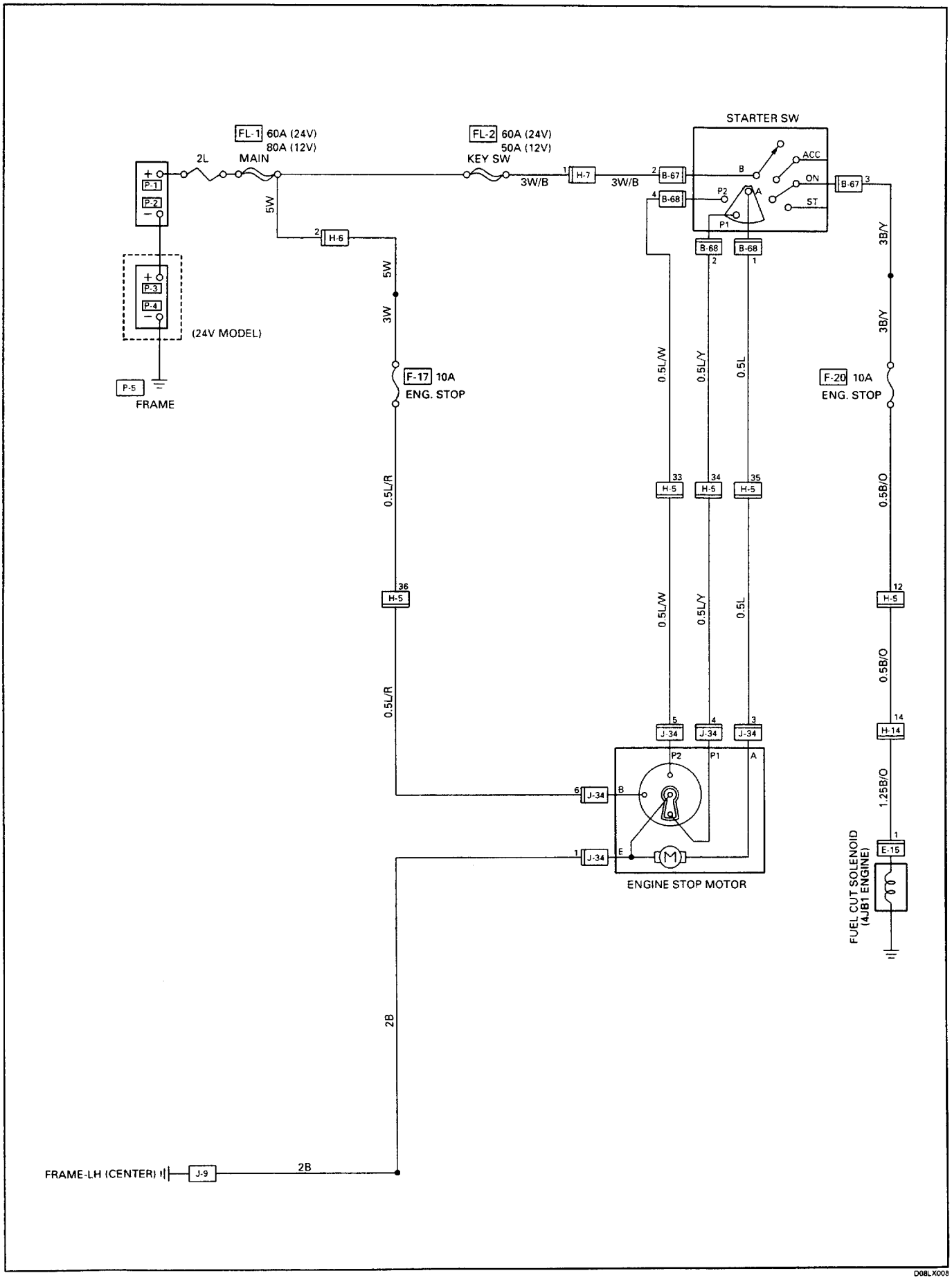
The circuit consists of starter switch and engine stop motor.
The engine stop mechanism aims at shut-off of fuel supply.
available are motor type and solenoid type depending on the types of the engine mounted.
Motor type is forcible pull the injection pump control rack to the direction of fuel supply reduction by means of engine stop motor, thus shutting it off.
Solenoid type is to have the starter switch turn from "ON" position to "OFF", so that the solenoid valve fitted to the injection pump closes to shut off the fuel circuit.

Engine stop system	Engine model
Motor type	4HF1
Solenoid type	4JB1, 4JG2

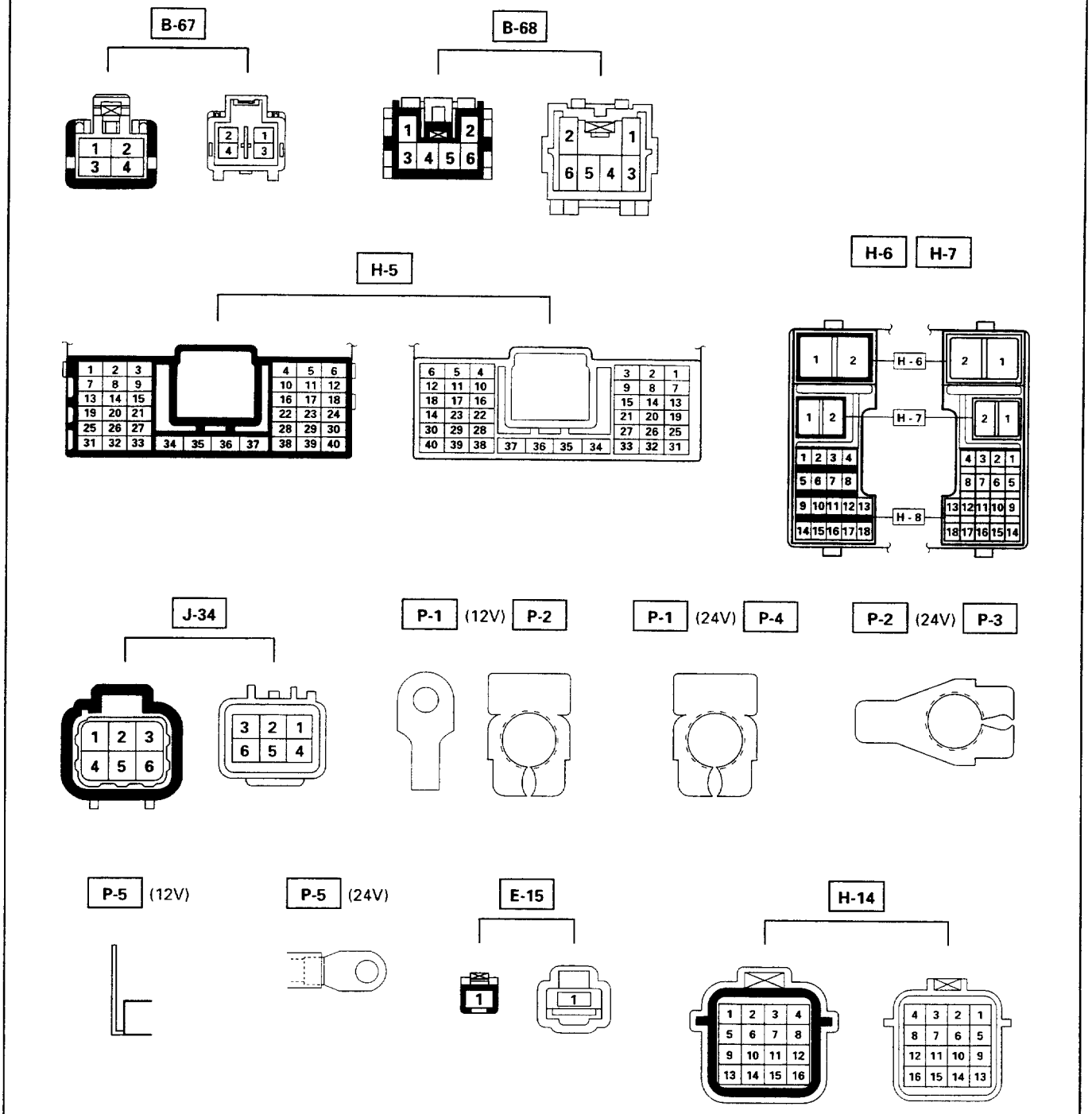
PARTS LOCATION



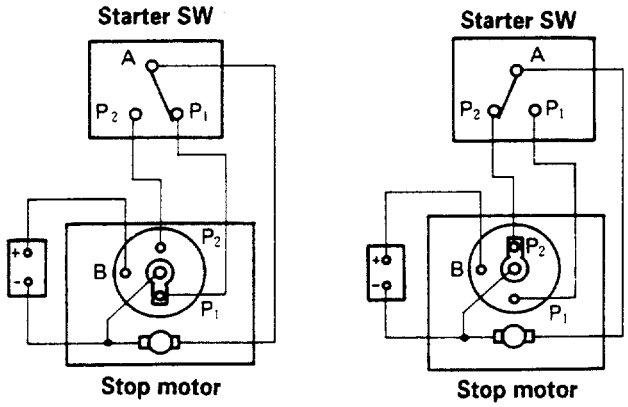
CIRCUIT DIAGRAM



CONNECTOR LIST



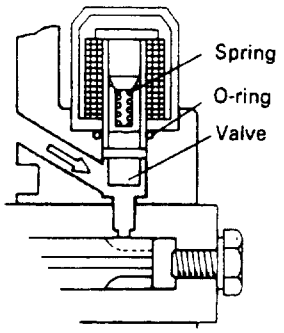
FUNCTION OF ENGINE STOP MOTOR



Turn the starter switch from "ACC" position to "ON", and the engine stop motor will turn by 180 degress (from 0° to 180°) so that the stop motor's electrode will be in potential equal to that of the starter switch for the stop.

Turn the starter switch from "ON" position to "ACC" or "LOCK", and then the stop motor will rotate by 180 degree (from 180° to 360°) and crease operating.

Connector No. / Terminal No. / Starter SW key position	B-68			Stop motor	Stop lever position
	A	P1	P2		
	1	2	4		
LOCK	○——	——○		0° (360°)	Stop
ACC	○——	——○			
ACC → ON				0° → 180°	Stop → Run
ON	○——	———	——○	180°	Stop
START	○——	———	——○		
ON → ACC LOCK				0° → 360°	Stop → Run



Key position	Solenoid valve
LOCK	Close
ACC	
ON	Open
START	

SOLENOID TYPE

STARTER SWITCH AND SOLENOID VALVE

Turn the starter switch from "ON" position to "OFF", and then the solenoid valve fitted to the injection pump closes to cut off the fuel circuit.

For the circuit of solenoid type fuel cut, refer to QOSⅢ circuit diagrams in this section.

HEADLIGHT, FOG LIGHT, REAR FOG LIGHT AND CORNERING LIGHT

GENERAL DESCRIPTION

The circuit consists of headlight, fog light, Cornering light, starter switch, Combination switch (Lighting switch, dimmer · passing switch, cornering light switch), fog light switch, high beam indicator light and relay.

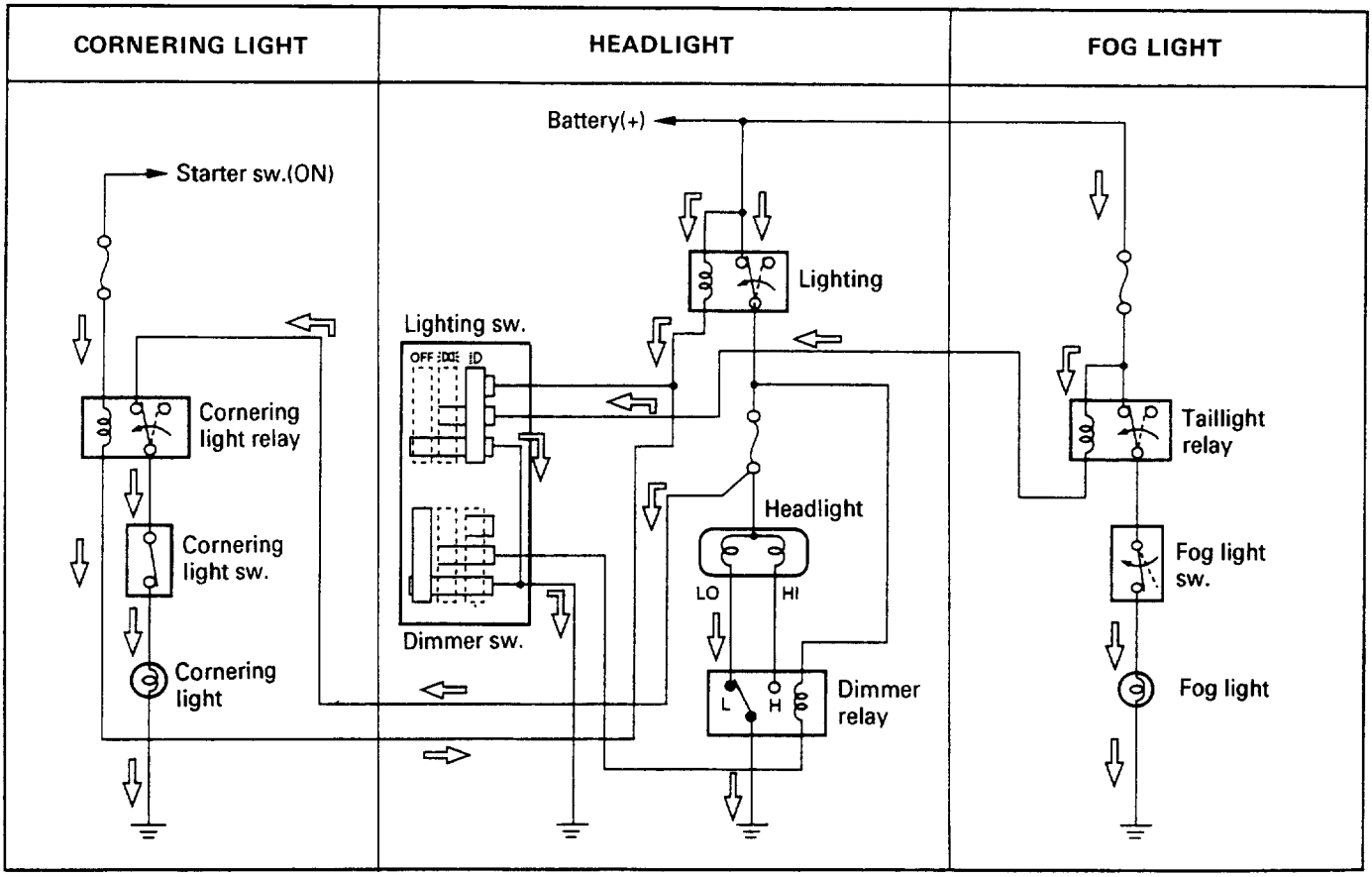
When the lighting SW is turned on by setting it at headlight position, the lighting relay is actuated to turn on the headlight. The optical axis of the headlight can be turned up or down by operating the dimmer SW while headlight is on.

The passing SW is independent of the lighting SW, and the optical axis of the passing light can be turned up only while the switch lever is pulled up and held in this state.

Fog light turns on by switching it to "ON" position to activate relay only while lighting SW is on.

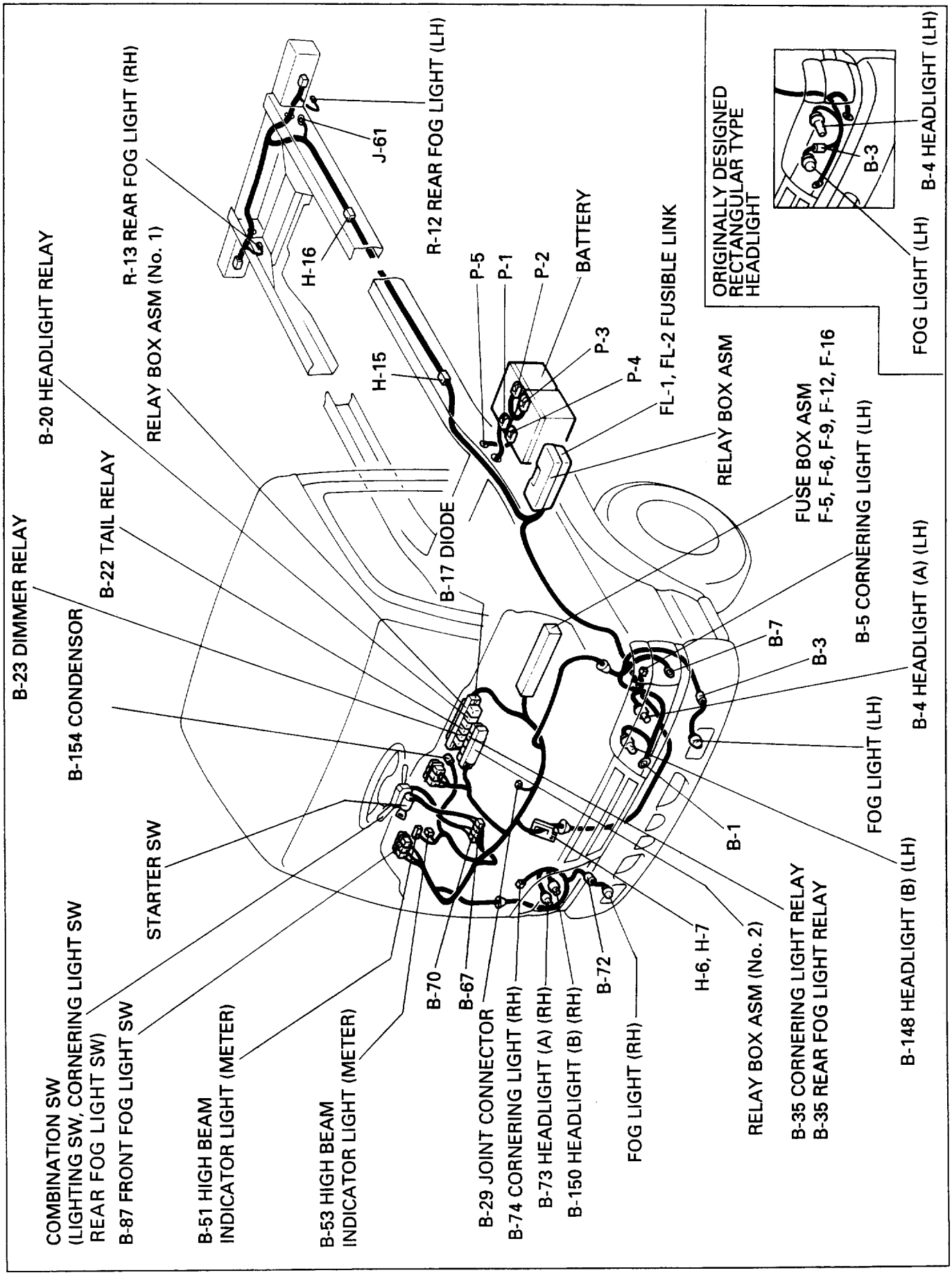
When the headlight is on, turn the turn-signal switch left or right, and then the cornering switch built in the combination switch turns on, followed by the cornering light turning on.

LIGHTING CIRCUIT

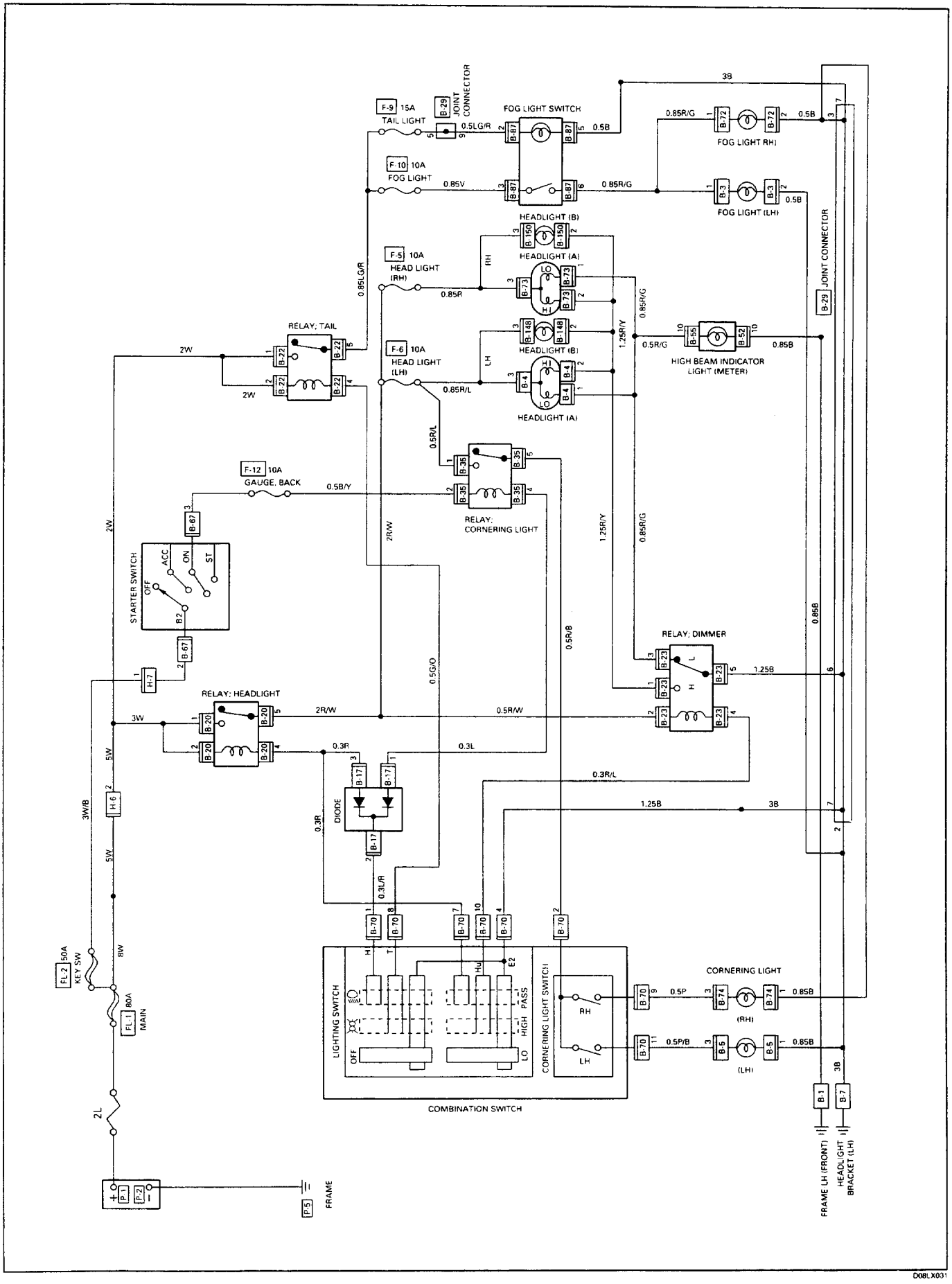


NOTE: Arrow marks " ⇨ " indicate the direction of current.

PARTS LOCATION

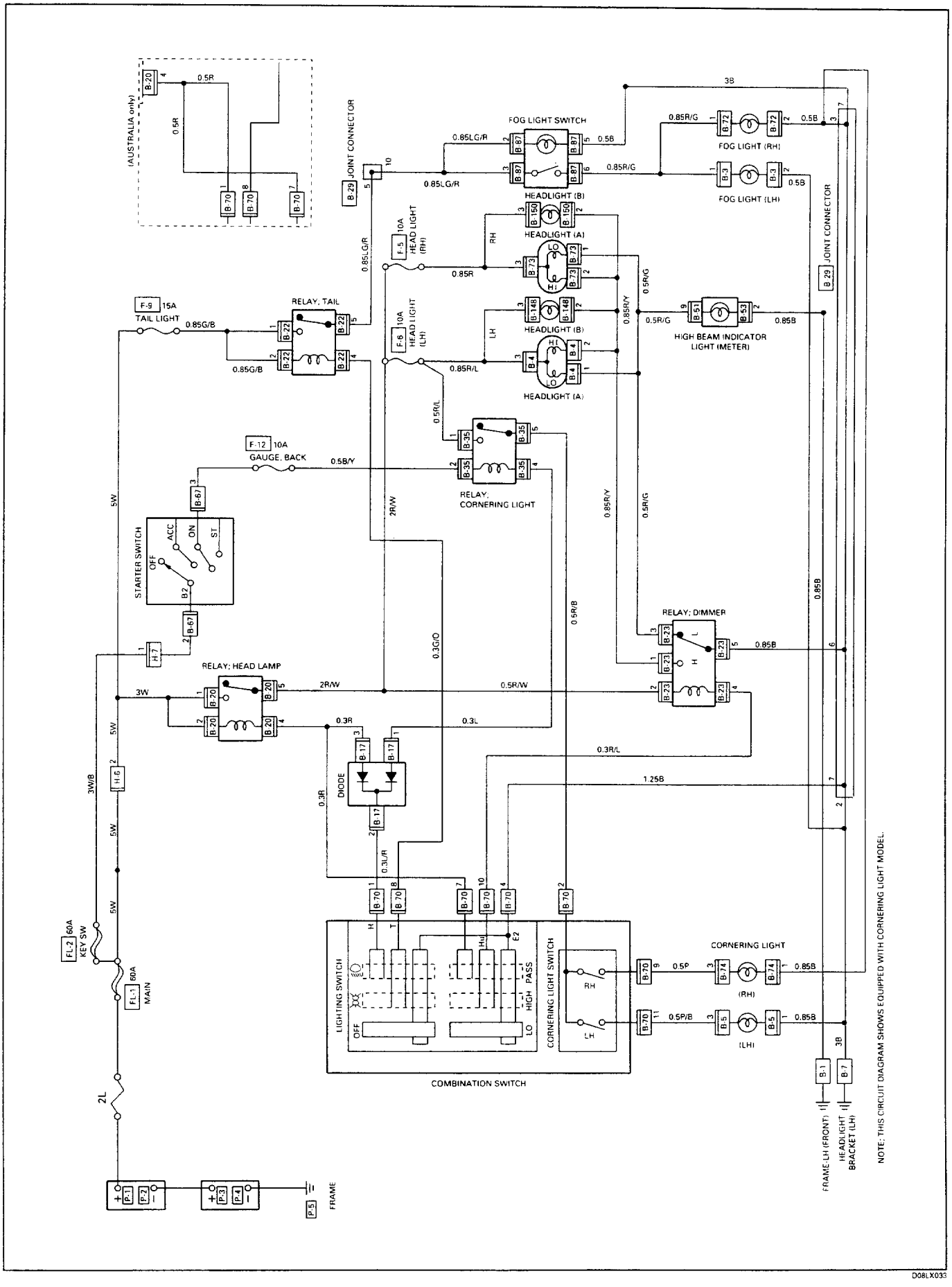


CIRCUIT DIAGRAM - FOR 12 VOLT



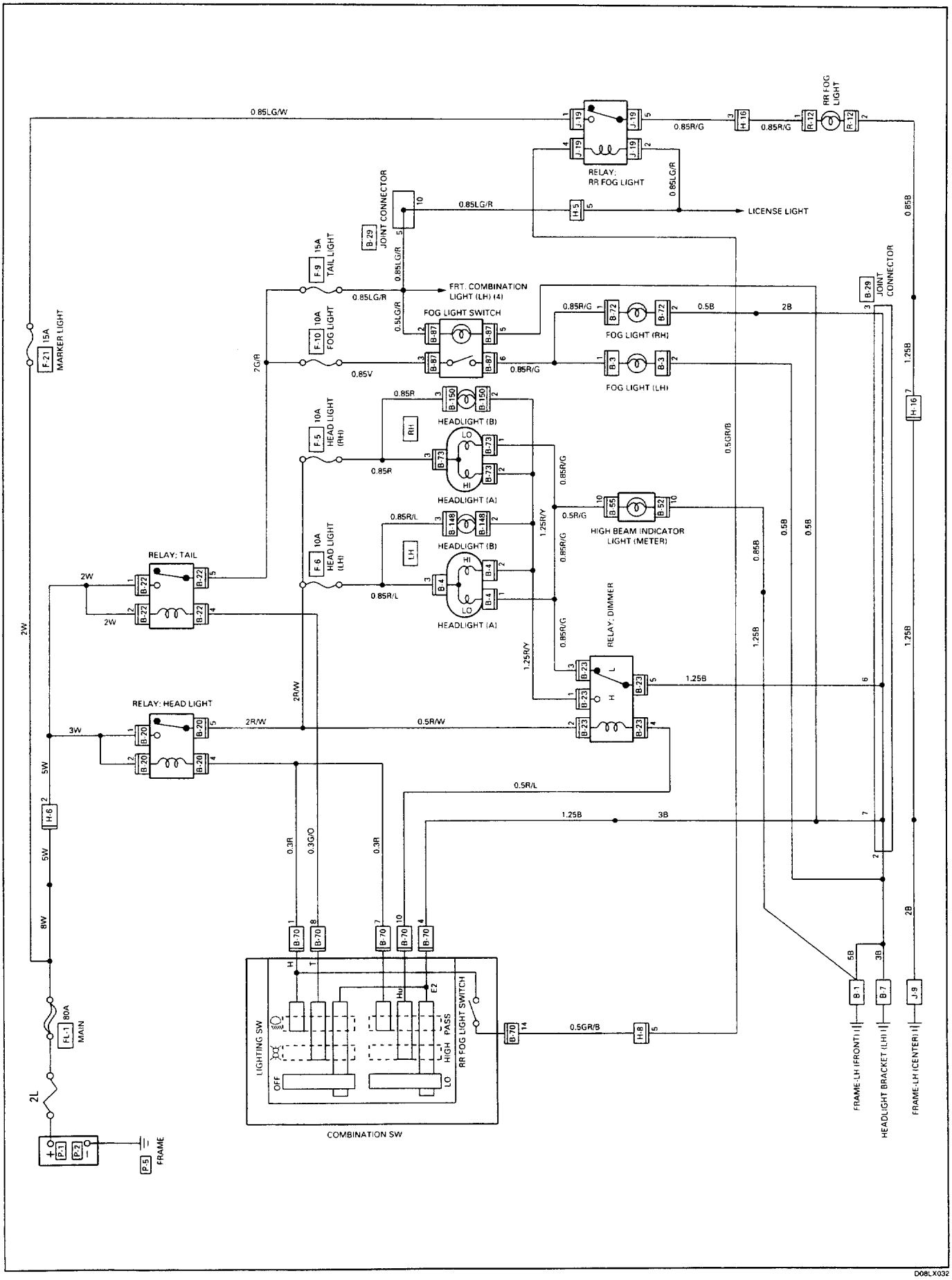
D08LX031

CIRCUIT DIAGRAM - FOR 24VOLT



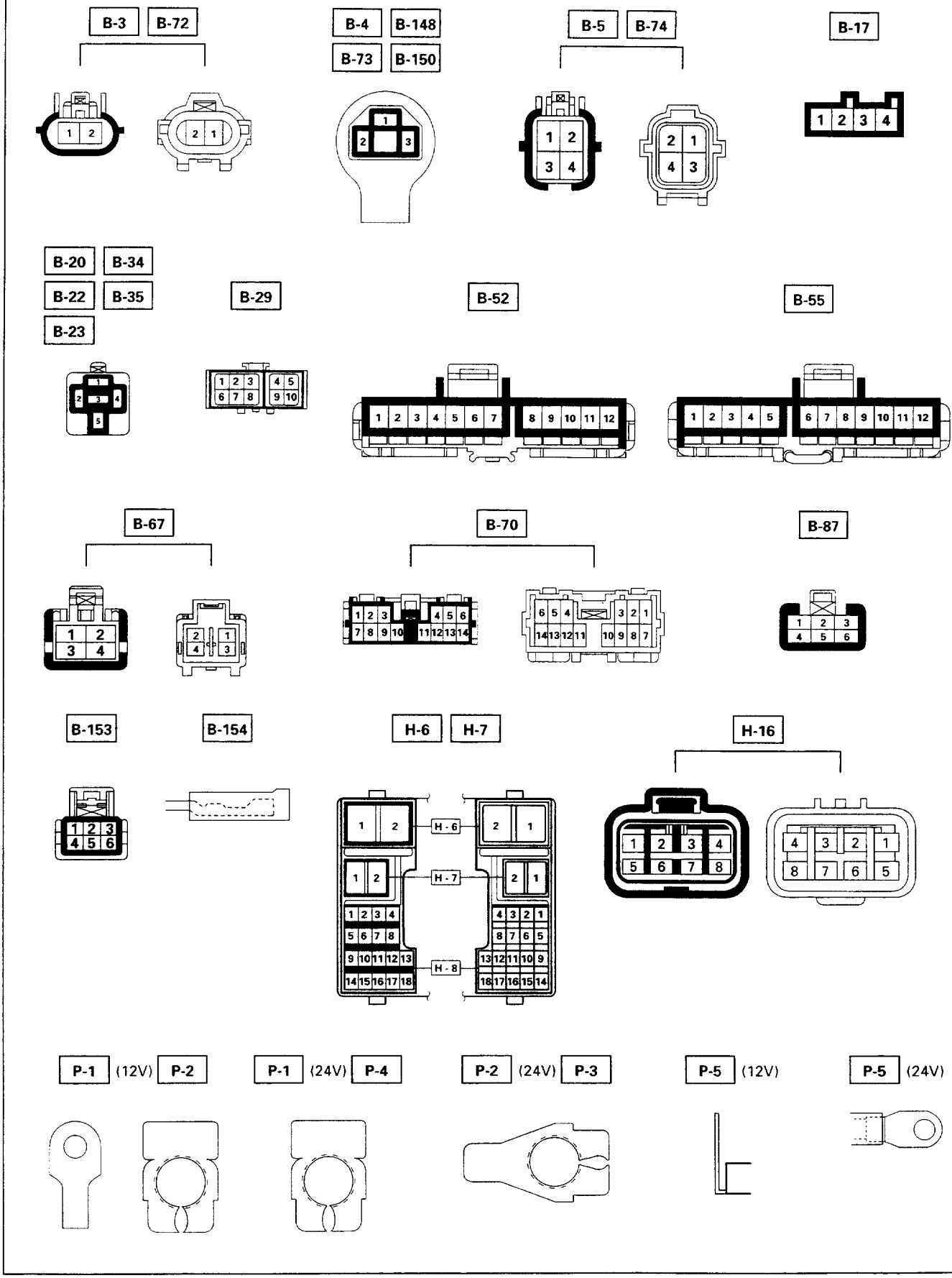
D08LX033

CIRCUIT DIAGRAM - FOR EUROPE



D08LX032

CONNECTOR LIST



DIAGNOSIS

QUICK CHART FOR CHECK POINT

1. HEADLIGHT

Check point / Trouble mode	Fuse F-5 (10A)	Fuse F-6 (10A)	Headlight relay	Lighting SW	Dimmer·passing SW	Dimmer relay	Headlight bulb LH	Headlight bulb RH	Cable harness
1-1. Both Headlights inoperative			○ (1)	○ (3)					○ (2)
1-2. Headlight on the left (or right) side inoperative	○ (1)	○ ((1))							○ (2)
1-3. Headlight in low-beam inoperative						(1)			○ (2)
1-4. Headlight in high-beam inoperative						(1)			○ (2)
1-5. Headlight on the left (or right) side in low (or high)-beam inoperative							○ (1)	○ ((1))	○ (2)
1-6. Headlight beam does not change					○ (1)	(2)			○ (3)
1-7. Headlights remain on when the lighting switch turned off			○ (1)	○ (2)					○ (3)
1-8. Headlights come on with the lighting SW at the clearance light position				○ (1)					

NOTE: Figure in parenthesis "( )" indicates the order of inspection.

2. FOG LIGHT

Check point / Trouble mode	Fuse F-9 (15A) 24V F-10 (10A)12V	Taillight relay	Fog light SW	Fog light bulb LH	Fog light bulb RH	Cable harness
2-1. Both fog lights inoperative (while lighting switch is on)	○ (1)	○ (2)	○ (3)			○ (4)
2-2. Fog light on the left (or right) side inoperative (while lighting switch is on)				○ (1)	○ ((1))	○ (2)
2-3. Fog lights remains on		○ (1)	○ (2)			○ (3)

NOTE: Figure in parenthesis "( )" indicates the order of inspection.

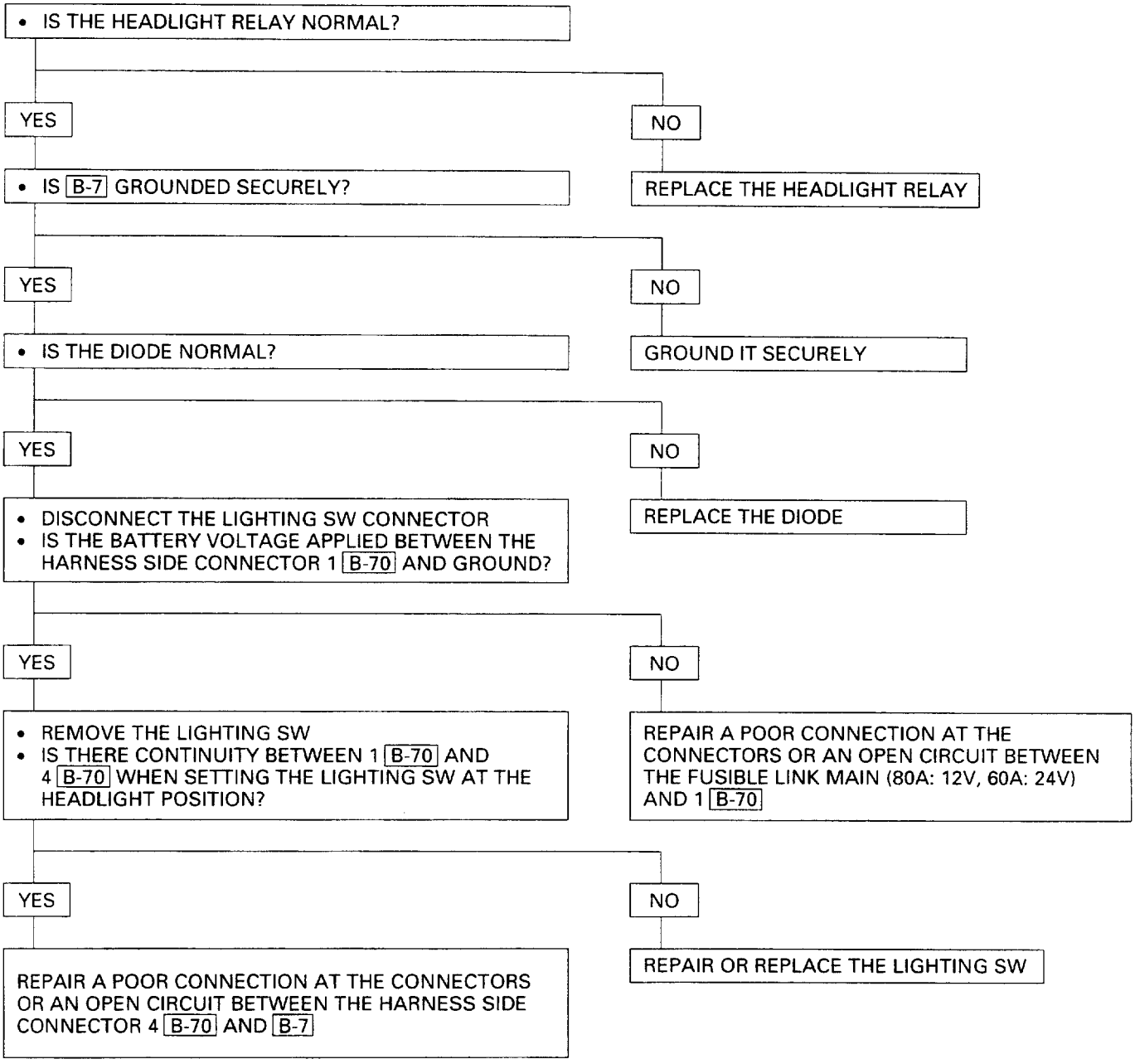
3. CORNERING LIGHT

Trouble mode \ Check point	Fuse F-6 (10A)	Fuse F-12 (10A)	Cornering light SW	Cornering light bulb	Cornering light relay	Cable harness
3-1. Both cornering lights inoperative	○ (2)	○ (1)	○ (5)		○ (3)	○ (4)
3-2. Cornering light on the left (or right) side inoperative			○ (2)	○ (1)		○ (3)
3-3. Cornering light remains on even when steering wheel is in the straight ahead position.			○ (1)			

4. REAR FOG LIGHT

Trouble mode \ Check point	Fuse F-21 (15A)	Rear fog light SW	Rear fog light relay	Rear fog light bulb	Cable harness
4-1. Rear fog light inoperative (while headlight is on)	○ (2)	○ (4)	○ (3)	○ (1)	○ (5)

1-1. BOTH HEADLIGHTS INOPERATIVE



1-2. HEADLIGHT ON THE LEFT (OR RIGHT) SIDE INOPERATIVE

- IS THE FUSE F-6 (10A) (F-5 10A) NORMAL?

YES

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN FUSE F-6 (10A) AND 3 [B-4] OR 3 [B-148] (FUSE F-5 (10A) AND 3 [B-73] OR 3 [B-150])

NO

REPLACE THE FUSE

1-3. HEADLIGHTS IN LOW-BEAM INOPERATIVE

- IS THE DIMMER RELAY NORMAL?

YES

REPAIR A POOR CONNECTION AT THE CONNECTOR OR AN OPEN CIRCUIT BETWEEN 1 [B-4] AND 3 [B-23]

NO

REPLACE THE RELAY

1-4. HEADLIGHT IN HIGH-BEAM INOPERATIVE

- IS THE DIMMER RELAY NORMAL?

YES

- DISCONNECT THE DIMMER · PASSING SW CONNECTOR
- IS THERE ANY CONTINUITY BETWEEN SW SIDE CONNECTOR 4 [B-70] AND 10 [B-70] WHEN THE SW IS AT HIGH-BEAM POSITION?

YES

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN 1 [B-23] AND 2 [B-73]

NO

REPAIR OR REPLACE THE SW

NO

REPLACE THE RELAY

1-5. HEADLIGHT ON THE LEFT (OR RIGHT) SIDE IN LOW (OR HIGH) BEAM INOPERATIVE

- IS THE BULB NORMAL?
  - YES
    - REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT
      [LOW BEAM]
      BETWEEN 1 B-4 (OR 1 B-73) AND 3 B-23
      [HIGH BEAM]
      BETWEEN 2 B-4 (OR 2 B-73) AND 1 B-23
  - NO
    - REPLACE THE BULB

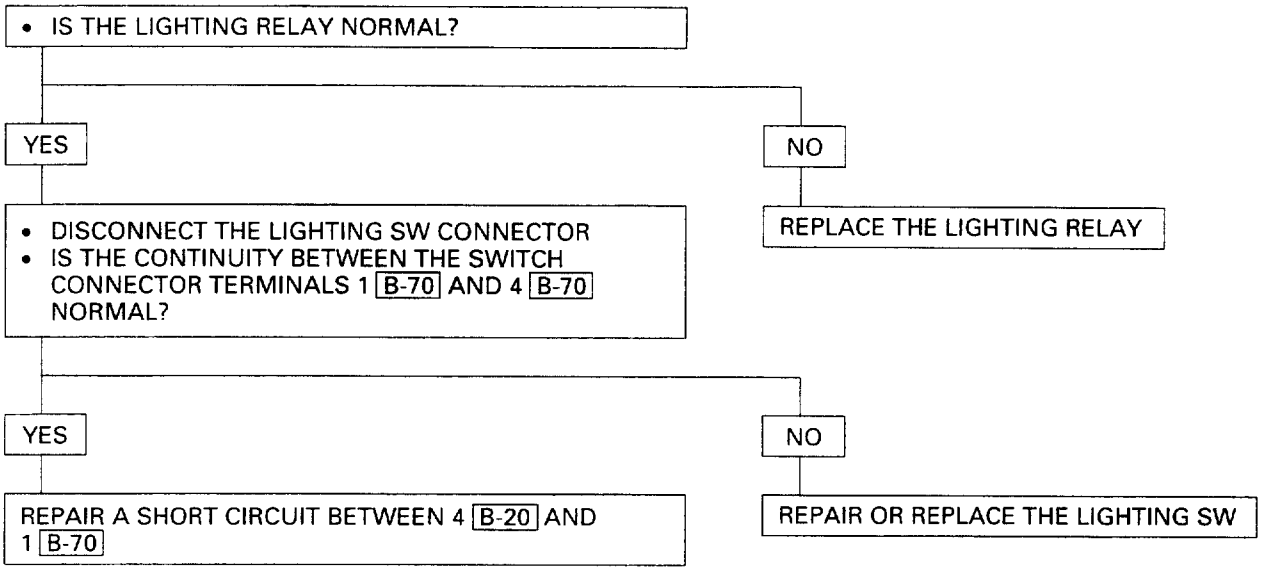
1-6. HEADLIGHT BEAM DOES NOT CHANGE

- IS THE DIMMER RELAY NORMAL?
  - YES
    - DOES THE DIMMER · PASSING SW LEVER OPERATE SMOOTHLY AND SECURELY?
      - YES
        - DISCONNECT THE DIMMER · PASSING SWITCH CONNECTOR (COMBINATION SW).
        - CHECK IF THERE IS CONTINUITY BETWEEN 4 B-70 AND 10 B-70

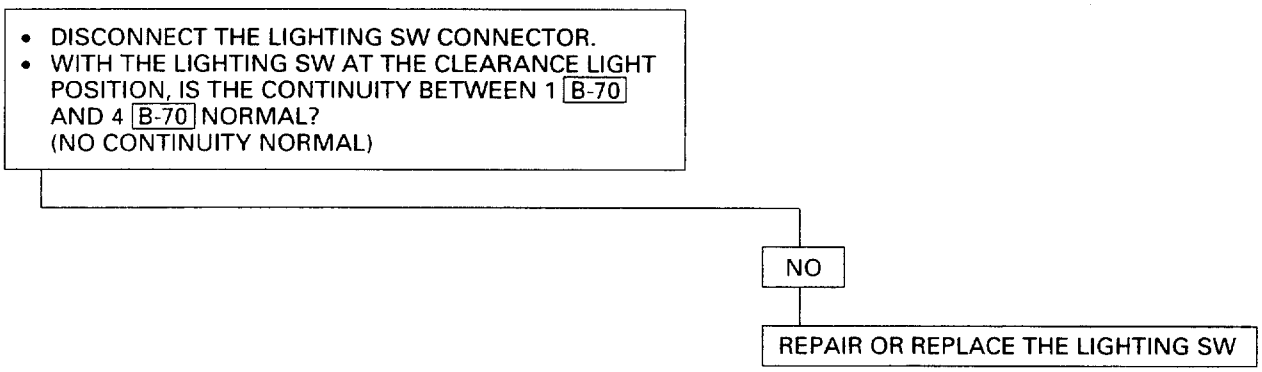
          DIMMER SW
          "LO" POSITION.....NO CONTINUITY
          "HI" POSITION.....CONTINUITY

          - NO
            - REPAIR OR REPLACE THE DIMMER · PASSING SW (COMBINATION SW)
      - NO
        - REPAIR OR REPLACE THE DIMMER · PASSING SW
  - NO
    - REPLACE THE RELAY

1-7. HEADLIGHTS REMAIN ON WHEN THE LIGHTING SW IS TURNED OFF

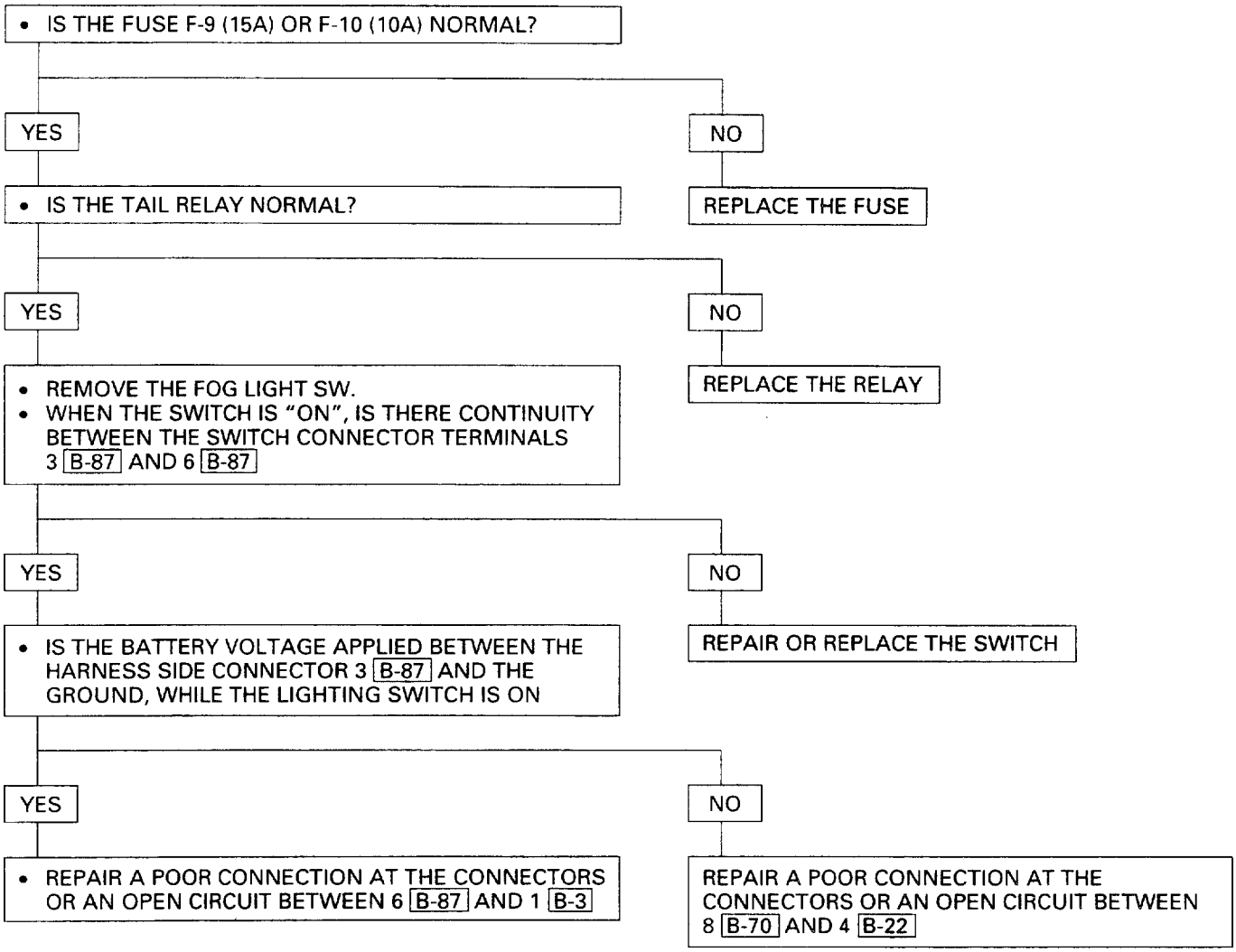


1-8. HEADLIGHT COME ON WITH THE LIGHTING SW AT THE CLEARANCE LIGHT POSITION

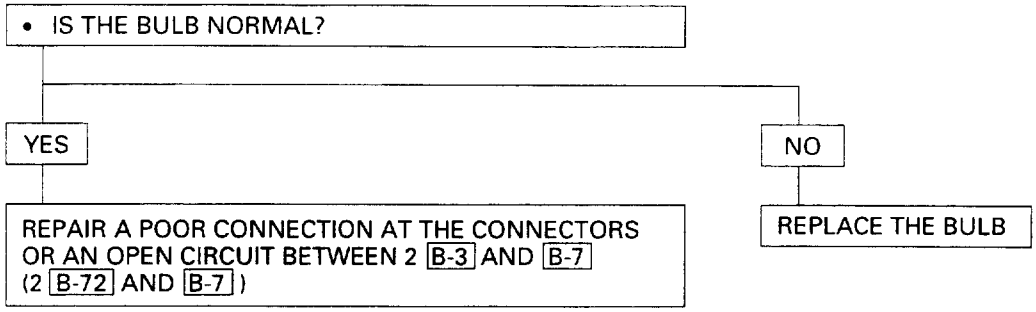


2. FOG LIGHT

2-1. BOTH FOG LIGHT INOPERATIVE (WHILE LIGHTING SWITCH IS ON)

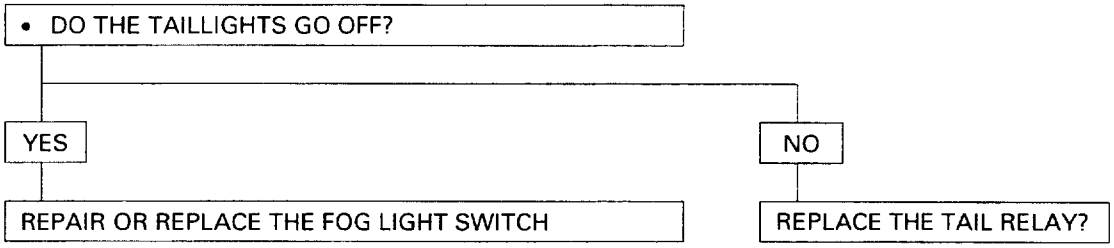


2-2. FOG LIGHT ON THE LEFT (OR RIGHT) SIDE INOPERATIVE (WHILE LIGHTING SWITCH IS ON)



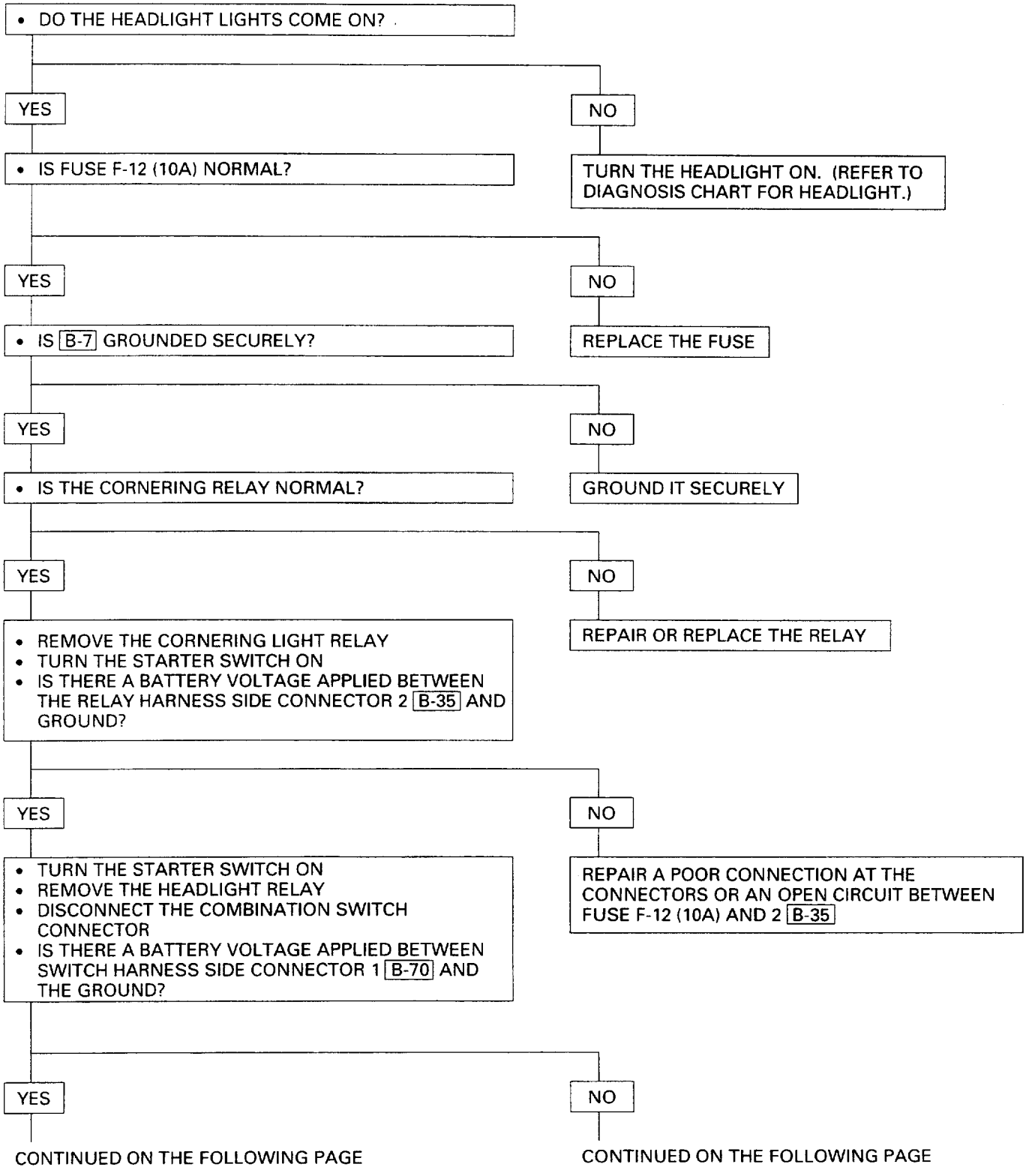
NOTE: FIGURES IN PARENTHESIS "( )" INDICATE PLACE OF INSPECTION FOR THE FOG LIGHT ON THE RIGHT.

2-3. FOG LIGHTS REMAINS ON



3. CORNERING LIGHT

3-1. BOTH CORNERING LIGHTS INOPERATIVE



CONTINUED FROM THE PREVIOUS PAGE

- IS THERE ANY CONTINUITY BETWEEN THE SWITCH CONNECTORS 2 [B-70] AND 11 [B-70] (WHEN TURNING LEFT) OR 2 [B-70] AND 9 [B-70] (WHEN TURNING RIGHT) RESPECTIVELY?

YES

REPAIR A POOR CONNECTION OR AN OPEN CIRCUIT BETWEEN THE HARNESS SIDE CONNECTORS 5 [B-35] AND 2 [B-70]

NO

REPAIR OR REPLACE THE SWITCH

CONTINUED FROM THE PREVIOUS PAGE

REPAIR A POOR CONNECTION OR A OPEN CIRCUIT AT THE CONNECTOR BETWEEN 4 [B-35] AND 1 [B-70]

3-2. CORNERING LIGHT ON THE LEFT (OR RIGHT) SIDE INOPERATIVE

- IS THE CORNERING LIGHT BULB ON THE LEFT (OR RIGHT) NORMAL?

YES

- DISCONNECT THE COMBINATION SWITCH CONNECTOR
- IS THERE ANY CONTINUITY BETWEEN THE SWITCH CONNECTOR TERMINALS 2 [B-70] AND 11 [B-70] (IN TURNING LEFT) (2 [B-70] – 9 [B-70]: IN TURNING RIGHT)

YES

- IS THERE ANY CONTINUITY BETWEEN THE CORNERING LIGHT SWITCH HARNESS SIDE CONNECTOR TERMINALS 11 [B-70] AND 3 [B-5] (9 [B-70] AND 3 [B-74])?

YES

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN 1 [B-5] AND [B-7] OR 1 [B-74] AND [B-7]

NO

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN 11 [B-70] AND 3 [B-5] (9 [B-70] AND 3 [B-74]

NO

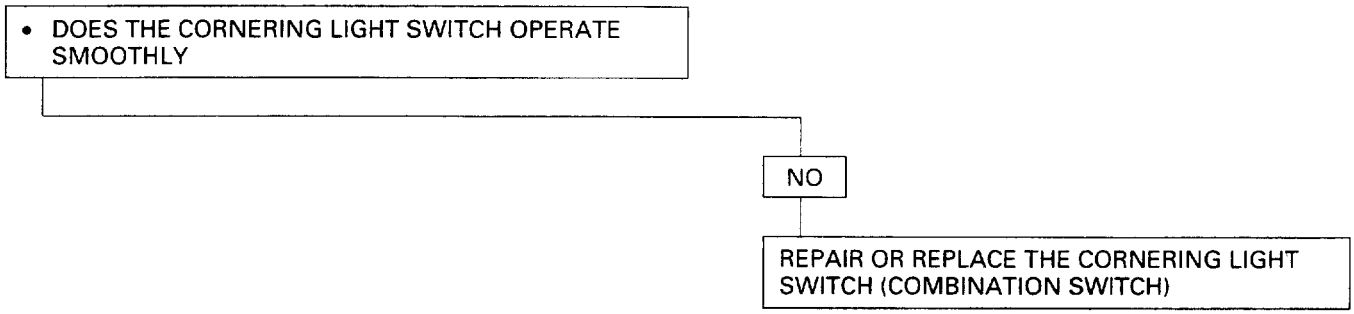
REPAIR OR REPLACE THE CORNERING LIGHT SWITCH

NO

REPLACE THE BULB

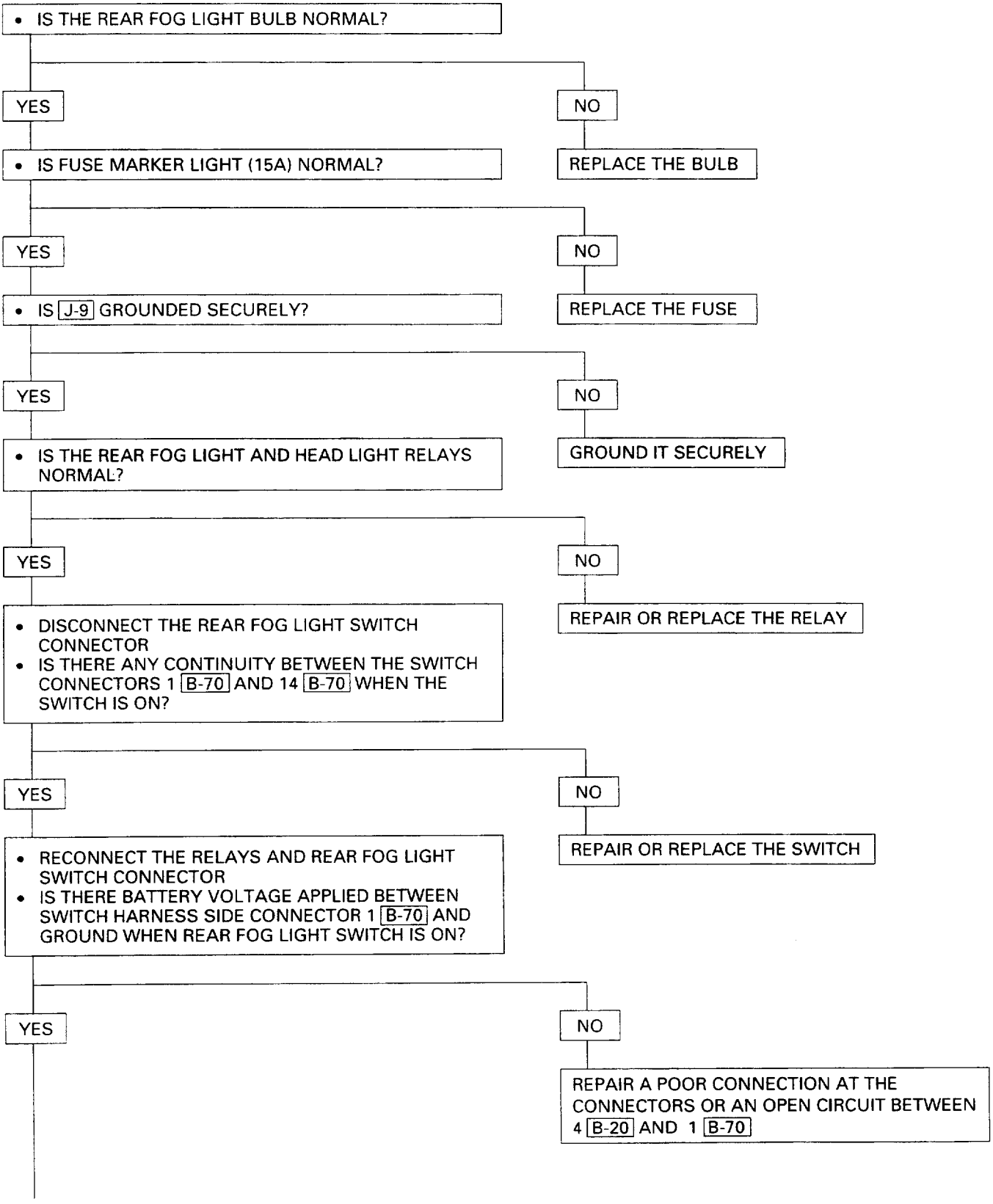
NOTE: FIGURES IN PARENTHESIS "( )" INDICATE PLACE OF INSPECTION FOR THE CORNERING LIGHT ON THE RIGHT.

3-3. CORNERING LIGHT REMAINS ON EVEN WHEN STEERING WHEEL IS IN STRAIGHT AHEAD POSITION



4. REAR FOG LIGHT

4-1. REAR FOG LIGHT INOPERATIVE (WHILE HEADLIGHT IS ON)



CONTINUED ON THE FOLLOWING PAGE

CONTINUED FROM THE PREVIOUS PAGE

- SET THE REAR FOG LIGHT SWITCH TO ON POSITION
- IS THERE BATTERY VOLTAGE APPLIED BOTH BETWEEN REAR FOG LIGHT RELAY HARNESS SIDE CONNECTOR 4 [J-19] AND GROUND, AND 1 [J-19] AND GROUND?

YES

- DISCONNECT THE REAR FOG LIGHT CONNECTOR
- IS THERE BATTERY VOLTAGE APPLIED BETWEEN REAR FOG LIGHT HARNESS SIDE CONNECTOR 1 [R-12] AND GROUND WHEN REAR FOG LIGHT SWITCH IS ON?

YES

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN 2 [R-12] AND [J-9] (GROUND)

NO

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN 1 [R-12] AND 5 [J-19]

NO

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN FUSE MERKER LIGHT (15A) AND 1 [J-19] AND 14 [B-70] AND 4 [J-19]

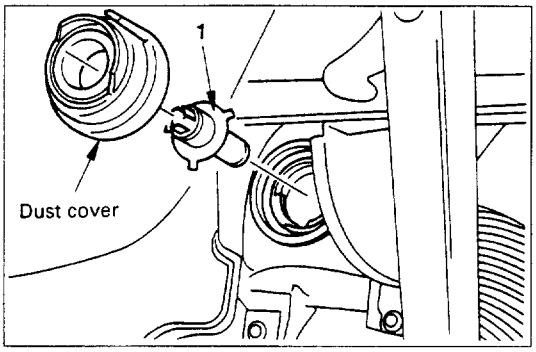
STARTER SWITCH

Refer to "START AND CHARGING" in this section.

HIGH BEAM INDICATOR LIGHT

Refer to "METER AND WARNING/INDICATOR LIGHT" in this section.

HEADLIGHT BULB



REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Headlight Bulb**
   1) Tilt up the cab.
   2) Disconnect the connector.
   3) Remove the dust cover.
   4) Remove the bulb by loosen the clip.

NOTE:

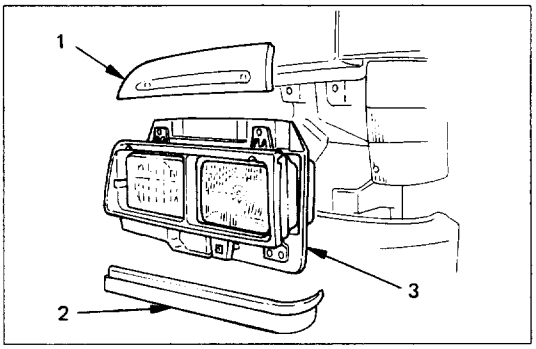
In case of non-tilt type cab, and depending on the equipment fitted, above removal is not applied.

In such a case, the bulbs can be removed after headlight and fog light assembly is removed. (Refer to HEADLIGHT ASSEMBLY in this section.

INSTALLATION

To install, follow the removal steps in the reverse order.

HEADLIGHT ASSEMBLY



REMOVAL

Preparation:

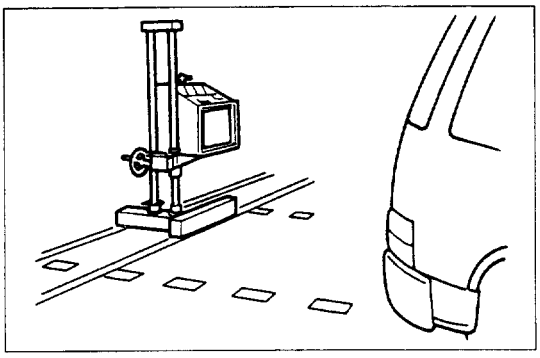
Disconnect the battery ground cable.

1. **Dummy lens**
   - Remove two screws.
2. **Lower cover**
   - Pull the lower cover to disconnect the clips.
3. **Headlight assembly**
   - Remove the fixing screws.
   - Disconnect the connectors.

INSTALLATION

To install, follow the removal steps in the reverse order, noting the following point.

1. After installing the headlight assembly, be sure to adjust the headlight aim.

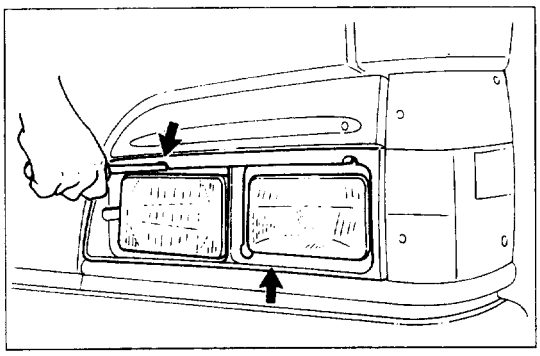


AIMING OF HEADLIGHT

Preparation:

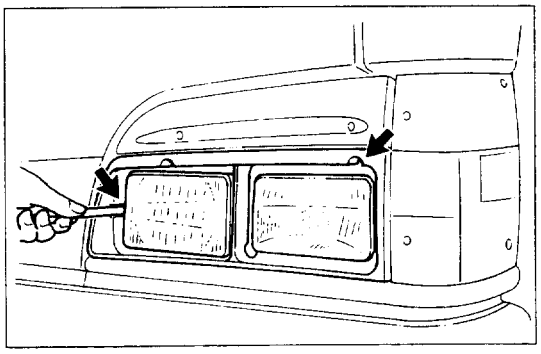
Place the unloaded vehicle on a level surface and check to see if the inflation pressure of the tires is correct, the lenses are clean, and the battery is sufficiently charged. Adjust the aim with the headlight tester.

When adjusting, follow the procedure of the tester manufacturer's.



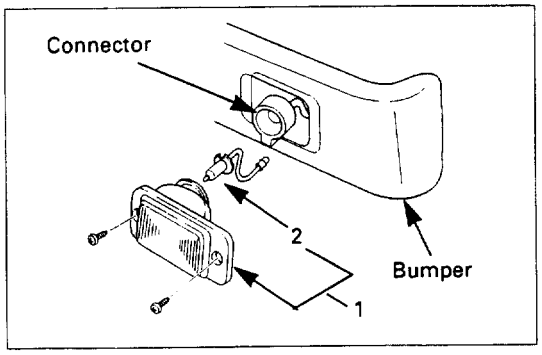
VERTICAL ADJUSTMENT

Use a screwdriver for vertical adjustment.



HORIZONTAL ADJUSTMENT

Use a screwdriver for horizontal adjustment.



FRT FOG LIGHT BULB

REMOVAL

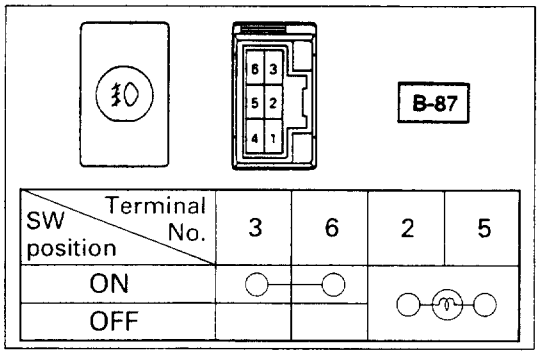
Preparation:

Disconnect the battery ground cable.

1. **Fog Light Assembly**
   1) Remove two screws.
   2) Disconnect the connector.
2. **Bulb**

INSTALLATION

To install, follow the removal steps in the reverse order.

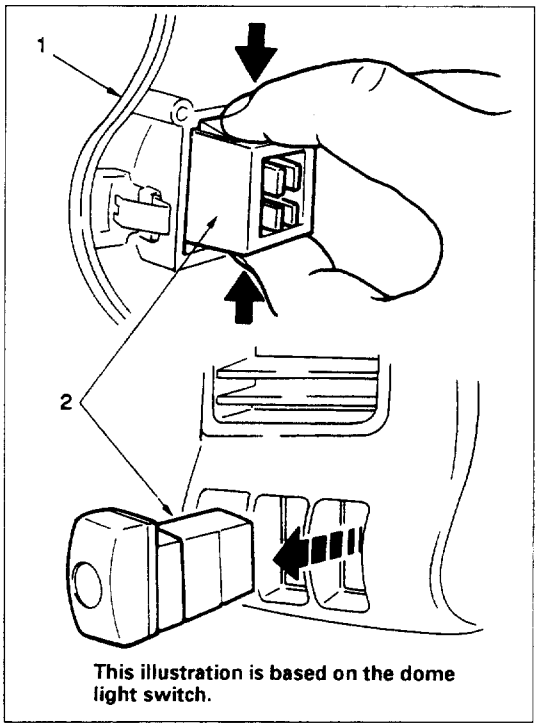


FOG LIGHT SWITCH

INSPECTION

Check the continuity between the connector terminals while operating the switch.

Replace the switch when the result of inspection is found abnormal.



This illustration is based on the dome light switch.

REMOVAL

Preparaion:

Disconnect the battery ground cable.

1. **Meter Cluster**

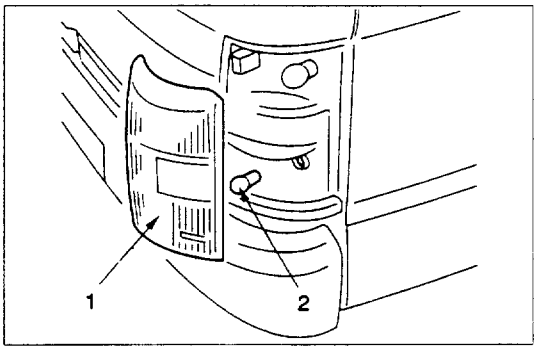
   Refer to "METER AND WARNING/INDICATOR LIGHT" in this section.

2. **Fog Light Switch**

   Release the lock pushing the switch from the back side of the meter cluster.

INSTALLATION

To install, follow the removal steps in the reverse order.



CORNERING LIGHT/BULB

REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Front Combination Light Lens**

   Remove four screws.

2. **Bulb**

INSTALLATION

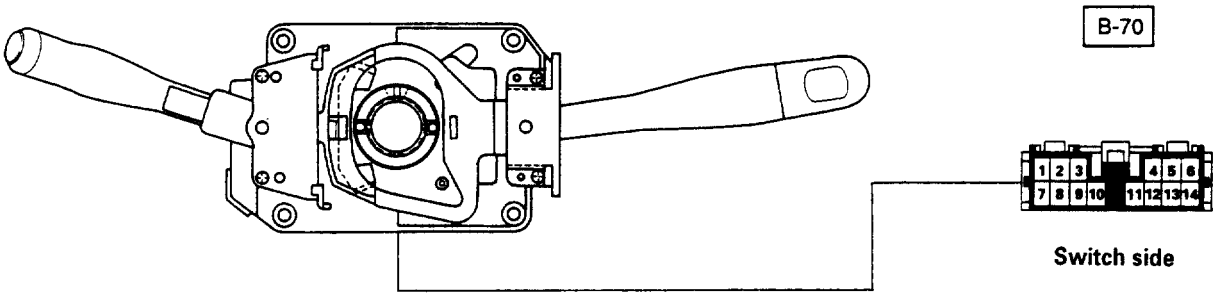
To install, follow the removal steps in the reverse order.

COMBINATION SWITCH (LIGHTING SWITCH, DIMMER·PASSING SWITCH, CORNERING LIGHT SWITCH AND REAR FOG LIGHT SWITCH)

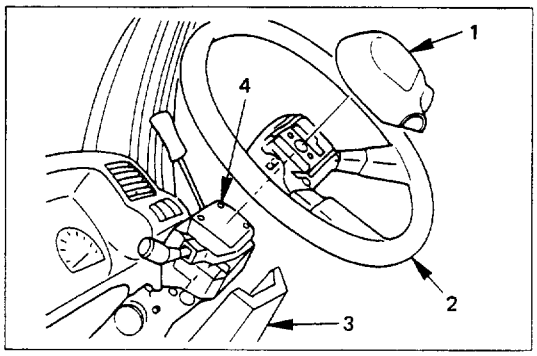
INSPECTION

Check the continuity between the connector terminals while operating the switch.

Replace the switch when the result of inspection is found abnormal.



SW position \ Terminal No.		1	2	4	5	7	8	9	10	11	12	13	14
Lighting SW		○		○			○						
				○			○						
	REAR FOG SW	○		○			○						○
	OFF												
Dimmer· passing SW	High beam			○					○				
	Passing			○		○			○				
Cornering light SW	Turning left		○							○			
	Neutral												
	Turning right		○					○					



REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Horn Pad**
   1) Hold the horn pad and pull it upward.
2. **Steering Wheel**
   1) Remove the steering shaft nut.
   2) Remove the steering wheel by using steering wheel remover.

   (Refer to Section 3D "STEERING COLUMN" for steering wheel removal steps.)
3. **Steering Cowl**

   Remove four screws
4. **Combination Switch**
   1) Remove four screws.
   2) Disconnect the connector.

INSTALLATION

To install, follow the removal steps in the reverse order, noting the following point.

1. Tighten the steering shaft nut to the specified torque.

Shaft nut torque	N·m (kg·m/lb·ft)
	49 (5/36)

HEADLIGHT LEVELING

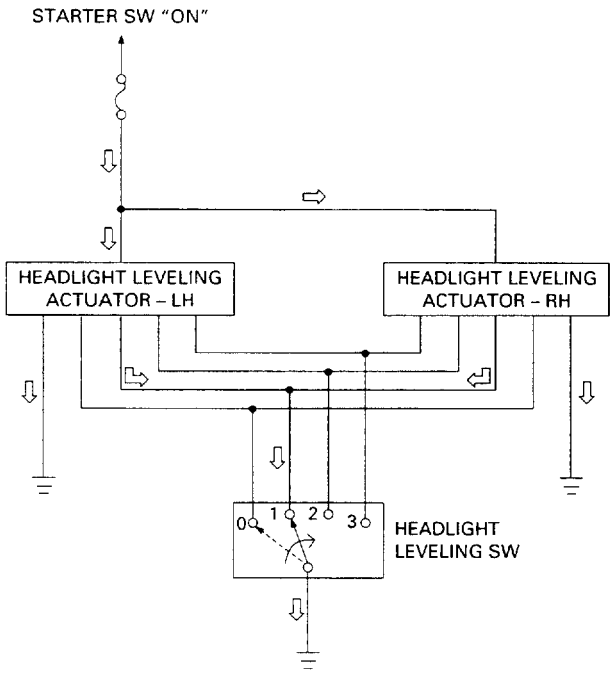
GENERAL DESCRIPTION

The circuit consists of starter SW, headlight leveling SW and headlight leveling actuator.

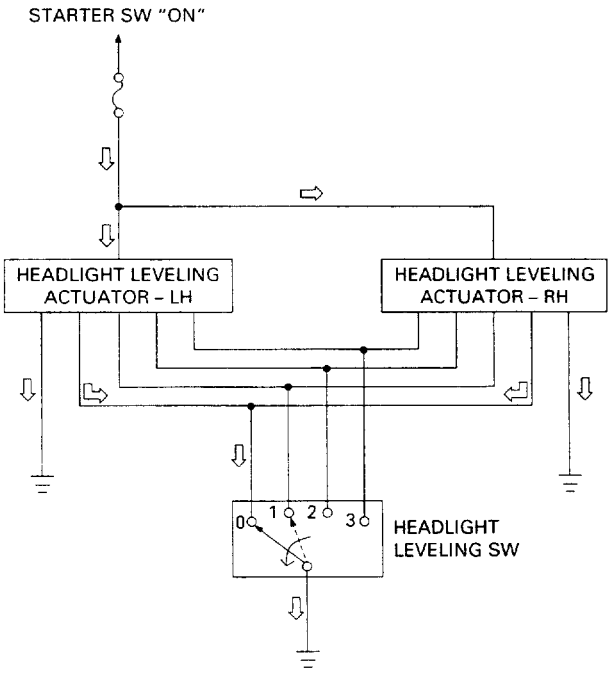
When the headlight leveling SW is operated with the starter SW at ON position, the actuator is operated to change the angle of the optical axis of the headlight.

OPERATION OF THE CIRCUIT

1. When headlight leveling SW is turned to "1" position

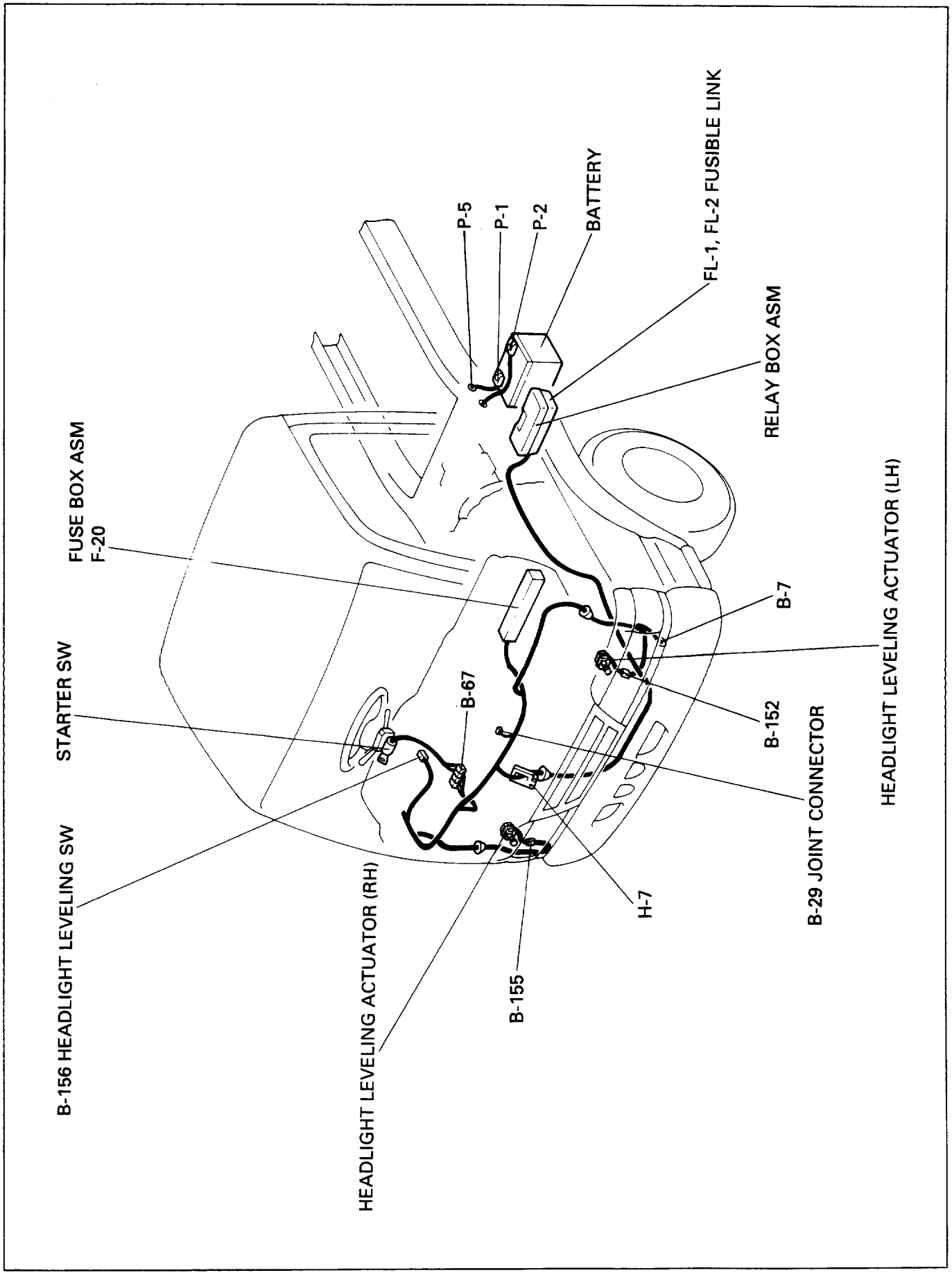


2. When headlight leveling SW is turned to "0" position

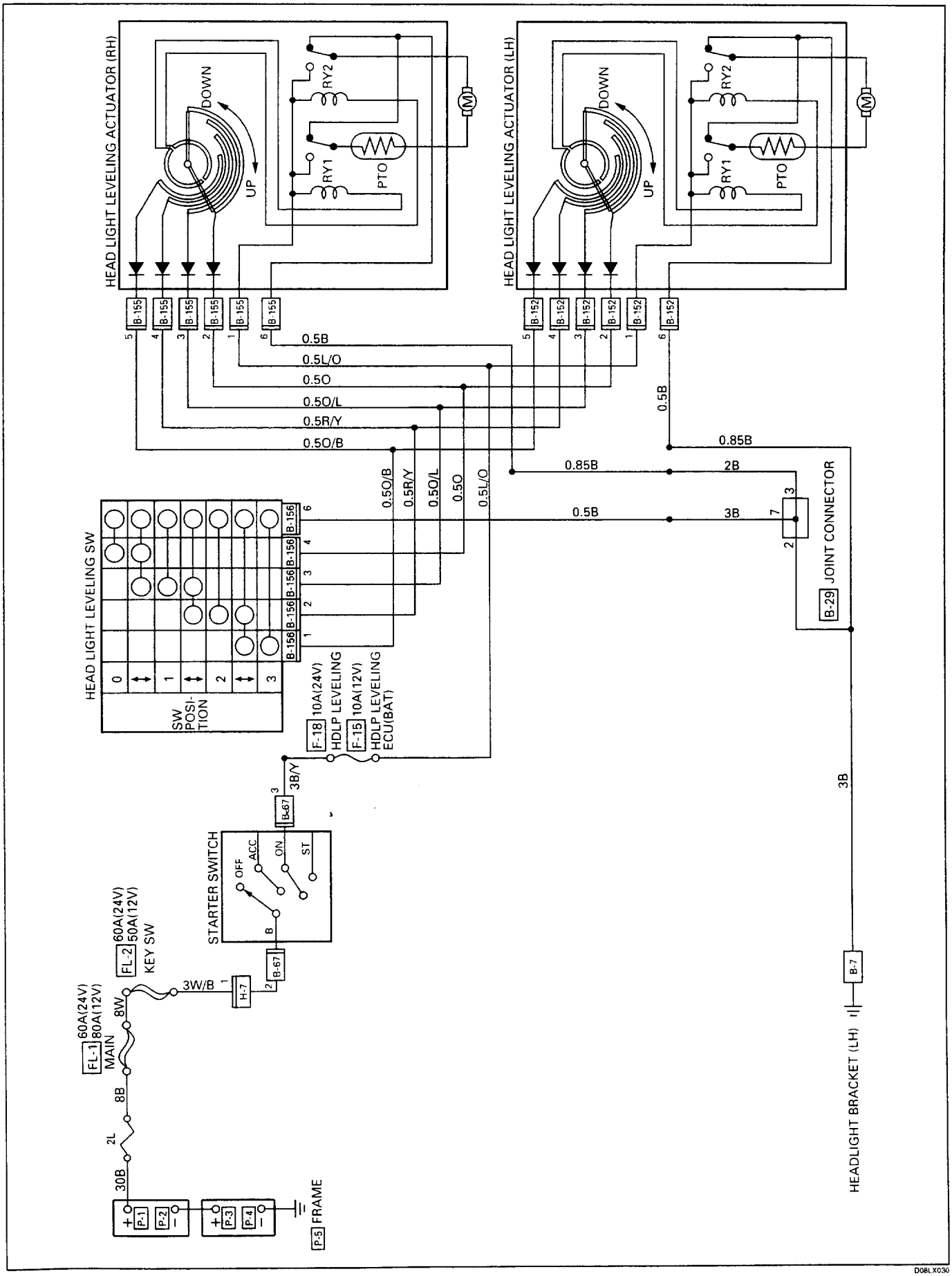


NOTE: Arrow marks "⇨" indicate the direction of current.

PARTS LOCATION

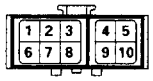


CIRCUIT DIAGRAM

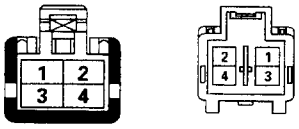


CONNECTOR LIST

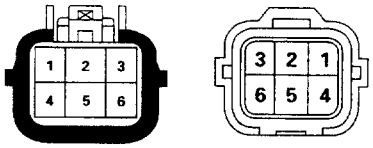
B-29



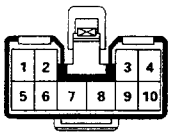
B-67



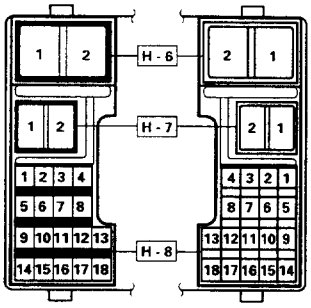
B-152 B-155



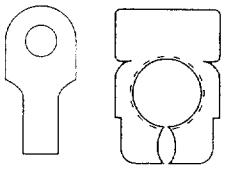
B-156



H-7



P-1 P-2



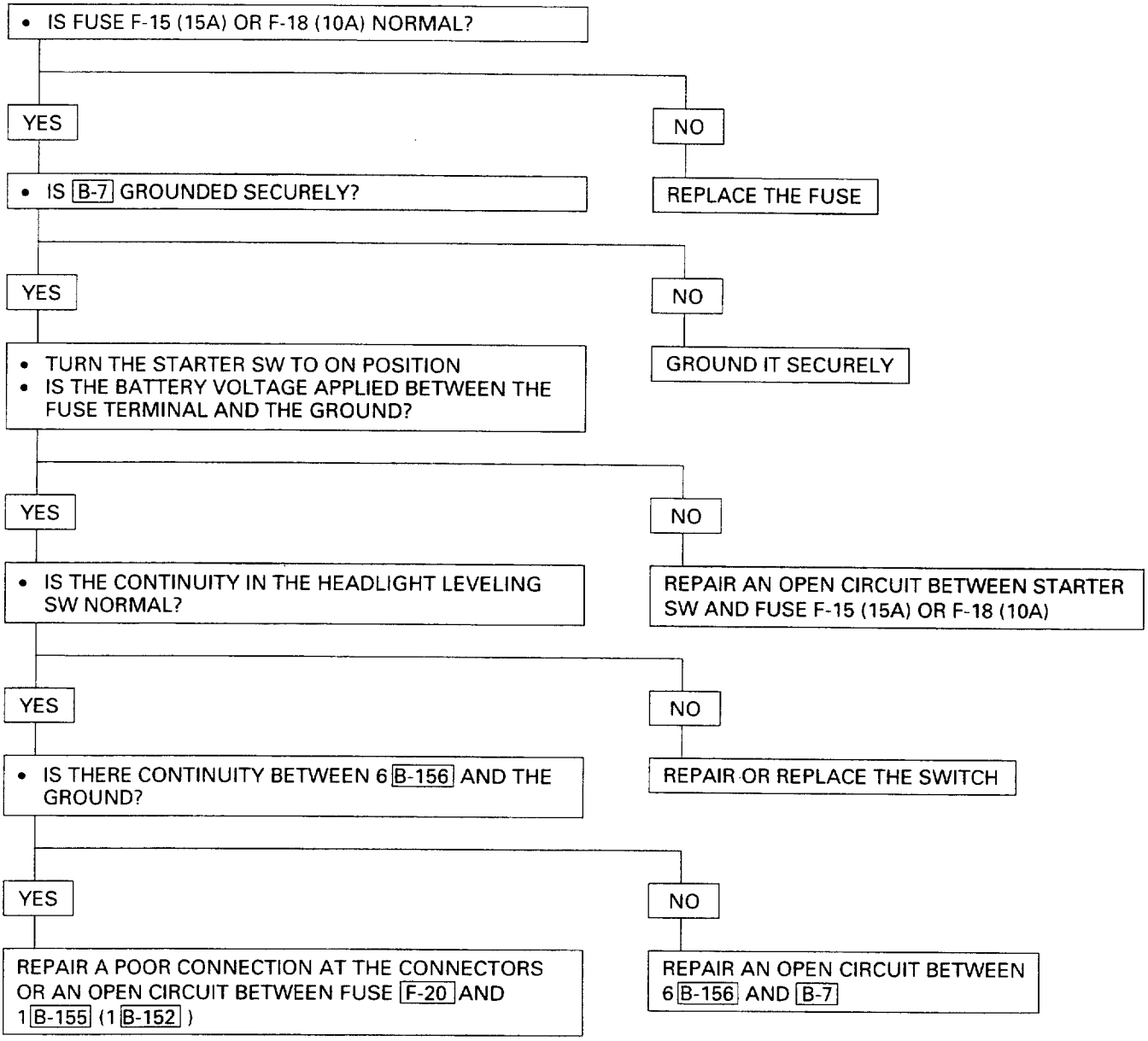
P-5

DIAGNOSIS

QUICK CHART FOR CHECK POINTS

Trouble mode \ Check point	Fuse F-18 (10A):24V F-15 (15A):12V	Headlight leveling switch	Headlight leveling actuator	Cable harness
1. Both actuators inoperative	○	○		○
2. Actuator on the left (right) side inoperative			○	○
3. When leveling SW is turned to a certain position, actuator inoperative		○	○	○

1. BOTH ACTUATORS INOPERATIVE



2. ACTUATOR ON THE RIGHT (LEFT) SIDE INOPERATIVE

- IS THE ACTUATOR ON THE LEFT (RIGHT) SIDE NORMAL?
  - NO → REPLACE THE ACTUATOR
  - YES → • IS THERE CONTINUITY BETWEEN 6 B-155 (6 B-152) AND THE GROUND?
    - NO → REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN 6 B-155 (6 B-152) AND B-7
    - YES → REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN FUSE F-15 (15A) OR F-18 (10A) AND 1 B-155 (1 B-152)

3. WHEN HEADLIGHT LEVELING SW IS TURNED TO A CERTAIN POSITION, ACTUATOR INOPERATIVE

- IS THE CONTINUITY IN THE HEADLIGHT LEVELING SW NORMAL?
  - NO → REPAIR OR REPLACE THE SWITCH
  - YES → • IS THE ACTUATOR ON THE RIGHT (LEFT) SIDE NORMAL?
    - NO → REPLACE THE ACTUATOR
    - YES → REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT (REFER TO THE FOLLOWING PAGE)

Inspect and repair the circuit that is corresponding to the headlight leveling switch position where the actuator becomes inoperative.

Actuator – RH

Headlight level SW position	Circuit
1	Between 3 B-156 and 3 B-155
2	Between 2 B-156 and 4 B-155
3	Between 1 B-156 and 5 B-155
0	Between 4 B-156 and 2 B-155

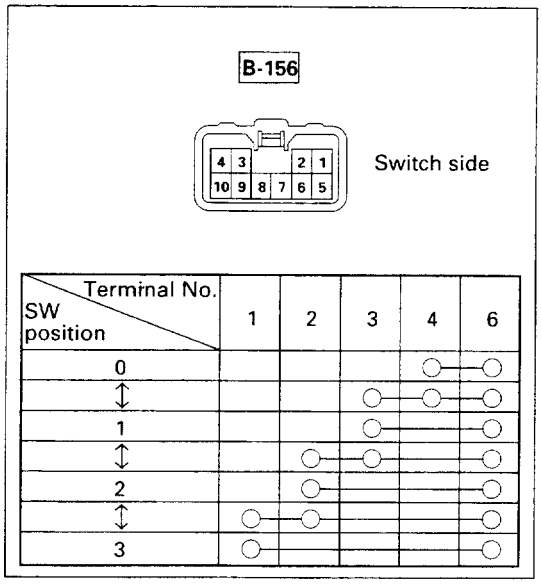
Actuator – LH

Headlight level SW position	Circuit
1	Between 3 B-156 and 3 B-152
2	Between 2 B-156 and 4 B-152
3	Between 1 B-156 and 5 B-152
0	Between 4 B-156 and 2 B-152

STARTER SWITCH

Refer to "START AND CHARGING" in this manual.

HEADLIGHT LEVELING SWITCH

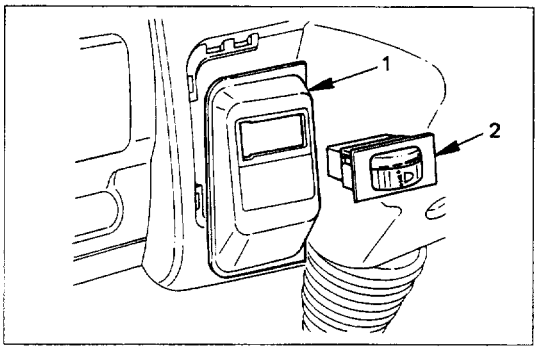


SW position \ Terminal No.	1	2	3	4	6
0				○—○	○
↕			○	○—○	○
1			○		○
↕		○	○		○
2		○			○
↕	○	○			○
3	○				○

INSPECTION

Check the continuity between the switch connector terminals.

Repair or replace the switch when the result of inspection is found abnormal.



REMOVAL

Preparation:

Disconnect the battery ground cable.

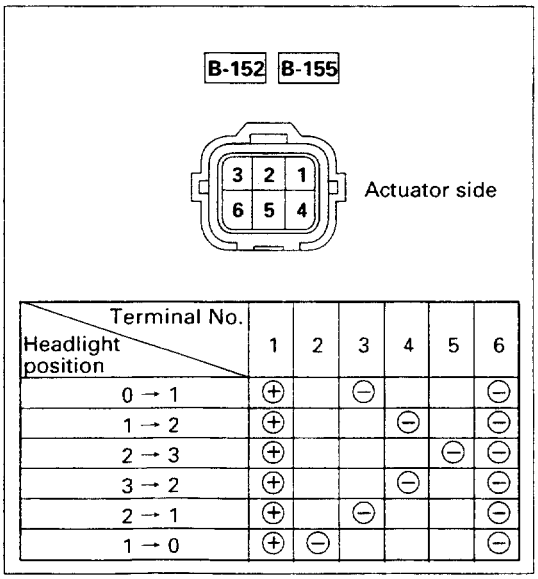
1. **Switch Bezel**
2. **Headlight Leveling Switch**

Disconnect the connector.

INSTALLATION

To install, follow the removal steps in the reverse order.

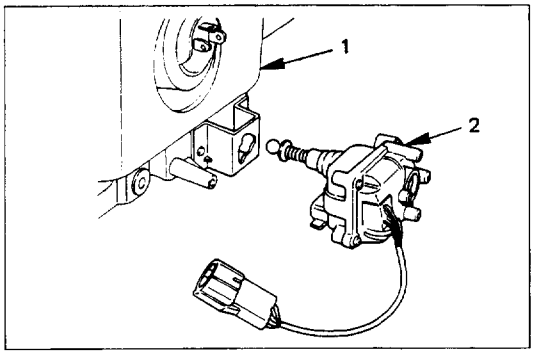
HEADLIGHT LEVELING ACTUATOR



Headlight position \ Terminal No.	1	2	3	4	5	6
0 → 1	⊕		⊖			⊖
1 → 2	⊕			⊖		⊖
2 → 3	⊕				⊖	⊖
3 → 2	⊕			⊖		⊖
2 → 1	⊕		⊖			⊖
1 → 0	⊕	⊖				⊖

INSPECTION

Apply the battery voltage to the connector terminals and check its function.



REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Headlight Assembly**

   Refer to HEADLIGHT ASSEMBLY removal steps in this manual.

2. **Headlight Leveling Actuator**
   1) Disconnect the connector.
   2) Remove the screw.

INSTALLATION

To install, follow the removal steps in the reverse order, noting the following point.

1. After installing the headlight leveling actuator and headlight assembly, be sure to adjust the headlight aim.

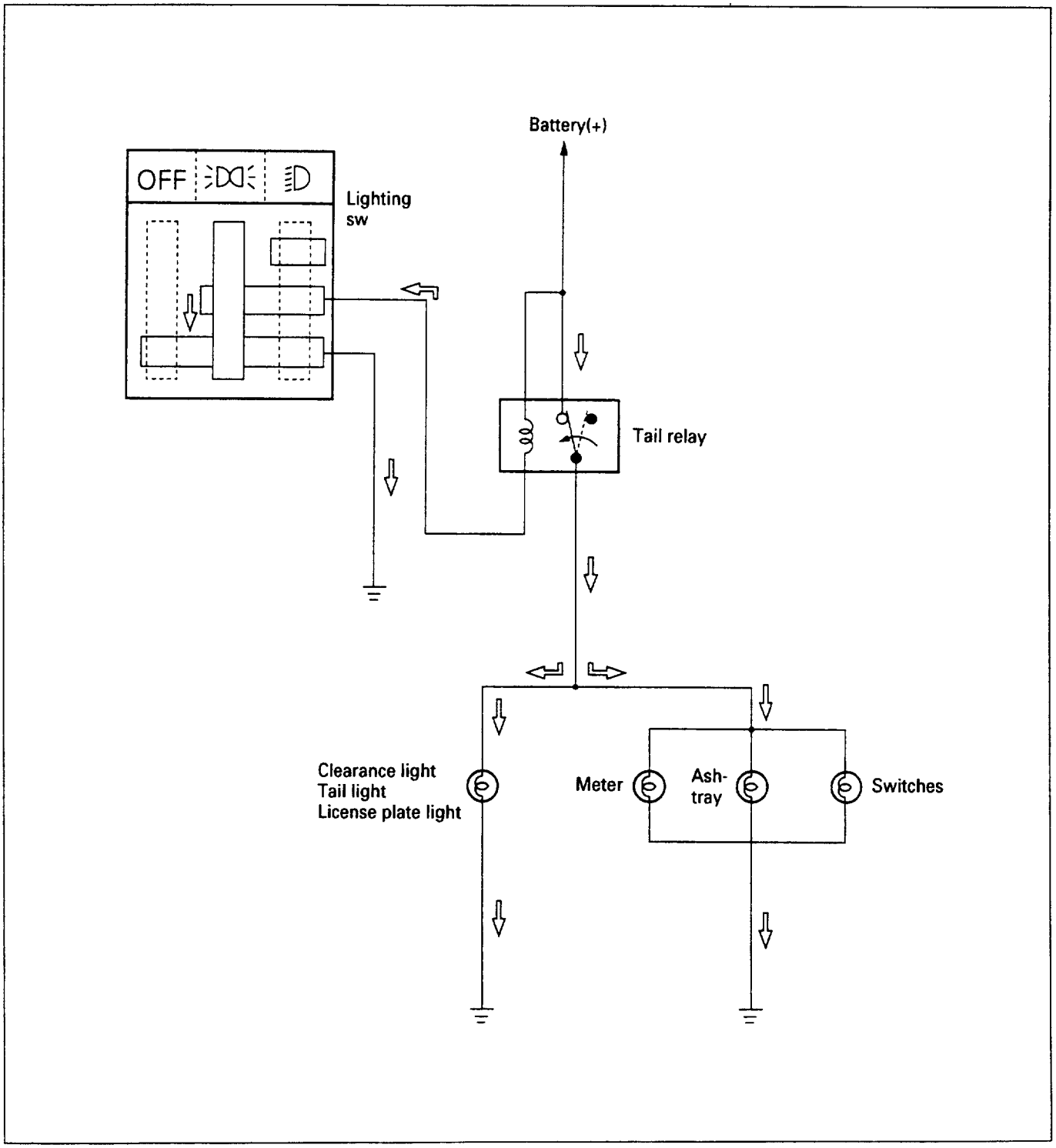
CLEARANCE LIGHT, TAILLIGHT, LICENSE PLATE LIGHT AND ILLUMINATION LIGHT

GENERAL DESCRIPTION

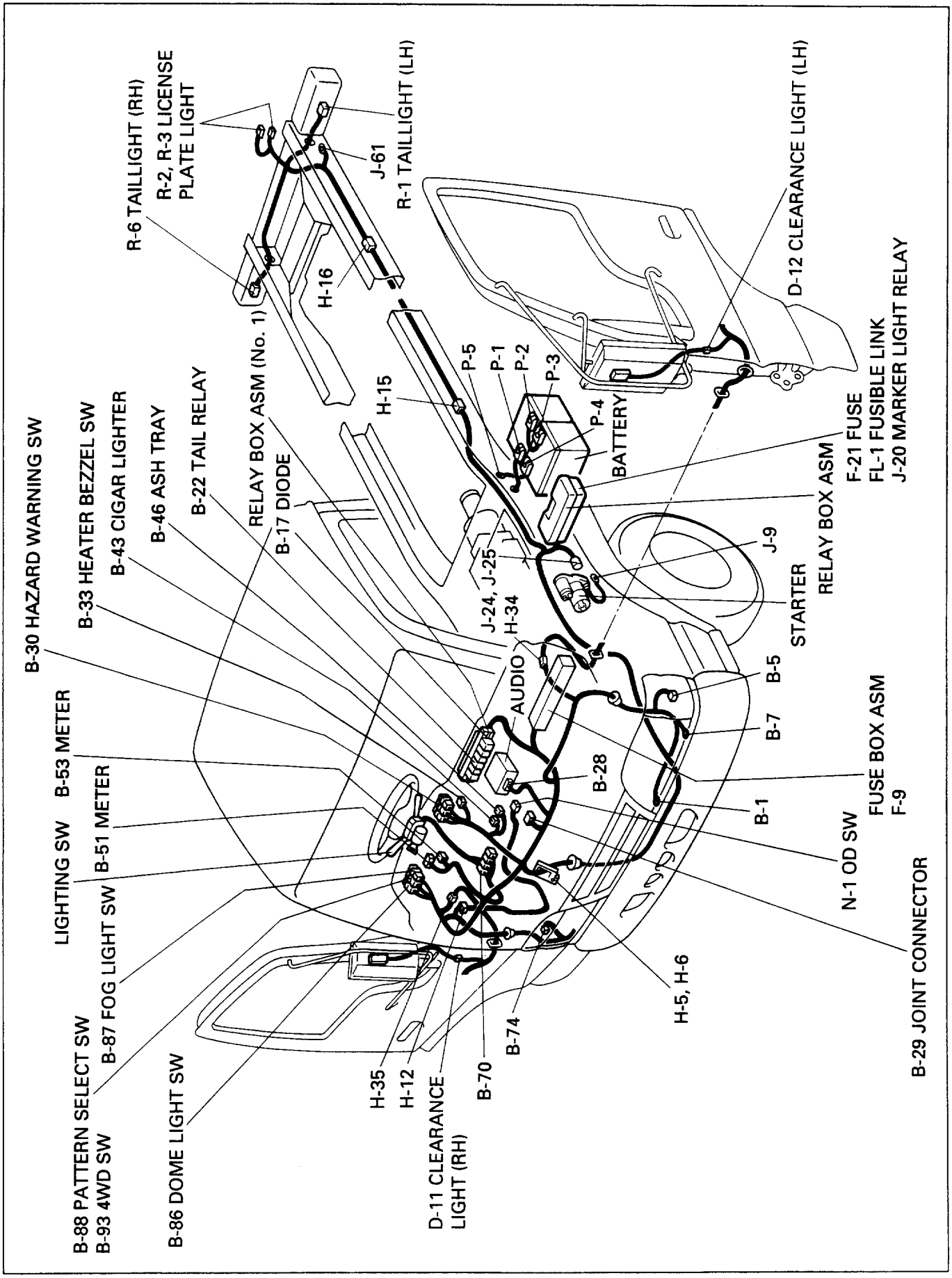
The circuit consists of the lighting switch, clearance light, taillight, license plate light and the illumination light for each of switch, meter and ashtray.

All these lights come on when the lighting switch are turned on with the switch to either clearance or headlight position.

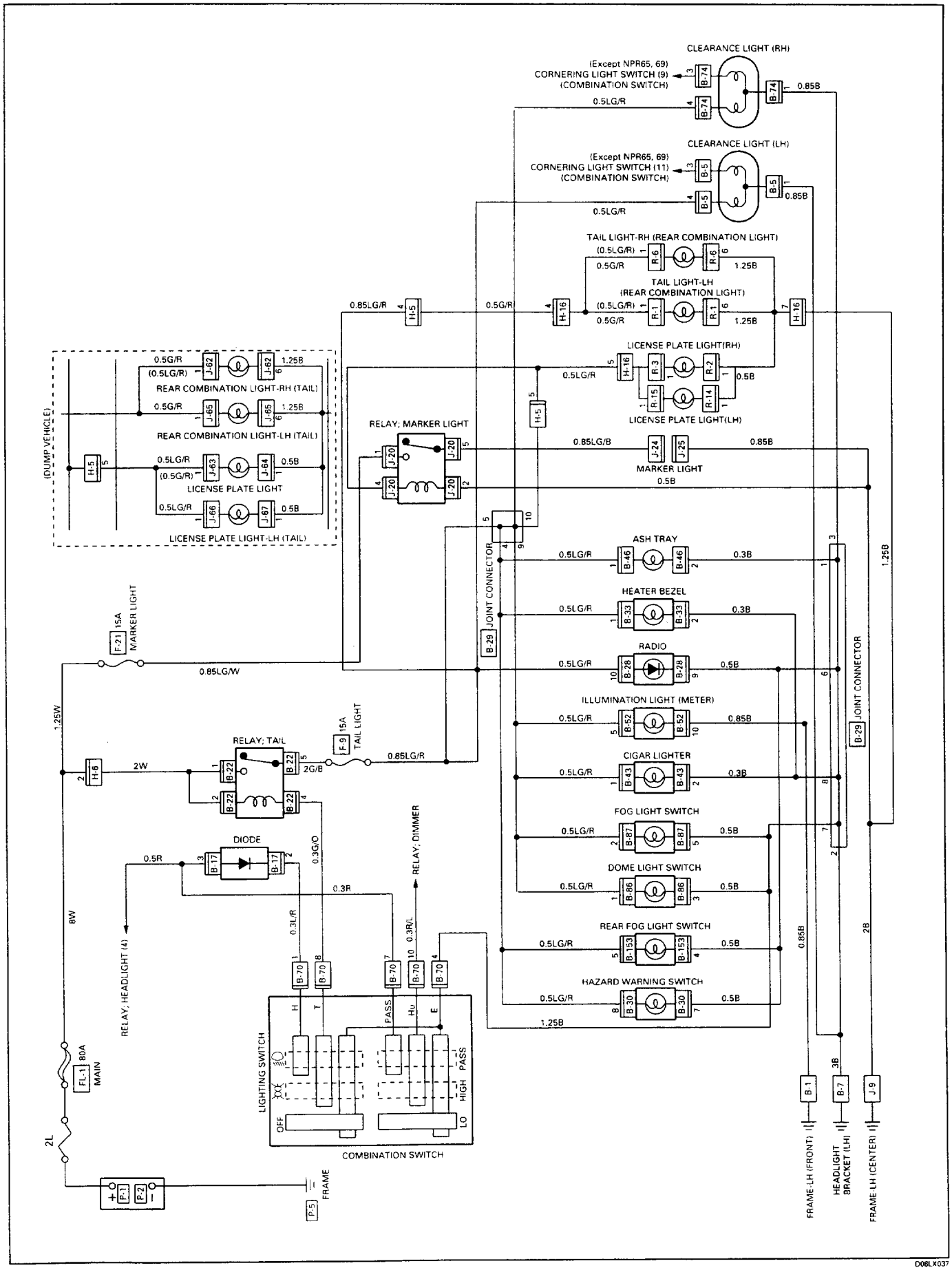
LIGHTING CIRCUIT



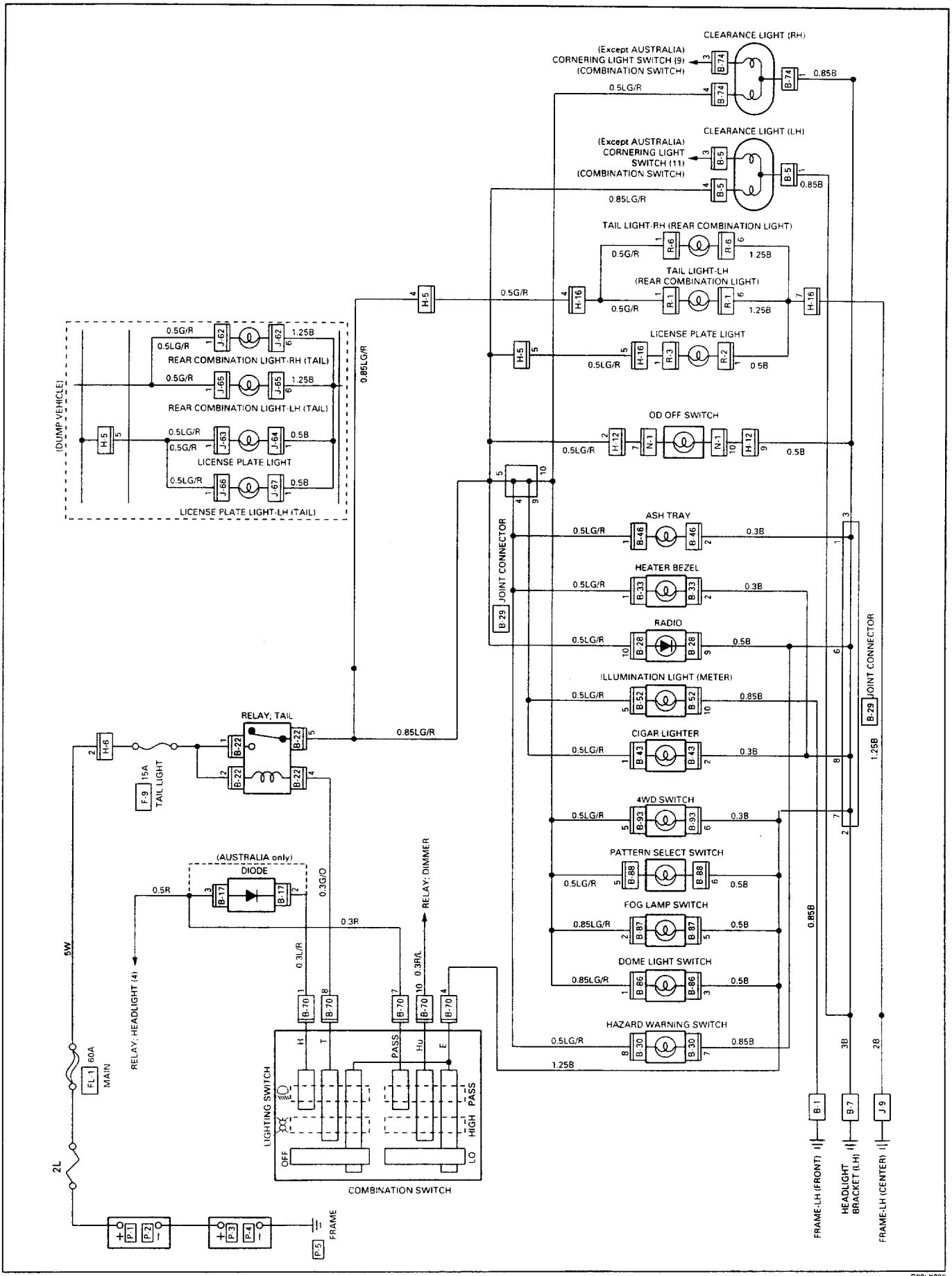
PARTS LOCATION



CIRCUIT DIAGRAM – FOR 12 VOLT



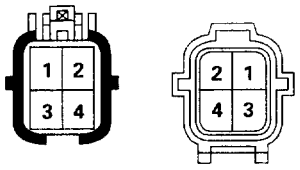
CIRCUIT DIAGRAM – FOR 24 VOLT



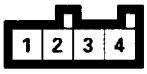
D08LX038

CONNECTOR LIST

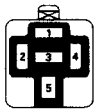
B-5 B-74



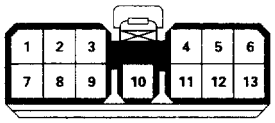
B-17



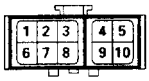
B-22 J-20



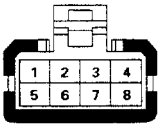
B-28



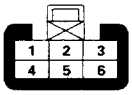
B-29



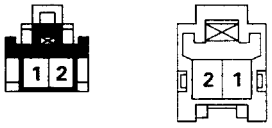
B-30 B-88 B-93



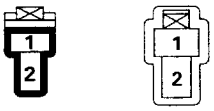
B-87



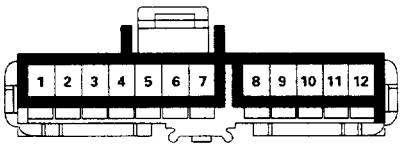
B-33 B-46



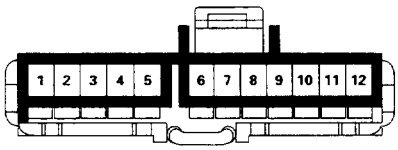
B-43



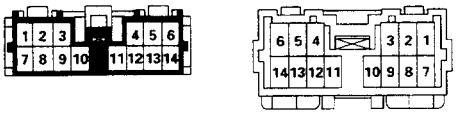
B-52



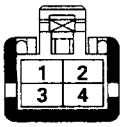
B-53



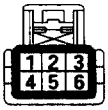
B-70 H-12



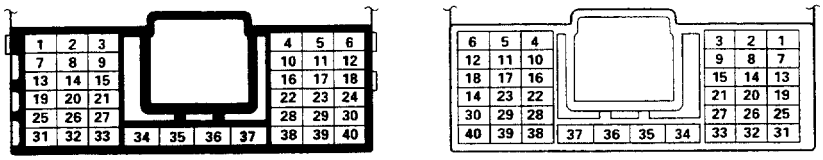
B-86



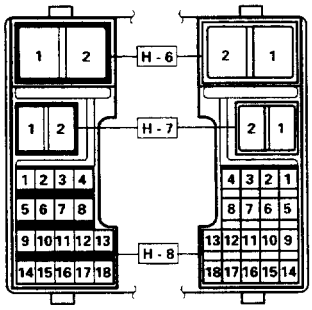
B-153



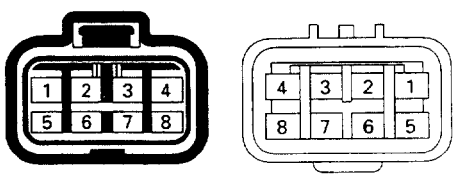
H-5



H-6



H-16

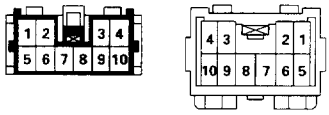


J-24 J-63 J-66 R-2 R-14
J-25 J-64 J-67 R-3 R-15

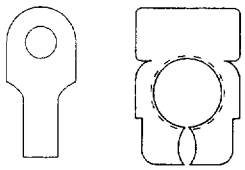
CONNECTOR LIST

J-62
J-65

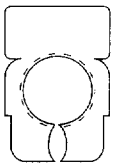
N-1



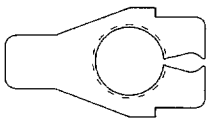
P-1 (12V) P-2



P-1 (24V) P-4

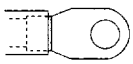


P-2 (24V) P-3

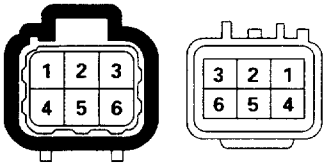


P-5 (12V)

P-5 (24V)



R-1 R-6



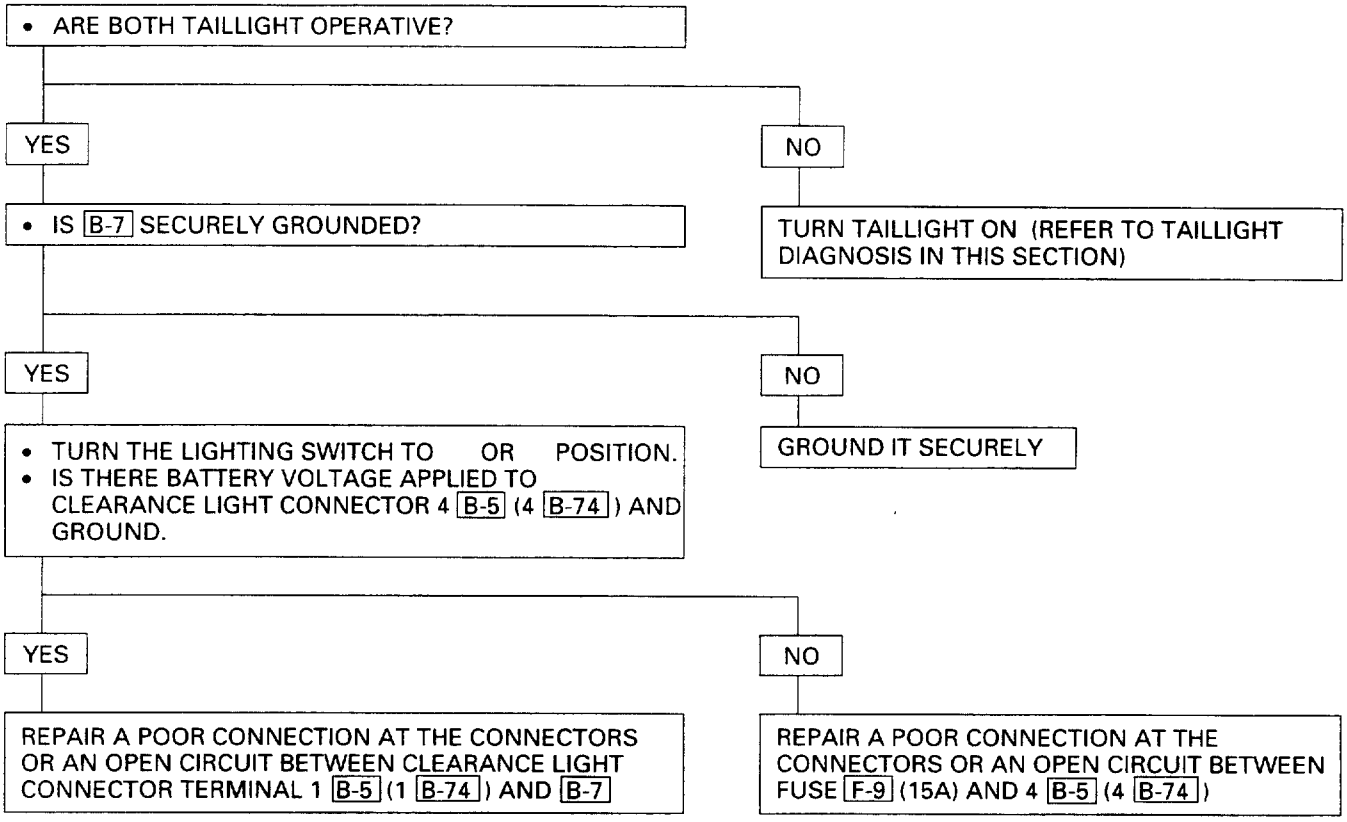
DIAGNOSIS

QUICK CHART FOR CHECK POINT

Trouble mode \ Check point	Fuse		Lighting SW	Taillight bulb	Clearance light bulb	License plate light bulb	Marker light relay	Cable harness
	F-9 (15A)	F-21 (15A)						
1. Both clearance lights inoperative	○ (1)		○ (3)		○ (2)			○ (4)
2. Clearance light on the left (or right) side inoperative					○ (1)			○ (2)
3. Both taillights inoperative	○ (1)		○ (2)					○ (3)
4. Taillight on the left (or right) side inoperative				○ (1)				○ (2)
5. License plate light inoperative						○ (1)		○ (2)
6. Marker light inoperative		○ (1)					○ (2)	○ (3)

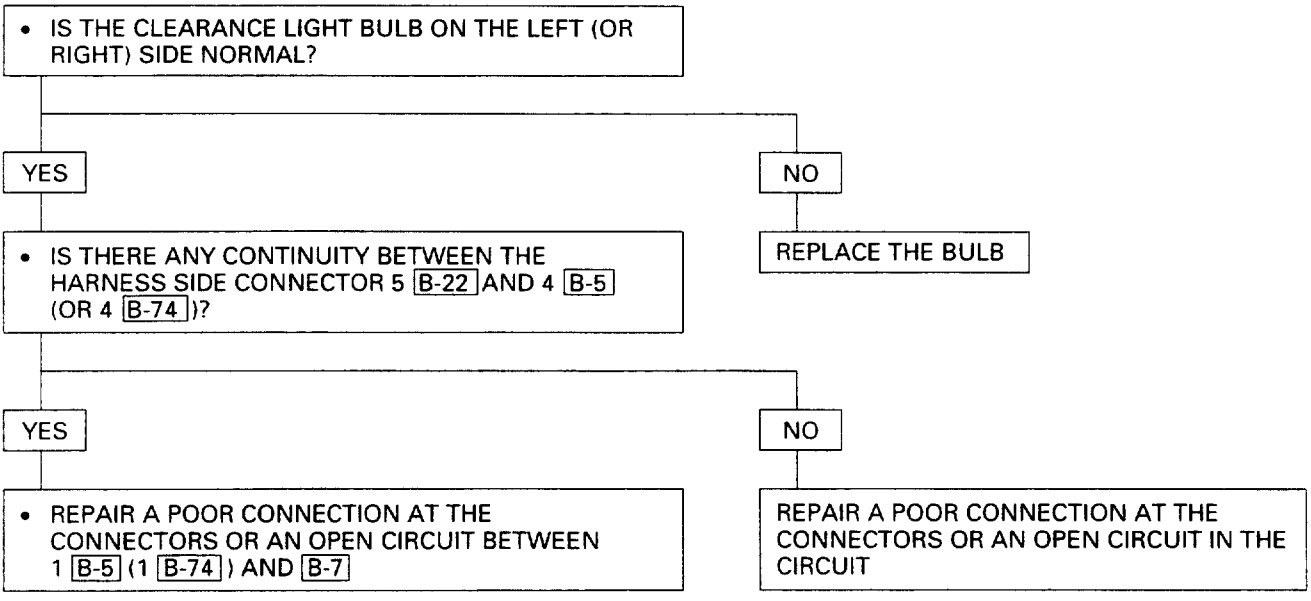
NOTE: Figure in parenthesis "( )" indicates the order of inspection.

1. BOTH CLEARANCE LIGHTS INOPERATIVE



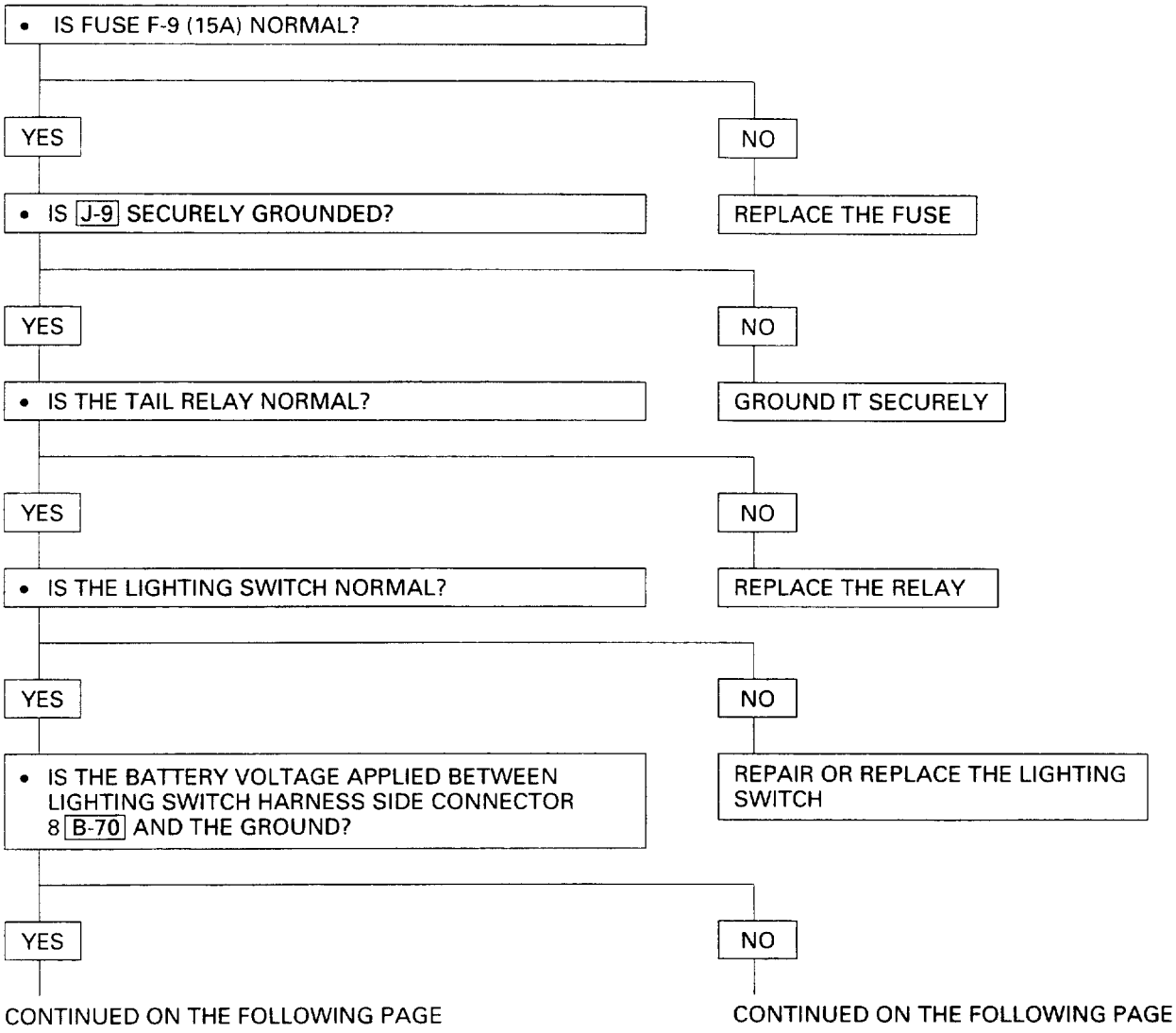
NOTE: FIGURE IN PARENTHESIS "( )" INDICATES PLACE OF INSPECTION FOR CLEARANCE LIGHT ON THE RIGHT SIDE.

2. CLEARANCE LIGHT ON THE LEFT (OR RIGHT) SIDE INOPERATIVE



NOTE: FIGURE IN PARENTHESIS "( )" INDICATES PLACE OF INSPECTION FOR CLEARANCE LIGHT ON THE RIGHT SIDE.

3. BOTH TAILLIGHTS INOPERATIVE



CONTINUED FROM THE PREVIOUS PAGE

- TURN THE LIGHTING SWITCH TO ≫D≪ OR ≫D POSITION
- IS THERE BATTERY VOLTAGE APPLIED TO 4 [H-16] AND GROUND

YES

- REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN LIGHTING SWITCH HARNESS SIDE CONNECTORS 7 [H-16] AND [J-9]

CONTINUED FROM THE PREVIOUS PAGE

NO

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN FUSE F-9 (15A) AND 8 [B-70]

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN TAILLIGHT RELAY CONNECTORS 5 [B-22] AND 4 [H-16]

4. TAILLIGHT ON THE LEFT (OR RIGHT) SIDE INOPERATIVE

- IS TAILLIGHT BULB ON THE LEFT (OR RIGHT) SIDE NORMAL?

YES

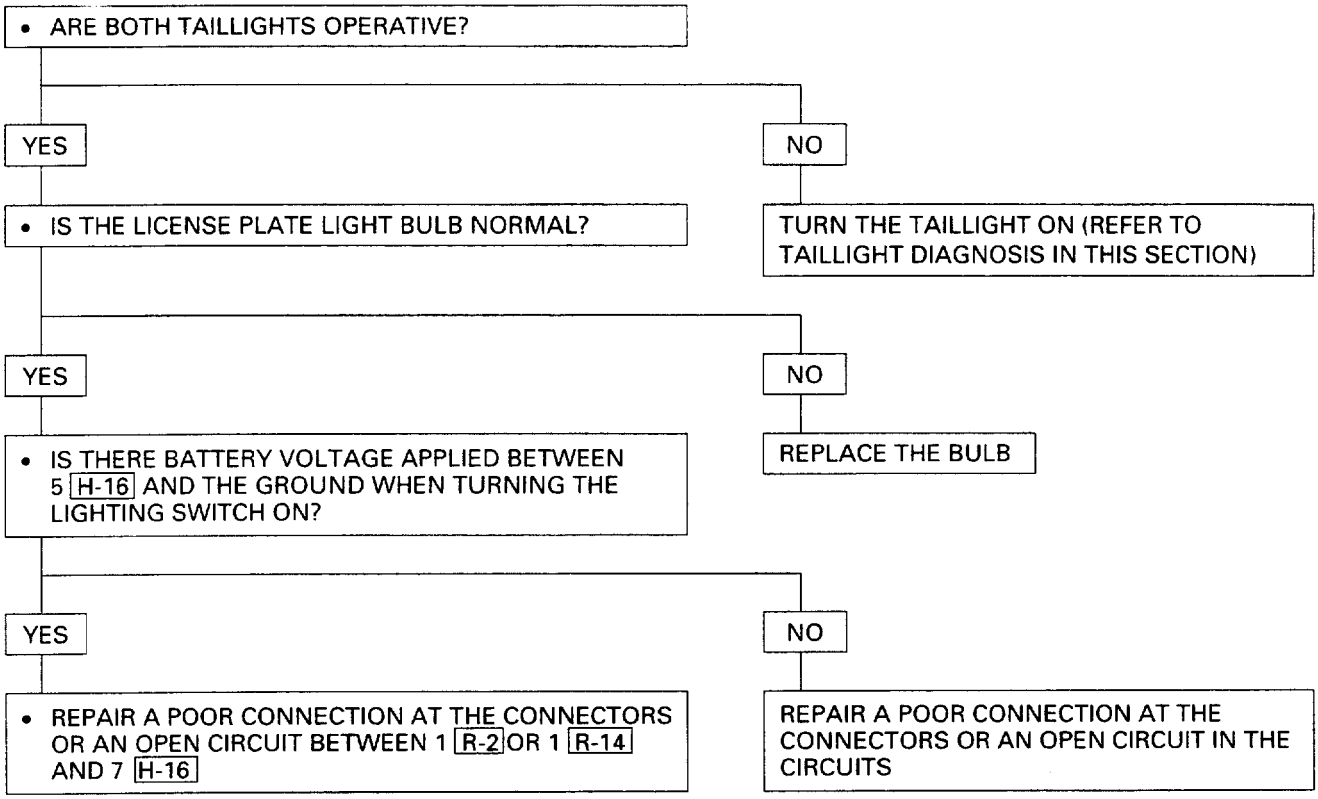
- REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN CONNECTOR TERMINAL 4 [H-16] AND TAILLIGHT CONNECTOR 1 [R-1] (1 [R-6])

NO

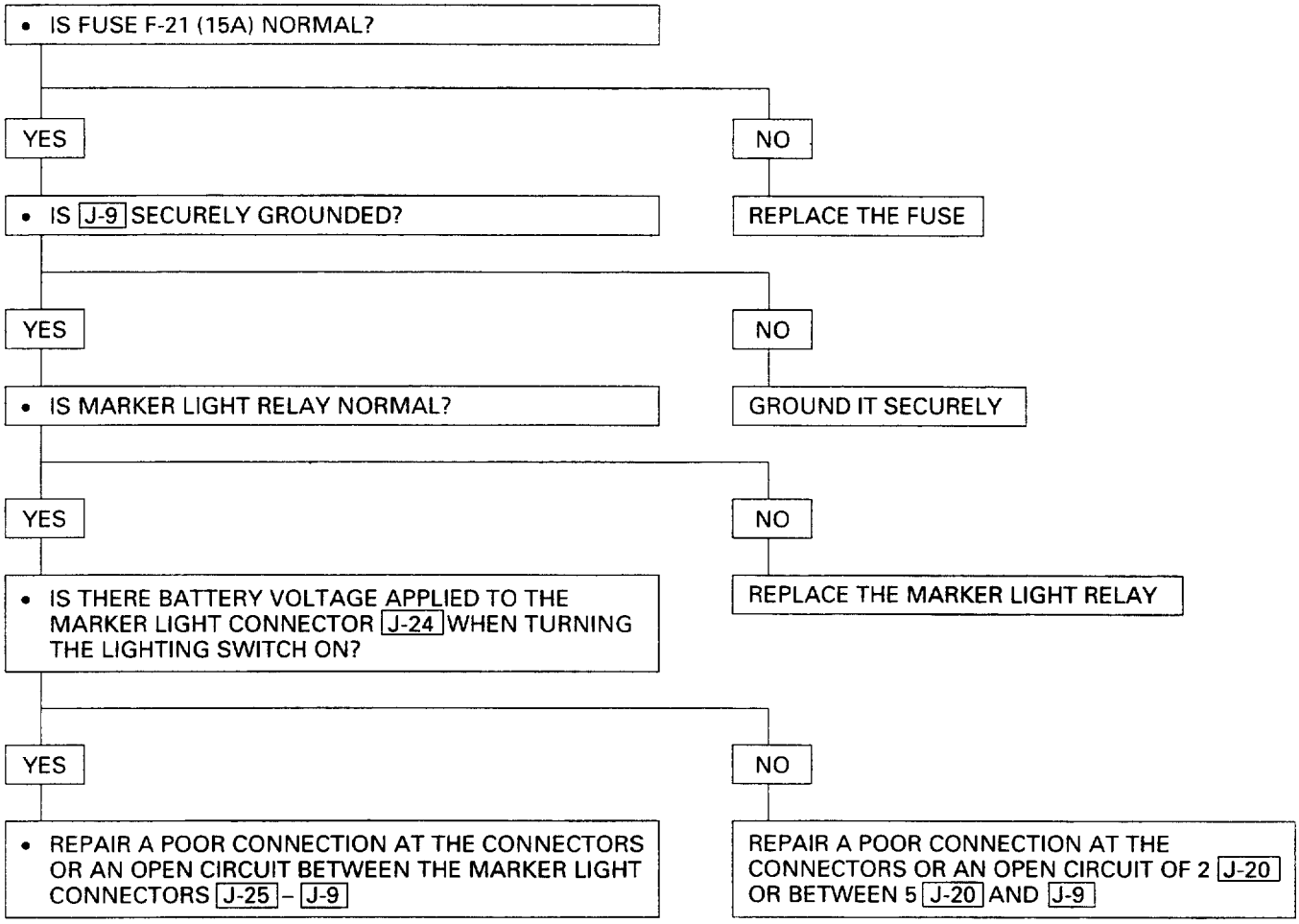
REPLACE THE BULB

NOTE: FIGURE IN PARENTHESIS "( )" INDICATES PLACE OF INSPECTION FOR TAILLIGHT ON THE RIGHT SIDE.

5. LICENSE PLATE LIGHT INOPERATIVE

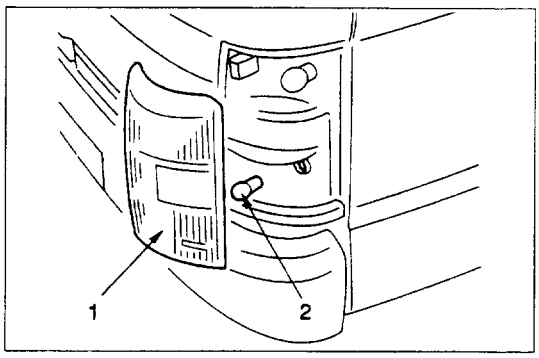


6. MARKER LIGHT INOPERATIVE



LIGHTING SWITCH

Refer to "HEADLIGHT, FOG LIGHT AND CORNERING LIGHT" in this section.



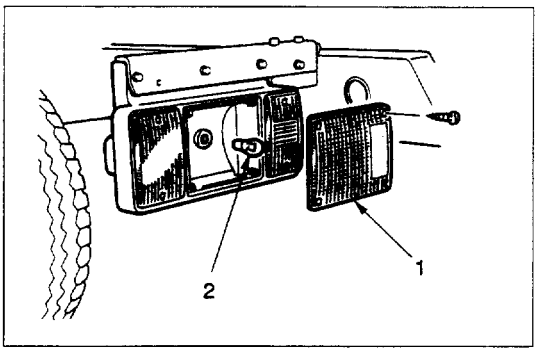
CLEARANCE LIGHT/BULB

REMOVAL

1. **Front Combination Light Lens**
   1) Remove four screws.
2. **Bulb**

INSTALLATION

To install, follow the removal steps in the reverse order.



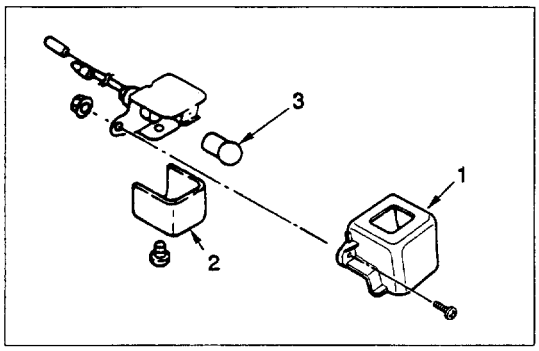
TAILLIGHT BULB

REMOVAL

1. **Lens**
2. **Bulb**

INSTALLATION

To install, follow the removal steps in the reverse order.



LICENSE PLATE LIGHT BULB

REMOVAL

1. **Cover**
2. **Lens**
3. **Bulb**

INSTALLATION

To install, follow the removal steps in the reverse order.

TURN SIGNAL LIGHT, HAZARD WARNING LIGHT, AND STOPLIGHT

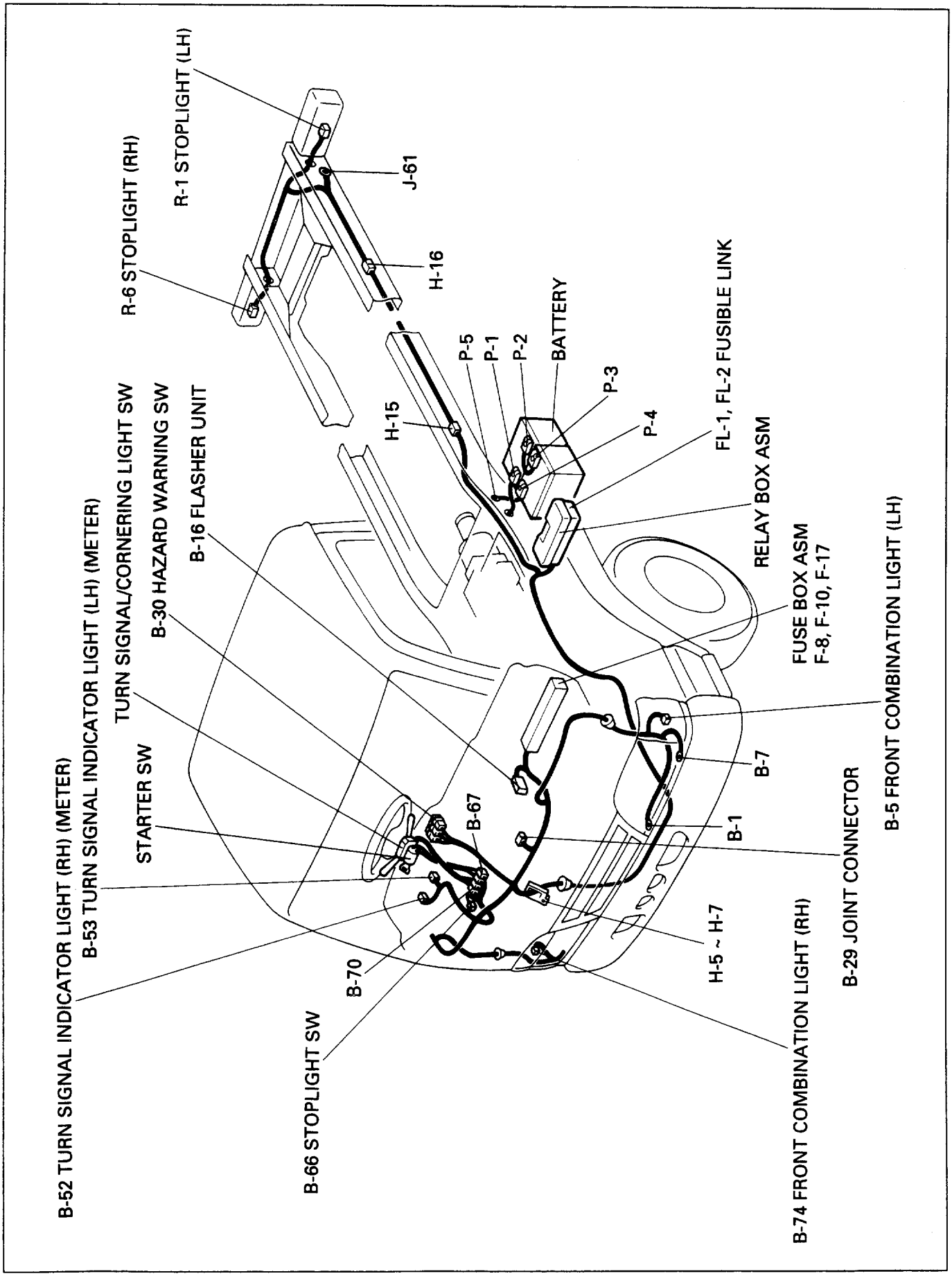
GENERAL DESCRIPTION

The circuit consists of the starter switch, turn signal light (front and rear), turn signal light switch, hazard warning light, flasher unit, stoplight and stoplight switch.

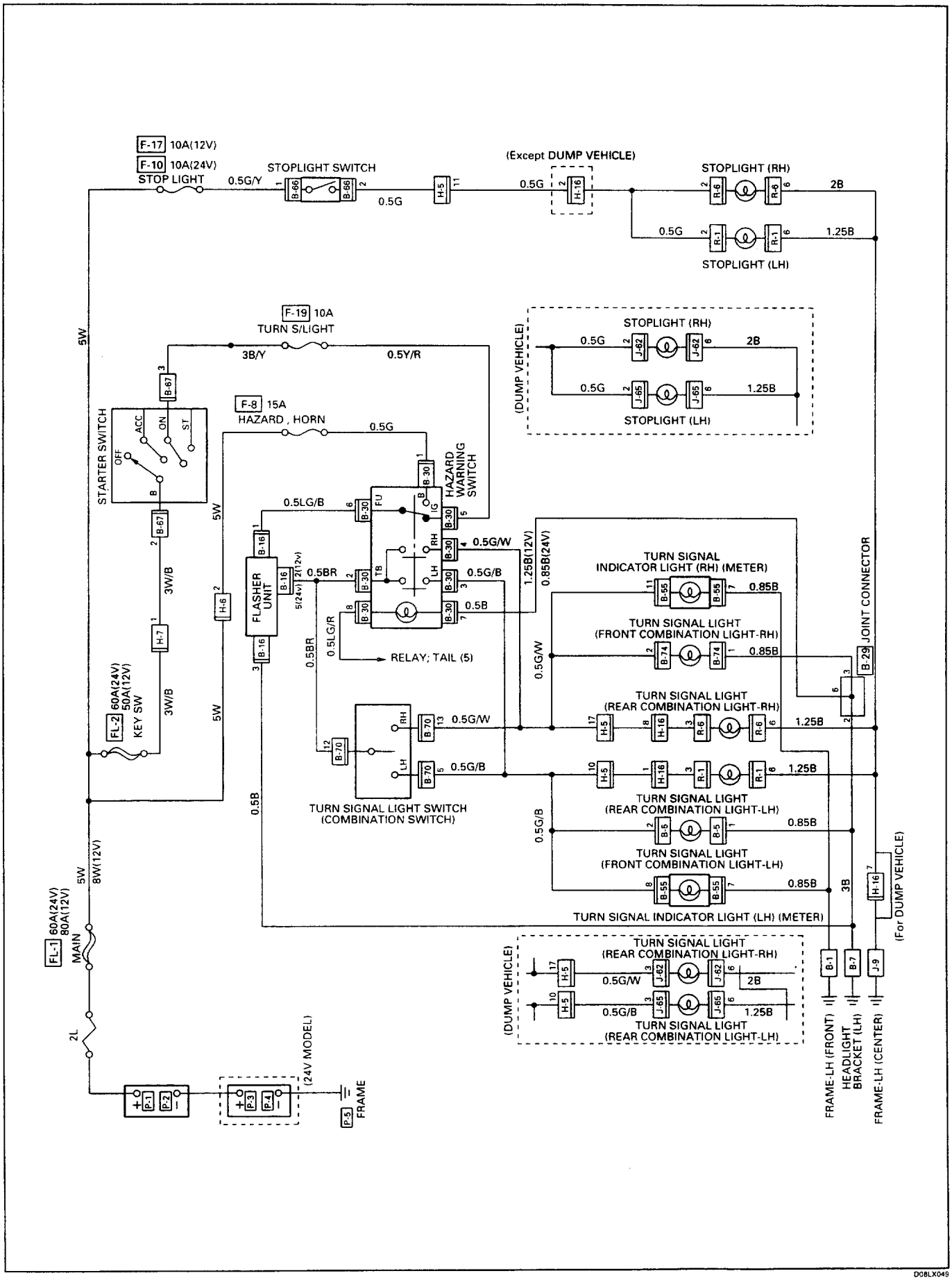
When turning on the respective switches with the starter switch on, the turn signal light will operate. When the turn signal light is flashing, the indicator light in the meter also start flashing. When the hazard warning switch is turned on, the current flows to the flasher unit through the hazard warning switch to cause the hazard warning light to flash, independent of the position of the starter switch. At the same time, the indicator lights in the meter also start flashing.

The stoplight switch will turn on and the light comes on once the brake pedal is depressed, independent of the position of the starter switch.

PARTS LOCATION

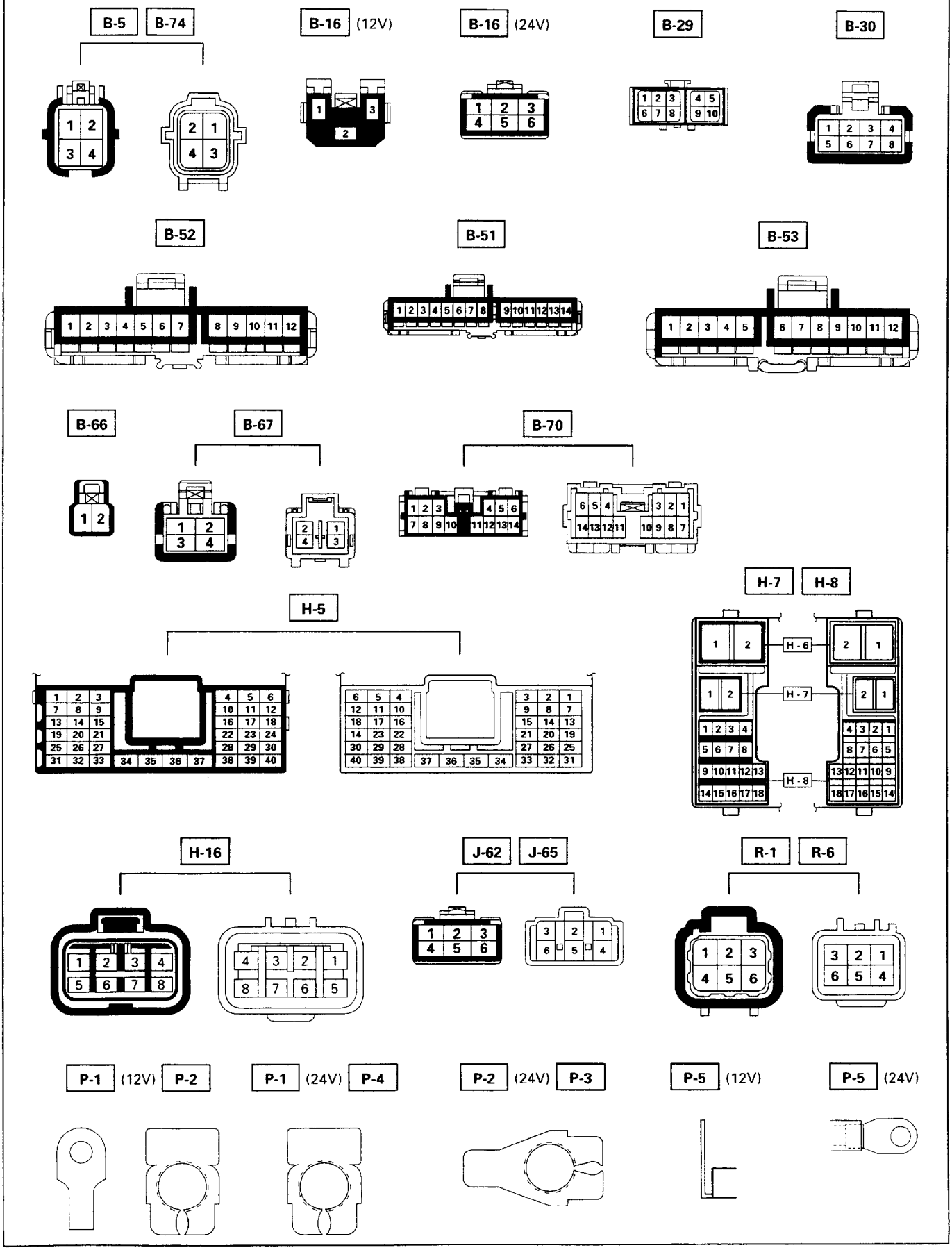


CIRCUIT DIAGRAM



D08LX049

CONNECTOR LIST



DIAGNOSIS

QUICK CHART FOR CHECK POINT

1. TURN SIGNAL LIGHT, HAZARD WARNING LIGHT

Trouble mode \ Check point	Fuse		Turn signal light SW	Hazard warning light SW	Flasher unit	Turn signal light bult	Cable harness
	F-8 (15A)	F-19 (10A)					
1-1. Turn signal lights inoperative		○ (1)	○ (3)		○ (2)		○ (4)
1-2. Turn signal lights flashes too quickly						○ (1)	○ (2)
1-3. Hazard warning lights inoperative	○ (1)			○ (2)			

NOTE: Figure in parenthesis "( )" indicates the order of inspection.

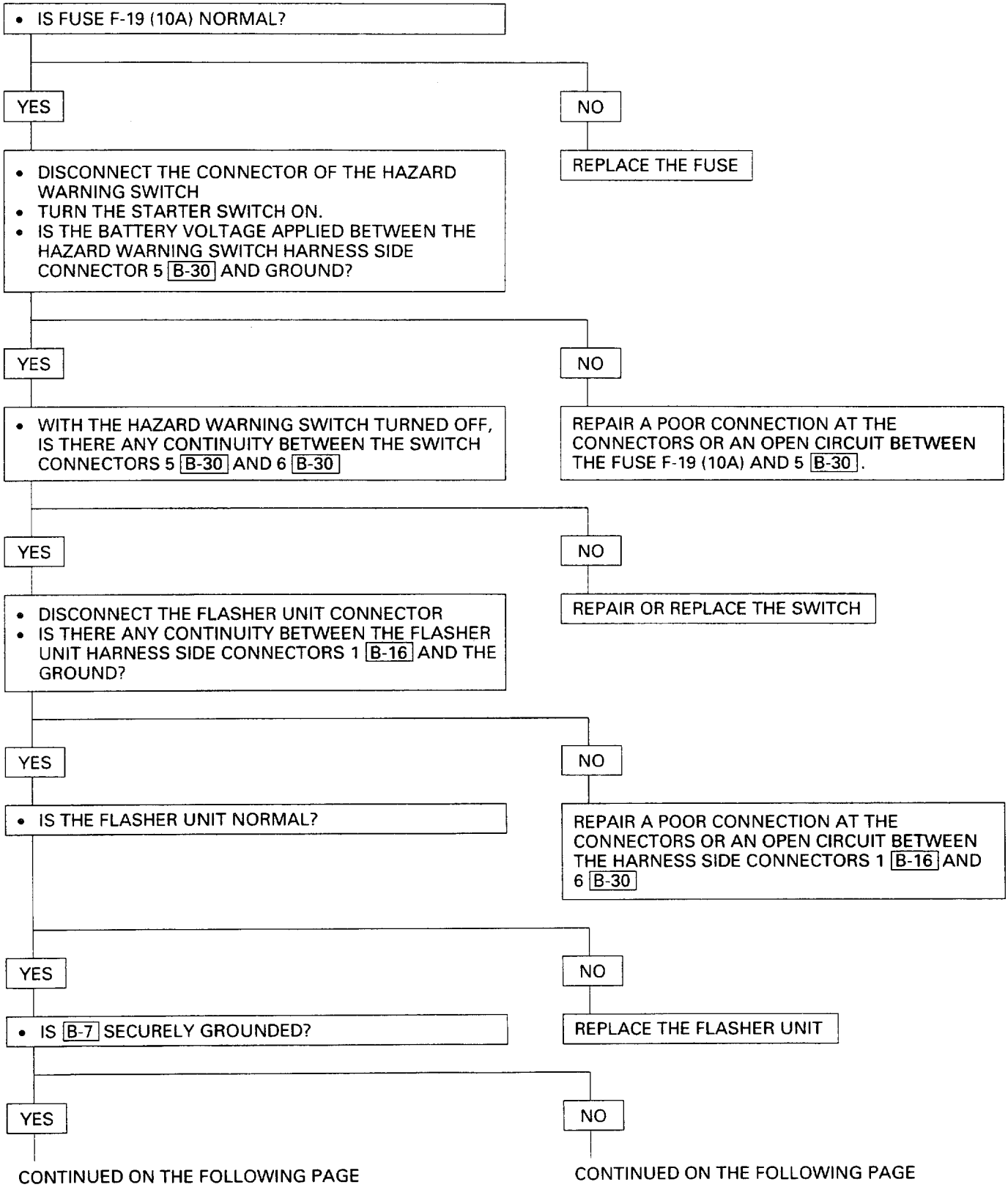
2. STOPLIGHT

Trouble mode \ Check point	Fuse F-10(10A):24V F-17(10A):12V	Stoplight SW	Stoplight bulb	Cable harness
2-1. Both stoplights inoperative	○ (1)	○ (2)		○ (3)
2-2. Stoplight on the left (or right) side inoperative			○ (1)	○ (2)

NOTE: Figure in parenthesis "( )" indicates the order of inspection.

1. TURN SIGNAL LIGHT, HAZARD WARNING LIGHT

1-1. TURN SIGNAL LIGHTS INOPERATIVE



CONTINUED FROM THE PREVIOUS PAGE

- IS THERE ANY CONTINUITY BETWEEN THE HARNESS SIDE CONNECTORS 3 [B-16] AND [B-7] ?

YES

- DISCONNECT THE COMBINATION SWITCH CONNECTOR
- IS THERE ANY CONTINUITY BETWEEN THE SWITCH CONNECTORS 5 [B-70] AND 12 [B-70] (WHEN TURNING LEFT), 13 [B-70] AND 12 [B-70] (WHEN TURNING RIGHT) RESPECTIVELY?

YES

- REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN THE HARNESS SIDE CONNECTORS 2 [B-16] (12V), 5 [B-16] (24V) AND 12 [B-70]

CONTINUED FROM THE PREVIOUS PAGE

GROUND IT SECURELY

NO

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN THE CIRCUIT

NO

REPAIR OR REPLACE THE SWITCH

1-2. TURN SIGNAL LIGHTS FLASHES TOO QUICKLY

- DOES ANY TURN SIGNAL LIGHT REMAIN UNLIGHTED?

YES

DISCONNECT AND REINSTALL THE BULB, OR REPLACE IT, OR REPAIR AN OPEN CIRCUIT IN THE CIRCUIT OF THE INOPERATIVE BULB, OR CHECK THE GROUND

1-3. HAZARD WARNING LIGHTS INOPERATIVE

- IS FUSE F-8 (15A) NORMAL?
  - NO → REPLACE THE FUSE
  - YES →
- DOES THE HAZARD WARNING LIGHT SWITCH FUNCTION NORMALLY?
  - NO → REPLACE THE HAZARD WARNING LIGHT SWITCH
  - YES →
- REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN FUSE F-8 (15A) AND 1 B-30

2. STOPLIGHT

2-1. BOTH STOPLIGHTS INOPERATIVE

- IS FUSE F-10 (10A) OR F-17 (10A) NORMAL?
  - NO → REPLACE THE FUSE
  - YES →
- IS J-9 GROUNDED SECURELY?
  - NO → GROUND IT SECURELY
  - YES →
- IS BATTERY VOLTAGE APPLIED TO THE 1 B-66 OF THE STOPLIGHT SW?
  - NO → REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN THE FUSE F-10 (10A) OR F-17 (10A) AND 1 B-66
  - YES →
- IS STOPLIGHT SWITCH IS NORMALLY?
  - NO → CONTINUED ON THE FOLLOWING PAGE
  - YES → CONTINUED ON THE FOLLOWING PAGE

CONTINUED FROM THE PREVIOUS PAGE

- DOES THE PUSH ROD OF THE STOPLIGHT SW OPERATE SMOOTHLY?

YES

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN 2 [B-66] AND [J-9]

CONTINUED FROM THE PREVIOUS PAGE

NO

REPLACE THE STOPLIGHT SW

2-2. STOPLIGHT ON THE LEFT (OR RIGHT)SIDE INOPERATIVE

- IS THE STOPLIGHT BULB ON THE LEFT (OR RIGHT) SIDE NORMAL?

YES

- IS THERE CONTINUITY BETWEEN THE STOPLIGHT CONNECTOR 2 [J-65] AND 11 [H-5] OR 2 [R-1] AND 2 [H-16] (2 [J-62] AND 11 [H-5] OR 2 [R-6] AND 2 [H-16])

YES

- REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN THE STOPLIGHT CONNECTOR 6 [J-65] AND [J-9] OR 6 [R-1] AND 7 [H-16] (6 [J-62] AND [J-9] OR 6 [R-6] AND 7 [H-16])

NO

REPAIR A POOR CONNECTION AT CONNECTORS OR AN OPEN CIRCUIT

NO

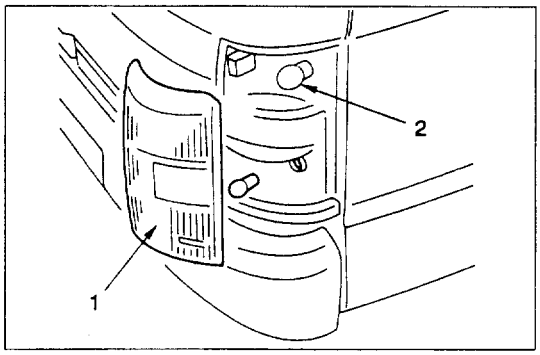
REPLACE THE BULB

NOTE: FIGURE IN PARENTHESIS "( )" INDICATE THE PLACE OF INSPECTION FOR THE RIGHT SIDE STOPLIGHT.

STARTER SWITCH

Refer to "START AND CHARGING" in this section.

FRONT TURN SIGNAL LIGHT/BULB



REMOVAL

Preparation:

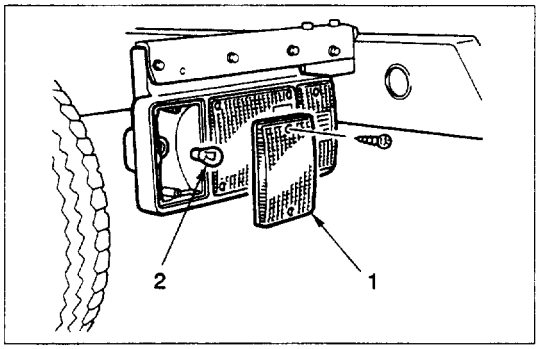
Disconnect the battery ground cable.

1. **Front Combination Light Lens**
   Remove four screws.
2. **Bulb**

INSTALLATION

To install, follow the removal steps in the reverse order.

REAR TURN SIGNAL LIGHT/BULB



REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Lens**
2. **Bulb**

INSTALLATION

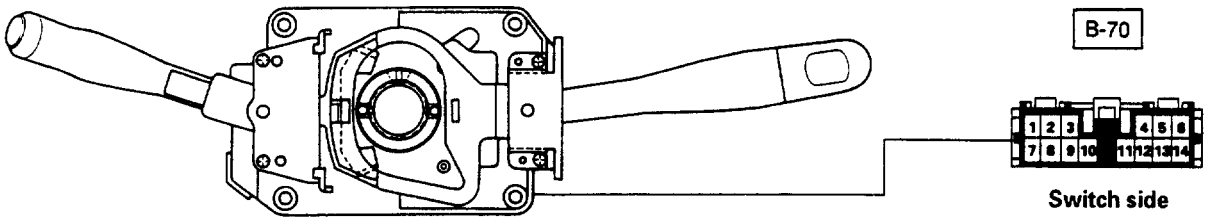
To install, follow the removal steps in the reverse order.

TURN SIGNAL LIGHT SWITCH (COMBINATION SWITCH)

INSPECTION

Check the continuity between the terminals of the turn signal light switch.

Repair or replace the switch when the result of inspection is found abnormal.

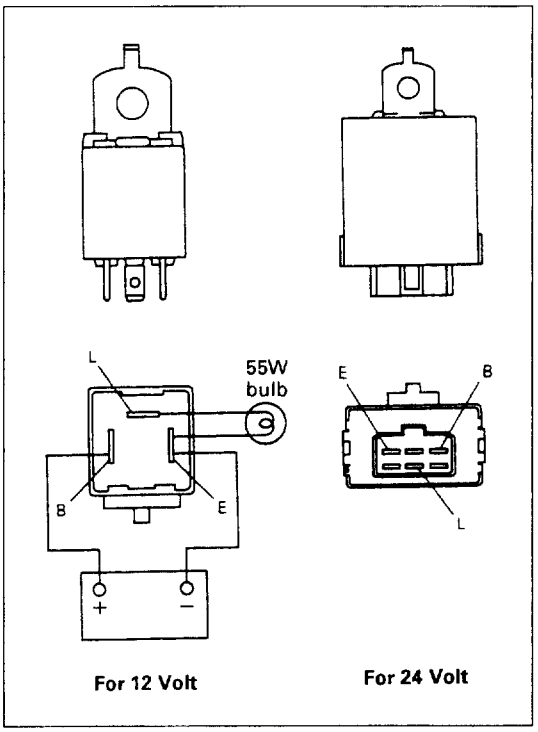


SW position \ Terminal No.		2	5	9	11	12	13
Turn signal light SW	Turning left		○			○	
	Neutral						
	Turning right					○	○

REMOVAL AND INSTALLATION

Refer to "HEADLIGHT, FOG LIGHT AND CORNERING LIGHT" in this section.

FLASHER UNIT



INSPECTION

When a 55W bulb is connected to the unit side terminals "L" and "E" while connecting the battery (+) terminal to terminal "B", and the battery (–) terminal to terminal "E" does the bulb light on and off?

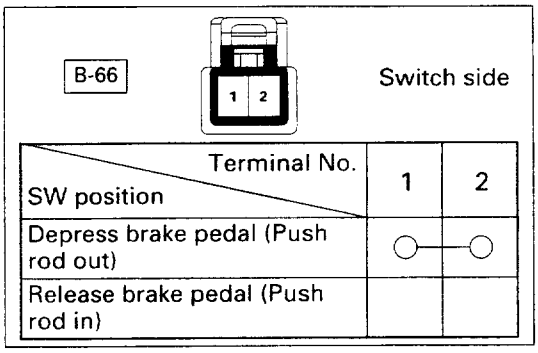
Replace the unit when the result of inspection is found abnormal.

STOPLIGHT BULB

REMOVAL AND INSTALLATION

Refer to "CLEARANCE LIGHT, TAILLIGHT, LICENSE PLATE LIGHT AND ILLUMINATION LIGHT" for TAILLIGHT BULB removal and installation steps in this section.

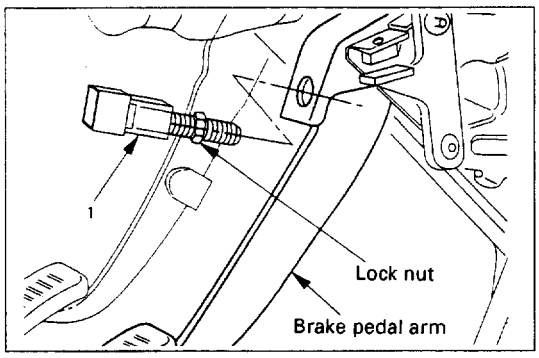
STOPLIGHT SWITCH



INSPECTION

1) Check to see if the stoplight switch is installed correctly to the specified position. Adjust the position when the result of the inspection is found abnormal.
2) Check to see if there is any continuity between the terminals of the stoplight switch.

   Replace the switch when the result of inspection is found abnormal.

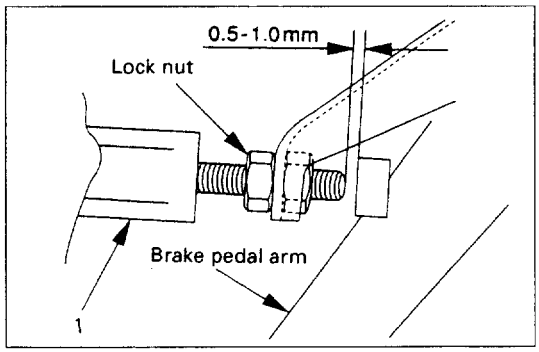


REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Stoplight Switch**
   1) Disconnect the connector.
   2) Loosen the lock nut of the switch.
   3) Remove the switch by turning it.

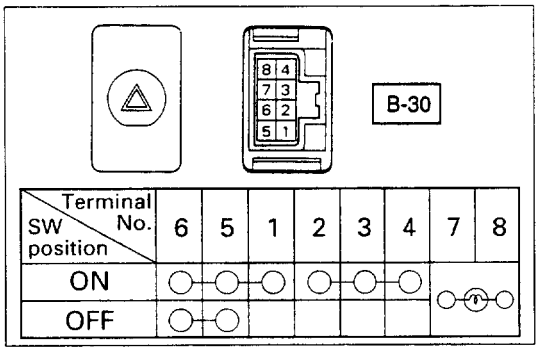


INSTALLATION

To install, follow the removal steps in the reverse order, noting the following points.

1) Check to see if the brake pedal has been returned by the return spring to the specified position.
2) Turn the stoplight switch clockwise until the tip of the threaded portion of the switch contacts the pedal arm.
3) Turn the switch counterclockwise until the space between the tip of the threaded portion and the pedal arm is 0.5 to 1.0mm (0.02 – 0.04in.)

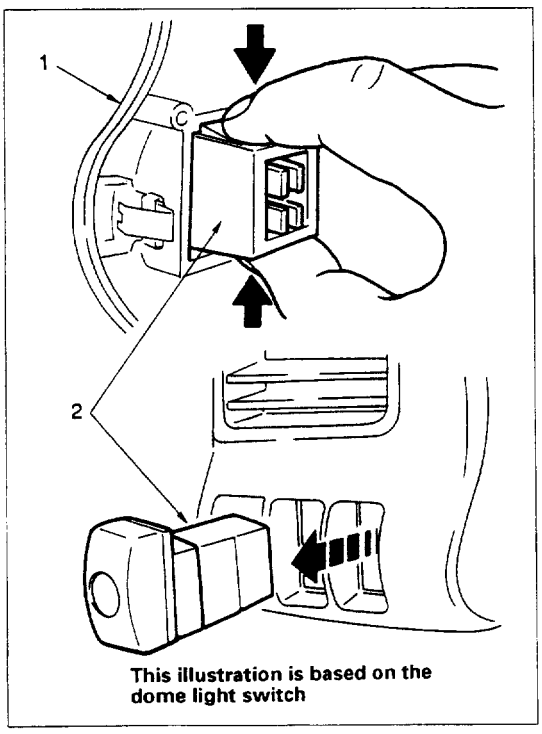
HAZARD WARNING SWITCH



INSPECTION

Check the continuity between the terminals of the hazard warning switch.

Repair or replace the switch when the result of inspection is found abnormal.



This illustration is based on the dome light switch

REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Meter cluster**

   Refer to the "METER AND WARNING/INDICATOR LIGHT" in this section.

2. **Hazard Warning Switch**

   Release the lock pushing the switch from the back side of the meter cluster.

INSTALLATION

To install, follow the removal steps in the reverse order noting the following point.

1. Push the switch with your fingers until locks securely.

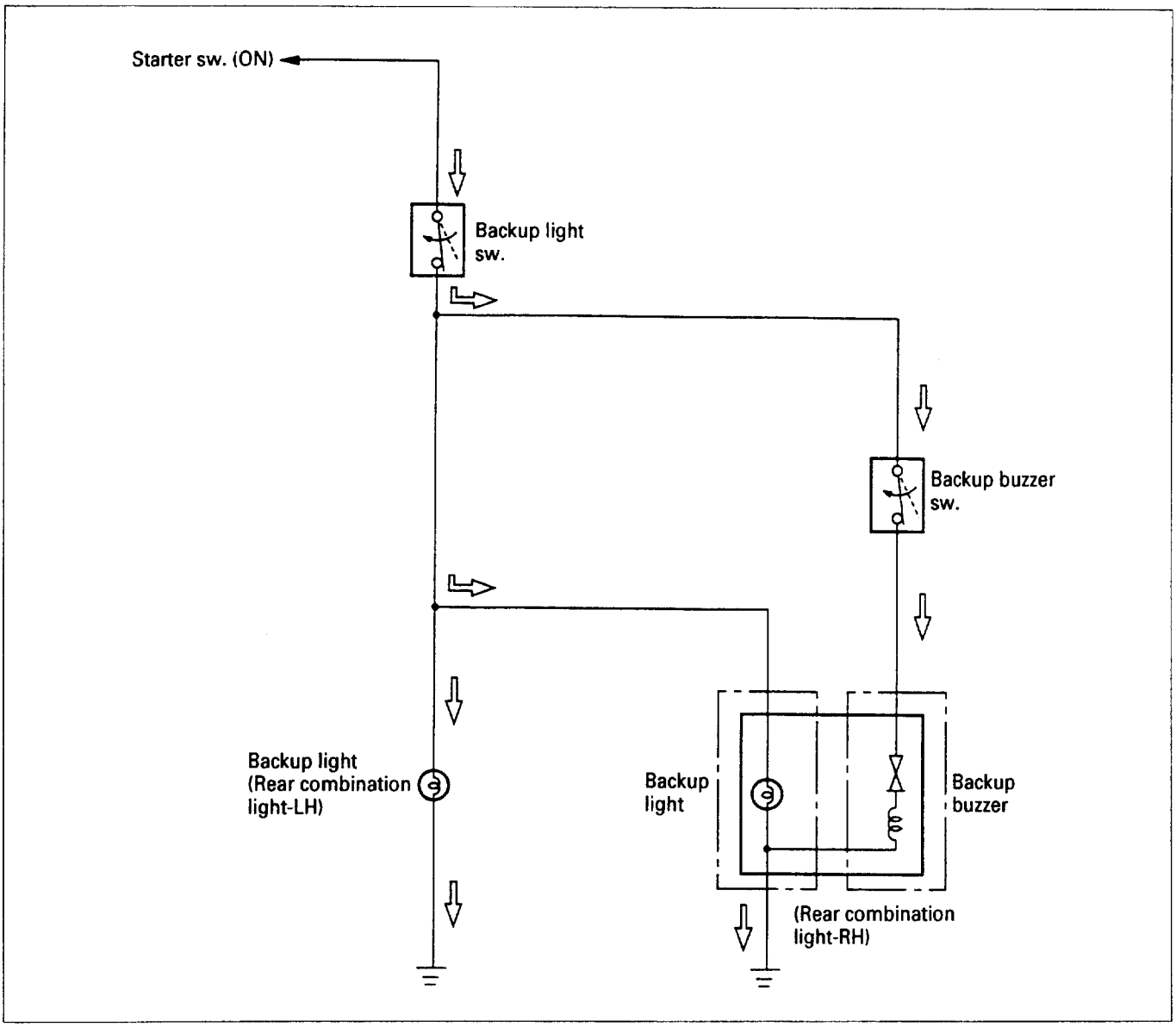
HORN, BACKUP LIGHT AND BACKUP BUZZER

GENERAL DESCRIPTION

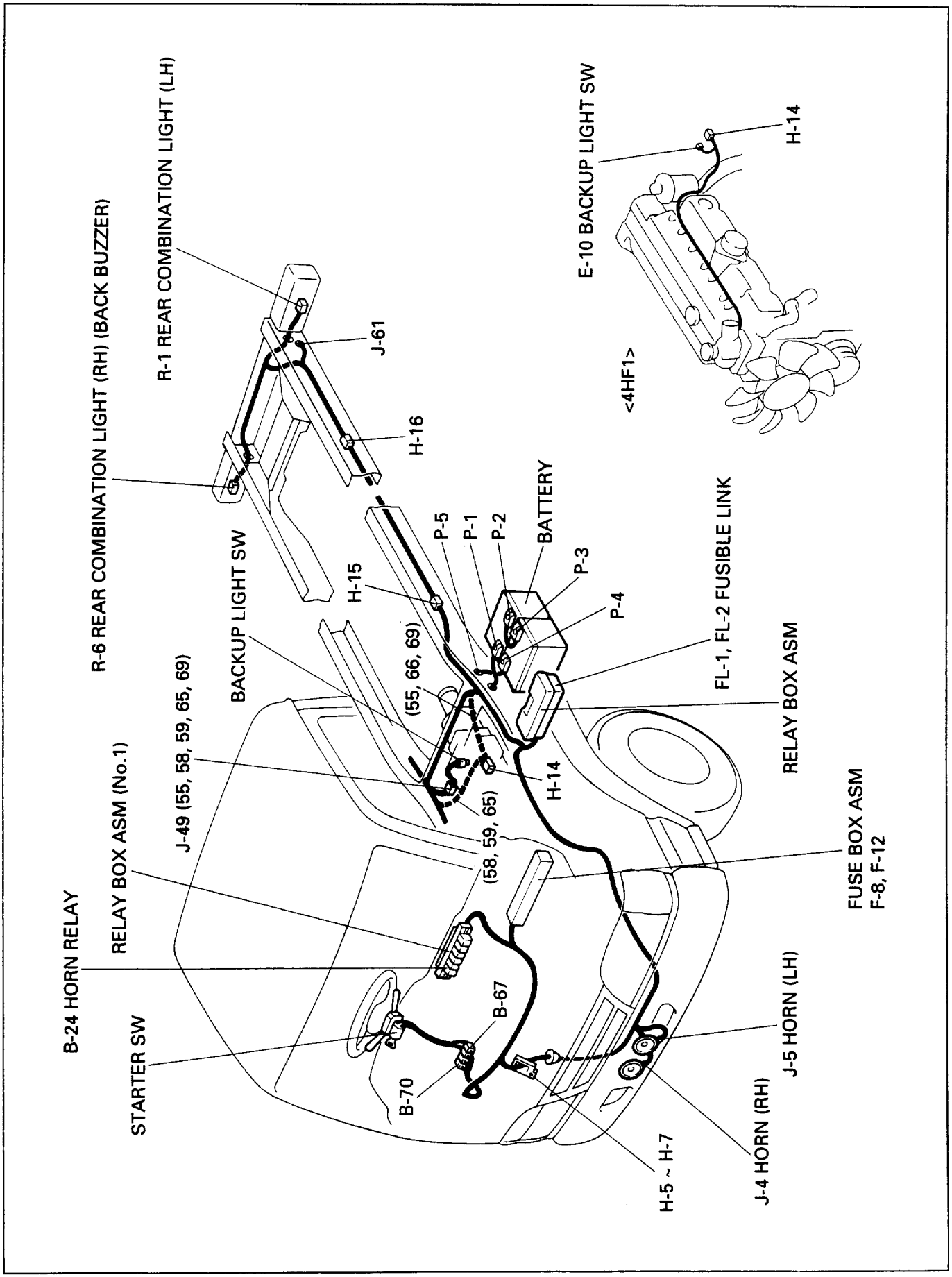
The circuit consists of the starter switch, horn, horn switch, backup light (Rear combination light), backup light switch, back buzzer and the relay.

When the horn switch is turned on independent of the position of the starter switch, the relay is activated to sound the horn. When the backup light switch turns on with the starter switch on, the backup light will operate.

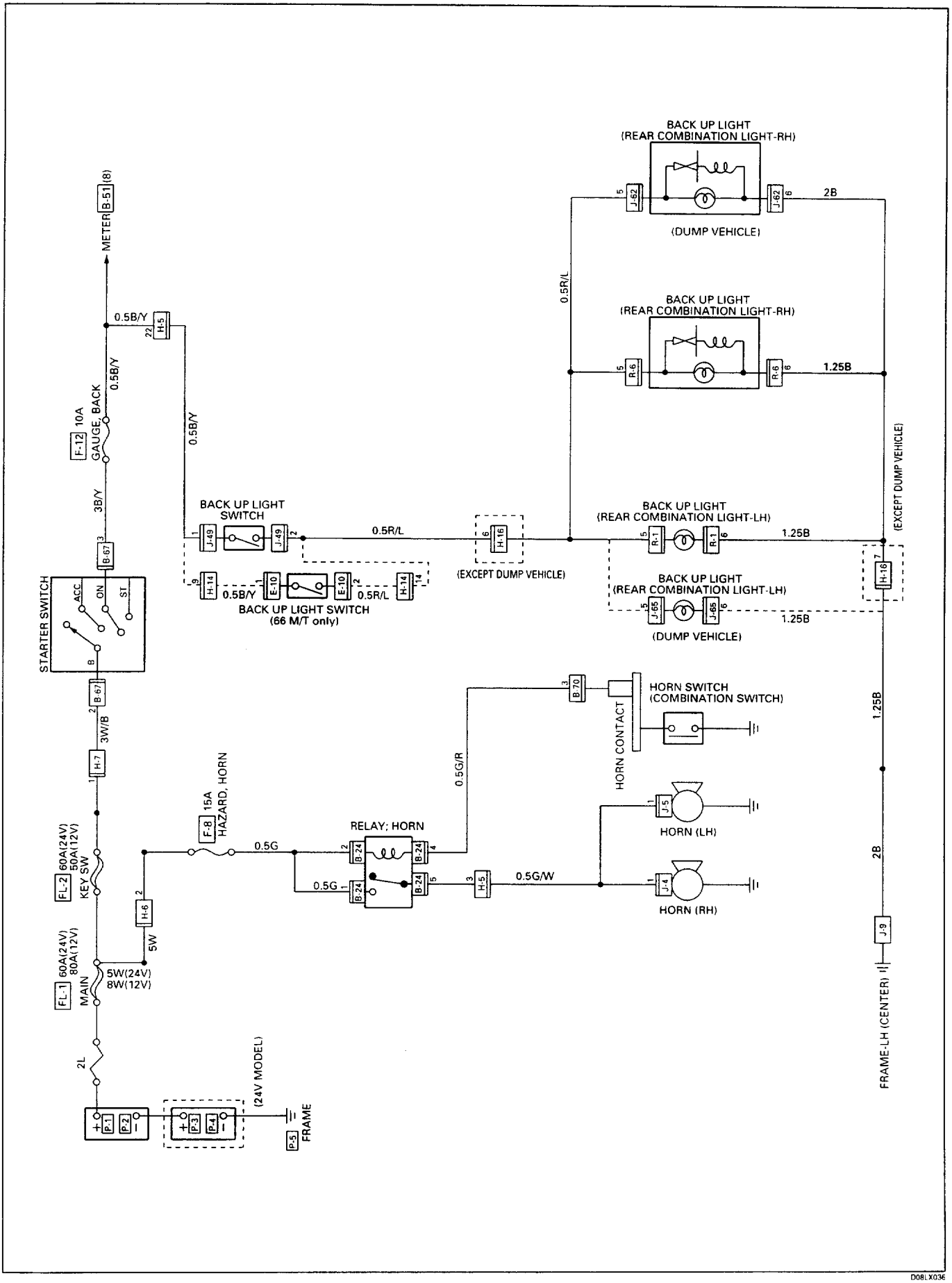
BACKUP LIGHT AND BACKUP BUZZER CIRCUIT



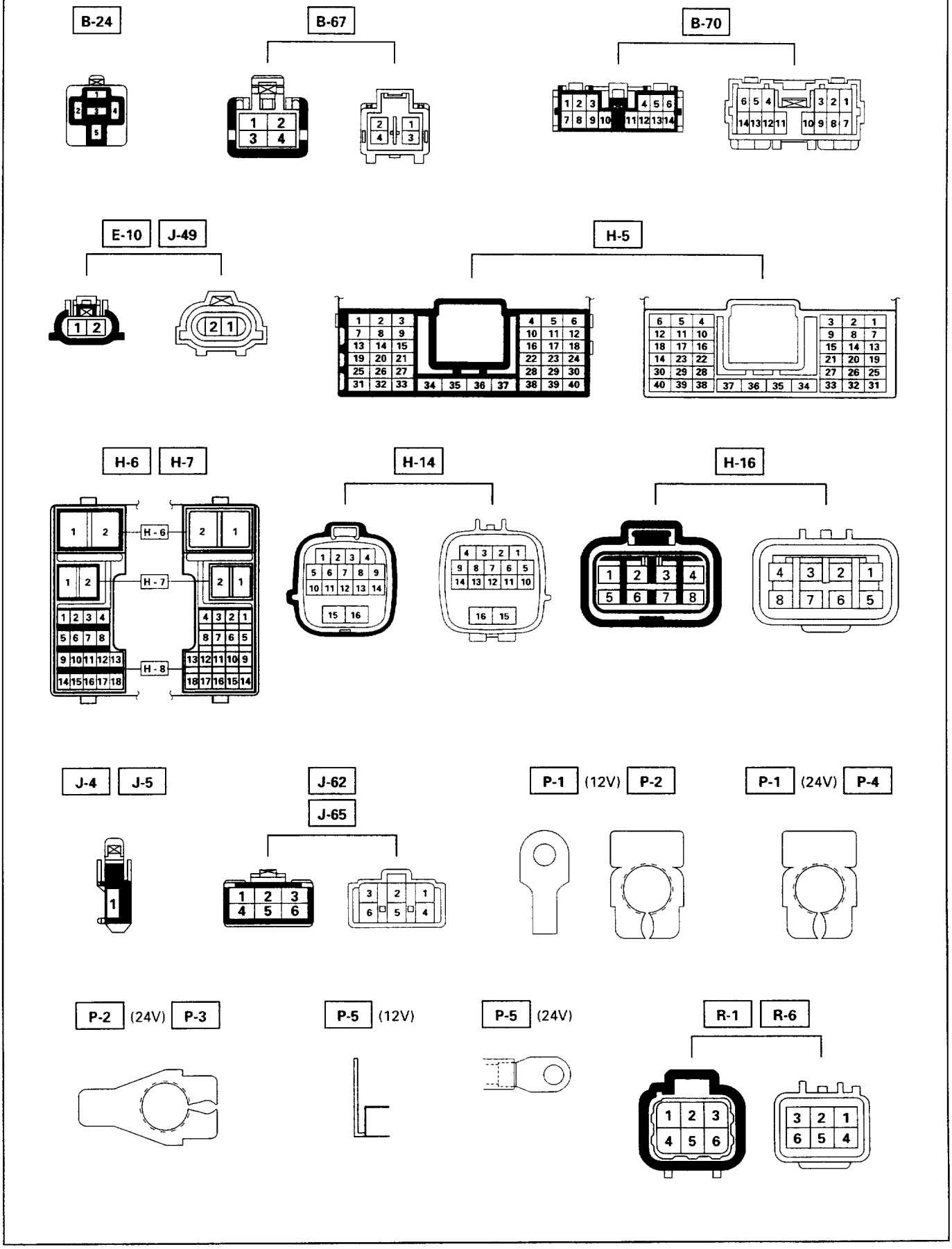
PARTS LOCATION



CIRCUIT DIAGRAM



CONNECTOR LIST



DIAGNOSIS

QUICK CHART FOR CHECK POINT

1. HORN

Trouble mode \ Check point	Fuse F-8 (15A)	Horn	Horn SW	Horn relay	Horn contact	Cable harness
1-1. Horn does not sound	○ (1)	○ (4)	○ (6)	○ (2)	○ (5)	○ (3)
1-2. Horn does not shut off			○ (2)	○ (1)		○ (3)

NOTE: Figure in parenthesis "( )" indicates the order of inspection.

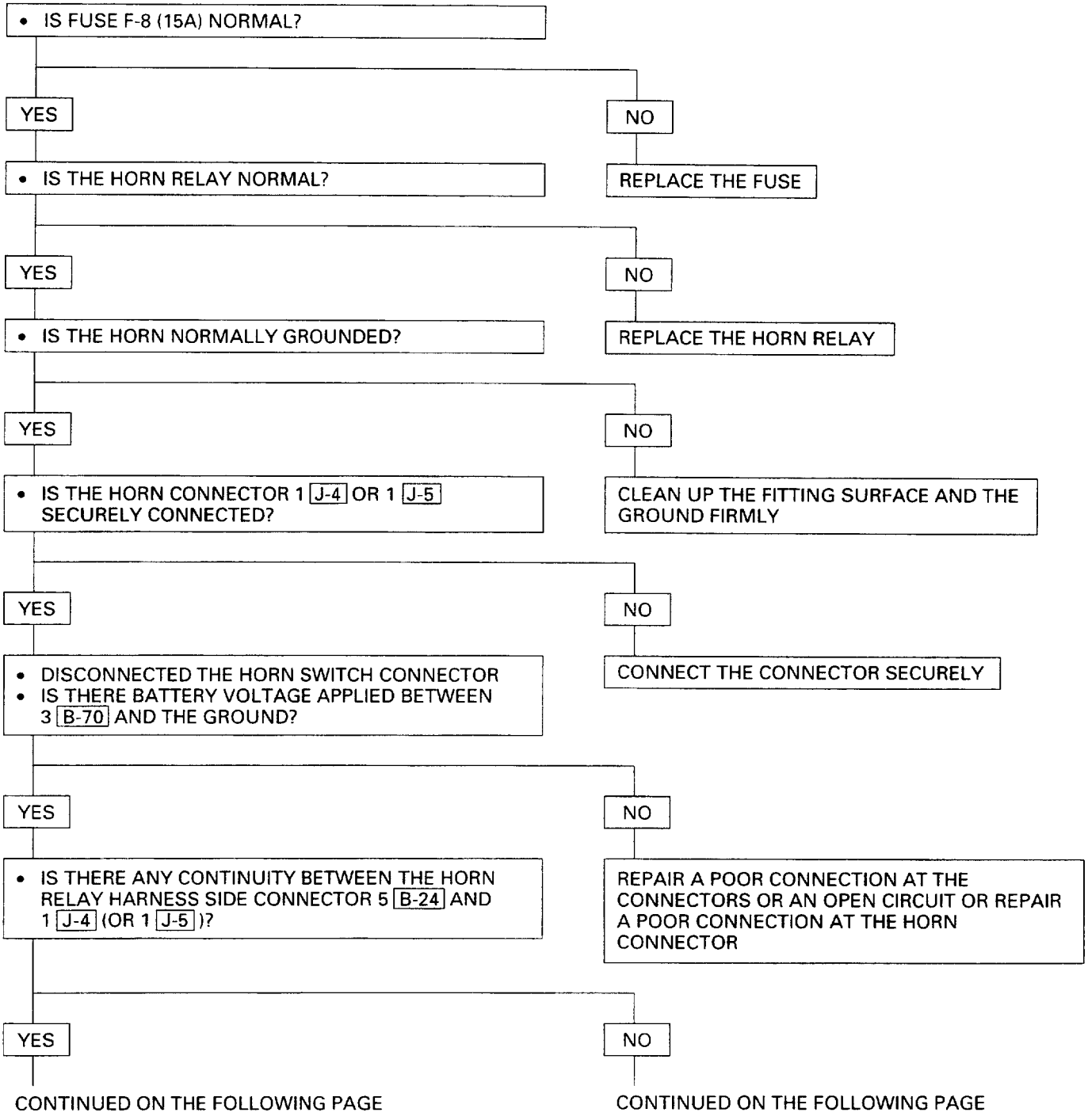
2. BACKUP LIGHT

Trouble mode \ Check point	Fuse F-12 (10A)	Backup light SW (Inhibitor SW)	Backup light bulb	Backup buzzer	Cable harness
2-1. Both backup lights inoperative	○ (1)	○ (3)			○ (2)
2-2. Backup light on the left (or right) side inoperative			○ (1)		○ (2)
2-3. Backup light remains on		○ (1)			

NOTE: Figure in parenthesis "( )" indicates the order of inspection.

1. HORN

1-1. HORN DOES NOT SOUND



CONTINUED FROM THE PREVIOUS PAGE

- DOES THE HORN SOUND WHEN CONNECTING THE BATTERY (+) TERMINAL TO THE HORN CONNECTOR 1 [J-4] (1 [J-5]), AND (–) TERMINAL TO THE HORN BRACKET?

NO

PEPLACE THE HORN

CONTINUED FROM THE PREVIOUS PAGE

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT IN THE CIRCUIT

1-2. HORN DOES NOT SHUT OFF

- IS THE HORN RELAY NORMAL?

YES

- REMOVE THE HORN SW
- IS THE MOVABLE PORTION OF THE HORN SW ALWAYS OUT OF CONTACT WITH THE GROUND BRACKET?

YES

REPAIR A SHORT CIRCUIT BETWEEN HORN RELAY HARNESS SIDE CONNECTOR 4 [B-24] AND 3 [B-70]

NO

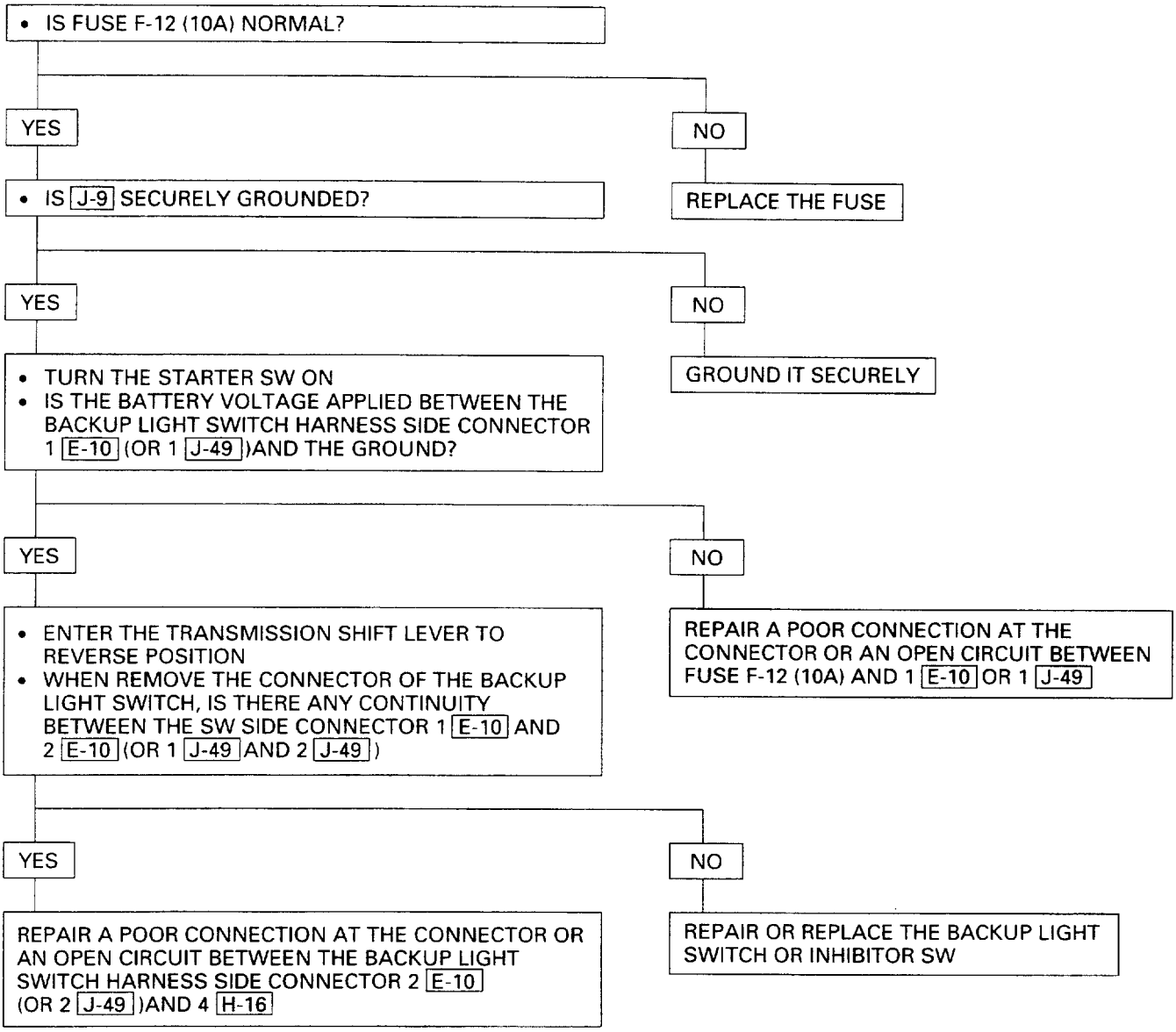
REPLACE THE HORN RELAY

NO

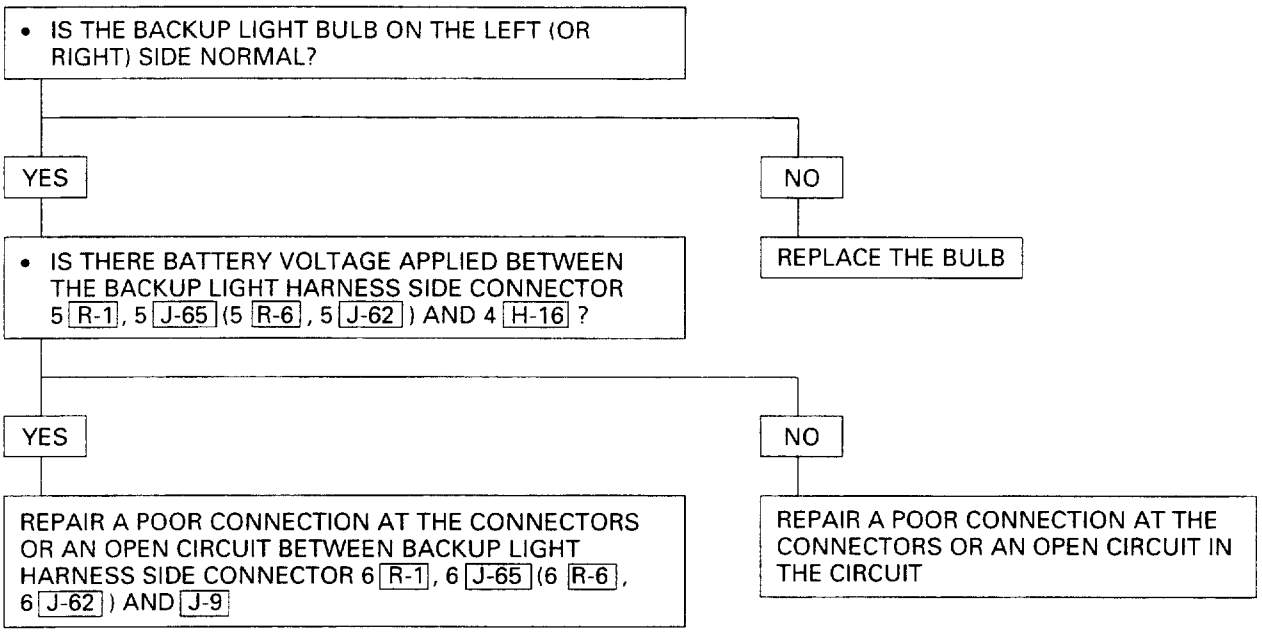
REPAIR OR REPLACE THE HORN SW

2. BACKUP LIGHT

2-1. BACKUP LIGHTS INOPERATIVE



2-2. BACKUP LIGHT ON THE LEFT (OR RIGHT)SIDE INOPERATIVE



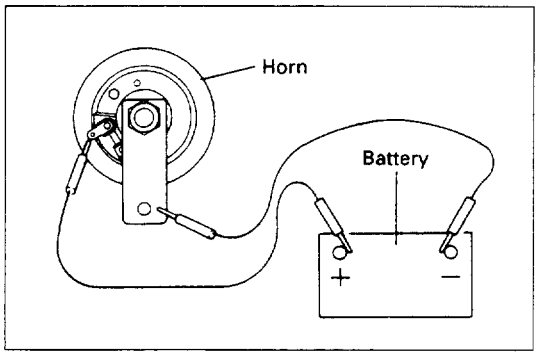
2-3. BACKUP LIGHT REMAINS ON

REPAIR OR REPLACE THE BACKUP LIGHT SW OR INHIBITOR SW

STARTER SWITCH

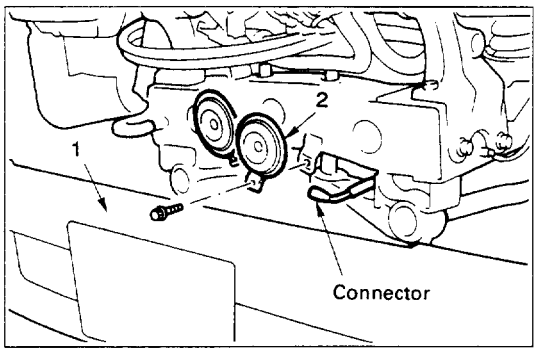
Refer to "START AND CHARGING" in this section.

HORN



INSPECTION

Check to see if horn sound when a battery voltage between horn terminal and the fixing bracket. Repair or replace the horn when the result of inspection is found abnormal.



REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Bumper**

   Refer to "BUMPER" in section 2B.

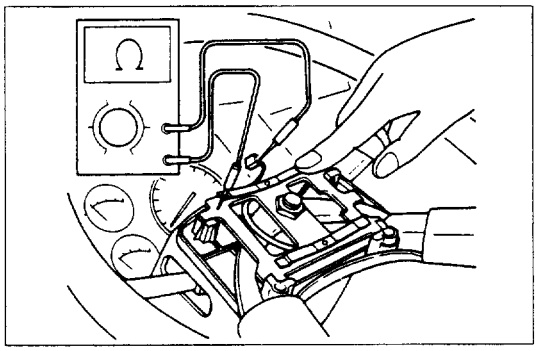
2. **Horn**

   Disconnect the connector.

INSTALLATION

To install, follow the removal steps in the reverse order.

HORN SWITCH

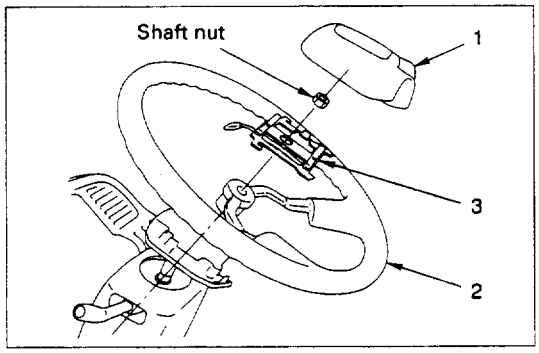


INSPECTION

With the contact point of the horn switch pressed to the switch bracket, check the continuity between the connector terminal and the bracket of the switch.

Check the contact condition between horn contact of the combination switch and contact plate of steering wheel.

Repair or replace the switch when the result of inspection is found abnormal.



REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Horn Pad**

   1) Hold the horn pad and pull it upward.

2. **Steering Wheel**

   1) Remove the steering shaft nut.
   2) Remove the steering wheel by using steering wheel remover.

      (Refer to Section 3D "STEERING COLUMN" for steering wheel removal steps.)

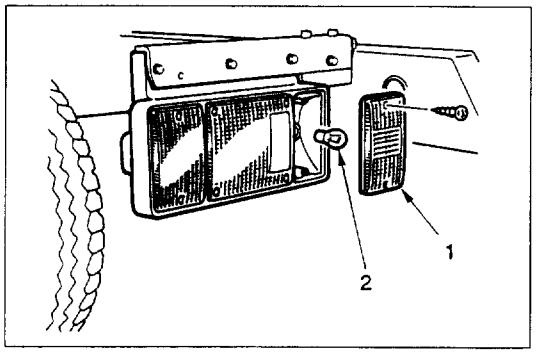
3. **Horn Switch**

INSTALLATION

To install, follow the removal steps in the reverse order, noting the following point.

1. Tighten the steering shaft nut to the specified torque

Shaft nut torque	N·m (kg·m/lb·ft)
	49 (5/36)



BACKUP LIGHT BULB

REMOVAL

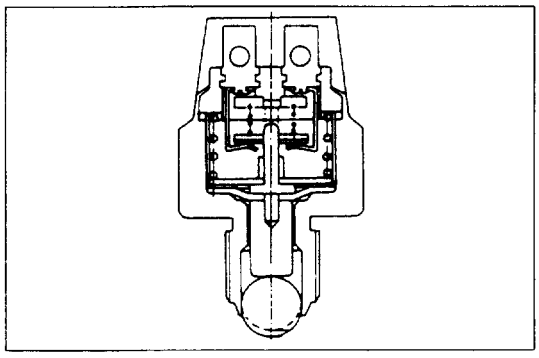
Preparation:

Disconnect the battery ground cable.

1. **Lens**
2. **Bulb**

INSTALLATION

To install, follow the removal steps in the reverse order.



BACKUP LIGHT SWITCH

INSPECTION

1. With the switch installed to the transmission, check the continuity between the terminals of the switch connectors.

   When the continuity is found between the terminals only with the switch shifted to the reverse position, the switch is normal.
2. When the result of the above inspection is found abnormal, remove the switch from the transmission and conduct a test on the switch alone.

   If the continuity appears between the connector terminals when the ball of the switch is pushed, the switch is normal. (When the ball is released, the continuity disappears.)
3. If there is no continuity with the switch installed to the transmission, even though the switch is found to be normal, then adjust the stroke of the switch by changing the thickness of the switch gasket.

REMOVAL

Preparation:

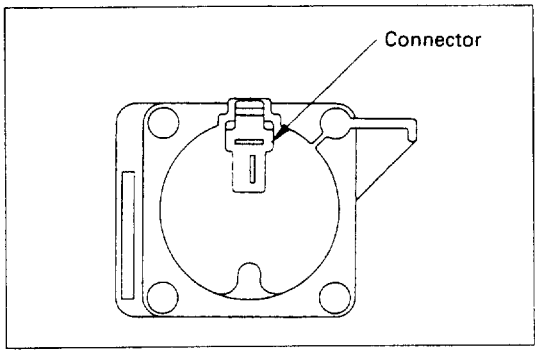
Disconnect the battery ground cable.

1. **Backup Light Switch**
   1) Disconnect the connectors.
   2) Remove the switch by turning it counterclockwise.

INSTALLATION

1. **Backup Light Switch**

   Apply liquid gasket to the screw portion of the switch to prevent oil leak.

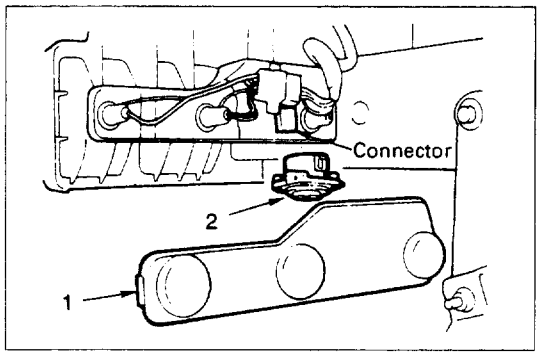


BACKUP BUZZER

INSPECTION

Apply battery voltage to the backup buzzer connector to check the buzzer sound.

Repair or replace the buzzer when the result of inspection is found abnormal.



REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Rear Combination Light Cover**
2. **Backup Buzzer**
   1) Remove the rear combination light connector fixing screw.
   2) Remove buzzer fixing screw.
   3) Disconnect the connector.

INSTALLATION

To install, follow the removal steps in the reverse order.

DOME LIGHT AND BACKUP BUZZER

GENERAL DESCRIPTION

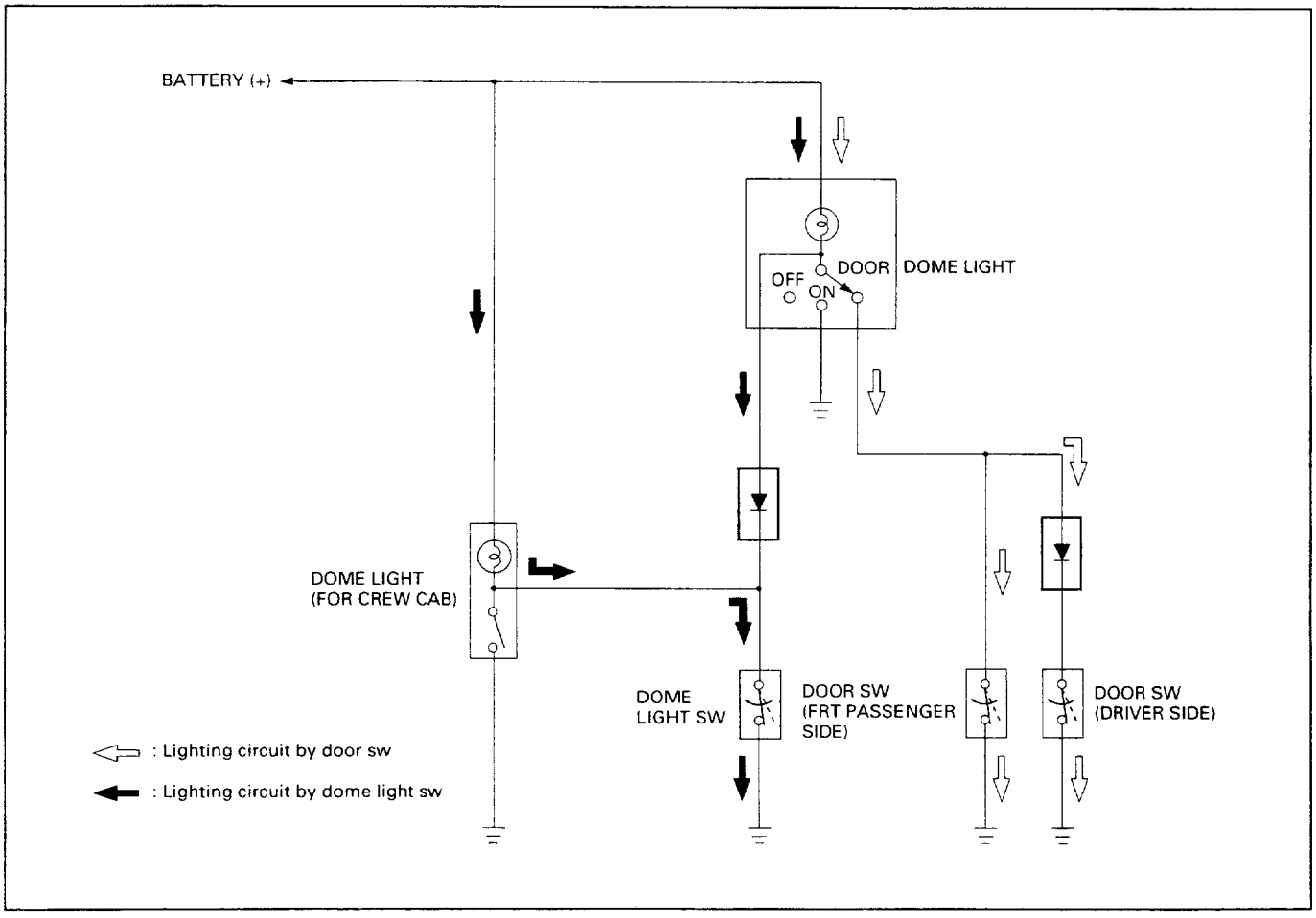
The circuit consists of the starter switch, dome light, dome light switch, door switch, backup light switch and the backup buzzer.

The dome light lights up when the left or right side door is opened with the switch set at the door mode. It can be lit by operating ON or OFF of the dome light switch.

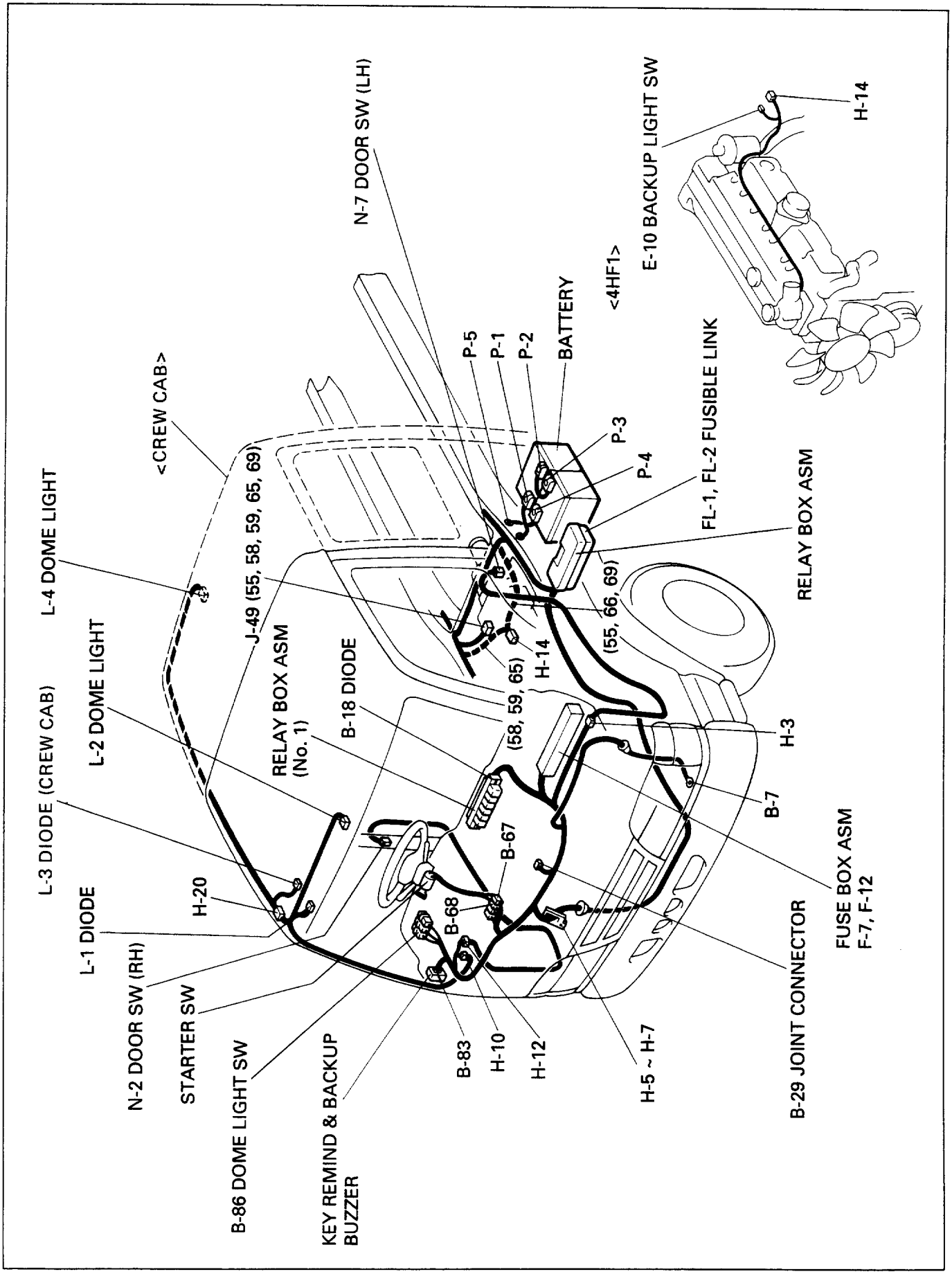
The dome light can be lit by respective switch independent of the position of the starter switch.

By operating the dome light switch fitted on the instrument panel, the dome light can be lit indpendent of the switch position of dome light.

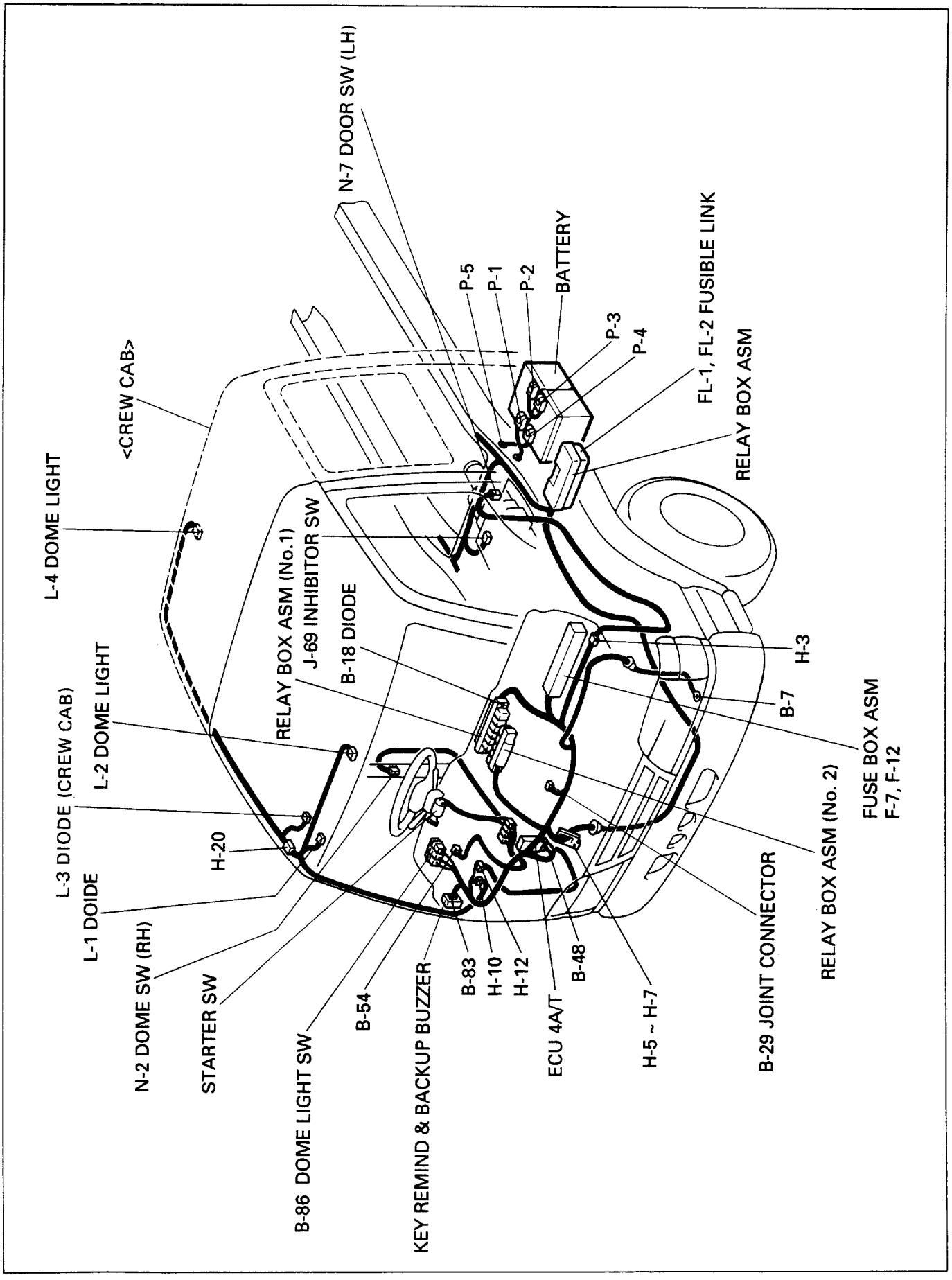
LIGHTING CIRCUIT



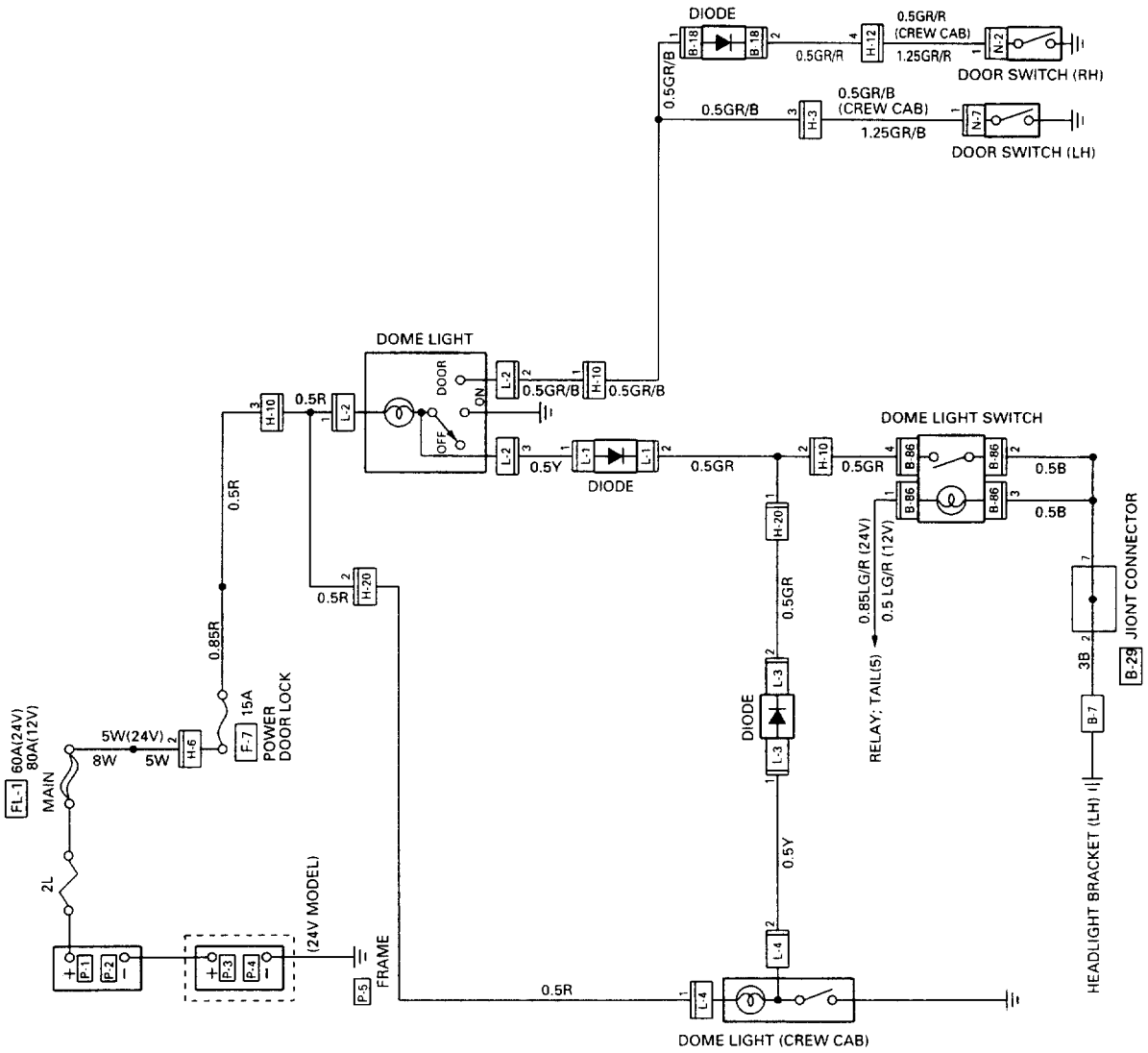
PARTS LOCATION – EXCEPT 24 VOLT·A/T



PARTS LOCATION – FOR 24 VOLT·A/T

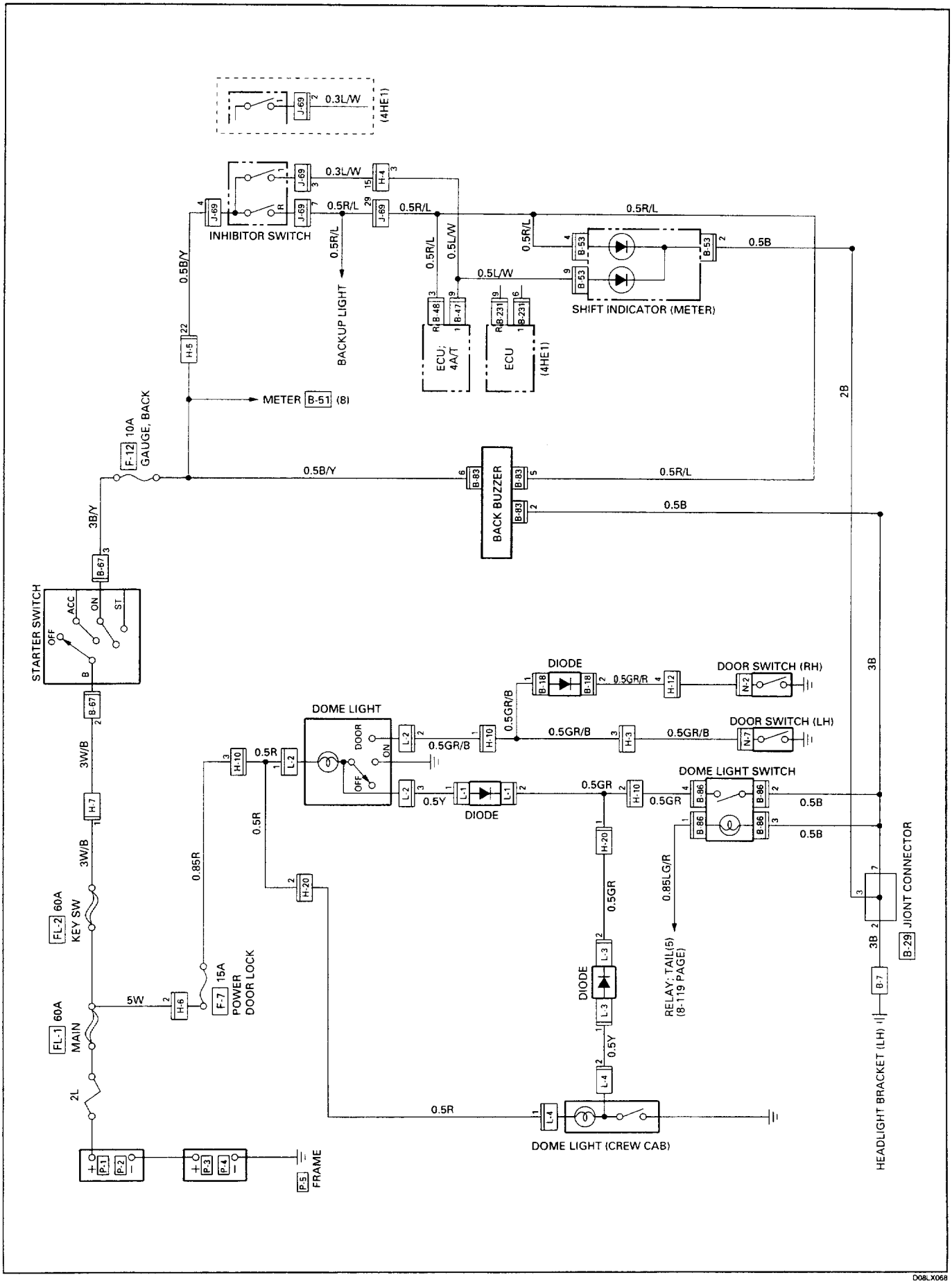


CIRCUIT DIAGRAM – EXCEPT 24 VOLT·A/T



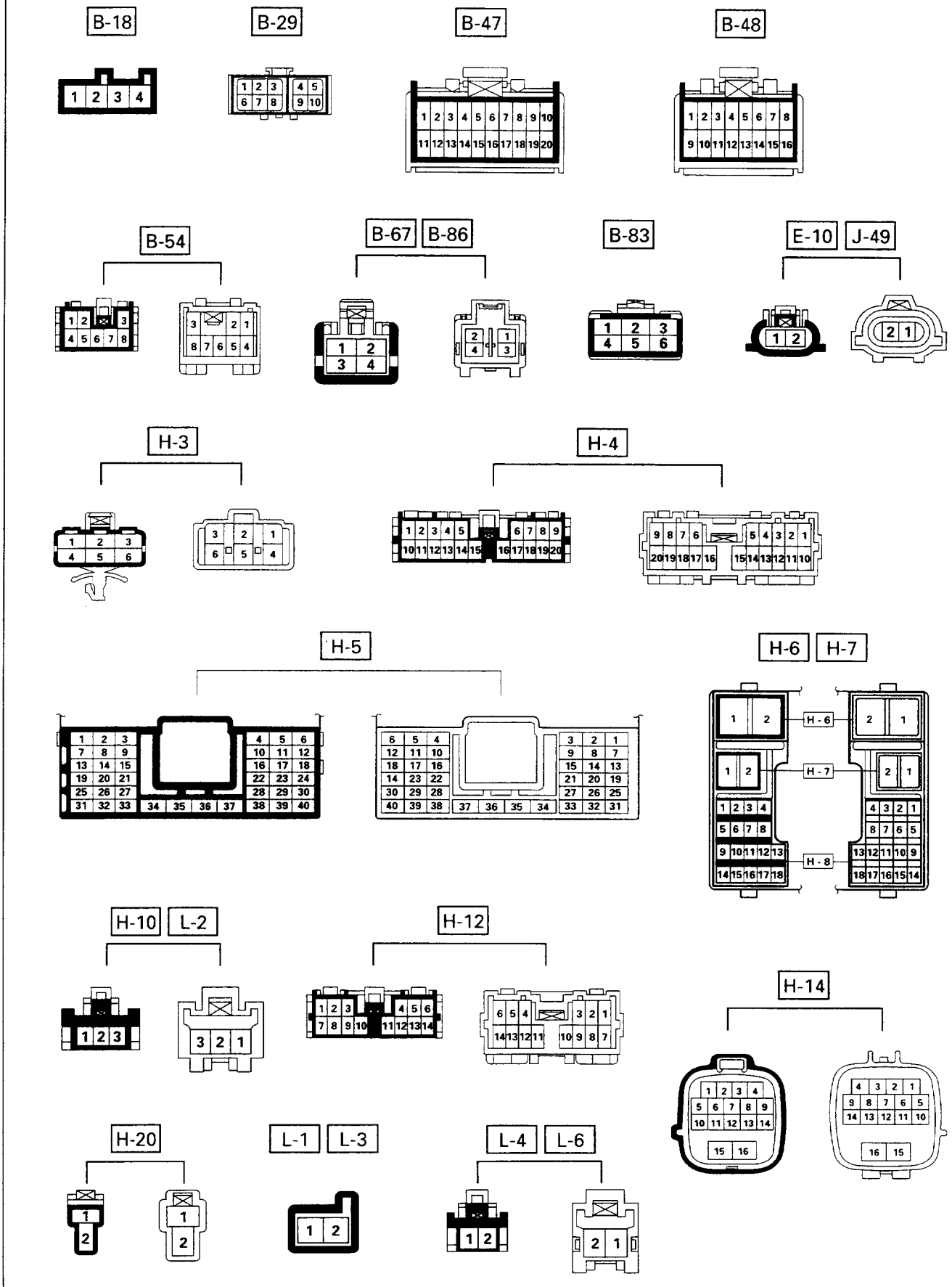
D08LX052

CIRCUIT DIAGRAM – FOR 24 VOLT·A/T



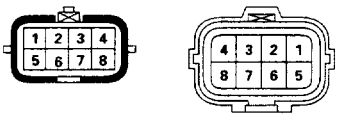
D08LX068

CONNECTOR LIST



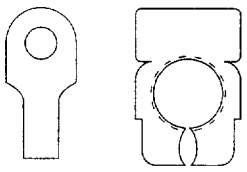
CONNECTOR LIST

J-69

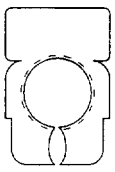


N-2 N-7

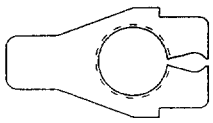
P-1 (12V) P-2



P-1 (24V) P-4

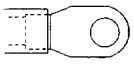


P-2 (24V) P-3

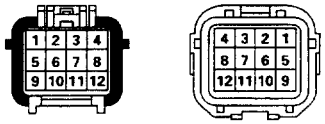


P-5 (12V)

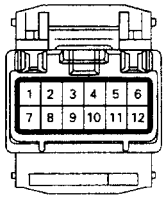
P-5 (24V)



J-69



B-231

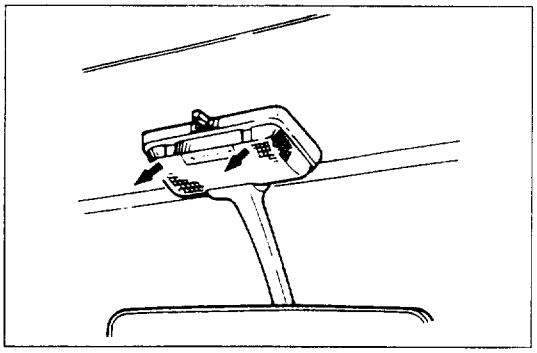


STARTER SWITCH
KEY CYLINDER SWITCH

Refer to "START AND CHARGING" in this section.

BACKUP LIGHT SWITCH

Refer to "HORN, BACKUP LIGHT AND BACKUP BUZZER" in this section.



DOME LIGHT BULB

REMOVAL

Preparation:

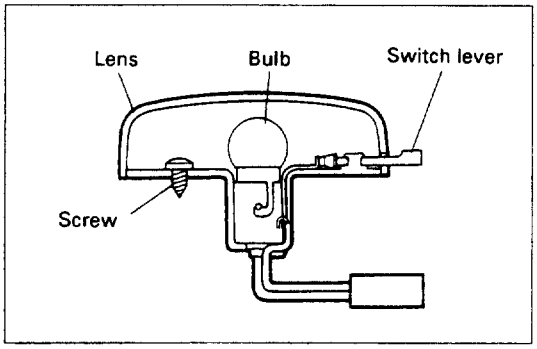
Disconnect the battery ground cable.

1. **Lens**

   Hold the lens and pull it downward.
2. **Bulb**

INSTALLATION

To install, follow the removal steps in the reverse order.



DOME LIGHT BULB (FOR CREW CAB)

REMOVAL

Preparation:

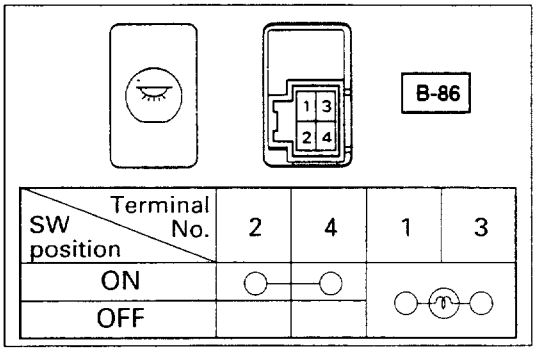
Disconnect the battery ground cable.

1. **Lens**

   Hold the lens and pull it down.
2. **Bulb**

INSTALLATION

To install, follow the removal steps in the reverse order.

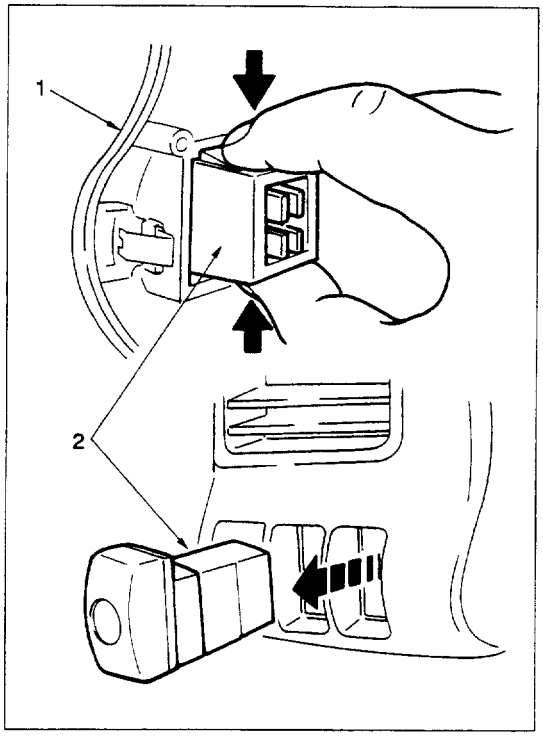


DOME LIGHT SWITCH

INSPECTION

Check the continuity between the dome light switch connector terminals.

Repair or replace the switch when the result of inspection is found abnormal.



REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Meter cluster**

   Refer to the "METER AND WARNING/INDICATOR LIGHT" in this section.

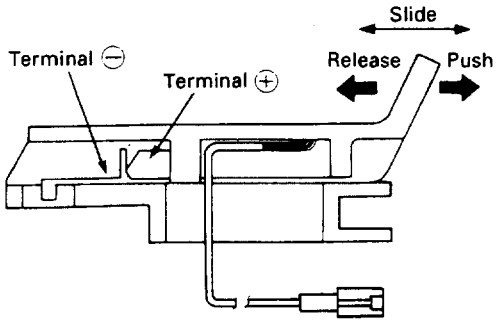
2. **Dome Light Switch**

   Release the lock pushing the switch from the back side of the meter cluster.

INSTALLATION

To install, follow the removal steps in the reverse order noting the following point.

1. Push the switch with your fingers until locks securely.



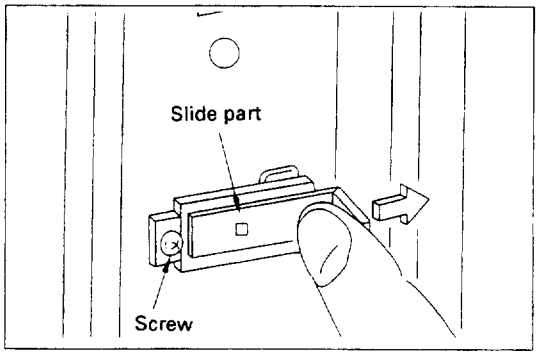
Connector No. / Terminal No. / SW operation	N-2	N-7
	1	Body
Push		
Release	○	○

DOOR SWITCH

INSPECTION

Check to see if there is any continuity between the terminals and the body while operating the door switch.

Repair or replace the switch, when the result of inspection is found abnormal.



REMOVAL

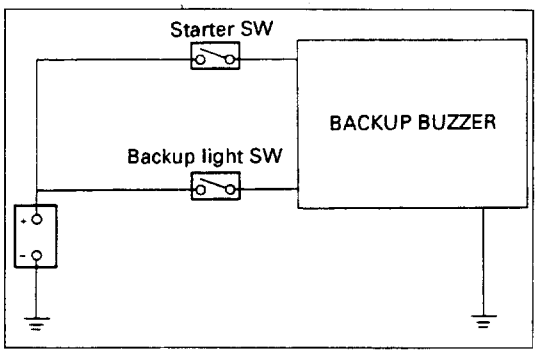
Preparation:

Disconnect the battery ground cable.

1. **Door Switch**
   1) Remove the screw.
   2) Disconnect the connector of the switch.

INSTALLATION

To install, follow the removal steps in the reverse order.



BACKUP BUZZER

Warning function	Operative conditions
Warning to reverse driving	When the transmission shift lever is engaged to the reverse position.

INSPECTION OF THE BUZZER CIRCUIT

Disconnect the backup buzzer connector, measure the continuity and voltage between the harness side connector terminals.

B-83

Harness side

Terminal No.	Wire color	Connected to	Item to be checked	Connecting terminal	Checking conditions	Standard
2	B	Ground	Continuity	2-Ground	–	Continuity
5	R/L	Backup light SW (Inhibitor SW)	Voltage	5-Ground	· Starter SW ON · Backup light SW (Inhibitor SW) ON	Approx. battery voltage
6	B/Y	Fuse F-12 (10A)		6-Ground	· Starter SW ON	Approx. battery voltage

POWER DOOR LOCK

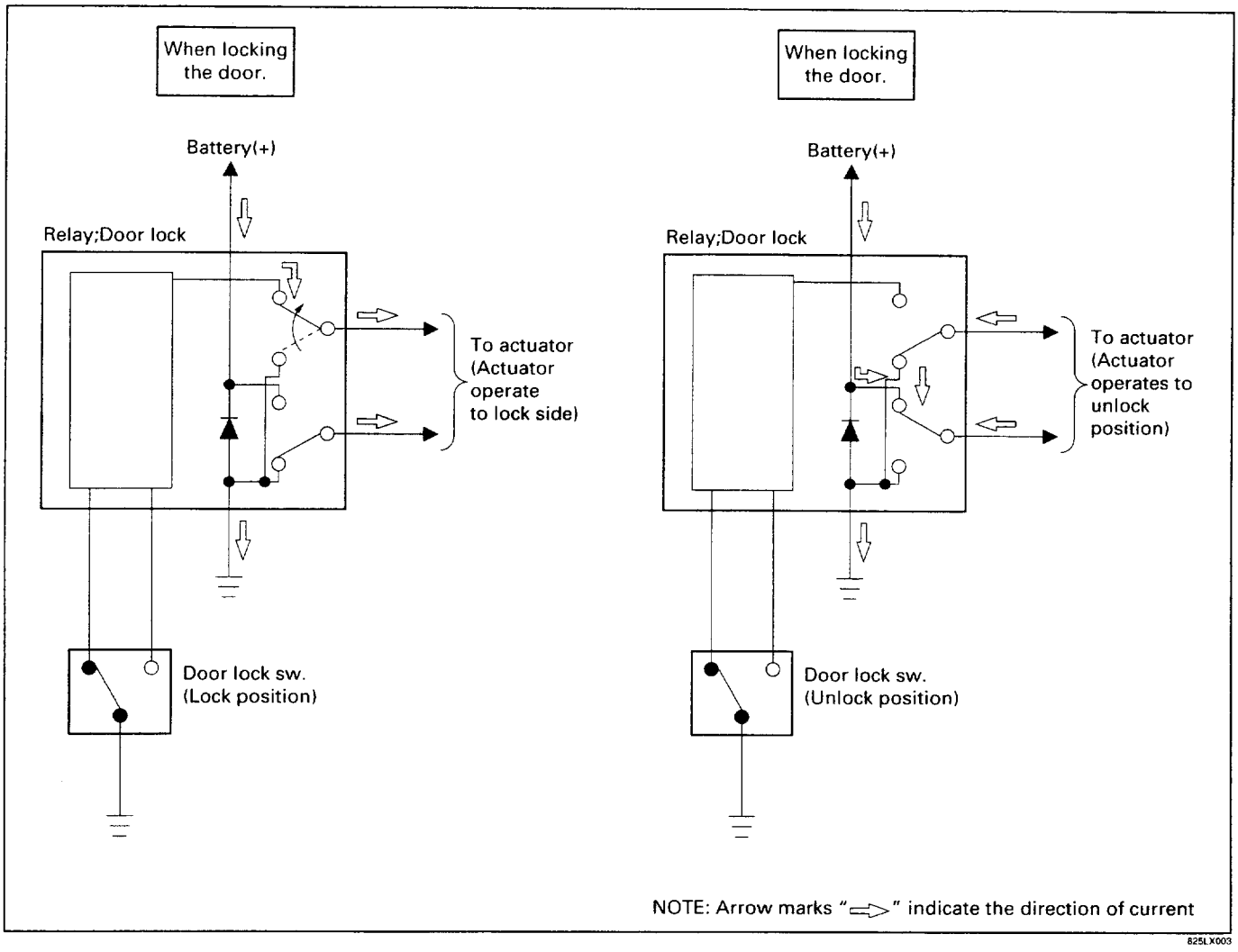
GENERAL DESCRIPTION

The circuit consists of the door lock switch, actuator for the front passenger door, rear doors and the door lock controller.

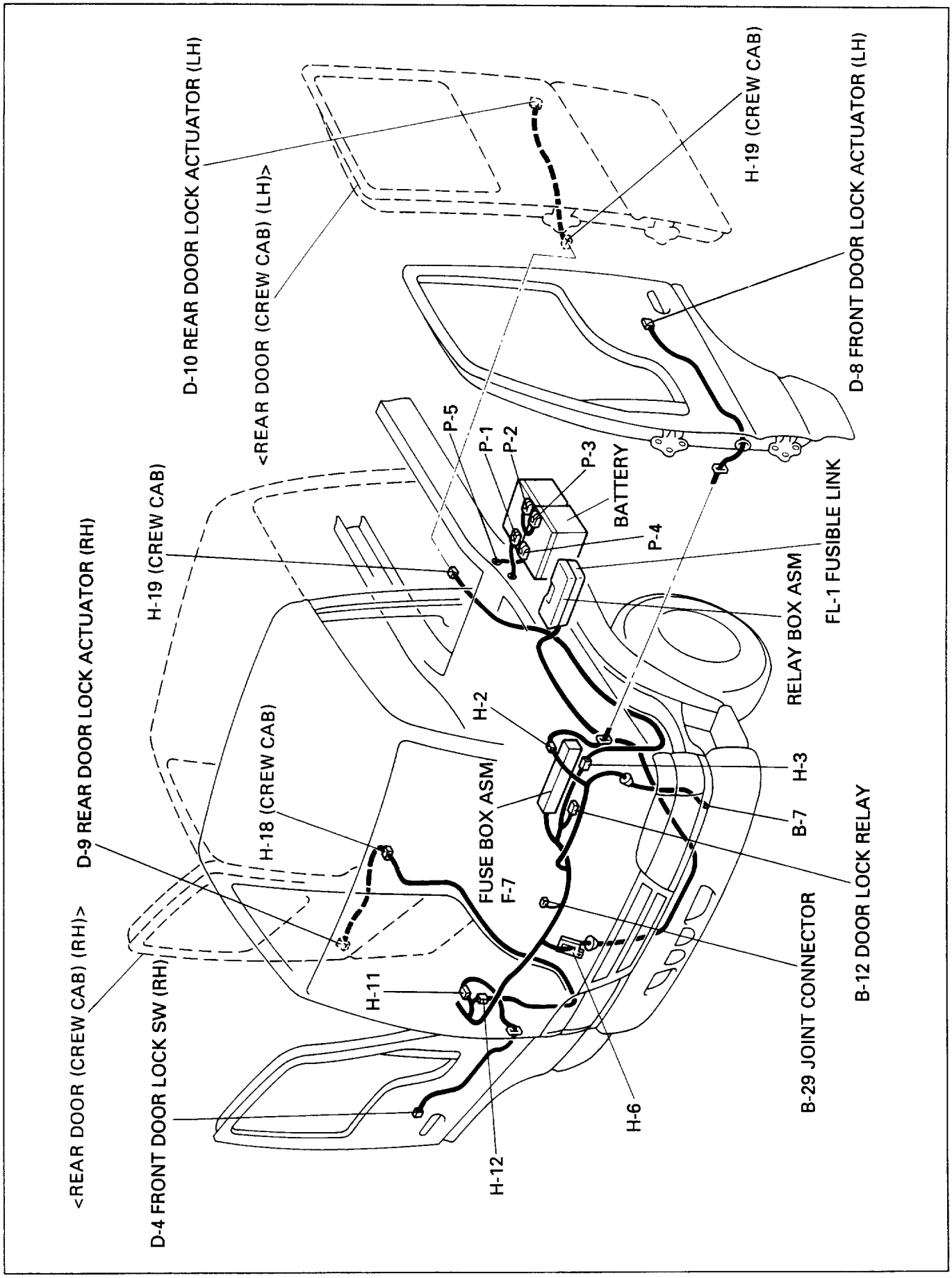
The door lock controller is always provided with battery voltage. The key or the inside lock knob on the driver's door can activate the lock mechanism of all the doors.

When the driver's door lock switch is turned on, current flows for about one second to the door lock actuator of each door connected in parallel with the controller to activates the actuator to lock and unlock the doors.

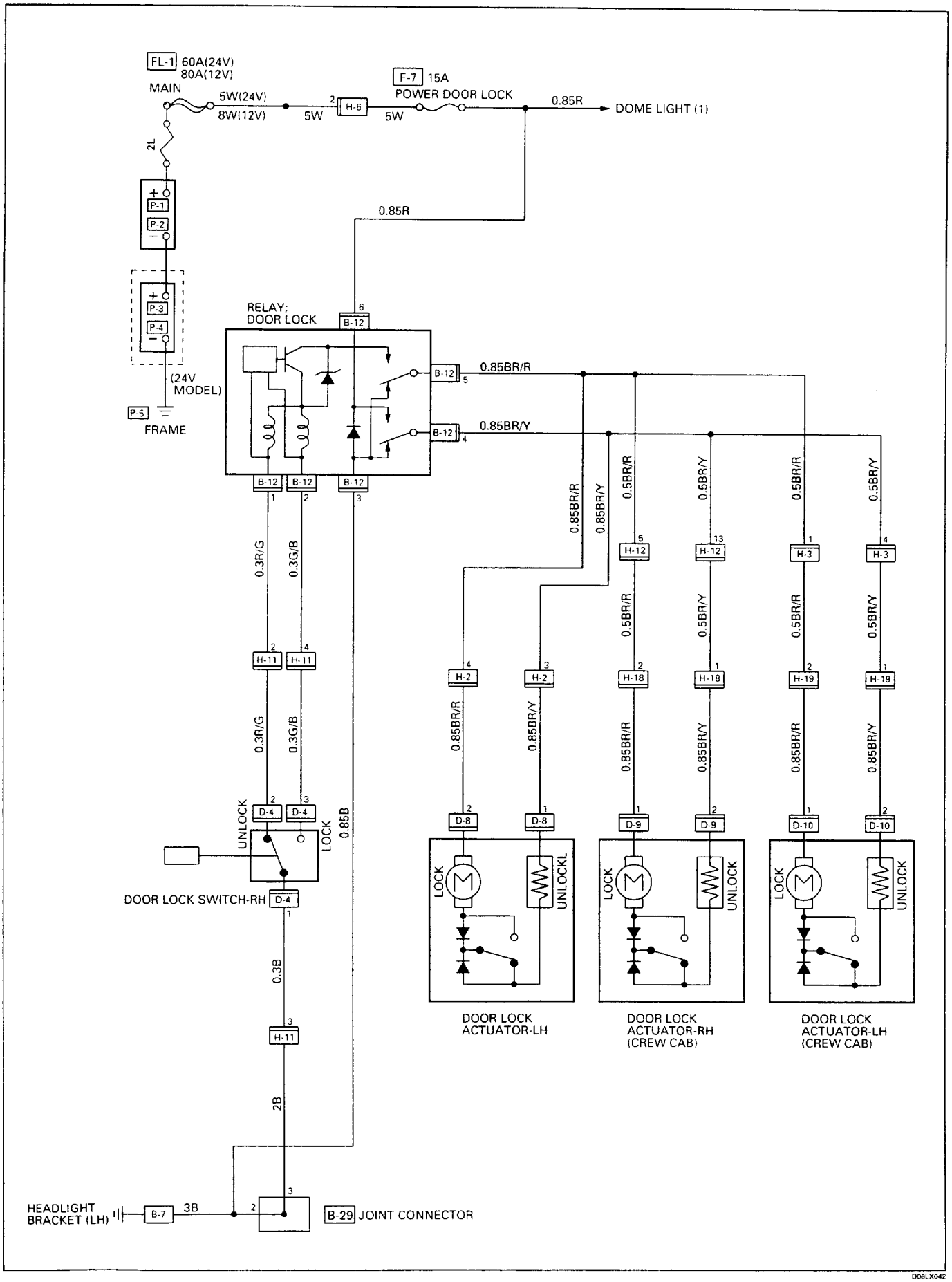
OPERATION OF DOOR LOCK CONTROLLER



PARTS LOCATION

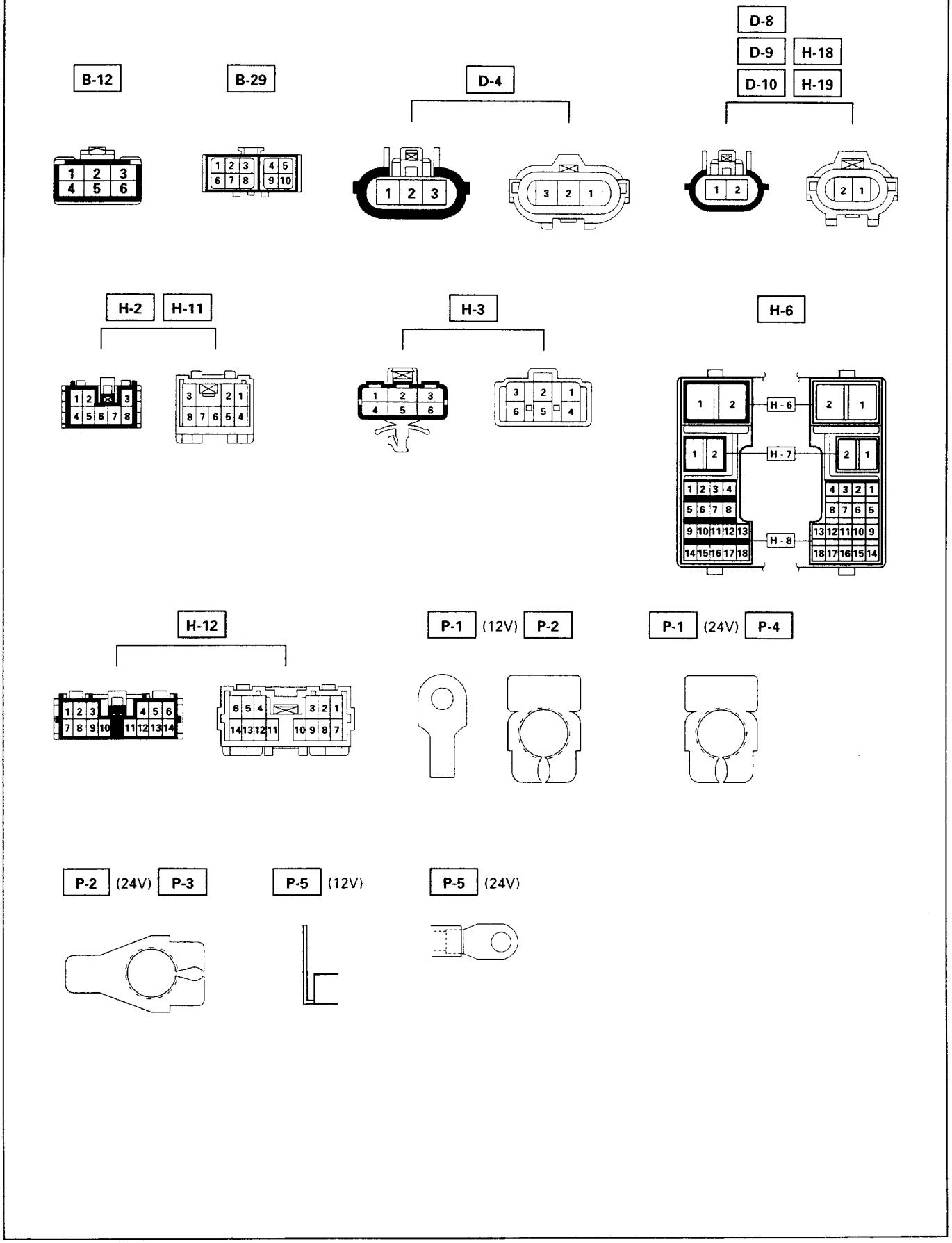


CIRCUIT DIAGRAM



D08LX042

CONNECTOR LIST



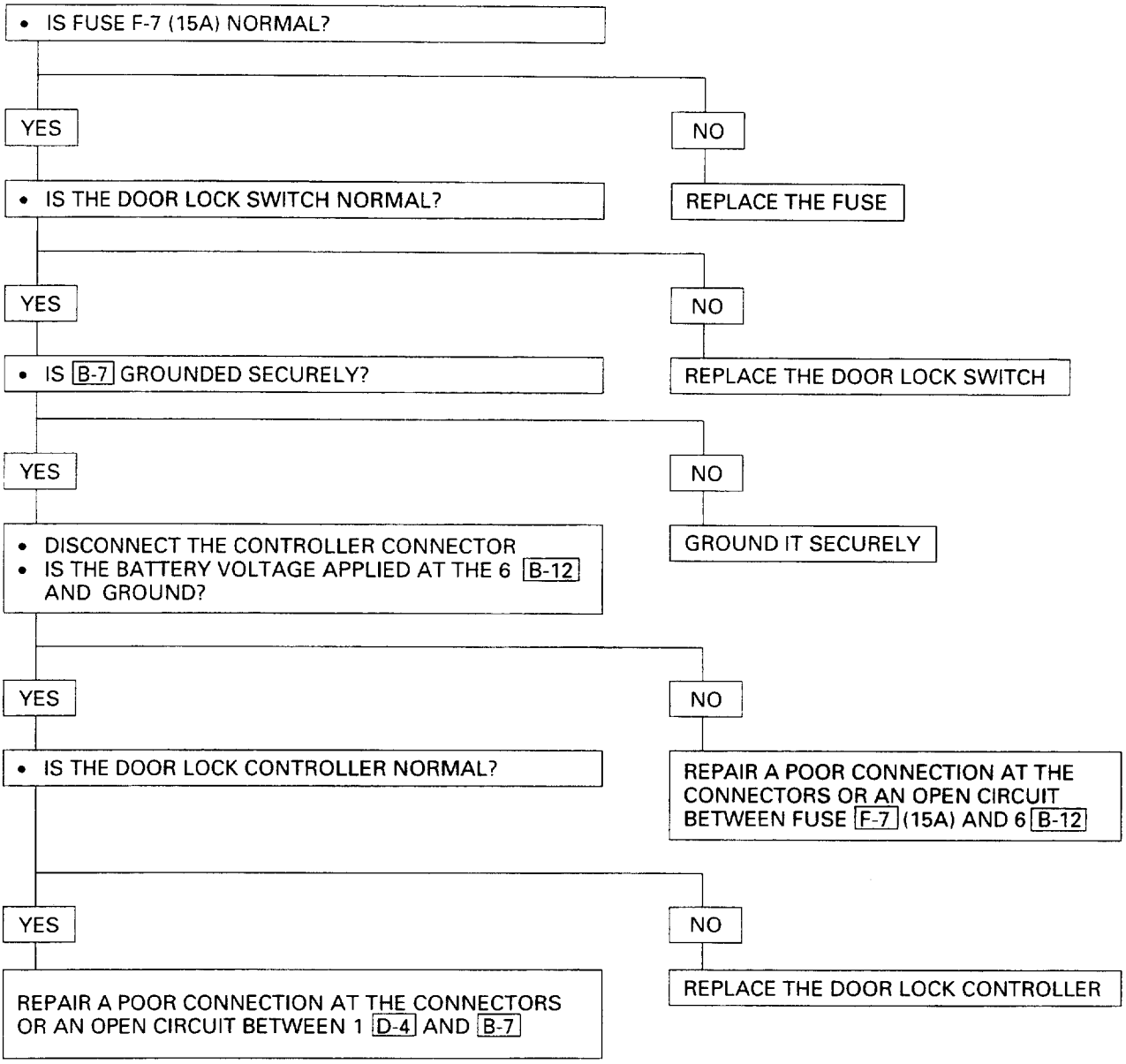
DIAGNOSIS

QUICK CHART FOR CHECK POINT

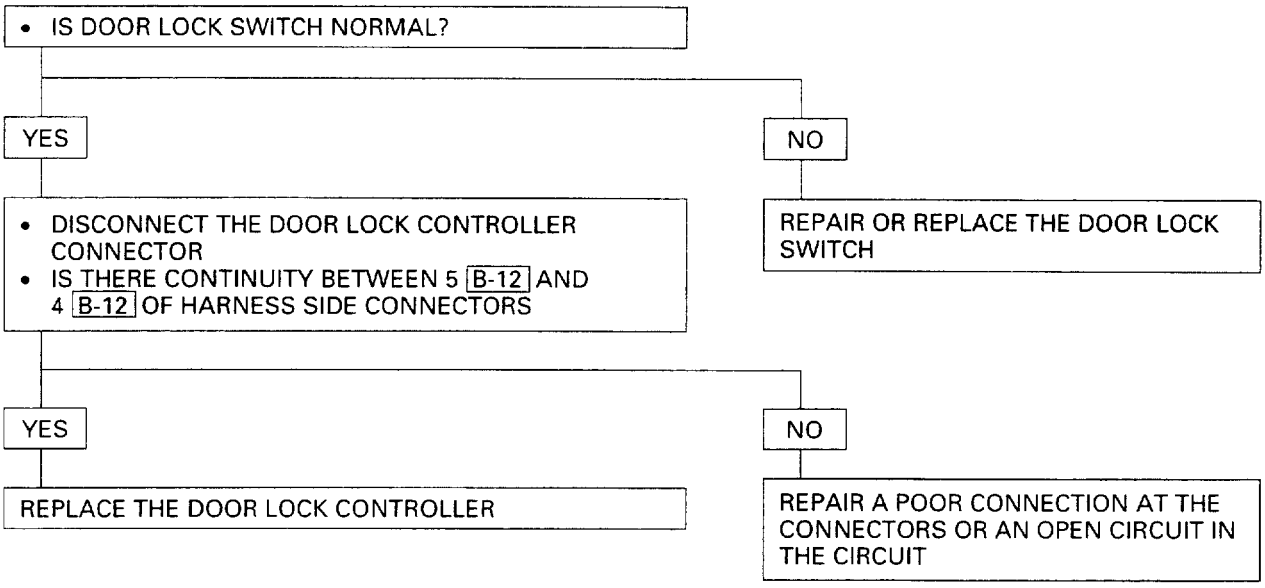
Trouble mode \ Check point	Fuse F-7 (15A)	Door lock controller	Door lock sw (Driver side)	Door lock actuator			
				Front (Passen-ger side)	Rear (RH)	Rear (LH)	Cable harness
1. All the doors do not lock and unlock	○ (1)	○ (2)					○ (3)
2. All the doors do not get locked (or unlocked)		○ (1)					○ (2)
3. Driver side door does not get locked (or unlocked)			○ (1)				○ (2)
4. Front passenger side door does not get locked (or unlocked)				○ (1)			○ (2)
5. Rear door-RH side does not get locked (or unlocked)					○ (1)		○ (2)
6. Rear door-LH side does not get locked (or unlocked)						○ (1)	○ (2)

NOTE: Figure in parenthesis "( )" indicates the order of inspection.

1. ALL THE DOORS DO NOT LOCK AND UNLOCK



2. ALL THE DOORS DO NOT GET LOCKED (OR UNLOCKED)



3. DRIVER SIDE DOOR DOES NOT GET LOCKED (OR UNLOCKED)

REPLACE THE DOOR LOCK SWITCH

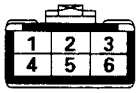
4. FRT PASSENGER SIDE DOOR DOES NOT GET LOCKED (OR UNLOCKED)
5. RR DOOR-RH SIDE DOES NOT GET LOCKED (OR UNLOCKED)
6. RR DOOR-LH SIDE DOES NOT GET LOCKED (OR UNLOCKED)

REPLACE THE DOOR LOCK ACTUATOR

INSPECTION OF THE DOOR LOCK CIRCUIT

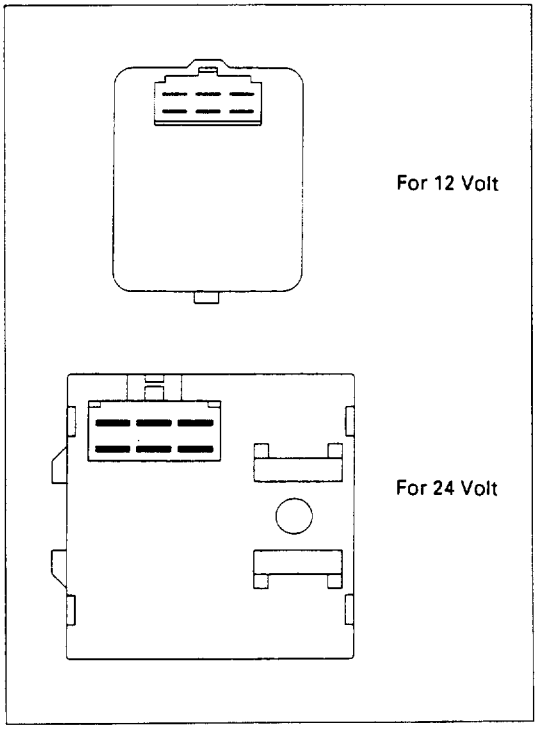
Check the voltage and the continuity between the controller harness side connector terminals.

B-12



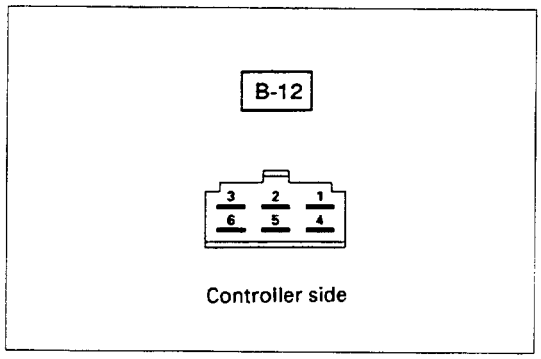
Harness side

Terminal No.	Wire color	Connected to	Item to be checked	Connecting terminal	Checking conditions		Standard
1	R/G	Door lock SW (Unlock)	Continuity (Resistance)	1-Ground	Driver seat side door	Unlock	Continuity
						Lock	No continuity
2	G/B	Door lock SW (Lock)		2-Ground	Driver seat side door	Unlock	No continuity
						Lock	Continuity
3	B	Ground		3-Ground	–		Continuity
4	BR/Y	Actuator (Unlock)		4-5	–		Continuity (There is some resistance)
5	BR/R	Actuator (Lock)		5-4	–		Continuity (There is some resistance)
6	R	Fuse F-7 (15A)	Voltage	6-Ground	–		Battery voltage



DOOR LOCK CONTROLLER

The door lock controller sends out to each door lock actuator the lock/unlock signals received from door lock switch of driver seat side.



INSPECTION

Remove the connector of the door lock controller, and check the continuity and the voltage between the controller side connector terminals.

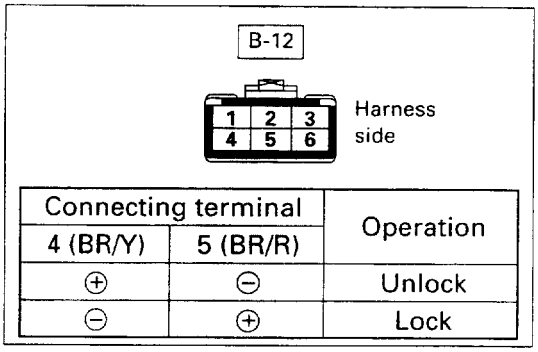
(Connect the ⊕ terminal of the battery to 6 B-12 and the ⊖ terminal to 3 B-12)

3 B-12 – 5 B-12 .....Continuity
3 B-12 – 4 B-12 .....Continuity

(Then, ground 2 B-12)
5 B-12.....Voltage for approx. 1 second

(Disconnect the ground of 2 B-12, and ground 1 B-12 .)
4 B-12.....Voltage for approx. 1 second

Replace the controller when the result of inspection is found abnormal.

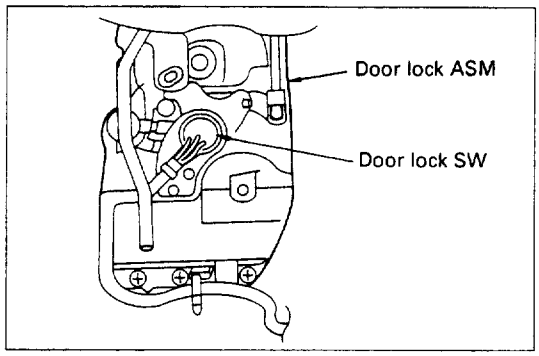


Connecting terminal		Operation
4 (BR/Y)	5 (BR/R)	
⊕	⊖	Unlock
⊖	⊕	Lock

DOOR LOCK OPERATION TEST

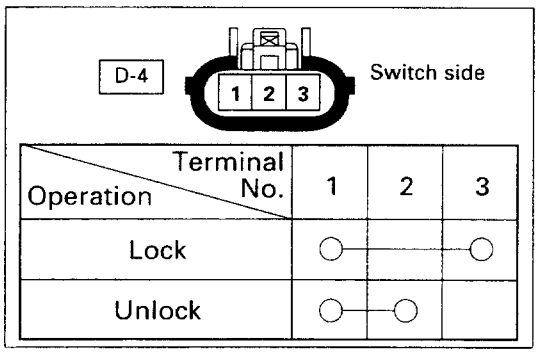
After confirming that there is continuity between the harness side connector terminals 4 B-12 and 5 B-12 of the door lock controller, apply battery voltage to each of the terminals to conduct the operation test.

When the door lock will not operate, check the door lock actuator for any trouble.



DOOR LOCK SWITCH (DRIVER SEAT SIDE)

The door lock switch on the driver's door is connected with the door lock cylinder and the inside lock knob with a rod. The switch sends lock/unlock signals to the door lock controller.



Operation \ Terminal No.	1	2	3
Lock	○		○
Unlock	○	○	

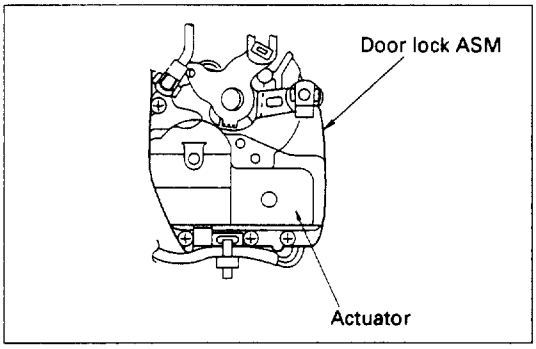
INSPECTION

Check to see if there is any continuity between the connector terminals of the door lock switch.

Replace the switch when the result of inspection is found abnormal.

REMOVAL AND INSTALLATION

Refer to Section 10 "CAB" for "DOOR LOCK ASSEMBLY (front and rear)".



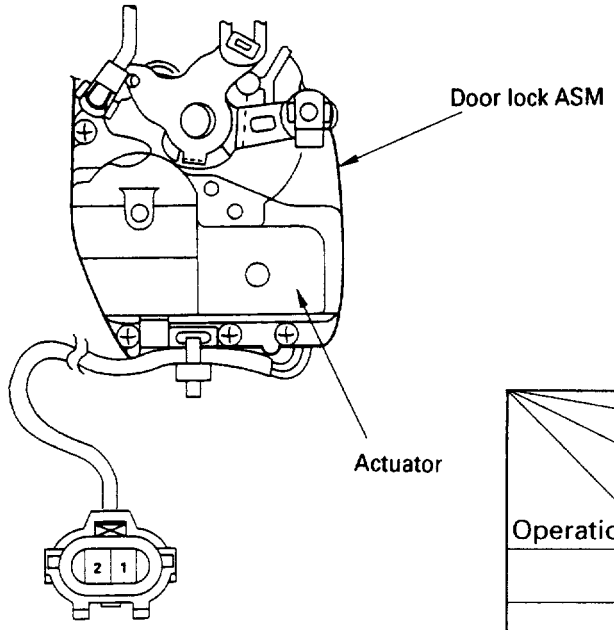
DOOR LOCK ACTUATOR

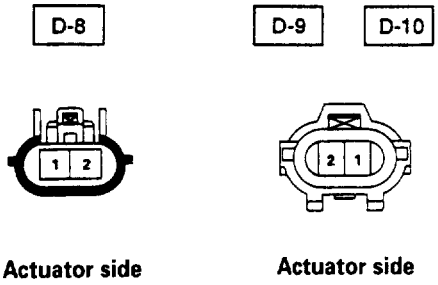
Receiving forward or reverse current from the door lock controller, the door lock actuator locks or unlocks the door with the rod connected to the door lock mechanism.

INSPECTION OF THE DOOR LOCK ACTUATOR

Apply the battery voltage to the connector terminals of the door lock actuator to check the operation.

When the door lock actuator is checked on the vehicle and there is no continuity, and when the door lock actuator itself is checked and no trouble is found, check the circuit between the door lock actuator and the door lock controller for any failure.





Door	FRT Passenger		RR-RH		RR-LH	
Connector No.	D-8		D-9		D-10	
Operation \ Terminal No.	1	2	1	2	1	2
Lock	⊖	⊕	⊕	⊖	⊕	⊖
Unlock	⊕	⊖	⊖	⊕	⊖	⊕

REMOVAL AND INSTALLATION

Refer to Section 10 "CAB" for "DOOR LOCK ASSEMBLY (Front and rear)".

POWER WINDOW

GENERAL DESCRIPTION

The circuit consist of the starter switch, power window switch for each of the windows and power window motor.

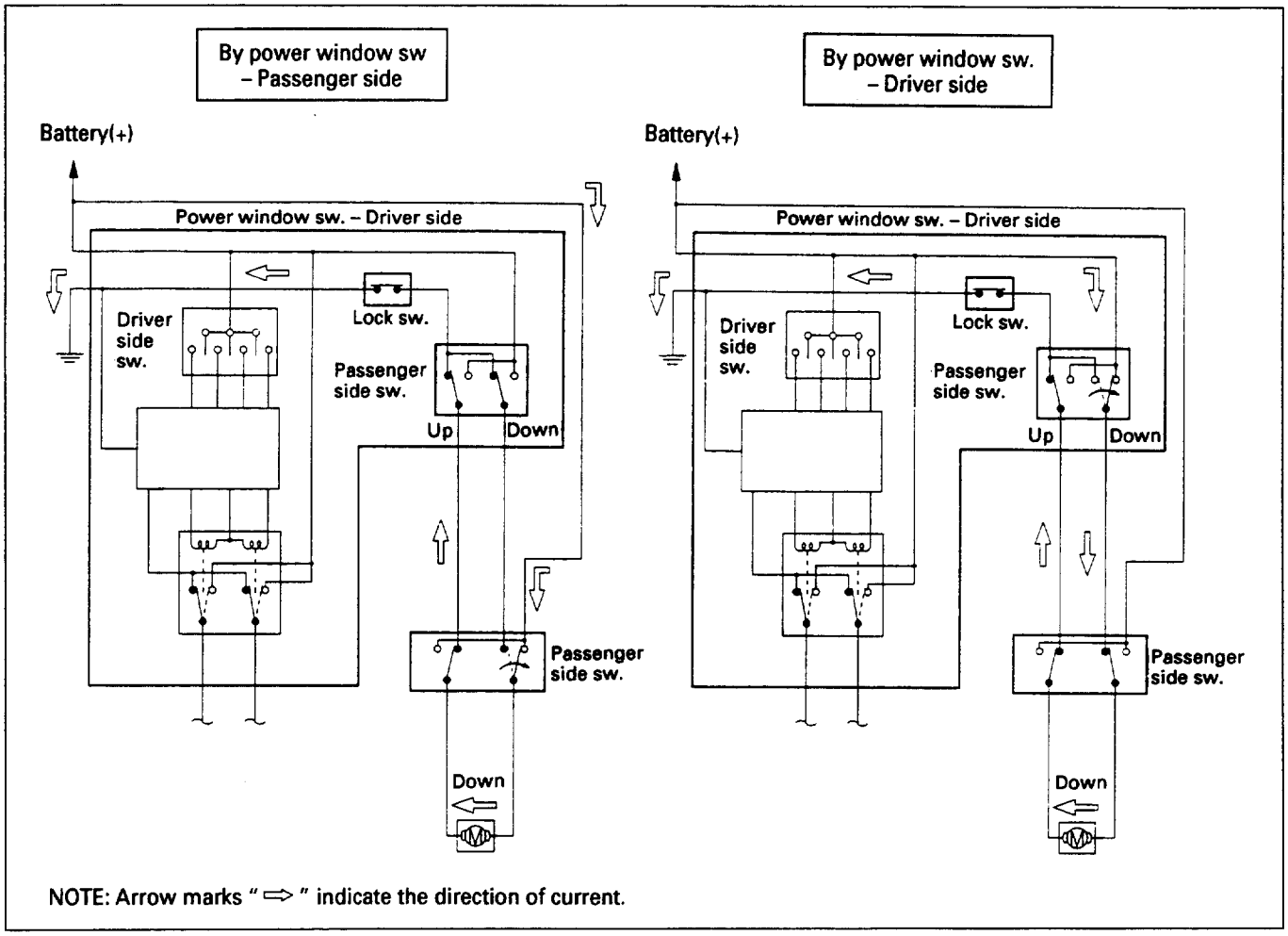
When the starter switch is turned on, the battery voltage is applied to each of the power window switches through the circuit breaker and the power window relay on the circuit.

By operating the switches of each window to select "UP" or "DOWN", the revolving direction of the power window motor changes to open or close the window.

The driver's power window switch has a built-in one-touch operating circuit which allows to automatically open the window by operating the switch to the AUTO position.

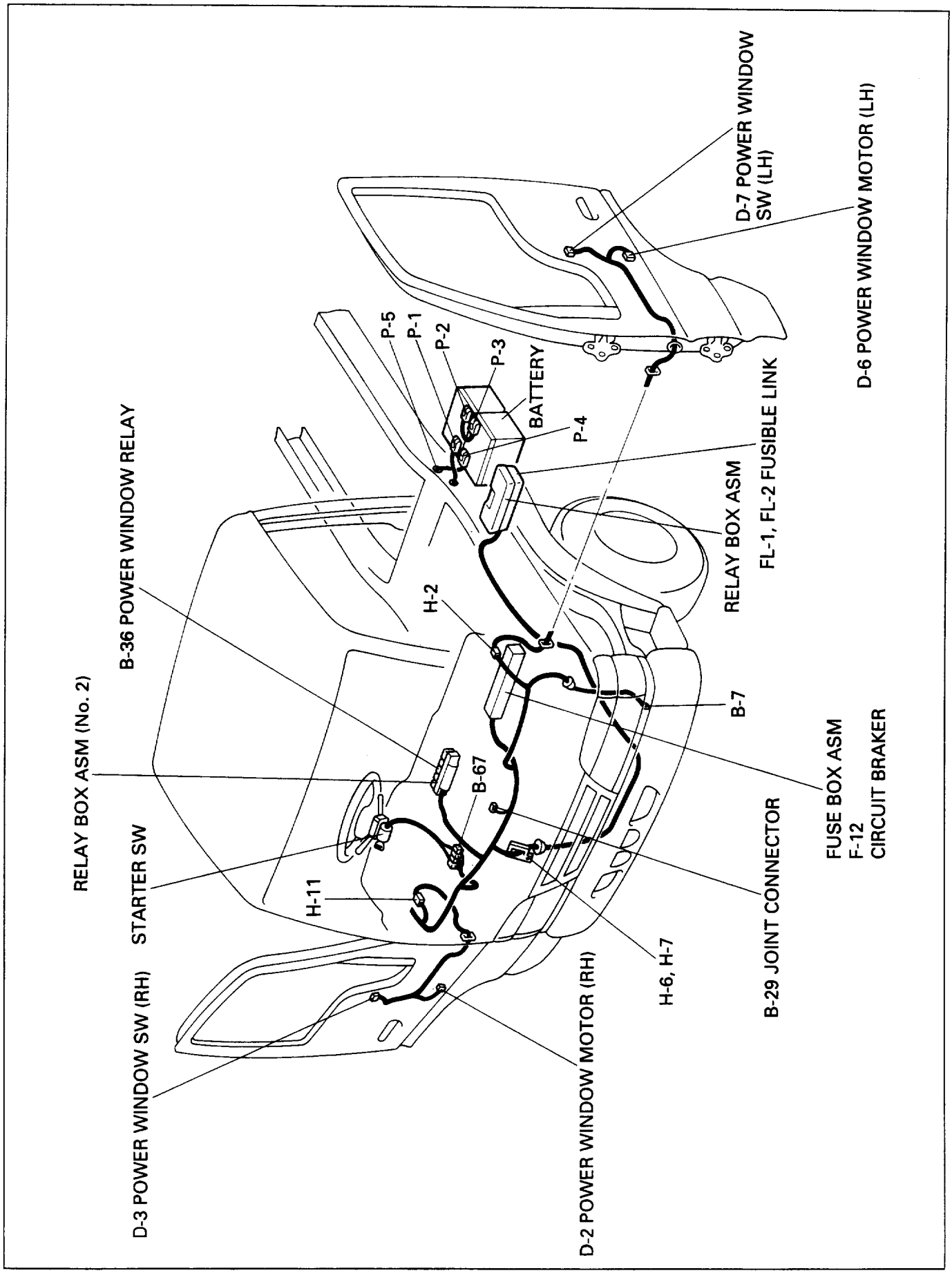
When the driver's power lock switch at the driver side is depressed, the power source to the passenger's power window switches will be shut off and passenger's power window motor will not operate if the switch is operated.

OPERATION OF PASSENGER SIDE WINDOW

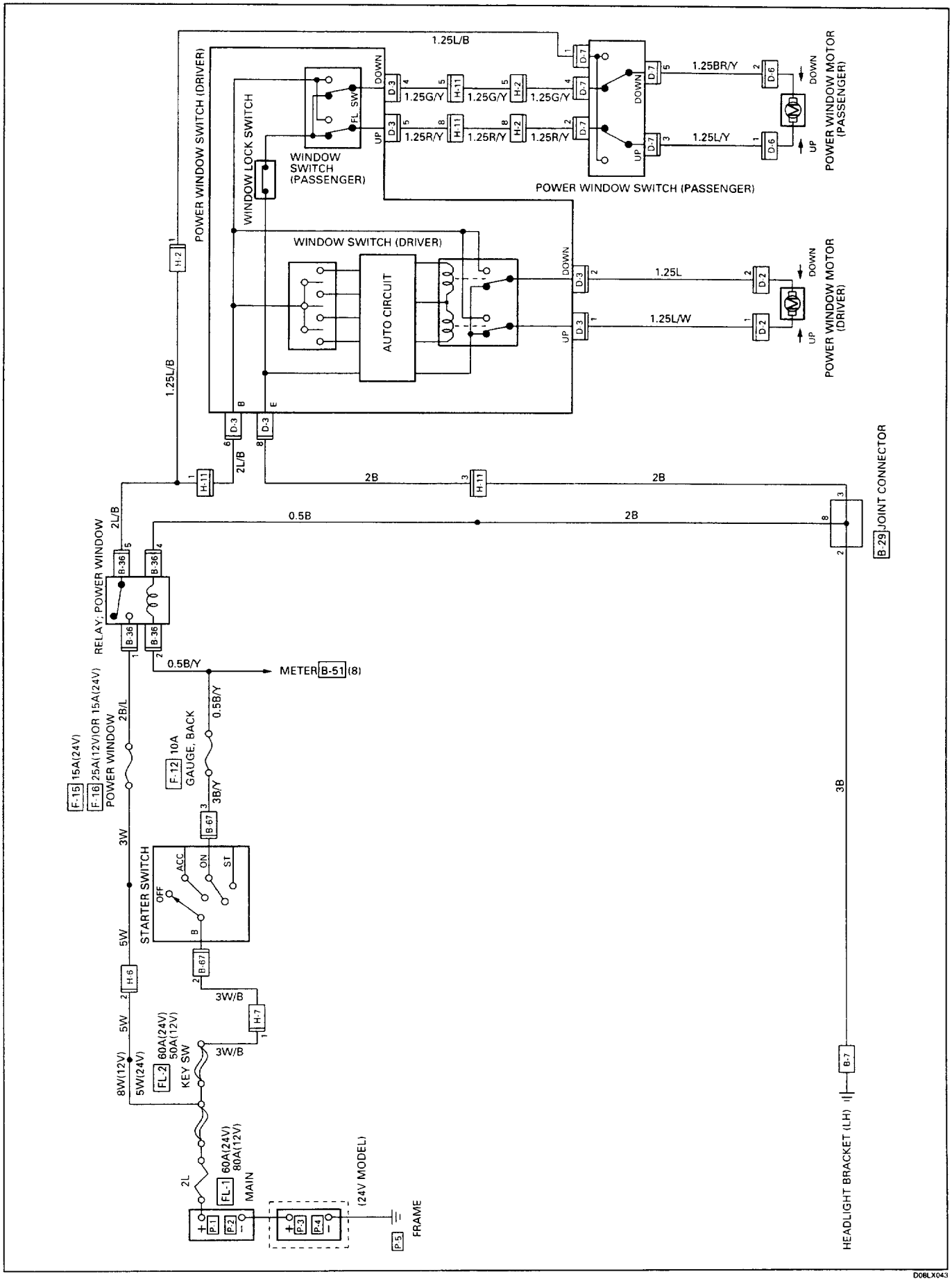


NOTE: Arrow marks " ⇨ " indicate the direction of current.

PARTS LOCATION



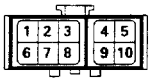
CIRCUIT DIAGRAM



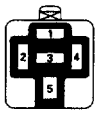
D08LX043

CONNECTOR LIST

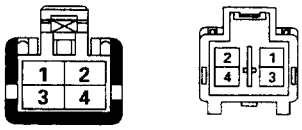
B-29



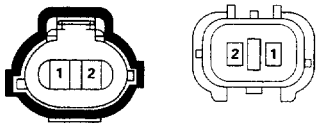
B-36



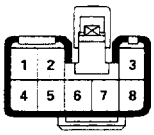
B-67



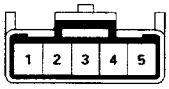
D-2 D-6



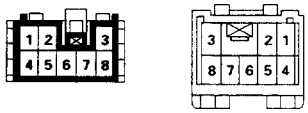
D-3



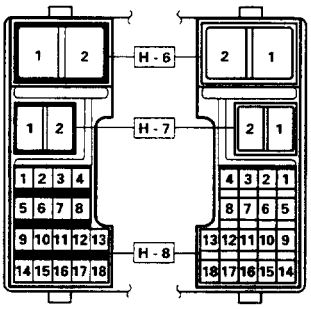
D-7



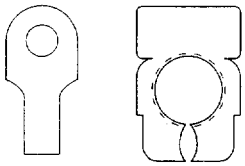
H-2 H-11



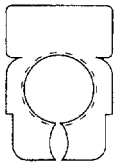
H-6 H-7



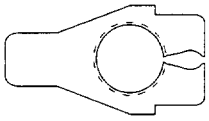
P-1 (12V) P-2



P-1 (24V) P-4

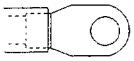


P-2 (24V) P-3



P-5 (12V)

P-5 (24V)



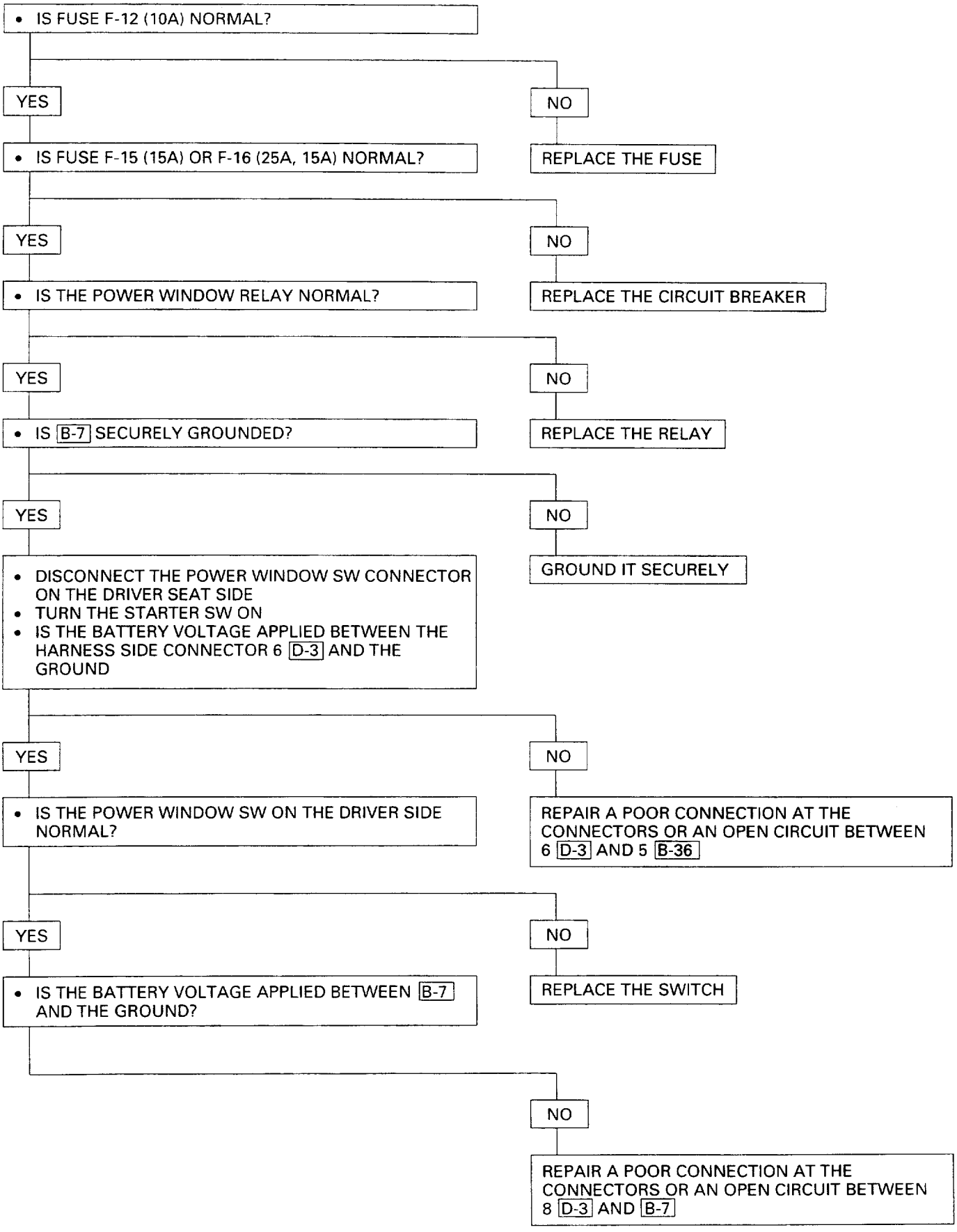
DIAGNOSIS

QUICK CHART FOR CHECK POINT

Trouble mode \ Check point	Fuse F-12 (10A)	Fuse F-15 (15A) F-16 (25A, 15A)	Power window relay	Power window SW		Power window motor		Cable harness
				Driver side	Passen-ger side	Driver side	Passen-ger side	
All windows do not operate	○ (1)	○ (2)	○ (3)	○ (5)				○ (4)
Lock SW does not function				○ (1)				
Driver side window								
Window does not operate				○ (1)		○ (2)		○ (3)
One-touch operation does not operate				○ (1)				
Window operates in only one direction				○ (1)				
Front passenger side window								
Window does not operate				○ (2)	○ (1)		○ (3)	○ (4)
Window does not operate when operating the driver side SW				○ (1)				○ (2)
Window does not operate when operating the passenger side SW					○ (1)			○ (2)
Window operates in only one direction when operating the driver side SW				○ (1)				○ (2)
Window operates in only one direction when operating the passenger side SW				○ (2)	○ (1)			○ (3)

NOTE: Figure in parenthesis "( )" indicates the order of inspection.

ALL WINDOWS DO NOT OPERATE



LOCK SW DOES NOT FUNCTION

REPAIR OR REPLACE THE POWER WINDOW SW ON THE DRIVER SEAT SIDE

WINDOW ON THE DRIVER SIDE DOES NOT OPERATE

- IS THE POWER WINDOW SWITCH ON THE DRIVER SEAT SIDE NORMAL?

YES

- DISCONNECT THE CONNECTOR OF THE POWER WINDOW MOTOR ON THE DRIVER SEAT SIDE
- WHEN CONNECTING THE MOTOR CONNECTOR 1 [D-2] TO THE BATTERY (+) TERMINAL AND 2 [D-2] TO THE (–) TERMINAL, DOES THE MOTOR ROTATE IN THE "UP" DIRECTION OF THE WINDOW (OR WHEN CONNECTING 2 [D-2] TO THE (+) TERMINAL AND 1 [D-2] TO THE (–) TERMINAL, DOES THE MOTOR ROTATE IN THE "DOWN" DIRECTION OF THE WINDOW?

YES

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN HARNESS SIDE CONNECTOR TERMINALS 1 [D-3] AND POWER WINDOW MOTOR 1 [D-2] OR 2 [D-3] AND 2 [D-2]

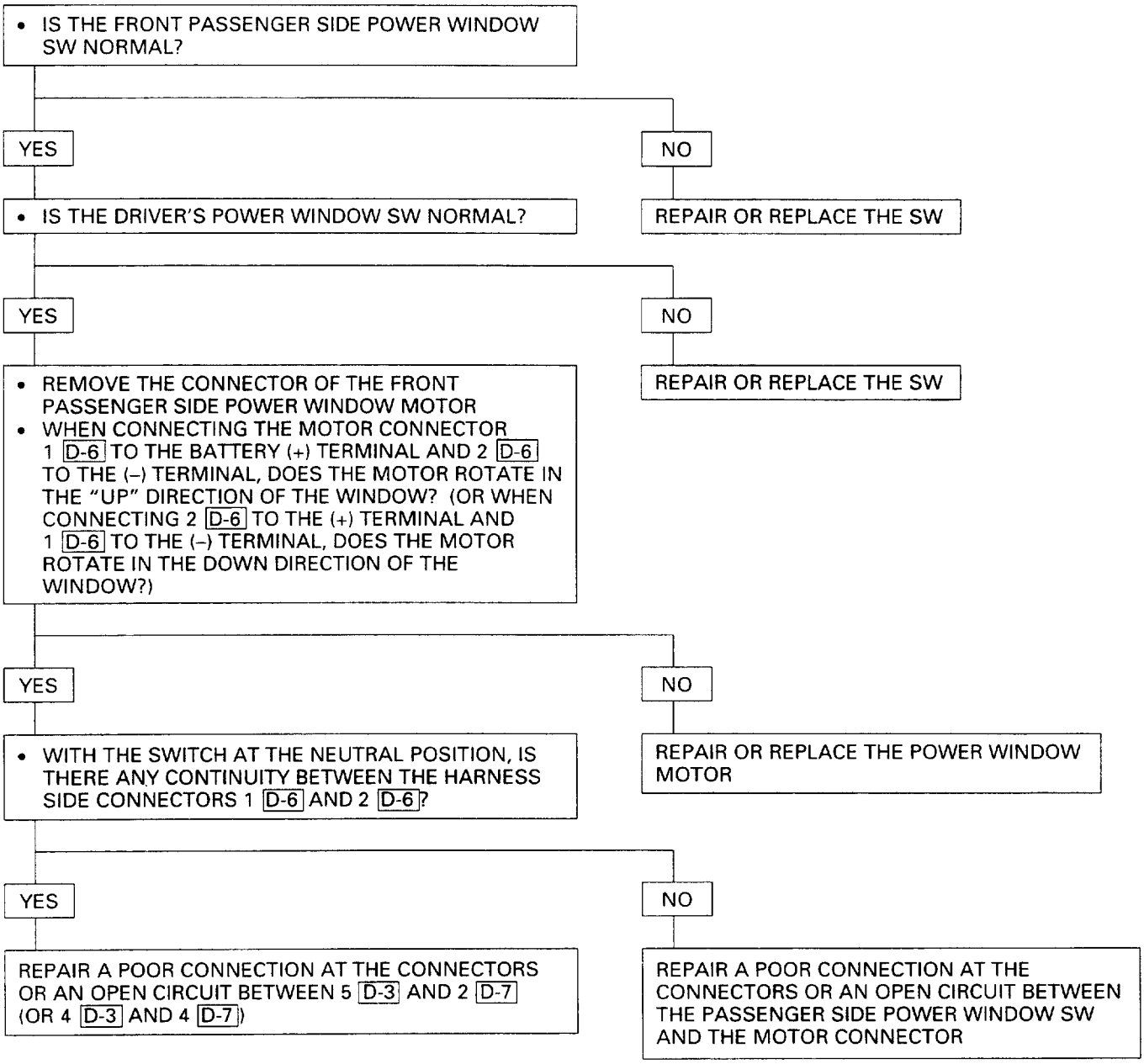
NO

REPAIR OR REPLACE THE POWER WINDOW MOTOR

NO

REPLACE THE POWER WINDOW SWITCH ON THE DRIVER SEAT SIDE

WINDOW ON THE FRONT PASSENGER SIDE DOES NOT OPERATE



STARTER SWITCH

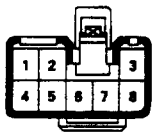
Refer to "START AND CHARGING" in this section.

POWER WINDOW SWITCH-DRIVER SIDE

CIRCUIT INSPECTION

Disconnect the switch connectors to check the voltage and the continuity between the harness side connector terminals.

D-3



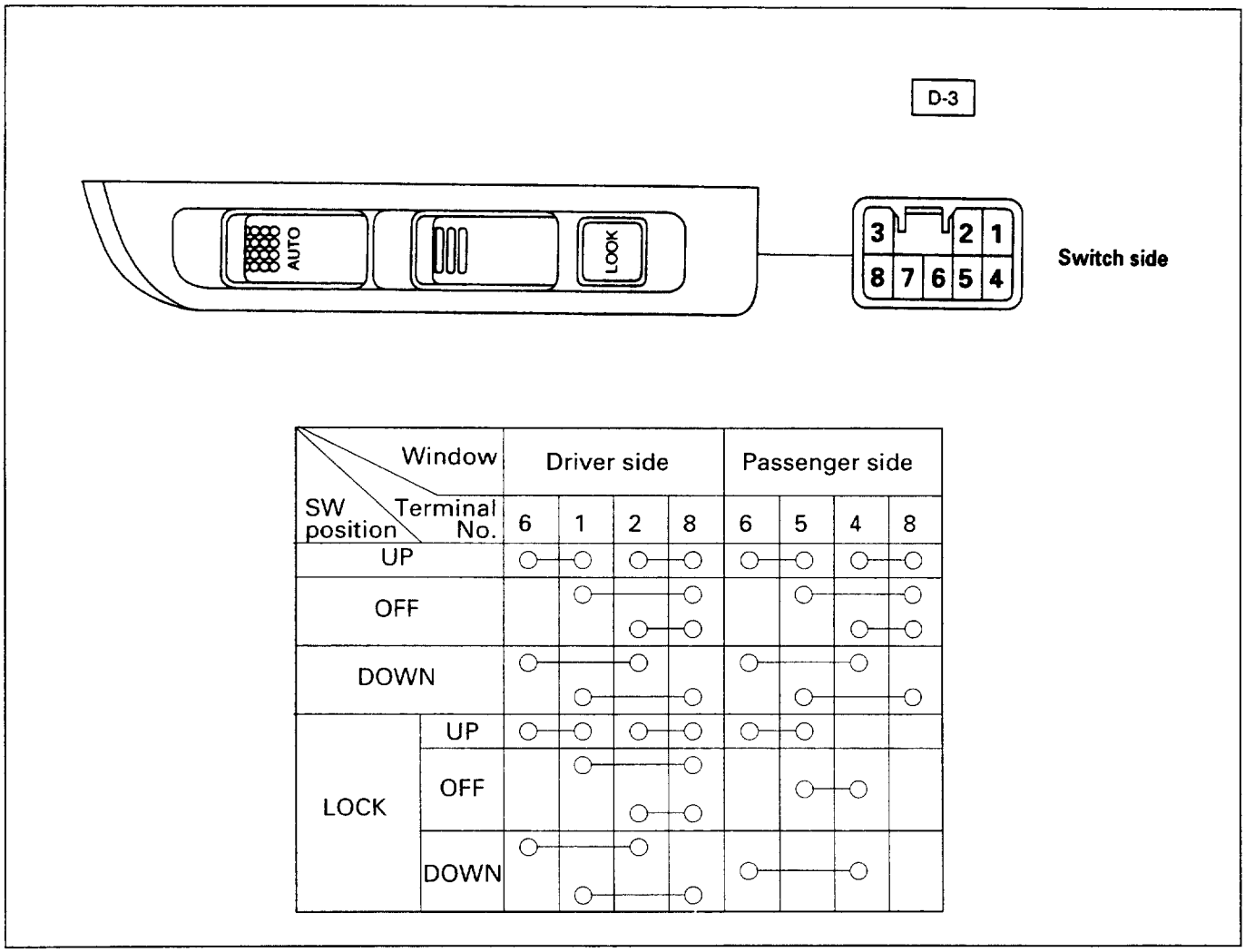
Harness side

Terminal No.	Wire color	Connected to	Item to be checked	Connecting terminal	Checking conditions	Standard
1	L/W	Driver seat side motor	Continuity (resistance)	1-2	–	Continuity
2	L					
4	G/Y	Passenger side power window SW		4-5		
5	R/Y			5-4		
6	L/B	Power window relay	Voltage	6-Ground	Starter SW "ON"	Battery voltage
8	B	Ground	Continuity (resistance)	8-Ground	–	Continuity

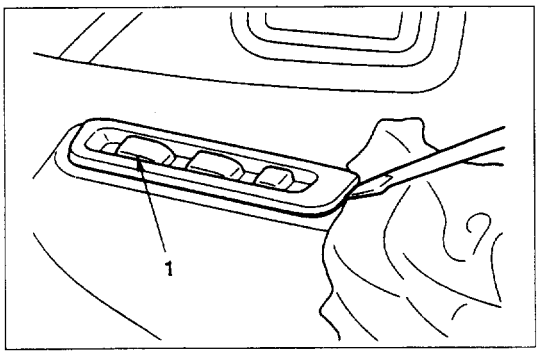
INSPECTION

Check the continuity between the connector terminals of the switch.

Repair or replace the switch when the result of inspection is found abnormal.



Window / SW position / Terminal No.		Driver side				Passenger side			
		6	1	2	8	6	5	4	8
UP		○—○		○—○		○—○		○—○	
OFF			○—○		○—○		○—○		○—○
DOWN		○—○		○—○		○—○		○—○	
LOCK	UP	○—○		○—○		○—○			
	OFF		○—○		○—○		○—○		
	DOWN	○—○		○—○		○—○		○—○	



REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Switch**
   1) Insert the screw driver to the cut off portion to remove the switch.
   2) Disconnect the connector

INSTALLATION

To install, follow the removal steps in the reverse order.

POWER WINDOW SWITCH-PASSENGER SIDE

CIRCUIT INSPECTION

Disconnect the switch connectors to check the voltage and the continuity between the harness side connector terminals

D-7

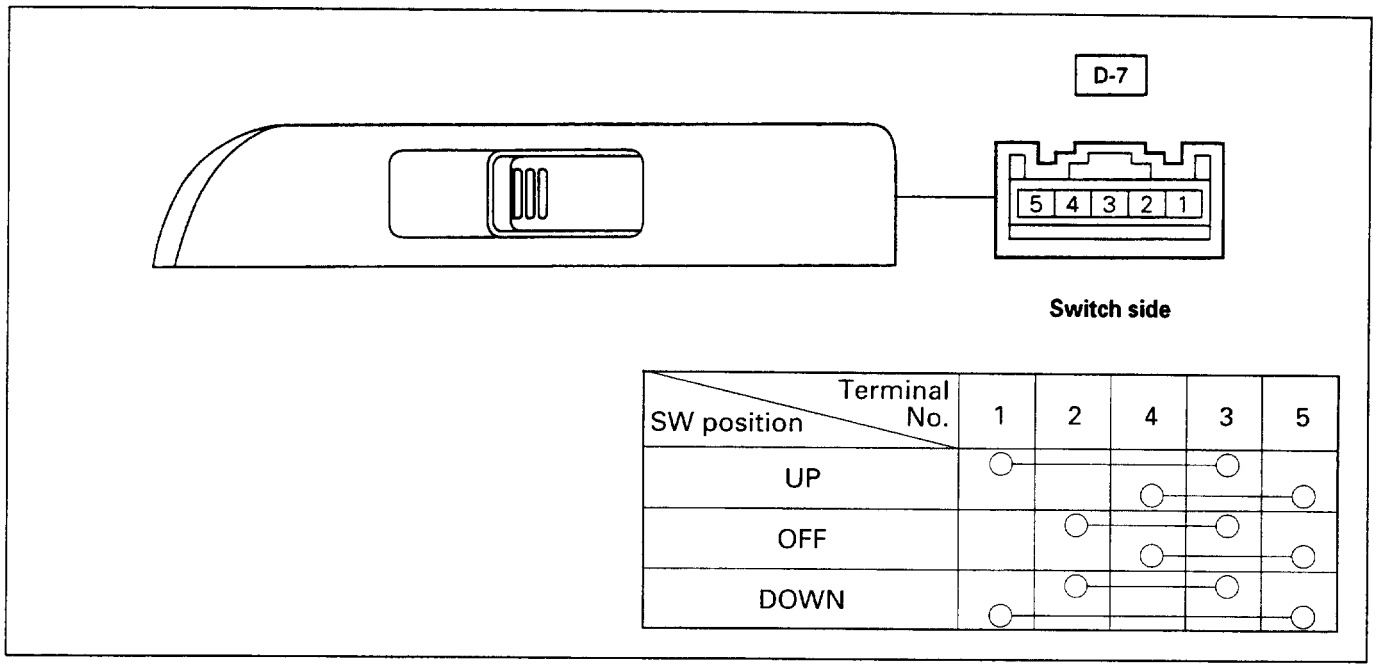
Harness side

Terminal No.	Wire color	Connected to	Item to be checked	Connecting terminal	Checking conditions	Standard
1	L/B	Power window relay	Voltage	1-Ground	· Turn "ON" the starter SW	Battery voltage
2	R/Y	Driver side SW	Continuity (Resistance)	2-Ground	· Turn "OFF" the passenger side SW at the driver side SW	Continuity
			Voltage	2-Ground	· Turn "ON" the starter SW · Turn to "UP" the passenger side SW at the driver side SW	Battery voltage
3	L/Y	Passenger side motor	Continuity (Resistance)	3-5	–	Continuity
4	G/Y	Driver side SW	Continuity (Resistance)	4-Ground	· Turn "OFF" the passenger side SW at the driver side SW	Continuity
			Voltage	4-Ground	· Turn "ON" the starter SW · Turn to "DOWN" the passenger side SW at the driver side SW	Battery voltage
5	BR/Y	Passenger side motor	Continuity (Resistance)	5-3	–	Continuity

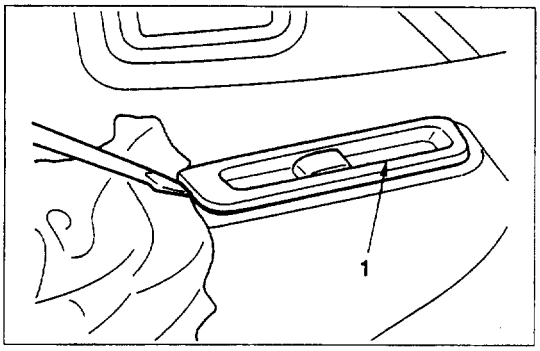
INSPECTION

Check the continuity between the connector terminals of the switch.

Repair or replace the switch when the result of inspection is found abnormal.



SW position \ Terminal No.	1	2	4	3	5
UP	○		○	○	
OFF		○	○	○	
DOWN	○	○		○	



REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Switch**
   1) Insert the screw driver to the cut off portion to remove the switch.
   2) Disconnect the connector.

INSTALLATION

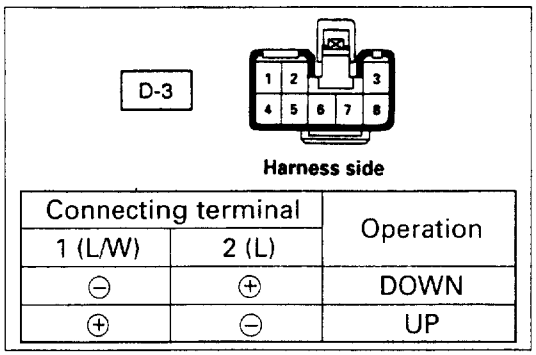
To install, follow the removal steps in the reverse order.

DRIVER SEAT SIDE POWER WINDOW MOTOR

INSPECTION

Before checking to see if the motor functions correctly, be sure to check the circuit through the connector D-3 of the driver's power window switch.

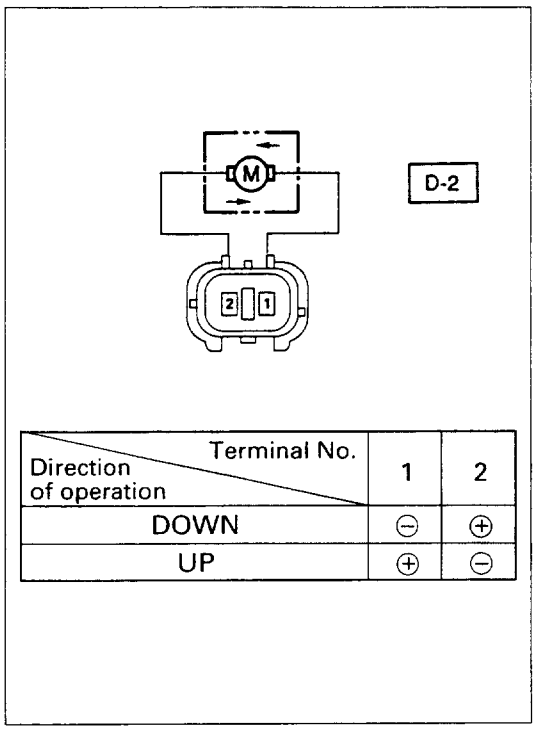
If the motor does not operate smoothly, either the motor or the circuit between the switch and the motor is defective.



Connecting terminal		Operation
1 (L/W)	2 (L)	
⊖	⊕	DOWN
⊕	⊖	UP

1. Circuit inspection of the driver side window switch

Disconnect the switch connector and apply battery voltage to the harness side connector terminals to check its function.

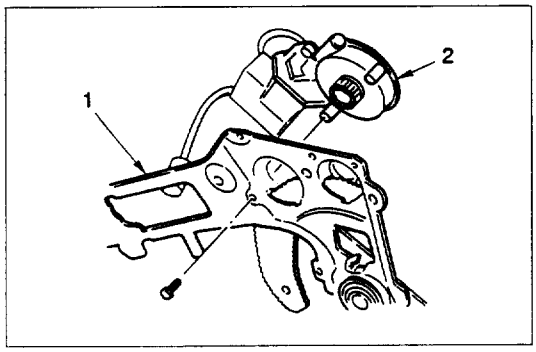


Direction of operation \ Terminal No.	1	2
DOWN	⊖	⊕
UP	⊕	⊖

2. Inspection of the driver seat side motor

Remove the motor connector and apply battery voltage to the motor side connector terminals to check its function.

Replace the motor when the result of inspection is found abnormal.



REMOVAL

Preparation:

Disconnect the battery ground cable.

1. Window Regulator Assembly

Refer to Section 10 "BODY" for Window Regulator and Glass.

2. Power Window Motor

Remove three screws.

INSTALLATION

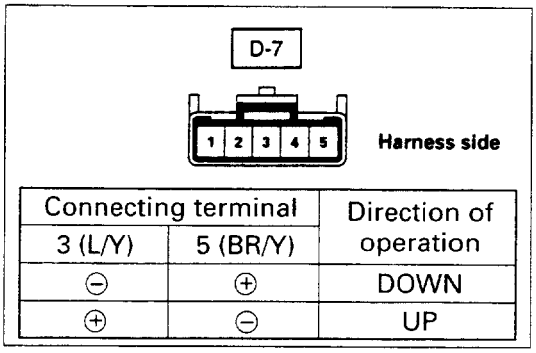
To install, follow the removal steps in the reverse order.

FRONT PASSENGER SEAT SIDE POWER WINDOW MOTOR

INSPECTION

Before checking to see if the motor functions correctly, be sure to check the circuit through the front passenger's switch connector D-7 and the driver's power window switch connector D-3.

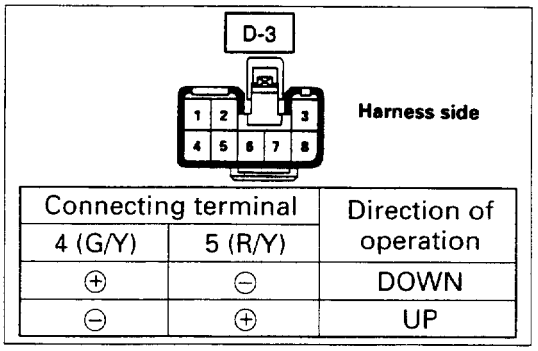
If the motor does not operate smoothly, either the motor or the circuit between the switch and the motor is defective.



Connecting terminal		Direction of operation
3 (L/Y)	5 (BR/Y)	
⊖	⊕	DOWN
⊕	⊖	UP

1. Circuit inspection of the front passenger seat side window

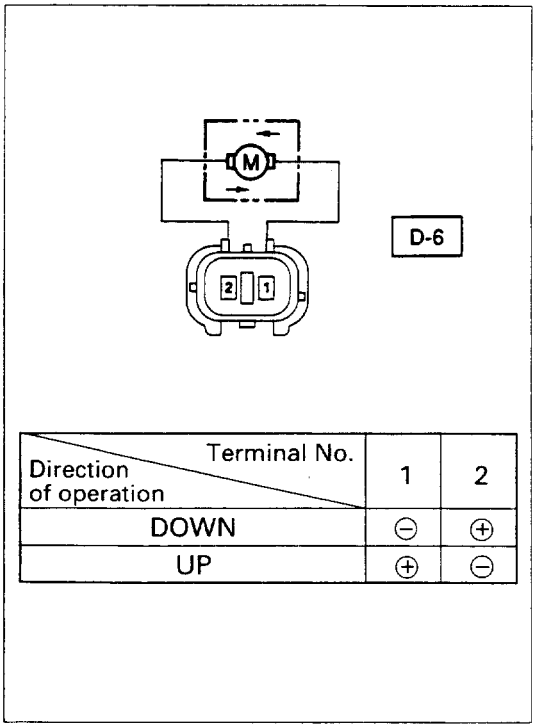
Disconnect the switch connector and apply battery voltage to the harness side connector terminals to check its function.



Connecting terminal		Direction of operation
4 (G/Y)	5 (R/Y)	
⊕	⊖	DOWN
⊖	⊕	UP

2. Circuit inspection of the driver seat side switch

Disconnect the switch connector and apply battery voltage to the harness side connector terminals to check its function.

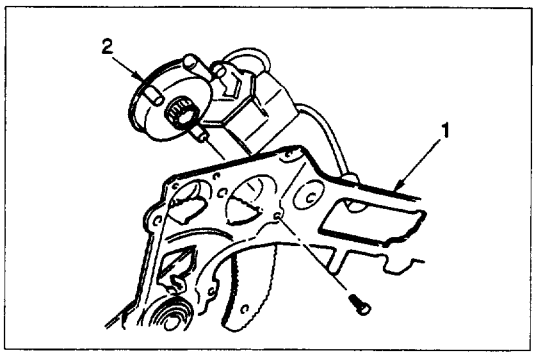


Direction of operation \ Terminal No.	1	2
DOWN	⊖	⊕
UP	⊕	⊖

3. Inspection of the front passenger window motor

Disconnect the motor connector and apply battery voltage to the motor side connector terminals to check its function.

Repair or replace the motor when the result of inspection is found abnormal.



REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Window Regulator Assembly**

   Refer to Section 10 "BODY" for Window Regulator and Glass.

2. **Power Window Motor**

   Remove three screws.

INSTALLATION

To install, follow the removal steps in the reverse order.

A/T ECU (ELECTRONIC CONTROL UNIT)

GENERAL DESCRIPTION

The circuit consists of the starter switch ECU, pattern select switch, inhibitor switch, kickdown switch, idle switch, tacho sensor, vehicle speed sensor, throttle sensor, full throttle switch, dropping resistor OD switch and the relay.

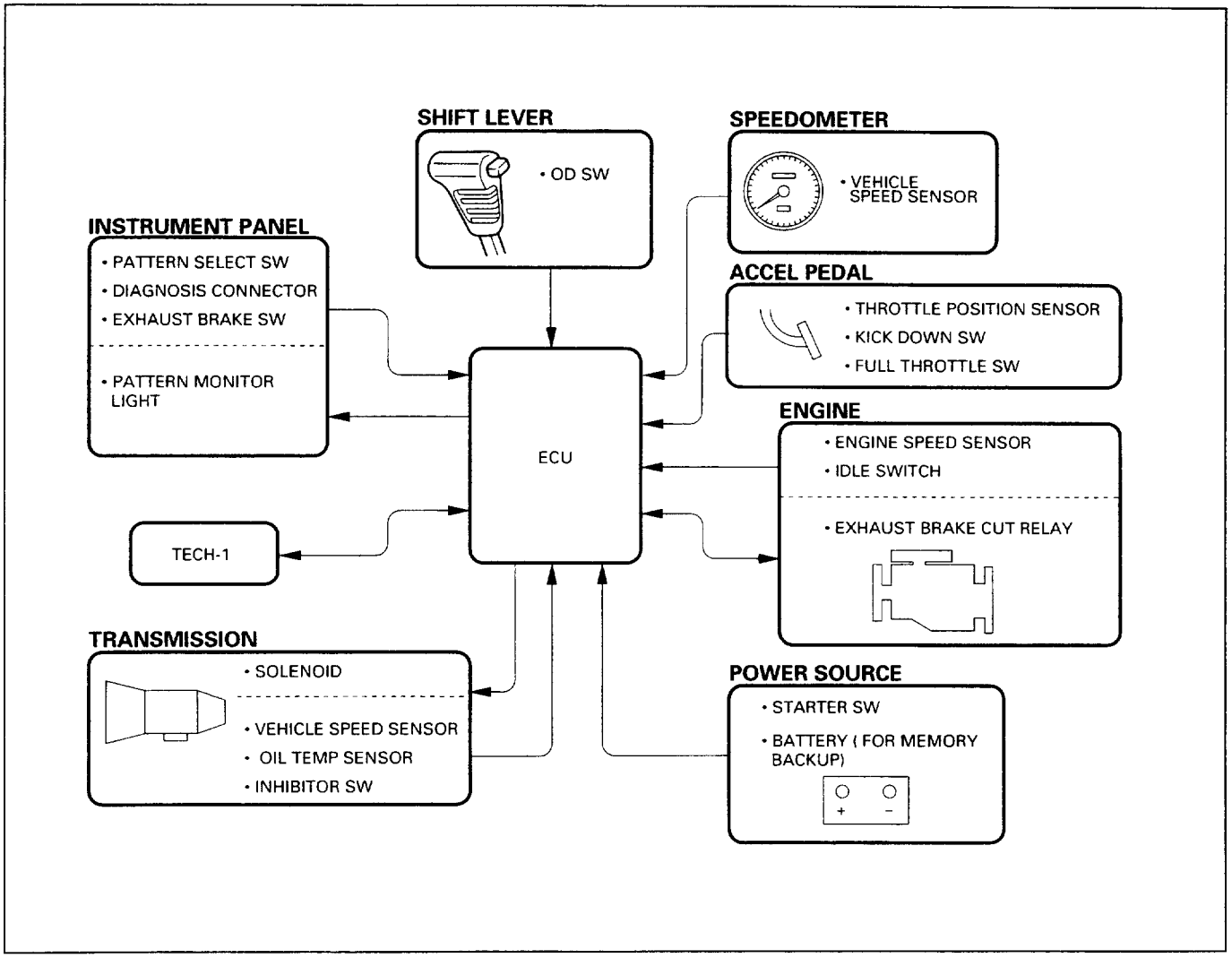
ECU, the key component of A/T ECU, judges where to shift speed and where to lock up shifting by the electric signals delivered from each one of the switches and sensors, and send controlling signals to respective solenoids.

The controllable items are speed shift pattern, speed shift, lock-up, oil pressure for each line and exhaust brake operative timing.

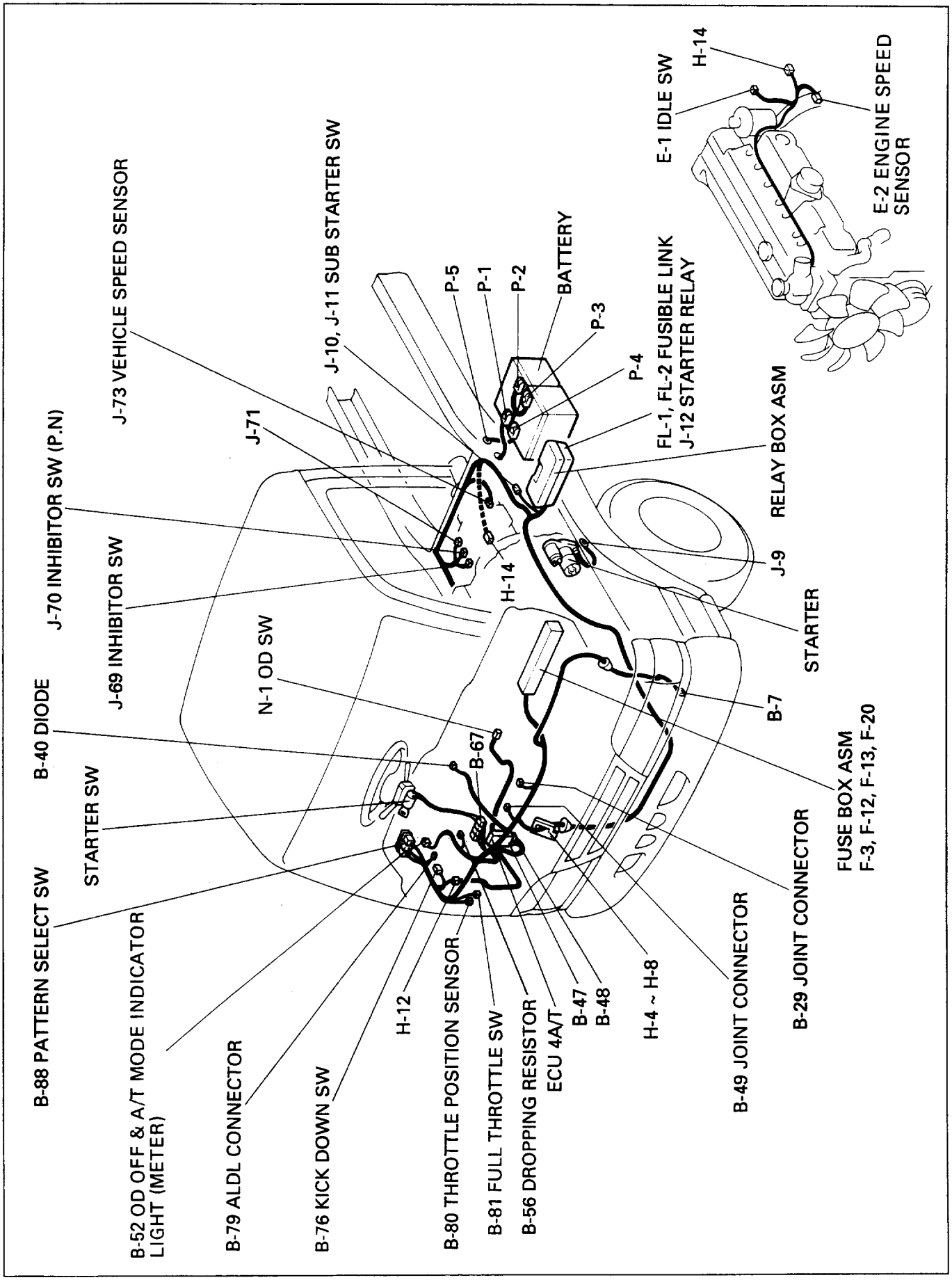
ECU also has TECH-1 diagnosis controlling function.

For details, refer to section 1A1 and 7A2 "AUTOMATIC TRANSMISSION".

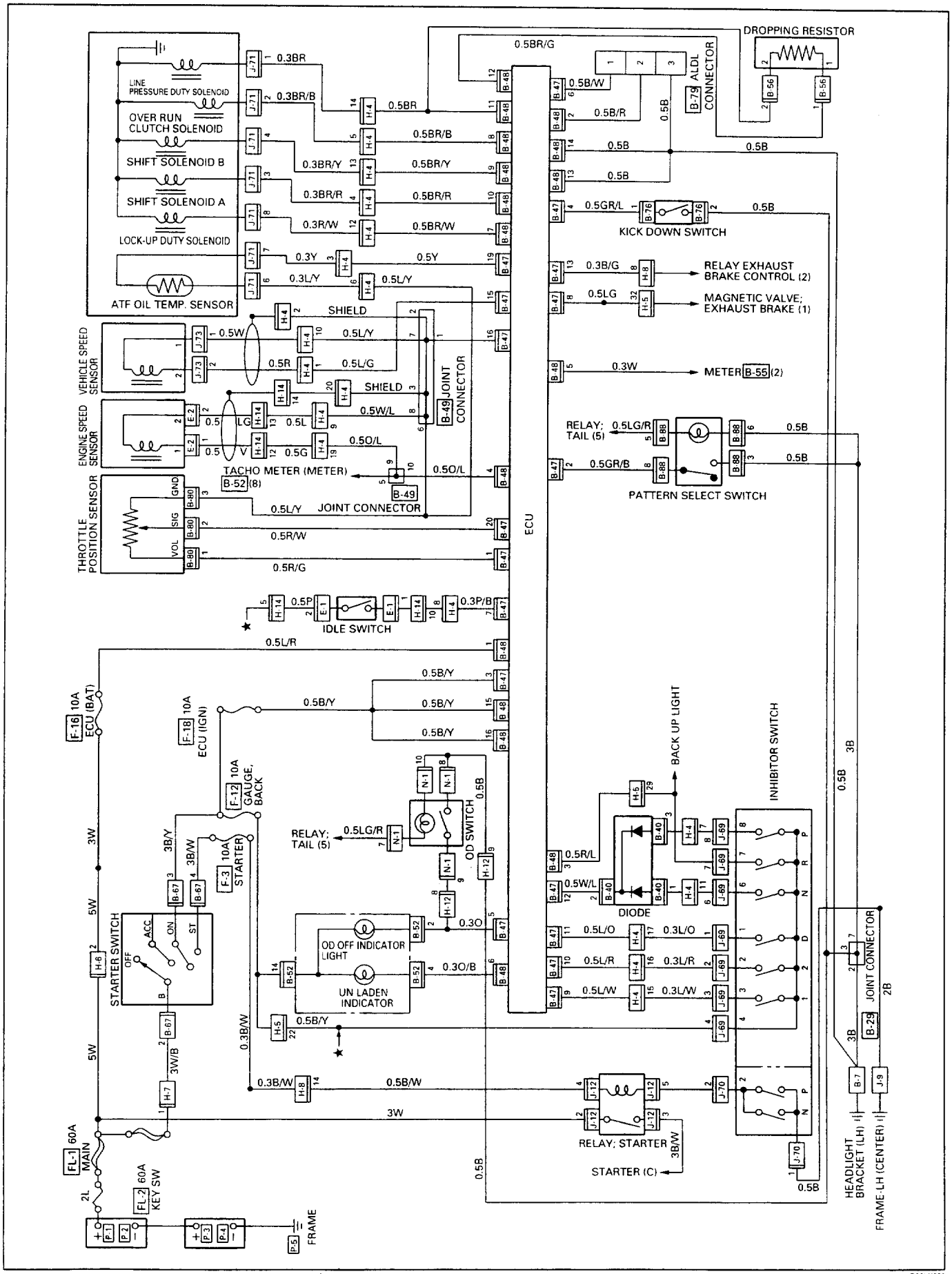
ECU OUTPUT AND INPUT DIAGRAM



PARTS LOCATION

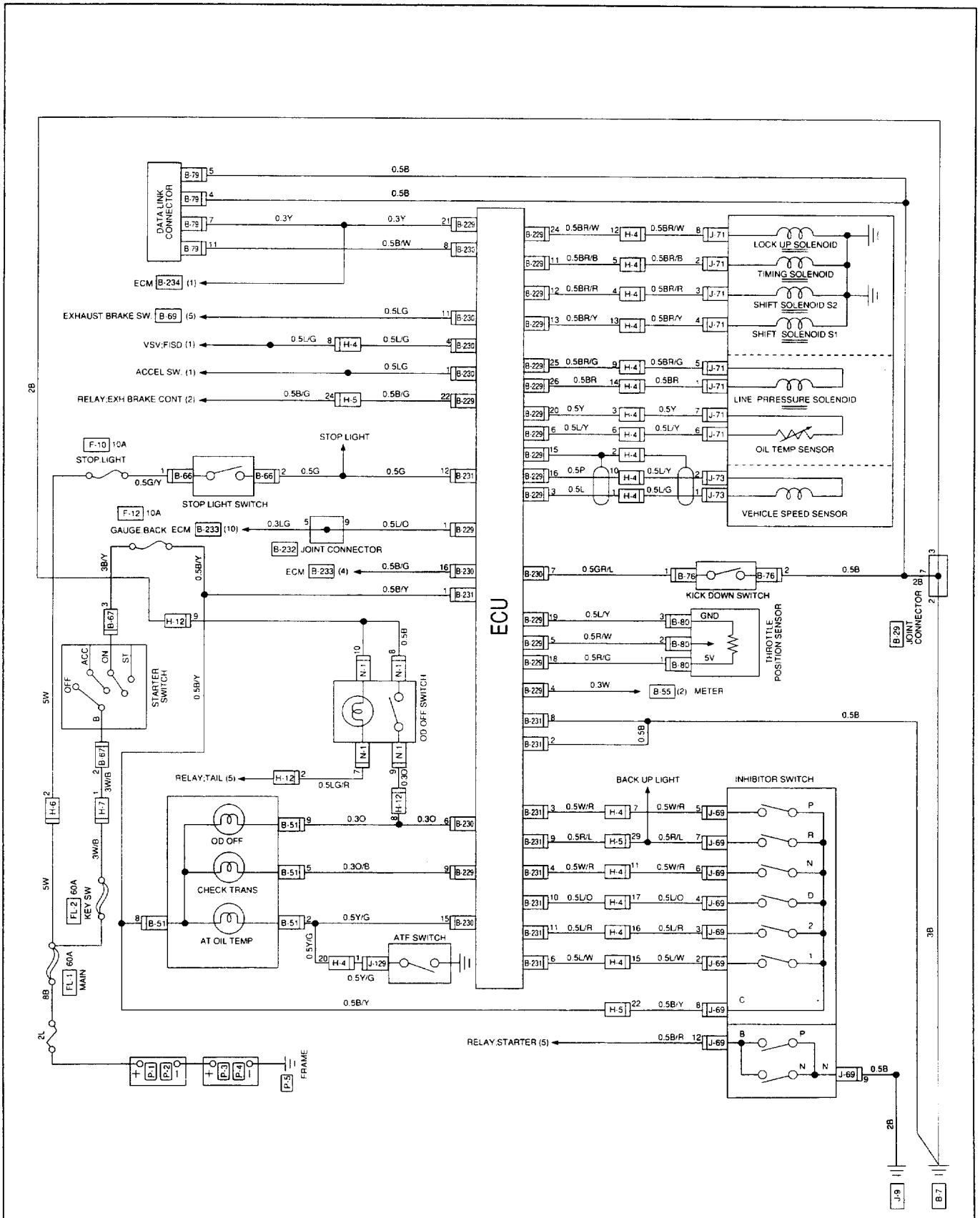


CIRCUIT DIAGRAM - FOR 4HF1 ENGINE MODEL



D08LX050

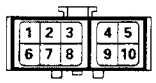
CIRCUIT DIAGRAM - FOR 4HE1 ENGINE MODEL



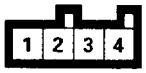
D08LX057

CONNECTOR LIST

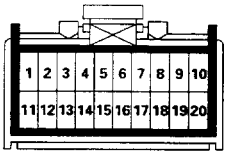
B-29 B-49 B-232



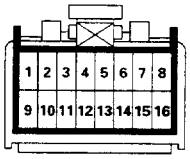
B-40



B-47



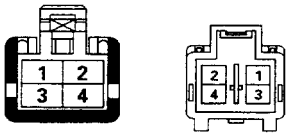
B-48



B-51

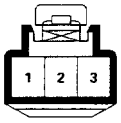
B-56

B-67

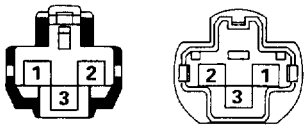


B-76

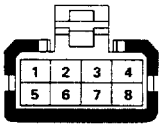
B-79



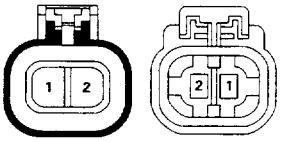
B-80



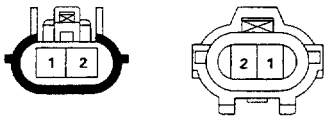
B-88



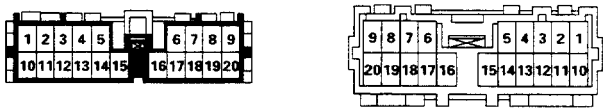
E-1



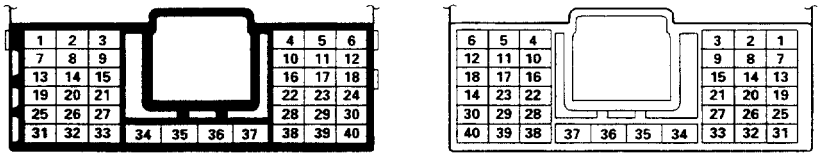
E-2 J-70 J-73



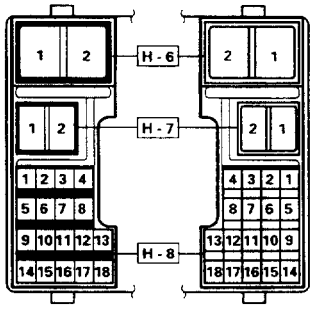
H-4



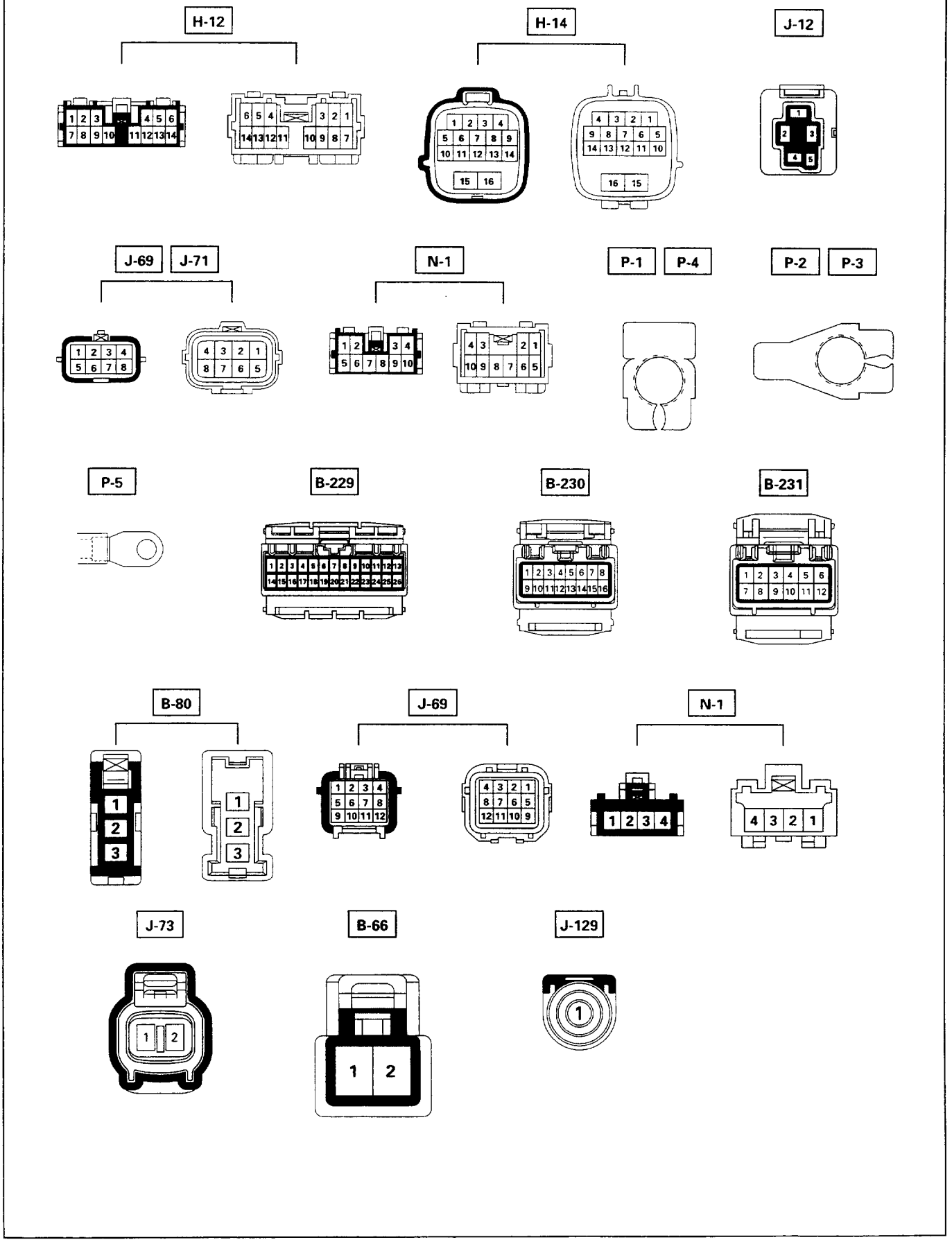
H-5



H-6 H-7 H-8



CONNECTOR LIST



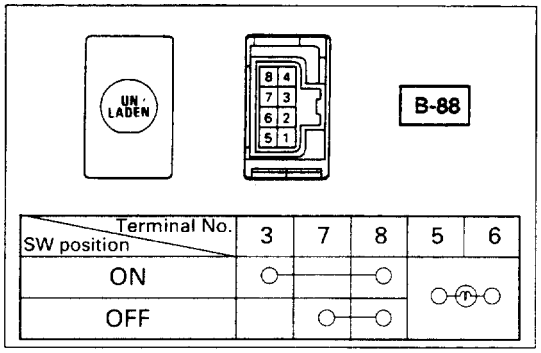
STARTER SWITCH
STARTER RELAY

Refer to "START AND CHARGING" in this section.

STOPLIGHT SWITCH

Refer to "TURN SIGNAL LIGHT, HAZARD WARNING LIGHT AND STOPLIGHT" in this section.

PATTERN SELECT SWITCH

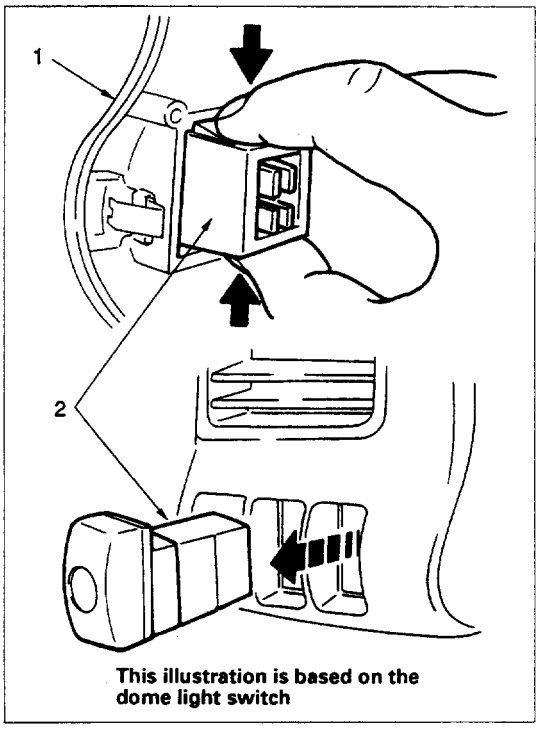


SW position \ Terminal No.	3	7	8	5	6
ON	○		○	○	○
OFF		○	○		

INSPECTION

Check the continuity between the connector terminals of the switch.

Repair or replace the switch when the result of inspection is found abnormal.



This illustration is based on the dome light switch

REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Meter cluster**

   Refer to the "METER AND WARNING/INDICATOR LIGHT" in this section.

2. **Pattern Select Switch**

   Release the lock pushing the switch from the back side of the meter cluster.

INSTALLATION

To install, follow the removal steps in the reverse order noting the following point.

1. Push the switch with your fingers until locks securely.

MEMO

WINDSHIELD WIPER AND WASHER

GENERAL DESCRIPTION

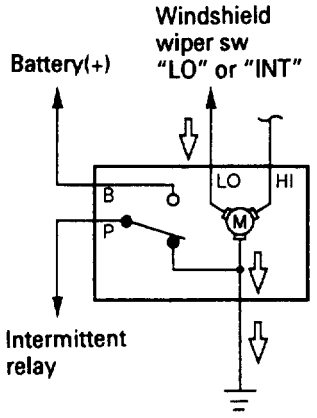
The circuit consists of the starter switch, windshield wiper & washer switch, wiper motor, washer motor and the intermittent relay.

When the wiper & washer switch is turned on with starter switch on, the battery voltage is applied to the wiper motor to activate the wiper.

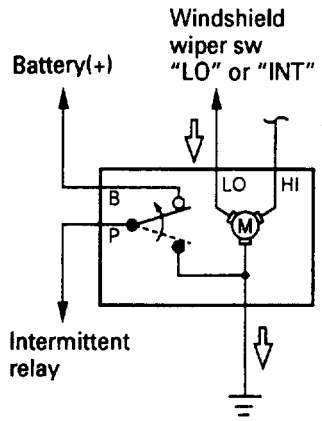
The washer motor squirts glass cleaning fluid while the washer switch is being pushed. The intermittent relay is used to control motion of the wiper.

OPERATION OF WINDSHIELD WIPER MOTOR (When wiper "LO" or "INT" position)

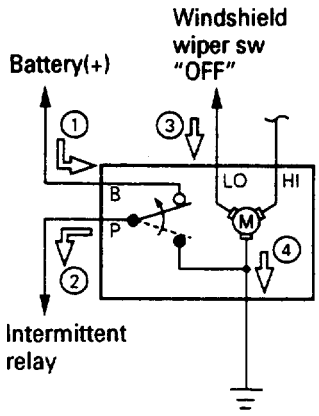
1. Condition of wiper switch is "LO"or "INT"position (Wiper motor is starting to operate)



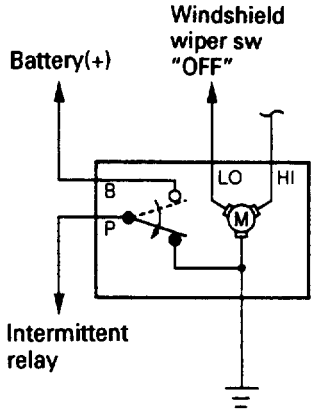
2. Condition of wiper motor is operating



3. Condition of wiper switch is just"OFF" (Wiper motor is still operating until auto-stop position)

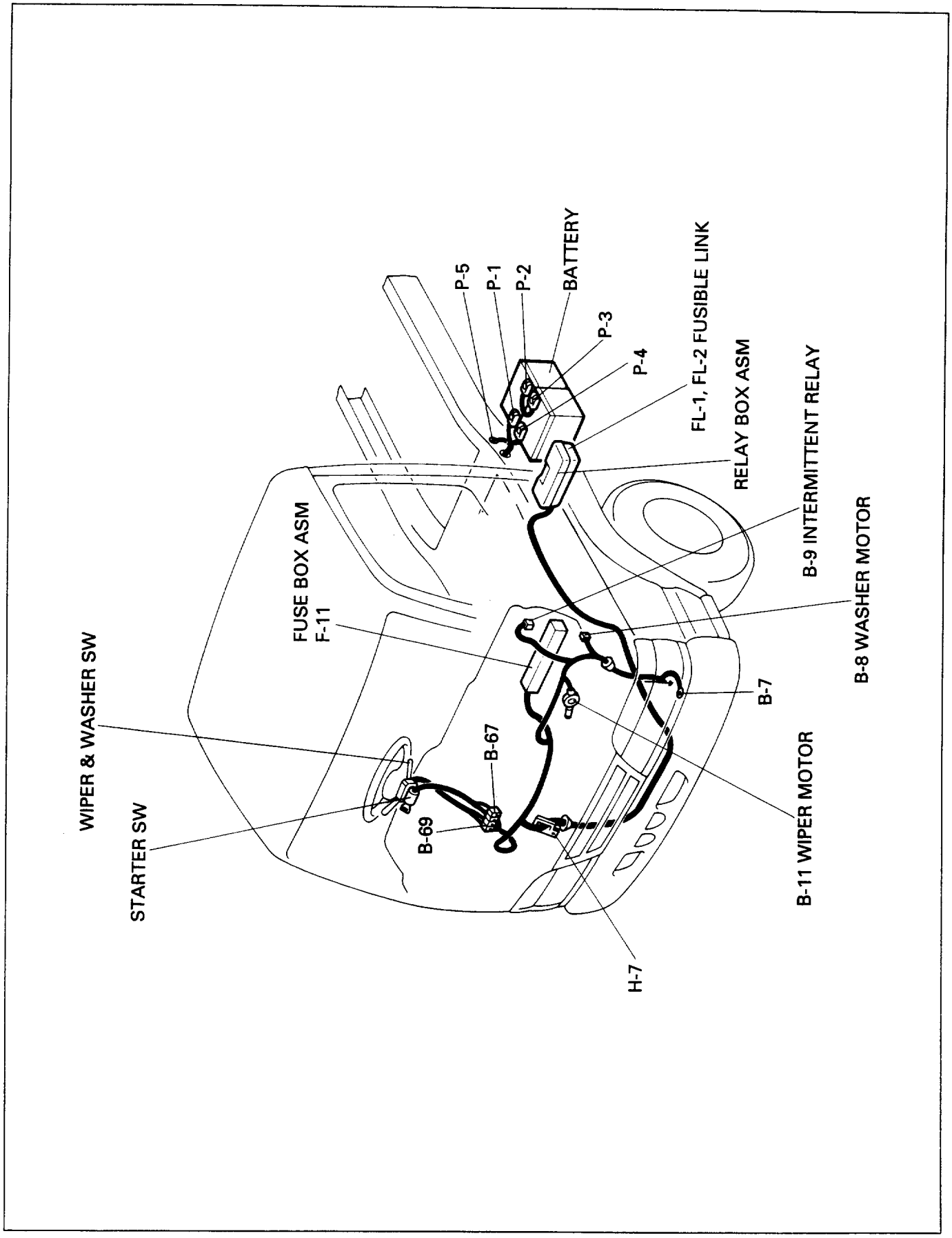


4. Wiper motor stops at auto-stop position

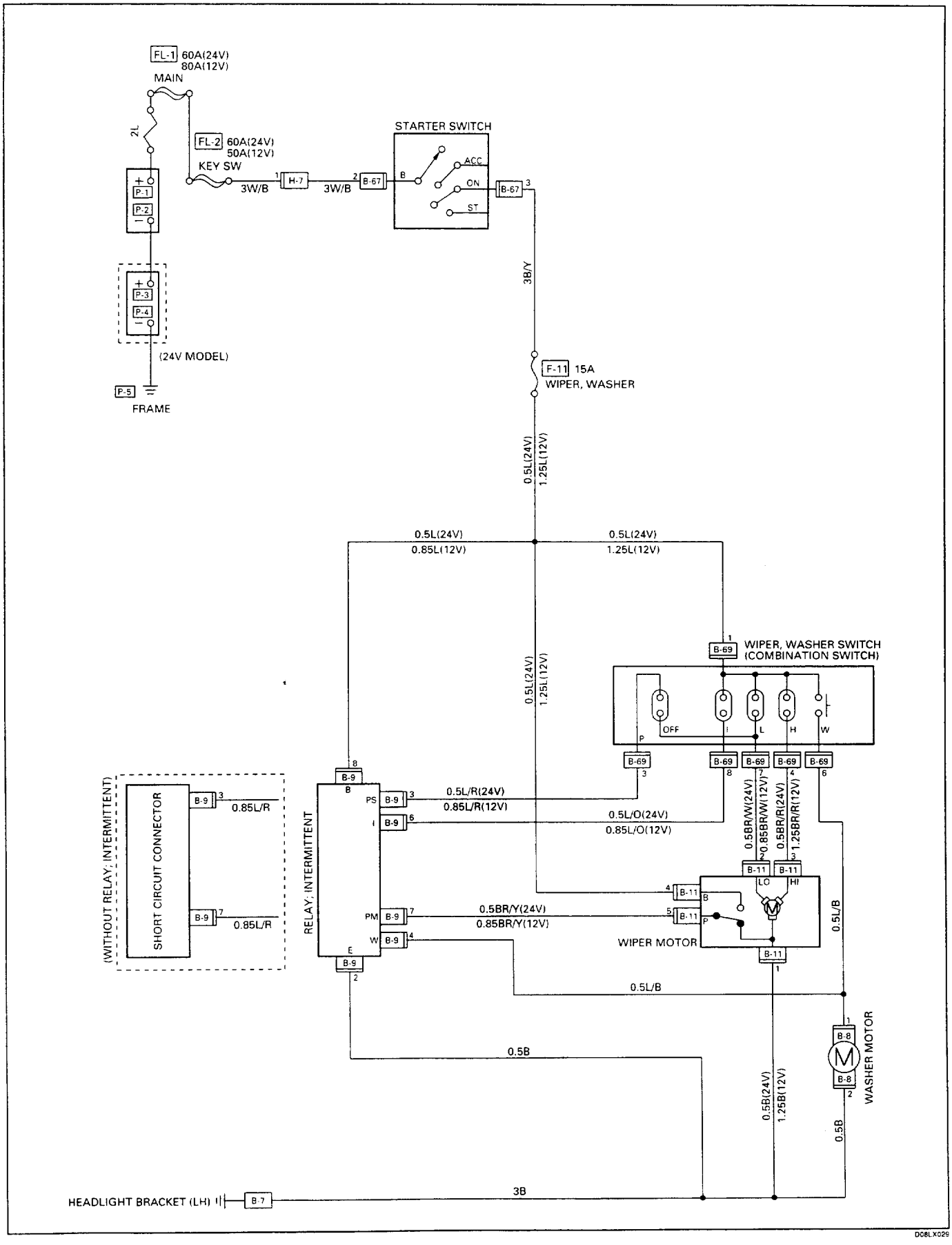


NOTE: Arrow marks "➪" indicate the direction of current

PARTS LOCATION



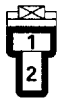
CIRCUIT DIAGRAM



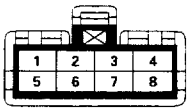
D08LX029

CONNECTOR LIST

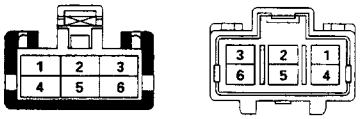
B-8



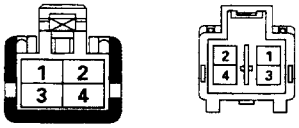
B-9



B-11

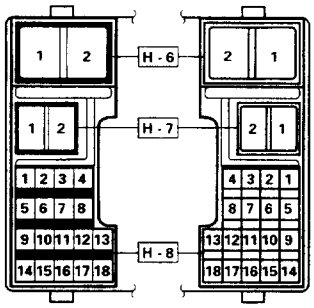


B-67

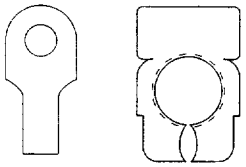


B-69

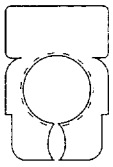
H-7



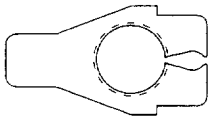
P-1 (12V) P-2



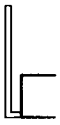
P-1 (24V) P-4



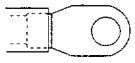
P-2 (24V) P-3



P-5 (12V)



P-5 (24V)



DIAGNOSIS

QUICK CHART FOR CHECK POINT

1.WINDSHEILD WIPER AND WASHER

Check point / Trouble mode	Fuse F-11 (15A)	Wiper & washer SW	Inter-mittent relay	Wiper motor	Washer motor	Cable harness
1. Windshield wiper does not operate at any switch position	○ (1)	○ (3)		○ (4)		○ (2)
2. Windshield wiper does not operate at "INT" position		○ (1)	○ (3)			○ (2)
3. Windshield wiper does not operate at "LO" position		○ (1)		○ (3)		○ (2)
4. Windshield wiper does not operate at "HI" position		○ (1)		○ (2)		○ (3)
5. Auto-stop function of the windshield wiper motor does not operate		○ (1)	○ (4)	○ (2)		○ (3)
6. Rotation of the windshield wiper motor does not stop		○ (1)		○ (2)		
7. Windshield washer motor does not operate		○ (1)			○ (3)	○ (2)

NOTE: Figure in parenthesis "( )" indicates the order of inspection.

1. WINDSHIELD WIPER DOES NOT OPERATE AT ANY SWITCH POSITION

- IS FUSE F-11 (15A) NORMAL?

YES

- DISCONNECT THE CONNECTOR OF THE WINDSHIELD WIPER & WASHER SWITCH
- TURN THE STARTER SWITCH ON
- IS THE BATTERY VOLTAGE APPLIED BETWEEN THE SWITCH HARNESS SIDE CONNECTOR 1 [B-69] AND THE GROUND?

YES

- IS CONTINUITY IN THE WINDSHIELD WIPER & WASHER SWITCH NORMAL?

YES

- IS [B-7] GROUNDED SECURELY?

YES

- DISCONNECT THE CONNECTOR OF THE WINDSHIELD WIPER MOTOR WITH THE MOTOR CONNECTOR 2 [B-11] CONNECTED TO THE BATTERY (+) TERMINAL, AND THE CONNECTOR 1 [B-11] TO THE (–) TERMINAL, DOES THE MOTOR ROTATE AT A LOW SPEED?
- AND WITH THE CONNECTOR 3 [B-11] CONNECTED TO THE (+) TERMINAL, DOES THE MOTOR ROTATE AT A HIGH SPEED?

YES

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN 1 [B-11] AND [B-7]

NO

REPAIR OR REPLACE THE WINDSHIELD WIPER MOTOR

NO

GROUND IT SECURELY

NO

REPAIR OR REPLACE THE SWITCH

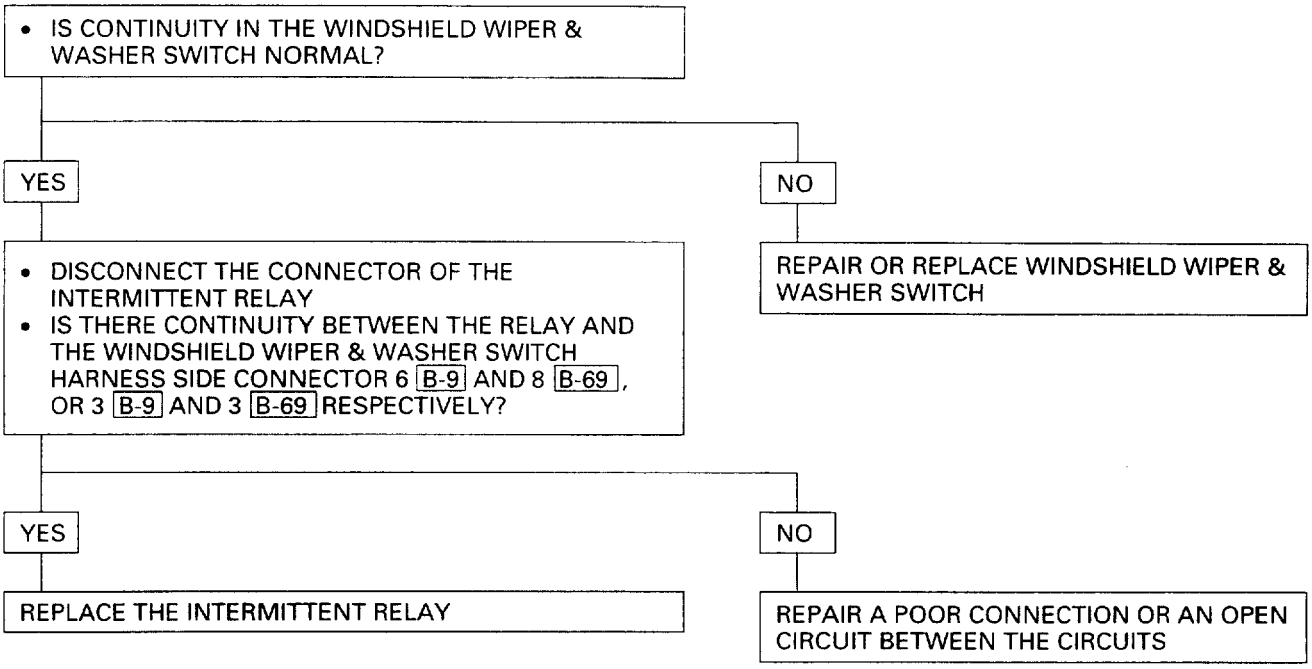
NO

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN THE FUSE F-11 (15A) AND 1 [B-69]

NO

REPLACE THE FUSE

2. WINDSHIELD WIPER DOES NOT OPERATE AT "INT" POSITION



3. WINDSHIELD WIPER DOES NOT OPERATE AT "LO" POSITION

- IS CONTINUITY IN THE WINDSHIELD WIPER & WASHER SWITCH NORMAL?

NO → REPAIR OR REPLACE THE WINDSHIELD WIPER & WASHER SWITCH

YES →

- DISCONNECT THE WINDSHIELD WIPER MOTOR CONNECTOR
- CONNECT THE BATTERY (+) TERMINAL TO THE WINDSHIELD WIPER MOTOR CONNECTOR 2 [B-11] AND THE (–) TERMINAL TO 1 [B-11]
- DOES THE MOTOR ROTATE AT A LOW SPEED?

NO → REPAIR OR REPLACE THE WINDSHIELD WIPER MOTOR

YES → REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN THE CONNECTORS 7 [B-69] AND 2 [B-11]

4. WINDSHIELD WIPER DOES NOT OPERATE AT "HI" POSITION

- IS CONTINUITY IN THE WINDSHIELD WIPER AND WASHER SWITCH NORMAL?

NO → REPAIR OR REPLACE THE WINDSHIELD WIPER & WASHER SWITCH

YES →

- DISCONNECT THE WINDSHIELD WIPER MOTOR CONNECTOR
- CONNECT THE BATTERY (+) TERMINAL TO THE WINDSHIELD WIPER MOTOR CONNECTOR 3 [B-11] AND THE (–) TERMINAL TO 1 [B-11]
- DOES THE MOTOR ROTATE AT A HIGH SPEED?

NO → REPAIR OR REPLACE THE WINDSHIELD WIPER MOTOR

YES → REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN 4 [B-69] AND 3 [B-11]

5. AUTO-STOP FUNCTION OF THE WINDSHIELD WIPER MOTOR DOES NOT OPERATE

- IS CONTINUITY IN THE WINDSHIELD WIPER AND WASHER SWITCH NORMAL?

YES

- DISCONNECT THE CONNECTOR OF THE WINDSHIELD WIPER MOTOR
- CONNECT THE MOTOR CONNECTOR 2 [B-11] TO THE BATTERY (+) TERMINAL, AND 1 [B-11] TO THE BATTERY (–) TERMINAL, AND THEN CHANGE THE CONNECTION OF THE BATTERY (+) TERMINAL TO THE CONNECTOR 4 [B-11] WHILE ROTATING THE MOTOR AT A LOW SPEED
- WHEN CONNECTING THE CONNECTOR TERMINALS 2 [B-11] AND 5 [B-11] IN THIS CONDITION, DOES THE MOTOR STOP AT AUTO STOP POSITION?

YES

- TURN THE STARTER SWITCH ON
- IS THERE BATTERY VOLTAGE APPLIED BETWEEN THE WINDSHIELD WIPER MOTOR HARNESS SIDE CONNECTOR TERMINAL 4 [B-11] AND GROUND?

YES

- DISCONNECT THE CONNECTOR OF THE WINDSHIELD INTERMITTENT RELAY
- IS THERE CONTINUITY BETWEEN THE RELAY HARNESS SIDE CONNECTOR 7 [B-9] AND THE WINDSHIELD WIPER MOTOR HARNESS SIDE CONNECTOR 5 [B-11] ?

YES

REPLACE THE WINDSHIELD INTERMITTENT RELAY

NO

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN THE CIRCUITS

NO

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN THE FUSE F-11 (15A) AND 4 [B-11]

NO

REPAIR OR REPLACE THE WINDSHIELD WIPER MOTOR

NO

REPAIR OR REPLACE THE WINDSHIELD WIPER & WASHER SWITCH

6. ROTATION OF THE WINDSHIELD WIPER MOTOR DOES NOT STOP

- IS CONTINUITY IN THE WINDSHIELD WIPER & WASHER SWITCH NORMAL?

NO → REPAIR OR REPLACE THE WINDSHIELD WIPER & WASHER SWITCH

YES →

- THE MOMENT THE WINDSHIELD WIPER COMES TO AUTO-STOP POSITION, TURN THE STARTER SWITCH OFF.
  (ALTERNATIVELY, CONNECT THE BATTERY (+) TERMINAL TO THE WINDSHIELD WIPER MOTOR CONNECTORS 2 [B-11] AND THE (–) TERMINAL TO 1 [B-11], AND THEN MOVE THE WINDSHIELD WIPER MOTOR TO AUTO-STOP POSITION AND STOP IT

YES →

CONFIRM CONTINUITY BETWEEN THE WINDSHIELD WIPER MOTOR SIDE CONNECTOR TERMINALS 4 [B-11] AND 5 [B-11], AND REPAIR OR REPLACE THE MOTOR

7. WINDSHIELD WASHER MOTOR DOES NOT OPERATE

- IS CONTINUITY IN THE WINDSHIELD WIPER & WASHER SWITCH NORMAL?

YES

- TURN THE STARTER SWITCH ON
- IS THE BATTERY VOLTAGE APPLIED BETWEEN THE WINDSHIELD WIPER & WASHER SWITCH HARNESS SIDE CONNECTOR TERMINAL 1 [B-69] AND THE GROUND?

YES

- DISCONNECT THE CONNECTOR OF THE WINDSHIELD WASHER MOTOR
- TURN THE STARTER SWITCH ON
- WITH THE WASHER BUTTON OF THE WINDSHIELD WIPER & WASHER SWITCH DEPRESSED, IS THE BATTERY VOLTAGE APPLIED BETWEEN THE WASHER MOTOR HARNESS SIDE CONNECTOR TERMINAL 1 [B-8] AND THE GROUND?

YES

- IS [B-7] GROUNDED SECURELY?

YES

- CONNECT THE MOTOR SIDE CONNECTOR 1 [B-8] OF THE WINDSHIELD WASHER MOTOR TO THE BATTERY (+) TERMINAL, AND THE CONNECTOR 2 [B-8] TO THE (–) TERMINAL
- DOES THE MOTOR ROTATE?

YES

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN 2 [B-8] AND [B-7]

NO

REPAIR OR REPLACE THE WINDSHIELD WASHER MOTOR

NO

GROUND IT SECURELY

NO

REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN 1 [B-8] AND 6 [B-69]

NO

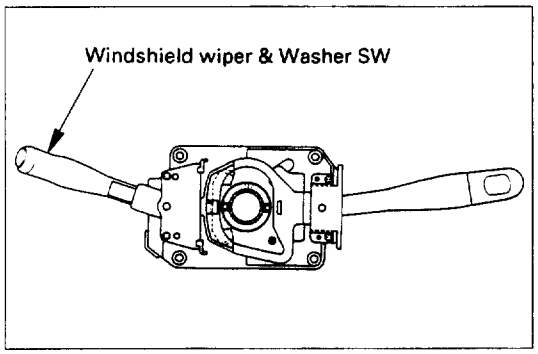
REPAIR A POOR CONNECTION AT THE CONNECTORS OR AN OPEN CIRCUIT BETWEEN FUSE F-11 (15A) AND 1 [B-69]

NO

REPAIR OR REPLACE THE WINDSHIELD WIPER & WASHER SWITCH

STARTER SWITCH

Refer to "START AND CHARGING" in this section.



WINDSHIELD WIPER & WASHER SWITCH

With the starter switch on, the windshield wiper and washer switch controls the start and stop operation as well as the change of operating speeds.

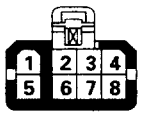
Both the windshield washer motor and the wiper motor jointly operate while the washer button is pushed.

INSPECTION

Check the continuity between the connector terminals of the switch.

Repair or replace the switch when the result of inspection is found abnormal.

B-69

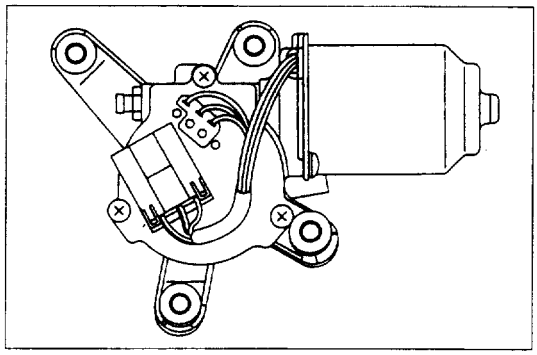


Switch side

Washer SW	Wiper SW	Terminal No.					
		3	7	1	4	8	6
OFF	OFF	○	○				
	INT	○	○	○		○	
	LO		○	○			
	HI			○	○		
ON	OFF, INT LO, HI			○			○

REMOVAL AND INSPECTION

Refer to "HEADLIGHT, FOG LIGHT AND CORNERING LIGHT" in this section.



WINDSHIELD WIPER MOTOR

INSPECTION

1. **Operation in low speed**

   With the motor connector terminal 2 [B-11] connected to the battery (+) terminal and the connector 1 [B-11] to the (–) terminal, check to see if the motor rotates in low speed.

2. **Operation in high speed**

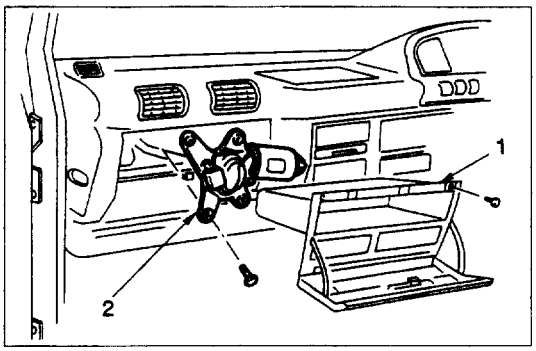
   With the motor connector terminal 3 [B-11] connected to the battery (+) terminal and the connector 1 [B-11] to the (–) terminal, check to see if the motor rotates in low speed.

3. **Stop operation**

   After stopping the windshield wiper in the position on the way by confirming the operation at the low speed in item No. 1.

   When the connectors 2 [B-11] and 5 [B-11] are connected, while connecting the motor connector terminal 4 [B-11] to the battery (+) terminal, check to see, if the motor rotates at low speed and stops at the auto-stop position.

   Repair or replace the motor when the results of the above inspections are found abnormal.



REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Glove Box**

   Refer to "GLOVE BOX" of section 10 "BODY".

2. **Windshield Wiper Motor**

   1) Disconnect the connector.
   2) Remove four screws.
   3) Remove the ball joint between crank arm and wiper link.

INSTALLATION

To install, follow the removal steps in the reverse order, noting the following points.

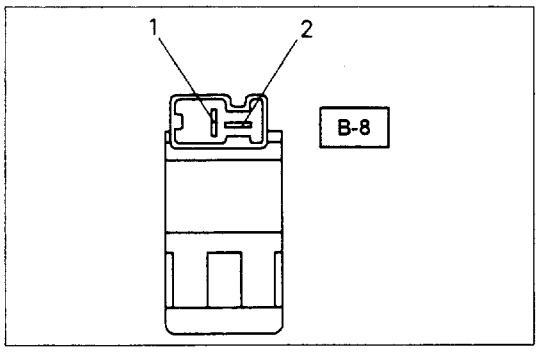
- Windshield Wiper Motor

  When the crank arm is removed from the windshield wiper motor, tighten the motor shaft nut with the specified torque.

Shaft nut torque	N·m (kg·cm/lb·in)
17 (170 / 147)	

- Temporarily fit the motor by using one of the four wiper motor fixing screws.
- Put the crank arm ball joint in the wiper link hole and fix them together while pulling the wiper link.

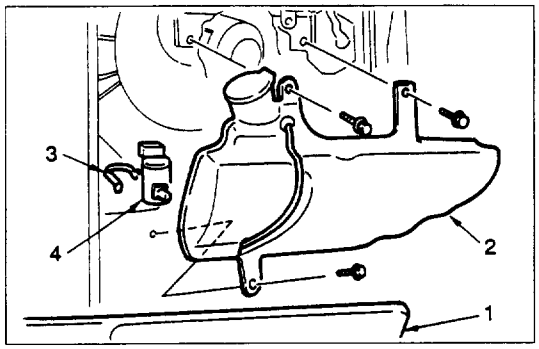
WINDSHIELD WASHER MOTOR



INSPECTION

With the battery (+) terminal connected to the washer motor connector terminal 1 B-8 and the (–) terminal to the connector 2 B-8 , check to see if the cleaning fluid pushes out.

Replace the tank/motor when the result of inspection is found abnormal.



REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Instrument Panel Under Cover**

   Refer to "INSTRUMENT PANEL" of section 10 "CAB".
2. **Washer Tank**
   1) Disconnect the washer motor connector.
   2) Disconnect the washer hose.
   3) Remove three fixing screws.
3. **Clip Band**
4. **Windshield Washer Motor**

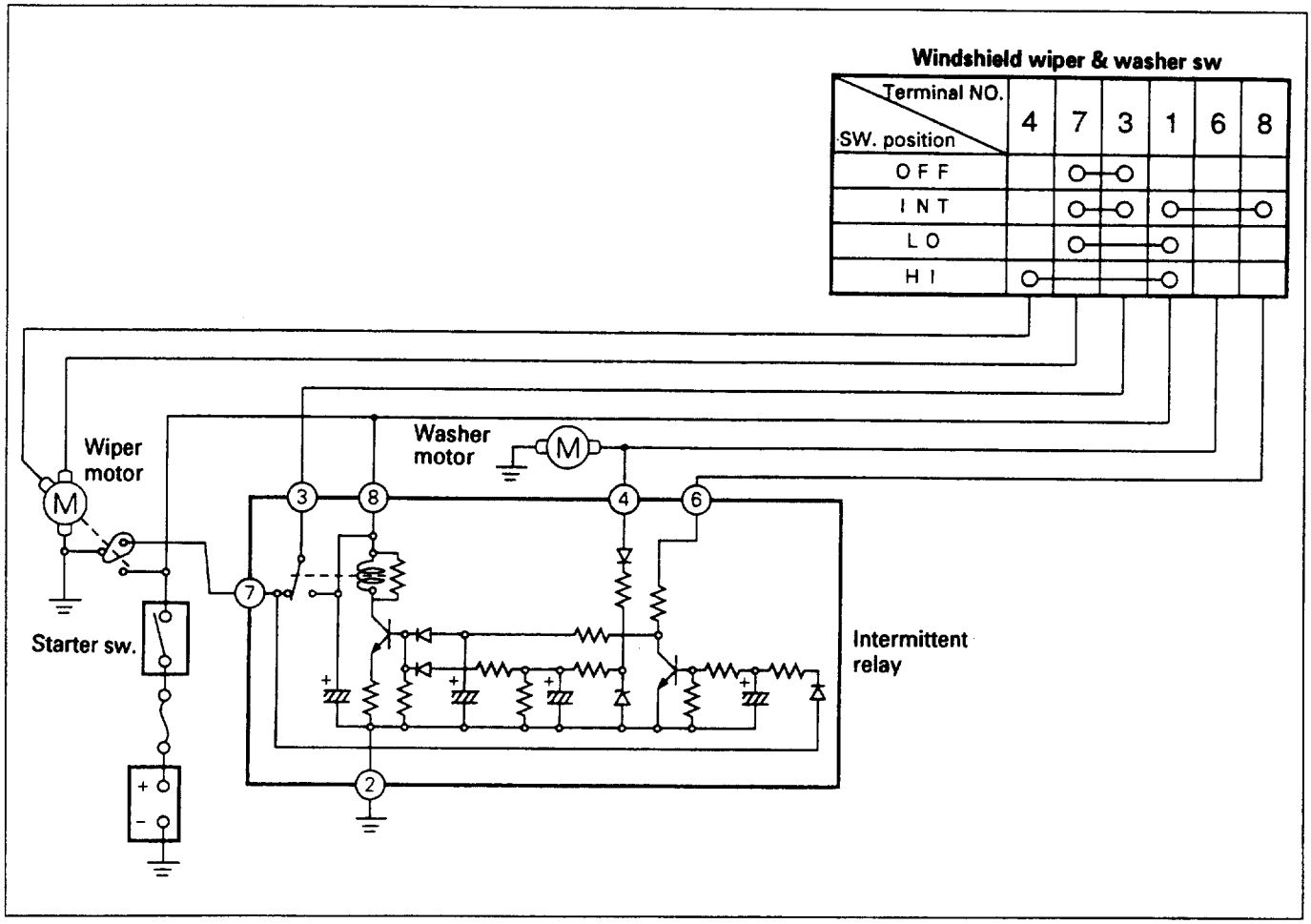
   Hold the motor and pull it out from the washer tank.

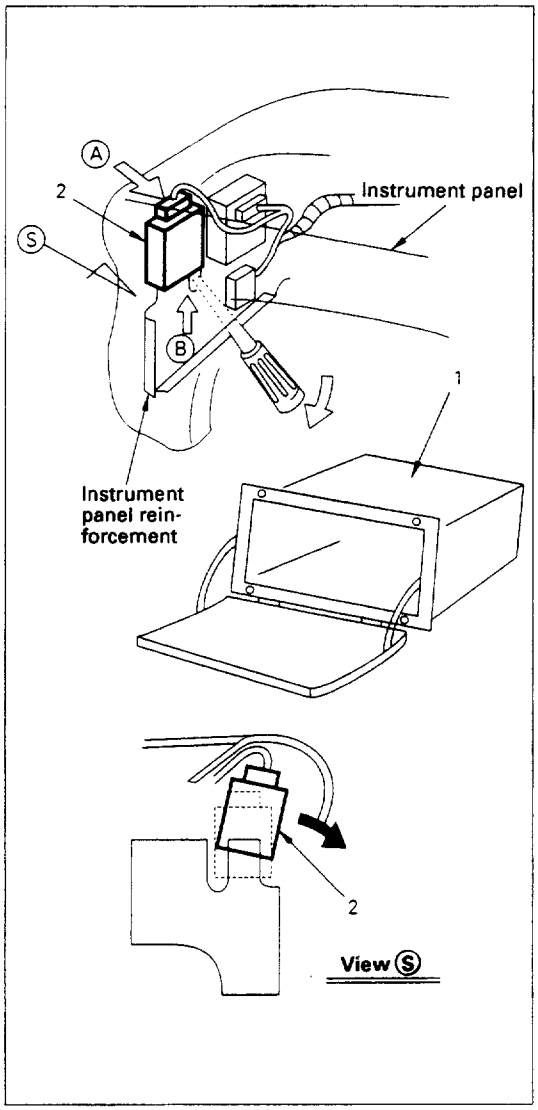
INSTALLATION

To install, follow the removal steps in the reverse order.

INTERMITTENT RELAY

CIRCUIT DIAGRAM





REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Glove Box**

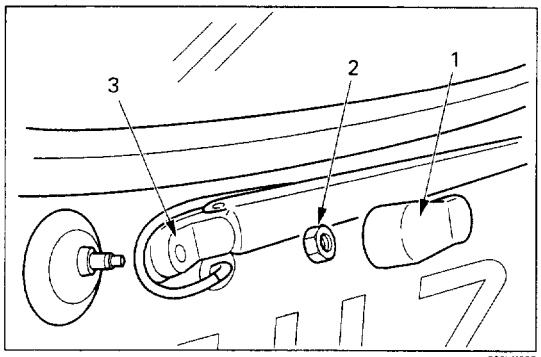
   Open the lid and remove the four screws.

2. **Intermittent Relay**

   1) Press Ⓐ position with your finger and pry up Ⓑ position with the tip of a screw-driver.
   2) When the relay moves up by about 2/3 of its size, tilt and take off the relay to avoid interference with the instrument panel.
   3) Disconnect the connector.

INSTALLATION

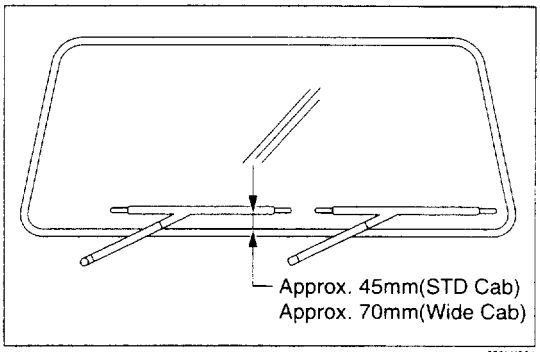
To install, follow the removal steps in the reverse



WINDSHIELD WIPER ARM/BLADE

REMOVAL

1. **Cover**
2. **Wiper Arm Nut**
3. **Wiper Arm/Blade**



INSTALLATION

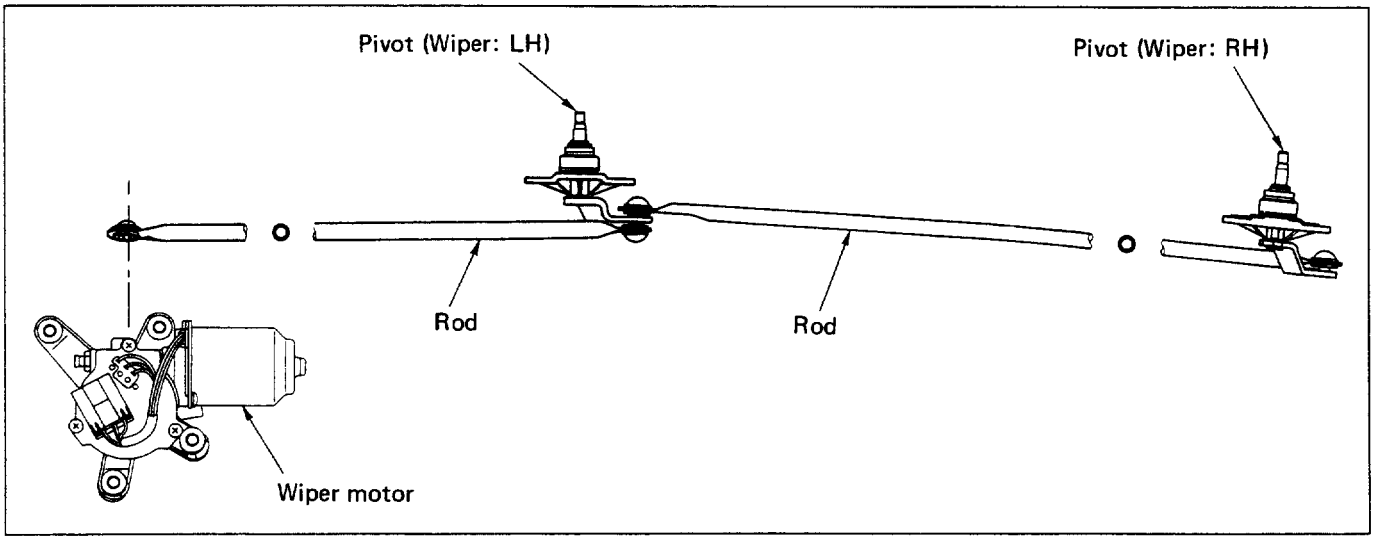
To install, follow the removal steps in the reverse order, noting the following points.

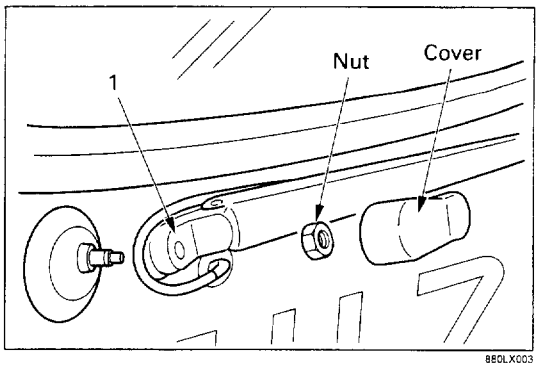
1) Before installing the wiper arm/blade to the shaft, confirm that the motor stops at the auto-stop position.
2) Set the wiper arm/blade so that the tips of both blades are positioned as shown in the illustration.
3) Tighten the wiper arm nut to the specified torque.

Wiper arm nut torque	N·m (kg·cm/lb·in)
	17 (170 / 147)

WINDSHIELD WIPER LINKAGE

LOCATION OF ROD AND PIVOT



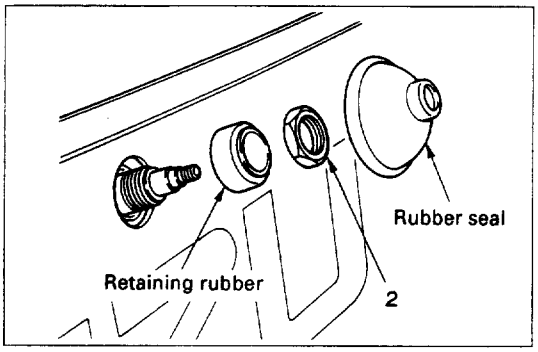


REMOVAL

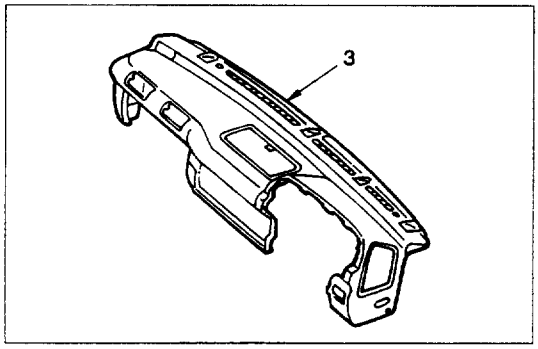
Preparation:

Disconnect the battery ground cable.

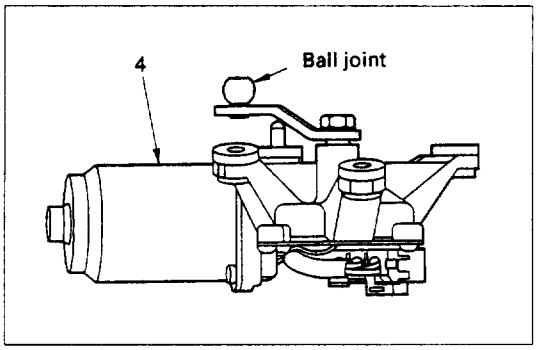
1. **Wiper Arm & Blade**
   Remove the cover, nut and wiper arm & blade.



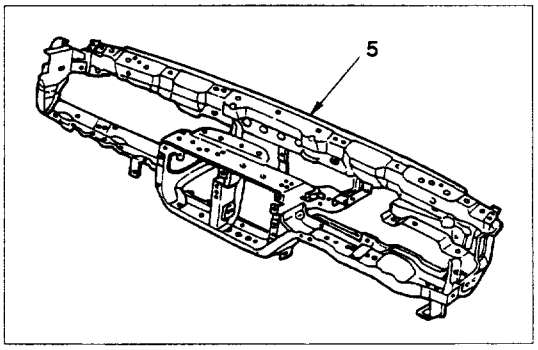
2. **Pivot Nut**
   Remove the rubber seal, nut and retaining rubber.



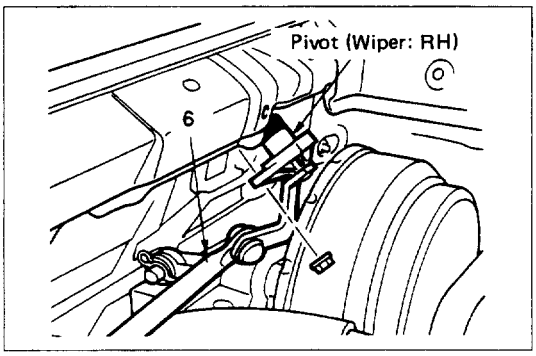
3. **Instrument Panel Assembly**
   Refer to "INSTRUMENT PANEL" of section 10 "CAB".



4. **Wiper Motor**
   1) Remove four screws.
   2) Disconnect the ball joint between the crank arm and the wiper link.

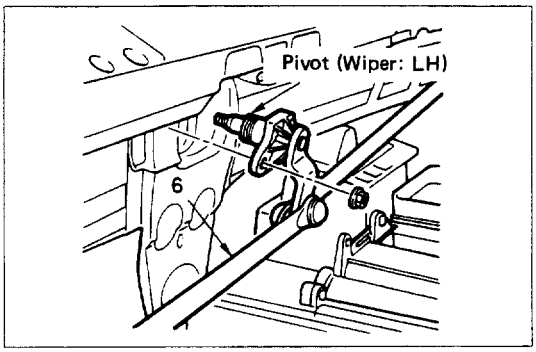


5. **Instrument Panel Reinforcement**
   Refer to "INSTRUMENT PANEL" of section 10 "CAB".



6. Wiper Link Assembly

Remove two retaining nut from right hand side of pivot.



Remove two retaining nut from left hand side of pivot.

INSTALLATION

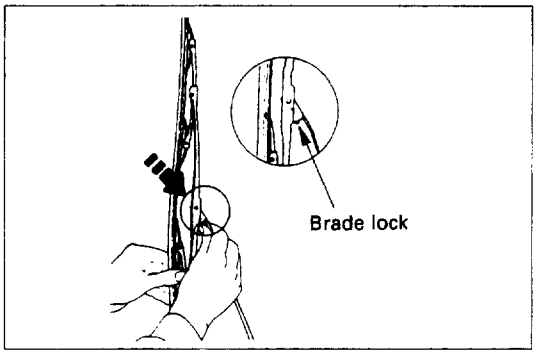
To install, follow the removal steps in the reverse order, noting the following points.

- Temporarily fit the wiper motor by using one of the four wiper motor fixing screw.
- Put the crank arm ball joint in the wiper link hole and fix them together while pulling the wiper link.
- Fit the motor with four screws.
- Tighten the pivot nut with the specified torque.

Pivot nut torque	N·m (kg·cm/lb·in)
8 (80 / 70)	

- Tighten the wiper arm nut with the specified torque.

Wiper arm nut torque	N·m (kg·cm/lb·in)
17 (170 / 147)	



WIPER BLADE RUBBER

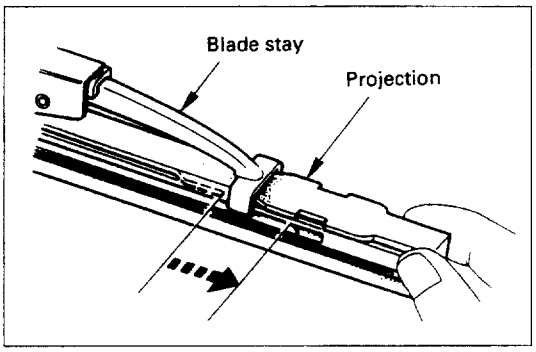
REMOVAL

1. **Wiper Blade**

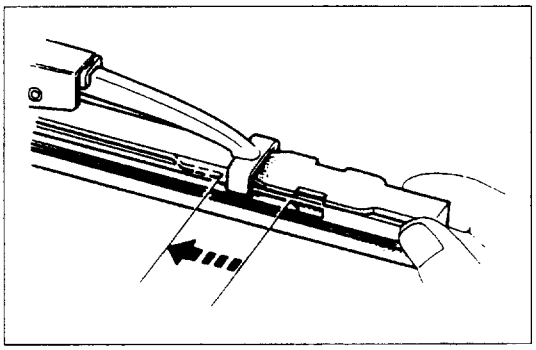
   Push the wiper blade lock while pulling the wiper blade in the arrow direction.

   NOTE:

   When the wiper blade has been removed, wrap the tip of the wiper arm with cloth, to avoid damaging the glass.



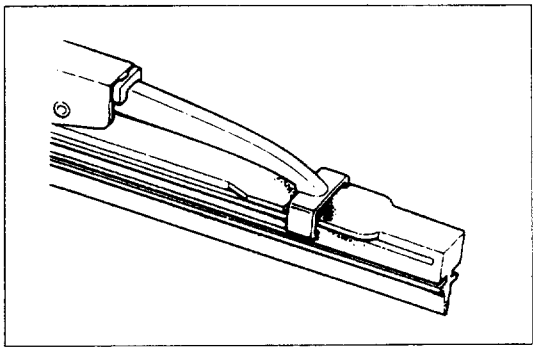
2. **Wiper Blade Rubber**
   1) Pull the end of rubber and remove the projection from the click of the blade stay.
   2) Pull the rubber out in the same direction.



INSTALLATION

2. **Wiper Blade Rubber**

   Install the click of the blade stay in the groove of the new rubber and slide it in. Complete installation by pushing the click.



Finally, check that the click of the stay has caught in the hole of the rubber.

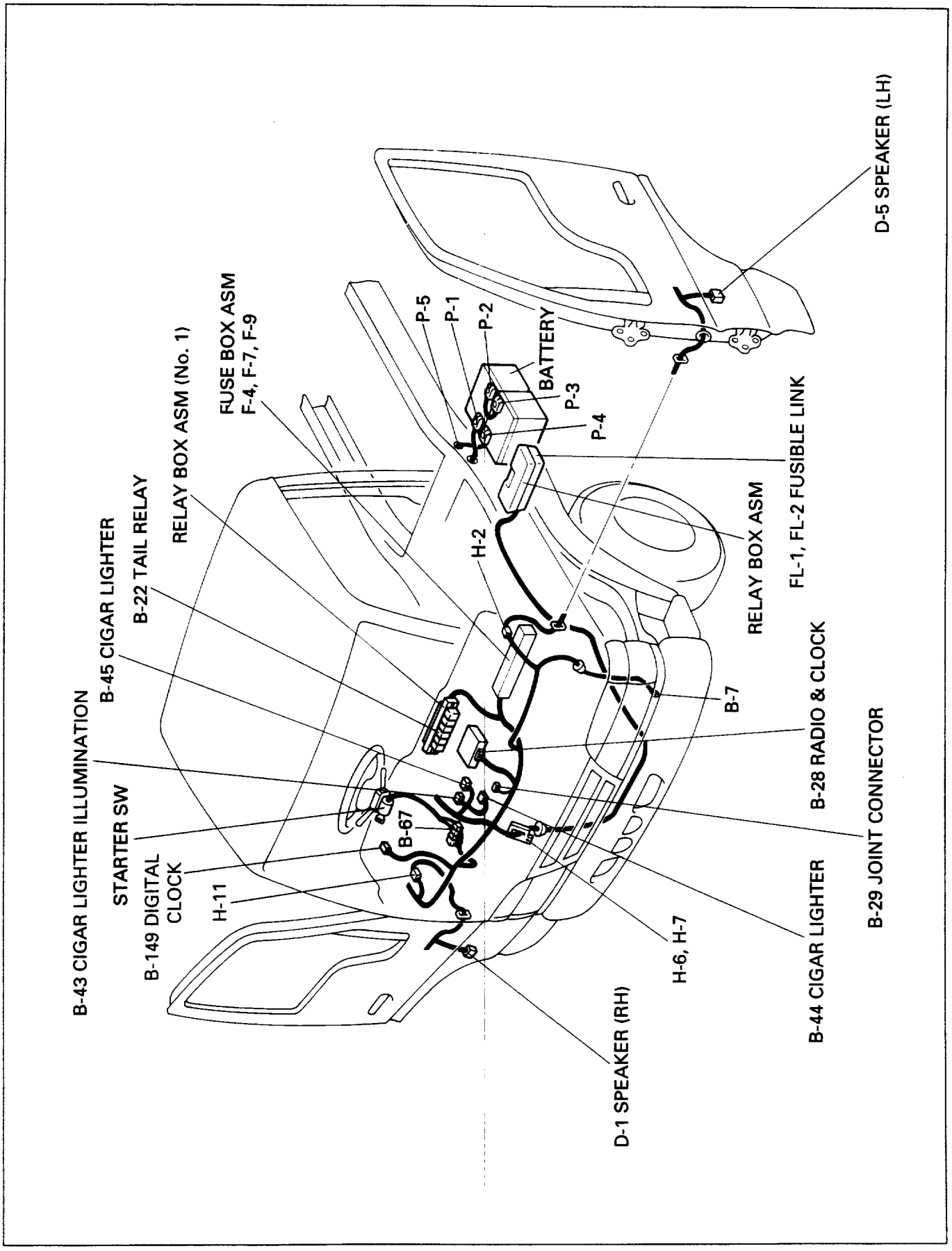
1. **Wiper Blade**

AUDIO AND CIGAR LIGHTER

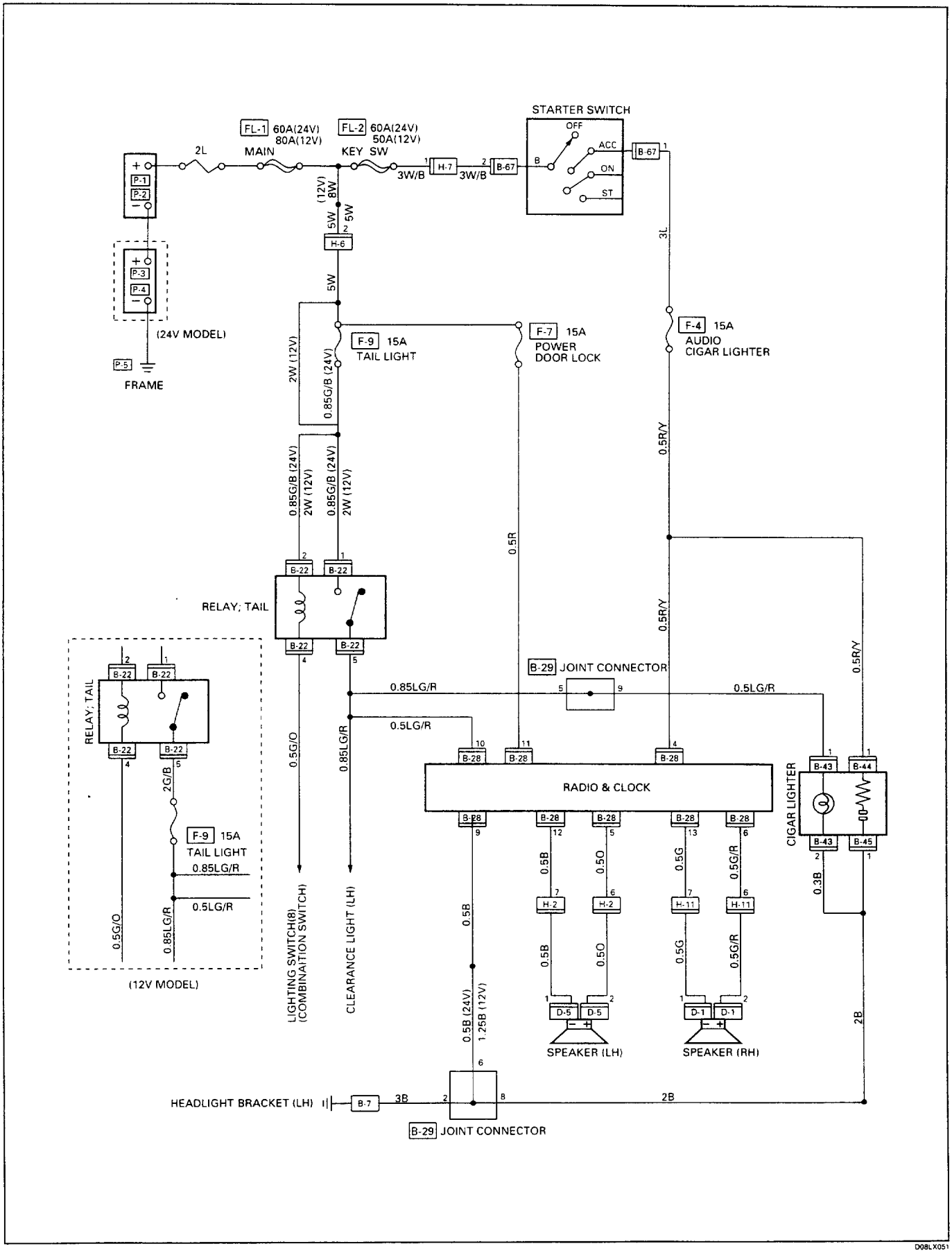
GENERAL DESCRIPTION

The circuit consists of the starter switch, radio, cigar lighter and the relay.
The audio circuit is designed for the current to flow through the receiver circuit when the radio switch is turned on with the starter switch in "ACC" or "ON". Current runs through the memory circuit of the audio regardless of the position of the starter switch.
When the cigar lighter is pushed in with the starter switch at either "ACC" or "ON" position, a circuit is formed in the cigar lighter case to heat the lighter coil. The cigar lighter is spring back to its original position after the lighter coil is heated.

PARTS LOCATION

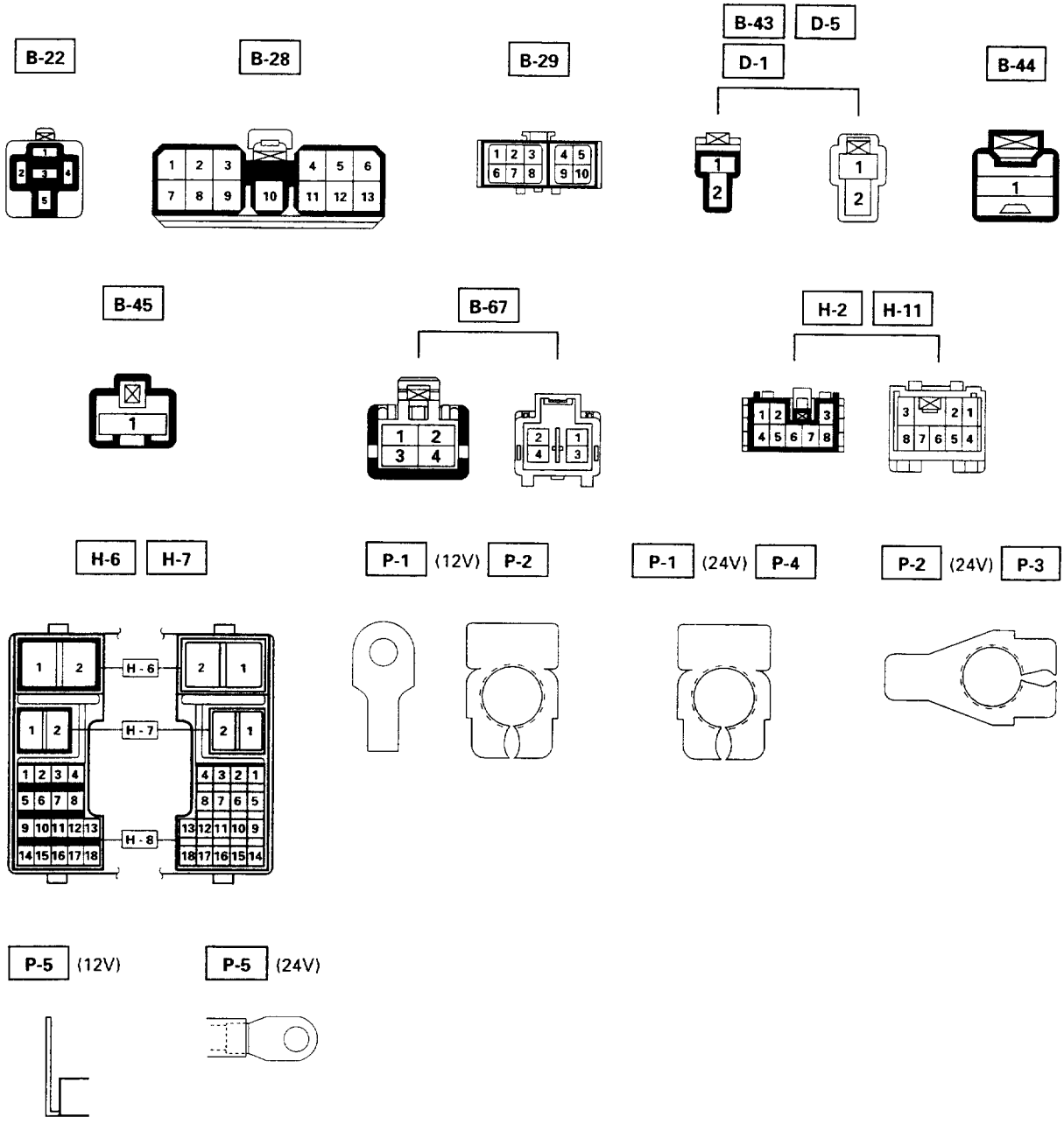


CIRCUIT DIAGRAM



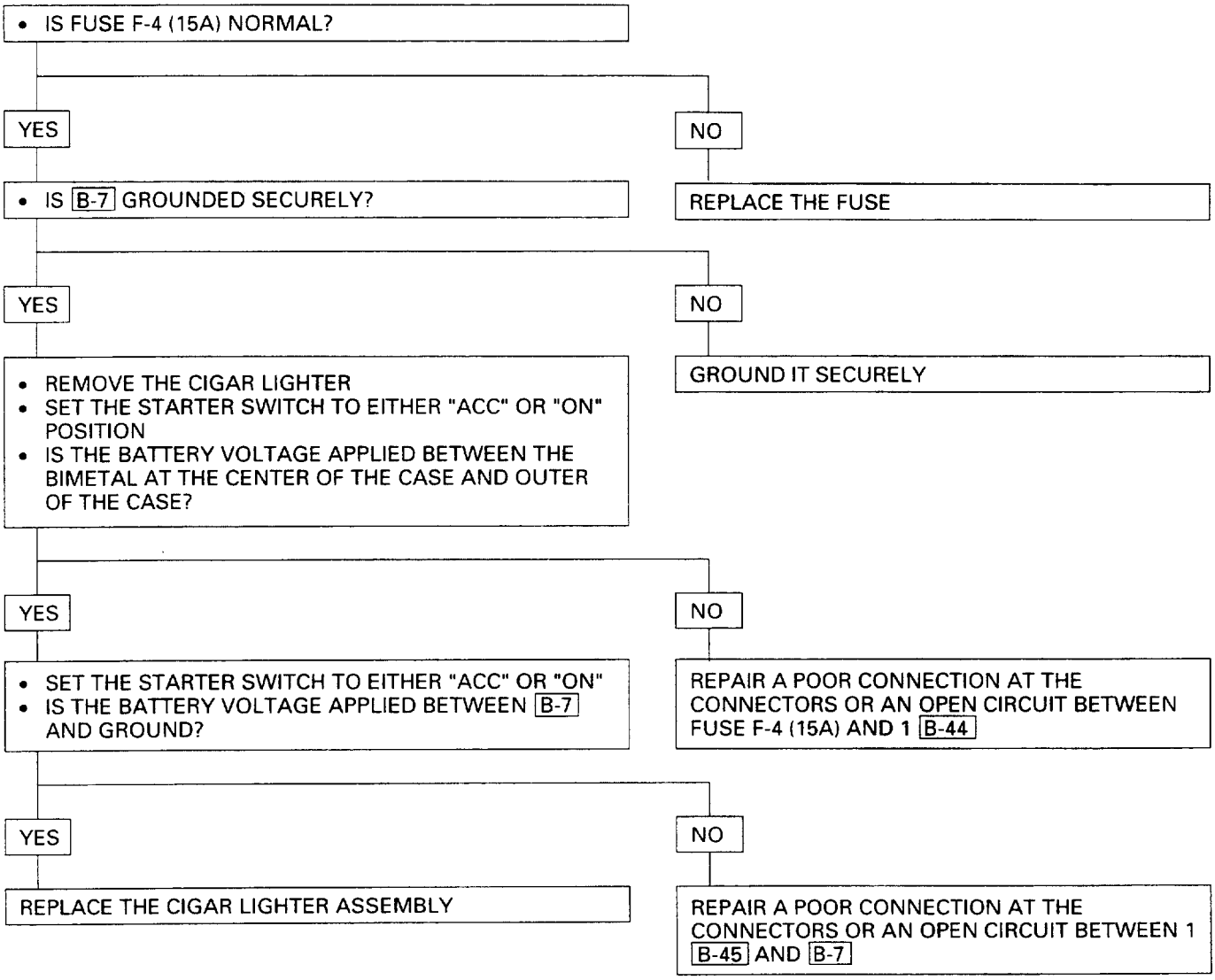
D08LX051

CONNECTOR LIST

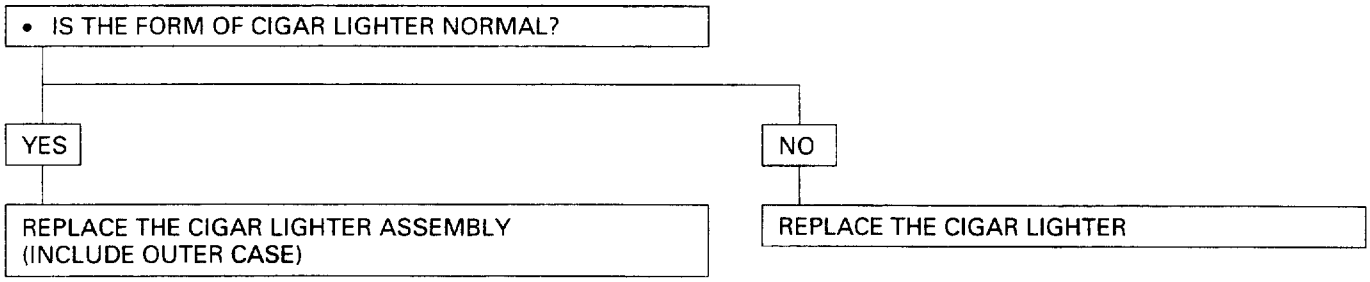


DIAGNOSIS

1. CIGAR LIGHTER DOES NOT HEAT SUFFICIENTLY



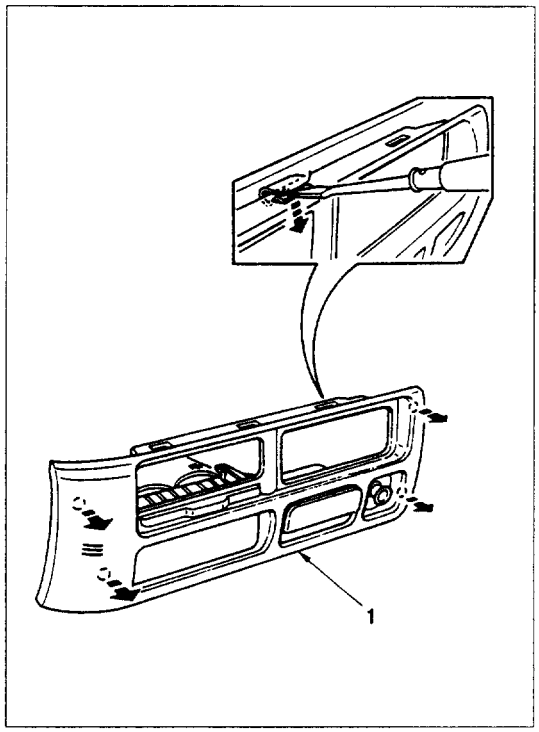
2. THE CIGAR LIGHTER DOES NOT SPRING OUT AFTER BEING HEATED



STARTER SWITCH

Refer to "START AND CHARGING" in this section.

RADIO



REMOVAL

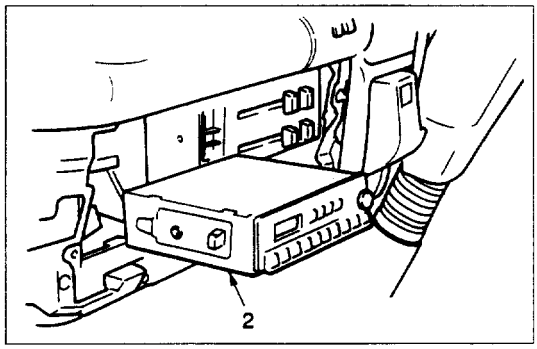
Preparation:

Disconnect the battery ground cable.

1. **Center Cluster**
   1) Pull it to remove. Pry off three clips by the tip of screwdriver.
   2) Remove the cigar lighter power source and its illumination connector.

Note:

To remove the center cluster, do not force to pry off three clips at upper portion of the center cluster.

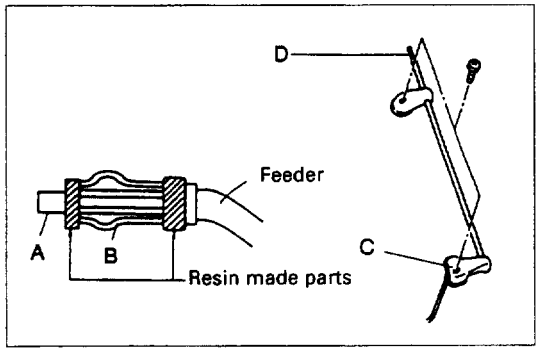


2. **Radio**
   1) Remove two radio fixing screws.
   2) Disconnect the connector and feeder plug.

INSTALLATION

To install, follow the removal steps in the reverse order.

ANTENNA



INSPECTION

The metal A is connected to the pole D at the top of the antenna through the core of the feeder.

The metal B is fitted in the feeder shielding the core, and grounded at the screw C to avoid the core hampered by noise.

Defective grounding would cause noise.

In checking, measure the following three points with the circuit tester in the range of "resistence x 1 (Ω)"

Between A and B

No continuity (No reading at the indicator) → Normal

Continuity (A bite in the feeder. The core grounded) → Lower reception

Between B and C

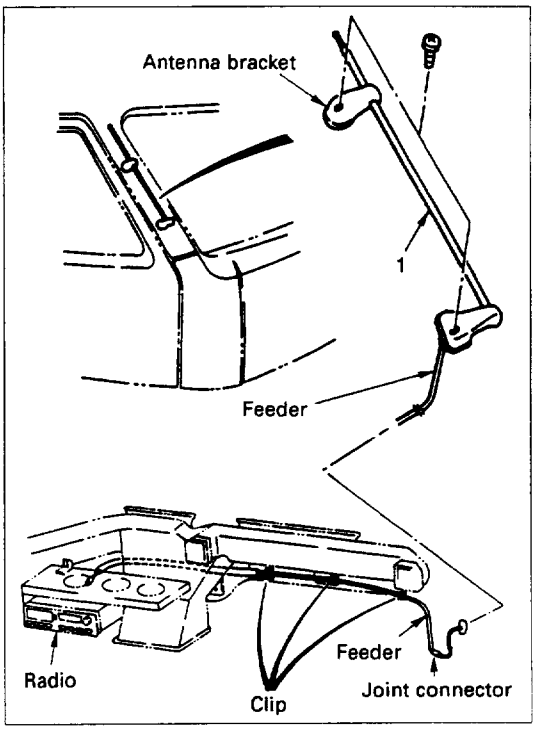
Continuity (Indicator reading: 0Ω) → Normal.

No continuity (Shielded core disconnected or defective grounding at the screw → Hampered by noise)

Between A and D

Continuity or no continuity

There are some antenna feeders and relay feeders with a condenser built in their connections. Measuring resistance between the two points does not result in correct judgment. Connect temporarily another normal antenna to the radio and check to see if its reception is audible. Most antenna now available are slide type. Rust at the screw C and the cab panel where grounded would lead no continuity, followed by lower reception. Keep this portion clean to avoid rust.



REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Antenna**
   1) Disconnect the joint connector.
   2) Remove the upper and lower side antenna bracket.
   3) Pull out the antenna feeder.

NOTE:

For easier fitting, tie the lead wire to the end of the antenna feeder in advance.

INSTALLATION

To install, follow the removal steps in the reverse order.

SPEAKER

INSPECTION

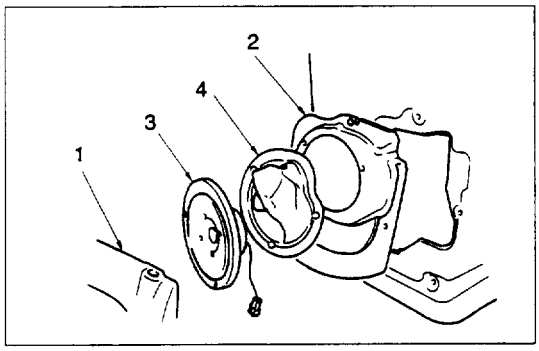
1. With the circuit tester set to the range of x 1 (Ω), connect the circuit tester probes (red and black) to the (+) and (–) terminals of the speaker.
2. When the speaker is normal, a low buzzing sound is heard.
3. When the speaker is defective, no sound is heard.

   However, the distortion or chattering of the sound cannot be identified.

   When the speaker is installed to the vehicle, disconnect the connectors before checking.

   When no sound is heard, the following are considered as the cause.

- The speaker wiring is disconnected at the speaker terminals.
- The speaker body is defective.
- There is an open circuit somewhere in the speaker harness on the vehicle side.
- The speaker harness on the vehicle side is grounded or caught up.



REMOVAL

Preparation:

Disconnect the battery ground cable.

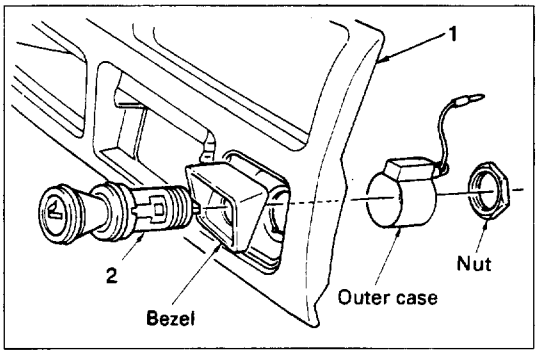
1. **Door Pad**

   Refer to "FRONT DOOR TRIM PAD" of section 10 "BODY"
2. **Speaker Panel**

   Disconnect the speaker connector.
3. **Speaker**
4. **Water proof sheet**

INSTALLATION

To install, follow the removal steps in the reverse order.



CIGAR LIGHTER

REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Center Cluster**

   Refer to "RADIO" in this section.

2. **Cigar Lighter Assembly**

   Remove the nut, then remove cigar lighter assembly, bezel and outer case.

INSTALLATION

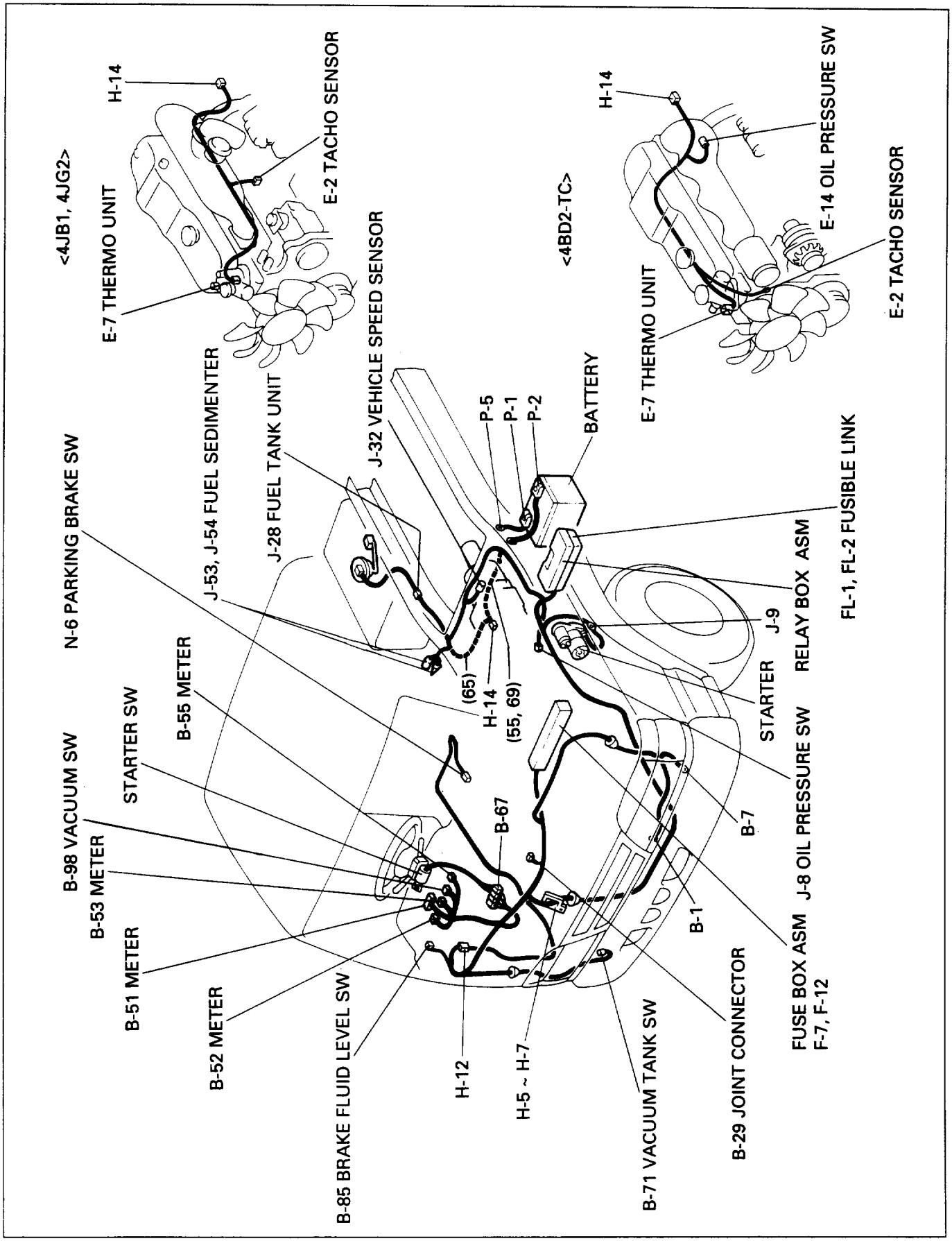
To install, follow the removal steps in the reverse order.

METER AND WARNING/INDICATOR LIGHT

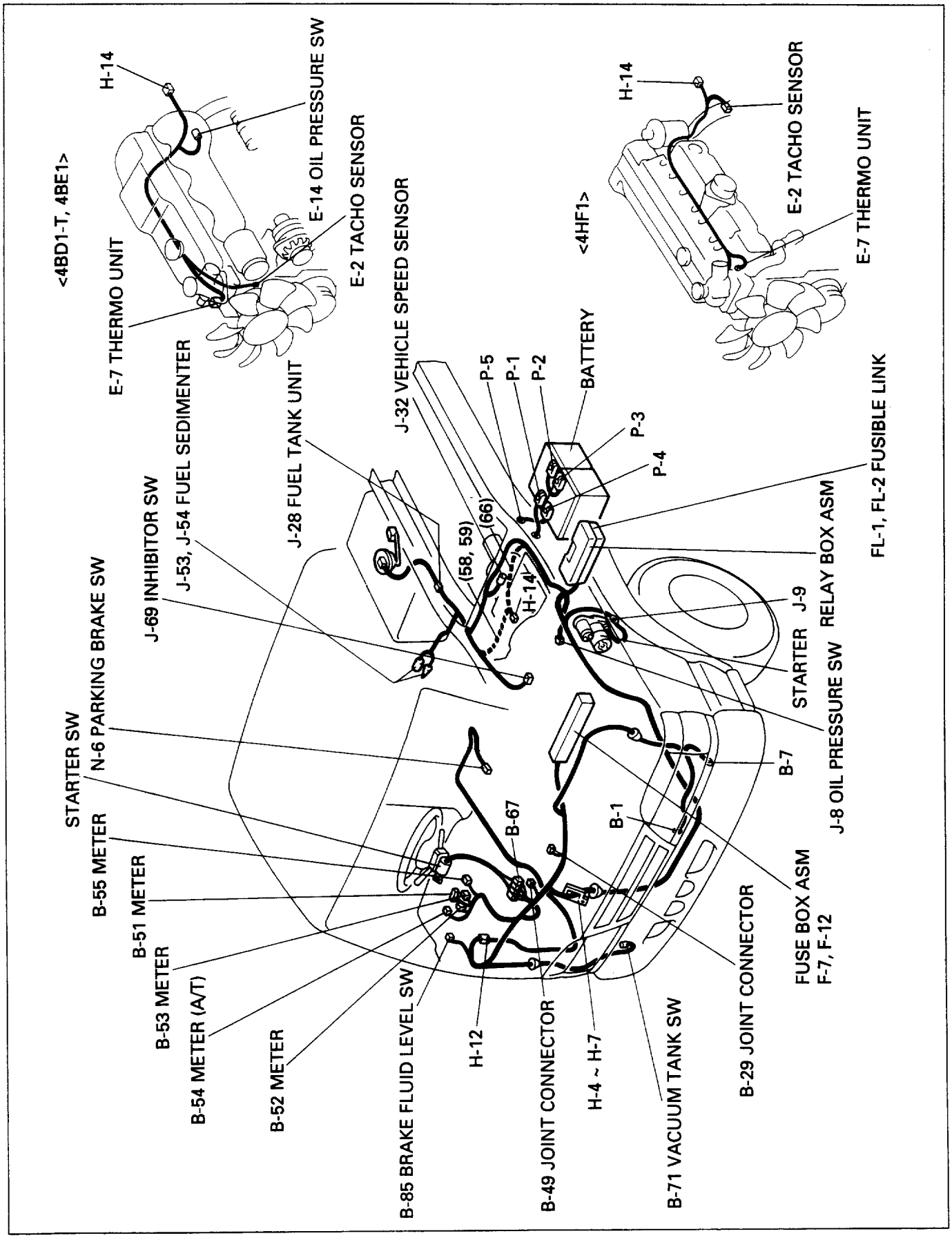
GENERAL DESCRIPTION

The circuit consists of the starter switch, meter assembly, vacuum tank switch, seat belt switch, oil pressure switch, fuel sedimentor switch, brake fluid switch, parking brake switch, vehicle speed sensor, fuel tank unit, thermo unit and engine speed sensor.
The meter assembly contains the speedometer, tachometer, fuel meter, thermometer and the warning/indicator light.
The meter warning/indicator lights and their bulb sockets are a unit, they are installed from the back of the speedometer assembly.

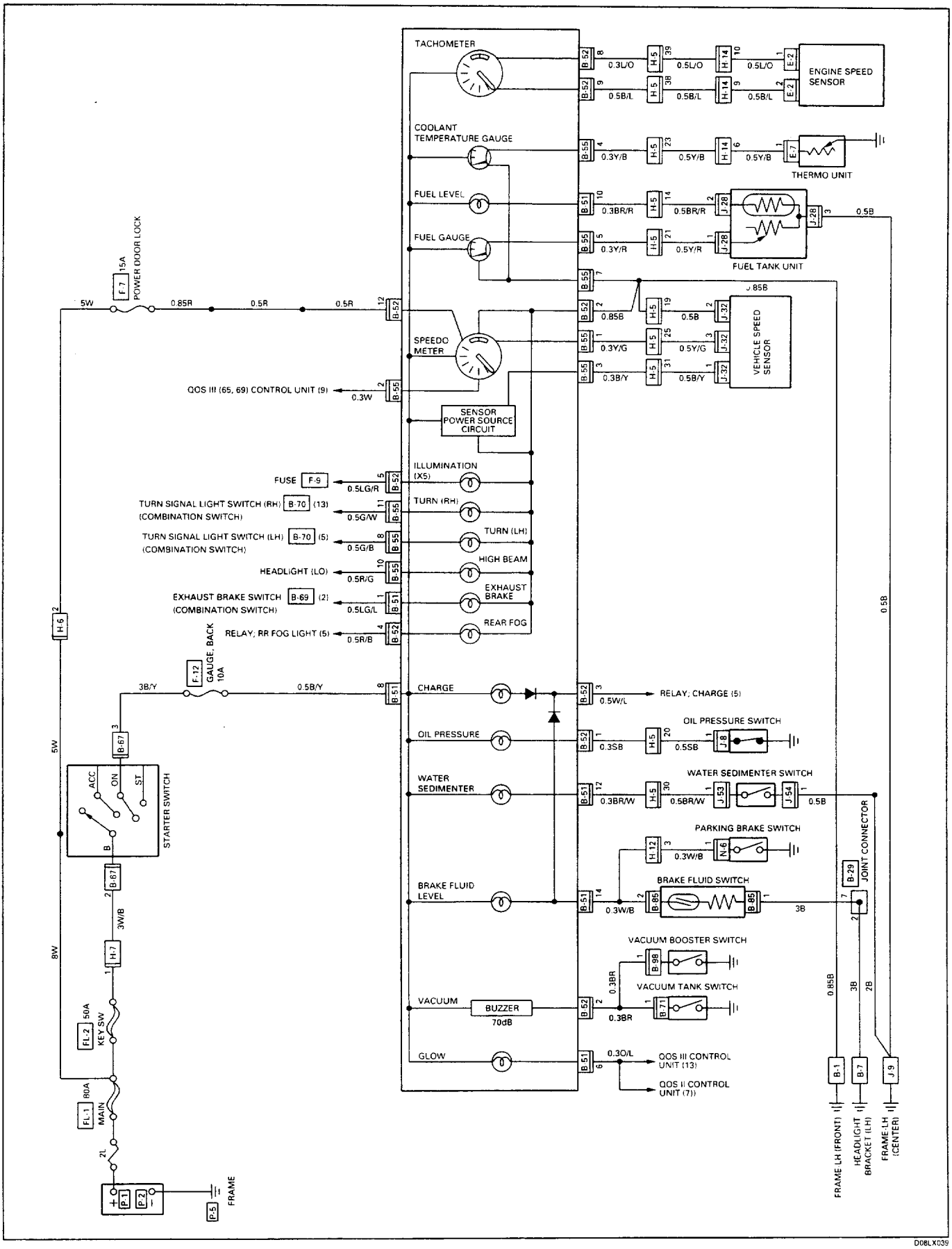
PARTS LOCATION-FOR 12 VOLT



PARTS LOCATION - FOR 24 VOLT

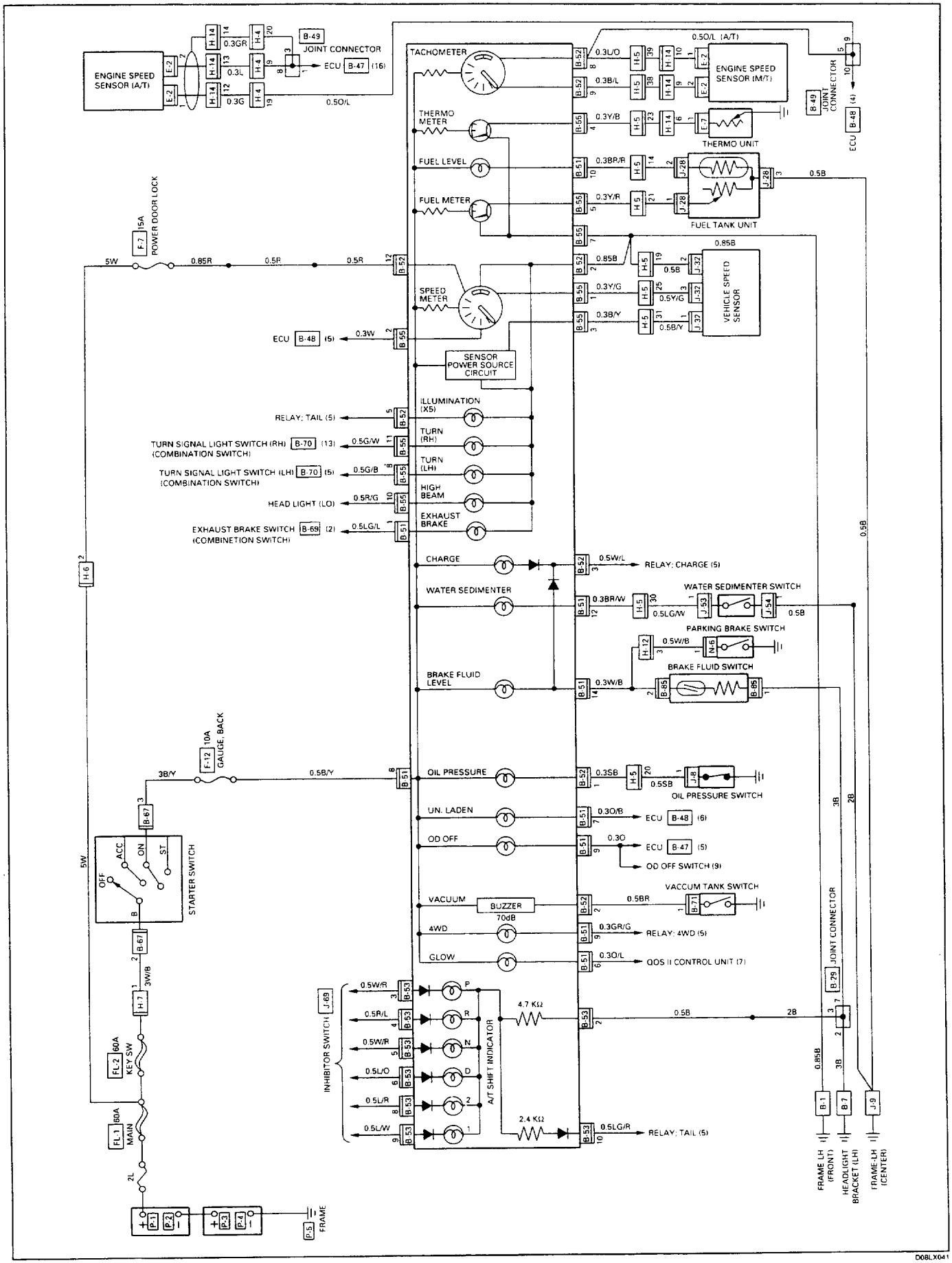


CIRCUIT DIAGRAM - FOR 12 VOLT



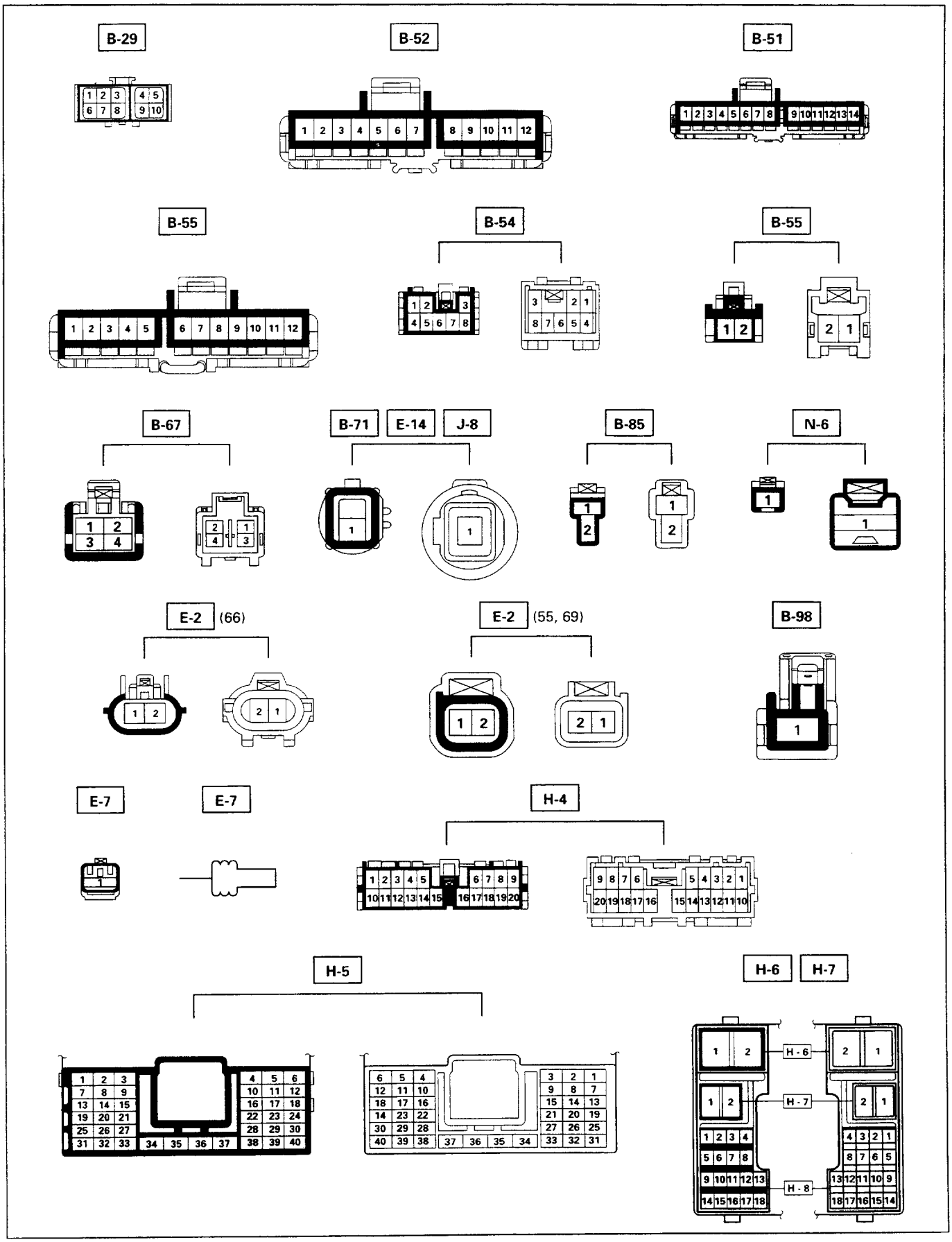
D08LX039

CIRCUIT DIAGRAM - FOR 24 VOLT



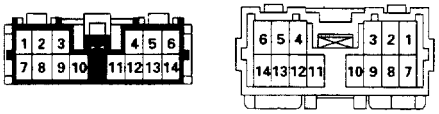
D08LX041

CONNECTOR LIST

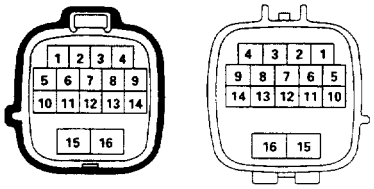


CONNECTOR LIST

H-12

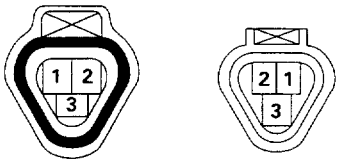


H-14

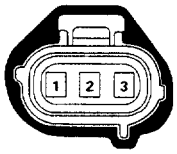


J-53 J-54

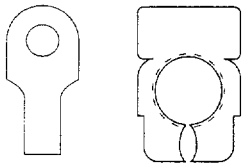
J-28



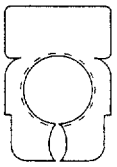
J-32



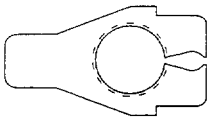
P-1 (12V) P-2



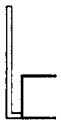
P-1 (24V) P-4



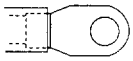
P-2 (24V) P-3



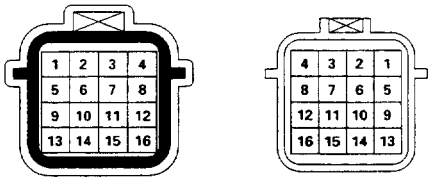
P-5 (12V)



P-5 (24V)



H-14



J-8 (FOR 4J TYPE ENGINE)

DIAGNOSIS

QUICK CHART FOR CHECK POINT

1. SPEEDOMETER

Trouble mode \ Check point	Speedometer	Vehicle speed sensor	Cable harness
1-1 Speedometer and odometer do not function	○ (3)	○ (1)	○ (2)
1-2 Speedometer does not function (odometer is normal)	○ (1)		
1-3 Odometer does not function (Speedometer is normal)	○ (1)		
1-4 Speedometer needle fluctuates (May be wide fluctuation)	○ (3)	○ (1)	○ (2)
1-5 Speedometer needle jumps erratically	○ (3)	○ (1)	○ (2)

NOTE: Figure in parenthesis "( )" indicates the order of inspection.

2. TACHOMETER

Trouble mode \ Check point	Tachometer	Engine speed sensor	Cable harness
2-1 Tachometer does not function	○ (3)	○ (1)	○ (2)
2-2 Tachometer needle fluctuates (May be wide fluctuation)	○ (3)	○ (1)	○ (2)
2-3 Tachometer needle jumps erratically	○ (3)	○ (1)	○ (2)

NOTE: Figure in parenthesis "( )" indicates the order of inspection.

3. COOLANT TEMPERATURE GAUGE

Trouble mode \ Check point	Meter ASM	Thermo-meter	Thermo unit	Thermo stat	Cable harness
3-1 Coolant temperature gauge needle does not move	○ (3)	○ (4)	○ (2)		○ (1)
3-2 Coolant temperature gauge reading is too low (or high)	○ (4)	○ (5)	○ (3)	○ (1)	○ (2)
3-3 Needle overshoots (or goes up to the "H" range)	○ (3)	○ (4)	○ (1)		○ (2)

NOTE: Figure in parenthesis "( )" indicates the order of inspection.

4. FUEL GAUGE

Trouble mode \ Check point	Meter ASM	Fuel gauge	Fuel tank unit	Cable harness
4-1 Fuel gauge needle does not move	○ (3)	○ (4)	○ (2)	○ (1)
4-2 Even when the tank is filled up with fuel, the needle does not reach "F"	○ (3)	○ (4)	○ (2)	○ (1)
4-3 When the tank is not full of fuel, the needle overshoots (or goes to "F")	○ (3)	○ (4)	○ (2)	○ (1)

NOTE: Figure in parenthesis "( )" indicates the order of inspection.

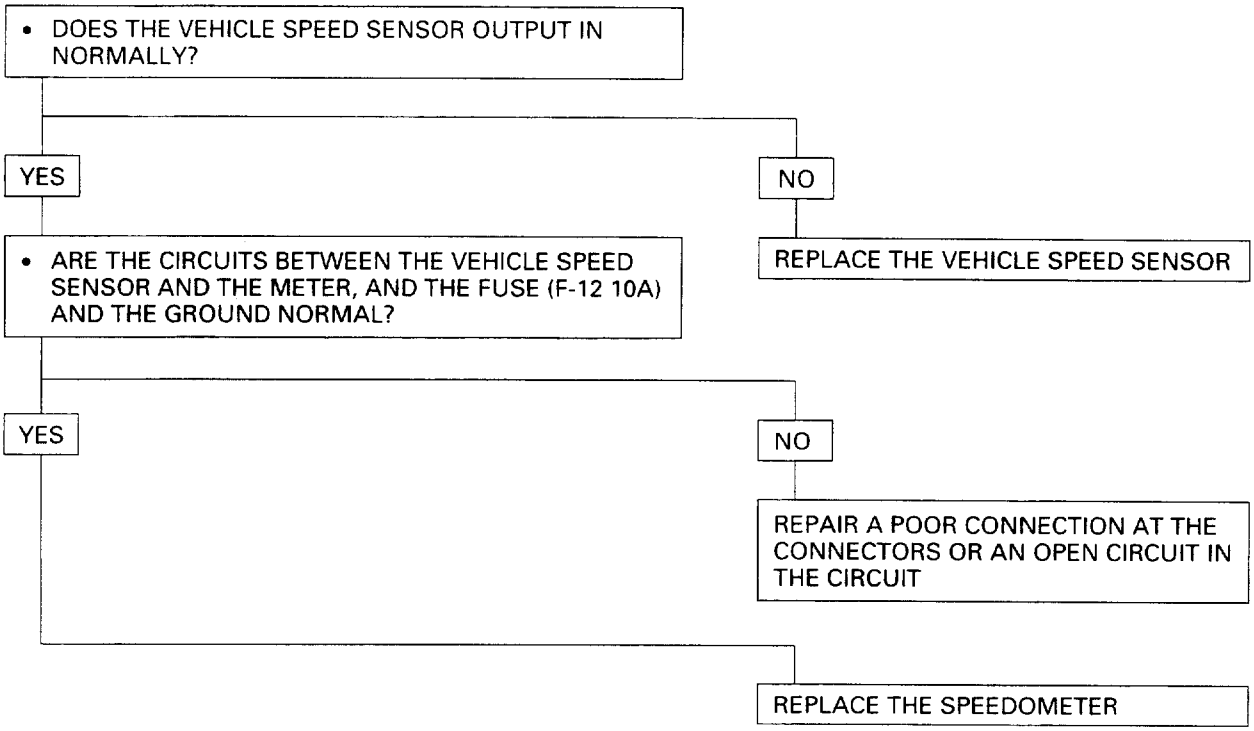
5. WARNING/INDICATOR LIGHT

Trouble mode \ Check point	Light bulb	Parking brake SW	Brake fluid SW	Oil pressure SW	Fuel tank unit	Vacuum SW	4WD SW	Sedimentor SW	Seat belt SW	Cable harness
5-1 When the parking brake lever is pulled, the indicator light does not light up.	○ (2)	○ (1)								○ (3)
5-2 Even when the parking brake lever is released, the indicator light does not go off.		○ (1)								○ (2)
5-3 While the engine operating, the oil pressure warning light does not go off.				○ (2)						○ (1)
5-4 Even when the tank is full with fuel, the fuel warning light lights up.					○ (1)					○ (2)
5-5 Even when the tank is empty, the low fuel warning light does not light up.	○ (1)				○ (2)					○ (3)
5-6 Even when the transfer lever is shifted to 4WD position, the indicator light does not light up.	○ (2)						○ (1)			○ (3)
5-7 Even when the float in the water sedimenter goes up above the drain warning level, the indicator light does not light up.	○ (2)							○ (1)		○ (3)
5-8 Even when the brake fluid is lower than specified level, the level warning light does not light up.	○ (1)		○ (2)							○ (3)
5-9 Even when the vacuum tank is empty vacuum warning buzzer does not sound						○ (1)				○ (2)

NOTE: Figure in parenthesis "( )" indicates the order of inspection.

1. SPEEDOMETER

1-1. SPEEDOMETER AND ODOMETER DO NOT FUNCTION



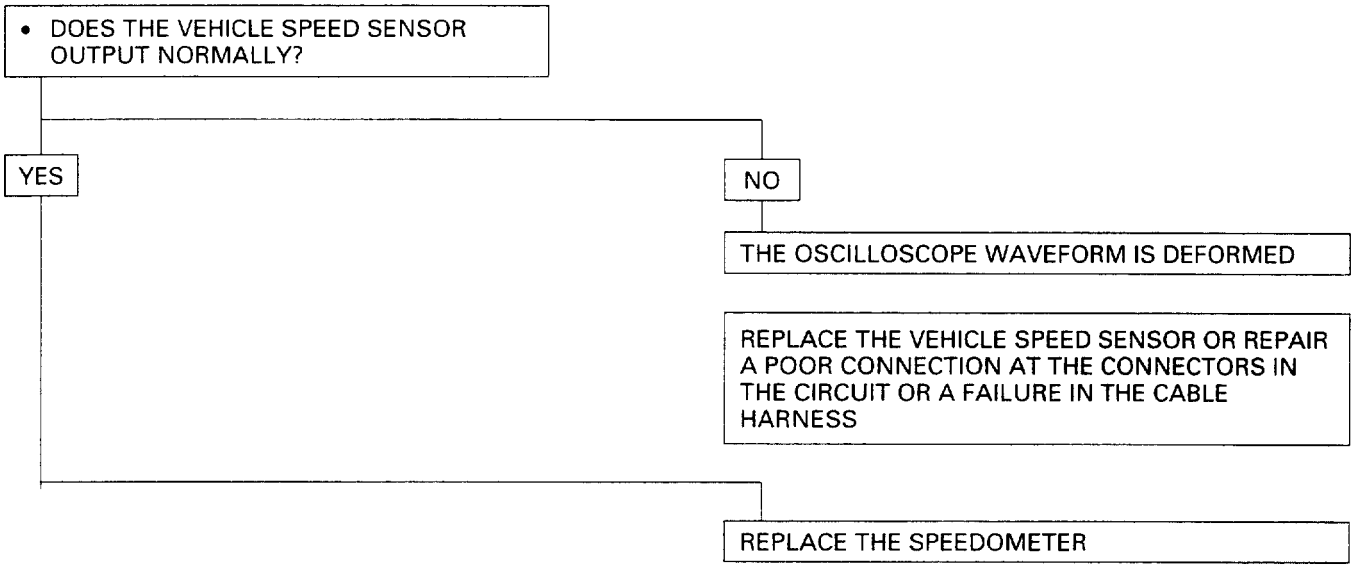
1-2. SPEEDOMETER DOES NOT FUNCTION (ODOMETER IS NORMAL)

REPLACE THE SPEEDOMETER ASSEMBLY

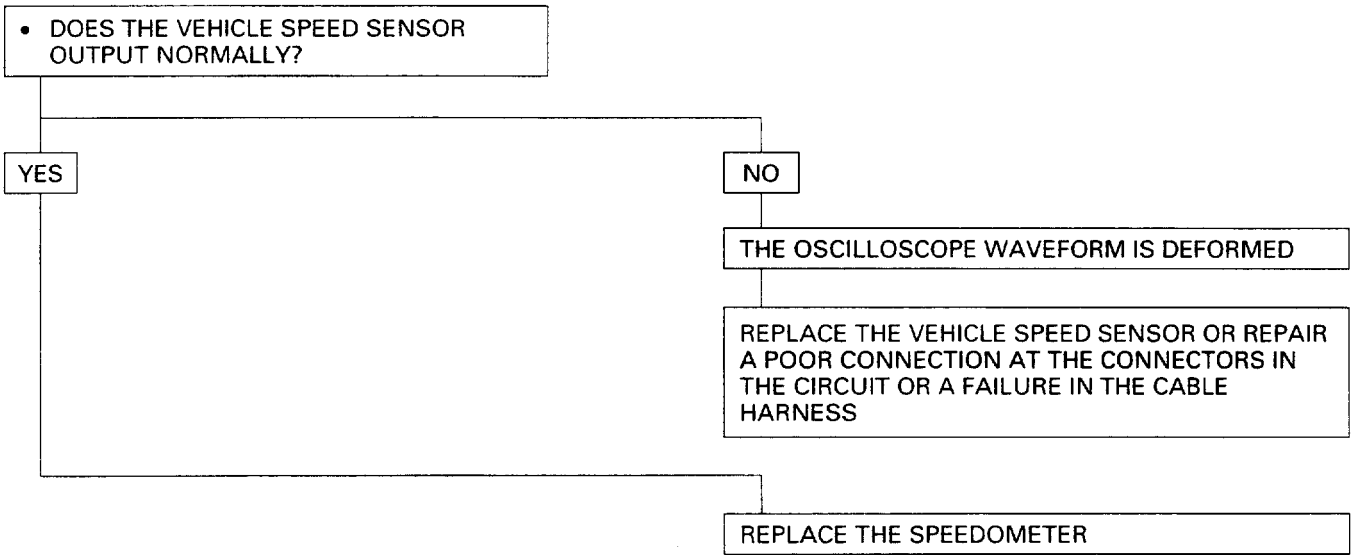
1-3. ODOMETER DOES NOT FUNCTION (SPEEDOMETER IS NORMAL)

REPLACE THE SPEEDOMETER ASSEMBLY

1-4. SPEEDOMETER NEEDLE FLUCTUATES (MAY BE WIDE FLUCTUATION)

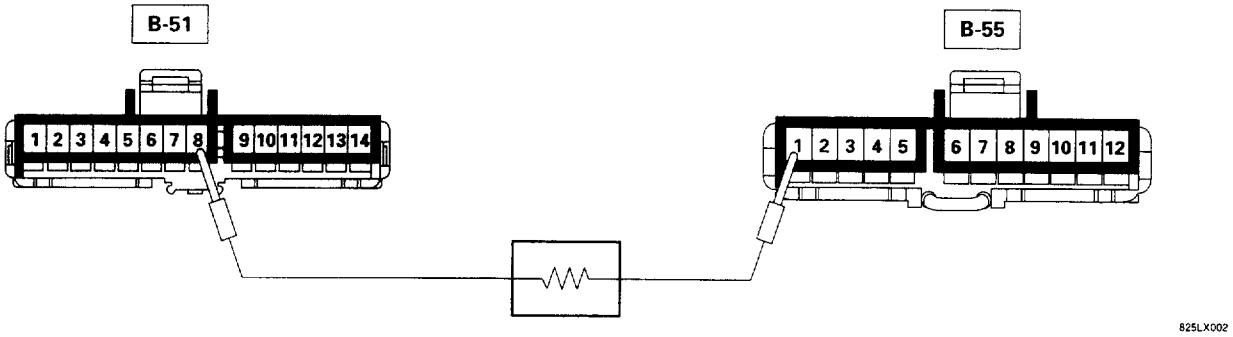


1-5. SPEEDOMETER NEEDLE JUMPS ERRATICALLY

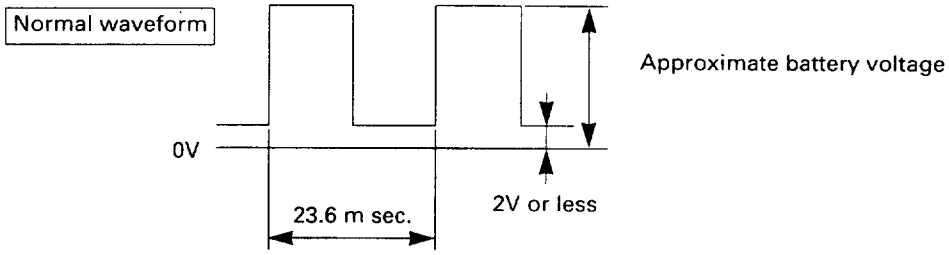


Inspection of waveform by oscilloscope

1. Connect a resistance of 1.3 to 5k ohm (1.4W or more) between the harness side connectors 8 B-51 and 1 B-55 of the meter.



2. Install a speedometer tester.
2. Turn on the starter SW.
3. Check the waveform at the time when the vehicle speed is at 60 Km (37 mph)



2. TACHOMETER

2-1. TACHOMETER DOES NOT FUNCTION

- IS THE PULSE INPUT NORMAL?

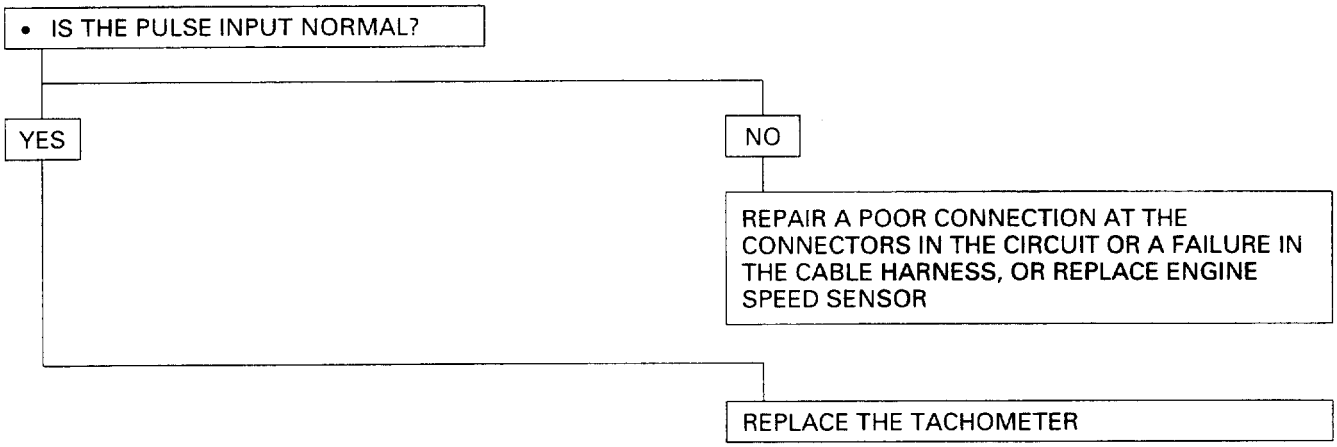
YES

NO

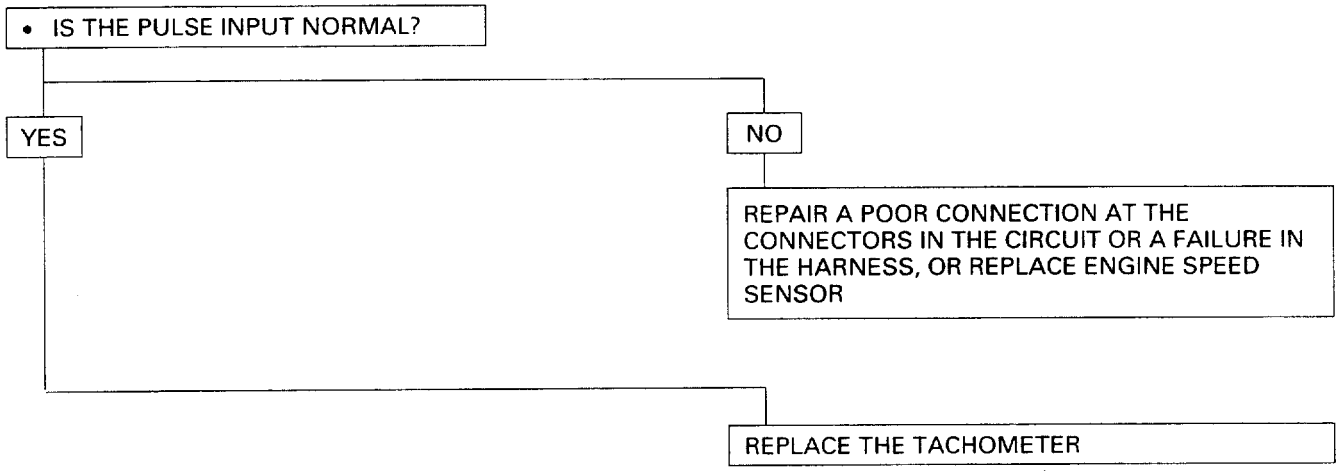
REPAIR A POOR CONNECTION AT THE CONNECTORS IN THE CIRCUIT OR A FAILURE IN THE CABLE HARNESS, OR REPLACE ENGINE SPEED SENSOR

REPLACE THE TACHOMETER

2-2 TACHOMETER NEEDLE FLUCTUATES (MAY BE WIDE FLUCTUATION)

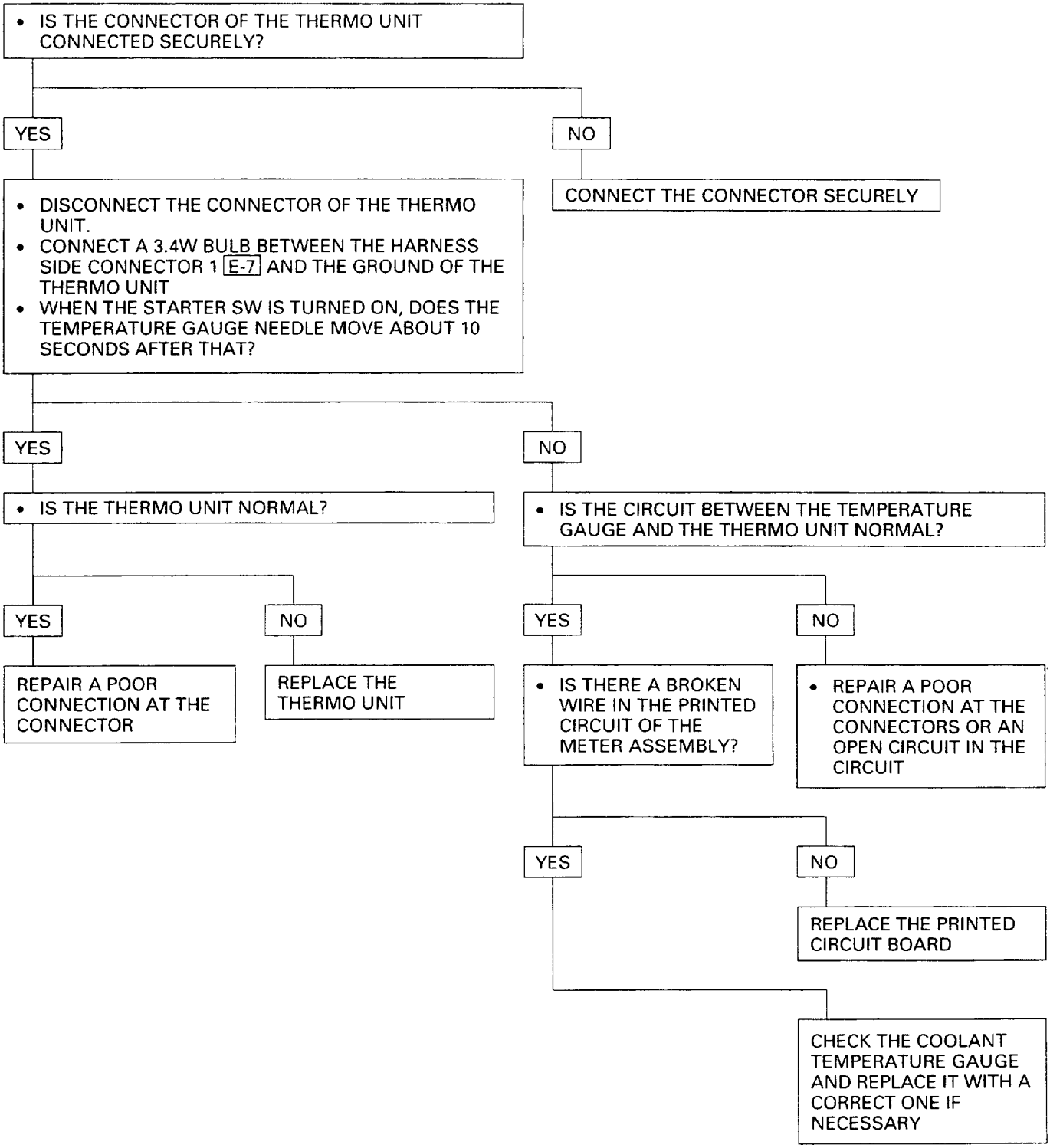


2-3 TACHOMETER NEEDLE JUMPS ERRATICALLY

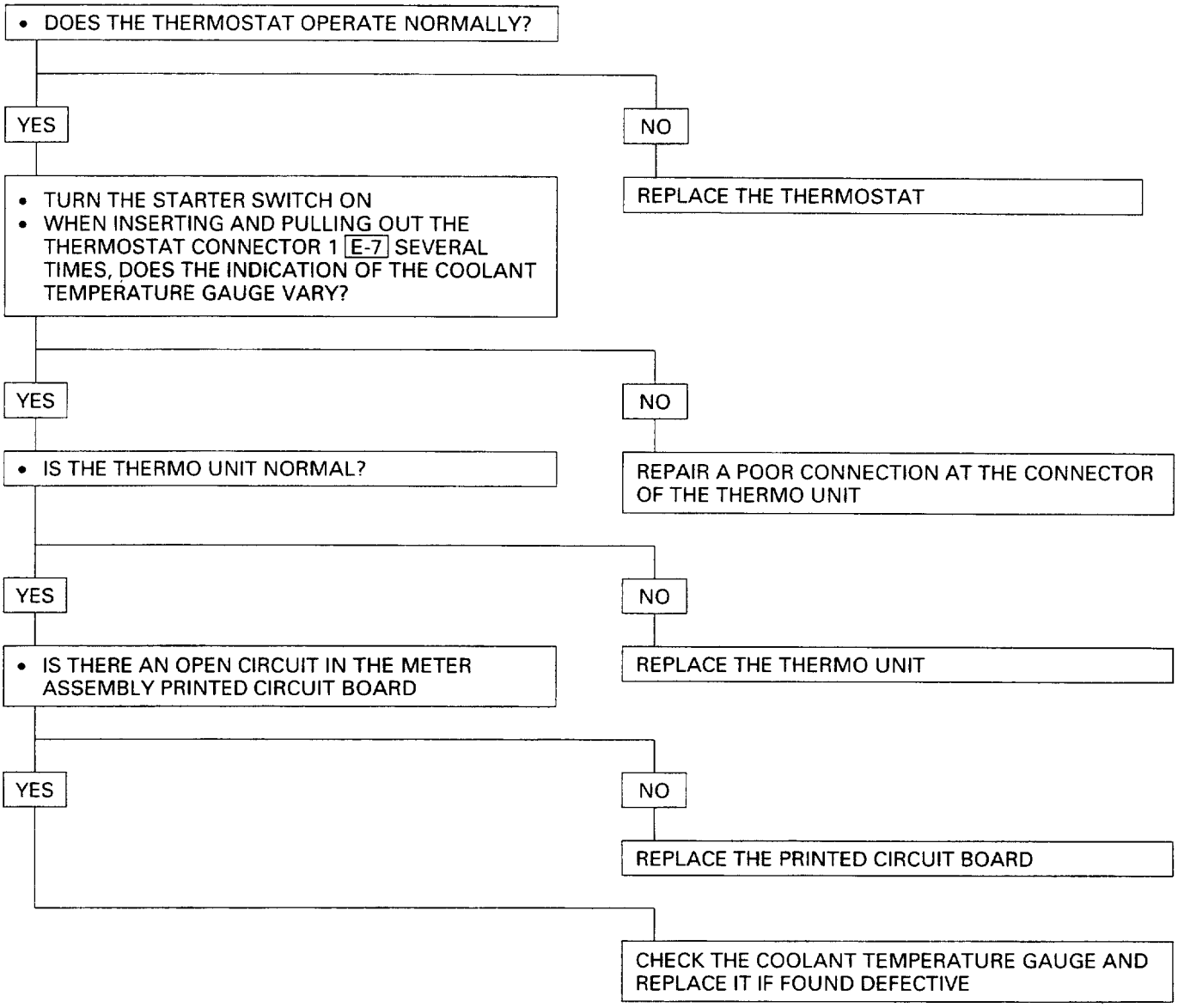


3. COOLANT TEMPERATURE GAUGE

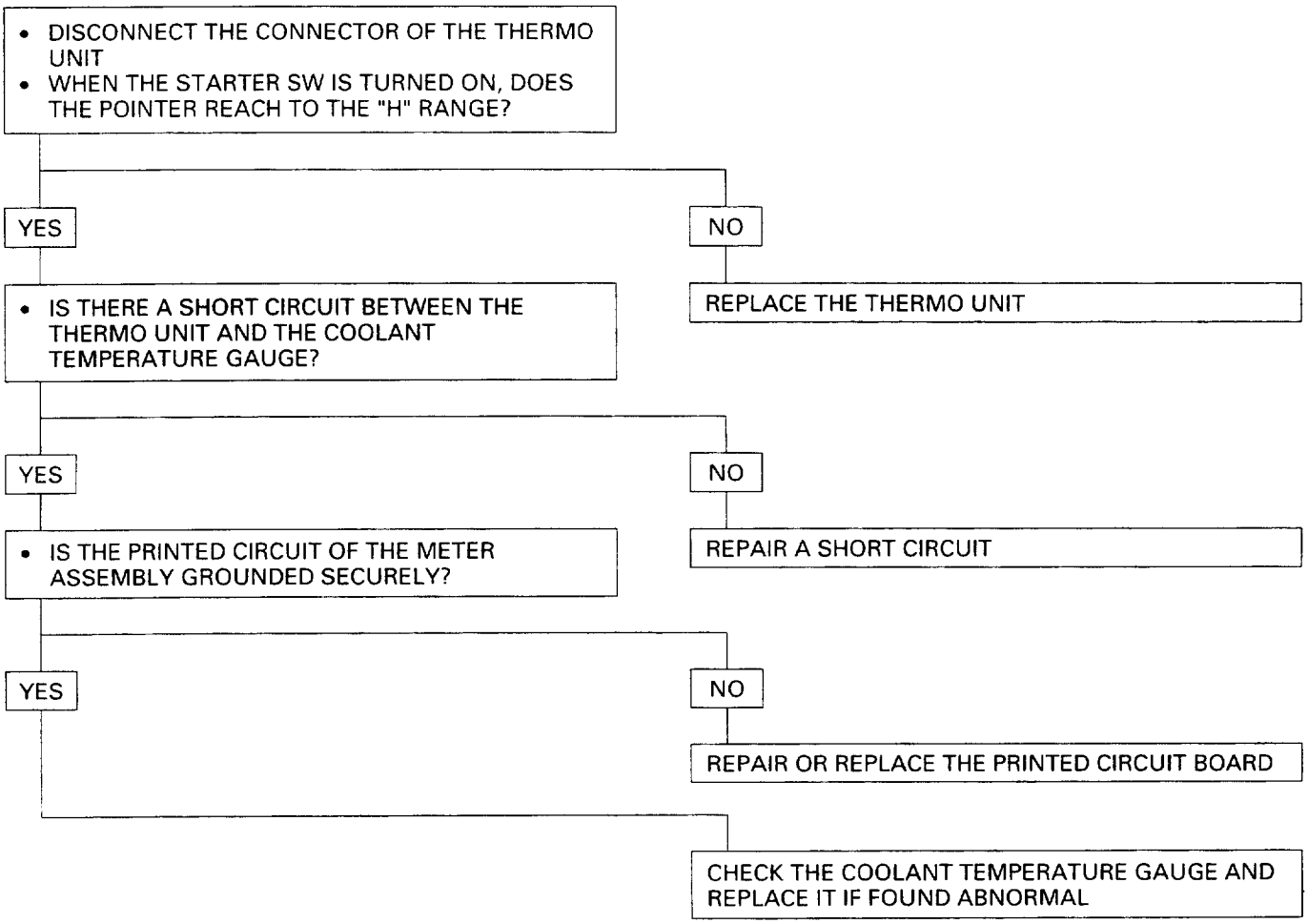
3-1 COOLANT TEMPERATURE GAUGE NEEDLE DOES NOT MOVE



3-2 COOLANT TEMPERATURE GAUGE READING IS TOO LOW (OR HIGH)

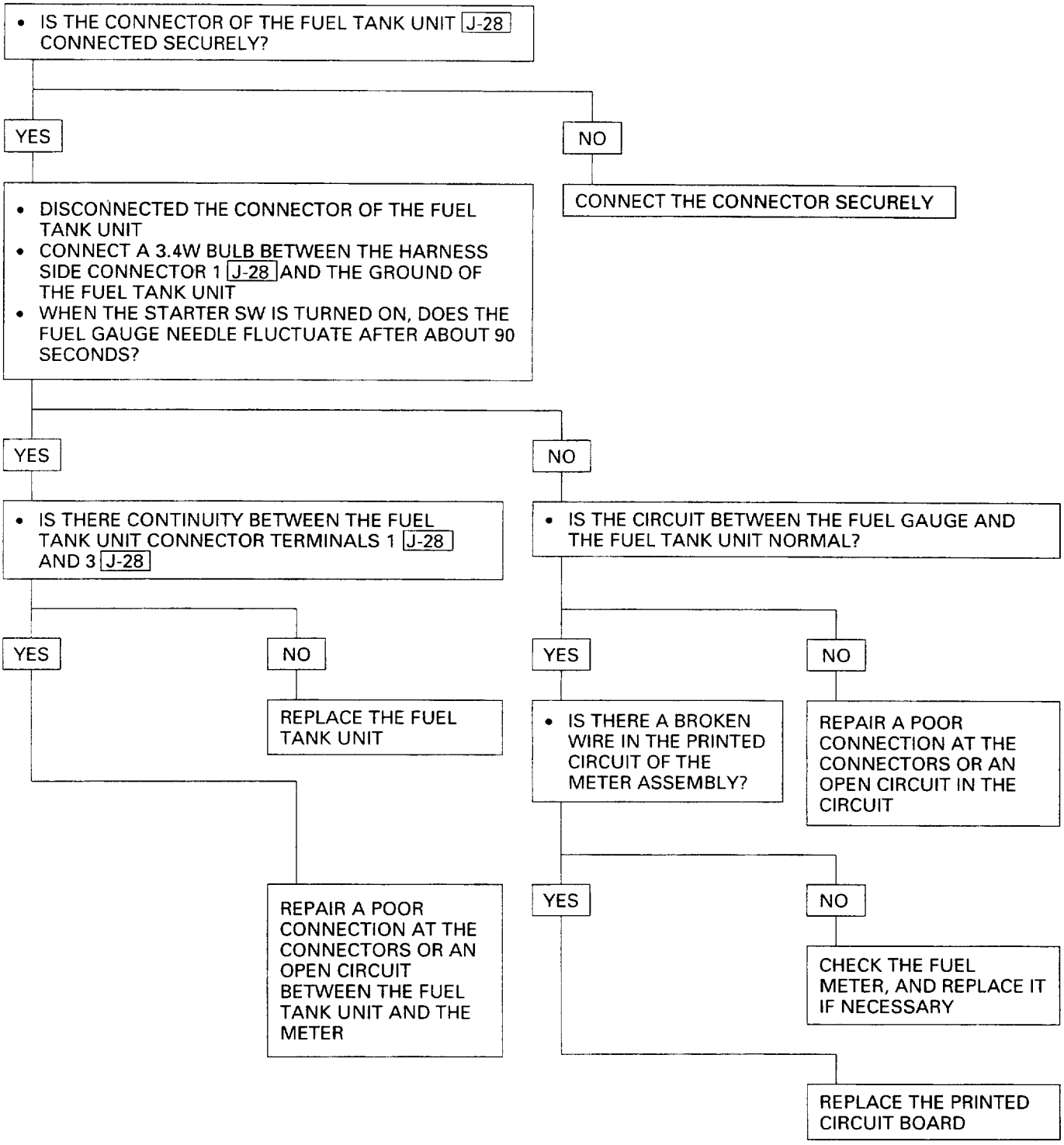


3-3 NEEDLE OVERSHOOTS (OR GOES UP TO THE "H" RANGE)

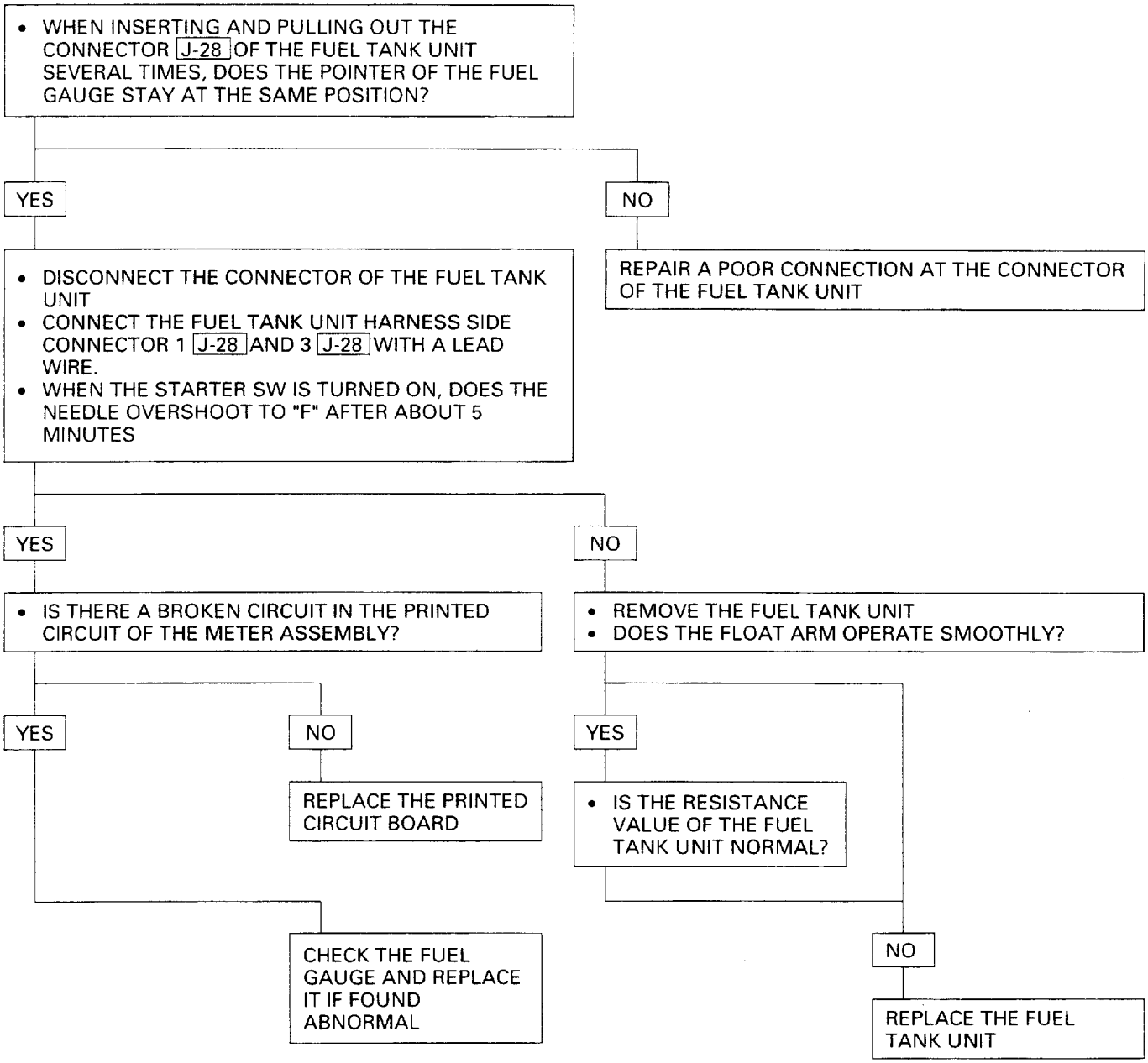


4. FUEL GAUGE

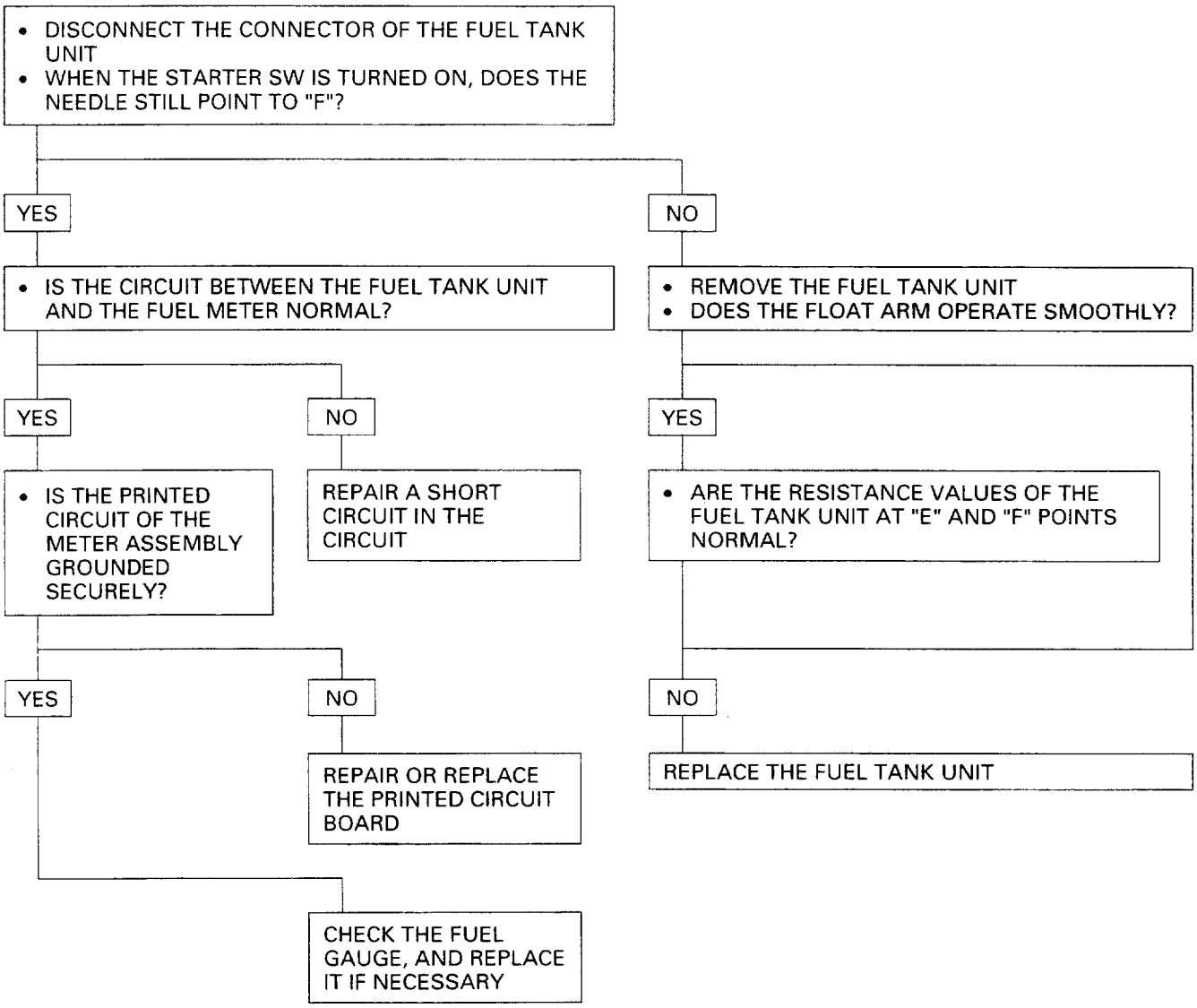
4-1. FUEL GAUGE NEEDLE DOES NOT MOVE



4-2 EVEN WHEN THE TANK IS FILLED UP WITH FUEL,THE NEEDLE DOES NOT REACH "F"

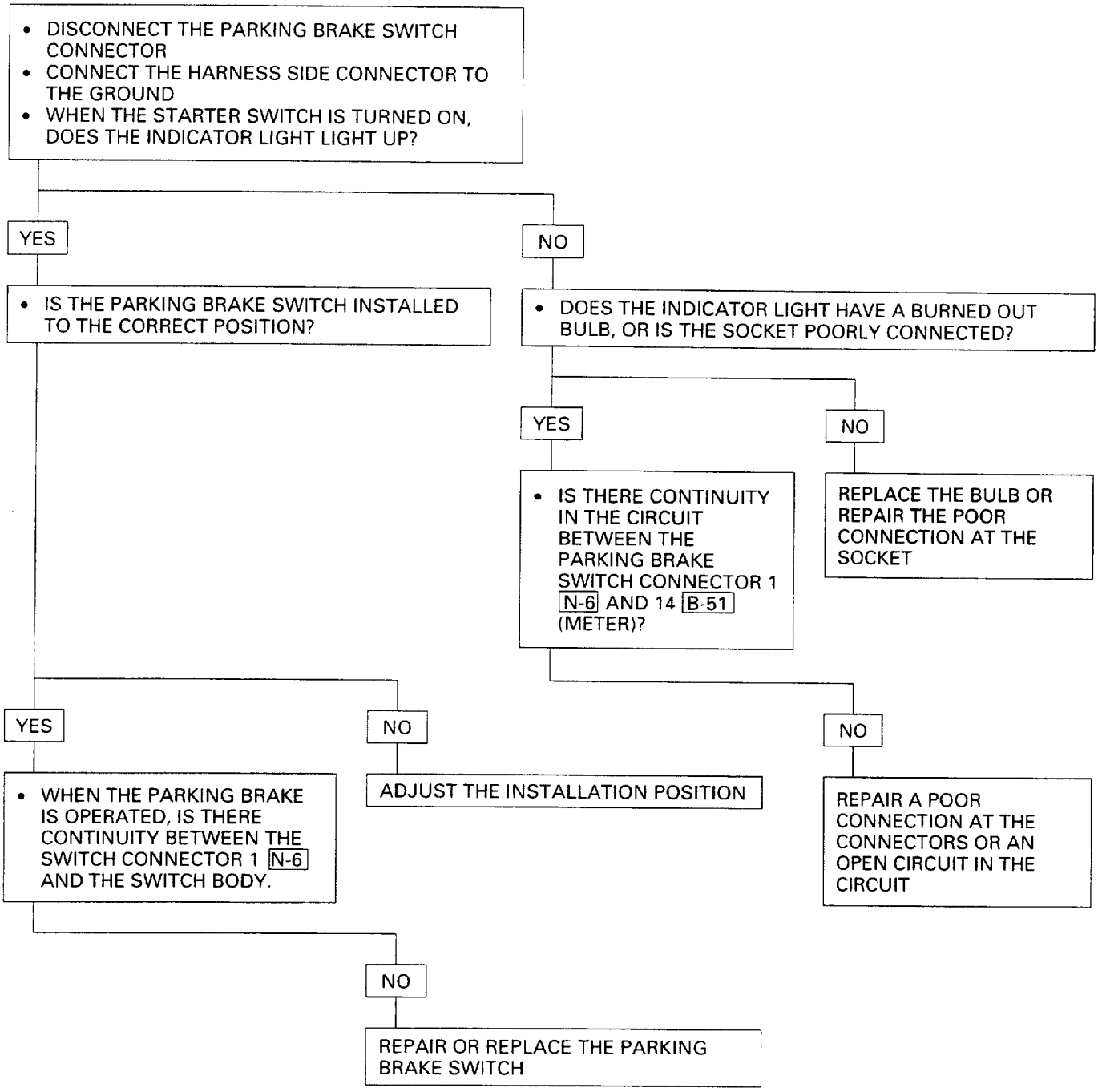


4-3 WHEN THE TANK IS NOT FULL OF FUEL, THE NEEDLE OVERSHOOTS (OR GOES UP TO "F")



5. WARNING/INDICATOR LIGHT

5-1 WHEN THE PARKING BRAKE LEVER IS PULLED, THE INDICATOR LIGHT DOES NOT LIGHT UP



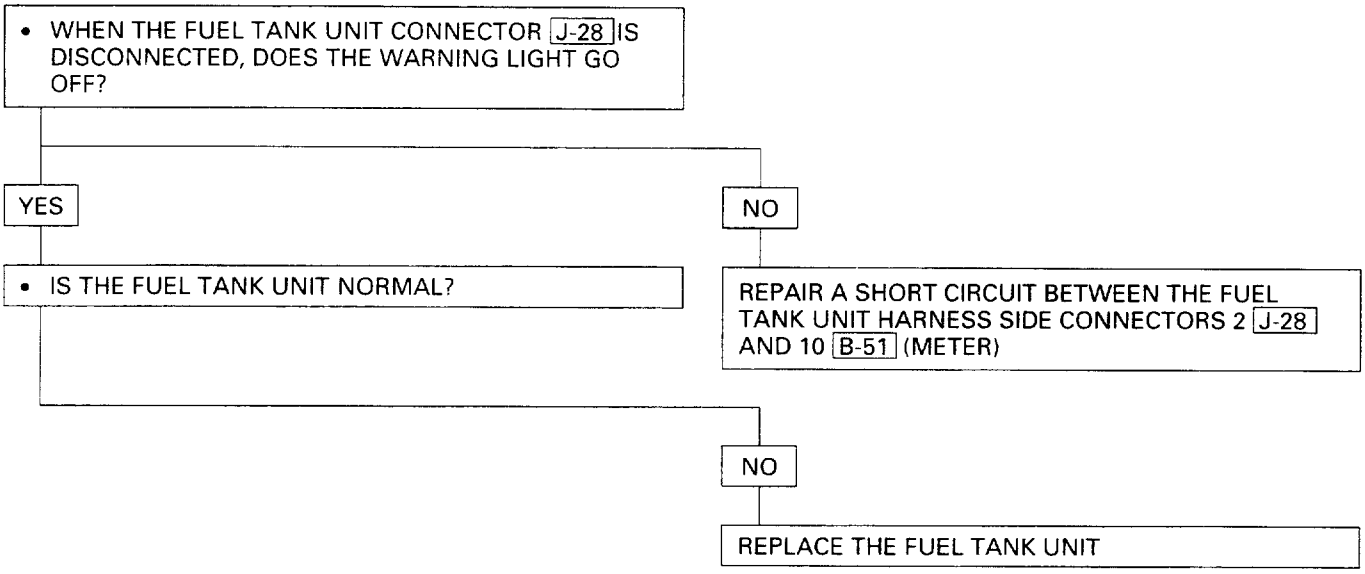
5-2 EVEN WHEN THE PARKING BRAKE LEVER IS RELEASED THE INDICATOR LIGHT DOES NOT GO OFF

- IS THE PARKING BRAKE SWITCH INSTALLED TO THE CORRECT POSITION, AND DOES IT OPERATE NORMALLY?
  - NO → ADJUST THE SWITCH INSTALLATION POSITION, OR REPAIR OR REPLACE THE SWITCH
  - YES →
- WHEN THE PARKING BRAKE SWITCH CONNECTOR [N-6] DISCONNECTED, DOES THE INDICATOR LIGHT GO OFF?
  - NO → REPAIR A SHORT CIRCUIT BETWEEN THE PARKING BRAKE SWITCH CONNECTOR 1 [N-6] AND 14 [B-51]
  - YES →

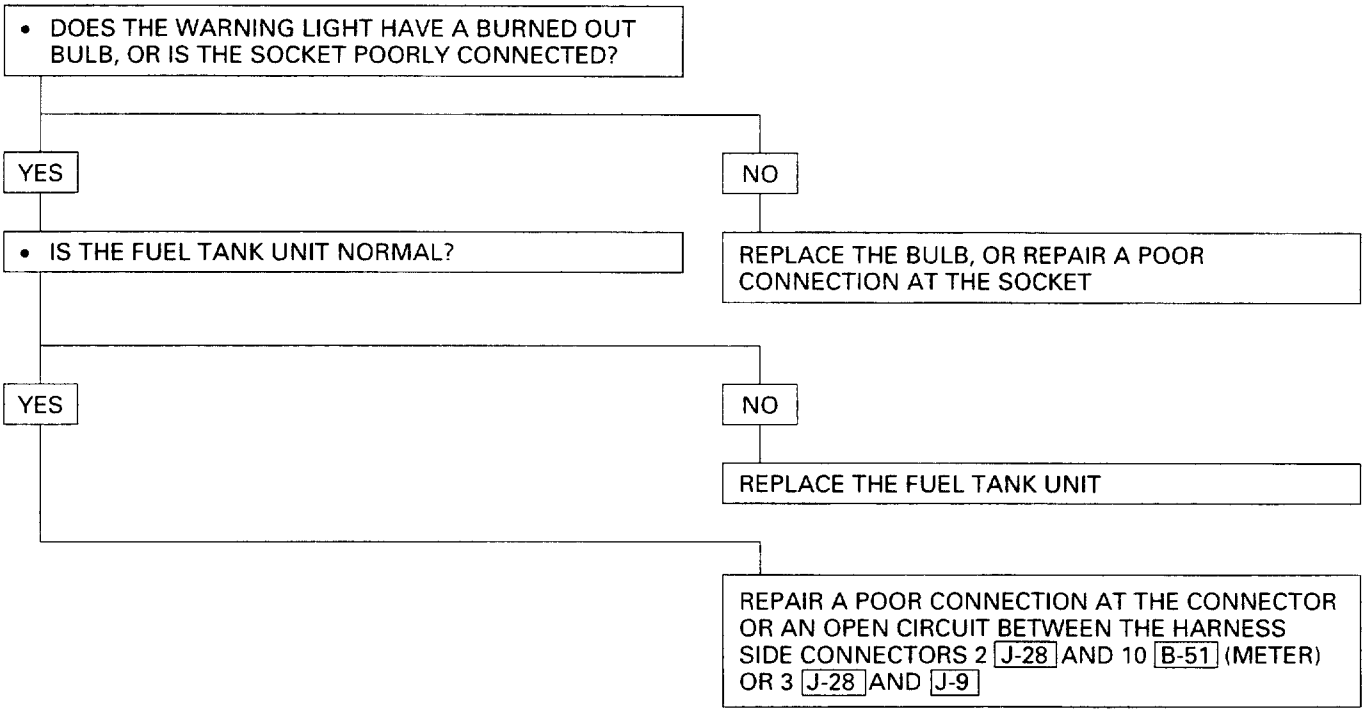
5-3 WHILE THE ENGINE IS OPERATING, THE OIL PRESSURE WARNING LIGHT DOES NOT GO OFF

- IS THE ENGINE OIL PRESSURE NORMAL?
  - NO → REFER TO THE "ENGINE" SECTION
  - YES →
- WITH THE OIL PRESSURE SWITCH CONNECTOR [J-8] DISCONNECTED, DOES THE WARNING LIGHT GO OFF?
  - NO → REPAIR A SHORT CIRCUIT BETWEEN 1 [J-8] AND 1 [B-52] (METER)
  - YES →
- WHILE THE ENGINE IS OPERATING, IS THERE CONTINUITY BETWEEN THE OIL PRESSURE SWITCH CONNECTOR [J-8] AND THE BODY GROUND?
  - NO → REPLACE THE OIL PRESSURE SWITCH
  - YES →

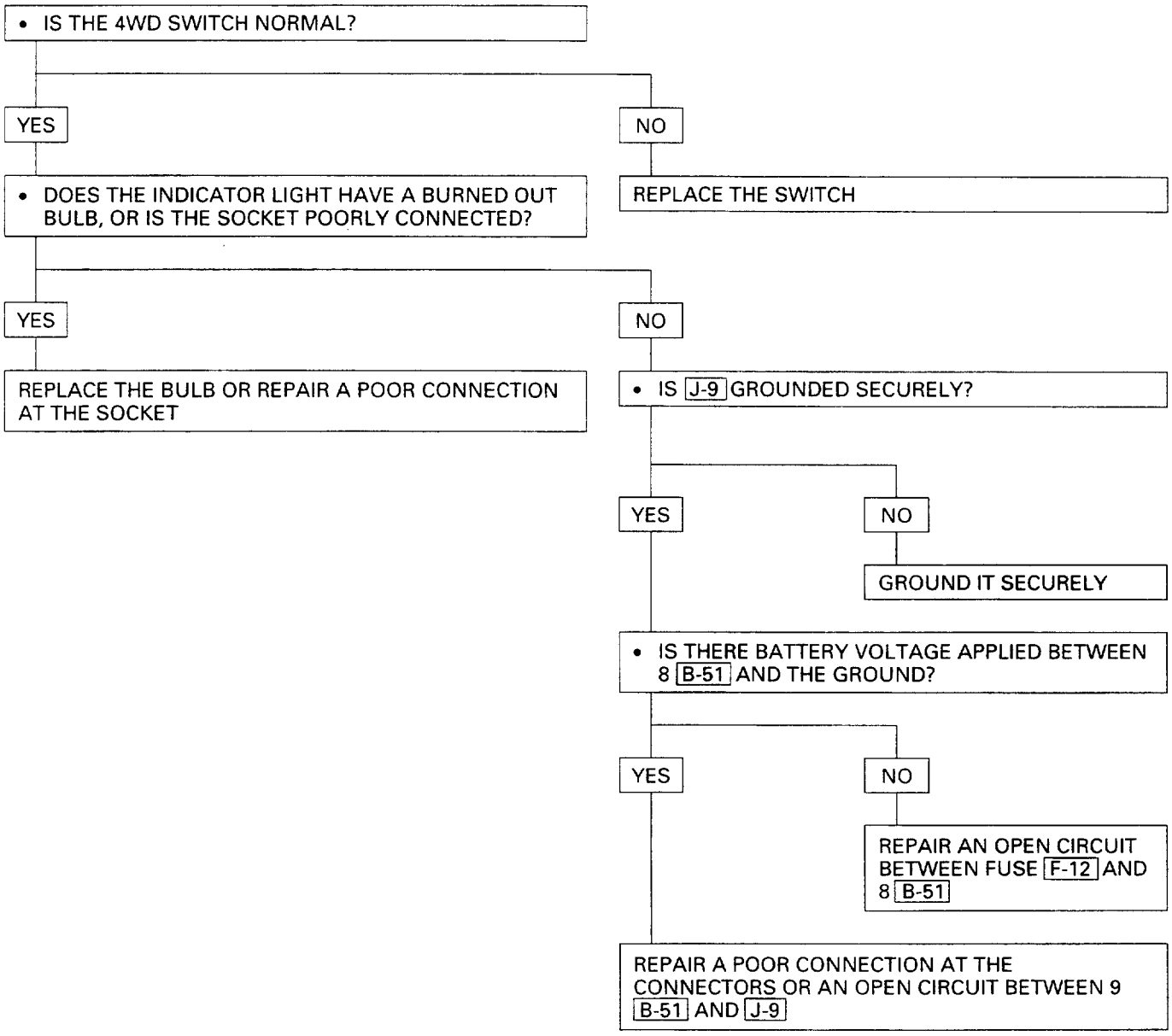
5-4 EVEN WHEN THE FUEL TANK IS FULL WITH FUEL, THE FUEL WARNING LIGHT LIGHTS UP



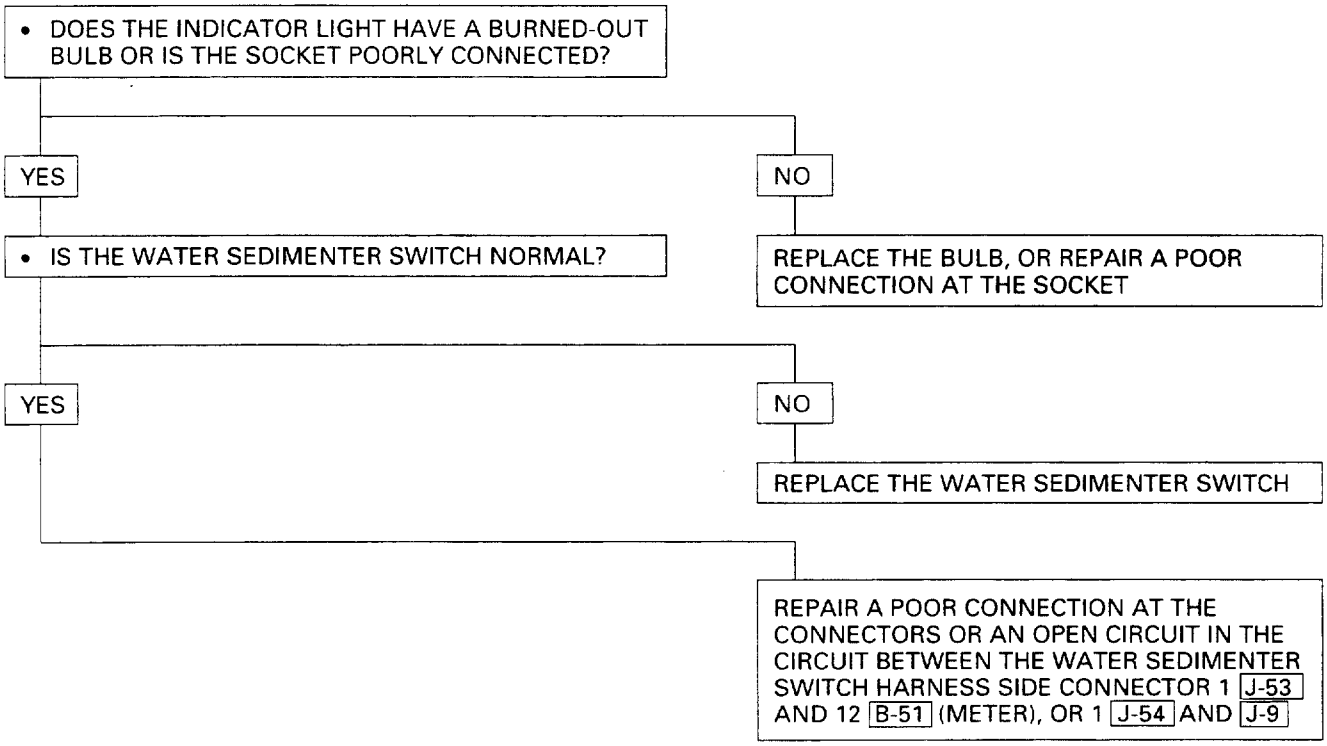
5-5 EVEN WHEN THE FUEL TANK IS EMPTY, THE LOW FUEL WARNING LIGHT DOES NOT LIGHT UP



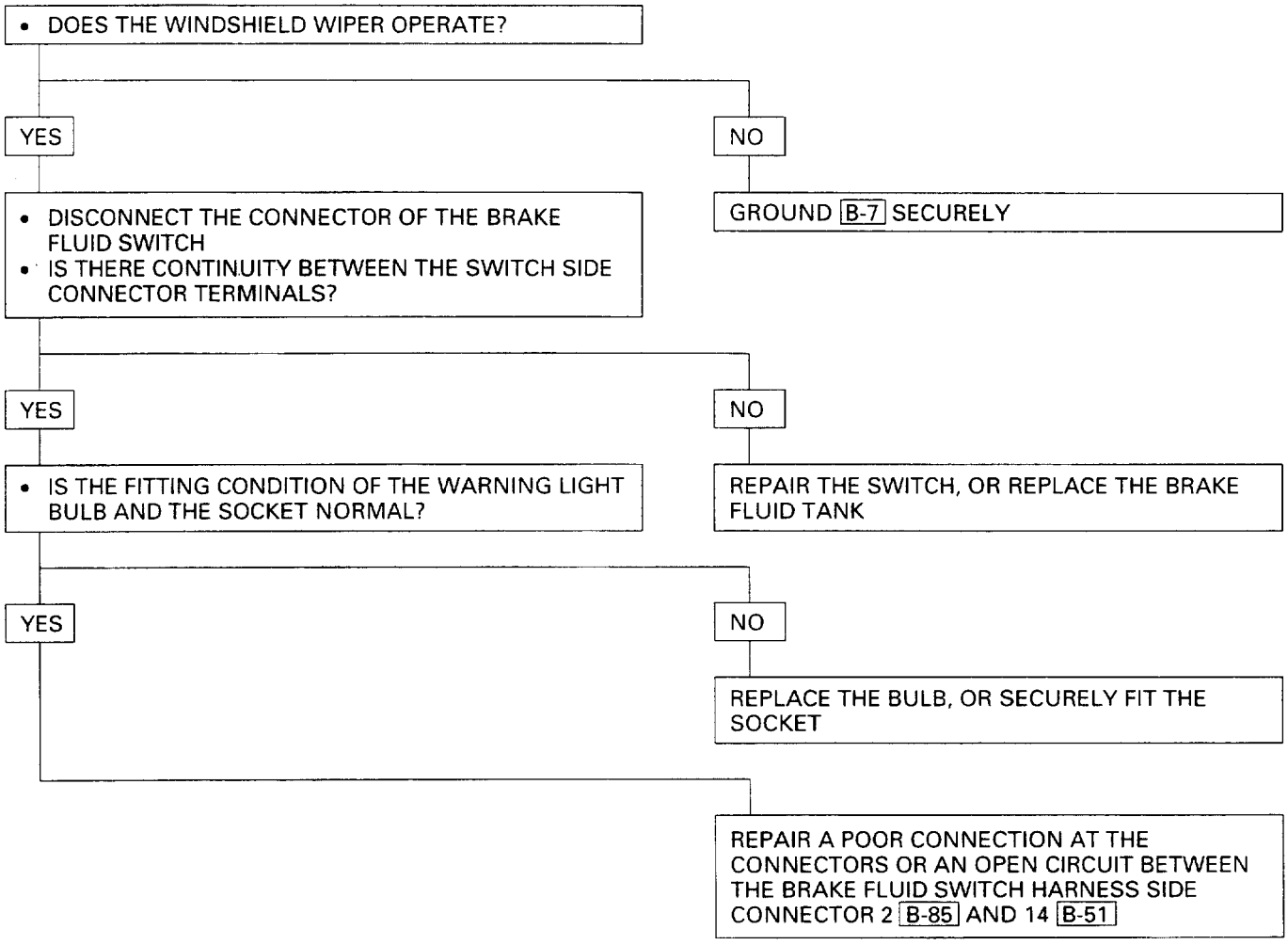
5-6 EVEN WHEN THE TRANSFER LEVER IS SHIFTED TO 4WD POSITION , THE INDICATOR LIGHT DOES NOT LIGHT UP



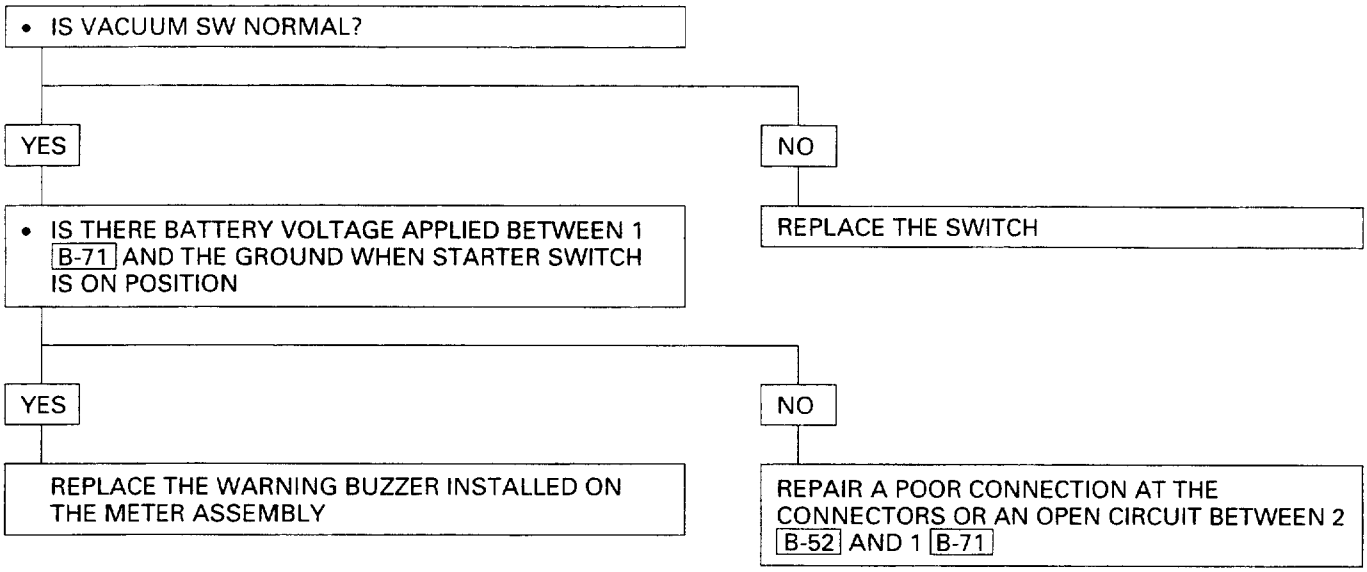
5-7 EVEN WHEN THE FLOAT IN THE WATER SEDIMENTER GOES UP ABOVE THE DRAIN WARNING LEVEL, THE INDICATOR LIGHT DOES NOT LIGHT UP



5-8 EVEN WHEN THE BRAKE FLUID IS LOWER THAN SPECIFIED LEVEL, THE LEVEL WARNING LIGHT DOES NOT LIGHT UP



5-9 VACUUM WARNING BUZZER DOES NOT SOUND



STARTER SWITCH

Refer to "START AND CHARGING" in this section.

TURN SIGNAL LIGHT SWITCH

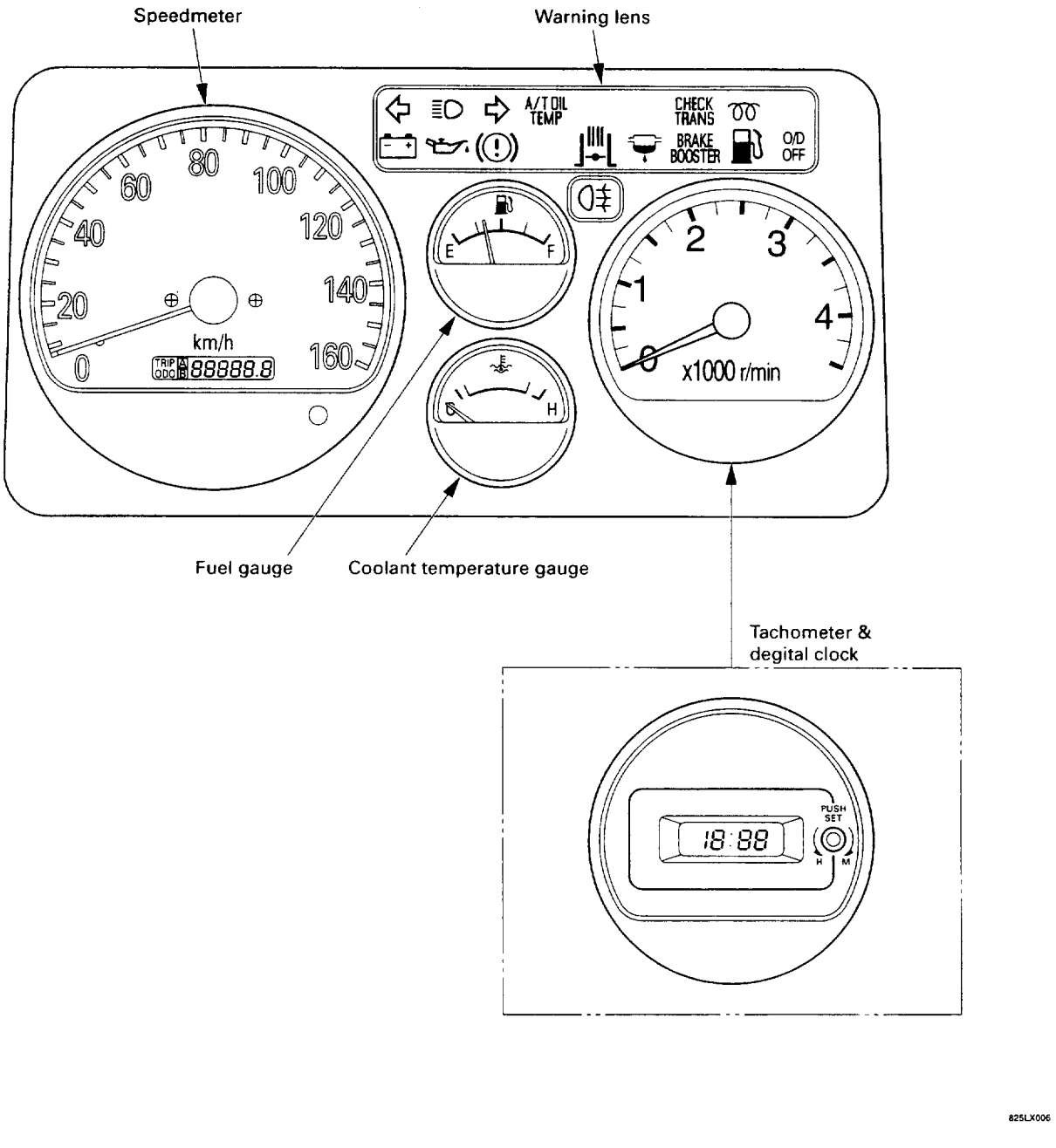
Refer to "TURN SIGNAL LIGHT, HAZARD WARNING LIGHT AND STOPLIGHT" in this section.

EXHAUST BRAKE SWITCH

Refer to "EXHAUST BRAKE" in this section.

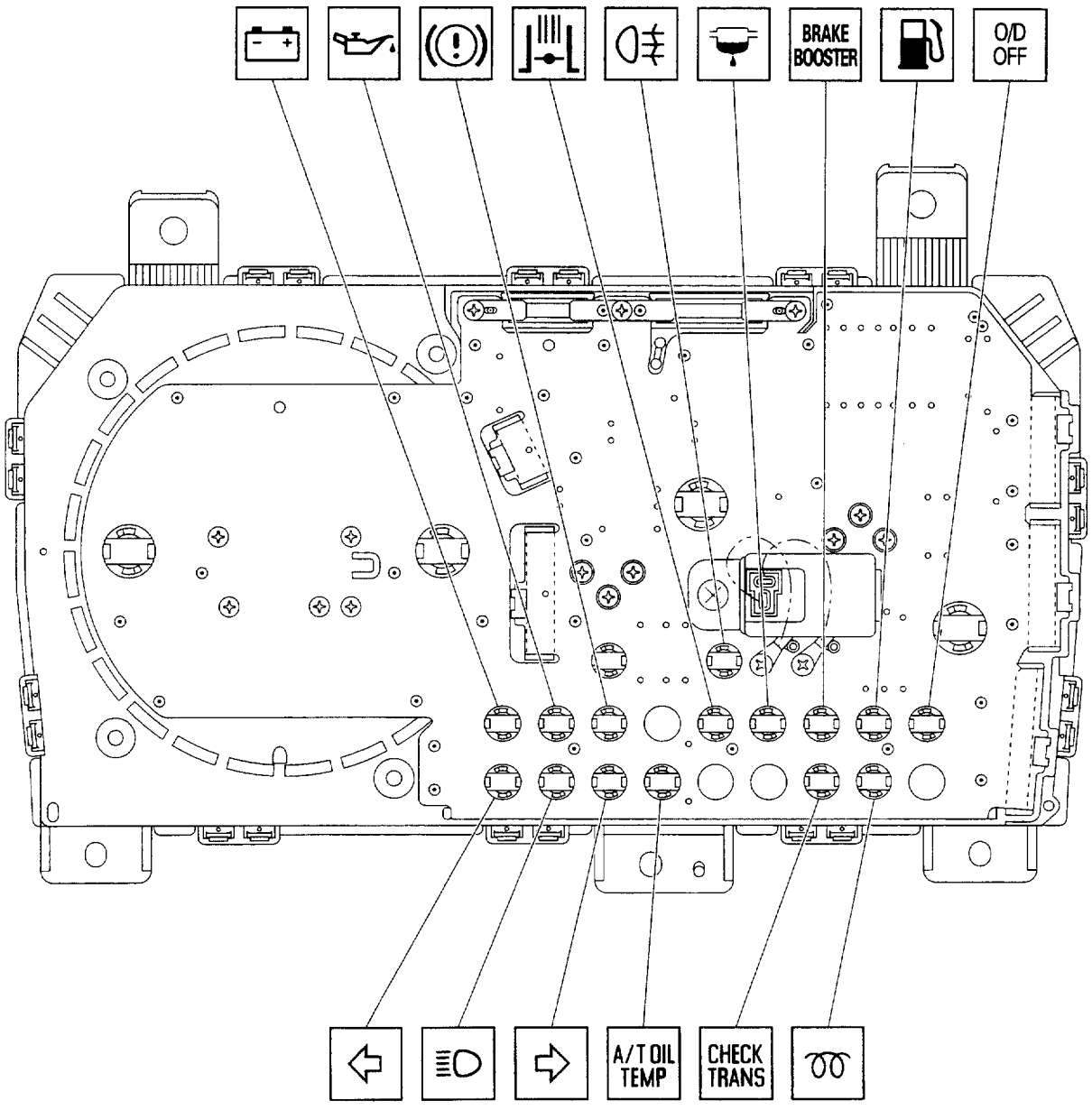
METER ASSEMBLY

LAYOUT FOR GAUGES, WARNING, INDICATOR AND ILLUMINATION LIGHTS



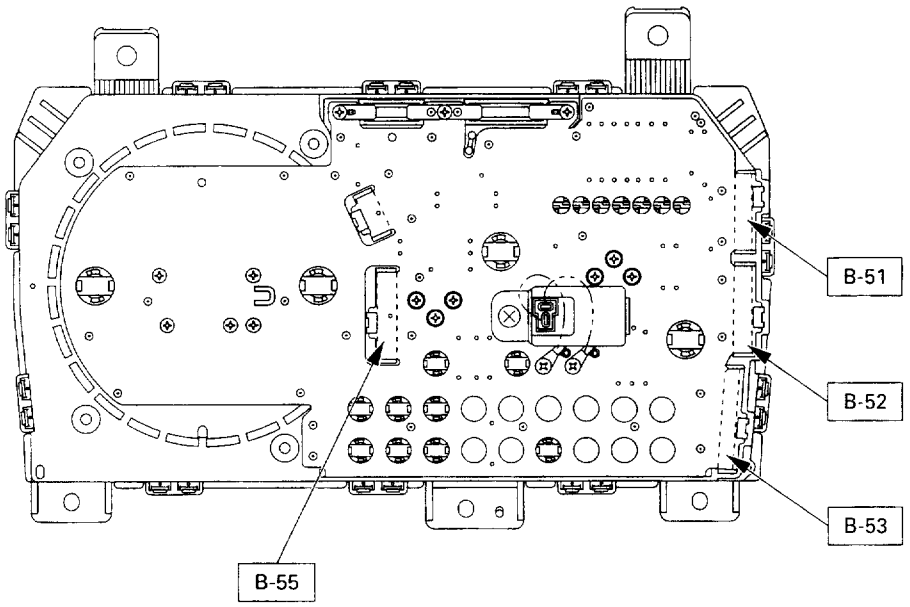
NOTE: The calibration and the red zone of tachometer are various depending on the models fitted.

BULB LOCATION FOR WARNING LENS



825LX005

TABLE FOR METER CONNECTOR TERMINAL CONNECTIONS



B-53

Terminal No.	Connected to	Terminal No.	Connected to
1	—	6	A/T Shift indicator D4
2	Ground	7	A/T Shift indicator D3
3	A/T Shift indicator P	8	A/T Shift indicator 2
4	A/T Shift indicator R	9	A/T Shift indicator 1
5	A/T Shift indicator N	10	Illumination (+)

B-51

Terminal No.	Connected to
1	Exh. Brake
2	—
3	—
4	—
5	Check trans
6	Glow
7	—
8	IGN (F-12) (+)
9	o/d off
10	Fuel low
11	—
12	Sedimentor
13	Low coolant
14	Brake

B-55

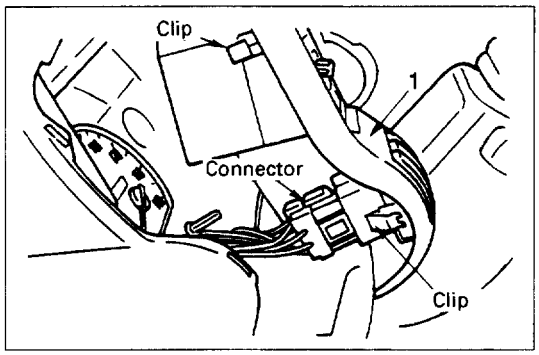
Terminal No.	Connected to
1	Speed pulse input
2	—
3	Power output (sensor)
4	ECT unit (GAGE)
5	Fuel tank unit (GAGE)
6	—
7	Ground
8	Turn signal (LH)
9	—
10	Beam (+) (F-7)
11	Turn signal (RH)
12	—

B-52

Terminal No.	Connected to
1	Oil pressure
2	Vacuum SW
3	Charge
4	Parking
5	Illumination (+)
6	—
7	—
8	Signal (tacho)
9	Ground (tacho)
10	Ground
11	—
12	+B (F-8)

ECT - Engine Coolant Temperature

825LX004

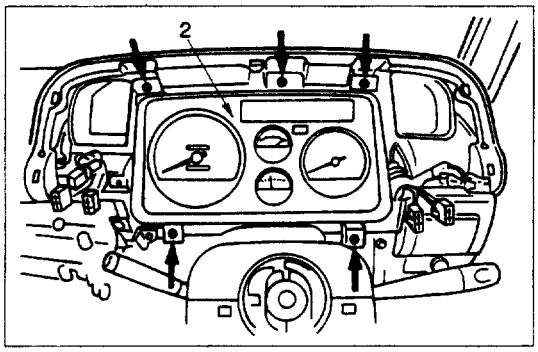


REMOVAL

Preparation:

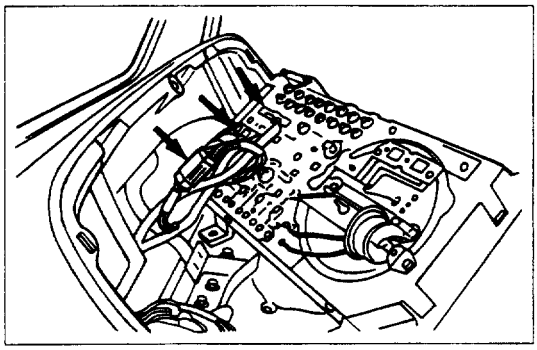
Disconnect the battery ground cable.

1. **Meter Cluster**



2. **Meter Assembly**

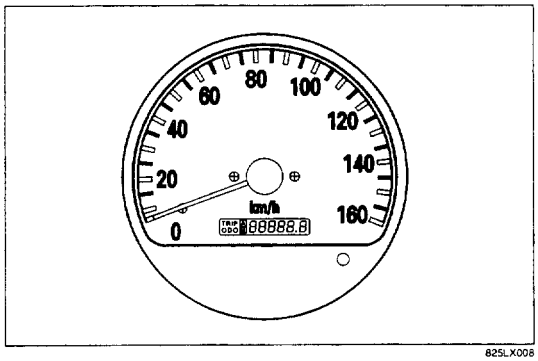
   Remove the five screws.



Disconnect the meter connectors.

INSTALLATION

To install, follow the removal steps in the reverse order.

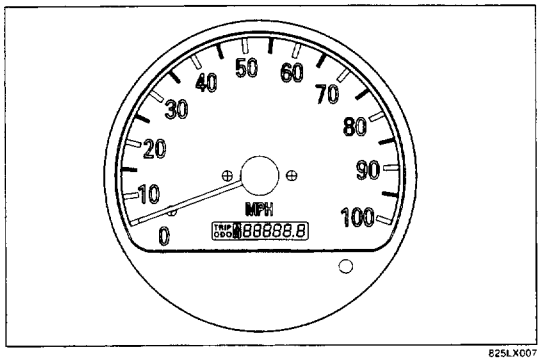


825LX008

SPEEDOMETER

The speedometer is made up of the cross coil type ammeter (movement) that displays indications, the stepper motor that drives and adds up the odometer and trip meter, and the driving circuit (printed circuit board) that makes exchanges between the pulse signals and the current.

Tester display speed	Meter display parmissible level
20 km/h	17.5 - 22.5 km/h
40	37.5 - 42.5
60	57.5 - 62.5
80	77.5 - 82.5
100	97.6 - 103.4
120	117.6 - 123.4
140	137.6 - 143.4



825LX007

Tester display speed	Meter display parmissible level
20 MPH	18.3 - 21.7 MPH
40	38.3 - 41.7
60	58.3 - 61.7
80	78.8 - 82.8

ON-VEHICLE SERVICE

Check the meter display accuracy and the operation of the odometer with the speedometer tester.

NOTE:

Inappropriate tire inflation may affect the accuracy of the odometer.

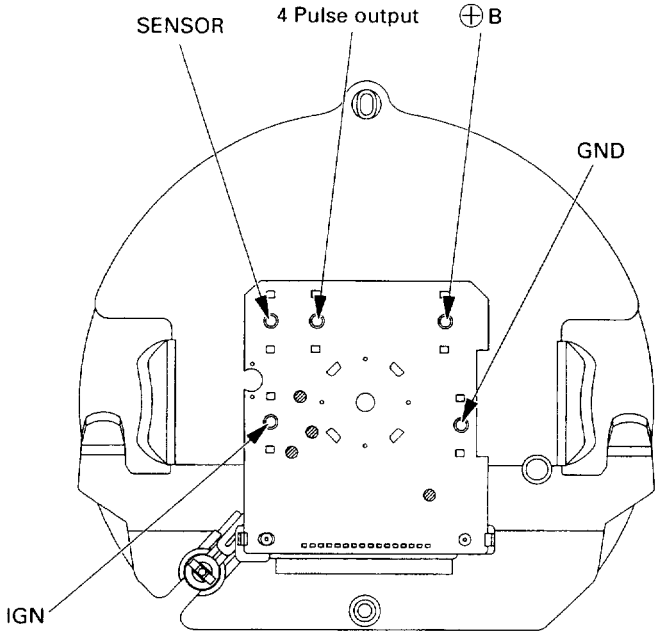
(To conduct this test, refer to the tester manufacturer's instruction manual.)

Since the meter display permissible levels above are specifications solely for the meter, they are to be used as reference values when conducting on-vehicle service.

INDIVIDUAL INSPECTION

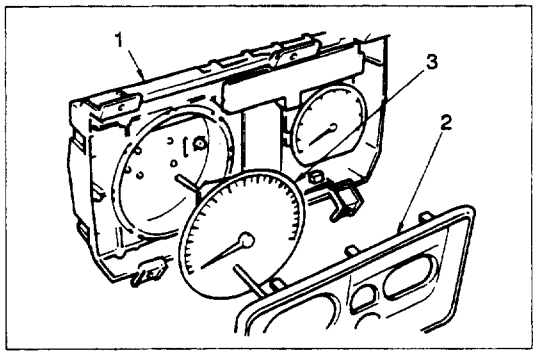
Remove the speedometer from the meter assembly and measure the resistance and the current consumption between each terminal.

Replace the speedometer when the result of inspection is found abnormal.



Terminal symbol	Resistance value
IGN-GND	58 ± 20kΩ
SEN-GND	70 ± 20kΩ
4P-GND	∞

825LW022



REMOVAL

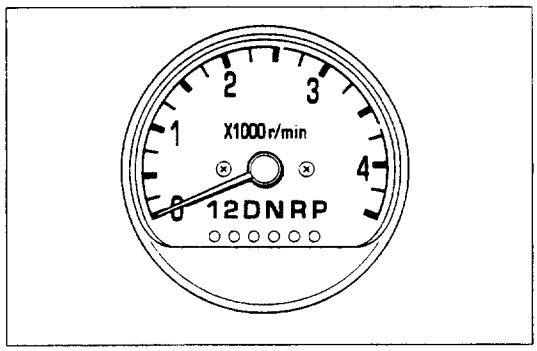
Preparation:

Disconnect the battery ground cable.

1. **Meter Assembly**
   Refer to "METER ASSEMBLY" in this section.
2. **Meter Glass**
   Remove it by pushing the catches with your finger.
3. **Speedometer**
   Remove four screws securing the meter at the back side.

INSTALLATION

To install, follow the removal steps in the reverse order.



TACHOMETER

The tachometer is made up of the cross coil type ammeter (movement) that displays indications, and the drive circuit (printed board) that makes exchange between the pulse signals and the current.

Tester display speed	Meter display parmissible level
500	400 - 500
1000	800 - 1050
2000	1800 - 2050
3000	2800 - 3050
4000	3800 - 4050

ON-VEHICLE SERVICE INSPECTION

1. Set up the tune-up tester to the engine.
2. Start the engine and compare the readings displayed by the tachometer and the tester.
   When the difference between these two readings differs largely from the specified value, replace it with a correct one.

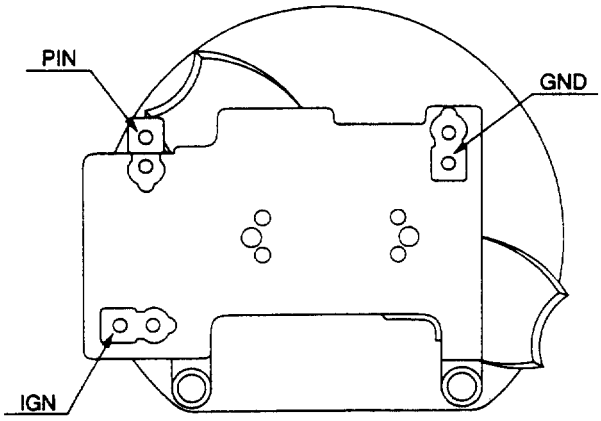
NOTE:

Since the meter display permissible levels above are specifications solely for the meter, they are to be used as reference values when conducting on-vehicle inspection.

INDIVIDUAL INSPECTION

Remove the tachometer from the meter assembly and measure the resistance value and the current consumption between each terminals.

Replace the tachometer when the result of inspection is found abnormal.



Tachometer (Back side)

1. Resistance value

Use the analog type circuit tester. (Range: 1K)

For 12 Volt tachometer

Tester terminal / Terminal symbol	Red (+)	Black (–)	Black (–)	Red (+)
IGN–GND	IGN	GND	IGN	GND
	∞		30 ± 5kΩ	
PIN–GND	PIN	GND	PIN	GND
	33 ± 5kΩ		500~1000kΩ	

For 24 Vol tachometer

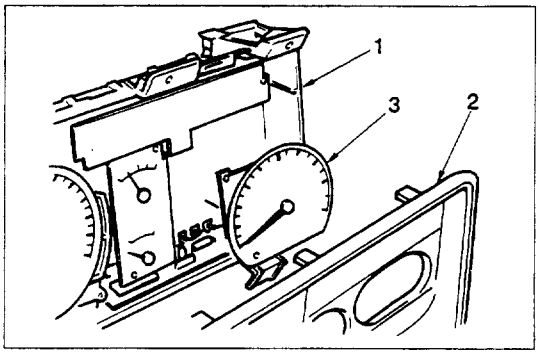
Tester terminal / Terminal symbol	Red (+)	Black (–)	Black (–)	Red (+)
IGN–GND	IGN	GND	IGN	GND
	∞		30 ± 5kΩ	
PIN–GND	PIN	GND	PIN	GND
	33 ± 5kΩ		500~1000kΩ	

2. Current value

Use the analog type circuit tester.

Since the current consumption fluctuates as the power voltage varies, check to be sure that the voltage applied is 12 ± 1V or 24 ± V.

Voltage	Connecting terminal	Current consumption	Remarks
12Volt	IGN–GND	12 ± 1V (when 12 ± 1V applied)	No signal input
24Volt		24 ± 1V (when 24 ± 1V applied)	No signal input



REMOVAL

Preparation:

Disconnect the battery ground cable.

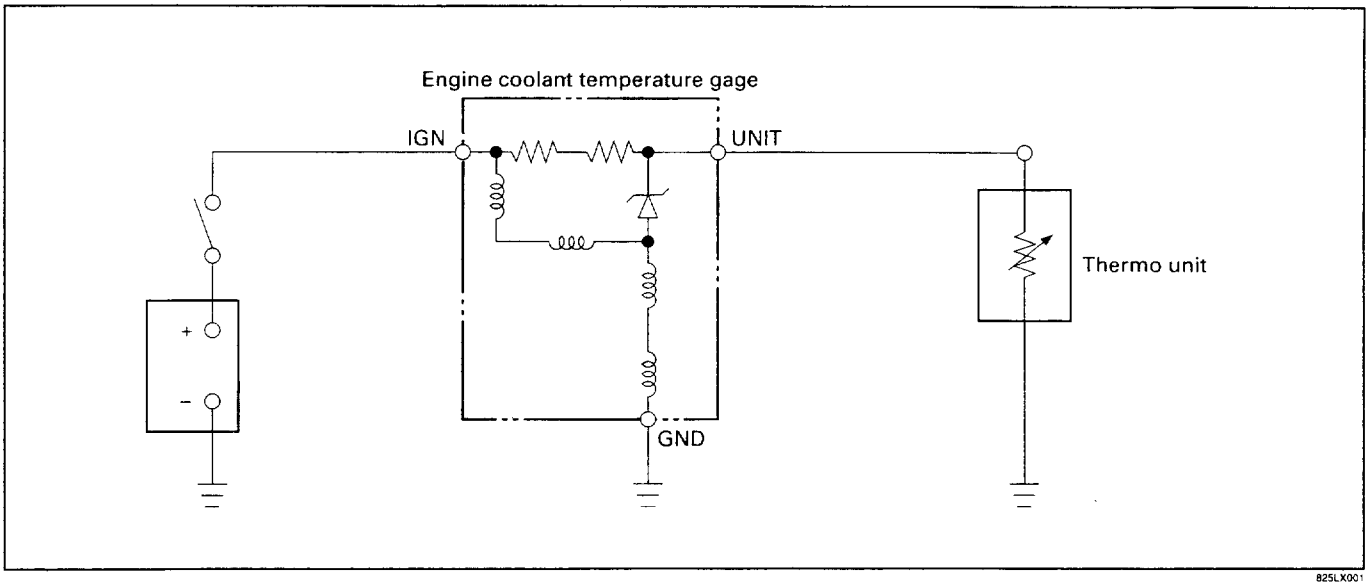
1. **Meter Assembly**
   Refer to "METER ASSEMBLY" in this section.
2. **Meter Glass**
   Remove it by pushing the catches with your finger.
3. **Tachometer**
   Remove three screws securing the meter at the back side.

INSTALLATION

To install, follow the removal steps in the reverse order.

COOLANT TEMPERATURE GAUGE

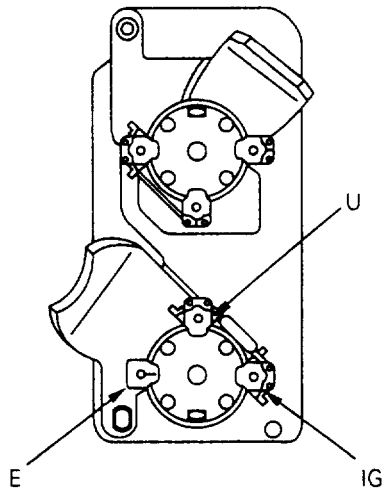
CIRCUIT DIAGRAM



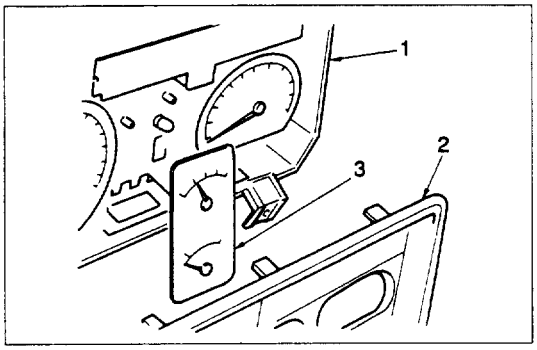
INSPECTION

Remove the coolant temperature gauge from the meter assembly, and measure the resistance value between each terminal.

Replace the coolant temperature gauge when the result of inspection is found abnormal.



Terminal symbol	Resistance value
IG–U	169Ω ± 10%
U–E	333Ω ± 10%
IG–E	242Ω ± 10%



REMOVAL

Preparation:

Disconnect the battery ground cable.

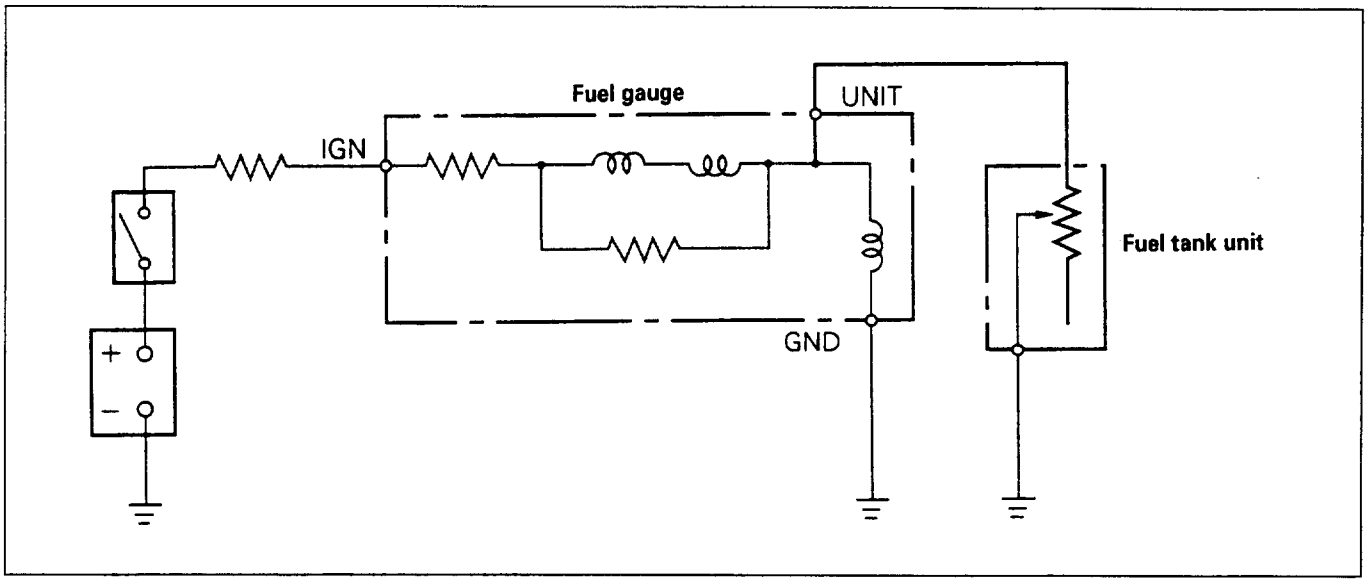
1. **Meter Assembly**
   Refer to "METER ASSEMBLY" in this section.
2. **Meter Glass**
   Remove it by pushing the catches with your finger.
3. **Coolant Temperature Gauge**
   Remove six screws securing the meter at the back side.

INSTALLATION

To install, follow the removal steps in the reverse order.

FUEL GAUGE

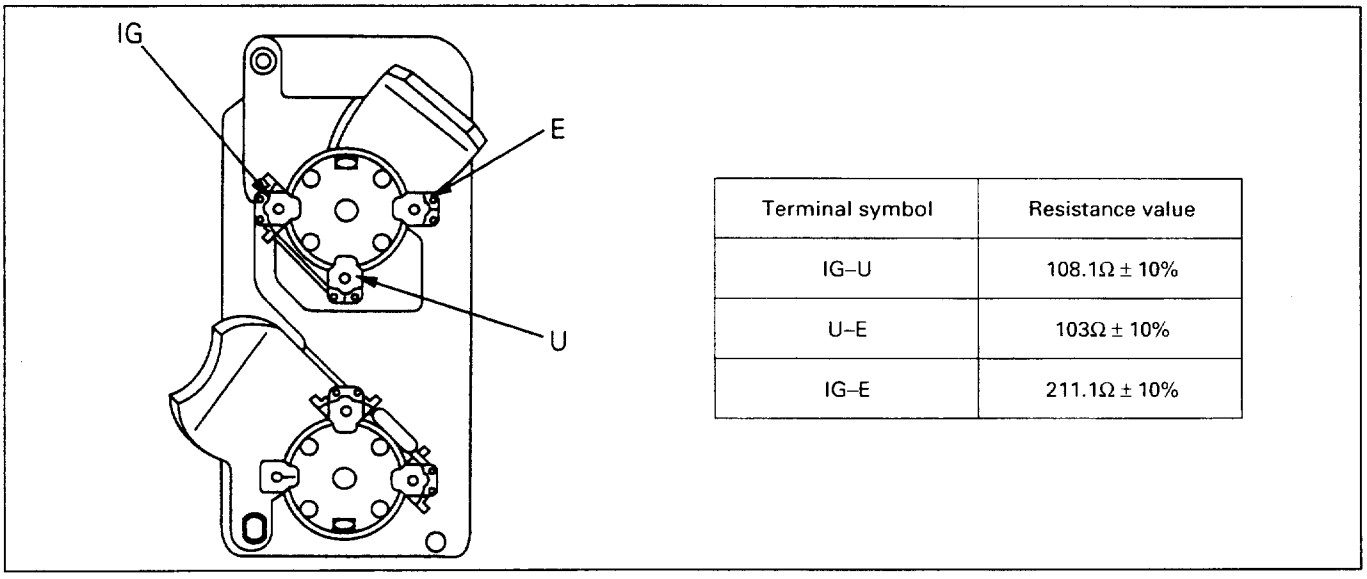
CIRCUIT DIAGRAM



INSPECTION

Remove the fuel gauge from the meter assembly, and measure the resistance value between each terminal.

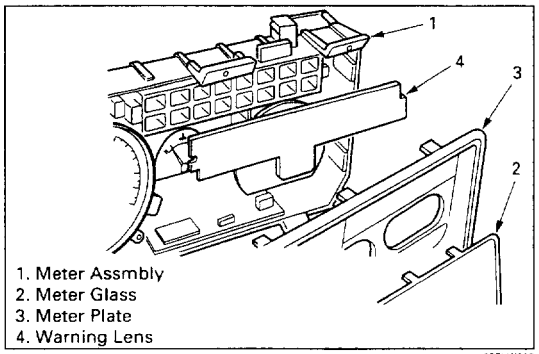
Replace the meter when the result of inspection is found abnormal.



Terminal symbol	Resistance value
IG–U	108.1Ω ± 10%
U–E	103Ω ± 10%
IG–E	211.1Ω ± 10%

REMOVAL AND INSTALLATION

Refer to the "COOLANT TEMPERATURE GAUGE" in this section.



1. Meter Assmbly
2. Meter Glass
3. Meter Plate
4. Warning Lens

825LW009

WARNING LENS

REMOVAL

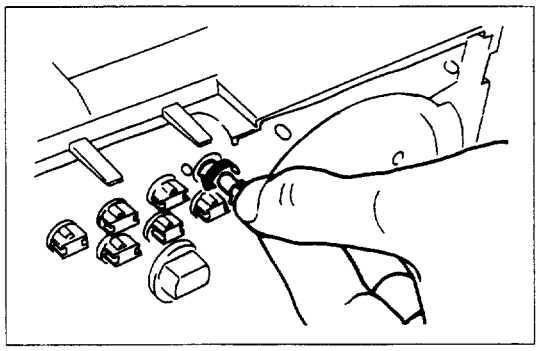
Preparation:

Disconnect the battery ground cable.

1. **Meter Assembly**
   Refer to "METER ASSEMBLY" in this section.
2. **Meter Glass**
   Remove it by pushing the catches with your finger.
3. **Meter Plate**
   Remove it by pushing the catches with your finger.
4. **Warning Lens**

INSTALLATION

To install, follow the removal steps in the reverse order.



WARNING LIGHT BULB, INDICATOR LIGHT BULB AND ILLUMINATION LIGHT BULB.

REMOVAL

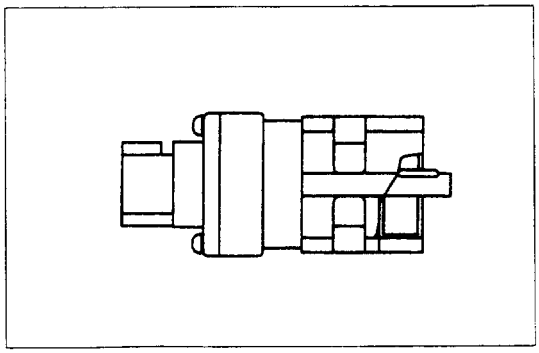
Preparation:

Disconnect the battery ground cable.

1. **Meter Assembly**
   Refer to "METER ASSEMBLY" in this section.
2. **Socket and Bulb**
   Hold the bulb socket by hand and rotate it counterclockwise to remove them from the meter body.
3. **Bulb**
   Pull out the bulb from the socket.

INSTALLATION

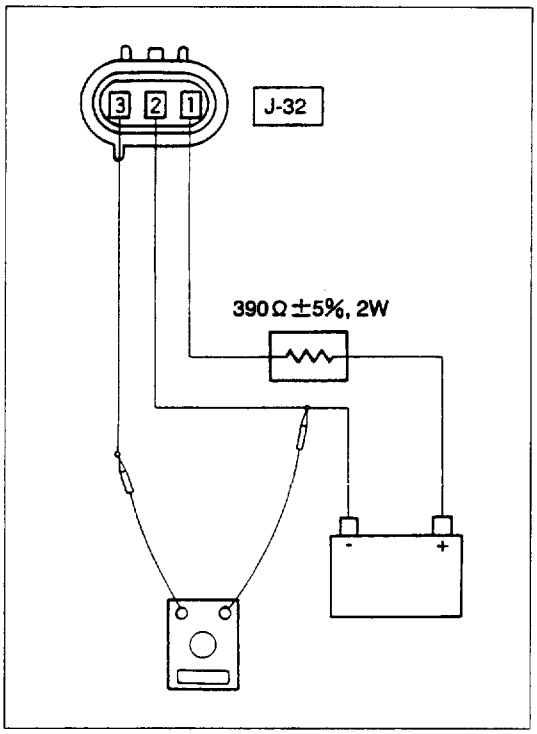
To install, follow the removal steps in the reverse order.



VEHICLE SPEED SENSOR

The vechicle speed sensor is installed on the rear portion of the transmission or transfer case.

The number of pulses generated is four pulses per one rotation of the pinion shaft.



INSPECTION

1. Connect a resistance of 390Ω ± 5%, 2W between connector terminal 1 J-32 and battery (+) terminal and connect the connector terminal 2 J-32 to the battery (–) terminal.

CAUTION

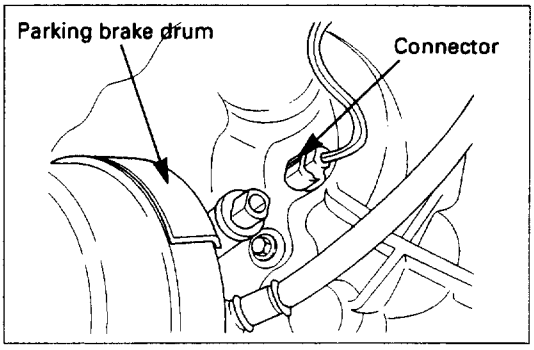
Be extremely careful not to connect the battery (+) terminal to the connector 3 J-32.

This may damage the vehicle speed sensor.

2. Rotate the shaft of the vehicle speed sensor slowly and measure the voltage between 3 J-32 and 2 J-32 with a digital tester.

The voltage, with one rotation of shaft, fluctuates four times in the following range: 10 to 14V ↔ 24 or less.

Replace the sensor when the result of inspection is found abnormal.



REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Vehicle Speed Sensor**

Disconnect the connector.

INSTALLATION

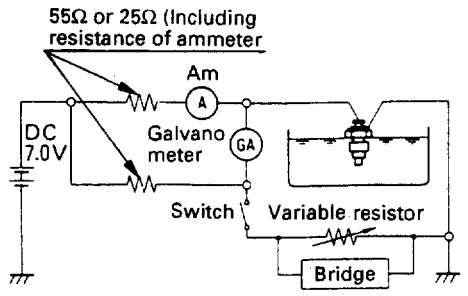
1. Tighten the vehicle speed sensor to the specified torque.

Vehicle speed sensor torque	N·m (kg·m/lb·ft)
	25 (2.5/18)

CAUTION:

Tightening must be made at the hexagonal part of the sensor.

To tighten the connector itself would cause damage.



Check condition \ Temperature		50°c (112°F)	115°c (239°F)
7V 55Ω Gauge	Resistance value (Ω)	+33.6 −36.6 226.0	+1.71 −2.21 26.4
7V 25Ω Gauge		–	+2.68 −3.68 24.3

THERMO UNIT

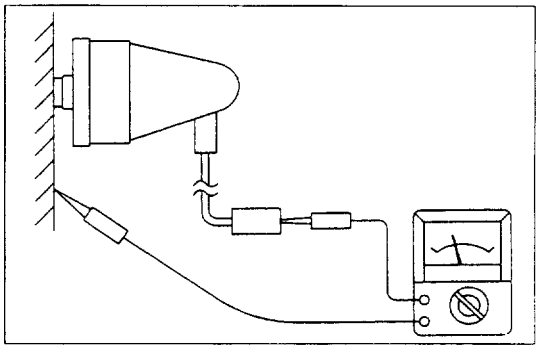
INSPECTION

The thermo unit is thermistor type and must be inspected under the conditions as shown in the left chart.

1. Put the deviation of the galvanometer to 0 by using the variable resistor, switch the thermo unit off and then measure the resistance of the resistor through the bridge.

   Confirm that the resistance is continuously variable in any other points than those shown in the left chart.
2. Dip the thermo unit into 80 - 90°C (176 - 194°F) water and confirm that there is no bubble continuously coming out of inside of the unit.

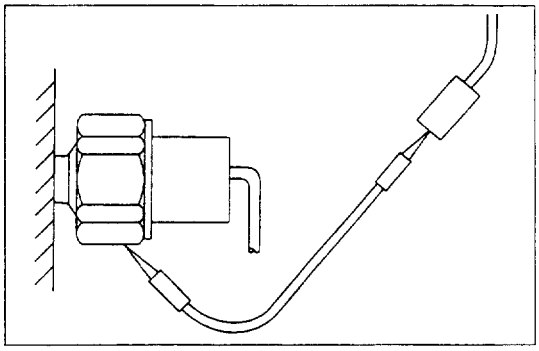
   Replace the unit when the result of inspection is found abnormal.



OIL PRESSURE SWITCH

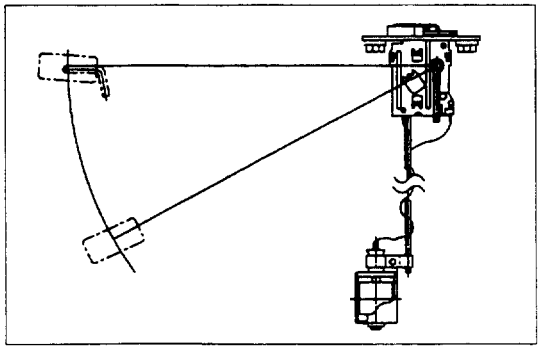
INSPECTION

Check the continuity between the switch terminal and the body ground with the starter switch is OFF position. Replace the switch when the result of inspection is found abnormal.



CIRCUIT INSPECTION

1. Start the engine
2. When disconnecting the oil pressure switch connector then connecting the harness side connector to the ground, check to see if the oil pressure warning light lights up. When the light will not light up, check the circuit between the meter and the oil pressure switch, and repair an open circuit if necessary.



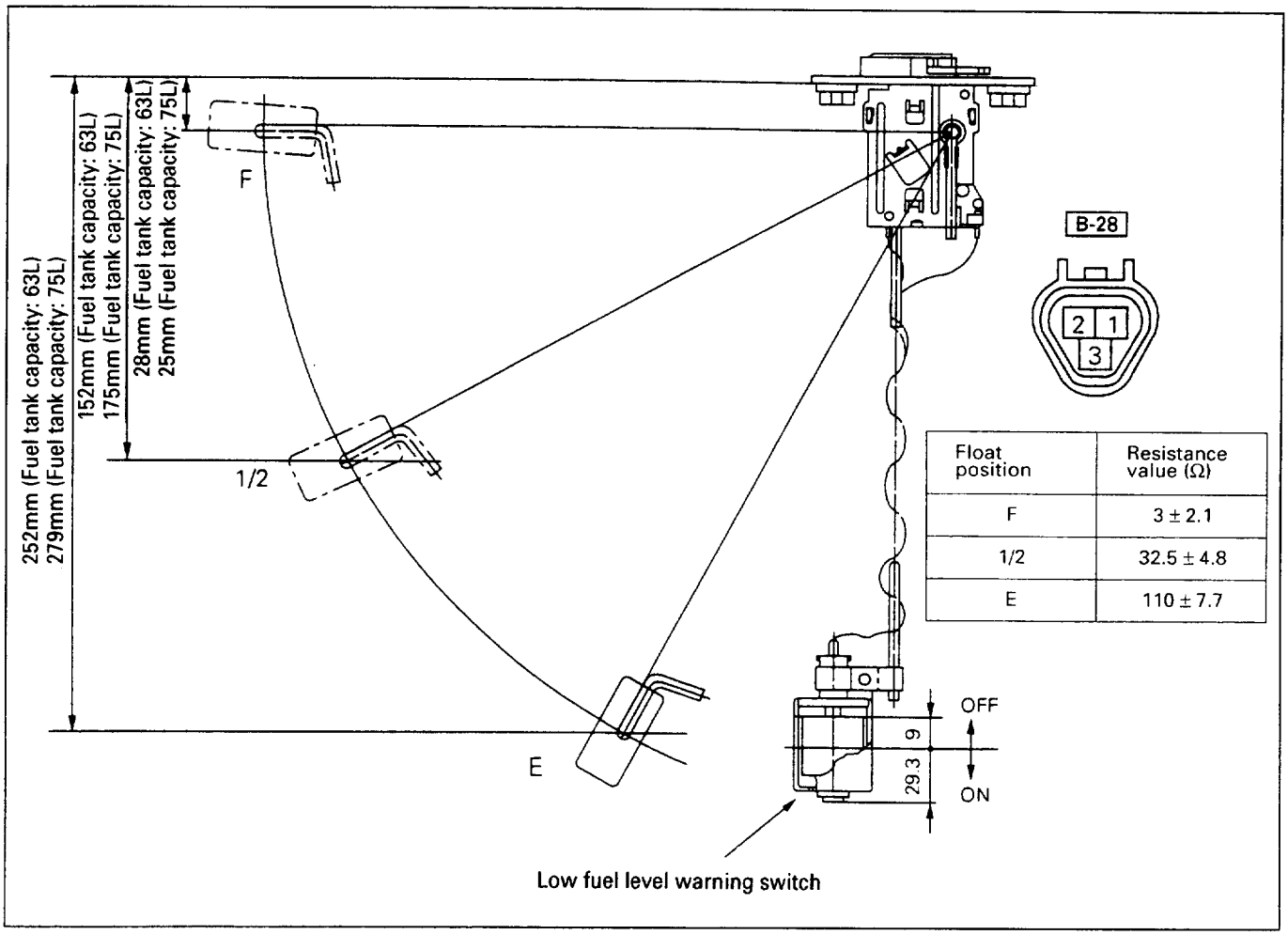
FUEL TANK UNIT

The tank unit varies the internal resistance according to the float position (fluid level) to operate the fuel meter needle. Also available is the build-in switch type to warn the driver of low fuel level (about 5 liters left in the tank) by illuminating the fuel warning light.

INSPECTION

(Level Switch type of warn low fuel level)

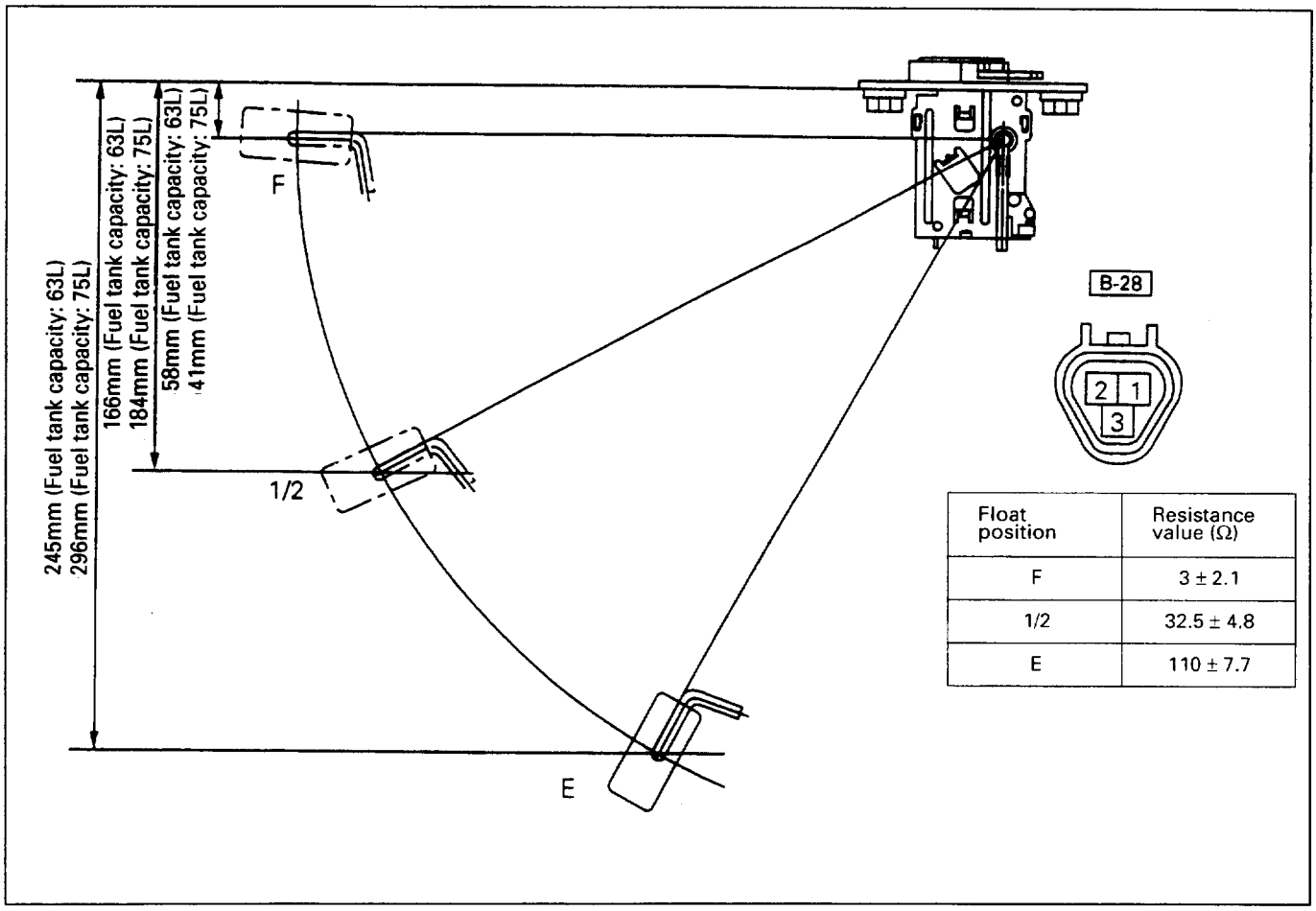
1. Check the resistance between the connector terminals 1 [J-28] and 3 [J-28] while shifting the float from "E" to "F" point.
2. Check if the low fuel warning switch turns on and off at the specified positions. If found defective, replace the fuel tank unit.



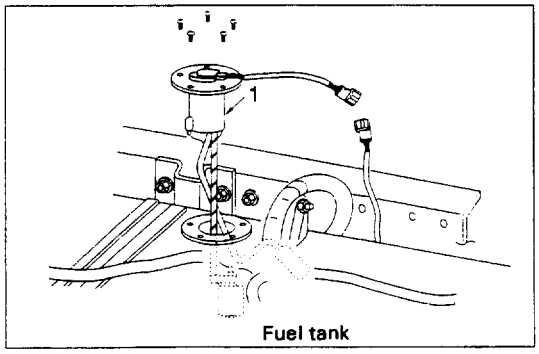
Float position	Resistance value (Ω)
F	3 ± 2.1
1/2	32.5 ± 4.8
E	110 ± 7.7

(Float type of warn low fuel level)

1. Check the resistance between the connector terminals 1 J-28 and 3 J-28 while shifting the float from "E" to "F" point.
2. Check if the low fuel warning light turns on when the float is at "E" position. If found defective replace the fuel tank unit.



Float position	Resistance value (Ω)
F	3 ± 2.1
1/2	32.5 ± 4.8
E	110 ± 7.7



Fuel tank

REMOVAL

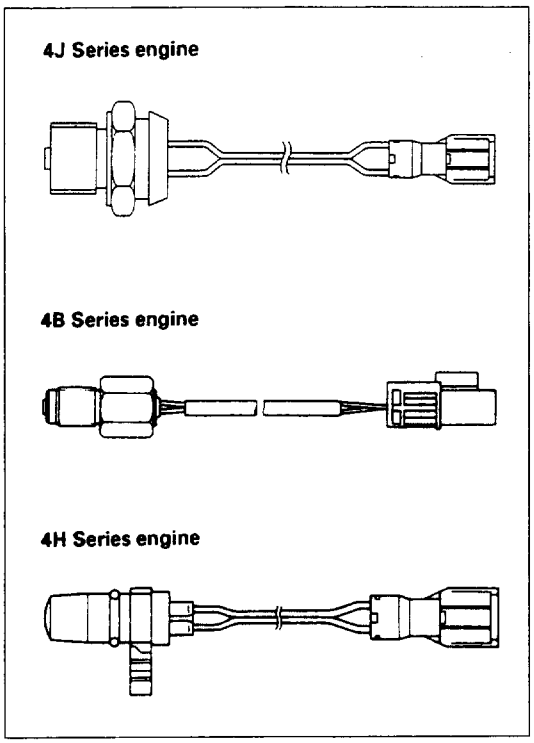
Preparation:

Disconnect the battery ground cable.

1. **Fuel Tank Unit**
   1) Disconnect the connector.
   2) Remove five screws.

INSTALLATION

To install, follow the removal steps in the reverse order.



ENGINE SPEED SENSOR

INSPECTION

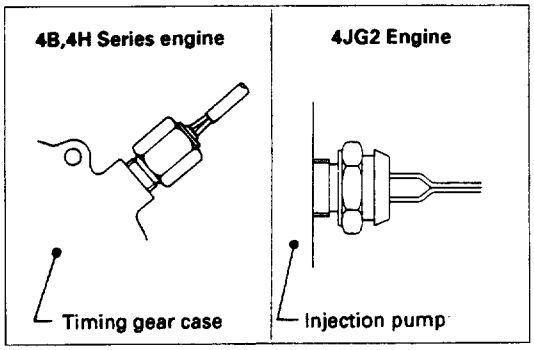
Measure the resistance value between the engine speed sensor connector terminals.

Replace the engine speed sensor when the result of inspection is found abnormal.

4J Series engine = 1.36 - 1.86 KΩ

4B Series engine = 0.24 - 0.36 KΩ

4H Series engine = 0.57 - 0.86 KΩ



REMOVAL

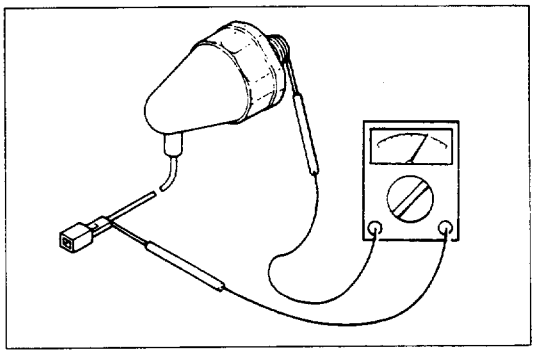
Preparation:

Disconnect the battery ground cable.

1. **Engine Speed Sensor**
   1) Disconnect the connector.
   2) Remove the engine speed sensor.

INSTALLATION

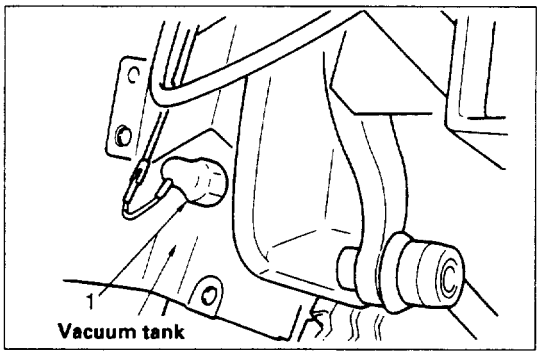
To install, follow the removal steps in the reverse order.



VACUUM SWITCH

INSPECTION

When the pressure value is below 250 ± 30mm Hg (33.3 ± 4.0 kPa), check to see if there is continuity between the terminal and the ground. If no continuity, replace the switch with a normal one.



REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Vacuum Switch**
   1) Disconnect the connector.
   2) Remove the vacuum switch.

INSTALLATION

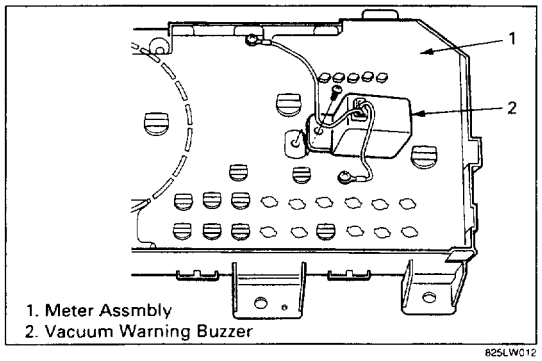
Apply liquid gasket to the screw portion of the switch to prevent vacuum leak.

VACUUM WARNING BUZZER

INSPECTION

Apply battery voltage to the buzzer connector terminals to check the buzzer sound.

Replace the buzzer when the result of inspection is found abnormal.



REMOVAL

Preparation:

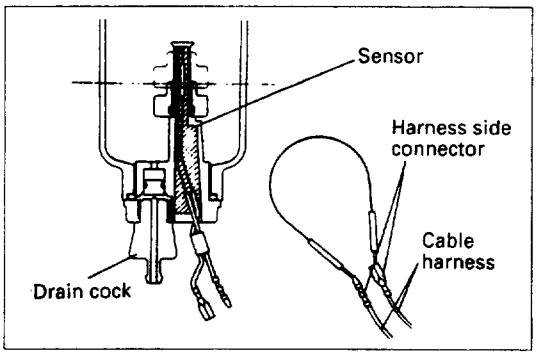
Disconnect the battery ground cable.

1. **Meter Assembly**

   Refer to "METER ASSEMBLY" in this section.
2. **Vacuum Warning Buzzer**
   1) Disconnect the connector.
   2) Remove the buzzer fixing screw.

INSTALLATION

To install, follow the removal steps in the reverse order.

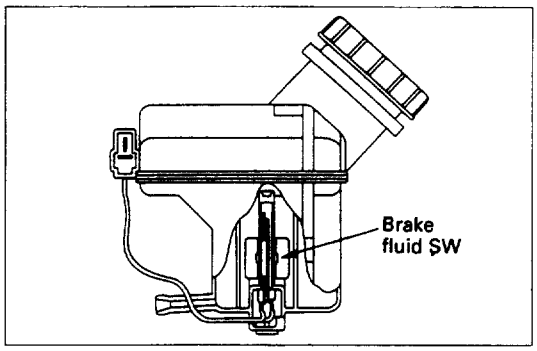


WATER SEDIMENTER SWITCH

INSPECTION

1. When the float in the water sedimenter is above the drain warning level, confirm if there is continuity between the switch connector terminals.
2. Turn the starter switch on, disconnect the water sedimenter connector and connect the harness side connector terminals. Then confirm that the sedimenter warning light turns on.

   If found defective, replace the switch or repair a poor connection or an open circuit between the connector terminals.



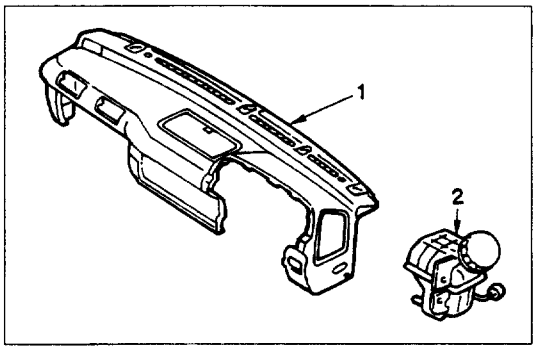
BRAKE FLUID SWITCH

INSPECTION

1. Confirm there is continuity between the switch connector terminals when the brake fluid in the tank is between 60 - 75 cc level.
2. Turn the switch on, disconnect the brake fluid switch connector and connect the harness side connector terminals.

   Then confirm that brake warning light turns on.

   If found defective, replace the tank, or repair a poor connection or an open circuit between the connector terminals.



REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Instrument Panel Assembly**

   Refer to "INSTRUMENT PANEL" of section 10 "CAB".
2. **Brake Fluid Tank (Brake Fluid Switch)**
   1) Disconnect the switch connector.
   2) Remove four fixing nuts.
   3) Drain brake fluid in the tank.
   4) Disconnect the tubes.

CAUTION:

Be very careful not to allow the brake fluid to come in contact with painted surfaces or resin parts surfaces.

INSTALLATION

To install, follow the removal steps in the reverse order, noting the following points.

1. Bleed the air from brake and clutch fluid pipe line.
2. Check to see if the brake fluid level in the tank within specified level.
3. Check to see if brake warning light comes on when starter switch is turned on and then warning light go off after the engine running.

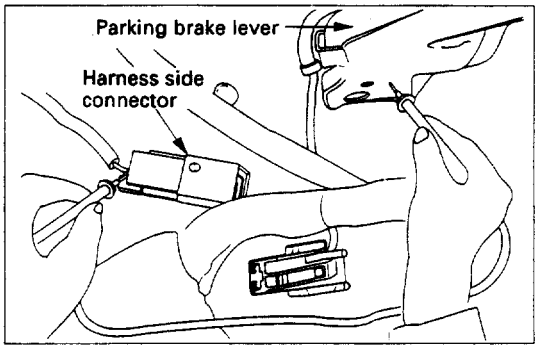
PARKING BRAKE INDICATOR LIGHT

The parking brake indicator light is connected in series with the parking brake switch installed to the parking brake lever bracket.

The light comes on when the parking brake lever is pulled, and goes out when the parking brake lever is fully released.

NOTE:

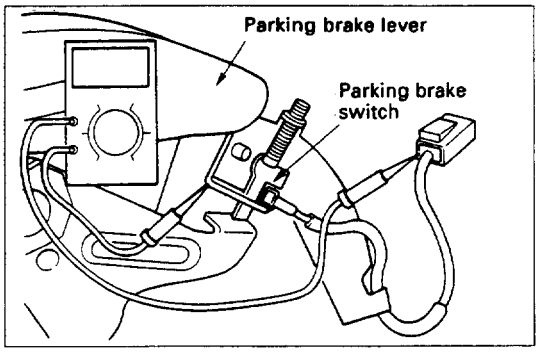
The parking brake indicator light illuminates to warn the driver that the parking brake is on. This light does not indicate the condition of the operability of the parking brake.



CIRCUIT INSPECTION

1. Disconnect the parking brake switch connector.
2. Connect the harness side connector terminal to the ground.
3. Check to see if the indicator light comes on with the starter switch "ON".

   Check the bulb or the harness when the result of inspection is found abnormal.



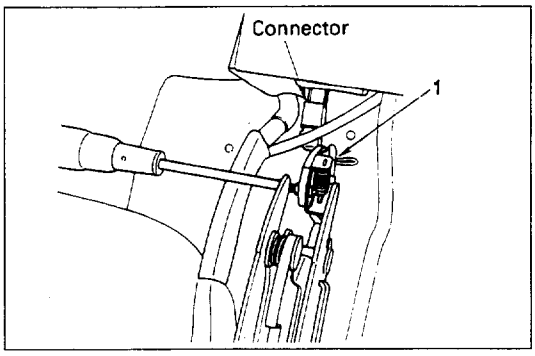
PARKING BRAKE SWITCH

INSPECTION

1. Disconnect the parking brake switch connector.
2. Check to see if there is any continuity between the switch terminal and the body ground with the circuit tester connected between them.

When parking brake applied	Continuity
When parking brake released	No continuity

Repair the parking brake switch or replace it when the result of inspection is found abnormal.



REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Parking Brake Switch**
   1) Disconnect the connector.
   2) Remove the fixing screw.

INSTALLATION

To install, follow the removal steps in the reverse order.

HEATER AND AIR CONDITIONING

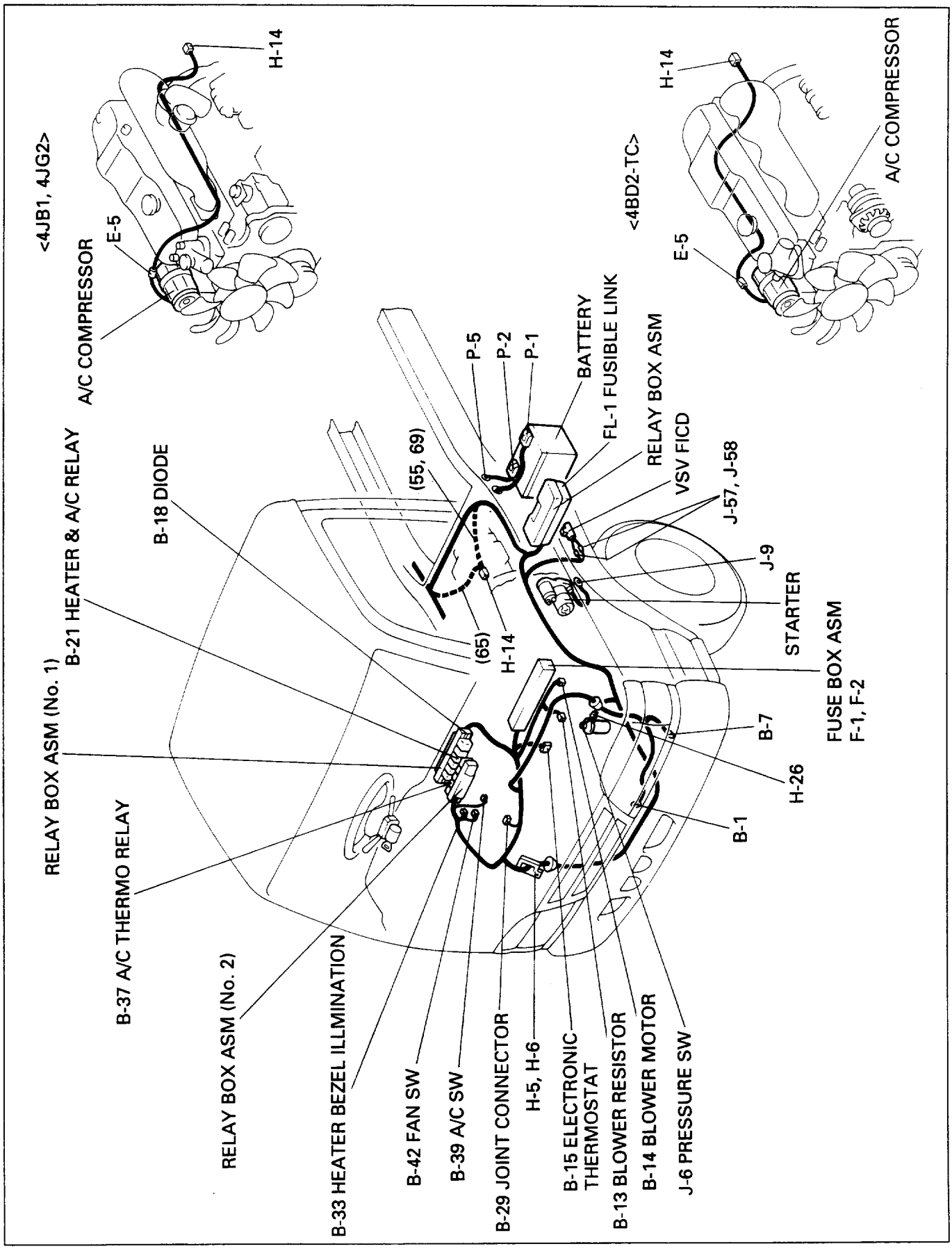
GENERAL DESCRIPTION

The air conditioning consists of compressor, evaporator, condenser, A/C switch, fan switch, etc. When the engine is rotating, the A/C starts to work with both the A/C and fan switches "ON", followed by the engagement of the magnetic clutch. It stops to work when either the fan switch or the A/C switch turns "OFF". In addition to the switches, the A/C has the function of temporary stop of its operation by the sensing system in the A/C cycle, such as:

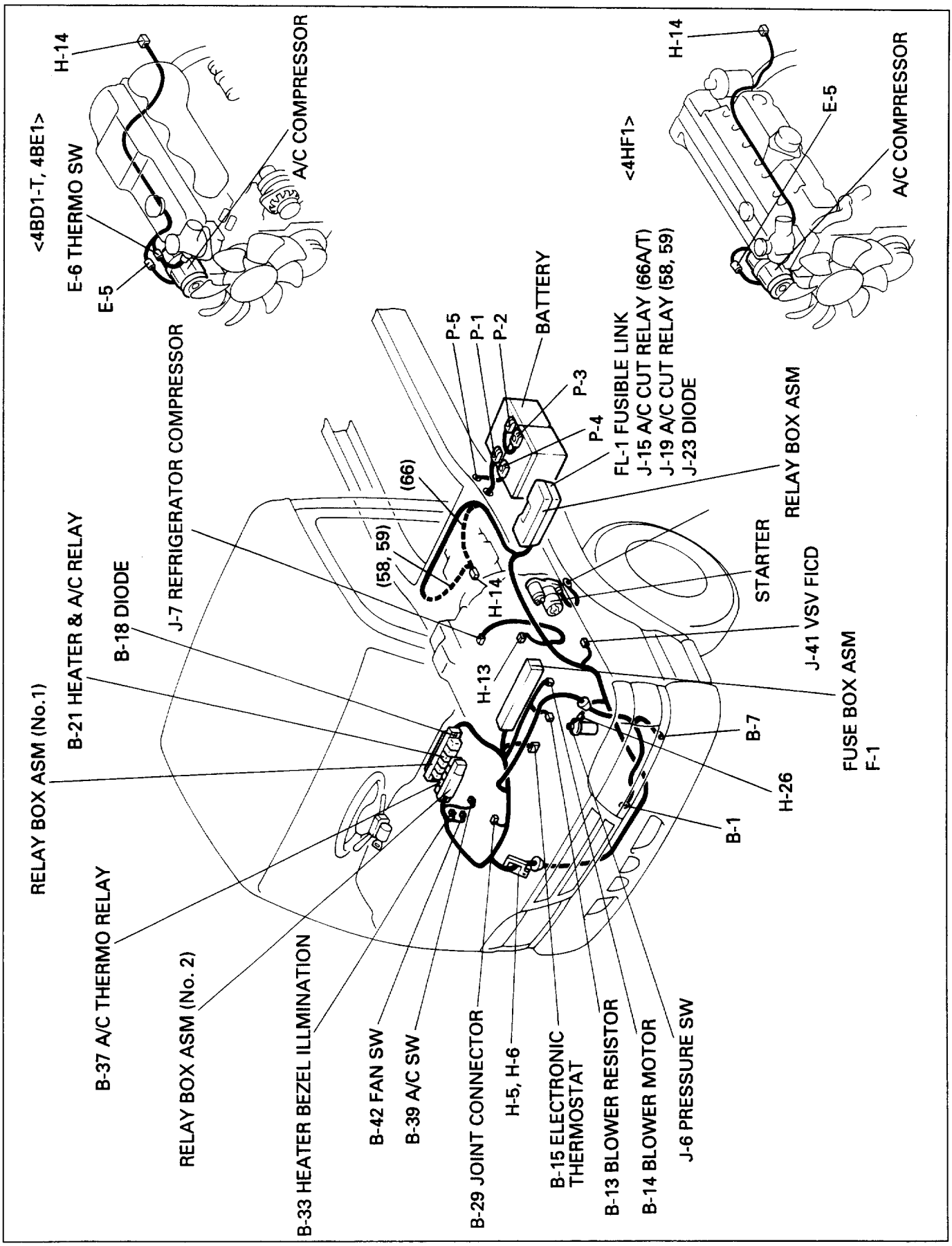
- sensing abnormal rise of the refrigerant pressure by means of the pressure switch.
- sensing temperature of the blowing-off air by means of the thermo switch preventing the evaporator from freezing.
- sensing the coolant temperature by the thermo switch (available for limited models only).

When fan control knob (fan switch) is put on with temp. Control lever being in the "FULL HOT" position (FULL HOT switch on) ceramic heater within heater unit generates heat, raising a heater blow-off temperature to enhance heating performance.

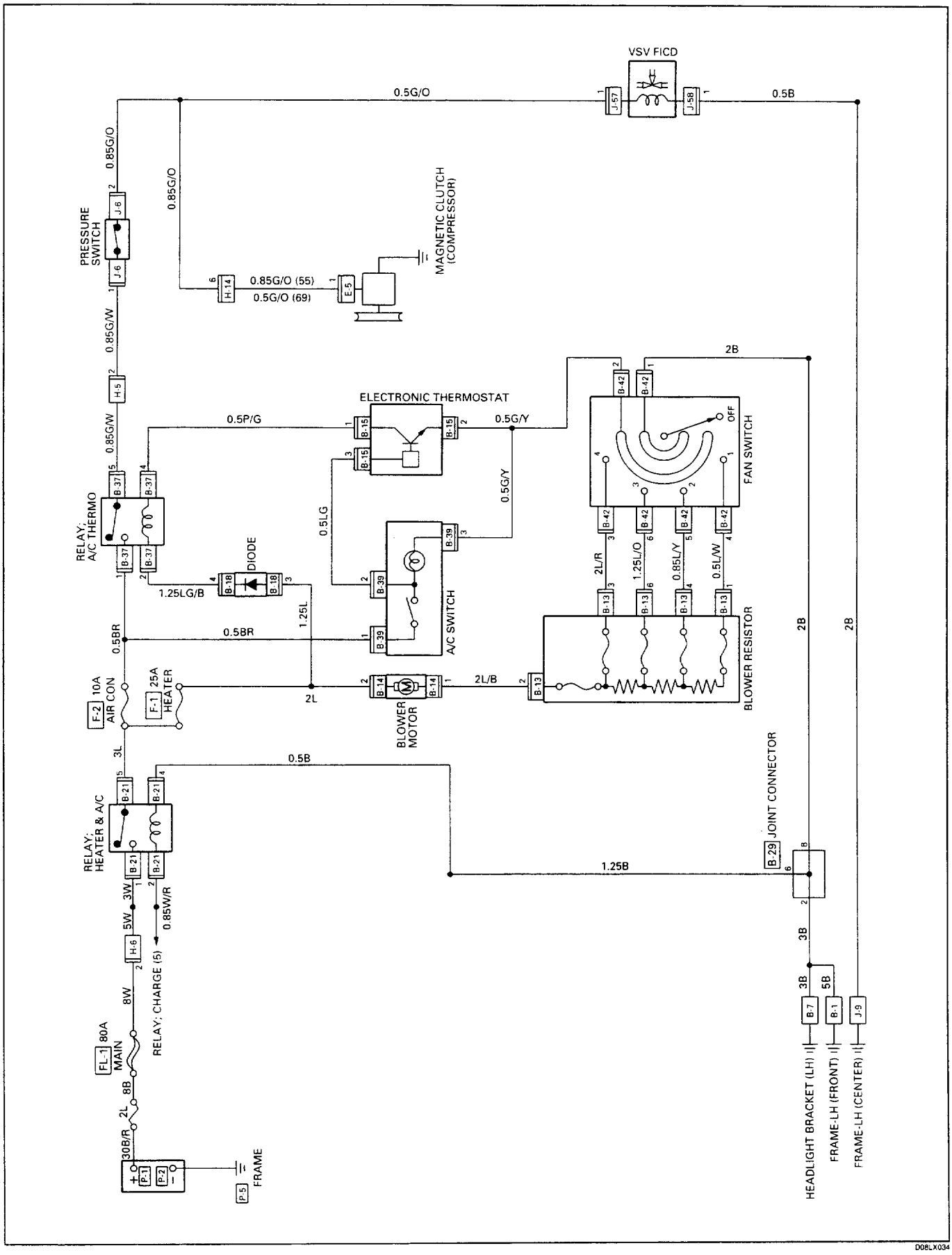
PARTS LOCATION- FOR 12 VOLT



PARTS LOCATION- FOR 24 VOLT

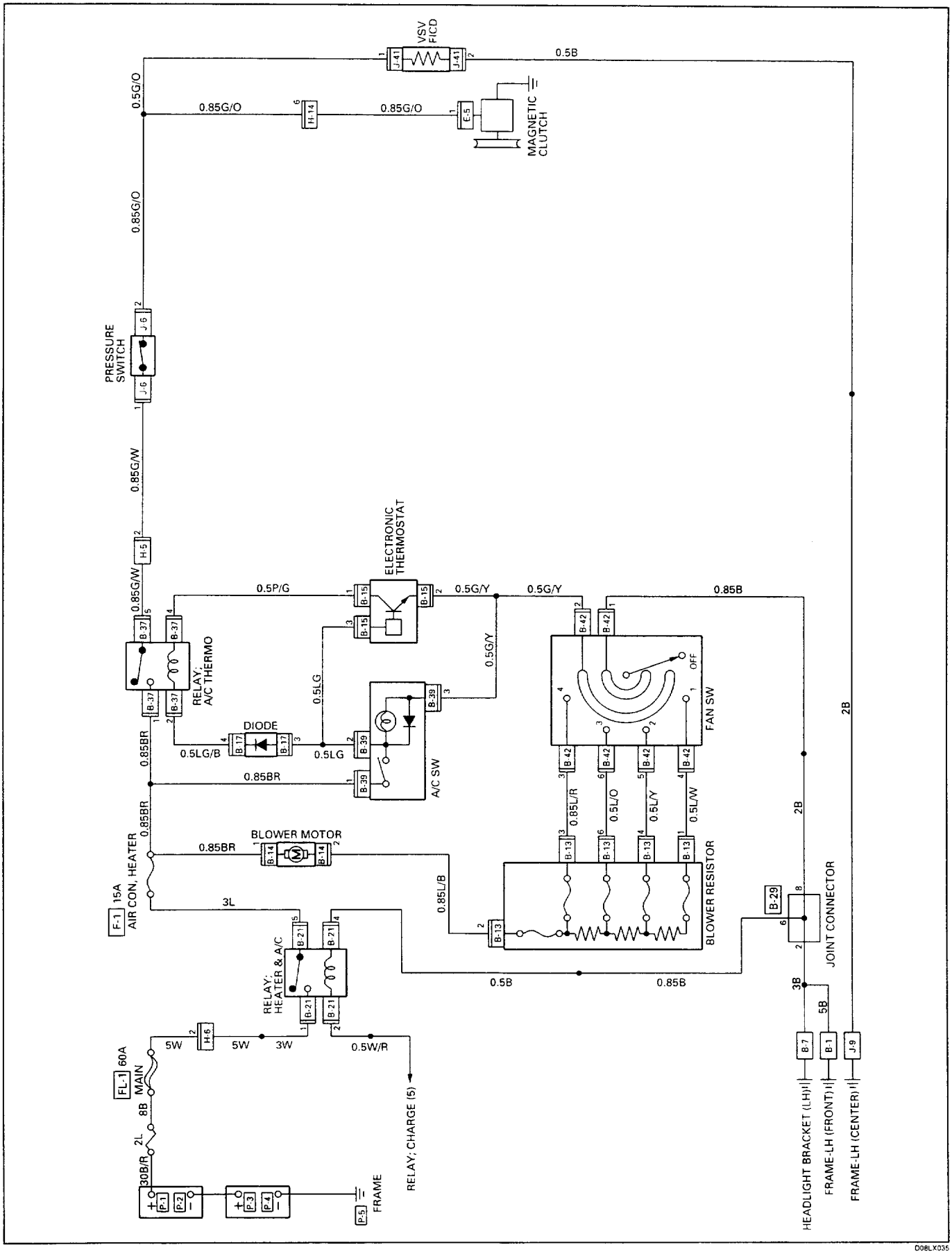


CIRCUIT DIAGRAM - FOR 12 VOLT



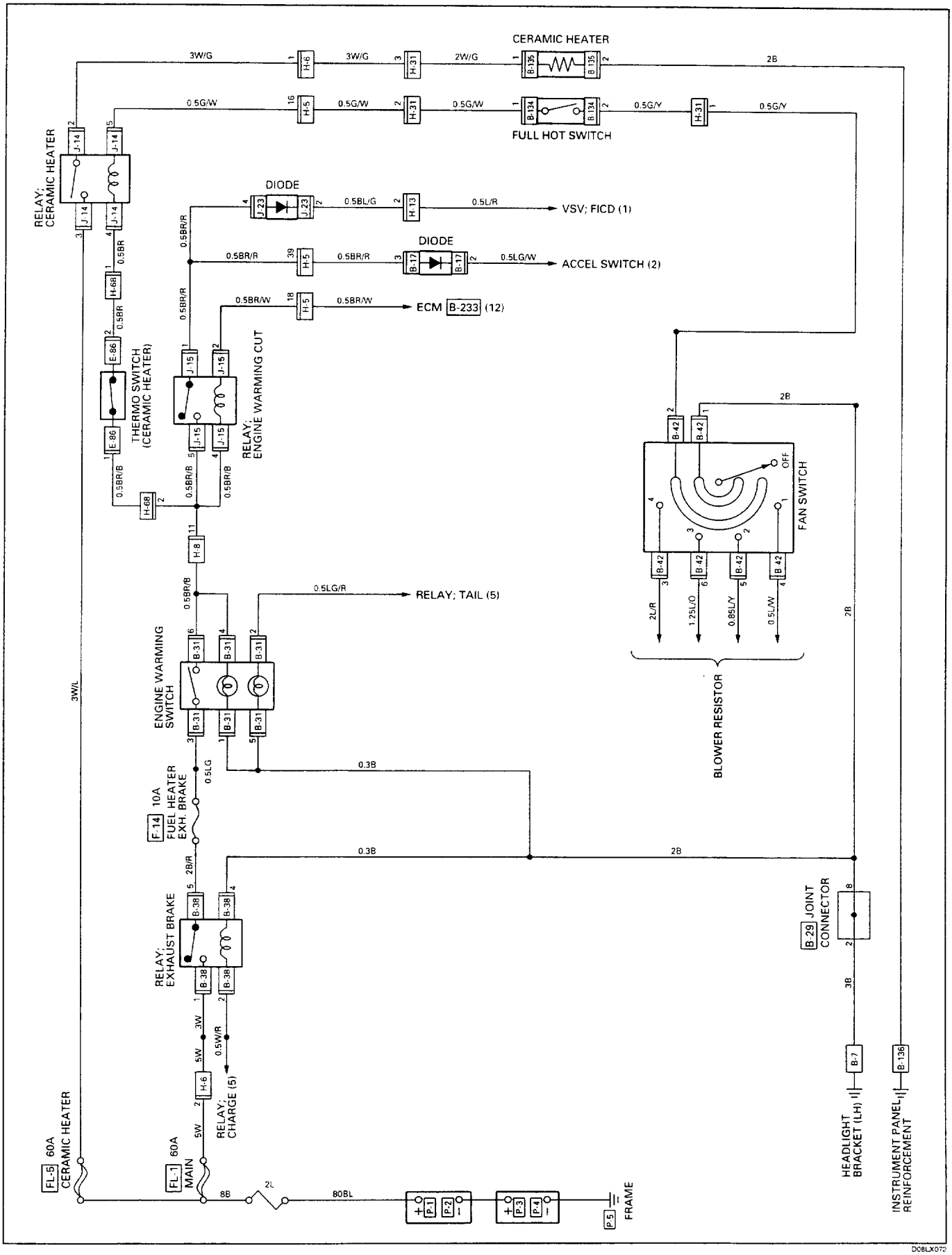
D08LX034

CIRCUIT DIAGRAM - FOR 24 VOLT - NKR66 · NPR66 · NQR66 · NPS66



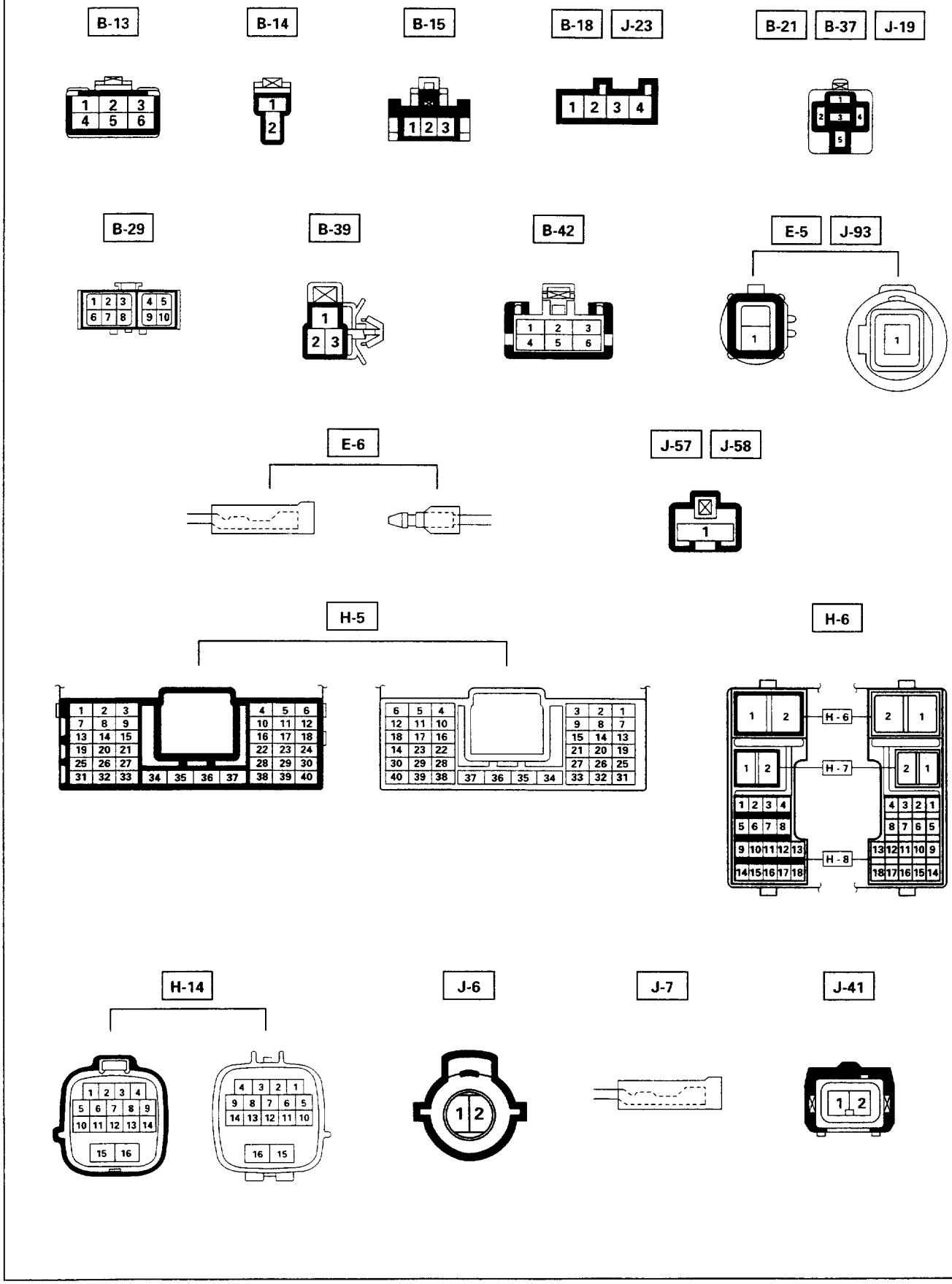
D08LX035

CIRCUIT DIAGRAM - CERAMIC HEATER



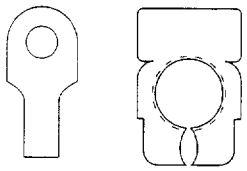
D08LX072

CONNECTOR LIST

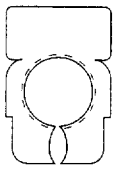


CONNECTOR LIST

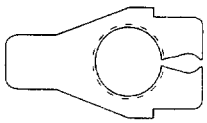
P-1 (12V) P-2



P-1 (24V) P-4

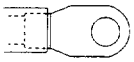


P-2 (24V) P-3

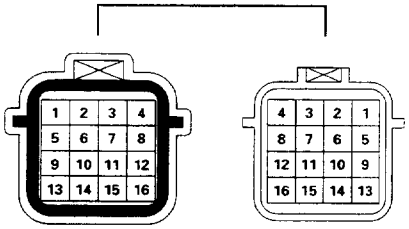


P-5 (12V)

P-5 (24V)



H-14



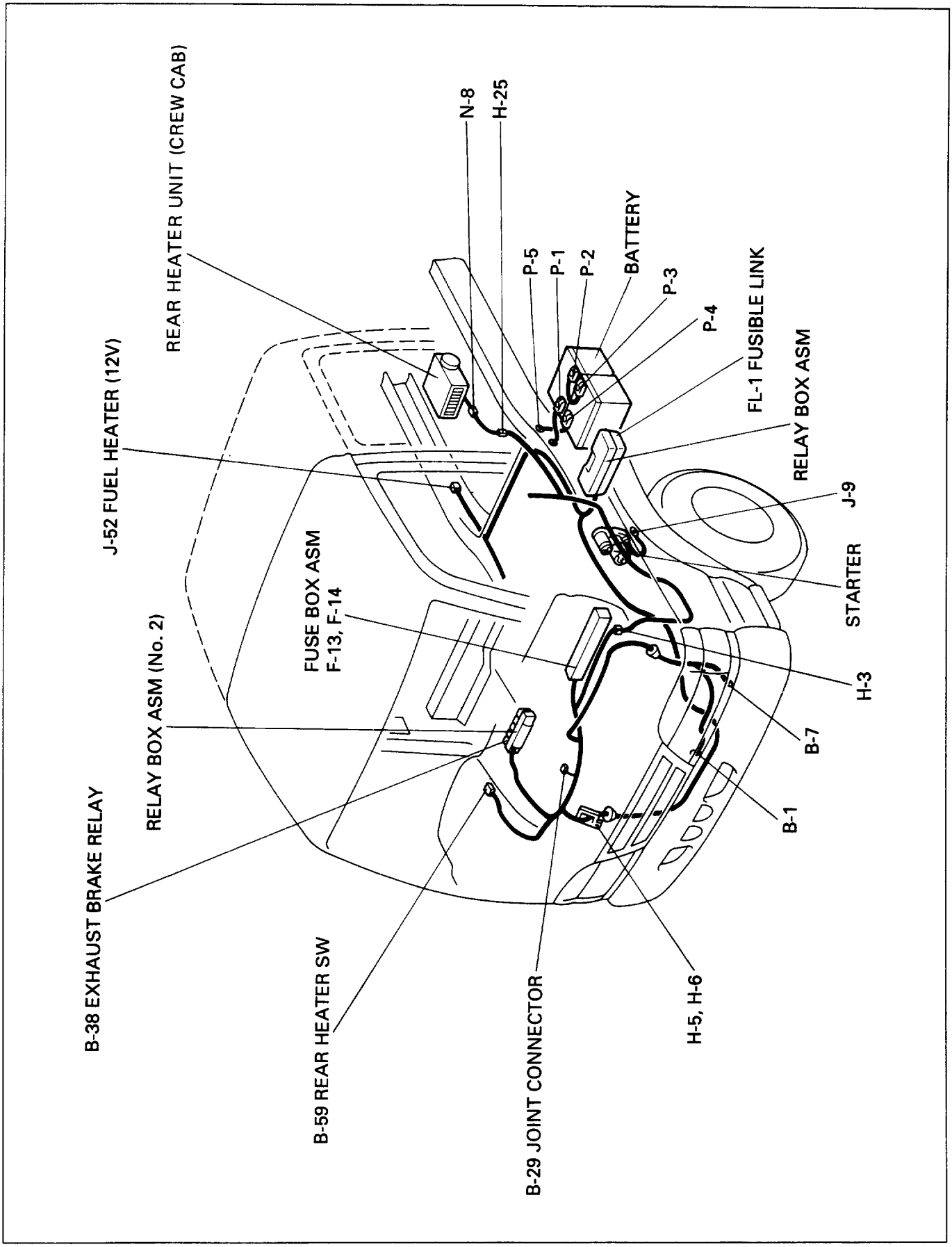
FUEL HEATER AND REAR HEATER

GENERAL DESCRIPTION

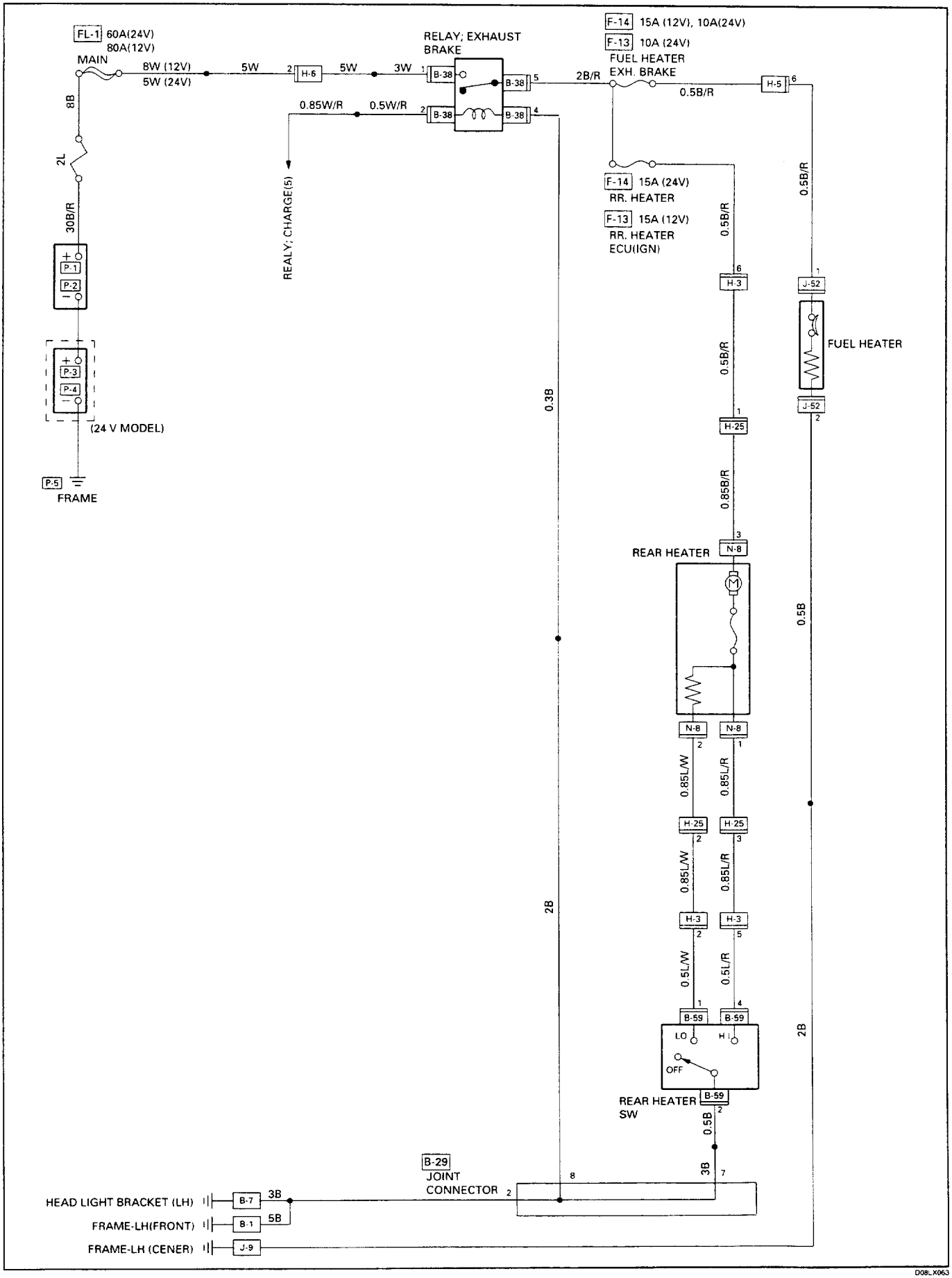
The circuit consists of fuel heater, rear heater, rear heater switch and the exhaust brake relay.

The fuel heater circuit is always in "ON" position when the generator is charging and its temperature is automatically controlled by the circuit breaker built in the fuel heater.

PARTS LOCATION



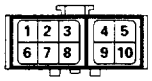
CIRCUIT DIAGRAM



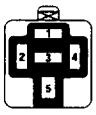
D08LX063

CONNECTOR LIST

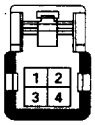
B-29



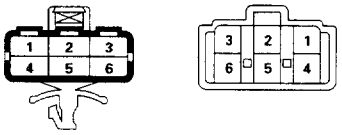
B-38



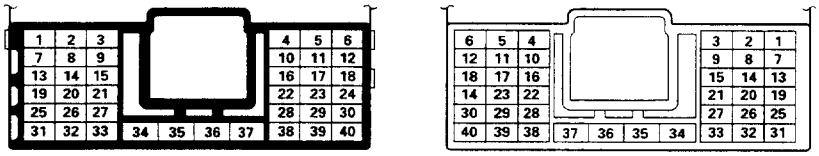
B-59



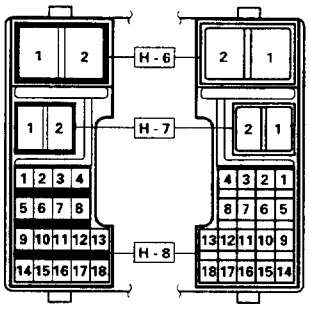
H-3



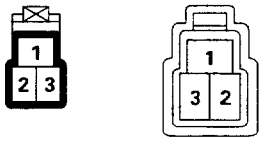
H-5



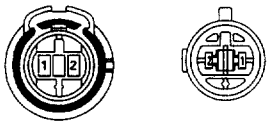
H-6



H-25

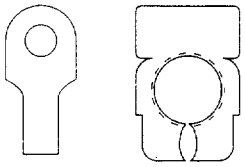


J-52

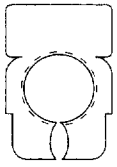


N-8

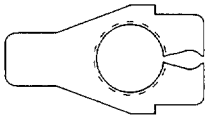
P-1 (12V) P-2



P-1 (24V) P-4

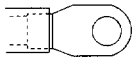


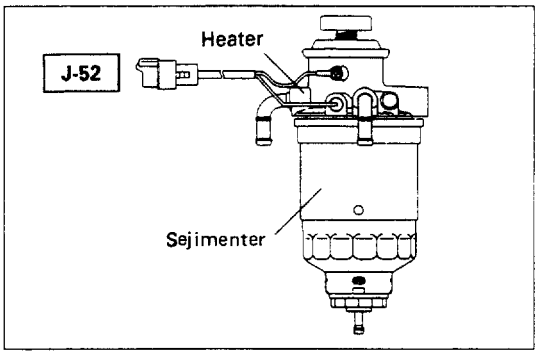
P-2 (24V) P-3



P-5 (12V)

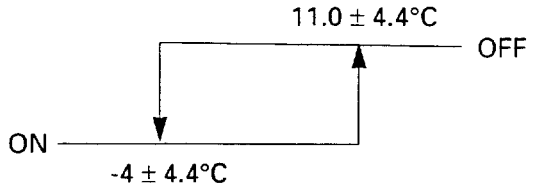
P-5 (24V)

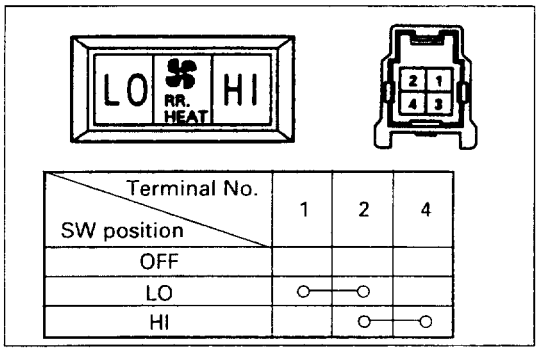




FUEL HEATER

Characteristic of fuel heater





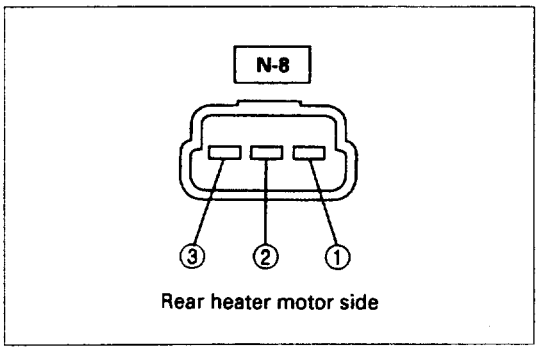
Terminal No. / SW position	1	2	4
OFF			
LO	○	○	
HI		○	○

REAR HEATER SWITCH

INSPECTION

Check the continuity between the connector terminals while operating the switch.

Replace the switch when the result of inspection is found abnormal.



REAR HEATER MOTOR

INSPECTION

Disconnect the rear heater connector.

Connect the battery positive terminal to the No. 3 terminal of the rear heater motor side connector and negative to the No. 2. Check to see if rear heater motor operates low-speed correctly.

Connect the battery positive terminal to the No. 3 terminal of the rear heater motor side connector and negative to the No. 1. Check to see if rear heater motor operates high-speed correctly.

Replace the rear heater motor when the result of inspection is found abnormal.

4WD TRANSFER (VACUUM CONTROL)

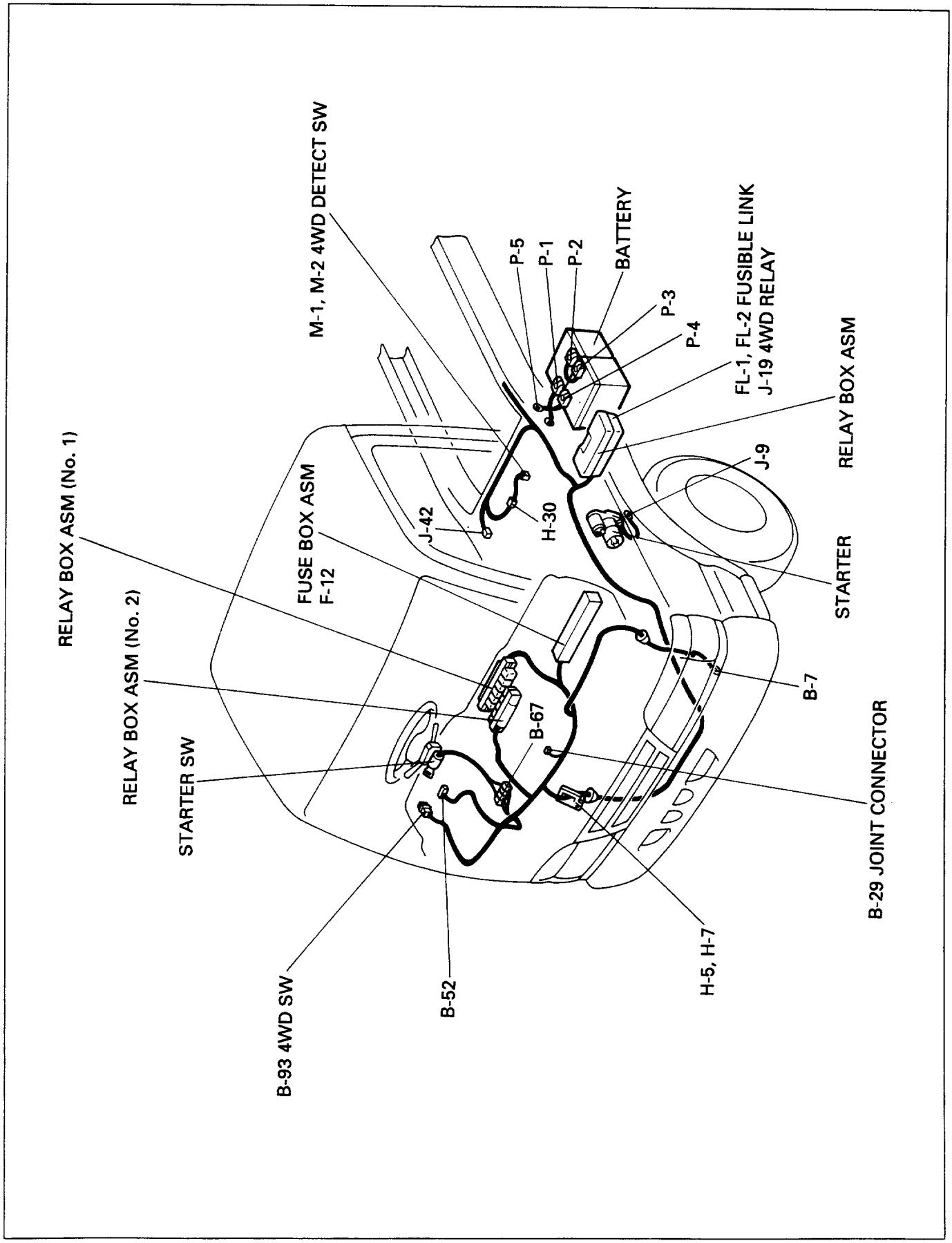
GENERAL DESCRIPTION

The circuit consists of the starter switch, 4WD switch, 4WD detect switch, 4L switch, vacuum switching valve, 4WD indicator light, neutral switch and the relay.

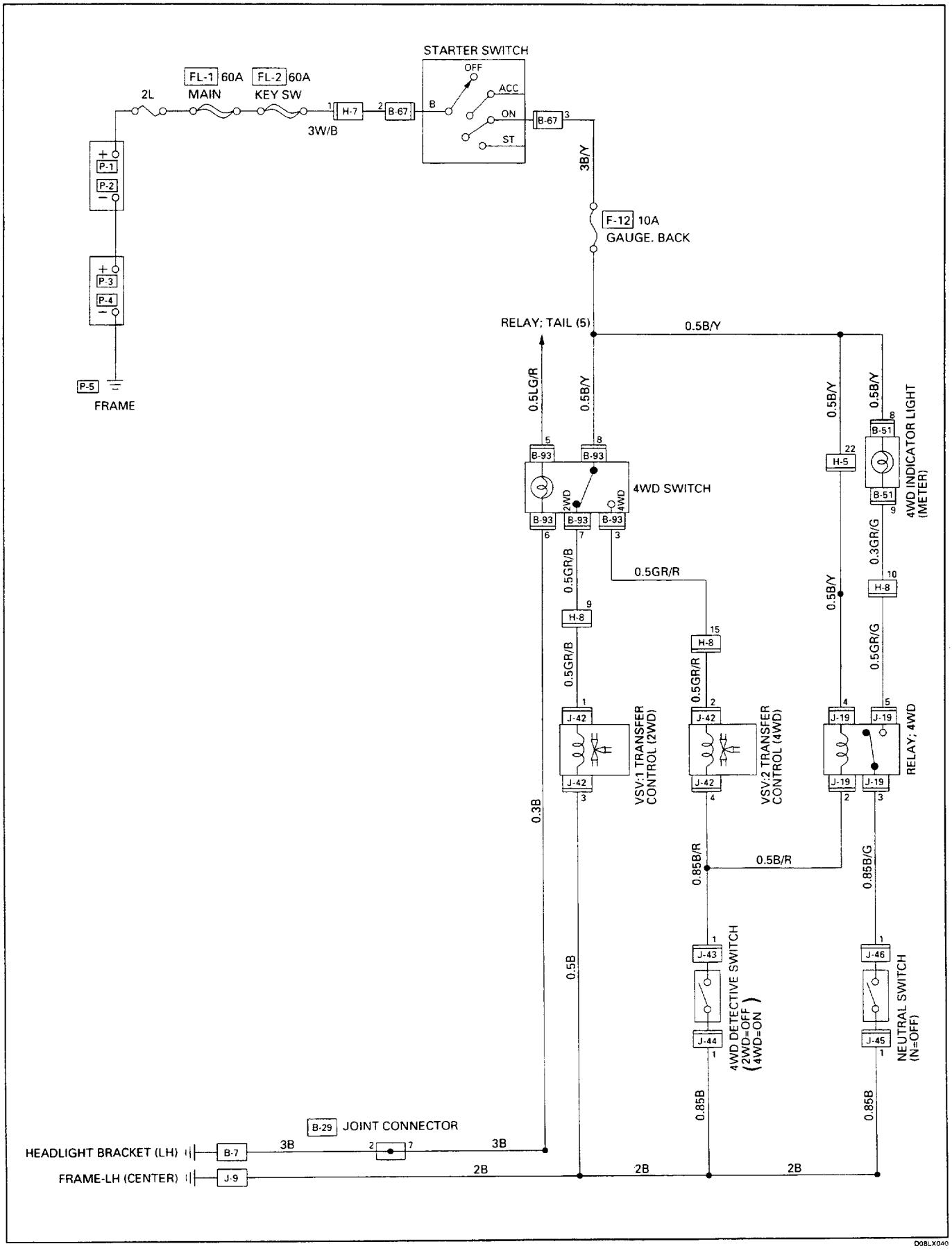
When the 4WD switch is turned on to drive in the 4WD mode, the vacuum switching valve for the transfer control is activated through the 4WD relay, and the transfer shift rod connected to the vacuum actuator is shifted to the 4WD side to turn on the 4WD detect switch. At the same time, the indicator light in the meter lights on to tell that the mode is transferred to 4WD mode.

However, when running in the normal mode (2WD), the 4WD switch is not operated. Accordingly, no current flows through the 4WD vacuum switching valve for the transfer control, with the 4WD detect switch left in the "OFF" condition (2WD mode).

PARTS LOCATION

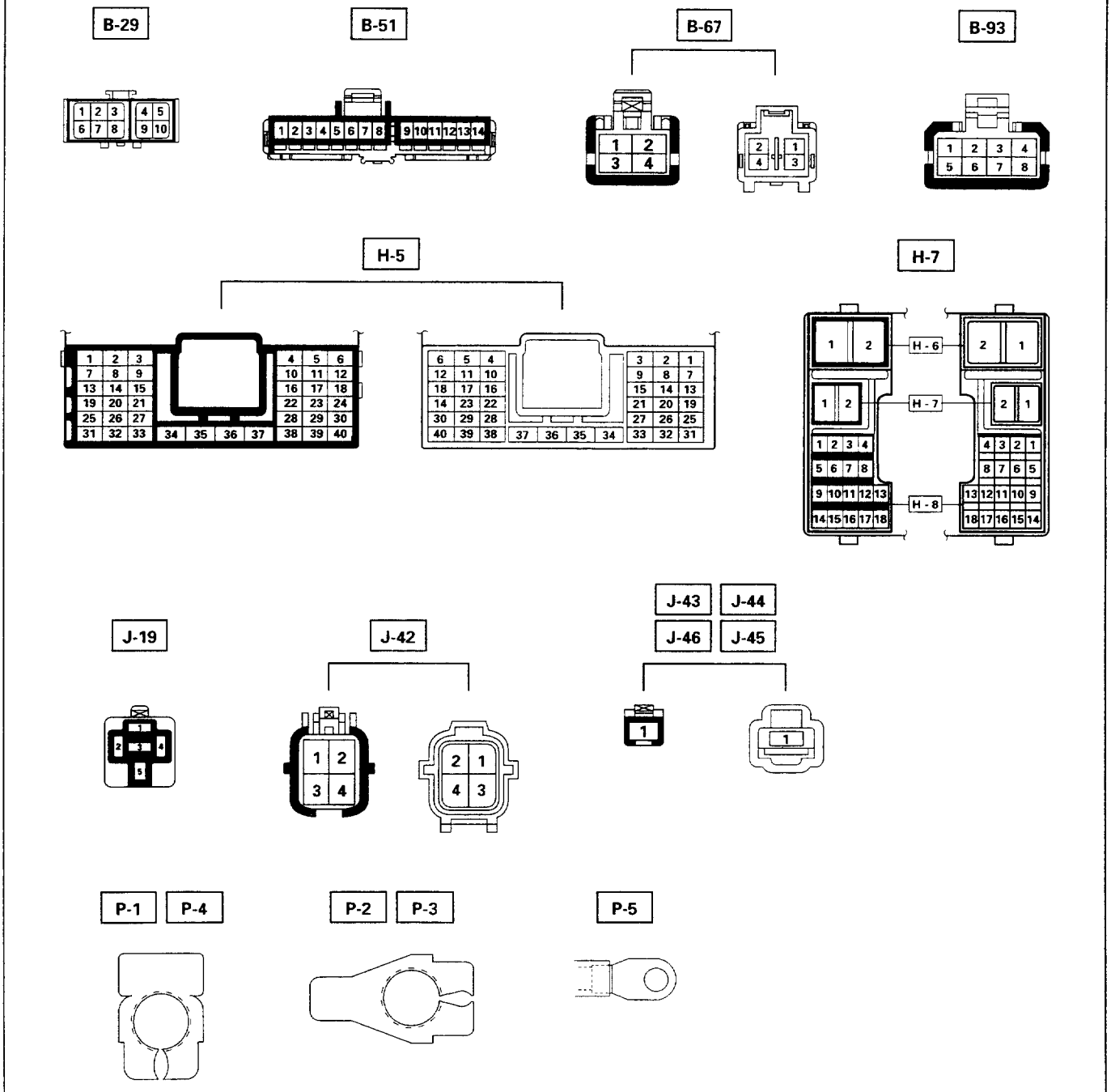


CIRCUIT DIAGRAM



D08LX040

CONNECTOR LIST



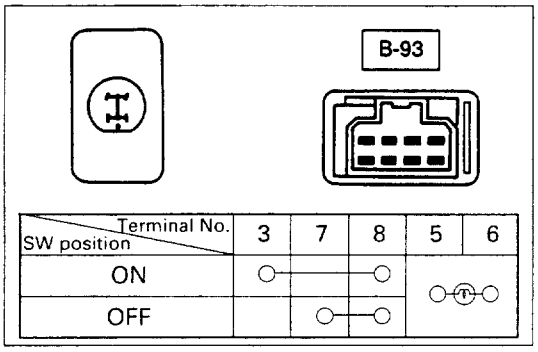
STARTER SWITCH

NEUTRAL SWITCH

Refer to "START AND CHARGING" in this section.

4WD INDICATOR LIGHT

Refer to "METER AND WARNING/ INDICATOR LIGHT" in this section.



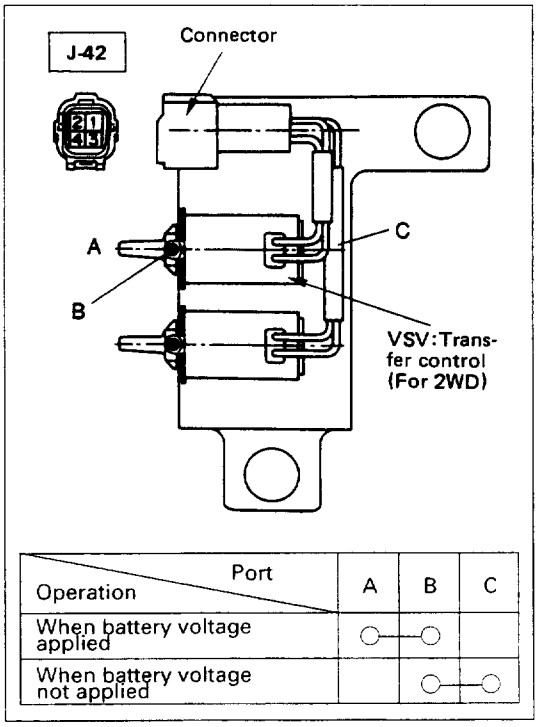
SW position \ Terminal No.	3	7	8	5	6
ON	○		○	○	○
OFF		○	○		

4WD SWITCH

INSPECTION

Check the continuity between the connector terminals while operating the switch.

Replace the switch when the result of inspection is found abnormal.

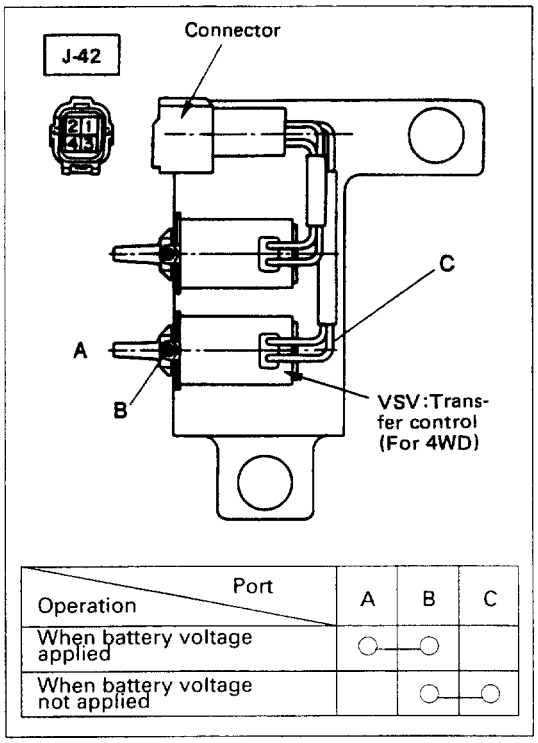


Operation \ Port	A	B	C
When battery voltage applied	○	○	
When battery voltage not applied		○	○

VACUUM SWITCHING VALVE: TRANSFER CONTROL (FOR 2WD)

INSPECTION

Connect the vacuum switching valve connector terminal No. 1 to the battery (+) terminal and terminal No. 3 to the (-) terminal and then check the continuity among each port.

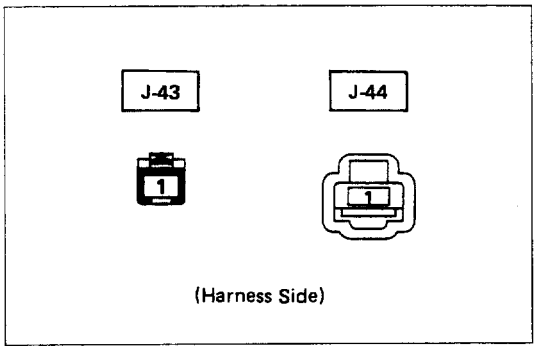


Operation \ Port	A	B	C
When battery voltage applied	○	○	
When battery voltage not applied		○	○

VACUUM SWITCHING VALVE: TRANSFER CONTROL (FOR 4WD)

INSPECTION

Connect the vacuum switching valve connector terminal No. 2 to the battery (+) terminal and terminal No. 4 to the (–) terminal and then check the continuity among each port.

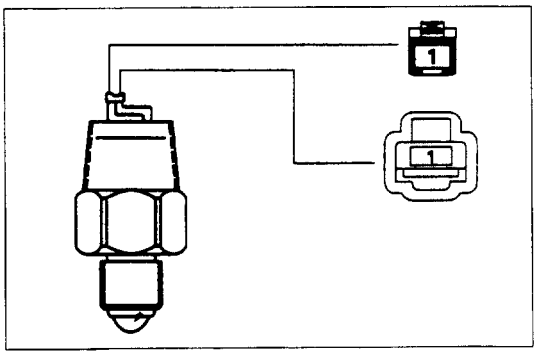


4WD DETECTIVE SWITCH

INSPECTION OF THE 4WD WARNING LIGHT CIRCUIT

1. Disconnect the 4WD switch connectors.
2. Connect the harness side connector terminals.
3. Check to see if the indicator light comes on with the starter switch "ON".

   Check the bulb or harness when the result of inspection is found abnormal.



INSPECTION

1. Shift the transfer lever to the 4H (4L) position.
2. Check to see if there is continuity between the 4WD switch connectors.

   Replace the switch when the result of the inspection is found abnormal.

LGCEL-WE-9981RH

You are requested to order this manual using the manual number that is shown above.

This manual is applicable for vehicles in all countries except the USA and Canada.

All rights reserved. This manual may not be reproduced in whole or in part, without the permission in writing of ISUZU MOTORS LIMITED.

Issued by

ISUZU MOTORS LIMITED

INTERNATIONAL SERVICE DEPARTMENT

Tokyo, Japan

First edition Jan., 1999 9009-03K-0.2

LGCEL-WE-9981RH PRINTED IN JAPAN

WORKSHOP MANUAL

NHR, NKR, NPR, NQR, NPS

FRAME AND CAB

SECTION 2

ISUZU

ISUZU

International Service & Parts
Tokyo, Japan

NOTICE

Before using this Workshop Manual to assist you in performing vehicle service and maintenance operations, it is recommended that you carefully read and thoroughly understand the information contained in Section 0A under the headings "GENERAL REPAIR INSTRUCTIONS" and "HOW TO USE THIS MANUAL".

**All material contained in this Manual is based on latest product information available at the time of publication.
All rights are reserved to make changes at any time without prior notice.**

Applicable Model

N-Series		
NHR55	NPR55	NPS66
NHR69	NPR69	NPS71
NKR55	NPR58	NQR66
NKR69	NPR59	NQR70
NKR58	NPR65	NQR71
NKR66	NPR66	
	NPR70	
	NPR71	

This manual is applicable to 1994 year model and later vehicles.

THIS MANUAL INCLUDES THE FOLLOWING SECTION:

SECTION NO.	CONTENTS
00	Service information
2	Cab & Frame

SECTION 00
SERVICE INFORMATION

CONTENTS

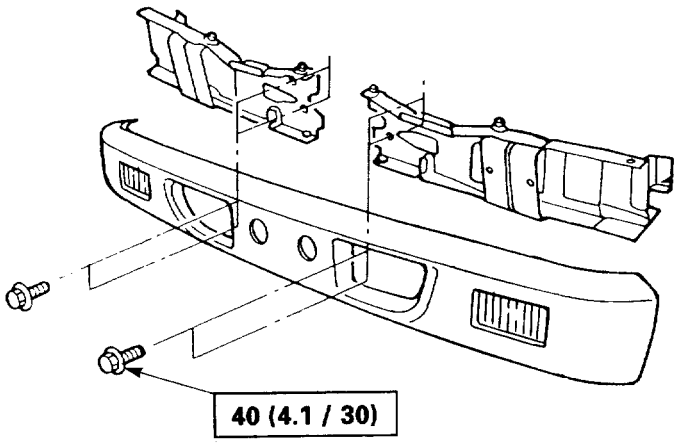
PAGE

Fixing Torque.....00-2

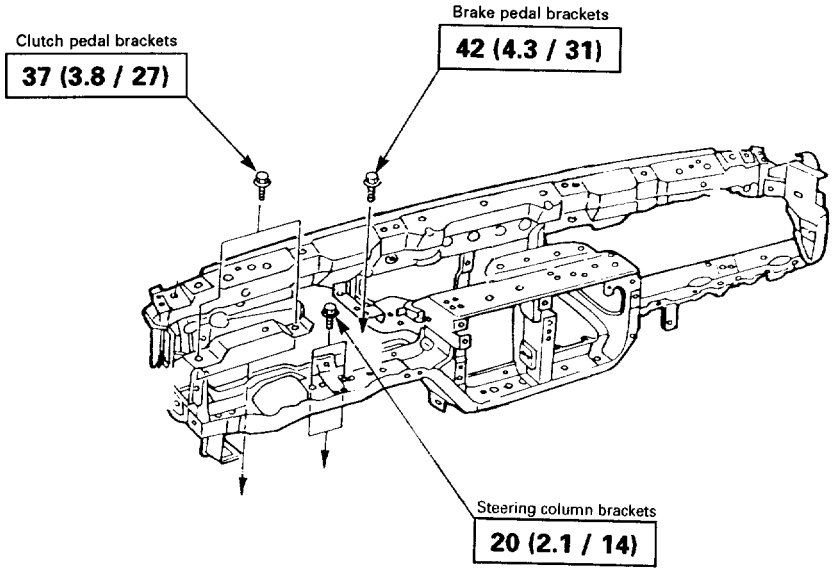
FIXING TORQUE

N•m (kg•m / lb•ft)

Front bumper fixing bolts

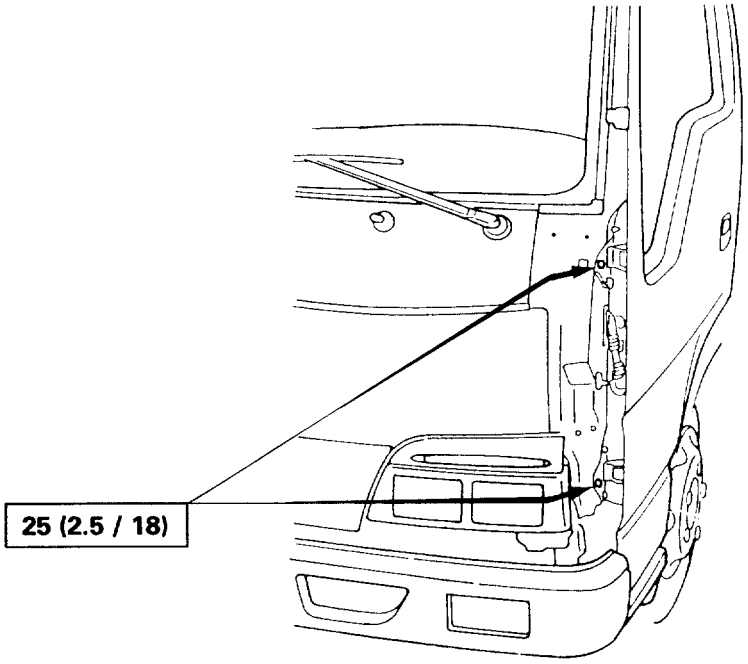


Instrment panel

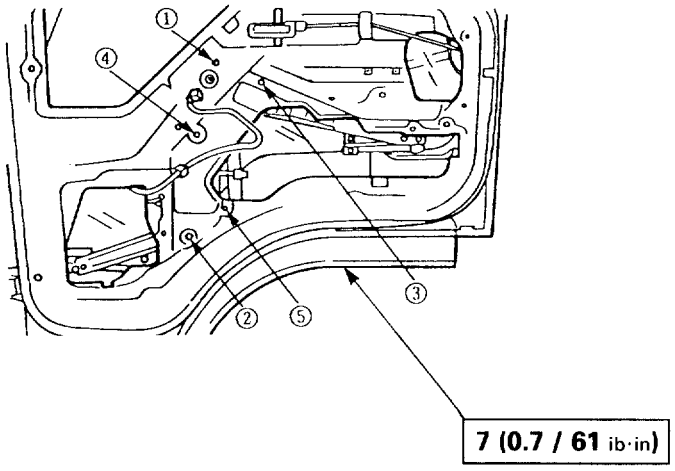


N•m (kg•m / lb•ft)

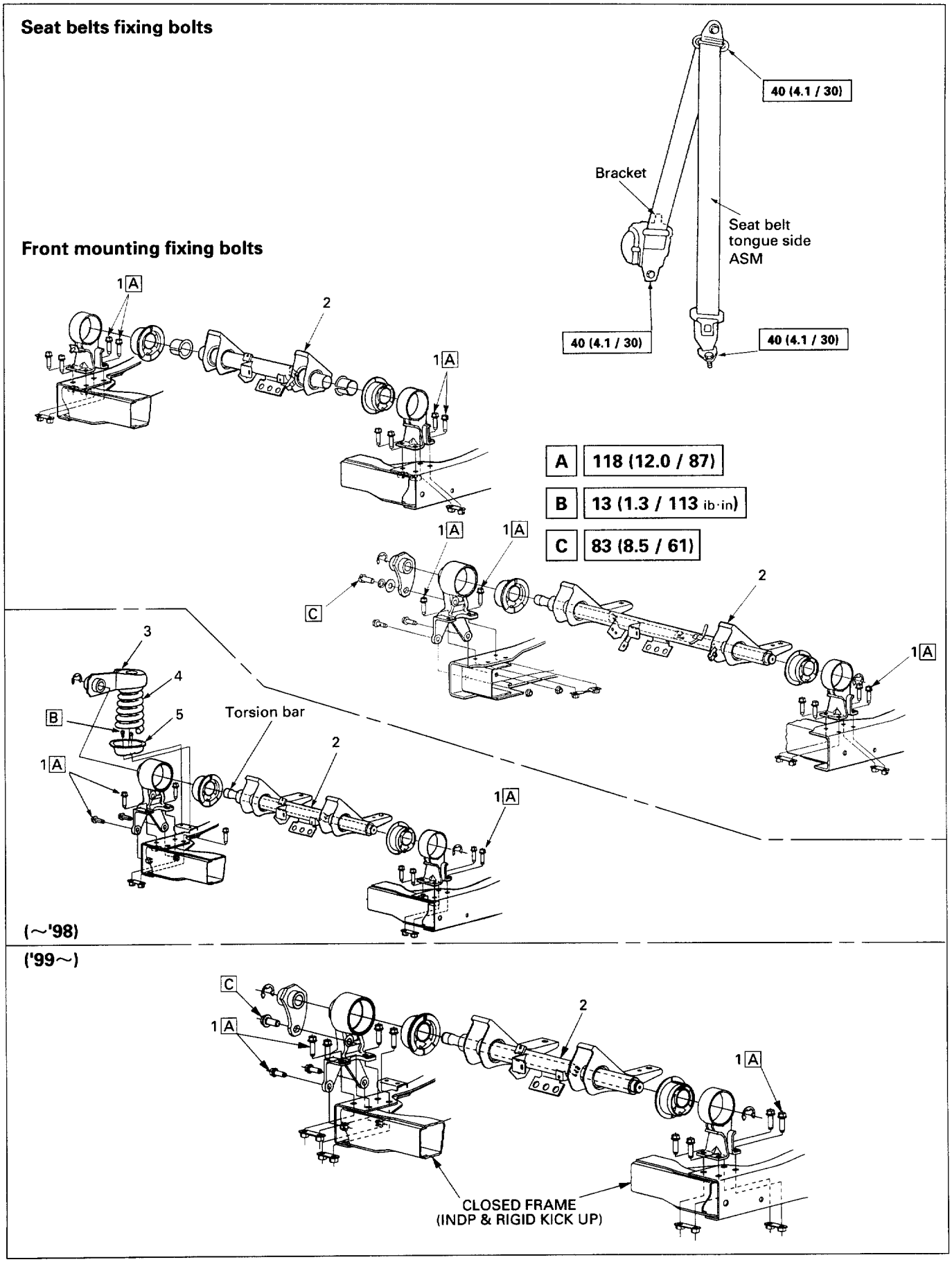
Front door fixing bolts



Window regulator fixing bolts



N•m (kg•m / lb•ft)


Seat belts fixing bolts
40 (4.1 / 30)
Bracket
Seat belt tongue side ASM
40 (4.1 / 30)
40 (4.1 / 30)
Front mounting fixing bolts
1 A
2
1 A
A 118 (12.0 / 87)
B 13 (1.3 / 113 ib·in)
C 83 (8.5 / 61)
1 A
1 A
C
2
1 A
3
4
B
5
Torsion bar
2
1 A
1 A
(~'98)
('99~)
C
1 A
2
1 A
CLOSED FRAME
(INDP & RIGID KICK UP)

SECTION 2
CAB AND FRAME

CAUTION:

At assembly and installation, install parts properly with the specified tightening torque values.

CONTENTS

PAGE

General Description 2-3
On-Vehicle Service 2-4
Front Bumper 2-4
Fixed Glass 2-6
Front Window Glass 2-6
Removal of Adhesion Type 2-6
Installation of Adhesion Type 2-8
Mounting/Dismounting Procedure for Ornament Panel 2-9
Installation of Weather Strip Type 2-11
Removal of Weather Strip Type 2-12
Back Light Glass 2-14
Front Step 2-16
Instrument Panel ASM 2-18
Instrument Reinforcement ASM 2-22
Door 2-25
Front Door ASM 2-25
Front Door Trim Pad 2-29
Front Pillar Garnish 2-31
Door Window Glass, Regulator and Glass Run 2-32
Door Lock ASM 2-36
Door Outside Handle and Door Lock Cylinder 2-37
Seat 2-39
Driver Side 2-39

Center and Passenger Side 2-41
Interior Trim 2-43
Front Pillar Trim Cover 2-43
Header Shelf (~'98) 2-44
Disassembly of Header Shelf ASM 2-45
Header Shelf ('99~) 2-46
Header Lining 2-48
Roof Ventilator 2-50
Seat Belt 2-51
Side Seat Belt Tongue 2-51
Front Center and Driver Side Seat Belt Buckle 2-52
Front Center Seat Belt Tongue and Passenger Side Seat Belt Buckle 2-53
Cab Mounting 2-54
Front Mounting 2-54
Rear Mounting 2-56
Cab Stay 2-57
Cab Lock ASM 2-58
Removal and Installation of Cab ASM 2-61
Body Panel Sealing 2-64
Melting Seat Sticking Positions 2-74
Silencer Mat Setting Positions 2-75
Body Panel Sectional Shapes 2-76
Body Sizes 2-81
Door Opening Clearance/Level Difference 2-81
Door-to-Seal Size Accuracy 2-82
Front Window Frontage Sizes 2-83
Door Frontage Sizes 2-84
Room Diagonal Sizes 2-85
Front Bumper Installation Basic Sizes 2-86
For Crew Cab 2-87
On-Vehicle Service 2-87
Back Light Glass 2-87
Rear Step 2-89
Rear Door ASM 2-90
Rear Door Trim Pad 2-90

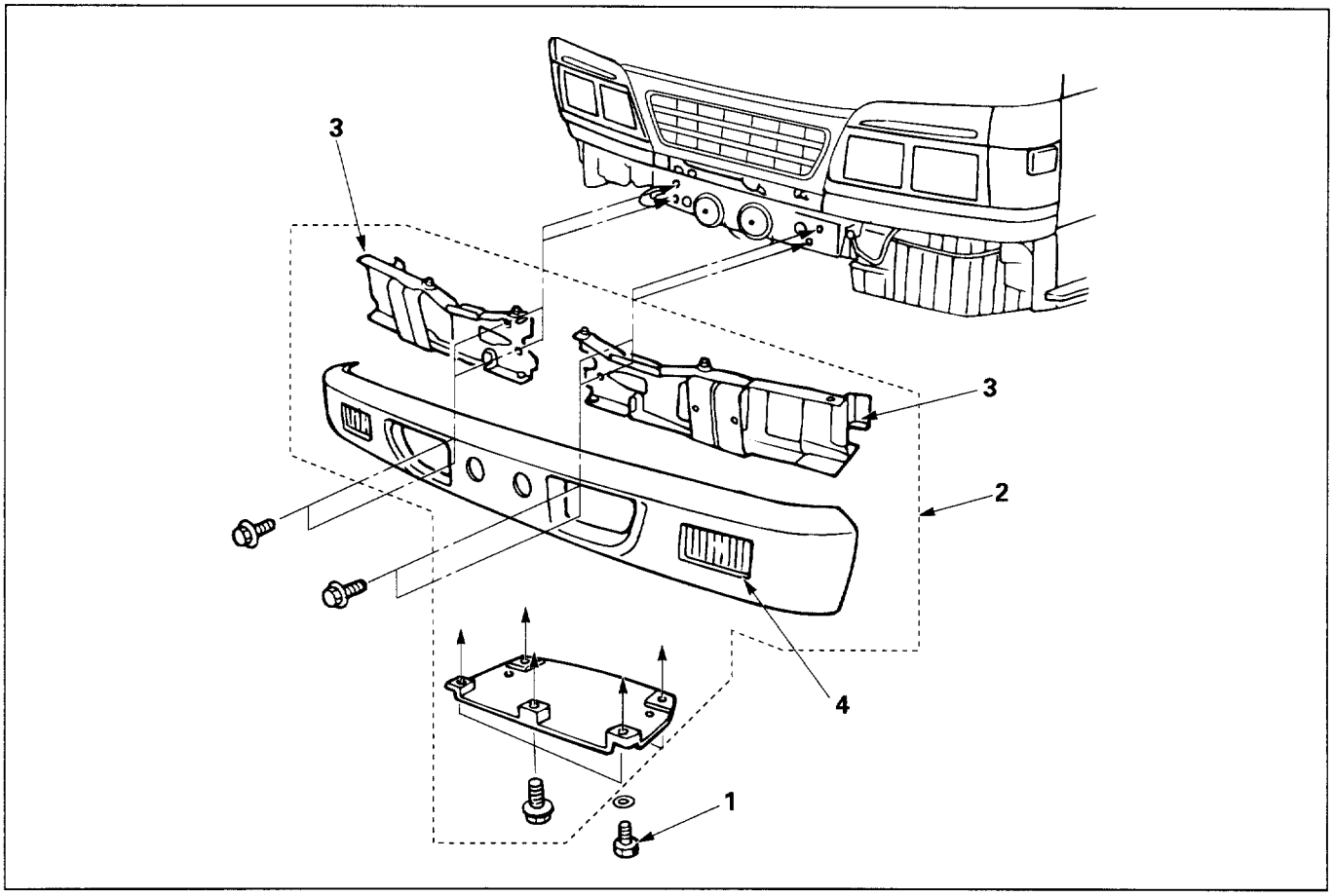
Rear Window Glass, Regulator and Glass Run 2-92
Seat 2-95
Rear Seat 2-95
Head Lining 2-96
Body Panel Sealing 2-97
Frame Dimensions 2-108

GENERAL DESCRIPTION

This Section describes the installation and removal procedures for the main parts related to the N series body (cab).
Each service procedure is applicable to all N series unless otherwise specified.

ON-VEHICLE SERVICE

FRONT BUMPER



Removal Steps

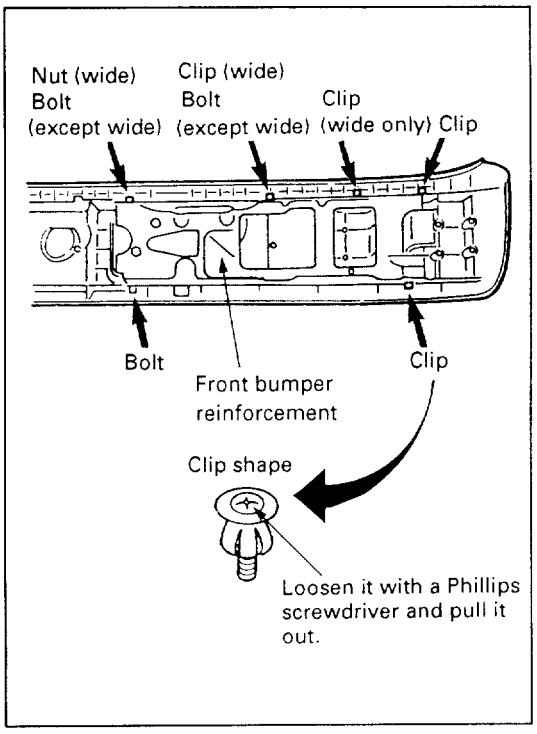
1. Air guide fixing bolts (rigid suspension vehicle only)
2. Front bumper ASM
3. Front bumper reinforcement
4. Fog lamp ASM

Installation Steps

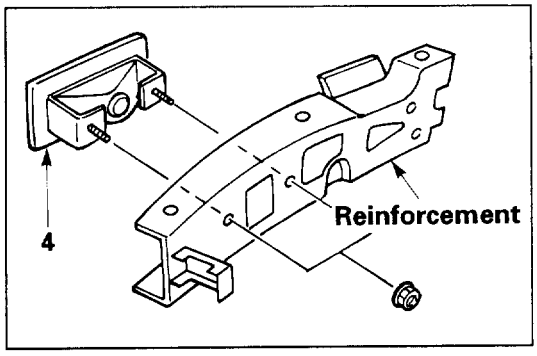
For installation, reverse the removal procedure.

Removal

1. **Air guide fixing bolts (rigid suspension vehicle only)**
   - Remove the rear-side bolts/washers fixing the air guide.
2. **Front bumper ASM**
   - Remove the two fixing bolts on each side of the left and right front bumper ASM.
     And disconnect fog lamp harness connection.
3. **Front bumper reinforcement**
   - Loosen the fixing nuts and bolts, and clips and pull them out.



	Bolt	Clip	Nut
Wide cab	1	4	1
Others than wide	3	2	—



4. **Fog lamp assembly**
   - Remove the fixing nuts and pull out the fog lamp to forward from reinforcement.

Installation

For installation, reverse the removal procedure taking the following points into consideration.

1. Tighten the front bumper ASM fixing bolts to the specified tightening torque.

Tightening torque	N•m (kg•m)
	40 (4.1)

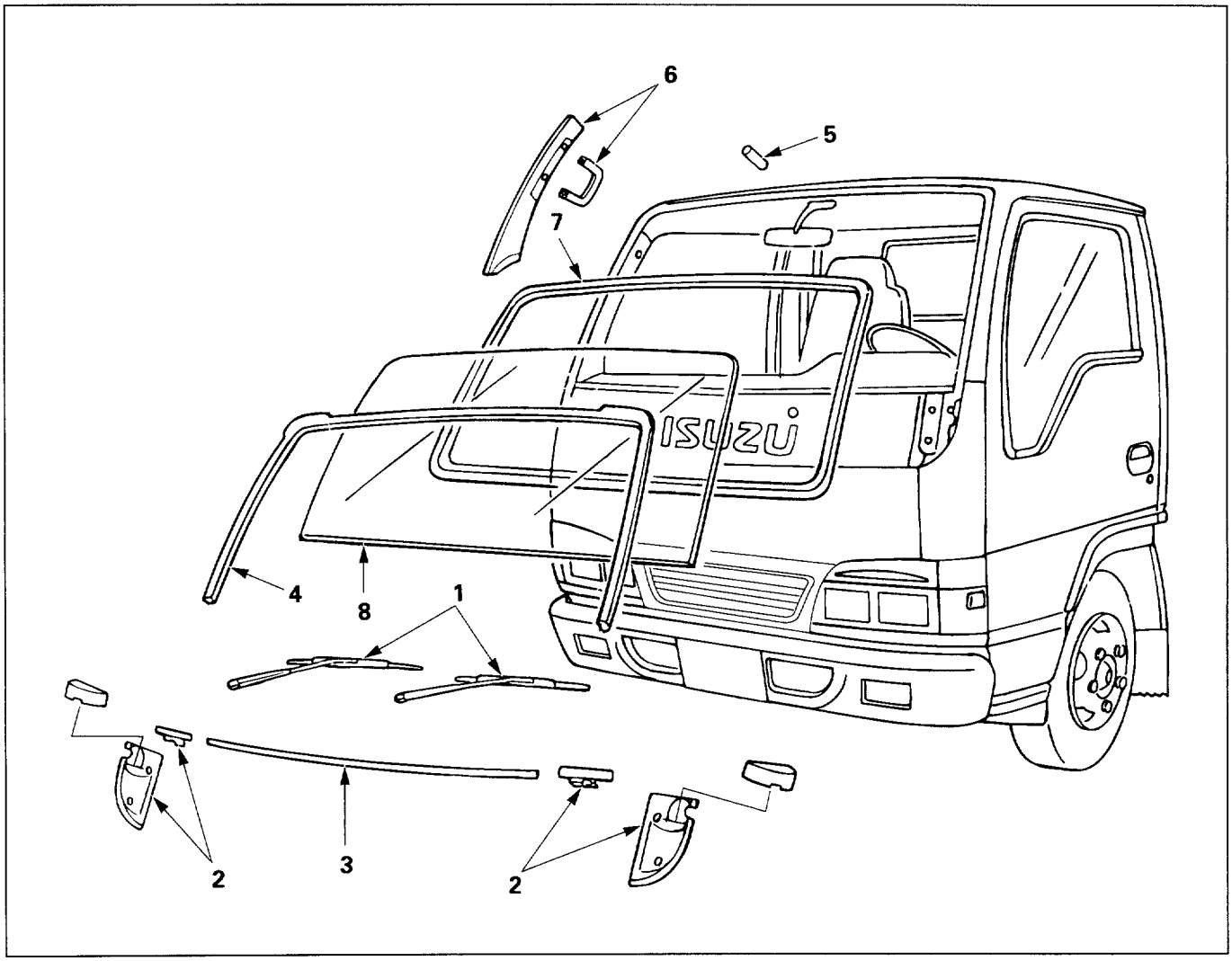
2. Adjust the installation position referring to "Basic sizes for installation of the front bumper".

FIXED GLASS

This paragraph describes the procedures for mounting and dismounting and replacing the front window glass. Note that there is a difference in procedures among glass fixing methods.

FRONT WINDOW GLASS

Removal of Adhesion Type



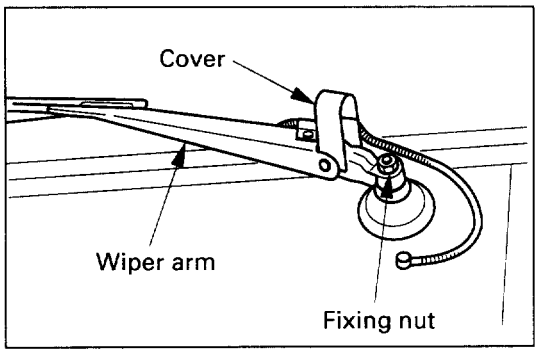
Removal Steps

1. Front wiper
2. Ornament corner piece/molding
3. Ornament panel upper molding
4. Front window molding
5. Room mirror stopper rubber
6. Front pillar grip/trim cover
7. Front window glass finisher
8. Front window glass

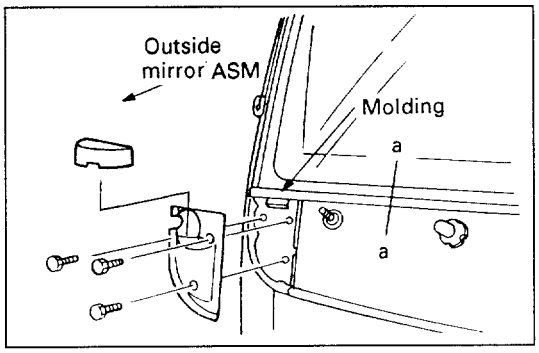
Installation Steps

Adhesion type ..... Page 2-8
Weather strip ..... Page 2-11

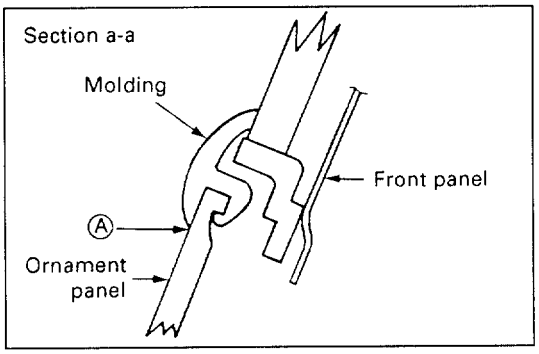
Removal



1. **Front wiper**
   - Open the cover and remove the fixing nut.



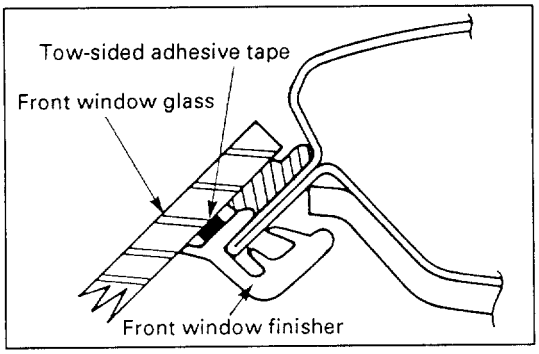
2. **Ornament corner piece/molding**
   - Remove the 3 fixing bolts.



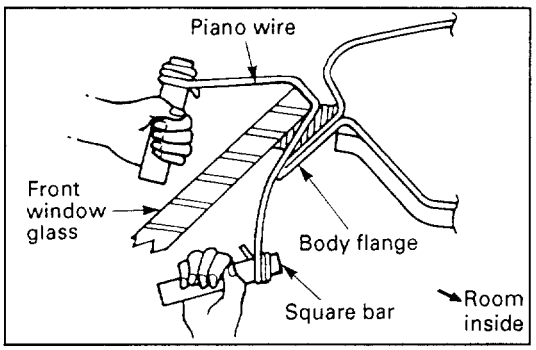
3. **Ornament panel upper molding**
   - Remove it with a bladed screwdriver from portion Ⓐ.
4. **Front window molding**
   - Remove it according to the same procedure as 3. Don't reuse it.

CAUTION:

If the cab painted surface is scratched, this causes rust.



5. **Room mirror stopper rubber**
6. **Front pillar grip/trim cover**
   - Refer to "Front pillar trim cover" in this Section.
7. **Front window glass finisher**
   - Don't reuse it.

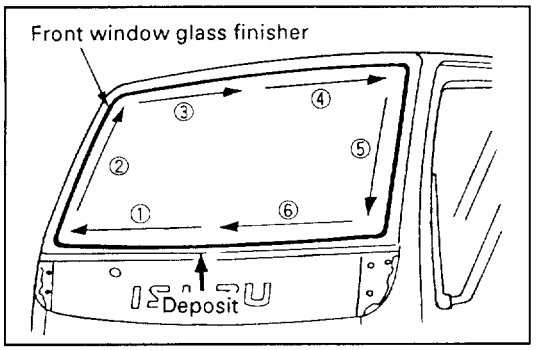


8. Front window glass

- Pass the the piano wire of ϕ0.5 mm or so to the room inside through the adhesive portion of the front window glass.
  Bind both ends of this piano wire to the square bar and cut the adhering portions in the whole periphery of the glass moving it back and forth inside and outside the room. Remove the glass.

CAUTION:

Completely remove the adhesive remaining on the body flange and perform cleaning. If there is any convex or concave portion, this causes imperfect contact when installing the glass, leading to cracks or water leakage. To reuse the removed glass, perform the same treatment on the adhering surface of the glass side as well as the flange side. When the glass is an adhesion type, take care not to damage the glass stopper which must be reused. If the painted surface of the body flange is scratched, this will cause rust. Accordingly, repair it completely.



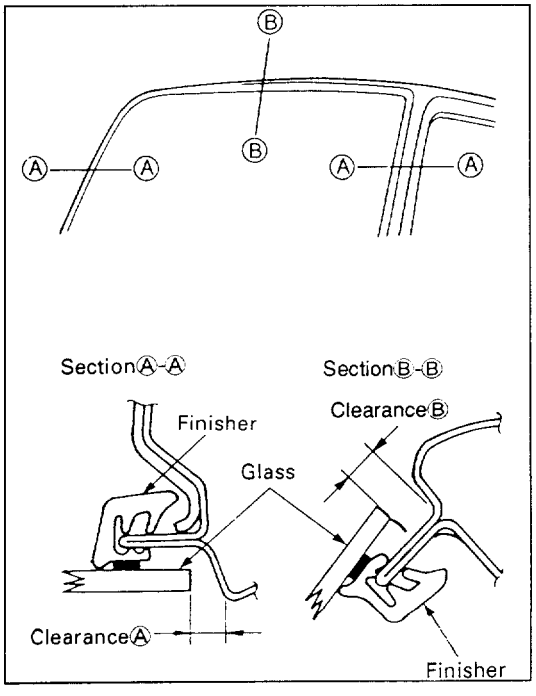
Installation of Adhesion Type

Before starting installation, be sure check the fixing positions.

Positioning Steps

7. Front window glass finisher

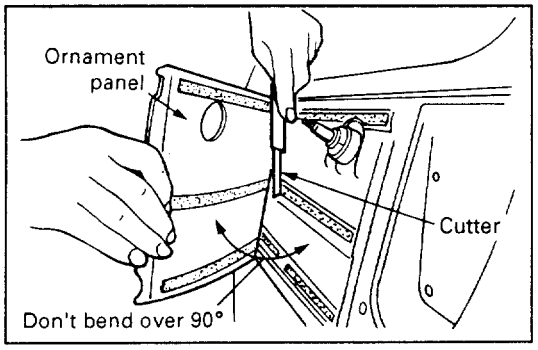
- Be sure to use a new finisher. Set the deposit in the central lower part. Insert the flange in the order of ① to ⑥ as shown in the figure. After setting, proceed to the next step without peeling off the exfoliate paper of two-sided adhesive tape.



8. Front window glass

- Temporarily set the glass, perform positioning marking so that the left/right clearance Ⓐ of the Section Ⓐ-Ⓐ may be uniform. Next, when the clearance Ⓑ of the Section Ⓑ-Ⓑ is equal to the clearance Ⓐ of the Section Ⓐ-Ⓐ, proceed to the installation step. At this time, if the clearance Ⓑ must be adjusted, remove the ornament panel and adjust the glass stopper. When installing an adhesion type after removing the weather strip type, use a new glass stopper.

Mounting/Dismounting Procedure for Ornament Panel

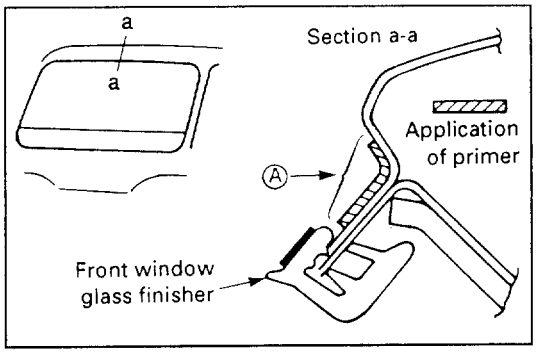


- First, remove the washer nozzle (refer to Section 8 "Electrical Equipment Workshop Manual"), cut off the two-sided adhesive tape fixing the ornament panel with a cutter and remove it from the front panel. At this time, don't bend the ornament panel over 90°. Take care not to scratch the painted surface of the body panel. If it is scratched, repair it completely to prevent rust. When installing the ornament panel, completely remove the two-sided adhesive tape remaining on the ornament panel side and install the ornament panel with a new two-sided adhesive tape.

CAUTION:

After removing the washer nozzle, take care not to drop the washer tube to the inside of the front panel. After removing the ornament panel, connect the nozzle to the tube and fix it.

Installation (When installing an adhesion type after removing an adhesion type.)

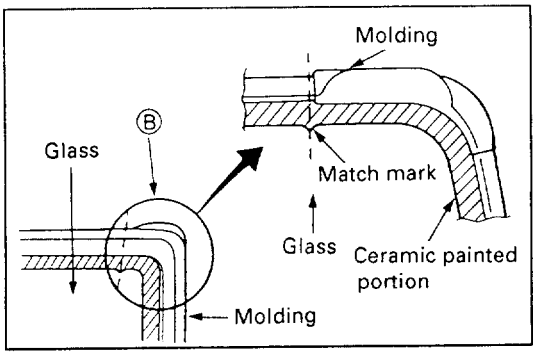


7. **Front window glass finisher**
   - Be sure to use a new finisher.
   - Apply the primer to the whole periphery of portion Ⓐ shown in the figure.

CAUTION:

Check that there remains no adhesive on the flange surface to which the primer is to be applied. If the primer is applied on the residual adhesive, the contact of the adhesive for glass to be applied later may be imperfect, resulting in cracks or water leakage. After applying the primer, keep the status for 3 minutes or more.

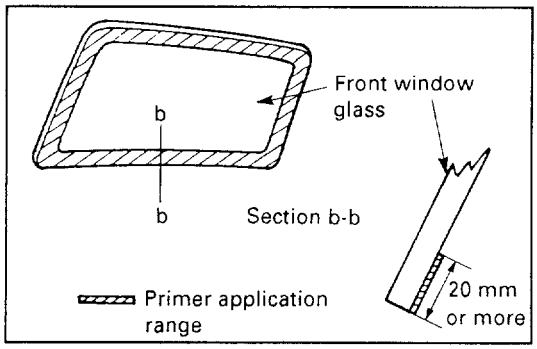
Primer: PRIMER RC-50E for painting manufactured by the Yokohama Rubber Co., Ltd.

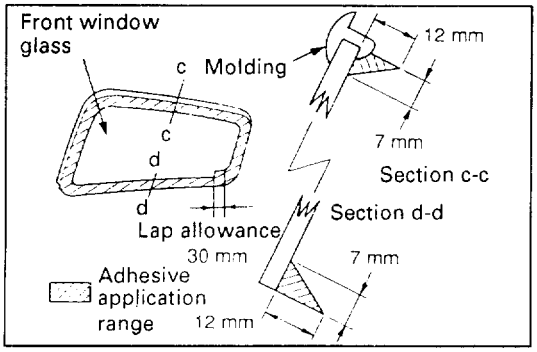


4. **Front window molding**
   - Adjust the rising portion of the upper end of the molding corner mold to the match mark of the glass ceramic painted portion and fit the upper end (left/right) and fix the both sides. Be sure to use a new front window molding.

CAUTION:

Before reusing the glass, completely remove the residual adhesive and perform cleaning.





8. Front window glass

- Apply the primer to the outer periphery on the room side of the glass. Apply it over 20 mm from the end.

CAUTION:

Before reusing the glass, completely remove the residual adhesive and perform cleaning. If the primer is applied on the residual adhesive, the contact of the adhesive for glass to be applied later may be imperfect, leading to cracks or water leakage. After applying the primer, keep the status for 3 minutes or more.

Primer: PRIMER MS-80 for both sides of glass manufactured by the Yokohama Rubber Co., Ltd.

- After keeping the status for 3 minutes or more after primer application, apply the adhesive. Apply it to the whole outer periphery and make a 30 mm lap allowance.

Adhesive: ADHESIVE WS-90F for glass manufactured by the Yokohama Rubber Co., Ltd.

CAUTION:

Install the glass on the cab within 5 minutes after applying the adhesive. At this time, peel off the exfoliate paper of the two-sided adhesive tape of the front window glass finisher and set the glass by press accurately at the installation position determined in the positioning procedure described on the previous page.
Harden the adhesive at 20 - 30°C for 24 hours. Press the periphery by using a gummed tape as an auxiliary means.
Imperfect press fitting will cause water leakage.

6. Front pillar grip/Trim cover

- For the grip, be sure to use the specified bolt.
- Be sure to use a new two-sided adhesive tape for the trim cover.

CAUTION:

Take care not to push the glass from the inside of the room at installation.

3. Ornament panel upper molding

2. Outside mirror ASM/molding

- Be sure to use a new two-sided adhesive tape for the molding.

1. Front wiper

- Refer to Section 8 "Electrical Equipment Workshop Manual".

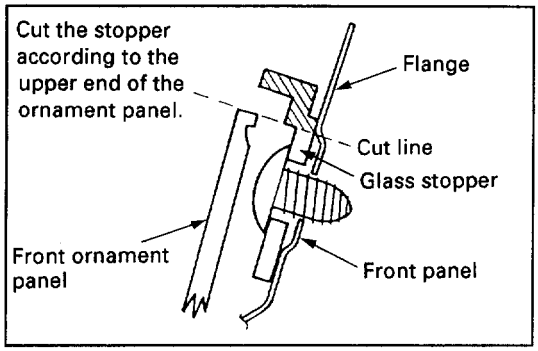
5. Room mirror stopper rubber

- Install this rubber after the adhesive for the front window glass becomes completely hard.

Caution after Installation:

- As described before, fix the periphery by using a gummed tape as an auxiliary means in the period of 24 hours when the adhesive for the front window glass is hardened.
- After installation, avoid driving within 24 hours.
- After installation, open or close the door with the side window glass or roof ventilator open. When the door must be opened or closed inevitably in the closed status, open it slowly without giving any vibration or shock to it.
- Make a water leakage test.

Installation of Weather Strip Type



Before installation, completely remove the adhesive remaining on the flange so that the weather strip may be accurately fitted to the flange.
Cut the glass stopper by referring to the figure at left.
When making a change from the adhesion type glass to the weather strip type, the following items become unnecessary.

2. **Ornament corner piece/molding**
3. **Ornament panel upper molding**
4. **Front window molding**
7. **Front window glass finisher**

CAUTION:

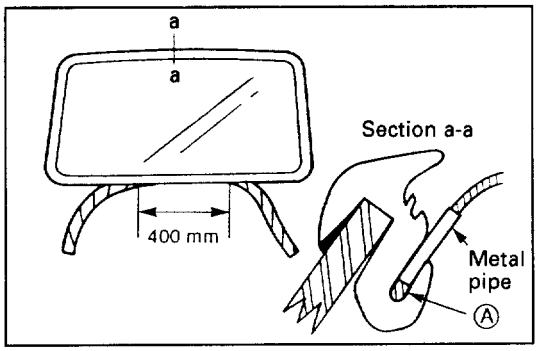
Regarding the removal of the adhesive remaining on the flange, take the same measure as the installation of the adhesion type.

Installation (When installing a weather strip type after removing an adhesion type.)

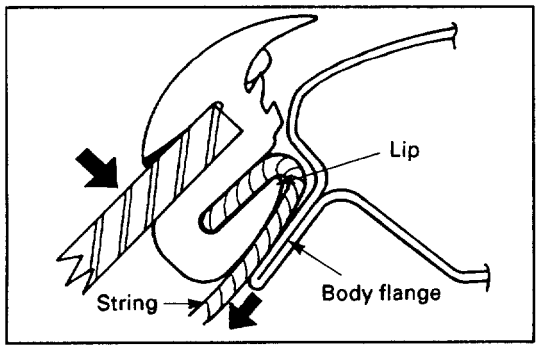
2. **Ornament corner piece/molding**
8. **Front window glass**
   - Fit the weather strip into the front window glass.

CAUTION:

Closely contact each portion equally to avoid local sag or float.



- Set a string of ϕ5 - 6 mm into the portion Ⓐ (lip on the body flange side) by using a metal pipe of about ϕ8 mm in the weather strip installed on the front window glass. At this time, cross it about 400 mm in the middle of the lower part of the glass.



- Adjust the glass to the center of the body and push down the glass with force from the outside. Pull the string from the inside toward the middle of the glass. Thus, fit the lip into the body flange in succession.

CAUTION:

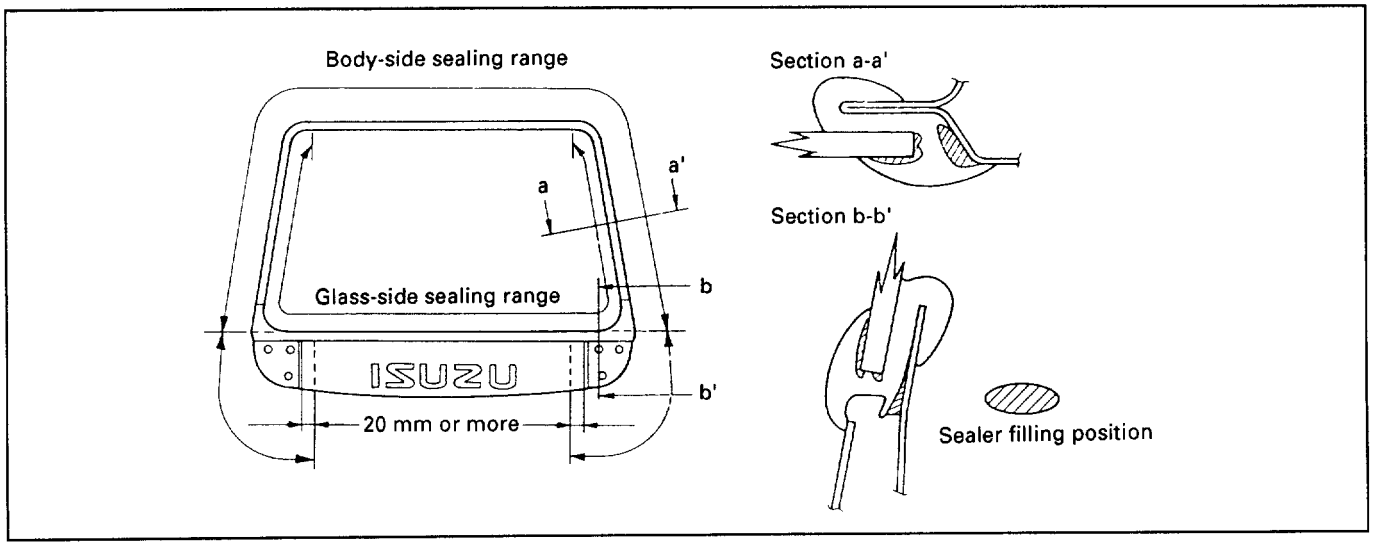
Correct a corrugated or roll-in status of the lip because it will cause water leakage.

- To make the contact between the weather strip and flange better, strike a glass position of about 150 mm from the outside weather strip with a hammer equally.
- Fill the body side and glass side with the sealant referring to the following figure. The sealant shown in the figure must be continuous without break. Perform filling until the sealant protrudes from the weather strip.

Sealant: CEMEDINE POSSEAL or equivalent

CAUTION:

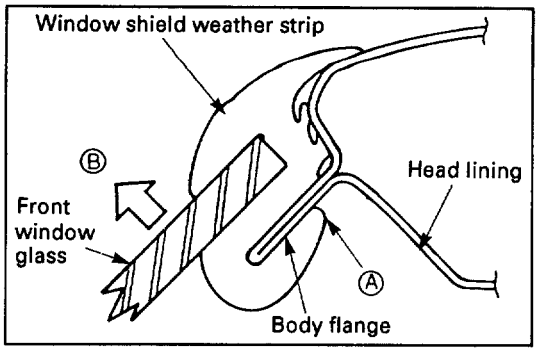
If sealant filling is imperfect, this will cause water leakage or rust. Remove the protruding sealant completely.



6. **Front pillar grip/trim cover**
5. **Room mirror stopper rubber**
1. **Front wiper**
   - The above 3 items can be installed at any position. For caution at installation, refer to the adhesion type.

Removal of Weather Strip Type

1. **Front wiper**
5. **Room mirror stopper rubber**



8. **Front window glass/weather strip**
   - Pry off the upper edge of the front window glass and the weather strips at both angles with force from the position Ⓐ and push out the glass toward Ⓑ. After removing it from the cab, remove the weather strip from the glass.

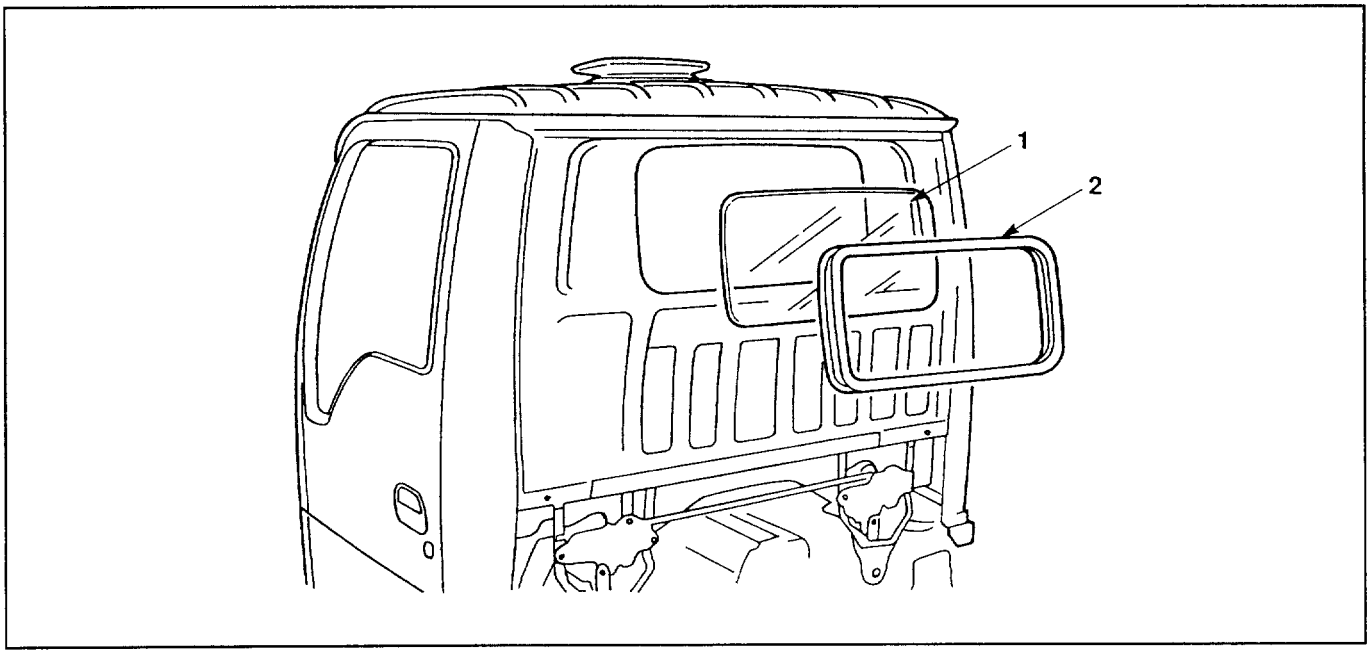
CAUTION:

If the painted surface is scratched, this will cause rust. Completely remove the sealant remaining on the flange.

Installation

- To install the weather strip type after removing the weather strip type glass, reverse the above removal procedure. For sealant filling, refer to page 2-12.
- To install the adhesion type glass after removing the weather strip type glass, remove the ornament panel and install a new glass stopper, referring to "Installation of adhesion type" on page 2-8. For the mounting/dismounting procedure for the ornament panel, refer to page 2-9.

BACKLIGHT GLASS



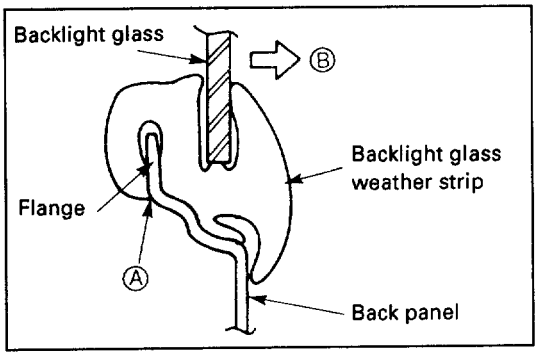
Removal Steps

1. Backlight glass
2. Backlight glass weather strip

Installation Steps

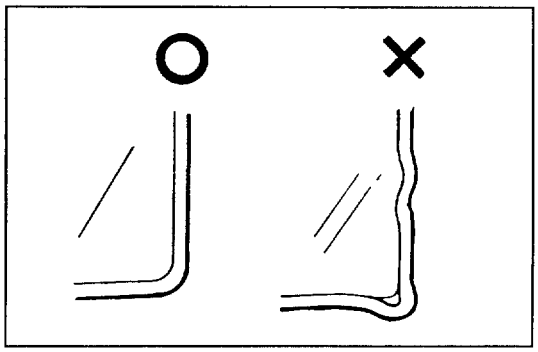
Reverse the removal procedure.

Removal



1. **Backlight glass**
   - Pry off the top edge of the backlight glass and the weather strips on the both angles from the position Ⓐ and remove them from the body flange. Push out the backlight glass toward Ⓑ.
2. **Backlight glass weather strip**
   - Remove the weather strip from the backlight glass.

Installation

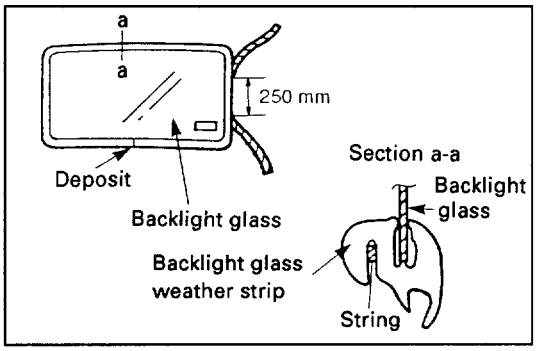


2. Backlight glass weather strip

- Fit the backlight glass weather strip into the backlight glass. At this time, turn the deposit of the weather strip downward.

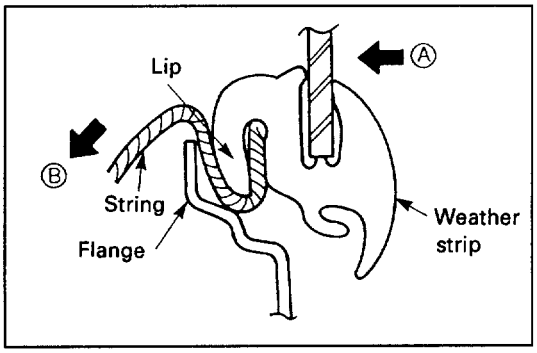
CAUTION:

Bring each portion into close contact without any float or corrugation.



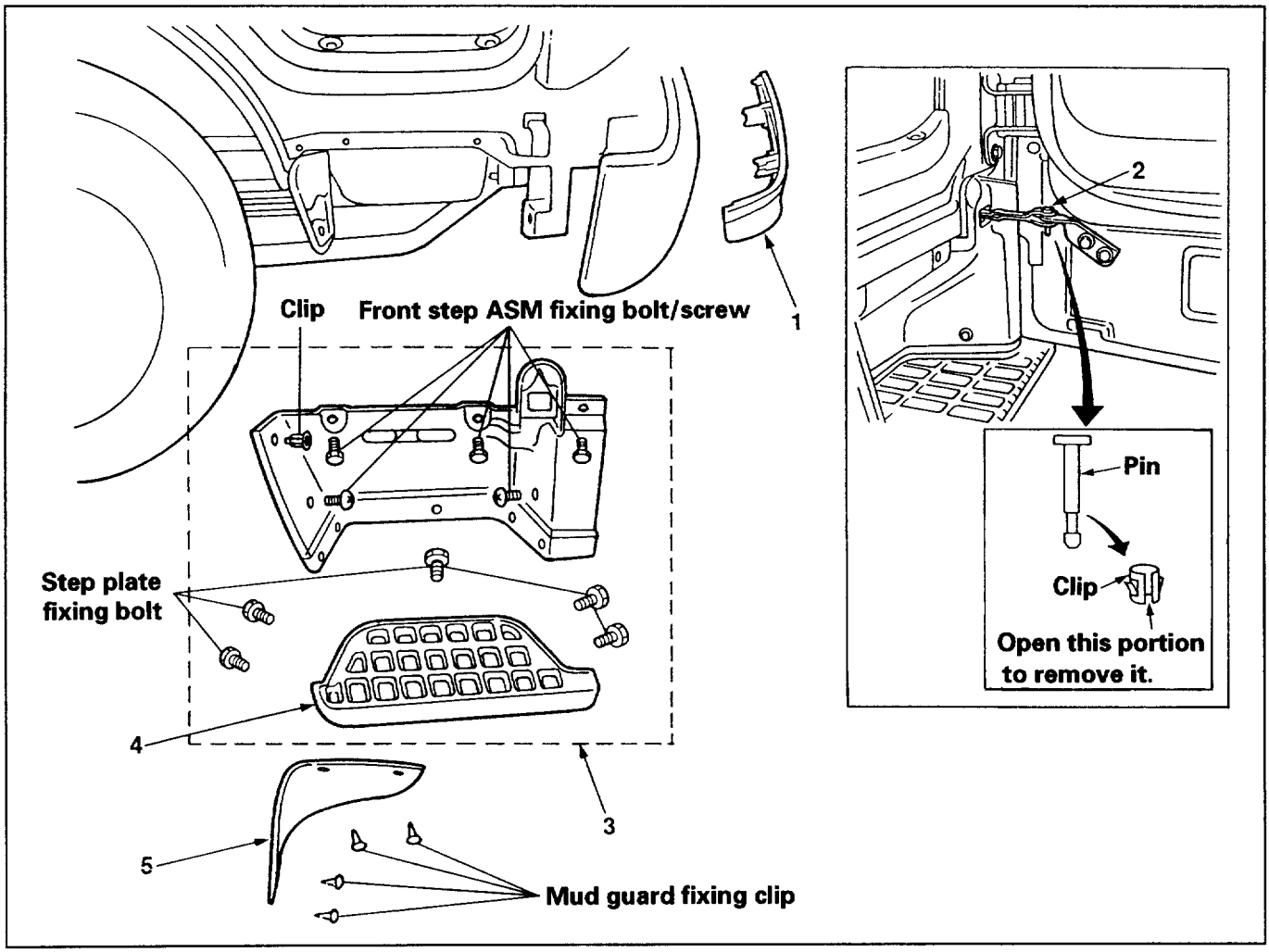
1. Backlight glass

- Set the string for installing the window shield of ϕ5 - 6 mm into the portion Ⓐ of the backlight glass weather strip installed on the backlight glass. Cause the string to go round and cross it about 250 mm in the center on the left of the backlight glass.



- Adjust the backlight glass to the body position. Pushing down the backlight glass from the direction Ⓐ, pull the string toward Ⓑ and fit the lip into the flange. To make the contact between the weather strip and body flange better, strike a glass position of about 150 mm from the outside weather strip equally with a hammer.

FRONT STEP



Removal Steps

1. Headlight lower garnish
2. Front door check arm pin
3. Front step ASM
4. Step plate
5. Mud guard

Installation Steps

For installation, reverse the removal procedure.

Removal

1. **Headlight lower garnish**
   - Pull it out.
2. **Front door check arm pin**
   - Open the clip cut at the pin tip and strike the pin with a plastic hammer.
3. **Front step ASM**
   - Remove the 3 fixing bolts, 2 screws and 1 clip.

4. **Step plate**
   - Remove the 5 fixing bolts.
5. **Mud guard**
   - Remove the 4 fixing clips.

Installation

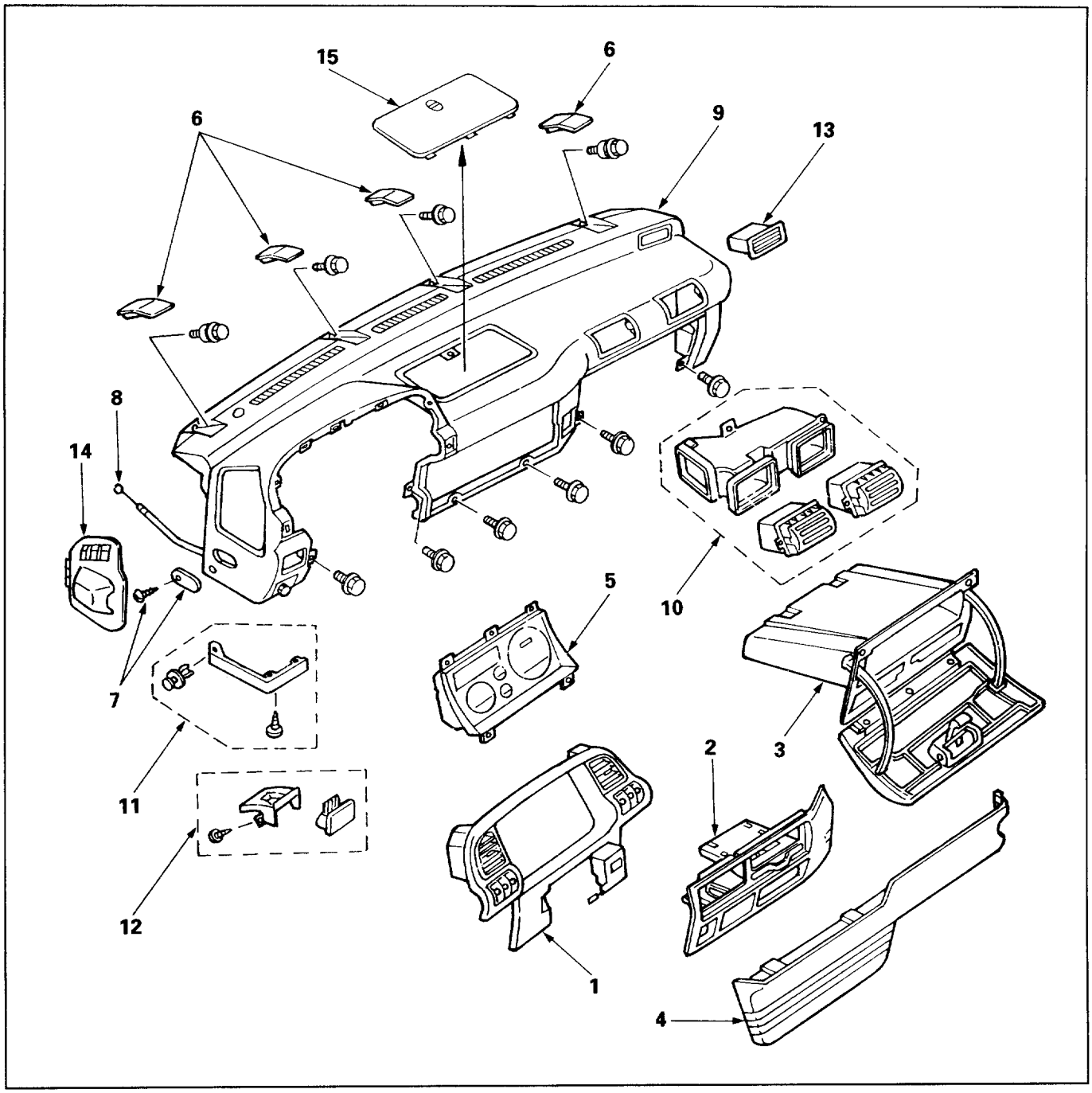
For installation, reverse the removal procedure taking the following points into consideration.

1. Tighten the fixing bolts to the specified tightening torque.

Tightening torque	N•m (kg•m)
12.7 (1.3) to 17.7 (1.8)	

2. Check that the clip at the tip of the check arm pin is securely caught.

INSTRUMENT PANEL ASM



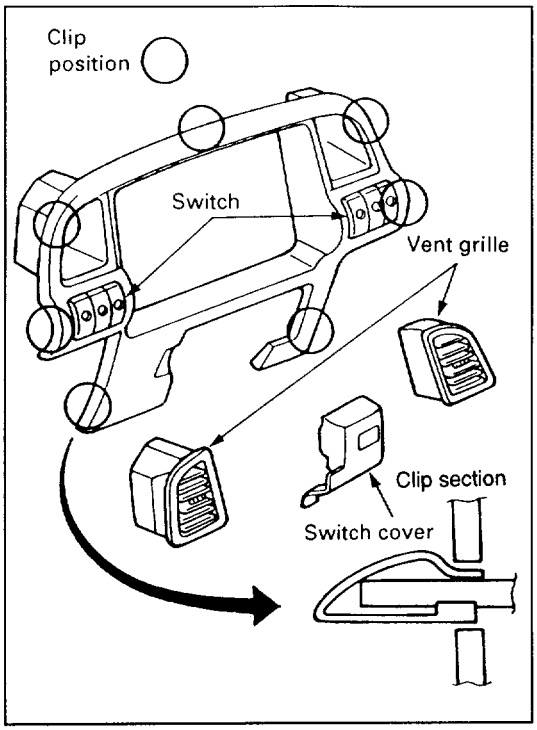
Removal Steps

1. Meter cluster
2. Center cluster
3. Glove box
4. Under cover
5. Meter ASM
6. Front cover
7. Instrument side grommet
8. Idling control cable
9. Instrument panel ASM
10. Vent duct
11. Instrument panel extension
12. Ashtray (driver's seat side)
13. Side defroster nozzle
14. Fluid tank cover
15. Relay lid

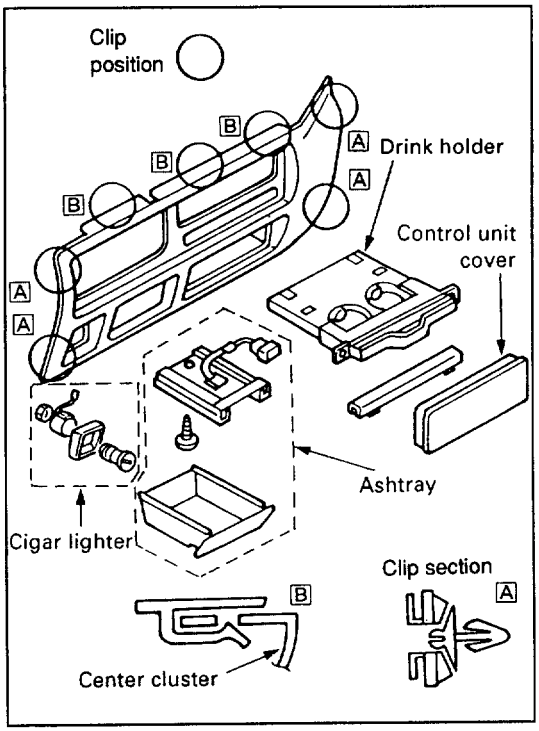
Installation Steps

For installation, reverse the removal procedure.

Removal



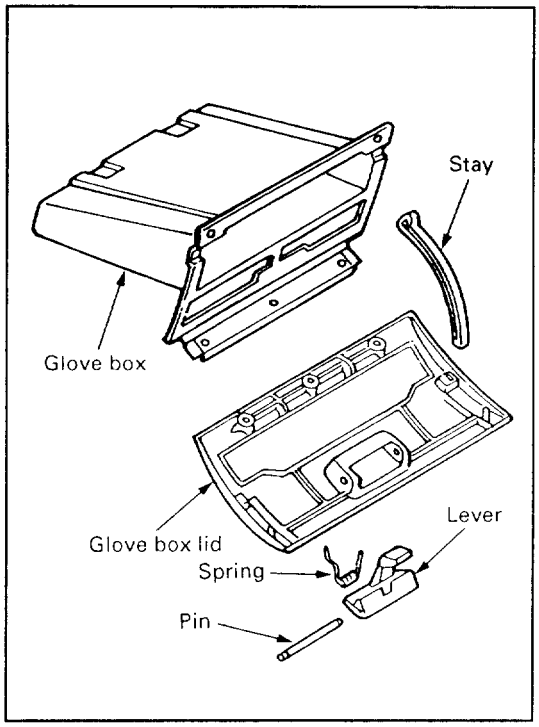
1. **Meter cluster**
   - Pull the main unit toward you and remove the clips at 7 positions. Remove each switch connector. When switches are mounted on the switch cover, remove the connectors.
   - Remove the vent grille, switch cover and each switch from the cluster proper.



2. **Center cluster**
   - Pull the main unit toward you and remove the clips [A] at 4 positions, clips [B] at 3 positions, cigar lighter power source and ashtray lighting connector. When an auto air conditioner is mounted, remove the room sensor.
   - Remove the drink holder, control unit cover (or glove compartment), ashtray and cigar lighter from the center cluster proper.

CAUTION:

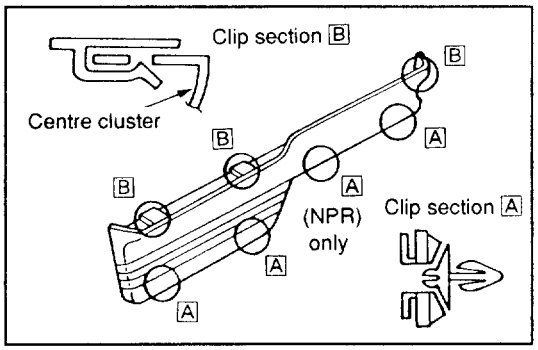
Remove the clips [B] with a bladed screwdriver.



3. **Glove box**
   - Open the lid and remove the 4 mounting screws. Then, remove the main unit.
   - Remove the left and right stays, remove the 3 mounting screws, and remove the lid.
   - Pull out the pin from the lid and remove the spring and lever.

CAUTION:

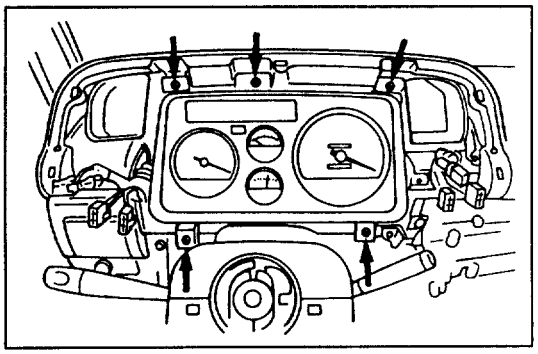
The Instrument panel ASM of this item can be removed without disassembling each of the parts of above items 1 to 3.



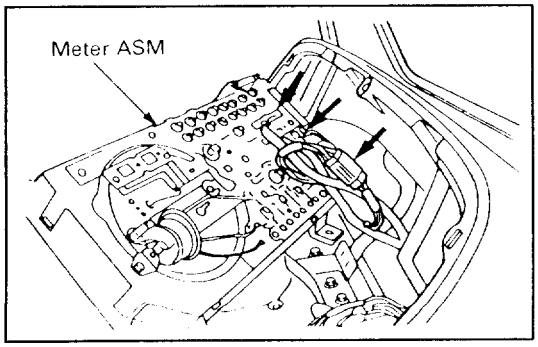
4. **Under cover**
   - Pull the main unit toward you and remove the clips A at 3 positions (4 positions for the wide cab) and clips B at 3 positions. First remove the clips B.

CAUTION:

The above parts of 1 to 4 can be removed in any order, or each of them can be removed independently.



5. **Meter ASM**
   - Remove the 5 mounting screws.



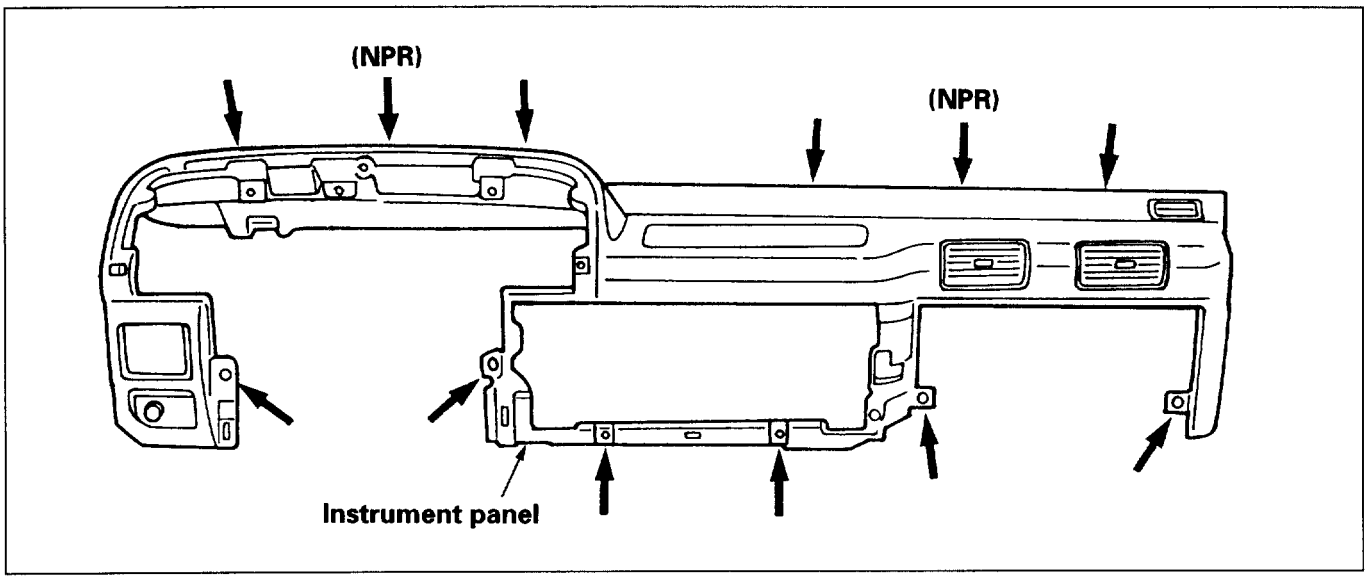
   - Remove the connector.

CAUTION:

To remove only the meter ASM, it can be attained by removing the meter cluster.

6. **Front cover**
7. **Instrument side grommet**
   - Remove the screws and pull out the instrument side grommet.

8. **Idling control cable**
   - Remove the clip on the accelerator pedal side.
9. **Instrument Panel ASM**
   - Remove the 10 mounting bolts (Wide cab=12 bolts). When the vehicle is provided with an auto air conditioner, remove the solar radiation sensor connector and harness clips from the duct and push the instrument panel ASM from the rear side.



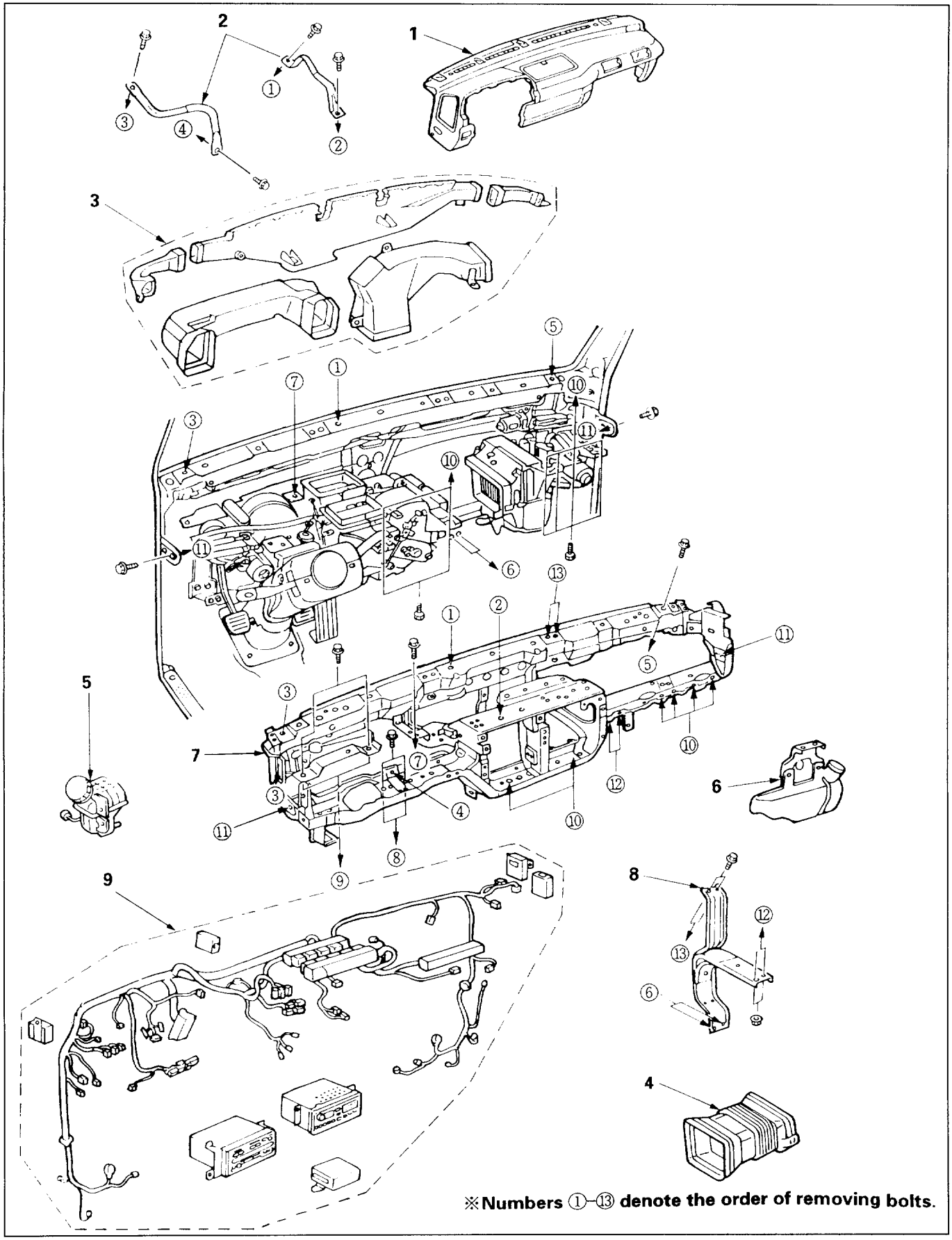
10. **Vent duct**
    - Remove the mounting screws.
11. **Instrument panel extension**
    - Remove the mounting screws and clips.
12. **Ashtray (driver's seat side)**
    - Pull out the main unit and remove the tray mounting screws.
13. **Side defroster nozzle**
    - Push out the side defroster nozzle from the rear side of the instrument panel ASM.
14. **Fluid tank cover**
    - Pull out the fluid tank cover.
15. **Relay lid**

Installation

For installation, reverse the removal procedure taking the following points into consideration.

1. After installing each connector, check the operation of each equipment.

INSTRUMENT REINFORCEMENT ASM



Removal Steps

1. Instrument panel ASM
2. Instrument center/side stay
3. Defroster nozzle/ventilation duct
4. Intermediate duct (wide cab)
5. Brake/clutch fluid reserve tank
6. Washer tank/bracket
7. Instrument reinforcement ASM
8. Instrument support bracket (wide cab)
9. Body harness/controller/radio

Installation Steps

For installation, reverse the removal procedure.

Removal

1. **Instrument panel ASM**
   - Refer to "Instrument panel ASM" in this Section.
2. **Instrument center/side stay**
   - Remove the mounting bolts ①-④.
3. **Defroster nozzle/ventilation duct**
   - Refer to "Heater/Air Conditioner Workshop Manual".
4. **Intermediate duct (wide cab)**
5. **Brake/clutch fluid reserve tank**
   - Remove the level switch connector and remove the 4 nuts.
   - Extract the fluid and remove each tube.

CAUTION:

Don't apply the brake/clutch fluid to the resign portions and painted portions in any case.

6. **Washer tank/bracket**
   - Remove the washer motor connector and washer tube and remove the two bolts fixing the bracket and the one bolt in the lower part of the tank.
7. **Instrument reinforcement ASM**
   - Remove all the connectors of electrical equipments included in the body harness and the connectors H-1 - H-12 and H-29 that joint the body harness and other harnesses. For connector numbers and positions, refer to Electrical Equipment Workshop Manual".
   - Remove the mounting bolts ⑤-⑪.
   - When the vehicle is provided with a manual air conditioner, remove each control cable. For removal, refer to "Heater/Air conditioner Workshop Manual".
8. **Instrument support bracket (wide cab)**
   - Remove the bolts ⑫ and ⑬ and remove the instrument support bracket from the instrument reinforcement ASM.

9. **Body harness/controller/radio**
   - Remove the body harness/controller/radio from the instrument reinforcement ASM. Refer to "Electrical Equipment Workshop Manual" and "Heater/Air Conditioner Workshop Manual".

Installation

For installation, reverse the removal procedure taking the following points into consideration.

1. Tighten each bolt to the specified tightening torque.

Tightening torque:

⑦ Clutch pedal bracket upper bolt	N•m (kg•m)
37 (3.8)	

⑧ Steering column bracket bolt	N•m (kg•m)
20 (2.1)	

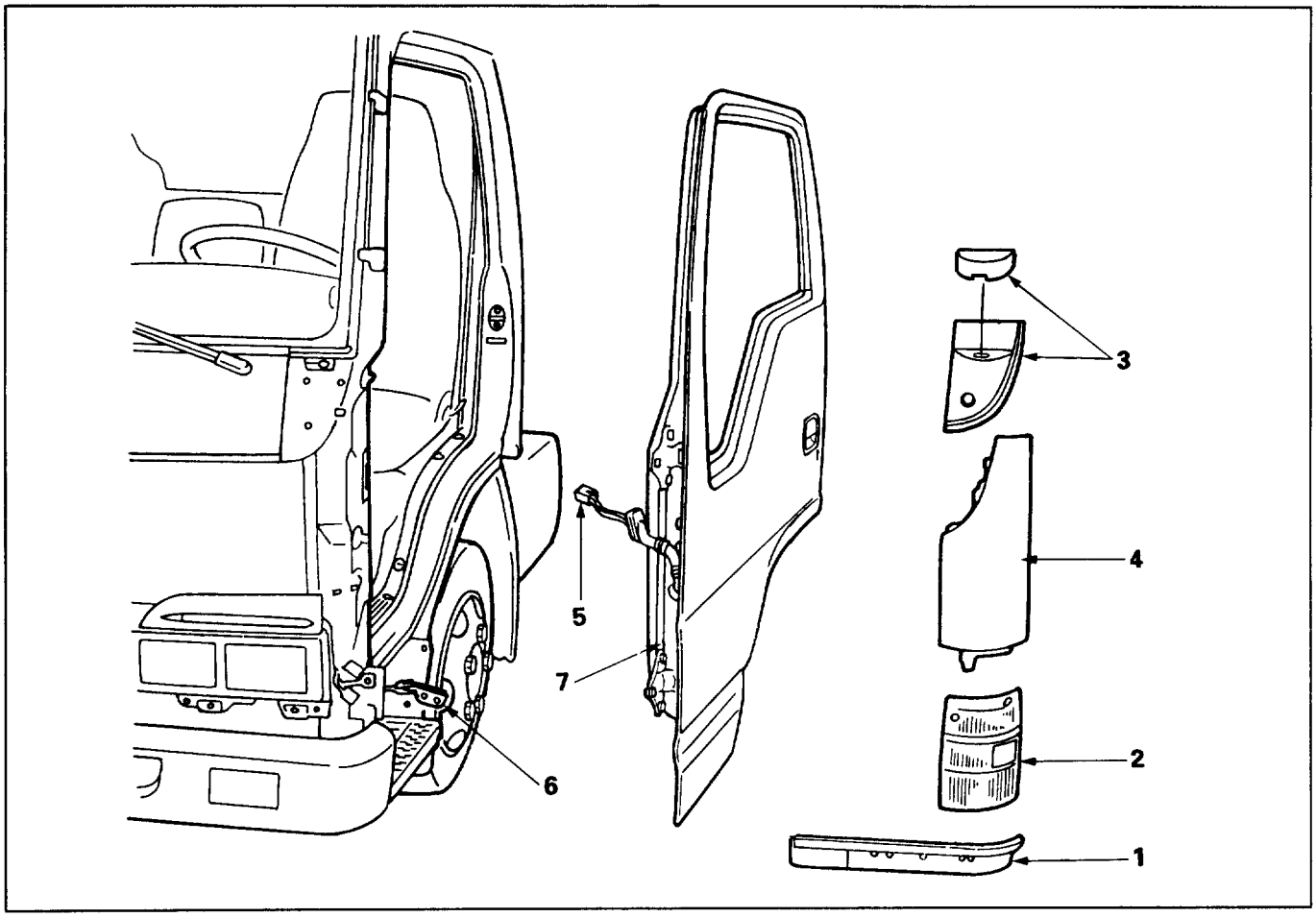
⑨ Brake pedal bracket upper bolt	N•m (kg•m)
42 (4.3)	

Tighten the other bolts and nuts to the standard torque.

2. Perform air bleeding for the brake and clutch.

DOOR

Front Door ASM



Removal Steps

1. Head lamp grille
2. Front combination lamp
3. Ornament corner piece
4. Front corner panel
5. Door harness connection
6. Door check arm
7. Front door ASM

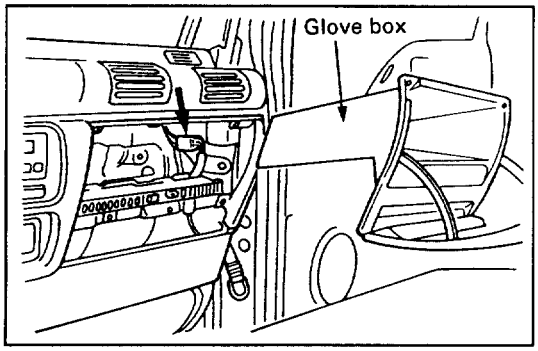
Installation Steps

For installation, reverse the removal procedure.

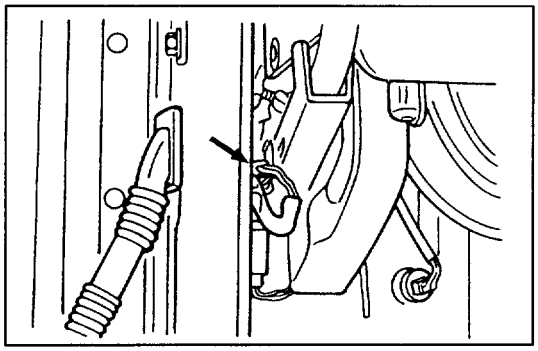
Removal

1. **Head lamp grille**
   - Pull out the head lamp grille toward you.
2. **Front combination lamp**
   - Remove the 3 mounting screws and connectors.
3. **Ornament corner piece**
   - Remove the cover and 3 mounting bolts.

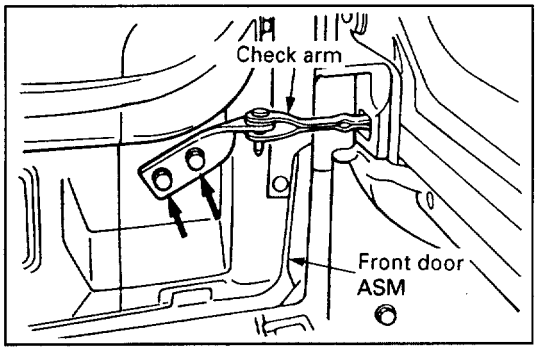
4. **Front corner panel**
   - Remove the 3 mounting screws and pull out the front corner panel.



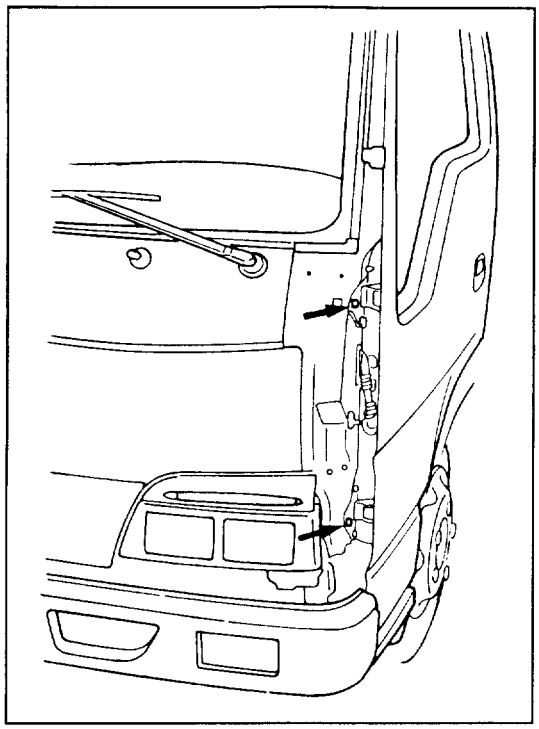
5. **Door harness connection**
   - To remove the door on the assistant's seat side, remove the glove box and disconnect the connector.



   - To remove the door on the driver's seat side, disconnect the connector from the bottom side of the instrument panel.

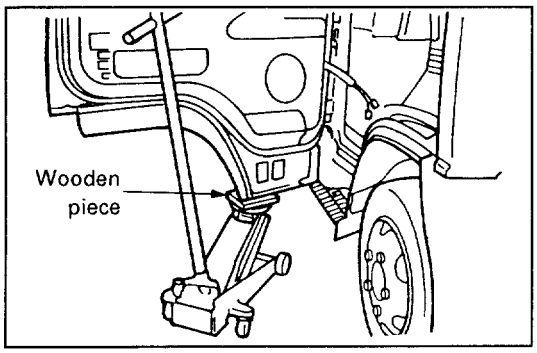


6. **Door check arm**
   - Remove the 2 mounting bolts on the door side.



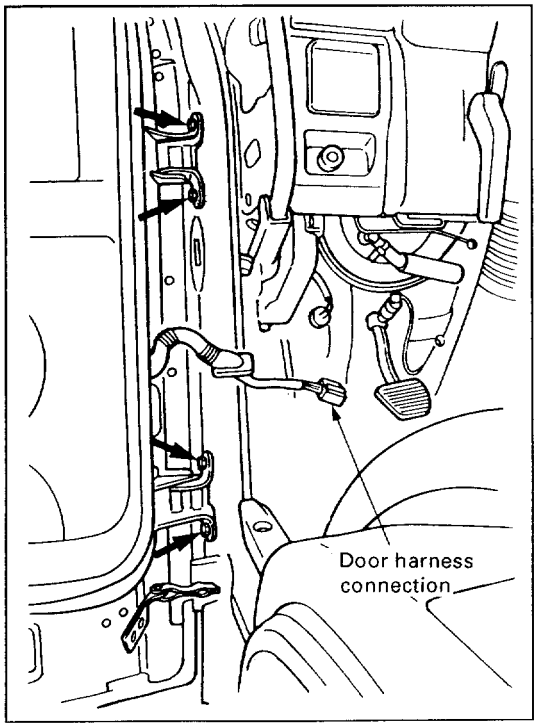
7. Front door ASM

- Remove the one mounting bolt for each hinge on the front side while the door is closed.



CAUTION:

To prevent scratches, support it with a waste cloth or wooden piece.



- Remove the 2 mounting bolts for each hinge on the rear side while the door is open.

Installation

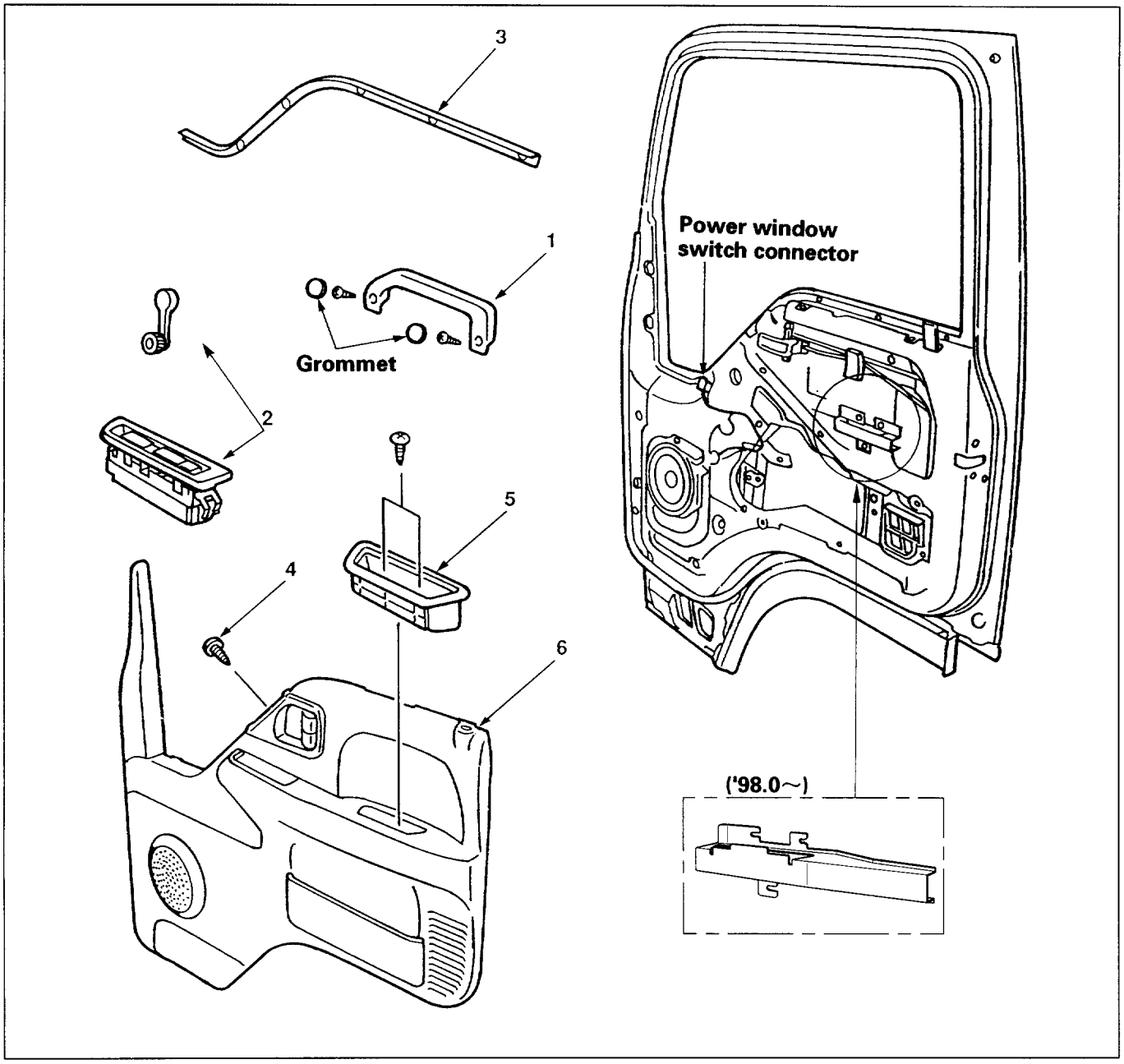
For installation, reverse the removal procedure taking the following points into consideration.

1. Tighten the mounting bolts to the specified torque.

Tightening torque	N•m (kg•m)
21.2 (2.2) to 26.8 (2.7)	

2. Adjust the door installation position referring to the item pertaining to Body Dimensions.

Front Door Trim Pad



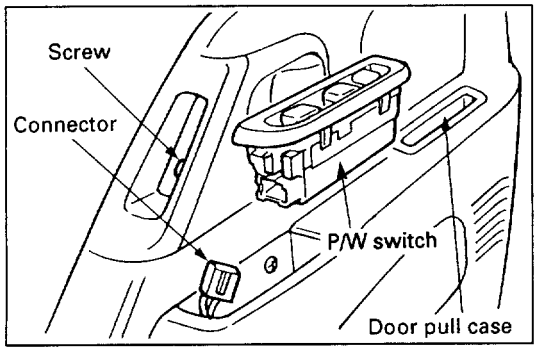
Removal Steps

1. Guard bar
2. Power window switch or regulator handle
3. Inner waist seal
4. Screw
5. Door pull case
6. Front door trim pad

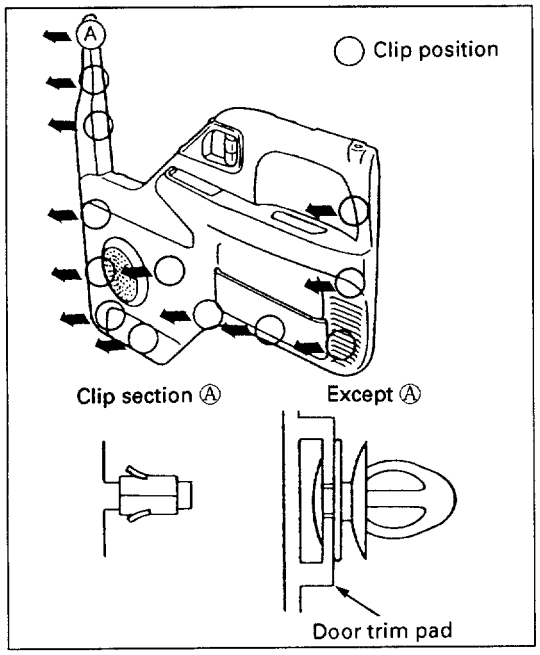
Installation

For installation, reverse the removal procedure.

Removal



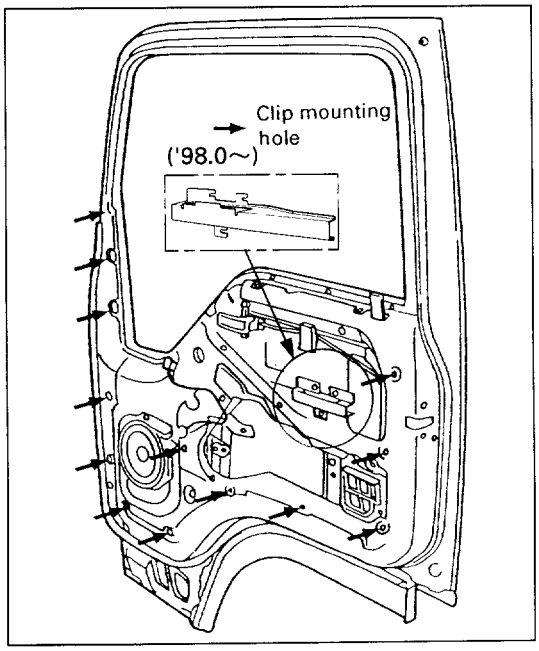
1. **Guard bar (high cab, wide cab)**
   - Open the grommet and remove the 2 screws.
2. **Power window switch or regulator handle**
   - Pull out the switch from the door trim panel and disconnect the connector.
3. **Inner waist seal**
   - Remove each clip from the rear side with a bladed screwdriver.
     Note that excessive force will cause deformation.
4. **Screw**
5. **Door pull case**
   - Remove the 2 mounting screws.



CAUTION:

The above parts 2 - 5 can be removed in any order or each of them can be removed independently.

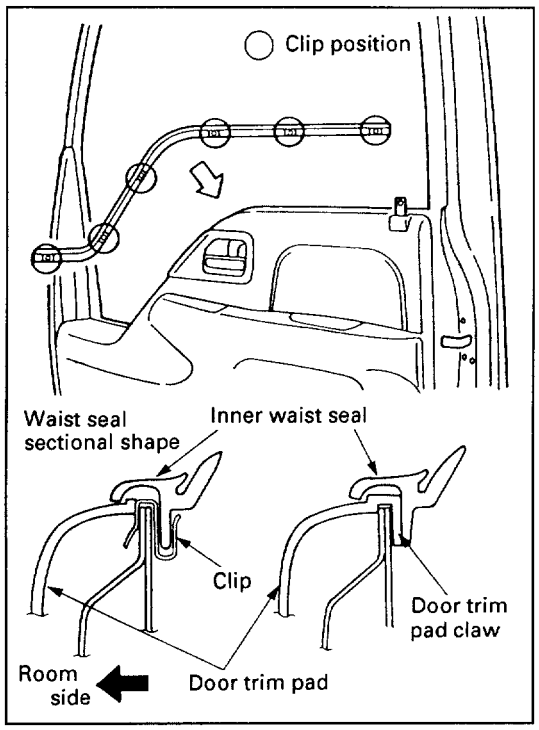
6. **Front door trim pad**
   - Remove the clips at 13 positions.



Installation

For installation, reverse the removal procedure taking the following point into consideration.

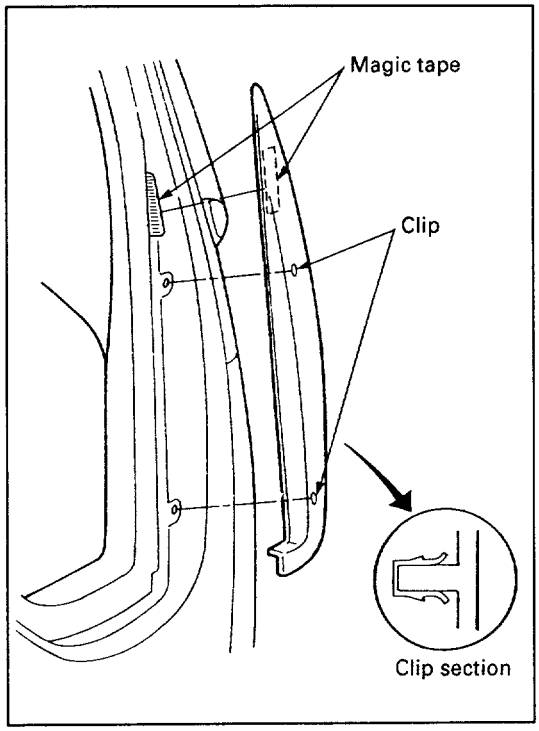
1. Adjust the trim pad clip to the mounting hole on the door panel side and install the trim pad so as to prevent any float, skewness or door harness bite.



2. Align the front end together with the 4 claws in the upper part of the trim pad and insert the clips in sequence starting from the front end clip. Note that applying force in transverse direction will cause deformation.

Front Pillar Garnish

Removal



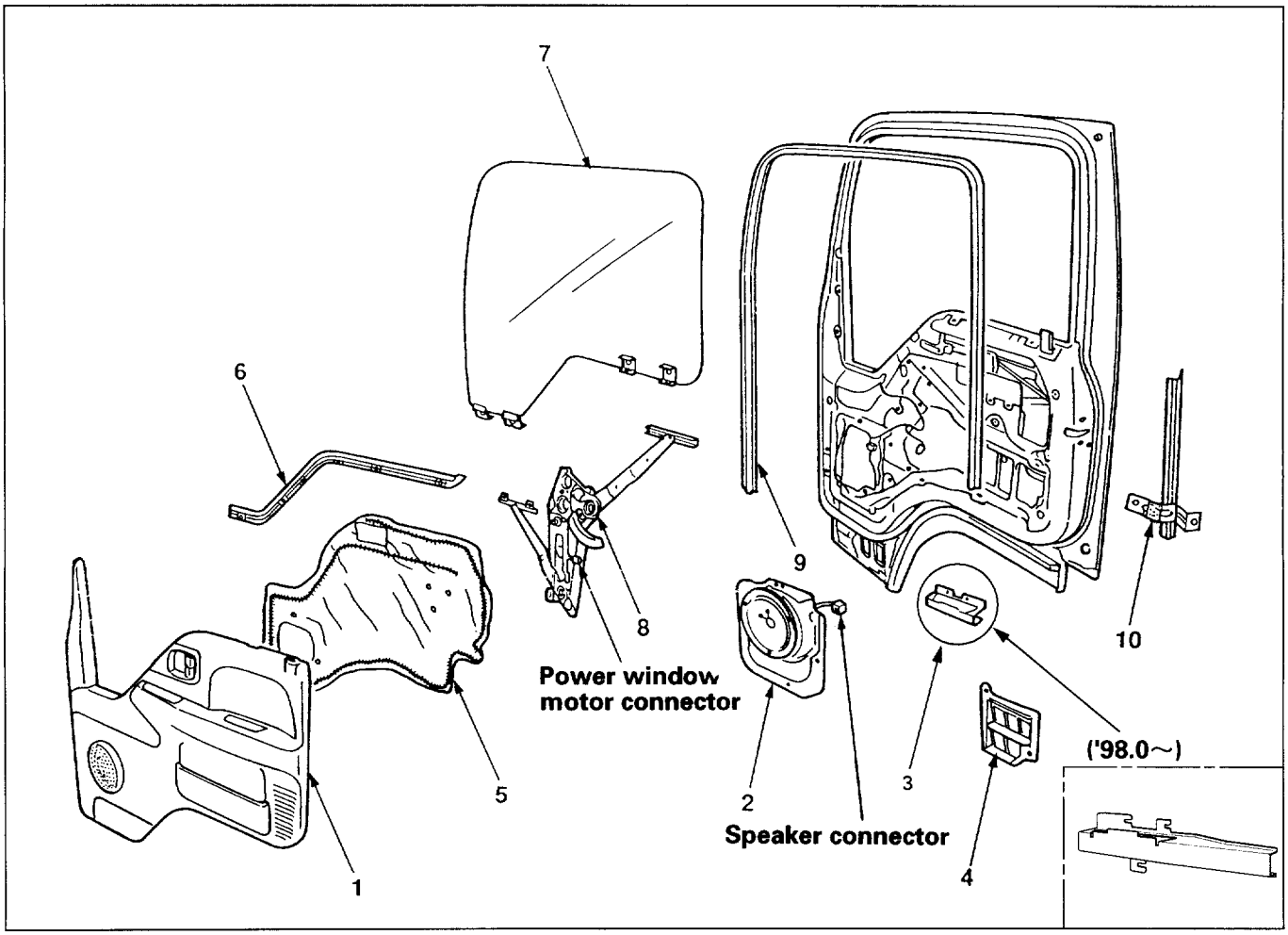
1. **Front pillar garnish**

   Peel off the magic tape and pull it toward you. Pull out the clips at 2 positions.

Installation

For installation, reverse the removal procedure.

Door Window Glass, Regulator and Glass Run



Removal Steps

1. Front door trim pad
2. Speaker
3. Door case bracket
4. Outlet one-way valve
5. Water-proof sheet
6. Outer waist seal
7. Glass
8. Window regulator
9. Glass run
10. Glass run rear channel

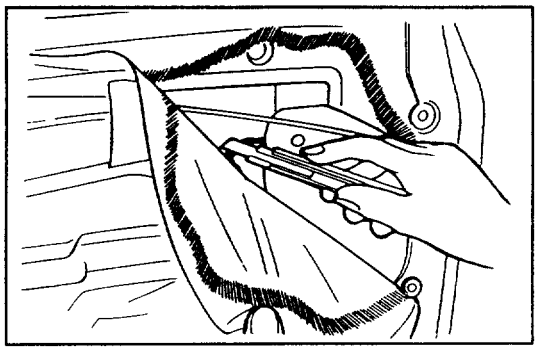
Installation Steps

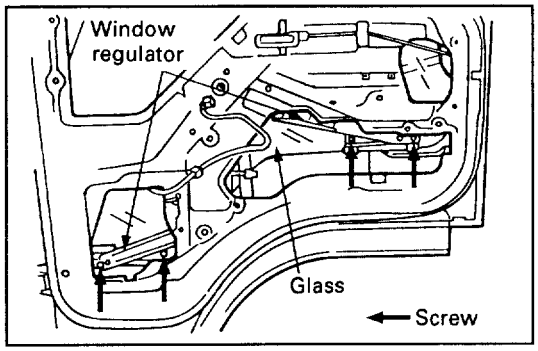
For installation, reverse the removal procedure.

Removal

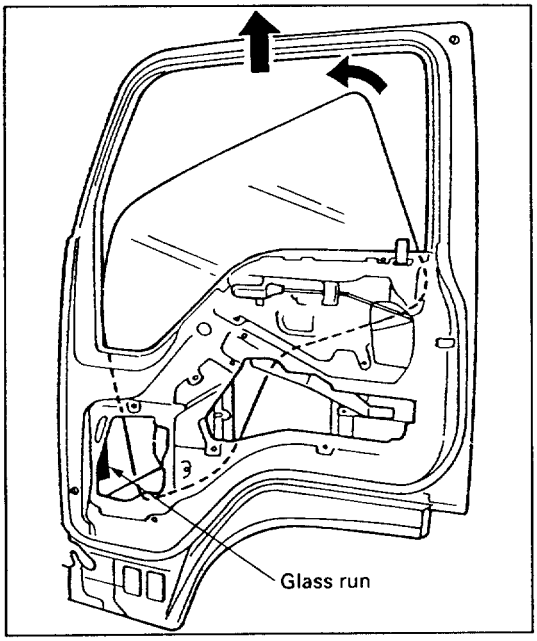
1. **Front door trim pad**
   - Refer to "Front door trim pad" in this Section.
2. **Speaker**
   - Remove the 3 screws and 1 clip and disconnect the connector.

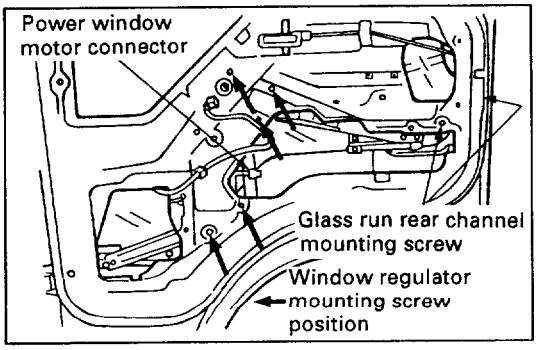
3. **Door pull case bracket**
4. **Outlet one-way valve**
5. **Water-proof sheet**
   - Peel off the water-proof sheet carefully with a cutter or knife. Take care not to damage it when peeling it off.
6. **Outer waist seal**





7. **Glass**
   - Lower the glass to a position where the mounting screw can be seen, and remove the 4 screws.
   - Lower the front side of the glass. After the front side of the glass comes off from the glass run, pull up the rear side of the glass.



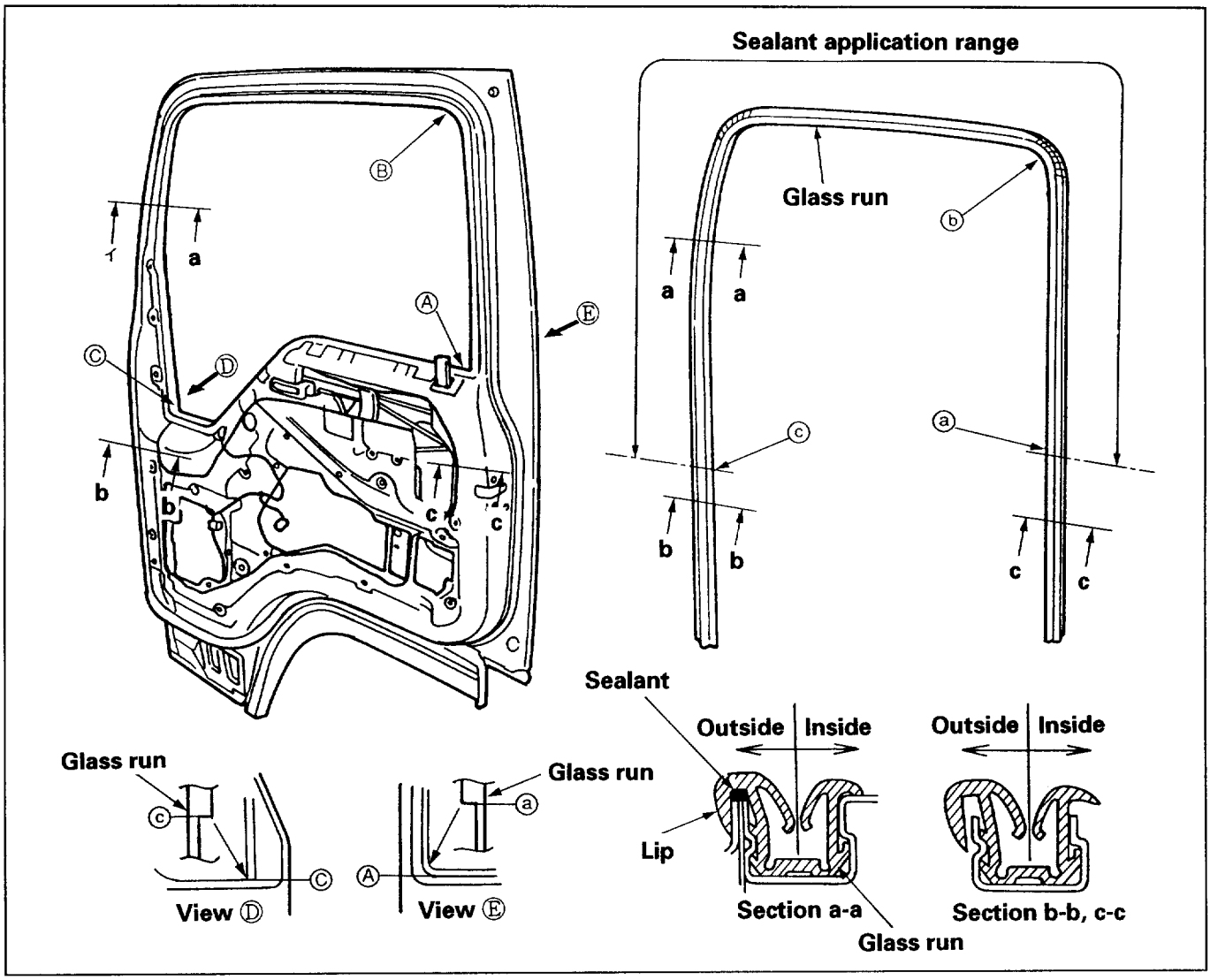


8. **Window regulator**
   - Disconnect the harness connector of the power window motor and remove the 5 mounting screws.
9. **Glass run**
   - Pull out the glass run from the door frame groove.
10. **Glass run rear channel**
    - Pull out the 2 mounting screws.

Installation

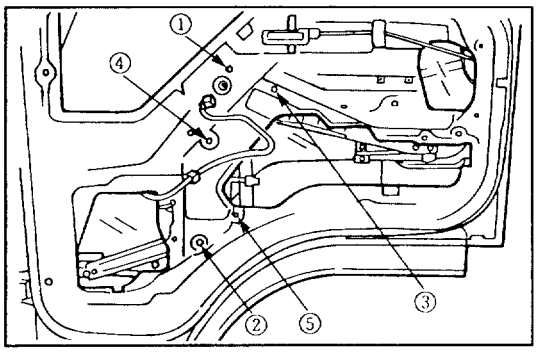
For installation, reverse the removal procedure taking the following points into consideration.

1. Align the notch ⓐ of the glass run lip with the door outer waist line Ⓐ. Align the glass run slit ⓑ with the door Ⓑ and fit the glass run between Ⓐ and Ⓑ. Next, align the notch ⓒ of the glass run lip with the door outer waist line Ⓒ and fit the glass run between Ⓑ and Ⓒ. Fit the glass run in the channel within the door. (Refer to the illustration shown on the next.)



- Fit the glass run with the lip toward the outside of the vehicle.

2. While the front side of the glass is lowered, insert the glass into the door panel. First, insert the rear side of the glass into the glass run, then insert the front side into the glass run. Raise the front side gradually along the glass run.



CAUTION:

When reusing the glass run, apply the sealant to the range shown in the figure.

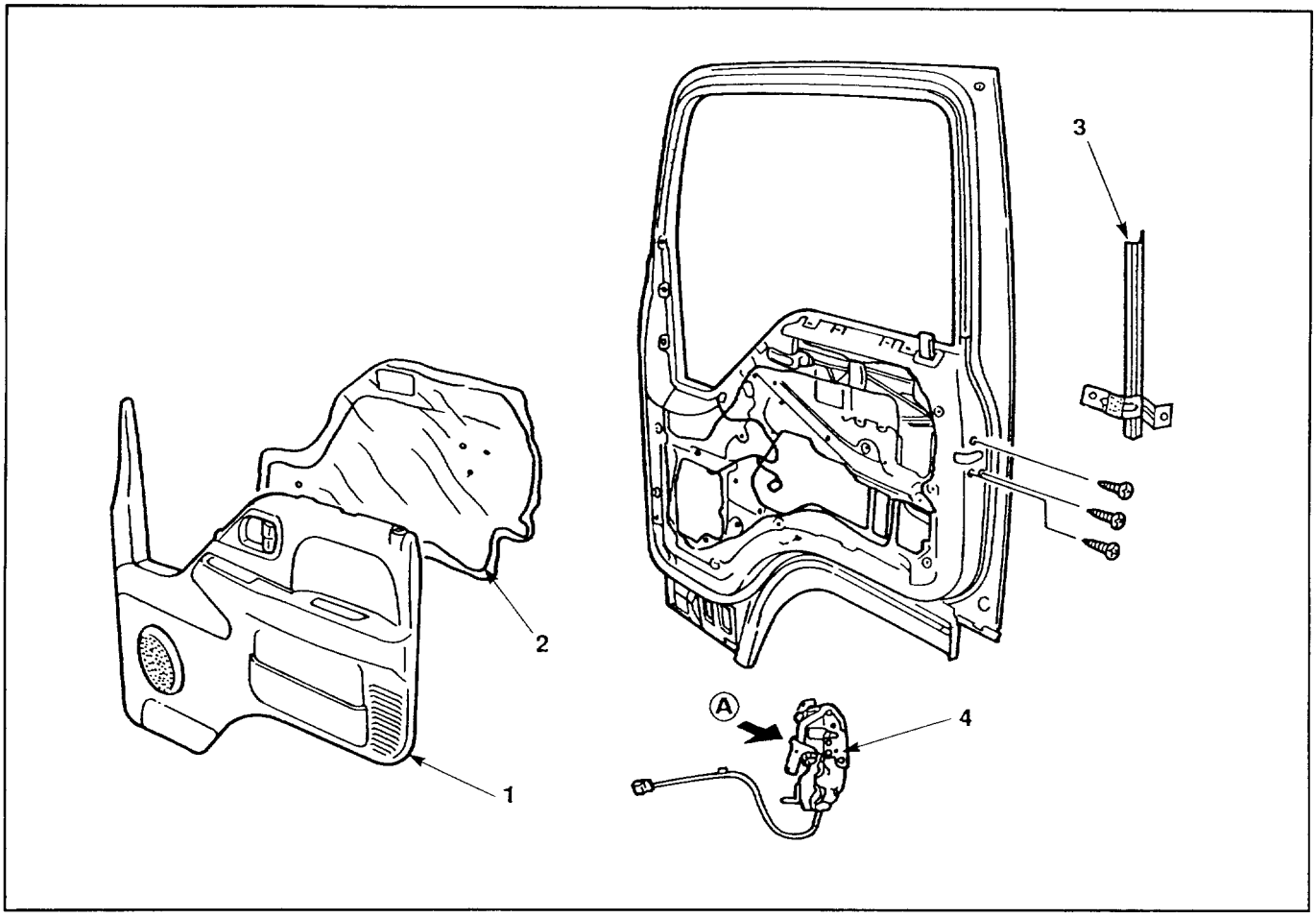
Sealant: CEMEDINE 366DX or equivalent

3. Temporarily tighten the window regulator mounting screw ③ (basic hole) and tighten ① to ⑤ firmly. Lastly, tighten ③ (basic hole) firmly.

Tightening torque	N•m (kg•m)
6 (0.6) to 7.8 (0.8)	

4. Glue the water-proof sheet with an IIR tape securely.
   Check the water-proof sheet for breakage.

Door Lock ASM



Removal Steps

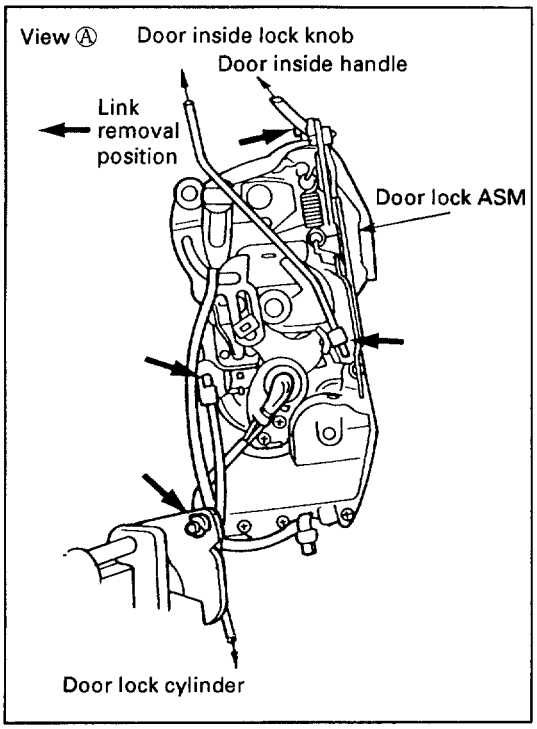
1. Door trim pad
2. Water-proof sheet
3. Glass run rear channel
4. Door lock ASM

Istallation Steps

For installation, reverse the removal procedure.

Removal

1. **Door trim pad**
2. **Water-proof sheet**
   - Refer to "Window regulator" in this Section.
3. **Glass run rear channel**
   - Pull out the 2 mounting screws.



4. **Door lock ASM**
   - Disconnect each link and remove the 3 mounting screws.

Installation

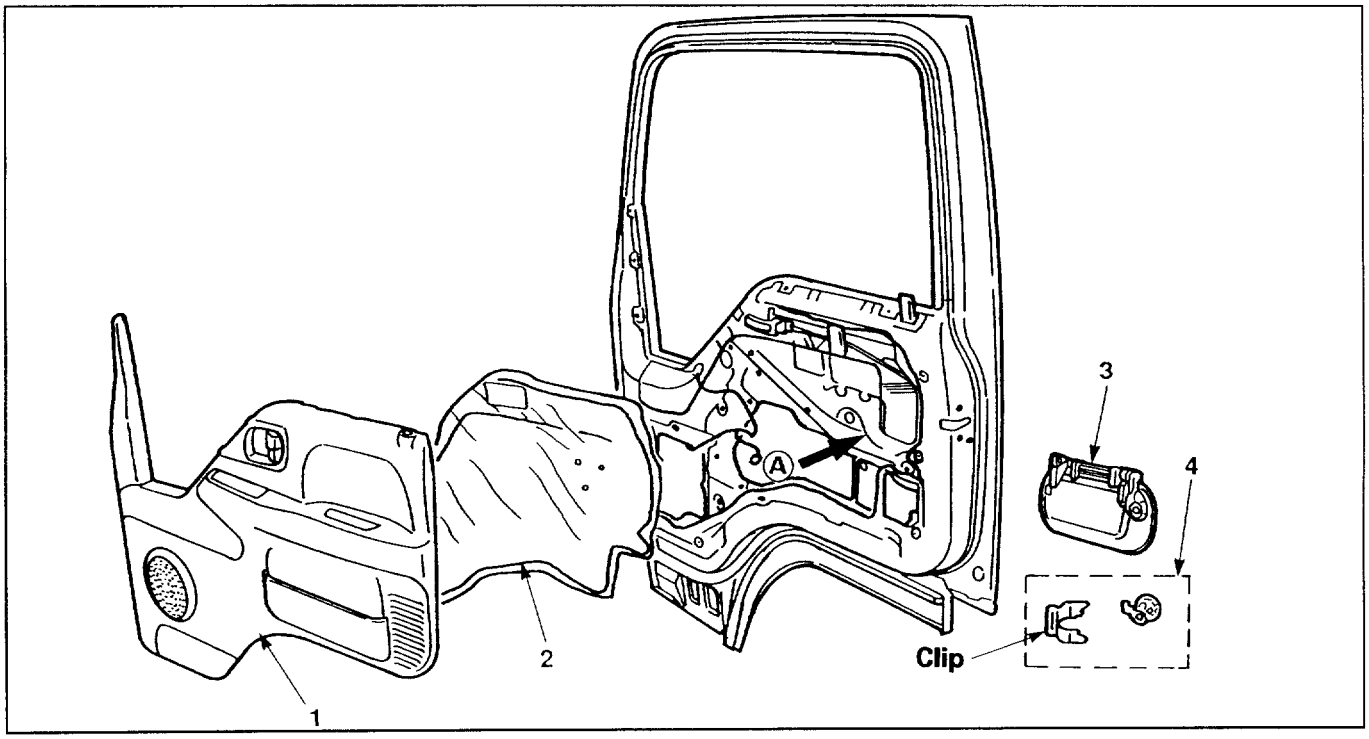
For installation, reverse the removal procedure taking the following points into consideration.

1. Tighten the door lock ASM to the specified torque.

Tightening torque	N•m (kg•m)
12.7 (1.3) to 17.7 (1.8)	

2. After installation, check the operation.

Door Outside Handle and Door Lock Cylinder



Removal Steps

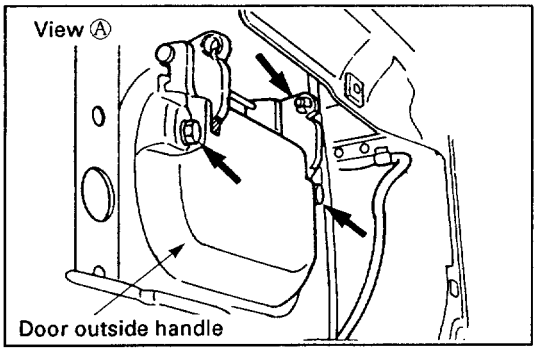
1. Door trim pad
2. Water-proof sheet
3. Door outside handle
4. Door lock cylinder

Installation Steps

For installation, reverse the removal procedure.

Removal

1. **Door trim pad**
2. **Water-proof sheet**
   - Refer to "Window regulator" in this Section.



3. **Door outside handle**
   - Disconnect the link and remove the 2 mounting bolts.
4. **Door lock cylinder**
   - Disconnect the link and pull out the clip.

Installation

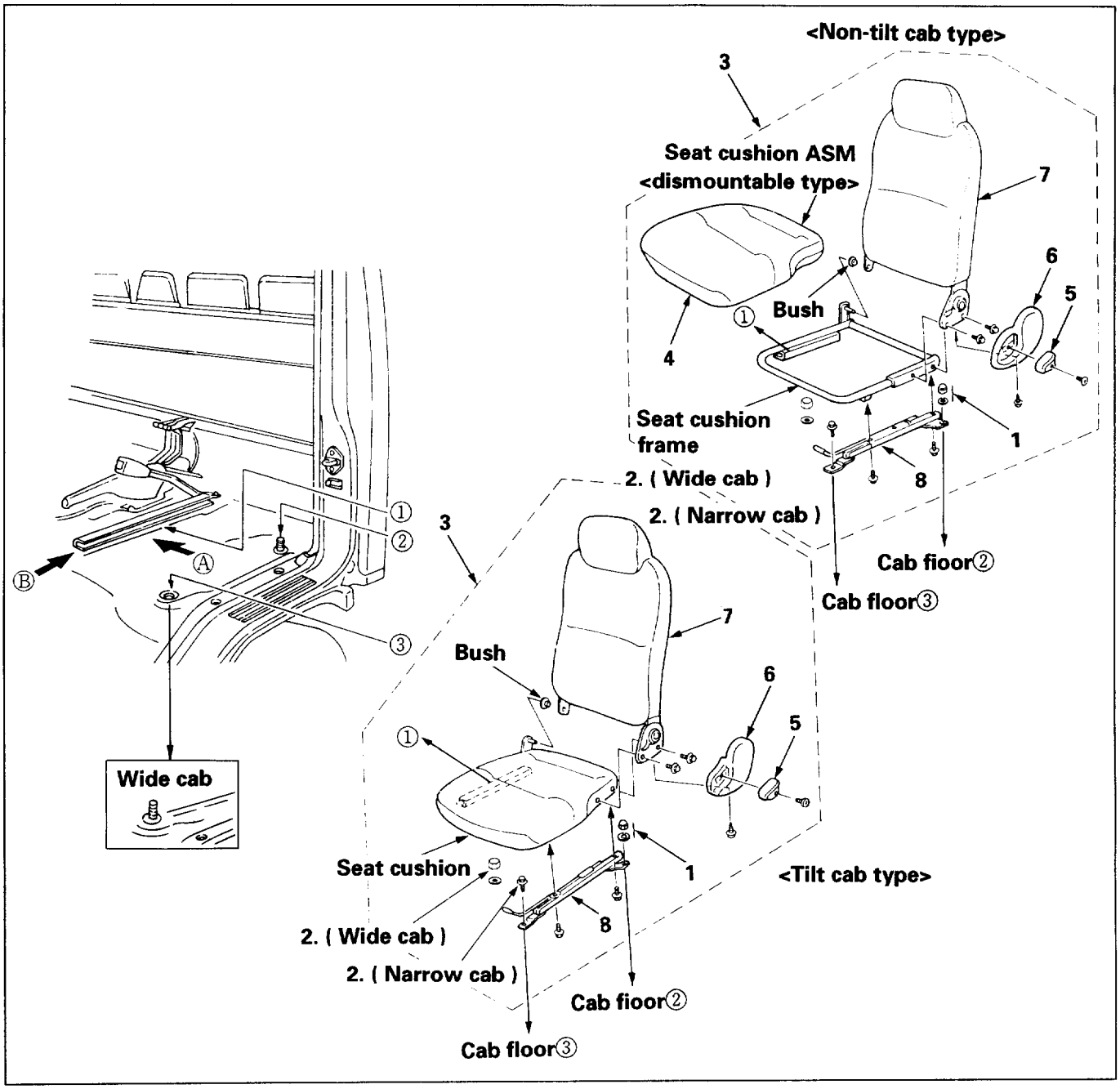
For installation, reverse the removal procedure taking the following point into consideration.

1. Tighten the door outside handle mounting bolts to the specified tightening torque.

Tightening torque	N•m (kg•m)
12.7 (1.3) to 17.7 (1.8)	

SEAT

Driver Side



Removal Steps

1. Cap nut and plain washer
2. Seat bolt (Narrow), cap nut and plain washer (wide)
3. Seat ASM
4. Seat cushion ASM
5. Reclining lever
6. Reclining cover
7. Seat back ASM
8. Seat rail

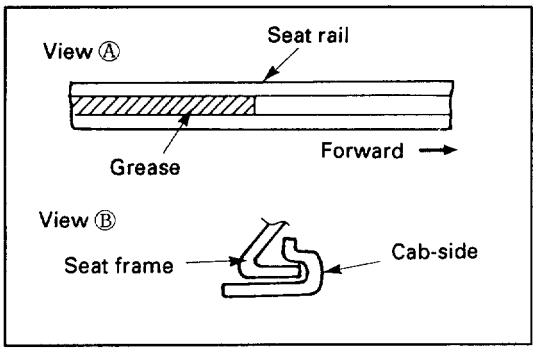
Installation Steps

For installation, reverse the removal steps.

Removal

1. **Cap nut and plain washer**
   - Slide the seat forward and remove the cap nut.
2. **Seat bolt (narrow), cap nut and plain washer (wide)**
   - Slide the seat backward and remove the seat bolt or cap nut.
3. **Seat ASM**
4. **Seat cushion ASM (non-tilt cab type only)**
5. **Reclining lever**
   - Remove the one screw.
6. **Reclining cover**
   - Remove the one screw.
7. **Seat back ASM**
8. **Seat rail**
   - Remove the 2 bolts.

Installation



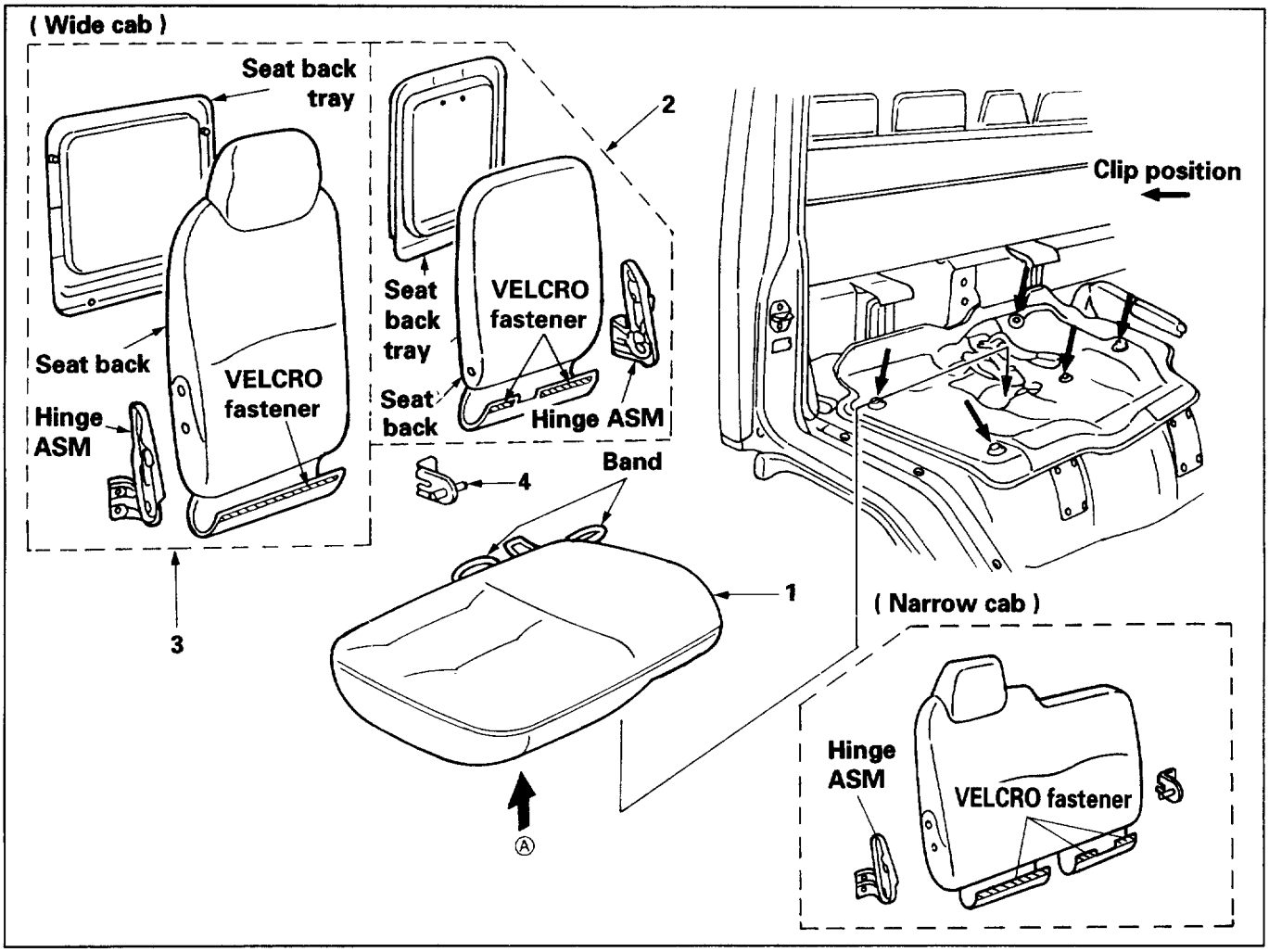
For installation, reverse the removal procedure taking the following point into consideration.

1. Before installing the seat ASM, apply grease to the backward half of the cab-side seat rail (view at A) and set the claw on the seat frame side (view at B). After that, tighten the cap nut (with lock), plain washer and seat bolt (with Loctite) securely.

Tightening torque (reference value)	N•m (kg•m)
13 (1.3)	

Grease: MITSUBISHI MULTI-PURPOSE No.2 or equivalent

Center and Passenger Side



Removal Steps

1. Seat cushion ASM
2. Center seat back ASM
3. Passenger seat back ASM
4. Hinge bracket

Installation Steps

For installation, reverse the removal procedure.

Removal

1. **Seat cushion ASM**
   - Raise the cushion and remove the clips and peel off the magic fasteners at 5 positions and pull out the seat belt from the band.
2. **Center seat back ASM (Wide cab)**
   - Remove the 2 hinge fixing bolts.
   - Remove the 2 fixing bolts and remove the hinge ASM.
   - Remove the fixing screw and remove the seat back tray.

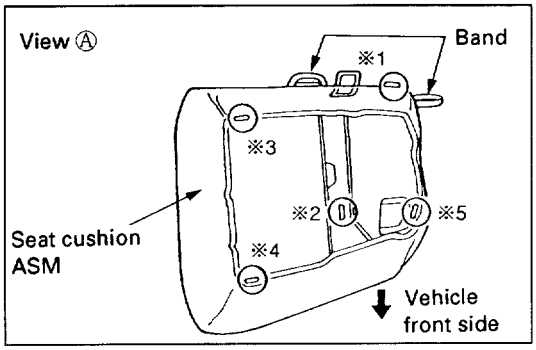
3. **Passenger seat back ASM**
   - Remove the 2 hinge fixing bolts.
   - Remove the 2 fixing bolts and remove the hinge ASM.
   - Remove the fixing screws and remove the seat back tray.
4. **Hinge bracket**
   - Remove 2 fixing bolts.

Installation

For installation, reverse the removal procedure taking the following point into consideration.

1. Tighten each hinge of the seat back with the specified bolts (with Loctite) securely.

Tightening torque	N•m (kg•m)
12.9 (1.3)	

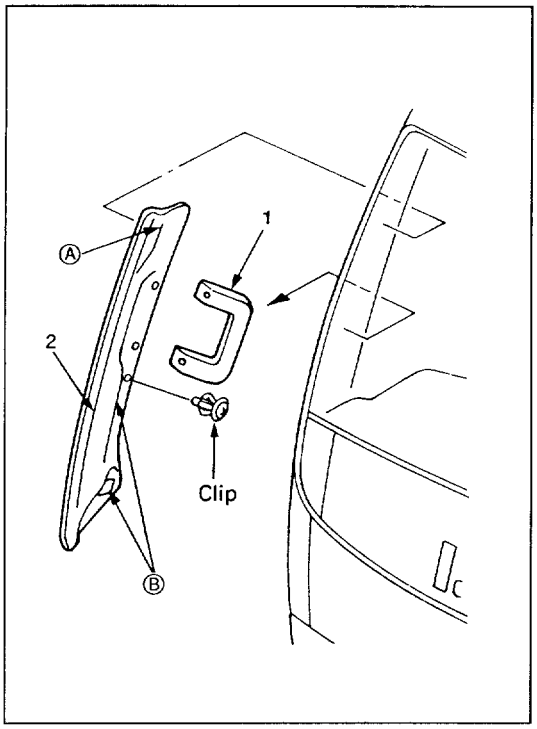


2. Check the direction of seat cushion fixing clip and set its mate clip on the engine cover.
3. Pass the seat belt through the seat cushion band.
4. Install the seat cushion in the following order: ※1, ※2, ※3, ※4 and ※5

INTERIOR TRIM

Front Pillar Trim Cover

Removal



1. **Front grip**
   - Remove the 2 mounting screws.

   CAUTION:

   These screws are coated with Loctite. When removing them, take care not to damage their heads.

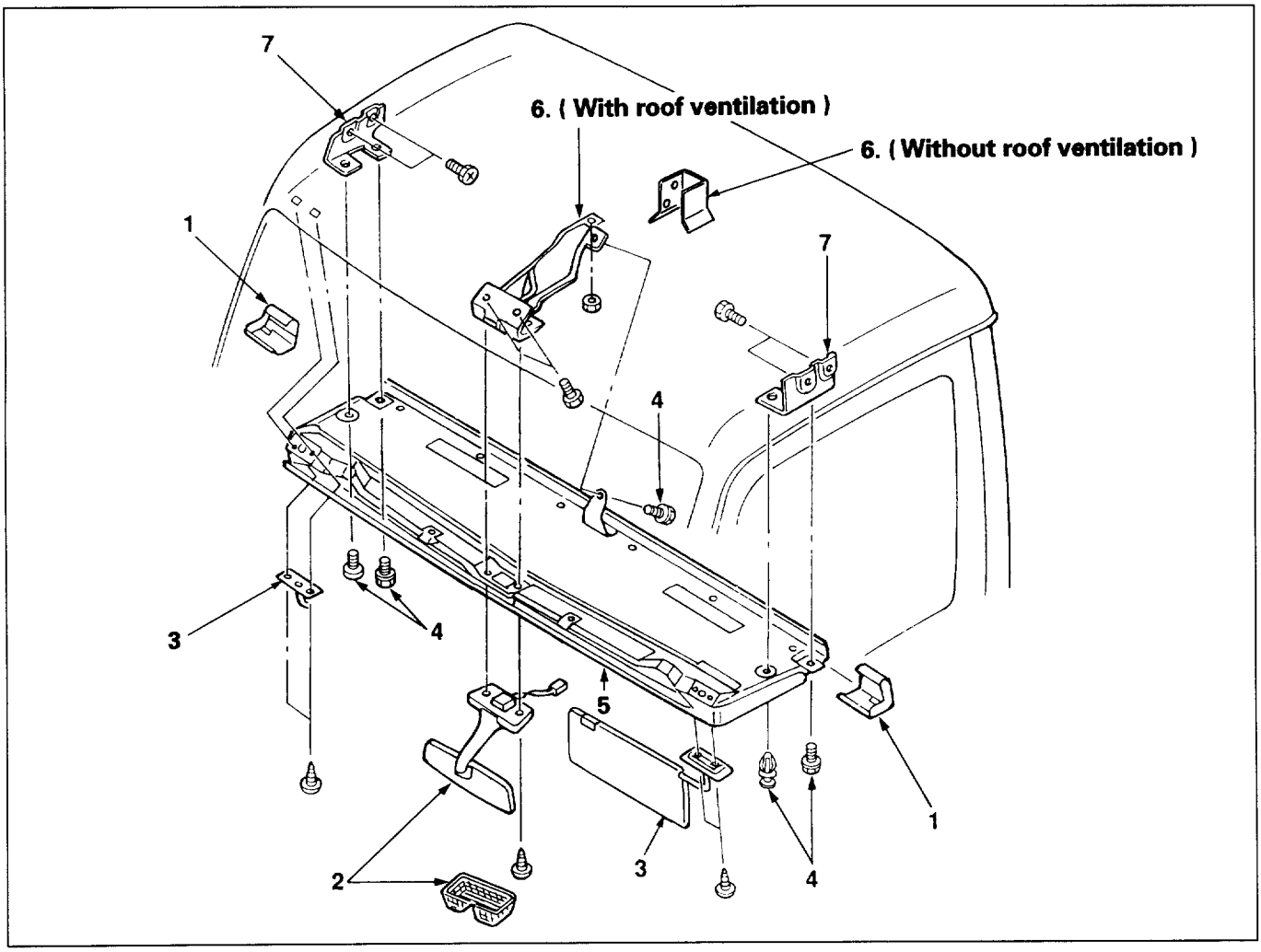
2. **Front pillar trim cover**
   - Remove the one clip at the position Ⓐ and peel off the two-sided adhesive tape at the position Ⓑ shown in the figure.
     For the high cab or wide cab, remove the clip.

Installation

For installation, reverse the removal procedure taking the following point into consideration.

- Use a new two-sided adhesive tape and stick it securely by press at installation.

Header Shelf (~'98)



Removal Steps

1. Header shelf corner finisher
2. Room lamp/mirror
3. Sun visor/grommet
4. Mounting screw/clip
5. Header shelf ASM
6. Center bracket
7. Side bracket

Installation Steps

Form installation, reverse the removal procedure.

Removal

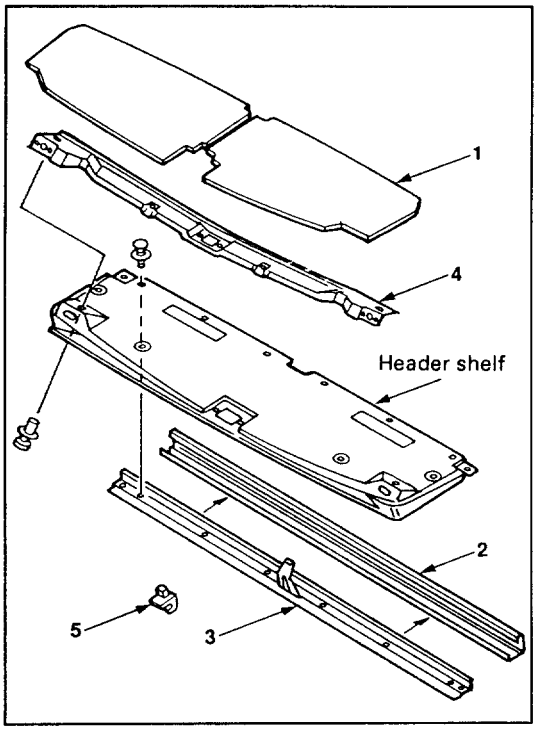
1. **Header shelf corner finisher**
2. **Room lamp/mirror**
   - Remove the lens and remove 2 mounting screws and connector.

3. **Sun visor/grommet**
   - Remove the 2 mounting screws. For a custom vehicle, a sun visor is mounted on each of the left and right sides.
4. **Mounting screw/clip**
   - Slide the left-hand 2 screws/clips and right-hand 2 screws/clips and the roof ventilator cover backward, then pull them out. Remove the one screw in the center of the rear side.
5. **Header shelf ASM**
6. **Center bracket**
   - Remove the 2 mounting screws and 1 nut. (With roof ventilation)
   - Remove the 2 clips. (Without roof ventilation)
7. **Side bracket**
   - Remove the 2 mounting screws each.

Installation

For installation, reverse the removal procedure.

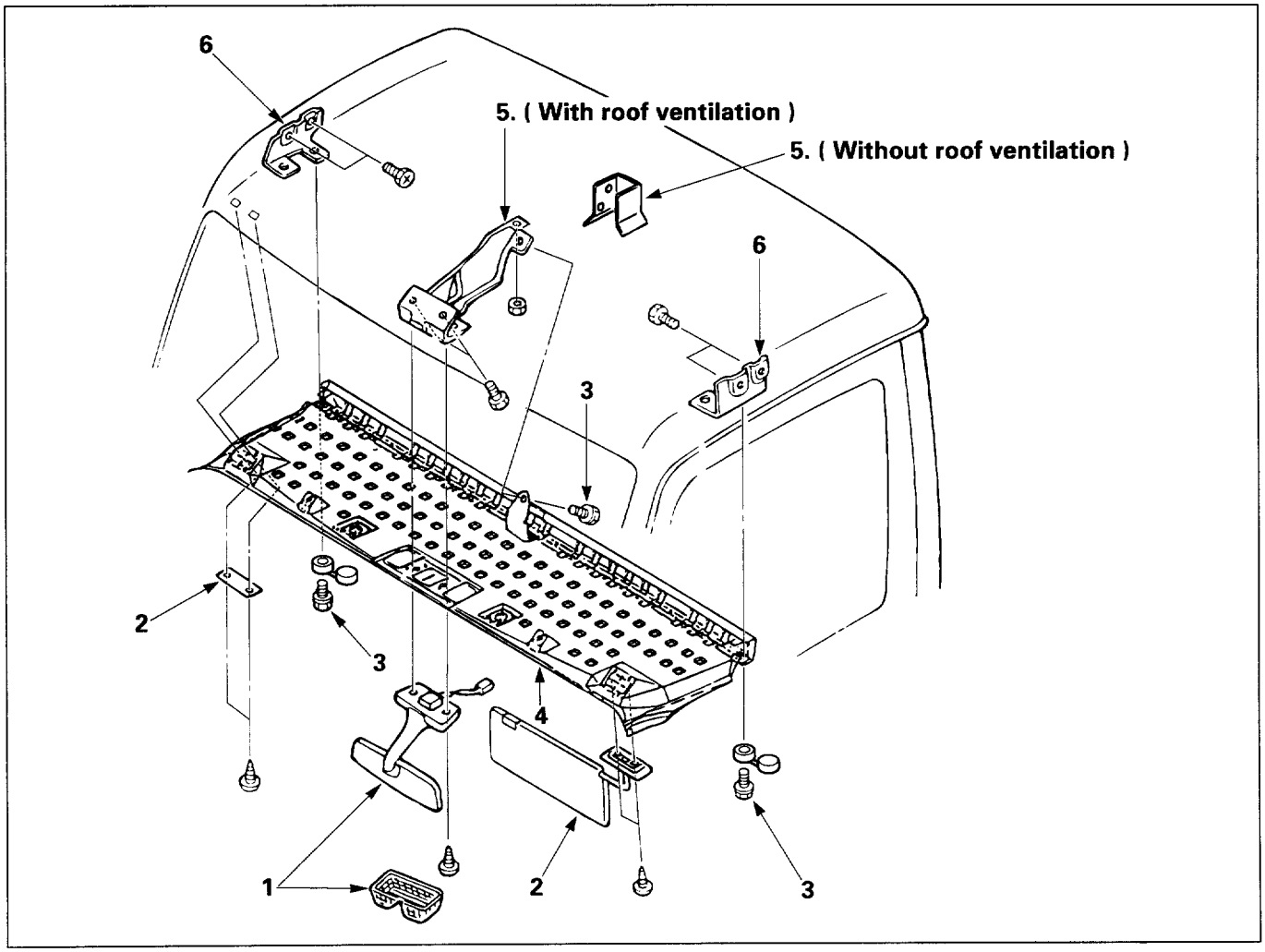
Disassembly of Header Shelf ASM



1. **Sheet**
2. **Rear finisher**
3. **Rear reinforcement**
   - Remove the 6 clips.
4. **Front reinforcement**
   - Remove the 2 clips.
5. **Sun visor holder**
   - Turn it 45° for removal.

For assembly, reverse the disassembly procedure.

Header Shelf ('99~)



Removal Steps

1. Room lamp/mirror
2. Sun visor/grommet
3. Mounting screw
4. Header shelf ASM
5. Center bracket
6. Side bracket

Installation Steps

Form installation, reverse the removal procedure.

Removal

1. Room lamp/mirror

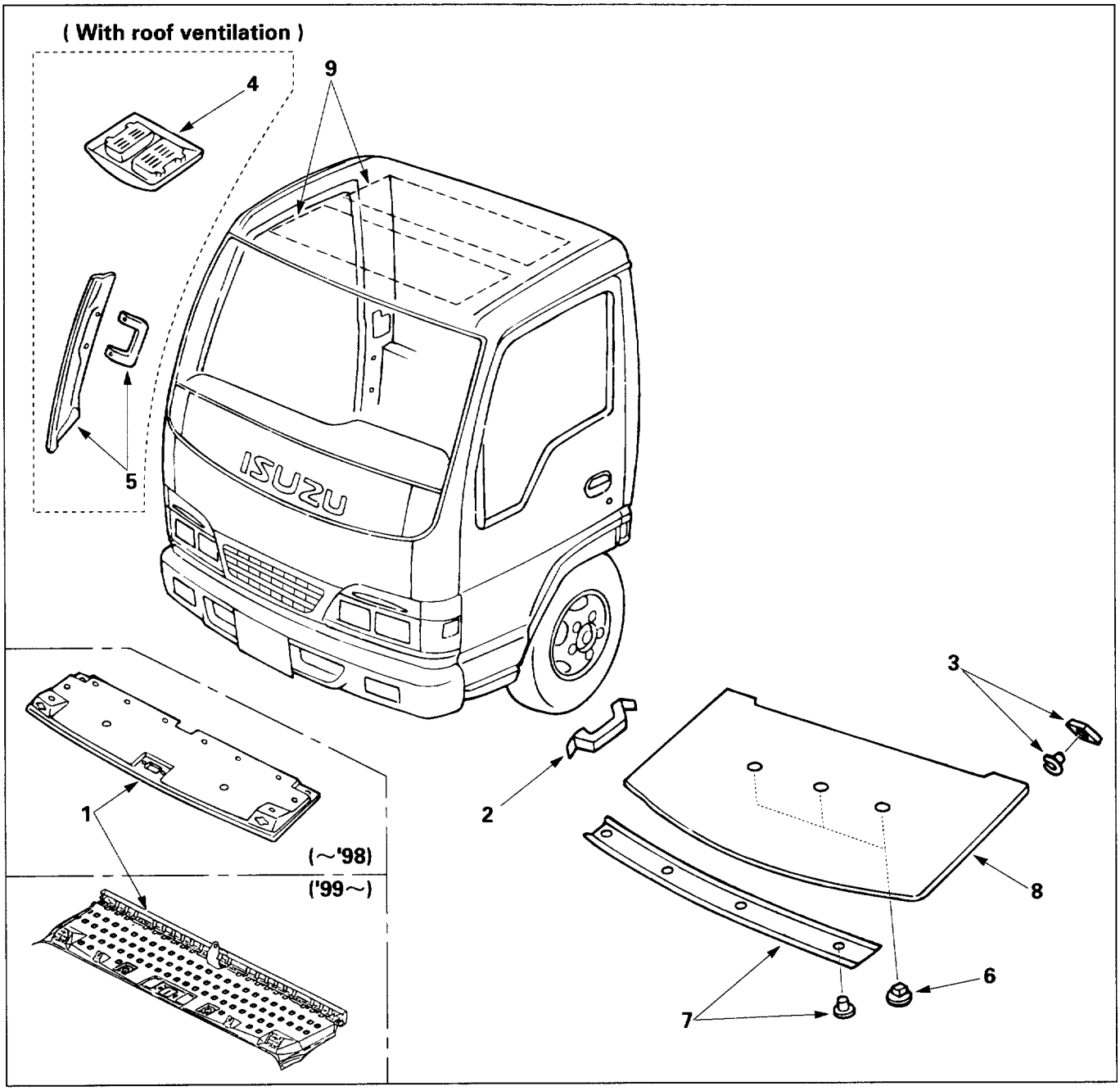
- Remove the lens and remove 2 mounting screws and connector.

2. **Sun visor/grommet**
   - Remove the 2 mounting screws. For a custom vehicle, a sun visor is mounted on each of the left and right sides.
3. **Mounting screw**
   - Slide the left-hand 1 screws and right-hand 1 screws and the roof ventilator cover backward, then pull them out. Remove the one screw in the center of the rear side.
4. **Header shelf ASM**
5. **Center bracket**
   - Remove the 2 mounting screws and 1 nut. (With roof ventilation)
   - Remove the 2 clips. (Without roof ventilation)
6. **Side bracket**
   - Remove the 2 mounting screws each.

Installation

For installation, reverse the removal procedure.

Head Lining



Removal Steps

1. Header shelf
2. Assist grip
3. Coat hanger/spacer
4. Roof ventilator grille
5. Front grip/front pillar trim cover
6. Clip
7. Front retainer/clip
8. Head lining
9. Insulator

Installation Steps

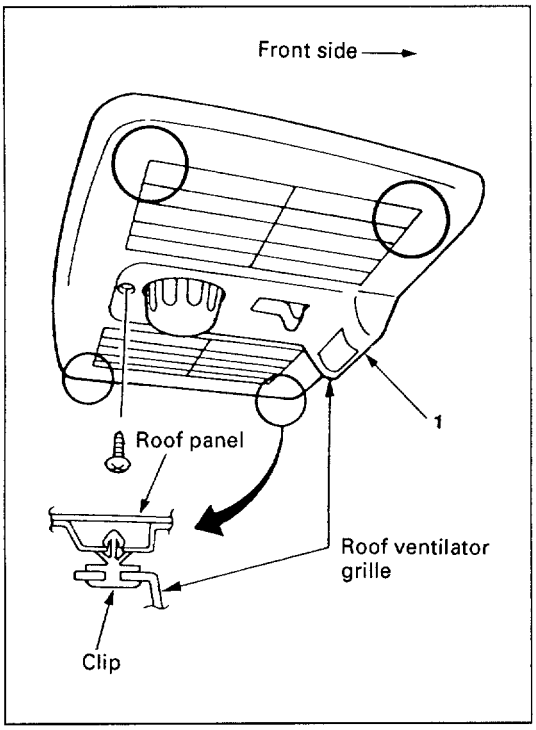
For installation, reverse the removal procedure.

Removal

1. **Header shelf**
   - Refer to "Header shelf" in this Section.
2. **Assist grip**
   - Open the covers at 2 positions and remove the mounting screws.
3. **Coat hanger/spacer**
   - Turn the coat hanger 45° for removal.
4. **Roof ventilator grille**
   - Refer to "Roof ventilator" in this Section.
5. **Front grip/front pillar trim cover**
   - Refer to "Front pillar trim cover" in this Section.
6. **Clip**
   - Remove the 3 clips at these positions.
7. **Front retainer/clip**
   - Remove the clips at 4 positions (Narrow), 5 positions (Wide) and remove the retainer.
8. **Head lining**
9. **Insulator**

Installation

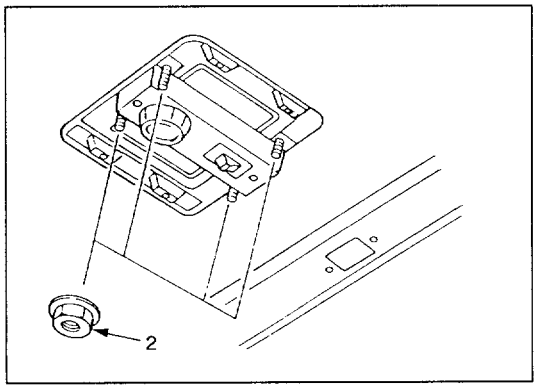
For installation, reverse the removal procedure.



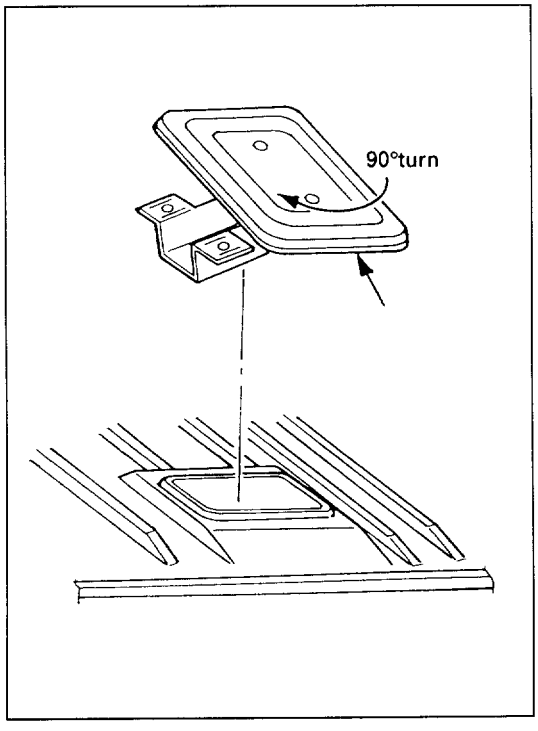
Roof Ventilator

Removal

1. **Roof ventilator grille**
   - Remove the one mounting screw and pull out the clips at 4 positions.



2. **Roof ventilator mounting nut**
   - Remove the nuts at 4 positions.



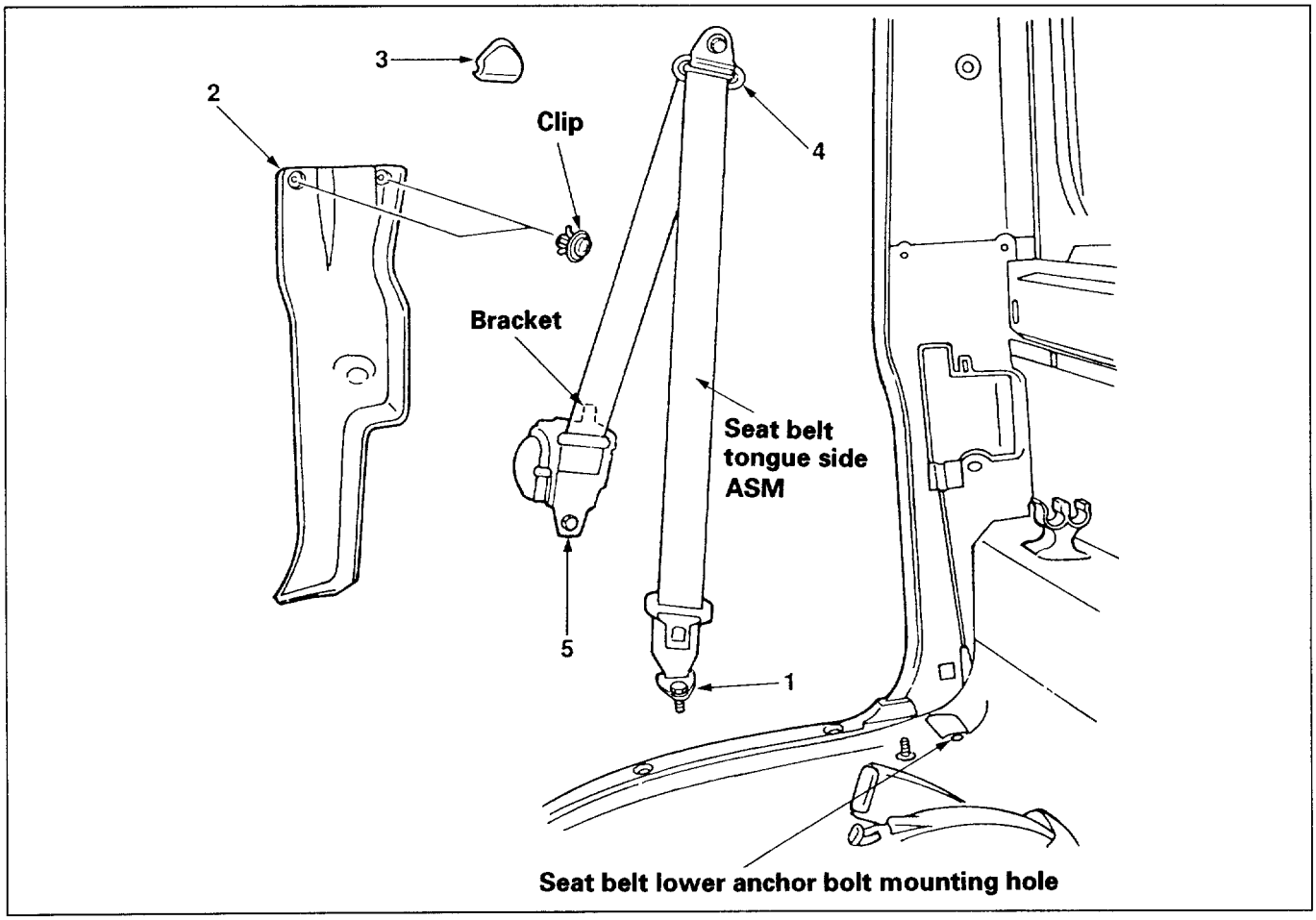
3. **Roof ventilator ASM**
   - Align the main unit with the inlet side and remove it from the stud. Turn it 90° and pull it out.

Installation

For installation, reverse the removal procedure.

SEAT BELT

Side Seat Belt Tongue



Removal Steps

1. Seat belt lower anchor bolt
2. Rear pillar lower trim cover
3. Through anchor cover (Except wide cab driver side)
4. Seat belt upper anchor bolt
5. Retractor fixing bolt

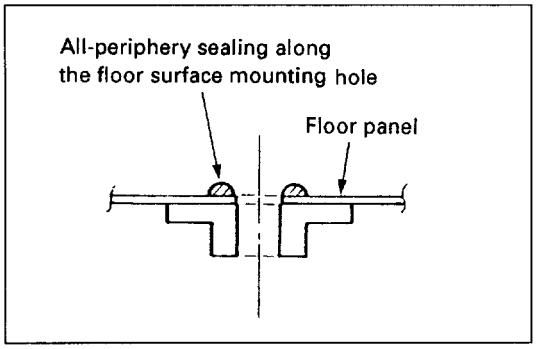
Installation Steps

For installation, reverse the removal procedure.

Removal

1. **Seat belt lower anchor bolt**
2. **Rear pillar lower trim cover**
   - Remove the 2 clips and pull up the cover.
3. **Through anchor cover (Except wide cab driver side)**
4. **Seat belt upper anchor bolt**
5. **Retractor fixing bolt**
   - Remove the bolt and pull out the upper bracket of the retractor from the panel.

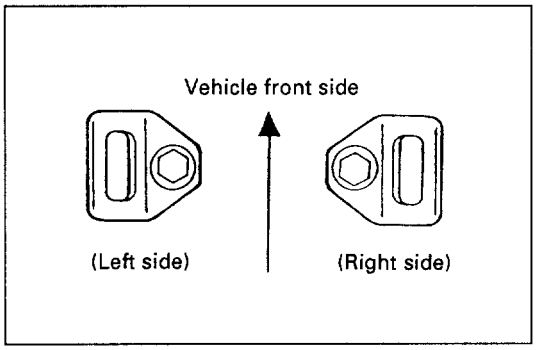
Installation



For installation, reverse the removal procedure taking the following point into consideration.

1. Apply the sealant around the seat belt lower anchor bolt mounting hole.

Sealant: TOKIWA CHEMICAL INDUSTRY 770GA or equivalent



2. Install the seat belt lower anchor in the specified direction and tighten it to the specified torque.

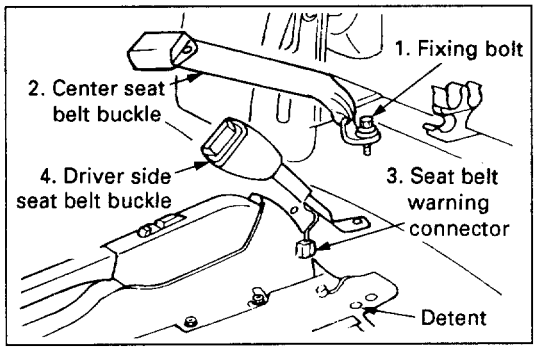
Tightening torque	N•m (kg•m)
45 (4.5)	

CAUTION:

Install the seat belt lower anchor so that it may not run on the anchor detent bead.

Front Center and Driver Side Seat Belt Buckle

Removal

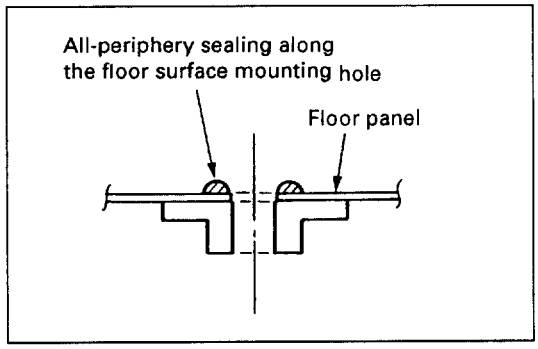


1. **Fixing bolt**
2. **Center seat belt buckle**
3. **Seat belt warning connector**
4. **Driver side seat belt buckle**

CAUTION:

For a wide cab vehicle, execute steps 1 - 2 (center) and 1 - 3 (driver) in the above procedure in this order.

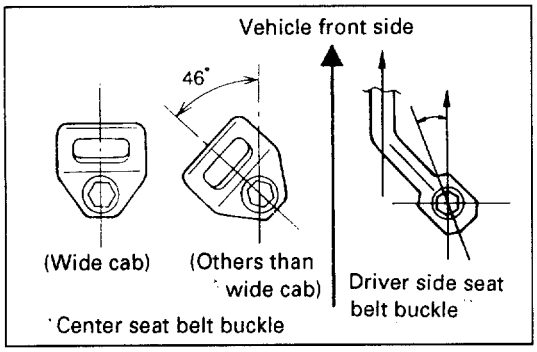
Installation



For installation, reverse the removal procedure taking the following points into consideration.

1. Apply the sealant around the mounting bolt mounting hole.

Sealant: TOKIWA CHEMICAL INDUSTRY 770GA or equivalent



2.Install the anchor in the specified direction and tighten it to the specified torque.

Tightening torque	N•m (kg•m)
45 (4.5)	

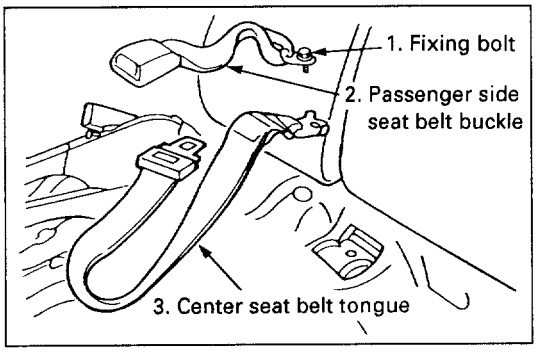
3.Pass the center seat belt buckle through the band at the end of the seat cushion.

CAUTION:

Install the anchor so that it may not run on the anchor detent bead.

Front Center Seat Belt Tongue and Passenger Side Seat Belt Buckle

Removal

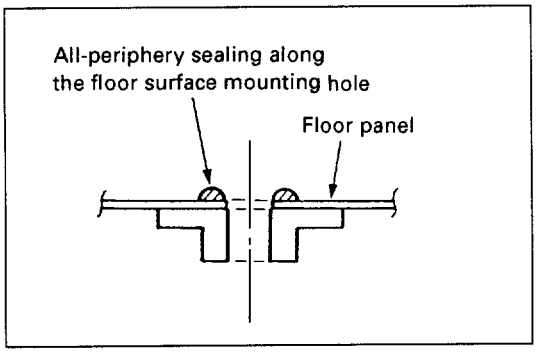


Preparations

Remove the seat cushion on the passenger side. (3-seater vehicle)

1. **Fixing bolt**
2. **Passenger side seat belt buckle**
3. **Center seat belt tongue**

Installation



For installation, reverse the removal procedure taking the following points into consideration.

1.Apply the sealant around the mounting bolt mounting hole.

Sealant: TOKIWA CHEMICAL INDUSTRY 770GA or equivalent

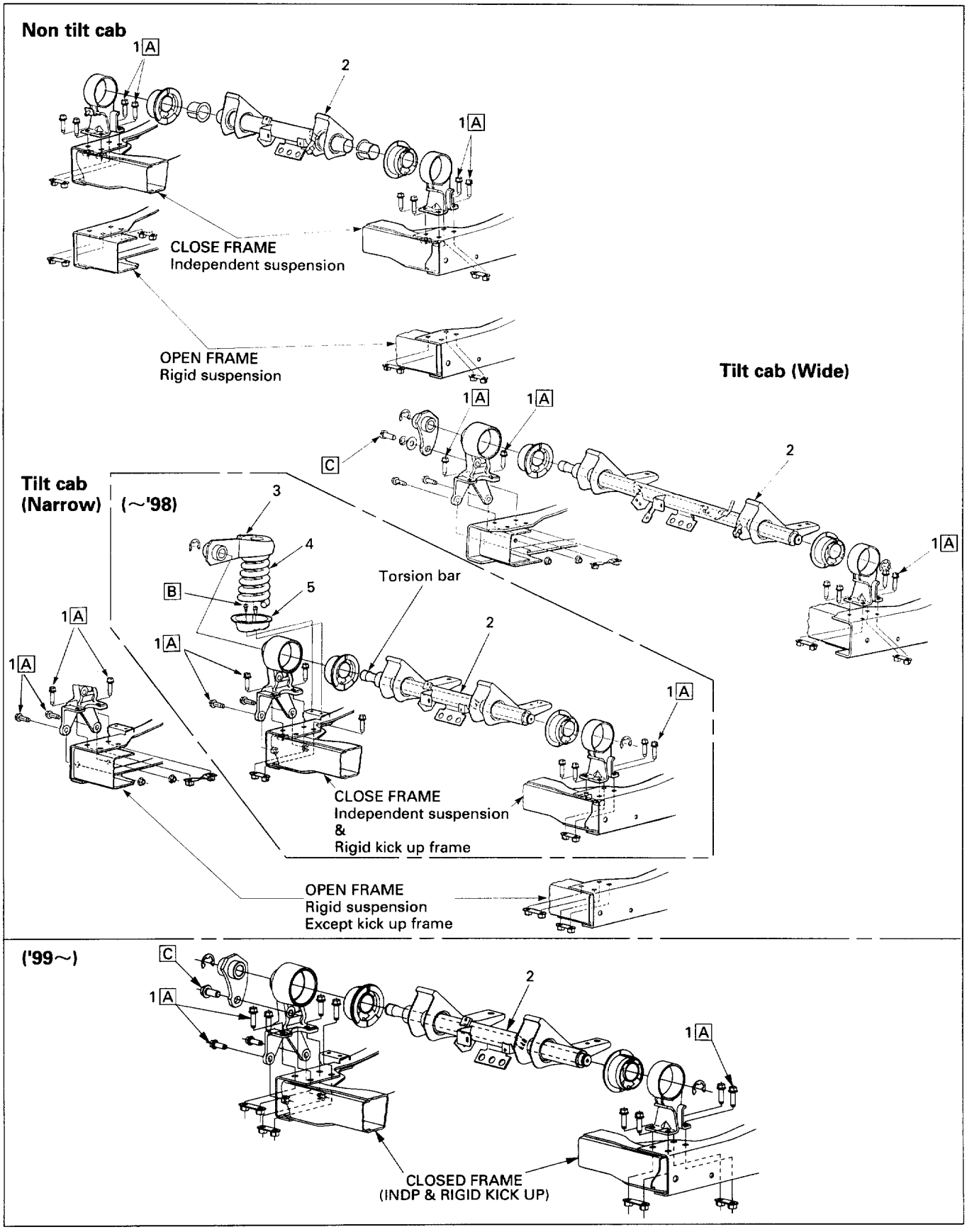
2.Install the anchor in parallel to the running direction of the vehicle.

3.Tighten the mounting bolt to the specified torque.

Tightening torque	N•m (kg•m)
45 (4.5)	

CAB MOUNTING

Front Mounting



Removal Steps

1. Cab mounting bracket fixing bolt
2. Cab mounting lever ASM
3. Anchor arm (Except the non-tilt vehicle) (~'98)
4. Tilt coil spring (Except the non-tilt and wide cab) (~'98)
5. Coil spring sheet (Except the non-tilt and wide cab) (~'98)

Installation Steps

For installation, reverse the removal procedure.

Removal

1. **Cab mounting bracket fixing bolt**
   - Remove the left-hand 4 bolts. The nut side is classified into two types, weld and plate, depending on models.

   Right side: Vehicle with tilt cab and independent suspension 5 bolts (upper = 3, side = 2)
   Vehicle with tilt cab and rigid suspension 4 bolts (upper = 2, side = 2)
   Non-tilt vehicle 4 bolts (upper = 4)
2. **Cab mounting lever ASM**
3. **Anchor arm (except the non-tilt vehicle) (~'98)**
4. **Tilt coil spring (except the non-tilt and wide cab) (~'98)**
5. **Coil spring sheet (except the non-tilt and wide cab) (~'98)**

Installation

For installation, reverse the removal procedure taking the following points into consideration.

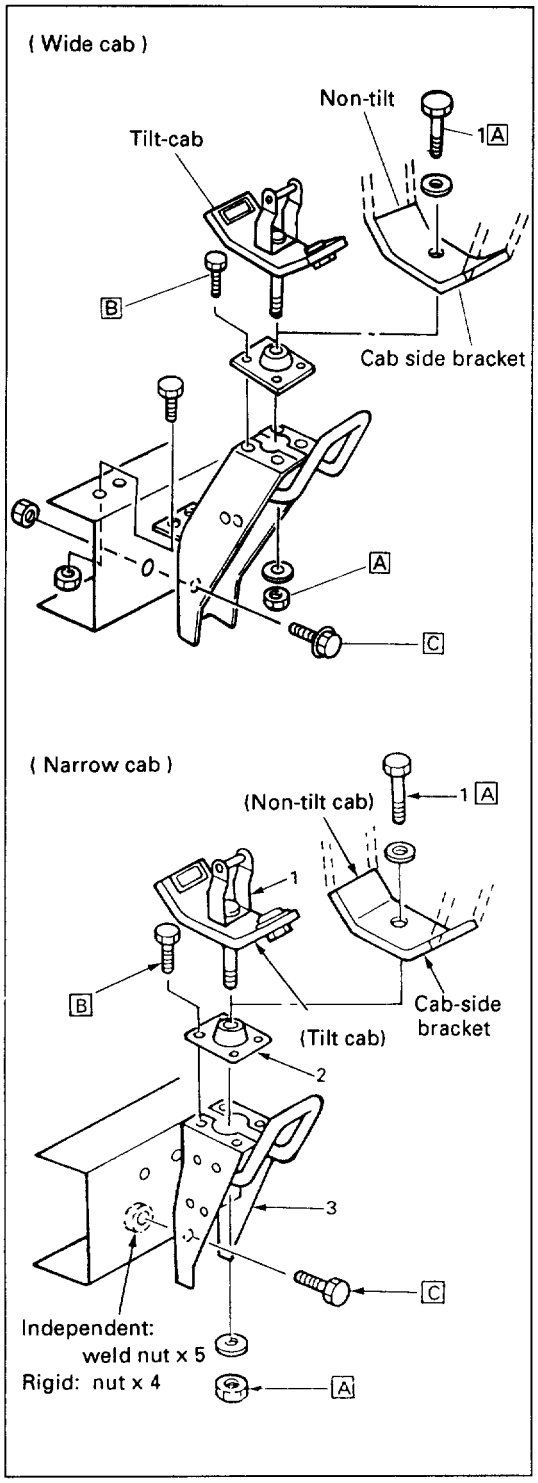
- Tighten each bolt to the specified torque.

Tightening torque. N•m (kg•m)

A	B	C
118 (12.0)	13 (1.3)	83 (8.5)

- When installing the anchor arm, align the match mark with the missing tooth of the torsion bar.

Rear Mounting



Removal

Preparations

For a tilt vehicle, tilt up the cab.

1. **Cab mounting rear bracket (tilt cab)**
   - Remove the nut and pull up the bracket.

   Cab mounting rear bolt (non-tilt cab)
   - Remove the bolt from the cab-side bracket.
2. **Mounting rubber**
   - Remove the 4 bolts.
3. **Cab mounting bracket**
   - Remove the bolts. (Narrow cab)
   - Remove the 2 bolts and the 4 nuts. (Wide cab)

Installation

For installation, reverse the removal procedure taking the following points into consideration.

- Tighten each bolt to the specified torque.

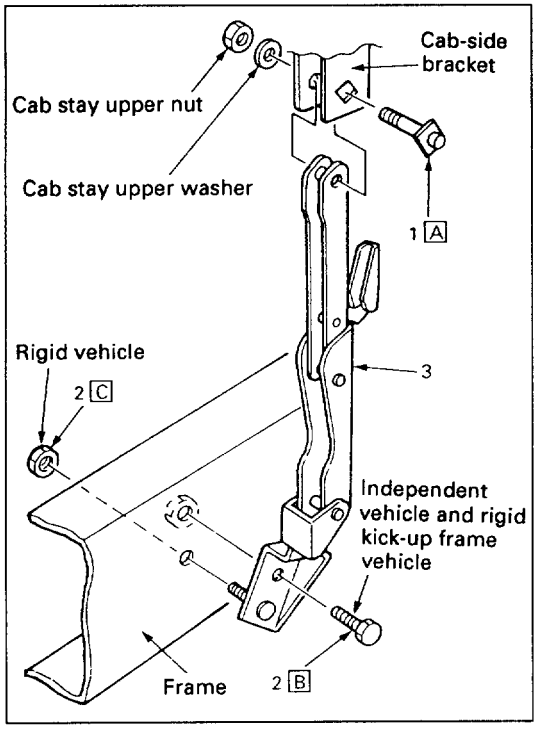
Tightening torque. N•m (kg•m)

A	B	C
88 (9.0)	50 (4.0)	81 (8.3)

- Set the tilt of the cab mounting rear bracket to ± 2° or less.

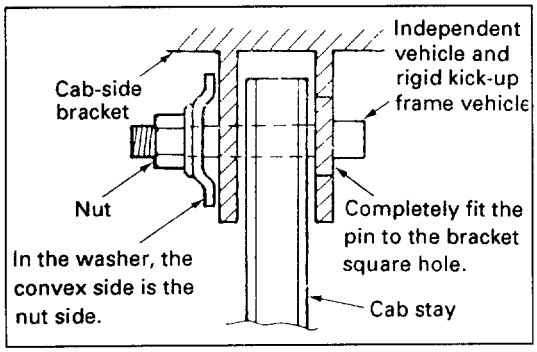
Cab Stay

Removal



1. **Cab stay pin**
   - Remove the pin, nut and washer.
2. **Cab stay bolt (independent suspension vehicle and kick-up frame with rigid suspension vehicle)**
   - Cab stay nut (rigid suspension vehicle)
3. **Cab stay**

Installation



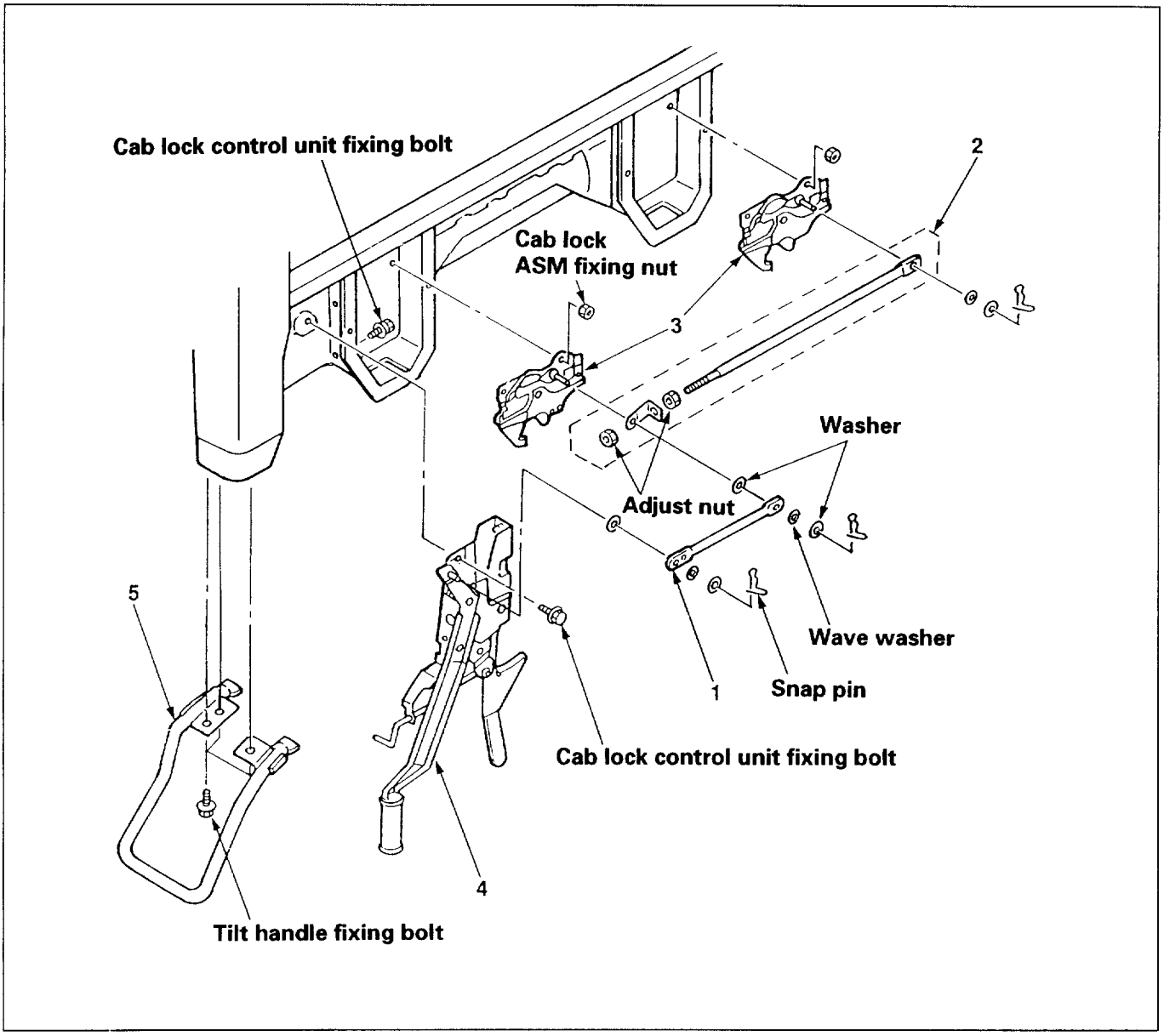
For installation, reverse the removal procedure taking the following points into consideration.

- Install the cab stay pin as shown in the left-hand figure.
- Tighten each bolt or nut to the specified torque.

Tightening torque. N•m (kg•m)

A	B	C
10 (1.0)	40 (4.1)	50 (5.1)

Cab Lock ASM



Removal Steps

1. Handle lever hook rod
2. Hook rod ASM
3. Cab lock ASM
4. Cab lock control unit ASM
5. Tilt handle ASM

Installation Steps

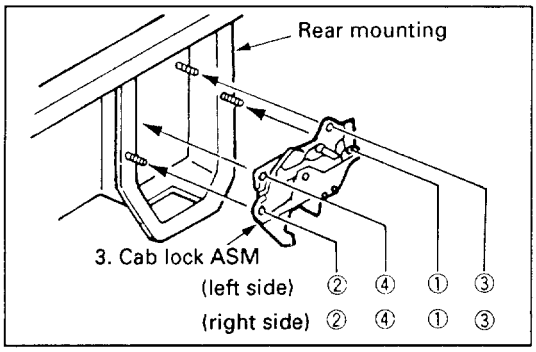
For installation, reverse the removal procedure.

Removal

1. **Hand lever hook rod**
   - Pull out the snap pins and remove the washers and wave washers.
2. **Hook rod ASM**

3. **Cab lock ASM**
   - Remove the 3 fixing nuts.
4. **Cab lock control unit ASM**
   - Remove the 3 fixing bolts.
5. **Tilt handle ASM**
   - Remove the 3 tilt handle fixing bolts.

Installation

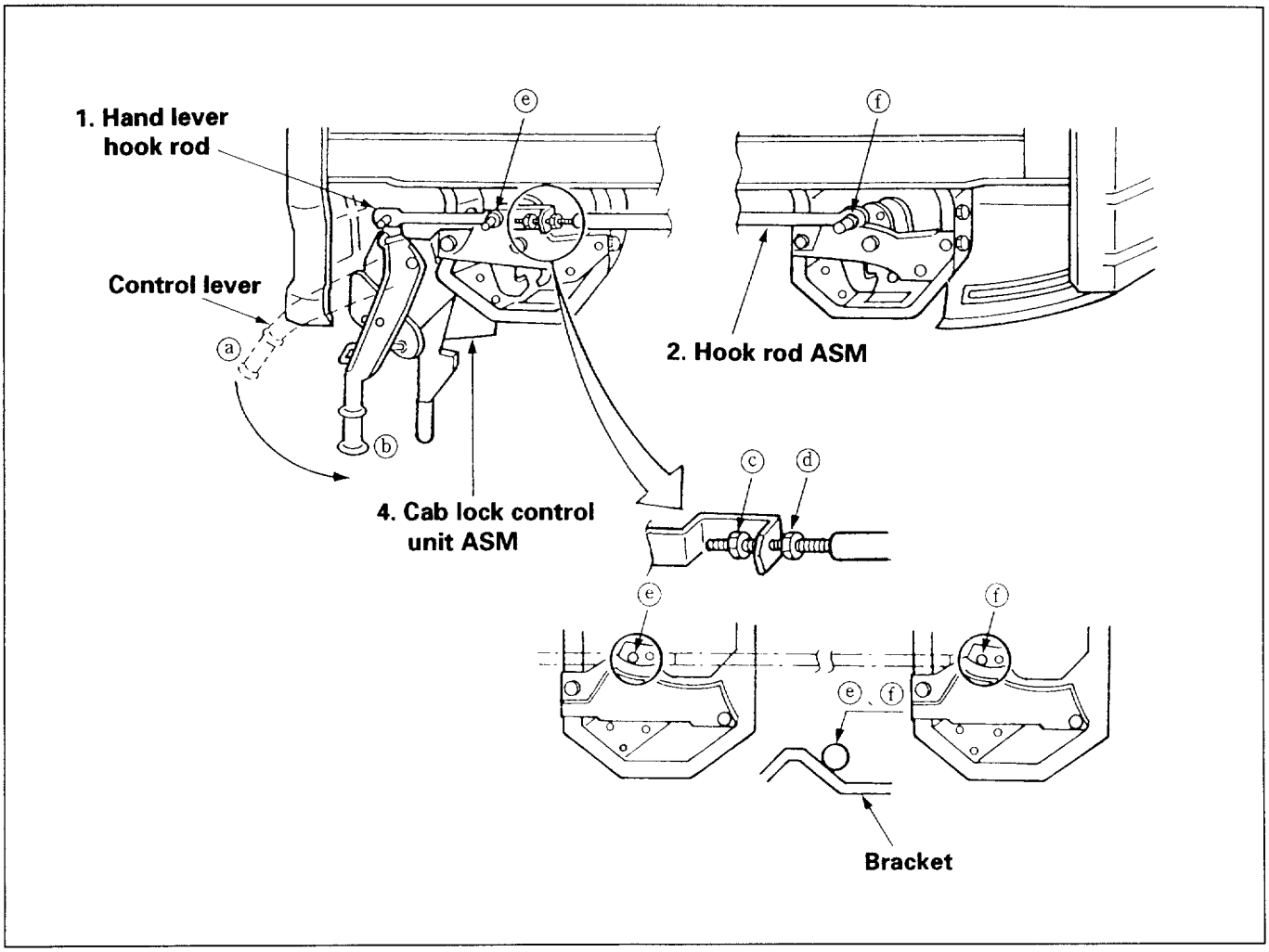


For installation, reverse the removal procedure taking the following points into consideration.

3. **Cab lock ASM**
   - Temporarily tighten the rear mounting ① with the left and right cab lock ASM mounting nuts in the order shown in the figure, tighten ② to ④ to the specified torque, and lastly tighten ① firmly.

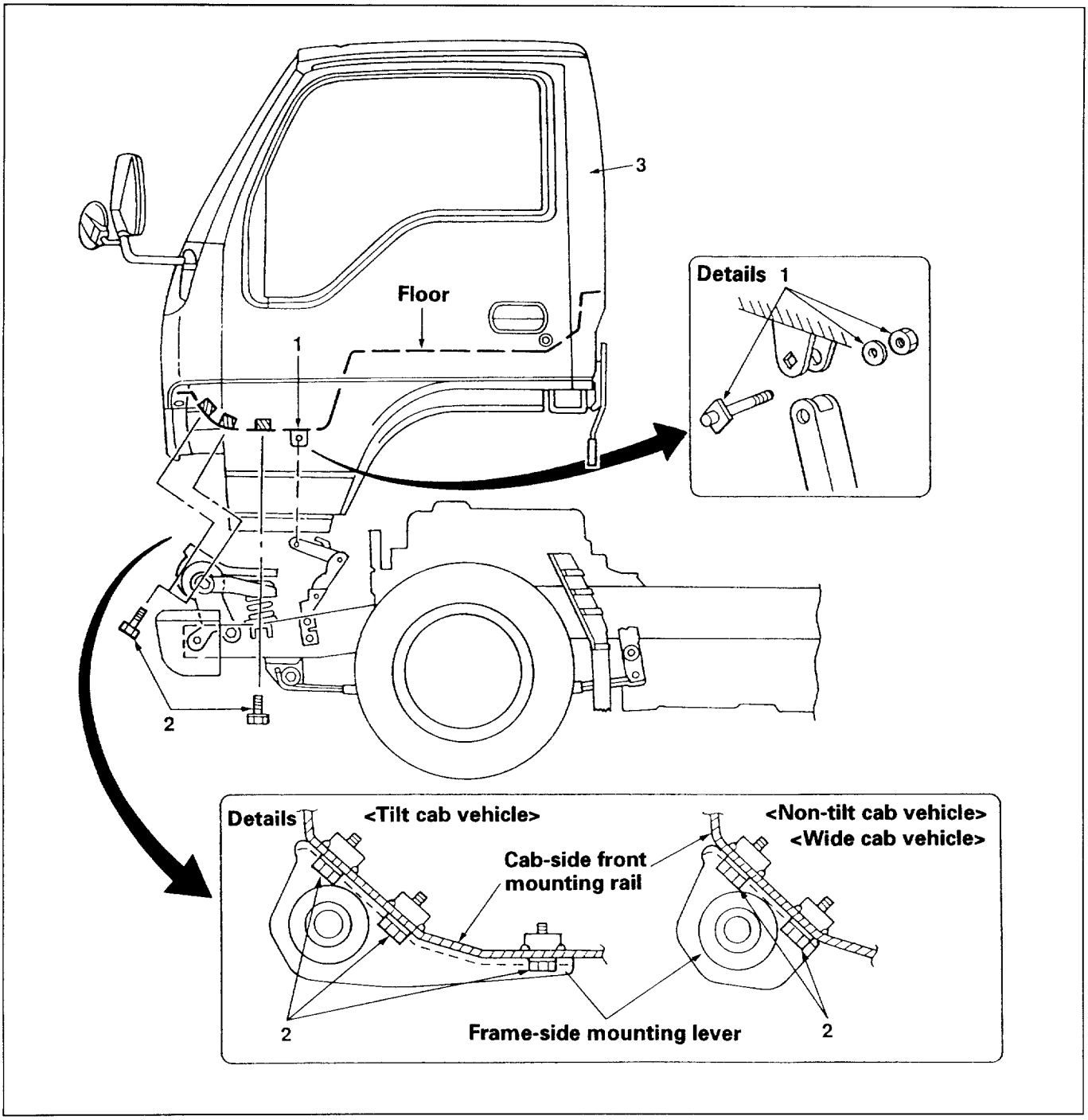
Tightening torque	N•m (kg•m)
	19 (1.9)

2. **Hook rod ASM**



1. **Hand lever hook rod**
   - Install the above two items and adjust them.
   - Change the control lever position from ⓐ to ⓑ and hold the control lever so that ⓔ may touch the bracket. At that time, adjust the lock nuts ⓒ and ⓓ and tighten them to the specified torque so that both ⓔ and ⓕ may touch the bracket.

Removal and Installation of Cab ASM



Removal Steps

1. Cab stay pin and nut (tilt cab vehicle)
2. Cab fixing bolt
3. Cab ASM

Installation Steps

For installation, reverse the removal procedure.

Preparations

- Before removal or installation of the cab ASM, remove the following connections. The removal order is free. However, perform each step surely referring to each workshop manual.

1. **Heater hose/air conditioner piping**
   - Refer to "Heater and Ventilator" in Section 1A and "Air Conditioner" in Section 1B.
2. **Accelerator control cable**
   - Refer to "Fuel System" in Section 6C. Perform the work surely according to the procedure fit for the mounted engine.
3. **Brake fluid piping**
   - Refer to "Hydraulic Brake" in Section 5.
4. **Hydraulic clutch piping**
   - Refer to "Clutch" in Section 7C.
5. **Transmission control cable/linkage**
   - Refer to the Sections ranging from Section 7A1 to Section 7B4.
     Perform the work surely according to the procedure fit for the mounted engine.
6. **Parking brake control cable**
   - Refer to "Parking Brake" in Section 5C.
7. **Steering linkage**
   - Refer to "Steering Linkage" in Section 3B2.
8. **Harness connector/frame earth bolt**
   - Refer to "Electrical Equipment" in Section 8.
9. **PTO control cable**
   - Refer to "Power take-off (PTO)" in Section 11. Perform the work surely according to the procedure fit for Section 11A to Section 11E for each type of PTO.
   - After disconnecting all the above connections, tilt the cab for a tilt cab vehicle or remove the rear mounting connection for a non-tilt vehicle. For removal of the rear mounting, refer to "Cab mounting" in this Section.

Removal

1. **Cab stay pin and nut (tilt cab vehicle)**
2. **Cab mounting bolt**
3. **Cab ASM**

Installation

For installation, reverse the removal procedure taking the following point into consideration.

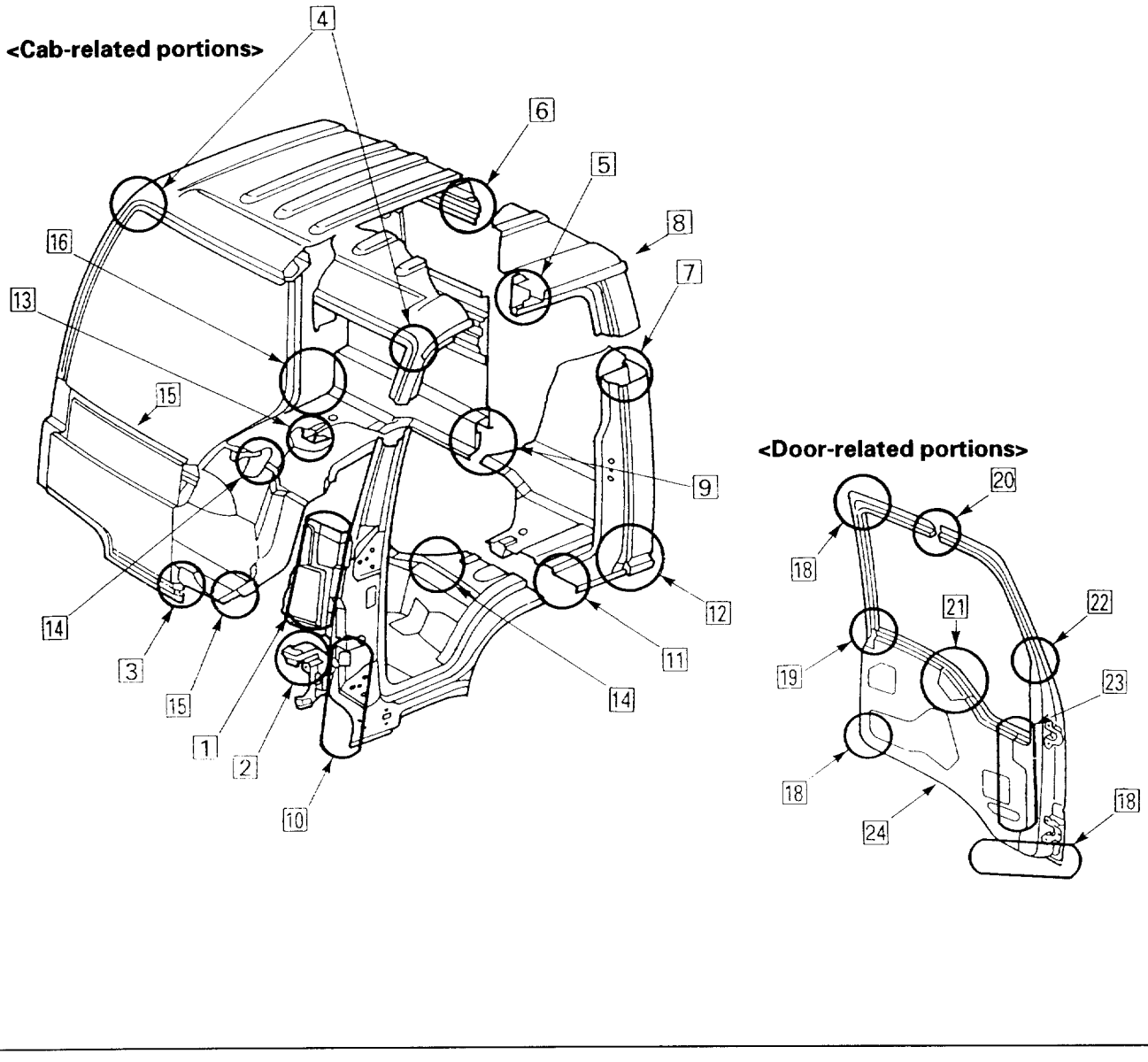
- Tighten the cab mounting bolt to the specified torque.

Tightening torque	N•m (kg•m)
82 (8.4)	

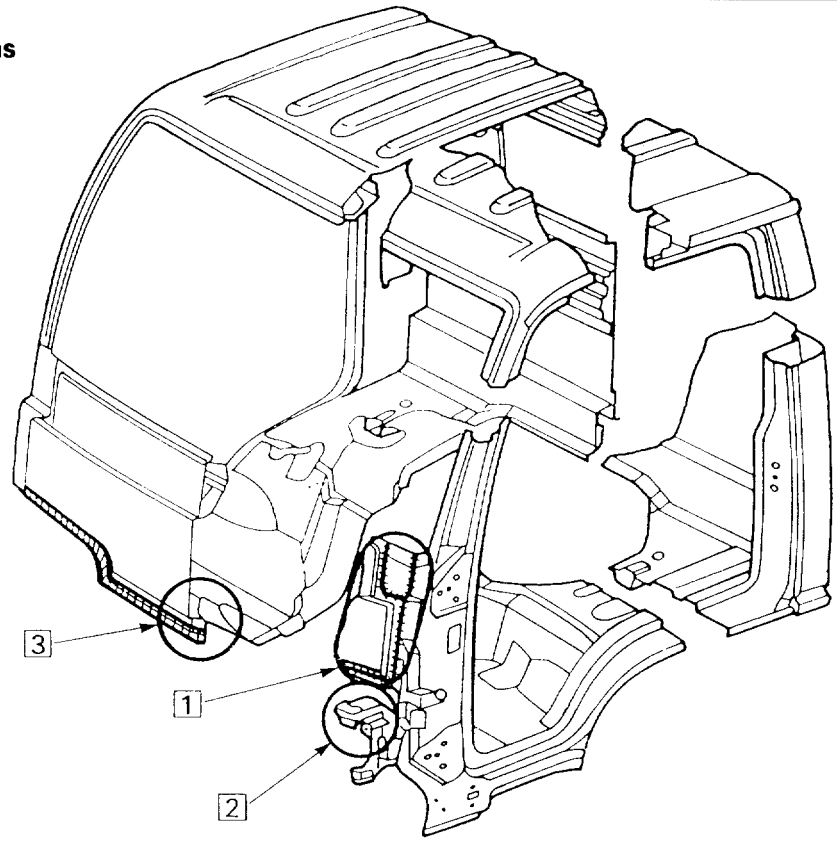
BODY PANEL SEALING

This paragraph describes body panel sealing. The sealing procedure described in this text should be performed as follows.

Purpose	①	Anti-rust	②	Air/water tightness	③	Sound insulation
External finish	Ⓐ	Specially important	Ⓑ	Important	Ⓒ	Common
Sealing range						
Vehicle model	N	Narrow cab	W	Wide cab		

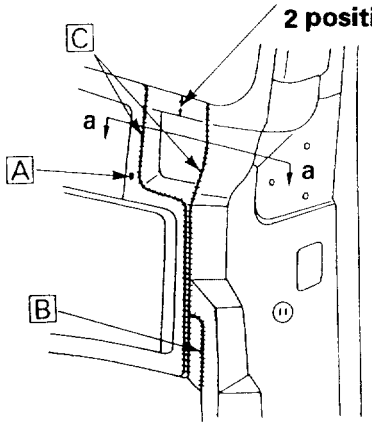


Front-related portions

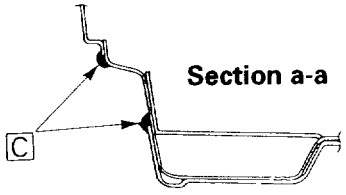


1

Glass adhesion surface smoothing
2 positions x R/L

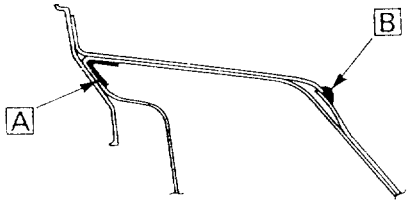


Section a-a



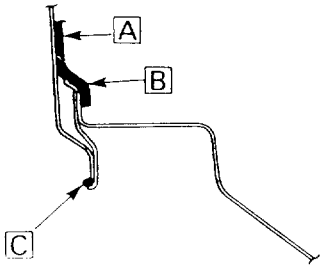
A: **Center front panel location hole ø12 (l = 38) x 2**
B: **Hinge lower reinforcement + side panel junction l = 75 x 2**
C: **Center front panel + hinge reinforcement junction**
Side panel + hinge reinforcement junction
l = 800 x 2 ①,②-Ⓒ
※ The indicated portion should be smoothed.

2



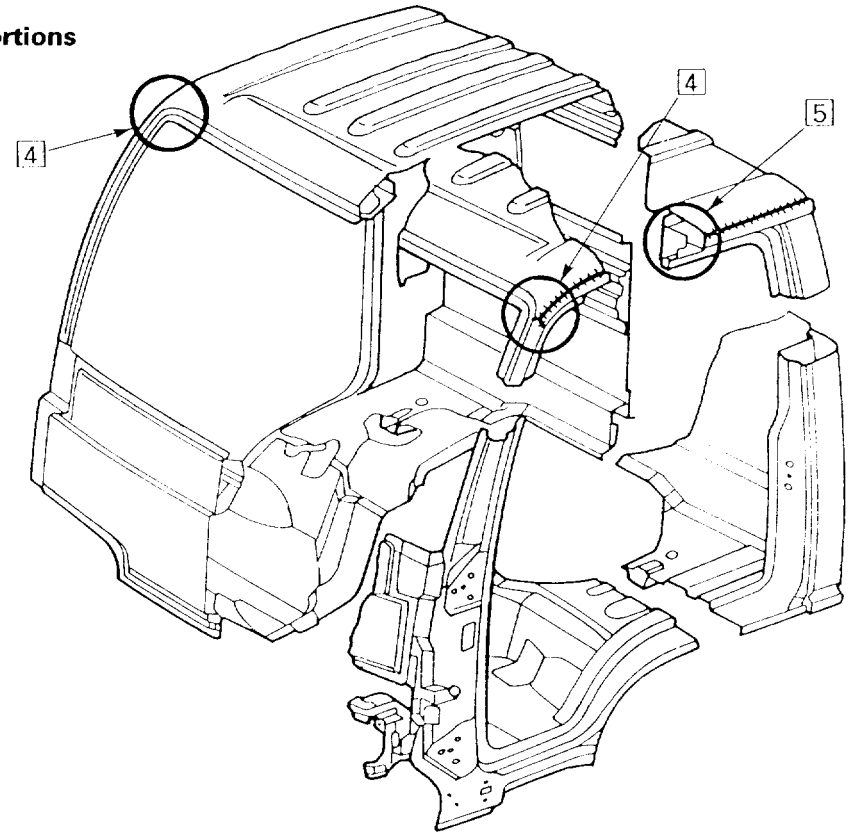
A: **Head lamp bracket Sheet metal sealant ③-Ⓑ**
B: **Sealing for the above ③-Ⓑ**

3

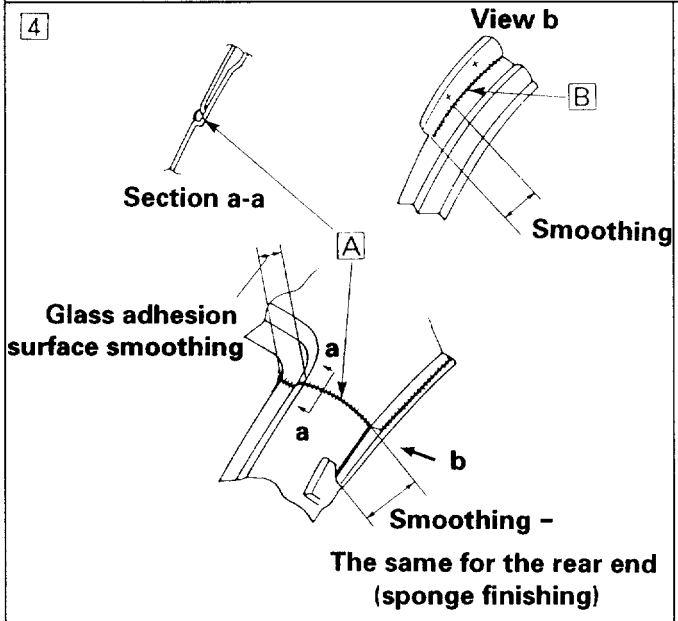


A: **Center floor panel to front mounting rail Extension + front floor panel melting sheet sticking**
B: **Front mounting extension + front mounting rail junction Sealing ②-Ⓒ**
C: **Center front panel + front mounting extension junction Sealing ①,②-Ⓒ**

Roof-related portions



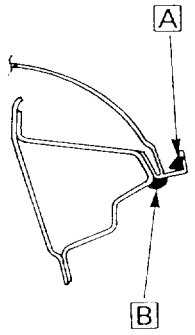
4



A: Side panel + roof panel + side drip junction
l = 120 x 2 ①-Ⓐ
※Perform finishing without any corrugation or curvature.
The indicated portion should be smoothed.

B: Side panel + side drip junction
①,②-Ⓐ
l = 1040 x 2
※The indicated portion should be smoothed.

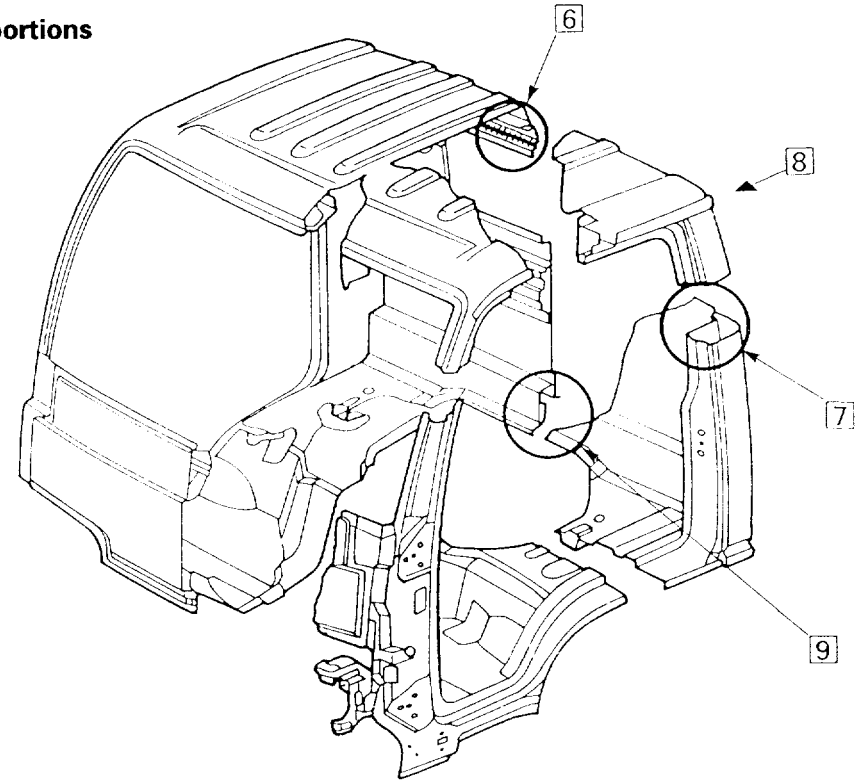
5



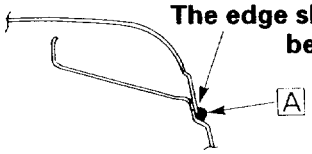
A: Roof panel + side drip junction
①,②-Ⓒ
l = 1000 x 2
※No break should be found on sealing.

B: Refer to 4-B

Back panel-related portions

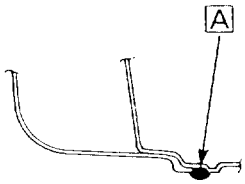


6



A: Roof panel + back panel junction
Narrow cab l = 1300 ①,②-Ⓐ
Wide cab l = 1720

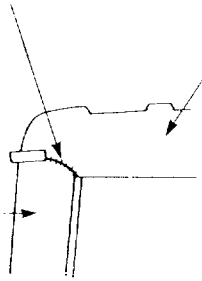
7



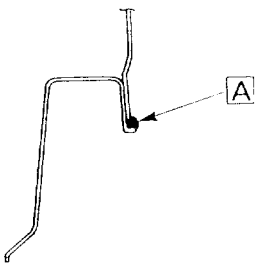
A: Side panel + back panel junction
①,②-Ⓐ
l = 845 x 2
※Uniformity is required without any corrugation.

8

The junction between the roof panel and side panel should not have any exposed edge.

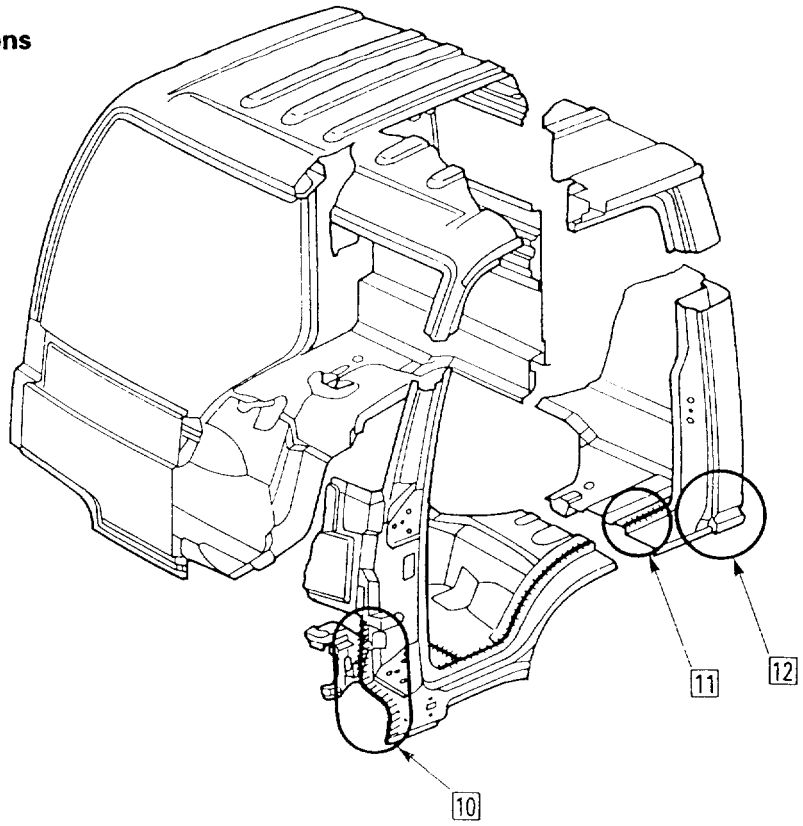


9

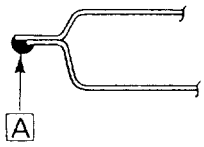


A: Back panel + rear mounting rail junction
Narrow cab l = 1320
Wide cab l = 1700
※Uniformity should be required without any corrugation.

Side panel-related portions

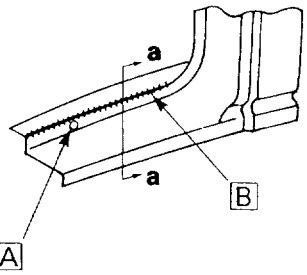


10

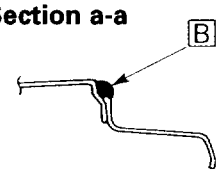


A: Side panel + hinge lower reinforcement junction
l = 300 x 2 ②-Ⓒ

11

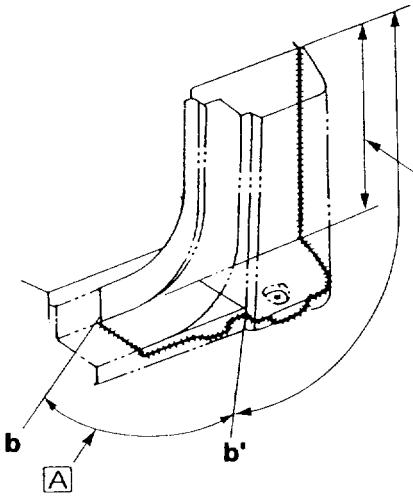


Section a-a



A: Side panel location hole periphery
ø8 (l = 25) x 2 ①-Ⓒ
※Don't block up the hole.
B: Side panel + floor panel junction
l = 1000 x 2 ②-Ⓒ

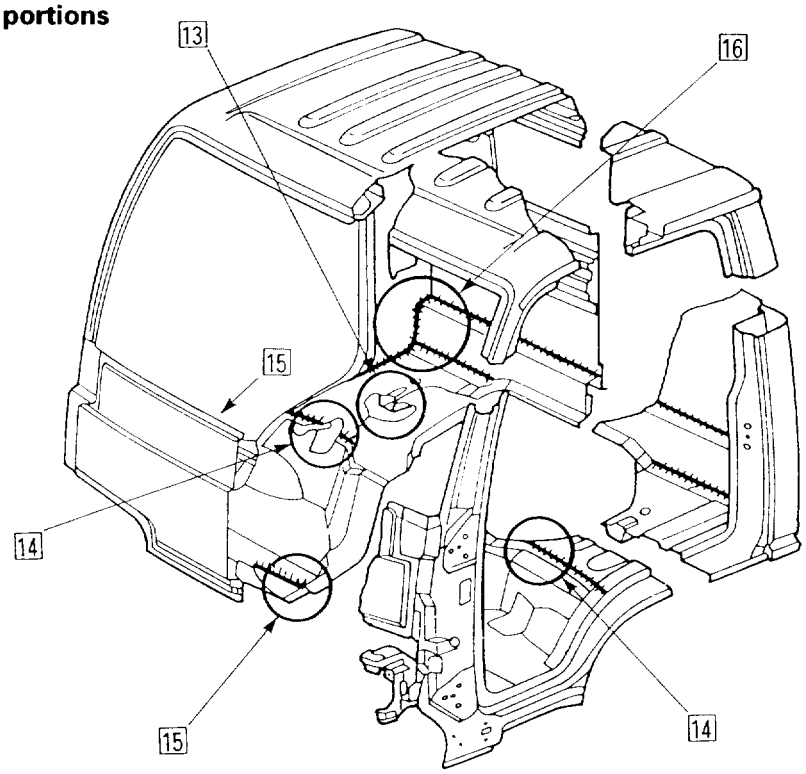
12



A: Side panel + rear pillar lower closing junction
l = 280 x 2 ①,②,③-Ⓒ
※Completely fill up the clearance between b and b'.

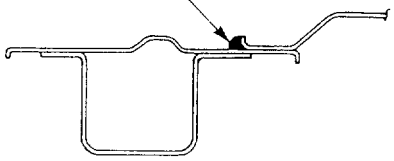
This section should not have any exposed edge.

Floor panel-related portions



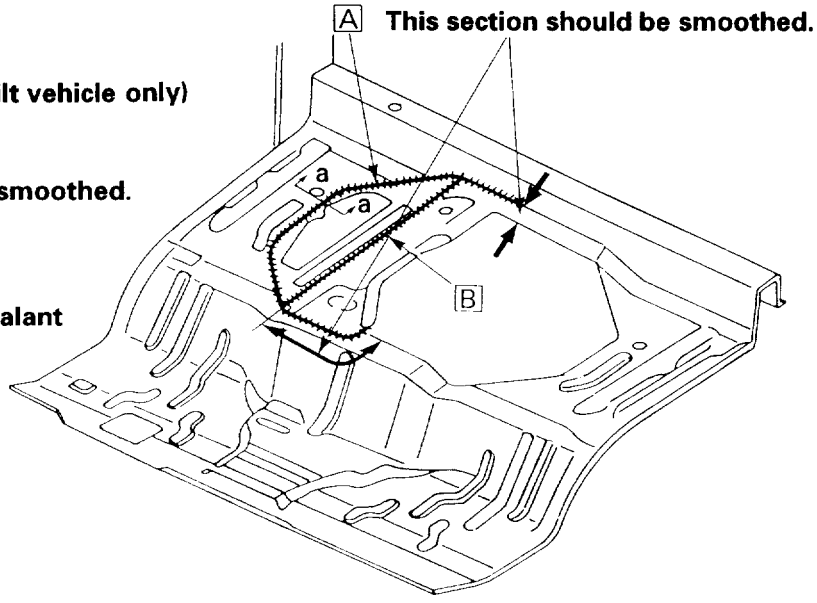
13

Section a-a A



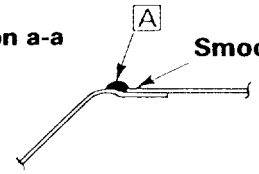
A: **Support cover + floor panel + rear mounting rail junction periphery (tilt vehicle only)**
Narrow cab l = 1580 ②-Ⓒ
Wide cab l = 1760
※The indicated portion should be smoothed.

B: **Support cover + engine lever reinforcement junction**
l = 720 ②-Ⓒ
※Perform finishing without any sealant break or clearance.



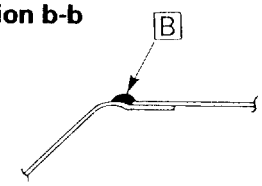
14

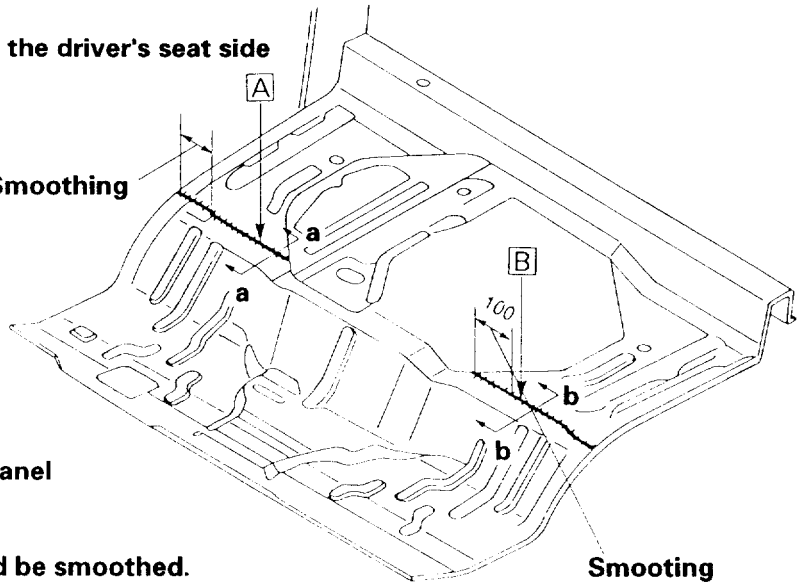
Section a-a



Smoothing for the driver's seat side

Section b-b

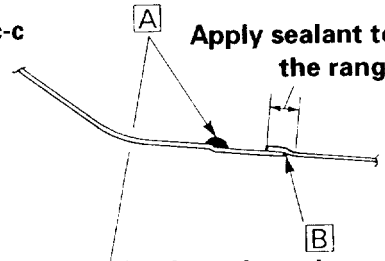




A, B: Front floor panel + rear floor panel junction
l = 400
※The indicated portion should be smoothed.

15

Section c-c

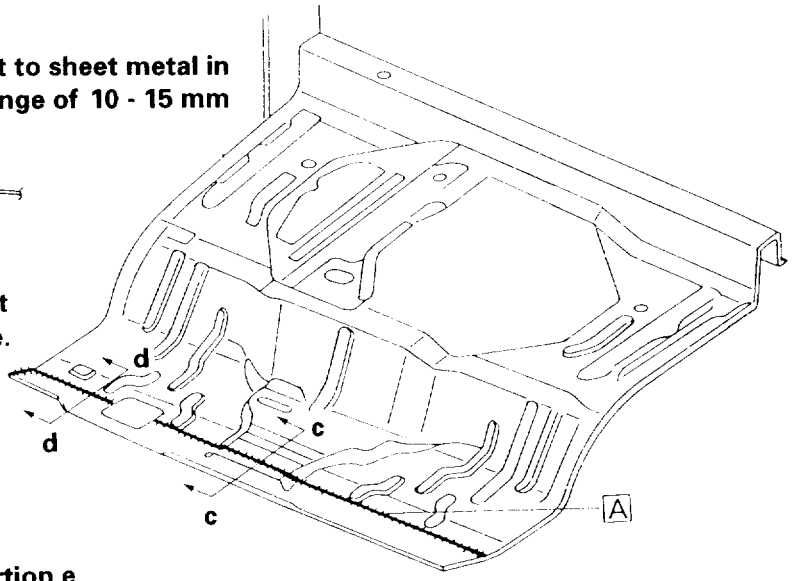


Apply sealant to sheet metal in the range of 10 - 15 mm

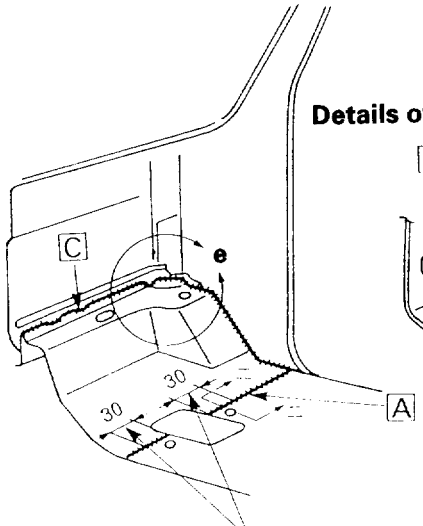
Section d-d

Don't apply sealant around the hole.

Round hole

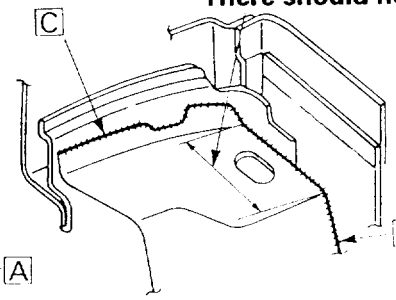


Details of portion e



Perform brushing in the width of 30 mm without touching the grommet hole.

There should not be any swell around the hole.



A: Front mounting rail + front floor panel junction
Narrow cab l = 1330
Wide cab l = 1620 ②-Ⓒ
※The indicated portion should be smoothed.

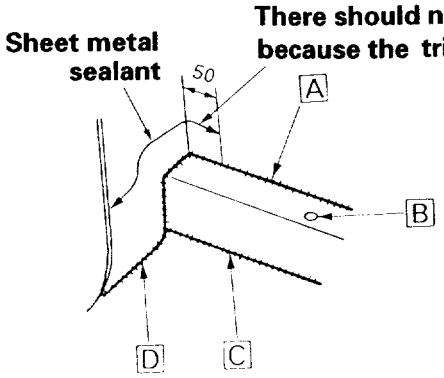
B: Front floor panel end
Apply sheet metal sealant.
10 - 15 mm

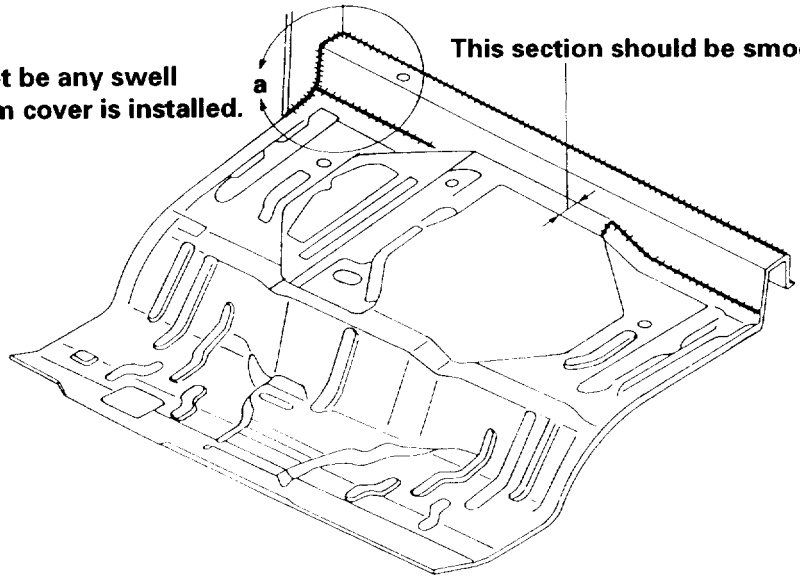
C: Front mounting rail + front mounting rail extension junction
Narrow cab l = 1450
Wide cab l = 1750 ②-Ⓒ

D: Front pillar lower closing + front mounting + front floor panel junction
l = 370 x 2 ②-Ⓒ
※Apply sheet metal sealant without touching the grommet hole.

16

Details of portion a





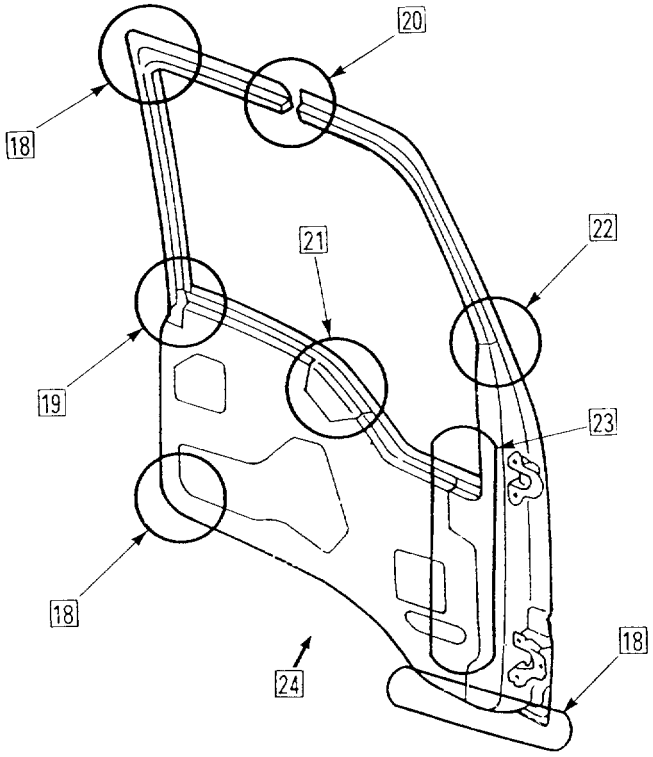
A: Rear mounting rail + back panel junction
Narrow cab l = 1320 ①,②-Ⓒ
※The indicated portion should be smoothed.
Perform finishing without any clearance
between both ends.

B: Rear mounting rail location hole
ø20 (l = 63) x 2 ②-Ⓒ

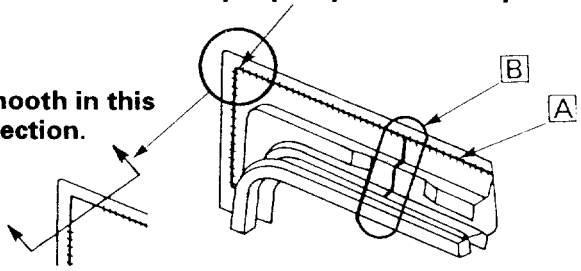
C: Rear floor panel + rear mounting rail junction
l = 460 x 2 ②-Ⓒ
※The indicated portion should be smoothed,

D: Rear pillar lower closing + rear floor panel + rear mounting rail junction
l = 590 x 2 ②-Ⓒ
※Sheet metal sealant

Door-related portions

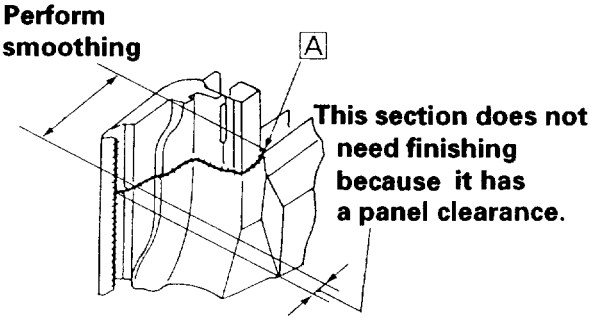


18

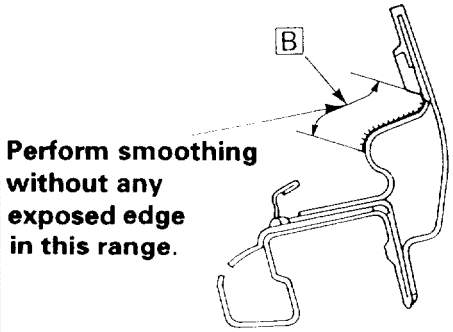


A: Door outer panel + door inner panel junction
l = 4970 x 2 ①,②-Ⓐ
※The indicated portion should be smoothed.

19

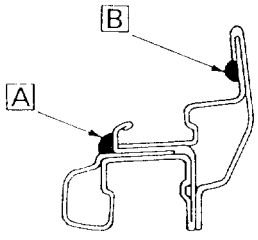


A: Door outer panel + door sash junction
l = 120 x 2 ①,②-Ⓐ
※Be careful about finishing.



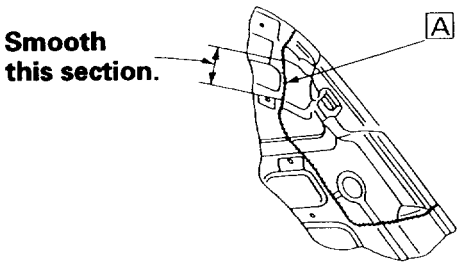
B: Door sash rear + door sash front junction
①-Ⓐ
※The indicated portion should be smoothed.

20



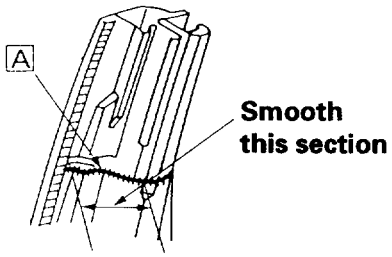
A: Door sash junction
①-Ⓒ
B: Refer to 18-A

21



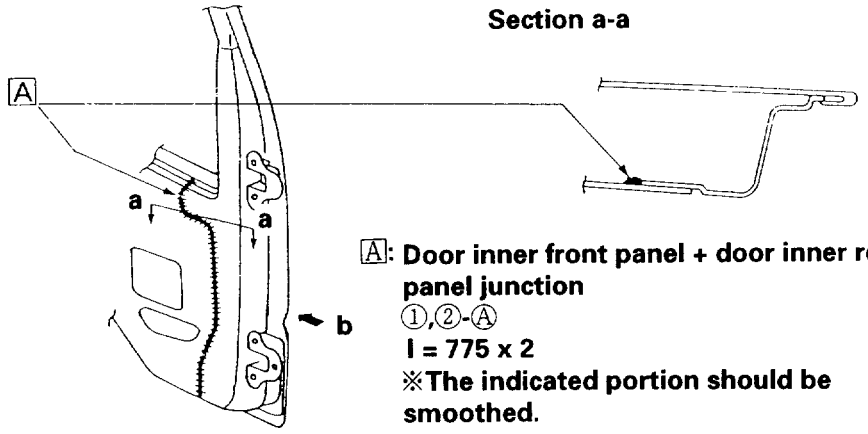
A: Door inner panel + door pull handle reinforcement junction
l = 400 x 2 ②-Ⓒ
※The indicated portion should be smoothed.

22

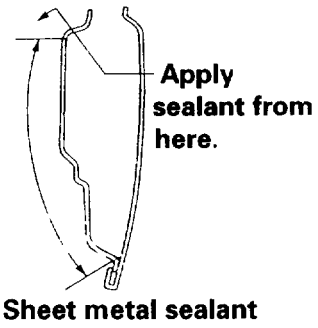


A: Door inner panel + door frame ASM junction
①,②-Ⓐ
※The indicated portion should be smoothed.

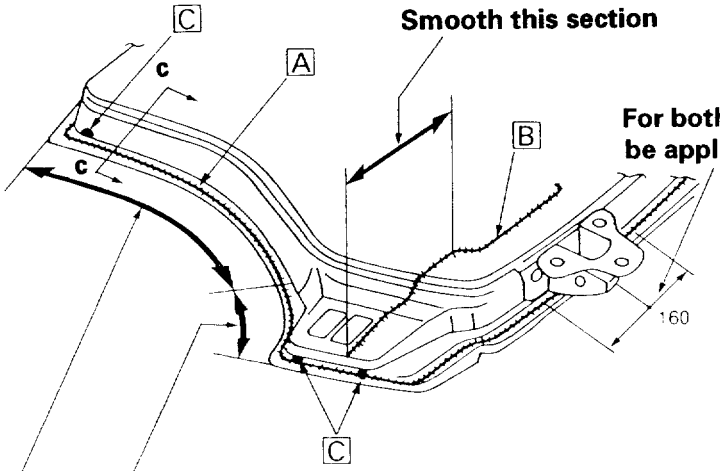
23



A: Door inner front panel + door inner rear panel junction
①,②-Ⓐ
l = 775 x 2
※The indicated portion should be smoothed.

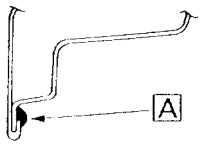


24



For both upper and lower parts, no sealant may be applied to the up/down side of the hinge.

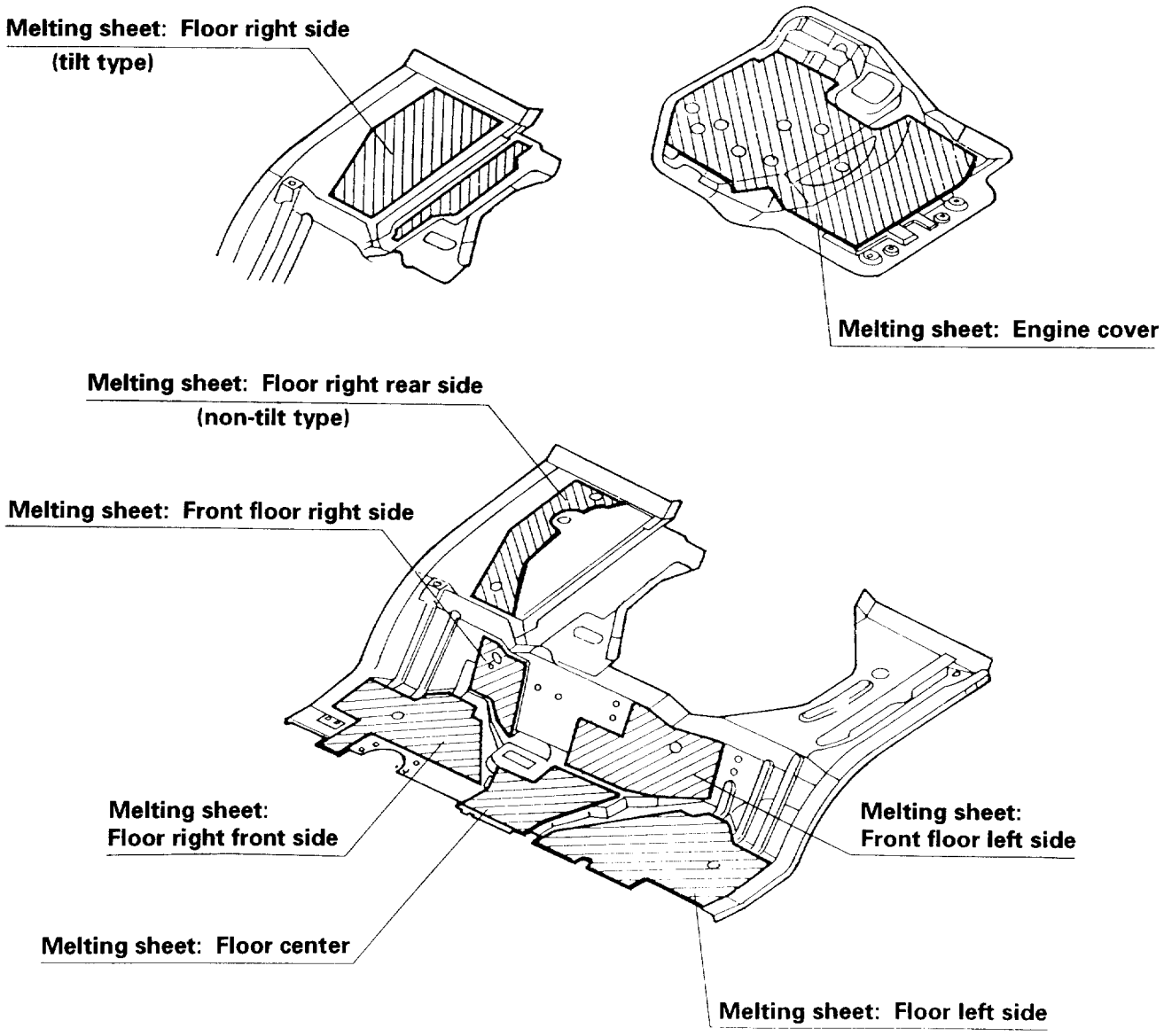
Section c-c



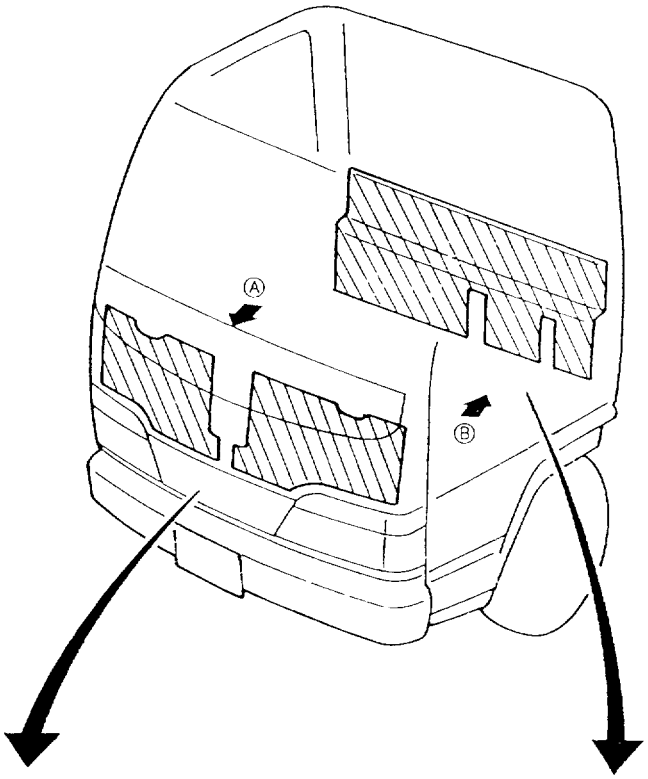
Brush this section evenly.
This section should be finished without any exposed edge.
The height should be limited to 2 mm or less.

A: Refer to 18-A.
B: Refer to 23-A.
C: Door outer panel + door inner panel junction drain hole
l = 30 x 3 positions x 2

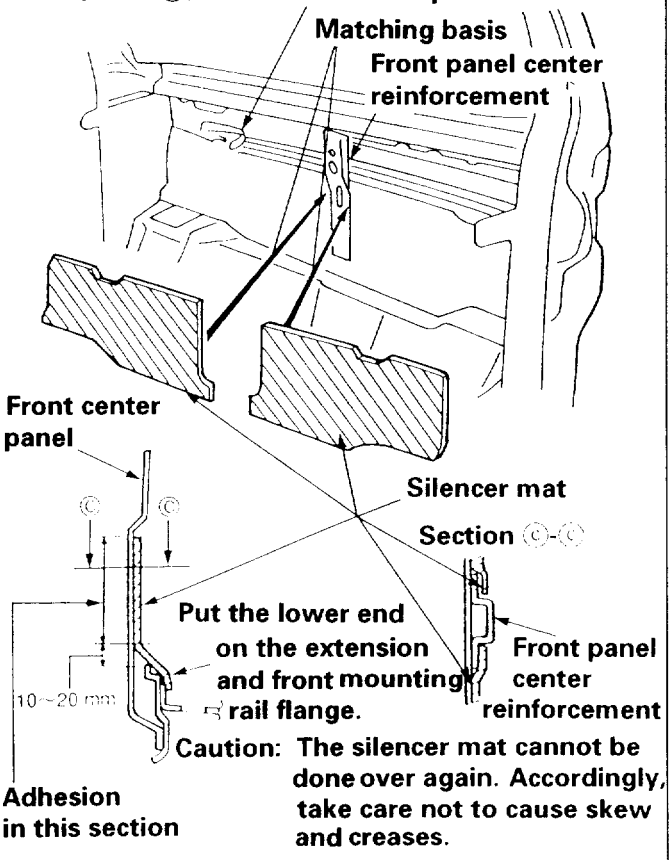
Melting Sheet Sticking Positions



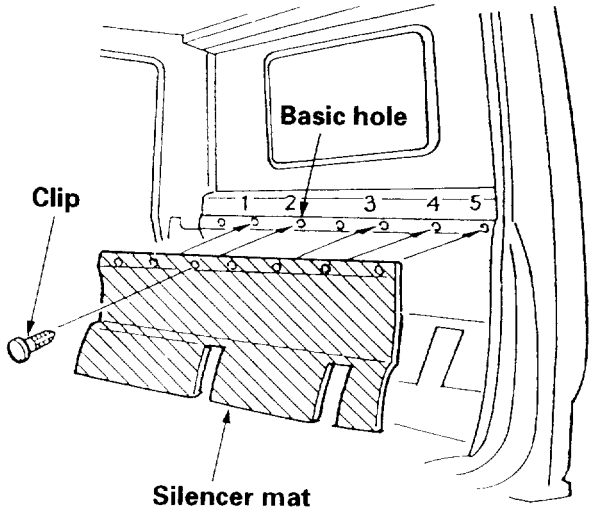
Silencer Mat Setting Positions



Front (View Ⓐ)

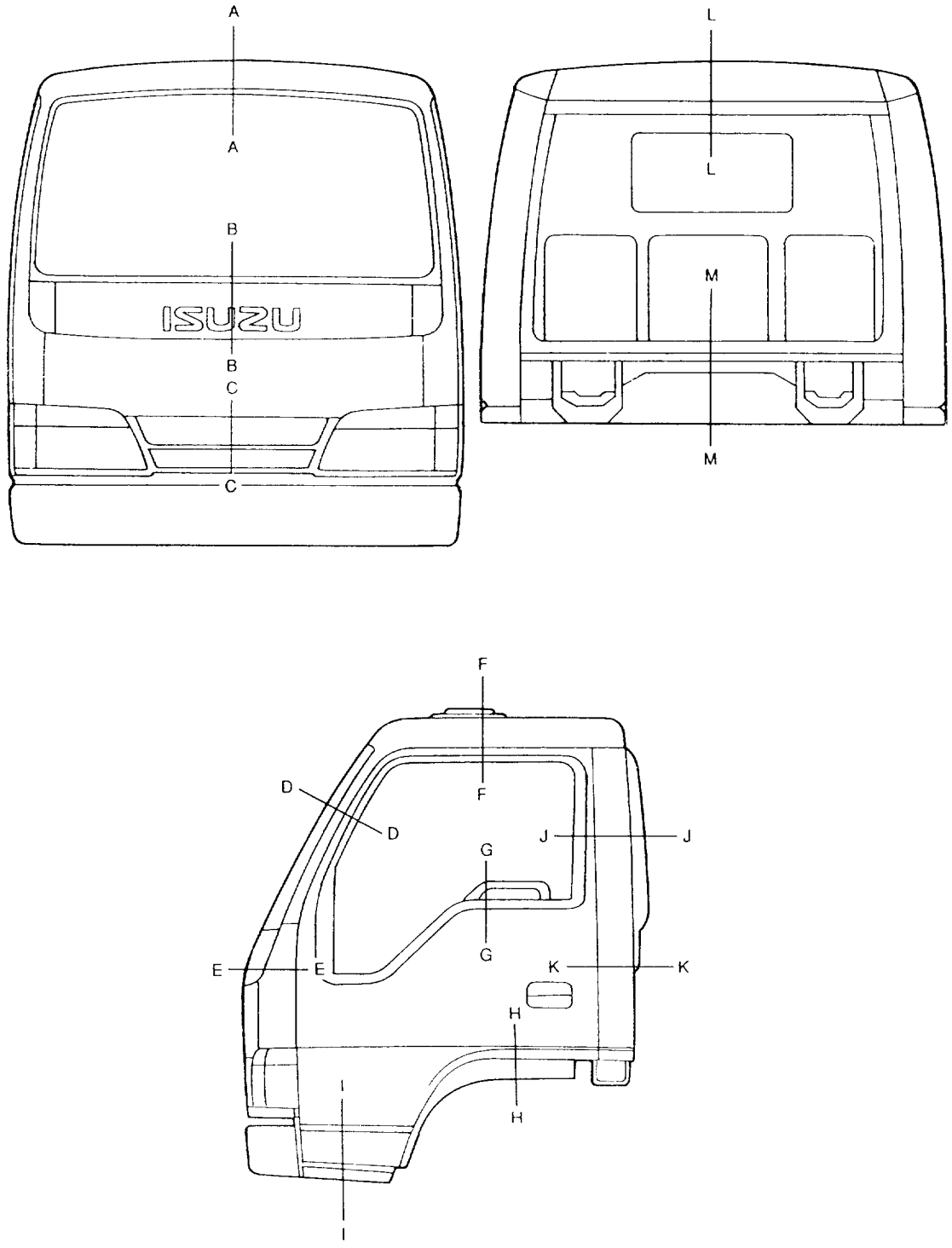


Rear (View Ⓑ)

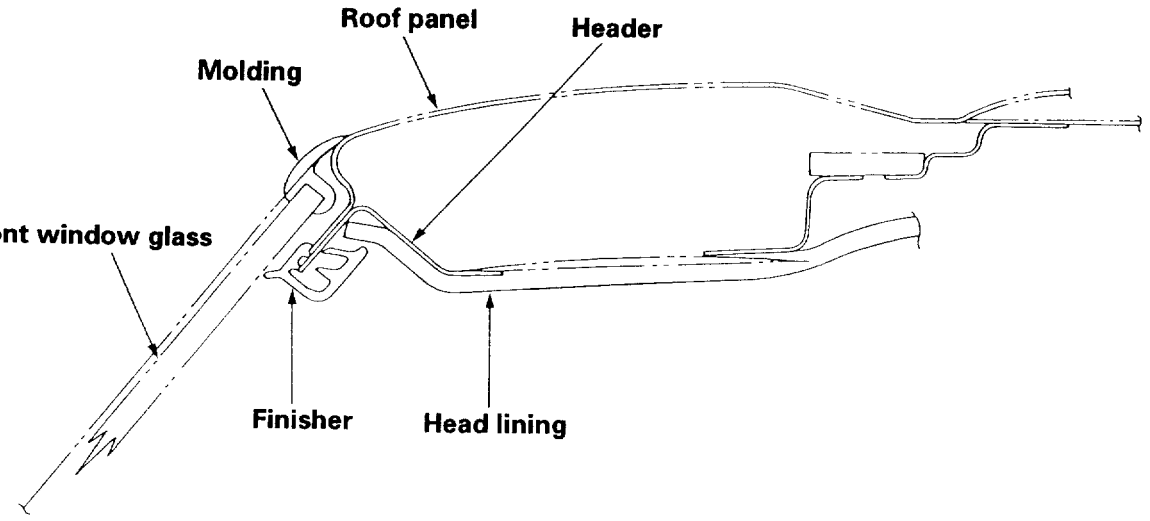


Insert clips into two basic holes and fix the remaining 4 positions with clips.

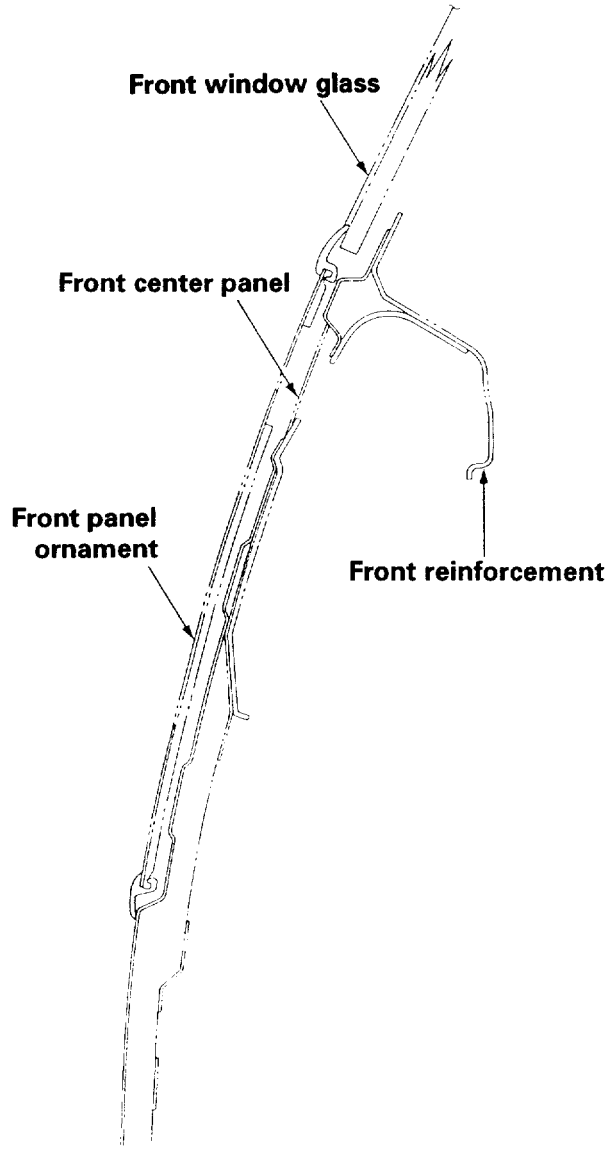
Body Panel Sectional Shapes



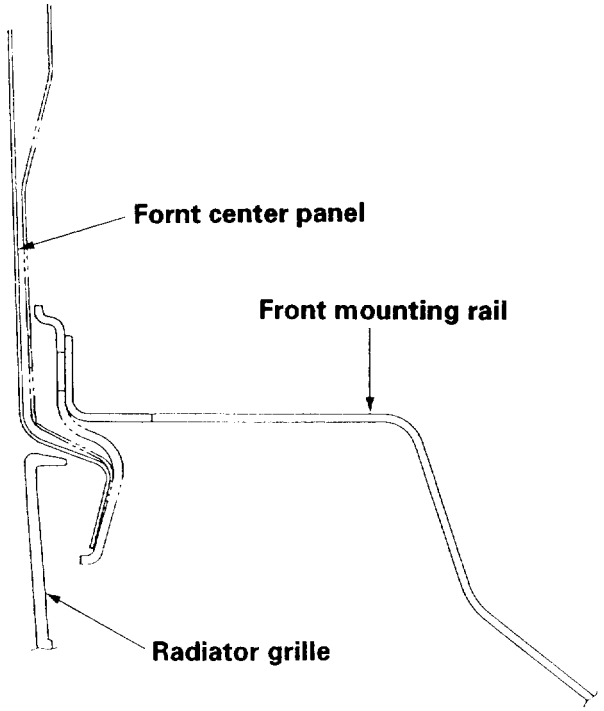
Section A-A



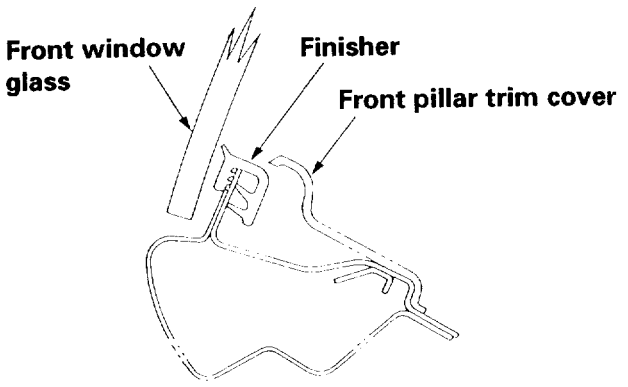
Section B-B



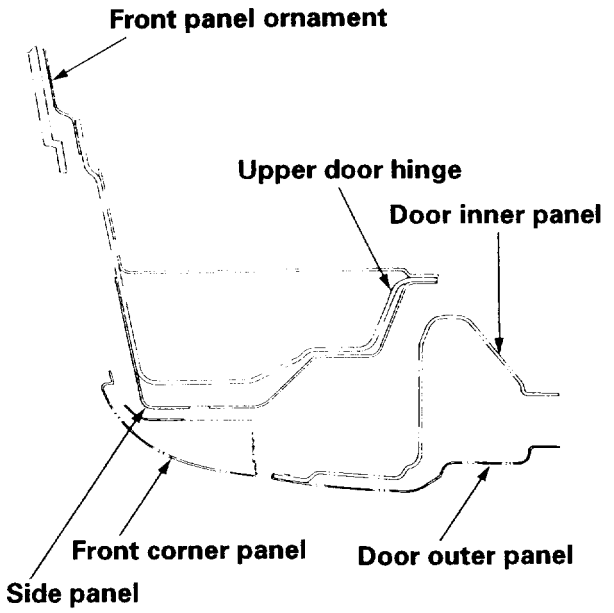
Section C-C



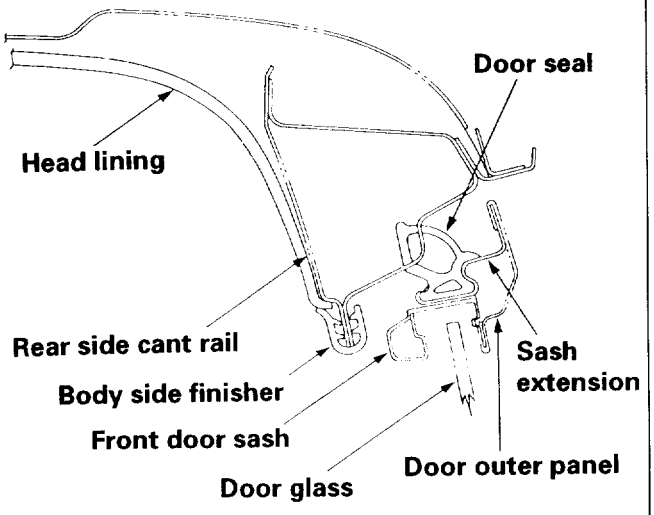
Section D-D



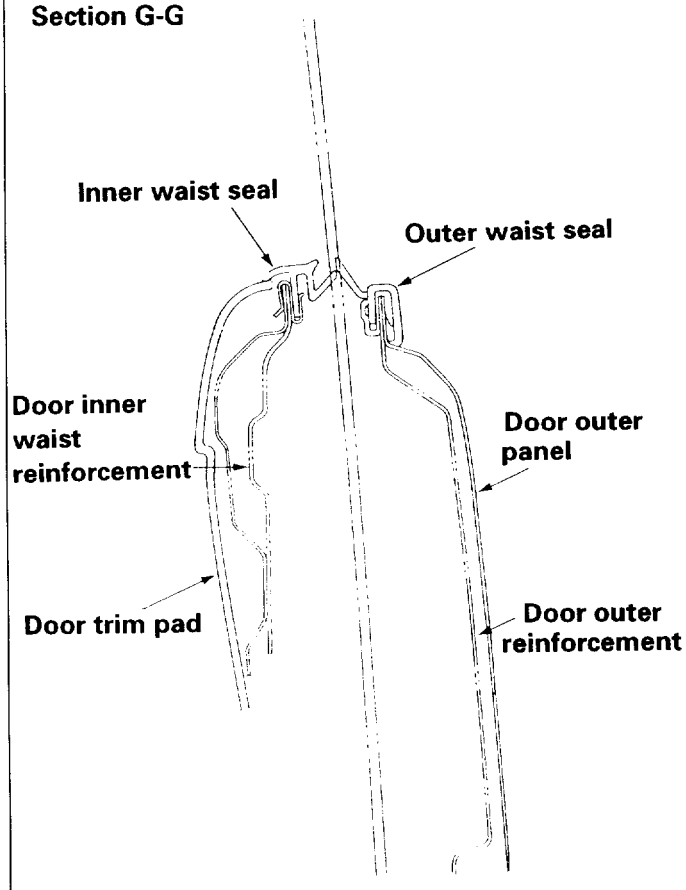
Section E-E



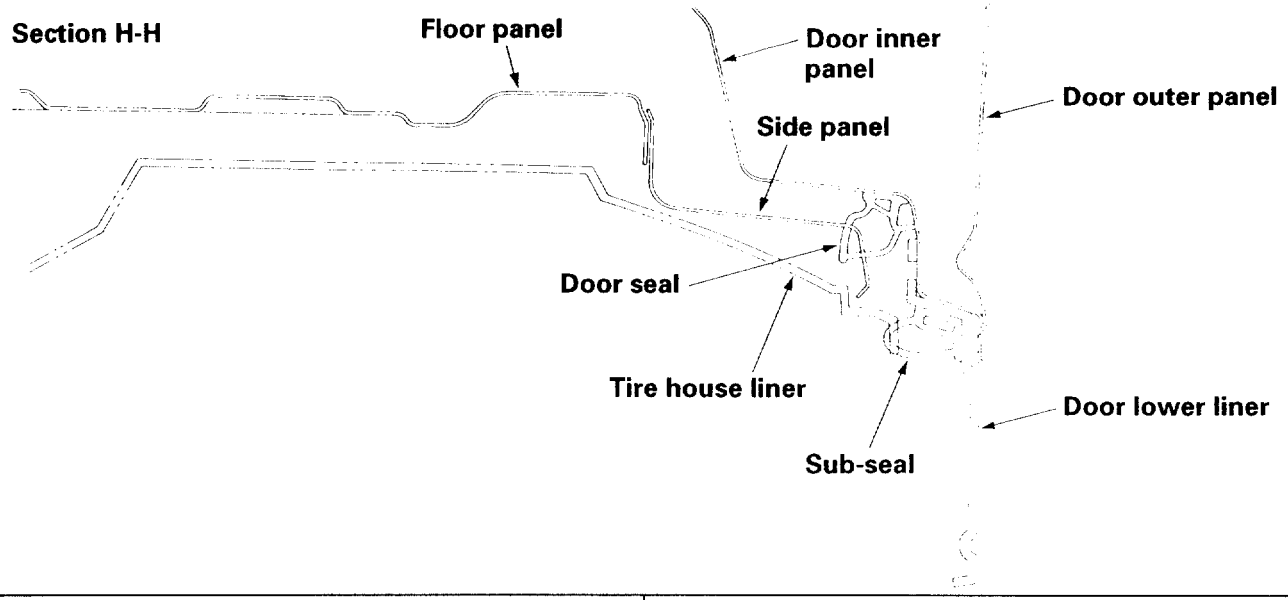
Section F-F



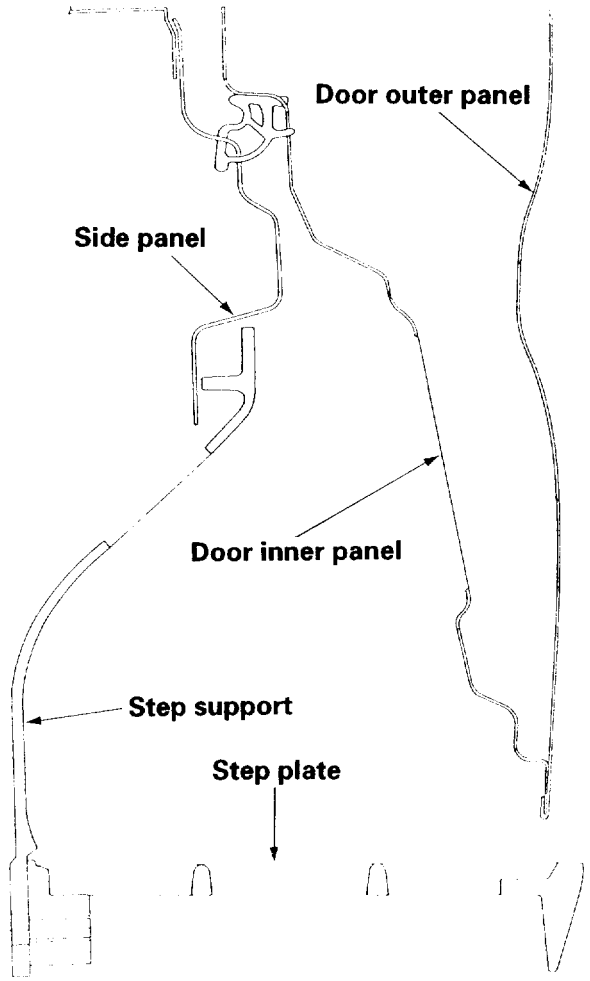
Section G-G



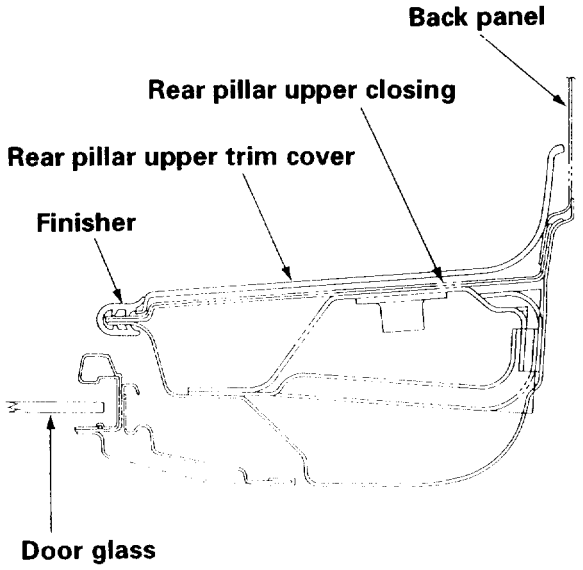
Section H-H

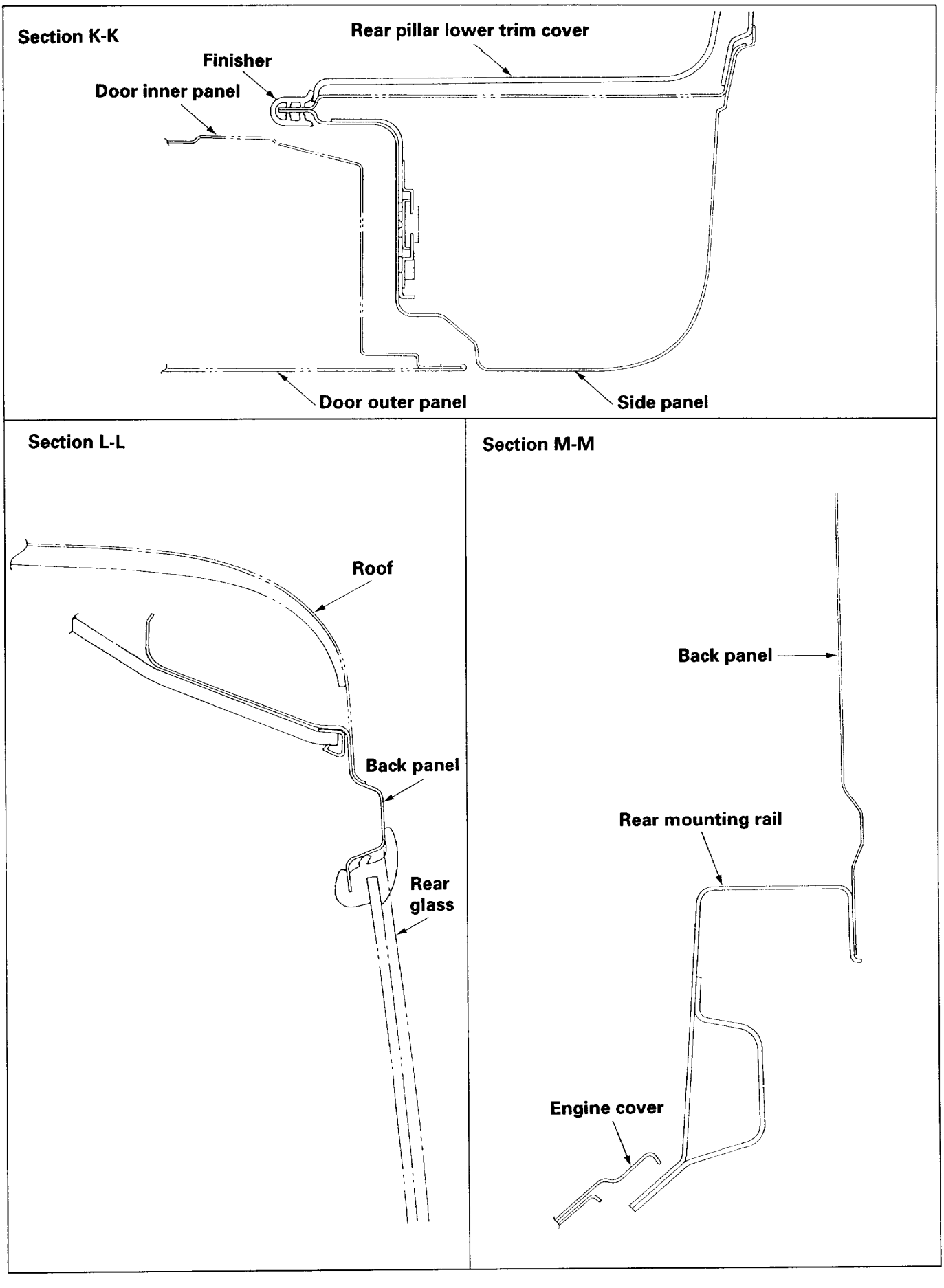


Section I-I



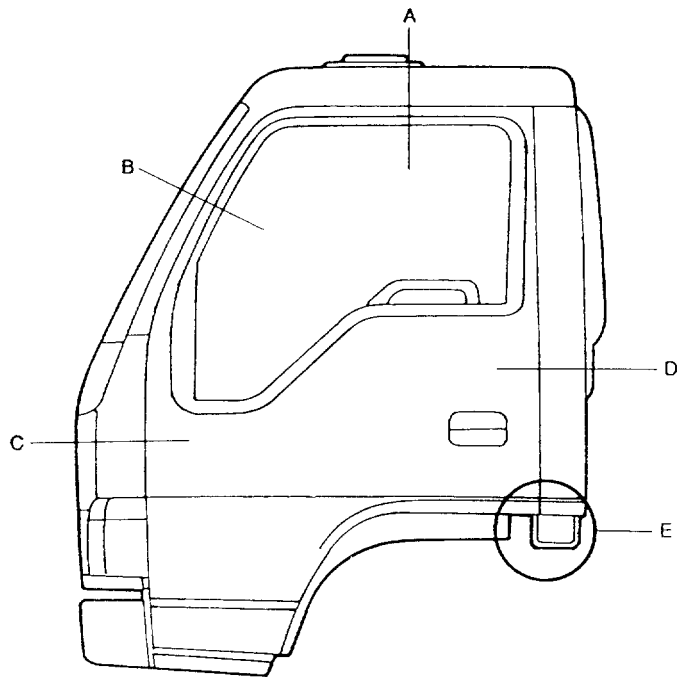
Section J-J



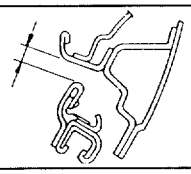
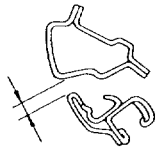
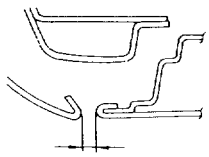
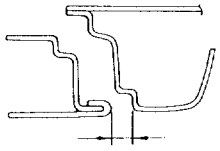
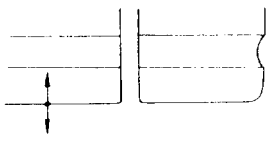

Section K-K
Rear pillar lower trim cover
Finisher
Door inner panel
Door outer panel
Side panel
Section L-L
Roof
Back panel
Rear glass
Section M-M
Back panel
Rear mounting rail
Engine cover

BODY SIZES

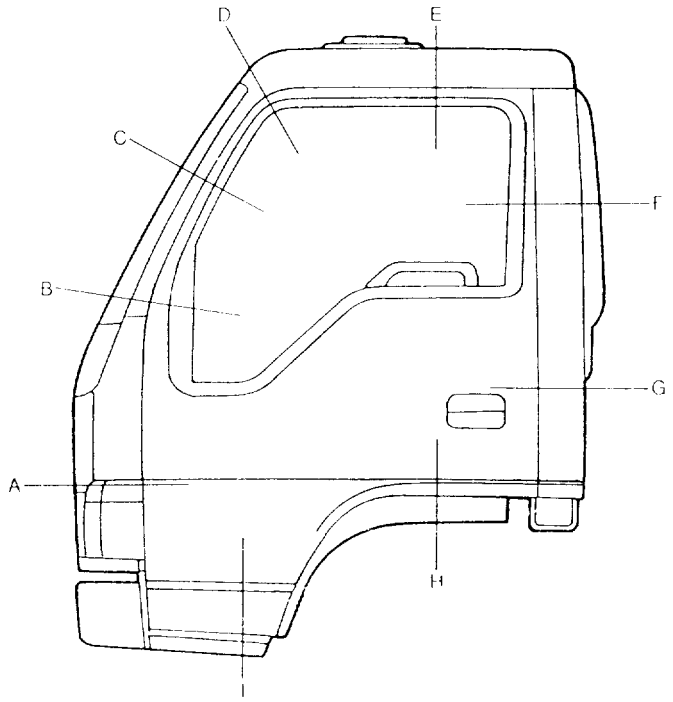
Door Opening CLearance/Level Difference



(m/m)

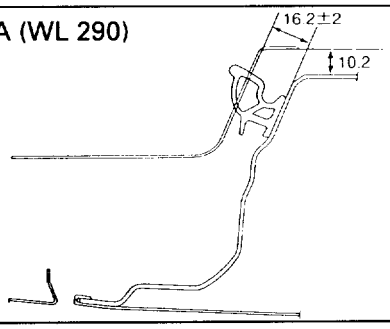
Portion		Clearance	Level difference	Parallelism (difference in clearance)
A		6.7 ± 2.0	—	2.0
B		5.7 ±1.5	± 1.5	2.0
C		5.7 ± 1.5	± 2.0	2.0
D		4.0 ± 1.5	± 1.5	2.0
E		—	± 1.5	—

Door-to-Seal Size Accuracy

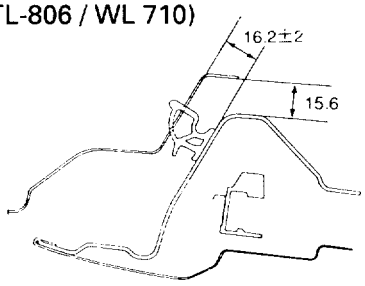


(m/m)

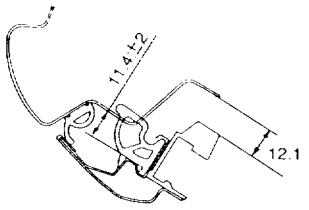
A (WL 290)



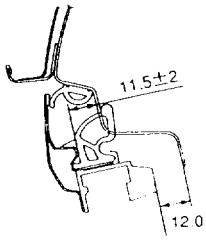
B (TL-806 / WL 710)



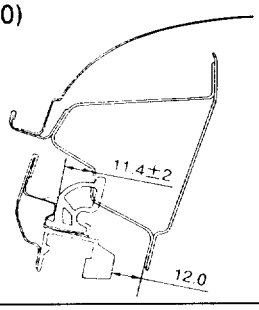
C (TL-693 / WL 1020)



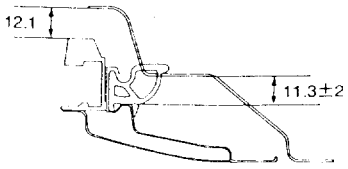
D (TL-1500 / WL 1291)



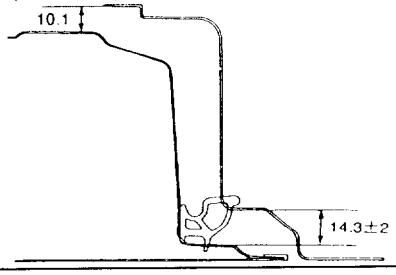
E (TL-70)



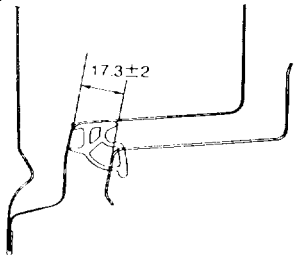
F (WL 1030)



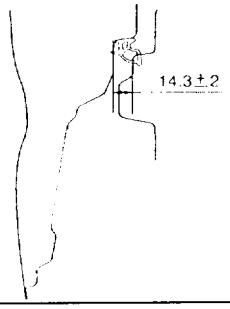
G (WL 526)



H (TL 0)

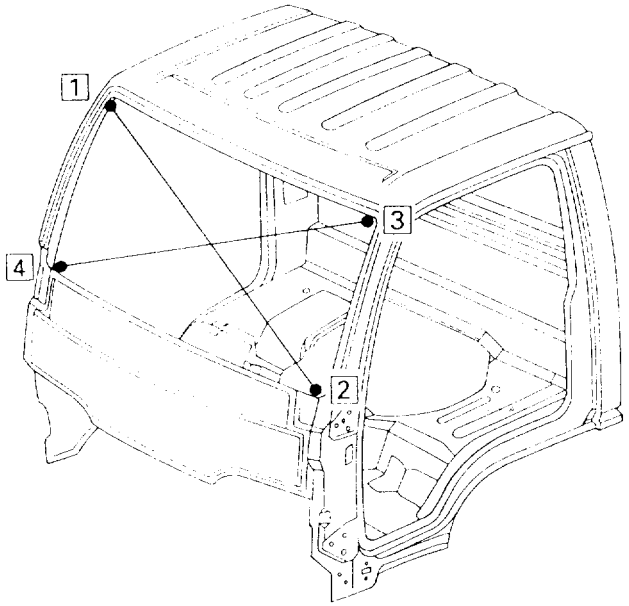


I (TL-490)



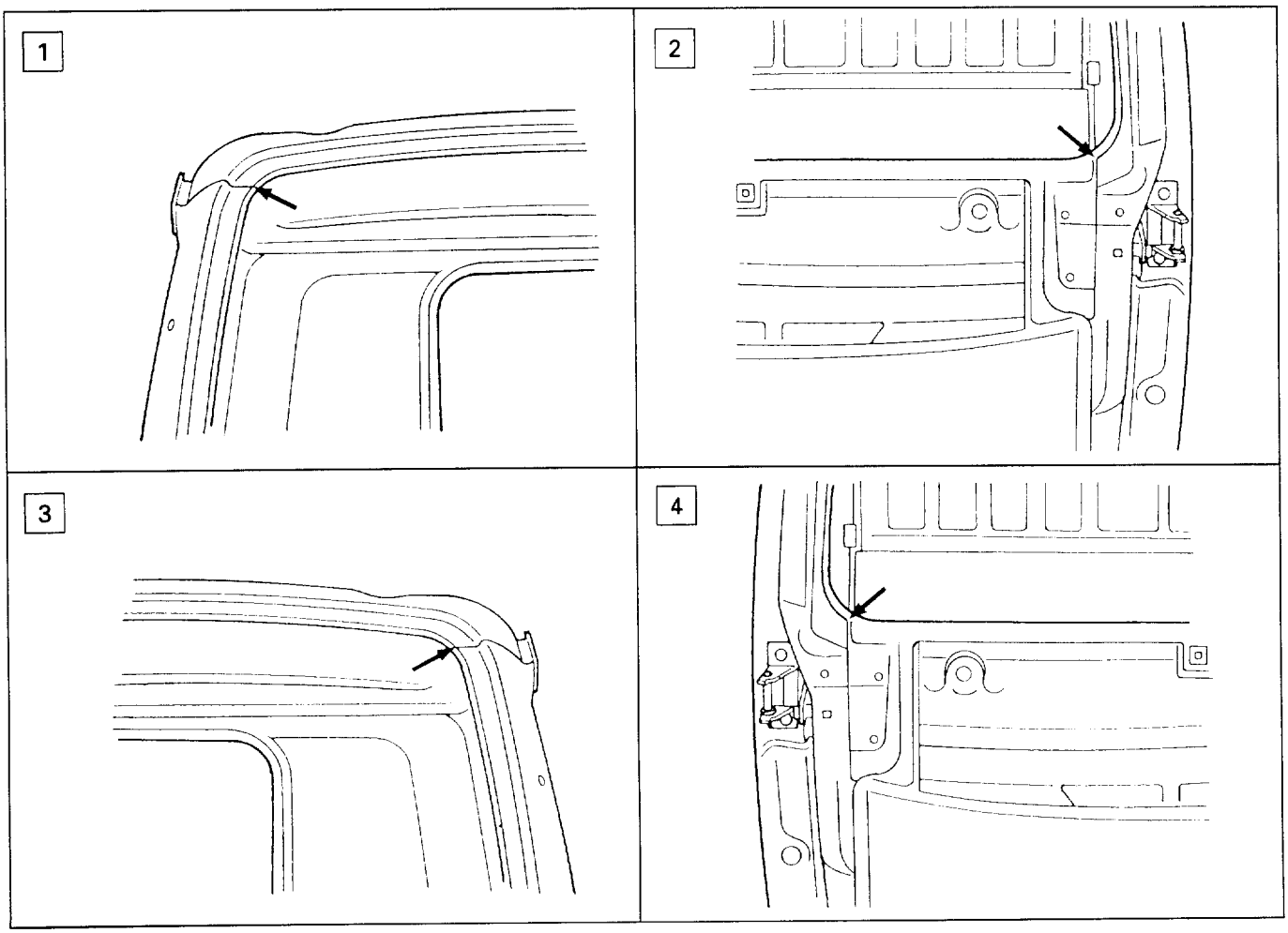
Front Window Frontage Sizes

(m/m)



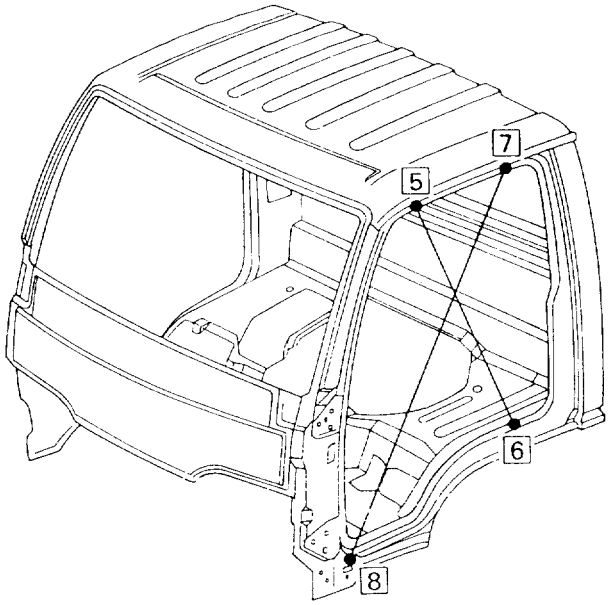
	1 ~ 2	3 ~ 4
Narrow cab	1553.03	1553.03
Wide cab	1830.37	1830.37

Details of each portion



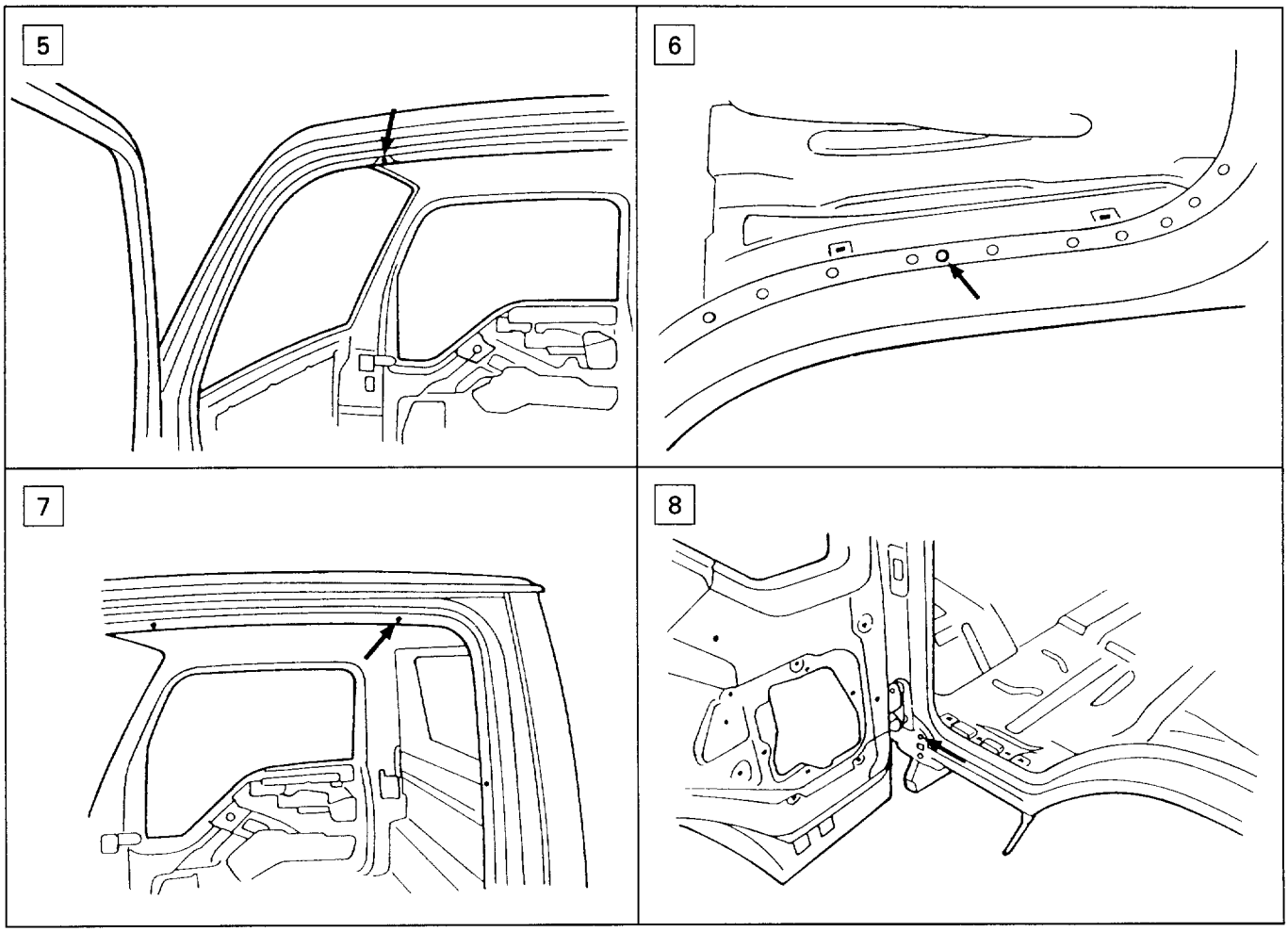
Door Frontage Sizes

(m/m)

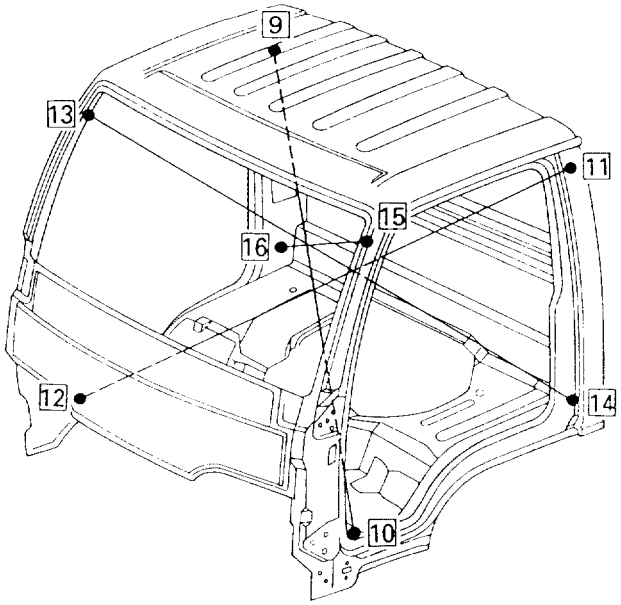


	5 ~ 6	7 ~ 8
Narrow cab	1079.69	1577.49
Wide cab	1079.69	1577.49

Details of each portion



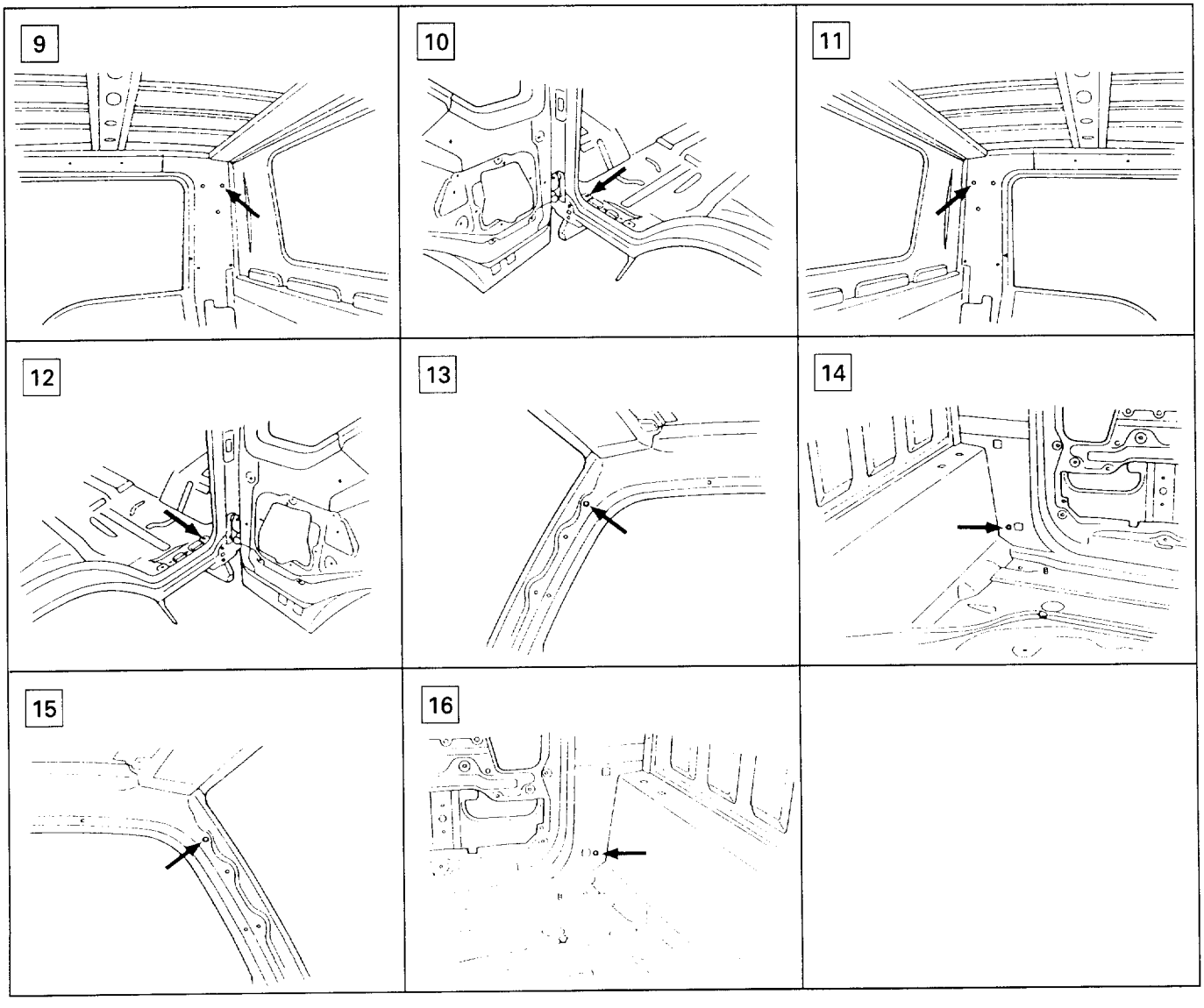
Room Diagonal Sizes



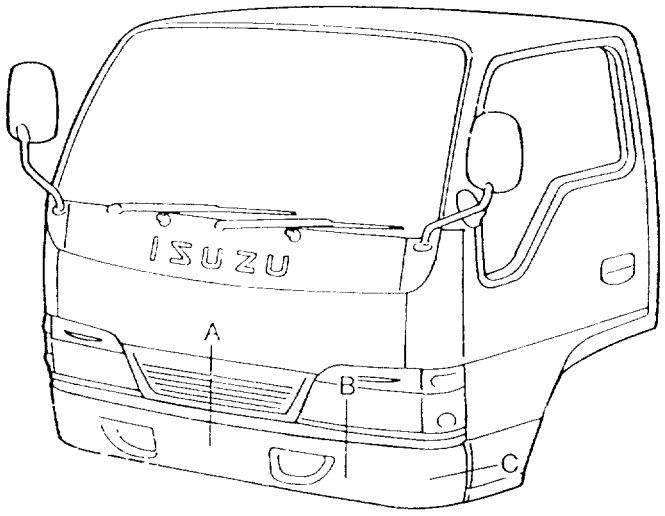
(m/m)

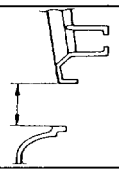
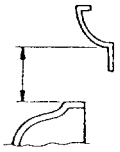
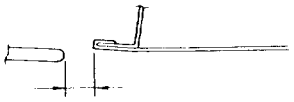
	9 ~ 10 11 ~ 12	13 ~ 14 15 ~ 13
Narrow cab	2136.32	1886.05
Wide cab	2336.98	2128.51

Details of each portion

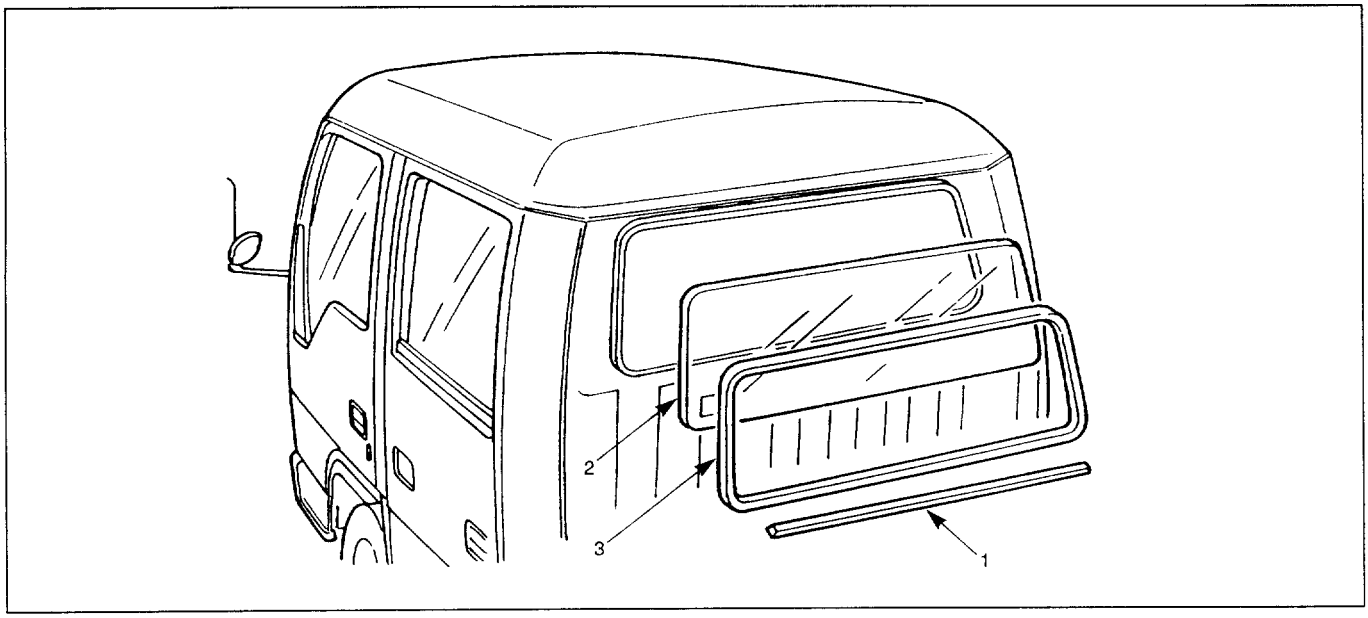


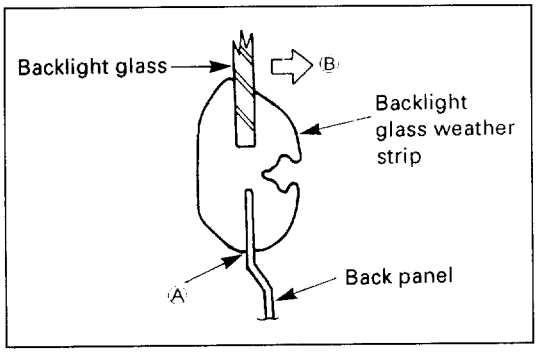
Front Bumper Installation Basic Sizes



Portion		Clearance	Level difference	Parallelism (difference in clearance)
A		41.5 ± 3.0	—	—
B		34.0 ±3.0	—	3.0 or less
C		$16.0^{+5.0}_{-4.0}$	—	Up / down 3.0 Left / right 5.0 or less
		—	- 6.6 ± 4.6	Up / down 3.0 Left / right 5.0 or less

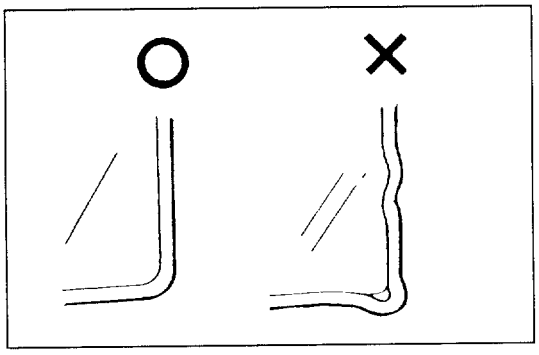
FOR CREW CAB
ON-VEHICLE SERVICE
BACK LIGHT GLASS (CREW CAB VEHICLE)





Removal

1. **Wedge Rubber**
   - Draw out the wedge rubber from the bottom end of the backlight glass weather strip.
2. **Backlight glass**
   - Pry off the weather strip at the top edge and both angles of the backlight glass from the position A and remove it from the body flange. Push out the backlight glass toward B.
3. **Backlight glass weather strip**
   - Remove the weather strip from the backlight glass.

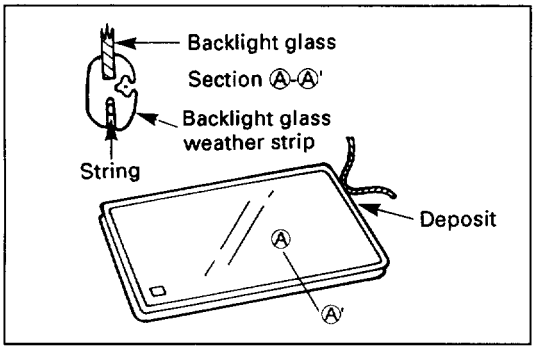


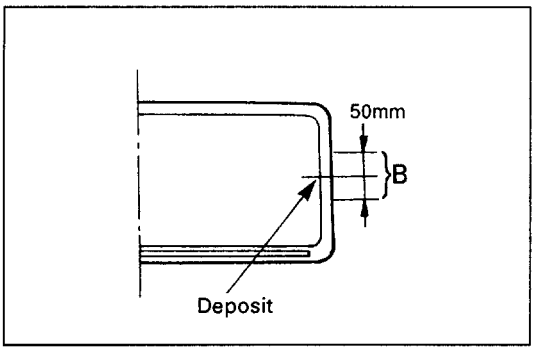
Installation

3. **Backlight glass weather strip**
   - Fit the backlight weather strip into the backlight glass. At this time, turn the deposit of the weather strip to the right side of the vehicle.

CAUTION:

Bring each portion into close contact without any float or corrugation.





2. Backlight glass

- Set a ϕ5 to 6 mm string for installing the window shield into the portion A of the backlight weather strip installed on the backlight glass by means of a metal tube of about 8 mm.
  Adjusting the center of the glass to that of the body, push down the glass with force from the outside and pull the string toward the center of the glass from the inside.
  Thus, set the lip into the body flange in succession.

- After installing the backlight glass, fill the portion B in the range of 50 mm up and down of the deposit of the weather strip with sealant.

Sealant: CS3061D

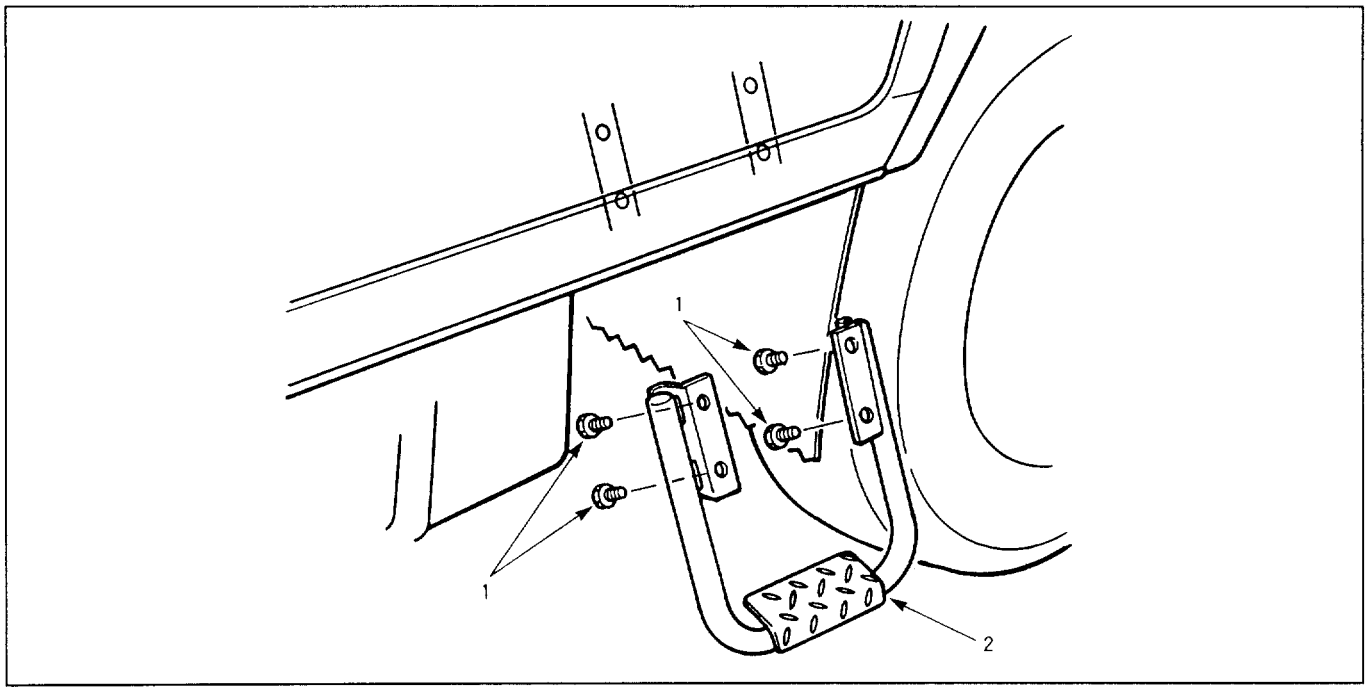
CAUTION:

Fill the portion B in the specified range with sealant securely. Completely remove overflowed sealant.

1. Wedge rubber

- Fit the wedge rubber securely into the bottom end of the backlight glass weather strip.

REAR STEP (CREW CAB VEHICLE)



Removal

1. **Rear step fixing bolts**
   - Remove the 2 fixing bolts.
2. **Rear step**

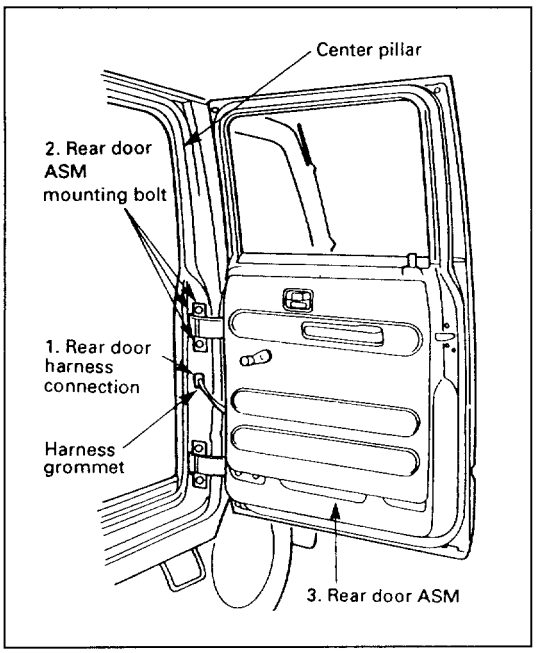
Installation

For installation, reverse the removal procedure taking the following points into consideration.

1. Tighten the fixing bolts/screws with the specified tightening torque.

Tightening torque	N•m (kg•m)
12.7 (1.3) to 17.7 (1.8)	

REAR DOOR ASM



Removal

1. **Rear door harness connection**
   - Remove the harness grommet and disconnect the connector inside the center pillar.
2. **Rear door ASM mounting bolts**
   - Remove the 3 bolts holding the rear door ASM.
3. **Rear door ASM**

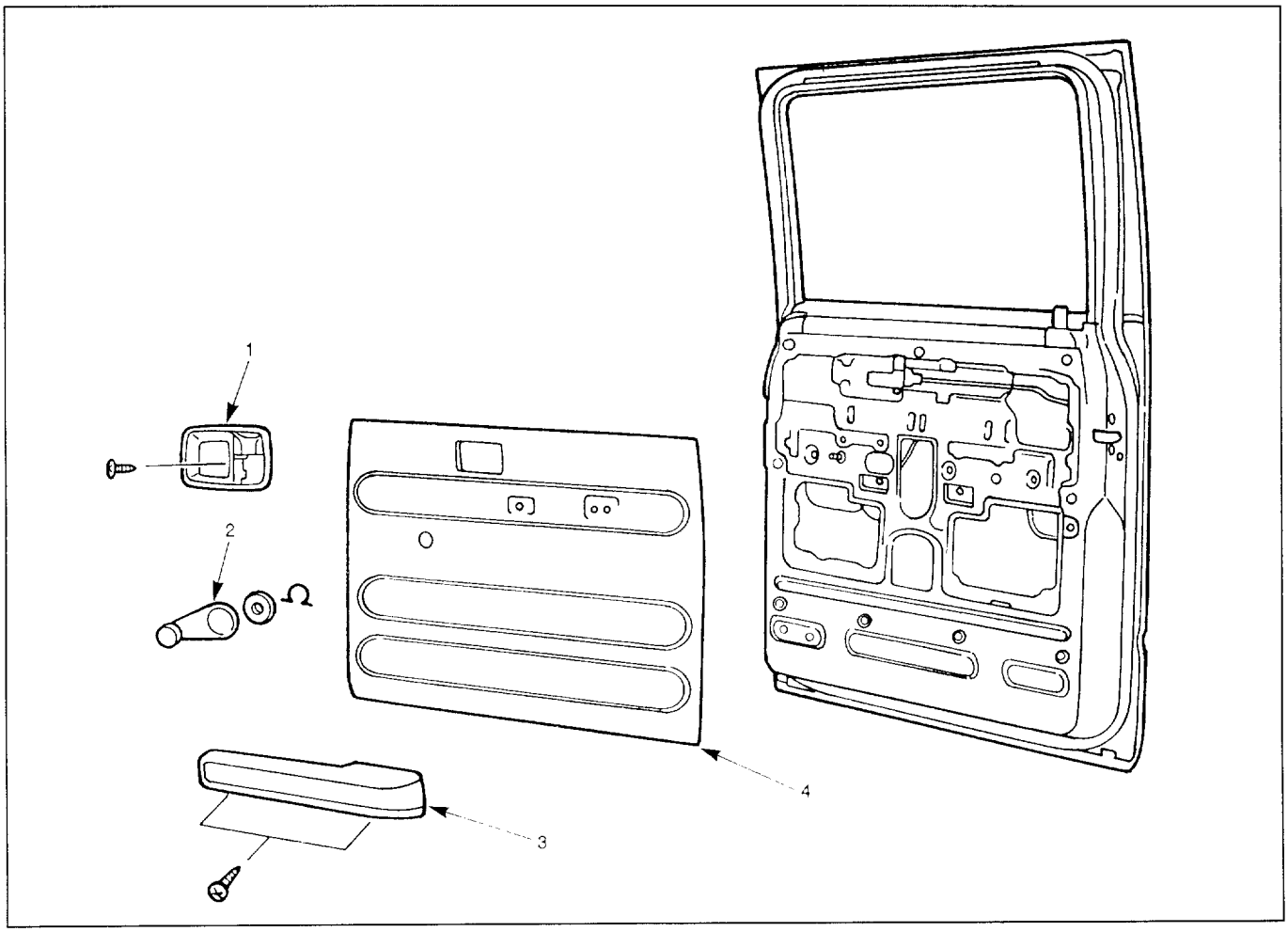
Installation

For installation, reverse the removal procedure taking the following point into consideration.

1. Tighten the rear door ASM mounting bolts with the specified tightening torque.

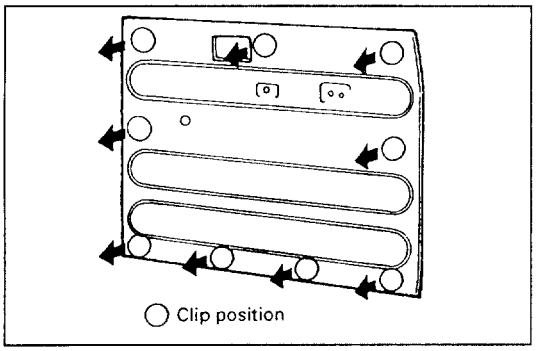
Tightening torque	N•m (kg•m)
22 (2.2) to 27 (2.8)	

REAR DOOR TRIM PAD



Removal

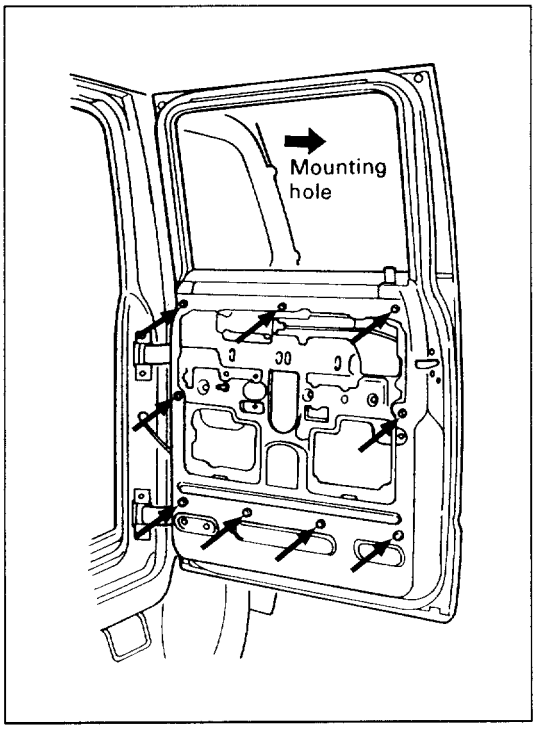
1. **Inside lever bezel**
   - Remove the mounting screws and draw out the bezel forward by pulling the inside lever.
2. **Window regulator handle**
   - Draw out the hook and dismount the handle.
3. **Arm rest ASM**
   - Remove the 2 mounting screws.
4. **Rear door trim pad**
   - Remove the clip fitting at 9 positions.



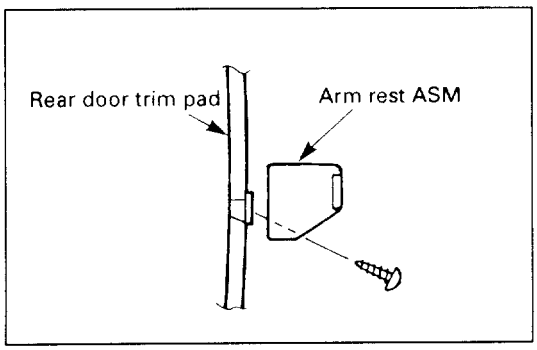
Installation

For installation, reverse the removal procedure taking the following points into consideration.

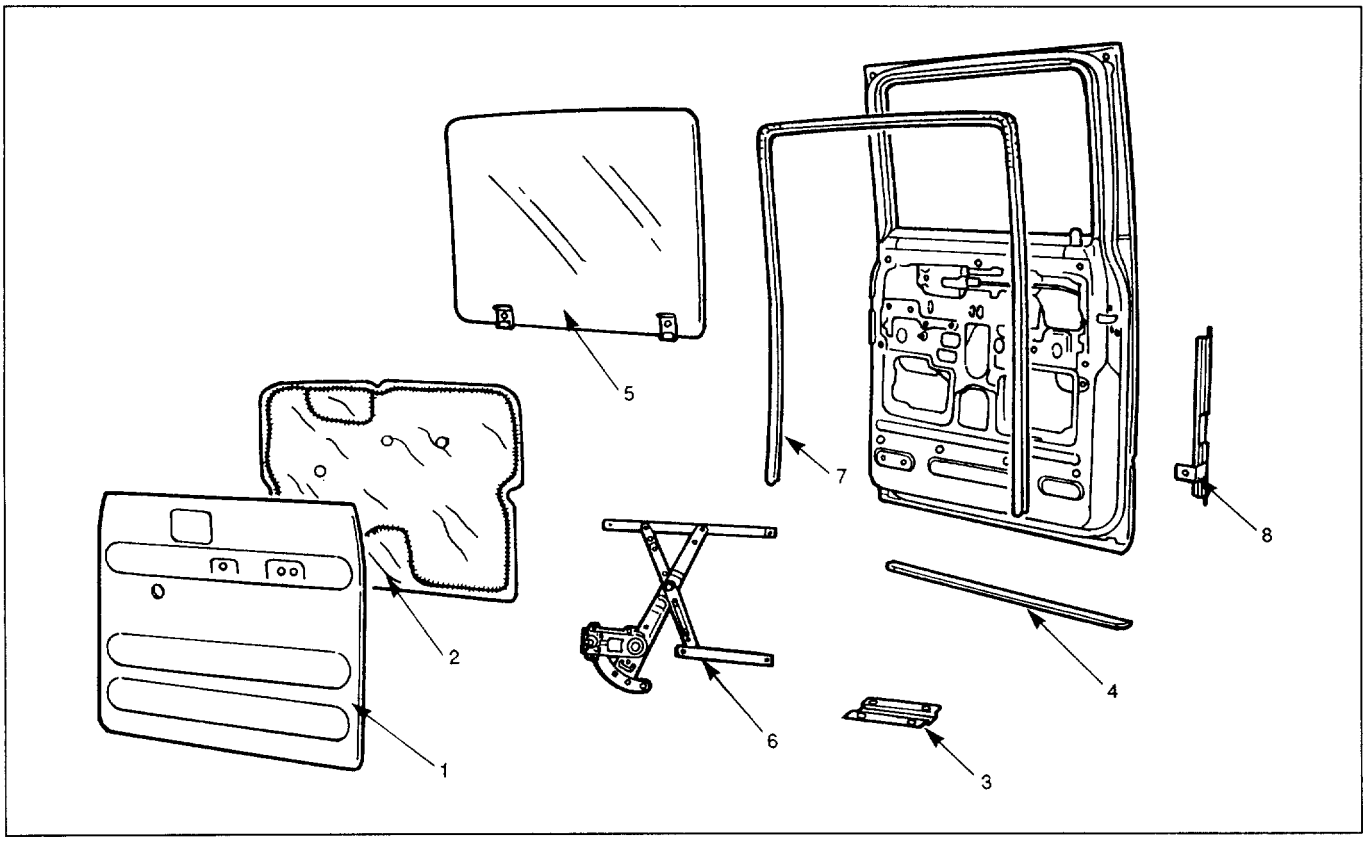
1. Install the rear door trim pad by adjusting the trim pad grip to the mounting hole on the door panel side so that any float, skewness, harness bite may not exist.



2. Take care not mistake the tightening direction for the arm rest ASM mounting screws.

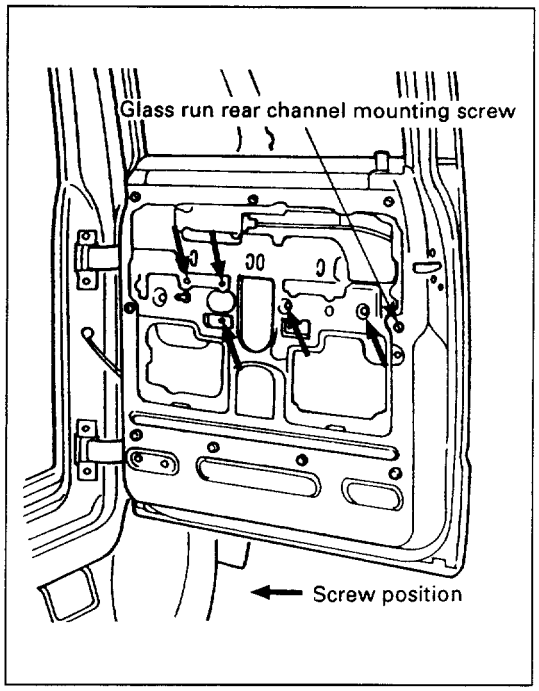


REAR WINDOW GLASS, REGULATOR AND GLASS RUN



Removal

1. **Rear door trim pad**
   - Refer to "Rear Door Trim Pad" in this Section.
2. **Water-proof sheet**
   - Peel off the water-proof sheet carefully with a cutter knife.
     At this time, take care not to damage it.
3. **Door bottom bracket**
   - Remove the 4 screws.
4. **Rear door glass plug**
5. **Rear door glass**
   - Lower the glass to a working hole position where the mounting screws can be seen. Remove the 2 screws and pull out the rear door glass from the hole in the lower part of the door.



6. **Window regulator**
   - Remove 5 mounting screws and pull out the window regulator from the working hole.
7. **Glass run**
   - Pull out the glass run from the channel.
8. **Glass run rear channel**
   - Remove the 2 mounting screws and pull out the glass run rear channel.

Installation

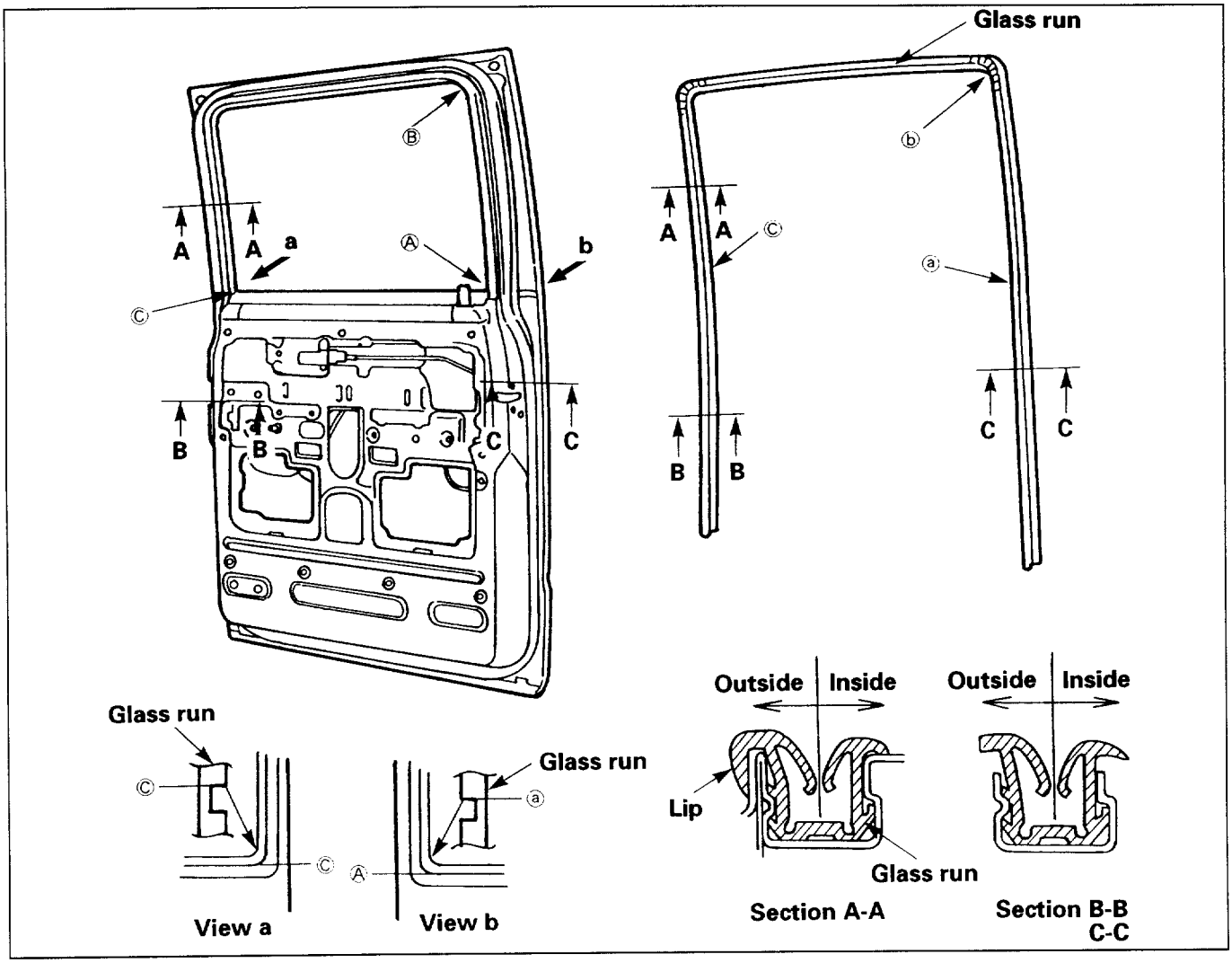
For installation, reverse the removal procedure taking the following point into consideration.

1. Adjust the glass run lip cut ① to the door outer waist line ①'. Adjusting the glass run slit ② to the door ②', fit the glass run between 1 and 2. Next, adjusting the glass run lip cut ③ to the door outer waist line ③', fit the glass run between ② and ③. Then, fit the glass run into the channel in the panel. Fit the glass run turning the lip toward the outside of the vehicle.

CAUTION:

When reusing the glass run, apply sealant into the range shown in the figure.

Sealant: CEMEDINE 366DX



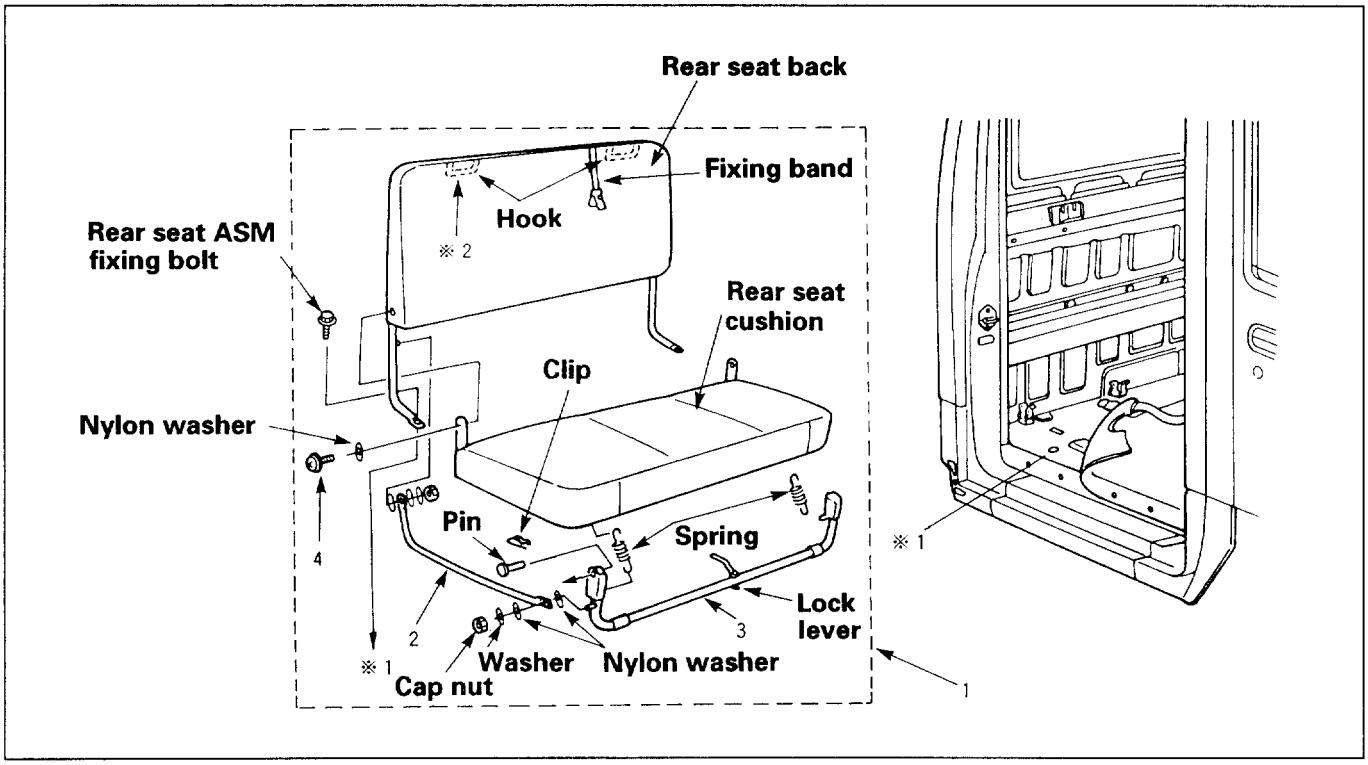
2. Insert the window regulator from the working hole and tighten the 5 mounting screws with the specified tightening torque.

Tightening torque	N•m (kg•m)
6 (0.6) to 7.8 (0.8)	

3. Stick the water-proof sheet securely with an isobutylene-isoprene tape. Check that there is no breakage in the sheet.

SEAT

Rear Seat



Removal

1. **Rear seat ASM**
   - Remove the rear seat ASM fixing bolts and dismount the rear seat back from the hooks.
2. **Rear seat link ASM**
   - Remove the two front and back fixing nuts.
3. **Rear seat cushion Stay**
   - Remove the left and right springs and the clips, then pull out the pins.
4. **Seat back/cushion fixing screws**
   - Remove the left and right screws and dismount the seat back from the seat cushion.

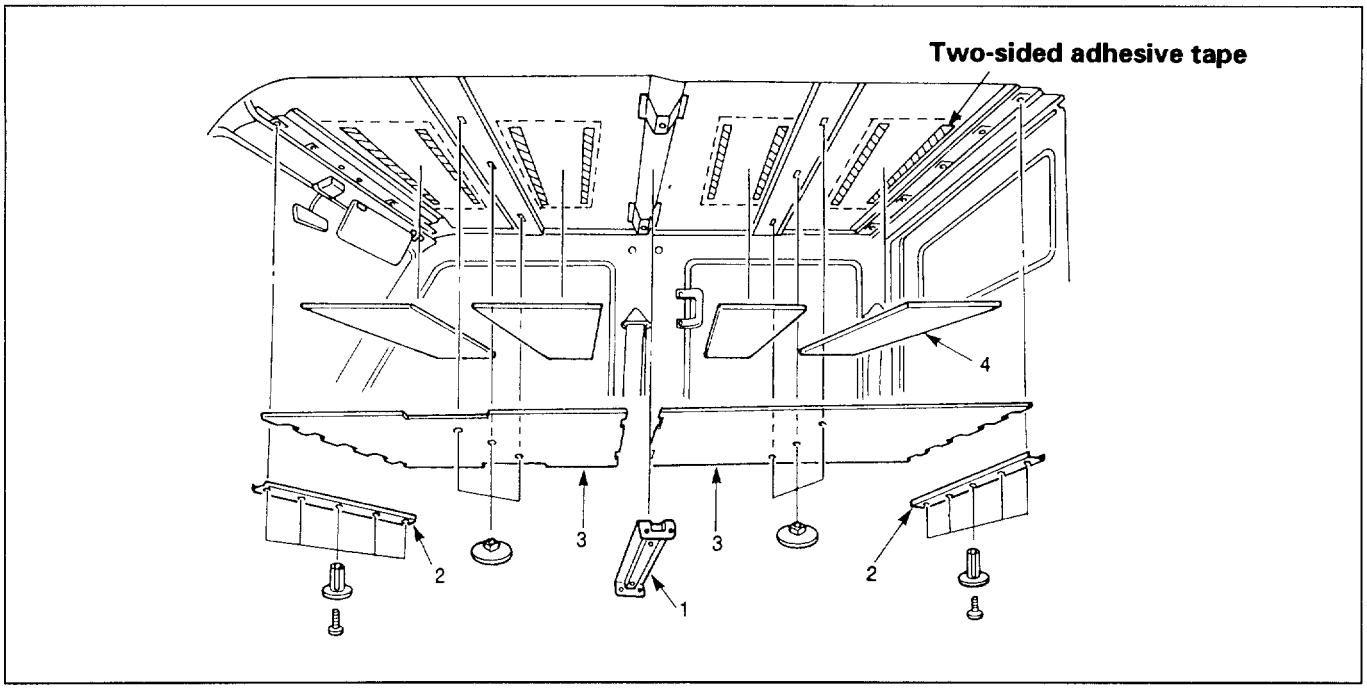
Installation

For installation, reverse the removal procedure taking the following point into consideration.

1. Tighten the rear seat ASM securely with the specified bolts (with lock tight).

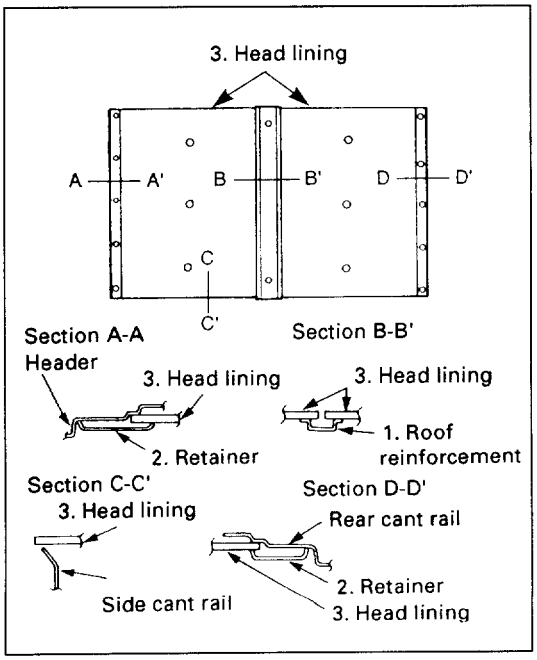
Tightening torque	N•m (kg•m)
7.8 (0.8) to 17.7 (1.8)	

HEAD LINING (CREW CAB VEHICLE)



Removal

1. **Roof reinforcement**
   - Remove the 3 left fixing bolts and 3 right fixing bolts.
2. **Retainer**
   - Remove the 5 front clips and 5 back clips.
3. **Head lining**
   - Remove the 5 front clips and 5 back clips.
4. **Insulator**



Installation

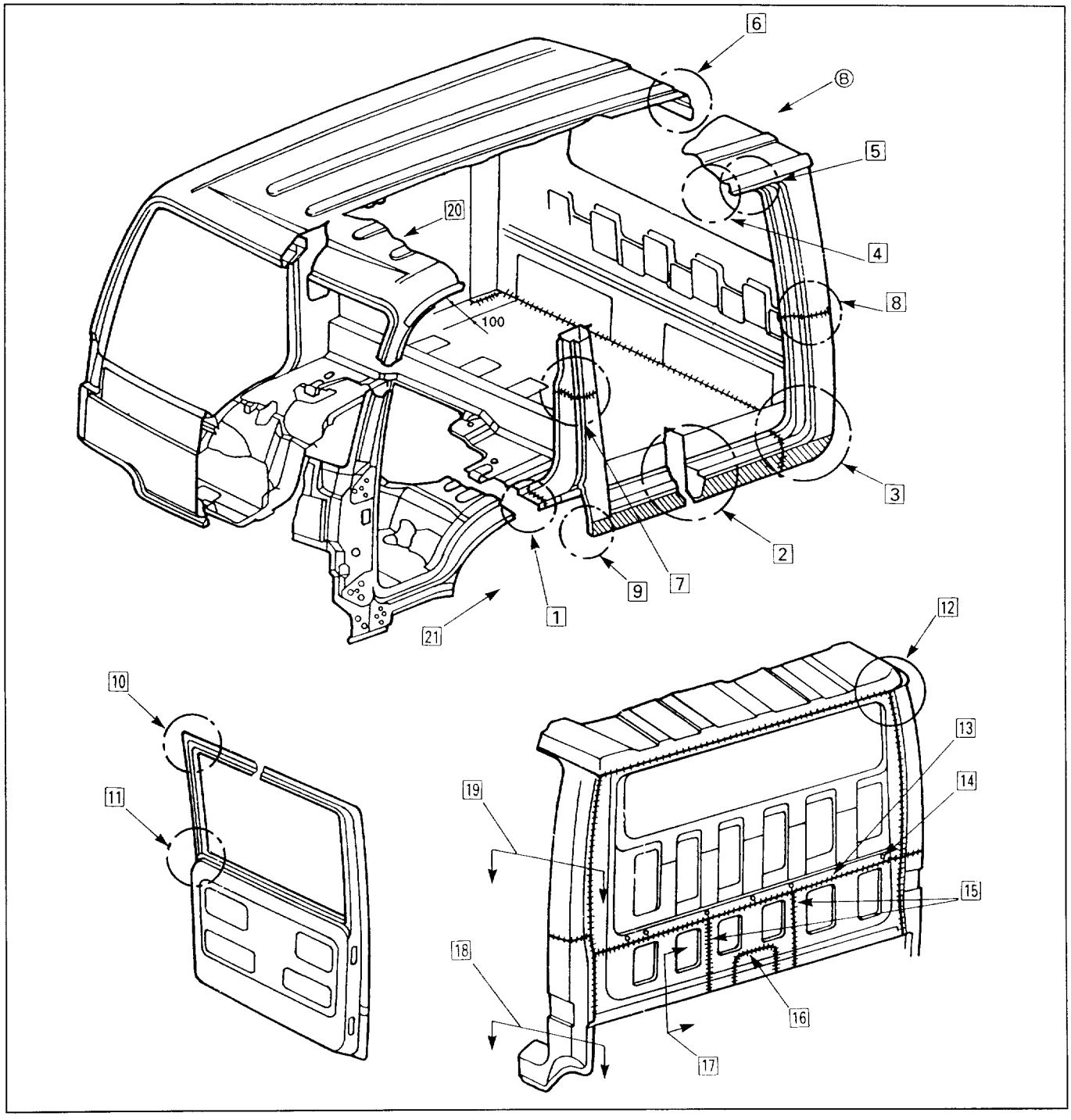
For installation, reverse the removal procedure.

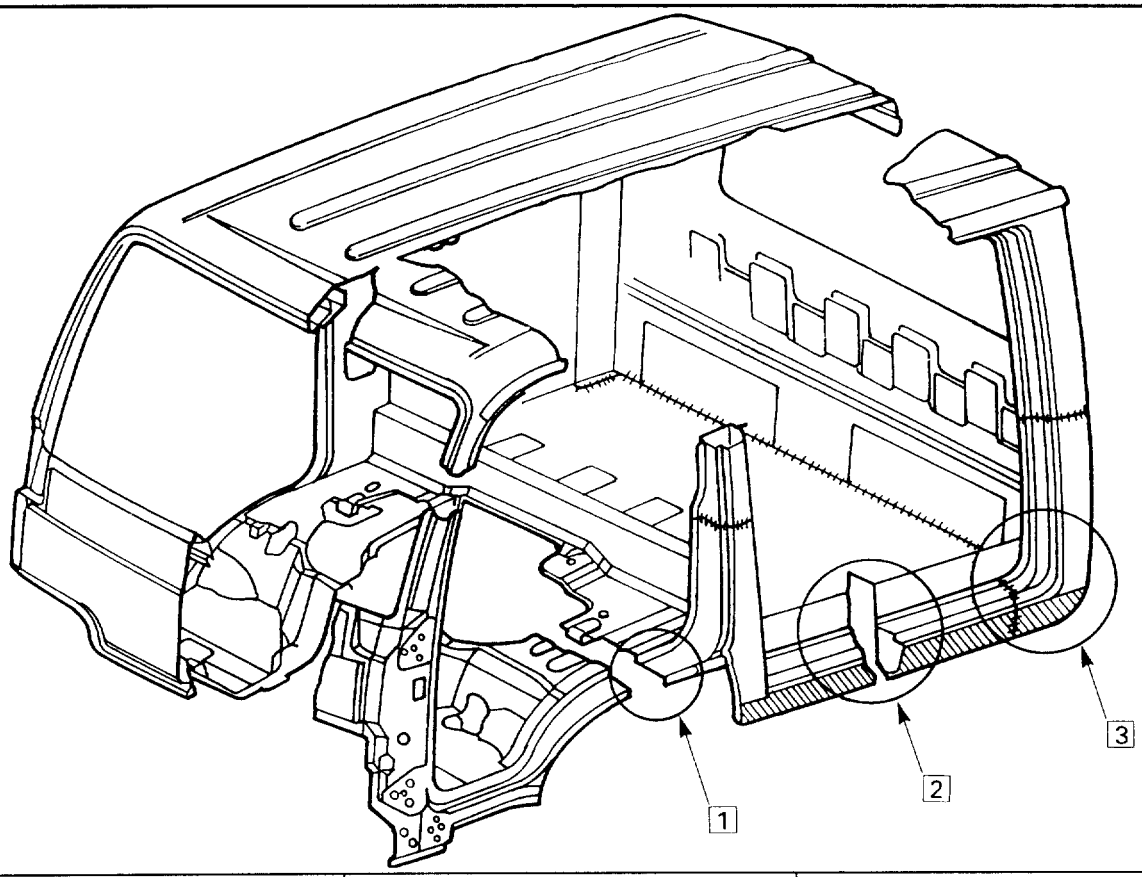
1. When installing the insulator, be sure to use a new two-sided adhesive tape.
2. Install the head lining by nipping it with the front and back retainers and the central reinforcement referring to the figure shown at left.

BODY PANEL SEALING (CREW CAB VEHICLE)

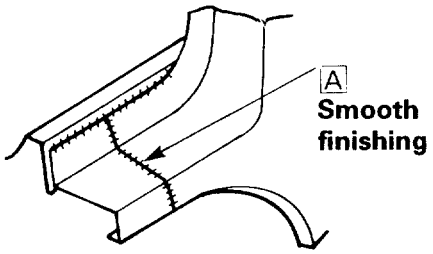
This Chapter describes the sealing procedure for body panel.
The sealing procedure described in the text should conform to the following.

Purpose	①	Rust prevention	②	Air-tightness and water-tightness	③	Sound insulation
External finish	A	Specially important	B	Important	C	Common
Sealing range						



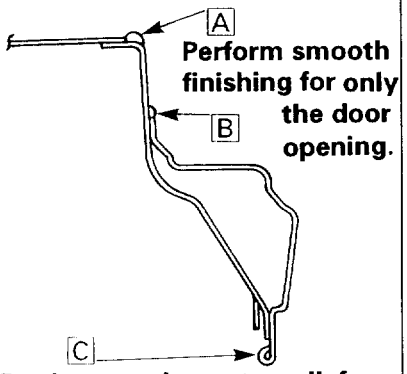


1



A: Floor panel + Side panel + Center pillar fitting.
①-B
※Perform smooth finishing.

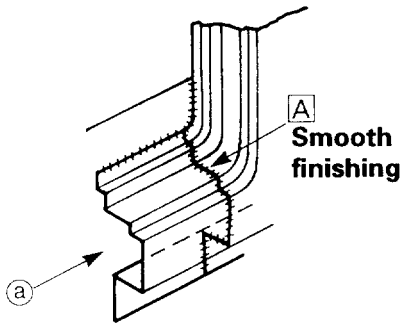
2



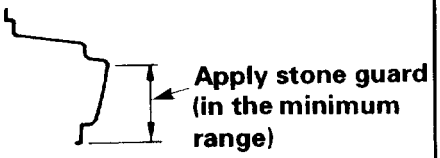
Don't cover the water relief hole.

A: Rear floor panel + Floor side panel fitting
①, ②-B
※Perform smooth finishing for the door opening.
B: Outer sill + Floor side panel fitting
①
D: Outer sill + Floor side panel fitting
①-C
※Don't cover the water relief hole.

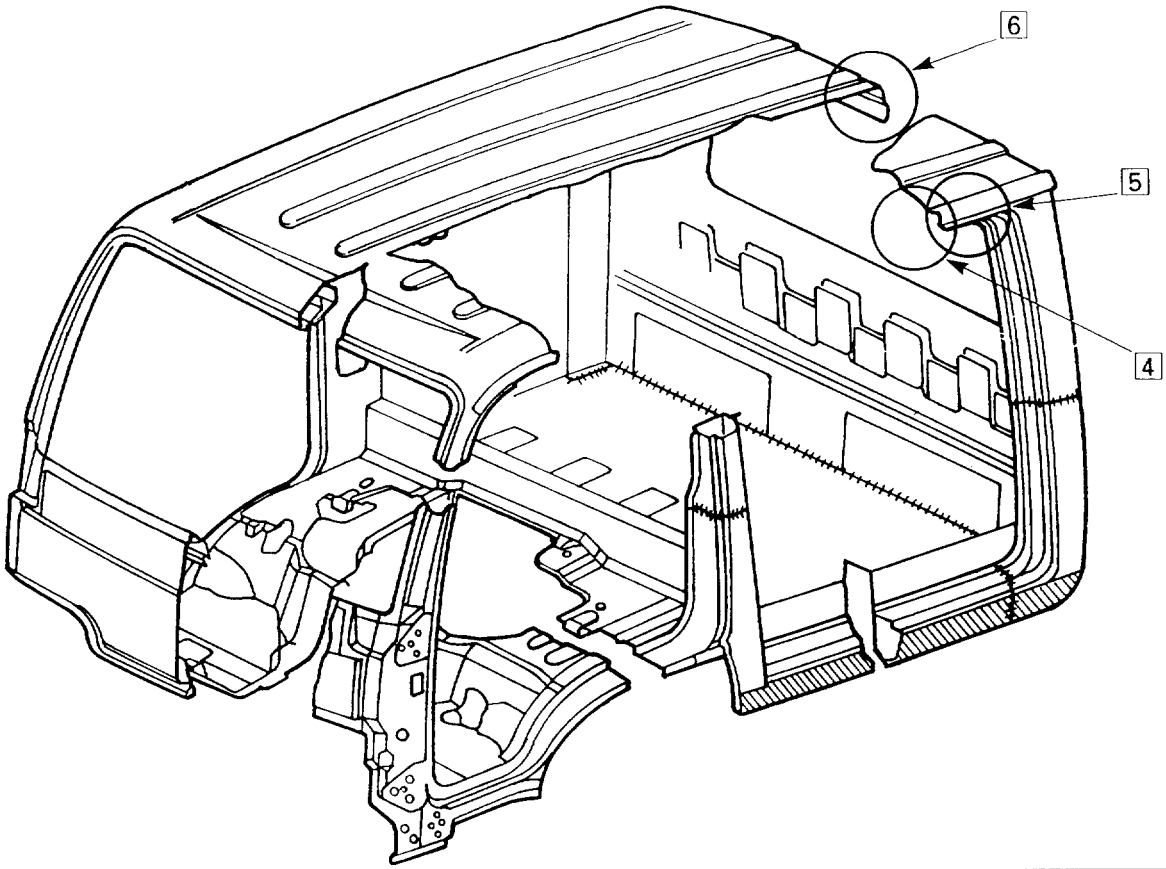
3



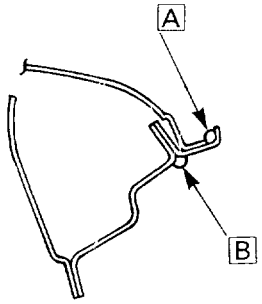
View ⓐ



A: Rear pillar + Outer sill fitting
①-B
※Perform smooth finishing.

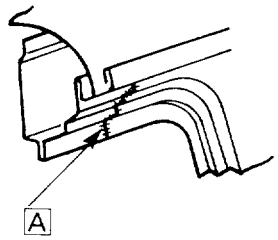


4



A: Roof panel + Drip rail fitting
①, ②-C
※Don't expose the panel edge. Apply to the section from the front end to the back end.
B: Drip rail + Drip reinforcement fitting
①, ②-A
※Apply to the section from the front end to the back end without break or gap.

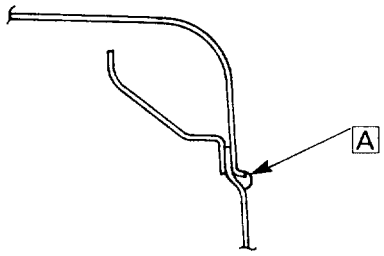
5



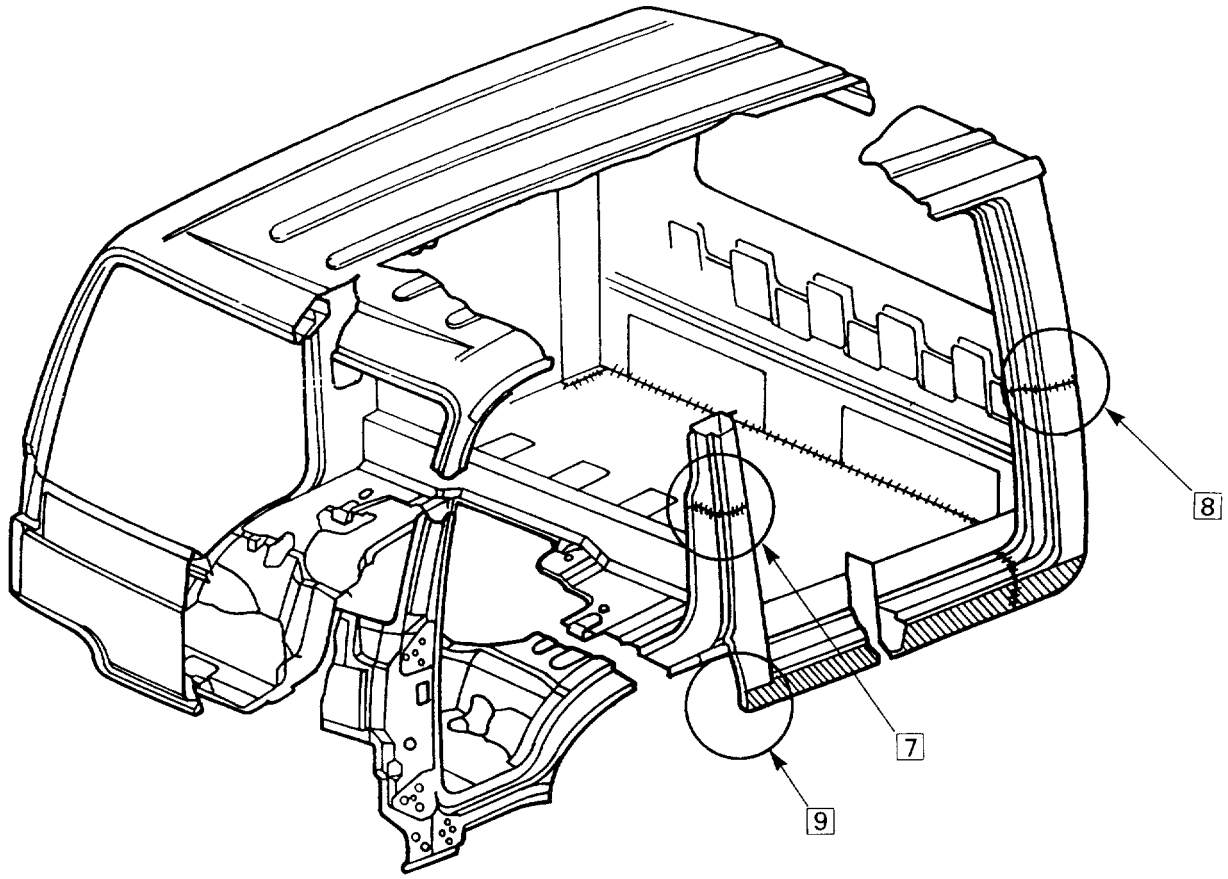
Smooth finishing

A: Center pillar + Drip reinforcement fitting
①, ②-A
※Perform smooth finishing.

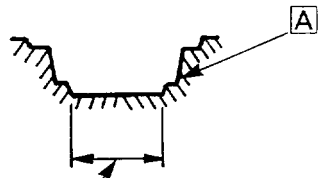
6



A: Roof panel + Back panel fitting
①, ②-A



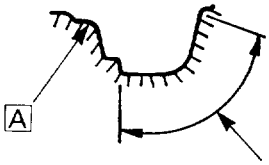
7



Perform finishing paying special attention to this section.

A: Center pillar upper + Center pillar lower fitting
①, ②-A
※The indicated range is the most important in respect of external finishing.

8

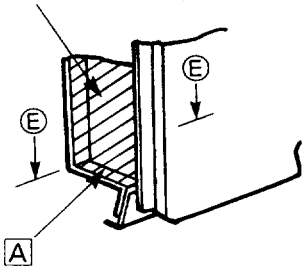


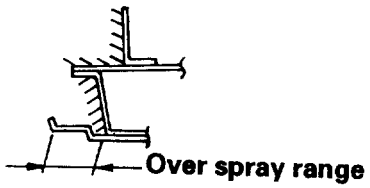
Perform finishing paying special attention to this section.

A: Rear pillar upper + Rear pillar lower fitting
①, ②-A
※The indicated range is the most important in respect of external finishing.

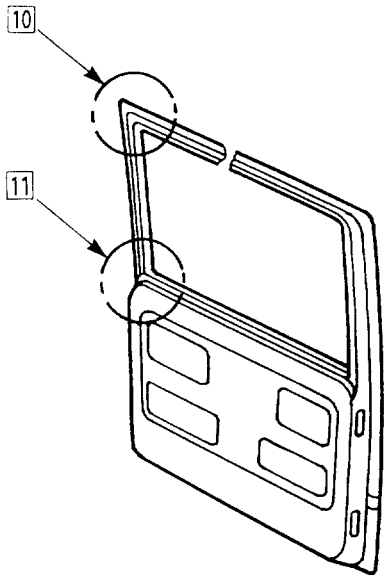
9

Under coat application range

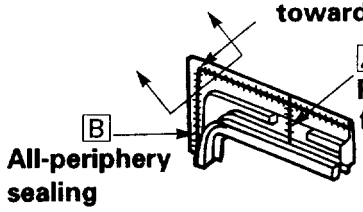




A: Rear door hinge + Floor side panel + Center pillar lower fitting
①, ②-B



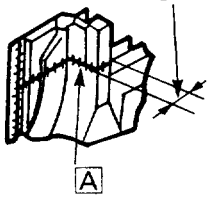
10



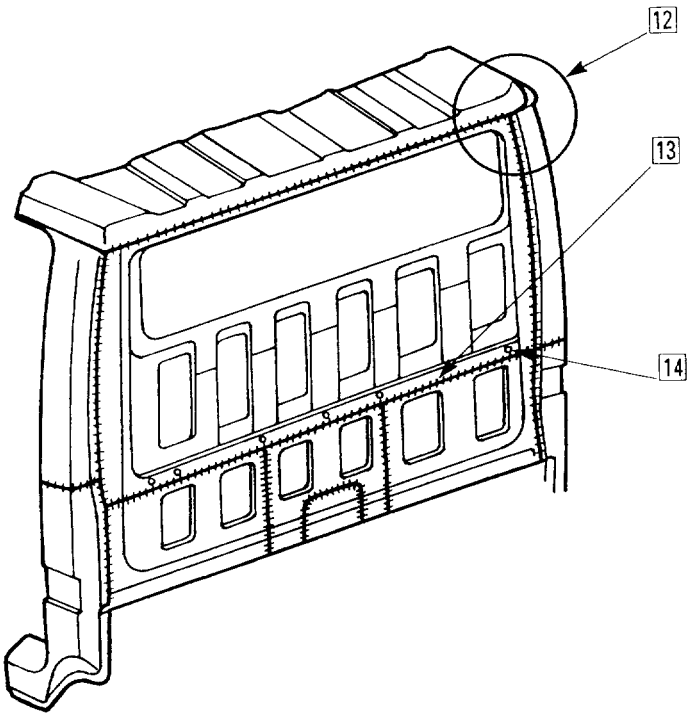
A: Door sash extension front + Door sash extension rear fitting
①-A
※Perform smooth finishing for only the door seal mount.

B: Door outer panel + Door inner panel fitting
①-A
※Perform sealing for all the periphery of the door. Finish the 4 angle portions toward the indicated arrow.

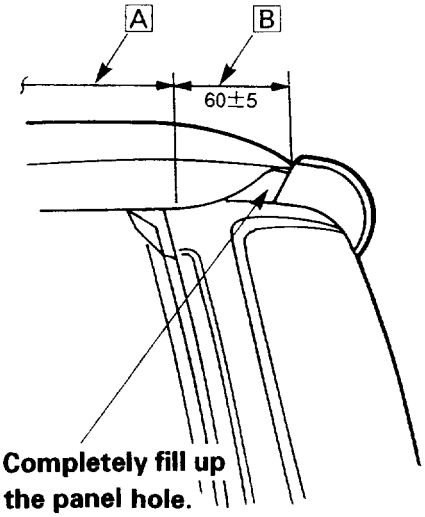
11



A: Door sash extension + Door inner panel fitting
①-A
※Perform smooth finishing for the door seal mount.

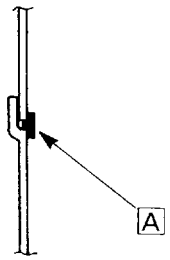


12



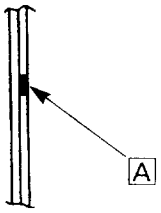
A: Roof panel + Back panel fitting
①, ②-C
B: Roof panel + Back panel fitting
①, ②-B
※Perform smooth finishing for the section from the end to a 60 ±5 mm position and completely fill up the panel hole.

13

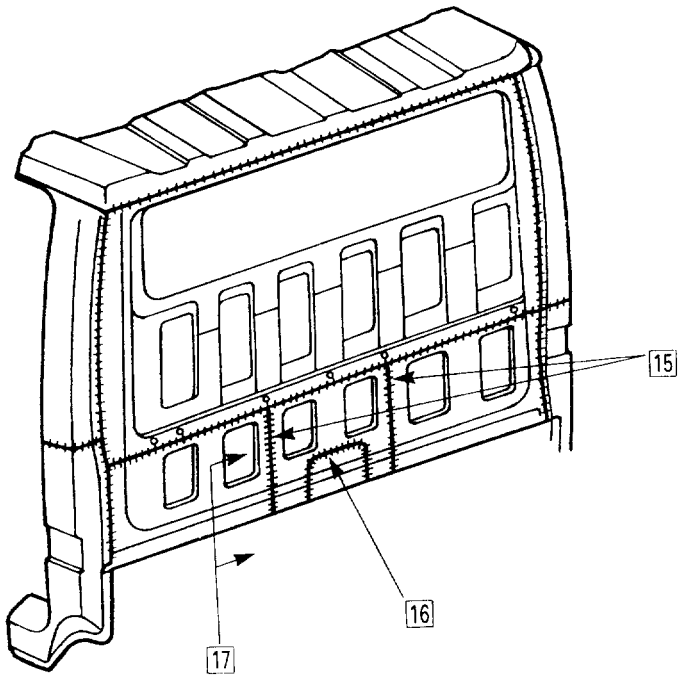


A: Back panel + Back panel lower fitting
①, ②-C
※Perform smooth finishing for the section from the end to a 5 ±3 mm position and don't expose the panel edge.

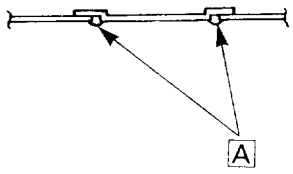
14



A: All the periphery of the back panel hole
①, ②-B

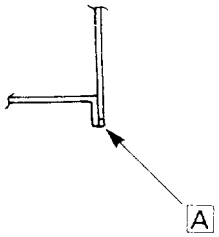


15 (Wide cab only)



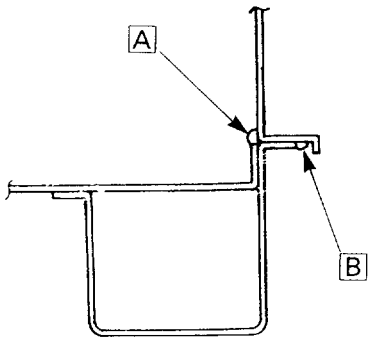
A: back panel lower side + Back panel center fitting
①, ②-C
※Don't expose the panel edge.

16 (Fire engine only)



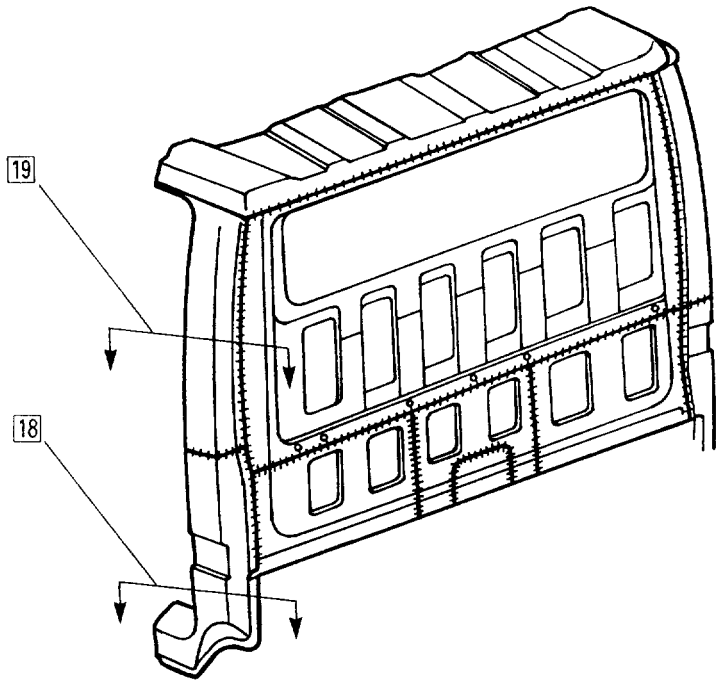
A: Back panel lower + P.T.O. cover fitting
①-C
※Fill up the panel angle securely with care because of its large gap.

17

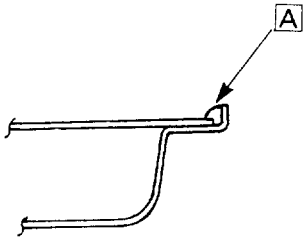


A: Back panel lower + Rear floor panel bolster fitting
②-B

B: Back panel + Rear bolster fitting
①-C

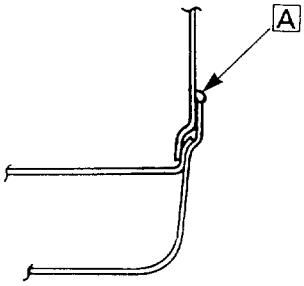


18

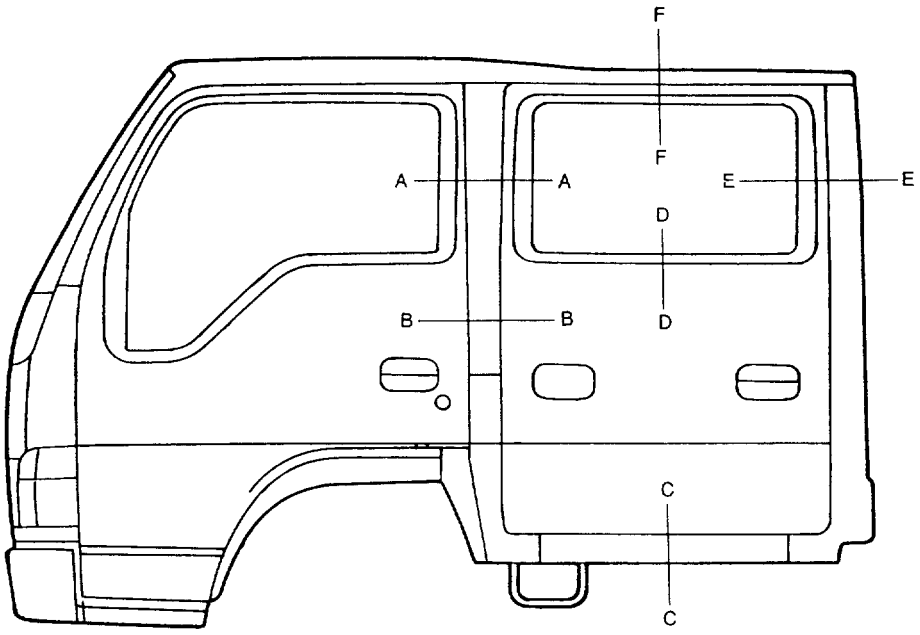


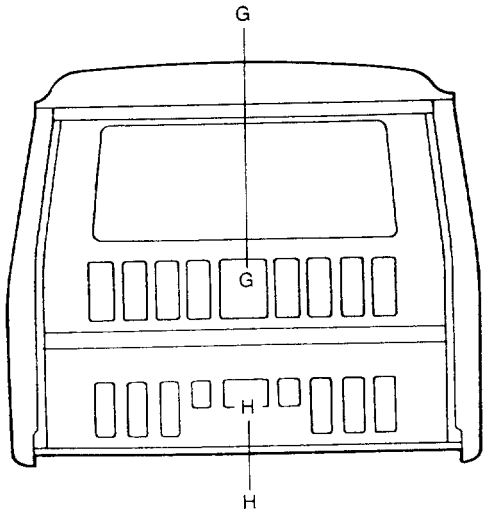
A: **Front side panel + Rear pillar fitting**
①, ②-**B**
Refer to 2-C.

19

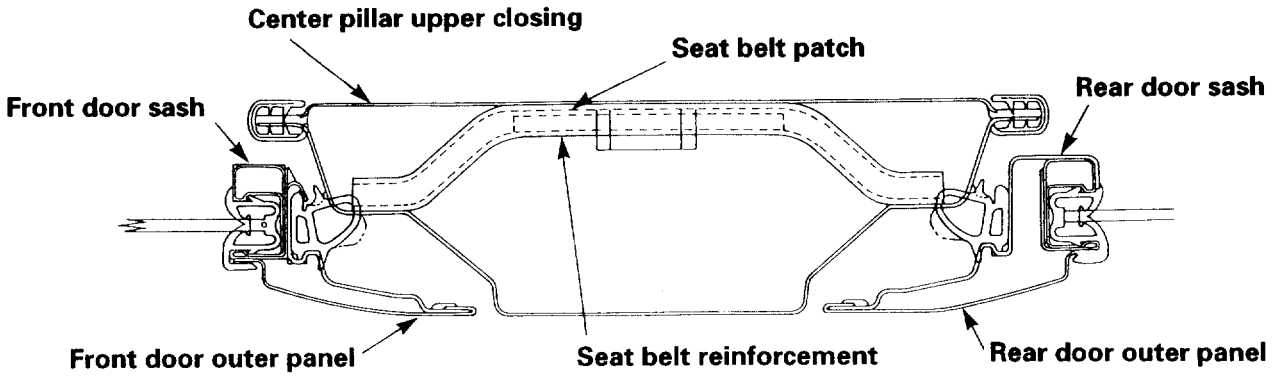


A: **Rear pillar + Back panel fitting**
①, ②-**A**

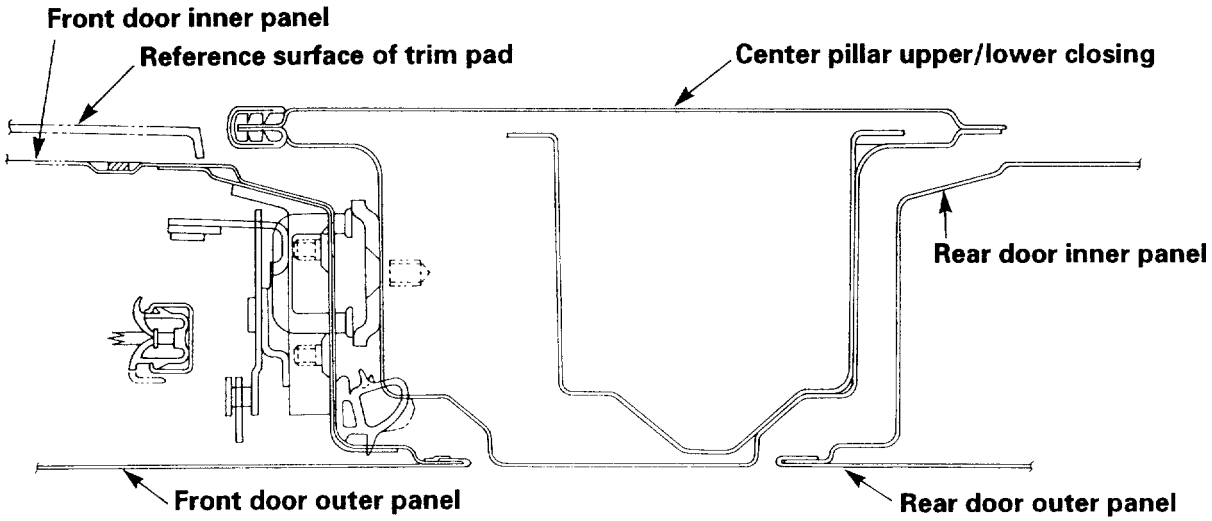

F
F
A
A
E
E
D
B
B
D
C
C


G
G
H
H

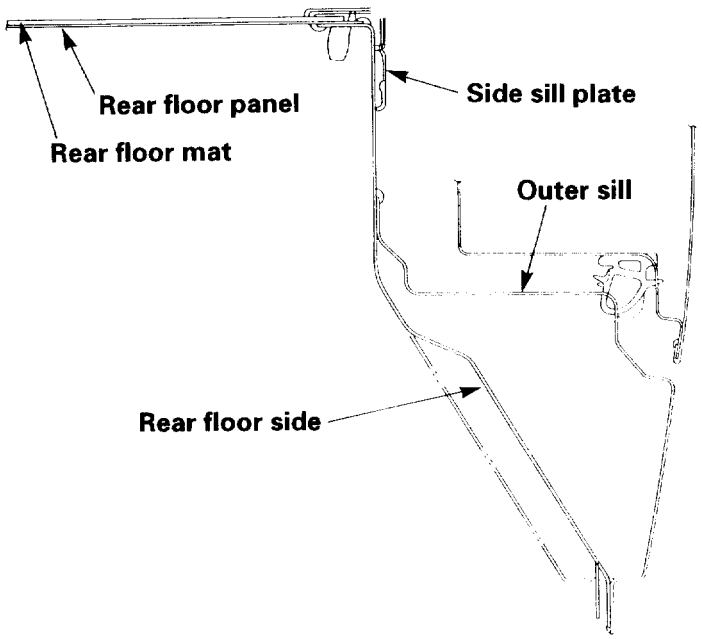
Section A-A



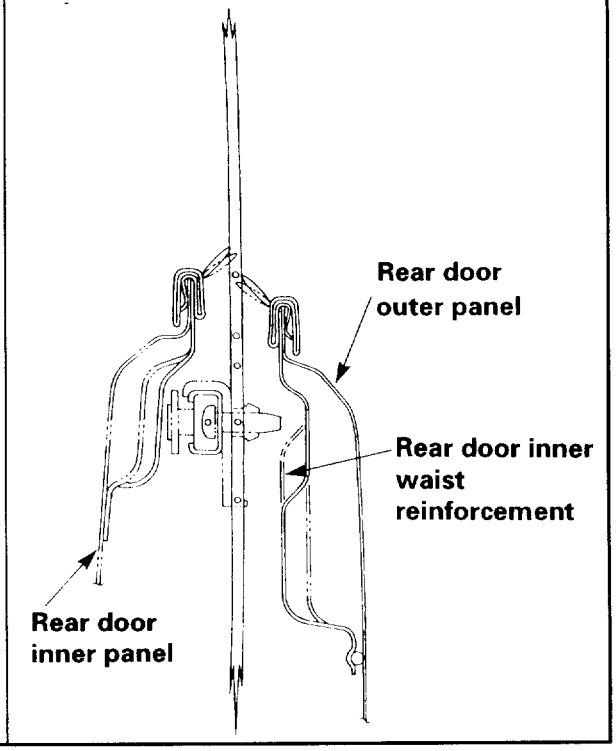
Section B-B



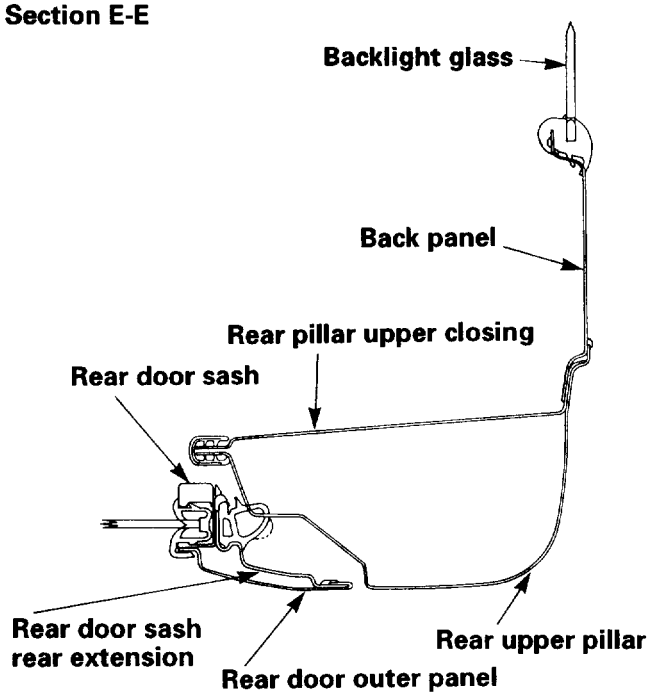
Section C-C



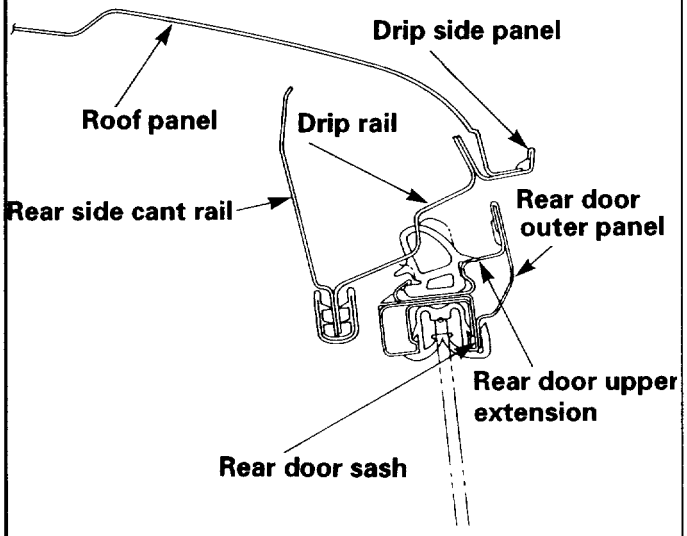
Section D-D



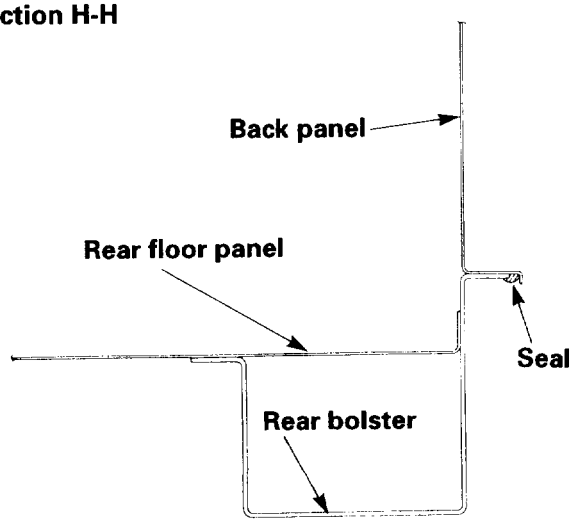
Section E-E



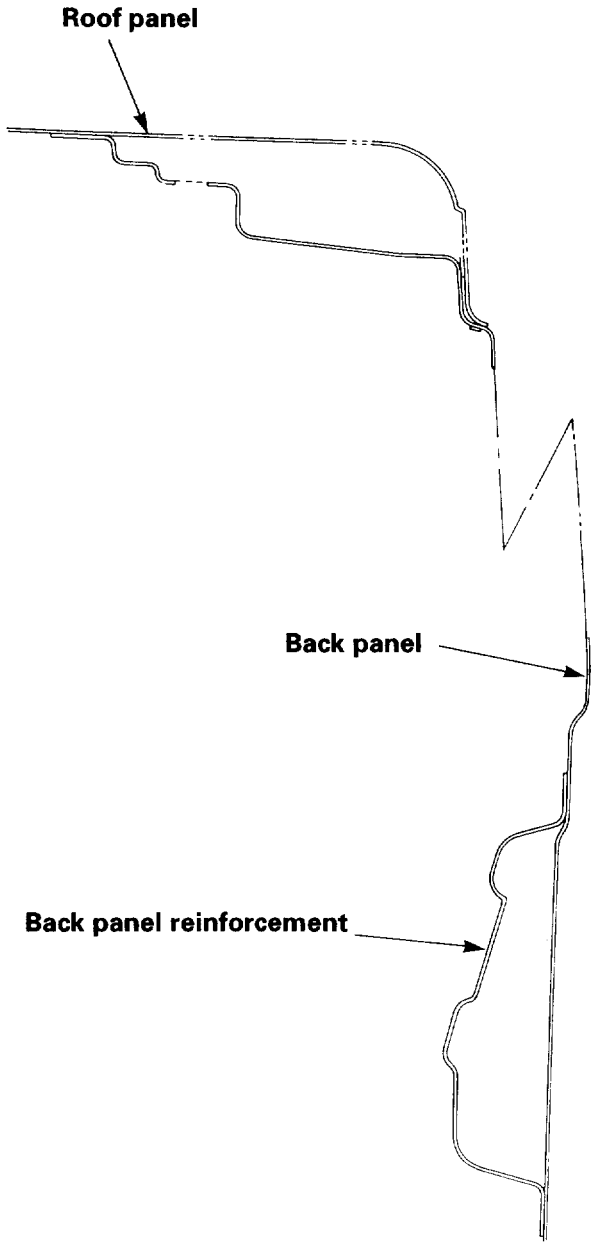
Section F-F



Section H-H

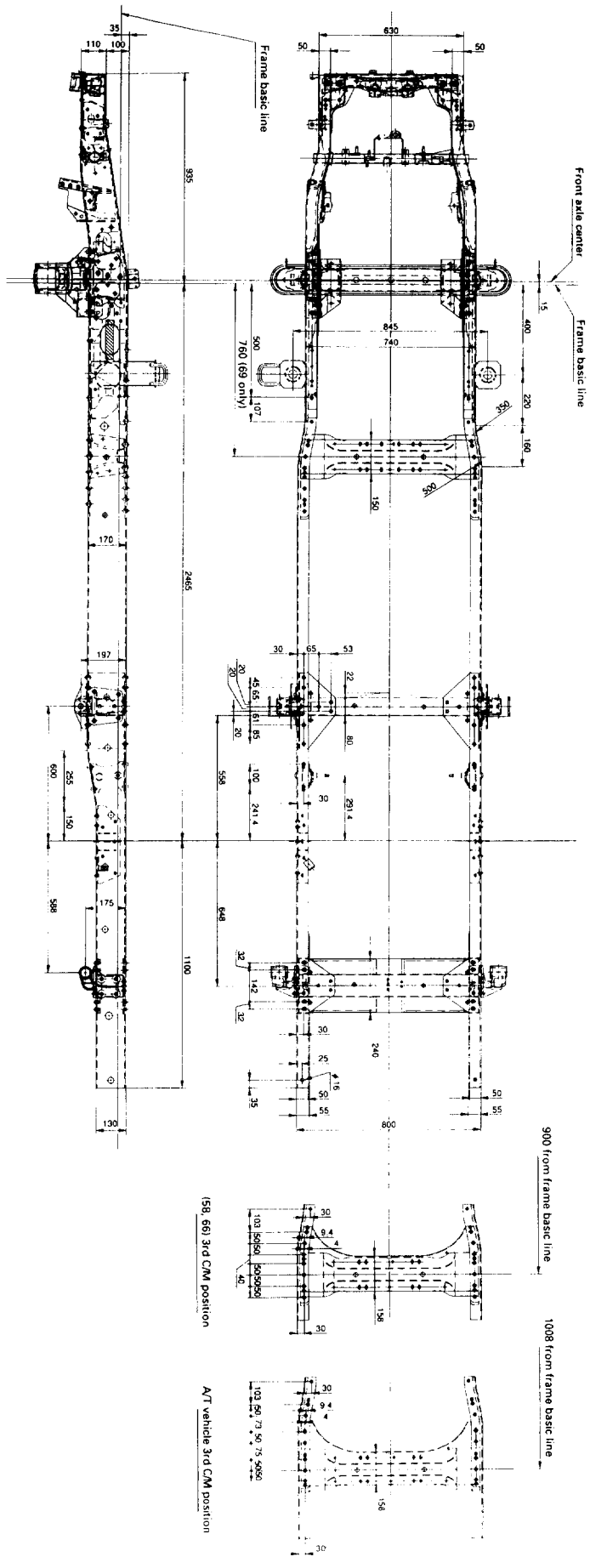


Section G-G

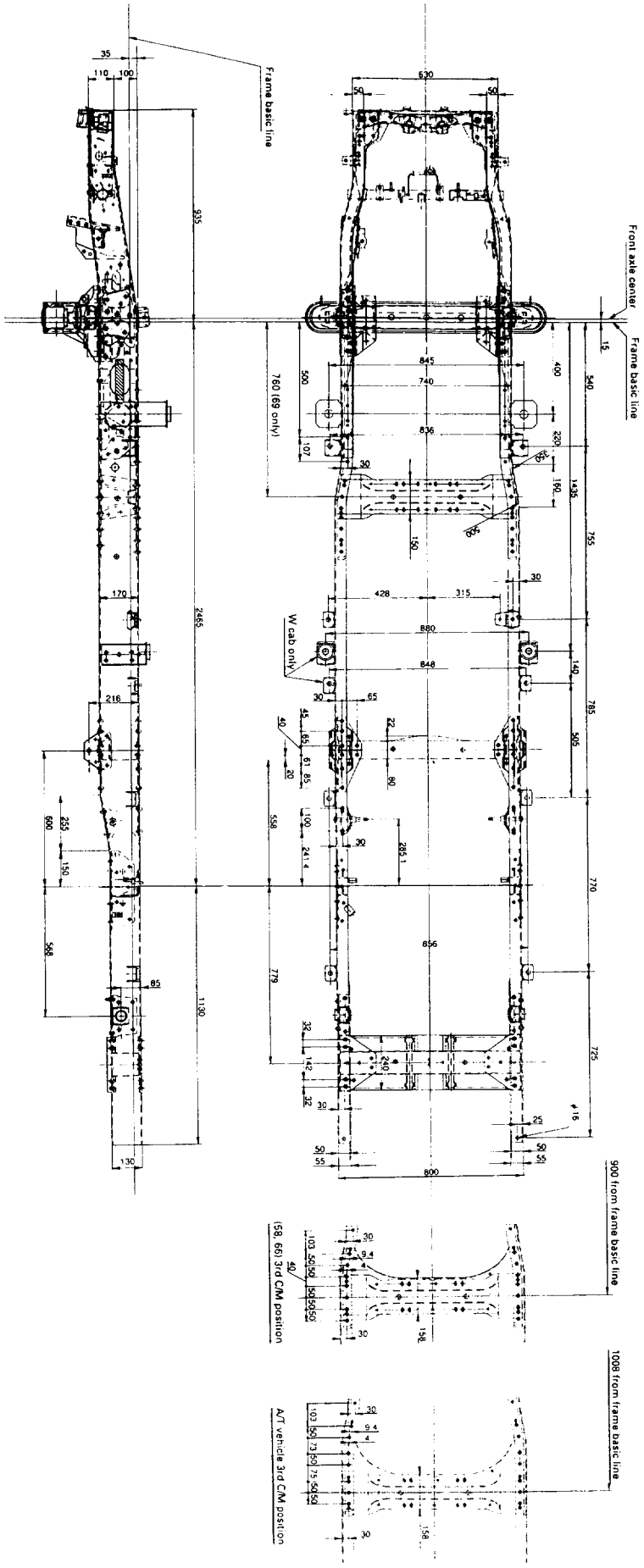


FRAME DIMENSIONS

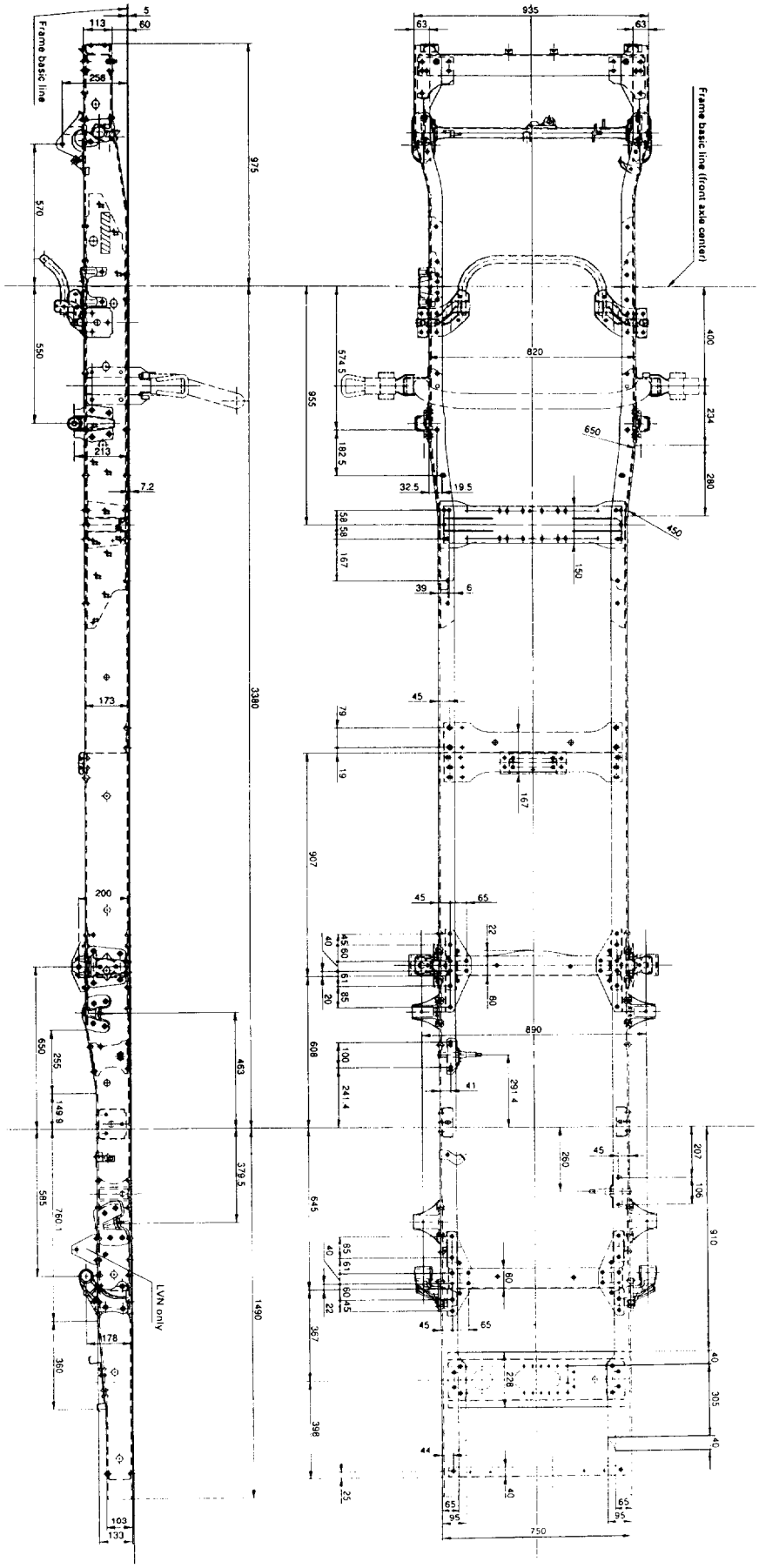
Small dual tire



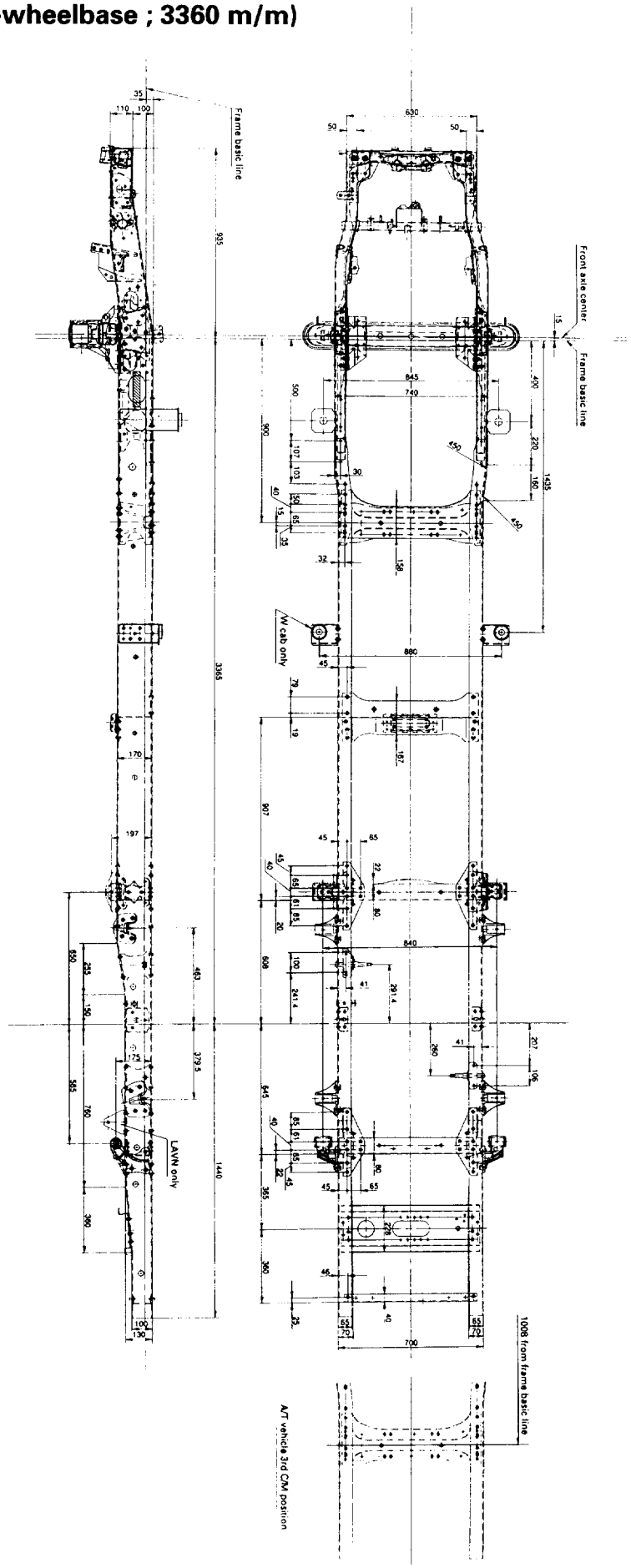
Single tire


Frame basic line
Front axle center
Frame basic line
760 (69 only)
W cab only
900 from frame basic line
(58, 66) 3rd C/M position
1008 from frame basic line
A/T vehicle 3rd C/M position

Dual tire (Wide-wheelbase ; 3365 m/m)

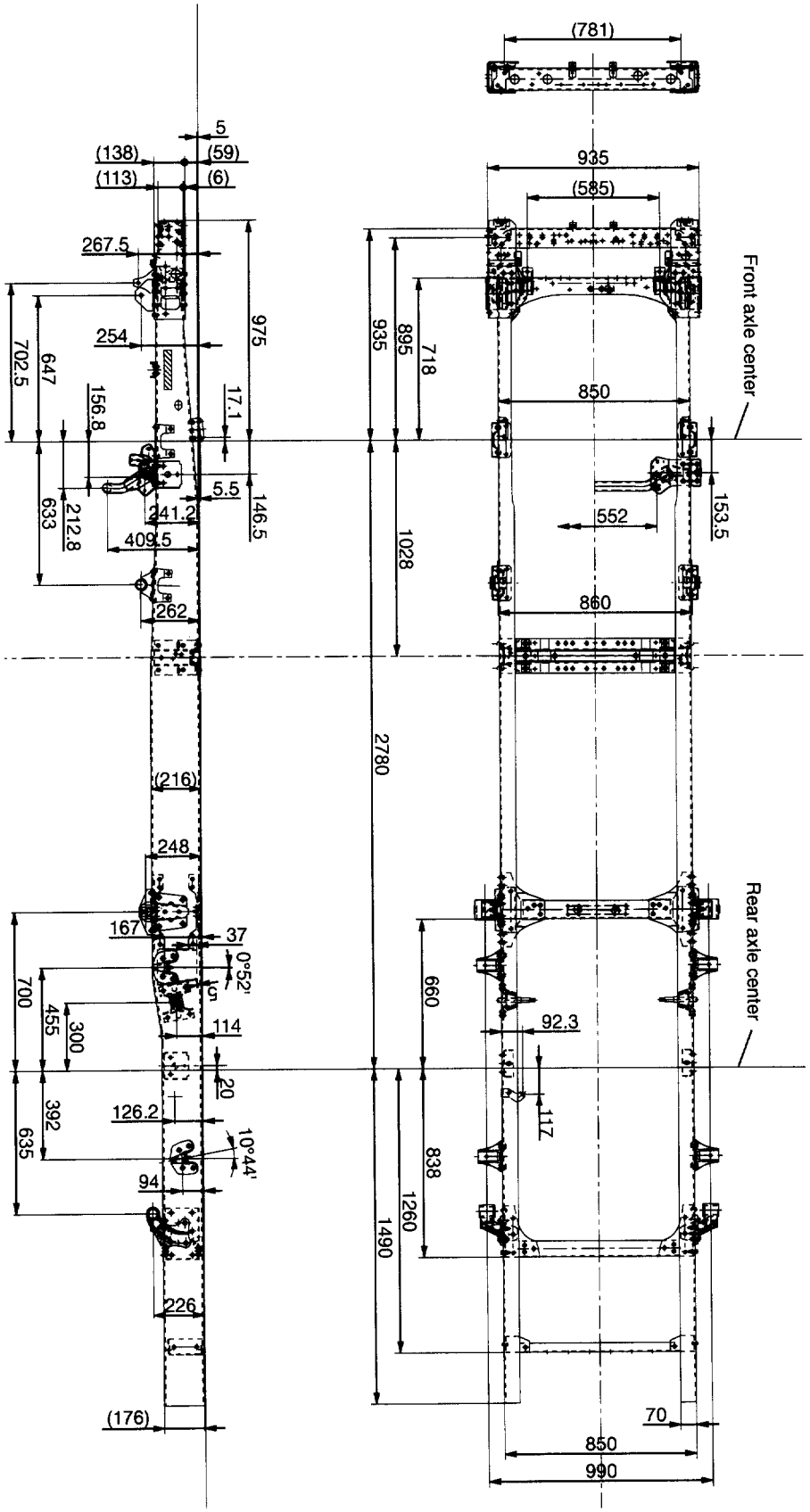


Dual tire (Narrow-wheelbase ; 3360 m/m)

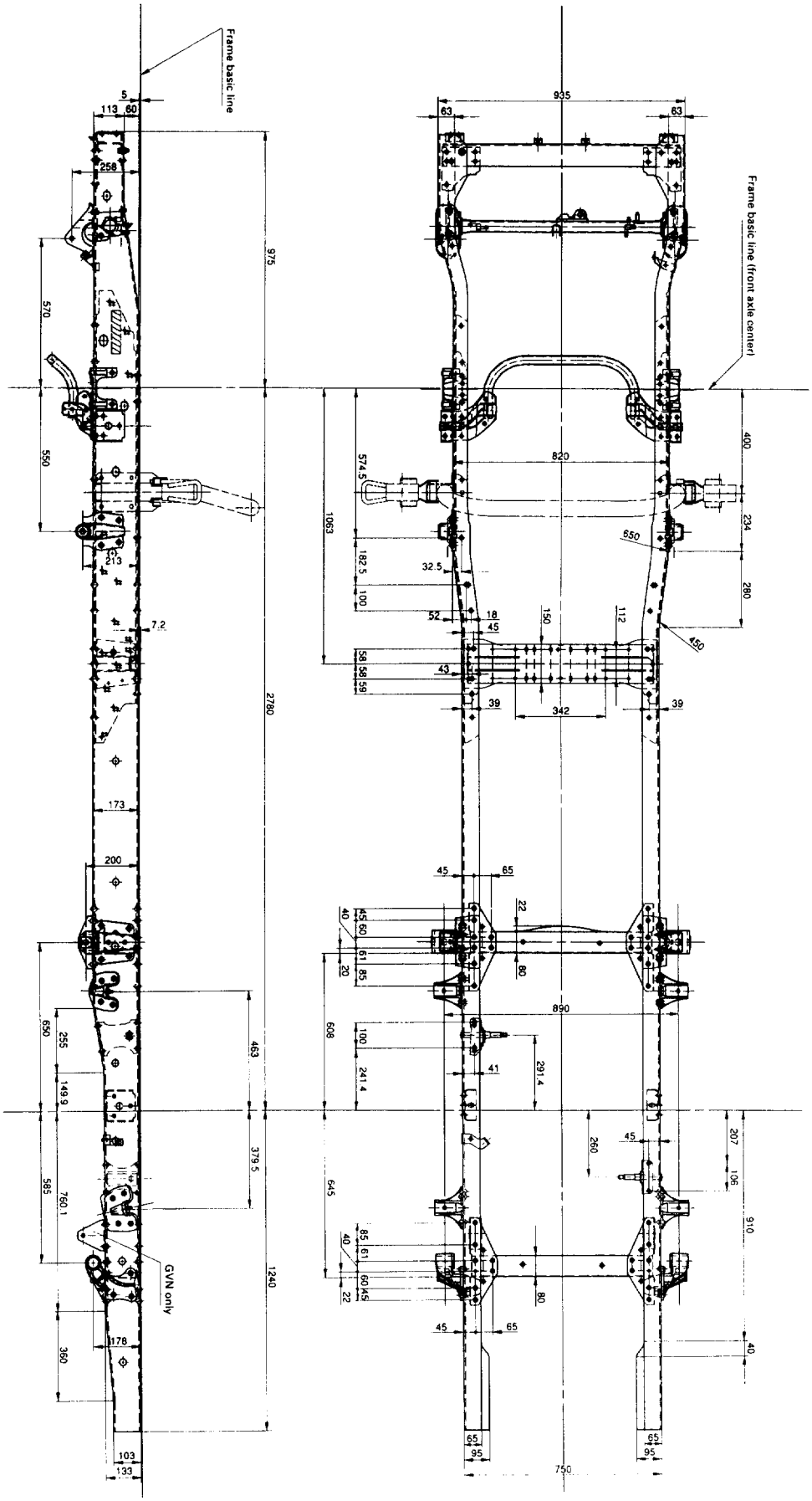


Dual tire (Wide-wheelbase ; 2760 m/m)

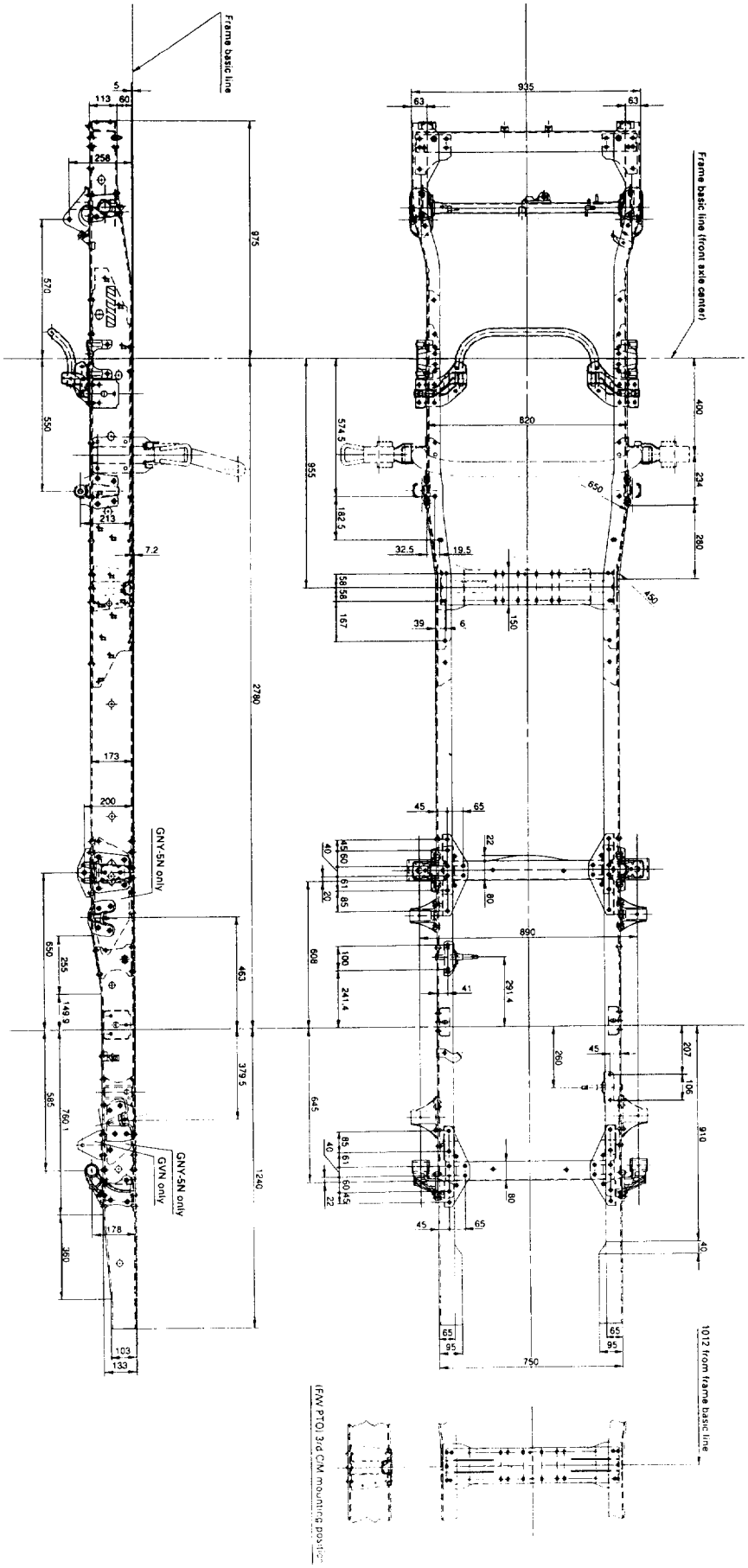
('99～)



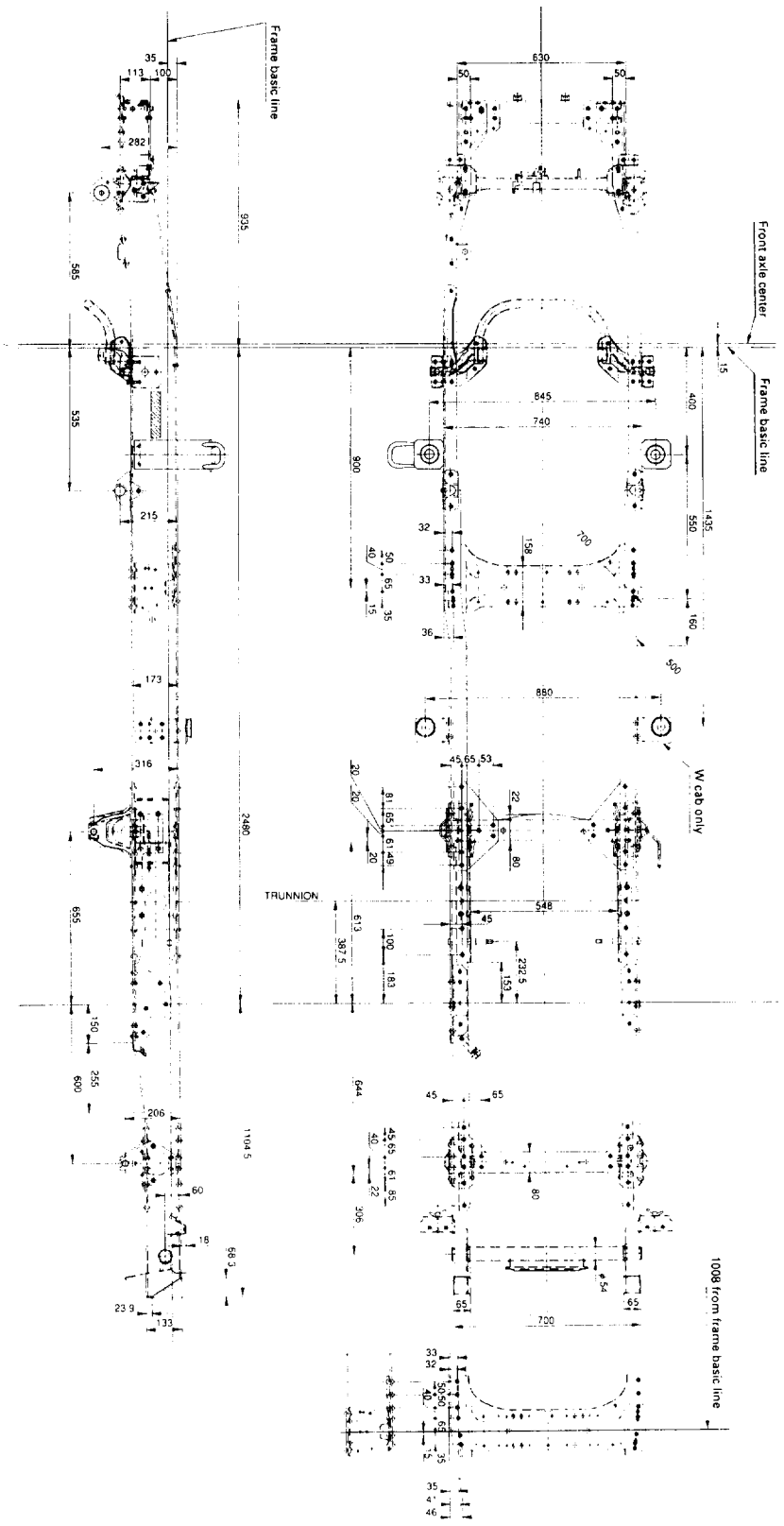
Dual tire (Wide-wheelbase ; 2765 m/m)



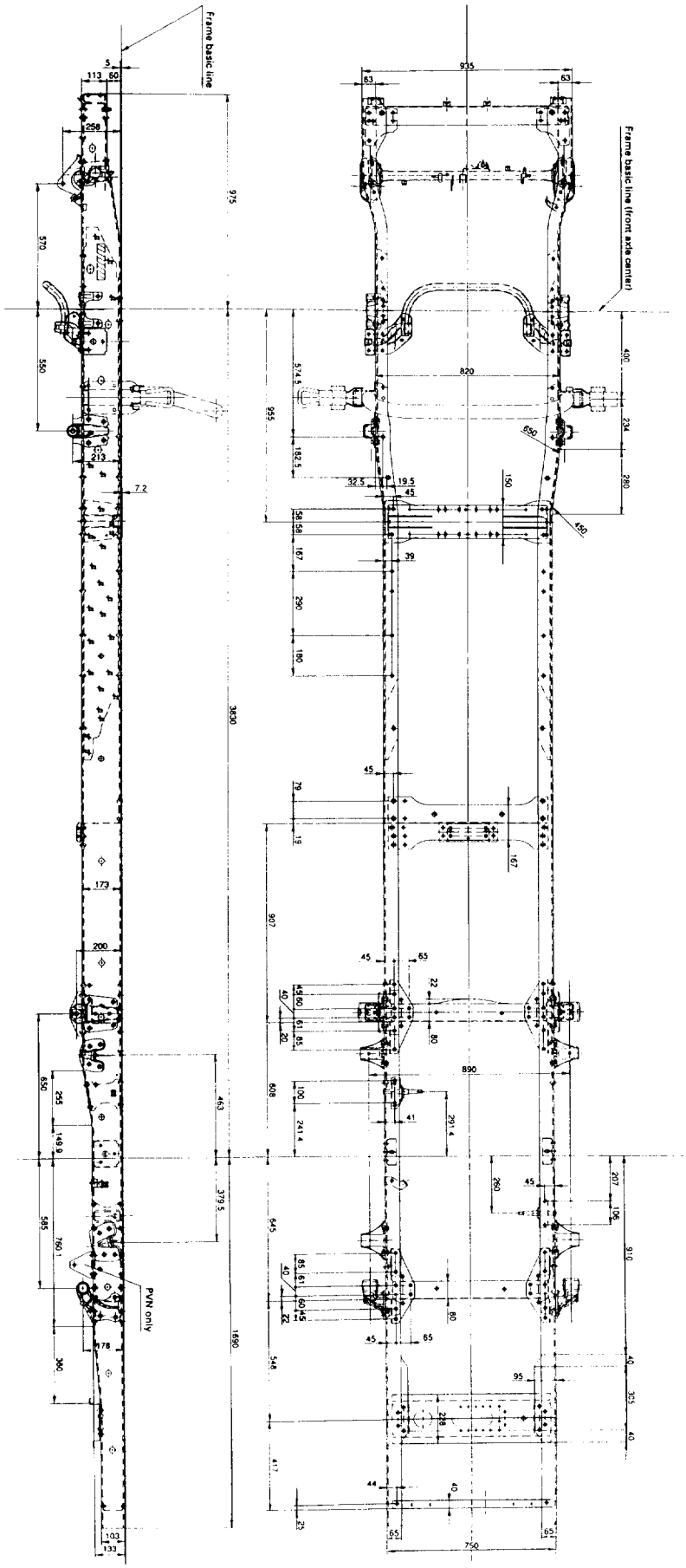
Dump (Wide)


Frame basic line
Frame basic line (front axle center)
GNY-5N only
GVN only
GNY-5N only
(FW PTO) 3rd C/M mounting position
1012 from frame basic line

Dump (Narrow)


Frame basic line
Front axle center
Frame basic line
W cab only
TRUNNION
1008 from frame basic line

Dual tire (Wide-wheelbase ; 3815 m/m)



LGFRM-WE-461

You are requested to order this manual using the manual number that is shown above.

This manual is applicable for vehicles in all countries except the USA and Canada.

All rights reserved. This manual may not be reproduced in whole or in part, without the permission in writing of ISUZU MOTORS LIMITED.

Issued by

ISUZU MOTORS LIMITED

INTERNATIONAL SERVICE DEPARTMENT

Tokyo, Japan

First edition Jan., 1994 9004-16N-1

NO.LGFRM-WE-461 PRINTED IN JAPAN

WORKSHOP MANUAL

NKR · NPR · NQR

GENERAL INFORMATION

SECTION 0

ISUZU

ISUZU

International Service & Parts

Tokyo, Japan

NOTICE

Before using this Workshop Manual to assist you in performing vehicle service and maintenance operations, it is recommended that you carefully read and thoroughly understand the information contained in Section 0A under the headings "GENERAL REPAIR INSTRUCTIONS" and "HOW TO USE THIS MANUAL".

All material contained in this Manual is based on latest product information available at the time of publication.
All rights are reserved to make changes at any time without prior notice.

Applicable Model

N-Series		
NKR55	NPR55 NPR70	NQR70

This manual is applicable to 2000 year model.

THIS MANUAL INCLUDES THE FOLLOWING SECTIONS:

SECTION NO.	CONTENTS
0A	General Information
0B	Maintenance and Lubrication

SECTION 0A
GENERAL INFORMATION

CONTENTS

	PAGE
General Repair Instructions	0A– 2
How To Use This Manual	0A– 3
Identification	0A– 6
Lifting Instruction	0A– 7
Torque Specifications	0A– 9
Recommended Liquid Gasket	0A–10
Recommended Thread Locking Agent	0A–12

GENERAL REPAIR INSTRUCTIONS

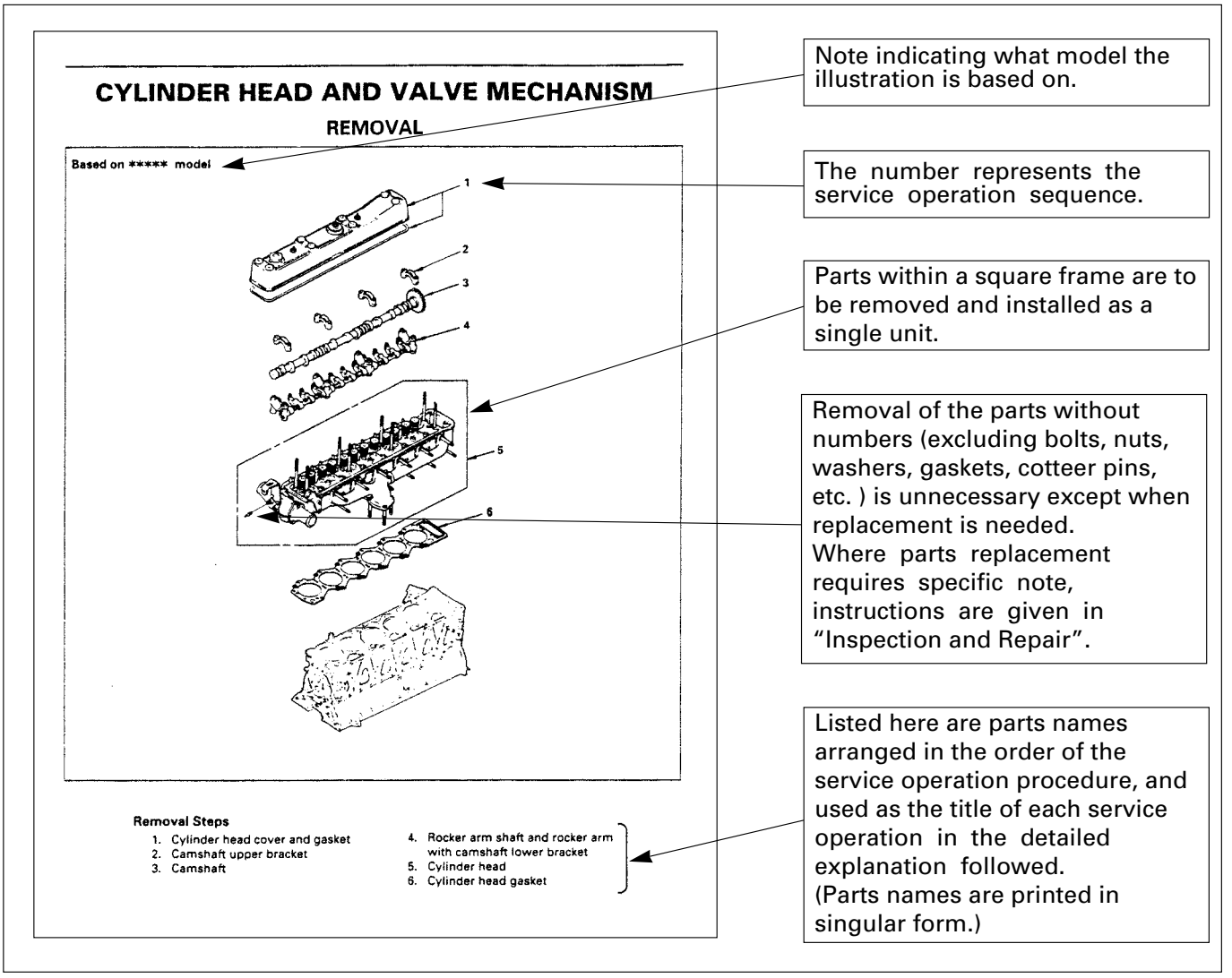
1. Park the vehicle on level ground and chock the front or rear wheels before lifting the vehicle.
2. Use covers on the vehicle body, seats, and floor to prevent damage and/or contaminations.
3. Disconnect the grounding cable from the battery before performing service operations. This will prevent cable damage or burning due to shortcircuiting.
4. Raise the vehicle with a jack set against the axle or the frame.
5. Support the vehicle on chassis stands.
6. Handle brake fluid and antifreeze solution with great care.
   Spilling these liquids on painted surfaces will damage the paint.
7. The use of the proper tool(s) and special tool(s) where specified is essential to efficient, reliable, and safe service operations.
8. Always use genuine ISUZU replacement parts.
9. Discard used cotter pins, gasket, O-rings, oil seals, lock washers, and self-locking nuts at disassembly.
   Normal function of these parts cannot be guaranteed if they are reused.
10. Keep the disassembled parts neatly in groups. This will facilitate smooth and correct reassembly.
11. Keep fixing nuts and bolts separate.
    Fixing nuts and bolts vary in hardness and design according to installation positions.
12. Clean all parts before inspection or reassembly.
13. Clean the oil ports and other openings with compressed air to make certain that they are free of dirt and obstructions.
14. Lubricate the rotating and sliding faces of all moving parts with oil or grease before installation.
15. Use the recommended liquid gasket to prevent leakage.
16. Be sure to tighten bolts and nuts to the specified torque, using a properly maintained torque wrench.
17. When service operation is completed, make a final check to be sure service has been done properly and problem has been corrected.
18. When removing or replacing parts that require refrigerant to the discharged from the Air conditioning system, be sure to use the ACR^4 or equivalent to recover and recycle Refrigerant-134a, to promote the movement for the protection of the ozone layer covering the earth.
19. To assure safety, always slowly release air pressure from the air tanks before disconnecting pipes, hoses or other parts from any unit under pressure.

HOW TO USE THIS MANUAL

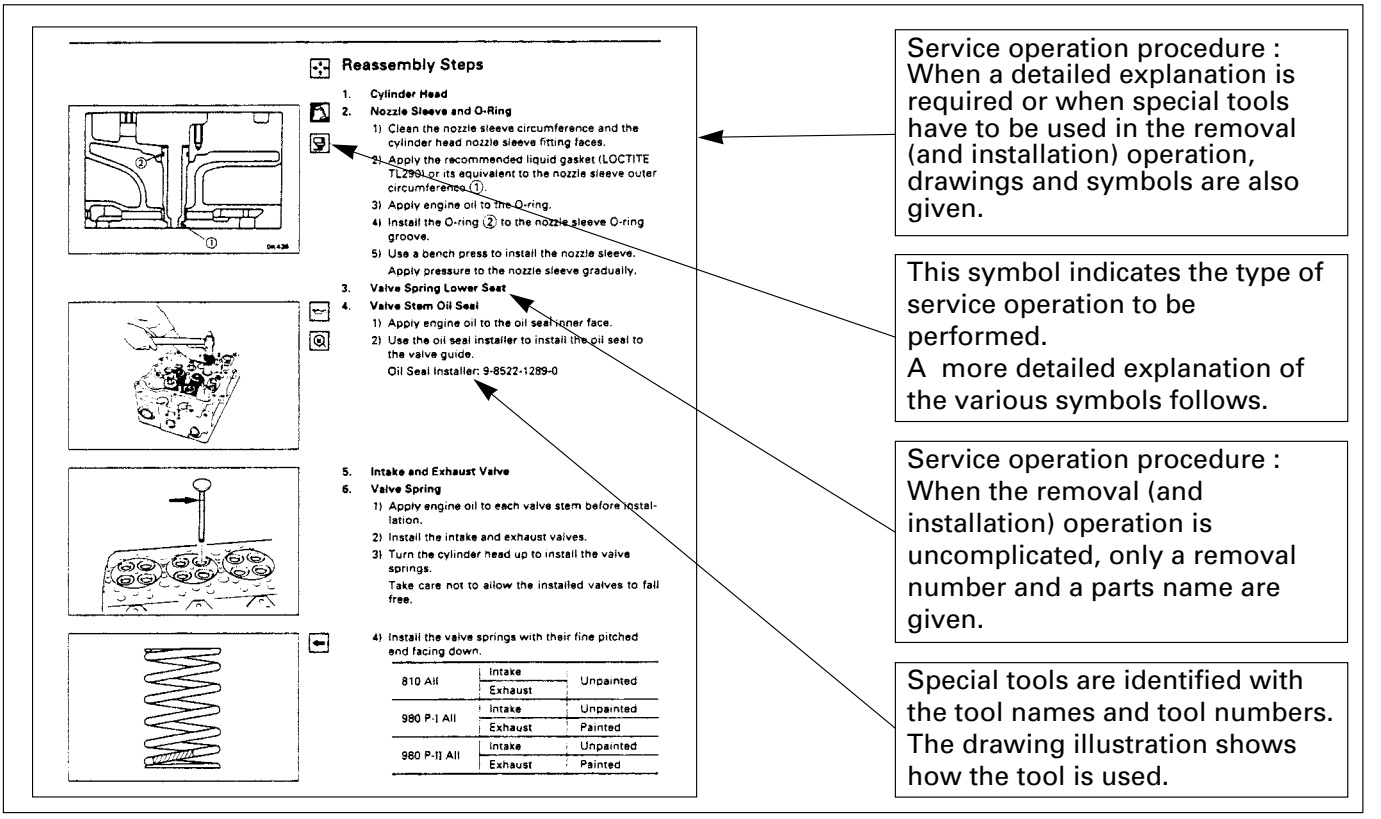
1. The "GENERAL INFORMATION" includes collectively the following items ① to ⑪ which have relations with all the sections. These items should be read and understood fully before starting each service operations.
   - ① General Repair Instruction
   - ② How To Use This Manual
   - ③ Model Change Information
   - ④ Lifting Instruction
   - ⑤ Torque Specification
   - ⑥ Recommended Liquid Gasket
   - ⑦ Liquid Gasket Application Procedure
   - ⑧ Maintenance Schedule
   - ⑨ Recommended Fluids, Lubricants and Fuels
   - ⑩ Oil Viscosity Chart
   - ⑪ Lubrication Chart
2. The "SERVICE INFORMATION" at the beginning of each service operation section, describes the following information and data ① to ⑥ necessary for the service operation.
   - ① Troubleshooting
   - ② Main Data and Specifications
   - ③ Service Standard
   - ④ Servicing
   - ⑤ Fixing Torque
   - ⑥ Special Tools
3. The description of each service operation section consists of Removal and Installation, Disassembly, Inspection and Repair and Reassembly.

4. Each service operation section begins with a disassembly view of the unit of equipment (with exception of Inspection and Repair).

   This illustration is useful for finding components, service procedure, etc.



5. Service operation procedure.

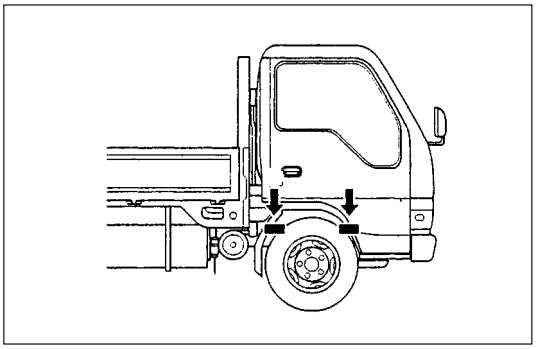


6. In this manual, the following symbols are used to give a full understanding of the service operation to be performed.

... Remove		... Clean	
... Install		... Pay close attention	
... Disassemble		... Tighten to specified torque	
... Reassemble		... Use special tool(s) (Isuzu's tool(s))	
... Align the marks		... Use special tool(s) (parts manufacturer's tool(s))	
... Correct direction		... Lubricate with oil	
... Inspect		... Lubricate with grease	
... Take measurement		... Apply liquid gasket	
... Adjustment			

7. The service standard is indicated in terms of "Standard" and "Limit".
The "Standard" means the assembly standard and standard range within which the parts are considered serviceable. "Limit" indicates the limit value (Correction or replacement is necessary when measurement is beyond this limit).

IDENTIFICATION

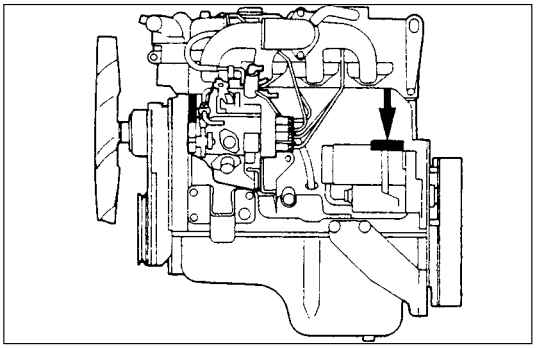


Chassis Number:

It is stamped on the front right-hand side face of the chassis side member.

①: NKR model with independent front suspension.

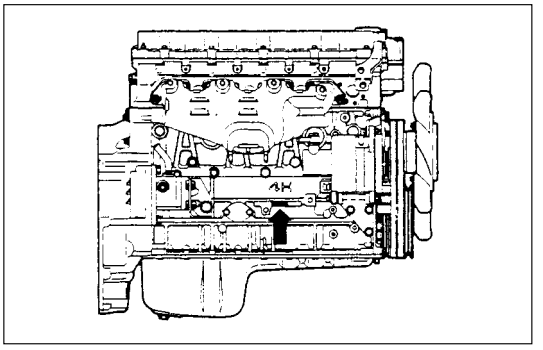
②: NKR, NPR and NQR models with rigid axle front suspension.



Engine Number:

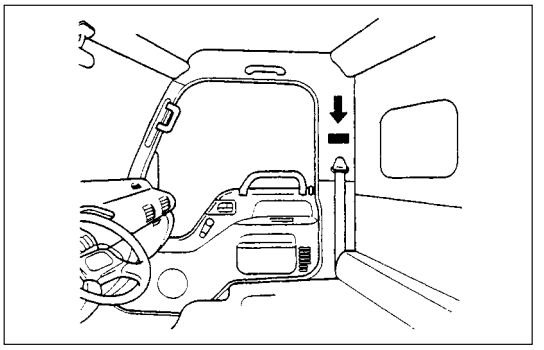
4J Series Engine

It is stamped on the left side rear of the cylinder body.



4H Series Engine

The engine number is stamped on the right side of the cylinder body.



Vehicle Identification plate

The vehicle identification plate is attached to the interior side of the cab side panel on the right side.

LIFTING INSTRUCTION

If it is necessary to use a lifting device other than the original equipment jack, see illustration for acceptable lifting points.

Lifting should only be done at the positions indicated to prevent possible damage to the vehicle.

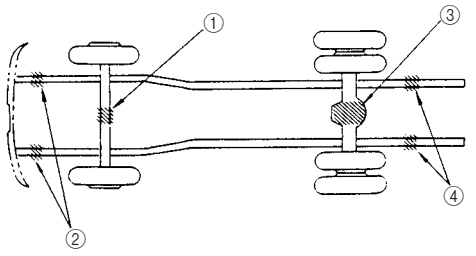
CAUTION:

Failure to observe the acceptable lift points may result in unsatisfactory vehicle performance or a durability failure which may result in loss of control of the vehicle.

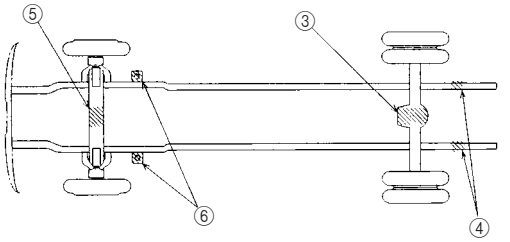
Garage Jack and Safety Stand

Lifting point and supportable point location

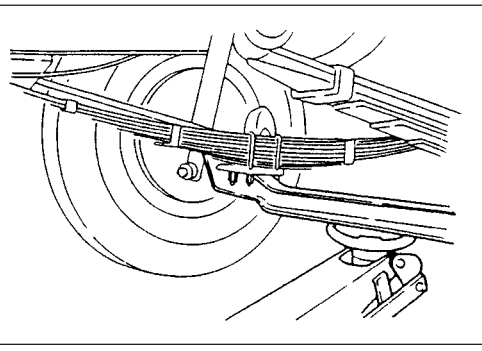
NKR,NPR,NQR



NKR
(Front independent suspention)



① Front axle
② Side frame front side
③ Rear axle center
④ Side frame rear side
⑤ Suspension cross member
⑥ Jack up bracket

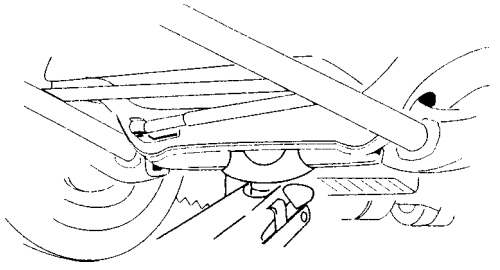


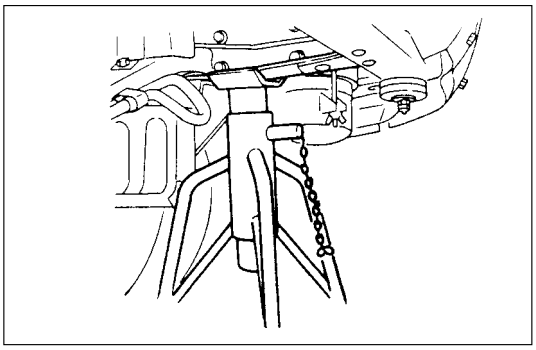
Front Side; Lifting Point

Note:

Do not lift or support on engine oil pan.

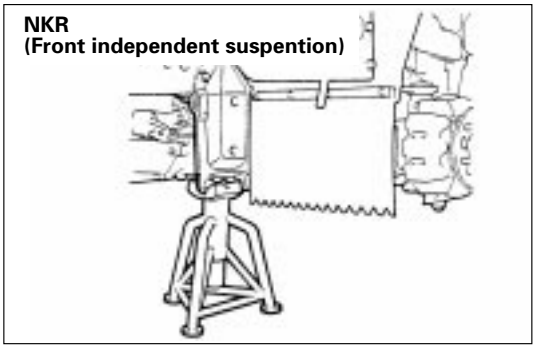
NKR
(Front independent suspention)

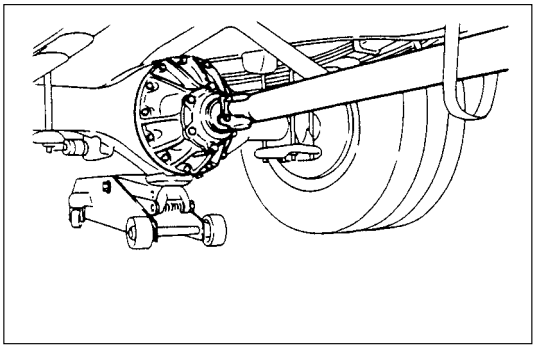




Front Side Supportable Point

NKR
(Front independent suspention)

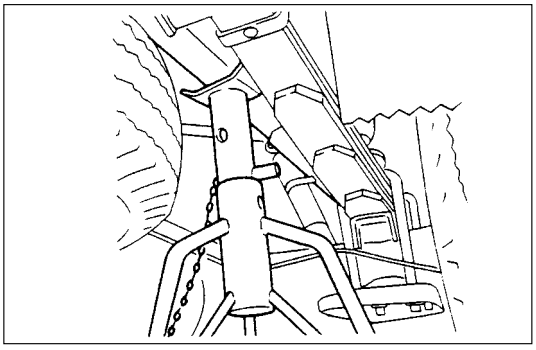




Rear Side Lifting Point

Note:

Do not lift or support on rear axle tube.



Rear Side Supportable Point

TORQUE SPECIFICATIONS

STANDARD BOLTS

The torque values given in the following table should be applied where a particular torque is not specified.

N·m (kg·m / lb·ft)
N·m kg·cm / lb·in

Strength Class / Bolt Identification / Bolt Diameter x Pitch (mm)	4.8	8.8 Refined	8.8 Non-Refined	9.8
Bolt Identification	4	8	.8	9
	No mark			
M 6x1.0	6 60 / 52	7 75 / 65		–
M 8x1.25	13 130 / 113	17 175 / 152		24 240 / 208
M10x1.25	27 (2.8 / 20)	37 (3.8 / 27)		50 (5.1 / 37)
M12x1.25	61 (6.3 / 45)	76 (7.8 / 56)		95 (9.7 / 70)
M14x1.5	96 (9.8 / 71)	116 (11.9 / 86)		142 (14.5 / 105)
M16x1.5	130 (13.3 / 96)	170 (17.3 / 125)		200 (20.4 / 148)
M18x1.5	188 (19.2 / 139)	244 (24.9 / 180)		287 (29.3 / 212)
M20x1.5	258 (26.3 / 190)	337 (34.4 / 249)		396 (40.4 / 292)
M22x1.5	332 (33.9 / 245)	453 (46.3 / 335)		530 (54.1 / 391)
M24x2.0	449 (45.8 / 331)	570 (58.2 / 421)		692 (70.6 / 511)
*M10x1.5	26 (2.7 / 20)	36 (3.7 / 27)		48 (4.9 / 35)
*M12x1.5	57 (5.8 / 42)	71 (7.2 / 52)		89 (9.1 / 66)
*M14x2.0	89 (9.1 / 66)	110 (11.2 / 81)		133 (13.6 / 98)
*M16x2.0	124 (12.7 / 92)	162 (16.5 / 119)		191 (19.5 / 141)

The asterisk * indicates that the bolts are used for female-threaded parts that are made of soft materials such as casting, etc.

FLARE NUTS

N·m (kg·m / lb·ft)

Pipe diameter mm (in)	Torque	Pipe diameter mm (in)	Torque
4.76 (0.187)	16 (1.6 / 12)	10.00 (0.394)	54 (5.5 / 40)
6.35 (0.250)	26 (2.7 / 20)	12.00 (0.472)	88 (9.0 / 65)
8.00 (0.315)	44 (4.5 / 33)	15.00 (0.591)	106 (10.8 / 78)

RECOMMENDED LIQUID GASKET

TYPE	BRAND NAME	MANUFACTURER	APPLICATION PARTS (EXAMPLE)
RTV* Silicon Base	ThreeBond 1207B ThreeBond 1207C ThreeBond 1215 ThreeBond 1216 ThreeBond 1281	ThreeBond ThreeBond ThreeBond ThreeBond ThreeBond	Engine Oil Seal Retainer Engine Oil Pan Timing Gear Case Cylinder Head Cover Fuel Pump Water Pump Rear Axle etc.
Water Base	ThreeBond 1141E	ThreeBond	
Solvent	ThreeBond 1104 BelcoBond 4 BelcoBond 401 BelcoBond 402	ThreeBond Isuzu Isuzu Isuzu	
Anaerobic	LOCTITE 515 LOCTITE 518 LOCTITE 5127	LOCTITE LOCTITE LOCTITE	Engine Oil Seal Retainer Water Pump Transaxle etc.

*RTV: Room Temperature Vulcanizer

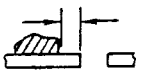
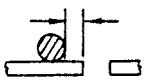
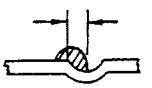
NOTE:

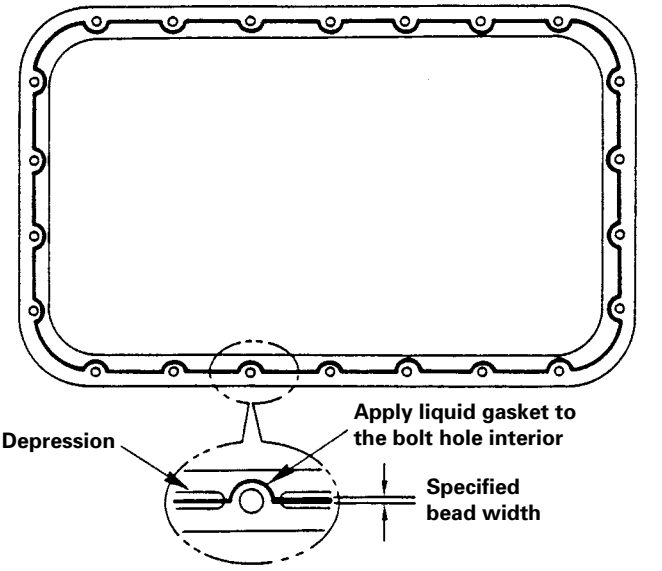
1. **It is very important that the liquid gaskets listed above or their exact equivalent be used on the vehicle.**
2. **LOCTITE 515 and LOCTITE 518 harden upon contact with a metal surface.**
   Do not apply LOCTITE 515 or LOCTITE 518 between two metal surfaces having a clearance of greater than 0.25 mm (0.001 in). Poor adhesion will result.
3. **Be careful to use the specified amount of liquid gasket.**
   Follow the manufacturer's instructions at all times.

Application Procedure

1. Completely remove lubricant and moisture from the connecting surfaces.
   The surfaces must be perfectly dry.
2. Apply specified bead width of liquid gasket to one of the connecting surfaces.

mm (in.)

SCREW HOLE	DEPRESSION	JUDGE-MENT
1~3 (0.04~0.12) 		OK
1~3 (0.04~0.12) 	More than 2(0.08) 	OK
		NG

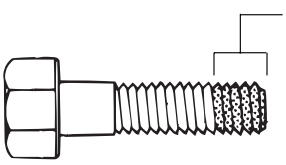


Example
Anaerobic Type : 2-3mm (0.08-0.12 inch)
Others : 2-6mm (0.08-0.24 inch)

NOTE:

When the application procedures are specified in this Workshop manual, follow them.

RECOMMENDED THREAD LOCKING AGENT

<table>
<tr><th>TYPE</th><th>COLOR</th><th>APPLICATION STEPS</th></tr>
<tr><td>LOCTITE 242</td><td>Blue</td><td rowspan="3">1. Completely remove all lubricant and moisture from the bolts and the female threaded surfaces of the parts to be joined.
The surfaces must be perfectly dry.
2. Apply LOCTITE to the bolts.
 

3. Tighten the bolts to the specified torque.
NOTE:
After tightening, be sure to keep the bolts free from vibration and torque for at least an hour until LOCTITE hardens.</td></tr>
<tr><td>LOCTITE 262</td><td>Red</td></tr>
<tr><td>LOCTITE 271</td><td>Red</td></tr>
</table>

NOTE:

When the application procedures are specified in this Workshop manual, follow them.

SECTION 0B
MAINTENANCE AND LUBRICATION

CONTENTS

PAGE

Maintenance Schedule 0B– 2
4JB1-TC engine model (ACEA B2 specification engine oil) 0B– 3
4JB1-TC engine model (Engine oil that meets or exceeds ACEA B3 specification) . . 0B– 9
4HE1-TC engine model 0B–15
Maintenance schedule under severe driving conditions 0B–21
Recommended Fluids, Lubricants and Diesel Fuels 0B–21
Oil Viscosity Chart 0B–22

MAINTENANCE SCHEDULE

When performing the checks on the following items, regular inspection items should also be checked.

ABBREVIATIONS USED IN THIS MANUAL

I : Inspect, clean and correct or replace as necessary
A : Adjust
R : Replace or change
T : Tighten to specified torque
L : Lubricate

V .....Variation (optional on some models).

OPT .....Optional equipment.

4J .....For 4JB1-TC engine model.

4H .....For 4HE1-TC engine model.

Maintenance schedule: 4JB1-TC engine model (ACEA B2 specification engine oil)

SERVICE INTERVAL: (Use odometer reading or months Whichever comes first)	x 1000 km / x 1000 mile	10 / 6	20 / 12	30 / 18	40 / 24	50 / 30	60 / 36	70 / 42	80 / 48	90 / 54	100 / 60	
4J	**ENGINE**											
*	Engine oil	R	R	R	R	R	R	R	R	R	R	or every 6 months
*	Engine oil filter	R	R	R	R	R	R	R	R	R	R	or every 6 months
	Fuel filter	-	R	-	R	-	R	-	R	-	R	or every 12 months
*	Air cleaner element	I	I	I	R	I	I	I	R	I	I	or every 24 months
	Idling speed and acceleration	-	I	-	I	-	I	-	I	-	I	or every 12 months
	Valve clearances	-	-	-	A	-	-	-	A	-	-	or every 24 months
	Fuel tank cap and fuel pipes for loose connections or damage	-	-	-	I	-	-	-	I	-	-	or every 24 months
	Drive belt tension and damage	I	I	I	I	I	I	I	I	I	I	or every 6 months
	Radiator coolant (Ethylene glycol anti-freeze)	-	-	-	R	-	-	-	R	-	-	or every 24 months
*	Exhaust pipes and mountings for looseness or damage	-	I	-	I	-	I	-	I	-	I	or every 12 months
	Cooling system for water leakage	-	I	-	I	-	I	-	I	-	I	or every 12 months
	Engine operation condition	I	I	I	I	I	I	I	I	I	I	or every 6 months

(I): Inspect and correct or replace as necessary (A): Adjust (R): Replace or change (T): Tighten to specified torque (L): Lubricate

Maintenance schedule: 4JB1-TC engine model (ACEA B2 specification engine oil)

SERVICE INTERVAL: (Use odometer reading or months Whichever comes first)	x 1000 km / x 1000 mile	10 / 6	20 / 12	30 / 18	40 / 24	50 / 30	60 / 36	70 / 42	80 / 48	90 / 54	100 / 60	
CLUTCH												
Clutch fluid		I	I	I	R	I	I	I	R	I	I	or every 24 months
Clutch pedal travel and free play		I	I	I	I	I	I	I	I	I	I	or every 6 months
TRANSMISSION												
* Manual transmission oil		I	I	I	R	I	I	I	R	I	I	or every 24 months
Gear control mechanism for looseness		-	-	-	I	-	-	-	I	-	-	or every 24 months
Gear control cables		-	A	-	A	-	A	-	A	-	A	or every 12 months
PROPELLER SHAFT												
* Universal joints and sliding sleeve grease		-	L	-	L	-	L	-	L	-	L	or every 12 months
Loose connections		I	I	I	I	I	I	I	I	I	I	or every 6 months
Splines for excessive wear		-	-	-	I	-	-	-	I	-	-	or every 24 months
Bearings and related parts for looseness		-	-	-	I	-	-	-	I	-	-	or every 24 months
Center bearing		-	L	-	L	-	L	-	L	-	L	or every 12 months
REAR AXLE												
* Differential gear oil		I	I	I	R	I	I	I	R	I	I	or every 24 months

(I): Inspect and correct or replace as necessary (A): Adjust (R): Replace or change (T): Tighten to specified torque (L): Lubricate

Maintenance schedule: 4JB1-TC engine model (ACEA B2 specification engine oil)

SERVICE INTERVAL: (Use odometer reading or months Whichever comes first)	x 1000 km / x 1000 mile	10 / 6	20 / 12	30 / 18	40 / 24	50 / 30	60 / 36	70 / 42	80 / 48	90 / 54	100 / 60	
FRONT AXLE												
* Kingpins		L	L	L	L	L	L	L	L	L	L	or every 6 months
STEERING												
Power steering system oil leakage		I	I	I	I	I	I	I	I	I	I	or every 6 months
* Power steering system for looseness or damage		I	I	I	I	I	I	I	I	I	I	or every 6 months
Power steering fluid		-	-	-	R	-	-	-	R	-	-	or every 24 months
Power steering hoses		-	-	-	-	-	-	-	R	-	-	or every 48 months
Fitting of knuckles and front axle for looseness		I	I	I	I	I	I	I	I	I	I	or every 6 months
Steering mechanism for looseness or damage		-	-	-	I	-	-	-	I	-	-	or every 24 months
Ball joints for damage		I	I	I	I	I	I	I	I	I	I	or every 6 months
(Independent suspension model only)												
Ball joints for excessive play		I	I	I	I	I	I	I	I	I	I	or every 6 months
(Independent suspension model only)												
Relay lever shaft for excessive play		I	I	I	I	I	I	I	I	I	I	or every 6 months
(Independent suspension model only)												
Steering wheel play		I	I	I	I	I	I	I	I	I	I	or every 6 months

(I): Inspect and correct or replace as necessary (A): Adjust (R): Replace or change (T): Tighten to specified torque (L): Lubricate

Maintenance schedule: 4JB1-TC engine model (ACEA B2 specification engine oil)

SERVICE INTERVAL: (Use odometer reading or months Whichever comes first)	x 1000 km / x 1000 mile	10 / 6	20 / 12	30 / 18	40 / 24	50 / 30	60 / 36	70 / 42	80 / 48	90 / 54	100 / 60	
	Steering function	I	I	I	I	I	I	I	I	I	I	or every 6 months
	Wheel alignment	-	-	-	I	-	-	-	I	-	-	or every 24 months
SERVICE BRAKES												
	Brake fluid	I	I	I	R	I	I	I	R	I	I	or every 24 months
	Brake system for fluid leakage	I	I	I	I	I	I	I	I	I	I	or every 6 months
*	Brake linings and drums for wear	I	I	I	I	I	I	I	I	I	I	or every 6 months
*	Disc brake pads and discs for wear	I	I	I	I	I	I	I	I	I	I	or every 6 months
	Brake pedal travel and free play	I	I	I	I	I	I	I	I	I	I	or every 6 months
	Pipes and hoses for loose connections or damage	I	I	I	I	I	I	I	I	I	I	or every 6 months
PARKING BRAKE												
	Parking brake cables	I	I	I	I	I	I	I	I	I	I	or every 6 months
	Parking brake function	I	I	I	I	I	I	I	I	I	I	or every 6 months
	Parking brake lever travel	I	I	I	I	I	I	I	I	I	I	or every 6 months
	Linings for wear	-	-	-	I	-	-	-	I	-	-	or every 24 months
	Drum for wear or damage	-	-	-	I	-	-	-	I	-	-	or every 24 months
	Ratchet for wear or damage	-	-	-	I	-	-	-	I	-	-	or every 24 months

(I): Inspect and correct or replace as necessary (A): Adjust (R): Replace or change (T): Tighten to specified torque (L): Lubricate

Maintenance schedule: 4JB1-TC engine model (ACEA B2 specification engine oil)

SERVICE INTERVAL: (Use odometer reading or months Whichever comes first)	x 1000 km / x 1000 mile	10 / 6	20 / 12	30 / 18	40 / 24	50 / 30	60 / 36	70 / 42	80 / 48	90 / 54	100 / 60	
SUSPENSION												
Spring leaves for damage		I	I	I	I	I	I	I	I	I	I	or every 6 months
Torsion bar spring		I	I	I	I	I	I	I	I	I	I	or every 6 months
(Independent suspension model only)												
Ball joint boots for damage		I	I	I	I	I	I	I	I	I	I	or every 6 months
(Independent suspension model only)												
Ball joints for excessive play		-	-	-	I	-	-	-	I	-	-	or every 24 months
(Independent suspension model only)												
Mounts for looseness or damage		I	I	I	I	I	I	I	I	I	I	or every 6 months
Shock absorbers for oil leakage		I	I	I	I	I	I	I	I	I	I	or every 6 months
Shock absorbers mount for looseness		I	I	I	I	I	I	I	I	I	I	or every 6 months
Upper links (Independent suspension model only)		L	L	L	L	L	L	L	L	L	L	or every 6 months
WHEELS												
Wheel pins and nuts		-	T	-	T	-	T	-	T	-	T	or every 12 months
Wheel discs for damage		-	I	-	I	-	I	-	I	-	I	or every 12 months
Hub bearings grease		-	-	-	R	-	-	-	R	-	-	or every 24 months
Tire pressures and damage		I	I	I	I	I	I	I	I	I	I	or every 6 months

(I): Inspect and correct or replace as necessary (A): Adjust (R): Replace or change (T): Tighten to specified torque (L): Lubricate

Maintenance schedule: 4JB1-TC engine model (ACEA B2 specification engine oil)

SERVICE INTERVAL:												
(Use odometer reading or months	x 1000 km	10	20	30	40	50	60	70	80	90	100	
Whichever comes first)	x 1000 mile	6	12	18	24	30	36	42	48	54	60	
ELECTRICAL EQUIPMENT												
Specific gravity of battery electrolyte		I	I	I	I	I	I	I	I	I	I	or every 6 months
OTHERS												
Lights, horn, windshield, wiper and washers		I	I	I	I	I	I	I	I	I	I	or every 6 months
Bolts and nuts on chassis and body		-	-	-	I	-	-	-	I	-	-	or every 24 months

(I): Inspect and correct or replace as necessary (A): Adjust (R): Replace or change (T): Tighten to specified torque (L): Lubricate

Maintenance schedule: 4JB1-TC engine model (Engine oil that meets or exceeds ACEA B3 specification)

	SERVICE INTERVAL: (Use odometer reading or months Whichever comes first)	x 1000 km x 1000 mile	15 9	30 18	45 27	60 36	75 45	90 54	105 63	120 72	135 81	150 90	
4J	**ENGINE**												
*	Engine oil		R	R	R	R	R	R	R	R	R	R	or every 9 months
*	Engine oil filter		R	R	R	R	R	R	R	R	R	R	or every 9 months
	Fuel filter		-	R	-	R	-	R	-	R	-	R	or every 18 months
*	Air cleaner element		I	I	I	R	I	I	I	R	I	I	or every 36 months
	Idling speed and acceleration		-	I	-	I	-	I	-	I	-	I	or every 18 months
	Valve clearances		-	-	-	A	-	-	-	A	-	-	or every 36 months
	Fuel tank cap and fuel pipes for loose connections or damage		-	-	-	I	-	-	-	I	-	-	or every 36 months
	Drive belt tension and damage		I	I	I	I	I	I	I	I	I	I	or every 9 months
	Radiator coolant (Ethylene glycol anti-freeze)		-	-	-	R	-	-	-	R	-	-	or every 36 months
*	Exhaust pipes and mountings for looseness or damage		-	I	-	I	-	I	-	I	-	I	or every 18 months
	Cooling system for water leakage		-	I	-	I	-	I	-	I	-	I	or every 18 months
	Engine operation condition		I	I	I	I	I	I	I	I	I	I	or every 9 months

(I): Inspect and correct or replace as necessary (A): Adjust (R): Replace or change (T): Tighten to specified torque (L): Lubricate

Maintenance schedule: 4JB1-TC engine model (Engine oil that meets or exceeds ACEA B3 specification)

SERVICE INTERVAL:												
(Use odometer reading or months	x 1000 km	15	30	45	60	75	90	105	120	135	150	
Whichever comes first)	x 1000 mile	9	18	27	36	45	54	63	72	81	90	
CLUTCH												
	Clutch fluid	I	I	I	R	I	I	I	R	I	I	or every 24 months
	Clutch pedal travel and free play	I	I	I	I	I	I	I	I	I	I	or every 6 months
TRANSMISSION												
*	Manual transmission oil	I	I	I	R	I	I	I	R	I	I	or every 24 months
	Gear control mechanism for looseness	-	-	-	I	-	-	-	I	-	-	or every 24 months
	Gear control cables	-	A	-	A	-	A	-	A	-	A	or every 12 months
PROPELLER SHAFT												
*	Universal joints and sliding sleeve grease	-	L	-	L	-	L	-	L	-	L	or every 12 months
	Loose connections	I	I	I	I	I	I	I	I	I	I	or every 6 months
	Splines for excessive wear	-	-	-	I	-	-	-	I	-	-	or every 24 months
	Bearings and related parts for looseness	-	-	-	I	-	-	-	I	-	-	or every 24 months
	Center bearing	-	L	-	L	-	L	-	L	-	L	or every 12 months
REAR AXLE												
*	Differential gear oil	I	I	I	R	I	I	I	R	I	I	or every 24 months

(I): Inspect and correct or replace as necessary (A): Adjust (R): Replace or change (T): Tighten to specified torque (L): Lubricate

Maintenance schedule: 4JB1-TC engine model (Engine oil that meets or exceeds ACEA B3 specification)

SERVICE INTERVAL: (Use odometer reading or months Whichever comes first)	x 1000 km / x 1000 mile	15 / 9	30 / 18	45 / 27	60 / 36	75 / 45	90 / 54	105 / 63	120 / 72	135 / 81	150 / 90	
FRONT AXLE												
* Kingpins		L	L	L	L	L	L	L	L	L	L	or every 9 months
STEERING												
Power steering system oil leakage		I	I	I	I	I	I	I	I	I	I	or every 9 months
* Power steering system for looseness or damage		I	I	I	I	I	I	I	I	I	I	or every 9 months
Power steering fluid		-	-	-	R	-	-	-	R	-	-	or every 36 months
Power steering hoses		-	-	-	-	-	-	-	R	-	-	or every 72 months
Fitting of knuckles and front axle for looseness		I	I	I	I	I	I	I	I	I	I	or every 9 months
Steering mechanism for looseness or damage		-	-	-	I	-	-	-	I	-	-	or every 36 months
Ball joints for damage		I	I	I	I	I	I	I	I	I	I	or every 9 months
(Independent suspension model only)												
Ball joints for excessive play		I	I	I	I	I	I	I	I	I	I	or every 9 months
(Independent suspension model only)												
Relay lever shaft for excessive play		I	I	I	I	I	I	I	I	I	I	or every 9 months
(Independent suspension model only)												
Steering wheel play		I	I	I	I	I	I	I	I	I	I	or every 9 months

(I): Inspect and correct or replace as necessary (A): Adjust (R): Replace or change (T): Tighten to specified torque (L): Lubricate

Maintenance schedule: 4JB1-TC engine model (Engine oil that meets or exceeds ACEA B3 specification)

SERVICE INTERVAL:												
(Use odometer reading or months	x 1000 km	15	30	45	60	75	90	105	120	135	150	
Whichever comes first)	x 1000 mile	9	18	27	36	45	54	63	72	81	90	
Steering function		I	I	I	I	I	I	I	I	I	I	or every 9 months
Wheel alignment		-	-	-	I	-	-	-	I	-	-	or every 36 months
SERVICE BRAKES												
Brake fluid		I	I	I	R	I	I	I	R	I	I	or every 36 months
Brake system for fluid leakage		I	I	I	I	I	I	I	I	I	I	or every 9 months
* Brake linings and drums for wear		I	I	I	I	I	I	I	I	I	I	or every 9 months
* Disc brake pads and discs for wear		I	I	I	I	I	I	I	I	I	I	or every 9 months
Brake pedal travel and free play		I	I	I	I	I	I	I	I	I	I	or every 9 months
Pipes and hoses for loose connections or damage		I	I	I	I	I	I	I	I	I	I	or every 9 months
PARKING BRAKE												
Parking brake cables		I	I	I	I	I	I	I	I	I	I	or every 9 months
Parking brake function		I	I	I	I	I	I	I	I	I	I	or every 9 months
Parking brake lever travel		I	I	I	I	I	I	I	I	I	I	or every 9 months
Linings for wear		-	-	-	I	-	-	-	I	-	-	or every 36 months
Drum for wear or damage		-	-	-	I	-	-	-	I	-	-	or every 36 months
Ratchet for wear or damage		-	-	-	I	-	-	-	I	-	-	or every 36 months

(I): Inspect and correct or replace as necessary (A): Adjust (R): Replace or change (T): Tighten to specified torque (L): Lubricate

Maintenance schedule: 4JB1-TC engine model (Engine oil that meets or exceeds ACEA B3 specification)

SERVICE INTERVAL: (Use odometer reading or months Whichever comes first)	x 1000 km / x 1000 mile	15 / 9	30 / 18	45 / 27	60 / 36	75 / 45	90 / 54	105 / 63	120 / 72	135 / 81	150 / 90	
SUSPENSION												
Spring leaves for damage		I	I	I	I	I	I	I	I	I	I	or every 9 months
Torsion bar spring		I	I	I	I	I	I	I	I	I	I	or every 9 months
(Independent suspension model only)												
Ball joint boots for damage		I	I	I	I	I	I	I	I	I	I	or every 9 months
(Independent suspension model only)												
Ball joints for excessive play		-	-	-	I	-	-	-	I	-	-	or every 36 months
(Independent suspension model only)												
Mounts for looseness or damage		I	I	I	I	I	I	I	I	I	I	or every 9 months
Shock absorbers for oil leakage		I	I	I	I	I	I	I	I	I	I	or every 9 months
Shock absorbers mount for looseness		I	I	I	I	I	I	I	I	I	I	or every 9 months
Upper links (Independent suspension model only)		L	L	L	L	L	L	L	L	L	L	or every 9 months
WHEELS												
Wheel pins and nuts		-	T	-	T	-	T	-	T	-	T	or every 18 months
Wheel discs for damage		-	I	-	I	-	I	-	I	-	I	or every 18 months
Hub bearings grease		-	-	-	R	-	-	-	R	-	-	or every 36 months
Tire pressures and damage		I	I	I	I	I	I	I	I	I	I	or every 9 months

(I): Inspect and correct or replace as necessary (A): Adjust (R): Replace or change (T): Tighten to specified torque (L): Lubricate

Maintenance schedule: 4JB1-TC engine model (Engine oil that meets or exceeds ACEA B3 specification)

SERVICE INTERVAL:												
(Use odometer reading or months	x 1000 km	15	30	45	60	75	90	105	120	135	150	
Whichever comes first)	x 1000 mile	9	18	27	36	45	54	63	72	81	90	
ELECTRICAL EQUIPMENT												
Specific gravity of battery electrolyte		I	I	I	I	I	I	I	I	I	I	or every 9 months
OTHERS												
Lights, horn, windshield, wiper and washers		I	I	I	I	I	I	I	I	I	I	or every 9 months
Bolts and nuts on chassis and body		-	-	-	I	-	-	-	I	-	-	or every 36 months

(I): Inspect and correct or replace as necessary (A): Adjust (R): Replace or change (T): Tighten to specified torque (L): Lubricate

Maintenance schedule: 4HE1-TC engine model

SERVICE INTERVAL: (Use odometer reading or months Whichever comes first)	km / mile	11250 7000	22500 14000	33750 21000	45000 28000	56250 35000	67500 42000	78750 49000	90000 56000	
4H **ENGINE**										
* Engine oil		-	R	-	R	-	R	-	R	or every 14 months
* Engine oil filter		-	R	-	R	-	R	-	R	or every 14 months
Fuel filter: Main fuel filter		-	R	-	R	-	R	-	R	or every 14 months
OPT Main fuel filter and Sub fuel filter: with Sub fuel filter		-	-	-	R	-	-	-	R	or every 28 months
* Air cleaner element		I	I	I	R	I	I	I	R	or every 28 months
Idling speed and acceleration		-	I	-	I	-	I	-	I	or every 14 months
Valve clearances		-	-	-	A	-	-	-	A	or every 28 months
Feed pump strainer		-	I	-	I	-	I	-	I	or every 14 months
Fuel tank cap and fuel pipes for loose connections or damage		-	-	-	I	-	-	-	I	or every 28 months
Drive belt tension and damage		I	I	I	I	I	I	I	I	or every 7 months
Radiator coolant (Ethylene glycol anti-freeze)		-	-	-	R	-	-	-	R	or every 28 months
* Exhaust pipes and mountings for looseness or damage		-	I	-	I	-	I	-	I	or every 14 months
Cooling system for water leakage		-	I	-	I	-	I	-	I	or every 14 months
Engine operation condition		I	I	I	I	I	I	I	I	or every 7 months

(I): Inspect and correct or replace as necessary (A): Adjust (R): Replace or change (T): Tighten to specified torque (L): Lubricate

Maintenance schedule: 4HE1-TC engine model

SERVICE INTERVAL: (Use odometer reading or months Whichever comes first)	km / mile	11250 7000	22500 14000	33750 21000	45000 28000	56250 35000	67500 42000	78750 49000	90000 56000	
CLUTCH										
	Clutch fluid	I	I	I	R	I	I	I	R	or every 28 months
	Clutch pedal travel and free play	I	I	I	I	I	I	I	I	or every 7 months
TRANSMISSION										
*	Manual transmission oil	I	I	I	R	I	I	I	R	or every 28 months
	Gear control mechanism for looseness	-	-	-	I	-	-	-	I	or every 21 months
	Gear control cables	-	A	-	A	-	A	-	A	or every 14 months
PROPELLER SHAFT										
*	Universal joints and sliding sleeve grease	-	L	-	L	-	L	-	L	or every 14 months
	Loose connections	I	I	I	I	I	I	I	I	or every 7 months
	Splines for excessive wear	-	-	-	I	-	-	-	I	or every 28 months
	Bearings and related parts for looseness	-	-	-	I	-	-	-	I	or every 28 months
	Center bearing	-	L	-	L	-	L	-	L	or every 14 months
REAR AXLE										
*	Differential gear oil	I	I	I	R	I	I	I	R	or every 28 months

(I): Inspect and correct or replace as necessary (A): Adjust (R): Replace or change (T): Tighten to specified torque (L): Lubricate

Maintenance schedule: 4HE1-TC engine model

SERVICE INTERVAL: (Use odometer reading or months Whichever comes first)	km / mile	11250 7000	22500 14000	33750 21000	45000 28000	56250 35000	67500 42000	78750 49000	90000 56000	
FRONT AXLE										
* Kingpins		L	L	L	L	L	L	L	L	or every 7 months
STEERING										
Power steering system oil leakage		I	I	I	I	I	I	I	I	or every 7 months
* Power steering system for looseness or damage		I	I	I	I	I	I	I	I	or every 7 months
Power steering fluid		-	-	-	R	-	-	-	R	or every 28 months
Power steering hoses		-	-	-	-	-	-	-	R	or every 56 months
Fitting of knuckles and front axle for looseness		I	I	I	I	I	I	I	I	or every 7 months
Steering mechanism for looseness or damage		-	-	-	I	-	-	-	I	or every 28 months
Steering wheel play		I	I	I	I	I	I	I	I	or every 7 months
Steering function		I	I	I	I	I	I	I	I	or every 7 months
Wheel alignment		-	-	-	I	-	-	-	I	or every 28 months

(I): Inspect and correct or replace as necessary (A): Adjust (R): Replace or change (T): Tighten to specified torque (L): Lubricate

Maintenance schedule: 4HE1-TC engine model

SERVICE INTERVAL: (Use odometer reading or months Whichever comes first)	km / mile	11250 7000	22500 14000	33750 21000	45000 28000	56250 35000	67500 42000	78750 49000	90000 56000	
SERVICE BRAKES										
Brake fluid		I	I	I	R	I	I	I	R	or every 28 months
V Hydro booster fluid (ATF)		I	I	I	R	I	I	I	R	or every 28 months
Brake system for fluid leakage		I	I	I	I	I	I	I	I	or every 7 months
* Brake linings and drums for wear		I	I	I	I	I	I	I	I	or every 7 months
* Disc brake pads and discs for wear		I	I	I	I	I	I	I	I	or every 7 months
Brake pedal travel and free play		I	I	I	I	I	I	I	I	or every 7 months
Pipes and hoses for loose connections or damage		I	I	I	I	I	I	I	I	or every 7 months
PARKING BRAKE										
Parking brake cables		I	I	I	I	I	I	I	I	or every 7 months
Parking brake function		I	I	I	I	I	I	I	I	or every 7 months
Parking brake lever travel		I	I	I	I	I	I	I	I	or every 7 months
Linings for wear		-	-	-	I	-	-	-	I	or every 28 months
Drum for wear or damage		-	-	-	I	-	-	-	I	or every 28 months
Ratchet for wear or damage		-	-	-	I	-	-	-	I	or every 28 months

(I): Inspect and correct or replace as necessary (A): Adjust (R): Replace or change (T): Tighten to specified torque (L): Lubricate

Maintenance schedule: 4HE1-TC engine model

SERVICE INTERVAL: (Use odometer reading or months Whichever comes first)	km / mile	11250 7000	22500 14000	33750 21000	45000 28000	56250 35000	67500 42000	78750 49000	90000 56000	
SUSPENSION										
Spring leaves for damage		I	I	I	I	I	I	I	I	or every 7 months
Mounts for looseness or damage		I	I	I	I	I	I	I	I	or every 7 months
Shock absorbers for oil leakage		I	I	I	I	I	I	I	I	or every 7 months
Shock absorbers mount for looseness		I	I	I	I	I	I	I	I	or every 7 months
WHEELS										
Wheel pins and nuts		T	T	T	T	T	T	T	T	or every 7 months
Wheel discs for damage		I	I	I	I	I	I	I	I	or every 7 months
Hub bearings grease		-	-	-	R	-	-	-	R	or every 28 months
Tire pressures and damage		I	I	I	I	I	I	I	I	or every 7 months
ELECTRICAL EQUIPMENT										
Specific gravity of battery electrolyte		I	I	I	I	I	I	I	I	or every 7 months
OTHERS										
Lights, horn, windshield, wiper and washers		I	I	I	I	I	I	I	I	or every 7 months
Bolts and nuts on chassis and body		-	-	-	I	-	-	-	I	or every 28 months

(I): Inspect and correct or replace as necessary (A): Adjust (R): Replace or change (T): Tighten to specified torque (L): Lubricate

Maintenance schedule under severe driving conditions

Severe driving conditions

A: Repeated short trips

B: Driving on rough roads

C: Driving on dusty roads

D: Driving in extremely cold weather and/or on salted roads

Item	Interval	Condition				
		A	B	C	D	A+B
Engine oil	Change every 5,000 km (3,000 miles)			●		●
Engine oil filter	Replace every 5,000 km (3,000 miles)			●		●
Air cleaner element	Replace every 20,000 km (12,000 miles)			●		
Exhaust pipes and mountings for looseness or damage	Inspect every 10,000 km (6,000 miles)	●	●		●	
Manual transmission oil and differential gear oil	Change every 20,000 km (12,000 miles)		●			
Universal joints and sliding sleeve grease	Lubricate every 10,000 km (6,000 miles)		●			
Kingpins	Lubricate every 5,000 km (3,000 miles)			●	●	
Steering system for looseness or damage	Inspect every 5,000 km (3,000 miles)		●			
Brake linings and drums for wear	Inspect every 5,000 km (3,000 miles)	●	●	●		
Disc brake pads and discs for wear	Inspect every 5,000 km (3,000 miles)	●	●	●		

RECOMMENDED FLUIDS, LUBRICANTS AND DIESEL FUELS

In order to obtain maximum performance and longest service life from your ISUZU vehicles, it is very important to select and use correctly best lubricants and diesel fuels.

When lubricating, be sure to use ISUZU genuine lubricants or recommended lubricants listed below, according to the maintenance schedule for each vehicle model.

LUBRICATION/FLUID	GRADE		
	ACEA	API	Other
Diesel engine crankcase	B2/B3 E2/E3		
Manual transmission Transfer case	B2/B3 E2/E3		
Differential		GL-5	
Automatic transmission Power steering Hydro brake booster			DEXRON II, III
Clutch and brake fluid reservoir			Hydraulic brake fluid SAE J1703 FMVSS 116 DOT. 3 or 4 grade
Center bearing King pin Upper links			NLGI #2 or #3 multi purpose type grease or wheel bearing grease
Propeller shaft sliding yoke Universal joint (General purpose grease in Molybdenum)			NLGI #2 or #3 multi purpose type grease containing molybdenum disulfide
Engine cooling system			Good quality ethylene glycol antifreeze or GM spec. 6038-M or equivalent

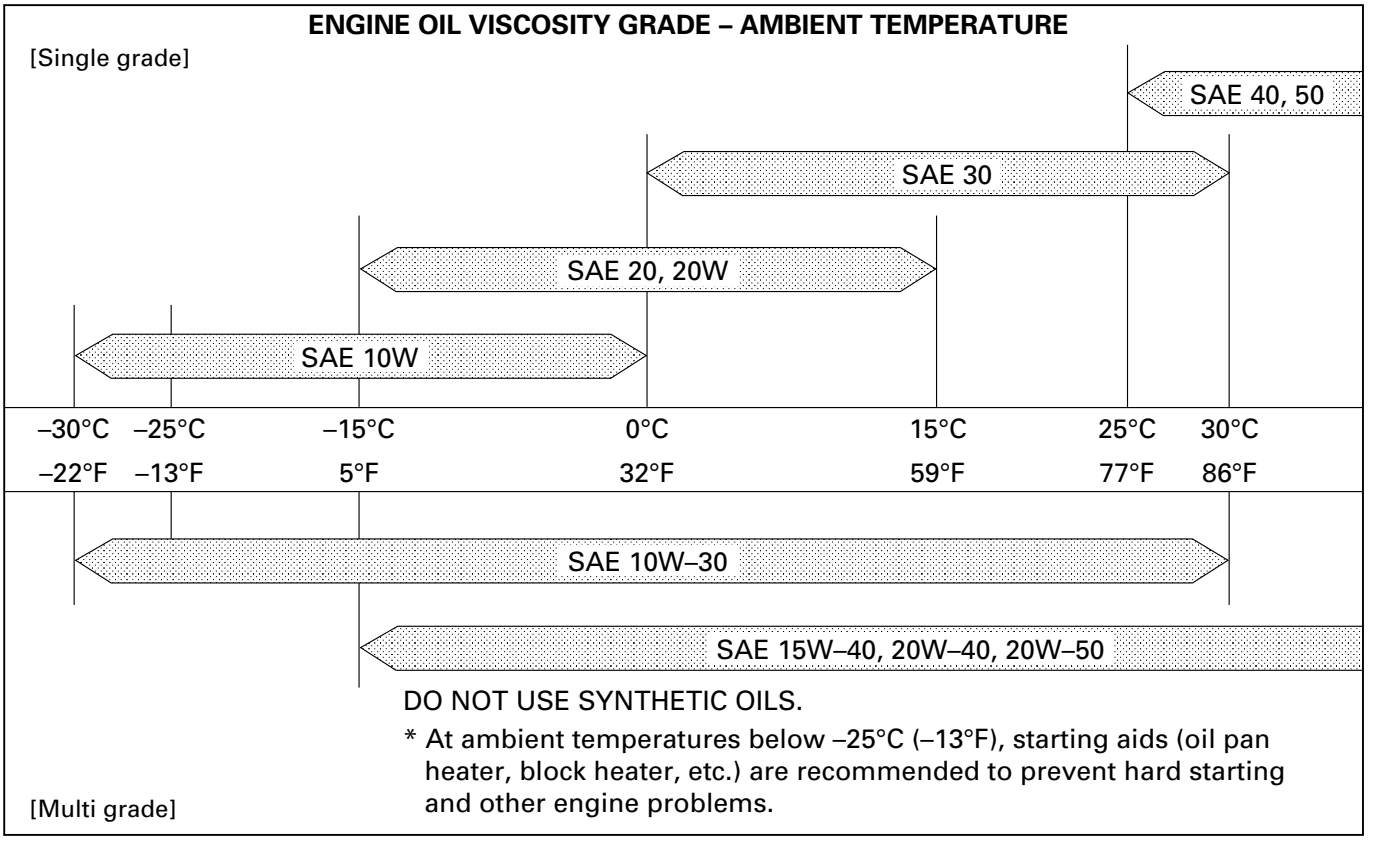
FLUID	TYPE
Clutch and brake fluid reservoir	Besco brake fluid (For light duty) Hydraulic brake fluid SAE J1703 FMVSS 116 DOT.3 grade

NOTE:

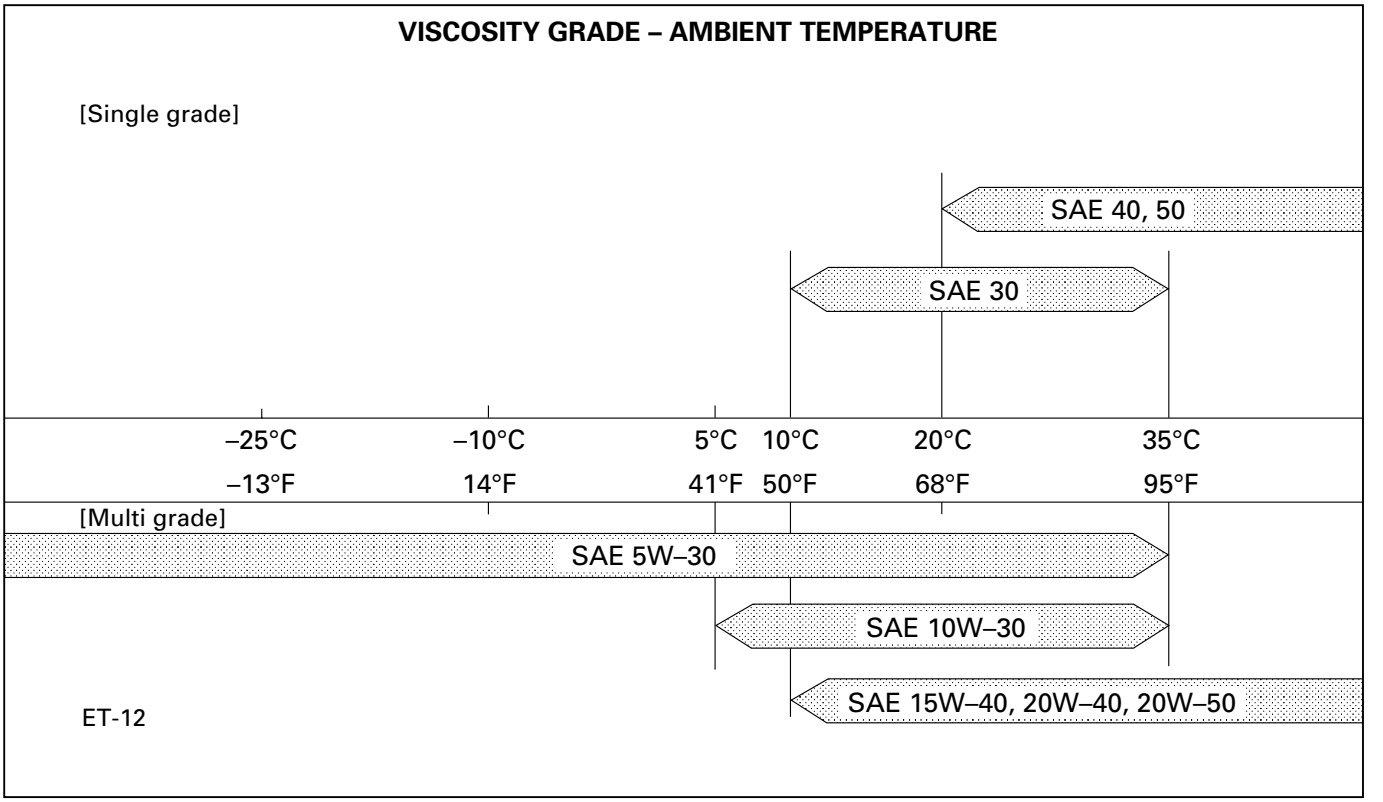
When the recommended lubricants are specified in the workshop manual, follow them.

OIL VISCOSITY CHART

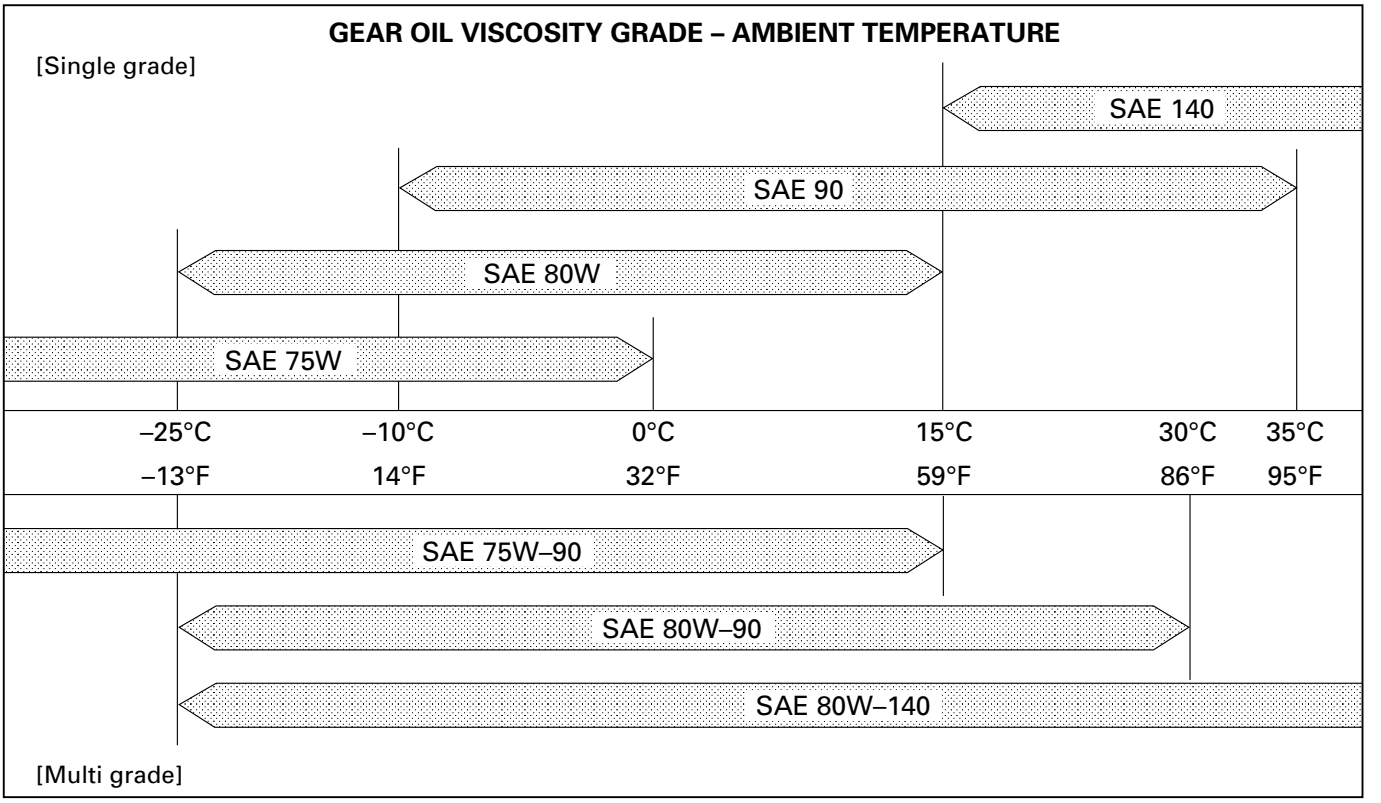
ENGINE OIL



MANUAL TRANSMISSION AND TRANSFER CASE OIL (ENGINE OIL)



FRONT AXLE AND REAR AXLE OIL



LGGEN-WE-0001EU

You are requested to order this manual using the manual number that is shown above.

This manual is applicable for vehicles in Europe.

All rights reserved. This manual may not be reproduced in whole or in part, without the permission in writing of ISUZU MOTORS LIMITED.

Issued by

ISUZU MOTORS LIMITED

INTERNATIONAL SERVICE DEPARTMENT

Tokyo, Japan

First edition April, 2000 0004-01K-1

WORKSHOP MANUAL

NHR · NKR · NPR · NQR · NPS

GENERAL INFORMATION

SECTION 0

ISUZU

ISUZU

International Service & Parts

Tokyo, Japan

NOTICE

Before using this Workshop Manual to assist you in performing vehicle service and maintenance operations, it is recommended that you carefully read and thoroughly understand the information contained in Section 0A under the headings "GENERAL REPAIR INSTRUCTIONS" and "HOW TO USE THIS MANUAL".

All material contained in this Manual is based on latest product information available at the time of publication.
All rights are reserved to make changes at any time without prior notice.

Applicable Model

N-Series

NHR55	**NPR55**	**NQR66**
NHR69	**NPR69**	**NQR70**
NKR55	**NPR65**	**NQR71**
NKR69	**NPR66**	**NPS66**
NKR58	**NPR70**	**NPS71**
NKR66	**NPR71**	

This manual is applicable to 1999 year model.

THIS MANUAL INCLUDES THE FOLLOWING SECTIONS:

SECTION NO.	CONTENTS
0A	General Information
0B	Maintenance and Lubrication

SECTION 0A
GENERAL INFORMATION

CONTENTS

PAGE

General Repair Instructions 0A– 2
How To Use This Manual 0A– 3
Identification 0A– 6
Lifting Instruction 0A– 7
Torque Specifications 0A– 9
Recommended Liquid Gasket 0A–10
Recommended Thread Locking Agent 0A–12

GENERAL REPAIR INSTRUCTIONS

1. Park the vehicle on level ground and chock the front or rear wheels before lifting the vehicle.
2. Use covers on the vehicle body, seats, and floor to prevent damage and/or contaminations.
3. Disconnect the grounding cable from the battery before performing service operations. This will prevent cable damage or burning due to shortcircuiting.
4. Raise the vehicle with a jack set against the axle or the frame.
5. Support the vehicle on chassis stands.
6. Handle brake fluid and antifreeze solution with great care.
   Spilling these liquids on painted surfaces will damage the paint.
7. The use of the proper tool(s) and special tool(s) where specified is essential to efficient, reliable, and safe service operations.
8. Always use genuine ISUZU replacement parts.
9. Discard used cotter pins, gasket, O-rings, oil seals, lock washers, and self-locking nuts at disassembly.
   Normal function of these parts cannot be guaranteed if they are reused.
10. Keep the disassembled parts neatly in groups. This will facilitate smooth and correct reassembly.
11. Keep fixing nuts and bolts separate.
    Fixing nuts and bolts vary in hardness and design according to installation positions.
12. Clean all parts before inspection or reassembly.
13. Clean the oil ports and other openings with compressed air to make certain that they are free of dirt and obstructions.
14. Lubricate the rotating and sliding faces of all moving parts with oil or grease before installation.
15. Use the recommended liquid gasket to prevent leakage.
16. Be sure to tighten bolts and nuts to the specified torque, using a properly maintained torque wrench.
17. When service operation is completed, make a final check to be sure service has been done properly and problem has been corrected.
18. When removing or replacing parts that require refrigerant to the discharged from the Air conditioning system, be sure to use the ACR4 or equivalent to recover and recycle Refrigerant-134a, to promote the movement for the protection of the ozone layer covering the earth.
19. To assure safety, always slowly release air pressure from the air tanks before disconnecting pipes, hoses or other parts from any unit under pressure.

HOW TO USE THIS MANUAL

1. The “GENERAL INFORMATION” includes collectively the following items ① to ⑪ which have relations with all the sections. These items should be read and understood fully before starting each service operations.

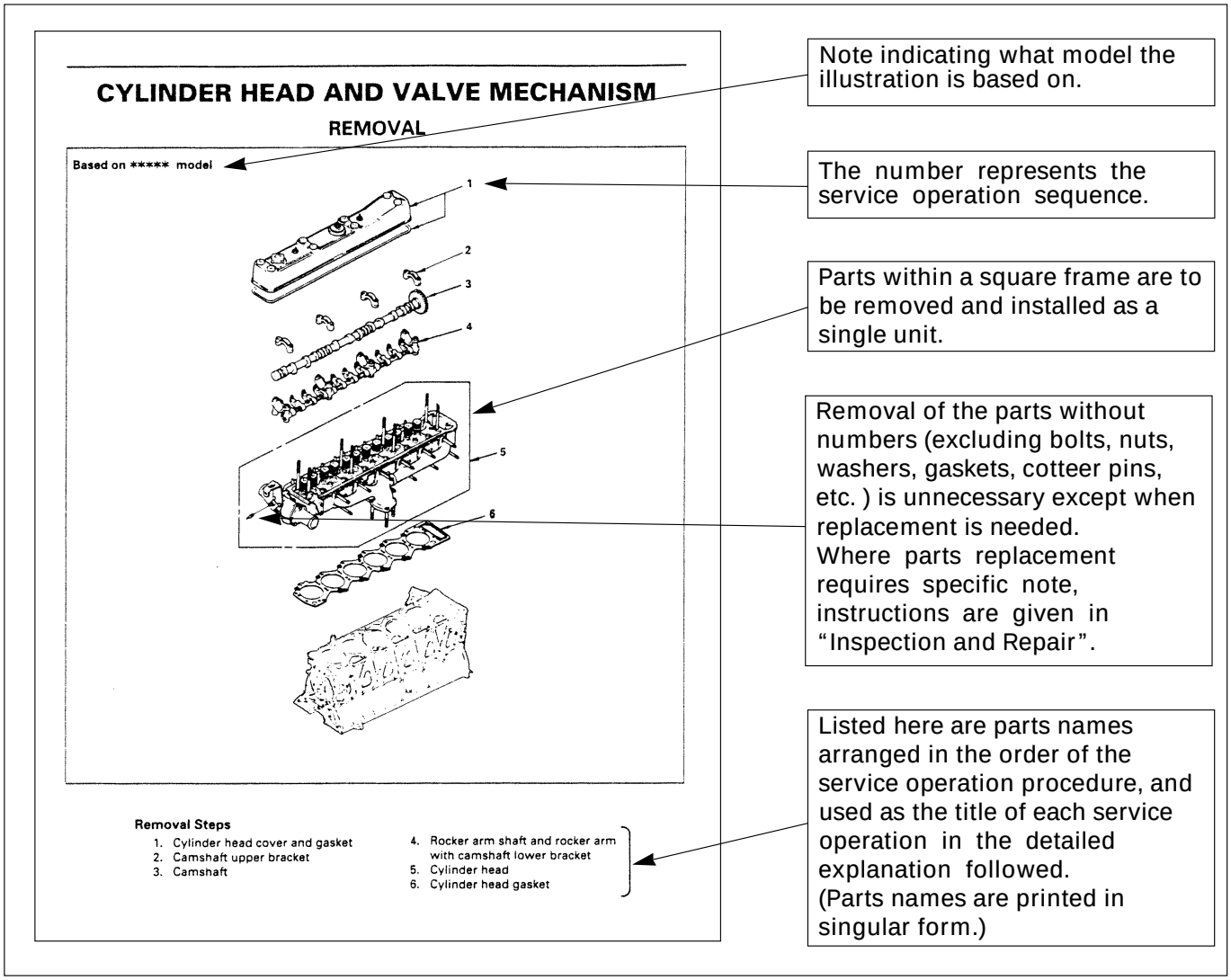
   ① General Repair Instruction
   ② How To Use This Manual
   ③ Model Change Information
   ④ Lifting Instruction
   ⑤ Torque Specification
   ⑥ Recommended Liquid Gasket
   ⑦ Liquid Gasket Application Procedure
   ⑧ Maintenance Schedule
   ⑨ Recommended Fluids, Lubricants and Fuels
   ⑩ Oil Viscosity Chart
   ⑪ Lubrication Chart

2. The “SERVICE INFORMATION” at the beginning of each service operation section, describes the following information and data ① to ⑥ necessary for the service operation.

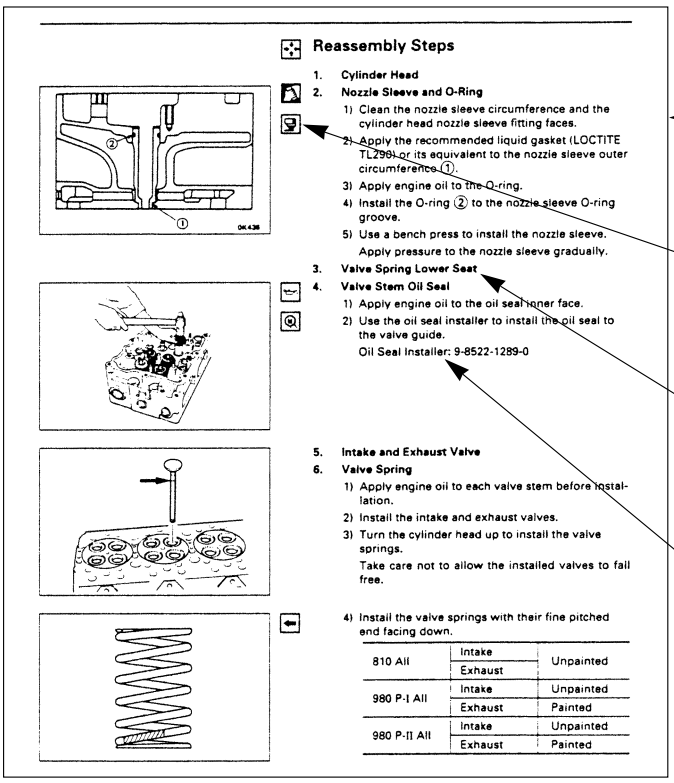
   ① Troubleshooting
   ② Main Data and Specifications
   ③ Service Standard
   ④ Servicing
   ⑤ Fixing Torque
   ⑥ Special Tools

3. The description of each service operation section consists of Removal and Installation, Disassembly, Inspection and Repair and Reassembly.

4. Each service operation section begins with a disassembly view of the unit of equipment (with exception of Inspection and Repair). This illustration is useful for finding components, service procedure, etc.



5. Service operation procedure.

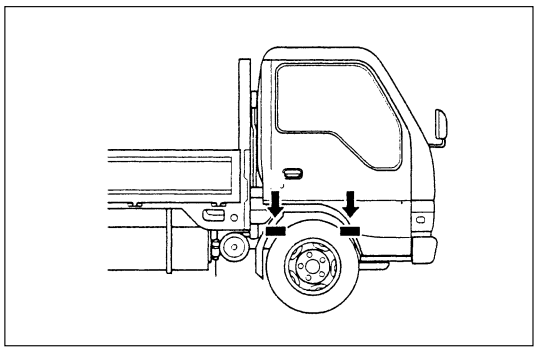


6. In this manual, the following symbols are used to give a full understanding of the service operation to be performed.

... Remove
... Install
... Disassemble
... Reassemble
... Align the marks
... Correct direction
... Inspect
... Take measurement
... Adjustment
... Clean
... Pay close attention
... Tighten to specified torque
... Use special tool(s) (Isuzu's tool(s))
... Use special tool(s) (parts manufacturer's tool(s))
... Lubricate with oil
... Lubricate with grease
... Apply liquid gasket

7. The service standard is indicated in terms of "Standard" and "Limit".
The "Standard" means the assembly standard and standard range within which the parts are considered serviceable. "Limit" indicates the limit value (Correction or replacement is necessary when measurement is beyond this limit).

IDENTIFICATION

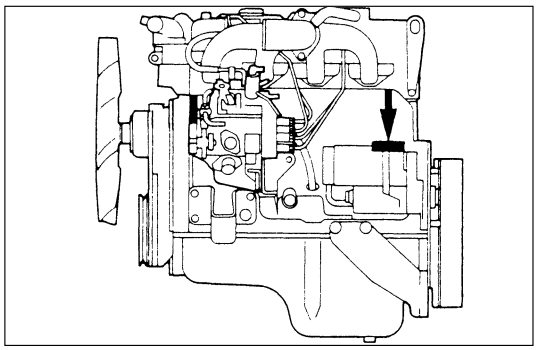


Chassis Number:

It is stamped on the front right-hand side face of the chassis side member.

①: NHR and NKR models with independent front suspension.

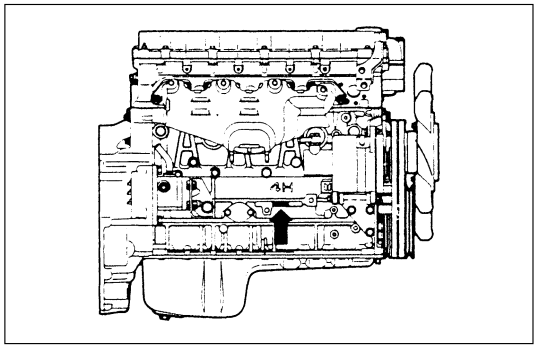
②: NPR, NQR and NPS models with rigid axle front suspension.



Engine Number:

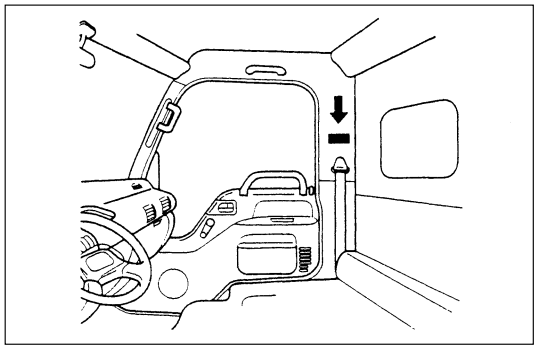
4J Series Engine

It is stamped on the left side rear of the cylinder body.



4H Series Engine

The engine number is stamped on the right side of the cylinder body.



Vehicle Identification plate

The vehicle identification plate is attached to the interior side of the cab side panel on the right side.

LIFTING INSTRUCTION

If it is necessary to use a lifting device other than the original equipment jack, see illustration for acceptable lifting points.

Lifting should only be done at the positions indicated to prevent possible damage to the vehicle.

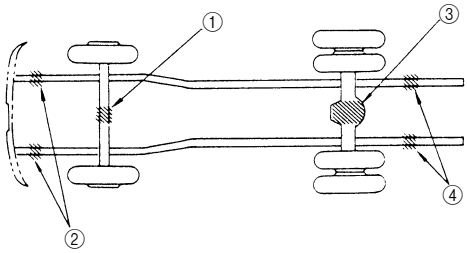
CAUTION:

Failure to observe the acceptable lift points may result in unsatisfactory vehicle performance or a durability failure which may result in loss of control of the vehicle.

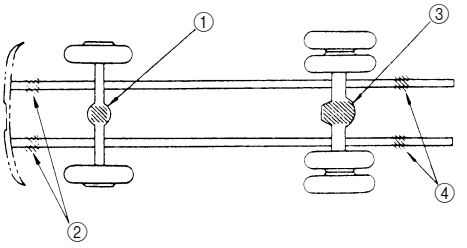
Garage Jack and Safety Stand

Lifting point and supportable point location

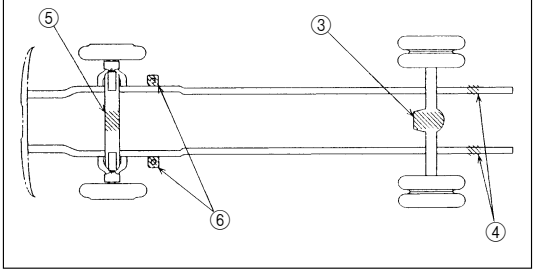
NHR,NKR,NPR,NQR

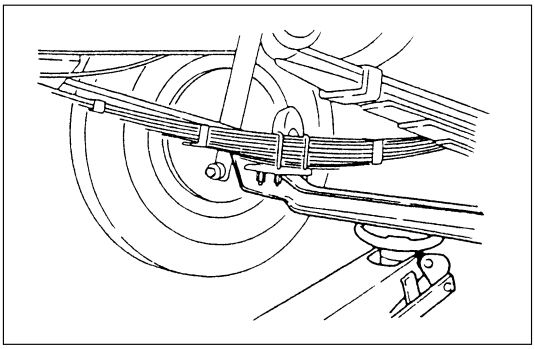


NPS



NHR,NKR
(Front independent suspention)





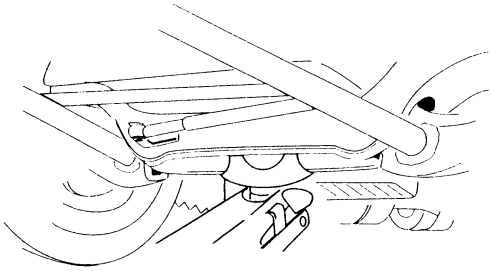
① Front axle
② Side frame front side
③ Rear axle center
④ Side frame rear side
⑤ Suspension cross member
⑥ Jack up bracket

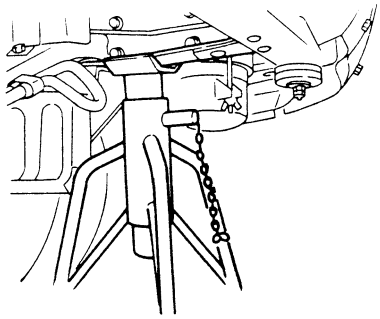
Front Side; Lifting Point

Note:

Do not lift or support on engine oil pan.

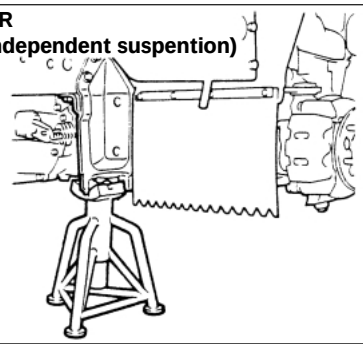
NHR,NKR
(Front independent suspention)

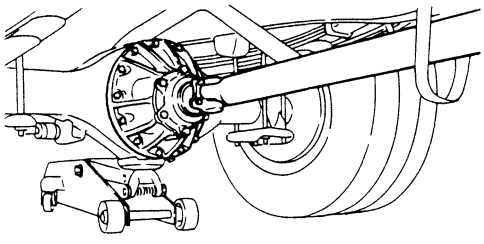




Front Side Supportable Point

NHR,NKR
(Front independent suspention)

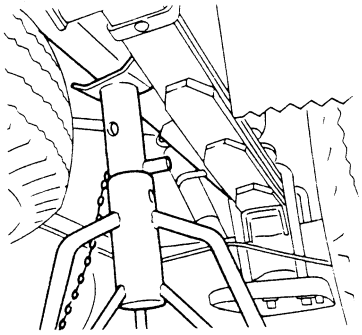




Rear Side Lifting Point

Note:

Do not lift or support on rear axle tube.



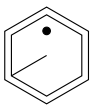
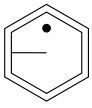
Rear Side Supportable Point

TORQUE SPECIFICATIONS

STANDARD BOLTS

The torque values given in the following table should be applied where a particular torque is not specified.

N·m (kg·m / lb·ft)
N·m kg·cm / lb·in

Strength Class	4.8	8.8		9.8
		Refined	Non-Refined	
Bolt Identification				
Bolt Diameter x Pitch (mm)	No mark			
M 6x1.0	6 60 / 52	7 75 / 65		–
M 8x1.25	13 130 / 113	17 175 / 152		24 240 / 208
M10x1.25	27 (2.8 / 20)	37 (3.8 / 27)		50 (5.1 / 37)
M12x1.25	61 (6.3 / 45)	76 (7.8 / 56)		95 (9.7 / 70)
M14x1.5	96 (9.8 / 71)	116 (11.9 / 86)		142 (14.5 / 105)
M16x1.5	130 (13.3 / 96)	170 (17.3 / 125)		200 (20.4 / 148)
M18x1.5	188 (19.2 / 139)	244 (24.9 / 180)		287 (29.3 / 212)
M20x1.5	258 (26.3 / 190)	337 (34.4 / 249)		396 (40.4 / 292)
M22x1.5	332 (33.9 / 245)	453 (46.3 / 335)		530 (54.1 / 391)
M24x2.0	449 (45.8 / 331)	570 (58.2 / 421)		692 (70.6 / 511)
*M10x1.5	26 (2.7 / 20)	36 (3.7 / 27)		48 (4.9 / 35)
*M12x1.5	57 (5.8 / 42)	71 (7.2 / 52)		89 (9.1 / 66)
*M14x2.0	89 (9.1 / 66)	110 (11.2 / 81)		133 (13.6 / 98)
*M16x2.0	124 (12.7 / 92)	162 (16.5 / 119)		191 (19.5 / 141)

The asterisk * indicates that the bolts are used for female-threaded parts that are made of soft materials such as casting, etc.

FLARE NUTS

N·m (kg·m / lb·ft)

Pipe diameter mm (in)	Torque	Pipe diameter mm (in)	Torque
4.76 (0.187)	16 (1.6 / 12)	10.00 (0.394)	54 (5.5 / 40)
6.35 (0.250)	26 (2.7 / 20)	12.00 (0.472)	88 (9.0 / 65)
8.00 (0.315)	44 (4.5 / 33)	15.00 (0.591)	106 (10.8 / 78)

RECOMMENDED LIQUID GASKET

TYPE	BRAND NAME	MANUFACTURER	APPLICATION PARTS (EXAMPLE)
RTV* Silicon Base	ThreeBond 1207B ThreeBond 1207C ThreeBond 1215 ThreeBond 1216 ThreeBond 1281	ThreeBond ThreeBond ThreeBond ThreeBond ThreeBond	Engine Oil Seal Retainer Engine Oil Pan Timing Gear Case Cylinder Head Cover Fuel Pump Water Pump Rear Axle etc.
Water Base	ThreeBond 1141E	ThreeBond	
Solvent	ThreeBond 1104 BelcoBond 4 BelcoBond 401 BelcoBond 402	ThreeBond Isuzu Isuzu Isuzu	
Anaerobic	LOCTITE 515 LOCTITE 518	LOCTITE LOCTITE	Engine Oil Seal Retainer Water Pump Transaxle etc.

*RTV: Room Temperature Vulcanizer

NOTE:

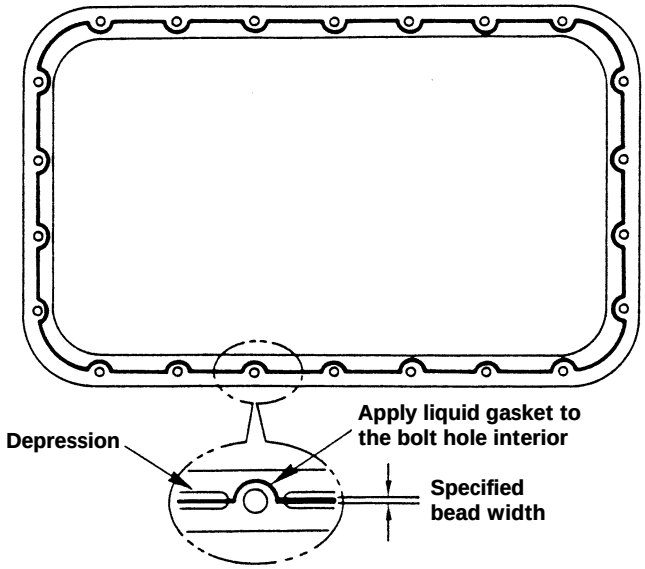
1. **It is very important that the liquid gaskets listed above or their exact equivalent be used on the vehicle.**
2. **LOCTITE 515 and LOCTITE 518 harden upon contact with a metal surface.**
   Do not apply LOCTITE 515 or LOCTITE 518 between two metal surfaces having a clearance of greater than 0.25 mm (0.001 in). Poor adhesion will result.
3. **Be careful to use the specified amount of liquid gasket.**
   Follow the manufacturer's instructions at all times.

Application Procedure

1. Completely remove lubricant and moisture from the connecting surfaces.
   The surfaces must be perfectly dry.
2. Apply specified bead width of liquid gasket to one of the connecting surfaces.

mm (in.)

SCREW HOLE	DEPRESSION	JUDGE-MENT
1~3 (0.04~0.12)		OK
1~3 (0.04~0.12)	More than 2(0.08)	OK
		NG

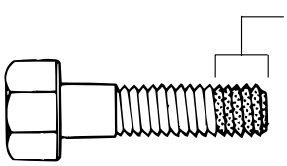


Example
Anaerobic Type : 2-3mm (0.08-0.12 inch)
Others : 2-6mm (0.08-0.24 inch)

NOTE:

When the application procedures are specified in this Workshop manual, follow them.

RECOMMENDED THREAD LOCKING AGENT

<table>
<tr><th>TYPE</th><th>COLOR</th><th>APPLICATION STEPS</th></tr>
<tr><td>LOCTITE 242</td><td>Blue</td><td rowspan="3">1. Completely remove all lubricant and moisture from the bolts and the female threaded surfaces of the parts to be joined.
The surfaces must be perfectly dry.
2. Apply LOCTITE to the bolts.
 

3. Tighten the bolts to the specified torque.
NOTE:
After tightening, be sure to keep the bolts free from vibration and torque for at least an hour until LOCTITE hardens.</td></tr>
<tr><td>LOCTITE 262</td><td>Red</td></tr>
<tr><td>LOCTITE 271</td><td>Red</td></tr>
</table>

NOTE:

When the application procedures are specified in this Workshop manual, follow them.

SECTION 0B
MAINTENANCE AND LUBRICATION

CONTENTS

PAGE

Maintenance Schedule (for Europe) 0B– 2
Maintenance Schedule (Except Europe) 0B– 8
Recommended Fluids, Lubricants and Diesel Fuels 0B–14
Oil Viscosity Chart 0B–16
Lubrication Chart 0B–18

MAINTENANCE SCHEDULE (For Europe only)

When performing the checks on the following items, regular inspection items should also be checked.

ABBREVIATIONS USED IN THIS MANUAL

I : Inspect, clean and correct or replace as necessary
A : Adjust
R : Replace or change
T : Tighten to specified torque
L : Lubricate

V .....Variation (optional on some models).

OPT .....Optional equipment.

4J .....For 4JB1-TC engine model.

4H .....For 4HE1-TC engine model.

Maintenance schedule

Use odometer reading or months whichever comes first

SERVICE INTERVAL:																				
	x 1,000 km.	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
	x 1,000 miles	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
	or months	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
4J ENGINE																					
*Engine oil		–	R	–	R	–	R	–	R	–	R	–	R	–	R	–	R	–	R	–	R
*Oil filter		–	R	–	R	–	R	–	R	–	R	–	R	–	R	–	R	–	R	–	R
Fuel filter		–	–	–	R	–	–	–	R	–	–	–	R	–	–	–	R	–	–	–	R
*Air cleaner element		–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
Idling speed and acceleration		–	–	–	I	–	–	–	I	–	–	–	I	–	–	–	I	–	–	–	I
Valve clearances		–	–	–	–	–	–	–	A	–	–	–	–	–	–	–	A	–	–	–	–
Fuel tank cap & fuel pipes for loose connections or damage		–	–	–	–	–	–	–	I	–	–	–	–	–	–	–	I	–	–	–	–
Drive belt tension and damage		–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
Radiator coolant (Ethylene glycol antifreeze)		–	–	–	–	–	–	–	R	–	–	–	–	–	–	–	R	–	–	–	–
*Exhaust pipes and mounting damage or looseness		–	–	–	I	–	–	–	I	–	–	–	I	–	–	–	I	–	–	–	I
Cooling system		–	–	–	I	–	–	–	I	–	–	–	I	–	–	–	I	–	–	–	I
Engine operation condition		–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
4H ENGINE																					
*Engine oil		–	–	R	–	–	R	–	–	R	–	–	R	–	–	R	–	–	R	–	–
*Oil filter		–	–	R	–	–	R	–	–	R	–	–	R	–	–	R	–	–	R	–	–
Fuel filter: Main Fuel filter		–	–	–	R	–	–	–	R	–	–	–	R	–	–	–	R	–	–	–	R
OPT Main Fuel filter and Sub Fuel filter: With Sub fuel filter		–	–	–	–	–	–	–	R	–	–	–	–	–	–	–	R	–	–	–	–
*Air cleaner element		–	I	–	I	–	I	–	R	–	I	–	I	–	I	–	R	–	I	–	I
Idling speed and acceleration		–	–	–	I	–	–	–	I	–	–	–	I	–	–	–	I	–	–	–	I
Valve clearances		–	–	–	–	–	–	–	A	–	–	–	–	–	–	–	A	–	–	–	–
Feed pump strainer		–	–	–	I	–	–	–	I	–	–	–	I	–	–	–	I	–	–	–	I
Fuel tank cap & fuel pipes for loose connections or damage		–	–	–	–	–	–	–	I	–	–	–	–	–	–	–	I	–	–	–	–
Drive belt tension and damage		–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
Radiator coolant (Ethylene glycol antifreeze)		–	–	–	–	–	–	–	R	–	–	–	–	–	–	–	R	–	–	–	–
*Exhaust pipes and mounting damage or looseness		–	–	–	I	–	–	–	I	–	–	–	I	–	–	–	I	–	–	–	I
Cooling system		–	–	–	I	–	–	–	I	–	–	–	I	–	–	–	I	–	–	–	I
Engine operation condition		–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
CLUTCH																					
Clutch fluid		–	–	I	–	–	I	–	–	R	–	–	I	–	–	R	–	–	I	–	–
Clutch pedal travel and free play		–	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I

Maintenance schedule

Use odometer reading or months whichever comes first

SERVICE INTERVAL:	x 1,000 km.	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
	x 1,000 miles	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
	or months	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
TRANSMISSION																					
*Manual Transmission oil		–	–	I	–	–	I	–	–	R	–	–	I	–	–	R	–	–	I	–	–
Gear control mechanism for looseness		–	–	–	–	–	–	–	I	–	–	–	–	–	–	–	I	–	–	–	–
Gear control cable		–	–	A	–	–	–	–	–	A	–	–	–	–	–	A	–	–	–	–	–
PROPELLER SHAFT																					
*Universal joints and sliding sleeve		–	–	L	–	–	–	–	–	L	–	–	–	–	–	L	–	–	–	–	–
Loose connections		–	–	I	–	–	I	–	–	I	–	–	I	–	–	I	–	–	I	–	–
Splines for excessive wear		–	–	–	–	–	–	–	–	I	–	–	–	–	–	I	–	–	–	–	–
Bearings and related parts for looseness		–	–	–	–	–	–	–	–	I	–	–	–	–	–	I	–	–	–	–	–
Center bearing		–	–	L	–	–	–	–	–	L	–	–	–	–	–	L	–	–	–	–	–
REAR AXLE																					
*Differencial gear oil		–	–	I	–	–	I	–	–	R	–	–	I	–	–	I	–	–	R	–	–
FRONT AXLE																					
*Kingpin		–	L	–	L	–	L	–	L	–	L	–	L	–	L	–	L	–	L	–	L
STEERING																					
Power steering system oil leakage		–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
Power steering fluid		–	–	–	–	–	–	–	R	–	–	–	–	–	–	–	R	–	–	–	–
*Power steering system for looseness or damage		–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
Fitting of knuckles and front axle for looseness		–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
Steering mechanism for looseness or damage		–	–	–	–	–	–	–	I	–	–	–	–	–	–	–	I	–	–	–	–
Ball joint boots for damage (Independent suspension model only)		–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
Ball joint for excessive play (Independent suspension model only)		–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
Relay lever shaft for excessive play (Independent suspension model ony)		–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
Steering wheel play		I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Steering function		I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Wheel alignment		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	I	–	–	–	–
Power steering hose		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	R	–	–	–	–

Maintenance schedule

Use odometer reading or months whichever comes first

SERVICE INTERVAL:		5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
	x 1,000 km.	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
	x 1,000 miles	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
	or months	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
SERVICE BRAKES																					
Brake fluid		–	–	I	–	–	I	–	–	R	–	–	I	–	–	I	–	–	R	–	–
V Hydro booster fluid (ATF)		–	–	I	–	–	I	–	–	R	–	–	I	–	–	I	–	–	R	–	–
Brake system for fluid leakage		–	–	I	–	–	I	–	–	I	–	–	I	–	–	I	–	–	I	–	–
*Brake lining and drum for wear		–	–	I	–	–	I	–	–	I	–	–	I	–	–	I	–	–	I	–	–
*Disc brake pads and discs for wear		–	–	I	–	–	I	–	–	I	–	–	I	–	–	I	–	–	I	–	–
Brake pedal travel and free play		I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Pipes and hoses for loose connections or damage		–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
PARKING BRAKE																					
Parking brake cables		–	–	I	–	–	I	–	–	I	–	–	I	–	–	I	–	–	I	–	–
Parking brake function		–	–	I	–	–	I	–	–	I	–	–	I	–	–	I	–	–	I	–	–
Parking brake lever travel		–	–	I	–	–	I	–	–	I	–	–	I	–	–	I	–	–	I	–	–
Lining for wear		–	–	–	–	–	–	–	–	I	–	–	–	–	–	–	–	–	I	–	–
Drum for wear or damage		–	–	–	–	–	–	–	–	I	–	–	–	–	–	–	–	–	I	–	–
Ratchet for wear or damage		–	–	–	–	–	–	–	–	I	–	–	–	–	–	–	–	–	I	–	–
SUSPENSION																					
Spring leaves for damage		–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
Torsion bar Spring (Independent suspension model only)		–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
Ball joint boots for damage (Independent suspension model only)		–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
Mount for looseness or damage		–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
Shock absorvers for oil leakage		–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
Shock absorbers mount for looseness		–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
Ball joint for excessive play (independent suspension model only)		–	–	–	–	–	–	–	I	–	–	–	–	–	–	–	I	–	–	–	–
Upper links (Independent suspension model only)		L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
WHEELS																					
Wheel pins and nuts		–	–	–	T	–	–	–	T	–	–	–	T	–	–	–	T	–	–	–	T
Wheel disc for damage		–	–	–	I	–	–	–	I	–	–	–	I	–	–	–	I	–	–	–	I
Hub bearing grease		–	–	–	–	–	–	–	R	–	–	–	–	–	–	–	R	–	–	–	–
Tire pressure and damage		–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I

Maintenance schedule

Use odometer reading or months whichever comes first

SERVICE INTERVAL:																				
	x 1,000 km.	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
	x 1,000 miles	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
	or months	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
ELECTRICAL EQUIPMENT																					
Specific gravity of battery electrolyte		–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
OTHERS																					
Lights, horn, windshield, wiper and washer		–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
Bolts and nuts on chassis and body		–	–	–	–	–	–	–	I	–	–	–	–	–	–	–	I	–	–	–	–

Maintenance schedule under severe driving conditions

Severe driving conditions
- A : Repeated short trips
- B : Driving on rough roads
- C : Driving on dusty roads
- D : Driving extremely cold weather and/or on salted roads

Item	Interval	Condition				
		A	B	C	D	A+D
4J Engine oil and oil filter	Change every 5,000 km (3,000 miles)			●		●
4H Engine oil and oil filter	Change every 7,500 km (4,500 miles)			●		●
Exhaust pipes and mounting	Inspect every 10,000 km (6,000 miles)	●	●		●	
Air cleaner element	Replace every 20,000 km (12,000 miles)			●		
Steering system for looseness or damage	Inspect every 5,000 km (3,000 miles)		●			
Universal joints and sliding sleeve grease	Lubricate every 10,000 km (6,000 miles)		●			
Manual transmission and differential gear oil	Change every 20,000 km (12,000 miles)		●			
Brake lining and drum for wear	Inspect every 10,000 km (6,000 miles)	●	●	●		
Disc brake pads and discs for wear	Inspect every 5,000 km (3,000 miles)	●	●	●		

MAINTENANCE SCHEDULE (EXCEPT EUROPE)

When performing the checks on the following items, regular inspection items should also be checked.

ABBREVIATIONS USED IN THIS MANUAL

I : Inspect, clean and correct or replace as necessary
A : Adjust
R : Replace or change
T : Tighten to specified torque
L : Lubricate

V .....Variation (optional on some models).
OPT .....Optional equipment.
4JG .....For 4JG2 engine model.
4J .....For 4J engine models.
4HF1-2 .....For 4HF1-2 engine model.
4H .....For 4H engine model.
MT .....For manual transmission model only.
AT .....For automatic transmission model only.

Maintenance schedule

Use odometer reading or months whichever comes first

SERVICE INTERVAL:																						
	x 1,000 km.	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
	x 1,000 miles	0.6	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
	or months	1	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
4J ENGINE																						
*Engine oil		–	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
*Oil filter		–	–	R	–	R	–	R	–	R	–	R	–	R	–	R	–	R	–	R	–	R
Fuel filter		–	–	–	–	R	–	–	–	R	–	–	–	R	–	–	–	R	–	–	–	R
*Air cleaner element		–	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
Idling speed and acceleration		–	–	–	–	I	–	–	–	I	–	–	–	I	–	–	–	I	–	–	–	I
Valve clearances		I	–	–	–	–	–	–	–	A	–	–	–	–	–	–	–	A	–	–	–	–
Fuel tank cap & fuel pipes for loose connections or damage		–	–	–	–	–	–	–	–	I	–	–	–	–	–	–	–	I	–	–	–	–
OPT 4JG Timing belt		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	R
Drive belt tension and damage		I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
Radiator coolant (Ethylene glycol antifreeze)		–	–	–	–	–	–	–	–	R	–	–	–	–	–	–	–	R	–	–	–	–
*Exhaust pipes and mounting damage or looseness		–	–	–	–	I	–	–	–	I	–	–	–	I	–	–	–	I	–	–	–	I
Cooling system		–	–	–	–	I	–	–	–	I	–	–	–	I	–	–	–	I	–	–	–	I
Engine operation condition		–	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
4H ENGINE																						
*Engine oil		–	–	R	–	R	–	R	–	R	–	R	–	R	–	R	–	R	–	R	–	R
*Oil filter		–	–	R	–	R	–	R	–	R	–	R	–	R	–	R	–	R	–	R	–	R
Fuel filter: Main Fuel filter		–	–	–	–	R	–	–	–	R	–	–	–	R	–	–	–	R	–	–	–	R
OPT Main Fuel filter and Sub Fuel filter: With Sub fuel filter		–	–	–	–	–	–	–	–	R	–	–	–	–	–	–	–	R	–	–	–	–
*Air cleaner element		–	–	I	–	I	–	I	–	R	–	I	–	I	–	I	–	R	–	I	–	I
Idling speed and acceleration		–	–	–	–	I	–	–	–	I	–	–	–	I	–	–	–	I	–	–	–	I
Valve clearances		I	–	–	–	–	–	–	–	A	–	–	–	–	–	–	–	A	–	–	–	–
Feed pump strainer (Except 4HF1-2)		–	–	–	–	I	–	–	–	I	–	–	–	I	–	–	–	I	–	–	–	I
Fuel tank cap & fuel pipes for loose connections or damage		–	–	–	–	–	–	–	–	I	–	–	–	–	–	–	–	I	–	–	–	–
Drive belt tension and damage		I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
Radiator coolant (Ethylene glycol antifreeze)		–	–	–	–	–	–	–	–	R	–	–	–	–	–	–	–	R	–	–	–	–
*Exhaust pipes and mounting damage or looseness		–	–	–	–	I	–	–	–	I	–	–	–	I	–	–	–	I	–	–	–	I
Cooling system		–	–	–	–	I	–	–	–	I	–	–	–	I	–	–	–	I	–	–	–	I
Engine operation condition		–	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
MT CLUTCH																						
Clutch fluid		–	–	I	–	I	–	I	–	R	–	I	–	I	–	I	–	R	–	I	–	I
Clutch pedal travel and free play		–	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I

Maintenance schedule

Use odometer reading or months whichever comes first

SERVICE INTERVAL:	x 1,000 km.	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
	x 1,000 miles	0.6	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
	or months	1	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
TRANSMISSION																						
* MT Manual Transmission oil		–	–	I	–	I	–	I	–	R	–	I	–	I	–	I	–	R	–	I	–	I
* AT Automatic Transmission fluid		–	–	–	–	–	–	–	–	R	–	–	–	–	–	–	–	R	–	–	–	–
Gear control mechanism for looseness		–	–	–	–	–	–	–	–	I	–	–	–	–	–	–	–	I	–	–	–	–
Gear control cable		–	–	–	–	A	–	–	–	A	–	–	–	A	–	–	–	A	–	–	–	A
TRANSMISSION WITH TRANSFER CASE (NPS model only)																						
*Transmission with transfer case oil		–	–	I	–	I	–	I	–	R	–	I	–	I	–	I	–	R	–	I	–	I
Gear control mechanism for looseness		–	–	–	–	–	–	–	–	I	–	–	–	–	–	–	–	I	–	–	–	–
Gear control cable		–	–	–	–	A	–	–	–	A	–	–	–	A	–	–	–	A	–	–	–	A
PROPELLER SHAFT																						
*Universal joints and sliding sleeve		–	–	–	–	L	–	–	–	L	–	–	–	L	–	–	–	L	–	–	–	L
Loose connections		–	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
Splines for excessive wear		–	–	–	–	–	–	–	–	I	–	–	–	–	–	–	–	I	–	–	–	–
Bearings and related parts for looseness		–	–	–	–	–	–	–	–	I	–	–	–	–	–	–	–	I	–	–	–	–
Center bearing		–	–	–	–	L	–	–	–	L	–	–	–	L	–	–	–	L	–	–	–	L
REAR AXLE																						
*Differencial gear oil		–	–	I	–	I	–	I	–	R	–	I	–	I	–	I	–	R	–	I	–	I
FRONT AXLE																						
*Kingpin		–	–	L	–	L	–	L	–	L	–	L	–	L	–	L	–	L	–	L	–	L
Differential gear oil (NPS model only)		–	–	I	–	I	–	I	–	R	–	I	–	I	–	I	–	R	–	I	–	I

Maintenance schedule

Use odometer reading or months whichever comes first

SERVICE INTERVAL:		1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
	x 1,000 km.	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
	x 1,000 miles	0.6	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
	or months	1	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
STEERING																						
Manual steering gear oil		–	–	–	–	–	–	I	–	–	–	–	–	I	–	–	–	–	–	I	–	–
OPT Power steering system oil leakage		–	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
OPT Power steering fluid		–	–	–	–	–	–	–	–	R	–	–	–	–	–	–	–	R	–	–	–	–
* OPT Power steering system for looseness or damage		–	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
Fitting of knuckles and front axle for looseness		–	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
Steering mechanism for looseness or damage		–	–	–	–	–	–	–	–	I	–	–	–	–	–	–	–	I	–	–	–	–
Ball joint boots for damage (Independent suspension model only)		–	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
Ball joint for excessive play (Independent suspension model only)		–	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
Relay lever shaft for excessive play (Independent suspension model ony)		–	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
Steering wheel play		–	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Steering function		–	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Wheel alignment		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	I	–	–	–	–
OPT Power steering hose		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	R	–	–	–	–
SERVICE BRAKES																						
Brake fluid		–	–	I	–	I	–	I	–	R	–	I	–	I	–	I	–	R	–	I	–	I
V Hydro booster fluid (ATF)		–	–	I	–	I	–	I	–	R	–	I	–	I	–	I	–	R	–	I	–	I
Brake system for fluid leakage		–	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
* Brake lining and drum for wear		–	–	–	–	I	–	–	–	I	–	–	–	I	–	–	–	I	–	–	–	I
* Disc brake pads and discs for wear		–	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
Brake pedal travel and free play		I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Pipes and hoses for loose connections or damage		–	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
PARKING BRAKE																						
Parking brake cables		–	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
Parking brake function		–	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
Parking brake lever travel		–	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
Lining for wear		–	–	–	–	–	–	–	–	I	–	–	–	–	–	–	–	I	–	–	–	–
Drum for wear or damage		–	–	–	–	–	–	–	–	I	–	–	–	–	–	–	–	I	–	–	–	–
Ratchet for wear or damage		–	–	–	–	–	–	–	–	I	–	–	–	–	–	–	–	I	–	–	–	–

Maintenance schedule

Use odometer reading or months whichever comes first

SERVICE INTERVAL:	x 1,000 km.	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
	x 1,000 miles	0.6	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
	or months	1	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
SUSPENSION																						
Spring leaves for damage		–	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
Torsion bar Spring (Independent suspension model only)		–	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
Ball joint boots for damage (Independent suspension model only)		–	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
Mount for looseness or damage		–	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
Spring pin (NPS model only)		–	–	L	–	L	–	L	–	L	–	L	–	L	–	L	–	L	–	L	–	L
Shock absorvers for oil leakage		–	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
Shock absorbers mount for looseness		–	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
Ball joint for excessive play (independent suspension model only)		–	–	–	–	–	–	–	–	I	–	–	–	–	–	–	–	I	–	–	–	–
Upper links (Independent suspension model only)		–	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
WHEELS																						
Wheel pins and nuts		T	–	–	–	T	–	–	–	T	–	–	–	T	–	–	–	T	–	–	–	T
Wheel disc for damage		–	–	–	–	I	–	–	–	I	–	–	–	I	–	–	–	I	–	–	–	I
Hub bearing grease		–	–	–	–	–	–	–	–	R	–	–	–	–	–	–	–	R	–	–	–	–
Tire pressure and damage		–	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
ELECTRICAL EQUIPMENT																						
Specific gravity of battery electrolyte		–	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
OTHERS																						
Lights, horn, windshield, wiper and washer		–	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I	–	I
Drive shaft dust boots for damage (NPS model only)		–	–	–	–	I	–	–	–	I	–	–	–	I	–	–	–	I	–	–	–	I
Bolts and nuts on chassis and body		I	–	–	–	–	–	–	–	I	–	–	–	–	–	–	–	I	–	–	–	–

Maintenance schedule under severe driving conditions

Severe driving conditions
- A : Repeated short trips
- B : Driving on rough roads
- C : Driving on dusty roads
- D : Driving extremely cold weather and/or on salted roads

Item	Interval	Condition				
		A	B	C	D	A+D
[4J] Engine oil: with Partial-flow oil filter	Change every 2,500 km (1,500 miles)			●		●
[4H] Engine oil: with Partial-flow oil filter	Change every 5,000 km (3,000 miles)			●		●
Engine oil filter	Replace every 5,000 km (3,000 miles)			●		●
Exhaust pipes and mounting	Inspect every 10,000 km (6,000 miles)	●	●		●	
Air cleaner element	Replace every 20,000 km (12,000 miles)			●		
Steering system for looseness or damage	Inspect every 5,000 km (3,000 miles)		●			
Universal joints and sliding sleeve grease	Lubricate every 10,000 km (6,000 miles)		●			
Manual transmission and differential gear oil	Change every 20,000 km (12,000 miles)		●			
Automatic transmission gear fluid	Change every 20,000 km (12,000 miles)		●			
Transmission with transfer case gear oil (NPS model)	Change every 20,000 km (12,000 miles)		●			
Brake lining and drum for wear	Inspect every 10,000 km (6,000 miles)	●	●	●		
Disc brake pads and discs for wear	Inspect every 5,000 km (3,000 miles)	●	●	●		

RECOMMENDED FLUIDS, LUBRICANTS AND DIESEL FUELS

In order to obtain maximum performance and longest service life from your ISUZU vehicles, it is very important to select and use correctly best lubricants and diesel fuels.

When lubricating, be sure to use ISUZU genuine lubricants or recommended lubricants listed below, according to the maintenance schedule for each vehicle model.

The lubrication intervals in the maintenance schedule and the coverage and period of new vehicle warranty are based on the use of ISUZU genuine lubricants or recommended lubricants as given in the chart which will serve as a guide for selecting lubricants of proper brand name.

LUBRICATION	MAKE	BRAND / TYPE	GRADE	
			API	ACEA
Diesel engine crankcase	**ISUZU GENUINE**	**BESCO MULTI – Z TYPE CE (10W-30)**	**CE**	
	ISUZU GENUINE	**BESCO MULTI – Z (10W-30)**	**CD**	
	ISUZU GENUINE	**BESCO S – 3 (10W, 20W, 30, 40)**	**CD**	
	EXXON / ESSO	ESSOLUBE XD-3+ (15W-40)	CG-4/CF	E2/B2
	EXXON / ESSO	ESSOLUBE XT331 (15W-40)	CG-4/CF	E2/B2
	MOBIL	DELVAC HP (15W-40, 20, 30, 40)	CF/CE	
	CALTEX/CHEVRON	DELO CXJ (15W-40, 30, 40)	CF	
	SHELL	RIMURA D (15W-40, 30, 40)	CD/CF	
	ELF	PERFORMANCE TROPHY (15W-40)	CE	E3
	TOTAL	RUBIA XT (15W-40)	CF-4	E2
Manual transmission Transfer case	**ISUZU GENUINE**	**BESCO GEAR OIL TRANSAXLE (5W-30)**	**SG**	
	EXXON / ESSO	ESSOLUBE XD-3+ (15W-40)	CG-4/CF	E2/B2
	EXXON / ESSO	ESSOLUBE XT331 (15W-40)	CG-4/CF	E2/B2
	MOBIL	MOBIL SUPER (10W-30)	SH	
	CALTEX / TEXACO	HAVOLINE FORMULA-3 (15W-40, 20W-50)	SH	
	SHELL	RIMURA D (15W-40)	CD/CF	
	ELF	SUPER SPORTI S (15W-40)	SG/CD	
	TOTAL	QUARTZ 5000 (15W-40, 20W-50)	SJ/CF	A2/B2
Differential	**ISUZU GENUINE**	**BESCO GEAR OIL SH (80W-90, 90, 140)**	**GL-5**	
	EXXON / ESSO	GEAR OIL GX (85W-90)	GL-5	
	MOBIL	MOBILUBE HD (80W-90, 85W-140)	GL-5	
	CALTEX	THURBAN GL-5 EP (80W-90, 85W-140)	GL-5	
	SHELL	SPIRAX HD (90, 140)	GL-5	
	ELF	TRANSELF TYPE B (80W-90, 85W-140)	GL-5	
	TOTAL	TRANSMISSION TM (80W-90, 85W-140)	GL-5	
Automatic transmission Power steering Hydro brake booster	**ISUZU GENUINE**	**BESCO ATF II, ATF III**		
	EXXON / ESSO	ESSO ATF D (DEXRON® II-D)		
	MOBIL	MOBIL ATF (DEXRON® III)		
	CALTEX	ATF HD (DEXRON® II)		
	SHELL	SHELL DONAX TA (DEXRON® II-D)		
	ELF	ELFMATIC G3 (DEXRON® III)		
	TOTAL	TOTAL FLUID IID (DEXRON® II-D)		
Center bearing King pin Upper links (General purpose grease)	**ISUZU GENUINE**	**BESCO L-2 GREASE (No.2), L-3 GREASE (No.3)**		
	EXXON / ESSO	RONEX MP (No.2)		
	MOBIL	MOBILGREASE HP 222 (No.2)		
	CALTEX / TEXACO	STARPLEX-2 (No.2)		
	SHELL	SHELL RETINAX A (No.2)		
	TOTAL	MULTIS EP2, EP3 (No.2, No.3)		

LUBRICATION	MAKE	BRAND / TYPE	GRADE	
			API	ACEA
Propeller shaft sliding yoke Universal joint (General purpose grease in Molybdenum)	**ISUZU GENUINE** EXXON / ESSO EXXON / ESSO CALTEX TOTAL	**ONE LUBER MO GREASE** BEACON Q2 (No.2) MULTIPURPOSE GREASE (Moly) (No.2) MOLYTEX GREASE EP2 (No.2) TOTAL MULTIS MS2 (No.2)		
Engine cooling system	**ISUZU GENUINE** TEXACO / CALTEX	**BESCO LLC SUPER TYPE E** HAVOLINE EXTENDED LIFE ANTIFREEZE COOLANT HAVOLINE XLC EXTENDED LIFE COOLANT 6280		

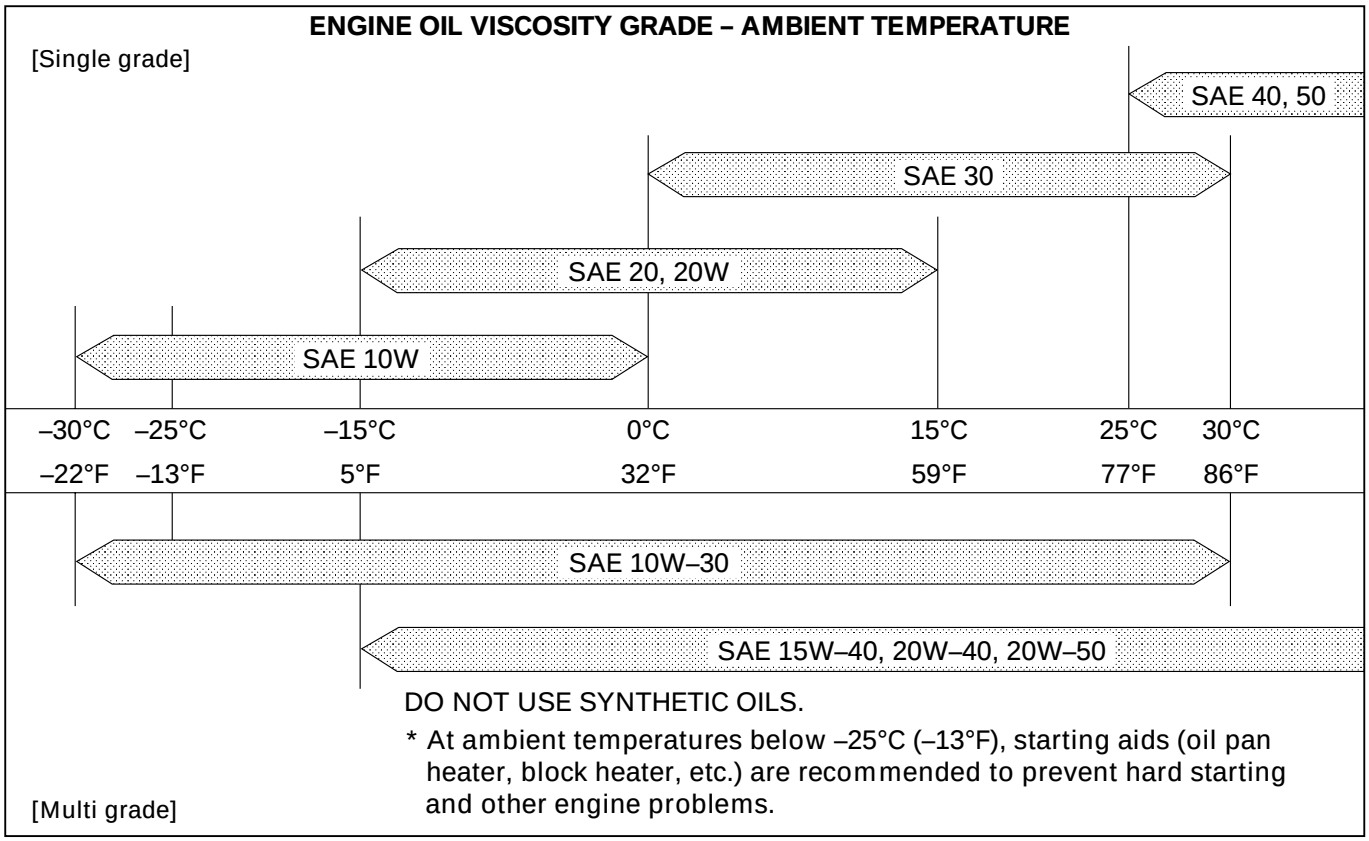
FLUID	TYPE
Clutch and brake fluid reservoir	Besco brake fluid (For light duty) Hydraulic brake fluid SAE J1703 FMVSS 116 DOT.3 grade

NOTE:

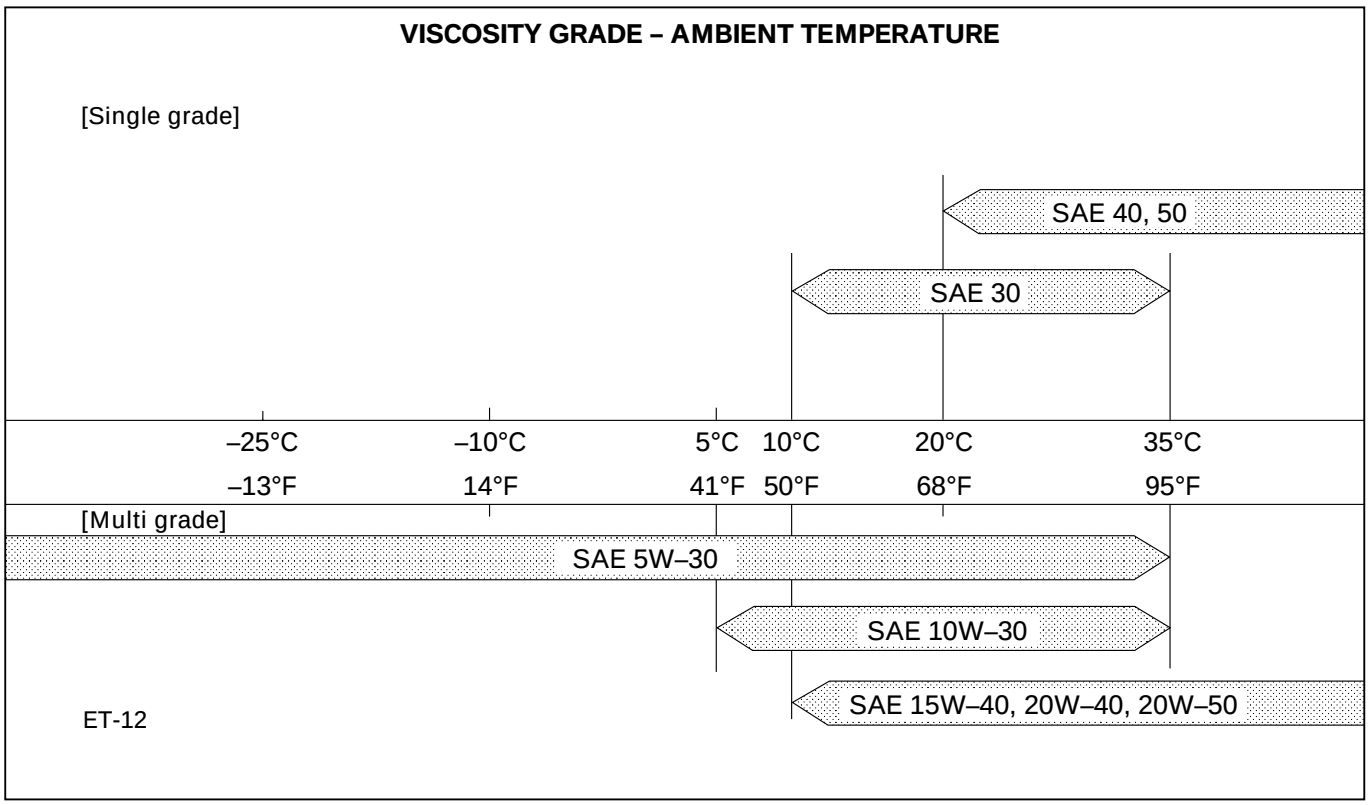
When the recommended lubricants are specified in the workshop manual, follow them.

OIL VISCOSITY CHART

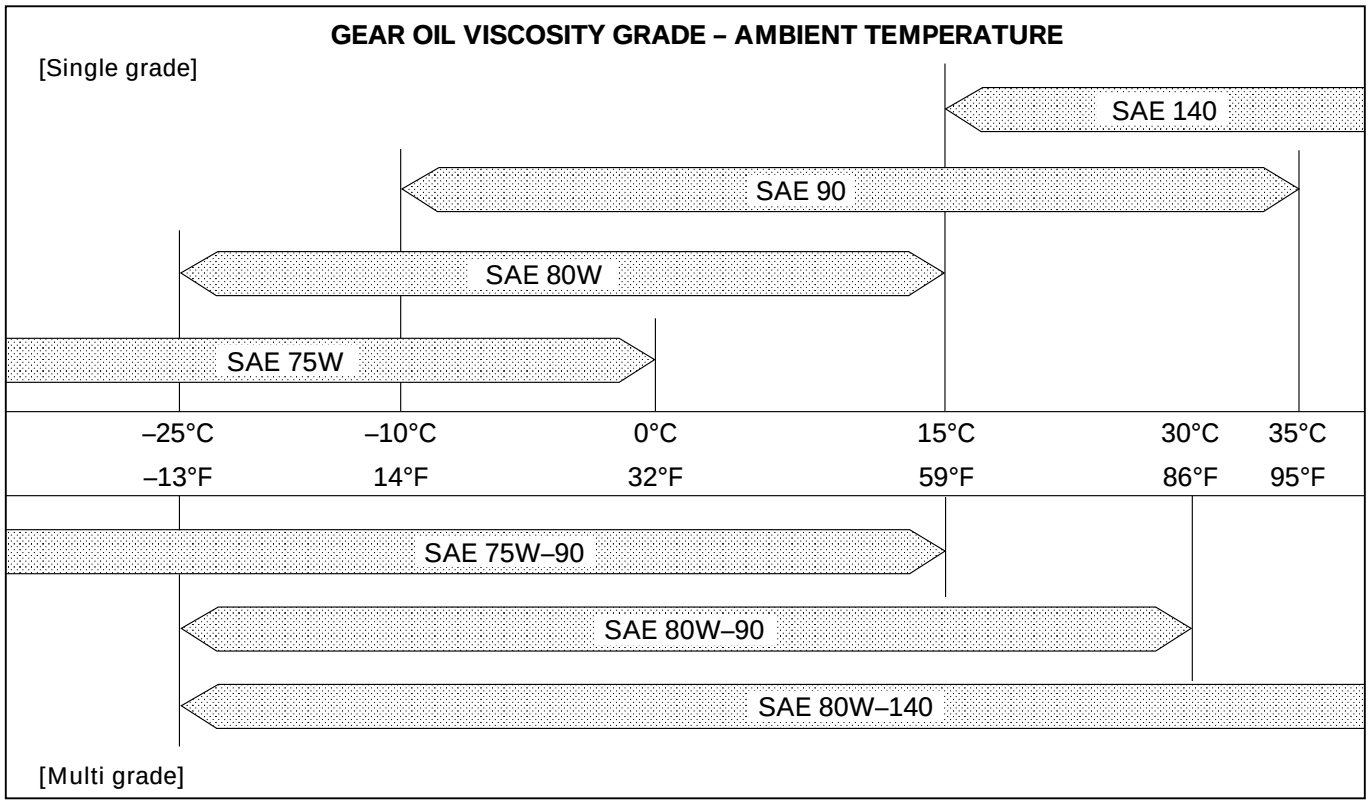
ENGINE OIL



MANUAL TRANSMISSION AND TRANSFER CASE OIL (ENGINE OIL)



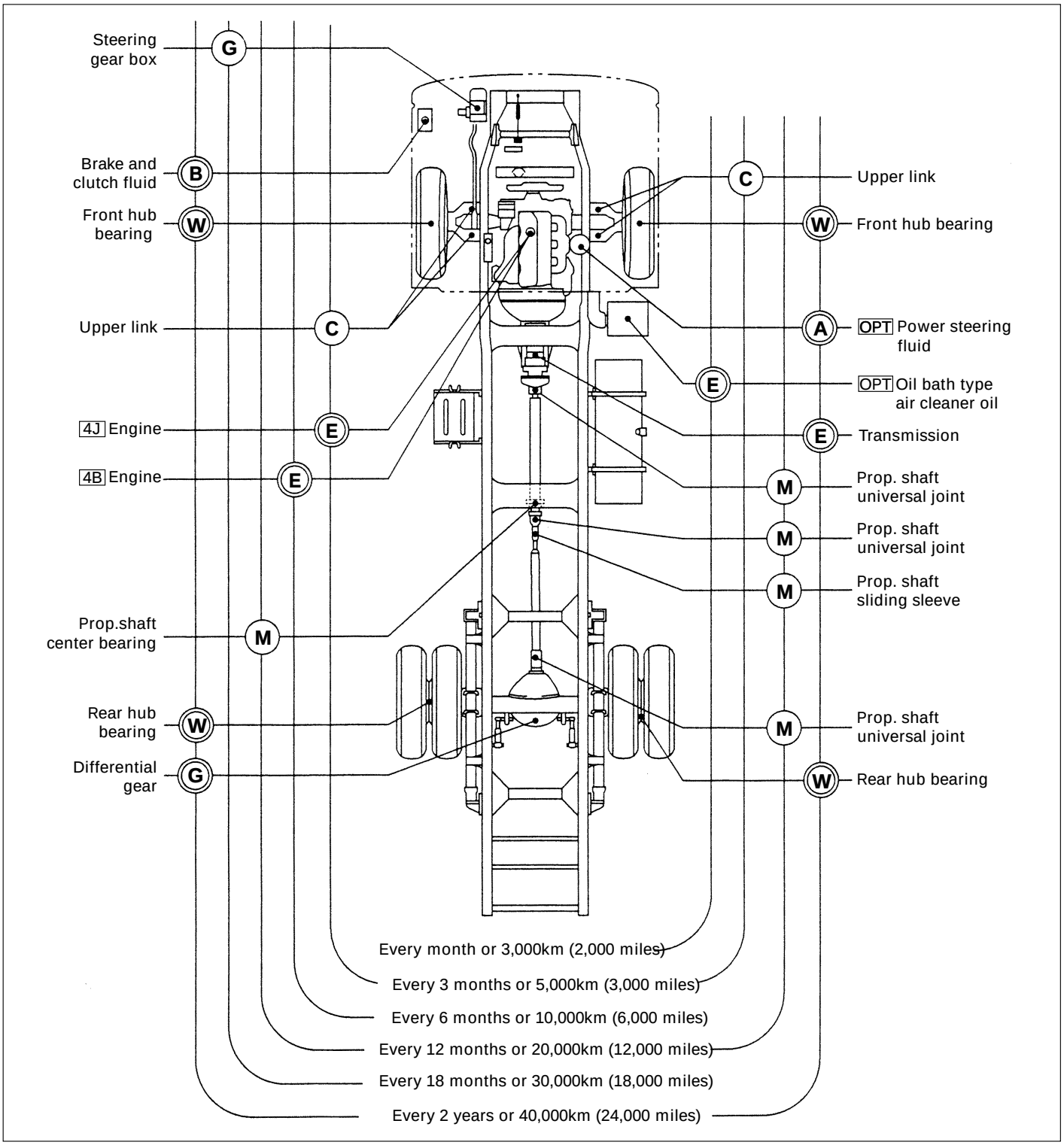
FRONT AXLE AND REAR AXLE OIL



LUBRICATION CHART

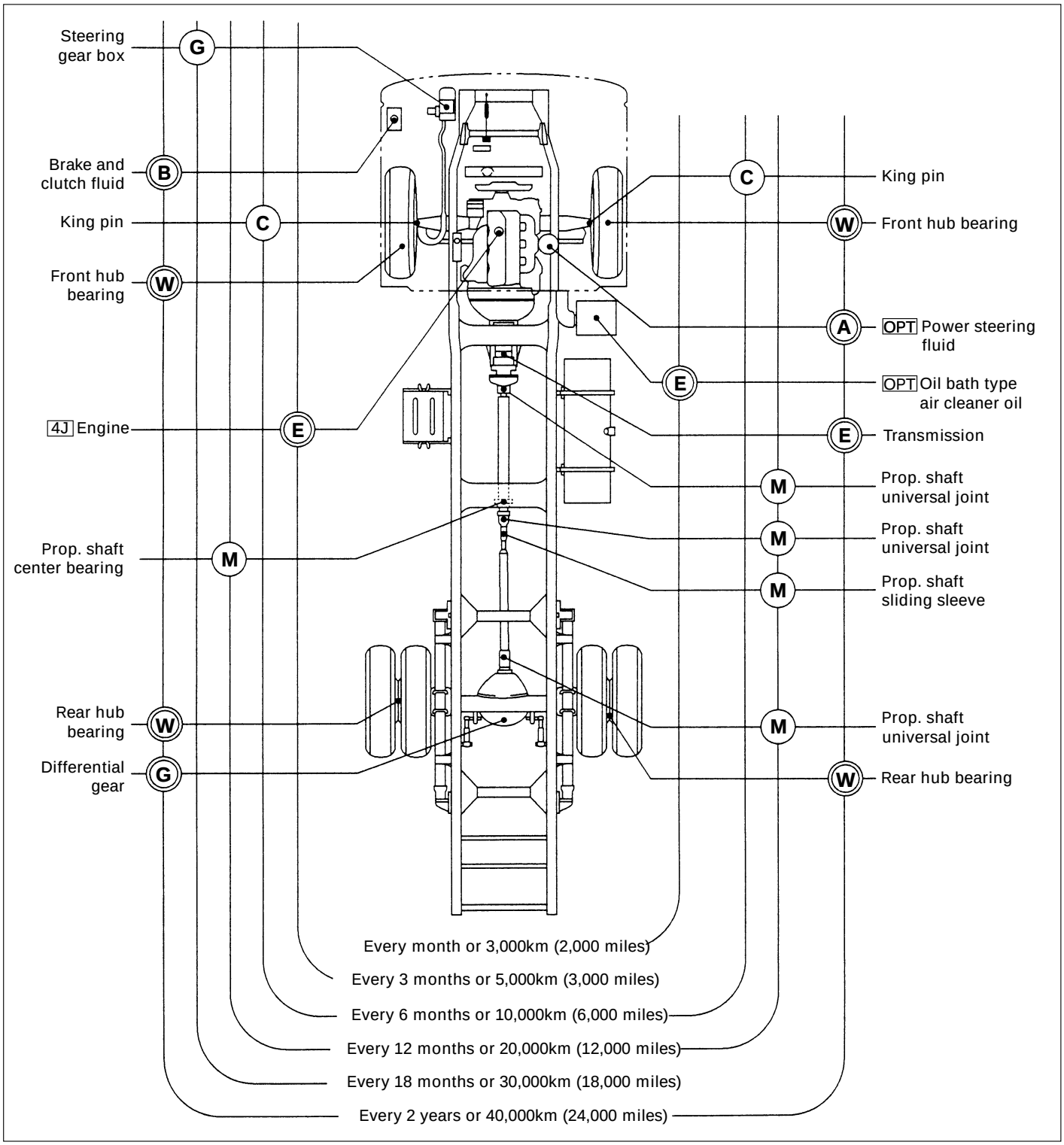
NHR, NKR (Front Independent Suspension) models

◎ Change
○ Check and Replenish or Lubricate
E : Engine oil
G : Gear Oil
W : Wheel bearing grease
C : Multipurpose type grease
M : MoS2 contained type grease
B : Brake fluid
A : Automatic transmission fluid



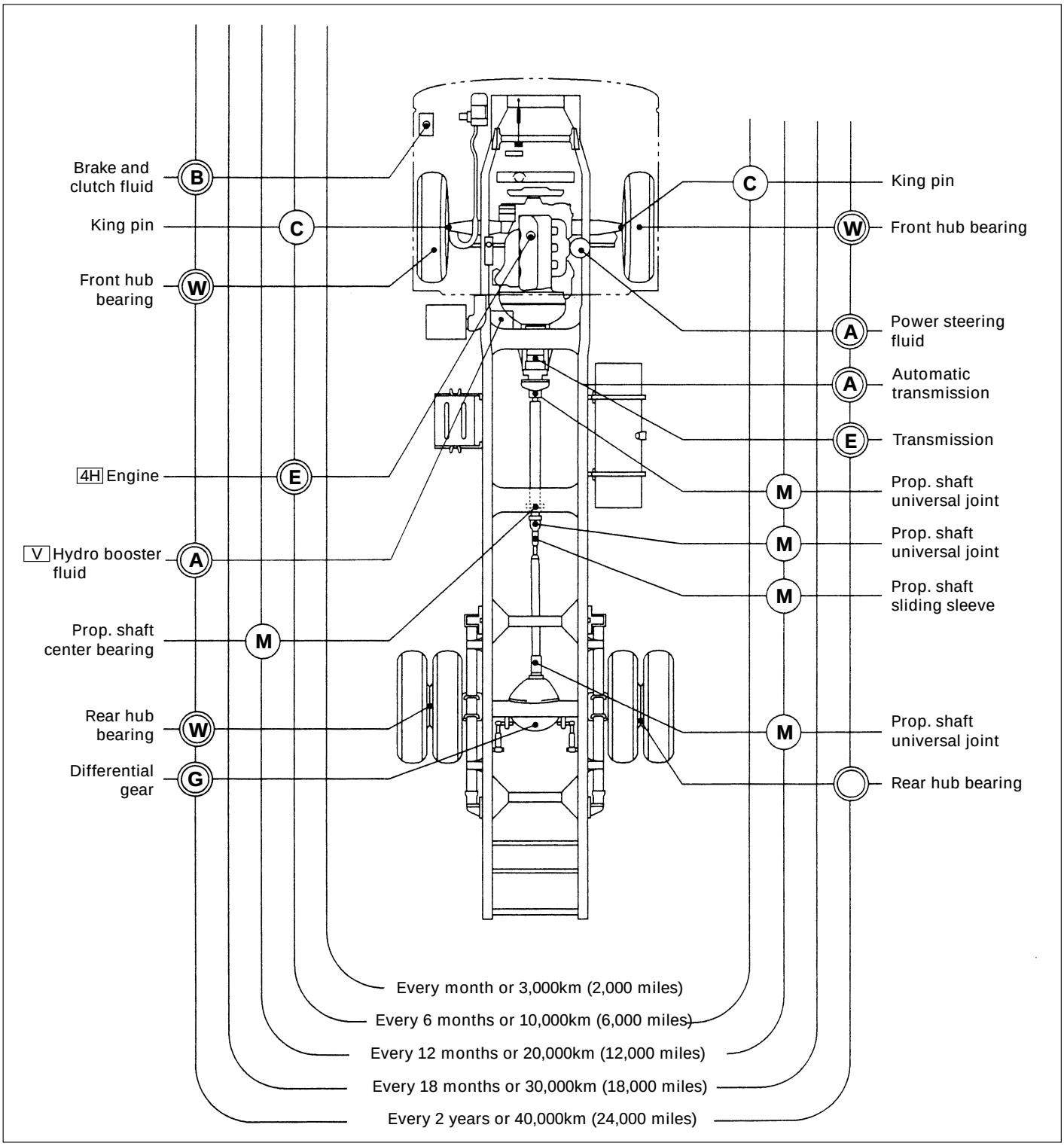
NHR, NKR55, NKR69, NPR55 and NPR69 models

◎ Change
○ Check and Replenish or Lubricate
E : Engine oil
G : Gear Oil
W : Wheel bearing grease
C : Multipurpose type grease
M : MoS2 contained type grease
B : Brake fluid
A : Automatic transmission fluid



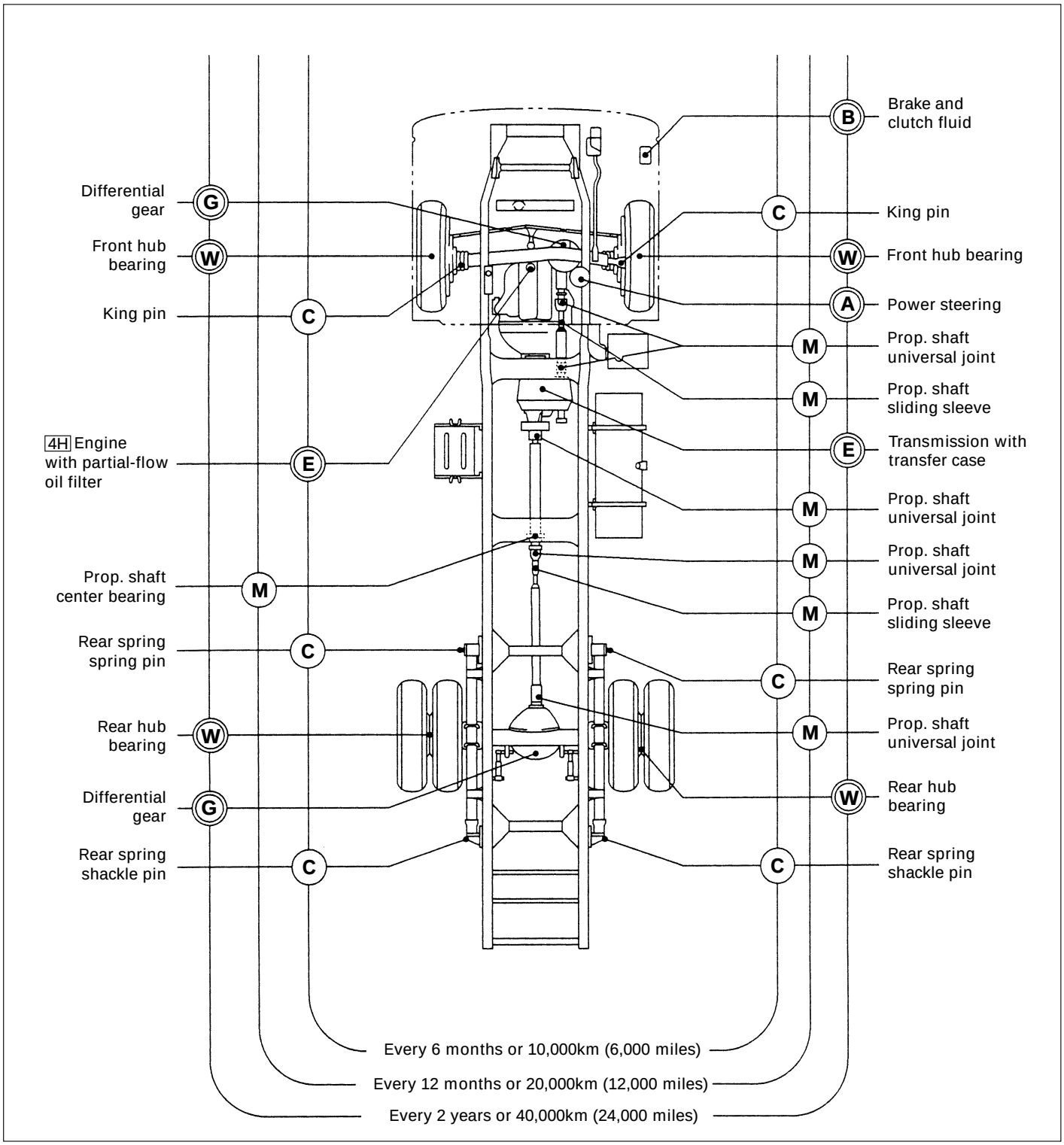
NKR66, NPR66, NPR70, NPR71, NQR66,NQR70 and NQR71 models

◎ Change
○ Check and Replenish or Lubricate
E : Engine oil
G : Gear Oil
W : Wheel bearing grease
C : Multipurpose type grease
M : MoS2 contained type grease
B : Brake fluid
A : Automatic transmission fluid



NPS66 and NPS71 model

◎ Change
○ Check and Replenish or Lubricate
E : Engine oil
G : Gear Oil
W : Wheel bearing grease
C : Multipurpose type grease
M : MoS2 contained type grease
B : Brake fluid
A : Automatic transmission fluid



MEMO

LGGEN-WE-9991

You are requested to order this manual using the manual number that is shown above.

This manual is applicable for vehicles in all countries except the USA and Canada.

All rights reserved. This manual may not be reproduced in whole or in part, without the permission in writing of ISUZU MOTORS LIMITED.

Issued by

ISUZU MOTORS LIMITED

INTERNATIONAL SERVICE DEPARTMENT

Tokyo, Japan

First edition Sept., 1999 9909-01K-1

No.LGGEN-WE-9991 PRINTED IN JAPAN

WORKSHOP MANUAL

NHR · NKR · NPR · NQR · NPS

HEATING AND AIR CONDITIONING

SECTION 1

ISUZU

ISUZU

International Service & Parts

Tokyo, Japan

NOTICE

Before using this Workshop Manual to assist you in performing vehicle service and maintenance operations, it is recommended that you carefully read and thoroughly understand the information contained in Section 0A under the headings "GENERAL REPAIR INSTRUCTIONS" and "HOW TO USE THIS MANUAL".

**All material contained in this Manual is based on latest product information available at the time of publication.
All rights are reserved to make changes at any time without prior notice.**

Applicable Model

N-Series	
NHR55	NPR69
NKR55	NPR58
NKR69	NPR59
NKR58	NPR65
NKR66	NPR66
	NQR66
	NPS66

This manual is applicable to 1994 year model and later vehicles equipped with factory installed heater and air conditioning system.

THIS MANUAL INCLUDES THE FOLLOWING SECTIONS:

SECTION NO.	CONTENTS
00	Service Information
1A	Heating and Ventilation
1B	Air Conditioning
1C	—
1D	Compressor Overhaul

SECTION 00
SERVICE INFORMATION

CONTENTS

PAGE

Troubleshooting 00– 3
Main Data and Specifications 00–21
Fixing Torque 00–23
Special Tools 00–25

TROUBLESHOOTING

CONTENTS

PAGE

Heating Cycle Troubleshooting 00– 4
Fan Switch Troubleshooting 00– 5
Blower Motor Does Not Run 00– 6
Blower Motor Does Not Run In Certain Position 00– 7
Blower Motor Does Not Stop at "OFF" Position 00– 7
Air Conditioning Cycle Troubleshooting 00– 8
Checking Refrigerant System with Manifold Gauge 00– 9
Magnetic Clutch Troubleshooting 00–12
Compressor Troubleshooting 00–17
Individual Inspection 00–18

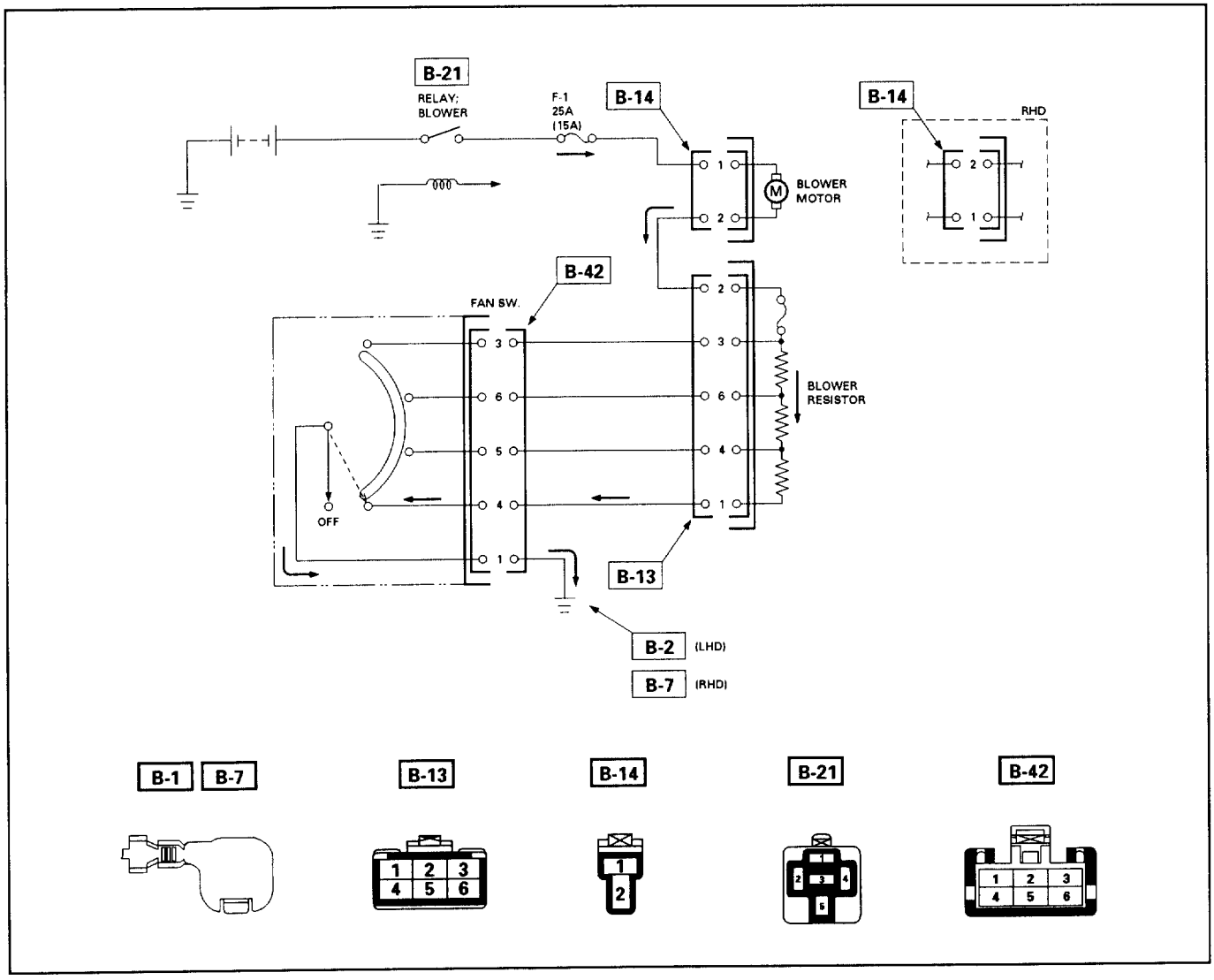
HEATING CYCLE TROUBLESHOOTING

TROUBLE	POSSIBLE CAUSE	CORRECTION
No heating or Insufficient heating.	1. Blower motor does not run, or runs improperly. 2. Engine coolant temperature is low. 3. Insufficient engine coolant. 4. Circulation volume of engine coolant is insufficient. 5. Heater core clogged or collapsed. 6. The heater core is not provided with air sent from the blower motor. 7. Duct connections defective or unsealing.	• Refer to "Fan Switch Troubleshooting". • Check the engine coolant temperature after warming up the engine and check the thermostat. Replace as necessary. • Add engine coolant as required. • Check if the water hose to the heater core is clogged, collapsed or twisted. Repair or replace as necessary. • Check water pump function. Repair or replace as necessary. • Clean or replace as necessary. • Repair the temperature control link unit or mode doors. • Repair or adjust the control cables. • Repair or replace as necessary.
Control knob moves but mode door does not operate.	1. Cable attaching clip is not correct. 2. Link unit of heater unit or blower assembly defective.	• Repair. • Repair.
The mode door cannot be set to the mode selected.	1. Link unit of heater unit or blower assembly defective 2. Control cable is not adjusted.	• Repair. • Adjust.

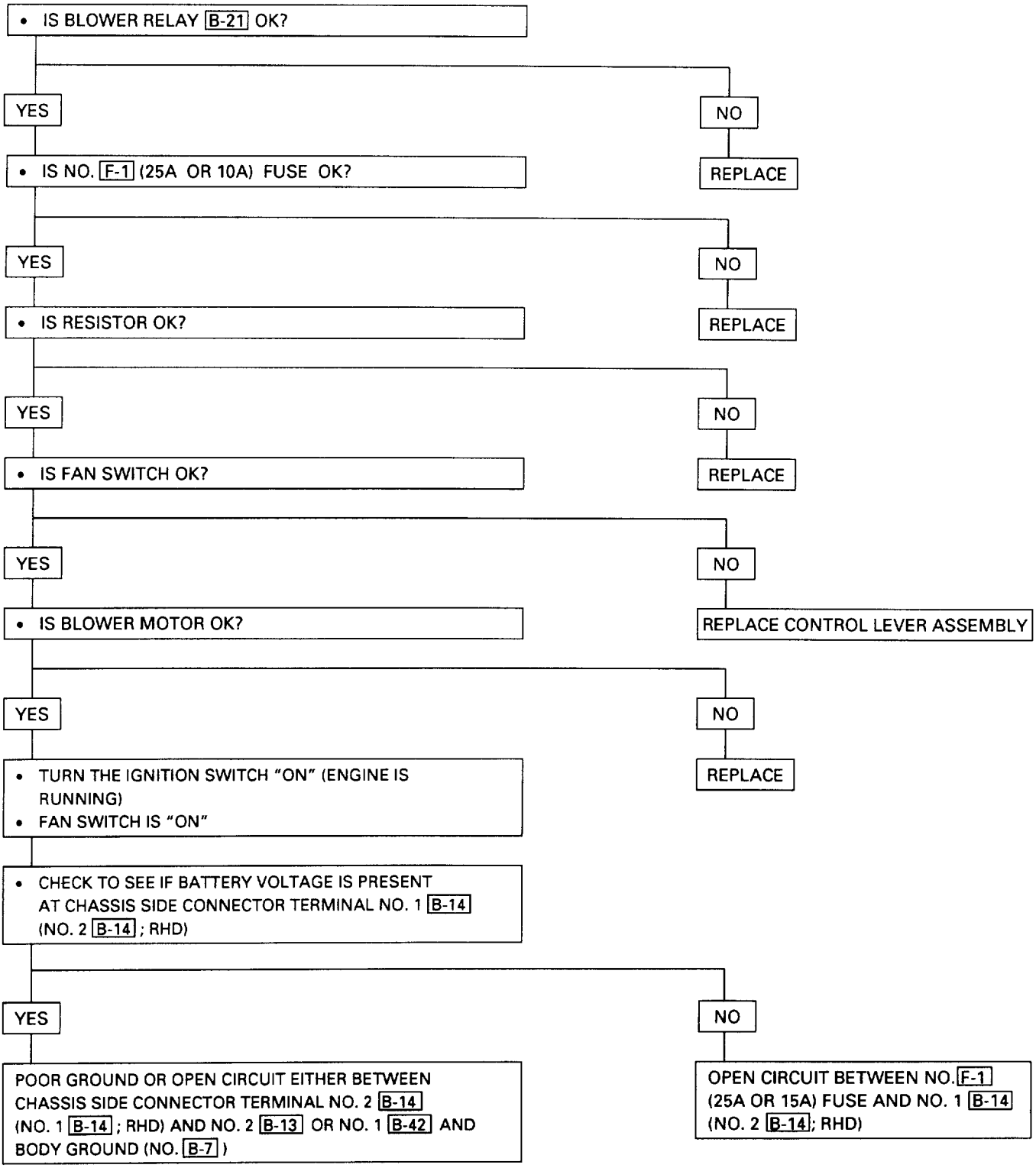
FAN SWITCH TROUBLESHOOTING

Current flows to the blower motor through the blower relay B-21 to activate the rotation of the blower motor by turning "ON" the fan switch.

Blower motor speed is controlled in stages by the resistor, by operating the switch from "LOW" to "HIGH."



BLOWER MOTOR DOES NOT RUN



BLOWER MOTOR DOES NOT RUN IN CERTAIN POSITION

BLOWER MOTOR DOES NOT RUN AT
- Ⓐ 1 : (LOW)
- Ⓑ 2 : (MEDIUM LOW)
- Ⓒ 3 : (MEDIUM HI)
- Ⓓ 4 : (HIGH)

POSITION

* CHECKING IS PERFORMED ONLY WHEN IN THE MALFUNCTION MODE.

- IS RESISTOR OK?

YES

- IS FAN SWITCH OK?

YES

Ⓐ CONDITION:
- OPEN CIRCUIT BETWEEN CHASSIS SIDE CONNECTOR TERMINAL NO. 1 B-13 AND NO. 4 B-42

Ⓑ CONDITION:
- OPEN CIRCUIT BETWEEN CHASSIS SIDE CONNECTOR TERMINAL NO. 4 B-13 AND NO. 5 B-42

Ⓒ CONDITION:
- OPEN CIRCUIT BETWEEN CHASSIS SIDE CONNECTOR TERMINAL NO. 6 B-13 AND NO. 6 B-42

Ⓓ CONDITION:
- OPEN CIRCUIT BETWEEN CHASSIS SIDE CONNECTOR TERMINAL NO. 3 B-13 AND NO. 3 B-42

NO

REPLACE

NO

REPLACE CONTROL LEVER ASSEMBLY

BLOWER MOTOR DOES NOT STOP AT "OFF" POSITION

- IS FAN SWITCH OK?

YES

SHORT CIRCUIT BETWEEN CHASSIS SIDE CONNECTOR TERMINAL
- NO. 2 B-14 (NO. 1 B-14 ; RHD) AND NO. 2 B-13
  (OR)
- NO. 3 B-13 AND NO. 3 B-42
  (OR)
- NO. 6 B-13 AND NO. 6 B-42
  (OR)
- NO. 4 B-13 AND NO. 5 B-42
  (OR)
- NO. 1 B-13 AND NO. 4 B-42

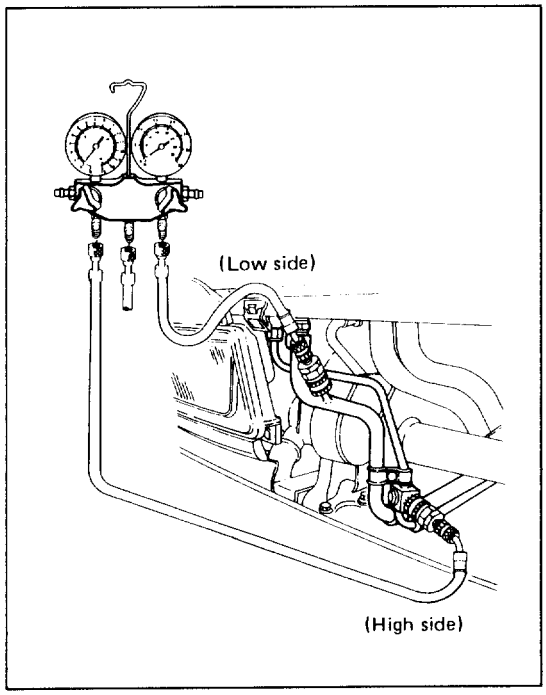
NO

REPLACE CONTROL LEVER ASSEMBLY

AIR CONDITIONING CYCLE TROUBLESHOOTING

TROUBLE	POSSIBLE CAUSE	CORRECTION
No cooling or insufficient cooling	1. Magnetic clutch does not run	• Refer to "MAGNETIC CLUTCH TROUBLESHOOTING"
	2. Compressor is not rotating properly	
	• Drive belt loosened or broken	• Adjust the drive belt to the specified tension or replace the drive belt
	• Magnetic clutch face is not clean and slips	• Clean the magnetic clutch face or replace
	• Incorrect clearance between magnetic drive plate and pulley	• Adjust the clearance (Refer to Section 1D "COMPRESSOR OVERHAUL"
	• Compressor oil leaks from shaft seal or shell	• Replace the compressor
	• Compressor seized	• Replace the compressor
	3. Insufficient or excessive charge of refrigerant	• Discharge and recover refrigerant. Recharge to specified amount.
	4. Leaks in the refrigerant system	• Check refrigerant system for leaks and repair as necessary Discharge and recover refrigerant. Recharge to specified amount.
	5. Condenser clogged or insufficient radiation	• Clean the condenser or replace as necessary • Check radiator or condenser fan function
	6. Temperature control link unit of the heater unit defective	• Repair the link unit
	7. Unsteady operation due to foreign substance in expansion valve	• Replace the expansion valve
	8. Poor operation of electronic thermostat	• Check electronic thermostat and replace as necessary
Insufficient velocity of cooling air	1. Evaporator clogged or frosted	• Check evaporator core and replace or clean the core
	2. Air leaking from cooling unit or air duct	• Check evaporator and duct connection, then repair as necessary
	3. Blower motor does not rotate properly	• Refer to "FAN SWITCH TROUBLESHOOTING"

* For the execution of the charging and discharging operation in the table above, refer to the "RECOVERY, RECYCLING, EVACUATING AND CHARGING" in section 1B.



CHECKING REFRIGERANT SYSTEM WITH MANIFOLD GAUGE

Conditions;

- Ambient temperature at approx. 30 ~ 35°C (86 ~ 95°F)
- Run the engine at 1,500 rpm
- A/C switch is "ON"
- Run the blower motor at "4" (high) position
- Temperature control lever sets at "MAX COLD"
- Air source selector lever at "CIRC"
- Open the all doors and engine hood

Normal pressures **kpa (kg·cm² / PSI)**

Low-pressure side:

Approx. 127 – 245 (1.3 – 2.5 / 18 – 36)

High-pressure side:

Approx. 1373 – 1667 (14 – 17 / 199 – 242)

Connect the manifold gauge

Low-pressure hose (LOW)~Suction side

High-pressure hose (HI)~Discharge side

CAUTION

Vehicles that use Refrigerant-134a (R-134a) is used in the air conditioning system, be sure to use manifold gauges, charging hoses and other air conditioning service tools for R-134a when checking the refrigerant system. (Refer to "ON-VEHICLE SERVICE" for Precautions for R-134a Air Conditioning System in section 1B.)

RESULT	SYMPTOM	TROUBLE CAUSE	CORRECTION
Discharge (High) pressure gauge abnormally high	Reduced or no air flow through the condenser	• Condenser clogged or dirty • Radiator (condenser) fan does not operate properly	• Clean • Check cooling fan operation
	No bubbles in sight glass when condenser is cooled by water (Insufficient cooling)	• Excessive refrigerant in system	• Check sight glass. (See "Reading Sight Glass") • Discharge and recover refrigerant. Recharge to specified amount
	After stopping air conditioning, pressure drops approx. 196 kPa (2.0 kg·cm^2/28 PSI) quickly	• Air in system	• Evacuate and charge refrigerant system
Discharge (High) pressure gauge abnormally low	Insufficient cooling and excessive bubbles in the sight glass	• Insufficient refrigerant in system	• Check sight glass. (See "Reading Sight Glass") • Check for leaks • Discharge and recover refrigerant. Recharge to specified amount
	Low pressure gauge indicates vacuum	• Clogged or defective expansion valve	• Replace the expansion valve
	Frost or dew on refrigerant line before and after receiver/ drier or expansion valve, and low pressure gauge indicates vacuum	• Restriction caused by debris or moisture in receiver/drier	• Check system for restriction and replace receiver/drier
	After turning off air conditioning, high and low pressure gauge balanced quickly	• Compressor seal defective • Poor compression due to defective compressor gasket	• Replace or repair compressor
Suction (Low) pressure gauge abnormally high	Low pressure gauge is lowered after condenser is cooled by water	• Excessive refrigerant in system	• Discharge and recover refrigerant Recharge to specified amount
	Low pressure hose temperature around the compressor refrigerant line connector is lower than around evaporator	• Unsatisfactory valve operation due to defective temperature sensor of expansion valve • Expansion valve opens too long	• Replace the expansion valve
	After turning off air conditioning, high and low pressure gauge is balanced quickly	• Compressor gasket is defective	• Replace
	Air conditioning turns off before passenger compartment is sufficiently cool	• Electronic thermostat defective	• Check the electronic thermostat and replace as necessary

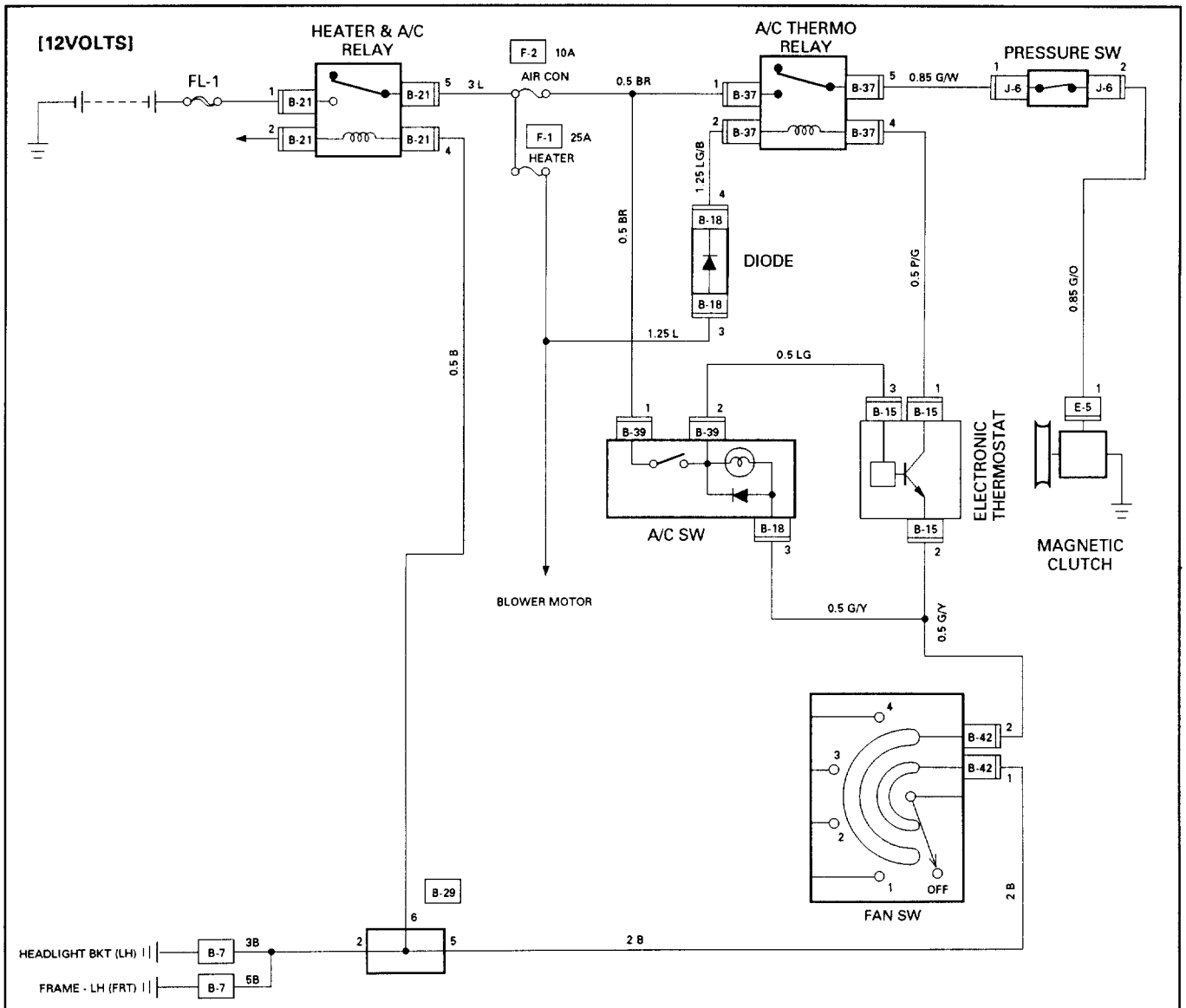
* For the charging and discharging operations in the table above, refer to "RECOVERY, RECYCLING, EVACUATION AND CHARGING" in this section.

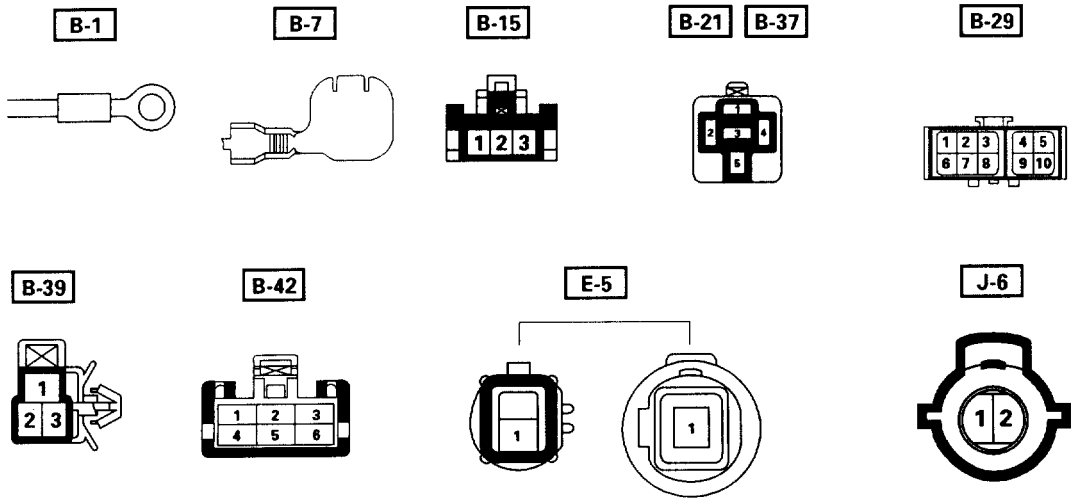
RESULT	SYMPTOM	TROUBLE CAUSE	CORRECTION
Suction (Low) pressure abnormally low	Condenser is not hot and excessive bubble in sight glass	• Insufficient refrigerant	• Check sight glass.(See "Reading Sight Glass") • Check for leaks • Discharge and recover refrigerant. Recharge to specified amount
	Frost on the expansion valve inlet line	• Expansion valve clogged	• Replace the expansion valve
	A distinct difference in temperature between the inlet and outlet refrigerant lines of the receiver/drier	• Receiver/drier clogged	• Replace the receiver/drier
	Expansion valve outlet refrigerant line is not cold and low-pressure gauge indicates vacuum	• The temperature sensor of the expansion valve is defective, and the valve cannot regulate the correct flow of the refrigerant	• Replace the expansion valve
	Discharge temperature is low and air flow from vents is restricted	• Frozen evaporator core fins	• Check electronic thermostat and replace as necessary
	Low-pressure gauge reading is low, or a vacuum reading may be shown	• Clogged or blocked refrigerant line	• Replace refrigerant line
Suction (Low) and Discharge (High) pressure abnormally high	No bubbles in sight glass after condenser is cooled by water (Insufficient cooling)	• Excessive refrigerant in system	• Check sight glass.(See "Reading Sight Glass") • Discharge and recover refrigerant. Recharge to specified amount
	Reduce air flow through condenser	• Condenser clogged • Radiator (condenser) fan does not rotate properly	• Clean • Check cooling fan operation
	Suction (Low) pressure hose is not cold	• Air in system	• Evacuate and charge refrigerant
Suction (Low) and Discharge (High) pressure abnormally low	Insufficient cooling and excessive bubbles in the sight glass	• Insufficient refrigerant in system	• Check sight glass. (See "Reading Sight Glass") • Check for leaks • Discharge and recover refrigerant. Recharge to specified amount

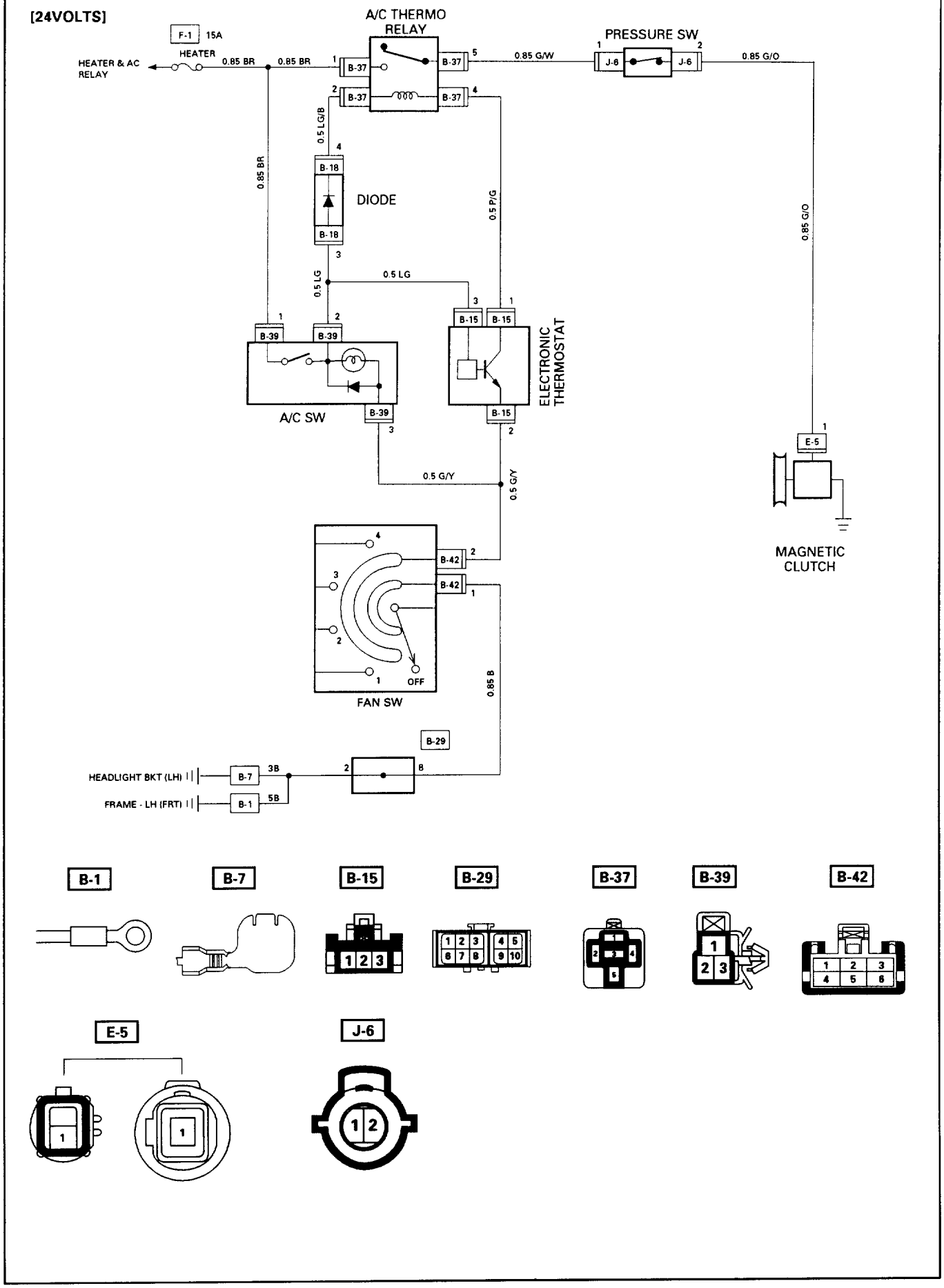
MAGNETIC CLUTCH TROUBLESHOOTING

The air conditioning is made up of the evaporator, condenser, electronic thermostat, A/C switch, fan switch and relays.
The air conditioning starts its operation when both the A/C switch and the fan switch are turned on and the magnetic clutch gets engaged through the A/C thermo relay while the engine is running. And it stops when either A/C switch or fan switch is turned off.

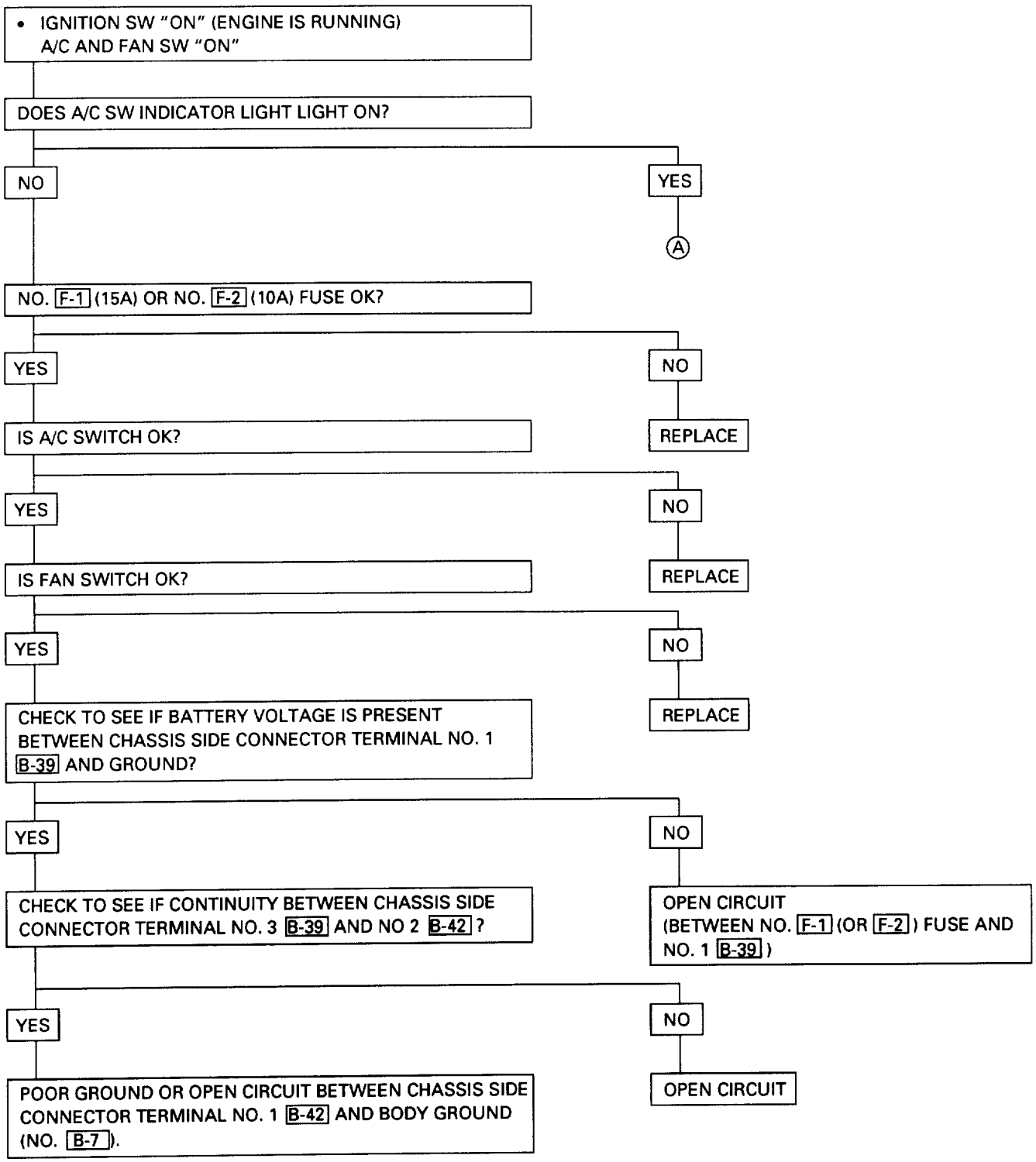
In addition to these switches, the air conditioning is also stopped by turning off the magnetic clutch temporarily under the predetermined condition when the abnormal refrigerant pressure is sensed by pressure switch, or when the air temperature is sensed by electronic thermostat that prevents the evaporator core from freezing.

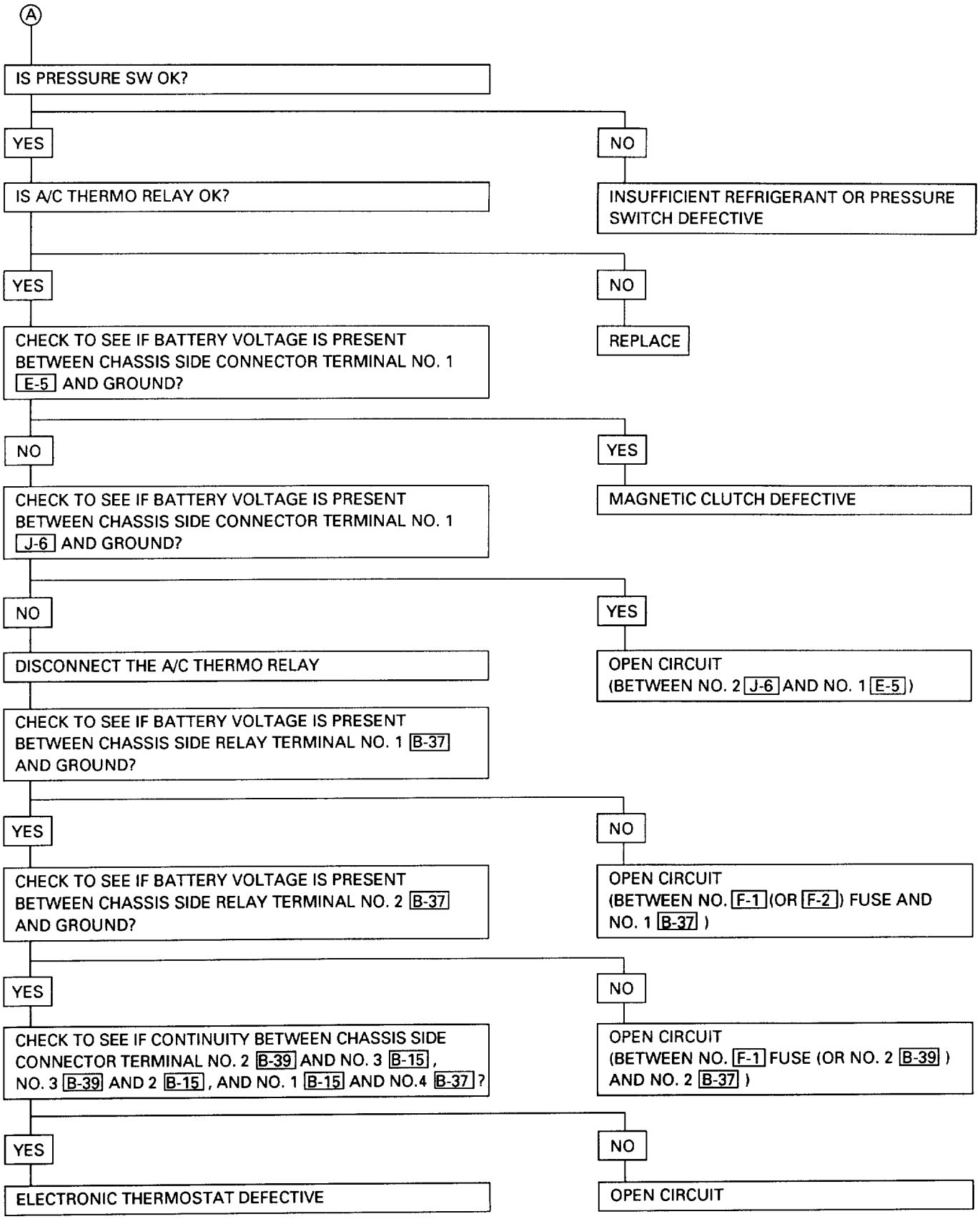

[12VOLTS]
HEATER & A/C RELAY
FL-1
F-2 10A
AIR CON
F-1 25A
HEATER
A/C THERMO RELAY
PRESSURE SW
DIODE
A/C SW
ELECTRONIC THERMOSTAT
MAGNETIC CLUTCH
BLOWER MOTOR
FAN SW
OFF
HEADLIGHT BKT (LH)
FRAME - LH (FRT)
3L
0.5 BR
0.85 G/W
1.25 LG/B
0.5 B
0.5 P/G
0.85 G/O
1.25 L
0.5 LG
0.5 G/Y
2 B
3B
5B


B-1
B-7
B-15
B-21 B-37
B-29
B-39
B-42
E-5
J-6


[24VOLTS]
A/C THERMO RELAY
F-1 15A
HEATER
HEATER & AC RELAY
0.85 BR
0.85 BR
B-37
B-37
B-37
B-37
0.85 G/W
PRESSURE SW
J-6
J-6
0.85 G/O
0.5 LG/B
B-18
B-18
DIODE
0.85 BR
0.5 P/G
0.85 G/O
0.5 LG
0.5 LG
B-39
B-39
B-39
A/C SW
B-15
B-15
B-15
ELECTRONIC THERMOSTAT
E-5
MAGNETIC CLUTCH
0.5 G/Y
0.5 G/Y
B-42
B-42
OFF
FAN SW
0.85 B
B-29
HEADLIGHT BKT (LH)
B-7
3B
FRAME - LH (FRT)
B-1
5B
B-1
B-7
B-15
B-29
B-37
B-39
B-42
E-5
J-6

MAGNETIC CLUTCH DOES NOT OPERATE

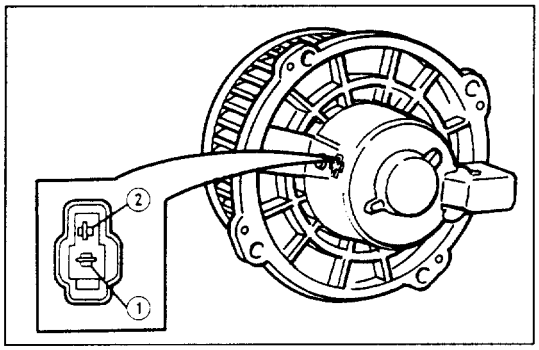



Ⓐ
IS PRESSURE SW OK?
YES
NO
IS A/C THERMO RELAY OK?
INSUFFICIENT REFRIGERANT OR PRESSURE SWITCH DEFECTIVE
YES
NO
REPLACE
CHECK TO SEE IF BATTERY VOLTAGE IS PRESENT BETWEEN CHASSIS SIDE CONNECTOR TERMINAL NO. 1 E-5 AND GROUND?
NO
YES
MAGNETIC CLUTCH DEFECTIVE
CHECK TO SEE IF BATTERY VOLTAGE IS PRESENT BETWEEN CHASSIS SIDE CONNECTOR TERMINAL NO. 1 J-6 AND GROUND?
NO
YES
OPEN CIRCUIT (BETWEEN NO. 2 J-6 AND NO. 1 E-5)
DISCONNECT THE A/C THERMO RELAY
CHECK TO SEE IF BATTERY VOLTAGE IS PRESENT BETWEEN CHASSIS SIDE RELAY TERMINAL NO. 1 B-37 AND GROUND?
YES
NO
OPEN CIRCUIT (BETWEEN NO. F-1 (OR F-2) FUSE AND NO. 1 B-37)
CHECK TO SEE IF BATTERY VOLTAGE IS PRESENT BETWEEN CHASSIS SIDE RELAY TERMINAL NO. 2 B-37 AND GROUND?
YES
NO
OPEN CIRCUIT (BETWEEN NO. F-1 FUSE (OR NO. 2 B-39) AND NO. 2 B-37)
CHECK TO SEE IF CONTINUITY BETWEEN CHASSIS SIDE CONNECTOR TERMINAL NO. 2 B-39 AND NO. 3 B-15 , NO. 3 B-39 AND 2 B-15 , AND NO. 1 B-15 AND NO.4 B-37 ?
YES
NO
OPEN CIRCUIT
ELECTRONIC THERMOSTAT DEFECTIVE

COMPRESSOR TROUBLESHOOTING

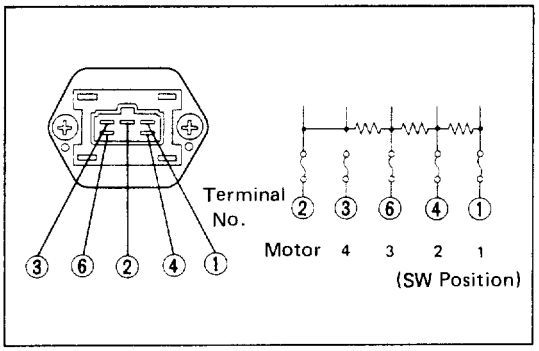
ITEM	TROUBLE	POSSIBLE CAUSE	CORRECTION
1	Noise from compressor	1. Defective piston 2. Defective bearing 3. Defective shaft	Replace cylinder and shaft assembly Replace cylinder and shaft assembly Replace cylinder and shaft assembly
2	Noise from magnetic clutch face	1. Defective bearing 2. Defective clutch 3. Clearance between drive plate and pulley is not standard	Replace magnetic clutch Replace magnetic clutch Adjust the clearance or replace magnetic clutch
3	Insufficient cooling	1. Defective gasket 2. Defective reed valve 3. Defective suction valve	Replace gasket Replace valve plate Replace suction valve
4	Not rotating	1. Defective piston 2. Defective shaft 3. Rotating parts seized due to insufficient oil	Replace cylinder and shaft assembly Replace cylinder and shaft assembly Replace compressor
5	Oil and/or gas leakage	1. Defective seal 2. Defective O-ring	Replace shaft seal Replace

INDIVIDUAL INSPECTION



Blower Motor

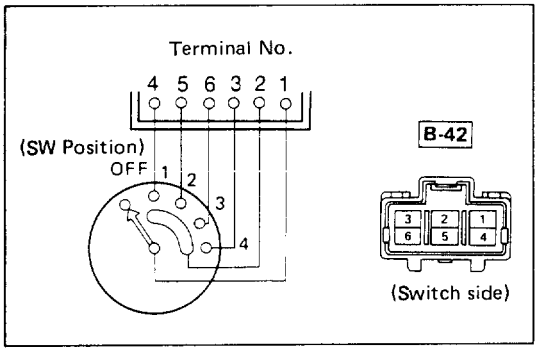
1) Disconnect the blower motor connector from the blower motor.
2) Connect the battery positive terminal to the No. 1 (No. 2; RHD) terminal of the blower motor and negative to the No. 2 (NO. 1; RHD).
3) Be sure to check to see if the blower motor operates correctly.



Resister

1) Disconnect resistor connector.
2) Check for continuity and resistance between the terminals of the resistor.

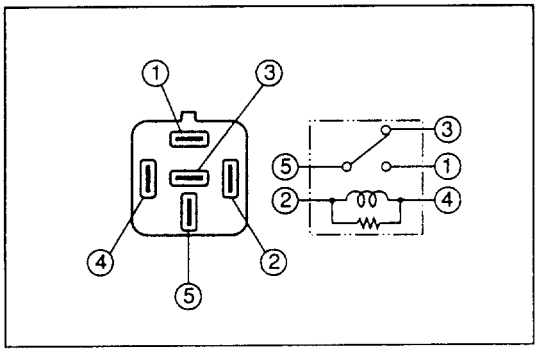
Terminal No. / SW position	1	2	3	4	6	Resistance value (Ω) 12V	Resistance value (Ω) 24V
1	○	○				2.3	9.3
2		○		○		1.0	4.0
3		○			○	0.3	1.2
4		○	○			—	—



Fan Switch

Check for continuity between fan switch and A/C switch side connector terminals.

Terminal No. / SW position	1	2	3	4	5	6
1	○	○		○		
2	○	○			○	
3	○	○				○
4	○	○	○			



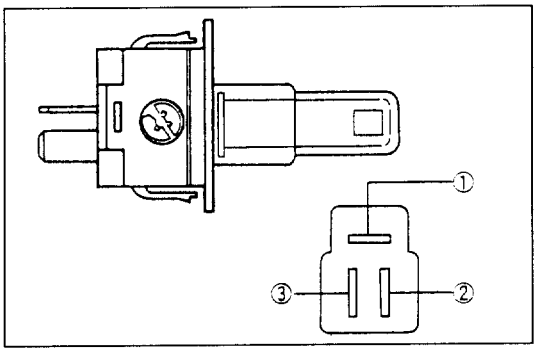
Heater & A/C and A/C Thermo Relay

Check for continuity between relay side connector terminal.

③ – ⑤ - - - Continuity
① – ⑤ - - - No Continuity

(When battery voltage is applied between ② – ④

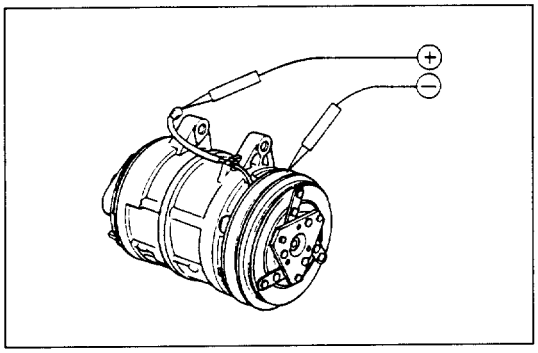
③ – ⑤ - - - No Continuity
① – ⑤ - - - Continuity



A/C Switch

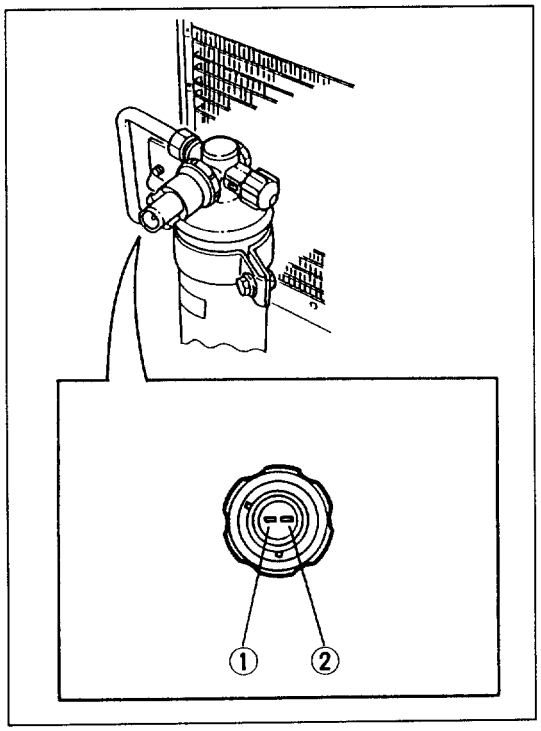
Check for continuity between A/C switch side connector terminals.

SW position \ Terminal No.	1	2	3
ON	○	○	○
OFF		○	○



Magnetic Clutch

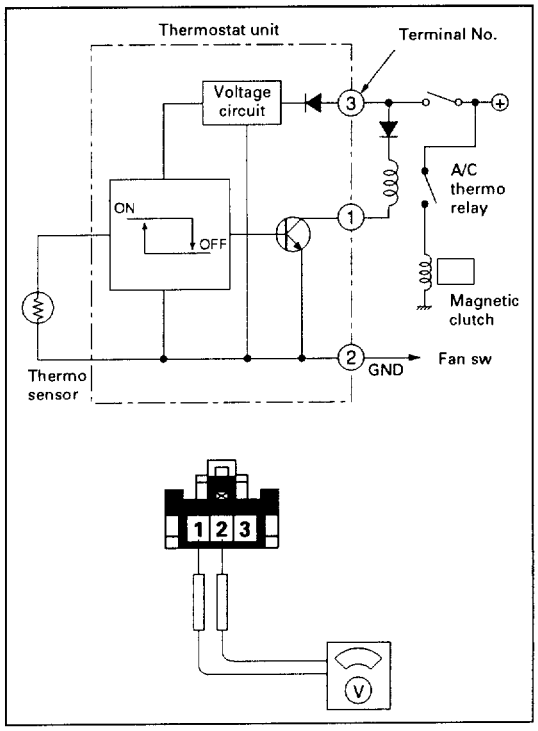
1) Disconnect the magnetic clutch harness connectors.
2) Apply battery voltage to the clutch side connector terminal, check to see if the magnetic clutch is attracted to the pulley.



Pressure Switch

Disconnect the connector and check for continuity between pressure switch side connector terminal.

Terminal No.	Control	Continuity
① – ②	Magnetic Clutch	Continuity



Electronic Thermostat

1. With the air select lever set to "VENT" and the air source select lever to "CIRC", start the air conditioning.
2. While shifting the temperature control lever from "FULL COOL" through the "FULL HOT", check to see if the magnetic clutch turns on and off.
   (* Note that the time required to reach the "OFF" point depends on the warm or cold air at 3.5 ± 0.5°C at the electronic thermostat thermosensor).
3. While the magnetic clutch is turning "ON" and "OFF", measure the voltage between chassis side connector terminal No. ① and No. ②.

Terminal No.	Magnetic clutch	Voltage
① – ②	ON	0V
	OFF	Battery voltage

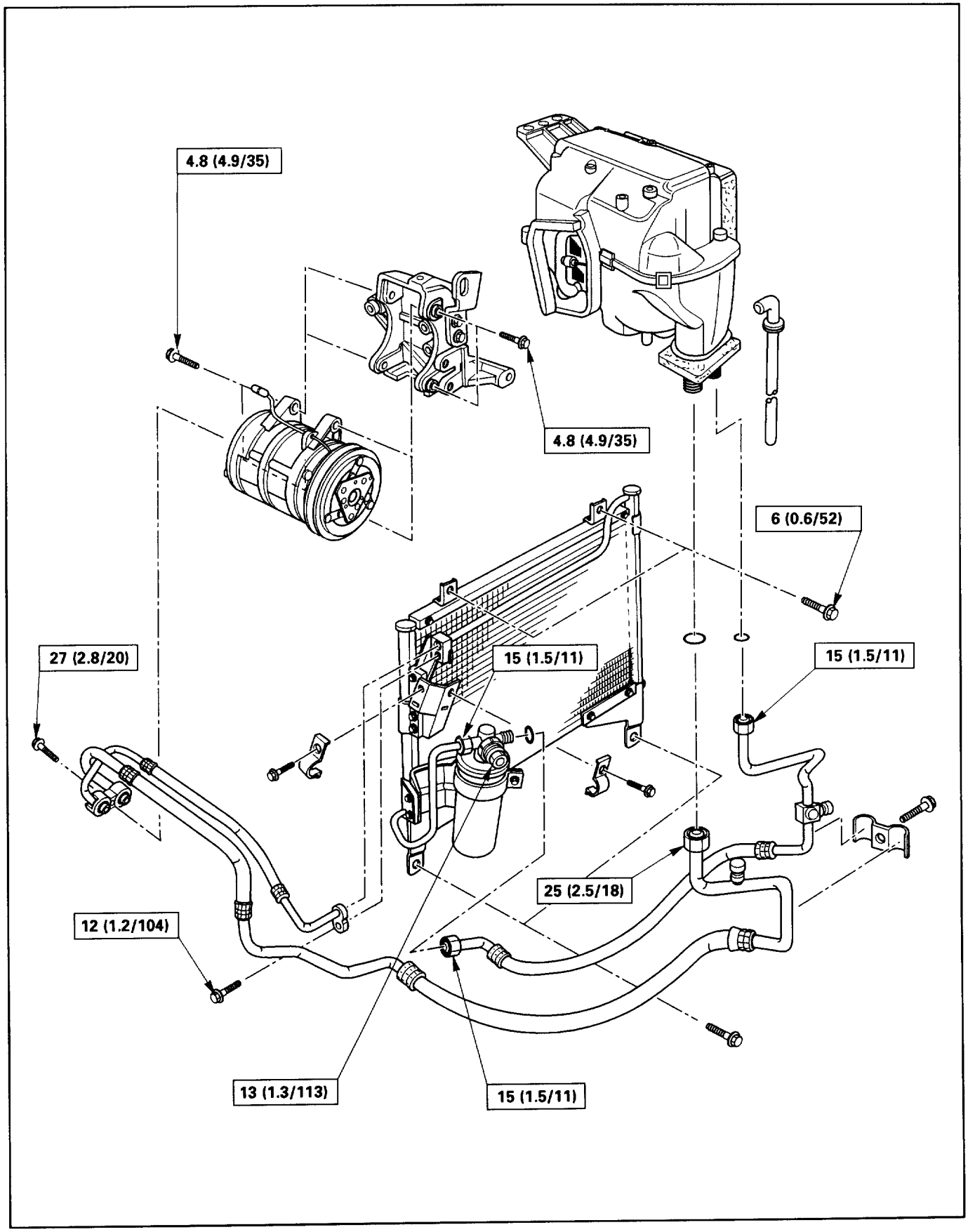
MAIN DATA AND SPECIFICATIONS

HEATER UNIT		
Temperature control		Reheat air mix system
Capacity	kW (kcal)	4.30 (3,700)
Air flow	(m^3/hr)	280
HEATER CORE		
Type		Fin & tube type
EVAPORATOR ASSEMBLY		
Capacity	kW (kcal)	4.47 (3,850)
Air flow	(m^3/hr)	420
EVAPORATOR CORE		
Type		Al-laminate louver fin type
EXPANSION VALVE		
Type		External pressure equalizer type
THERMOSTAT SWITCH		
Type		Electronic thermostat
	°C (F)	OFF: Below 3.5 ± 0.5 (38.3 ± 0.9) ON: Above 5.0 ± 0.5 (41.0 ± 0.9)
CONDENSER		
Type		Parallel flow
Radiator performance	kW (kcal)	11.0 (9,500) – NPR 7.9 (6,800) – NKR
RECEIVER/DRIER		
Internal volume	cc (Imp. fl oz)	300 (8.5)
PRESSURE SWITCH		
Type		Dual pressure switch
	kPa (kg·cm^2/PSI)	• Low pressure control ON: 206 ± 30 (2.1 ± 0.3 / 30 ± 4) OFF: 176 ± 20 (1.8 ± 0.2 / 26 ± 3) • High pressure control ON: 2354 ± 196 (24.0 ± 2.0 / 341 ± 28) OFF: 2942 ± 196 (30.0 ± 2.0 / 327 ± 28)
REFRIGERANT		
Type/Specified amount	g (lbs)	R-134a / 600 (1.32)

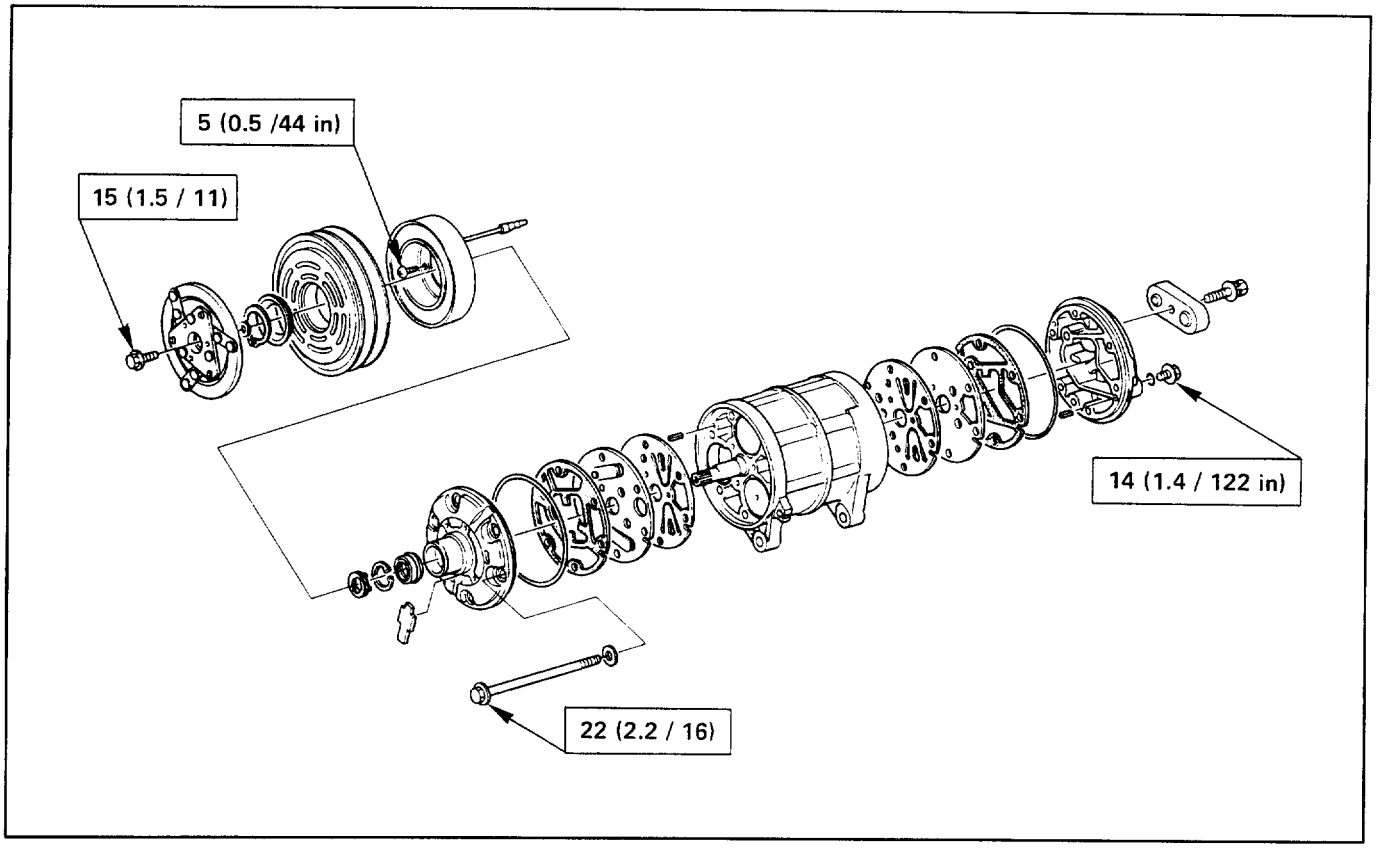
COMPRESSOR		
Model		DKS-15CH
Type		Swash plate type
Number of cylinder		6
Bore	mm (in)	36 (1.42)
Stroke	mm (in)	24 (0.94)
Displacement	cc (Imp fl oz)	147 (4.1)
Maximum speed	(rpm)	7,000 (up to 8,400)
Direction of rotation		Clockwise (Front-side view)
Lubrication system		Pressure differential type
Lubricant	cc (Imp fl oz)	ZXL-100PG / 180 (5.0) (ISUZU PART NO. 8-97101-338-0)
Refrigerant	g (lbs)	R-134a / 600 (1.32)
Shaft seal		Lip type
Weight	kg (lbs)	4.0 – 4.3 (8.8 – 9.5)
MAGNETIC CLUTCH		
Type		Electromagnetic single-plate dry clutch
Rated voltage		12 (24) Volts D.C.
Starting torque	N·m (kg·m / lb·ft)	49 (5.0 / 36)
Direction of rotation		Clockwise (Front-side view)
Weight	kg (lbs)	2.0 (4.4)

FIXING TORQUE

N·m (kg·m / lb·ft)



N·m (kg·m / lb·ft)



SPECIAL TOOLS

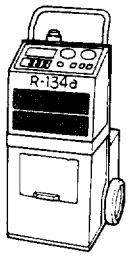
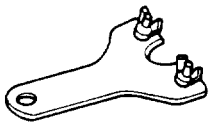
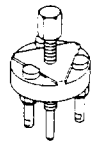
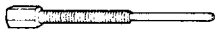
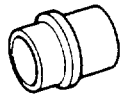
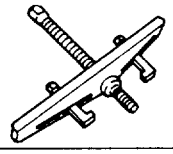
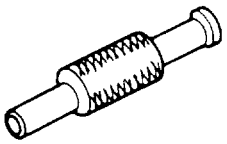
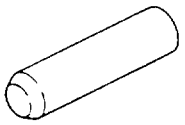
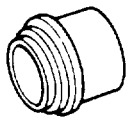
ILLUSTRATION	PARTS NO.	PART NAME
	5-8840-0629-0 (J-39500-A)	ACR^4 (115V 60Hz)
	5-8840-0630-0 (J-39500-220A)	ACR^4 (220-240V 50/60Hz)
	5-8840-0631-0 (J-39500-220ANZ)	ACR^4 (220-240V 50/60Hz Australian model)
		ACR^4 : R-134a Refrigerant Recovery / Recycling / Recharging / System

ILLUSTRATION	PARTS NO.	PART NAME
	5-8840-0117-0 (J-33939)	Drive plate holder
	5-8840-0122-0 (J-33944-A)	Drive plate puller
	5-8840-0621-0 (J-3394-4)	Forcing screw
	5-8840-0121-0 (J-33943)	Pulley puller pilot
	5-8840-0111-0 (J-8433)	Pulley puller
	5-8840-0120-0 (J-33942)	Shaft seal remover and installer
	5-8840-0368-0 (J-34614)	Shaft seal guide
	5-8840-0118-0 (J-33940)	Pulley installer
	5-8840-0007-0 (J-8092)	Drive handle

SECTION 1A
HEATING AND VENTILATION

CAUTION
When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size and strength (or stronger) may be used.

Fasteners that are not reused, and those requiring thread locking compound, will be called out. The correct torque values must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

CONTENTS

PAGE

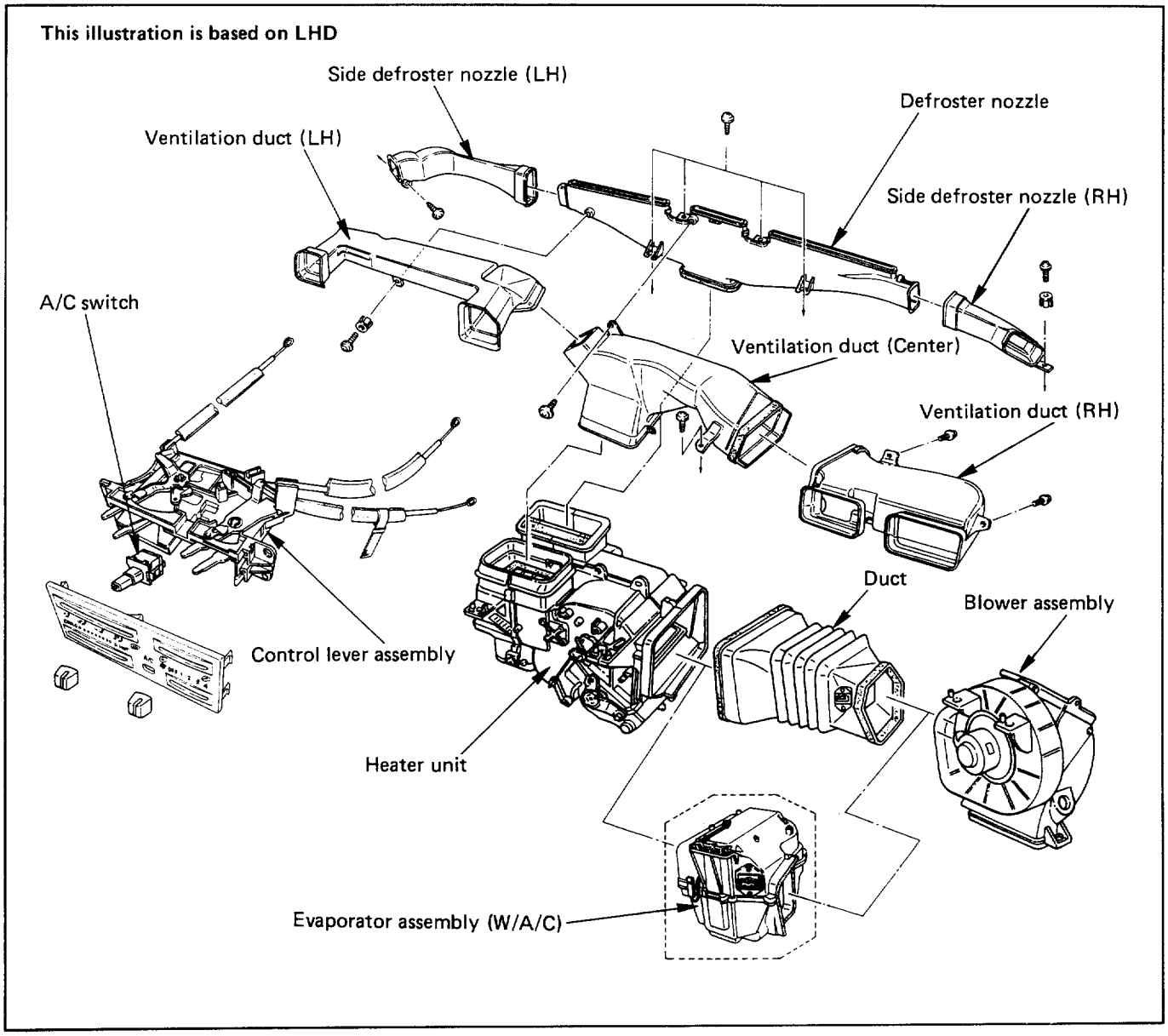
General Description 1A– 2
Heater 1A– 2
Control Lever Assembly 1A– 3
Ventilation 1A– 3
Air Select Lever 1A– 4
Air Source Select Lever 1A– 4
Fan Switch 1A– 4
Temperature Control Lever 1A– 4
On-Vehicle Service 1A– 6
Heater Unit/Heater Core 1A– 6
Heater Temperature Control Link Unit/Air Mix Door 1A– 9
Heater Mode Control Link Unit/Mode Door 1A–11
Blower Assembly 1A–13
Blower Link Unit/Mode Door 1A–16
Blower Motor 1A–18
Blower Filter 1A–20
Ventilation Grille 1A–21
Defroster Nozzle/Ventilation Duct 1A–23
Control Lever Assembly 1A–25
Control Panel Illumination Bulb 1A–28
Resistor 1A–29

GENERAL DESCRIPTION

HEATER

When the engine warming up, the warmed engine coolant is sent out into the heater core. The heater system supplies warm air into the passenger compartment to warm it up.
Outside air is circulated through the heater core of the heater unit and then back into the passenger compartment. By controlling the mixture of outside air and heater core air, the most comfortable passenger compartment temperature can be selected and maintained.
The temperature of warm air sent to the passenger compartment is controlled by the temperature control lever. This lever acts to open and close the air mix door, thus controlling the amount of air passed through the heater core.

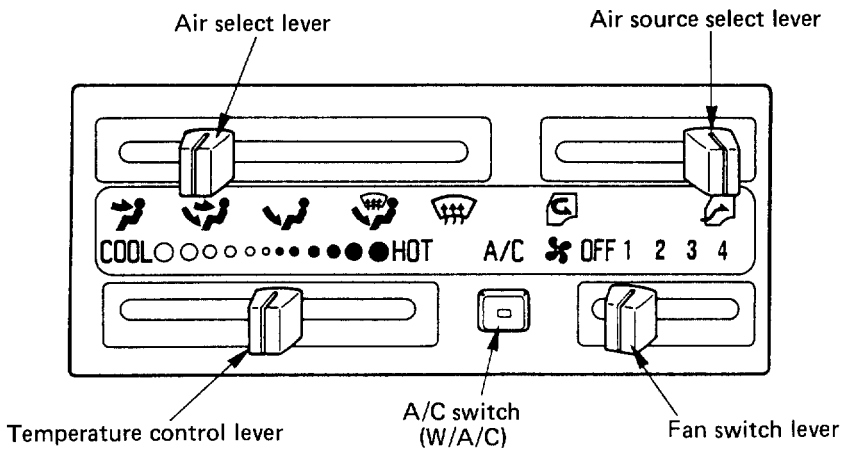
The air select lever, with its different modes, also allows you to select and maintain the most comfortable passenger compartment temperature. The air source select lever is used to select either "FRESH" for the introduction of the outside air, or "CIRC" for the circulation of the inside air. When the lever is set to "FRESH", the outside air is always taken into the passenger compartment. When setting the lever to "CIRC" position, the circulation of air is restricted only to the inside air with no introduction of the outside air and the air in the passenger compartment gets warm quickened. However, the lever is normally set to "FRESH" to prevent the windshield from clouding.



CONTROL LEVER ASSEMBLY

The vehicle has cable-control-type to control by cable the mode and temperature of the heater unit and the mode door for the air source of the blower assembly.

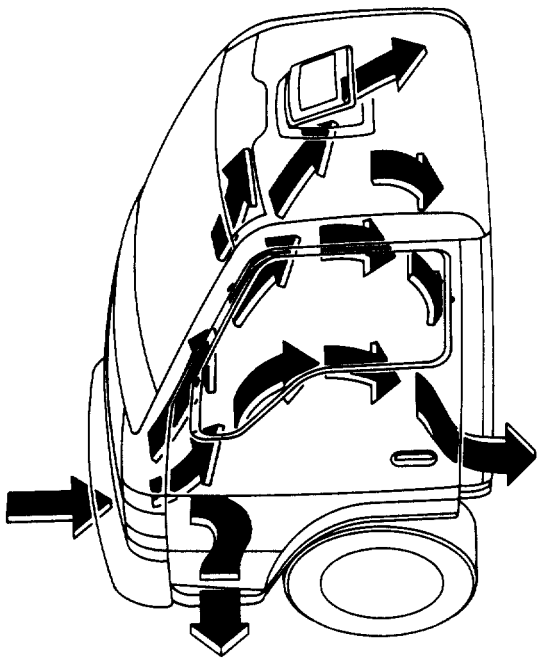
The fan control is used to control the amount of air sent out by the resistor at four levels from "LOW" to "HIGH".



VENTILATION

Set "AIR SOURCE SELECT LEVER" to "FRESH" position and turn on the blower fan. Heating can be done in this lever position, sending in fresh air from outside.

The blower fan also serves to deliver fresh outside air to the vehicle interior to assure adequate ventilation.



AIR SELECT LEVER

The air selector lever allows you to direct heated air into the passenger compartment through different outlets.

1. **Vent** - In this position, air is discharged from the upper air outlet. Air quantity is controlled by the fan control knob.
2. **Bi-Level** - In this position, air flow is divided between the upper air outlets and the foot air outlets, with warmer air delivered to the floor outlets than the air delivered to the upper air outlets.
3. **Foot** - In this position, air flow is delivered to the foot only.
4. **Def/Foot** - In this position, air flow is delivered to the foot, while sending approx. 30% of total amount of air to the windshield.
5. **Defrost** - In this position, most of the air is delivered to the windshield and a small amount is delivered to the side windows.

AIR SOURCE SELECT LEVER

The intake of outside air and the circulation of inside air are controlled by sliding this lever left or right. Moving the air source select lever to the "CIRC" position provides quickest heat delivery by closing the blower assembly mode door. In this position, outside air is not delivered to the passenger compartment.

FAN SWITCH LEVER

This lever controls the blower motor speed to regulate the amount of air delivered to the defrost, foot, and ventilation ducts:

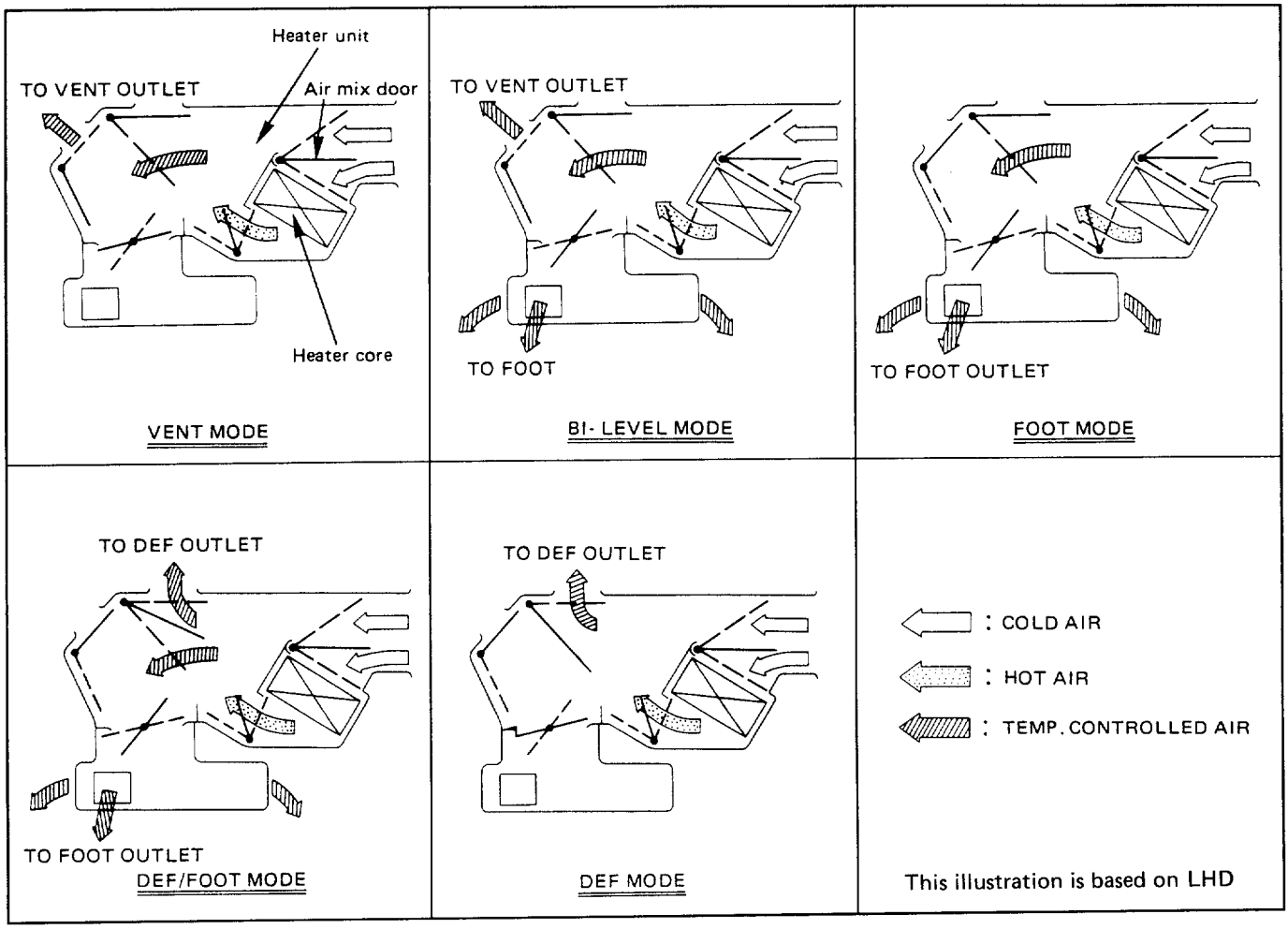
1. Low
2. Medium Low
3. Medium High
4. High

TEMPERATURE CONTROL LEVER

When the temperature control lever is in the "COLD" position, the air mix door closes to block the flow of air to the heater core.

When the temperature control lever is in the "HOT" position, the air mix door opens to allow air to pass through the heater core and heat the passenger compartment.

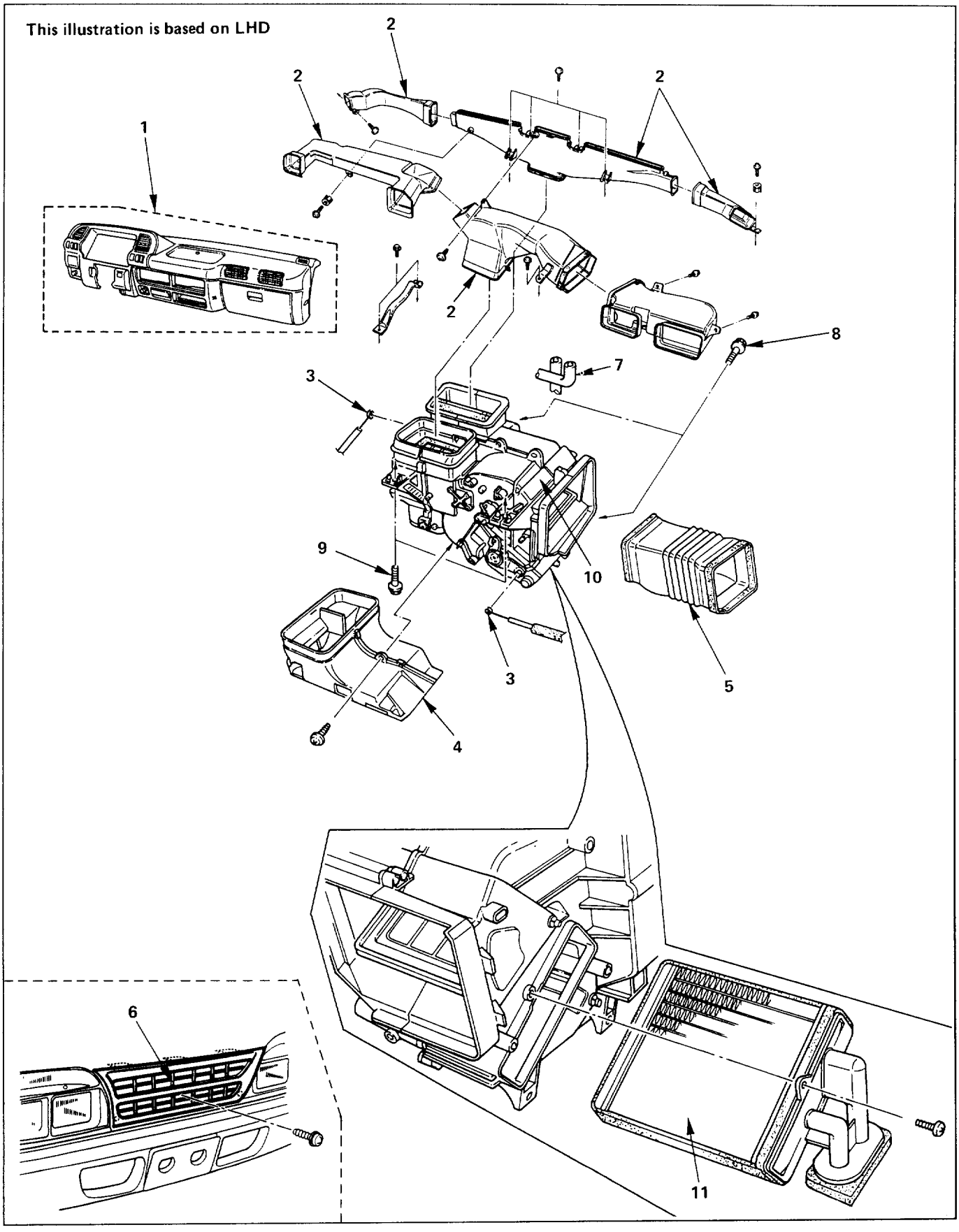
Placing the lever in an intermediate position will cause a lesser or greater amount of air to reach the heater core. In this mode the passenger compartment temperature can be regulated.



MEMO

ON-VEHICLE SERVICE

Heater Unit/Heater Core



Removal Steps

1. Instrument panel assembly
2. Defroster nozzle and ventilation duct
3. Heater control cable
4. Foot duct
5. Duct (NPR only)
6. Front grille
7. Water hose
8. Bolt (Panel – heater unit)
9. Bolt (Heater unit – reinforce)
10. Heater unit
11. Heater core

Installation Steps

To install, follow the removal steps in the reverse order.

Removal Steps

Preparation:

Disconnect the battery ground cable.

1. **Instrument Panel Assembly**

   Refer to Section 10 "BODY" for INSTRUMENT PANEL ASSEMBLY removal procedure.

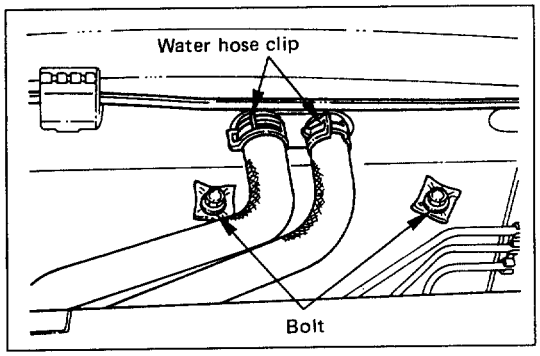
2. **Defroster Nozzle and Ventilation Duct**

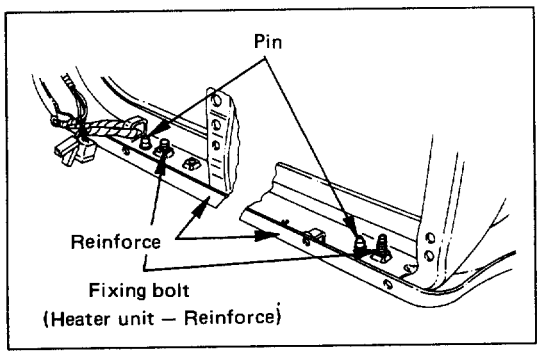
   Refer to "DEFROSTER NOZZLE AND VENTILATION DUCT" removal procedure in this section.

3. **Heater Control Cable**

   Disconnect the cables from the heater unit.

4. **Foot Duct**
5. **Duct (NPR only)**
6. **Front Grille**
7. **Water Hose**
   - Loosen the water hose clips and disconnect the water hoses from the heater unit.
   - Put caps to the openings of the heater unit and the water hoses to prevent a lot of engine coolant from spilling out of them.
8. **Bolt (Panel – Heater Unit)**





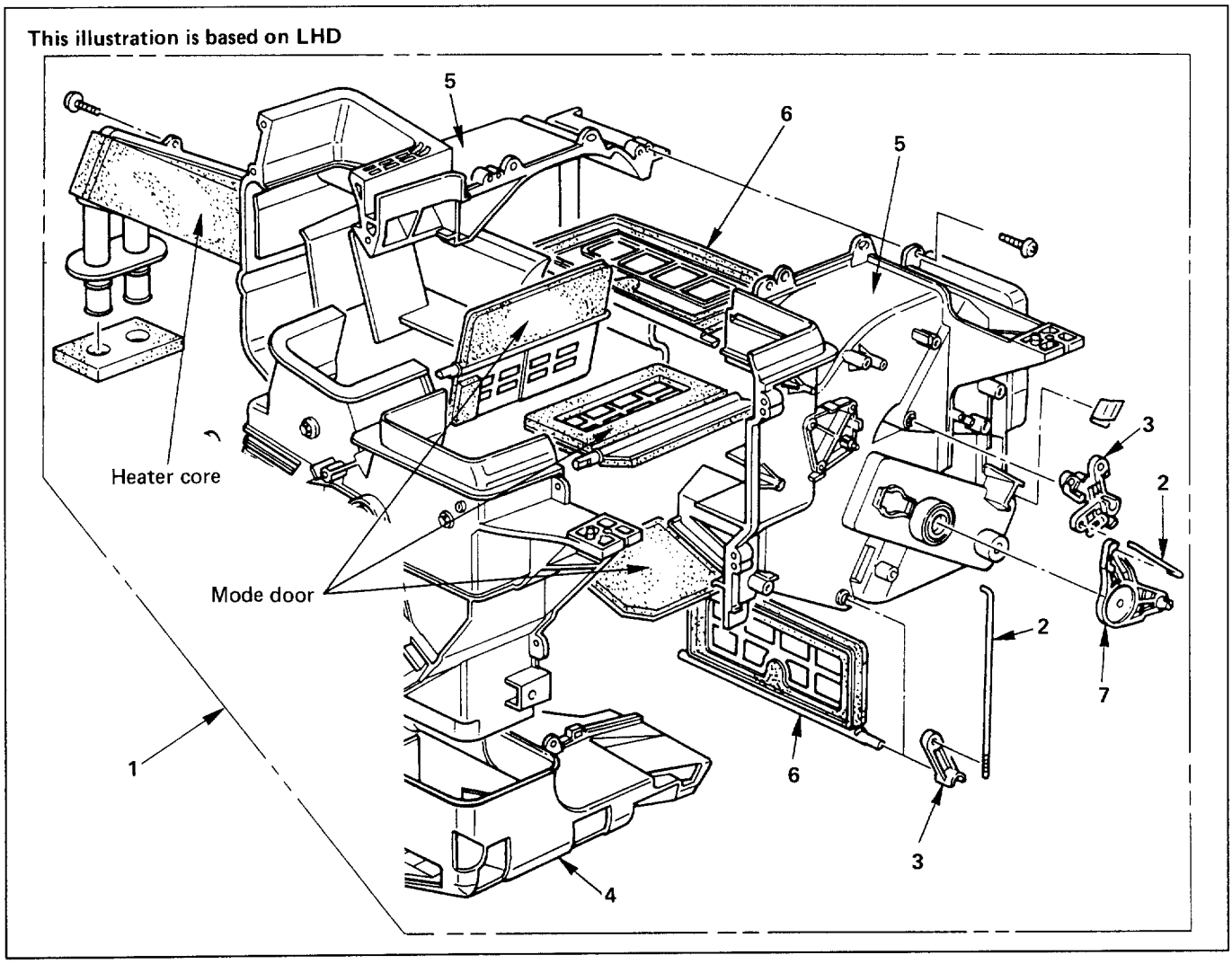
9. **Bolt (Heater Unit – Reinforce)**
10. **Heater Unit**
    - Drop the heater unit positioning pins from the reinforce, and remove the heater unit while sliding the engaged section between the evaporator and the heater unit.
11. **Heater Core**

Installation Steps

To install, follow the removal steps in the reverse order, noting the following points.

1. **Adjust the heater control cable**
   Refer to "CONTROL LEVER ASSEMBLY" installation procedure in this section.
2. **When installing the heater unit, defroster nozzles and ventilation ducts, be sure that proper seal is made, without any gap between them.**
3. **Check the engine coolant level. When the level is below the specified amount, replenish engine coolant to the proper level.**

Heater Temperature Control Link Unit/Air Mix Door



Removal Steps

1. Heater unit
2. Rod
3. Door lever
4. Foot duct
5. Upper case
6. Air mix door
7. Mix sub lever

Installation Steps

To install. follow the removal steps in the reverse order.

Removal Steps

Preparation:

Disconnect the battery ground cable.

1. **Heater Unit**

   Refer to "HEATER UNIT" removal procedure in this section.
2. **Rod**
3. **Door Lever**

   Pull out the door lever while raising up the catch of the door lever.
4. **Foot Duct**
5. **Upper Case**

   Separate two halves of the upper case.
6. **Air Mix Door**
7. **Mix Sub Lever**

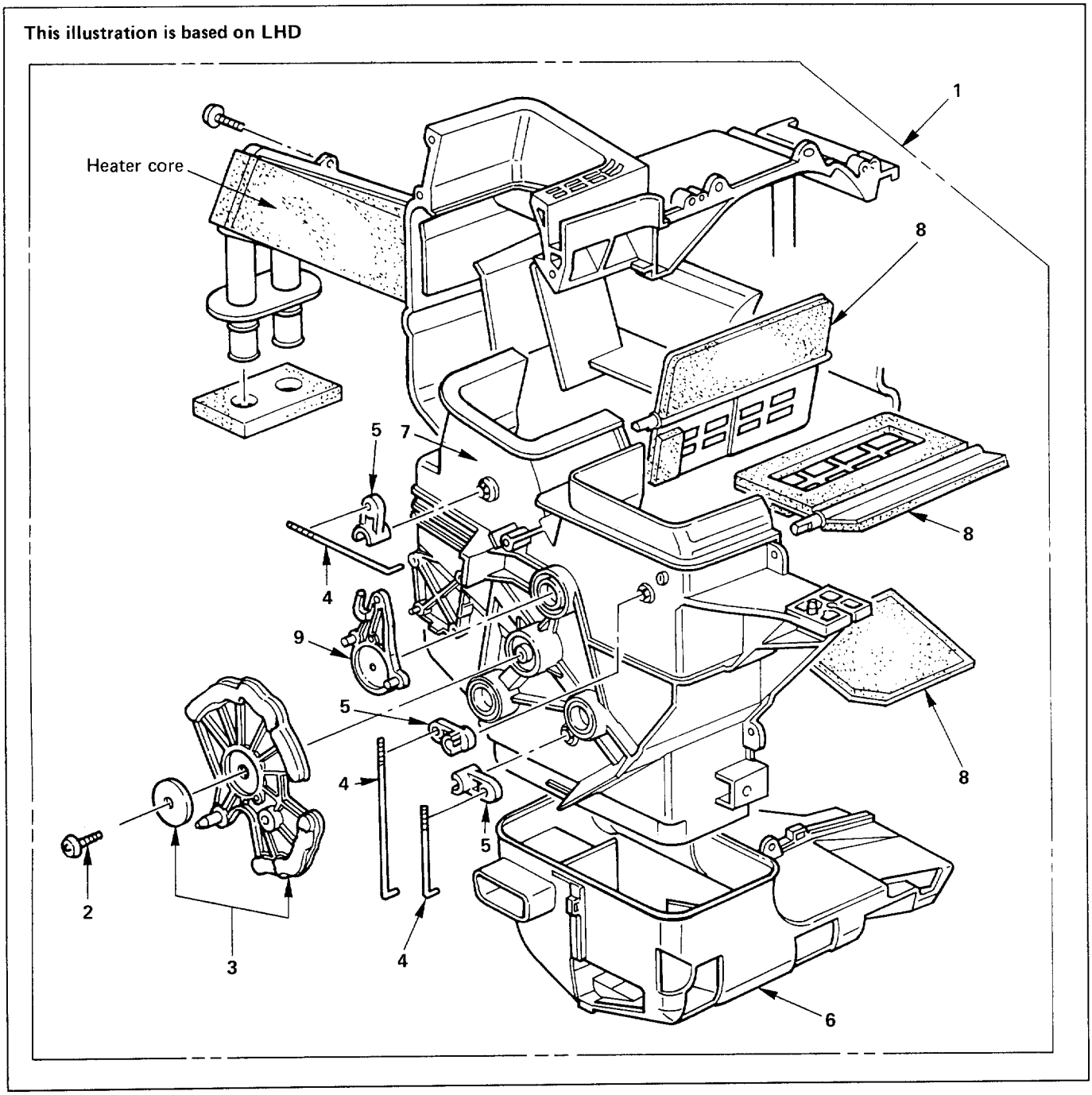
   Press the tab of the sub lever inward, and take out the sub lever.

Installation Steps

To install, follow the removal steps in the reverse order.

Heater Mode Control Link Unit/Mode Door

This illustration is based on LHD



Removal Steps

1. Heater unit
2. Screw
3. Washer and mode main lever
4. Rod
5. Door lever
6. Foot duct
7. Upper case
8. Mode door
9. Mode sub lever

Installation Steps

To install, follow the removal steps in the reverse order.

Removal Steps

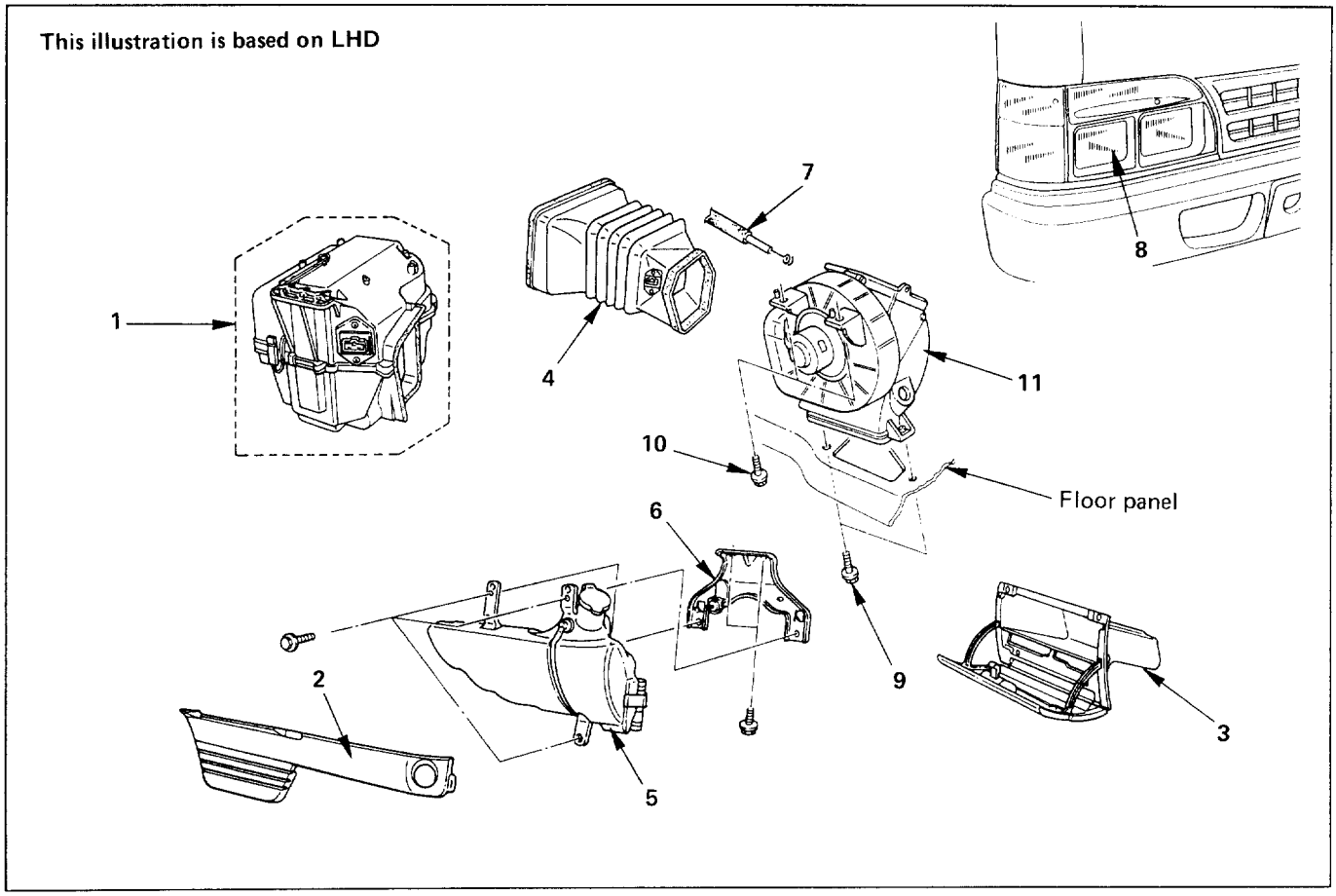
Preparation:
Disconnect the battery ground cable.

1. **Heater Unit**
   Refer to "HEATER UNIT" removal procedure in this section.
2. **Screw**
3. **Washer and Mode Main Lever**
4. **Rod**
5. **Door Lever**
   Pull out the door lever while raising up the catch of the door lever.
6. **Foot Duct**
7. **Upper Case**
8. **Mode Door**
9. **Mode Sub Lever**
   Press the tab of the sub lever inward, and take out the sub lever.

Installation Steps

To install, follow the removal steps in the reverse order.

Blower Assembly



Removal Steps

1. Evaporator assembly (A/C only)
2. Under cover (Without A/C)
3. Glove box (Without A/C)
4. Duct (Without A/C)
5. Washer tank (Without A/C)
6. Washer tank bracket
7. Blower control cable
8. Headlight assembly (RH)
9. Bolt (Panel – Blower assembly)
10. Bolt (Blower assembly – Reinforce)
11. Blower assembly

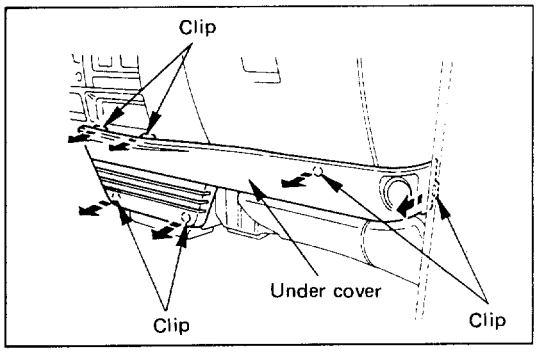
Installation Steps

To install, follow the removal steps in the reverse order.

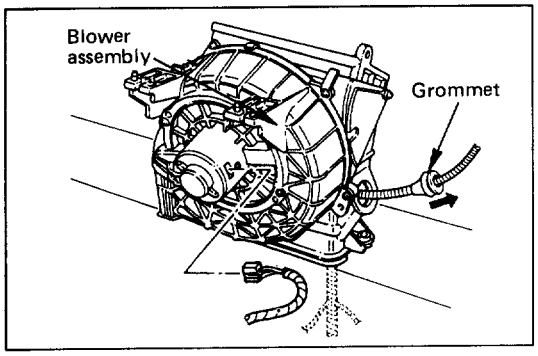
Removal Steps

Preparation:
Disconnect the battery ground cable.
Discharge and recover refrigerant (A/C only)

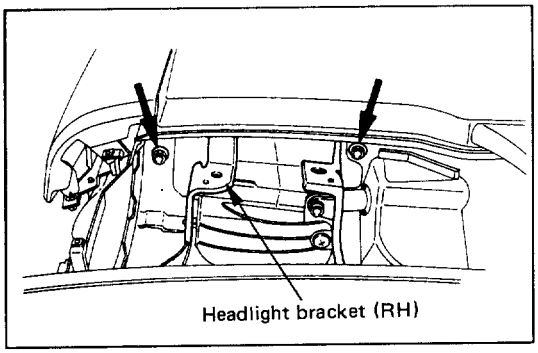
1. **Evaporator Assembly**
   Refer to Section 1B "AIR CONDITIONING" for Evaporator Assembly removal procedure.
2. **Under Cover (Without A/C)**
   While pulling the under cover with care, remove the clips on the back side of the cover.
3. **Glove Box (Without A/C)**
   Open the glove box and remove the fixing screws.



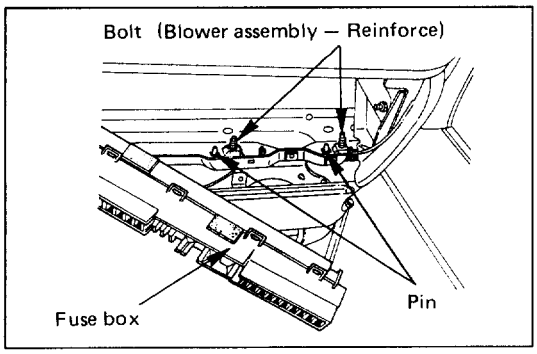
4. **Duct (Without A/C)**
5. **Washer Tank (Without A/C)**
   Remove the washer tank fixing three bolts (Upper: two, Lower: one) and disconnect the connector.
6. **Washer Tank Bracket**
   Disconnect the harness connection connector and remove the fixing bolts.
7. **Blower Control Cable**
   Disconnect the blower control cable from the blower assembly



8. **Headlight Assembly (RH)**
   - Refer to Section 8 "CAB AND CHASSIS ELECTRICAL" for Headlight removal procedure.
   - Remove the grommet provided at the lower right side of the blower assembly, and pull in the harness to the room through the blower hole.



9. **Bolt (Panel – Blower Assembly)**



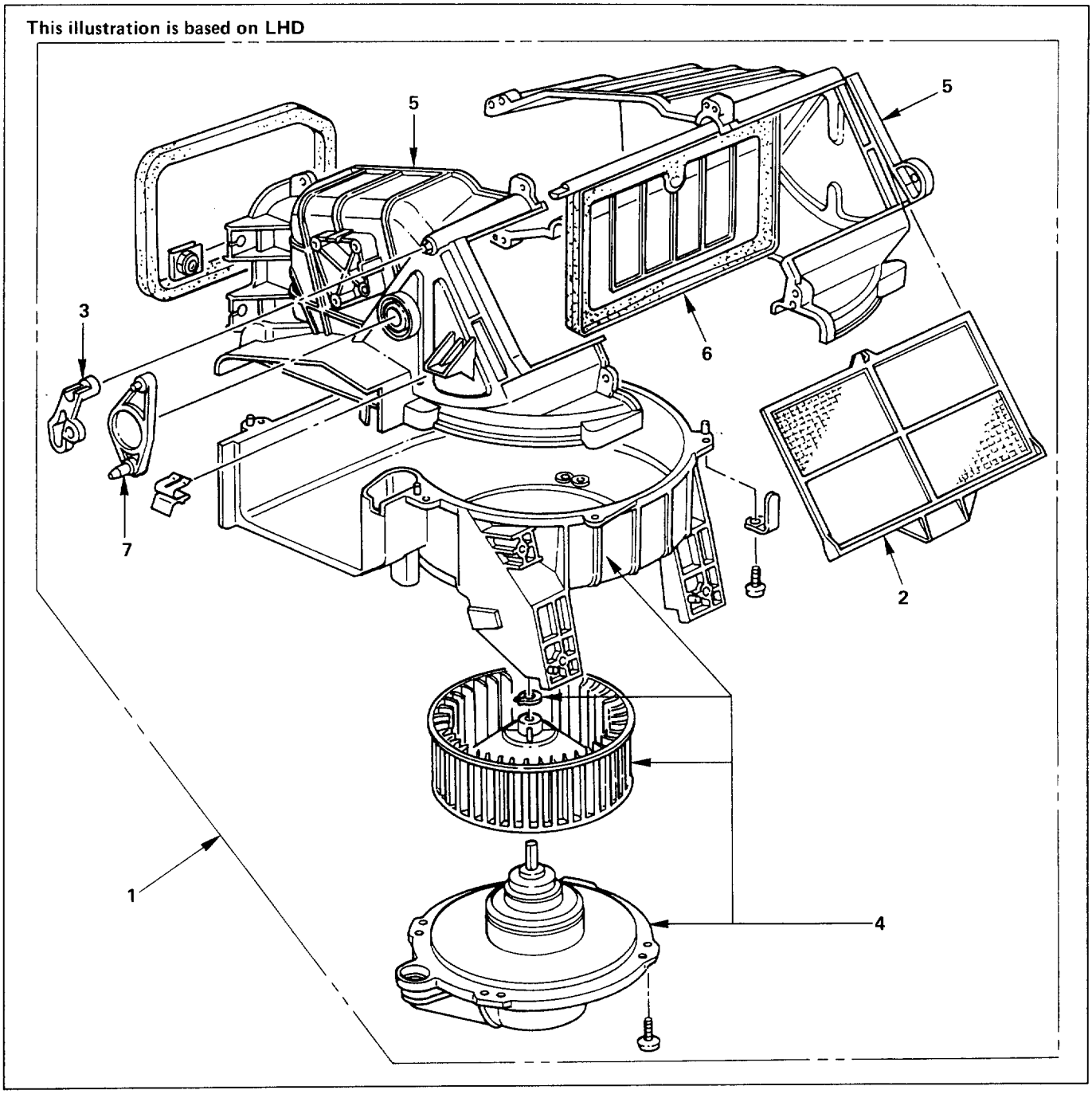
10. **Bolt (Blower Assembly – Reinforce)**
11. **Blower Assembly**
    - Remove the blower fixing bolts.
    - Drop the blower positioning pins from the reinforce to remove them.

Installation Steps

To install, follow the removal steps in the reverse order, noting the following point.

1. **Adjust the blower control cable**
   Refer to "CONTROL LEVER ASSEMBLY" installation procedure in this section.

Blower Link Unit/Mode Door



Removal Steps

1. Blower assembly
2. Blower filter
3. Door lever
4. Lower case
5. Upper case
6. Mode door
7. Mode sub lever

Installation Steps

To install, follow the removal steps in the reverse order.

Removal Steps

Preparation:

Disconnect the battery ground cable.

1. **Blower Assembly**

   Refer to "BLOWER ASSEMBLY" removal procedure in this section.
2. **Blower Filter**
3. **Door Lever**

   Pull out the door lever while raising up the catch of the door lever.
4. **Lower Case**
5. **Upper Case**

   Separate two halves of the upper case.
6. **Mode Door**
7. **Mode Sub Lever**

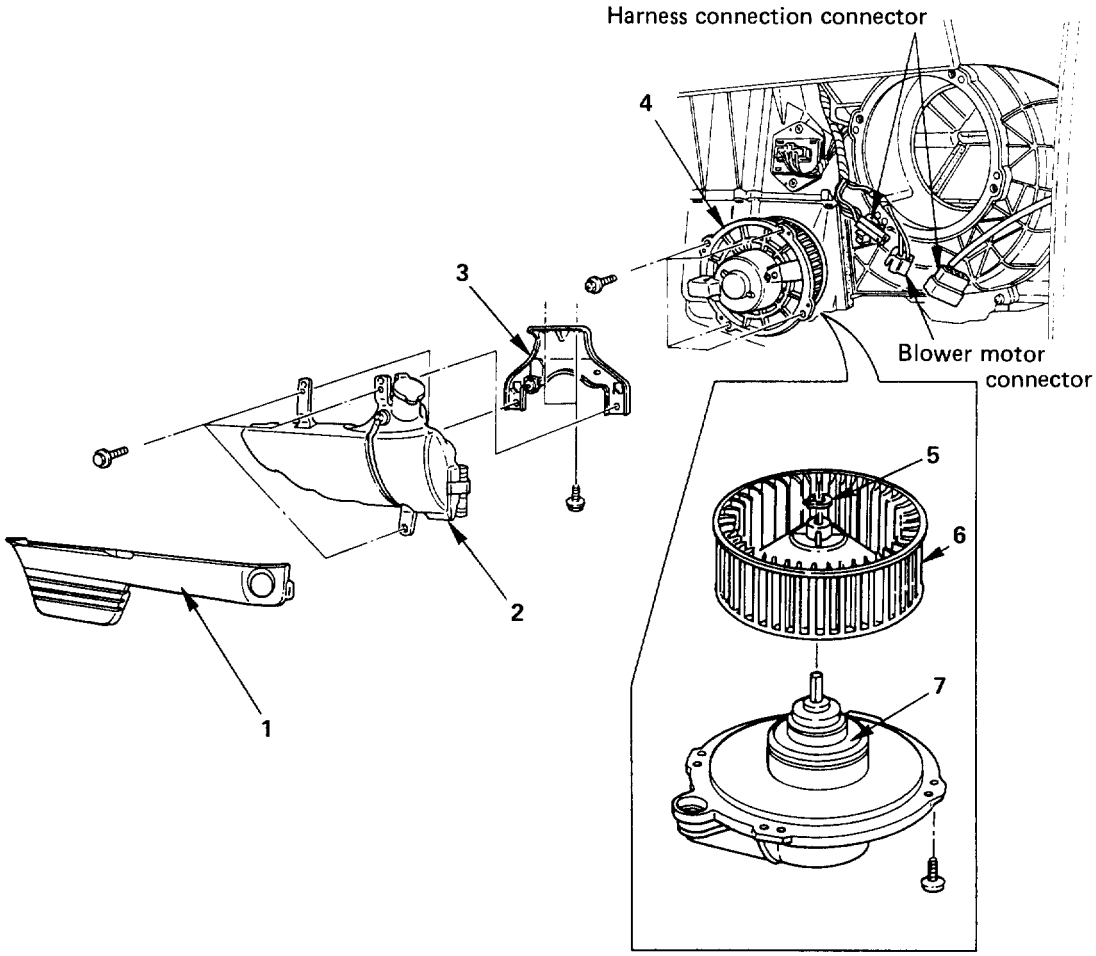
   Press the tab of the sub lever inward, and take out the sub lever.

Installation Steps

To install, follow the removal steps in the reverse order.

Blower Motor

This illustration is based on LHD

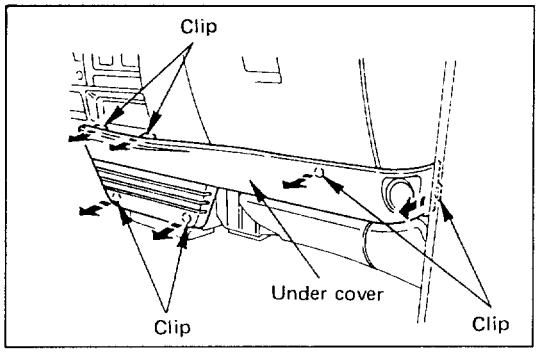


Removal Steps

1. Under cover
2. Washer tank
3. Washer tank bracket
4. Blower motor assembly
5. Clip
6. Fan
7. Blower motor

Installation Steps

To install, follow the removal steps in the reverse order.



RemovaL Steps

Preparation:

Disconnect the battery ground cable.

1. **Under Cover**

   While pulling the under cover with care, remove the clips on the back side of the cover.

2. **Washer Tank**

   Remove the washer tank fixing three bolts (Upper: two, Lower: one) and disconnect the connector

3. **Washer Tank Bracket**

   Disconnect the harness connection connector and remove the fixing bolts.

4. **Blower Motor Assembly**

   Disconnect the motor connector

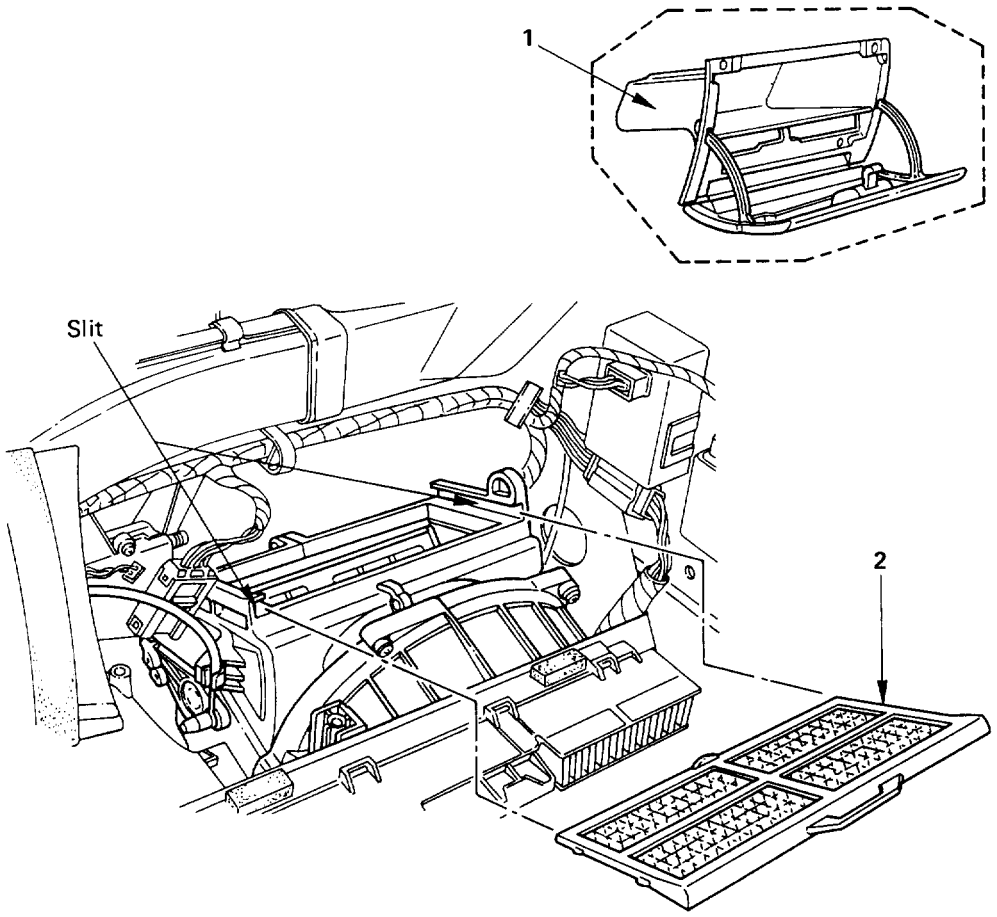
5. **Clip**
6. **Fan**
7. **Blower Motor**

Installation Steps

To install, follow the removal steps in the reverse order.

Blower Filter

This illustration is based on LHD



Removal Steps

1. Glove box
2. Blower filter

Installation Steps

To install, follow the removal steps in the reverse order.

Removal Steps

1. **Glove Box**

   Open the glove box and remove the fixing screws.

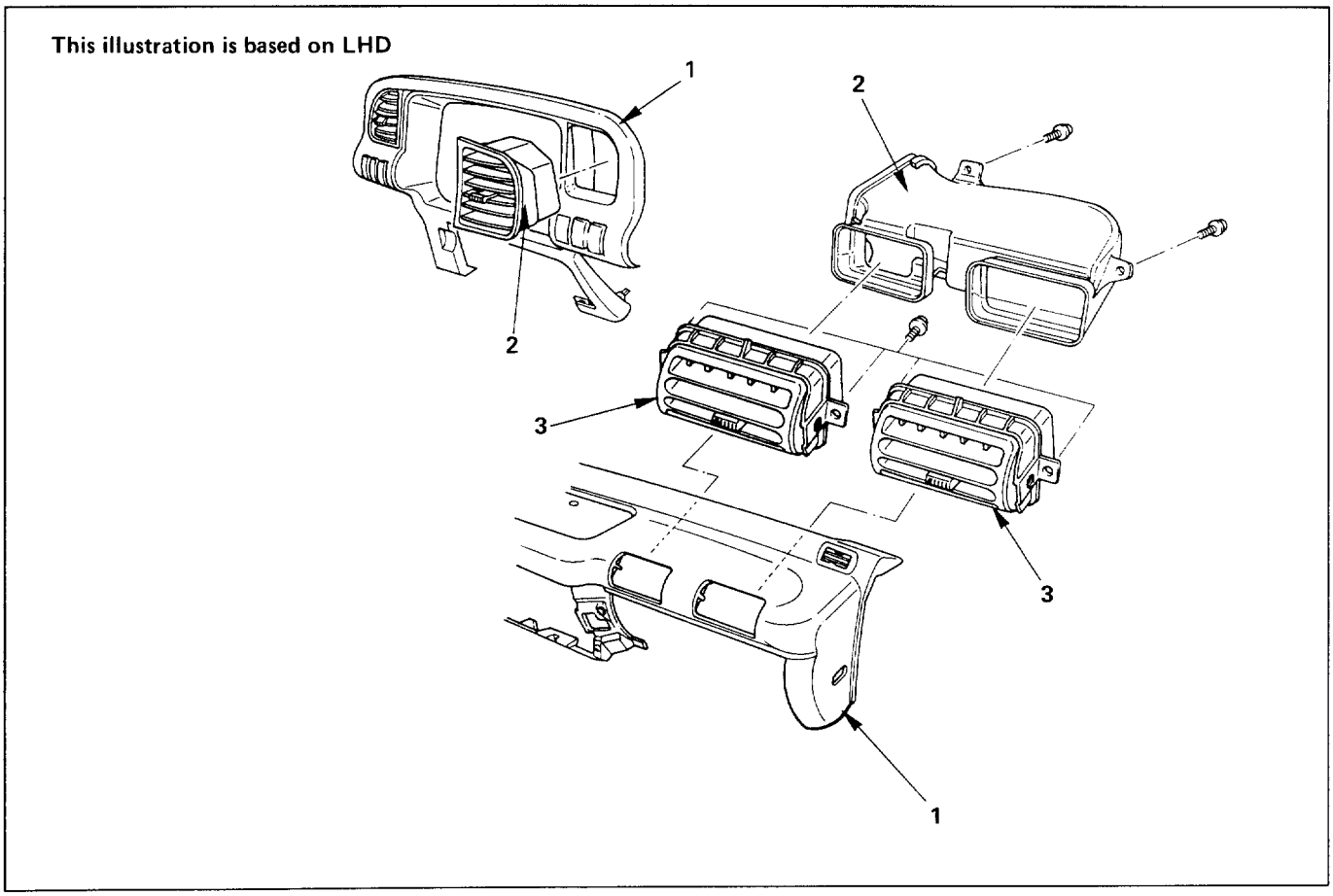
2. **Blower Filter**

   Pull out the blower filter from the blower upper slit.

Installation Steps

To install, follow the removal steps in the reverse order.

Ventilation Grille



Removal steps

[Driver Side]

1. Meter cluster
2. Ventilation grille

[Passenger Side]

1. Instrument panel assembly
2. Ventilation duct
3. Ventilation grille

Installation Steps

To install, follow the removal steps in the reverse order.

Removal Steps

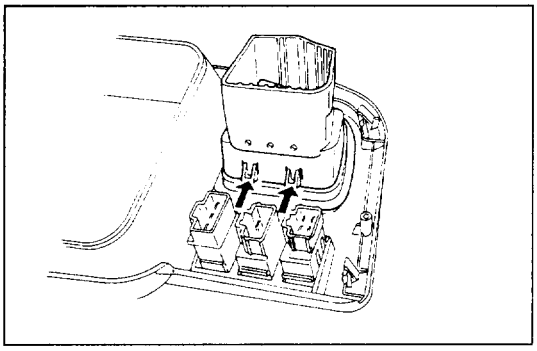
Preparation:

Disconnect the battery ground cable.

[Driver Side]

1. **Meter Cluster**

   Refer to Section 8 "CAB AND CHASSIS ELECTRICAL" for Meter Cluster removal procedure.



2. **Ventilation Grille**
   Push the catches of the grille on the back side of the cluster to the inside, and remove the ventilation grille.

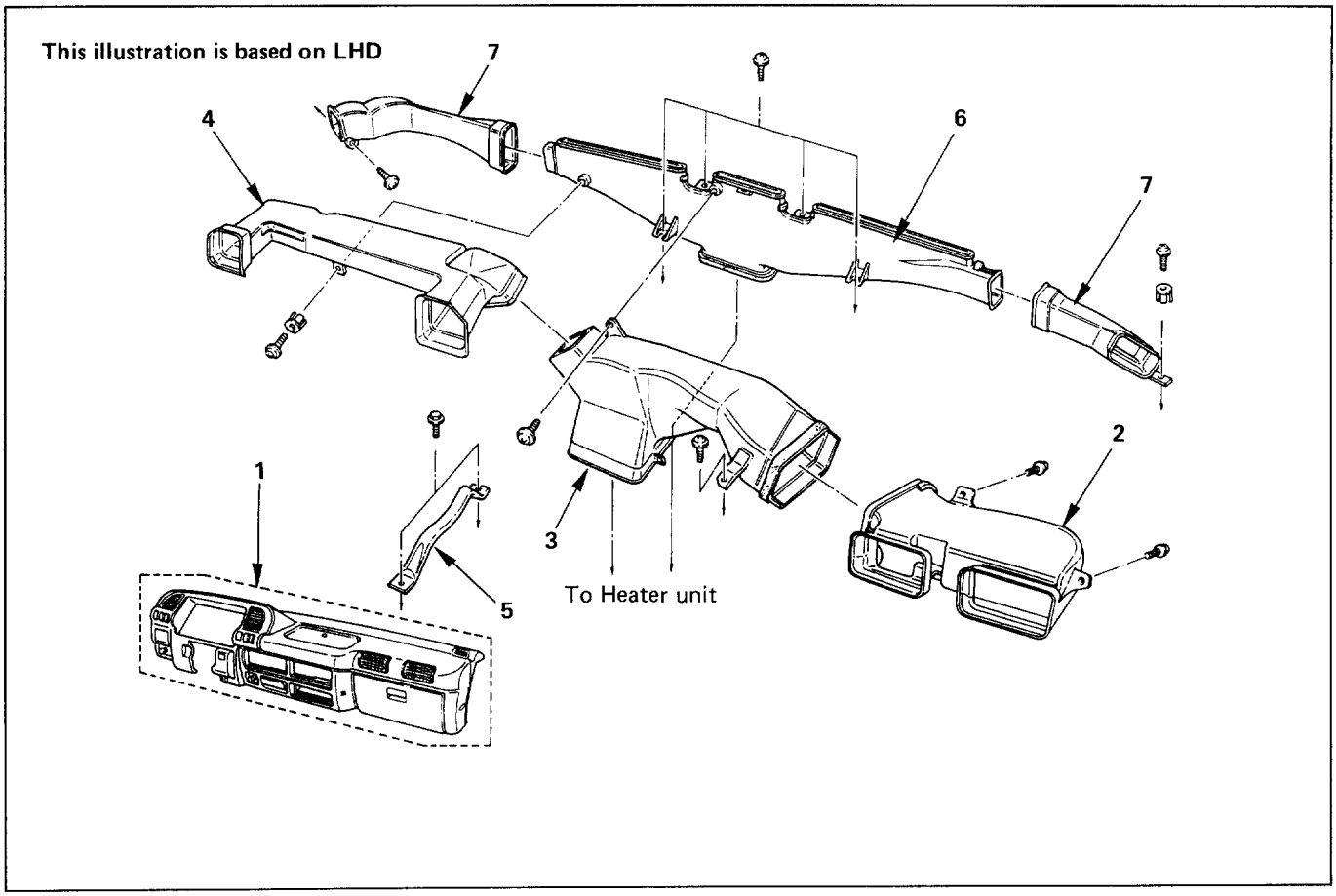
[Passenger Side]

1. **Instrument Panel Assembly**
   Refer to Section 10 "BODY" for Instrument Panel removal procedure
2. **Ventilation Duct**
3. **Ventilation Grille**

Installation Steps

To install, follow the removal steps in the reverse order.

Defroster Nozzle/Ventilation Duct



Removal Steps

1. Instrument panel assembly
2. Ventilation duct (RH)
3. Ventilation duct (CTR)
4. Ventilation duct (LH)
5. Reinforcement stay
6. Defroster nozzle
7. Side defroster nozzle

Installation Steps

To install, follow the removal steps in the reverse order.

Removal Steps

Preparation:

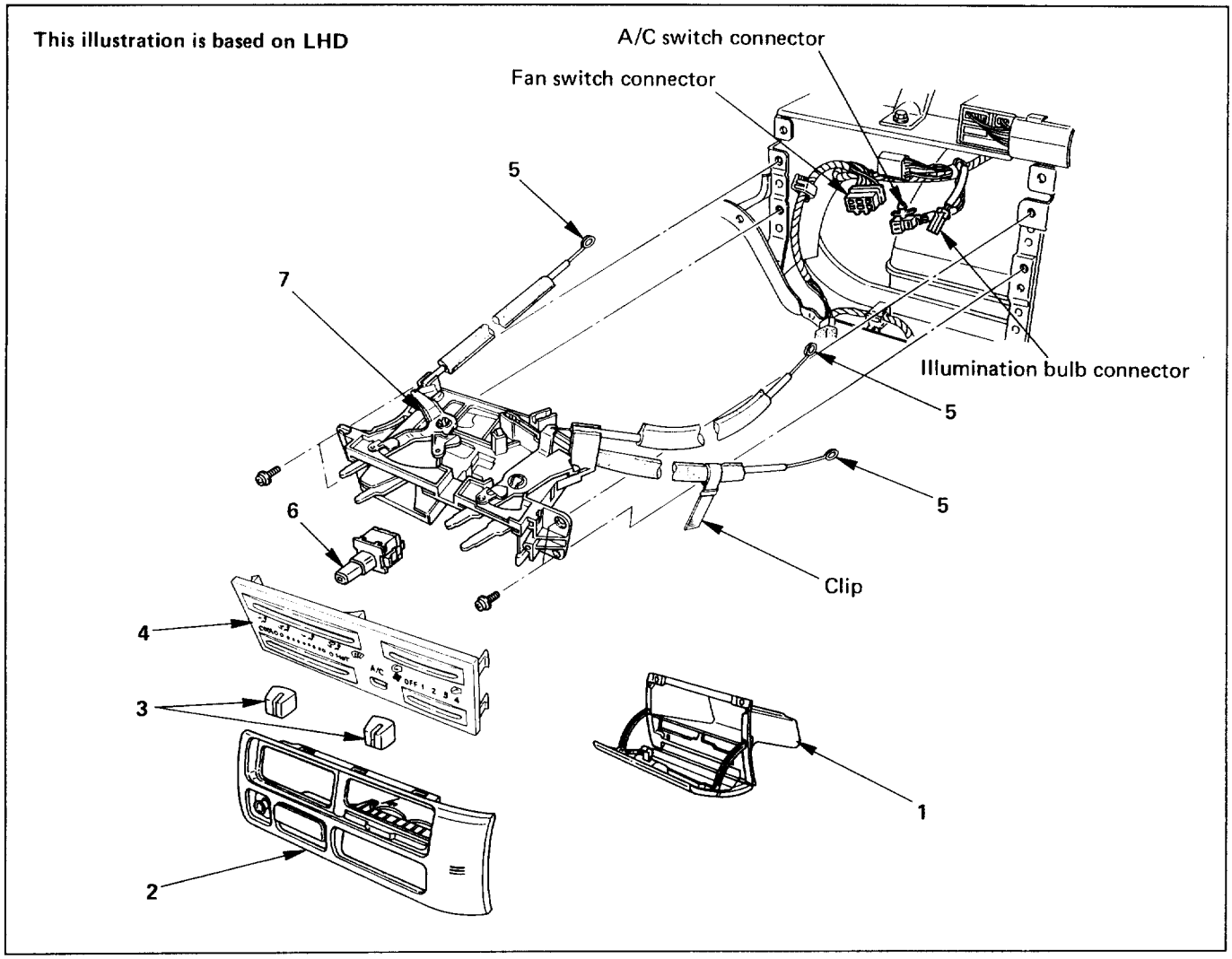
Disconnect the battery ground cable.

1. **Instrument Panel Assembly**
   Refer to Section 10 "BODY" for Instrument Panel removal procedure.
2. **Ventilation Duct (RH)**
3. **Ventilation Duct (CTR)**
4. **Ventilation Duct (LH)**
5. **Reinforcement Stay**
6. **Defroster Nozzle**
7. **Side Defroster Nozzle**

Installation Steps

To install, follow the removal steps in the reverse order.

Control Lever Assembly



Removal Steps

1. Glove box
2. Center cluster
3. Knob
4. Control panel bezel
5. Control cable
6. A/C switch (A/C only)
7. Control lever assembly

Installation Steps

To install, follow the removal steps in the reverse order.

Removal Steps

Preparation:

Disconnect the battery ground cable.

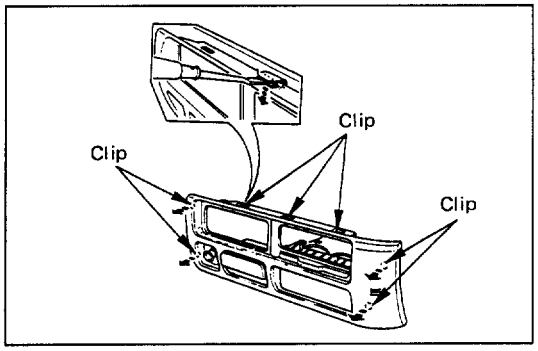
1. **Glove Box**

   Open the glove box and remove the fixing screws.

2. **Center Cluster**

   - While pulling the cluster with care, remove the upper and the back side clips of the cluster.
   - Disconnect the cigar lighter and illumination connectors.

3. **Knob**

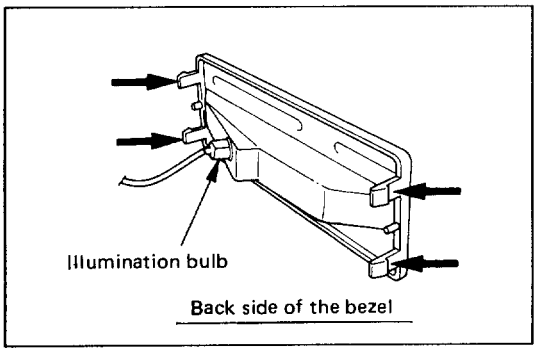


4. **Control Panel Bezel**

   Push the four catches at both sides of the bezel to the inside, and remove the illumination bulb from the bezel.

5. **Control Cable**

   Disconnect the control cables from the heater and blower units.

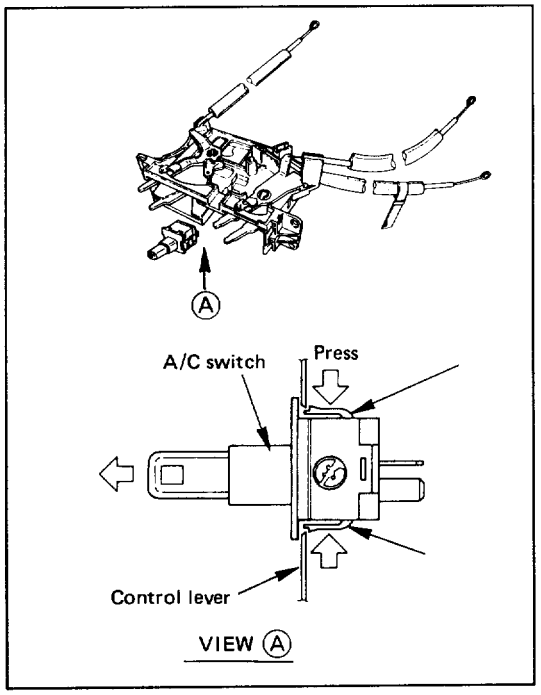


6. **A/C Switch**

   Push the catches at both sides of the A/C switch to the inside, and remove the A/C switch by pulling it out.

7. **Control Lever Assembly**

   - Remove the lever fixing bolts and pull the lever assembly out.
   - Disconnect the A/C switch connector clip and fan switch connector from the lever assembly.
   - Remove the control cable fixing clip.



Installation Steps

To install, follow the removal steps in the reverse order, noting the following points:

1. Adjust the control cables

   Air source control cable

   1) Slide the control lever to the left ("CIRC" position).
   2) Connect the control cable at the "CIRC" position of the link unit of blower assembly and fix it with the clip.

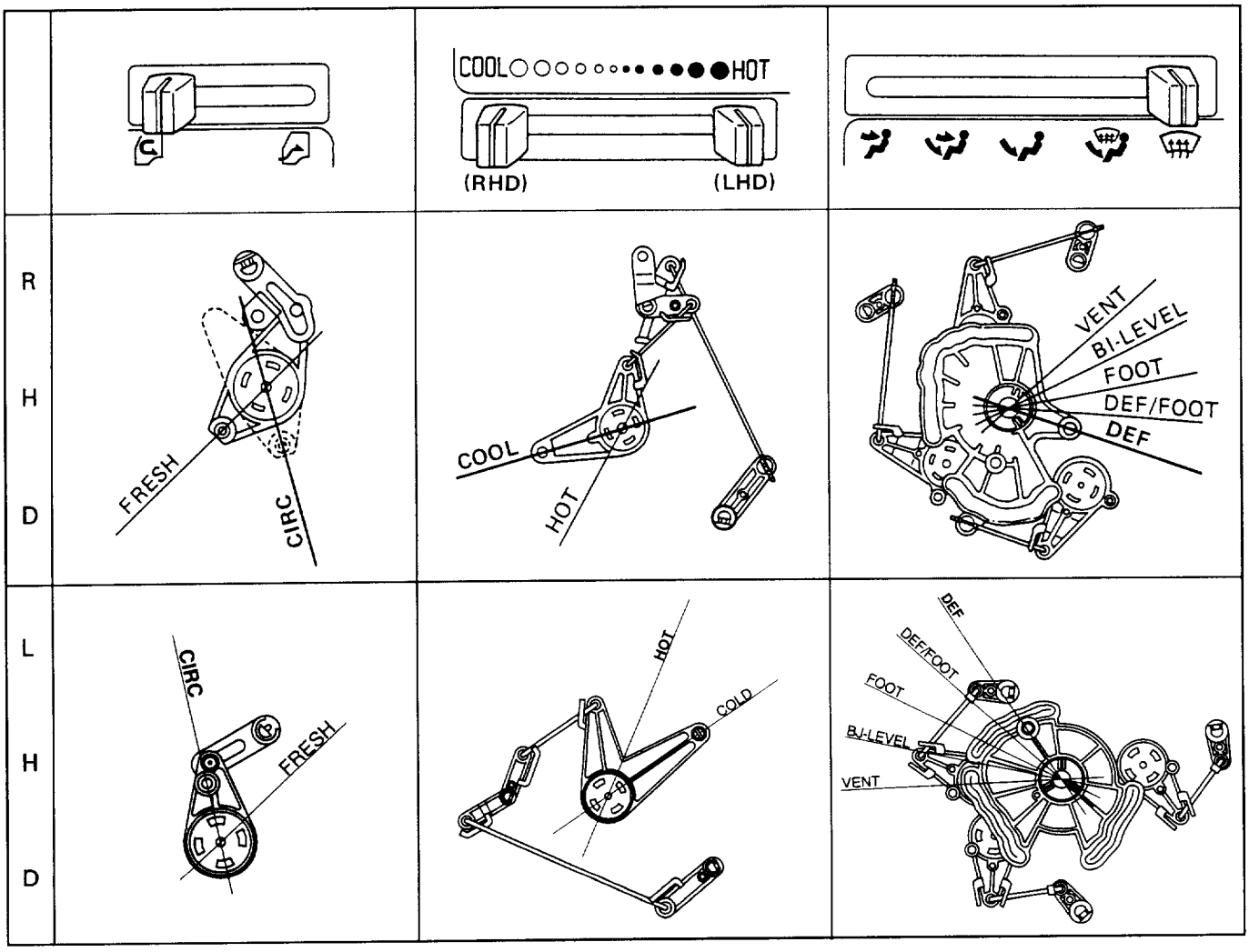
   Temperature control cable

   1) Slide the control lever to the left/right ("MAX COLD"/"MAX HOT" position).
   2) Connect the control cable at the "COLD"/"HOT" position of the temperature control link of the heater unit and fix it with the clip.

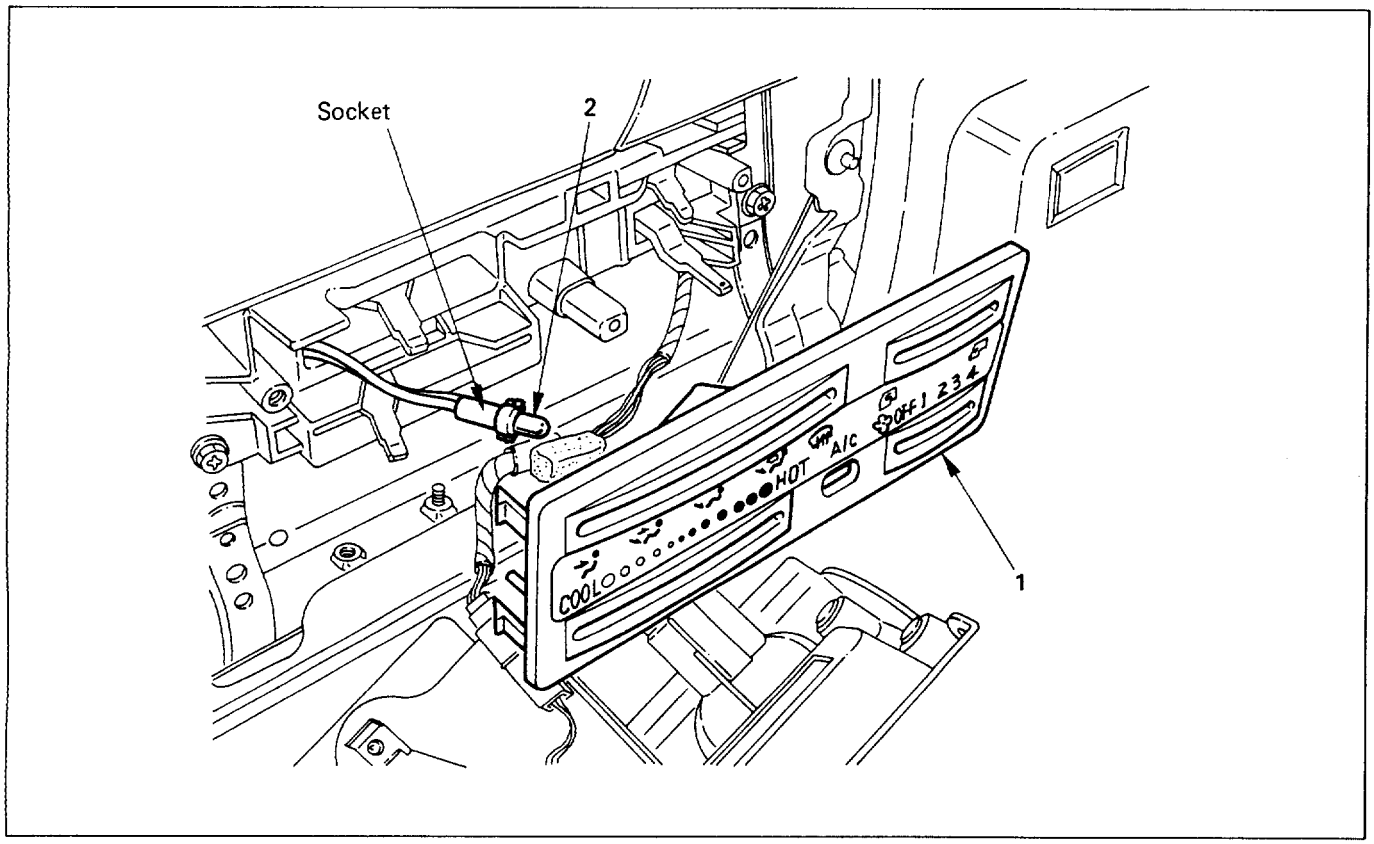
   Air select control cable

   1) Slide the control lever to the right ("DEFROST" position).
   2) Connect the control cable at the "DEFROST" position of the mode control link of the heater unit and fix it with the clip.

2. Check control cable operation.



Control Panel Illumination Bulb



Removal Steps

1. Control panel bezel
2. Control panel illumination bulb

Installation Steps

To install, follow the removal steps in the reverse order.

Removal Steps

Preparation:

Disconnect the battery ground cable.

1. **Control Panel Bezel**

   Refer to "CONTROL LEVER ASSEMBLY" removal procedure.

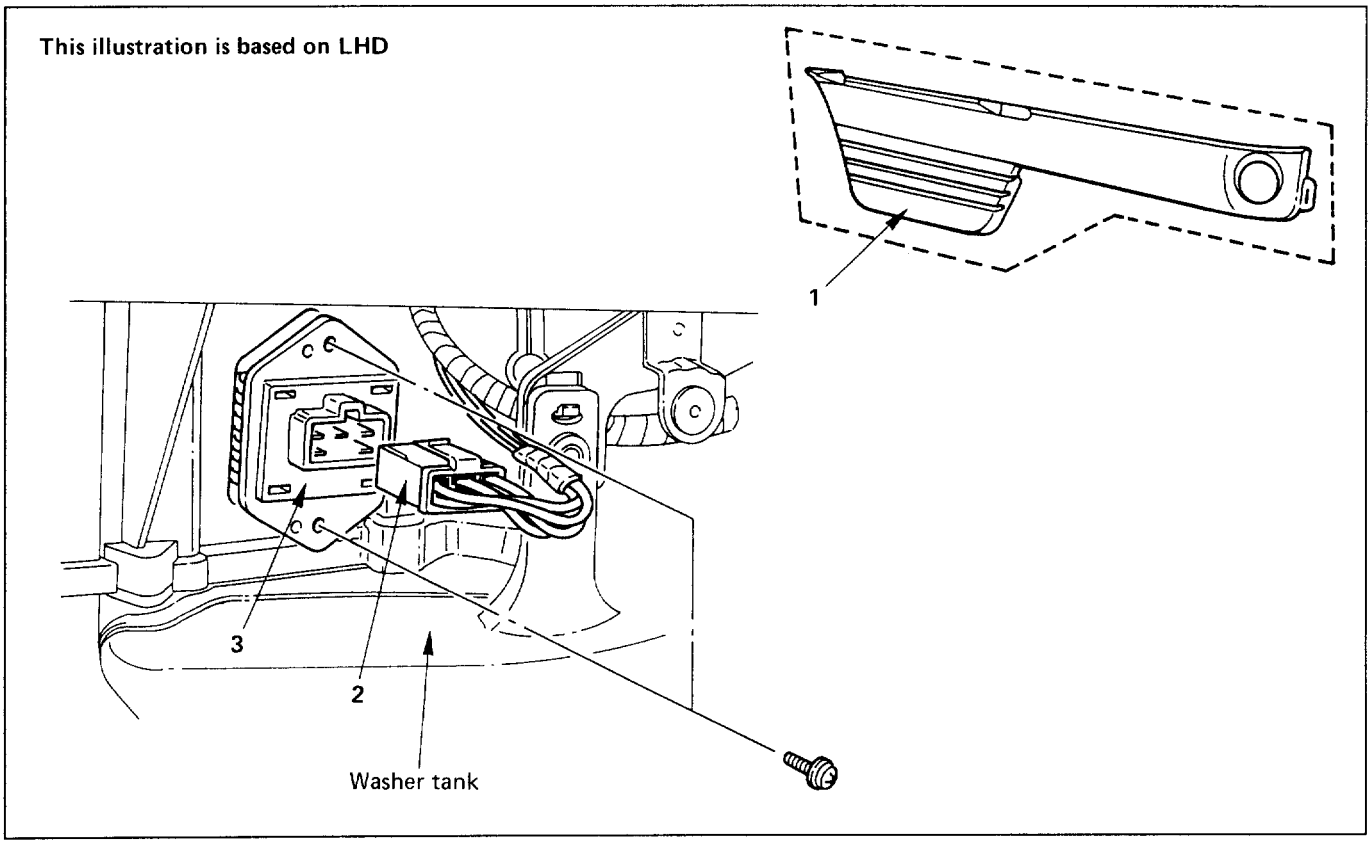
2. **Control Panel Illumination Bulb**

   Pull the bulb from the bulb socket.

Installation Steps

To install, follow the removal steps in the reverse order.

Resister

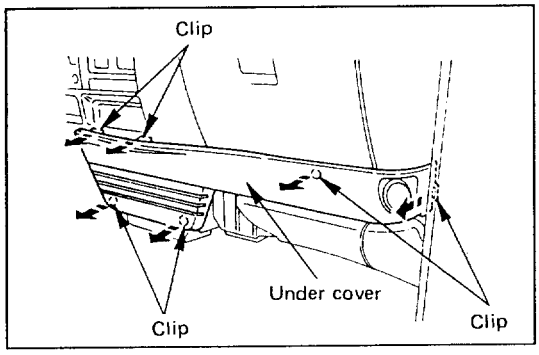


Removal Steps

1. Under cover
2. Resistor connector
3. Resistor

Installation Steps

To install, follow the removal steps in the reverse order.



Removal Steps

Preparation:

Disconnect the battery ground cable.

1. **Under Cover**

   While pulling the under cover with care, remove the clips on the back side of the cover.
2. **Resistor Connector**
3. **Resistor**

Installation Steps

To install, follow the removal steps in the reverse order.

SECTION 1B
AIR CONDITIONING

CAUTION

When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size and strength (or stronger) may be used.

Fasteners that are not reused, and those requiring thread locking compound, will be called out. The correct torque values must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

CONTENTS

PAGE

General Description 1B– 3
- Air Conditioning Refrigerant Cycle Construction 1B– 4
- Compressor 1B– 5
- Magnetic Clutch 1B– 6
- Condenser 1B– 6
- Receiver/Drier 1B– 6
- Dual Pressure Switch 1B– 7
- Evaporator 1B– 7
- Expansion Valve 1B– 8
- Electronic Thermostat 1B– 8
- Refrigerant Line 1B– 8
- Service Charge Valves 1B– 9
- Air Conditioning Parts 1B–10

On-Vehicle Service 1B–11
- Precautions For Refrigerant-134a (R-134a) Air Conditioning System 1B–11
- Precautions For Replacement or Repair of R-134a Air Conditioning Parts 1B–14
- Compressor 1B–24
- New Compressor Installation 1B–26
- Condenser Assembly 1B–27
- Receiver/Drier 1B–29
- Pressure Switch 1B–31
- Evaporator Assembly 1B–32

Evaporator Core/Expansion Valve 1B–35
A/C Switch. 1B–38
Refrigerant Line. 1B–40

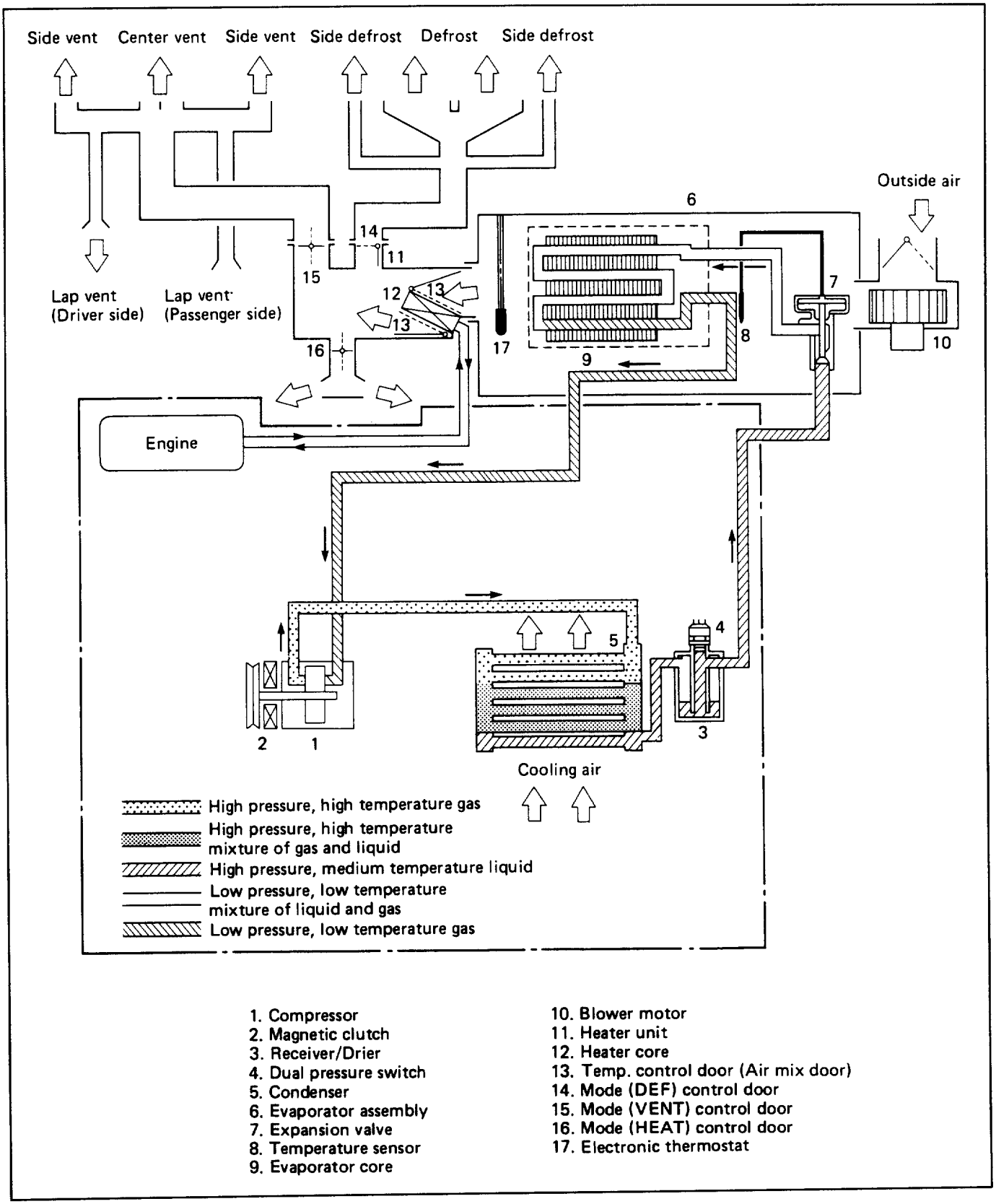
GENERAL DESCRIPTION

CAUTION:

This Vehicle is equipped with Refrigerant-134a (R-134a) air conditioning system.

R-134a and R-12 systems require different types of lubricating oil. Components designed solely for use with one refrigerant and oil type must never be interchanged with components designed solely for use with another refrigerant and oil type. Refer to "ON-VEHICLE SERVICE" for Precautions for R-134a Air Conditioning System in this section.

Air Conditioning Refrigerant Cycle Construction



1. Compressor
2. Magnetic clutch
3. Receiver/Drier
4. Dual pressure switch
5. Condenser
6. Evaporator assembly
7. Expansion valve
8. Temperature sensor
9. Evaporator core
10. Blower motor
11. Heater unit
12. Heater core
13. Temp. control door (Air mix door)
14. Mode (DEF) control door
15. Mode (VENT) control door
16. Mode (HEAT) control door
17. Electronic thermostat

The refrigeration cycle includes the following four processes as the refrigerant changes repeatedly from liquid to gas and back to liquid while circulating.

Evaporation

The refrigerant is changed from a liquid to a gas inside the evaporator. The refrigerant mist that enters the evaporator vaporizes readily. The liquid refrigerant removes the required quantity of heat (latent heat of vaporization) from the air around the evaporator core cooling fins and rapidly vaporizes. Removing the heat cools the air, which is then radiated from the fins and lowers the temperature of the air inside the vehicle.

The refrigerant liquid sent from the expansion valve and the vaporized refrigerant gas are both present inside the evaporator and the liquid is converted to gas.

With this change from liquid to gas, the pressure inside the evaporator must be kept low enough for vaporization to occur at a lower temperature. Because of that, the vaporized refrigerant is sucked into the compressor.

Compression

The refrigerant is compressed by the compressor until it is easily liquefied at normal temperature.

The vaporized refrigerant in the evaporator is sucked into the compressor. This action maintains the refrigerant inside the evaporator at a low pressure so that it can easily vaporize, even at low temperatures close to 0°C (32°F).

Also, the refrigerant sucked into the compressor is compressed inside the cylinder to increase the pressure and temperature to values such that the refrigerant can easily liquefy at normal ambient temperatures.

Condensation

The refrigerant inside the condenser is cooled by the outside air and changes from gas to liquid.

The high temperature, high pressure gas coming from the compressor is cooled and liquefied by the condenser with outside air and accumulated in the receiver/drier. The heat radiated to the outside air by the high temperature, high pressure gas in the compressor is called heat of condensation. This is the total quantity of heat (heat of vaporization) the refrigerant removes from the vehicle interior via the evaporator and the work (calculated as the quantity of heat) performed for compression.

Expansion

The expansion valve lowers the pressure of the refrigerant liquid so that it can easily vaporize.

The process of lowering the pressure to encourage vaporization before the liquefied refrigerant is sent to the evaporator is called expansion. In addition, the expansion valve controls the flow rate of the refrigerant liquid while decreasing the pressure.

That is, the quantity of refrigerant liquid vaporized inside the evaporator is determined by the quantity of heat which must be removed at a prescribed vaporization temperature. It is important that the quantity of refrigerant be controlled to exactly the right value.

Compressor

The compressor performs two main functions:

It compresses low-pressure and low-temperature refrigerant vapor from the evaporator into high-pressure and high-temperature refrigerant vapor to the condenser. And it pumps refrigerant and refrigerant oil through the A/C system.

This vehicle is equipped with a swash plate type compressor (DKS-15 CH Type).

Swash plate compressors have a swash (slanted) plate mounted on the shaft. When the shaft turns, the rotation of the swash plate is converted to reciprocating piston motion which sucks in and compresses the refrigerant gas.

Shaft seal (Lip type) is installed between the valve plate and shaft & cylinder head to prevent refrigerant gas leaks. A specified amount of compressor oil is contained in the oil pan.

This oil is supplied to the cylinders, bearings, etc., by an oil pump which is connected to the swash plate shaft.

With some compressors the differential between the intake pressure and discharge pressure generated while the compressor is operating is used for lubrication instead of an oil pump.

The specified amount of compressor oil is 180cc (5.0 Imp fl oz).

The oil used in the R-134a system compressor differs from that used in R-12 systems.

Also, compressor oil to be used varies according to the compressor model. Be sure to avoid mixing two or more different types of oil.

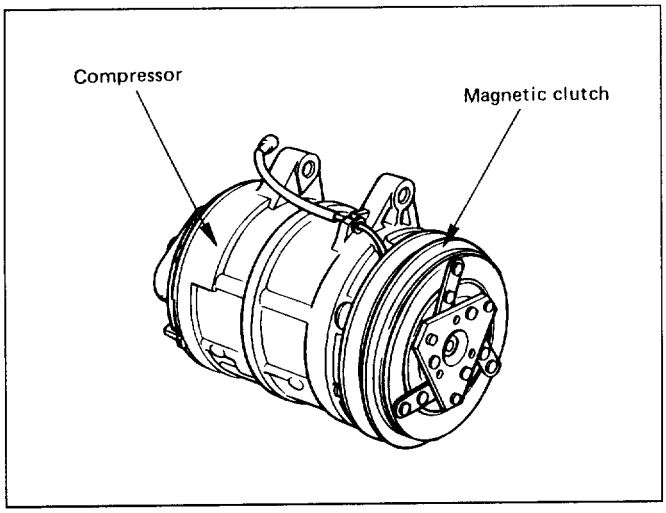
If the wrong oil is used, lubrication will be poor and the compressor will seize or malfunction.

(Refer to "ON-VEHICLE SERVICE" for Precautions for R-134a Air Conditioning System in this section)

The magnetic clutch connector is a waterproof type.

Magnetic Clutch

The compressor is driven by the drive belt from the crank pulley of the engine. If the compressor is activated each time the engine is started, this causes too much load to the engine. The magnetic clutch transmits the power from the engine to the compressor and activates it when the air conditioning is "ON". Also, it cuts off the power from the engine to the compressor when the air conditioning is "OFF". (Magnetic clutch repair procedure can be found in Section 1D)



Condenser

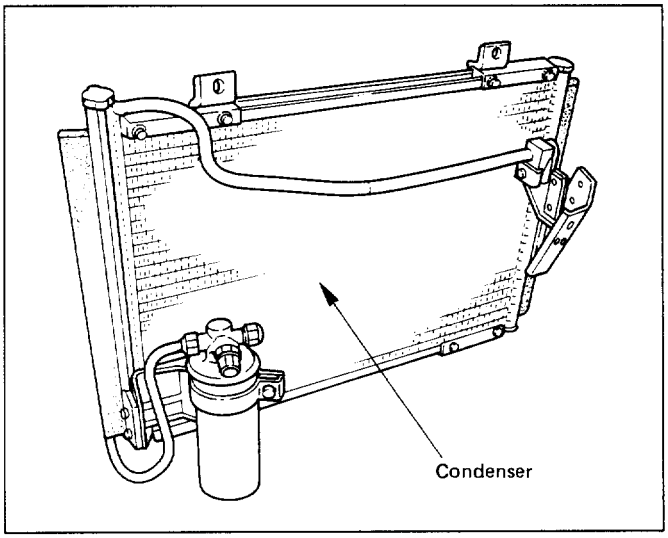
The condenser assembly in front of the radiator, which carry the refrigerant and cooling fins to provide rapid transfer of heat.

Also, it functions to cool and liquefy the high-pressure and high-temperature vapor sent from the compressor by the radiator fan or outside air.

A condenser may malfunction in two ways: it may leak, or it may be restricted. A condenser restriction will result in excessive compressor discharge pressure. If a partial restriction is present, the refrigerant expands after passing through the restriction.

Thus, ice or frost may from immediately after the restriction. If air flow through the condenser or radiator is blocked, high discharge pressures will result. During normal condenser operation, the refrigerant outlet line will be slightly cooler than the inlet line.

The vehicle is equipped with the condenser of the parallel flow type condenser. A larger thermal transmission area on the inner surface of the tube allows the radiant heat to increase and the ventilation resistance to decrease.



Receiver/Drier

The receiver/drier performs four functions;

- As the quantity of refrigerant circulated varies depending on the refrigeration cycle conditions, sufficient refrigerant is stored for the refrigeration cycle to operate smoothly in accordance with fluctuations in the quantity circulated.
- The liquefied refrigerant from the condenser is mixed with refrigerant gas containing air bubbles. If refrigerant containing air bubbles is sent to the expansion valve, the cooling capacity will decrease considerably. Therefore, the liquid and air bubbles are separated and only the liquid is sent to the expansion valve.
- The receiver/drier utilizes a filter and dryer to remove the dirt and water mixed in the cycling refrigerant.

A receiver/drier may fail due to a restriction inside the body of the unit. A restriction at the inlet to the receiver/drier will cause high pressures.

Outlet restrictions will be indicated by low pressure and little or no cooling. An excessively cold receiver/ drier outlet may indicate a restriction.

The receiver/drier of this vehicle is made of aluminum with a smaller tank. It has 300 cc (8.5 Imp fl oz) refrigerant capacity.

Dual Pressure Switch

The dual pressure switch is installed on the upper part of the receiver/drier, to detect excessively high pressure (high pressure switch) and prevent compressor seizure due to the refrigerant leaking (low pressure switch), switching the compressor "ON" or "OFF" as required.

The pressure switch connector is waterproof type.

R-134a refrigerant pressure characteristics differ from those of R-12. Thus, the dual pressure switch operation for R-134a systems has been changed from R-12.

- Low-pressure control kpa (kg/cm^2 / PSI)

  Compressor

  ON: 206 ± 30 (2.1 ± 0.3 / 30 ± 4)

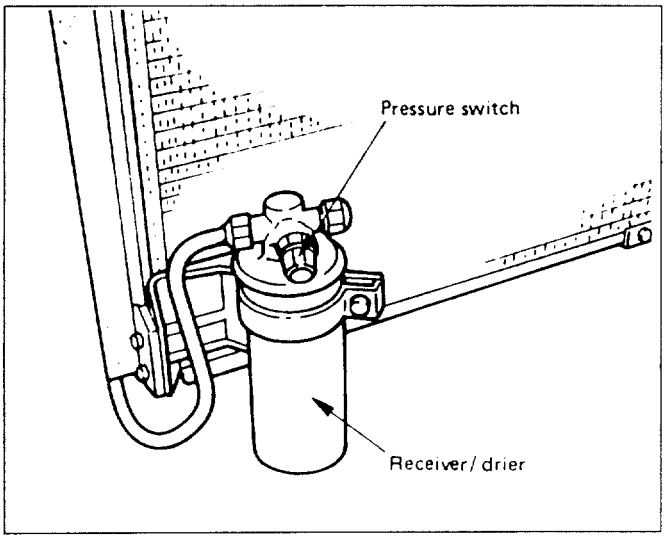
  OFF: 176 ± 20 (1.8 ± 0.2 / 26 ± 3)

- High-pressure control

  Compressor

  ON: 2354 ± 196 (24.0 ± 2.0 / 341 ± 28)

  OFF: 2942 ± 196 (30.0 ± 2.0 / 427 ± 28)



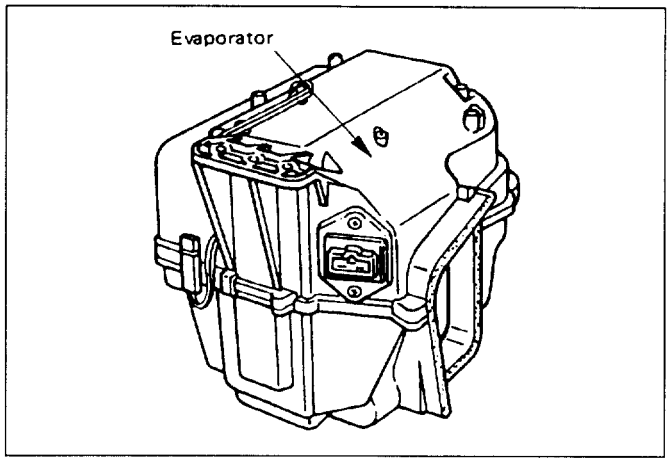
Evaporator

The evaporator cools and dehumidifies the air before the air enters the vehicle. High-pressure liquid refrigerant flows through the expansion valve into the low-pressure area of the evaporator. The heat in the air passing through the evaporator core is lost to the cooler surface of the core, thereby cooling the air.

As heat is lost between the air and the evaporator core surface, moisture in the vehicle condenses on the outside surface of the evaporator core and is drained off as water.

When the evaporator malfunctions, the trouble will show up as inadequate supply of cool air. The cause is typically a partially plugged core due to dirt, or a malfunctioning blower motor.

The evaporator core with a laminate louver fin is a single-sided tank type where only one tank is provided under the core.



Expansion Valve

This expansion valve is external pressure type and it is installed at the evaporator intake port.

The expansion valve converts the high pressure liquid refrigerant sent from the receiver/drier to a low pressure liquid refrigerant by forcing it through a tiny port before sending it to the evaporator.

This type of expansion valve consists of a temperature sensor, diaphragm, ball valve, ball seat, spring adjustment screw, etc.

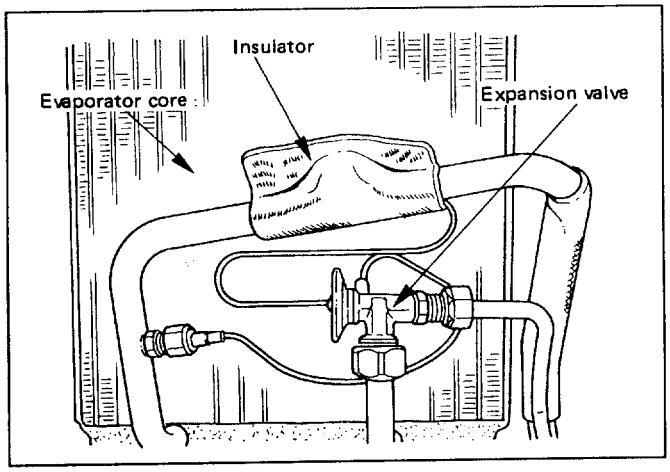
The temperature sensor contacts the evaporator outlet pipe, and converts changes in temperature to pressure. It then transmits these to the top chamber of the diaphragm.

The refrigerant pressure is transmitted to the diaphragms bottom chamber through the external equalizing pressure tube.

The ball valve is connected to the diaphragm. The opening angle of the expansion valve is determined by the force acting on the diaphragm and the spring pressure.

The expansion valve regulates the flow rate of the refrigerant. Accordingly, when a malfunction occurs to this expansion valve, both discharge and suction pressures get low, resulting in insufficient cooling capacity of the evaporator.

For R-134a air conditioning, the expansion valve calibration has been changed from R-12 to match the R-134a characteristics.

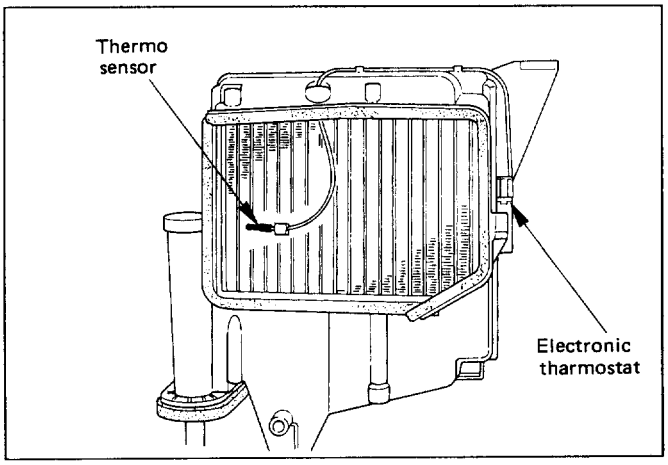


Electronic Thermostat

The thermostat consists of the thermosensor and thermostat unit which functions electrically to reduce the noises being generated while the system is in operation.

The electronic thermosensor is mounted at the evaporator core outlet and senses the temperature of the cool air from the evaporator. Temperature signals are input to the thermostat unit. This information is compared by the thermo unit and the results in output to operate the A/C Thermo relay and turn the magnetic clutch "ON" or "OFF" to prevent evaporator freeze-up.

A characteristic of the sensor is that the resistance decreases as the temperature increases and the resistance increases as the temperature decreases.



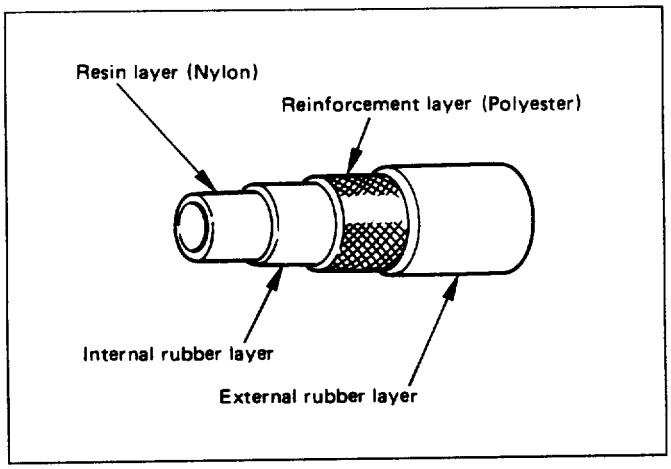
Refrigerant Line

Restrictions in the refrigerant line will be indicated by:

1. Suction line; A restricted suction line will cause low suction pressure at the compressor, low discharge pressure and little or not cooling.
2. Discharge line; A restriction in the discharge line generally will cause the discharge line to leak.
3. Liquid line; A liquid line restriction will be evidenced by low discharge and suction pressure and insufficient cooling.

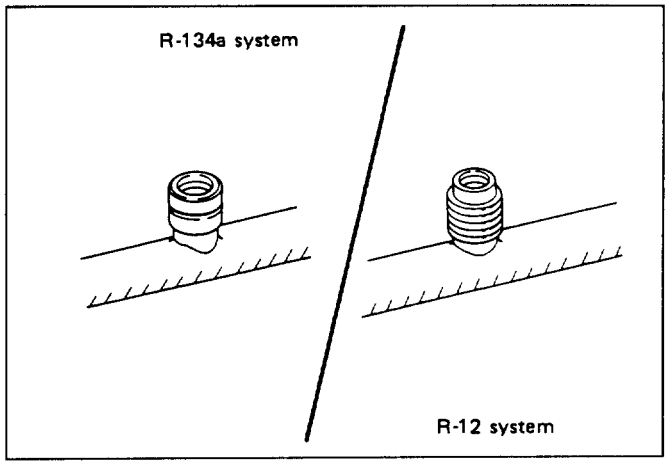
Refrigerant flexible hoses that have a low permeability to refrigerant and moisture are used.

These low permeability hoses have a special nylon layer on the inside.



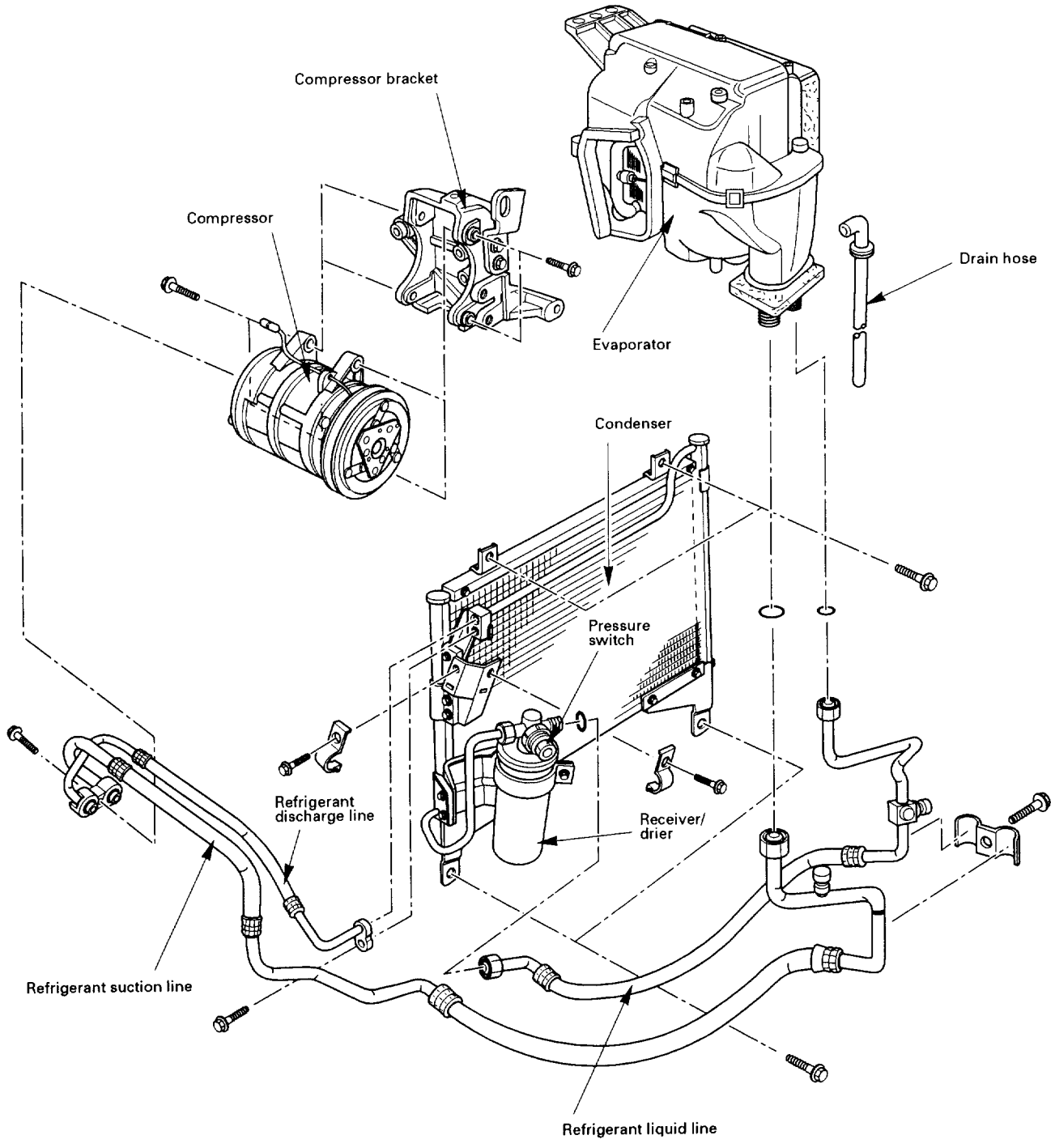
Service Charge Valves

R-134a service charge valve shapes is different from the charge valves used in the R-12 system. The charging hoses have a quick-joint type fitting, to reduce refrigerant loss during removal and installation. This type of valve also eliminates the possibility of cross charging R-12 and R-134a systems when using approved service equipment.



Air Conditioning Parts

This illustration is based on LHD (N∗R66)



ON-VEHICLE SERVICE

Precautions for Refrigerant -134a (R-134a) Air Conditioning System

This vehicle is equipped with Refrigeraut-134a (R-134a) air conditioning system.

R-134a and R-12 systems require different types of lubricating oil. Components designed solely for use with one refrigerant and oil type must never be interchanged with components designed solely for use with another refrigerant and oil type.

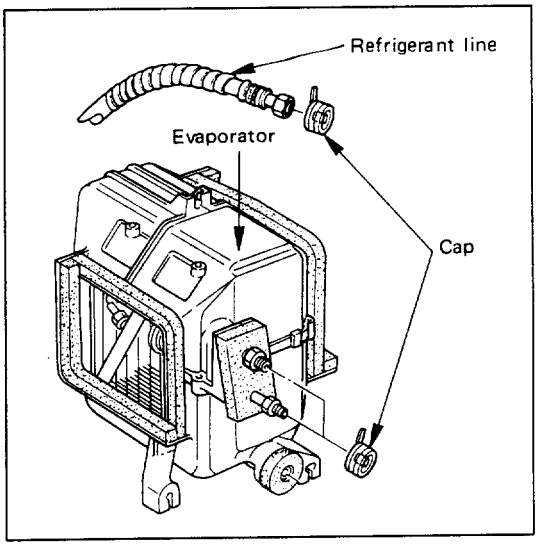
R-134a Refrigerant:

- R-134a differs entirely from R-12 in its composition and, therefore, the two should never be mixed. Always charge the specified amount of R-134a.
- The pressure characteristics of R-134a differ from those of R-12. The low pressure is lower, and the high pressure is higher.

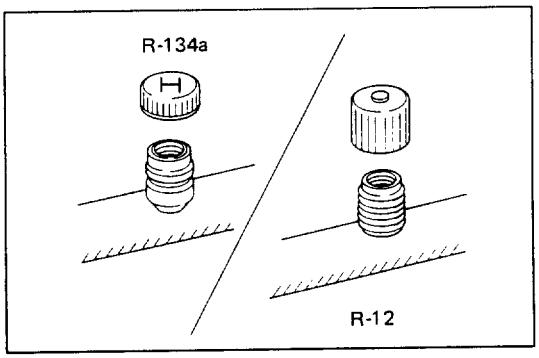
R-134a Compressor oil:

- The R-134a system requires a synthetic (PAG) compressor oil whereas the R-12 system requires a mineral compressor oil. The two oils must never be mixed.
- Compressor (PAG) oil varies according to compressor model. Be sure to use oil specified for the model of compressor.

Oil Specification
ZXL-100PG (ISUZU PART No. 8-97101-338-0)

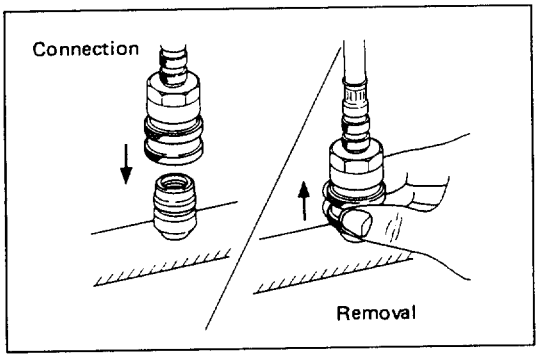


- The PAG compressor oil for the R-134a system tends to absorb moisture more quickly than mineral oil. When air conditioning parts are removed for servicing, all the open ends of parts and components must be sealed with caps to keep out contaminants.
- The PAG compressor oil must be stored in metal containers, not in plastic containers.



Service charge valve:

- The diameter of the service charge valve for the R-134a system is made larger than that for the R-12 system to prevent cross-contamination. In addition, the screw-in type joint of the R-12 system is replaced with a quick joint type in the R-134a system.



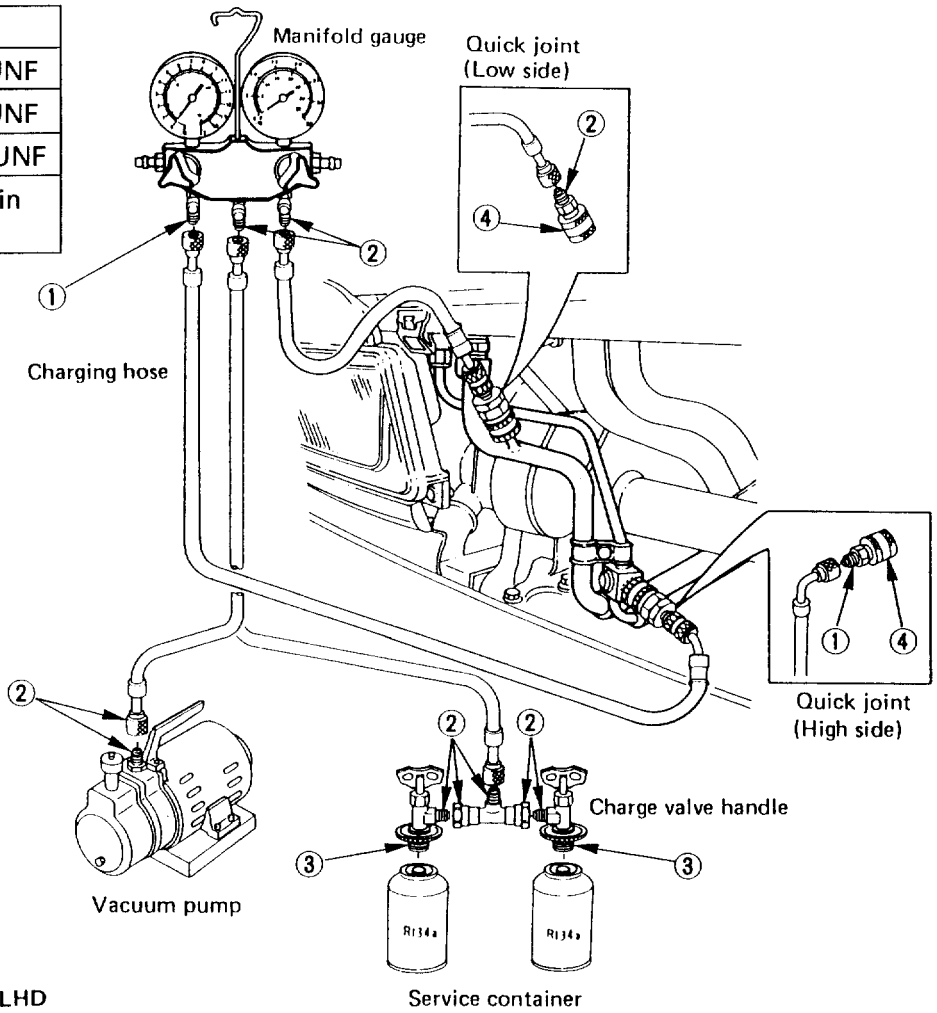
- To prevent refrigerant from escaping during installation and removal of charging hoses from the service charge valves, quick-joint type fittings are used.

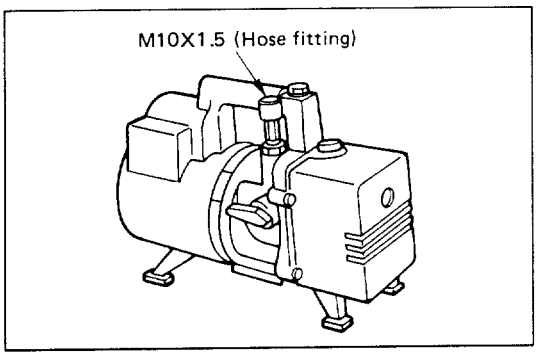
  Connection: Push on firmly until locked(a "click" will be heard).

  Removal: Hold the grip-ring and pull to remove.

- Air conditioning manifold gauges, charging hoses and other service tools designed exclusively for the R-134a system must be used with this vehicle.

No.	R-134a	R-12
1	M12 × 1.75	7/16-20UNF
2	M10 × 1.5	7/16-20UNF
3	M14 × 1.25	15/32-20UNF
4	Quick joint type	Screw-in type

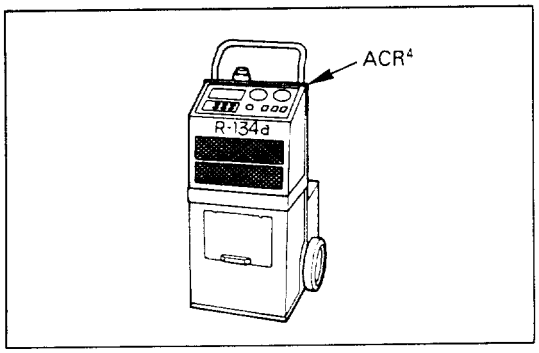




- Do not use the same vacuum pump for evacuating the R-134a and R-12 systems interchangeably (The vacuum pump hose fitting is a M10X1.5.
- R-134a vacuum pumps must have a positive shutoff valve.

CAUTION

Never use the same vacuum pump for both R-134a and R-12 systems, as cross contamination of compressor oil may occur.



Refrigerant Recovery, Recycling and Charging

- Avoid releasing the R-134a into the atmosphere. Use the ACR⁴ (R-134a Refrigerant Recovery/ Recycling/ Recharging/ System) or equivalent to recover and recycle R-134a. Note that the ACR⁴ (or equivalent) is not interchangeable between the R-134a and R-12 systems.

  ACR⁴ (115V 60Hz) : 5-8840-0629-0 (J-39500-A)

  ACR⁴ (220-240V 50/60Hz)
  : 5-8840-0630-0 (J-39500-220A)

  ACR⁴ (220-240V 50/60Hz Australian model)
  : 5-8840-0631-0 (J-39500-220ANZ)

Refrigerant Leak Inspection

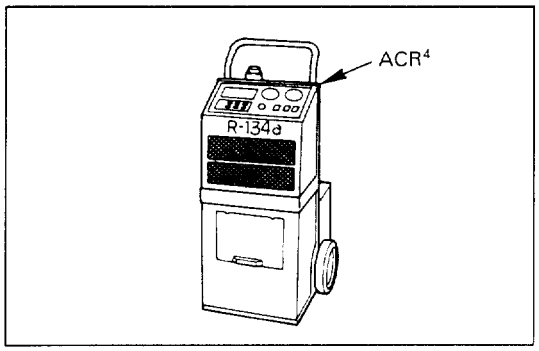
- The flame type gas leak detector for the R-12 system cannot be used with the R-134a system.
- The electric leak detector for the R-12 cannot be used with the R-134a system as the R-134a particles are far smaller than the R-12 molecules and, therefore, may not be always detected. Use leak detectors designed exclusively for the R-134a system.

Precautions for Replacement or Repair of R-134a Air Conditioning Parts

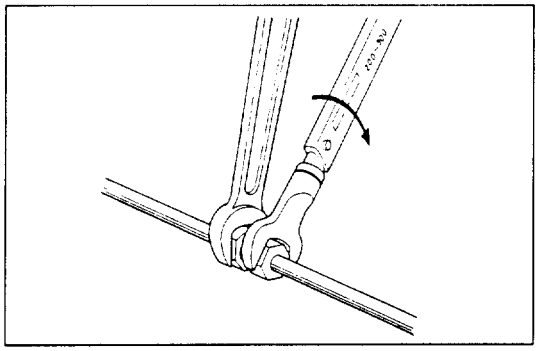
There are certain procedure, practices and precautions that should be followed when servicing air conditioning systems:

- Keep your work area clean.
- Always wear safety goggle and protective gloves when working on refrigerant systems.
- Beware of the danger of carbon monoxide fumes caused by running the engine.
- Beware of discharged refrigerant in enclosed or improperly ventilated garages.
- Always disconnect the negative battery cable and discharge and recover the refrigerant whenever repairing the air conditioning system.
- When discharging and recovering the refrigerant, do not allow refrigerant to discharge too fast; it will draw compressor oil out of the system.
- Keep moisture and contaminants out of the system. When disconnecting or removing any lines or parts, use plugs or caps to close the fittings immediately.

  Never remove the caps or plugs until the lines or parts are reconnected or installed.
- When disconnecting or reconnecting the lines, use two wrenches to support the line fitting, to prevent from twisting or other damage.
- Always install new O-rings whenever a connection is disassembled.
- Before connecting any hoses or lines, apply new specified compressor oil to the O-rings.
- When removing and replacing any parts which require discharging the refrigerant circuit, the operations described in this section must be performed in the following sequence:



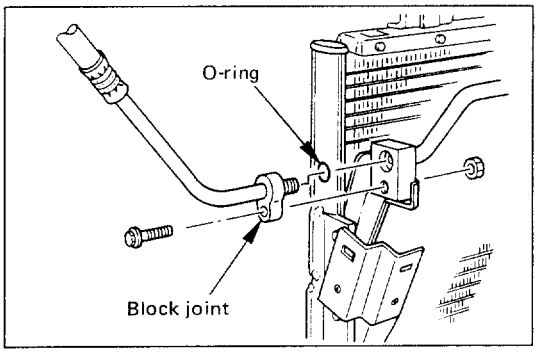
1) Using the ACR4 (R-134a Refrigerant Recovery/ Recycling/ Recharging/ System) or equivalent to thoroughly discharge and recover the refrigerant.
   ACR4 (115V 60Hz)
   : 5-8840-0629-0 (J-39500-A)
   ACR4 (220-240V 50/60Hz)
   : 5-8840-0630-0 (J-39500-220A)
   ACR4 (220-240V 50/60Hz Australian model)
   : 5-8840-0631-0 (J-39500-220ANZ)
2) Remove and replace the defective part.
3) After evacuation, charge the air conditioning system and check for leaks.



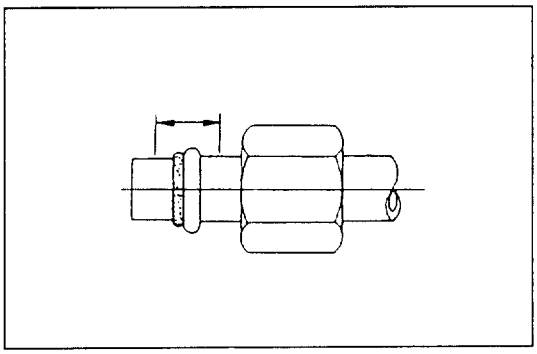
Repair of Refrigerant Leaks

Refrigerant Line Connections

Install new O-rings, if required. When disconnecting or connecting lines, use two wrenches to prevent the connecting portion from twisting or becoming damaged.



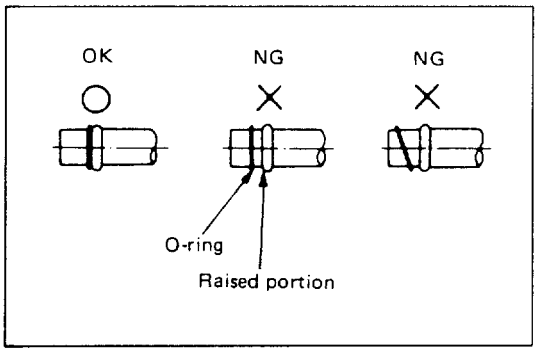
When connecting the refrigerant line at the block joint, securely insert the projecting portion of the joint portion into the connecting hole on the unit side and secure with a bolt.



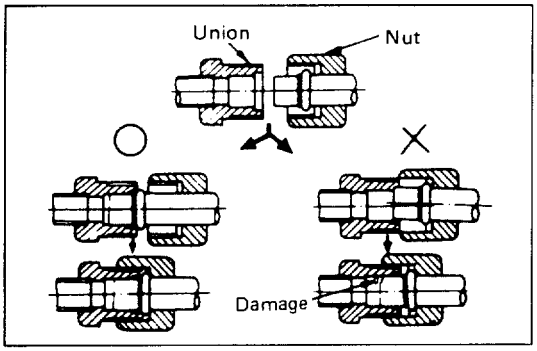
Apply specified compressor oil to the O-rings prior to connecting.

CAUTION:

Compressor (PAG) oil to be used varies according to compressor model. Be sure to apply specified oil for the model of compressor.



O-rings must be closely aligned with raised portion of refrigerant line.



Insert nut into union. First tighten nut by hand as much as possible. Then, tighten nut to specified torque.

(Refer to "SERVICE INFORMATION" for Fixing Torque in section 00)

Leak at Refrigerant Line Connections

1) Check the torque on the refrigerant line fitting and, if too loose, tighten to the specified torque.
   - Use two wrenches to prevent twisting and damage to the Line.
   - Do not over tighten.
2) Perform a leak test on the refrigerant line fitting.
3) If the leak is still present, discharge and recover the refrigerant from the system.
4) Replace the O-rings.
   - O-rings cannot be reused. Always replace with new ones.
   - Be sure to apply specified compressor oil to the new O-rings.
5) Retighten the refrigerant line fitting to the specified torque.
   - Use two wrenches to prevent twisting and damage to the line.
6) Evacuate, charge and retest the system.

Leak in The Hose

If the compressor inlet or outlet hose is leaking, the entire hose must be replaced. Refrigerant hose must not be cut or spliced for repair.

1) Locate the leak.
2) Discharge and recover the refrigerant.
3) Remove the hose assembly.
   - Cap the open connections at once.

4) Connect the new hose assembly.
   - Use two wrenches to prevent twisting or damage to the hose fitting.
   - Tighten the hose fitting to the specified torque.
5) Evacuate, charge and test the system.

Compression Leaks

If leaks are located around the compressor shaft seal or shell, replace or repair the compressor.

Recovery, Recycling, Evacuation and Charging

Handling Refrigerant-134a

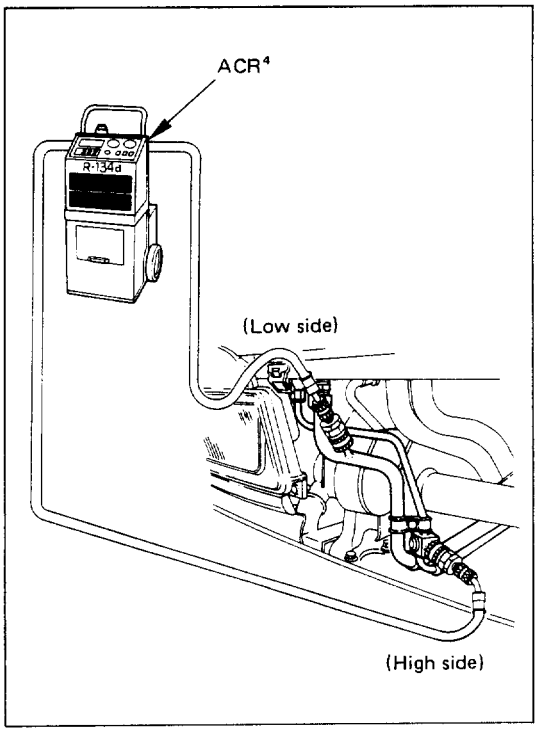
Air conditioning systems contain R-134a.

This is a chemical mixture which requires special handling procedures to avoid personal injury.

- Always wear safety goggles and protective gloves.
- Always work in a well-ventilated area. Do not weld or steam clean on or near any vehicle-installed air conditioning lines or components.
- If R-134a should come in contact with any part of the body, flush the exposed area with cold water and immediately seek medical help.
- If it is necessary to transport or carry any container of R-134a in a vehicle, do not carry it in the passenger compartment.
- If it is necessary to fill a small R-134a container from a large one, never fill the container completely. Space should always be allowed above the liquid for expansion.
- R-134a and R-12 should never be mixed as their compositions are not the same.
- R-134a PAG oil tends to absorb moisture more quickly than R-12 mineral oil and, therefore, should be handled more carefully.
- Keep R-134a containers stored below 40 °C (100°F).

WARNING

- **SHOULD R-134a CONTACT YOUR EYE(S), CONSULT A DOCTOR IMMEDIATELY.**
- **DO NOT RUB THE AFFECTED EYE(S). INSTEAD, SPLASH QUANTITIES OF FRESH COLD WATER OVER THE AFFECTED AREA TO GRADUALLY RAISE THE TEMPERATURE OF THE REFRIGERANT ABOVE THE FREEZING POINT.**
- **OBTAIN PROPER MEDICAL TREATMENT AS SOON AS POSSIBLE. SHOULD THE R-134a TOUCH THE SKIN, THE INJURY MUST BE TREATED THE SAME AS SKIN WHICH HAS BEEN FROSTBITTEN OR FROZEN.**



Refrigerant Recovery

The refrigerant must be discharged and recovered by using ACR4 (R-134a Refrigerant Recovery/ Recycling/ Recharging/ System) or equivalent before removing or mounting air conditioning parts.

ACR4 (115V 60Hz) :5-8840-0629-0 (J-39500-A)

ACR4 (220-240V 50/60Hz)
:5-8840-0630-0 (J-39500-220A)

ACR4 (220-240V 50/60Hz Australian model)
:5-884\0-0631-0 (J-39500-220ANZ)

1) Connect the high and low charging hoses of the ACR4 (or equivalent) as shown
2) Recover the refrigerant by following the ACR4 Manufacture's Instructions.
3) When a part is removed, put a cap or a plug on the connecting portion so that dust, dirt or moisture cannot get into it.

Refrigerant Recovery

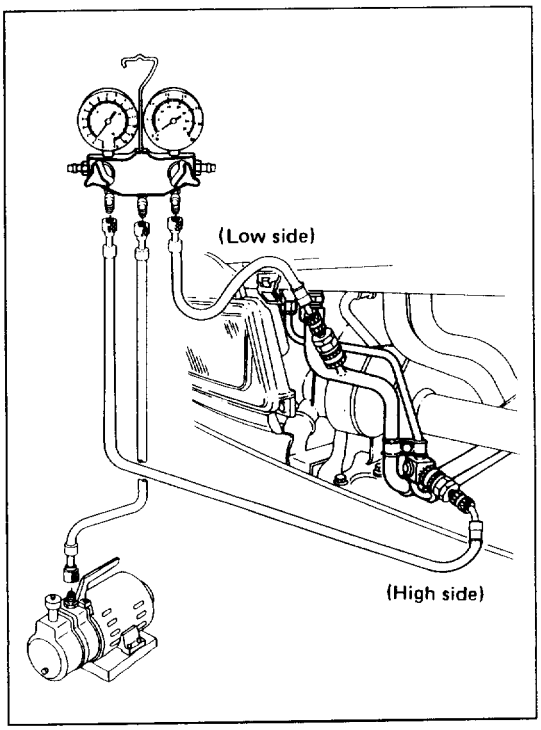
Recycle the refrigerant recovered by ACR4 or equivalent.

For the details of the actual operation, follow the steps in the ACR4 Manufacture's Instructions.

ACR4 (115V 60Hz) :5-8840-0629-0 (J-39500-A)

ACR4 (220-240V 50/60Hz)
:5-8840-0630-0 (J-39500-220A)

ACR4 (220-240V 50/60Hz Australian model)
:5-8840-0631-0 (J-39500-220ANZ)



Evacuation of The Refrigerant System

NOTE:

Explained below is a method using a vacuum pump. Refer to ACR4 (or equivalent) manufacture's instructions when evacuating the system with ACR4 (or equivalent)

Air and moisture in the refrigerant will cause problems in the air conditioning system.

Therefore, before charging the refrigerant, be sure to evacuate air and moisture thoroughly from the system.

1) Connect the gauge manifold.
   - High-pressure valve (HI) – Discharge-side
   - Low-pressure valve (LOW) – Suction-side
2) Discharge and recover the refrigerant.
3) Connect the center hose of the gauge manifold set to the vacuum pump inlet.
4) Operate the vacuum pump, open shutoff valve and then open both hand valves.

5) When the low-pressure gauge indicates approx. 750 mmHg (30 inHg), continue the evacuation for 5 minutes or more.
6) Close both hand valves and stop the vacuum pump.
7) Check to ensure that the pressure does not change after 10 minutes or more.
   - If the pressure changes, check the system for leaks.
   - If leaks occur, retighten the refrigerant line connections and repeat the evacuation steps.
8) If no leaks are found, again operate the vacuum pump for 20 minutes or more, After confirming that the gauge manifold pressure is at 750 mmHg(30 inHg), close both hand valves.
9) Close positive shutoff valve.

   Stop the vacuum pump and disconnect the center hose from the vacuum pump.

Charging The Refrigerant System

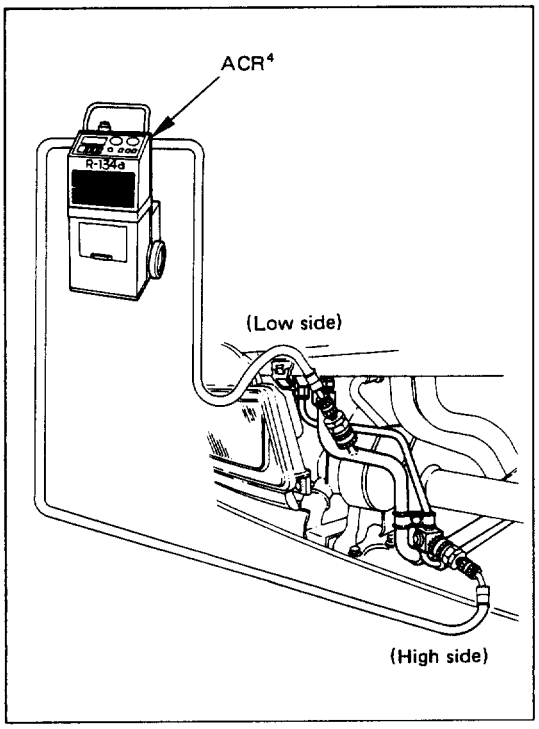
There are various methods of charging refrigerant into the air conditioning system.

These include using ACR4 (R-134a Refrigerant Recovery/ Recycling/ Recharging/ System) or equivalent and direct charging with a manifold gauge charging station.

ACR^4 (115V 60Hz) :5-8840-0629-0 (J-39500-A)

ACR^4 (220-240V 50/60Hz)
:5-8840-0630-0 (J-39500-220A)

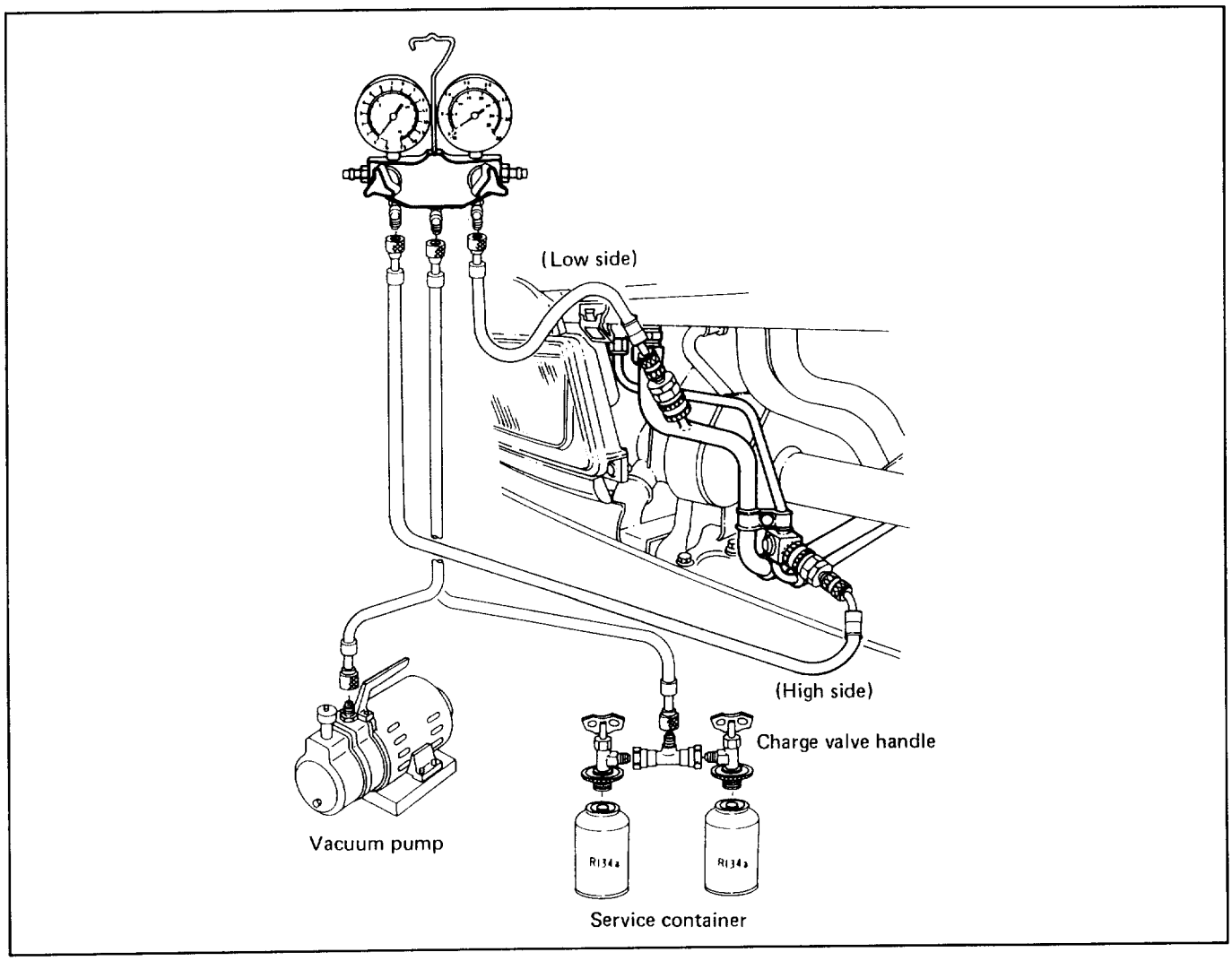
ACR^4 (220-240V 50/60Hz Australian model)
:5-8840-0631-0 (J-39500-220ANZ)

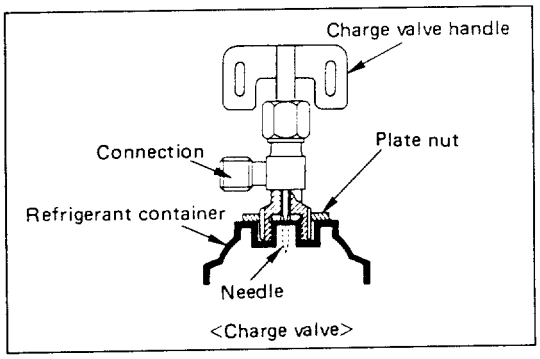


Charging procedure

- **ACR^4 (or equivalent) method**

  For the charging of refrigerant recovery by ACR^4, follow the manufacture's instruction.





- **Direct charging with a manifold gauge charging station method**

  Handling the charging valve handle when installing refrigerant container.

1) Before attaching the charge valve to the refrigerant container, turn the charge valve handle counterclockwise until the needle is fully retracted.
2) Turn the plate nut counterclockwise until it reaches its highest position relative to the charge valve.
3) Install the charge valve onto the refrigerant container.
4) Turn the plate nut clockwise and connect the center hose of the manifold gauge to the charge valve.
5) Tighten the plate nut sufficiently by hand. Then turn the charge valve handle clockwise to lower the needle and bore a hole in the refrigerant container.
6) Turn the charge valve handle counterclockwise to raise the needle. The refrigerant in the refrigerant container is charged into the air conditioning system by the operation of the manifold gauge.
   - Be absolutely sure not to reuse the emptied refrigerant container.

1) Make sure the evacuation process is correctly completed.
2) Connect the center-hose of the manifold gauge to the refrigerant container.
   - Turn the charge valve handle counterclockwise to purge the charging line and purge any air existing in the center-hose of the manifold gauge.
3) Open the low-pressure hand valve and charge the refrigerant about 200 g(0.44 lbs.).
   - Make sure the high-pressure hand valve is closed.
   - Avoid charging the refrigerant by turning the refrigerant container upside down.
4) Close the low-pressure hand valve of the manifold gauge.
   - Check to ensure that the degree of pressure does not charge.
5) Check the refrigerant leaks by using a R-134a leak detector.
   - If a leak occurs, repair the leak connection, and start all over again from the first step of evacuation.
6) If no leaks are found, open the low-pressure hand valve of the manifold gauge.Then continue charging refrigerant to the system.
   - When charging the system becomes difficult:
   (1) Run the engine at 1,300 - 1,500 rpm and open the all vehicle doors.
   (2) A/C switch is "ON".
   (3) Set the fan control knob (fan switch) to its highest position.

WARNING

BE ABSOLUTELY SURE NOT TO OPEN THE HIGH-PRESSURE HAND VALVE. SHOULD THE HIGH-PRESSURE HAND VALVE BE OPENED, THE HIGH-PRESSURE REFRIGERANT GAS WOULD FLOW BACKWARD, AND THIS MAY CAUSE THE REFRIGERANT CONTAINER TO BURST.

7) When the refrigerant container is emptied, use the following procedure to replace it with a new refrigerant container.
   (1) Close the low pressure hand valve.
   (2) Raise the needle upward and remove the charge valve.
   (3) Reinstall the charge valve to the new refrigerant container.
   (4) Purge any air existing in the center hose of the manifold gauge.

8) Charge the system to the specified amount and then close the low-pressure hand valve.

Refrigerant Amount	g(lbs.)
600 (1.32)	

- A fully charged system is indicated by the sight glass on the receiver/driver being free of any. bubbles(Refer to "Reading Sight Glass").
- Check the high and low pressure value of the manifold gauge.
- Check for refrigerant leaks by using a R-134a leak detector.

  Immediately after charging refrigerant, both high and low pressures are slightly high and to the left of the gauge, but they settle down to the guide pressure valves as shown below:
- Ambient temperature; 30 ~ 35°C (86 ~ 95°F)
- Guide pressure

High-pressure side;

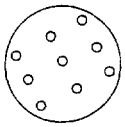
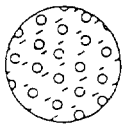
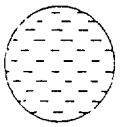
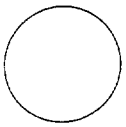
Approx. 1373 – 1667 kPa
(14 – 17 kg/cm^2 / 199 – 242 PSI)

Low-pressure side;

Approx. 127 – 245 kPa
(1.3 – 2.5 kg/cm^2 / 18 – 36 PSI)

9) Close the low pressure hand valve and charge valve of the refrigerant container.
10) Stop the air conditioning and the engine.
11) Disconnect the high and low pressure hoses from the manifold gauge fittings.

Reading Sight Glass

High and low pressure pipe temperature	The high pressure pipe is hot and the low pressure pipe is cold. There is a distinct difference in temperature between them.	The high pressure pipe is warm and the low pressure pipe is cool. There is no great difference in temperature between them.	There is little difference in temperature between the high pressure pipe and the low pressure pipe.	The high pressure pipe is hot and the low pressure pipe is slightly warm. There is a difference in temperature between them.
Sight glass condition	Almost transparent. A flow of bubbles can be seen, but they disappear when the throttle is opened. 	A flow of bubbles always can be seen. It appears sometimes transparent, and sometimes frothy. 	Something like fog faintly can be seen. 	Even at idle with the fan at "HI" (with the window fully open), the bubbles cannot be seen. 
Air conditioner cycle condition	OK	NG (Not enough refrigerant)	NG (Almost no refrigerant)	NG (Too much refrigerant)

The sight glass provides accurate diagnosis only under the following conditions.

If the vehicle can be tested under these conditions, check the sight glass appearance and compare to the chart.

* Engine speed 1,500 RPM
* A/C switch "ON"
* Blower fan operating at highest speed
* Air source selector lever at "RECIRC"
* Temperature control knob at coldest position
* Ambient temperature below 35°C (95°F) and humidity below 70% (See NOTE 1)
* High side pressure less than 1667 kPa (17 kg·cm^2 / 242 PSI) (See NOTE 2)

NOTE 1

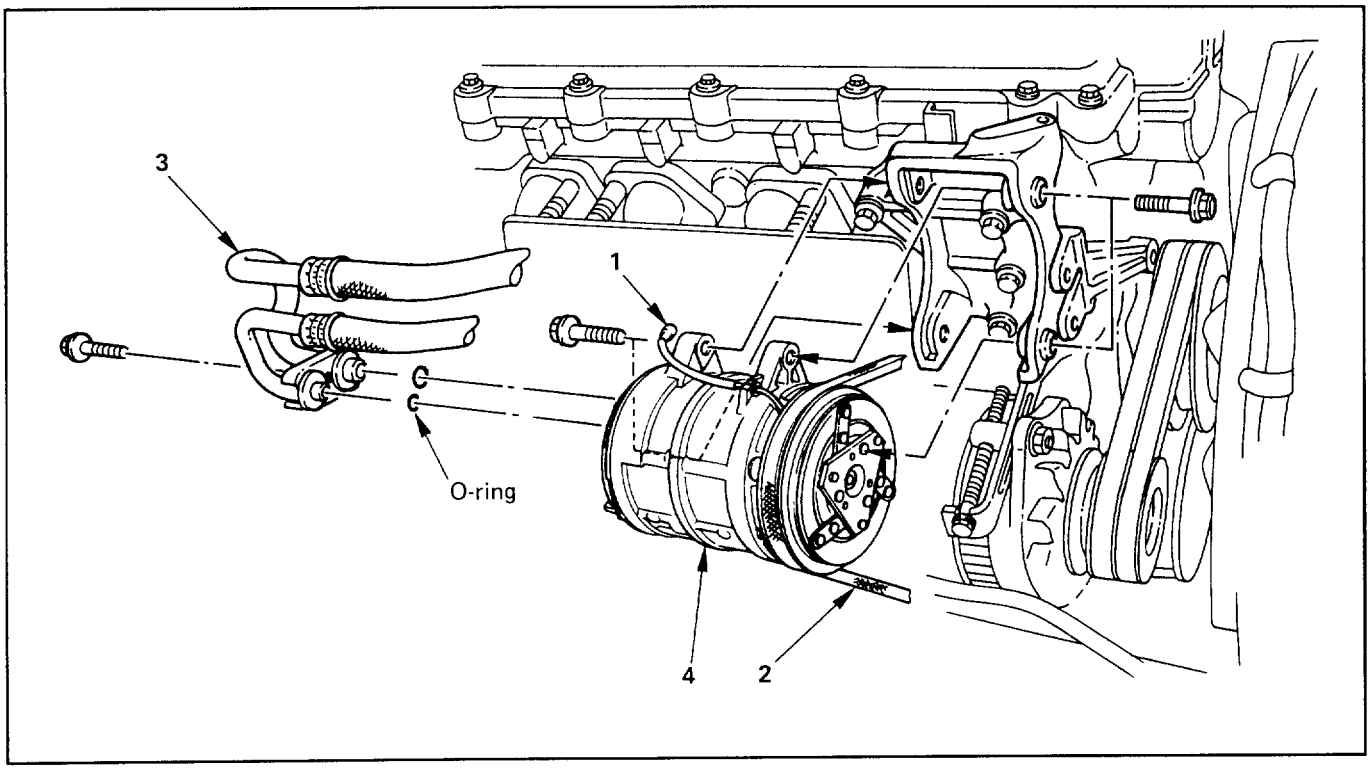
If the vehicle cannot be moved to a testing location that meets these specifications, then the sight glass cannot be used for diagnosis. You must discharge and recover the refrigerant, then recharge the system with the specified amount of refrigerant. Then continue checking the system performance.

NOTE 2

If the high side pressure is greater than stated, the sight glass cannot be used for diagnosis. You must discharge and recover the refrigerant, then recharge the system with the specified amount of refrigerant.

Then continue checking system performance.

COMPRESSOR

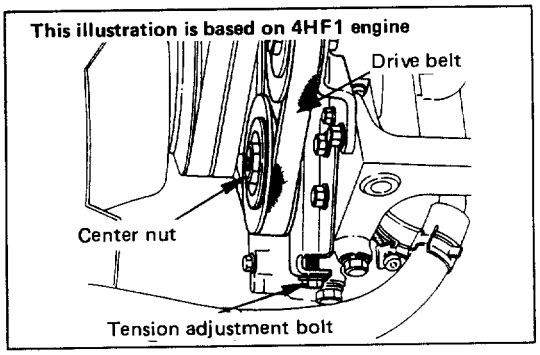


Removal Steps

1. Magnetic clutch harness connector
2. Drive belt
3. Refrigerant line
4. Compressor

Installation Steps

To install, follow the removal steps in the reverse order.



Removal Steps

Preparation:

Disconnect the battery ground cable.

Discharge and recover refrigerant.

1. **Magnetic Clutch Harness Connector**
2. **Drive Belt**

   Loosen the tension pulley center nut and tension adjustment bolt, then remove the drive belt.

3. **Refrigerant line**

   When removing the line connector, the connecting part should immediately be plugged or capped to prevent foreign matter from being mixed into the line.

4. **Compressor**

Installation Steps

4. **Compressor**

   Tighten the compressor fixing bolts to the specified torque.

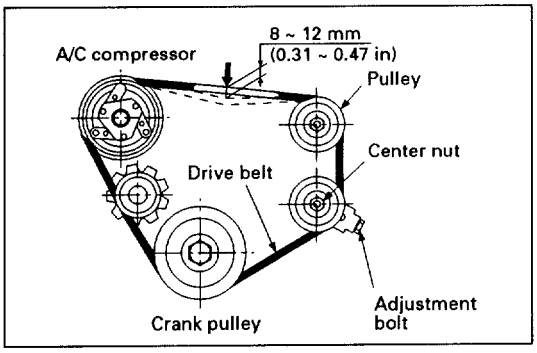
Compressor Bolt Torque	N·m (kg·m/lb·ft)
	48 (4.9/35)

3. **Refrigerant Line**

   - Tighten the refrigerant line fixing bolt to the specified torque.

Refrigerant Line Bolt Torque	N·m (kg·m/lb·ft)
	27 (2.8/20)

   - O-ring cannot be reused. Always replace with new ones.
   - Be sure to apply new specified compressor oil to the O-rings when connecting refrigerant lines.

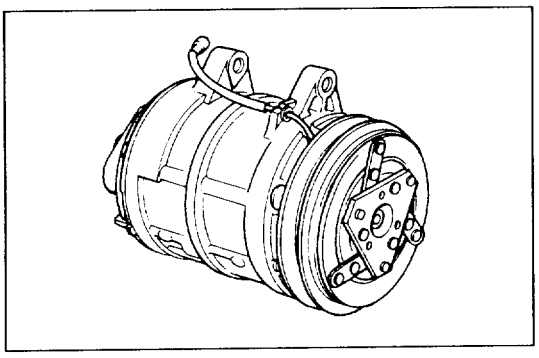


2. **Drive Belt**

   Push the drive belt with the force of 10kg (22 lbs) and adjust the drive belt tension by tightening idle pulley tension adjustment bolt, until the 8 - 12 mm (0.31 - 0.47 in) deflection of the belt is obtained. Then tighten the pulley center nut.

Idle Pulley Center Nut Torque	N·m (kg·m/lb·ft)
	39 (4.0/29)

1. **Magnetic Clutch Harness Connector**



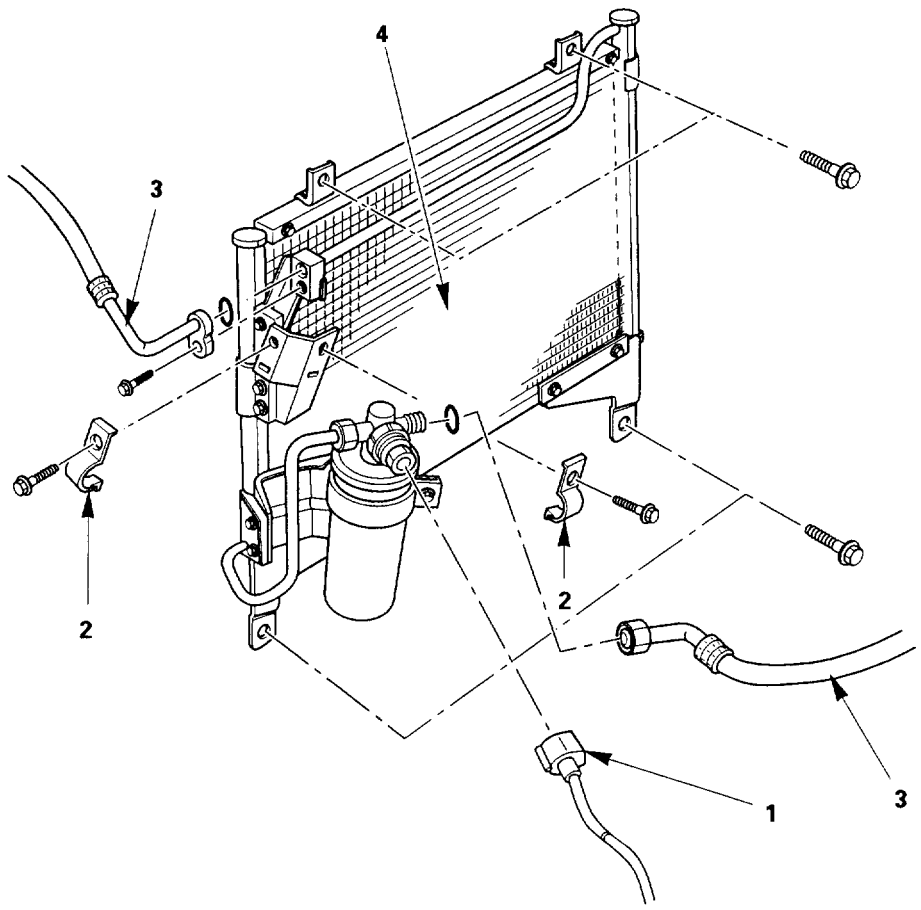
New Compressor Installation

The new compressor is filled with 180cc (5.0 Imp fl oz) of compressor oil and nitrogen gas. When mounting the compressor on the vehicle, perform the following steps;

1) Gently release nitrogen gas from the rear head of the new compressor.
   - Take care not to let the compressor oil flow out.
   - Inspect O-rings and replace if necessary.
2) Turn the compressor several times by hand and release the compressor oil in the cylinder.
3) When installing on a new system, the compressor should be installed as it is. When installing on a used system, the compressor should be installed after adjusting the amount of compressor oil.
   (Refer to Section 1D "COMPRESSOR OVERHAUL" for General Information.)

Condenser Assembly

This illustration is based on LHD



Removal Steps

1. Pressure switch connector
2. Refrigerant line fixing clamp
3. Refrigerant line
4. Condenser assembly

Installation Steps

To install, follow the removal steps in the reverse order.

Removal Steps

Preparation:

Disconnect the battery ground cable.

Discharge and recover refrigerant.

1. **Pressure switch connector**
2. **Refrigerant line fixing clamp**

3. **Refrigerant Line**
   - Use a back up wrench when disconnecting and reconnecting the refrigerant lines.
   - When removing the line, the connecting part should immediately be plugged or capped to prevent foreign matter from being mixed into the line.
4. **Condenser assembly**

Installation Steps

4. **Condenser Assembly**
   - If installing a new condenser, be sure to add 30cc (0.8 Imp fl oz) of new specified compressor oil to a new one.
   - Tighten the to the specified torque.

Condenser Bolt Torque	N·m (kg·m/lb·in)
6 (0.6/52)	

3. **Refrigerant Line**
   - Tighten the inlet line to the specified torque.

Inlet Line Torque	N·m (kg·m/lb·in)
12 (1.2/104)	

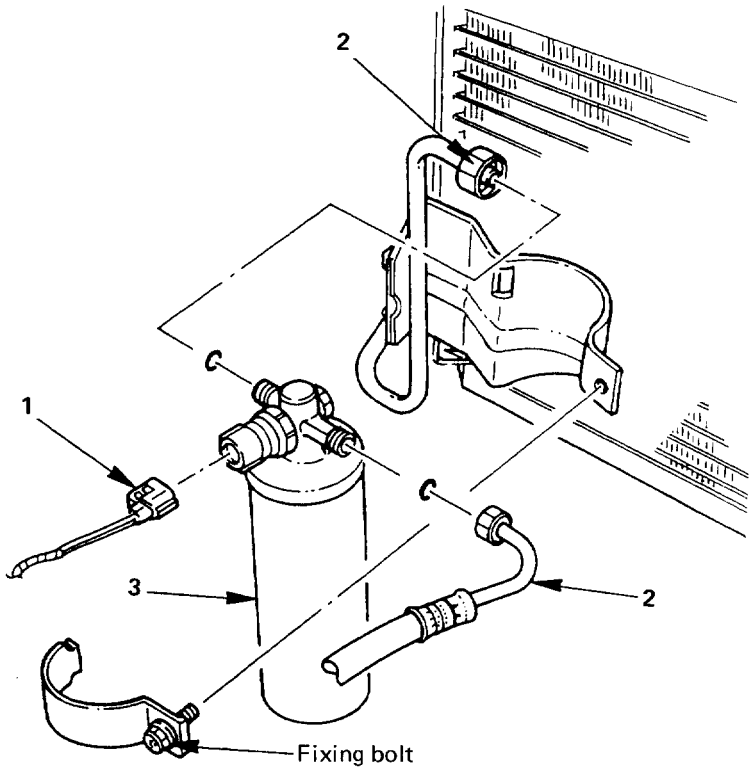
   - Tighten the outlet line to the specified torque.

Outlet Line Torque	N·m (kg·m/lb·ft)
15 (1.5/11)	

   - O-rings cannot be reused. Always replace with new ones.
   - Be sure to apply new specified compressor oil to the O-rings when connecting refrigerant line.
2. **Refrigerant Line Fixing Clamp**
1. **Pressure Switch Connector**

Receiver/Drier

This illustration is based on LHD



Removal Steps

1. Pressure switch connector
2. Refrigerant line
3. Receiver/drier

Installation Steps

To install, follow the removal steps in the reverse order.

Removal Steps

Preparation:

Disconnect the battery ground cable.

Discharge and recover refrigerant.

1. **Pressure Switch Connector**
2. **Refrigerant Line**
   - Use a back up wrench when disconnecting and reconnecting the refrigerant line.
   - When removing the line connected part, the connecting part should immediately be plugged or capped to prevent foreign matter from being mixed into the line.
3. **Receiver/Driver**

   Loosen the fixing bolt and carefully pull out the receiver/drier.

Installation Steps

To install, follow the removal steps in the reverse order, noting the following points:

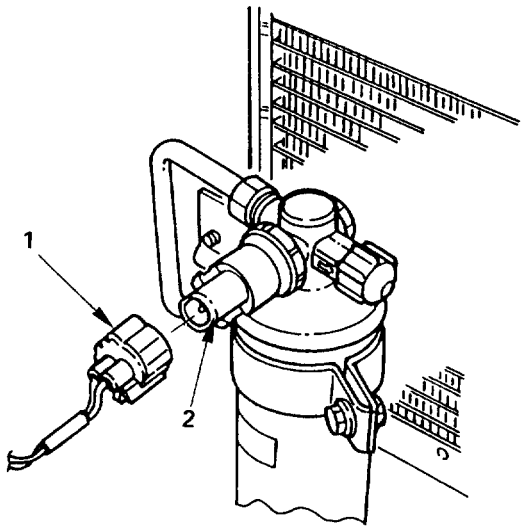
1. If installing a new receiver/drier, be sure to add 30 cc (0.8 Imp fl oz) of new specified compressor oil to a new one.
2. Put the receiver/drier in the bracket, and connect with the refrigerant line. Check that no excessive force is imposed on the line. Fasten the fixing bolt to the receiver/drier.
3. Tighten the line to the specified torque.

Refrigerant Line Torque	N·m (kg·m/lb·ft)
	15 (1.5/12)

4. O-rings cannot be reused. Always replace with new ones.
5. Be sure to apply new specified compressor oil to the O-rings when connecting refrigerant line.

Pressure Switch

This illustration is based on LHD



Removal Steps

1. Pressure switch connector
2. Pressure switch

Installation Steps

To install, follow the removal steps in the reverse order.

Removal Steps

Preparation:

Disconnect the battery ground cable.

Discharge and recover refrigerant.

1. **Pressure Switch Connector**
2. **Pressure Switch**
   - Turn the pressure switch counterclockwise to remove it.
   - When removing the switch connected part, the connecting part should immediately be plugged or capped to prevent foreign matter from being mixed into the line.

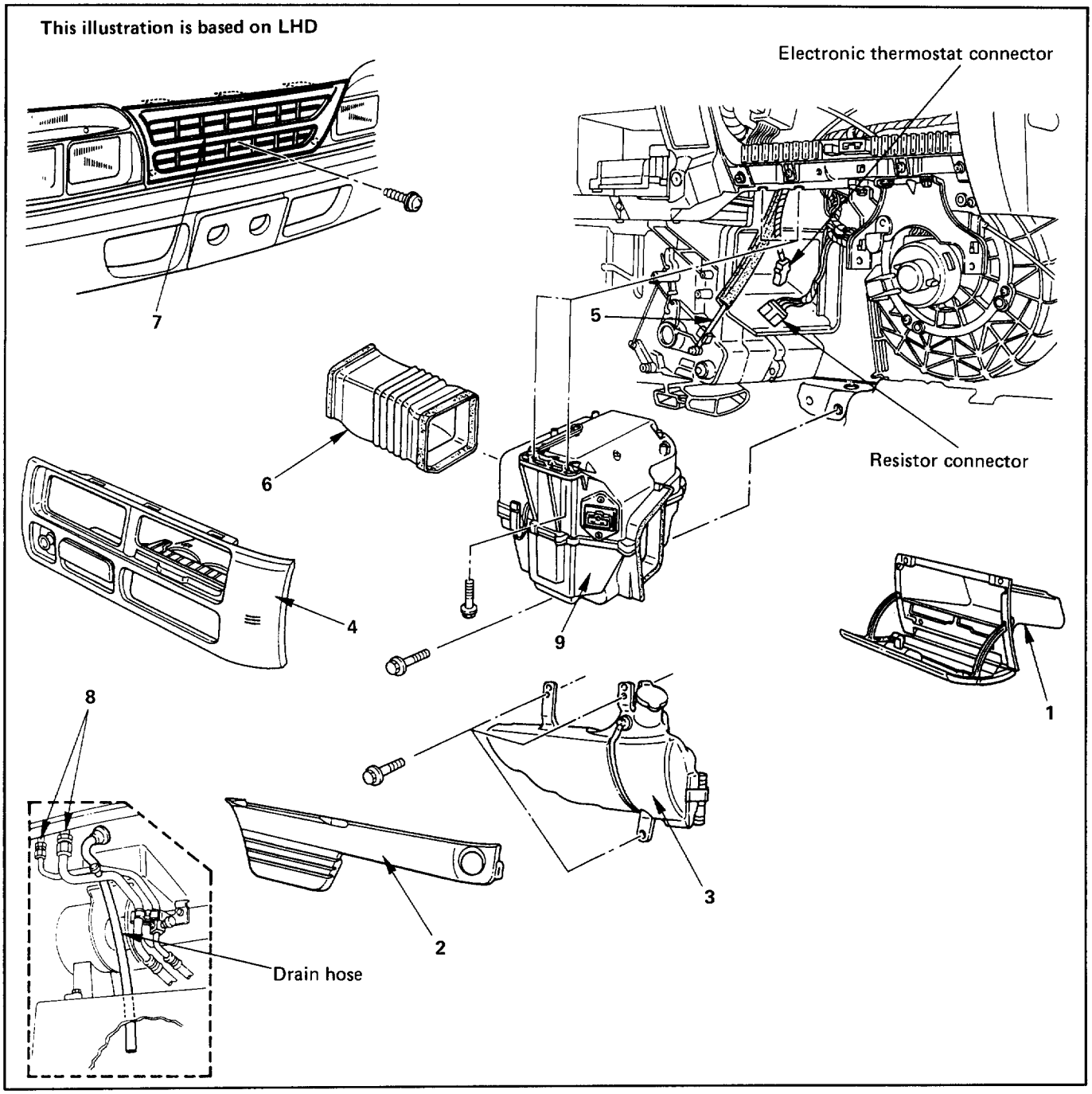
Installation Steps

To install, follow the removal steps in the reverse order, noting the following points:

1. O-ring cannot be reused. Always replace with a new one.
2. Be sure to apply new specified compressor oil to the O-ring when connecting pressure switch.
3. Tighten the pressure switch to the specified torque.

Pressure Switch Torque	N·m (kg·m/lb·in)
	13 (1.3/113)

Evaporator Assembly



Removal Steps

1. Glove box
2. Under cover
3. Washer tank
4. Center cluster
5. Temperature control cable
6. Duct (NPR only)
7. Front grille
8. Refrigerant line
9. Evaporator assembly

Installation Steps

To install, follow the removal steps in the reverse order.

Removal Steps

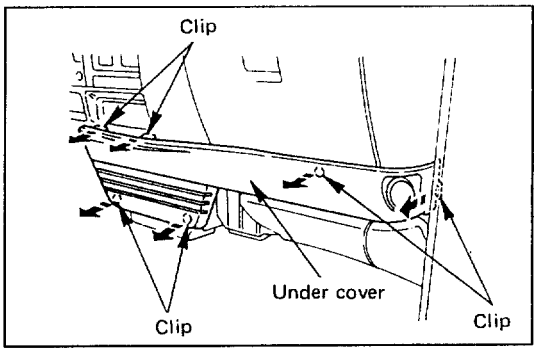
Preparation:

Disconnect the battery ground cable.

Discharge and recover refrigerant

1. **Glove Box**

   Open the glove box and remove the fixing screws.

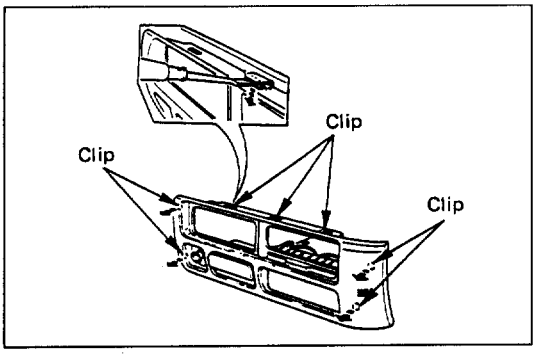


2. **Under Cover**

   While pulling the under cover with care, remove the clips on the back side of the cover.

3. **Washer Tank**

   - Remove the washer tank fixing three bolts (Upper: two, Lower: one) and disconnect the connector.
   - Do not disconnect the washer tank tube.



4. **Center Cluster**

   - While pulling the cluster with care, remove the upper and back side clips of the cluster.
   - Disconnect the cigar lighter and illumination connectors.

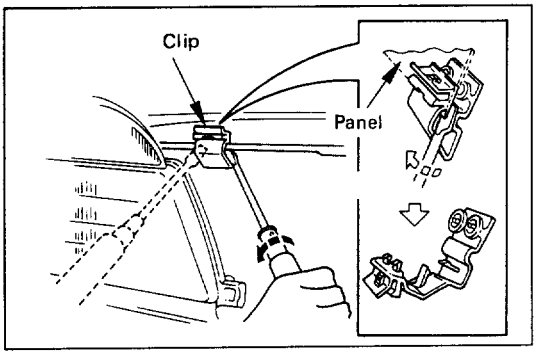
5. **Temperature Control Cable**

   Disconnect the temperature control cable of the control lever assembly from the heater unit.

6. **Duct (NPR only)**

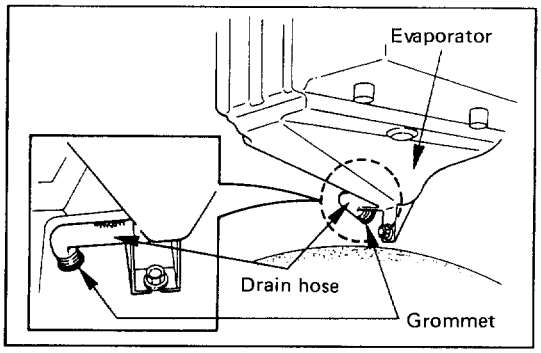
7. **Front Grille**

   After removing the grille, remove the grille fixing clip (RH).



8. **Refrigerant Line**

   - Use a back up wrench when disconnecting and reconnecting the refrigerant line.
   - When removing the refrigerant line connected part, the connecting part should immediately be plugged or capped to prevent foreign matter from being mixed into the line.



9. **Evaporator Assembly**
   - Disconnect the resistor and thermostat connectors
   - Disconnect the drain hose.

Installation Steps

To install, follow the removal steps in the reverse order, noting the following points:

1. To install a new evaporator assembly, add 50cc (1.4 Imp fl oz) of new specified compressor oil to a new core.
2. Tighten the refrigerant outlet line to the specified torque.

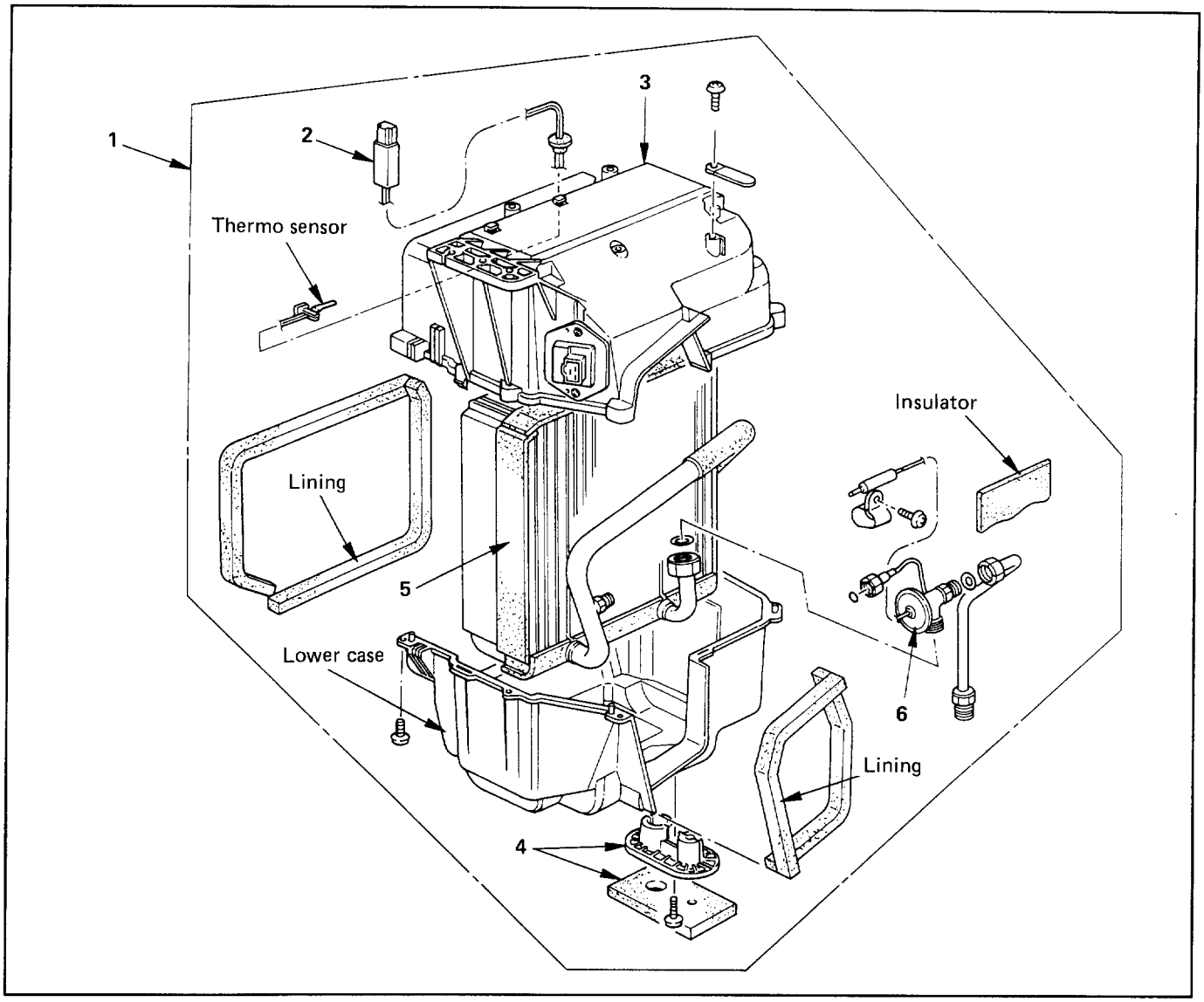
Outlet Line Torque	N·m (kg·m/lb·ft)
	25 (2.5/18)

3. Tighten the refrigerant inlet line to the specified torque.

Inlet Line Torque	N·m (kg·m/lb·ft)
	15 (1.5/11)

4. O-rings cannot be reused. Always replace with new ones.
5. Be sure to apply new specified compressor oil to the O-rings when connecting lines.

Evaporator Core/Expansion Valve



Removal Steps

1. Evaporator assembly
2. Electronic thermostat
3. Upper case
4. Insulator and under cover
5. Evaporator core
6. Expansion valve

Installation Steps

To install, follow the removal steps in the reverse order.

Removal Steps

Preparation:

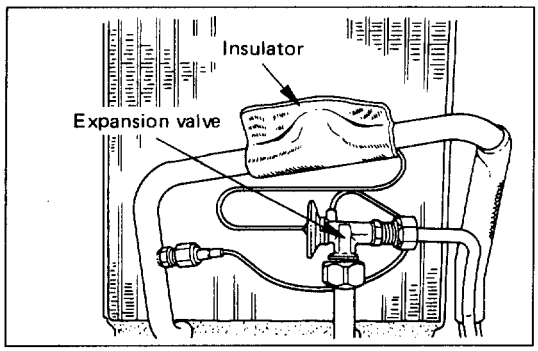
Disconnect the battery ground cable.

Discharge and recover refrigerant.

1. **Evaporator Assembly**

   Refer to "EVAPORATOR ASSEMBLY" removal procedure in this section.

2. **Electronic Thermostat**
   - Remove the sensor fixing clip.
   - Pull out the grommet from the upper case to remove the thermostat.
3. **Upper Case**
   - Separate the upper and lower case.
   - Slit the case parting face with a knife since the lining is separated.
4. **Insulator and Under Cover**
5. **Evaporator Core**
   Pull up the core from the lower case.
6. **Expansion Valve**
   - Tear off the insulator carefully.
   - Remove the sensor fixing clip.
   - Use a back up wrench when disconnecting all refrigerant pipes, and remove the expansion valve.

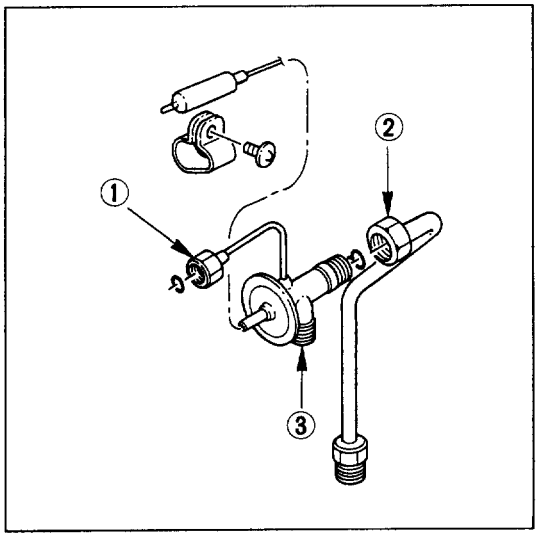


Installation Steps

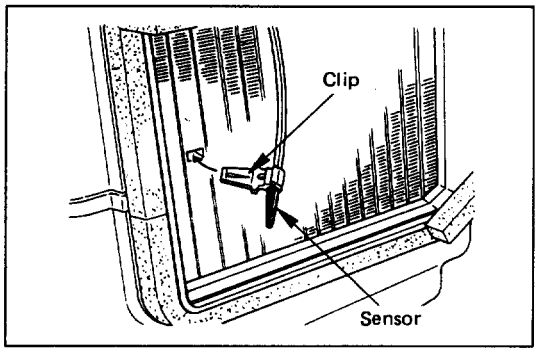
To install, follow the removal steps in the reverse order, noting the following points:

1. O-rings cannot be reused. Always replace new ones.
2. Be sure to apply new specified compressor oil to the O-rings when connecting lines.
3. Be sure to install the expansion valve sensor and the insulator on the place where it was before.
4. To install a new evaporator core, add 50cc (1.4 Imp. fl oz) of new specified compressor oil to a new core and install the thermostat sensor to the evaporator core specified position with the clip where it was before.
5. Tighten the refrigerant lines to the specified torque.

Refrigerant Line Torque	N·m (kg.m/lb.ft)
①: 10 (1.0/7)	
②: 15 (1.5/11)	
③: 20 (2.0/14)	



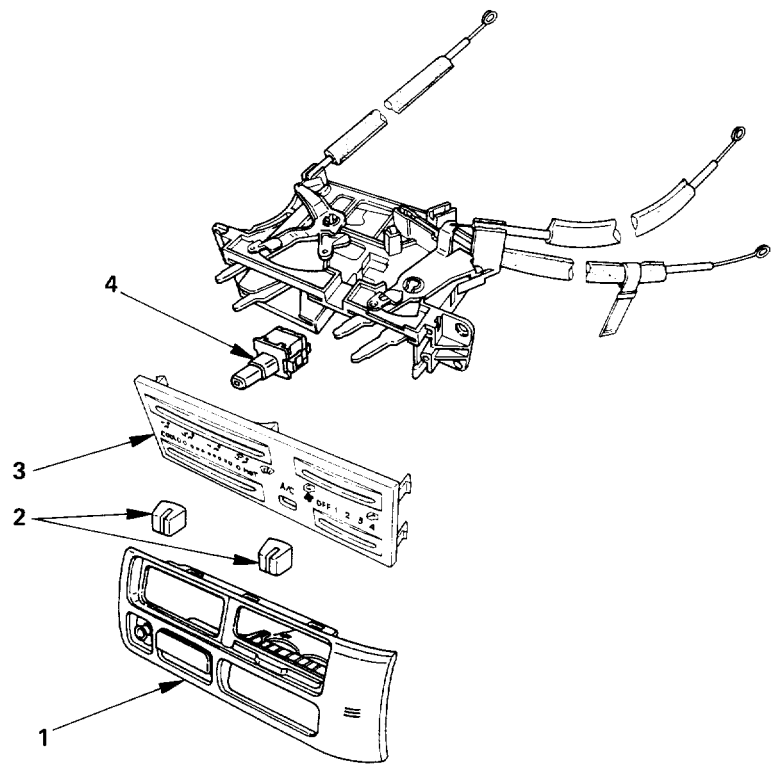
6. Apply an adhesive to parting face of lining when assembling evaporator assembly.



7. The thermostat sensor is installed on the core with the clip and it must not interfere with the core.

A/C Switch

This illustration is based on LHD

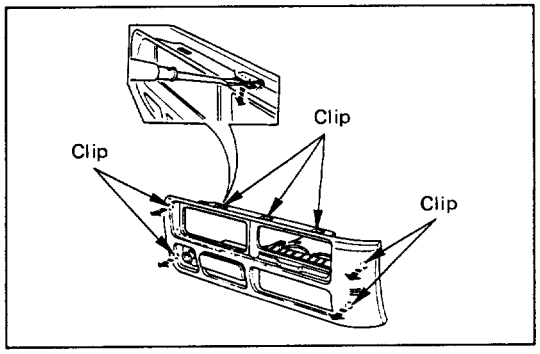


Removal Steps

1. Center cluster
2. Knob
3. Control panel bezel
4. A/C switch

Installation Steps

To install, follow the removal steps in the reverse order.

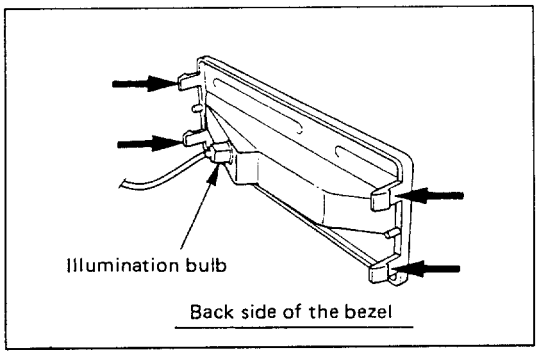


Removal Steps

Preparation:

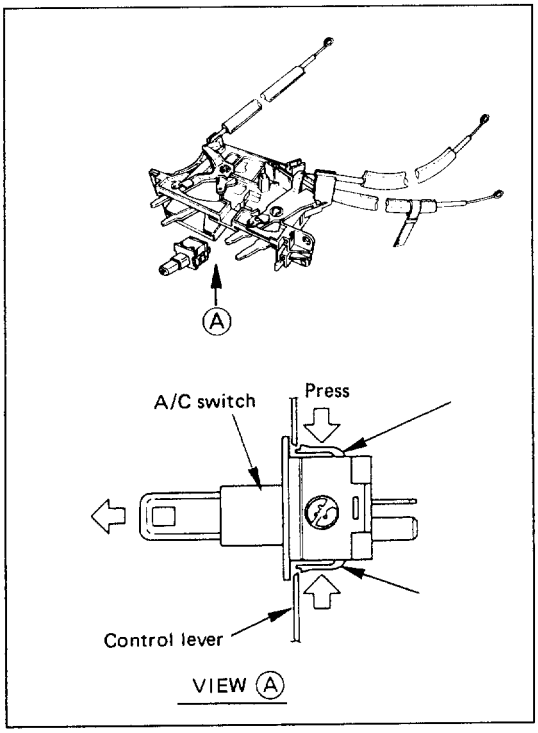
Disconnect the battery ground cable.

1. **Center Cluster**
   - While pulling the cluster with care, remove the upper and back side clips of the cluster.
   - Disconnect the cigar lighter and illumination connectors.
2. **Knob**



3. **Control Panel Bezel**

   Push the four catches at both sides of the bezel to the inside, and remove the illumination bulb from the bezel.



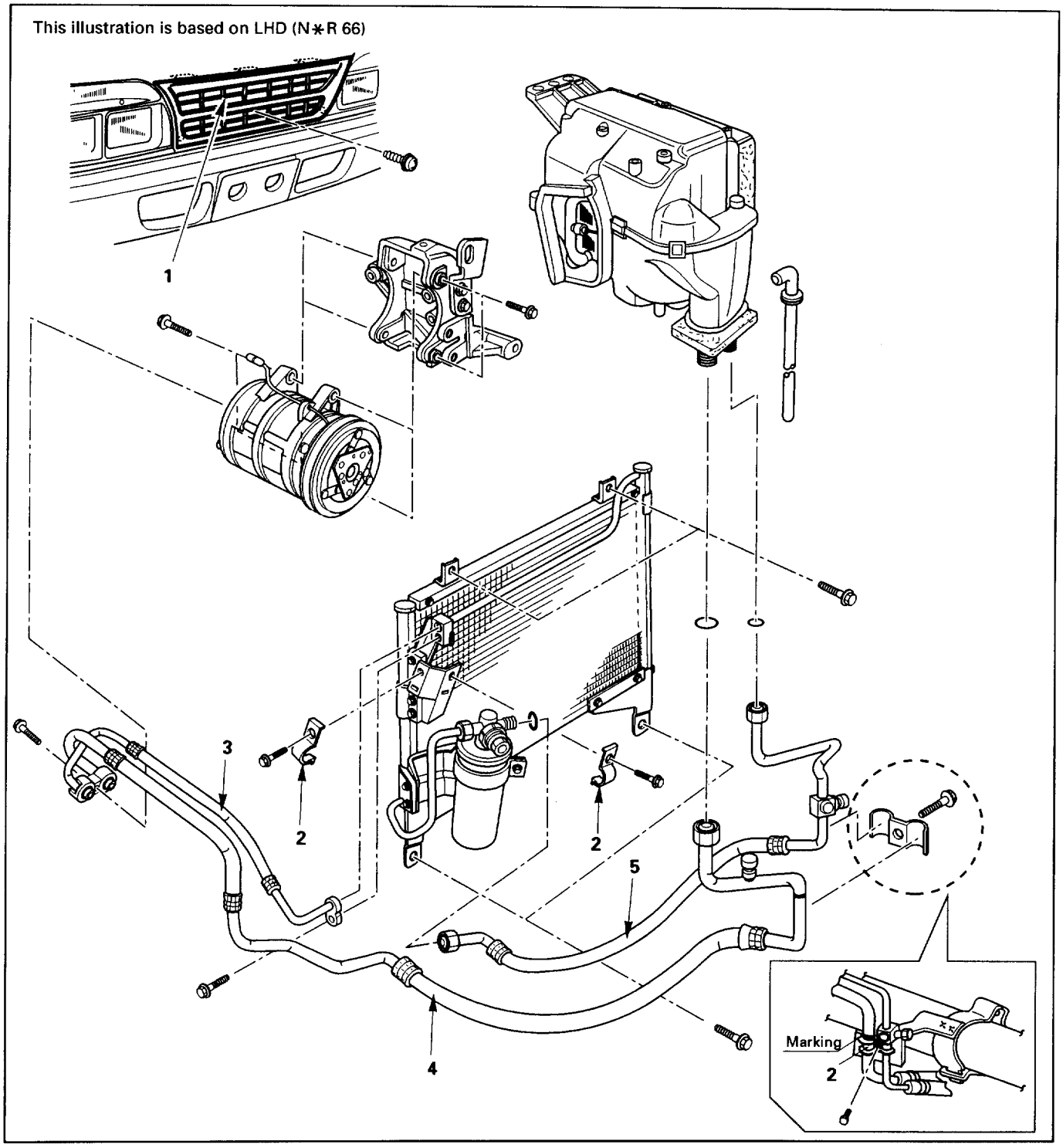
4. **A/C Switch**

   Push the catches at both sides of the A/C switch to the inside, and remove the switch by pulling it out.

Installation Steps

To install, follow the removal steps in the reverse order.

Refrigerant Line



Removal Steps

1. Front grille
2. Clamp/Clip
3. Refrigerant line (Compressor – Condenser)
4. Refrigerant line (Compressor – Evaporator)
5. Refrigerant line (Receiver/drier – Evaporator)

Installation Steps

To install, follow the removal steps in the reverse order.

Removal Steps

Preparation:

Disconnect the battery ground cable.

Discharge and recover refrigerant

1. **Front grille**
2. **Clamp/Clip**
3. **Refrigerant Line (Compressor – Condenser)**
4. **Refrigerant Line (Compressor – Evaporator)**
5. **Refrigerant Line (Receiver/drier – Evaporator)**
   - Use a back-up wrench when disconnecting and reconnecting the refrigerant lines.
   - When removing the refrigerant line connecting part, the connecting part should immediately be plugged or capped to prevent foreign matter from being mixed into the line.

Installation Steps

To install, follow the removal steps in the reverse order, noting the following points:

1. O-rings cannot be reused. Always replace new ones.
2. Be sure to apply new specified compressor oil to the O-rings when connecting refrigerant lines.
3. If installing a new refrigerant line, be sure to add 10cc (0.3 Imp fl oz) of new specified compressor oil to a new one.
4. Tighten the refrigerant line to the specified torque.
   (Refer to "SERVICE INFORMATION" for FIXING TORQUE in section 00.)

SECTION 1D

COMPRESSOR OVERHAUL

CAUTION

When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size and strength (or stronger) may be used.

Fasteners that are not reused, and those requiring thread locking compound, will be called out. The correct torque values must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

CONTENTS

PAGE

General Description 1D– 2

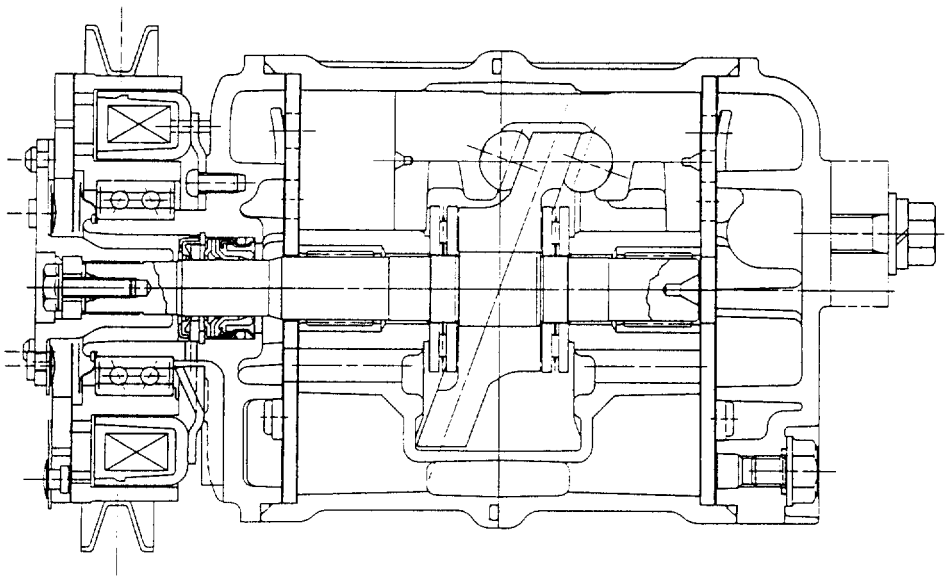
General Information 1D– 4

Compressor Oil 1D– 4

Service Procedures 1D– 6

Compressor Overhaul 1D– 6

GENERAL DESCRIPTION



When servicing the compressor, keep dirt or foreign material from getting on or into the compressor parts and system. Clean tools and a clean work area are important for proper service. The compressor connections and the outside of the compressor should be cleaned before any "On-Vehicle" repair, or before removal of the compressor. The parts must be kept clean at all times and any parts to be reassembled should be cleaned with Trichloroethane, naphtha, kerosene, or equivalent solvent, and dried with dry air. Use only lint free cloths to wipe parts.

The operations described below are based on bench overhaul with compressor removed from the car, except as noted. They have been prepared in order of accessibility of the components. When the compressor is removed from the car for servicing, the oil remaining in the compressor should be discarded and new refrigerant oil added to the compressor.

Magnetic clutch assembly repair procedures require that the system be discharged of refrigerant. (Refer to Section 1B for "REFRIGERANT RECOVERY".)

Compressor malfunction will appear in one of four ways: noise, seizure, leakage or low discharge pressure. Resonant compressor noises are not cause for alarm; however, irregular noise or rattles may indicate broken parts or excessive clearances due to wear. To check seizure, de-energize the magnetic clutch and check to see if the drive plate can be rotated. If rotation is impossible, the compressor is seized. Low discharge pressure may be due to a faulty internal seal of the compressor, or a restriction in the compressor. Low discharge pressure may also be due to an insufficient refrigerant charge or a restriction elsewhere in the system. These possibilities should be checked prior to servicing the compressor. If the compressor is inoperative, but is not seized, check to see if current is being supplied to the magnetic clutch coil terminals.

This vehicle is provided with a swash plate type compressor (DKS-15 CH Type)

Swash plate compressors have a swash (slanted) plate mounted on the shaft. When the shaft turns, the rotation of the swash plate is converted to reciprocating piston motion which sucks in and compresses the refrigerant gas.

Shaft seal (Lip type) is installed between the valve plate and shaft & cylinder head to prevent refrigerant gas leaks. A specified amount of compressor oil is contained in the oil pan.

This oil is supplied to the cylinders, bearings, etc., by an oil pump which is connected to the swash plate shaft.

With some compressors the differential between the intake pressure and discharge pressure generated while the compressor is operating is used for lubrication instead of an oil pump.

Three pistons are arranged at 120deg. intervals around the center of the swash plate shaft. These pistons are connected to the ends of the swash plate through balls.

The rotation of the swash plate causes reciprocating movement of the piston inside the

cylinders, with each piston operating as two cylinders. Because of that, the compressor operates as though it has 6 cylinders.

The specified amount of the compressors oil is 180cc (5.0 Imp fl oz).

The oil used in the R-134a system compressor differs from that used in R-12 systems.

Also, compressor oil to be used varies according to the compressor model. Be sure to avoid mixing two or more different types of oil.

If the wrong oil is used, lubrication will be poor and the compressor will seize or malfunction.

(Refer to Section 1B "ON-VEHICLE SERVICE" for Precautions for R-134a Air Conditioning System in this manual.)

GENERAL INFORMATION

Compressor Oil

OIL SPECIFICATION

- The R-134a system requires a synthetic (PAG) compressor oil whereas the R-12 system requires a mineral compressor oil. The two oils must never be mixed.
- Compressor (PAG) oil varies according to compressor model. Be sure to use oil specified for the model of compressor.

Specified Compressor Oil

ZXL-100PG (ISUZU PART NO.8-97101-338-0)

HANDLING OF OIL

- The oil should be free from moisture, dust, metal powder, etc.
- Do not mix with other oil.
- The water content in the oil increases when exposed to the air. After use, seal oil from air immediately.

  (R-134a PAG Compressor Oil absorbs moisture very easily than R-12.)
- The compressor oil must be stored in steel containers, not in plastic containers.

COMPRESSOR OIL CHECK

The oil used to lubricate the compressor is circulating with the refrigerant.

Whenever replacing any component of the system or a large amount of gas leakage occurs, add oil to maintain the original amount of oil.

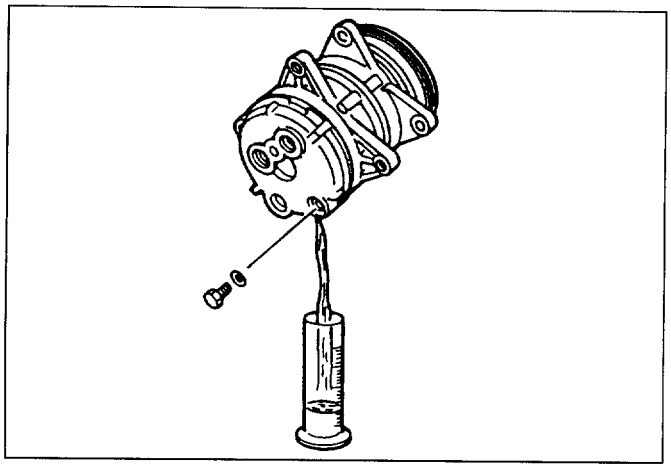
Oil Capacity

Capacity total in system	180cc (5.0 Imp fl oz)
Compressor (Service parts) charging amount	180cc (5.0 Imp fl oz)

Checking and Adjusting for Used Compressor

1) Perform Oil return operation.

   (Refer to "Oil Return Operation" in this section.)
2) Discharge refrigerant and remove the compressor.
3) Drain the compressor oil and measure the extracted oil with a measuring cylinder.



4) If the amount of oil drained is much less than 90cc (2.5 Imp fl oz), some refrigerant may have leaked out. Conduct leak tests on connections of each system, and if necessary, repair or replace faulty parts.
5) Check the compressor oil for contamination.

   (Refer to "Contamination of Compressor Oil" in this section.)
6) Adjust oil level following the procedure below.

Collected Amount	Charging Amount
more than 120cc (3.4 Imp fl oz)	same as collected amount
less than 120cc (3.4 Imp fl oz)	120cc (3.4 Imp fl oz)

7) Install the compressor, then evacuate, charge and perform oil return operation.
8) Check system operation.

When it is impossible to perform oil return operation, the compressor oil should be checked in the following order:

1) Discharge refrigerant and remove the compressor.
2) Drain the compressor oil and measure the extracted oil with a measuring cylinder.
3) Check the oil for contamination.
4) If more than 120cc (3.4 Imp fl oz) of oil is extracted from the compressor, supply same amount of oil to the compressor to be installed.

   If the amount of oil extracted is less than 120cc (3.4 Imp fl oz), recheck the compressor oil in the following order:
5) Supply 120cc (3.4 Imp fl oz) of oil to the compressor and install it onto the vehicle.
6) Perform oil return operation.

Checking and Adjusting for Compressor Replacement

180cc (5.0 Imp fl oz) of oil is charged in compressor (service parts). So it is necessary to drain the proper amount of oil from the new compressor.

1) Perform oil return operation.
2) Discharge refrigerant and remove the compressor.
3) Drain the compressor oil and measure the extracted oil.
4) Check the compressor oil for contamination.
5) Adjust oil level as required.

Amount of oil drained from used compressor	Draining amount of oil from new compressor
less than 180cc (3.4 Imp fl oz)	Same as drained amount
more than 180cc (3.4 Imp fl oz)	180cc (3.4 Imp fl oz)

6) Evacuate, charge and perform oil return operation.
7) Check system operation.

CONTAMINATION OF COMPRESSOR OIL

Unlike engine oil, no cleaning agent is added to the compressor oil. Even if the compressor runs for a long period of time (approximately 1 season), the oil never becomes contaminated as long as there is nothing wrong with the compressor or its method of use.

Inspect the extracted oil for any of the following conditions:

- The capacity of the oil has increased.
- The oil has changed color to red.
- Foreign substances, metal powder, etc., are present in the oil.

If any of these conditions exists, compressor oil is contaminated. Whenever contaminated compressor oil is discovered, the receiver/drier must be replaced.

OIL RETURN OPERATION

There is close affinity between the oil and the refrigerant. During normal operation, part of the oil recirculates with the refrigerant in the system.

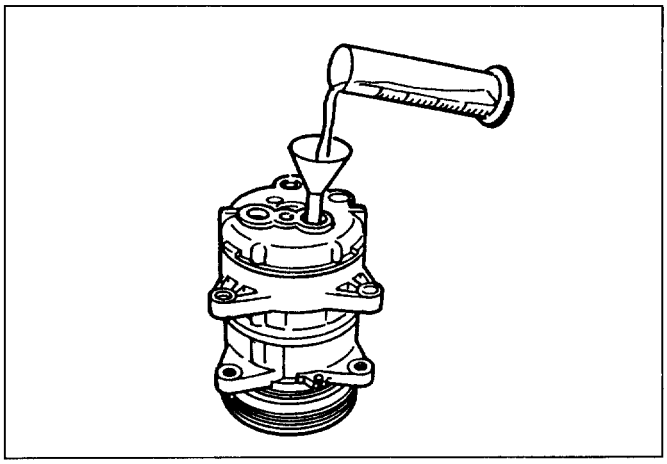
When checking the amount of oil in the system, or replacing any component of the system, the compressor must be run in advance for oil return operation. The procedure is as follows:

1) Open the all doors and engine hood.
2) Start the engine and A/C switch is "ON" and Set the fan control knob at its highest position.
3) Run the compressor for more than 20 minutes between 800 and 1,000 rpm in order to operate the system.
4) Stop the engine.

REPLACEMENT OF COMPONENT PARTS

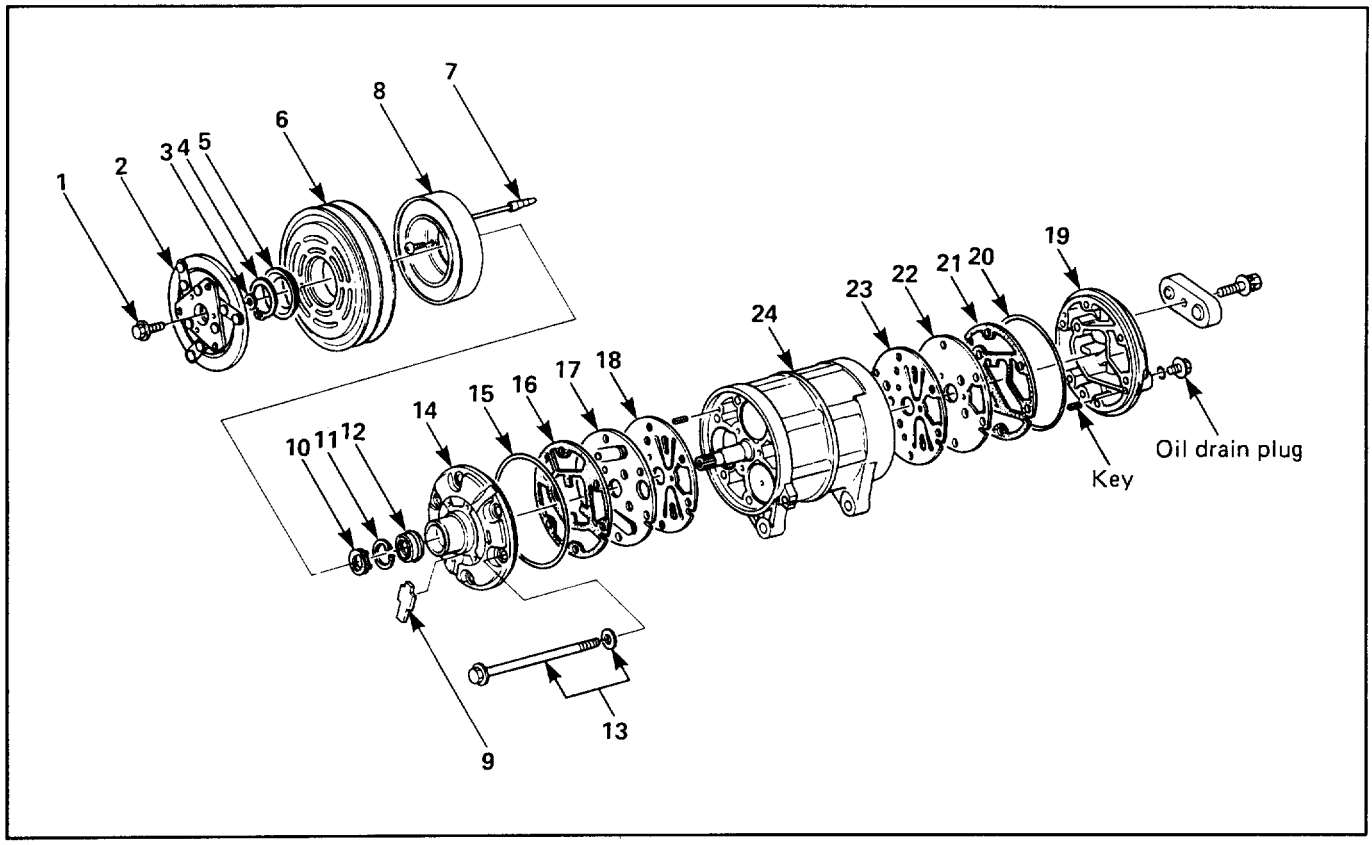
When replacing system component parts, supply the following amount of oil to the component parts to be installed.

Component parts to be installed	Amount of oil
Evaporator	50cc (1.4 Imp fl oz)
Condenser	30cc (0.8 Imp fl oz)
Receiver/drier	30cc (0.8 Imp fl oz)
Refrigerant line (One piece)	10cc (0.3 Imp fl oz)



SERVICE PROCEDURES

Compressor Overhaul



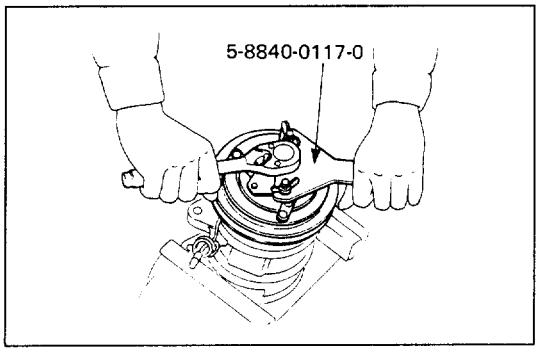
Disassembly Steps

1. Drive plate bolt
2. Drive plate
3. Shim(s)
4. Snap ring
5. Cover (If so equipped)
6. Pulley assembly
7. Lead wire connector
8. Field coil
9. Felt (If so equipped)
10. Shaft seal cover (If so equipped)
11. Snap ring
12. Shaft seal assembly
13. Through bolt with gasket
14. Front cylinder head
15. O-ring
16. Gasket
17. Front valve plate
18. Front suction valve
19. Rear cylinder head
20. O-ring
21. Gasket
22. Rear valve plate
23. Rear suction valve
24. Cylinder and shaft assembly

Reassembly Steps

To reassemble, follow the disassembly steps in the reverse order.

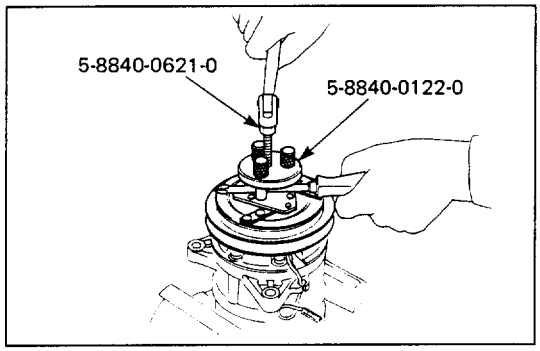
Disassembly Steps



1. **Drive Plate Bolt**

   Using drive plate holder to prevent the drive plate from rotating, then remove the bolt.

   Drive Plate Holder : 5-8840-0117-0 (J-33939)



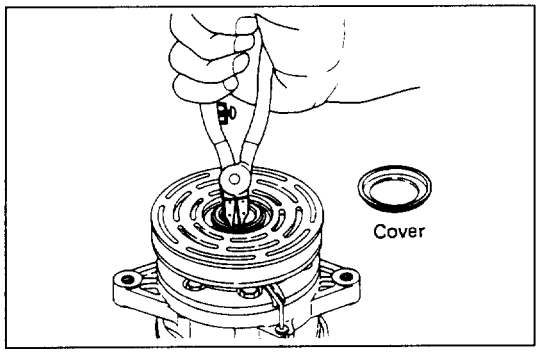
2. **Drive Plate**

   Using drive plate puller and forcing screw to remove the drive plate.

   Drive Plate Puller : 5-8840-0122-0 (J-33944-A)

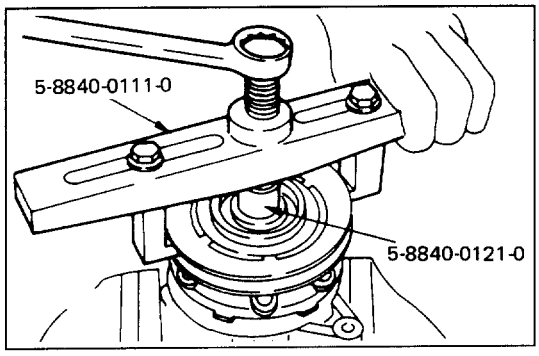
   Forcing Screw : 5-8840-0621-0 (J-33944-4)

   If the frictional surface shows signs of damage due to excessive heat, the drive plate and pulley should be replaced.



3. **Shim(s)**
4. **Snap Ring**
5. **Cover (If so equipped)**

   Using snap ring pliers to remove the snap ring.



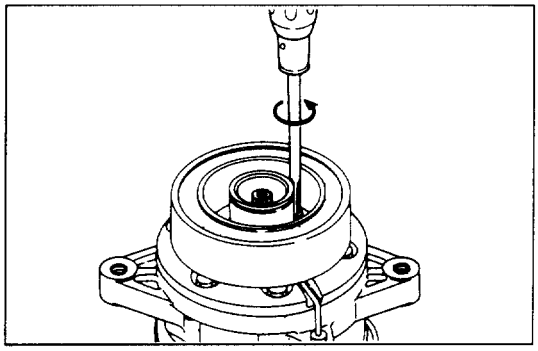
6. **Pulley Assembly**

   Using pulley puller pilot and pulley puller to remove the pulley assembly.

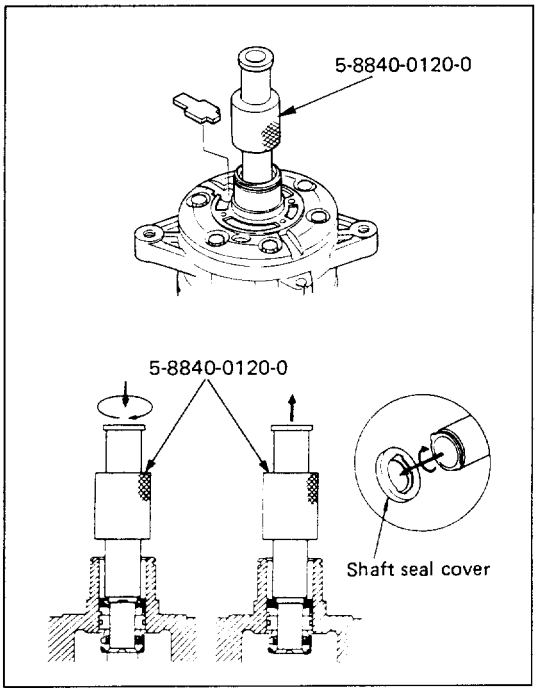
   Pulley Puller Pilot : 5-8840-0121-0 (J-33943)

   Pulley Puller : 5-8840-0111-0 (J-8433)

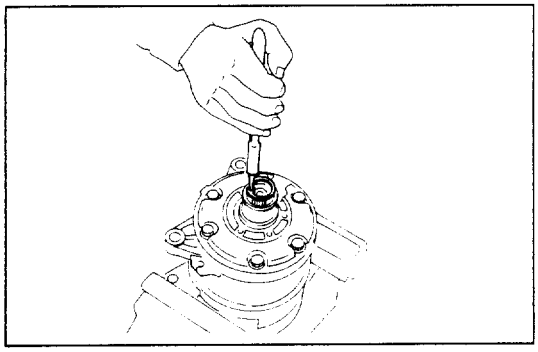
   Check the appearance of the pulley assembly. If the frictional surface of the pulley shows signs of excessive grooving due to slippage, both the pulley and drive plate should be replaced. The frictional surfaces of the pulley assembly should be cleaned with a suitable solvent before reinstallation.



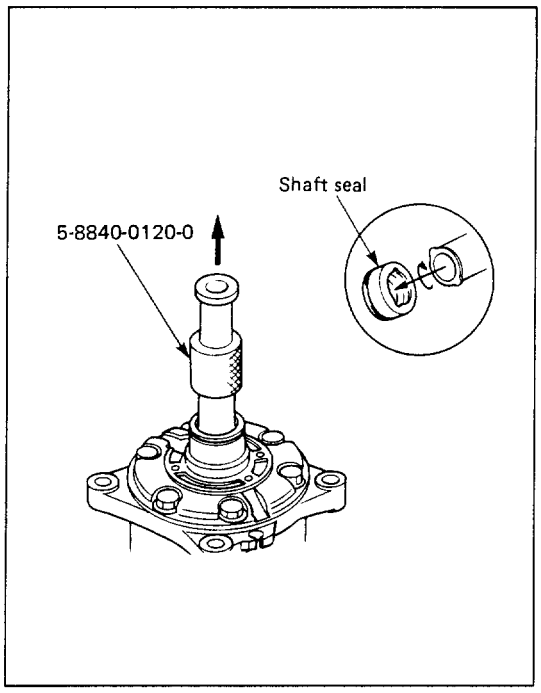
7. **Lead Wire Connector**
   Remove the lead wire from lead wire fixing bush.
8. **Field Coil**
   Loosen three screws and remove the field coil with lead wire.
   Check coil for loose connector or cracked insulation.



9. **Felt (If so equipped)**
10. **Shaft Seal Cover (If so equipped)**
    Using shaft seal remover to remove the shaft seal cover.
    Engage the remover hook with the shaft seal cover groove and slowly draw the shaft seal cover out.
    Shaft Seal Remover : 5-8840-0120-0 (J-33942)



11. **Snap Ring**
    Using snap ring pliers to remove the snap ring.



12. Shaft Seal Assembly

Using shaft seal remover to remove the shaft seal assembly.

Engage the remover hook with the shaft seal assembly groove and slowly draw the shaft seal assembly out.

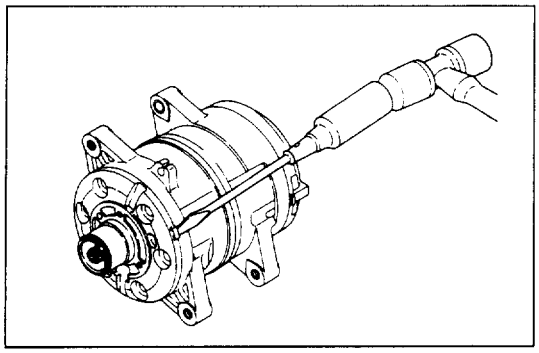
Shaft Seal Remover : 5-8840-0120-0 (J-33942)

The shaft seal is precision-machined and its critical parts are finished to extremely close tolerances. The assembly must be handled with great care, it slips face demanding particularly careful handling.

The shaft seal can not be reused. Install a new shaft seal at reassembly.

Take care not to scratch or otherwise damage the shaft seal face.

Keep the shaft seal free from lint and dirt.



13. Through Bolt with Gasket

14. Front Cylinder Head

15. O-ring

Alternately tap the projections on the circumference of the front cylinder head with a screwdriver and a plastic hammer to remove the front cylinder head.

16. Gasket

17. Front Valve Plate

18. Front Suction Valve

Check the front valve plate for scratching and bending.

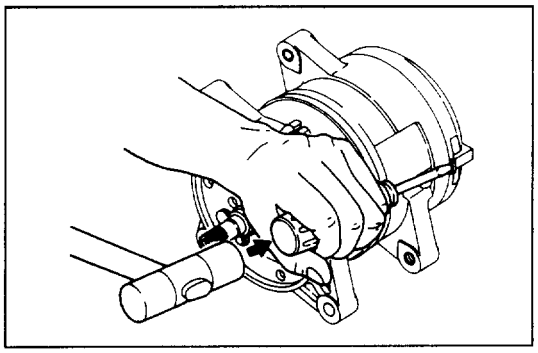
Check the front valve plate and the front cylinder head for nicks and burrs on the sealing surface.

Buff or replace the valve plate and cylinder head if nicks and burrs are present.

Check that the front valve plate passage is free from obstructions.

Check the front valve plate and the cylinder head for cracks.

Replace the valve plate and cylinder head if cracks are present.



19. **Rear Cylinder Head**
20. **O-ring**

    Alternately tap the projections on the circumference of the rear cylinder head with a screwdriver and a plastic hammer to remove the rear cylinder head.

21. **Gasket**
22. **Rear Valve Plate**
23. **Rear Suction Valve**
24. **Cylinder and shaft assembly**

    Check the rear valve plate for scratching and bending.

    Check the rear valve plate and the rear cylinder head for nicks and burrs on the sealing surface.

    Buff or replace the valve plate and cylinder head if nicks and burrs are present.

    Check that the rear valve plate passage is free from obstructions.

    Check the rear valve plate and the cylinder head for cracks.

    Replace the valve plate and cylinder head if cracks are present.

REASSEMBLY

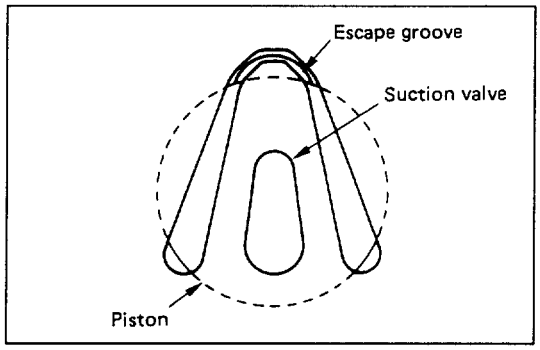
24. Cylinder and Shaft Assembly

Clamp the cylinder shaft assembly in a vise. The rear side of the cylinder shaft assembly must be facing up.

23. Rear Suction Valve

Apply a coat of new compressor oil to the new suction valve.

Install the suction valve by aligning it with the spring pin and the cylinder valve relief grooves.



22. Rear Valve Plate

Apply a coat of new compressor oil to the new valve plate.

Install the valve plate to the suction valve by aligning it with the spring pin.

NOTE:

Do not mix up the front and rear valve plates.

21. Gasket

Apply a coat of new compressor oil to the new gasket.

Install the gasket to the valve plate.

20. O-ring

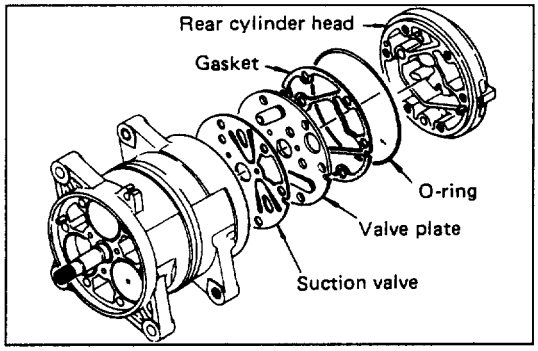
19. Rear Cylinder Head.

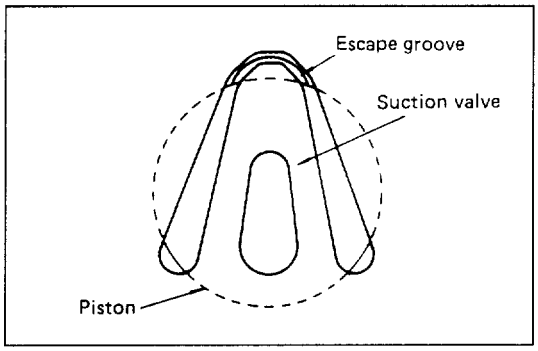
Apply a coat of new compressor oil to the new O-ring.

Install the O-ring to the rear cylinder head.

Install the rear cylinder head.

Tap the rear cylinder head into place with a plastic hammer.



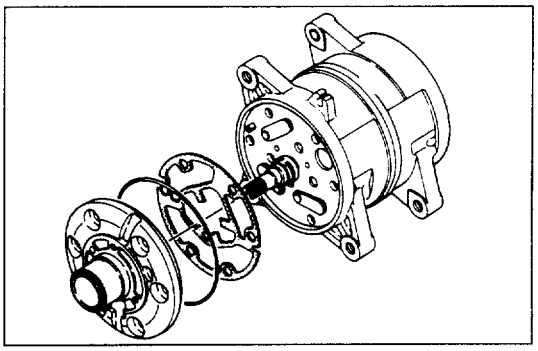


18. Front Suction Valve

Set the cylinder shaft assembly with the front side facing up.

Apply a coat of new compressor oil to the new suction valve.

Install the suction valve by aligning it with the spring pin and the cylinder valve relief grooves.



17. Front Valve Plate

Apply a coat of new compressor oil to the new valve plate.

Install the valve plate to the suction valve by aligning it with the spring pin.

NOTE:

Do not mix up the front and rear valve plates.

16. Gasket

Apply new compressor oil to the new gasket.

Install the gasket to the valve plate by aligning it with the spring pin.

15. O-ring

14. Front Cylinder Head

Apply a coat of new compressor oil to the new O-ring.

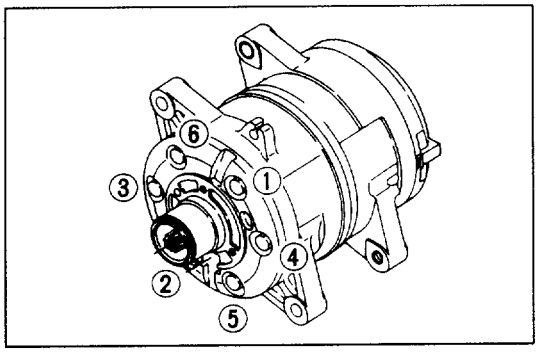
Install the O-ring to the front cylinder head.

Install the front cylinder head.

Tap the front cylinder head into place with a plastic hammer.

NOTE:

When installing the cylinder head, be careful that the end of the drive shaft does not damage the shaft seal assembly surface in the cylinder head.



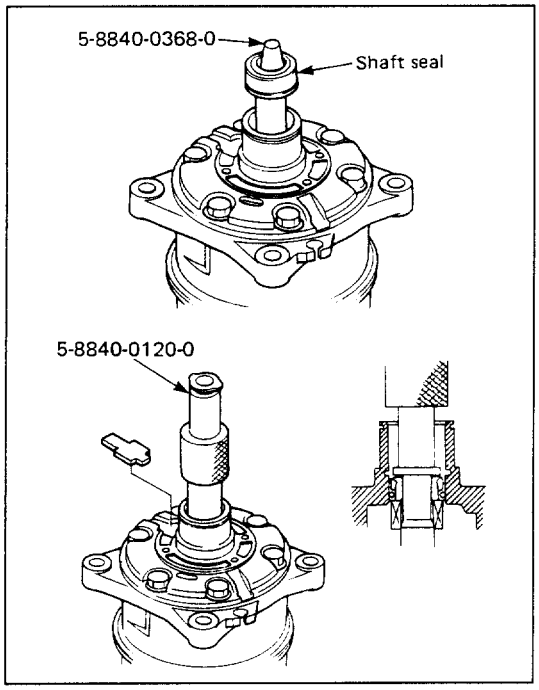
13. Through Bolt with Gasket

Gaskets cannot reused. Always replace new ones.

Tighten the bolts to the specified torque a little at a time in the sequence shown in the illustration.

Through Bolt Torque	N·m (kg·m / lb·ft)
	22 (2.2 / 16)

Rotate the compressor drive shaft two or three times to make sure that it moves smoothly.



12. Shaft Seal Assembly

Clean the sealing portion of the compressor and shaft seal.

Install the shaft seal guide onto the end of the drive shaft.

Shaft Seal Guide : 5-8840-0368-0 (J-34614)

Apply new compressor oil to the shaft seal guide.

Install the shaft seal onto the compressor drive shaft head by using shaft seal installer.

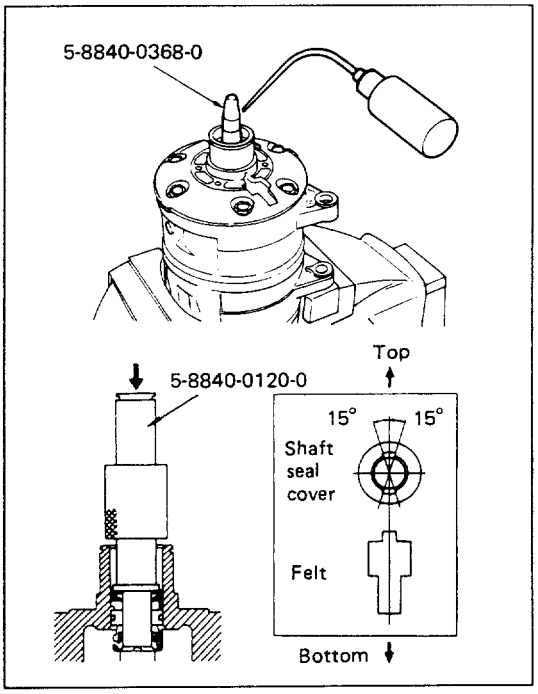
Shaft Seal Installer: 5-8840-0120-0 (J-33942)

11. Snap Ring

Using snap ring pliers to install the snap ring.

10. Shaft Seal Cover (If so equipped)

9. Felt (If so equipped)



Clean the sealing portion of the compressor and shaft seal cover.

Install the shaft seal guide onto the end of the drive shaft.

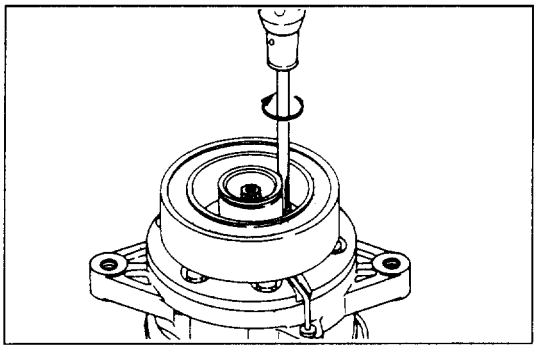
Shaft Seal Guide : 5-8840-0368-0 (J-34614)

Apply new compressor oil to the shaft seal guide.

Install the shaft seal cover onto the drive shaft by using shaft seal installer.

The installation position of the shaft seal cover is shown in the illustration.

Shaft Seal Installer : 5-8840-0120-0 (J-33942)



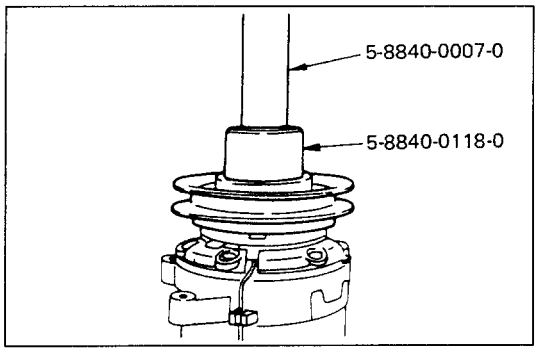
8. **Field Coil**
7. **Lead Wire Connector**

Install the field coil to the compressor.

Lead wire must be facing up.

Tighten the field coil fixing screws to the specified torque.

Field Coil Screw Torque	N·m (kg·m / lb·in)
	5 (0.5 / 44)

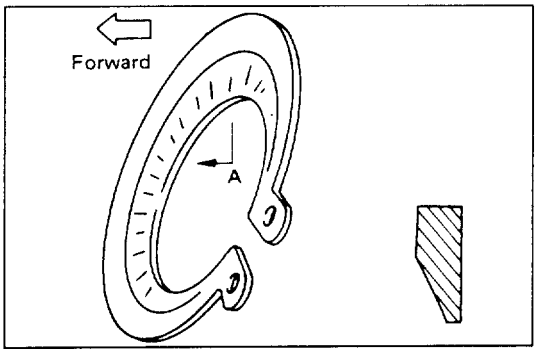


6. **Pulley Assembly**

Using pulley installer and drive handle to install the pulley assembly.

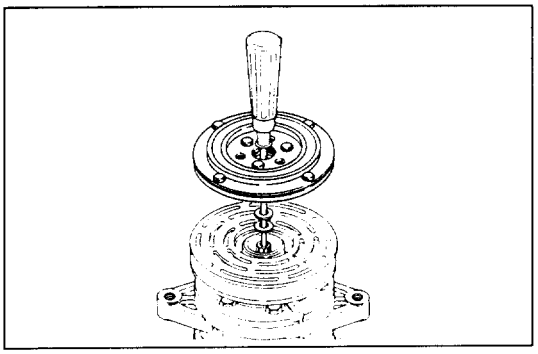
Pulley Installer : 5-8840-0118-0 (J-33940)

Drive Handle : 5-8840-0007-0 (J-8092)



5. **Cover (If so equipped)**
4. **Snap Ring**

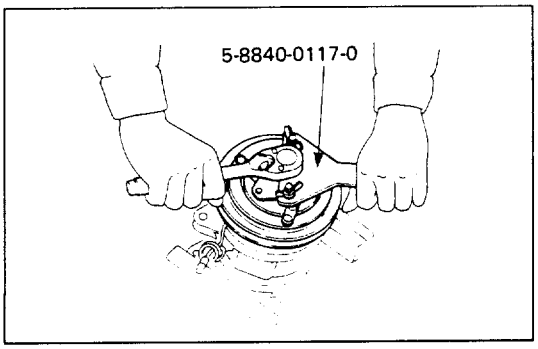
Install the snap ring with the inside indented portion facing out.



3. **Shim(s)**
2. **Drive Plate**

Install the drive plate to the compressor drive shaft together with the original shim(s).

Press the drive plate by hand.



1. **Drive Plate Bolt**

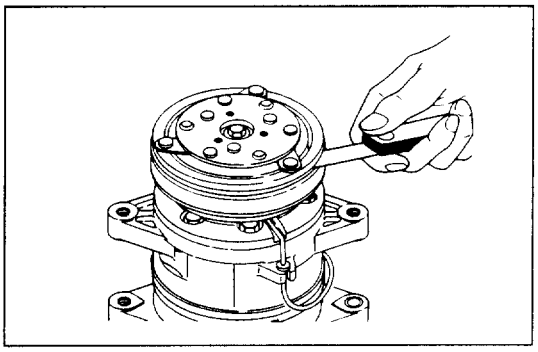
Using drive plate holder to prevent the drive plate from rotating.

Drive Plate Holder: 5-8840-0117-0 (J-33939)

Tighten the bolt to the specified torque.

Drive Plate Bolt Torque	N·m (kg·m / lb·ft)
	15 (0.5 / 11)

After tightening the bolt, check to be sure the pulley rotates smoothly.



Check to be sure that the clutch clearance is between 0.3 – 0.6 mm (0.01 – 0.02 in).

If necessary, install adjusting shim(s).

Adjusting shims are available in the following thickness.

Thickness	0.1 mm (0.0039 in)
	0.3 mm (0.0118 in)
	0.5 mm (0.0197 in)

LGHAC-WE-461

You are requested to order this manual using the manual number that is shown above.

This manual is applicable for vehicles in all countries except the USA and Canada.

All rights reserved. This manual may not be reproduced in whole or in part, without the permission in writing of ISUZU MOTORS LIMITED.

Issued by

ISUZU MOTORS LIMITED

INTERNATIONAL SERVICE DEPARTMENT

Tokyo, Japan

First edition Jan., 1994 8005-16K-1

LGHAC-WE-461 PRINTED IN JAPAN

WORKSHOP MANUAL

N-SERIES

MANUAL TRANSMISSION AND CLUTCH

MBP SERIES

SECTION 7

ISUZU

ISUZU

International Service & Parts

Tokyo, Japan

NOTICE

Before using this Workshop Manual to assist you in performing vehicle service and maintenance operations, it is recommended that you carefully read and thoroughly understand the information contained in Section 0A under the headings "GENERAL REPAIR INSTRUCTIONS" and "HOW TO USE THIS MANUAL".

**All material contained in this Manual is based on the latest product information available at the time of publication.
All rights are reserved to make changes at any time without prior notice.**

Applicable Model : NPR70, NQR70

This manual is applicable to 1998 year model and later vehicles.

THIS MANUAL INCLUDES THE FOLLOWING SECTIONS:

SECTION NO.	CONTENTS
00	Service Information
7B	Manual Transmission
7C	Clutch

SECTION 00
GENERAL INFORMATION

CONTENTS

PAGE

Troubleshooting 00- 2
Main Data and Specifications 00- 6
Service Standard 00- 8
Servicing 00- 9
Fixing Torque 00-15
Special Tools 00-20

TROUBLESHOOTING

MANUAL TRANSMISSION

PROBLEM	POSSIBLE CAUSE	CORRECTION
Abnormal Noise	• Insufficient or improper lubricant	• Replenish or replace lubricant
	• Flywheel pilot bearing worn or broken	• Replace flywheel pilot bearing
	• Bearing(s) worn or broken (Top gear shaft, main shaft, counter shaft, and reverse idler gear)	• Replace bearing(s)
	• Gear tooth contact surfaces worn or scuffed (Top gear, main shaft, counter shaft, and reverse idler gear)	• Replace gear(s)
	• Spline worn (main shaft, synchronizer clutch hub)	• Replace worn parts
	• Floating gear on main shaft or bearing thrust face seized	• Replace gear(s)
	• Transmission misalignment	• Realign transmission
	• Lack of backlash between mating gears, or improper shimming of P.T.O UNITS	• Replace gear(s)
	• Vibration in power train (Engine, propeller shafts, joint angle, rear axle, differential, transfer)	• Check and correct
Hard Shifting	• Insufficient or improper lubricant	• Replenish or replace lubricant
	• Clutch improperly adjusted	• Readjust clutch linkage
	• Hard operating of change lever caused insufficient grease	• Regrease
	• Change lever sliding portions worn	• Repair or replace applicable parts and regrease
	• Control cable worn	• Replace control cable
	• Shift linkage improperly adjusted	• Readjust shift linkage
	• Shift shaft and/or bearing worn	• Replace worn parts
	• Power assister and/or air line malfunctioning	• Correct or replace
	• Shift rod and/or quadrant box sliding face worn	• Replace worn parts
	• Shift arm and synchronizer sleeve groove worn	• Replace worn parts
	• Synchronizer parts worn	• Replace worn parts
	• Thrust washer, collar, and/or gear thrust faces worn (main shaft and counter shaft thrust play)	• Replace worn parts

TROUBLESHOOTING (CONT.)

MANUAL TRANSMISSION

PROBLEM	POSSIBLE CAUSE	CORRECTION
Walking or Jumping Out of Gear	• Shift linkage improperly adjusted	• Readjust shift linkage
	• Change lever sliding portion worn and excessive play	• Replace worn parts
	• Detent ball worn	• Replace detent ball
	• Detent spring weakened or broken	• Replace detent spring
	• Shift rod and/or quadrant box sliding faces worn	• Replace worn parts
	• Shift arm and synchronizer sleeve groove worn	• Replace worn parts
	• Thrust washer, collar, and/or gear thrust faces worn (Main shaft, counter shaft thrust play)	• Replace worn parts
	• Bearing worn or broken (Main shaft, counter shaft, and individual gears)	• Replace bearing(s)
	• Main shaft splines and synchronizer clutch hub splines worn	• Replace main shaft and synchronizer clutch hub
	• Synchronizer parts worn or broken	• Replace worn or broken parts
Oil Leakage	• Oil level too high	• Drain oil to correct level
	• Improper lubricant	• Replace lubricant
	• Drain plug and/or filler plug loose	• Tighten plug and replenish lubricant
	• Defective or improperly installed gasket(s)	• Replace gasket(s)
	• Air breather not installed, air breather clogged	• Install air breather, replace air breather
	• Oil seal worn or scratched	• Replace oil seal

TROUBLESHOOTING (CONT.)

CLUTCH

PROBLEM	POSSIBLE CAUSE	CORRECTION
Clutch Slippage	• No free pedal • Clutch pedal assembly binding or sticking	• Adjust free pedal • Repair or replace faulty parts, and check linkage for proper adjustment
	• Driven plate facing worn or burned	• Replace facing or driven plate assembly
	• Oil or grease on facing	• Replace driven plate assembly and repair oil leak
	• Clutch pressure springs weakened or broken	• Replace pressure plate assembly
	• Pressure plate or flywheel warped	• Replace defective parts, check transmission, clutch, and engine alignment
	• Master cylinder or slave cylinder malfunctioning	• Correct or replace
	• Binding or sticking of clutch disc hub	• Lubricate splines with high temperature grease (if dry), replace driven plate if splined hub are worn
Clutch Dragging	• Fluid leakage • Air in bydraulic line • Master cylinder or slave cylinder malfunctioning	• Correct • Blead • Correct or replace
	• Release lever improperly adjusted	• Adjust slave cylinder
	• Driven plate warped	• Replace driven plate assembly, also check flywheel for deep heat cracks
	• Loose rivet in facings	• Replace driven plate assembly, check for damage flywheel and pressure plate, replace as necessary
	• Clutch spline worn • Driven plate sticking on splines	• Replace worn parts • Lubricate with grease or correct
	• Clutch pressure springs weakened	• Replace pressure plate assembly
	• Clutch pressure plate warped	• Replace pressure plate assembly, also check flywheel surface for wear
	• Release bearing worn or damaged	• Replace release bearing
	• Misalignment of transmission	• Check engine mounts, wear on flywheel housing, and bolt torque

TROUBLESHOOTING (CONT.)

CLUTCH

PROBLEM	POSSIBLE CAUSE	CORRECTION
Clutch Chatter	• Grease or oil on facings	• Replace driven plate assembly and repair oil leak
	• Driven plate facing warped	• Replace driven plate assembly
	• Surface of facing hardened	• Replace driven plate assembly
	• Rivets on driven plate loosened	• Replace driven plate assembly
	• Damper springs in clutch disc weakened or broken	• Replace driven plate assembly
	• Pressure spring weakened	• Replace pressure plate assembly
	• Pressure plate or flywheel warped	• Correct or replace
	• Pilot bearing worn or broken	• Replace and lubricate pilot bearing
	• Flywheel warpage or discoloration	• Replace or resurface flywheel
	• Engine mounts loose or damaged	• Tighten engine mount bolts to specifications
Clutch Noisy	• Driven plate cracked	• Replace driven plate
	• Damper springs weakened or broken	• Replace driven plate
	• Head of rivets exposed	• Replace driven plate
	• Release bearing worn or damaged	• Replace release bearing
	• Release bearing poorly lubricated or damaged	• Lubricate or replace
	• Loose flywheel or clutch cover bolts	• Tighten bolts to specifications
	• Pilot bearing worn or broken	• Replace pilot bearing

MAIN DATA AND SPECIFICATIONS

MANUAL TRANSMISSION

Type	Over drive 6 speed	
Gear mesh type	1st and reverse:	Constant mesh
	2nd to 6th:	Inertia lock (blocking ring) type synchromesh
Gear type	1st and reverse:	Spur gear
	Others:	Helical gear
Lubrication oil capacity Liters (US gal / Imp. gal)	Approx. 5.3 (1.40 / 1.17) (6 speed, without P.T.O.) Approx. 6.1 (1.61 / 1.34) (6 speed, with P.T.O.)	

The oil capacity in the list above are for reference only.
The level must always be checked with the level indicator.

GEAR RATIO

T/M-Model	Type	1st	2nd	3rd	4th	5th	6th	Reverse
MBP6P	6-speed O.D.	6.378	3.627	2.339	1.452	1.000	0.787	6.595
MBP6Q		6.378	3.469	1.963	1.357	1.000	0.787	6.595

POWER TAKE OFF

Allowable Maximum Torque	N·m (kg·m / lb·ft)	245 (25 / 181) /at output shaft 1,500RPM
Gear Ratio (to Engine)		0.776
Distance Plate Thickness	mm (in)	3.93 (0.156)
Revolution Direction		Clockwise (Viewed from rear)

SIZE mm (in)		325 (13)
Set Force	N (kg / lb)	9,512 (970 / 2,139)
Pressure Plate		
Type		Coil spring-strap drive
No. of pressure spring		12
Driven Plate		
Type		Dry single plate with damper spring
No. of torsion spring		12
Facing		
Inside dia. × Outside dia.	mm (in)	210 × 325 (8.27 × 12.80)
Thickness	mm (in)	4.0 × 2 (0.157 × 0.08)
Master Cylinder Inside Diameter		
Without Booster	mm (in)	19.050 – 19.102 (0.7500 – 0.7520)
With Booster	mm (in)	20.640 – 20.692 (0.8126 – 0.8146)
Slave Cylinder		
Inside Diameter	mm (in)	25.400 – 25.452 (1.0000 – 1.0020)
Clutch Booster		
Diaphragm Diameter	mm (in)	130 (5.118)
Clutch pedal stroke	mm (in)	159 – 169 (6.260 – 6.654)
Clutch pedal free play	mm (in)	15 – 25 (0.591 – 0.984)
Clutch pedal Height	mm (in)	45 – 65 (1.77 – 2.56)

SERVICE STANDARD

MANUAL TRANSMISSION

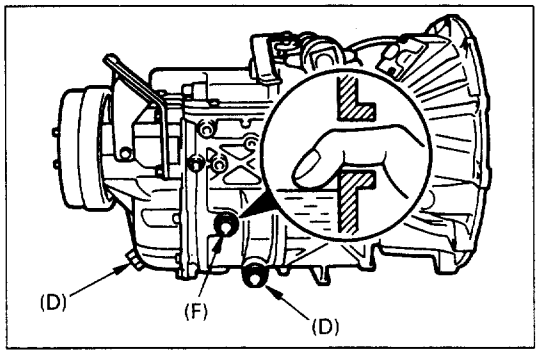
ITEMS			SERVICE STANDARD	SERVICE LIMIT
Clutch Hub and insert				
Clutch Hub and Insert Clearance		mm (in)	0.1 – 0.4 (0.004 – 0.016)	0.5 (0.020)
Insert Spring				
Spring Free Length		mm (in)		
	2nd & 3rd		19.9 (0.784)	—
	4th & 5th		19.9 (0.784)	—
	6th		18.7 (0.736)	—
Blocking Ring and Synchronizer				
Blocking ring and Synchronizer Clearance		mm (in)	2.0 (0.079)	0
Synchronizer (Dual Cone Type)				
Dog Teeth and Synchronizer Clearance		mm (in)	1.1 (0.043)	0
Shift Arm				
Shift Arm Thickness		mm (in)	11.0 (0.433)	10.0 (0.394)
Detent Spring				
Detent Spring Free Length		mm (in)	28.0 (1.102)	26.0 (1.024)
Select Cable and Shift Cable Fitting Length				
Gear Shift Lever Side				
Shift Cable / Select Cable		mm (in)	283 ± 15 (11.1 ± 0.6)	—
Transmission side				
Shift Cable / Select Cable		mm (in)	283 ± 15 (11.1 ± 0.6)	—

CLUTCH

ITEMS		SERVICE STANDARD	SERVICE LIMIT
Master Cylinder			
Master Cylinder Body and Piston Clearance	mm (in)	0.03 – 0.11 (0.0018 – 0.0043)	0.12 (0.0047)
Slave Cylinder			
Slave Cylinder Body and Piston Clearance	mm (in)	0.02 – 0.10 (0.0008 – 0.0039)	0.15 (0.0059)
Pressure Plate			
Pressure Plate Warpage	mm (in)	0.05 (0.0020) or less	0.30 (0.0118)
Clutch Set Force	mm (in)	9,512 (970 / 2,139)	—
Diaphragm Spring Finger Height	mm (in)	61.8 – 63.8 (2.433 – 2.512)	—
Driven Plate			
Depression of Rivet Head from Surface	mm (in)	—	0.2 (0.008)
Driven Plate Warpage	mm (in)	less than 0.7 (0.028)	1.0 (0.039)
Driven Plate Wear in Splines	mm (in)	1.8 – 2.4 (0.071 – 0.094)	—

SERVICING

TRANSMISSION OIL LEVEL



1. **Remove the filler plug.**
2. **Check the oil level.**
   - Add lubricant to within 0 to 10 mm (0 to 0.4 in) of bottom edge of the filler hole if necessary.

CAUTION

Use ENGINE OIL (SAE 5W-30) for transmission .

3. **Install the filler plug (F).**

Filler Plug Torque	N·m (kg·m / lb·ft)
	49 (5.0 / 36)

TRANSMISSION OIL CHANGE

1. **Remove the drain plug (D) from the transmission case and drain the oil.**
2. **Install the drain plug (D).**

Drain Plug Torque	N·m (kg·m / lb·ft)
	69 (7.0 / 51)

3. **Remove the filler plug (F).**
4. **Fill the transmission case from the filler plug hole with new oil of specified grade.**

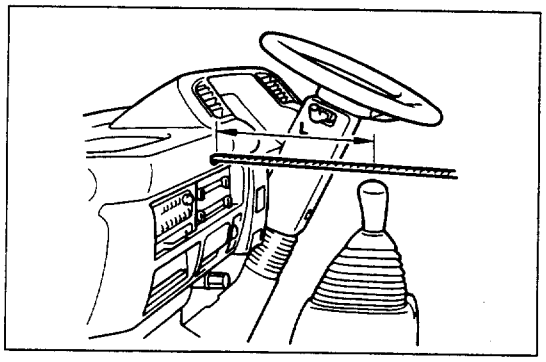
Oil Capacity	Litres (US·qt / Imp·qt)
6-Speed with PTO	6.1 (1.61 / 1.34)
6-Speed without PTO	6.1 (1.61 / 1.34)

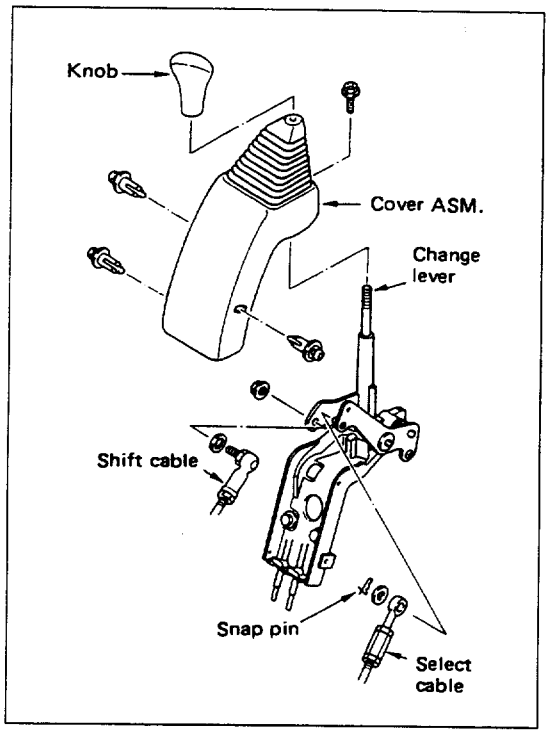
CAUTION

Use ENGINE OIL (SAE 5W-30) for transmission.

5. **Install filler plug (F).**

Filler Plug Torque	N·m (kg·m / lb·ft)
	69 (7.0 / 51)

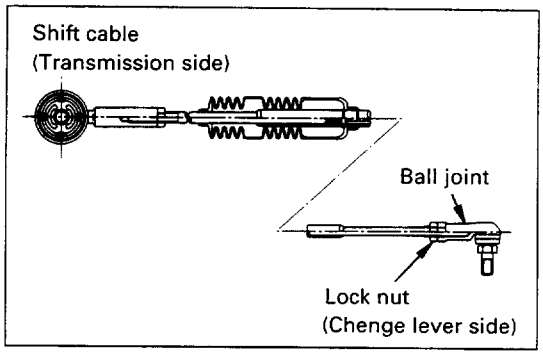


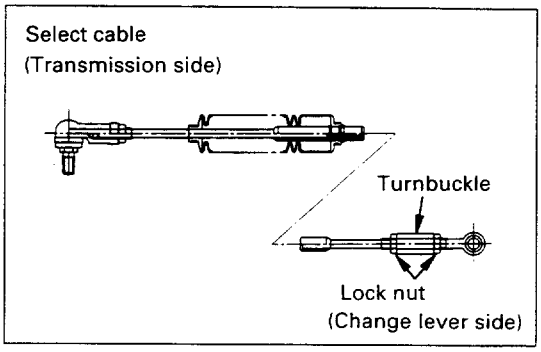


GEAR CONTROL CABLE ADJUSTMENT

1. **Set the change lever in the neutral position, then confirm if the dimension between the center of the change lever play and the instrument center cluster is within the reference value.**

Change Lever Position	mm (in)
Wide Cab	283 ± 15 (11.1 ± 0.6)



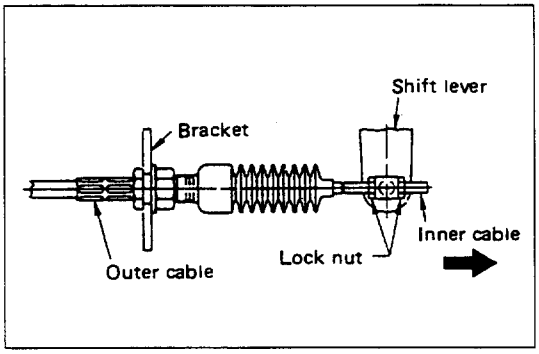


2. **If the dimension is out of the reference adjust as required.**
   1) Remove the change lever knob.
   2) Remove the cover assembly.
   3) Disconnect the shift cable from the change lever.
   4) Set the transmission in the neutral position.
   5) Loosen the lock nut of the shift cable ball joint and the select cable turnbuckle, then turn the ball joint and turnbuckle as necessary for hole and pin.
   6) Tighten the lock nuts and install the shift cable to the change lever.

Lock nut torque	N·m (kg·m / lb·in)
	6 (0.6 / 52)

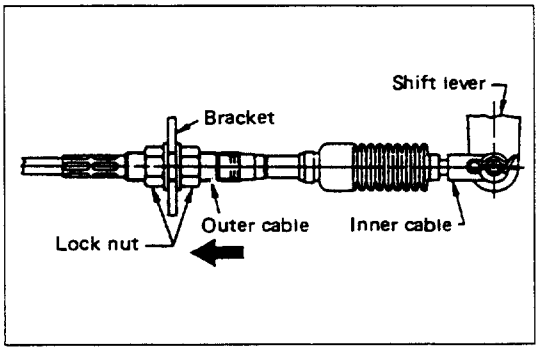
   7) Install the cover assembly and the change lever knob.

POWER TAKE OFF CONTROL CABLE ADJUSTMENT



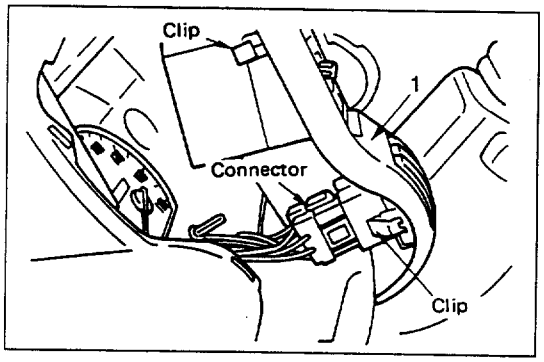
Inner Cable Adjustment Type

1. Loosen the lock nuts.
2. Set the PTO shift lever in the OFF position. Be sure to confirm the PTO control lever is in the OFF position (PTO indicator light turned off).
3. Remove slack from the inner cable by pulling the inner cable in the direction of the arrow.
4. Tighten the lock nuts.



Outer Cable Adjustment Type

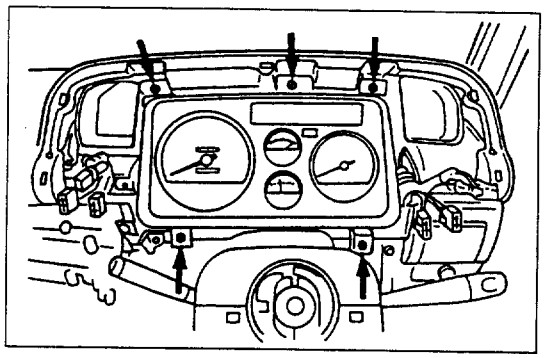
1. Loosen the lock nuts.
2. Set the PTO shift lever in the OFF position. Be sure to confirm the PTO control lever is in the OFF position (PTO indicator light turned off).
3. Connect the inner cable to the PTO shift lever.
4. Remove slack from the inner cable by pulling the outer cable in the direction of the arrow.
5. Tighten the lock nuts.



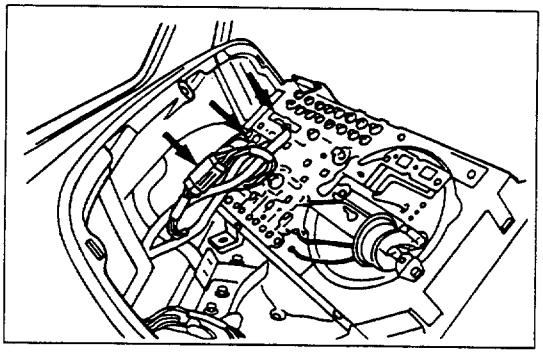
CLUTCH PEDAL TRAVEL AND FREE PLAY ADJUSTMENT

Clutch Pedal Height and Stroke

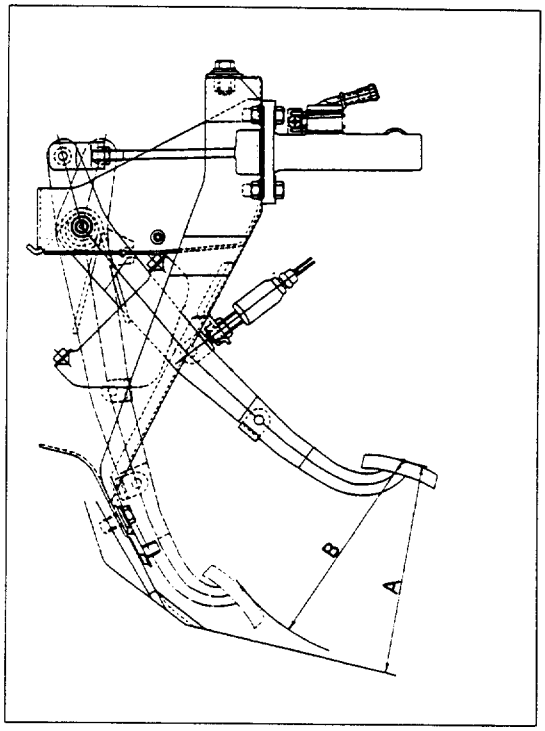
1. **Remove the meter cluster.**
   - Pull out the meter cluster and disconnect the harness connectors.



2. **Remove the meter assembly.**
   - Remove the 5 fixing screws.



- Disconnect the harness connectors.



3. **Loosen the lock nut of the clutch booster plunger or clutch master cylinder push rod.**
4. **Adjust the pedal height by turning plunger or push rod.**

Clutch Pedal Height and Stroke — mm (in)

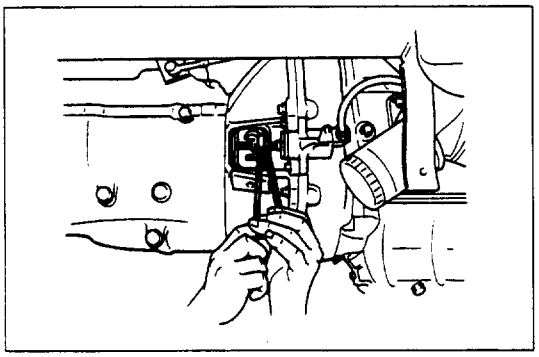
Height(A)	160 – 170 (6.299 – 6.693)
Stroke(B)	159 – 169 (6.260 – 6.654)

5. **Tighten the lock nut.**

Lock Nut Torque — N·m (kg·m / lb·ft)

Plunger	20 (2.0 / 14)
Push Rod	13 (1.3 / 10)

6. **Install the meter assembly and meter cluster.**



Clutch Pedal Free Play

Slave Cylinder

1. Remove the slave cylinder return spring.
2. Loosen the lock nut of the push rod.
3. Turn the adjust nut until it reaches the shift fork.
4. Back off the adjust nut 1.5 turns (shift fork free play approximately 2 mm).
5. Tighten the lock nut.

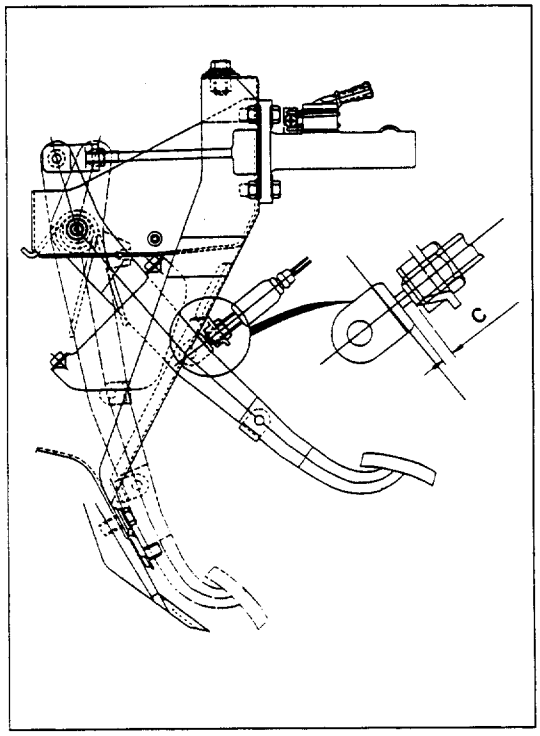
Lock Nut Torque	N·m (kg·m / lb·ft)
19 (1.9 / 14)	

6. Install the return spring.

Clutch Switch or Stopper Bolt

After completion of clutch pedal height adjustment,adjust the clutch switch or stopper bolt clearance.

1. Loosen the lock nut of clutch switch or stopper bolt.
2. Adjust the clutch switch or stopper bolt clearance by turning clutch switch or stopper bolt.



Clutch Switch or Stopper Bolt Clearance(C)	mm (in)
0.5 – 1.0 (0.02 – 0.04)	

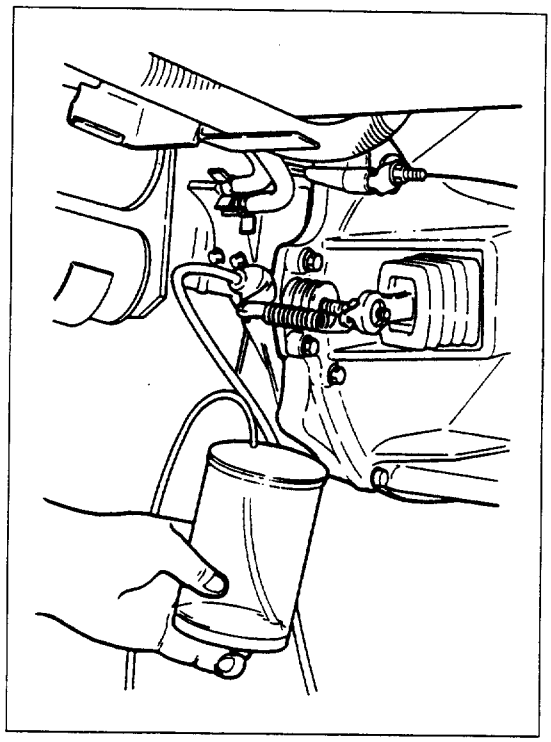
Clutch Pedal Free Play	mm (in)
15 – 25 (0.59 – 0.98)	

3. Tighten the lock nut.

Lock Nut Torque	N·m(kg·m / lb·ft)
19 (1.9 / 14)	

CLUTCH HYDRAULIC CIRCUITS BLEEDING

If air enters the clutch circuit, it will causes clutch dragging. Therefore, bleeding operation should be performed if the clutch fluid reservoir has been emptied due to failure to mal-replenishment or if the hydraulic circuit has been disassembled. Bleeding operation calls for cooperative action of two men.



1. Check the level of clutch fluid in the reservoir and replenish of necessary.
2. Remove the rubber cap from the bleeder screw and wipe clean the bleeder screw.

   Connect a vinyl tube to the bleeder screw and insert the other end of the vinyl tube into a transparent container.
3. Pump the clutch pedal repeatedly and hold it depressed.
4. Loosen the bleeder screw on the clutch slave cylinder to release clutch fluid with air bubbles into the container and tighten the bleeder screw immediately.
5. Release the clutch pedal carefully. Repeat the above operation until air bubbles disappear from the clutch fluid being pumped out into the container. During the bleeding operation, keep the clutch fluid reservoir filled to the specified level.

   Reinstall the rubber cap.

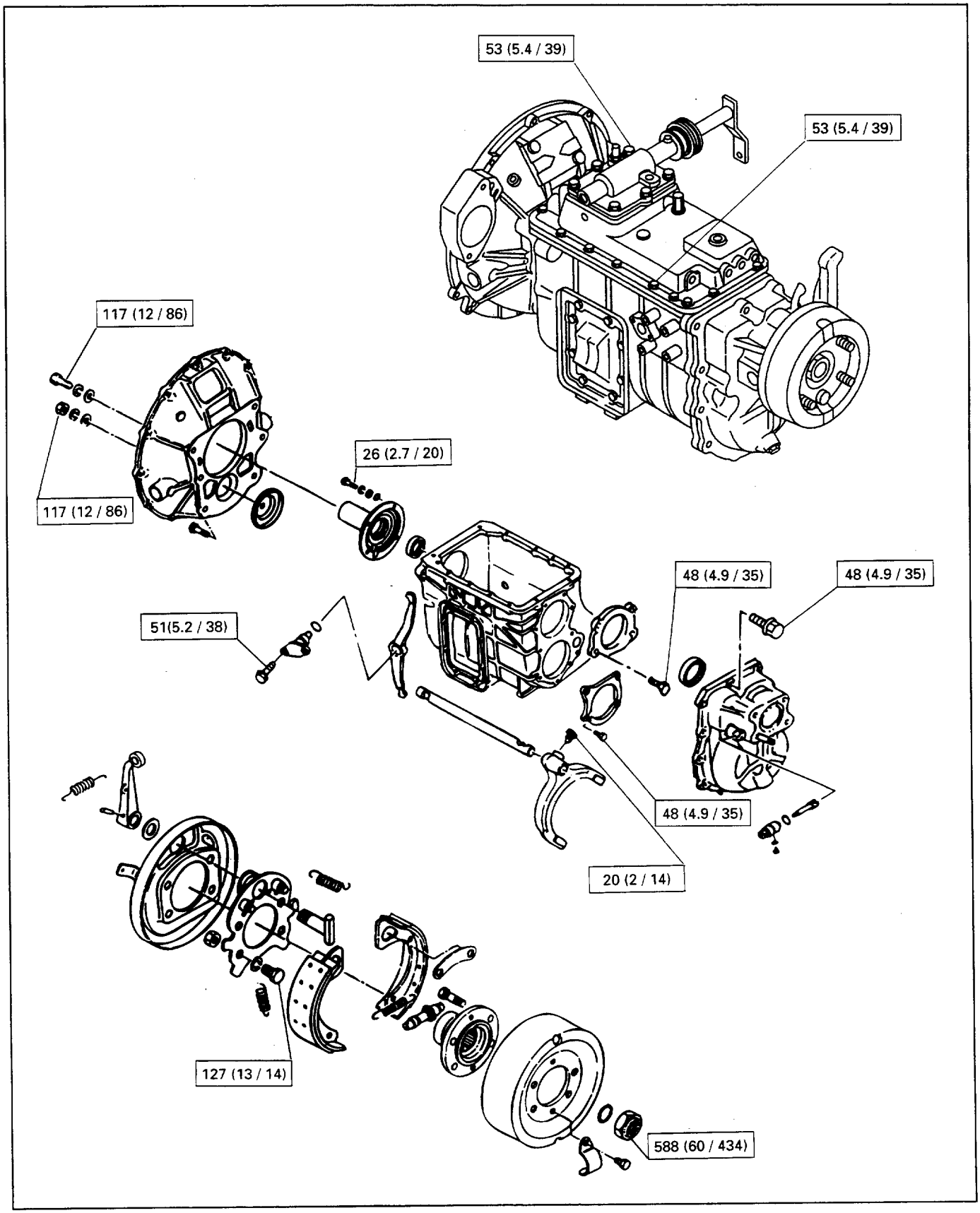
CAUTION

Do not let clutch fluid remain on a painted surface. Wash it off immediately.

FIXING TORQUE

MANUAL TRANSMISSION

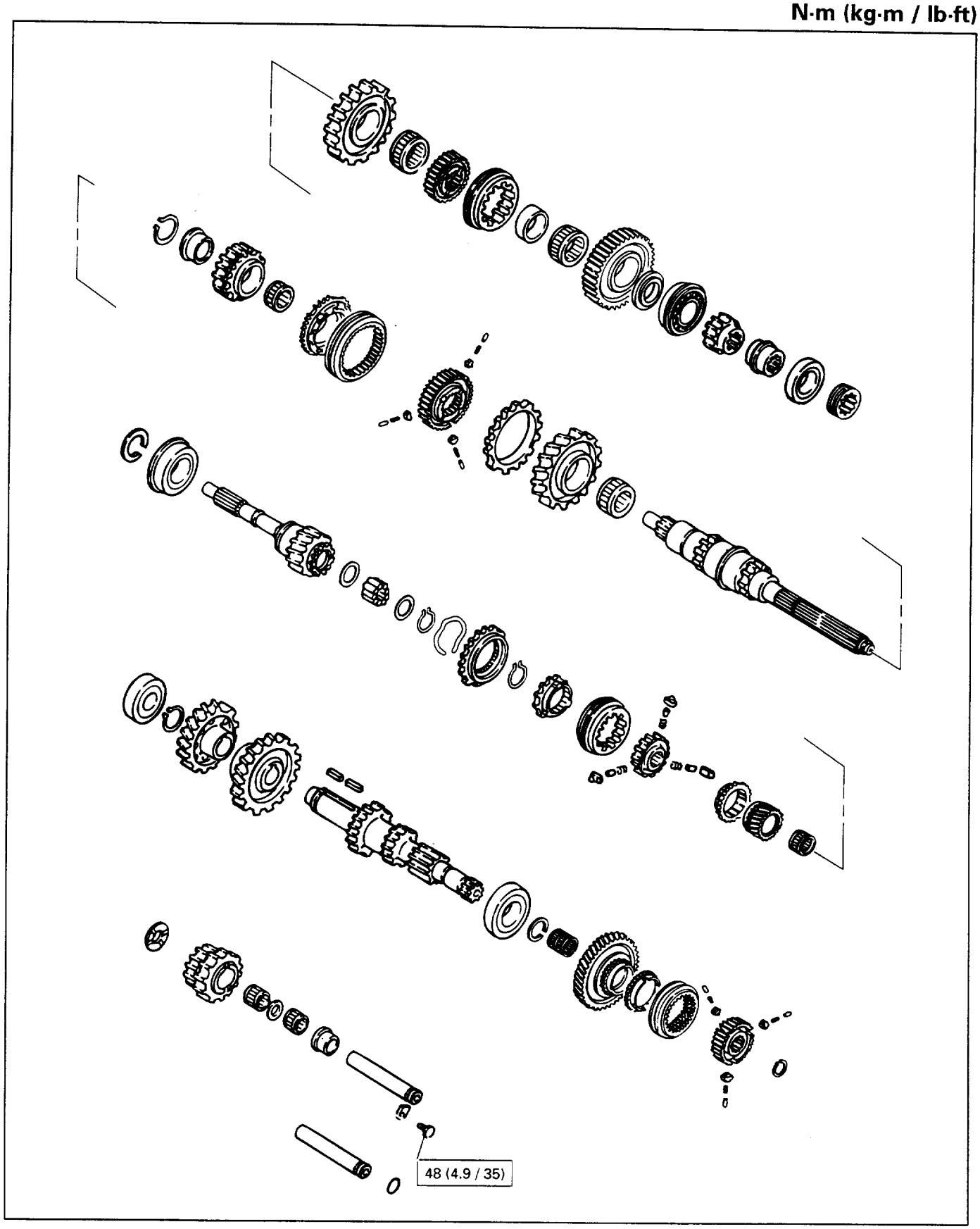
N·m (kg·m / lb·ft)



FIXING TORQUE (CONT.)

MANUAL TRANSMISSION

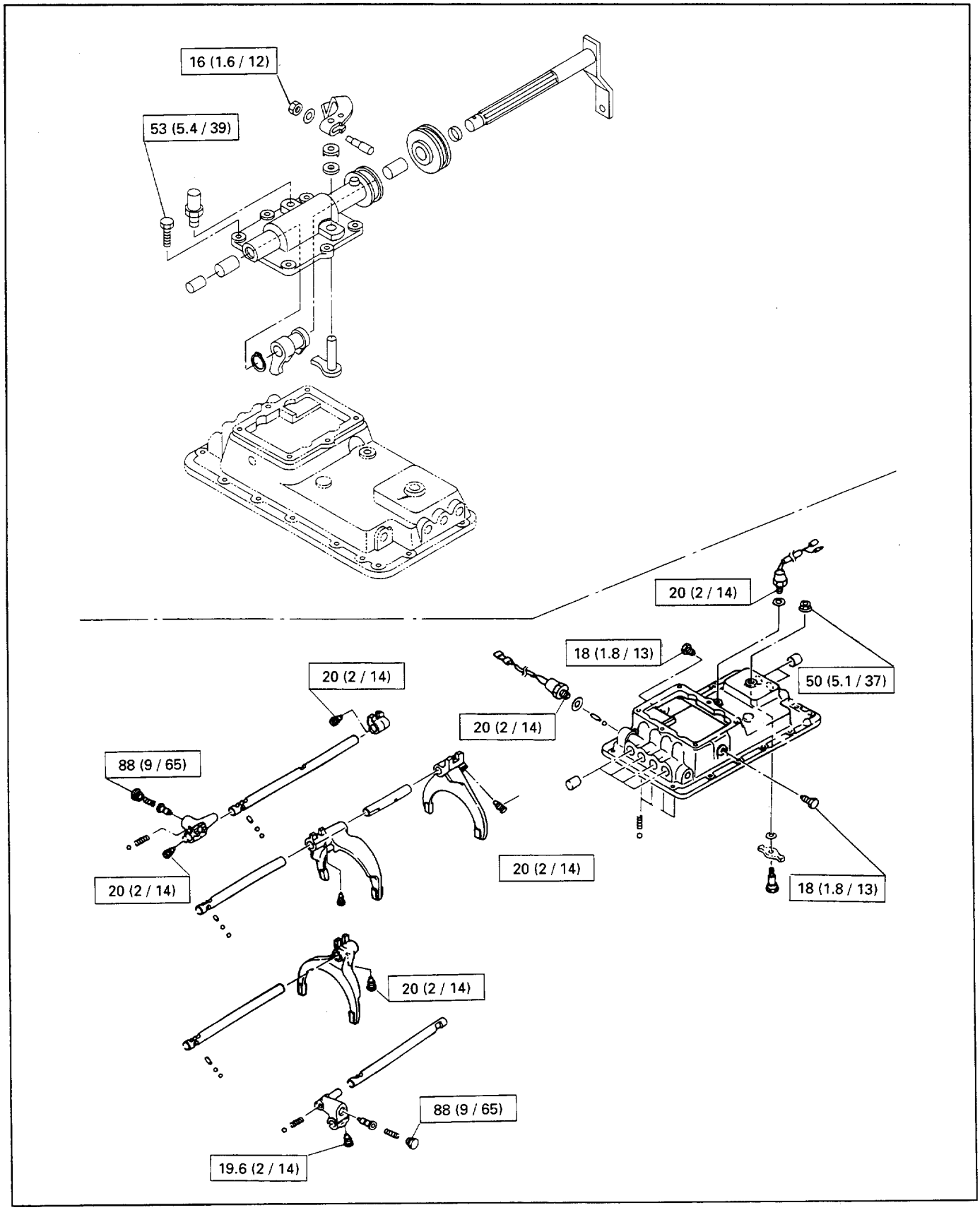
N·m (kg·m / lb·ft)



FIXING TORQUE (CONT.)

MANUAL TRANSMISSION

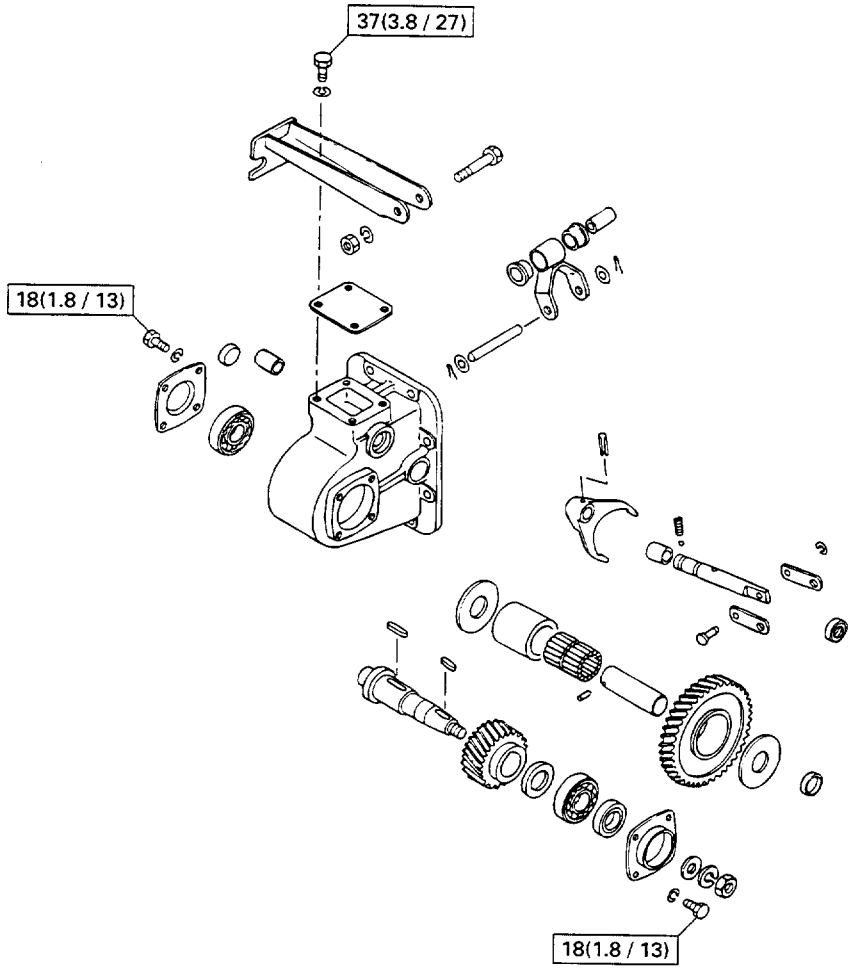
N·m (kg·m / lb·ft)



FIXING TORQUE (CONT.)

SIDE POWER TAKE-OFF

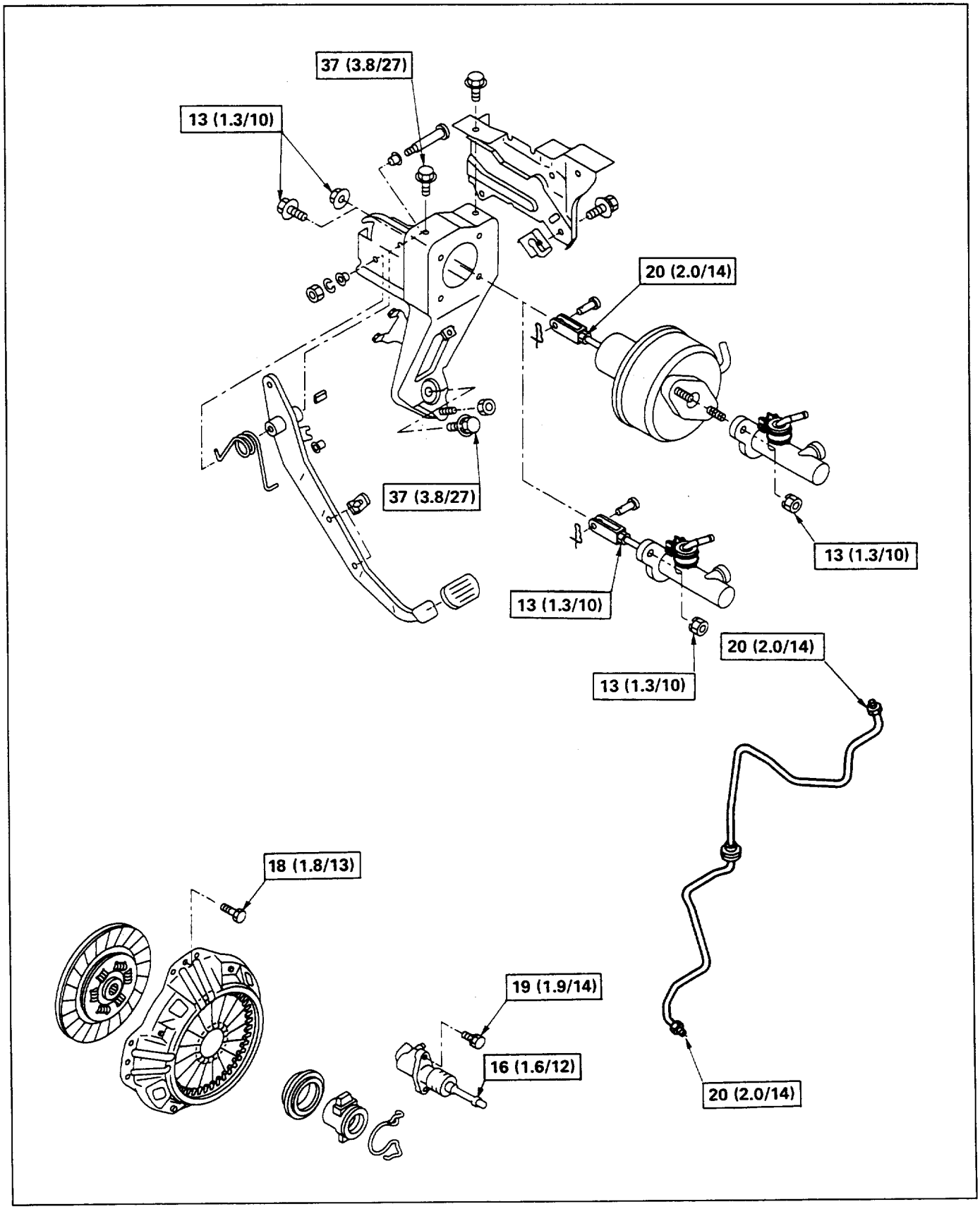
N·m (kg·m / lb·ft)



FIXING TORQUE (CONT.)

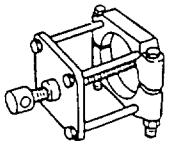
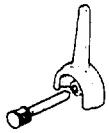
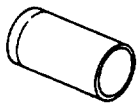
CLUTCH

N·m (kg·m / lb·ft)



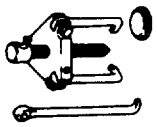
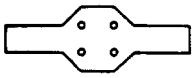
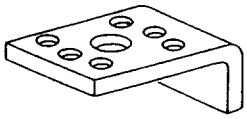
SPECIAL TOOL

MANUAL TRANSMISSION

ILLUSTRATION	PART NUMBER	PART NAME	REMARKS
	9-8521-0091-0	Gear bushing Remover	For speedometer gear
	9-8521-0169-0	Bearing Remover	For main/counter shaft rear
	9-8521-0095-0	Gear shaft Remover	For idle gear shaft
	9-8521-0168-0	Bearing Remover	For counter shaft front
	9-8522-0040-0	Setting tool	For bearing

SPECIAL TOOL (CONT.)

CLUTCH

ILLUSTRATION	PART NUMBER	PART NAME	REMARKS
	9-8521-0148-0	Bearing puller	
	1-8525-3008-0	Pilot Aligner	
	9-8523-1733-0	Handle	For clutch booster
	5-8840-2056-0	Support Plate	For clutch booster

SECTION 7

MANUAL TRANSMISSION AND CLUTCH

CONTENTS

PAGE

Manual Transmission 7B– 1

Clutch 7C– 1

SECTION 7B

MANUAL TRANSMISSION (MBP)

CONTENTS

	PAGE
General Description	7B– 3
On-Vehicle Service	7B– 4
Change Lever Assembly Replacement	7B– 4
Gear Control Cable Replacement	7B– 5
Car Speed Sensor Driven Gear Replacement	7B– 8
Back-up Light Switch and Neutral Switch Replacement	7B– 9
Transmission Assembly Replacement	7B–10
Unit Repair	7B–15
Major Components	7B–15
Disassembly	7B–17
Inspection and Repair	7B–21
Reassembly	7B–23
Top Gear Shaft Assembly	7B–32
Disassembly	7B–32
Inspection and Repair	7B–33
Reassembly	7B–34
Main Shaft Assembly	7B–37
Disassembly	7B–37
Inspection and Repair	7B–39
Reassembly	7B–41
Counter Shaft Assembly	7B–45
Disassembly	7B–45
Inspection and Repair	7B–46
Reassembly	7B–47
Upper Quadrant Box Assembly	7B–48
Disassembly	7B–48
Inspection and Repair	7B–49

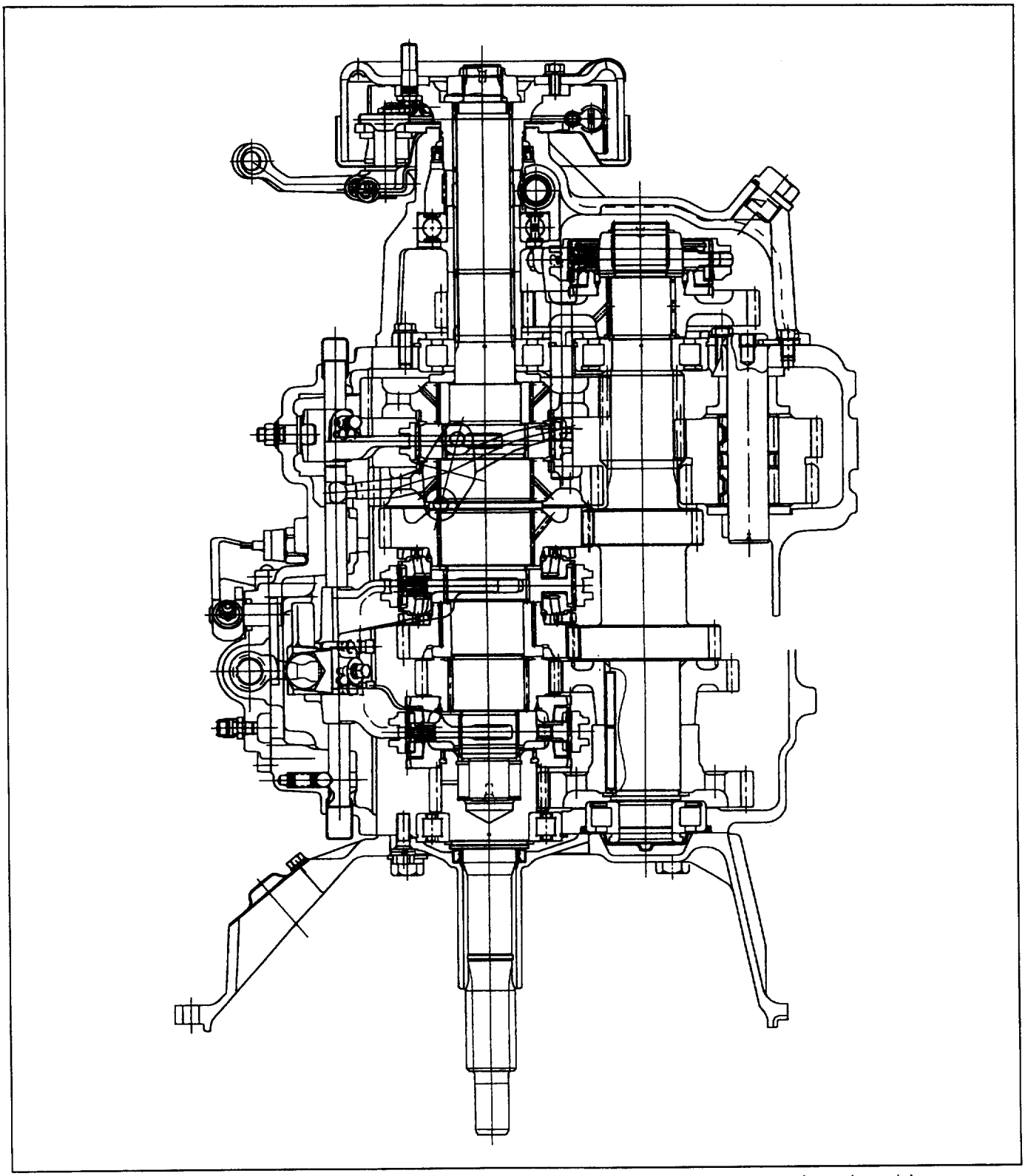
CONTENTS (CONT.)

PAGE

Reassembly 7B–50
Lower Quadrant Box Assembly 7B–53
Disassembly 7B–53
Inspection and Repair 7B–56
Reassembly 7B–58
Side Power Take Off 7B–62
Disassembly 7B–62
Inspection and Repair 7B–66
Reassembly 7B–68

GENERAL DESCRIPTION

Manual Transmission



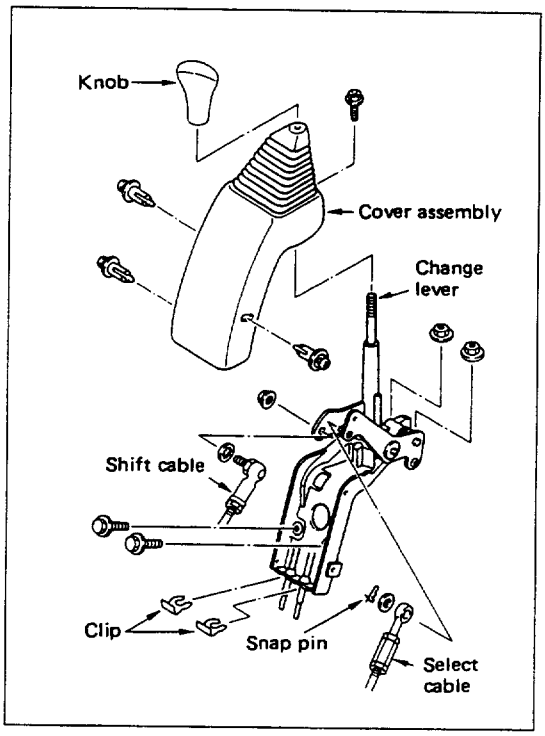
The 6-speed transmissions have constant mesh first and reverse gears and the remaining gears are synchronized. Shifting is done with a remote shift control and two cables operating a shift quadrant mounted on the top of the transmission.

Both transmissions are equipped to drive a power take off unit. An identification plate is mounted on the side of the transmission.

ON-VEHICLE SERVICE

CHANGE LEVER ASSEMBLY REPLACEMENT

Removal Steps



1. **Change Lever Knob**
2. **Cover Assembly**
   - Remove the fixing screw and three clips.
3. **Shift Cable and Select Cable**
   - Disconnect the cables from the change lever.
   - Remove the clips and disconnect the cables from bracket.
4. **Change Lever Assembly**

Installation Steps

1. **Change Lever Assembly**
2. **Shift Cable and Select Cable**

When connecting the shift cable and the select cable to the change lever, adjust the cable.

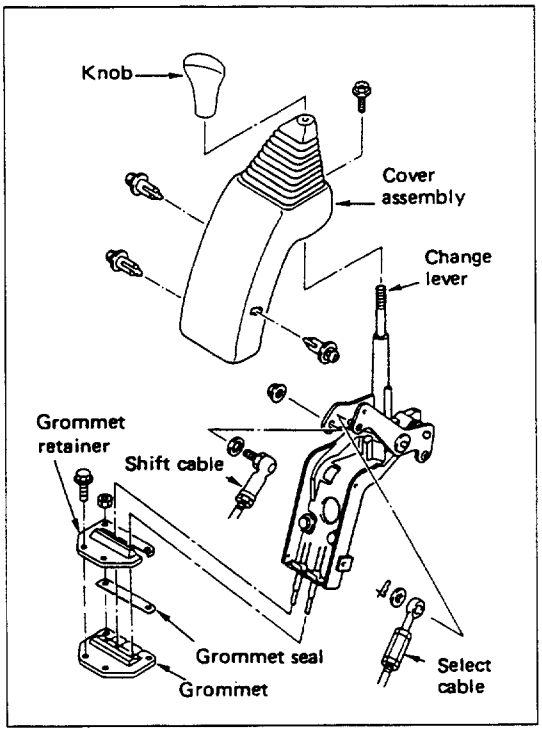
Refer to "GEAR CONTROL CABLE ADJUSTMENT" given previously in section 00.

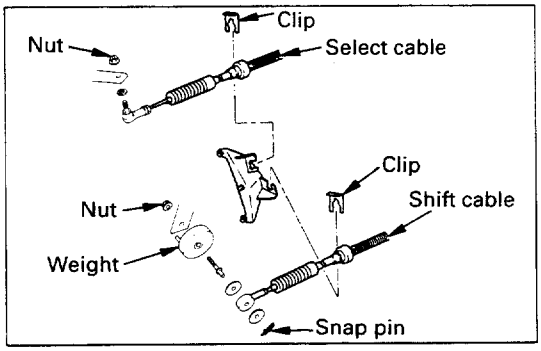
Lock nut torque	N·m (kg·m / lb·ft)
	21 (2.1 / 15.2)

3. **Cover Assembly**
4. **Change Lever Knob**

GEAR CONTROL CABLE REPLACEMENT

Removal Steps



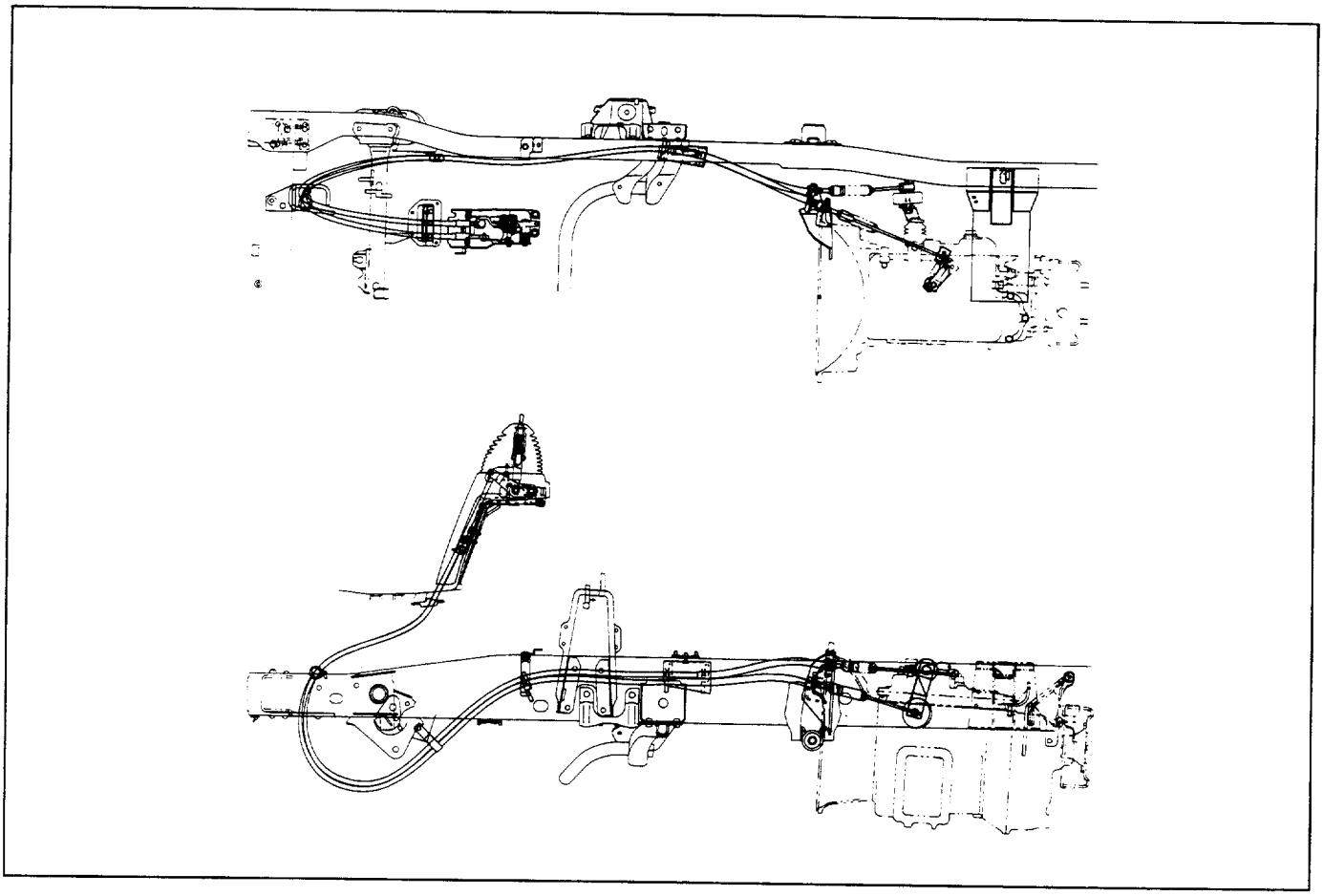


1. **Change Lever Knob**
2. **Cover Assembly**
3. **Shift Cable and Select Cable**
   1) Disconnect the shift and select cables from change lever.
   2) Remove the clips and disconnect the cables from change lever bracket.
   3) Remove the grommet retainer, grommet seal and grommet.
   4) Raise vehicle and support with suitable safety stands.
   5) Tilt the cab.
   6) Disconnect the shift cable and the select cable on the transmission side.
   7) Remove the c-clips and disconnect the shift cable and the select cable from the bracket.
   8) Remove the clips that fix the cables to the frames.
   9) Remove the shift and select cable assemblies.

Inspection and Repair

Check the cables for any deformation, damage or rust, and also check the sliding portion for any abnormal condition.

When there is any abnormal condition found, replace it with a new one.



Installation Steps

1. **Shift Cable and Select Cable**
   1) Install temporarily that the shift cable and the select cable.

CAUTION:

Never bend the cables to radius less than 450 mm (18 in) unless it is necessary to do so for wiring purposes. And never bend the cables to radius less than 180 mm(7 in) even during wiring.

Install the cables carefully without unnecessary twisting the cable boots.

2) Fasten the cables with clips to the brackets on the transmission side.
3) Fasten the cables with clips to the change lever bracket.
4) Fasten the cables with clips to the frames. At this time, take care that the select cable comes above the shift cable.

5) Connect the shift cable and the select cable to the transmission.

Select Cable Nut Torque	N·m (kg·m / lb·ft)
	21 (2.1 / 15)

Shift Weight Fixing Nut Torque	N·m (kg·m / lb·ft)
	103 (10.5 / 76)

6) Install the grommet, grommet seal and grommet retainer.

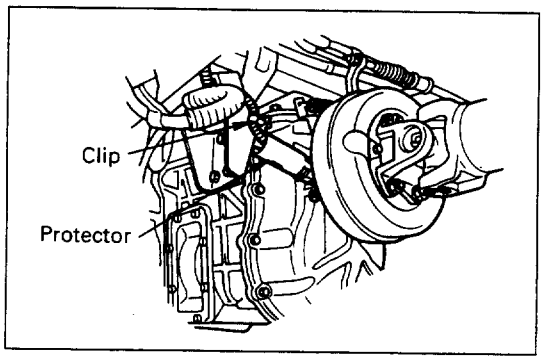
Fixing Bolt & Nut Torque	N·m (kg·m / lb·ft)
	11 (1.1 / 8)

7) When connecting the shift cable and the select cable to the change lever, adjust the cables.
Refer to "GEAR CONTROL CABLE ADJUSTMENT" given previously in section 00.

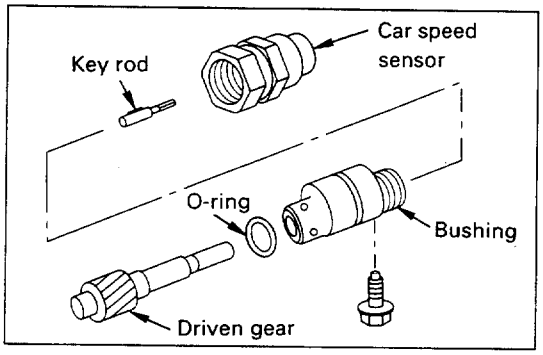
2. **Cover Assembly**
3. **Change Lever Knob**

CAR SPEED SENSOR DRIVEN GEAR REPLACEMENT

Removal Steps



1. **Protector**
2. **Wiring Connector**



3. **Car Speed Sensor with Key Rod**
4. **Car Speed Sensor Driven Gear Assembly**
   - Remove the fixing bolt.
   - Remove the driven gear assembly.

Installation Steps

1. **Car Speed Sensor Driven Gear Assembly**

Fixing Bolt Torque	N·m (kg·m / lb·in)
	8 (0.8 / 69)

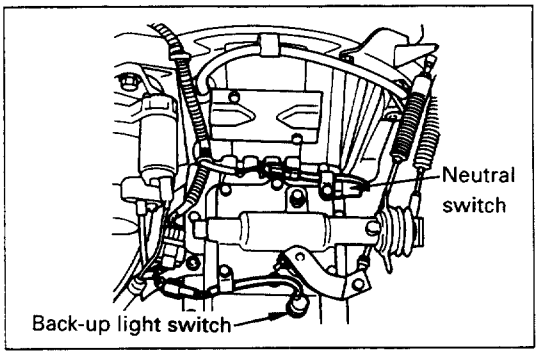
2. **Car Speed Sensor with Key Rod**

Fixing Bolt Torque	N·m (kg·m / lb·ft)
	25 (2.5 / 18)

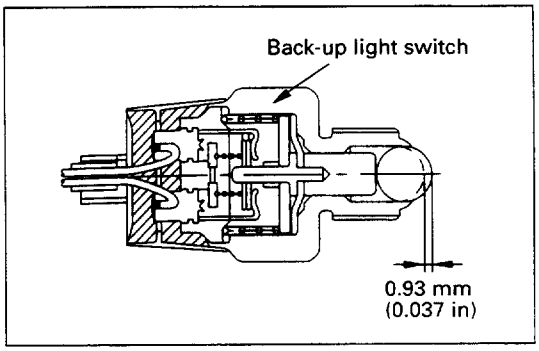
3. **Wiring Connector**
4. **Protector**

BACK-UP LIGHT SWITCH AND NEUTRAL SWITCH REPLACEMENT

Removal Steps



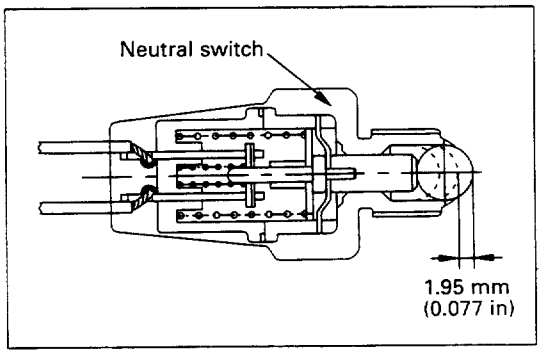
1. **Wiring Connector**
2. **Switch**



Inspection and Repair

- When there is continuity between the terminals in the condition as it is, and when the continuity between the terminals is turned off by pressing the ball of the switch, the switch is normal.

Switch Operating Stroke	mm (in)
Back-up light Switch	0.93 (0.037)
Neutral Switch	1.95 (0.077)



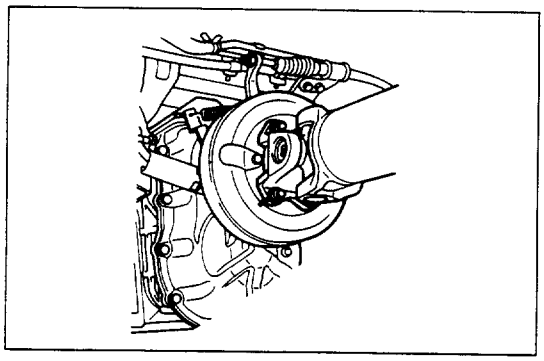
Installation Steps

1. **Switch**

Switch Torque	N·m (kg·m / lb·ft)
	20 (2.0 / 14)

2. **Wiring Connector**

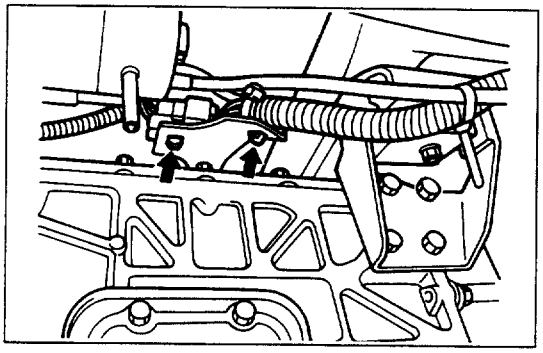
TRANSMISSION ASSEMBLY REPLACEMENT



Removal Steps

- Block the vehicle so it cannot move.
- Disconnect the ground cable from the battery negative(-) post.
- Raise vehicle and support with suitable safety stands.

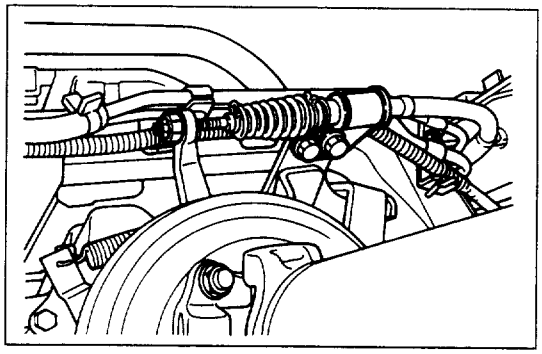
1. **Propeller Shaft**
   - Reference mark the flange yoke to the parking brake drum.
   - Disconnect the propeller shaft at flange yoke.
   - Put aside propeller shaft and tie it to the frame so it dose not interfere with servicing work.
2. **Wiring Connnector**
   - Disconnect the wiring connector from the vehicle speed sensor, the neutral switch and the back-up light switch.



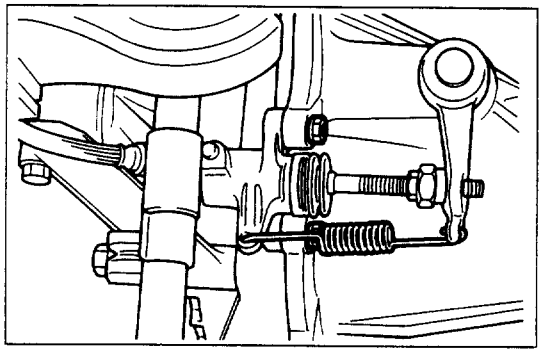
3. **Harness Connector**
   - Remove the clip from the bracket.

   NOTE:

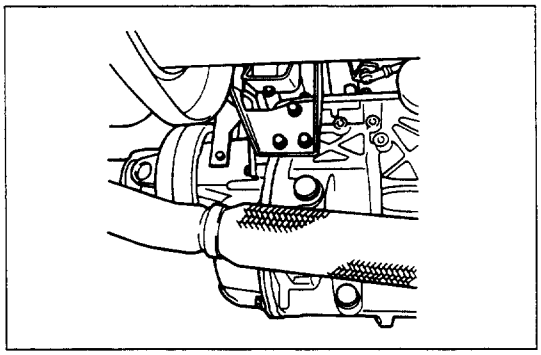
   Take care not to damage the clip.



4. **Parking Brake Cable**
   - Remove the lock nut from the parking brake cable.
   - Remove the parking brake cable with the bracket.
5. **Shift Cable and Select Cable**
   - Disconnect the shift cable and select cable on the transmission side.



6. **Clutch Slave Cylinder**
   - Remove the slave cylinder assembly with flexible hose attached and then tie it to the frame so that it dose not interfere with servicing works.
7. **Starter Motor Assembly**
   - Remove the starter moter assembly then tie it to the frame so that it dose not interfere with servicing works.

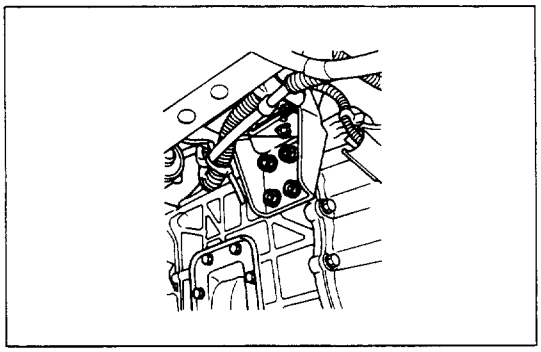


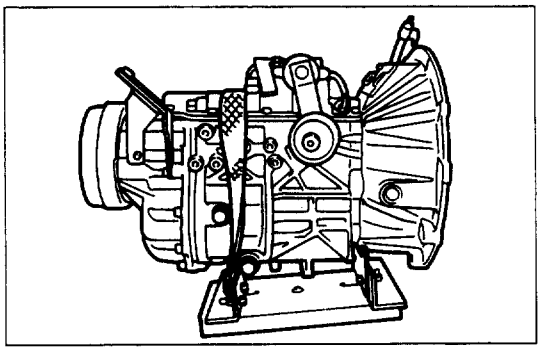
8. **Exhaust Pipe**
9. **Mounting Bracket Bolts**
   - Support the transmission with mission jack.

CAUTION:

To prevent the falling of the transmission, tie it securely to the mission jack with a chain or belt.

Do not allow transmission to hang unsupported from clutch. Damege to the clutch assembly will result.





10. **Transmission Assembly**
    - Remove the nuts of the transmission mounting bracket on the crossmember saide.
    - Engine and transmission angle may need to be adjusted for removal.
    - Hold the rear section of the engine by the jack or hoist.

CAUTION:

When lifting the engine by the jack, use wood blocks to prevent any possible damage to the oil pan.

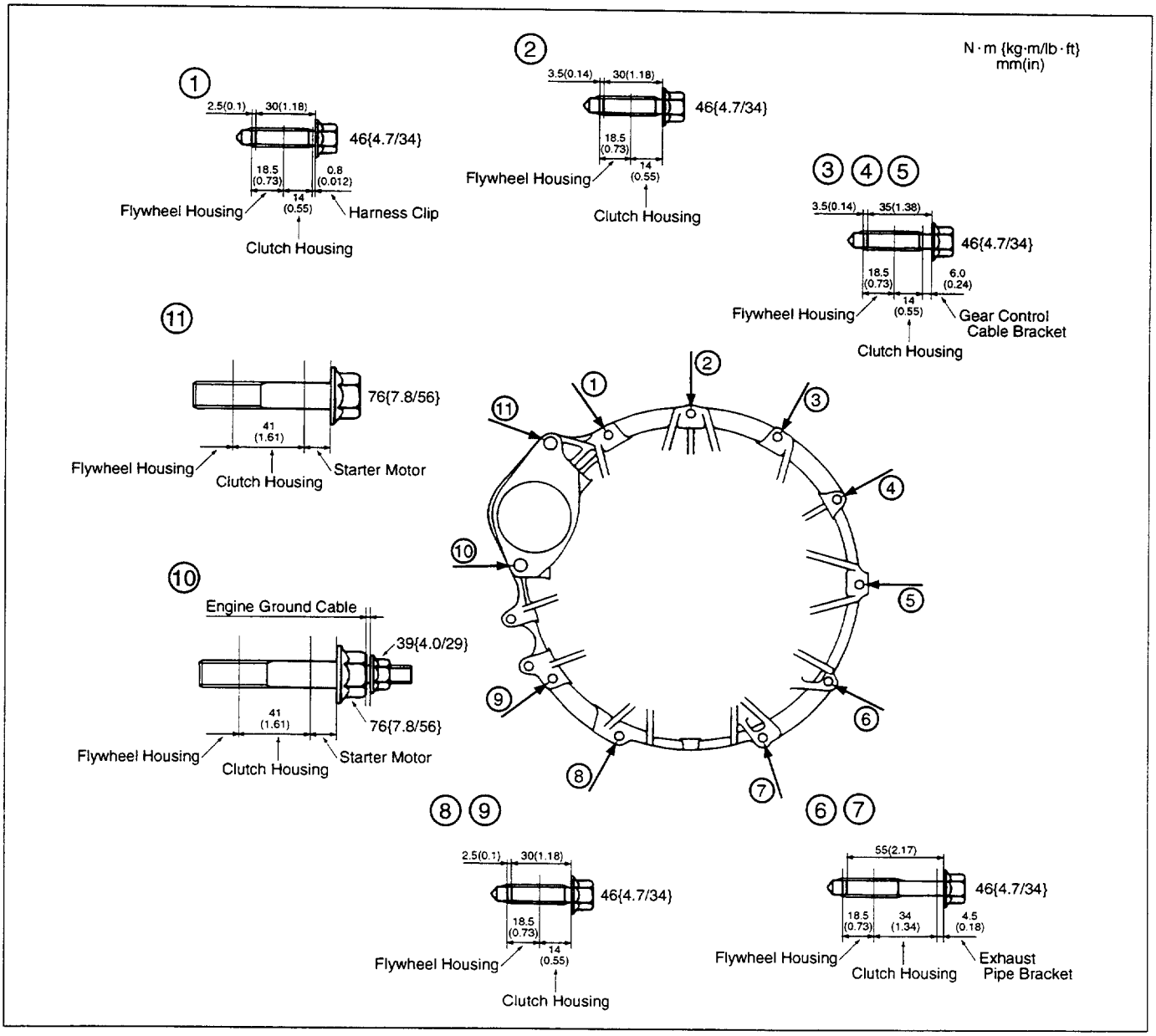
- Remove transmission fastening bolts.
- Put on the transmission assembly rearward.

Installation Steps

1. **Transmission Assembly**
   - Support the transmission with mission jack.

CAUTION:
To prevent the falling of the transmission, tie it securely to the mission jack with a chain or belt.

- Shift the transmission into high gear.
- Align the with the engine slope.
- Turn the output parking brake drum to aid clutch spline engagement.
- Install the clutch housing to flywheel housing fixing bolts.
- Clutch housing to flyheel housing bolts to figure.



2. **Mounting Bracket Bolts**

Mounting bracket bolts Torque	N·m (kg·m / lb·ft)
97 (9.9 / 72)	

3. **Exhaust Pipe**
   - Install the exhaust pipe to bracket.

Exhaust pipe bracket bolts Torque	N·m (kg·m / lb·ft)
97 (9.9 / 72)	

4. **Starter Motor Assembly**
   - Starter motor to flyheel housing bolts to figure.
5. **Clutch Sleave Cylinder**

Clutch sleave cylinder bolts Torque	N·m (kg·m / lb·ft)
16 (1.6 / 12)	

6. **Shift Cable and Select Cable**
7. **Wirring Connector**
8. **Harness Connector**
9. **Parking Brake Cable**
10. **Propeller Shaft**
    - Line up reference mark.

Propeller shaft nuts Torque	N·m (kg·m / lb·ft)
103 (10.5 / 76)	

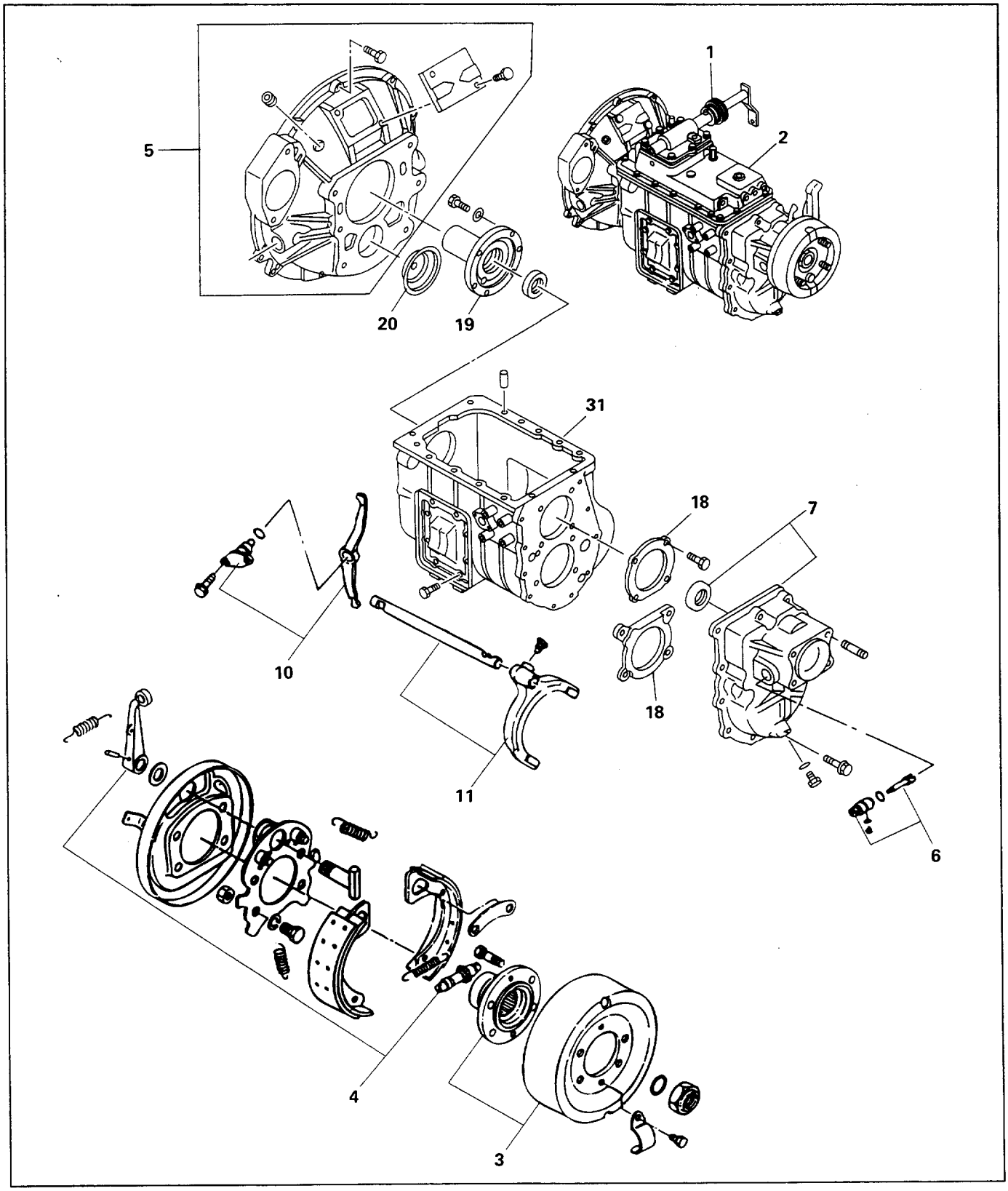
- Connect the battery negative cable and remove the wheel blocks.
- Remove the safety stands.

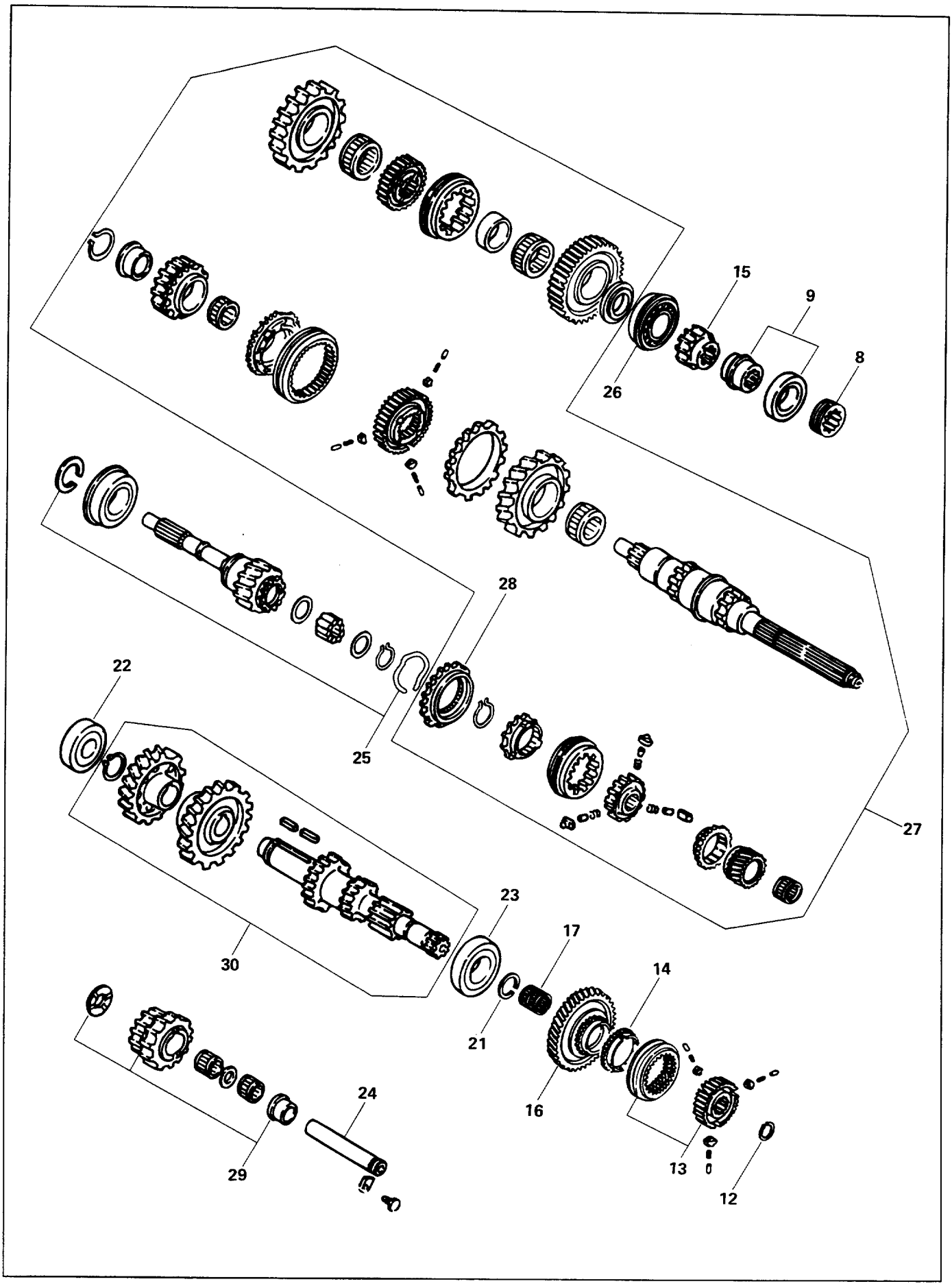
MEMO

UNIT REPAIR

MAJOR COMPONENTS

DISASSEMBLY

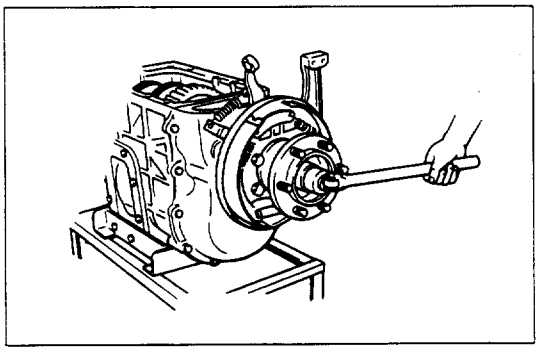



15
9
8
26
28
22
25
27
23
17
14
30
21
16
24
29
13
12

Disassembly Steps

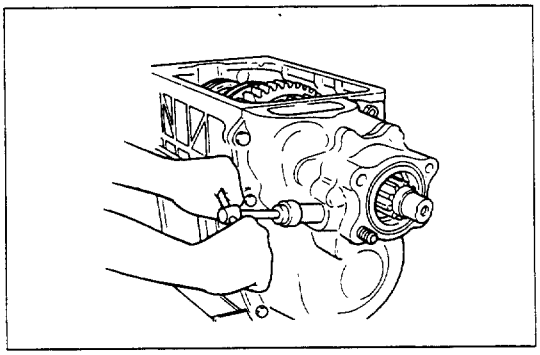
1. Upper quadrant box assembly
2. Lower quadrant box assembly
3. Parking brake drum and flange
4. Parking brake assembly
5. Clutch housing assembly
6. Speedometer driven gear assembly
7. Rear cover
8. Speedometer drive gear
9. Main shaft rear bearing and distance piece (for 6 speed)
10. 6th relay lever and spindle
11. 6th shift arm and rod
12. Snap ring; 6th synchronizer
13. 6th synchronizer assembly
14. 6th blocking ring
15. 6th main shaft gear
16. 6th counter shaft gear
17. Needle roller bearing; 6th counter gear
18. Bearing retainer
19. Front cover assembly
20. Counter shaft front bearing cover
21. Snap ring; counter shaft rear bearing
22. Counter shaft front bearing
23. Counter shaft rear bearing
24. Reverse idle gear shaft
25. Top gear shaft assembly
26. Main shaft rear bearing
27. Main shaft assembly
28. Synchronizer clutch gear
29. Reverse idle gear, thrust collar and washer
30. Counter shaft assembly
31. Transmission case

Disassembly Steps



1. **Upper Quadrant Box Assembly**
2. **Lower Quadrant Box Assembly**
3. **Parking Brake Drum and Flange**

   Engage two gear sets or wedge a piece of hard between the gears and case to prevent turning of main shaft.



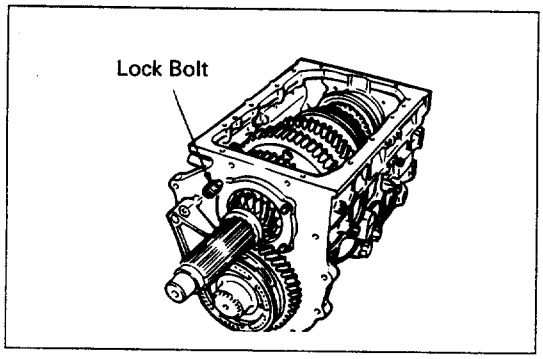
4. **Parking Brake Assembly**
5. **Clutch Housing Assembly**
6. **Speedometer Driven Gear Assembly**

   Disassemble these parts if necessary.

   Remover: 9-8521-0091-0

7. **Rear Cover**
8. **Speedometer Drive Gear**
9. **Main Shaft Rear Bearing and Distance Piece**
10. **6th Relay Lever and Spindle**
11. **6th Shift Arm and Rod**

    Remove the lock bolt, then pull out the 6th shift arm and rod.

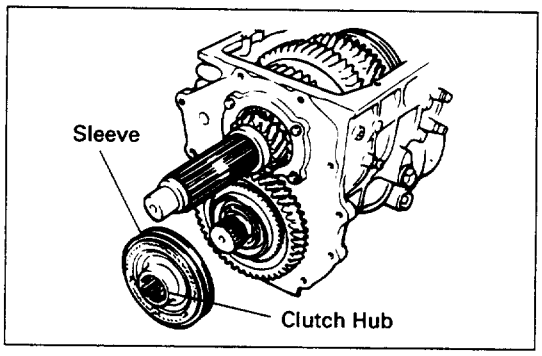


12. **Snap Ring; 6th Synchronizer**
13. **6th Synchronizer Assembly**

    Clutch hub must be removed with sleeve.

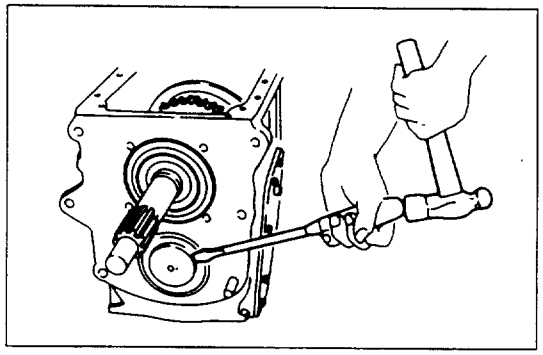
    NOTE:

    Be careful not to lose plungers and springs.

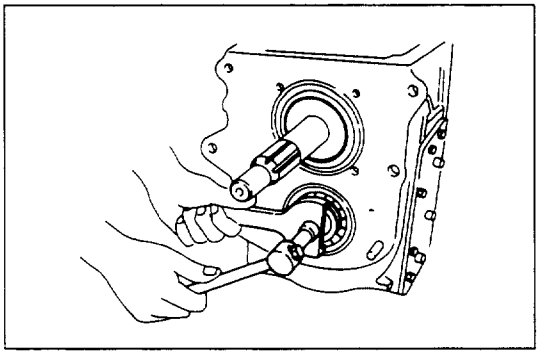


14. **6th Blocking Ring**
15. **6th Main Shaft Gear**
16. **6th Counter Shaft Gear**
17. **Needle Roller Bearing; 6th Counter Shaft Gear**
18. **Bearing Retainer**
19. **Front Cover Assembly**
20. **Counter Shaft Front Bearing Cover**

    Tap the side of seal cover as shown.



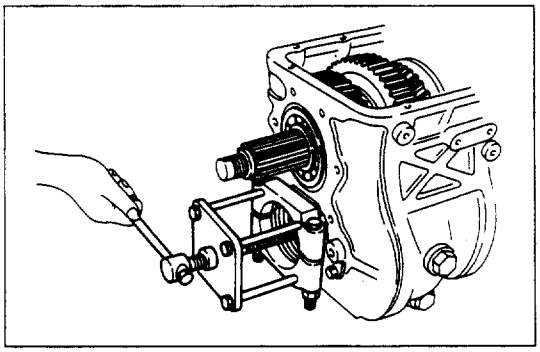
21. **Snap Ring; Counter Shaft Rear Bearing**



22. Counter Shaft Front Bearing

Remove the counter shaft front bearing using a special tool.

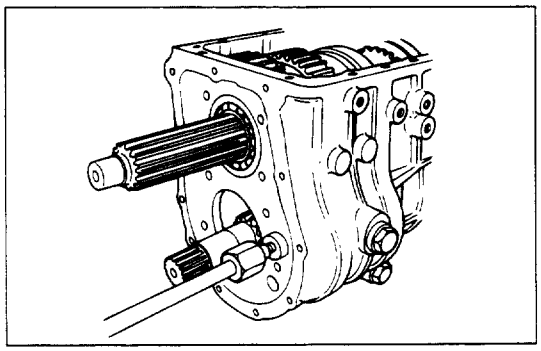
Remover: 9-8521-0168-0



23. Counter Shaft Rear Bearing

Remove the counter shaft rear bearing using a special tool.

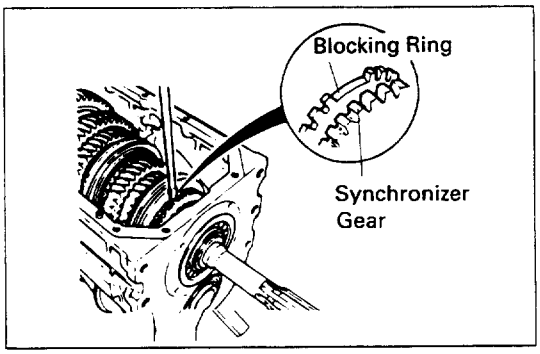
Remover: 9-8521-0169-0



24. Reverse Idle Gear Shaft

Before removing, remove the set screw.

Remover: 9-8521-0095-0

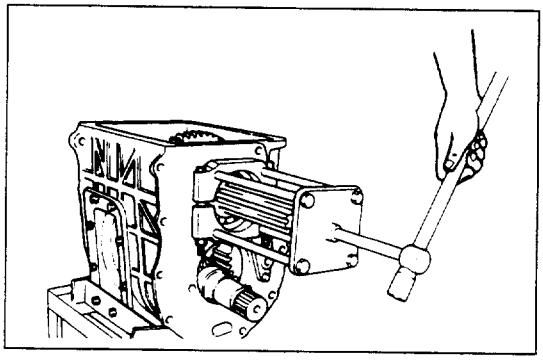


25. Top Gear Shaft Assembly

- Insert "–" screwdriver between top gear and synchronizer gear, disconnect synchronizer from retaining clip of top gear.
- Remove the top gear shaft assembly.

NOTE:

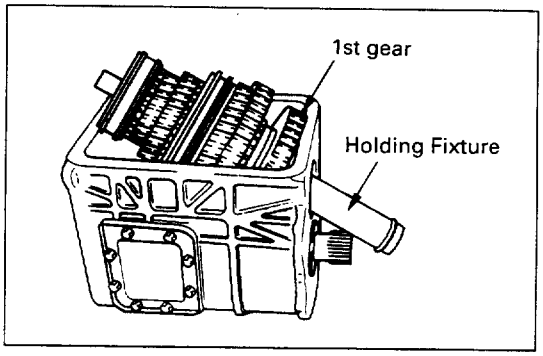
Be careful not to damage to the synchronizer blocking ring.



26. Main Shaft Rear Bearing

Remove the main shaft rear bearing using a special tool.

Remover: 9-8521-0169-0



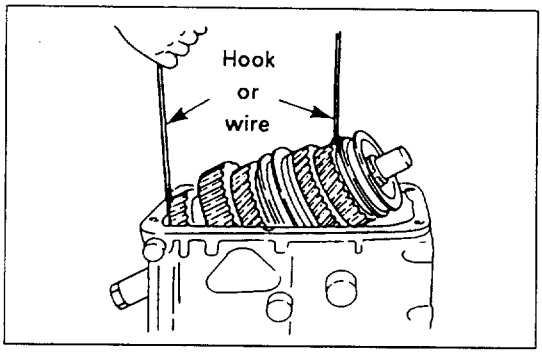
27. Main Shaft Assembly

1. Use a flange nut to attach a Holding fixture to the rear of the main shaft.

   This will prevent the reverse gear, and the thrust washer from falling free during the disassembly procedure.

Holding Fixture Dimensions (Reference) mm (in.)

Length	Inside Dia.	Thickness
210 (8.27)	46 – 48 (1.81 – 1.89)	3 – 5 (0.12 – 0.20)



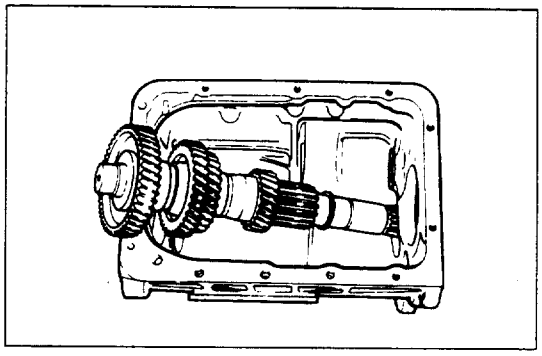
2. Remove the main shaft assembly from the case using a suitable hook or wire.

28. Synchronizer Clutch Gear

29. Reverse Idle Gear, Thrust Collar and Washer

30. Counter Shaft Assembly

- Remove the counter shaft assembly from the case using a suitable hook or wire.



31. Transmission Case

INSPECTION AND REPAIR

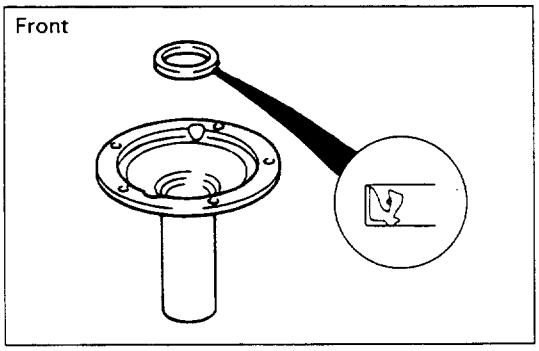
Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.

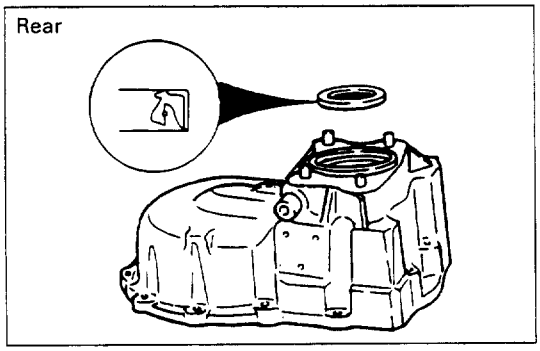
- Bearing
- Gear
- Synchronizer clutch gear
- Flange
- Top gear shaft
- Reverse idle gear shaft

Visual Check

Inspect all disassembled parts for wear, damage or other abnormal conditions.

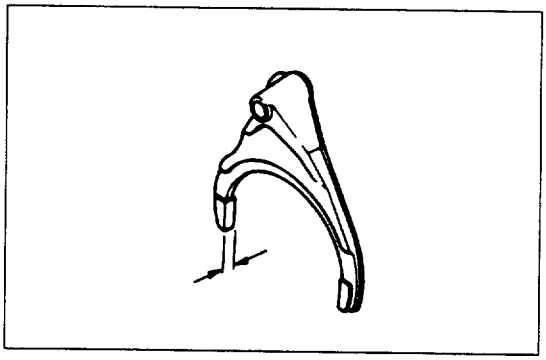
Inspect the following parts paying particular attention to the points shown in the illustrations.





Front and Rear Cover Oil Seal Replacement

1. Note direction of oil seal installation.
2. Apply engine oil to outer circumference of oil seal.
3. Apply grease to the lip of oil seal
4. Insert oil seal until it is properly seated in position.



6th Shift Arm

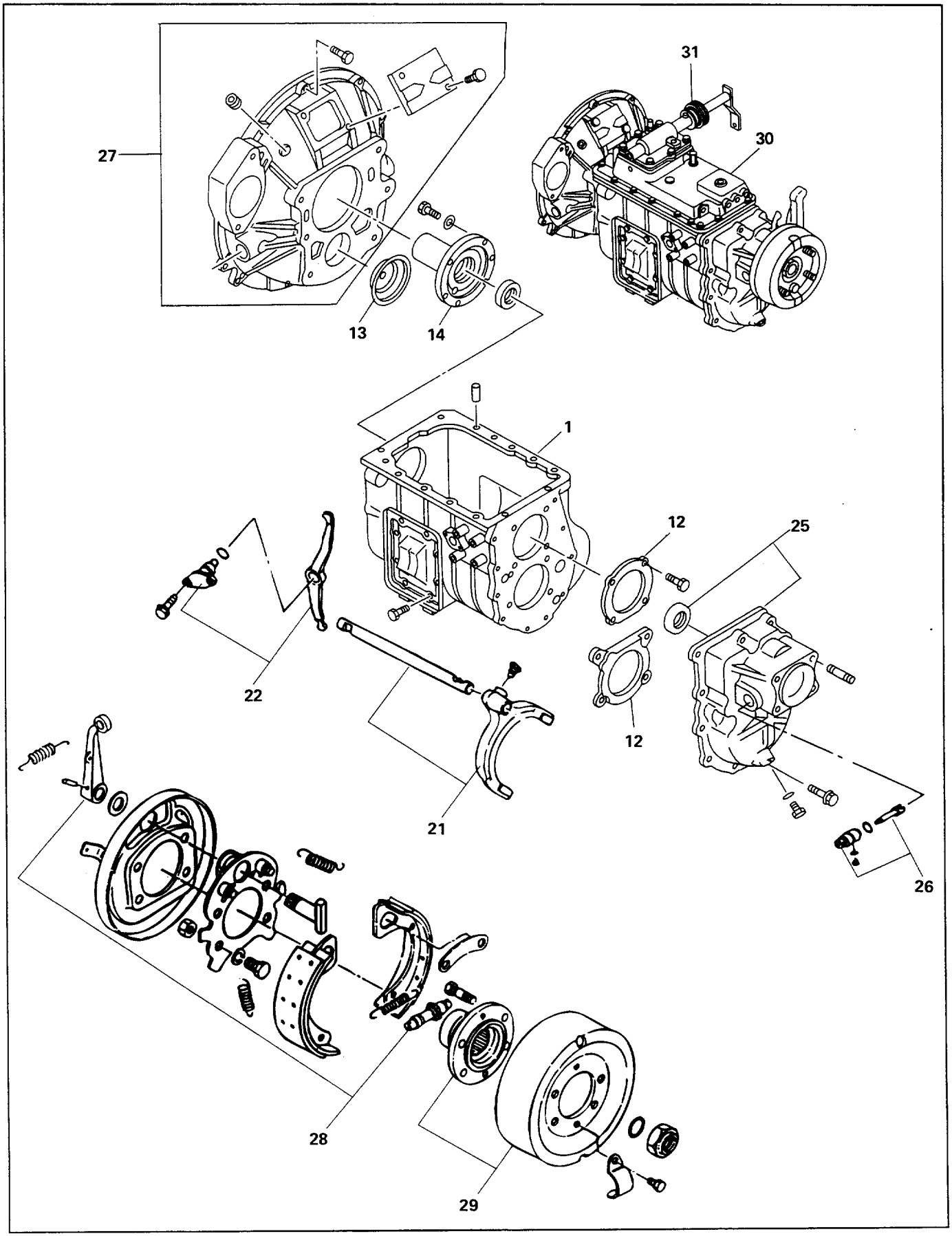
Measure the 6th shift arm thickness.

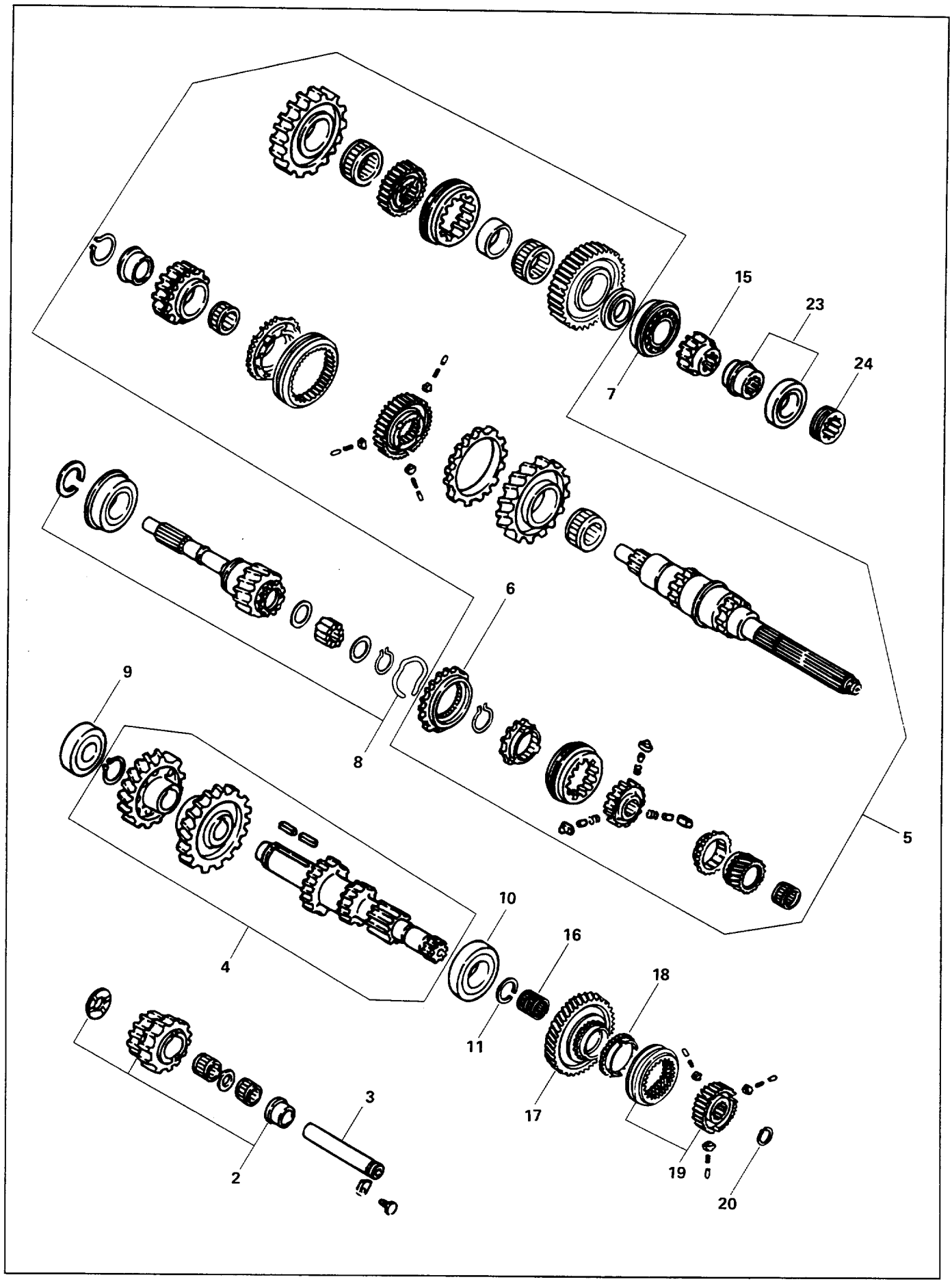
Shift Arm Thickness mm (in)

Standard	Limit
11.0 (0.433)	10.0 (0.394)

If the measured value exceeds the specified limit, the shift arm should be replaced.

REASSEMBLY




15
23
24
7
6
9
8
5
10
16
18
4
11
17
3
2
19
20

Reassembly Steps

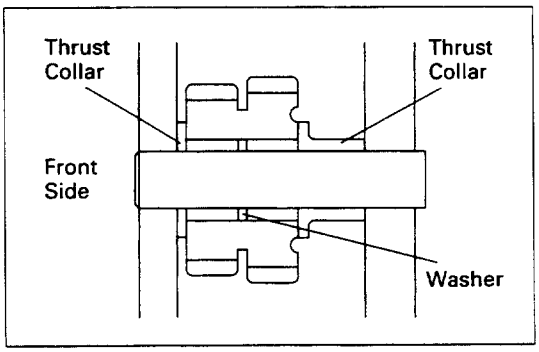
1. Transmission case
2. Reverse idle gear, thrust collar and washer
3. Reverse idle gear shaft
4. Counter shaft assembly
5. Main shaft assembly
6. Synchronizer clutch gear
7. Main shaft rear bearing
8. Top gear shaft assembly
9. Counter shaft front bearing
10. Counter shaft rear bearing
11. Snap ring; counter shaft rear bearing
12. Bearing retainer
13. Counter shaft front bearing cover
14. Front cover assembly
15. 6th main shaft gear
16. Needle roller bearing; 6th counter gear
17. 6th counter shaft gear
18. 6th blocking ring
19. 6th synchronizer assembly
20. Snap ring; 6th synchronizer
21. 6th shift arm and rod
22. 6th relay lever and spindle
23. Main shaft rear bearing and distance piece (for 6 speed)
24. Speedometer drive gear
25. Rear cover
26. Speedometer driven gear assembly
27. Clutch housing assembly
28. Parking brake assembly
29. Parking brake drum and flange
30. Lower quadrant box assembly
31. Upper quadrant box assembly

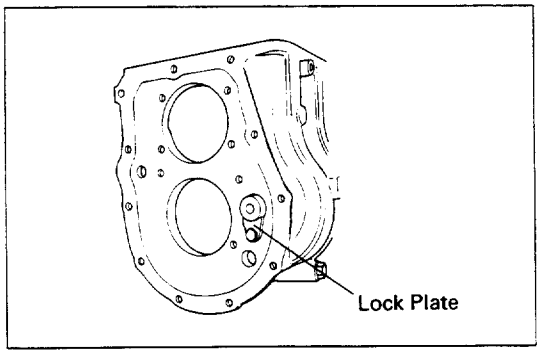
Reassembly Steps

Preparation

1. Clean each parts before reassembly
2. Be sure to use anew O-ring and oil seal.
3. Remove liquid gasket from each fitting surface.

1. **Transmission Case**
2. **Reverse Idle Gear, Thrust Collar and Washer**
3. **Reverse Idle Gear Shaft**
   - Apply grease to needle roller bearing.
   - Reassemble each parts as figure.





- Align cutting groove of reverse idle gear shaft and lock plate installation position.
- Install the reverse idle gear shaft by tapping lightly.

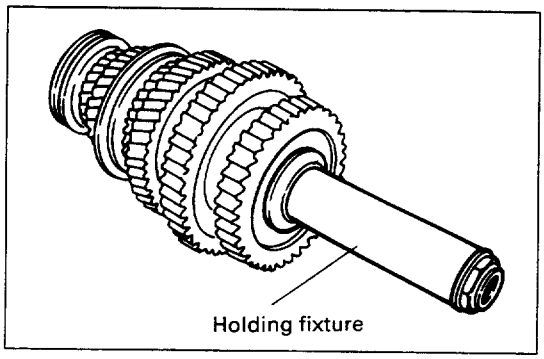
Lock Plate Bolt Torque	N·m (kg·m / lb·ft)
48 (4.9 / 35)	

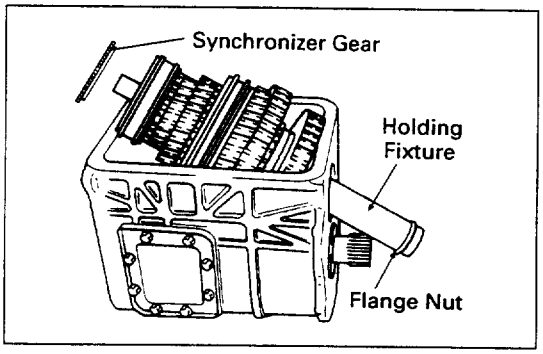
4. **Counter Shaft Assembly**

   NOTE:

   The counter shaft assembly is very heavy. Always support the counter shaft assembly with a hoist and wire.

5. **Main Shaft Assembly**
6. **Synchronizer Clutch Gear**
   - Check that the gear and washer are installed to the correct position.
   - Install the holding fixture to the main shaft, then semi tighten the used flange nut.



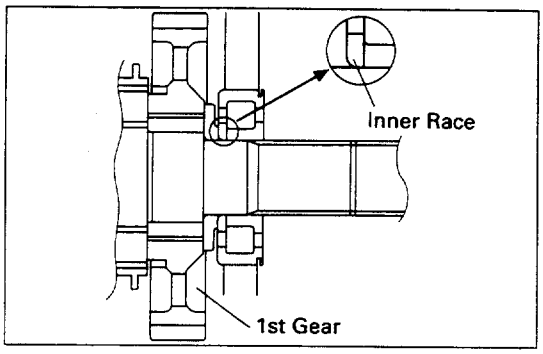


   - Set the synchronizer clutch gear.
   - Remove the main shaft assembly from the case using a suitable hook or wire.

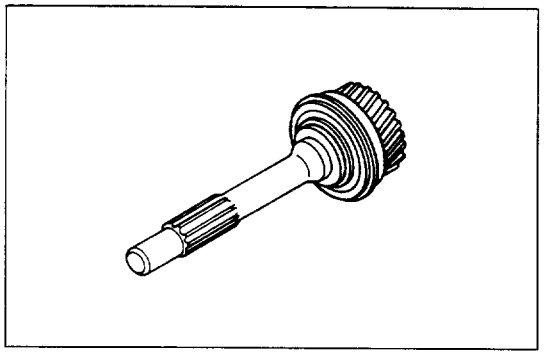
   NOTE:

   The main shaft assembly is very heavy. If it falls, it can cause serious injury to service personnel.

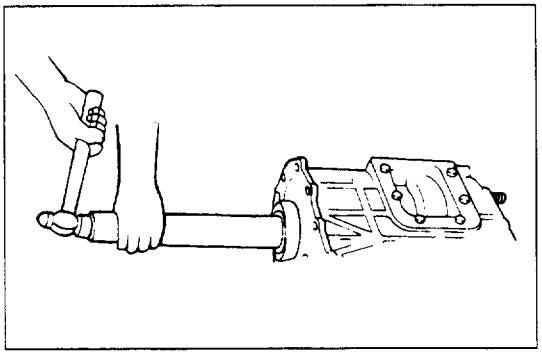
   Place supports beneath the main shaft assembly to prevent it from falling.



7. **Main Shaft Rear Bearing**
   - Apply engine oil to the bearing.
   - Install the bearing to the main shaft. Chamfered side of inner race must be facing the thrust washer.
   - Install snap ring to the groove of outer race.



8. **Top Gear Shaft Assembly**
   - Apply grease to the pilot bearing.
   - Install top gear shaft.
   - Check that the synchronizer clutch gear is fitted into the main shaft retaining clip correctly.
   - Check that the top gear shaft turns smoothly.



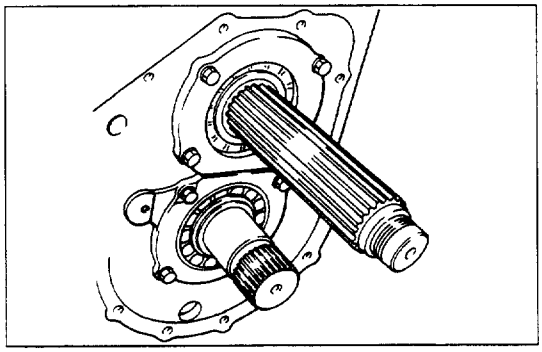
9. Counter Shaft Front Bearing

10. Counter Shaft Rear Bearing

11. Snap Ring; Counter Shaft Rear Bearing

Installer: 9-8522-0040-0

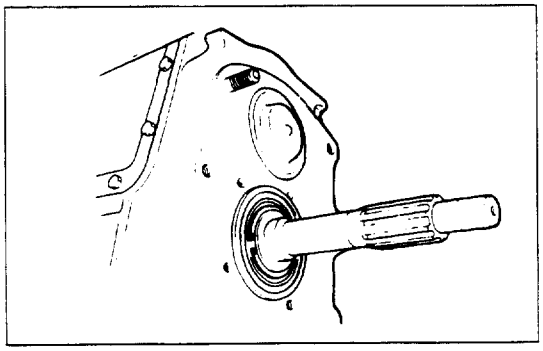
1. Turn the transmission case upside down.
2. Use a hammer and the bearing installer to install the bearing to be transmission case.
3. Return the transmission case to its upright position.



12. Bearing Retainer

Tighten bearing retainer bolts evenly.

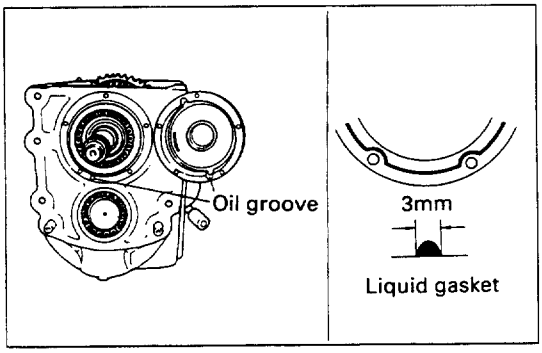
Bearing Retainer Bolt Torque	N·m (kg·m / lb·ft)
	48 (4.9 / 35)



13. Counter Shaft Front Bearing Cover

Use a plastic hammer to lightly drive the front bearing cover into position in the transmission case.

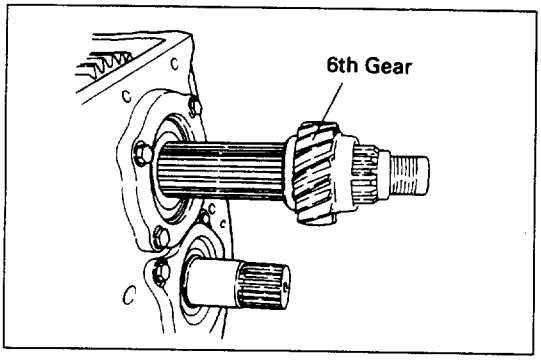
NOTE:
Take care not to damage bearing cover outside rubber.



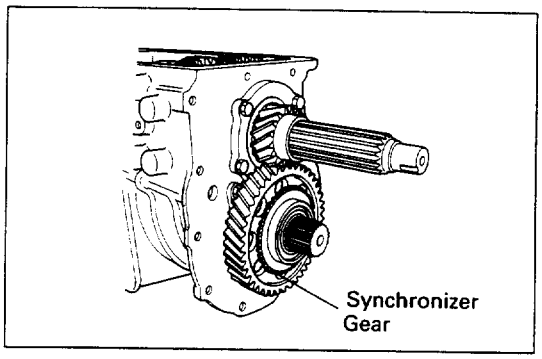
14. Front Cover Assembly

1. When installing the front cover, be careful not to damage the oil seal lip.
2. Apply grease to the oil seal lip.
3. Align the main housing oil holes and the front cover oil grooves.
4. Apply recommended liquid gasket (LOCTITE FMD-127 or equivalent) to the front cover fitting surface.

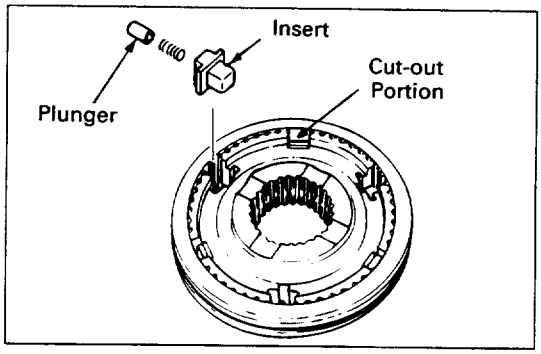
Front Cover Bolt Torque	N·m (kg·m / lb·ft)
	26 (2.7 / 20)



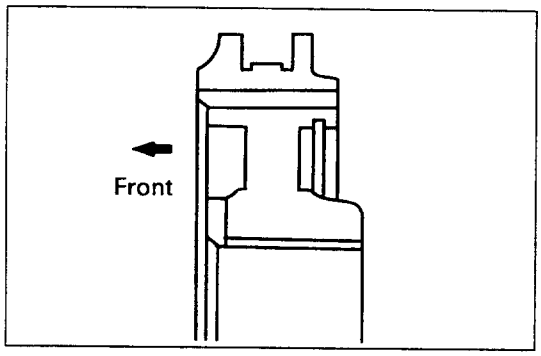
15. **6th Main Shaft Gear**
    Install the 6th main gear as figure.



16. **Needle Roller Bearing; 6th Counter Gear**
17. **6th Counter Shaft Gear**
18. **6th Blocking Ring**
    - Apply grease to needle roller bearing.
    - Install needle roller bearing and 6th counter shaft gear. Synchronizer clutch gear side of the 6th counter shaft gear must be facing rear of the transmission case.

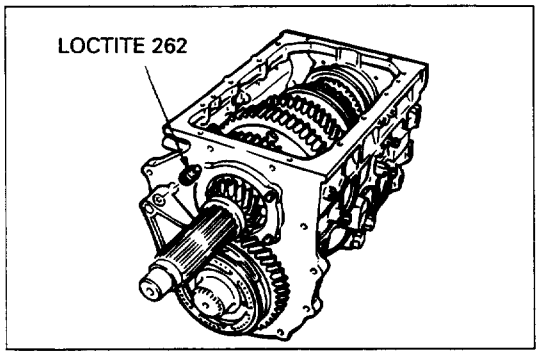


19. **6th Synchronizer Assembly**
    - Install snap ring to the sleeve.
    - Install insert, spring and plunger to the clutch hub.
    - Align cut-out portion of sleeve spline and clutch hub groove (except plunger installing position).
    - Install the sleeve to the clutch hub with pressing plunger.



- The clutch hub oil grooves must be facing the front of the transmission case.

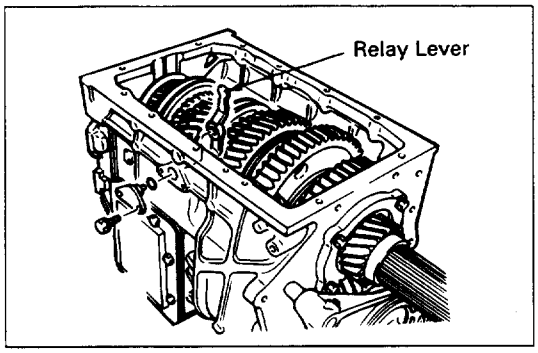
20. **Snap Ring; 6th Synchronizer**



21. 6th Shift Arm and Rod

- Apply liquid gasket (LOCTITE 262 or equivalent) to threaded portion of the bolt.
- Tighten lock bolt to the specified torque.

Lock Bolt Torque	N·m (kg·m / lb·ft)
	20 (2.0 / 14)



22. 6th Relay Lever and Spindle

- Install O-ring to the spindle.
- Align the relay lever to the groove of shift arm rod.
- Install the spindle to the specified torque.

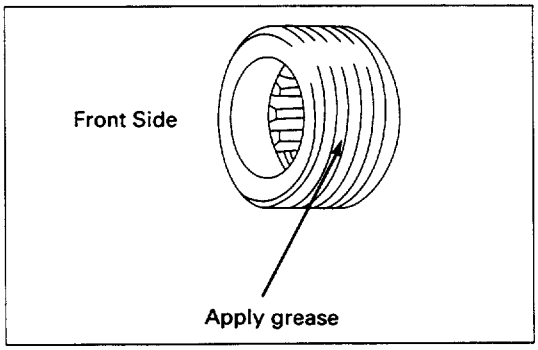
Spindle Bolt Torque	N·m (kg·m / lb·ft)
	51 (5.2 / 38)

NOTE:

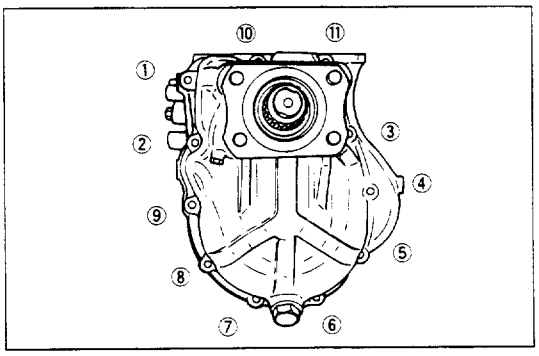
Be careful not to damage to O-ring.

23. Main Shaft Rear Bearing and Distance Piece

24. Speedometer Drive Gear



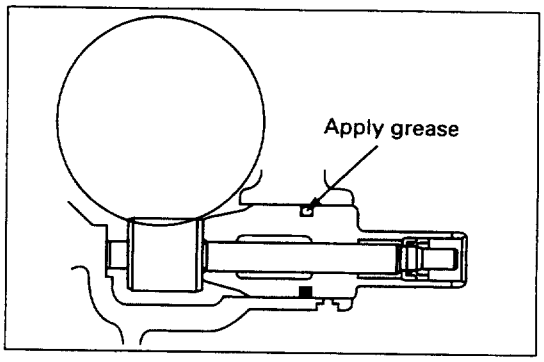
- Apply grease to gear teeth surface.
- Install the speedometer drive gear. The spline cutting portion of the speedometer drive gear must be facing front of the transmission case.

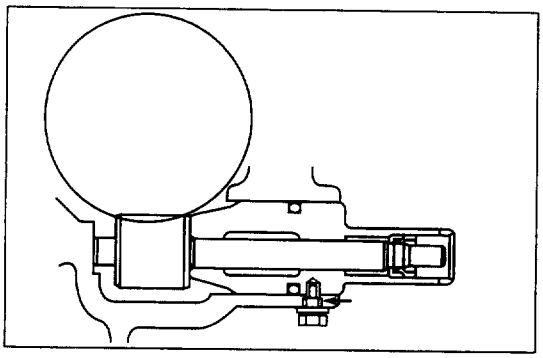


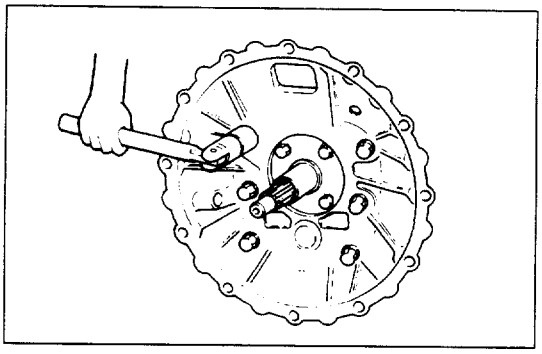
25. Rear Cover

- Apply grease to the oil seal lip.
- Apply liquid gasket (LOCTITE FMD-127 or equivalent) to the fitting surface of the rear cover.
- Tighten rear cover bolts in the sequence show in the figure.

Rear Cover Bolt Torque	N·m (kg·m / lb·ft)
	48 (4.9 / 35)







26. Speedometer Driven Gear Assembly

1. Apply grease to O-ring, then install it to the bushing.
2. Insert the bushing to the rear cover, then adjust it for 0.1 – 0.3mm (0.004 – 0.012 in.) clearance between the speedometer drive gear and driven gear.
3. Apply screw hole mark to the bushing from screw hole of the rear cover, then remove the bushing.
4. Make a screw hole to screw hole mark applied at step No.3.

Screw Hole Size mm(in)

Diameter	Depth
4.5 (0.177)	3.5 – 4.0 (0.138 – 0.157)

5. Install the bushing to the rear cover, then align screw holes.
6. tighten the set screw.

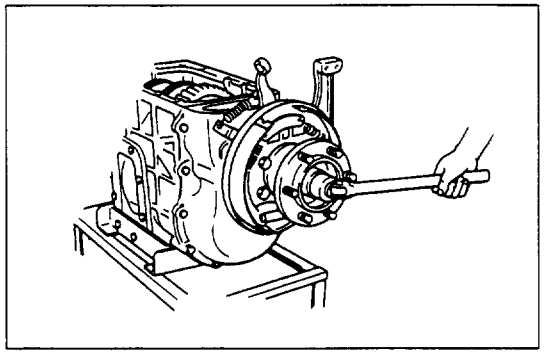
27. Clutch Housing Assembly

Clutch Housing Bolt Torque	N·m (kg·m / lb·ft)
118 (12 / 87)	

28. Parking Brake Assembly

Parking Brake Bolt (or Nut) Torque	N·m (kg·m / lb·ft)
127 (13 / 94)	

Refer to Sec.5C "Parking Brake" for parking brake adjustment.



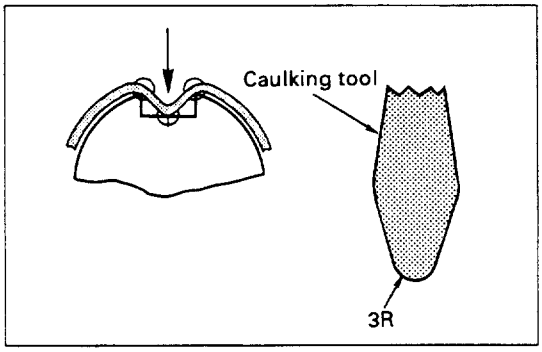
29. Parking Brake Drum and Flange

- Apply grease to O-ring, and install it to the groove of the flange.
- Tighten new flange nut to the specified torque.

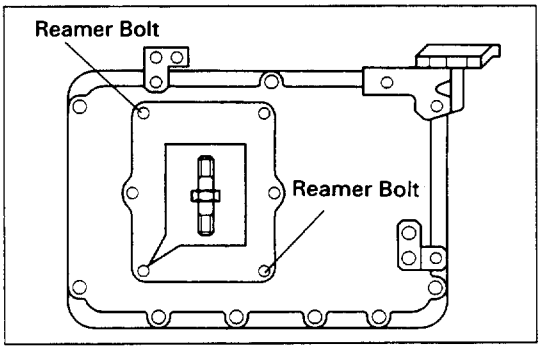
Flange Nut Torque	N·m (kg·m / lb·ft)
	588 (60 / 434)

NOTE:

Be sure to use a new flange nut.



- After tightening, caulk the flange nut against slot in main shaft. When caulking, the nut flange and the groove of the main shaft or/and must touch at both shoulders and the bottom of the grove even if small crack occurs on the caulking flange of nut.



30. Lower Quadrant Box Assembly

31. Upper Quadrant Box Assembly

- Apply liquid gasket (LOCTITE FMD-127 or equivalent) to lower and upper quadrant box fitting surface.
- At first fix a reamer bolt with mark (Δ), then fix other bolts.
- Tighten bolts to the specified torque.

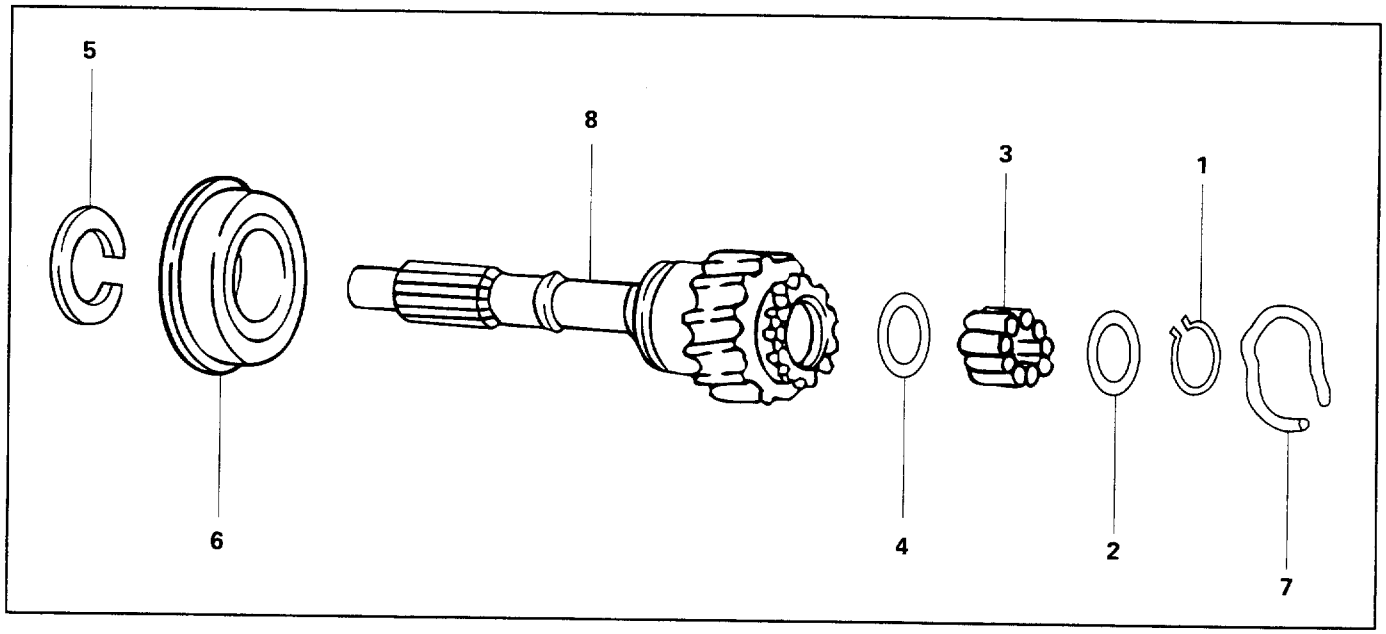
Quadrant Box Bolt Torque	N·m (kg·m / lb·ft)
	53 (5.4 / 39)

After reassembling the transmission, refill the case with the new specified transmission oil.

Lubricating Oil Capacity (Reference)	Liters (US gal / Imp. gal)
With P.T.O	6.1 (1.61 / 1.34)
Without P.T.O	5.3 (1.40 / 1.17)

TOP GEAR SHAFT ASSEMBLY

DISASSEMBLY

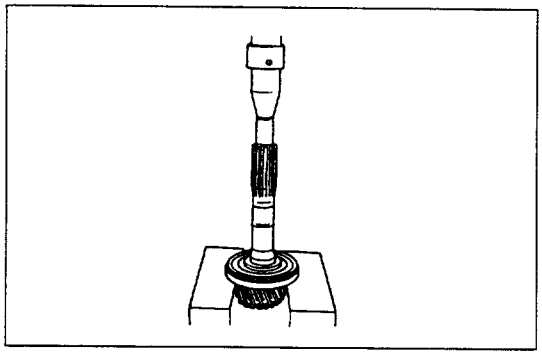


Disassembly Steps

1. Snap ring
2. Thrust washer
3. Pilot bearing
4. Thrust washer
5. Snap ring
6. Top gear shaft bearing
7. Retaining clip
8. Top gear shaft

Disassembly Steps

1. **Snap Ring**
2. **Thrust Washer**
3. **Pilot Bearing**
4. **Thrust Washer**
5. **Snap Ring**
6. **Top Gear Shaft Bearing**



Use a bench press to remove the top gear shaft bearing.

7. **Retaining clip**
8. **Top Gear Shaft**

INSPECTION AND REPAIR

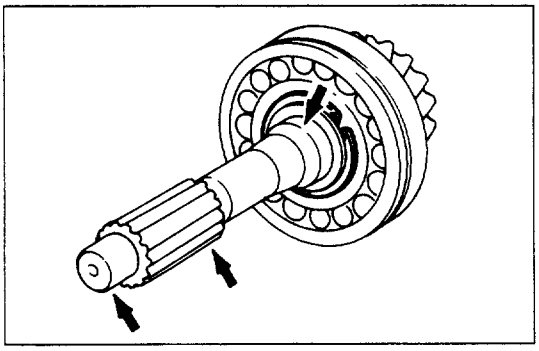
Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.

- Top gear shaft
- Top gear shaft bearing
- Pilot bearing
- Snap ring
- Retaining clip
- Thrust washer

Visual Check

Visually check each of the parts.

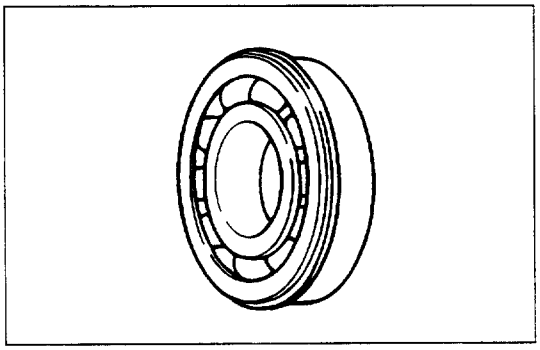
Check the bearing fittings, the faces, the splines, and the gears for excessive wear and damage.



Top Gear Shaft

Visually check the oil seal lip sealing face and the spline for excessive wear and distortion.

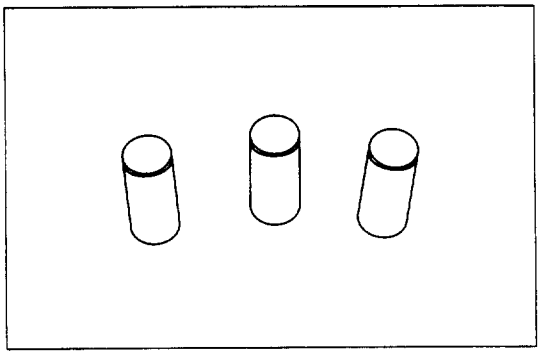
If there is excessive wear or distortion, the oil seal lip sealing face and the spline should be replaced.



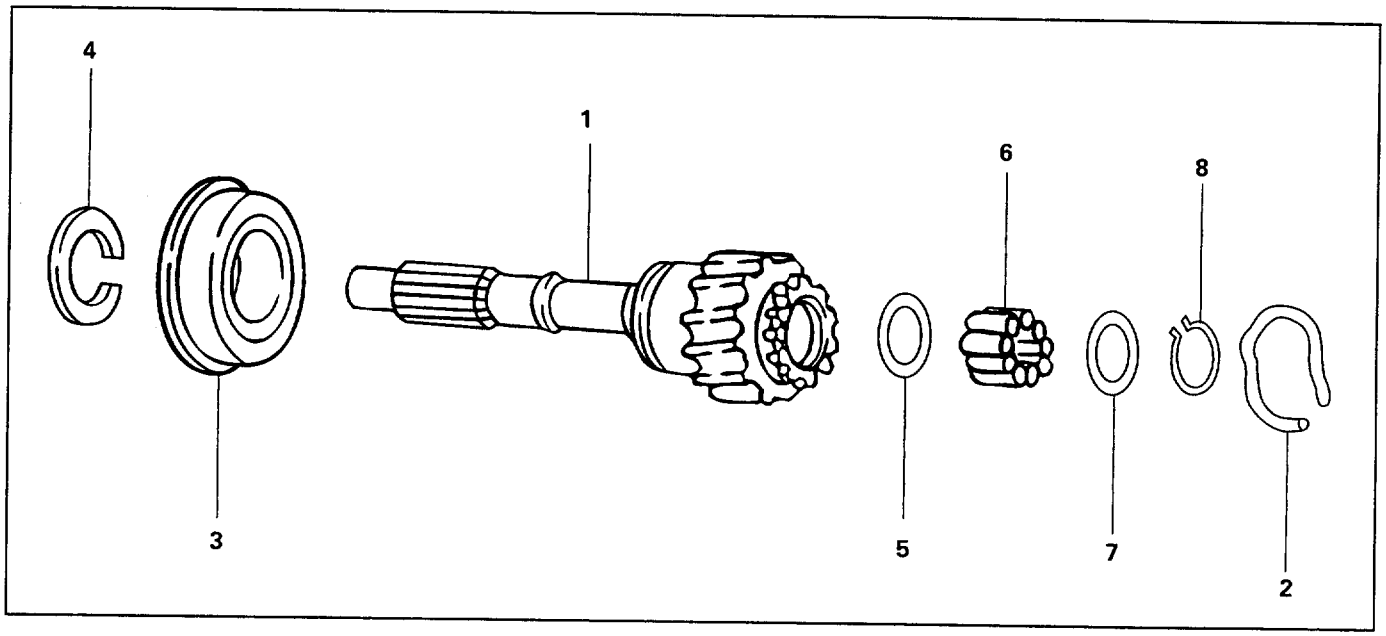
Bearings

Visually check the balls and rollers for worn contact surfaces and abrasion.

If there is wear and abrasion, the bearings should be replaced.



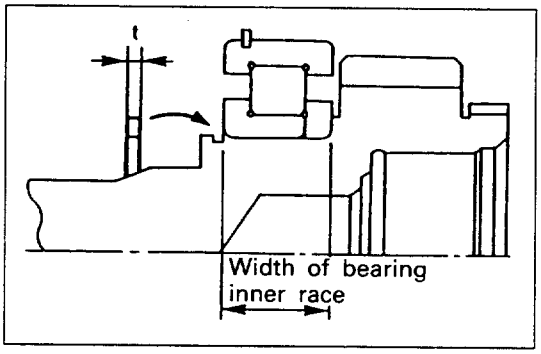
REASSEMBLY

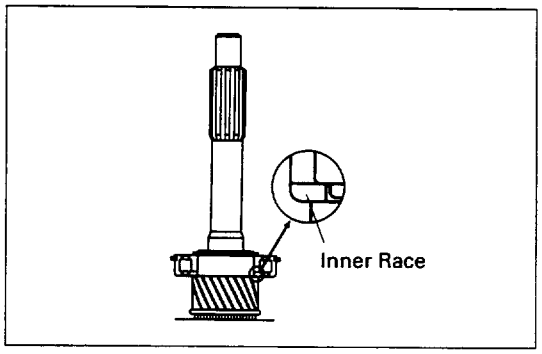


Reassembly Steps

1. Top gear shaft
2. Retaining clip
3. Top gear shaft bearing
4. Snap ring
5. Thrust washer
6. Pilot bearing
7. Thrust washer
8. Snap ring

Reassembly Steps



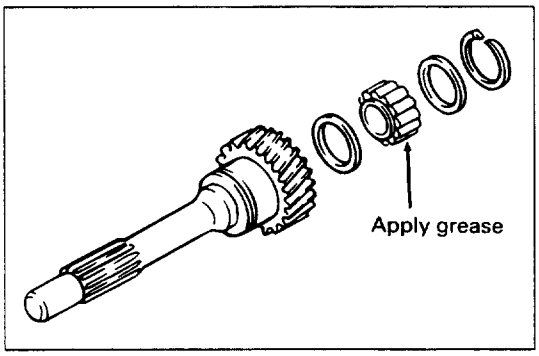


1. **Top Gear Shaft**
2. **Retaining Clip**
3. **Top Gear Shaft Bearing**
4. **Snap Ring**
   - If the bearing is to be replaced with a new one, measure the bearing inner race width to determine the correct snap ring thickness.
   - Attach a suitable bar and use a bench press.

Bearing Inner Race, Snap Ring, Thickness and Color

mm (in.)

Width of Bearing Inner Race	Snap Ring Thickness (t)	Color
21.85 - 21.89 (0.8602 - 0.8618)	2.64 (0.1039)	Green
21.89 - 21.93 (0.8618 - 0.8634)	2.60 (0.1024)	Blue
21.93 - 21.97 (0.8634 - 0.8650)	2.56 (0.1008)	Yellow
21.97 - 22.00 (0.8650 - 0.8661)	2.53 (0.0996)	White

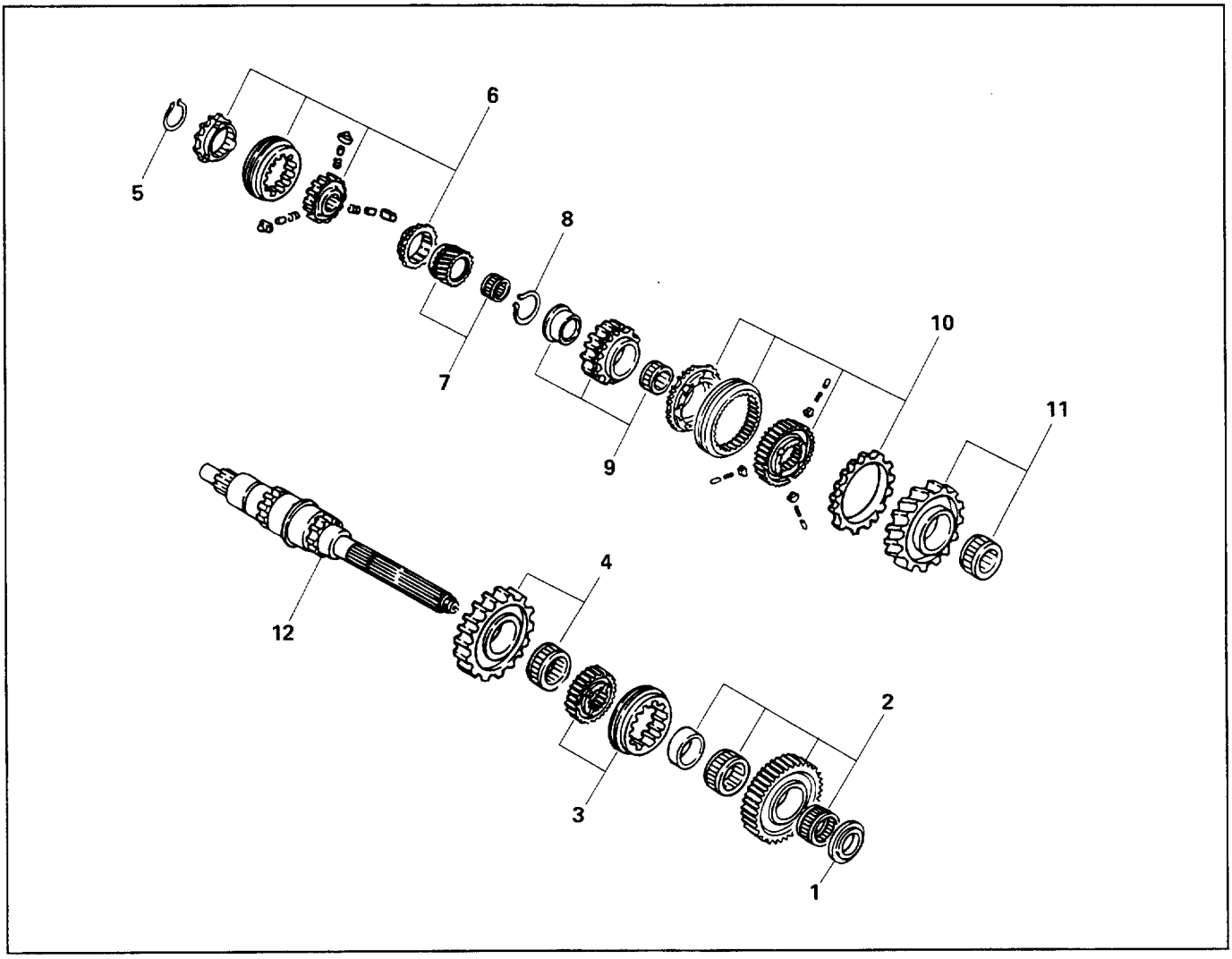


5. **Thrust Washer**
6. **Pilot Bearing**
   Apply multi-purpose type grease to the bearing.
7. **Thrust Washer**
8. **Snap Ring**

MEMO

MAIN SHAFT ASSEMBLY

DISASSEMBLY



Disassembly Steps

1. Thrust washer
2. 1st gear, needle roller bearing and collar
3. 1st – reverse sleeve and clutch hub
4. Reverse gear and needle roller bearing
5. Snap ring
6. 4th – 5th synchronizer assembly
7. 4th gear and needle roller bearing
8. Snap ring
9. Collar, 3rd gear and needle roller bearing
10. 2nd – 3rd synchronizer assembly
11. 2nd gear and needle roller bearing
12. Main shaft

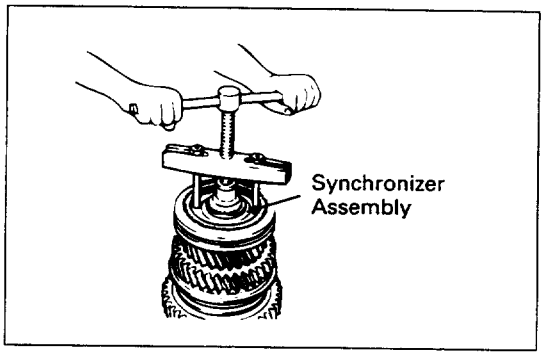
Disassembly Steps

NOTE:

The main shaft assembly is very heavy. If it falls, it can cause serious injury to service personnel.

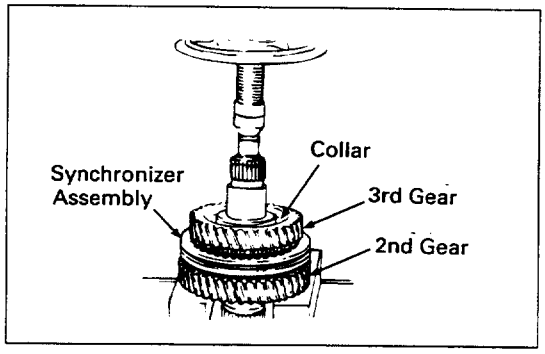
Place supports beneath the main shaft assembly to prevent it from falling.

1. **Thrust Washer**
2. **1st Gear, Needle Roller Bearing and Collar**
3. **1st – Reverse Sleeve and Clutch Hub**
4. **Reverse Gear and Needle Roller Bearing**
5. **Snap Ring**
6. **4th – 5th Synchronizer Assembly**
   - Remove the 4th – 5th synchronizer assembly from the main shaft assembly using a adequate puller.
   - Remove the sleeve from the clutch hub. Be careful not to lose plunger, spring and block after removal of the sleeve.



7. **4th Gear and Needle Roller Bearing**
8. **Snap Ring**
9. **Collar, 3rd Gear and Needle Roller Bearing**
10. **2nd – 3rd Synchronizer Assembly**
11. **2nd Gear and Needle Roller Bearing**

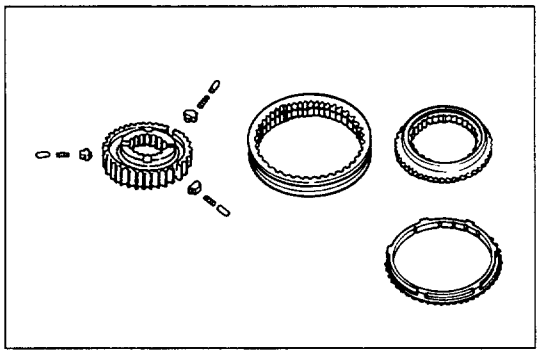
    Use a bench press to remove each parts.



12. **Main Shaft**

INSPECTION AND REPAIR

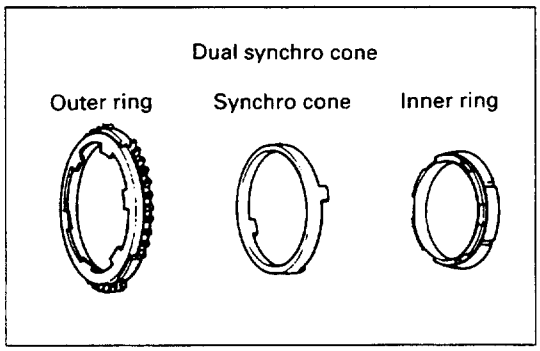
Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.



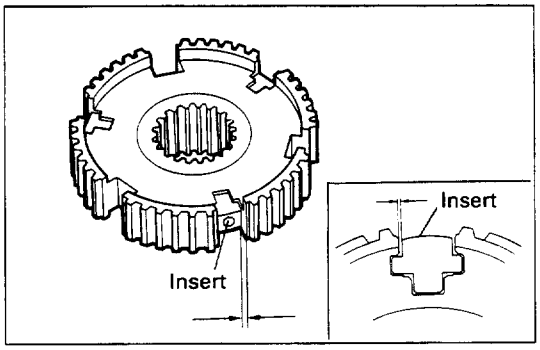
Visual Check

Inspect all disassembled parts for wear, damage or other abnormal conditions.

Inspect the following parts paying particular attention to the points shown in the illustrations.



Dual Synchronizer Assembly (2nd and 3rd)



Clutch Hub

Visually check for worn clutch hub inside and outside splines and sliding sleeves.

If wear is discovered during inspection, the clutch hub should be replaced.

Measure the clearance between the insert and the clutch hub.

Insert and Clutch Hub Clearance mm (in.)

Standard	Limit
0.1 - 0.4 (0.004 - 0.016)	0.5 (0.020)

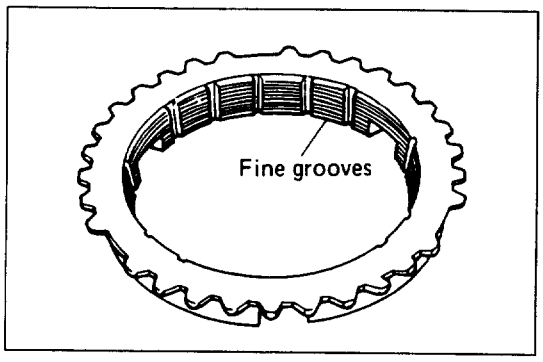
Insert Spring

Only the insert springs for the 6th synchronizer are different in free length from the 2nd – 3rd and 4th – 5th synchronizer, so be careful to assemble correctly.

Spring Free Length mm (in.)

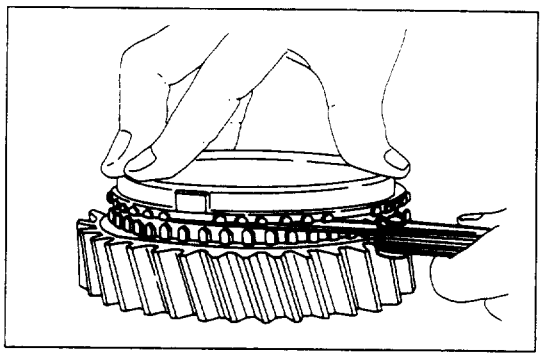
2nd – 3rd and 4th – 5th	6th
19.0 (0.748)	18.7 (0.736)

For identification, the 6th synchronizer insert springs are painted white.



Blocking Ring

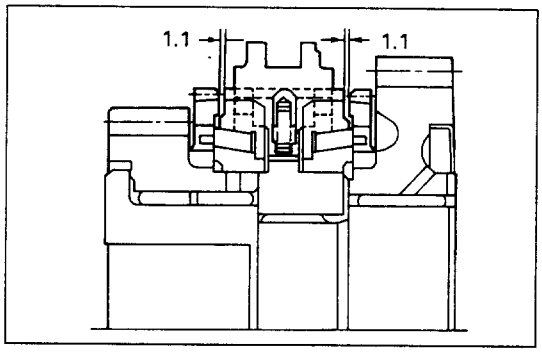
Visually check for worn blocking ring inside fine grooves.



Measure the clearance between the synchronizer cone and the blocking ring.

Blocking Ring and Synchronizer Clearance mm (in.)

Standard	Limit
2.0 (0.079)	0



2nd – 3rd Synchronizer (Dual Cone Type)

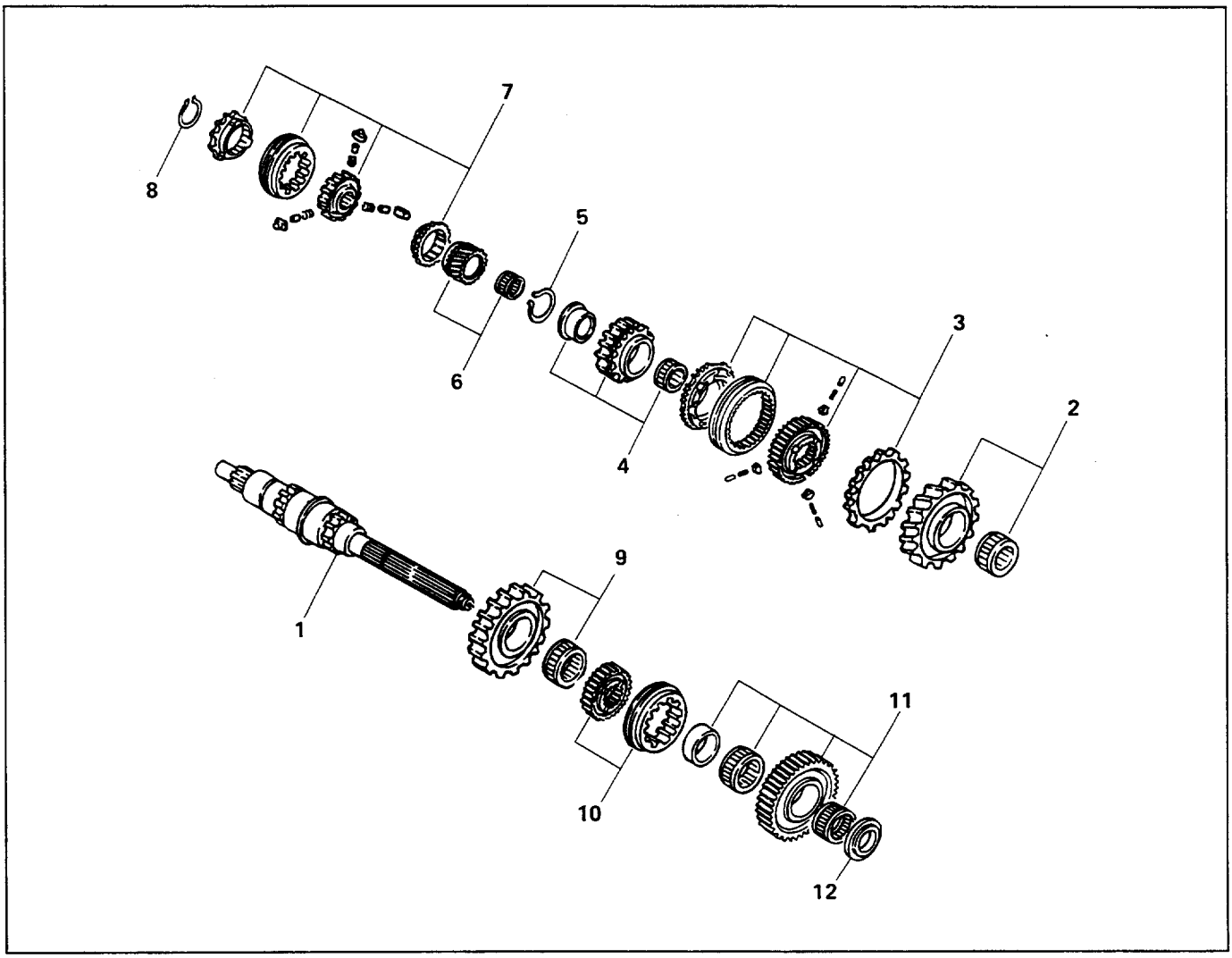
Measure the clearance between the synchronizer cone and synchronizer gear teeth.

If the measured valve exceeds the specified limit, the synchronizer assembly must be replaced.

Gear Teeth and Synchronizer Cone Clearance mm (in.)

Standard	Limit
1.1 (0.043)	0

REASSEMBLY



Reassembly Steps

1. Main shaft
2. 2nd gear and needle roller bearing
3. 2nd – 3rd synchronizer assembly
4. Collar, 3rd gear and needle roller bearing
5. Snap ring
6. 4th gear and needle roller bearing
7. 4th – 5th synchronizer assembly
8. Snap ring
9. Reverse gear and needle roller bearing
10. 1st – reverse sleeve and clutch hub
11. 1st gear, needle roller bearing and collar
12. Thrust washer

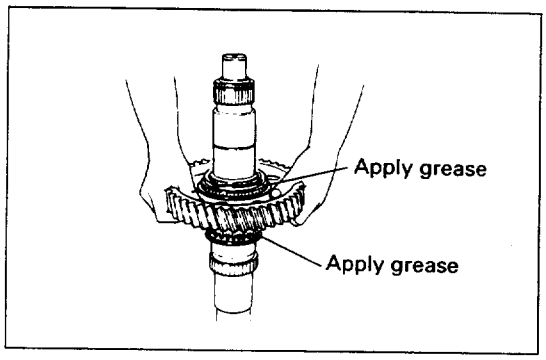
Reassembly Steps

NOTE:

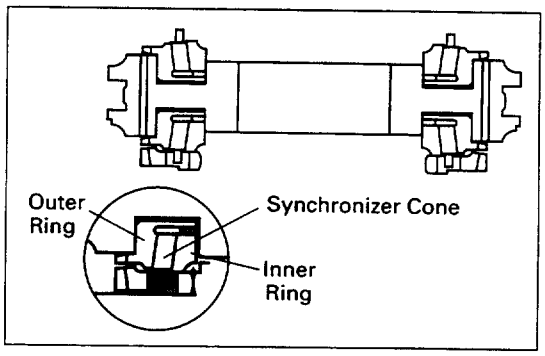
The main shaft assembly is very heavy. If it falls, it can cause serious injury to service personnel.

Place supports beneath the main shaft assembly to prevent it from falling.

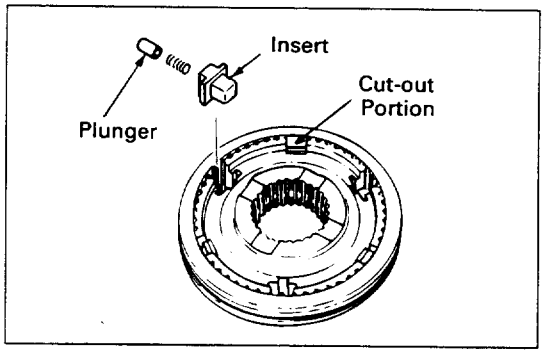
1. **Main Shaft**
2. **2nd Gear and Needle Roller Bearing**
   1. Secure main shaft with a vise and supporter. The top gear shaft side must be facing upward.
   2. Lubricate the main shaft with transmission oil.
   3. Apply grease to needle roller bearing
   4. Install the needle roller bearing and 2nd gear. The synchronizer gear teeth side of the 2nd gear must be facing upward.



3. **2nd – 3rd Synchronizer Assembly**
   1. Align synchronizer gear holes of the 2nd gear and synchronizer cone claws (4 portion).
   2. Align outer ring claw and inner ring groove (6 potion).
   3. Fit the outer ring to correct position by turning the 2nd gear.
   4. Reassemble the synchronizer of 3rd gear side in a same procedure.

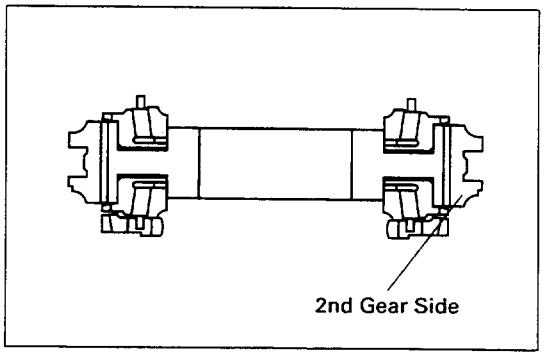


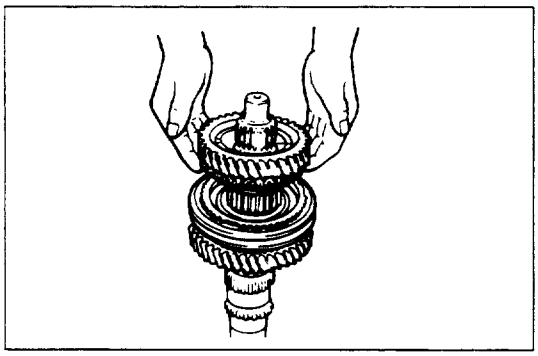
   5. Install insert, spring and plunger to the clutch hub.
   6. Align cut-out portion of sleeve spline and clutch hub groove (except plunger installing position).
   7. Install the sleeve to the clutch hub with pressing plunger.
   8. Note the direction as figure.



NOTE:

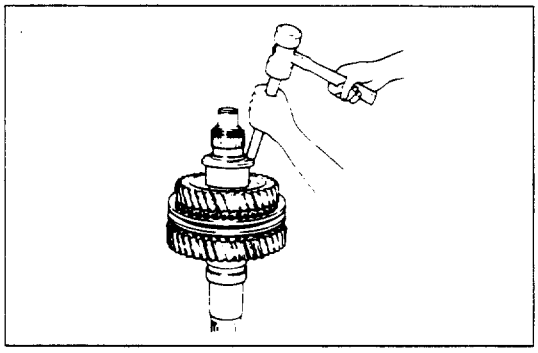
If the synchronizer cone claw and outer ring claw are not fit to holes or grooves, the synchronizer assembly cannot be reassemble to the correct position.





4. Collar, 3rd Gear and Needle Roller Bearing

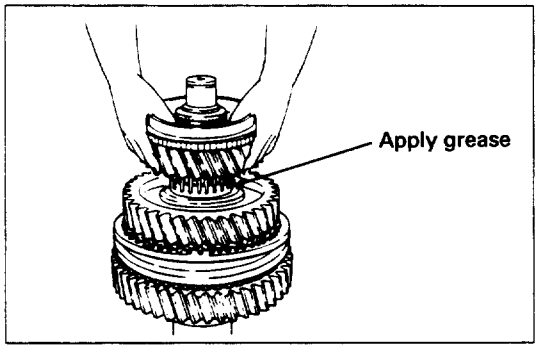
1. Apply grease to needle roller bearing.
2. Apply grease to 3rd gear thrust surface.
3. Install needle roller bearing and 3rd gear to the main shaft. The synchronizer gear side of the 3rd gear must be facing downward.



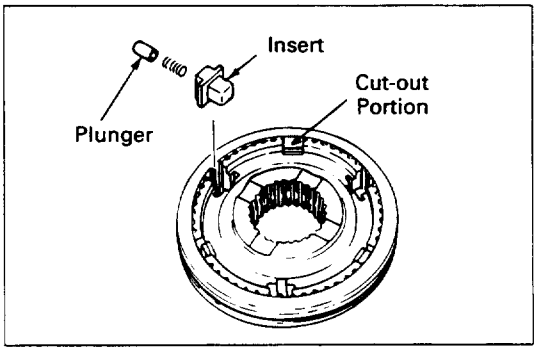
4. Install the collar to the main shaft by tapping with a brass bar.
5. Check that the 2nd and 3rd gear turn smoothly.

5. Snap Ring

6. 4th Gear and Needle Roller Bearing

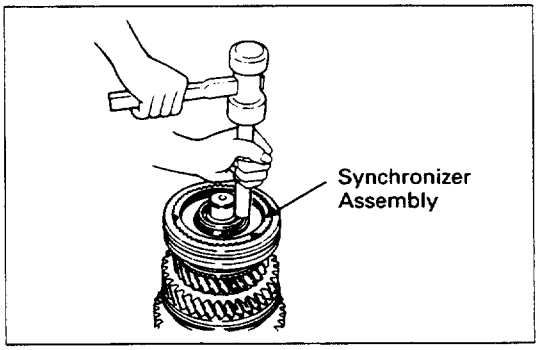


1. Apply grease to needle roller bearing.
2. Apply grease to 4th gear thrust surface.
3. Install needle roller bearing and 4th gear to the main shaft. The synchronizer gear side of the 4th gear must be facing upward.

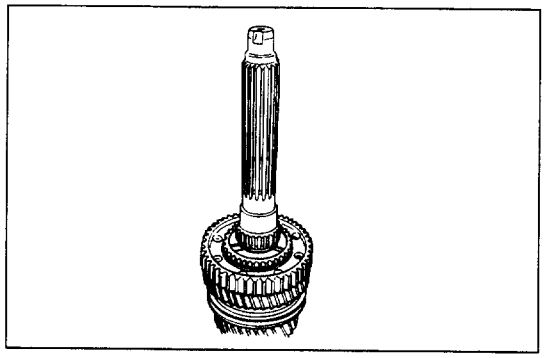


7. 4th – 5th Synchronizer Assembly

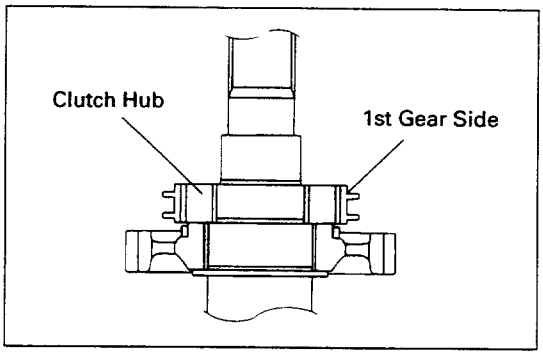
1. Align cut-out portion of sleeve spline and clutch hub groove (except plunger installing position).
2. Install the sleeve to the clutch hub with pressing plunger.



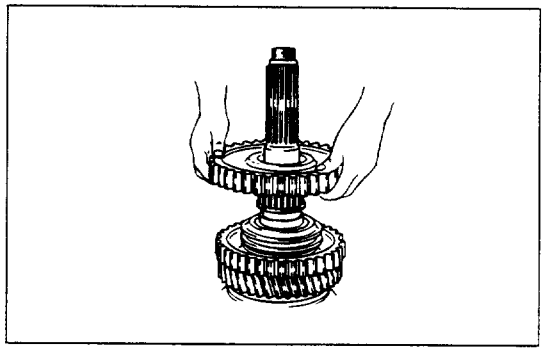
3. Fit the blocking ring to the correct position by turning the 4th gear.
4. Install the synchronizer assembly to the main shaft by tapping with a brass bar.
5. The clutch hub oil grooves must be facing 4th gear side.



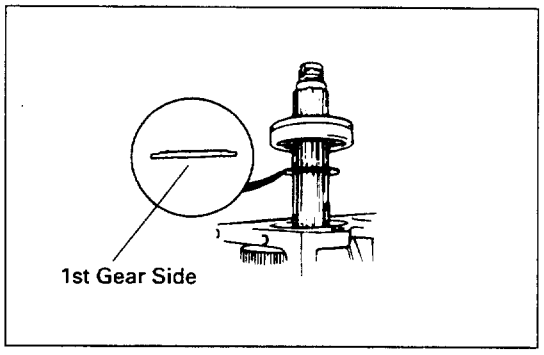
8. **Snap Ring**
9. **Reverse Gear and Needle Roller Bearing**
   1. Remove the main shaft assembly from a vise
   2. Apply grease to needle roller bearing.
   3. Apply grease to reverse gear thrust surface.
   4. Install needle roller bearing and reverse gear to the main shaft. The synchronizer gear side of the reverse gear must be facing upward.



10. **1st – Reverse Sleeve and Clutch Hub**
    1. Install the clutch hub to the main shaft assembly.
    2. Install the sleeve to the main shaft assembly
    3. Note the direction of the sleeve as figure.



11. **1st Gear, Needle Roller Bearing and Collar**
    1. Install the collar to the main shaft assembly.
    2. Apply grease to needle roller bearing.
    3. Install needle roller bearing to the collar.
    4. Apply grease to 1st gear thrust surface.
    5. Install the 1st gear to the main shaft. The synchronizer gear side of the 1st gear must be facing downward.

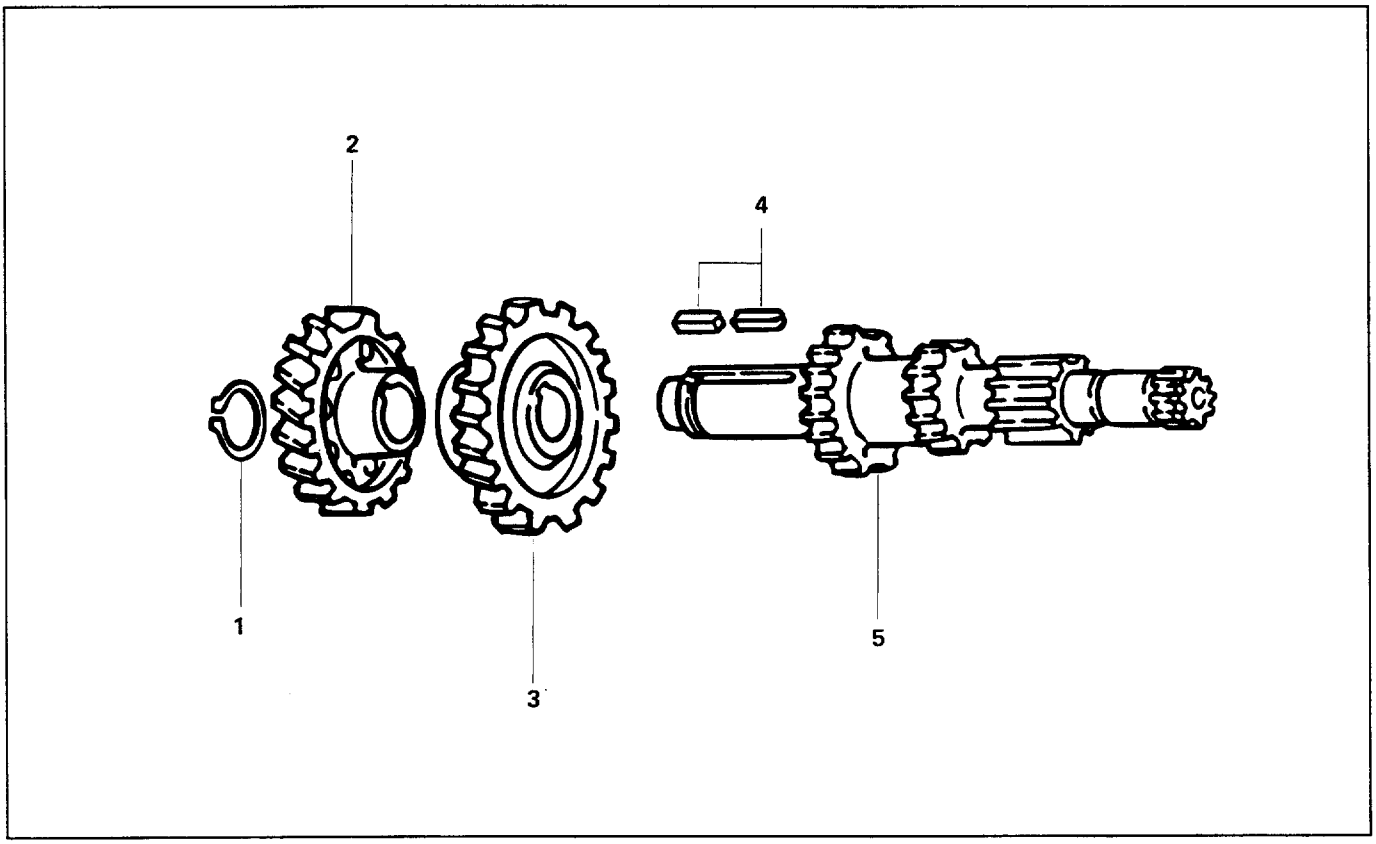


12. **Thrust Washer**
    1. Apply grease to the thrust washer, and install to the main shaft assembly.
    2. Thrust washer flat surface must be facing 1st gear side.

Install the holding fixture to the main shaft, then semi tighten the used flange nut.

COUNTER SHAFT ASSEMBLY

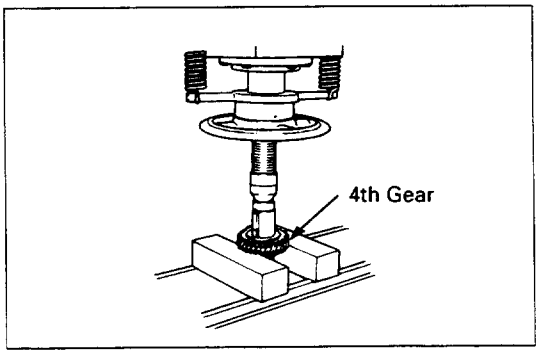
DISASSEMBLY



Disassembly Steps

1. Snap ring
2. Counter drive gear
3. 4th gear
4. Key
5. Counter shaft

Disassembly Steps



1. **Snap Ring**
2. **Counter Drive Gear**
3. **4th Gear**

   Use a bench press to remove the counter drive gear, 4th gear and key from counter shaft assembly.

   NOTE:

   Be careful not to damage to the counter shaft

4. **Key**
5. **Counter Shaft**

INSPECTION AND REPAIR

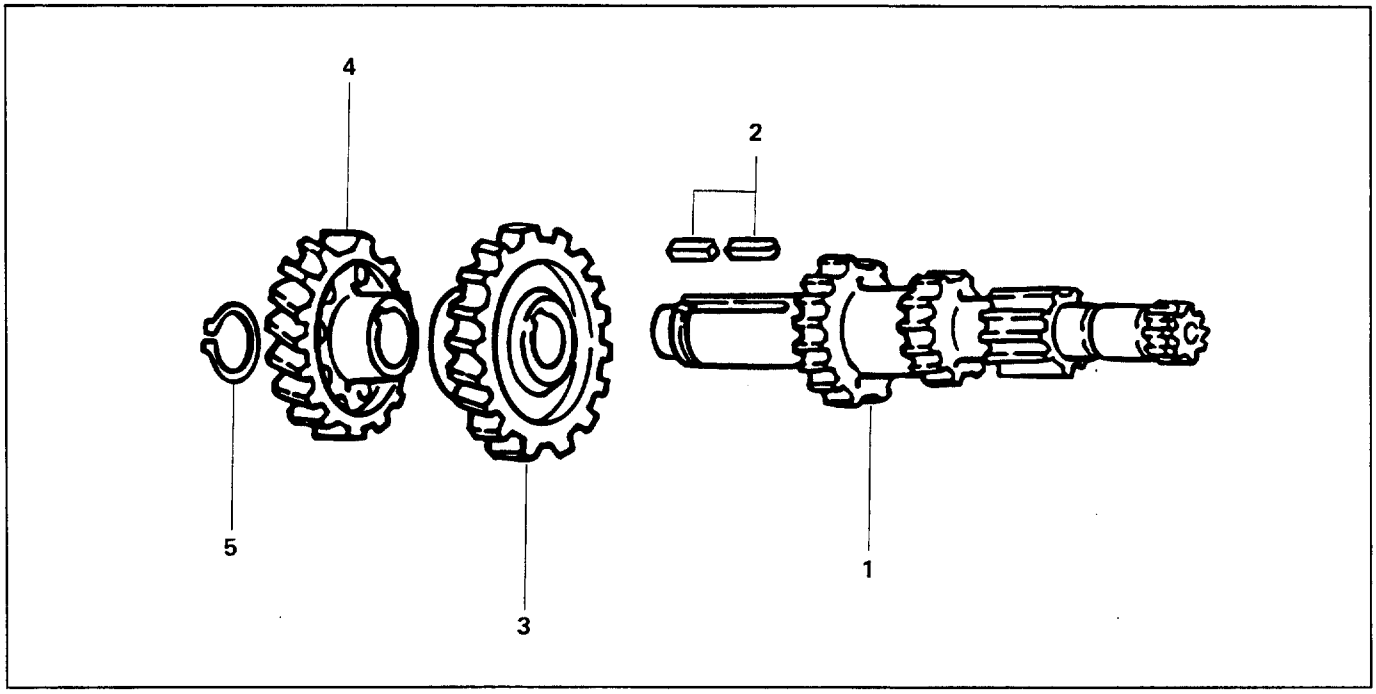
Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.

- Gears
- Counter shaft

Visual Check

Inspect all disassembled parts for wear, damage or other abnormal conditions.

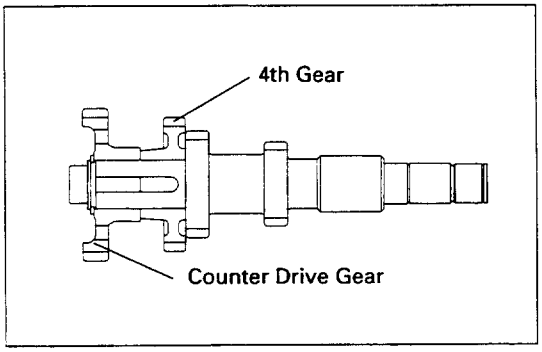
REASSEMBLY



Reassembly Steps

1. Counter shaft
2. Key
3. 4th gear
4. Counter drive gear
5. Snap ring

Reassembly Steps



1. **Counter Shaft**
2. **Key**
3. **4th Gear**
4. **Counter Drive Gear**
   1. Lubricate the counter shaft spindle with gear oil.
   2. Use a bench press to set each gear and key to install the counter shaft.
   3. Note the direction of each gears installation as figure.
5. **Snap Ring**

   Install the snap ring to the snap ring groove of the counter shaft firmly.

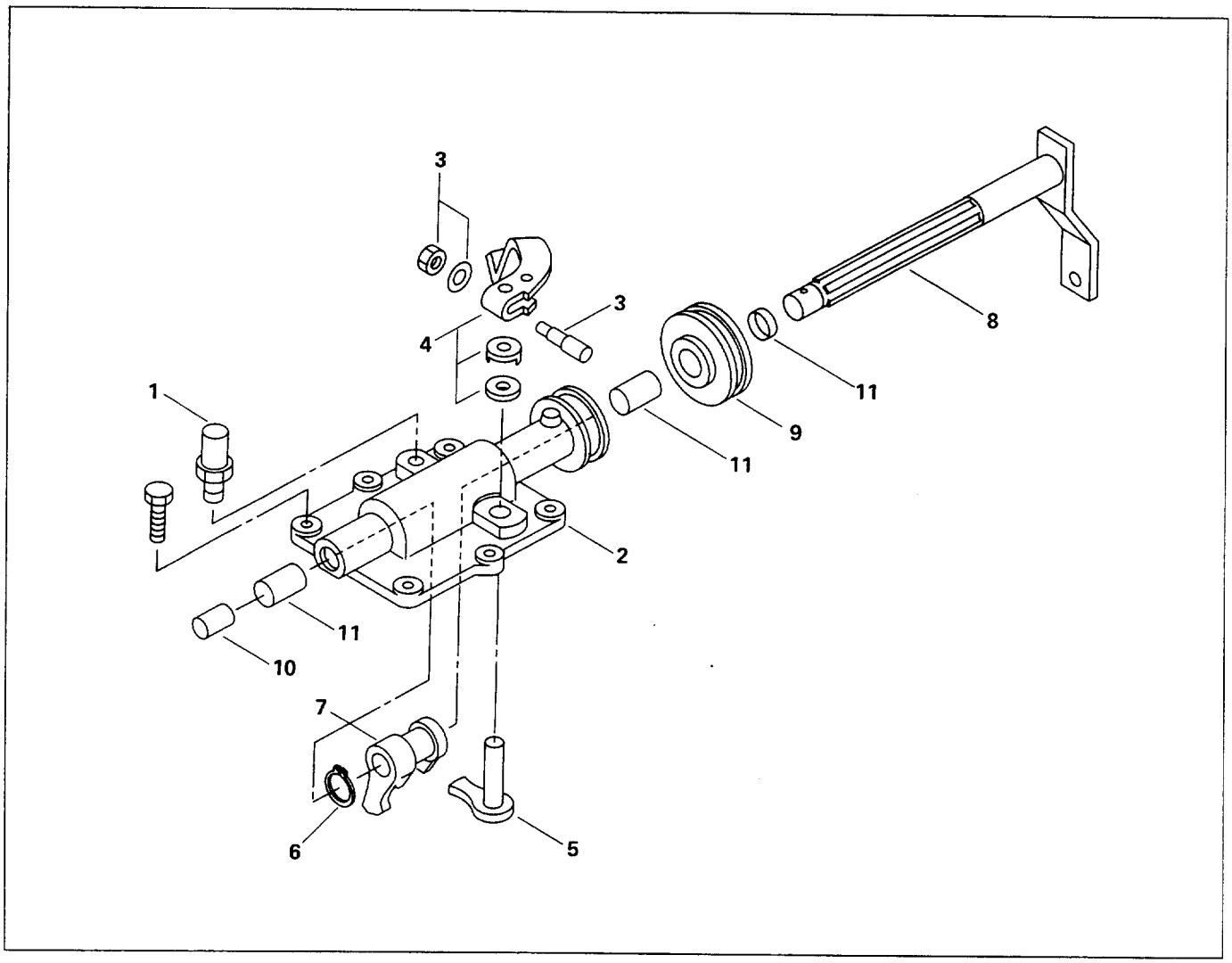
   NOTE:

   The counter shaft assembly is very heavy.

   Always support the counter shaft assembly with a hoist and wire.

UPPER QUADRANT BOX

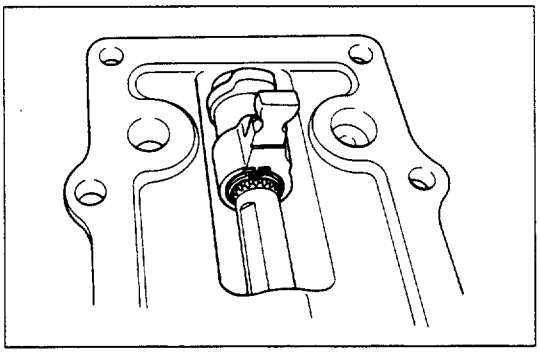
DISASSEMBLY



Disassembly Steps

1. Air breather
2. Upper quadrant box
3. Key bolt
4. External select lever
5. Internal select lever
6. Snap ring
7. Internal shift lever
8. Shift shaft
9. Boot
10. Cap
11. Oil seal and Bushing

Disassembly Steps



1. **Air Breather**
2. **Upper Quadrant Box**
3. **Key Bolt**
4. **External Select Lever**
5. **Internal Select Lever**
6. **Snap Ring**
7. **Internal Shift Lever**
8. **Shift Shaft**
   Remove the snap ring from snap ring groove on the shift shaft, then pull out the shift shaft.
9. **Boot**
10. **Cap**
11. **Oil Seal and Bushing**

INSPECTION AND REPAIR

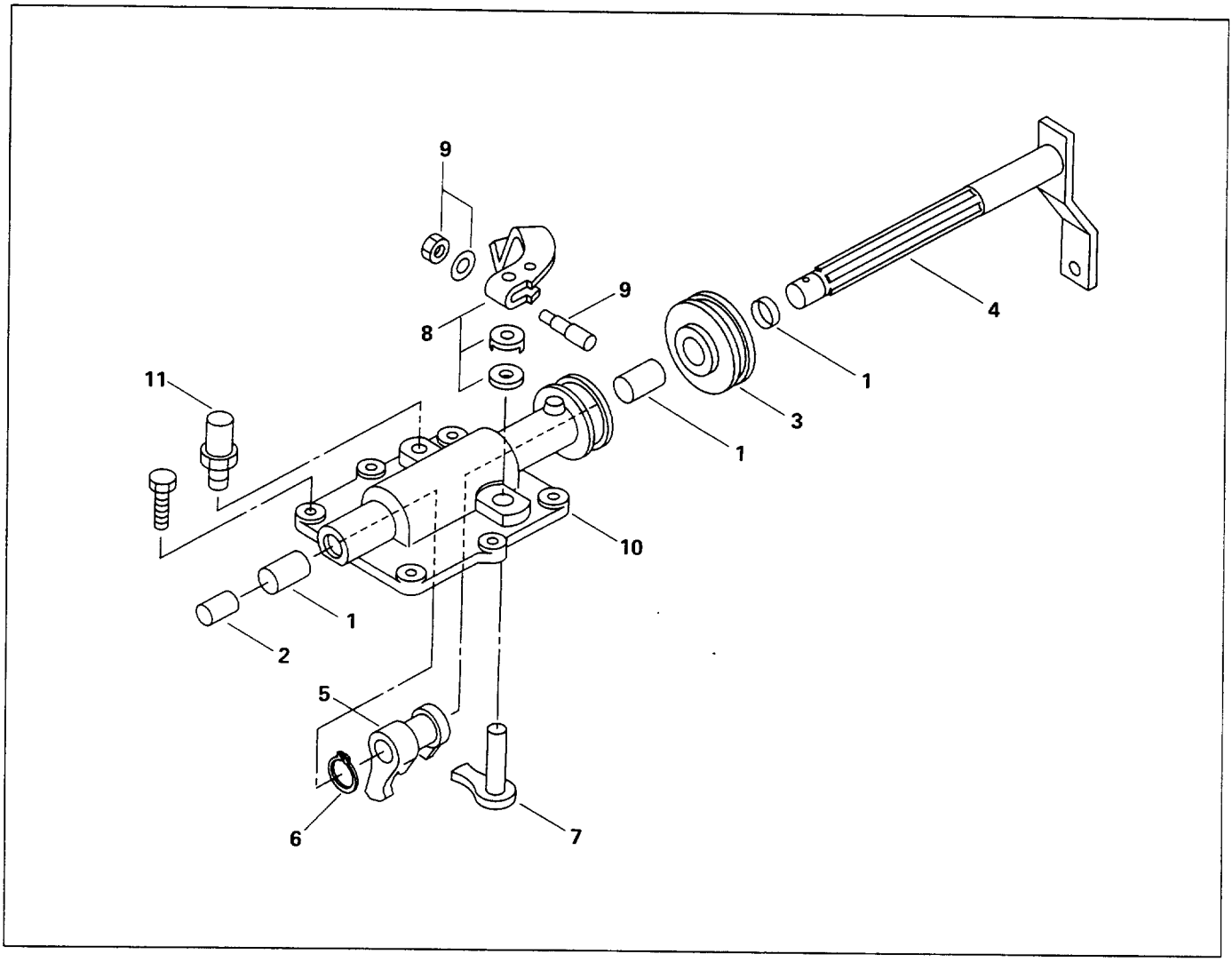
Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.

- Link rod ball joint
- Bushing
- Shift shaft
- Boot
- Oil seal
- Air Breather

Visual Check

Insect the following parts for wear, damage or other abnormal conditions.

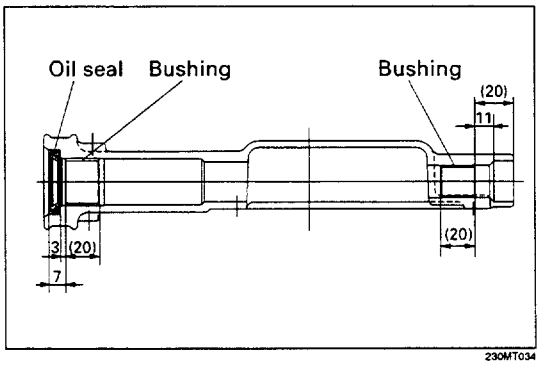
REASSEMBLY



Reassembly Steps

1. Oil seal and Bushing
2. Cap
3. Boot
4. Shift shaft
5. Internal shift lever
6. Snap ring
7. Internal select lever
8. External select lever
9. Key bolt
10. Upper quadrant box
11. Air breather

Reassembly Steps



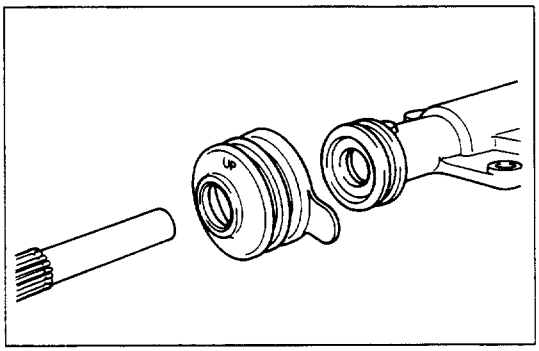
1. **Oil Seal and Bushing**
   - Apply engine oil to the oil seal outer circumference.
   - Apply multi-purpose type grease to the oil seal lip.

   Use a suitable bar to drive the bushing and install it specified depth as shown in the illustration.

   NOTE:

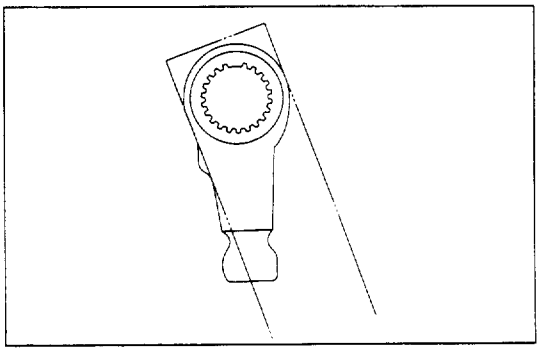
   Be sure to use a new oil seal.

   Be careful not to bend the bushing.



2. **Cap**
3. **Boot**

   Install the boot to the upper quadrant box. The "UP" mark of the boot must be facing upward.



4. **Shift Shaft**
5. **Internal Shift Lever**
6. **Snap Ring**
   1) Apply engine oil to the shift shaft sliding portion.
   2) Install the shift shaft to the upper quadrant box.
   3) Align the shift shaft spline and internal shift lever spline, install the internal shift lever to the shift shaft.
   4) Install the snap ring to the shift shaft snap ring groove.

   NOTE:

   Be careful not to damage the oil seal.

7. **Internal Select Lever**
8. **External Select Lever**

9. Key Bolt

1) Apply engine oil to the internal select lever sliding portion.
2) Install the internal select lever to the upper quadrant box.
3) Install the washer to the internal select lever.
4) Install the key bolt to the external select lever.

Key Bolt Nut Torque	N·m (kg·m / lb·ft)
	16 (1.6 / 12)

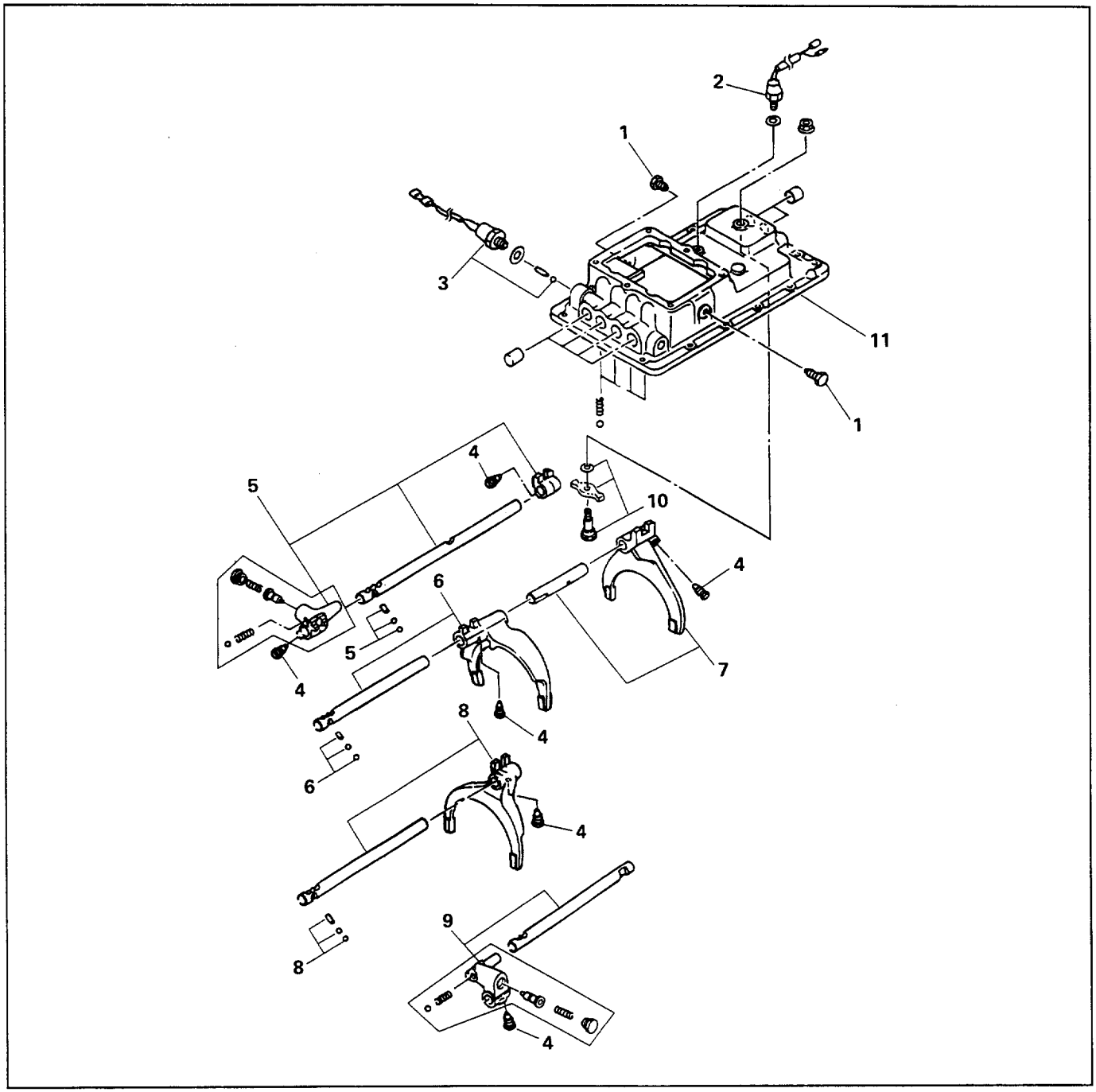
10. Upper Quadrant Box

11. Air Breather

Apply LOCTITE 242 or equivalent to the air breather threaded portion.
Install the air breather to the upper quadrant box.

LOWER QUADRANT BOX

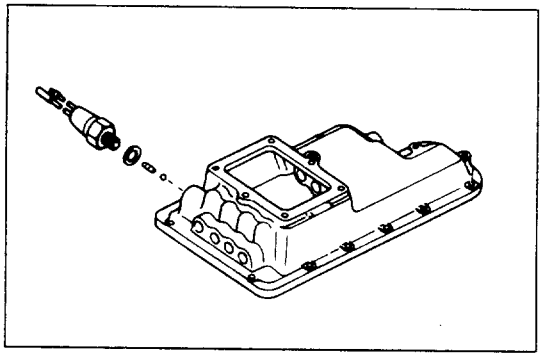
DISASSEMBLY



Disassembly Steps

1. Set bolt
2. Back up light switch
3. Neutral switch, pin and interlock ball
4. Lock bolt
5. 1st – reverse shift rod and shift block
6. 2nd – 3rd shift rod and shift arm
7. 1st – reverse shift rod and shift arm
8. 4th – 5th shift rod and shift arm
9. 6th shift rod and shift block
10. 1st – reverse shift lever and spindle
11. Lower quadrant box

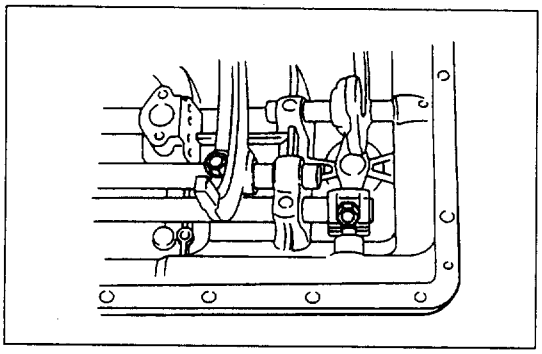
Disassembly Steps



1. **Set Bolt**
2. **Back Up Light Switch**
3. **Neutral Switch, Pin and Interlock Ball**
   - After remove the switch, remove a neutral switch pin and a ball from the hole.

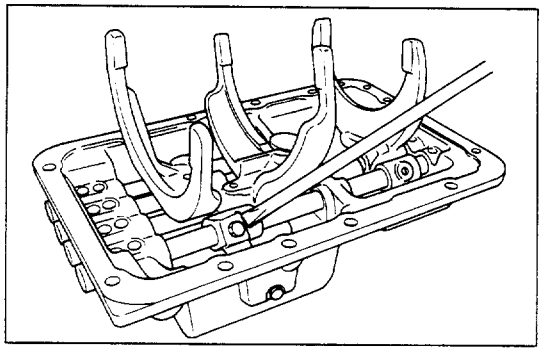
NOTE:

Be careful not to lose the interlock ball and pin.



4. **Lock Bolt**

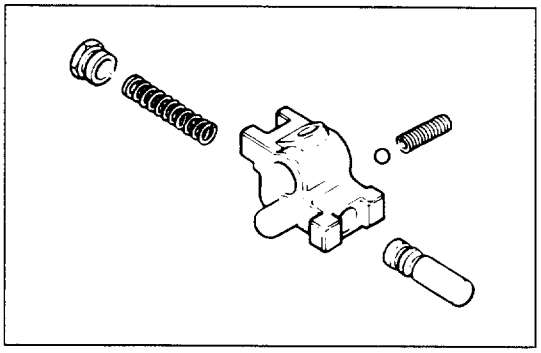
   Place the shift rod to the neutral position, and remove each lock bolts.



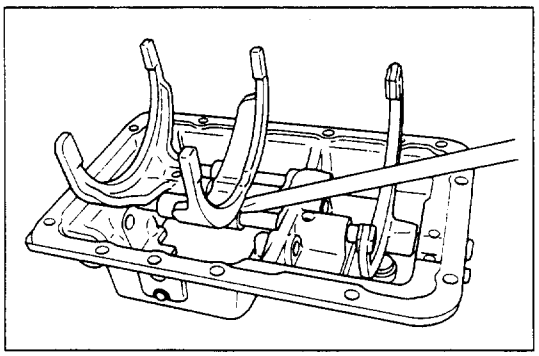
5. **1st – Reverse Shift Rod and Interlock Ball**
   - Temporarily tighten only the upper quadrant box side shift block to the regular position.
   - Drive out the rod together with cap. When removing parts, exercise care so as not to permit detent ball to snap out of position.
   - The interlock pin is loosely fitted in the shift rod which is installed in position between the interlock balls. Do not lose the pin after removal of the rod.

NOTE:

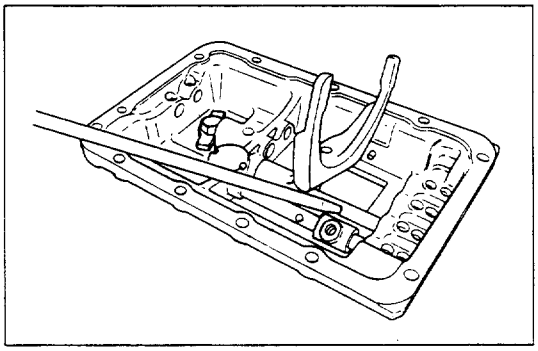
Be careful not to damage the shift rod and quadrant box inner surface.



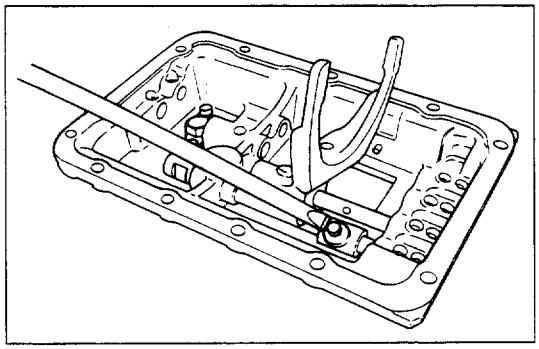
- Disassemble the shift block assembly.
  Remove the cap from the shift block and draw out the return spring and sleeve. A locking ball and locking spring will jump out when the sleeve is pulled out, so be careful not to lose them.



6. **2nd – 3rd Shift Rod and Shift Arm**
   - Refer to disassembly step for No.5.



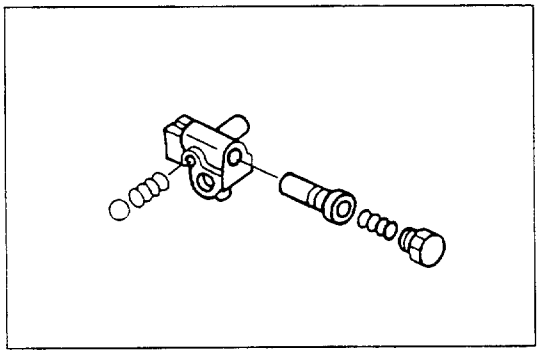
7. **1st – Reverse Shift Rod and Shift Arm**
8. **4th – 5th Shift Rod and Shift Arm**
   - Refer to disassembly step for No.5.



9. **6th Shift Rod and Shift Block**
   - Temporarily tighten the shift block to the regular position.
   - Drive out the rod together with cap. When removing parts, exercise care so as not to permit detent ball to snap out of position.
   - The interlock pin is loosely fitted in the shift rod which is installed in position between the interlock balls. Do not lose the pin after removal of the rod.

NOTE:

Be careful not to damage the shift rod and quadrant box inner surface.



   - Disassemble the shift block assembly.
     Remove the cap from the shift block and draw out the return spring and sleeve. A locking ball and locking spring will jump out when the sleeve is pulled out, so be careful not to lose them.

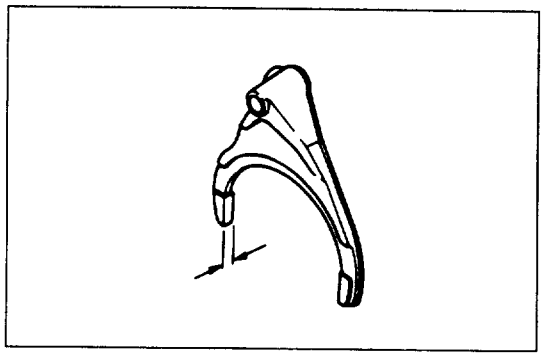
10. **1st – Reverse Shift Lever and Spindle**
11. **Lower Quadrant Box**

INSPECTION AND REPAIR

Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.

Visual Check

- Inspect all disassembled parts for wear, damage or other abnormal conditions.
- Inspect the following parts paying particular attention to the points shown in the illustrations.



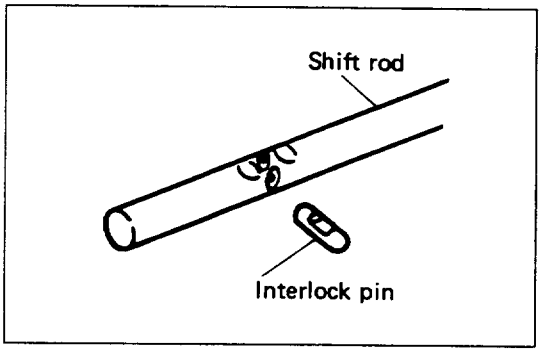
Shift Arm

Measure each shift arm thickness.

Shift Arm Thickness mm (in)

Standard	Limit
11.0 (0.433)	10.0 (0.394)

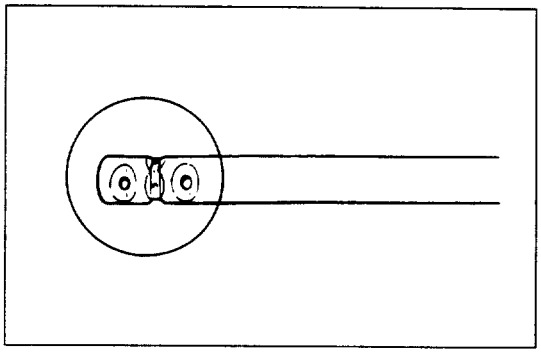
If the measured value exceeds the specified limit, the shift arm should be replaced.

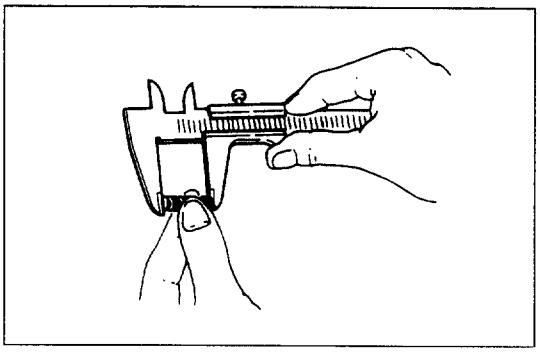


Shift Rod and Interlock Pin Assembly

Check the shift rods for excessively worn detent grooves.

If the detent groove wear is excessive, the shift rod should be replaced.





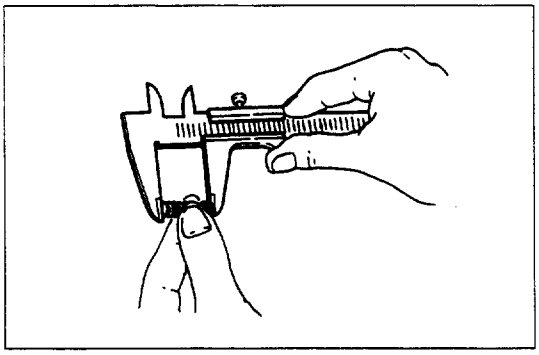
Detent Spring

Measure the detent spring.

Detent Spring Free Length (Reference) mm (in)

Standard	Limit
28.0 (1.102)	26.0 (1.024)

If the measured value exceeds the specified limit, detent spring should be replaced.



Shift Block Assembly

Measure sleeve return spring and lock ball spring.

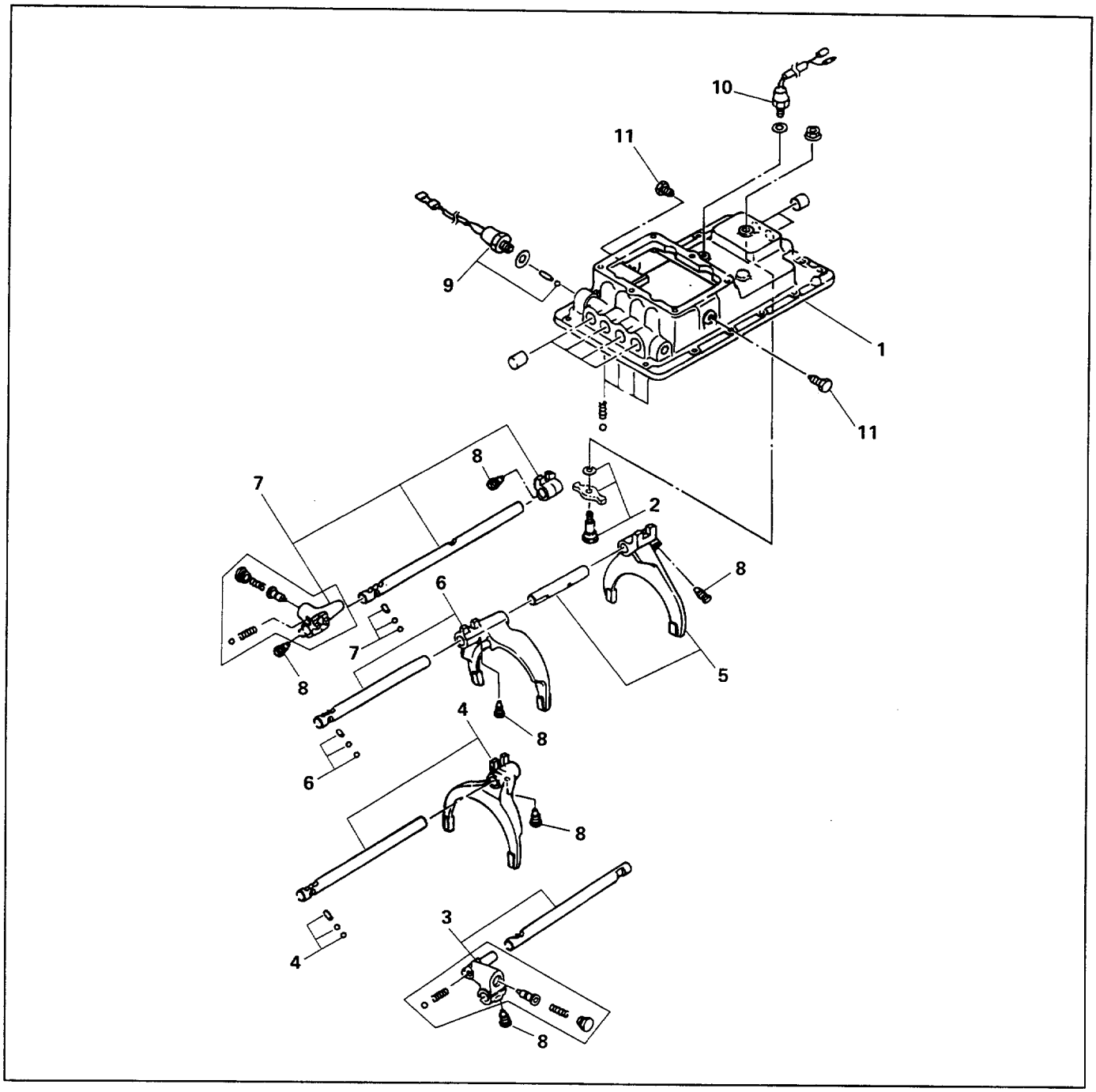
Sleeve Return Spring Free Length (Reference) mm (in.)

1st – Reverse	6th
61.5 (2.421)	61.5 (2.421)

Lock Ball Spring (Reference) mm (in.)

1st – Reverse	6th
35 (1.378)	33 (1.299)

REASSEMBLY



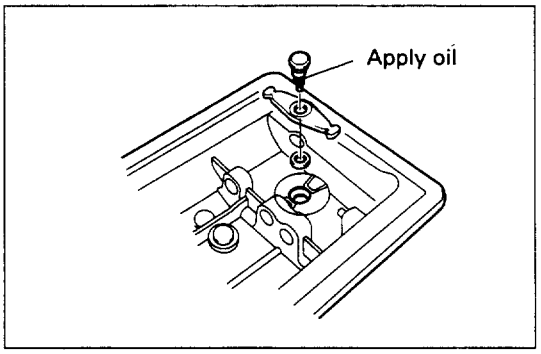
Reassembly Steps

1. Lower quadrant box
2. 1st – reverse spindle and shift lever
3. 6th shift rod and shift block
4. 4th – 5th shift rod and shift arm
5. 1st – reverse shift rod and shift arm
6. 2nd – 3rd shift rod and shift arm
7. 1st – reverse shift rod and shift block
8. Lock bolt
9. Neutral switch, pin and interlock ball
10. Back up light switch
11. Set bolt

Reassembly Steps

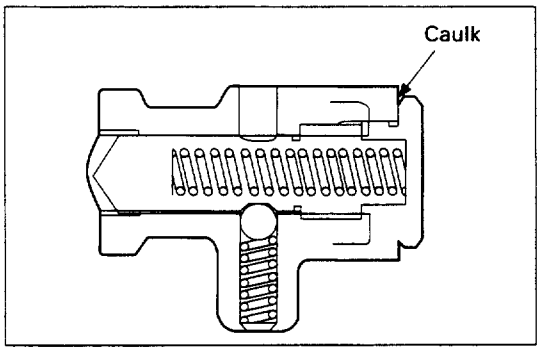
Preparation

Clean each parts, and apply gear oil to sliding surface.



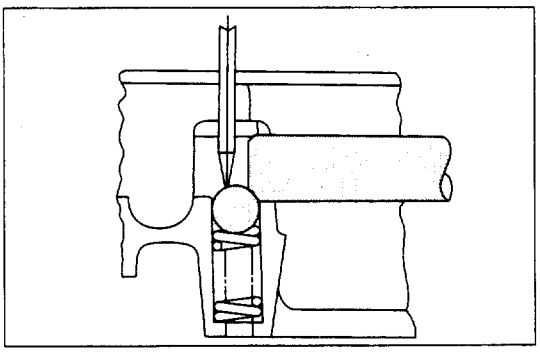
1. **Lower Quadrant Box**
2. **1st – Reverse Spindle and Shift Lever**
   - Apply engine oil to the spindle.
   - Install the spindle and shift lever to the lower quadrant box.

Spindle Nut Torque	N·m (kg·m / lb·ft)
	50 (5.1 / 37)

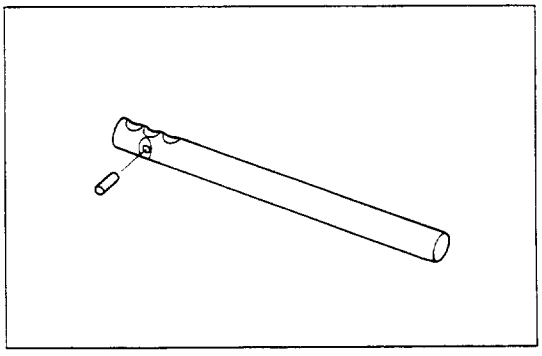


3. **6th Shift Rod and Shift Block**
   - Insert the lock ball spring and ball to the shift block.
   - Apply engine oil and install the sleeve.
   - Tighten cap to the specified torque, then caulk 1 portion.

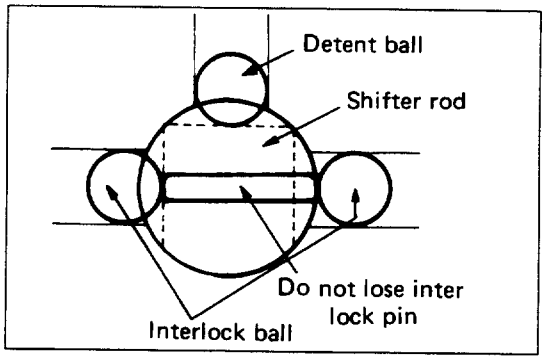
Cap Torque	N·m (kg·m / lb·ft)
	88 (9 / 65)



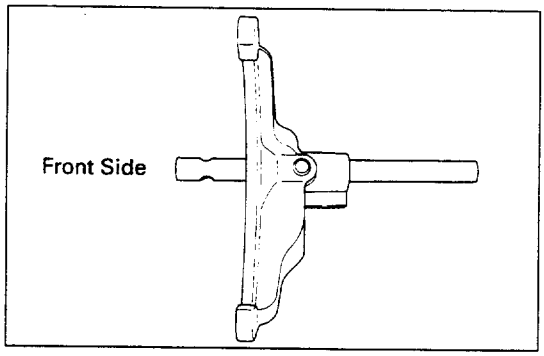
- Apply engine oil to rod.
- Insert detent spring and ball to the shift box.
- Install shift rod and arm in proper direction of installation, then set the rod in neutral position.
- Semi tighten the lock bolt to the shift block.



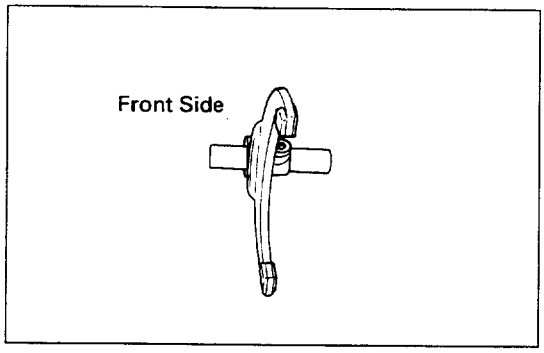
4. **4th – 5th Shift Rod and Shift Arm**
   - Apply engine oil to rod, and insert the inter lock pin.



- The interlock pin is fitted in the shift rod which is installed in position between the lock balls. When installing rod, exercise care to prevent the pin from being mislocated.

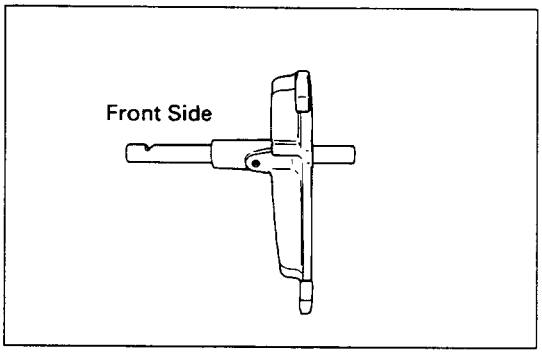


- Install shift rod and arm in proper direction of installation, then set rod in neutral position.



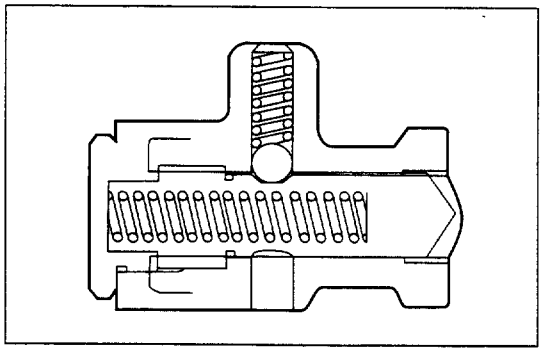
5. 1st – Reverse Shift Rod and Shift Arm

- Refer to reassembly procedure No.4.
- Note the direction of shift arm installation as figure.



6. 2nd – 3rd Shift Rod and Shift Arm

- Refer to reassembly procedure No.4.
- Note the direction of shift arm installation as figure.

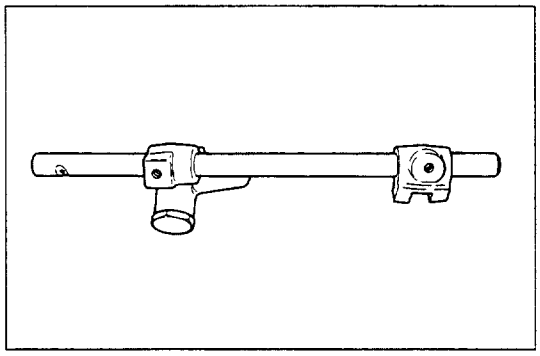


7. 1st – Reverse Shift Rod and Shift Block

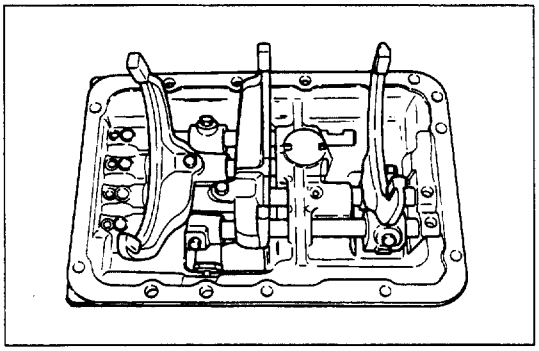
- Insert the lock ball spring and ball to the shift block.
- Apply engine oil and install the sleeve.
- Apply liquid gasket (LOCTITE 242 or equivalent) to threaded portion of the cap.

Cap Torque	N·m (kg·m / lb·ft)
	88 (9 / 65)

- Refer to reassembly procedure No.4.



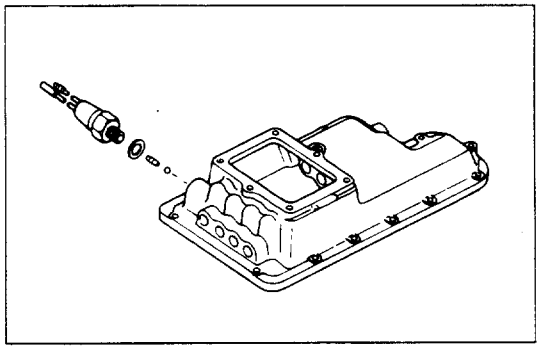
- Note the direction of shift block installation as figure.



8. Lock Bolt

- Apply liquid gasket (LOCTITE 262 or equivalent) to threaded portion of the bolt.
- Tighten lock bolts to the specified torque.

Lock Bolt Torque	N·m (kg·m / lb·ft)
	20 (2.0 / 14)



9. Neutral Switch, Pin and Interlock Ball

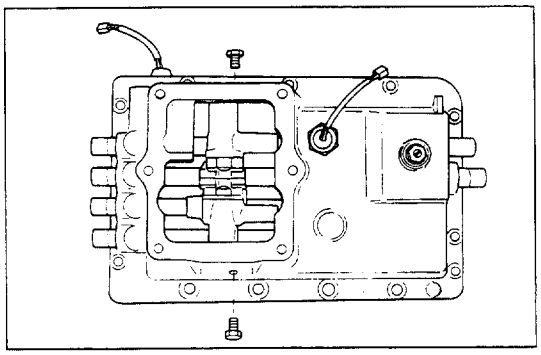
Insert interlock ball and pin to the switch hole, and tighten neutral switch to the specified torque.

Neutral Switch Torque	N·m (kg·m / lb·ft)
	20 (2.0 / 14)

10. Back Up Light Switch

Tighten back up light switch to the specified torque.

Back Up light Switch Torque	N·m (kg·m / lb·ft)
	20 (2.0 / 14)



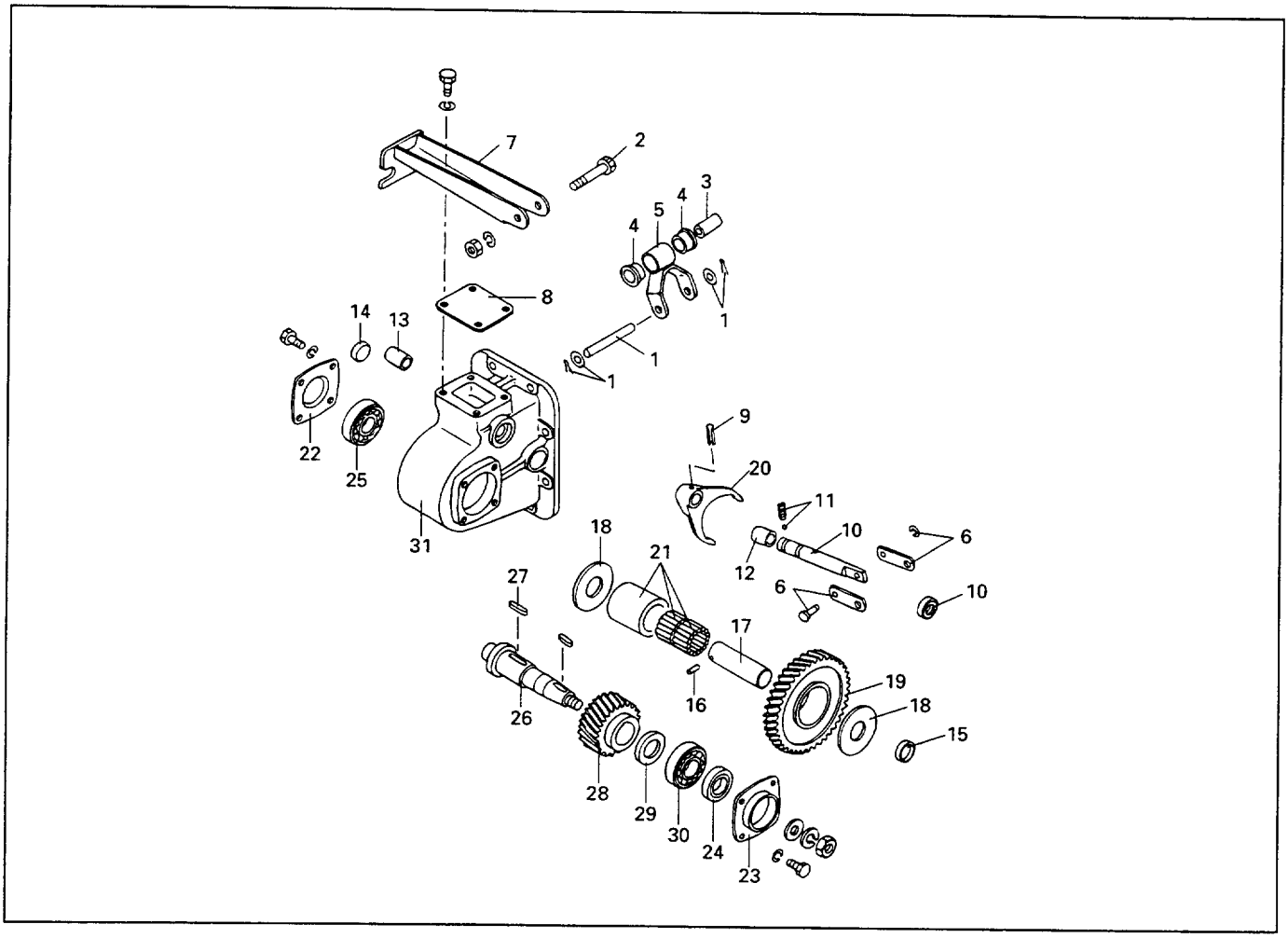
11. Set Bolt

Apply liquid gasket (LOCTITE 242 or equivalent) to threaded portion of the set bolt.

Set Bolt Torque	N·m (kg·m / lb·ft)
	18 (1.8 / 13)

SIDE POWER TAKE-OFF

DISASSEMBLY

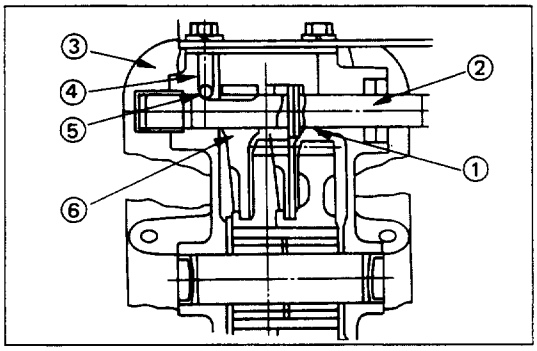


Disassembly Steps

1. Cotter pin, washer and pin
2. Bolt, washer and nut
3. Distance collar
4. Bushing
5. Control lever
6. Snap ring, plate and pin
7. Control lever bracket
8. Upper cover
9. Spring pin
10. Shift rod and oil seal
11. Spring and ball
12. Shift rod stopper
13. Cover
14. Plug
15. Plug
16. Spring pin
17. Idler gear shaft
18. Thrust washer
19. Idler gear
20. Shift arm
21. Needle roller bearing
22. Front cover
23. Rear cover
24. Oil seal
25. Front bearing
26. Output shaft
27. Key
28. Output gear
29. Distance collar
30. Rear bearing
31. Gear case

Disassembly Steps

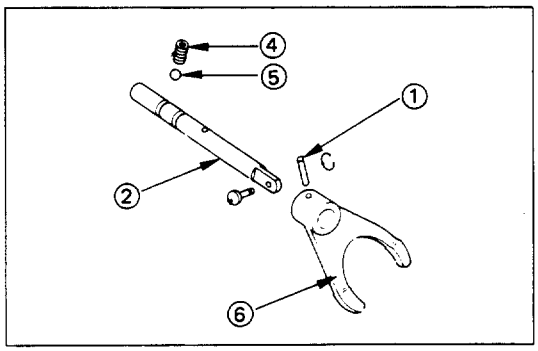
1. **Cotter Pin, Washer and Pin**
2. **Bolt, Washer and Nut**
3. **Distance collar**
4. **Bushing**
5. **Control Lever**
6. **Snap Ring, Plate and Pin**
7. **Control Lever Bracket**
8. **Upper Cover and Gasket**
9. **Spring pin**
10. **Shift Rod and Oil Seal**
11. **Spring and Ball**
    1. Use a hammer and a drift punch to drive out the spring pin ①.
       Drive the pin in a downward direction.
    2. Remove the shift rod ② or the shift rod and O-ring from the rear side of the gear case ③.



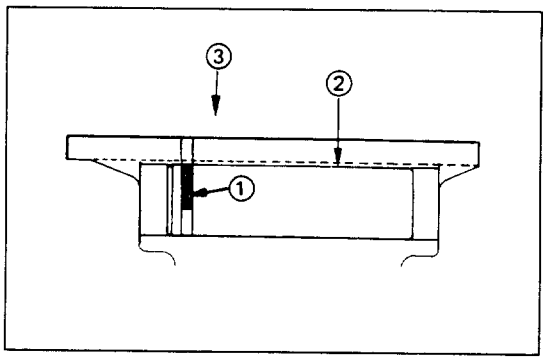
NOTE:

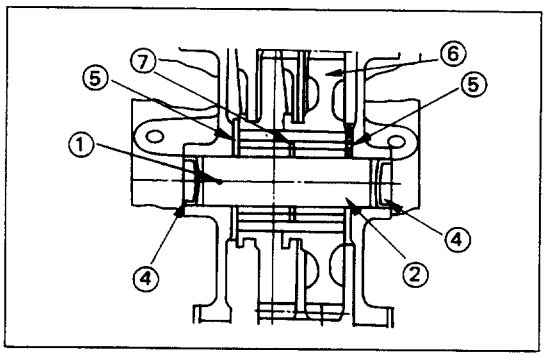
Take care not to misplace the spring ④ and the ball ⑤ or the straight pin and ball.

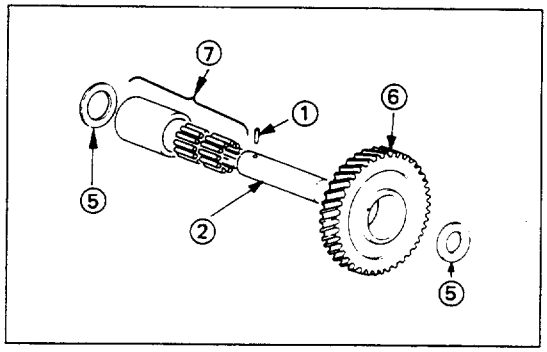
Leave the shift arm in the gear case. Remove it after removing the idler gear.



12. **Shift Rod Stopper**
13. **Cover**
14. **Plug**
15. **Plug**
16. **Spring Pin**
17. **Idler Gear Shaft**
18. **Thrust Washer**
19. **Idler Gear**
20. **Shift Arm**







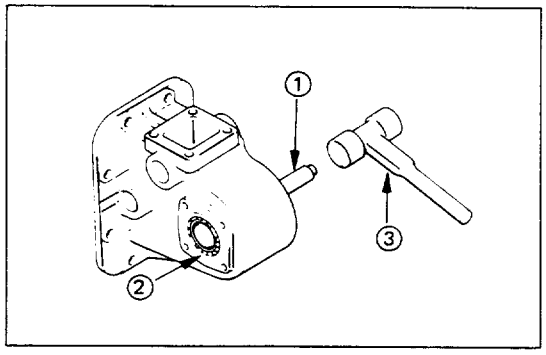
21. Needle Roller Bearing

1. Drive the spring pin ① into the idler gear shaft ② from the gear case opening side ③.
2. Use a hammer and brass bar to drive out the plugs ④ along with the idler gear shaft ②.
3. Remove the idler gear shaft ② from the gear case.
4. Use a hammer and a drift punch to drive the spring pin from the idler gear shaft.
5. Remove the thrust washer ⑤, the idler gear ⑥, and the needle bearing ⑦ from the gear case opening side.

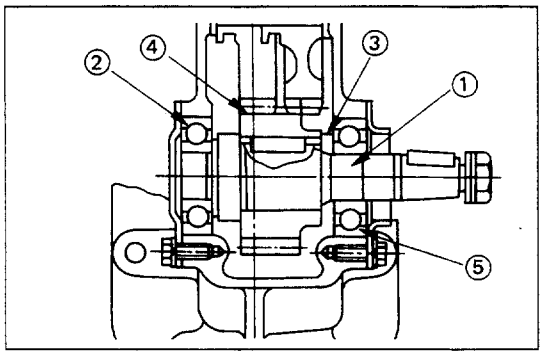
NOTE:

Take care not to allow the needle bearings to fall from the bearing case.

22. Front Cover and Gasket
23. Rear Cover and Gasket
24. Oil Seal
25. Front Bearing
26. Output Shaft
27. Key
28. Output Gear
29. Distance Collar
30. Rear Bearing



1. Use a hammer and a brass bar to drive out the output shaft ① and the front bearing ②.
   Drive the shaft towards the front of the gear case.



2. Use a bench press and a bearing remover to remove the front bearing from the output shaft.
3. Remove the keys from the output shaft.
4. Remove the distance collar ③ and the output gear ④ from the gear case opening side.
5. Use a hammer and a bearing remover to drive out the rear bearing ⑤ towards the rear of the gear case.

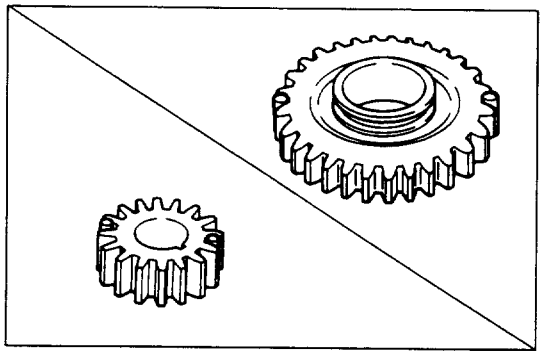
31. Gear Case

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.

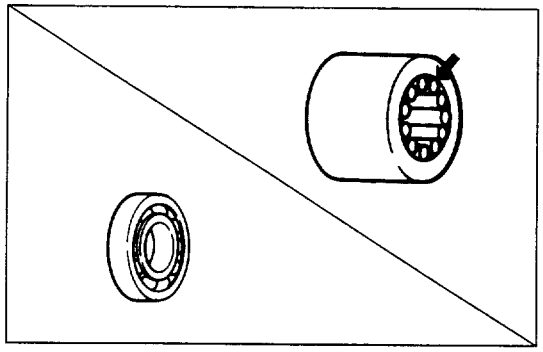
Visual Check

Visually inspect the following parts for excessive wear and damage.



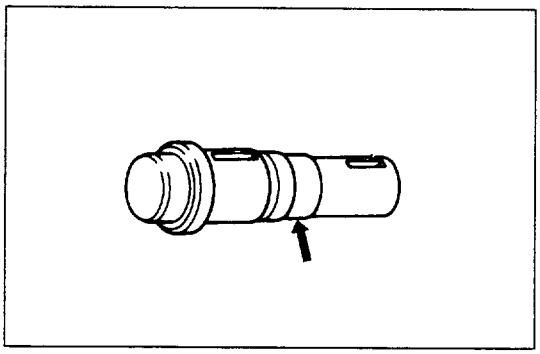
Idler Gear and Output Gear

Check the gear surfaces.



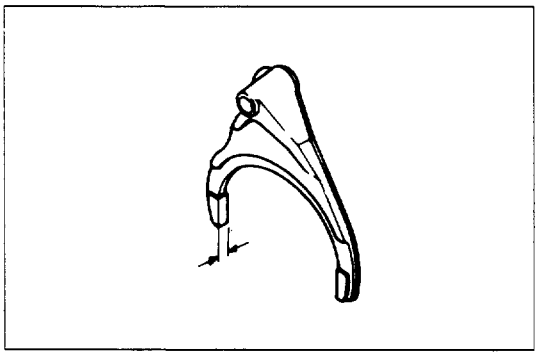
Needle Roller Bearings and Other Bearings

Check the bearing roller surfaces.



Output Shaft

Check the oil seal seating surfaces.



Shift Arm Thickness

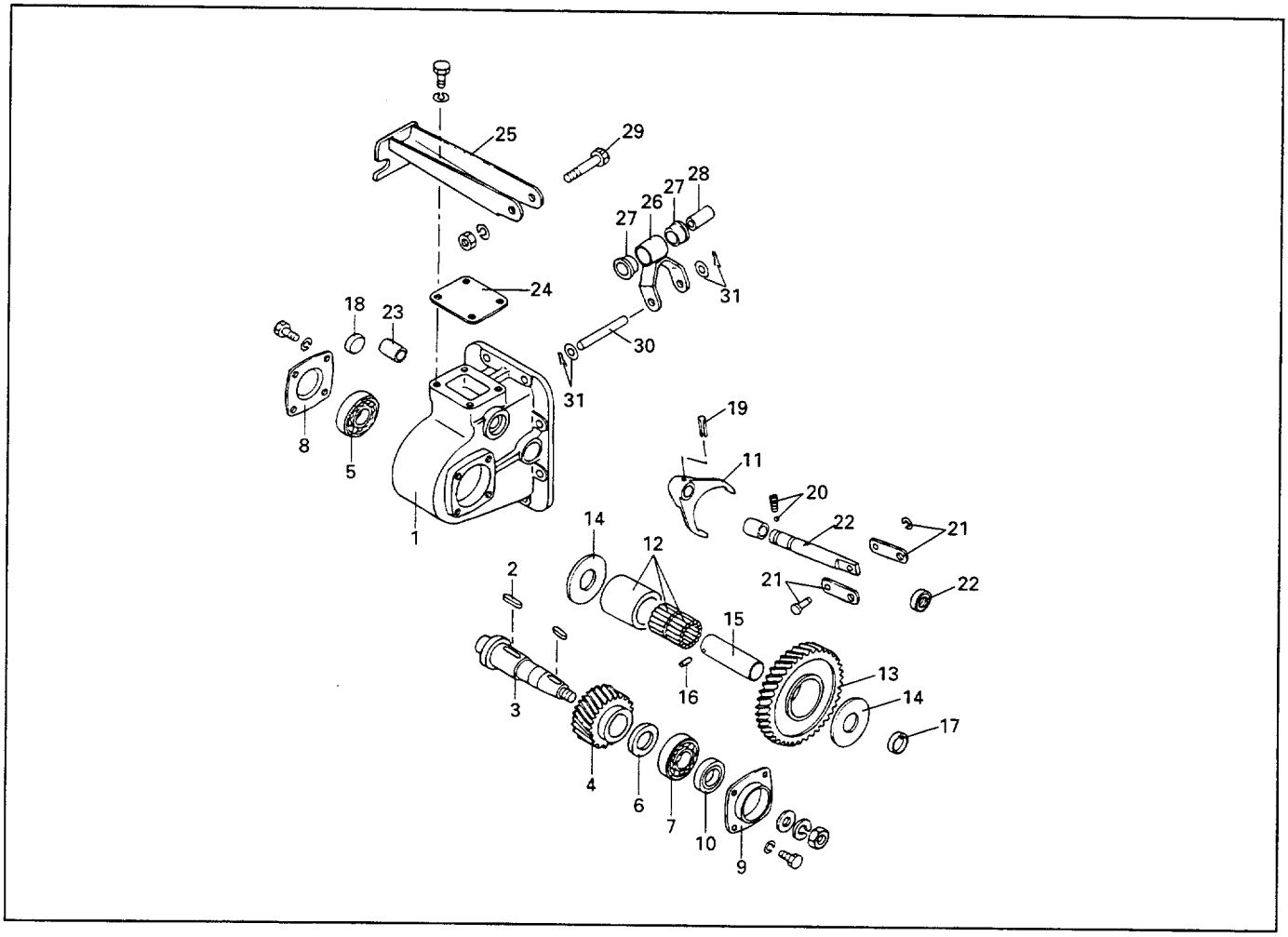
Use a vernier caliper to measure the shift arm thickness.

Shift Arm Thickness mm (in)

Standard	Limit
7.0 (0.276)	6.0 (0.236)

If the measured value is less than the specified limit, the shift arm must be replaced.

REASSEMBLY

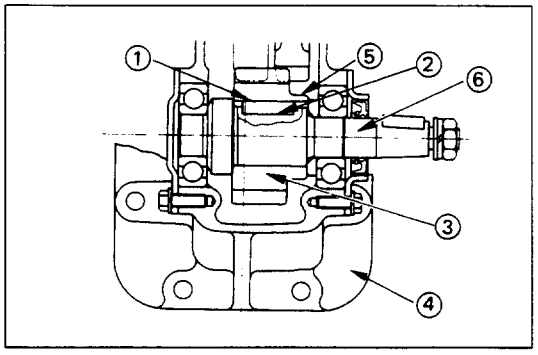


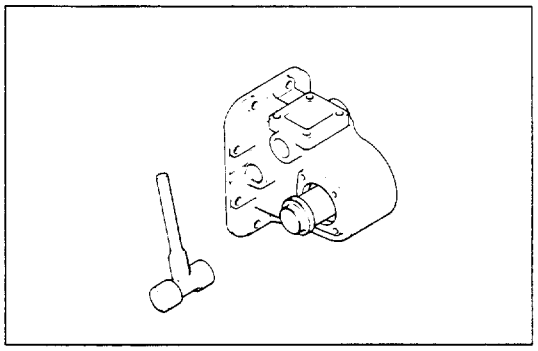
Reassembly Steps

1. Gear case
2. Key
3. Output shaft
4. Output gear
5. Front bearing
6. Distance collar
7. Rear bearing
8. Front cover
9. Rear cover
10. Oil seal
11. Shift arm
12. Needle roller bearing
13. Idler gear
14. Thrust washer
15. Idler gear shaft
16. Spring pin
17. Plug
18. Plug
19. Spring pin
20. Spring and ball
21. Snap ring, plate and pin
22. Shift rod and oil seal
23. Cover
24. Upper cover
25. Control lever bracket
26. Control lever
27. Bushing
28. Distance collar
29. Bolt, spring washer, and nut
30. Pin
31. Cotter pin and washer

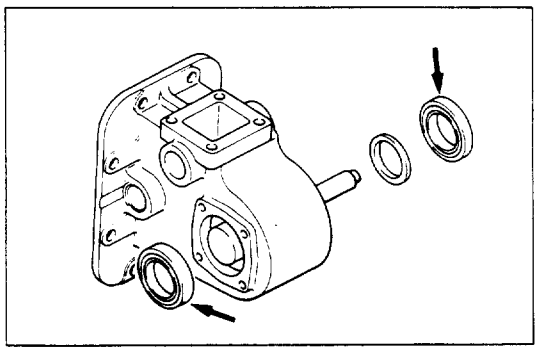
Reassembly Steps

1. **Gear Case**
2. **Key**
3. **Output Shaft**
4. **Output Gear**
   1. Use a copper hammer to drive the key ① into the output shaft key groove ②.
   2. Install the output gear ③ to the gear case ④ from the gear case opening side.
      The gear boss ⑤ must be facing the rear of the gear case.
   3. Align the output gear key groove with the output shaft key.
   4. Use a copper hammer to drive the output shaft ⑥ into the output gear from the front side of the gear case.

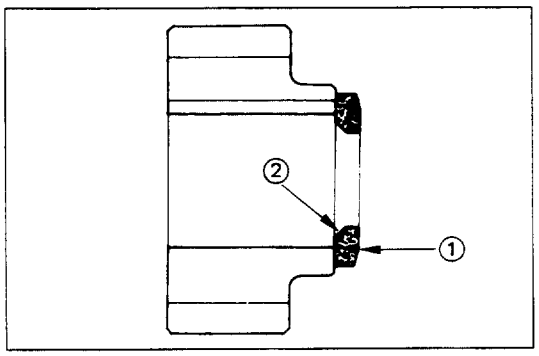


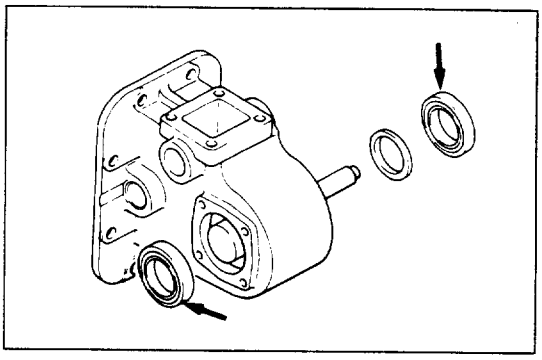


5. **Front Bearing**
   1. Apply gear oil to the bearing outer circumference.
   2. Use a hammer and a bearing installer to drive the bearing into the gear case.



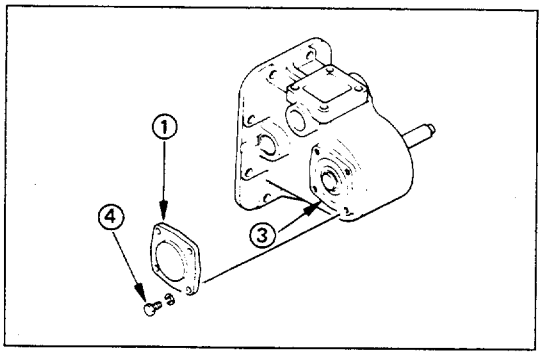
6. **Distance Collar**
   Install the distance collar ① to the output shaft.
   The distance collar inside chamfer ② must be facing the front side of the gear case.





7. Rear Bearing

1. Apply gear oil to the bearing outer circumference.
2. Use a hammer and a bearing installer to drive the bearing into the gear case.

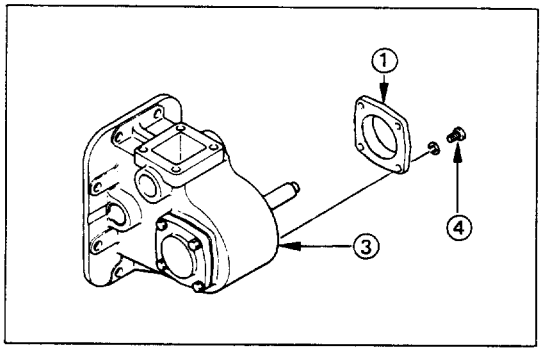


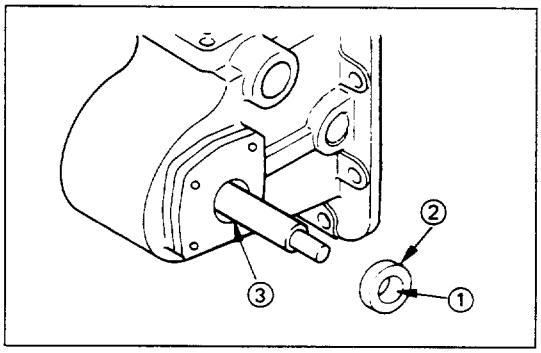
8. Front Cover and Gasket

9. Rear Cover and Gasket

1. Apply liquid gasket LOCTITE (FMD-127 or equivalent) to each of the covers ①.
2. Install the covers to the front and rear of the gear case ③.
3. Tighten the cover bolts ④ to the specified torque.

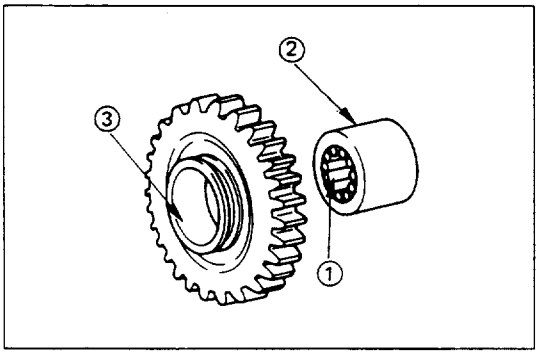
Bolts Torque	N·m (kg·m / lb·ft)
	18 (1.8 / 13)





10. Oil Seal

1. Apply chassis grease to the oil seal lip ①.
2. Apply gear oil to the oil seal outer circumference ②.
3. Install the oil seal to the cover ③ from the rear side.

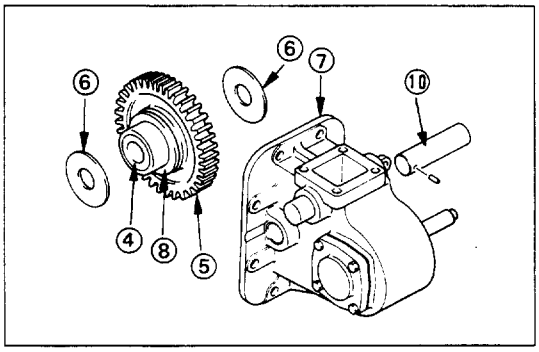


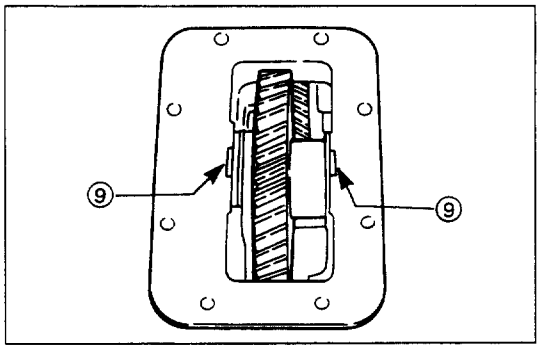
11. **Shift Arm**
12. **Needle Roller Bearing**
13. **Idler Gear**
14. **Thrust Washer**
15. **Idler Gear Shaft**
16. **Spring Pin**

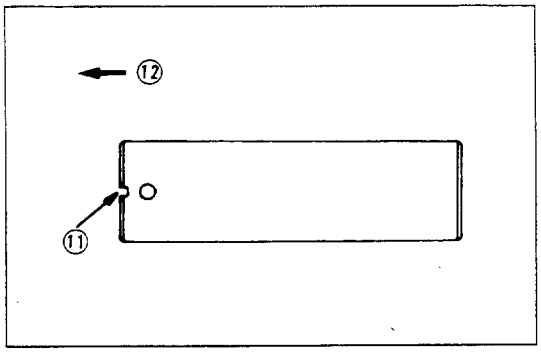
1. Apply chassis grease to the needle roller bearings ①.
2. Install the needle roller bearings ① to the bearing case ②.
3. Apply gear oil to the idler gear inside surface ③.
4. Install the shift arm to the gear box.
5. Install the needle roller bearing ④ along with the idler gear ⑤ and the thrust washers ⑥ to the gear case ⑦ from the gear case open side.

   Be sure that the shift arm is inserted to the idler gear shaft arm groove ⑧.

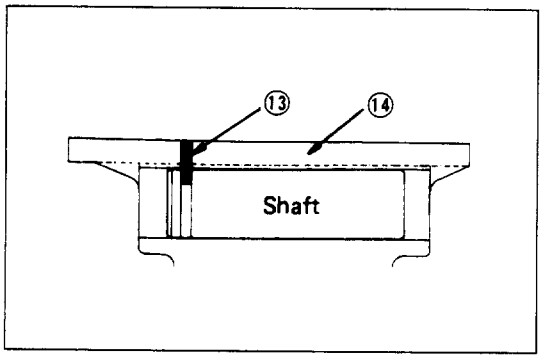
   The thrust washer projections ⑨ must be facing outward.
6. Install the idler gear shaft ⑩ to the needle roller bearing.





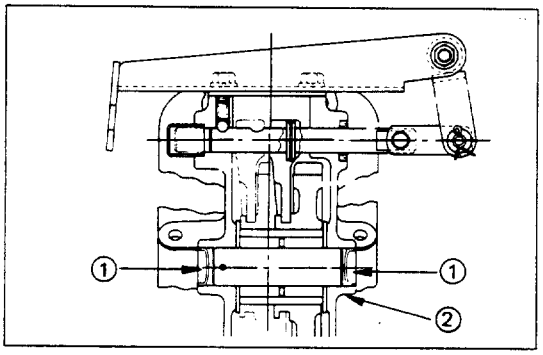


The idler gear shaft groove ⑪ must be facing the front ⑫.



7. Use a screwdriver to align the idler gear shaft spring hole with the gear case spring hole.
8. Use a hammer to drive the spring pin ⑬ into position.

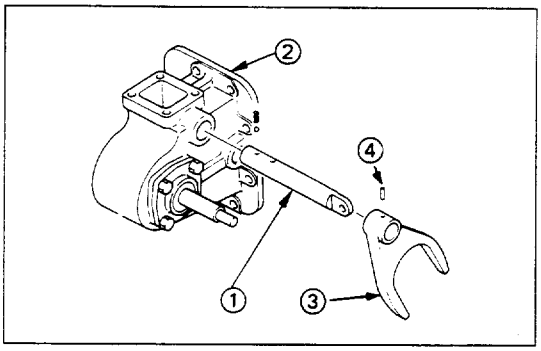
   The spring pin must be perfectly flush with the gear case end ⑭.



17. Plug

18. Plug

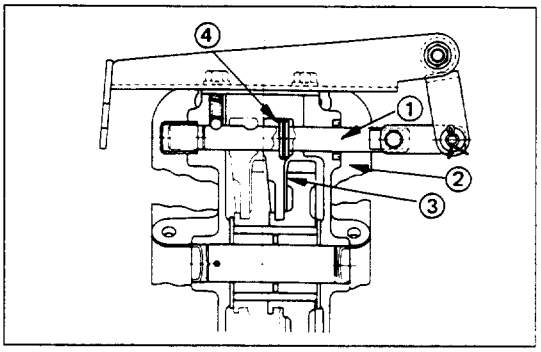
1. Apply liquid gasket (LOCTITE FMD-127 or equivalent) to the outer circumference of each of the plugs.
2. Use the installer and a hammer to drive each plug into the gear case.



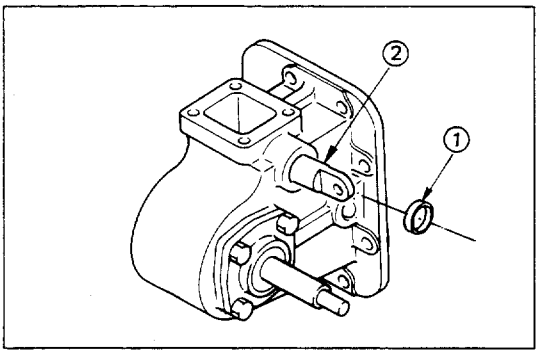
20. Spring Pin

21. Straight Pin and Ball

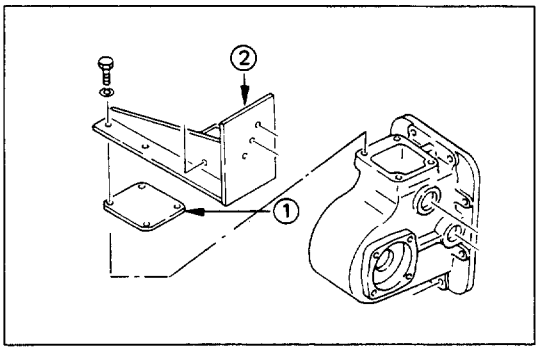
1. Install the shift rod ① to the gear case ② and the shift arm hole ③ from the rear side of the gear case.
2. Align the shift arm pin ④ hole with the shift rod pin hole.
3. Use a hammer and a drift punch to drive the spring pin into the shift arm and shift pin holes.
4. Install the straight pin and ball to the gear case from the gear case upper side.



19. **Spring Pin**
20. **Spring Pin**
21. **Snap Ring, Plate and Pin**



22. **Cover**
    1. Apply liquid gasket to the cover outer circumference ①.
    2. Use the installer and a hammer to install the cover to the gear case from the front side.



23. **Shift Rod and O-ring**
24. **Upper Cover Plate and Gasket**
25. **Control Lever Bracket**
    1. Apply liquid gasket (LOCTITE FMD-127 or equivalent) to the upper cover ① .
    2. install the upper cover ① to the control level bracket ②.
    3. Tighten the control lever bracket ③ along with the upper cover ① to the specified torque.

Bolts Torque	N·m (kg·m / lb·ft)
	37 (3.8 / 27)

26. **Control Lever**
27. **Bushing**
28. **Distance Collar**
29. **Bolt**
30. **Pin**
31. **Cotter Pin and Washer**

SECTION 7C
CIUTCH

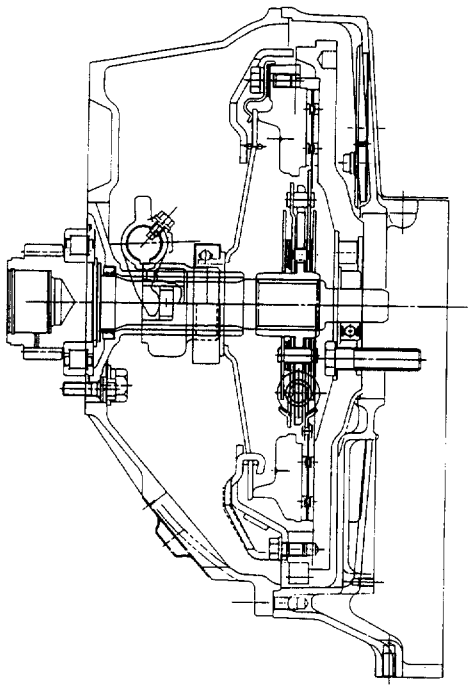
CONTENTS

PAGE

General Description 7C– 2
Clutch Assembly 7C– 2
Pressure Plate Assembly and Driver Plate 7C– 2
Clutch Booster 7C– 3
Master Cylinder 7C– 3
Slave Cylinder 7C– 4
On-Vehicle Service 7C– 5
Clutch Assembly 7C– 5
Removal 7C– 5
Inspection and Repair 7C– 7
Installation 7C–11
Clutch Control 7C–14
Removal 7C–14
Inspection and Repair 7C–15
Installation 7C–16
Unit Repair 7C–19
Master Cylinder 7C–19
Disassembly 7C–19
Inspection and Repair 7C–20
Reassembly 7C–21
Clutch Booster 7C–23
Disassembly 7C–23
Inspection and Repair 7C–24
Reassembly 7C–25
Slave Cylinder 7C–28
Disassembly 7C–28
Inspection and Repair 7C–29
Reassembly 7C–30

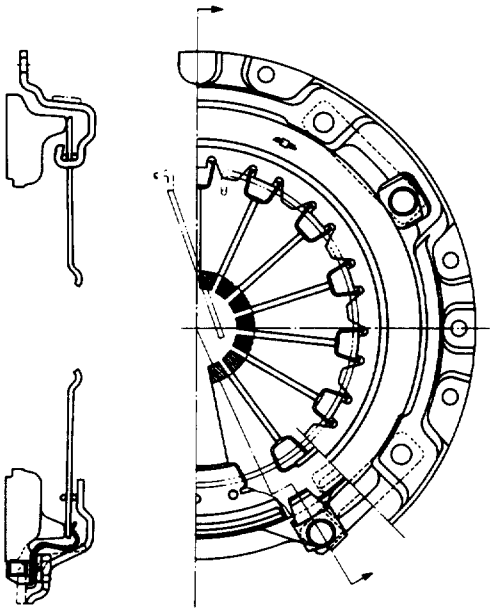
GENERAL DESCRIPTION

CLUTCH ASSEMBLY

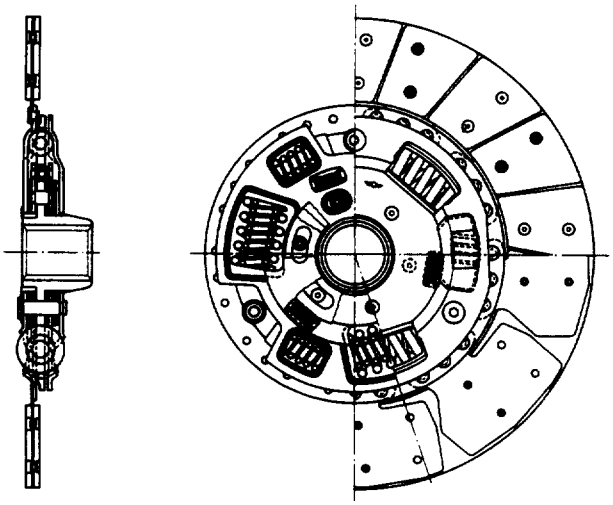


PRESSURE PLATE ASSEMBLY AND DRIVEN PLATE

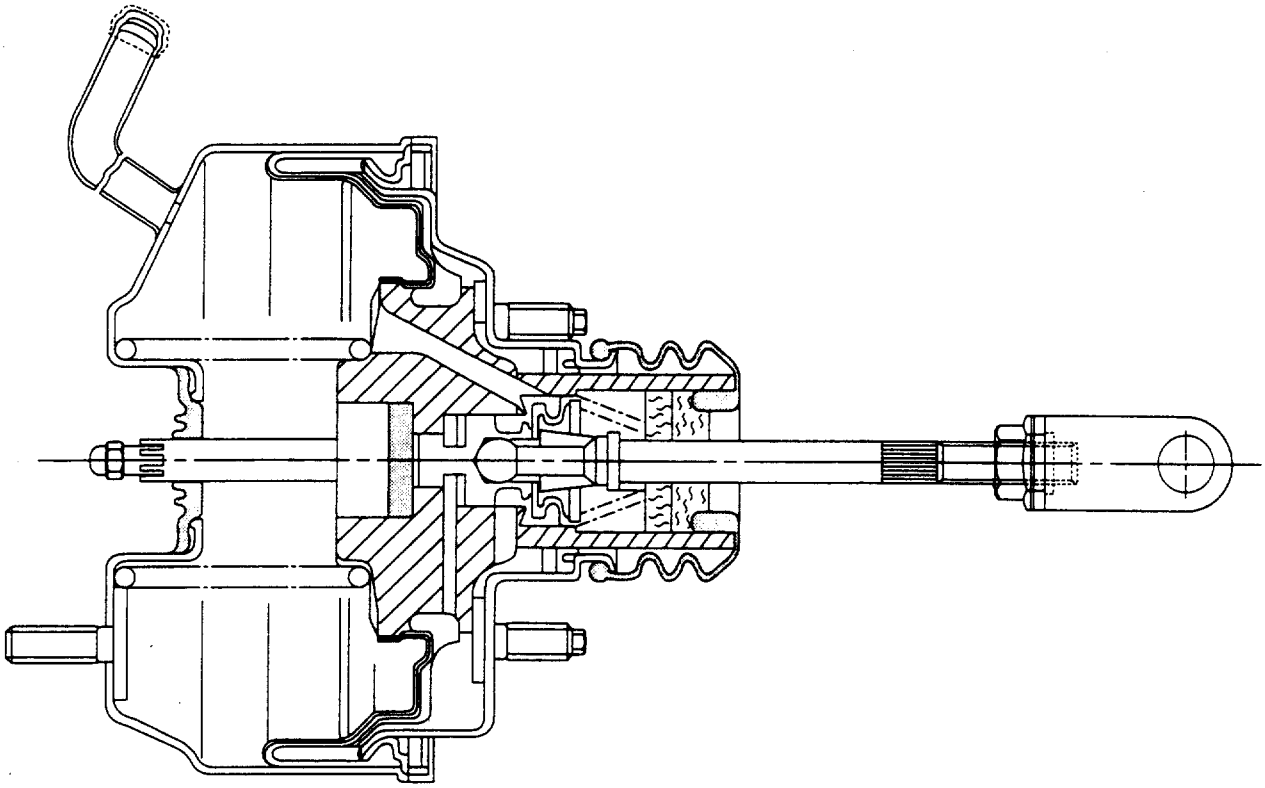
Pressure plate assembly



Driven plate assembly

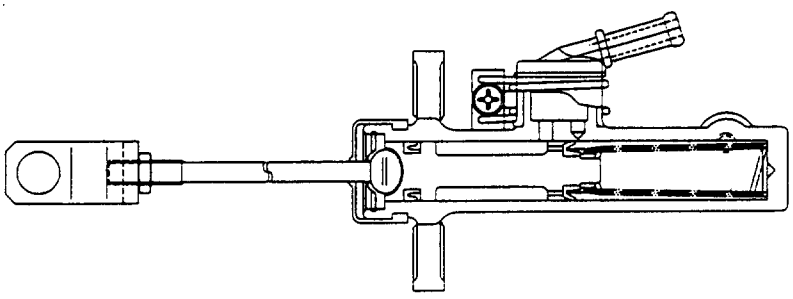


CLUTCH BOOSTER

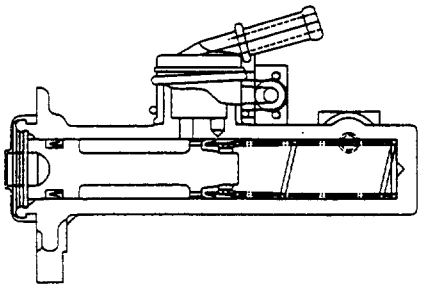


MASTER CYLINDER

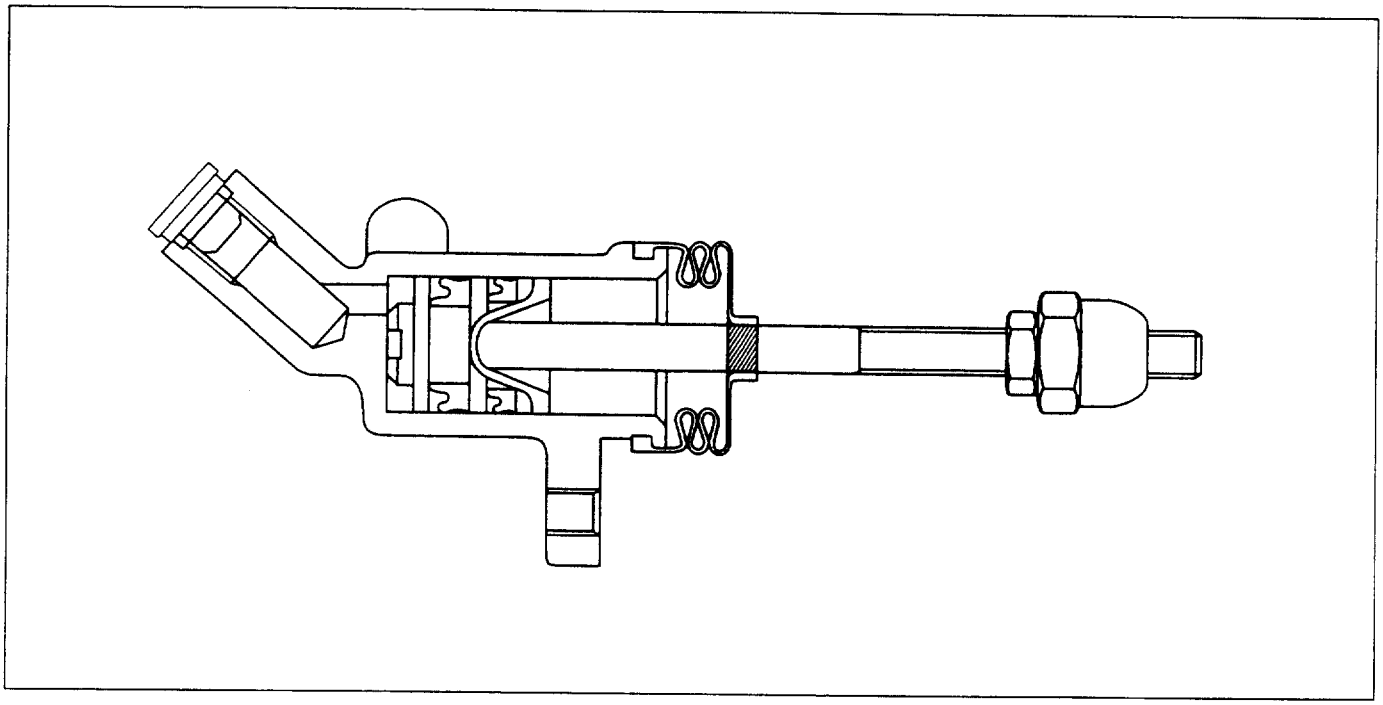
Booster less



With Booster



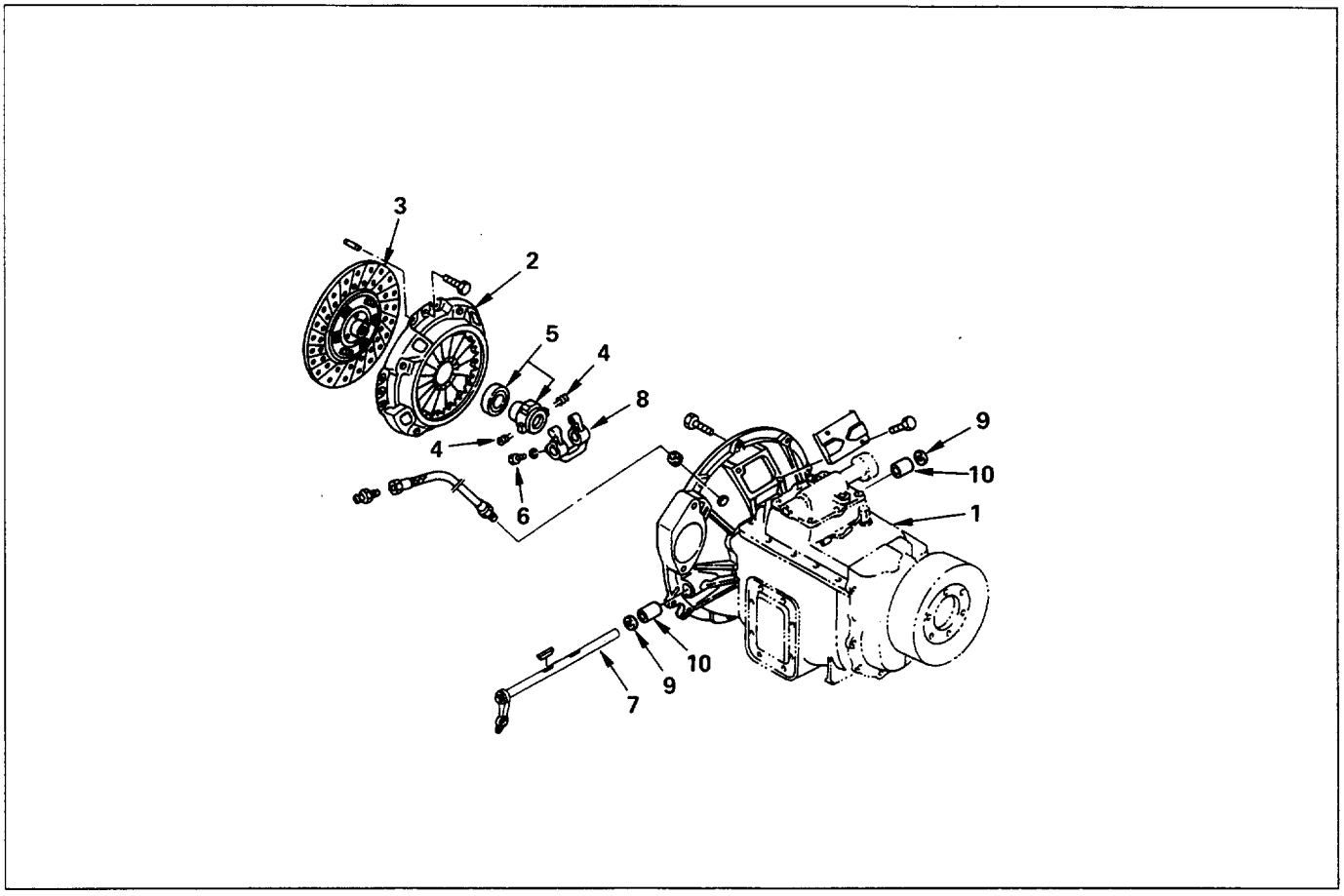
SLAVE CYLINDER



ON-VEHICLE SERVICE

CLUTCH ASSEMBLY

REMOVAL



Removal Steps

1. Transmission assembly
2. Pressure plate assembly
3. Driven plate assembly
4. Return spring
5. Shift block and release bearing
6. Set bolt
7. Shift shaft and key
8. Shift fork
9. Dust seal
10. Needle bearing

Removal Step

- Raise vehicle and support with suitable safety stands.

CAUTION

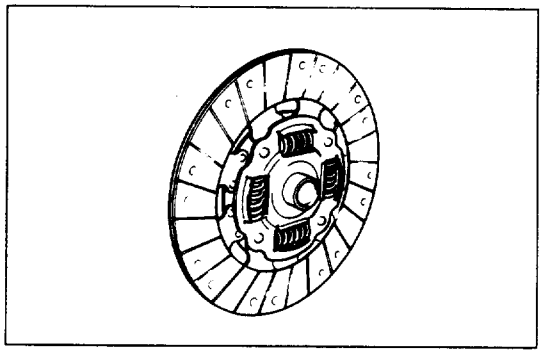
Do not clutch fluid remain on a painted surface.

Wash it off immediately.

1. **Transmission Assembly**

   Refer to "SECTION 7B ON-VEHICLE SERVICE: TRANSMISSION ASSEMBLY REPLACEMENT" in this manual.

2. **Pressure Plate Assembly**
3. **Driven Plate Assembly**

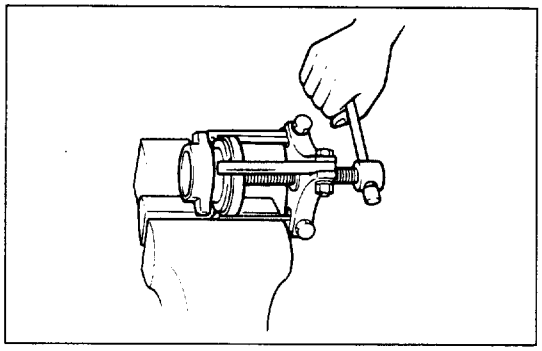


- Use the pilot aligner to prevent the driven plate assembly from falling free.

  Pilot aligner: 1-85253-008-0

- Mark the flywheel and pressure plate lug for alignment when installing.

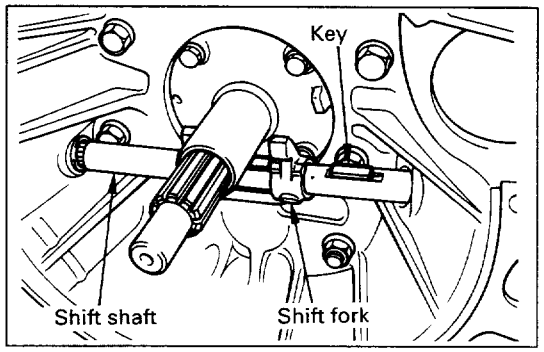
4. **Return Spring**



5. **Shift Block and Release Bearing**
   - Use the bearing puller to release bearing from the shift block.

     Bearing puller: 9-85210-148-0

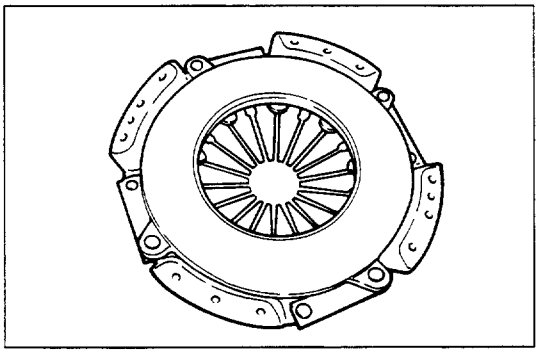
6. **Set Bolt**



7. **Shift Shaft and Key**
8. **Shift Fork**
   - Remove shift shaft by tapping. Install a round bar from the end of the shaft.
9. **Dust Seal**
10. **Needle Bearing**

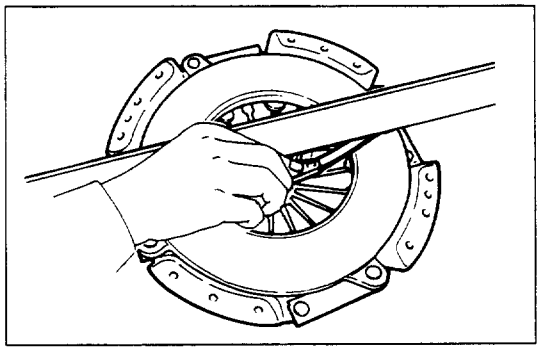
INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacement if excessive wear or damage is discovered during inspection.



Pressure Plate Assembly

- Visually inspect the pressure plate friction surface for excessive wear and heat cracks. If excessive wear or deep heat cracks are present, the pressure plate must be replaced.

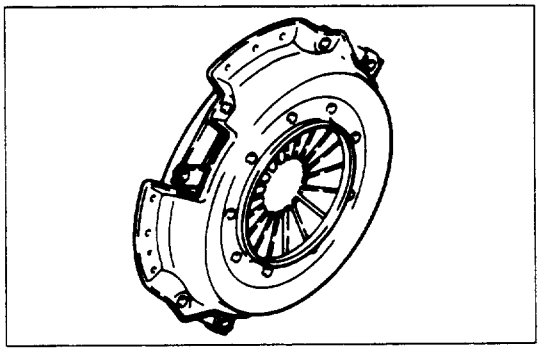


Pressure Plate Warpage

- Use a straight edge and a feeler gauge to measure the pressure plate friction surface flatness in four directions.

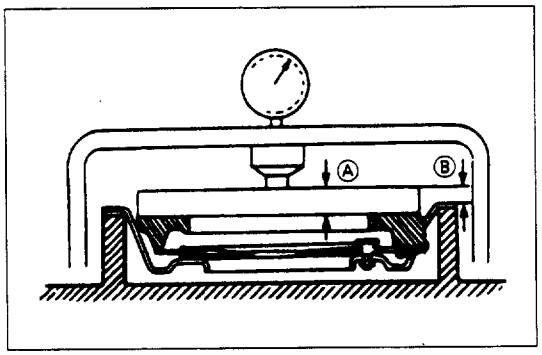
  If any of the measured values exceed the specified limit, the pressure plate assembly must be replaced.

Pressure Plate Warpage	mm (in)
Limit	
0.3 (0.0118)	



Clutch Cover

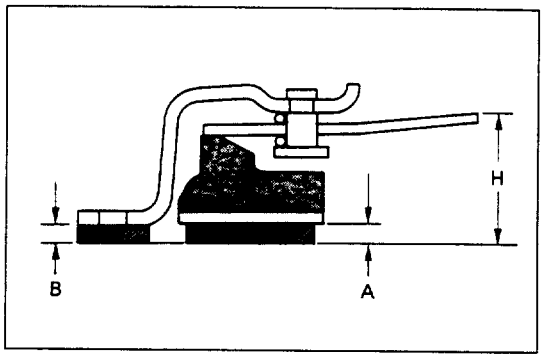
- Visually inspect the entire clutch cover for excessive wear, cracking, and other damage.
- The Pressure plate assembly must be replaced if any of these conditions are present.



Clutch Set Force

1) Invert the pressure plate.
2) Place a metal sheet with "A" thickness of 9.2 mm (0.362 in) on the pressure plate.
3) Compress the pressure plate assembly until the distance "B" becomes 19 mm (0.748 in).
4) Note the pressure plate gauge reading.

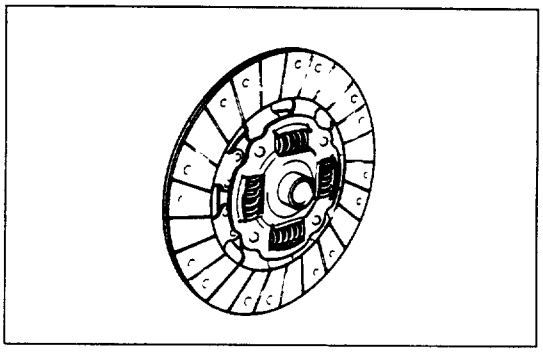
Clutch Set Force	N (kg / lb)
Standard	
9,512 (970 / 2,139)	



Diaphragm Spring Finger Height

1) Place a metal sheet with "A" thickness of 9.2 mm (0.362 in) under the pressure plate.
2) Compress the pressure plate assembly until the distance "B" becomes 19 mm (0.748 in). There are two ways to do this.
   a. Use a bench press to press down on the pressure plate assembly from the top.
   b. Tighten the pressure plate assembly fixing bolts.
3) Measure the spring finger height "H" from base to spring tip.

Spring Finger Height	mm (in)
Standard	
61.8 – 63.8 (2.433 – 2.512)	



Driven Plate Assembly

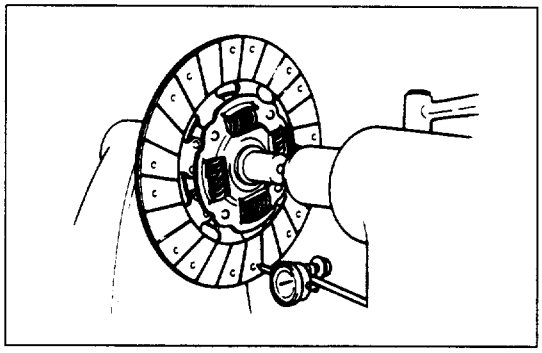
- Visually inspect the torsion spring for looseness, breakage, and weakening.

  If any of these conditions are discovered, the driven plate assembly must be replaced.
- Visually inspect the facing surfaces for cracking and excessive scorching.

  Visually inspect the facing surfaces for the presence of oil or grease.

  If any of these conditions are discovered, the facing must be cleaned or the driven plate assembly replaced.
- Check that the driven plate moves smoothly on the transmission top gear shaft spline.

  Minor ridges on the top gear shaft spline may be removed with an oil stone.



Driven Plate Warpage

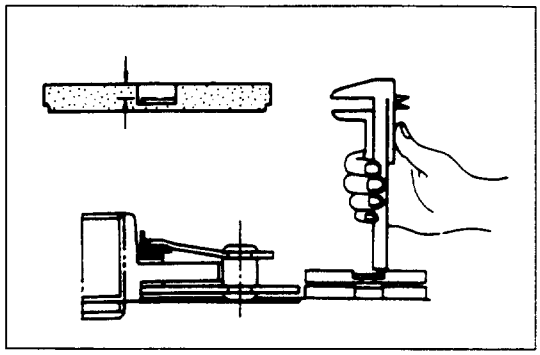
- Insert the pilot aligner into the driven plate spline hub.

  The pilot aligner must be held perfectly horizontal.
  Pilot Aligner: 1-8525-3008-0
- Set a dial indicator to the driven plate outside circumference.
- Slowly turn the driven plate.

  Read the dial indicator as you turn the driven plate.

  If the measured value exceeds the specified limit, the driven plate assembly.

Driven Plate Warpage	mm (in)
Standard	Limit
0.7 (0.028)	1.0 (0.039)

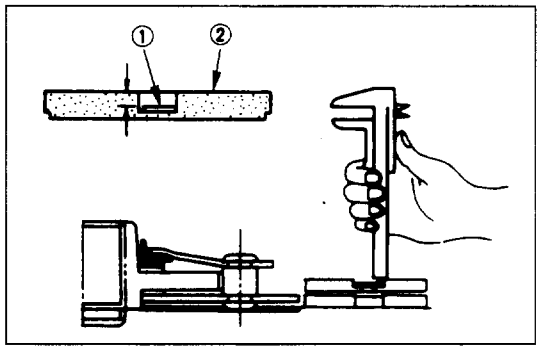


Driven Plate Splined Hub Spline Ware

- Clean the driven plate splined hub.
- Install the driven plate to the transmission top gear shaft spline.
- Set a surface gauge to the driven plate outside circumference.
- Slowly turn the driven plate. Measure the spline rotation play as you turn the driven plate.

  If the measured value exceeds the specified limit, the driven plate assembly must be replaced.

Driven Plate Splined Hub Spline Wear	mm (in)
Standard	
1.8 - 2.4 (0.071 - 0.094)	



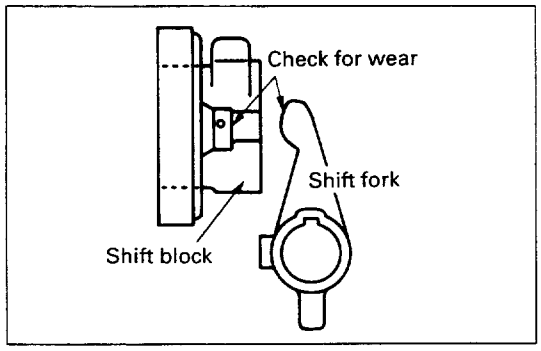
Driven Plate Rivet Head Depression

- Use the depth gauge or a straight edge with steel rule to measure the rivet head depression from the facing surface.

  Be sure to measure the rivet head depression on both sides of the driven plate.

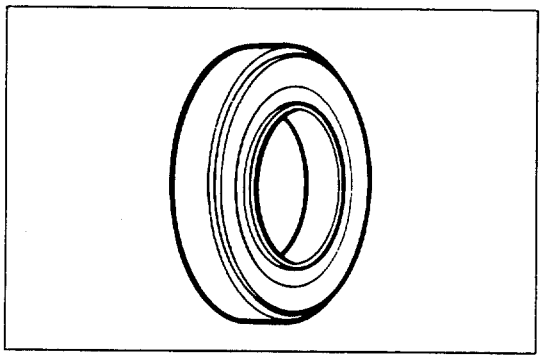
  If the measured value is less than the specified limit, the driven plate must be replaced.

Rivet Head Depression	mm (in)
Standard	Limit
1.8 - 2.4 (0.070 - 0.094)	0.6 (0.024)



Shift Block and Shift Fork Wear

- Check the surface of the shift block for wear or damage.
- Check the surface of the shift fork for wear or damage.

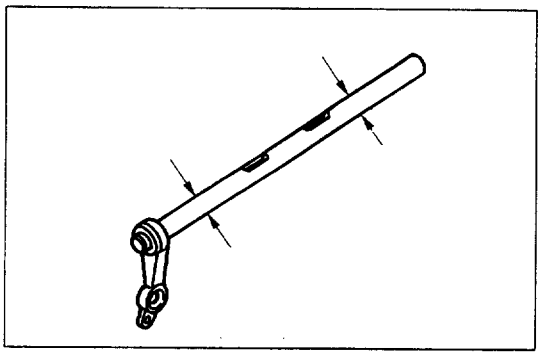


Clutch Shaft Wear

- Clutch shaft diameters as shown in figure. If the diameter is less then 24.5mm(0.964in), replace the clutch shaft and needle bearing.

Clutch Shaft Wear mm (in)

Standard	Limit
25.0 (0.984)	24.5 (0.964)

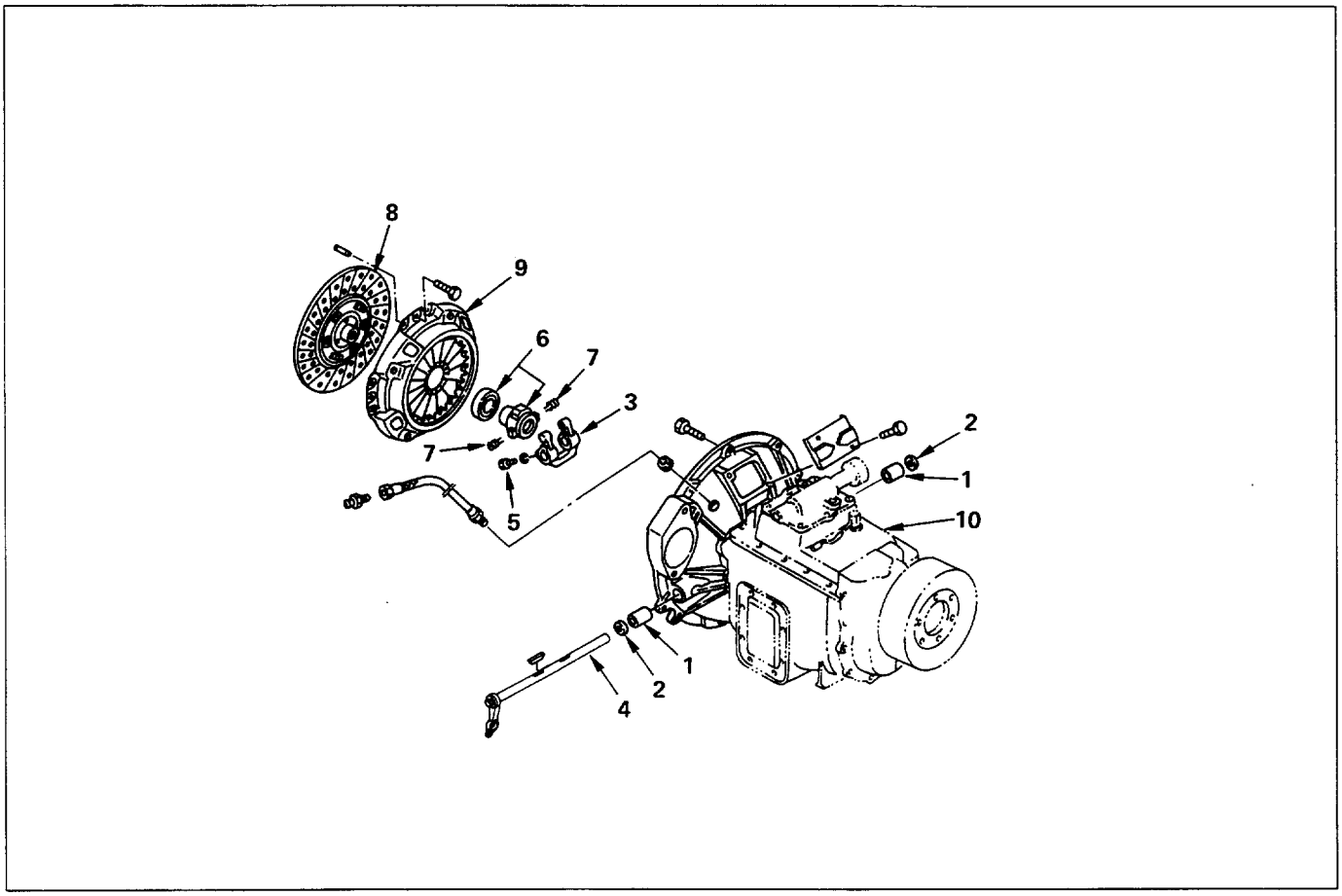


Release Bearing

- Visually inspect the release bearing for looseness, breakage, and weakening.

  If any of these conditions are discovered, the release bearing must be replaced.

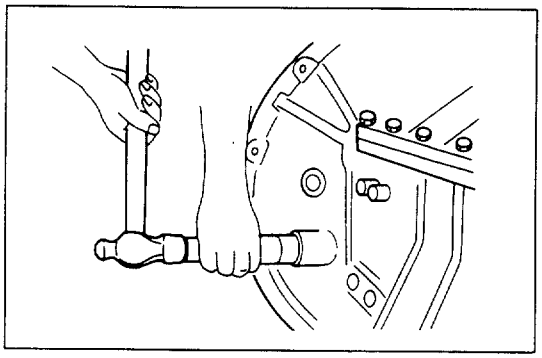
INSTALLATION



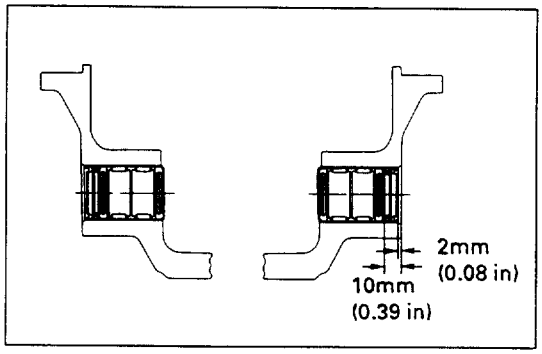
Installation Steps

1. Needle bearing
2. Dust seal
3. Shift fork
4. Shift shaft and Key
5. Set bolt
6. Shift block and release bearing
7. Return spring
8. Driven plate assembly
9. Pressure plate assembly
10. Transmission assembly

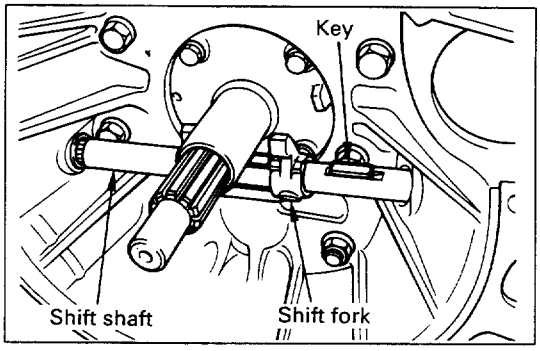
Installation Step



1. **Needle Bearing**
   - Use a 31.5mm (1.24inch) diameter bar to drive the needle bearing from the marked side of the bearing and install it specified depth as shows in illustration.

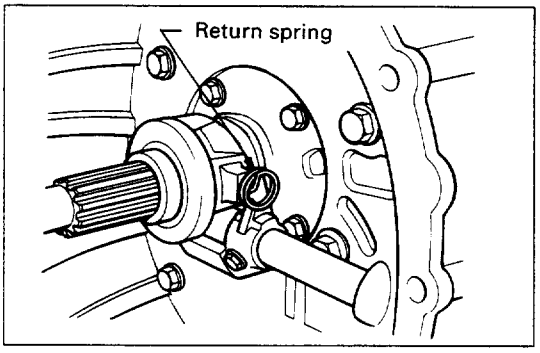


2. **Dust Seal**
   - Before installing the new bearing, apply grease to the bearing surfaces and the clearance area between the bearing and the dust seal.
3. **Shift Fork**
4. **Shift Shaft and Key**

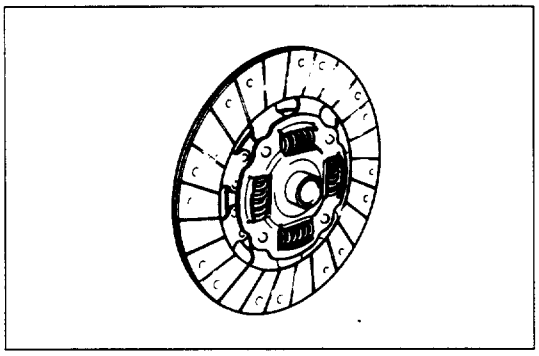


5. **Set Bolt**
   - Install the clutch shaft to the clutch housing.
   - Key and shift fork onto the clutch shaft assembly.
   - Tighten the set bolt.

Set Bolt Torque	N·m (kg·m / lb·in)
	13 (1.3 / 113)



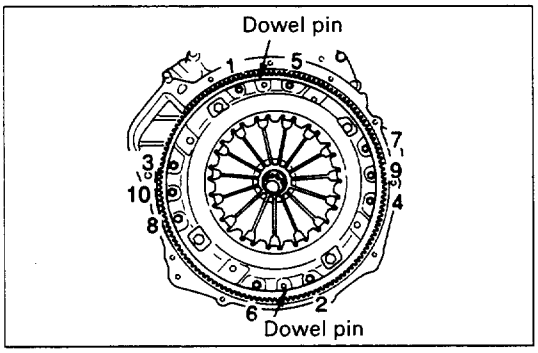
6. **Shift Block and Release Bearing**
7. **Return Spring**
   - Apply the MoS^2 contained type grease to shift fork and shift block surfaces.
   - Install the return spring.



8. Driven Plate Assembly

- Attach driven plate to flywheel by clutch pilot aligner.

  Pilot aligner: 1-85253-008-0



9. Pressure Plate Assembly

- Install the pressure plate assembly to the flywheel.

  If the pressure plate was replaced to new parts, be sure to remove the ring which is installed to the diaphragm spring.
- Tighten the pressure plate bolt, in the sequence shown figure.

Pressure Plate Bolt Torque	N·m (kg·m / lb·ft)
	40 (4.1 / 30)

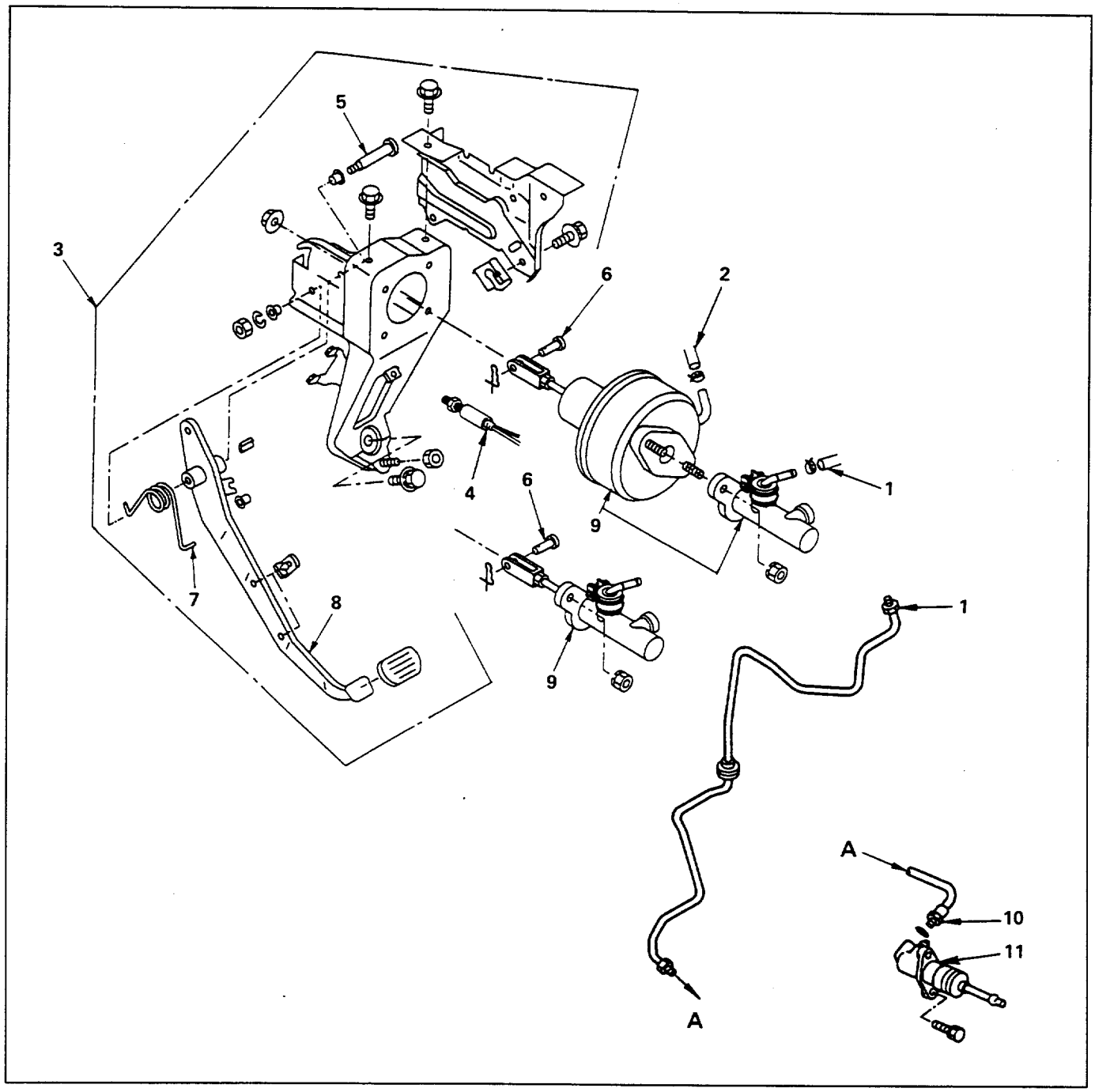
- Remove the pilot aligner.

10. Transmission Assembly

Refer to "SECTION 7B ON-VEHICLE SERVICE: TRANSMISSION ASSEMBLY REPLACEMENT" in this manual.

CLUTCH CONTROL

REMOVAL



Removal Steps

1. Clutch pipe and hose
2. Vacuum hose
3. Clutch pedal and bracket assembly
4. Clutch switch or stopper bolt
5. Shaft
6. Clevis pin
7. Return spring
8. Clutch pedal
9. Clutch booster with master cylinder or master cylinder
10. Flexible hose
11. Slave cylinder

Preparation

1. **Remove Meter Cluster**
   - Pull out the meter cluster and disconnect the harness connectors.
2. **Meter Assembly**
   - Remove the 5 fixing screws, then remove the meter assembly and disconnect the harness connector.

Removal Steps

- Drain the clutch fluid from the clutch hydraulic line.

CAUTION

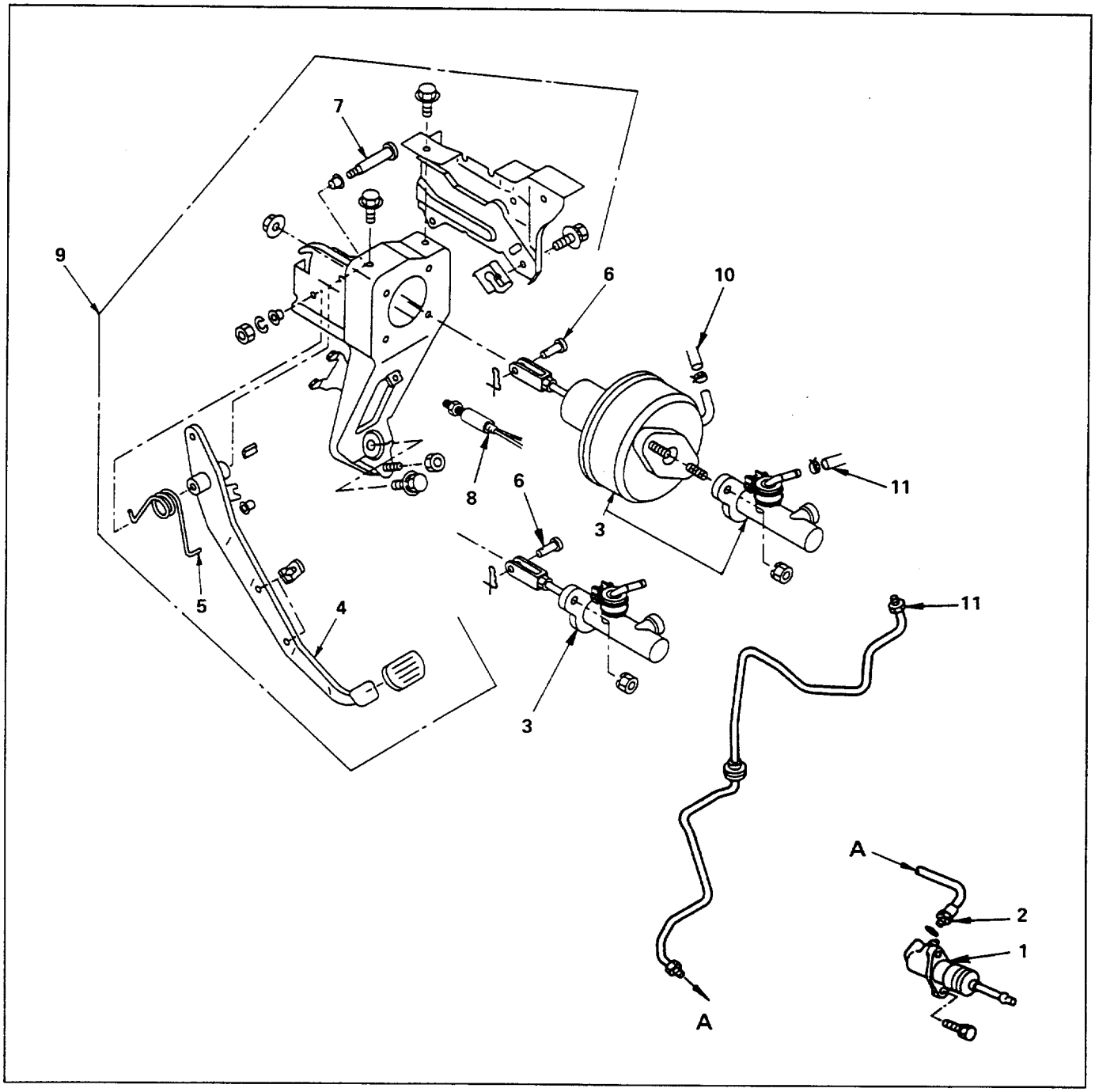
Do not let clutch fluid remain on a painted surface. Wash it off immediately.

1. **Clutch Pipe and Hose**
2. **Vacuum Hose**
3. **Clutch Pedal and Bracket Assembly**
4. **Clutch Switch or Stopper Bolt**
5. **Shaft**
6. **Clevis Pin**
7. **Return Spring**
8. **Clutch Pedal**
9. **Clutch Booster with Master Cylinder or Master Cylinder**
10. **Flexible Hose**
11. **Slave Cylinder**

INSPECTION AND REPAIR

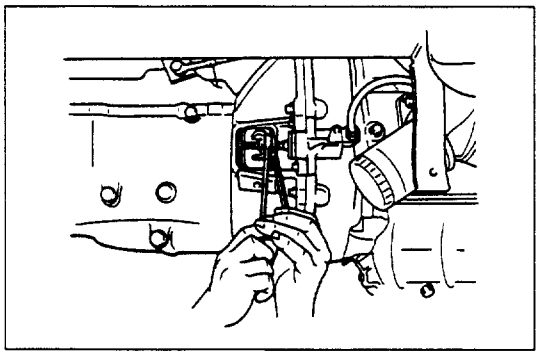
Make the necessary adjustment, repairs, and part replacement if excessive wear or damage is discovered during inspection.

INSTALLATION



Installation Steps

1. Slave cylinder
2. Flexible hose
3. Clutch booster with master cylinder or master cylinder
4. Clutch pedal
5. Return spring
6. Clevis pin
7. Shaft
8. Clutch switch or stopper bolt
9. Clutch pedal and bracket assembly
10. Vacuum hose
11. Clutch pipe and hose



Installation Steps

1. **Slave Cylinder**

Slave Cylinder Bolt Torque — N·m (kg·m / lb·ft)
16 (1.6 / 12)

- Perform slave cylinder adjustment before installation of the return spring.

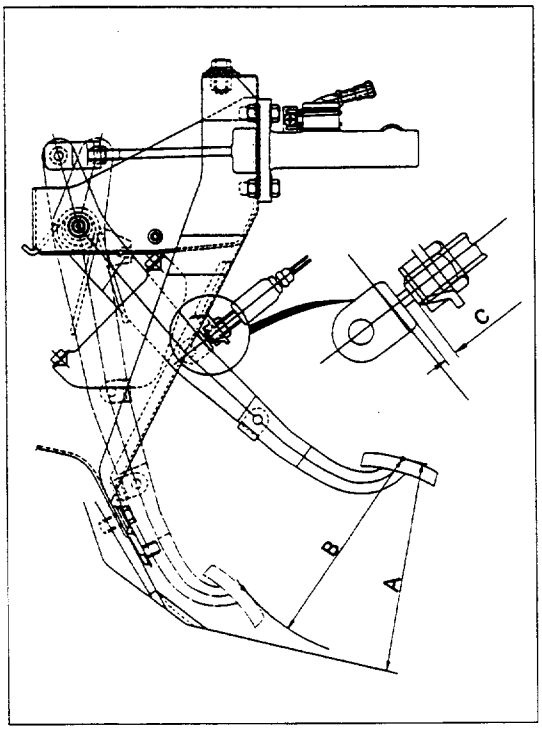
1) Loosen the lock nut of the push rod.
2) Turn the adjust but until it reaches the shift fork.
3) Back off the adjust nut 1.5 turns. (shift fork free play approximately 2 mm).
4) Tighten the lock nut.

Push Rod Lock Nut Torque — N·m (kg·m / lb·ft)
19 (1.9 / 14)

2. **Flexible Hose**
3. **Clutch Booster with Master Cylinder or Master Cylinder**
   - Install the clutch booster with master cylinder assembly or the master cylinder assembly to the clutch pedal bracket.

Fixing Nuts Torque — N·m (kg·m / lb·in)
13 (1.3 / 113)

4. **Clutch Pedal**
5. **Return Spring**
6. **Clevis Pin**
7. **Shaft**
8. **Clutch Switch or Stopper Bolt**
9. **Clutch Pedal and Bracket Assembly**



Clutch Bracket Bolts Torque — N·m (kg·m / lb·ft)
37 (3.8 / 27)

- Perform the clutch pedal adjustment after installation of clutch control.

Clutch Pedal Height and Stroke

1) Loosen the lock nut of the clutch booster operating rod or the master cylinder push rod.
2) Adjust the pedal height by turning operating rod or push rod.

Clutch Pedal Height and Stroke — mm (in)
Height(A) : 160 - 170 (6.30 - 6.69)
Stroke(B) : 159 - 169 (6.26 - 6.65)

3) Tighten the lock nut.

Lock Nut Torque — N·m (kg·m / lb·ft)
With Booster: 20 (2.0 / 14)
Booster Less : 13 (1.3 / 9.4)

4) Install the meter assembly and meter cluster.

Clutch Pedal Free Play

Clutch Switch or Stopper Bolt

After completion of clutch pedal height and slave cylinder adjustment, adjust the clutch switch or stopper bolt clearance.

1) Loosen the lock nut of clutch switch or stopper bolt.

2) Adjust the clutch switch or stopper bolt clearance by turning clutch switch or stopper bolt.

Clutch Switch or Stopper Bolt Clearance

Clearance(C)	mm (in)
0.5 - 1.0 (0.02 - 0.04)	

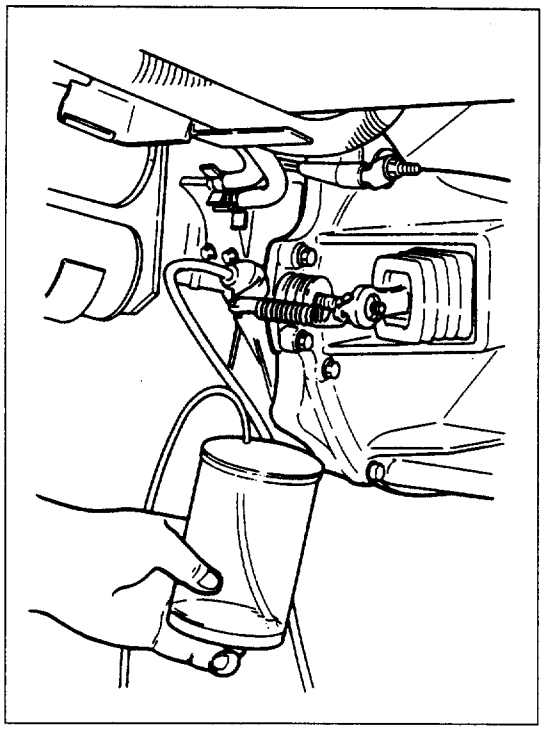
Clutch Pedal Free Play	mm (in)
15 - 25 (0.59 - 0.98)	

3) Tighten the lock nut.

Lock Nut Torque	N·m (kg·m / lb·ft)
19 (1.9 / 14)	

10. Vacuum Hose

11. Clutch Pipe and Hose



- Perform the clutch hydraulic circuit bleeding after installation of the clutch control.

Bleeding operation calls for cooperative action of two men.

1) Check the level of clutch fluid in the reservoir and replenish of necessary.

2) Remove the rubber cap from the bleeder screw and wipe clean the bleeder screw.

Connect a vinyl tube to the bleeder screw and insert the other end of the vinyl tube into a transparent container.

3) Pump the clutch pedal repeatedly and hold it depressed.

4) Loosen the bleeder screw on the clutch slave cylinder to release clutch fluid with air bubbles into the container and tighten the bleeder screw immediately.

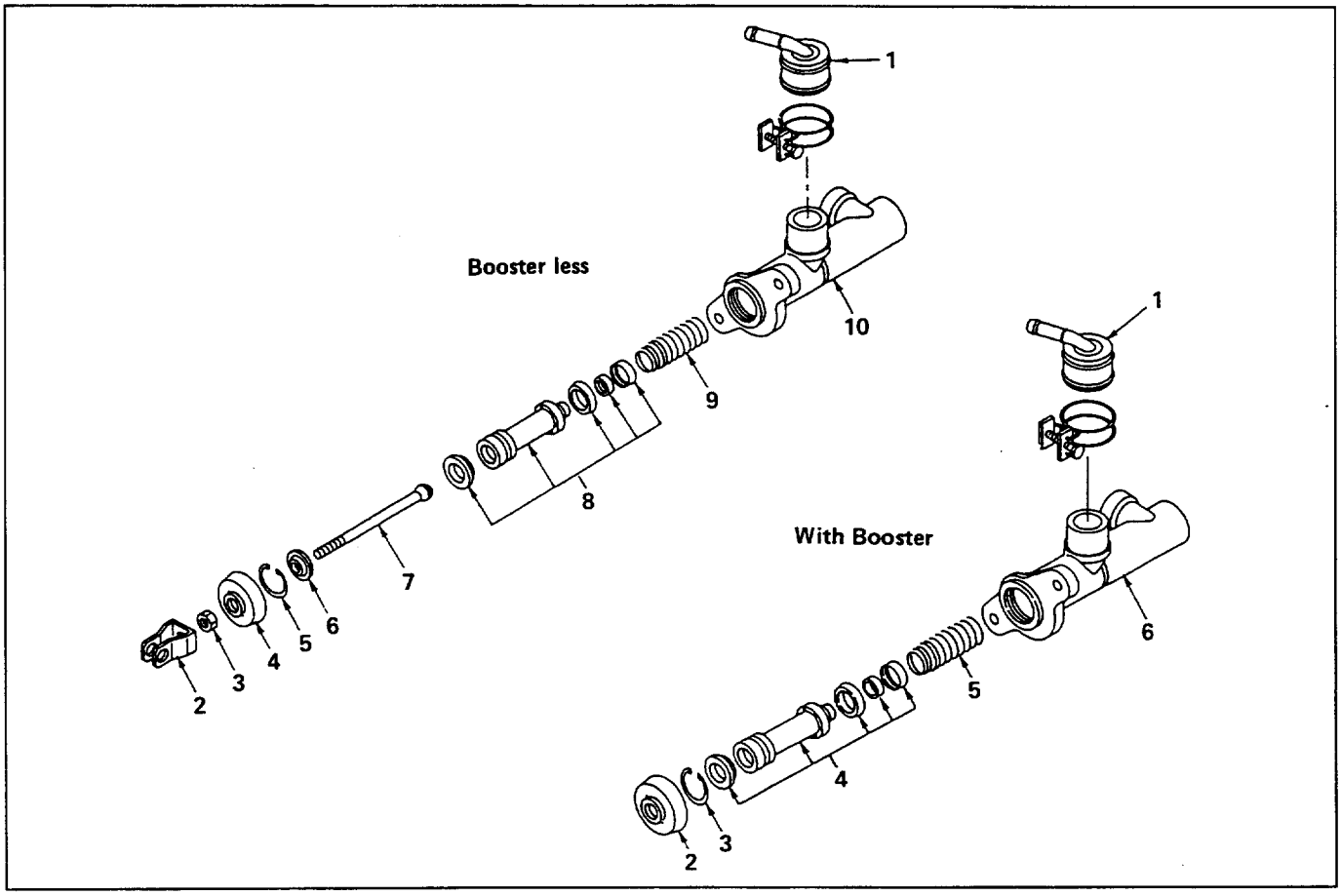
5) Release the clutch pedal carefully. Repeat the above operation until air bubbles disappear from the clutch fluid being pumped out into the container. During the bleeding operation, keep the clutch fluid reservoir filled to the specified level.

Reinstall the rubber cap.

UNIT REPAIR

MASTER CYLINDER

DISASSEMBLY



Removal Steps

Booster Less

1. Pipe joint
2. Clevis yoke
3. Lock nut
4. Dust cover
5. snap ring
6. Stopper
7. Push rod
8. Piston assembly
9. Return spring
10. Cylinder body

With Booster

1. Pipe joint
2. Dust cover
3. Snap ring
4. Piston assembly
5. Return spring
6. Cylinder body

Disassembly Steps

Booster Less

1. **Pipe Joint**
2. **Clevis Yoke**

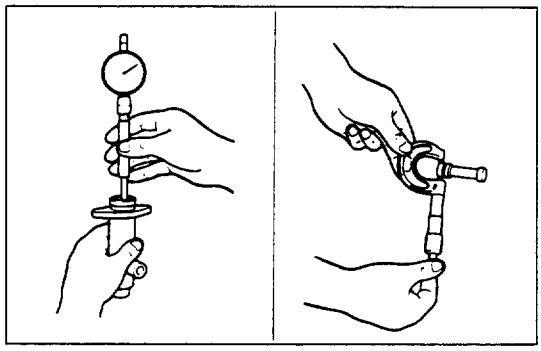
3. **Lock Nut**
4. **Dust Cover**
5. **Snap Ring**
   - Press down the piston with your finger to prevent it from jumping out.
6. **Stopper**
7. **Push Rod**
8. **Piston Assembly**
9. **Return Spring**
10. **Cylinder Body**

With Booster

1. **Pipe Joint**
2. **Dust Cover**
3. **Snap Ring**
   - Press down the piston with your finger to prevent it from jumping out.
4. **Piston Assembly**
5. **Return Spring**
6. **Cylinder Body**

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and parts replacements if excessive wear or damage is discovered during inspection.



Cylinder Body

- Wash clean the cylinder body in brake fluid.
- Check the fluid return port for restrictions and clean it if necessary.
- Measure the cylinder inside diameter.

Master Cylinder Inside Diameter	mm (in)
Standard	
With Booster : ø 20.640 - 20.692 (0.8126 - 0.8146) Booster Less : ø 19.050 - 19.102 (0.7500 - 0.7520)	

Clearance between Cylinder Bore and Piston Clearance — mm (in)

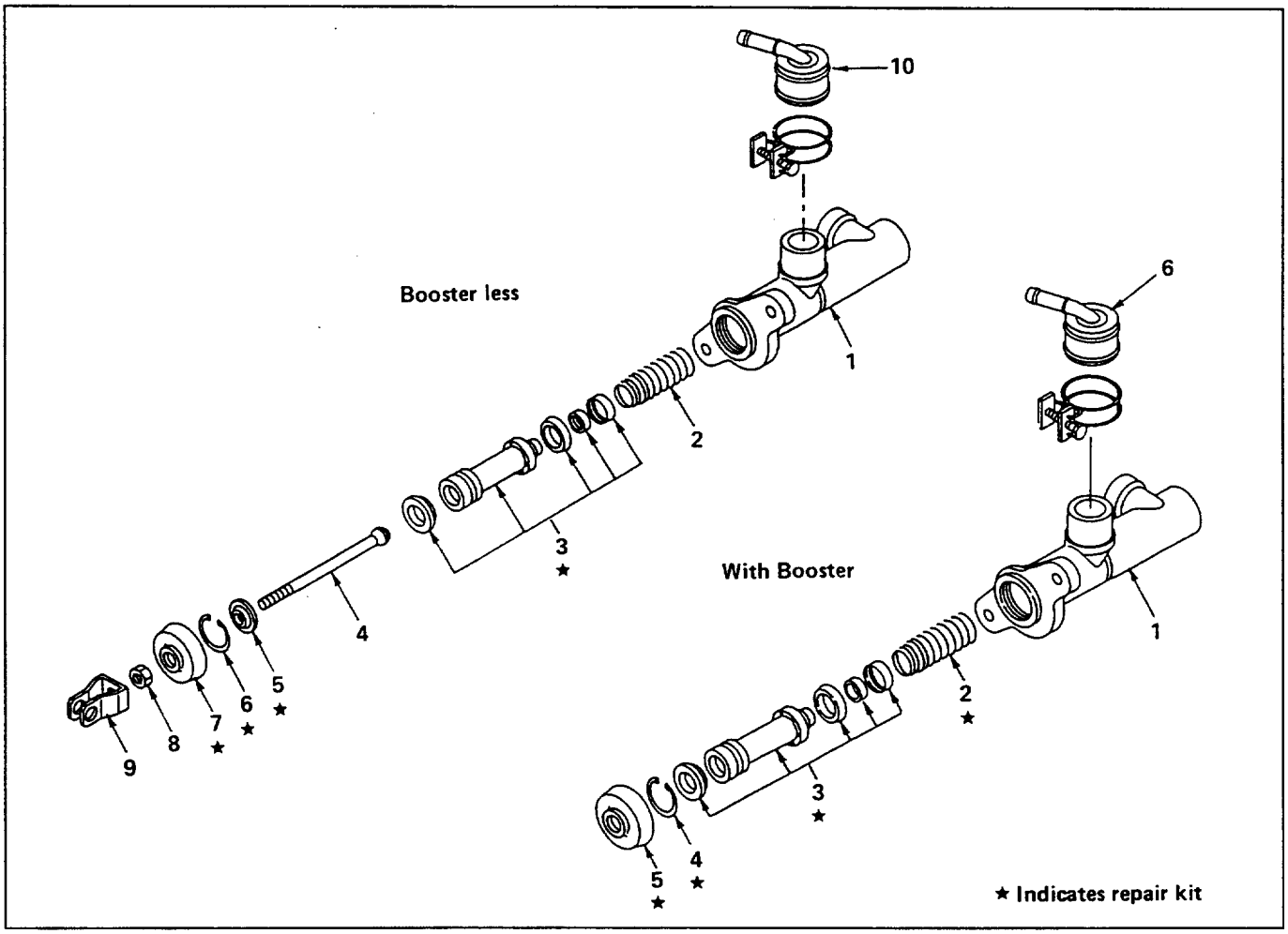
Standard	Limit
0.03 - 0.11 (0.0012 - 0.0043)	0.12 (0.0047)

- If excessive wear or any abnormal conditions are present, the master cylinder assembly must be replaced with new one.

CAUTION

If the master cylinder has been disassembled, the repair kit must be replaced with new one.

REASSEMBLY



Reassembly Step

Booster Less

1. Cylinder body
2. Return spring
3. Piston assembly
4. Push rod
5. Stopper
6. Snap ring
7. Dust cover
8. Lock nut
9. Clevis yoke
10. Pipe joint

With Booster

1. Cylinder body
2. Return spring
3. Piston assembly
4. Snap ring
5. Dust cover
6. Pipe joint

Reassembly Step

Booster Less

1. **Cylinder Body**
   - Immerse the cylinder body in clean brake fluid.
2. **Return Spring**
   - Install the return spring to the piston assembly.
3. **Piston Assembly**
   - Before installing, apply a thin coat of rubber grease to the piston.

CAUTION

Use care to prevent damaging the lip of the piston cup.

4. **Push Rod**
5. **Stopper**
6. **Snap Ring**
7. **Dust Cover**
8. **Lock Nut**

Lock Nut Torque	N·m (kg·m / lb·in)
	13 (1.3 / 113)

9. **Clevis Yoke**
10. **Pipe Joint**

Pipe Joint Torque	N·m (kg·m / lb·in)
	5 (0.5 / 43)

With Booster

1. **Cylinder Body**
   - Immerse the cylinder body in clean brake fluid.
2. **Return Spring**
   - Install the return spring to the piston assembly.
3. **Piston Assembly**
   - Before installing, apply a thin coat of rubber grease to the piston.

CAUTION

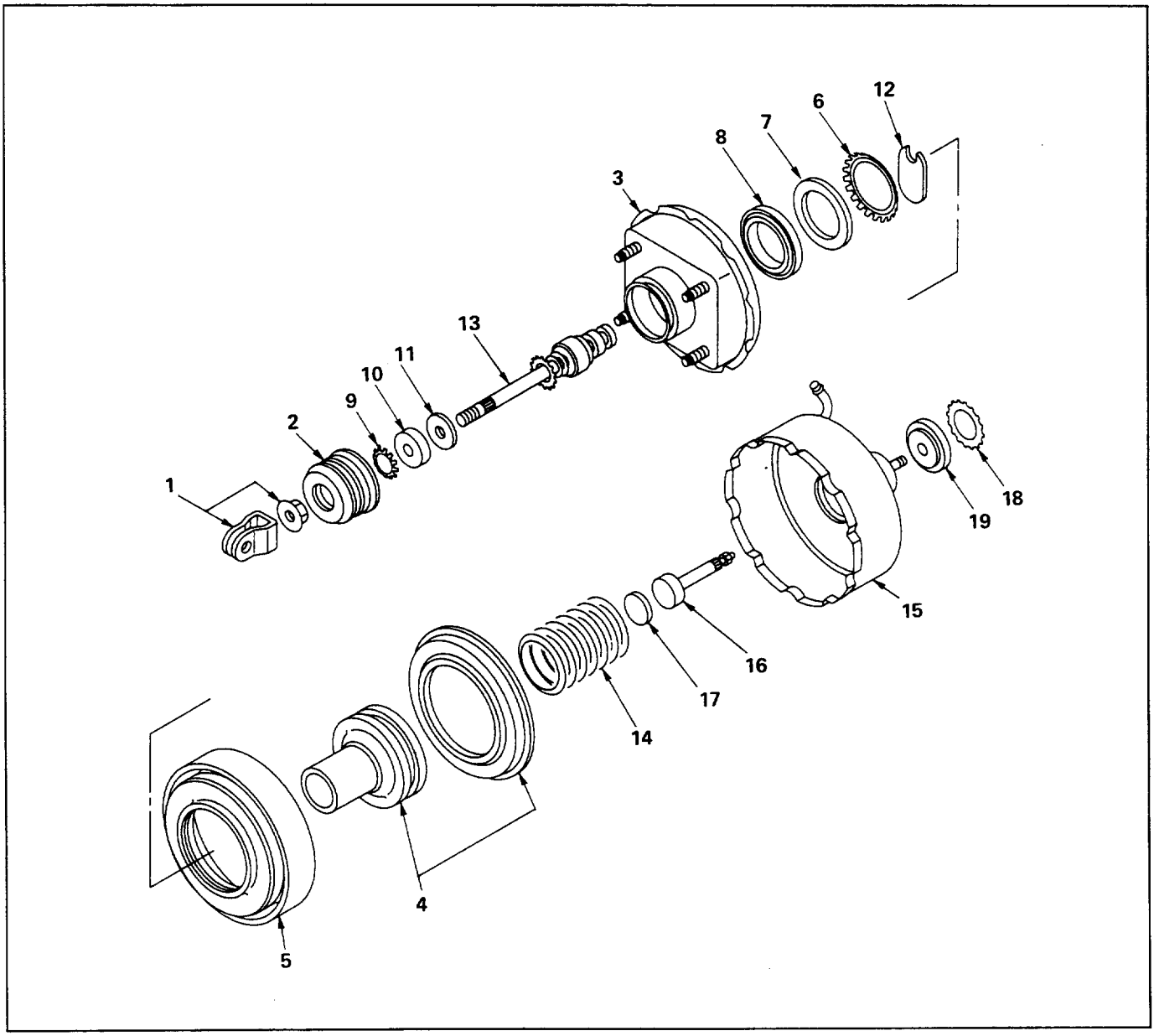
Use care to prevent damaging the lip of the piston cup.

4. **Snap Ring**
5. **Dust Cover**
6. **Pipe Joint**

Pipe Joint Torque	N·m (kg·m / lb·in)
	5 (0.5 / 43)

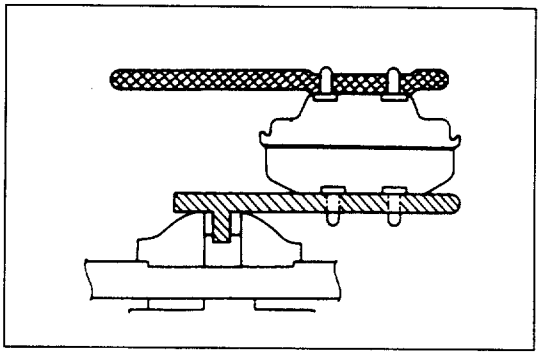
CLUTCH BOOSTER

DISASSEMBLY



Disassembly Steps

1. Clevis yoke
2. Boot
3. Rear shell
4. Diaphragm plate assembly
5. Diaphragm
6. Bearing retainer
7. Bearing
8. Seal
9. Silencer retainer
10. Silencer
11. Filter
12. Stopper key
13. Valve plunger assembly
14. Return spring
15. Front shell
16. Push rod
17. Reaction disc
18. Retainer
19. Push rod seal



Disassembly Steps

1. **Clevis Yoke**
2. **Boot**
3. **Rear Shell**
   - Apply setting marks to the front shell and rear shell.
   - Install the support plate to the front shell.
   - Install the handle to the rear shell.

     Support Plate : 5-8840-2058-0
     Handle : 9-8523-1733-0

   NOTE

   Note that the diaphragm spring pops out of position as the rear shell is removal.
4. **Diaphragm Plate Assembly**
5. **Diaphragm**
6. **Bearing Retainer**
7. **Bearing**
8. **Seal**
9. **Silencer Retainer**
10. **Silencer**
11. **Filter**
12. **Stopper Key**
13. **Valve Plunger Assembly**
14. **Return Spring**
15. **Front Shell**
16. **Push Rod**
17. **Reaction Disc**
18. **Retainer**
19. **Push Rod Seal**

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and parts replacements if excessive wear or damage is discovered during inspection.

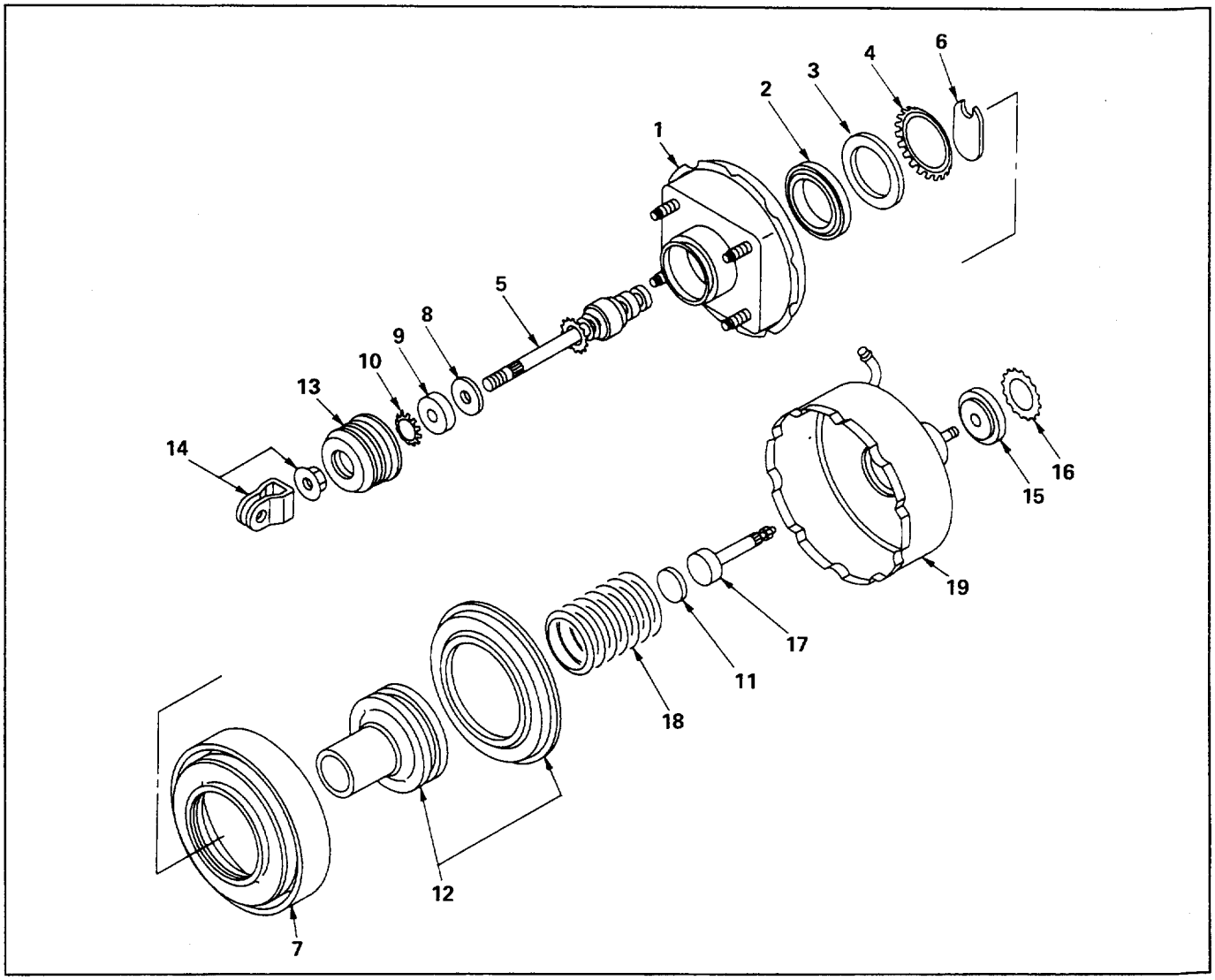
CAUTION:

If the clutch booster has been disassembled, the repair kit must be replaced with new one.

NOTE:

Before inspection, wash metal parts in metal cleaner, and wash rubber or resin parts in alcohol.

REASSEMBLY

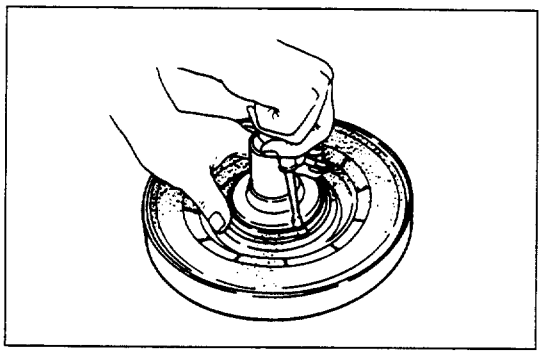


Reassembly Step

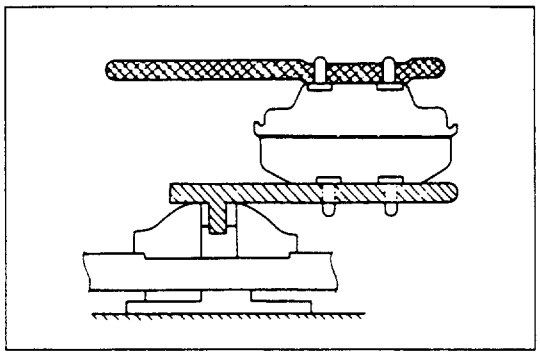
1. Rear shell
2. Seal
3. Bearing
4. Bearing retainer
5. Valve plunger assembly
6. Stopper key
7. Diaphragm
8. Filter
9. Silencer
10. Silencer retainer
11. Reaction disc
12. Diaphragm plate assembly
13. Boot
14. Clevis yoke
15. Push rod seal
16. Retainer
17. Push rod
18. Return spring
19. Front shell

Reassembly Steps

1. **Rear Shell**
   - Apply silicone grease to the portions of the rear shell in contact with the seal and lip.
2. **Seal**
3. **Bearing**
4. **Bearing Retainer**
5. **Valve Plunger Assembly**
   - Apply silicone grease to the valve body outside surfaces and the plunger sliding surfaces.
6. **Stopper Key**
7. **Diaphragm**
   - Apply silicone grease to the outside and inside surfaces of the diaphragm in contact with the rear shell and front shell.



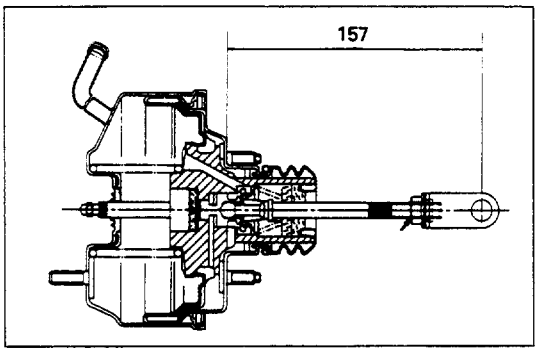
8. **Filter**
9. **Silencer**
10. **Silencer Retainer**
11. **Reaction Disc**
    - Apply silicone grease to the reaction disc surfaces.
12. **Diaphragm Plate Assembly**
    - Apply silicone grease to the outside and inside surfaces of the diaphragm plate.
13. **Boot**
14. **Clevis Yoke**
15. **Push Rod Seal**
16. **Retainer**
17. **Push Rod**
    - Apply silicone grease to the push rod sliding surfaces.
18. **Return Spring**



19. Front Shell

- Apply silicone grease to the sliding surfaces of the front shell with the push rod.
- Install the support plate and handle.
- Rotate handle to align the setting mark.

  Support Plate : 5-8840-2056-0
  Handle : 5-8523-1733-0

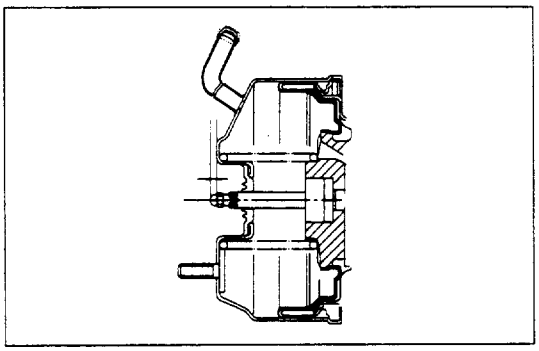


- Measure the push rod distance between pin center of clevis and rear shell.

  If the distance is not equal to the specification, it must be adjusted.

Distance between Pin Center and Rear Shell mm (in)
157 (6.18)

Lock Nut Torque N·m (kg·m / lb·ft)
20 (2.0 / 14)



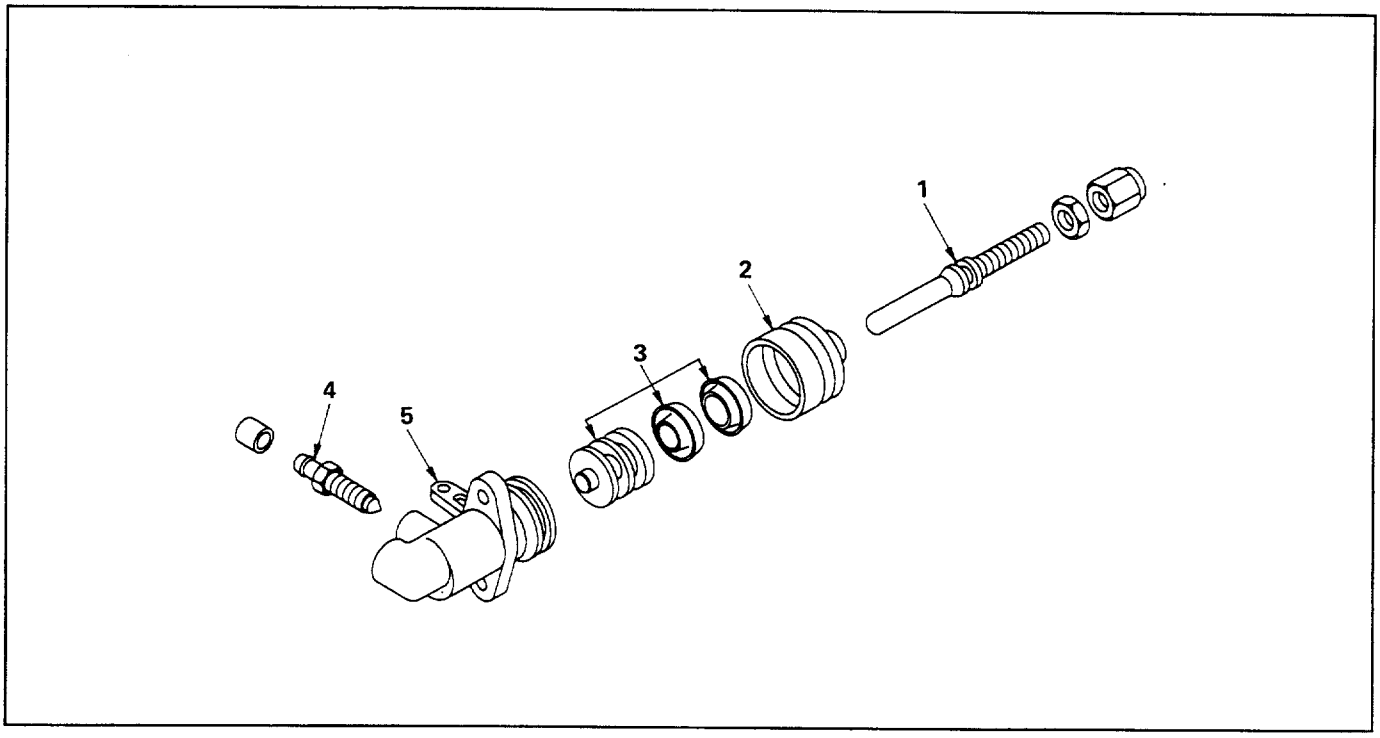
- Apply 66.66 kPa (500 mmHg) of negative pressure to the clutch booster.
- Measure the push rod distance between end of push rod and rear shell flange face.

  If the distance is not equal to the specification, it must be adjusted.

Distance between Push Rod End and Rear Shell mm (in)
3.75 – 4.00 (0.148 – 0.157)

SLAVE CYLINDER

DISASSEMBLY



Disassembly Steps

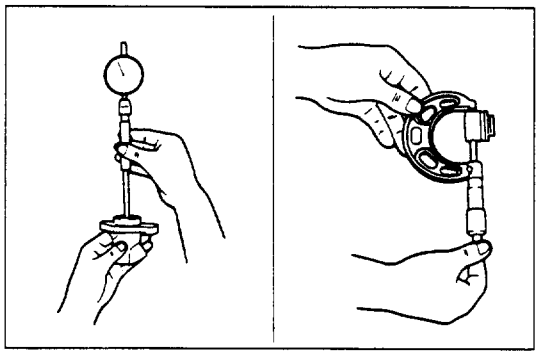
1. Push rod
2. Boot
3. Piston assembly
4. Bleeder screw
5. Cylinder body

Disassembly Steps

1. **Push Rod**
2. **Boot**
3. **Piston Assembly**
4. **Bleeder Screw**
5. **Cylinder Body**

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and parts replacements if excessive wear or damage is discovered during inspection.



Cylinder Body

- Wash clean the cylinder body in brake fluid.
- Measure the cylinder inside diameter.

Master Cylinder Inside Diameter	mm (in)
Standard	
ø 25.400 – 25.452 (1.0000 – 1.0020)	

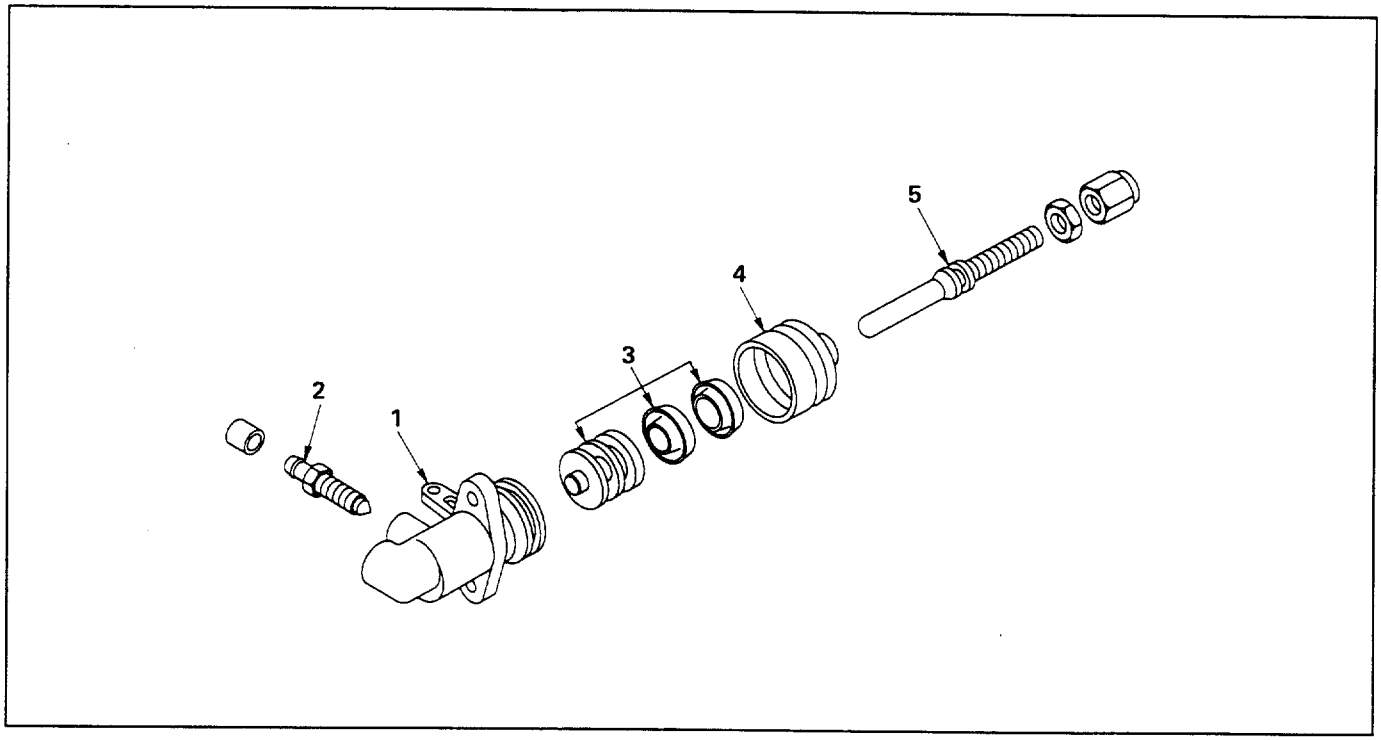
Clearance between Cylinder Bore and Piston Clearance	mm (in)
Standard	Limit
0.02 – 0.10 (0.0008 – 0.0039)	0.11 (0.0043)

- If excessive wear or any abnormal conditions are present, the master cylinder assembly must be replaced with new one.

CAUTION

If the master cylinder has been disassembled, the repair kit must be replaced with new one.

REASSEMBLY



Reassembly Steps

1. Cylinder body
2. Blender screw
3. Piston assembly
4. Boot
5. Push rod

Reassembly Step

1. **Cylinder Body**
2. **Bleeder Screw**
3. **Piston Assembly**
   - Before installing, apply a thin coat of rubber grease to the piston.

CAUTION:

Use care to prevent damaging the lip of the piston cup.

4. **Boot**
5. **Push Rod**

LGMBP-WE-881

You are requested to order this manual using the manual number that is shown above.

This manual is applicable for vehicles in all countries except the USA and Canada.

All rights reserved. This manual may not be reproduced in whole or in part, without the permission in writing of ISUZU MOTORS LIMITED.

Issued by

ISUZU MOTORS LIMITED

INTERNATIONAL SERVICE DEPARTMENT

Tokyo, Japan

First edition Feb., 1998 8101-03K-0.3

No.LGMBP-WE-881 PRINTED IN JAPAN

WORKSHOP MANUAL

NHR · NKR · NPR

MANUAL TRANSMISSION AND CLUTCH

MSB SERIES

SECTION 7

ISUZU

ISUZU

International Service & Parts

Tokyo, Japan

NOTICE

Before using this Workshop Manual to assist you in performing vehicle service and maintenance operations, it is recommended that you carefully read and thoroughly understand the information contained in Section 0A under the headings "GENERAL REPAIR INSTRUCTIONS" and "HOW TO USE THIS MANUAL".

All material contained in this Manual is based on latest product information available at the time of publication.

All rights are reserved to make changes at any time without prior notice.

Applicable Model

N Series		
NHR55	NKR55	NPR69
NHR69	NKR69	
	NKR17	

This manual is applicable to 1994 year model and later vehicles.

THIS MANUAL INCLUDES THE FOLLOWING SECTIONS:

SECTION NO.	CONTENTS
00	Service Information
7B	Manual Transmission
7C	Clutch

SECTION 00

SERVICE INFORMATION

CONTENTS

	PAGE
Troubleshooting	00– 2
Transmission	00– 3
Clutch	00– 4
Main Data and Specifications	00– 5
Service Standard	00– 6
Transmission	00– 6
Clutch	00– 7
Servicing	00– 8
Transmission Oil Level Check	00– 8
Transmission Oil Change	00– 8
Gear Control Cable Adjustment	00– 9
Clutch Pedal Travel and Free Play Adjustment	00–10
Clutch Hydraulic Circuits Bleeding	00–12
Fixing Torque	00–13
Transmission	00–13
Clutch	00–14
Special Tools	00–15
Transmission	00–15
Power Take Off	00–16
Clutch	00–17

TROUBLESHOOTING

CONTENTS

PAGE

Transmission 00–3
- Abnormal Noise 00–3
- Hard Shifting 00–3
- Walking or Jumping out of Gear 00–3

Clutch 00–4
- Dragging 00–4
- Slipping 00–4
- Shudder (Chattering) 00–4
- Noisy 00–4
- Pedal is Hard to Push 00–4

TROUBLESHOOTING

TRANSMISSION

PROBLEM	POSSIBLE CAUSE	CORRECTION
Abnormal Noise	1. Flywheel pilot bearing worn. 2. Bearing worn or broken (Main shaft or counter shaft). 3. Anti-lash plate malfunction. 4. Gear tooth contact surface worn or scuffed (Main shaft, counter shaft and/or reverse idle gear). 5. Spline worn (Synchronizer clutch hub). 6. Gear, clutch hub or thrust washer thrust face seized. 7. Lack of backlash between mating gears.	1. Replace. 2. Repair or replace 3. Repair or replace. 4. Repair or replace. 5. Replace. 6. Replace. 7. Replace.
Hard Shifting	1. Improper clutch pedal free play. 2. Wrong oil in use. 3. Gear control linkage misadjust. 4. Change lever sliding portions worn. 5. Shift block, shift rod and/or control box sliding faces worn. 6. Shift arm and/or synchronizer sleeve groove worn. 7. Synchronizer parts worn or weakend. 8. Thrust washer, collar, and/or gear thrust faces worn (Main shaft and/or counter shaft thrust play).	1. Readjust. 2. Replace with recommended oil. 3. Readjust. 4. Repair or replace. 5. Repair or replace. 6. Replace. 7. Replace. 8. Replace.
Walking or Jumping out of Gear	1. Gear control linkage misadjust. 2. Detent spring weakened or broken. 3. Detent ball worn. 4. Change lever sliding portions worn. 5. Shift block, shift rod and/or control box sliding faces worn. 6. Shift arm and/or synchronizer sleeve groove worn. 7. Synchronizer parts worn or weakened. 8. Thrust washer, collar, and/or gear thrust faces worn (Main shaft and/or counter shaft thrust play). 9. Spline worn (Synchronizer hub). 10. Bearings worn or broken.	1. Readjust. 2. Replace. 3. Replace. 4. Repair or replace. 5. Repair or replace. 6. Replace. 7. Replace. 8. Replace. 9. Replace. 10. Replace.

TROUBLESHOOTING (CONT.)

CLUTCH

PROBLEM	POSSIBLE CAUSE	CORRECTION
Dragging	1. Hydraulic line leakage. 2. Air in line. 3. Master cylinder and/or slave cylinder piston cup worn. 4. Driven plate worn or warped. 5. Diaphragm spring weak or tip of finger worn. 6. Driven plate sticking on spline. 7. Release bearing worn or damaged. 8. Clutch pedal excessive free play.	1. Repair. 2. Bleed and check for damage. 3. Replace. 4. Replace driven plate. 5. Replace pressure plate assembly. 6. Clean and free spline and lubricate with grease. 7. Replace release bearing. 8. Readjust.
Slipping	1. Driven plate facing worn or oil soaked. 2. Diaphragm spring weak. 3. Pressure plate and/or flywheel warped. 4. Clutch pedal lack of free play.	1. Replace driven plate and check for leaks as needed. 2. Replace pressure plate assembly. 3. Repair or replace. 4. Readjust.
Shudder (Chattering)	1. Engine mounting loose or broken. 2. Driven plate facing warped. 3. Driven plate surface of facing hardened. 4. Driven plate facing oil soaked. 5. Driven plate damper spring weakened or broken. 6. Pressure plate and/or flywheel warped.	1. Tighten or replace. 2. Replace driven plate. 3. Replace driven plate. 4. Replace driven plate and check for leaks. 5. Replace driven plate. 6. Repair or replace.
Noisy	1. Release bearing binding. 2. Release bearing worn or broken. 3. Release bearing insufficiently lubricate. 4. Driven plate damper springs weakened or broken. 5. Pilot bearing worn or broken. 6. Driven plate rivet loosen. 7. Ball stud insufficiently lubricate. 8. Clutch pedal lack of free play. 9. Clutch pedal shaft insufficiently lubricate. 10. Pilot bearing loose or broken.	1. Clean or replace if damaged, and lubricate. 2. Replace. 3. Lubricate with grease or replace. 4. Replace driven plate. 5. Replace. 6. Replace driven plate. 7. Lubricate with grease. 8. Readjust. 9. Lubricate with grease. 10. Replace.
Pedal is Hard to Push	1. Hydraulic line blocked or crimped. 2. Clutch pedal shaft insufficiently lubricate.	1. Clean out or replace. 2. Lubricate with grease.

MAIN DATA AND SPECIFICATIONS

TRANSMISSION				
Type		MSB-5 5 Speed		
Gear Mesh Type		1st to 5th : Synchro-mesh Reverse : Constant-mesh		
Control Type		Floor remote control		
Gear Ratio		(MSB-5S) (MSB-5M) 1st : 5.016 5.594 2nd: 2.672 2.814 3rd : 1.585 1.660 4th : 1.000 1.000 5th : 0.770 0.794 Reverse: 4.783 5.334		
Lubricating Oil		Engine Oil SAE 5W-30		
Oil Capacity	L (US qt/Imp qt)	Approx. 2.7 (2.9/2.4)		
POWER TAKE OFF				
Allowable Maximum Torque	N·m(kg·m)	147 (15) / at output shaft 1000 RPM		
Gear Ratio (to Engine)		1.8214		
Revolution Direction		Clockwise (viewed from rear)		
CLUTCH		NHR55, NKR55	NHR69, NKR69, NPR69	NKR17
Pressure Plate				
Spring Type		Diaphragm	Diaphragm	Disphragm
Outside Diameter	mm (in)	240 (9.4)	250 (9.8)	240 (9.4)
Clamping Force	N (kg/lb)	4,119 (420/926)	6,276 (640/1,411)	5,492 (560/1,235)
Spring Finger Height	mm (in)	40.7-42.7 (1.60-1.68)	39.0-41.0 (1.54-1.61)	37.5-39.5 (1.48-1.56)
Driven Plate				
Inside x Outside Diameter	mm (in)	240 x 160 (9.4 x 6.3)	250 x 160 (9.8 x 6.3)	240 x 160 (9.4 x 6.3)
Free Thickness	mm (in)	7.5-8.1 (0.295-0.319)	7.9-8.5 (0.311-0.335)	7.9-8.5 (0.311-0.335)
Clamping Thickness	mm (in)	7.1-7.7 (0.280-0.303)	7.7-8.3 (0.303-0.327)	7.7-8.3 (0.303-0.327)
Clutch Pedal				
Height	mm (in)	160-170 (6.3-6.7)		
Stroke	mm (in)	159-169 (6.3-6.7)		
Free Play	mm (in)	15-25 (0.6-1.0)		
Master Cylinder				
Bore Diameter	mm (in)	ø 19.050-19.102 (0.7500-0.7520)		
Slave Cylinder				
Bore Diameter	mm (in)	ø 26.990-27.042 (1.0626-1.0646)		ø 22.220-22.272 (0.8748-0.8768)

SERVICE STANDARD

TRANSMISSION

Items		Service Standard	Service Limit
Gear Shift Position between Center of Shift Lever Play and Instrument Center Cluster	mm(in)	Standard Cab : 247±15 (9.7±0.6) Wide Cab : 283±15 (11.1±0.6)	
Ball Bearing Run-out	mm(in)		0.2 (0.01)
Gear Inside Diameter	mm(in)	1st Gear : 61 (2.402) 2nd Gear : 54 (2.126) 3rd Gear : 42 (1.654) Reverse Gear : 54 (2.126)	61.1 (2.406) 54.1 (2.130) 42.1 (1.657) 54.1 (2.130)
Clearance between 5th gear and Main Shaft	mm(in)	0.05-0.09 (0.002-0.004)	0.2 (0.01)
Clearance between Reverse Idle Gear and Idle Gear Shaft	mm(in)	0.04-0.08 (0.002-0.003)	0.2 (0.01)
Spline Play between 5th Counter Gear and Counter Shaft at 5th Counter Gear Outer Circumference	mm(in)	0.18-0.43 (0.007-0.017)	0.45 (0.018)
Thrust Washer Thickness	mm(in)	2nd : 3.0 (0.12) 5th : 3.8 (0.15)	2.8 (0.11) 3.6 (0.14)
Main Shaft Run-out	mm(in)	Les than 0.025 (0.0010)	0.1 (0.004)
Clearance between Block Ring and Dog Gear	mm(in)	3rd/4th : 1.0 (0.04) 1st/2nd : 1.5 (0.06) 5th : 1.5 (0.06)	0.5 (0.02) 0.5 (0.02) 0.5 (0.02)
Spline Play between Clutch Hub and Main Shaft at Clutch Hub Outer Circumference	mm(in)	Less than 0.05 (0.002)	0.3 (0.01)
Clearance between Block Ring and Insert	mm(in)	3.59-3.91 (0.141-0.154)	4.1 (0.16)
Clearance between Clutch Hub and Insert	mm(in)	0.09-0.31 (0.004-0.012)	0.4 (0.02)
Shift Arm Thickness	mm(in)	10.0 (0.39)	9.0 (0.35)
Detent Spring Free Length	mm(in)	31.6 (1.24)	30.1 (1.19)

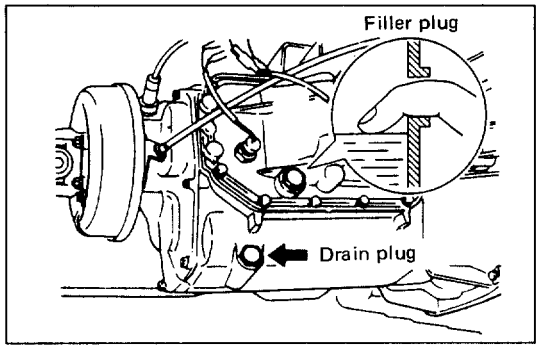
SERVICE STANDARD (CONT.)

CLUTCH

Items		Service Standard	Service Limit
Pressure Plate Distortion	mm (in)		0.3 (0.01)
Pressure Plate Clamping Force	N (kg/lb)		
NHR55, NKR55		4,119 (420/926)	3,785 (386/851)
NHR69, NKR69, NPR69		6,276 (640/1,411)	5,776 (589/1,299)
NKR17		5,492 (560/1,235)	5,050 (515/1,136)
Diaphragm Spring Finger Height	mm (in)		
NHR55, NKR55		40.7-42.7 (1.60-1.68)	
NHR69, NKR69, NPR69		39.0-41.0 (1.54-1.61)	
NKR17		37.5-39.5 (1.48-1.56)	
Driven Plate Warpage	mm (in)	Less than 0.7 (0.03)	1.0 (0.04)
Spline Play between Top Gear Shaft and Driven Plate at Driven Plate Outer Circumference	mm (in)	Less than 0.5 (0.02)	1.0 (0.04)
Driven Plate Rivet Head Depression			
NHR55, NKR55	mm (in)	1.1-1.7 (0.04-0.01)	0.2 (0.01)
NKR17, NHR69, NKR69, NPR69		1.3-1.9 (0.05-0.08)	0.2 (0.01)
Clutch Pedal Height	mm (in)	160-170 (6.3-6.7)	
Clutch Pedal Stroke	mm (in)	159-169 (6.3-6.7)	
Clutch Pedal Free Play	mm (in)	15-25 (0.6-1.0)	
Clearance between Pedal Stopper and Clutch Switch Thread End or Stopper Bolt	mm (in)	0.5-1.0 (0.02-0.04)	
Master Cylinder Bore Diameter	mm (in)	19.050-19.102 (0.7500-0.7520)	
Clearance between Master Cylinder Bore and Piston	mm (in)	0.03-0.11 (0.001-0.004)	0.12 (0.005)
Slave Cylinder Bore Diameter	mm (in)	26.990-27.042 (1.0626-1.0646)	
Clearance between Slave cylinder Bore and Piston	mm (in)	0.02-0.10 (0.0008-0.0039)	0.11 (0.0043)

SERVICING

TRANSMISSION OIL LEVEL CHECK



1. **Remove Filler Plug.**
2. **Check Oil Level.**
   - Add lubricant to within 0 to 10 mm (0 to 0.4 in) of bottom edge of the filler hole if necessary.

CAUTION:

Use ENGINE OIL SAE 5W-30 for transmission case.

3. **Install Filler Plug.**

Filler Plug Torque	N·m (kg·m/lb·ft)
	49 (5.0/36)

TRANSMISSION OIL CHANGE

1. **Drain Oil**
   - Remove the drain plug from the transmission case and drain the oil.
2. **Install Drain Plug.**

Drain Plug Torque	N·m (kg·m/lb·ft)
	49 (5.0/36)

3. **Remove Filler Plug.**
4. **Fill Oil**
   - Fill the transmission case from the filler plug hole with new oil of specified grade.

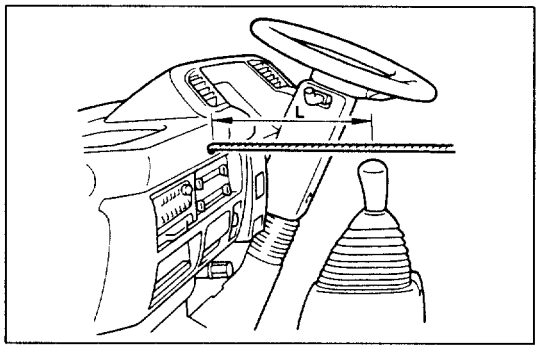
Oil Capacity	Liters (US·qt/Imp·qt)
	2.7 (2.9/2.4)

CAUTION:

Use ENGINE OIL SAE 5W-30 for transmission case.

5. **Install Filler Plug**

Filler Plug Torque	N·m (kg·m/lb·ft)
	49 (5.0/36)

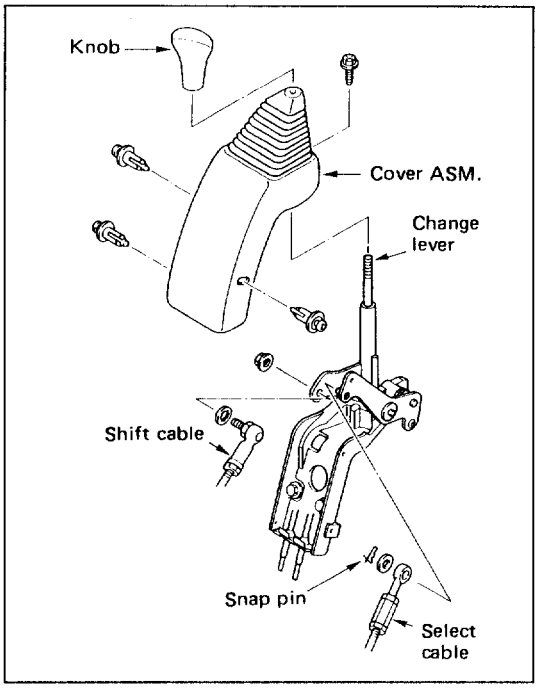


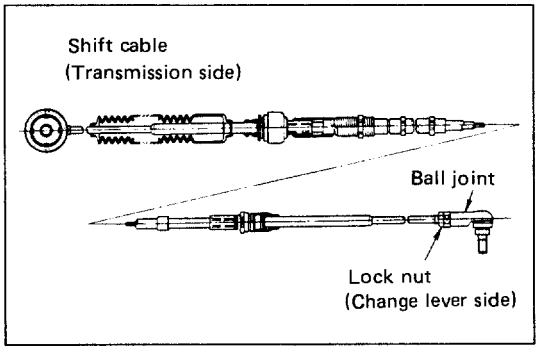
GEAR CONTROL CABLE ADJUSTMENT

1. Measure

- Set the change lever in the neutral position, then confirm if the dimension between the center of the change lever play and the instrument center cluster is within the reference value.

Change Lever Position	mm (in)
Standard cab	247±15 (9.7±0.6)
Wide Cab	238±15 (11.1±0.6)



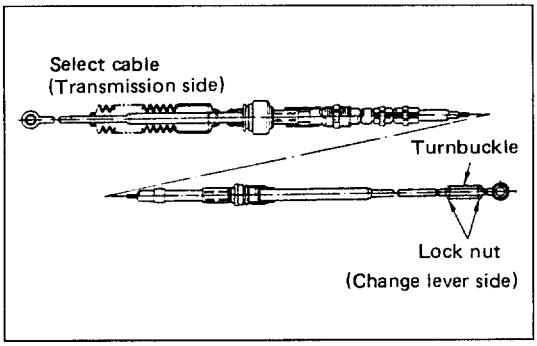


2. Adjust

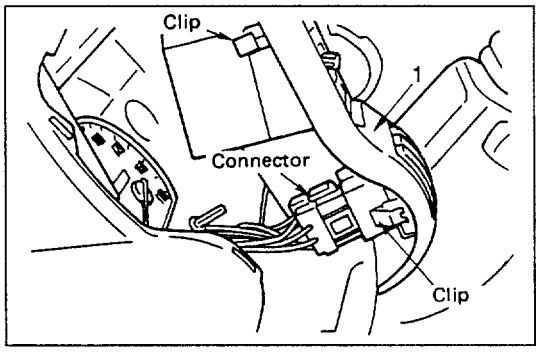
- If the dimension is out of the reference adjust as required.

1) Remove the change lever knob.
2) Remove the cover assembly.
3) Disconnect the shift cable from the change lever.
4) Set the transmission in the neutral position.
5) Loosen the lock nut of the shift cable ball joint and the select cable turnbuckle, then turn the ball joint and turnbuckle as necessary for hole and pin.
6) Tighten the lock nuts and install the shift cable to the change lever.

Lock nut torque	N·m (kg·m/lb·in)
6 (0.6/52)	



7) Install the cover assembly and the change lever knob.

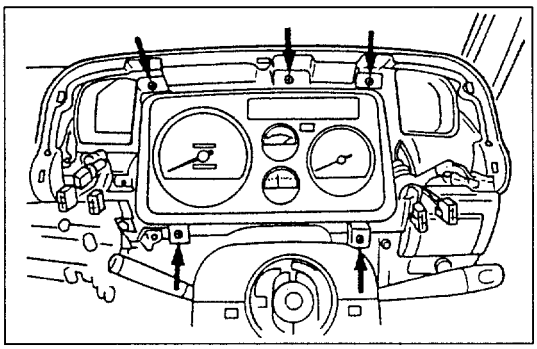


CLUTCH PEDAL TRAVEL AND FREE PLAY ADJUSTMENT

Clutch Pedal Height and Stroke

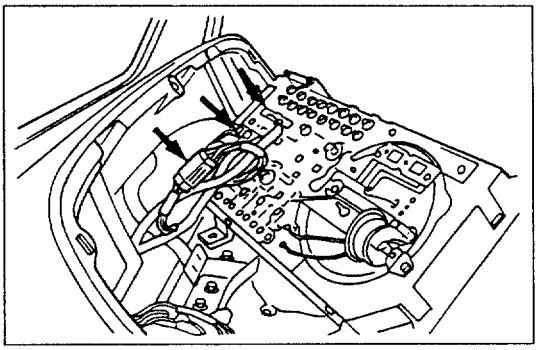
1. Remove Meter Cluster.

- Pull out the meter cluster and disconnect the harness connectors.

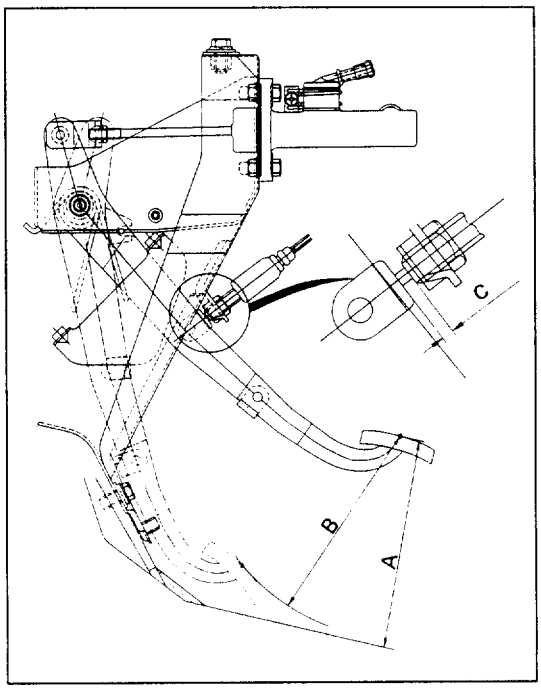


2. Remove Meter Assembly.

- Remove the 5 fixing screws.



- Disconnect the harness connectors.



3. Adjust

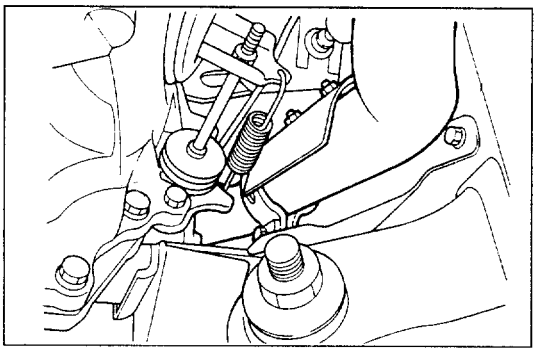
- Loosen the lock nut of the clutch master cylinder push rod.
- Adjust the pedal height by turning the push rod.

Clutch Pedal Height and Stroke	mm(in)
Height(A) : 160-170 (6.3-6.7) Stroke(B) : 159-169 (6.3-6.7)	

4. Tighten Lock Nut.

Lock Nut Torque	N·m (kg·m/lb·ft)
20 (2.0/14)	

5. Install Meter Assembly and Meter Cluster.



Clutch Pedal Free Play

Slave Cylinder

1) Remove the slave cylinder return spring.
2) Loosen the lock nut of the push rod.
3) Turn the adjust nut until it reaches the shift fork.
4) Back off the adjust nut 1.5 turns (shift fork free play approximately 2 mm/0.1 in.).
5) Tighten the lock nut.

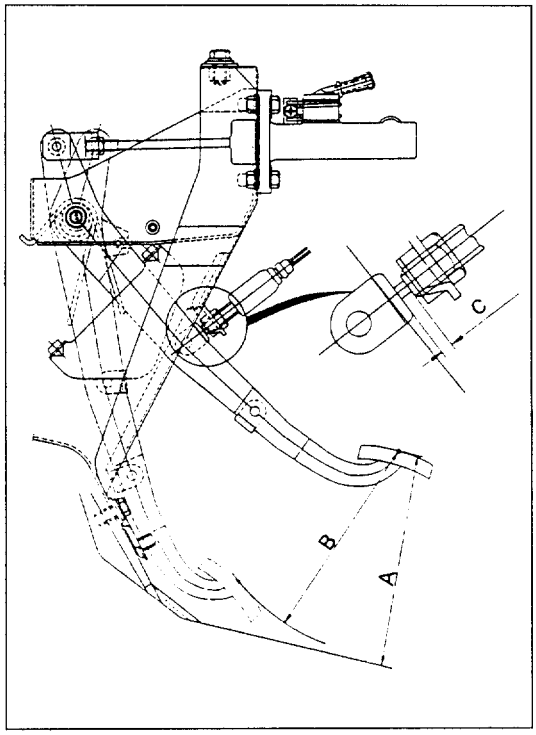
Lock Nut Torque	N·m(kg·m/lb·ft)
16 (1.6/12)	

6) Install the return spring.

Clutch Switch or Stopper Bolt

After completion of clutch pedal height adjustment, adjust the clutch switch or stopper bolt clearance.

1) Loosen the lock nut of clutch switch or stopper bolt.
2) Adjust the clutch switch or stopper bolt clearance by turning clutch switch or stopper bolt.



Clutch Switch or Stopper Bolt Clearance(C)	mm(in)
0.5-1.0 (0.02-0.04)	

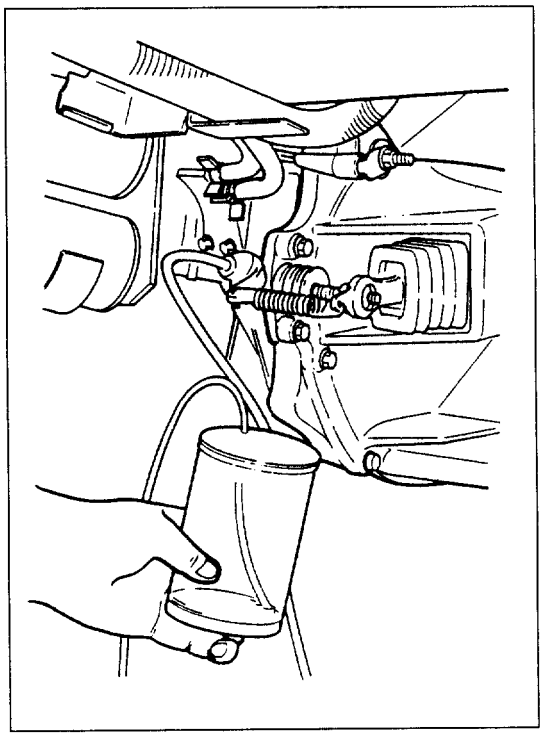
Clutch Pedal Free Play	mm(in)
15-25 (0.6-1.0)	

3) Tighten the lock nut.

Lock Nut Torque	N·m(kg·m/lb·ft)
19 (1.9/14)	

CLUTCH HYDRAULIC CIRCUITS BLEEDING

If air enters the clutch circuit, it will causes clutch dragging. Threfore, bleeding operation should be performed if the clutch fluid reservoir has been emptied due to failure to mal-replenishment or if the hydraulic circuit has been disassembled. Bleeding operation calls for cooperative action of two men.



1) Check the level of clutch fluid in the reservoir and replenish of necessary.
2) Remove the rubber cap from the bleeder screw and wipe clean the bleeder screw.

   Connect a vinyl tube to the bleeder screw and insert the other end of the vniyl tube into a transparent container.
3) Pump the clutch pedal repeatedly and hold it depressed.
4) Loosen the bleeder screw on the clutch slave cylinder to release clutch fluid with air bubbles into the container and tighten the bleeder screw immediately.
5) Release the clutch pedal carefully. Repeat the above operation until air bubbles disappear from the clutch fluid being pumped out into the container. During the bleeding operation, keep the clutch fluid reservoir filled to the specified level.

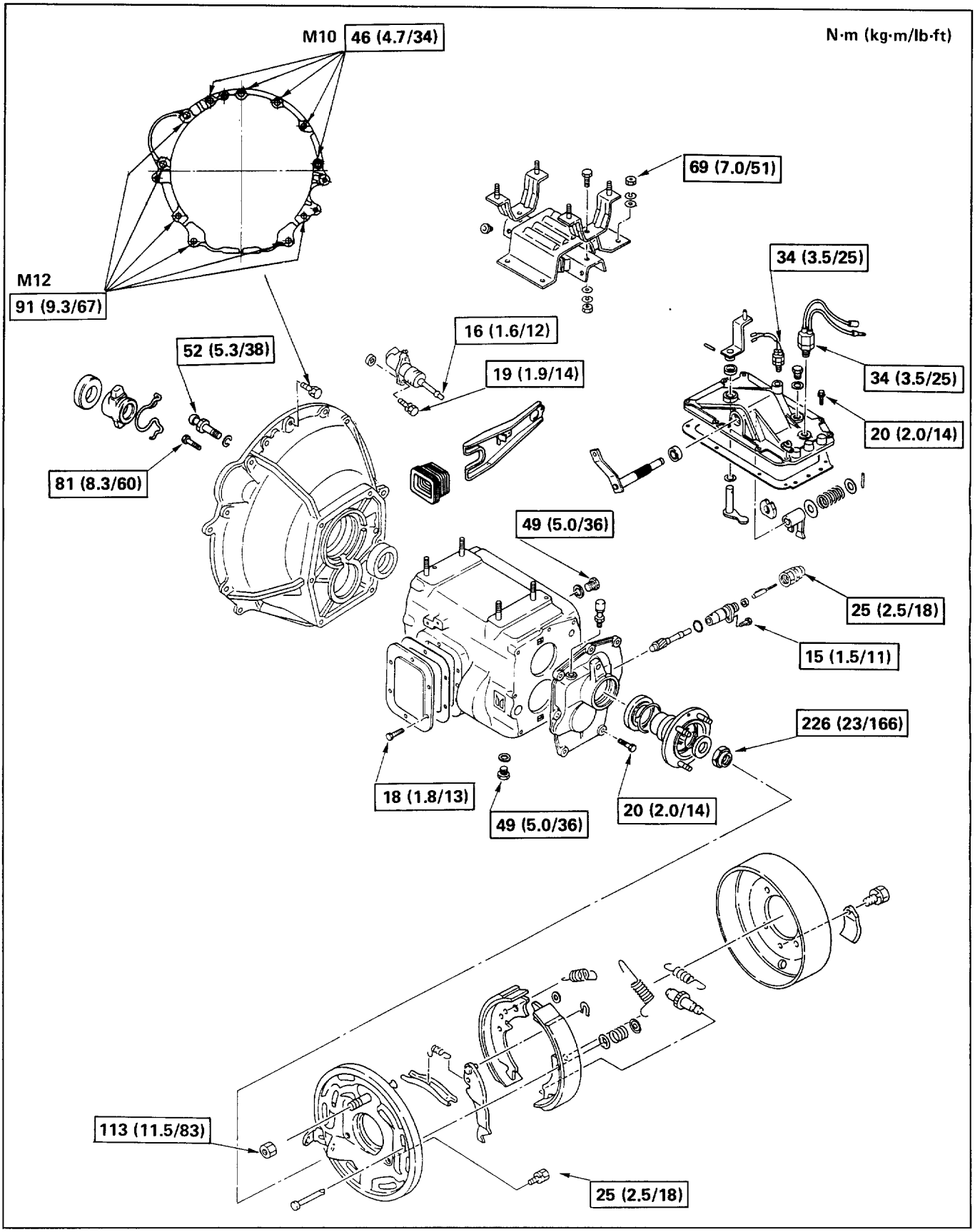
   Reinstall the rubber cap.

CAUTION:

Do not let clutch fluid remain on a painted surface. Wash it off immediately.

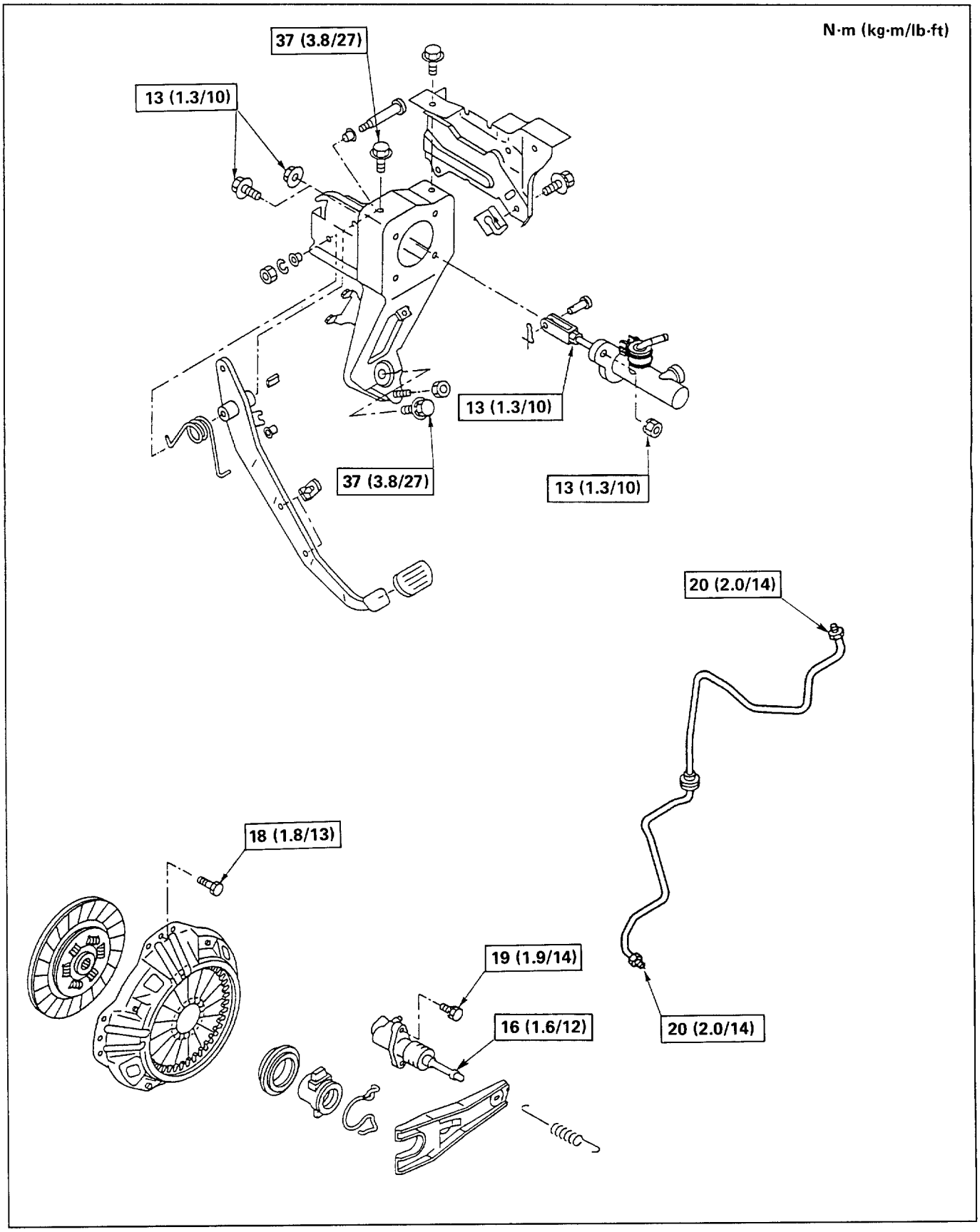
FIXING TORQUE

TRANSMISSION



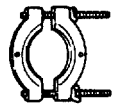
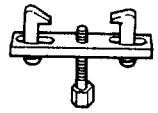
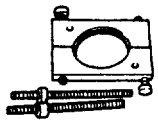
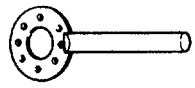
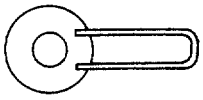
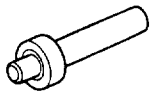
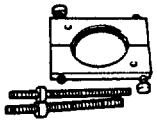
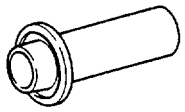
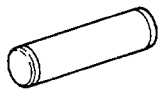
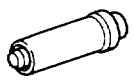
FIXING TORQUE (CONT.)

CLUTCH



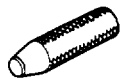
SPECIAL TOOL

TRANSMISSION

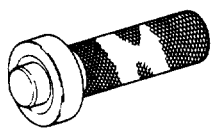
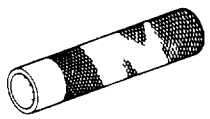
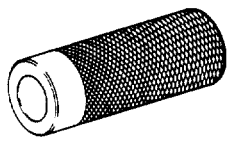
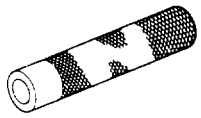
ILLUSTRATION	PART NUMBER	PART NAME	REMARKS
	5-8840-0587-0	Gear Remover	
	5-8840-2027-0	Universal Puller	
	5-8840-2042-0	Bearing Remover	
	5-8840-2043-0	Handle	
	5-8840-2044-0	Anti-lash Plate Installer	
	5-8840-2064-0	Oil Seal Installer	For front cover oil seal install
	5-8840-2078-0	Bearing Remover	
	5-8840-2242-0	Oil Seal Installer	For rear cover oil seal install
	5-8840-2244-0	Bearing Installer	
	5-8840-2245-0	Oil Seal Installer	For control box oil seal (shift and select lever shaft) install

SPECIAL TOOL (CONT.)

TRANSMISSION (CONT.)

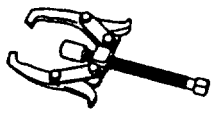
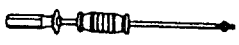
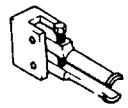
ILLUSTRATION	PART NUMBER	PART NAME	REMARKS
	9-8522-1615-0	Bearing Installer	
	9-8529-2201-0	Spring Pin Remover	

POWER TAKE OFF

ILLUSTRATION	PART NUMBER	PART NAME	REMARKS
	5-8840-2064-0	Oil Seal Installer	For output shaft oil seal
	5-8840-2065-0	Oil Seal Installer	For shift rod oil seal
	5-8840-2066-0	Bearing Installer	For output shaft bearing
	5-8840-2067-0	Plug Installer	For shift rod cap
	9-8529-2201-0	Spring Pin Remover	

SPECIAL TOOL (CONT.)

CLUTCH

ILLUSTRATION	PART NUMBER	PART NAME	REMARKS
	5-8525-3001-0	Pilot Aligner	
	5-8840-0013-0	Bearing Remover	
	5-8840-0084-0	Sliding Hammer	
	5-8840-2000-0	Pilot Bearing Remover	

SECTION 7B

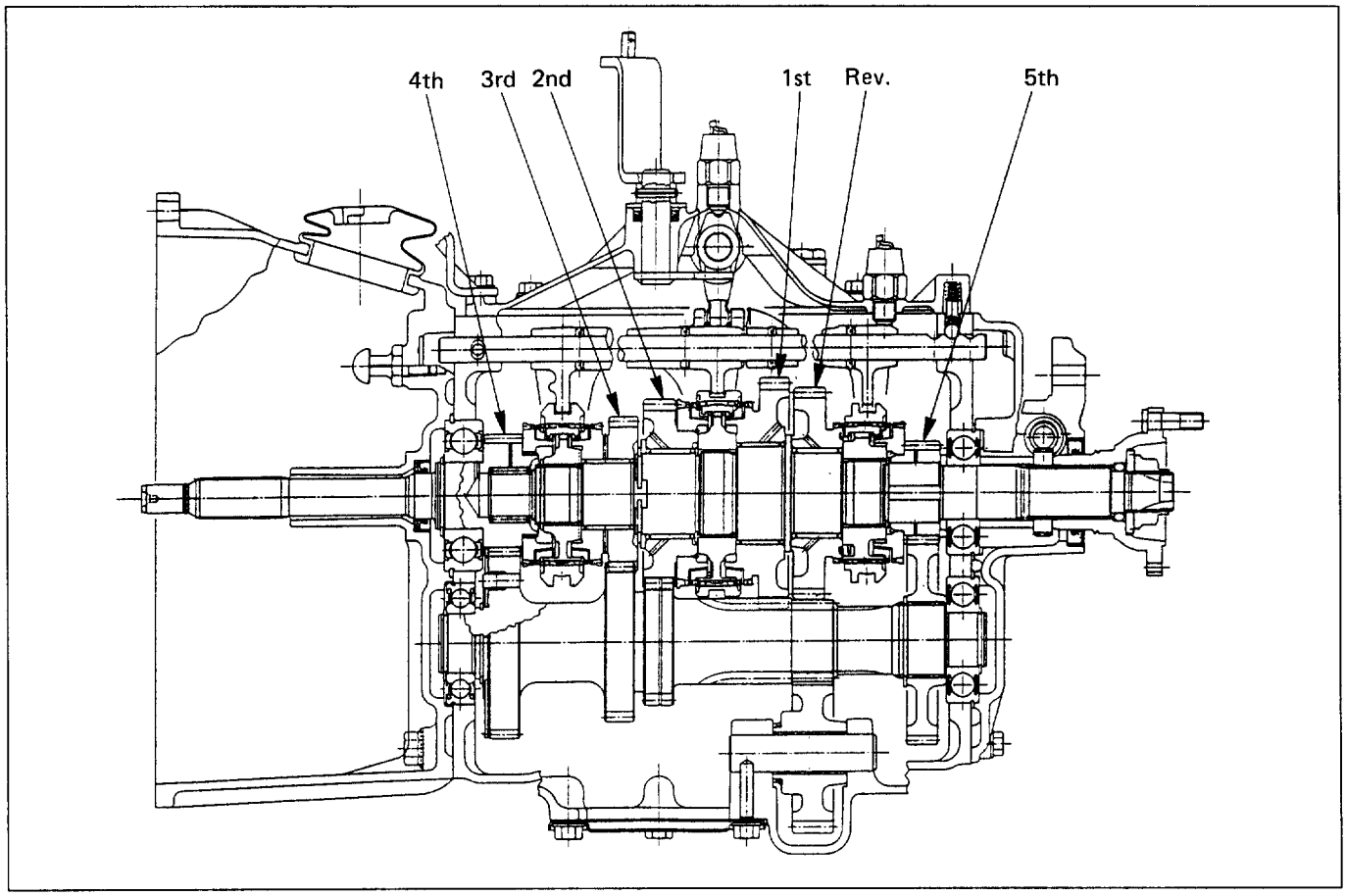
MANUAL TRANSMISSION MSB

CONTENTS

PAGE

General Description 7B- 2
On-Vehicle Service 7B- 3
Change Lever Assembly Replacement 7B- 3
Gear Control Cable Replacement 7B- 4
Car Speed Sensor Driven Gear Replacement 7B- 6
Back-up Light Switch and Neutral Switch Replacement 7B- 7
Rear Oil Seal Replacement 7B- 8
Transmission Assembly Replacement 7B-11
Front Oil Seal Replacement 7B-15
Unit Repair 7B-16
Major Components 7B-16
Disassembly 7B-16
Reassembly 7B-26
Top Gear Shaft Assembly, Main Shaft Assembly and Counter Shaft Assembly . . 7B-37
Disassembly 7B-37
Inspection and Repair 7B-43
Reassembly 7B-48
Power Take Off 7B-57
General Description 7B-57
Power Take Off Replacement 7B-58
Unit Repair 7B-62

GENERAL DESCRIPTION



For MSB model transmission, a forward 5-shift all synchromesh type and a backward 1-shift constant-mesh type transmission are employed.

The transmission case is made of a high rigidity cast iron, and the front cover integral with the clutch housing is made of aluminum die-cast. An alminum die-cast control box containing a gear shift and gear select mechanism is installed on the right side of the transmission case. A window for power take-off is also provided on the left side.

For all the gears, helical gears are employed to reduce noises.

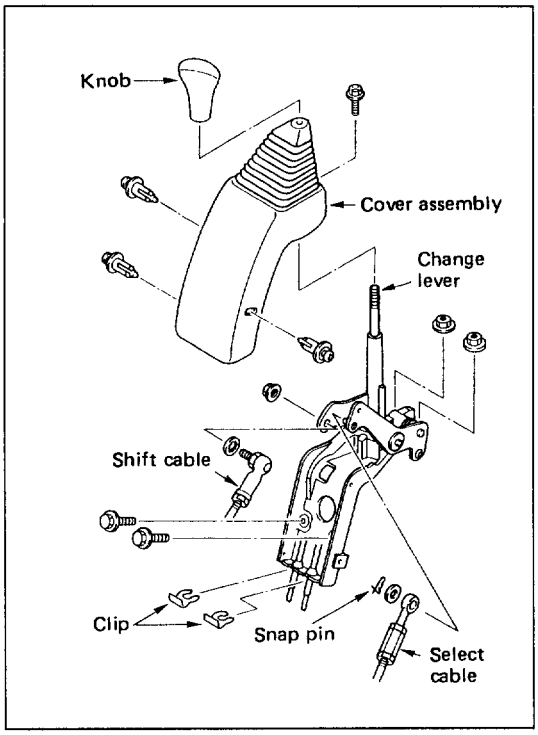
The synchromesh mechanism that employs balking rings use block rings of special brass to obtain improved synchromesh performance.

With the main shaft screwed up at the rear, ball bearings are employed for the bearings on both sides of the main shaft and the counter shaft, and needle roller bearings employed for the bearings at the tip end of the main shaft and also for those of the 1st gear, 2nd gear, 3rd gear and reverse gear to secure improved durability and reduced noises.

Furthermore, with the anti-lash mechanism employed for the engagement of the top gear with the counter gear, fine-pitch gears are also employed for the 4th gear and the 5th gear to reduce noises.

ON-VEHICLE SERVICE

CHANGE LEVER ASSEMBLY REPLACEMENT



Removal Steps

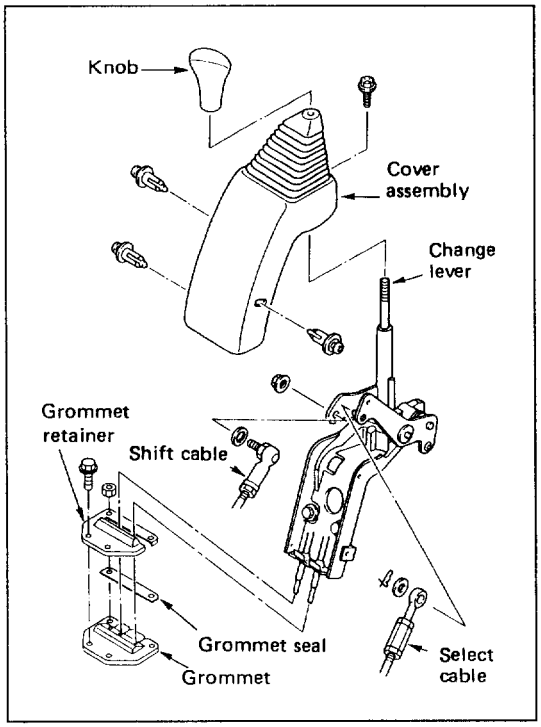
1. **Change Lever Knob**
2. **Cover Assembly**
   - Remove the fixing screw and three clips.
3. **Shift Cable and Select Cable**
   - Disconnect the cables from the change lever.
   - Remove the clips and disconnect the cables from bracket.
4. **Change Lever Assembly**

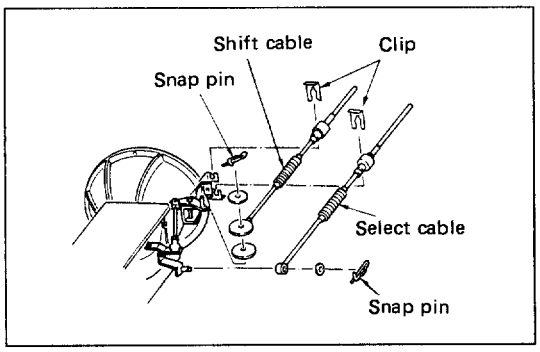
Installation Steps

1. **Change Lever Assembly**
2. **Shift Cable and Select Cable**

   When connecting the shift cable and the select cable to the change lever, adjust the cable.

   Refer to "SERVICING: GEAR CONTROL CABLE ADJUSTMENT" given previously in this section.
3. **Cover Assembly**
4. **Change Lever Knob**





GEAR CONTROL CABLE REPLACEMENT

Removal Steps

1. **Change Lever Knob**
2. **Cover Assembly**
3. **Shift Cable and Select Cable**
   1) Disconnect the shift and select cables from change lever.
   2) Remove the clips and disconnect the cables from change lever bracket.
   3) Remove the grommet retainer, grommet seal and grommet.
   4) Tilt the cab.
   5) Disconnect the shift cable and the select cable on the transmission side.
   6) Remove the clips and disconnect the shift cable and the select cable from the bracket.
   7) Remove the clips that fix the cables to the frames.
   8) Remove the shift and select cable assemblies.

Inspection and Repair

Check the cables for any deformation, damage or rust, and also check the sliding portion for any abnormal condition.

When there is any abnormal condition found, replace it with a new one.

Installation Steps

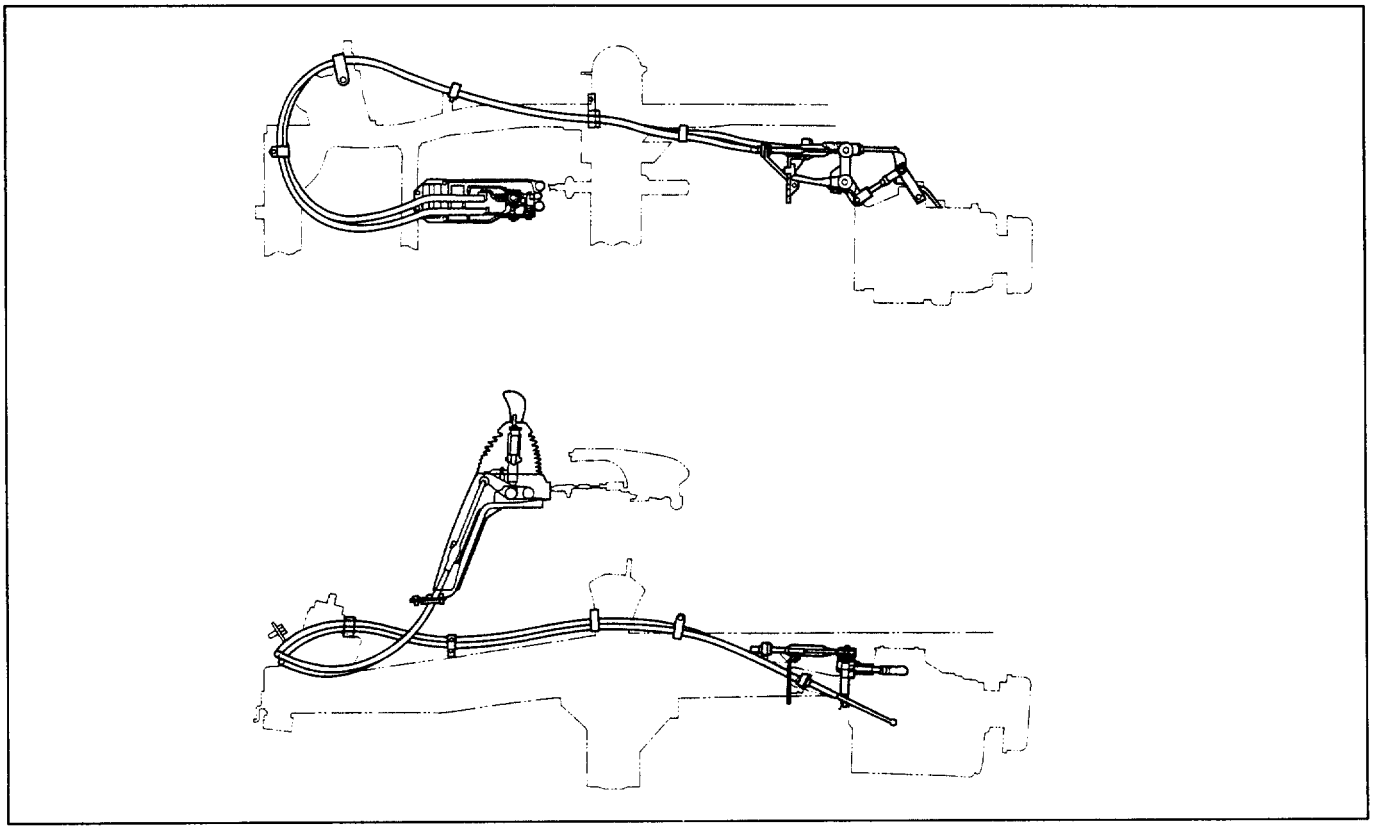
1. **Shift Cable and Select Cable**
   1) Install temporarily that the shift cable and the select cable.

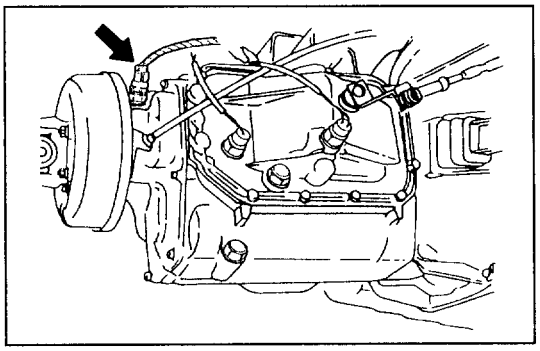
CAUTION:

Never bend the cables to radius less than 450 mm (18 in) unless it is necessary to do so for wiring purposes. And never bend the cables to radius less than 180 mm(7 in) even during wiring.

Install the cables carefully without unnecessary twisting the cable boots.

   2) Connect the shift cable and the select cable to the transmission.
   3) Fasten the cables with clips to the brackets on the transmission side.
   4) Fasten the cables with clips to the change lever bracket.
   5) Fasten the cables with clips to the frames. At this time, take care that the select cable comes above the shift cable.
   6) Install the grommet, grommet seal and grommet retainer.
   7) When connecting the shift cable and the select cable to the change lever, adjust the cables.
      Refer to "SERVICING: GEAR CONTROL CABLE ADJUSTMENT" given previously in this section.
2. **Cover Assembly**
3. **Change Lever Knob**

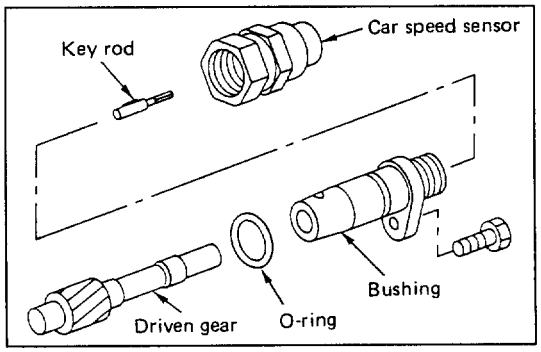




CAR SPEED SENSOR DRIVEN GEAR REPLACEMENT

Removal Steps

1. **Wiring Connector**
2. **Car Speed Sensor with Key Rod**
3. **Car Speed Sensor Driven Gear Assembly**
   - Remove the fixing bolt.
   - Remove the driven gear assembly.



Installation Steps

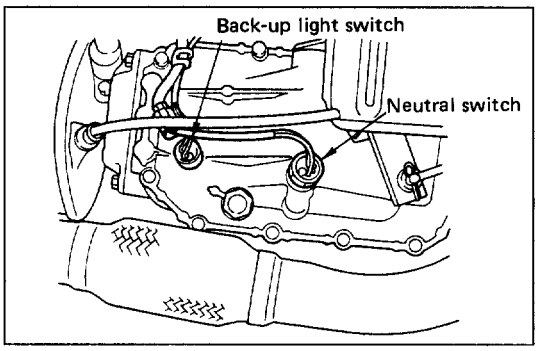
1. **Car Speed Sensor Driven Gear Assembly**

Fixing Bolt Torque	N·m(kg·m/lb·ft)
	15 (1.5/11)

2. **Car speed Sensor with Key Rod**

Fixing Bolt Torque	N·m(kg·m/lb·ft)
	25 (2.5/18)

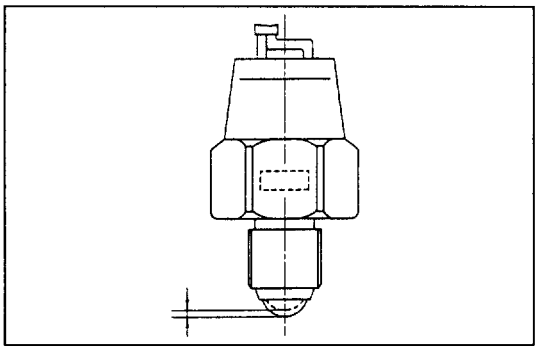
3. **Wiring Connector**



BACK-UP LIGHT SWITCH AND NEUTRAL SWITCH REPLACEMENT

Removal Steps

1. **Wiring Connector**
2. **Switch**



Inspection and Repair

- When there is continuity between the terminals in the condition as it is, and when the continuity between the terminals is turned off by pressing the ball of the switch, the switch is normal.

Switch Operating Stroke	mm (in)
0.93 (0.037)	

Installation Steps

1. **Switch**
   - Apply liquid gasket (Three Bond 1141 or equivalent) to the switch's threaded portion to prevent oil leakage, and install the switch to the control box.
   - Color of Connector
     Back-up Light Switch: Brown
     Neutral Switch: Gray

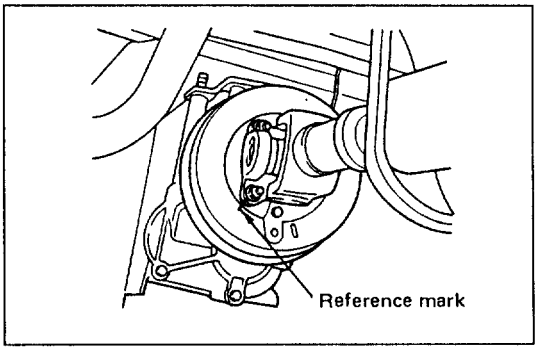
Switch Torque	N·m (kg·m/lb·ft)
34 (3.5/25)	

2. **Wiring Connector**

REAR OIL SEAL REPLACEMENT

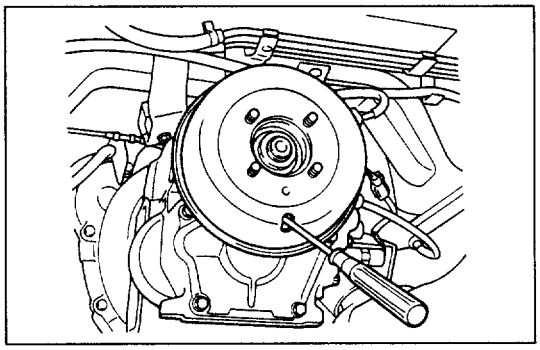
Removal Steps

- Raise vehicle and support with suitable safety stands.



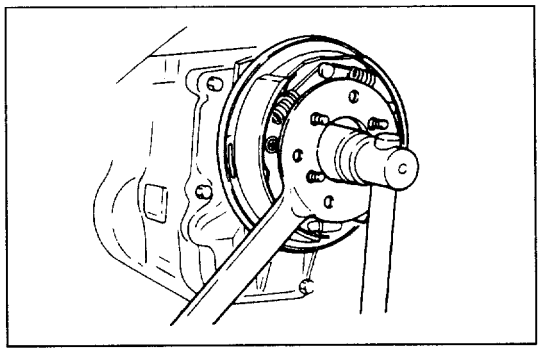
1. Propeller Shaft

- Reference mark the flange yoke to the parking brake drum.
- Disconnect the propeller shaft at flange yoke.
- Put aside the propeller shaft and tie it to the frame so it does not interfere with servicing work.



2. Parking Brake Drum

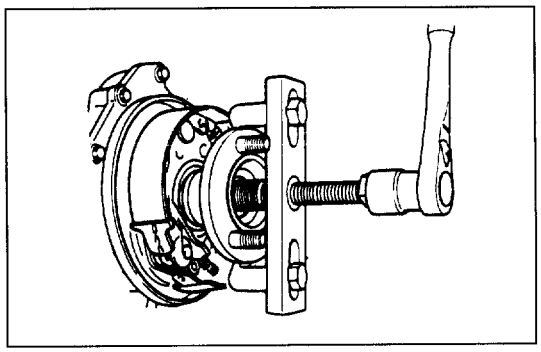
- Remove the screw and the adjust hole cover.
- It may be necessary to back off the shoe adjuster.



3. Lock Nut

- Make sure to raise the caulking of the coupling driver lock nut, then remove the lock nut.
- Use the handle to remove the lock nut.

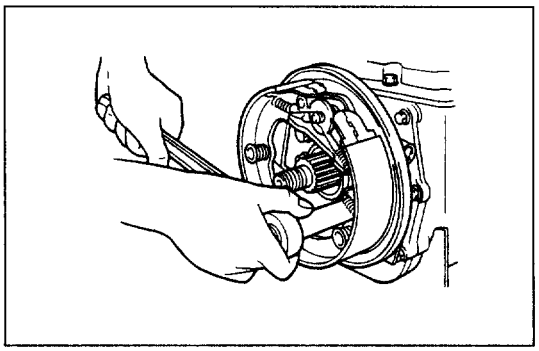
  Handle: 5-8840-2043-0



4. Coupling Driver

- Remove the coupling driver using the universal puller.

  Universal Puller: 5-8840-2027-0
- Remove the conical washer and the o-ring.

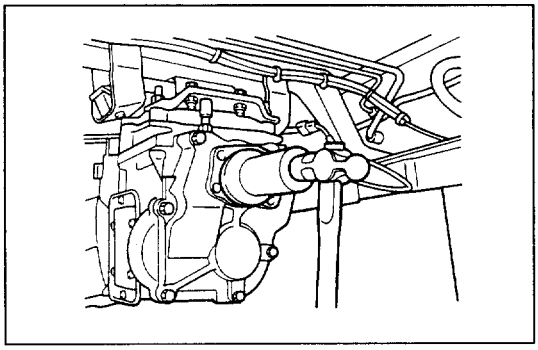


5. **Parking Brake Assembly**

6. **Oil Seal**
   - Use the screwdriver to remove the oil seal from the rear cover.

CAUTION:

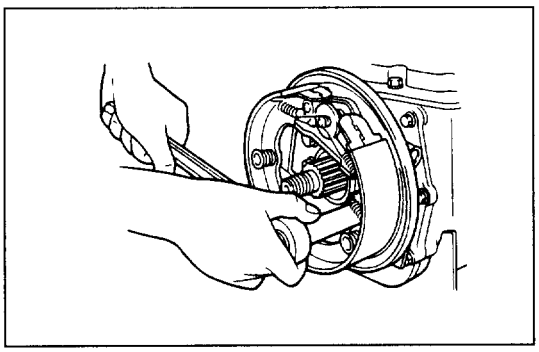
Take care not to damage the sealing seat of the rear cover.



Installation Steps

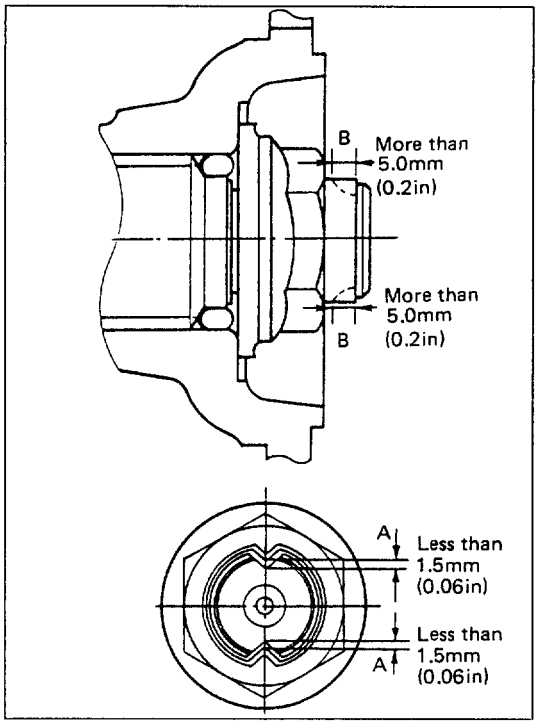
1. **Oil Seal**
   - Apply engine oil to the new oil seal outer circumference and apply multi-purpose grease to the oil seal lip.
   - Use the oil seal installer to install the oil seal to the rear cover.

     Oil Seal Installer: 5-8840-2242-0



2. **Parking Brake Assembly**

Parking Brake Nut and Bolts Torque	N·m (kg·m/lb·ft)
Bolts: 25 (2.5/18)	
Nut : 113 (11.5/83)	



3. Coupling Driver

4. Lock Nut

- Install the o-ring and the conical washer.
  The conical washer is to be set up with its identification groove to the nut side.

CAUTION:

Do not reuse the lock nut.

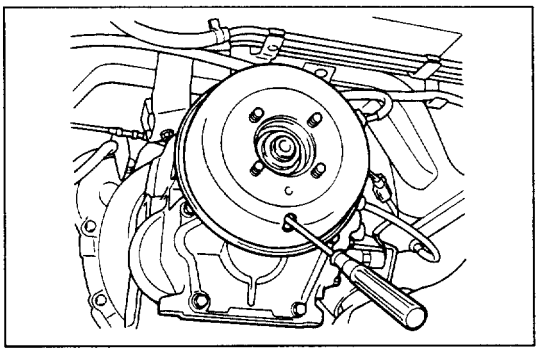
- Apply the engine oil to the setting face of the new lock nut and tighten it up at the specified torque.
  Handle: 5-8840-2043-0

Lock Nut Torque	N·m (kg·m/lb·ft)
226 (23.0/166)	

- Align the lock nut with the V-shaped groove at the tip of the main shaft, and caulk the nut lip portion by using a chisel.
  (Round edge approximately 1 mm (0.04 in)x 60°).
- As shown in the illustration, be sure to caulk the nut lip so that the clearance between the V-shaped groove portion at the tip of the main shaft and the caulked up lip(A) is less than 1.5 mm (0.06 in), and the caulking length(B) is 5 mm (0.2 in) or more.

CAUTION:

Be sure to confirm that there is no crack at the caulked portion of the end nut after caulking.



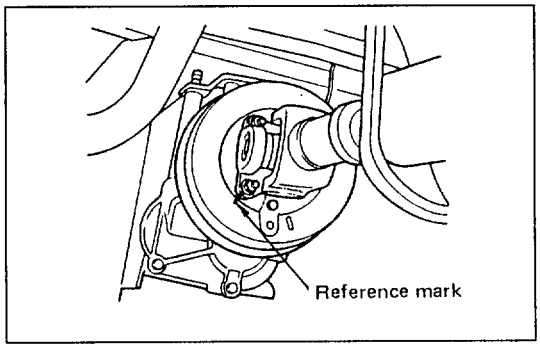
5. Parking Brake Drum

- Adjust the parking brake after installation.

1) Rotate the brake drum to align the adjust hole with the adjuster.
2) Move the camshaft lever from side to side several times to center the brake shoes.
3) Insert a screwdriver into the hole and rotate the adjuster by pushing it upward until the shoes drag on the drum.
4) Back off the adjuster 30 notches.

- Install the adjust hole cover.

Adjust Hole Cover Bolt Torque	N·m (kg·m/lb·in)
8 (0.8/69)	



6. Propeller Shaft

- Line up reference mark.

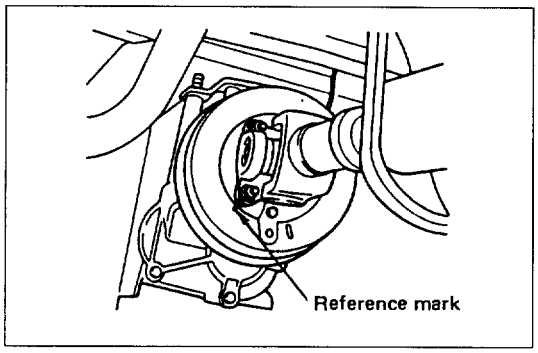
Propeller Shaft Bolt Torque	N·m (kg·m/lb·ft)
66 (6.7/48)	

- Remove the safety stands.

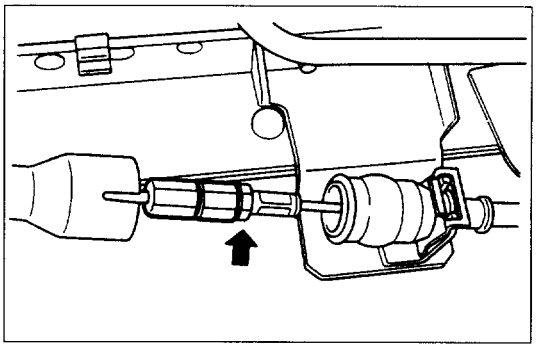
TRANSMISSION ASSEMBLY REPLACEMENT

Removal Steps

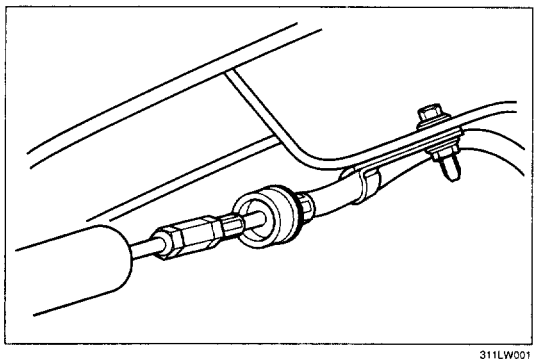
- Raise vehicle and support with suitable safety stands.



1. **Propeller Shaft**
   - Reference mark the flange yoke to the parking brake drum.
   - Disconnect the propeller shaft at flange yoke.
   - Put aside the propeller shaft and tie it to the frame so that it does not interfere with servicing work.

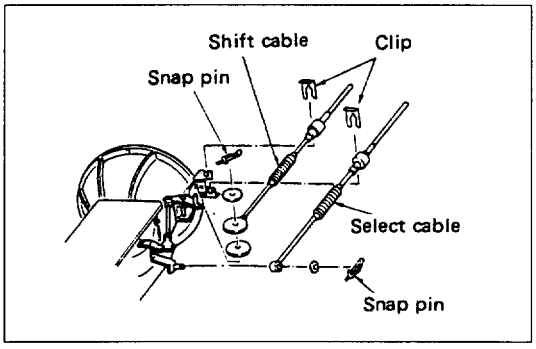


2. **Parking Brake Cable**
   - Move the joint cover.
   - Disconnect the joint bolt.
   - Remove the clip then disconnect the cable from the bracket.

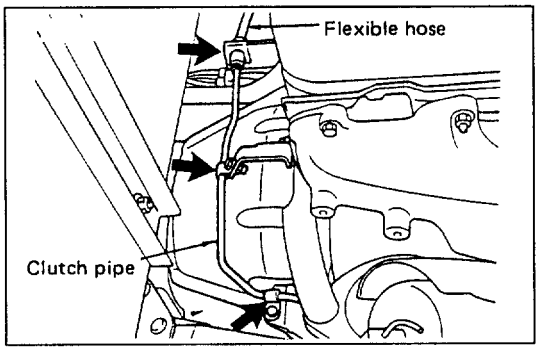


311LW001

3. **Wiring Connector**
   - Disconnect the wiring connectors from the car speed sensor, the neutral switch and the back-up light switch.

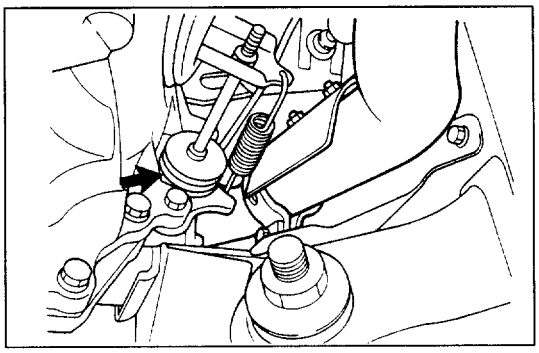


4. **Shift Cable and Select Cable**
   - Disconnect the shift cable and select cable on the transmission side.

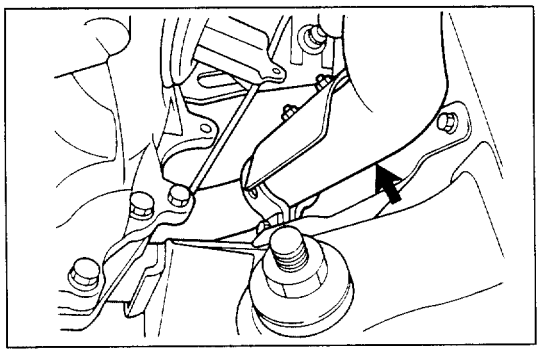


5. Clutch Slave Cylinder

- Remove the clutch pipe fixing clips and the clip bracket (Right hand drive models only).



- Remove the slave cylinder assembly with the flexible hose attached, and then tie it to the frame so that it does not interfere with servicing work.



6. Exhaust Brake Assembly

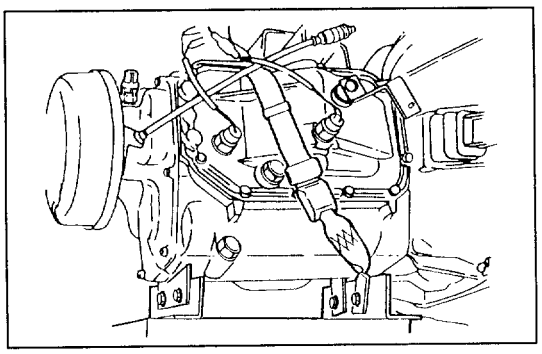
7. Front Exhaust Pipe

8. Transmission Assembly

NOTE:

The exhaust pipe bracket, the gear control bracket and the clips are sometimes installed in the wrong position or direction confusedly. To prevent incorrect installation of these parts, put a correct installation mark on them.

- Support the transmission with mission jack.



CAUTION:

To prevent the falling of the transmission, tie it firmly to the jack with a chain or belt.

Do not allow transmission to hang unsupported from clutch. Damage to the clutch assembly will result.

- Remove the nuts of the transmission mounting bracket on the crossmember side.
- Engine and transmission angles may need to be adjusted for removal.
- Hold the rear section of the engine by the jack or hoist.

CAUTION:

When lifting the engine by the jack, use wood blockes to prevent any possible damage to the oil pan.

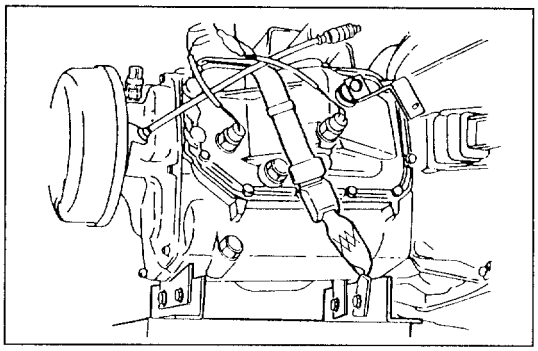
- Remove transmission fastening bolts.
- Pull out the transmission assembly rearward.

9. **Mounting Bracket**

Installation Steps

1. **Mounting Bracket**

Mounting Bracket Nuts Torque	N·m (kg·m/lb·ft)
69 (7.0/51)	

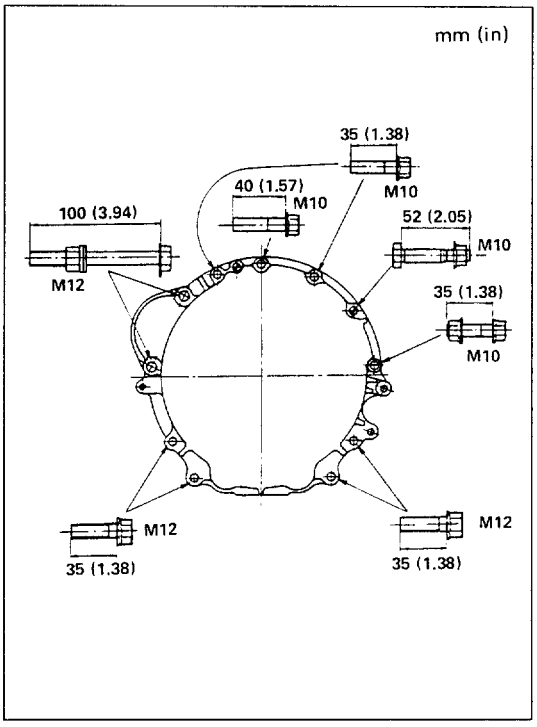


2. **Transmission Assembly**
   - Support the transmission with mission jack.

CAUTION:

To prevent the falling of the transmission, tie it securely to the jack with a chain or belt.

- Shift transmission into high gear.
- Align transmission with engine slope.
- Turn output parking brake drum to aid clutch spline engagement.



Clutch Housing to Flywheel Hosing Bolts Torque	N·m (kg·m/lb·ft)
M10 : 46 (4.7/34) M12 : 91 (9.3/67)	

- Raise engine and transmission up into rear transmission mount.

Engine Rear Mounting Nuts and Bolts Torque	N·m (kg·m/lb·ft)
M10 : 40 (4.1/30) M12 : 69 (7.0/51)	

3. **Front Exhaust Pipe**

Front Exhaust Pipe Bolts Torque	N·m (kg·m/lb·ft)
37 (3.8/27)	

4. **Exhaust Brake Assembly**

Exhaust Brake Bolts Torque	N·m (kg·m/lb·ft)
17 (1.8/12)	

5. **Clutch Slave Cylinder**

Slave Cylinder Bolts Torque	N·m (kg·m/lb·ft)
19 (1.9/14)	

- Perform slave cylinder adjustment before installation of the return spring.

1) Loosen the lock nut of the push rod.
2) Turn the adjust nut until it reaches the shift fork.
3) Back off the adjust nut 1.5 turns.(shift fork free play Approximately 2 mm/0.1 in).
4) Tighten the lock nut.

Push Rod Lock Nut Torque	N·m(kg·m/lb·ft)
16 (1.6/12)	

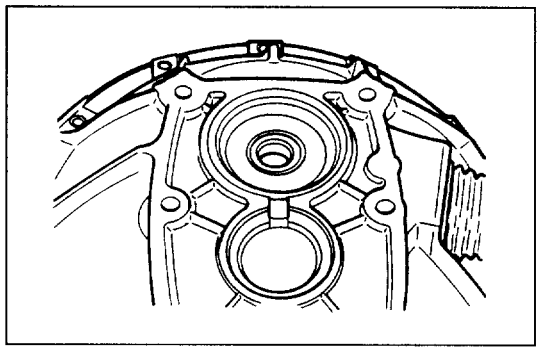
6. **Shift Cable and Select Cable**
7. **Wiring Connector**
   - Color of Connector
     Back-up Light Switch : Brown
     Neutral Switch : Gray
8. **Parking Brake Cable**
9. **Propeller Shaft**
   - Line up reference mark.

Propeller Shaft Nuts Torque	N·m (kg·m/lb·ft)
66 (6.7/48)	

FRONT OIL SEAL REPLACEMENT

Removal Steps

1. **Transmission Assembly**
   Refer to "ON-VEHICLE SERVICE: TRANSMISSION ASSEMBLY REPLACEMENT" previously in this section.
2. **Clutch Housing**
3. **Oil Seal**
   - Use the screwdriver to remove the oil seal from the clutch housing.

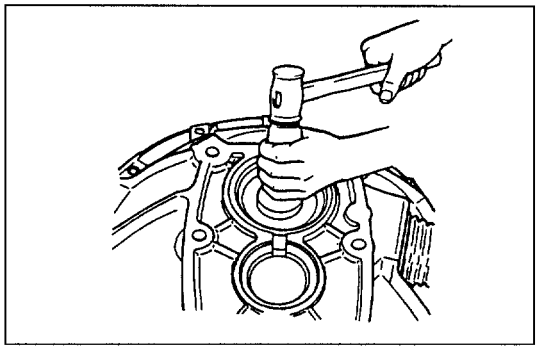


CAUTION:

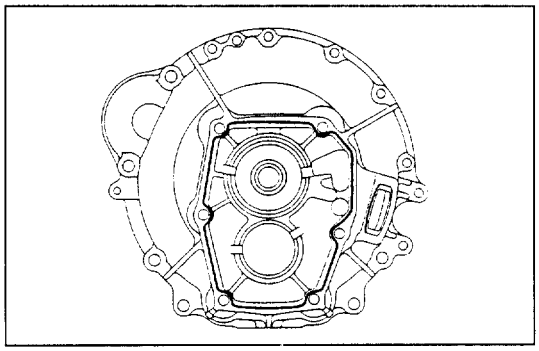
Take care not to damage the sealing seat of the clutch housing.

Installation Steps

1. **Oil Seal**
   - Apply engine oil to the new oil seal outer circumference and apply multi-purpose grease to the oil seal lip.
   - Use the oil seal installer to install the oil seal to the clutch housing.
     Oil Seal Installer: 5-8840-2064-0



2. **Clutch Housing**
   - Remove water and oil on the mating face before applying the liquid gasket.
   - Apply a ø 2 mm (0.1 in) bead of the liquid gasket (Three Bond 1215 or equivalent) to the clutch housing surface shown in the illustration.



NOTE:

Install the clutch housing on the transmission case within 30 minutes after liquid gasket application.

Clutch Housing to Transmission Case Bolts Torque	N·m (kg·m/lb·ft)
	81 (8.3/60)

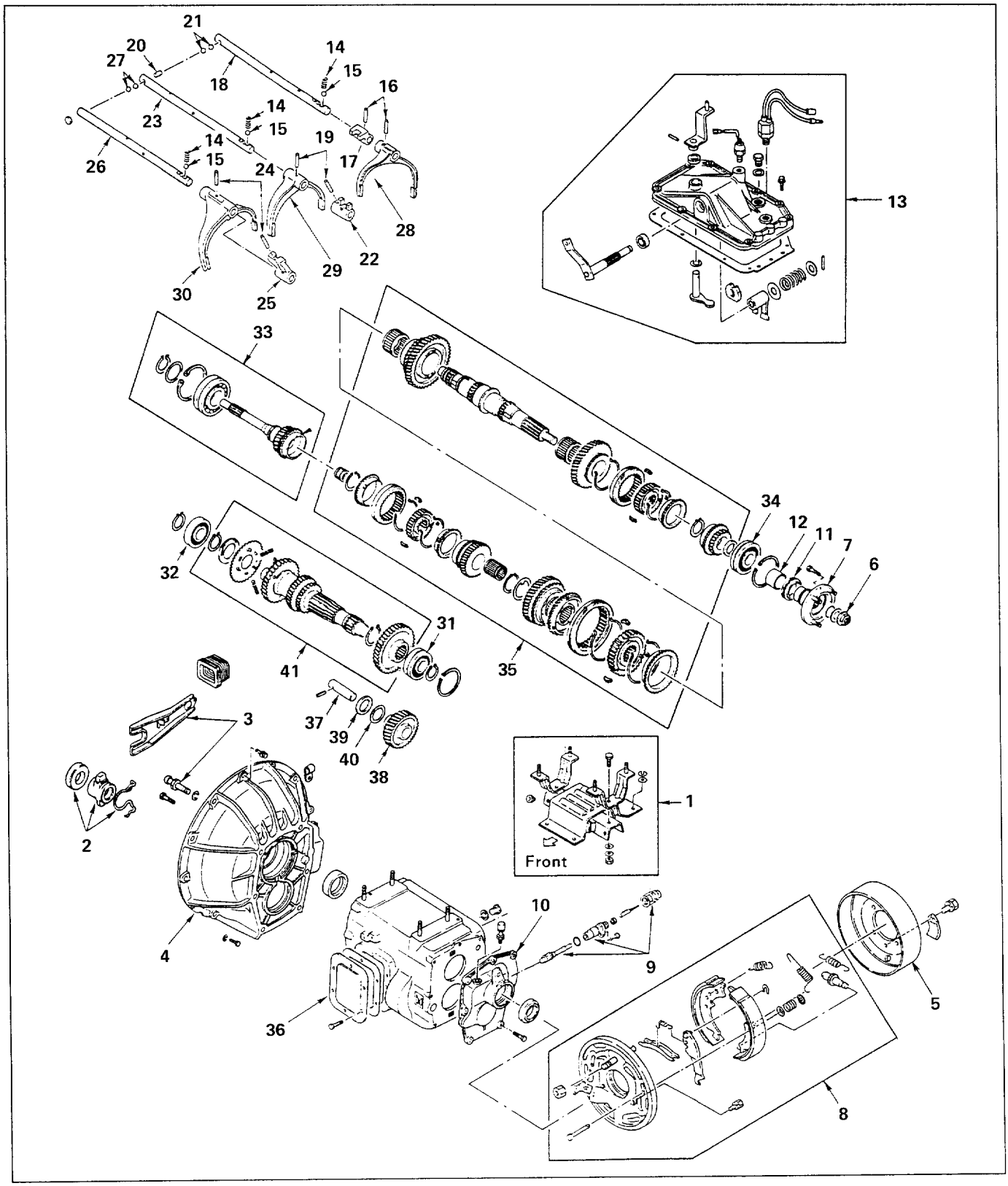
3. **Transmission Assembly**
   Refer to "ON-VEHICLE SERVICE: TRANSMISSION ASSEMBLY REPLACEMENT" previously in this section.

Clutch Housing to Flywheel Housing Bolts Torque	N·m (kg·m/lb·ft)
	M10 : 46 (4.7/34) M12 : 91 (9.3/67)

UNIT REPAIR

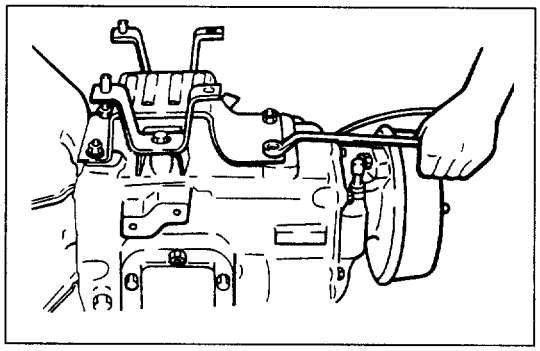
MAJOR COMPONENTS

DISASSEMBLY



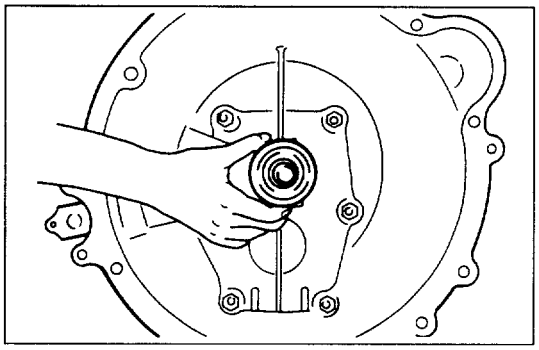
Disassembly Step

1. Mission mounting assembly
2. Shift block assembly
3. Shift fork and support bolt
4. Clutch housing
5. Parking brake drum
6. Lock nut
7. Coupling driver
8. Parking brake assembly
9. Car speed sensor driven gear assembly
10. Rear cover
11. Car speed sensor drive gear
12. Spacer
13. Control box assembly
14. Detent spring
15. Detent ball
16. Spring pin
17. 5th/Reverse shift block
18. 5th/Reverse shift rod
19. Spring pin
20. Interlock pin
21. Interlock ball
22. 3rd/4th shift block
23. 3rd/4th shift rod
24. Spring pin
25. 1st/2nd shift block
26. 1st/2nd shift rod
27. Interlock ball
28. 5th/Reverse shift arm
29. 3rd/4th shift arm
30. 1st/2nd shift arm
31. Counter shaft rear bearing
32. Counter shaft front bearing
33. Top Gear shaft assembly
34. Main shaft rear bearing
35. Main shaft assembly
36. Side cover
37. Reverse idle gear shaft
38. Reverse idle gear
39. Thrust washer
40. Conical washer
41. Counter shaft assembly

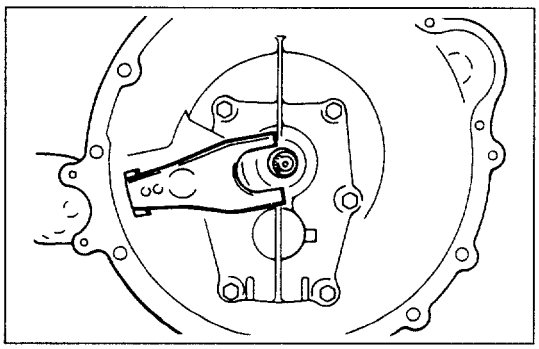


Disassembly Steps

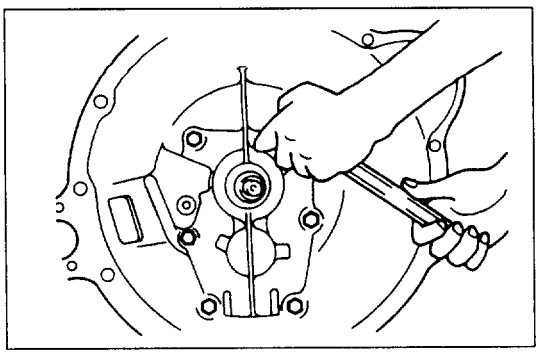
1. Mission Mounting Assembly



2. Shift Block Assembly



3. Shift Fork and Support Bolt

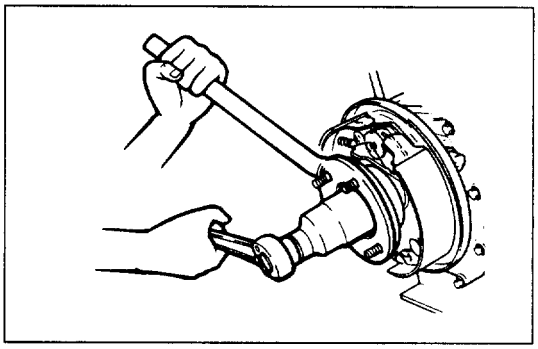


4. **Clutch Housing**
   - Remove the clutch housing from the transmission case.
   - Use the screwdriver to remove the oil seal from the clutch housing.

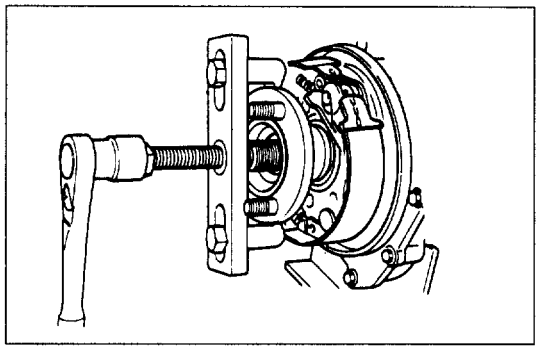
CAUTION:

Take care not to damage the sealing seat of the clutch housing.

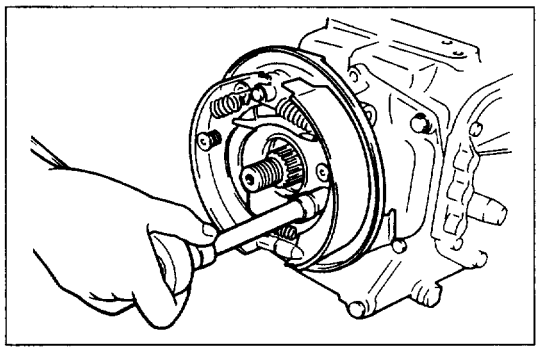
5. **Parking Brake Drum**
   - Remove the screw and the adjust hole cover.
   - It may be necessary to back off the shoe adjuster.



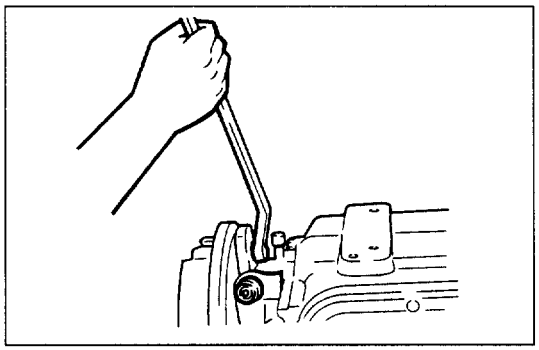
6. **Lock Nut**
   - Make sure to rise the caulking of the coupling driver lock nut.
   - Use the handle to remove the lock nut.
     Handle : 5-8840-2043-0

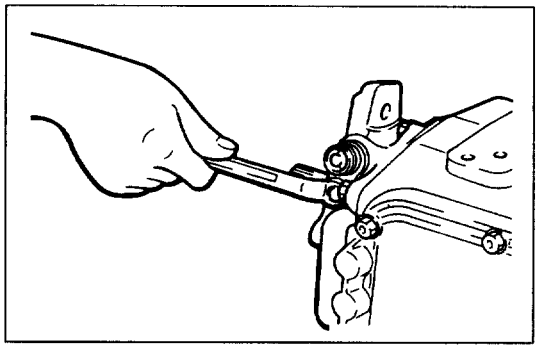


7. **Coupling Driver**
   - Remove coupling driver using the universal puller.
     Universal Puller: 5-8840-2027-0
   - Remove the conical washer and the o-ring.



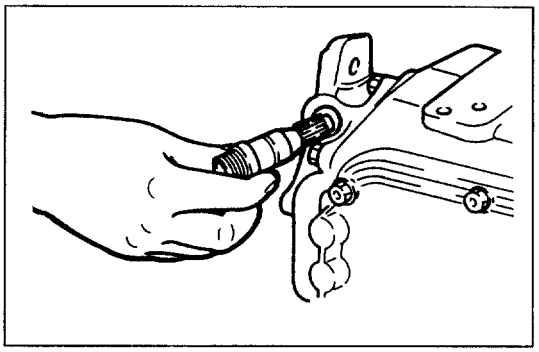
8. **Parking Brake Assembly**



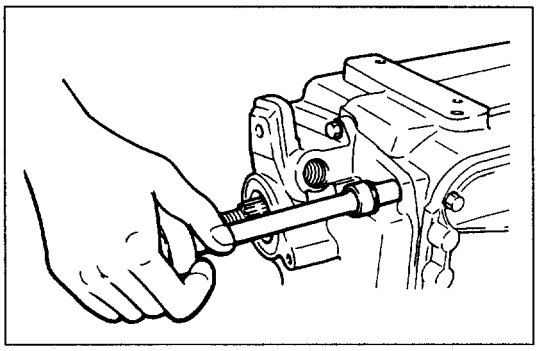


9. Car Speed Sensor Driven Gear Assembly

- Remove the car speed sensor with the key rod.
- Remove the fixing bolt.



- Remove the driven gear assembly.

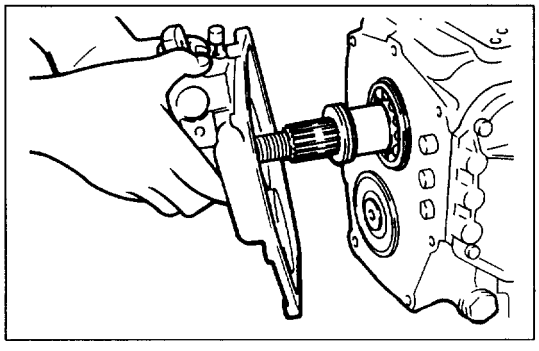


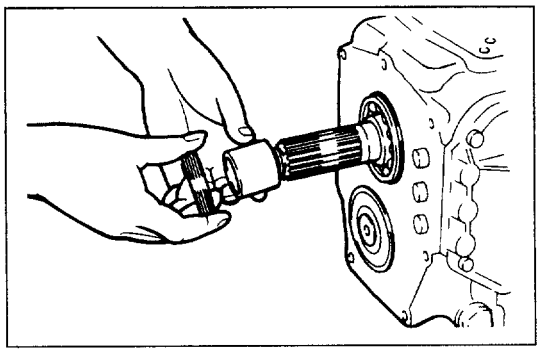
10. Rear Cover

- Remove 7 fixing bolts. Tap the rear cover with a copper or plastic hammer to remove it. The rear cover is provided with lugs for hammering both side.
- Remove the oil seal using the screwdriver.

CAUTION:

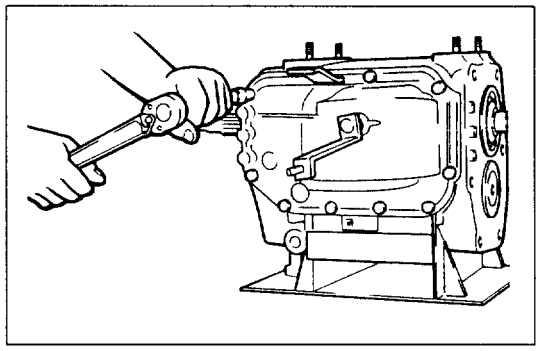
Take care not to damage the sealing seat of the rear cover with the screwdriver.





11. Car Speed Sensor Drive Gear

12. Spacer

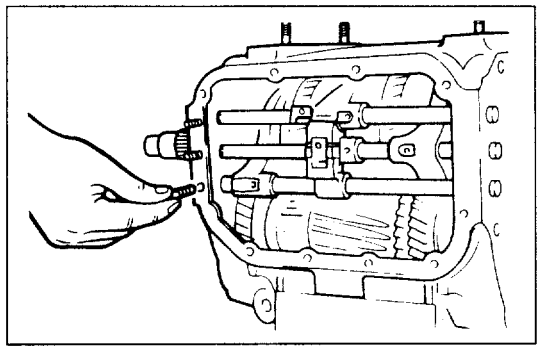


13. Control Box Assembly

- Remove 10 control box fixing bolts, and then prize open the four corners of the control box with a screwdriver to remove the control box assembly.

NOTE:

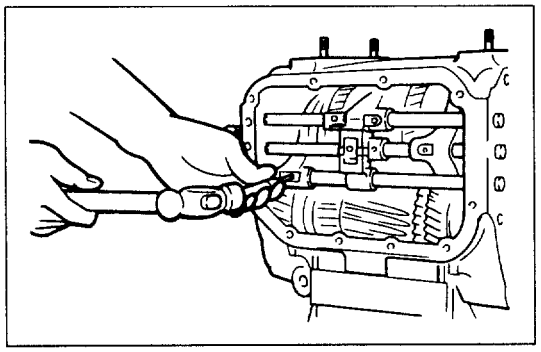
Be careful not lose the detent springs and balls of the transmission case.



14. Detent Spring

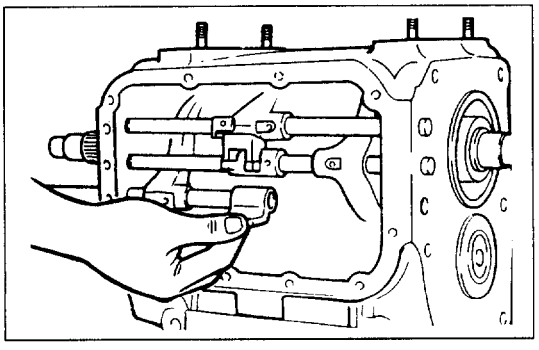
15. Detent Ball

- Take out the three detent springs and the three detent balls from the transmission case.



16. Spring Pin

- Before removal, set all shift rods in neutral position.
  Spring Pin Remover : 9-8529-2201-0



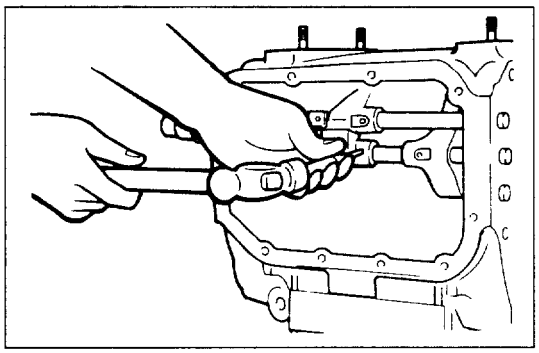
17. 5th/Reverse Shift Block

18. 5th/Reverse Shift Rod

- Move the 5th/reverse shift rod rearward and remove the shift block and shift rod.

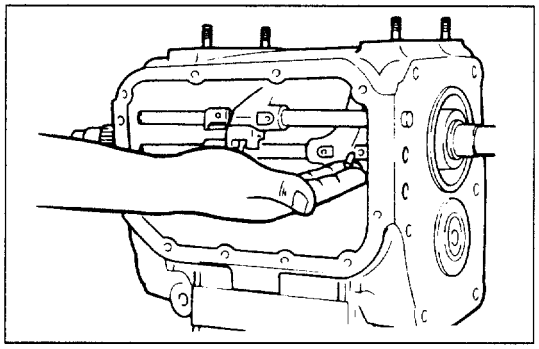
NOTE:

When removing the parts, exercise care to prevent the interlock balls and pin fitted to the front part from falling apart.



19. Spring Pin

- Spring Pin Remover : 9-8529-2201-0



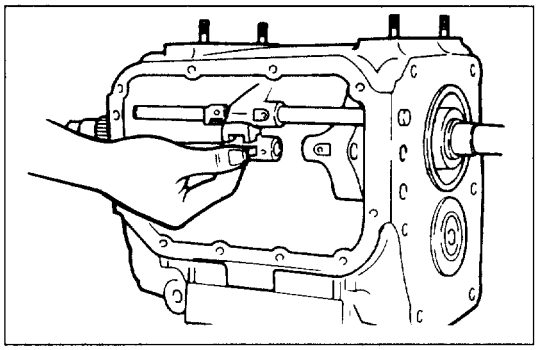
20. Interlock Pin

- Move the 3rd/4th shift rod rearward by pushing its front end.

  Then take out the interlock pin from the 3rd/4th shift rod.

21. Interlock Ball

- Take out the 2 interlock balls from the transmission case.



22. 3rd/4th Shift Block

23. 3rd/4th Shift Rod

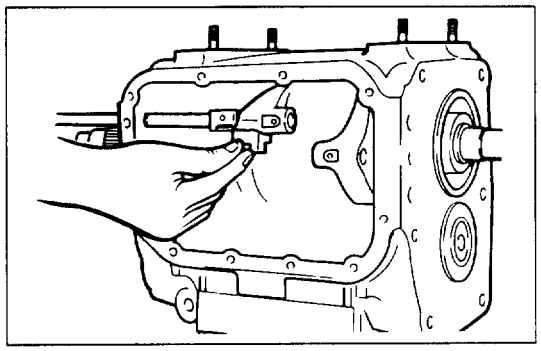
- Move the shift rod rearward and remove the shift block and shift rod.

NOTE:

When removing the parts, exercise care to prevent the interlock balls fitted to the front part from falling apart.

24. Spring Pin

Spring Pin Remover : 9-8529-2201-0



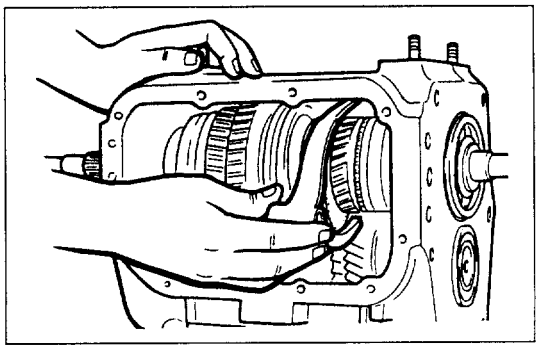
25. 1st/2nd Shift Block

26. 1st/2nd Shift Rod

- Move the shift rod rearward and remove the shift block and shift rod.

27. Interlock Ball

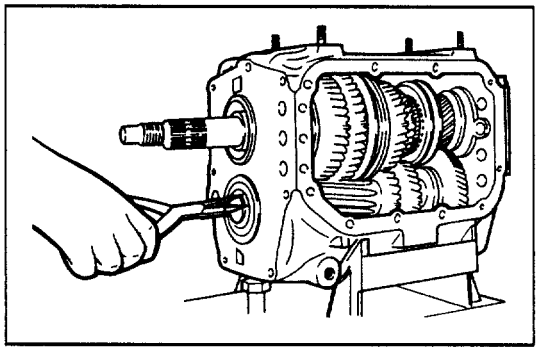
- Take out the 2 interlock balls from the transmission case.



28. 5th/Reverse Shift Arm

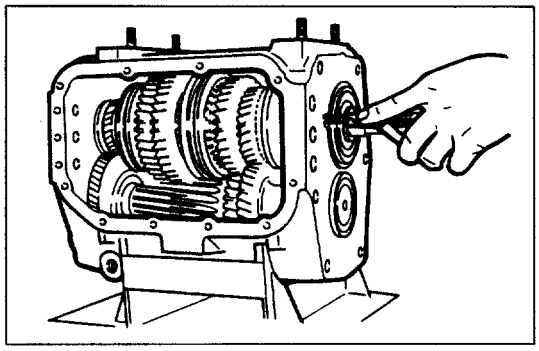
29. 3rd/4th Shift Arm

30. 1st/2nd Shift Arm

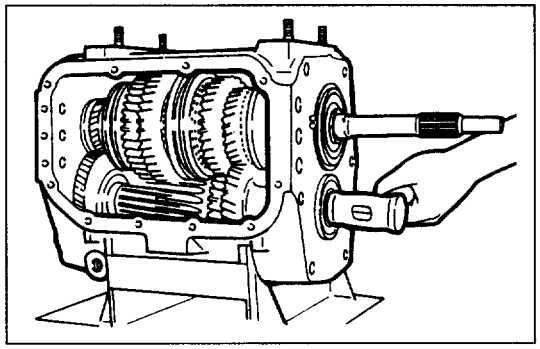


31. Counter Shaft Rear Bearing

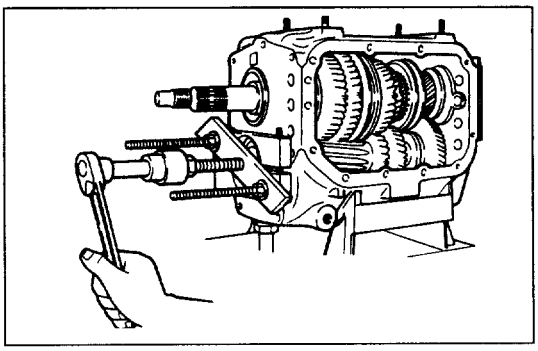
- Remove the snap ring from the countershaft rear end.



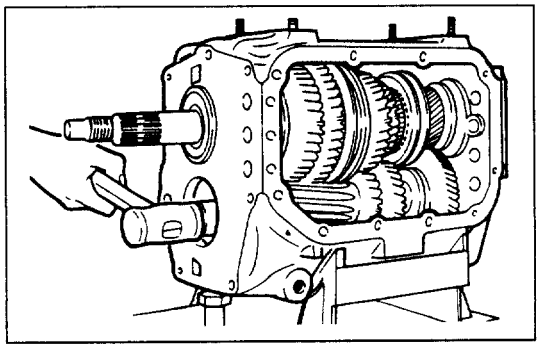
- Remove the snap ring from the top gear shaft bearing outer circumference.



- Move the countershaft approximately 3 mm (0.1 in) rearward by tapping on its front end with brass or plastic hammer.
- Remove the snap ring from the rear bearing outer circumference.

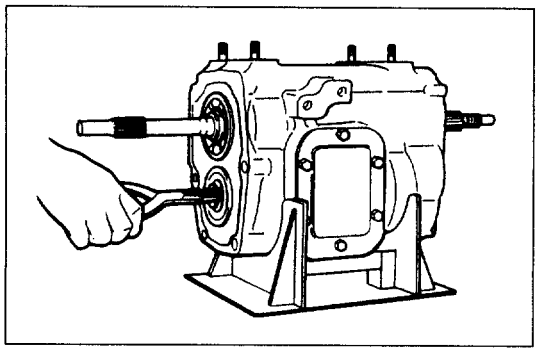


- Set the bearing remover to the snap ring groove to remove the rear bearing.
  Bearing Remover : 5-8840-2042-0
  Universal Puller : 5-8840-2027-0

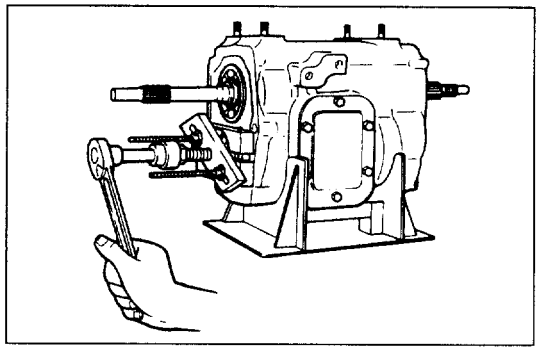


32. Counter Shaft Front Bearing

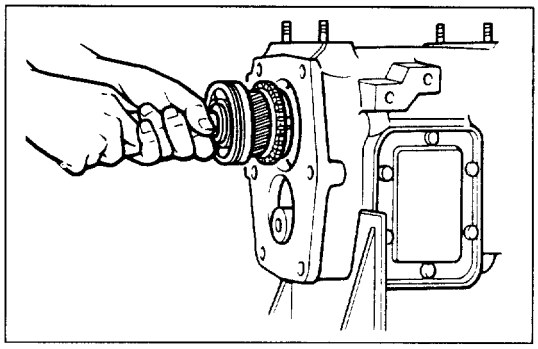
- Move the counter shaft approximately 3 mm (0.1 in) forward by tapping on its rear end with brass or plastic hammer.



- Remove the snap ring from the counter shaft front end.

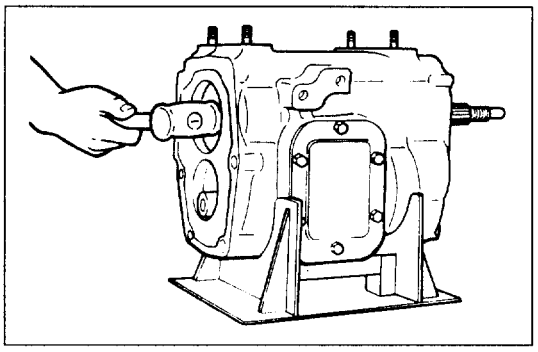


- Set the bearing remover to the snap ring groove to remove the front bearing.
  Bearing Remover : 5-8840-2078-0
  Universal Puller : 5-8840-2027-0



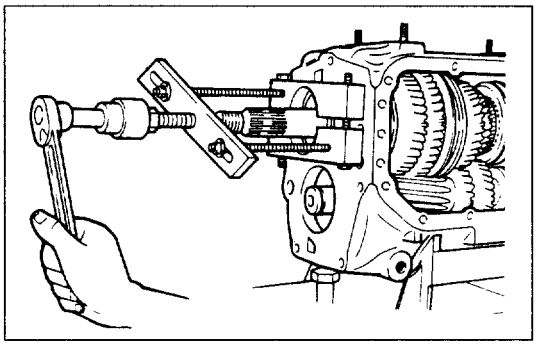
33. Top Gear Shaft Assembly

- Remove the top gear shaft bearing outer race toward front end using a hammer and soft metal bar.
- Remove the block ring and needle bearing.

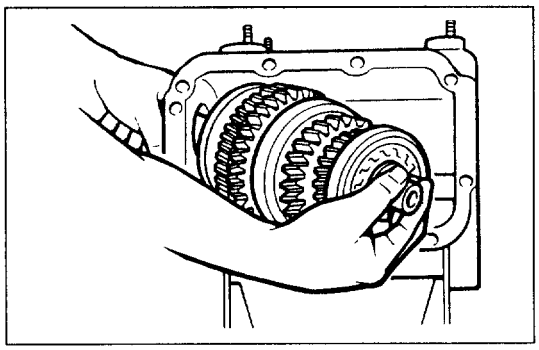


34. Main Shaft Rear Bearing

- Move the main shaft approximately 3 mm (0.1 in) rearward by tapping on its front end with brass or plastic hammer.

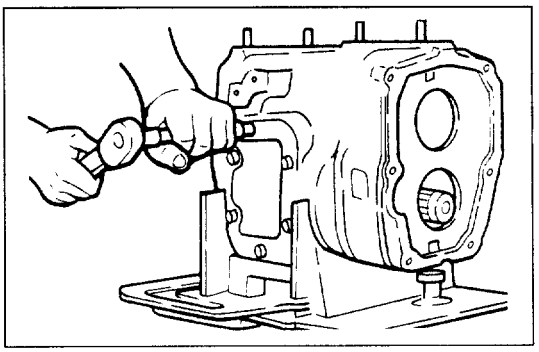


- Remove the snap ring and set the bearing remover to the snap ring groove to remove the bearing.
  Bearing Remover : 5-8840-2078-0
  Universal Puller : 5-8840-2027-0

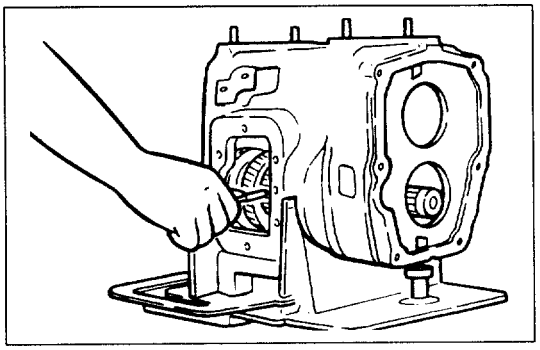


35. Main Shaft Assembly

- Take main shaft assembly out from the transmission case.

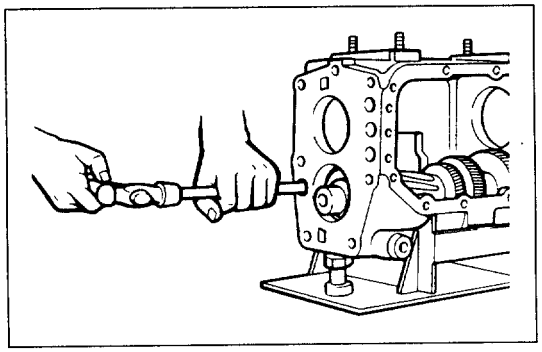


36. Side Cover

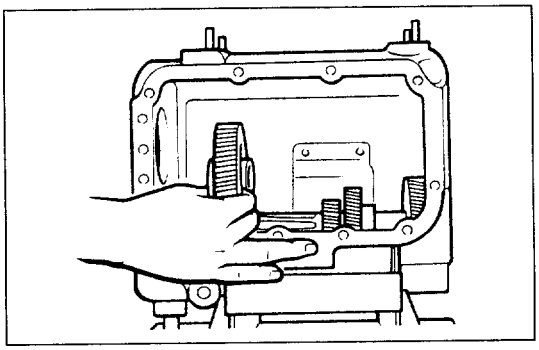


37. Reverse Idle Gear Shaft

- Take out the pin of reverse idle gear shaft form the transmission case.



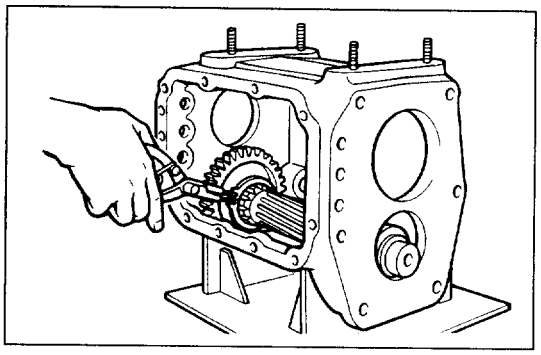
- Drive out the reverse idle gear shaft inward the transmission case, with a suitable bar at the end of reverse gear shaft.



38. Reverse Idle Gear

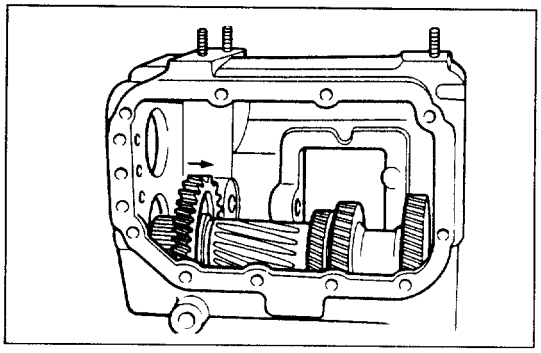
39. Thrust Washer

40. Conical Spring

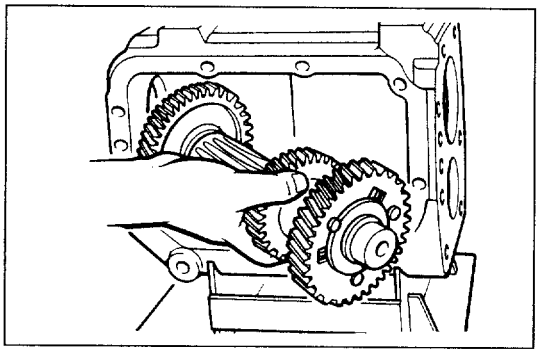


41. Counter Shaft Assembly

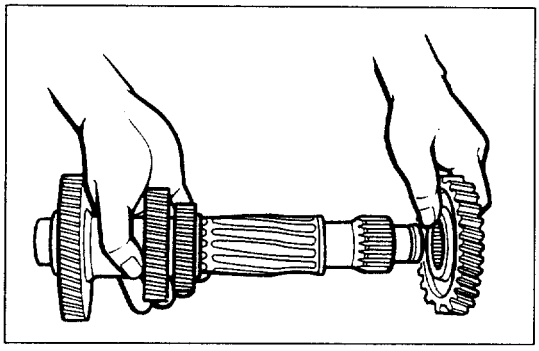
- Remove the snap ring of the counter 5th gear and place aside inward temporarily.



- Move the counter 5th gear inward and take it out together with the counter shaft assembly.

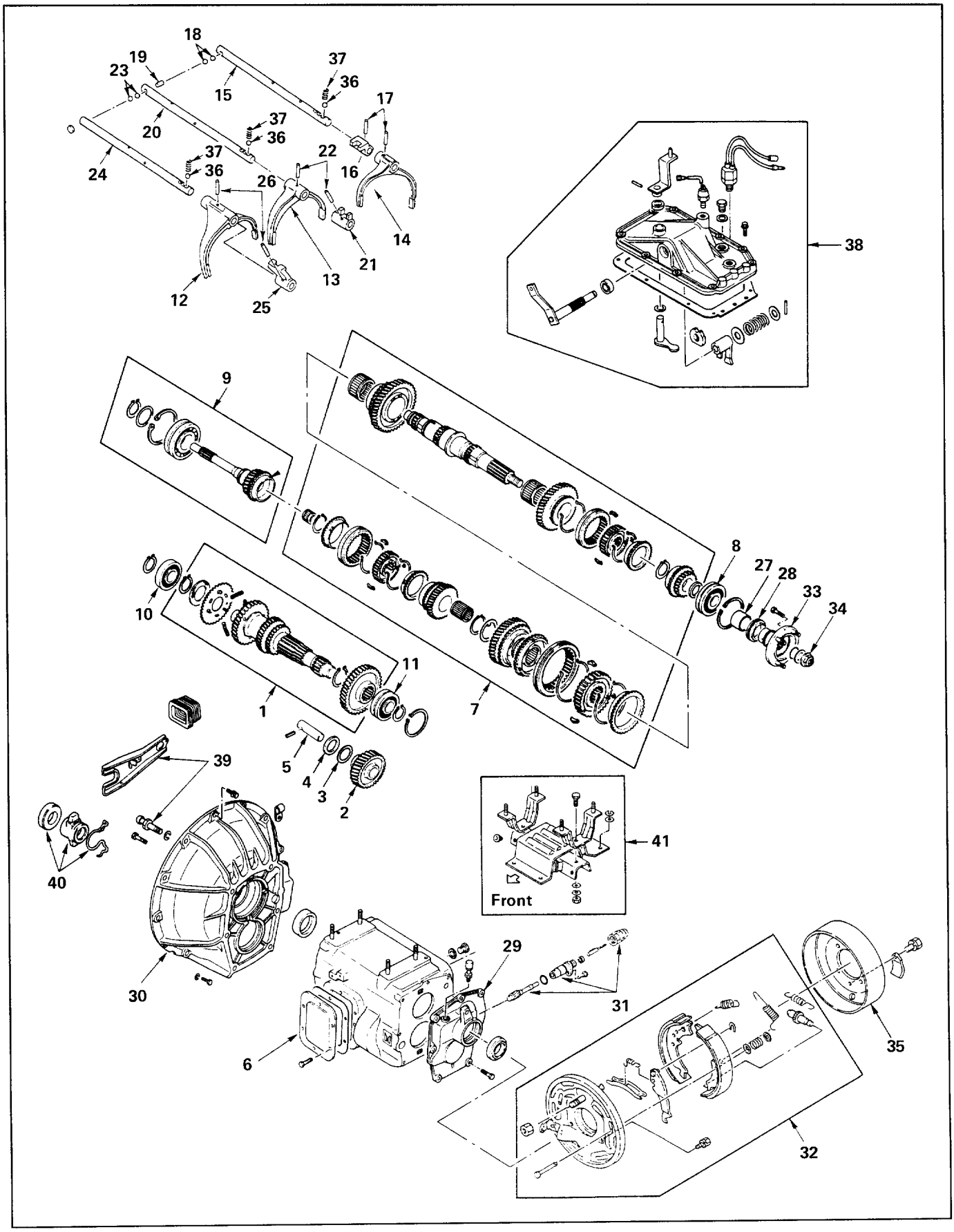


- Remove the counter shaft assembly from the transmission case.



- Remove the counter 5th gear and the snap ring from the counter shaft.

REASSEMBLY


18
19
23
15
37
36
17
20
37
36
24
37
36
22
16
26
14
21
13
12
25
38
9
8
27
28
33
34
10
11
1
7
5
4
3
2
39
40
30
41
Front
29
31
6
35
32

Reassembly Steps

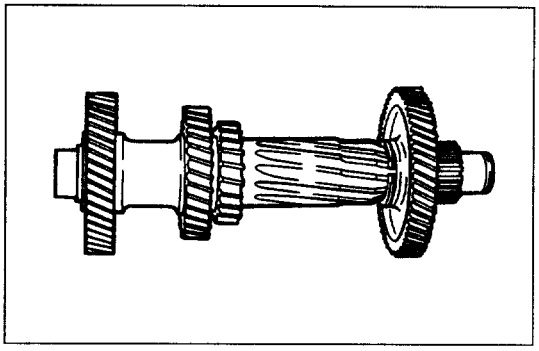
1. Counter shaft assembly
2. Reverse idle gear
3. Conical washer
4. Thrust washer
5. Reverse idle gear shaft
6. Side cover
7. Main shaft assembly
8. Main shaft rear bearing
9. Top Gear shaft assembly
10. Counter shaft front bearing
11. Counter shaft rear bearing
12. 1st/2nd shift arm
13. 3rd/4th shift arm
14. 5th/Reverse shift arm
15. 5th/Reverse shift rod
16. 5th/Reverse shift block
17. Spring pin
18. Interlock ball
19. Interlock pin
20. 3rd/4th shift rod
21. 3rd/4th shift block
22. Spring pin
23. Interlock ball
24. 1st/2nd shift rod
25. 1st/2nd shift block
26. Spring pin
27. Spacer
28. Car speed sensor drive gear
29. Rear cover
30. Clutch housing
31. Car speed sensor driven gear assembly
32. Parking brake assembly
33. Coupling driver
34. Lock nut
35. Parking brake drum
36. Detent ball
37. Detent spring
38. Control box assembly
39. Shift fork and support bolt
40. Shift block assembly
41. Mission mounting assembly

Reassembly Steps

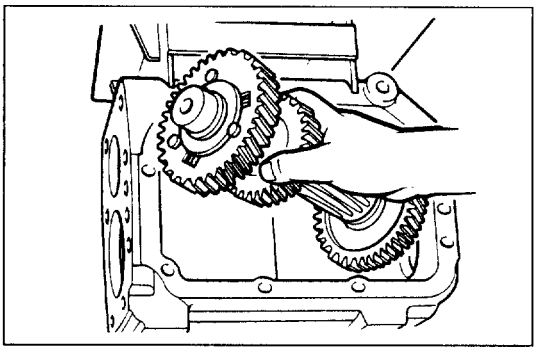
NOTE:

Clean each part throughly.

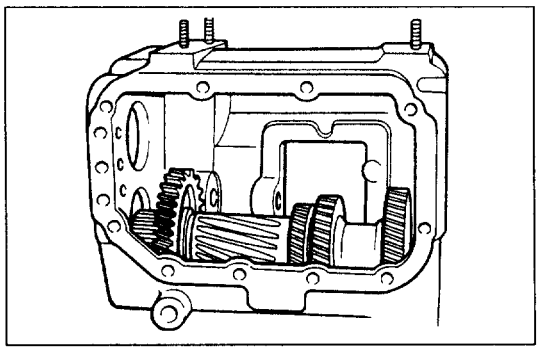
When assembling parts, apply clean engine oil (SAE 5W-30) to their sliding and mating sections.

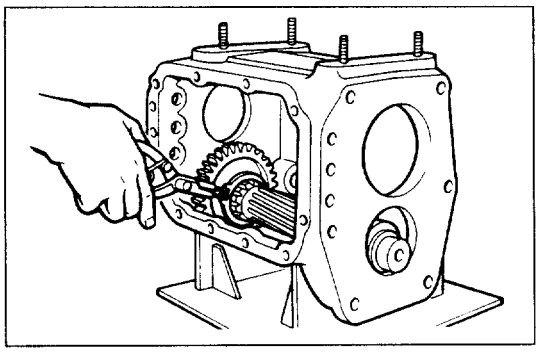


1. **Counter Shaft Assembly**
   - Install the snap ring to the counter shaft and place it aside inward temporarily.
   - Then install the counter 5th gear and move it inward.

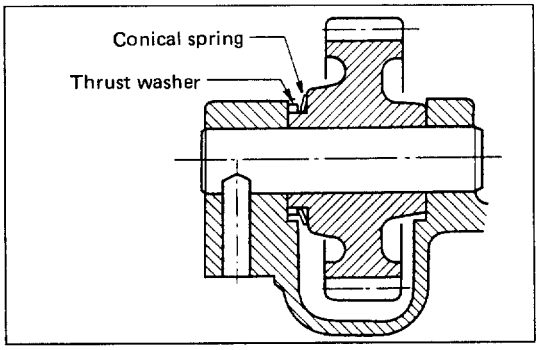


- Install the counter shaft assembly in the tansmission case.



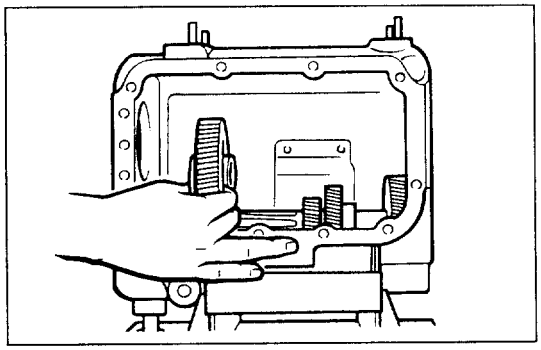


- Install the snap ring to fix the counter 5th gear.

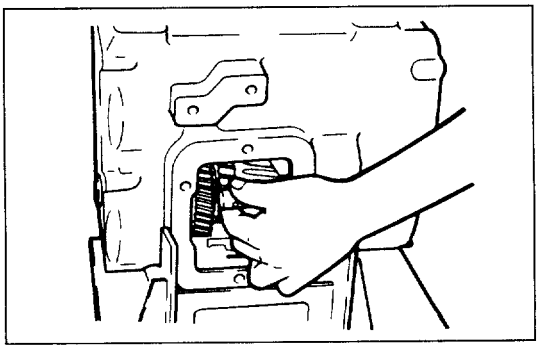


2. Reverse Idle Gear
3. Conical Spring
4. Thrust Washer

- Install the conical spring and the thrust washer to the reverse idle gear.
- The conical spring is to be set up with its concave face to the gear side shown in the illustration.

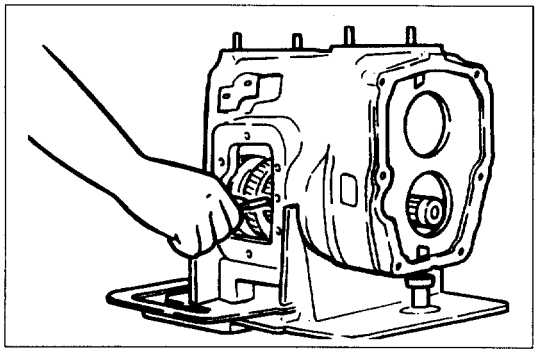


- The reverse idle gear should be installed with the thrust washer side turned to the forward

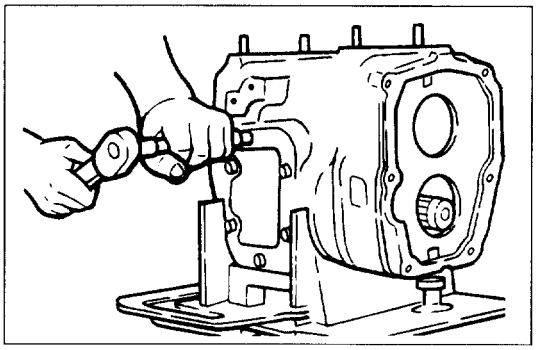


5. Reverse Idle Gear Shaft

- Aligning the knock pin hole on the reverse idle gear shaft with its hole of the transmission case.



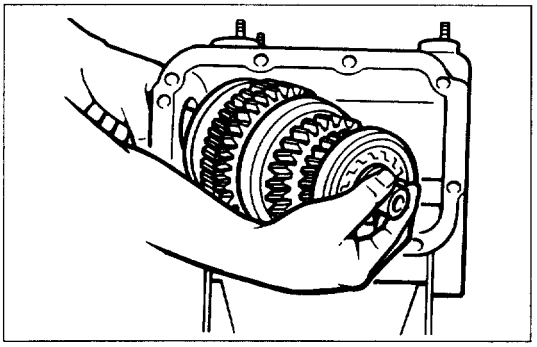
- Then insert the knock pin.



6. Side Cover

- Install the side cover with new gasket.

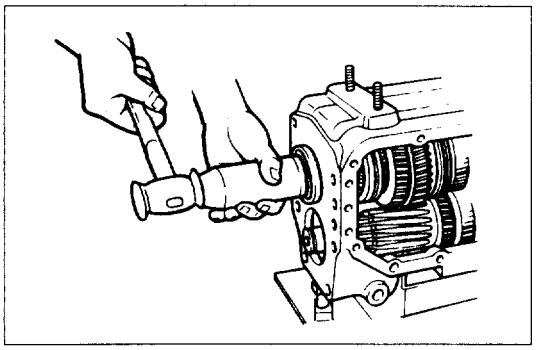
Side Cover Bolt Torque	N·m (kg·m/lb·ft)
	18 (1.8/13)



7. Main Shaft Assembly

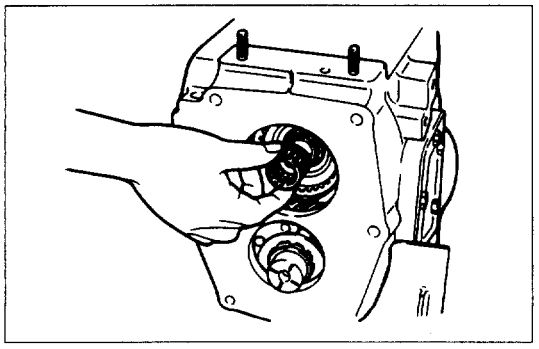
NOTE:

Take care that the thrust washer of the reverse gear does not drop off.



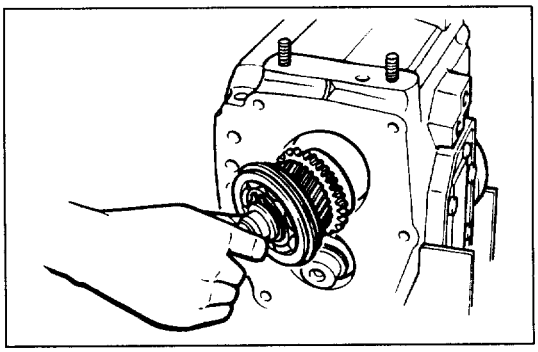
8. Main Shaft Rear Bearing

- Install the snap ring to the rear bearing outer circumference.
- Install the rear bearing using the bearing installer.
  Bearing Installer : 9-8522-1615-0
- Check to be certain the block ring on the 5th gear side fitted properly to the inserts.

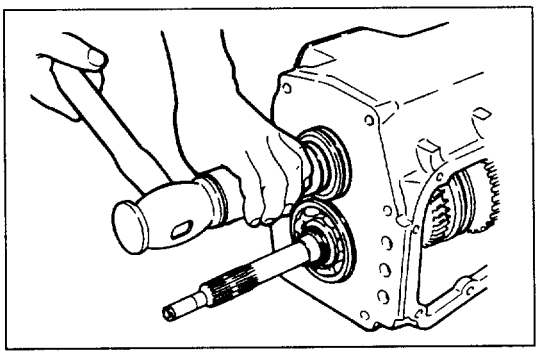


9. Top Gear Shaft Assembly

- Install the needle bearing to the top gear shaft.

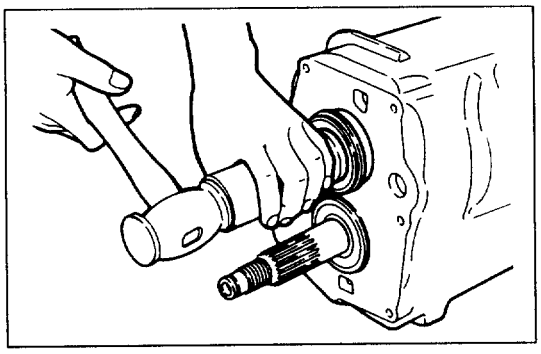


- Install the top gear shaft assembly into the transmission case.
- Check to be certain the block ring on the 4th gear side fitted properly to the inserts.
- Press in the bearing until the snap ring of the bearing outer circumference comes into contact with the transmission case.



10. Counter Shaft Front Bearing

- Use the bearing installer to install the front bearing.
  Bearing Installer: 5-8840-2244-0
- Install the counter shaft snap ring



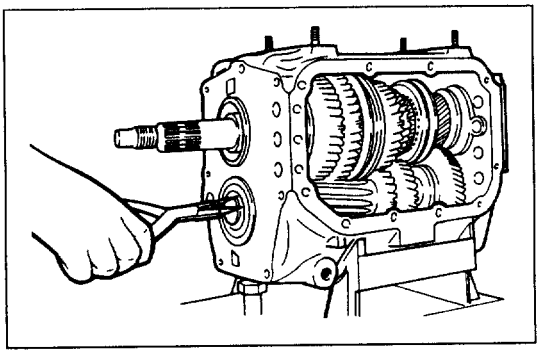
11. Counter Shaft Rear Bearing

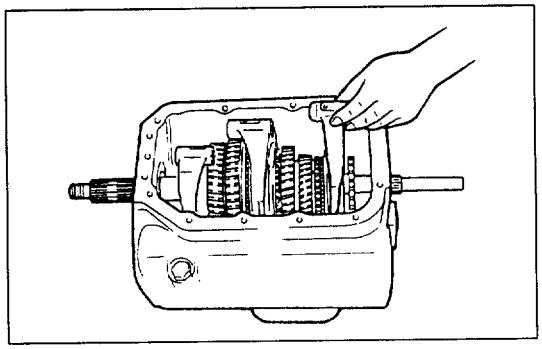
- Install the snap ring to the rear bearing outer circumference.
- Install the rear bearing using bearing installer and install the snap ring.
  Bearing Installer: 5-8840-2244-0

NOTE:

With each gear set to the neutral position, check to see if the shaft and each gear rotate smoothly.

Check to see if each block ring is free. When it gets caught and stuck in the tapper cone, use a screwdriver to make it free.





12. 1st/2nd Shift Arm

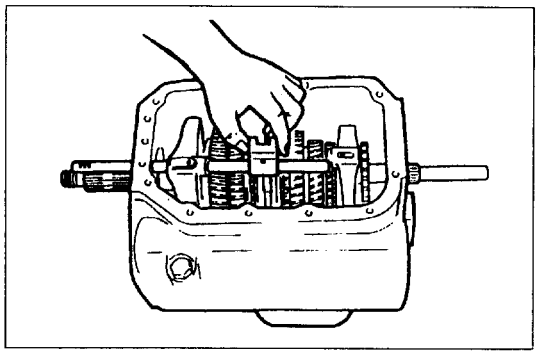
- With the longer boss side set to the front.

13. 3rd/4th Shift Arm

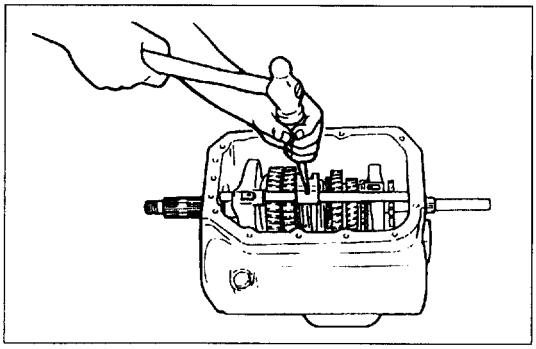
- With the longer boss side set to the rear.

14. 5th/Reverse Shift arm

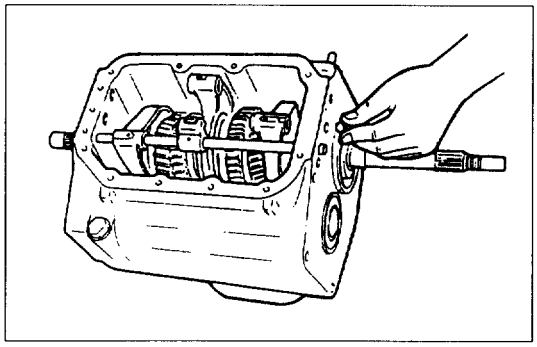
- With the longer boss side set to the front.



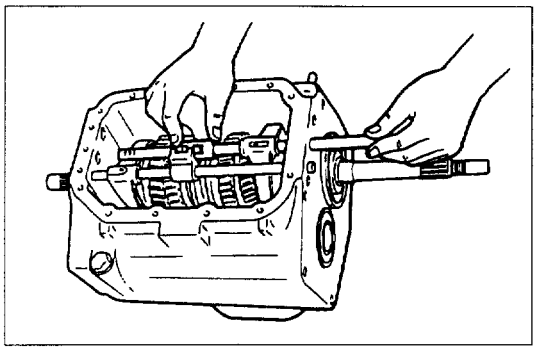
15. **5th/Reverse Shift Rod**
16. **5th/Reverse Shift Block**
    - Turning the detent groove to the outside (detent ball side), insert the shift rod from the rear side with the detent groove side at the rear.



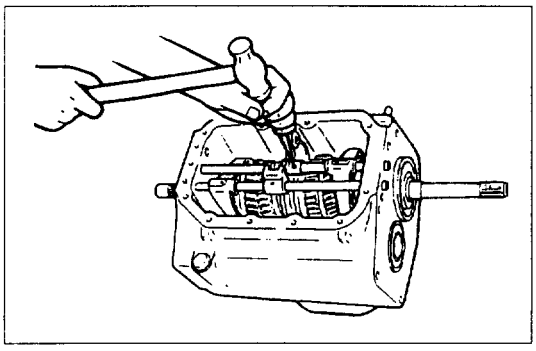
17. **Spring Pin**
    - Setting the hole of the shift arm and shift block to that of the shift rod, fix them with a new spring pin.
    - Install spring pin properly with the slit in line with the shaft center line.



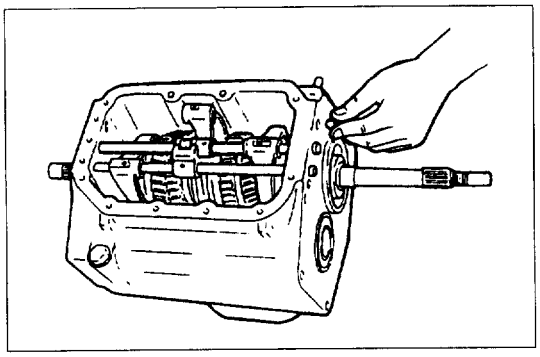
18. **Interlock Ball**
    - Apply small amount of multi-purpose grease to the interlock balls.
    - Install the 2 interlock balls in position between the 5th/reverse shift rod and 3rd/4th shift rod.



19. **Interlock Pin**
20. **3rd/4th Shift Rod**
21. **3rd/4th Shift Block**
    - Apply small amount of multi-purpose grease to the interlock pin.
    - Insert a interlock pin into the 3rd/4th shift rod.
    - Turning the detent groove to the outside (detent ball side), insert the shift rod from the front side with the detent groove side at the front.

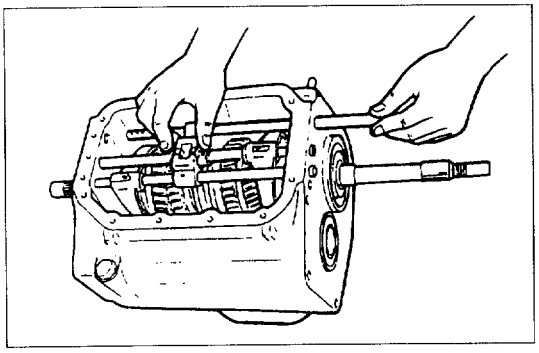


22. **Spring Pin**
    - Setting the hole of the shift arm and shift block to that of the shift rod, fix them with a new spring pin.
    - Install spring pin properly with the slit in line with the shaft center line.



23. Interlock Ball

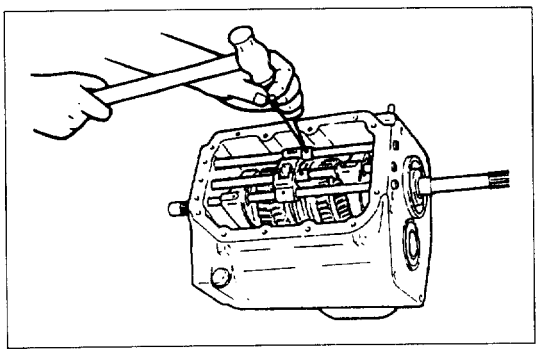
- Apply small amount of multi-purpose grease to the interlock balls.
- Install the 2 interlock balls in position between the 3rd/4th shift rod and 1st/2nd shift rod.



24. 1st/2nd Shift Rod

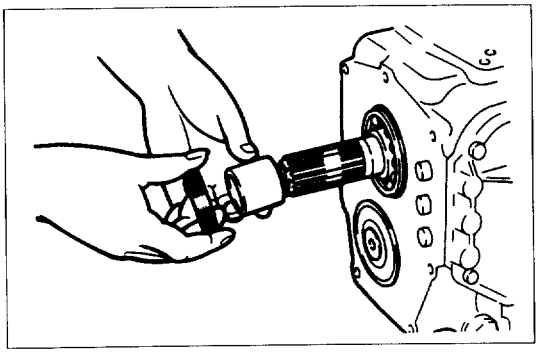
25. 1st/2nd Shift Block

- Before reassembly, set the 5th/reverse and 3rd/4th shift rods already reassembled in neutral position.
- Turning the detent groove to the outside (detent ball side), insert the shift rod from the front side with the detent groove side at the front.



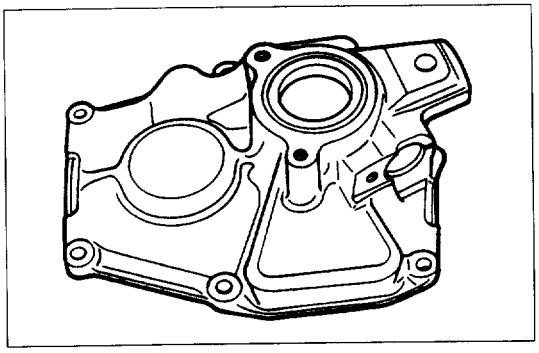
26. Spring Pin

- Setting the hole of the shift arm and shift block to that of the shift rod, fix them with a new spring pin.
- Install spring pin properly with the slit in line with the shaft center line.



27. Spacer

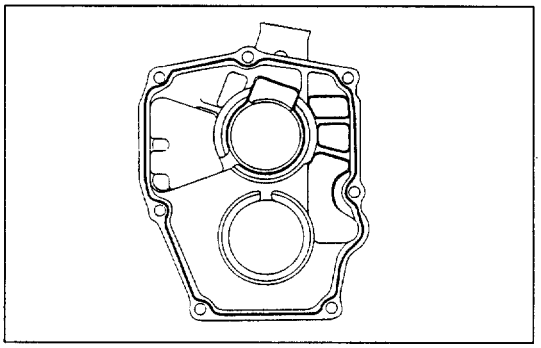
28. Car Speed Sensor Drive Gear



29. Rear Cover

- Apply engine oil to the new oil seal outer circumference and apply multi-purpose grease to the oil seal lip.
- Use the oil seal installer to install the oil seal to the rear cover.

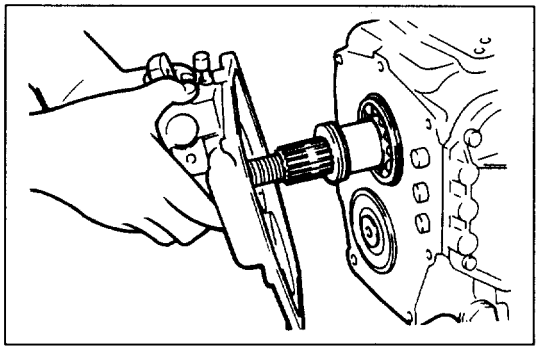
  Oil Seal Installer : 5-8840-2242-0

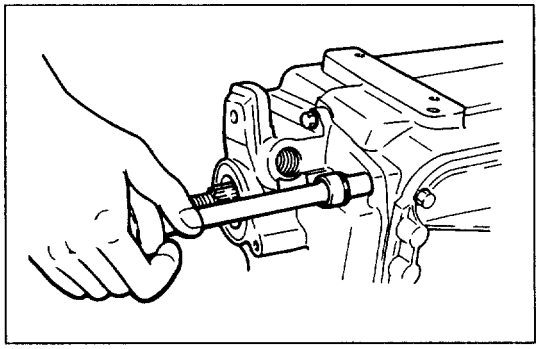


- Remove water and oil on the mating face before applying the liquid gasket.
- Apply a ø 2 mm (0.1 in) bead of the liquid gasket (Three Bond 1215 or equivalent) to the rear cover surface shown in the illustration.

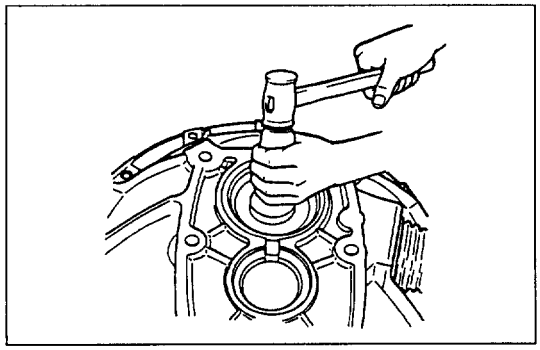
CAUTION:

Install the rear cover on the transmission case within 30 minutes after liquid gasket application.



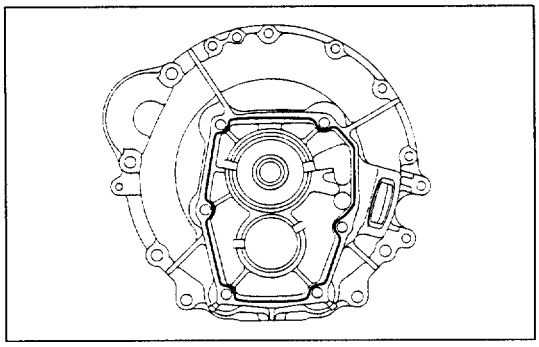


Rear Cover Bolts Torque	N·m (kg·m/lb·ft)
	20 (2.0/14)



30. Clutch Housing

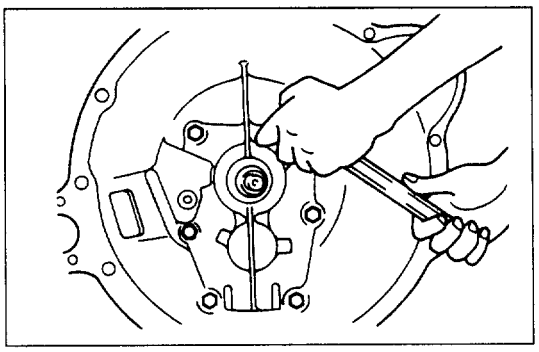
- Apply engine oil to the new oil seal outer circumference and apply multi-purpose grease to the oil seal lip.
- Use the oil seal installer to install the oil seal to the clutch housing.
  Oil Seal Installer: 5-8840-2243-0



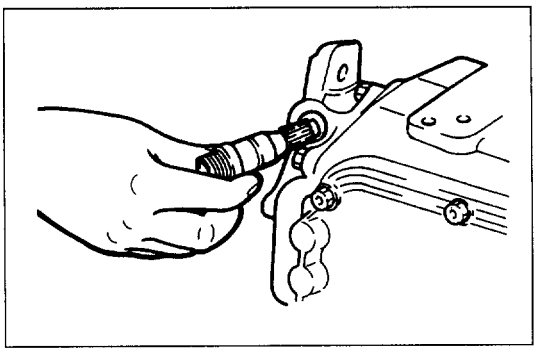
- Remove water and oil on the mating face before applying the liquid gasket.
- Apply a ø 2 mm (0.1 in) bead of the liquid gasket (Three Bond 1215 or equivalent) to the clutch housing surface shown in the illustration.

CAUTION:

Install the clutch housing on the transmission case within 30 minutes after liquid gasket application.



Clutch Housing to Transmission Case Bolts Torque	N·m (kg·m/lb·ft)
	81 (8.3/60)

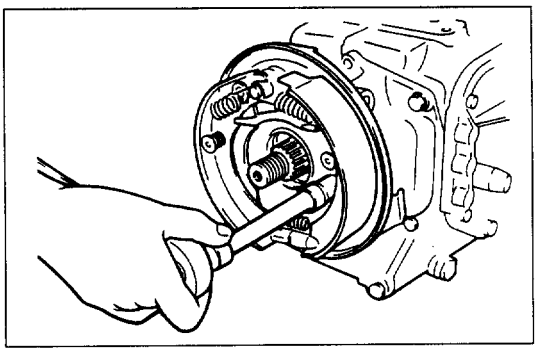


31. Car Speed Sensor Driven Gear Assembly

Driven Gear Lock Plate Bolt Torque	N·m (kg·m/lb·ft)
	15 (1.5/11)

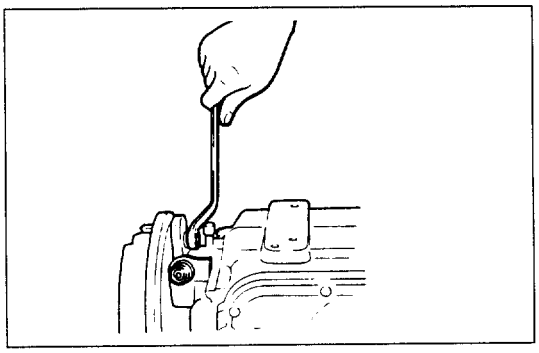
- Install the car speed sensor with key rod.

Car Speed Sensor Torque	N·m (kg·m/lb·ft)
	25 (2.5/18)

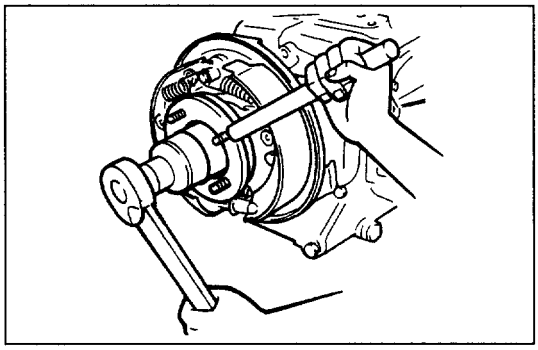


32. Parking Brake Assembly

Parking Brake Bolts Torque	N·m(kg·m/lb·ft)
	M8: 25 (2.6/19)



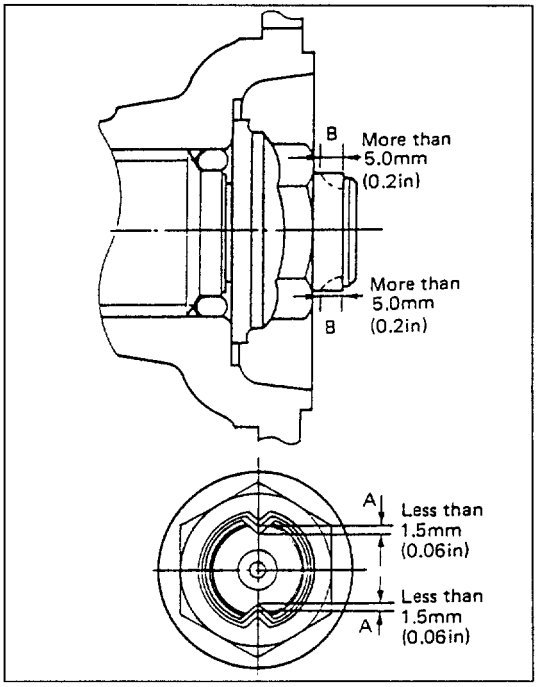
Parking Brake Nut Torque	N·m (kg·m/lb·ft)
	M12: 113 (11.5/83)



33. **Coupling Driver**
34. **Lock Nut**
    - Install the o-ring and conical washer. The conical washer is to be set up with its identification groove to the nut side.
    - Apply the engine oil to the setting face of the new lock nut and tighten it up at the specified torque.

CAUTION:

Do not reuse the lock nut.



Handle: 5-8840-2043-0

Lock Nut Torque	N·m (kg·m/lb·ft)
226 (23.0/166)	

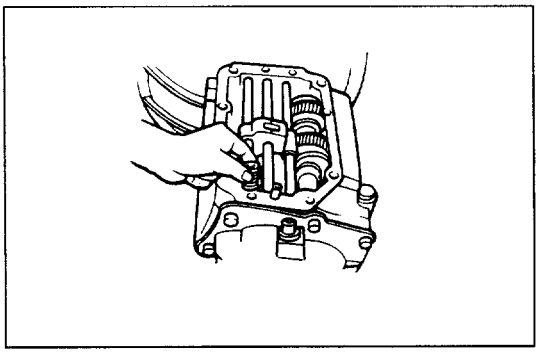
- Align the lock nut with the V-shaped groove at the tip of the main shaft, and caulk the nut lip portion by using a chisel.
  (Round edge approximately 1 mm (0.04 in) x 60°).
- As shown in the illustration, be sure to caulk the nut lip so that the clearance between the V-shaped groove portion at the tip of the main shaft and the caulked up lip(A) is less than 1.5 mm (0.06 in), and the caulking length(B) is 5 mm (0.2 in) or more.

CAUTION:

Be sure to confirm that there is no crack at the caulked portion of the lock nut after cauking.

35. **Parking Brake Drum**
    - Adjust the parking brake after installation.
    1) Rotate the brake drum to align the adjust hole with the adjuster.
    2) Move the camshaft lever from side to side several times to center the brake shoes.
    3) Insert a screwdriver into the hole and rotate the adjuster by pushing it upward until the shoes drag on the drum.
    4) Back off the adjuster 30 notches.
    - Install the adjust hole cover.

Adjust Hole Cover Bolt Torque	N·m (kg·m/lb·in)
8 (0.8/69)	

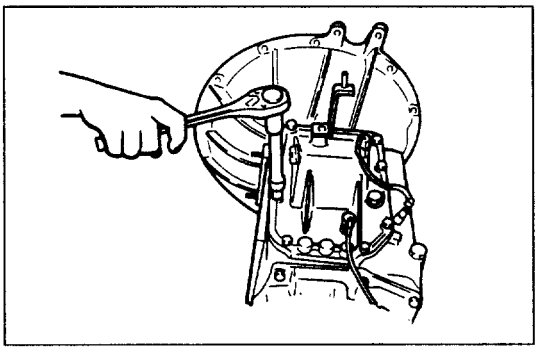


36. Detent Ball

37. Detent Spring

38. Control Box Assembly

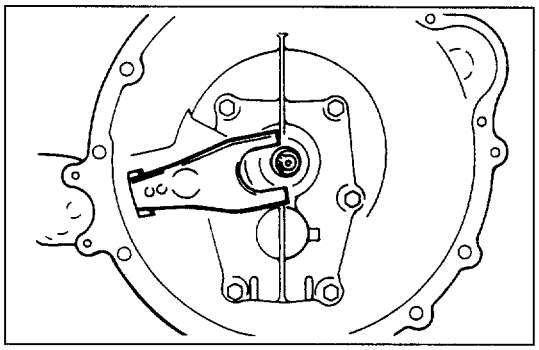
- Apply small amount of multi-purpose grease to the detent balls.
- Install the 3 detent balls and the 3 detent springs to the transmission case.
- Install the control box assembly with new gasket.



Control Box to Transmission Case Bolts Torque	N·m (kg·m/lb·ft)
	20 (2.0/14)

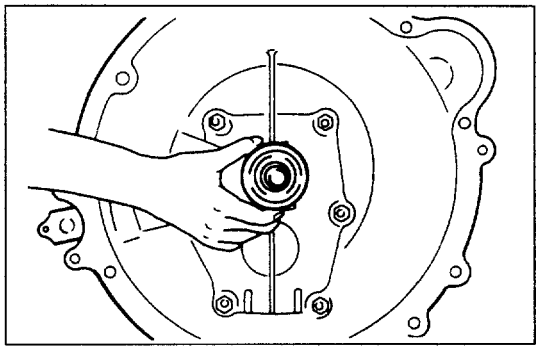
NOTE:

Operating the shift lever and the select lever, make sure that they shift to each position smoothly.

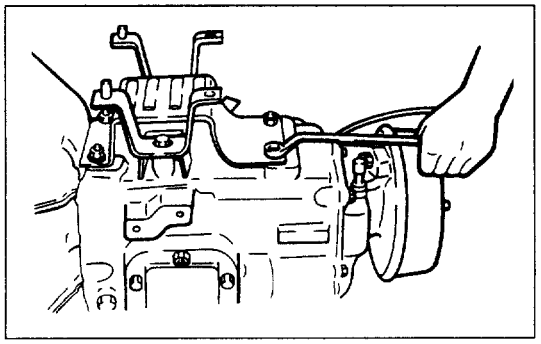


39. Shift Fork and Support Bolt

Support Bolt Torque	N·m (kg·m/lb·ft)
	52 (5.3/38)



40. Shift Block Assembly

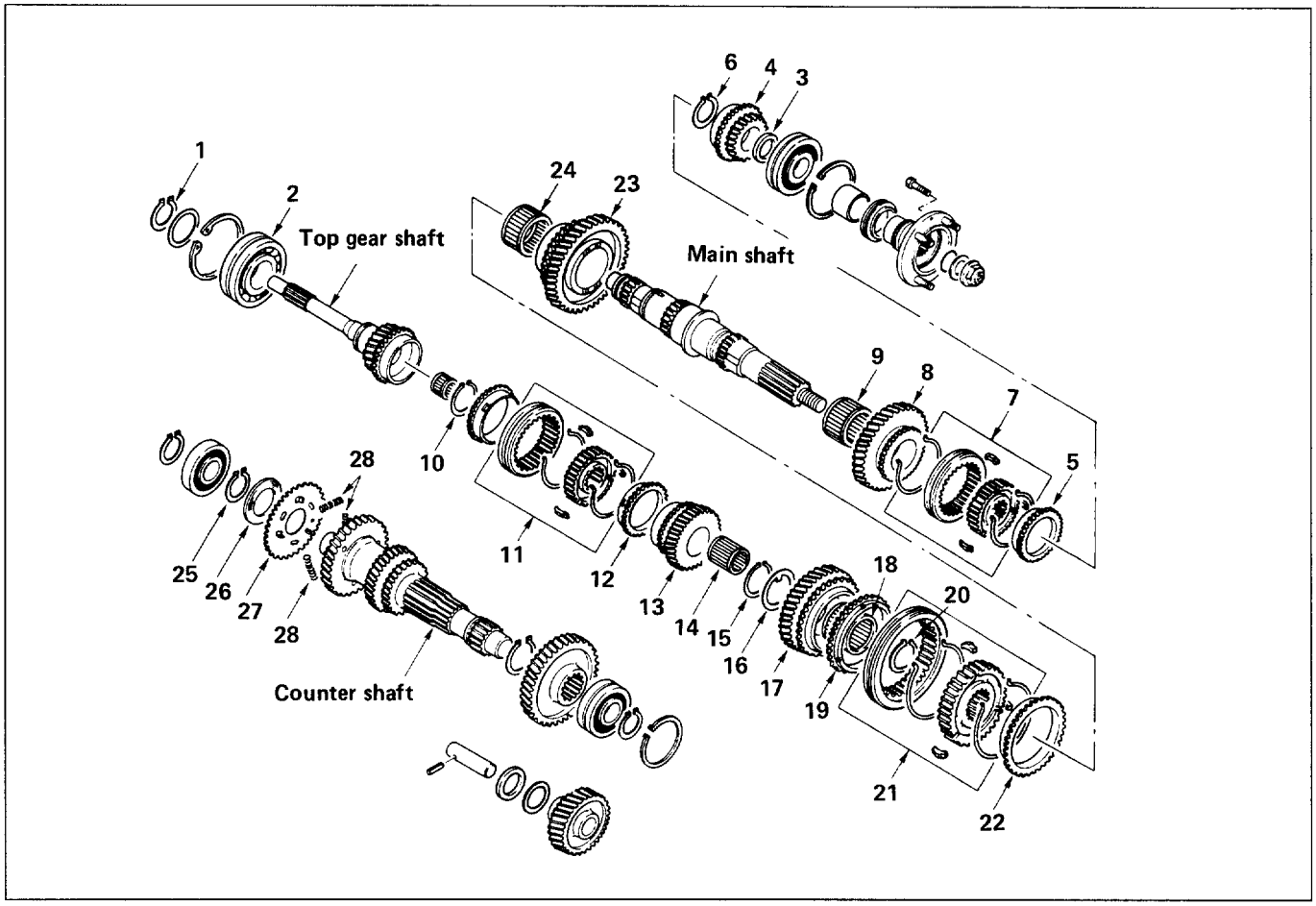


41. Mission Mounting Assembly

Mission Mounting Bolt Torque	N·m (kg·m/lb·ft)
	69 (7.0/51)

TOP GEAR SHAFT ASSEMBLY, MAIN SHAFT ASSEMBLY AND COUNTER SHAFT ASSEMBLY

DISASSEMBLY



Disassembly Step

Top gear shaft assembly

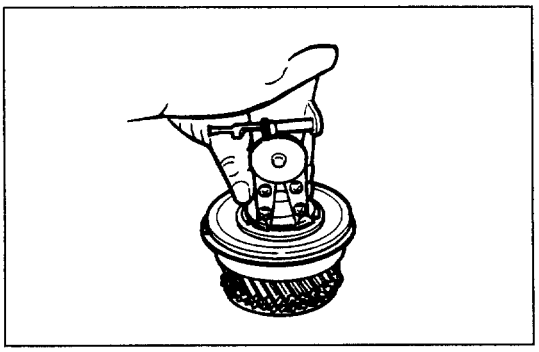
1. Snap ring
2. Ball bearing

Main shaft assembly

3. Thrust washer
4. 5th gear
5. Block ring
6. Snap ring
7. 5th/reverse synchronizer assembly
8. Reverse gear
9. Needle bearing
10. Snap ring
11. 3rd/4th synchronizer assembly
12. Block ring
13. 3rd gear
14. Needle bearing
15. Snap ring
16. Thrust washer
17. 2nd gear
18. Needle bearing
19. Block ring
20. Snap ring
21. 1st/2nd synchronizer assembly
22. Block ring
23. 1st gear
24. Needle bearing

Counter shaft assembly

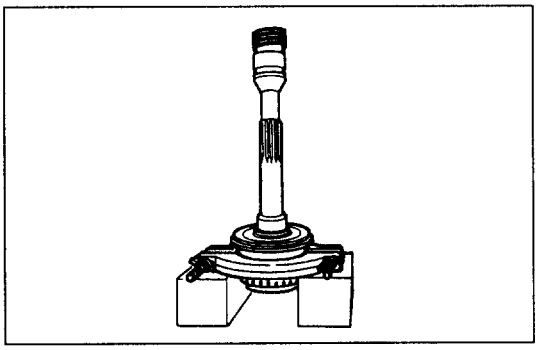
25. Snap ring
26. Conical washer
27. Anti-lash plate
28. Spring



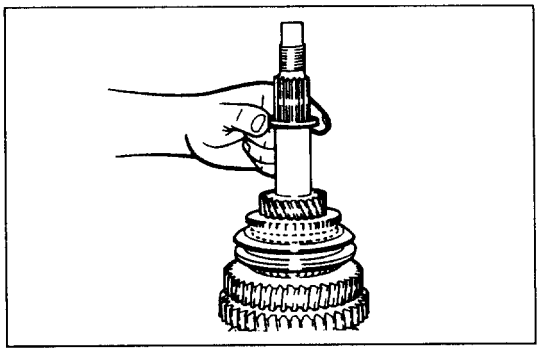
Disassembly Steps

Top Gear Shaft Assembly

1. **Snap Ring**

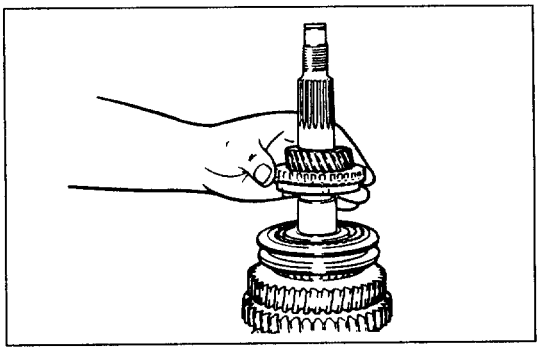


2. **Ball Bearing**
   - Use the bearing remover to remove the bearing from top gear shaft.
     Bearing Remover : 5-8840-0587-0

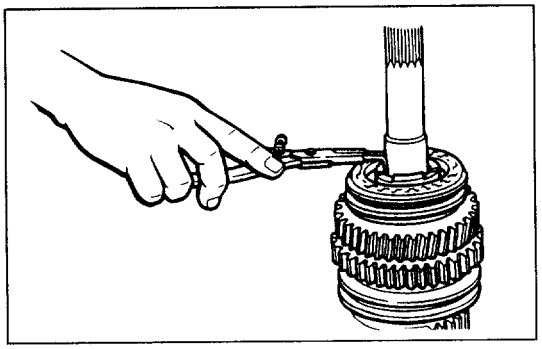


Main Shaft Assembly

3. **Thrust Washer**



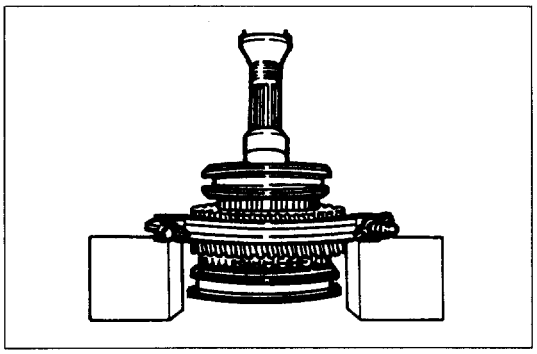
4. **5th Gear**
5. **Block Ring**
   - Attach a backing plate to the vise, secure the main shaft at the top end, and remove the 5th gear and block ring.



6. **Snap Ring**

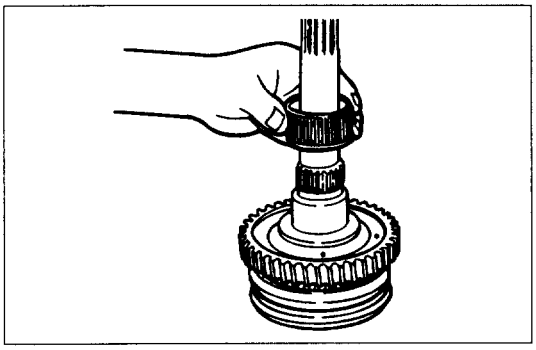
   NOTE:

   Snap ring of appropriate sizes are combined to fill the gap to the clutch hub. Never mix them with other snap rings.

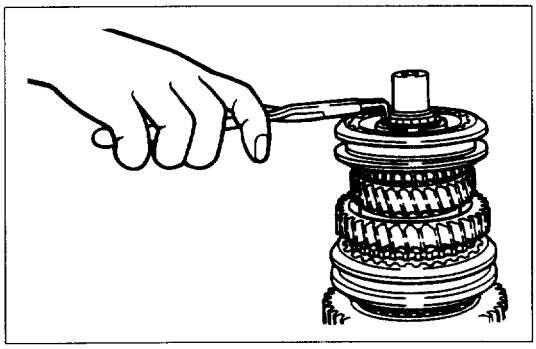


7. **5th/Reverse Synchronizer Assembly**
8. **Reverse Gear**
   - Use a bench press and the bearing remover to remove the reverse gear together with the 5th/reverse synchronizer assembly.

     Bearing Remover : 5-8840-0587-0
   - Disassemble synchronizer assemblies into the clutch hub, sleeve, inserts (3 pieces) and insert springs (2 pieces).



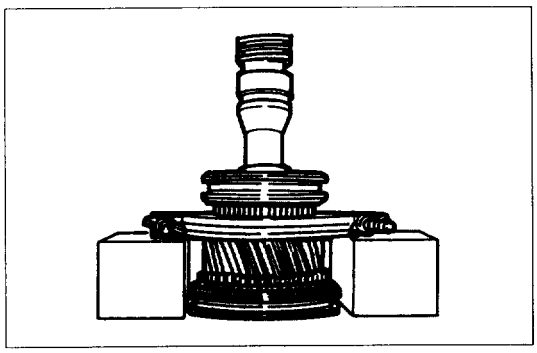
9. **Needle Bearing**



10. **Snap Ring**
    - Attach a backing plate to the vise, secure the main shaft at the spline end, and remove the snap ring at the end.

    NOTE:

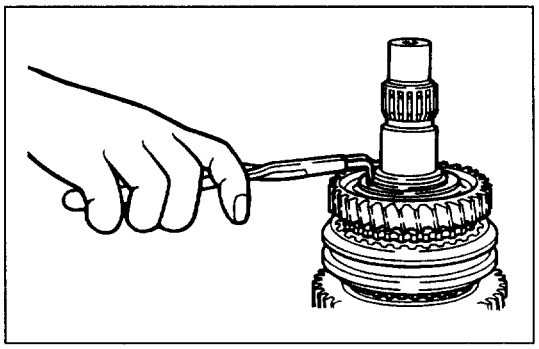
    Snap ring of appropriate sizes are combined to fill the gap to the clutch hub. Never mix them with other snap rings.



11. **3rd/4th Synchronizer Assembly**
12. **Block Ring**
13. **3rd Gear**
    - Use a bench press and the bearing remover to remove the 3rd gear together with the 3rd/4th synchronizer assembly and the block ring.

      Bearing Remover : 5-8840-0587-0
    - Disassemble synchronizer assemblies into the clutch hub, sleeve, inserts (3 pieces) and insert springs (2 pieces).

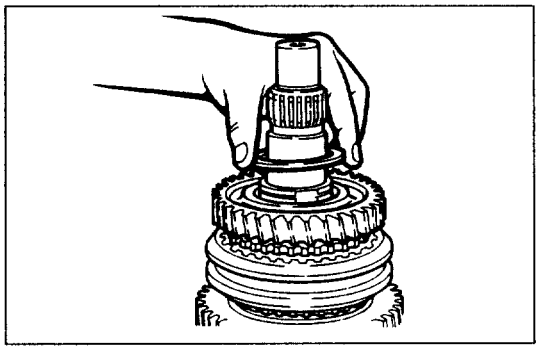
14. **Needle Bearing**



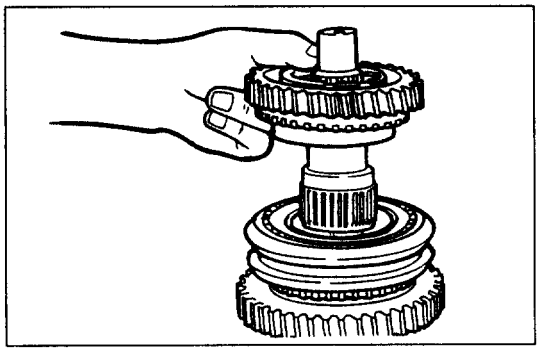
15. Snap Ring

NOTE:

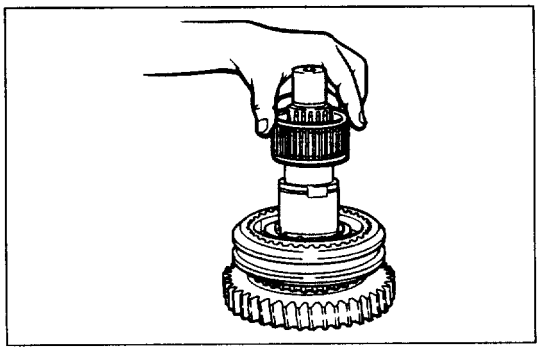
Snap ring of appropriate sizes are combined to fill the gap to the clutch hub. Never mix them with other snap rings.



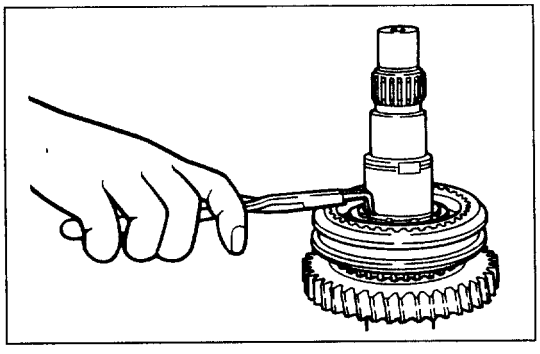
16. Thrust Washer



17. 2nd Gear



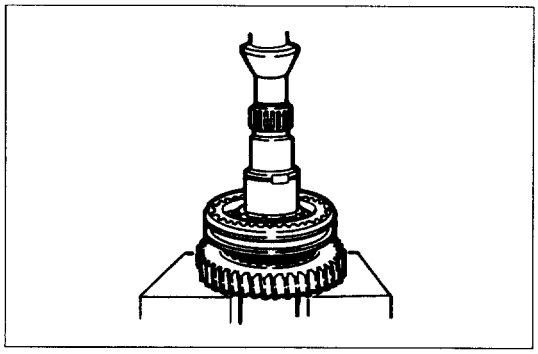
18. Needle Bearing
19. Block Ring



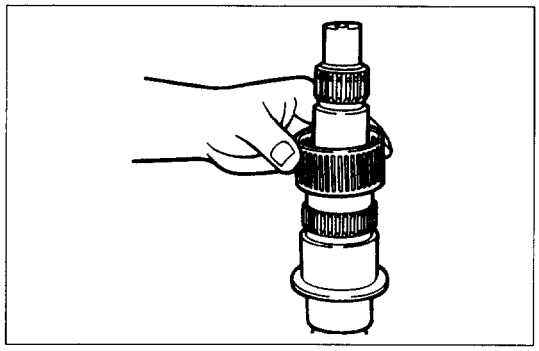
20. Snap Ring

NOTE:

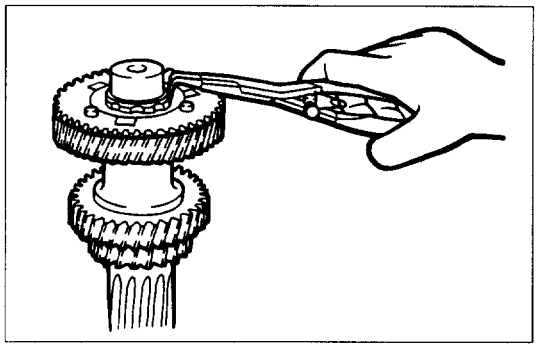
Snap ring of appropriate sizes are combined to fill the gap to the clutch hub. Never mix them with other snap rings.



21. **1st/2nd Synchronizer Assembly**
22. **Block Ring**
23. **1st Gear**
    - Use a bench press to remove the 1st gear together with the 1st/2nd synchronizer assembly and the block ring.
    - Disassemble synchronizer assemblies into the clutch hub, sleeve, inserts (3 pieces) and insert springs (2 pieces).

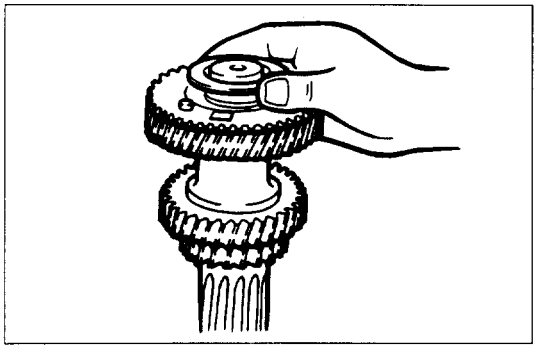


24. **Needle Bearing**

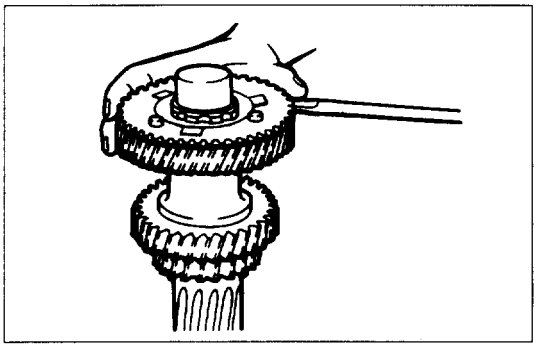


Counter Shaft Assembly

25. **Snap Ring**



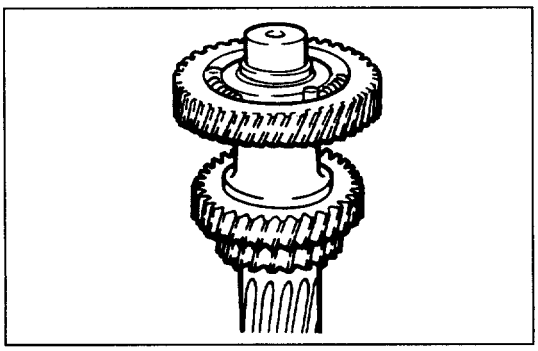
26. **Conical Washer**



27. **Anti-lash Plate**
    - Insert a flat-end screwdriver between the anti-lash plate and the counter drive gear, and remove the anti-lash plate.

WARNING:

THE ANTI-LASH PLATE SHOULD BE REMOVED VERY SLOWLY WITH SPECIAL CARE OTHERWISE SOME SPRINGS INSTALLED INSIDE THE PLATE COULD POP OUT AND CAUSE INJURY.

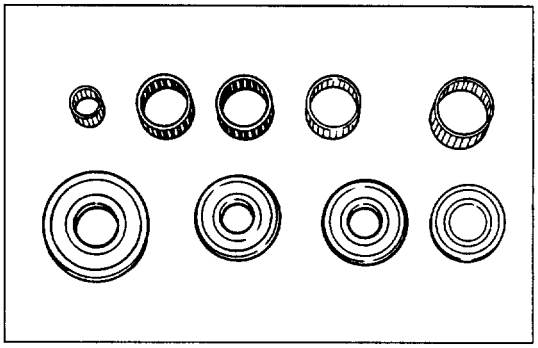


28. Spring

- Remove the 3 springs that are assembled to the counter drive gear side.

INSPECTION AND REPAIR

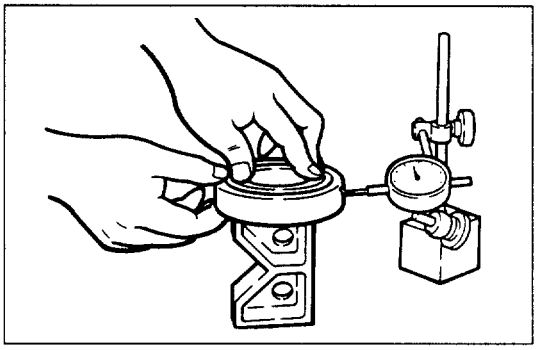
Make the necessary adjustment, repairs, and part replacements if excessive wear or damage is discovered during inspection.



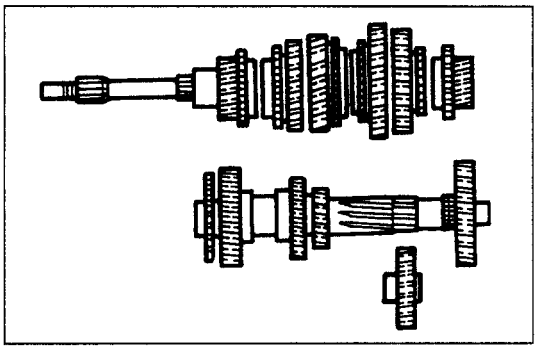
Bearings

Check each bearing, and replace in either of the following cases.

- Rotation is not smooth.
- Abnormal sound is generated.
- There is extreme damage or rust.
- Rolling element or rolling contact surface of needle roller bearing is discolored, extremely worn or pitted.



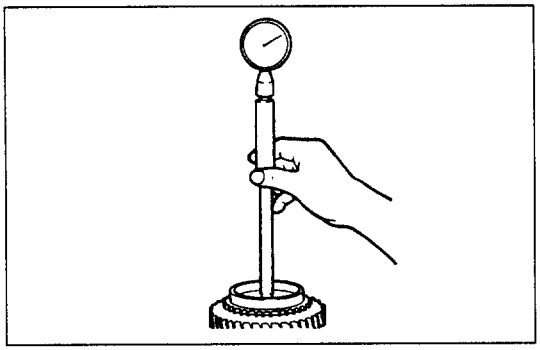
Ball Bearing Run-out	mm (in)
Limit	
0.2 (0.01)	



Gears

Check each gear for the following points. Correct a slight stepped wear or surface roughness with an oil stone or pencil grinder, or replace the gear if unrecoverable damage is found.

- Break or damage of tooth.
- Roughness or damage of taper cone (contact surface with block ring).
- Extreme wear of tooth.
- Inspect the dog gear teeth, and replace if hard contact is found on the force receive side (coast side) during engine braking.

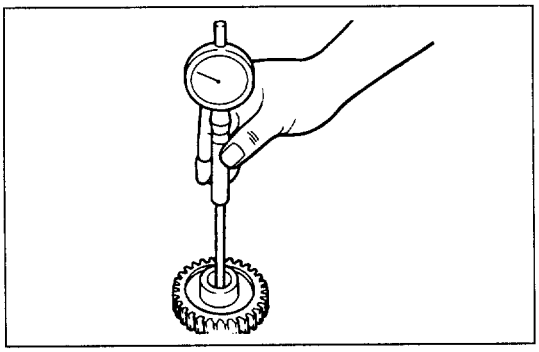


Gear Inside Diameter mm (in)

Gear	Nominal	Limit
3rd Gear	42.0 (1.654)	42.1 (1.657)
2nd Gear	54.0 (2.126)	54.1 (2.130)
1st Gear	61.0 (2.402)	61.1 (2.406)
Reverse Gear	54.0 (2.126)	54.1 (2.130)

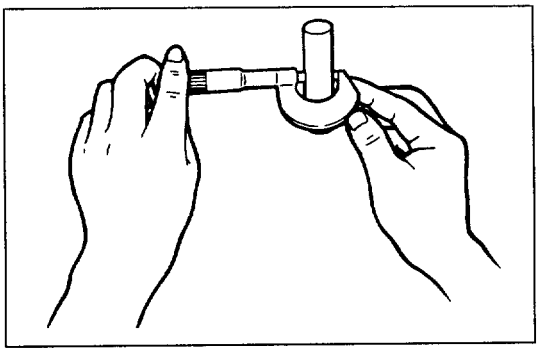
5th Gear Bushing and Main Shaft Clearance mm (in)

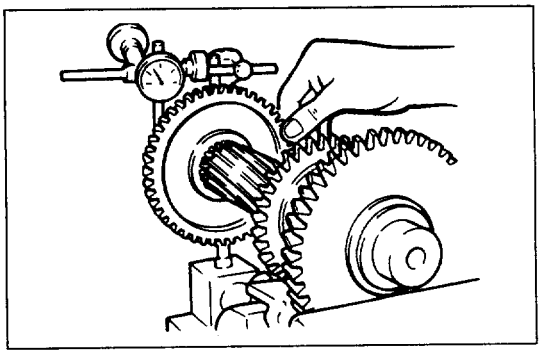
Standard	Limit
0.05-0.09 (0.002-0.004)	0.2 (0.01)



Reverse Idle Gear Bushing and Reverse Idle Shaft Clearance mm (in)

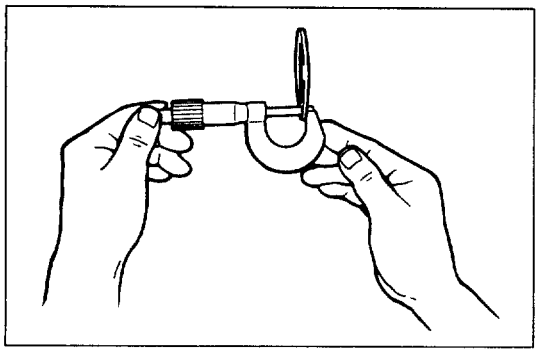
Standard	Limit
0.04-0.08 (0.002-0.003)	0.2 (0.01)





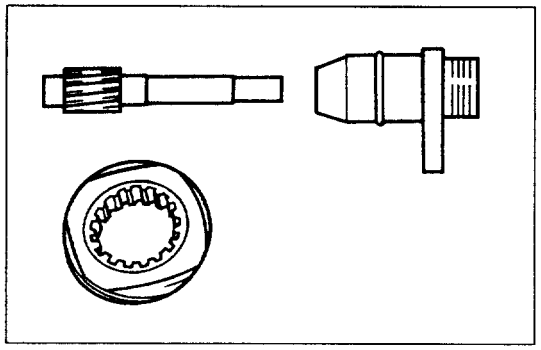
Counter 5th Gear Spline Play (At counter 5th gear outer circumference) mm (in)

Standard	Limit
0.18 -0.43 (0.007-0.017)	0.45 (0.018)

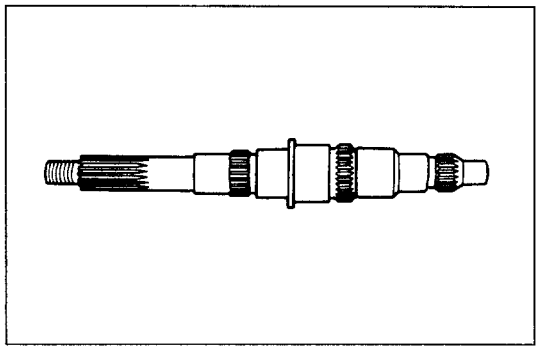


Thrust Washer Thickness mm (in)

Gear	Nominal	Limit
For 2nd Gear	3.0 (0.12)	2.8 (0.11)
For 5th Gear	3.8 (0.15)	3.6 (0.14)

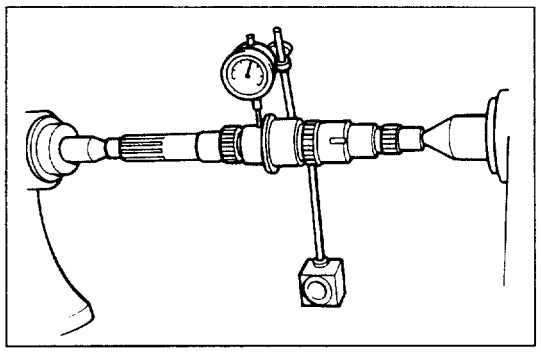


- Wear or damage of the car speed sensor drive gear and driven gear bushing.



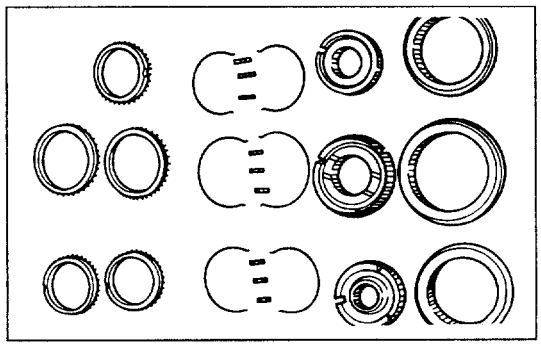
Main Shaft

Check the main shaft external surface for any damage or wear, and its spline sections for wear, damage or bent. When there is any abnormal condition found, or when it is used excessively beyond a proper use limit, replace it with new one.



Main shaft Run-out mm (in)

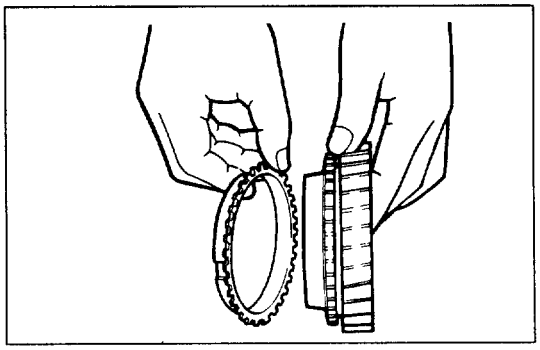
Standard	Limit
0.025 (0.0010) or Less	0.1 (0.004)



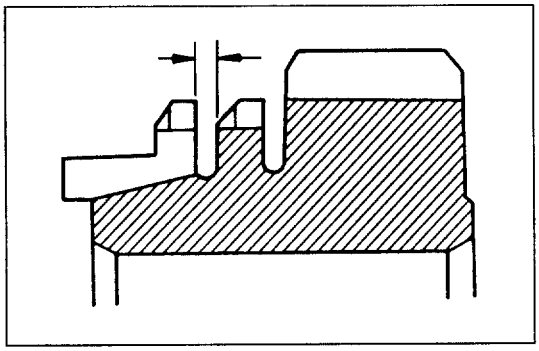
Synchromesh

Check the components of the synchronizer for any abnormal conditions. When there are uneven slight wears or rough surfaces found, improve them with an oil stone or pencil grinder.

When they are abnormally damaged, or when they are used excessively beyond a proper use limit, replace them with new one.

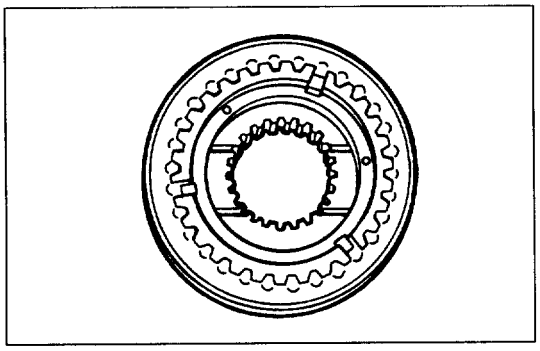


- Damages or wears found on the taper, gear and insert groove sections of the block ring.

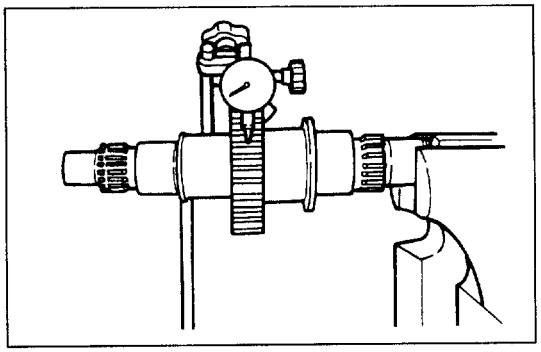


Block Ring and Dog Gear Teeth Clearance mm(in)

Gear	Nominal	Limit
3rd/4th	1.0 (0.04)	0.5 (0.02)
1st/2nd	1.5 (0.06)	0.5 (0.02)
5th	1.5 (0.06)	0.5 (0.02)

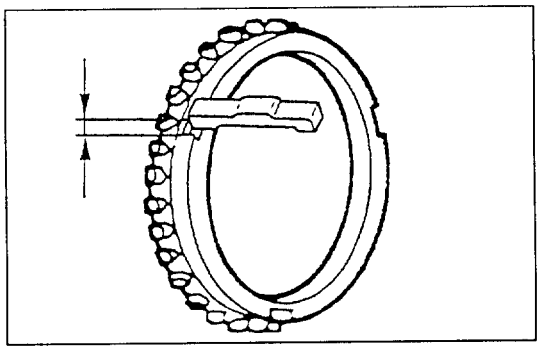


- Wears or damages found on the clutch hub, the sliding sections of the sleeve, the spline sections and insert grooves.



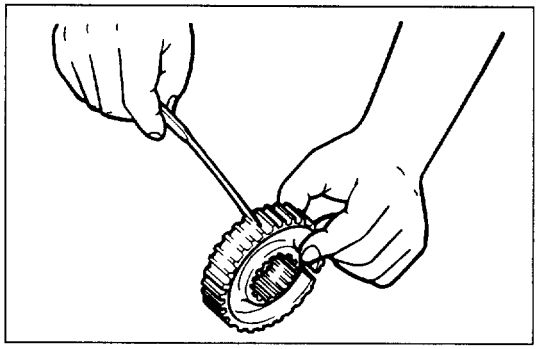
Clutch Hub Spline Play
(At clutch hub outer circumference) mm (in)

Standard	Limit
0-0.05 (0-0.002)	0.3 (0.01)



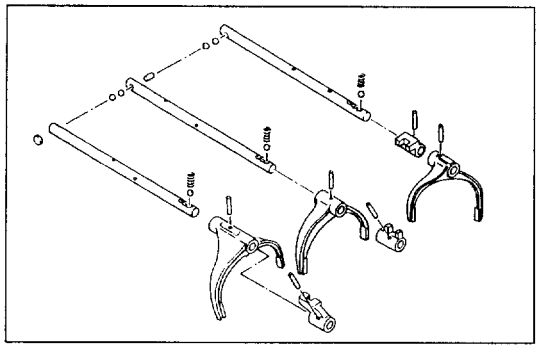
Block Ring Groove and Insert Clearance mm (in)

Standard	Limit
3.59-3.91 (0.141-0.154)	4.1 (0.16)



Clutch Hub Groove and Insert Clearance mm (in)

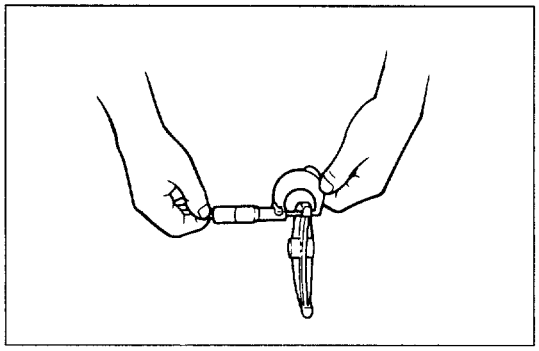
Standard	Limit
0.09-0.31 (0.004-0.012)	0.4 (0.02)



Shift Mechanism

Inspect all disassembled parts for wear, damage or other abnormal conditions.

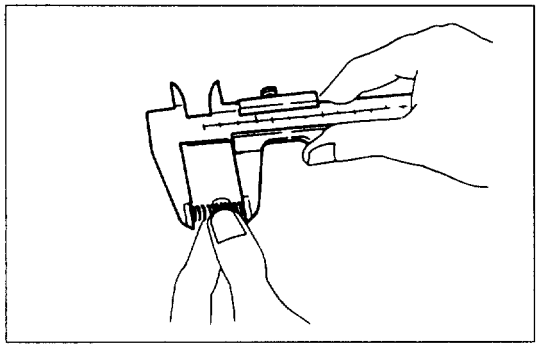
- Check the shift rod wear, bent and damage.



- Check the shift arm and shift block groove for wear or deformation.

Shift Arm Thickness mm(in)

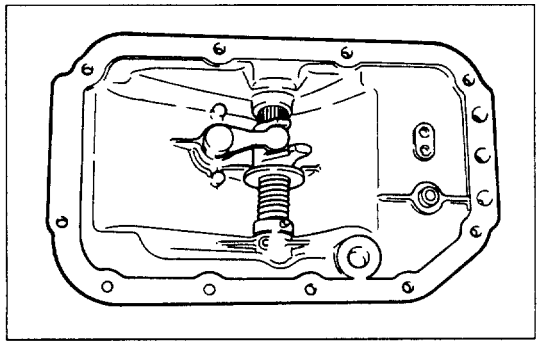
Standard	Limit
10.0 (0.39)	9.0 (0.35)



- Check the detent spring for weakening and deformation.

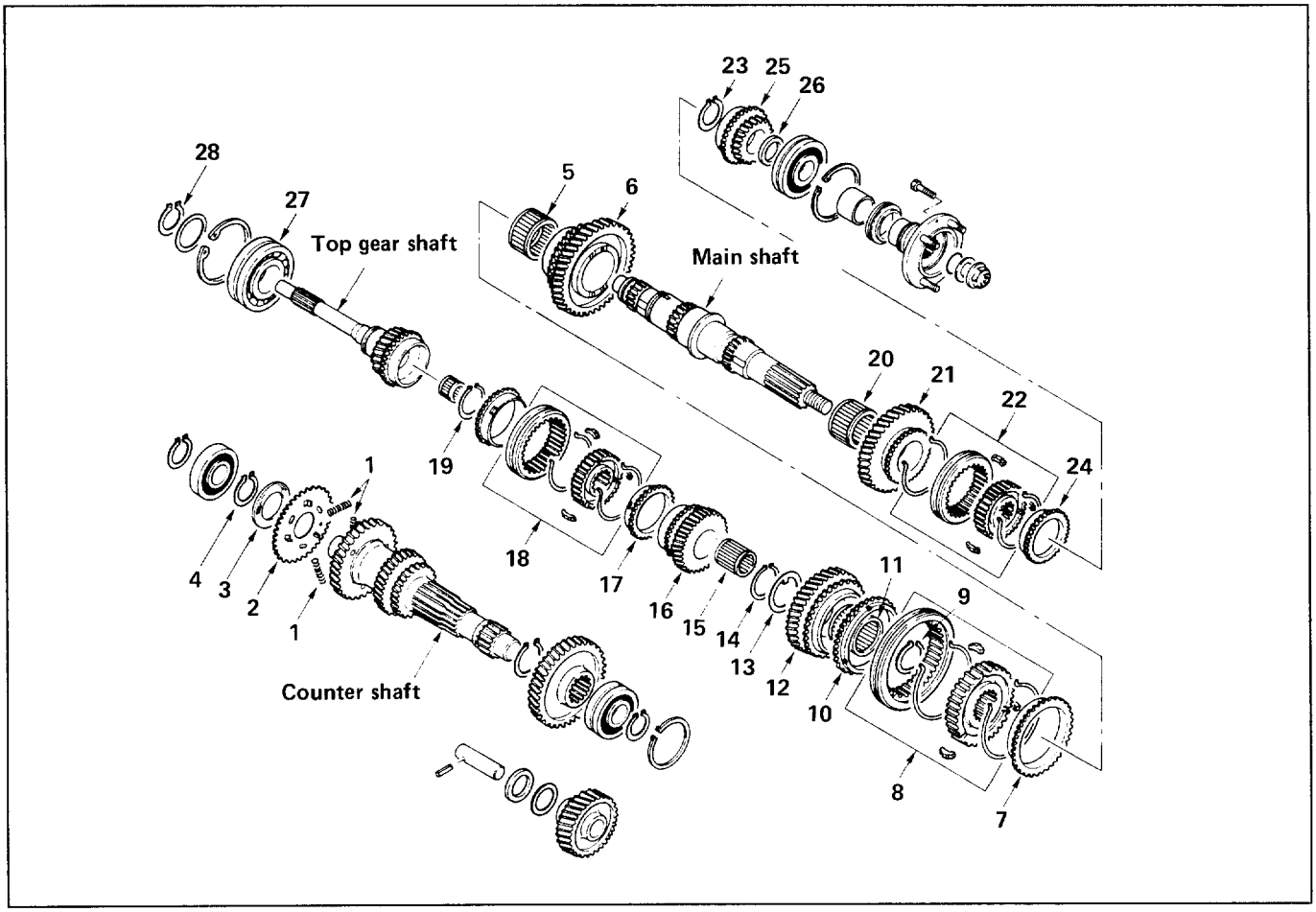
Free Length of Detent Spring mm(in)

Nominal	Limit
31.6 (1.24)	30.1 (1.19)



- The wear of the select lever, and the backlash and awkward operation of the control box.

REASSEMBLY



Reassembly Steps

Counter shaft assembly

1. Spring
2. Anti-lash plate
3. Conical washer
4. Snap ring

Main shaft assembly

5. Needle bearing
6. 1st gear
7. Block ring
8. 1st/2nd synchronizer assembly
9. Snap ring
10. Block ring
11. Needle bearing
12. 2nd gear
13. Thrust washer
14. Snap ring
15. Needle bearing
16. 3rd gear
17. Block ring
18. 3rd/4th synchronizer assembly
19. Snap ring
20. Needle bearing
21. Reverse gear
22. 5th/reverse synchronizer assembly
23. Snap ring
24. Block ring
25. 5th gear
26. Thrust washer

Top gear shaft assembly

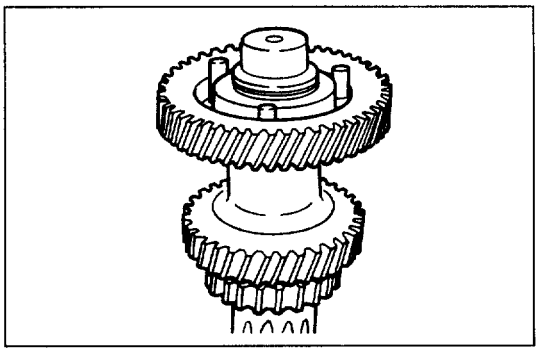
27. Ball bearing
28. Snap ring

Reassembly Steps

NOTE:

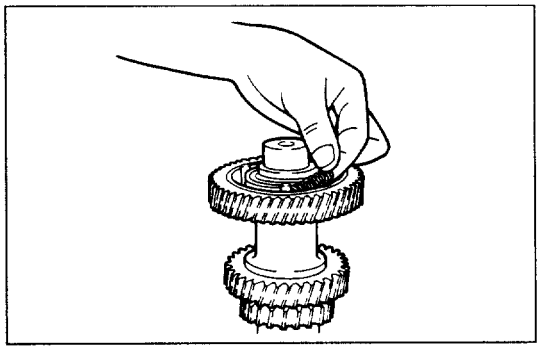
Clean each part throughly.

When assembling parts, apply clean engine oil (SAE 5W-30) to their sliding and mating sections.



Counter Shaft Assembly

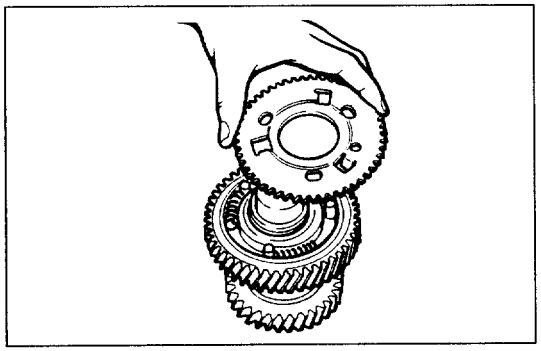
1. **Spring**
   - Attach a backing plate to the vise, secure the counter shaft rear end, and install the springs.



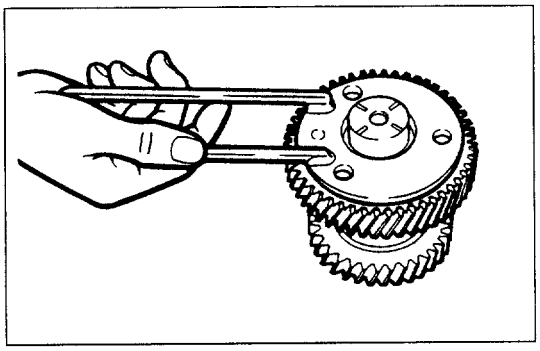
- The spring should be installed to the left of the inside counter drive gear pin.

NOTE:

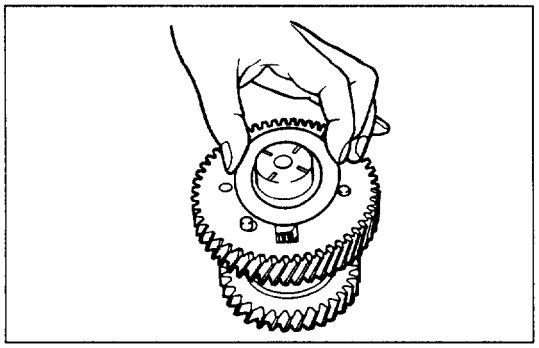
When replacing the pin with a new one, hammer it in until its height becomes 3 mm (0.12 in) from the gear end face.



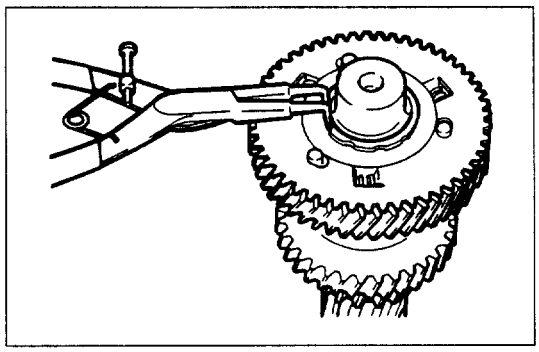
2. **Anti-lash Plate**
   - Asemble the anti-lash plate to the drive gear so that the drive gear hole (ø 7.7 mm/0.3 in) comes roughly in line with the hole (ø 7.7 mm/0.3 in) of the anti-lash plate.



- With the guide pin aligned with the drive gear hole (ø 7.7 mm/0.3 in), set the installer to the guide pin. Anti-lash Plate Installer: 5-8840-2044-0
- Turn the installer clockwise. When the drive gear pin comes to the position where it can be seen fully, put the installer into the drive gear side to fix the anti-lash plate to the drive gear.



3. **Conical Washer**
   - Install the conical washer above the anti-lash plate with the convex side (front side) up.

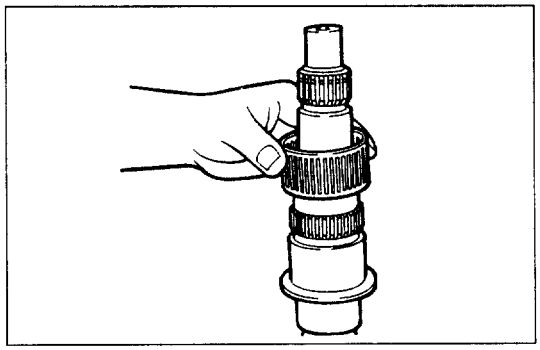


4. **Snap Ring**
   - Use a new snap ring to fix the conical washer.

NOTE:

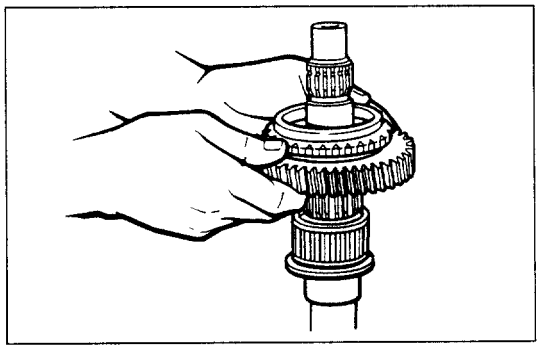
Avoid the reuse of snap ring.

Check visually the anti-lash plate for a warp or curve after assembly.

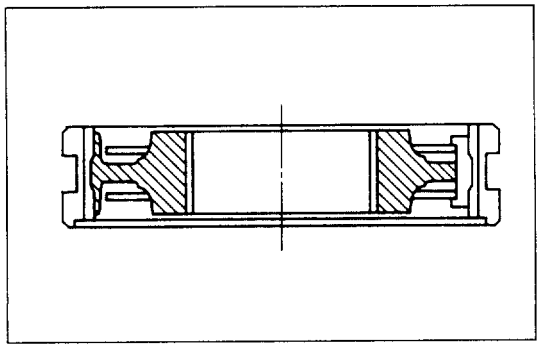


Main Shaft Assembly

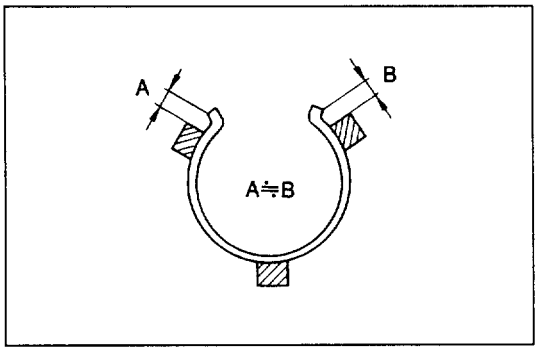
5. **Needle Bearing**
   - Attach a backing plate to the vise, secure the main shaft at the spline end.



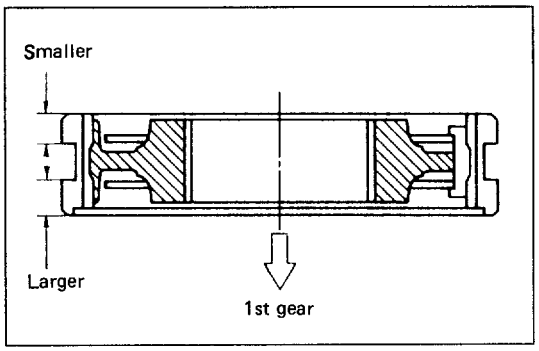
6. **1st Gear**
   - Install the 1st gear with its taper cone side upward (front of transmission).
7. **Block Ring**
   - Align the insert groove of the block ring with the insert.



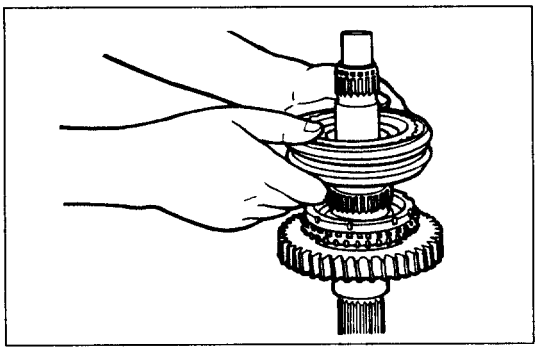
8. **1st/2nd Synchronizer Assembly**
   - Assemble the sleeve to the clutch hub. The clutch hub has no specific directionality.
   - Put the inserts into the clutch hub groove, and install the insert spring.



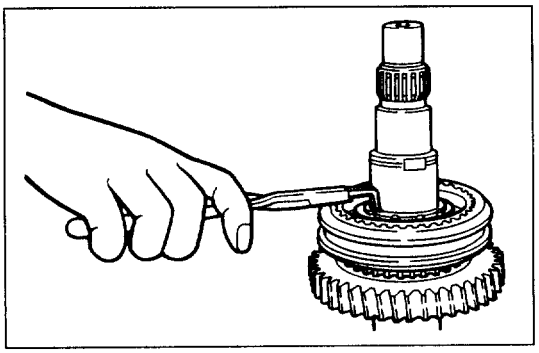
- Assemble the insert springs so that the distances (A and B) between inserts and the opening of the spring can be nearly equal, and also this opening may not be the same direction on both side.



- Larger width side of the sleeve outer circumference should be positioned toward the 1st gear side (rear of transmission).
- Align the insert with the insert groove of the block ring.



- Tap the clutch hub boss section with a plastic hammer to press it in until it contacts closely with the main shaft stepped section.
- When it is difficult to engage the clutch hub boss with the main shaft spline, heat the clutch hub boss section to a temperature between 80 and 120°C (176 and 248°F) with the piston heater before assembling.
- Check to see if the 1st gear rotates smoothly.



9. Snap Ring

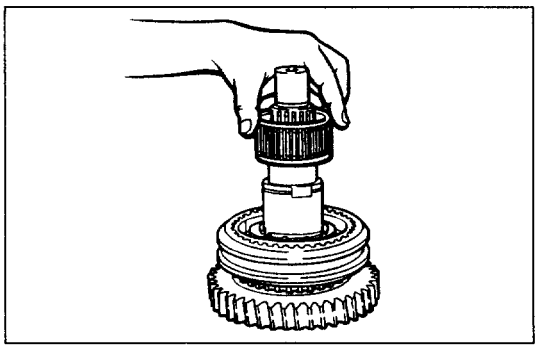
- Install the built-in snap ring and measure the clearance between the snap ring and the clutch hub.

Clutch Hub and Snap Ring Clearance	mm(in)
0-0.09 (0-0.004)	

- When the clearance is out of the reference value, select a snap ring with the maximum thickness that can be inserted from among the following three types, and built it in.

Snap Ring mm(in)

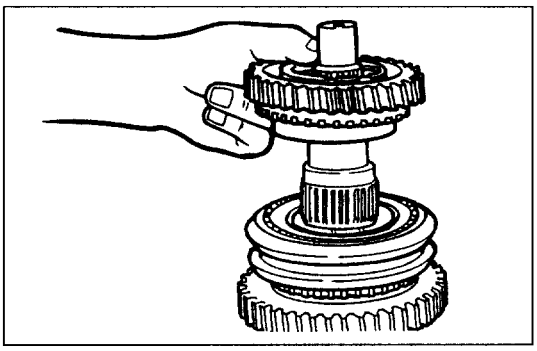
Color	Thickness (Reference)
Pink	1.75-1.80 (0.069-0.071)
White	1.80-1.85 (0.071-0.073)
Yellow	1.85-1.90 (0.073-0.075)



10. Block Ring

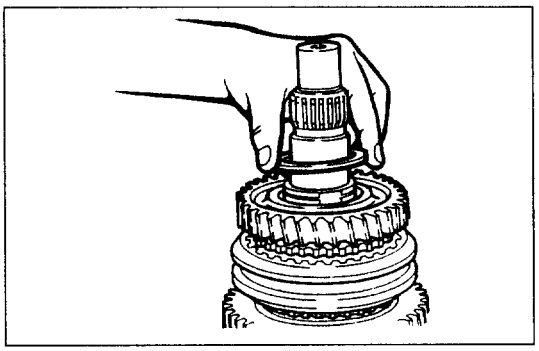
- Align the insert groove of the block ring with the insert.

11. Needle Bearing



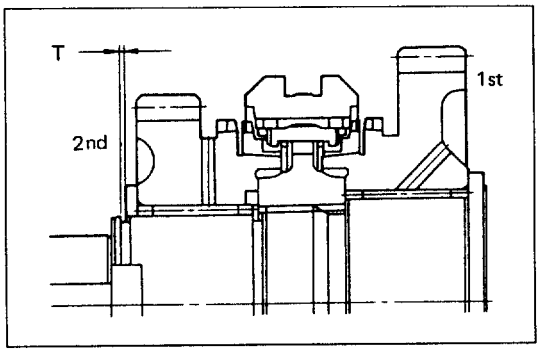
12. 2nd Gear

- Install the 2nd gear with the taper cone side turned to the 1st gear side (to the bottom).



13. Thrust Washer

- With the thrust washer set to main shaft groove, assemble it.

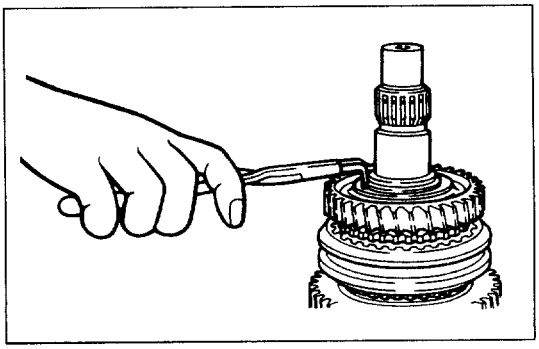


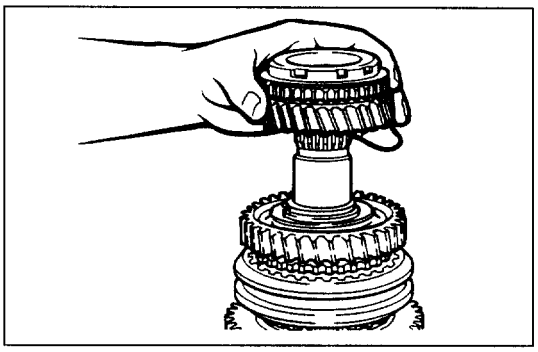
14. Snap Ring

- After installation, measure distance (T) and select the optimum snap ring from the table.

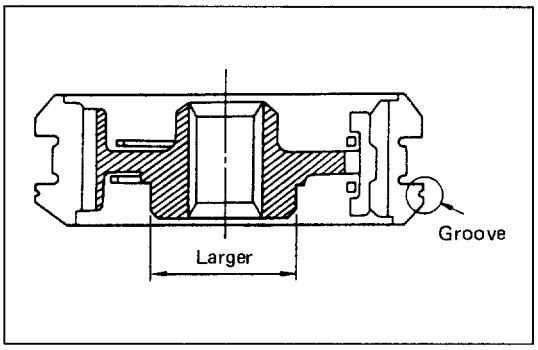
Snap Ring mm (in)

Distance (T)	Color	Thickness (Reference)
2.20-2.27 (0.087-0.089)	Yellow	1.85-1.90 (0.073-0.075)
2.27-2.32 (0.089-0.091)	Blue	1.90-1.95 (0.075-0.077)
2.32-2.37 (0.091-0.093)	Brown	1.95-2.00 (0.077-0.079)
2.37-2.43 (0.093-0.096)	Green	2.00-2.05 (0.079-0.081)

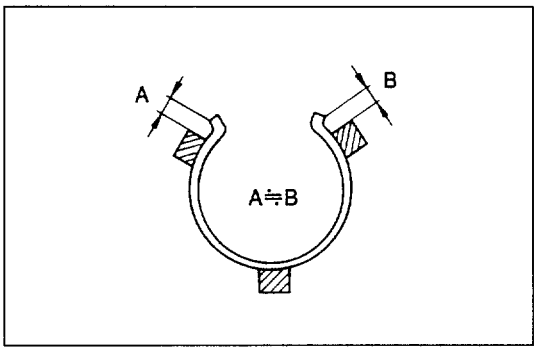




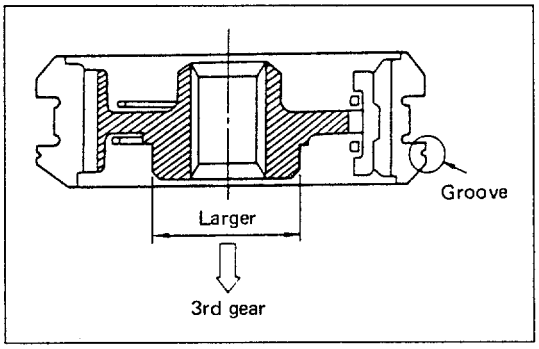
15. **Needle Bearing**
16. **3rd Gear**
    - Install with the taper cone side turned upward (front of transmission).
17. **Block Ring**



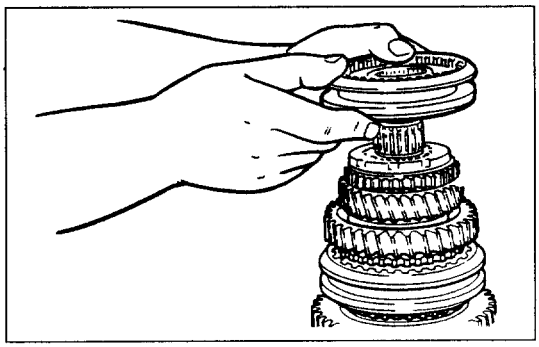
18. **3rd/4th Synchronizer Assembly**
    - Mate the clutch hub and the sleeve so that the larger diamater side of the clutch hub boss and the identification groove of the sleeve outer circumference point to the same direction.
    - Put the inserts into the clutch hub groove, and install the insert spring.



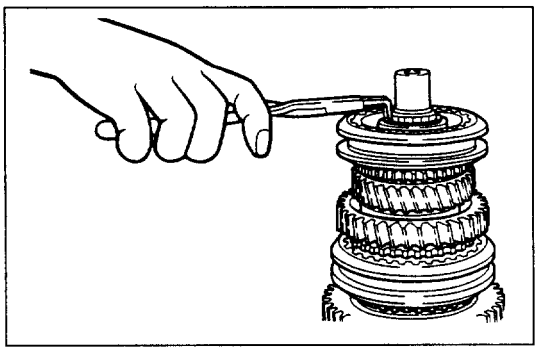
- Assemble the insert springs so that the distances (A and B) between inserts and the opening of the spring can be nearly equal, and also this opening may not be the same direction on both side.



- Grooved face of the sleeve and the havey boss of clutch hub should be positioned toward the 3rd gear (rear of transmission).
- Align the insert groove of the block ring with the insert.



- Tap the clutch hub boss section with a plastic hammer to press it in until it contacts closely with the main shaft stepped section.
- When it is difficult to engage the clutch hub boss with the main shaft spline, heat the clutch hub boss section to a temperature between 80 and 120°C (176 and 248°F) with the piston heater before assembling.
- Check to see if the 3rd gear rotates smoothly.



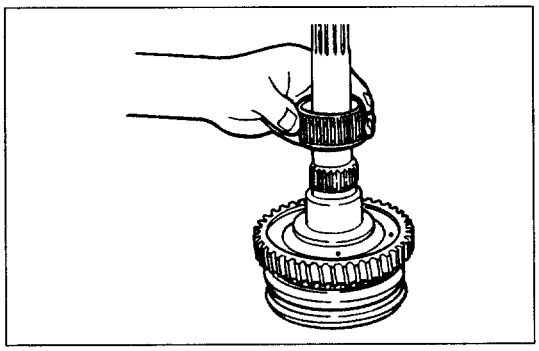
19. Snap Ring

- Install the built-in snap ring and measure the clearance between the snap ring and the clutch hub.

Clutch Hub and Snap Ring Clearance	mm(in)
0-0.09 (0-0.004)	

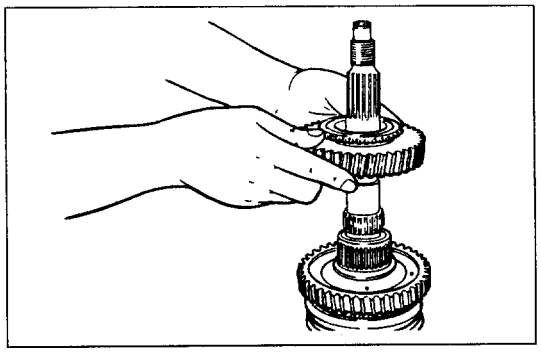
- When the clearance is out of the reference value, select a snap ring with the maximum thickness that can be inserted from among the following three types, and built it in.

Snap Ring	mm(in)
Color	Thickness (Reference)
Pink	1.75-1.80 (0.069-0.071)
White	1.80-1.85 (0.071-0.073)
Yellow	1.85-1.90 (0.073-0.075)



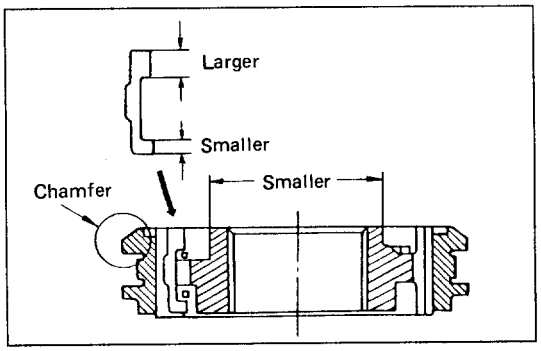
20. Needle Bearing

- Attach a backing plate to the vise, secure the main shaft at the top end.



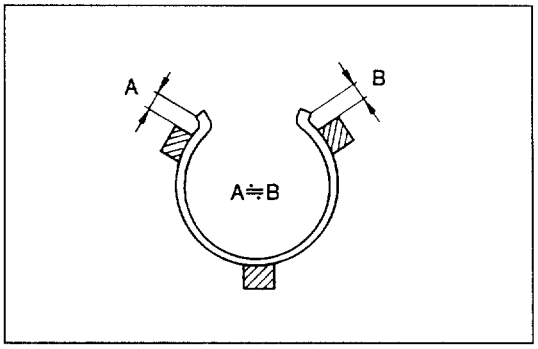
21. Reverse Gear

- Install with the taper cone side turned upward (rear of transmission).

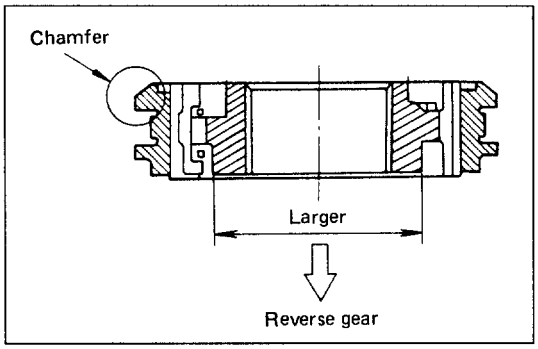


22. 5th/Reverse Synchronizer Assembly

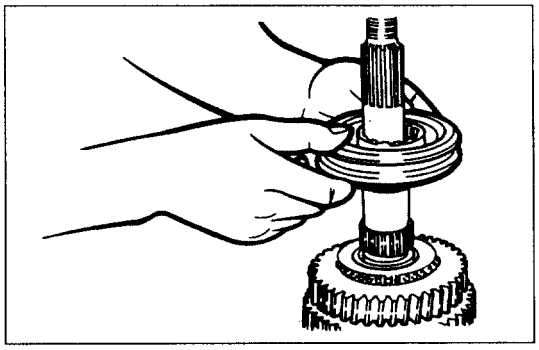
- Mate the clutch hub and the sleeve so that the smaller diameter side of the clutch hub boss and the chamfer of the sleeve outer circumference point to the same direction.
- Put the inserts into the clutch hub groove so that the smaller catch of the insert should be positioned toward the reverse gear (larger diameter side of the clutch hub boss), and install the insert spring.



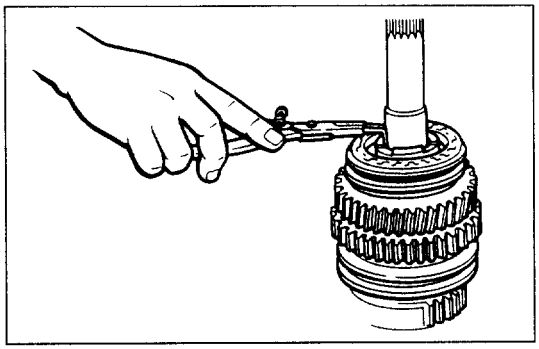
- Assemble the insert springs so that the distances (A and B) between inserts and the opening of the spring can be nearly equal, and also this opening may not be the same direction on both side.



- Face of the clutch hub with larger boss should be positioned toward reverse gear (front of transmission).
- Align the insert with the insert groove of the block ring.



- Tap the clutch hub boss section with a plastic hammer to press it in until it contacts closely with the main shaft stepped section.
- When it is difficult to engage the clutch hub boss with the main shaft spline, heat the clutch hub boss section to a temperature between 80 and 120°C (176 and 248°F) with the piston heater before assembling.
- Check to see if the Reverse gear rotates smoothly.



23. Snap Ring

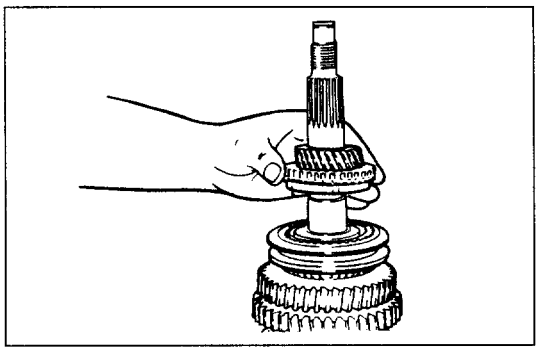
- Install the built-in snap ring and measure the clearance between the snap ring and the clutch hub.

Clutch Hub and Snap Ring Clearance	mm(in)
0-0.09 (0-0.004)	

- When the clearance is out of the reference value, select a snap ring with the maximum thickness that can be inserted from among the following three types, and built it in.

Snap Ring mm(in)

Color	Thickness (Reference)
Pink	1.75-1.80 (0.069-0.071)
White	1.80-1.85 (0.071-0.073)
Yellow	1.85-1.90 (0.073-0.075)

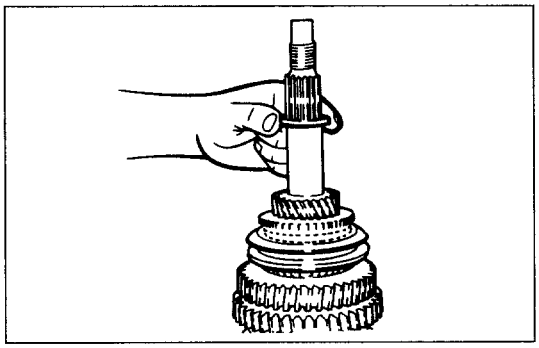


24. Block Ring

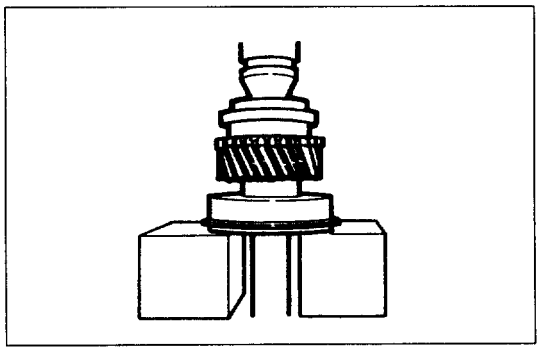
- Align the insert groove of the block ring with the insert.

25. 5th Gear

- Install with the taper cone side turned reverse gear side (front of transmission).



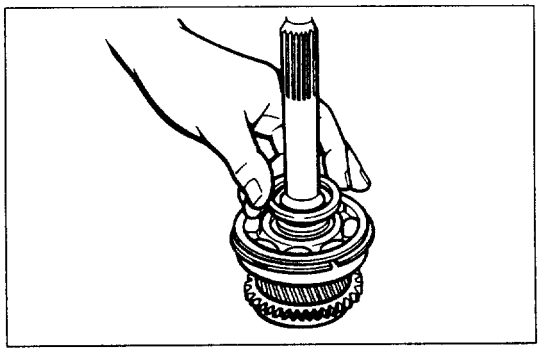
26. Thrust Washer



Top Gear Shaft Assembly

27. Ball bearing

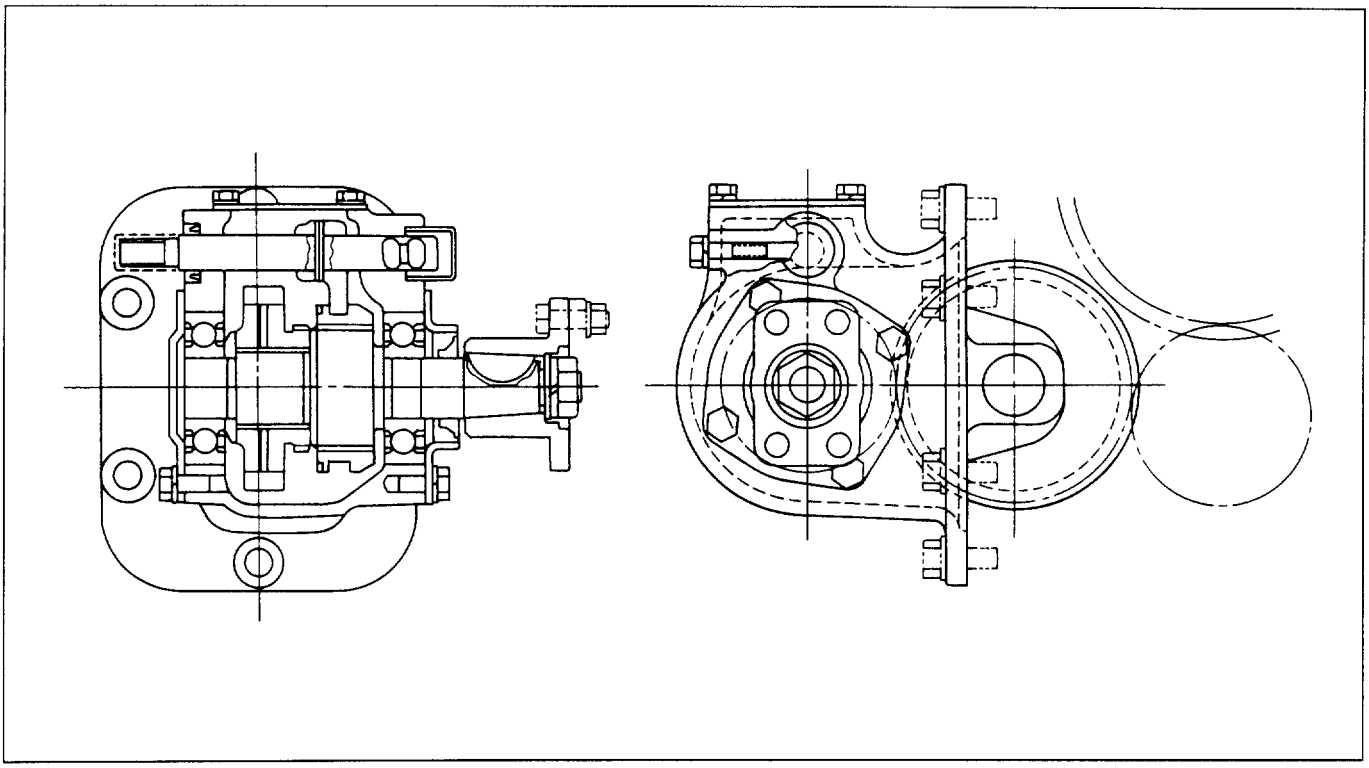
- Install the ball bearing to the top gear shaft and press it in so that the outer circumference snap ring side turns to the outside (in the direction opposite to the gear).



28. Snap Ring

POWER TAKE OFF (PTO)

GENERAL DESCRIPTION



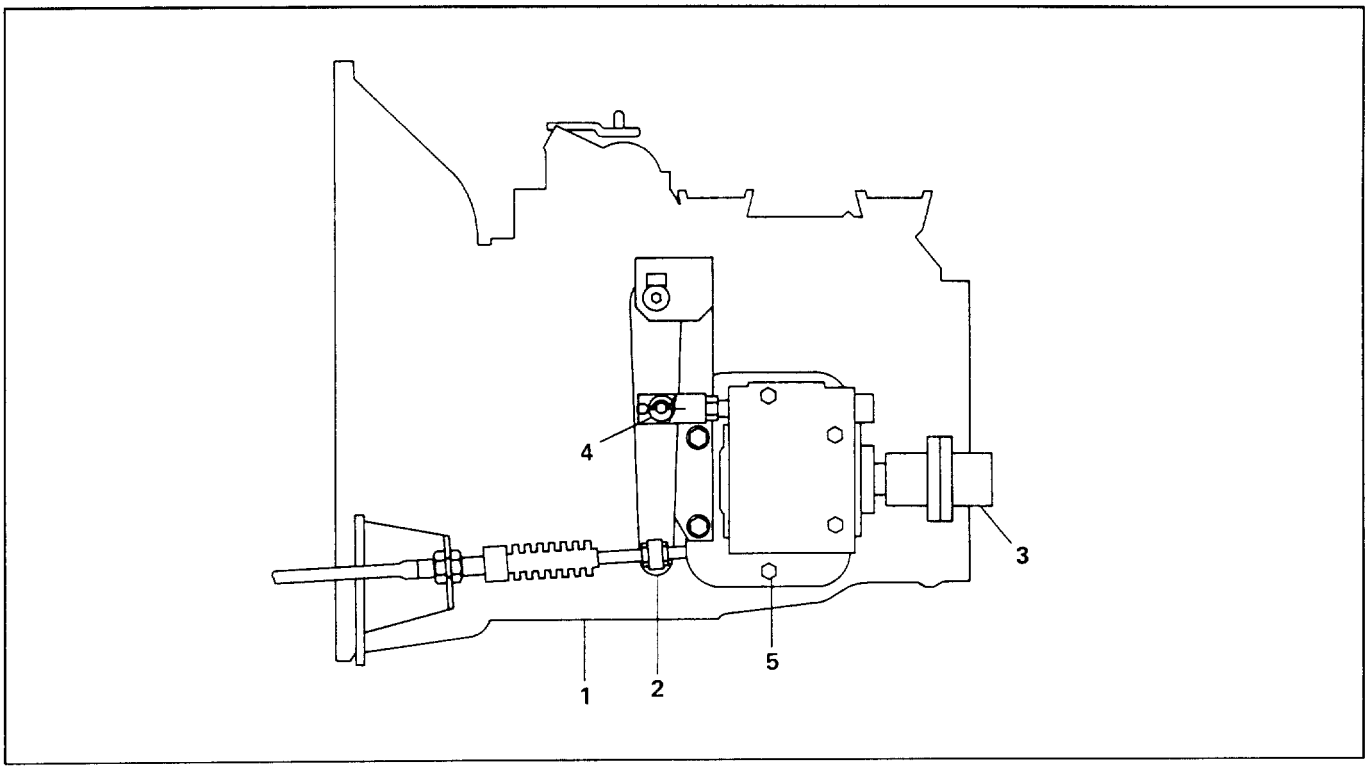
The side PTO is provided at the left side of the transmission.

For the gear, the same helical gear as the one used for the transmission is employed to reduce noises.

The roller type needle bearing is employed for the idle shaft and the ball bearing for the output shaft to obtain the increased durability and quietness.

The gear employed is of a constant-mesh type. The gear engagement control (ON/OFF) by a cable is made by the shift rod provided at the upper section of the case, which slides the sleeve on the output shaft through the shaft arm.

POWER TAKE OFF (PTO) REPLACEMENT

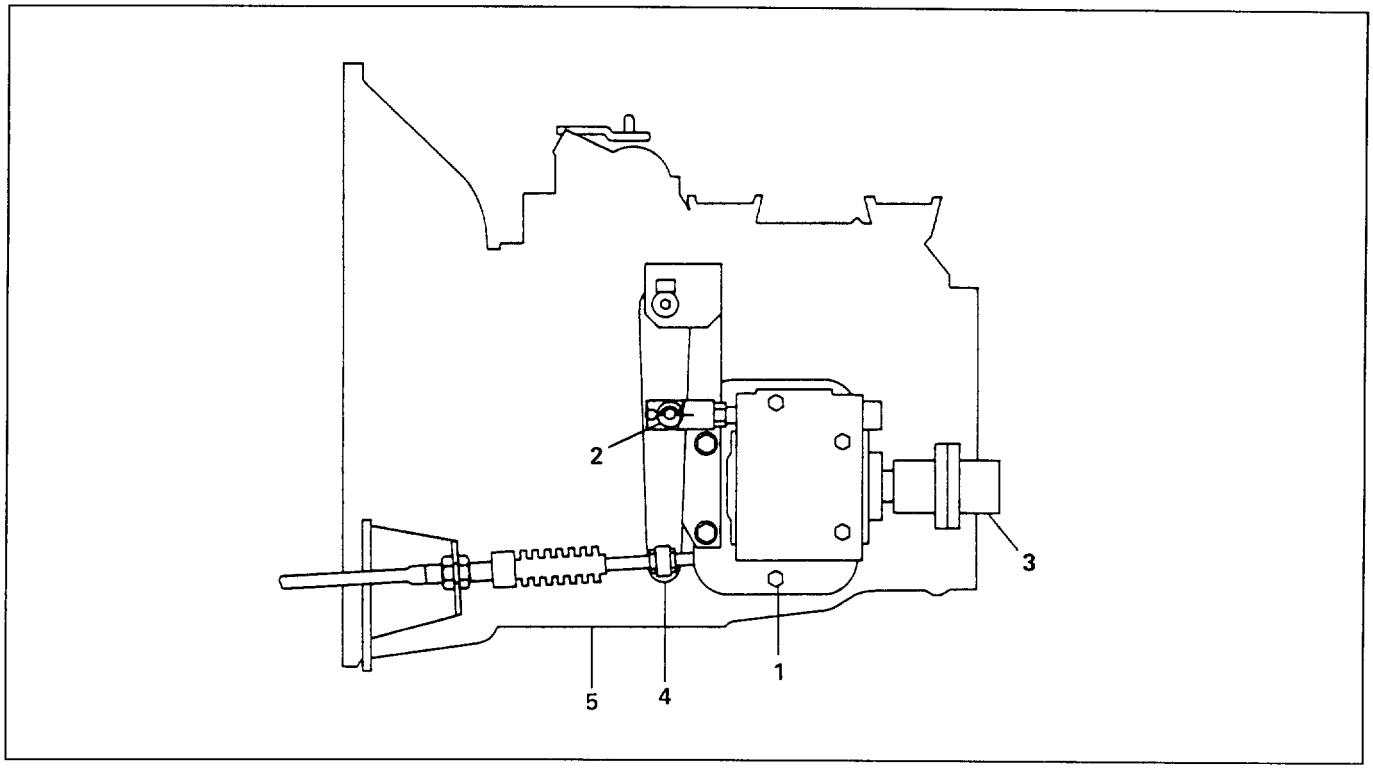


Removal Steps

1. Transmission oil
2. Control cable
3. PTO output propeller shaft
4. Connecting pin
5. PTO assembly

Removal Steps

1. **Transmission Oil**
   - Remove the drain plug from the transmission case and drain the oil.
2. **Control Cable**
   - Disconnect the control cable from the PTO shift lever.
3. **PTO Output Propeller Shaft**
   - Disconnect the propeller shaft from the PTO output flange.
4. **Connecting Pin**
   - Remove the snap pin, washer and the connecting pin from the shift rod and the shift lever.
5. **PTO Assembly**
   - Remove the 6 PTO fixing bolts, and the PTO assembly.



Installation Steps

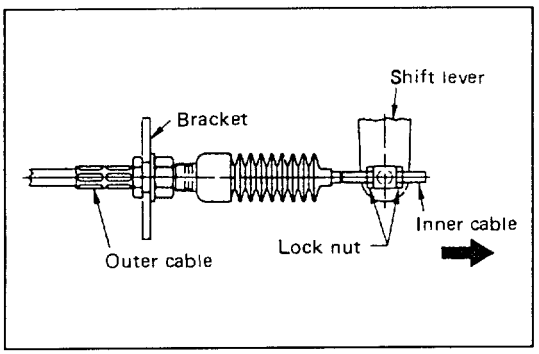
1. PTO assembly
2. Connecting pin
3. PTO output propeller shaft
4. Control cable
5. Transmission oil

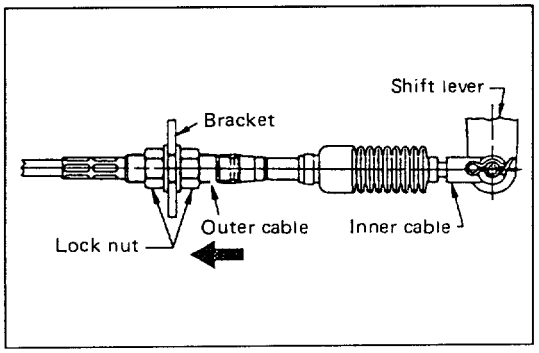
Installation Steps

1. **PTO Assembly**
   - Clean and dry on the mating faces before applying the liquid gasket.
   - Apply liquid gasket (Three Bond 1141E or equivalent) to the PTO and transmission surfaces, and both sides of the distance plate (if installed).
   - Install the distance plate (if installed) and PTO with new gasket(s).

PTO Bolt Torque	N·m(kg·m/lb·ft)
	37(3.8/27)

2. **Connecting Pin**
   - Install the connecting pin to the shift rod and shift lever and install the snap pin with washer.
3. **PTO Output Propeller Shaft**





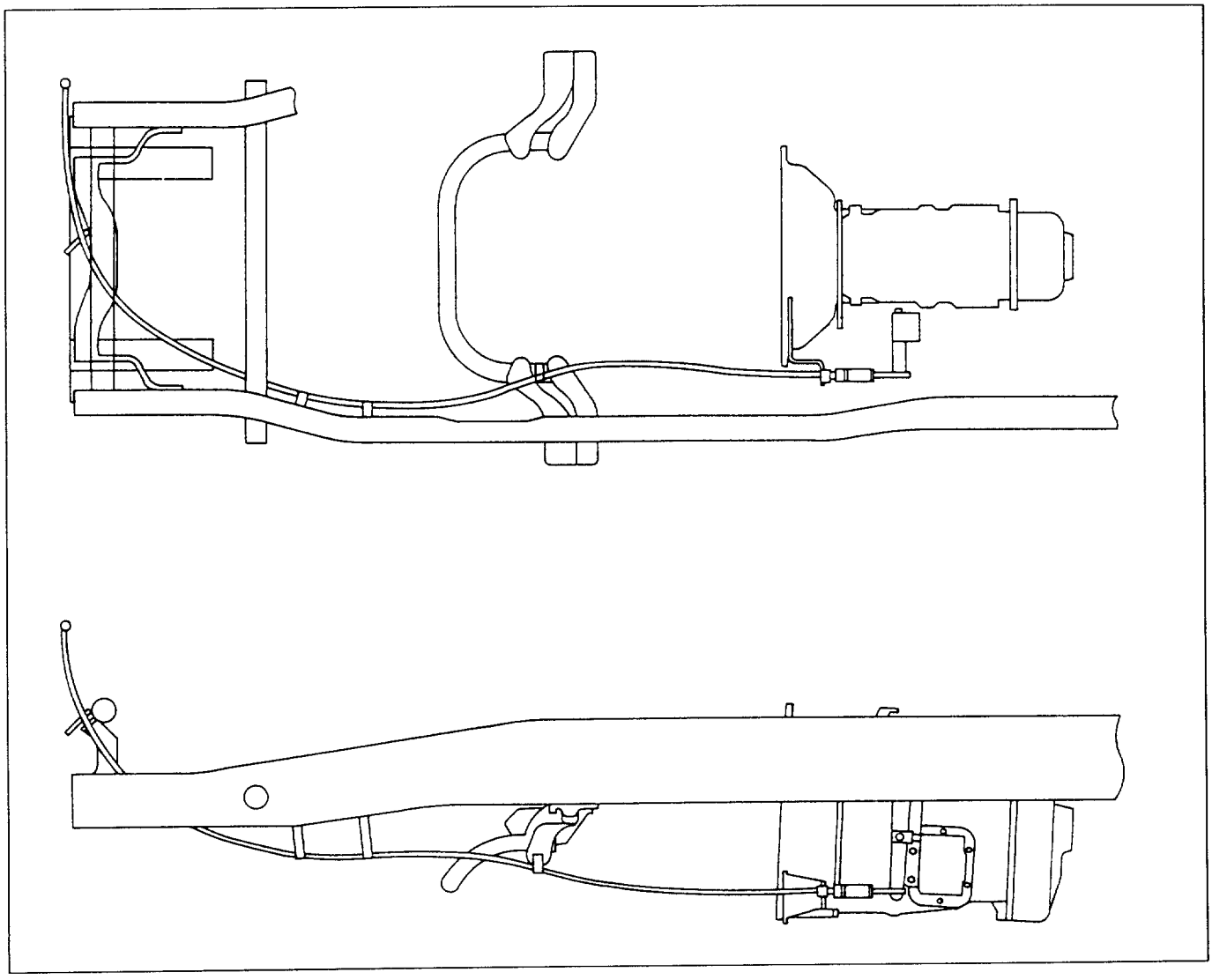
4. **Control Cable**

Inner Cable Adjustment Type

1) Fix the outer cable.
2) Set the PTO shift lever in the OFF position. Be sure to confirm the PTO control lever is in the OFF position (PTO indicator light turned off).
3) Remove slack from the inner cable by pulling the inner cable in the direction of the arrow.
4) Tighten the lock nuts.

Outer Cable Adjustment Type

1) Set the PTO shift lever in the OFF position. Be sure to confirm the PTO control lever is in the OFF position (PTO indicator light turned off).
2) Connect the inner cable to the PTO shift lever.
3) Remove slack from the inner cable by pulling the outer cable in the direction of the arrow.
4) Tighten the lock nuts.



5. Transmission Oil

1) Install the drain plug.

Drain Plug Torque	N·m(kg·m/lb·ft)
	49(5.0/36)

2) Remove the filler plug and fill the transmission case with the specified engine oil through the filler plug hole.

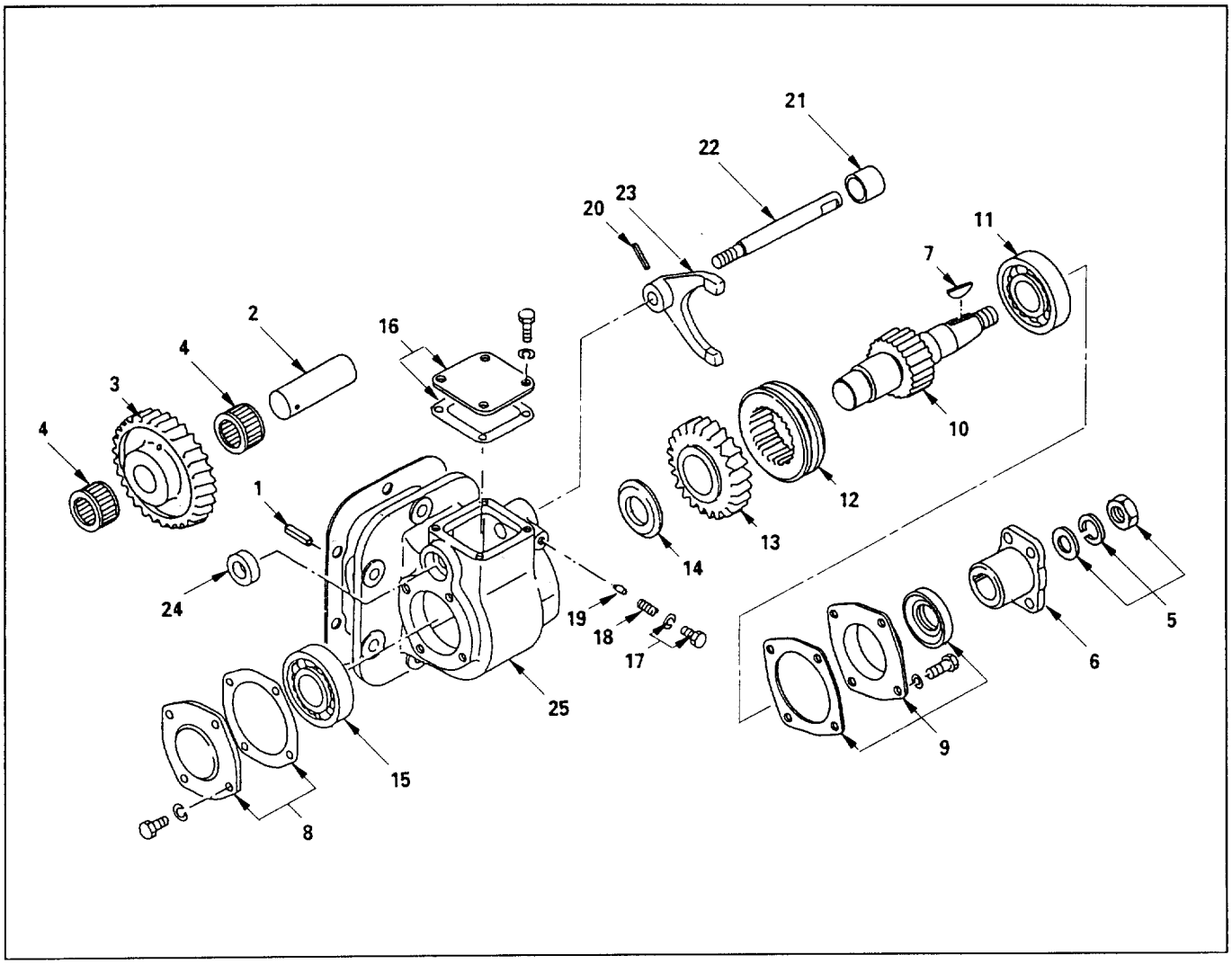
Oil Capacity	Liters(US·qt/Imp·qt)
	2.7(2.9/2.4)

CAUTION:
Use ENGINE OIL SAE 5W-30 for transmission case.

3) Install the filler plug.

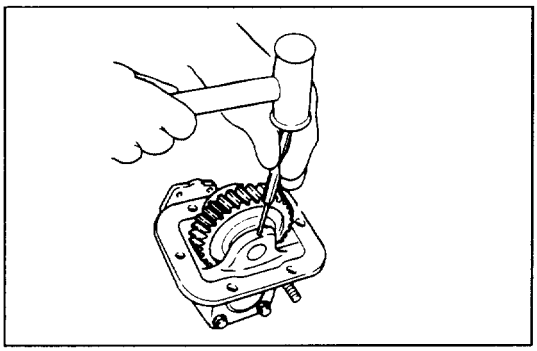
Filler Plug Toruqe	N·m(kg·m/lb·ft)
	49(5.0/36)

UNIT REPAIR



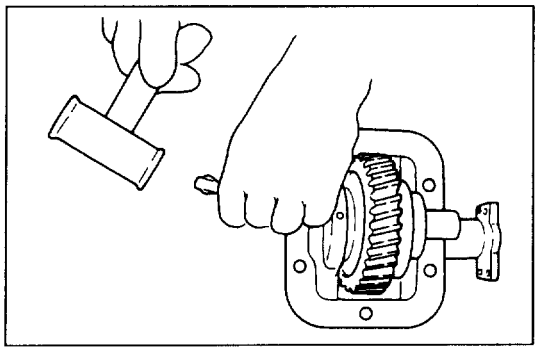
Disassembly Steps

1. Spring pin
2. Idle gear shaft
3. Idle gear
4. Needle bearing
5. Lock nut and washer
6. Coupling driver
7. Key
8. Front cover
9. Rear cover with oil seal
10. Output shaft
11. Rear bearing
12. Sleeve
13. Output gear with bushing
14. Thrust collar
15. Front bearing
16. Upper cover
17. Plug and spring washer
18. Detent spring
19. Detent pin
20. Spring pin
21. Shift rod cap
22. Shift rod
23. Shift arm
24. Shift rod oil seal
25. Gear case

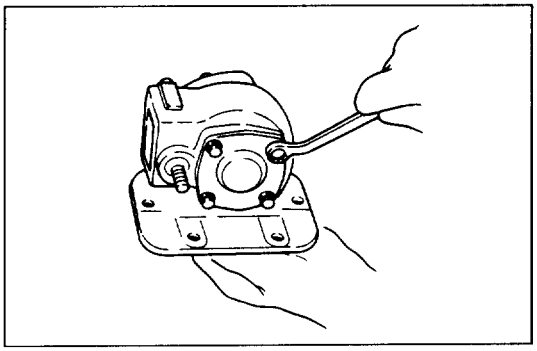


Disassembly Steps

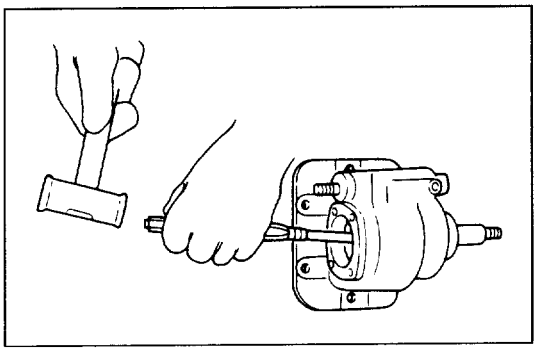
1. **Spring Pin**
   - Tap the spring pin into the idle shaft.
     Spring Pin Remover: 9-8529-2201-0



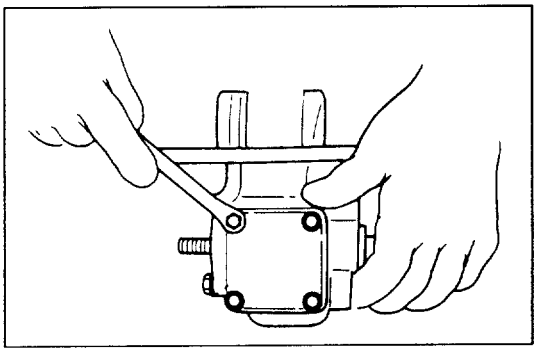
2. **Idle Gear Shaft**
   - Drive out the idle gear shaft by tapping on its front end with a suitable bar and hammer.
   - Remove the spring pin from the idle gear shaft.
     Spring Pin Remover: 9-8529-2201-0
3. **Idle Gear**
4. **Needle Bearing**
5. **Lock Nut and Washer**
   - Attach a backing plate to the vice, secure the coupling driver, and remove the lock nut, spring washer and plane washer.
6. **Coupling Driver**
7. **Key**
8. **Front Cover**

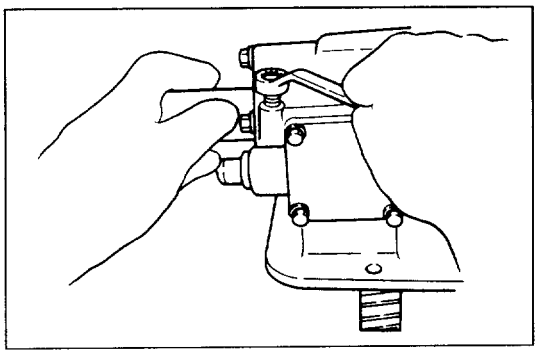


9. **Rear Cover (with Oil Seal)**
   - Remove the oil seal from the rear cover.
10. **Output Shaft**
11. **Rear Bearing**
    - Drive out the output shaft by tapping on its front end with a suitable bar and hammer.
    - Remove the rear bearing from the output shaft.

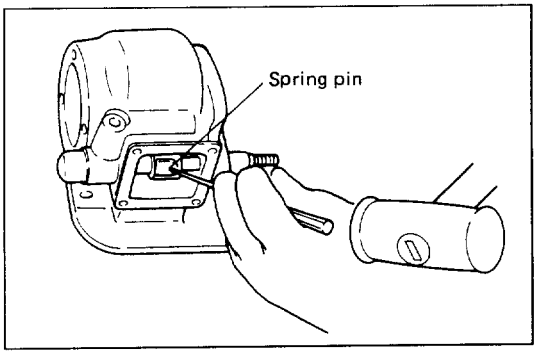


12. **Sleeve**
13. **Output Gear with Bushing**
14. **Thrust Collar**
15. **Front Bearing**
16. **Upper Cover**



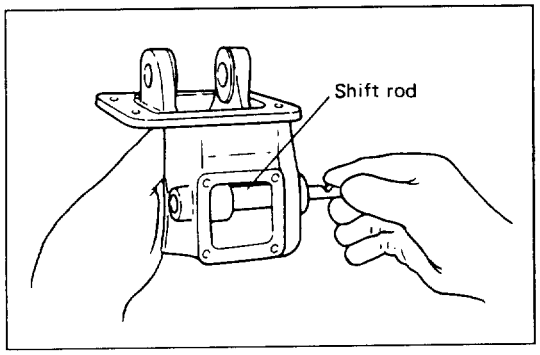


17. **Plug and Spring Washer**
18. **Detent Spring**
19. **Detent Pin**



20. **Spring Pin**

    Spring Pin Remover: 9-8529-2201-0



21. **Shift Rod Cap**
22. **Shift Rod**
23. **Shift Arm**
    - Move the shift rod rearward by tapping on its front end. then, remove the each parts.

24. **Shift Rod Oil Seal**
25. **Gear Case**

Inspection and Repair

Make the necessary adjustments, repairs and part replacement if excessive wear or damage is discovered during inspection.

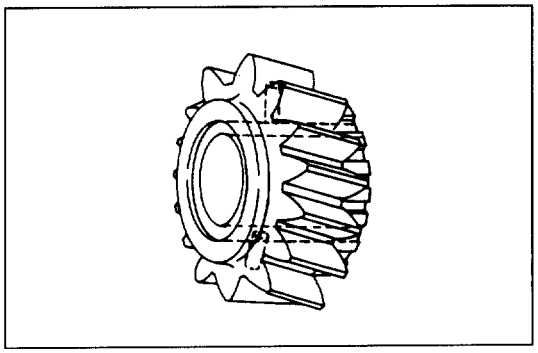
Bearings

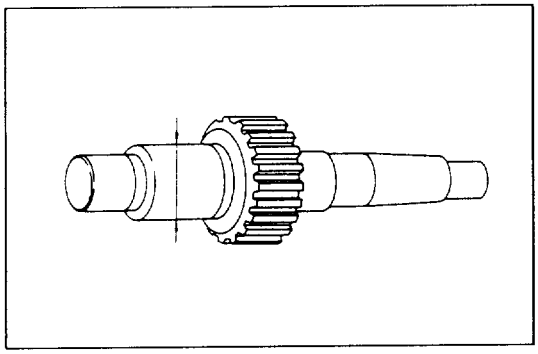
Check the each bearing, and replace in either of the following cases.

- Rotation is not smooth.
- Abnormal sound is generated.
- There is extreme damage or rust.
- Rolling element or rolling contact surface of needle roller bearing is discolored, extremely worn or pitted.

Ball Bearing Run-out	mm(in)
Limit	
0.2 (0.01)	

Gears





Check each gear for the following points. Correct a slight stepped wear or surface roughness with an oil stone or pencil grinder, or replace the gear if unrecoverable damage is found.

- Break or damage of tooth.
- Extreme wear of tooth.

Output Shaft and Output Gear Bushing Clearance	mm(in)
Limit	
0.2 (0.01)	

Idle Gear Shaft and Output Shaft

Check the shaft external surface for any damage or wear, and its spline section for wear, damage or bent.

When there is any abnormal condition found, or when it is used excessively beyond a proper use limit, replace it with new one.

Shift Mechanism

Inspect all disassembled parts for wear, damage or other abnormal conditions.

- Check the shift rod for wear, bent and damage.
- Check the shift arm for wear or deformation.

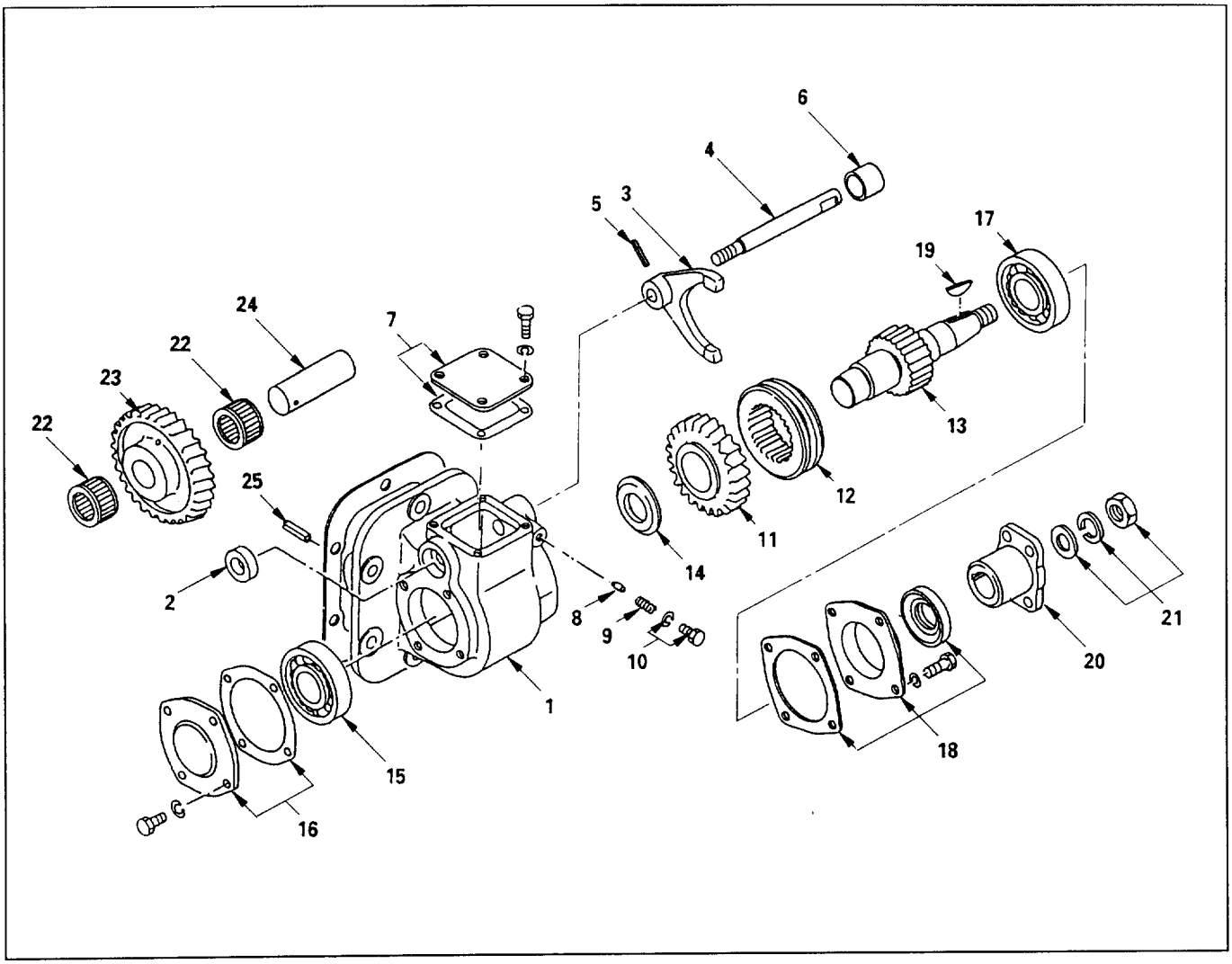
Shift Arm Thickness mm(in)

Nominal	Limit
9.0 (0.35)	8.0 (0.31)

- Check the detent spring and detent pin for wear, weakening and deformation.
- The wear of the shift rod, and the awkward operation of the gear case.

Sleeve

Check the sleeve for any abnormal conditions. Correct a slight stepped wear or surface roughness with an oil stone or pencil grinder, or replace the sleeve if unrecoverable damage is found.



Reassembly Step

1. Gear Case
2. Shift Rod Oil Seal
3. Shift Arm
4. Shift Rod
5. Spring Pin
6. Shift Rod Cap
7. Upper Cover
8. Detent Pin
9. Detent Spring
10. Plug and Spring Washer
11. Output Gear with Bushing
12. Sleeve
13. Output Shaft
14. Thrust Collar
15. Front Bearing
16. Front Cover
17. Rear Bearing
18. Rear Cover
19. Key
20. Coupling Driver
21. Lock Nut and Washer
22. Needle Bearing
23. Idle Gear
24. Idle Gear Shaft
25. Spring Pin

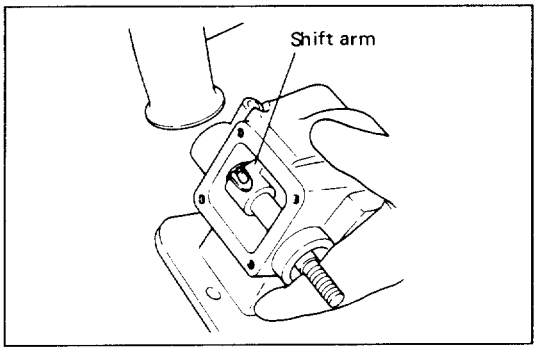
Reassembly Steps

NOTE:

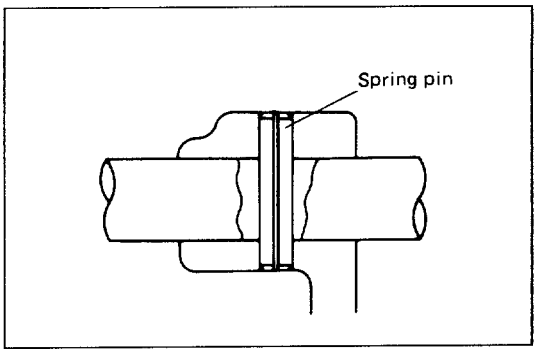
Clean each part thoroughly.

When assembling parts, apply clean engine oil (SAE 5W-30) to their sliding and mating sections.

1. **Gear Case**
2. **Shift Rod Oil Seal**
   - Clean and dry on the mating faces before applying the liquid gasket.
   - Apply liquid gasket (Three Bond 1141E or equivalent) to the new oil seal outer circumference and apply multi-purpose grease to the oil seal lip.
   - Use the oil seal installer to install the oil seal.
     Oil Seal Installer:5-8840-2065-0



3. **Shift Arm**
   - With the boss side of the shift arm set to the rear.
4. **Shift Rod**
   - Turning the detent groove to the outside (detent pin side), insert the shift rod from the front side with the detent groove side at the front.

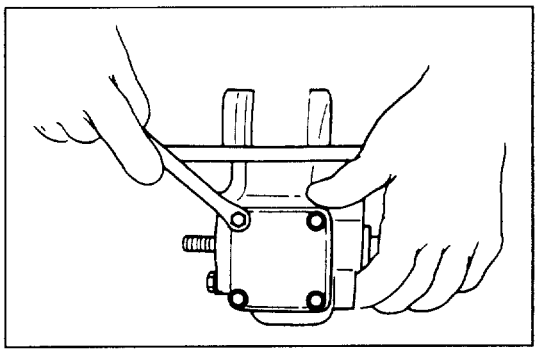


5. **Spring Pin**
   - Setting the hole of the shift arm to that of the shift rod, fix them with a new spring pin.

6. **Shift Rod Cap**
   - Clean and dry on the mating faces before applying the liquid gasket.
   - Apply liquid gasket (Three Bond 1141E or equivalent) to the cap outer circumference.
   - Use the plug installer to install the shift rod cap.
     Plug Installer: 5-8840-2067-0

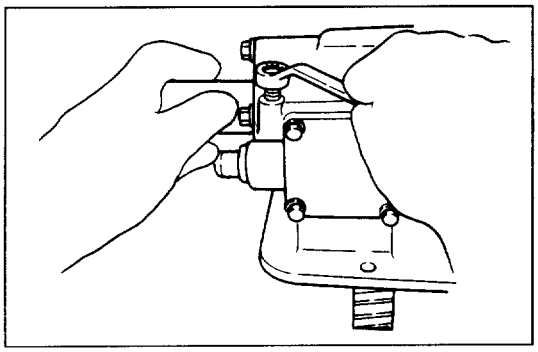
NOTE:

When there is any warp or flaw found with the shift rod cap, replace it with new one.



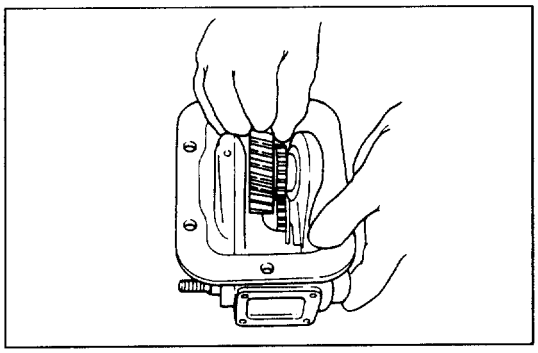
7. **Upper Cover**
   - Clean and dry on the mating faces before applying the liquid gasket.
   - Apply liquid gasket (Three Bond 1141E or equivalent) to the gear case and upper cover surfaces.
   - Install the upper cover with new gasket.

Upper Cover Bolt Torque	N·m(kg·m/lb·ft)
	18(1.8/13)



8. **Detent Pin**
9. **Detent Spring**
10. **Plug and Spring Washer**
    - Remove sealant from the plug and female threaded surfaces and the surfaces must be perfectly dry.
    - Apply liquid gasket (LOCTITE 242 or equivalent) to the plug's threaded portion.

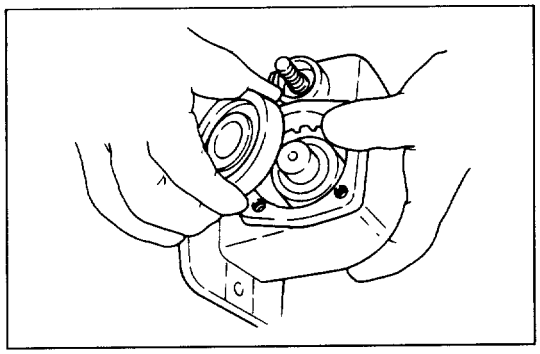
Detent Pin Plug Torque	N·m(kg·m/lb·ft)
	25(2.5/18)



11. **Output Gear with Bushing**
    - Install with the dog gear side turned to the coupling driver side (to the rear).

12. **Sleeve**
    - Chamfer face of the sleeve outer circumference should be positioned toward the coupling driver and assemble the sleeve groove to the shift arm.
13. **Output Shaft**
14. **Thrust Collar**
15. **Front Bearing**
    - Install the thrust collar and front bearing using bearing installer.

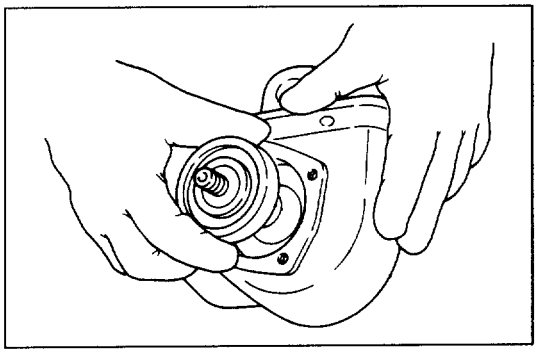
      Bearing Installer: 5-8840-2066-0



16. Front Cover

- Clean and dry on the mating faces before applying the liquid gasket.
- Apply liquid gasket (Three Bond 1141E or equivalent) to the gear case and front cover surfaces.
- Install the front cover with new gasket.
- Apply liquid gasket (LOCTITE 242 or equivalent) to the fixing bolt's threaded portion.

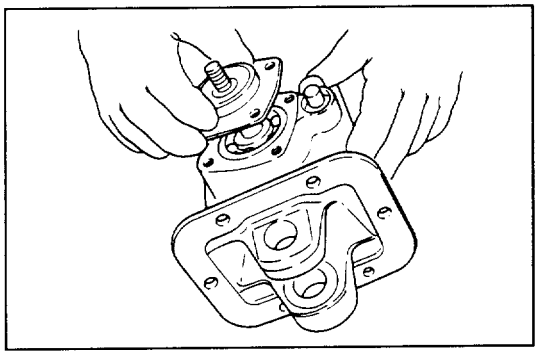
Upper Cover Bolt Torque	N·m(kg·m/lb·ft)
18(1.8/13)	



17. Rear Bearing

- Use the bearing installer to install the rear bearing.

  Bearing Installer:5-8840-2066-0

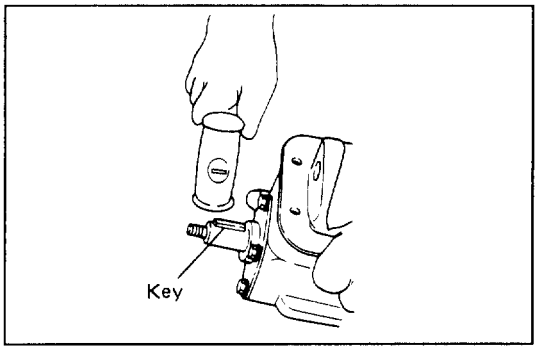


18. Rear Cover

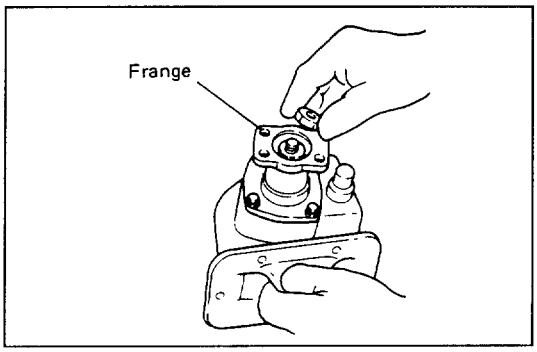
- Apply liquid gasket (Three Bond 1141E or equivalent) to the new oil seal outer circumference and apply multi-purpose grease to the oil seal lip.
- Use oil seal installer to install the oil seal to the rear cover.

  Oil Seal Installer: 5-8840-2064-0
- Apply approx. 3 grams (0.1 ounce) of the Multi-purpose with MOS2 type grease to the inside of rear cover.
- Clean and dry on the mating faces before applying the liquid gasket.
- Apply liquid gasket (Three Bond 1141E or equivalent) to the rear cover and gear case surfaces.
- Install the rear cover with new gasket.

Rear Cover Bolt Torque	N·m(kg·m/lb·ft)
18(1.8/13)	

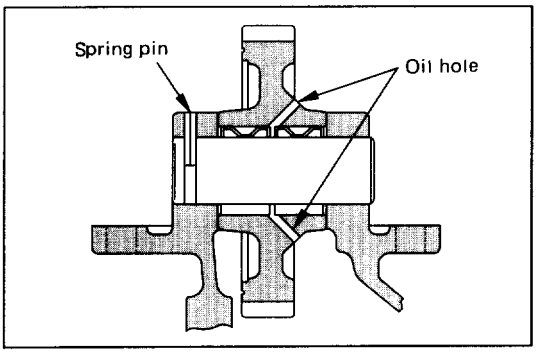


19. **Key**



20. **Coupling Driver**
21. **Lock Nut and Washer**
    - Attach a backing plate to the vice, secure the coupling driver, and tighten the lock nut.

Lock Nut Torque	N·m(kg·m/lb·ft)
	105(10.7/77)



22. **Needle Bearing**
23. **Idle Gear**
    - Install with the oil holes side turned to the rear.
24. **Idle Gear Shaft**
25. **Spring Pin**

SECTION 7C

CLUTCH

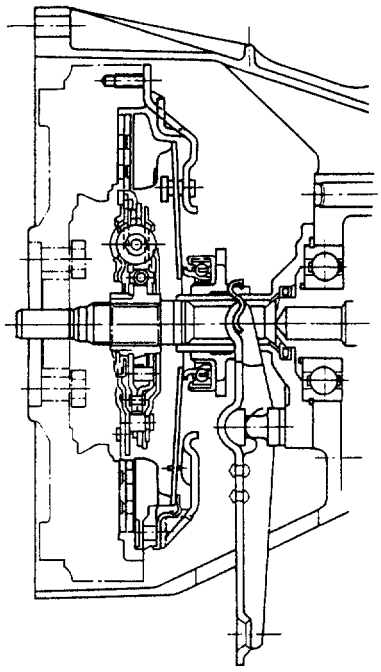
CONTENTS

PAGE

General Description 7C- 2
Clutch Assembly 7C- 2
Pressure Plate Assembly and Driven Plate 7C- 2
Master Cylinder 7C- 3
Slave Cylinder 7C- 3
On-Vehicle Service 7C- 4
Clutch Assembly 7C- 4
Removal 7C- 4
Inspection and Repair 7C- 6
Installation 7C-11
Clutch Control 7C-14
Removal 7C-14
Inspection and Repair 7C-15
Installation 7C-16
Unit Repair 7C-19
Master Cylinder 7C-19
Disassembly 7C-19
Inspection and Repair 7C-21
Reassembly 7C-22
Slave Cylinder 7C-24
Disassembly 7C-24
Inspection and Repair 7C-25
Reassembly 7C-26

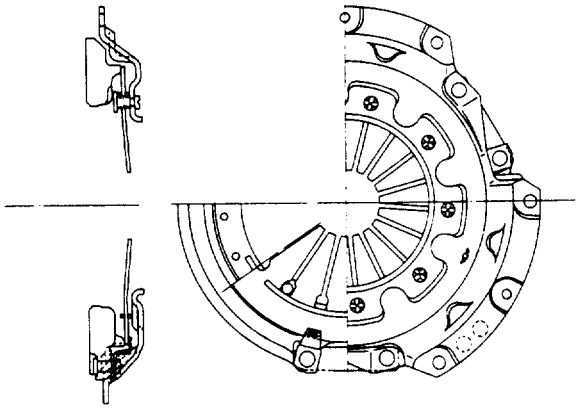
GENERAL DESCRIPTION

CLUTCH ASSEMBLY

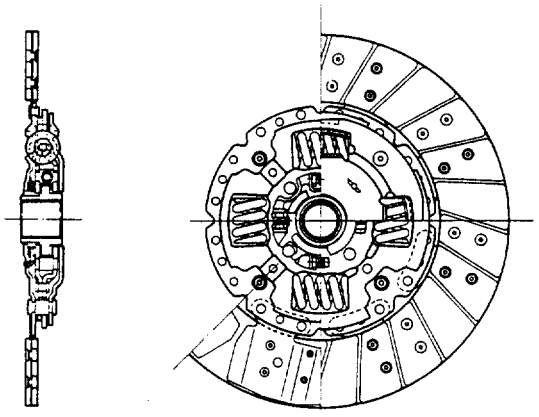


PRESSURE PLATE ASSEMBLY AND DRIVEN PLATE

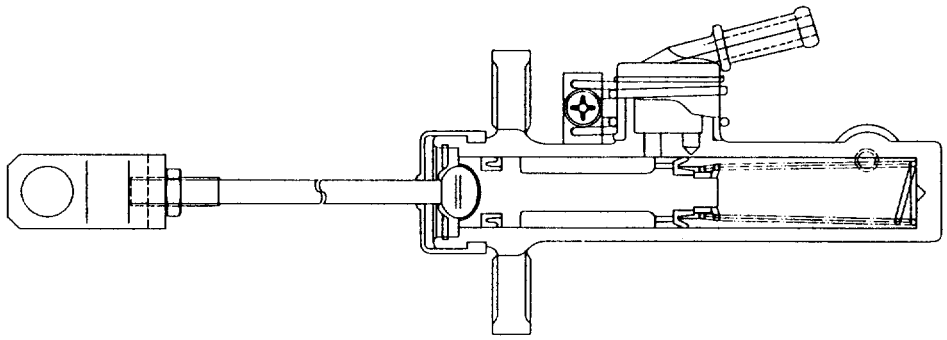
Pressure plate assembly



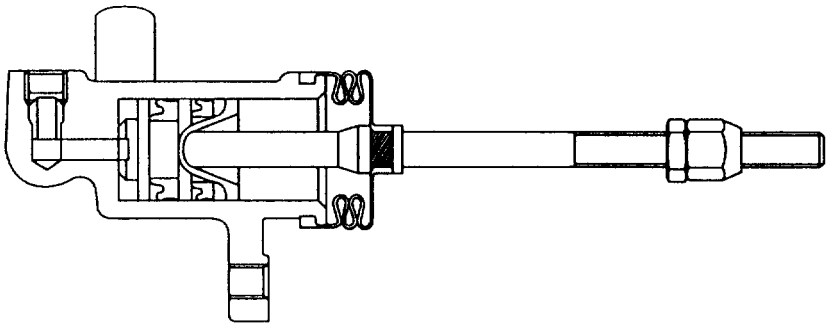
Driven plate assembly



MASTER CYLINDER



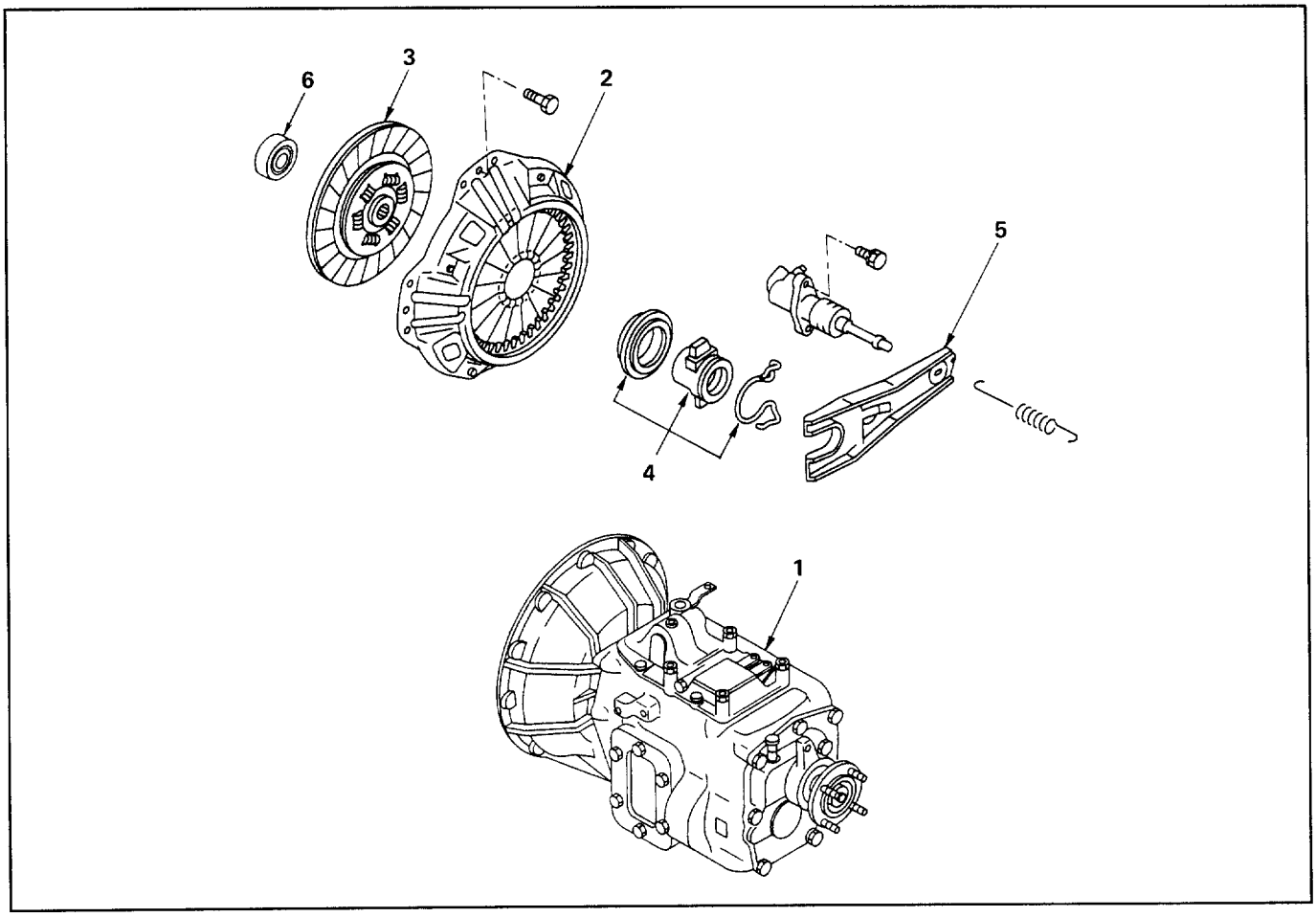
SLAVE CYLINDER



ON-VEHICLE SERVICE

CLUTCH ASSEMBLY

REMOVAL



Removal Steps

1. Transmission asembly
2. Pressure plate assembly
3. Driven plate assembly
4. Shift block assembly
5. Shift fork
6. Pilot bearing

Removal Steps

- Raise vehicle and support with suitable safety stands.

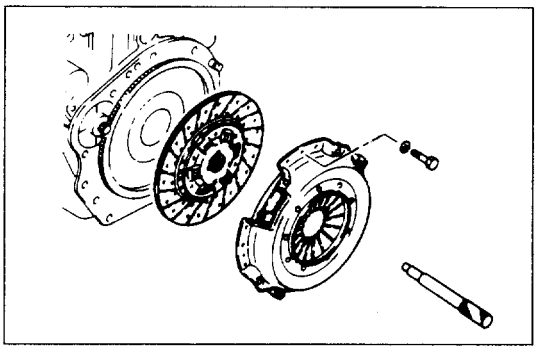
CAUTION:

Do not let clutch fluid remain on a painted surface. Wash it off immediately.

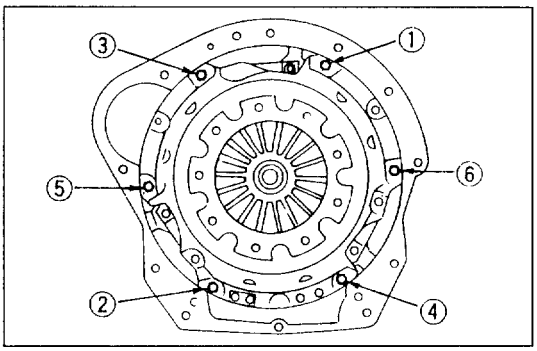
1. **Transmission Assembly**

   Refer to "SECTION 7B ON-VEHICLE SERVICE: TRANSMISSION ASSEMBLY REPLACEMENT" in this manual.

2. **Pressure Plate Assembly**
3. **Driven Plate Assembly**

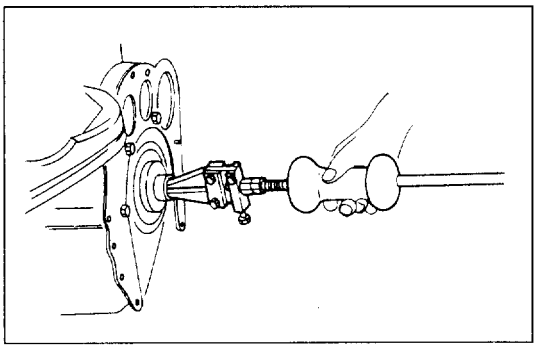


- Use the pilot aligner to prevent the driven plate assembly from falling free.
  Pilot Aligner: 5-8525-3001-0
- Mark the flywheel and pressure plate lug for alignment when installing.



- Loosen the pressure plate assembly fixing bolts in the numerical order shown in the illustration.

4. **Shift Fork**
5. **Shift Block Assembly**
   - Take out the shift block and support spring together.



6. **Pilot Bearing**

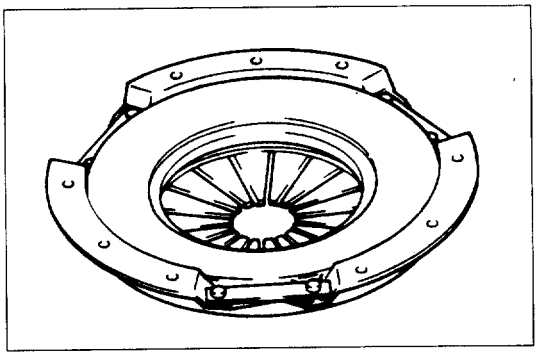
NOTE:

Do not remove pilot bearing when unless absolutely necessary.

- Use the pilot bearing remover to remove the pilot bearing.
  Pilot Bearing Remover : 5-8840-2000-0
  Sliding Hammer : 5-8840-0084-0

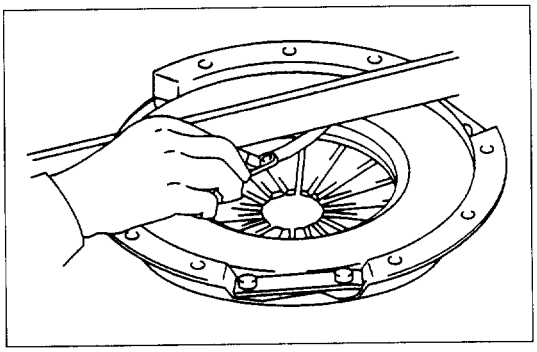
INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacement if excessive wear or damage is discovered during inspection.



Pressure Plate Assembly

- Visually inspect the pressure plate friction surface for excessive wear and heat cracks. If excessive wear or deep heat cracks are present, the pressure plate assembly must be replaced.

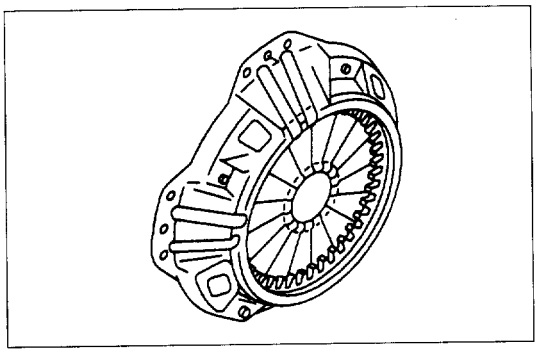


Pressure Plate Warpage

- Use a straight edge and a feeler gauge to measure the pressure plate friction surface flatness in four directions.

  If any of the measured values exceed the specified limit, the pressure plate assembly must be replaced.

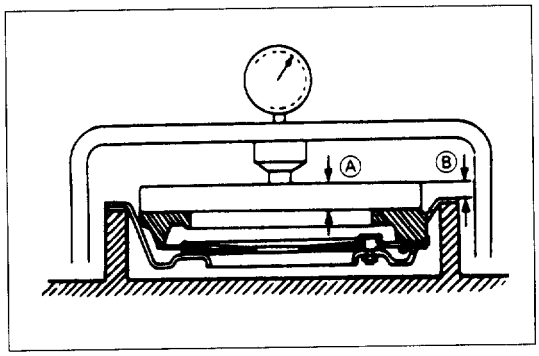
Pressure Plate Warpage	mm (in)
Limit	
0.3 (0.01)	



Clutch Cover

- Visually inspect the entire clutch cover for excessive wear, cracking, and other damage.

  The Pressure plate assembly must be replaced if any of these conditions are present.



Clutch Set Force

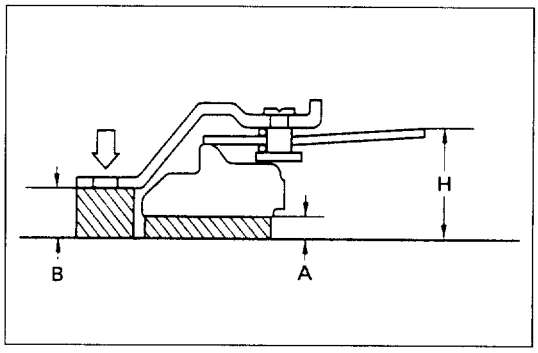
1) Invert the pressure plate assembly.
2) Place a metal sheet with "A" thickness of 8.0 mm (0.31 in) on the pressure plate.
3) Compress the pressure plate assembly until the distance "B" becomes specified.

Thickness and Distance		mm (in)
	A	B
NHR55, HKR55	7.4 (0.29)	18 (0.71)
NHR69, NKR69, NPR69	8.0 (0.31)	18 (0.71)
NKR17	8.0 (0.31)	4 (0.16)

4) Note the pressure plate gauge reading.

Clutch Set Force — N (kg/lb)

	Nominal	Limit
NHR55, NKR55	4,119 (420/926)	3,785 (386/851)
NHR69, NKR69, NPR69	6,276 (640/1,411)	5,776 (589/1,299)
NKR17	5,492 (560/1,235)	5,050 (515/1,136)



Diaphragm Spring Finger Height

1) Place distance pieces beneath the pressure plate and clutch cover.

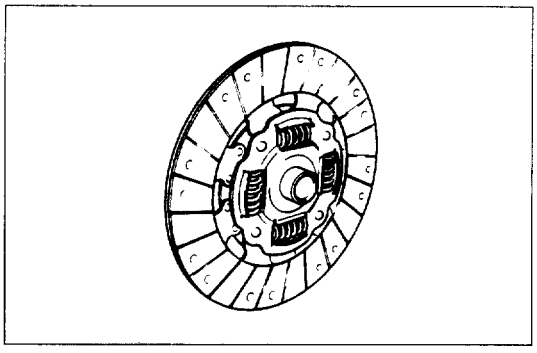
Distance Piece — mm (in)

	A	B
NHR55, NKR55	7.4 (0.29)	18 (0.71)
NHR69, NKR69, NPR69	8.0 (0.31)	18 (0.71)
NKR17	8.0 (0.31)	4 (0.16)

2) Fully compress the pressure plate assembly.
   There are two ways to do this.
   a. Use a bench press to press down on the pressure plate assembly from the top.
   b. Tighten the pressure plate assembly fixing bolts.
3) Measure the spring finger height from base to spring tip.

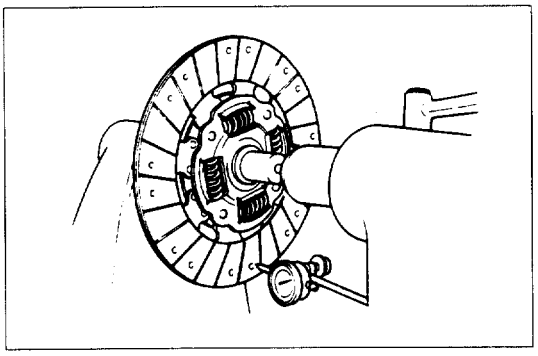
Spring Finger Height (H) — mm (in)

	Standard
NHR55, NKR55	: 40.7-42.7 (1.60-1.68)
NHR69, NKR69, NPR69	: 39.0-41.0 (1.54-1.61)
NKR17	: 37.5-39.5 (1.48-1.56)



Driven Plate Assembly

- Visually inspect the torsion spring for looseness, breakage, and weakening.
  If any of these conditions are discovered, the driven plate assembly must be replaced.
- Visually inspect the facing surfaces for cracking and excessive scorching.
  Visually inspect the facing surfaces for the presence of oil or grease.
  If any of these conditions are discovered, the facing must be cleaned or the driven plate assembly replaced.
- Check that the driven plate moves smoothly on the transmission top gear shaft spline.
  Minor ridges on the top gear shaft spline may be removed with an oil stone or pencil grinder.



Driven Plate Warpage

- Insert the pilot aligner into the driven plate spline hub.

  The pilot aligner must be held perfectly horizontal.

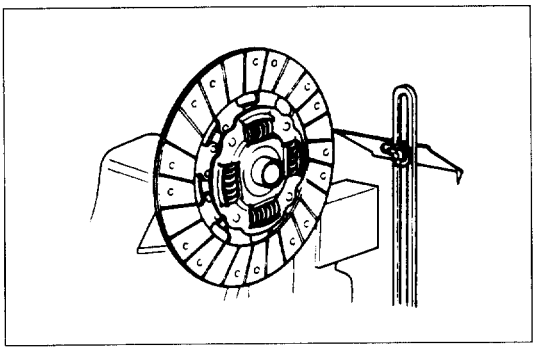
  Pilot Aligner : 5-8525-3001-0
- Set a dial indicator to the driven plate outside circumference.
- Slowly turn the driven plate.

  Read the dial indicator as you turn the driven plate.

  If the measured value exceeds the specified limit, the driven plate assembly must be replaced.

Driven Plate Warpage — mm (in)

Standard	Limit
Less than 0.7 (0.03)	1.0 (0.04)



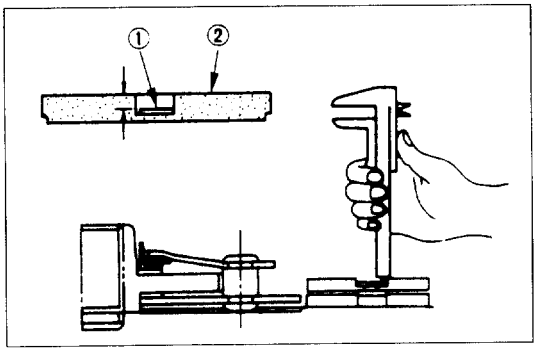
Driven Plate Splined Hub Spline Ware

- Clean the driven plate splined hub.
- Install the driven plate to the transmission top gear shaft spline.
- Set a surface gauge to the driven plate outside circumference.
- Slowly turn the driven plate. Measure the spline rotation play as you turn the driven plate.

  If the measured value exceeds the specified limit, the driven plate assembly must be replaced.

Driven Plate Splined Hub Spline Wear — mm (in)

Standard	Limit
Less then 0.5 (0.02)	1.0 (0.04)



Driven Plate Rivet Head Depression

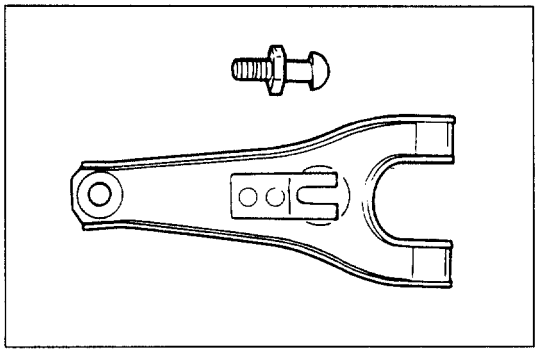
- Use the depth gauge or a straight edge with steel rule to measure the rivet head depression from the facing surface.

  Be sure to measure the rivet head depression on both sides of the driven plate.

  If the measured value is less than the specified limit, the driven plate mest be replaced.

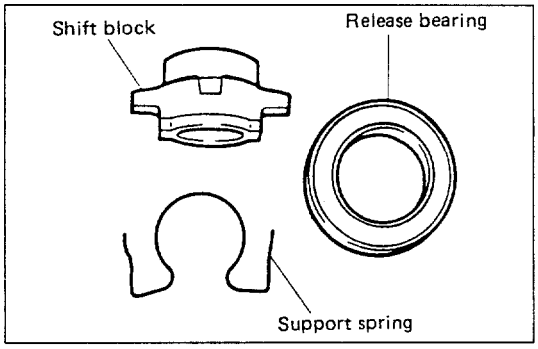
Rivet Head Depression — mm (in)

	A	B
NHR55, NKR55	1.1-1.7 (0.04-0.07)	0.2 (0.01)
NKR17, NHR69, NKR69, NPR69	1.3-1.9 (0.05-0.08)	0.2 (0.01)



Shift Fork and Support Bolt

- Visually inspect the surfaces of the shift fork making contact with the shift block and support bolt.
- Correct a slight stepped wear or surfaces roughness with an oil stone or pencil grinder, or replace the shift fork and/or support bolt if unrecoverable damage is found.



Shift Block Assembly

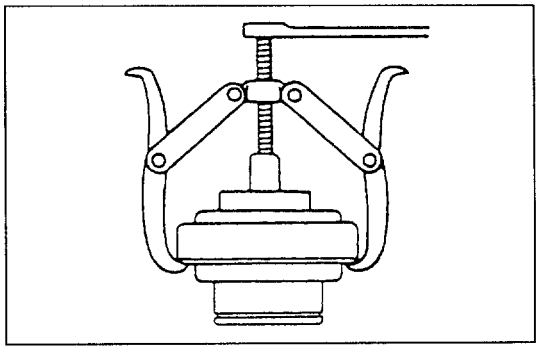
- Before disassembly, check the shift block assembly for the following point. Correct a slight stepped wear or surface roughness with an oil stone or pencil grinder, or replace the part if unrecoverable damage is found.
  a. Release bearing for roughness or noise by rotating the bearing race under light pressure.
  b. Roughness or damage of shift block (contact surfaces with shift fork or front cover).

CAUTION:

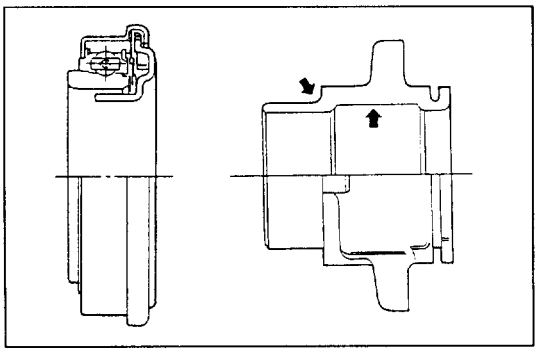
The release bearing is permanently packed with lubricant and should not be soaked in cleaning solvent, as this will dissolve the lubricant.

NOTE:

Do not disassemble the shift block assembly if no fault is apparent.



- Use the bearing remover and bench press to remove the release bearing.
  Bearing Remover : 5-8840-0013-0

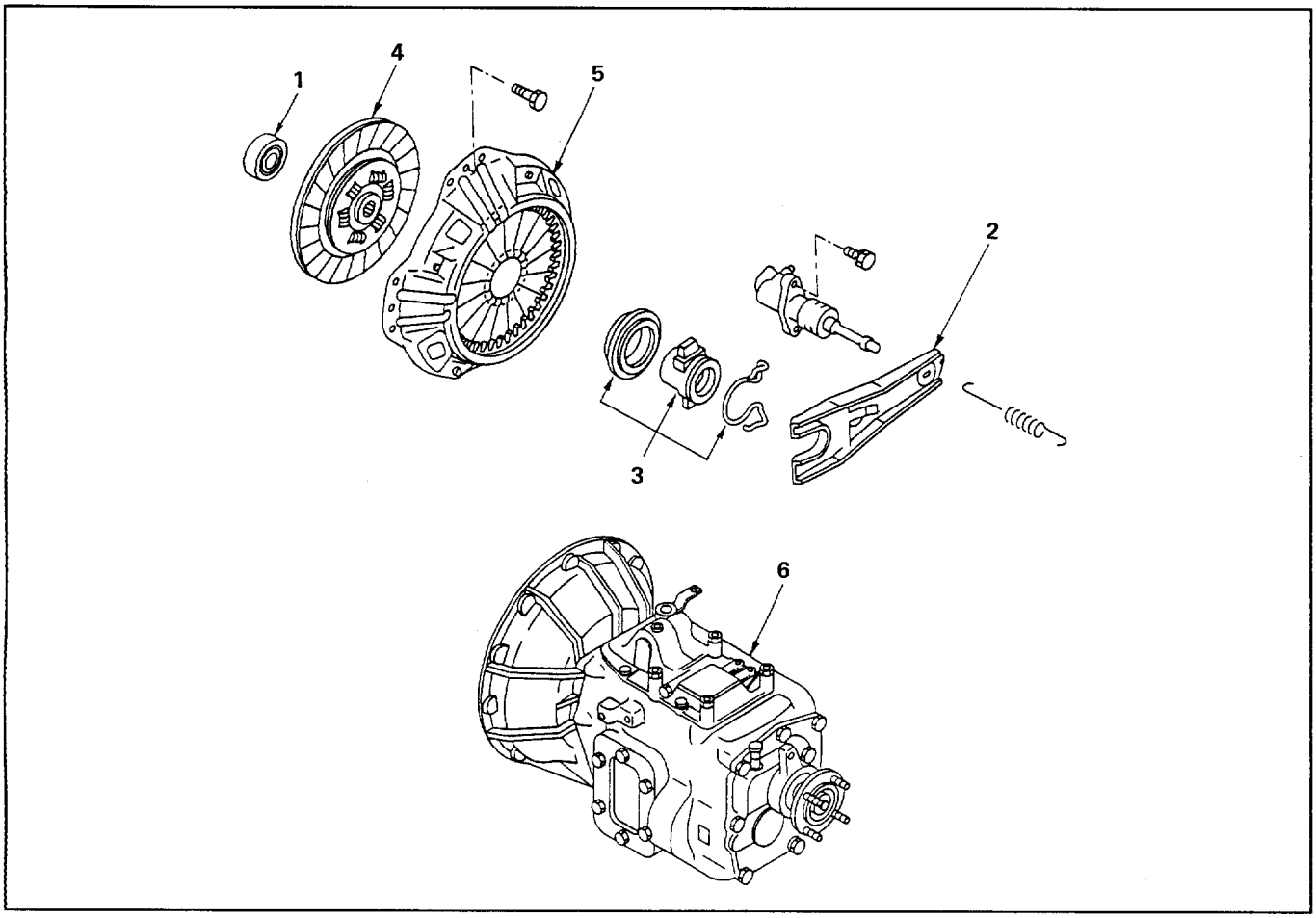


- Install the parts as shown after applying multi-purpose with MOS2 type grease.
  Use a bench press.

Support Spring

- Visually inspect the support spring for breakage and weakening.
- If any of these condition are discoverd, parts must be replaced.

INSTALLATION

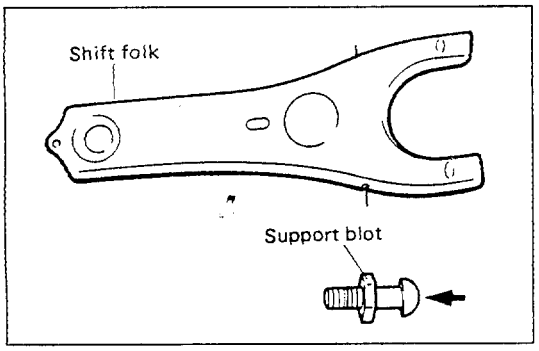


Installation Steps

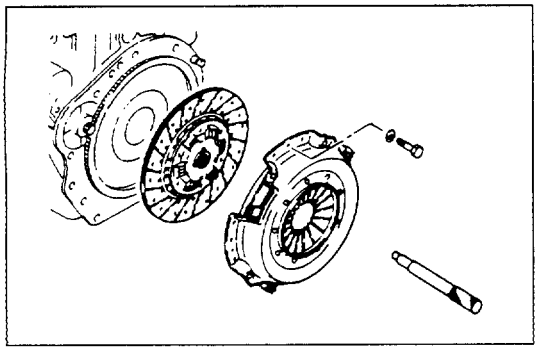
1. Pilot bearing
2. Shift fork
3. Shift block assembly
4. Driven plate assembly
5. Pressure plate assembly
6. Transmission assembly

Installation Steps

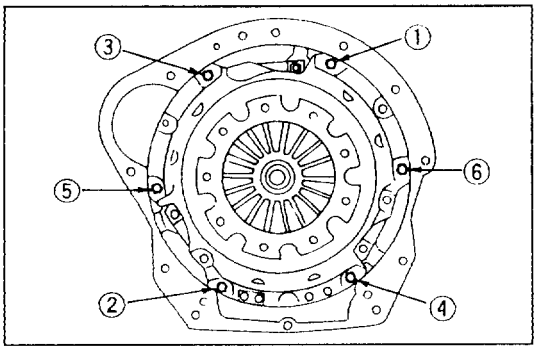
1. **Pilot Bearing**
   - Use the pilot bearing installer to install the clutch pilot bearing.
     Pilot Bearing Installer: 5-8522-0024-0
2. **Shift Block Assembly**
   - Install the shift block and support spring together.



3. **Shift Fork**
   - Apply multi-purpose with MOS2 type grease to the contact surfaces with the shift block and support bolt head.



4. **Driven Plate Assembly**
   - Apply multi-purpose with MOS2 type grease to the driven plate hub spline.
   - Use the pilot aligner to install the driven plate assembly.
     Pilot Aligner : 5-8525-3001-0



5. **Pressure Plate Assembly**
   - Tighten pressure plate assembly fixing bolts in numerical order.

Pressure Plate Fixing Bolt Torque	N·m (kg·m/lb·ft)
18 (1.8/13)	

   - Remove the pilot aligner.

NOTE:

In case a new pressure plate assembly is mounted, after tightening a pressure plate at the specified torque, be sure to remove the wire for protection of a diaphragm spring.

6. **Transmission Assembly**

   Refer to "SECTION 7B ON-VEHICLE SERVICE: TRANSMISSION ASSEMBLY REPLACEMENT" in this manual.

Clutch Housing to Flywheel Housing Bolts Torque	N·m (kg·m/lb·ft)
M10 : 46 (4.7/34) M12 : 91 (9.3/67)	

Engine Rear Mounting Nuts and Bolts Torque	N·m (kg·m/lb·ft)
M10 : 40 (4.1/30) M12 : 69 (7.0/51)	

Front Exhaust Pipe Bolts Torque	N·m (kg·m/lb·ft)
37 (3.8/27)	

Exhaust Brake Bolts Torque	N·m (kg·m/lb·ft)
17 (1.7/12)	

Slave Cylinder Bolts Torque	N·m (kg·m/lb·ft)
16 (1.6/12)	

Perform slave cylinder adjustment before installation of the return spring.

1) Loosen the lock nut of the push rod.
2) Turn the adjust nut until it reaches the shift fork.
3) Back off the adjust nut 1.5 turns (shift fork free play Approximately 2 mm/0.1 in).
4) Tighten the lock nut.

Push Rod Lock Nut Torque	N·m (kg·m/lb·ft)
19 (1.9/14)	

Wiring Connector Color

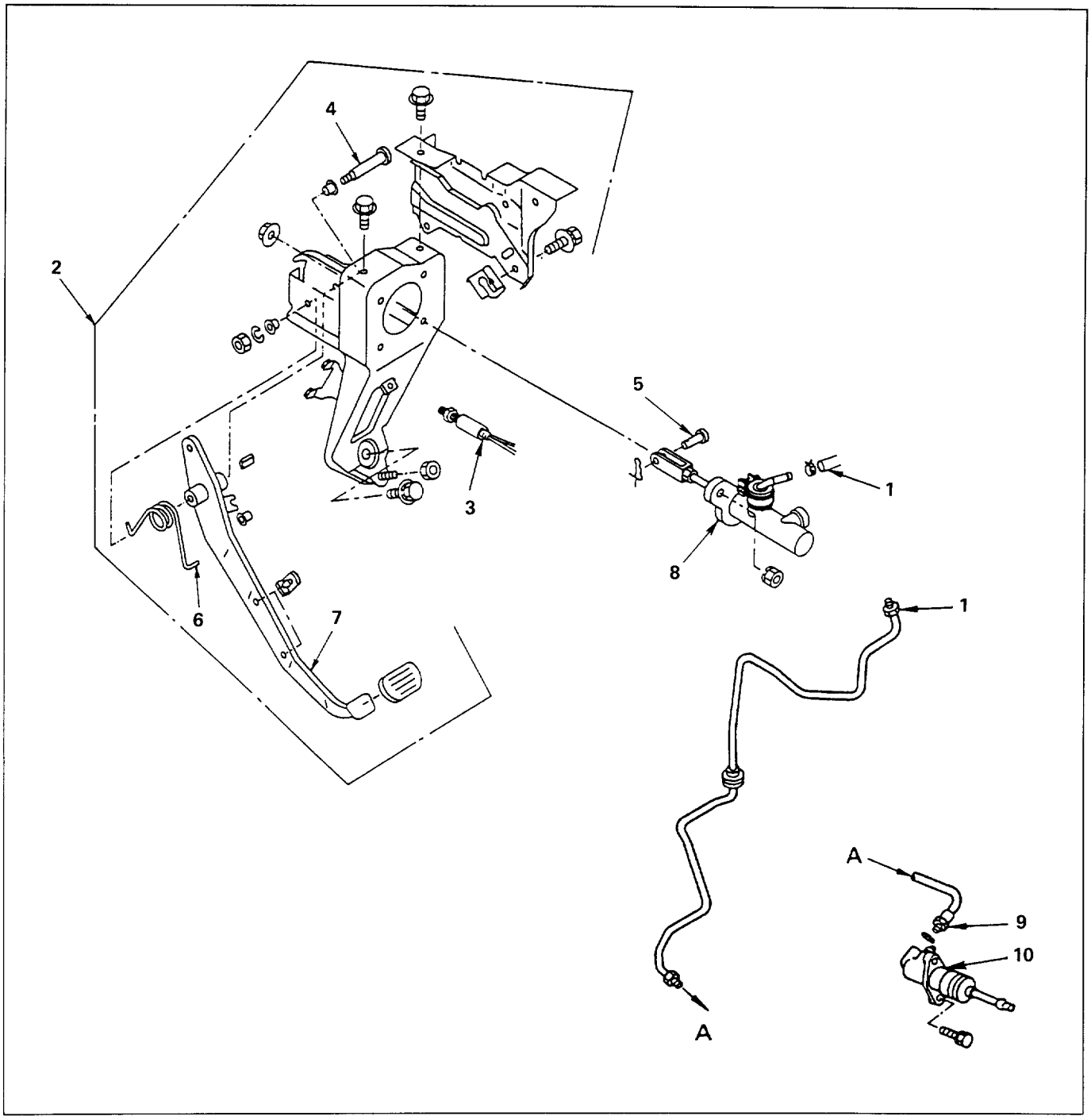
Back-up Light Switch :Brown

Neutral Switch :Gray

Propeller Shaft Nuts Torque	N·m (kg·m/lb·ft)
66 (6.7/48)	

CLUTCH CONTROL

REMOVAL



Removal Steps

1. Clutch pipe and hose
2. Clutch pedal and bracket assembly
3. Clutch switch or stopper bolt
4. Shaft
5. Crevis pin
6. Return spring
7. Clutch pedal
8. Master cylinder
9. Flexible hose
10. Slave cylinder

Preparation

1. **Meter Cluster**
   - Pull out the meter cluster and disconnect the harness connectors.
2. **Meter Assembly**
   - Remove the 5 fixing screws, then remove the meter assembly and disconnect the harness connector.

Removal Steps

- Drain the clutch fluid from the clutch hydraulic line.

CAUTION:

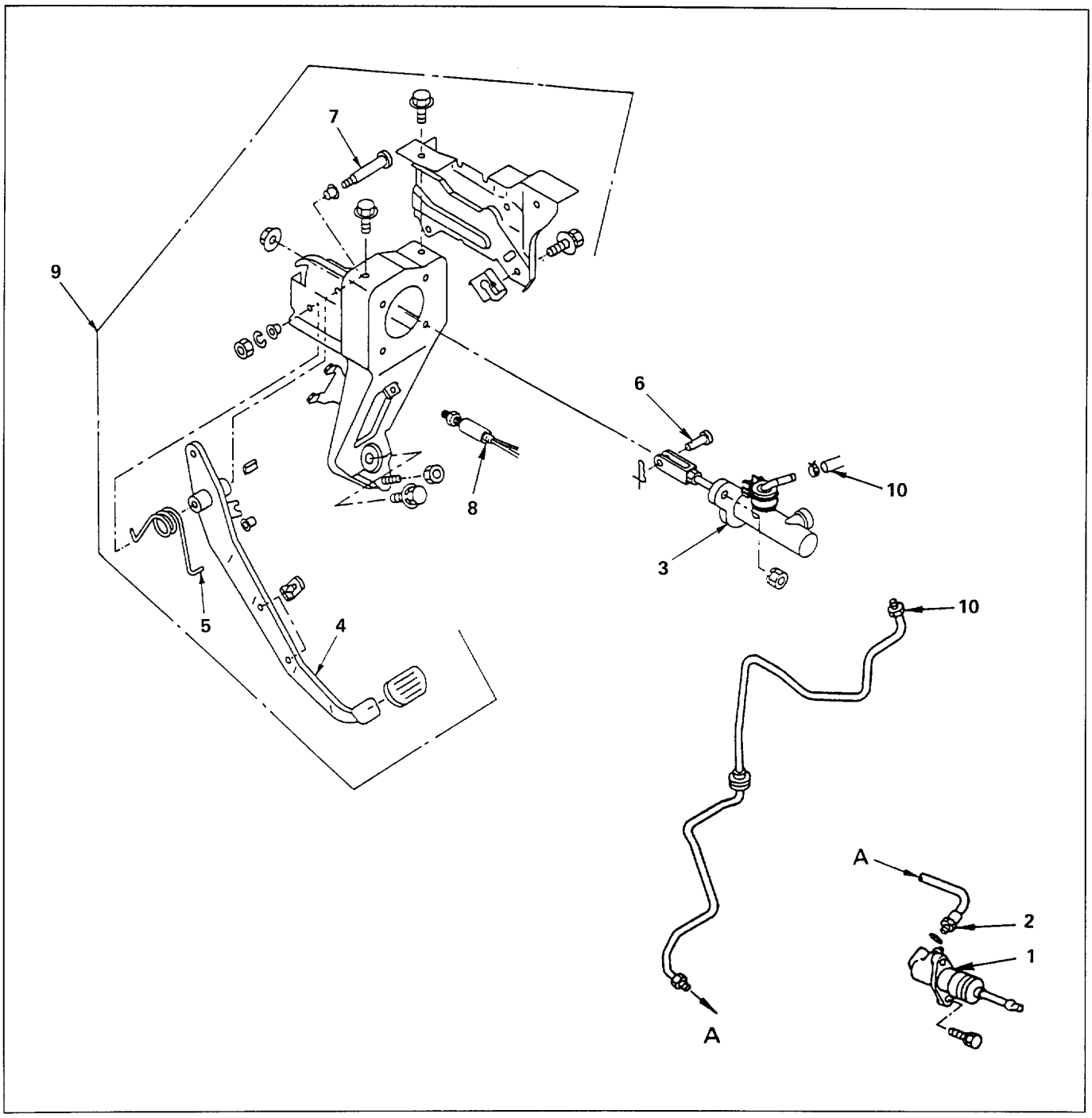
Do not let clutch fluid remain on a painted surface. Wash it off immediately.

1. **Clutch Pipe and Hose**
2. **Clutch Pedal and Bracket Assembly**
3. **Clutch Switch or Stopper Bolt**
4. **Shaft**
5. **Crevis Pin**
6. **Return Spring**
7. **Clutch Pedal**
8. **Master Cylinder**
9. **Flexible Hose**
10. **Slave Cylinder**

INSPECTION AND REPAIR

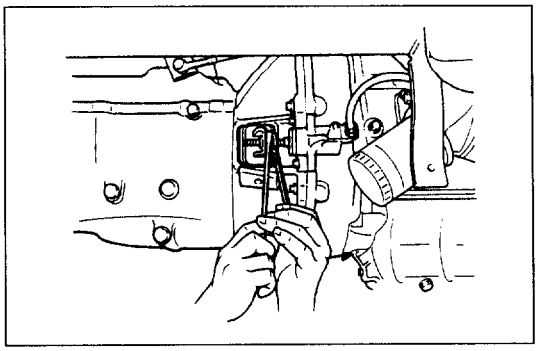
Make the necessary adjustment, repairs, and part replacement if excessive wear or damage is discovered during inspection.

INSTALLATION



Installation Steps

1. Slave cylinder
2. Flexible hose
3. Master cylinder
4. Clutch pedal
5. Return spring
6. Crevis pin
7. Shaft
8. Clutch switch or stopper bolt
9. Clutch pedal and bracket assembly
10. Clutch pipe and hose



Installation Steps

1. **Slave Cylinder**

Slave Cylinder Bolt Torque	N·m (Kg·m/lb·ft)
19 (1.9/14)	

- Perform slave cylinder adjustment before installation of the return spring.

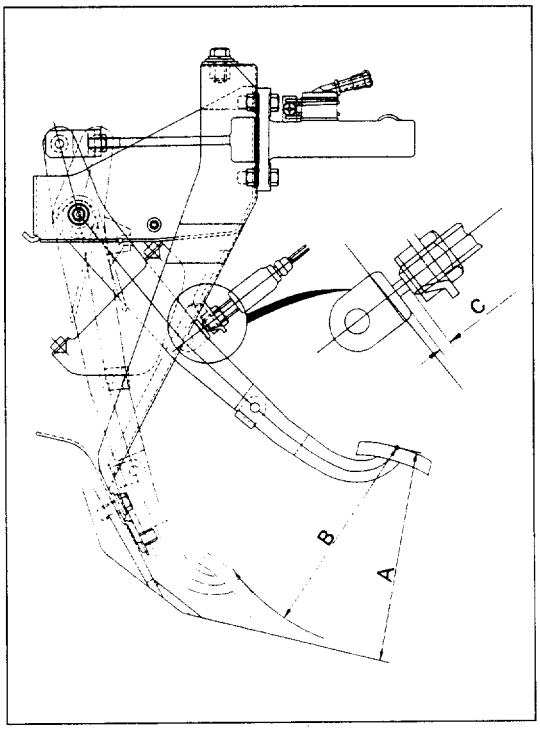
1) Loosen the lock nut of the push rod.
2) Turn the adjust nut until it reaches the shift fork.
3) Back off the adjust nut 1.5 turns. (shift fork free play approximately 2 mm/0.1 in).
4) Tighten the lock nut.

Push Rod Lock Nut Torque	N·m (kg·m/lb·ft)
16 (1.6/12)	

2. **Flexible Hose**
3. **Master Cylinder**
   - Install the master cylinder assembly to the clutch pedal bracket.

Fixing Nuts Torque	N·m (kg·m/lb·in)
13 (1.3/113)	

4. **Clutch Pedal**
5. **Return Spring**
6. **Crevis Pin**
7. **Shaft**
8. **Clutch Switch or Stopper Bolt**
9. **Clutch Pedal and Bracket Assembly**



Clutch Bracket Bolts Torque	N·m(kg·m/lb·ft)
37 (3.8/27)	

- Perform the clutch pedal adjustment after installation of clutch control.

Clutch Pedal Height and Stroke

1) Loosen the lock nut of the master cylinder push rod.
2) Adjust the pedal height by turning the push rod.

Clutch Pedal Height and Stroke	mm (in)
Height(A) : 160-170 (6.3-6.7) Stroke(B) : 159-169 (6.2-6.7)	

3) Tighten the lock nut.

Lock Nut Torque	N·m(kg·m/lb·in)
13 (1.3/113)	

4) Install the meter assembly and meter cluster.

Clutch Pedal Free Play

Clutch Switch or Stopper Bolt

After completion of clutch pedal height and slave cylinder adjustment, adjust the clutch switch or stopper bolt clearance.

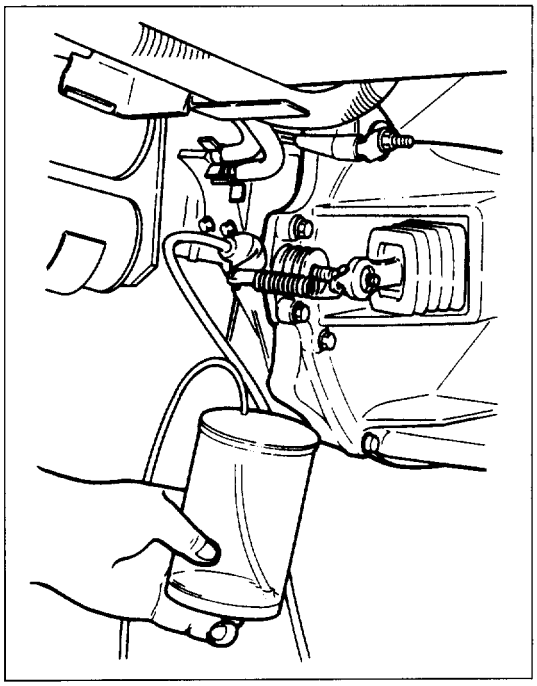
1) Loosen the lock nut of clutch switch or stopper bolt.
2) Adjust the clutch switch or stopper bolt clearance by turning clutch switch or stopper bolt.

Clutch Switch or Stopper Bolt Clearance (C)	mm (in)
0.5-1.0 (0.02-0.04)	

Clutch Pedal Free Play	mm (in)
15-25 (0.6-1.0)	

3) Tighten the lock nut.

Lock Nut Torque	N•m (kg•m/lb•ft)
19 (1.9/14)	



10. Clutch Pipe and Hose

- Perform the clutch hydraulic circuit bleeding after installation of the clutch control.

  Bleeding operation calls for cooperative action of two men.

1) Check the level of clutch fluid in the reservoir and replenish of necessary.
2) Remove the rubber cap from the bleeder screw and wipe clean the bleeder screw.

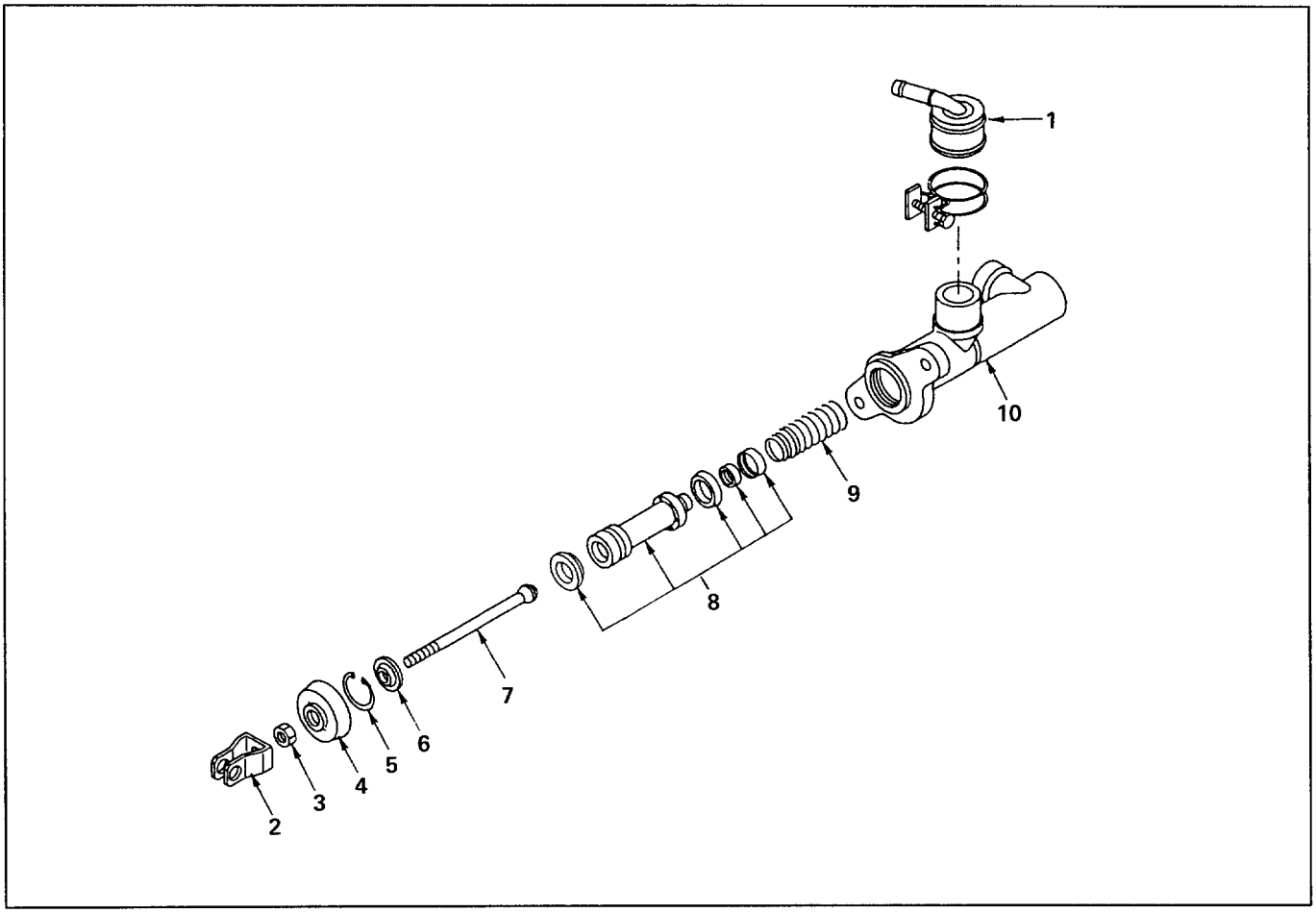
   Connect a vinyl tube to the bleeder screw and insert the other end of the vniyl tube into a transparent container.
3) Pump the clutch pedal repeatedly and hold it depressed.
4) Loosen the bleeder screw on the clutch slave cylinder to release clutch to release clutch fluid with air bubbles into the container and tighten the bleeder screw immediately.
5) Release the clutch pedal carefully. Repeat the above operation until air bubbles disappear from the clutch fluid being pumped out into the container. During the bleeding operation, keep the clutch fluid reservoir filled to the specified level.

   Reinstall the rubber cap.

UNIT REPAIR

MASTER CYLINDER

DISASSEMBLY



Disassembly Steps

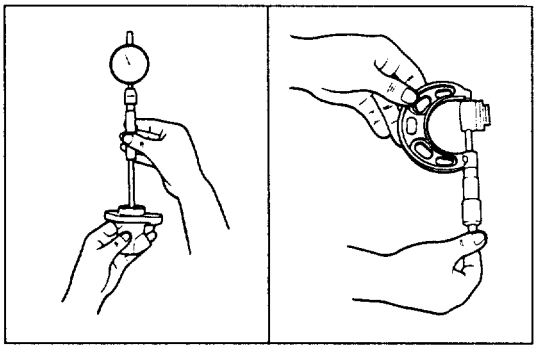
1. Pipe joint
2. Crevis yoke
3. Lock nut
4. Dust cover
5. Snap ring
6. Stopper
7. Push rod
8. Piston assembly
9. Return spring
10. Cylinder body

Disassembly Step

1. **Pipe Joint**
2. **Crevis Yoke**
3. **Lock Nut**
4. **Dust Cover**
5. **Snap Ring**
   - Press down the piston with your finger to prevent it from jumping out.
6. **Stopper**
7. **Push Rod**
8. **Piston Assembly**
9. **Return Spring**
10. **Cylinder Body**

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and parts replacements if excessive wear or damage is discovered during inspection.



Cylinder Body

- Wash clean the cylinder body in brake fluid.
- Check the fluid return port for restrictions and clean it if necessary.
- Measure the cylinder bore diameter.

Master Cylinder Bore Diameter — mm (in)

Standard
ø 19.050-19.102 (0.7500-0.7520)

Clearance between Cylinder Bore and Piston Clearance — mm (in)

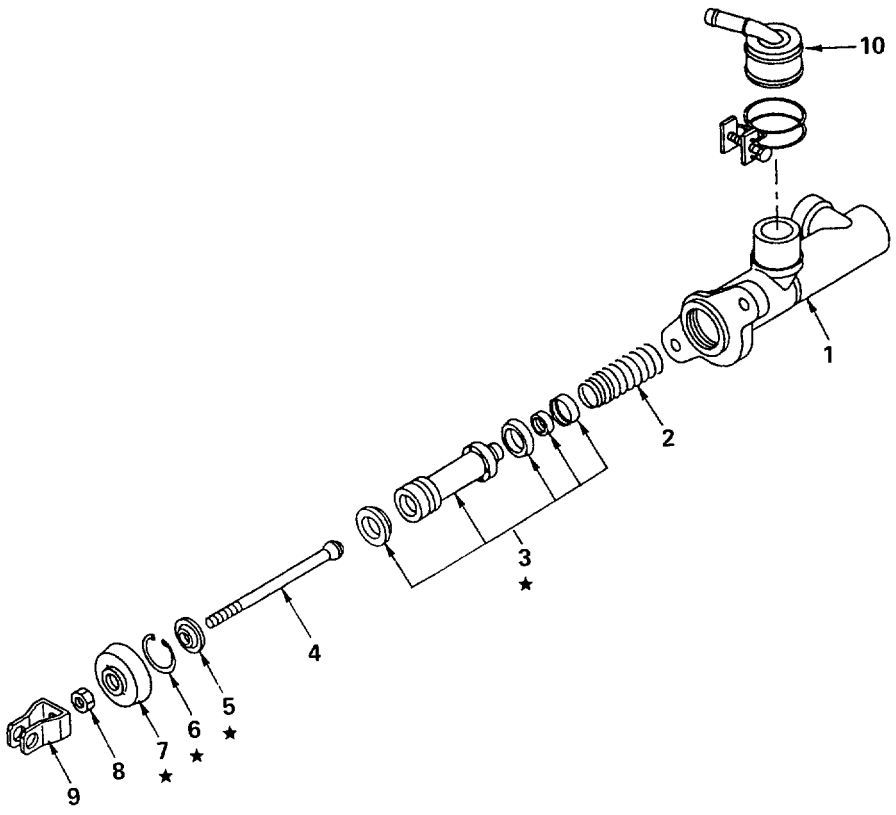
Standard	Limit
0.03-0.11 (0.001-0.004)	0.12 (0.005)

- If excessive wear or any abnormal conditions are present, the master cylinder assembly must be replaced with new one.

CAUTION:

If the master cylinder has been disassembled, the repair kit must be replaced with new one.

REASSEMBLY



★ Indicates repair kit

Reassembly Steps

1. Cylinder body
2. Return spring
3. Piston assembly
4. Push rod
5. Stopper
6. Snap ring
7. Dust cover
8. Lock nut
9. Crevis yoke
10. Pipe joint

Reassembly Steps

1. **Cylinder Body**
   - Immerse the cylinder body in clean brake fluid.
2. **Return Spring**
   - Install the return spring to the piston assembly.
3. **Piston Assembly**
   - Before installing, apply a thin coat of rubber grease to the piston.

CAUTION:

Use care to prevent damaging the lip of the piston cup.

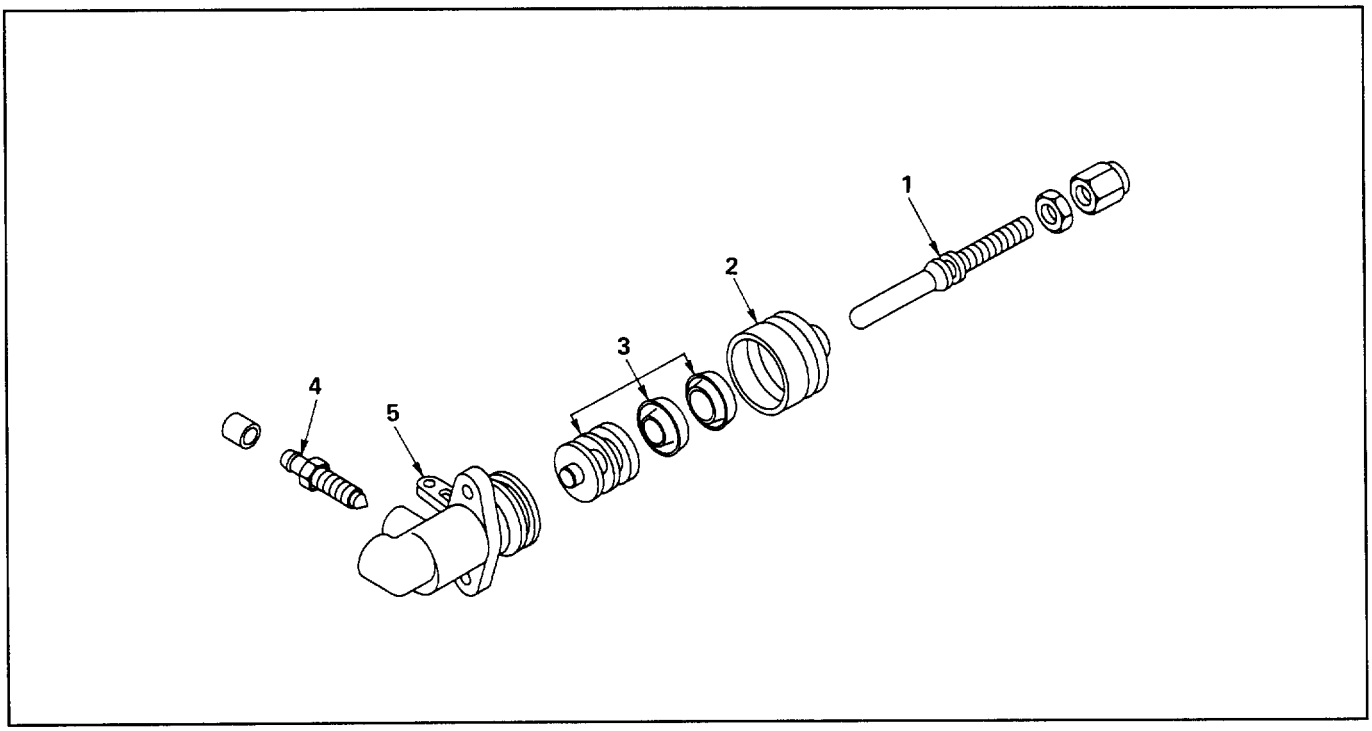
4. **Push Rod**
5. **Stopper**
6. **Snap Ring**
7. **Dust Cover**
8. **Lock Nut**

Lock Nut Torque	N·m (kg·m/lb·in)
	13 (1.3/113)

9. **Crevis Yoke**
10. **Pipe Joint**

Pipe Joint Torque	N·m (kg·m/lb·in)
	5 (0.5/43)

SLAVE CYLINDER
DISASSEMBLY



Disassembly Steps

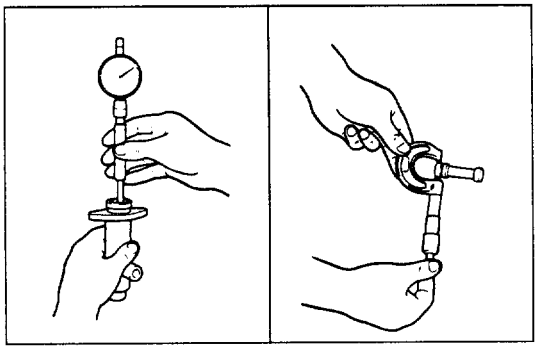
1. Push rod
2. Boot
3. Piston assembly
4. Bleeder screw
5. Cylinder body

Disassembly Steps

1. **Push Rod**
2. **Boot**
3. **Piston Assembly**
4. **Bleeder Screw**
5. **Cylinder Body**

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and parts replacements if excessive wear or damage is discovered during inspection.



Cylinder Body

- Wash clean the cylinder body in brake fluid.
- Measure the cylinder bore diameter.

Cylinder Bore Diameter mm (in)

Standard
ø 26.990-27.042 (1.0626-1.0646)

Clearance between Cylinder Bore and Piston Clearance mm (in)

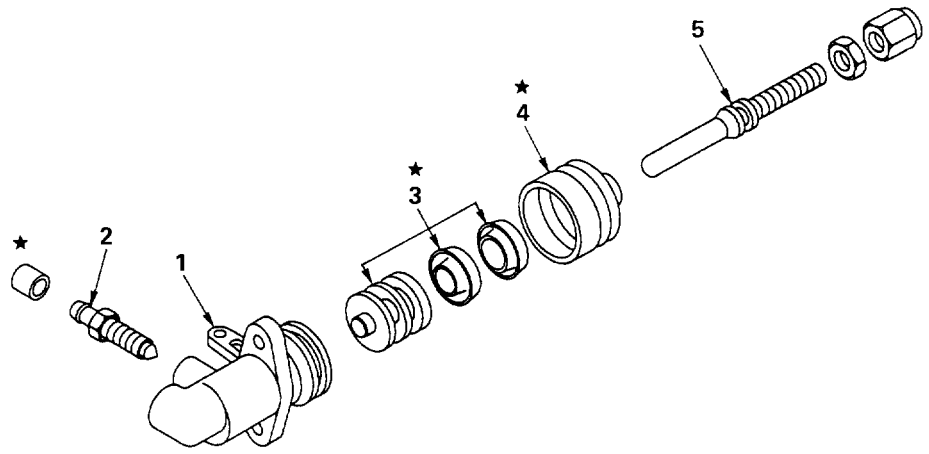
Standard	Limit
0.02-0.10 (0.0008-0.0039)	0.11 (0.0043)

- If excessive wear or any abnormal conditions are present, the slave cylinder assembly must be replaced with new one.

CAUTION:

If the slave cylinder has been disassembled, the repair kit must be replaced with new one.

REASSEMBLY



★ Indicates repair kit

Reassembly Steps

1. Cylinder body
2. Bleeder screw
3. Piston assembly
4. Boot
5. Push rod

Reassembly Steps

1. **Cylinder Body**
2. **Bleeder Screw**
3. **Piston Assembly**
   - Before installing, apply a thin coat of rubber grease to the piston.

   CAUTION:

   Use care to prevent damaging the lip of the piston cup.
4. **Boot**
5. **Push Rod**

LGMSB-WE-441

You are requested to order this manual using the manual number that is shown above.

This manual is applicable for vehicles in all countries except the USA and Canada.

All rights reserved. This manual may not be reproduced in whole or in part, without the permission in writing of ISUZU MOTORS LIMITED.

Issued by

ISUZU MOTORS LIMITED

INTERNATIONAL SERVICE DEPARTMENT

Tokyo, Japan

First edition Jan., 1994 9001-25K-1

No.LGMSB-WE-441 PRINTED IN JAPAN

WORKSHOP MANUAL

NKR · NPR · NQR · NPS

MANUAL TRANSMISSION AND CLUTCH

MXA SERIES

SECTION 7

ISUZU

ISUZU

International Service & Parts

Tokyo, Japan

NOTICE

Before using this Workshop Manual to assist you in performing vehicle service and maintenance operations, it is recommended that you carefully read and thoroughly understand the information contained in Section 0A under the headings "GENERAL REPAIR INSTRUCTIONS" and "HOW TO USE THIS MANUAL".

All material contained in this Manual is based on latest product information available at the time of publication.
All rights are reserved to make changes at any time without prior notice.

Applicable Model : NKR66. NPR66. NQR66. NPS66

This manual is applicable to 1994 year model and later vehicles.

THIS MANUAL INCLUDES THE FOLLOWING SECTIONS:

SECTION	CONTENTS
00	Service Information
7B	Manual Transmission
7C	Clutch

SECTION 00

SERVICE INFORMATION

CONTENTS

PAGE

Troubleshooting . . . . . 00 – 2
Main Data and Specifications . . . . . 00 – 5
Service Standard . . . . . 00 – 7
Servicing . . . . . 00 –10
- Transmission Oil Level Check . . . . . 00 –10
- Transmission Oil Change . . . . . 00 –10
- Gear Control Cable Adjustment . . . . . 00 –11
- Transfer Control Cable Adjustment . . . . . 00 –12
- Power Take Off Control Cable Adjustment . . . . . 00 –12
- Clutch Pedal Travel and Free Play Adjustment . . . . . 00 –13
- Clutch Hydraulic Circuits Bleeding . . . . . 00 –15

Fixing Torque . . . . . 00 –16
- Manual Transmission . . . . . 00 –16
- Transfer . . . . . 00 –17
- Clutch . . . . . 00 –18

Special Tools . . . . . 00 –19
- Manual Transmission . . . . . 00 –19
- Transfer . . . . . 00 –21
- Power Take Off . . . . . 00 –22
- Clutch . . . . . 00 –23

TROUBLESHOOTING

CONTENTS

PAGE

Transmission 00–3
- Abnormal Noise 00–3
- Hard Shifting 00–3
- Walking or Jumping out of Gear 00–3

Clutch 00–4
- Dragging 00–4
- Slipping 00–4
- Shudder (Chattering) 00–4
- Noisy 00–4
- Pedal is Hard to Push 00–4

TROUBLESHOOTING

MANUAL TRANSMISSION

PROBLEM	POSSIBLE CAUSE	CORRECTION
Abnormal Noise	1. Flywheel pilot bearing worn. 2. Bearing worn or broken (Main shaft or counter shaft). 3. Anti-lash plate malfunction. 4. Gear tooth contact surface worn or scuffed (Main shaft, counter shaft and/or reverse idle gear). 5. Spline worn (Synchronizer clutch hub). 6. Gear, clutch hub or thrust washer thrust face seized. 7. Lack of backlash between mating gears.	1. Replace. 2. Repair or replace 3. Repair or replace. 4. Repair or replace. 5. Replace. 6. Replace. 7. Replace.
Hard Shifting	1. Improper clutch pedal free play. 2. Wrong oil in use. 3. Gear control linkage misadjust. 4. Change lever sliding portions worn. 5. Shift block, shift rod and/or control box sliding faces worn. 6. Shift arm and/or synchronizer sleeve groove worn. 7. Synchronizer parts worn or weakened. 8. Trust washer, collar, and/or gear thrust faces worn (Main shaft and/or counter shaft thrust play).	1. Readjust. 2. Replace with recommended oil. 3. Readjust. 4. Repair or replace. 5. Repair or replace. 6. Replace. 7. Replace. 8. Replace.
Walking or Jumping out of Gear	1. Gear control linkage misadjust. 2. Detent spring weakened or broken. 3. Detent ball worn. 4. Change lever sliding portions worn. 5. Shift block, shift rod and/or control box sliding faces worn. 6. Shift arm and/or synchronizer sleeve groove worn. 7. Synchronizer parts worn or weakened. 8. Thrust washer, collar, and/or gear thrust faces worn (Main shaft and/or counter shaft thrust play). 9. Spline worn (Synchronizer hub). 10. Bearings worn or broken.	1. Readjust. 2. Replace. 3. Replace. 4. Repair or replace. 5. Repair or replace. 6. Replace. 7. Replace. 8. Replace. 9. Replace. 10. Replace.

TROUBLESHOOTING (CONT.)

CLUTCH

PROBLEM	POSSIBLE CAUSE	CORRECTION
Dragging	1. Hydraulic line leakage. 2. Air in line. 3. Master cylinder and/or slave cylinder seals worn. 4. Driven plate worn or warped. 5. Diaphragm spring weak or tip of finger worn. 6. Driven plate sticking on spline. 7. Release bearing worn or damaged. 8. Clutch pedal excessive free play.	1. Repair. 2. Bleed and check for damage. 3. Replace. 4. Replace driven plate. 5. Replace pressure plate. 6. Clean and free spline and lubricate with grease. 7. Replace release bearing. 8. Readjust.
Slipping	1. Driven plate facing worn or oil soaked. 2. Diaphragm spring weak. 3. Pressure plate and/or flywheel warped. 4. Clutch pedal lack of free play.	1. Replace driven plate and check for leaks as needed. 2. Replace pressure plate. 3. Repair or replace. 4. Readjust.
Shudder (Chattering)	1. Engine mounting loose or broken. 2. Driven plate facing warped. 3. Driven plate surface of facing hardened. 4. Driven plate facing oil soaked. 5. Driven plate damper spring weakened or broken. 6. Pressure plate and/or flywheel warped.	1. Tighten or replace. 2. Replace driven plate. 3. Replace driven plate. 4. Replace driven plate and check for leaks. 5. Replace driven plate. 6. Repair or replace.
Noisy	1. Release bearing binding. 2. Release bearing worn or broken. 3. Release bearing insufficiently lubricate. 4. Driven plate damper springs weakened or broken. 5. Pilot bearing worn or broken. 6. Driven plate rivet loosen. 7. Ball stud insufficiently lubricate. 8. Clutch pedal lack of free play. 9. Clutch pedal shaft insufficiently lubricate. 10. Pilot bearing loose or broken.	1. Clean or replace if damaged, and lubricate. 2. Replace. 3. Lubricate with grease or replace. 4. Replace driven plate. 5. Replace. 6. Replace driven plate. 7. Lubricate with grease. 8. Readjust. 9. Lubricate with grease. 10. Replace.
Pedal is Hard to Push	1. Hydraulic line blocked or crimped. 2. Clutch booster malfunction. 3. Clutch pedal shaft insufficiently	1. Clean out or replace. 2. Repair or replace. 3. Repair or replace.lubricate.

MAIN DATA AND SPECIFICATIONS

MANUAL TRANSMISSION

Transmission Model		MXA5S	MXA5R	MXA6S
Transmission Type		5-Speed Overdrive		6-Speed Overdrive
Gear Mesh Type		Synchromesh on all forward gear		
Control Type		Floor Remote Control		
Gear Ratio				
	1st	4.987	4.987	4.987
	2nd	2.870	2.870	2.870
	3rd	1.684	1.594	1.684
	4th	1.000	1.000	1.000
	5th	0.728	0.728	0.728
	6th	–	–	0.626
	Reverse	4.774	4.774	4.774
Lubricating Oil		Engine Oil (SAE 5W-30)		
Oil Capacity	Litres(US qt/Imp qt)	3.2 (3.38/2.82)		4.0 (4.23/3.52)

TRANSFER

Transfer Type		2 Speed, Helical Gear
Gear Ratio (to Engine)	High Speed	1.000
	Low Speed	1.868
Lubricating Oil		Engine Oil (SAE 5W–30)
Oil Capacity	Litres(US qt/Imp qt)	Approx 2.0 (2.11/1.76)

POWER TAKE OFF

Allowable Maximum Torque	N·m (kg·m)	147 (15)/at output shaft 1,000 RPM
Gear Ratio (to Engine)		1.4741
Distance Plate Thickness	mm (in)	1.460 (0.057)
Revolution Direction		Clockwise (Viewed from rear)

MAIN DATA AND SPECIFICATIONS (CONT.)

CLUTCH

Pressure Plate		
Spring Type		Diaphragm Spring
Outside Diameter	mm (in)	300 (11.811)
Clamping Force	N (kg/lb)	8,336 (850/1,874)
Spring Finger Height	mm (in)	49 – 51 (1.929 – 2.008)
Driven Plate		
Type		Dry Single Plate with Damper Spring
Outside Dia. × Inside Dia.	mm (in)	300 × 190 (11.811 × 7.480)
Free Thickness	mm (in)	9.0 (0.354)
Clamping Thickness	mm (in)	8.6 (0.339)
Clutch Control		
Type		Hydraulic
Clutch Pedal Free Play	mm (in)	15 – 25 (0.591 – 0.984)
Clutch Pedal Height	mm (in)	160 – 170 (6.299 – 6.693)
Clutch Pedal Stroke	mm (in)	159 – 169 (6.260 – 6.654)
Master Cylinder Inside Diameter		
Without Booster	mm (in)	19.050 – 19.102 (0.7500 – 0.7520)
With Booster	mm (in)	20.640 – 20.692 (0.8126 – 0.8146)
Slave Cylinder Inside Diameter	mm (in)	25.400 – 25.452 (1.0000 – 1.0020)
Clutch Booster Diaphragm Diameter	mm (in)	130 (5.118)

SERVICE STANDARD

MANUAL TRANSMISSION

Items		Service Standard	Service Limit
BALL BEARING			
Ball Bearing Run-Out	mm (in)	–	0.20 (0.0079)
GEAR			
Gear Inside Diameter			
6th,5th	mm (in)	42.000 (1.6535)	42.100 (1.6575)
3rd,2nd,1st,Rev.	mm (in)	61.000 (2.4016)	61.100 (2.4055)
MAIN SHAFT			
Main shaft Run-Out	mm (in)	Less than 0.025 (0.001)	0.10 (0.0079)
BLOCK RING AND DOG TEETH			
Block Ring and Dog Teeth Clearance			
6th,5th,4th	mm (in)	1.4 (0.055)	0.5 (0.020)
3rd,2nd,1st,Rev.	mm (in)	1.5 (0.059)	0.5 (0.020)
CLUTCH HUB			
Clutch Hub Spline Play	mm (in)	Less than 0.05 (0.002)	0.3 (0.012)
BLOCK RING AND INSERT			
Block Ring and Insert Clearance			
6th,5th,4th,3rd,2nd	mm (in)	3.59 – 3.91 (0.141 – 0.154)	–
1st,Rev.	mm (in)	3.54 – 3.86 (0.139 – 0.152)	–
CLUTCH HUB AND INSERT			
Clutch Hub and Insert Clearance	mm (in)	0.09 – 0.31 (0.004 – 0.012)	–
SHIFT ARM			
Shift Arm Thickness	mm (in)	10.0 (0.3937)	9.0 (0.3543)
SHIFT PIECE			
Shift Piece Thickness	mm (in)	10.0 (0.3937)	9.0 (0.3543)
DETENT SPRING			
Detent Spring Free Length	mm (in)	31.6 (1.2441)	30.1 (1.1850)
PLUNGER SPRING			
Plunger Spring Free Length	mm (in)	35.1 (1.3819)	34.0 (1.3386)
DETENT SPRING(for shift block assembly)			
Detent Spring Free Length	mm (in)	24.4 (0.9606)	23.0 (0.9055)

SERVICE STANDARD (CONT.)

TRANSFER

Items		Service Standard	Service Limit
SHIFT ARM			
Shift Arm Thickness			
(2WD–4WD)	mm (in)	10.0 (0.3937)	9.0 (0.3543)
(High–Low)	mm (in)	10.5 (0.4134)	9.5 (0.3740)
DETENT SPRING			
Detent Spring Free Length	mm (in)	31.6 (1.2441)	30.1 (1.1850)
MAIN SHAFT			
Main shaft Run-Out	mm (in)	–	0.1 (0.0039)
GEAR			
Gear Inside Diameter			
Input Shaft High Gear	mm (in)	81.000 (3.1890)	81.100 (3.1929)
Input Shaft Low Gear	mm (in)	58.000 (2.2835)	58.100 (2.2874)
Front Drive Gear	mm (in)	55.000 (2.1654)	55.100 (2.1693)
BALL BEARING			
Ball Bearing Run-Out	mm (in)	–	0.2 (0.008)

POWER TAKE OFF

Items		Service Standard	Service Limit
BALL BEARING			
Ball Bearing Run-Out	mm (in)	–	0.2 (0.008)
GEAR			
Output Shaft and Output Gear Bushing Clearance	mm (in)	–	0.2 (0.008)
SHIFT ARM			
Shift Arm Thickness	mm (in)	9.0 (0.354)	8.0 (0.315)

SERVICE STANDARD (CONT.)

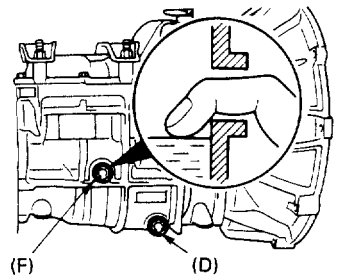
CLUTCH

Items		Service Standard	Service Limit
PRESSURE PLATE			
Pressure Plate Warpage	mm (in)	–	0.3 (0.012)
Clutch Set Force	N (kg/lb)	8,336 (850/1,874)	–
Diaphragm Spring Finger Height	mm (in)	49 – 51 (1.929 – 2.008)	–
DRIVEN PLATE			
Driven Plate Warpage	mm (in)	less than 0.7 (0.028)	1.0 (0.039)
Spline Wear	mm (in)	less than 0.5 (0.020)	1.0 (0.039)
Depression of Rivet Head	mm (in)	1.6 – 2.2 (0.063 – 0.087)	0.2 (0.008)
CLUTCH PEDAL			
Clutch Pedal Free Play	mm (in)	15 – 25 (0.591 – 0.984)	–
Clutch Pedal Height	mm (in)	160 – 170 (6.299 – 6.693)	–
Clutch Pedal Stroke	mm (in)	159 – 169 (6.260 – 6.654)	–
Clutch Switch and Pedal Clearance	mm (in)	0.5 – 1.0 (0.020 – 0.039)	–
MASTER CYLINDER			
Cylinder Body and Piston Clearance	mm (in)	0.03 – 0.11 (0.0118 – 0.0043)	0.120 (0.0047)
SLAVE CYLINDER			
Cylinder Body and Piston Clearance	mm (in)	0.02 – 0.10 (0.0008 – 0.0039)	0.110 (0.0043)
CLUTCH BOOSTER			
Push Rod Length	mm (in)	3.75 – 4.00 (0.1476 – 0.1575)	–
Clevis Yoke Distance	mm (in)	157.00 (6.1811)	–

SERVICING

TRANSMISSION OIL LEVEL CHECK

MXA-5



1. **Remove the filler plug.**
2. **Check the oil level.**
   - Add lubricant to within 0 to 10 mm (0 to 0.4 in) of bottom edge of the filler hole if necessary.

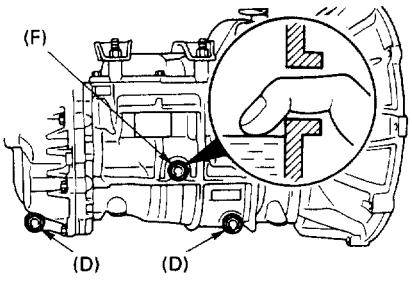
CAUTION

Use ENGINE OIL (SAE 5W-30) for transmission and transfer case.

3. **Install the filler plug.**

Filler Plug Torque	N·m (kg·m/lb·ft)
	49 (5.0/36)

MXA-6

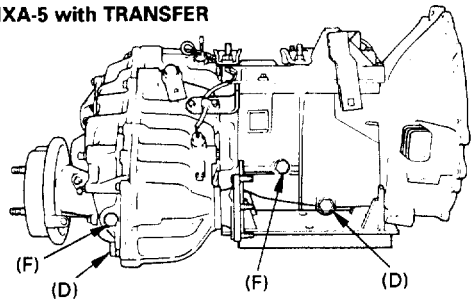


TRANSMISSION OIL CHANGE

1. **Remove the drain plug (D) from the transmission case and drain the oil.**
2. **Install the drain plug (D).**

Drain Plug Torque	N·m (kg·m/lb·ft)
	49 (5.0/36)

MXA-5 with TRANSFER



3. **Remove the filler plug (F).**
4. **Fill the transmission case from the filler plug hole with new oil of specified grade.**

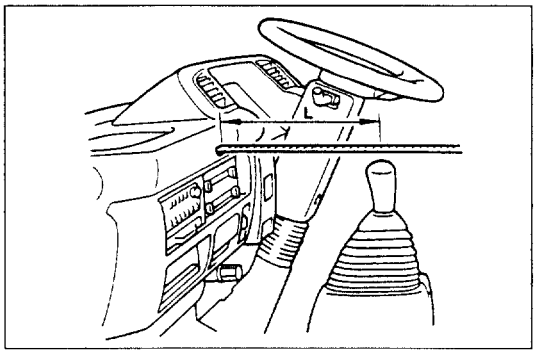
Oil Capacity	Litres (US qt/Imp.qt)
5-Speed Type	3.2 (3.38/2.82)
6-Speed Type	4.0 (4.23/3.52)
Transfer	2.0 (2.11/1.82)

CAUTION

Use ENGINE OIL (SAE 5W-30) for transmission and transfer case.

5. **Install filler plug (F).**

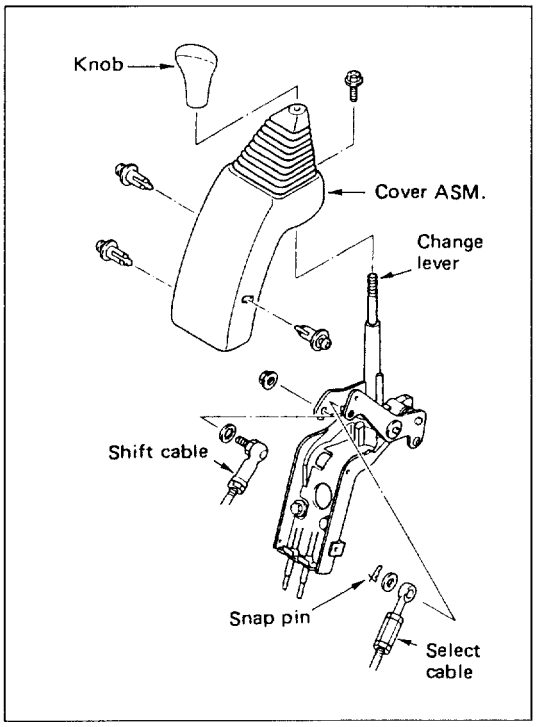
Filler Plug Torque	N·m (kg·m/lb·ft)
	49 (5.0/36)

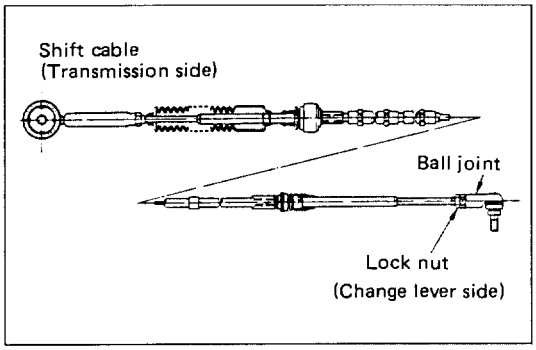


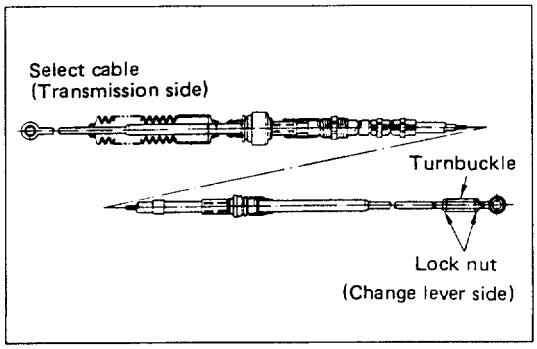
GEAR CONTROL CABLE ADJUSTMENT

1. **Set the change lever in the neutral position, then confirm if the dimension between the center of the change lever play and the instrument center cluster is within the reference value.**

Change Lever Position	mm (in)
Standard cab	247±15 (9.7±0.6)
Wide Cab	283±15 (11.1±0.6)





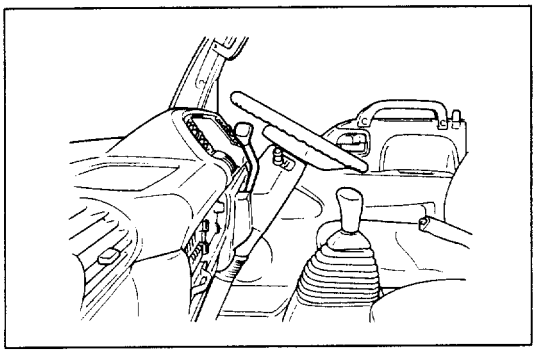


2. **If the dimension is out of the reference adjust as required.**
   1) Remove the change lever knob.
   2) Remove the cover assembly.
   3) Disconnect the shift cable from the change lever.
   4) Set the transmission in the neutral position.
   5) Loosen the lock nut of the shift cable ball joint and the select cable turnbuckle, then turn the ball joint and turnbuckle as necessary for hole and pin.
   6) Tighten the lock nuts and install the shift cable to the change lever.

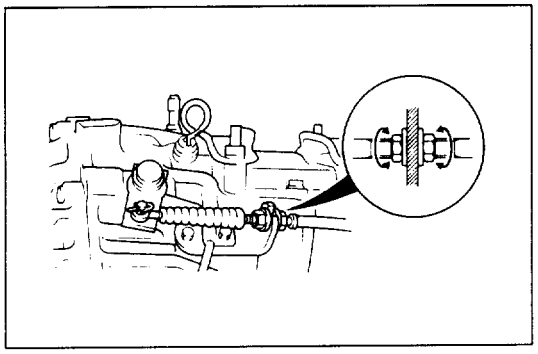
Lock nut torque	N·m (kg·m/lb·in)
6 (0.6/52)	

   7) Install the cover assembly and the change lever knob.

TRANSFER CONTROL CABLE ADJUSTMENT

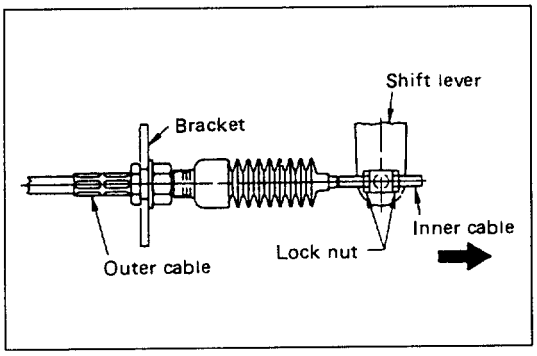


1. Set the external shift lever of transfer in the high speed range (4H) position.
2. Loosen the adjust nut.
3. Remove the split pin and the washer, then disconnect the control cable.



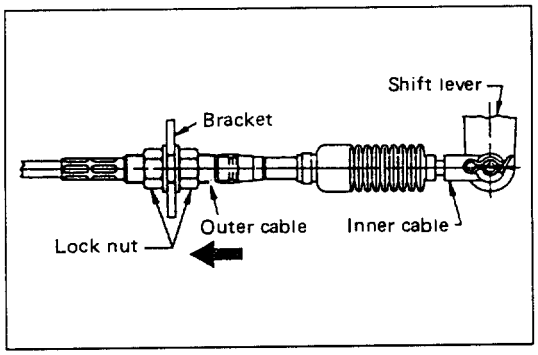
4. Set the external shift lever of transfer in the high speed range (4H) position. Adjust the position of the control cable eye end, then connect the control cable to the external shift lever.
5. Tighten the lock nut.
6. Install the washer and the split pin.

POWER TAKE OFF CONTROL CABLE ADJUSTMENT



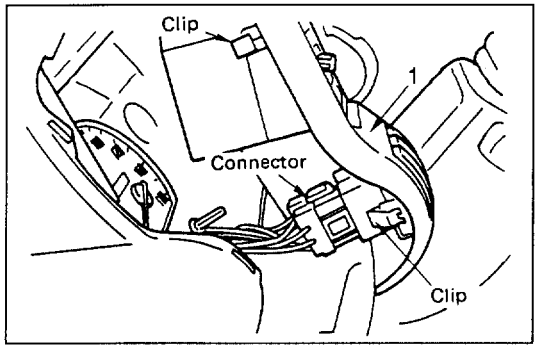
Inner Cable Adjustment Type

1. Loosen the lock nuts.
2. Set the PTO shift lever in the OFF position. Be sure to confirm the PTO control lever is in the OFF position (PTO indicator light turned off).
3. Remove slack from the inner cable by pulling the inner cable in the direction of the arrow.
4. Tighten the lock nuts.



Outer Cable Adjustment Type

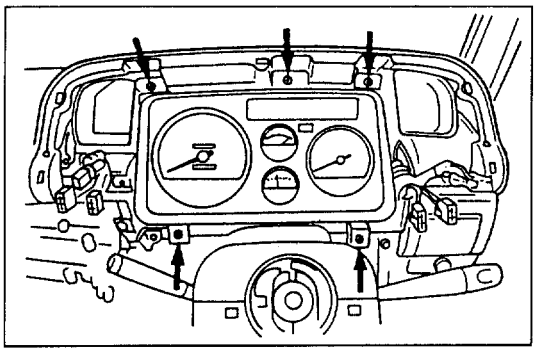
1. Loosen the lock nuts.
2. Set the PTO shift lever in the OFF position. Be sure to confirm the PTO control lever is in the OFF position (PTO indicator light turned off).
3. Connect the inner cable to the PTO shift lever.
4. Remove slack from the inner cable by pulling the outer cable in the direction of the arrow.
5. Tighten the lock nuts.



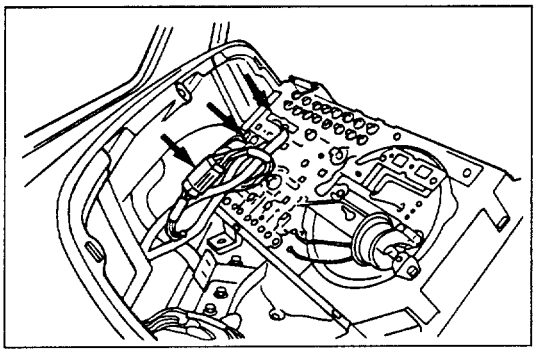
CLUTCH PEDAL TRAVEL AND FREE PLAY ADJUSTMENT

Clutch Pedal Height and Stroke

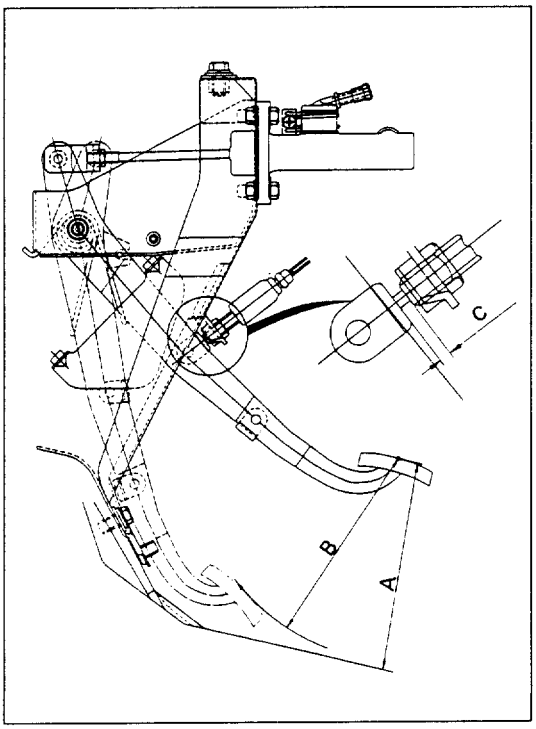
1. **Remove the meter cluster.**
   - Pull out the meter cluster and disconnect the harness connectors.



2. **Remove the meter assembly.**
   - Remove the 5 fixing screws.



- Disconnect the harness connectors.



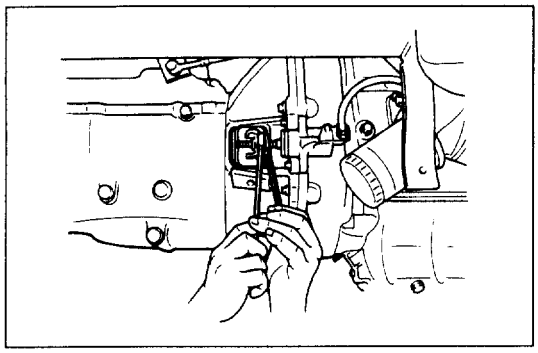
3. **Loosen the lock nut of the clutch booster plunger or clutch master cylinder push rod.**
4. **Adjust the pedal height by turning plunger or push rod.**

Clutch Pedal Height and Stroke	mm(in)
Height(A)	160 – 170 (6.299 – 6.693)
Stroke(B)	159 – 169 (6.260 – 6.654)

5. **Tighten the lock nut.**

Lock Nut Torque	N·m (kg·m/lb·ft)
Plunger	20 (2.0/14)
Push Rod	13 (1.3/10)

6. **Install the meter assembly and meter cluster.**



Clutch Pedal Free Play

Slave Cylinder

1. Remove the slave cylinder return spring.
2. Loosen the lock nut of the push rod.
3. Turn the adjust nut until it reaches the shift fork.
4. Back off the adjust nut 1.5 turns (shift fork free play approximately 2 mm).
5. Tighten the lock nut.

Lock Nut Torque	N·m(kg·m/lb·ft)
19 (1.9/14)	

6. Install the return spring.

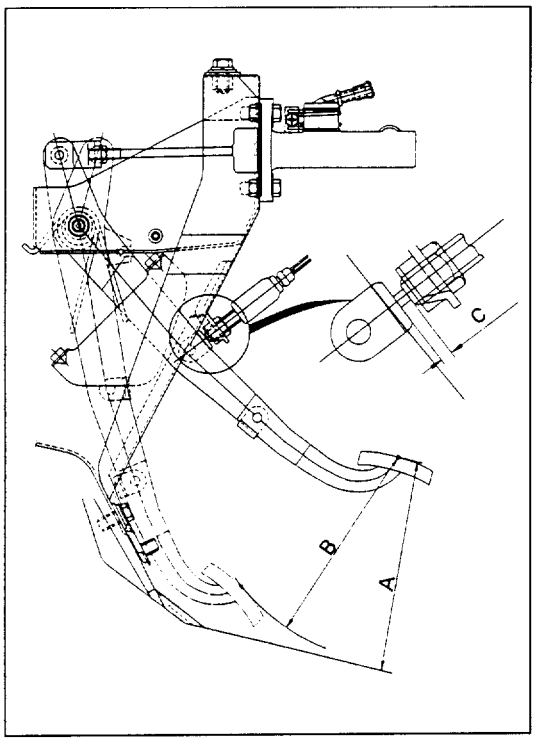
Clutch Switch or Stopper Bolt

After completion of clutch pedal height adjustment,adjust the clutch switch or stopper bolt clearance.

1. Loosen the lock nut of clutch switch or stopper bolt.
2. Adjust the clutch switch or stopper bolt clearance by turning clutch switch or stopper bolt.

Clutch Switch or Stopper Bolt Clearance(C)	mm(in)
0.5 – 1.0 (0.02 – 0.04)	

Clutch Pedal Free Play	mm(in)
15 – 25 (0.59 – 0.98)	

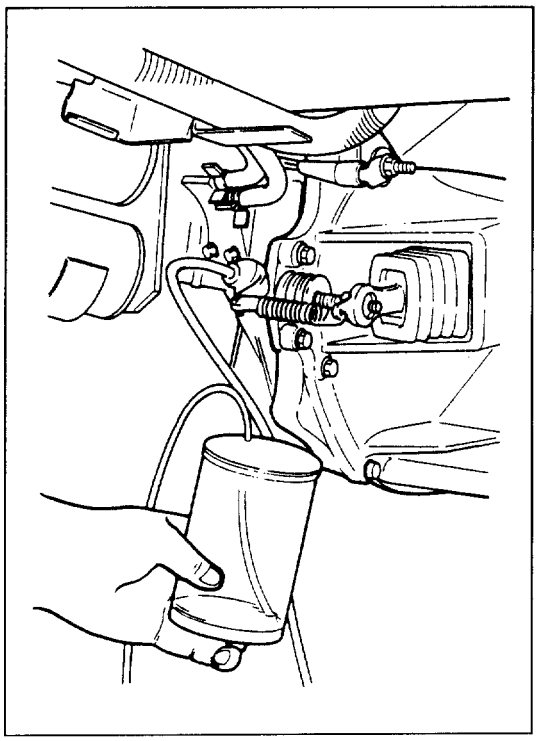


3. Tighten the lock nut.

Lock Nut Torque	N·m(kg·m/lb·ft)
19 (1.9/14)	

CLUTCH HYDRAULIC CIRCUITS BLEEDING

If air enters the clutch circuit, it will causes clutch dragging. Therefore, bleeding operation should be performed if the clutch fluid reservoir has been emptied due to failure to mal-replenishment or if the hydraulic circuit has been disassembled. Bleeding operation calls for cooperative action of two men.



1. Check the level of clutch fluid in the reservoir and replenish of necessary.
2. Remove the rubber cap from the bleeder screw and wipe clean the bleeder screw.

   Connect a vinyl tube to the bleeder screw and insert the other end of the vinyl tube into a transparent container.
3. Pump the clutch pedal repeatedly and hold it depressed.
4. Loosen the bleeder screw on the clutch slave cylinder to release clutch fluid with air bubbles into the container and tighten the bleeder screw immediately.
5. Release the clutch pedal carefully. Repeat the above operation until air bubbles disappear from the clutch fluid being pumped out into the container. During the bleeding operation, keep the clutch fluid reservoir filled to the specified level.

   Reinstall the rubber cap.

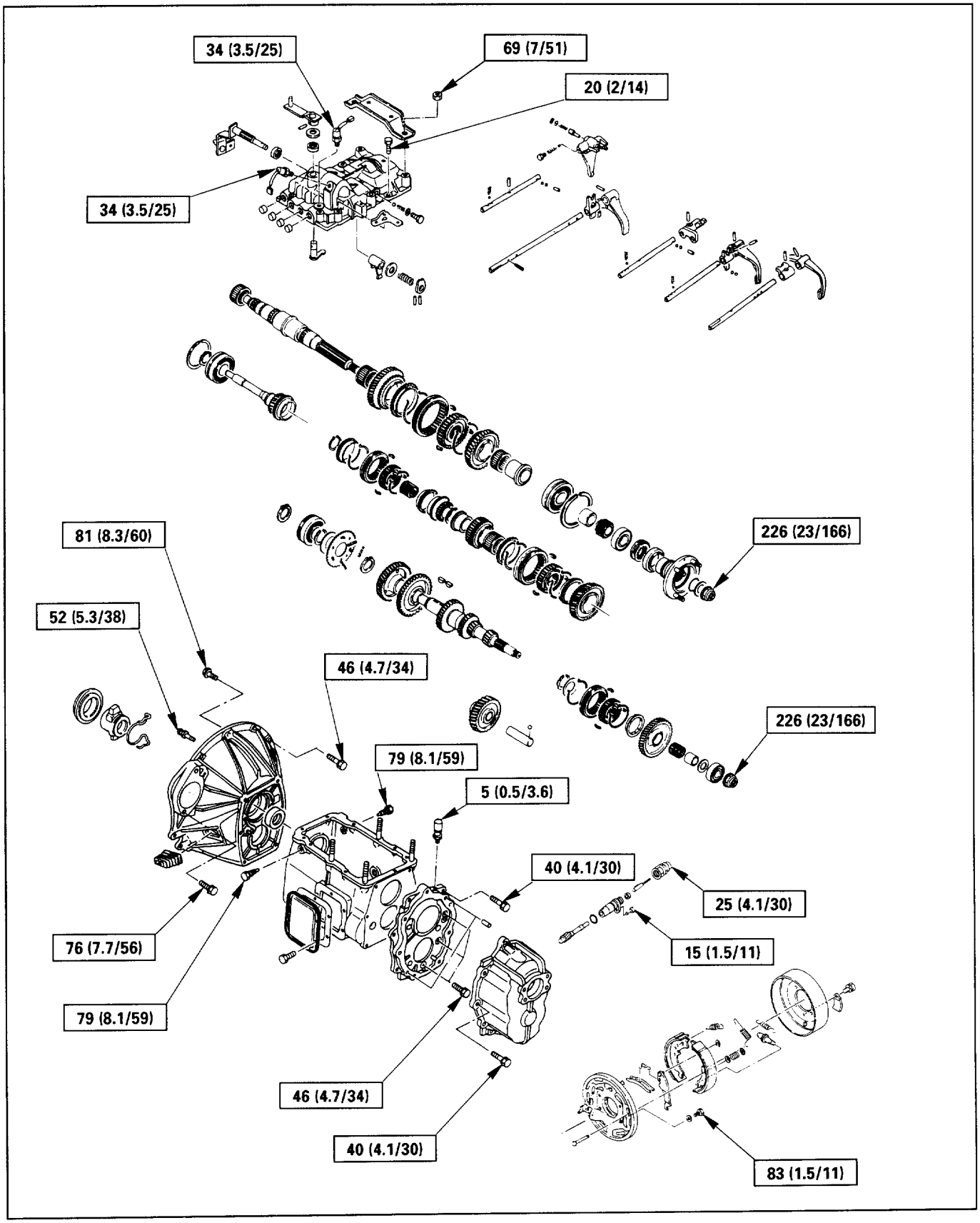
CAUTION

Do not let clutch fluid remain on a painted surface. Wash it off immediately.

FIXING TORQUE

MANUAL TRANSMISSION

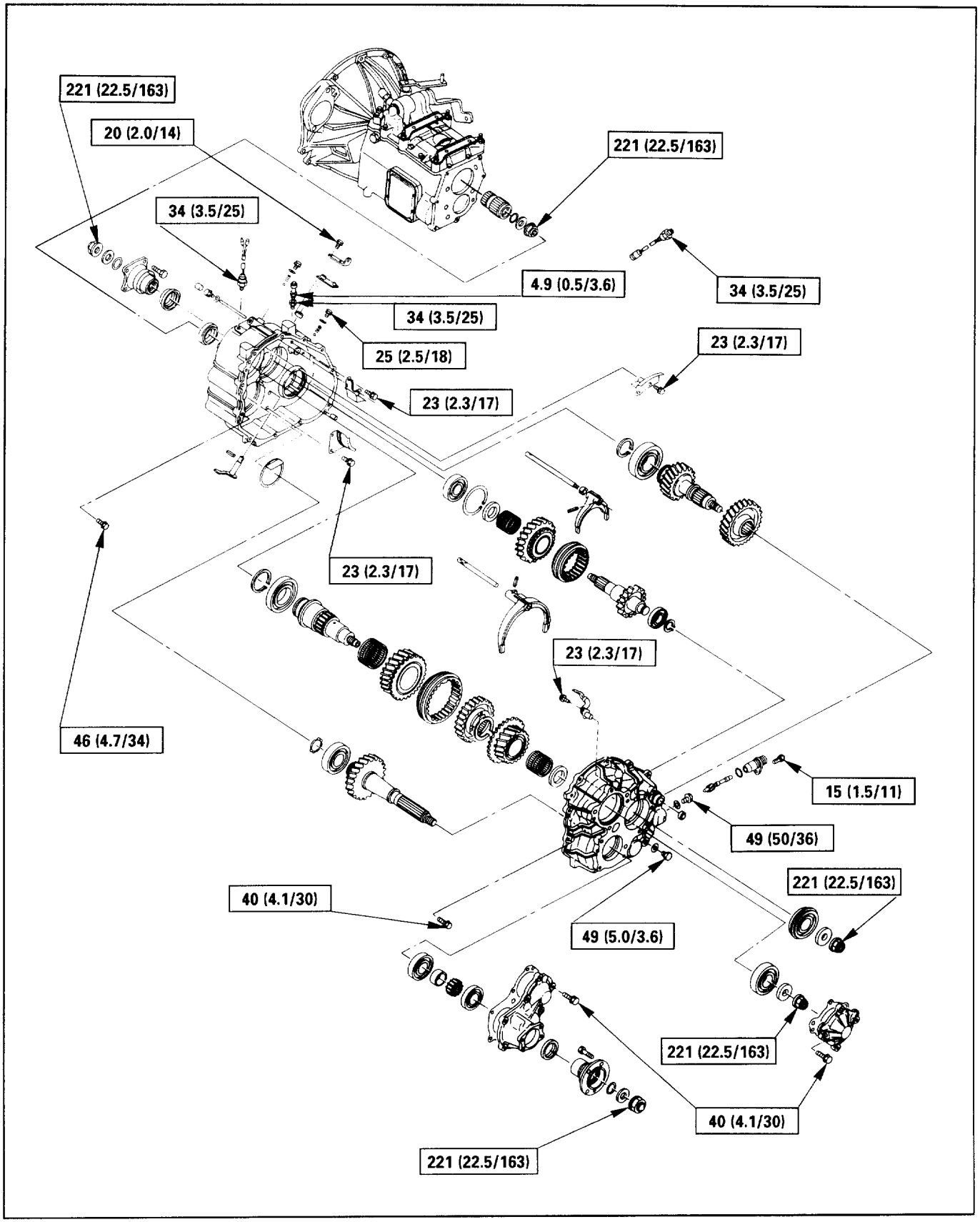
N·m(kg·m/lb·ft)



FIXING TORQUE (CONT.)

TRANSFER

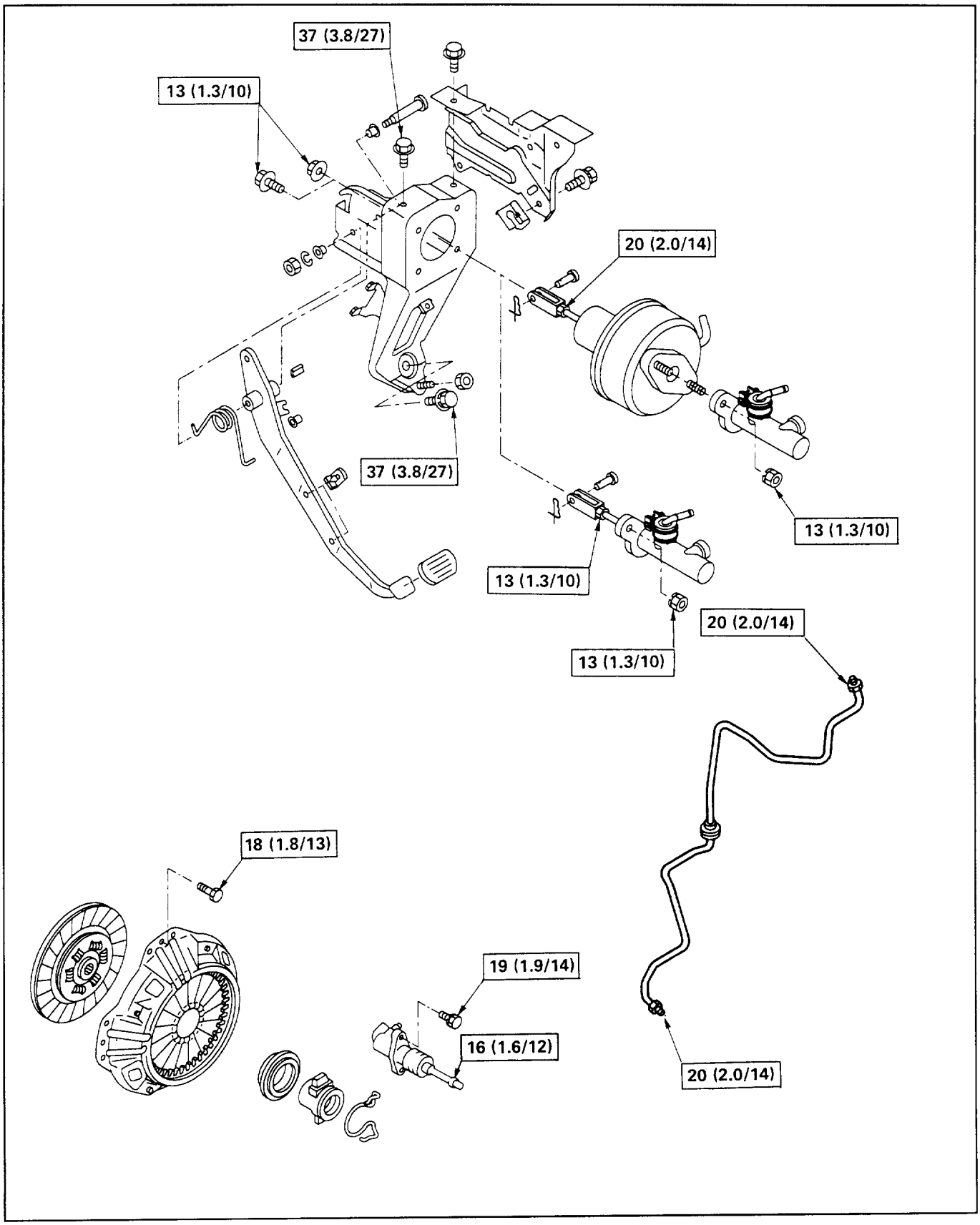
N·m(kg·m/lb·ft)



FIXING TORQUE (CONT.)

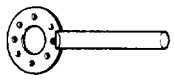
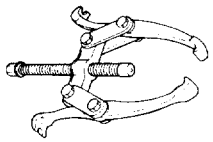
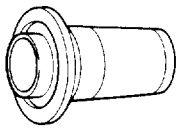
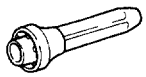
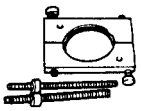
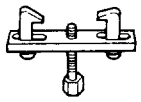
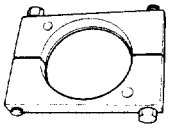
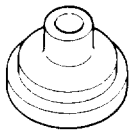
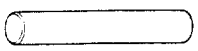
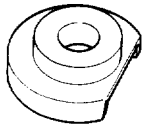
CLUTCH

N·m(kg·m/lb·ft)



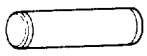
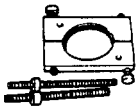
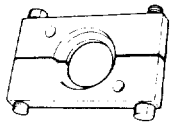
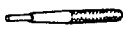
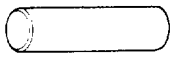
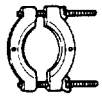
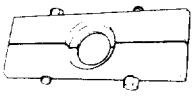
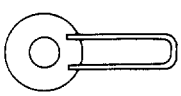
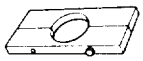
SPECIAL TOOL

MANUAL TRANSMISSION

ILLUSTRATION	PART NUMBER	PART NAME	REMARKS
	5-8840-2043-0	Handle	
	5-8840-2198-0	Bearing Remover	
	5-8840-2242-0	Oil Seal Installer	For rear cover oil seal
	5-8840-2243-0	Oil Seal Installer	For front cover oil seal
	5-8840-2042-0	Bearing Remover	
	5-8840-2027-0	Universal Puller	
	5-8840-2342-0	Bearing Remover	For main shaft rear bearing
	5-8840-2347-0	Main Shaft Holder	
	5-8840-2345-0	Clutch Hub & Collar Installer	
	5-8840-2348-0	Counter Shaft Holder	

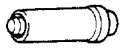
SPECIAL TOOL (CONT.)

MANUAL TRANSMISSION (CONT.)

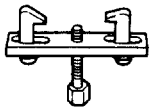
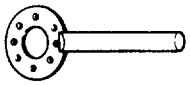
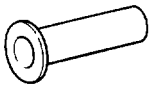
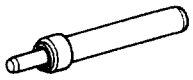
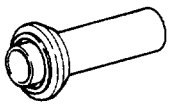
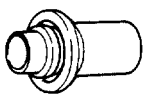
ILLUSTRATION	PART NUMBER	PART NAME	REMARKS
	5-8840-2244-0	Bearing Installer	
	5-8840-2112-0	Bearing Remover	
	5-8840-2341-0	Gear Remover	For main 6th gear
	9-8529-2201-0	Spring Pin Remover	
	5-8840-2344-0	Bolts & Nut	
	5-8840-2346-0	Gear Collar Installer	For Counter 6th gear collar
	5-8840-0587-0	Gear Remover	
	5-8840-2343-0	Clutch Hub Remover	
	5-8840-2045-0	Anti-Lash Plate Installer	
	5-8840-2295-0	Bearing Remover	

SPECIAL TOOL (CONT.)

MANUAL TRANSMISSION (CONT.)

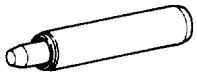
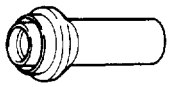
ILLUSTRATION	PART NUMBER	PART NAME	REMARKS
	5-8840-2245-0	Oil Seal Installer	For control box oil seal

TRANSFER

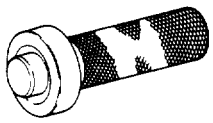
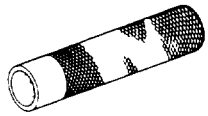
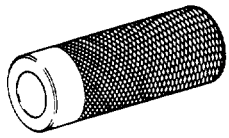
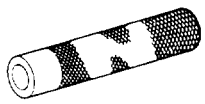
ILLUSTRATION	PART NUMBER	PART NAME	REMARKS
	5-8840-2027-0	Universal Puller	
	5-8840-2043-0	Handle	
	9-8522-1615-0	Bearing Collar Install	For reverse gear bearing collar
	5-8840-2144-0	Bearing Installer	
	5-8840-2146-0	Oil Seal Installer	For transfer case rear oil seal
	5-8840-2147-0	Oil Seal Installer	For rear cover oil seal
	5-8840-2148-0	Oil Seal Installer	For transfer case front oil seal

SPECIAL TOOL (CONT.)

TRANSFER (CONT.)

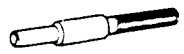
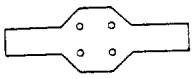
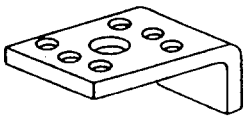
ILLUSTRATION	PART NUMBER	PART NAME	REMARKS
	5-8840-2149-0	Oil Seal Installer	For transfer case front oil seal
	9-8840-2150-0	Oil Seal Installer	For transfer case front oil seal
	5-8840-2151-0	Transfer Case Cap	

POWER TAKE OFF

ILLUSTRATION	PART NUMBER	PART NAME	REMARKS
	5-8840-2064-0	Oil Seal Installer	For output shaft oil seal
	5-8840-2065-0	Oil Seal Installer	For shift rod oil seal
	5-8840-2066-0	Bearing Installer	For output shaft bearing
	5-8840-2067-0	Plug Installer	For shift rod cap
	9-8529-2201-0	Spring Pin Remover	

SPECIAL TOOL (CONT.)

CLUTCH

ILLUSTRATION	PART NUMBER	PART NAME	REMARKS
	5-8840-2240-0	Pilot Aligner	
	9-8523-1733-0	Handle	For clutch booster
	5-8840-2056-0	Support Plate	For clutch booster

SECTION 7

MANUAL TRANSMISSION AND CLUTCH

CONTENTS

PAGE

Manual Transmission 7B– 1

Clutch 7C– 1

SECTION 7B

MANUAL TRANSMISSION

CONTENTS

PAGE

General Description 7B– 3
On-Vehicle Service 7B– 9
Change Lever Assembly Replacement 7B– 9
Gear Control Cable Replacement 7B– 10
Transfer Control lever and Control Cable Replacement 7B– 13
Transfer Control Vacuum Actuator Replacement 7B– 15
Transfer Control Vacuum Switching Valve Replacement 7B– 17
Car Speed Sensor Driven Gear Replacement 7B– 18
Back-up Light Switch and Neutral Switch Replacement 7B– 19
Transfer Neutral Switch and 4WD Detective Switch Replacement 7B– 20
Rear Oil Seal Replacement 7B– 22
Transmission Assembly Replacement 7B– 25
Front Oil Seal Replacement 7B– 29
Unit Repair 7B– 32
Major Components 7B– 32
Disassembly 7B– 32
Reassembly 7B– 42
Top Gear Shaft Assembly, Main Shaft Assembly and Counter Shaft Assembly . . 7B– 56
Disassembly 7B– 56
Inspection and Repair 7B– 61
Reassembly 7B– 64
Control Box 7B– 74
Disassembly 7B– 74
Inspection and Repair 7B– 84
Reassembly 7B– 86
Transfer 7B– 98
Transfer Rear Case Disassembly 7B– 98
Rear Drive Shaft, Input Shaft Disassembly 7B–103
Front Drive Shaft, Idle Shaft Disassembly 7B–107
Transfer Front Case Disassembly 7B–110

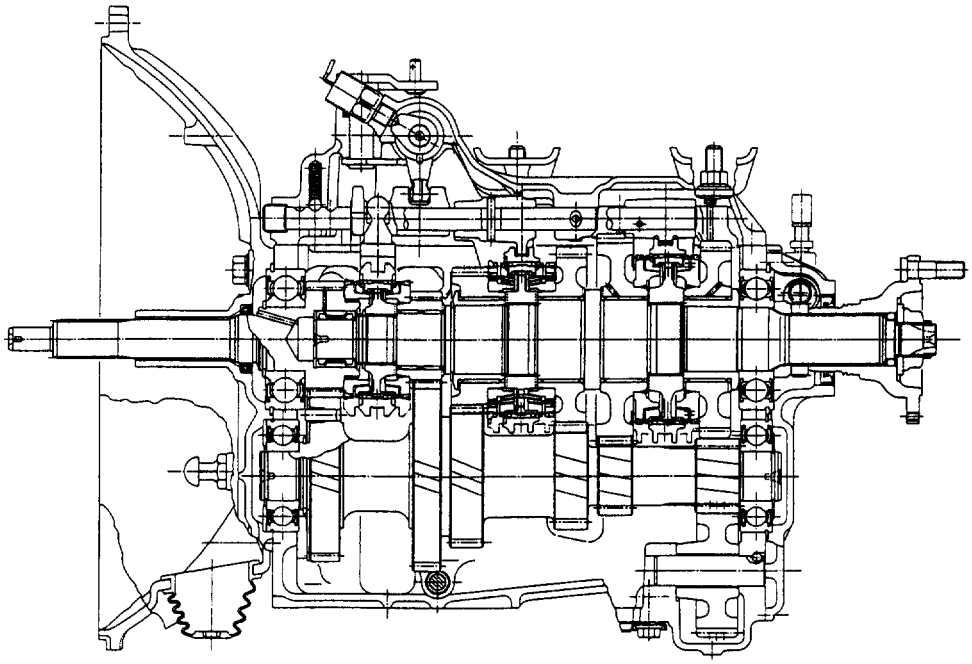
CONTENTS (CONT.)

PAGE

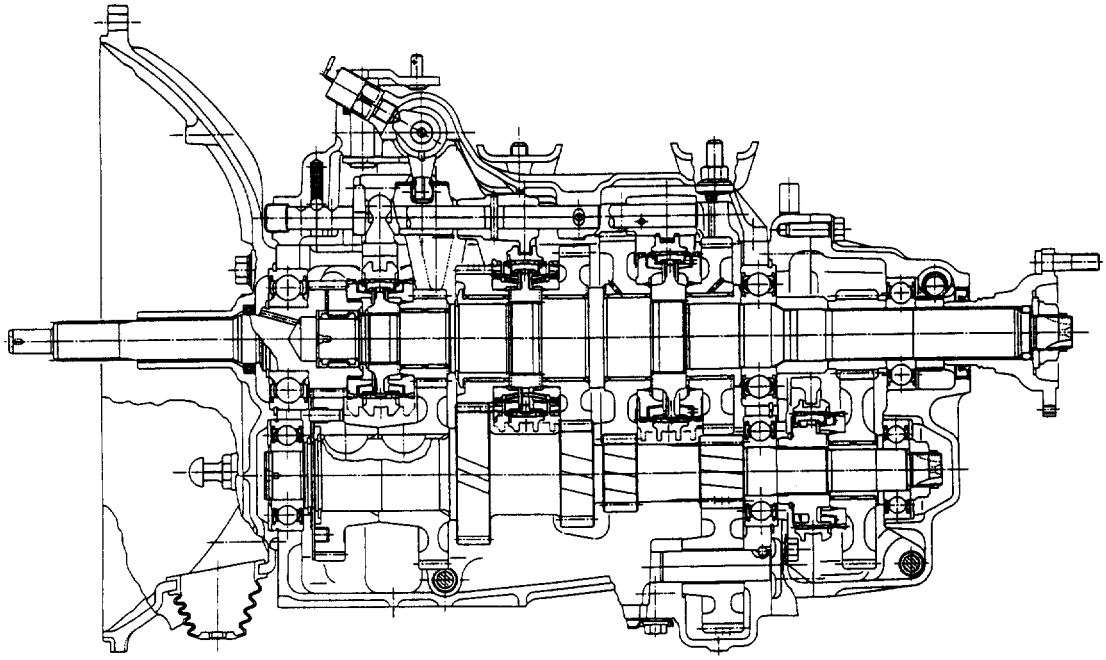
Inspection and Repair 7B–112
Transfer Front Case Reassembly 7B–114
Input Shaft Assembly Reassembly 7B–119
Idle Shaft Assembly Reassembly 7B–121
Front Drive Shaft Assembly Reassembly 7B–123
Rear Drive Shaft Assembly Reassembly 7B–128
Rear Drive (2WD) ↔ Four Wheel Drive (4WD) Select Mechanism Reassembly. 7B–130
Four Wheel Drive High Speed Range (4H) ↔ Low Speed Range
Select Mechanism Reassembly 7B–133
Transfer Rear Case Reassembly 7B–137
Other Parts Reassembly 7B–145
Power Take Off 7B–147
General Description 7B–147
Power Take Off Replacement 7B–148
Unit Repair 7B–152

GENERAL DESCRIPTION

MXA-5R and MXA-5S Models



MXA-6S Model



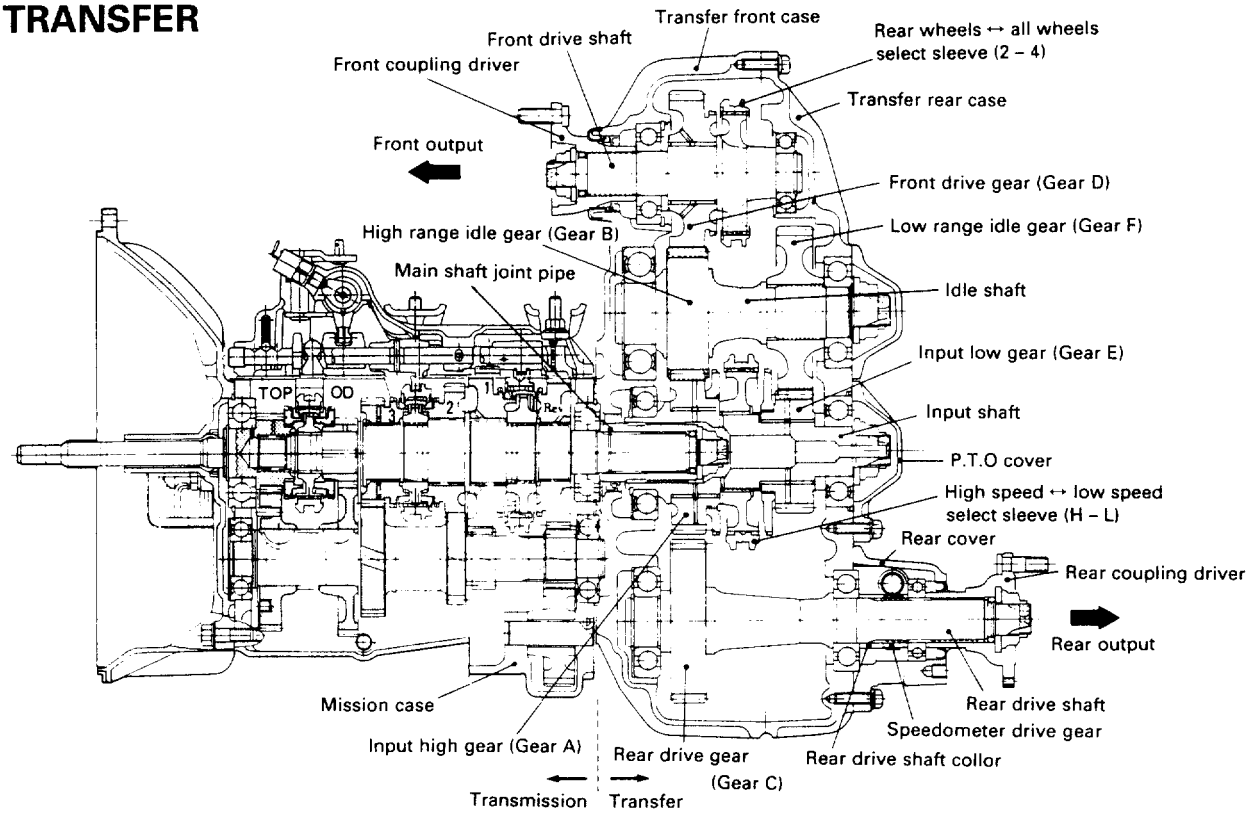
For MXA model transmission, a forward 5 or 6-shift all synchromesh type and a backward 1-shift constant-mesh type transmission are employed. The transmission case is made of a high rigidity cast iron, and the front cover integral with the clutch housing is made of aluminum die-cast. An aluminum die-cast control box containing a gear shift and gear select mechanism is installed on the top of the transmission case. A window for power take-off is also provided on the left side. For all the gears, helical gears are employed to reduce noises.

The synchromesh mechanism that employs balking rings use block rings of special brass to obtain improved synchromesh performance.

With the main shaft screwed up at the rear, ball bearings are employed for the bearings on both sides of the main shaft and the counter shaft, and needle roller bearings employed for the bearings at the tip end of the main shaft and also for those of the 1st gear, 2nd gear, 3rd gear, 5th gear, reverse gear and 6th counter gear to secure improved durability and reduced noises.

Furthermore, with the anti-lash mechanism employed for the engagement of the top gear with the counter gear, fine-pitch gears are also employed for the top gear, the 5th and the 6th gear to reduce noises.

TRANSFER



To cope with the 4-wheel drive (4WD), the transmission that contains a sub-transmission (transfer) with a one-step reduction gear for 4WD at the rear of transmission is employed.

The transmission gear ratio employed is the same as that of MXA5R type transmission.

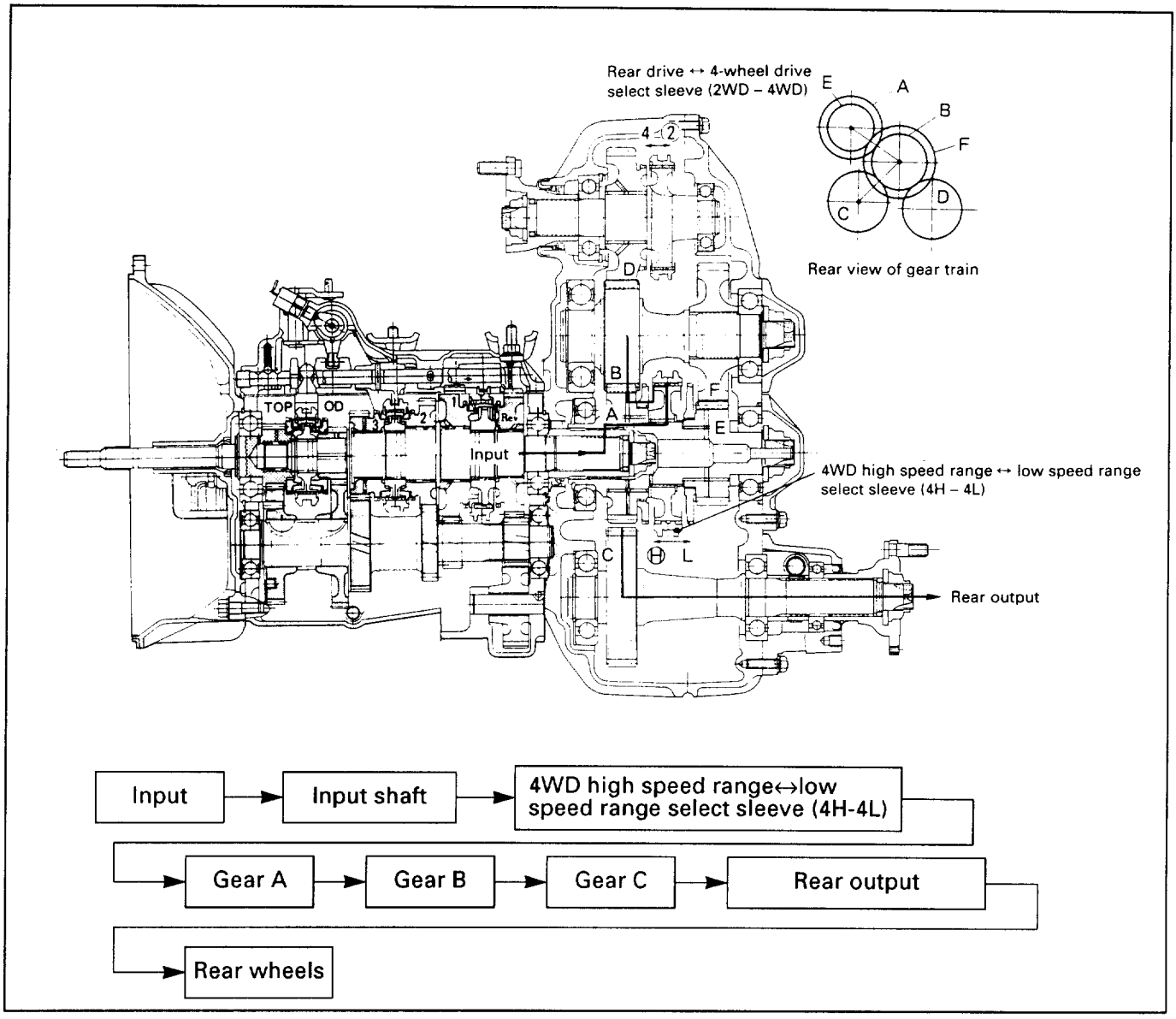
Besides use of M10x1.25 screws to clamp the transmission and transfer, a clutch housing made of cast iron is employed to increase joint rigidity and strength.

In the transfer, selection of rear drive (2WD) or 4-wheel drive (4WD) is done with vacuum actuator by one-touch switch operation, and selection of 4WD high speed range (4H) or 4WD low speed range (4L) is done with cable by column lever operation. Selection of 4-wheel drive low speed range (4L) during rear drive (2WD) causes a drive system trouble or motor trouble. To avoid this, a mechanical interlock system is employed between rear drive (2WD) 4-wheel drive (4WD) select rod and 4-wheel drive high speed range (4H) low speed range (4L) select rod, so that the 4-wheel drive low speed range (4L) cannot be selected during rear drive (2WD).

TRANSFER OPERATION

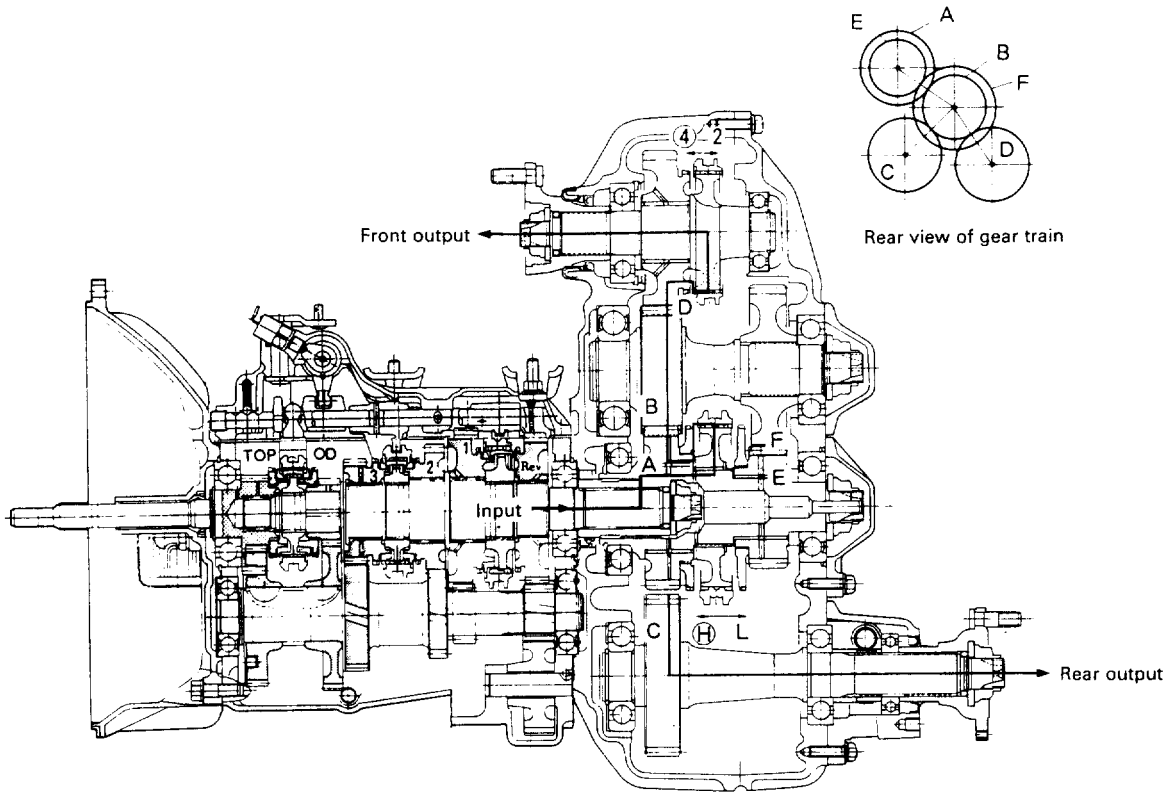
1) Normal rear drive (2H)

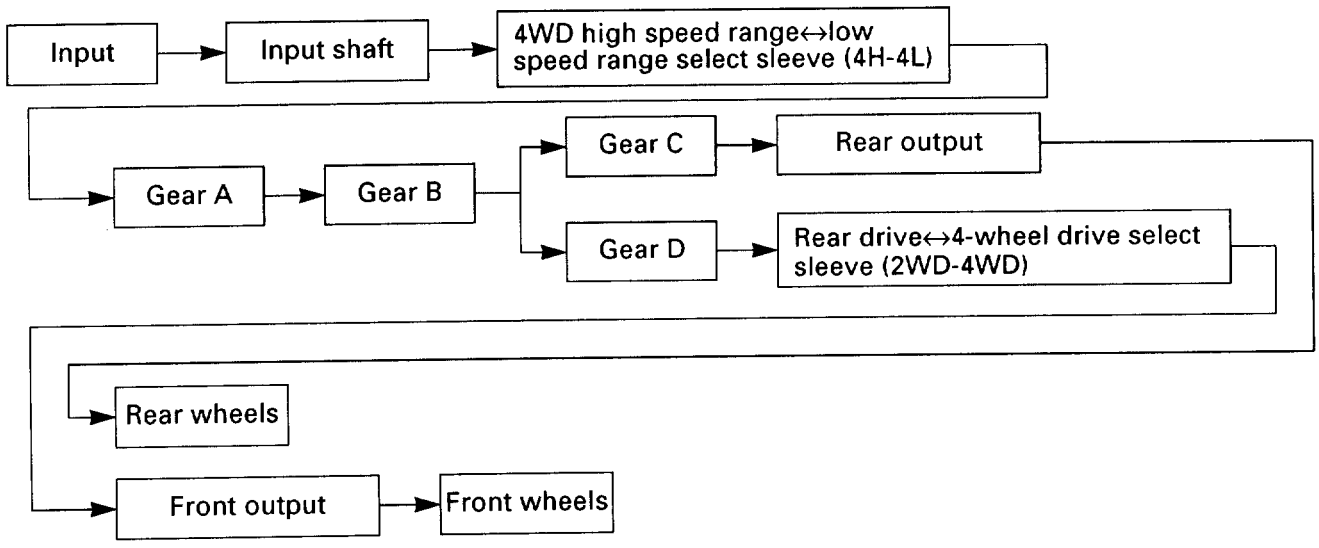
The drive force is transmitted to the rear wheels as shown below.



2) 4-wheel drive high speed range (4H)

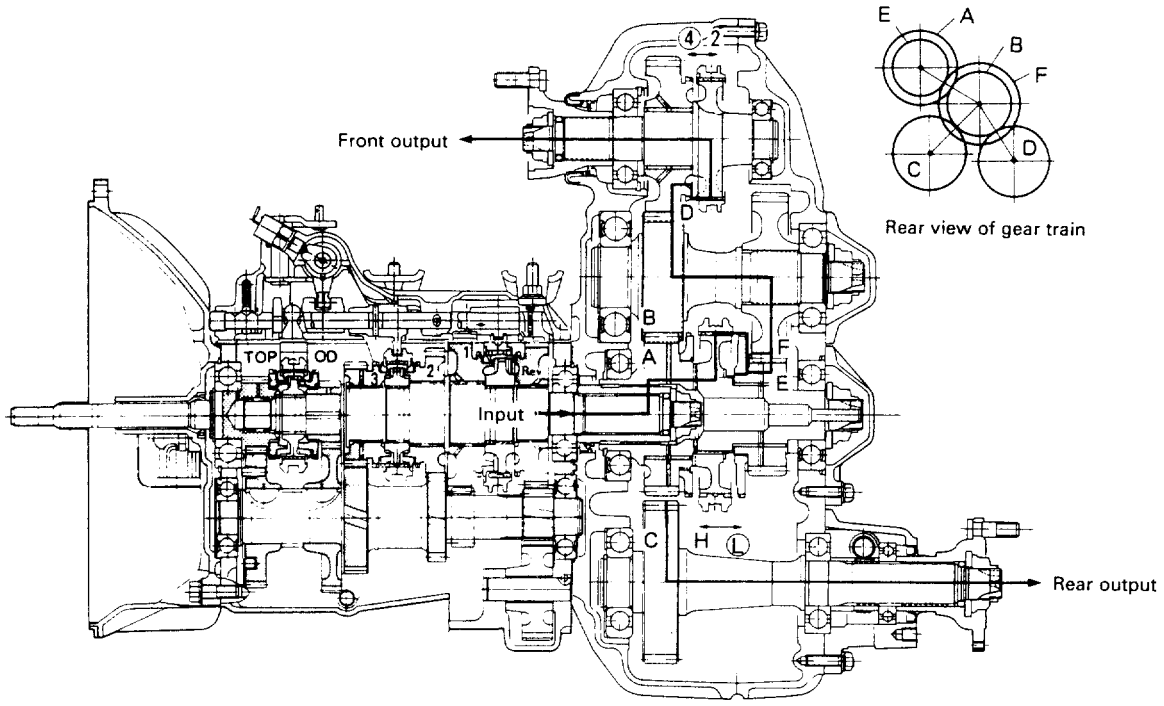
The drive force is transmitted to both rear wheels and front wheels as shown below.

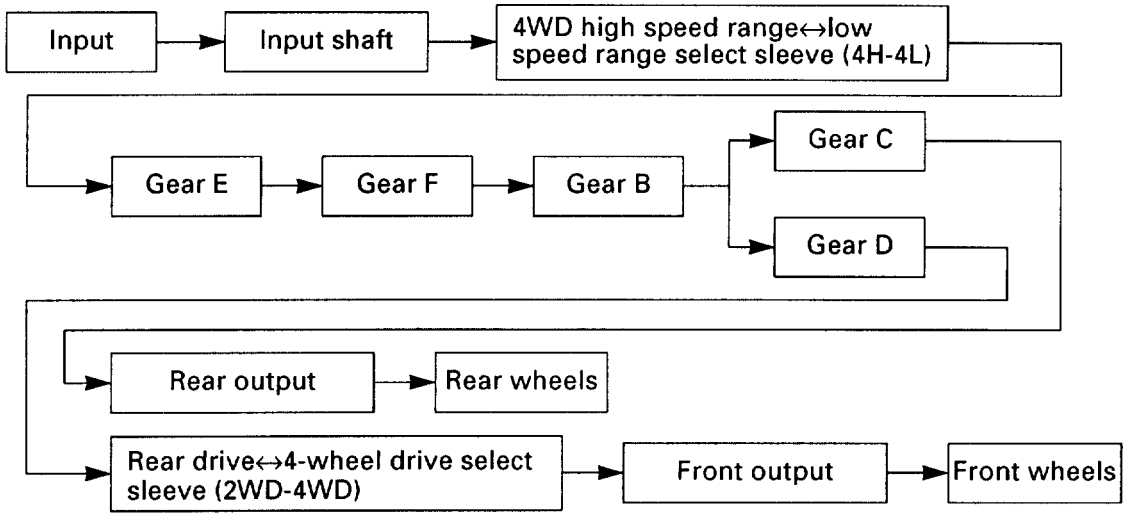




3) 4-wheel drive low speed range (4L)

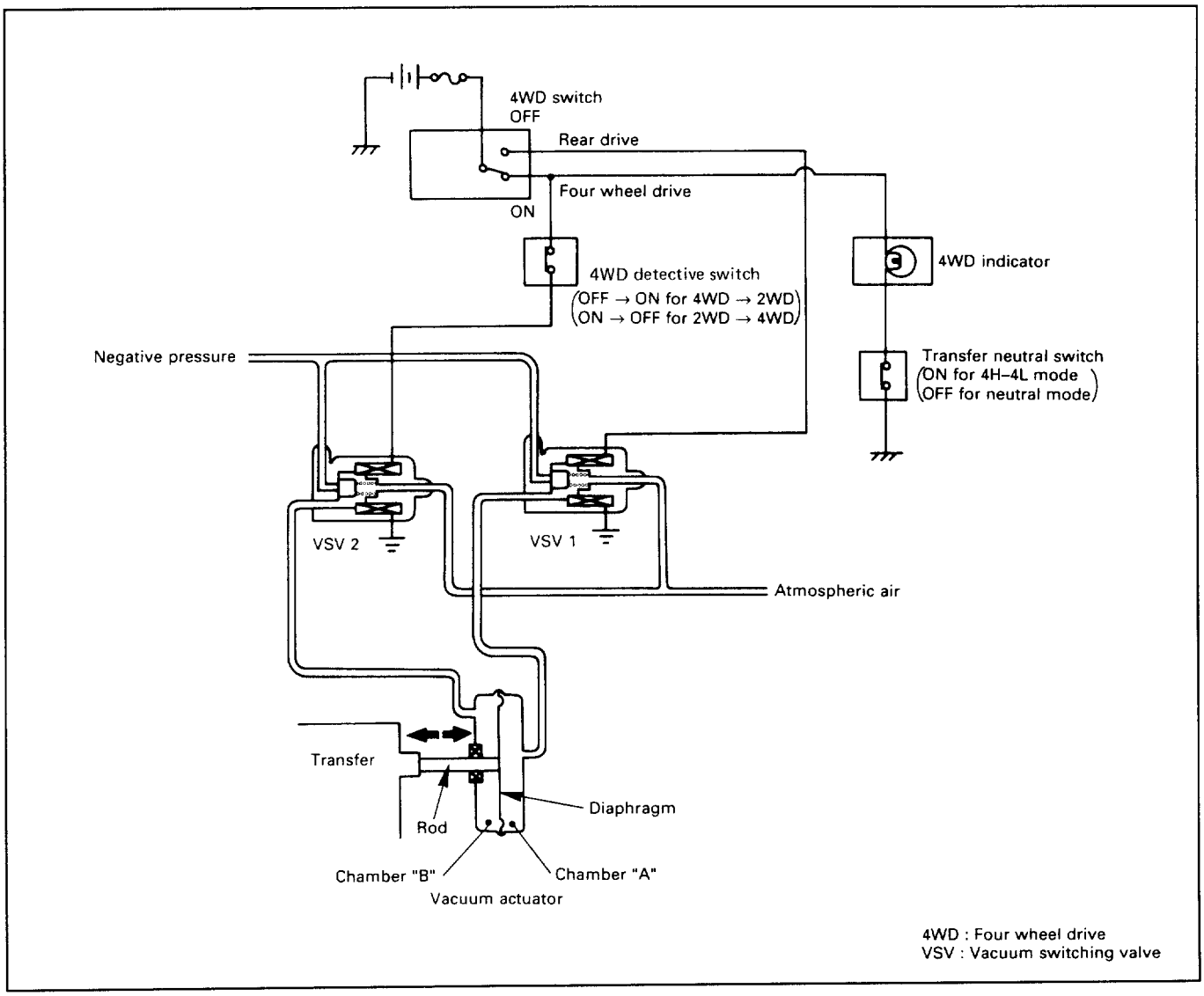
The drive force is reduced by one-step and transmitted to both rear wheels and front wheels as shown below:





TRANSFER CONTROL VACUUM ACTUATOR

Operational circuit diagram



Operational Description of Vacuum Actuator

When the 4WD switch turns off, the VSV 1 turns ON and the VSV 2 OFF. The chamber "A "of the actuator is applied with a negative pressure through the VSV 1 and the chamber "B" with the atmospheric air pressure through the VSV 2. This causes the actuator diaphragm to be pulled toward the chamber "A" side and held in the rear drive mode by the actuator rod.

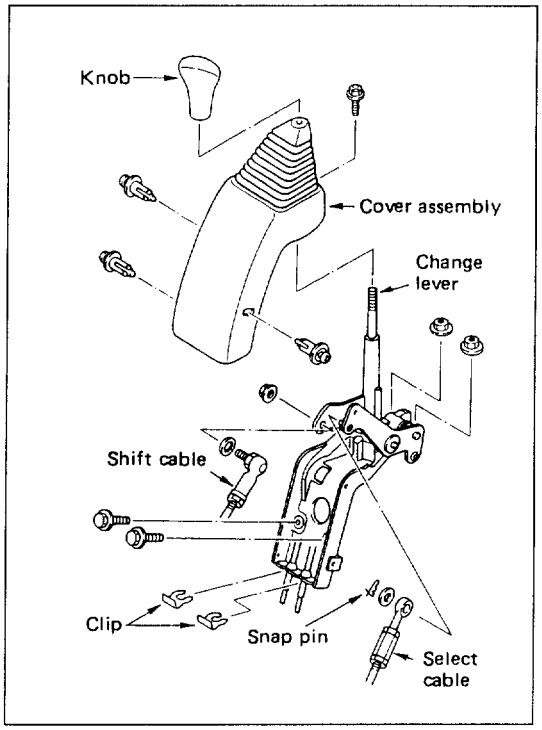
When the 4WD switch turns on, the VSV 1 turns OFF with the VSV 2 ON, and chamber "A" of the actuator is applied with the atmospheric pressure and the chamber "B" with the negative pressure, thus the actuator diaphragm being pulled toward the chamber "B" side and set to the four-wheel drive mode by the actuator rod.

In accordance with this operation, the 4WD detective switch turns off and the circuit of the VSV 2 is cut off to turn the VSV 2 OFF. But the actuator rod maintains the 4WD mode by the detent ball.

In this operation, the 4WD indicator lights also turns on.

ON-VEHICLE SERVICE

CHANGE LEVER ASSEMBLY REPLACEMENT



Removal Steps

1. **Change Lever Knob**
2. **Cover Assembly**
   - Remove the fixing screw and three clips.
3. **Shift Cable and Select Cable**
   - Disconnect the cables from the change lever.
   - Remove the clips and disconnect the cables from bracket.
4. **Change Lever Assembly**

Installation Steps

1. **Change Lever Assembly**
2. **Shift Cable and Select Cable**

When connecting the shift cable and the select cable to the change lever, adjust the cable.

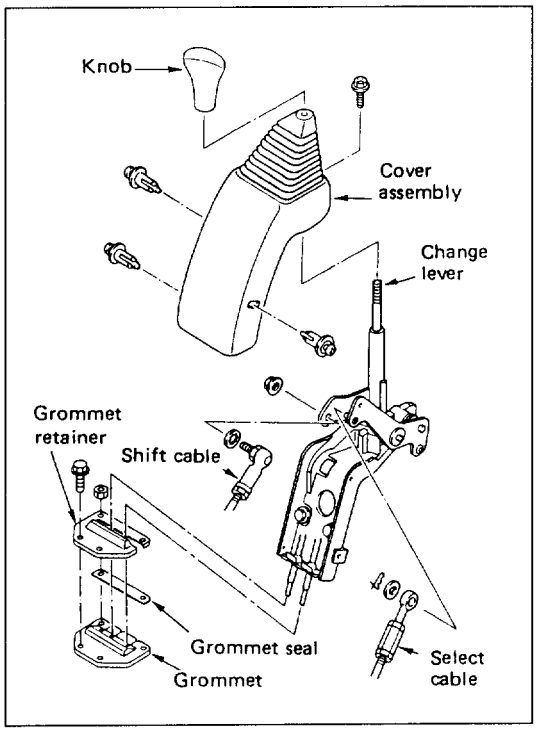
Refer to "GEAR CONTROL CABLE ADJUSTMENT" given previously in section 00.

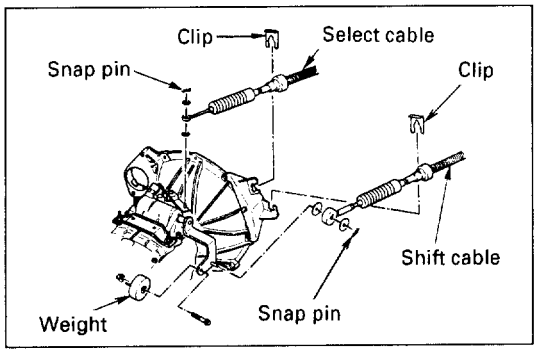
Lock nut torque	N·m (kg·m/lb·ft)
	21 (2.1/15.2)

3. **Cover Assembly**
4. **Change Lever Knob**

GEAR CONTROL CABLE REPLACEMENT

Removal Steps





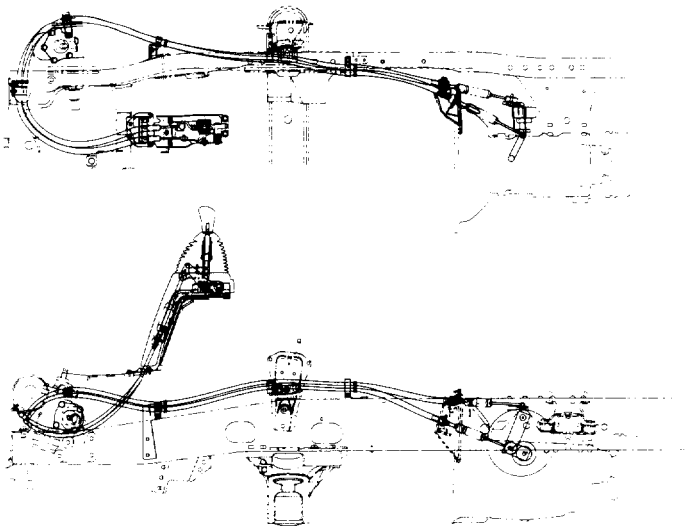
1. **Change Lever Knob**
2. **Cover Assembly**
3. **Shift Cable and Select Cable**
   1) Disconnect the shift and select cables from change lever.
   2) Remove the clips and disconnect the cables from change lever bracket.
   3) Remove the grommet retainer, grommet seal and grommet.
   4) Raise vehicle and support with suitable safety stands.
   5) Tilt the cab.
   6) Disconnect the shift cable and the select cable on the transmission side.
   7) Remove the c-clips and disconnect the shift cable and the select cable from the bracket.
   8) Remove the clips that fix the cables to the frames.
   9) Remove the shift and select cable assemblies.

Inspection and Repair

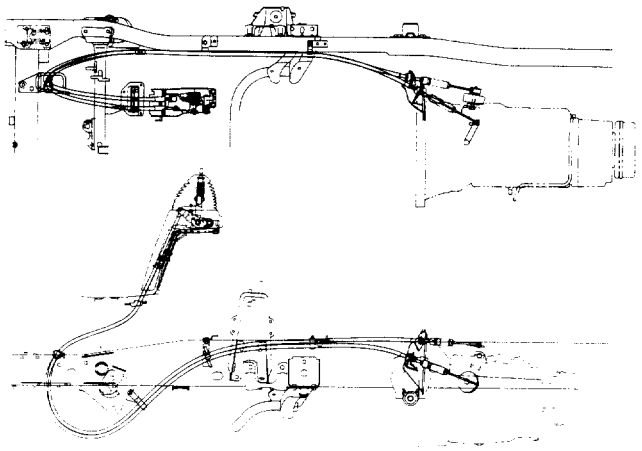
Check the cables for any deformation, damage or rust, and also check the sliding portion for any abnormal condition.

When there is any abnormal condition found, replace it with a new one.

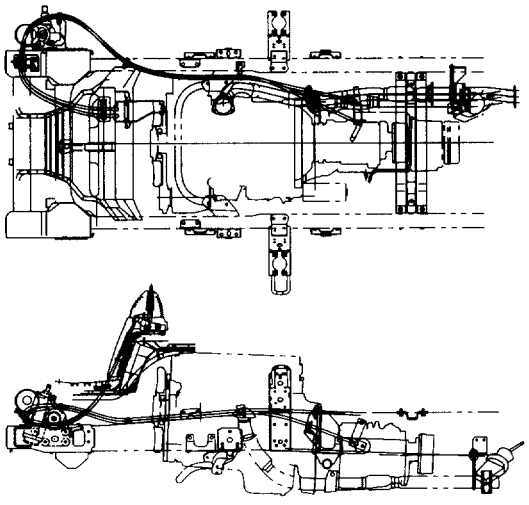
NKR



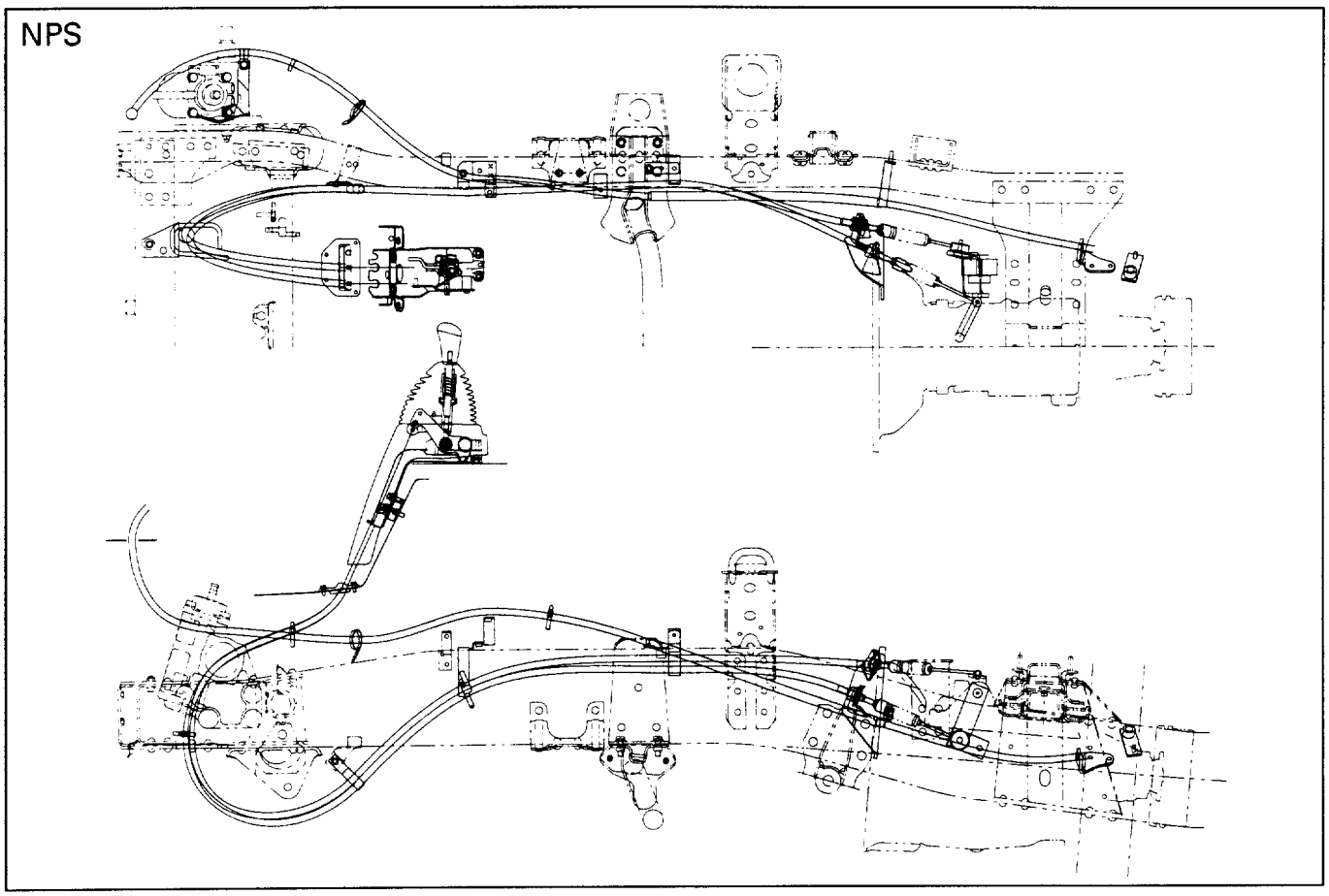
NPR



NQR



236LT002



Installation Steps

1. **Shift Cable and Select Cable**
   1) Install temporarily that the shift cable and the select cable.

CAUTION:

Never bend the cables to radius less than 450 mm (18 in) unless it is necessary to do so for wiring purposes. And never bend the cables to radius less than 180 mm(7 in) even during wiring.

Install the cables carefully without unnecessary twisting the cable boots.

   2) Fasten the cables with clips to the brackets on the transmission side.
   3) Fasten the cables with clips to the change lever bracket.
   4) Fasten the cables with clips to the frames. At this time, take care that the select cable comes above the shift cable.

5) Connect the shift cable and the select cable to the transmission.

Select Cable Nut Torque	N·m(kg·m/lb·ft)
	21 (2.1/15)

Shift Weight Fixing Nut Torque	N·m(kg·m/lb·ft)
	103 (10.5/76)

6) Install the grommet, grommet seal and grommet retainer.

Fixing Bolt & Nut Torque	N·m(kg·m/lb·ft)
	11 (1.1/8)

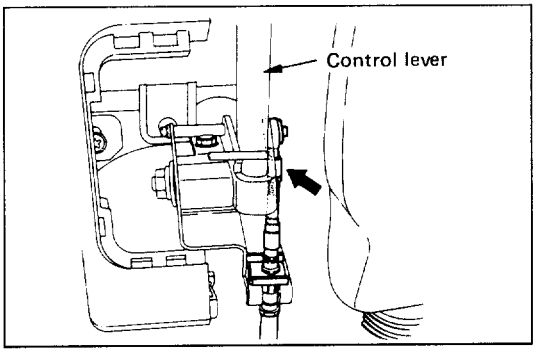
7) When connecting the shift cable and the select cable to the change lever, adjust the cables.
   Refer to "GEAR CONTROL CABLE ADJUSTMENT" given previously in section 00.

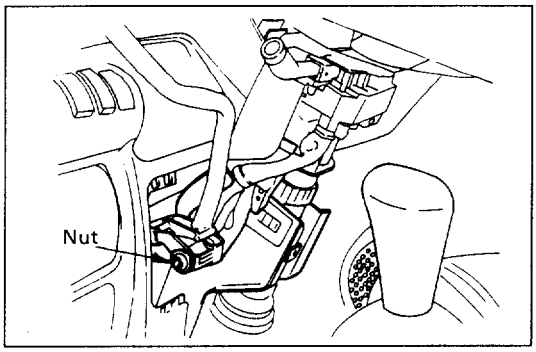
2. **Cover Assembly**
3. **Change Lever Knob**

TRANSFER CONTROL LEVER AND CONTROL CABLE REPLACEMENT

Removal Steps

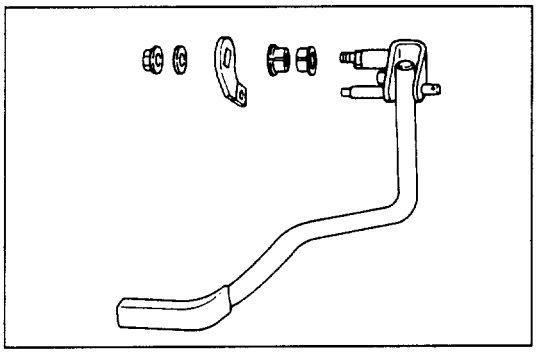
1. **Switch Cover**
   - Pull the switch cover to remove.
2. **Steering Cowl**
3. **Split Pin**
   - Remove the split pin from the control lever, then disconnect the control cable.
4. **Control Lever Assembly**

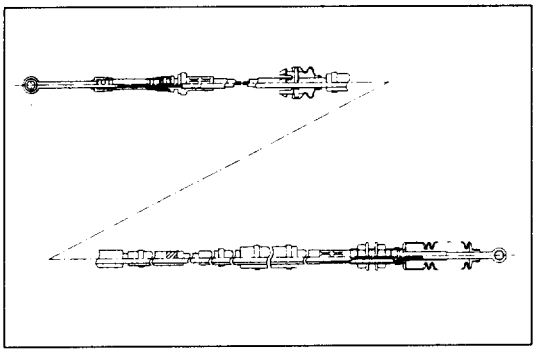




- Remove the fulcrum pin nut.
- Remove the control lever assembly with bush.

5. **Clip**
   - Remove the clips from the select bracket (transfer side) and the bracket (control lever side).
6. **Adjust Nut**
   - Loosen the adjust nut.
7. **Split Pin**
   - Remove the fixing bolt.
8. **Clip and Clamp**
   - Remove the clips and the clamp that fix the control cable to the frames.
9. **Control Cable Assembly**





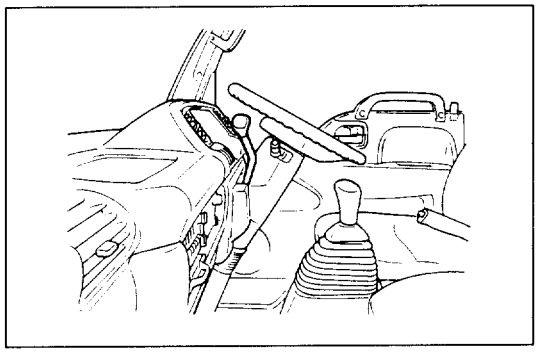
Inspection and Repair

Check the cables for any deformation, damage or rust, and also check the sliding portion for any abnormal condition.

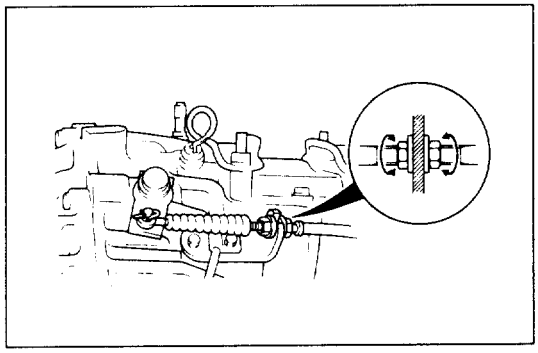
When there is any abnormal condition found, replace it with a new one.

Installation Steps

1. **Control Cable Assembly**
2. **Clip and Clamp**
3. **Clip**
4. **Control Lever Assembly**
5. **Split Pin**
6. **Steering Cowl**
7. **Switch Cover**
8. **Adjust Nut**



1) Set the transfer control lever in the high speed range (4H) position.

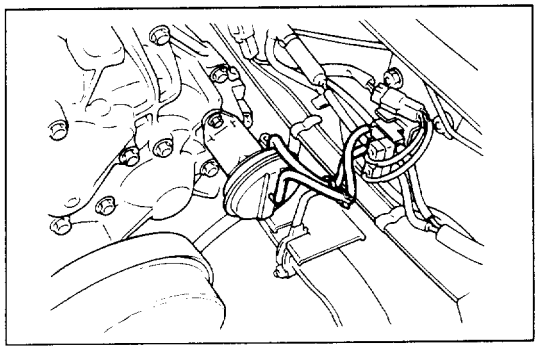


2) Set the external shift lever of transfer in the high speed range (4H) position.
3) Adjust the position of the control cable eye end, then connect the control cable to the external shift lever
4) Tighten the adjust nut.

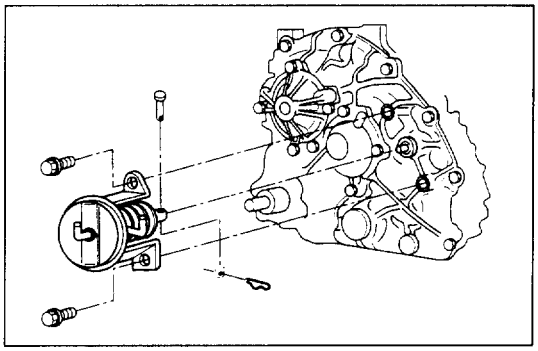
9. **Washer and Split Pin.**

TRANSFER CONTROL VACUUM ACTUATOR REPLACEMENT

Removal Steps



1. **Vacuum Hose**
   - Attach a tag to the vacuum hose, then note current position for proper installation.

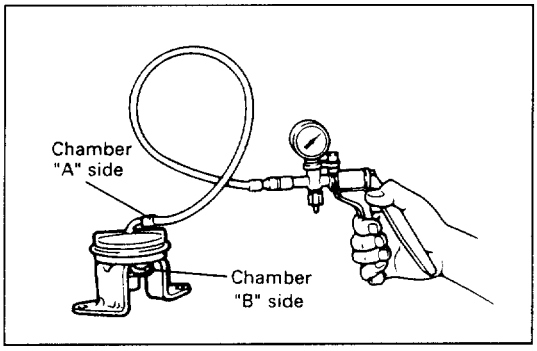


2. **Snap Pin and Joint Pin**
   - Turn over the dust boot, then remove the snap pin and the joint pin.
3. **Vacuum Actuator**

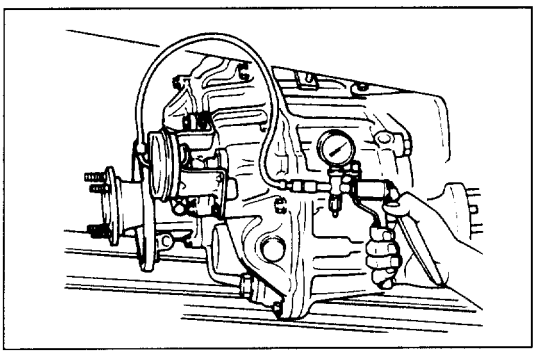
Inspection and Repair

Make necessary adjustments, repairs, and part replacements if excessive wear, or damage is discovered during inspection.

Inspection of the Vacuum Actuator



1. **Unit Inspection**
   1) Install the mighty bag to the chamber "A" side.
   2) Operate the mighty bag to apply a negative pressure to the chamber "A". Check to see if the vacuum actuator rod moves toward the chamber "A" side.
   3) And then, install the mighty bag to the chamber "B" side and apply a negative pressure to it. Check to see if the vacuum actuator rod moves toward the chamber "B" side.

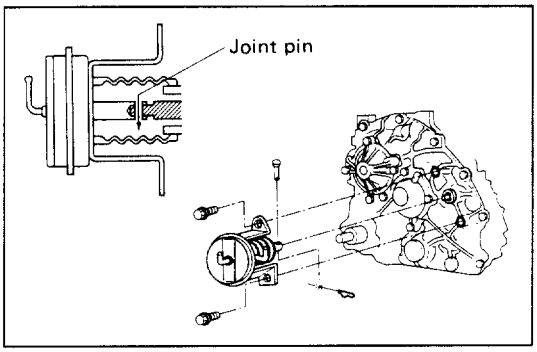


2. **Inspection When Installed**

   The inspection should be performed so that the operation of the shift rod can be confirmed by turning over the dust boot.
   1) Install the mighty bag to the chamber "A" side.
   2) With the negative pressure applied to the chamber "A" while operating the mighty bag, check to see if the shift rod moves toward the rear drive side .

      At this time, the shift rod should be fixed to the four-wheel drive side.
   3) Under the same conditions as 2) above, install the mighty bag to the chamber "B" side and apply a negative pressure in the same way. Check to see if the shift rod moves toward the four-wheel drive side.

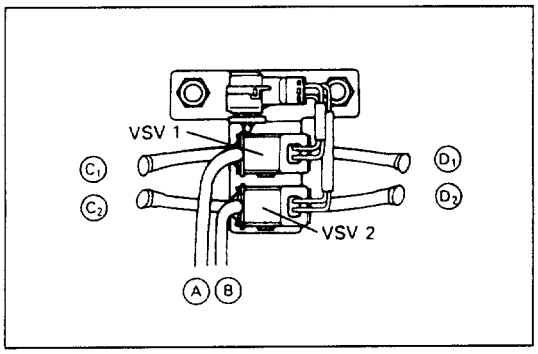
Installation Steps



1. **Vacuum Actuator**
2. **Snap Pin and Joint Pin**
3. **Vacuum Hose**
   - Reference the tag previously noted during removal.

TRANSFER CONTROL VACUUM SWITCHING VALVE (VSV) INSPECTION

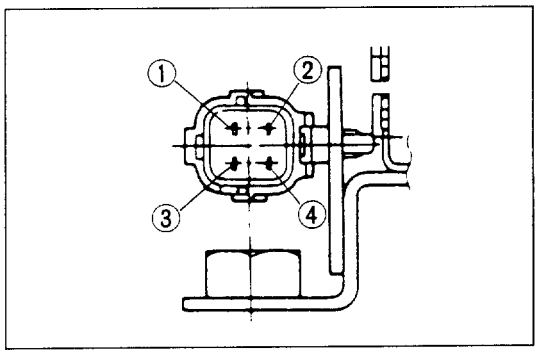
Inspection and Repair



1. **Check continuity between hoses.**

4WD SW (with key SW is ON position) \ Hose	VSV 1			VSV 2		
	Ⓐ	Ⓒ1	Ⓓ1	Ⓑ	Ⓒ2	Ⓓ2
ON	○——	——○		○—	—○	
OFF	○—	—○		○—	——	○

Ⓐ,Ⓑ.... Vacuum hose from the vacuum actuator.
Ⓒ1,Ⓒ2.... Negative pressure side hose.
Ⓓ1,Ⓓ2.... Atomospheric pressure side hose.

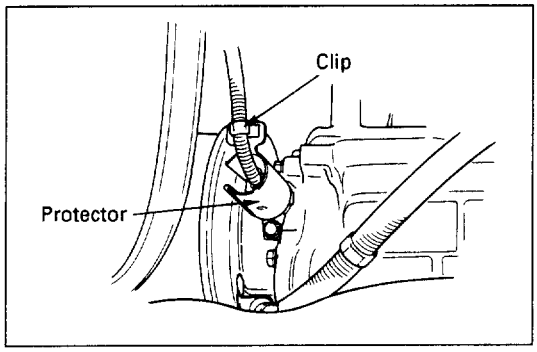


2. **Check continuity between terminals.**

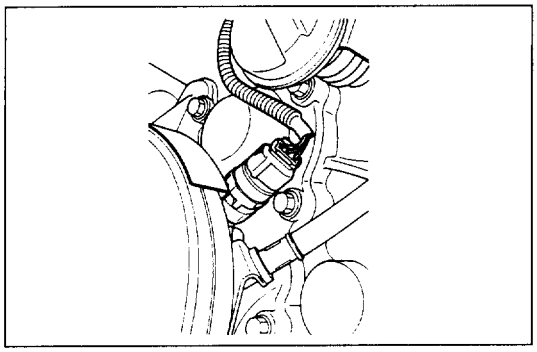
Condition \ Terminal No.	①	②	③	④
VSV 1 (Resistance approx. 137Ω)	○——	——○		
VSV 2 (Resistance approx. 137Ω)			○—	—○

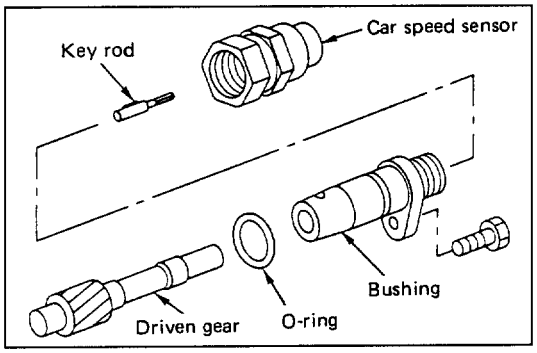
CAR SPEED SENSOR DRIVEN GEAR REPLACEMENT

Removal Steps



1. **Protector (for without transfer type only)**
2. **Wiring Connector**





3. **Car Speed Sensor with Key Rod**
4. **Car Speed Sensor Driven Gear Assembly**
   - Remove the fixing bolt.
   - Remove the driven gear assembly.

Installation Steps

1. **Car Speed Sensor Driven Gear Assembly**

Fixing Bolt Torque	N·m(kg·m/lb·ft)
	15 (1.5/11)

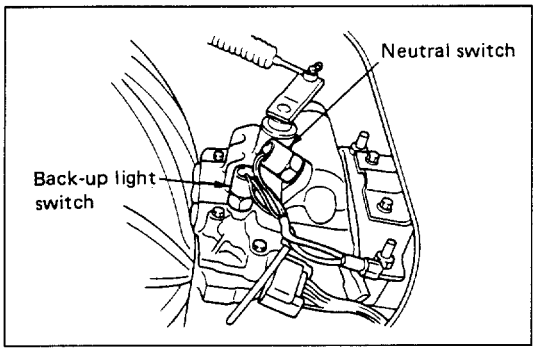
2. **Car speed Sensor with Key Rod**

Fixing Bolt Torque	N·m(kg·m/lb·ft)
	25 (2.5/18)

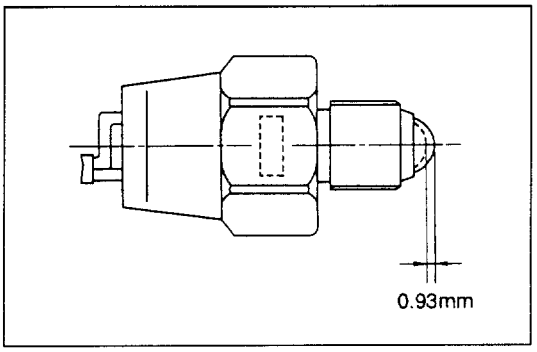
3. **Wiring Connector**
4. **Protector (for without transfer type only)**

BACK-UP LIGHT SWITCH AND NEUTRAL SWITCH REPLACEMENT

Removal Steps



1. **Wiring Connector**
2. **Switch**



Inspection and Repair

- When there is continuity between the terminals in the condition as it is, and when the continuity between the terminals is turned off by pressing the ball of the switch, the switch is normal.

Switch Operating Stroke	mm (in)
0.93 (0.037)	

Installation Steps

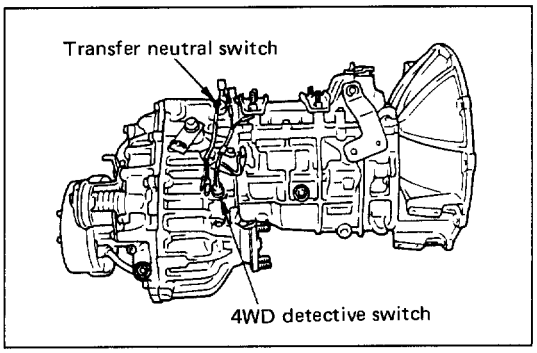
1. **Switch**
   - Apply liquid gasket (Three Bond 1141 or equivalent) to the switch's threaded portion to prevent oil leakage, and install the switch to the control box.
   - Color of Connector
     Back-up Light Switch: Brown
     Neutral Switch: Gray

Switch Torque	N·m (kg·m/lb·ft)
34 (3.5/25)	

2. **Wiring Connector**

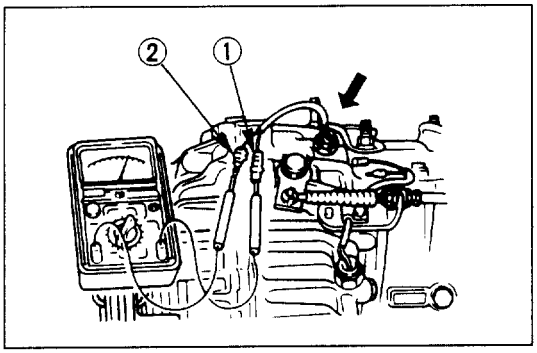
TRANSFER NEUTRAL SWITCH AND 4WD DETECTIVE SWITCH REPLACEMENT

Removal Steps



1. **Wiring Connector**
2. **Switch**

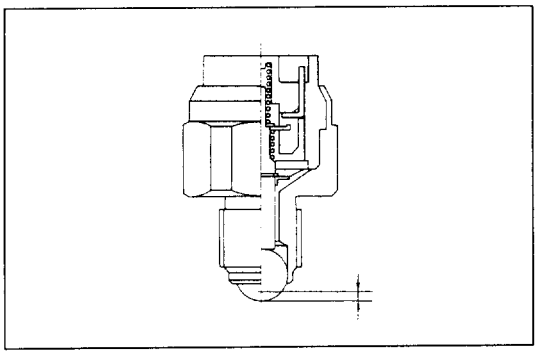
Inspection and Repair



Transfer Neutral Switch

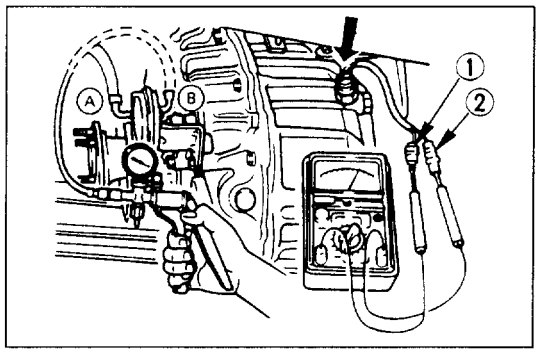
Inspect the switch continuity using this table.

Transfer gear shift lever position \ Terminal No.	①	②
2H • 4H or 4L	○——	——○
N (neutral)		



Transfer Neutral Switch Unit Inspection

If continuity exists when the ball of the transfer neutral switch is pushed up over 1.53mm (0.060 in), the transfer neutral switch is judged to be normal.



4WD Detective Switch

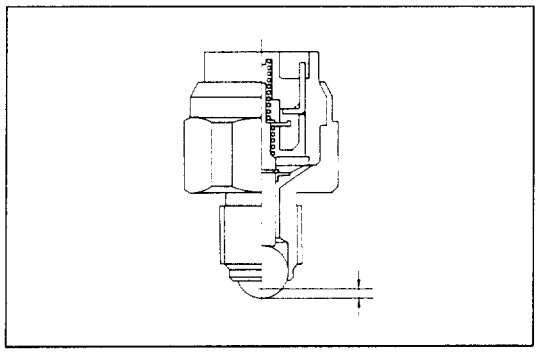
When the vacuum actuator's A chamber or B chamber is vacuumized with the vacuum pump and the transfer switch indicates conductivity as shown below, both the transfer switch and vacuum actuator are functioning properly.

Vacuum condition of vacuum actuator \ Terminal No.	①	②
A chamber vacuum	○——	——○
B chamber vacuum		

When the switch is not functioning properly, peel off the dust boot and vacuumize the vacuum actuator to verify whether the actuator rod is functioning.

Actuator rod is functioning : The transfer switch is defective

Actuator rod is not functioning : The actuator is defective.



4WD Detective Switch Unit Inspection

If continuity exists when the ball of the 4WD detective switch is pushed up over 1.53mm (0.060 in), the 4WD detective switch is judged to be normal.

Installation Steps

1. **Switch**
   - Apply liquid gasket (Three Bond 1141 or equivalent) to the switch's threaded portion to prevent oil leakage, and install the switch to the control box.

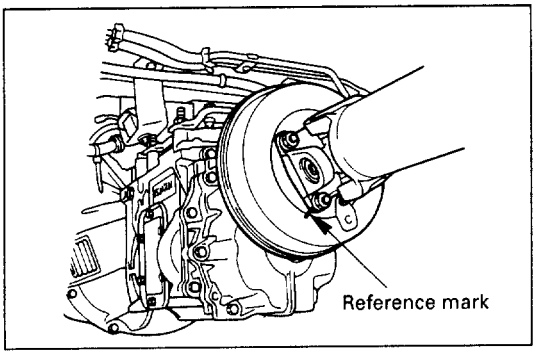
Switch Torque	N·m (kg·m/lb·ft)
	34 (3.5/25)

2. **Wiring Connector**

REAR OIL SEAL REPLACEMENT

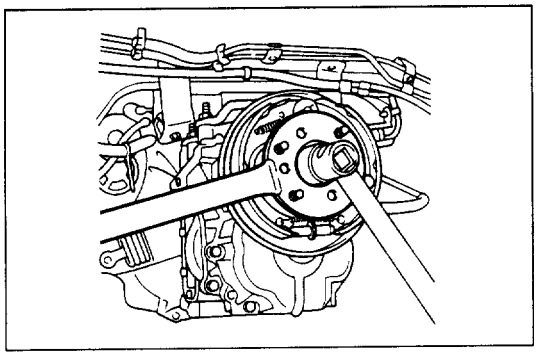
Removal Steps

- Raise vehicle and support with suitable safety stands.



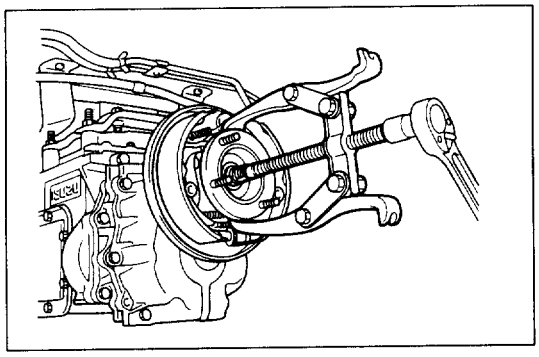
1. **Propeller Shaft**
   - Scribe reference mark to the flange yoke and the parking brake drum for proper installation.
   - Disconnect the propeller shaft at flange yoke.
   - Put aside the propeller shaft and tie it to the frame so it does not interfere with servicing work.

2. **Parking Brake Drum**
   - Remove the screw and the adjust hole cover.
   - It may be necessary to back off the shoe adjuster.



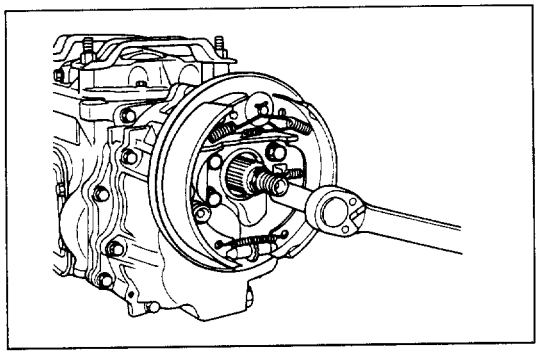
3. **Lock Nut**
   - Make sure to raise the caulking of the coupling driver lock nut, then remove the lock nut.
   - Use the handle to remove the lock nut.

     Handle: 5-8840-2043-0



4. **Coupling Driver**
   - Remove the coupling driver using the universal puller.

     Universal Puller: 5-8840-2027-0
   - Remove the conical washer and the o-ring.

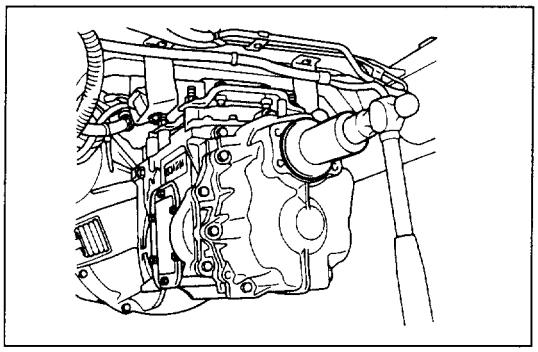


5. **Parking Brake Assembly**

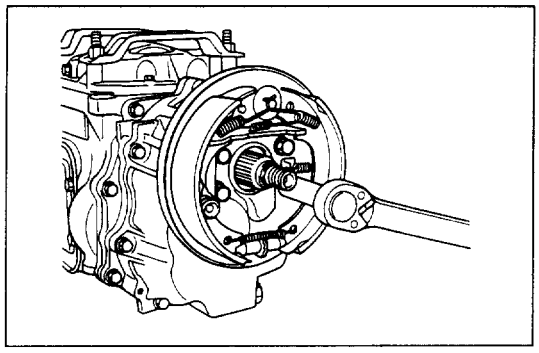
6. **Oil Seal**
   - Use the screwdriver to remove the oil seal from the rear cover.

CAUTION:
Take care not to damage the sealing seat of the rear cover.

Installation Steps

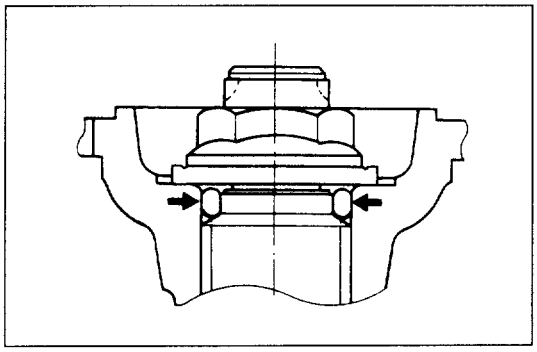


1. **Oil Seal**
   - Apply engine oil to the new oil seal outer circumference and apply multi-purpose grease to the oil seal lip.
   - Use the oil seal installer to install the oil seal to the rear cover.
     Oil Seal Installer: 5-8840-2242-0



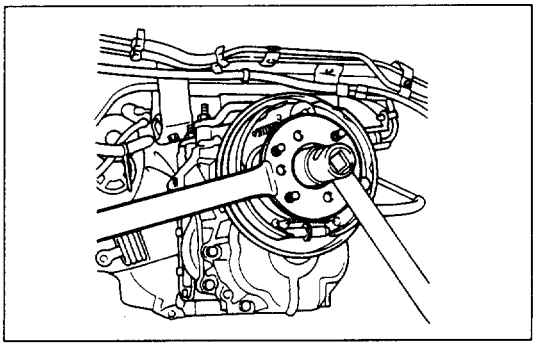
2. **Parking Brake Assembly**

Parking Brake Bolts Torque	N·m (kg·m/lb·ft)
	83 (8.5/61)



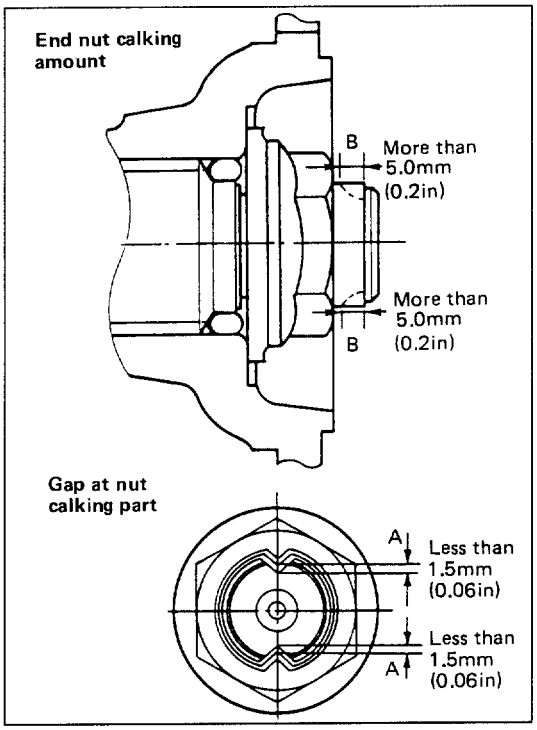
3. **Coupling Driver**
4. **Lock Nut**
   - Install the o-ring and the conical washer.
   - The conical washer is to be set up with its identification groove to the nut side.

CAUTION:
Do not reuse the lock nut.



- Apply the engine oil to the setting face of the new lock nut and tighten it up at the specified torque.
  Handle: 5-8840-2043-0

Lock Nut Torque	N·m (kg·m/lb·ft)
	226 (23.0/166)



- align the lock nut with the V-shaped groove at the tip of the main shaft, and caulk the nut lip portion by using a chisel.
  (Round edge approximately 1 mm (0.04 in)×60°).
- As shown in the illustration, be sure to caulk the nut lip so that the clearance between the V-shaped groove portion at the tip of the main shaft and the caulked up lip(A) is less than 1.5 mm (0.06 in), and the caulking length(B) is 5 mm (0.2 in) or more.

CAUTION:

Be sure to confirm that there is no crack at the caulked portion of the end nut after caulking.

5. Parking Brake Drum

- Adjust the parking brake after installation.

1) Rotate the brake drum to align the adjust hole with the adjuster.
2) Move the camshaft lever from side to side several times to center the brake shoes.
3) Insert a screwdriver into the hole and rotate the adjuster by pushing it upward until the shoes drag on the drum.
4) Back off the adjuster 30 notches.

- Install the adjust hole cover.

Adjust Cover Hole Bolt Torque	N·m (kg·m/lb·in)
8 (0.8/69)	

6. Propeller Shaft

- Align reference marks previously made during removal.

Propeller Shaft Bolt Torque	N·m (kg·m/lb·ft)
103 (10.5/76)	

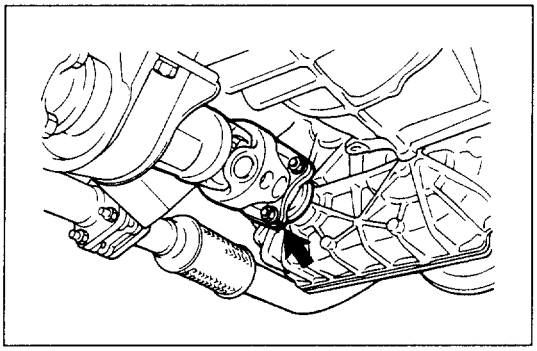
- Remove the safety stands.

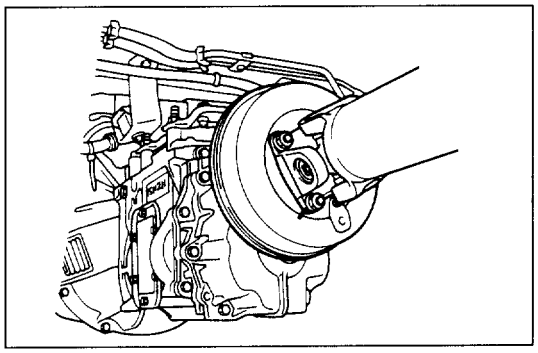
TRANSMISSION ASSEMBLY REPLACEMENT

Removal Steps

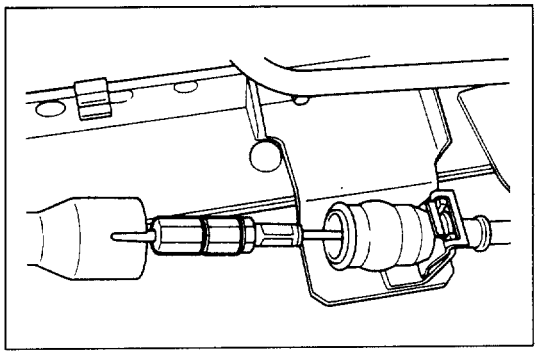
- Raise vehicle and support with suitable safety stands.

1. **Front Exhaust Pipe (for with transfer type only)**
2. **Front Propeller Shaft (for with transfer type only)**
   - Scribe reference mark to the flange yoke and the transfer flange for proper installation.
   - Disconnect the propeller shaft at flange yoke.
   - Put aside the propeller shaft and tie it to the frame so that it does not interfere with servicing work.

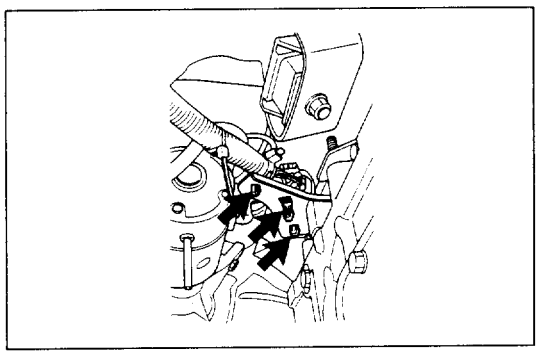




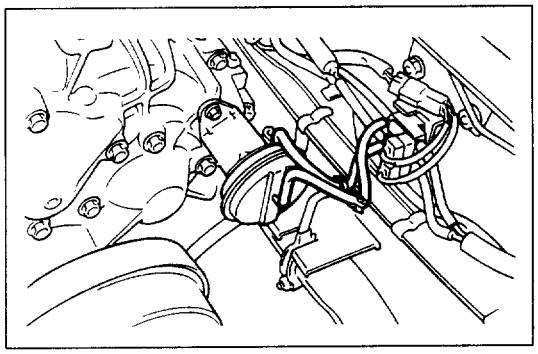
3 **Rear Propeller Shaft**
   - Scribe reference mark to the flange yoke and the parking brake drum for proper installation.
   - Disconnect the propeller shaft at flange yoke.
   - Put aside the propeller shaft and tie it to the frame so that it does not interfere with servicing work.



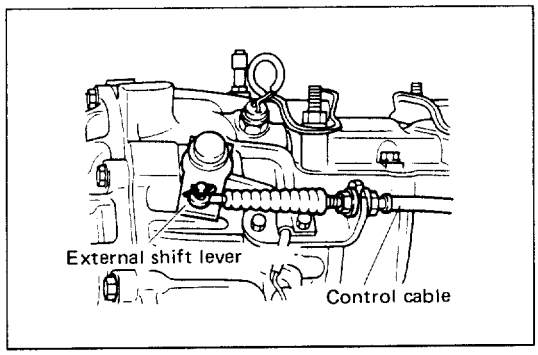
4. **Parking Brake Cable**
   - Move the joint cover.
   - Disconnect the joint bolt.
   - Remove the c-clip then disconnect the cable from the bracket.



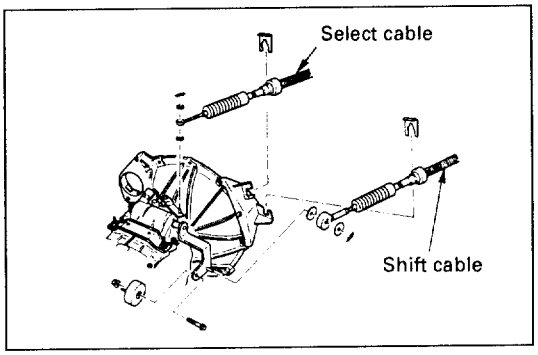
5. **Wiring Connector**
   - Disconnect the wiring connectors from the car speed sensor, the neutral switch, the back-up light switch, the transfer neutral switch and the 4WD switch.



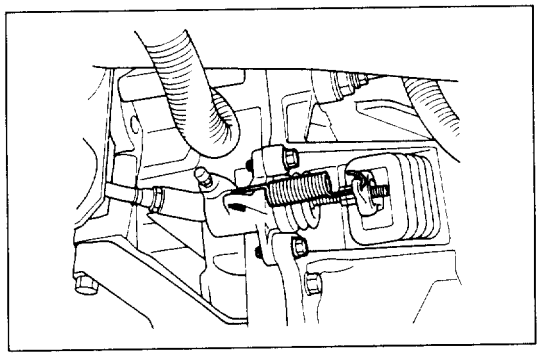
6. **Vacuum Hose (for with transfer type only)**
   - Disconnect the vacuum hose from the actuator.



7. **Transfer Control Cable (for with transfer type only)**

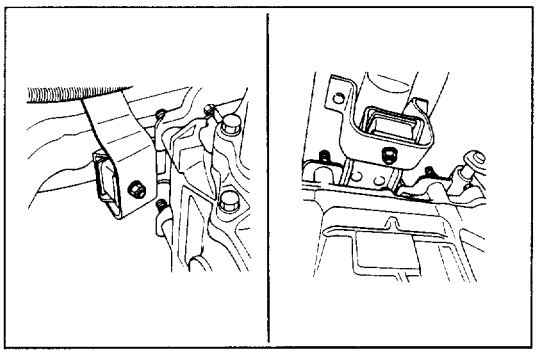


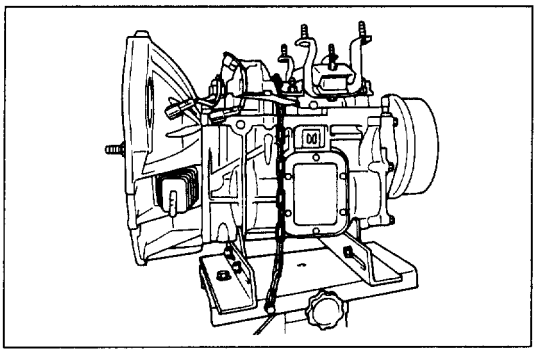
8. **Shift Cable and Select Cable**
   - Disconnect the shift cable and select cable on the transmission side.

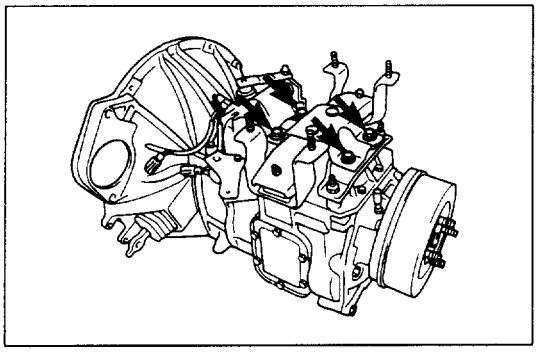


9. **Clutch Slave Cylinder**
   - Remove the slave cylinder assembly with the flexible hose attached, and then tie it to the frame so that it does not interfere with servicing work.

10. **Starter Motor Ground Cable**
11. **Starter Motor**
    - Remove the starter motor, and then tie it to the frame so that it does not interfere with servicing work.







12. **Transmission Assembly**

NOTE:

The exhaust pipe bracket, the gear control bracket and the clips are sometimes installed in the wrong position or direction confusedly. To prevent incorrect installation of these parts, put a correct installation mark on them.

- Support the transmission with mission jack.

CAUTION:

To prevent the falling of the transmission, tie it firmly to the jack with a chain or belt.

Do not allow transmission to hang unsupported from clutch. Damage to the clutch assembly will result.

- Remove the nuts of the transmission mounting bracket on the crossmember side.
- Remove transmission fastening bolts.
- Pull out the transmission assembly rearward.

13 **Mounting Bracket**

Installation steps

1. **Mounting Bracket**

Mounting Bracket Nuts Torque	N·m (kg·m/lb·ft)
	40 (4.1/30)

2. **Transmission Assembly**

- Support the transmission with mission jack.

CAUTION:

To prevent the falling of the transmission, tie it securely to the jack with a chain or belt.

- Shift transmission into high gear.
- Align transmission with engine slope.
- Turn output parking brake drum to aid clutch spline engagement.

Clutch Housing to Flywheel Hosing Bolts Torque	N·m (kg·m/lb·ft)
	46 (4.7/34)

Transmission Mounting Nuts Torque	N·m (kg·m/lb·ft)
	40 (4.1/30)

3. **Starter Motor**

Starter Motor Bolts Torque	N·m (kg·m/lb·ft)
	76 (7.7/56)

4. **Starter Motor Ground Cable**

Ground Cable Nuts Torque	N·m (kg·m/lb·ft)
	39 (4.0/29)

5. **Clutch Slave Cylinder**

Slave Cylinder Bolts Torque	N·m (kg·m/lb·ft)
	16 (1.6/12)

- Perform slave cylinder adjustment before installation of the return spring.

1) Loosen the lock nut of the push rod.
2) Turn the adjust nut until it reaches the shift fork.
3) Back off the adjust nut 1.5 turns.(shift fork free play Approximately 2 mm).
4) Tighten the lock nut.

Push Rod Lock Nut Torque	N·m(kg·m/lb·ft)
	19 (1.9/14)

6. **Shift Cable and Select Cable**
7. **Transfer Control Cable (for with transfer type only)**
8. **Vacuum Hose (for with transfer type only)**
9. **Wiring Connector**
   - Color of Connector
     Back-up Light Switch : Brown
     Neutral Switch : Gray
10. **Parking Brake Cable**
11. **Rear Propeller Shaft**
    - Align reference marks previously made during removal.

Propeller Shaft Nuts Torque	N·m (kg·m/lb·ft)
	103 (10.5/76)

12. **Front Propeller Shaft (for with transfer type only)**
    - Align reference marks previously made during removal.

Propeller Shaft Nuts Torque	N·m (kg·m/lb·ft)
	103 (10.5/76)

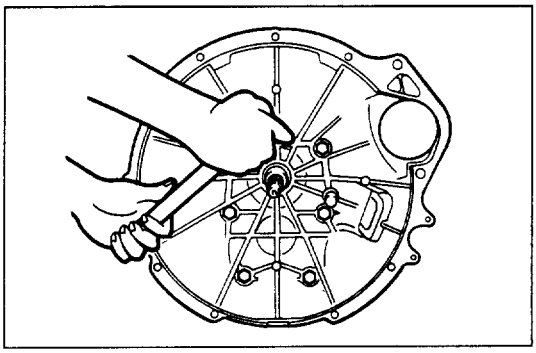
13. **Front Exhaust Pipe (for with transfer type only)**

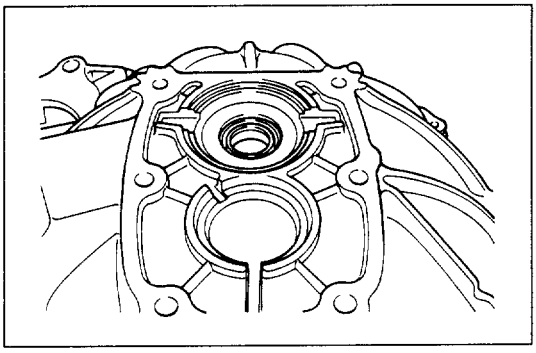
Nuts Torque	N·m (kg·m/lb·ft)
	50 (5.1/37)

FRONT OIL SEAL REPLACEMENT

Removal Steps

1. **Transmission Assembly**
   Refer to "ON-VEHICLE SERVICE: TRANSMISSION ASSEMBLY REPLACEMENT" previously in this section.
2. **Clutch Housing**

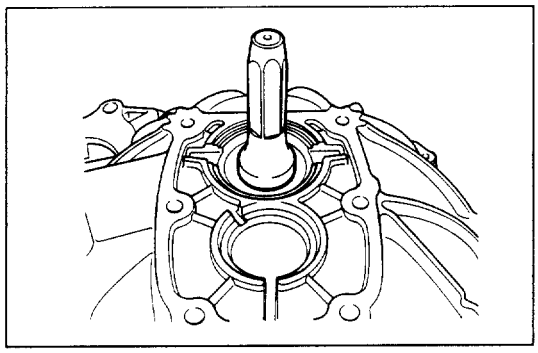




3. **Oil Seal**
   - Use the screwdriver to remove the oil seal from the clutch housing.

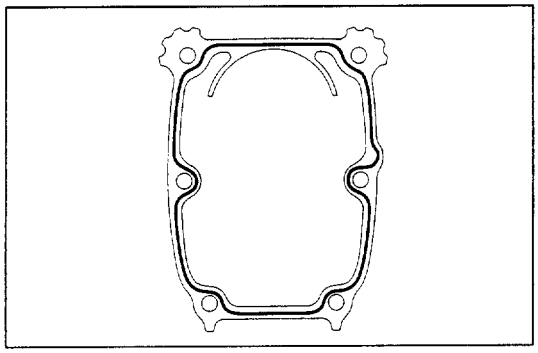
CAUTION:
Take care not to damage the sealing seat of the clutch housing.

Installation Steps



1. **Oil Seal**
   - Apply engine oil to the new oil seal outer circumference and apply multi-purpose grease to the oil seal lip.
   - Use the oil seal installer to install the oil seal to the clutch housing.

     Oil Seal Installer: 5-8840-2243-0



2. **Clutch Housing**
   - Remove water and oil on the mating face before applying the sealant.
   - Apply a ø 2 mm (0.08 in) bead of the liquid gasket (Three Bond 1215 or equivalent) to the clutch housing surface shown in the illustration.

   NOTE:

   Install the clutch housing on the transmission case within 30 minutes after liquid gasket application.

Clutch Housing to Transmission Case Bolts Torque	N·m (kg·m/lb·ft)
	81 (8.3/60)

3. **Transmission Assembly**

   Refer to "TRANSMISSION ASSEMBLY REPLACEMENT" previously in this section.

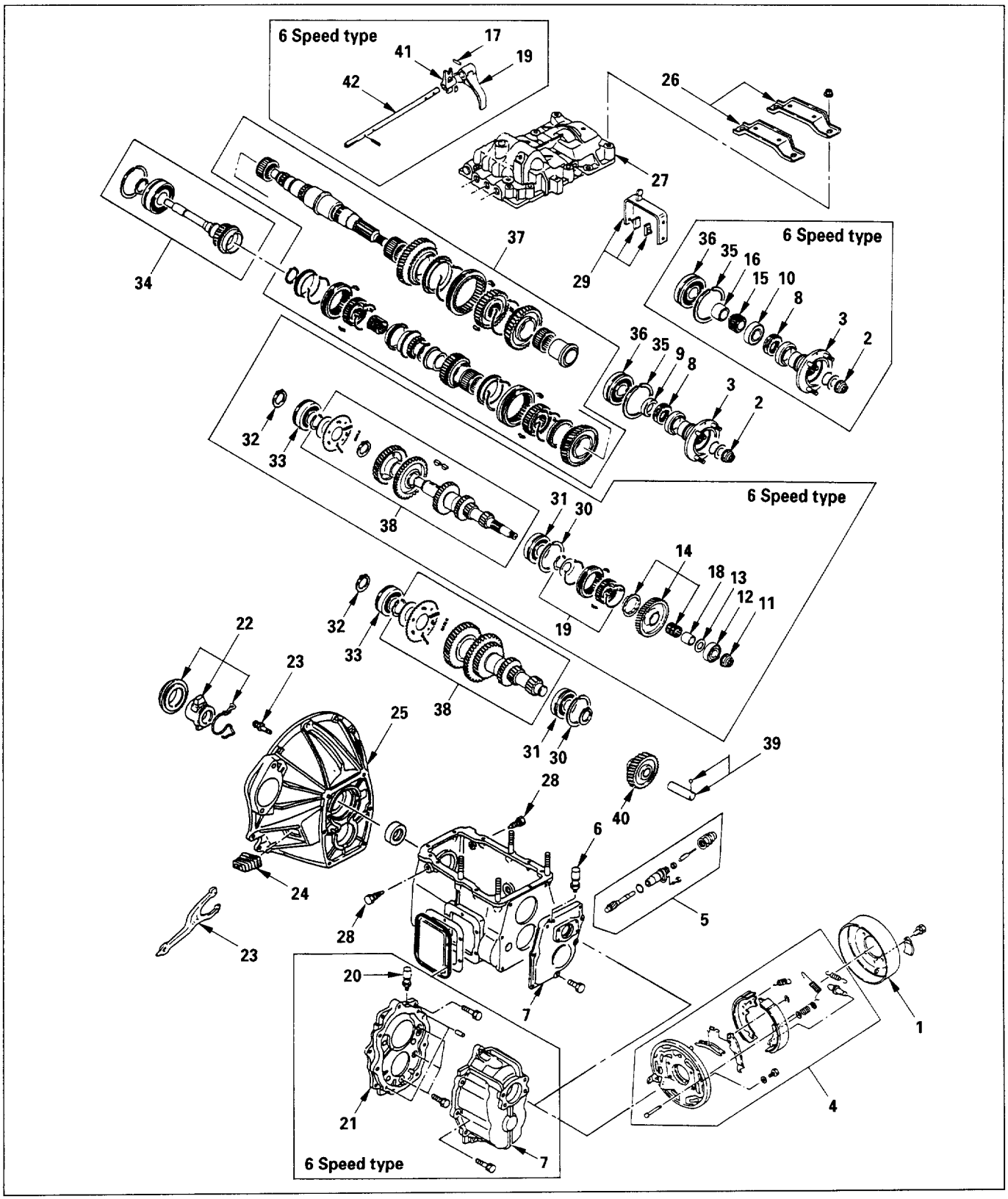
Clutch Housing to Flywheel Housing Bolts Torque	N·m (kg·m/lb·ft)
	46 (4.7/34)

MEMO

UNIT REPAIR

MAJOR COMPONENTS

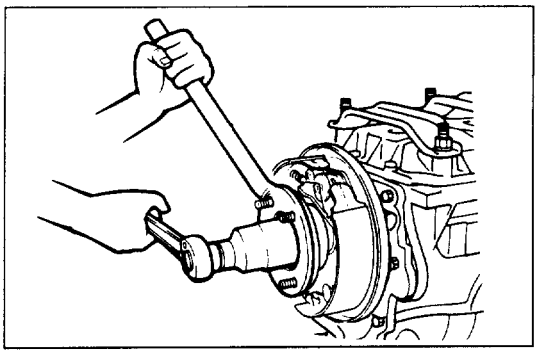
DISASSEMBLY



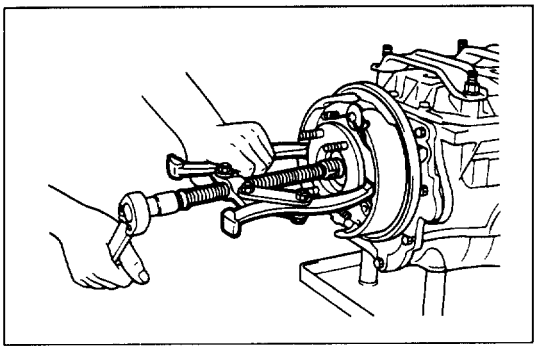
Disassembly step

1. Parking brake drum
2. Lock nut
3. Coupling driver
4. Parking brake assembly
5. Car speed sensor driven gear assembly
6. Breather (for 5 speed type only)
7. Rear cover
8. Car speed sensor drive gear
9. Spacer (for 5 speed type only)
10. Ball Bearing (for 6 speed type only)
11. Lock nut (for 6 speed type only)
12. Ball Bearing (for 6 speed type only)
13. Plate (for 6 speed type only)
14. Counter 6th gear assembly (for 6 speed type only)
15. Main 6th gear (for 6 speed type only)
16. Spacer (for 6 speed type only)
17. Spring pin (for 6 speed type only)
18. Collar (for 6 speed type only)
19. Synchronizer assembly & shift arm
20. Breather (for 6 speed type only)
21. Intermediate plate
22. Shift block assembly
23. Shift fork and support bolt
24. Dust cover
25. Clutch housing
26. Mounting bracket
27. Control box assembly
28. Fulcrum bolt
29. 4th/5th shift arm & shift piece
30. Snap ring
31. Counter shaft rear bearing
32. Snap ring
33. Counter shaft front bearing
34. Top gear shaft assembly
35. Snap ring
36. Main shaft rear bearing
37. Main shaft assembly
38. Counter shaft assembly
39. Reverse idle gear shaft & lock ball
40. Reverse idle gear
41. 6th shift block (for 6 speed type only)
42. 6th shift rod (for 6 speed type only)

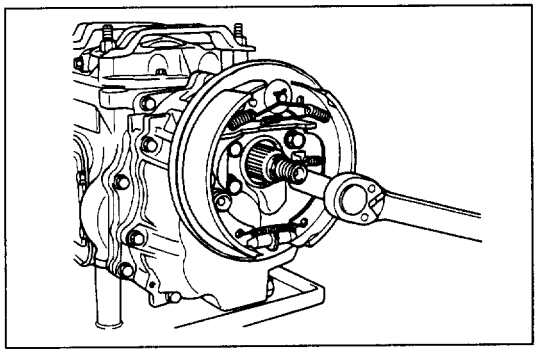
Disassembly Step



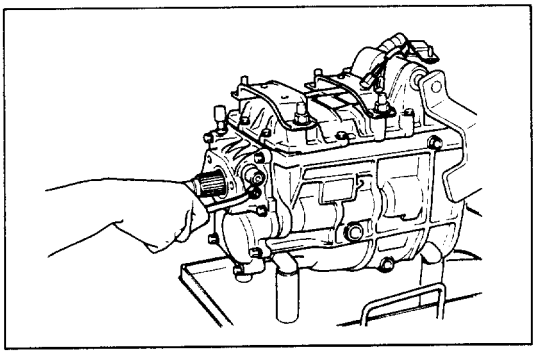
1. **Parking Brake Drum**
   - Remove the screw and the adjust hole cover.
   - It may be necessary to back off the shoe adjuster.
2. **Lock Nut**
   - Make sure to rise the caulking of the coupling driver lock nut.
   - Use the handle to remove the lock nut.
     Handle : 5-8840-2043-0



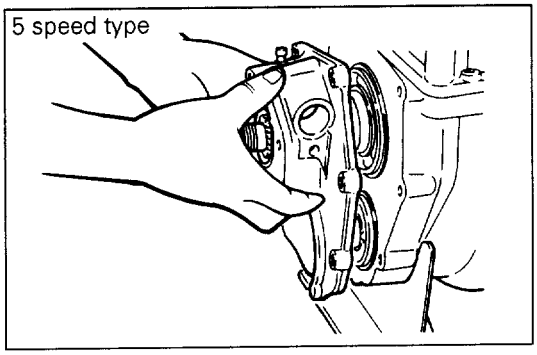
3. **Coupling Driver**
   - Remove coupling driver using the bearing remover
     Bearing Remover : 5-8840-2198-0
   - Remove conical washer and o-ring.



4. **Parking Brake Assembly**



5. **Car Speed Sensor Driven Gear Assembly**
   - Remove the car speed sensor with the key rod.
   - Remove the fixing bolt
   - Remove the driven gear assembly.



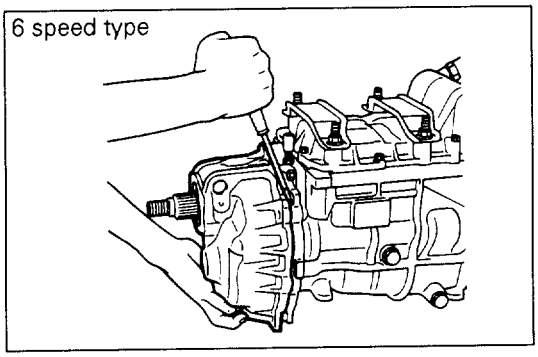
6. **Breather (for 5 speed type only)**
7. **Rear Cover**
   - **5 speed type**

     Remove 7 fixing bolts. Tap the rear cover with a copper or plastic hammer to remove it. The rear cover is provided with lugs for hammering both side.

   - **6 speed type**

     Remove 7 fixing bolts. Prize off the rear cover with a screwdriver.

   - Remove the oil seal using the screwdriver.



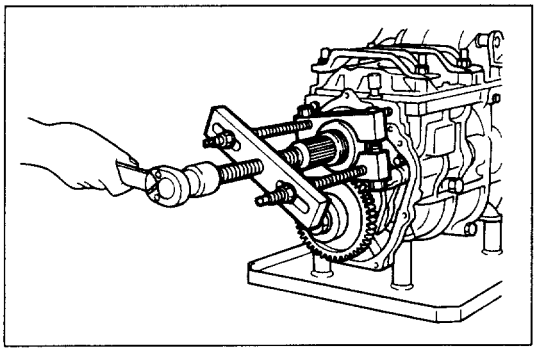
CAUTION:

Take care not to damage the sealing seat of the rear cover with the screwdriver.

8. **Car Speed Sensor Drive Gear**
   - **6 speed type**

     Remove car speed sensor drive gear together with ball bearing(10).

9. **Spacer (for 5 speed type only)**

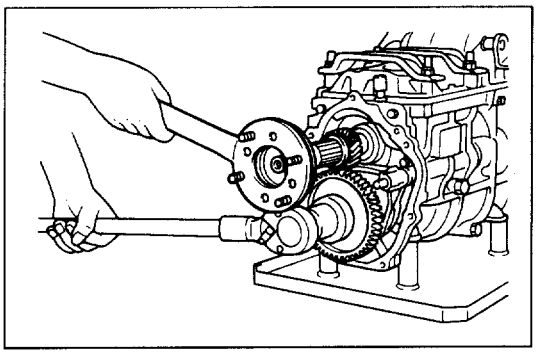


10. Ball Bearing (for 6 speed type only)

- Remove ball bearing using the bearing remover.

  Bearing Remover : 5-8840-2112-0
  Universal Puller : 5-8840-2027-0

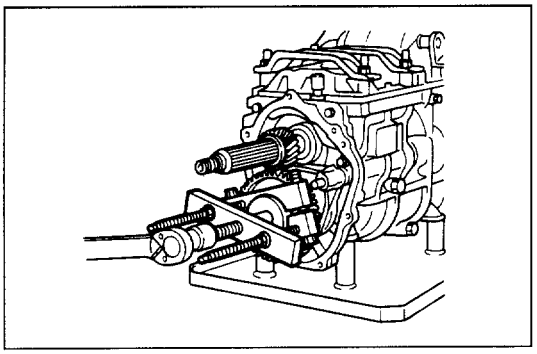
- Remove car speed sensor drive gear and ball bearing



11. Lock Nut (for 6 speed type only)

- Make sure to rise the caulking of the lock nut.
- Use the handle to remove the lock nut.

  Handle : 5-8840-2043-0



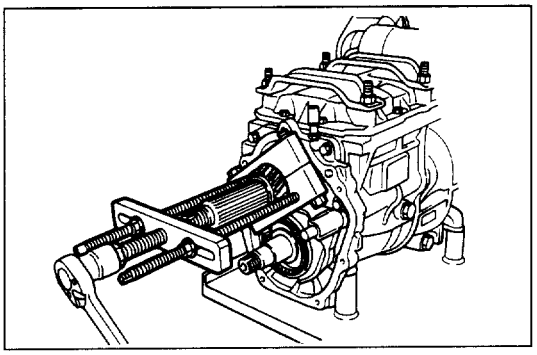
12. Ball Bearing (for 6 speed type only)

- Remove ball bearing using the bearing remover.

  Bearing Remover : 5-8840-2112-0
  Universal Puller : 5-8840-2027-0

13. Plate (for 6 speed type only)

14. Counter 6th Gear Assembly (for 6 speed type only)

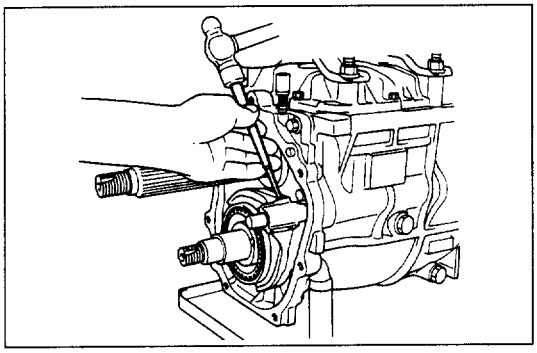


15. Main 6th Gear (for 6 speed type only)

- Remove the 6th gear using the gear remover.

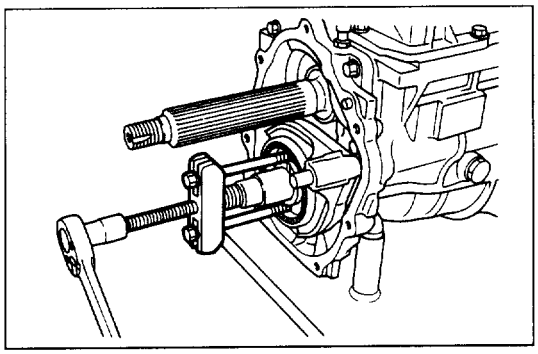
  Gear Remover : 5-8840-2341-0
  Universal Puller : 5-8840-2027-0

16. Spacer (for 6 speed type only)

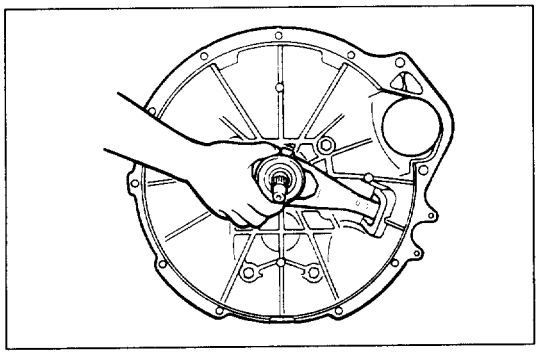


17. **Spring Pin (for 6 speed type only)**

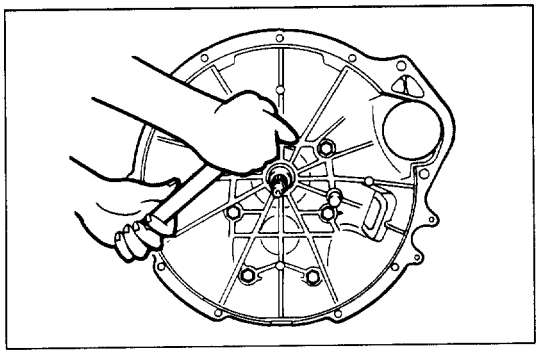
    Spring Pin Remover: 9-8592-2201-0



18. **Collar (for 6 speed type only)**
    - Remove the collar together with the synchronizer assembly(19).
19. **Synchronizer Assembly & Shift Arm (for 6 speed type only)**
    - Remove the synchronizer assembly using the universal puller.
    - Screw the universal puller bolts (M8×1.25) to the clutch hub.
20. **Breather(for 6 speed type only)**
21. **Intermediate Plate (for 6 speed type only)**
    - Tap the intermediate plate with a copper or plastic hammer to remove it.
22. **Shift Block Assembly**



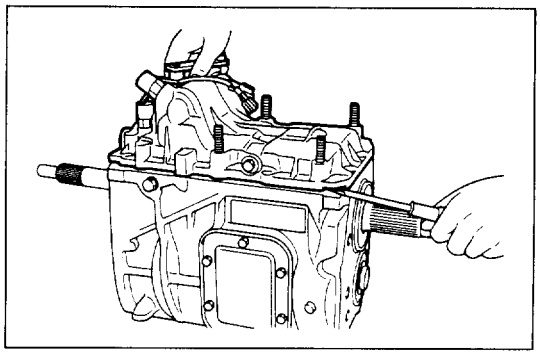
23. **Shift Fork and Support Bolt**
24. **Dust Cover**
25. **Clutch Housing**
    - Tap the clutch housing with a copper or plastic hammer to remove it.
    - Use the screwdriver to remove the oil seal from the clutch housing.



CAUTION:

Take care not to damage the sealing seat of the clutch housing.

26. **Mounting Bracket**

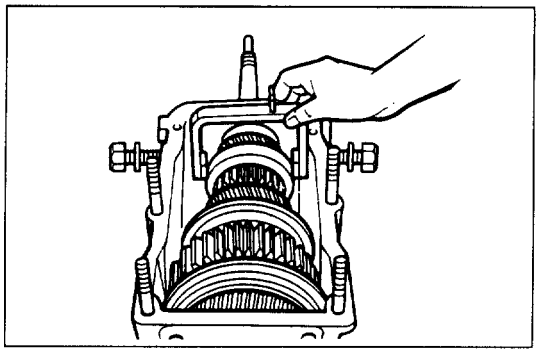


27. Control Box Assembly

- Remove 10 control box fixing bolts, and then prize open the four corners of the control box with a screwdriver to remove the control box assembly.

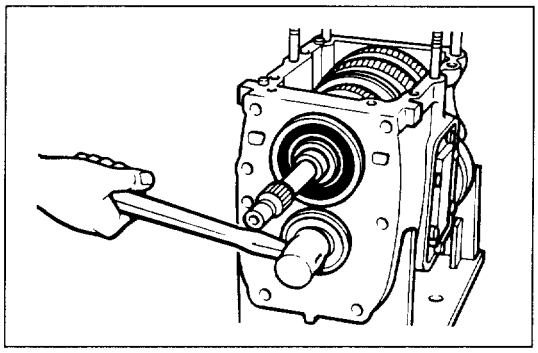
28. Fulcrum Bolt

- Remove the fulcrum bolts from 4th/5th shift arm on both sides.



29. 4th/5th Shift Arm & Shift Piece

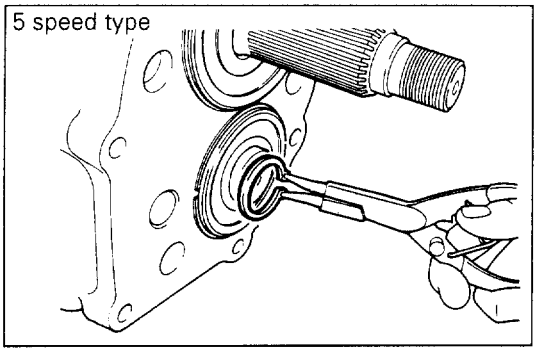
- Take out the shift arm and shift pieces together.



30. Snap Ring

- Move the countershaft approximately 3 mm (0.12 inch) rearward by tapping on its front end with brass or plastic hammer.
- Remove the snap ring from the counter shaft rear bearing outer circumference.

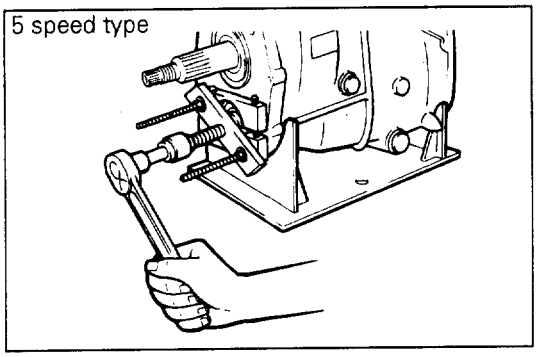
5 speed type



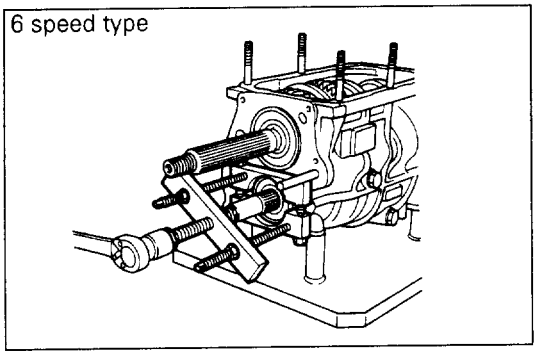
31. Counter Shaft Rear Bearing

- **5 speed type**

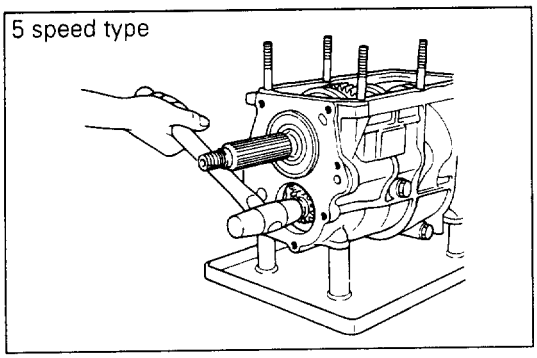
1) Remove the snap ring from the counter shaft rear end.



2) Set the bearing remover to the snap ring groove to remove the rear bearing.
   Bearing Remover : 5-8840-2042-0
   Universal Puller : 5-8840-2027-0

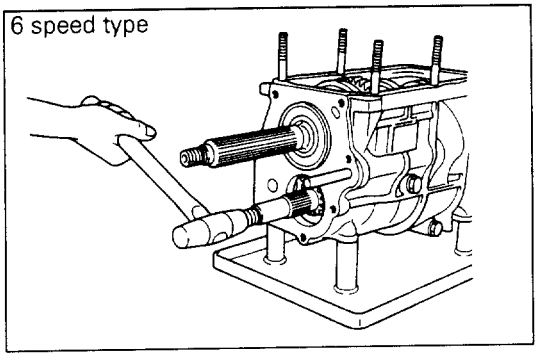


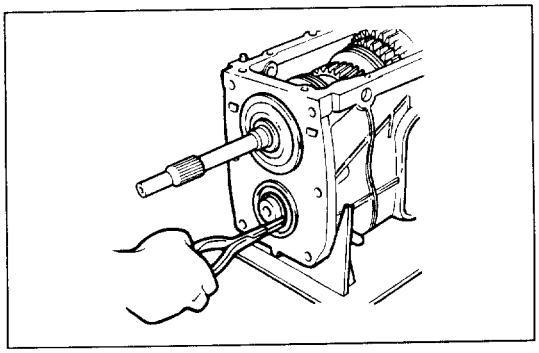
- **6 speed type**
  Set the bearing remover to the snap ring groove to remove the rear bearing.
  Bearing Remover : 5-8840-2042-0
  Universal Puller : 5-8840-2027-0



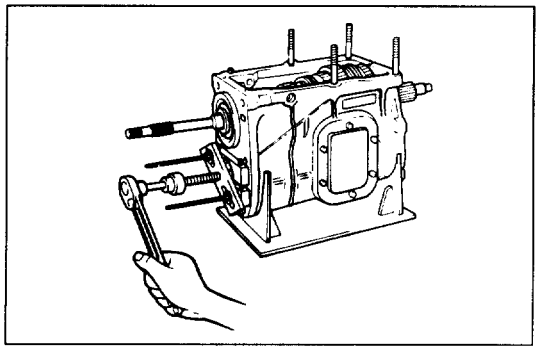
32. Snap Ring

- Move the countershaft approximately 3 mm (0.12 inch) forward by tapping on its rear end with brass or plastic hammer.





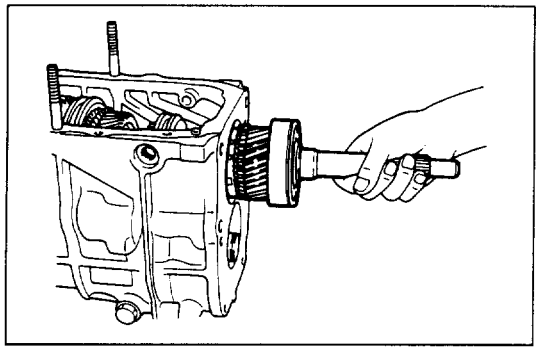
- Remove the snap ring from the countershaft front end.



33. Counter Shaft Front Bearing

- Set the bearing remover to the snap ring groove to remove the front bearing.

  Bearing Remover : 5-8840-2042-0
  Universal Puller : 5-8840-2027-0



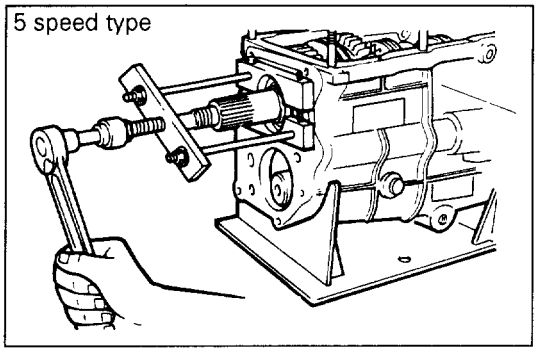
34. Top Gear Shaft Assembly

- Remove the top gear shaft bearing outer race toward front end using a hammer and soft metal bar.
- Remove the block ring and needle bearing.

35. Snap Ring

- Move the main shaft approximately 3 mm (0.12 inch) rearward by tapping on its front end with brass or plastic hammer.
- Remove the snap ring from the counter shaft front bearing outer circumference.

5 speed type

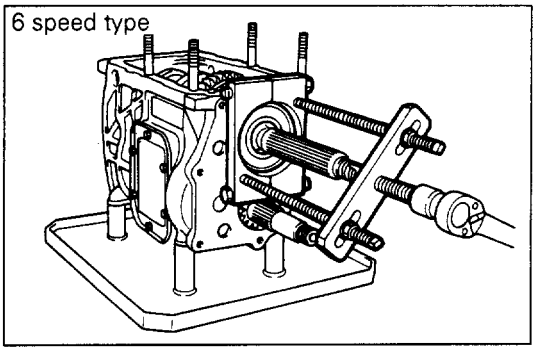


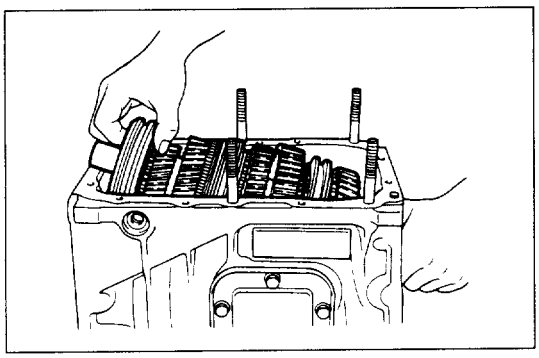
36. Main Shaft Rear Bearing

- Set the bearing remover to the snap ring groove to remove the bearing.

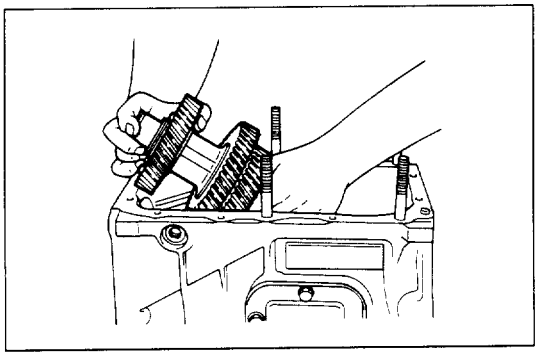
  Bearing Remover : 5-8840-2342-0
  Bolt & Nut : 5-8840-2344-0

6 speed type

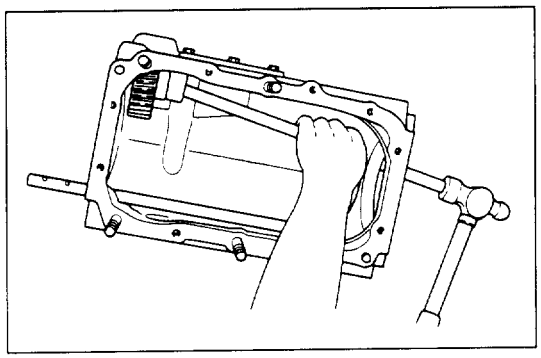




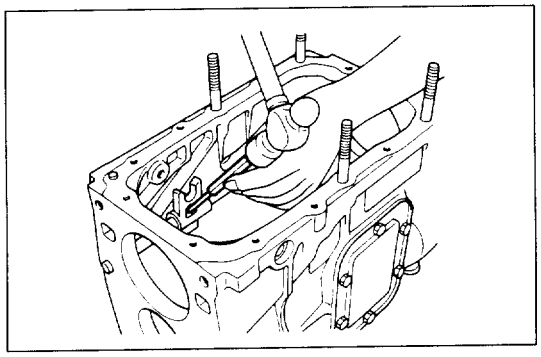
37. **Main Shaft Assembly**



38. **Counter Shaft Assembly**



39. **Reverse Idle Gear Shaft & Lock Ball**
    - Drive out the reverse gear shaft by tapping on its front end with a suitable bar and hammer.
    - Be careful not to lose the lock ball.



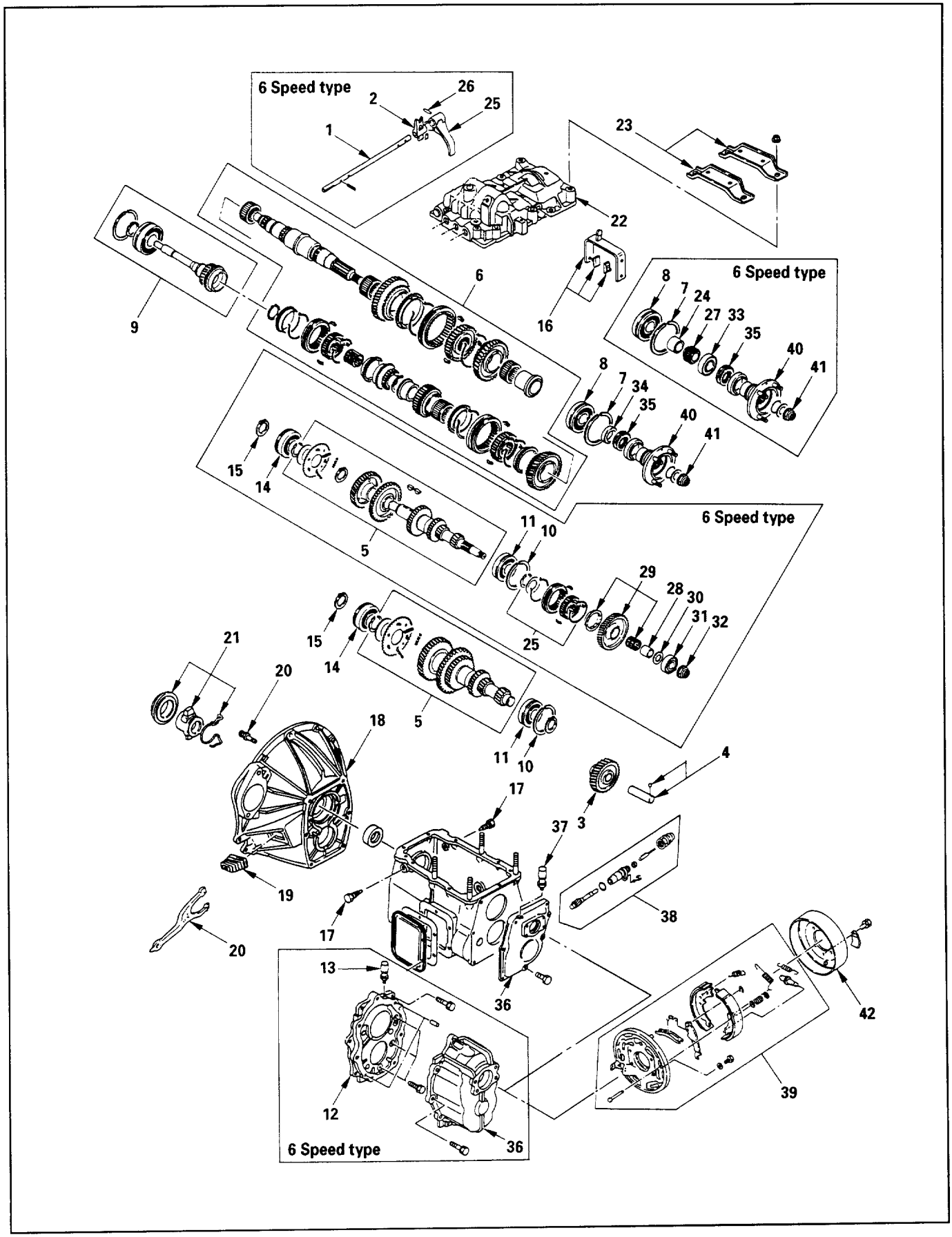
40. **Reverse Idle Gear**
41. **6th Shift Block (for 6 speed type only)**

    Spring Pin Remover: 9-8529-2201-0

42. **6th shift rod (for 6 speed type only)**

MEMO

REASSEMBLY


6 Speed type
1
2
25
26
22
23
16
6
9
6 Speed type
8
7
24
27
33
35
40
41
8
7
34
35
40
41
15
14
5
6 Speed type
11
10
29
28
30
31
32
25
15
14
5
11
10
21
20
18
19
20
17
3
4
37
38
17
13
36
12
36
6 Speed type
42
39

Reassembly steps

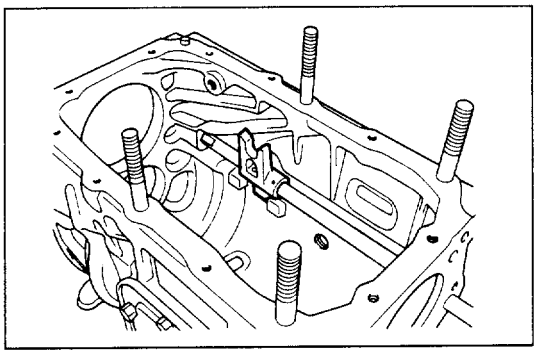
1. 6th shift rod (for 6 speed type only)
2. 6th shift block (for 6 speed type only)
3. Reverse idle gear
4. Reverse idle gear shaft & lock ball
5. Counter shaft assembly
6. Main shaft assembly
7. Snap ring
8. Main shaft rear bearing
9. Top gear shaft assembly
10. Snap ring
11. Counter shaft rear bearing
12. Intermediate plate (for 6 speed type only)
13. Breather (for 6 speed type only)
14. Counter shaft front bearing
15. Snap ring
16. 4th/5th shift arm & shift piece
17. Fulcrum bolt
18. Clutch housing
19. Dust cover
20. Shift fork and support bolt
21. Shift block assembly
22. Control box assembly
23. Mounting bracket
24. Spacer (for 6 speed type only)
25. Synchronizer assembly & shift arm (for 6 speed type only)
26. Spring pin (for 6 speed type only)
27. Main 6th gear (for 6 speed type only)
28. Collar (for 6 speed type only)
29. Counter 6th gear assembly (for 6 speed type only)
30. Plate (for 6 speed type only)
31. Ball Bearing (for 6 speed type only)
32. Lock nut (for 6 speed type only)
33. Ball Bearing (for 6 speed type only)
34. Spacer (for 5 speed type only)
35. Car speed sensor drive gear
36. Rear cover
37. Breather (for 5 speed type only)
38. Car speed sensor driven gear assembly
39. Parking brake assembly
40. Coupling driver
41. Lock nut
42. Parking brake drum

Reassembly Steps

NOTE:

Clean each part thoroughly.

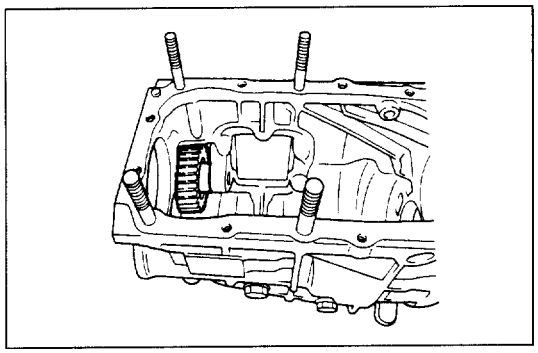
When assembling parts, apply clean engine oil (SAE 5W-30) to their sliding and mating sections.



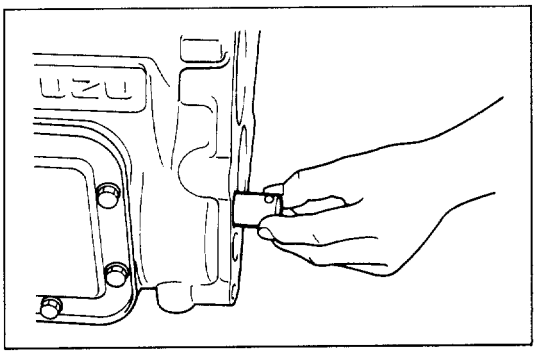
1. **6th Shift Rod (for 6 speed type only)**
   - Insert the 6th shift rod with the filed side at the front
2. **6th Shift Block (for 6 speed type only)**
   - The 6th shift block should be installed with the projection side of boss turned to the rearward

NOTE:

Install a new spring pin properly with the slit inline with the shaft centerline.

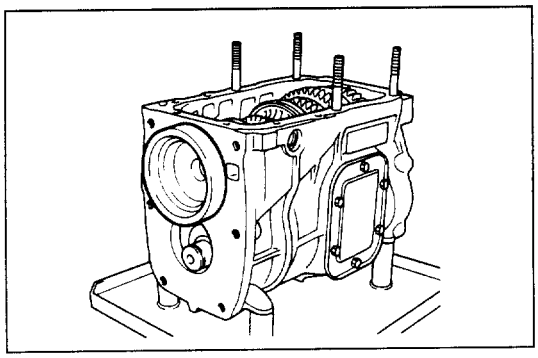


3. **Reverse Idle Gear**
   - The reverse idle gear should be installed with longer boss side turned to the forward

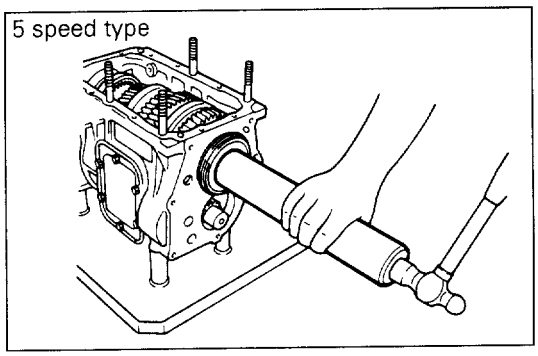


4. **Reverse Idle Gear Shaft**
   - With the ball built in the shaft rear section, install the reverse idle gear shaft from the rear side of the transmission.

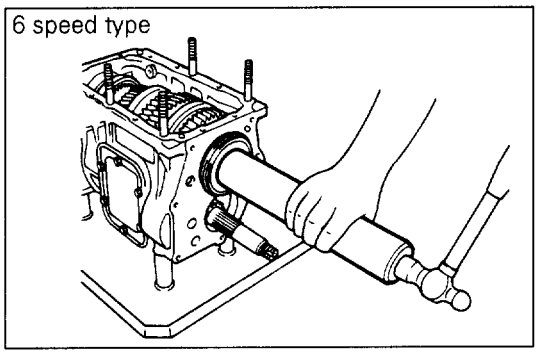
5. **Countershaft Assembly**
   - Place the counter shaft assembly in the bottom of the transmission case.
6. **Mainshaft Assembly**
   - Take care that the thrust washer of the reverse gear does not drop off.
7. **Snap Ring**
   - Install the snap ring to the main shaft rear bearing outer circumference.

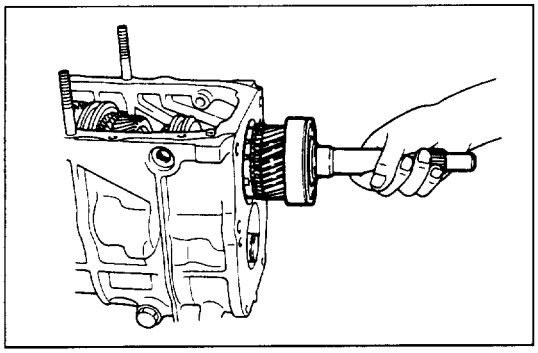


8. **Main Shaft Rear Bearing**
   - Apply engine oil to the main shaft front end.
   - Hold the main shaft using the main shaft holder.
     Main Shaft Holder : 5-8840-2347-0



- Install the rear bearing using the bearing installer.
  Bearing Installer : 5-8840-2345-0



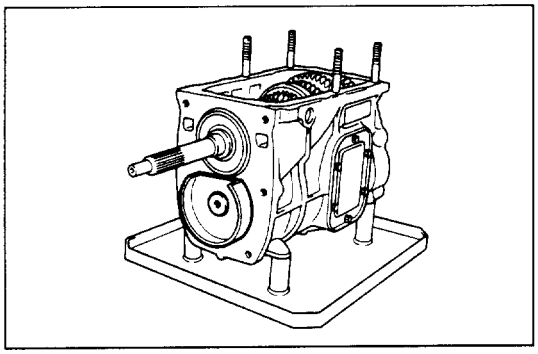


9. Top Gear Shaft Assembly

- Install the needle bearing to the top gear shaft.
- Install the top gear shaft assembly into the transmission case.
- Check to be certain the block ring on the 4th gear side fitted properly to the inserts.
- Press in the bearing until the snap ring of the bearing outer circumference comes into contact with the transmission case.

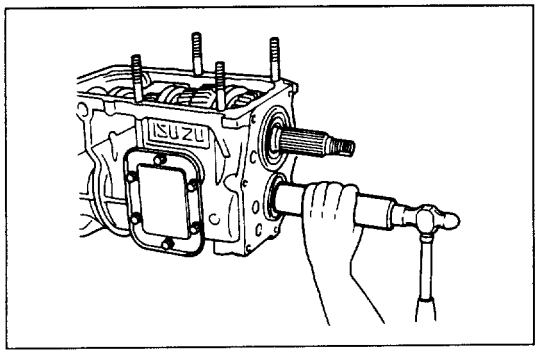
10. Snap Ring

- Install the snap ring to the counter shaft rear bearing outer circumference.

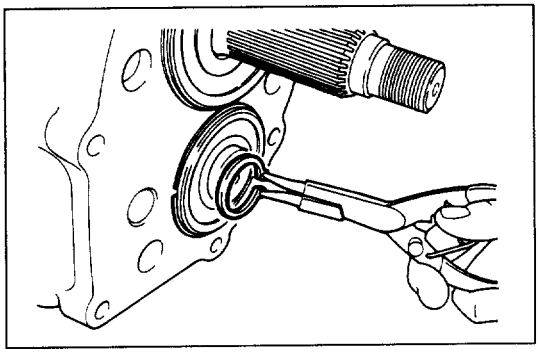


11. Counter Shaft Rear Bearing

- Hold the counter shaft using counter shaft holder.
  Counter Shaft Holder : 5-8840-2348-0

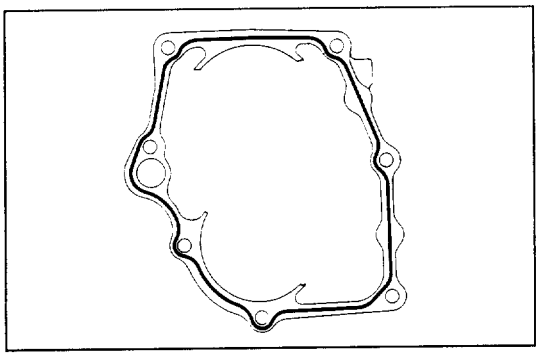


- Install the counter shaft rear bearing using bearing installer.
  Bearing Installer: 5-8840-2244-0



- **5 speed type**

  Install the counter shaft rear bearing snap ring



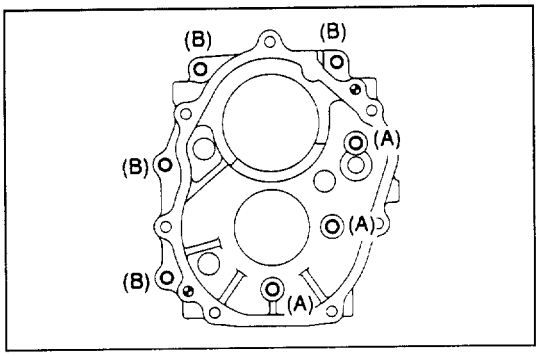
12. **Intermediate Plate (for 6 speed type only)**
    - Remove water and oil on the mating face before applying the liquid gasket.
    - Apply a ø 2 mm (0.08 inch) bead of the liquid gasket (Three Bond 1215 or equivalent) to the front surface of intermediate plate shown in the illustration.

CAUTION:

Install the intermediate plate on the transmission case within 30 minutes after liquid gasket application.

Intermediate plate to Transmission Case Bolts(A) Torque	N·m(kg·m/lb·ft)
	46 (4.7/34.0)

Intermediate plate to Transmission Case Bolts(B) Torque	N·m(kg·m/lb·ft)
	40 (4.1/29.7)

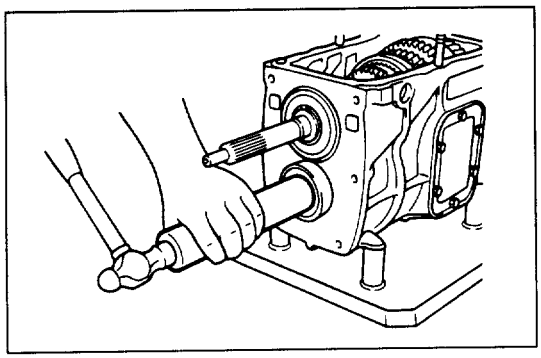


CAUTION:

Do not reuse the bolts (A).

13. **Breather (for 6 speed type only)**
14. **Countershaft Front Bearing**
    - Use the bearing installer to install the front bearing.

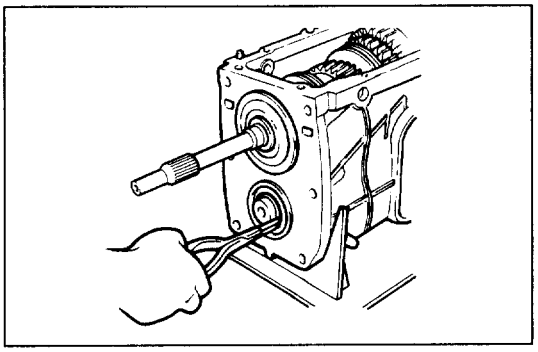
      Bearing Installer : 5-8840-2244-0



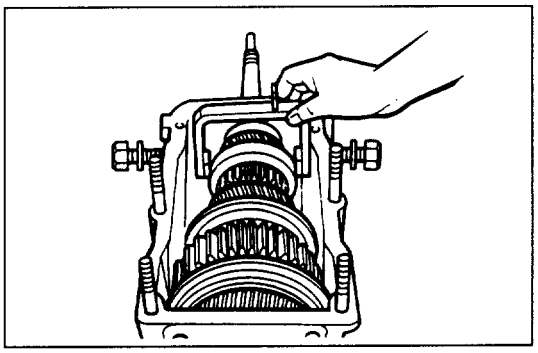
NOTE:

With each gear set to the neutral position, check to see if the shaft and each gear rotate smoothly.

Check to see if each block ring is free. When it gets caught and stuck in the tapper cone, use a screwdriver to make it free.



15. **Snap Ring**



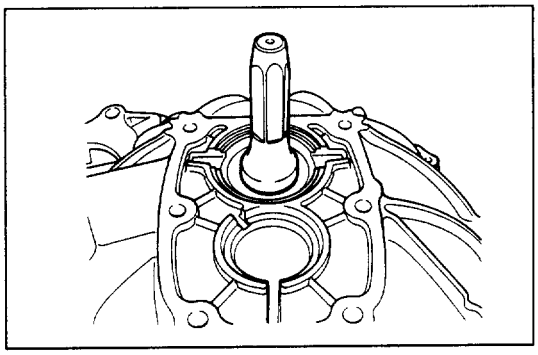
16. **4th/5th Shift Arm Assembly**
    - Install the shift pieces to the shift arm.
    - Install the shift arm by moving projected portion (to be fitted into the shift block) all the way to the right.

    NOTE:

    Take care not to drop the shift pieces in the transmission case.

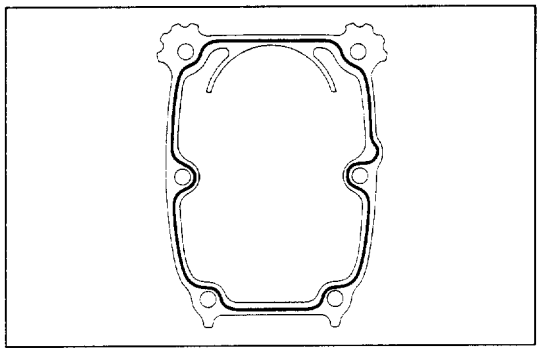
17. **Fulcrum Bolt**
    - Remove sealant from the bolts and the female threaded surfaces and the surfaces must be perfectly dry.
    - Apply liquid gasket (LOCTITE 242 or equivalent) to the bolt's threaded area.

Fulcrum Bolts Torque	N·m (kg·m/lb·ft)
	79 (8.1/59)



18. **Clutch Housing**
    - Apply engine oil to the new oil seal outer circumference and apply multi-purpose grease to the oil seal lip.
    - Use the oil seal installer to install the oil seal to the clutch housing.

      Oil Seal Installer : 5-8840-2243-0

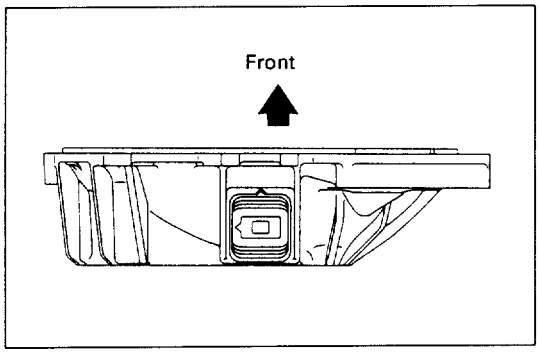


- Remove water and oil on the mating face before applying the liquid gasket.
- Apply a ø 2 mm (0.08 inch) bead of the liquid gasket (Three Bond 1215 or equivalent) to the clutch housing surface shown in the illustration.

CAUTION:

Install the clutch housing on the transmission case within 30 minutes after liquid gasket application.

Clutch Housing to Transmission Case Bolts Torque	N·m(kg·m/lb·ft)
	81 (8.3/60)

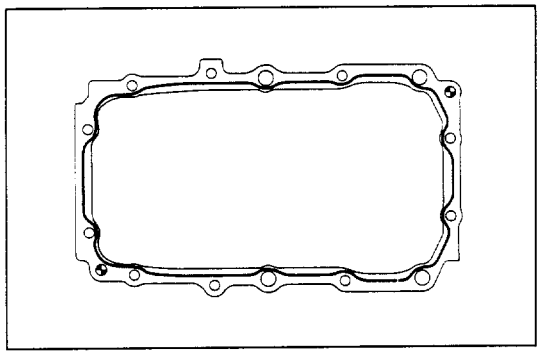


19. **Dust Cover**
    - Install the dust cover with its arrow mark face the clutch housing front side.

20. **Shift Fork and Support Bolt**

Support Bolts Torque	N·m(kg·m/lb·ft)
	52 (5.2/38)

21. **Shift Block Assembly**
22. **Control Box Assembly**



- Remove water and oil on the mating face before applying the liquid gasket.
- Apply a ø 2 mm (0.08 inch) bead of the liquid gasket (Three Bond 1215 or equivalent) to the control box surface shown in the illustration.

CAUTION:

Install the control box assembly on the transmission case within 30 minutes after liquid gasket application.

- Fixing bolt length
  Front side (2 pieces): 45 mm (1.77 inch)
  Rear side (5 pieces): 25 mm (0.98 inch)

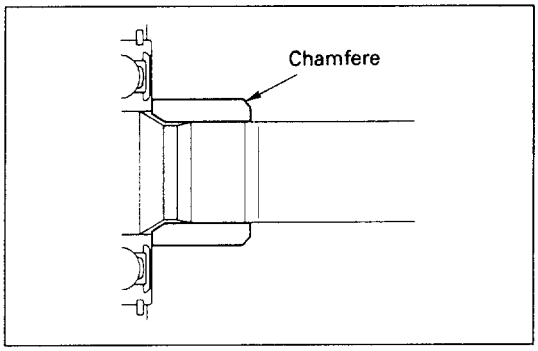
Control Box to Transmission Case Bolts Torque	N·m (kg·m/lb·ft)
	20 (2.0/14)

NOTE:

Operating the shift lever and the select lever, make sure that they shift to each position smoothly.

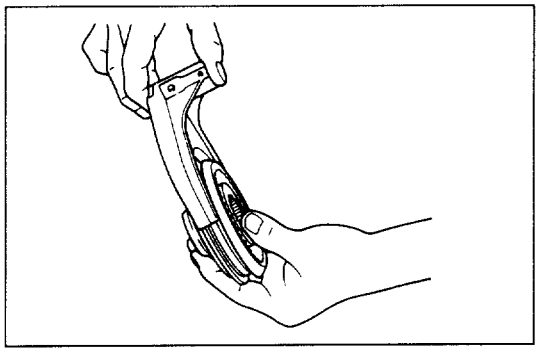
23. Mounting Bracket

Mounting Bracket Bolts Torque	N·m(kg·m/lb·ft)
69 (7.0/51)	



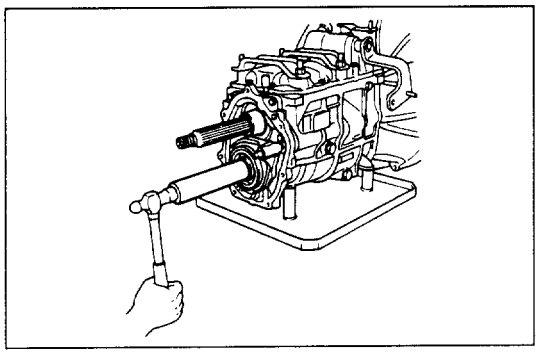
24. Spacer (for 6 speed type only)

- Install the spacer with its chamfered side face to the rearward.



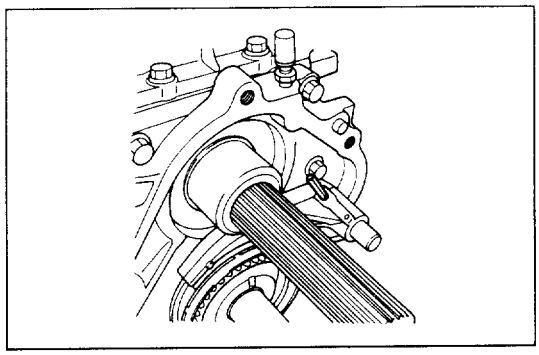
25. Synchronizer Assembly & Shift Arm (for 6 speed type only)

- Set the shift arm to the synchronizer assembly so that the oil groove of the clutch hub boss end face and the projection side of the shift arm boss point to the rearward .



- Use the installer to install the 6th synchronizer assembly & shift arm to the counter shaft and 6th shift rod.

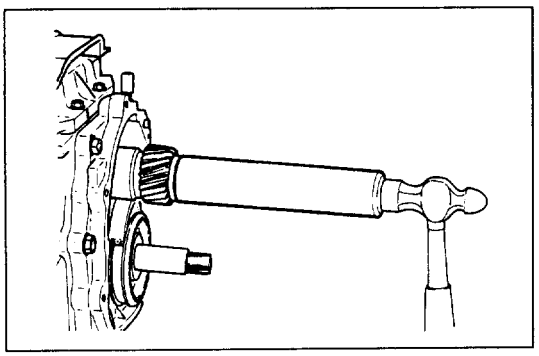
  Installer : 5-8840-2244-0



26. Spring Pin (for 6 speed type only)

NOTE:

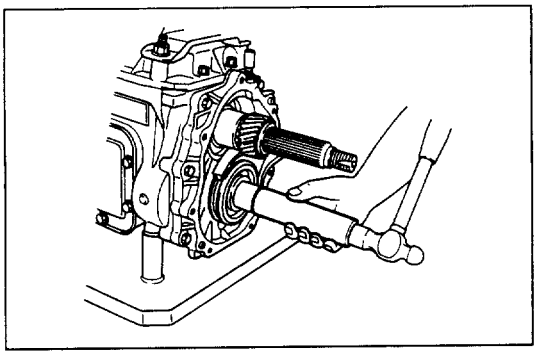
Install a new spring pin properly with the slit inline with the shaft center line.



27. Main 6th Gear (for 6 speed type only)

- Tap the main 6th gear with installer and a hammer to press it in until the spacer contacts closely with the bearing.

  Installer : 5-8840-2244-0
- When it is difficult to engage the collar with the main shaft, heat the collar to a temperature between 80 and 120°C (176 and 248°F) with the piston heater before assembling.



28. Collar (for 6 speed type only)

- Tap the collar with the gear collar installer and a hammer to press it in until it contacts closely with the clutch hub.

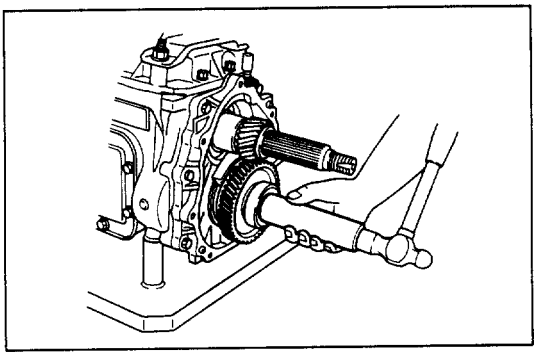
  Gear Collar Installer : 5-8840-2346-0
- When it is difficult to engage the collar with the main shaft, heat the collar to a temperature between 80 and 120°C (176 and 248°F) with the piston heater before assembling.

39. Counter 6th Gear Assembly (for 6 speed type only)

- Apply the engine oil to the block ring and the needle bearing.

30. Plate (for 6 speed type only)

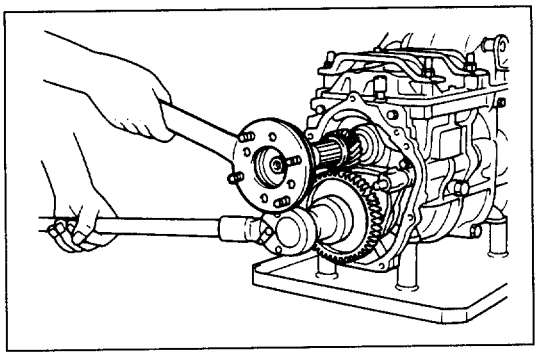
- Apply the engine oil to the plate.



31. Ball Bearing (for 6 speed type only)

- Tap the ball bearing with the gear collar installer and a hammer to press it in until it contacts closely with the plate.

  Gear Collar Installer : 5-8840-2346-0



32. Lock Nut (for 6 speed type only)

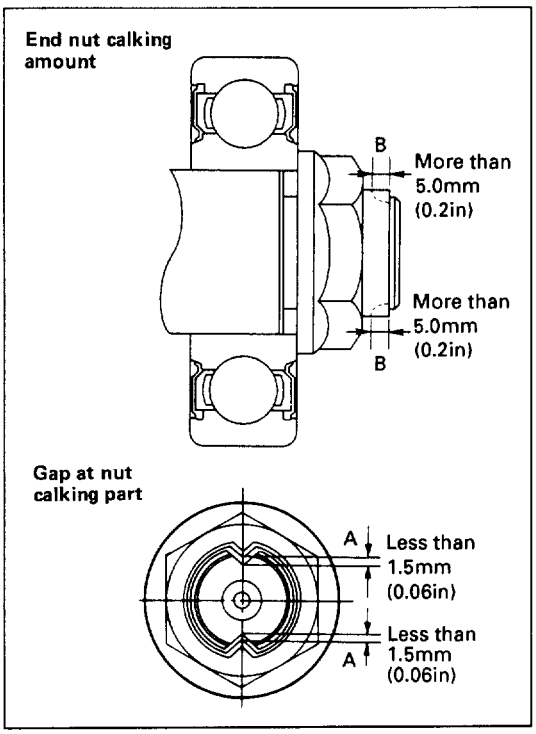
- Apply the engine oil to the setting face of the new lock nut and tighten it up at the specified torque.

  Handle: 5-8840-2043-0

Lock Nut Torque	N·m (kg·m/lb·ft)
	226 (23.0/166)

CAUTION:

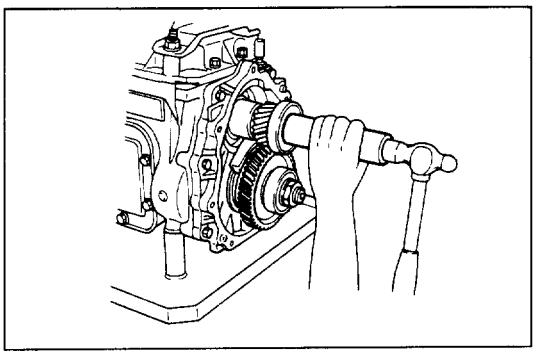
Do not reuse the lock nut.



- Align the lock nut with the V-shaped groove at the tip of the main shaft, and caulk the nut lip portion by using a chisel.
  (Round edge approximately 1 mm (0.04 in)×60°).
- As shown in the illustration, be sure to caulk the nut lip so that the clearance between the V-shaped groove portion at the tip of the main shaft and the caulked up lip(A) is less than 1.5 mm (0.06 in), and the caulking length(B) is 5 mm (0.2 in) or more.

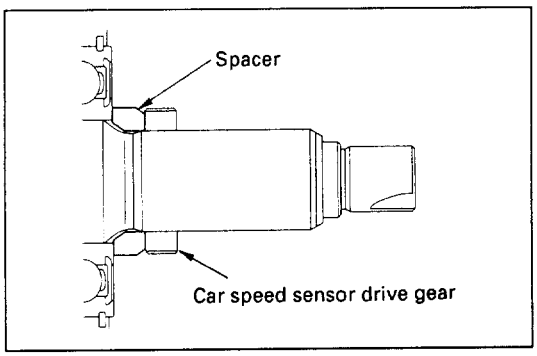
CAUTION:

Be sure to confirm that there is no crack at the caulked portion of the end nut after caulking.



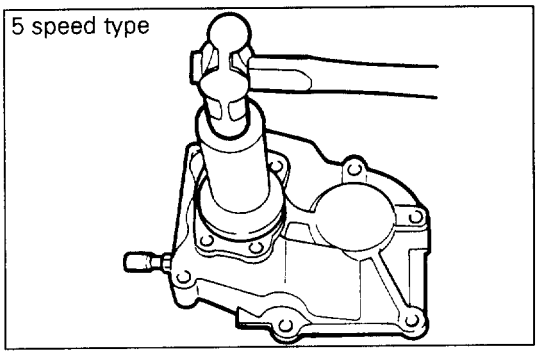
33. Ball Bearing (for 6 speed type only)

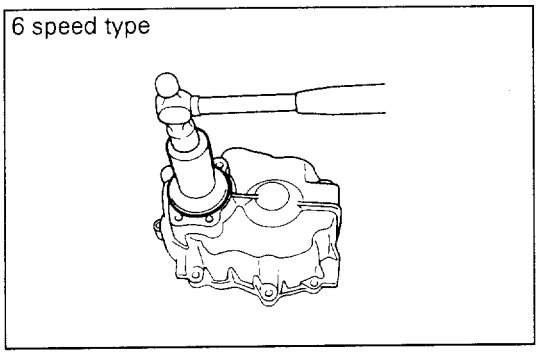
- Tap the ball bearing with installer and a hammer to press it in until it contacts closely with the main 6th gear.
  Installer : 5-8840-2244-0



34. Spacer (for 5 speed type only)

35. Car Speed Sensor Drive Gear

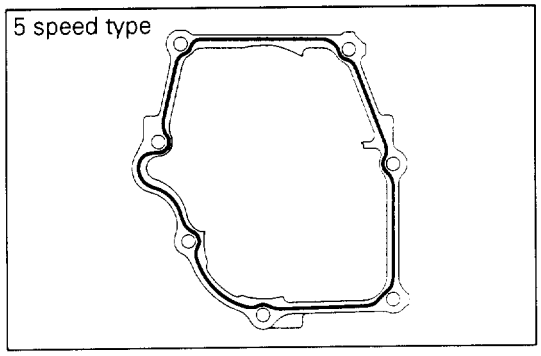


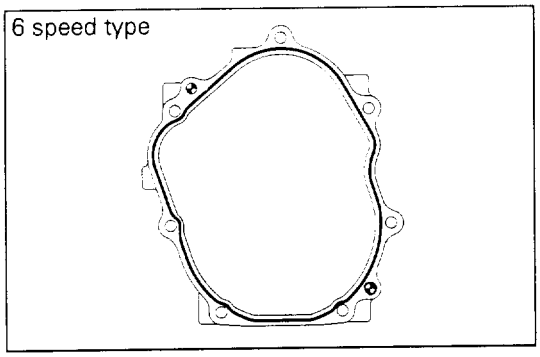


36. Rear Cover

- Apply engine oil to the new oil seal outer circumference and apply multi-purpose grease to the oil seal lip.
- Use the oil seal installer install the oil seal to the rear cover.

  Oil Seal Installer: 5-8840-2242-0





- Remove water and oil on the mating face before applying the liquid gasket.
- Apply a ø 2 mm (0.08 inch) bead of the liquid gasket (Three Bond 1215 or equivalent) to the rear cover surface shown in the illustration.

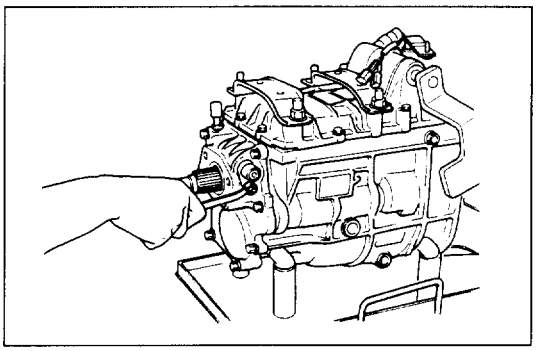
CAUTION:

Install the rear cover on the transmission case within 30 minutes after liquid gasket application.

Rear Cover Bolts Torque	N·m (kg·m/lb·ft)
	40 (4.1/30)

37. Breather (for 5 speed type only)

Breather Torque	N·m (kg·m/lb·ft)
	5 (0.5/3.6)

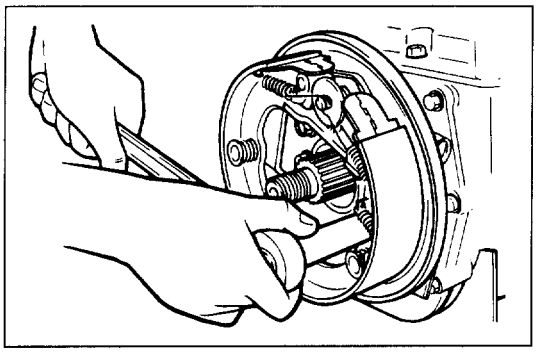


38. Car Speed Sensor Driven Gear Assembly

Driven Gear Lock Plate Bolt Torque	N·m (kg·m/lb·ft)
15 (1.5/11)	

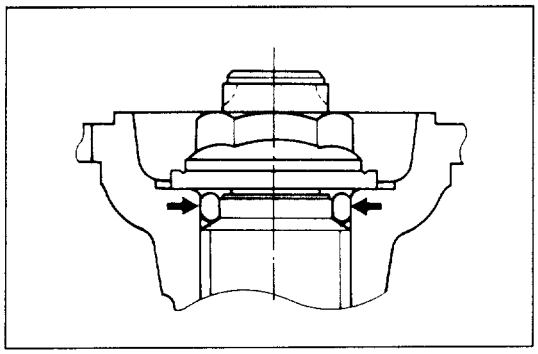
- Install the car speed sensor with key rod.

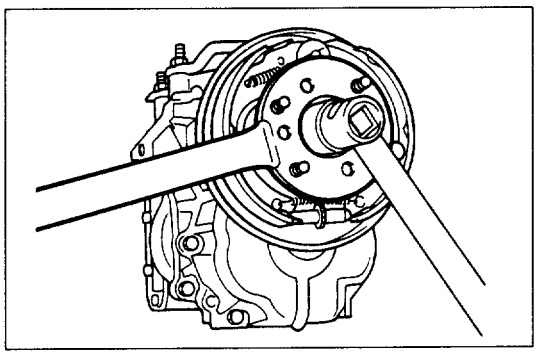
Car Speed Sensor Torque	N·m (kg·m/lb·ft)
25 (2.5/18)	



39. Parking Brake Assembly

Parking Brake Bolts Torque	N·m (kg·m/lb·ft)
83 (8.5/61)	





40. Coupling Driver

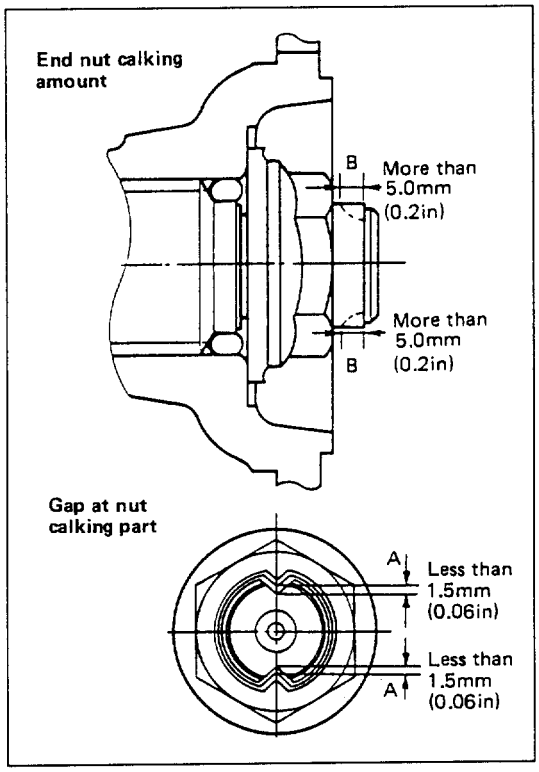
41. Lock Nut

- Install the o-ring and conical washer. The conical washer is to be set up with its identification groove to the nut side.
- Apply the engine oil to the setting face of the new lock nut and tighten it up at the specified torque.
  Handle: 5-8840-2043-0

Lock Nut Torque	N·m (kg·m/lb·ft)
226 (23.0/166)	

CAUTION:

Do not reuse the lock nut.



- Align the lock nut with the V-shaped groove at the tip of the main shaft, and caulk the nut lip portion by using a chisel.
  (Round edge approximately 1 mm (0.04 in)×60°).
- As shown in the illustration, be sure to caulk the nut lip so that the clearance between the V-shaped groove portion at the tip of the main shaft and the caulked up lip(A) is less than 1.5 mm (0.06 in), and the caulking length(B) is 5 mm (0.2 in) or more.

CAUTION:

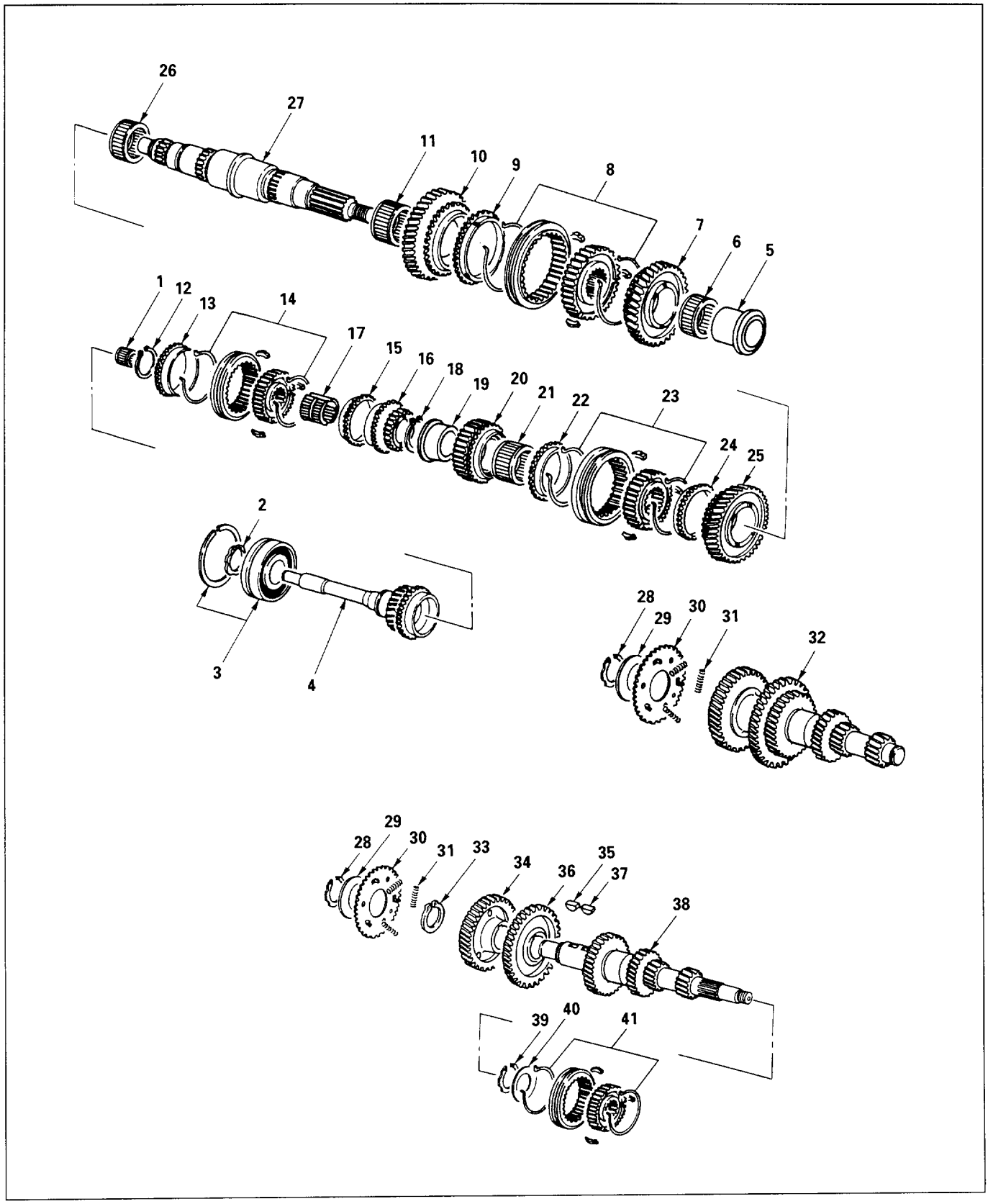
Be sure to confirm that there is no crack at the caulked portion of the end nut after caulking.

42. Parking Brake Drum

MEMO

TOP GEAR SHAFT ASSEMBLY, MAIN SHAFT ASSEMBLY AND COUNTER SHAFT ASSEMBLY

DISASSEMBLY



Disassembly step

Top Gear Shaft Assembly

1. Needle bearing
2. Snap ring
3. Ball bearing
4. Top gear shaft

Main Shaft Assembly

5. Collar
6. Needle bearing
7. Reverse gear
8. 1st/reverse synchronizer assembly
9. Block ring
10. 1st gear
11. Needle bearing
12. Snap ring
13. Block ring
14. 4th/5th synchronizer assembly
15. Block ring
16. 5th gear
17. Needle bearing
18. Snap ring
19. Collar
20. 3rd gear
21. Needle bearing
22. Block ring
23. 2nd/3rd synchronizer assembly
24. Block ring
25. 2nd gear
26. Needle bearing
27. Main shaft

Counter Shaft Assembly

28. Snap ring
29. Conical washer
30. Anti-lash plate
31. Spring
32. Counter shaft (for 5 speed type only)
33. Snap ring
34. Counter shaft drive gear (for 6 speed type only)
35. Key (for 6speed type only)
36. Counter shaft 5th gear (for 6 speed type only)
37. Key (for 6 speed type only)
38. Counter shaft (for 6 speed type only)

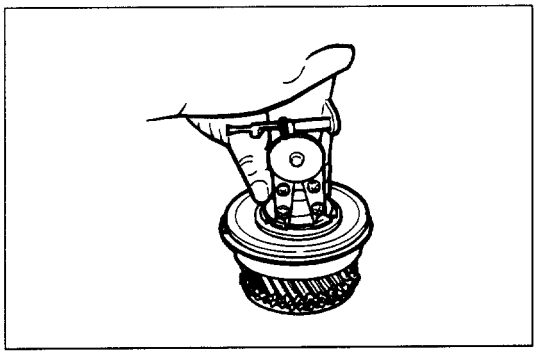
Counter Shaft Assembly

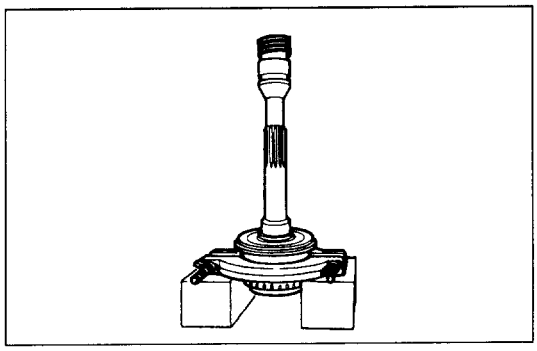
39. Snap ring
40. Conical washer
41. 6th synchronizer assembly

Disassembly Step

Top Gear Shaft Assembly

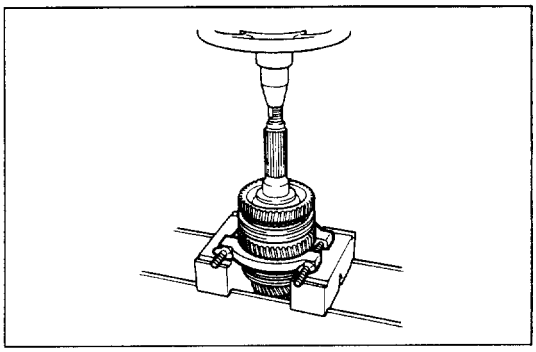
1. **Needle Bearing**
2. **Snap Ring**





3. **Ball Bearing**
   - Use the bearing remover to remove the bearing from top gear shaft.

     Bearing Remover: 5-8840-0587-0
4. **Top Gear Shaft**



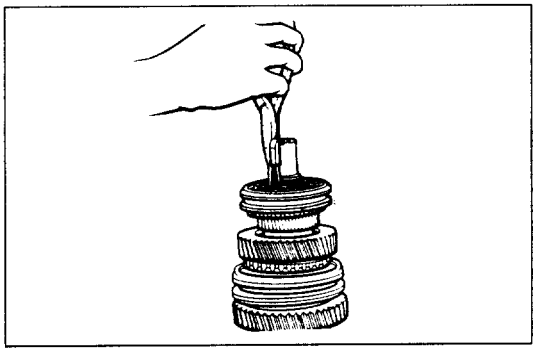
Main Shaft Assembly

5. **Collar**
6. **Needle Bearing**
7. **Reverse Gear**
8. **1st/Reverse Synchronizer Assembly**
9. **Block Ring**
10. **1st Gear**
    - Use a bench press and the bearing remover to remove the 1st gear together with the collar, the needle bearing, the reverse gear, the 1st/reverse synchronizer assembly and the block ring.

      Bearing Remover: 5-8840-0587-0
    - Disassembly synchronizer assemblies into the clutch hub, sliding sleeve, inserts (3 pieces) and insert springs (2 pieces).
11. **Needle Bearing**
12. **Snap Ring**
    - Attach a backing plate to the vise, secure the main shaft at the spline end, and remove the snap ring at the end.

    NOTE:

    Snap ring of appropriate sizes are combined to fill the gap to the clutch hub. Never mix them with other snap rings.

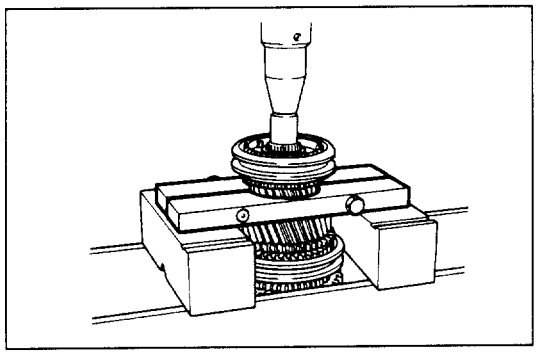


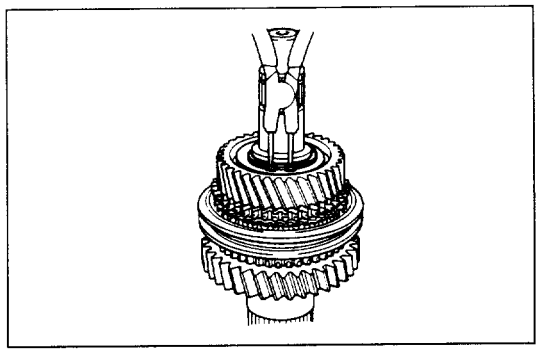
13. **Block Ring**
14. **4th/5th Synchronizer Assembly**
15. **Block Ring**
16. **5th Gear**
    - Use a bench press and the bearing remover to remove 5th gear together with the 4th/5th synchronizer assembly and the block ring.

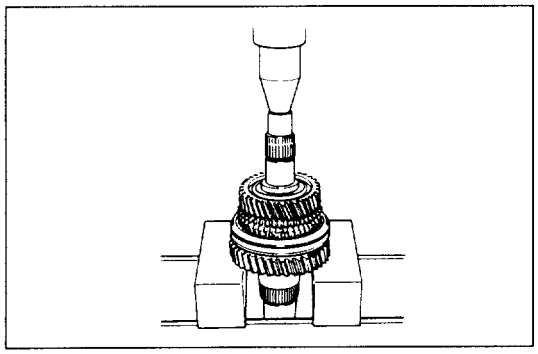
      Bearing Remover: 5-8840-0587-0
    - Disassembly synchronizer assemblies into the clutch hub, sliding sleeve, inserts (3 pieces) and insert springs (2 pieces).
17. **Needle Bearing**
18. **Snap Ring**

    NOTE:

    Snap ring of appropriate sizes are combined to fill the gap to the clutch hub. Never mix them with other snap rings.







19. **Collar**
20. **3rd Gear**
21. **Needle Bearing**
22. **Block Ring**

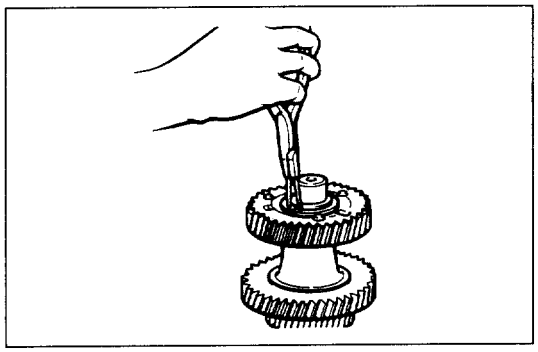
- Use a bench press and the bearing remover to remove the 3rd gear together with the collar, the needle bearing and the block ring.

  Bearing Remover: 5-8840-0587-0

23. **2nd/3rd Synchronizer Assembly**
24. **Block Ring**
25. **2nd Gear**
26. **Needle Bearing**

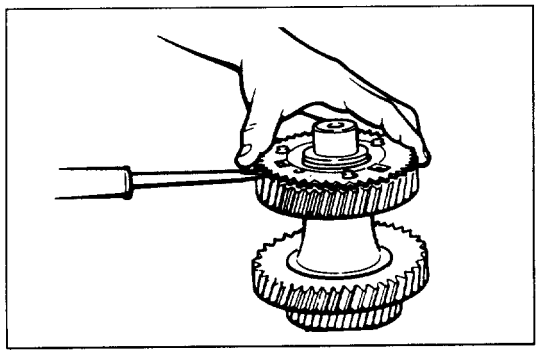
- Use a bench press to remove the 2nd gear together with the 2nd/3rd synchronizer assembly and the block ring.
- Disassembly synchronizer assemblies into the clutch hub, sliding sleeve, inserts (3 pieces) and insert springs (2 pieces).

27. **Main Shaft**



Counter Shaft Assembly

28. **Snap Ring**

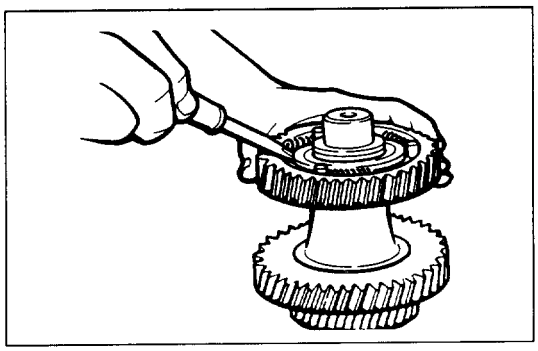


29. **Conical Washer**
30. **Anti-lash Plate**

- Insert a flat-end screwdriver between the anti-lash plate and the counter drive gear, and remove the anti-lash plate.

WARNING:

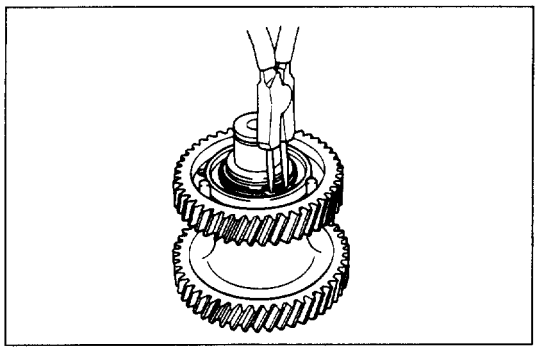
THE ANTI-LASH PLATE SHOULD BE REMOVED VERY SLOWLY WITH SPECIAL CARE OTHERWISE SOME SPRINGS INSTALLED INSIDE THE PLATE COULD POP OUT AND CAUSE INJURY.



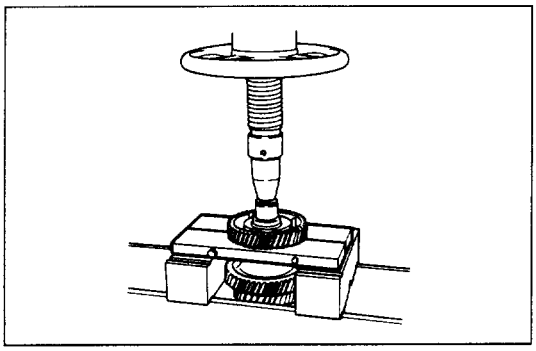
31. **Spring**

- Remove the three springs that are assembled to the counter drive gear side.

32. **Counter Shaft (for 5 speed type only)**



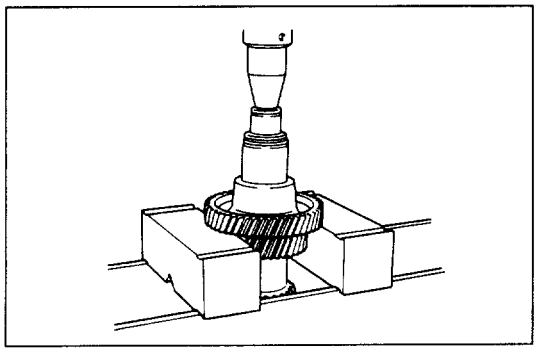
33. **Snap Ring**



34. **Counter Shaft Drive Gear**
    - Use a bench press and the bearing remover to remove the counter drive gear.
      Bearing Remover: 5-8840-0587-0

    NOTE

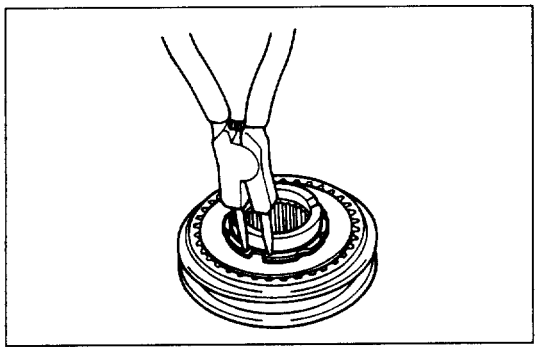
    Do not disassemble the counter drive gear and the counter 5th gear if no fault is apparent.



35. **Key**
36. **Counter Shaft 5th Gear**
    - Use a bench press to remove the counter shaft 5th gear.

37. **Key**
38. **Counter Shaft**

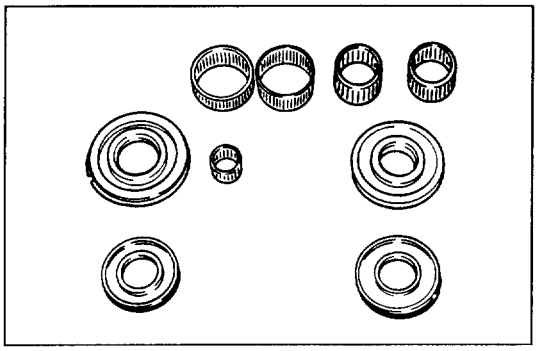
6th Synchronizer Assembly



39. **Snap Ring**
40. **Conical Washer**
41. **6th Synchronizer Assembly**
    - Disassembly synchronizer assemblies into the clutch hub, sliding sleeve, inserts (3 pieces) and insert springs (2 pieces).

INSPECTION AND REPAIR

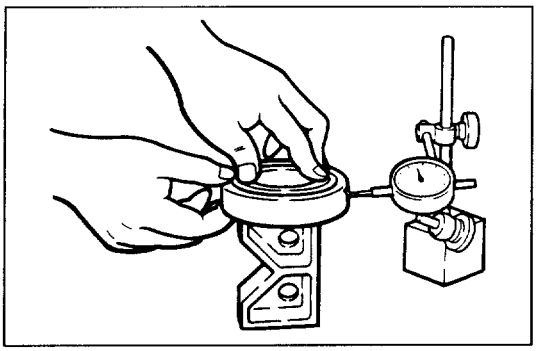
Make the necessary adjustment, repairs, and part replacements if excessive wear or damage is discovered during inspection.



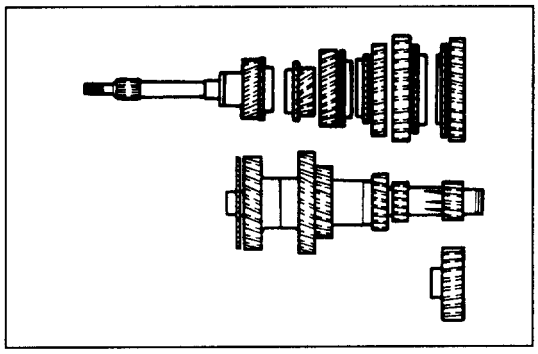
Bearings

Check each bearing, and replace in either of the following cases.

- Rotation is not smooth.
- Abnormal sound is generated.
- There is extreme damage or rust.
- Rolling element or rolling contact surface of needle roller bearing is discolored, extremely worn or pitted.



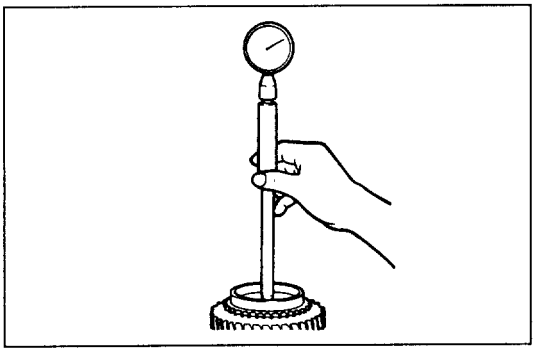
Ball Bearing Run-out	mm (in)
Limit	0.2 (0.008)



Gears

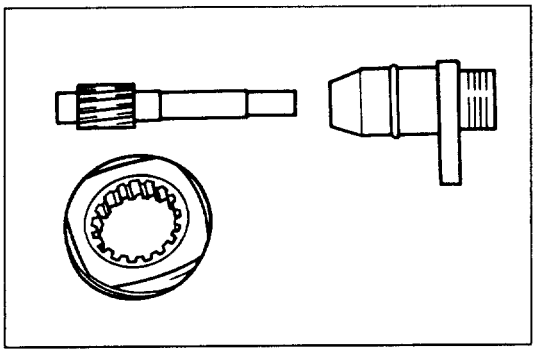
Check each gear for the following points. Correct a slight stepped wear or surface roughness with an oil stone or pencil grinder, or replace the gear if unrecoverable damage is found.

- Break or damage of tooth.
- Roughness or damage of taper cone (contact surface with block ring).
- Extreme wear of tooth.
- Inspect the dog gear teeth, and replace if hard contact is found on the force receive side (coast side) during engine braking.

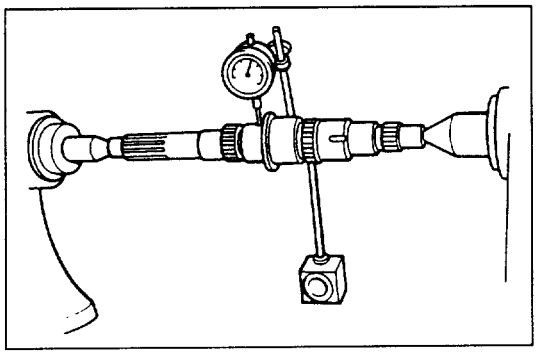


Gear Inside Diameter mm (in)

Gear	Nominal	Limit
6th Gear	42 (1.654)	42.1 (1.657)
5th Gear	42 (1.654)	42.1 (1.657)
3rd Gear	61 (2.402)	61.1 (2.406)
2nd Gear	61 (2.402)	61.1 (2.406)
1st Gear	61 (2.402)	61.1 (2.406)
Reverse Gear	61 (2.402)	61.1 (2.406)



- Wear or damage of car speed sensor drive gear and driven gear bushing.

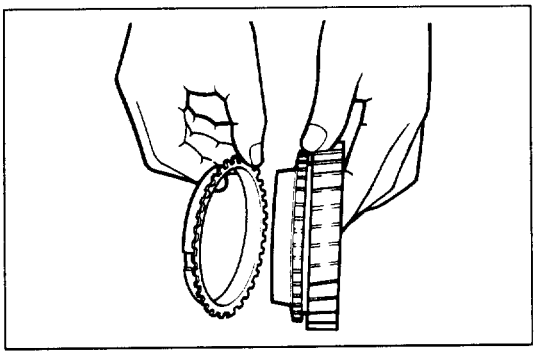


Main Shaft

Check the main shaft external surface for any damage or wear, and its spline sections for wear, damage or bent. When there is any abnormal condition found, or when it is used excessively beyond a proper use limit, replace it with new one.

Main Shaft Run-out mm (in)

Standard	Limit
0.05 (0.002) or Less	0.2 (0.008)

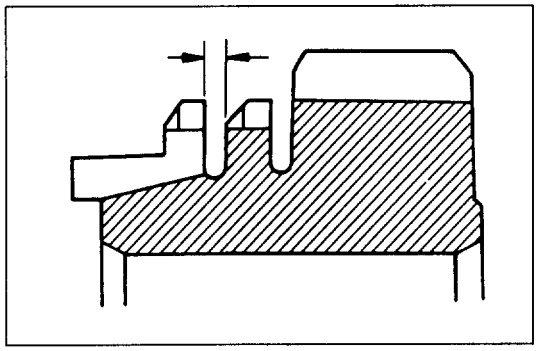


Synchromesh

Check the components of the synchronizer for any abnormal conditions. When there are uneven slight wears or rough surfaces found, improve them with an oil stone or pencil grinder.

When they are abnormally damaged, or when they are used excessively beyond a proper use limit, replace them with new one.

- Damages or wears found on the taper, gear and insert groove sections of the block ring.



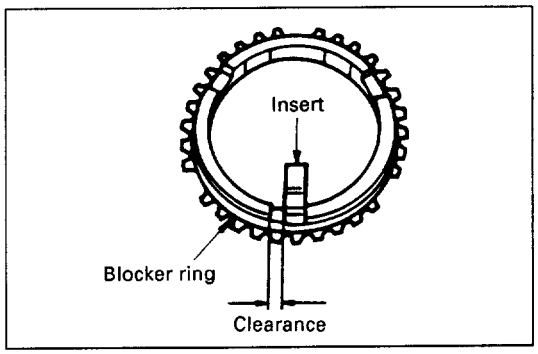
Block Ring and Dog Gear Teeth Clearance mm (in)

Gear	Nominal	Limit
6th	1.4 (0.055)	0.5 (0.02)
4th/5th	1.4 (0.059)	0.5 (0.02)
2nd/3rd	1.5 (0.059)	0.5 (0.02)
1st	1.5 (0.059)	0.5 (0.02)

- Wears or damages found on the clutch hub, the sliding sections of the sliding sleeve, the spline sections and insert grooves.

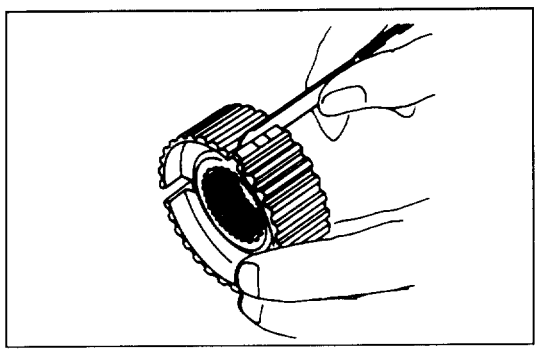
Clutch Hub Spline Play
(At clutch hub outer circumference) mm (in)

Standard	Limit
Less than 0.05 (0.0197)	0.3 (0.0118)



Block Ring Groove and Insert Clearance mm (in)

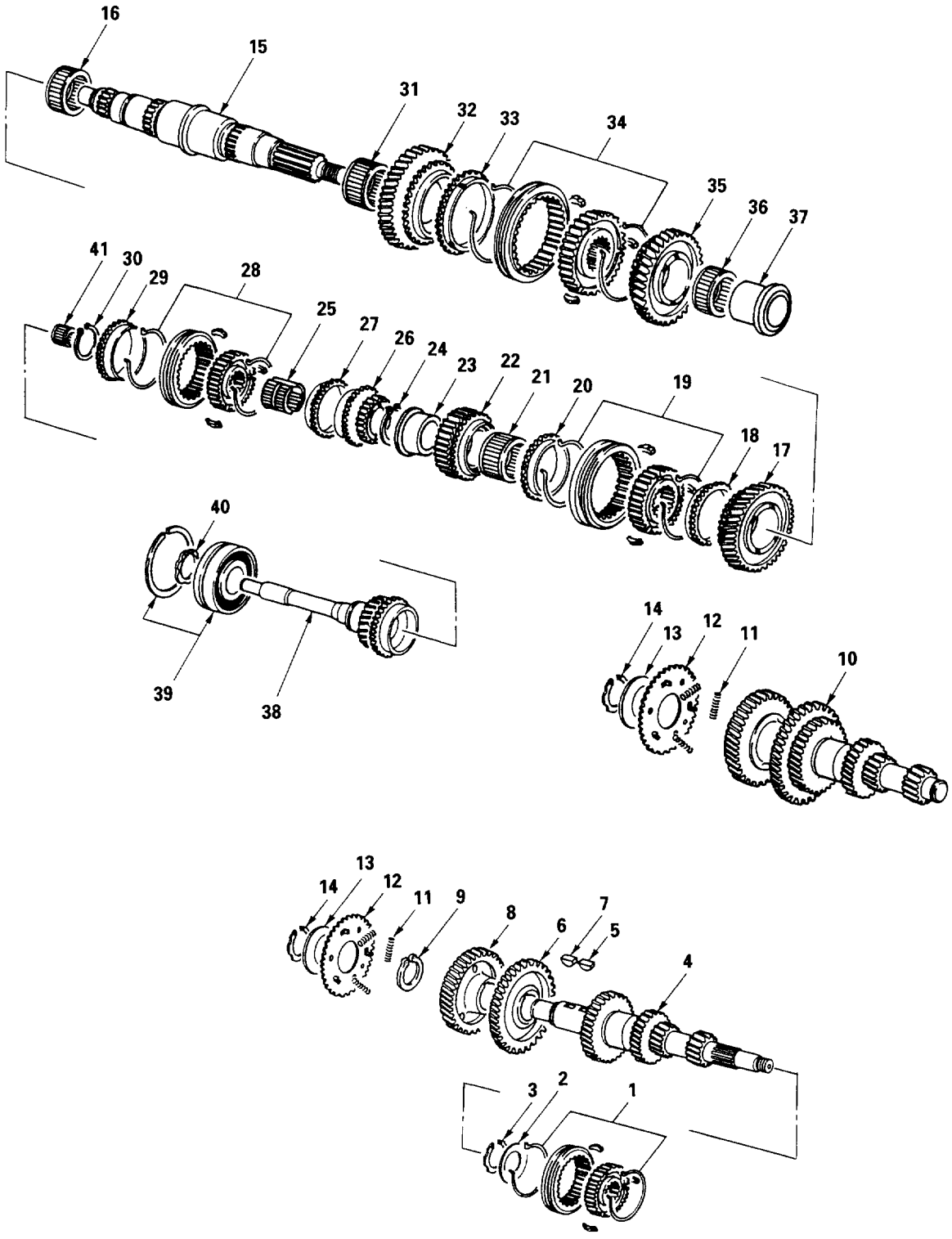
Gear	Standard
6th	3.59 – 3.91 (0.141 – 0.154)
4th/5th	3.59 – 3.91 (0.141 – 0.154)
2nd/3rd	3.59 – 3.91 (0.141 – 0.154)
1st	3.54 – 3.86 (0.139 – 0.152)



Clutch Hub Groove and Insert Clearance mm (in)

Gear	Standard
6th	0.09 – 0.31 (0.0035 – 0.0122)
4th/5th	0.09 – 0.31 (0.0035 – 0.0122)
2nd/3rd	0.09 – 0.31 (0.0035 – 0.0122)
1st/Reverse	0.09 – 0.31 (0.0035 – 0.0122)

REASSEMBLY


16
15
31
32
33
34
35
36
37
41
30
29
28
25
27
26
24
23
22
21
20
19
18
17
40
39
38
14
13
12
11
10
13
14
12
11
9
8
6
7
5
4
3
2
1

Reassembly steps

6th Synchronizer Assembly (for 6 speed type only)

1. 6th synchronizer assembly
2. Conical washer
3. Snap ring

Counter Shaft Assembly

4. Counter shaft (for 6 speed type only
5. Key (for 6 speed type only)
6. Counter shaft 5th gear (for 6 speed type only)
7. Key (for 6speed type only)
8. Counter shaft drive gear (for 6 speed type only)
9. Snap ring (for 6 speed type only)
10. Counter shaft (for 5 speed type only)
11. Spring
12. Anti-lash plate
13. Conical washer
14. Snap ring

Main Shaft Assembly

15. Main shaft
16. Needle bearing
17. 2nd gear
18. Block ring
19. 2nd/3rd synchronizer assembly
20 Block ring
21. Needle bearing
22. 3rd gear
23. Collar
24. Snap Ring
25. Needle bearing
26. 5th gear
27. Block ring
28. 4th/5th synchronizer assembly
29. Block ring
30. Snap ring
31. Needle bearing
32. 1st gear
33. Block Ring
34. 1st/reverse synchronizer assembly
35. Reverse gear
36. Needle bearing
37. Collar

Top Gear Shaft Assembly

38. Top gear shaft
39. Ball bearing
40. Snap ring
41. Needle bearing

Reassembly Step

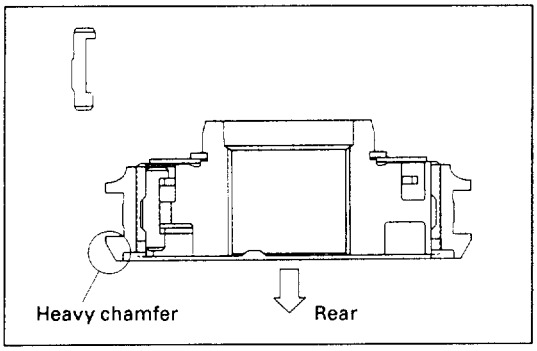
NOTE:

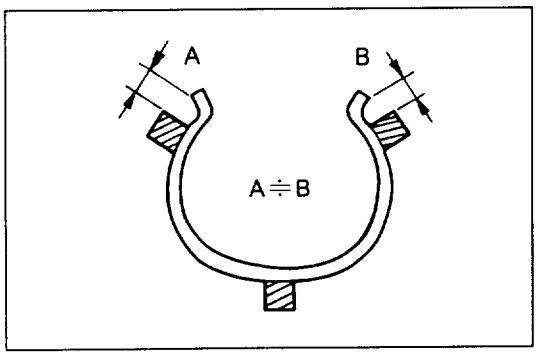
Clean each part thoroughly.

When assembling parts, apply clean engine oil (SAE 5W-30) to their sliding and mating sections.

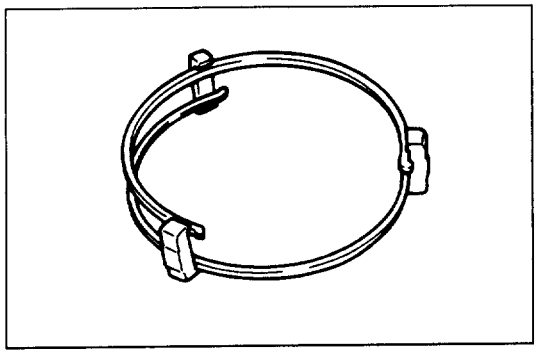
6th Synchronizer Assembly (for 6 speed type only)

1. **6th Synchronizer Assembly**
   - Mate the clutch hub and the sleeve so that the oil groove of the clutch hub boss end face and the heavy chamfered side of the sleeve outer circumference point to the same direction.
   - Put the inserts into the clutch hub groove so that big end of the insert turns to the 6th gear, and install the insert spring.





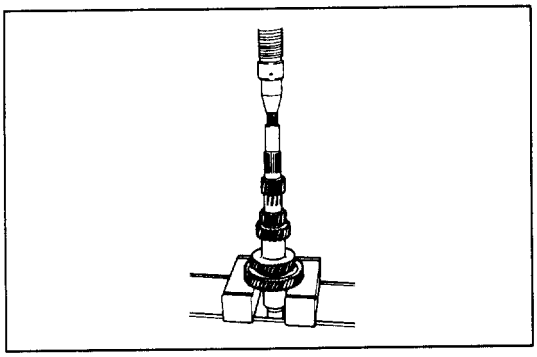
- Assemble the insert springs so that the distances (A and B) between inserts and the opening of the spring can be nearly equal, and also this opening may not be the same direction on both side.

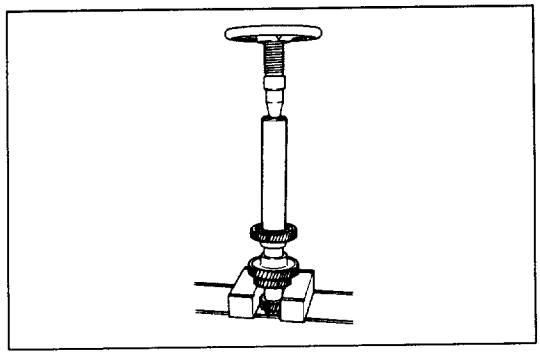


2. **Conical Washer**
3. **Snap Ring**

Counter Shaft Assembly

4. **Counter Shaft (for 6 speed type only)**
5. **Key (for 6 speed type only)**
6. **Counter Shaft 5th Gear (for 6 speed type only)**
   - Align the key groove of the 5th gear with the key.
   - Use a bench press to install the 5th gear.





7. **Key (for 6 speed type only)**
8. **Counter Shaft Drive Gear (for 6 speed type only)**
   - Align the key groove of the counter shaft drive gear with the key.
   - Use a bench press and the clutch hub & collar Installer to install the counter shaft drive gear.

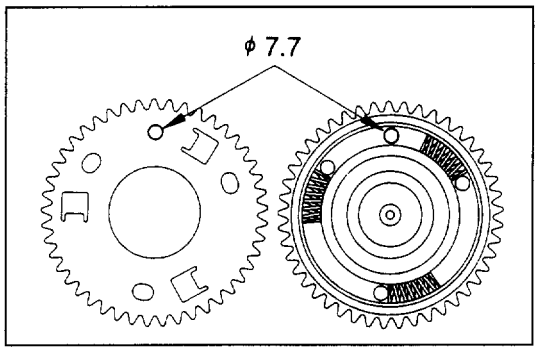
     Clutch Hub & Collar Installer : 5-8840-2345-0

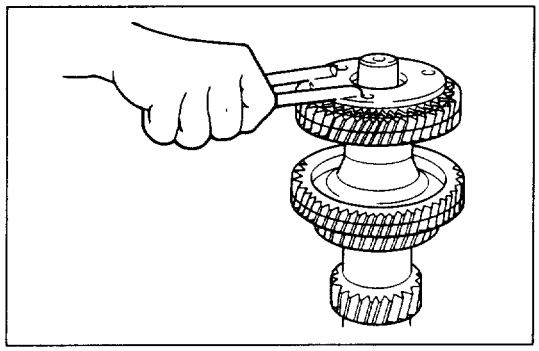
NOTE:

When replacing the pin with a new one, hammer it in until its height becomes 3 mm (0.12 in) from the gear end face.

9. **Snap Ring (for 6 speed type only)**
   - Use a new snap ring to fix the counter drive gear.

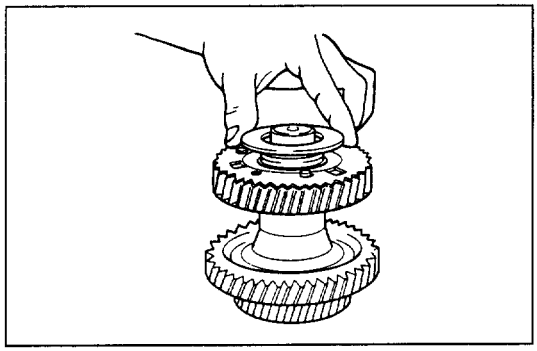
   NOTE:
   - **Avoid the reuse of snap ring.**
10. **Counter Shaft (for 5 speed type only)**
11. **Spring**
    - The spring should be installed to the left of the inside counter drive gear pin.
12. **Anti-lash Plate**
    - Assemble the anti-lash plate to the drive gear so that the drive gear hole (ø 7.7 mm/0.3 in) comes roughly in line with the hole of the anti-lash plate (ø 7.7 mm/0.3 in).



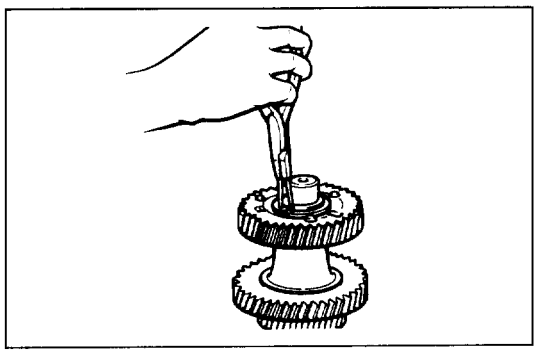


- With the guide pin aligned with the drive gear hole (ø 7.7 mm/0.3 in), set the installer to the guide pin.

  Anti-lash Plate Installer: 5-8840-2045-0
- Turn the installer clockwise. When the drive gear pin comes to the position where it can be seen fully, put the installer into the drive gear side to fix the anti-lash plate to the drive gear.



13. **Conical Washer**
    - Install the conical washer above the anti-lash plate with the convex side (front side) up.



14. **Snap Ring**
    - Use a new snap ring to fix the conical washer.

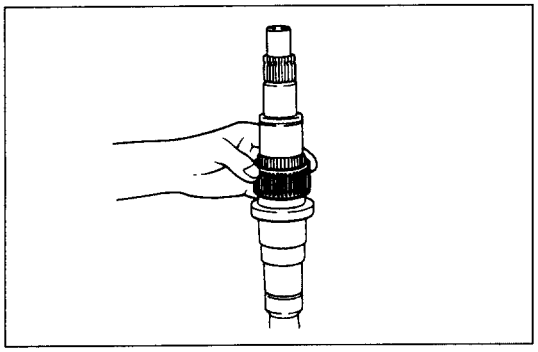
    NOTE:
    - **Avoid the reuse of snap ring.**
    - **Check visually the anti-lash plate for a warp or curve after assembly.**

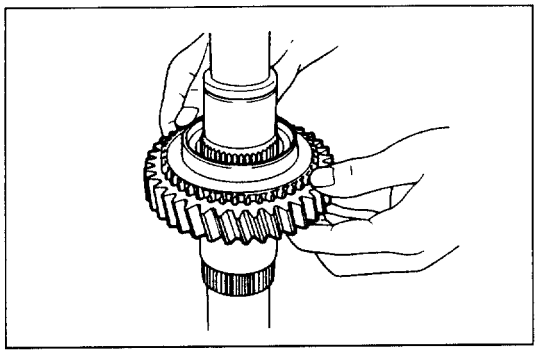
Main Shaft Assembly

15. Main Shaft

- Attach a backing plate to the vise, secure the main shaft at the spline end.

16. Needle Bearing





17. 2nd Gear

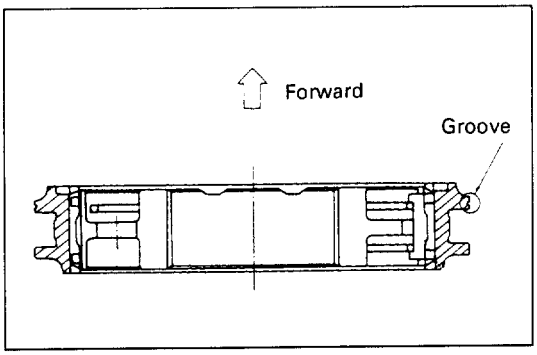
- Install the 2nd gear with its taper cone side upward (front of transmission).

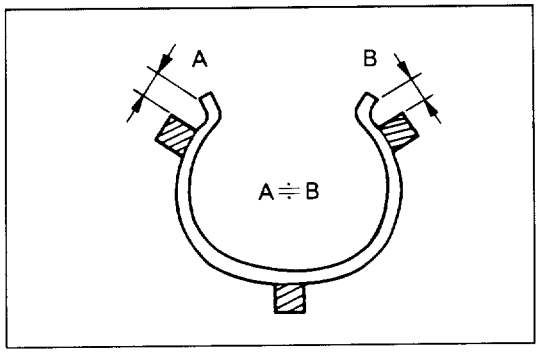
18. Block Ring

- Align the insert with the insert groove of the block ring.

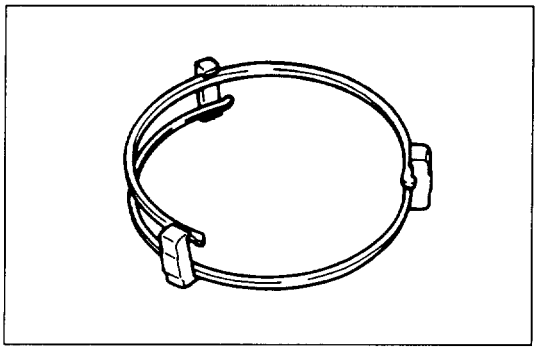
19. 2nd/3rd Synchronizer Assembly

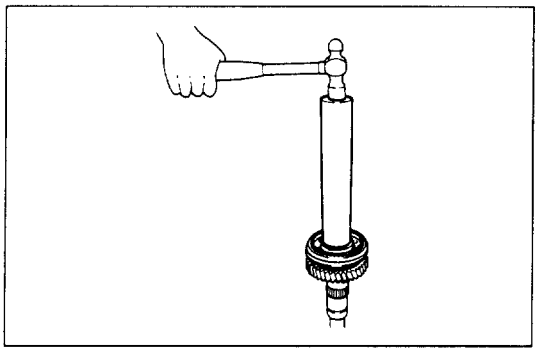
- Mate the clutch hub and the sleeve so that the white painted side of the clutch hub boss and the identification groove of the sleeve outer circumference point to the same direction.





- Put the inserts into the clutch hub groove, and install the insert spring.
- Assemble the insert springs so that the distances (A and B) between inserts and the opening of the spring can be nearly equal, and also this opening may not be the same direction on both side.



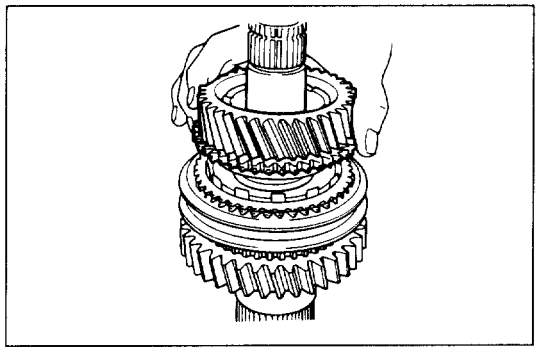


- Grooved side of the sliding sleeve should be positioned toward the 3rd gear side (front of transmission).
- Align the insert with the insert groove of the block ring.
- Tap the clutch hub boss section with the clutch hub & collar installer and a hammer to press it in until it contacts closely with the main shaft stepped section.

  Clutch Hub & Collar Installer : 5-8840-2345-0
- When it is difficult to engage the clutch hub boss with the main shaft spline, heat the clutch hub boss section to a temperature between 80 and 120 °C (176 and 248°F) with the piston heater before assembling.
- Check to see if the 2nd gear rotates smoothly.

20. Block Ring

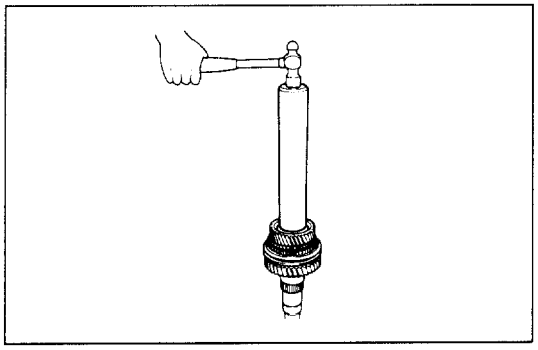
- Align the insert with the insert groove of the block ring.



21. Needle Bearing

22. 3rd Gear

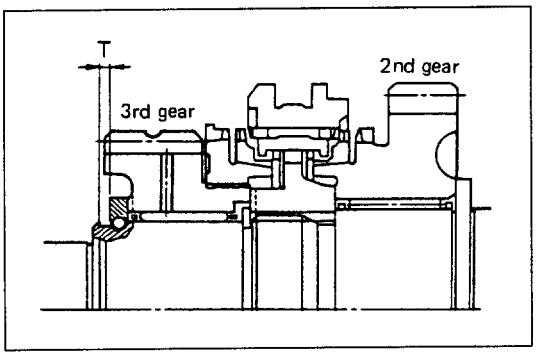
- Install the 3rd gear with the taper cone side turned to the 2nd gear side (to the bottom).



23. 3rd Gear Collar

- Tap the collar with the clutch hub & collar installer and a hammer to press it in until it contacts closely with the main shaft stepped section.

  Clutch Hub & Collar Installer : 5-8840-2345-0
- When it is difficult to engage the collar with the main shaft, heat the collar to a temperature between 80 and 120°C (176 and 248°F) with the piston heater before assembling.

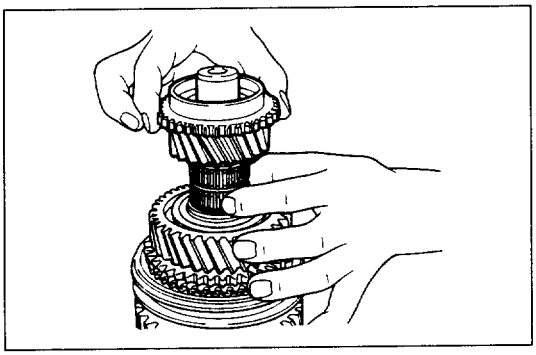


24. Snap Ring

- After installation, measure distance (T) and select the optimum snap ring from the table.

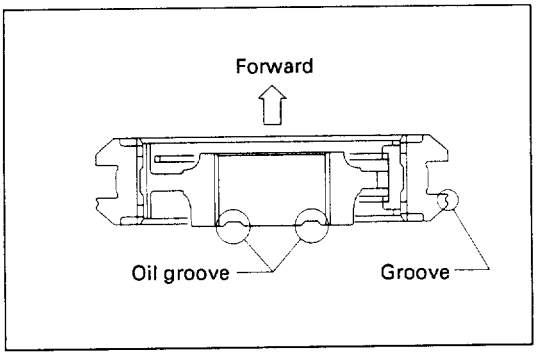
Snap Ring mm (in)

Distance (T)	Color	Thickness (Reference)
2.20 – 2.27 (0.087 – 0.089)	Yellow	1.85 – 1.90 (0.073 – 0.075
2.27 – 2.32 (0.089 – 0.091)	Blue	1.90 – 1.95 (0.075 – 0.077)
2.32 – 2.37 (0.091 – 0.093)	Brown	1.95 – 2.00 (0.077 – 0.079)
2.37 – 2.43 (0.093 – 0.096)	Green	2.00 – 2.05 (0.079 – 0.081)



25. Needle Bearing

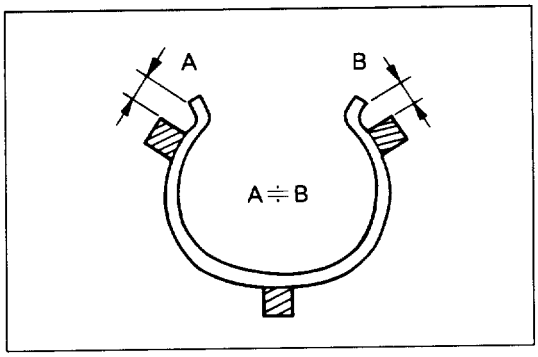
26. 5th Gear



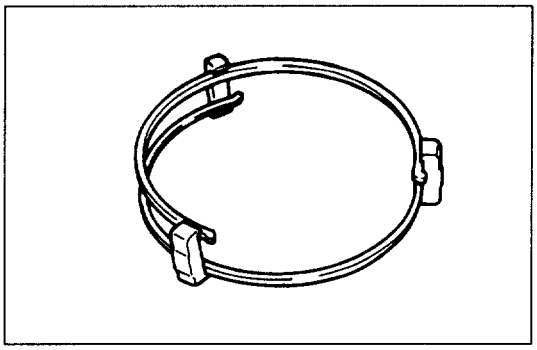
27. Block Ring

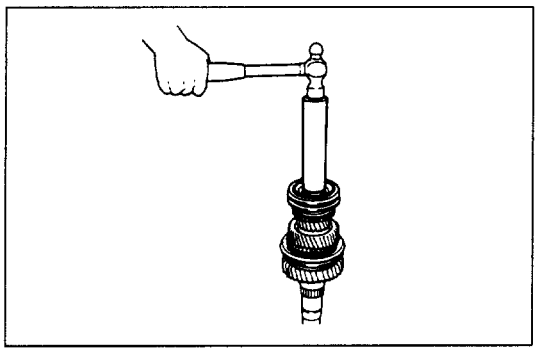
28. 4th/5th Synchronizer Assembly

- Mate the clutch hub and the sleeve so that the larger diameter side of the clutch hub boss and the identification groove of the sleeve outer circumference point to the same direction.



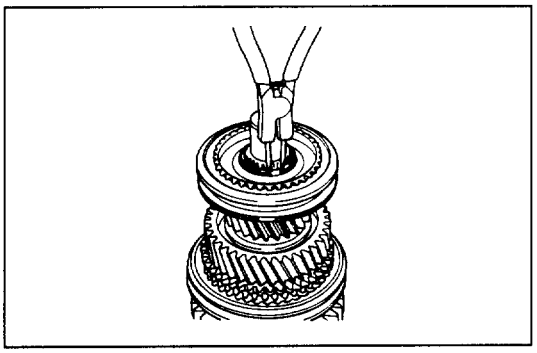
- Put the inserts into the clutch hub groove, and install the insert spring.
- Assemble the insert springs so that the distances (A and B) between inserts and the opening of the spring can be nearly equal, and also this opening may not be the same direction on both side.





- Grooved face of the sliding sleeve should be positioned toward the 5th gear (rear of transmission).
- Align the insert with the insert groove of the block ring.
- Tap the clutch hub boss section with the bearing installer and a hammer to press it in until it contacts closely with the main shaft stepped section.

  Bearing Installer : 5-8840-2244-0
- When it is difficult to engage the clutch hub boss with the main shaft spline, heat the clutch hub boss section to a temperature between 80 and 120 °C (176 and 248°F) with the piston heater before assembling.
- Check to see if the 5th gear rotates smoothly.



29. Block Ring

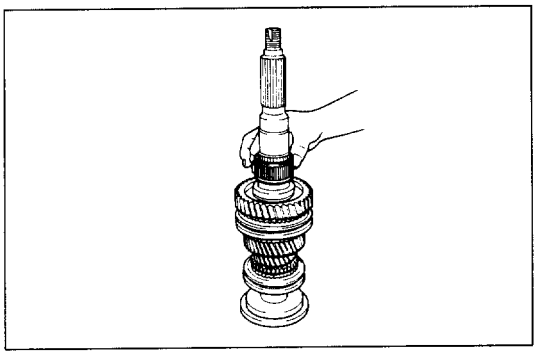
30. Snap Ring

- Install the built-in snap ring and measure the clearance between the snap ring and the clutch hub.

Clutch Hub and Snap Ring Clearance	mm (in)
0 – 0.09 (0 – 0.0035)	

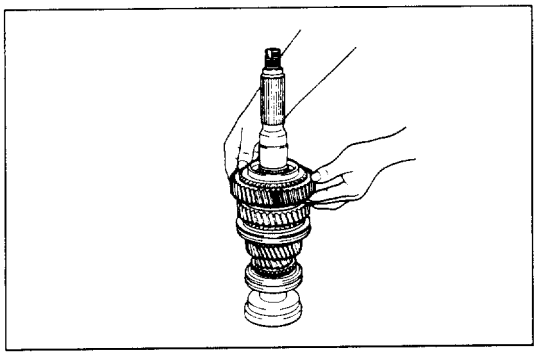
- When the clearance is out of the reference value, select a snap ring with the maximum thickness that can be inserted from among the following three types, and built it in.

Snap Ring	mm (in)
color	Thickness (Reference)
Pink	1.75 – 1.80 (0.0689 – 0.0709)
White	1.80 – 1.85 (0.0709 – 0.0728)
Yellow	1.85 – 1.90 (0.0728 – 0.0748)



31. Needle Bearing

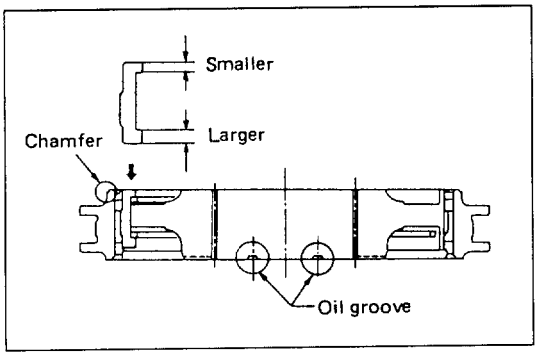
- Stand the main shaft on the main shaft holder.
  Main Shaft Holder : 5-8840-2347-0



32. 1st Gear

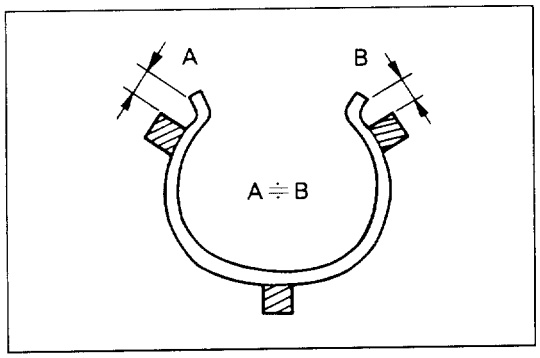
- Install with the taper cone side turned upward (rear of transmission).

33. Block Ring

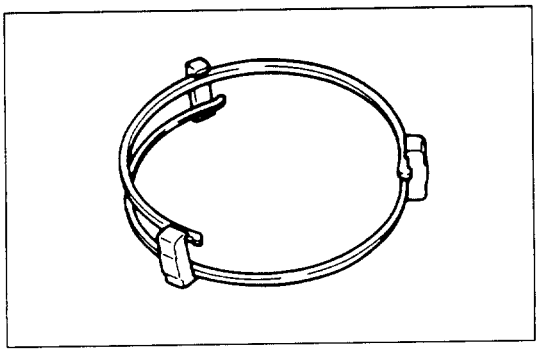


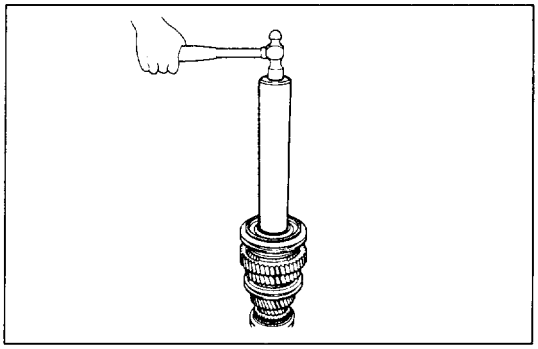
34. 1st/Reverse Synchronizer Assembly

- Mate the clutch hub and the sleeve so that the oil groove of the clutch hub boss end face points to the direction opposite to that of the chamfer of the sleeve outer circumference.
- Larger width side of insert should be positioned toward front of transmission.



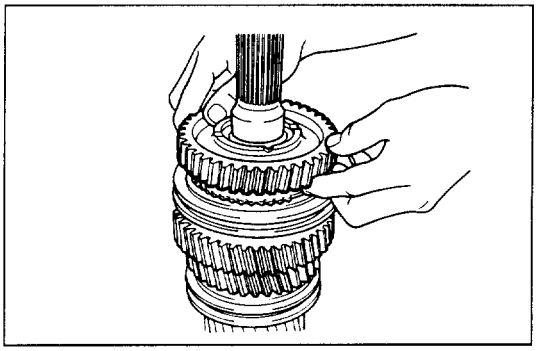
- Put the inserts into the clutch hub groove, and install the insert spring.
- Assemble the insert springs so that the distances (A and B) between inserts and the opening of the spring can be nearly equal, and also this opening may not be the same direction on both side.





- Face of the clutch hub with two-oil grooves should be positioned toward 1st gear (front of transmission).
- Align the insert with the insert groove of the block ring.
- Tap the clutch hub boss section with the clutch hub & collar installer and a hammer to press it in until it contacts closely with the main shaft stepped section.

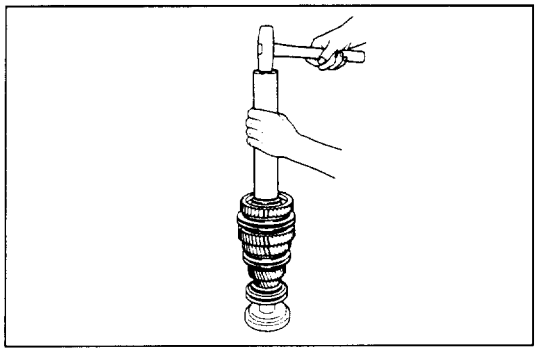
  Clutch Hub & Collar Installer : 5-8840-2345-0
- When it is difficult to engage the clutch hub boss with the main shaft spline, heat the clutch hub boss section to a temperature between 80 and 120 °C (176 and 248°F) with the piston heater before assembling.
- Check to see if the 1st gear rotates smoothly.



35. Reverse Gear

- Install with the dog gear side turned down (rear of transmission).

36. Needle Bearing



37. Collar

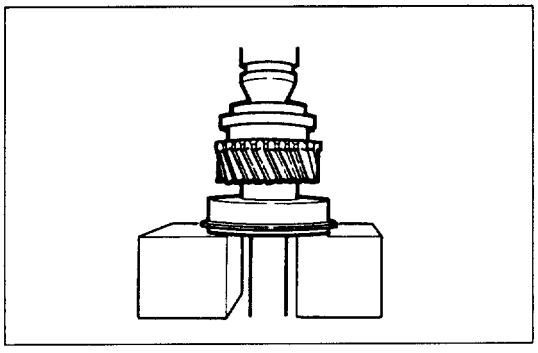
- Tap the collar with the clutch hub & collar installer and a hammer to press it in until it contacts closely with the main shaft stepped section.

  Clutch Hub & Collar Installer : 5-8840-2345-0
- When it is difficult to engage the clutch hub boss with the main shaft spline, heat the clutch hub boss section to a temperature between 80 and 120 °C (176 and 248°F) with the piston heater before assembling.

Top Gear Shaft Assembly

38. Top Gear Shaft

39. Ball bearing

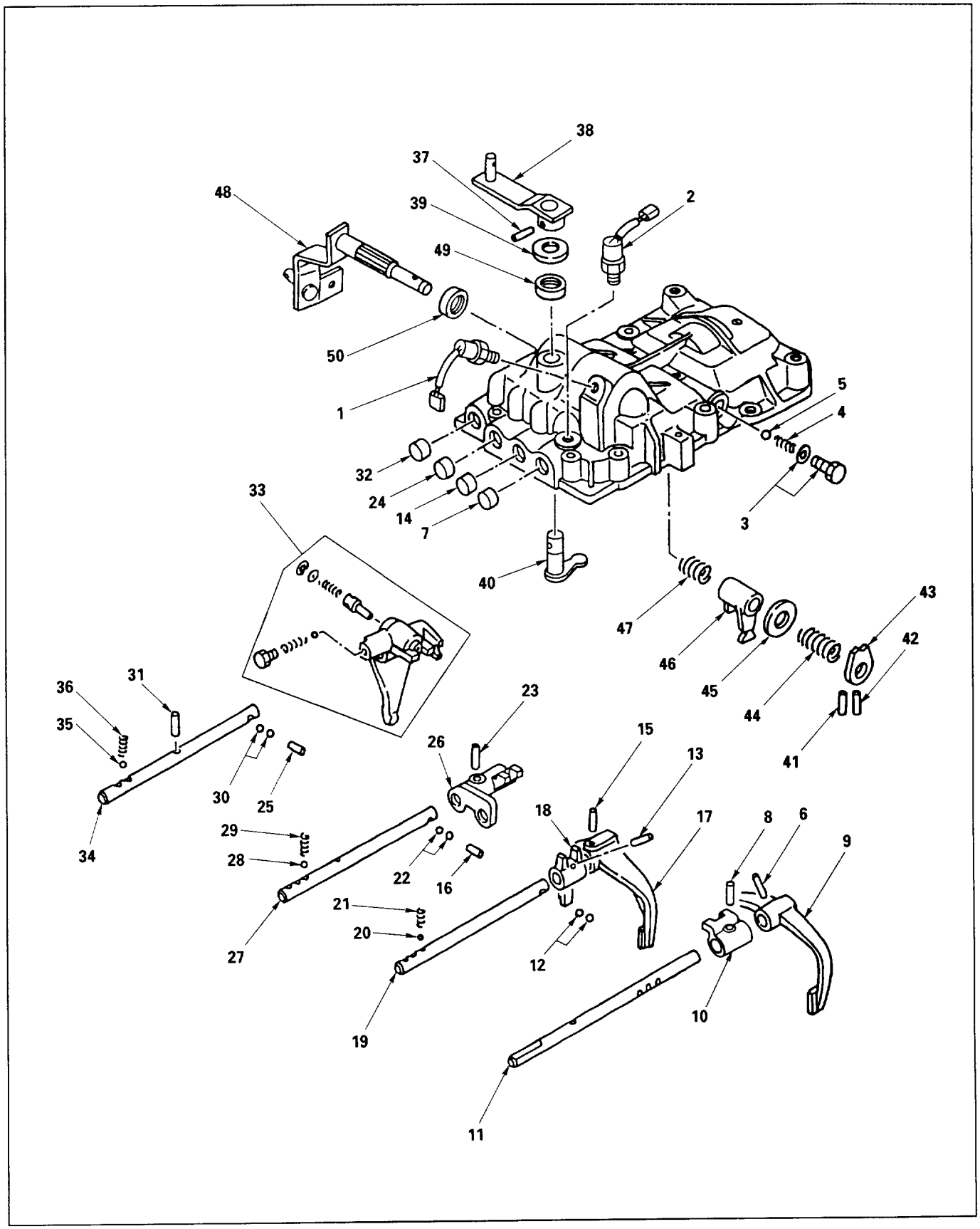


- Install the ball bearing to the top gear shaft so that the outer circumference snap ring side turns to the front side.
- Use a bench press to install the ball bearing until it contacts closely with the top gear shaft stepped section.

40. Snap Ring

41. Needle Bearing

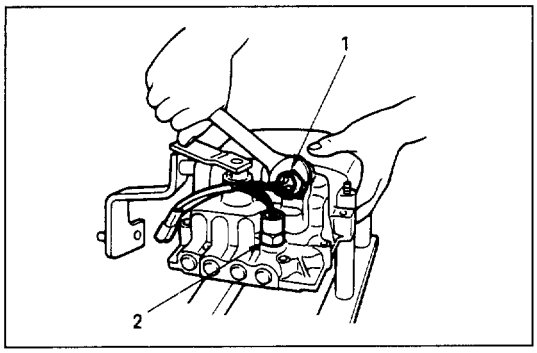
CONTROL BOX
DISASSEMBLY



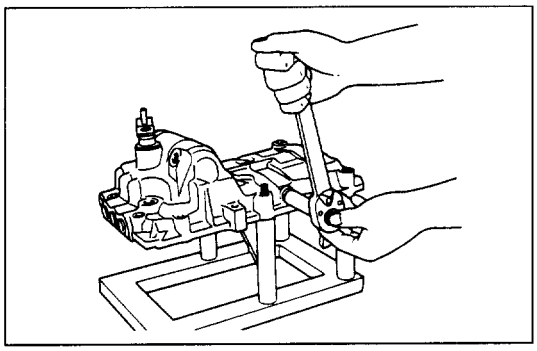
Disassembly Steps

1. Neutral switch
2. Back-up light switch
3. Plug and gasket
4. Detent spring
5. Detent ball
6. Spring pin
7. Shift rod cap
8. Spring pin
9. 1st/reverse shift arm
10. 1st/reverse shift block
11. 1st/reverse shift rod
12. Interlock ball
13. Spring pin
14. Shift rod cap
15. Spring pin
16. Interlock pin
17. 2nd/3rd shift arm
18. 2nd/3rd shift block
19. 2nd/3rd shift rod
20. Detent ball
21. Detent spring
22. Interlock ball
23. Spring pin
24. Shift rod cap
25. Interlock pin
26. Shift block
27. 4th/5th shift rod
28. Detent ball
29. Detent spring
30. Interlock ball
31 Spring pin (for 6 speed type only)
32. Shift rod cap (for 6 speed type only)
33. Shift block assembly (for 6 speed type only)
34. Shift rod (for 6 speed type only)
35. Detent ball (for 6 speed type only)
36 Detent spring (for 6 speed type only)
38. Spring pin
38. Select external lever
39. Washer
40. Select internal lever
41. Spring pin
42. Spring pin
43. Stopper ring
44. Spring (long)
45. Washer
46. Shift internal lever
47. Spring (short)(for 5 speed type only)
48. Shift lever shaft
49. Select lever shaft oil seal
50. Shift lever shaft oil seal

Disassembly Steps



1. **Neutral Switch**
2. **Back-up Light Switch**

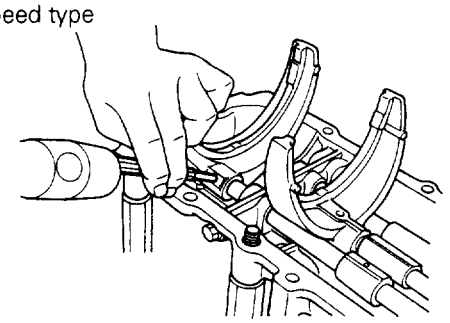


3. **Plug and Gasket**
4. **Detent Spring**
5. **Detent Ball**

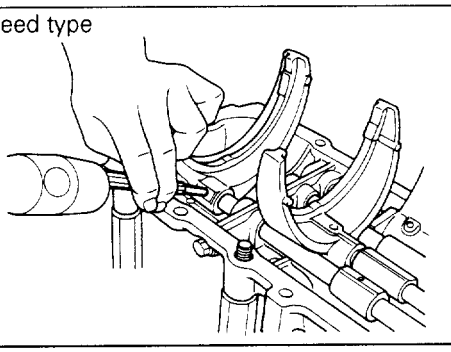
NOTE:

Be careful not to lose the detent ball and spring.

5 speed type



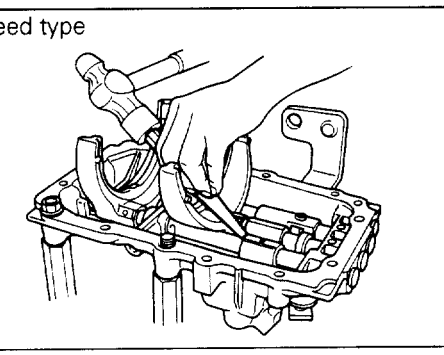
6 speed type



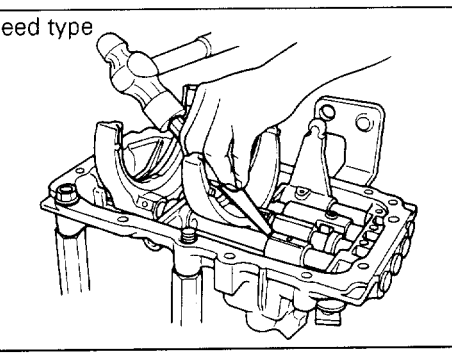
6. **Spring Pin**

Spring Pin Remover : 9-8529-2201-0

5 speed type



6 speed type



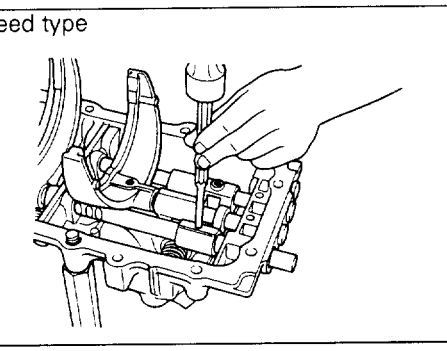
7. **Shift Rod Cap**

- Move the shift rod forward by tapping on shift block rear end with brass bar and hammer.

CAUTION:

Before removal, set all shift rods in neutral position.

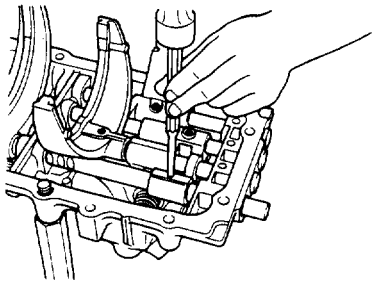
5 speed type



8. **Spring Pin**

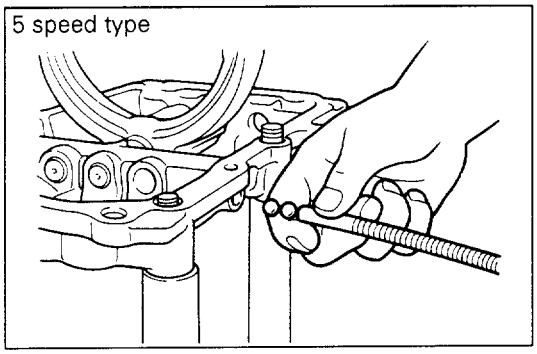
Spring Pin Remover : 9-8529-2201-0

6 speed type

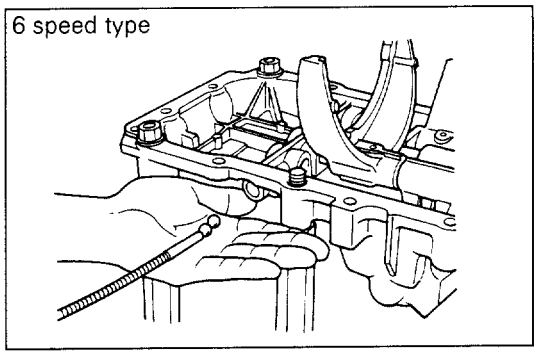


9. **1st/Reverse Shift Arm**
10. **1st/Reverse Shift Block**
11. **1st/Reverse Shift Rod**
12. **Interlock Ball**
    - Take out the two interlock balls from between the 1st/reverse shift rod and the 2nd/3rd shift rod.

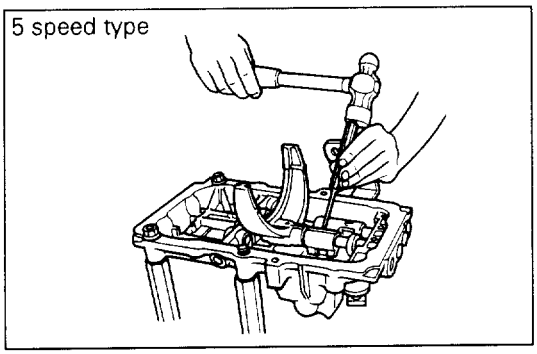
5 speed type



6 speed type



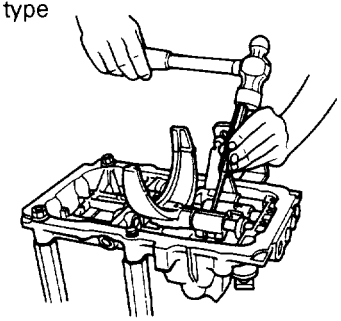
5 speed type



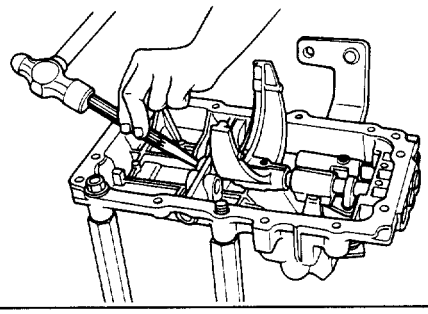
13. **Spring Pin**

    Spring Pin Remover : 9-8529-2201-0

6 speed type



5 speed type



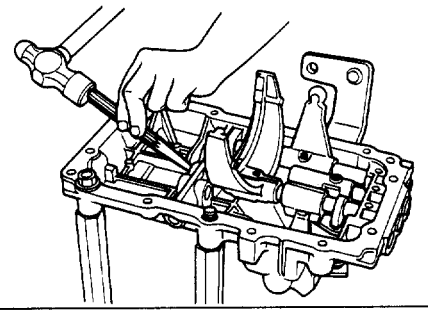
14. Shift Rod Cap

- Move the shift rod forward by tapping on its rear end. Then, remove the cap.

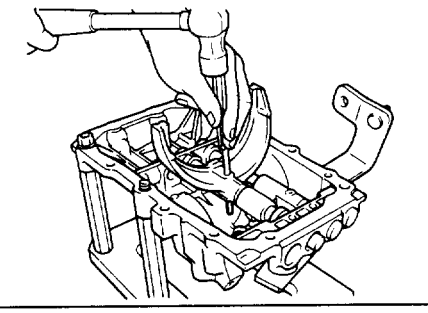
CAUTION:

Take care not to damage the shift rod hole of the control box when tapping the shift rod.

6 speed type



5 speed type

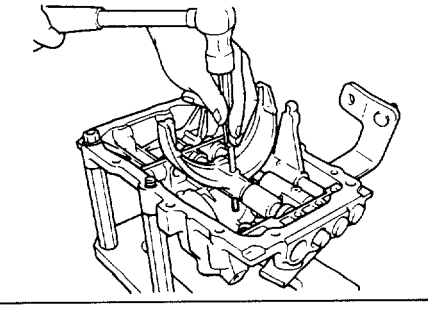


15. Spring Pin

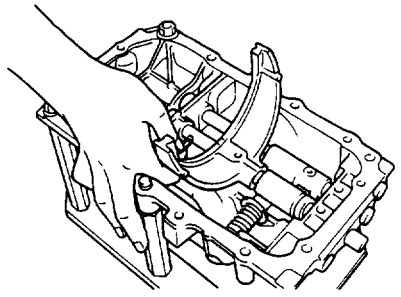
- Move the shift rod forward (about 20 mm) by tapping on its rear end. Then, remove the spring pin using the spring pin remover.

  Spring Pin Remover : 9-8529-2201-0

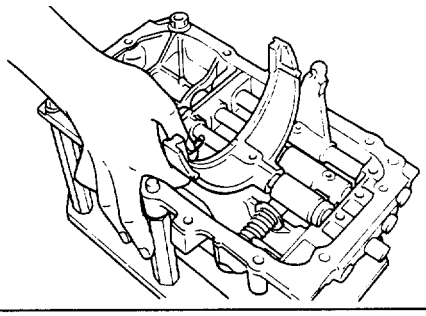
6 speed type



5 speed type



6 speed type



16. Interlock Pin

17. 2nd/3rd Shift Arm

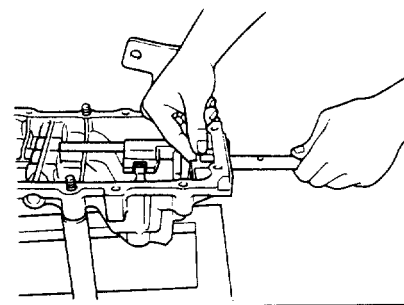
18. 2nd/3rd Shift Block

- Move the shift rod forward by tapping on its rear end. Then, remove the each parts.

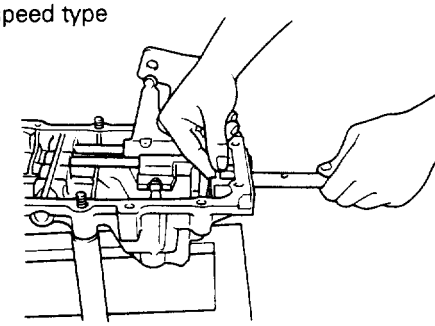
CAUTION:

Take care not to damage the shift rod hole of the control box when tapping the shift rod.

5 speed type



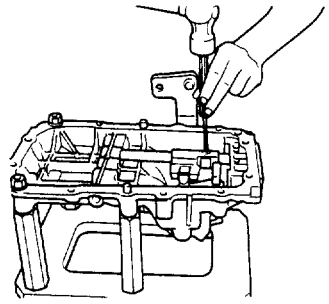
6 speed type



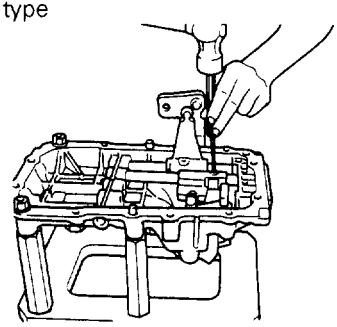
19. 2nd/3rd Shift Rod

- Close the shift rod hole of the control box with finger to avoid losing the detent ball when removing the shift rod.

5 speed type



6 speed type



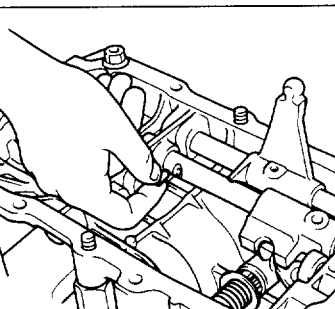
20. **Detent Ball**
21. **Detent Spring**
    - Take out the detent ball and spring from the control box.
22. **Interlock Ball**
    - Take out the two interlock balls from between the 2nd/3rd shift rod and 4th/5th shift rod.
23. **Spring Pin**

    Spring Pin Remover: 9-8529-2201-0

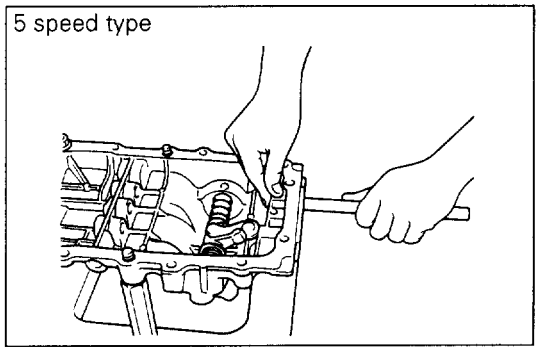
24. **Shift Rod Cap**
    - Move the shift rod forward by tapping on its rear end. Then, remove the cap.

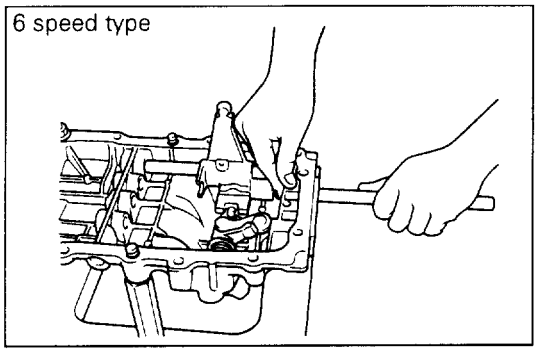
CAUTION:

Take care not to damage the shift rod hole of the control box when tapping the shift rod.



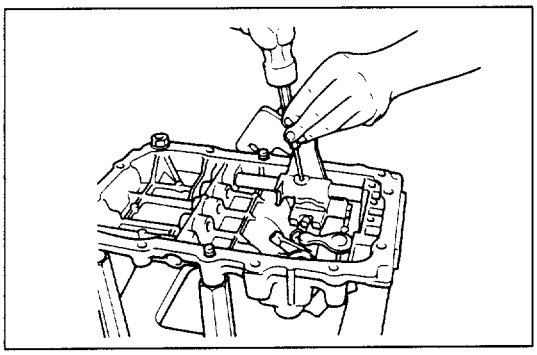
25. **Interlock Pin (for 6 speed type only)**
26. **Shift Block**





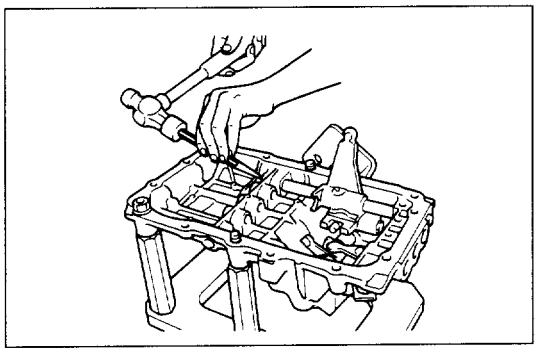
27. **4th/5th Shift Rod**
    - Close the shift rod hole of the control box with finger to avoid losing the detent ball when removing the shift rod.

28. **Detent Ball**
29. **Detent Spring**
30. **Interlock Ball**
    - Take out the two interlock balls from between the 4th/5th shift rod and 6th shift rod.



31. **Spring Pin (for 6 speed type only)**

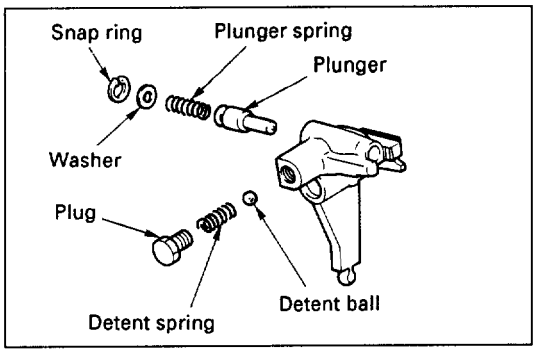
    Spring Pin Remover : 9-8529-2201-0



32. **Shift Rod Cap (for 6 speed type only)**
    - Move the shift rod forward by tapping on its rear end. Then, remove the cap and the shift block assembly.

CAUTION:

Take care not to damage the shift rod hole of the control box when tapping the shift rod.

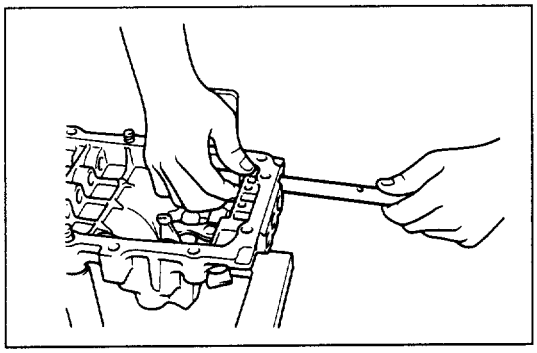


33. **Shift Block Assembly (for 6 speed type only)**

CAUTION:

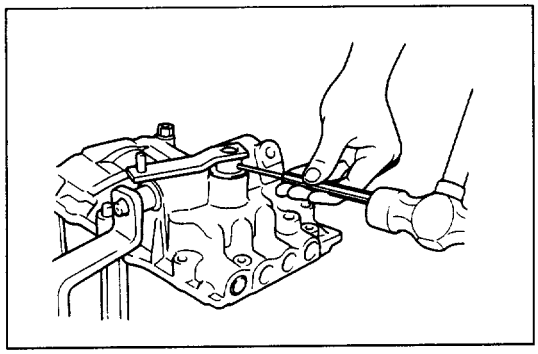
Shift Block Assembly contains the springs under tension. Take care to spring the parts when disassembling the shift block assembly.

- Remove the plug. Then, take out the detent spring and the detent ball.
- Remove the snap ring. Then,take out the washer,the plunger spring and the plunger.



34. **Shift Rod (for 6 speed type only)**
    - Close the shift rod hole of the control box with finger to avoid spring the detent ball when removing the shift rod.

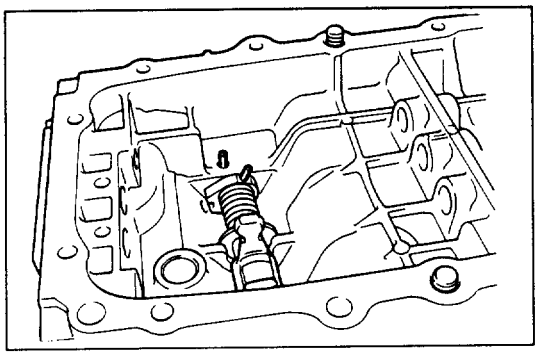
35. **Detent Ball (for 6 speed type only)**
36. **Detent Spring (for 6 speed type only)**



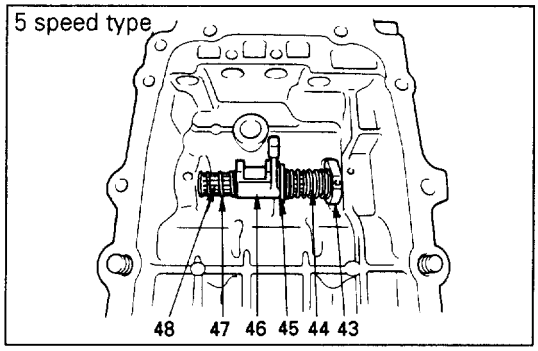
37. **Spring Pin**

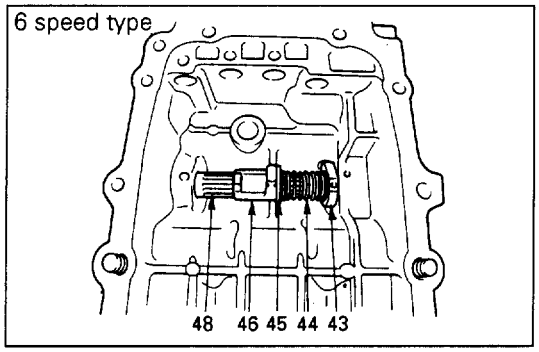
    Spring Pin Remover : 9-8529-2201-0

38. **Select External Lever**
39. **Washer**
40. **Select Internal Lever**
41. **Spring Pin**

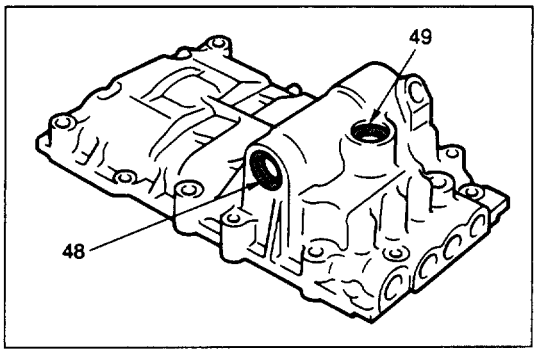


42. **Spring Pin**
    - Pull out the spring pin with a pair of pliers.





43. **Stopper Ring**
    - With pull out the shift lever shaft, remove the each parts.
44. **Spring**
45. **Washer**
46. **Shift Internal Lever**
47. **Spring (for 5 speed type only)**
48. **Shift Lever Shaft**



49. **Select Lever Shaft Oil Seal**
50. **Shift Lever Shaft Oil Seal**
    - Use the screwdriver to remove the oil seal from the control box.

CAUTION:

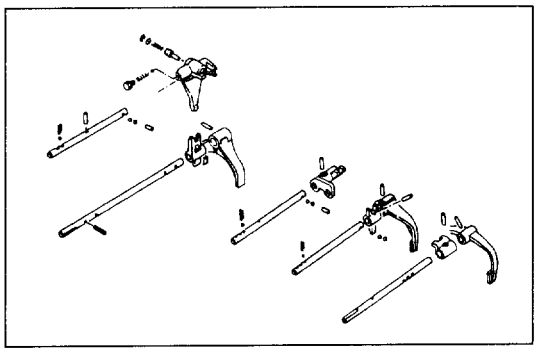
Take care not to damage the sealing seat of the control box.

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacement if excessive wear or damage is discovered during inspection.

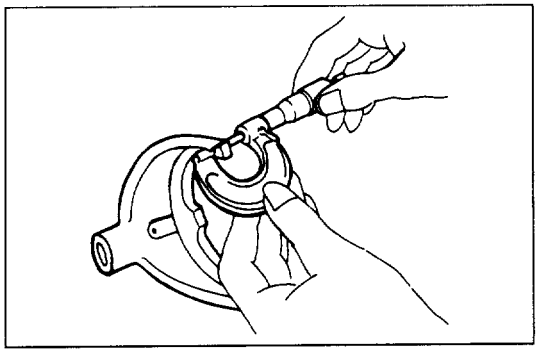
Visual Check

Inspect all disassembled parts for wear, damage or other abnormal conditions.



Shift Rod

Check the shift rod wear, bent and damage.



Shift Arm

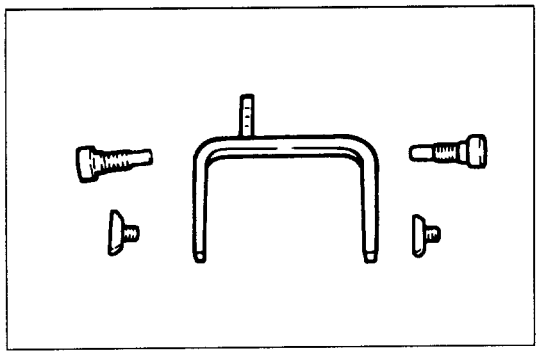
Inspect the shift arms for wear, distortion or scoring.

Replace it these conditions are present.

Shift Arm Thickness

Use a micrometer to measure the shift arm and shift pieces thickness.

If the measured value is less than the specified limit, the shift arm must be replaced.

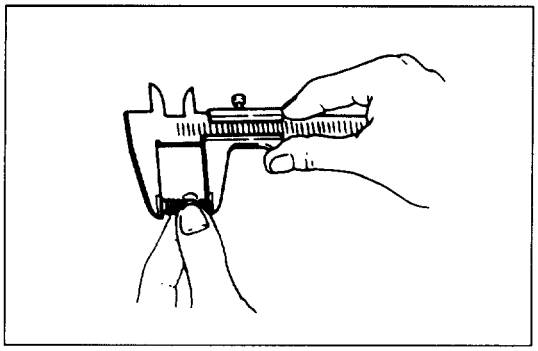


Shift Arm Thickness — mm (in)

Nominal	Limit
10.0 (0.394)	9.0 (0.354)

Detent Spring

Inspect the detent springs for wear, distortion or cracks. Replace detent spring if these conditions are present.

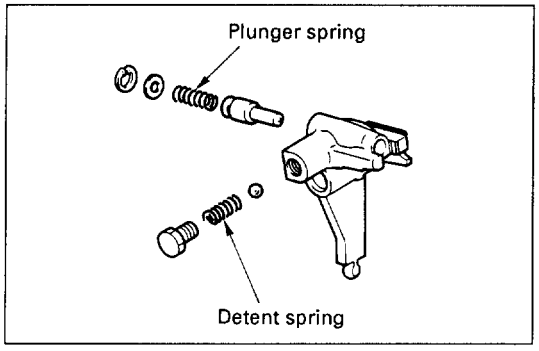


Detent Spring Free Length

Use a vernier caliper to measure the detent spring free length. If the measured value is less than the specified limit, the detent spring must be replaced.

Free Length of Detent Spring — mm (in)

Nominal	Limit
31.6 (1.244)	30.1 (1.185)



Plunger Spring and Detent Spring Free Length (for 6 speed only)

Use a vernier caliper to measure the detent spring free length. If the measured value is less than the specified limit, the detent spring must be replaced.

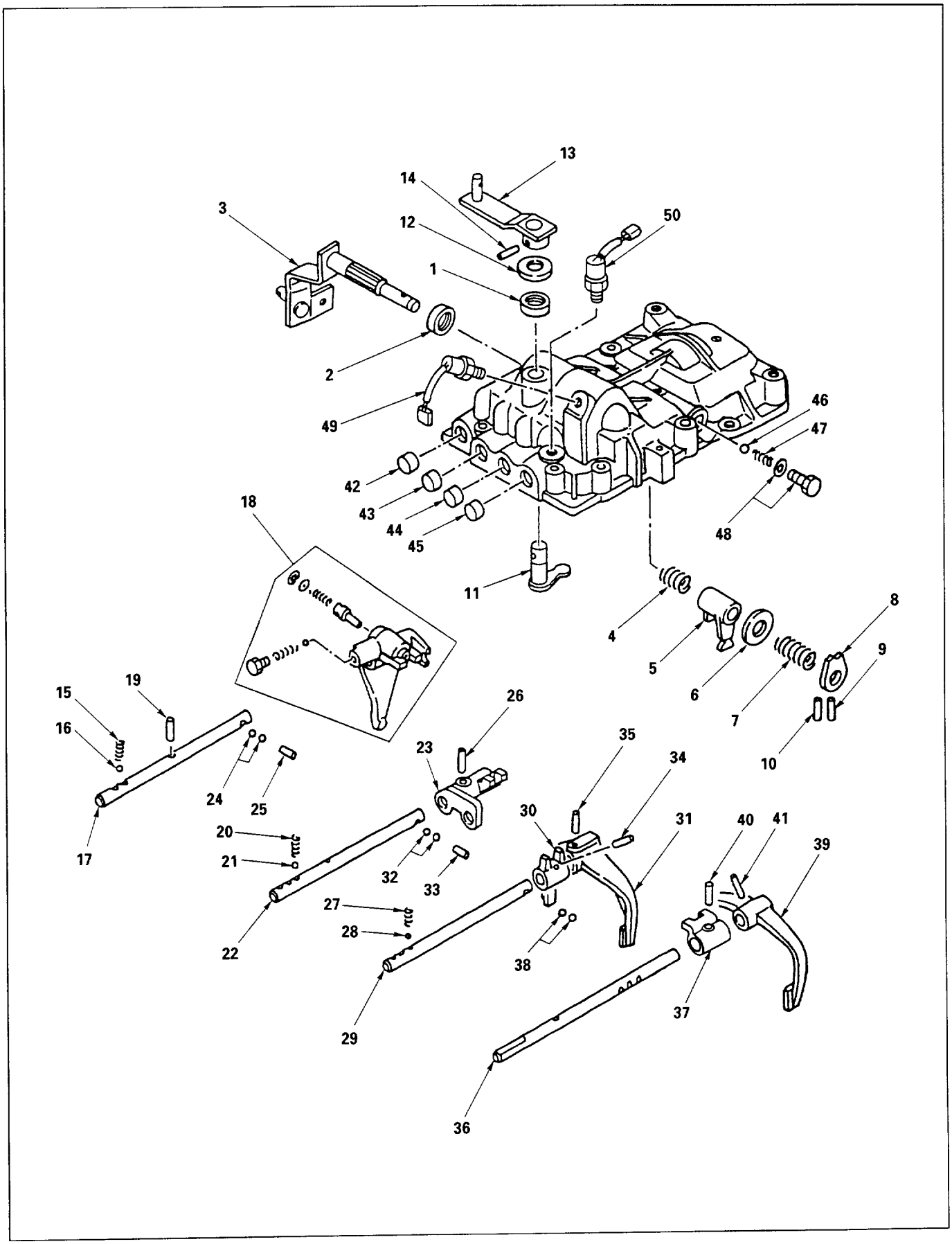
Free Length of Plunger Spring — mm (in)

Nominal	Limit
35.1 (1.382)	34.0 (1.339)

Free Length of Detent Spring — mm (in)

Nominal	Limit
24.2 (0.953)	23.0 (0.906)

REASSEMBLY


13
14
3
12
50
1
2
49
46
47
42
43
44
45
48
18
11
4
5
8
6
9
7
10
15
19
16
26
23
35
34
24
25
30
31
40
41
39
20
21
32
33
17
27
28
22
38
37
29
36

Reassembly Step

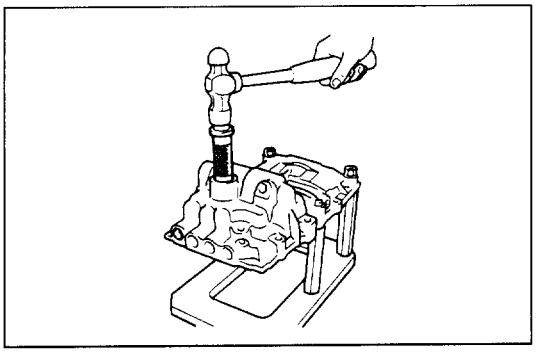
1. Select lever shaft oil seal
2. Shift lever shaft oil seal
3. Shift lever shaft
4. Spring (Short)(for 5 speed type only)
5. Shift internal lever
6. Washer
7. Spring (Long)
8. Stopper ring
9. Spring pin
10. Spring pin
11. Select internal lever
12. Washer
13. Select external lever
14. Spring pin
15. Detent spring (for 6 speed type only)
16. Detent ball (for 6 speed type only)
17. 6th shift rod (for 6 speed type only)
18. 6th Shift Block (for 6 speed type only)
19. Spring pin
20. Detent Spring
21. Detent Ball
22. 4th/5th Shift Rod
23. 4th/5th Shift Block
24. Interlock ball
25. Interlock pin
26. Spring pin
27. Detent spring
28. Detent ball
29. 2nd/3rd shift rod
30. 2nd/3rd shift block
31. 2nd/3rd shift arm
32. Interlock ball
33. Interlock pin
34. Spring pin
35. Spring pin
36. 1st/reverse shift rod
37. 1st/reverse shift block
38. Interlock ball
39. 1st/reverse shift arm
40. Spring pin
41. Spring pin
42. 6th shift rod cap (for 6 speed type only)
43. 4th/5th shift rod cap
44. 2nd/3rd shift rod cap
45. 1st/reverse shift rod cap
46. Detent ball
47. Detent spring
48. Plug and gasket
49. Neutral switch
50. Back-up light switch

Reassembly Step

NOTE:

Clean each part thoroughly.

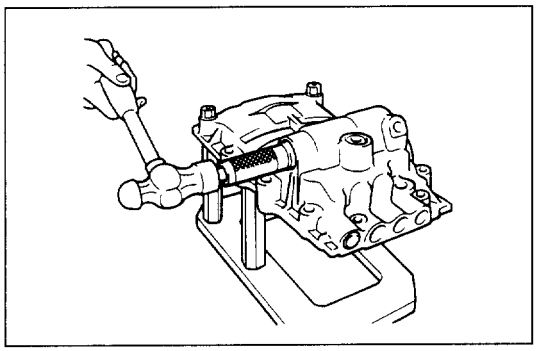
When assembling parts, apply clean engine oil (SAE 5W-30) to their sliding and mating section.



1. Select Lever Shaft Oil Seal

- Apply engine oil to the new oil seal outer circumference and apply multi-purpose grease on the oil seal lip.
- Use oil seal installer to install the oil seal to the control box.

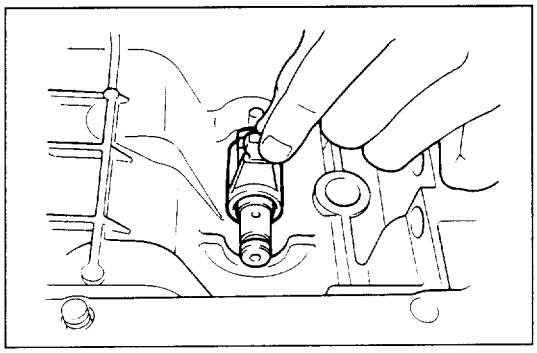
  Oil Seal Installer: 5-8840-2245-0



2. **Shift Lever Shaft Oil Seal**
   - Apply engine oil to the new oil seal outer circumference and apply multi-purpose grease on the oil seal lip.
   - Use oil seal installer to install the oil seal to the control box.

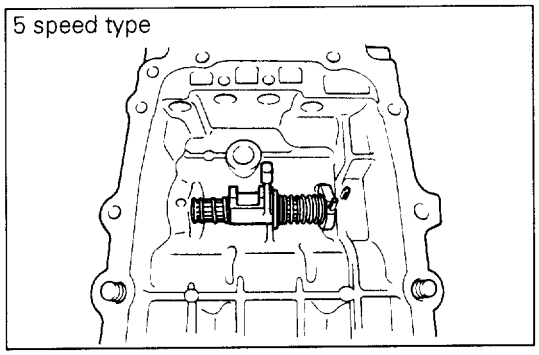
     Oil Seal Installer: 5-8840-2245-0

3. **Shift Lever Shaft**
   - Apply engine oil to the shift lever shaft.
4. **Spring (short)(for 5 speed type only)**
5. **Shift Internal Lever**
   - With the shift external lever turned down (to the transmission side), insert it into the control box.
   - Assemble the shift internal lever so that its direction points to the same direction as that of the stopper ring fixing pin hole.

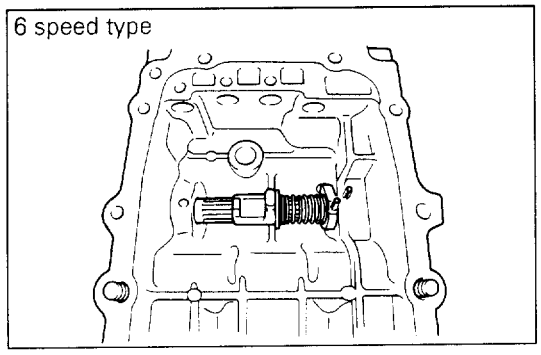


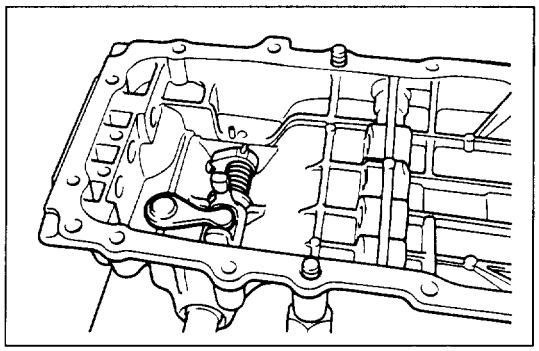
6. **Washer**
7. **Spring (long)**
8. **Stopper Ring**
9. **Spring Pin**
   - With the stopper ring pin hole set on that of the shift lever shaft, hammer a new spring pin into the holes.
10. **Spring Pin**
    - Setting the control box pin hole to the shift lever shaft groove, hammer a new spring pin into the hole.

5 speed type



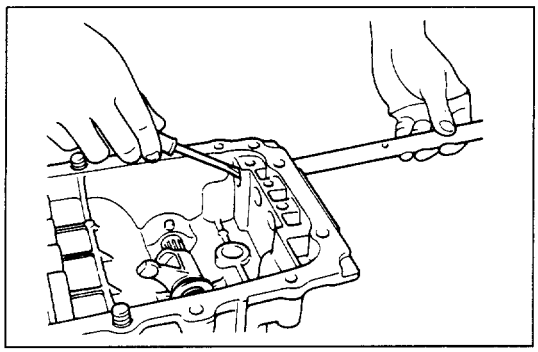
6 speed type

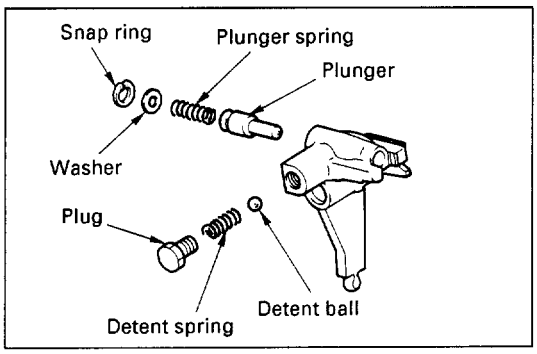




11. **Select Internal Lever**
    - Apply engine oil to the select internal lever shaft.
    - With the select internal lever paired with the shift internal lever, build them into the control box.

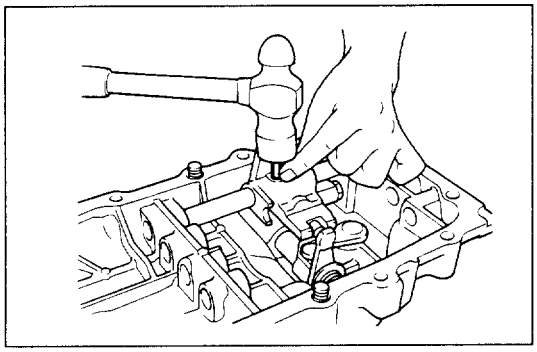
12. **Washer**
13. **Select External Lever**
14. **Spring Pin**
    - With the select external lever turned to the shift external lever side, fix it with a new pin after assembling.
15. **Detent Spring (for 6 speed type only)**
16. **Detent Ball (for 6 speed type only)**
17. **6th Shift Rod (for 6 speed type only)**
    - Press down the detent ball with a screwdriver to prevent it from jumping out.





18. **6th Shift Block (for 6 speed type only)**
    - Install plunger, plunger spring, plate and snap ring into the shift block.
    - Remove sealant from the plug and the female threaded surfaces and the surfaces must be perfectly dry.
    - Apply liquid gasket (LOCTITE 242 or equivalent) to the bolt's threaded area.
    - Install detent ball and detent spring into the shift block. Then, tighten plug to the specified torque.

Plug Torque	N·m (kg·m/lb·ft)
	13 (1.3/9.4)



19. Spring Pin (for 6 speed type only)

- Setting the hole of the 6th shift block to that of the shift rod, fix them with a new spring pin (25 mm/0.98 in).

NOTE:

Install spring pin properly with the slit inline with the shaft centerline.

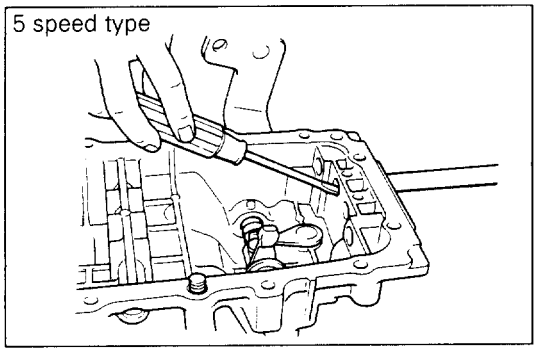
20. Detent Spring

21. Detent Ball

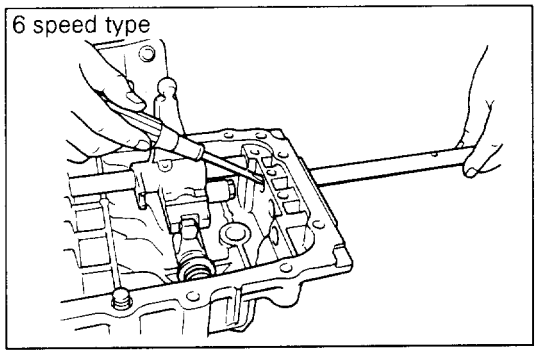
22. 4th/5th Shift Rod

- Press down the detent ball with a screwdriver to prevent it from jumping out.

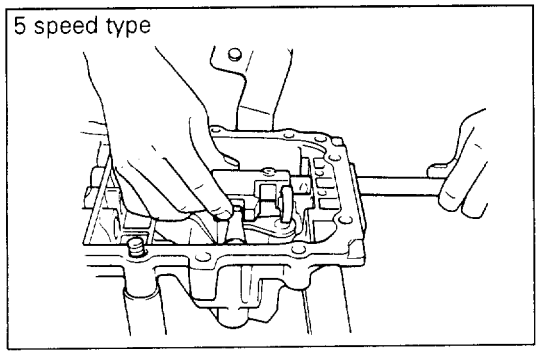
5 speed type



6 speed type

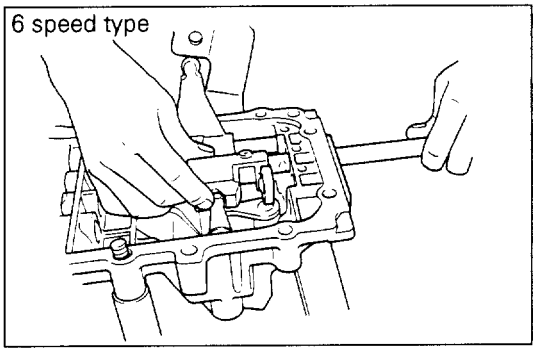


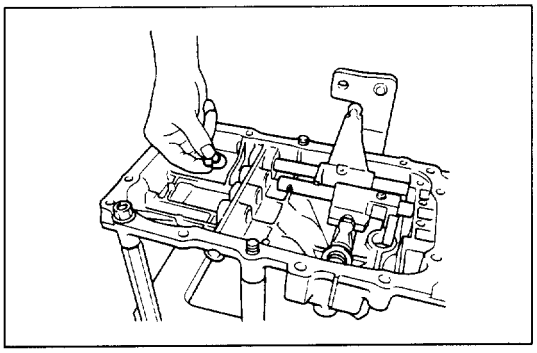
5 speed type



23. 4th/5th Shift Block

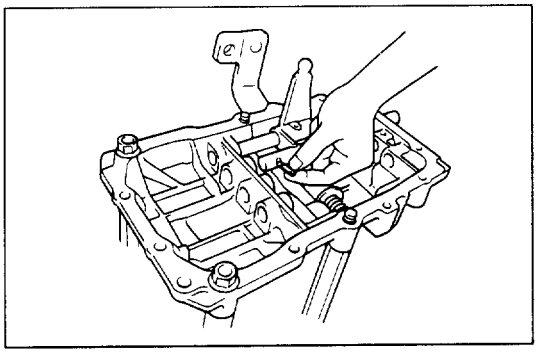
- With the spectacle detent side turned to the front, put the shift block through the rod.





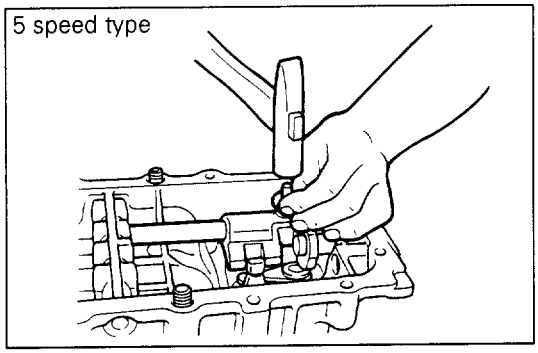
24. Interlock Ball (for 6 speed type only)

- Install 2 interlock balls in position between the 4th/5th shift rod and 6th shift rod.



25. Interlock Pin (for 6 speed type only)

- Install the interlock pin in position the pin hole of 4th/5th shift rod.

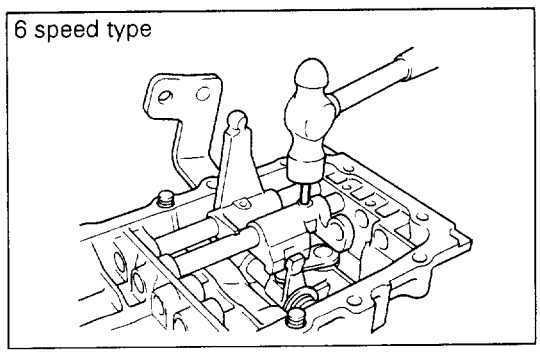


26. Spring Pin

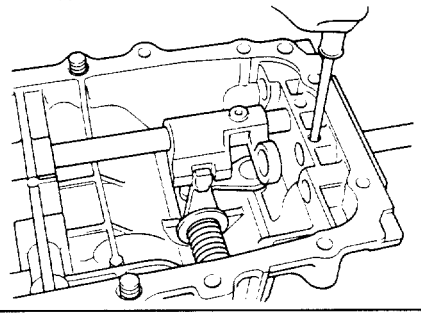
- Setting the hole of the 4th/5th shift block shift arm to that of the shift rod, fix them with a new spring pin (25 mm/0.98 in).

NOTE:

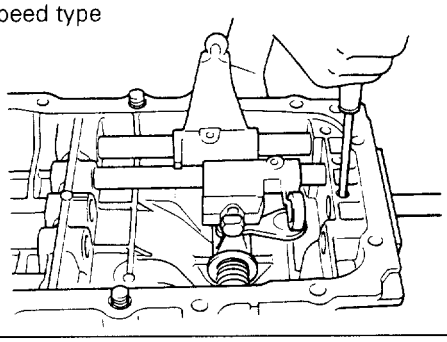
Install spring pin properly with the slit inline with the shaft centerline.



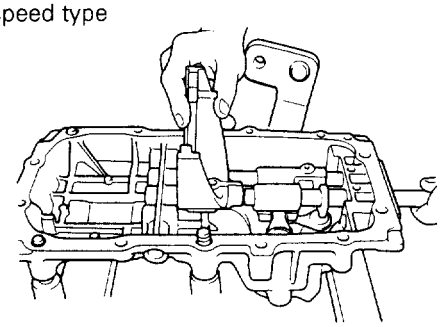
5 speed type



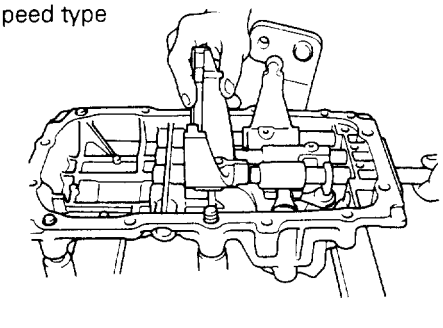
6 speed type



5 speed type

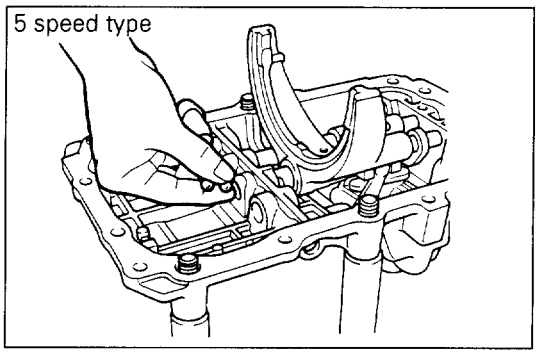


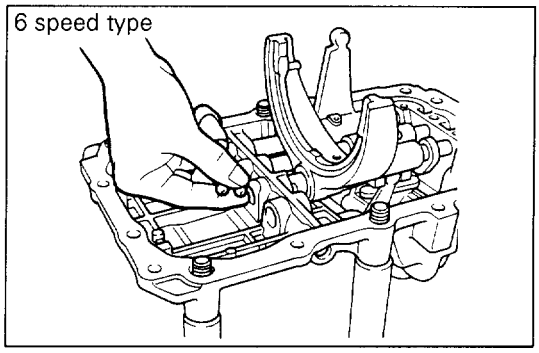
6 speed type



27. **Detent Spring**
28. **Detent Ball**
29. **2nd/3rd Shift Rod**
    - Press down the detent ball with a screwdriver to prevent it from jumping out.

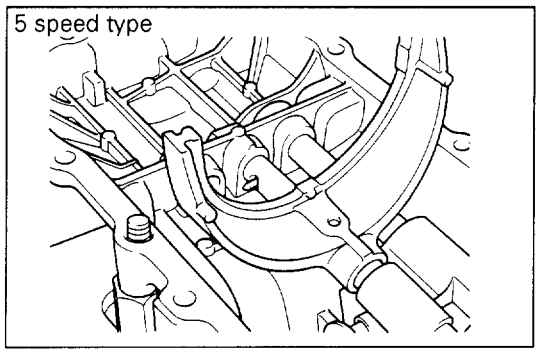
30. **2nd/3rd Shift Block**
    - Put the shift rod through the spectacle detent of 4th/5th shift block and 2nd/3rd shift block.
    - Assemble the 2nd/3rd shift block so that the shift block pin hole is inclined to the 4th/5th shift rod side.
31. **2nd/3rd Shift Arm**
    - With the projection side of the boss set to the front, put the 2nd/3rd shift arm through the shift rod.

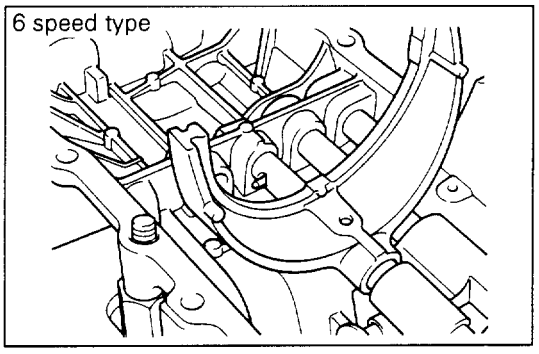




32. Interlock Ball

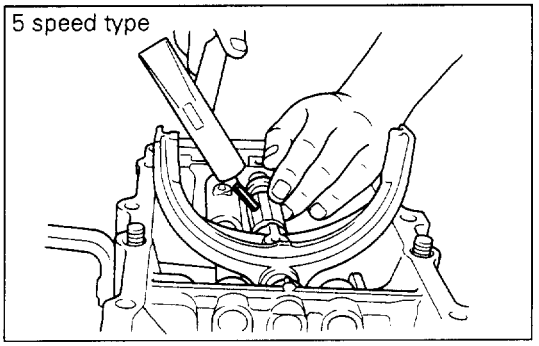
- Install 2 interlock balls in position between the 2nd/3rd shift rod and 4th/5th shift rod.





33. Interlock Pin

- Install the interlock pin in position the pin hole of 2nd/3rd shift rod.

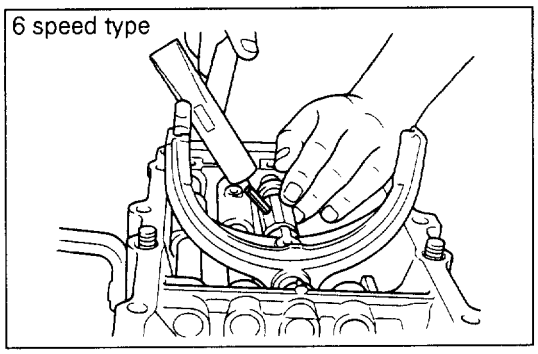


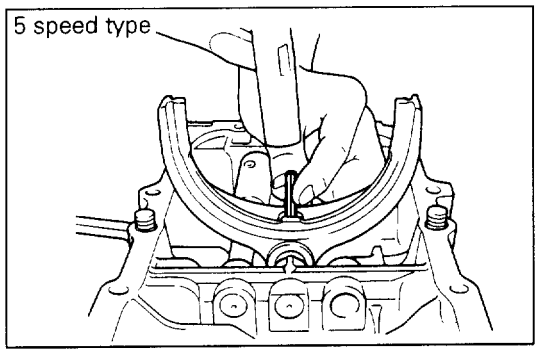
34. Spring Pin

- Setting the hole of the 2nd/3rd shift block to that of the shift rod, fix them with a new spring pin (25 mm/0.98 in).

NOTE:

Install spring pin properly with the slit inline with the shaft centerline.



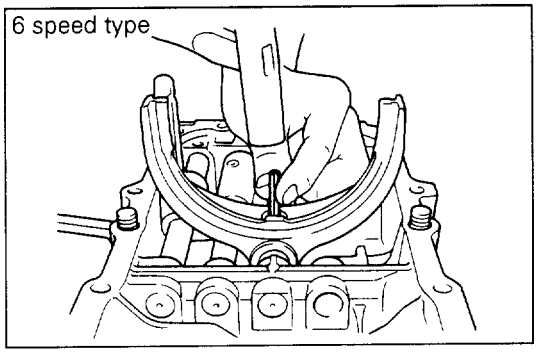


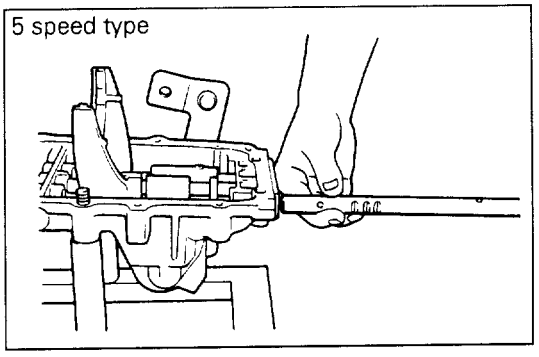
35. Spring Pin

- Setting the hole of the 2nd/3rd shift arm to that of the shift rod, fix them with a new spring pin (32 mm/1.26 in.).

NOTE:

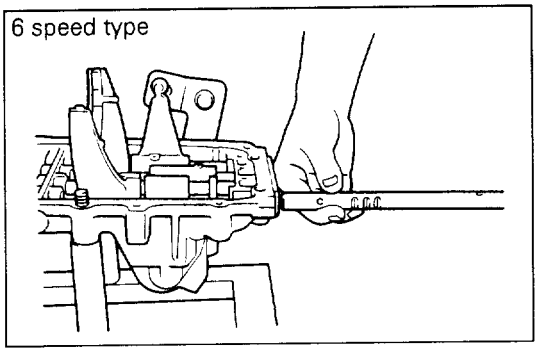
Install spring pin properly with the slit inline with the shaft centerline.



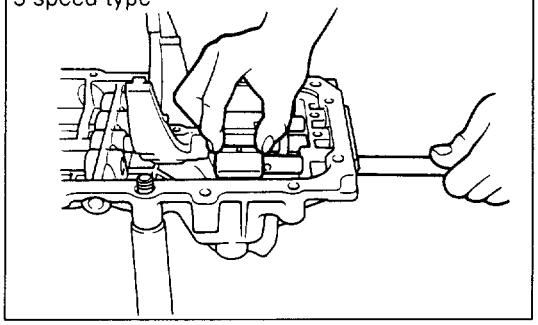


36. 1st/Reverse Shift Rod

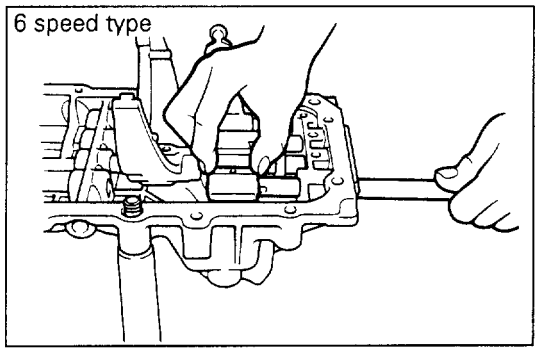
- Before reassembly, set the 4th/5th and 2nd/3rd shift rods already reassembled in neutral position.
- Insert the 1st/reverse shift rod so that the three detent ball grooves comes to the out side.



5 speed type



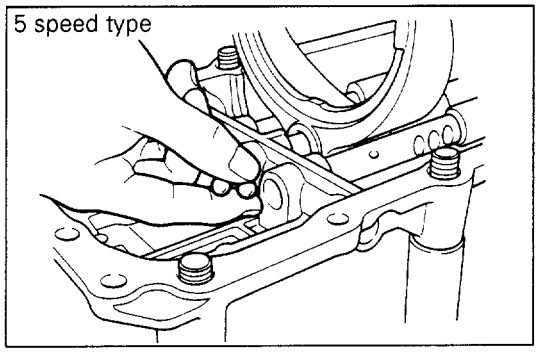
6 speed type



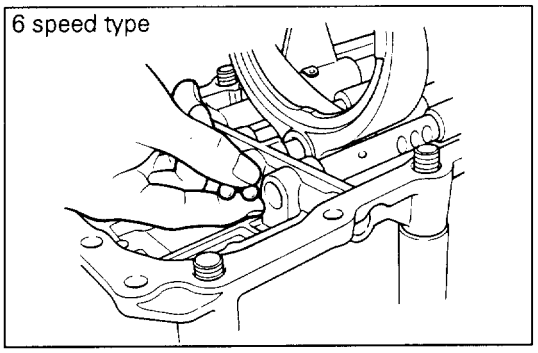
37. 1st/Reverse Shift Block

- Put the 1st/reverse shift block through the rod so that the catch turns up.

5 speed type



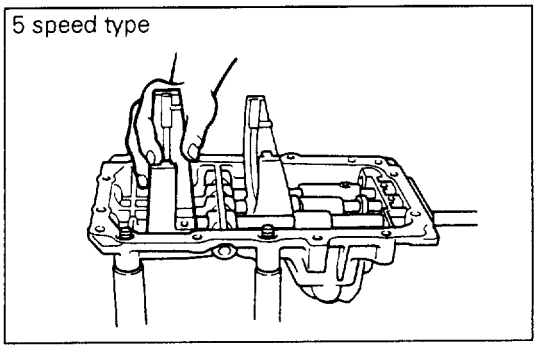
6 speed type



38. Interlock Ball

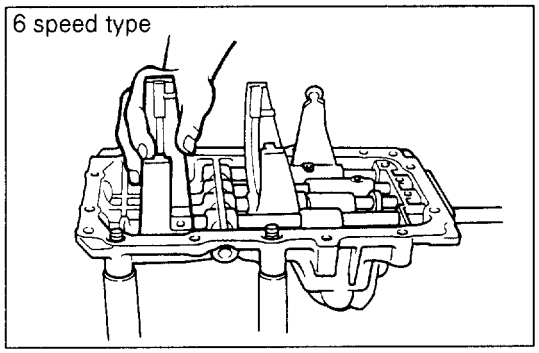
- Install 2 interlock balls in position between the 2nd/3rd shift rod and 1st/Reverse shift rod.

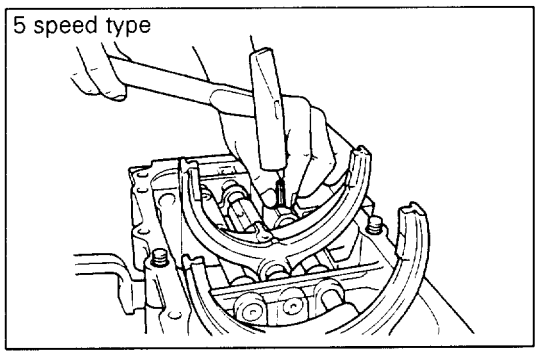
5 speed type



39. 1st/Reverse Shift Arm

- With the wider side of the arm section turned to the 2nd/3rd shift rod side, put the 1st/reverse shift arm through the shift rod.



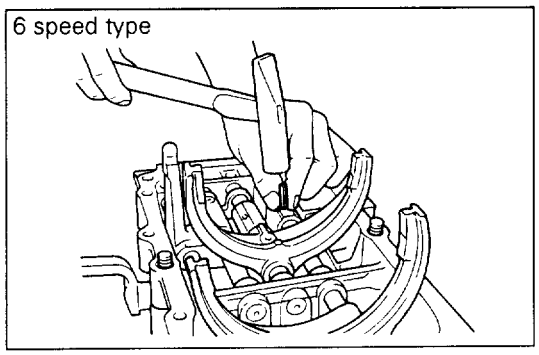


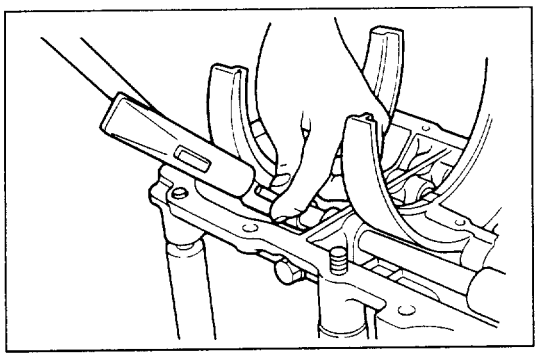
40. Spring Pin

- Setting the hole of the 1st/reverse shift block to that of the shift rod, fix them with a new spring pin (25 mm/0.98 in).

NOTE:

Install spring pin properly with the slit inline with the shaft centerline.





41. Spring Pin

- Setting the hole of the 1st/reverse shift arm to that of the shift rod, fix them with a new spring pin (32 mm/1.26 in.).

NOTE:

Install spring pin properly with the slit inline with the shaft centerline.

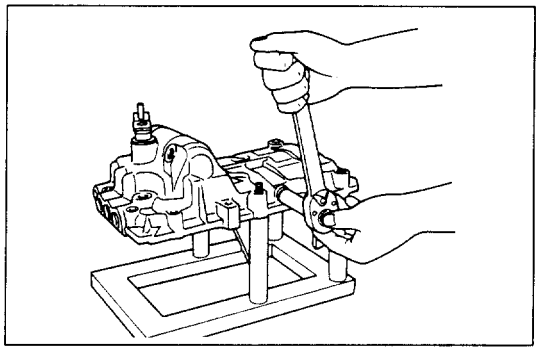
42. **Shift Rod Cap (for 6 speed type only)**
    - Apply liquid gasket (Three Bond 1141 or equivalent) to the cap outer circumference, and hammer it in with something soft such as a plastic hammer.

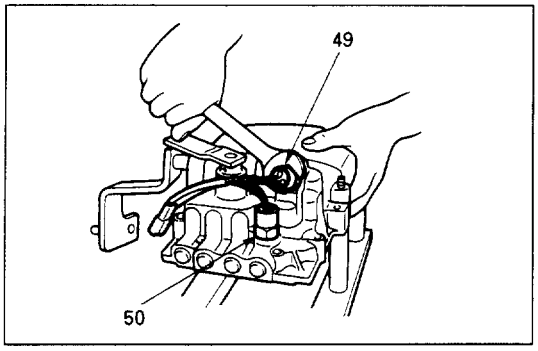
NOTE:

When there is any warp or flaw found with the shift rod cap, replace it with a new one.

43. **4th/5th Shift Rod Cap**
44. **2nd/3rd Shift Rod Cap**
45. **1st/Reverse Shift Rod Cap**
46. **Detent Ball**
47. **Detent Spring**
48. **Plug and Gasket**
    - With a new gasket, tighten plug to the specified torque.

Detent Ball Plug Torque	N·m (kg·m/lb·ft)
	25 (2.5/18)





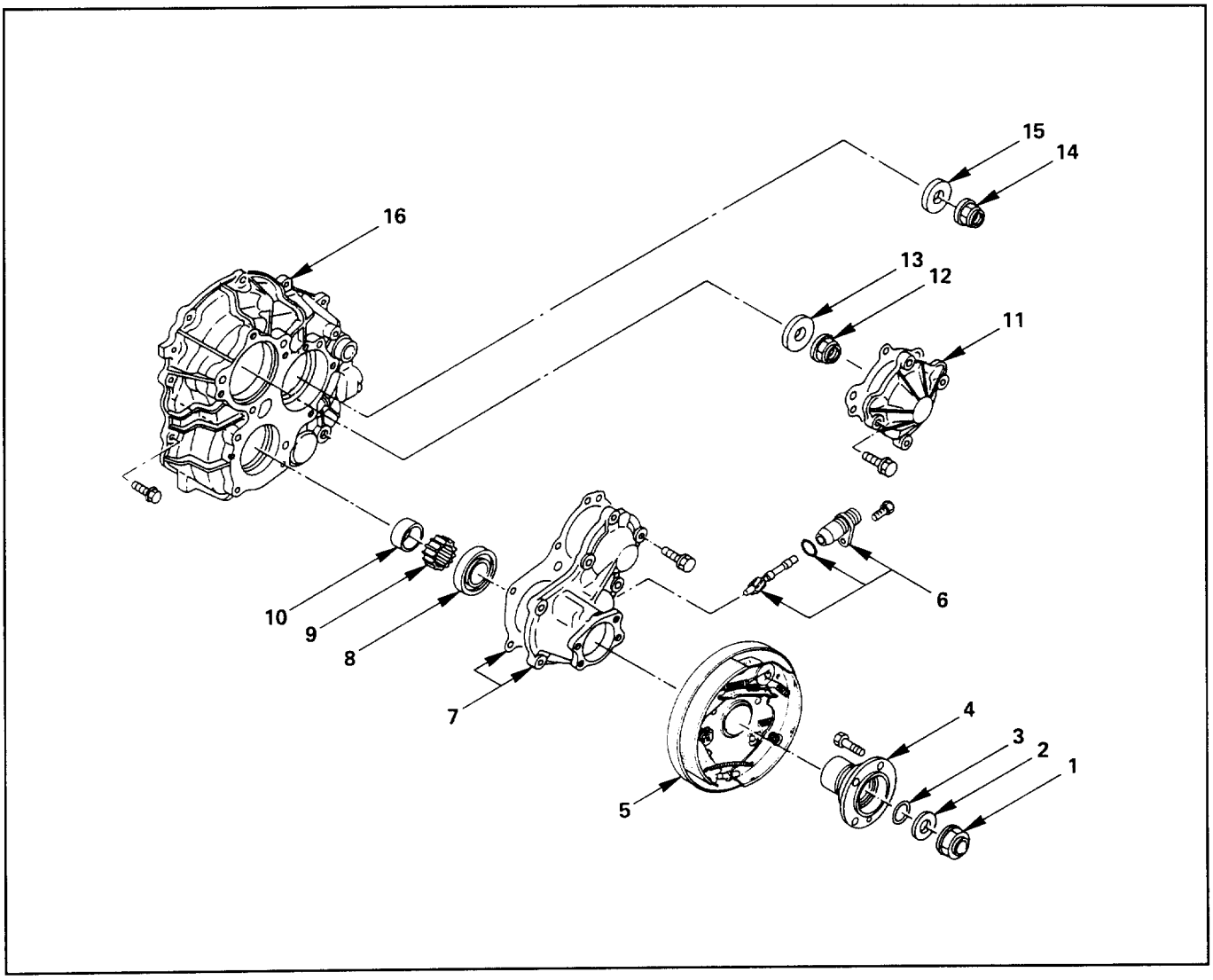
49. **Neutral Switch**
50. **Back-up Light Switch**
    - Apply liquid gasket (Three Bond 1141 or equivalent) to the switch's threaded portion and install the switches to the control box.
    - Color of connector
      Back-up light switch : Brown
      neutral switch : Gray

Neutral and Back-up Light Switch Torque	N·m (kg·m/lb·ft)
	34 (3.5/25)

TRANSFER

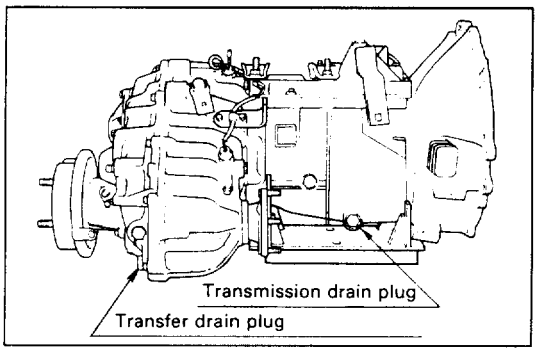
TRANSFER REAR CASE

DISASSEMBLY



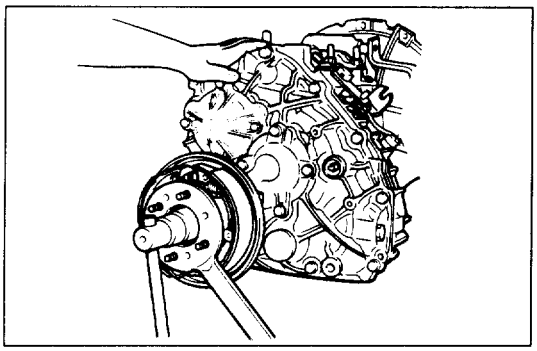
Disassembly Steps

1. Rear drive shaft end nut
2. Coupling driver washer
3. O-ring
4. Coupling driver
5. Center brake back plate assembly
6. Speedometer driven gear assembly
7. Rear cover assembly
8. Rear drive shaft bearing
9. Speedometer drive gear
10. Rear drive shaft collar
11. P.T.O cover
12. Input shaft end nut
13. Input shaft washer
14. Idle shaft end nut
15. Idle shaft washer
16. Transfer rear case



Disassembly Steps

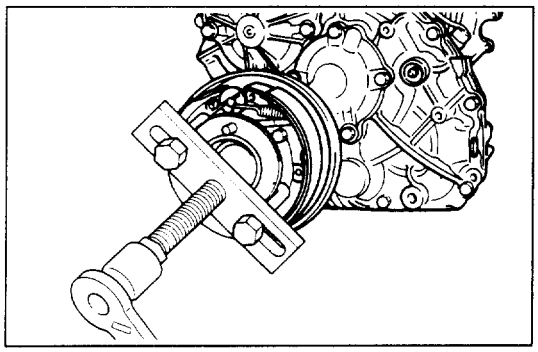
Place the transmission and transfer assembly on the bench, and drain oil by removing respective drain plugs on the transmission and transfer.



1. **Rear Drive Shaft End Nut**

Erect a calking part, then remove the rear drive shaft end nut in the coupling driver on the rear drive side by holding the coupling driver with the handle: main shaft flange.

Handle: main shaft flange : 5-8840-2043-0



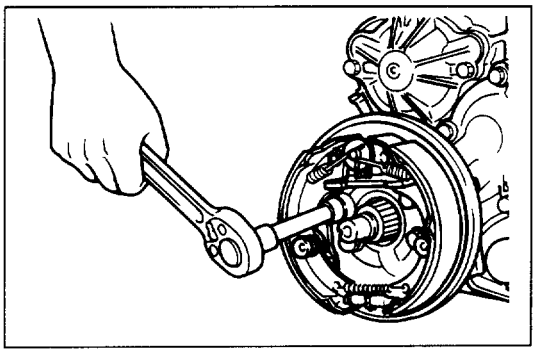
2. **Coupling Drive Washer**
3. **O-ring**
4. **Coupling Drive**

Remove the coupling driver using the universal puller. At the same time, a washer and O-ring will be removed.

Universal puller : 5-8840-2027-0

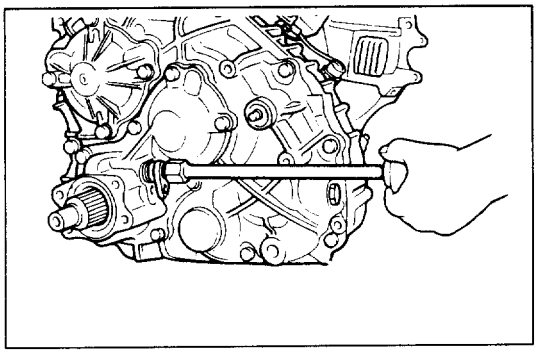
CAUTION:

Take care not to damage the O-ring.



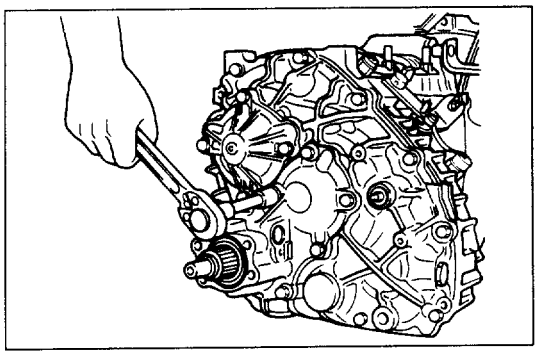
5. **Center Brake Back Plate Assembly**

Remove bolts on the center brake back plate assembly, then remove the back plate assembly.



6. Speedometer Driven Gear Assembly

- Remove a speedometer driven gear fixing bolt, and remove the speedometer driven gear using the remover.



7. Rear Cover Assembly

- Remove rear cover fixing bolts, then remove the rear cover assembly.

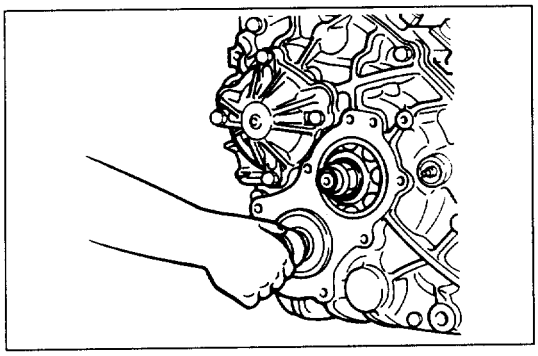
CAUTION:

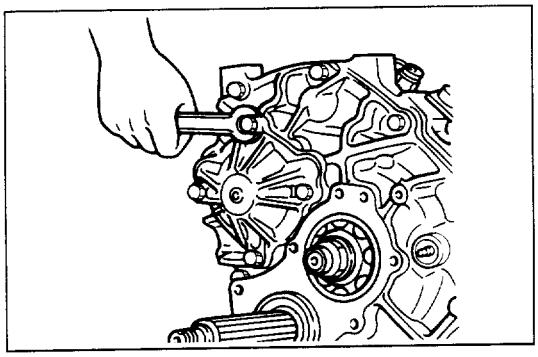
Take care not to damage the lip of oil seal.

8. Rear Drive Shaft Bearing

9. Speedometer Drive Gear

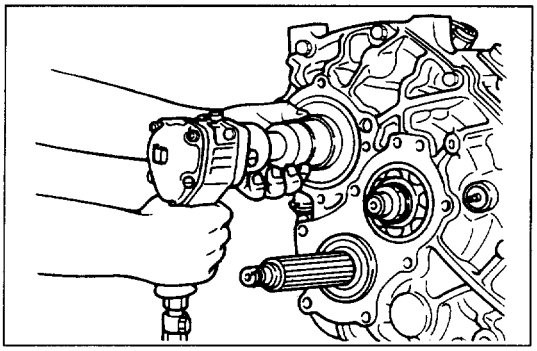
10. Rear Drive Shaft Collar





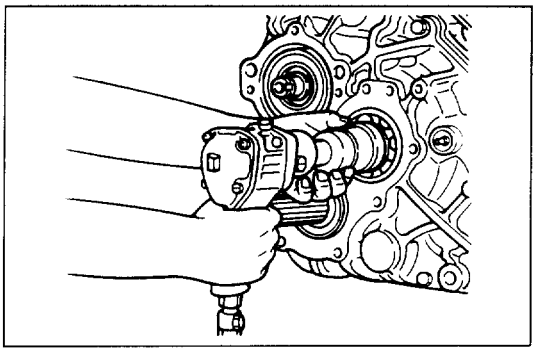
11. P.T.O Cover

- Remove P.T.O cover fixing bolts, then remove the P.T.O cover.



12. Input Shaft End Nut

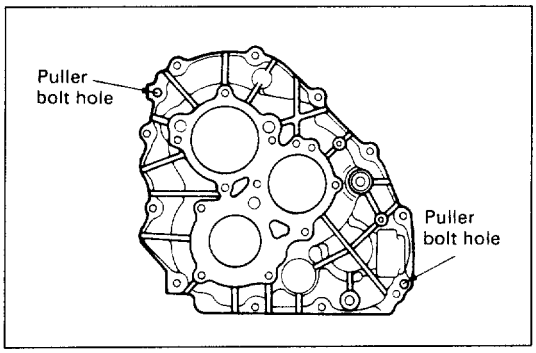
- Shift the shift external lever to L or H to place the transmission gear in a double meshing status. Then, erect a calking part and remove the input shaft end nut using the nut runner.



13. Input Shaft Washer

14. Idle Shaft End Nut

- Shift the shift external lever to L or H to place the transmission gear in a double meshing status. Then, erect a calking part and remove the idle shaft end nut using the nut runner.



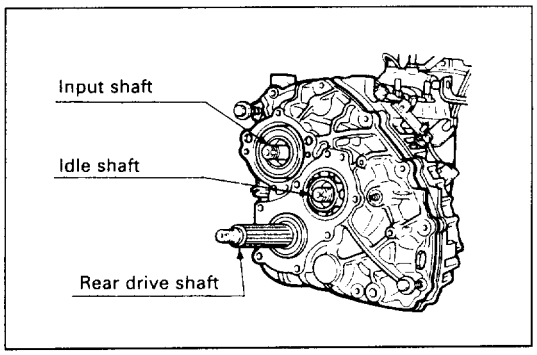
15. Idle Shaft Washer

16. Transfer Rear Case

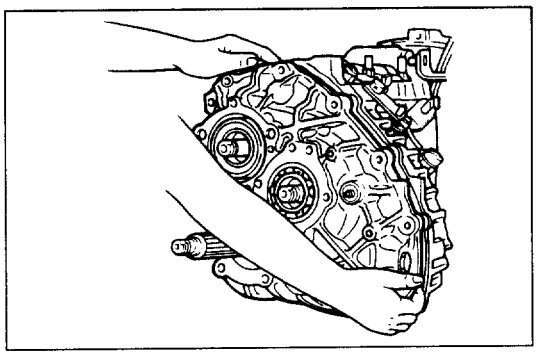
1) Remove transfer rear case fixing bolts, and insert bolts (M10 x 1.25, length=about 50mm, 2 pcs) into puller bolt holes and tighten bolts evenly to separate the transfer rear case and transfer front case by about 25mm.

CAUTION:

Tighten puller bolts (2 pcs) evenly; do not tighten extremely either bolt only.



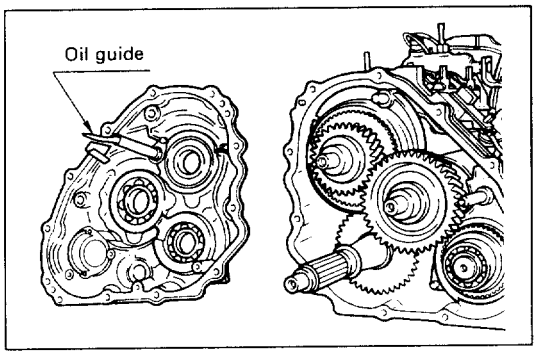
2) Hit lightly the idle shaft, input shaft and rear drive shaft respectively with a copper hammer (or plastic hammer) to insert into the transfer front case.



3) Pull the transfer rear case with both hands to remove.

CAUTION:

Take care not to allow shift rod for 4WD high speed range ↔ low speed range and the shift rod for rear drive ↔ 4WD to be removed.

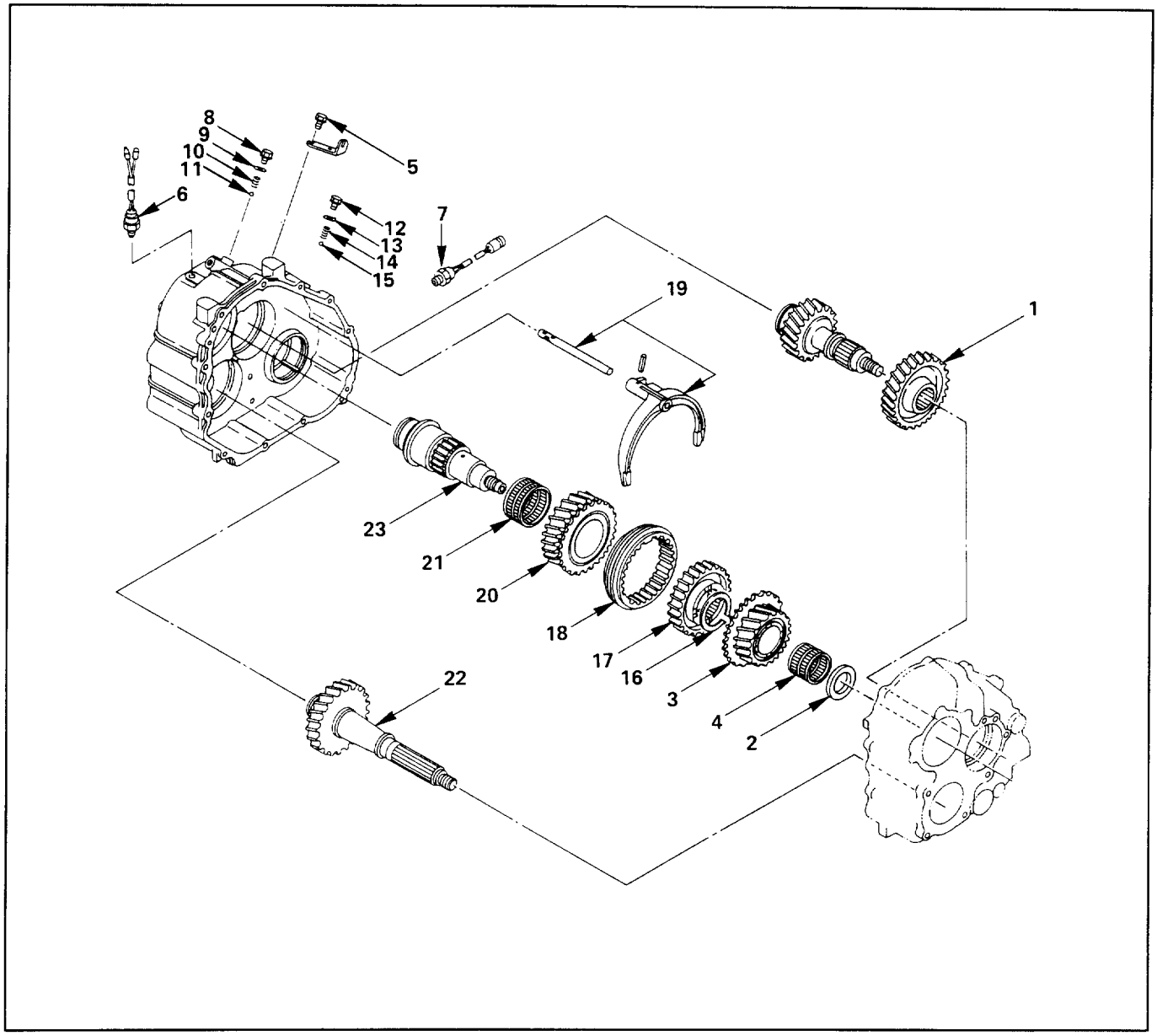


CAUTION:

Take care not to deform the oil guide fixed with a bolt internally when placing the transfer rear case.

REAR DRIVE SHAFT, INPUT SHAFT

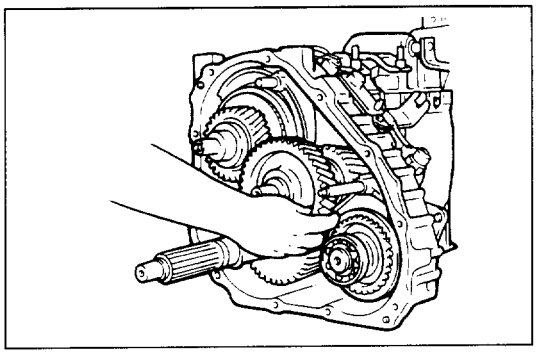
DISASSEMBLY



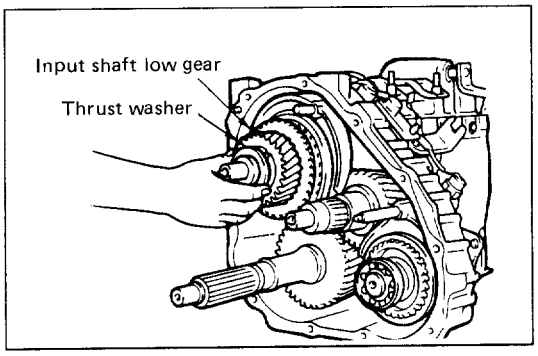
Disassembly Steps

1. Low range idle gear
2. Thrust washer
3. Input shaft low gear
4. Input shaft low gear needle bearing
5. Bracket bolt
6. Transfer neutral switch
7. 4WD detective switch
8. Detent spring plug
9. Detent spring plug gasket
10. Detent spring
11. Detent ball
12. Detent spring plug
13. Detent spring plug gasket
14. Detent spring
15. Detent ball
16. Clutch hub snap ring
17. Clutch hub
18. Sleeve
19. Shift arm and shift rod
20. Input shaft high gear
21. Input shaft high gear needle bearing
22. Rear drive shaft
23. Input shaft

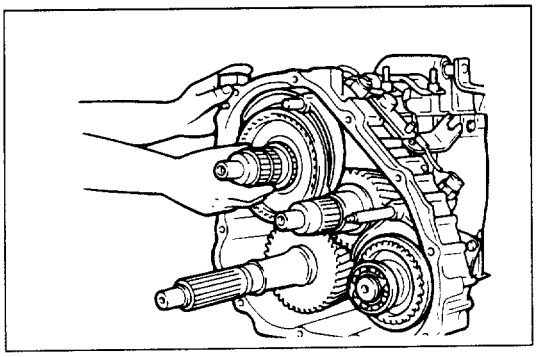
Disassembly Steps



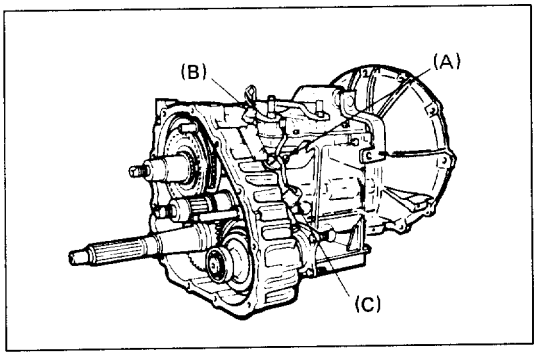
1. **Low Range Idle Gear**
   - Remove the low range idle gear.



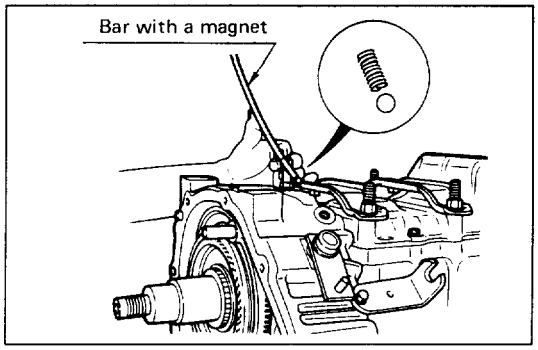
2. **Thrust Washer**
3. **Input Shaft Low Gear**
   - Remove a thrust washer. Then, remove the input shaft low gear.



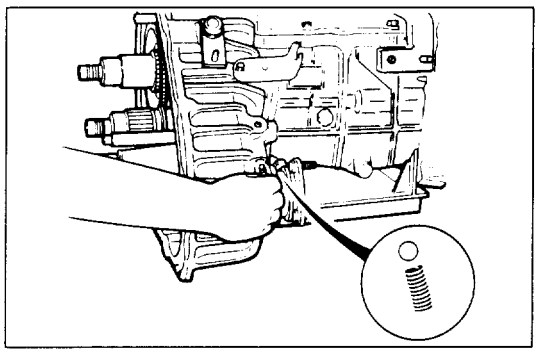
4. **Input Shaft Low Gear Needle Bearing**
   - Remove the input shaft low gear needle bearing.



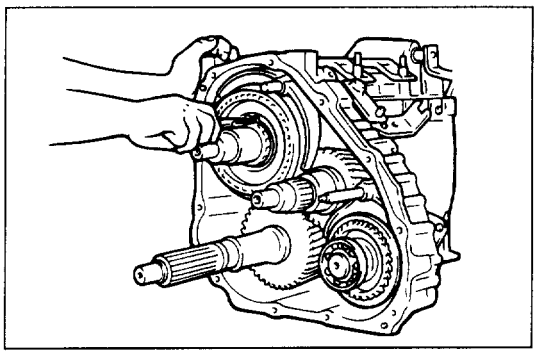
5. **Bracket Bolt**
6. **Transfer Neutral Switch**
7. **4WD Detective Switch**
   - Remove the bolt (A) to fix the push-pull cable clamping bracket on the transfer front case, transfer neutral switch (B) and 4WD detective switch (C).



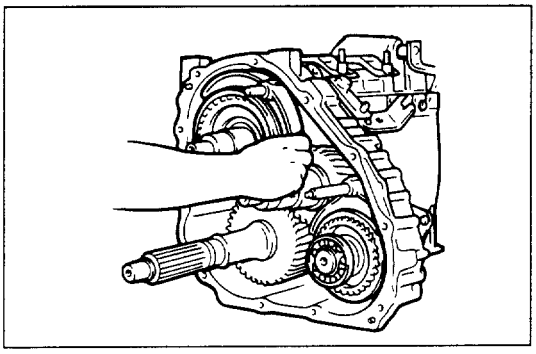
8. **Detent Spring Plug**
9. **Detent Spring Plug Gasket**
10. **Detent Spring**
11. **Detent Ball**
    - Remove a detent spring plug and gasket on the 4-wheel drive high speed range (4H) ↔ low speed range (4L) shift rod, then take out a detent spring and detent ball.



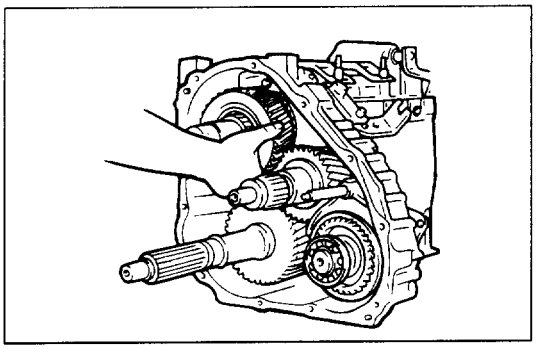
12. **Detent Spring Plug**
13. **Detent Spring Plug Gasket**
14. **Detent Spring**
15. **Detent Ball**
    - Remove a detent spring plug and gasket on the rear drive (2WD) ↔ 4-wheel drive (4WD) shift rod, then take out a detent spring and detent ball.



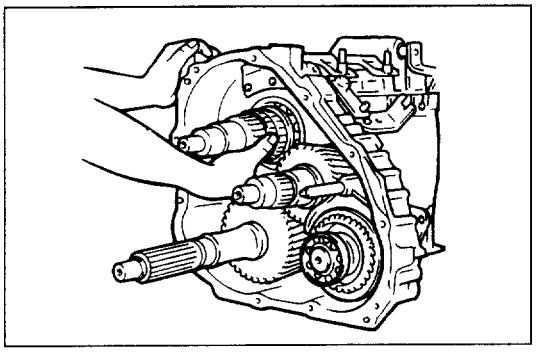
16. **Clutch Hub Snap Ring**
    - Remove a clutch hub snap ring on the 4-wheel dive high speed range (4H) ↔ low speed range (4L) select clutch hub using snap ring pliers.



17. **Clutch Hub**
18. **Sleeve**
19. **Shift Arm and Shift Rod**
    - Remove 4-wheel drive high speed range (4H) ↔ low speed range select clutch hub, sleeve and shift arm and shift rod at a time.

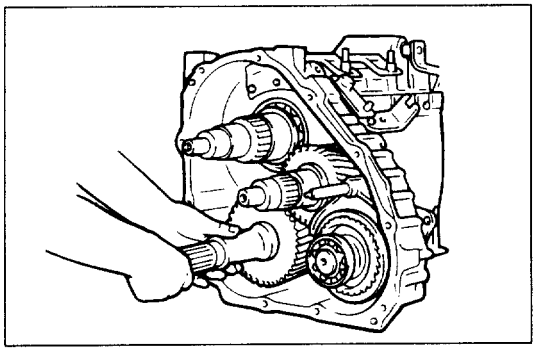


20. **Input Shaft High Gear**
    - Remove the input shaft high gear.



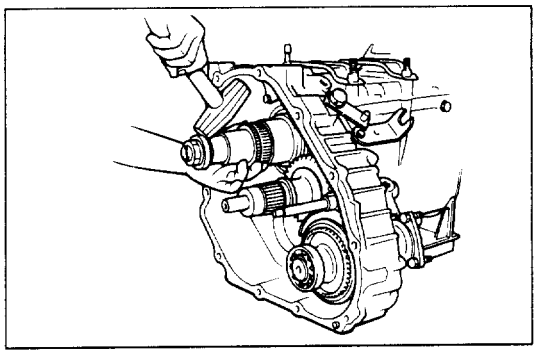
21. Input Shaft High Gear Needle Bearing

- Remove the input shaft high gear needle bearing.



22. Rear Drive Shaft

- Pull out the rear drive shaft.

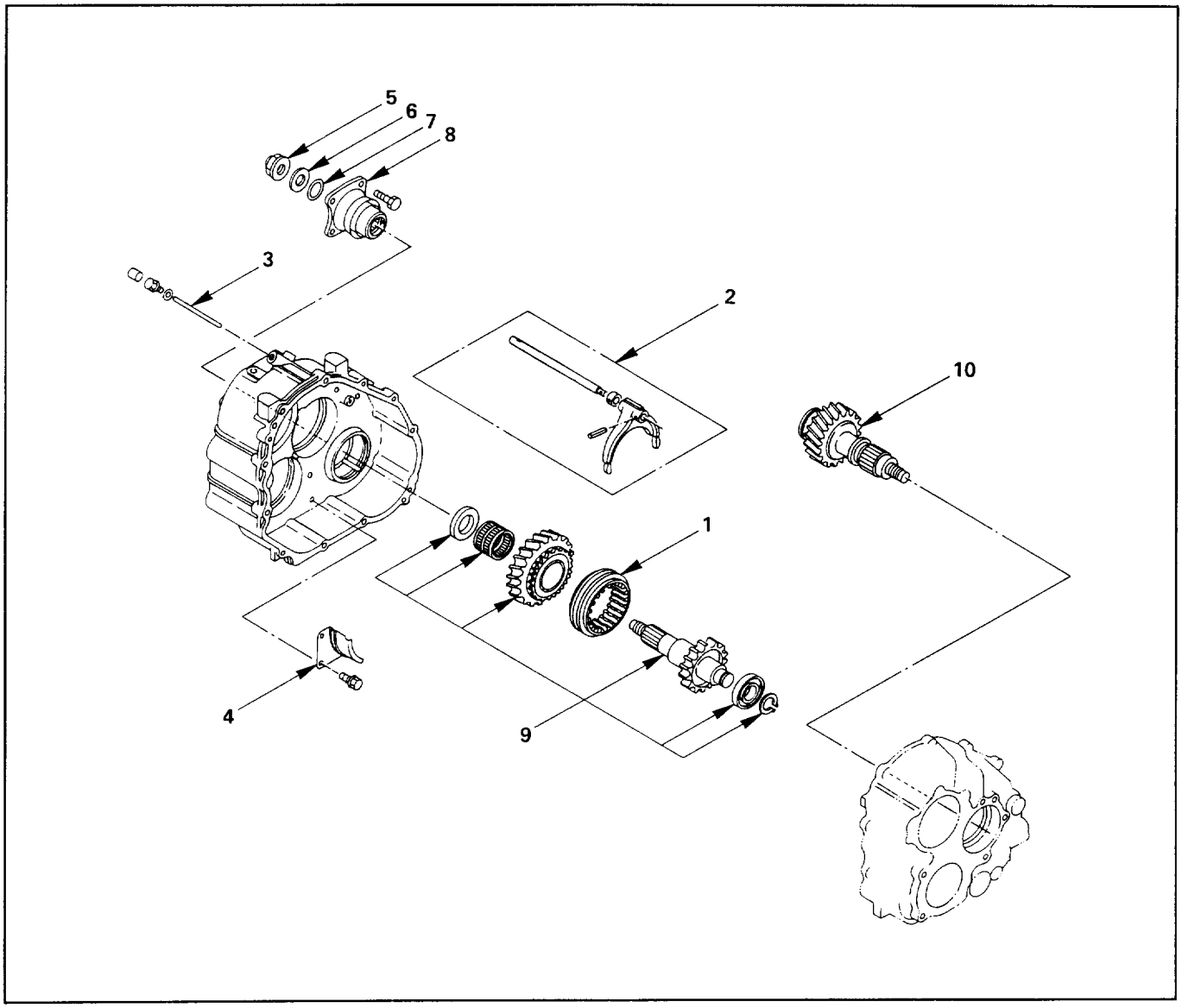


23. Input Shaft

- Tighten temporarily the end nut and washer to the input shaft end, and pull out the input shaft by hitting lightly the washer with a copper hammer.

FRONT DRIVE SHAFT, IDLE SHAFT

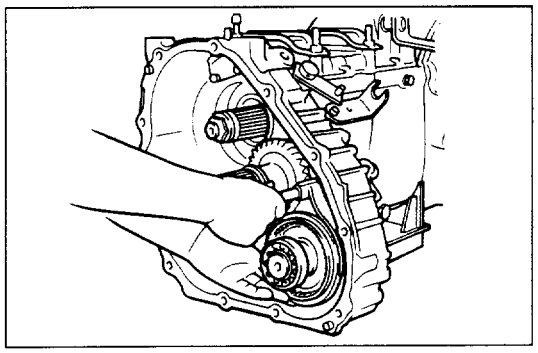
DISASSEMBLY



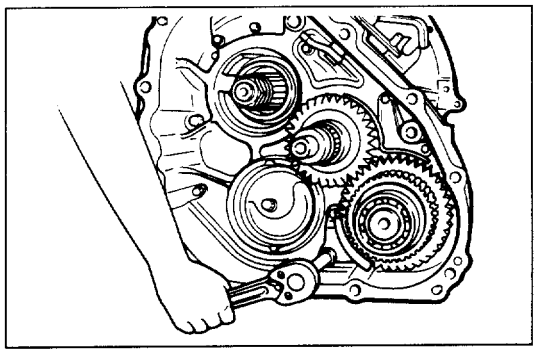
Disassembly Steps

1. Sleeve
2. Shift arm and shift rod assembly
3. Interlock rod
4. Guide plate:B
5. End nut
6. Coupling driver washer
7. O-ring
8. Coupling driver
9. Front drive shaft assembly
10. Idle shaft

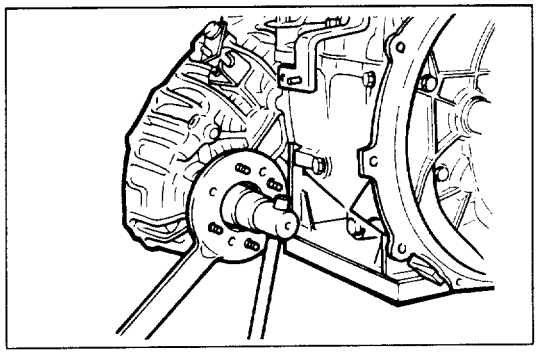
Disassembly Steps



1. **Sleeve**
2. **Shift Arm and Shift Rod Assembly**
3. **Interlock Rod**
   - Remove the sleeve, shift arm and shift rod for rear drive (2WD) ↔ 4-wheel drive (4WD) selection at a time, and pull the interlock rod off the detent spring hole.

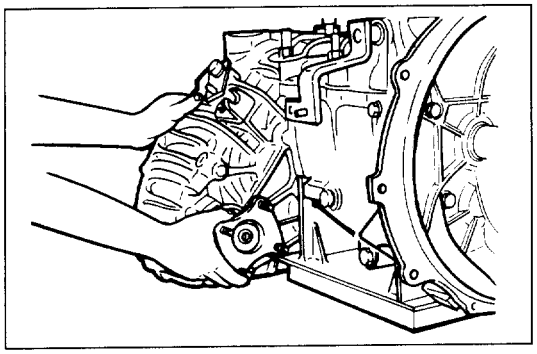


4. **Guide Plate:B**
   - Remove the guide plate : B fixing bolts in the transfer front case, then take out the guide plate : B.



5. **End Nut**
   - Erect a calking part and remove a coupling driver end nut on the leading end of front drive shaft. Then, remove the coupling driver using the handle: main shaft flange.

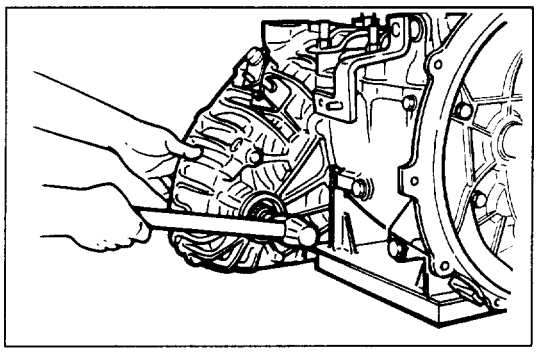
     Handle: main shaft flange : 5-8840-2043-0



6. **Coupling Drive Washer**
7. **O-ring**
8. **Coupling Driver**
   - Pull off the coupling driver, washer and O-ring.

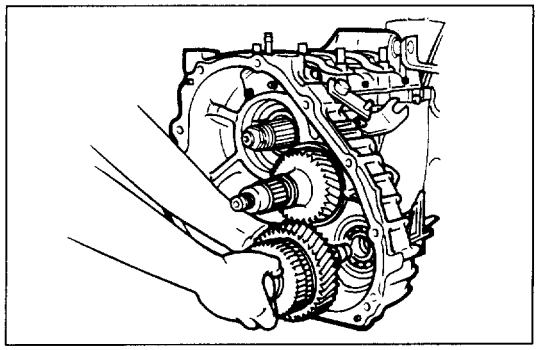
CAUTION:

Take care not to damage the O-ring.

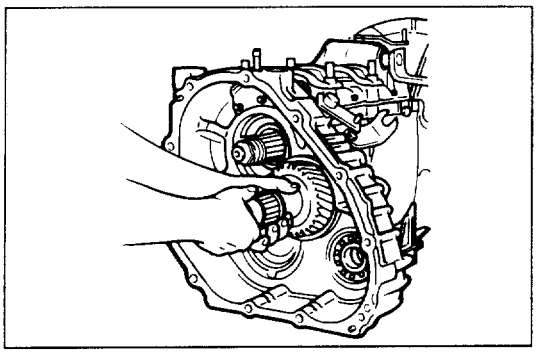


9. Front Drive Shaft Assembly

1) Hit lightly the front drive shaft end with a copper hammer to remove from the bearing.



2) Remove the front drive shaft assembly.

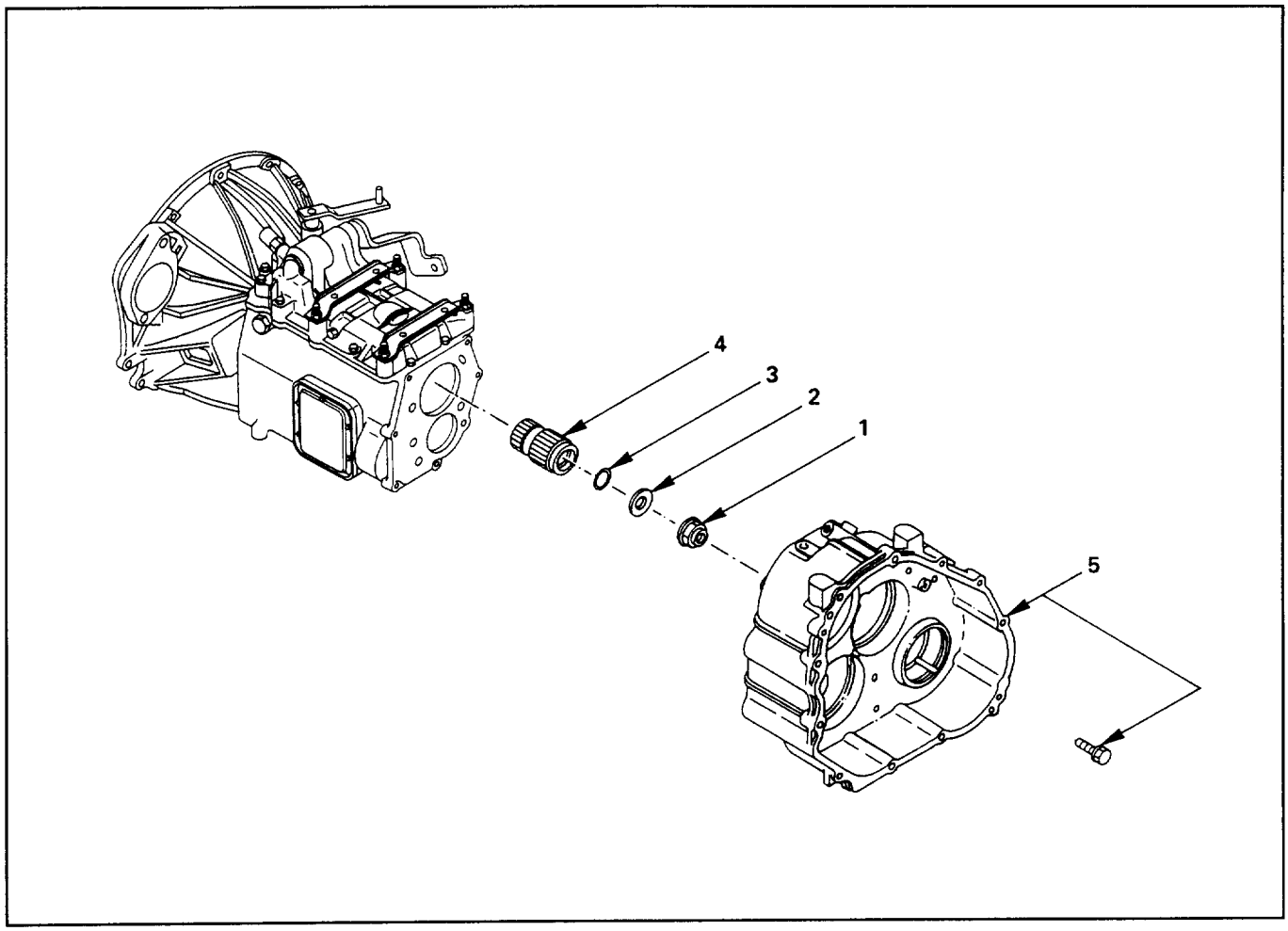


10. Idle Shaft

- Remove the idle shaft.

TRANSFER FRONT CASE

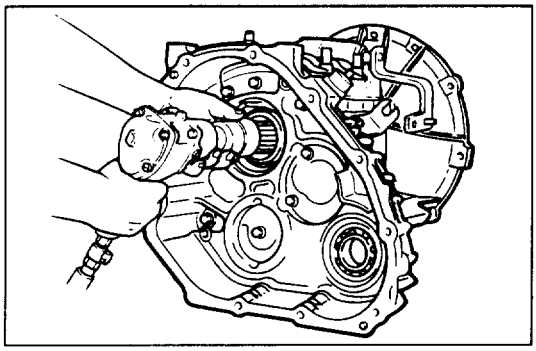
DISASSEMBLY



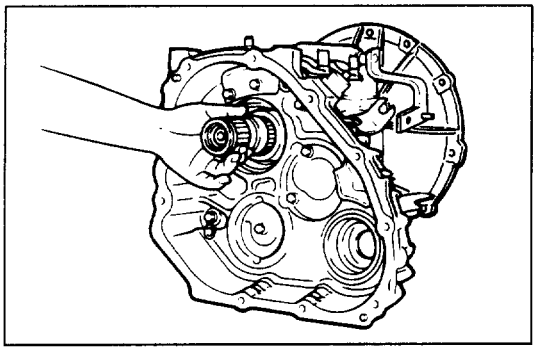
Disassembly Steps

1. Main shaft end nut
2. Washer
3. O-ring
4. Main shaft joint pipe
5. Transfer front case

Disassembly Steps



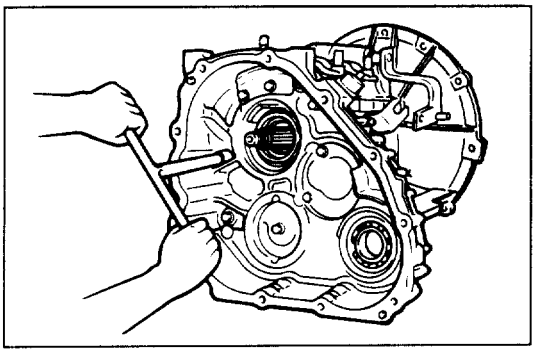
1. **Main Shaft End Nut**
   - Place the transmission gear in a double meshing status, erect a calking part and remove the main shaft end nut using the nut runner.



2. **Washer**
3. **O-ring**
4. **Main Shaft Joint Pipe**
   - Remove a washer and main shaft joint pipe. The O-ring will come out simultaneously.

CAUTION:

Take care not to damage the O-ring.



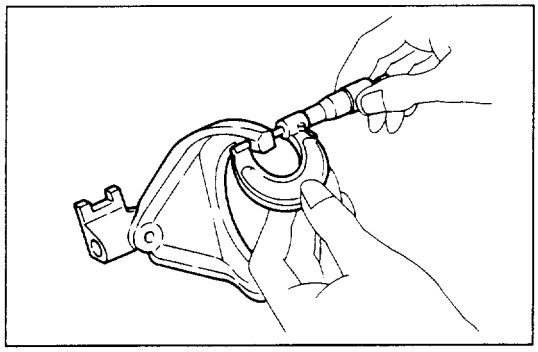
5. **Transfer Front Case**
   - Remove transfer front case fixing bolts, and hold the transfer front case with both hands to remove to your side.

Completion of Transfer Disassembly

For disassembly and reassembly of transmission, refer to "TRANSMISSION" described previously in this manual.

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.



Shift Arm

Inspect the shift arms for wear, distortion or scoring.

Replace it these conditions are present.

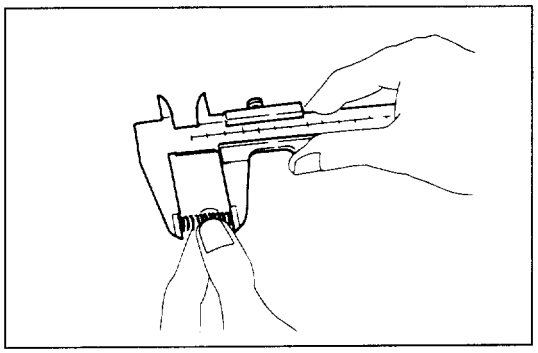
Shift Arm Thickness

Use a micrometer to measure the shift arm thickness.

If the measured value is less than the specified limit, the shift arm must be replaced.

Shift Arm Thickness mm(in.)

	Standard	Limit
Shift arm ; 2WD ~ 4WD	10.0 (0.394)	9.0 (0.355)
Shift arm ; High speed ~ Low speed	10.5 (0.413)	9.5 (0.374)



Detent Spring

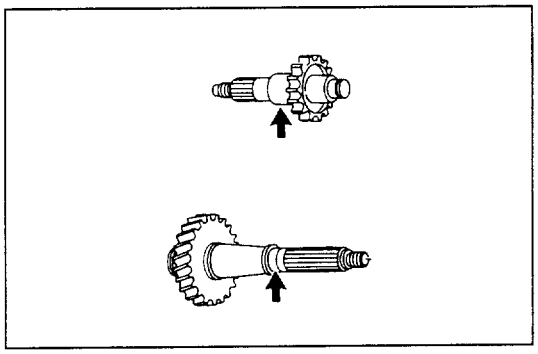
Inspect the detent springs for wear, distortion or cracks. Replace detent spring if these conditions are present.

Detent Spring Free Length

Use a vernier caliper to measure the detent spring free length. If the measured value is less than the specified limit, the detent spring must be replaced.

Detent Spring Free Length mm (in.)

Standard	Limit
31.6 (1.245)	30.1 (1.186)



Front Drive Shaft, Rear Drive Shaft Run-Out

Replace the drive shaft if the run-out is more than specified limit.

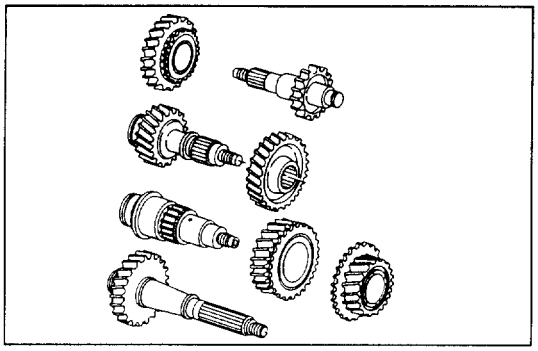
Front Drive Shaft, Rear Drive Shaft Run-Out mm(in.)

Limit	0.1 (0.0039)

In reference of both center holes,

Front drive shaft is measured at ø40 bearing mounting part.

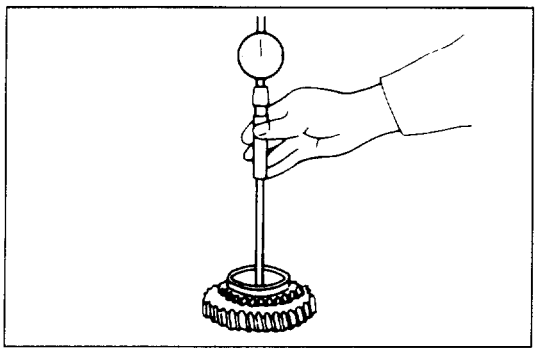
Rear drive shaft is measured at ø40 bearing mounting part.



Gears

Check each gear for the following points. Correct a slight stepped wear or surface roughness with an oil stone or pencil grinder, or replace the gear if unrecoverable damage is found.

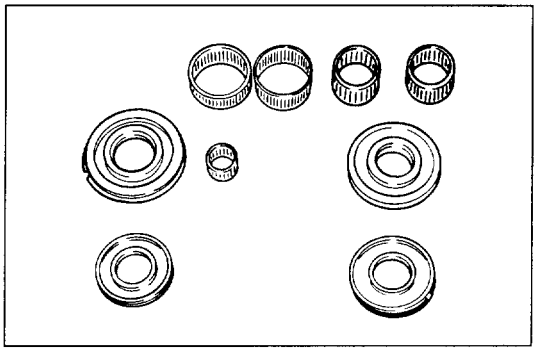
1) Break or damage of tooth
2) Extreme wear of tooth
3) Inspect the dog clutch teeth, and replace if hard contact is found on the force-receive side (coast side) during engine braking.



4) Measure inner diameter of input shaft high gear, input shaft low gear and front drive gear, and replace the gear if it exceeds the limit.

Gear inner diameter mm(in.)

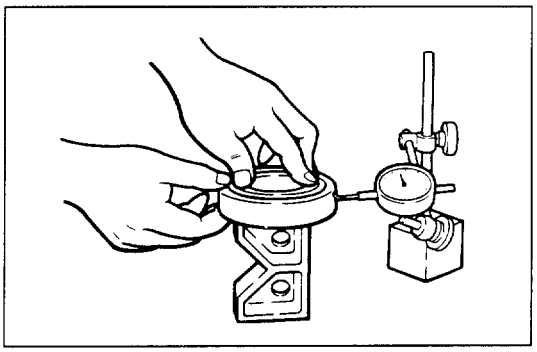
	Standard	Limit
Input shaft high gear	81 (3.189)	81.1.(3.193)
Input shaft low gear	58 (2.283)	58.1 (2.287)
Front drive gear	55 (2.165)	55.1 (2.169)



Bearings

Check each bearing, and replace in either of the following cases:

1) Rotation is not smooth.
2) Abnormal sound is generated.
3) There is extreme damage or rust.
4) Rolling element or rolling contact surface of needle roller bearing is discolored, extremely worn or pitted.



Ball bearing run-out

Replace the drive shaft if the run-out is more than specified limit.

Ball bearing run-out mm(in.)

Limit	0.2 (0.0079)

The above value shows play in radial direction.

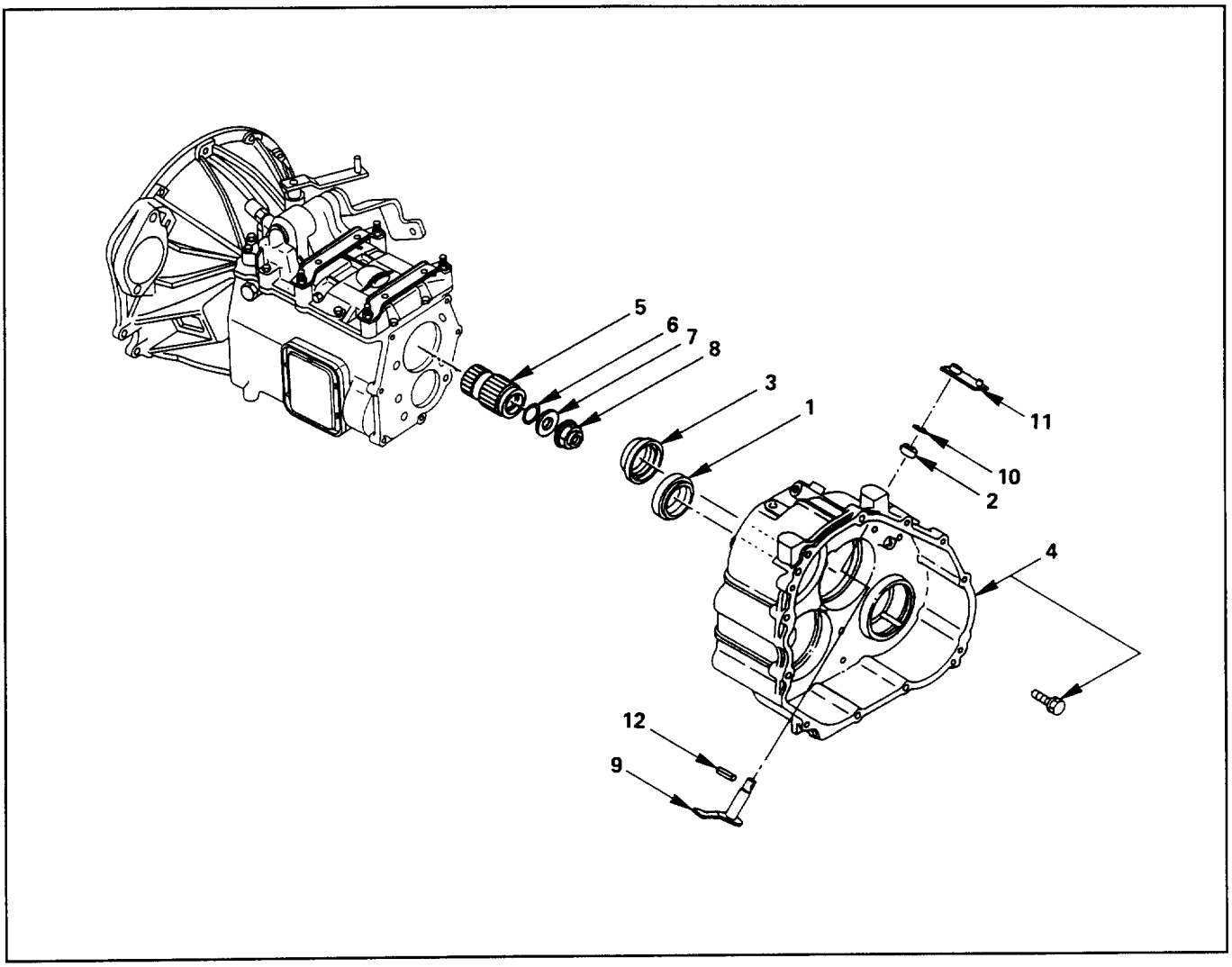
Oil seal

CAUTION:

Oil seal must be replaced by new one, once it removed.

TRANSFER FRONT CASE

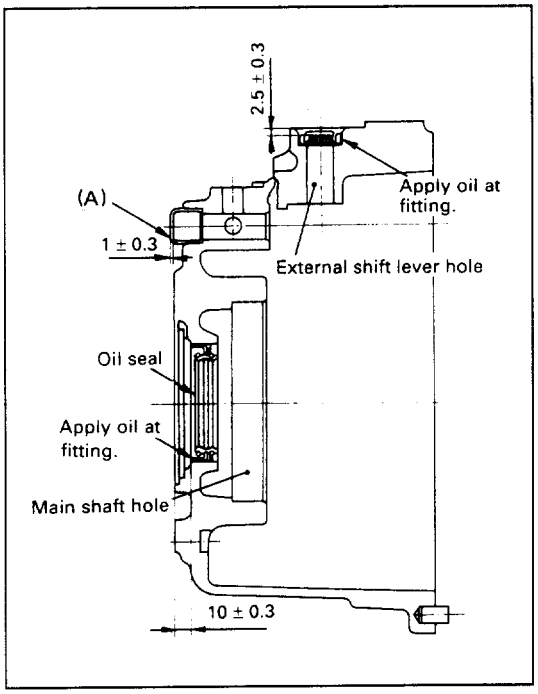
REASSEMBLY



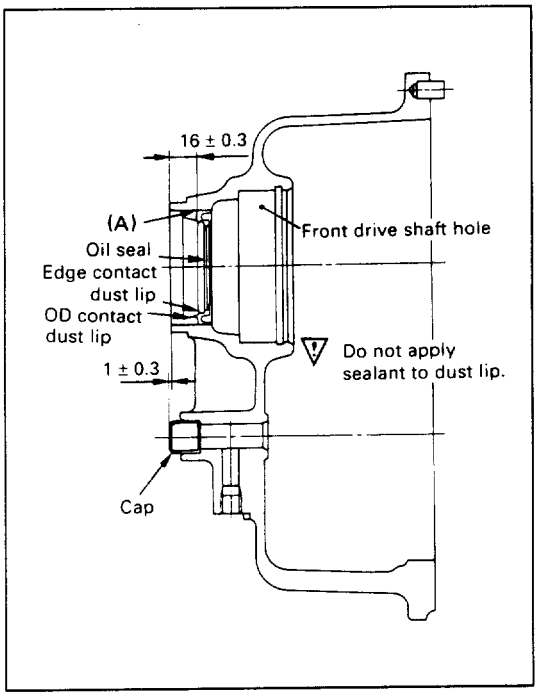
Reassembly Steps

1. Transfer front case oil seal:A
2. Internal shift lever oil seal
3. Transfer front case oil seal:B
4. Transfer front case
5. Main shaft joint pipe
6. O-ring
7. Washer
8. Main shaft end nut
9. Internal shift lever assembly
10. Plane washer
11. External shift lever assembly
12. External shift lever spring pin

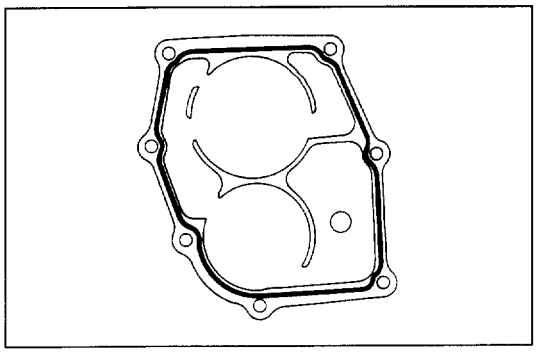
Reassembly Steps



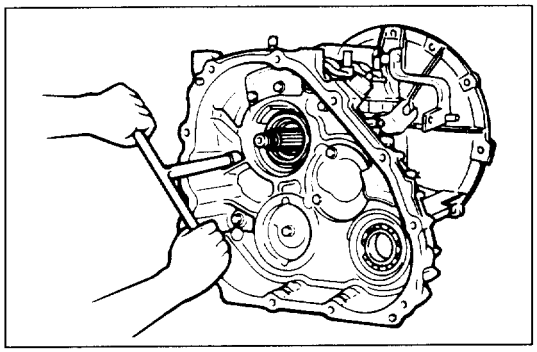
1. **Transfer Front Case Oil Seal:A**
2. **Internal Shift Lever Oil Seal**
   - Reassemble the front transfer case oil seal:A and internal shift lever oil seal in the front transfer case, as shown to the left.
     Oil seal installer : transfer front case
     : 5-8840-2148-0
     : 5-8840-2149-0
   - Apply sealant (ThreeBond 1141 or equivalent) to rod cap side face (A) at fitting.



3. **Transfer Front Case Oil Seal:B**
   - Reassemble the front transfer case oil seal:B and cap in the transfer front case, as shown to the left.
     Oil seal installer : transfer front case
     : 5-8840-2150-0
     Cap installer : transfer front case
     : 5-8840-2151-0
   - Apply sealant (ThreeBond 1207 or equivalent) to the new oil seal outer circumference (A).



4. **Transfer Front Case**
   - Apply sealant Three Bond 1215 or equivalent to the front transfer case where it meets with transmission case.

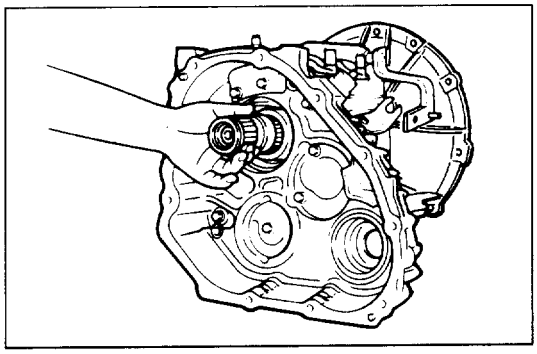


- Install the transfer front case and fix with bolts applied with an adhesive.

CAUTION:

Use new bolts applied with an adhesive.

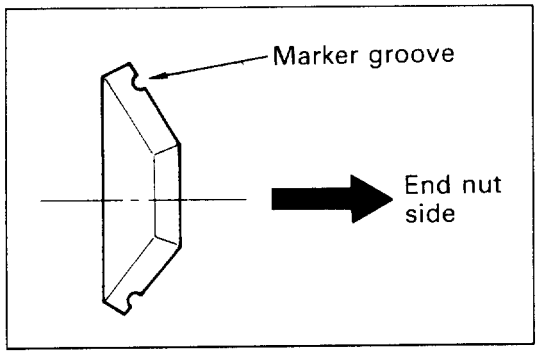
Transfer Case Bolt Torque	N·m(kg·m/lb·ft)
	46 (4.7/34)



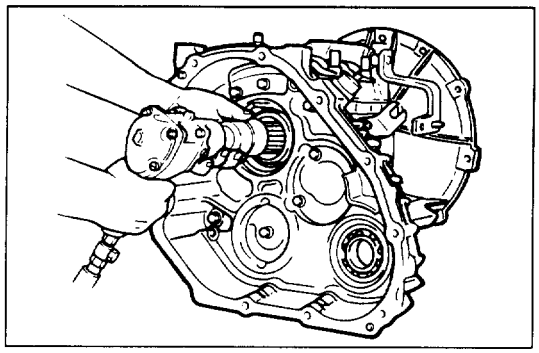
5. **Main Shaft Joint Pipe**
6. **O-ring**
   - Insert the main shaft joint pipe into the main shaft with its spline facing the main shaft end nut side, then insert the O-ring between main shaft and main shaft joint pipe.

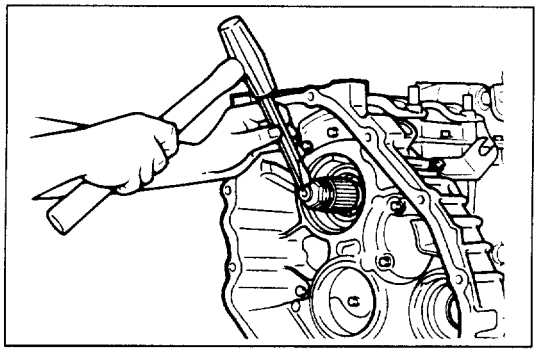
CAUTION:

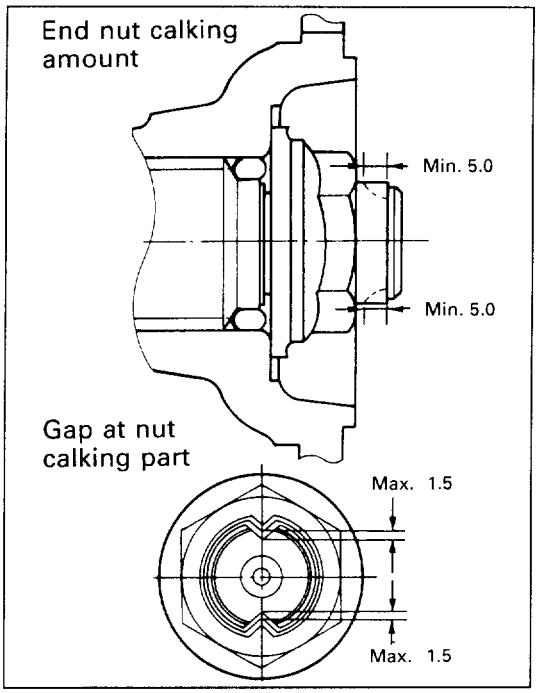
Take care not to damage the oil seal on the rear side during installation of main shaft joint pipe. Replace O-ring with new one, if damaged.



7. **Washer**
   - The washer insert direction must be as shown to the left.







8. Main Shaft End Nut

- Place the transmission gear in a double meshing status, insert a washer so that a marker groove faces the end nut side, and tighten the main shaft end nut with the nut runner.

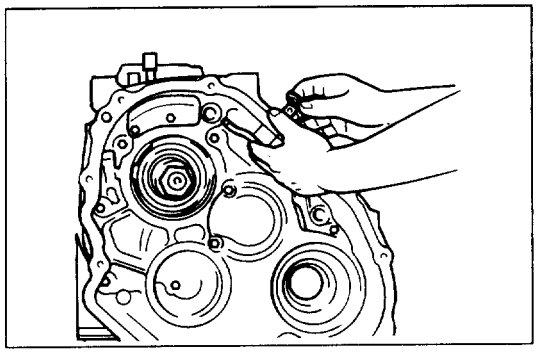
CAUTION:

Use a new main shaft end nut.

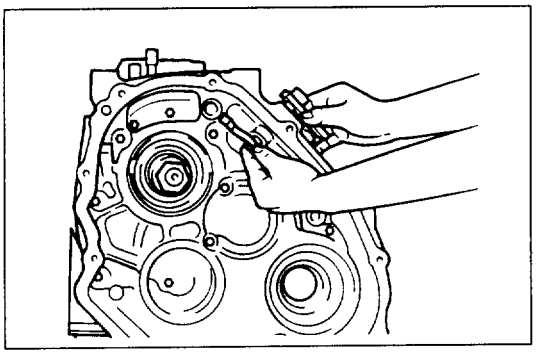
- Apply engine oil to the seat face of main shaft end nut when tightening the nut.

Main Shaft End Nut Torque	N·m(kg·m/lb·ft)
	221 (22.5/163)

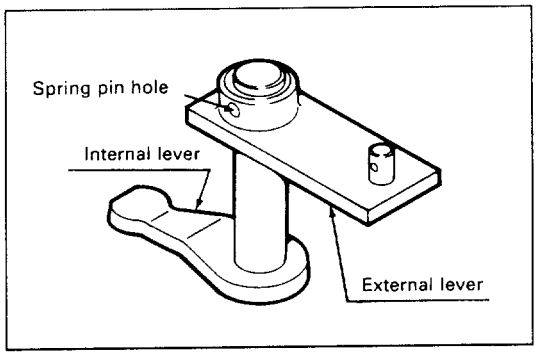
- Meet the flange of main shaft end nut with a V-groove of main shaft end, and calk two points with a chisel (edge form R1x60°) until a gap between main shaft groove bottom and nut is below 1.5mm at the calking point. Also, make sure after calking that no crack is found in the calking part of nut.



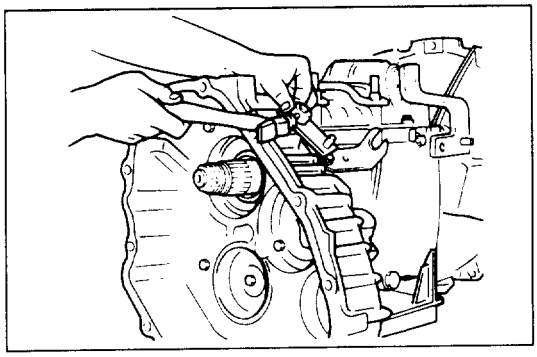
9. **Internal Shift Lever Assembly**
10. **Plane Washer**
    - Insert the internal shift lever assembly from inside of transfer front case, and install a plain washer on the shaft protruding from the case.



11. **External Shift Lever Assembly**
    - Install the external shift lever assembly on the internal shift lever shaft with its boss (spring pin hole side) facing up.



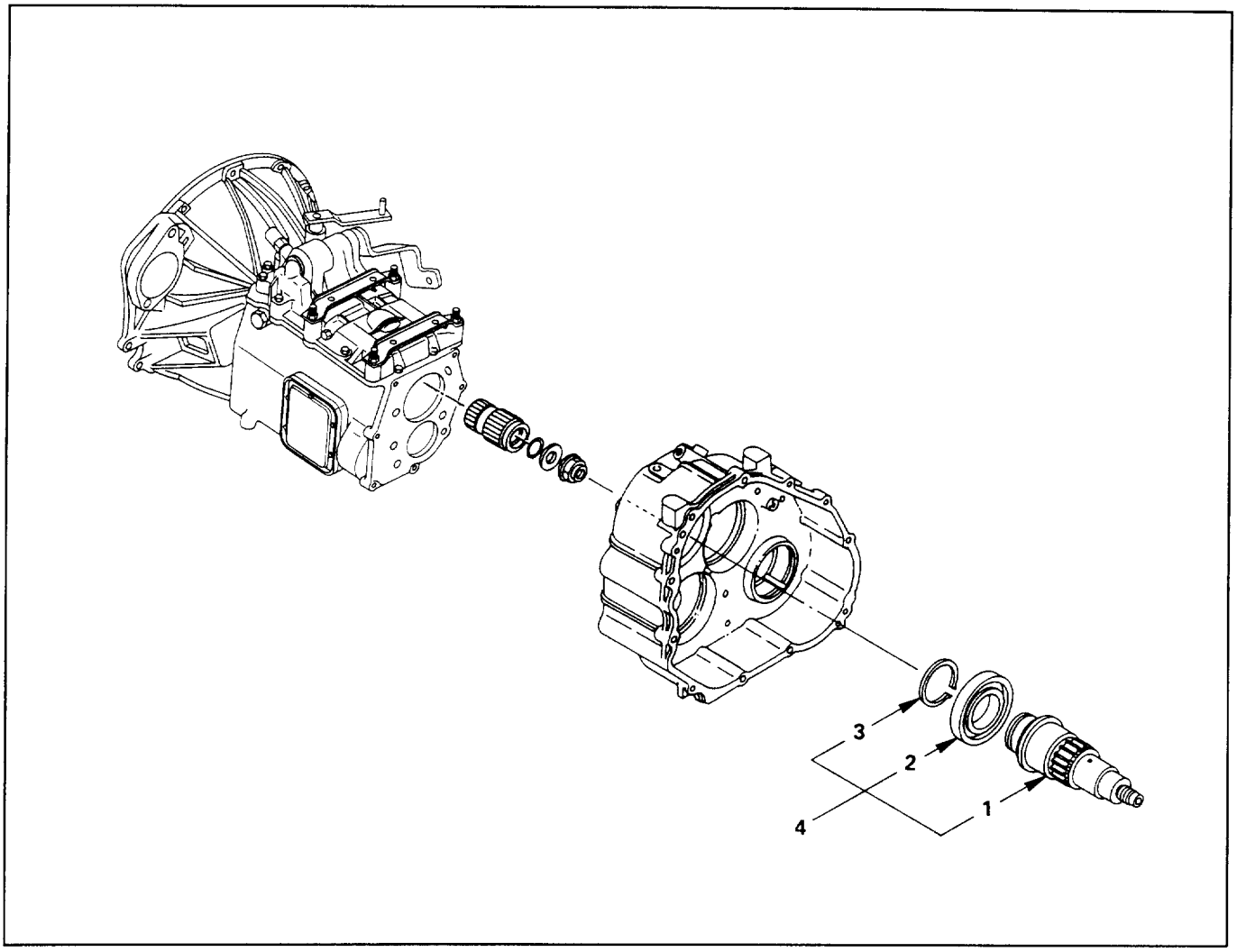
- The external shift lever assembly must be installed so that the internal lever and external lever are facing opposite direction (180° direction) each other.



12. **External Shift Lever Spring Pin**
    - Drive in a spring pin with a hammer until it is flushed with the external shift lever boss.

INPUT SHAFT ASSEMBLY

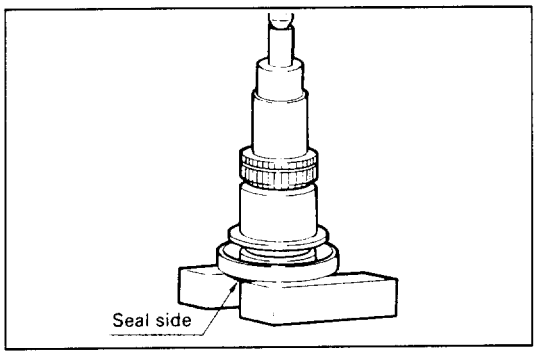
REASSEMBLY



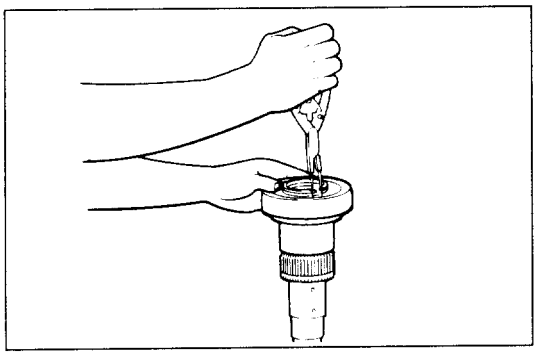
Reassembly Steps

1. Input shaft
2. Input shaft bearing
3. Snap ring
4. Input shaft assembly

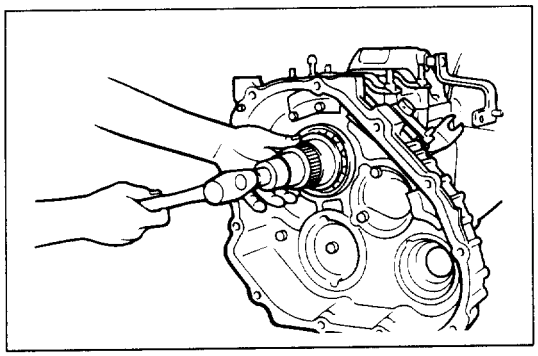
Reassembly Steps



1. **Input Shaft**
2. **Input Shaft Bearing**
   - Fit the input shaft bearing (one-side sealed bearing) on the input shaft using a press.
   - The bearing must be installed so that its seal side faces the opposite side of main shaft nut (outside of shaft).



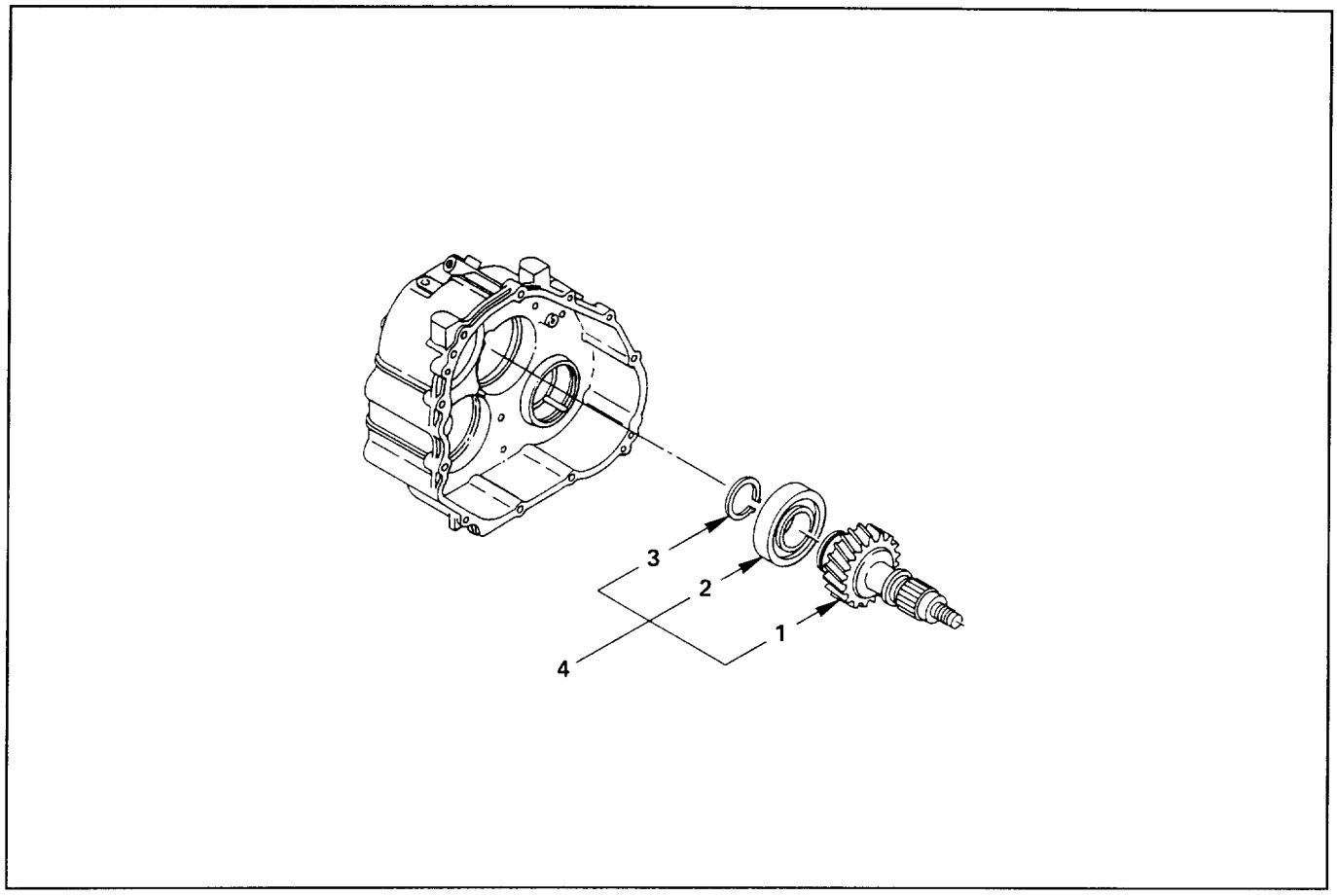
3. **Snap Ring**
   - Insert a snap ring in the input shaft using the snap ring pliers.



4. **Input Shaft Assembly**
   - Install the input shaft assembly so that it meshes with the joint pipe spline on the main shaft, and hit lightly with a copper hammer until the bearing cannot move in axial direction.

IDLE SHAFT ASSEMBLY

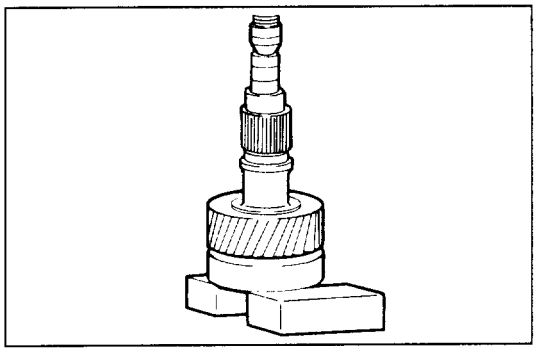
REASSEMBLY



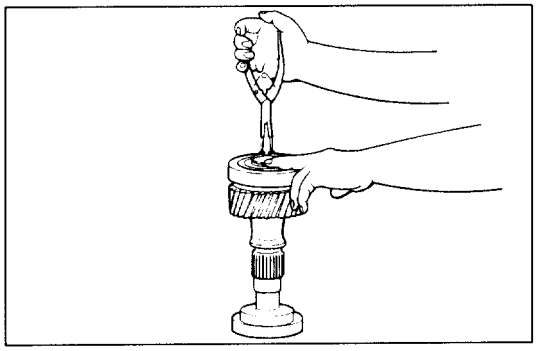
Reassembly Steps

1. Idle shaft
2. Idle shaft bearing
3. Idle shaft snap ring
4. Idle shaft assembly

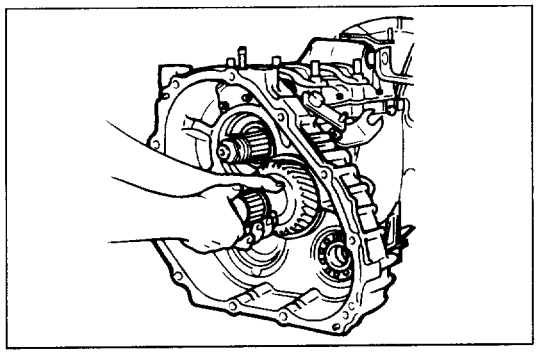
Reassembly Steps



1. **Idle Shaft**
2. **Idle Shaft Bearing**
   - Fit the idle shaft bearing (both-side sealed bearing) on the idle shaft using a press.



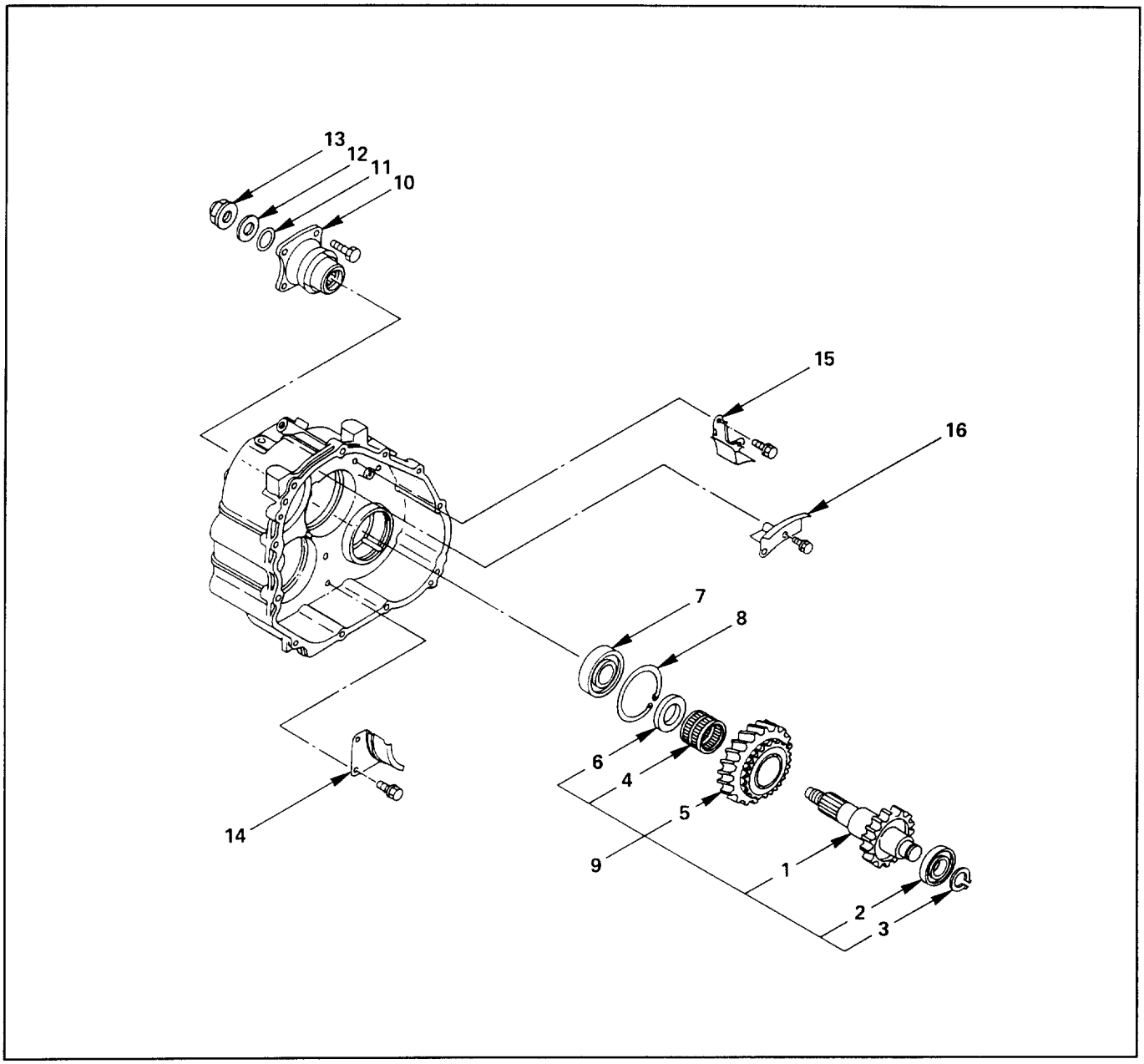
3. **Idle Shaft Snap Ring**
   - Insert a snap ring in the idle shaft using the snap ring pliers.



4. **Idle Shaft Assembly**
   - Install the idle shaft assembly.

FRONT DRIVE SHAFT ASSEMBLY

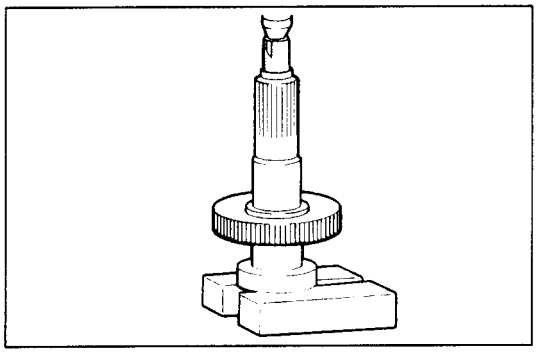
REASSEMBLY



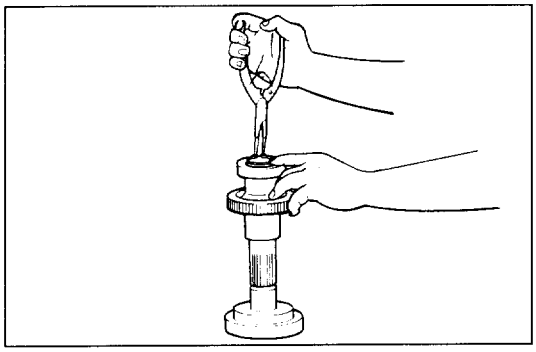
Reassembly Steps

1. Front drive shaft
2. Front drive shaft bearing
3. Snap ring
4. Front drive shaft needle bearing
5. Front drive gear
6. Thrust washer
7. Front drive shaft bearing
8. Snap ring
9. Front drive shaft assembly
10. Coupling driver
11. O-ring
12. Coupling driver washer
13. End nut
14. Guide plate:B
15. Guide plate:A
16. Baffle plate

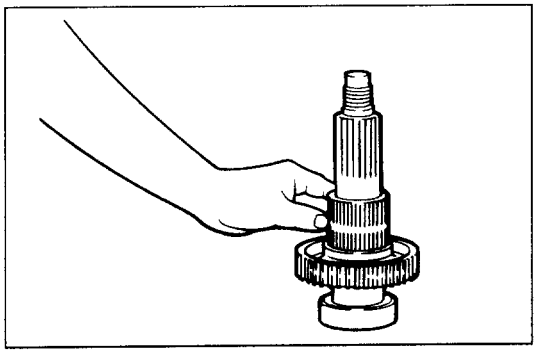
Reassembly Steps



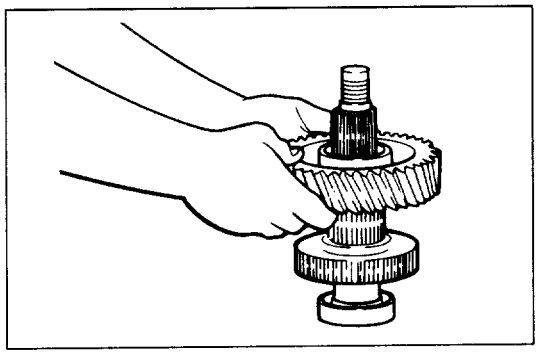
1. **Front Drive Shaft**
2. **Front Drive Shaft Bearing**
   - Fit the front drive shaft bearing (open type bearing) on the front drive shaft using a press.



3. **Snap Ring**
   - Insert a snap ring in the front drive shaft using the snap ring pliers.

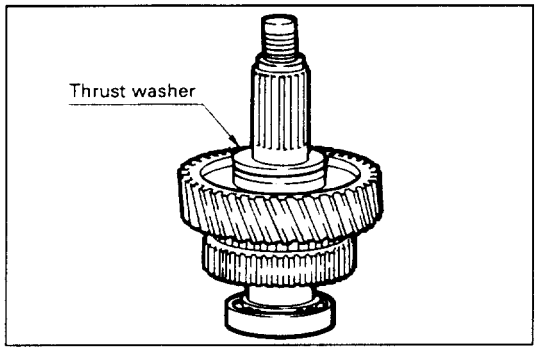


4. **Front Drive Shaft Needle Bearing**
   - Insert a needle bearing into the front drive shaft.
   - Apply engine oil to the front drive shaft bearing part.



5. **Front Drive Gear**

   Reassemble the front drive gear in the needle bearing part of front drive shaft.
   - In reassembling the front drive gear, its dog teeth must face the needle bearing side.
   - Apply engine oil to the inner diameter of front drive gear.

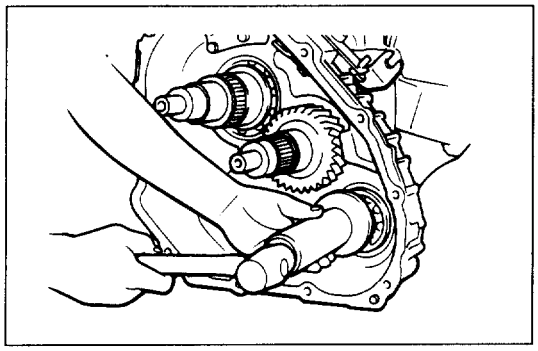


6. Thrust Washer

- Fit a thrust washer on the front drive shaft using a press.

CAUTION:

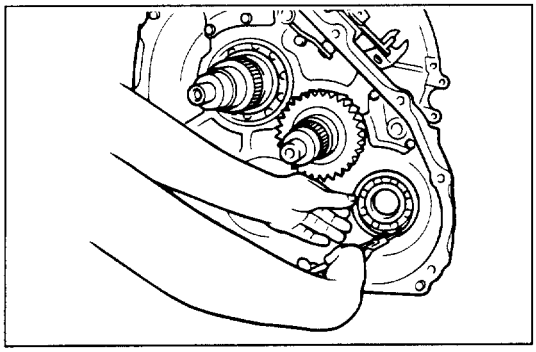
Make sure, after fitting, that the front drive gear rotates smoothly.



7. Front Drive Shaft Bearing

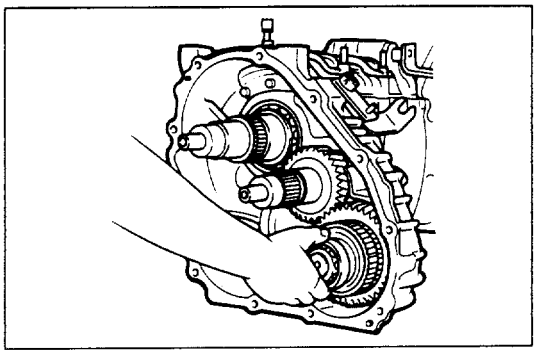
- Install the bearing in the front drive shaft hole of transfer front case using the bearing installer; front drive shaft.

  Bearing installer ; front drive shaft : 5-8840-2144-0



8. Snap Ring

- Insert a snap ring in the front drive shaft hole of transfer front case using the snap ring pliers.

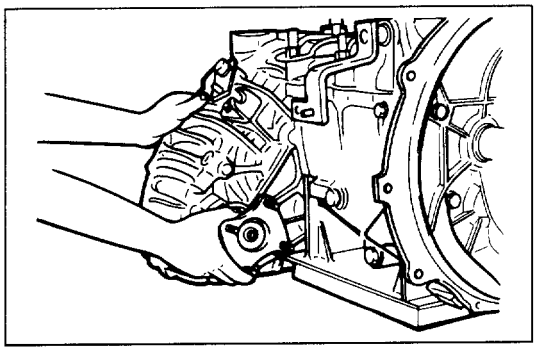


9. Front Drive Shaft Assembly

- Install the front drive shaft assembly with the ball bearing facing the rear side.

CAUTION:

Take care not to damage the oil seal lip.



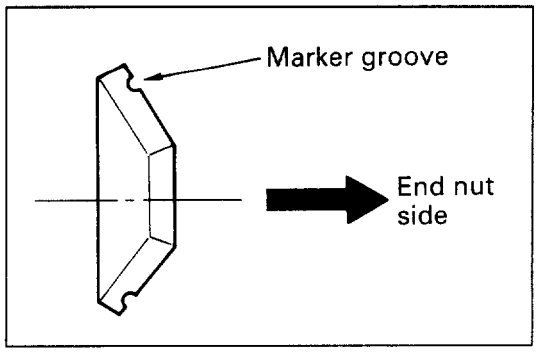
10. Coupling Driver

11. O-ring

- Install the coupling driver so that it engages with the front drive shaft spline, and insert O-ring between coupling driver and front drive shaft.
- Replace O-ring with a new one, if damaged.

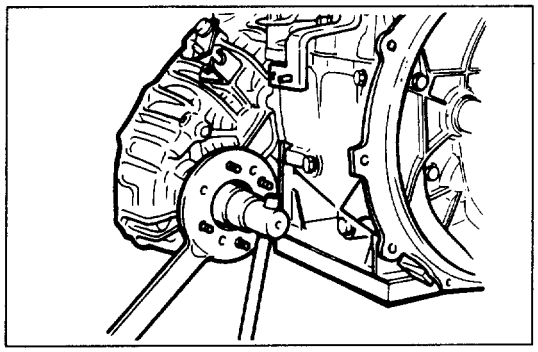
CAUTION:

Take care not to damage O-ring during installation.



12. Coupling Driver Washer

- The coupling driver washer insert direction must be as shown to the left.



13. End Nut

- Insert a coupling driver washer into the front drive shaft so that its marker groove faces the end nut side, hold the coupling driver with the handle; main shaft flange, and tighten the end nut.

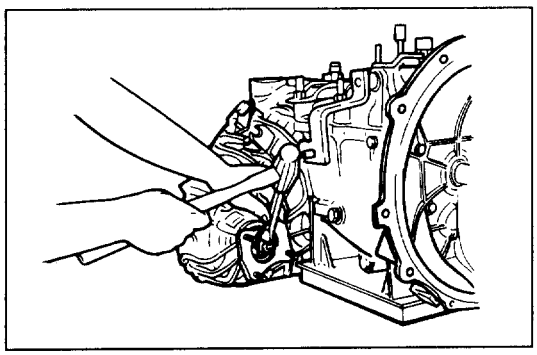
CAUTION:

Use a new end nut.

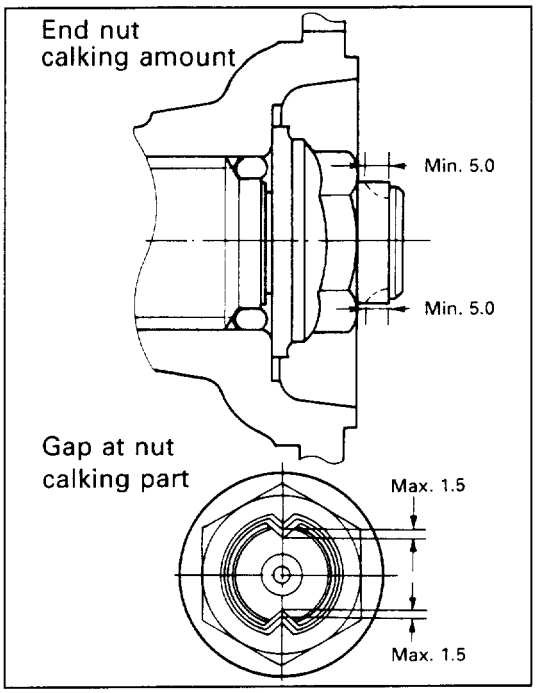
- Apply engine oil to the seat face of end nut when tightening the end nut.

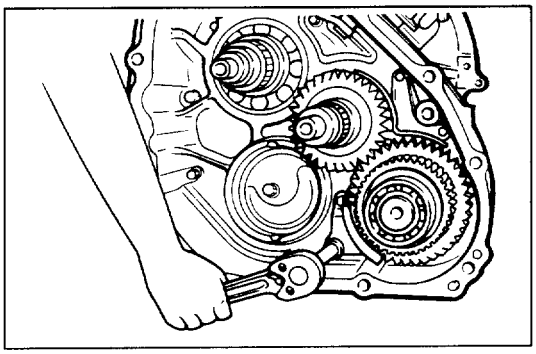
Handle; main shaft flange : 5-8840-2043-0

Flange Nut Torque	N·m(Kg·m/lb·ft)
221 (22.5/163)	



- Meet the flange of end nut with a V-groove of front drive shaft end, and calk two points with a chisel (edge form R1 x 60°) until a gap between shaft groove bottom and nut is below 1.5mm at the calking point. Also, make sure after calking that no crack is found in the calking part of nut.





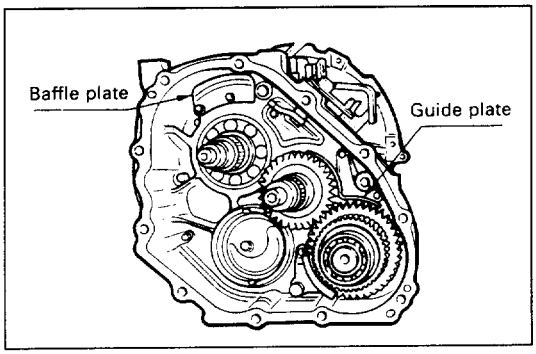
14. Guide Plate:B

- Using the bolts applied with an adhesive, fix the guide plate surrounding the front drive gear in the transfer front case.

CAUTION:

Use new bolts since they are applied with an adhesive.

Guide Plate : B Bolt Torque	N·m(kg·m/lb·ft)
	23.0 (2.3/17.0)



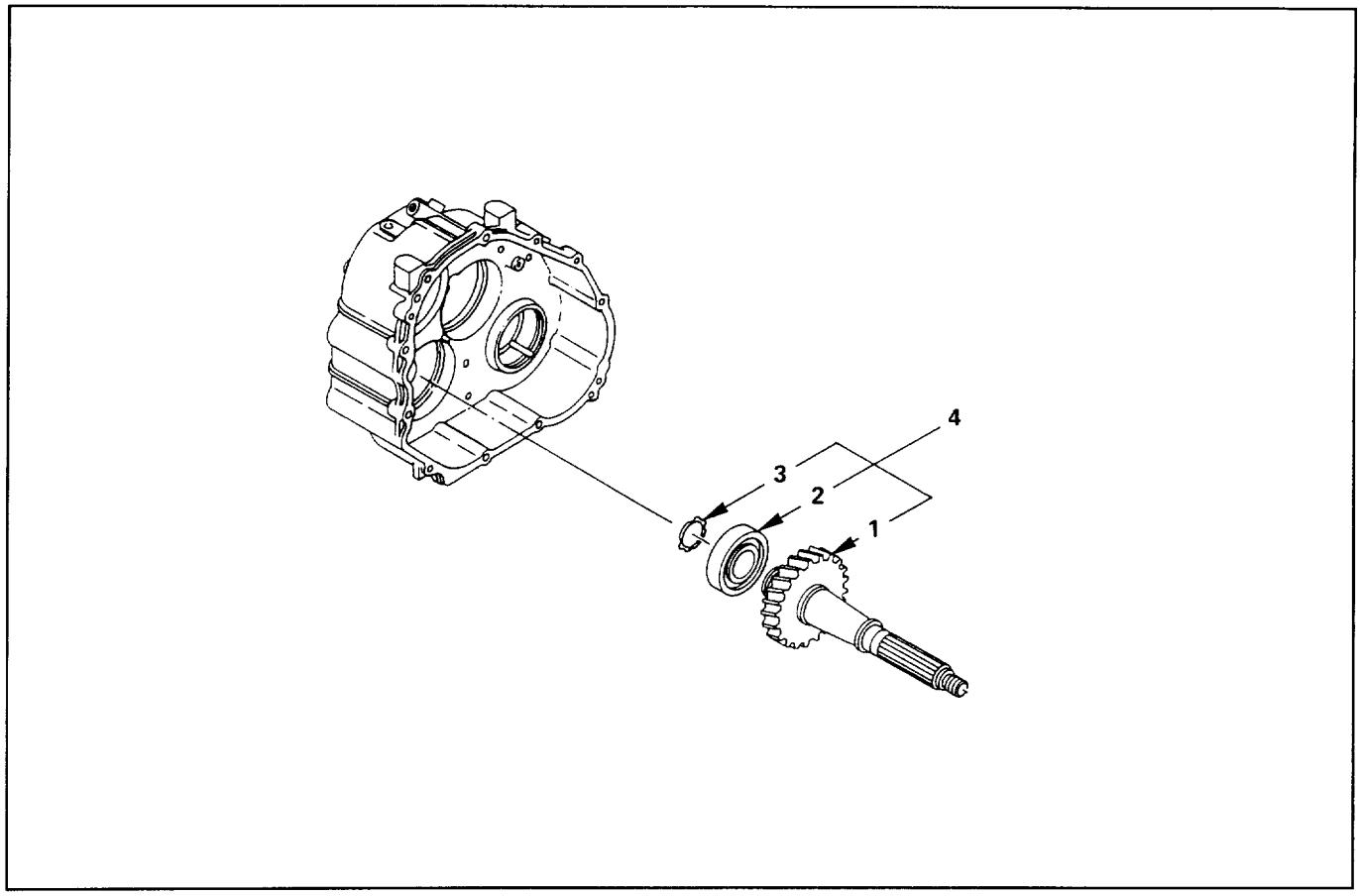
15. Guide Plate:A

16. Baffle Plate

Tighten the bolts to the torque specified above to fix the guide plate : A surrounding the idle gear and front drive gear and the baffle plate on the top of the transfer front case.

REAR DRIVE SHAFT ASSEMBLY

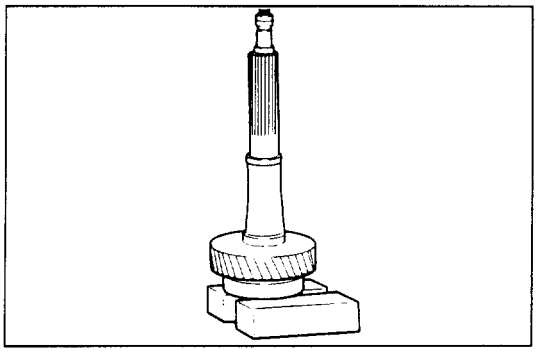
REASSEMBLY



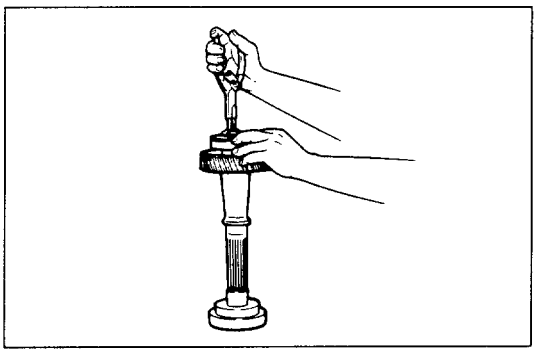
Reassembly Steps

1. Rear drive shaft
2. Rear drive shaft bearing
3. Snap ring
4. Rear drive shaft assembly

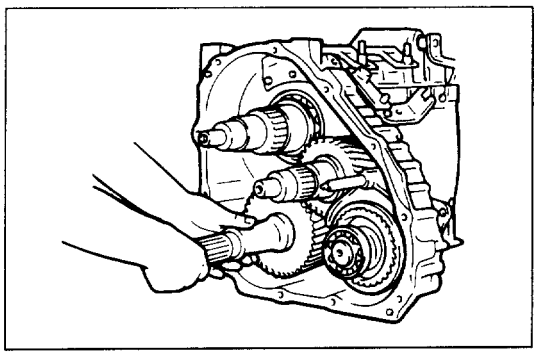
Reassembly Steps



1. **Rear Drive Shaft**
2. **Rear Drive Shaft Bearing**
   - Fit the rear drive shaft bearing on the rear drive shaft using a press.



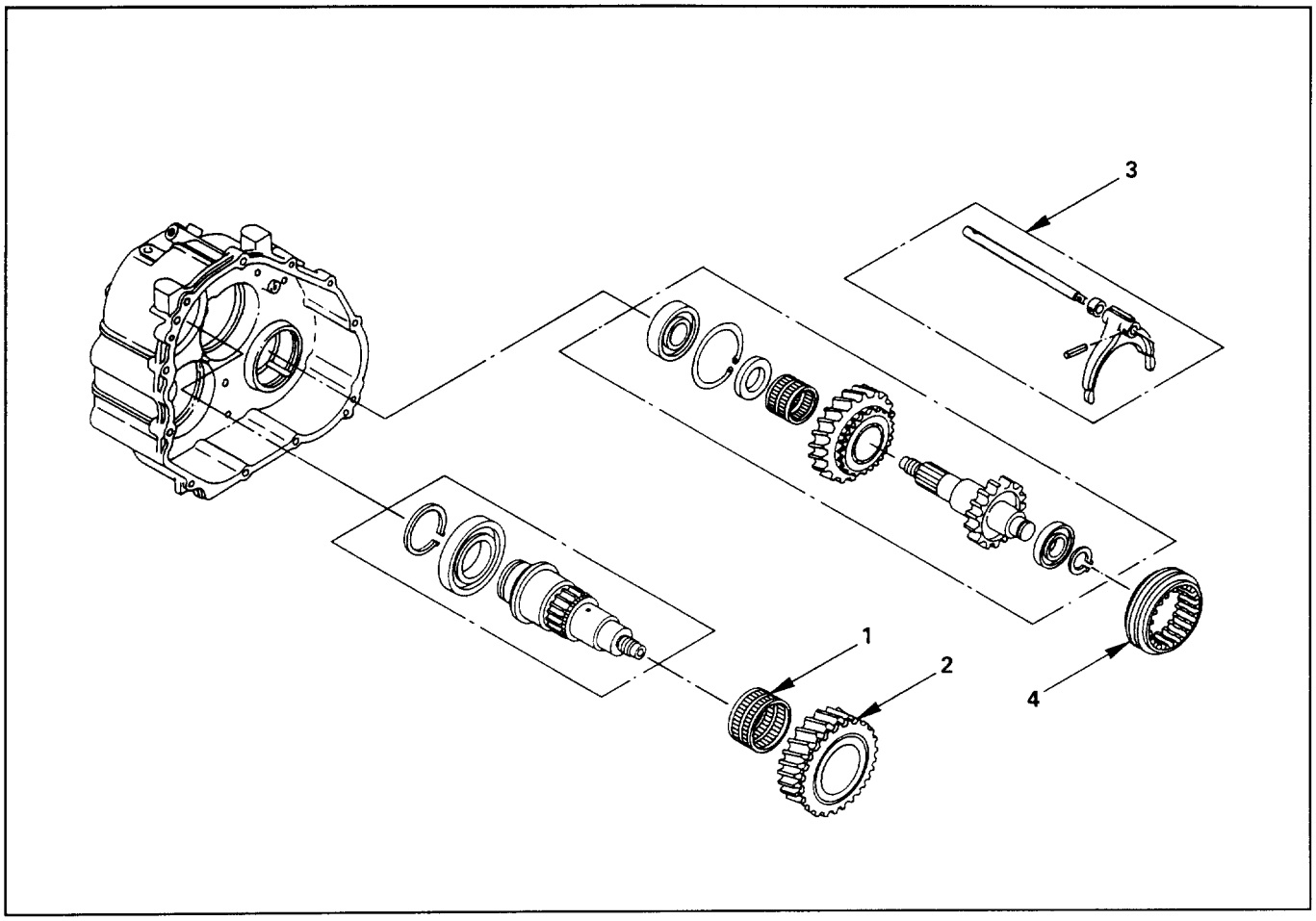
3. **Snap Ring**
   - Insert a snap ring into the rear drive shaft using the snap ring pliers.



4. **Rear Drive Shaft Assembly**
   - Install the rear drive shaft assembly.

REAR DRIVE (2WD) ↔ FOUR WHEEL DRIVE (4WD) SELECT MECHANISM

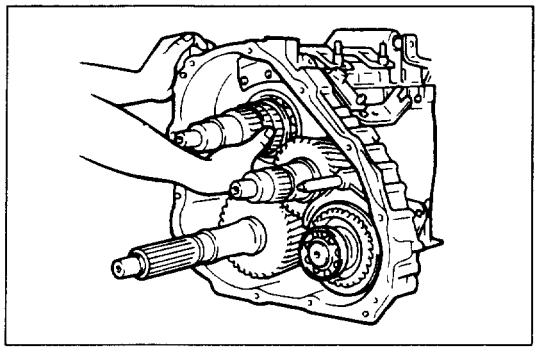
REASSEMBLY



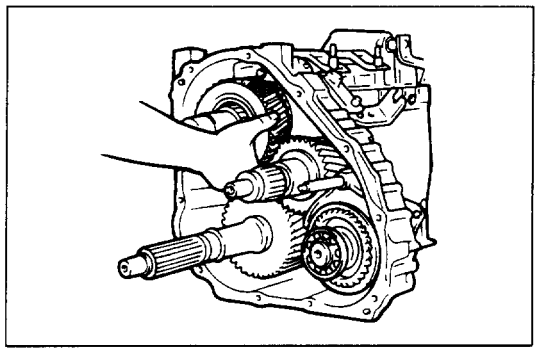
Reassembly Steps

1. Input shaft high gear needle bearing
2. Input shaft high gear
3. Shift arm and shift rod assembly
4. Sleeve

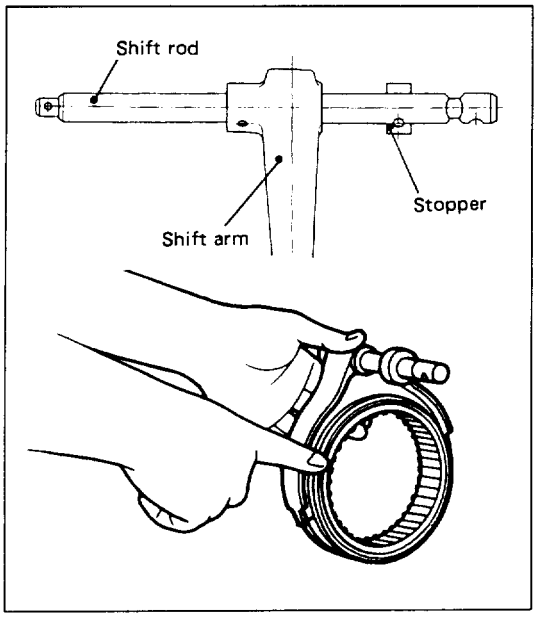
Reassembly Steps



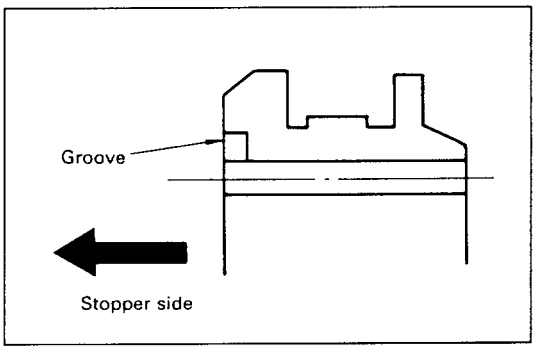
1. **Input Shaft High Gear Needle Bearing**
   Install the input shaft high gear needle bearing on the input shaft.
   - Apply engine oil to the shaft.



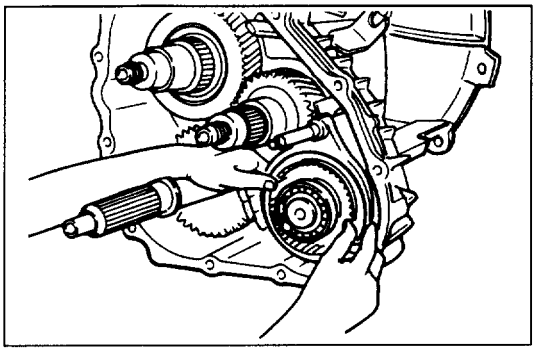
2. **Input Shaft High Gear**
   Install the input shaft high gear on the input shaft so that its dog teeth face the end nut side.
   - Apply engine oil to the inner diameter of input shaft high gear.
   - Make sure, after installation, that the input shaft high gear rotates smoothly.



3. **Shift Arm and Shift Rod Assembly**
4. **Sleeve**
   1) Install the rear drive (2WD) ↔ 4-wheel drive (4WD) select sleeve on the rear drive (2WD) ↔ 4-wheel drive (4WD) select shift arm and shift rod assembly.
      - The sleeve must be installed so that the groove of the sleeve spline is positioned on the stopper side of shift rod.



- The left figure shows the sleeve mounting direction.

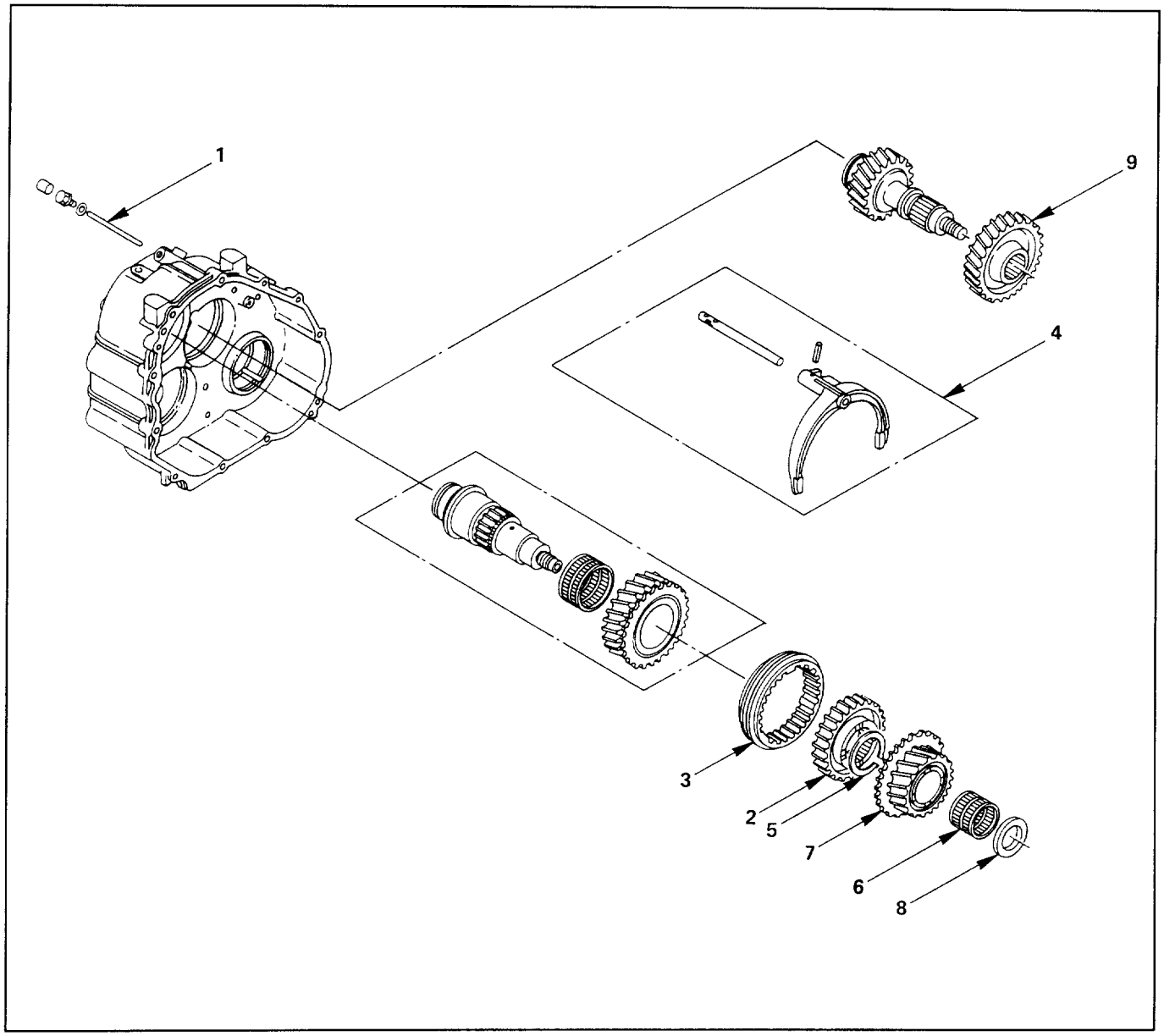


2) Install the rear drive (2WD) ↔ 4-wheel drive (4WD) select shift arm and shift rod assembly on the front drive shaft spline and in the rear drive (2WD) ↔ 4-wheel drive (4WD) select shift rod hole simultaneously.

   The shift arm and sleeve should be pushed in until they engage with the front drive gear dog teeth (in the 4WD status).

FOUR WHEEL DRIVE HIGH SPEED RANGE (4H) ↔ LOW SPEED RANGE SELECT MECHANISM

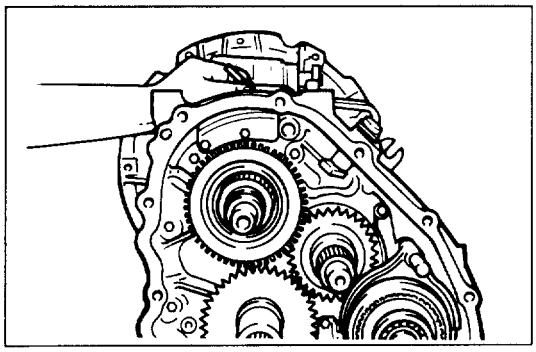
REASSEMBLY



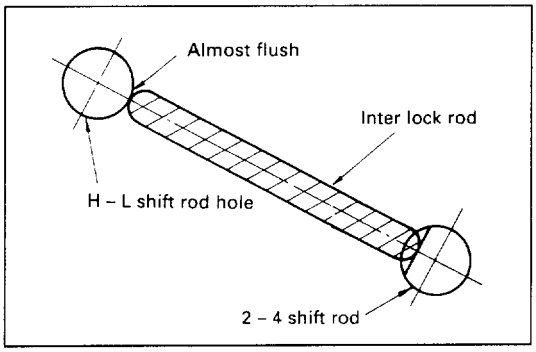
Reassembly Steps

1. Inter lock rod
2. Clutch hub
3. Sleeve
4. Shift arm and shift rod assembly
5. Clutch hub snap ring
6. Input shaft low gear needle bearing
7. Input shaft low gear
8. Input shaft low gear thrust washer
9. Low range idle gear

Reassembly Steps

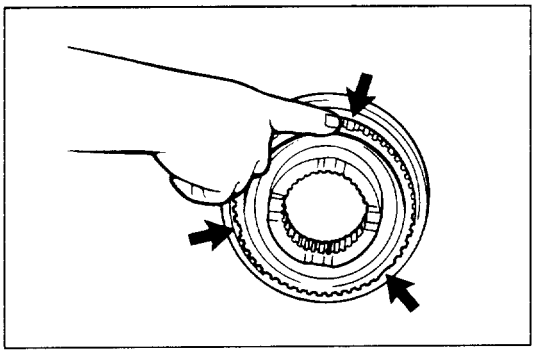


1. **Inter Lock Rod**
   - Insert the inter lock rod into the transfer front case from the top.



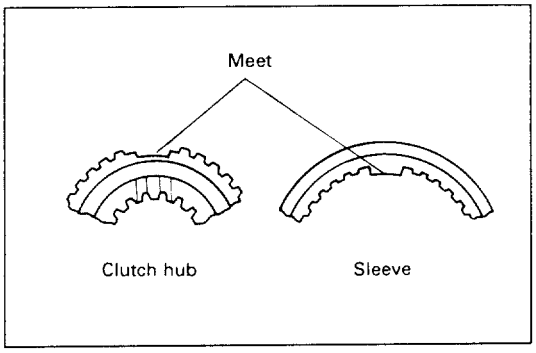
CAUTION:

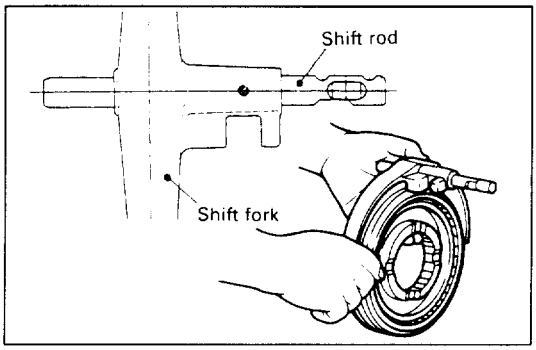
Make sure that the leading end of inter lock rod almost flushes with the outer diameter of 4WD high speed ranged (4H) ↔ low speed range (4L) select shift rod hole.



2. **Clutch Hub**
3. **Sleeve**

   Reassemble the sleeve with the 2WD high speed range (4H) ↔ low speed range (4L) select clutch hub.
   - Meet non-tooth portions (3 places) on the clutch hub outer diameter with stoppers (3 places) on sleeve teeth inner diameter.
   - Make sure that the sleeve moves smoothly in axial direction.

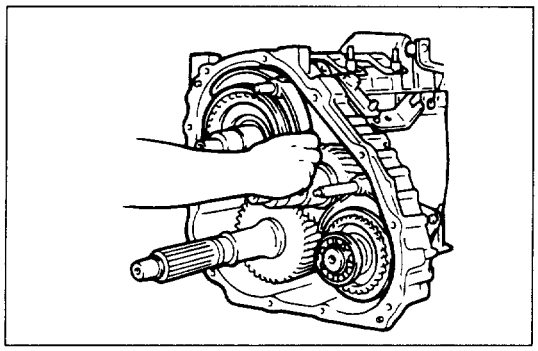




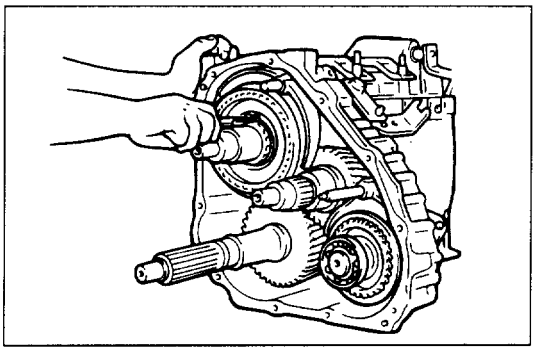
4. Shift Arm and Shift Rod Assembly

1) Install the 4WD high speed range (4H) ↔ low speed range (4L) select shift rod and shift arm assembly in the 4WD high speed range (4H) ↔ low speed range (4L) select sleeve hub assembly.

In installing the assembly, the groove of shift arm boss must be positioned on the oil groove side of clutch hub boss.

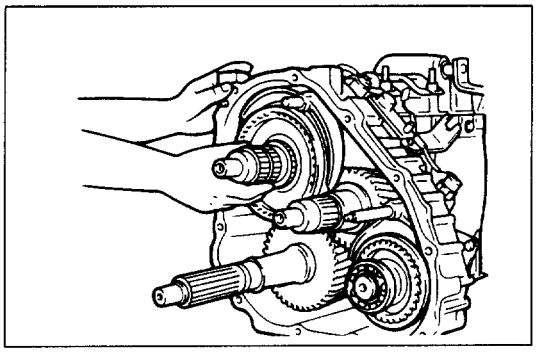


2) Moving the 4WD high speed range (4H) ↔ low speed range (4L) select external shift lever to the left or right, insert a spherical part of internal lever into the groove of shift arm, and push in the sleeve, hub and shift arm until they cannot move in axial direction.



5. Clutch Hub Snap Ring

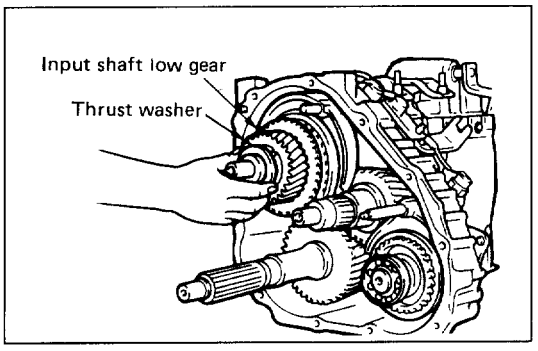
- Insert a snap ring into the input shaft spline using the snap ring pliers.



6. Input Shaft Low Gear Needle Bearing

Insert the input shaft low gear needle bearing into the input shaft.

- Apply engine oil to the input shaft.

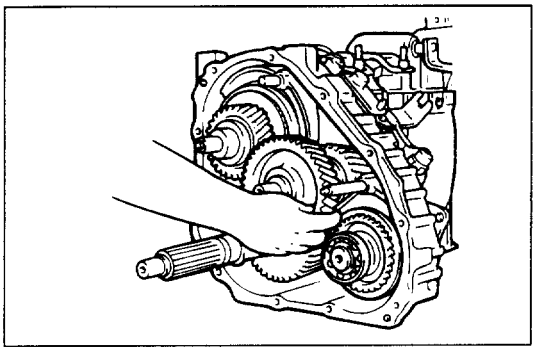


7. Input Shaft Low Gear

8. Input Shaft Low Gear Thrust Washer

Insert the input shaft low gear and thrust washer into the input shaft.

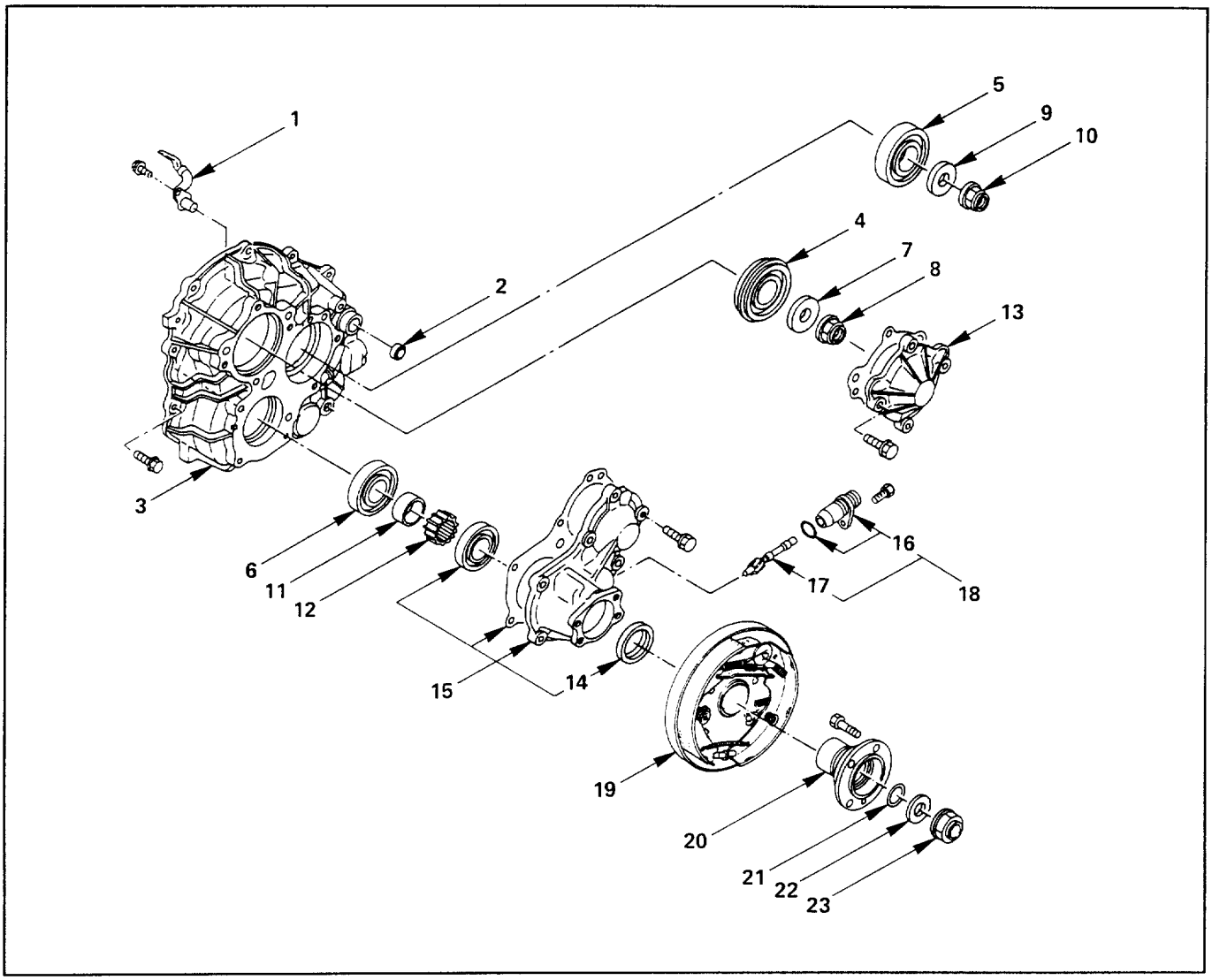
- Installing the input shaft low gear, its dog teeth must be positioned on the rear side (transmission side).
- Apply engine oil to the inner diameter of gear.



9. **Low Range Idle Gear**
   - Reassemble the low range idle gear with the idle shaft spline.
   - There is no direction in idle gear installation.

TRANSFER REAR CASE

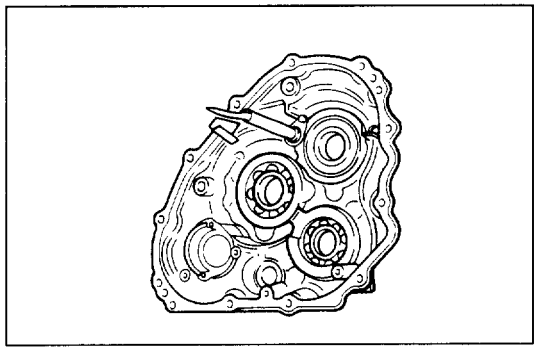
REASSEMBLY



Reassembly Steps

1. Oil guide
2. Shift rod oil seal
3. Transfer rear case
4. Input shaft bearing
5. Idle shaft bearing
6. Rear drive shaft bearing
7. Input shaft washer
8. Input shaft end nut
9. Idle shaft washer
10. Idle shaft end nut
11. Rear drive shaft collar
12. Speedometer drive gear
13. P.T.O cover
14. Rear cover oil seal
15. Rear cover assembly
16. Speedometer driven gear bushing
17. Speedometer driven gear
18. Speedometer driven gear assembly
19. Center brake assembly
20. Coupling driver
21. O-ring
22. Coupling driver washer
23. Rear drive shaft end nut

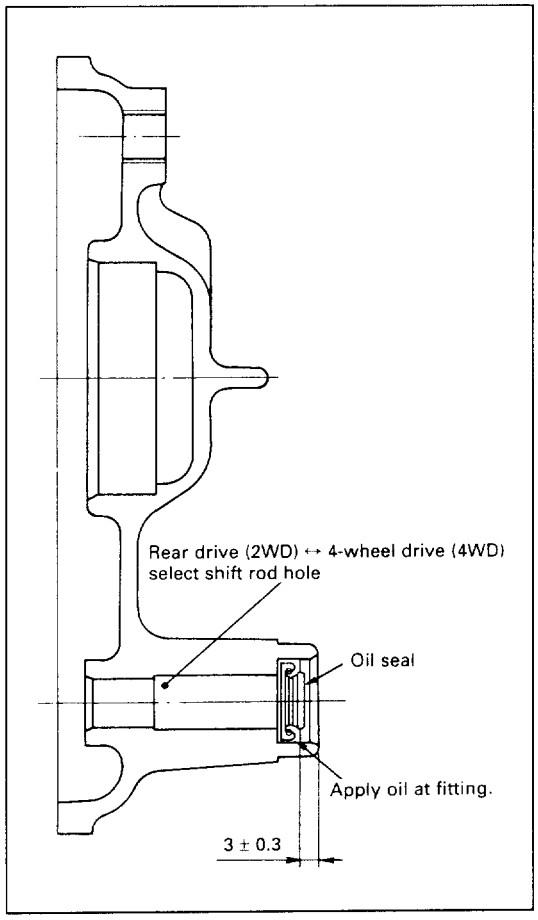
Reassembly Steps



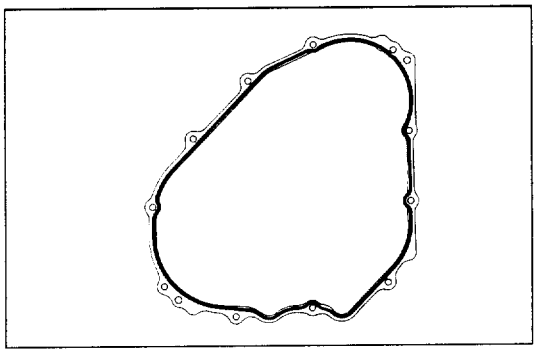
1. **Oil Guide**
   - Fix the oil guide in the transfer rear case with bolts applied with an adhesive, if it is replaced.

CAUTION:
Use new bolts since they are applied with an adhesive.

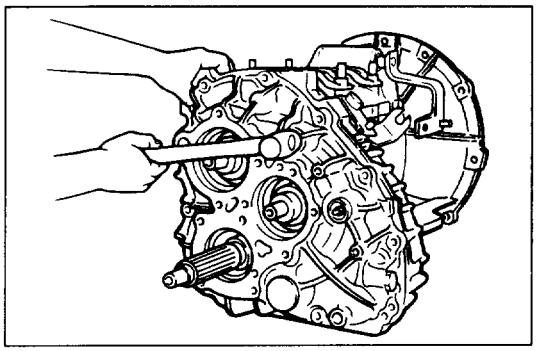
Oil Guide Bolt Torque	N·m(kg·m/lb·ft)
	23 (2.3/17)



2. **Shift Rod Oil Seal**
   Reassemble the shift rod oil seal in the transfer rear case.
   Oil seal installer; transfer rear case : 5-8840-2146-0



3. **Transfer Rear Case**
   1) Apply sealant Three Bond 1215 (or equivalent) to the mating face of transfer rear case.



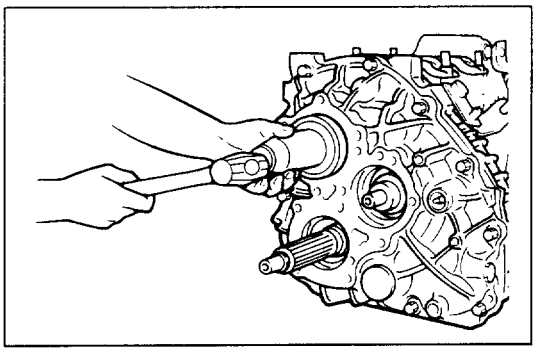
2) Install the transfer rear case while hitting lightly with a copper hammer.
- Take care not to damage the oil seal lip on the leading end of rear drive (2WD) ↔ 4-wheel drive (4WD) select shift rod.
- Each portion of transfer rear case should be hit evenly to avoid slant installation.
- Gap in a mating surface of transfer rear case and transfer front case should be almost zero.

3) Tighten the bolts on transfer rear case.

Transfer Rear Case Bolt Torque	N·m (kg·m/lb·ft)
40 (4.1/30)	

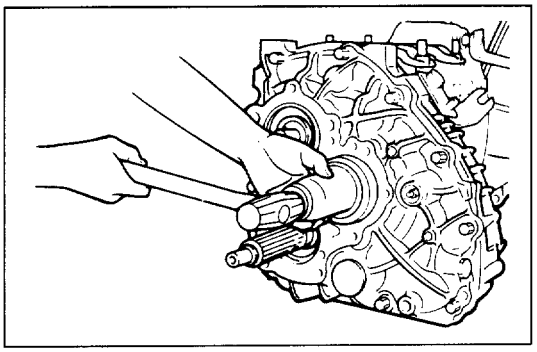
CAUTION:

Remove puller bolts that were used for disassembly.



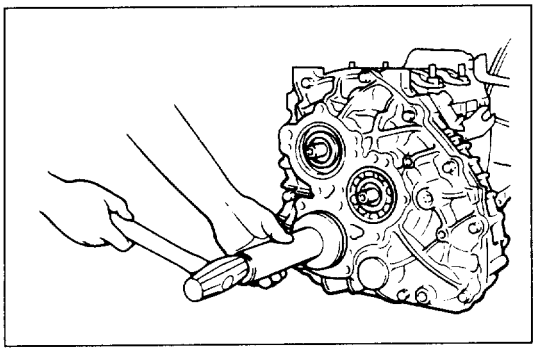
4. Input Shaft Bearing
- Drive the input shaft bearing (both-side sealed bearing) in the bearing hole on the input shaft using the bearing installer until it flushes with the mating face of the case.

  Bearing Installer : 9-8522-1615-0



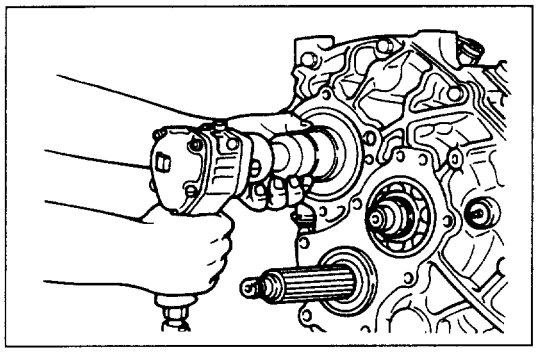
5. Idle Shaft Bearing
- Drive the idle shaft bearing in the bearing hole on the idle shaft using the bearing installer until it flushes with the mating face of the case.

  Bearing Installer : 9-8522-1615-0



6. Rear Drive Shaft Bearing
- Drive the rear drive shaft bearing (one-side sealed bearing) with the seal positioned on the end nut side in the bearing hole on the rear drive shaft using the bearing installer; front drive shaft until the bearing cannot move in axial direction.

  Bearing Installer : 5-8840-2144-0
- The bearing will protrude by about 5mm from the case mating face.



7. **Input Shaft Washer**
8. **Input Shaft End Nut**

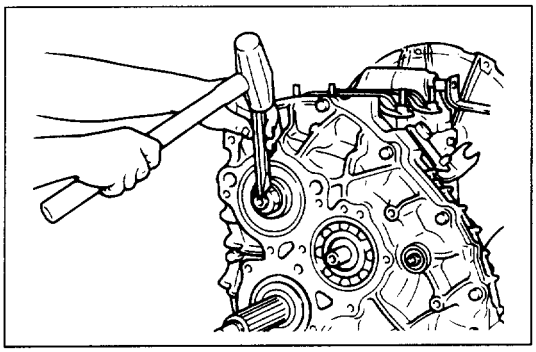
Shift the shift external lever to either L or H to place the transmission gear in a double meshing status, insert a plain washer into the input shaft, and tighten the end nut using the nut runner.

Input Shaft End Nut Torque	N·m(kg·m/lb·ft)
	221(22.5/163)

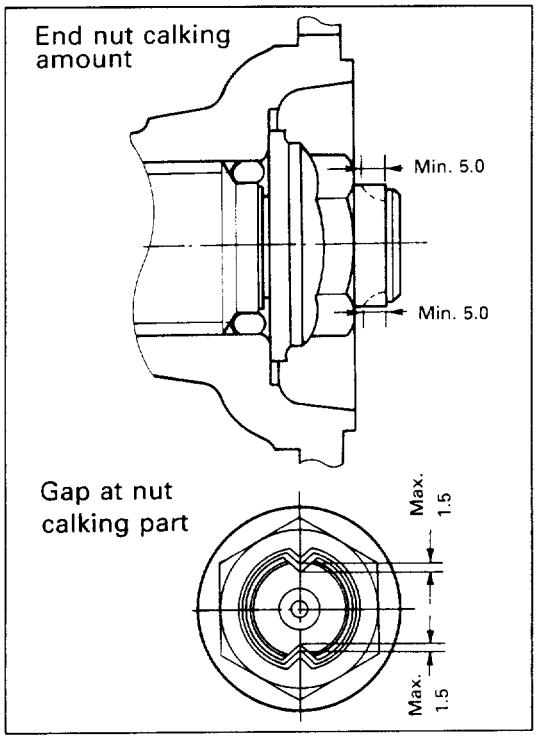
CAUTION:

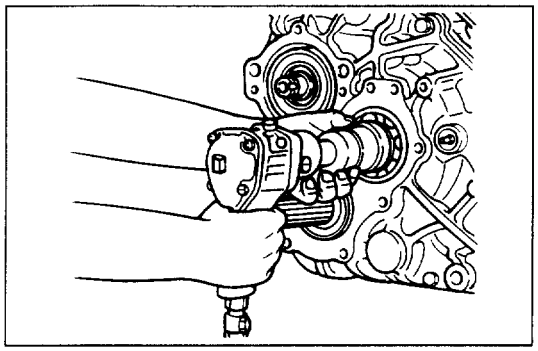
Use new end nut.

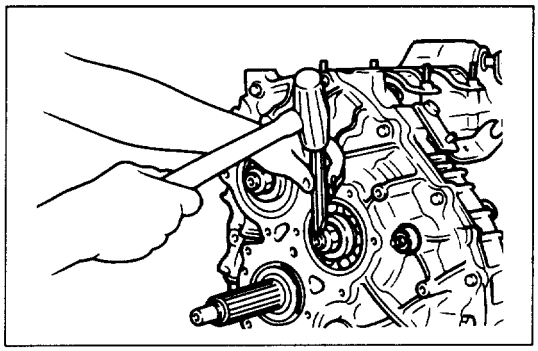
- Apply engine oil to the seat face of end nut when tightening the end nut.

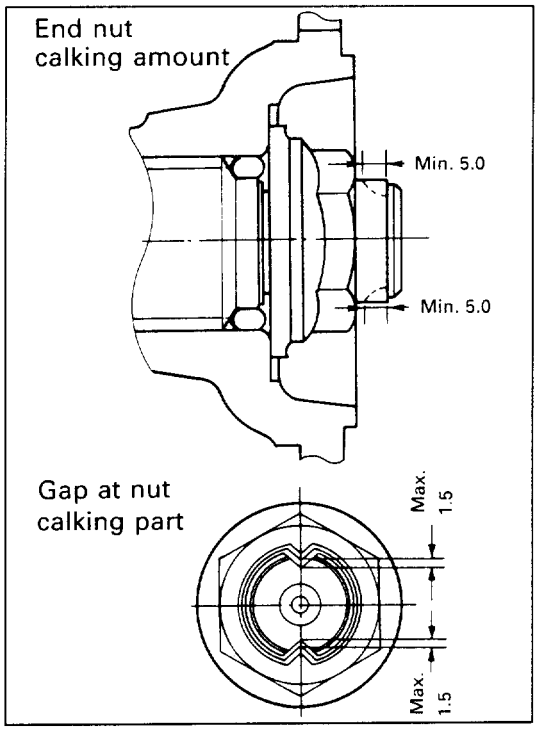


- Meet the flange of end nut with a V-groove of input drive shaft end, and calk two points with a chisel (edge form R1x60°) until a gap between shaft groove bottom and nut is below 1.5mm at the calking point. Also, make sure after calking that no crack is found in the calking part of nut.









9. **Idle Shaft Washer**
10. **Idle Shaft End Nut**

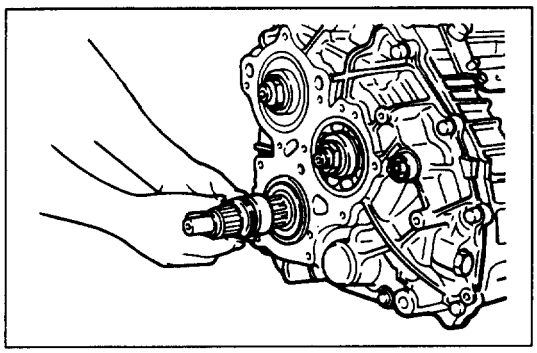
Shift the shift external lever to either L or H to place the transmission gear in a double meshing status, insert a plain washer into the idle shaft, and tighten the end nut using the nut runner.

Idle Shaft End Nut Torque	N·m(kg·m/lb·ft)
	221 (22.5/163)

CAUTION:

Use new end nut.

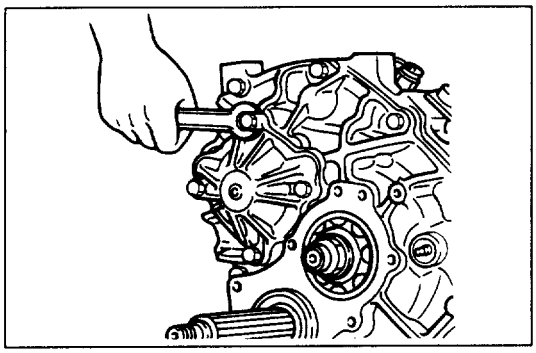
- Apply engine oil to the seat face of end nut when tightening the end nut.
- Meet the flange of end nut with a V-groove of idle shaft end, and calk two points with a chisel (edge form R1x60°) until a gap between shaft groove bottom and nut is below 1.5mm at the calking point. Also, make sure after calking that no crack is found in the calking part of nut.



11. Rear Drive Shaft Collar

12. Speedometer Drive Gear

- Install the rear drive shaft collar and speedometer drive gear in this order on the rear drive shaft spline.
- In installing the speedometer drive gear, its boss must be positioned on the end nut side.



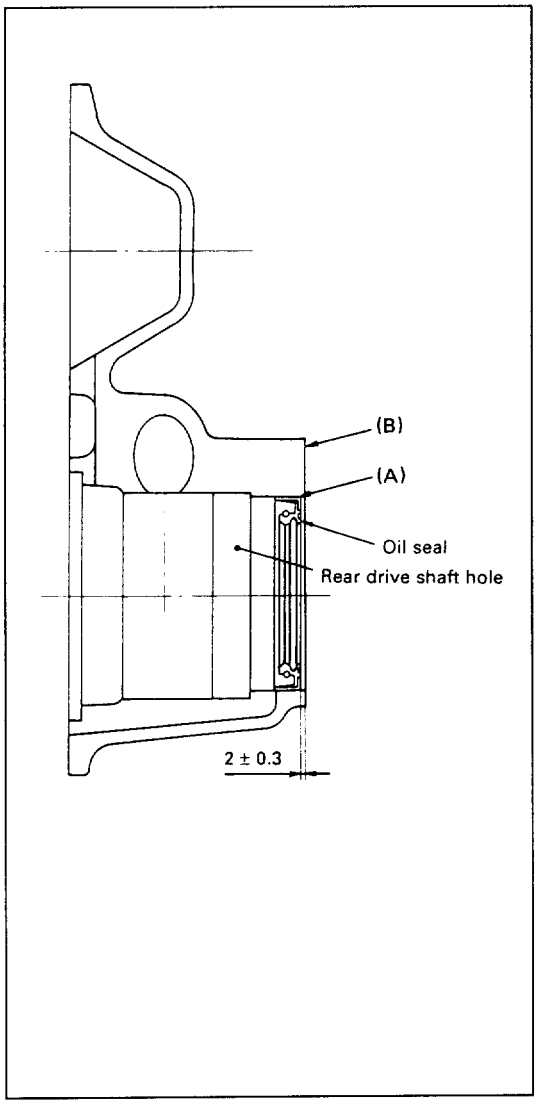
13. P.T.O Cover

Attach a gasket to the P.T.O cover mating face of transfer rear case, and fix the P.T.O cover with bolts.

P.T.O Cover Bolt Torque	N·m(kg·m/lb·ft)
	40 (4.1/30)

CAUTION:

Use a new gasket.



14. Rear Cover Oil Seal

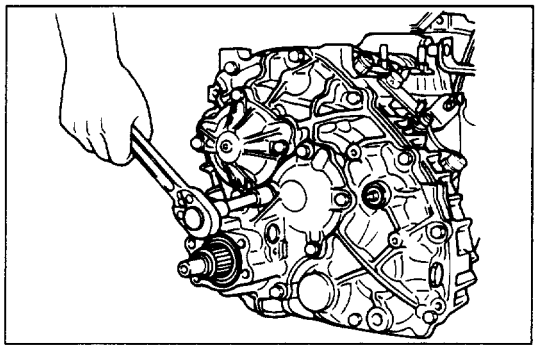
- Insert the oil seal in the rear cover as shown to the left.

  Oil seal installer; rear cover : 5-8840-2147-0

- Apply sealant (ThreeBond 1207 or equivalent) (A) part.

CAUTION:

Do not apply sealant to flange surface (B).



15. Rear Cover Assembly

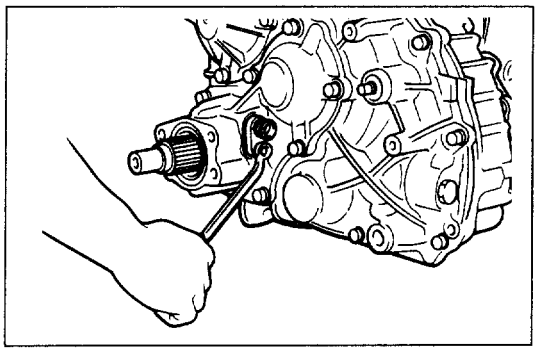
Attach a gasket to the rear cover mating face of transfer rear case, and fix the rear cover with bolts.

Rear Cover Bolt Torque	N·m(kg·m/lb·ft)
40 (4.1/30)	

- Before installing the rear cover, make sure that the ball bearing is in the rear cover.
- If there is no ball bearing in the rear cover, install the ball bearing on the rear drive shaft spline, then install the rear cover.

CAUTION:

Take care not to damage the oil seal lip during installation of rear cover.



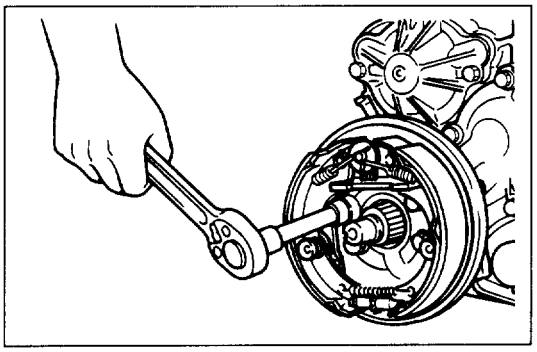
16. Speedometer Driven Gear Bushing

17. Speedometer Driven Gear

18. Speedometer Driven Gear Assembly

Insert the speedometer driven gear into the speedometer driven gear bushing, and fix the speedometer driven gear assembly to the rear cover assembly with bolts.

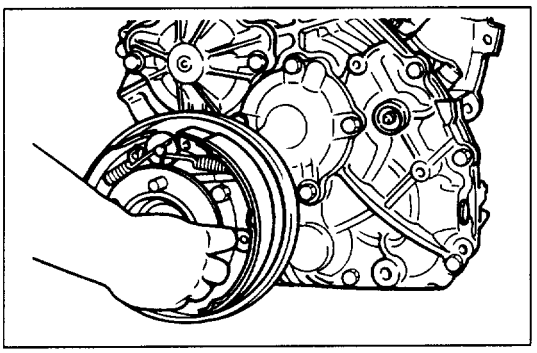
Speedometer Driven Gear Assembly Bolt Torque	N·m(kg·m/lb·ft)
15 (1.5/11)	



19. Center Brake Assembly

Fix the center brake assembly to the rear cover with bolts.

Center Brake Assembly Bolt Torque	N·m(kg·m/lb·ft)
83 (8.5/61)	



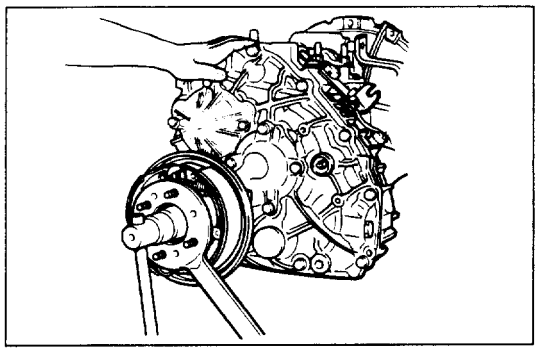
20. Coupling Driver

21. O-ring

- Drive the coupling driver into the rear drive shaft using a proper length of tube and a hammer, then insert O-ring between coupling driver and rear drive shaft.
- Replace O-ring with a new one if it is damaged.

CAUTION:

Take care not to damage the O-ring during installation.



22. **Coupling Driver Washer**
23. **Rear Drive Shaft End Nut**
    1) Insert a coupling driver washer into the rear drive shaft with a marker groove facing the end nut side, and tighten the rear drive shaft end nut by holding the coupling driver with handle ; the main shaft flange.

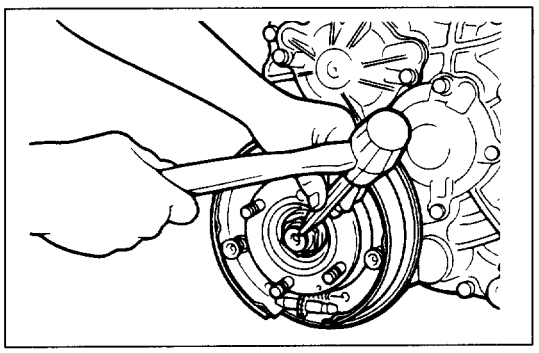
Rear Drive Shaft End Nut Torque	N·m(kg·m/lb·ft)
	221 (22.5/163)

CAUTION:

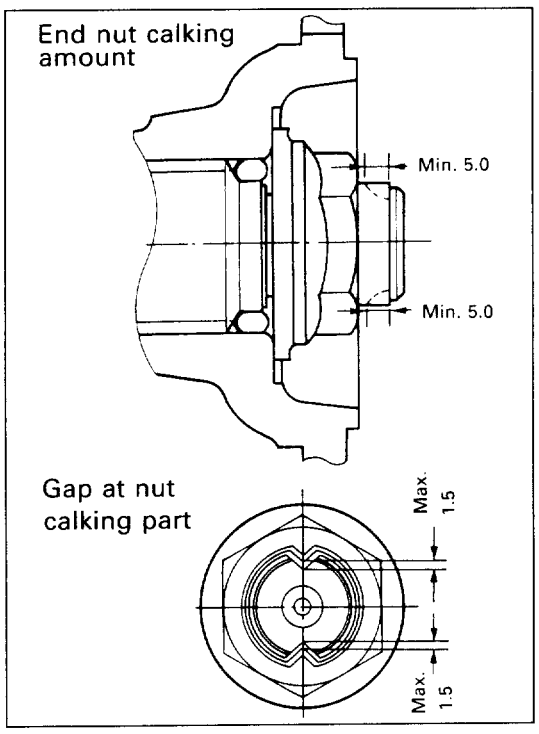
Use new end nut.

- Apply engine oil to the seat face of end nut when tightening the end nut.

  Handle; main shaft flange : 5-8840-2043-0

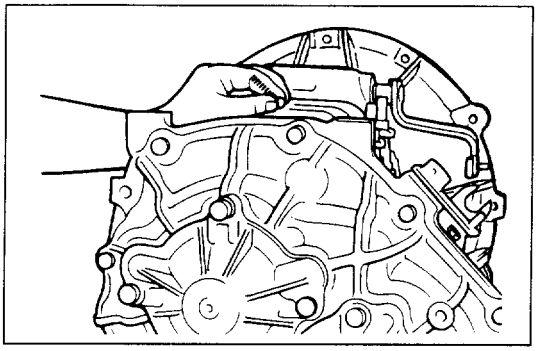


2) Meet the flange of end nut with a V-groove of rear drive shaft end, and calk two points with a chisel (edge form R1x60°) until a gap between shaft groove bottom and nut is below 1.5mm at the calking point. Also, make sure after calking that no crack is found in the calking part of nut.



OTHER PARTS REASSEMBLY

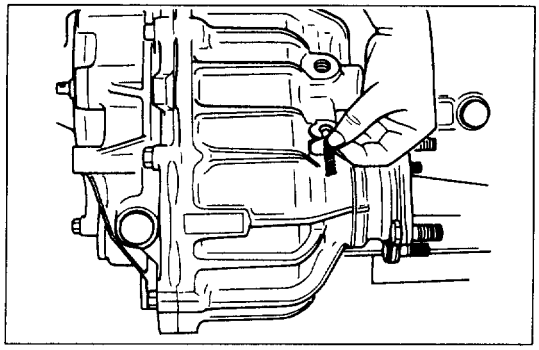
Installation Steps



1. **Detent Ball**
2. **Detent Spring**
3. **Detent Spring Plug Gasket**
4. **Detent Spring Plug**

Install the detent ball and spring for 4WD high speed range (4H) ↔ low speed range selection in the hole drilled in 45° direction at the upper left side of transfer front case, then fix them with the plug and gasket.

Detent Spring Plug Torque	N·m(kg·m/lb·ft)
	25 (2.5/18)

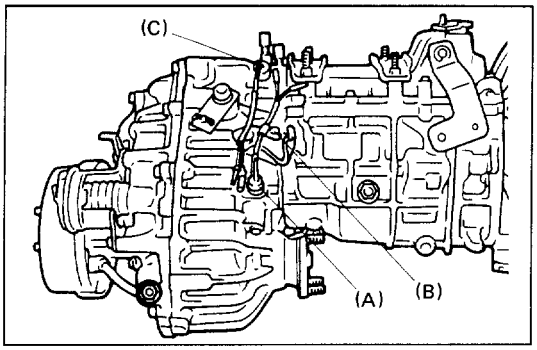


5. **Detent Ball**
6. **Detent Spring**
7. **Detent Spring Plug Gasket**
8. **Detent Spring Plug**

Install the detent ball and spring for rear drive (2WD) ↔ 4-wheel drive (4WD) selection in the hole drilled in 45° direction at the bottom right side of transfer front case, then fix them with the plug and gasket.

Detent Spring Plug Torque	N·m(kg·m/lb·ft)
	25 (2.5/18)

Take care not to drop parts.



9. **4WD Detective Switch**
10. **Harness Clip**
11. **Transfer Neutral Switch**

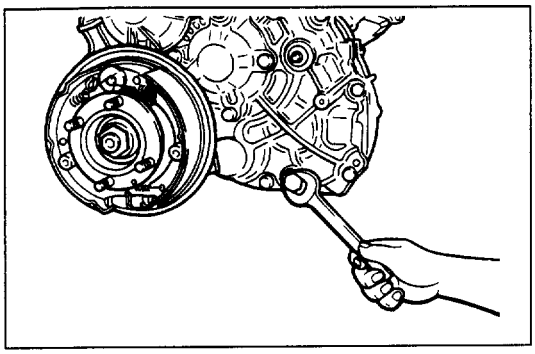
Fix the 4WD detective switch (A), harness clip clamp bolt (B) and transfer neutral switch (C) to the transfer front case.

Torque	N·m(kg·m/lb·ft)
4WD Detective Switch	34 (3.5/25)
Harness Clip	20 (2.0/14)
Transfer Neutral Switch	34 (3.5/25)

Apply sealant Three Bond 1141 (or equivalent) to the threads of 4WD detective switch and neutral switch before tightening.

12. **Breather**

Breather Torque	N·m(kg·m/lb·ft)
	4.9(0.5/3.6)



13. **Drain Plug Gasket**
14. **Drain Plug**

Fix the drain plug to the transfer rear case.

Drain Plug Torque	N·m(kg·m/lb·ft)
49 (5.0/36)	

15. **Filler Plug Gasket**
16. **Filler Plug**

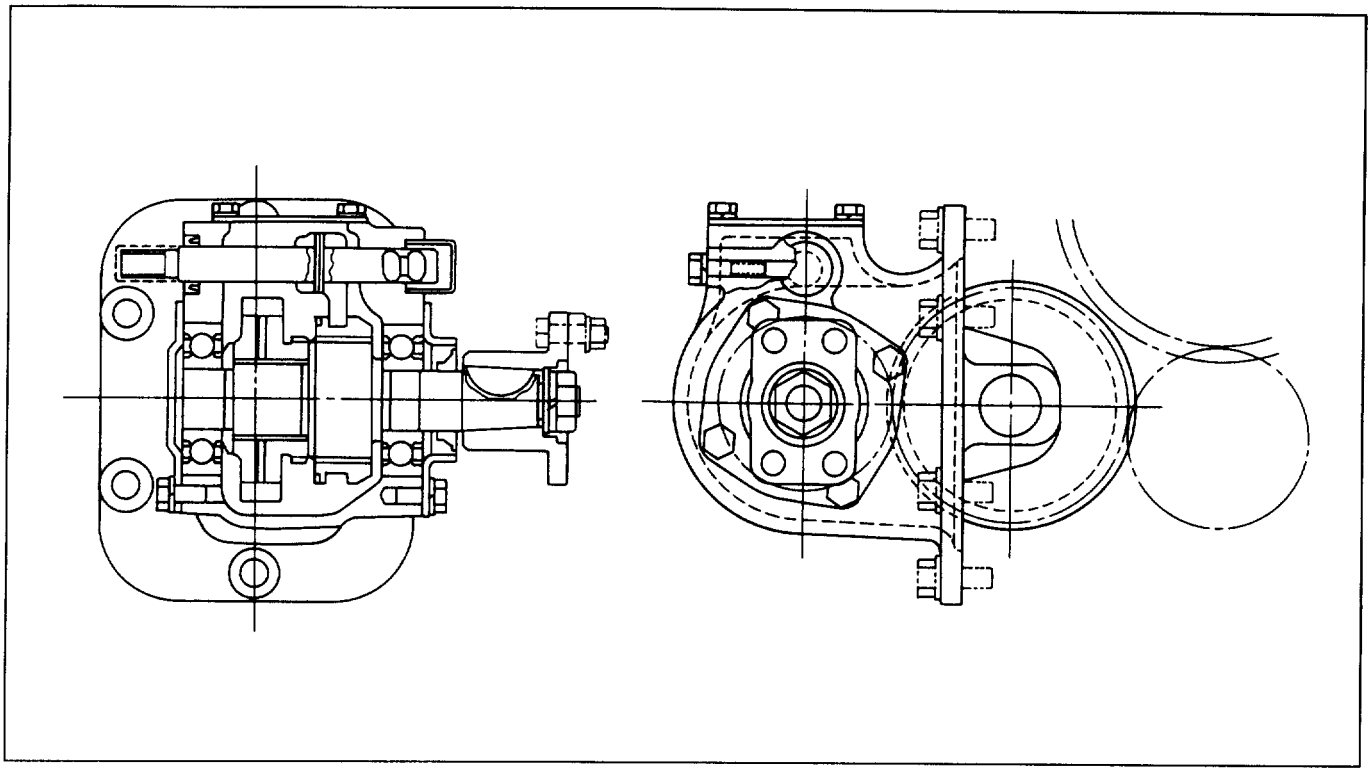
Supply engine oil from a filler port, then tighten gasket and plug.

Filler Plug Torque	N·m(kg·m/lb·ft)
49 (5.0/36)	

Oil Capacity	Liters (US qt/Imp.qt)
2.0 (2.11/1.76)	

POWER TAKE OFF (PTO)

GENERAL DESCRIPTION



The side PTO is provided at the left side of the transmission.

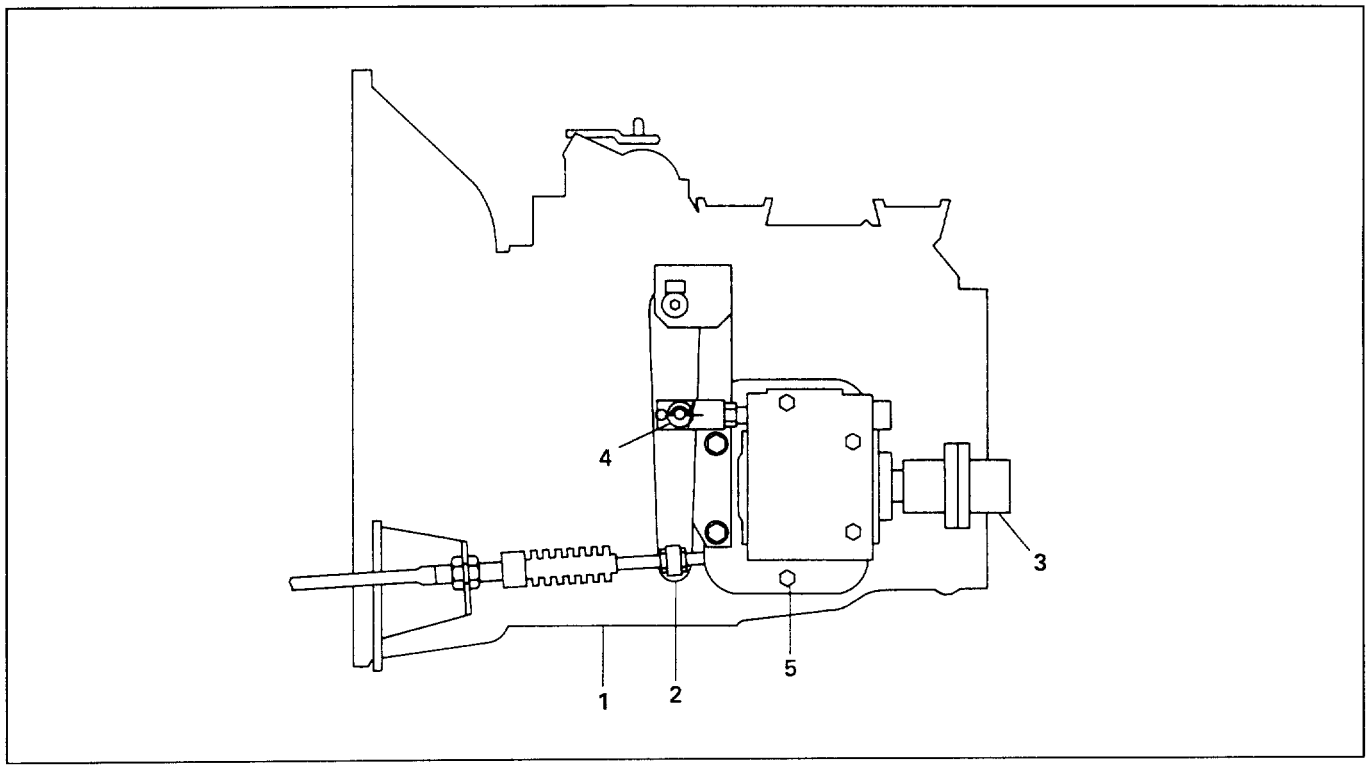
For the gear, the same helical gear as the one used for the transmission is employed to reduce noises.

The roller type needle bearing is employed for the idle shaft and the ball bearing for the output shaft to obtain the increased durability and quietness.

The gear employed is of a constant-engagement type. The gear engagement control (ON/OFF) by a cable is made by the shift rod provided at the upper section of the case, which slides the sleeve above the output shaft through the shaft arm.

POWER TAKE OFF (PTO) REPLACEMENT

REMOVAL



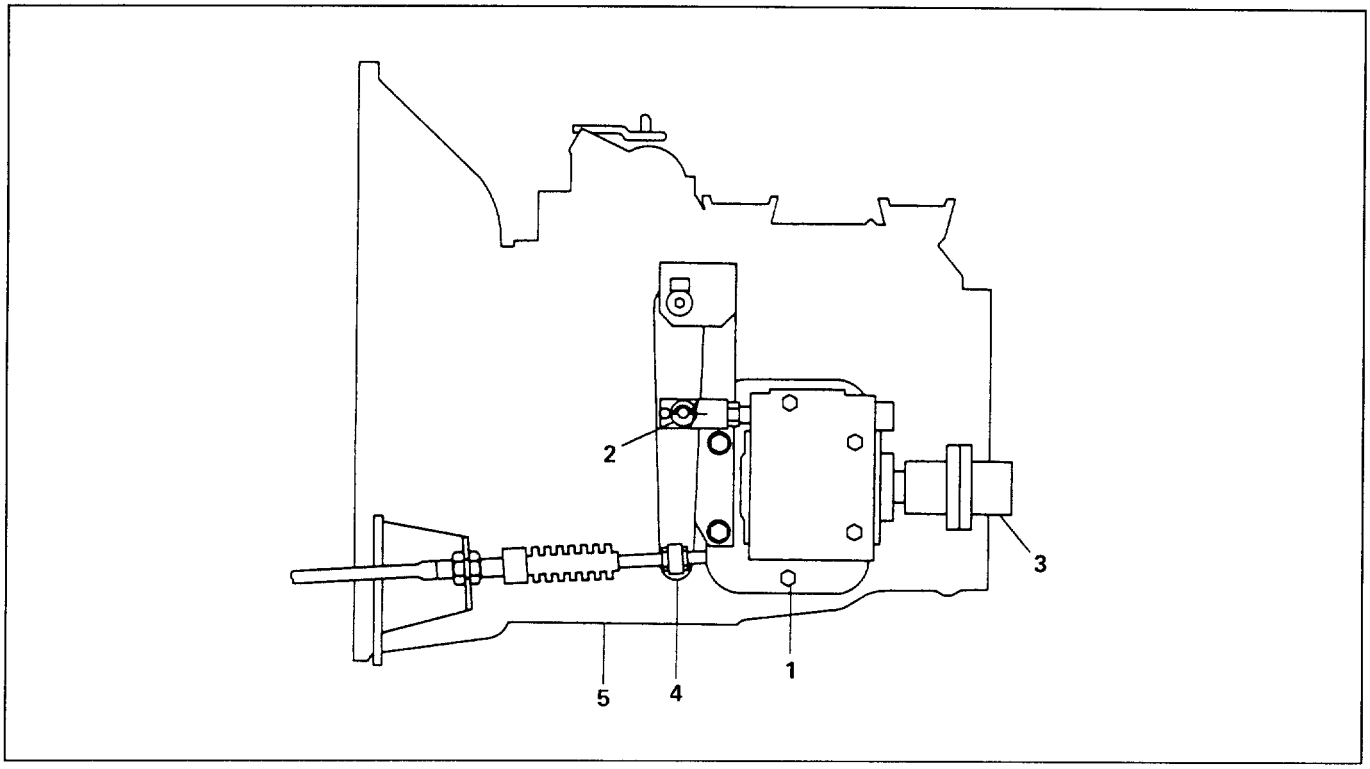
Removal Steps

1. Transmission oil
2. Control cable
3. PTO output propeller shaft
4. Connecting pin
5. PTO assembly

Removal Steps

1. **Transmission Oil**
   - Remove the drain plug from the transmission case and drain the oil.
2. **Control Cable**
   - Disconnect the control cable from the PTO shift lever.
3. **PTO Output Propeller Shaft**
   - Disconnect the propeller shaft from the PTO output flange.
4. **Connecting Pin**
   - Remove the snap pin, washer and the connecting pin from the shift rod and the shift lever.
5. **PTO Assembly**
   - Remove 6 PTO fixing bolts, and PTO assembly.

INSTALLATION



Installation Steps

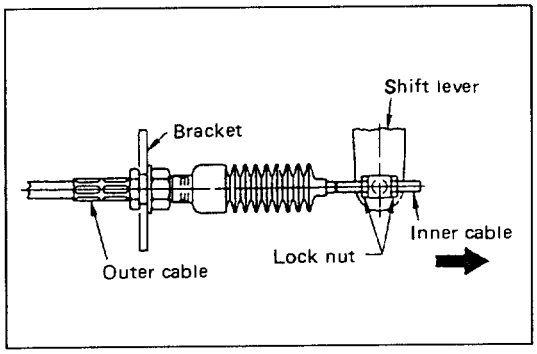
1. PTO assembly
2. Connecting pin
3. PTO output propeller shaft
4. Control cable
5. Transmission oil

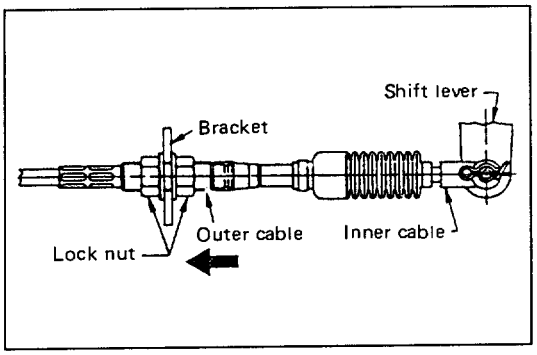
Installation Steps

1. **PTO Assembly**
   - Clean on the mating faces before applying the liquid gasket.
   - Apply liquid gasket (Three Bond 1141E or equivalent) to the PTO and transmission surfaces, and both sides of the distance piece (if installed).
   - Install the distance piece (if installed) and PTO with new gasket(s).

PTO Bolt Torque	N·m (kg·m/lb·ft)
	37 (3.8/27)

2. **Connecting Pin**
   - Install the connecting pin to the shift rod and shift lever and install the snap pin with washer.
3. **PTO Output Propeller Shaft**





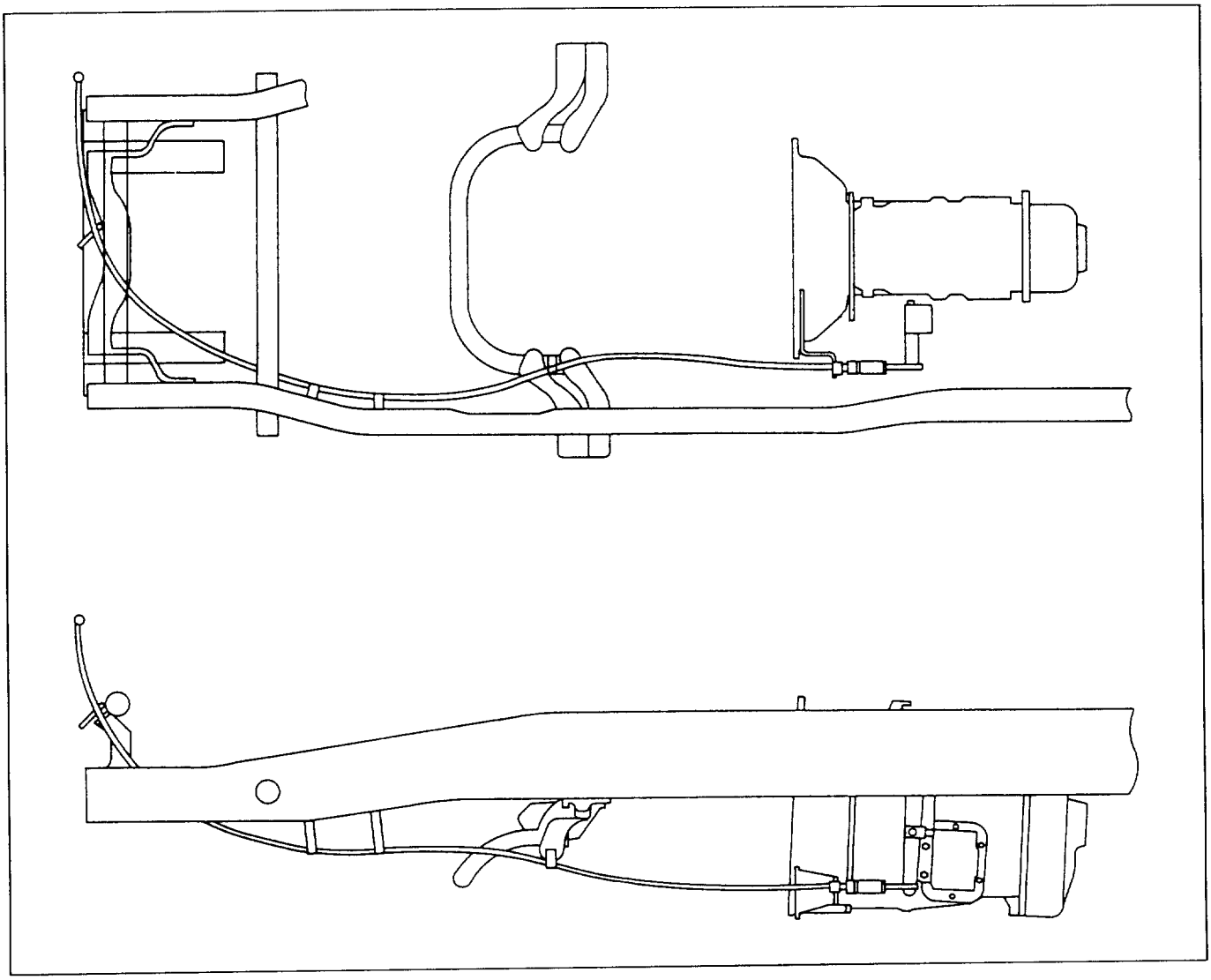
4. **Control Cable**

Inner Cable Adjustment Type

1) Fix the outer cable.
2) Set the PTO shift lever in the OFF position. Be sure to confirm the PTO control lever is in the OFF position (PTO indicator light turned off).
3) Remove slack from the inner cable by pulling the inner cable in the direction of the arrow.
4) Tighten the lock nuts.

Outer Cable Adjustment Type

1) Set the PTO shift lever in the OFF position. Be sure to confirm the PTO control lever is in the OFF position (PTO indicator light turned off).
2) Connect the inner cable to the PTO shift lever.
3) Remove slack from the inner cable by pulling the outer cable in the direction of the arrow.
4) Tighten the lock nuts.



5. **Transmission Oil**

1) Install the drain plug.

Drain Plug Torque	N·m (kg·m/lb·ft)
	49 (5.0/36)

2) Remove the filler plug and fill the transmission case with the specified engine oil through the filler plug hole.

Oil Capacity	Litres (US qt/Imp.qt)
5-Speed Type	3.2 (3.38/2.82)
6-Speed Type	4.0 (4.23/3.52)

CAUTION:

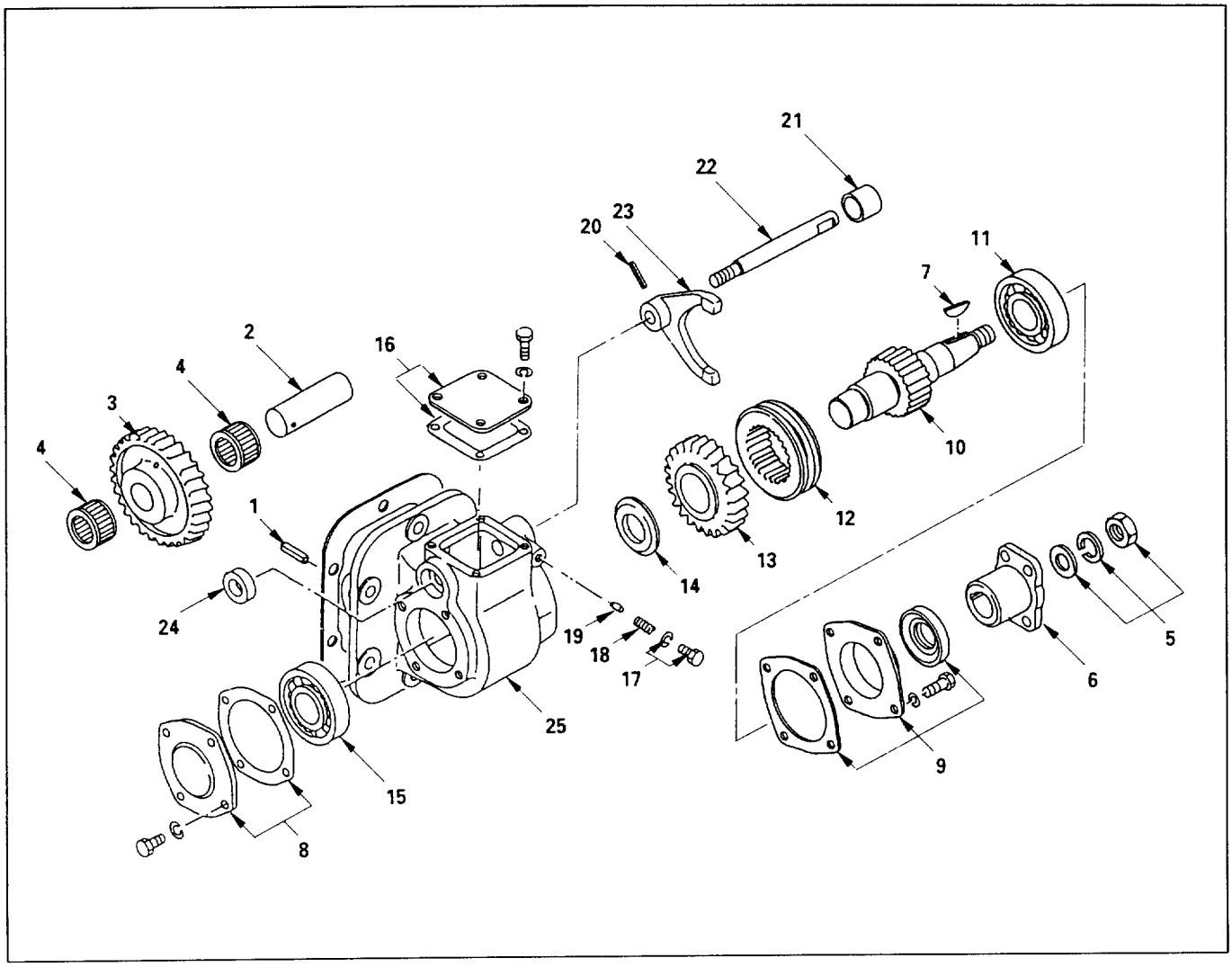
Use ENGINE OIL SAE 5W-30 for transmission case.

3) Install the filler plug.

Filler Plug Torque	N·m (kg·m/lb·ft)
	49 (5.0/36)

UNIT REPAIR

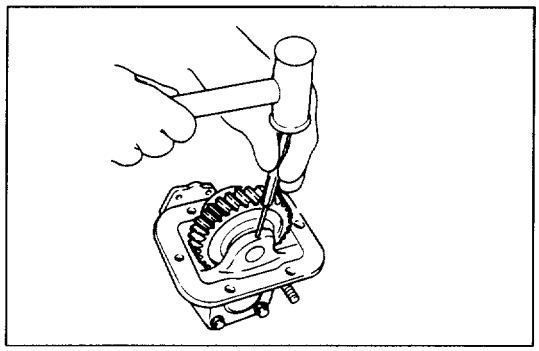
DISASSEMBLY



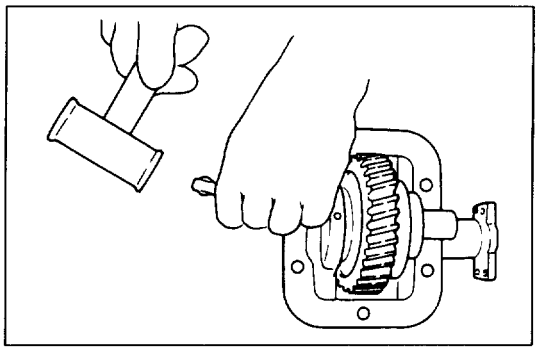
Disassembly Steps

1. Spring pin
2. Idle gear shaft
3. Idle gear
4. Needle bearing
5. Lock nut and washer
6. Coupling driver
7. Key
8. Front cover
9. Rear cover with oil seal
10. Output shaft
11. Rear bearing
12. Sleeve
13. Output gear with bushing
14. Thrust collar
15. Front bearing
16. Upper cover
17. Plug and spring washer
18. Detent spring
19. Detent pin
20. Spring pin
21. Shift rod cap
22. Shift rod
23. Shift arm
24. Shift rod oil seal
25. Gear case

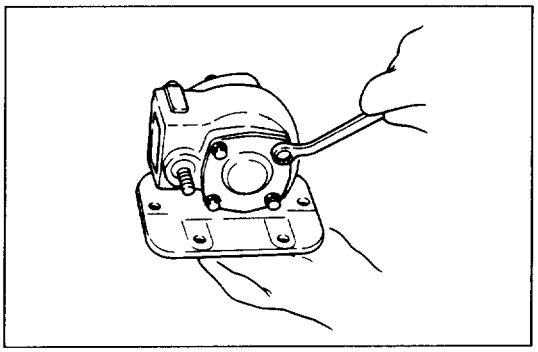
Disassembly Steps



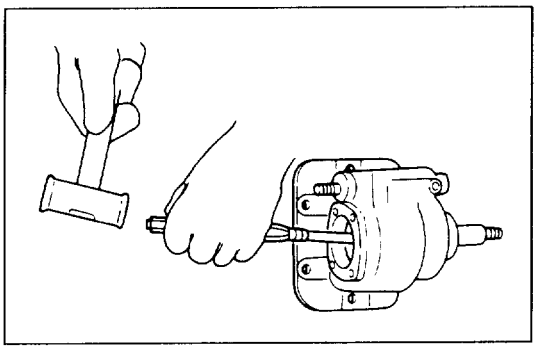
1. **Spring Pin**
   - Tap the spring pin into the idle shaft.
     Spring Pin Remover: 9-8529-2201-0



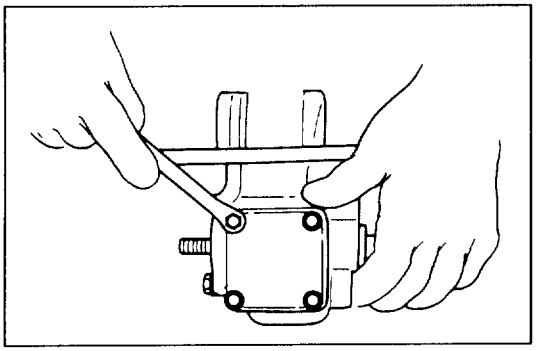
2. **Idle Gear Shaft**
   - Drive out the idle gear shaft by tapping on its front end with a suitable bar and hammer.
   - Remove the spring pin from the idle gear shaft.
     Spring Pin Remover: 9-8529-2201-0
3. **Idle Gear**
4. **Needle Bearing**
5. **Lock Nut and Washer**
   - Attach a backing plate to the vice, secure the coupling driver, and remove the lock nut, spring washer and plane washer.
6. **Coupling Driver**
7. **Key**
8. **Front Cover**

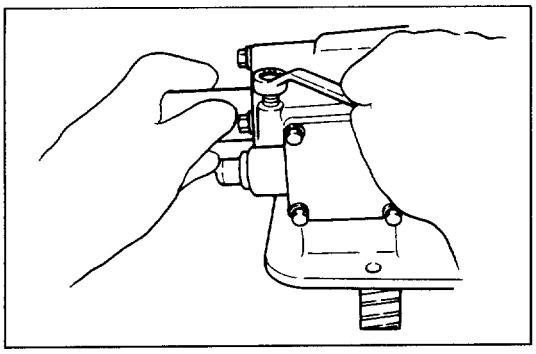


9. **Rear Cover (with Oil Seal)**
   - Remove the oil seal from the rear cover.
10. **Output Shaft**
11. **Rear Bearing**
    - Drive out the output shaft by tapping on its front end with a suitable bar and hammer.
    - Remove the rear bearing from the output shaft.

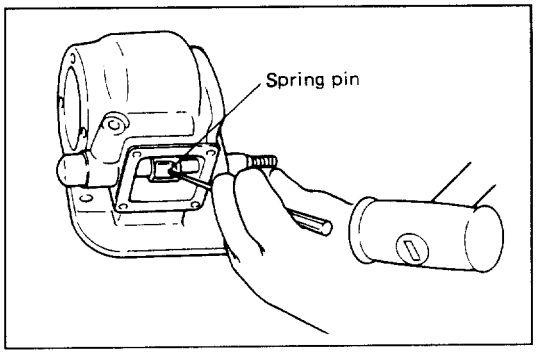


12. Sleeve
13. Output Gear with Bushing
14. Thrust Collar
15. Front Bearing
16. Upper Cover

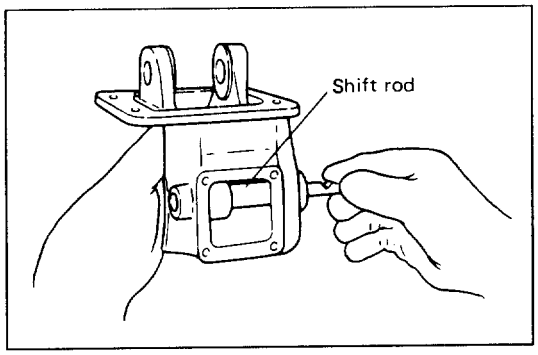




17. Plug and Spring Washer
18. Detent Spring
19. Detent Pin



20. Spring Pin
    Spring Pin Remover: 9-8529-2201-0



21. Shift Rod Cap
22. Shift Rod
23. Shift Arm
    - Move the shift rod rearward by tapping on its front end. then, remove the each parts.

24. Shift Rod Oil Seal
25. Gear Case

INSPECTION AND REPAIR

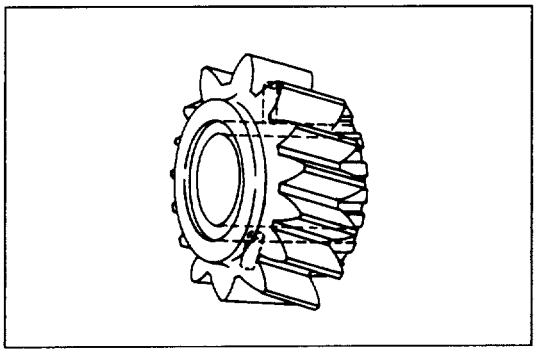
Make the necessary adjustments, repairs and part replacement if excessive wear or damage is discovered during inspection.

Bearings

Check the each bearing, and replace in either of the following cases.

- Rotation is not smooth.
- Abnormal sound is generated.
- There is extreme damage or rust.
- Rolling element or rolling contact surface of needle roller bearing is discolored, extremely worn or pitted.

Ball Bearing Run-out	mm(in)
Limit	
0.2 (0.01)	

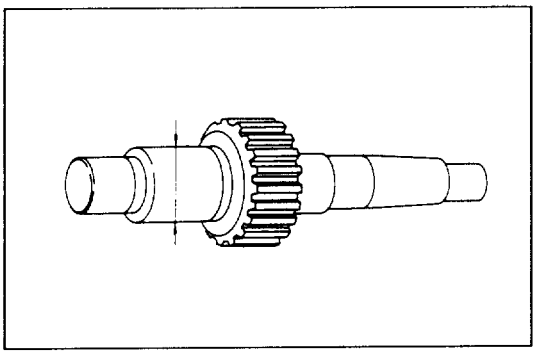


Gears

Check each gear for the following points. Correct a slight stepped wear or surface roughness with an oil stone or pencil grinder, or replace the gear if unrecoverable damage is found.

- Break or damage of tooth.
- Extreme wear of tooth.

Output Shaft and Output Gear Bushing Clearance	mm(in)
Limit	
0.2 (0.01)	



Idle Gear Shaft and Output Shaft

Check the shaft external surface for any damage or wear, and its spline section for wear, damage or bent.

When there is any abnormal condition found, or when it is used excessively beyond a proper use limit, replace it with new one.

Shift Mechanism

Inspect all disassembled parts for wear, damage or other abnormal conditions.

- Check the shift rod for wear, bent and damage.
- Check the shift arm for wear or deformation.

Shift Arm Thickness mm(in)

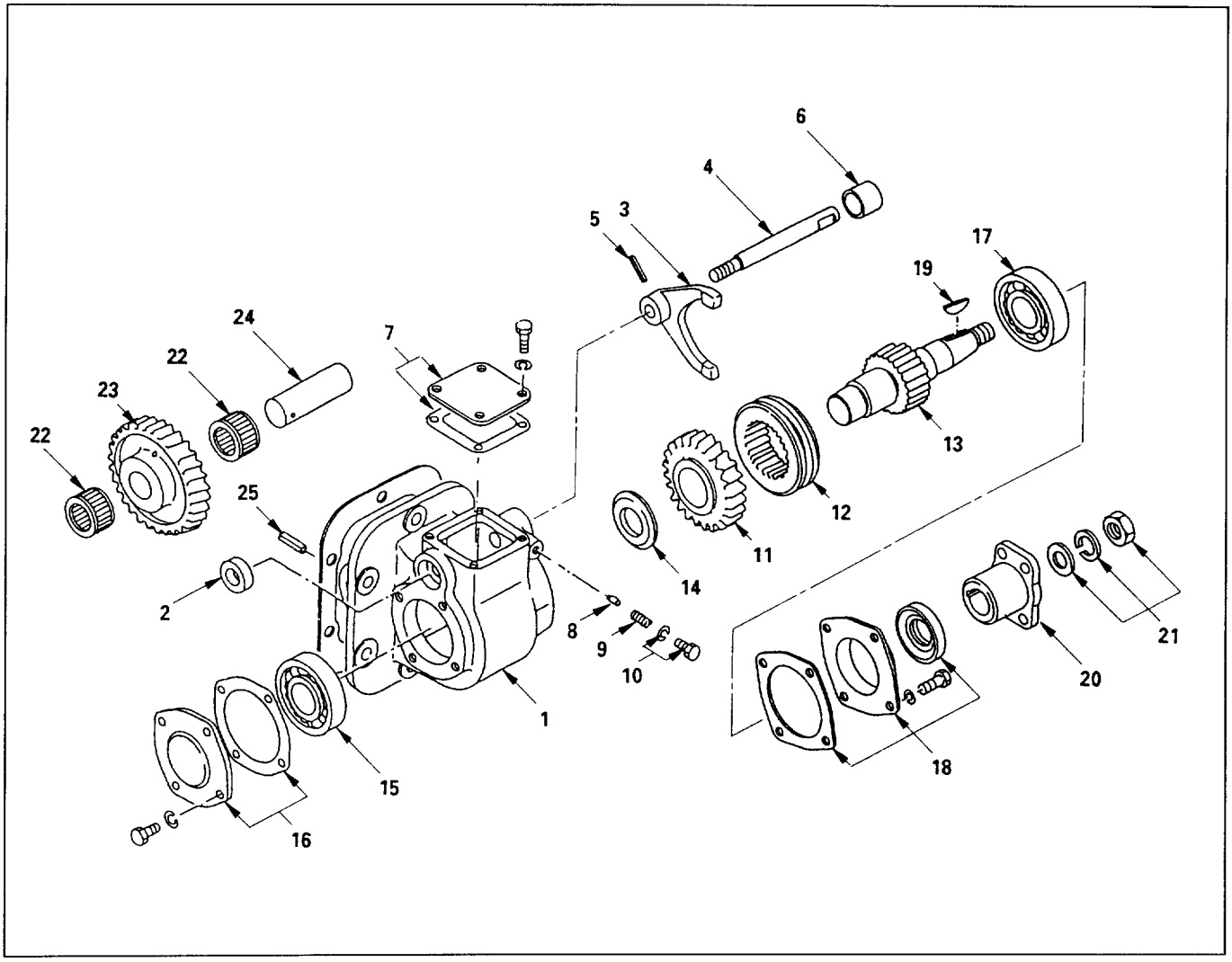
Nominal	Limit
9.0 (0.35)	8.0 (0.31)

- Check the detent spring and detent pin for wear, weakening and deformation.
- The wear of the shift rod, and the awkward operation of the gear case.

Sleeve

Check the sleeve for any abnormal conditions. Correct a slight stepped wear or surface roughness with an oil stone or pencil grinder, or replace the sleeve if unrecoverable damage is found.

REASSEMBLY



Reassembly Step

1. Gear Case
2. Shift Rod Oil Seal
3. Shift Arm
4. Shift Rod
5. Spring Pin
6. Shift Rod Cap
7. Upper Cover
8. Detent Pin
9. Detent Spring
10. Plug and Spring Washer
11. Output Gear with Bushing
12. Sleeve
13. Output Shaft
14. Thrust Collar
15. Front Bearing
16. Front Cover
17. Rear Bearing
18. Rear Cover
19. Key
20. Coupling Driver
21. Lock Nut and Washer
22. Needle Bearing
23. Idle Gear
24. Idle Gear Shaft
25. Spring Pin

Reassembly Steps

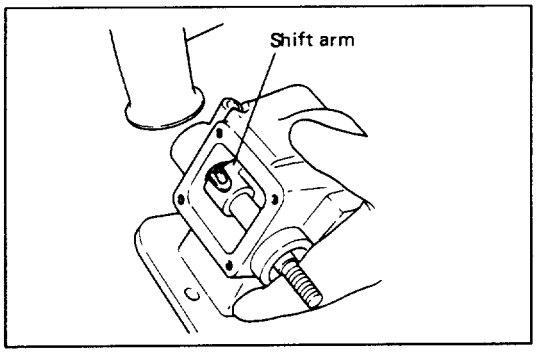
NOTE:

Clean each part thoroughly.

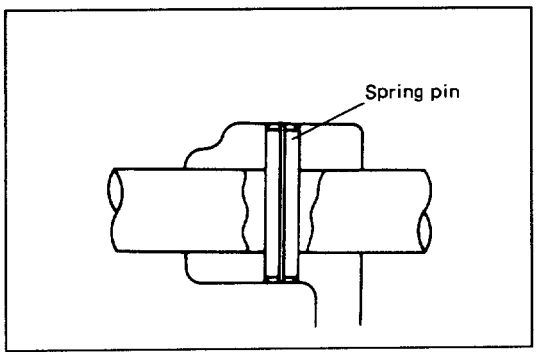
When assembling parts. apply clean engine oil (SAE 5W-30) to their sliding and mating sections.

1. **Gear Case**
2. **Shift Rod Oil Seal**
   - Clean and dry on the mating faces before applying the liquid gasket.
   - Apply liquid gasket (Three Bond 1141E or equivalent) to the new oil seal outer circumference and apply multi-purpose grease to the oil seal lip.
   - Use the oil seal installer to install the oil seal to the gear case.

     Oil Seal Installer:5-8840-2065-0



3. **Shift Arm**
   - With the boss side of the shift arm set to the rear.
4. **Shift Rod**
   - Turning the detent groove to the outside (detent pin side), insert the shift rod from the front side with the detent groove side at the front.



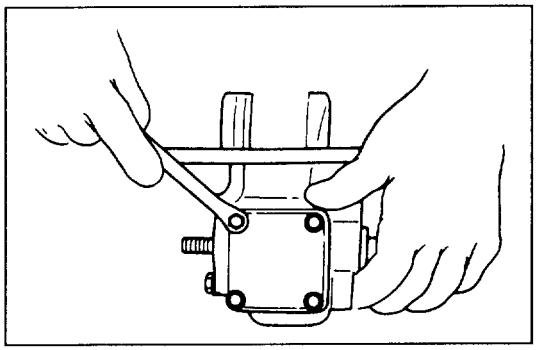
5. **Spring Pin**
   - Setting the hole of the shift arm to that of the shift rod, fix them with a new spring pin.

6. **Shift Rod Cap**
   - Clean and dry on the mating faces before applying the liquid gasket.
   - Apply liquid gasket (Three Bond 1141E or equivalent) to the cap outer circumference.
   - Use the plug installer to install the shift rod cap.

     Plug Installer: 5-8840-2067-0

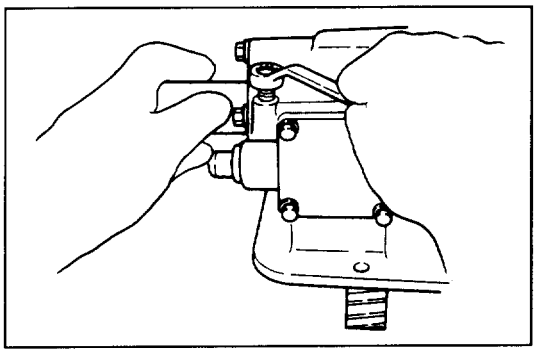
NOTE:

When there is any warp or flaw found with the shift rod cap, replace it with new one.



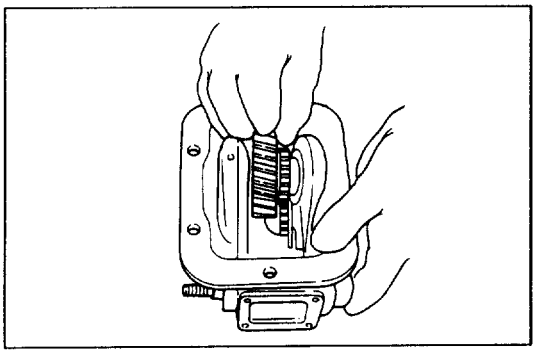
7. **Upper Cover**
   - Clean and dry on the mating faces before applying the liquid gasket.
   - Apply liquid gasket (Three Bond 1141E or equivalent) to the gear case and upper cover surfaces.
   - Install the upper cover with new gasket.

Upper Cover Bolt Torque	N·m (kg·m/lb·ft)
	18 (1.8/13)



8. **Detent Pin**
9. **Detent Spring**
10. **Plug and Spring Washer**
    - Remove sealant from the plug and female threaded surfaces and the surfaces must be perfectly dry.
    - Apply liquid gasket (LOCTITE 242 or equivalent) to the plug's threaded portion.

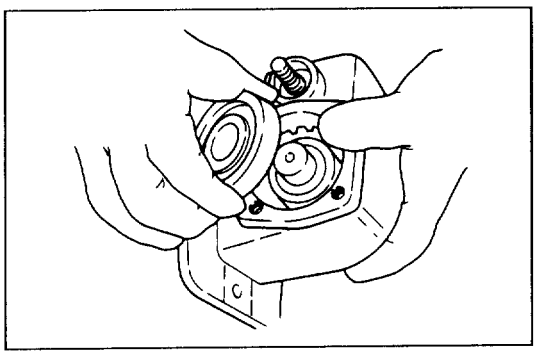
Detent Pin Plug Torque	N·m (kg·m/lb·ft)
	25 (2.5/18)



11. **Output Gear with Bushing**
    - Install with the dog gear side turned to the coupling driver side (to the rear).

12. **Sleeve**
    - Chamfer face of the sleeve outer circumference should be positioned toward the coupling driver and assemble the sleeve groove to the shift arm.
13. **Output Shaft**
14. **Thrust Collar**
15. **Front Bearing**
    - Install the thrust collar and front bearing using bearing installer.

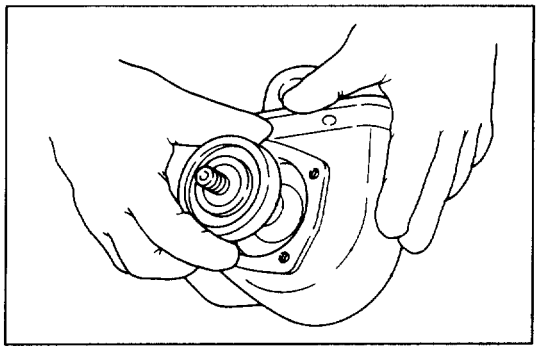
      Bearing Installer: 5-8840-2066-0



16. Front Cover

- Clean and dry on the mating faces before applying the liquid gasket.
- Apply liquid gasket (Three Bond 1141E or equivalent) to the gear case and front cover surfaces.
- Install the front cover with new gasket.
- Apply liquid gasket (LOCTITE 242 or equivalent) to the fixing bolts threaded portion.

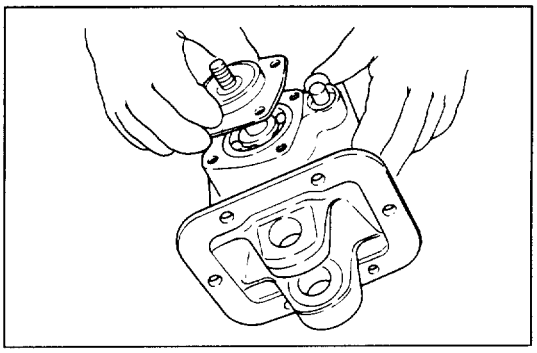
Upper Cover Bolt Torque	N·m (kg·m/lb·ft)
	18 (1.8/13)



17. Rear Bearing

- Use the bearing installer to install the rear bearing to the gear case.

  Bearing Installer:5-8840-2066-0

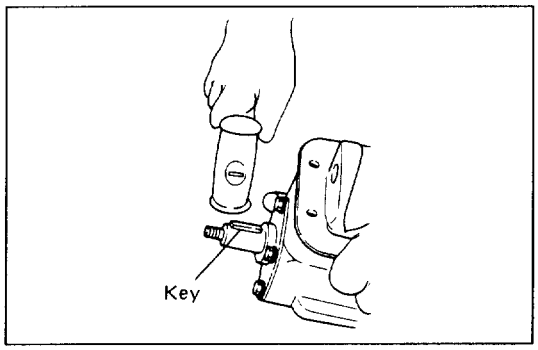


18. Rear Cover

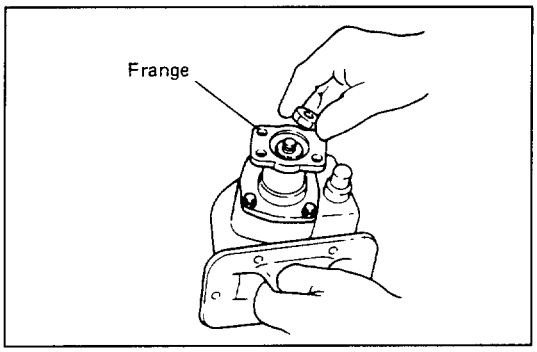
- Apply liquid gasket (Three Bond 1141E or equivalent) to the new oil seal outer circumference and apply multi-purpose grease to the oil seal lip.
- Use oil seal installer to install the oil seal to the rear cover.

  Oil Seal Installer: 5-8840-2064-0
- Apply approx. 3 grams (0.1 ounce) of the Multi-purpose with MoS^2 type grease to the inside of rear cover.
- Clean on the mating faces before applying the liquid gasket.
- Apply liquid gasket (Three Bond 1141E or equivalent) to the rear cover and gear case surfaces.
- Install the rear cover with new gasket.

Rear Cover Bolt Torque	N·m (kg·m/lb·ft)
	18 (1.8/13)

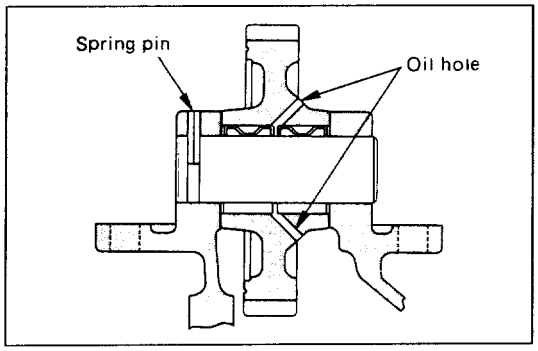


19. **Key**

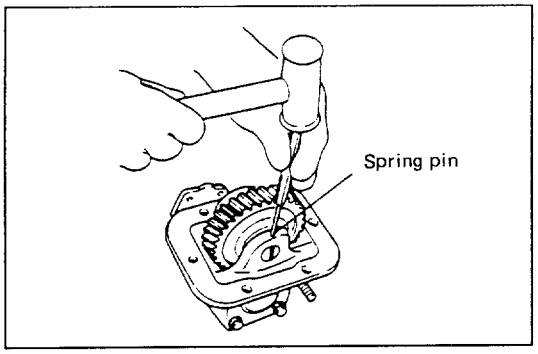


20. **Coupling Driver**
21. **Lock Nut and Washer**
    - Attach a backing plate to the vice, secure the coupling driver, and tighten the lock nut.

Lock Nut Torque	N·m (kg·m/lb·ft)
	105 (10.7/77)



22. **Needle Bearing**
23. **Idle Gear**
    - Install with the oil holes side turned to the rear.
24. **Idle Gear Shaft**



25. **Spring Pin**

SECTION 7C

CLUTCH

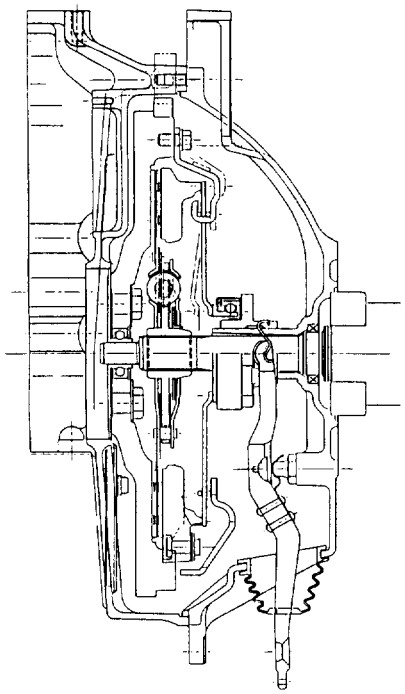
CONTENTS

PAGE

General Description 7C– 2
Clutch Assembly 7C– 2
Pressure Plate Assembly and Driver Plate 7C– 2
Clutch Booster 7C– 3
Master Cylinder 7C– 3
Slave Cylinder 7C– 4
On-Vehicle Service 7C– 5
Clutch Assembly 7C– 5
Removal 7C– 5
Inspection and Repair 7C– 6
Installation 7C–10
Clutch Control 7C–12
Removal 7C–12
Inspection and Repair 7C–13
Installation 7C–14
Unit Repair 7C–17
Master Cylinder 7C–17
Disassembly 7C–17
Inspection and Repair 7C–18
Reassembly 7C–19
Clutch Booster 7C–21
Disassembly 7C–21
Inspection and Repair 7C–22
Reassembly 7C–23
Slave Cylinder 7C–26
Disassembly 7C–26
Inspection and Repair 7C–27
Reassembly 7C–28

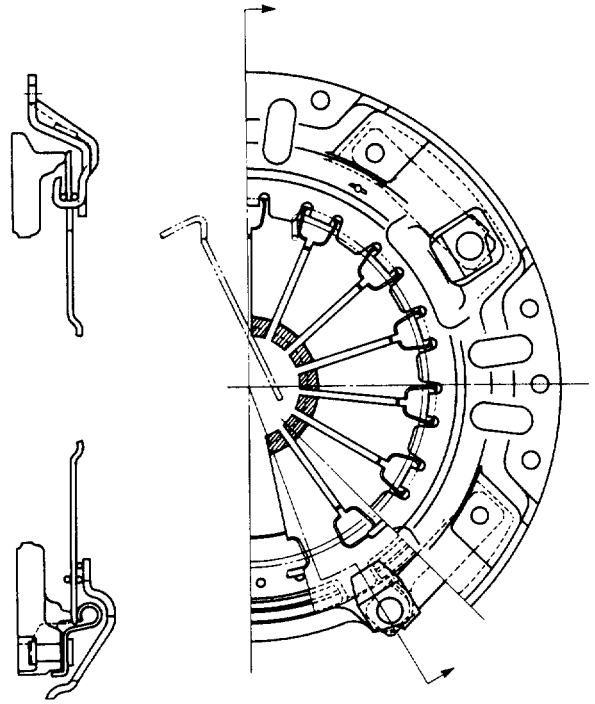
GENERAL DESCRIPTION

CLUTCH ASSEMBLY

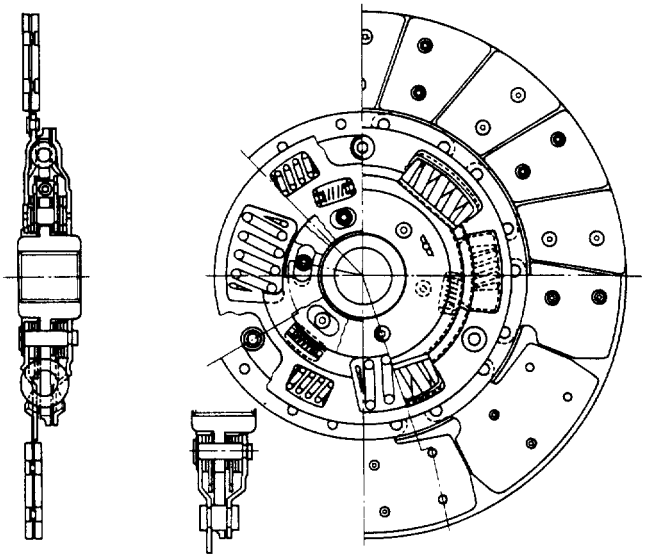


PRESSURE PLATE ASSEMBLY AND DRIVEN PLATE

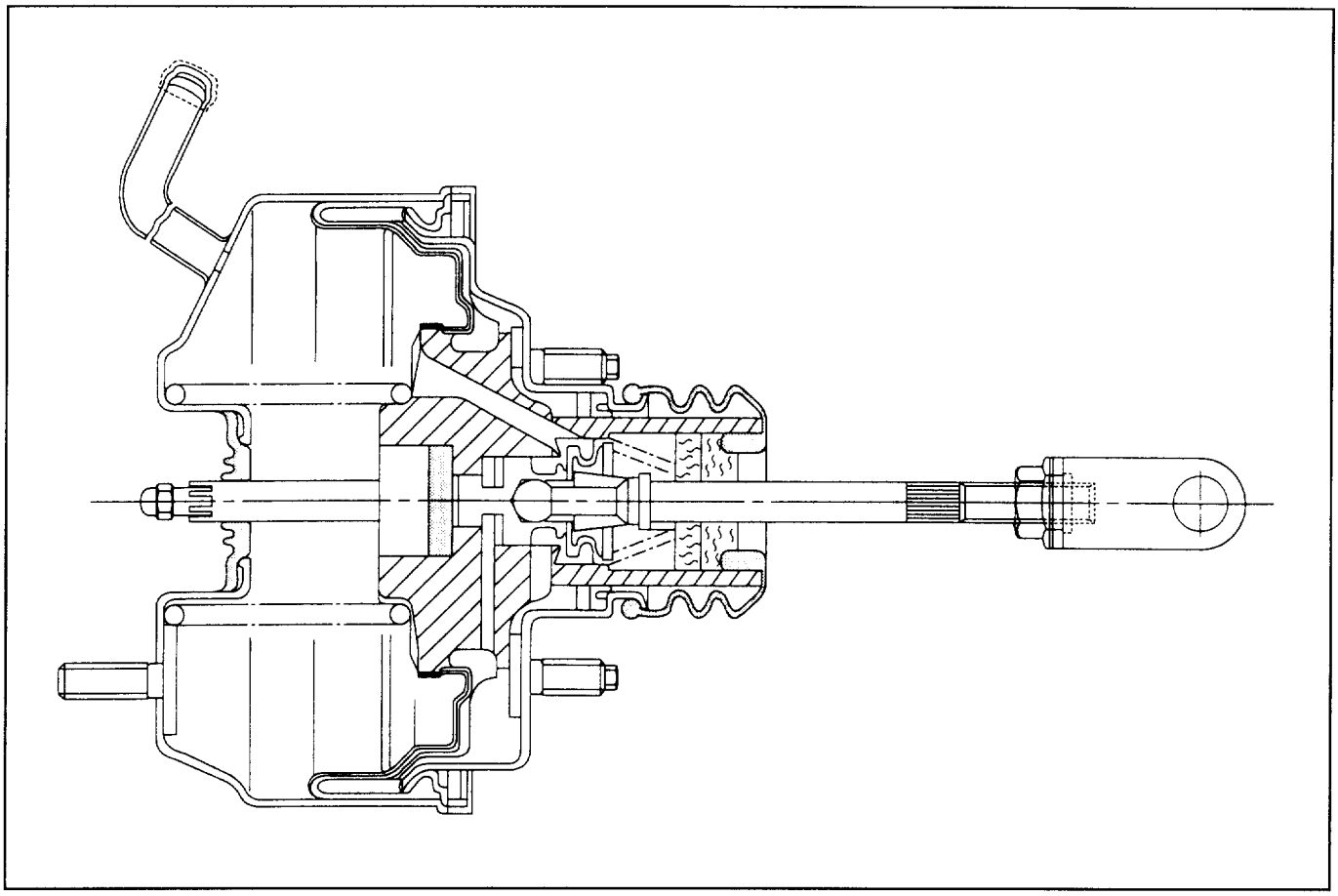
Pressure plate assembly



Driven plate assembly

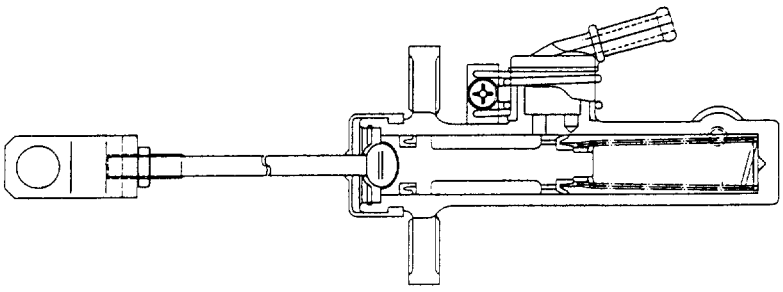


CLUTCH BOOSTER

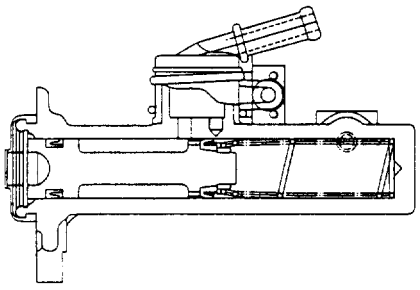


MASTER CYLINDER

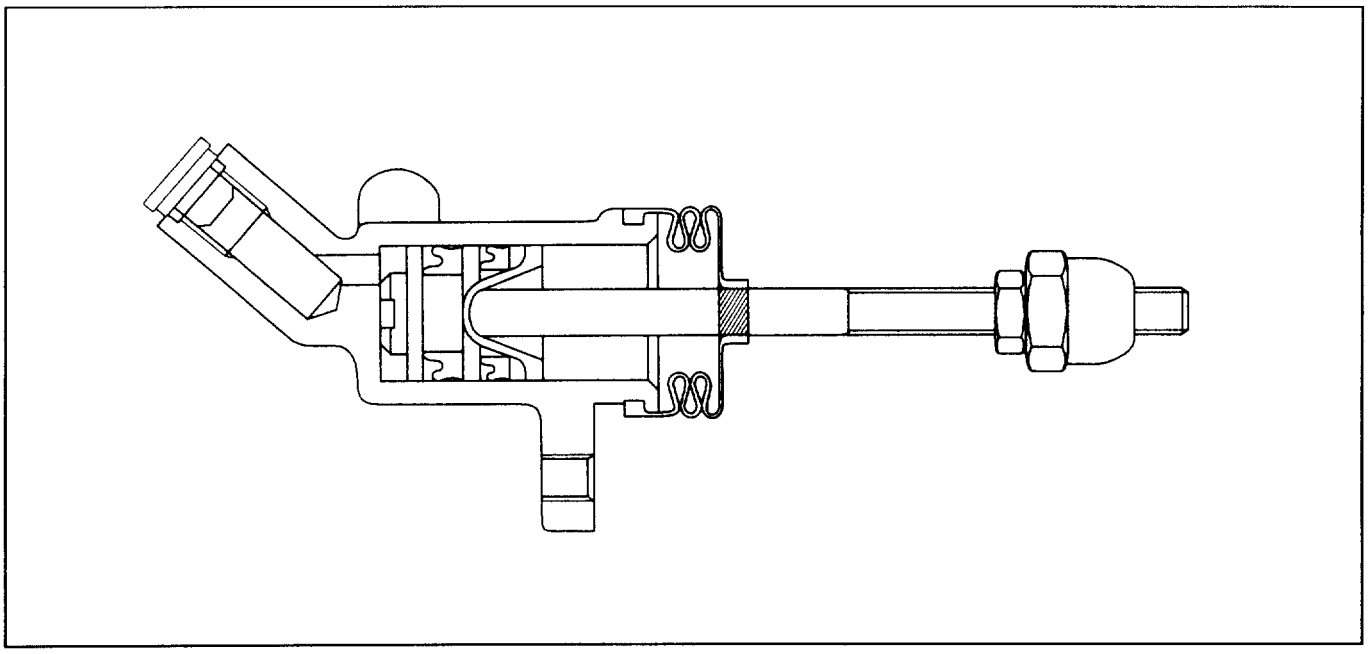
Booster less



With Booster



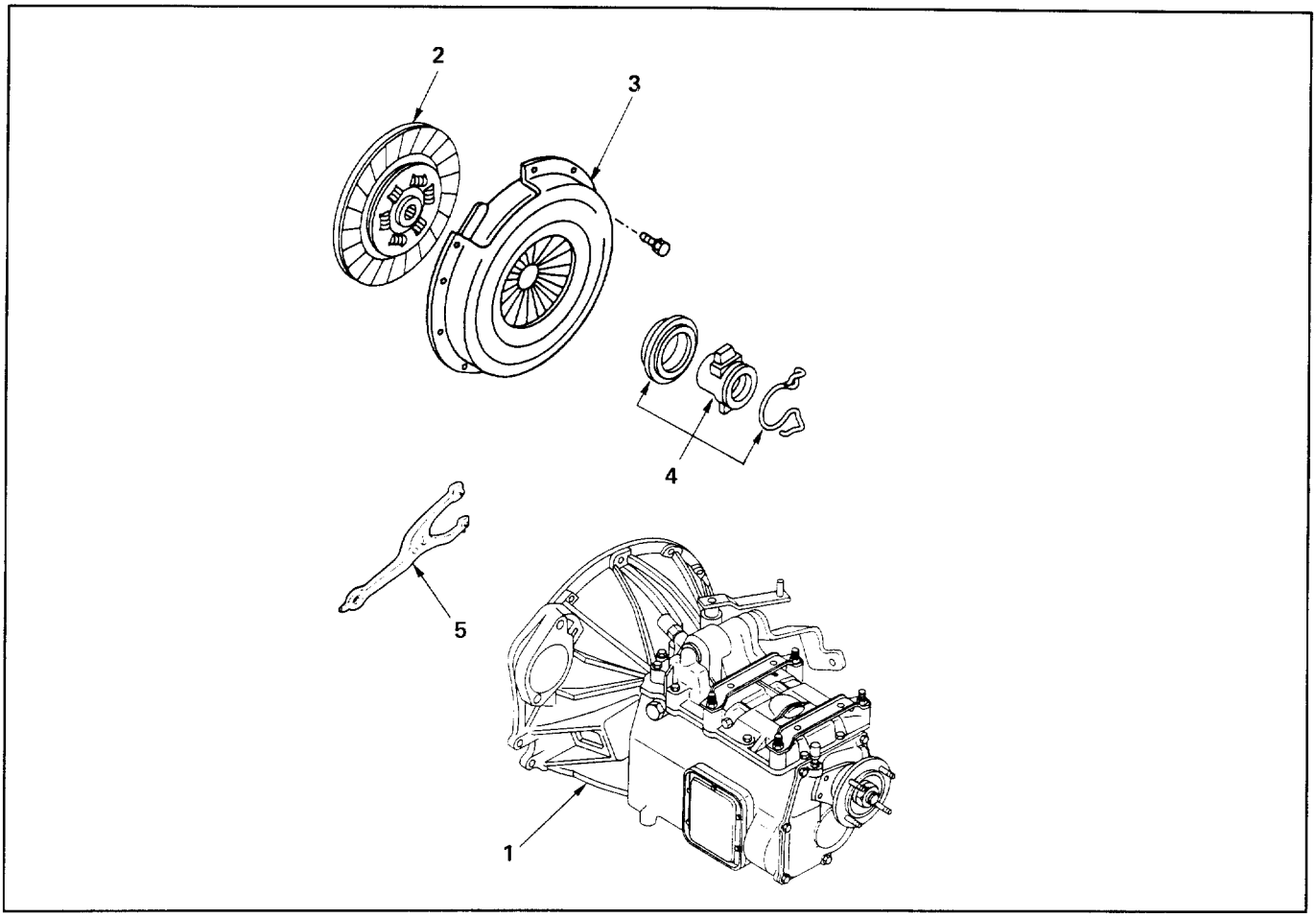
SLAVE CYLINDER



ON-VEHICLE SERVICE

CLUTCH ASSEMBLY

REMOVAL



Removal Steps

1. Transmission assembly
2. Pressure plate assembly
3. Driven plate assembly
4. Shift block assembly
5. Shift fork

Removal Steps

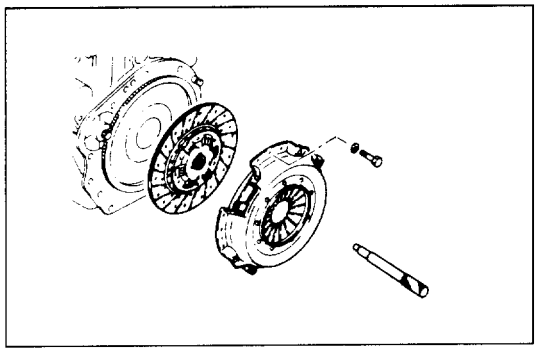
- Raise vehicle and support with suitable safety stands.

CAUTION

Do not let clutch fluid remain on a painted surface. Wash it off immediately.

1. **Transmission Assembly**

   Refer to "SECTION 7B ON-VEHICLE SERVICE: TRANSMISSION ASSEMBLY REPLACEMENT" in this manual.

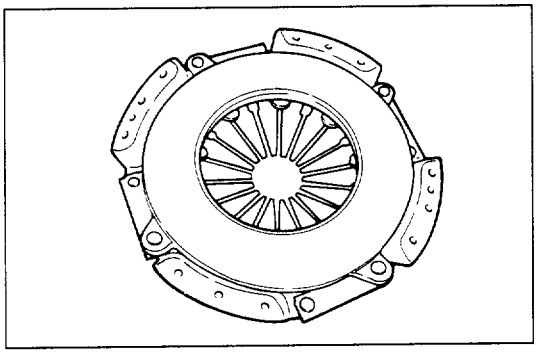


2. **Pressure Plate Assembly**
3. **Driven Plate Assembly**
   - Use the pilot aligner to prevent the driven plate assembly from falling free.

     Pilot Aligner: 5-8840-2240-0
   - Mark the flywheel and pressure plate lug for alignment when installing.
4. **Shift Fork**
5. **Shift Block Assembly**
   - Take out the shift block and support spring together.

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacement if excessive wear or damage is discovered during inspection.



Pressure Plate Assembly

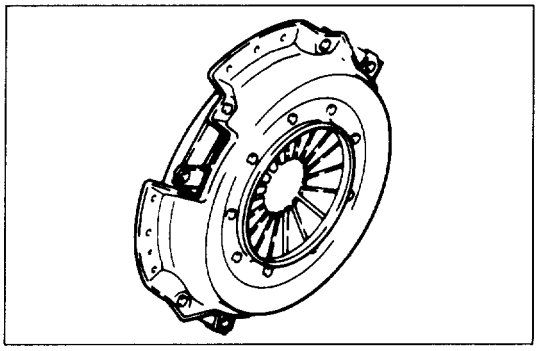
- Visually inspect the pressure plate friction surface for excessive wear and heat cracks. If excessive wear or deep heat cracks are present, the pressure plate must be replaced.

Pressure Plate Warpage

- Use a straight edge and a feeler gauge to measure the pressure plate friction surface flatness in four directions.

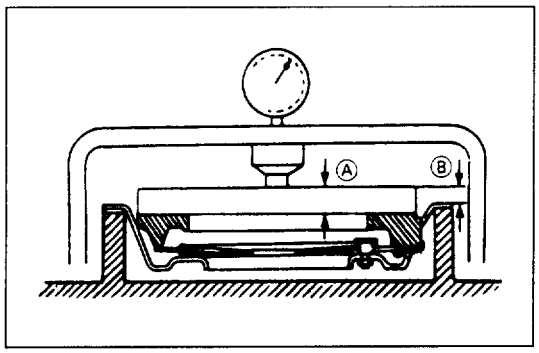
  If any of the measured values exceed the specified limit, the pressure plate assembly must be replaced.

Pressure Plate Warpage	mm (in)
Limit	
0.3 (0.012)	



Clutch Cover

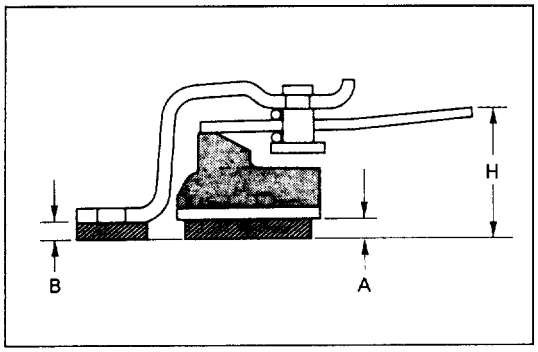
- Visually inspect the entire clutch cover for excessive wear, cracking, and other damage.
- The Pressure plate assembly must be replaced if any of these conditions are present.



Clutch Set Force

1) Invert the pressure plate.
2) Place a metal sheet with "A" thickness of 8.6 mm (0.339 in) on the pressure plate.
3) Compress the pressure plate assembly until the distance "B" becomes 19 mm (0.748 in).
4) Note the pressure plate gauge reading.

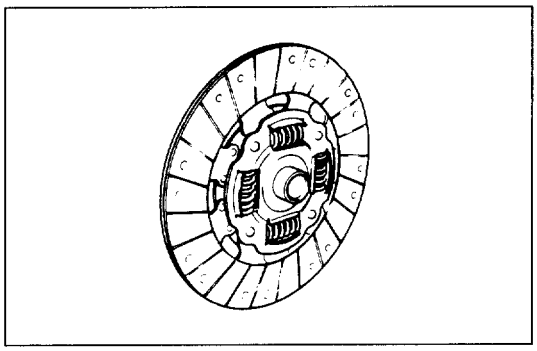
Clutch Set Force	N (kg/lb)
Standard	
8,336 (850/1,874)	



Diaphragm Spring Finger Height

1) Place a metal sheet with "A" thickness of 8.6 mm (0.339 in) under the pressure plate.
2) Compress the pressure plate assembly until the distance "B" becomes 19 mm (0.748 in). There are two ways to do this.
   a. Use a bench press to press down on the pressure plate assembly from the top.
   b. Tighten the pressure plate assembly fixing bolts.
3) Measure the spring finger height "H" from base to spring tip.

Spring Finger Height	mm (in)
Standard	
49.0 – 51.0 (1.929 – 2.008)	



Driven Plate Assembly

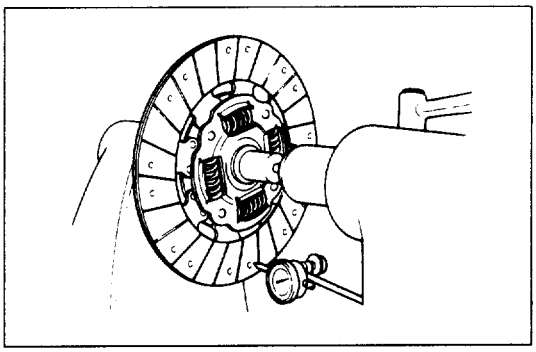
- visually inspect the torsion spring for looseness, breakage, and weakening.

  If any of these conditions are discovered, the driven plate assembly must be replaced.
- Visually inspect the facing surfaces for cracking and excessive scorching.

  Visually inspect the facing surfaces for the presence of oil or grease.

  If any of these conditions are discovered, the facing must be cleaned or the driven plate assembly replaced.
- Check that the driven plate moves smoothly on the transmission top gear shaft spline.

  Minor ridges on the top gear shaft spline may be removed with an oil stone.



Driven Plate Warpage

- Insert the pilot aligner into the driven plate spline hub.

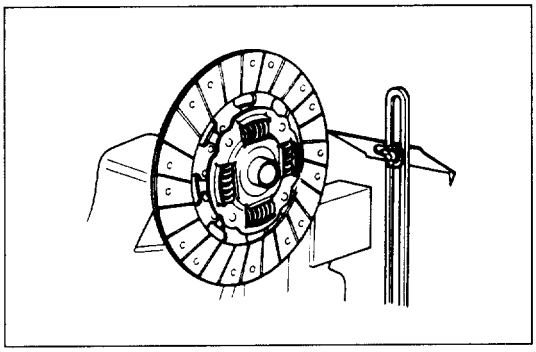
  The pilot aligner must be held perfectly horizontal.
  Pilot Aligner: 5-8840-2240-0
- Set a dial indicator to the driven plate outside circumference.
- Slowly turn the driven plate.

  Read the dial indicator as you turn the driven plate.

  If the measured value exceeds the specified limit, the driven plate assembly.

Driven Plate Warpage mm (in)

Standard	Limit
0.7 (0.028)	1.0 (0.039)



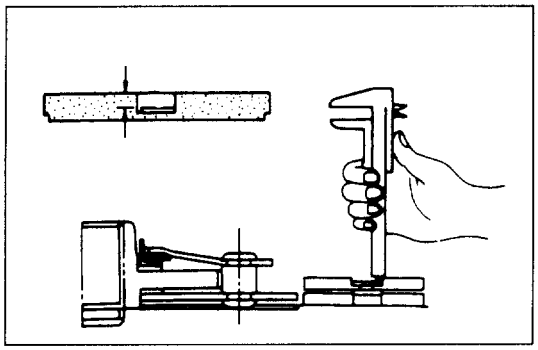
Driven Plate Splined Hub Spline Ware

- Clean the driven plate splined hub.
- Install the driven plate to the transmission top gear shaft spline.
- Set a surface gauge to the driven plate outside circumference.
- Slowly turn the driven plate. Measure the spline rotation play as you turn the driven plate.

  If the measured value exceeds the specified limit, the driven plate assembly must be replaced.

Driven Plate Splined Hub Spline Wear mm (in)

Standard	Limit
0.5 (0.020)	1.0 (0.039)



Driven Plate Rivet Head Depression

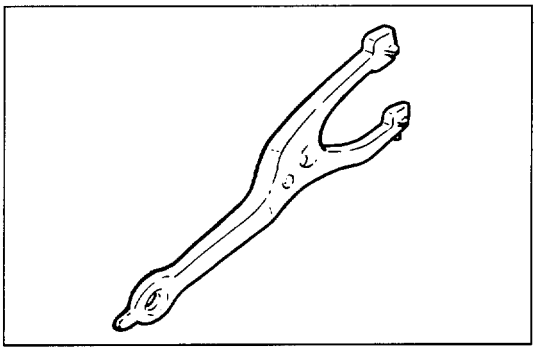
- Use the depth gauge or a straight edge with steel rule to measure the rivet head depression from the facing surface.

  Be sure to measure the rivet head depression on both sides of the driven plate.

  If the measured value is less than the specified limit, the driven plate must be replaced.

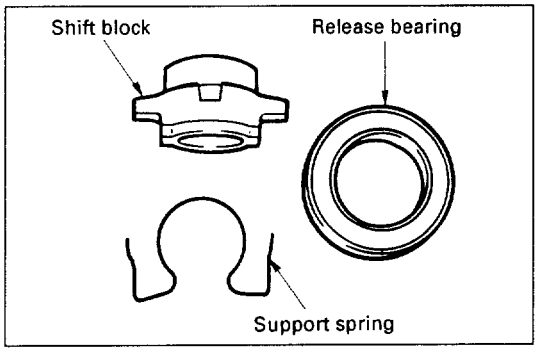
Rivet Head Depression — mm (in)

Standard	Limit
1.6 (0.063)	0.2 (0.008)



Shift Fork and Pivot

- Visually inspect the surfaces of the shift fork making contact with the shift block and pivot.
- Correct a slight stepped wear or surfaces roughness with an oil stone or pencil grinder, or replace the shift fork and/or pivot if unrecoverable damage is found.



Shift Block Assembly

- Before disassembly, check the shift block assembly for the following point. Correct a slight stepped wear or surface roughness with an oil stone or pencil grinder, or replace the part if unrecoverable damage is found.

a. Release bearing for roughness or noise by rotating the bearing race under light pressure.

b. Roughness or damage of shift block (contact surfaces with shift fork or front cover).

CAUTION

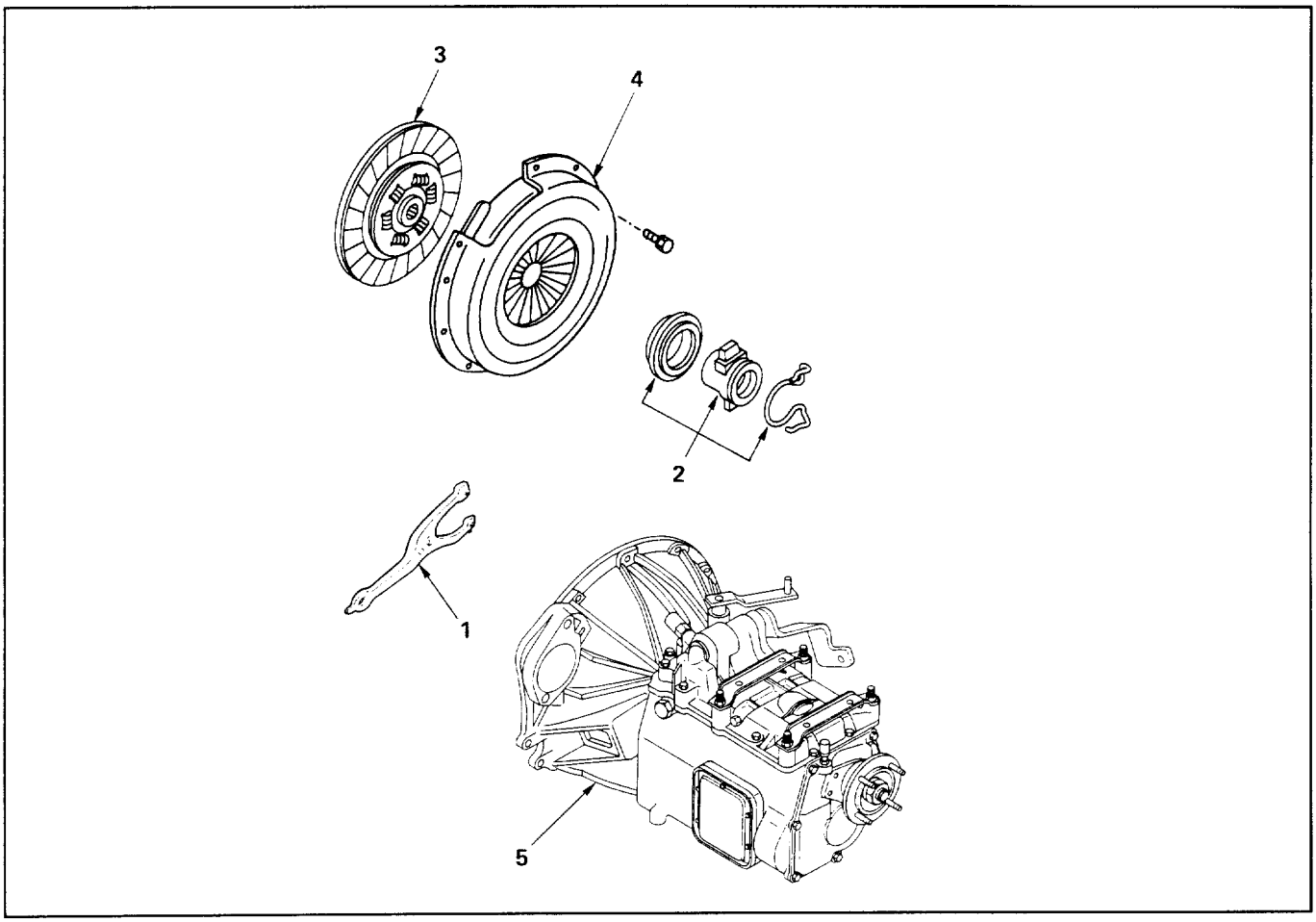
The release bearing is permanently packed with lubricant and should not be soaked in cleaning solvent, as this will dissolve the lubricant.

NOTE

Do not disassemble the shift block assembly if no fault is apparent.

- Visually inspect the support spring for breakage and weakening. If any of these condition are discovered, parts must be replaced.

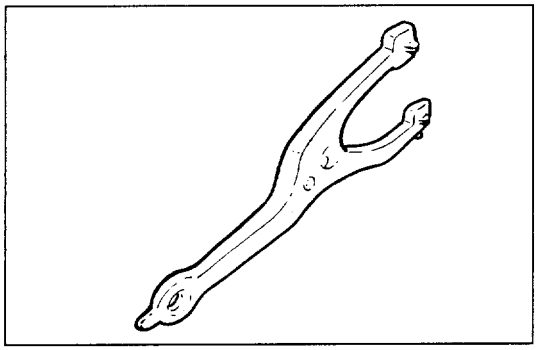
INSTALLATION



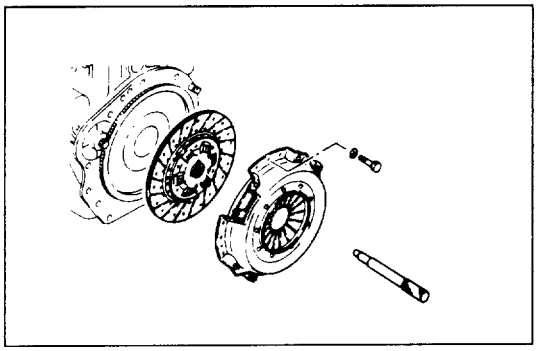
Installation Steps

1. Shift fork
2. Shift block assembly
3. Driven plate assembly
4. Pressure plate assembly
5. Transmission assembly

Installation Steps

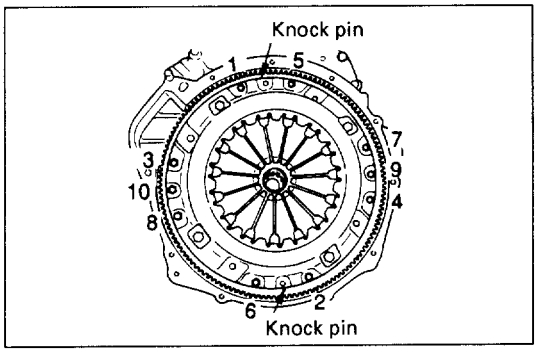


1. **Shift Fork**
   - Apply multi-purpose with MoS^2 type grease to the contact surfaces with the shift block and pivot.
2. **Shift Block Assembly**
   - Install the shift block and support spring together.



3. **Driven Plate Assembly**
4. **Pressure Plate Assembly**
   - Apply multi-purpose with MoS^2 type grease to the driven plate hub spline.
   - Use the pilot aligner to install the driven plate assembly.

     Pilot Aligner : 5-8840-2240-0



- Tighten pressure plate assembly fixing bolts in numerical order.

Pressure Plate Fixing Bolt Torque	N·m (kg·m/lb·ft)
40 (4.1/29.7)	

CAUTION:

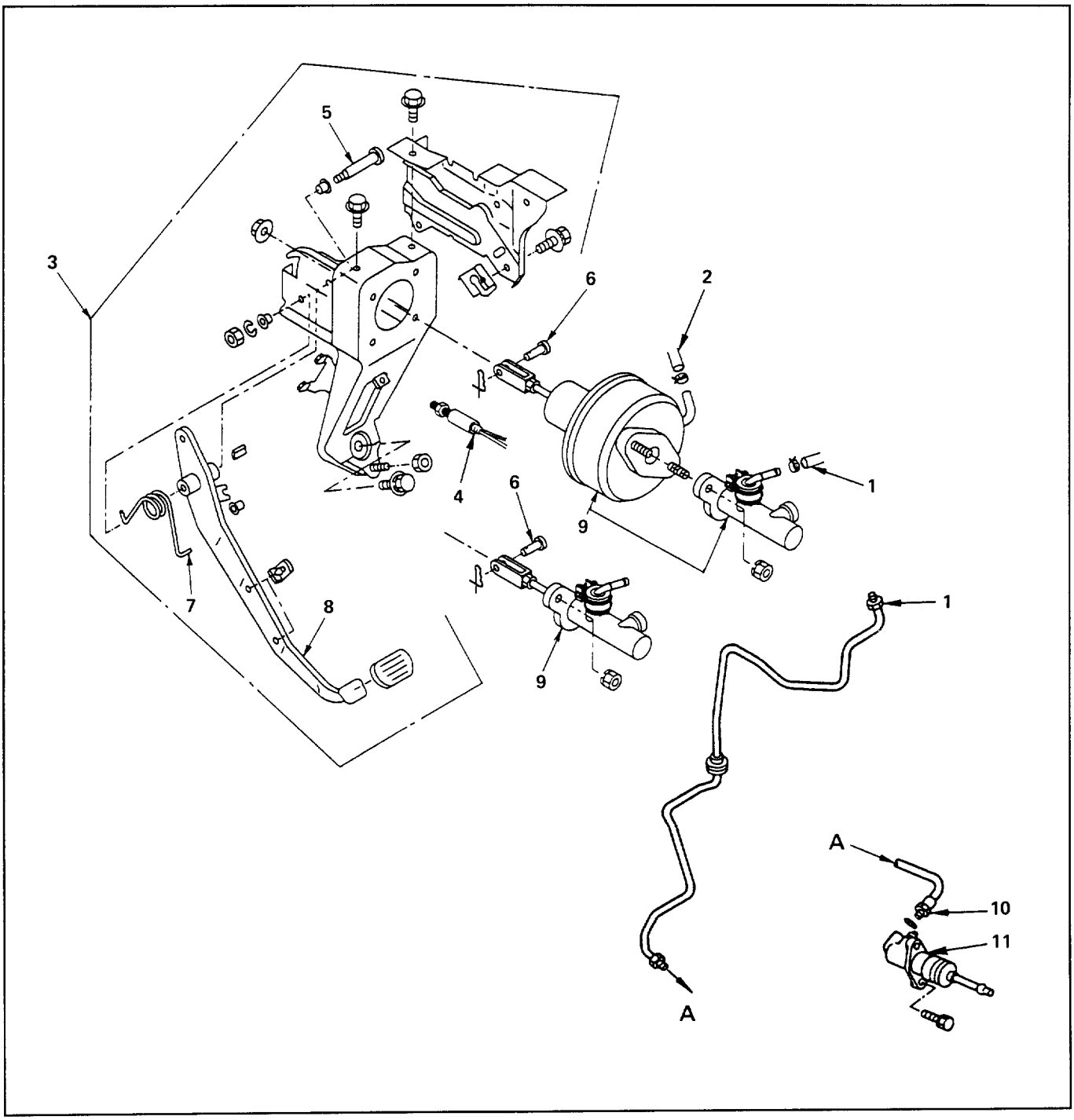
In case a new pressure plate assembly is mounted, after tightening a pressure plate at the specified torque, be sure to remove the wire for protection of a diaphragm spring.

6. **Transmission Assembly**

Refer to "SECTION 7B ON-VEHICLE SERVICE: TRANSMISSION ASSEMBLY REPLACEMENT" in this manual.

CLUTCH CONTROL

REMOVAL



Removal Steps

1. Clutch pipe and hose
2. Vacuum hose
3. Clutch pedal and bracket assembly
4. Clutch switch or stopper bolt
5. Shaft
6. Clevis pin
7. Return spring
8. Clutch pedal
9. Clutch booster with master cylinder or master cylinder
10. Flexible hose
11. Slave cylinder

Preparation

1. **Remove Meter Cluster**
   - Pull out the meter cluster and disconnect the harness connectors.
2. **Meter Assembly**
   - Remove the 5 fixing screws, then remove the meter assembly and disconnect the harness connector.

Removal Steps

- Drain the clutch fluid from the clutch hydraulic line.

CAUTION

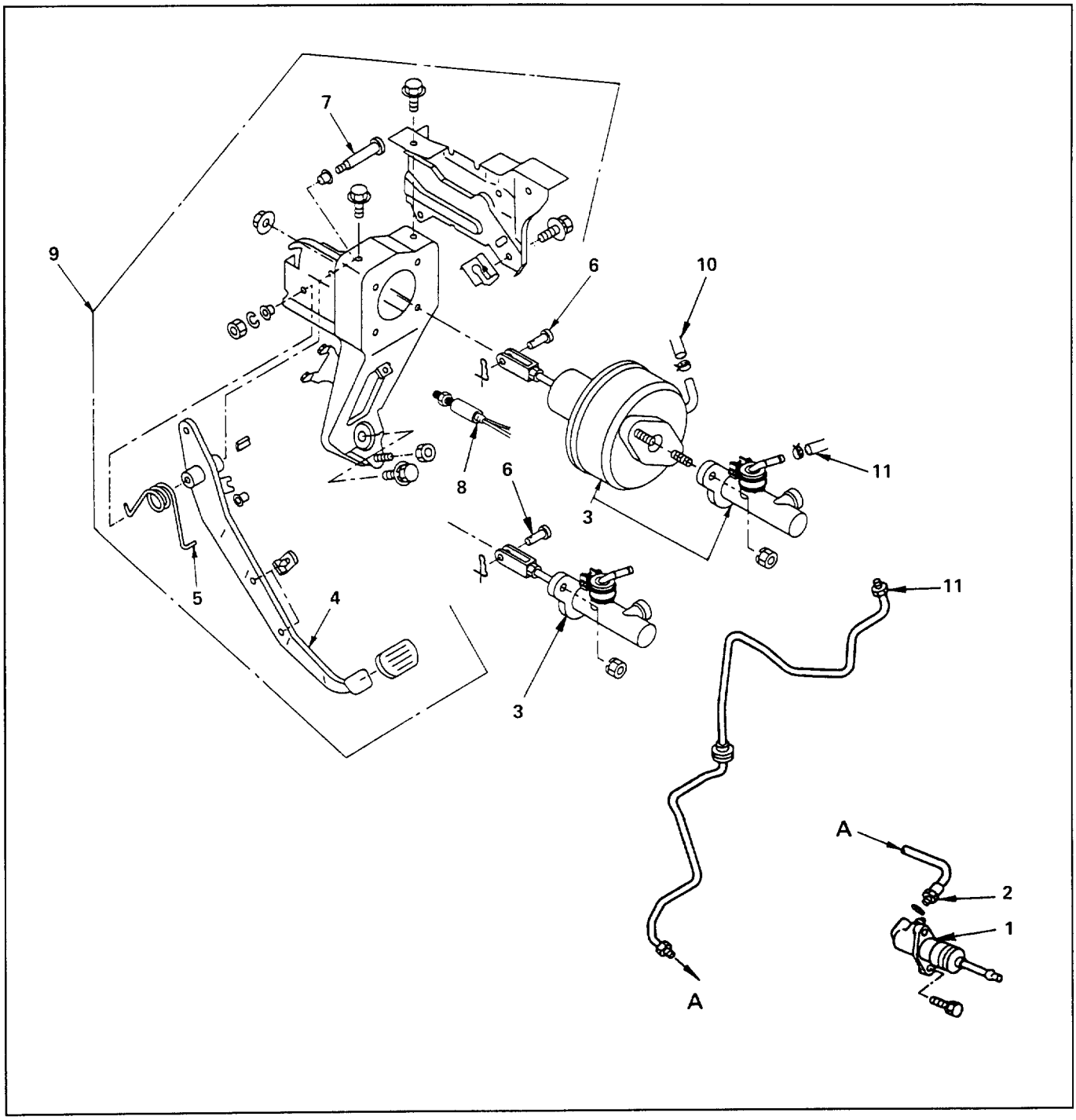
Do not let clutch fluid remain on a painted surface. Wash it off immediately.

1. **Clutch Pipe and Hose**
2. **Vacuum Hose**
3. **Clutch Pedal and Bracket Assembly**
4. **Clutch Switch or Stopper Bolt**
5. **Shaft**
6. **Clevis Pin**
7. **Return Spring**
8. **Clutch Pedal**
9. **Clutch Booster with Master Cylinder or Master Cylinder**
10. **Flexible Hose**
11. **Slave Cylinder**

INSPECTION AND REPAIR

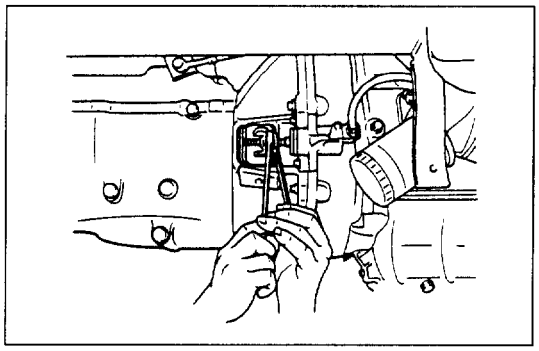
Make the necessary adjustment, repairs, and part replacement if excessive wear or damage is discovered during inspection.

INSTALLATION



Installation Steps

1. Slave cylinder
2. Flexible hose
3. Clutch booster with master cylinder or master cylinder
4. Clutch pedal
5. Return spring
6. Clevis pin
7. Shaft
8. Clutch switch or stopper bolt
9. Clutch pedal and bracket assembly
10. Vacuum hose
11. Clutch pipe and hose



Installation Steps

1. **Slave Cylinder**

Slave Cylinder Bolt Torque	N·m (Kg·m/lb·ft)
16 (1.6/12)	

- Perform slave cylinder adjustment before installation of the return spring.

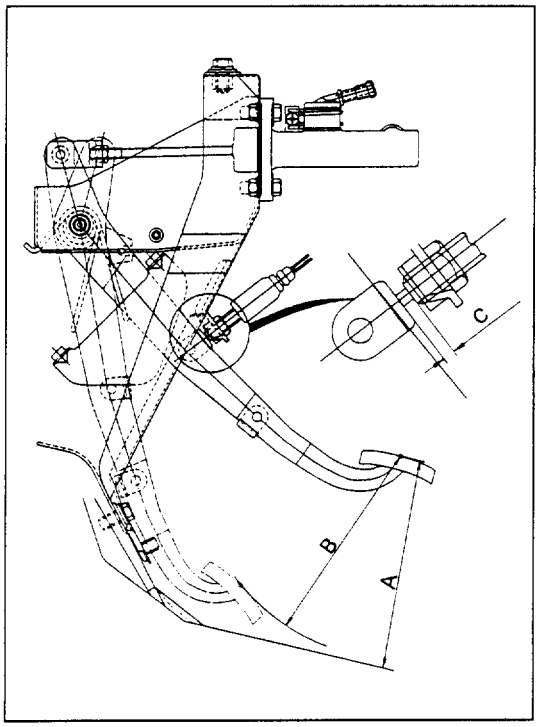
1) Loosen the lock nut of the push rod.
2) Turn the adjust but until it reaches the shift fork.
3) Back off the adjust nut 1.5 turns. (shift fork free play approximately 2 mm).
4) Tighten the lock nut.

Push Rod Lock Nut Torque	N·m (kg·m/lb·ft)
19 (1.9/14)	

2. **Flexible Hose**
3. **Clutch Booster with Master Cylinder or Master Cylinder**
   - Install the clutch booster with master cylinder assembly or the master cylinder assembly to the clutch pedal bracket.

Fixing Nuts Torque	N·m (kg·m/lb·in)
13 (1.3/113)	

4. **Clutch Pedal**
5. **Return Spring**
6. **Clevis Pin**
7. **Shaft**
8. **Clutch Switch or Stopper Bolt**
9. **Clutch Pedal and Bracket Assembly**



Clutch Bracket Bolts Torque	N·m (kg·m/lb·ft)
37 (3.8/27)	

- Perform the clutch pedal adjustment after installation of clutch control.

Clutch Pedal Height and Stroke

1) Loosen the lock nut of the clutch booster operating rod or the master cylinder push rod.
2) Adjust the pedal height by turning operating rod or push rod.

Clutch Pedal Height and Stroke	mm (in)
Height(A) : 160 – 170 (6.30 – 6.69) Stroke(B) : 159 – 169 (6.26 – 6.65)	

3) Tighten the lock nut.

Lock Nut Torque	N·m (kg·m/lb·ft)
With Booster : 20 (2.0/14) Booster Less : 13 (1.3/9.4)	

4) Install the meter assembly and meter cluster.

Clutch Pedal Free Play

Clutch Switch or Stopper Bolt

After completion of clutch pedal height and slave cylinder adjustment, adjust the clutch switch or stopper bolt clearance.

1) Loosen the lock nut of clutch switch or stopper bolt.

2) Adjust the clutch switch or stopper bolt clearance by turning clutch switch or stopper bolt.

Clutch Switch or Stopper Bolt Clearance(C)	mm (in)
0.5 – 1.0 (0.02 – 0.04)	

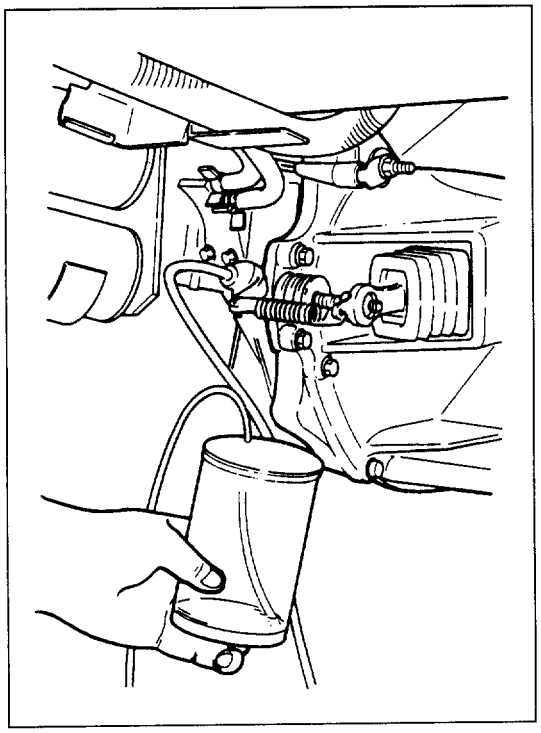
Clutch Pedal Free Play	mm (in)
15 – 25 (0.59 – 0.98)	

3) Tighten the lock nut.

Lock Nut Torque	N·m (kg·m/lb·ft)
19 (1.9/14)	

10. Vacuum hose

11. Clutch Pipe and Hose



- Perform the clutch hydraulic circuit bleeding after installation of the clutch control.

  Bleeding operation calls for cooperative action of two men.

1) Check the level of clutch fluid in the reservoir and replenish of necessary.
2) Remove the rubber cap from the bleeder screw and wipe clean the bleeder screw.

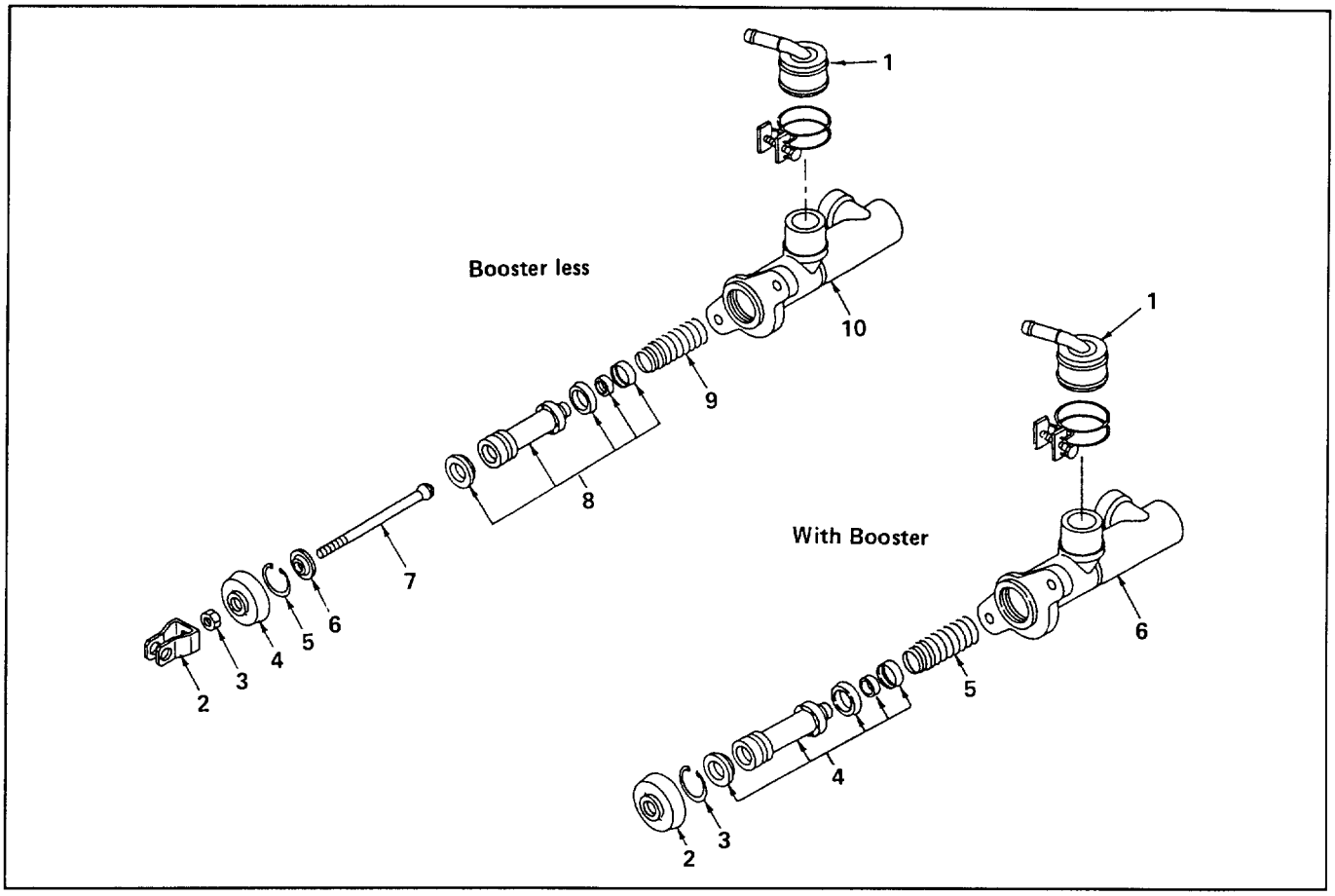
   Connect a vinyl tube to the bleeder screw and insert the other end of the vinyl tube into a transparent container.
3) Pump the clutch pedal repeatedly and hold it depressed.
4) Loosen the bleeder screw on the clutch slave cylinder to release clutch fluid with air bubbles into the container and tighten the bleeder screw immediately.
5) Release the clutch pedal carefully. Repeat the above operation until air bubbles disappear from the clutch fluid being pumped out into the container. During the bleeding operation, keep the clutch fluid reservoir filled to the specified level.

   Reinstall the rubber cap.

UNIT REPAIR

MASTER CYLINDER

DISASSEMBLY



Removal Steps

Booster Less

1. Pipe joint
2. Clevis yoke
3. Lock nut
4. Dust cover
5. snap ring
6. Stopper
7. Push rod
8. Piston assembly
9. Return spring
10. Cylinder body

With Booster

1. Pipe joint
2. Dust cover
3. Snap ring
4. Piston assembly
5. Return spring
6. Cylinder body

Disassembly Steps

Booster Less

1. **Pipe Joint**
2. **Clevis Yoke**

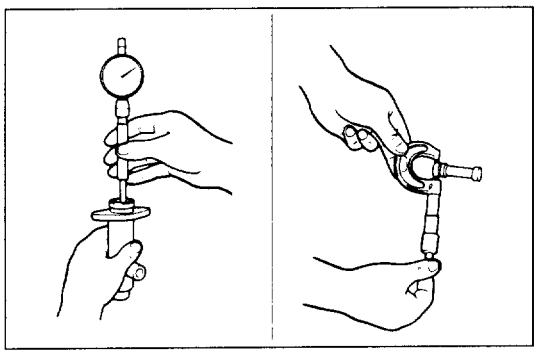
3. **Lock Nut**
4. **Dust Cover**
5. **Snap Ring**
   - Press down the piston with your finger to prevent it from jumping out.
6. **Stopper**
7. **Push Rod**
8. **Piston Assembly**
9. **Return Spring**
10. **Cylinder Body**

With Booster

1. **Pipe Joint**
2. **Dust Cover**
3. **Snap Ring**
   - Press down the piston with your finger to prevent it from jumping out.
4. **Piston Assembly**
5. **Return Spring**
6. **Cylinder Body**

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and parts replacements if excessive wear or damage is discovered during inspection.



Cylinder Body

- Wash clean the cylinder body in brake fluid.
- Check the fluid return port for restrictions and clean it if necessary.
- Measure the cylinder inside diameter.

Master Cylinder Inside Diameter mm (in)
Standard
With Booster : ø 20.640 – 20.692 (0.8126 – 0.8146) Booster Less : ø 19.050 – 19.102 (0.7500 – 0.7520)

Clearance between Cylinder Bore and Piston Clearance mm (in)

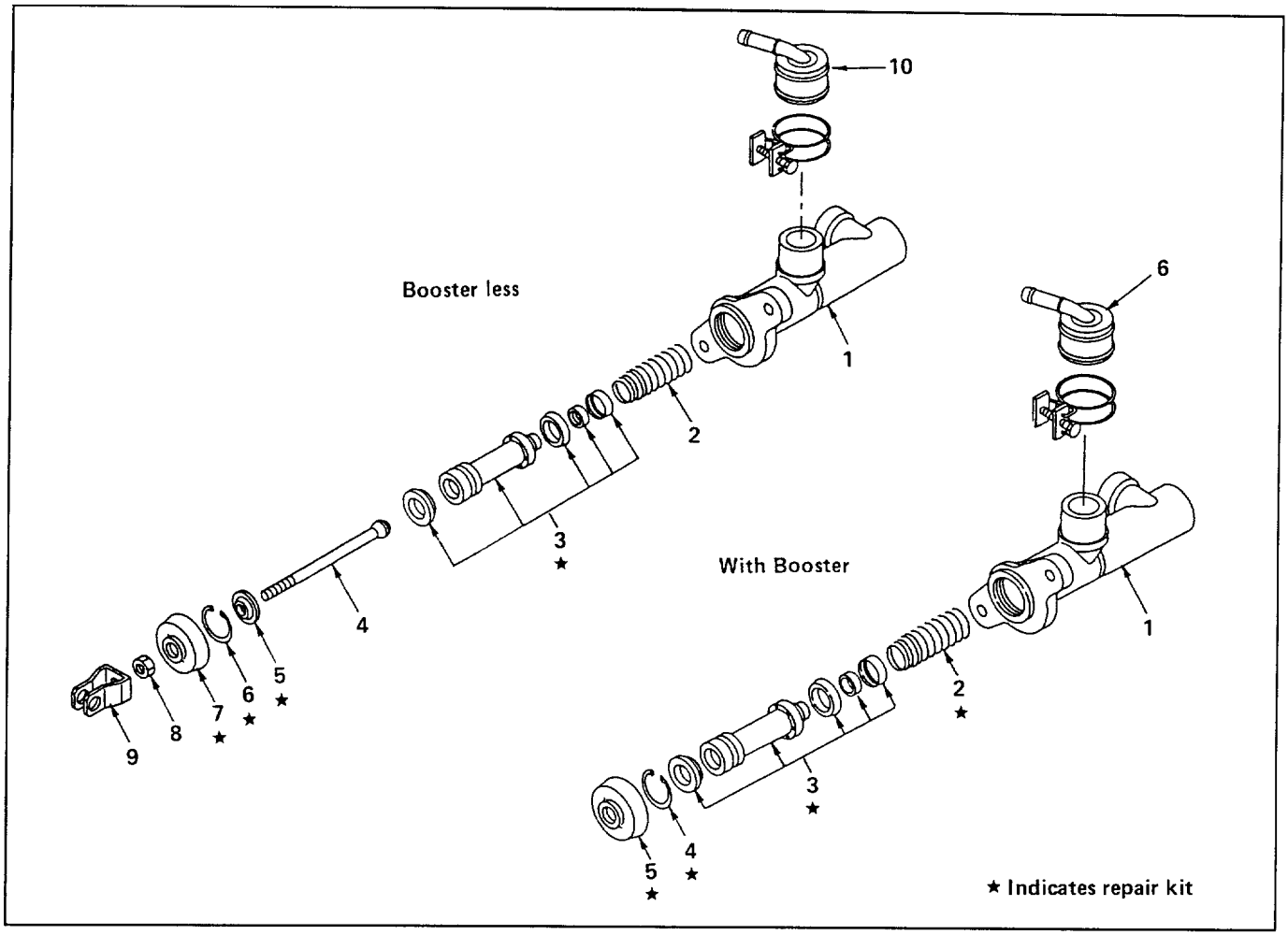
Standard	Limit
0.03 – 0.11 (0.0012 – 0.0043)	0.12 (0.0047)

- If excessive wear or any abnormal conditions are present, the master cylinder assembly must be replaced with new one.

CAUTION

If the master cylinder has been disassembled, the repair kit must be replaced with new one.

REASSEMBLY



Reassembly Step

Booster Less

1. Cylinder body
2. Return spring
3. Piston assembly
4. Push rod
5. Stopper
6. Snap ring
7. Dust cover
8. Lock nut
9. Clevis yoke
10. Pipe joint

With Booster

1. Cylinder body
2. Return spring
3. Piston assembly
4. Snap ring
5. Dust cover
6. Pipe joint

Reassembly Step

Booster Less

1. **Cylinder Body**
   - Immerse the cylinder body in clean brake fluid.
2. **Return Spring**
   - Install the return spring to the piston assembly.
3. **Piston Assembly**
   - Before installing, apply a thin coat of rubber grease to the piston.

CAUTION

Use care to prevent damaging the lip of the piston cup.

4. **Push Rod**
5. **Stopper**
6. **Snap Ring**
7. **Dust Cover**
8. **Lock Nut**

Lock Nut Torque	N·m (kg·m/lb·in)
	13 (1.3/113)

9. **Clevis Yoke**
10. **Pipe Joint**

Pipe Joint Torque	N·m (kg·m/lb·in)
	5 (0.5/43)

With Booster

1. **Cylinder Body**
   - Immerse the cylinder body in clean brake fluid.
2. **Return Spring**
   - Install the return spring to the piston assembly.
3. **Piston Assembly**
   - Before installing, apply a thin coat of rubber grease to the piston.

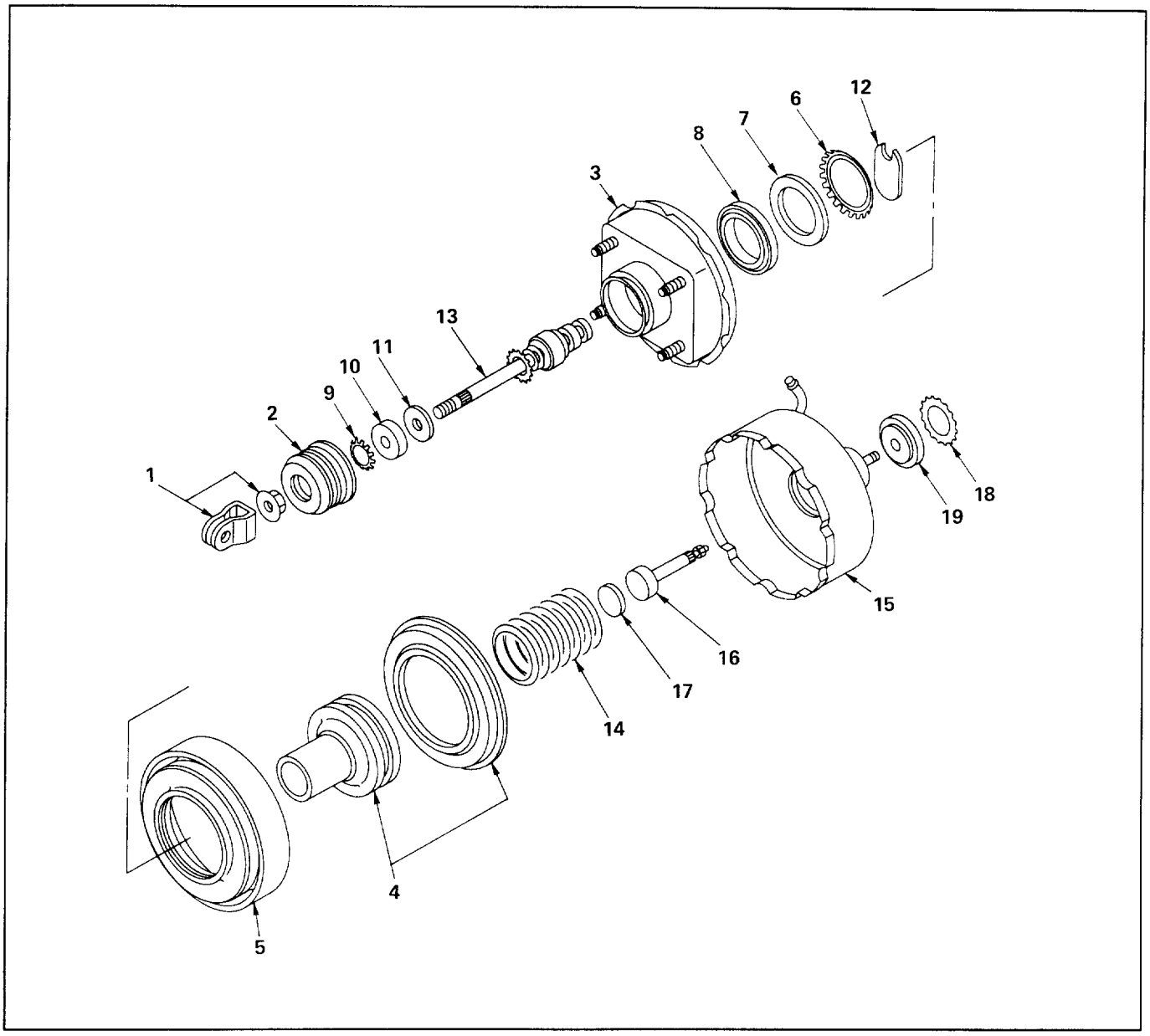
CAUTION

Use care to prevent damaging the lip of the piston cup.

4. **Snap Ring**
5. **Dust Cover**
6. **Pipe Joint**

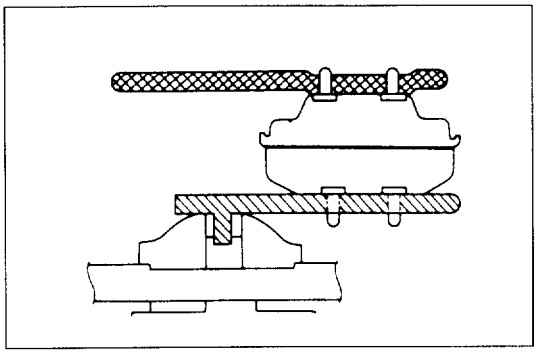
Pipe Joint Torque	N·m (kg·m/lb·in)
	5 (0.5/43)

CLUTCH BOOSTER
DISASSEMBLY



Disassembly Steps

1. Clevis yoke
2. Boot
3. Rear shell
4. Diaphragm plate assembly
5. Diaphragm
6. Bearing retainer
7. Bearing
8. Seal
9. Silencer retainer
10. Silencer
11. Filter
12. Stopper key
13. Valve Plunger assembly
14. Return spring
15. Front shell
16. Push rod
17. Reaction disc
18. Retainer
19. Push rod seal



Disassembly Steps

1. **Clevis Yoke**
2. **Boot**
3. **Rear Shell**
   - Apply setting marks to the front shell and rear shell.
   - Install the support plate to the front shell.
   - Install the handle to the rear shell.

     Support Plate : 5-8840-2056-0
     Handle : 9-8523-1733-0
   - Rotate the handle arrow direction.

   NOTE

   Note that the diaphragm spring pops out of position as the rear shell is removal.
4. **Diaphragm Plate Assembly**
5. **Diaphragm**
6. **Bearing Retainer**
7. **Bearing**
8. **seal**
9. **Silencer Retainer**
10. **Silencer**
11. **Filter**
12. **Stopper Key**
13. **Valve Plunger Assembly**
14. **Return Spring**
15. **Front Shell**
16. **Push Rod**
17. **Reaction Disc**
18. **Retainer**
19. **Push Rod Seal**

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and parts replacements if excessive wear or damage is discovered during inspection.

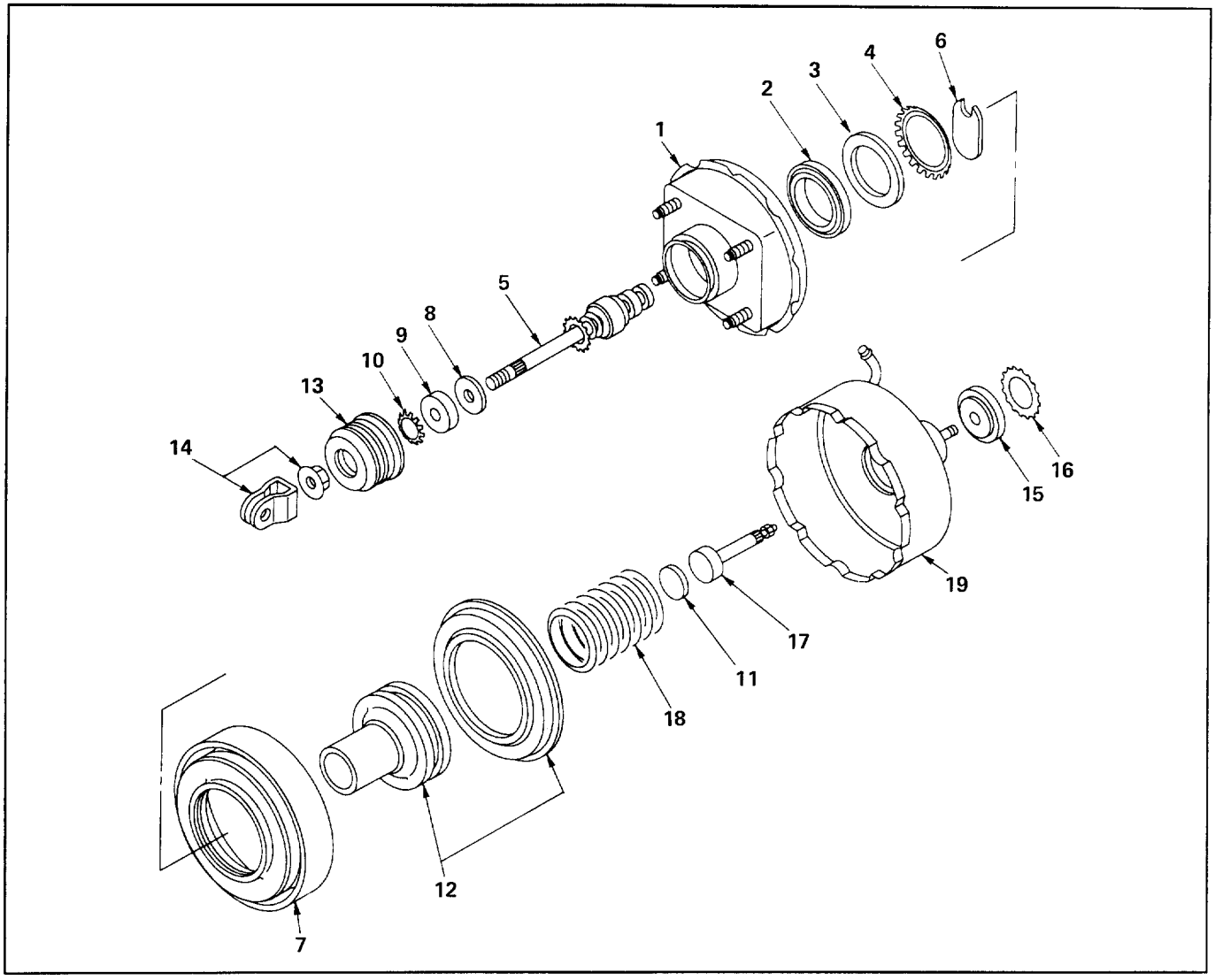
CAUTION:

If the clutch booster has been disassembled, the repair kit must be replaced with new one.

NOTE:

Before inspection, wash metal parts in metal cleaner, and wash rubber or resin parts in alcohol.

REASSEMBLY

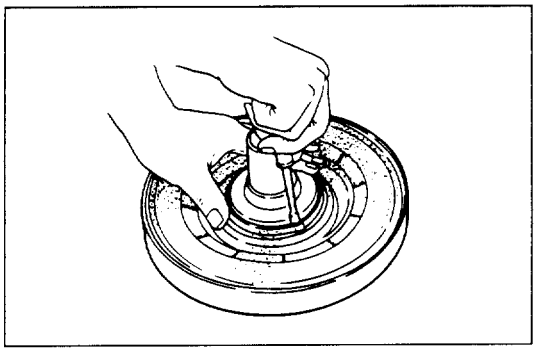


Reassembly Step

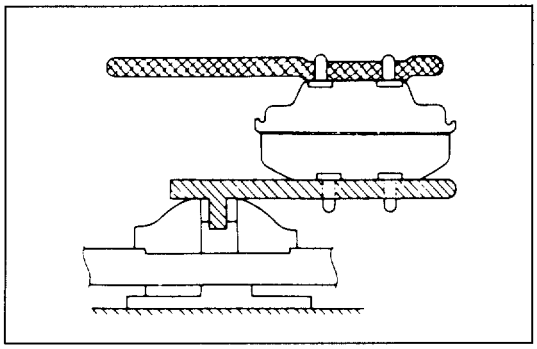
1. Rear shell
2. Seal
3. Bearing
4. Bearing retainer
5. Valve plunger assembly
6. Stopper key
7. Diaphragm
8. Filter
9. Silencer
10. Silencer retainer
11. Reaction disc
12. Diaphragm plate assembly
13. Boot
14. Clevis yoke
15. Push rod seal
16. Retainer
17. Push rod
18. Return spring
19. Front shell

Reassembly Steps

1. **Rear Shell**
   - Apply silicone grease to the portions of the rear shell in contact with the seal and lip.
2. **Seal**
3. **Bearing**
4. **Bearing Retainer**
5. **Valve Plunger Assembly**
   - Apply silicone grease to the valve body outside surfaces and the plunger sliding surfaces.
6. **Stopper Key**
7. **Diaphragm**
   - Apply silicone grease to the outside and inside surfaces of the diaphragm in contact with the rear shell and front shell.



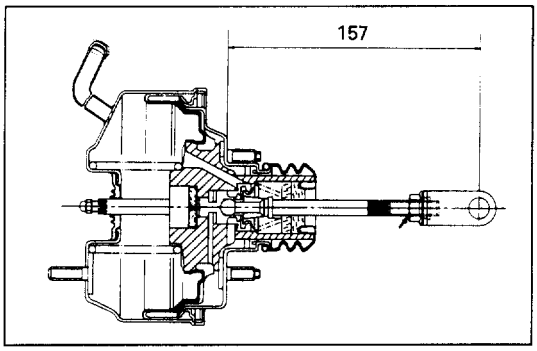
8. **Filter**
9. **Silencer**
10. **Silencer Retainer**
11. **Reaction Disc**
    - Apply silicone grease to the reaction disc surfaces.
12. **Diaphragm Plate Assembly**
    - Apply silicone grease to the outside and inside surfaces of the Diaphragm plate.
13. **Boot**
14. **Clevis Yoke**
15. **Push Rod Seal**
16. **Retainer**
17. **Push Rod**
    - Apply silicone grease to the push rod sliding surfaces.
18. **Return Spring**



19. Front Shell

- Apply silicone grease to the sliding surfaces of the front shell with the push rod.
- Install the support plate and handle.
- Rotate handle to align the setting mark.

  Support Plate : 5-8840-2056-0
  Handle : 5-8523-1733-0

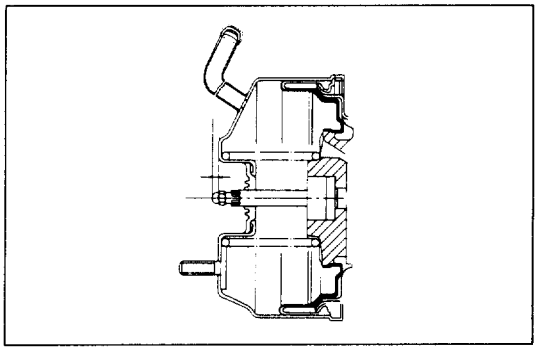


- Measure the push rod distance between pin center of clevis and rear shell.

  If the distance is not equal to the specification, it must be adjusted.

Distance between Pin Center and Rear Shell	mm (in)
157 (6.18)	

Lock Nut Torque	N·m (kg·m/lb·ft)
20 (2.0/14)	

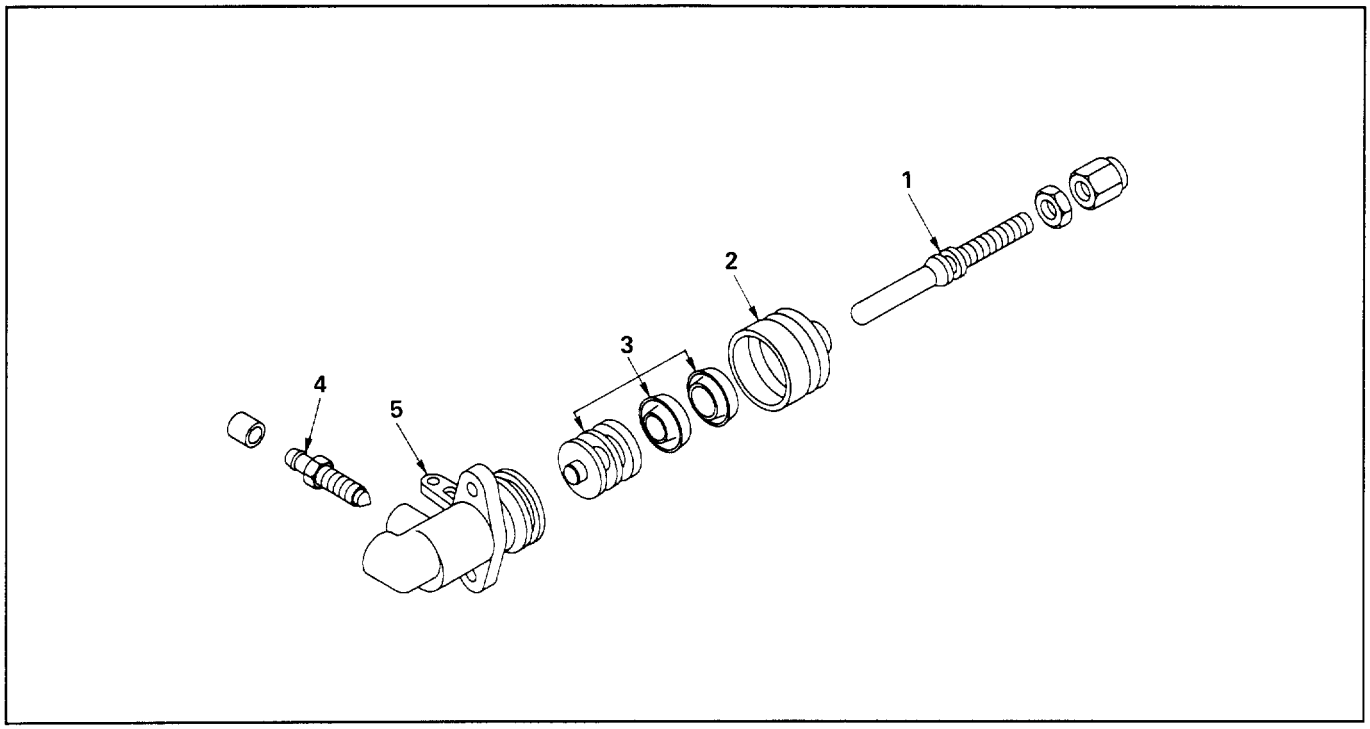


- Apply 66.66 kPa (500 mmHg) of negative pressure to the clutch booster.
- Measure the push rod distance between end of push rod and rear shell flange face.

  If the distance is not equal to the specification, it must be adjusted.

Distance between Push Rod End and Rear Shell	mm (in)
3.75 – 4.00 (0.148 – 0.157)	

SLAVE CYLINDER
DISASSEMBLY



Disassembly Steps

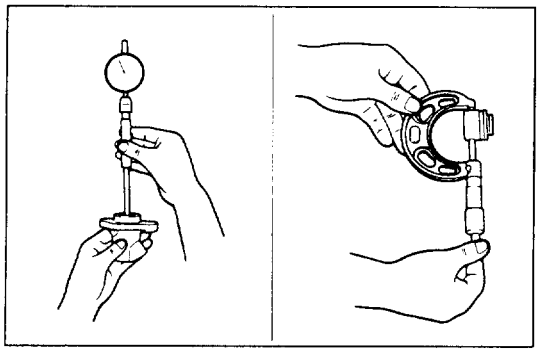
1. Push rod
2. Boot
3. Piston assembly
4. Bleeder screw
5. Cylinder body

Disassembly Steps

1. **Push Rod**
2. **Boot**
3. **Piston Assembly**
4. **Bleeder Screw**
5. **Cylinder Body**

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and parts replacements if excessive wear or damage is discovered during inspection.



Cylinder Body

- Wash clean the cylinder body in brake fluid.
- Measure the cylinder inside diameter.

Master Cylinder Inside Diameter	mm (in)
Standard	
ø 25.400 – 25.452 (1.0000 – 1.0020)	

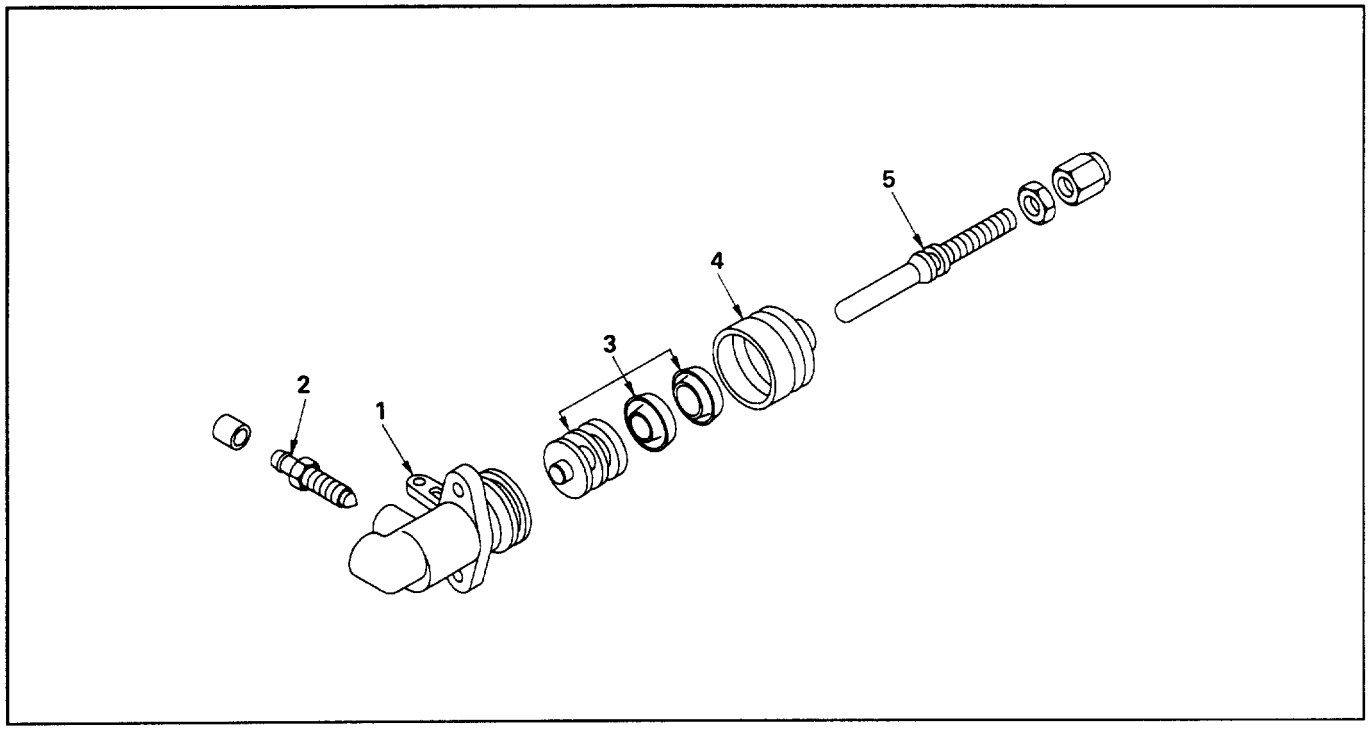
Clearance between Cylinder Bore and Piston Clearance	mm (in)
Standard	Limit
0.02 – 0.10 (0.0008 – 0.0039)	0.11 (0.0043)

- If excessive wear or any abnormal conditions are present, the master cylinder assembly must be replaced with new one.

CAUTION

If the master cylinder has been disassembled, the repair kit must be replaced with new one.

REASSEMBLY



Reassembly Steps

1. Cylinder body
2. Blender screw
3. Piston assembly
4. Boot
5. Push rod

Reassembly Step

1. **Cylinder Body**
2. **Bleeder Screw**
3. **Piston Assembly**
   - Before installing, apply a thin coat of rubber grease to the piston.

CAUTION

Use care to prevent damaging the lip of the piston cup.

4. **Boot**
5. **Push Rod**

LGMXA-WE-461

You are requested to order this manual using the manual number that is shown above.

This manual is applicable for vehicles in all countries except the USA and Canada.

All rights reserved. This manual may not be reproduced in whole or in part, without the permission in writing of ISUZU MOTORS LIMITED.

Issued by

ISUZU MOTORS LIMITED

INTERNATIONAL SERVICE DEPARTMENT

Tokyo, Japan

First edition Jan., 1994 8004-16K-1

LGMXA-WE-461 PRINTED IN JAPAN

WORKSHOP MANUAL

NHR.NKR.NPR.NQR.NPS

PROPELLER SHAFT AND AXLE

SECTION 4

ISUZU

ISUZU

International Service & Parts

Tokyo, Japan

NOTICE

Before using this Workshop Manual to assist you in performing vehicle service and maintenance operations, it is recommended that you carefully read and thoroughly understand the information contained in Section 0A under the headings "GENERAL REPAIR INSTRUCTIONS" and "HOW TO USE THIS MANUAL".

All material contained in this Manual is based on latest product information available at the time of publication.
All rights are reserved to make changes at any time without prior notice.

Applicable Model

N-Series		
NHR55	NPR55	NQR66
NHR69	NPR69	NQR70
NKR55	NPR58	NQR71
NKR69	NPR59	NPS66
NKR58	NPR65	NPS71
NKR66	NPR66	
	NPR70	
	NPR71	

This manual is applicable to 1994 year model and later vehicles.

THIS MANUAL INCLUDES THE FOLLOWING SECTION:

SECTION NO.	CONTENTS
00	Service Information
4A	Propeller Shaft
4B	Rear Axle
4C	Front Axle

SECTION 00
SERVICE INFORMATION

CONTENTS

	PAGE
Troubleshooting	00- 2
Main Data and Specifications	00- 3
Service Standard	00- 4
Servicing	00- 6
Fixing Torque	00- 7
Special Tools	00-19

TROUBLESHOOTING

PROPELLER SHAFT

PROBLEM	POSSIBLE CAUSE	CORRECTION
Noises from Propeller Shaft	1. Worn spline yoke. 2. Worn or stuck spider bearing. 3. Worn center bearing.	1. Replace the spline yoke. 2. Replace the spider bearing. 3. Replace the center bearing.
Vibration from Propeller Shaft	1. Incorrect shaft run-out. 2. Out of shaft balance. 3. Stuck spline yoke.	1. Replace the propeller shaft. 2. Adjust the shaft balance. 3. Replace the spline yoke.

REAR AXLE AND FRONT DRIVING AXLE

PROBLEM	POSSIBLE CAUSE	CORRECTION
Oil Leak At Front Axle or Rear Axle	1. Worn or defective oil seal. 2. Axle housing cracked.	1. Replace the oil seal. 2. Repair or replace.
Oil Leak At Pinion Shaft	1. Too much gear oil. 2. Oil seal worn or defective. 3. Pinion flange loose or damaged.	1. Correct the oil level. 2. Replace the oil seal. 3. Tighten or replace.
Noises in Front Axle or Rear Axle	1. Insufficient gear oil. 2. Wrong or poor grade gear oil. 3. Drive pinion to ring gear backlash incorrect. 4. Worn or chipped ring gear, pinion gear or side gear. 5. Pinion shaft bearing worn. 6. Wheel bearing worn. 7. Differential bearing loose or worn.	1. Replenish the gear oil. 2. Replace the gear oil. 3. Adjust the backlash. 4. Replace the ring gear, pinior gear or side gear 5. Replace the pinion shaft bearing. 6. Replace the wheel bearing. 7. Tighten or replace.

MAIN DATA AND SPECIFICATIONS

Propeller Shaft

		NHR, NKR55, 69, NPR55, 69	NKR58, 66 NPR58, 59, 65, 66, 70, 71 NQR66, 71, NPS	NQR70
Bearing retention method		Inside snap ring	Outside snap ring	
Spider length	mm (in)	69 (2.72)	85 (3.35)	96 (3.780)
Spider outside dia.	mm (in)	18.46 (0.73)	21.94 (0.86)	23.02 (0.9065)
Tube-outside dia. diameter × thickness	mm (in)	68.9 × 2.0 (2.71 × 0.08)	82.6 × 2.3 (3.25 × 0.09)	90 × 3.2 (3.54 × 0.13)
Flange bolt size		M10	M12	M12
Flange bolt P.C.D.	mm (in)	85 (3.35)	100 (3.94)	110 (4.33)

Rear Axle

Vehicle series / Specifications	NHR		NKR 55, 69	NKR		NPR, NPS	NPR NQR
	Single Tire	Dual Small Tire	Single Tire	Dual Small Tire	Dual Tire		
Rear axle type	Banjo semi-floating	Banjo full floating					
Gear type	Hypoid						
Number of Differential pinion	4						
Ring gear pitch diameter mm (in)	244 (9.6)			292 (11.5)			320 (12.5)
Amount of hub grease (each wheel) g (oz)	80 (2.8)	285 (10.1)	280 (9.9)	285 (10.1)			
Oil capacity lit (US/Imp qt)	2.7 (2.9/2.4)			3.0 (3.2/2.6)			3.4 (3.6/3.0)

Front Axle

Specifications	NPS
Front axle type	Banjo full floating
Tread	1,665 (65.55)
Gear type	Hypoid
Number of differential pinion	4
Ring gear pitch diameter mm (in)	244 (9.6)
Amount of hub grease (each wheel) g (oz)	200 (7.1)
Oil capacity lit (US/Imp qt)	2.7 (2.9/2.4)

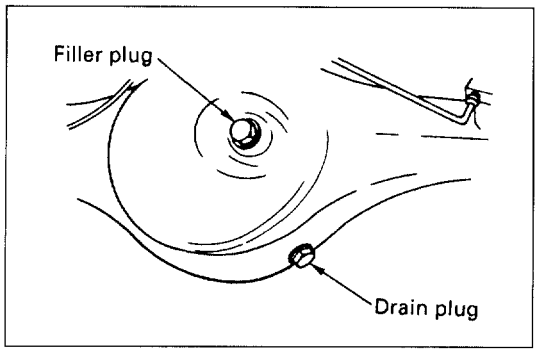
SERVICE STANDARD

Items	Service Standard			Limit		
PROPELLER SHAFT	**NHR, NKR 55, 69, NPR 55, 69**	**NKR 58, 66, NPR 58, 59, 65, NPR 66, 70,71, NQR66,71 NPS**	**NQR70**	**NHR, NKR 55, 69, NPR 55, 69**	**NKR 58, 66, NPR 58, 59, 65, NPR 66,70,71, NQR66,71, NPS**	**NQR70**
Outside Diameter of Spider Pin mm (in)	18.46 (0.73)	21.94 (0.86)	23.02 (0.906)	18.36 (0.72)	21.84 (0.8598)	22.8 (0.898)
Propeller Shaft Run-Out mm (in)	0.5 (0.02) or less		0.3 (0.12)or less	1.0 (0.039)		0.5(0.02)
Play between the Sleeve Yoke and the Propeller Shaft Spline mm (in)	0.1 (0.0039)			0.3 (0.012)		
Play in the Universal Joint mm (in)	0.1 (0.0039)			—		
REAR AXLE SHAFT						
Axle Shaft Run-Out mm (in)	—			1.0 (0.039)		
Axle Shaft Flange Run-Out mm (in)	—			0.05 (0.0097)		
REAR DIFFERENTIAL	**244 mm**	**292 mm**	**320 mm**	**244 mm**	**292 mm**	**320 mm**
Pinion Bearing Preload						
New Bearing N (kg/lb)	16-29 (1.6-3.0/3.5-6.6)	13-25 (1.3-2.6/2.9-5.7)	26-38 (2.7-3.9/6.0-8.6)	—		
Used Bearing N (kg/lb)	8-14.5 (0.8-1.5/1.8-3.3)	6.5-12.5 (0.65-1.3/1.5-2.9)	13-19 (1.35-1.95/3.0-4.3)	—		
Pinion Bearing Starting Torque						
New Bearing N•m (kg•cm/lb•in)	0.69-1.27 (7-13/6.1-11.3)	0.98-1.96 (10-20/8.7-17.4)	2.3-3.2 (23-33/20-28.6)	—		
Used Bearing N•m (kg•cm/lb•in)	0.35-0.64 (3.5-6.5/3.1-5.7)	0.49-0.98 (5-10/4.3-8.7)	1.2-1.6 (12-16/10.4-13.9)	—		
Ring Gear Backlash mm (in)	0.15-0.20 (0.006-0.008)	0.18-0.23 (0.007-0.009)	0.19-0.29 (0.007-0.011)	—		
Ring Gear Run-Out mm (in)	0.05 (0.002)	0.05 (0.002)	0.08 (0.003)	0.2 (0.008)	0.2 (0.008)	0.25 (0.01)
Clearance between the Differential Pinion and the Spider mm (in)	0.07-0.13 (0.003-0.005)	0.07-0.13 (0.003-0.005)	0.05-0.13 (0.002-0.005)	0.2 (0.008)	0.2 (0.008)	0.2 (0.008)
Clearance between the Side Gear and the Differential Cage mm (in)	0.05-0.11 (0.002-0.004)	0.05-0.11 (0.002-0.004)	0.13-0.2 (0.005-0.008)	0.25 (0.01)	0.25 (0.01)	0.25 (0.01)
Play in Splines between the Side Gear and the Axle Shaft mm (in)	0.02-0.12 (0.0008-0.005)	0.08-0.15 (0.003-0.006)	0.2 (0.008)	0.25 (0.01)	0.3 (0.012)	0.5 (0.02)
Clearance between the back face of the Side Gear and the Differential Cage mm (in)	0.13-0.18 (0.005-0.007)	0.21-0.28 (0.008-0.011)	0.10-0.38 (0.004-0.015)	—		
REAR HUB						
Rear Hub Bearing Preload (At Wheel Pin) N (kg/lb)	42-52 (4.3-5.3/9.5-11.7)		38-48.0 (3.9-4.9/8.6-10.8)	—		

SERVICE STANDARD (CONT.)

Items	Service Standard	Limit
FRONT DIFFERENTIAL		
Pinion Bearing Preload		
New Bearing N (kg/lb)	16-29 (1.6-3.0/3.5-6.6)	—
Used Bearing N (kg/lb)	8-14.5 (0.8-1.5/1.8-3.3)	—
Pinion Bearing Starting Torque		
New Bearing N•m (kg•cm/lb•in)	0.69-1.27 (7.0-13.0/6.1-11.3)	—
Used Bearing N•m (kg•cm/lb•in)	0.35-0.64 (3.5-6.5/3.1-5.7)	—
Ring Gear Backlash mm (in)	0.15-0.20 (0.006-0.008)	—
Ring Gear Run-Out mm (in)	0.05 (0.002)	0.2 (0.008)
Clearance between the Differential Pinion and the Spider mm (in)	0.07-0.13 (0.003-0.005)	0.2 (0.008)
Clearance between the Side Gear and the Differential Cage mm (in)	0.04-0.1 (0.002-0.004)	0.25 (0.01)
Play in Splines between the Side Gear and the Axle Shaft mm (in)	0.02-0.12 (0.0008-0.005)	0.25 (0.01)
Clearance between the Back Face of the Side Gear and the Differential Cage mm (in)	0.13-0.18 (0.005-0.007)	—
FRONT HUB		
Front Hub Bearing Preload (At wheel pin)		
New Bearing and New Oil Seal N (kg/lb)	17-31 (1.7-3.2/3.7-7.1)	—
Reused Bearing and New Oil Seal N (kg/lb)	14-28 (1.4-2.9/3.1-6.4)	—
FREE WHEEL HUB		
Clearance between the Free Wheeling Hub Body and the Snap Ring mm (in)	0-0.5 (0-0.02)	—

SERVICING



CHANGE THE REAR DIFFERENTIAL GEAR OIL

1. Remove the drain plug and filler plug and, drain the gear oil.
2. Tighten the drain plug to specified torque.

Drain Plug Torque	N•m (kg•m/lb•ft)
83 (8.5/61)	

3. Fill the rear axle case with hypoid gear lubricant, to just below the filler hole.

Rear Axle Case Oil Capacity	L (US/Imp qt)
244 mm Diff.	2.7 (2.9/2.4)
292 mm Diff.	3.0 (3.2/2.6)
320 mm Diff.	3.4 (3.6/3.0)

Note:

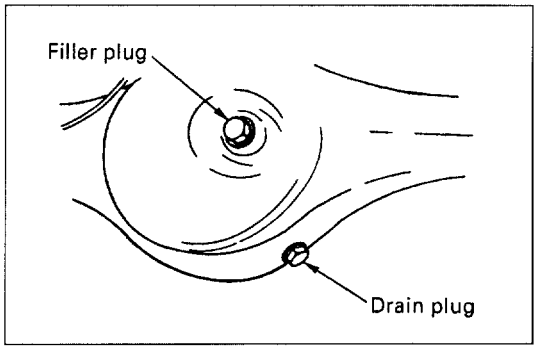
Limited slip Differential (LSD)-Friction Type Model :

Use GL-5 LSD gear lubricant together with LSD Lubricant Additive (ISUZU part No. 8-01052-358-0, GM part No. #1052358) or equivalent.

Quantity	
LSD Lubricant Additive	4 oz (112g)

4. Tighten the filler plug to specified torque.

Filler Plug Torque	N•m (kg•m/lb•ft)
83 (8.5/61)	



CHANGE THE FRONT DIFFERENTIAL GEAR OIL

1. Remove the drain plug and filler plug, and drain the gear oil.
2. Tighten the drain plug to specified torque.

Drain Plug Torque	N•m (kg•m/lb•ft)
83 (8.5/61)	

3. Fill the front axle case with hypoid gear lubricant, to just below the filler hole.

Front Axle Case Oil Capacity	L (US/Imp qt)
2.7 (2.9/2.4)	

4. Tighten the filler plug to specified torque.

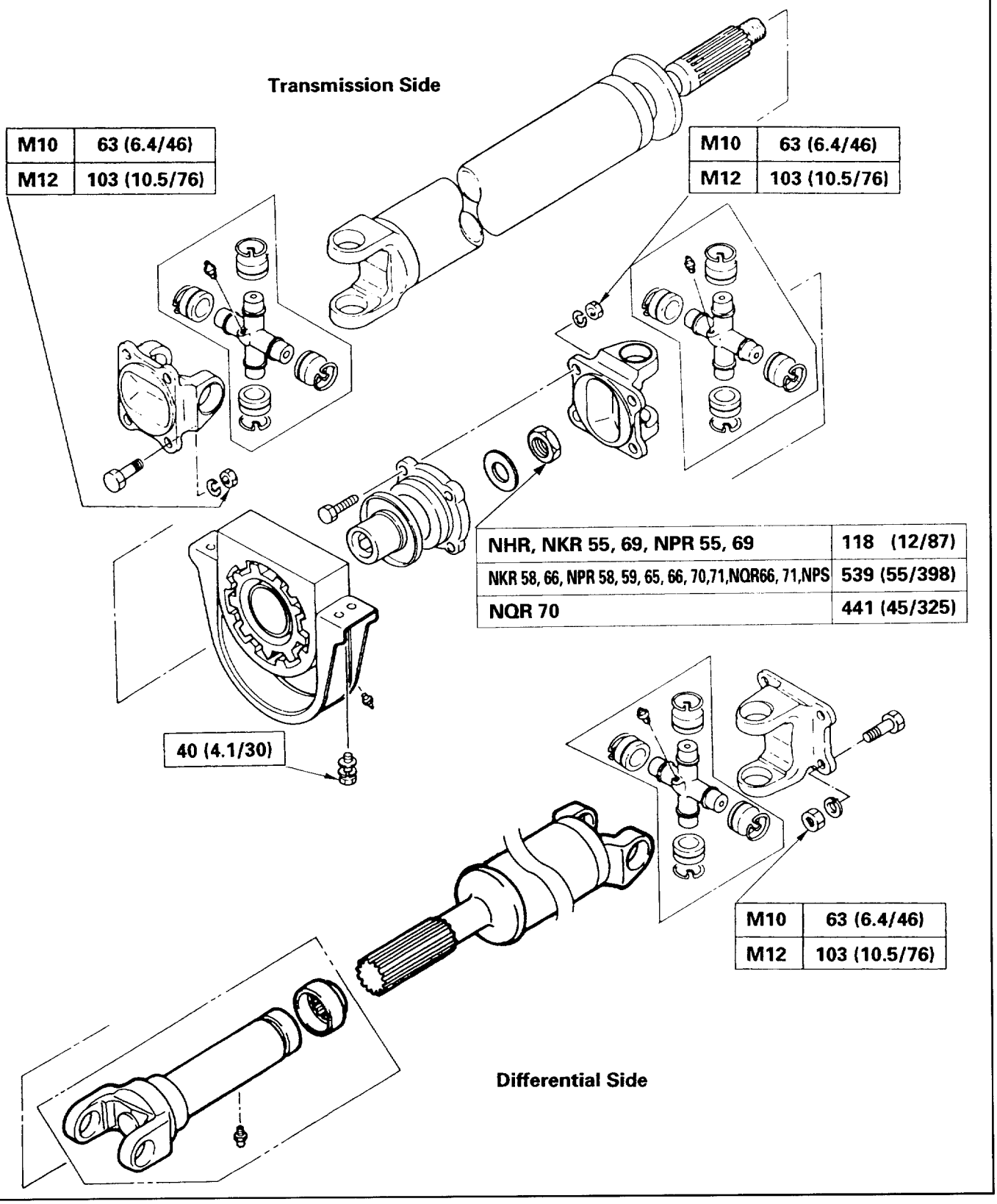
Filler Plug Torque	N•m (kg•m/lb•ft)
83 (8.5/61)	

FIXING TORQUE

Propeller Shaft

N•m (kg•m/lb•ft)

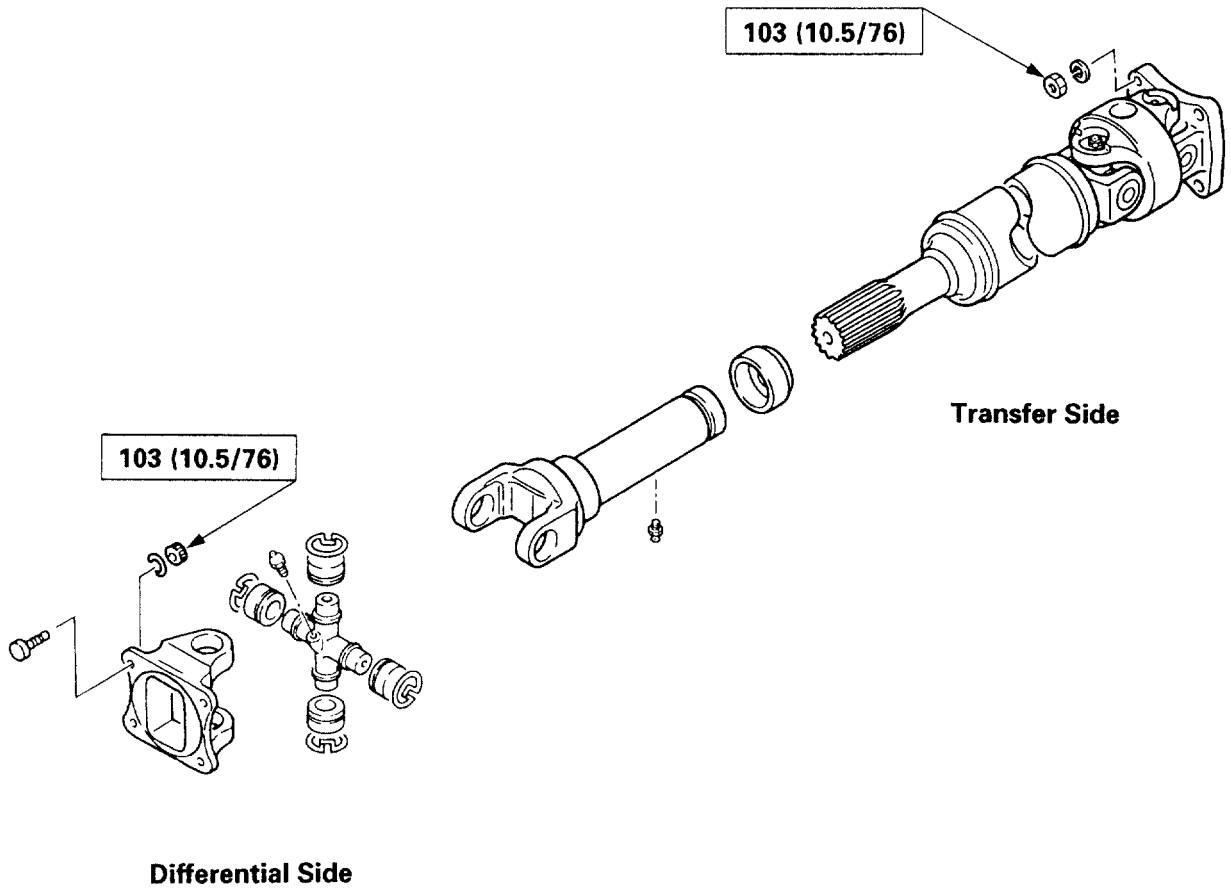
Rear propeller shaft



Propeller Shaft (Cont.)

N•m (kg•m/lb•ft)

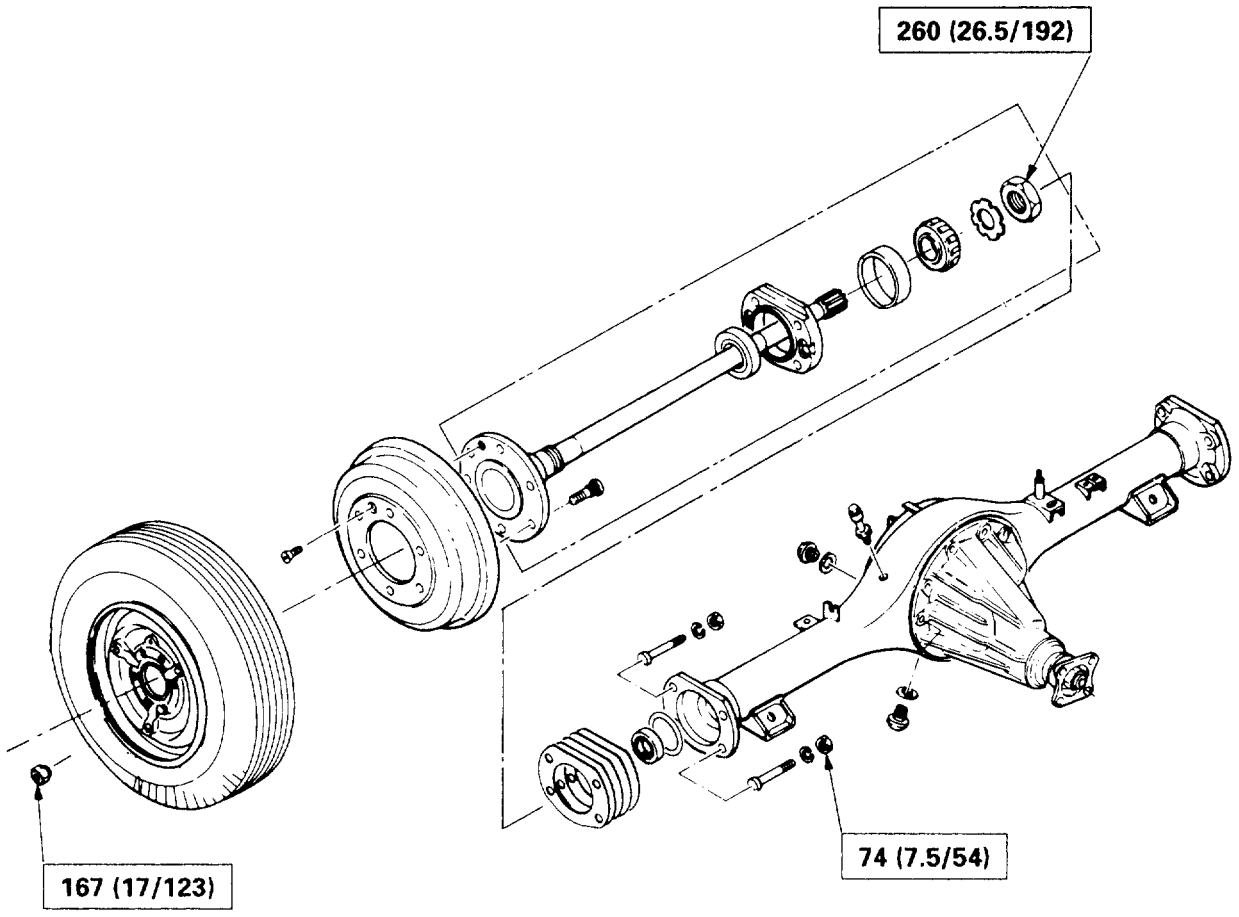
Front propeller shaft



Axle Shaft

N•m (kg•m/lb•ft)

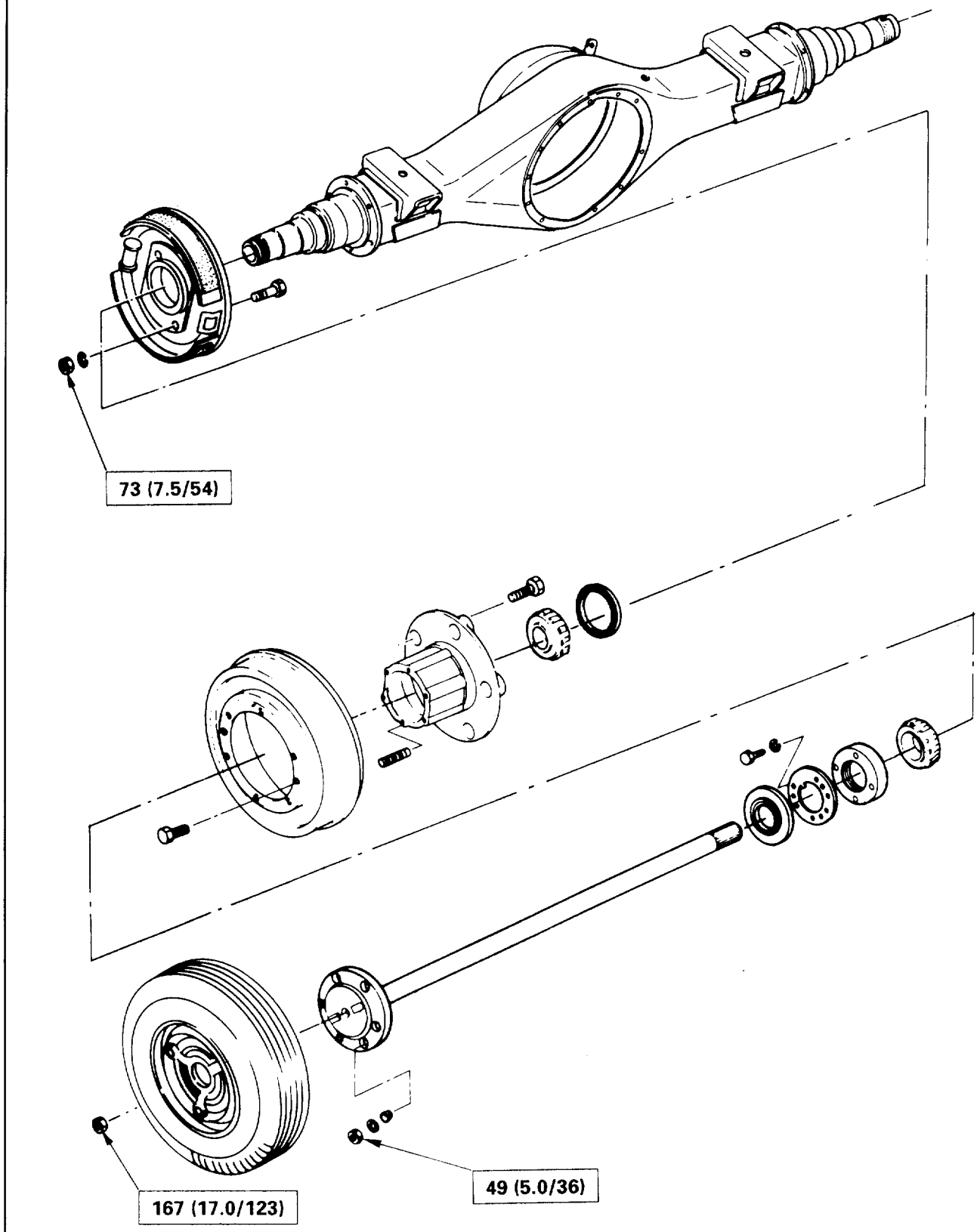
NHR Single Tire



Rear Hub, Brake Drum and Axle Shaft (NKR Model; Full Floating)

N•m (kg•m/lb•ft)

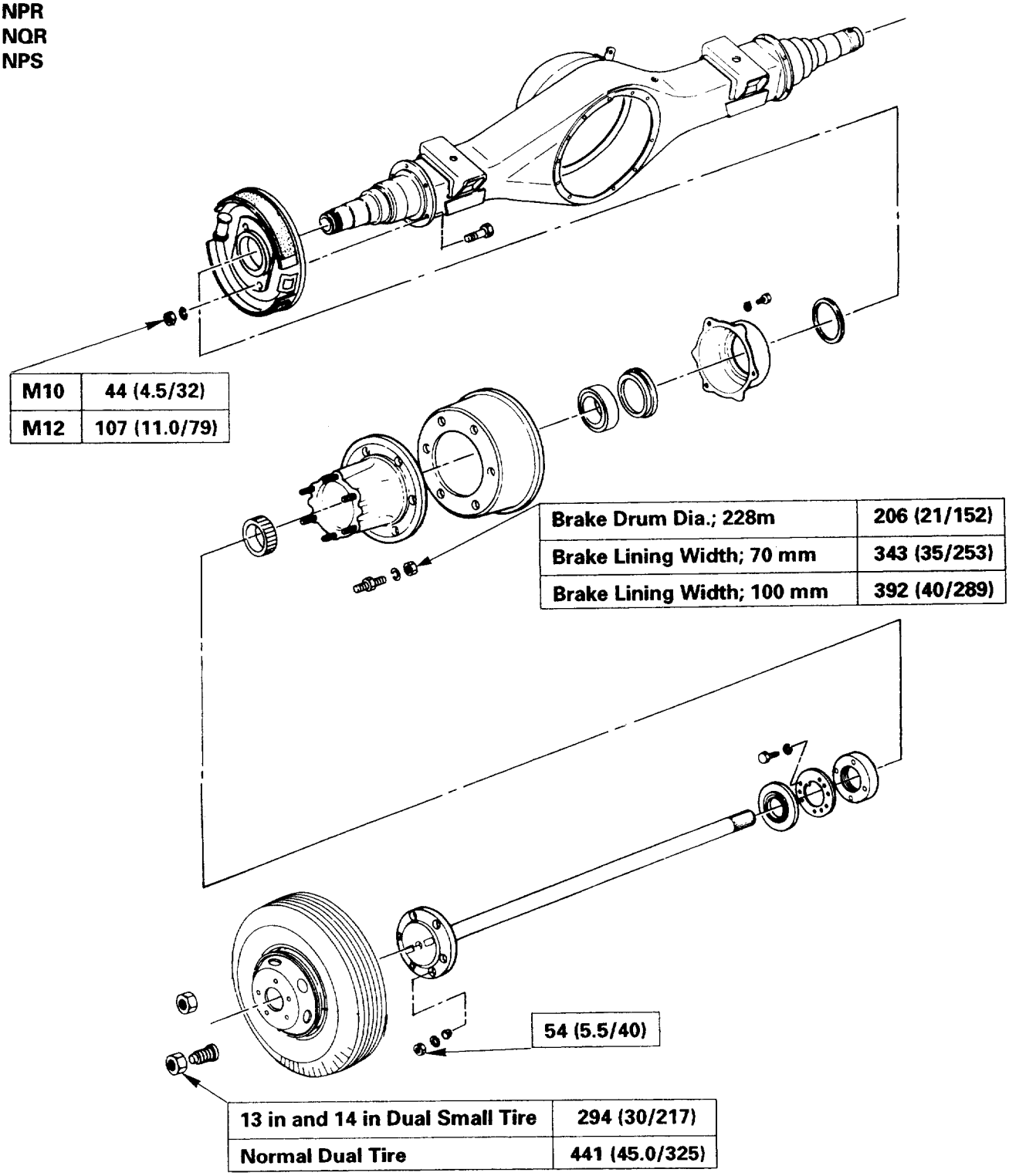
NKR Single Tire



Rear Hub, Brake Drum and Axle Shaft (NHR, NKR, NPR, NPS Models; Full Floating)

N•m (kg•m/lb•ft)

NHR Dual Small Tire
NKR Dual Tire
NPR
NQR
NPS



M10	44 (4.5/32)
M12	107 (11.0/79)

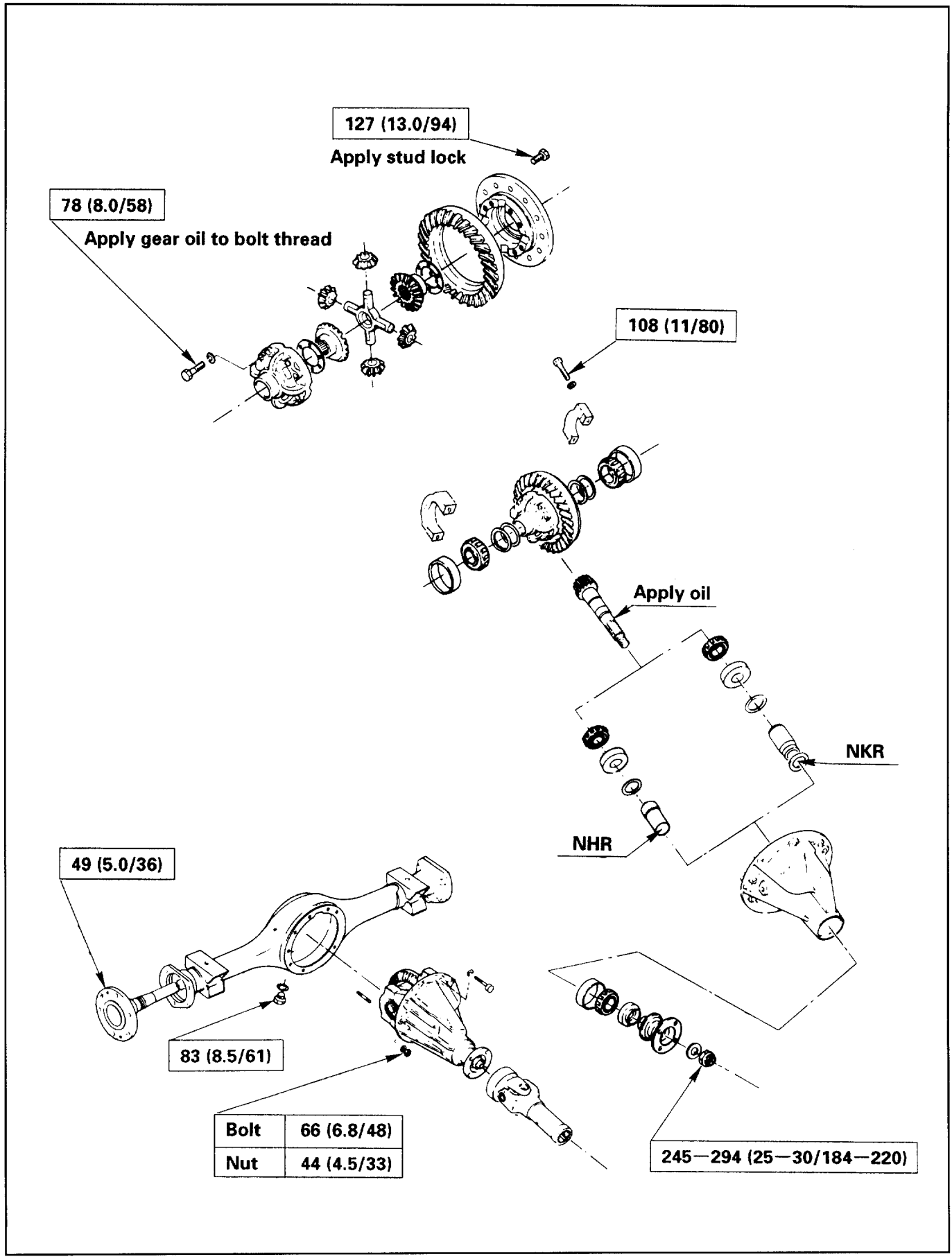
Brake Drum Dia.; 228m	206 (21/152)
Brake Lining Width; 70 mm	343 (35/253)
Brake Lining Width; 100 mm	392 (40/289)

54 (5.5/40)

13 in and 14 in Dual Small Tire	294 (30/217)
Normal Dual Tire	441 (45.0/325)

Rear Differential Assembly (244 mm)

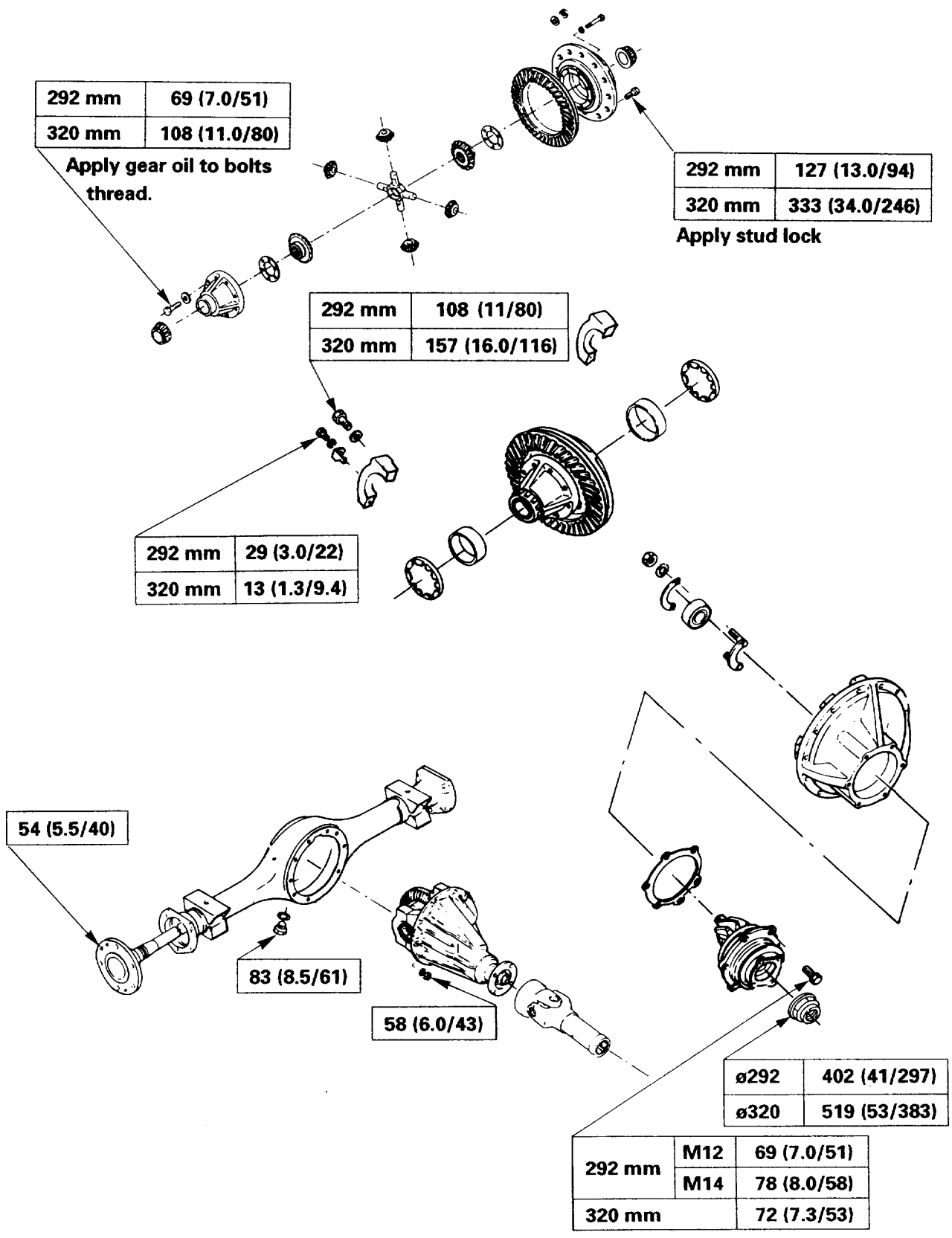
N•m (kg•m/lb•ft)



Bolt	66 (6.8/48)
Nut	44 (4.5/33)

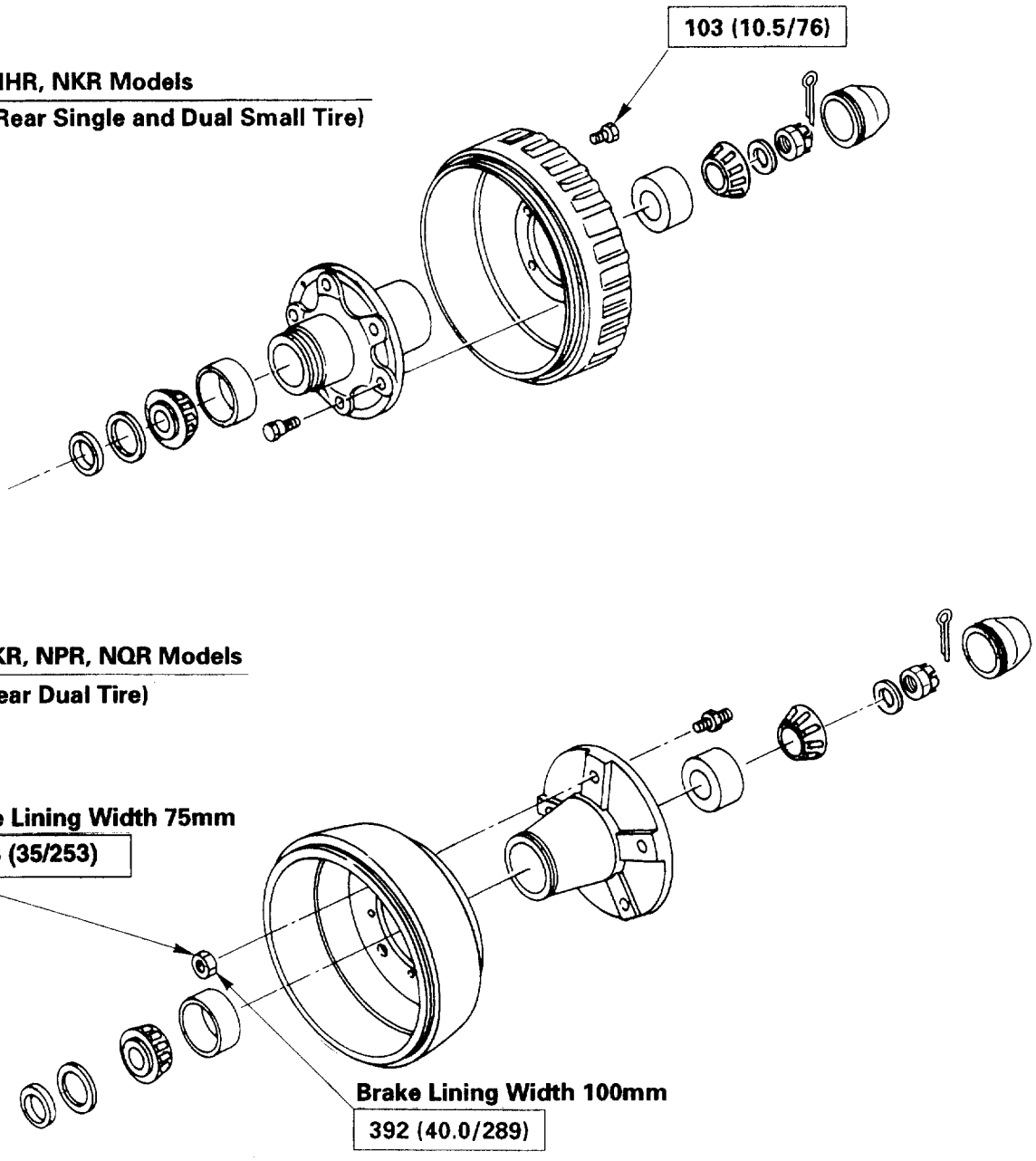
Rear Differential Assembly (292/320 mm)

N•m (kg•m/lb•ft)



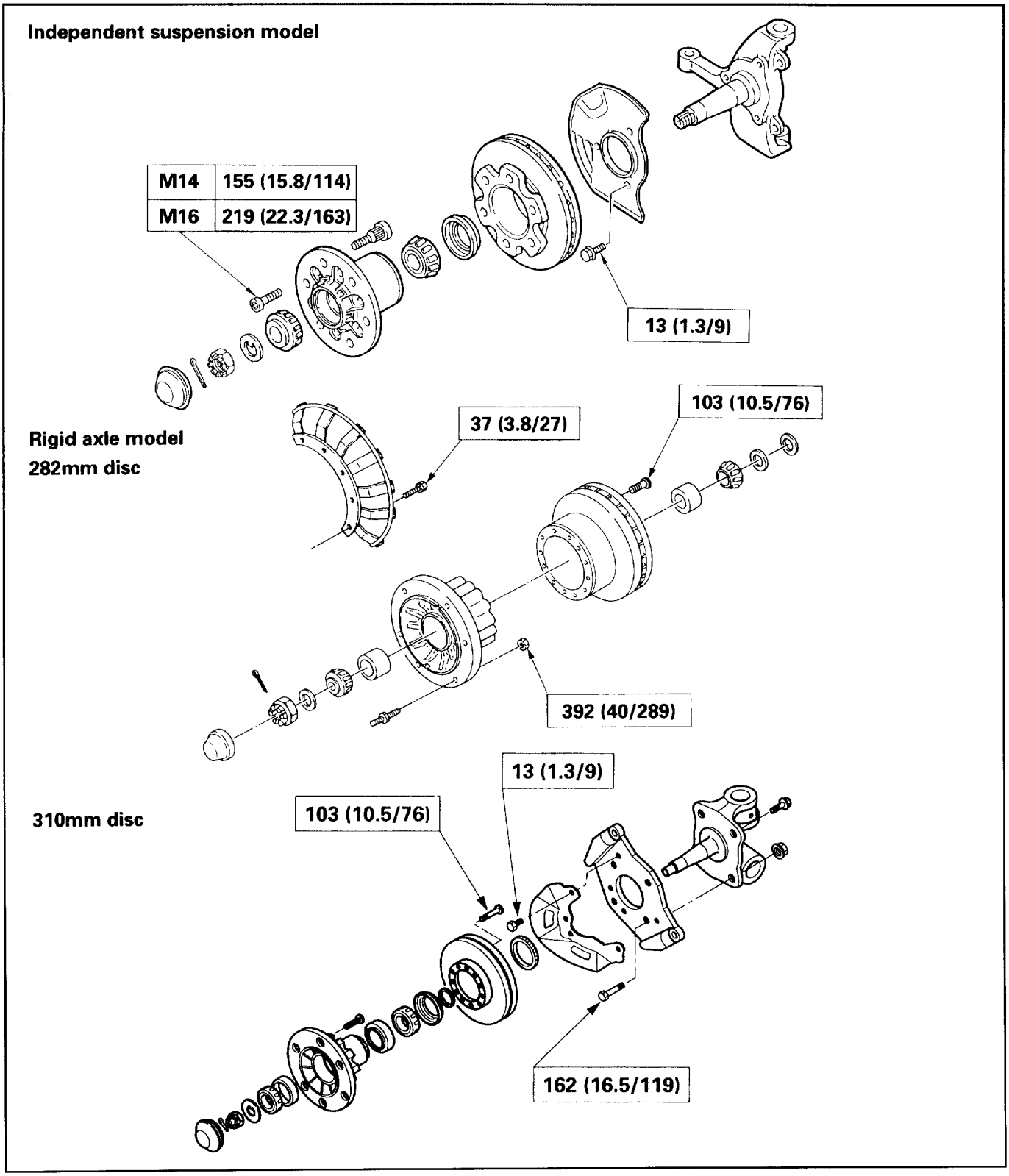
Front Hub and Brake Drum (4 × 2 Model)

N•m (kg•m/lb•ft)



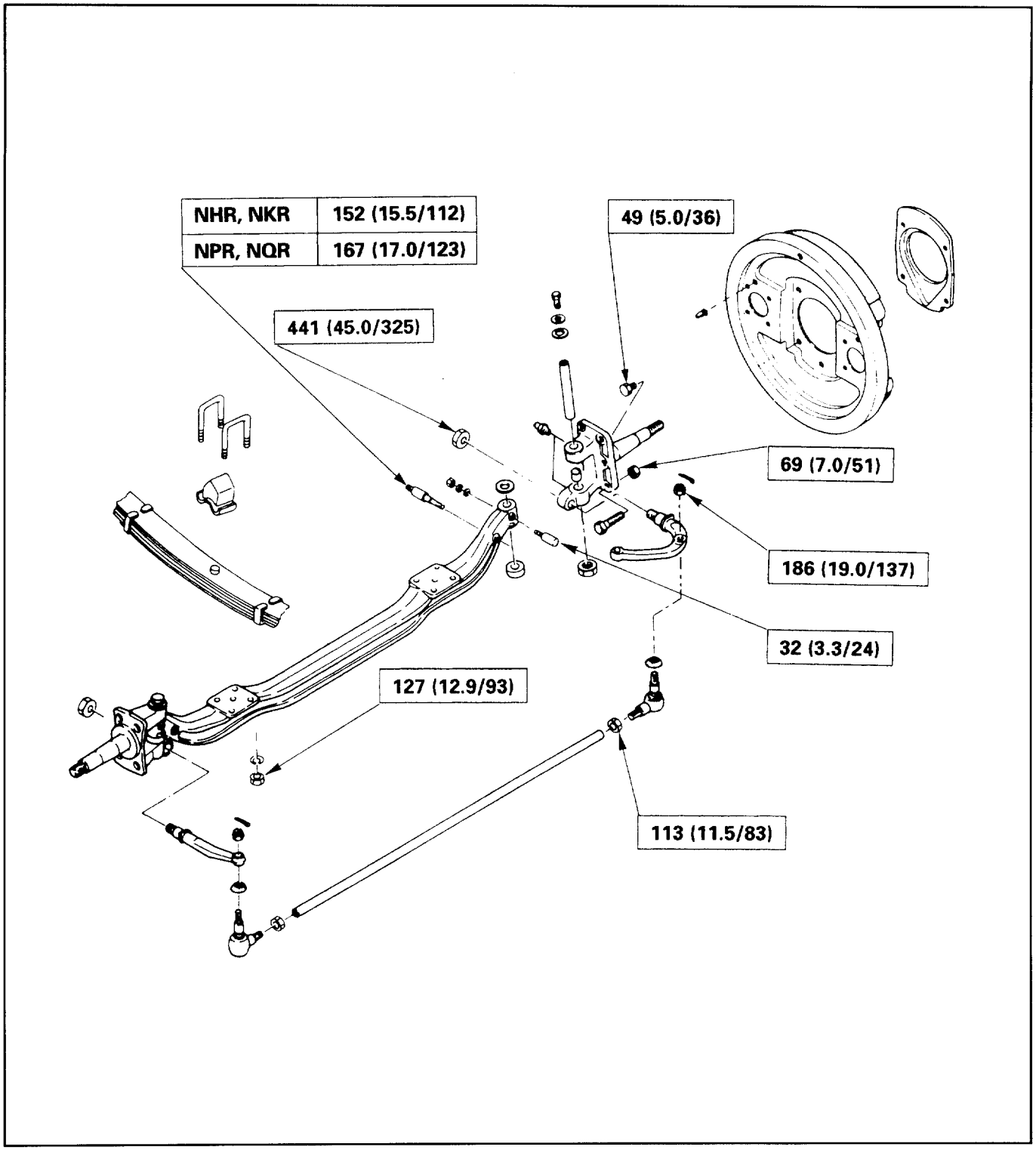
Front Hub and Disc (4 × 2 Model)

N•m (kg•m/lb•ft)



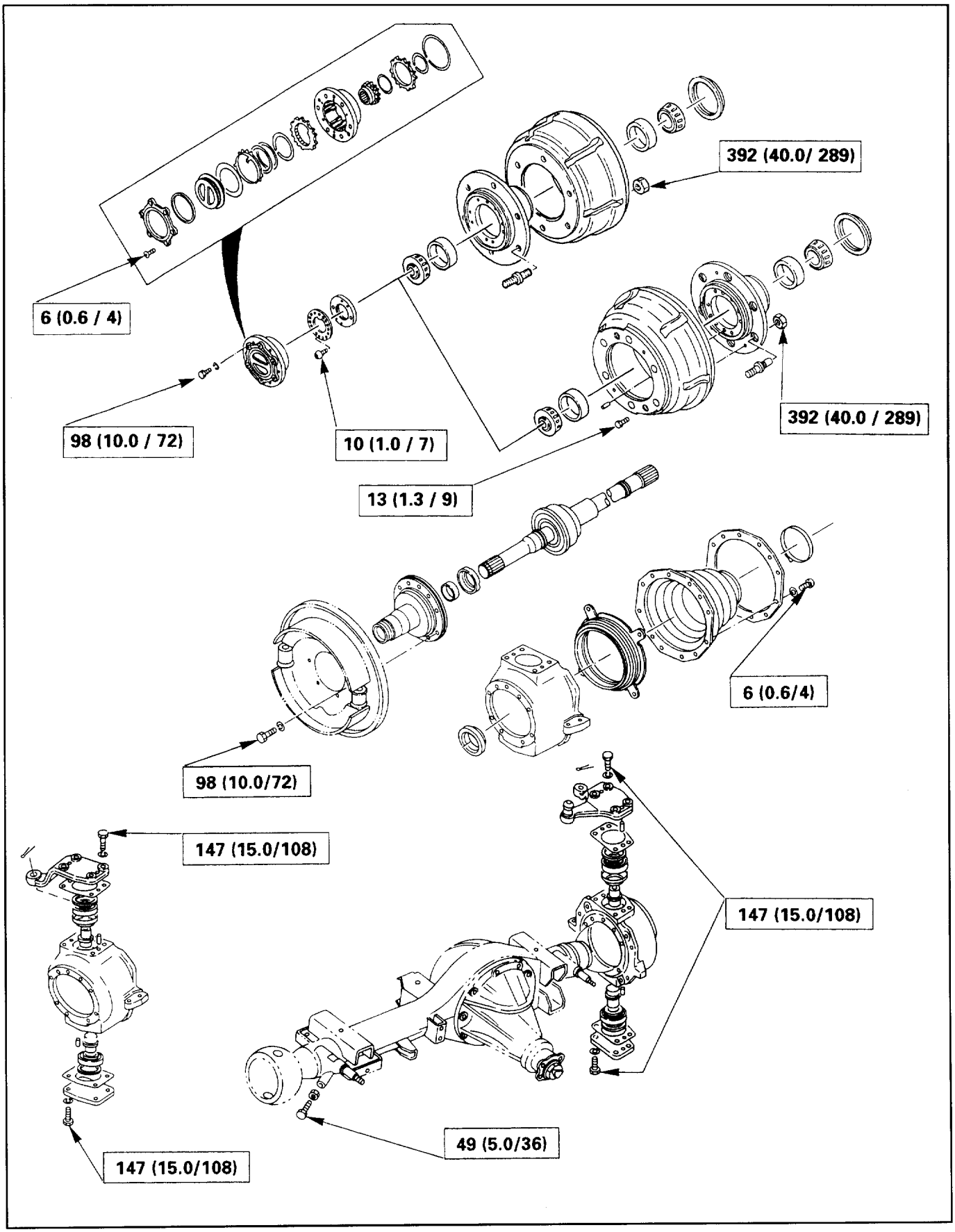
Front Axle, Knuckle and King Pin (4 × 2 Model)

N•m (kg•m/lb•ft)



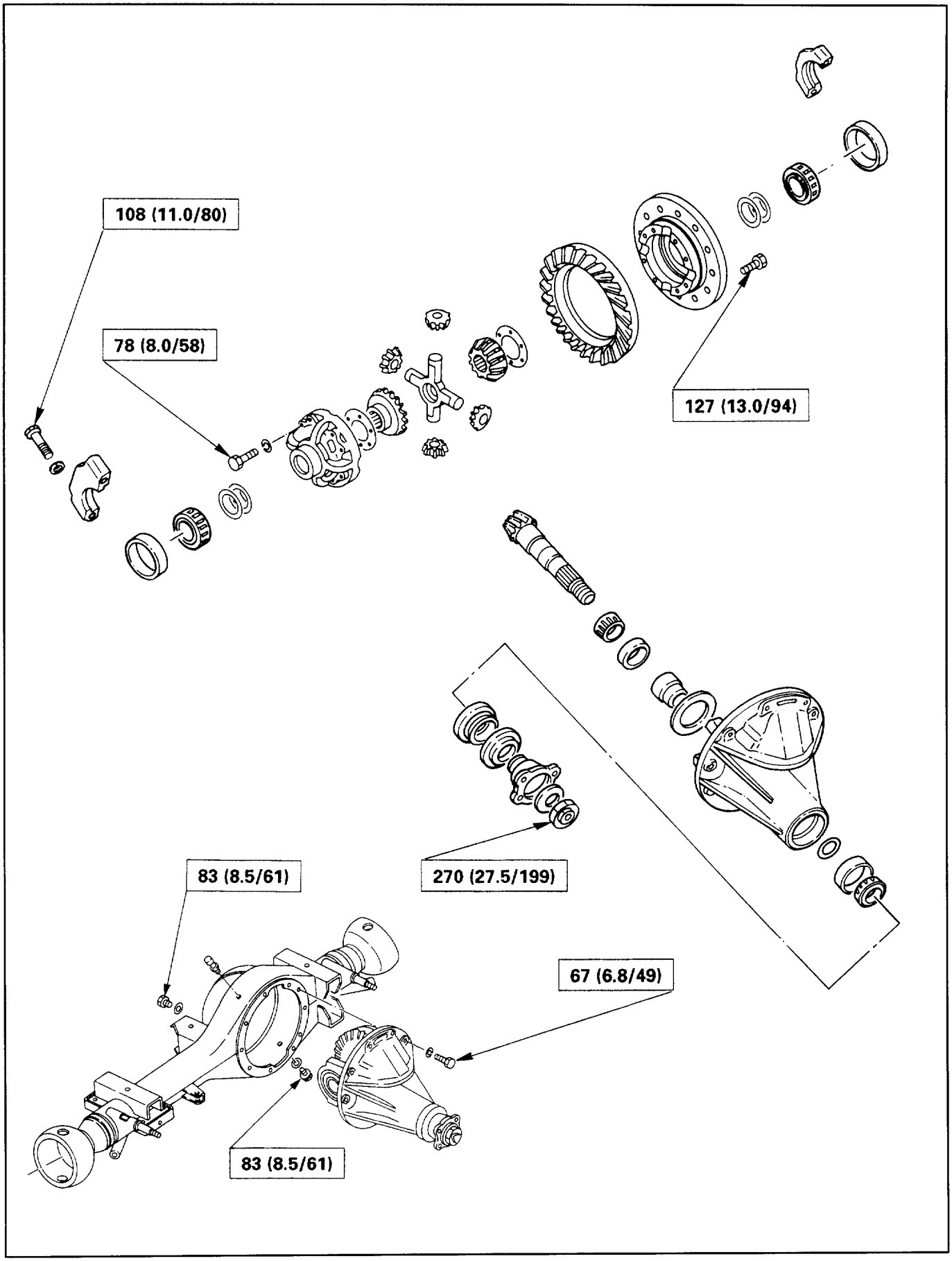
Front Hub, Brake Drum Spindle, Drive Shaft, Knuckle and King Pin (4 × 4 Model)

N•m (kg•m/lb•ft)



Front Differential Assembly

N•m (kg•m/lb•ft)

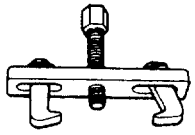
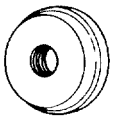
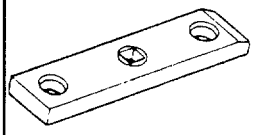
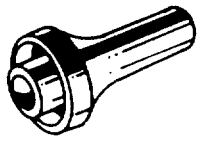
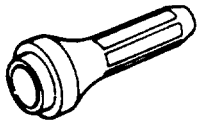
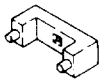


SPECIAL TOOLS

Propeller Shaft

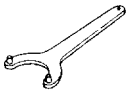
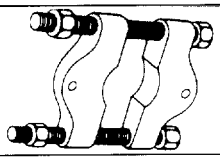
ILLUSTRATION	PART NO.	PART NAME	VEHICLE MODEL				
			NHR	NKR	NPR	NQR	NPS
	9-8529-2101-0	Drive pinion flange bracket		●	●	●	●

Rear Axle

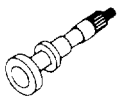
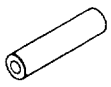
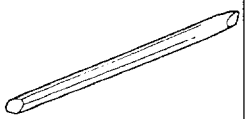
ILLUSTRATION	PART NO.	PART NAME	VEHICLE MODE								
			NHR		NKR			NPR		NQR	NPS
			S/T	F/L	S/T	F/L	D/T	55/58 65/69	59/66 70/71		
	5-8840-2027-0	Universal puller		●	●	●	●	●	●	●	●
	9-8521-0116-0	Rear hub remover		●	●	●	●				
	9-8521-2501-0	Rear hub remover						●	●	●	●
	9-8521-1772-0	Axle shaft bearing outer race remover	●								
	9-8522-1268-0 J-24259	Axle shaft bearing outer race installer	●								
	5-8840-2003-0 J-24246	Bearing holder nut wrench	●								
	9-8522-1269-0 J-24255	Bearing holder oil seal installer	●								
	9-8522-1272-0 J-24254	Axle case oil seal installer	●								
	9-8522-1271-0 J-8609-01	Axle shaft bearing installer	●								
	9-8522-1188-0	Rear hub bearing nut wrench {For 70mm (2.8 in.)}		●	●	●	●				

S/T: Single Tire, F/L: Flat Low, D/T: Dual Tire

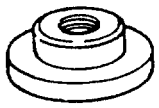
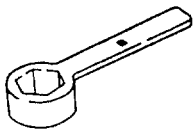
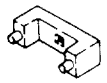
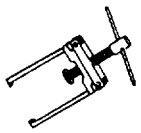
Rear Axle (Cont.)

ILLUSTRATION	PART NO.	PART NAME	VEHICLE MODE								
			NHR		NKR			NPR		NQR	NPS
			S/T	F/L	S/T	F/L	D/T	55/58 65/69	59/66 70/71		
	9-8529-2101-0	Drive pinion flange yoke bracket					●	●	●	●	
	9-8511-1507-0 J-29042	Drive pinion flange holding wrench	●	●	●	●	●	●	●	●	●
	5-8840-0015-0 J-22912-01	Drive pinion inner bearing remover	●	●	●	●	●	●	●	●	
	9-8522-1196-0	Drive pinion inner bearing outer race installer	●	●	●	●	●				
	5-8840-2046-0	Drive pinion inner bearing outer race installer (For 292mm)						●	● (59)		●
	9-8522-1197-0	Drive pinion outer bearing outer race installer	●	●	●	●	●				
	9-8522-1613-0	Drive pinion outer bearing outer race installer (For 292mm)						●	● (59)		●
	9-8522-0018-0	Drive pinion inner bearing inner race installer	●	●	●	●	●				
	9-8522-1615-0	Drive pinion inner bearing inner race installer						●	●	●	●
	5-8840-2047-0	Drive pinion oil seal installer	●	●	●	●	●				

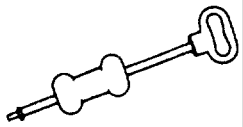
Rear Axle (Cont.)

ILLUSTRATION	PART NO.	PART NAME	VEHICLE MODE								
			NHR		NKR			NPR		NQR	NPS
			S/T	F/L	S/T	F/L	D/T	55/58 65/69	59/66 70/71		
	9-8522-1607-0	Drive pinion oil seal installer			●		●	●	●		●
	9-8521-0061-0	Differential side bearing remover	●	●	●	●	●	●	● (59)		●
	5-8840-2031-0	Differential side bearing remover adaptor	●	●	●	●					
	9-8521-2701-0	Differential side bearing remover adaptor					●	●	●	●	●
	5-8840-2050-0	Differential side bearing installer	●	●	●	●					
	9-8522-1614-0	Differential side bearing installer					●	●	●	●	●
	9-8522-1603-0	Dummy pinion shaft	●	●	●	●					
	9-8522-1624-0	Dummy nut	●	●	●	●					
	9-8522-1138-0	Dummy shaft	●	●	●	●					
	9-8522-1137-0	Dummy bearing (2 pcs required)	●	●	●	●					
	5-8840-2293-0 (J-39209)	Punch: End nut lock	●	●	●	●	●	●	●	●	●

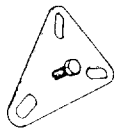
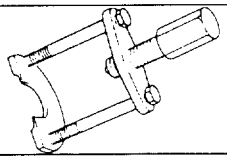
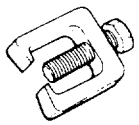
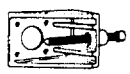
Rear Axle (Cont.)

ILLUSTRATION	PART NO.	PART NAME	VEHICLE MODE								
			NHR		NKR			NPR		NQR	NPS
			S/T	F/L	S/T	F/L	D/T	55/58 65/69	59/66 70/71		
	5-8840-2373-0	Differential side bearing remover (For 320mm)							● (66)	●	
	5-8840-2377-0	Drive pinion oil seal installer (For 320mm)							● (66)	●	
	5-8840-2379-0	Drive pinion inner bearing outer race installer (For 320mm)							● (66)	●	
	5-8840-2376-0	Drive pinion outer bearing outer race installer (For 320mm)							● (66)	●	
	5-8840-2329-0	Hub nut wrench	●		●						
	9-8522-1606-0	Rear hub bearing nut wrench {For 74mm (2.9 in.)}		●	●	●	●	●	●	●	●
	9-8521-0092-0	Rear hub inner bearing remover		●	●	●	●	●	●	●	
	9-8522-1607-0	Rear hub oil seal installer (For 292mm)		●	●	●	●	●	● (59)	●	●
	5-8840-2427-0	Rear hub oil seal installer								● (70)	
	9-8522-1194-0	Rear hub inner bearing outer race installer		●	●	●	●	●	●		●
	9-8522-1609-0	Rear hub inner bearing outer race installer		●	●	●	●	● (58)	●	●	

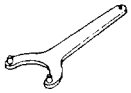
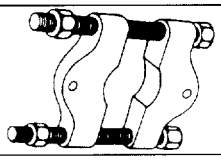
Rear Axle (Cont.)

ILLUSTRATION	PART NO.	PART NAME	VEHICLE MODE								
			NHR		NKR			NPR		NQR	NPS
			S/T	F/L	S/T	F/L	D/T	55/58 65/69	59/66 70/71		
	5-8840-2426-0	Rear hub inner bearing outer race installer								● (70)	
	9-8522-1195-0	Rear hub outer bearing outer race installer		●	●	●	●	● (58)			
	9-8522-1610-0	Rear hub outer bearing outer race installer						●	●	●	●
	9-8522-1608-0	Grip						●	●	●	●
	9-8522-1148-0	Grip		●	●	●	●	●	●	●	
	5-8840-0084-0 (J-2619-01)	Sliding hammer		●	●	●	●	●	●	●	●

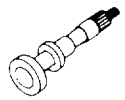
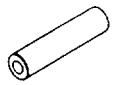
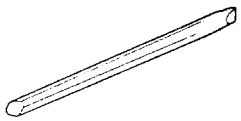
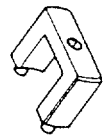
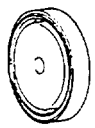
Front Axle

ILLUSTRATION	PART NO.	PART NAME	VEHICLE MODE								
			NHR		NKR			NPR		NQR	NPS
			S/T	F/L	S/T	F/L	D/T	55/58 65/69	59/66 70/71		
	5-8840-2015-0	Front hub nut wrench	●	●	●	●	●	●	●	●	
	9-8521-0115-0	Front hub remover (6 studs)	●	●	●	●					
	5-8840-2016-0	Front hub remover (5 studs)					●	●	●	●	
	5-8840-2017-0	Tie rod end remover (driver side)	●	●	●	●	●	●	●	●	
	5-8840-2018-0	Tie rod end remover (assist side)	●	●	●	●	●	●	●	●	
	5-8840-2019-0	Tie rod arm & knuckle arm remover	●	●	●	●	●	●	●	●	
	5-8840-2020-0	King pin key bolt remover	●	●	●	●	●	●	●	●	
	5-8840-2021-0	King pin remover	●	●							
	5-8840-2022-0	King pin remover			●	●	●	●	●	●	
	5-8840-2023-0	Front hub inner bearing outer race installer	●	●							

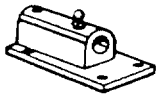
Front Axle (Cont.)

ILLUSTRATION	PART NO.	PART NAME	VEHICLE MODE								
			NHR		NKR			NPR		NQR	NPS
			S/T	F/L	S/T	F/L	D/T	55/58 65/69	59/66 70/71		
	5-8840-2024-0	Front hub inner bearing outer race installer			●	●	●	●	●	●	
	5-8840-2025-0	Front hub outer bearing outer race installer	●	●							
	5-8840-2026-0	Front hub outer bearing outer race installer			●	●	●	●	●	●	
	5-8840-2235-0	Front hub Oil Seal installer	●	●	●	●	●	●	●	●	
	9-8511-1507-0 J-29042	Drive pinion flange holding wrench									●
	5-8840-0015-0 J-22912-01	Drive pinion inner bearing remover									●
	9-8522-1196-0	Drive pinion inner bearing outer race installer									●
	9-8522-1197-0	Drive pinion outer bearing outer race installer									●
	9-8522-0018-0	Drive pinion inner bearing inner race installer									●
	5-8840-2047-0	Drive pinion oil seal installer									●
	9-8521-0061-0	Differential side bearing remover									●

Front Axle (Cont.)

ILLUSTRATION	PART NO.	PART NAME	VEHICLE MODE								
			NHR		NKR			NPR		NQR	NPS
			S/T	F/L	S/T	F/L	D/T	55/58 65/69	59/66 70/71		
	5-8840-2031-0	Differential side bearing remover adaptor									●
	5-8840-2050-0	Differential side bearing installer									●
	9-8522-1603-0	Dummy pinion shaft									●
	9-8522-1624-0	Dummy nut									●
	9-8522-1138-0	Dummy shaft									●
	9-8522-1137-0	Dummy bearing (2 pcs required)									●
	5-8840-2293-0 (J-39209)	Punch: End nut lock									●
	5-8840-2182-0	Front hub bearing nut wrench									●
	5-8840-2187-0	Front hub oil seal installer									●
	5-8840-2184-0	Front hub inner bearing outer race installer									●
	5-8840-2183-0	Front hub outer bearing outer race installer									●

Front Axle (Cont.)

ILLUSTRATION	PART NO.	PART NAME	VEHICLE MODE								
			NHR		NKR			NPR		NQR	NPS
			S/T	F/L	S/T	F/L	D/T	55/58 65/69	59/66 70/71		
	9-8521-0187-0	Front hub remover (6 studs)									●
	5-8840-2368-0	Torx bit (T70) (Disk Brake Only)	●	●	●	●	●	●	●		
	5-8840-0003-0 (J-3289-20)	Holding fixture base									●
	5-8840-2029-0	Differential holding fixture									●
	9-8522-1148-0	Grip		●	●	●	●	●	●	●	

SECTION 4A
PROPELLER SHAFT

CONTENTS

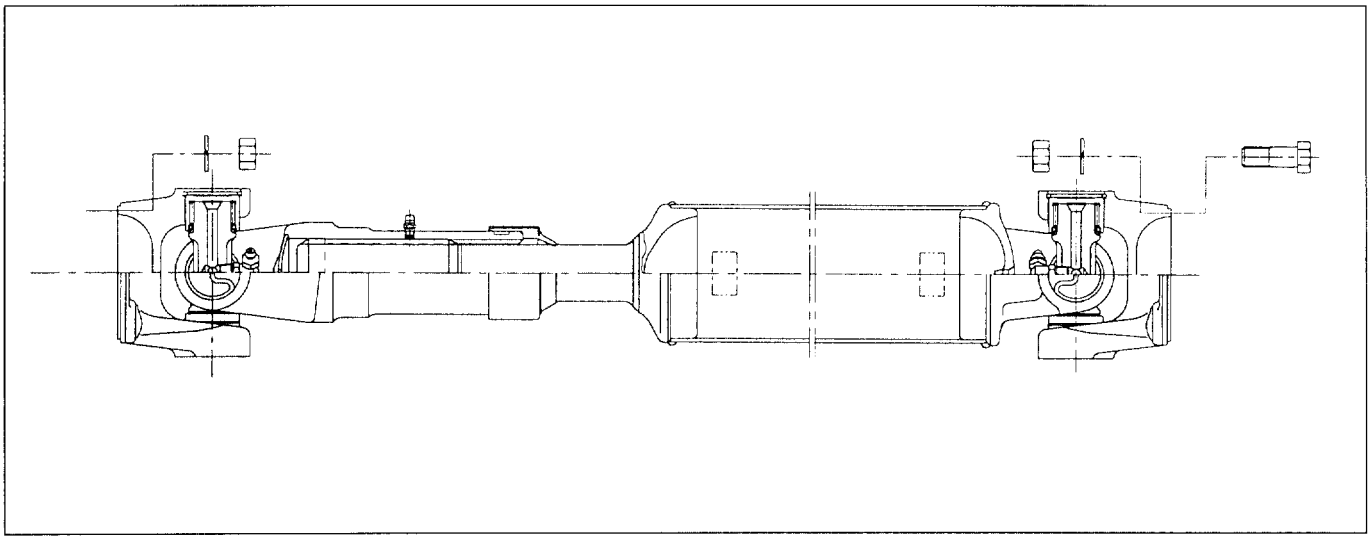
PAGE

General Description 4A- 2
On-Vehicle Service 4A- 4
Rear Drive Propeller Shaft 4A- 4
Front Drive Propeller Shaft 4A- 7
Unit Repair 4A- 9
Universal Joint 4A- 9
Center Bearing 4A-16

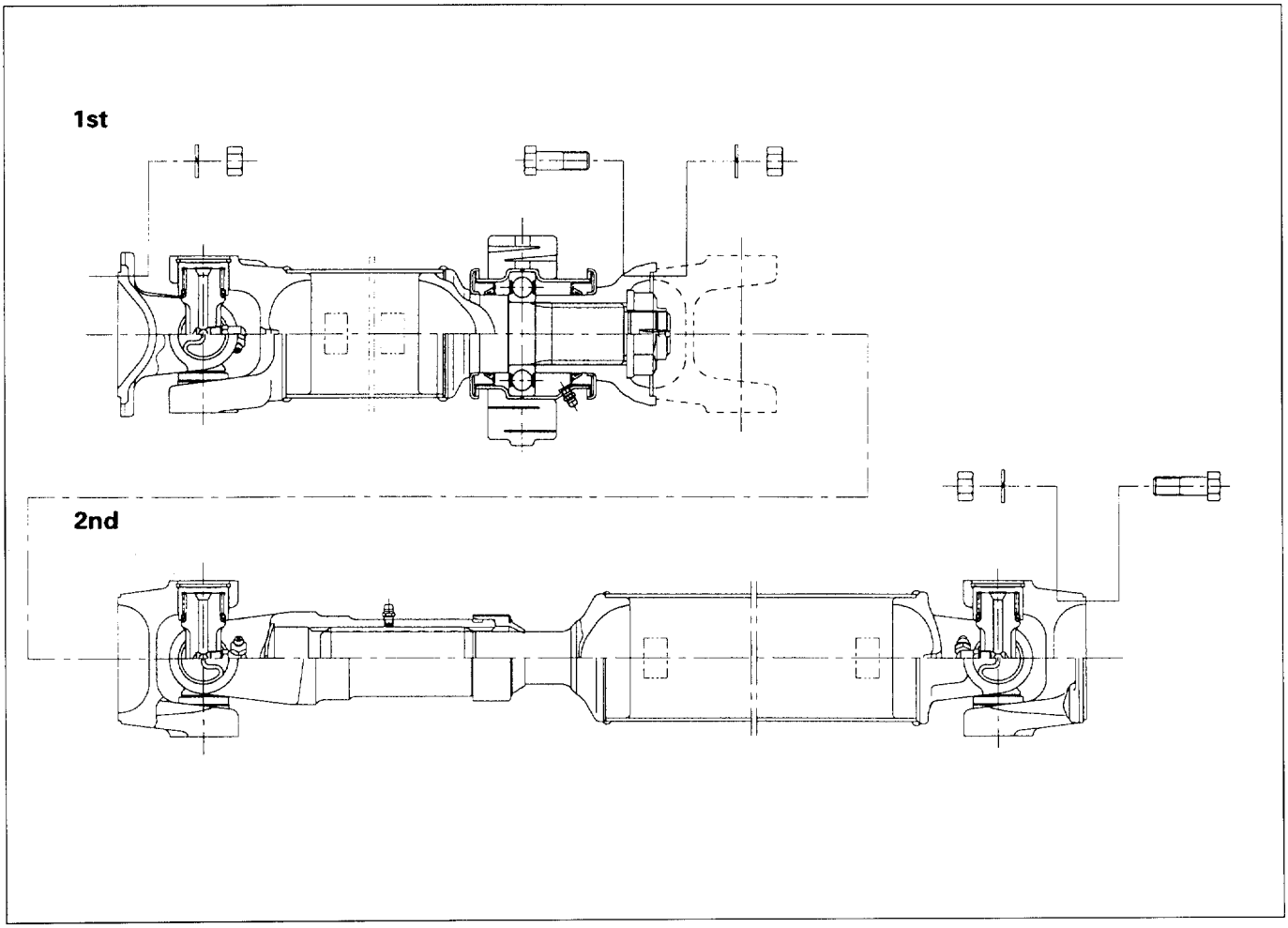
GENERAL DESCRIPTION

Rear Drive Propeller Shaft

Short Wheel Base Models

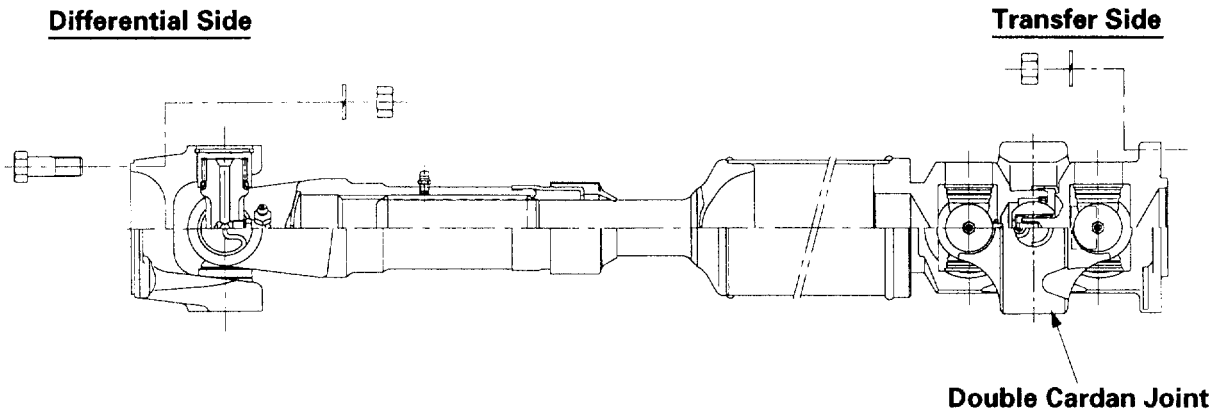


Long Wheel Base Models



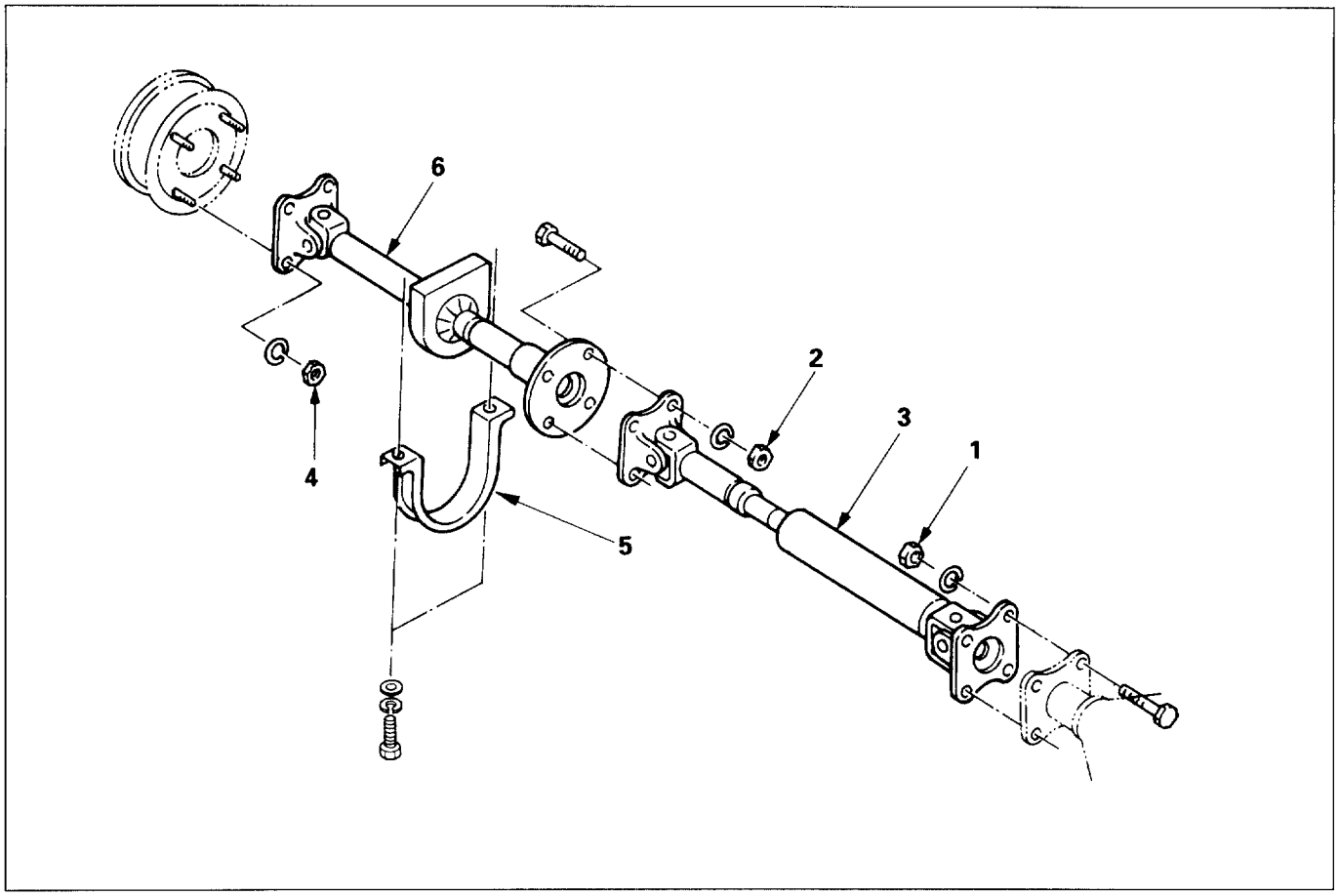
Front Drive Propeller Shaft

NPS Model



ON-VEHICLE SERVICE

Rear Drive Propeller Shaft



Removal Steps

(Long wheel base models)

1. Differential side nut
2. Center bearing side nut
3. 2nd propeller shaft
4. Transmission side nut
5. Center bearing bracket
6. 1st propeller shaft

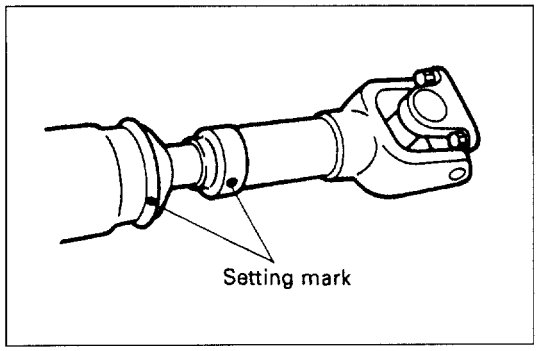
(Short wheel base models)

1. Differential side nut
3. Propeller shaft assembly
4. Transmission side nut

Installation Steps

To install, follow the removal steps in the reverse order.

REMOVAL



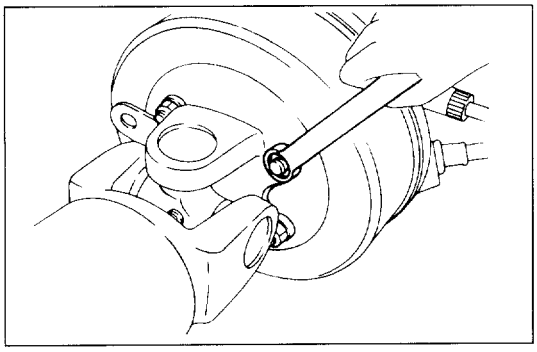
Preparation:

Since the propeller shaft assembly is carefully balanced, a setting mark should be applied to the joints (1st propeller shaft and parking brake drum, 1st propeller shaft and 2nd propeller shaft, 2nd propeller shaft and final drive flange), before removal in to original position.

1. **Differential Side Nut**
2. **Center Bearing Side Nut**
3. **2nd Propeller Shaft**
4. **Transmission Side Nut**
5. **Center Bearing Bracket**
6. **1st Propeller Shaft**

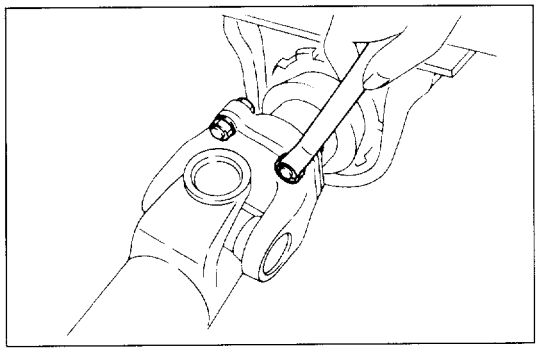
INSTALLATION

6. **1st Propeller Shaft**
5. **Center Bearing Bracket**



4. **Transmission Side Nut**

Transmission Side Nut Torque	N•m (kg•m/lb•ft)
M10	63 (6.4/46)
M12	103 (10.5/76)

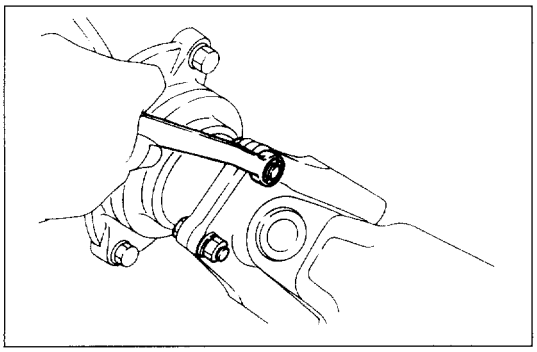


3. **2nd Propeller Shaft**

Center Bearing Side Nut Torque	N•m (kg•m/lb•ft)
M10	63 (6.4/46)
M12	103 (10.5/76)

2. **Center Bearing Side Nut**

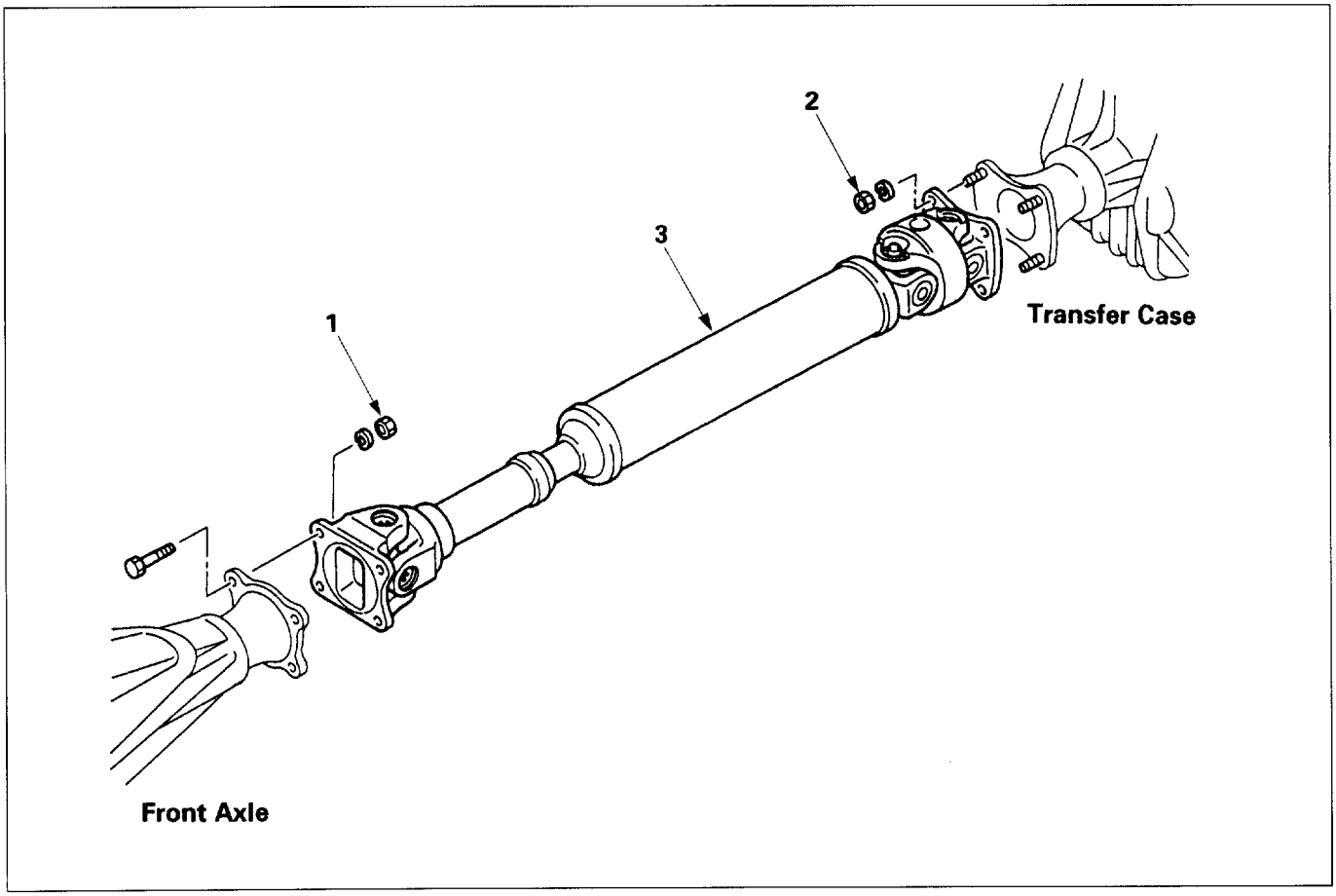
Center Bearing Bracket Bolt Torque	N•m (kg•m/lb•ft)
40 (4.1/30)	



1. Differential Side Nut

Differential Side Nut Torque	N•m (kg•m/lb•ft)
M10	63 (6.4/46)
M12	103 (10.5/76)

Front Drive Propeller Shaft

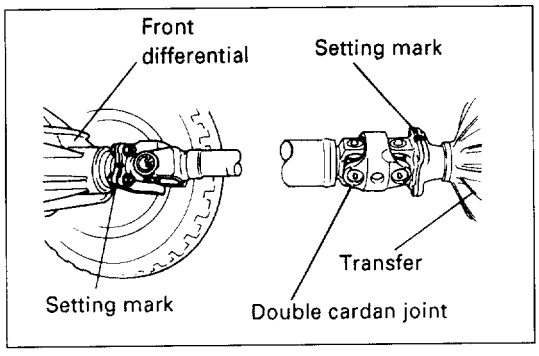


Removal Steps

1. Differential side nut
2. Transfer case side nut
3. Propeller shaft assembly

Installation Steps

To install, follow the removal steps in the reverse order



REMOVAL

Preparation:

Since the propeller shaft assembly is carefully balanced, a setting mark should be applied to the joints, before removal in to original position.

1. **Differential Side Nut**
2. **Transfer Case Side Nut**
3. **Propeller Shaft Assembly**

NOTE:

- **The double cardan joint can not be disassembled. When it is defective, replace it as a propeller shaft assembly.**
- **Be sure not to bend double cardan joint at an angle of 30° or more. Futher, be careful removing or carrying the assembly not to shock the double cardan joint.**

INSTALLATION

3. **Propeller Shaft Assembly**
2. **Transfer Case Side Nut**

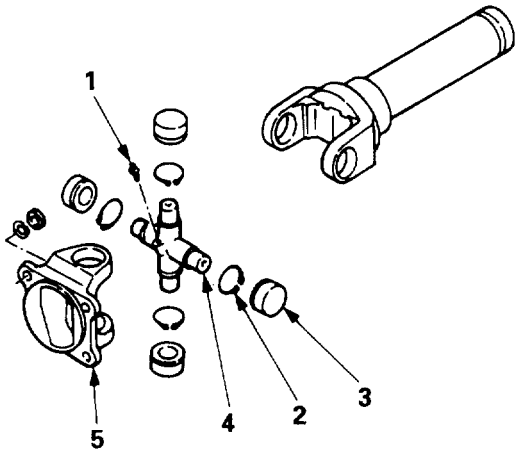
Transfer Case Side Nut Torque	N•m (kg•m/lb•ft)
M12	103 (10.5/76)

1. **Differential Side Nut**

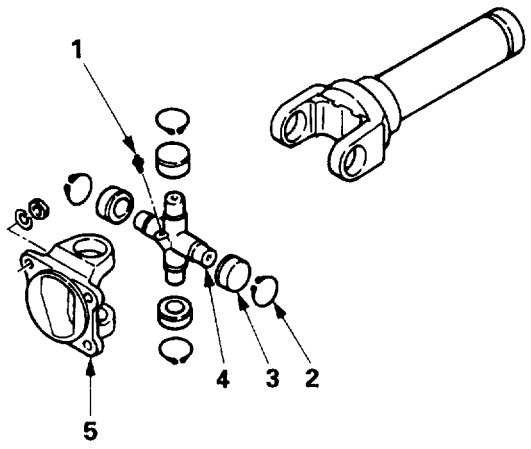
Differential Side Nut Torque	N•m (kg•m/lb•ft)
M12	103 (10.5/76)

UNIT REPAIR

Universal Joint



Inside Type
NHR
NKR 55, 69
NPR 55, 69



Outside Type
NKR 58, 66
NPR 58, 59, 65, 66,70,71
NQR
NPS

Disassembly Steps

1. Grease fitting
2. Snap ring
3. Needle roller bearing
4. Spider
5. Flange yoke

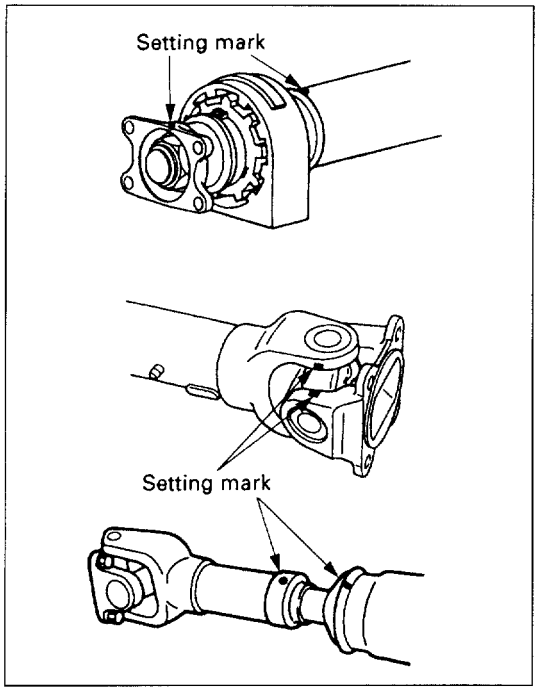
Reassembly Steps

To reassemble, follow the disassembly steps in the reverse order.

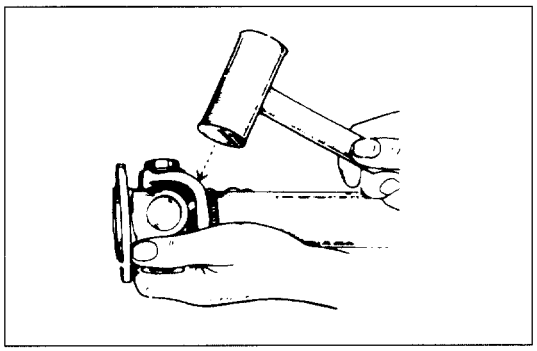
DISASSEMBLY

Preparation:

Since the propeller shaft assembly is carefully balanced, a setting mark should be applied to the joints, before disassembly.



1. **Grease Fitting**
2. **Snap Ring**



3. **Needle Roller Bearing**

   Tap out the bearing by applying a shock to the shoulder of the yoke, using a copper hammer. Remove the needle roller bearings remaining in position by tapping lightly on the spider.

   Remove the remaining bearings in the similar manner.

4. **Spider**
5. **Flange Yoke**

INSPECTION AND REPAIR

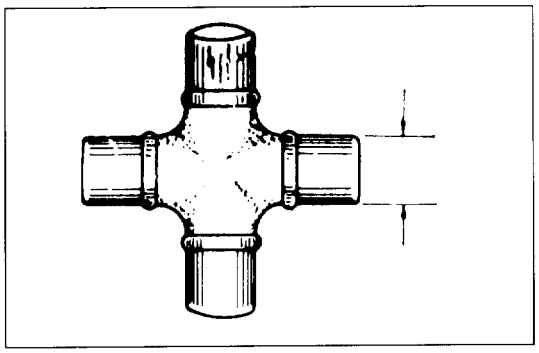
Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.

Spider
Needle roller bearing
Yoke
Flange
Center bearing
Cushioning rubber
Bracket

Visual Check

Inspect following parts for wear, damage or other abnormal conditions.

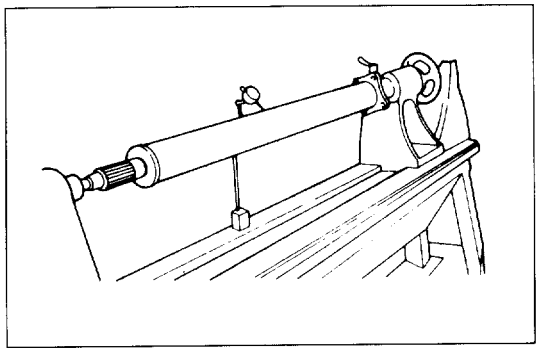
NOTE:
When any part of the journal assembly requires replacement, be sure to replace the entire assembly.



Outside Diameter of Spider Pins

mm (in.)

	Standard	Limit
NHR, NKR55, 69 NPR55, 69	18.46 (0.73)	18.36 (0.72)
NKR58, 66 NPR58, 59, 66, 65 NQR66, 71,NPS	21.94 (0.86)	21.84 (0.8598)
NQR70	23.02 (0.906)	22.8 (0.898)

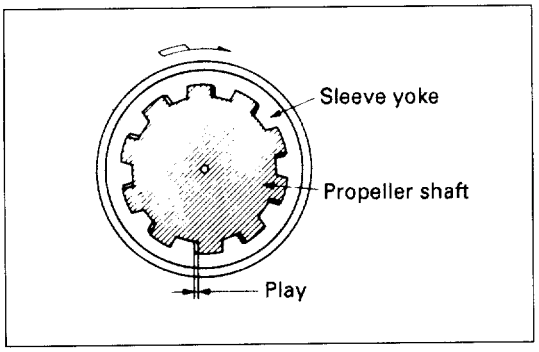


Propeller Shaft Run-Out

Support the propeller shaft at its ends and check for run-out by holding the probe of a dial indicator agains the center part of the shaft.
If the amount of run-out it beyond the standard value for assembly, correct with a bench press or replace with a new one.

mm (in.)

Standard	Limit
0.5 (0.02) or less	1.0 (0.039)

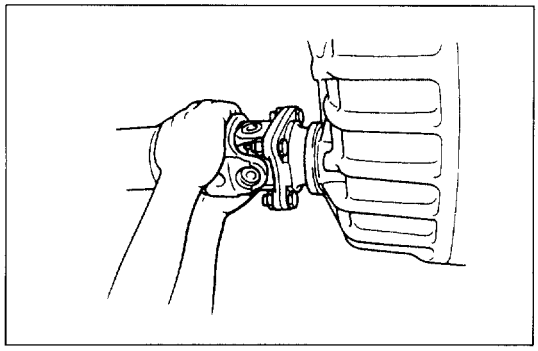


Play in Splines in Normal Direction of Rotation

Check the amount of play in the sleeve yoke and propeller shaft splines in direction of rotation using a pointed feeler gauge.

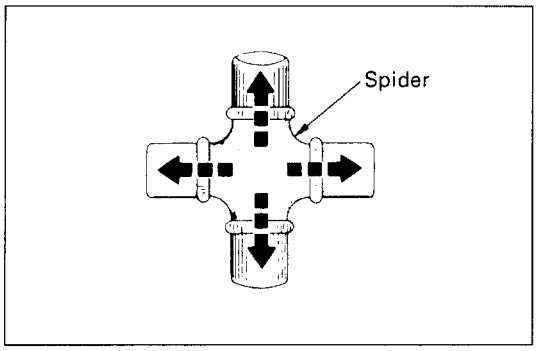
mm (in.)

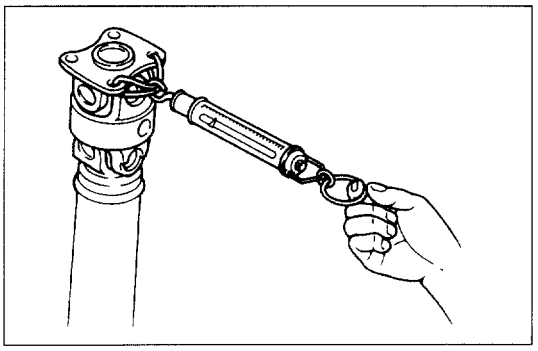
Standard	Limit
0.1 (0.0039)	0.3 (0.012)



Checking of Play of Double Cardan Joint (Front Propeller Shaft Only)

1. Check the double cardan joint for play in the direction of the spider shaft. When there is an excessive play found, replace it as a propeller shaft assembly.





Preload Checking of The Double Cardan Joint (Front Propeller Shaft Only)

(1) As shown in the illustration left, tie a wire firmly by passing it through the bolt holes which are in the same direction with the flange yoke shaft.

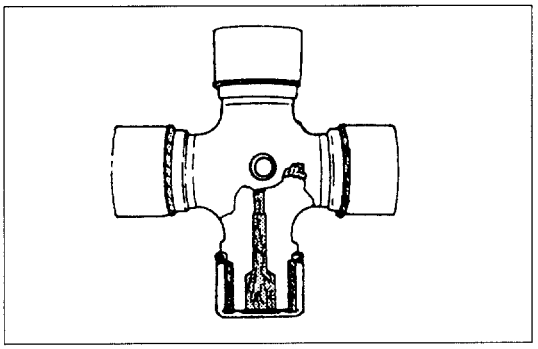
(2) Hook a spring balance at the center of the wire, and pull the spring balance in the direction of a right angle.

(3) Measure the value and check if the reading of the spring balance is within the specified value at the moment when the flange starts to move.

Preload	N (kg/lb)
	52 (5.3/11.7)

LUBRICATION

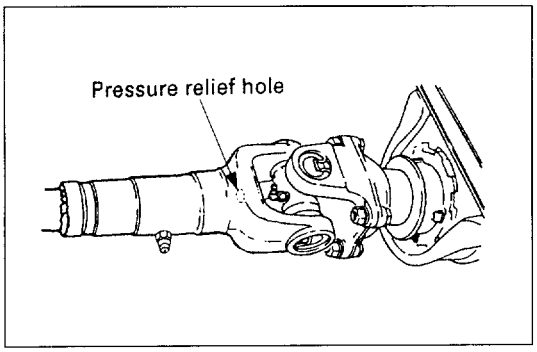
Universal Joints



Universal joints are drilled and provided with a lubrication fitting through which the lubricant travels to all four bearing caps, direct to the needle bearing. Needle bearings are protected against lubricant leakage and the entrance of foreign matter by seals.

1) Lubricate with a chassis lubricant.

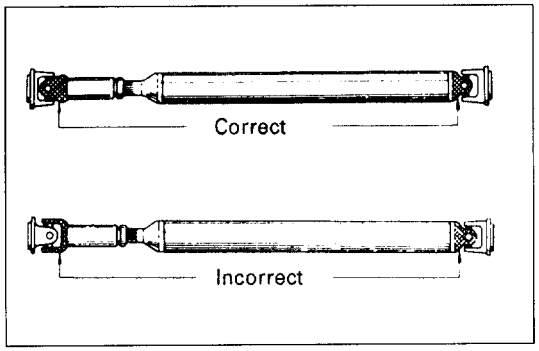
2) When greasing the joint, a flow of grease at all four trunnion seals must be visible to ensure lubrication of the U-joint. If grease does not appear at all four trunnion seals, the universal joint should be rotated while applying lubricant under pressure to relieve any air lock inside the joint which would prevent lubricant from reaching the bearing area.



Sliding Spline Sections

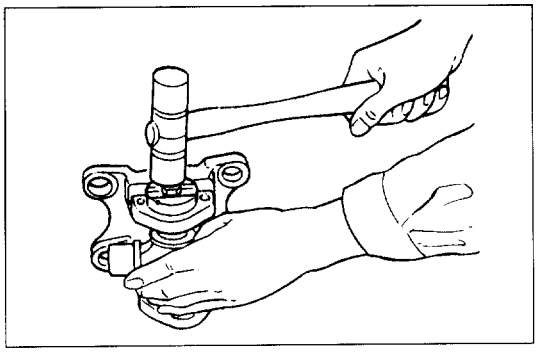
Apply grease gun pressure to the lubrication fitting until lubricant appears at the pressure relief hole as shown in the figure. Now cover the pressure relief hole with your finger and continue to apply pressure until grease appears at the sleeve yoke seal as shown in the figure.

REASSEMBLY



5. Flange Yoke

The flange yoke at end of the propeller shaft should be in alignment with the spline yoke as illustrated. The direction of the flange yoke at each end of the propeller shafts (setting mark) are in alignment.



4. Spider

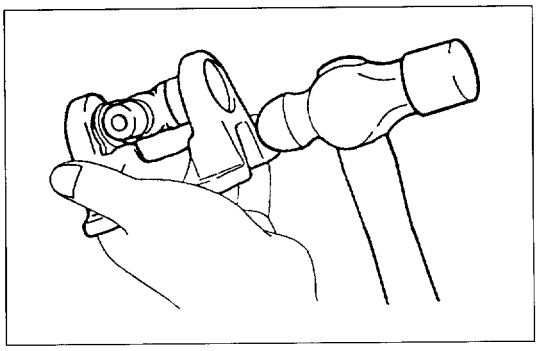
3. Needle Roller Bearing

Apply MoS_2 grease to lip of the oil seal and needle roller bearing.

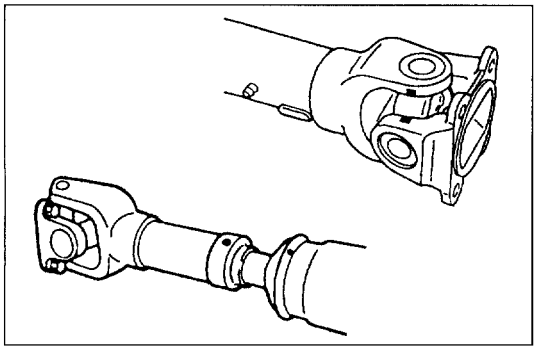
NOTE:
Excessive greasing could make the bearing difficult to install or make accurate data unobtainable for the selection of the right snap ring.

Assemble the spider to the flange yoke. Using the spider as a guide, install the needle roller bearing into the hole in the arm of the flange yoke by press or tapping with a soft-faced hammer.

CAUTION:
- **The needle roller bearing cannot be installed smoothly if is set at an incorrect angle with the flange.**
- **Excessive hammering will damage the needle roller bearing.**



Eliminate the clearance between snap ring and bearing by striking the yoke with a hammer.



Align setting marks and join the yokes.

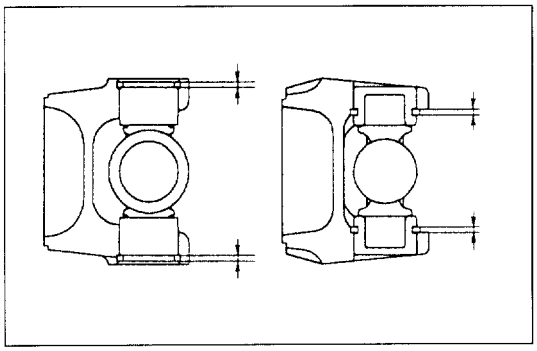
2. **Snap Ring**

   Discard used snap ring and install new one.
   When the bearing is fitted into position, select and install the snap ring of suitable thickness so that the end play of the spider pin is held within 0.1 mm.

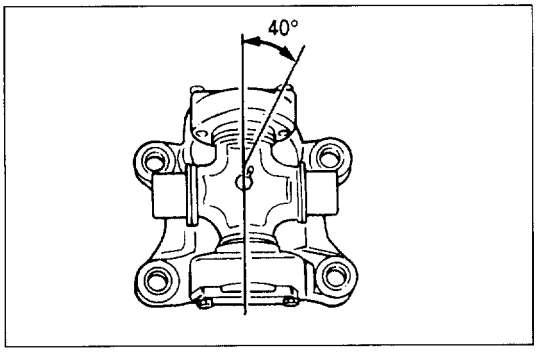
Thickness of Snap Ring Available mm (in.)

NHR, NKR55, 69, NPR55, 69	
Snap ring thickness	Identification color
1.5 (0.059)	Blue
1.53 (0.060)	White
1.59 (0.063)	Yellow
1.62 (0.064)	Green
1.68 (0.066)	Not colored

NKR58, 66, NPR58, 59, 65, 66, 70,71,NQR66, 71,NPS	
Snap ring thickness	Identification color
1.95 (0.077)	Blue
2.00 (0.079)	White
2.05 (0.081)	Yellow or Not colored



NOTE:
Be sure to use snap rings of the same thickness on both sides.

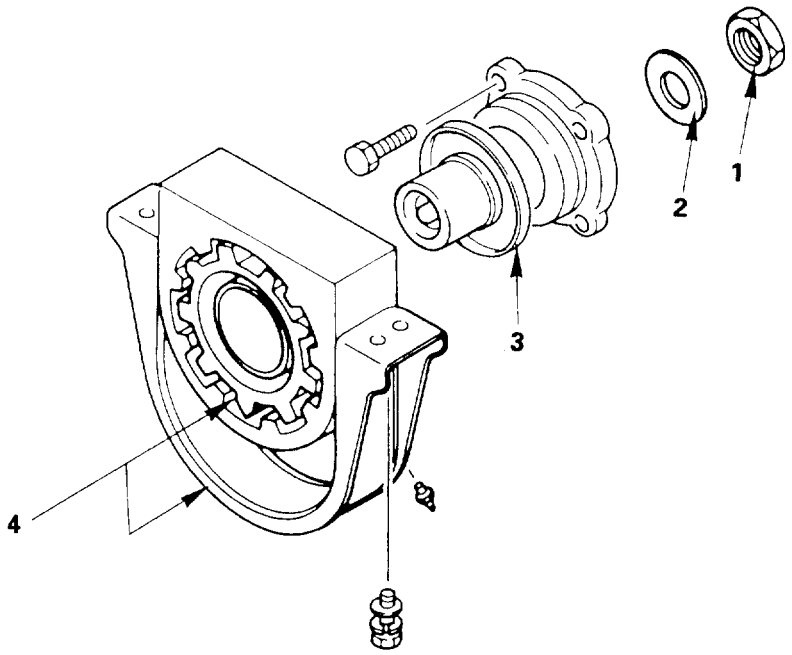


1. **Grease Fitting**

   Install the grease fitting at an angle of approximately 40 degrees to the spider. The parts should be so installed that all grease fittings are pointed upward.

Center Bearing

NKR 58, 66
NPR 58, 59, 65, 66, 70, 71
NQR
NPS

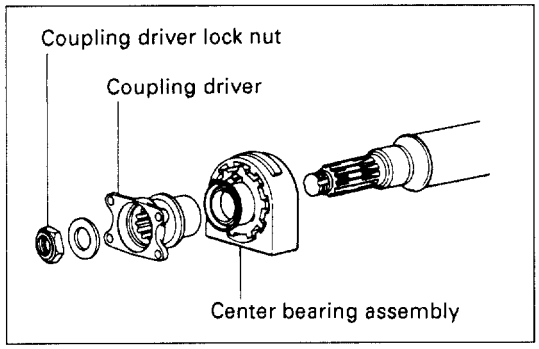


Disassembly Steps

1. Lock nut
2. Washer (NQR70 only)
3. Coupling driver
4. Center bearing assembly

Reassembly Steps

To reassemble, follow the disassembly steps in the reverse order.



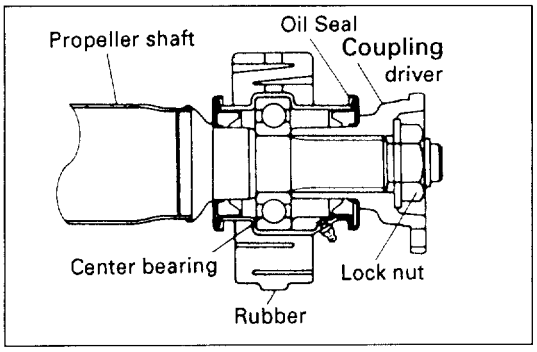
DISASSEMBLY

1. **Lock Nut**
2. **Washer** (NQR70 only)
3. **Coupling Driver**

   Apply alignment marks on the flange and tube assembly.
4. **Center Bearing Assembly**

NOTE:
The center bearing can not be disassembled.

REASSEMBLY



4. Center Bearing Assembly

Install the center bearing assembly so that the grease fitting side is faced toward the coupling driver side.

When pressing in the center bearing, the bearing should be pressed through a coupling driver to avoid bearing damage.

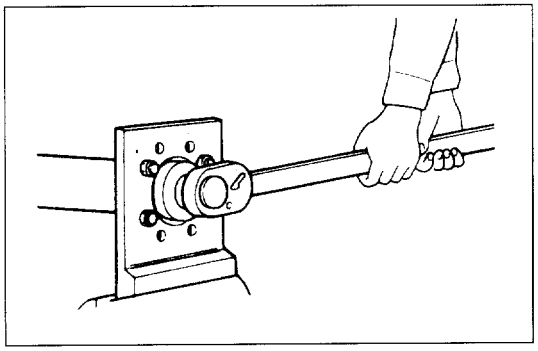
Apply bearing grease to lip of the oil seal and center bearing.

Amount of grease required	g (oz)
Except NQR70	20–25 (0.7–0.9)
NQR70	40–50 (1.4–1.8)

3. Coupling Driver

Be sure to align the setting marks described before disassembling.

2. Washer



1. Lock Nut

Set a special tool into a vice then attach the propeller shaft assembly.

Flange bracket: 9-8529-2101-0

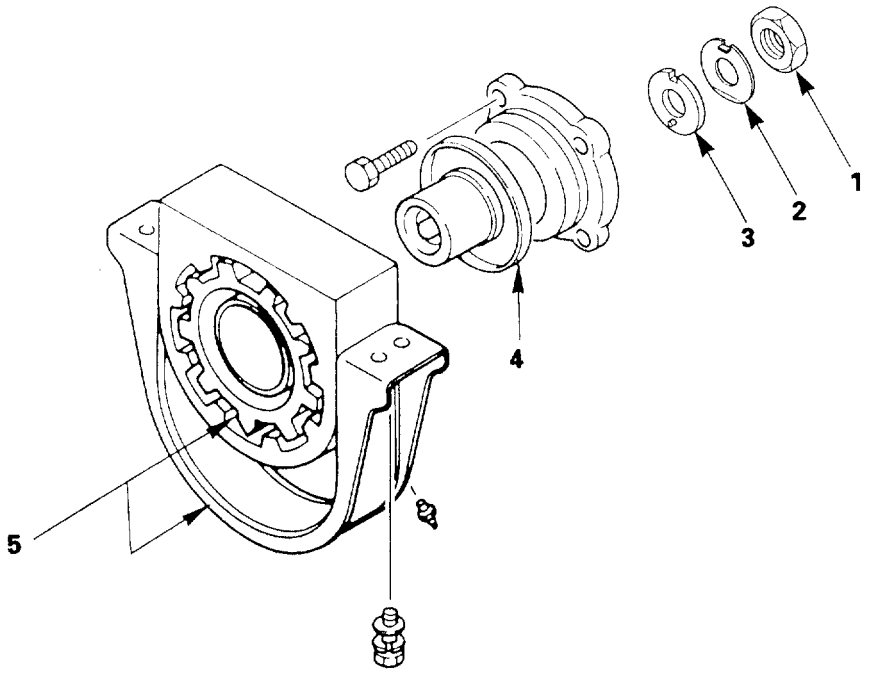
Discard used flange nut and install new one.

Lock Nut Torque	N•m (kg•m/lb•ft)
NQR70	441 (45/325)
Except NQR70	539 (55/398)

Caulk the lock nut at the V-shaped groove portion of the shaft.

Center Bearing

NKR 55, 69
NPR 55, 69

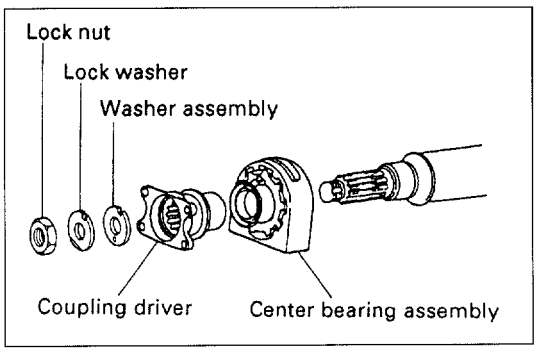


Disassembly Steps

1. Lock nut
2. Lock Washer
3. Washer assembly
4. Coupling driver
5. Center bearing assembly

Reassembly Steps

To reassemble, follow the disassembly steps in the reverse order.



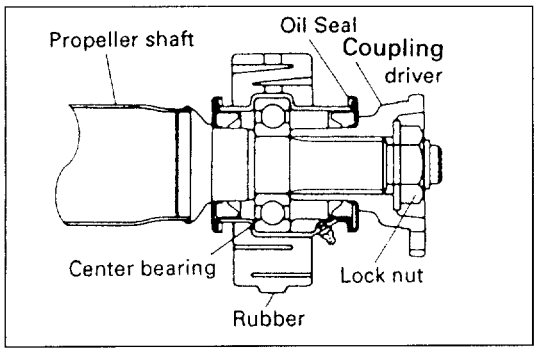
DISASSEMBLY

1. **Lock Nut**
2. **Lock Washer**
3. **Washer Assembly**
4. **Coupling Driver**

   Apply alignment marks on the flange and tube assembly.
5. **Center Bearing Assembly**

NOTE:
The center bearing can not be disassembled.

REASSEMBLY



5. Center Bearing Assembly

Install the center bearing assembly so that the grease fitting side is faced toward the coupling driver side.

When pressing in the center bearing, the bearing should be pressed through a coupling driver to avoid bearing damage.

Apply bearing grease to lip of the oil seal and center bearing.

Amount of grease required	g (oz)
20–25 (0.7–0.9)	

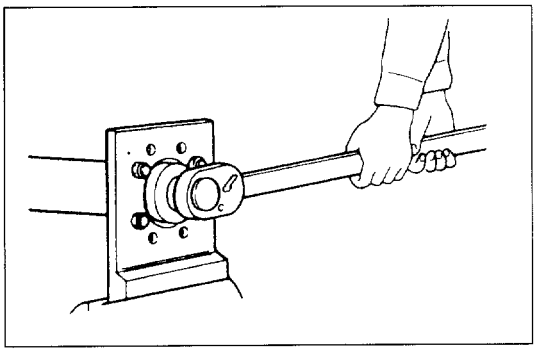
4. Coupling Driver

Be sure to align the setting marks described before disassembling.

3. Washer Assembly

2. Lock Washer

Discard used lock washer and install new one.

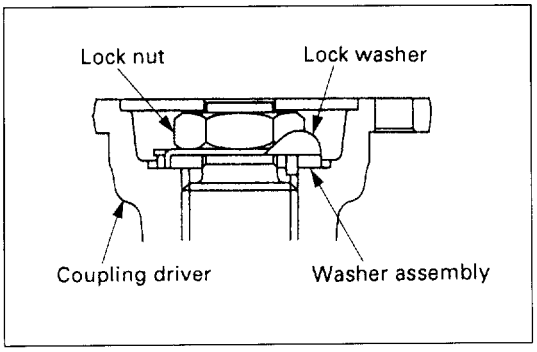


1. Lock Nut

Set a special tool into a vice then attach the propeller shaft assembly.

Flange bracket: 9-8529-2101-0

Lock Nut Torque	N•m (kg•m/lb•ft)
118 (12/87)	



After tightening the lock nut to specified torque, bend a part of the lock washer to the nut side.

SECTION 4B
REAR AXLE

CONTENTS

PAGE

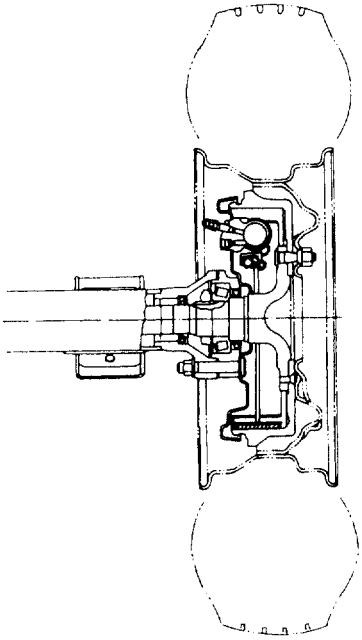
General Description 4B- 2
On-Vehicle Service 4B- 5
Rear Hub and Brake Drum (NHR Model; Semi Floating) 4B- 5
Rear Hub and Brake Drum (NKR Model; Full Floating) 4B-11
Rear Hub and Brake Drum (NHR, NKR, NPR, NQR, NPS Models; Full Floating) 4B-16
Rear Axle Assembly 4B-26
Differential Assembly (NHR Single Tire Model; Semi Floating) 4B-29
Differential Assembly (NKR Single Tire and All Dual Tire Models; Full Floating) 4B-31
Unit Repair 4B-34
244 mm Rear Differential 4B-34
Major Component 4B-34
Differential Cage Assembly 4B-45
292/320 mm Rear Differential 4B-48
Major Component 4B-48
Differential Cage Assembly 4B-54
Drive Pinion Cage Assembly 4B-58
Limited Slip Differential (LSD); Viscose Type 4B-62
Limited Slip Differential (LSD); Friction Type 4B-64

GENERAL DESCRIPTION

Hub and Drum

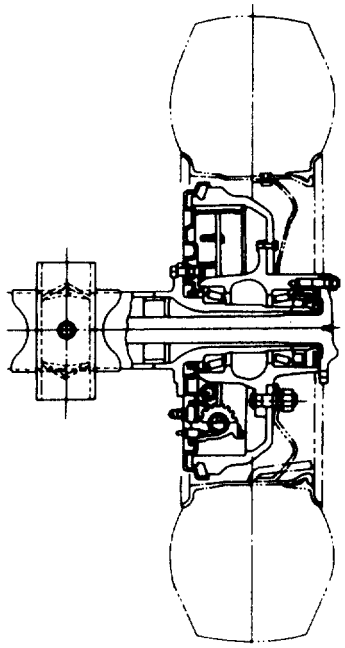
NHR Model

Single Tire (Semi Floating Type)

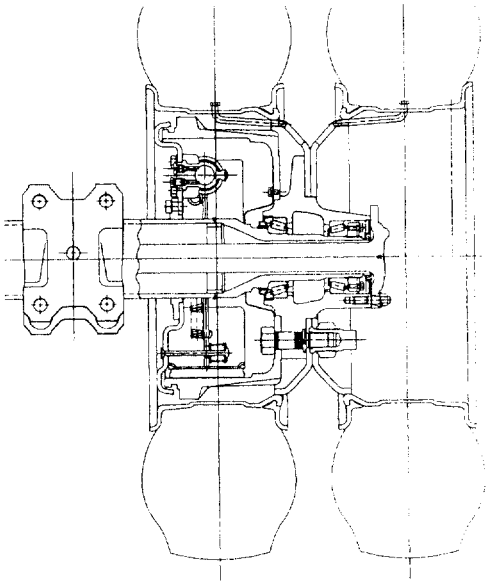


NKR Model

Single Tire (Full Floating Type)

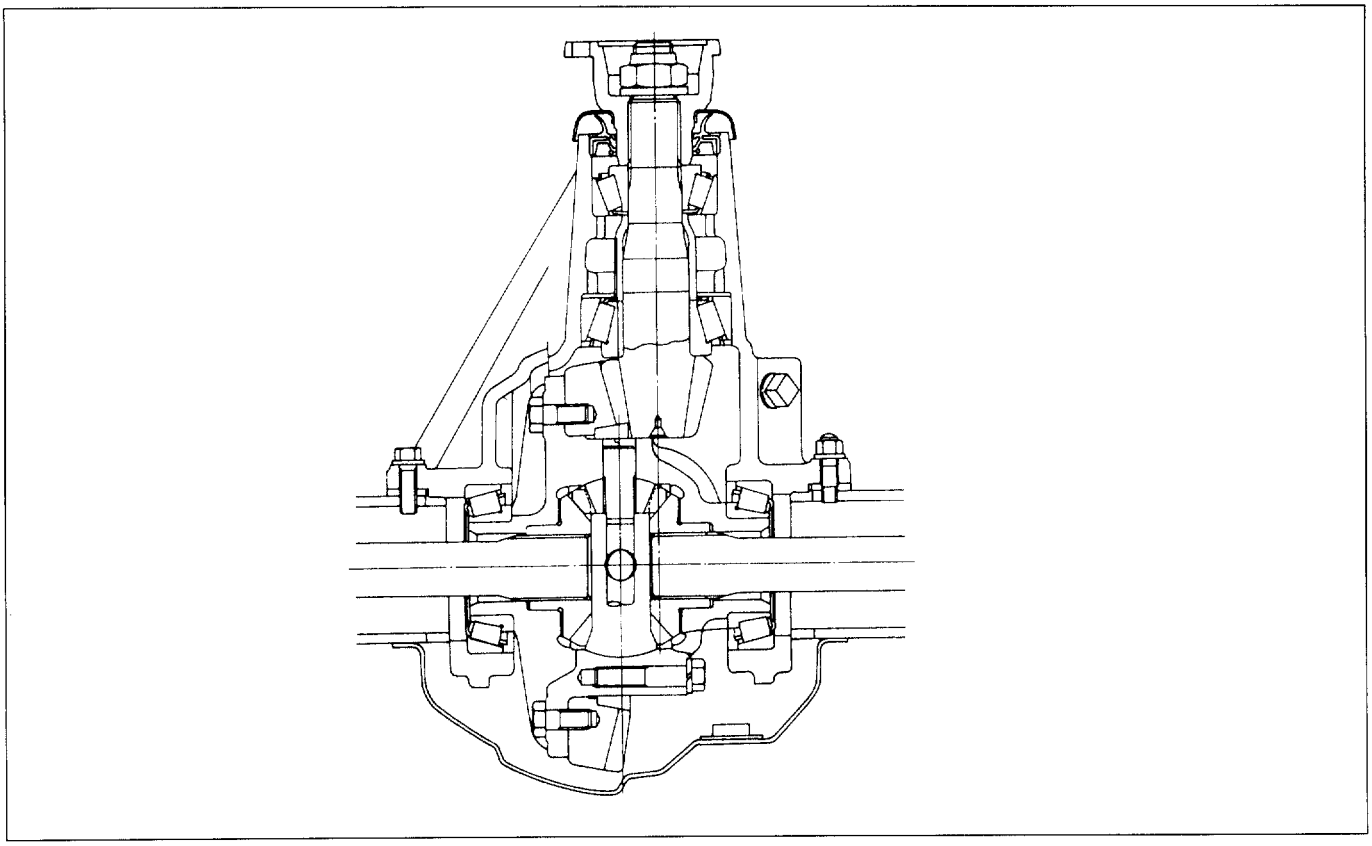


NHR, NKR, NPR, NQR, NPS66 Models (Dual Tire)

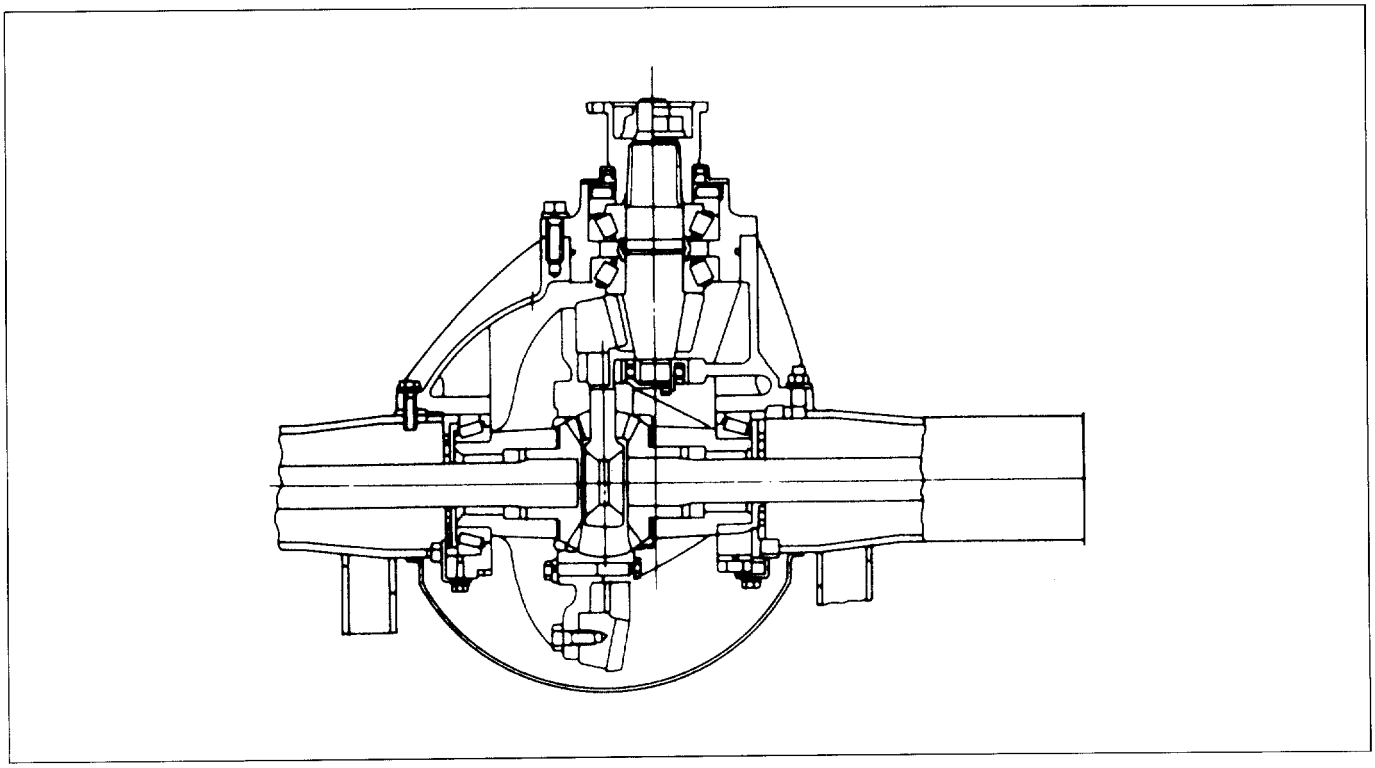


Differential Carrier Assembly

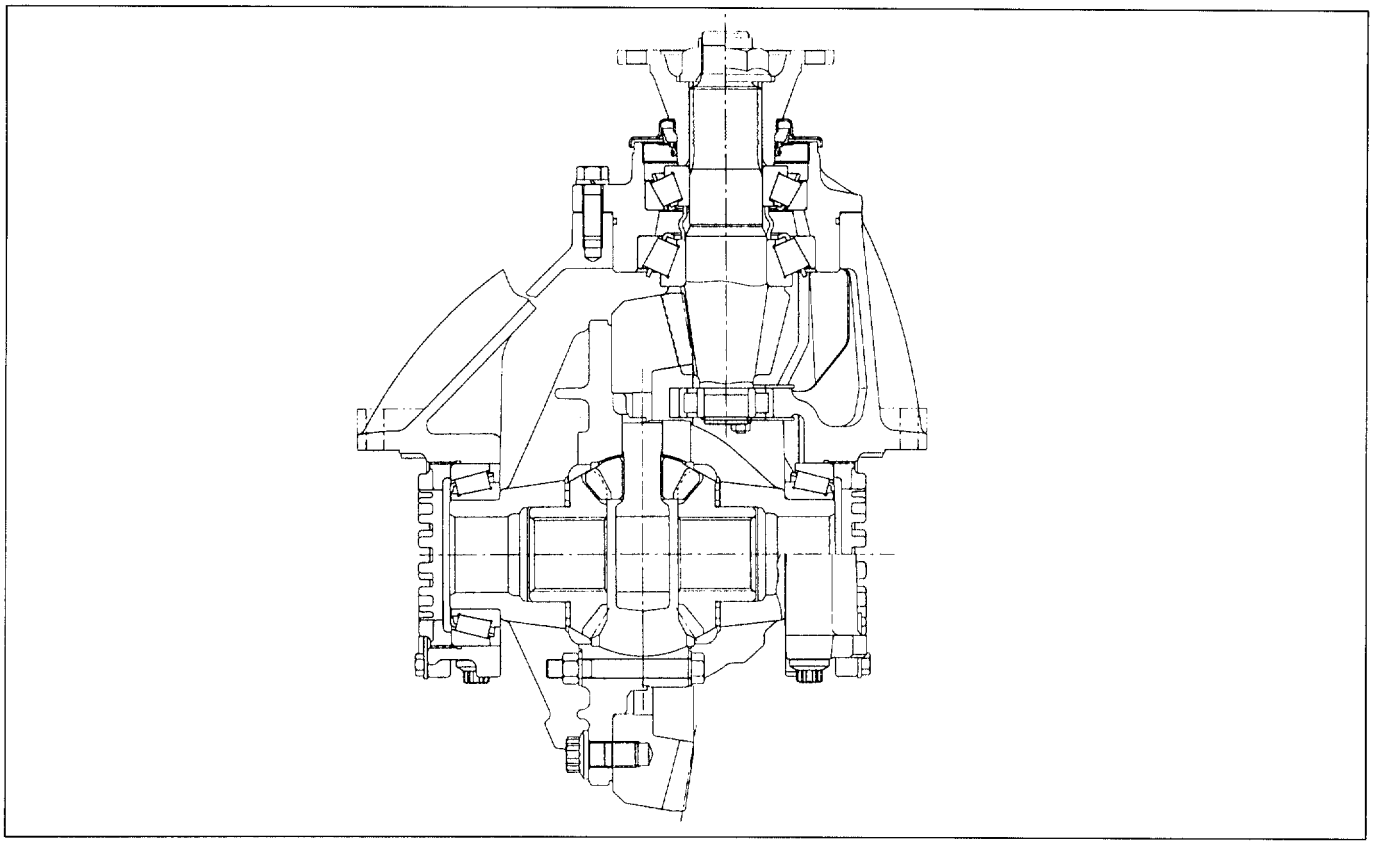
244 mm (9.6 in) size



292 mm (11.5 in) size

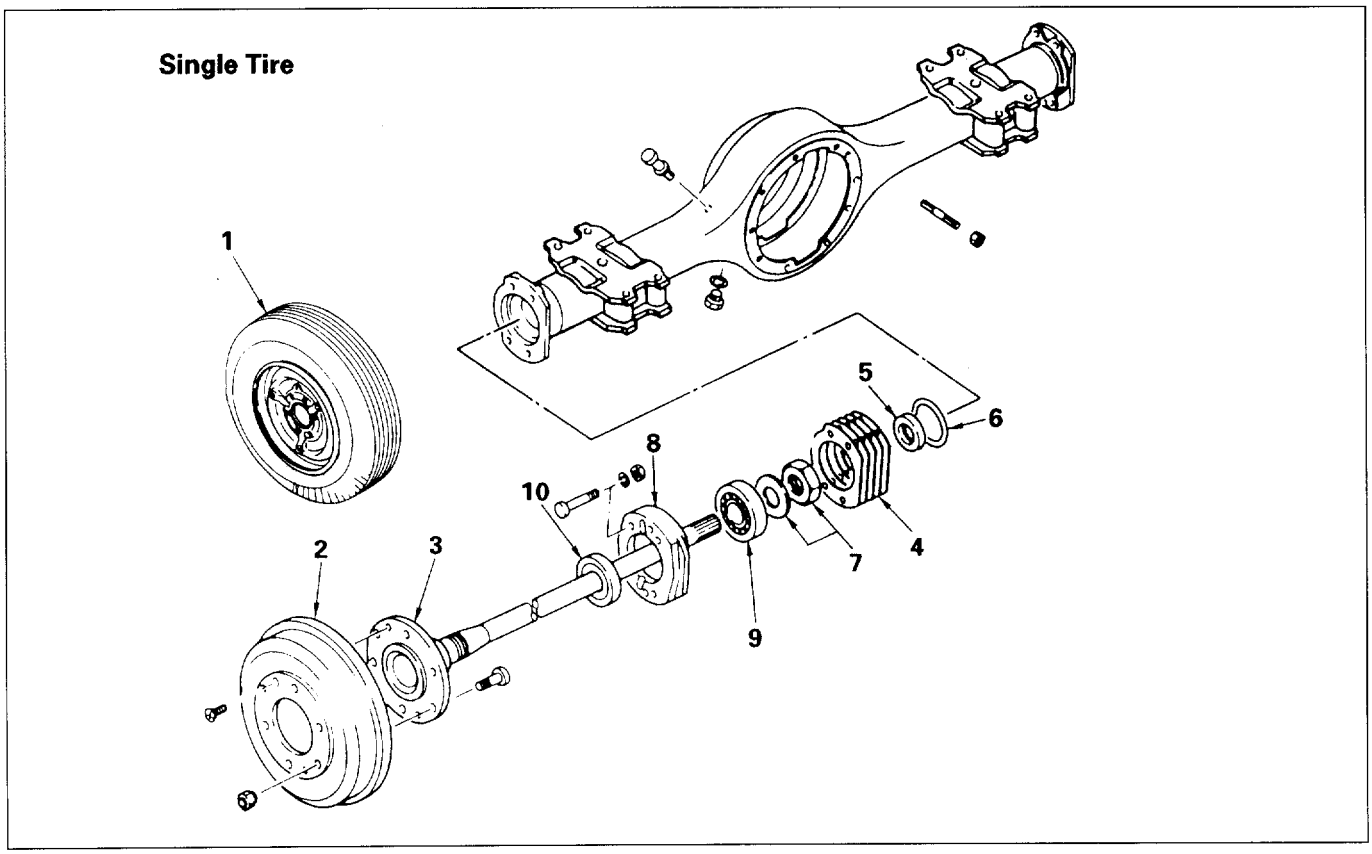


320 mm (12.5 in) size



ON-VEHICLE SERVICE

REAR HUB AND BRAKE DRUM (NHR MODEL; SEMI FLOATING)



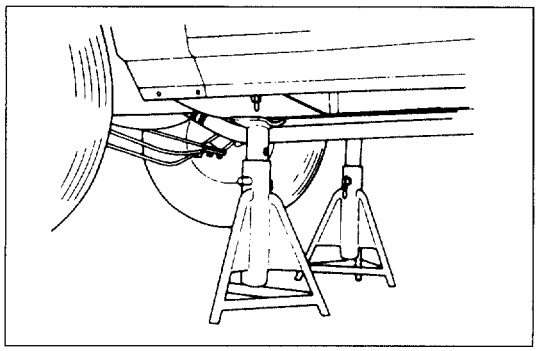
Removal Steps

1. Wheel and tire
2. Brake drum
3. Axle shaft with brake assembly
4. Shim
5. Axle case oil seal
6. O-ring
7. Bearing lock nut and washer
8. Bearing holder
9. Bearing
10. Oil seal

Installation Steps

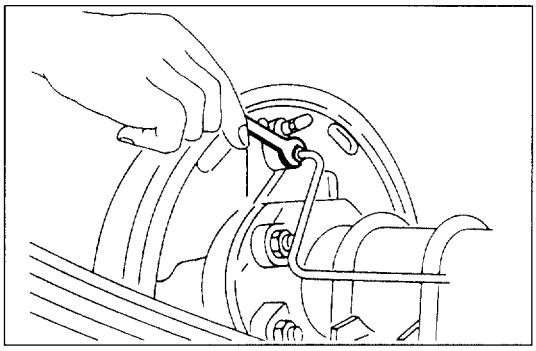
To install, follow the removal steps in the reverse order.

REMOVAL



Preparation:

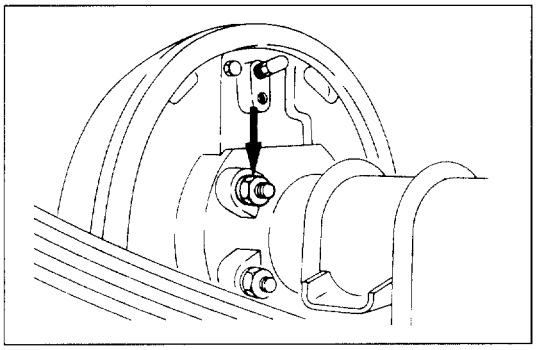
Raise vehicle to working level.
Support the axle assembly with a suitable jack and chassis stands.



1. **Wheel and Tire**
2. **Brake Drum**

   Before disassembly of axle shaft assembly, disconnect the following parts.

   Disconnect the brake pipe from brake wheel cylinder on the back plate.



3. **Axle Shaft with Brake Assembly**

   Remove four nuts from the bearing holder fixing-bolts.

4. **Shim**
5. **Axle Case Oil Seal**
6. **O-ring**
7. **Bearing Lock Nut and Washer**

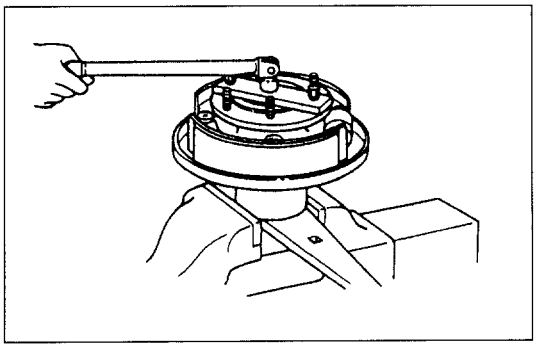
   (1) Flatten the locking portion on the lock nut.

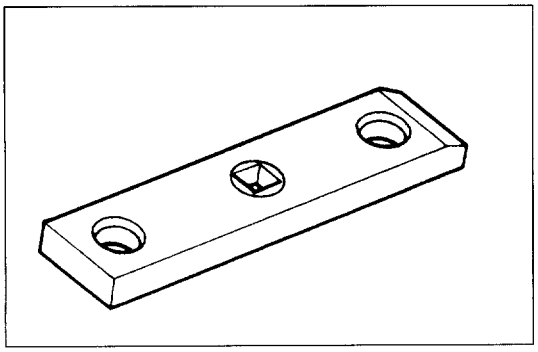
   (2) Clamp special tool; wrench into vise, and mount axle shaft into wrench.

   Wrench: 5-8840-2329-0

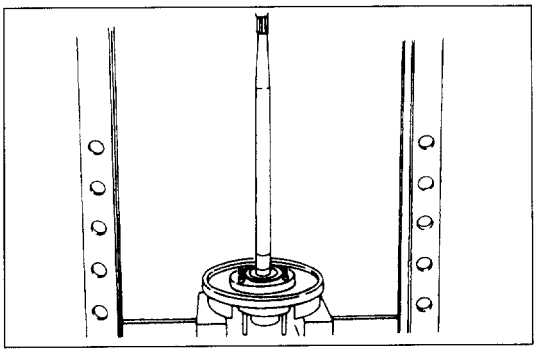
   (3) Install special tool onto flange studs, lock into position with two wheel nuts, and turn axle shaft loose from lock nut.

   Remover: 5-8840-2003-0





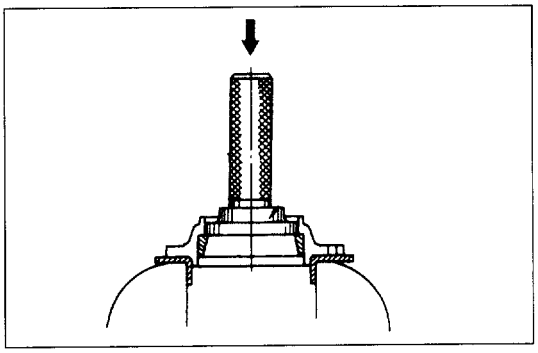
NOTE:
Because of the high torque on the locknut, it is sometimes advantageous to have an assistant when performing this operation.



8. Bearing Holder

Remove the bearing holder and bearing from the axle shaft by means of a press.

NOTE:
Only a slight amount of pressure from the press is required to loosen bearing from the shaft. Be sure to support the backing plate solidly, and to hold onto the axle shaft to prevent it from falling to the floor.



9. Bearing

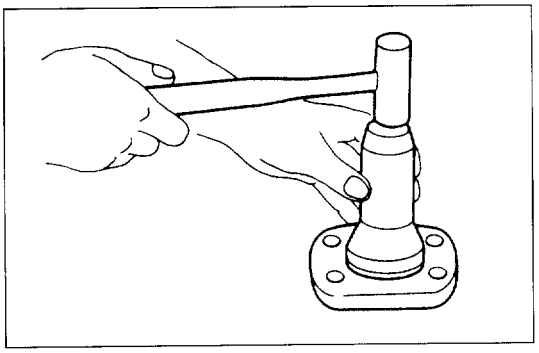
Drive out the bearing outer race using a special tool.

Remover: 9-8521-1772-0

Grip: 9-8522-1148-0

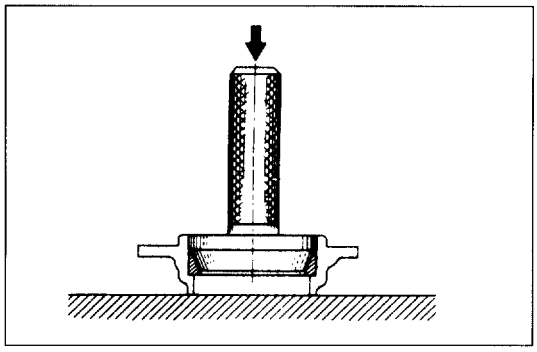
10. Oil Seal

INSTALLATION



10. Oil Seal

Installer: 9-8522-1269-0

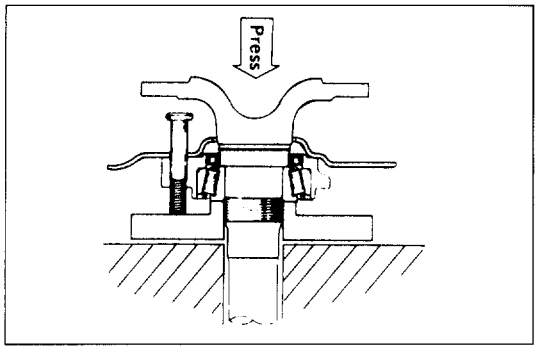


9. Bearing

Installer: 9-8522-1268-0

Grip: 9-8522-1148-0

Apply generous amount of grease to the bearing inner race.



8. Bearing Holder

(1) Insert four through-bolts into back plate.

(2) Install bearing holder to back plate.

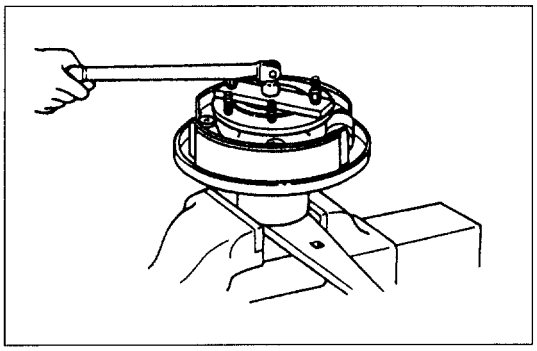
(3) Install the above parts onto the axle shaft.

(4) Install bearing over axle shaft and press into bearing holder.

Installer: 9-8522-1271-0

7. Bearing Lock Nut and Washer

(1) Install the washer with the washer tab inserted to the groove on the axle shaft.

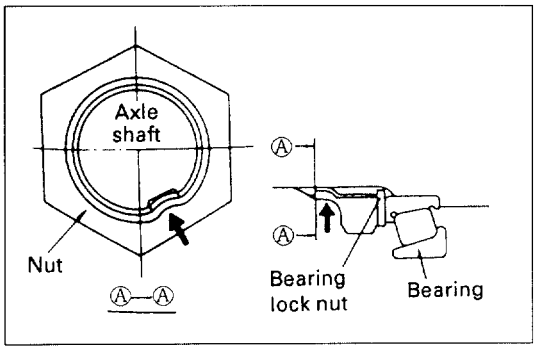


(2) Discard used bearing lock nut and install a new one into the position by using a vise and special tools.

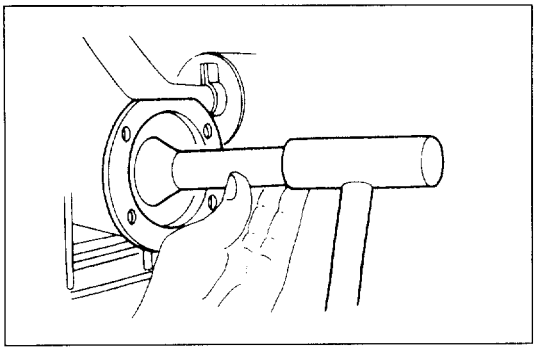
Installer: 5-8840-2003-0

Wrench: 5-8840-2329-0

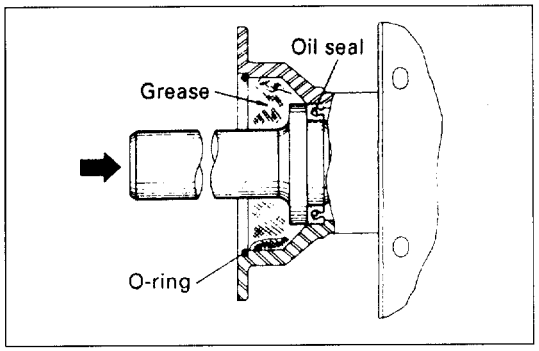
Bearing Lock Nut Torque	N•m (kg•m/lb•ft)
	260 (26.5/192)



(3) Stake the bearing lock nut at groove portion on the axle shaft.



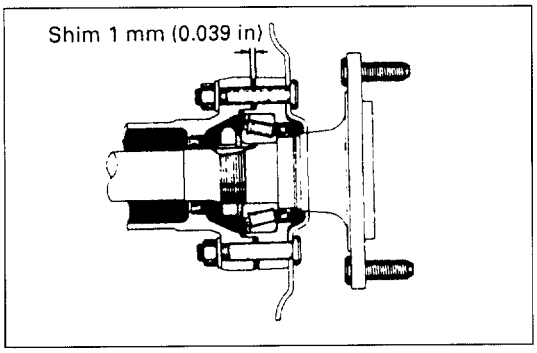
6. **O-Ring**
5. **Oil seal; Axle Case**
   (1) Installer: 9-8522-1272-0



(2) Apply measured amount of good quality grease to the inner face of the rear axle case.

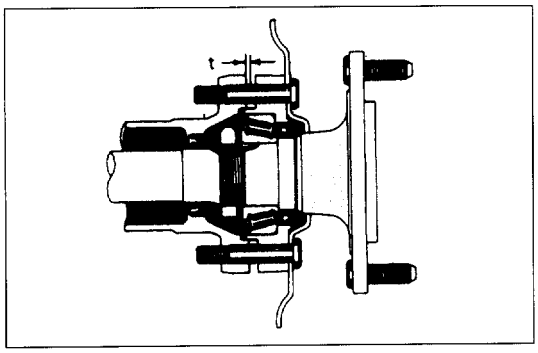
g (oz)

Type of grease:	Wheel bearing grease of Multipurpose type grease
Amount of grease required:	80 (2.8)



4. **Shim**
   Install the axle shaft assembly to the axle case with a 1 mm (0.039 in) thick shim fitted in position between the bearing holder and axle case flange. Install and tighten the bolts evenly in progression.

Bearing Holder Nut Torque	N•m (kg•m/lb•ft)
	74 (7.5/54)

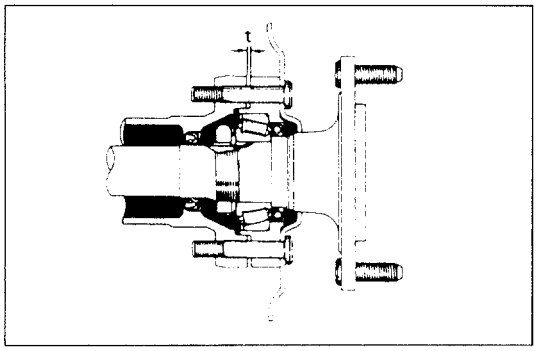


Install the axle shaft assembly on the opposite side and push it in until it is fitted against the differential thrust block.

Then, measure the clearance (t) between the bearing holder and axle case flange and determine the thickness of the shim to be installed by the following formula:

Measured clearance (t) + 0.3 mm (0.012 in.)=thickness of shim to be installed.

Thickness of Shims Available	mm (in.)
	0.05, 0.076, 0.13, 0.5, 1.0 (0.002, 0.003, 0.005, 0.02, 0.04)



3. Axle Shaft with Brake Assembly

Bearing Holder Nut Torque	N•m (kg•m/lb•ft)
	74 (7.5/54)

- Connect the brake pipes to wheel cylinder.
- Brake air bleeding, refer to servicing to Section 5 "Brake".

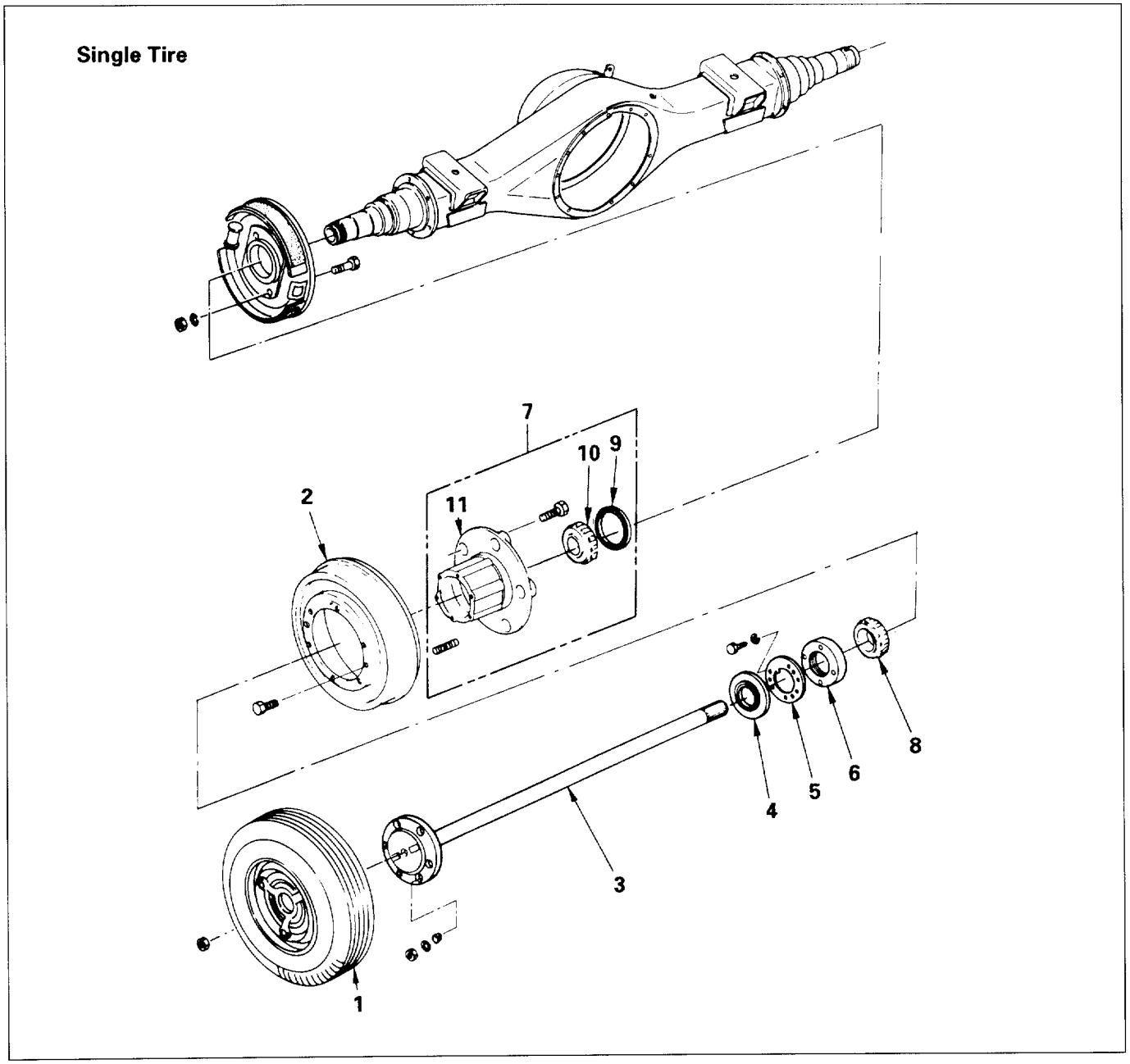
NOTE:
To install the axle shaft assembly, follow the reassembly procedure outline under the Section 5 "Brake".

2. Brake Drum

1. Wheel and Tire

Wheel Nut Torque	N•m (kg•m/lb•ft)
	167 (17/123)

REAR HUB AND BRAKE DRUM (NKR MODEL; FULL FLOATING)



Removal Steps

1. Wheel and tire
2. Brake drum
3. Axle shaft
4. Outer oil seal
5. Lock washer
6. Bearing Lock Nut
7. Hub assembly
8. Outer bearing
9. Inner oil seal
10. Inner bearing
11. Hub

Installation Steps

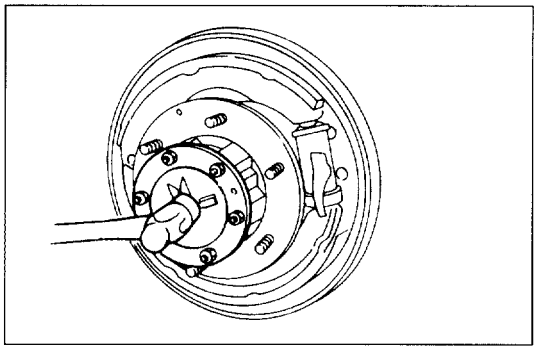
11. Hub
10. Inner bearing
9. Inner oil seal
8. Outer bearing
7. Hub assembly
6. Bearing lock nut
5. Lock washer
4. Outer oil seal
3. Axle shaft
2. Brake drum
1. Wheel and tire

REMOVAL

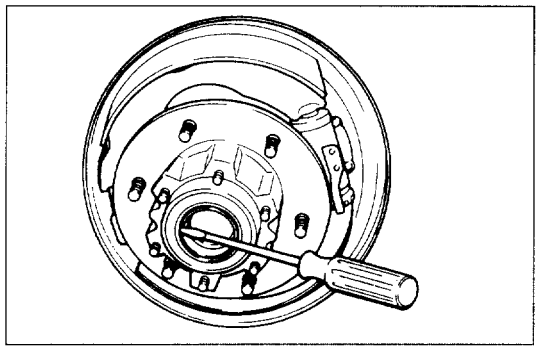
Preparation:

Jack up and support the vehicle on stands.

1. **Wheel and Tire**
2. **Brake Drum**
3. **Axle Shaft**



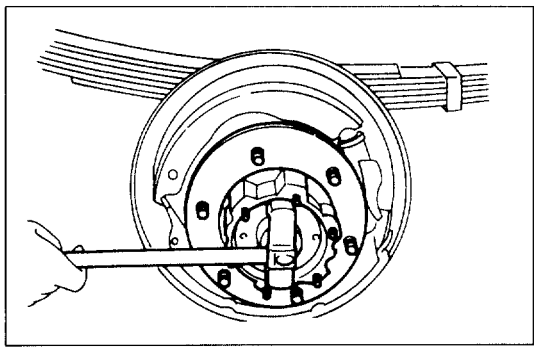
Remove the collar by tapping on the upper face of the axle shaft with a hammer, then remove the axle shaft.



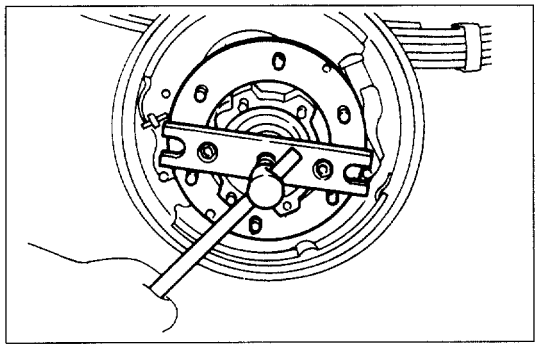
4. **Outer Oil Seal**

Take out the hub outer oil seal using a screw drive.

5. **Lock Washer**
6. **Bearing Lock Nut**



Wrench: 9-8522-1188-0

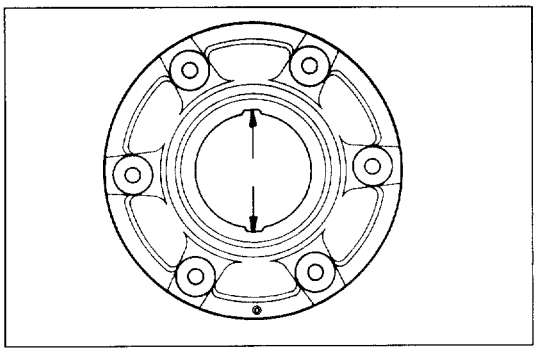


7. **Hub Assembly**

Remover: 9-8521-0116-0

If the hub inner bearing and the hub inner oil seal remain on the axle tube, remove the hub inner bearing using a special tool.

Remover: 9-8521-0092-0



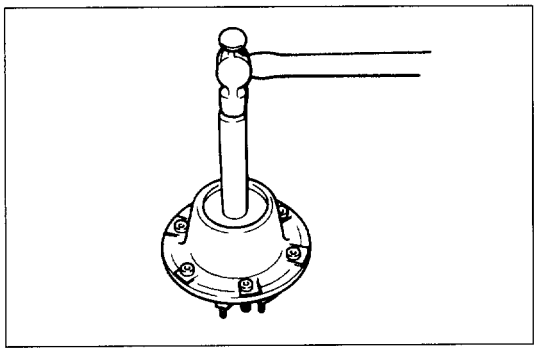
8. **Outer Bearing**
9. **Inner Oil Seal**
10. **Inner Bearing**

    Drive out the hub inner bearing outer race together with the hub inner bearing inner race and the hub inner oil seal by using a proper bar through two notches.

11. **Hub**

INSTALLATION

11. **Hub**
10. **Inner Bearing**



Install the bearing outer race.

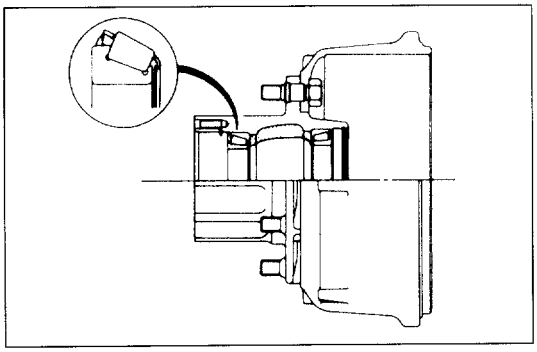
Installer: 9-8522-1194-0

Grip: 9-8522-1148-0

If removed outer bearing outer race, install the bearing outer race.

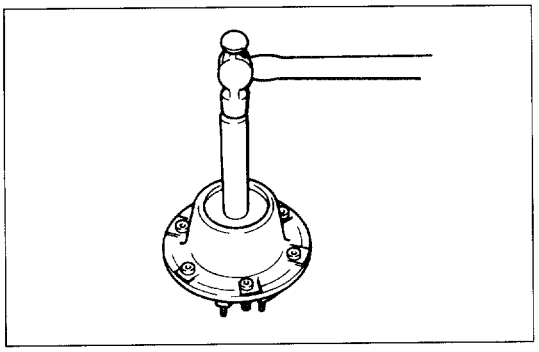
Installer: 9-8522-1195-0

Grip: 9-8522-1148-0



Apply specified grease into the bearing and grease well in the hub.

Amount of Grease	g (oz)
280 (9.8)	

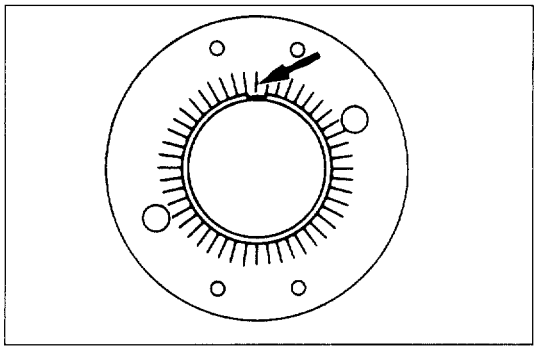


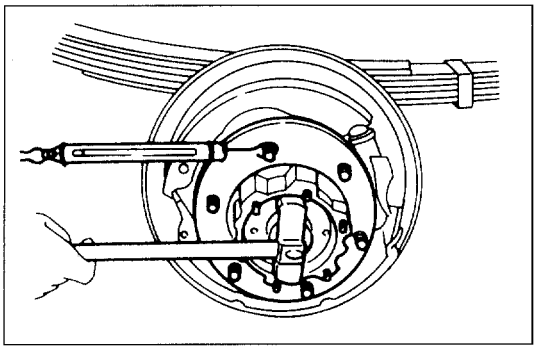
9. **Inner Oil Seal**

Installer: 9-8522-1607-0

Grip: 9-8522-1608-0

8. **Outer Bearing**
7. **Hub Assembly**





6. Bearing Lock Nut

(1) Install the bearing nut, so that its side with notched line is turned outward.

The fourty eight (48) slits are provided on the bearing nut, to ensure locking and easy maintenance.

(2) Align notched line on the bearing nut with the center of groove in the axle case, so that two threaded holes in the bearing nut line up with two holes in the lock washer.

Wrench: 9-8522-1188-0

(3) Adjustment of wheel bearing preload.

N (kg/lb)

Bearing preload (at wheel pin)	42–52 (4.3–5.3/9.5–11.7)

(4) While the wheel bearing pre-load is adjusted, if the notched line on the bearing nut is not aligned with the groove on the axle case, adjust to turn the lock nut clockwise to align.

5. Lock Washer

Install lock washer and fix it to the bearing nut by the lock bolt. The lug of lock washer should be inserted to the groove on the axle case.

4. Outer Oil Seal

3. Axle Shaft

Axle Shaft Nut Torque	N•m (kg•m/lb•ft)
49 (5.0/36)	

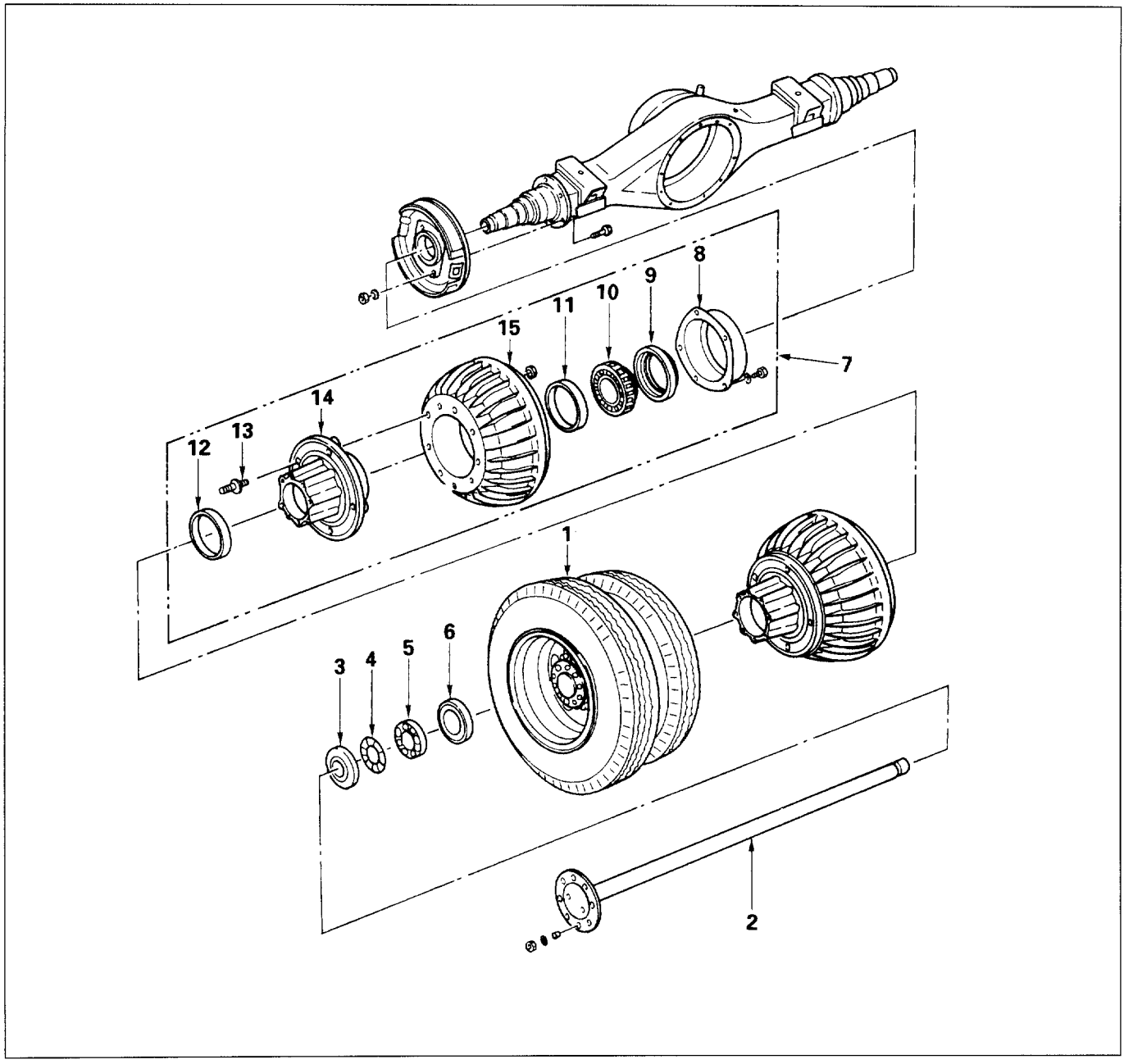
2. Brake Drum

1. Wheel and Tire

Wheel Nut Torque	N•m (kg•m/lb•ft)
167 (17/123)	

MEMO

REAR HUB AND BRAKE DRUM
(NHR, NKR, NPR, NQR, NPS MODELS; FULL FLOATING)



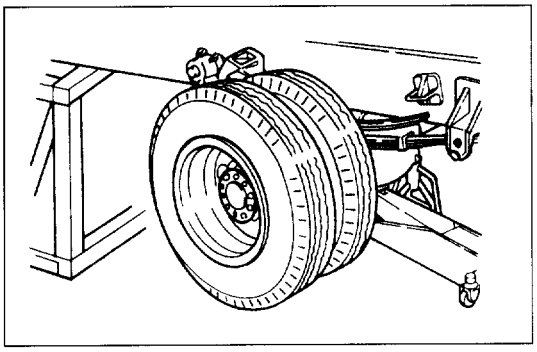
Removal Steps

1. Wheel and tire
2. Axle shaft
3. Outer oil seal
4. Lock washer
5. Bearing lock nut
6. Outer bearing
7. Hub and brake drum
8. Oil catcher
9. Inner oil seal
10. Inner bearing
11. Inner bearing outer race
12. Outer bearing outer race
13. Wheel pin
14. Hub
15. Brake drum

Installation Steps

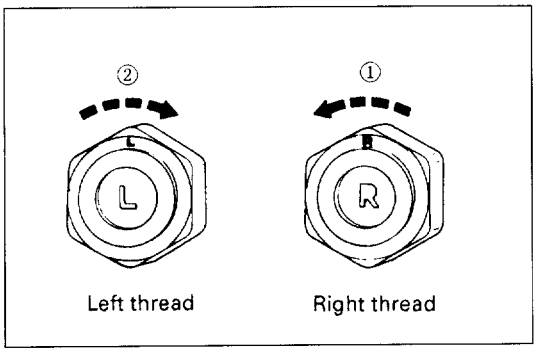
To install, follow the removal steps in the reverse order.

REMOVAL



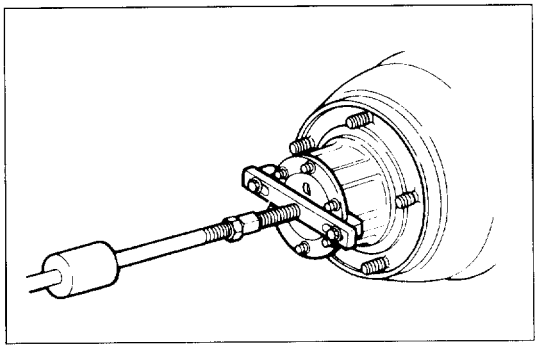
Preparation:

Jack up and support the vehicle on stands.



1. Wheel and Tire

Right side wheel nut ① have right hand threads and left side wheel nut ② have left hand threads.

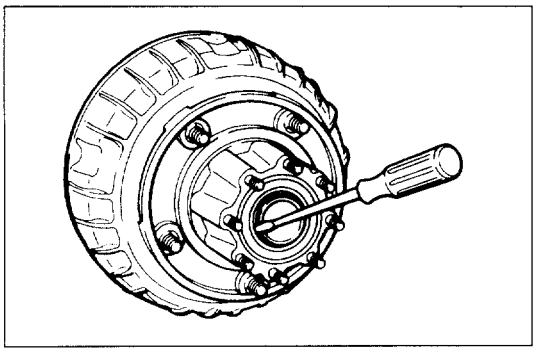


2. Axle Shaft

Use the axle shaft remover and the sliding hammer to remove the axle shaft.

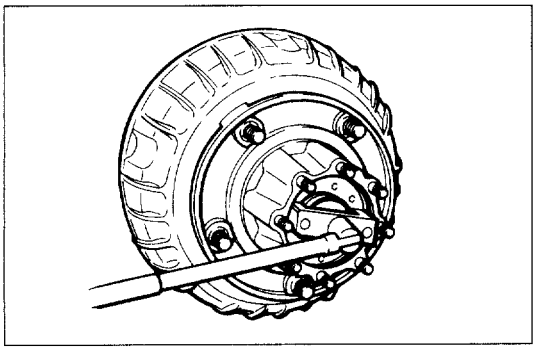
Axle Shaft Remover: 5-8840-2027-0

Sliding Hammer: 5-8840-0084-0



3. **Outer Oil Seal**

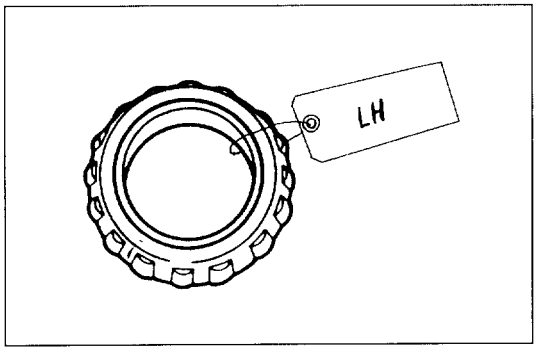
   Use a pry bar to pry the oil seal from the axle case.



4. **Lock Washer**
5. **Bearing Lock Nut**

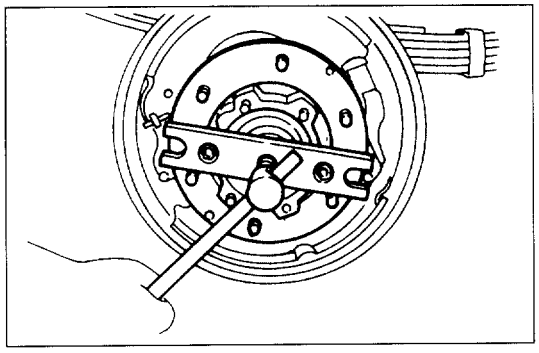
   Use the lock nut remover to remove the lock nut.

   Lock Nut Remover: 9-8522-1188-0
   (For lock bolt P.C.D. 70 mm (2.8 in.))
   9-8522-1606-0
   (For lock bolt P.C.D. 74 mm (2.9 in.))



6. **Outer Bearing**

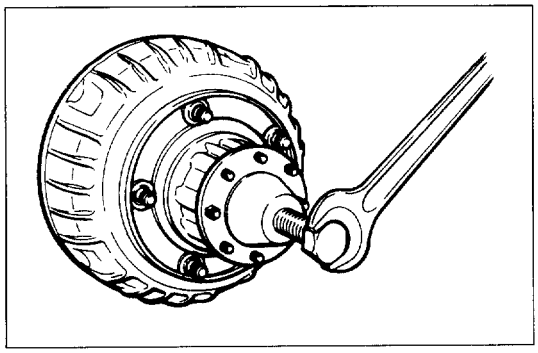
   If the bearings are to be reinstalled, tag each bearing with the fitting position from which it was removed.



7. **Hub and Brake Drum**

   Use the rear hub remover to remove the hub and the brake drum.

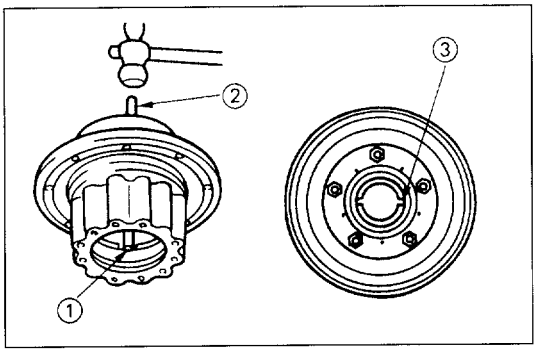
   Rear Hub Remover: 9-8521-0116-0
   (For NHR, NKR Flat Low)

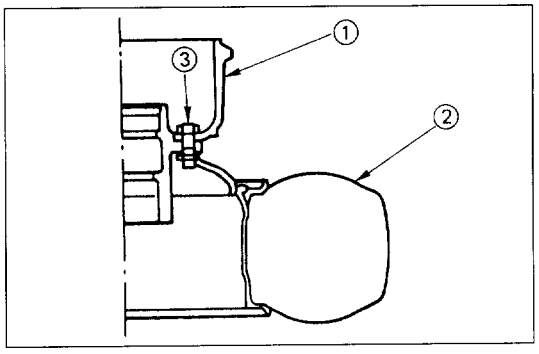


Rear Hub Remover: 9-8521-2501-0
(For Except NHR, NKR Flat Low)

8. **Oil Catcher**
9. **Inner Oil Seal**
10. **Inner Bearing**
11. **Inner Bearing Outer Race**
12. **Outer Bearing Outer Race**

    Use a hammer and a brass bar to drive the outer races from the hub at the two points shown in the illustration.





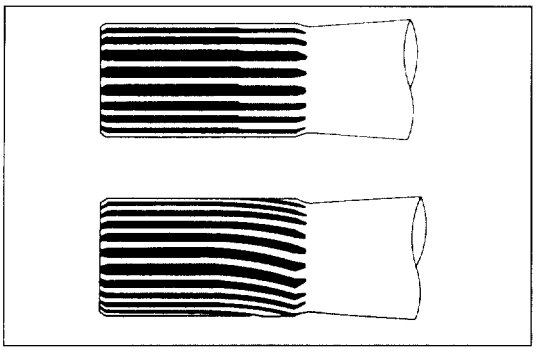
13. **Wheel Pin**
    1. Set the rear hub with brake drum ① to the wheel with tire ② previously removed from the vehicle.
    2. Turn the wheel pin nuts ③ counterclockwise to loosen them.

       The pin nuts are loosened counterclockwise on both sides of the vehicle.
    3. Remove the brake drum from the rear hub.
    4. Discard the wheel pins and nuts.

       The wheel pins and nuts cannot be reused.
14. **Hub**
15. **Brake Drum**

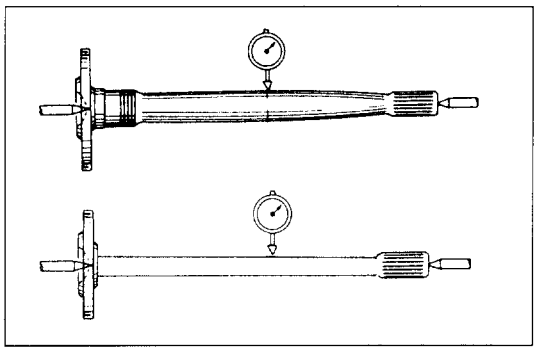
INSPECTION AND REPAIR

Make necessary adjustments, repairs, and part replacement if excessive wear or damage is discovered during inspection.



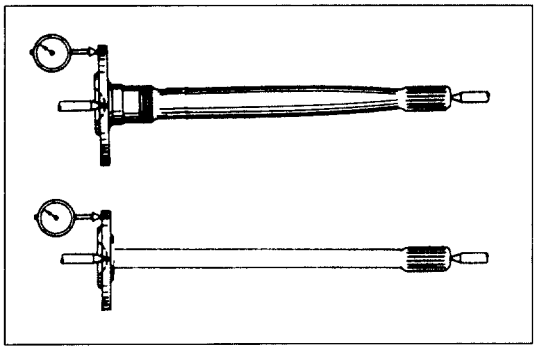
Axle Shaft Spline

Inspect the spline for wear, damage or other abnormal conditions.



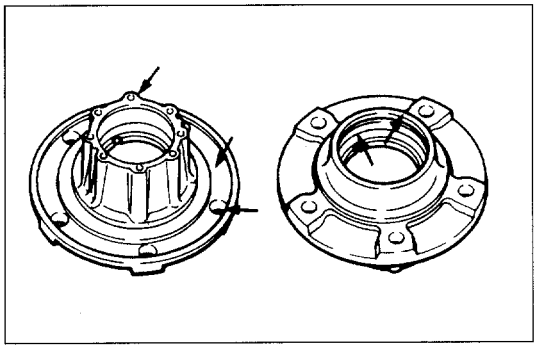
Axle Shaft Run-Out

Limit	mm (in.)
1.0 (0.039)	



Axle Shaft Flange Run-Out

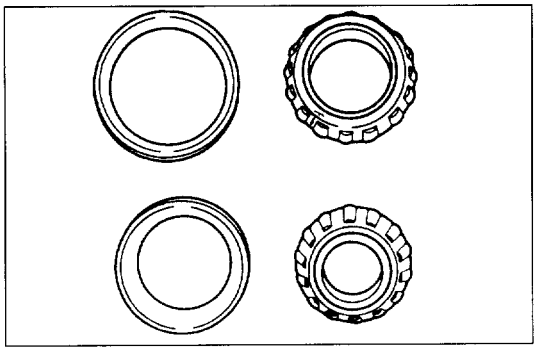
Limit	mm (in.)
0.05 (0.00197)	



Hub

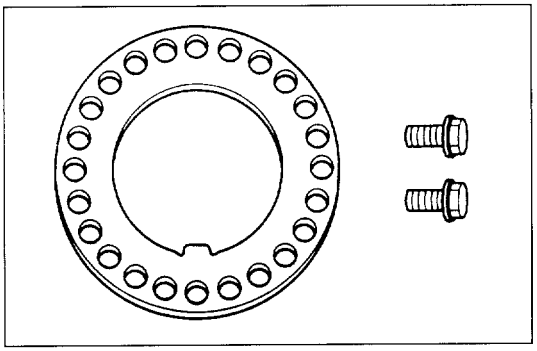
Inspect the oil seal and bearing fitting faces for excessive wear and damage.

Inspect the wheel pin threads and stud bolt threads for excessive damage and cracks.



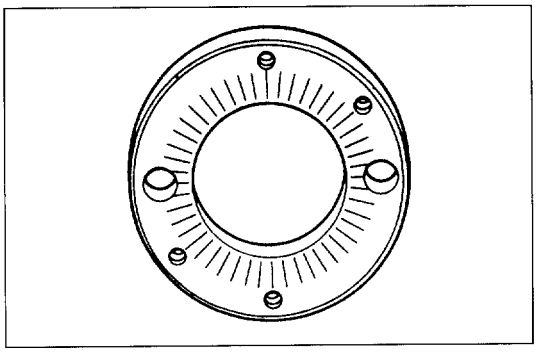
Bearing

Inspect the bearing for excessive wear, abnormal noise, rough rotation, and freezing.



Lock Washer

Inspect the lock washer for excessive wear, cracks, warpage, and other damage.



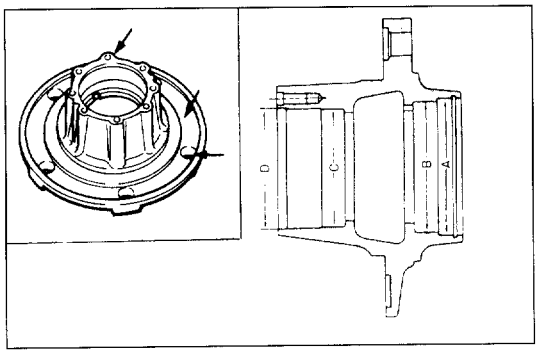
Bearing Lock Nut

Inspect the bearing lock nut threads and contact surfaces for excessive wear, warpage, and other damage.

Light damage to the contact surfaces can be repaired with an oil stone or a piece of fine sandpaper.

INSTALLATION

15. Brake Drum

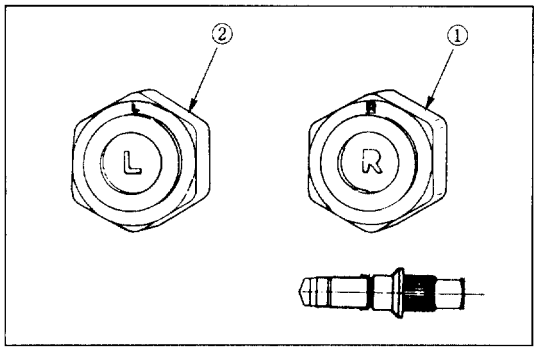


14. Hub

(1) Clean the hub inside and outside surfaces.

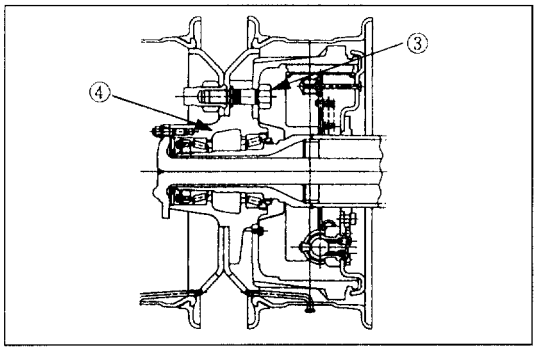
(2) Apply bearing grease to the hub cavity.

Hub Bearing Grease Amount	g (oz)
	285 (10.1)



13. Wheel Pin

(1) Right side hub wheel pins ① have right hand threads and left side hub wheel pins ② have left hand threads.



(2) Install the wheel pins ③ to the hub ④.

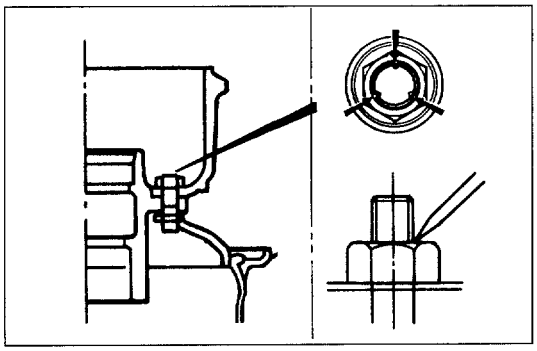
Note the installation direction shown in the illustration.

Tap the wheel pin into the hub with a hammer.

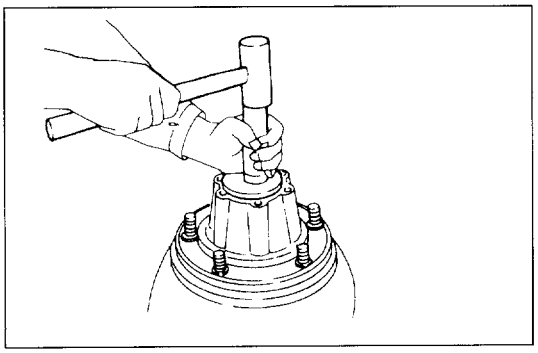
(3) Wheel Pin Nut Torque

N•m (kg•m/lb•ft)

Brake drum diameter 228 mm	206 (21/152)
Brake lining width 75 mm	343 (35/253)
Brake lining width 100 mm	392 (40/289)



(4) Caulk three portions of each wheel nut to prevent them from loosening.



12. Outer Bearing Outer Race

11. Inner Bearing Outer Race

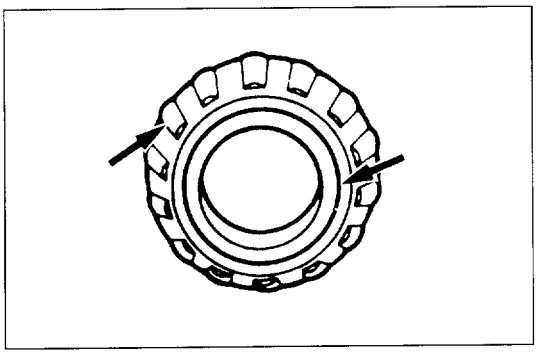
Use the bearing outer race installer and the drive handle to install the outer race to the hub.

Outer Bearing Outer Race Installer: 9-8522-1195-0 (Outer race outside diameter 92 mm (3.6 in.))
9-8522-1610-0 (Outer race outside diameter 97.6 mm (3.8 in.))

Drive Handle: 9-8522-1608-0

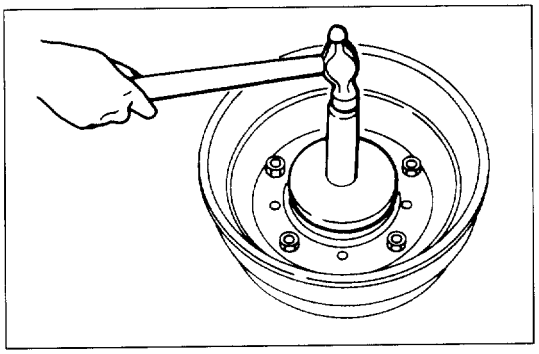
Inner Bearing Outer Race Installer: 9-8522-1194-0 (Outer race outside diameter 101.6 mm (4 in.))
9-8522-1609-0 (Outer race outside diameter 108 mm (4.3 in.))
5-8840-2426-0 (Outer race outside diameter 120 mm (4.72 in.))

Drive Handle: 9-8522-1148-0



10. Inner Bearing

Apply an ample coat of bearing grease between the inner race and the roller cage.



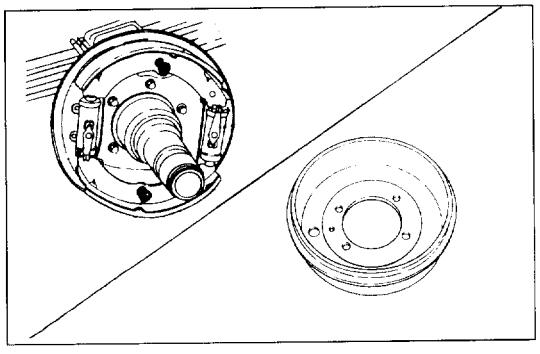
9. Inner Oil Seal

1. Apply grease to the oil seal lip inner and outer circumferences.
2. Use the oil seal installer and the drive handle to install the oil seal to the hub.

   Oil Seal Installer: 9-8522-1607-0(Except NQR70)
   5-8840-2427-0(NQR70)

   Drive Handle: 9-8522-1608-0

8. Oil Catcher

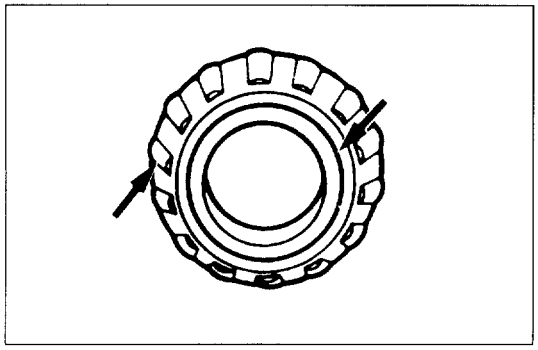


7. Hub and Brake Drum

(1) Wipe away any oil or other foreign material from the brake linings and the brake drum inside surfaces.

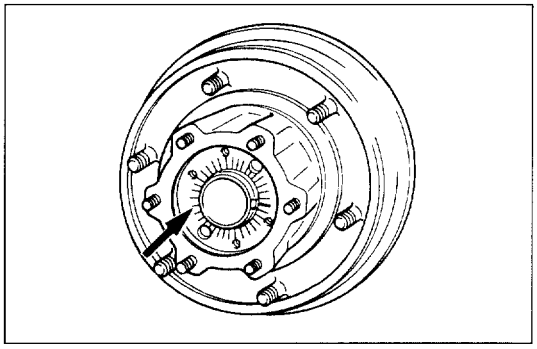
(2) Clean the rear axle case tip.

(3) Install the hub assembly to the rear axle case.



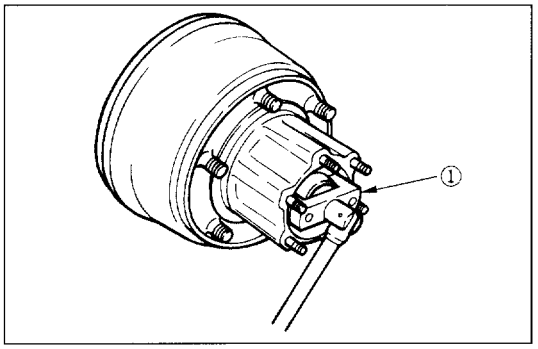
6. Outer Bearing

Apply an ample coat of bearing grease between the inner race and the roller cage.



5. Bearing Lock Nut

Install the lock nut with the notched line facing out.



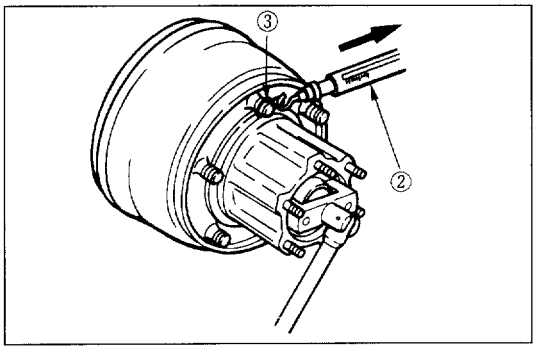
Hub Bearing Preload Measuring Method

(1) Turn the hub to the left and right several times to establish bearing conformity.

(2) Use the bearing nut wrench ① to tighten the bearing nut until the hub can not be manually rotated.

Bearing Nut Wrench: 9-8522-1188-0
(For lock bolt P.C.D. 70 mm (2.8 in.))
9-8522-1606-0
(For lock bolt P.C.D. 74 mm (2.9 in.))

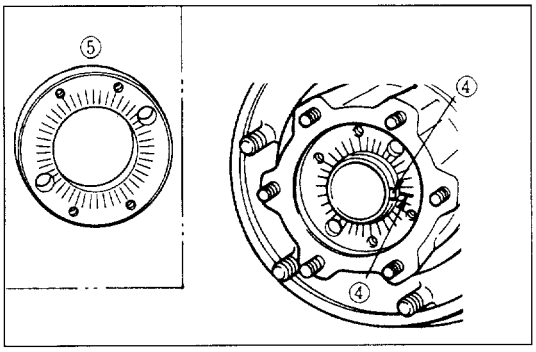
(3) Loosen the bearing nut until hub rotates easily.



(4) Set the spring balancer ② to the wheel pin ③ in the position shown in the illustration.

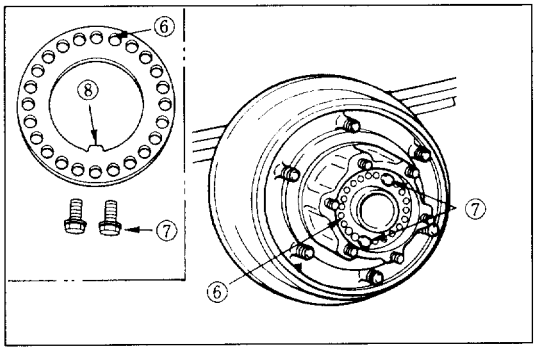
(5) Measure the hub bearing preload by carefully pulling on the spring balancer and noting the indicator reading.

Hub Bearing Preload (At Wheel Pin)	N (kg/lb)
NHR, NKR 55, 69, NPR 55, 69	42–52 (4.3–5.3/9.5–11.7)
NKR 58, 66, NPR 58, 59, 65, NPR 66, 70, 71, NQR, NPS	38–48.0 (3.9–4.9/8.6–10.8)



(6) Rotate the hub several times to the right and left.
(7) Measure the bearing preload a second time.
(8) Align the axle case groove with the closest bearing nut slit.

NOTE:
If it is difficult to align the axle case and bearing nut, slightly tighten the bearing nut.

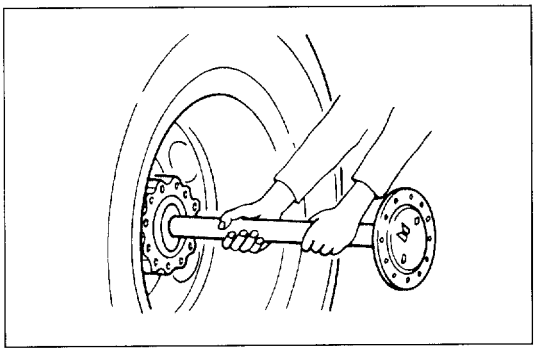


4. Lock Washer

(1) Install the lock washer ⑥ with the lock washer tabs inserted to the axle case grooves.
(2) Install the lock bolts ⑦ to prevent the bearing nut from loosening.
(3) Check that the lock washer tabs are inserted to the axle case grooves.

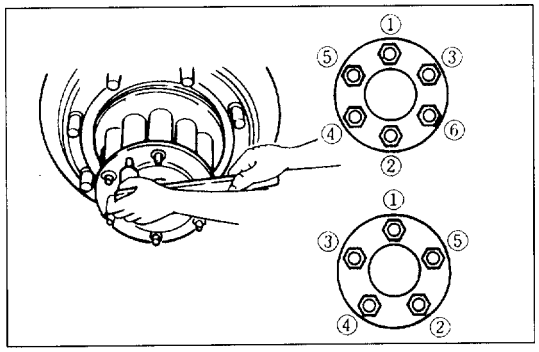
3. Outer Oil Seal

Apply grease to the oil seal lip inner and outer circumferences.



2. Axle Shaft

(1) Clean the axle shaft.
(2) Apply gear oil to the axle shaft spline.
(3) Insert the axle shaft into the axle case.
Take care not to damage the oil seal.



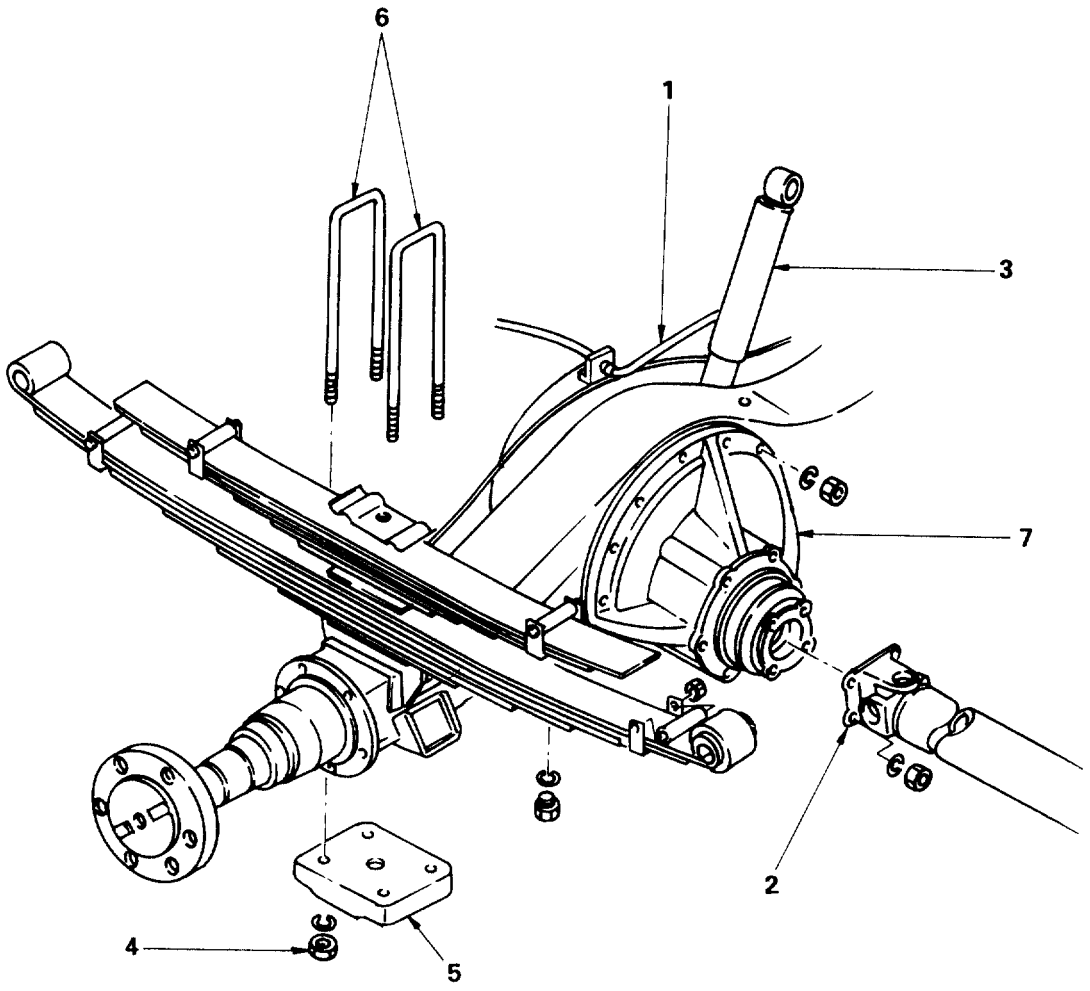
(4) Tighten the axle shaft nuts to the specified torque a little at a time in the numerical order shown in the illustration.

Axle Shaft Nut Torque	N•m (kg•m/lb•ft)
54 (5.5/40)	

1. Wheel and Tire

Wheel Nut Torque	N•m (kg•m/lb•ft)
NHR Dual Tire, NKR Flat Low	294 (30/217)
Except Above Models	441 (45/325)

REAR AXLE ASSEMBLY



Removal Steps

1. Rear flexible hose
2. Rear propeller shaft
3. Rear shock absorber
4. Nut and washer
5. Lower clamp
6. U-bolt
7. Rear axle assembly

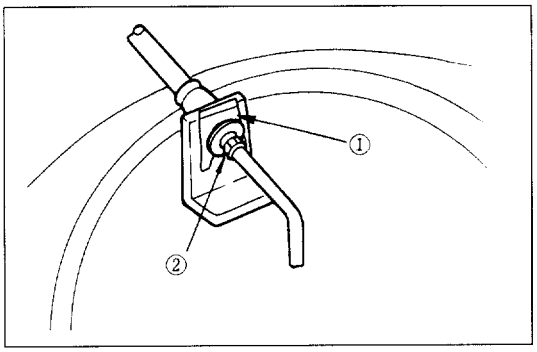
Installation Steps

To install, follow the removal steps in the reverse order.

REMOVAL

Preparation:

Jack up and support the vehicle on stands.

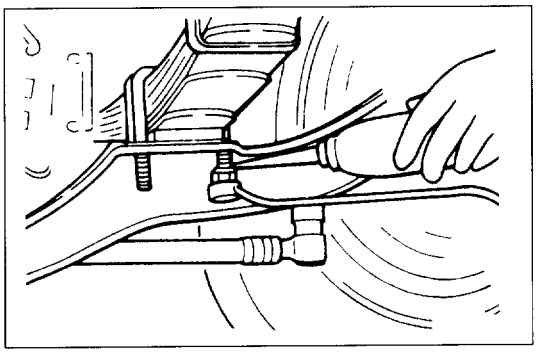


1. **Rear Flexible Hose**

   Loosen the nut ①, then ply off a clip ②.

2. **Rear Propeller Shaft**
3. **Rear Shock Absorber**

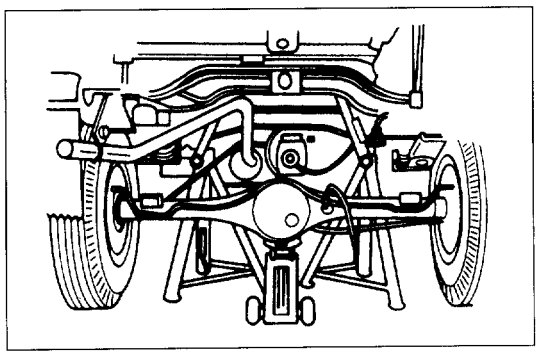
   Remove the shock absorber lower end.



4. **Nut and Washer**

   If the U-bolt are heavily rusted, apply a generous amount of oil to the threads when turning them loose the prevent seizure.

5. **Lower Clamp**
6. **U-bolt**

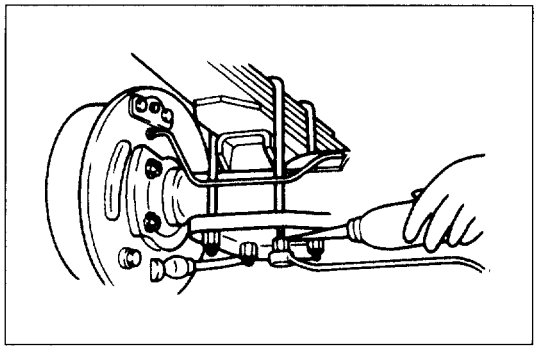


7. **Rear Axle Assembly**

   Move to the rear axle side.

INSTALLATION

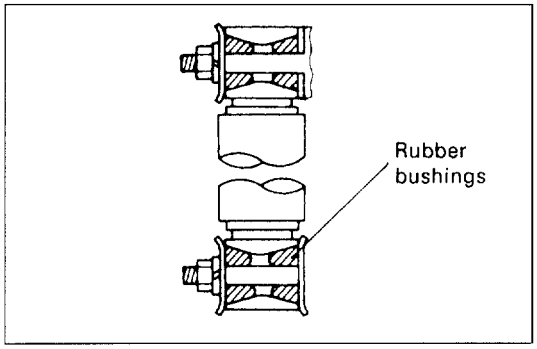
7. **Rear Axle Assembly**
6. **U-bolt**
5. **Lower Clamp**



4. **Nut and Washer**

When tightening the nuts apply oil as necessary to prevent damaging the threads.

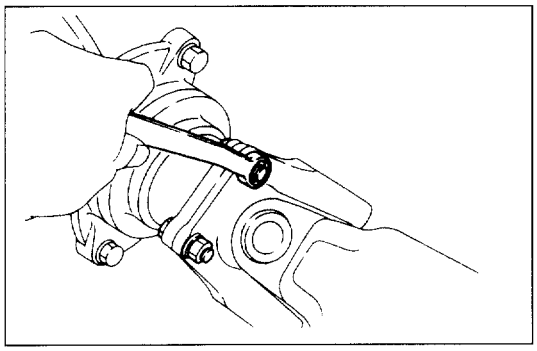
U-bolt Nut Torque	N•m (kg•m/lb•ft)
NQR	294 (30/217)
except NQR	177 (18/130)



3. **Rear Shock Absorber**

Refer to the drawing for parts installation.

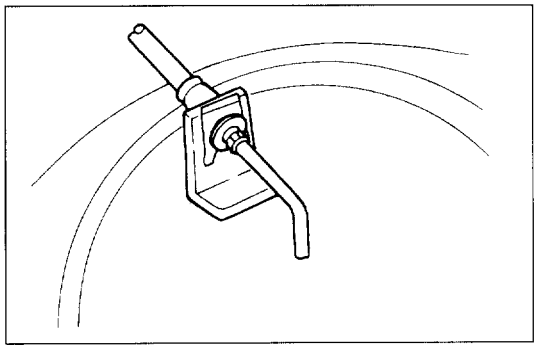
Shock Absorber Lower Nut Torque	N•m (kg•m/lb•ft)
NHR, NKR Single Tire	61 (6.2/45)
NKR Dual Tire	95 (9.7/70)
NPR, NQR, NPS	40 (4.1/30)



2. **Rear Propeller Shaft**

Connect the propeller shaft assembly after tightening U-bolt nuts.

Propeller Shaft Nut Torque	N•m (kg•m/lb•ft)
M10	63 (6.4/46)
M12	103 (10.5/76)



1. **Rear Flexible Hose**

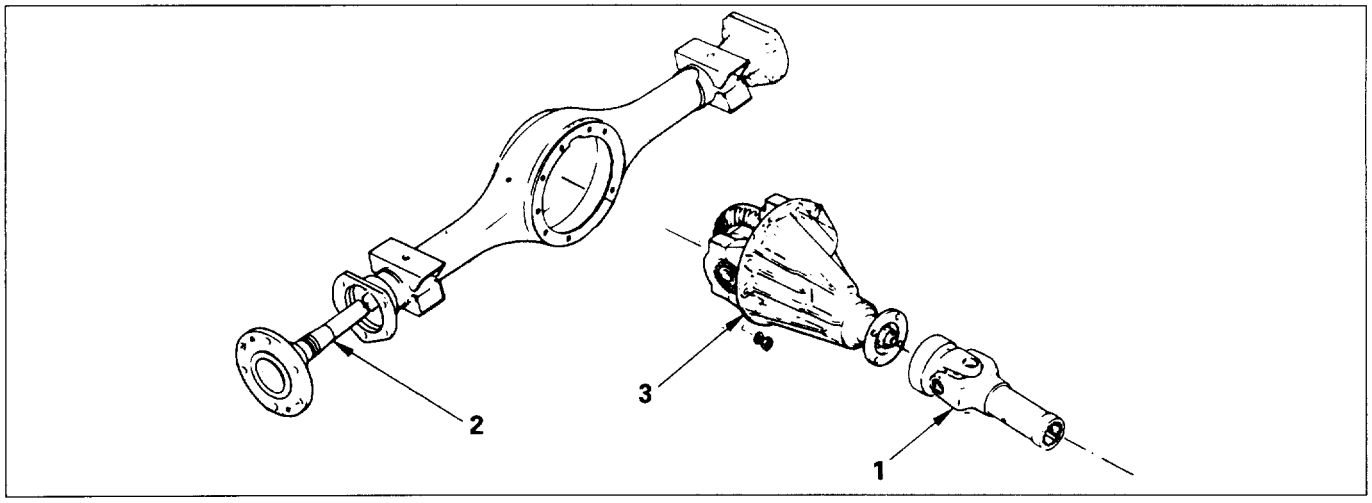
To install, follow the disassemble procedure in reverse order.

Flare Nut Torque	N•m (kg•m/lb•ft)
16 (1.6/12)	

Perform bleeding operation after installation of the brake flexible hoses.

Refer to Section 5 "Service information" for brake oil air bleeding procedure.

DIFFERENTIAL ASSEMBLY
(NHR SINGLE TIRE MODEL; SEMI-FLOATING)



Removal Steps

1. Propeller shaft
2. Axle shaft with brake assembly
3. Differential assembly

Installation Steps

To install, follow the removal steps in the reverse order.

REMOVAL

Preparation:

- Raise vehicle to working level.
- Support the axle assembly with suitable jack and chassis stand.
- Drain the oil from the axle case.

1. **Propeller Shaft**
2. **Axle Shaft with Brake Assembly**

   To remove the axle shaft assembly, follow the removal procedure outlined under "Rear Hub and Brake Drum" after finding the axle assembly is semi-floating rear axle.
3. **Differential Assembly**

INSTALLATION

3. Differential Assembly

Apply liquid gasket (BELCO BOND NO. 4 or equivalent) to the jointing faces of the axle case and carrier.

Differential Carrier Bolt and Nut Torque	N•m (kg•m/lb•ft)
Bolt	63 (6.4/46)
Nut	44 (4.5/32)

2. Axle Shaft with Brake Assembly

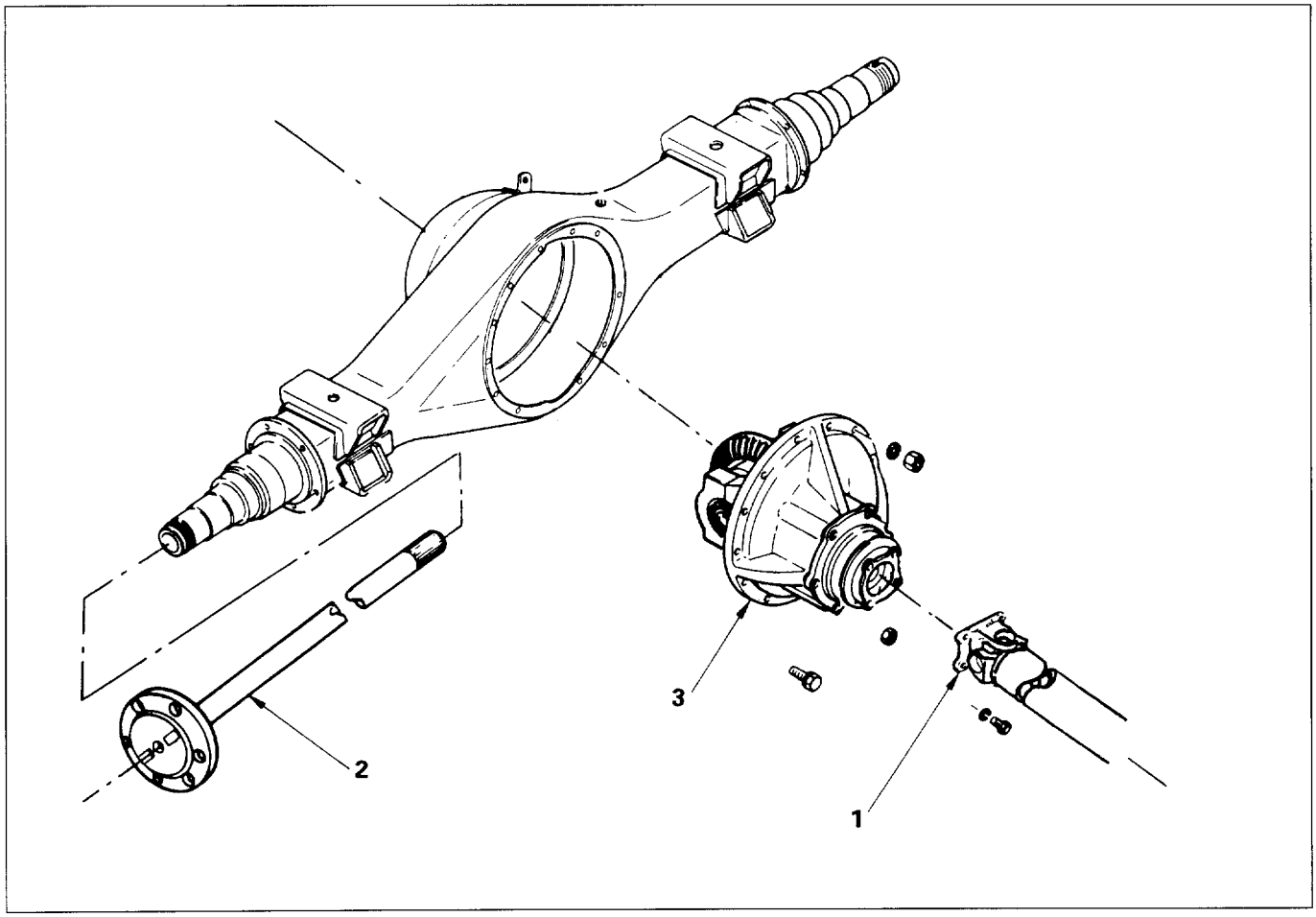
To install the axle shaft assembly, follow the installation procedure outlined under "Rear Hub and Brake Drum" after finding the axle assembly is semi-floating rear axle.

Bearing Holder Nut Torque	N•m (kg•m/lb•ft)
74 (7.5/54)	

1. Propeller Shaft

Propeller Shaft Nut Torque	N•m (kg•m/lb•ft)
63 (6.4/46)	

DIFFERENTIAL ASSEMBLY
(NKR SINGLE TIRE AND ALL DUAL TIRE MODELS; FULL FLOATING)



Removal Steps

1. Propeller shaft
2. Axle shaft
3. Differential assembly

Installation Steps

To install, follow the removal steps in the reverse order.

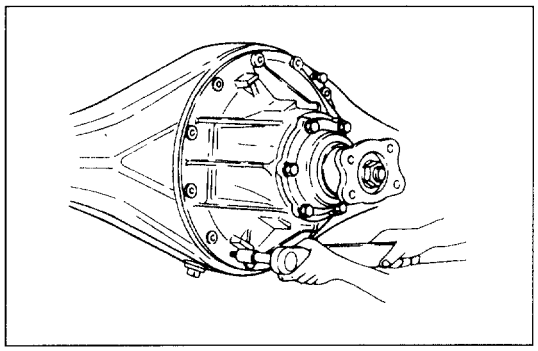
REMOVAL

Preparation:

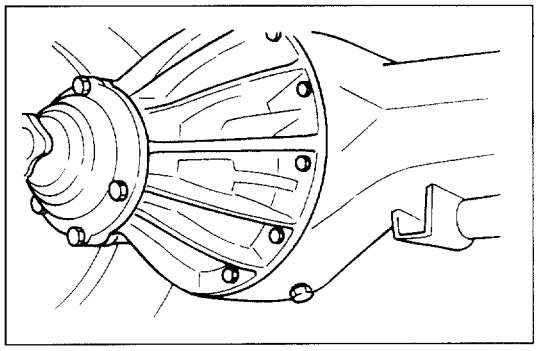
Drain the oil from the axle case.

1. **Propeller Shaft**
2. **Axle Shaft**
3. **Differential Assembly**

To remove, turn push bolt into threaded holes in the differential carrier, so that differential assembly is lifted off the position.



INSTALLATION



3. **Differential Assembly**

Apply liquid gasket (BELCO BOND No. 4 or equivalent) to the joining faces of the axle case and carrier.

Differential Carrier Bolt and Nut Torque — N•m (kg•m/lb•ft)

244 mm Differential	Bolt	66 (6.8/48)
	Nut	44 (4.5/32)
292/320 mm Differential	Nut	58 (6.0/43)

2. **Axle Shaft**

Axle Shaft Nut Torque	N•m (kg•m/lb•ft)
NKR Single tire	49 (5.0/36)
Others	54 (5.5/40)

1. **Propeller Shaft**

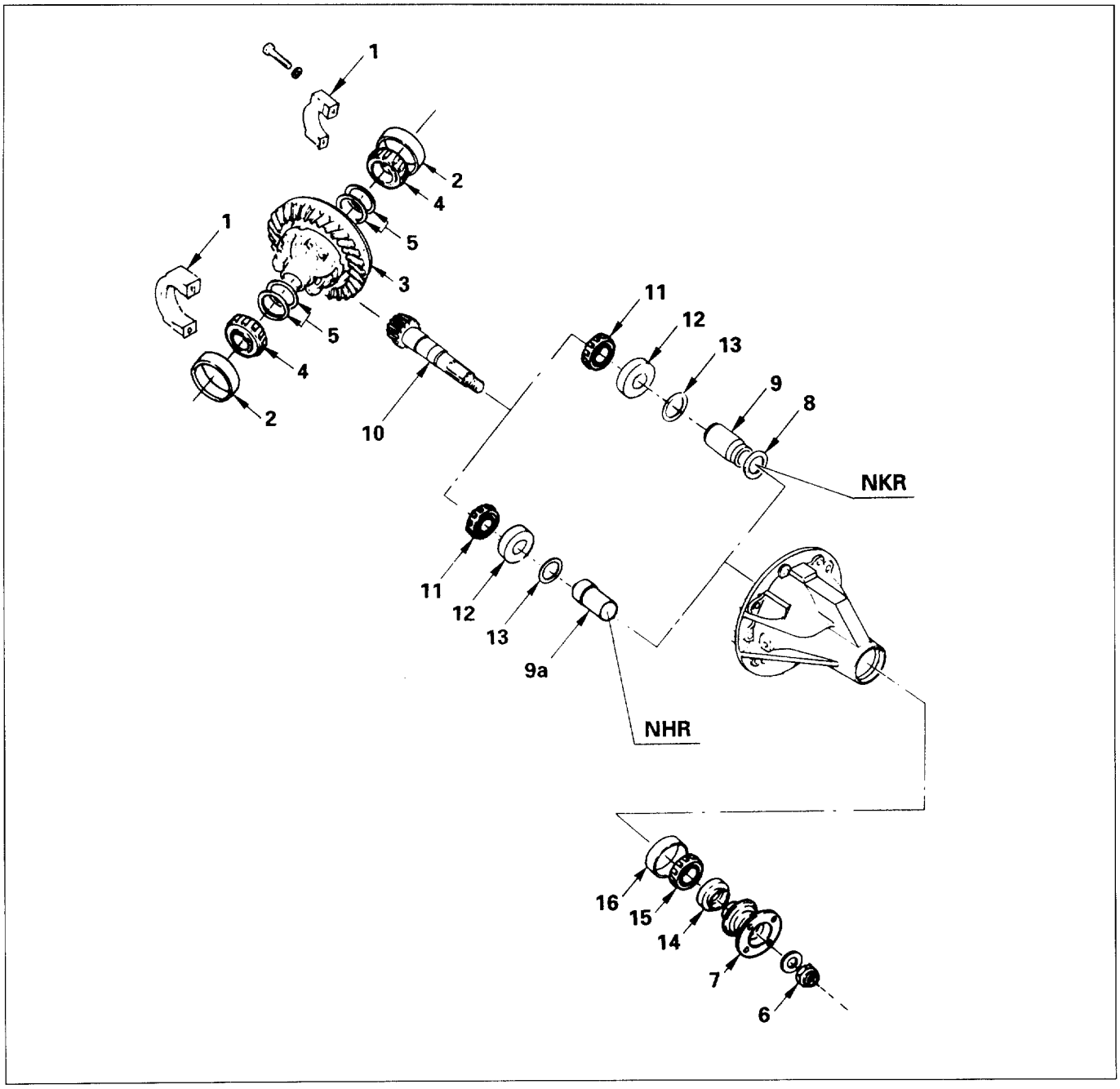
Propeller Shaft Nut Torque	N•m (kg•m/lb•ft)
M10	65 (6.7/48)
M12	103 (10.5/76)

MEMO

UNIT REPAIR

244 MM REAR DIFFERENTIAL

Major Components



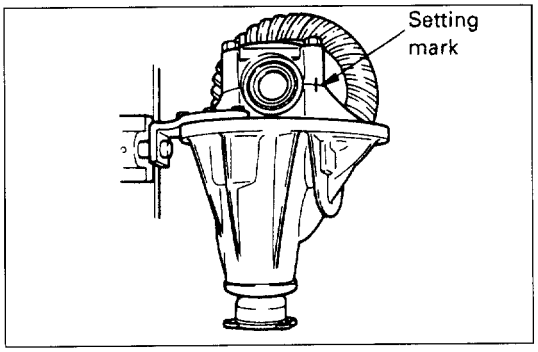
Disassembly Steps

1. Bearing cap
2. Side bearing outer race
3. Differential cage assembly
4. Side bearing inner race
5. Backlash and preload adjusting shim
6. Flange nut
7. Flange
8. Bearing preload adjusting shim
9. Distance piece
9a. Collapsible spacer
10. Drive pinion
11. Inner bearing inner race
12. Inner bearing outer race
13. Pinion depth adjusting shim
14. Oil seal
15. Outer bearing inner race
16. Outer bearing outer race

Reassembly Steps

16. Outer bearing outer race
13. Pinion depth adjusting shim
12. Inner bearing outer race
11. Inner bearing inner race
15. Outer bearing inner race
14. Oil seal
10. Drive pinion
9a. Collapsible spacer
9. Distance piece
8. Bearing preload adjusting shim
7. Flange
6. Flange nut
5. Backlash and preload adjusting shim
4. Side bearing inner race
3. Differential cage assembly
2. Side bearing outer race
1. Bearing cap

DISASSEMBLY

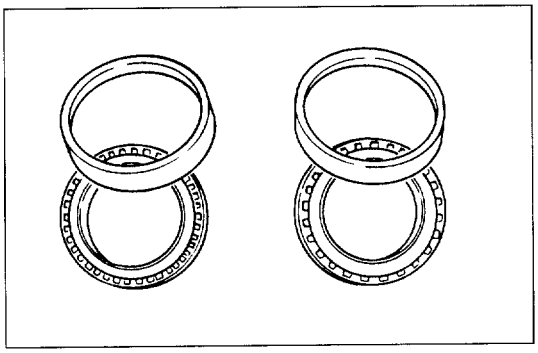


1. Bearing Cap

Set the differential assembly onto a special fixture. Apply a setting mark to the side bearing cap and differential carrier.

Fixture: 5-8840-2029-0

Base: 5-8840-0003-0



2. Side Bearing Outer Race

After removal, keep right and left side bearing assemblies separate to maintain inner and outer race combinations.

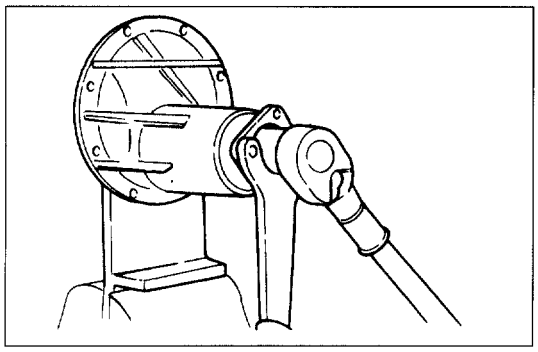
3. Differential Cage Assembly

4. Side Bearing Inner Race

Remover: 9-8521-0061-0

Adapter: 5-8840-2031-0

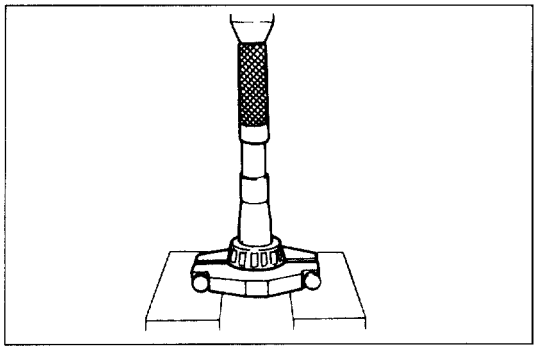
5. Backlash and Preload Adjusting Shim



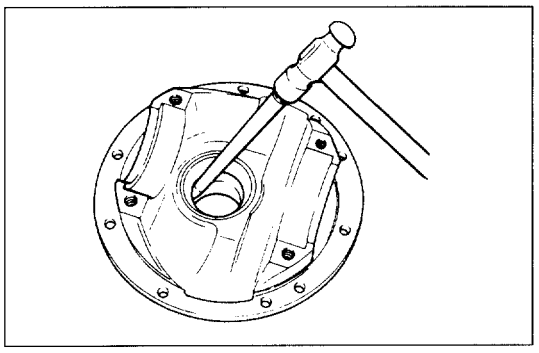
6. **Flange Nut**
   Holding wrench: 9-8511-1507-0
7. **Flange**
8. **Bearing Preload Adjusting Shim**
9. **Distance Piece (NKR model)**

9a. **Collapsible Spacer (NHR model)**

10. **Drive Pinion**



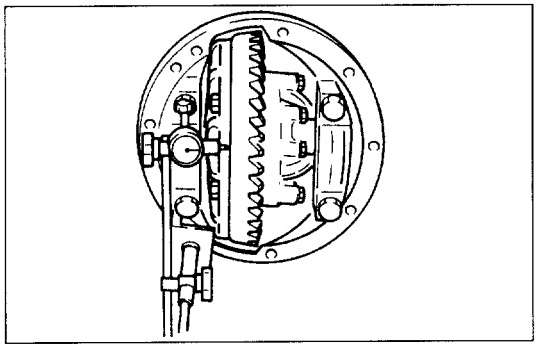
11. **Inner Bearing Inner Race**
    Remover: 5-8840-0015-0



12. **Inner Bearing Outer Race**
13. **Pinion Depth Adjusting Shim**
14. **Oil Seal**
15. **Outer Bearing Inner Race**
16. **Outer Bearing Outer Race**

    Drive out the inner bearing outer race or the outer bearing outer race together with the outer bearing inner race and oil seal by using a proper bar through two notches.

REASSEMBLY



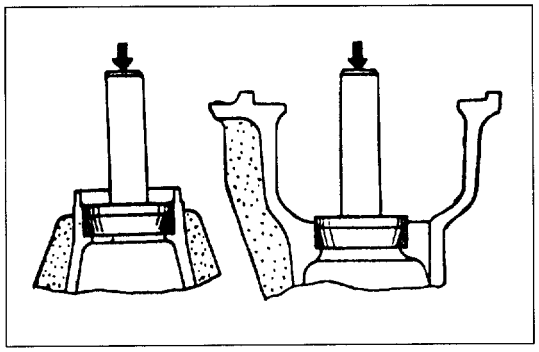
Measurement of ring gear run-out

Install dummy bearing into the differential assembly, then install these parts in the differential carrier. Install and tighten the bearing cap.

Dummy bearing: 9-8522-1137-0

Bearing Cap Bolt Torque	N•m (kg•m/lb•ft)
108 (11.0/80)	

Ring Gear Run-Out	mm (in.)
Standard	Limit
0.05 (0.002)	0.2 (0.008)

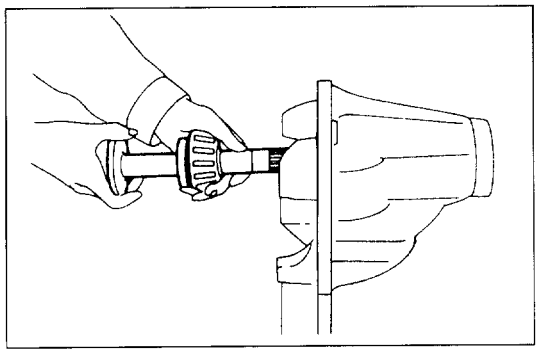


16. **Outer Bearing Outer Race**
13. **Pinion Depth Adjusting Shim**
12. **Inner Bearing Outer Races**

Adjustment of drive pinion engagement depth.

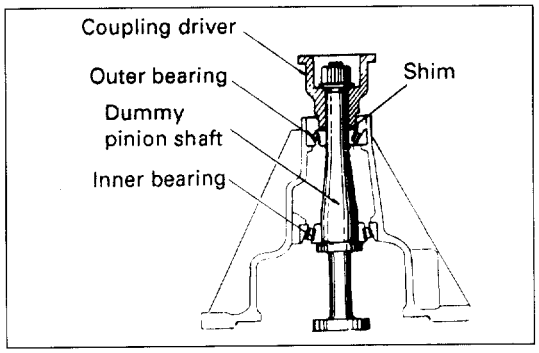
Install the inner and outer bearing outer races without shims into the differential carrier using a bench press.

Installer (inner): 9-8522-1196-0
(Outer): 9-8522-1197-0
Grip: 9-8522-1148-0



Assemble the inner bearing inner race to the dummy pinion shaft, then install these parts into the carrier.

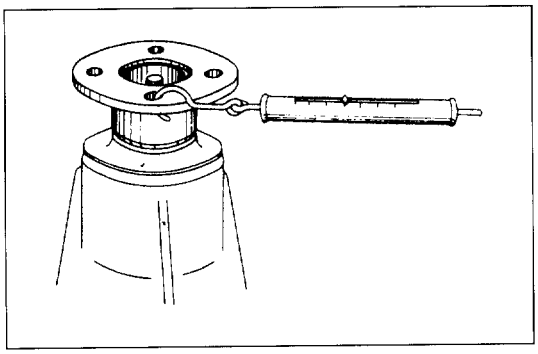
Dummy Pinion Shaft: 9-8522-1603-0



Install the outer bearing inner race, flange, washer and dummy nut.

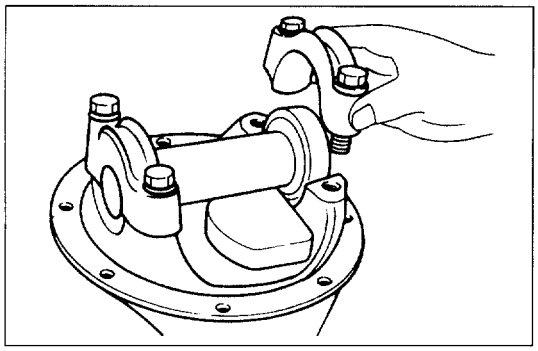
Lubricate the bearing before tighten the dummy nut.

Dummy Nut: 9-8522-1624-0



Tighten the dummy nut until specified preload are required to rotate the bearing.

Bearing Preload	N (kg/lb)
New bearing	16–29 (1.6–3.0/3.5–6.6)
Used bearing	8–14.5 (0.8–1.5/1.8–3.3)
Starting Torque	**N•m (kg•cm/lb•in)**
New bearing	0.69–1.27 (7.0–13.0/6.1–11.3)
Used bearing	0.35–0.64 (3.5–6.5/3.1–5.7)

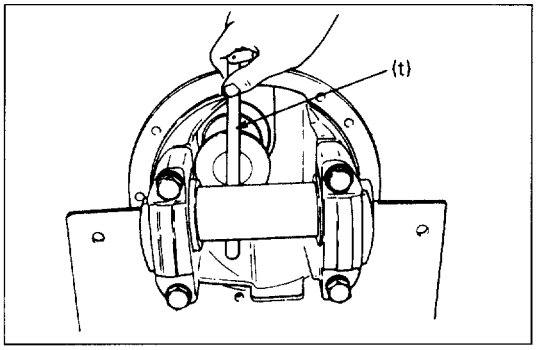


Install dummy bearing on dummy shaft and install these parts into the carrier. Install and tighten the bearing cap.

Dummy Shaft: 9-8522-1138-0

Dummy Bearing: 8-8522-1137-0

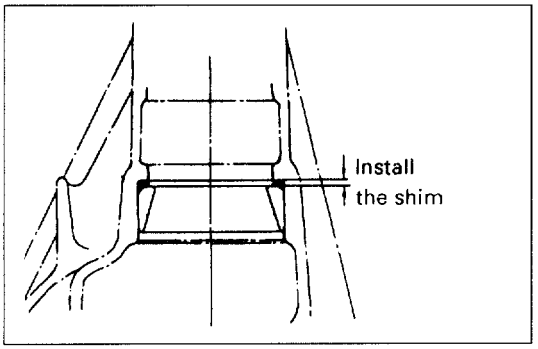
Bearing Cap Bolt Torque	N•m (kg•m/lb•ft)
	108 (11.0/80)



Measure the clearance (t) with a feeler gauge.

The clearance (t) is equal to the shim in thickness.

Thickness of Shim Available	mm (in.)
2.12, 2.16 ... 2.52, 2.56 (0.083, 0.085 ... 0.099, 0.100)	

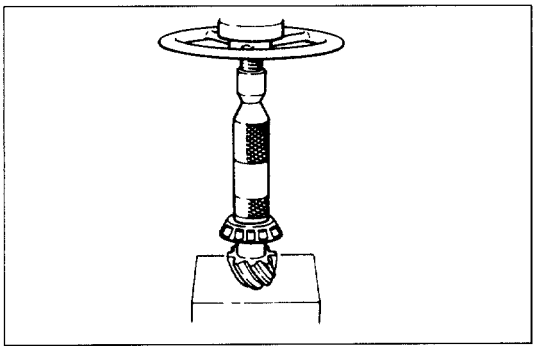


Remove dummy pinion, dummy shaft, dummy bearing and inner bearing outer race.

Install pinion depth adjusting shim of specified thickness in position between the inner bearing outer race and the carrier, then install the inner bearing outer race.

Installer: 9-8522-1196-0

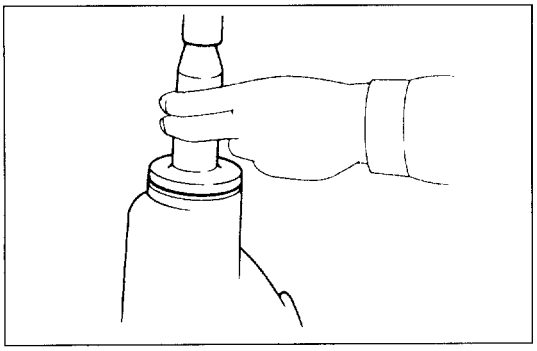
Grip: 9-8522-1148-0



11. Inner Bearing Inner Race

Installer: 9-8522-0018-0

Apply gear oil to the pinion shaft before installing final drive pinion assembly into carrier.



15. Outer Bearing Inner Race

14. Oil seal

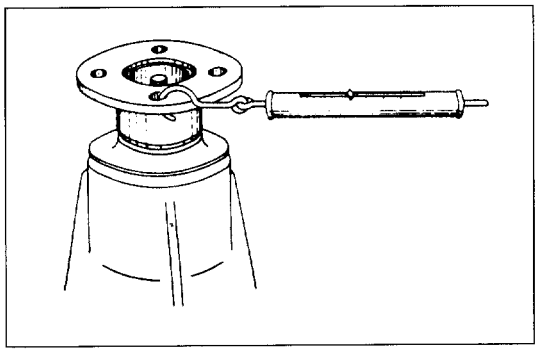
Installer: 5-8840-2047-0

10. Drive Pinion

9a. Collapsible Spacer (NHR model)

Discard used collapsible spacer and install a new one.

9. Distance Piece (NKR model)

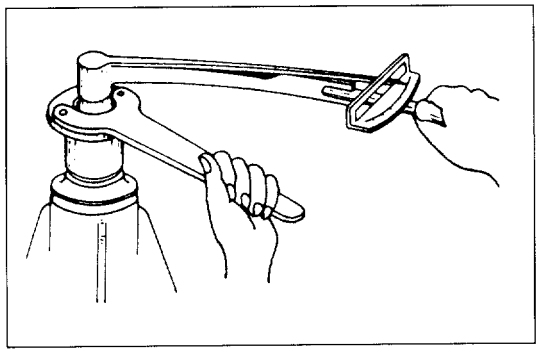


8. Bearing Preload Adjusting Shim (NKR model)

Use a dummy nut until specified bearing preload is obtained.

Bearing Preload	N (kg/lb)
New bearing	16–29 (1.6–3.0/3.5–6.6)
Used bearing	8–14.5 (0.8–1.5/1.8–3.3)

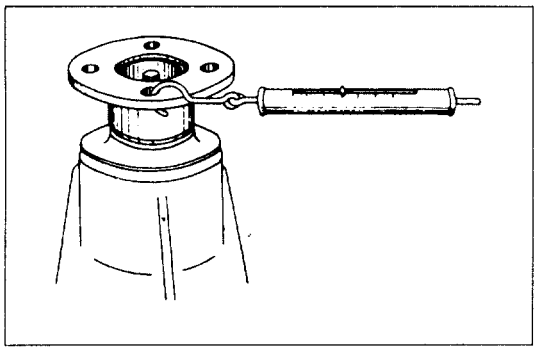
Starting Torque	N•m (kg•cm/lb•in)
New bearing	0.69–1.27 (7.0–13.0/6.1–11.3)
Used bearing	0.35–0.64 (3.5–6.5/3.1–5.7)



Dummy Nut Torque	N•m (kg•m/lb•ft)
270 (27.5/199)	

Thickness of Shim Available

mm (in.)
1.53, 1.56 ... 2.07, 2.10 (10.060, 0.061 ... 0.081, 0.082)



7. **Flange**
6. **Flange Nut**

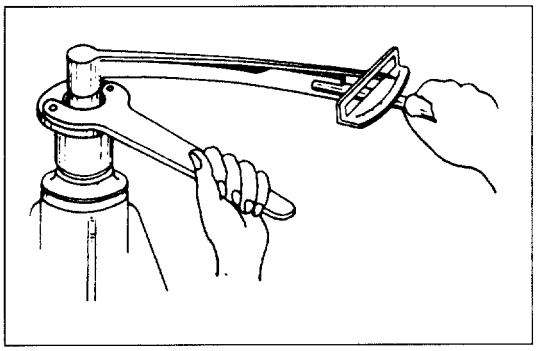
(NHR only for collapsible spacer)

1) Tighten the flange nut to a torque of 245 N•m (25 kg•m/181 lb•ft).
2) Make an adjustment by tightening the flange nut until specified bearing pre-load is obtained.

Bearing Preload	N (kg/lb)
New bearing	16–29 (1.6–3.0/3.5–6.6)
Used bearing	8–14.5 (0.8–1.5/1.8–3.3)

Starting Torque	N•m (kg•cm/lb•in)
New bearing	0.69–1.27 (7.0–13.0/6.1–11.3)
Used bearing	0.35–0.64 (3.5–6.5/3.1–5.6)

3) The flange nut should be within the specified range when specified bearing preload is obtained.



Flange Nut Torque	N•m (kg•m/lb•ft)
245–294 (25–30/181–217)	

Discard used flange nut and install new one.

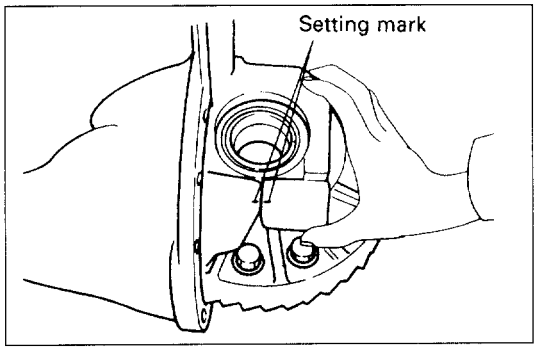
(NKR only for distance piece)

Once specified bearing preload is obtained by dummy nut, remove dummy nut and replace with flange nut.

Tighten the flange nut until specified bearing preload and nut torque.

Using special tool, stake the flange nut at two points.

Punch: 5-8840-2293-0



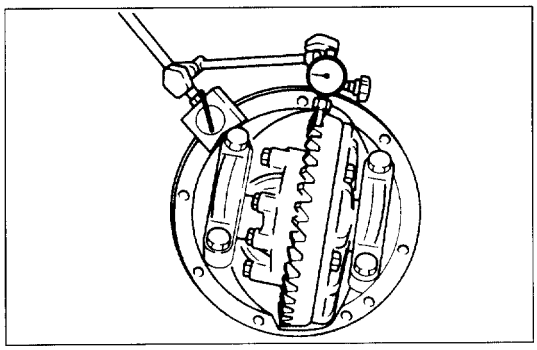
5. **Backlash and Preload Adjusting Shim**

1) Adjustment of Backlash

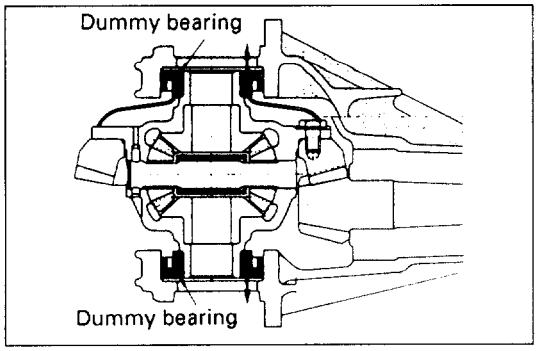
- Install dummy bearing in the differential cage assembly, then install differential cage assembly and ring gear into the differential carrier.
  Install the bearing caps after checking to make certain setting marks applied at disassembly are in alignment.

Bearing Cap Bolt Torque	N•m (kg•m/lb•ft)
108 (11.0/80)	

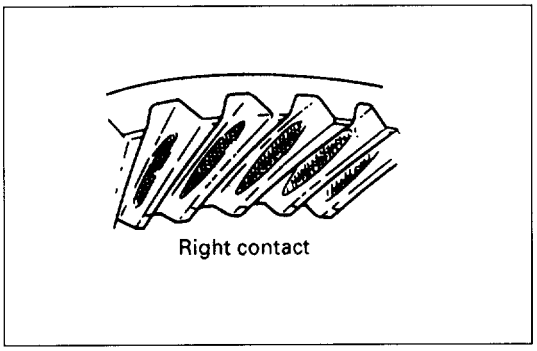
- Set the dial indicator and measure the backlash between the drive pinion and ring gear at the foot portion of the ring gear.



Backlash	mm (in.)
0.15–0.20 (0.006–0.008)	

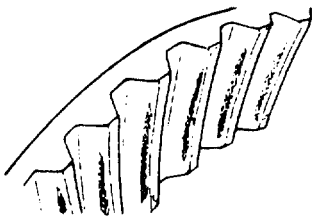
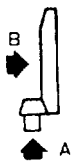
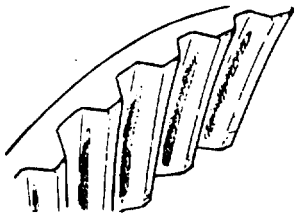
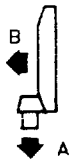
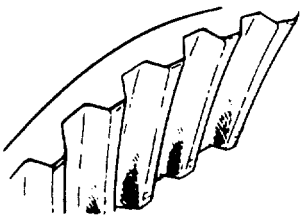
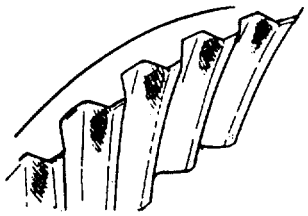


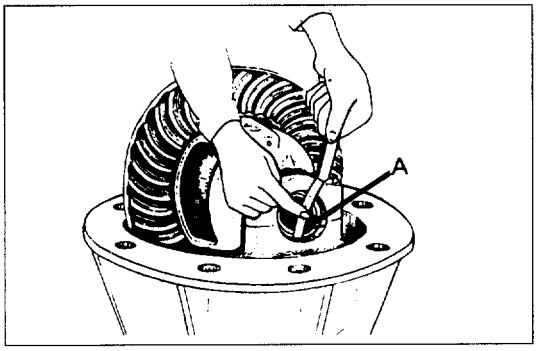
- To adjust backlash, loosen bearing cap bolts slightly and move the dummy bearing as necessary.
  A clearance should not be provided between dummy bearing and bearing fitting face of the differential cage.

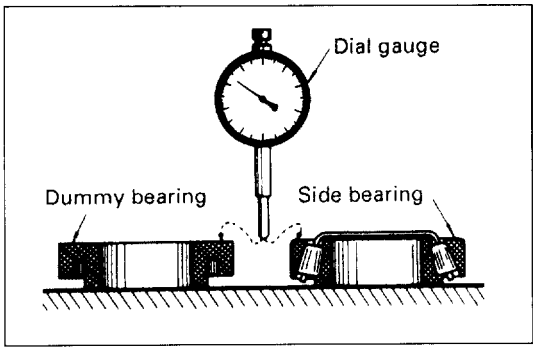


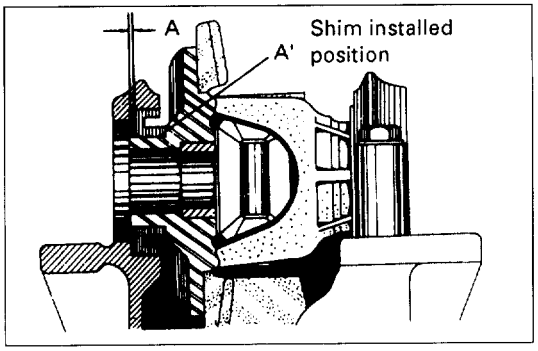
2) Inspection of drive pinion and ring gear tooth contact.

- Apply a thin coat of red check to faces of the 7–8 teeth of the ring gear.
- Check the impression of contact obtained on the ring gear teeth and make necessary adjustment as described below if the contact is abnormal.

Tooth Contact	Case	Adjustment Procedure
	Drive pinion is too far away from ring gear.	1. Move the drive pinion in toward the ring gear by decreasing the thickness of pinion depth adjusting shims. 2. Adjust the backlash by moving ring gear away from the drive pinion. 
	Drive pinion is too close to the ring gear.	1. Move the drive pinion away from the ring gear by increasing thickness of pinion depth adjusting shims. 2. Adjust the backlash by moving ring gear in toward the drive pinion. 
	Ring gear is too close to the drive pinion.	1. Move the drive pinion in toward the ring gear by decreasing thickness of pinion depth adjusting shims. 2. Adjust the backlash by moving ring gear away from the drive pinion.
	Ring gear is too for away from drive pinion.	1. Move the drive pinion away from the ring gear by increasing thickness of pinion depth adjusting shims. 2. Adjust the backlash by moving ring gear in toward the drive pinion.







3) Selection of Preload Adjusting Shim

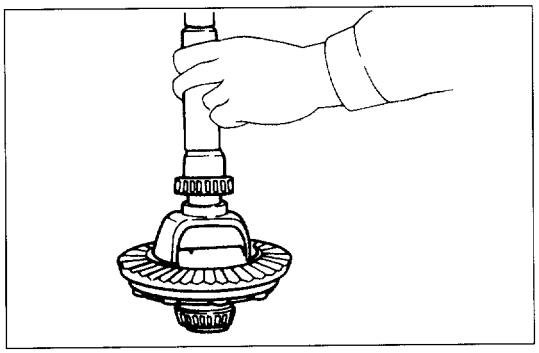
- Measure the clearance between the differential carrier and right and left side (dummy) bearings by using a feeler gauge.
  Carefully note the relationship between the values obtained through measurement at each side and dummy bearings.
- Measure the thickness of dummy bearing and side bearing.
  Comparison should be made between the thicknesses of dummy bearing and side bearing installed in the same position.

  When side bearing is thinner:
  A+(dummy bearing thickness–side bearing thickness)=(X)

  When side bearing is thicker:
  A–(side bearing thickness–dummy bearing thickness)=(X)
- (X)+0.025=Shim thickness
  Allowance for bearing preload at one side=0.025

Example of calculation	mm (in.)
Measured Clearance A:	+0.85 (+0.033)
Suppose that the side bearing is thicker [thinner] than dummy bearing by 0.05 mm	–0.05 (–0.002) [+0.05 (+0.002)]
An allowance for bearing preload:	+0.025 (+0.0009)
Thickness of shims to be installed:	0.825 (0.032) [0.925 (0.036)]

Thickness of Shim Available	mm (in.)
0.25, 0.30, 0.35, 0.5 (0.009, 0.012, 0.014, 0.019)	



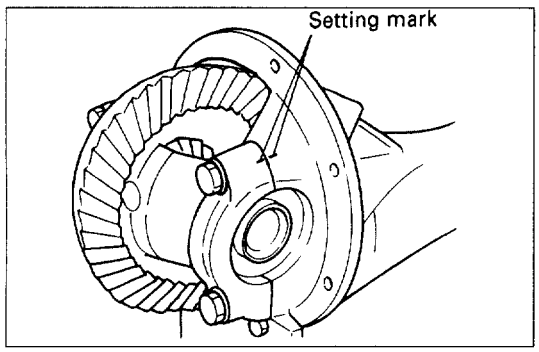
4. Side Bearing Inner Race

Installer: 5-8840-2050-0

Grip: 9-8522-1608-0

3. Differential Cage Assembly

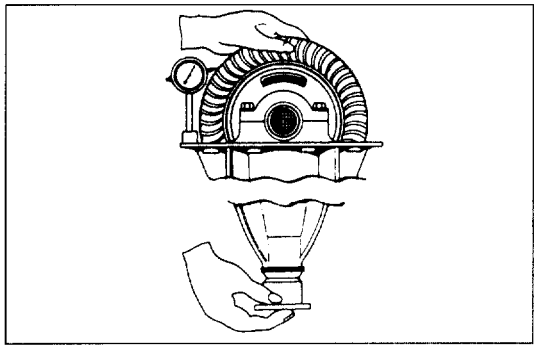
2. Side Bearing Outer Race



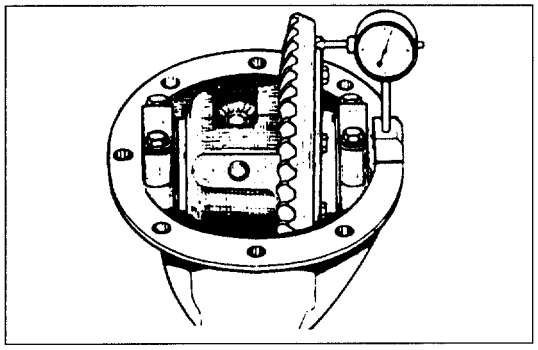
1. Bearing Cap

1) Install bearing caps by aligning setting marks applied at disassembly.

Bearing Cap Bolt Torque	N•m (kg•m/lb•ft)
108 (11.0/80)	



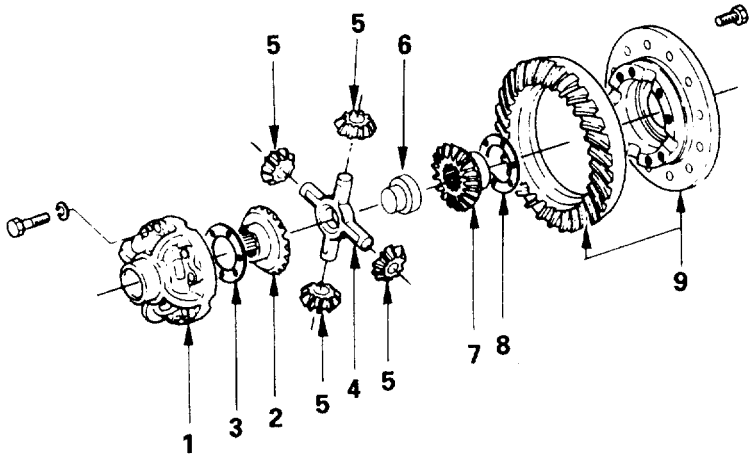
2) Recheck the backlash. If measurement indicates that the backlash deviates from the specified range, make an adjustment by shifting the position of shims in use without varying the total thickness.



Recheck the ring gear for run-out at the rear face. If the amount of run-out is excessive, repeat the disassembly and reassembly steps.

Ring Gear Run-Out	mm (in.)
Standard	Limit
0.05 (0.002)	0.2 (0.008)

Differential Cage Assembly



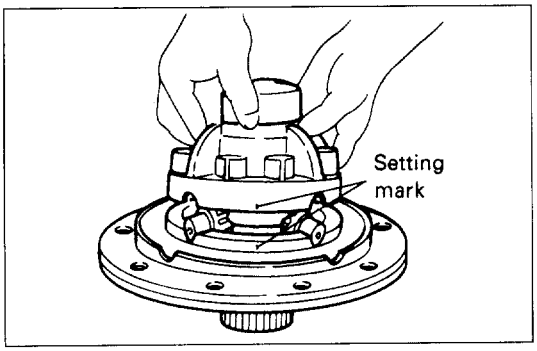
Disassembly Steps

1. Differential cage B
2. Side gear
3. Thrust washer
4. Spider
5. Differential pinion gear
6. Thrust piece
7. Side gear
8. Thrust washer
9. Differential cage A and ring gear

Reassembly Steps

To reassemble, follow the disassembly steps in the reverse order.

DISASSEMBLY



1. **Differential Cage B**

   Apply a setting mark to the differential cage assembly.
2. **Side Gear**
3. **Thrust Washer**
4. **Spider**
5. **Differential Pinion Gear**
6. **Thrust Piece**
7. **Side Gear**
8. **Thrust Washer**
9. **Differential Cage A and Ring Gear**

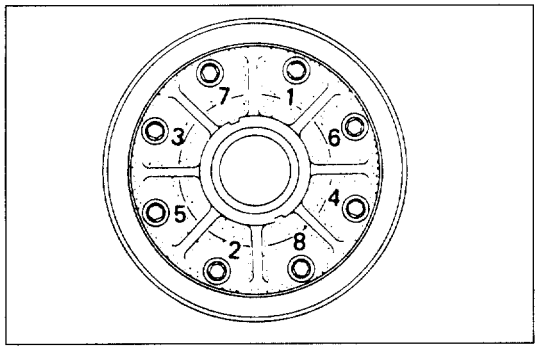
INSPECTION AND REPAIR

Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.

- Gear
- Bearing
- Oil seal
- Differential cage
- Drive pinion cage
- Parts organizing limited slip differential assembly

Visual Check

Inspect the following parts for wear, damage or other abnormal conditions.

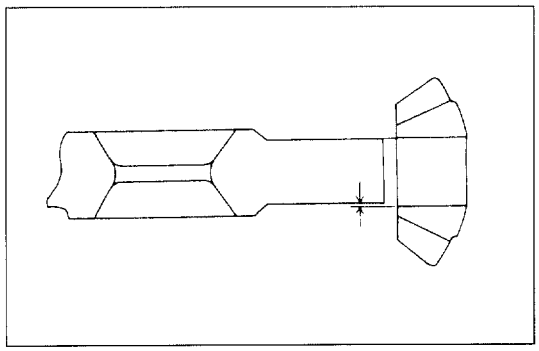


Ring Gear Replacement

The ring gear should always be replaced with drive pinion as a set.

When installing ring gear, apply stud lock to the threaded holes and bolts after treatment of the bolts with primer N.

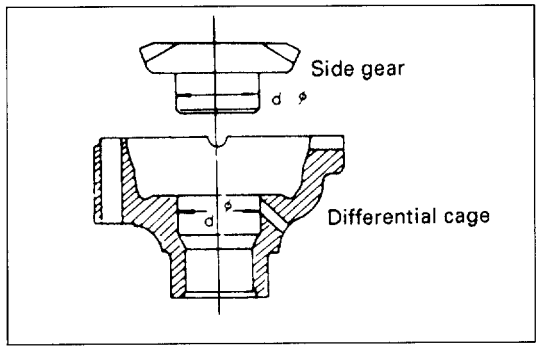
Ring Gear Bolt Torque	N•m (kg•m/lb•ft)
	127 (13.0/94)



Clearance between Differential Pinion and Spider

mm (in.)

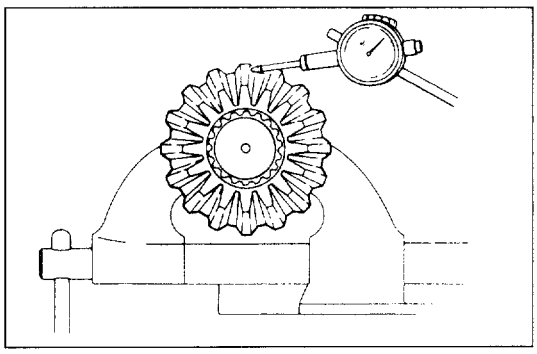
Standard	Limit
0.07–0.13 (0.003–0.005)	0.2 (0.008)



Clearance between Side Gear and Differential Cage

mm (in.)

Standard	Limit
0.05–0.11 (0.002–0.004)	0.25 (0.01)



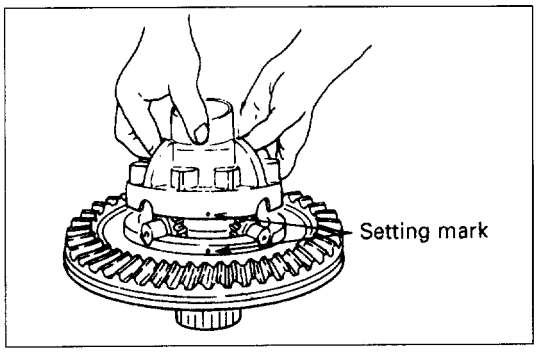
Play in Splines between Side Gear and Axle Shaft

mm (in.)

Standard	Limit
0.02–0.12 (0.0008–0.005)	0.25 (0.01)

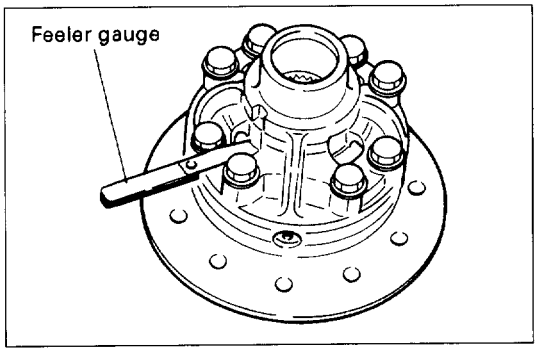
REASSEMBLY

9. **Differential Cage A and Ring Gear**
8. **Thrust Washer**
7. **Side Gear**
6. **Thrust Piece**
5. **Differential Pinion Gear**
4. **Spider**
3. **Thrust Washer**
2. **Side Gear**
1. **Differential Cage B**



1) Apply oil to the threaded portion of the bolts before installation.
2) Fasten the differential cages A and B so that the setting marks are correctly aligned.

Differential Cage Bolt Torque	N•m (kg•m/lb•ft)
78 (8.0/58)	



3) Measure the clearance between the back face of the side gear and the differential cage B by inserting a feeler gauge through the hole on the cage B.

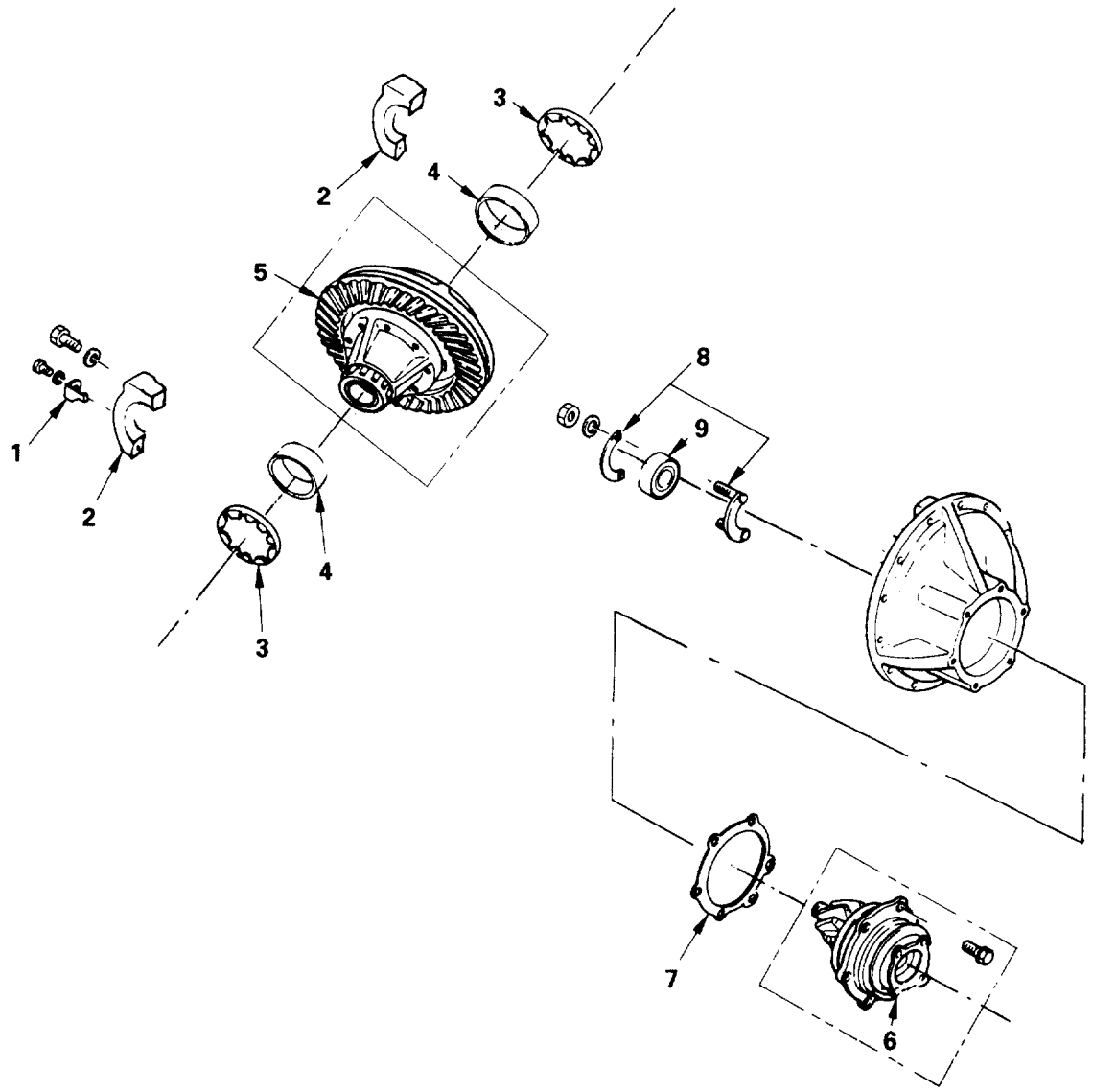
Clearance	mm (in.)
0.13–0.18 (0.005–0.007)	

When the clearance exceed a limit, replace the thrust washer or side gear.

292 MM/320 MM REAR DIFFERENTIAL

Major Components

This illustration is based on the 292 mm differential.



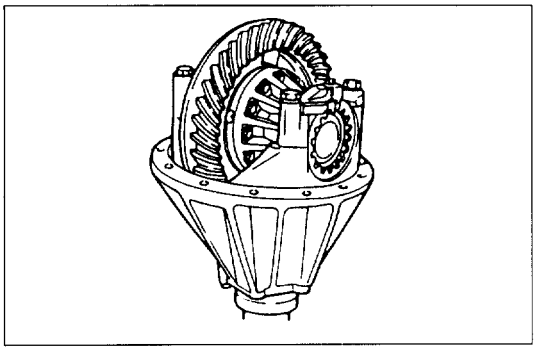
Disassembly Steps

1. Lock plate
2. Bearing cap
3. Adjust nut
4. Side bearing outer race
5. Differential cage assembly
6. Drive pinion cage assembly
7. Shim
8. Pilot bearing retainer
9. Pilot bearing

Reassembly Steps

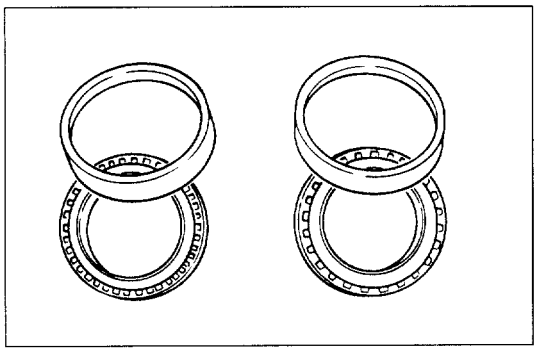
9. Pilot bearing
8. Pilot bearing retainer
5. Differential cage assembly
4. Side bearing outer race
2. Bearing cap
3. Adjust nut
7. Shim
6. Drive pinion cage assembly
1. Lock plate

DISASSEMBLY



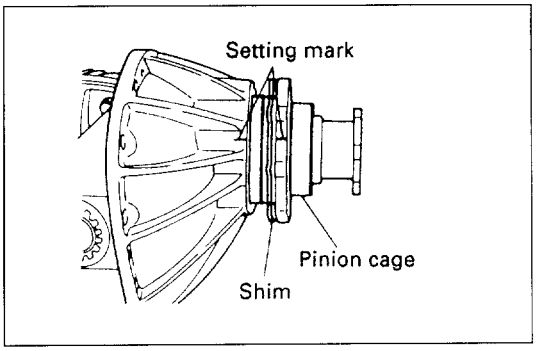
1. **Lock Plate**
2. **Bearing Cap**

   Set the differential assembly onto a special fixture. Apply a setting mark to the right and left side bearing caps to prevent interchanging.



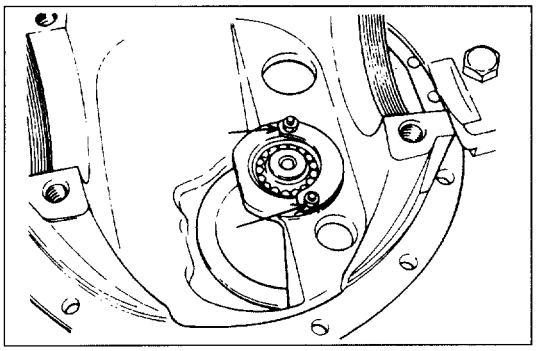
3. **Adjust Nut**
4. **Side Bearing Outer Race**

   Keep the side bearing outer race and inner races separate to prevent interchanging.
5. **Differential Cage Assembly**



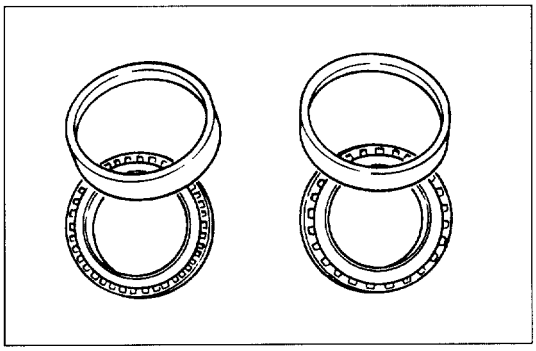
6. **Drive Pinion Cage Assembly**
7. **Shim**
8. **Pilot Bearing Retainer**
9. **Pilot Bearing**

REASSEMBLY



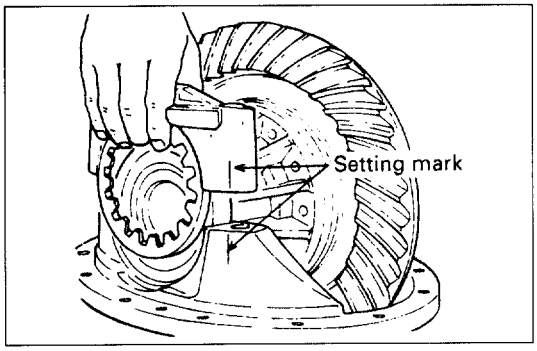
9. **Pilot Bearing**
8. **Pilot Bearing Retainer**

   The fixing nut should be on the inboard side of the case.



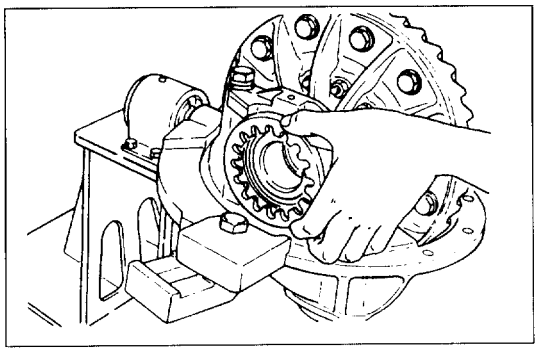
5. **Differential Cage Assembly**
4. **Side Bearing Outer Race**

   Install the outer and inner races, so that original combination is maintained.

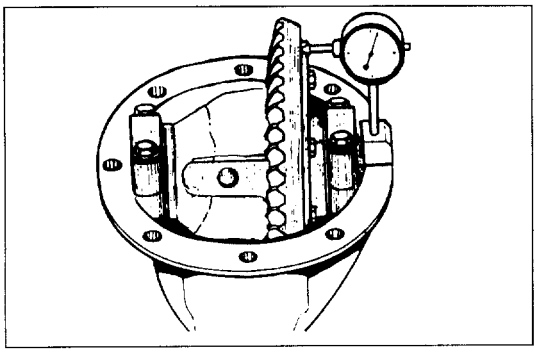


2. **Bearing Cap**

   Install the bearing caps by aligning setting marks applied at disassembly.



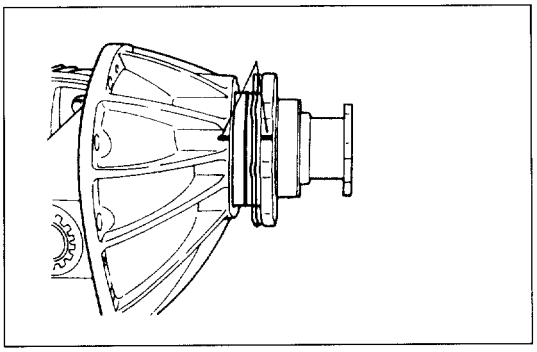
3. **Adjust Nut**
   (1) Threaded groove in nut should be properly aligned with threaded groove in the carrier.
   (2) Tighten the adjust nuts so that they can be turned after installing and semi-tightening bearing caps.



Inspection of Ring Gear for Run-Out

mm (in.)

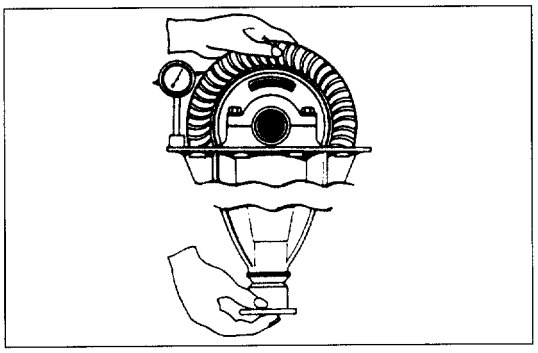
	Standard	Limit
292 mm	0.05 (0.002)	0.2 (0.008)
320 mm	0.08 (0.003)	0.25 (0.010)



7. **Shim**
6. **Drive Pinion Cage Assembly**

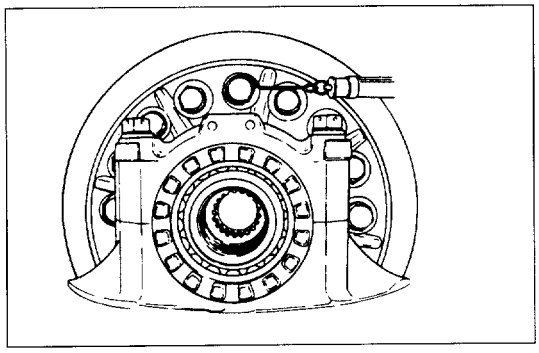
   Install the shim removed and pinion aligning the oil hole or setting mark applied on removal.

Drive Pinion Cage Bolt Torque		N•m (kg•m/lb•ft)
292 mm	M12	69 (7.0/51)
	M14	78 (8.0/58)
320 mm	72 (7.3/53)	



Backlash between Drive Pinion and Ring Gear

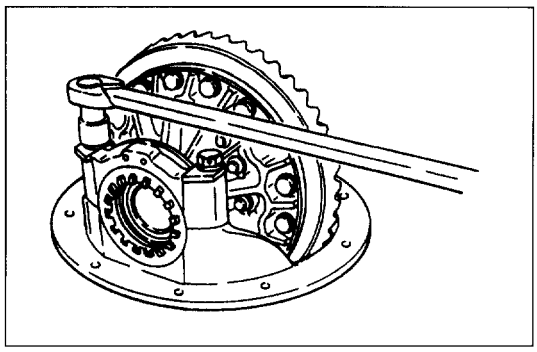
Backlash	mm (in.)
292 mm	0.18–0.23 (0.007–0.009)
320 mm	0.19–0.29 (0.007–0.011)



Bearing Preload	N (kg/lb)
N.S.K. bearing	5.7–13.0 (0.58–1.33/1.3–2.9)
Koyo bearing	11.5–17.9 (1.17–1.83/2.6–4.0)

Side Bearing Preload Adjustment

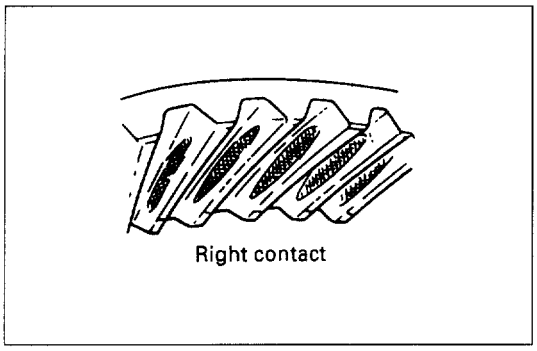
Thread the adjust nut on the ring gear side into 2 notches to give a proper bearing preload when correct backlash and tooth contact are obtained.



Fully tighten the bearing cap bolts.

Bearing Cap Bolt Torque	N•m (kg•m/lb•ft)
292 mm	108 (11/80)
320 mm	157 (16/116)

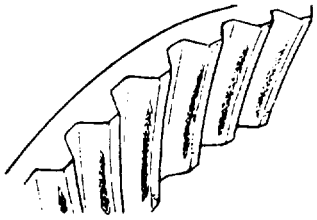
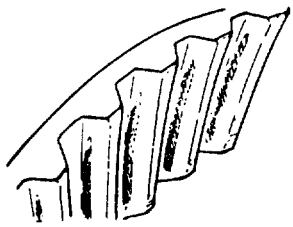
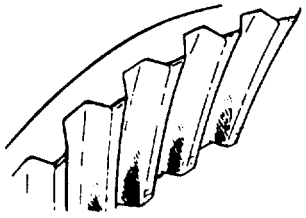
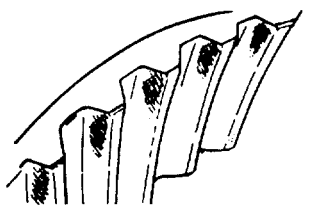
Recheck the backlash after tightening the bearing cap bolts.

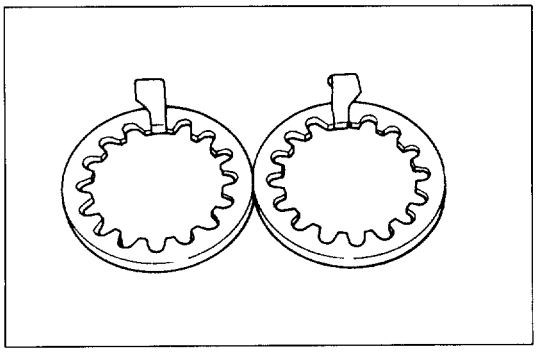


Inspection of Drive Pinion and Ring Gear Tooth Contact

- Apply a thin coat of red check to the faces of the 7–8 teeth of the ring gear.
- Check the impression of contact obtained on the ring gear teeth and make necessary adjustment as described below if the contact is abnormal.

Adjusting Shims Available	mm (in.)
0.10, 0.12, 0.14, 0.16, 0.18, 0.20 (0.004, 0.0047, 0.0055, 0.0063, 0.0071, 0.0079)	

Tooth Contact	Case	Adjustment Procedure
	Drive pinion is too far away from ring gear.	1. Move the drive pinion in toward the ring gear by decreasing the thickness of pinion depth adjusting shims. 2. Adjust the backlash by moving ring gear away from the drive pinion.
	Drive pinion is too close to the ring gear.	1. Move the drive pinion away from the ring gear by increasing thickness of pinion depth adjusting shims. 2. Adjust the backlash by moving ring gear in toward the drive pinion.
	Ring gear is too close to the drive pinion.	1. Move the drive pinion in toward the ring gear by decreasing thickness of pinion depth adjusting shims. 2. Adjust the backlash by moving ring gear away from the drive pinion.
	Ring gear is too for away from drive pinion.	1. Move the drive pinion away from the ring gear by increasing thickness of pinion depth adjusting shims. 2. Adjust the backlash by moving ring gear in toward the drive pinion.



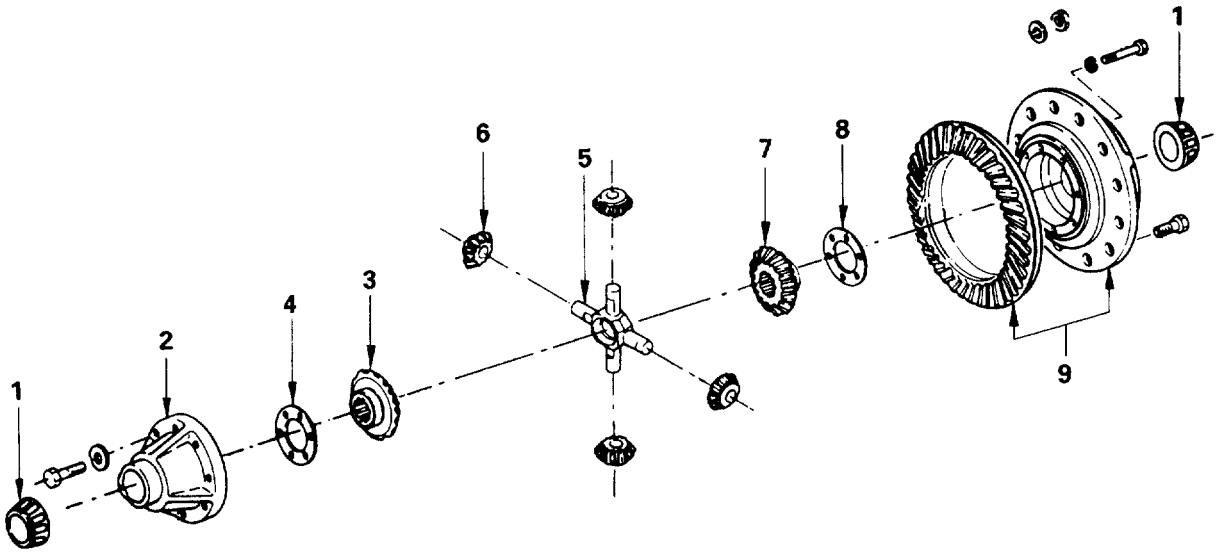
1. Lock Plate

Lock Plate Bolt Torque	N•m (kg•m/lb•ft)
292 mm	29 (3.0/22)
320 mm	13 (1.3/9)

The lock plates are available in 2 different kinds to permit gradual adjustment by 1/2 notch of the adjust nut.

Differential Cage Assembly

This illustration is based on the 292 mm differential.



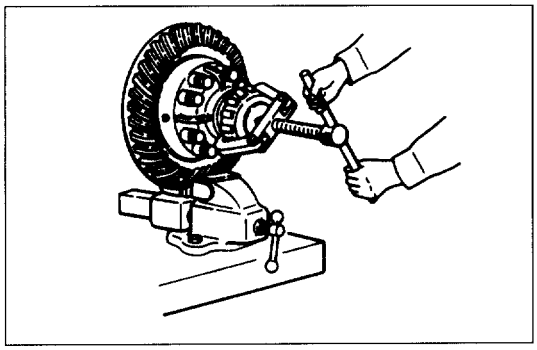
Disassembly Steps

1. Side bearing inner race
2. Differential cage B
3. Side gear
4. Thrust washer
5. Spider
6. Differential pinion
7. Side gear
8. Thrust washer
9. Differential cage A and ring gear

Reassembly Steps

To reassemble, follow the disassembly stops in the reverse order.

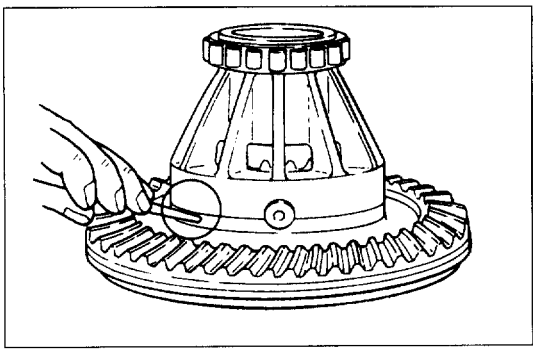
DISASSEMBLY



1. Side Bearing Inner Race

Remover: 9-8521-0061-0 (292 mm)
5-8840-2373-0 (320 mm)

Adapter: 9-8521-2701-0



2. **Differential Cage B**

   Apply a setting mark before removing the differential cage B to ensure reassembly into original position.

3. **Side Gear**
4. **Thrust Washer**
5. **Spider**
6. **Differential Pinion**
7. **Side Gear**
8. **Thrust Washer**
9. **Differential Cage A and Ring Gear**

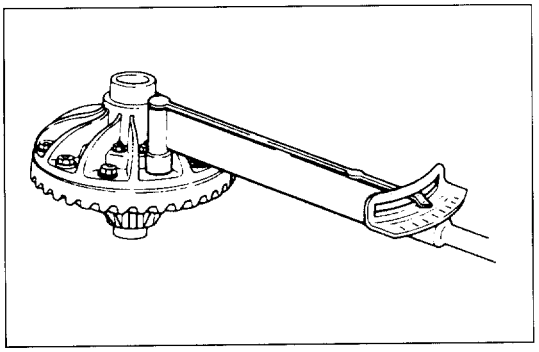
INSPECTION AND REPAIR

Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.

- Gear
- Bearing
- Oil seal
- Differential cage
- Drive pinion

Visual Check

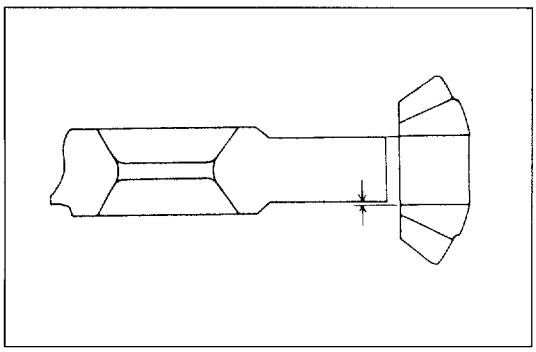
Inspect the following parts for wear, damage or other abnormal conditions.



Ring Gear Replacement

The ring gear should always be replaced together with the drive pinion as a matched set.
When installing ring gear, apply stud lock to the thread holes and bolts after treatment of the bolts with primer N.

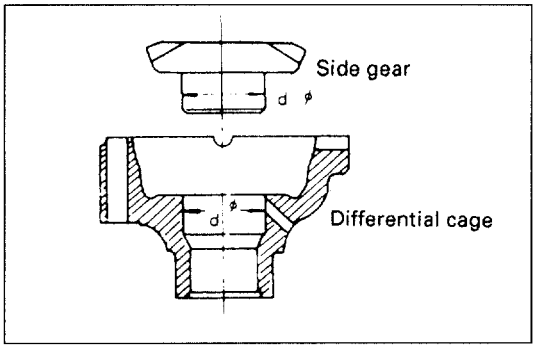
Ring Gear Bolt Torque		N•m (kg•m/lb•ft)
292 mm	M12	127 (13/94)
	M14	196 (20/145)
320 mm		333 (34/246)



Clearance between Spider and Differential Pinion

mm (in.)

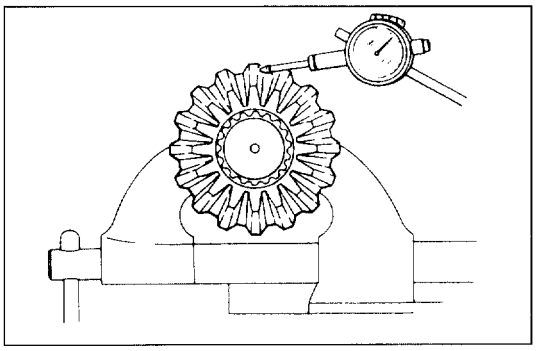
	Standard	Limit
292 mm	0.07–0.13 (0.003–0.005)	0.2 (0.008)
320 mm	0.05–0.13 (0.002–0.005)	0.2 (0.008)



Clearance between Side Gear and Differential Cage

mm (in.)

	Standard	Limit
292 mm	0.05–0.11 (0.002–0.004)	0.25 (0.01)
320 mm	0.13–0.20 (0.005–0.008)	0.25 (0.01)



Play in Spline between Side Gear and Axle Shaft

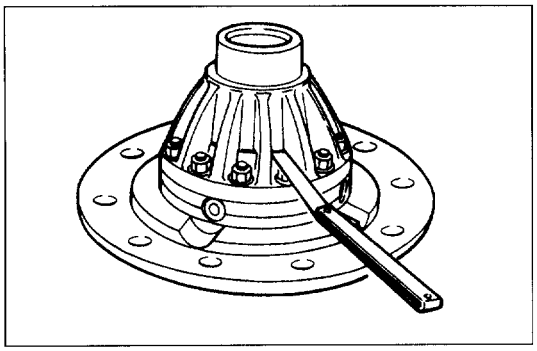
mm (in.)

	Standard	Limit
292 mm	0.08–0.15 (0.003–0.006)	0.3 (0.012)
320 mm	0.2 (0.008)	0.5 (0.02)

REASSEMBLY

9. **Differential Cage A and Ring Gear**
8. **Thrust Washer**
7. **Side Gear**
6. **Differential Pinion**
5. **Spider**
4. **Thrust Washer**
3. **Side Gear**
2. **Differential Cage B**
   1) Install by aligning setting marks.
   2) Apply oil to threaded portion of bolts before installation

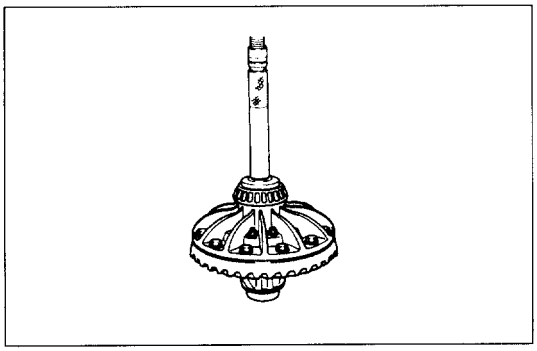
Differential Cage Nut Torque	N•m (kg•m/lb•ft)
292 mm	69 (7/51)
320mm	108 (11/80)



3) Measure the clearance between the back face of the side gear and the differential cage B by inserting a feeder gauge through the hole on the cage B.

Clearance	mm (in.)
292 mm	0.21–0.28 (0.008–0.011)
320mm	0.10–0.38 (0.004–0.015)

When the clearance exceed a limit, replace the thrust washer or side gear.



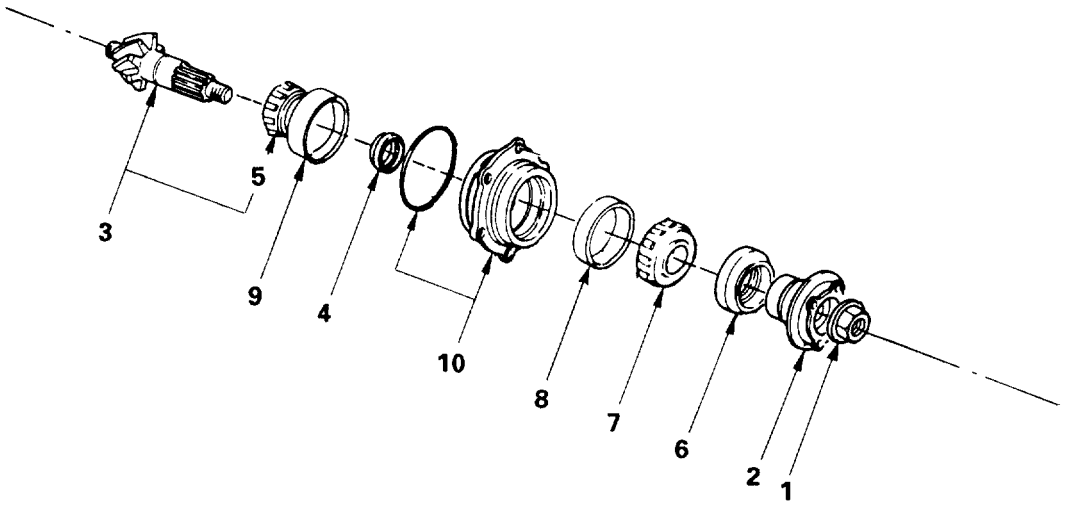
1. Side Bearing Inner Race

Installer: 9-8522-1614-0

Grip: 9-8522-1148-0

Drive Pinion Cage Assembly

This illustration is based on the 292 mm differential.



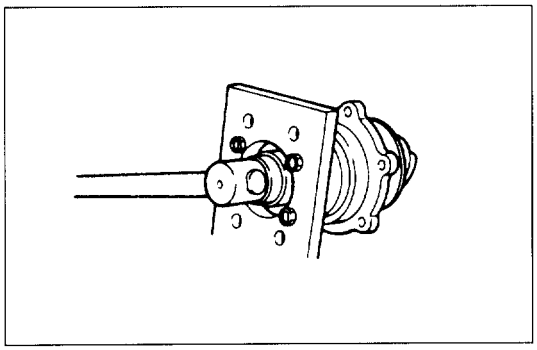
Disassembly Steps

1. Flange nut
2. Flange
3. Drive pinion
4. Collapsible spacer
5. Inner bearing inner race
6. Oil seal
7. Outer bearing inner race
8. Outer bearing outer race
9. Inner bearing outer race
10. Pinion cage and O-ring

Reassembly Steps

To reassemble,follow the disassembly steps in the reverse order.

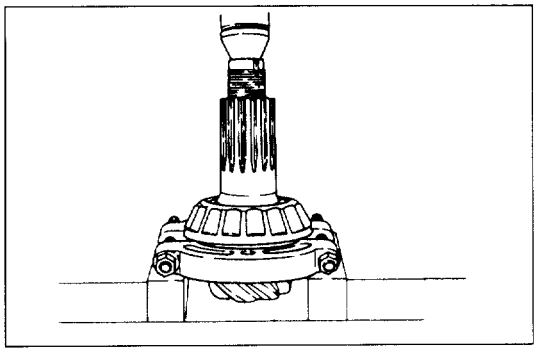
DISASSEMBLY



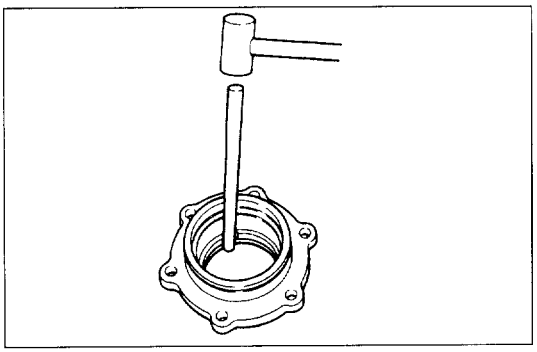
1. Flange Nut

Flange Bracket: 9-8529-2101-0

2. **Flange**
3. **Drive Pinion**
4. **Collapsible Spacer**



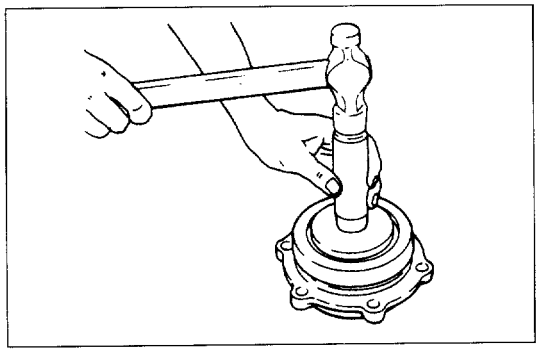
5. **Inner Bearing Inner Race**
   Remover: 5-8840-0015-0



6. **Oil Seal**
7. **Outer Bearing Inner Race**
8. **Outer Bearing Outer Race**
   Drive out the outer bearing outer race together with the outer bearing inner race and oil seal or the inner bearing outer race by using a proper bar through the two notches.
9. **Inner Bearing Outer Race**
10. **Pinion Cage and O-ring**

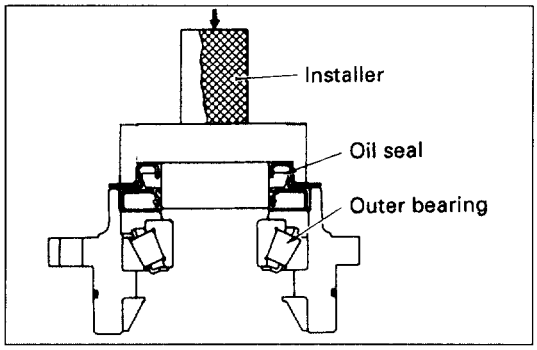
REASSEMBLY

10. **Pinion Cage and O-ring**
    Discard used O-ring and install a new one.

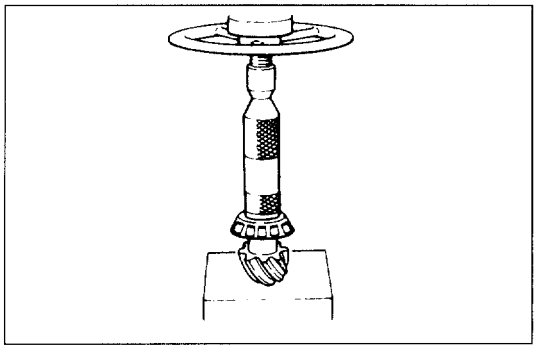


9. **Inner Bearing Outer Race**
   Installer: 5-8840-2046-0 (292 mm)
   5-8840-2379-0 (320 mm)
   Grip: 9-8522-1608-0

8. **Outer Bearing Outer Race**
   Installer: 9-8522-1613-0 (292 mm)
   5-8840-2376-0 (320 mm)
   Grip: 9-8522-1608-0
7. **Outer Bearing Inner Race**

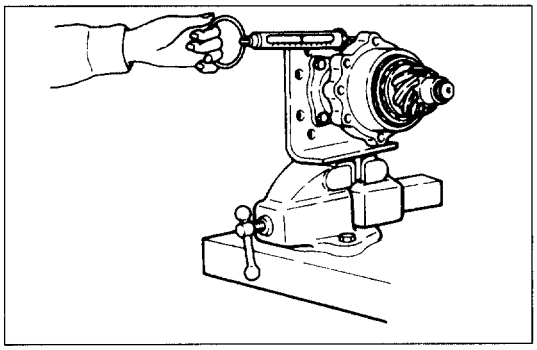


6. **Oil Seal**
   Installer: 9-8522-1607-0 (292 mm)
   5-8840-2377-0 (320 mm)
   Grip: 9-8522-1608-0



5. **Inner Bearing Inner Race**
   Installer: 9-8522-1615-0

4. **Collapsible Spacer**
   Discard used collapsible spacer and install a new one.
3. **Drive Pinion**
2. **Flange**
1. **Flange Nut**
   Discard used flange nut and install a new one at reassembly.



Adjustment of bearing preload.

(1) Tighten the flange nut to a torque of 245 N•m (25 kg•m/181lb•ft).

(2) Adjust bearing preload by tightening the flange nut until specified preload is obtained.

(3) The flange nut should be within the specified range when specified preload is obtained.

Flange Nut Torque	N•m (kg•m/lb•ft)
292 mm	324–480 (33–49/238–354)
320 mm	441–598 (45–61/325–441)

Apply oil to seated surface of nut when tightening.

Preload at Cage Fixing Hole		N (kg/lb)
292 mm	New bearing	13–25 (1.3–2.6/2.9–5.7)
	Used bearing	6.5–12.5 (0.65–1.3/1.5–2.9)
320 mm	New bearing	26–38 (2.7–3.9/6.0–8.6)
	Used bearing	13–19 (1.35–1.95/3.0–4.3)

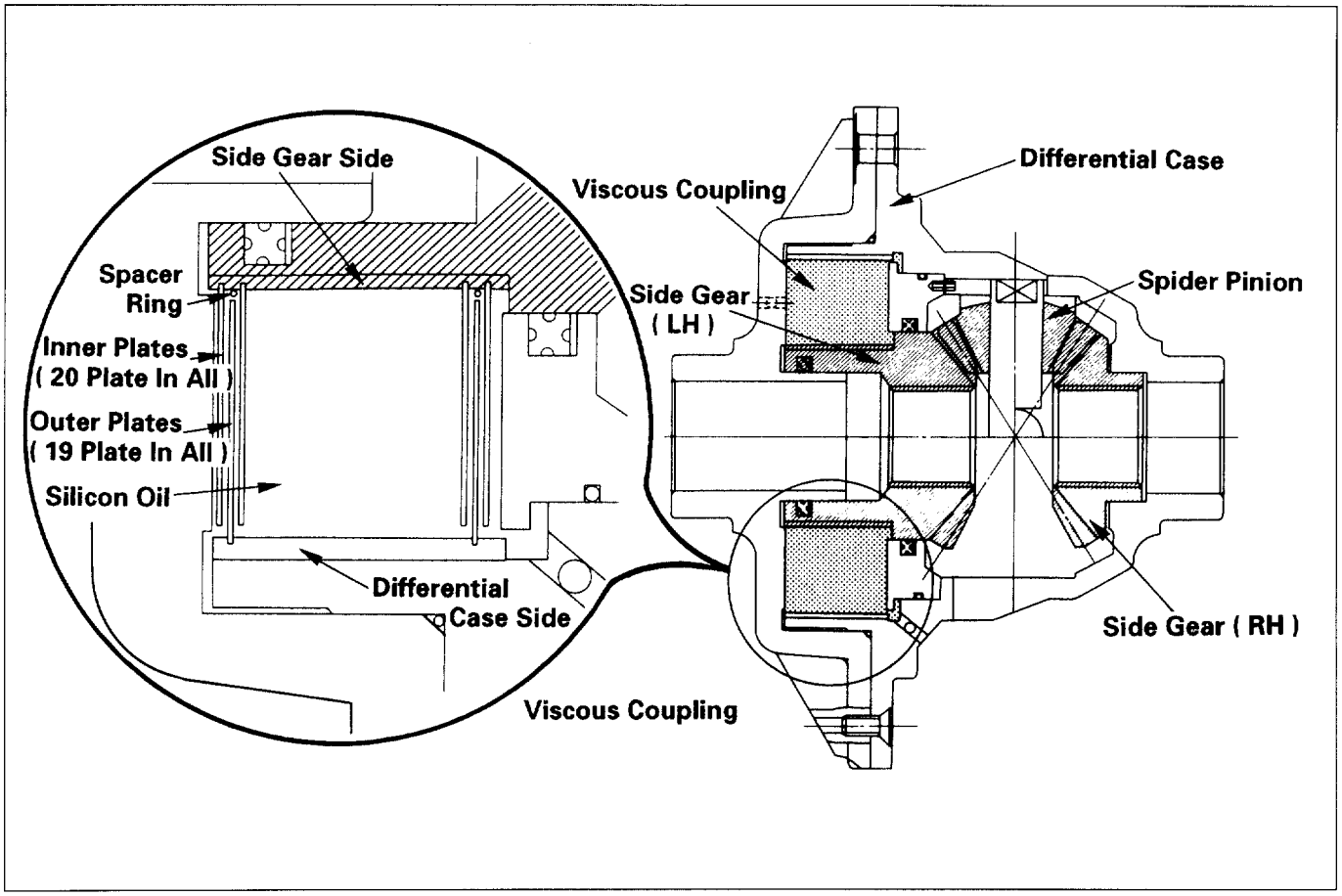
Starting Torque		N•m (kg•cm/lb•in)
292 mm	New bearing	0.98–1.96 (10.0–20.0/8.7–17.4)
	Used bearing	0.49–0.98 (5.0–10.0/4.3–8.7)
320 mm	New bearing	2.3–3.2 (23.0–33.0/20–28.6)
	Used bearing	1.2–1.6 (12.0–16.0/10.4–13.9)

(4) Using special tool, stake the flange nut at two points.

Punch: 5-8840-2293-0

LIMITED SLIP DIFFERENTIAL (LSD)

Function (NPS Model Only)



The viscose-type limited slip differential is of the structure filled with viscose (high viscosity silicone oil) between the outer plates connected to the differential case and the inner plates connected to the side gear on the left side. While driving, the difference in the number of revolutions between the right and left wheels causes the difference in the number of revolutions also between the differential case and the side gear on the left side. This difference in the number of revolutions results in shearing of silicone oil to generate viscous torque between the plates.
When either one of the wheels is caught up in muddy or snow melting road and starts racing while driving, the operation of the viscous torque mentioned above makes it facilitate to drive the vehicle by providing a driving force to the other wheel on the road where the road condition is better.

CAUTION:
The LSD assembly cannot be disassembled. When there occurs anything abnormal with the LSD assembly, replace it as an assembly. (Please note that when the silicone oil which has been sealed inside drains out while in disassembly, the LSD assembly will fail to display its intrinsic performance.)

Performance Check

Check the performance by following the procedure given below.

(1) Set the transmission gearshift lever to the neutral position.

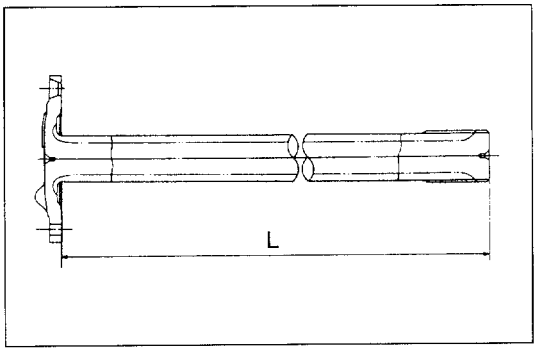
(2) Lift up the rear axle.

(3) Rotate with a gathered momentum either one of the wheels on the rear axle in the forward direction.

When the wheel on the opposite side rotates in the forward direction while in the operation of (3) above, it is considered that the performance of viscous coupling functions normally, and otherwise, that the viscous coupling has a lowered performance.

WARNING:
WHEN EITHER ONE OF THE REAR WHEELS IS LIFTED UP AND A DRIVING FORCE IS APPLIED TO THE REAR AXLE, THE VEHICLE IS IN DANGER OF STARTING ABRUPTLY. BE SURE NOT TO APPLY A DRIVING FORCE TO THE REAR AXLE IN THIS CONDITION.

For detailed information of disassembling, assembling, checking and servicing of parts other than the LSD assembly, refer to "292 MM DIFFERENTIAL".



Rear Axle Shaft

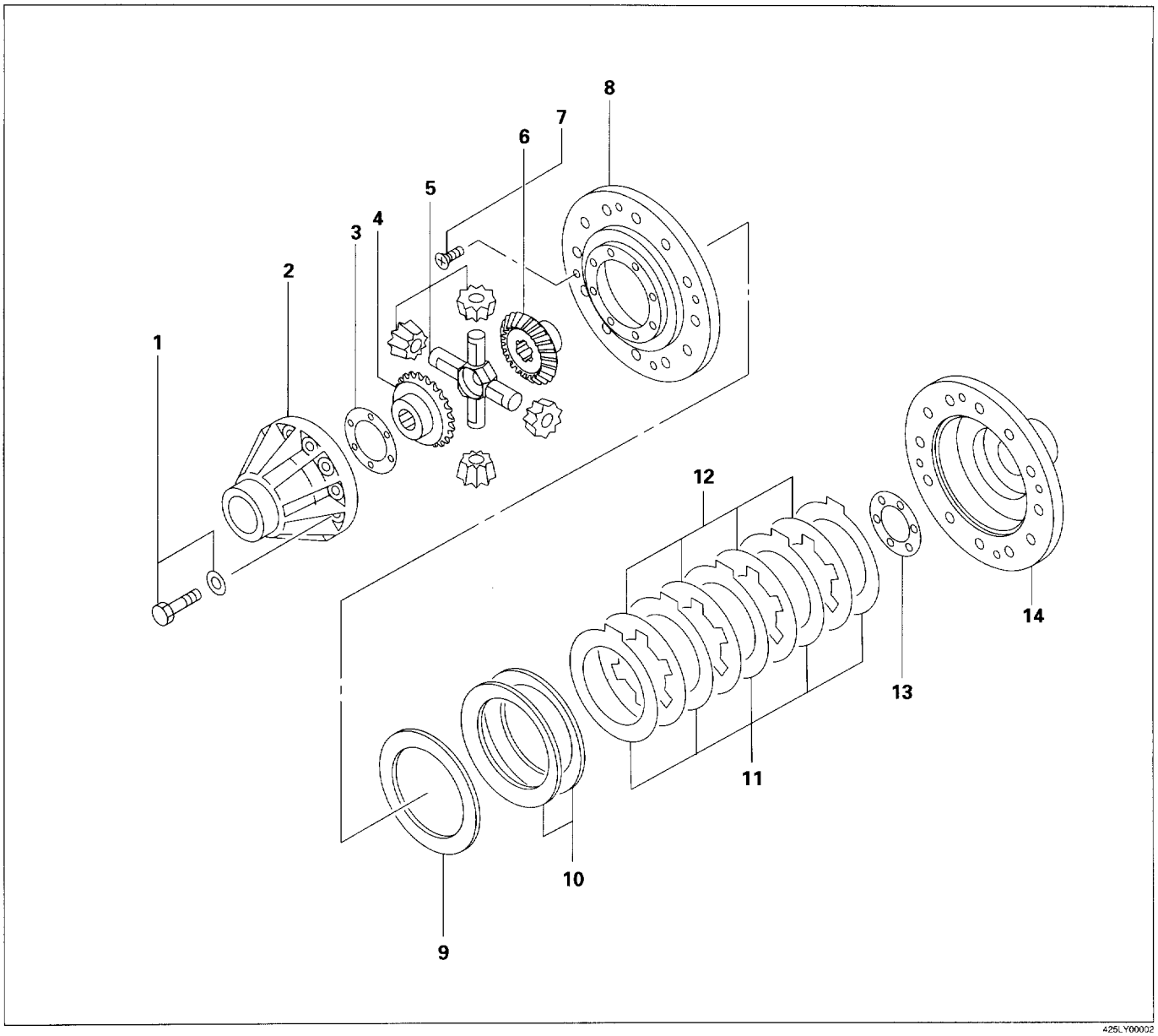
NOTE:
For vehicles provided with the LSD assembly, the length of the rear axle shafts is different from each other on the right and left sides. Be careful not to confuse one with another when replacing the rear axle shaft.

mm (in)

	L
Right side	800 ± 2 (31.5 ± 0.08)
Left side	856 ± 2 (33.7 ± 0.08)

LIMITED SLIP DIFFERENTIAL (LSD) -FRICTION TYPE

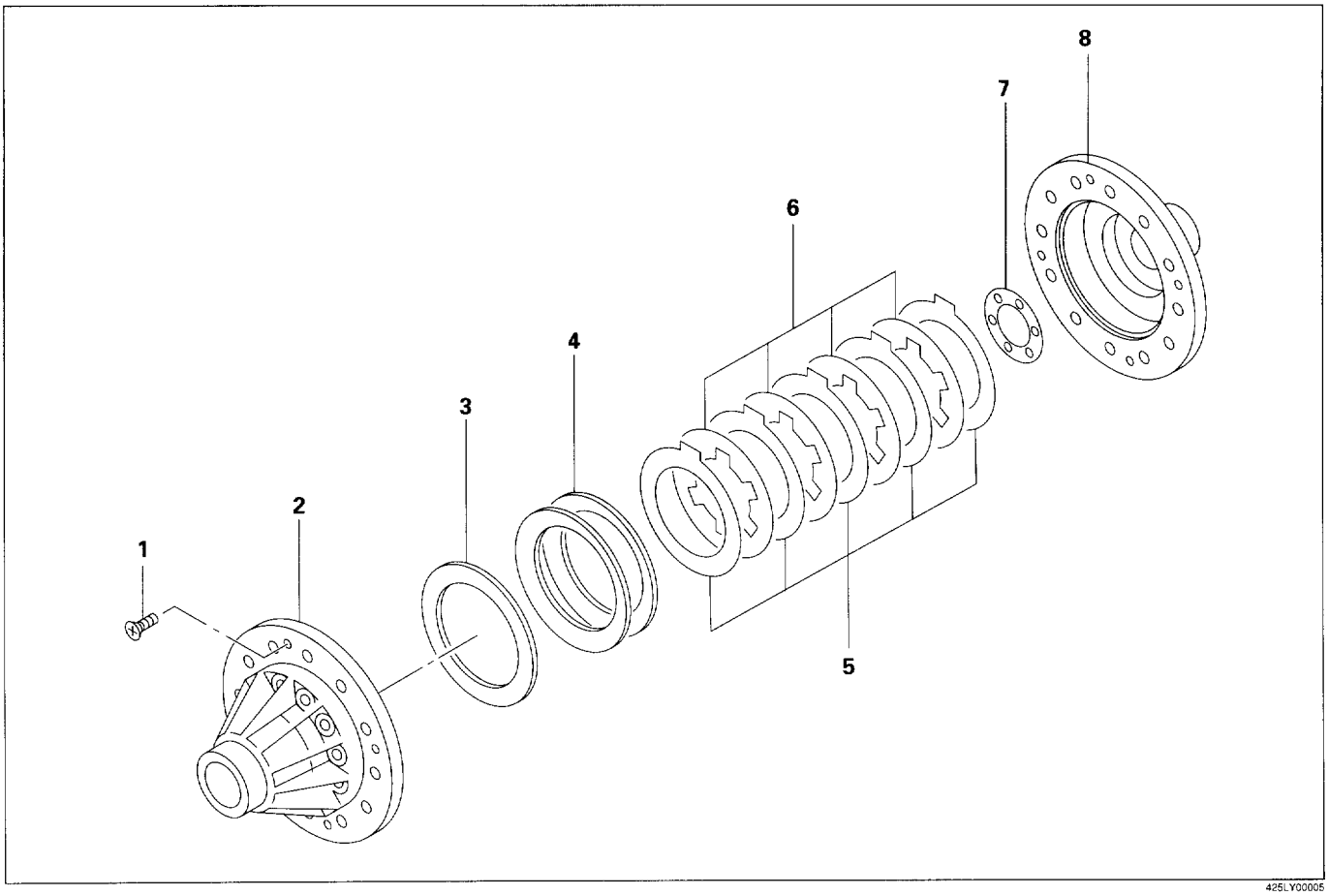
Disassembled View



Legend

1. Bolt and washer
2. Differential cage B
3. Thrust washer
4. Side gear
5. Spider and differential pinion
6. Side gear
7. Screw
8. Differential cage A'
9. Spacer
10. Spring disc
11. Friction plate
12. Friction disc
13. Thrust washer
14. Differential cage A

LIMITED SLIP DIFFERENTIAL (LSD)

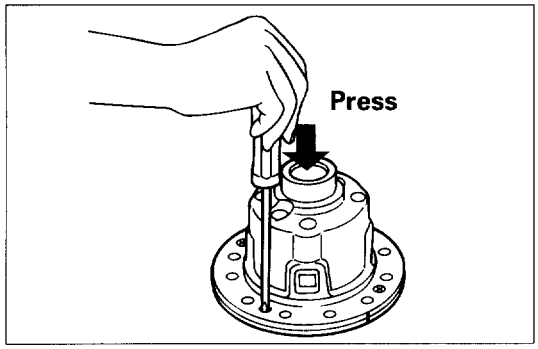


Disassembly steps

1. Screw
2. Differential cage B
3. Spacer
4. Spring disc
5. Friction plate
6. Friction disc
7. Thrust washer
8. Differential cage A

Reassembly steps

To reassemble, follow the disassembly steps in the reverse order.



DISASSEMBLY

1. **Screw**

   Apply a setting mark before removing the differential cages A and B.

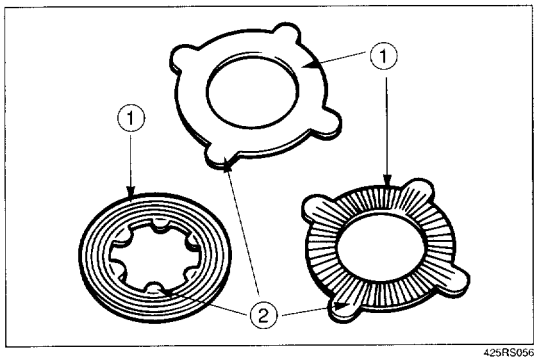
   Press the differential cage B and hold it.

   Gradually and evenly loosen the fixing screws of the differential cages.
2. **Differential cage B**
3. **Spacer**
4. **Spring disc**

   When removing the spring disc, friction plate, friction disc, place them in order for clear.
5. **Friction plate**
6. **Friction disc**
7. **Thrust washer and side gear**
8. **Differential cage A**

INSPECTION AND REPAIR

Make necessary correction or parts replacement if wear, damage, corrosion or any other abnormal condition is found through inspection.

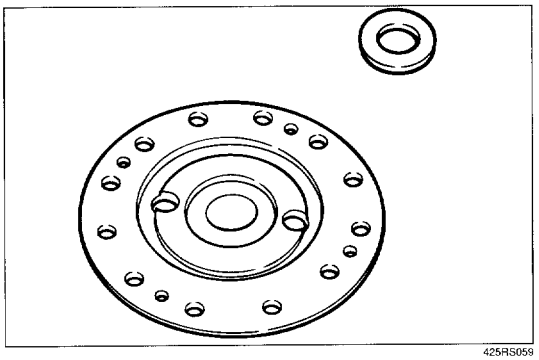


425RS056

Visual Check

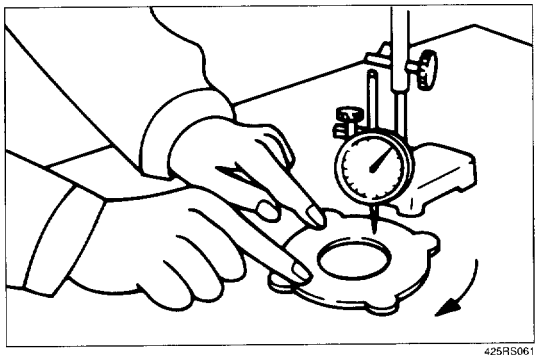
Check the following parts for wear, damage, noise or any other abnormal conditions.

- Friction disc, friction plate and spring disc.
  1. Sliding surfaces
  2. Projections


425RS059

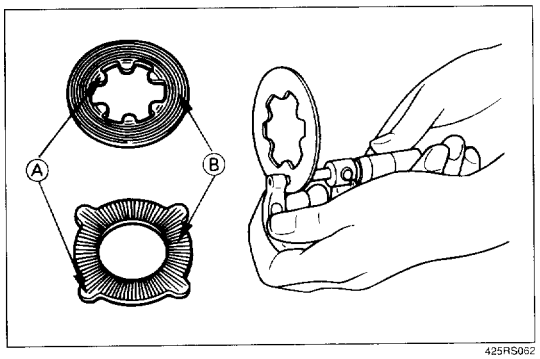
- Differential cage

  Inner groove of the differential cages. Repair light nicks and burrs using an oil stone.


425RS061

Deformation of the Friction Disc & Plate

Deformation of the Friction Disc & Plate	mm (in)
0.2 (0.008)	

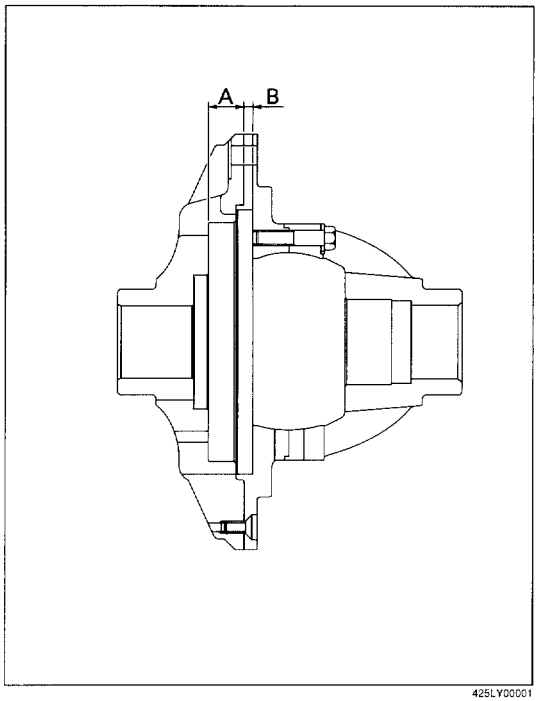


425RS062

Wear of the Friction Plate & Disc

Wear of the Friction Plate & Disc	mm (in)
0.1 (0.004)	

Remarks: A=Inner or outer projections
B=Sliding surface subjected to abrasion



REASSEMBLY

Clearance adjustment

1) Measuring the depth of the differential cages.

Depth of the differential cage mm (in)

Standard (A)	23.0 (0.9)
(B)	5.8 (0.23)

2) Measuring the Combind thickness of the spring disc (C), friction disc (D) and friction plate (E).
3) Select and install the appopriate spacer (F) to create the specified clearance.

Clearance = (A+B) – (C+D+E+F)

Clearance mm (in)

Standard	2.4-2.7 (0.094-0.106)

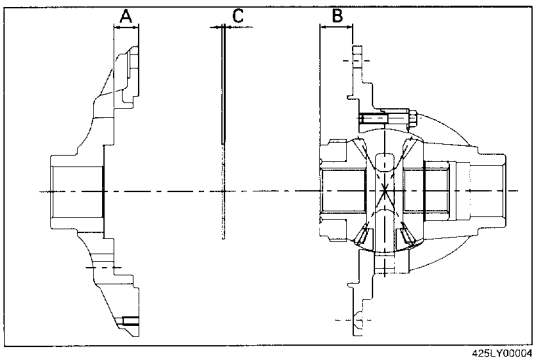
Thickness of spacer available mm

2.85, 3.0, 3.15, 3.3, 3.45, 3.6, 3.75

NOTE:

When assembling the parts, apply recommended gear oil sufficiently to each of the parts, especially, to the contact surfaces and sliding surface.

Recommended oil: Gear oil 5 LSD (limited slip differential) or equivalent



8. Differential Cage A

7. Thrust Washer

Measure the clearance the back face of the side gear and the differential cage A.

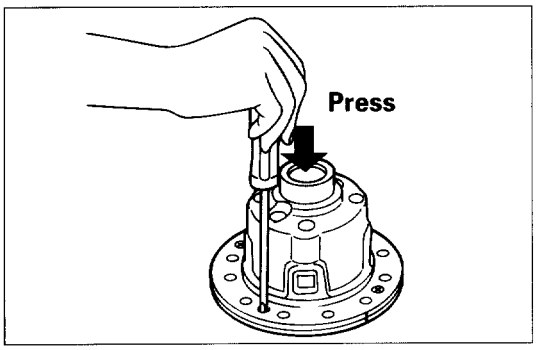
Clearance=A-B-C mm (in)

standard	0-0.235 (0-0.09)

C: Thrust washer thickness

Thickness of thrust washer available mm

1.3, 1.4, 1.5, 1.6



6. 5.Friction plate and Friction Disc

4. Spring Disc

3. Spacer

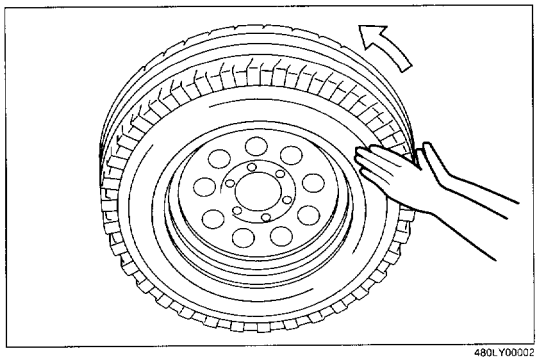
2. Differential Cage B

1. Screw

Matching the guide marks of the differential cages.

Press the differential cage B and hold it.

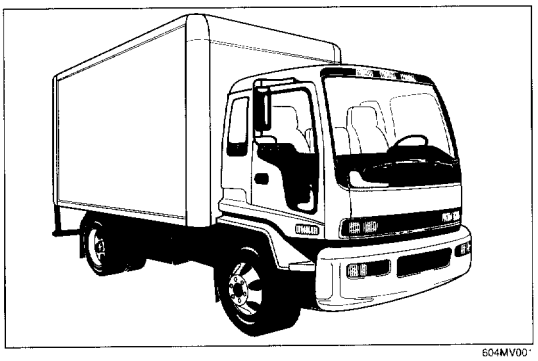
Tighten the screws evenly in the diagonal order.



Inspection (After installation to the vehicle)

Check parking brake function.

1) Make sure the vehicle is empty.
2) Set the parking brake
3) Jack up the rear of the vehicle
4) Check that the rear wheels do not turn when force is applied to them.



Road test

Drive the vehicle on the open road. Check that the limited slip differential operates when the vehicle is drive in a circular pattern and during cornering.

SECTION 4C
FRONT AXLE

CONTENTS

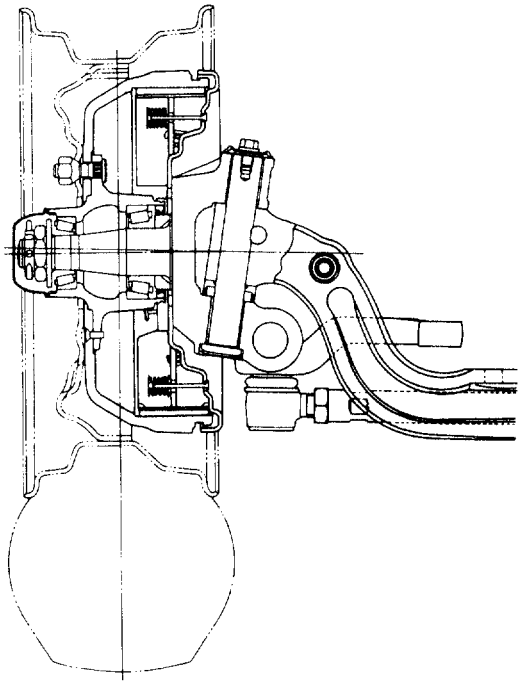
PAGE

General Description 4C- 2
On-Vehicle Service 4C-10
- Front Hub and Brake Drum (4 × 2 Model) 4C-10
- Front Hub and Disc (4 × 2 Model, 282mm Disc) 4C-16
- Front Hub and Disc (4 × 2 Model, 310mm Disc) 4C-22
- Front Hub, Disc and Knuckle (4 × 2, Independent Suspension Model) 4C-28
- Front Axle Assembly (4 × 2 Model) 4C-34
- Knuckle and King Pin (4 × 2 Model) 4C-38
- Free Wheel Hub (Manual Locking Hub) (4 × 4 Model) 4C-46
- Front Hub and Brake Drum (4 × 4 Model) 4C-53
- Spindle and Drive Shaft (4 × 4 Model) 4C-60
- Knuckle and King Pin (4 × 4 Model) 4C-66
- Front Differential Assembly (4 × 4 Model) 4C-75
- Front Axle Assembly (4 × 4 Model) 4C-77

Unit Repair 4C-82
- 244 mm Front Differential 4C-82
  - Major Component 4C-82
  - Differential Cage Assembly 4C-92

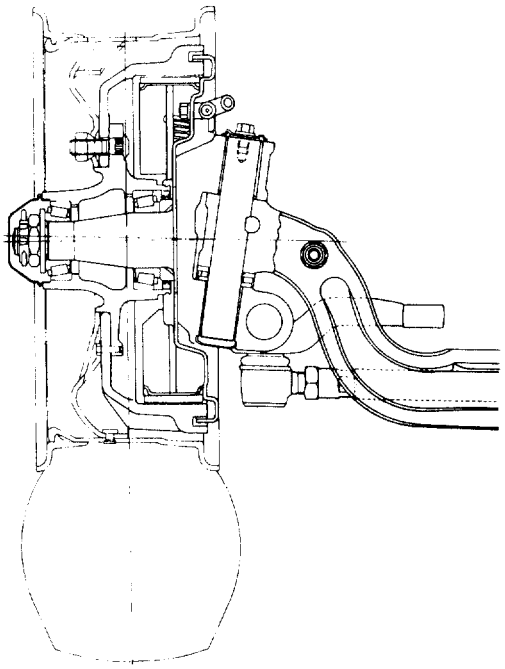
GENERAL DESCRIPTION

NHR Front Drum Brake Model (4 × 2 Model)

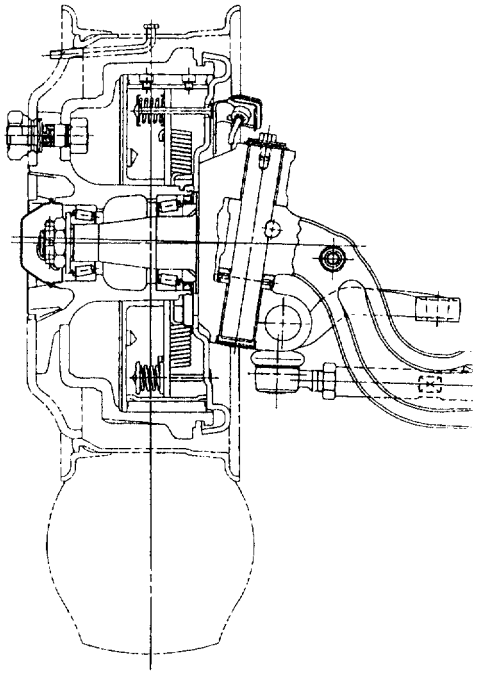


NKR Front Drum Brake Model (4 × 2 Model)

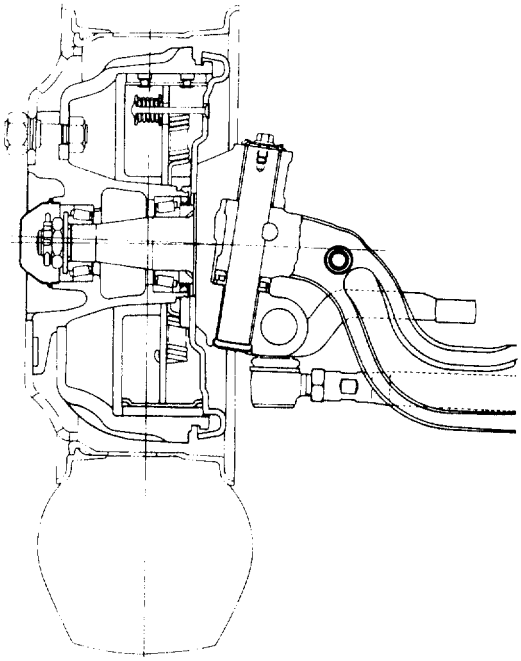
Rear Single Tire



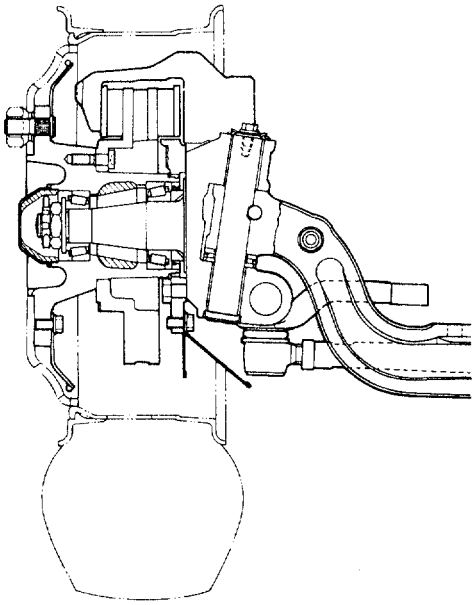
NKR Front Drum Brake Model (Rear Dual Tire) (4 × 2 Model)



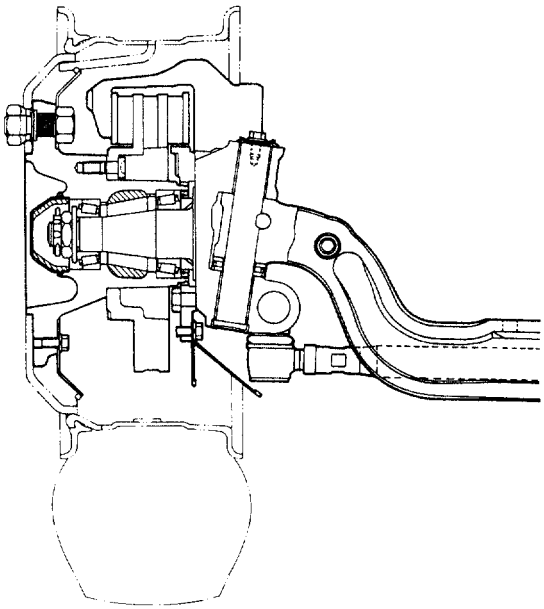
NPR, NQR Front Drum Brake Model (4 × 2 Model)



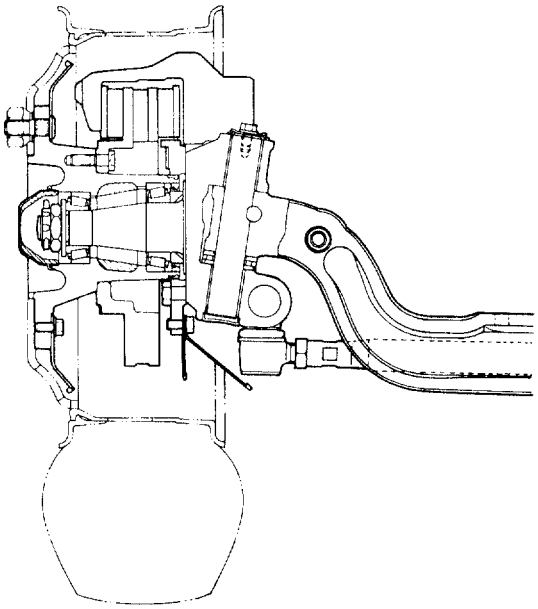
NKR Front Disc Brake Model (4 × 2 Model)



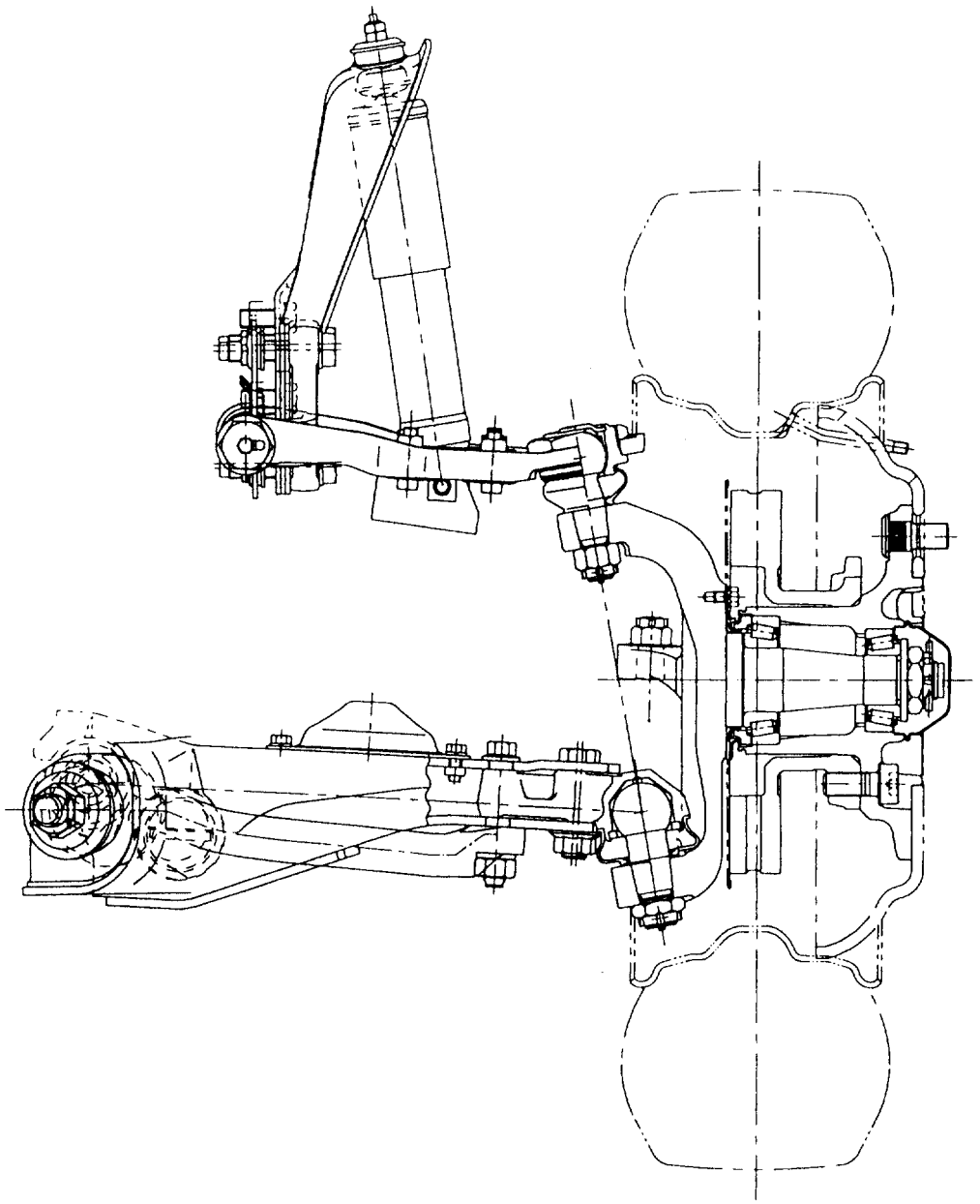
NPR Front Disc Brake Model (5 studs) (4 × 2 Model)



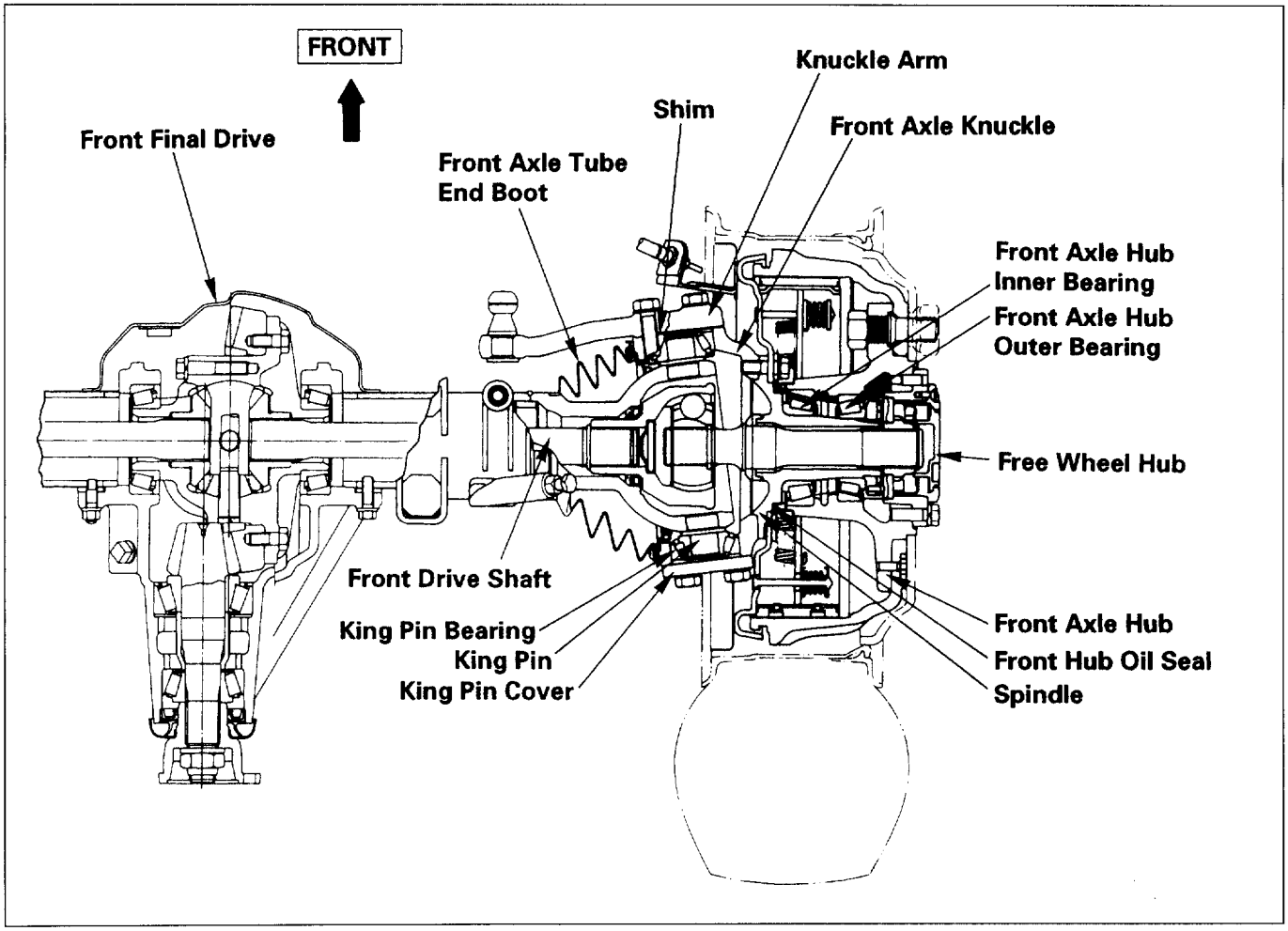
NPR Front Disc Brake Model (6 studs) (4 × 2 Model)



NHR/NKR Front Disc Brake Model (Independent Suspension, 4 × 2 Model)

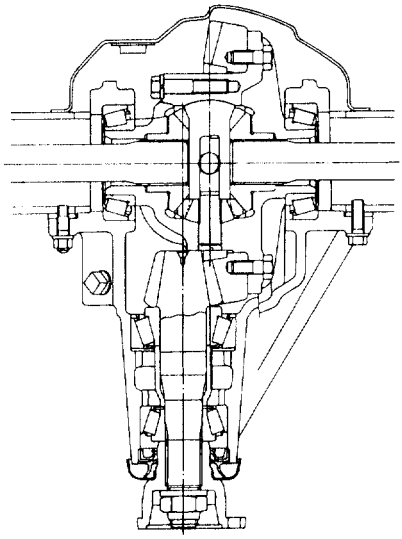


Front Axle (4 × 4 Model)



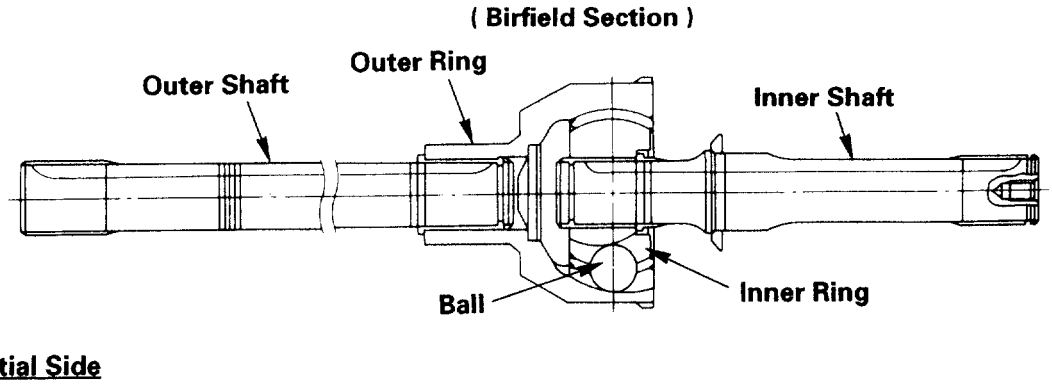
The front axle is full floating axle tube type with Birfield joints. The front axle supports the weight of the front of the vehicle and transfers it to the front tires. It also functions as a part of the steering system. The front axle is also designed to transmit the driving force to the front wheels in the four wheels drive mode.

Front Final Drive (244mm (9.6 in.) Size)



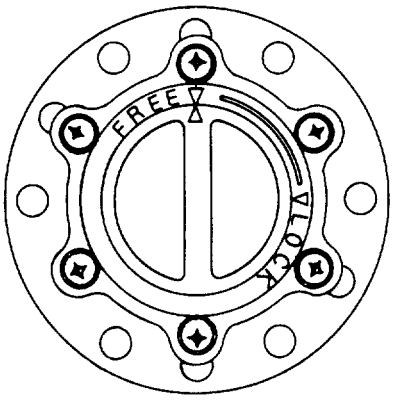
The differential system employs a hypoid gearing which is higher in strength and durability and quieter in operation than the spiral bevel gears to lower the center of gravity of the vehicle thereby improving running stability. The differential gear box which includes the side gears and pinion gears is mounted to the differential carrier via the two (2) taper roller bearings. The final drive gear reduces and changes axial rotary force (drive power) of transfer output to rectangular direction, and also it distributes the power to the drive wheels.

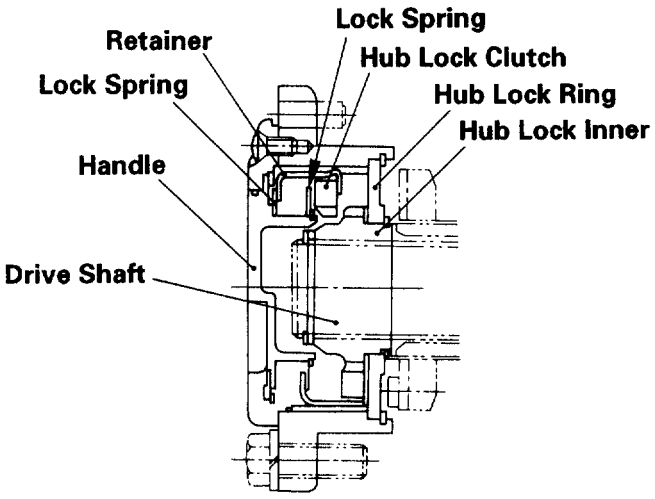
Front Drive Shaft (Birfield Joint)



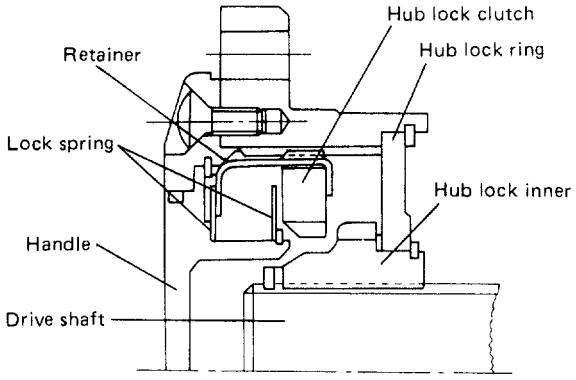
The drive power from the reduction and differential is transmitted from the outer drive shaft to the outer ring of Birfield joint to its ball to its inner ring to the inner drive shaft finally to drive the tire. When the vehicle is steered the balls automatically move according to the steering angle thereby operating as a complete constant velocity joint.

Free Wheel Hub (Manual Type)





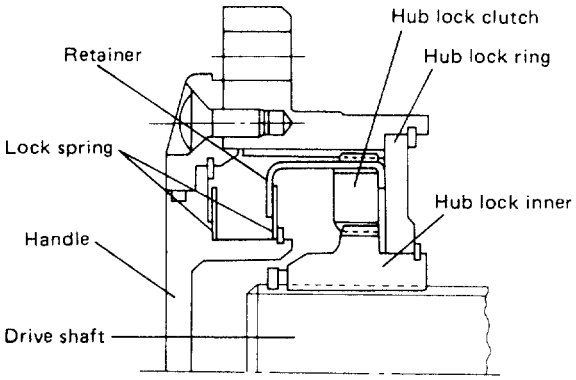
The free wheel hub, a hub lock device installed on the hub, transmits engine torque to the front wheels by engaging the dog clutch in the 4-wheel drive mode, or disengages the dog clutch in the 2-wheel drive mode to make free the front wheel drive system, so that it can improve fuel economy and reduce noise. Engagement or disengagement of dog clutch is done by handle operation.



[Operational Description]

(FREE status)

As the handle is rotated in the FREE direction, a lock spring assembled in the handle also rotates. Since the retainer lug moves along the slant face of lock spring, the hub lock clutch calked to the retainer is disengaged from lock inner,resulting in free status. If, however, the hub lock clutch is not disengaged from lock inner due to spline resistance, the lock spring is compressed to store spring force. Upon elimination of spline resistance, the hub lock clutch is disengaged by means of spring force.

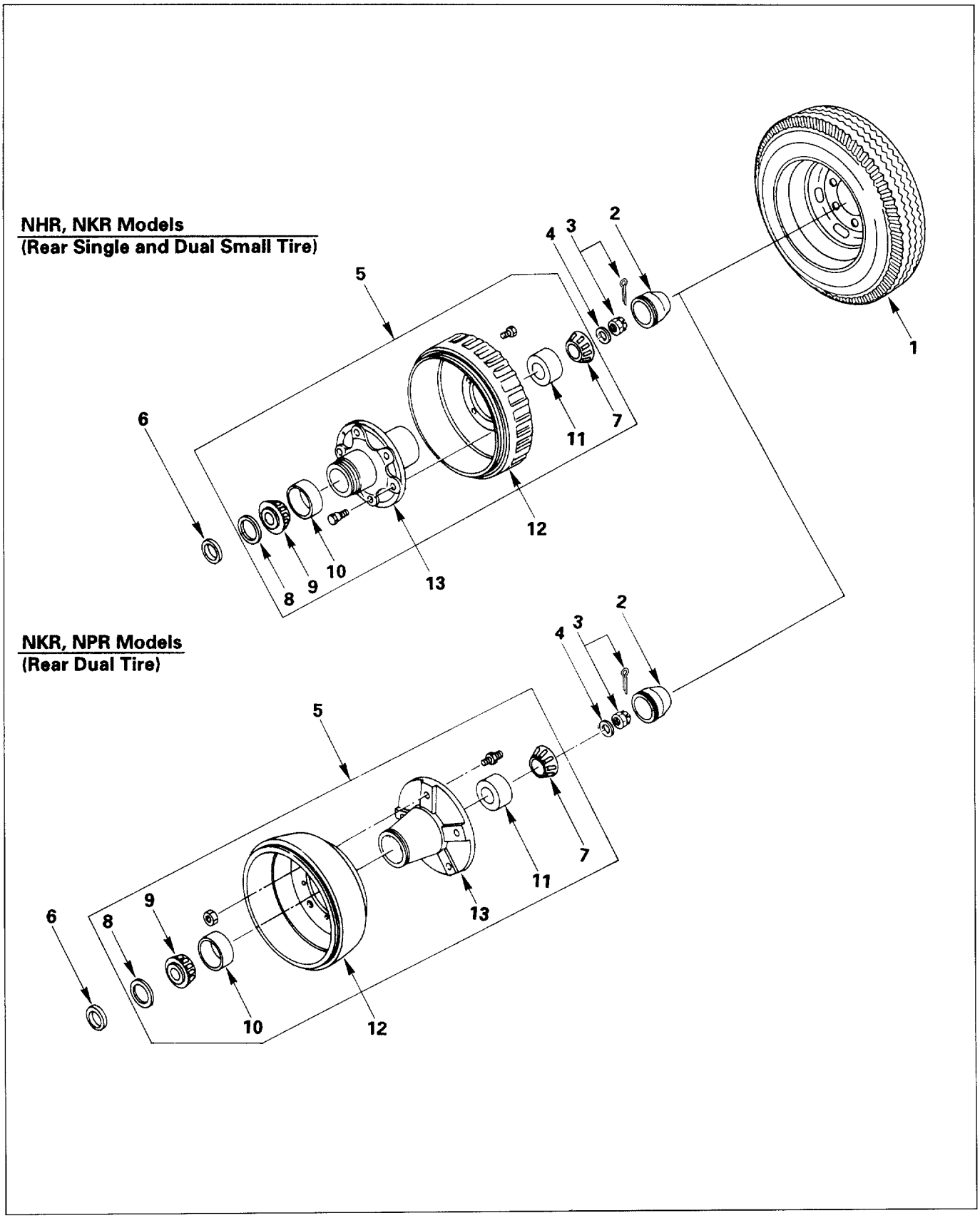


(LOCK status)

As the handle is rotated in the LOCK direction, the retainer lug moves along the slant face of lock spring, and the hub lock clutch is engaged with lock inner, resulting in lock status. If, however, phase between hub lock clutch and lock inner is not coincident, the lock spring is compressed to store spring force. Upon coincidence of phase, the hub lock clutch is engaged by means of spring force.

ON-VEHICLE SERVICE

FRONT HUB AND BRAKE DRUM (4 × 2 Model)



Removal Steps

1. Wheel and tire
2. Hub cap
3. Hub bearing nut
4. Lock washer
5. Hub with brake drum assembly
6. Distance piece
7. Outer bearing
8. Oil seal
9. Inner bearing
10. Inner bearing outer race
11. Outer bearing outer race
12. Brake drum
13. Hub

Installation Steps

To install, follow the removal steps in the reverse order.

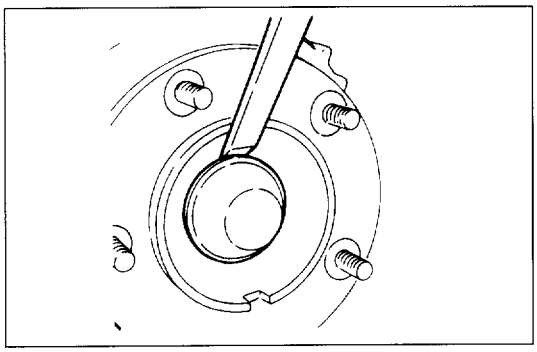
REMOVAL

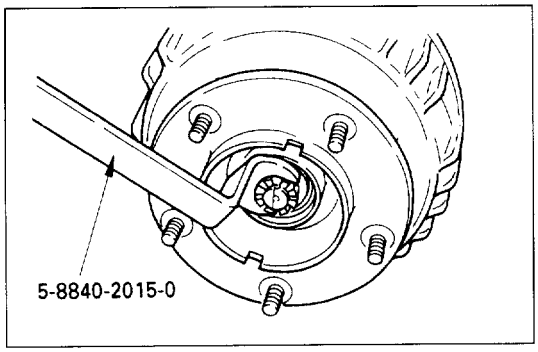
Preparation:

Jack up and support the vehicle on stands.

1. **Wheel and Tire**
2. **Hub Cap**

When removing hub cap, exercise care so as not to scratch or distort hub fitting face.

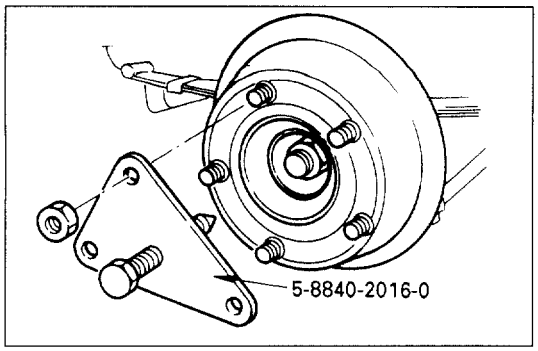




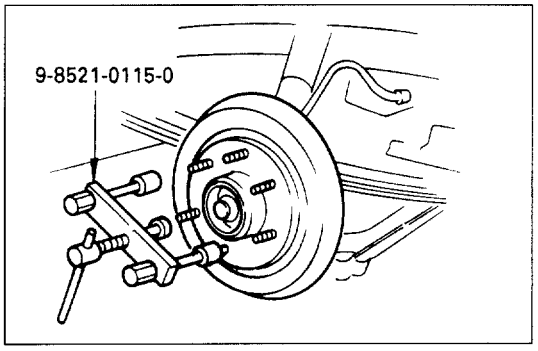
3. **Hub Bearing Nut**

Hub Nut Wrench : 5-8840-2015-0

4. **Lock Washer**

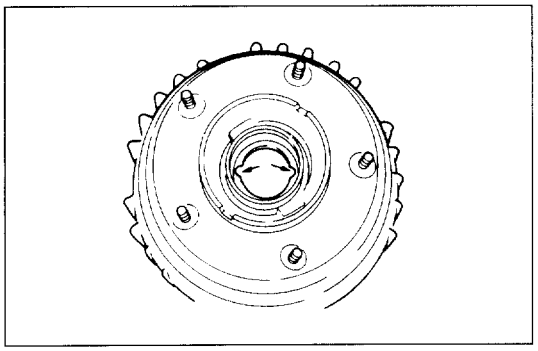


5. **Hub with Brake Drum Assembly**
   5 studs
   Hub Remover : 5-8840-2016-0



6 studs
Hub Remover : 9-8521-0115-0
(NHR, NKR rear small tire)

6. **Distance Piece**
7. **Outer Bearing**
8. **Oil seal**
9. **Inner Bearing**
10. **Inner Bearing Outer Race**
    Drive out the inner bearing outer race together with the oil seal with a proper bar through two notches.



11. **Outer Bearing Outer Race**
12. **Brake Drum**
13. **Hub**

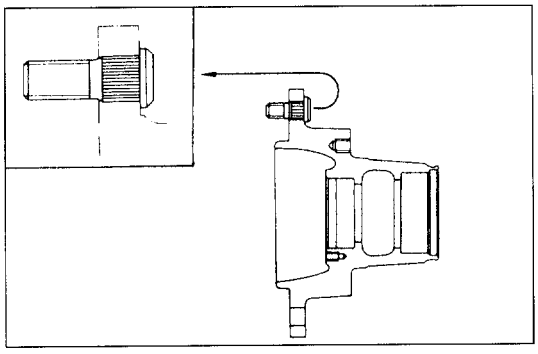
INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.

1. Hub
2. Hub bearing, oil seal
3. Knuckle spindle
4. Brake drum
5. Brake shoe, lining etc.

Visual Check

Inspect the following parts for wear, damage or other abnormal conditions.



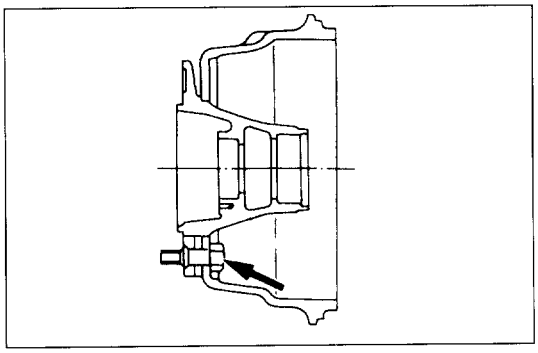
(NHR, NKR MODELS)

Check bolt for looseness.

INSTALLATION

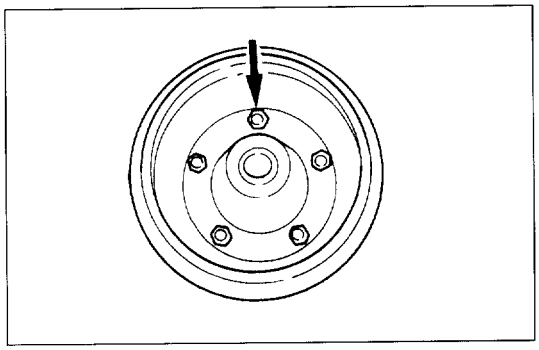
13. Hub

12. Brake Drum



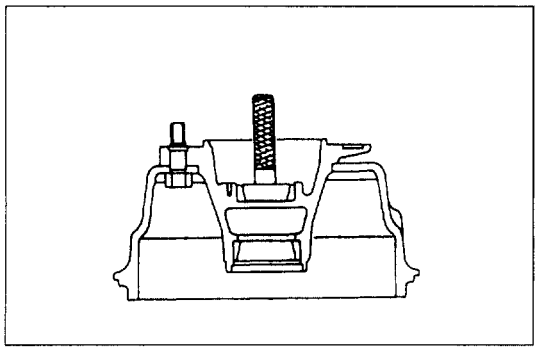
Tighten the brake drum wheel nuts to the specified torque.

Wheel Nut Torque	N•m (kg•m/lb•ft)
Brake Lining Width 75 mm	343 (35/253)
Brake Lining Width 100 mm	392 (40/289)



When replacement of hub or drum is completed, stake 3 portions of each wheel pin nut.

This illustration is based on 5 studs.

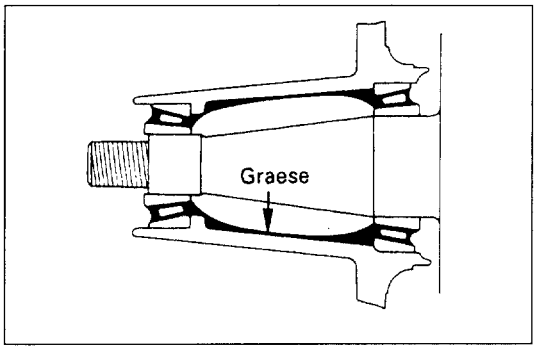


11. Outer Bearing Outer Race

10. Inner Bearing Outer Race

Bearing Outer Race Installer

	Parts No.	Remarks
All	9-8522-1148-0	Grip
NHR NKR	5-8840-2023-0	Inner Bearing
	5-8840-2025-0	Outer Bearing
NPR NQR	5-8840-2024-0	Inner Bearing
	5-8840-2026-0	Outer Bearing



Apply grease in the hub and bearing rollers

Hub Grease Amount g (oz)

		Hub	Hub cap
NHR	Rear Single and Dual Small Tire	55 (1.9)	30 (1.1)
NKR	Rear Single and Dual Small Tire	80 (2.8)	40 (1.4)
NKR	Rear Dual Tire	90 (3.2)	
NPR	NQR	160 (5.6)	

9. Inner Bearing

8. Oil Seal

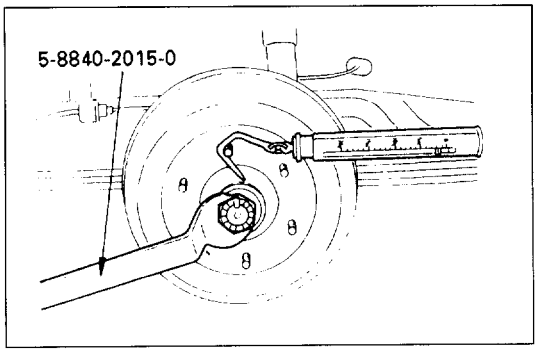
Drive the oil seal into the hub flush with the hub end surface.

7. Outer Bearing

6. Distance Piece

5. Hub with Brake Drum Assembly

4. Lock Washer



3. Hub Bearing Nut

Check the brake lining clearances first to avoid friction loss.

Adjust the hub bearing preload at the wheel pin.

Hub Bearing Preload (at Wheel Pin) N (kg/lb)

NHR	New	13.7–28.4 (1.4–2.9/3.1–6.4)
	Reused	7.8–22.5 (0.8–2.3/1.8–5.0)
NKR	New	11.8–26.5 (1.2–2.7/2.6–5.9)
	Reused	6.9–21.6 (0.7–2.2/1.5–4.8)
NPR NQR	New	9.8–24.5 (1.0–2.5/2.2–5.5)
	Reused	4.9–19.6 (0.5–2.0/1.1–4.4)

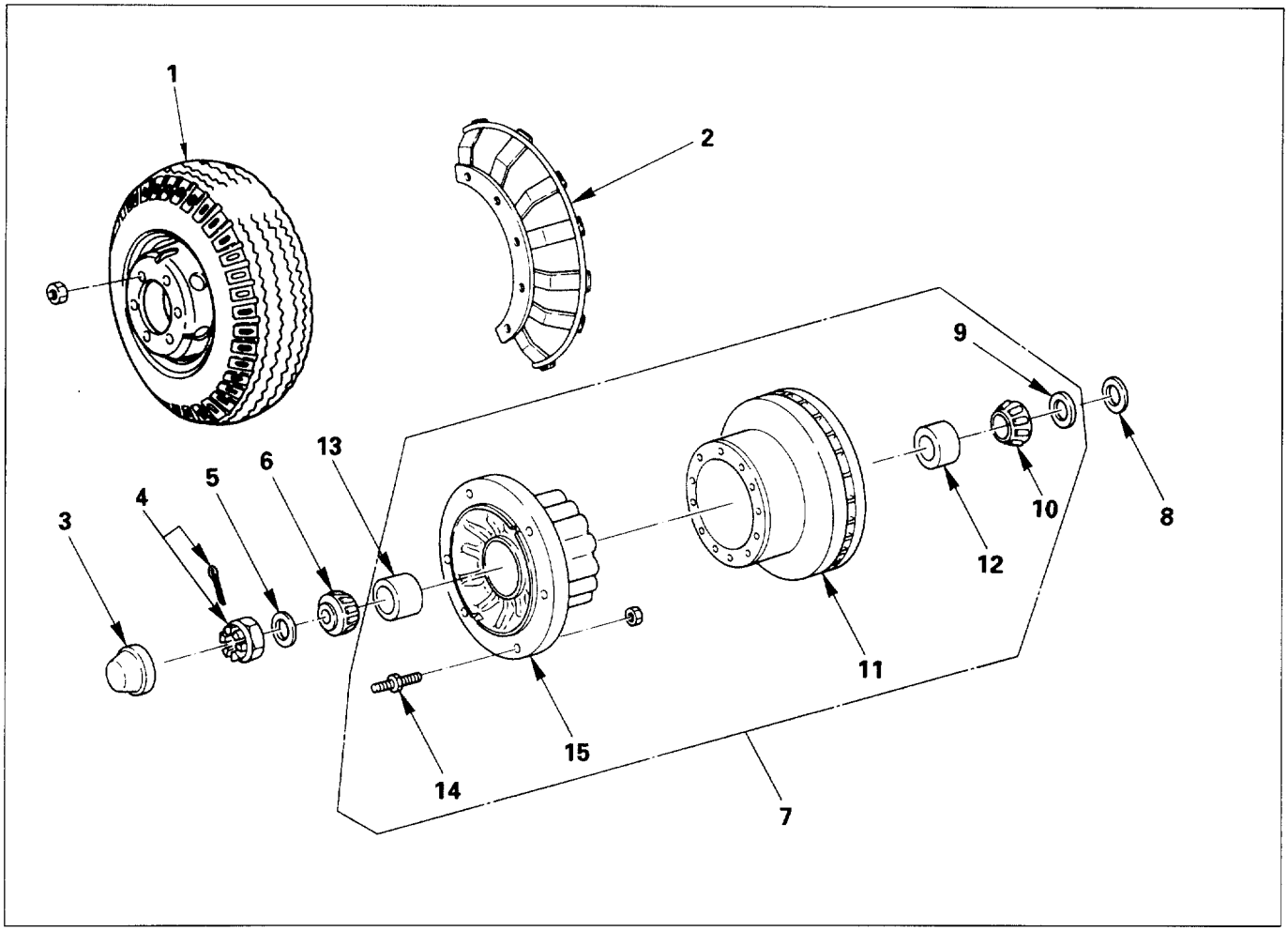
Hub Nut Wrench : 5-8840-2015-0

In case of misalignment of locking hole, align in direction of retightening.

2. Hub Cap

1. Wheel and Tire

FRONT HUB AND DISC (4 × 2 Model, 282mm Disc)



Removal Steps

1. Wheel and tire
2. Guard
3. Hub cap
4. Nut
5. Washer
6. Outer bearing
7. Hub and disc assembly
8. Spacer
9. Oil seal
10. Inner bearing
11. Disc
12. Inner bearing race
13. Outer bearing race
14. Wheel pin
15. Hub

Installation Steps

15. Hub
12. Inner bearing race
10. Inner bearing
9. Oil seal
13. Outer bearing race
14. Wheel pin
11. Disc
8. Spacer
7. Hub and disc assembly
6. Outer bearing
5. Washer
4. Nut
3. Hub cap
2. Guard
1. Wheel and tire

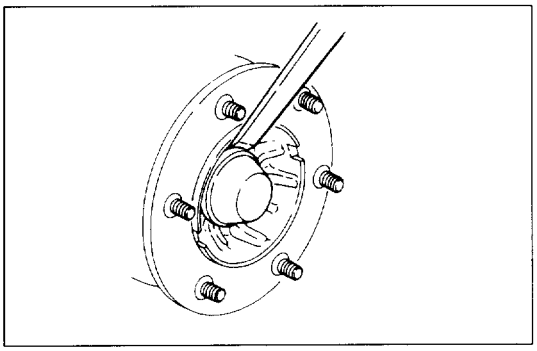
REMOVAL

Preparation:

Jack up and support the vehicle on stands.

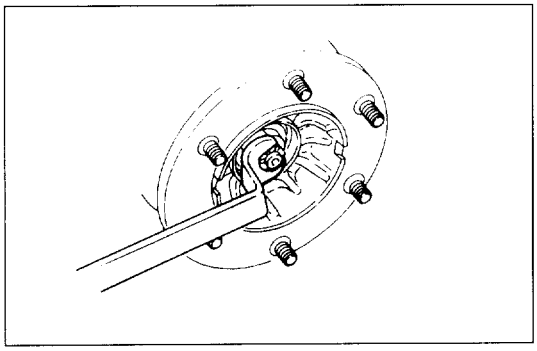
1. **Wheel and Tire**
2. **Guard**
3. **Hub cap**

   Use a lever to pry the hub cap from the hub.

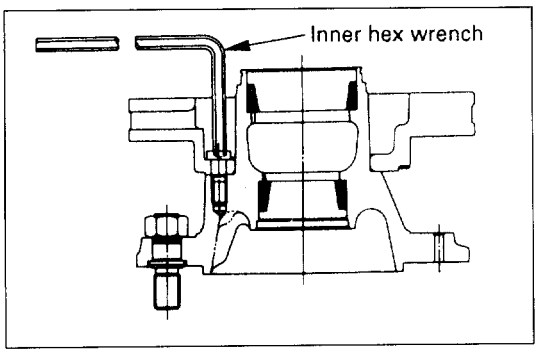


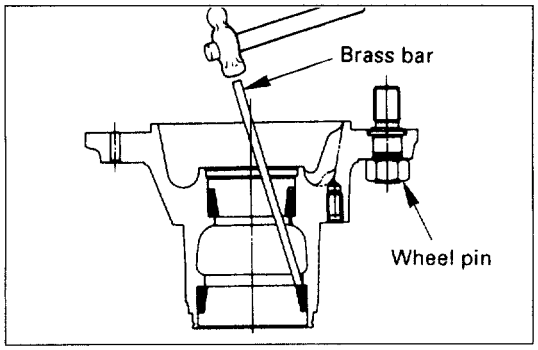
4. **Nut**

   Use a wrench to remove the nut.



5. **Washer**
6. **Outer Bearing**
7. **Hub and Disc Assembly**
   1) Turn the caliper assembly up and around the guide pin.
   2) Remove the hub and disc assembly from the knuckle.
8. **Spacer**
9. **Oil Seal**
10. **Inner Bearing**
11. **Disc**
    1) Use an inner hex wrench to loosen the disc fixing bolts.
    2) Remove the disc from the hub.

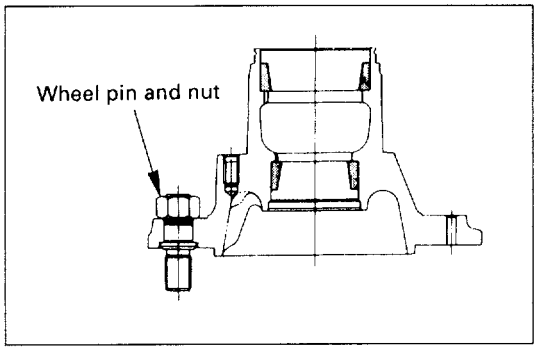




12. Inner Bearing Race

13. Outer Bearing Race

Use a hammer and a brass bar to remove the inner race and the outer race from the hub.



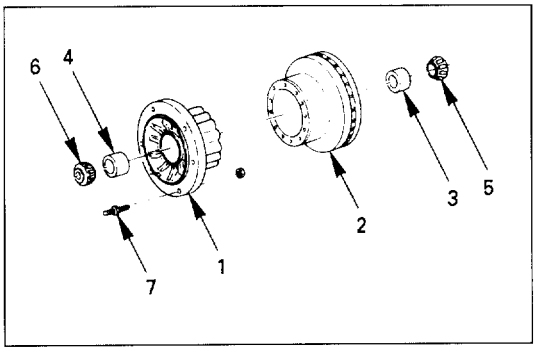
14. Wheel Pin

1) Grind the punched caulking from the wheel pin and nut.
2) Use a wrench to remove the wheel pin.

15. Hub

INSPECTION AND REPAIR

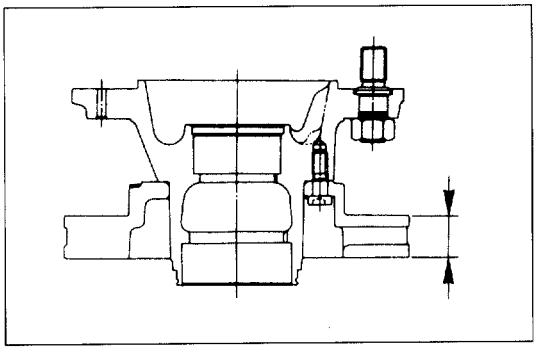
Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.



Visual Inspection

Inspect the following parts for cracking, deformation, and corrosion.

(1) Hub
(2) Disc
(3) Inner bearing race
(4) Outer bearing race
(5) Inner bearing
(6) Outer bearing
(7) Wheel pins



Disc

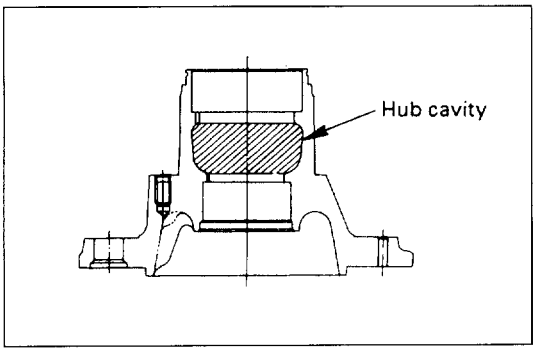
Use a vernier caliper to measure the disc thickness.

If the measured value is less than the specified limit, the disc must be replaced.

Disc Thickness mm (in.)

Standard	Limit
35.0 (1.38)	33.5 (1.32)

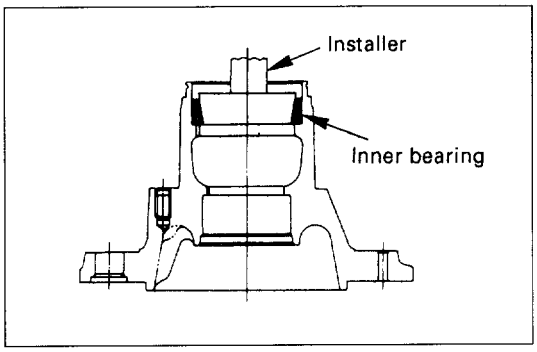
INSTALLATION



15. Hub

Apply the specified amount of the approved grease to the hub cavity.

Grease Amount	g (oz)
	160 (5.6)



12. Inner Bearing Race

10. Inner Bearing

9. Oil Seal

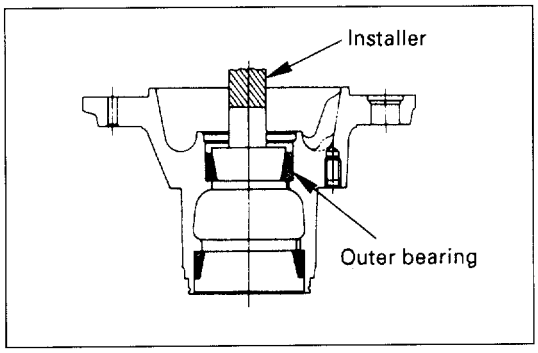
1) Use a hammer and the installer to install the inner bearing race to the hub.

   Be sure that the race is completely seated in the hub.

   Installer: 5-8840-2235-0

2) Apply grease to the inner bearing.
3) Install the inner bearing to the hub.
4) Use a plastic hammer to carefully tap the oil seal into place.

   The oil seal surfaces must be flat.

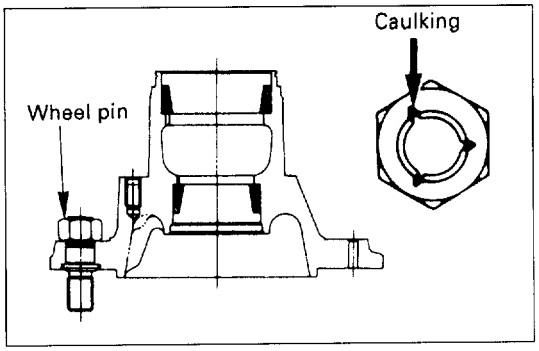


13. Outer Bearing Race

Use a hammer and the installer to install the outer race to the hub.

Be sure that the race is completely seated in the hub.

Installer: 5-8840-2026-0

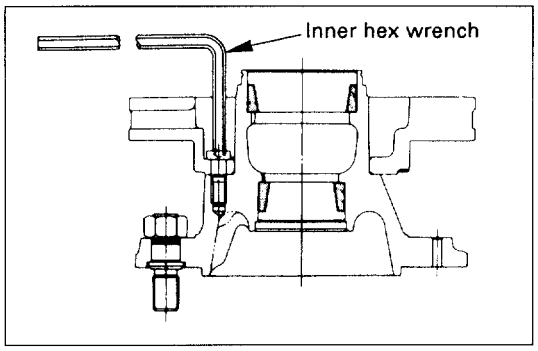


14. Wheel Pin

1) Install the new wheel pin to the hub.
2) Tighten the new wheel pin nuts to the specified torque.

Wheel Pin Nut Torque	N•m (kg•m/lb•ft)
	392 (40/289)

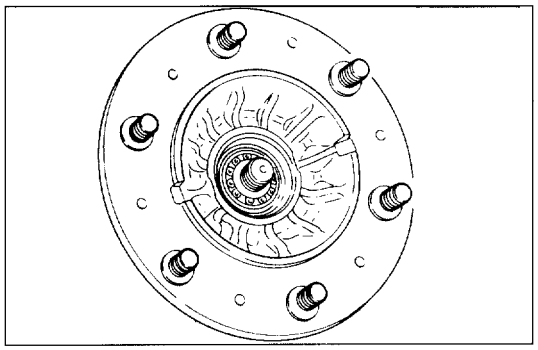
3) Caulk each of the nuts at three positions.



11. Disc

1) Install the disc to the hub.
2) Use an inner hex wrench to tighten the disc bolts to the specified torque.

Disc Bolt Torque	N•m (kg•m/lb•ft)
	103 (10.5/76)

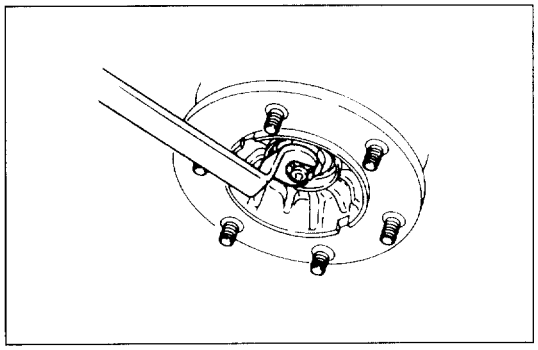


8. Spacer

7. Hub and Disc Assembly

6. Outer Bearing

1) Turn the caliper assembly up and around the guide pin.
2) Install the spacer and the hub and disc assembly to the knuckle.
3) Apply grease to the outer bearing.
4) Install the bearing to the hub.

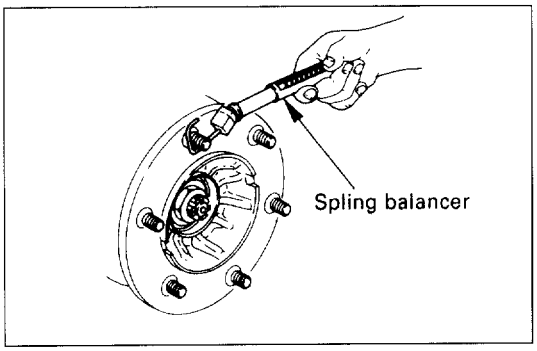


5. Washer

4. Nut

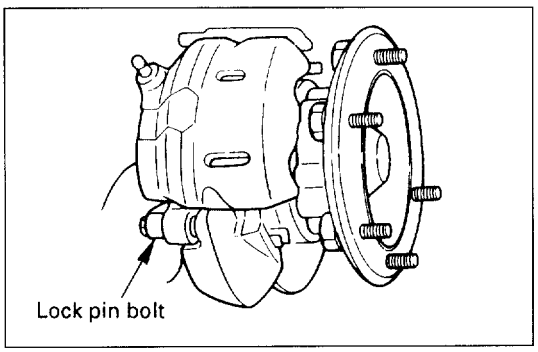
1) Install the washer to the hub.
2) Tighten the nut until you are unable to manually rotate the hub and disc assembly.
3) Loosen the nut.
4) Attach a spring balancer to one wheel pin. Gradually retighten the nut until the hub and disc assembly bearing is adjusted to the specified preload.

Hub Bearing Preload	N (kg/lb)
New Hub Bearing	17–31 (1.7–3.2/3.7–7.1)
Reused Hub Bearing	14–28 (1.4–2.9/3.1–6.4)



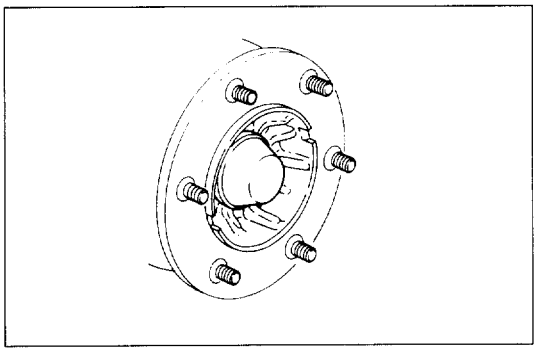
5) Align the nut slot with the knuckle cotter pin hole.

   If necessary, slightly tighten the nut to align the slot and the hole.
6) Insert the cotter pin to the slot and hole.
7) Bend back the cotter pin to lock the nut.
8) Return the caliper assembly to its original position.



9) Tighten the lock pin bolt to the specified torque.

Lock Pin Bolt Torque	N•m (kg•m/lb•ft)
92 (9.4/68)	

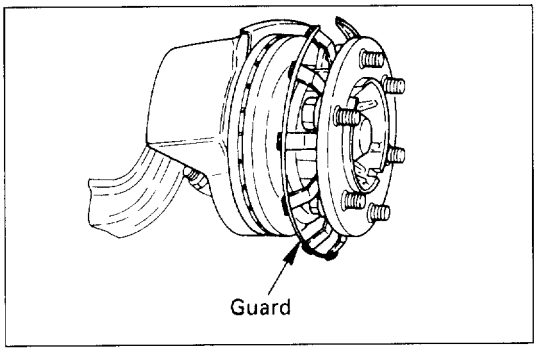


3. Hub Cap

1) Apply the specified amount of the approved grease to the hub cap.

Grease Amount	g (oz)
40 (1.4)	

2) Use a plastic hammer to install the hub cap to the hub.



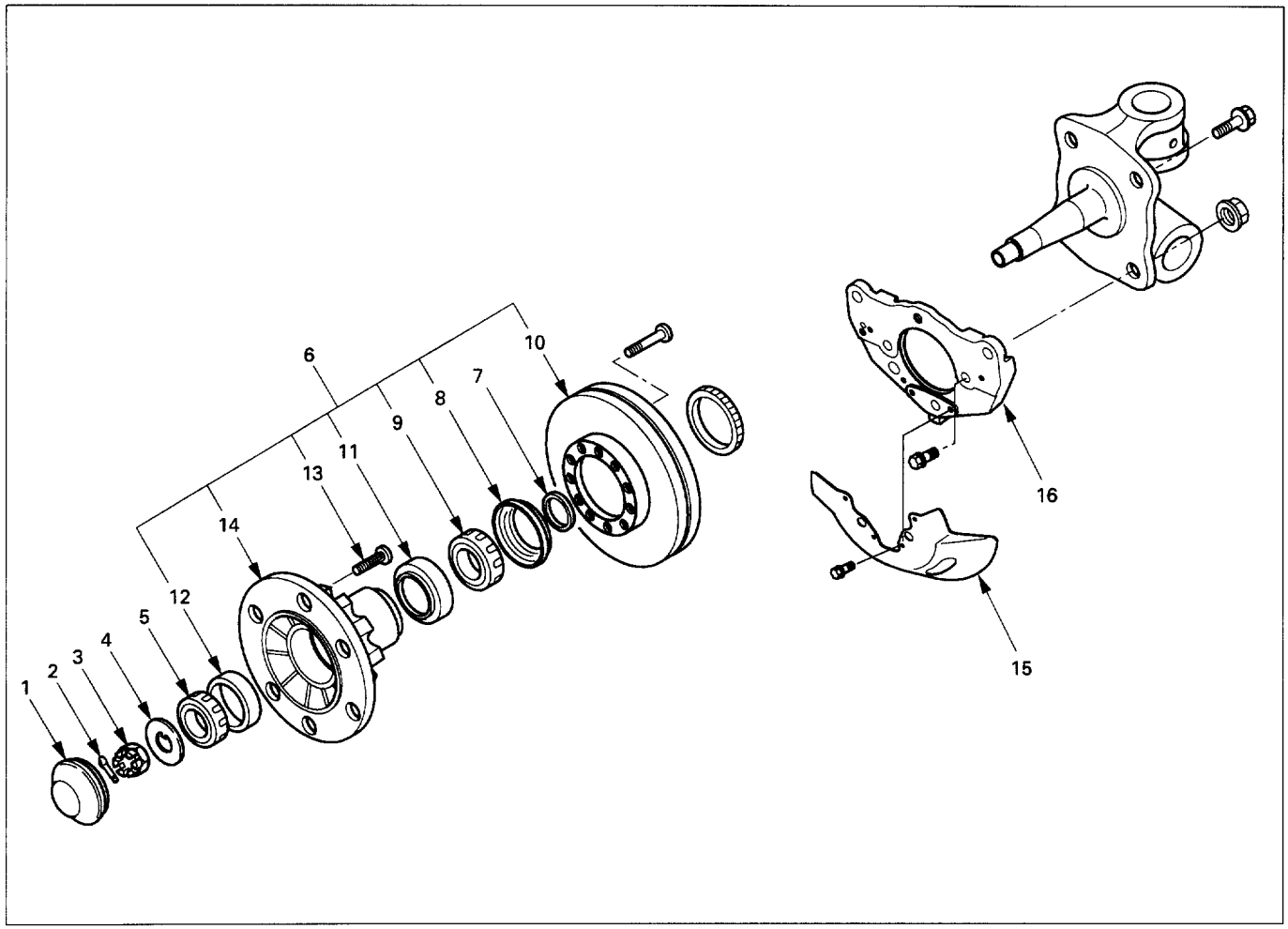
2. Guard

Tighten the guard fixing bolts to the specified torque.

Guard Fixing Bolt Torque	N•m (kg•m/lb•ft)
37 (3.8/27)	

1. Wheel and Tire

FRONT HUB AND DISC (4 × 2 Model, 293 & 310mm Disc)



Removal Steps

1. Hub cap
2. Cotter pin
3. Nut
4. Washer
5. Outer bearing
6. Hub and disc assembly
7. Spacer
8. Oil seal
9. Inner Bearing
10. Disc
11. Inner Bearing Race
12. Outer Bearing Race
13. Stud
14. Hub
15. Dust shield
16. Adapter

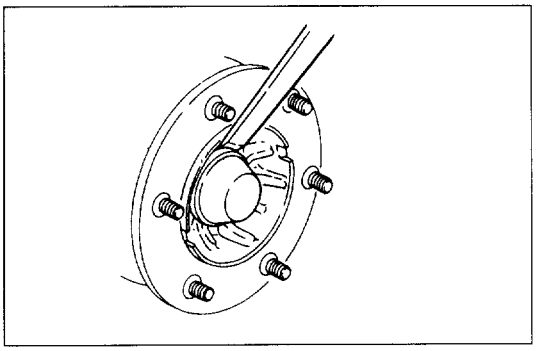
Installation Steps

16. Adapter
15. Dust shield
14. Hub
11. Inner Bearing Race
9. Inner bearing
8. Oil seal
12. Outer Bearing Race
13. Stud
10. Disc
7. Spacer
6. Hub and disc assembly
5. Outer bearing
4. Washer
3. Nut
2. Cotter pin
1. Hub cap

REMOVAL

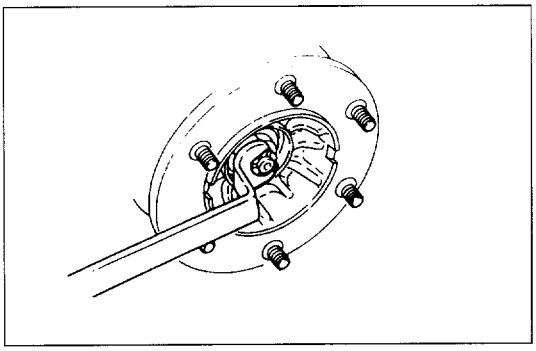
Preparation:

Jack up and support the vehicle on stands.



1. **Hub cap**

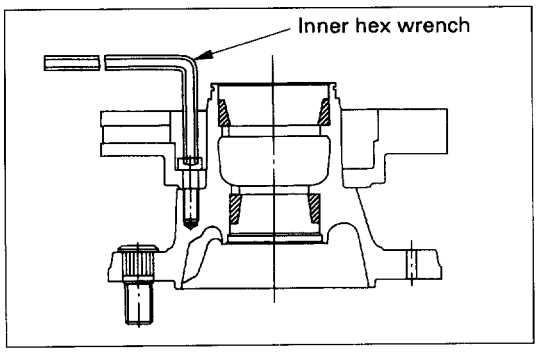
   Use a lever to pry the hub cap from the hub.

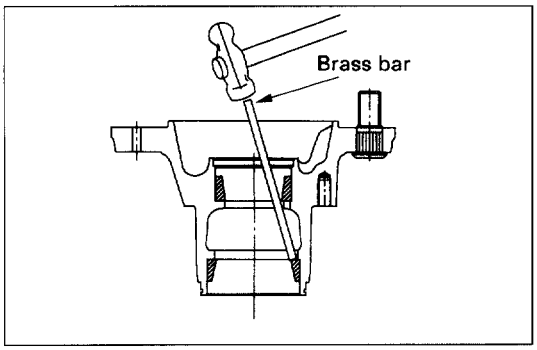


2. **Cotter Pin**
3. **Nut**

   Use a wrench to remove the nut.

4. **Washer**
5. **Outer Bearing**
6. **Hub and Disc Assembly**
   1) Turn the caliper assembly up and around the guide pin.
   2) Remove the hub and disc assembly from the knuckle.
7. **Spacer**
8. **Oil Seal**
9. **Inner Bearing**
10. **Disc**
    1) Use an inner hex wrench to loosen the disc fixing bolts.
    2) Remove the disc from the hub.

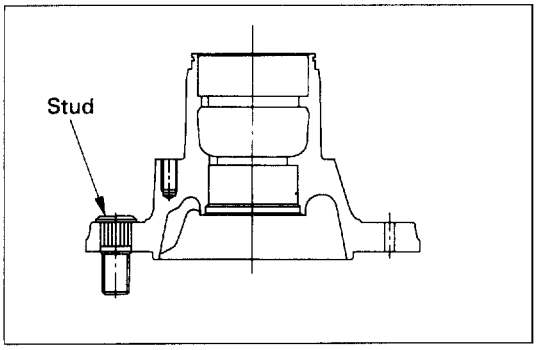




11. Inner Bearing Race

12. Outer Bearing Race

Use a hammer and a brass bar to remove the inner race and the outer race from the hub.



13. Stud

Place hub on a suitable work surface and remove the studs by using a hammer.

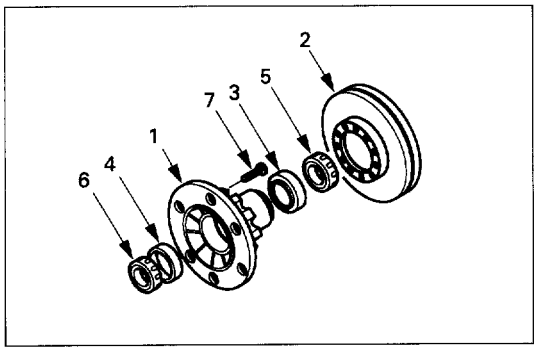
14. Hub

15. Dust Shield

16. Adapter

INSPECTION AND REPAIR

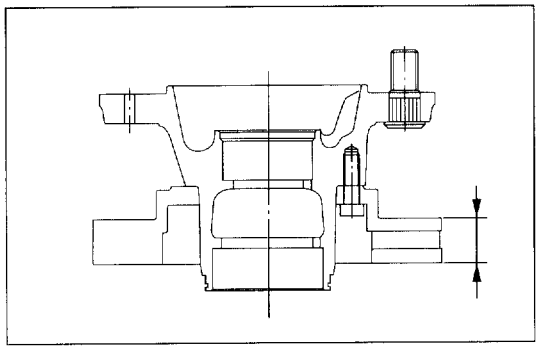
Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.



Visual Inspection

Inspect the following parts for cracking, deformation, and corrosion.

(1) Hub
(2) Disc
(3) Inner bearing race
(4) Outer bearing race
(5) Inner bearing
(6) Outer bearing
(7) Wheel pins



Disc

Use a vernier caliper to measure the disc thickness.

If the measured value is less than the specified limit, the disc must be replaced.

Disc Thickness mm (in.)

Standard	Limit
42.0 (1.654)	39.0 (1.535)

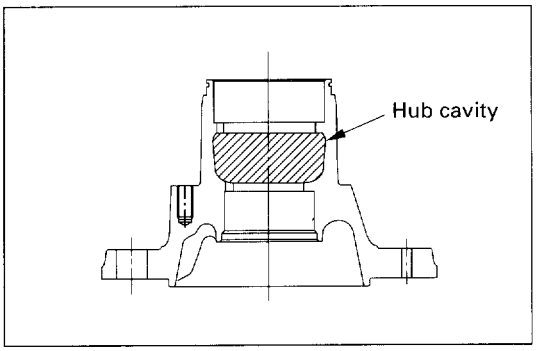
INSTALLATION

16. Adapter

Adapter Fixing Bolt Torque	N•m (kg•m/lb•ft)
162 (16.5/119)	

15. Dust Shield

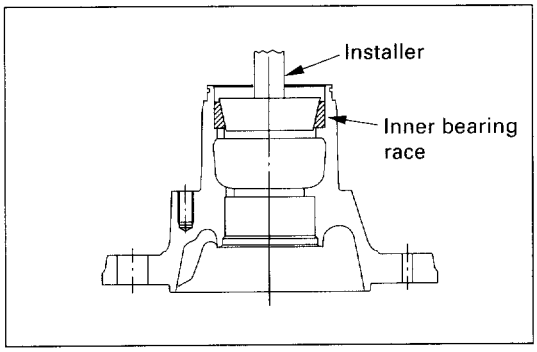
Dust Shield Fixing Torque	N•m (kg•m/lb•ft)
13 (1.3/113)	



14. Hub

Apply the specified amount of the approved grease to the hub cavity.

Grease Amount	g (oz)
160 (5.6)	



11. Inner Bearing Race

9. Inner Bearing

8. Oil Seal

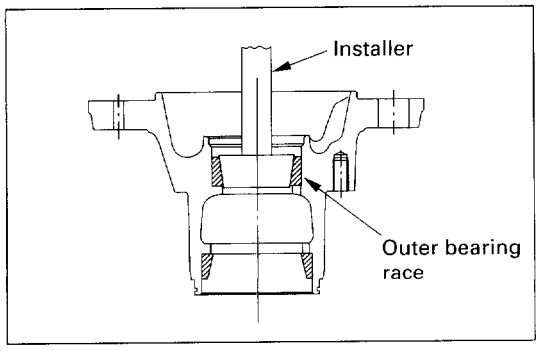
1) Use a hammer and the installer to install the inner bearing race to the hub.

   Be sure that the race is completely seated in the hub.

   Installer: 5-8840-2235-0

2) Apply grease to the inner bearing.
3) Install the inner bearing to the hub.
4) Use a plastic hammer to carefully tap the oil seal into place.

   The oil seal surfaces must be flat.

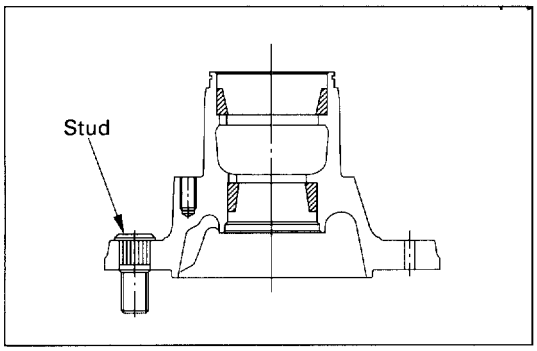


12. Outer Bearing Race

Use a hammer and the installer to install the outer bearing race to the hub.

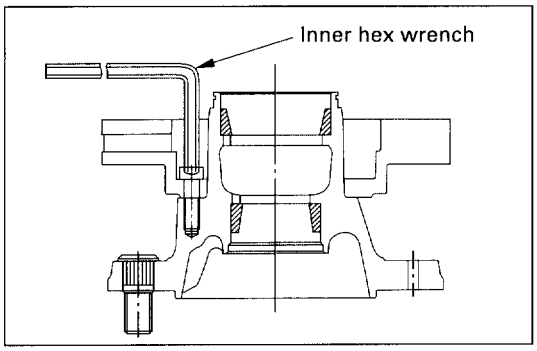
Be sure that the race is completely seated in the hub.

Installer: 5-8840-2026-0



13. Stud

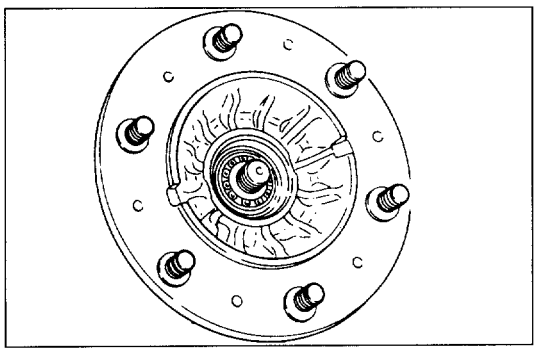
Insert a stud using ahammer.



10. Disc

1) Install the disc to the hub.
2) Use an inner hex wrench to tighten the disc bolts to the specified torque.

Disc Bolt Torque	N•m (kg•m/lb•ft)
	103 (10.5/76)

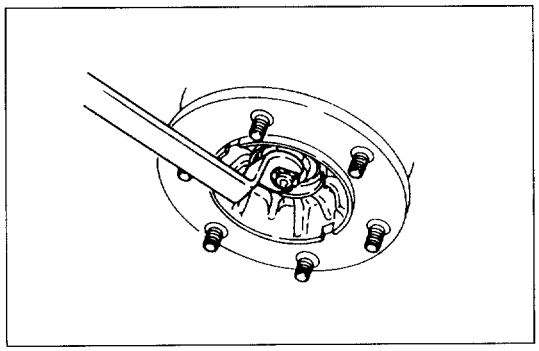


7. Spacer

6. Hub and Disc Assembly

5. Outer Bearing

1) Turn the caliper assembly up and around the guide pin.
2) Install the spacer and the hub and disc assembly to the knuckle.
3) Apply grease to the outer bearing.
4) Install the bearing to the hub.

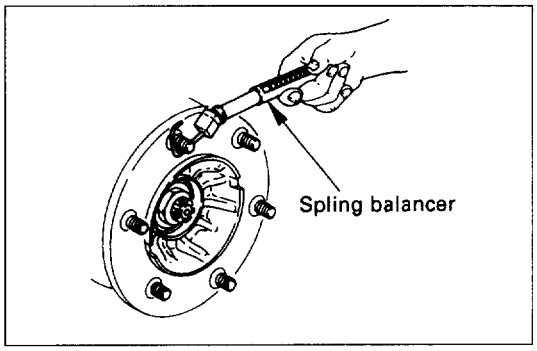


4. Washer

3. Nut

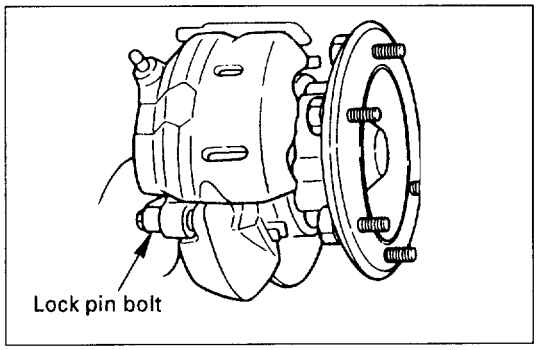
2. Cotter Pin

1) Install the washer to the hub.
2) Tighten the nut until you are unable to manually rotate the hub and disc assembly.
3) Loosen the nut.
4) Attach a spring balancer to one wheel pin. Gradually retighten the nut until the hub and disc assembly bearing is adjusted to the specified preload.



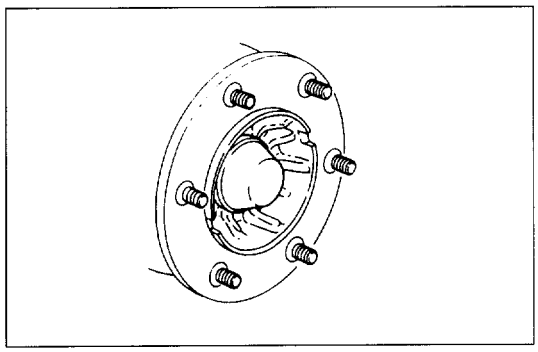
Hub Bearing Preload	N (kg/lb)
New Hub Bearing	17–31 (1.7–3.2/3.7–7.1)
Reused Hub Bearing	14–28 (1.4–2.9/3.1–6.4)

5) Align the nut slot with the knuckle cotter pin hole.
   If necessary, slightly tighten the nut to align the slot and the hole.
6) Insert the cotter pin to the slot and hole.
7) Bend back the cotter pin to lock the nut.
8) Return the caliper assembly to its original position.



9) Tighten the lock pin bolt to the specified torque.

Lock Pin Bolt Torque	N•m (kg•m/lb•ft)
137 (14/101)	



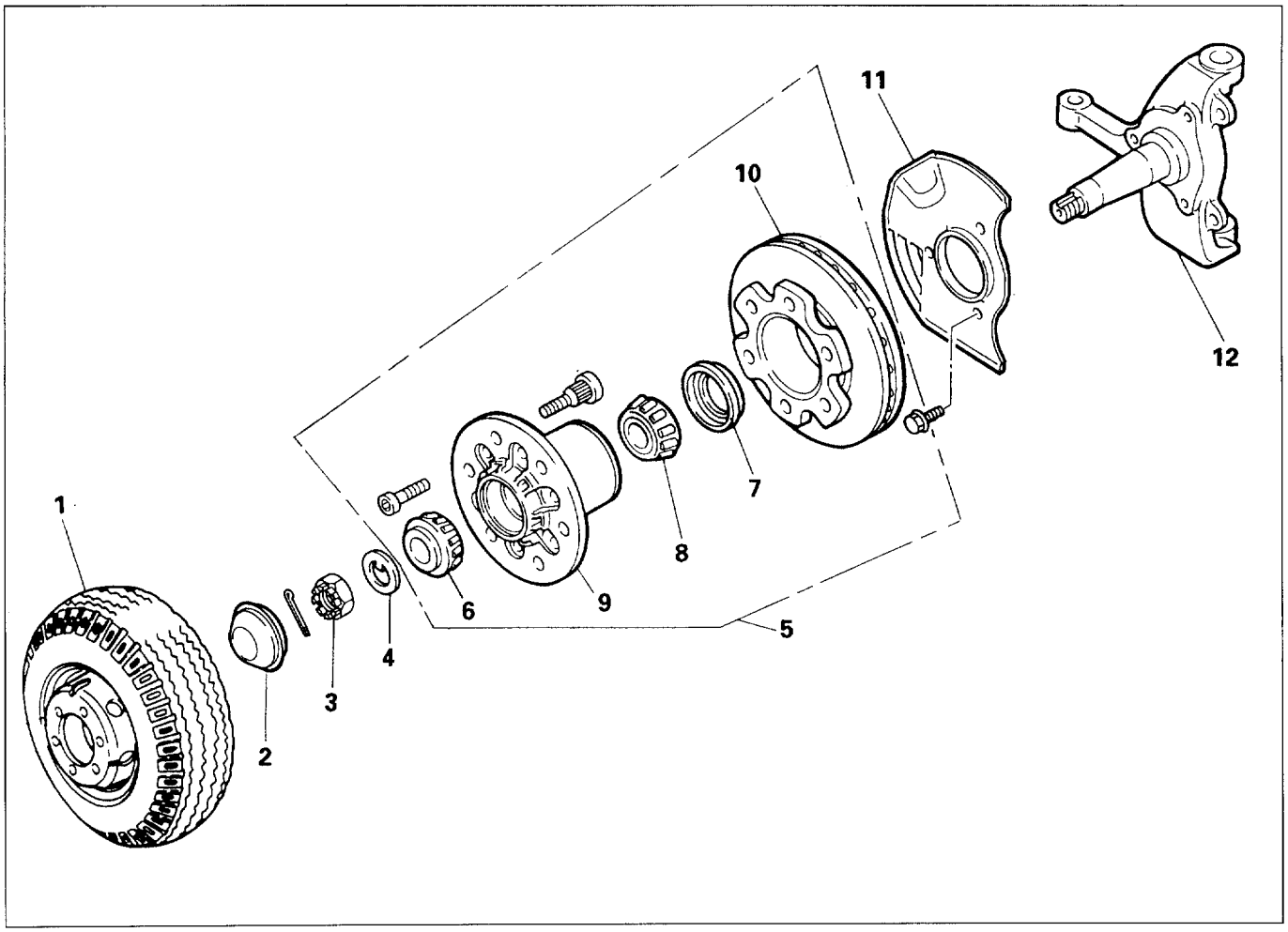
1. Hub Cap

1) Apply the specified amount of the approved grease to the hub cap.

Grease Amount	g (oz)
40 (1.4)	

2) Use a plastic hammer to install the hub cap to the hub.

FRONT HUB, DISC AND KNUCKLE
(4 × 2, Independent Suspension Model)



Removal Steps

1. Wheel and tire
2. Hub cap
3. Hub nut
4. Thrust washer
5. Hub and disc assembly
6. Outer bearing
7. Oil seal
8. Inner bearing
9. Hub
10. Disc
11. Back plate
12. Knuckle

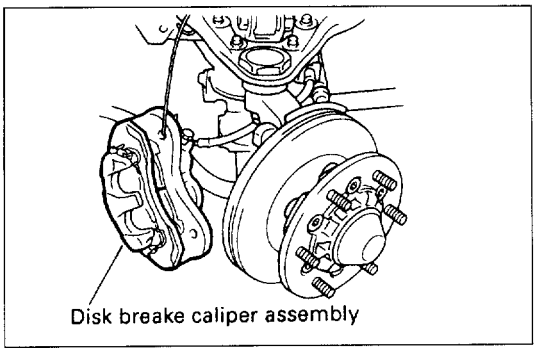
Installation Steps

To install follow the removal steps in the reverse order.

REMOVAL

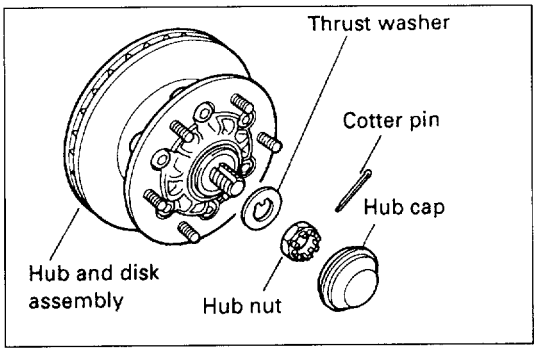
Preparation:

Jack up and support the vehicle on stands.



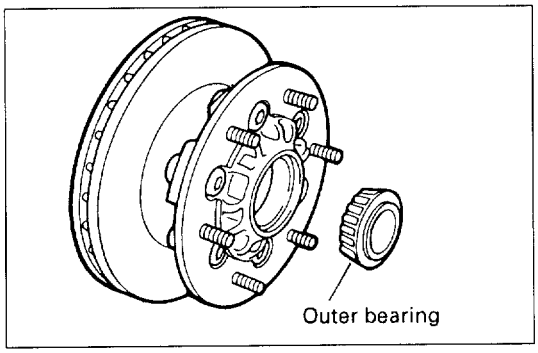
1. **Wheel and Tire**

   Remove the disc brake caliper assembly with brake hose and wire it to frame.

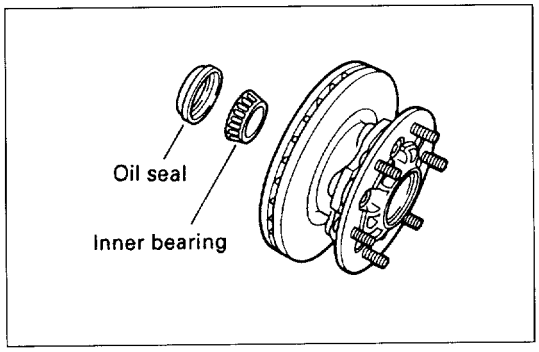


2. **Hub Cap**
3. **Hub Nut**
4. **Thrust Washer**
5. **Hub and Disc Assembly**

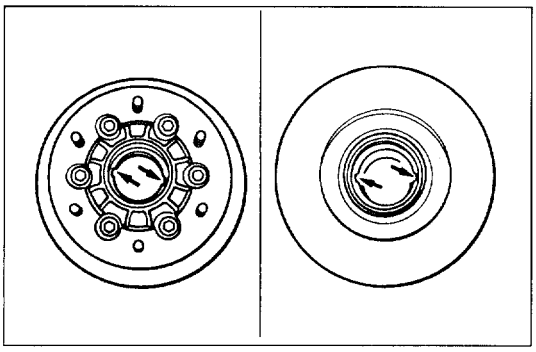
   Remove the hub and disc assembly from the knuckle.



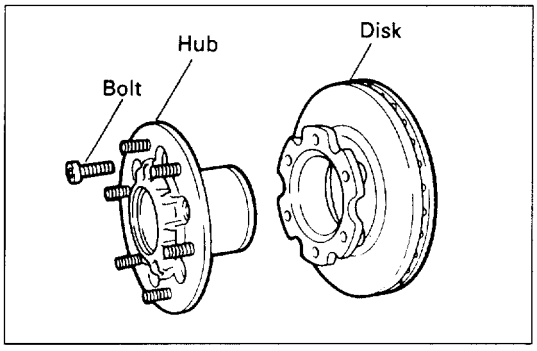
6. **Outer Bearing**



7. **Oil Seal**
8. **Inner Bearing**

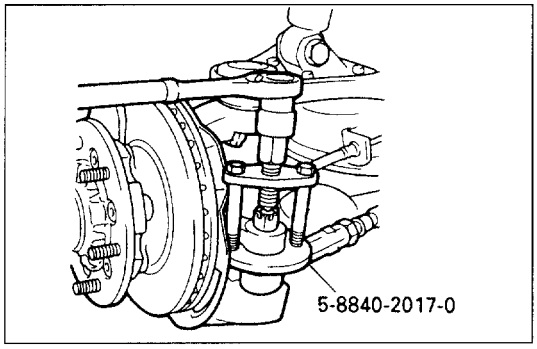


- Drive out the bearing outer races using with a proper bar through two notches.



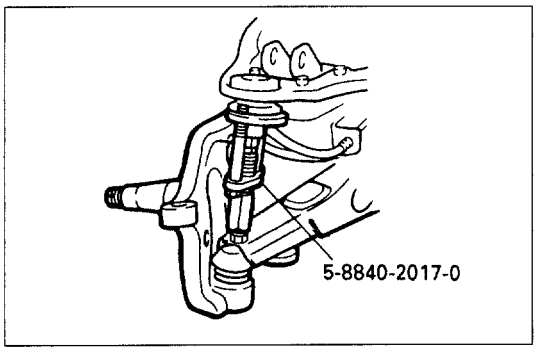
9. **Hub**
10. **Disc**
    - If need, separate the hub on disc.

      Torx bit (T70): 5-8840-2368-0
11. **Back Plate**



12. **Knuckle**
    - Disconnect the tie rod end joint and upper link end joint from the knuckle.

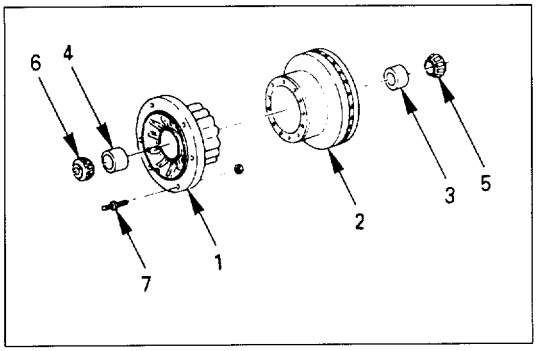
      Tie Rod End Remover: 5-8840-2017-0



- Remove the two bolts fixing the lower link end and remove the knuckle together with the lower link end.
- Remove the lower link end from the knuckle.

INSPECTION AND REPAIR

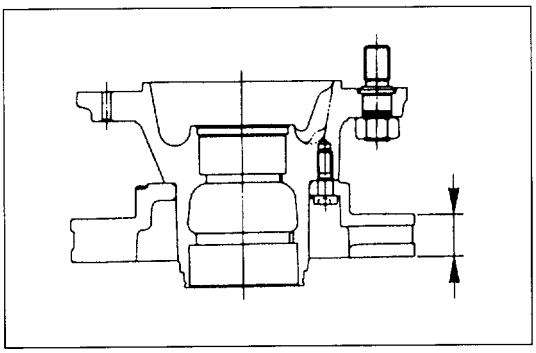
Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.



Visual Inspection

Inspect the following parts for cracking, deformation, and corrosion.

(1) Hub
(2) Disc
(3) Inner race
(4) Outer race
(5) Inner bearing
(6) Outer bearing
(7) Wheel pins



Disc

Use a vernier caliper to measure the disc thickness.

If the measured value is less than the specified limit, the disc must be replaced.

Disc Thickness — mm (in.)

Standard	Limit
35.0 (1.38)	33.5 (1.32)

INSTALLATION

12. Knuckle

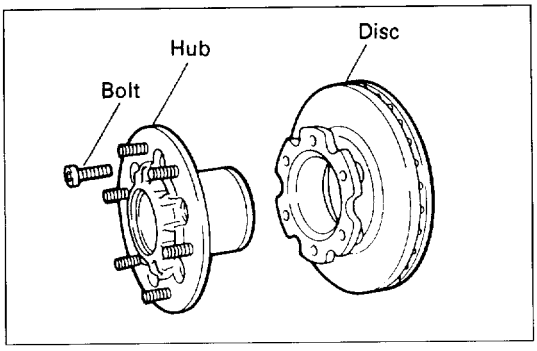
	N•m (kg•m/lb•ft)
Lower Link Joint Nut Torque	377 (38.4/278)
Lower Link End Bolt Torque	219 (22.3/161)
Upper Link Joint Nut Torque	205 (20.9/151)
Tie Rod Joint Nut Torque	108 (11/80)

- Discard used cotter pin and install new one.

11. Back Plate

Back Plate Bolt Torque — N•m (kg•m/lb•in)

13 (1.3/113)

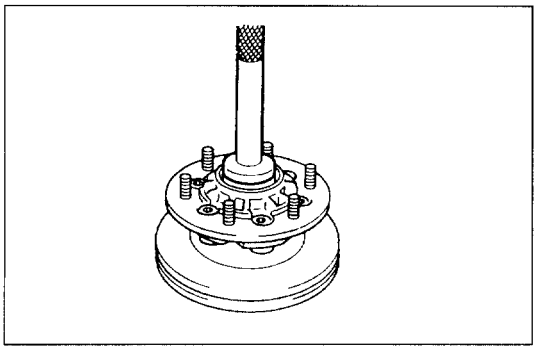


10. Disc

9. Hub

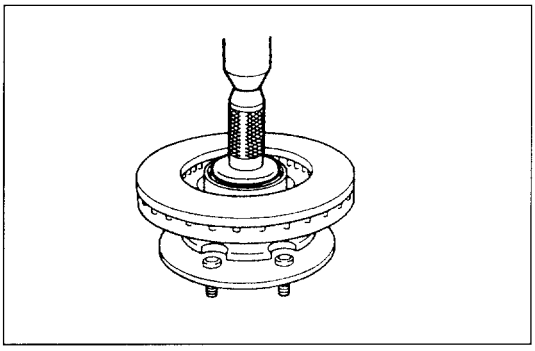
Disc Bolt Torque — N•m (kg•m/lb•ft)

M14	155 (15.8/114)
M16	219 (22.3/163)



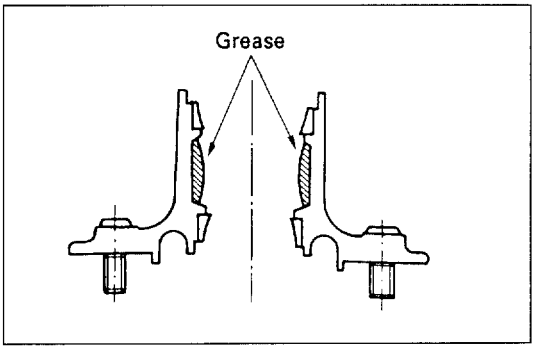
Be sure that the race is completely seated in the hub.

Outer Bearing Outer Race Installer: 5-8840-2026-0



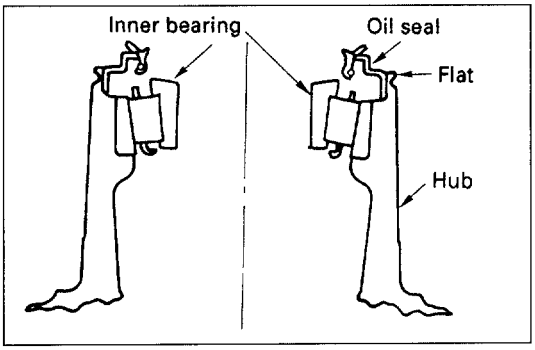
Be sure that the race is completely seated in the hub.

Inner Bearing Outer Race Installer: 5-8840-2235-0



Apply the specified amount of the multipurpose type grease to the hub cavity.

Grease Amount	g (oz)
96 (3.4)	



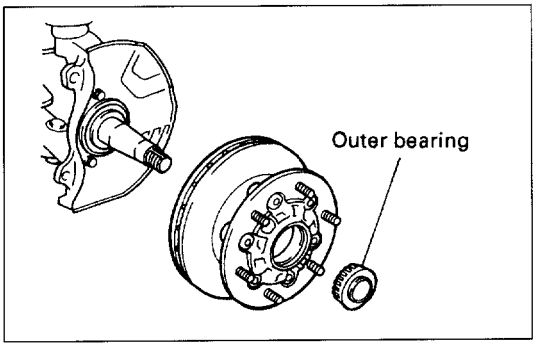
8. **Inner Bearing**

   Apply grease (multipurpose type) to the inner bearing.

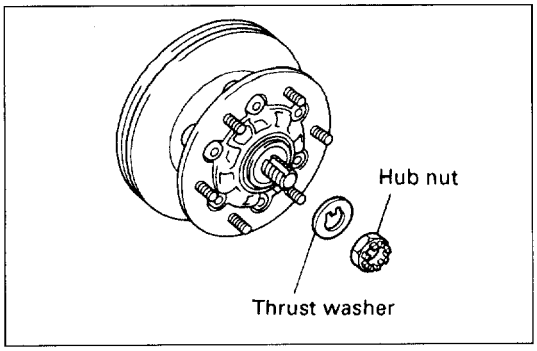
7. **Oil Seal**

   Use a hammer and installer to install the oil seal. The oil seal surfaces must be flat.

   Oil Seal Installer: 5-8840-2235-0



6. **Outer Bearing**
5. **Hub and Disc Assembly**
   1) Install the hub and disc assembly to the knuckle.
   2) Apply grease (multipurpose type) to the outer bearing.
   3) Install the bearing to the hub.

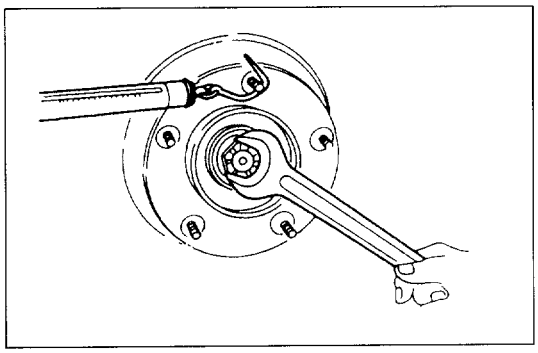


4. Thrust Washer

3. Hub Nut

1) Install the thrust washer and hub nut.
2) Tighten the nut until you are unable to manually rotate the hub and disc assembly.
3) Loosen the nut.
4) Attach a spring balancer to one wheel pin. Gradually retighten the nut until the hub and disc assembly bearing is adjusted to the specified preload.

Hub Bearing Preload	N (kg/lb)
NHR New Bearing	14–28 (1.4–2.9/3–6)
NKR New Bearing	12–26 (1.2–2.7/3–6)
NHR•NKR Reused Bearing	7–22 (0.7–2.2/2–5)

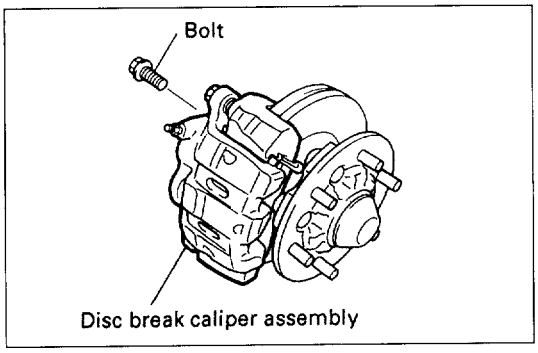


5) Align the nut slot with the knuckle cotter pin hole. If necessary, slightly tighten the nut to align the slot and the hole.
6) Discard used cotter pin and install new cotter pin.

2. Hub Cap

1) Apply the specified amount of the approved grease (Multipurpose type) to the hub cap.

Grease Amount	g (oz)
40 (1.4)	

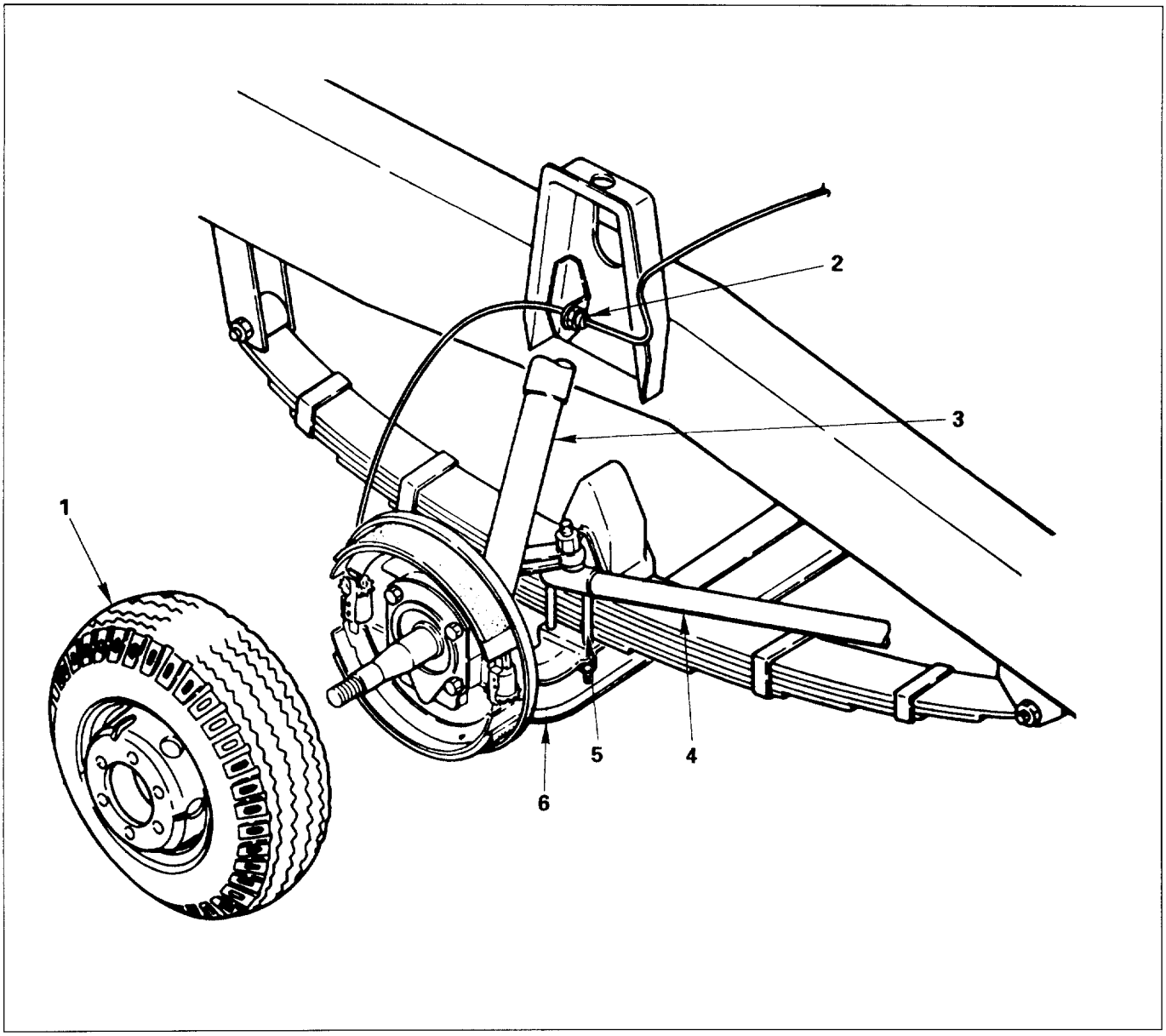


2) Install the disc brake caliper assembly to the knuckle.

Disc Brake Caliper Bolt Torque	N•m (kg•m/lb•ft)
219 (22.3/161)	

1. Wheel and Tire

FRONT AXLE ASSEMBLY (4 × 2 Model)



Removal Steps

1. Wheel and tire
2. Brake flexible hose
3. Shock absorber
4. Drag link
5. U-bolt
6. Front axle assembly

Installation Steps

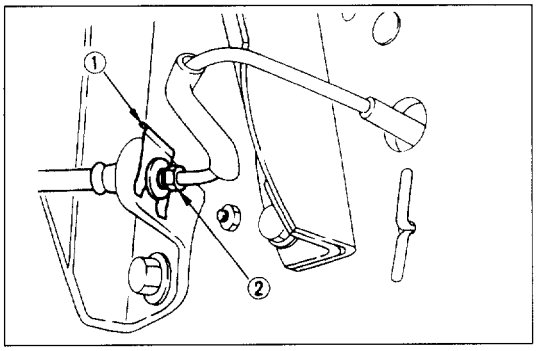
To install, follow the removal steps in the reverse order.

REMOVAL

Preparation:

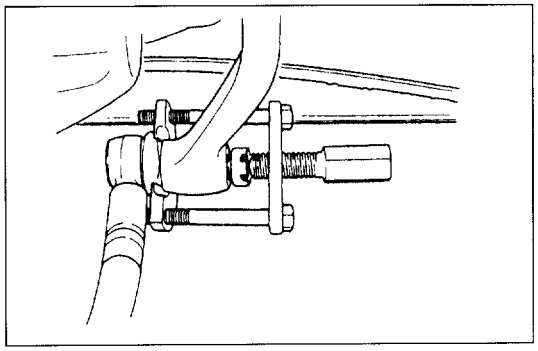
Jack up and support the vehicle on stands.

1. **Wheel and Tire**
2. **Brake Flexible Hoses**



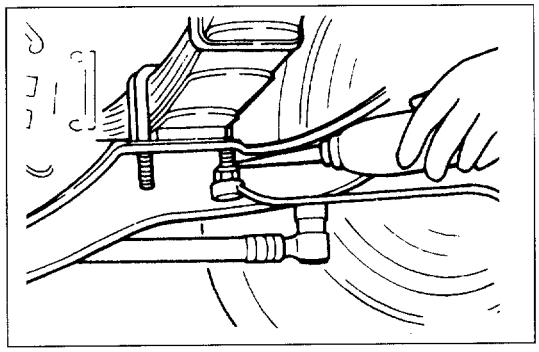
Loosen the nut ②, then pry off a clip ①.

3. **Shock Absorber**
4. **Drag Link**



Disconnect the drag link, using a special tool.

Remover: 5-8840-2017-0

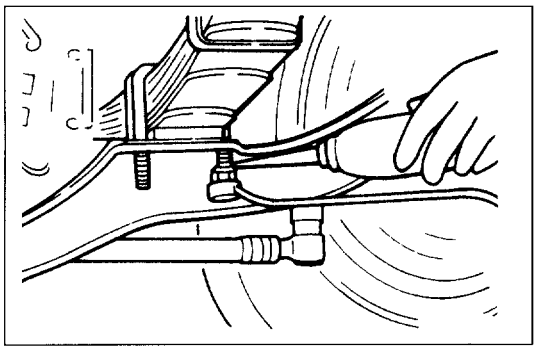


5. **U-Bolt**

Loosen the U-bolts after setting jack against the front axle. If the U-bolts are heavily rusted, apply a generous amount of oil to the threads before loosening them to prevent seizure.

6. **Front Axle Assembly**

INSTALLATION



6. Front Axle Assembly

5. U-bolt and Nut

Position the U-bolts and helper rubber on the leaf spring assemblies and jack up the front axle. When tightening the nuts, apply oil as necessary to prevent damaging the threads.

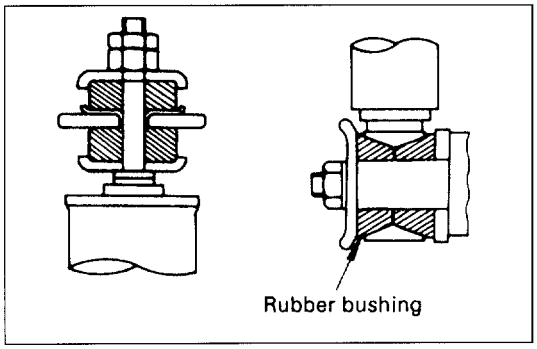
U-Bolt Nut Torque	N•m(kg•m/lb•ft)
NQR	196 (20/145)
NHR, NKR, NPR	127 (13/ 94)

4. Drag Link

Tighten drag link nut to specified torque, with just enough additional torque to align cotter pin holes.

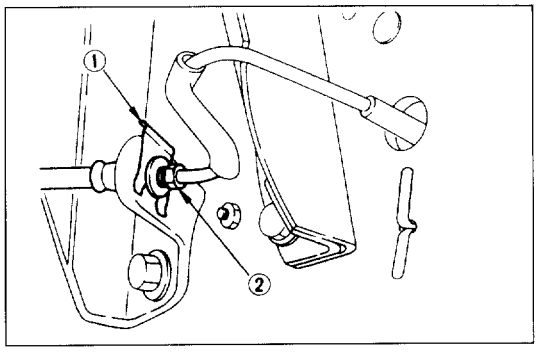
Install new cotter pin.

Drag Link Nut Torque	N•m(kg•m/lb•ft)
167 (17/123)	



3. Shock Absorber

Refer to illustration for installation of shock absorber, nut, washer and rubber bushing.



2. Brake Flexible Hose

Set first the wheels in the straight going position, then attach the flexible hose to the bracket without torsion using a clip ①.

Connect the pipe, then tighten the nut ② to the specified torque.

Brake Flexible Hose Torque	N•m(kg•m/lb•ft)
16 (1.6/12)	

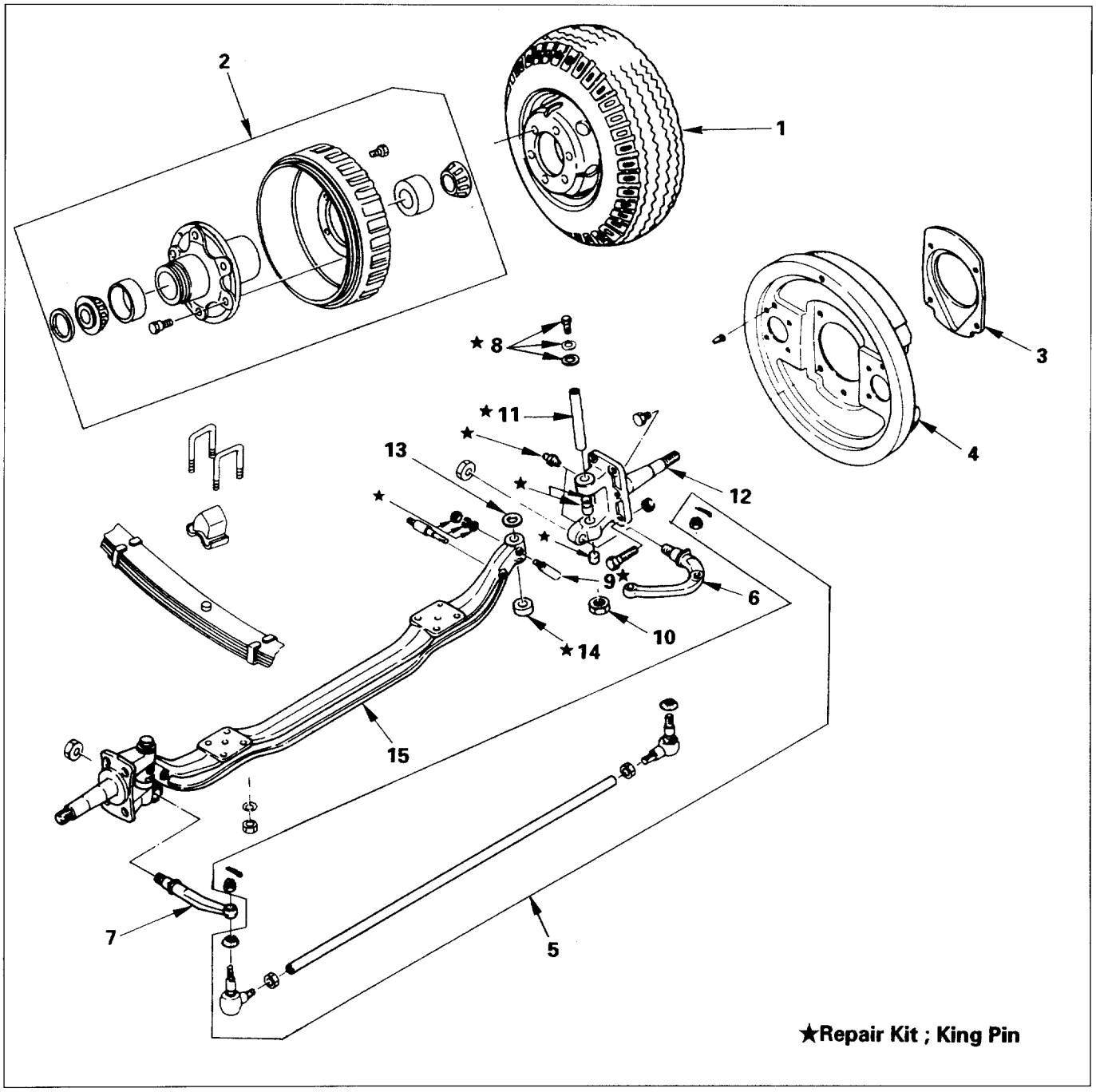
Refer to Section 5 "Service information" for brake fluid air bleeding procedure.

Perform bleeding operation after installation of the brake flexible hoses.

Also inspect wheel alignment after completion of front axle removal and installation.

1. **Wheel and Tire**

KNUCKLE AND KING PIN (4 × 2 Model)



Removal Steps

1. Wheel and tire
2. Hub with brake drum
3. Cover
4. Wheel brake assembly
5. Tie rod assembly
6. Knuckle arm
7. Tie rod arm
8. King pin cover
9. Key bolt
10. Plate plug
11. King pin
12. Knuckle
13. Shim
14. Thrust bearing
15. I-beam

Installation Steps

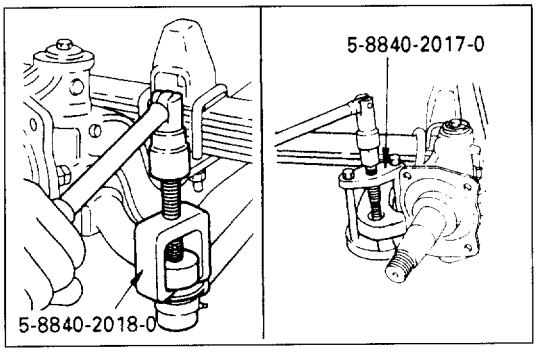
15. I-beam
12. Knuckle
14. Thrust bearing
13. Shim
11. King pin
9. Key bolt
8. King pin cover
10. Plate plug
7. Tie rod arm
6. Knuckle arm
5. Tie rod assembly
4. Wheel brake assembly
3. Cover
2. Hub with brake drum
1. Wheel and tire

REMOVAL

Preparation:

Jack up and support the vehicle on stands.

1. **Wheel and Tire**
2. **Hub with Brake Drum**
3. **Cover**
4. **Wheel Brake Assembly**
5. **Tie Rod Assembly**

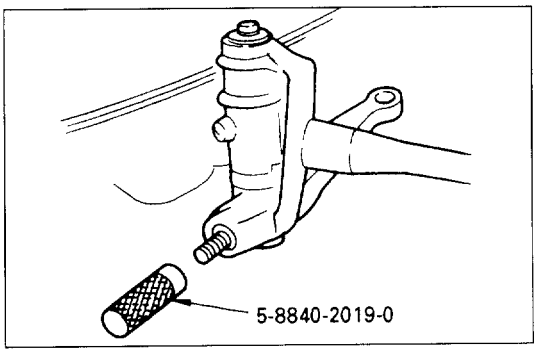


Remover

Driver Side : 5-8840-2017-0

Assistant Side : 5-8840-2018-0

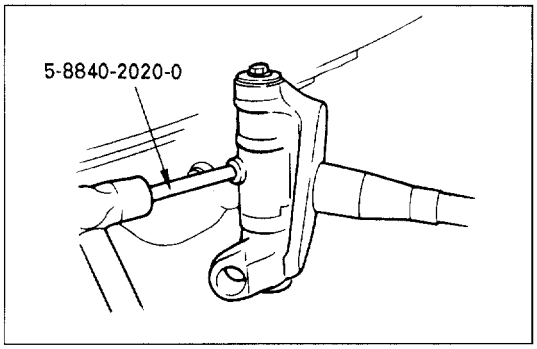
6. **Knuckle Arm**
7. **Tie Rod Arm**



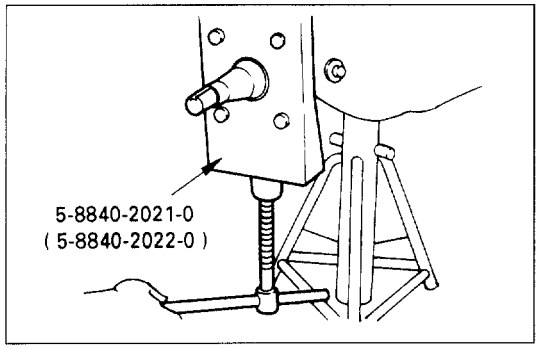
Remover : 5-8840-2019-0

Drive out with a heavy hammer.

8. **King Pin Cover**



9. **Key Bolt**
   Remover : 5-8840-2020-0



10. **Plate Plug**
11. **King Pin**
    Remover :

NHR	5-8840-2021-0
NKR, NPR	5-8840-2022-0
NQR	5-8840-2022-0

12. **Knuckle**
13. **Shim**
14. **Thrust Bearing**
15. **I-Beam**

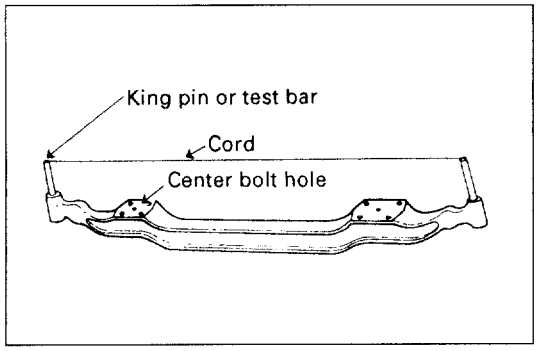
INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.

1. I-beam
2. Knuckle
3. Knuckle arm, tie rod arm
4. Tie rod, tie rod end
5. king pin, bushing, thrust bearing and shims
6. Joint ball
7. Front hub, bearing and oil seal
8. Brake drum
9. Brake shoe, lining etc.

Visual Check

Inspect the following parts for wear, damage or other abnormal conditions.

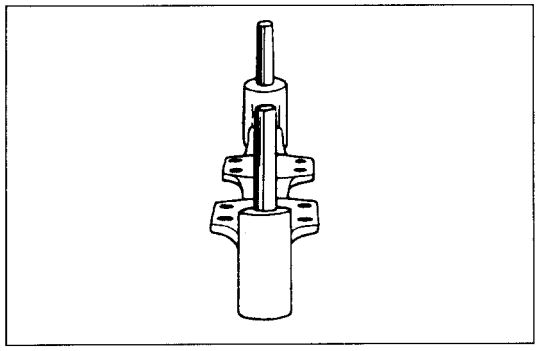


I-Beam (when removed from the vehicle)

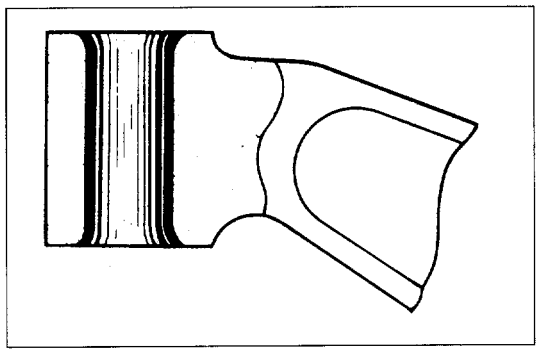
(1) Fit the king pin or test bar into the king pin hole.

(2) Stretch a cord across the centers of king pin or test bars.

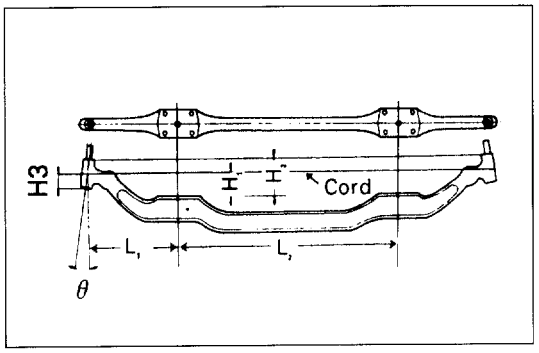
(3) Check to see if the cord is in line with the centers of the center bolt holes in the spring seat when looked down from above the cord.



(4) Also check to see if the king pins or test bar are in good parallel alignment as viewed from the side.



(5) Check to see if the king pin holes is worn.



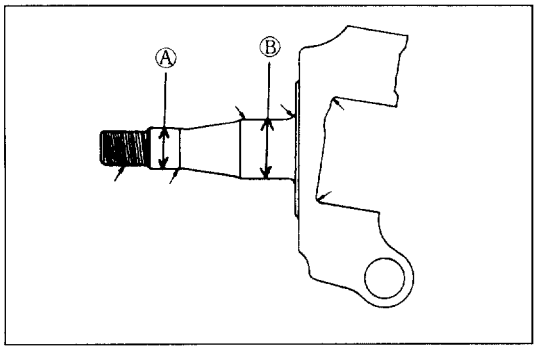
(6) Stretch a cord and check the following dimensions.

'94-97 model mm(in.)

	θ	H1	H2	H3	L1	L2
NHR	7°	97 (3.8)	135.3 (5.3)	27.2 (1.07)	260 (10.2)	690 (27.2)
NKR		97 (3.8)	135.3 (5.3)		260 (10.2)	690 (27.2)
NPR		83 (3.3)	121.3 (4.8)		315 (12.4)	860 (33.9)
NQR		83 (3.3)	121.3 (4.8)		315 (12.4)	860 (33.9)

'98~ model mm(in.)

	θ	H1	H2	H3	L1	L2
NHR	12°	97 (3.8)	135.3 (5.3)	25.2 (0.99)	260 (10.2)	690 (27.2)
NKR		97 (3.8)	134.4 (5.3)		260 (10.2)	690 (27.2)
NPR		83 (3.3)	120.4 (4.7)		315 (12.4)	860 (33.9)
NQR		83 (3.3)	120.4 (4.7)		315 (12.4)	860 (33.9)



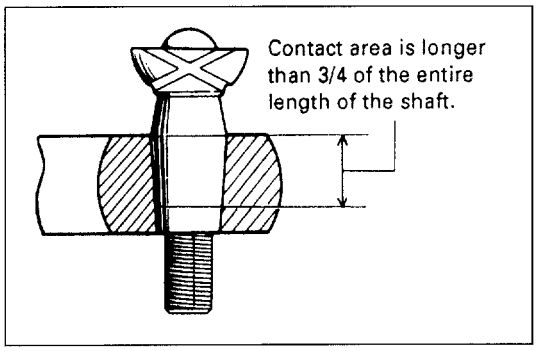
Cracks in Knuckles

Check the knuckles for cracks or damage paying a particular attention to the areas indicated by arrows.

Use a magnetic flaw detector or red check.

mm(in.)

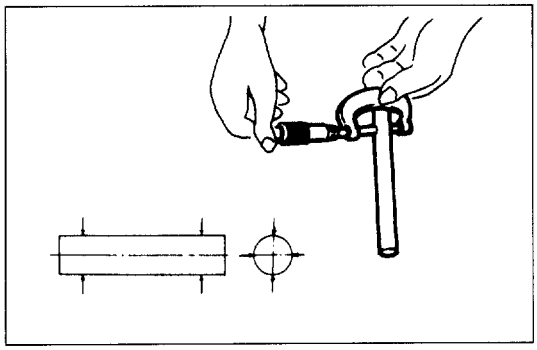
	A	B
NHR	30 (1.19)	40 (1.57)
NKR, NPR, NQR	35 (1.38)	50 (1.97)



Knuckle Arm and Tie Rod Arm

Check tapered portion of the knuckle arms and tie-rod arms for abnormal contact in the following manner.: Apply a thin coat of red check evenly to the tapered portion of the shaft and insert the shaft into the tapered hole. Remove the shaft and check impression of contact obtained on the shaft.

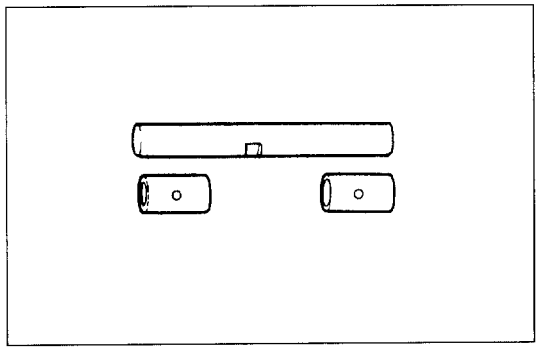
Correction or parts replacement is necessary if the contact is uneven or if contact area is smaller than 3/4 of the entire length of the shaft.



King Pin Diameter

mm(in.)

	Standard	Limit
NHR	25.0 (0.984)	24.9 (0.980)
NKR, NPR, NQR	30.0 (1.181)	29.9 (1.177)

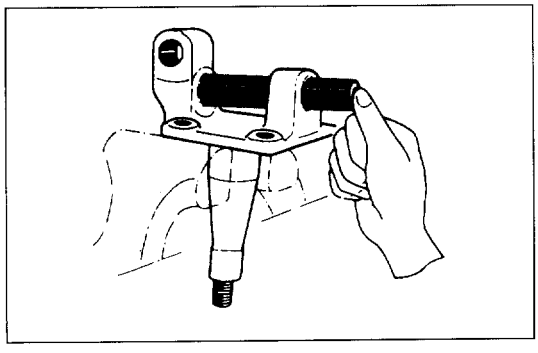


Clearance between King Pin and Bushing

mm(in.)

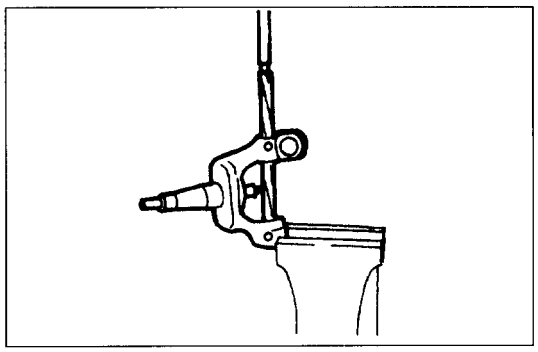
Standard	Limit
0.06 (0.0024)	0.15 (0.0059)

NOTE:
Install the king pin bushing by aligning its grease hole with grease fitting hole in the knuckle.



Fit of king pin into the king pin bushing can be checked in the following manner.

Clamp the knuckle with king pin bushings in a vise and insert the king pin into the bushings. Check for radial play by moving the king pin in direction at a right angle to its axis, then move the king pin endwise with finger.

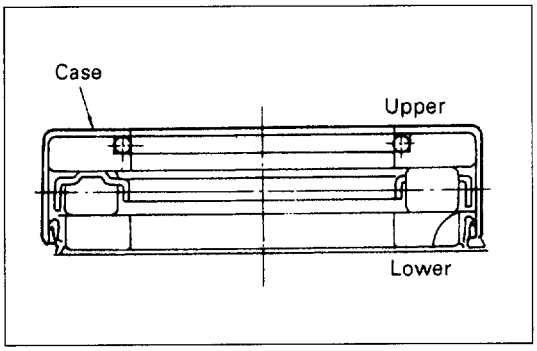


If fitting of king pin into the bushing is too tight, carefully cut inner face of the bushing with a reamer, so that upper and lower holes in the knuckle are well centered.

INSTALLATION

15. I-Beam

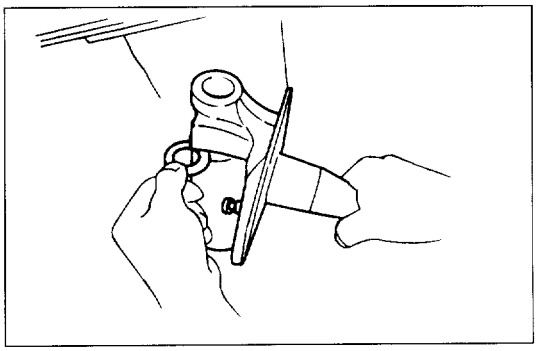
12. Knuckle



14. Thrust Bearing

(1) Apply grease

(2) Turn the bearing case-side upward



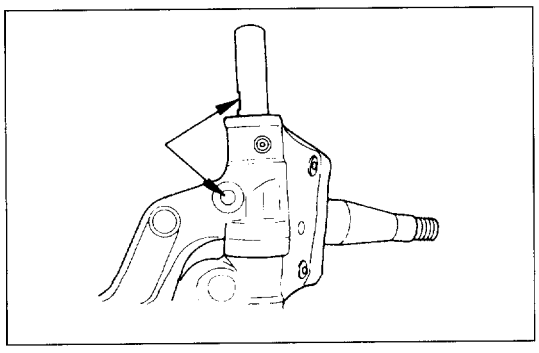
13. Shim

Check the clearance between the knuckle and front axle.

mm(in.)

Standard	Limit
0 – 0.10 (0 – 0.004)	0.20 (0.0079)

Shim Available	mm(in.)
Thickness	0.50 (0.019)
	0.55 (0.022)
	0.60 (0.024)
	0.65 (0.026)
	0.70 (0.028)
	0.80 (0.031)
	0.90 (0.035)

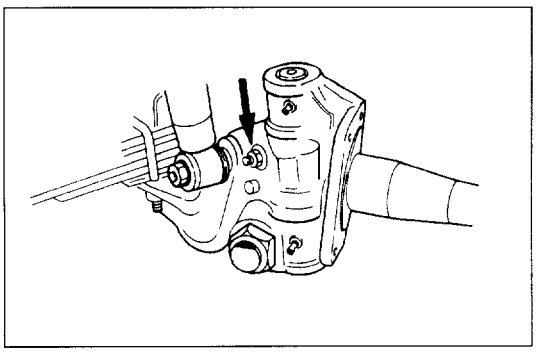


11. King Pin

(1) Apply grease

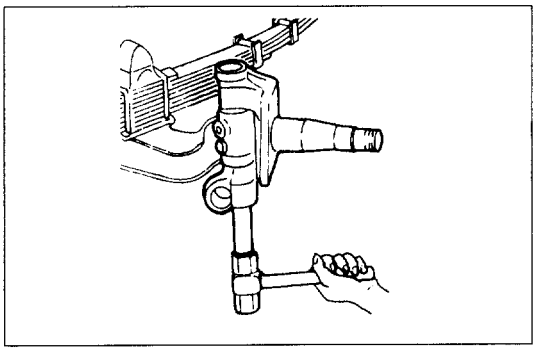
(2) Align the key groove with the key bolt hole in the front axle.

(3) After installing the king pin, check that the knuckle turns smoothly.



9. Key Bolt

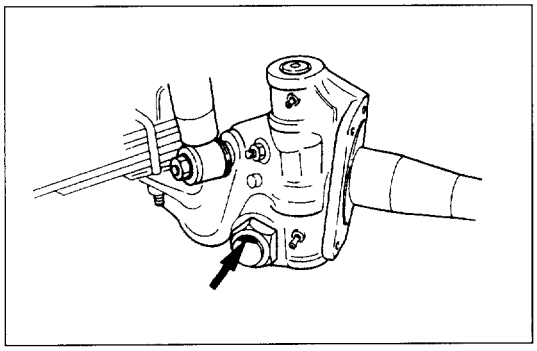
Key Bolt Torque	N•m(kg•m/lb•ft)
32 (3.3/24)	



8. King Pin Cover

10. Plate Plug

Drive the plate plug upward into position with an appropriate bar fitted against the lower end.

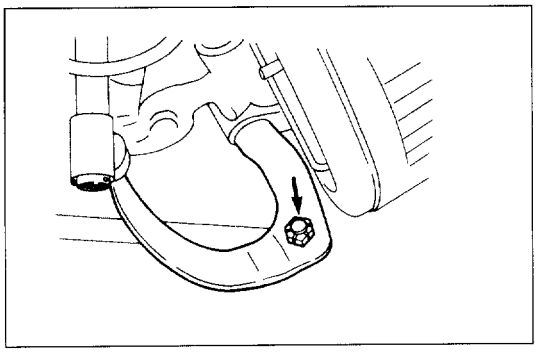


7. Tie Rod Arm

6. Knuckle Arm

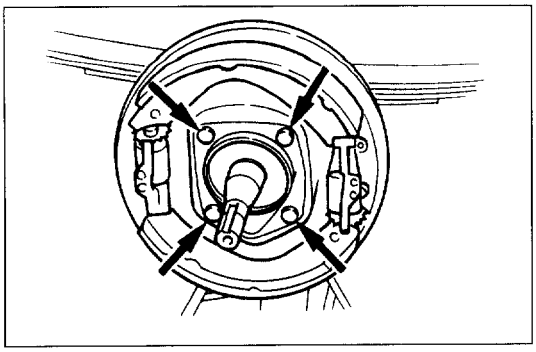
Knuckle Arm Nut Torque	N•m(kg•m/lb•ft)
441 (45/325)	

After tightening, stake nut.



5. Tie Rod Assembly

Tie Rod End Nut Torque	N•m(kg•m/lb•ft)
186 (19/137)	

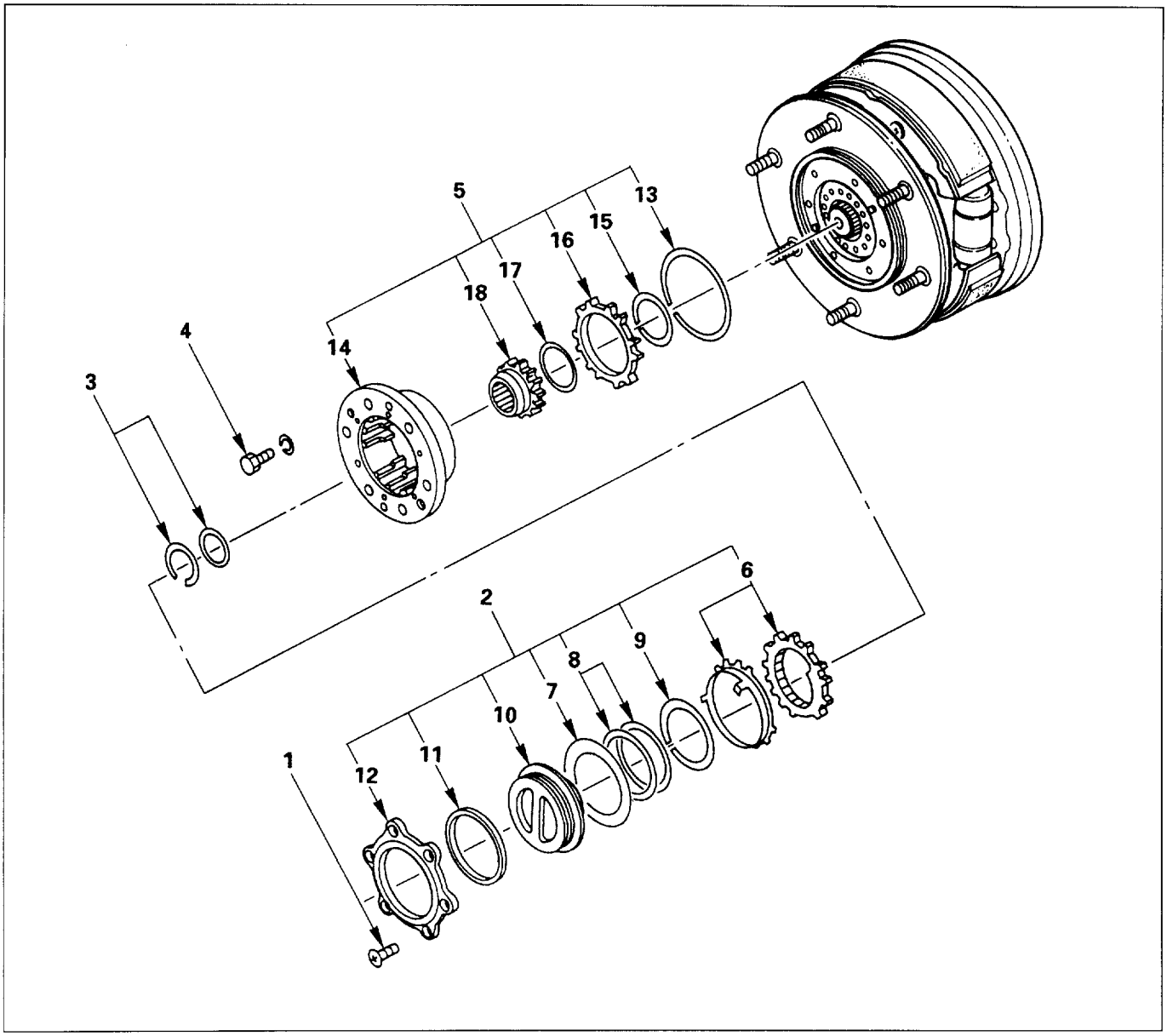


4. **Wheel Brake Assembly**
3. **Cover**

Wheel Brake Bolt Torque	N•m(kg•m/lb•ft)
	69 (7/51)

2. **Hub with Brake Drum**
1. **Wheel and Tire**

FREE WHEEL HUB (Manual Locking Hub) (4 × 4 Model)



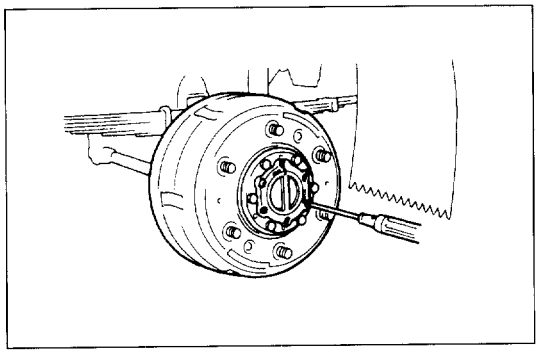
Removal Steps

1. Screw
2. Cover assembly
3. Snap ring and shim
4. Bolt
5. Body assembly
6. Clutch assembly
7. Inner snap ring
8. Tension spring
9. Inner snap ring
10. Handle
11. Ring
12. Cover
13. Inner snap ring
14. Body
15. Outer snap ring
16. Ring
17. Spacer
18. Inner hub lock

Installation Steps

To install, follow the removal steps in the reverse order.

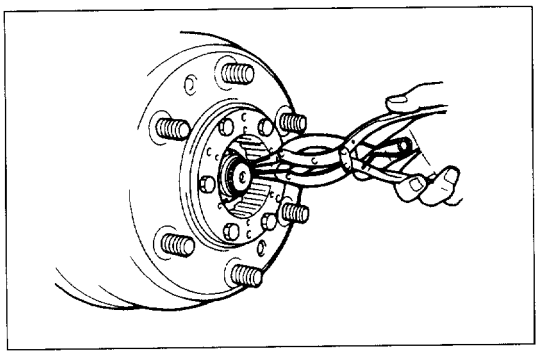
REMOVAL



1. **Screw**
2. **Cover Assembly**

   Set handle into "FREE" position and then remove cover assembly.

   (During removal, take care not to damage the flange on rear side of cover. Remove wheel (tire) as necessary.)



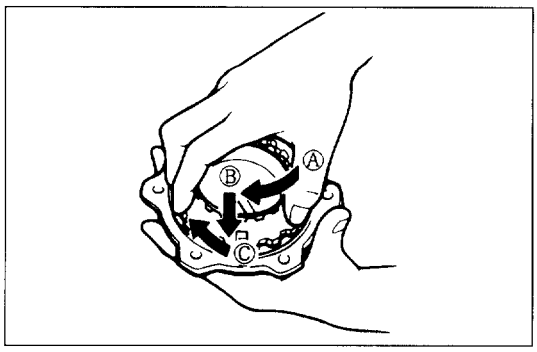
3. **Snap Ring and Shim**

   Confirm the quantity of shims.

4. **Bolt**
5. **Body Assembly**

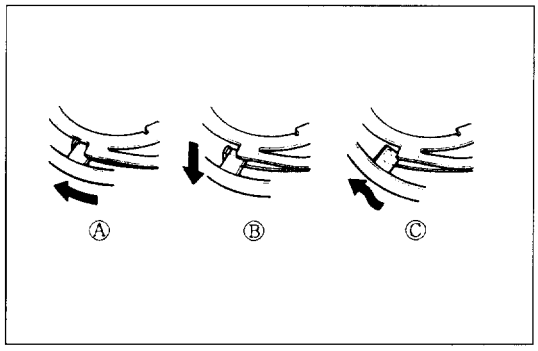
   Remove the body assembly using a push bolt (M10 × 1.5).

   During removal, do not damage the flange of body by hitting with a screwdriver or the like.



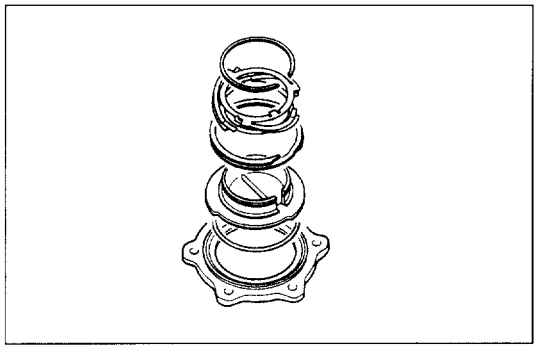
6. **Clutch Assembly**
   (1) With the handle in FREE position, hold the cover and rotate fully the clutch assembly clockwise as shown Ⓐ.

   At this time, the lug of clutch retainer gets stuck by the L-shaped part at the edge of tension spring (0 it is pinched by double parts of tension spring).



   (2) Under the condition of (1) above, rotate further the clutch assembly clockwise while pushing it Ⓑ. Consequently, the clutch retainer lug is freed from the L-shaped part at the edge of tension spring Ⓒ.

   Do not try to further disassemble the clutch assembly.



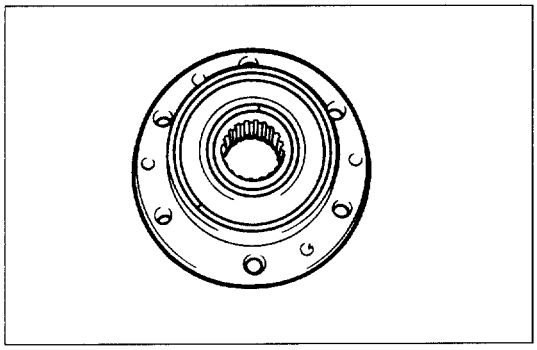
7. **Inner Snap Ring**
8. **Tension Spring**

   Remove the snap ring and then remove the tension spring from the cover.
9. **Inner Snap Ring**
10. **Handle**

    Remove the inner snap ring and then remove the handle from the cover.
11. **Ring**

    Remove the ring from the handle.
12. **Cover**
13. **Inner Snap Ring**
14. **Body**

    Remove the inner snap ring from the back of body.

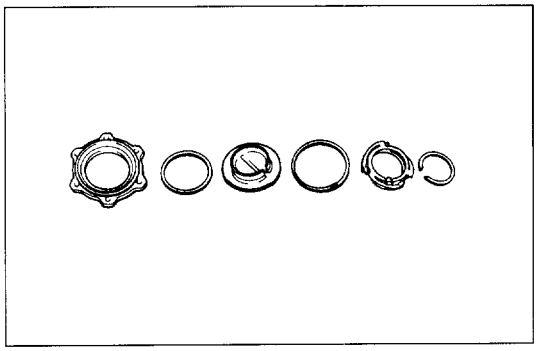


15. **Outer Snap Ring**
16. **Ring**

    Remove the outer snap ring that joints inner and ring, so that they are separated.
17. **Spacer**
18. **Inner Hub Lock**

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.

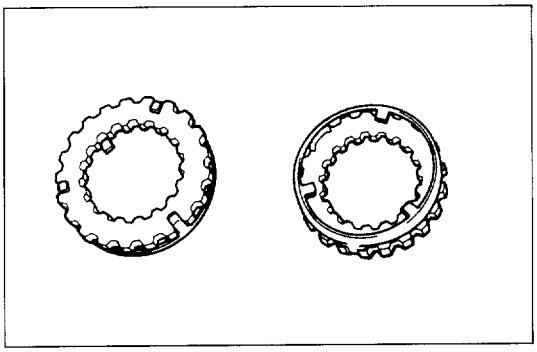


Cover Assembly

(1) Inspect the cover and handle for presence of crack or damage particularly in a sliding part.

(2) Inspect the inner snap ring of cover for local wear in the mounting groove.

(3) Inspect the tension spring for wear, damage or break.

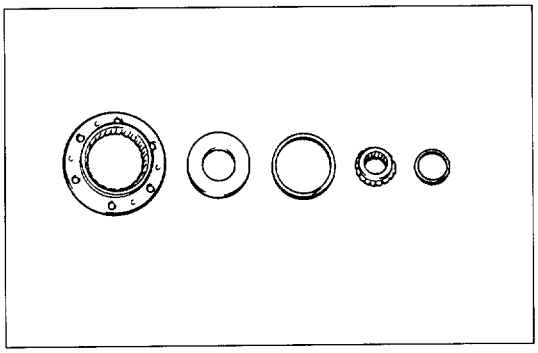


Clutch Assembly

(1) Inspect the retainer of clutch assembly for play in the calked parts (3 places).

Re-calk if the axial play exceeds 0.1 mm.

(2) Inspect the clutch teeth for crack, wear or damage, and also the retainer lug for break or wear. Replace the assembly if clutch or retainer is defective.



Body Assembly

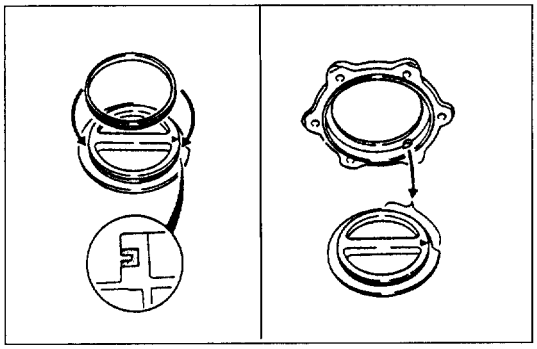
(1) Inspect the body, ring, inner snap ring, outer snap ring and inner hub lock for crack, wear or damage particularly in the teeth.

(2) Inspect the inner snap ring mounting groove of the hub lock body and the outer snap ring mounting groove of the hub lock inner for an uneven wear.

INSTALLATION

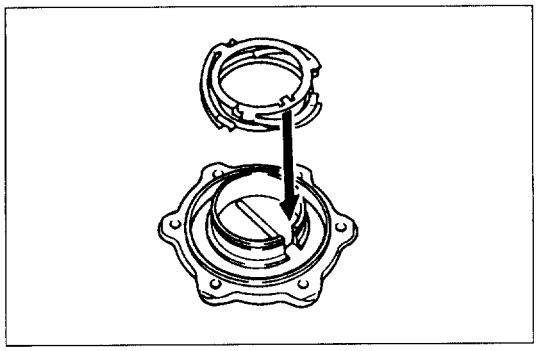
18. **Inner Hub Lock**
17. **Spacer**
16. **Ring**
15. **Outer Snap Ring**

    Apply grease (Multipurpose type) to each part of inner hub lock and install it to the hub lock ring (flange should face rear side), then fix it with outer snap ring.
14. **Body**
13. **Inner Snap Ring**
    (1) Install the inner hub lock to hub lock ring, then to the body, and fix them with inner snap ring.
    (2) Make sure that the inner hub lock and outer snap rings are installed properly.
12. **Cover**
11. **Ring**



    Apply grease (Multipurpose type) to the ring and install the ring to the handle.

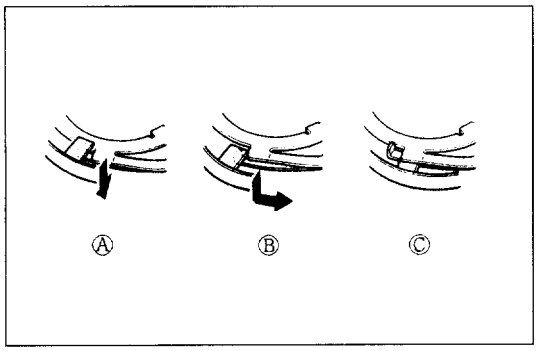
    Make sure that the ring is free from torsion.
10. **Handle**
9. **Inner Snap Ring**
    (1) Install the handle to the cover, and fix with inner snap ring.
    (2) Make sure that the inner snap ring is installed properly.



8. **Tension Spring**
    (1) Apply grease (Multipurpose type) to the tension spring.
    (2) Insert the tension spring into the cover assembly with the nail of spring engaged with the groove.

    There is no discrimination such as face or back in the tension spring.
7. **Inner Snap Ring**

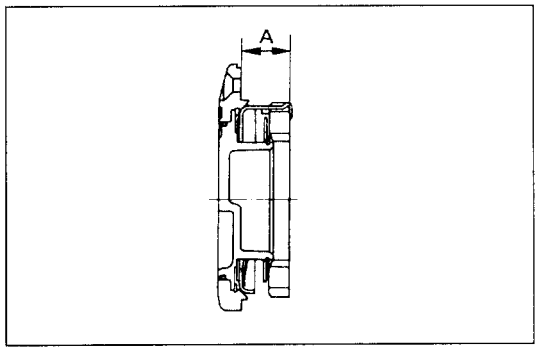
    Fix the tension spring with inner snap ring.



6. Clutch Assembly

(1) With the retainer lugs met with L-shaped parts (3 places) at the edge of tension spring Ⓐ, push and rotate spirally the retainer Ⓑ so that it is pinched by springs Ⓒ.

(2) The clutch must be in retract status when the handle is set in FREE position.



(3) Install the clutch assembly to the cover, and measure the dimension "A" to confirm that it satisfies the standard.

mm(in.)

FREE status	22.4–23.7(0.88–0.93)
LOCK status	32.6–33.9(1.28–1.33)

5. Body Assembly

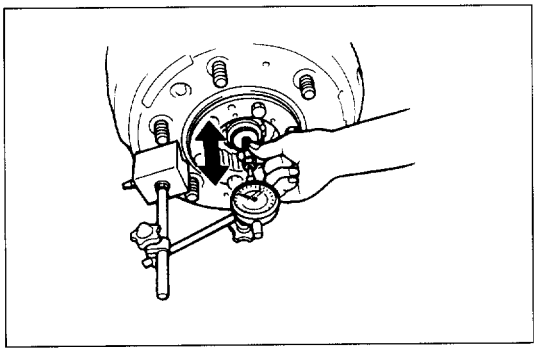
(1) Apply grease (Multipurpose type) to the teeth of hub lock body assembly.

(2) Apply adhesive (LOCTITE 515 or equivalent) to the flange surface of the body assembly.

4. Bolt

Apply adhesive (LOCTITE 242 or equivalent) to the threads of body assembly fixing bolts, and tighten them to the specified torque.

Bolt Torque	N•m(kg•m/lb•ft)
	98 (10/72)



Measurement of axial play of front drive shaft

After installation of body assembly, measure axial play of front drive shaft. If it is out of the standard range, adjust with shims listed below.

mm(in.)

Standard play	0–0.5(0–0.020)		
Kind of shims	1.0(0.039)	0.5(0.020)	0.3(0.012)

3. Snap Ring and Shim

Install the snap ring properly.

2. Cover Assembly

Apply adhesive (Three Bond 1215 or equivalent) to the flange surface of the cover assembly.

1. **Screw**

With the handle in FREE position (clutch is disengaged), adjust three grooves of body and tighten the screws to the specified torque after applying adhesive (LOCTITE 242 or equivalent) to the threads.

Screw Torque	N•m(kg•m/lb•in)
6 (0.6/52)	

<Inspection of free wheel hub locking operation>

(1) With the handle in FREE position, rotate the front drive shaft. Normal if no load is applied.

(2) With the handle in LOCK position, rotate the front drive shaft. Normal if load is applied.

[Reference]	N•m(kg•m/lb•in)
Load of front drive shaft	3 (0.3/26)

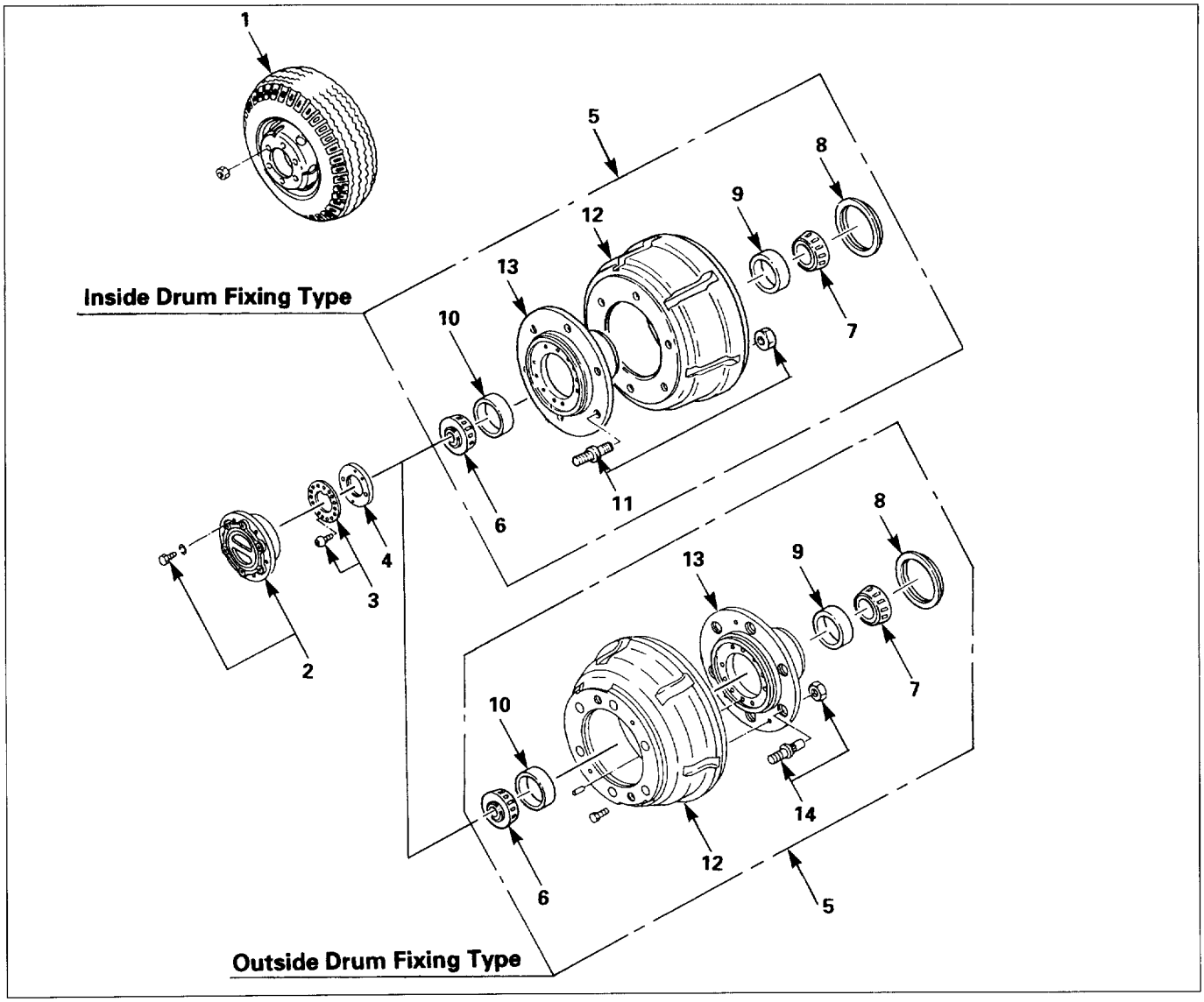
(3) Return the handle from LOCK to FREE position, rotate the front drive shaft. Normal if no load is applied.

<Inspection of hub lock handle operating force>

The handle should be operated smooth and be moderate in functioning when it is operated two or three times.

[Reference] Handle operating force:10kg·cm or less at 10°C or above 100kg·cm or less at –30°C.

FRONT HUB AND BRAKE DRUM (4 × 4 Model)



Removal Steps

1. Wheel and tire
2. Front locking hub set
3. Front hub bearing lock washer
4. Front hub bearing lock nut
5. Front hub and brake drum assembly
6. Front axle hub outer bearing
7. Front axle hub inner bearing
8. Front hub oil seal
9. Front axle hub inner bearing outer race
10. Front axle hub outer bearing outer race
11. Front wheel pin and nut (Inside drum fixing type)
12. Brake drum
13. Front axle hub
14. Front wheel pin and nut (Outside drum fixing type)

Installation Steps

To install, follow the removal steps in the reverse order.

REMOVAL

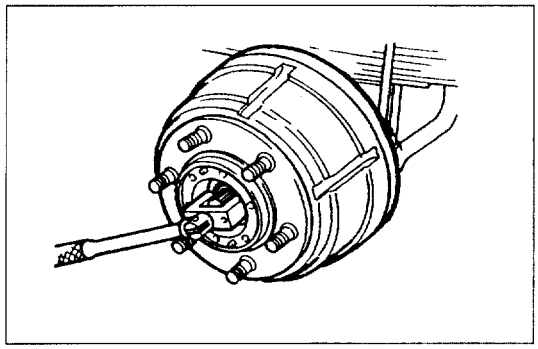
Preparation:

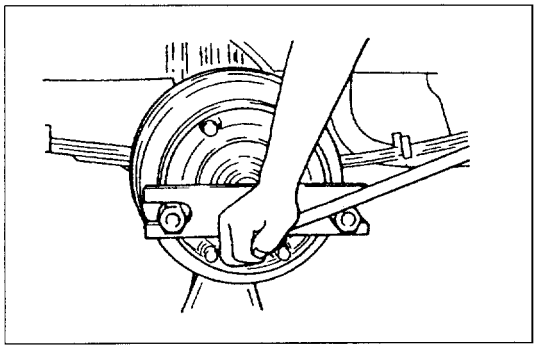
Jack up and support the vehicle on stands.

1. **Wheel and Tire**
2. **Front Locking Hub Set**

   Refer to "FREE WHEEL HUB" previously in this section.
3. **Front Hub Bearing Lock Washer**
4. **Front Hub Bearing Lock Nut**

   Front Hub Bearing Lock Nut Wrench: 5-8840-2182-0

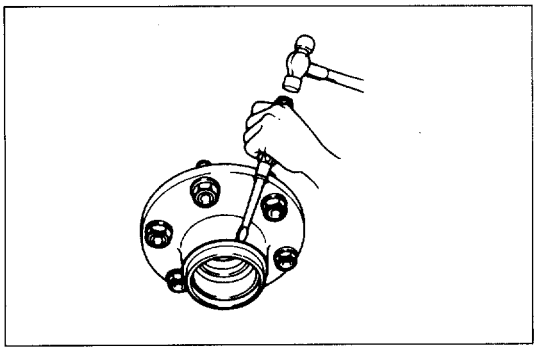




5. **Front Hub and Brake Drum Assembly**

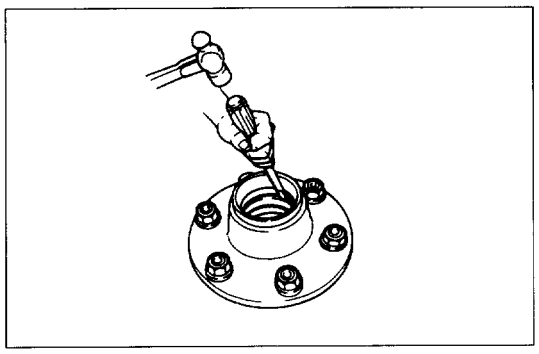
   Hub Remover: 9-8521-0187-0
6. **Front Axle Hub Outer Bearing**
7. **Front Axle Hub Inner Bearing**

   If the inner bearing is left on the spindle side, gouge from left and right with a screwdriver, and if floating up, pull to remove it.



8. **Front Hub Oil Seal**

   When removing the oil seal, hit the outer flange of oil seal. The oil seal must not be reused.



9. **Front Axle Hub Inner Bearing Outer Race**
10. **Front Axle Hub Outer Bearing Outer Race**

    Remove the outer race by driving out race from the hub with a brass drift inserted behind race in notches in the hub.

11. **Front Wheel Pin and Nut (Inside Drum Fixing Type)**

    Remove nuts and hit with hammer, or use a press to remove wheel pin.
    Remove the wheel pin as necessary.

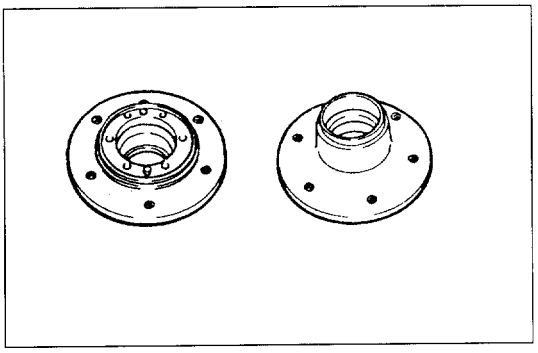
12. **Brake Drum**
13. **Front Axle Hub**
14. **Front Wheel Pin and Nut (Outside Drum Fixing Type)**

    Remove nuts and hit with hammer, or use a press to remove wheel pin.

    Remove the wheel pin as necessary.

INSPECTION AND REPAIR

Make necessary adjustments, repairs, and part replacement if excessive wear or damage is discovered during inspection.



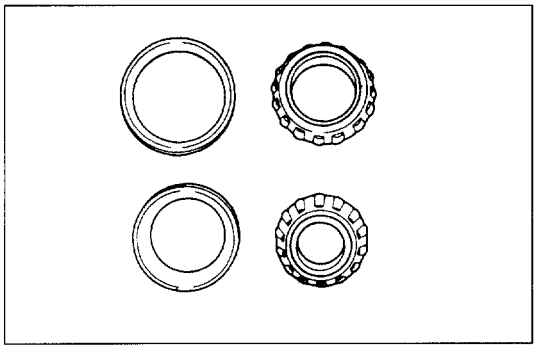
Front Axle Hub

(1) Inspect the inner surface of front axle hub.

Inspect the fitting portions of front axle hub bearing outer race and hub lock body assembly for crack, damage or wear.

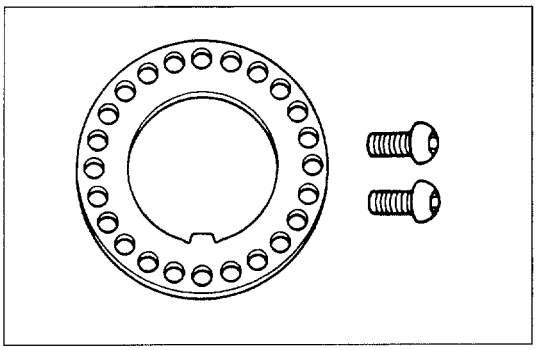
(2) Inspect the outer surface of front axle hub.

Inspect the flange and oil seal fitting portion for crack, deformation or damage.



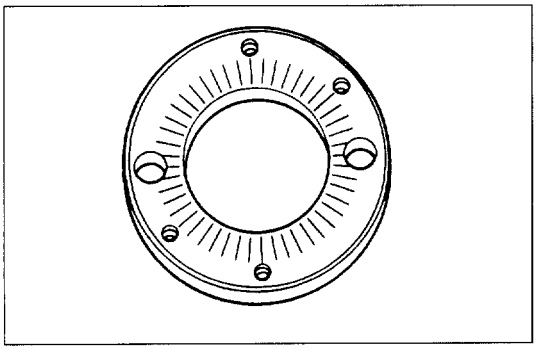
Bearing

Inspect the bearing for excessive wear, abnormal noise, rough rotation, and seizure



Front Hub Bearing Lock Washer

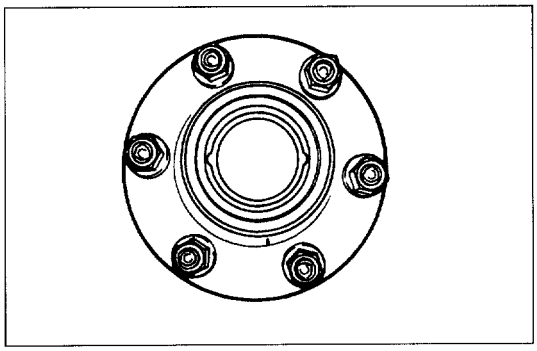
Inspect the lock washer for wear, deformation or crack, and also the lug for break.



Front Hub Bearing Lock Nut

Inspect the bearing lock nut threads and contact surfaces for excessive wear, warpage, and other damage. Light damage to the contact surfaces can be repaired with an oil stone or a piece of fine sandpaper.

INSTALLATION



14. Front Wheel Pin and Nut (Outside Drum Fixing Type)

If a wheel pin is replaced or removed, tighten the nut to the specified torque and calk the nut at three places per pin.

Front Wheel Pin Nut Torque	N•m(kg•m/lb•ft)
	392 (40/289)

13. Front Axle Hub

12. Brake Drum

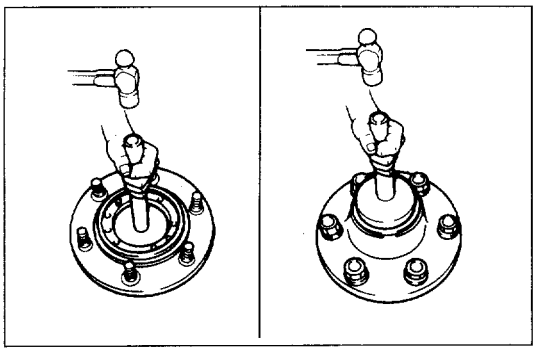
On the model with outside drum fixing type, tighten the brake drum bolts to the specified torque.

Brake Drum Bolt Torque	N•m(kg•m/lb•in)
	13 (1.3/113)

11. Front Wheel Pin and Nut (Inside Drum Fixing Type)

Tighten the nut to the specified torque and calk the nut at three places per pin.

Front Wheel Pin Nut Torque	N•m(kg•m/lb•ft)
392 (40/289)	



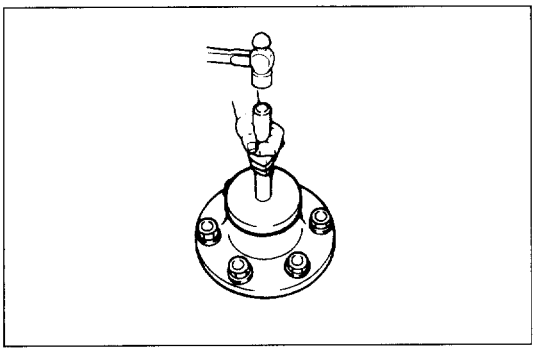
10. Front Axle Hub Outer Bearing Outer Race

9. Front Axle Hub Inner Bearing Outer Race

Use the bearing outer race installer to install the outer race to the hub.

Inner Bearing Outer Race Installerr : 5-8840-2184-0

Outer Bearing Outer Race Installer : 5-8840-2183-0



8. Front Hub Oil Seal

(1) Apply grease (Multipurpose type) to the oil seal lip inner circumferences.

(2) Use the oil seal installer to install the oil seal to the hub.

Oil Seal Installer : 5-8840-2187-0

During installation of oil seal, do not press or hit it other than outer flange of seal.

Apply the specified amount of the approved grease to the hub cavity, the outer bearing and the inner bearing.

Grease Amount	g(oz)
<per side> 200 (7.1)	

7. Front Axle Hub Inner Bearing

Install the inner bearing to the spindle.

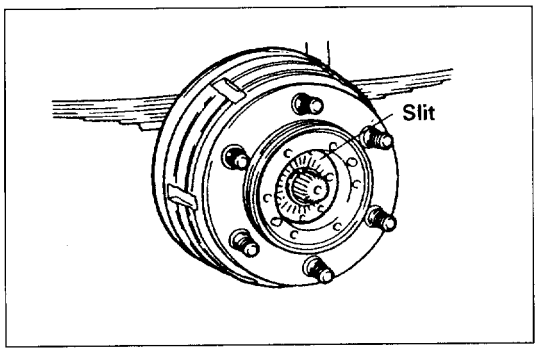
6. Front Axle Hub Outer Bearing

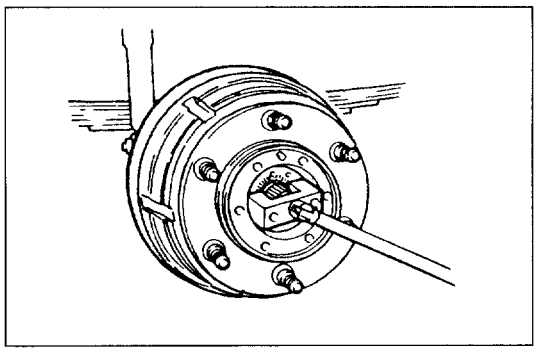
Install the outer bearing to the front hub assembly.

5. Front Hub and Brake Drum Assembly

4. Front Hub Bearing Lock Nut

Install the hub bearing lock nut with slits facing outside, and tighten provisionally.





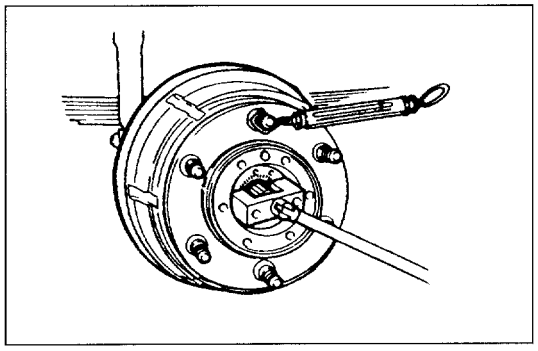
<Adjustment of Hub Bearing Preload>

(1) Turn the hub to the left and right several times to establish bearing conformity.

(2) Use the bearing nut wrench to tighten the bearing nut until the hub can not be manually rotated.

Bearing Nut Wrench:5-8840-2182-0

(3) Loosen the bearing nut until hub rotates easily.

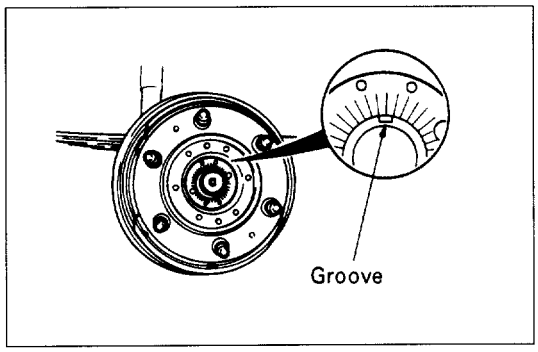


(4) Set the spring balancer to the wheel pin in the position shown in the illustration.

Gradually retighten the nut until the hub bearing is adjusted to the specified preload.

Hub Bearing Preload	N(kg/lb)
New Hub Bearing	17–31 (1.7–3.2/3.7–7.1)
Reused Hub Bearing	14–28 (1.4–2.9/3.1–6.4)

(5) Rotate the hub several times to the right and left. Measure the bearing preload a second time.

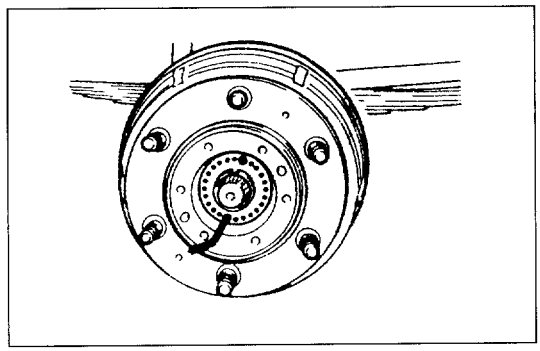


(6) Align the axle case groove with the closest bearing nut slit.

NOTE:
If it is difficult to align the axle case and bearing nut, slightly tighten the be.aring nut.

3. Front Hub Bearing Lock Washer

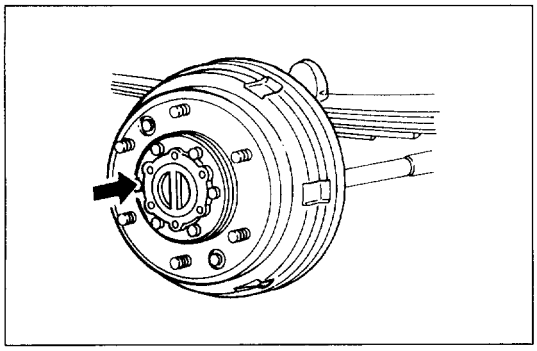
Engage the lug of lock washer with a notch in the spindle.



Apply adhesive (LOCTITE 242 or equivalent) to the threads of lock washer bolt, and tighten the hub bearing lock nut with lock washer.

Lock Washer Bolt Torque	N•m(kg•m/lb•in)
10 (1.0/87)	

In order to ensure locking, equally spaced 48 slits are scribed on the hub bearing lock nut. The tapped holes in hub bearing lock nut will meet either hole in lock washer (two holes provided at symmetric position) if a slit of hub bearing lock nut is aligned with the notch center at the threads of spindle end. Under this condition, tightening the bolts fix surely the hub bearing lock nut.



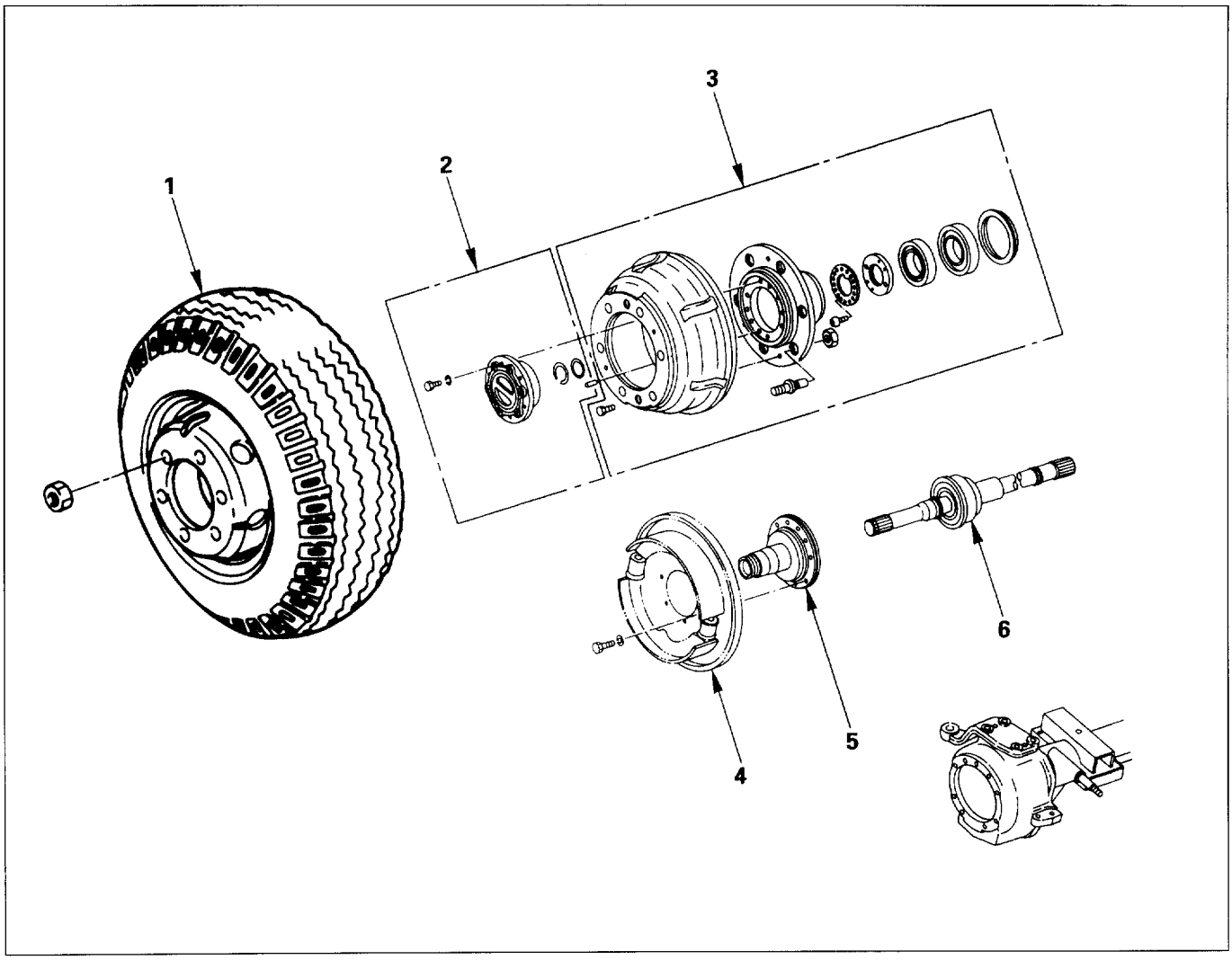
2. **Front Locking Hub Set**

   Refer to "FREE WHEEL HUB" previously in this section.

Front Locking Hub Set Bolt Torque	N•m(kg•m/lb•ft)
	98 (10.0/72)

1. **Wheel and Tire**

SPINDLE AND DRIVE SHAFT (4 × 4 Model)



Removal Steps

1. Wheel and tire
2. Front locking hub set
3. Front axle hub, brake drum and related parts
4. Front brake assembly
5. Spindle
6. Front drive shaft assembly

Installation Steps

To install, follow the removal steps in the reverse order.

REMOVAL

Preparation:

Jack up and support the vehicle on stands.

1. **Wheel and Tire**
2. **Front Locking Hub Set**

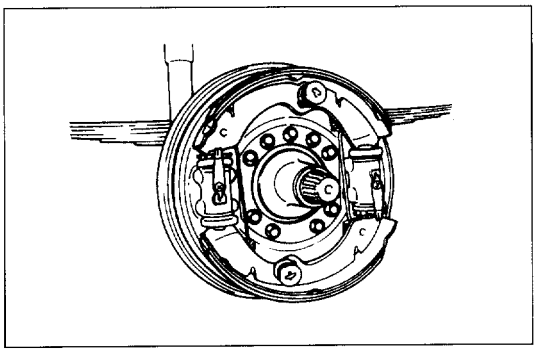
   Refer to "FREE WHEEL HUB" previously in this section.
3. **Front Axle Hub, Brake Drum and Related Parts**

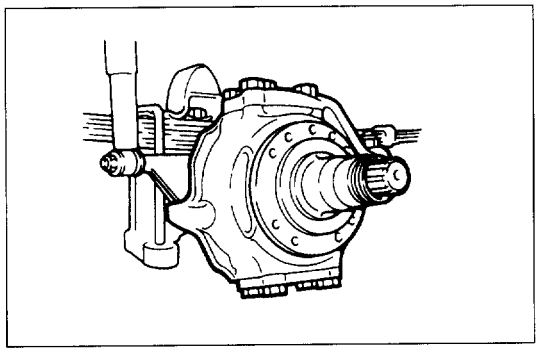
   Refer to "FRONT HUB and BRAKE DRUM (4 x 4 Model)" previously in this section.
4. **Front Brake Assembly**

   (1) Remove fixing bolts and front oil shield cover, then the brake assembly.

   The front oil shield cover, spindle and back plate are tightened together.

   (2) Using a wire, sling the brake assembly to the frame to hold. At this time, take care not to damage or bend the brake hose.

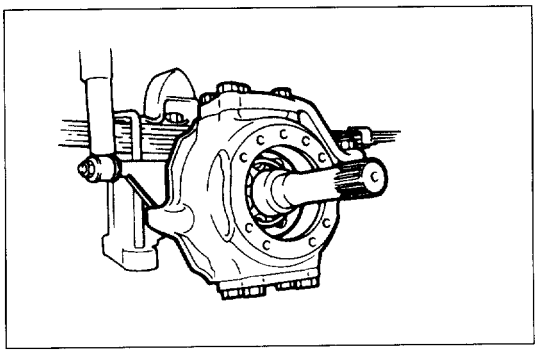




5. **Spindle**

   Hitting lightly the spindle end with a wood or plastic hammer, remove the spindle from knuckle.

   Do not use an iron hammer. Special care should be taken to protect the threads at the spindle end from damage.

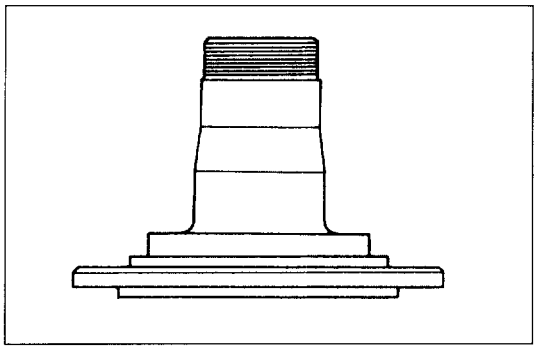


6. **Front Drive Shaft Assembly**

   Pull and remove the front drive shaft to your side.

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.

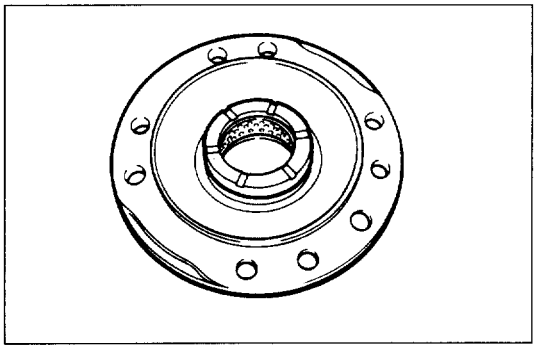


Spindle

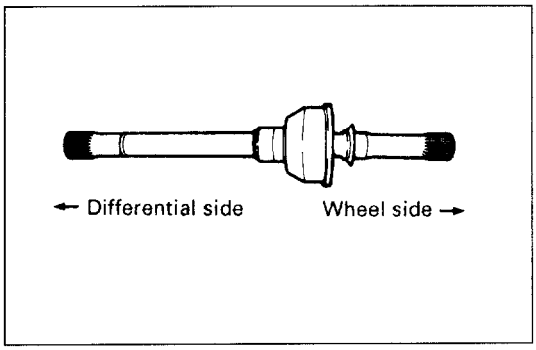
1. Inspect the whole of the spindle for crack, wear or damage.

   Replace the spindle if any abnormal condition is noticeable.

   Use a visible dye-penetrant flaw detection method or a magnetic flaw detector.

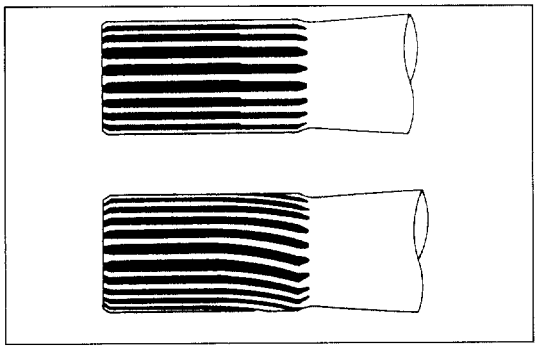


2. Inspect the front axle shaft thrust washer or bushing for wear and damage.



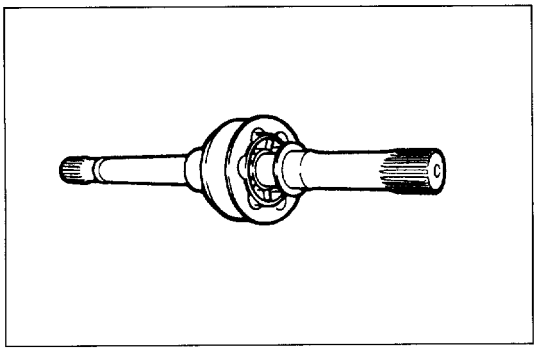
Front Drive Shaft Assembly

1. Inspect the front drive shaft for bending or distortion

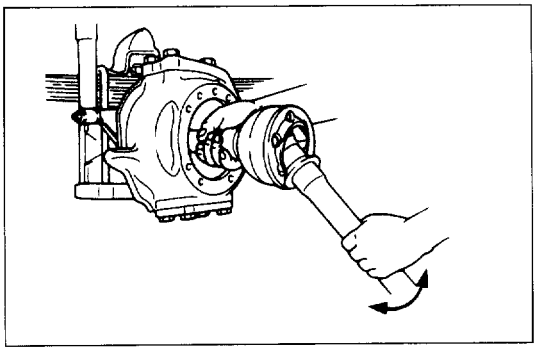


2. Inspect the front drive shaft spline for wear or distortion.

   Replace the front drive shaft assembly if wear or distortion is found.

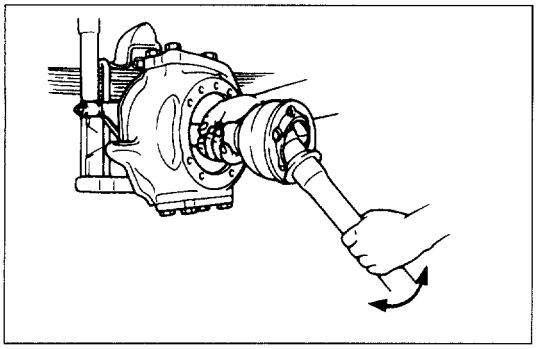


3. Inspect the stopper contact face (on the spindle s side) for wear or damage.



4. Moving the front drive shaft joint as shown, inspect for smooth operation or presence of excessive play.

   Replace the front drive shaft assembly if it does not move smoothly or there is excessive play.



INSTALLATION

6. Front Drive Shaft Assembly

(1) Apply the MoS2 contained type grease into the universal joint.

Grease Amont	g(oz)
94–106(3.3–3.7)	

(2) Install the front drive shaft assembly into the front axle case.

During installation, take care not to damage the oil seal lip on the front axle case side.

To install, bend the front drive shaft as shown, and moving the shaft a little to the left or right, push it into the spline on the differential side gear.

5. Spindle

(1) Apply MoS2 contained type grease to the surfaces of the thrust washer and bushing of spindle.

(2) Apply adhesive (LOCTITE 515 or equivalent) to the spindle flange, and install the spindle to the knuckle. At this time, a bolt hole of the spindle should be met with that of knuckle.

4. Front Brake Assembly

(1) Install the front oil shield cover with a cut in outer surface facing inside.

(2) Apply adhesive (LOCTITE 242 or equivalent) to the threads of fixing bolts and tighten them to the specified torque.

Front Brake Assembly Fixing Bolt Torque	N•m(kg•m/lb•ft)
98 (10/72)	

3. Front Axle Hub, Brake Drum and Related Parts

Refer to "FRONT HUB and BRAKE DRUM (4 × 4 Model)"previously in this section.

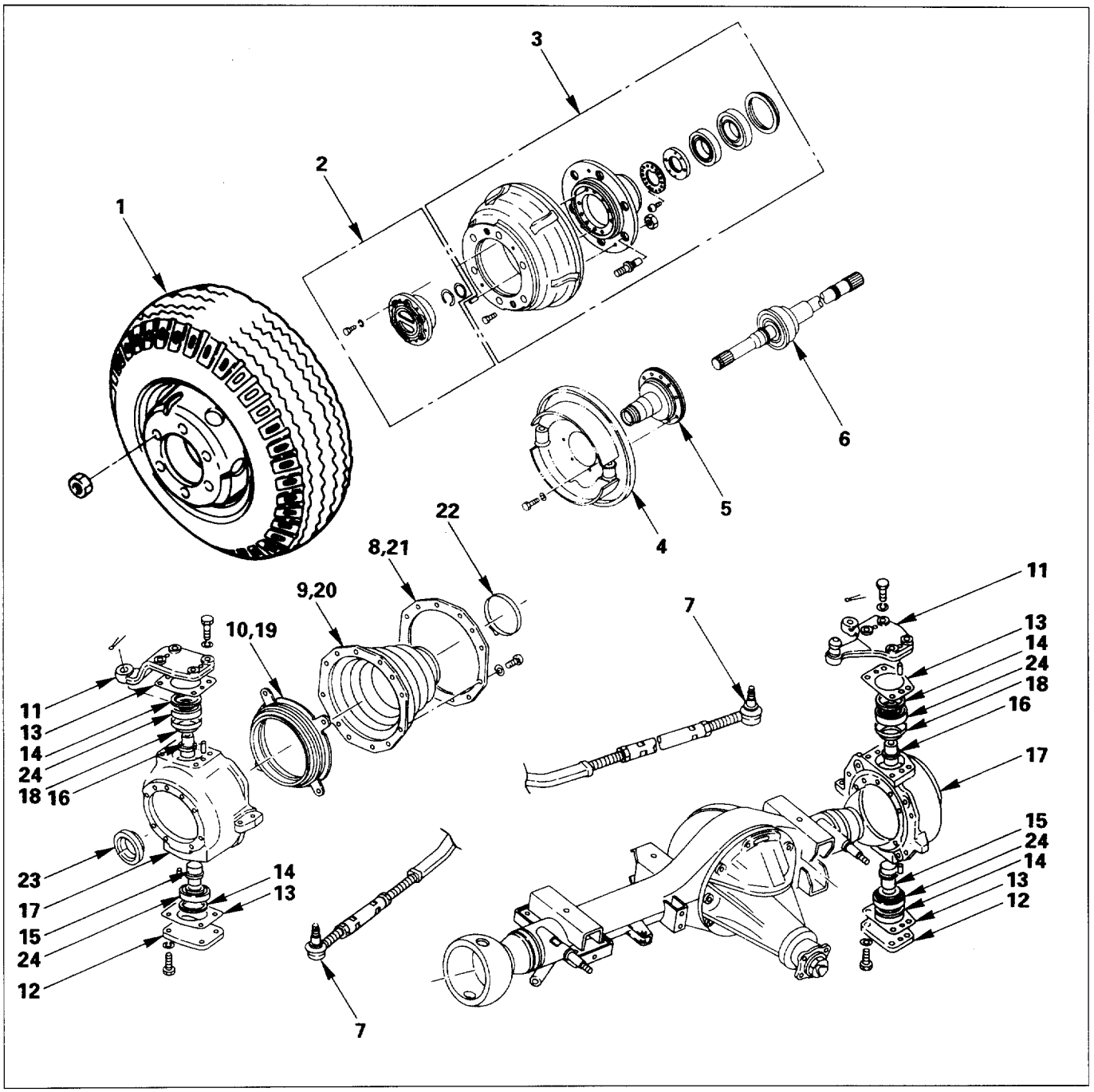
2. Front Locking Hub Set

Refer to "FREE WHEEL HUB" previously in this section.

1. Wheel and Tire

MEMO

KNUCKLE AND KING PIN (4 × 4 Model)



Removal Steps

1. Wheel and tire
2. Front locking hub set
3. Front axle hub, brake drum and relative parts
4. Front brake assembly
5. Spindle
6. Front drive shaft assembly
7. Tie rod end
8. Front axle tube end boot holder
9. Front axle tube end boot
10. Knuckle oil seal
11. Knuckle arm and tie rod arm
12. King pin cover
13. King pin bearing shim
14. Bearing distance collar
15. Front axle lower king pin
16. Front axle upper king pin
17. Front axle knuckle
18. King pin receiver
19. Knuckle oil seal
20. Front axle tube end boot
21. Front axle tube end boot holder
22. Front axle tube end boot band
23. Front axle shaft oil seal
24. King pin bearing

Installation Steps

23. Front axle shaft oil seal
21. Front axle tube end boot holder
20. Front axle tube end boot
19. Knuckle oil seal
22. Front axle tube end boot band
16. Front axle upper king pin
15. Front axle lower king pin
18. King pin receiver
24. King pin bearing
17. Front axle knuckle
14. Bearing distance collar
13. King pin bearing shim
12. King pin cover
11. Knuckle arm and tie rod arm
10. Knuckle oil seal
9. Front axle tube end boot
8. Front axle tube end boot holder
7. Tie rod end
6. Front drive shaft assembly
5. Spindle
4. Front brake assembly
3. Front axle hub, brake drum and relative parts
2. Front locking hub set
1. Wheel and tire

REMOVAL

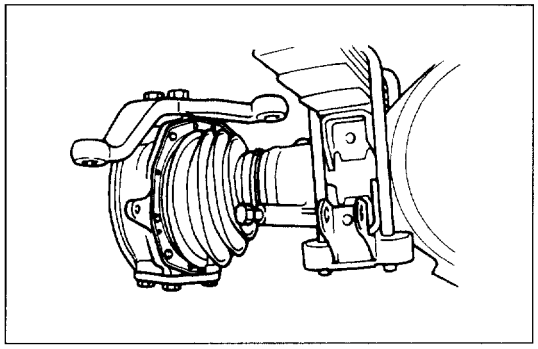
Preparation:

Jack up and support the vehicle on the stands.

1. **Wheel and Tire**
2. **Front Locking Hub Set**

   Refer to "FREE WHEEL HUB" previously in this section.
3. **Front Axle Hub, Brake Drum and Relative Parts**

   Refer to "FRONT HUB and BRAKE DRUM (4 × 4 Model)"previously in this section.
4. **Front Brake Assembly**
5. **Spindle**
6. **Front Drive Shaft Assembly**
7. **Tie Rod End**

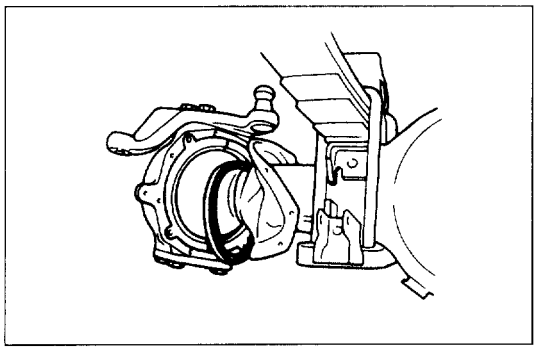


8. **Front Axle Tube End Boot Holder**

   Remove the front axle tube end boot holder at the back of knuckle. (The front axle tube end boot holder is divided into two pieces in horizontal directions.)

9. **Front Axle Tube End Boot**

   Remove the front axle tube end boot fixing bolts, and peel and shift the boot toward the differential.

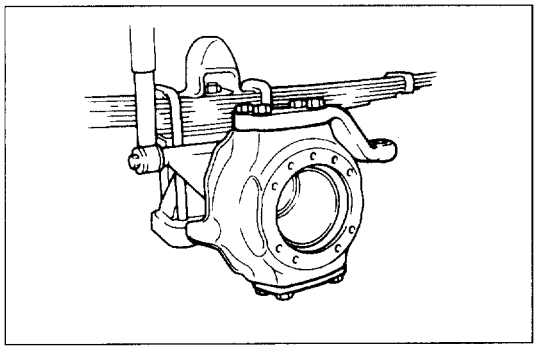


10. **Knuckle Oil Seal**

    (1) Remove the outer side of oil seal holder. (The oil seal holder outer is divided into two pieces in vertical direction.)

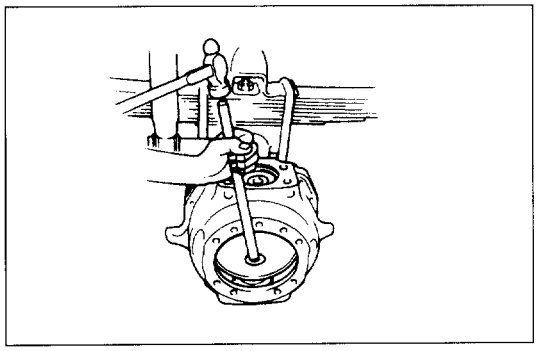
    (2) Shift the oil seal toward the front axle tube end boot (on Differential side).

    (3) Remove the inner side of oil seal holder. (The oil seal holder inner is divided into two pieces in horizontal direction.)



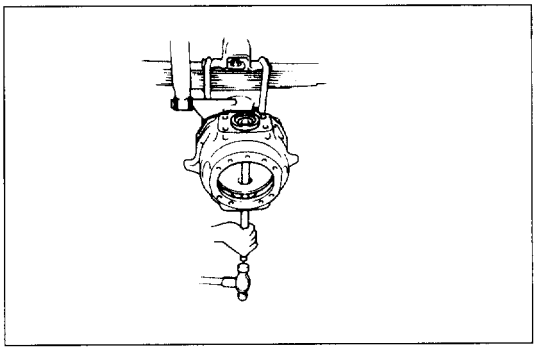
11. **Knuckle Arm and Tie Rod Arm**
12. **King Pin Cover**
13. **King Pin Bearing Shim**

    Confirm the quantity of shims and components when removing the knuckle arm, tie rod arm and king pin cover.



14. **Bearing Distance Collar**
15. **Front Axle Lower King Pin**

    Attach a bar to the center recess of king pin from tube end (spherical part) of front axle case, and hit with a hammer to remove the king pin downward.



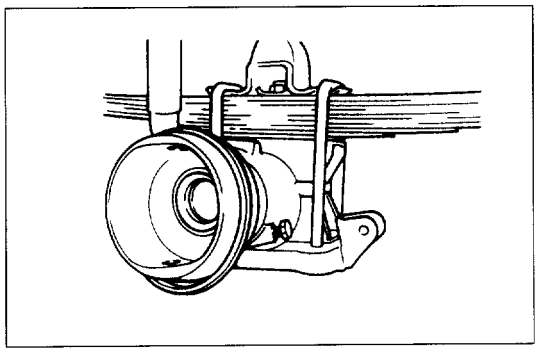
16. Front Axle Upper King Pin

17. Front Axle Knuckle

(1) From under the knuckle, hit a bar attached to the upper king pin to remove the outer race of king pin bearing first.

(2) At this time, support the knuckle with both hands and raise it to remove to your side.

(3) Again hit the king pin to remove.



18. King Pin Receiver

19. Knuckle Oil Seal

Remove the oil seal from the front axle case.

At this time, make sure the direction of oil seal.

20. Front Axle Tube End Boot

21. Front Axle Tube End Boot Holder

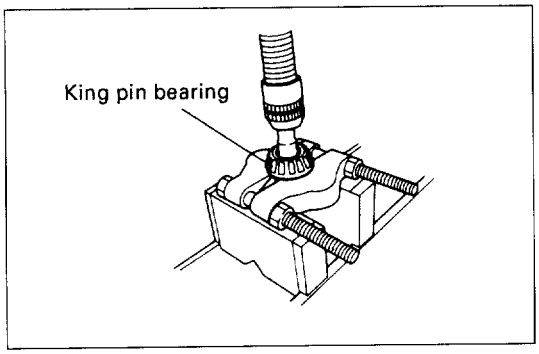
22. Front Axle Tube End Boot Band

Loosen and remove the tube end boot band.

Avoid frequent removal of tube end boot band except when it is to be replaced or removal is necessary for servicing.

23. Front Axle Shaft Oil Seal

The oil seal must not be reused.



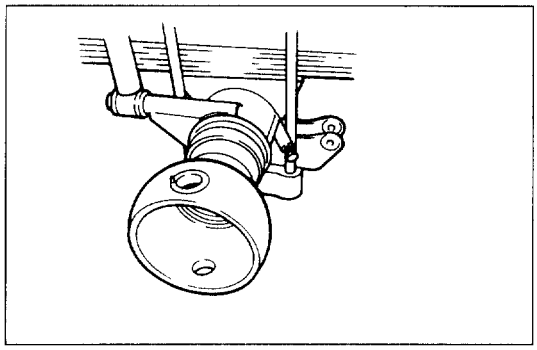
24. King Pin Bearing

Remove the bearing with a press.

Some components are different between upper and lower king pin bearings, and do not confuse them.

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.

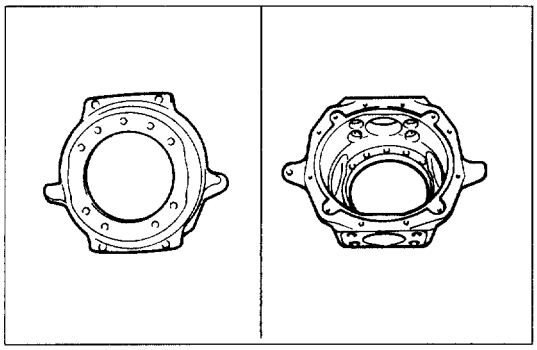


Front Axle Tube End

Inspect the front axle case tube end sphere for crack, wear, damage or rust. Slight rust of sphere should be polished with a sand paper.

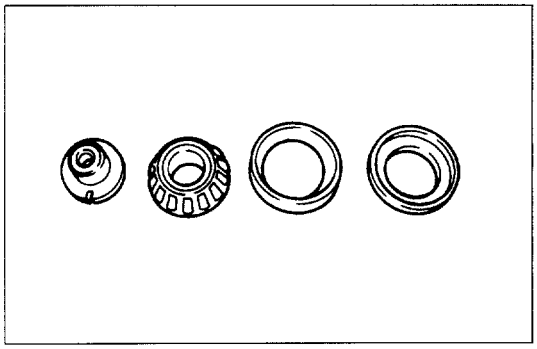
To check the tube end sphere for crack, use a red-check or a magnetic flaw detector.

If a crack is found, replace the front axle case assembly.



Front Axle Knuckle

Inspect the whole of the knuckle for cracks, wear or damage using a magnetic flaw detector or red-check. Replace the the knuckle if any abnormal condition is noticeable.



King Pin

Inspect the king pin for cracks.

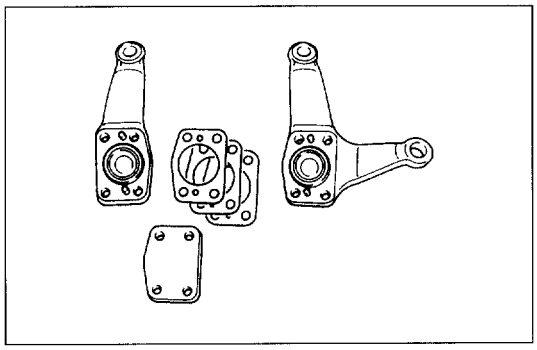
Use a magnetic flaw detector or red-check.

Replace king pin, if any cracks are found.

King Pin Bearing

Inspect the bearing for wear, seizure, damage and rough rotation.

Replace any flawed or damaged bearing.



Knuckle Arm

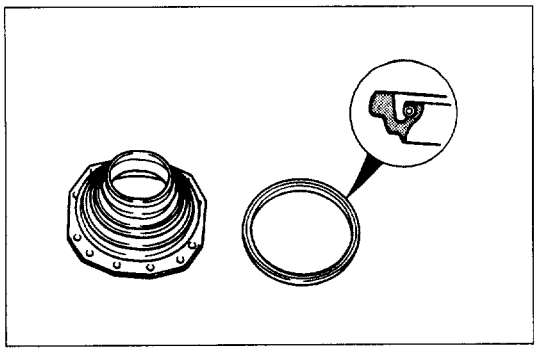
Tie Rod Arm

King Pin Cover

Inspect the knuckle arm, tie rod arm and king pin cover for cracks, damage or wear.

Replace the these parts if any abnormal condition is noticeable.

To check the arm for crack, use a visible dye-penetrant flaw detection method or a magnetic flaw detector. Replace the arm if a crack is found.

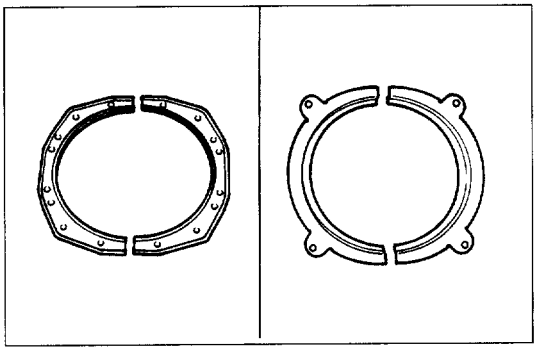


Front Axle Tube End Boot

Inspect the front axle tube end boot and replace if broken. It should be replaced if even one hole or crack is found.

Oil Seal

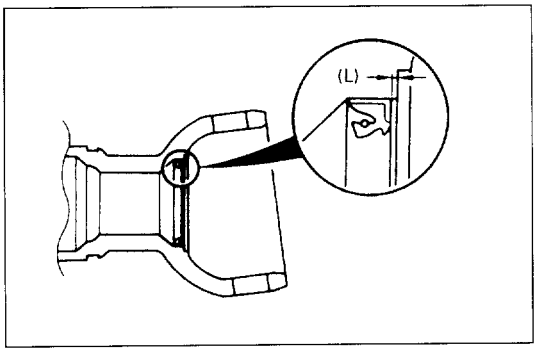
Inspect the oil seal, and replace it if its lip is damaged, worn or hardened.



Front Axle Tube End Boot Holder, Oil Seal Holder

Inspect the oil seal holder and front axle tube end boot holder, and replace if excessive deformation or rust is found.

INSTALLATION



23. Front Axle Shaft Oil Seal

(1) Drive in the oil seal to the dimension shown to the left. Take care not to damage the oil seal lip.

(2) Apply grease (Multipurpose type) to the oil seal lip.

Oil Seal Drive in Depth (L)	mm(in.)
0–0.5 (0–0.020)	

21. Front Axle Tube End Boot Holder

20. Front Axle Tube End Boot

(1) Apply gear oil GL-5 grade (SAE90) to the entire surface of front axle tube end sphere.

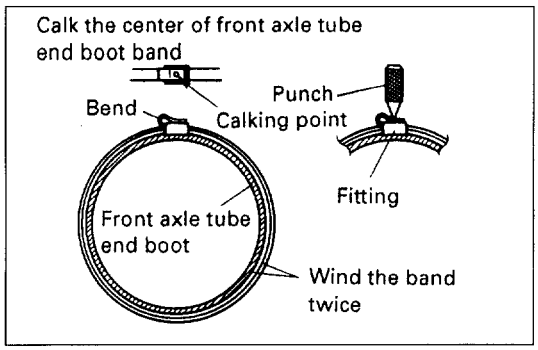
(2) Warm the front axle tube end boot to 70–80°C with hot water.

(3) Reverse the front axle tube end boot, and install into the front axle case. During this work, do not touch the front axle tube end boot by bear hand because it is too hot.

(4) After installation in the front axle case, remove the moisture immediately.

(5) Return the front axle tube end boot to original form, and insert the leading end of boot into the front axle tube end boot groove of the front axle case.

19. Knuckle Oil Seal



22. Front Axle Tube End Boot Band

(1) Fix the boot with front axle tube end boot band. Wind the front axle tube end boot band twice and tighten it up to eliminate looseness.

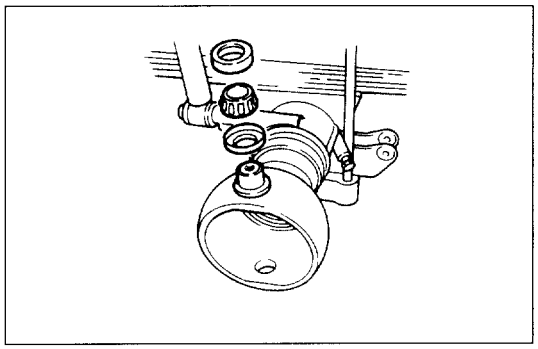
(2) Then, calk the center of fitting on the front axle tube end boot band with a punch.

(3) Turn back the front axle tube end boot band at the fitting, and again calk the center of front axle tube end boot band.

(4) Cut the front axle tube end boot band at the end face of fitting.

Install the oil seal to the front axle. (Apply Multipurpose type grease, to the entire surface of oil seal, and install it with care not to damage the oil seal lip.

In installing the oil seal, position the spring side on the differential side.)



16. Front Axle Upper King Pin

15. Front Axle Lower King Pin

(1) Seal multi-purpose grease NLGI No.2 in the king pin bearing.

(2) Install only the king pins (both upper and lower) in the front axle case.

(3) Align the locking groove of the king pin with the locking pin on the front axle tube end surface, and then drive in the king pin.

18. King Pin Receiver

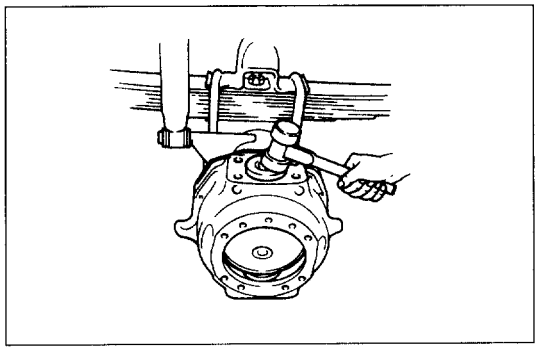
24. King Pin Bearing

Install the king pin bearing to the king pin. For the upper side, install the receiver, king pin bearing in this order.

17. Front Axle Knuckle

(1) Install the knuckle to the front axle. (Holding the knuckle with both hands, align the upper hole of knuckle to the upper king pin bearing and lower it slowly while passing the lower king pin bearing.)

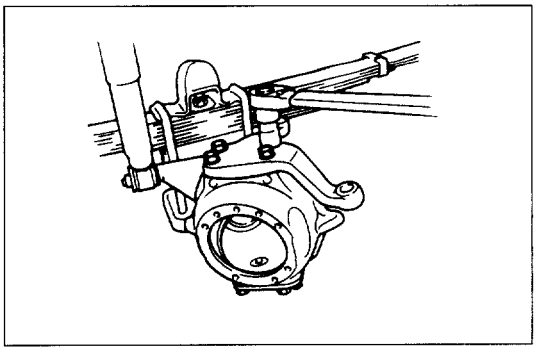
(2) Install upper and lower king pin bearing outer races. (Fit the king pin bearing outer race completely with the knuckle, and hit lightly the outer race until it gets stuck.)



14. Bearing Distance Collar

13. King Pin Bearing Shim

12. King Pin Cover



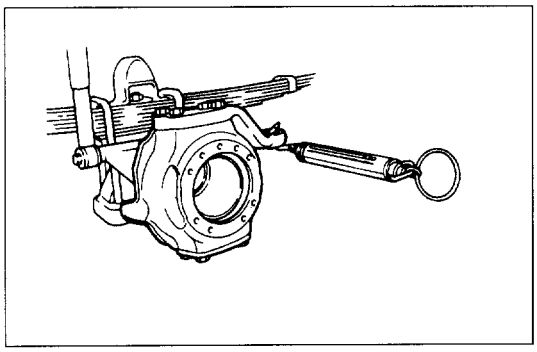
11. Knuckle Arm and Tie Rod Arm

(1) Install the knuckle arm (or tie rod arm) and the king pin cover. (Install the distance collar and shim in this order. Then, install knuckle arm (or tie rod arm) and the king pin cover and fix provisionally with bolts. Use the number of shims that were removed previously, and tighten the bolts lightly. At this time, do not apply LOCTITE to the shims, arms and king pin cover yet.

(2) Tighten the bolts on knuckle arm (or tie rod arm) and king pin cover to the specified torque while turning the knuckle to the left and right several times to run-in the king pin bearing.

Knuckle Arm, Tie Rod Arm and King Pin Cover Bolt Torque	N•m(kg•m/lb•ft)
	147 (15/108)

<Adjustment of Front Axle Knuckle Preload>



(1) Hook a spring balance to the edge of knuckle arm (or tie rod arm), and pull it in tangential direction to check if the spring balance reading at the start of movement is within the standard range.

(Measure preload in tangential direction.)

Front Axle Knuckle Preload	N(kg/lb)
	3.1–5.5(6.8–12.1/30.4–53.9)

(2) If it does not satisfy the standard, adjust with shims.

Shim Thickness Available	mm(in.)
	0.3(0.01)

(3) After adjustment, measure the preload again.

<Tighten completely the knuckle arm (or tie rod arm) and king pin cover>

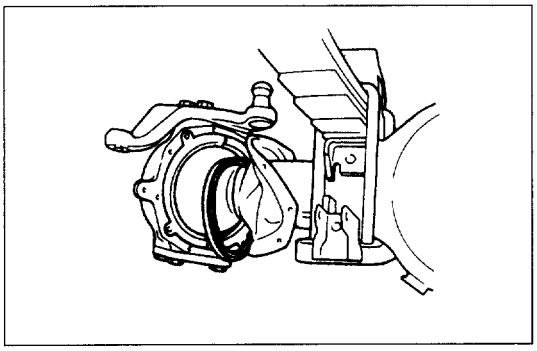
(1) Remove each arm and king pin cover once, and apply adhesive (LOCTITE 515 or equivalent) to the shims, each arm and king pin cover evenly.

(2) Tighten fixing bolts to the specified torque.

Knuckle Arm, Tie Rod Arm and King Pin Cover Bolt Torque	N•m(kg•m/lb•ft)
	147 (15/108)

(3) Reconfirm the preload.

If it is out of standard, readjust by repeating the above steps.



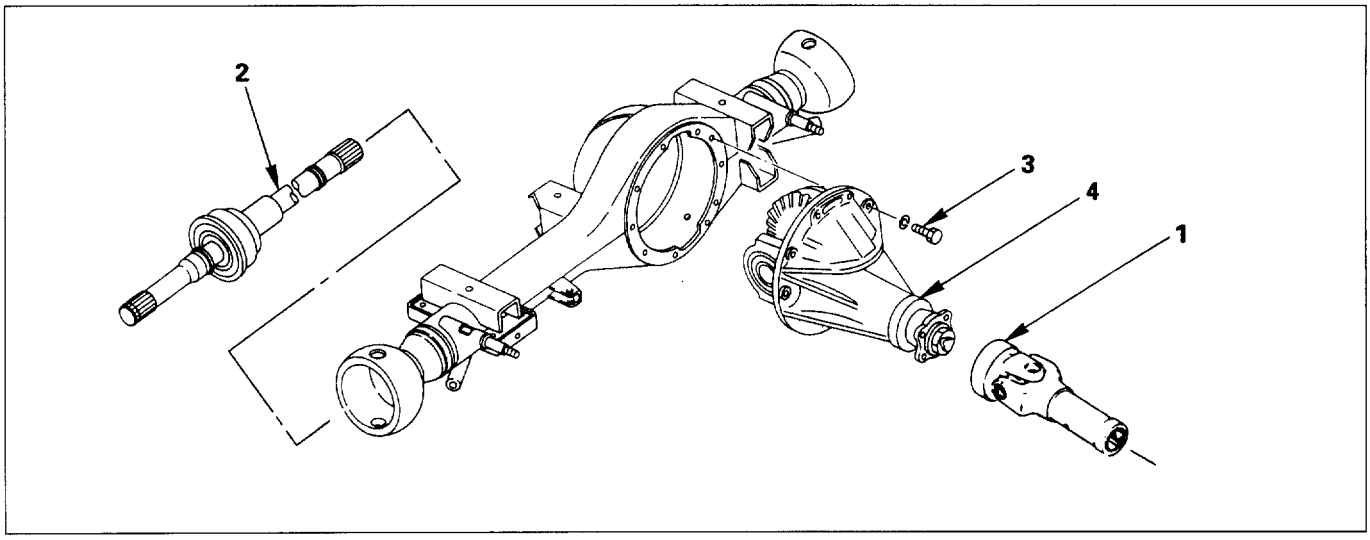
10. **Knuckle Oil Seal**
    (1) Install the inner oil seal holder to the knuckle.
    Install the inner oil seal holder in longitudinal direction.
    (2) Install the oil seal, then the outer oil seal holder.
    Install the outer oil seal holder in vertical direction (a mating face should be shifted 90° against the inner holder).

9. **Front Axle Tube End Boot**
8. **Front Axle Tube End Boot Holder**
    Install the front axle tube end boot, and tighten bolts to the specified torque via the front axle tube end boot holder.
    Install the front axle tube end boot holder in longitudinal direction.

Front Axle Tube End Boot Holder Bolt Torque	N•m(kg•m/lb•ft)
	6 (0.6/52)

7. **Tie Rod End**
6. **Front Drive Shaft Assembly**
5. **Spindle**
4. **Front Brake Assembly**
3. **Front Axle Hub, Brake Drum and Relative Parts**
    Refer to "FRONT HUB and BRAKE DRUM (4 × 4 Model)" previously in this section.
2. **Front Locking Hub Set**
    Refer to "FREE WHEEL HUB" previously in this section.
1. **Wheel and Tire**

FRONT DIFFERENTIAL ASSEMBLY (4 × 4 Model)



Removal Steps

1. Propeller shaft assembly
2. Front drive shaft assembly
3. Front axle case bolt
4. Front differential assembly

Installation Steps

To install, follow the removal steps in the reverse order.

REMOVAL

Support the front axle with a suitable jack and chassis stands.

Drain the front axle case by removing the drain plug on the lower part of the front axle case.

1. **Propeller Shaft Assembly**

   Remove the propeller shaft assembly.

2. **Front Drive Shaft Assembly**

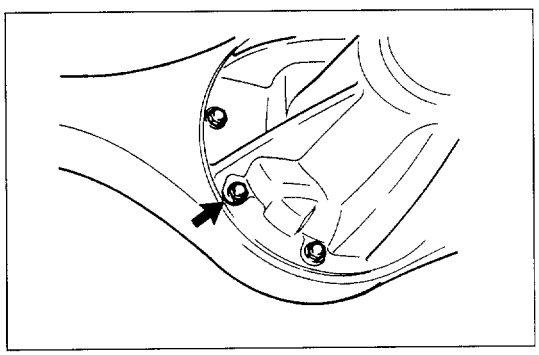
   Refer to "Spindle and Drive Shaft" previously in this secton.

3. **Front Axle Case Bolt**

   Put jack under the center of front axle then remove the front axle case bolts.

4. **Front Differential Assembly**

   Remove the front differential assembly from the front axle case.



INSTALLATION

4. Front Differential Assembly

Clean the faces of the front axle case and the final drive carrier.

Apply the recommended liquid gasket (Three Bond 1215 or its equivalent) to the sealing side of the front axle case and the final drive carrier.

3. Front Axle Case Bolt

Attach the front final drive assembly to the front axle case and tighten the bolts.

Front Axle Case Bolt Torque	N•m(kg•m/lb•ft)
67 (6.8/49)	

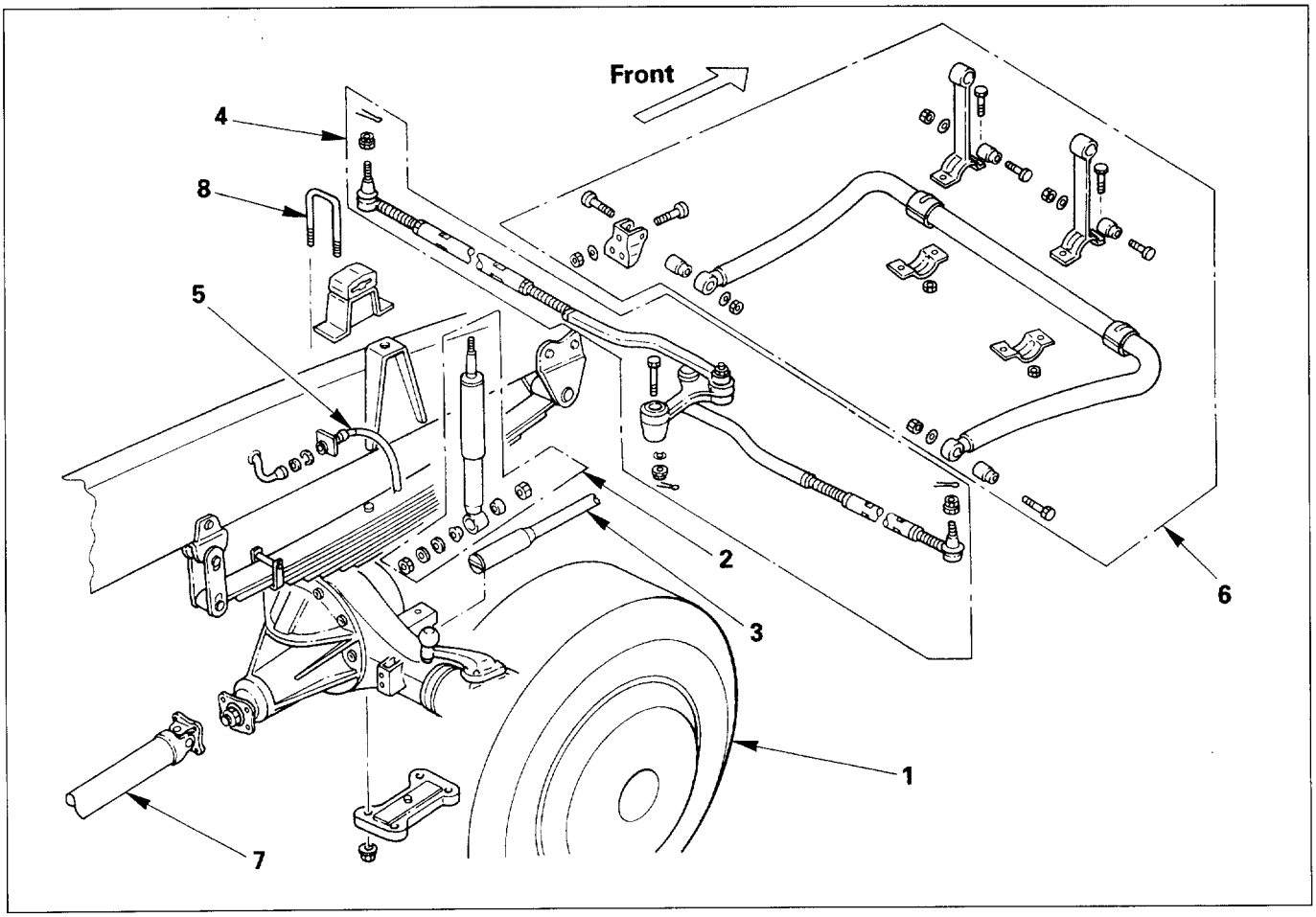
2. Front Drive Shaft Assembly

1. Propeller Shaft Assembly

Fill the axle case with hypoid gear lubricant to just below the filler hole.

Lubricant capacity	liter(US/Imp gal)
2.7(0.71/0.59)	

FRONT AXLE ASSEMBLY (4 × 4 Model)



Removal Steps

1. Wheel and tire
2. Shock absorber
3. Drag link
4. Tie rod assembly
5. Brake flexible hose
6. Stabilizer assembly
7. Front propeller shaft
8. Leaf spring U-bolt
9. Front axle assembly

Installation Steps

To install, follow the removal steps in the reverse order.

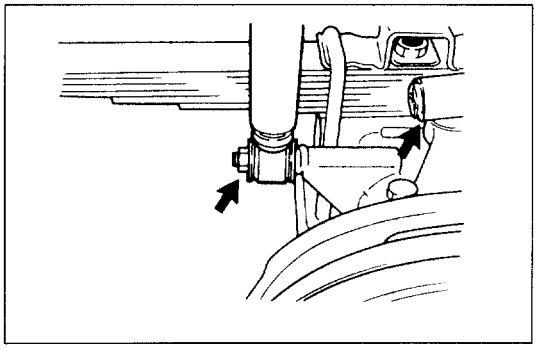
REMOVAL

Preparation:

Jack up and support the vehicle on stands.

1. **Wheel and Tire**
2. **Shock Absorber**

   Remove lower side of shock absorber.

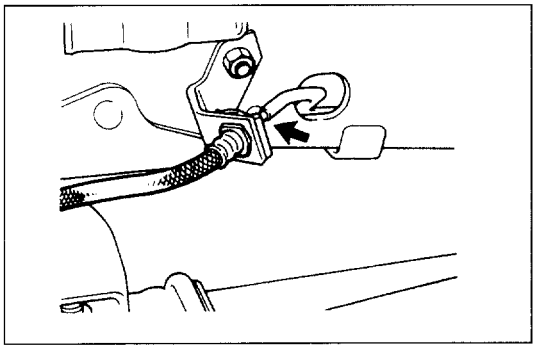


3. **Drag Link**

   Remove the drag link (on the knuckle arm side).
4. **Tie Rod Assembly**

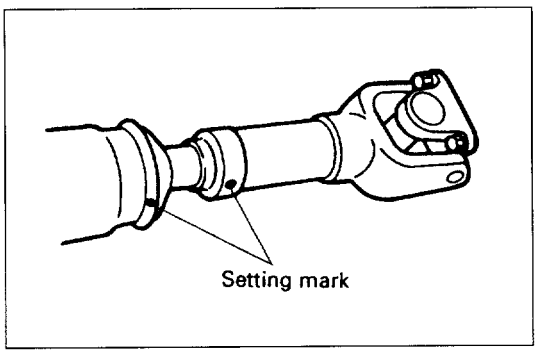
   Remove the tie rod assembly (with relay lever attached). Refer to STEERING LINKAGE (4 x 4 Model) in section 3B.
5. **Brake Flexible Hose**

   Remove a clip on the brake hose bracket.
   After the hose is disconnected, prevent brake fluid running out and invasion of foreign matters.



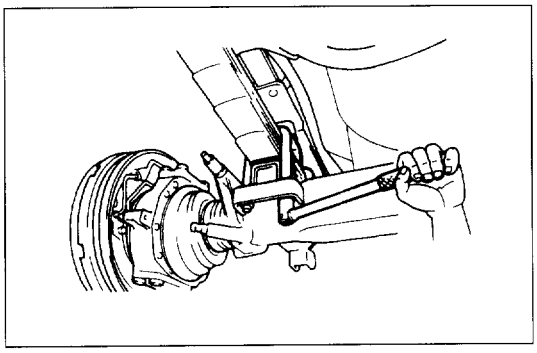
6. **Stabilizer Assembly**

   Refer to STABILIZER in section 3C.



7. Front Propeller Shaft

Draw setting marks on the front and rear flanges. Also, draw setting marks as shown to the left if the propeller shaft is removed at the spline yoke.



8. Leaf Spring U-Bolt

(1) Put jack under the center part of front axle then remove the U-bolts.

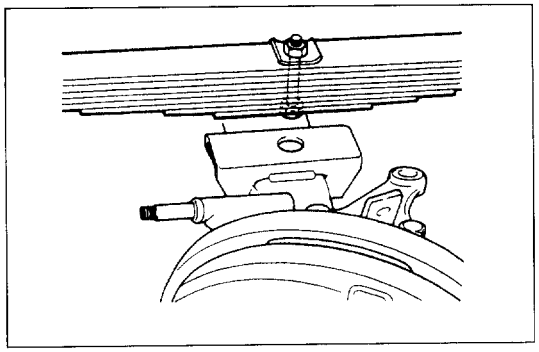
(2) Lower the front axle assembly and roll out toward the front of vehicle.

Use care so as not to cause damage to brake hose, back plate and front axle tube end boot.

9. Front Axle Assembly

INSTALLATION

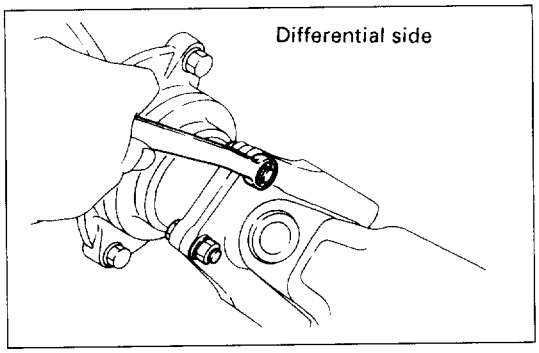
9. Front Axle Assembly



8. Leaf Spring U-Bolt

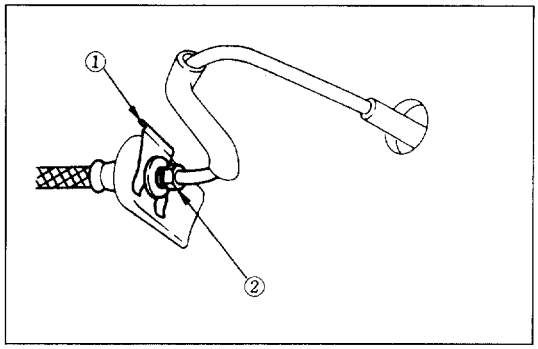
Align a hole in the center of spring seat in the front axle case with the center bolt of leaf spring, and tighten the leaf spring U-bolt.

U-Bolt Nut Torque	N•m(kg•m/lb•ft)
126 (12.9/93)	



7. Front Propeller Shaft

Front Propeller Shaft Bolt Torque	N•m(kg•m/lb•ft)
103 (10.5/76)	



6. Stabilizer Assembly

Refer to STABILIZER in section 3C.

5. Brake Flexible Hose

Set first the wheels in the straight going position, then attach the flexible hose to the bracket without torsion using a clip ①.

Connect the pipe, then tighten the nut ② to the specified torque.

Brake Flexible Nut Torque	N•m(kg•m/lb•ft)
	16 (1.6/12)

Refer to Section 5 "Service information" for brake fluid air bleeding procedure.

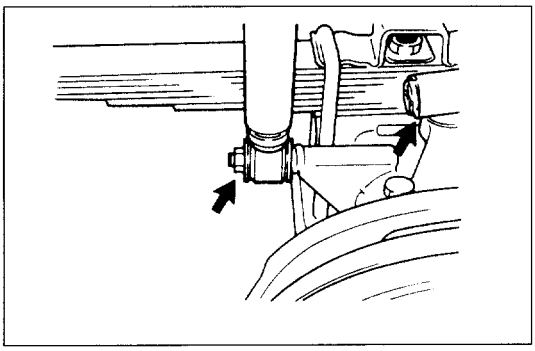
Perform bleeding operation after installation of the brake flexible hoses.

4. Tie Rod Assembly

Refer to STEERING LINKAGE (4 x 4 Model) in section 3B.

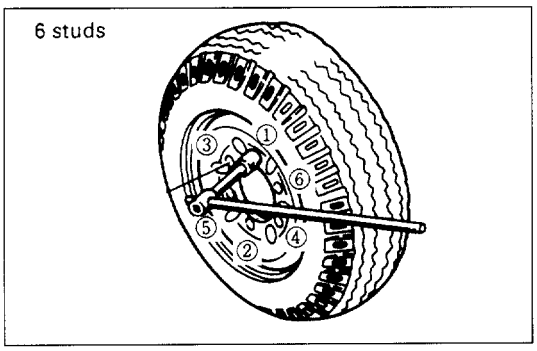
3. Drag Link

Refer to STEERING LINKAGE (4 x 4 Model) in section 3B.



2. Shock Absorber

Shock Absorber under Side Nut Torque	N•m(kg•m/lb•ft)
	95 (9.7/70)



1. Wheel and Tire

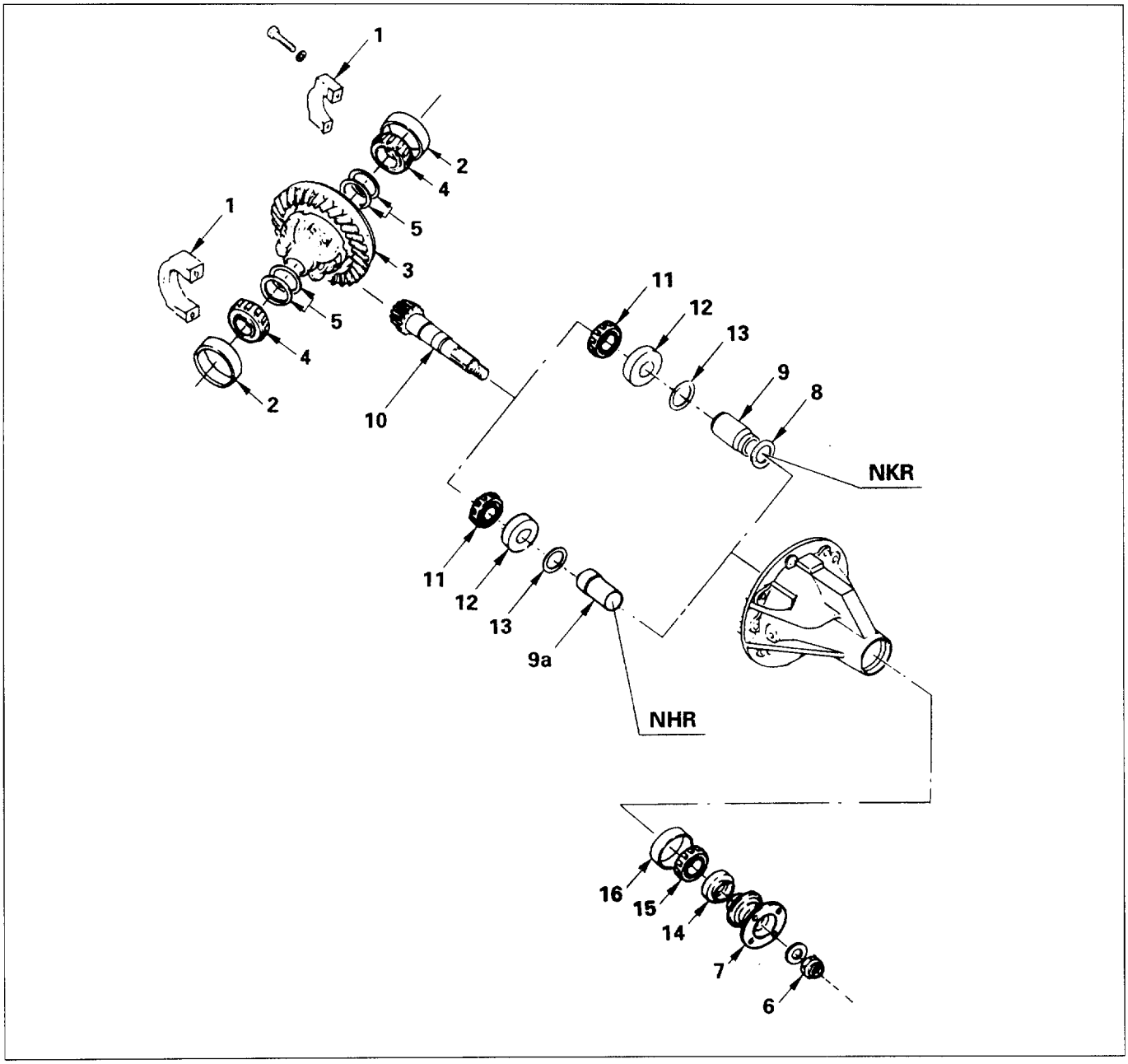
Wheel Nut Torque	N•m(kg•m/lb•ft)
	441 (45/325)

MEMO

UNIT REPAIR

244 MM FRONT DIFFERENTIAL

Major Components



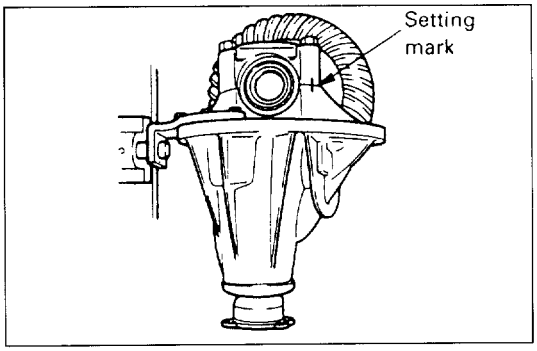
Disassembly Steps

1. Bearing cap
2. Side bearing outer race
3. Differential cage assembly
4. Side bearing inner race
5. Backlash and preload adjusting shim
6. Flange nut
7. Flange
8. Bearing preload adjusting shim
9. Distance piece
10. Drive pinion
11. Inner bearing inner race
12. Inner bearing outer race
13. Pinion depth adjusting shim
14. Oil seal
15. Outer bearing inner race
16. Outer bearing outer race

Reassembly Steps

16. Outer bearing outer race
13. Pinion depth adjusting shim
12. Inner bearing outer race
11. Inner bearing inner race
15. Outer bearing inner race
14. Oil seal
10. Drive pinion
9. Distance piece
8. Bearing preload adjusting shim
7. Flange
6. Flange nut
5. Backlash and preload adjusting shim
4. Side bearing inner race
3. Differential cage assembly
2. Side bearing outer race
1. Bearing cap

DISASSEMBLY

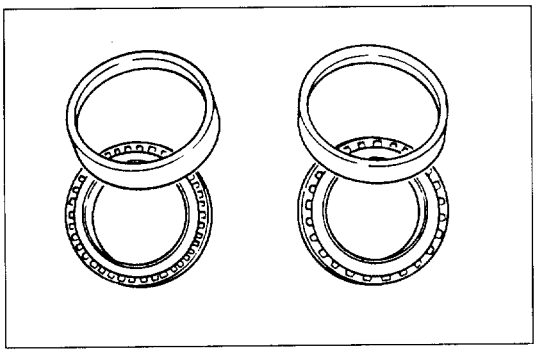


1. Bearing Cap

Set the differential assembly onto a special fixture. Apply a setting mark to the side bearing cap and differential carrier.

Fixture : 5-8840-2029-0

Base : 5-8840-0003-0



2. Side Bearing Outer Race

After removal, keep right and left side bearing assemblies separate to maintain inner and outer race combinations.

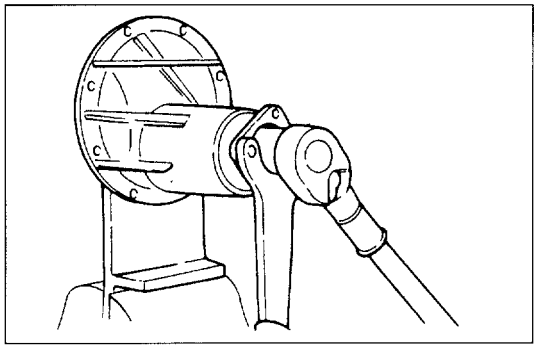
3. Differential Cage Assembly

4. Side Bearing Inner Race

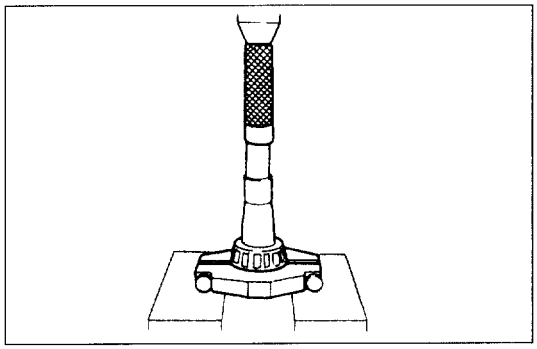
Remover : 9-8521-0061-0

Adapter : 5-8840-2031-0

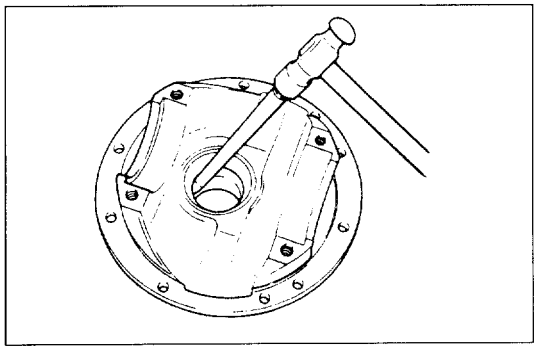
5. Backlash and Preload Adjusting Shim



6. **Flange Nut**
   Holding wrench : 9-8511-1507-0
7. **Flange**
8. **Bearing Preload Adjust Shim**
9. **Distance Piece**
10. **Drive Pinion**



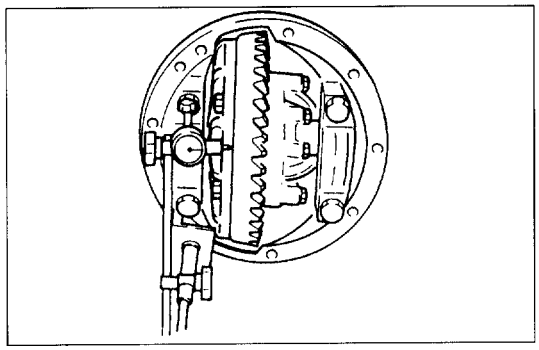
11. **Inner Bearing Inner Race**
    Remover : 5-8840-0015-0



12. **Inner Bearing Outer Race**
13. **Pinion Depth Adjusting Shim**
14. **Oil Seal**
15. **Outer Bearing Inner Race**
16. **Outer Bearing Outer Race**

    Drive out the inner bearing outer race or the outer bearing outer race together with the outer bearing inner race and oil seal by using a proper bar through two notches.

REASSEMBLY



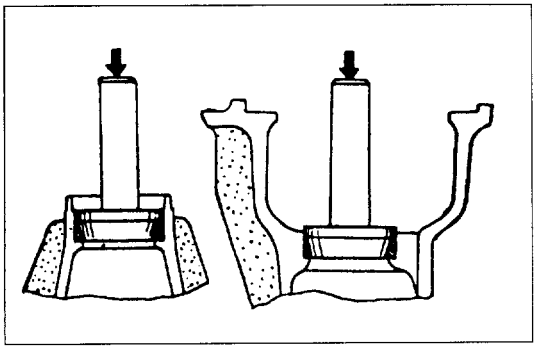
Measurement of ring gear run-out.

Install dummy bearing into the differential assembly, then install these parts in the differential carrier. Install and tighten the bearing cap.

Dummy bearing : 9-8522-1137-0

Bearing Cap Bolt Torque	N•m(kg•m/lb•ft)
108 (11.0/80)	

Ring Gear Run-Out	mm(in.)
Standard	Limit
0.05 (0.002)	0.2 (0.008)



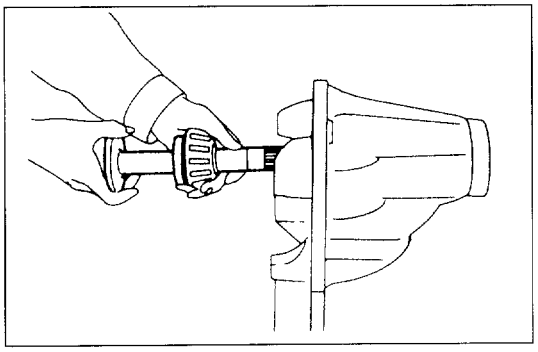
16. **Outer Bearing Outer Race**
13. **Pinion Depth Adjusting Shim**
12. **Inner Bearing Outer Races**

Adjustment of drive pinion engagement depth.

Install the inner and outer bearing outer races without shims into the differential carrier using a bench press.

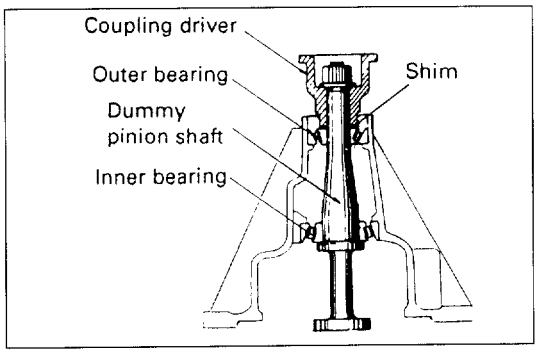
Installer (Inner) : 9-8522-1196-0
(Outer) : 9-8522-1197-0

Grip : 9-8522-1148-0



Assemble the inner bearing inner race to the dummy pinion shaft, then install these parts into the carrier.

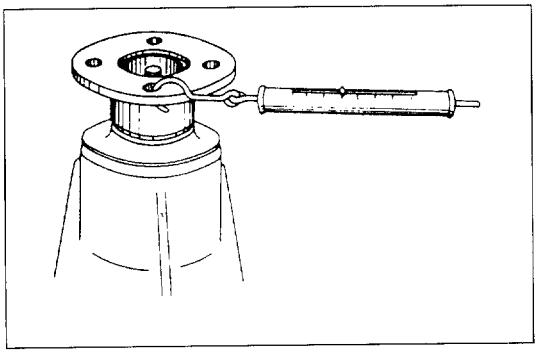
Dummy Pinion Shaft : 9-8522-1603-0



Install the outer bearing inner race flange, washer and dummy nut.

Lubricate the bearing before tighten the dummy nut.

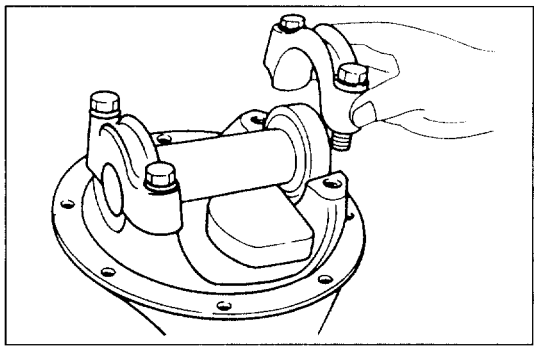
Dummy Nut : 9-8522-1624-0



Tighten the dummy nut until specified preload are required to rotate the bearing.

Bearing Preload	N(kg/lb)
New bearing	16–29 (1.6–3.0/3.5–6.6)
Used bearing	8–14.5 (0.8–1.5/1.8–3.3)

Bearing Starting Torque	N•m(kg•cm/lb•in)
New bearing	0.69–1.27 (7.0–13.0/6.1–11.3)
Used bearing	0.35–0.64 (3.5–6.5/3.1–5.7)

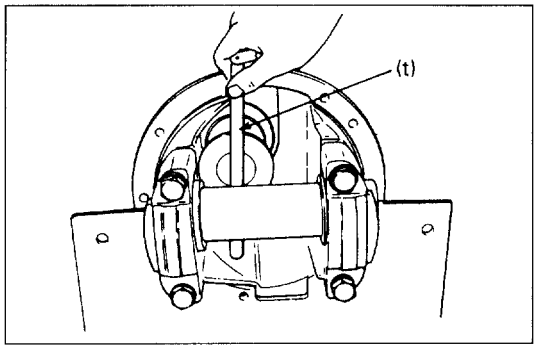


Install dummy bearing on dummy shaft and install these parts into the carrier. Install and tighten the bearing cap.

Dummy Shaft : 9-8522-1138-0

Dummy Bearing : 9-8522-1137-0

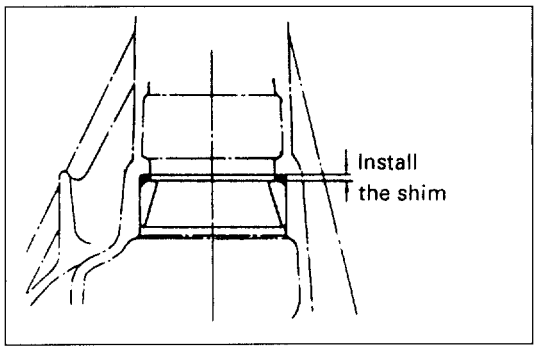
Bearing Cap Bolt Torque	N•m(kg•m/lb•ft)
108 (11.0/80)	



Measure the clearance (t) with a feeler gauge.

The clearance (t) is equal to the shim in thickness.

Thickness of Shim Available	mm(in.)
2.12, 2.16 ... 2.52, 2.56 (0.083, 0.085 ... 0.099, 0.100)	

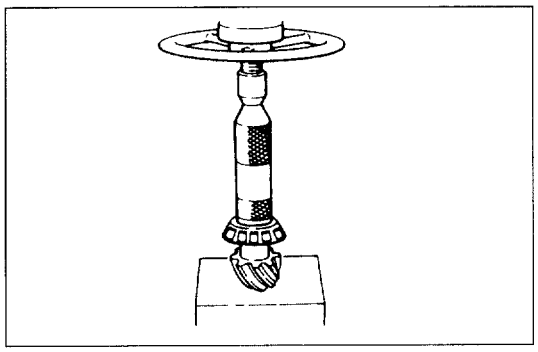


Remove dummy pinion, dummy shaft, dummy bearing and inner bearing outer race.

Install pinion depth adjusting shim of specified thickness in position between the inner bearing outer race and the carrier, then install the inner bearing outer race.

Installer : 9-8522-1196-0

Grip : 9-8522-1148-0

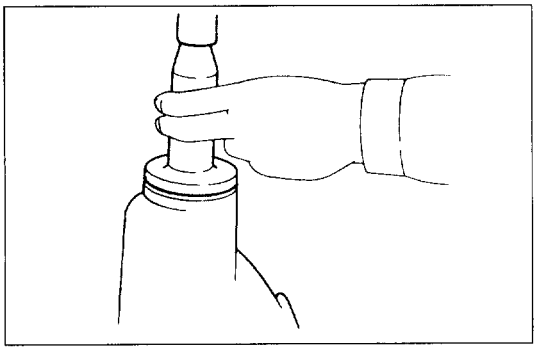


11. Inner Bearing Inner Race

Installer : 9-8522-0018-0

Apply gear oil to the pinion shaft before installing final drive pinion assembly into carrier.

15. Outer Bearing Inner Race

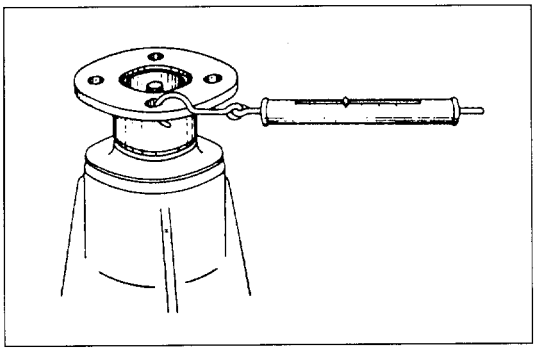


14. Oil Seal

Installer : 5-8840-2047-0

10. Drive Pinion

9. Distance Piece (NKR model)

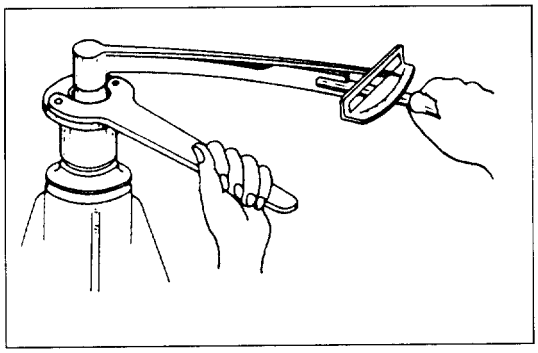


8. Bearing Preload Adjusting Shim

Use a dummy nut until specified bearing preload is obtained.

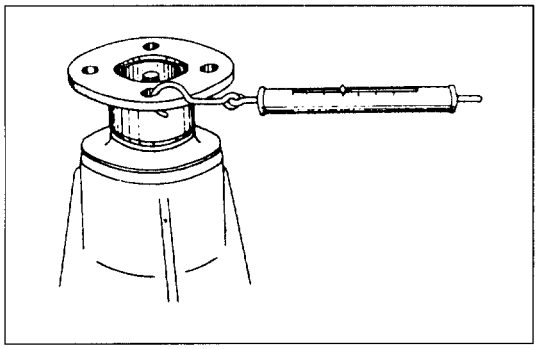
Bearing Preload	N(kg/lb)
New bearing	16–29 (1.6–3.0/3.5–6.6)
Used bearing	8–14.5 (0.8–1.5/1.8–3.3)

Bearing Starting Torque	N•m(kg•cm/lb•in)
New bearing	0.69–1.27 (7.0–13.0/6.1–11.3)
Used bearing	0.35–0.64 (3.5–6.5/3.1–5.7)



Dummy Nut Torque	N•m(kg•m/lb•ft)
270 (27.5/199)	

Thickness of Shim Available	mm(in.)
1.53, 1.56 ... 2.07, 2.10 (0.060, 0.061 ... 0.081, 0.082)	



7. Flange

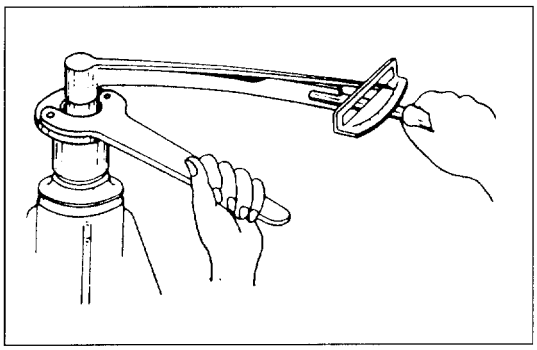
6. Flange Nut

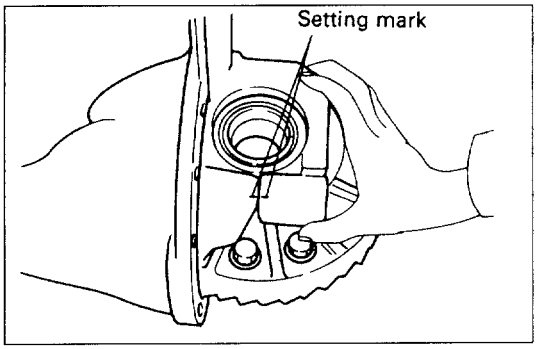
Once specified bearing preload is obtained by dummy nut, remove dummy nut and replace with frange nut.

Tighten the flange nut until specified bearing preload and nut torque.

Using special tool, stake the flange nut at two points.

Punch : 5-8840-2293-0





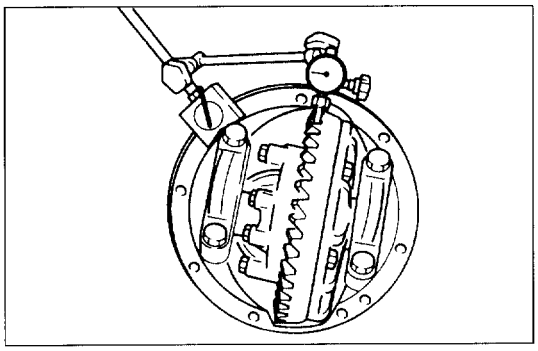
5. Backlash and Preload Adjusting Shim

1) Adjustment of Backlash

- Install dummy bearing in the differential cage assembly, then install differential cage assembly and ring gear into the differential carrier.

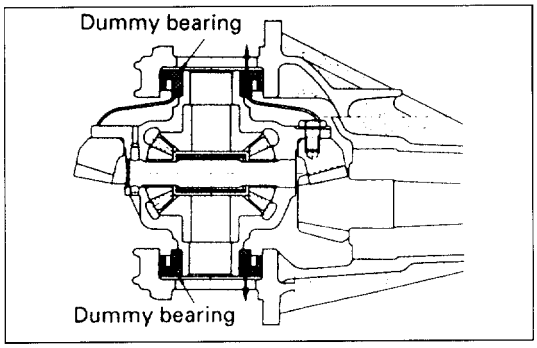
  Install the bearing caps after checking to make certain setting marks applied at disassembly are in alignment.

Bearing Cap Bolt Torque	N•m(kg•m/lb•ft)
108 (11.0/80)	



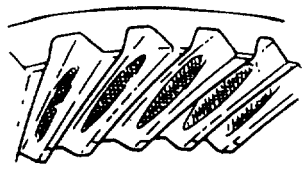
- Set the dial indicator and measure the backlash between the drive pinion and ring gear at the foot portion of the ring gear.

Backlash	mm(in.)
0.15–0.20 (0.006–0.008)	



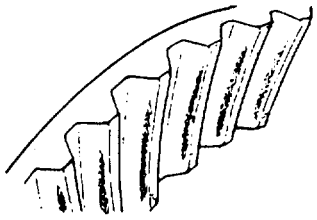
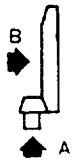
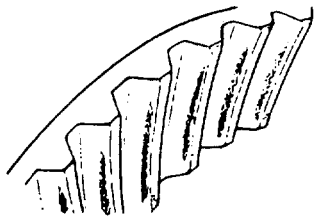
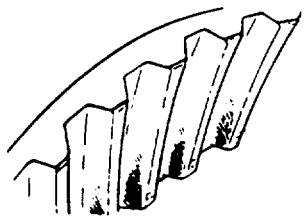
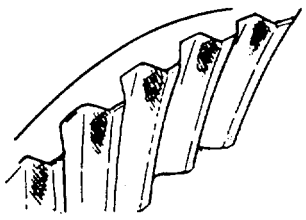
- To adjust backlash, loosen bearing cap bolts slightly and move the dummy bearing as necessary.

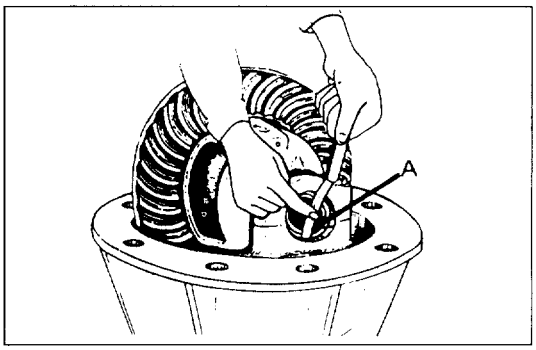
  A clearance should not be provided between dummy bearing and bearing fitting face of the differential cage.

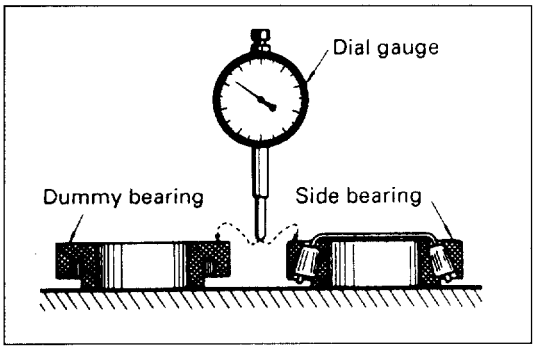

Right contact

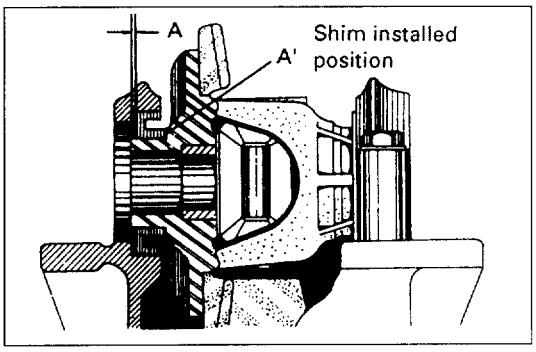
2) Inspection of drive pinion and ring gear tooth contact.

- Apply a thin coat of red check to faces of the 7 - 8 teeth of the ring gear.
- Check the impression of contact obtained on the ring gear teeth and make necessary adjustment as described below if the contact is abnormal.

Tooth Contact	Case	Adjustment Procedure
	Drive pinion is too far away from ring gear.	1. Move the drive pinion in toward the ring gear by decreasing the thickness of pinion depth adjusting shims. 2. Adjust the backlash by moving ring gear away from the drive pinion. 
	Drive pinion is too close to the ring gear.	1. Move the drive pinion away from the ring gear by increasing thickness of pinion depth adjusting shims. 2. Adjust the backlash by moving ring gear in toward the drive pinion.
	Ring gear is too close to the drive pinion.	1. Move the drive pinion in toward the ring gear by decreasing the thickness of pinion depth adjusting shims. 2. Adjust the backlash by moving ring gear away from the drive pinion.
	Ring gear is too for away from drive pinion.	1. Move the drive pinion away from the ring gear by increasing thickness of pinion depth adjusting shims. 2. Adjust the backlash by moving ring gear in toward the drive pinion.







3) Selection of Preload Adjusting Shim

- Measure the clearance between the differential carrier and right and left side (dummy) bearings by using a feeler gauge.

  Carefully note the relationship between the values obtained through measurement at each side and dummy bearings.
- Measure the thickness of dummy bearing and side bearing.

  Comparison should be made between the thicknesses of dummy bearing and side bearing installed in the same position.

  When side bearing is thinner:

  A + (dummy bearing thickness – side bearing thickness) = (X)

  When side bearing is thicker:

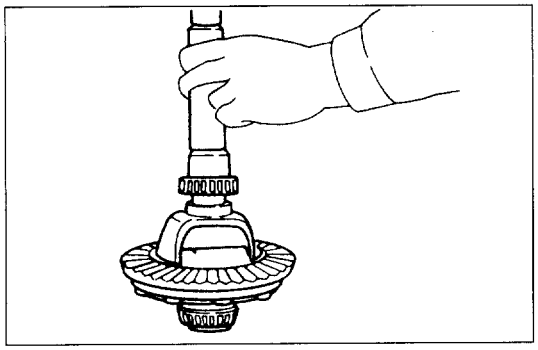
  A – (side bearing thickness – dummy bearing thickness) = (X)
- (X) + 0.025 = Shim thickness

  Allowance for bearing preload at one side = 0.025
- Example of calculation

mm(in.)

Measured Clearance A	+0.85 (+0.033)
Suppose that the side bearing is thicker [thinner] than dummy bearing by 0.05 mm	–0.05 (–0.002) [+0.05 (+0.002)]
An allowance for bearing preload:	+0.025 (+0.0009)
Thickness of shims to be installed:	0.825 (0.032) [0.925 (0.036)]

Thickness of Shim Available	mm(in.)
0.25, 0.30, 0.35, 0.5 (0.009, 0.012, 0.014, 0.019)	

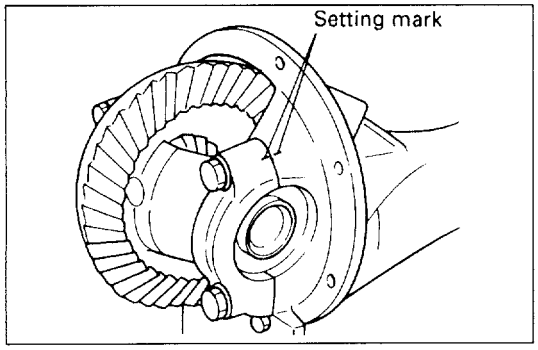


4. Side Bearing Inner Race

Installer : 5-8840-2050-0

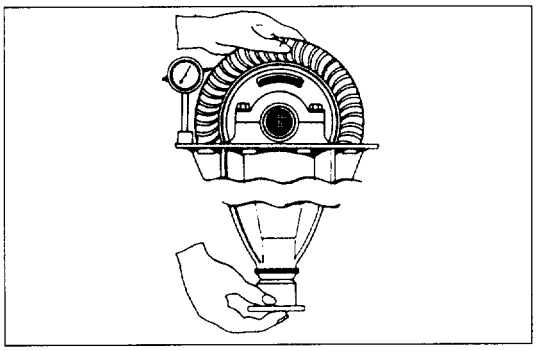
Grip : 9-8522-1608-0

3. **Differential Cage Assembly and Ring Gear**
2. **Side Bearing Outer Race**
1. **Bearing Cap**

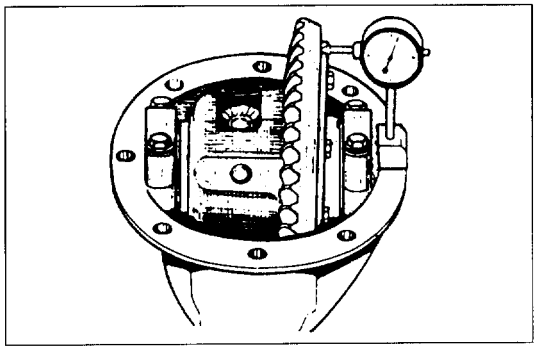


1) Install bearing caps by aligning setting marks applied at disassembly.

Bearing Cap Bolt Torque	N•m(kg•m/lb•ft)
108 (11.0/80)	



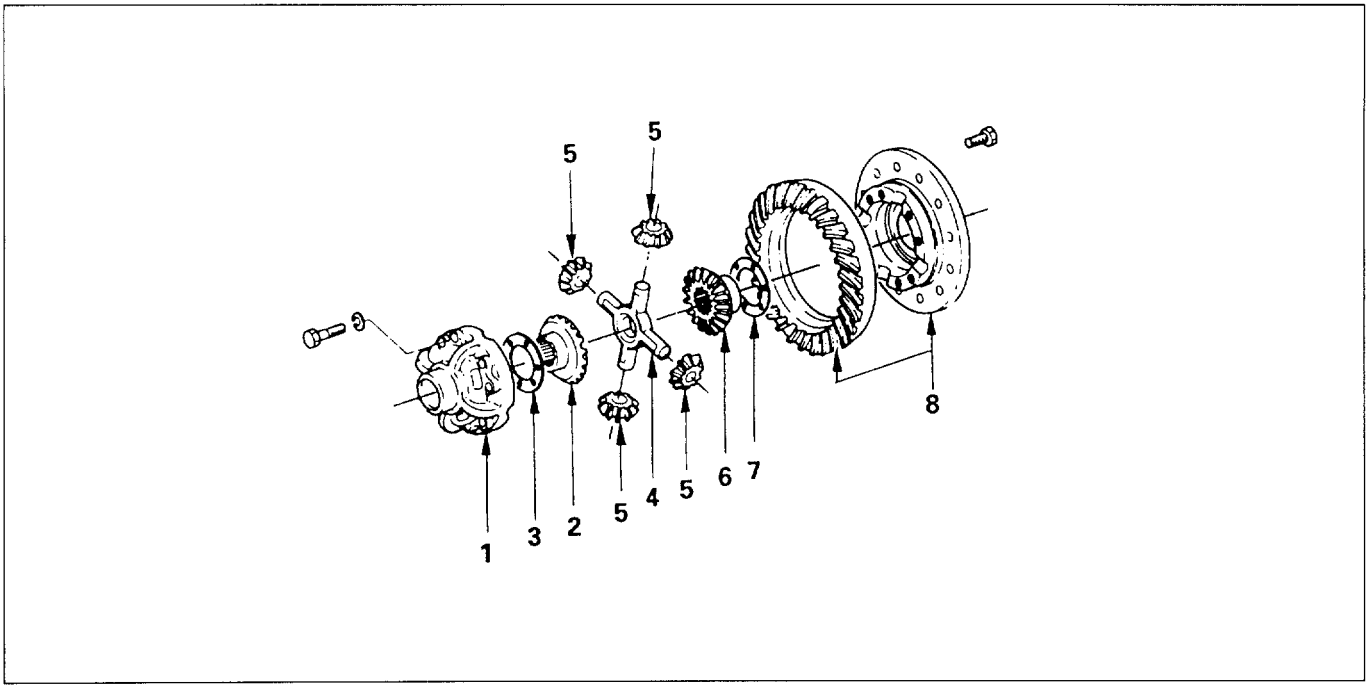
2) Recheck the backlash. If measurement indicates that the backlash deviates from the specified range, make an adjustment by shifting the position of shims in use without varying the total thickness.



Recheck the ring gear for run-out at the rear face. If the amount of run-out is excessive, repeat the disassembly and reassembly steps.

Ring Gear Run-Out	mm(in.)
Standard	Limit
0.05 (0.002)	0.2 (0.008)

Differential Cage Assembly



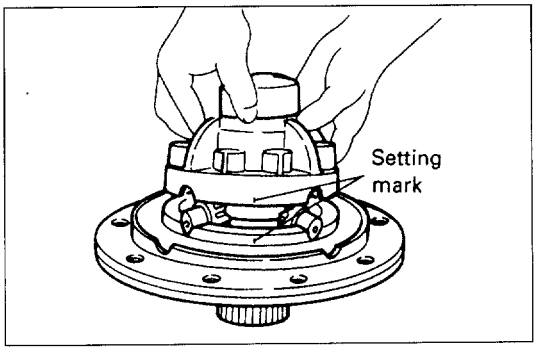
Disassembly Steps

1. Differential cage B
2. Side gear
3. Thrust washer
4. Spider
5. Differential pinion
6. Side gear
7. Thrust washer
8. Differential cage A and ring gear

Reassembly Steps

To reassemble, follow the disassembly steps in the reverse order.

DISASSEMBLY



1. Differential Cage B

Apply a setting mark to the differential cage assembly.

2. **Side Gear**
3. **Thrust Washer**
4. **Spider**
5. **Differential Pinion**
6. **Side Gear**
7. **Thrust Washer**
8. **Differential Cage A and Ring Gear**

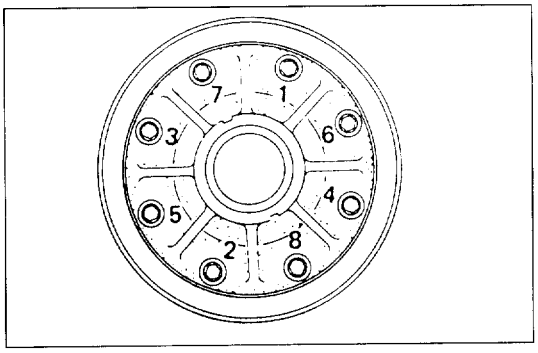
INSPECTION AND REPAIR

Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through in spection.

- Gear
- Bearing
- Oil seal
- Differential cage
- Drive pinion cage
- Parts organizing limited slip differential assembly

Visual Check

Inspect the following parts for wear, damage or other abnormal conditions.

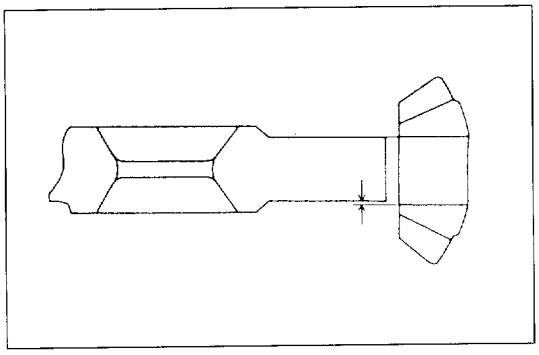


Ring Gear Replacement

The ring gear should always be replaced with drive pinion as a set.

When installing ring gear, apply stud lock to the threaded holes and bolts after treatment of the bolts with primer N.

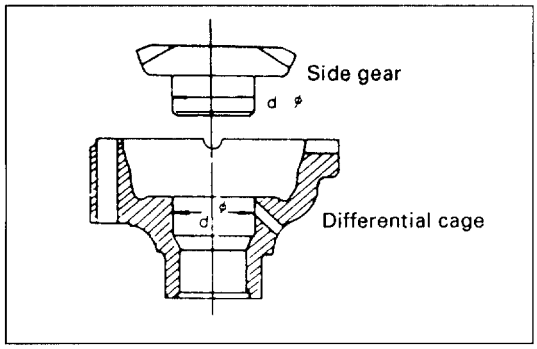
Ring Gear Bolt Torque	N•m(kg•m/lb•ft)
127 (13.0/94)	



Clearance between Differential Pinion and Spider

mm(in.)

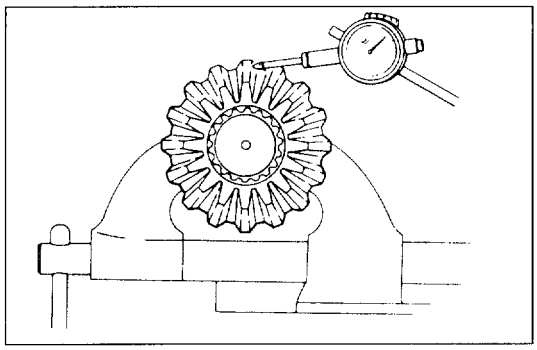
Standard	Limit
0.07–0.13 (0.003–0.005)	0.2 (0.008)



Clearance between Side Gear and Differential Cage

mm(in.)

Standard	Limit
0.04–0.1 (0.002–0.004)	0.25 (0.01)



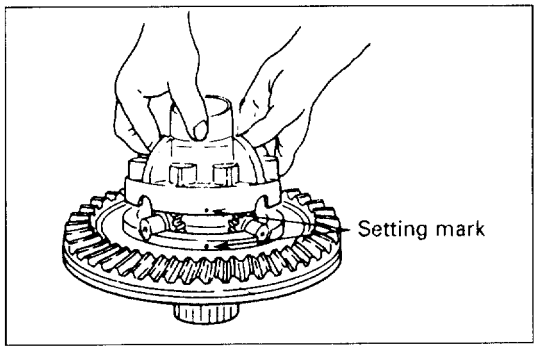
Play in Splines between Side Gear and Axle Shaft

mm(in.)

Standard	Limit
0.02–0.12 (0.0008–0.005)	0.25 (0.01)

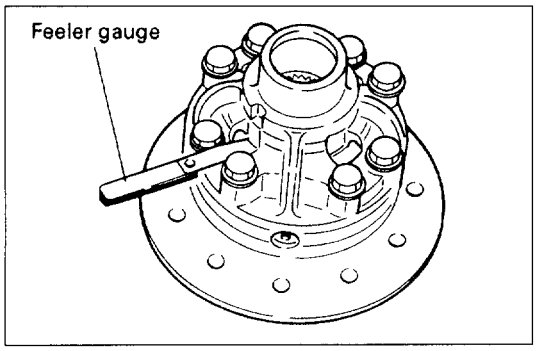
REASSEMBLY

8. **Differential Cage A and Ring Gear**
7. **Thrust Washer**
6. **Side Gear**
5. **Differential Pinion**
4. **Spider**
3. **Thrust Washer**
2. **Side Gear**
1. **Differential Cage B**



1) Apply oil to the threaded portion of the bolts before installation.
2) Fasten the differential cages A and B so that the setting marks are correctly aligned.

Differential Cage Bolt Torque	N•m(kg•m/lb•ft)
	78 (8.0/58)



3) Measure the clearance between the back face of the side gear and the differential cage B by inserting a feeler gauge through the hole on the cage B.

Clearance	mm(in.)
0.13–0.18 (0.005–0.007)	

When the clearance exceed a limit, replace the thrust washer or side gear.

LGPRO-WE-9401

You are requested to order this manual using the manual number that is shown above.

This manual is applicable for vehicles in all countries except the USA and Canada.

All rights reserved. This manual may not be reproduced in whole or in part, without the permission in writing of ISUZU MOTORS LIMITED.

Issued by

ISUZU MOTORS LIMITED

OVERSEAS SERVICE DEPARTMENT

Tokyo, Japan

First edition Feb., 2000 0002-01N-1

No. LGPRO-WE-9401 PRINTED IN JAPAN

WORKSHOP MANUAL

N-SERIES

POWER TAKE OFF
(with oil pump)

ISUZU

ISUZU

International Service & Parts

Tokyo, Japan

NOTICE

Before using this Workshop Manual to assist you in performing vehicle service and maintenance operations, it is recommended that you carefully read and thoroughly understand the information contained in Section 0A under the headings "GENERAL REPAIR INSTRUCTIONS" and "HOW TO USE THIS MANUAL".

All material contained in this Manual is based on the latest product information available at the time of publication.
All rights are reserved to make changes at any time without prior notice.

Applicable Model :

N-Series

This manual is applicable to 1994 year model and later vehicles.

THIS MANUAL INCLUDES THE FOLLOWING SECTIONS:

SECTION NO.	CONTENTS
_____	**Power Take Off**

POWER TAKE OFF

CONTENTS

PAGE

General Description 2
On-Vehicle Service 5
Inspection and Supply of The Hydraulic Operating Fluid 5
Supply Procedure of Hydraulic Operating Fluid 7
If the Dump Rise Operation is Disabled by Itself 8
Total Replacement of Hydraulic Operating Fluid 11
Air Bleeding Procedure of Hydraulic Operating Fluid 12
Control Cable (For Rear Dump Truck) 14
Oil Pump Unit (Replacement) 29
PTO (with Oil Pump) Assembly 34
Unit Repair 39
Disassembly 39
Inspection and Repair 44
Reassembly 46
Troubleshooting 52
Main Data and Specification 56
Fixing Torque 56
Special Tools 57

GENERAL DESCRIPTION

The side with an oil pump PTO integrates the PTO and the oil pump and installed in the left side of a transmission. The shift rod for switching the "ON" and "OFF" of the hydraulic circuit of the PTO is provided at the bottom of the PTO and the oil pump main unit.

The "ON" and "OFF" of the PTO uses a gear slide system and turn on and off the power by sliding the output gear.

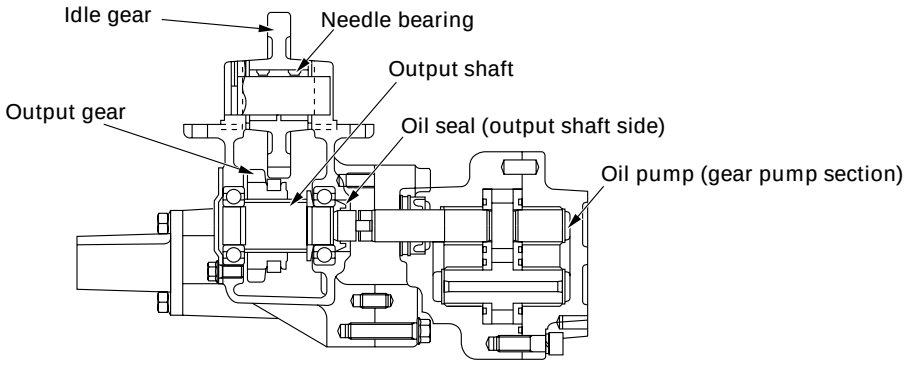
The idle gear bearing uses a needle bearing and the output shaft uses a ball bearing to ensure durability.

The oil pump section consists of the gear pump part and the hydraulic circuit switching part, and the gear pump section fixs efficiency by selecting and assembling the side plate. Further, the hydraulic circuit switching portion switches the three positions of "Up", "Neutral", and "Down" by the spool provided on the rod extension.

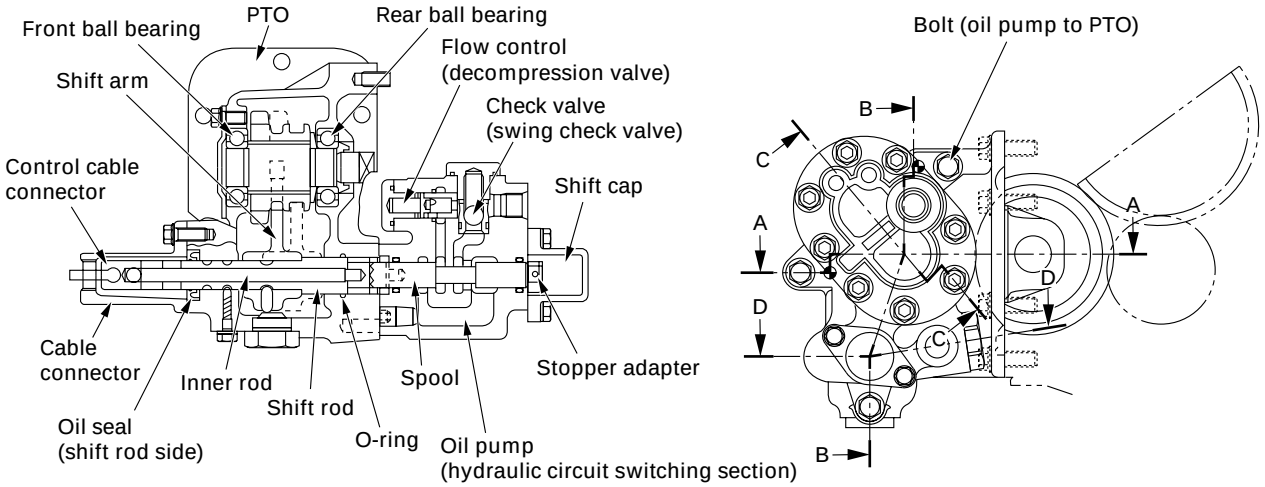
The dump control system uses a cable system.

CROSS-SECTION VIEW

* This illustration is based on a rear dump truck model.



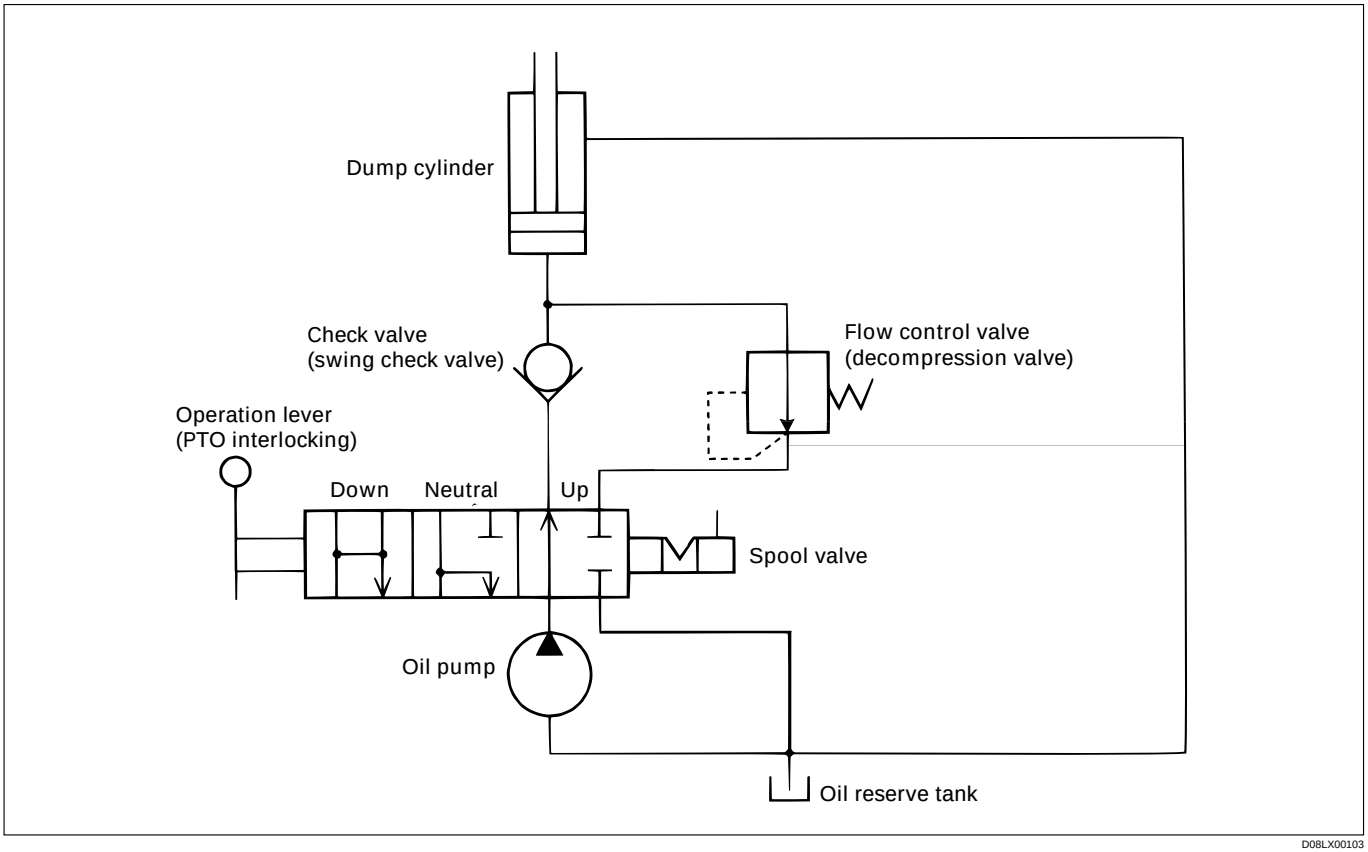
PTO oil pump assembled point assembly drawing
PTO side Section A-A, Pump side Section C-C (Illustrated by rotating by 90 degrees counterclockwise)



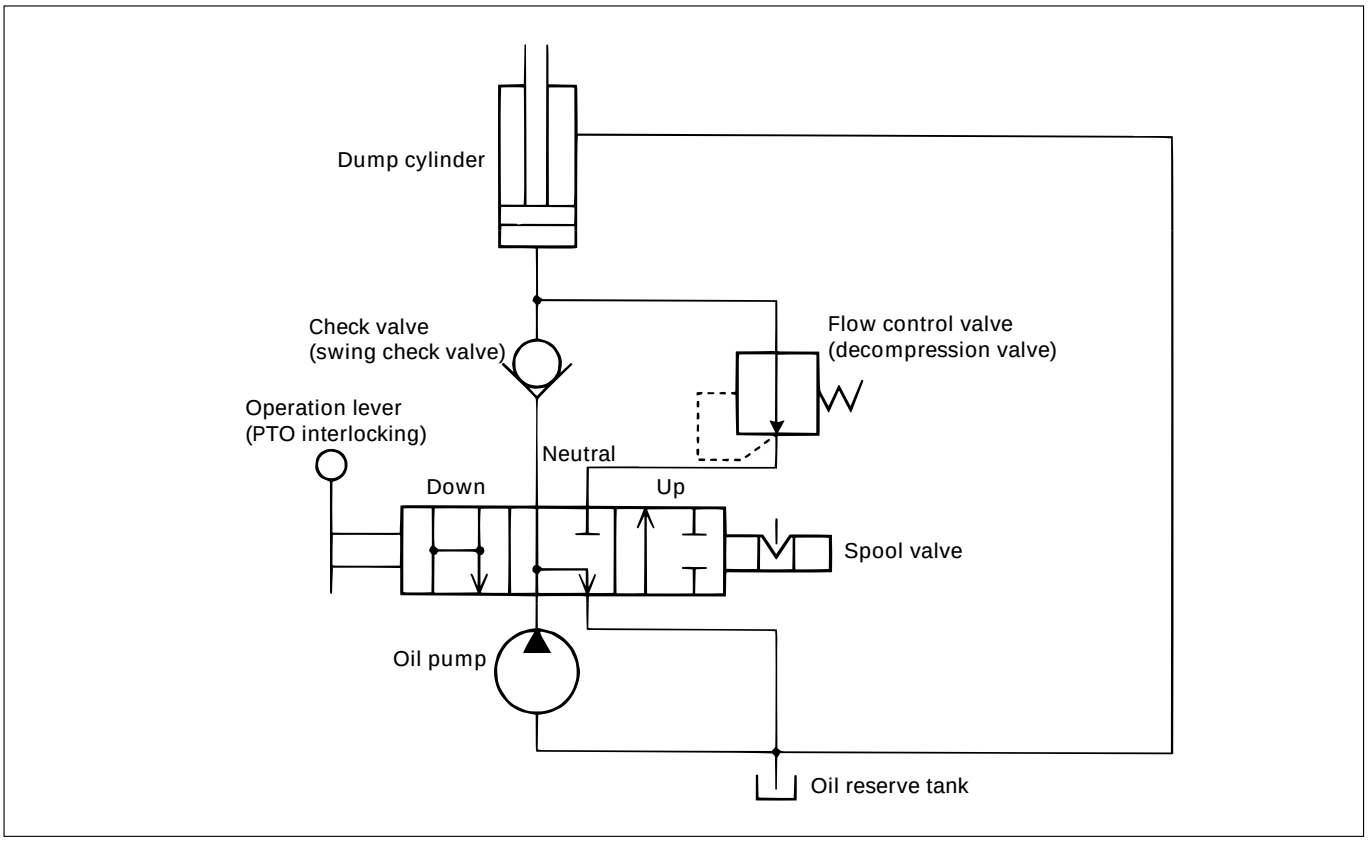
PTO oil pump hydraulic switching assembly drawing)
PTO side Section B-B, Pump side Section D-D

281LX00090

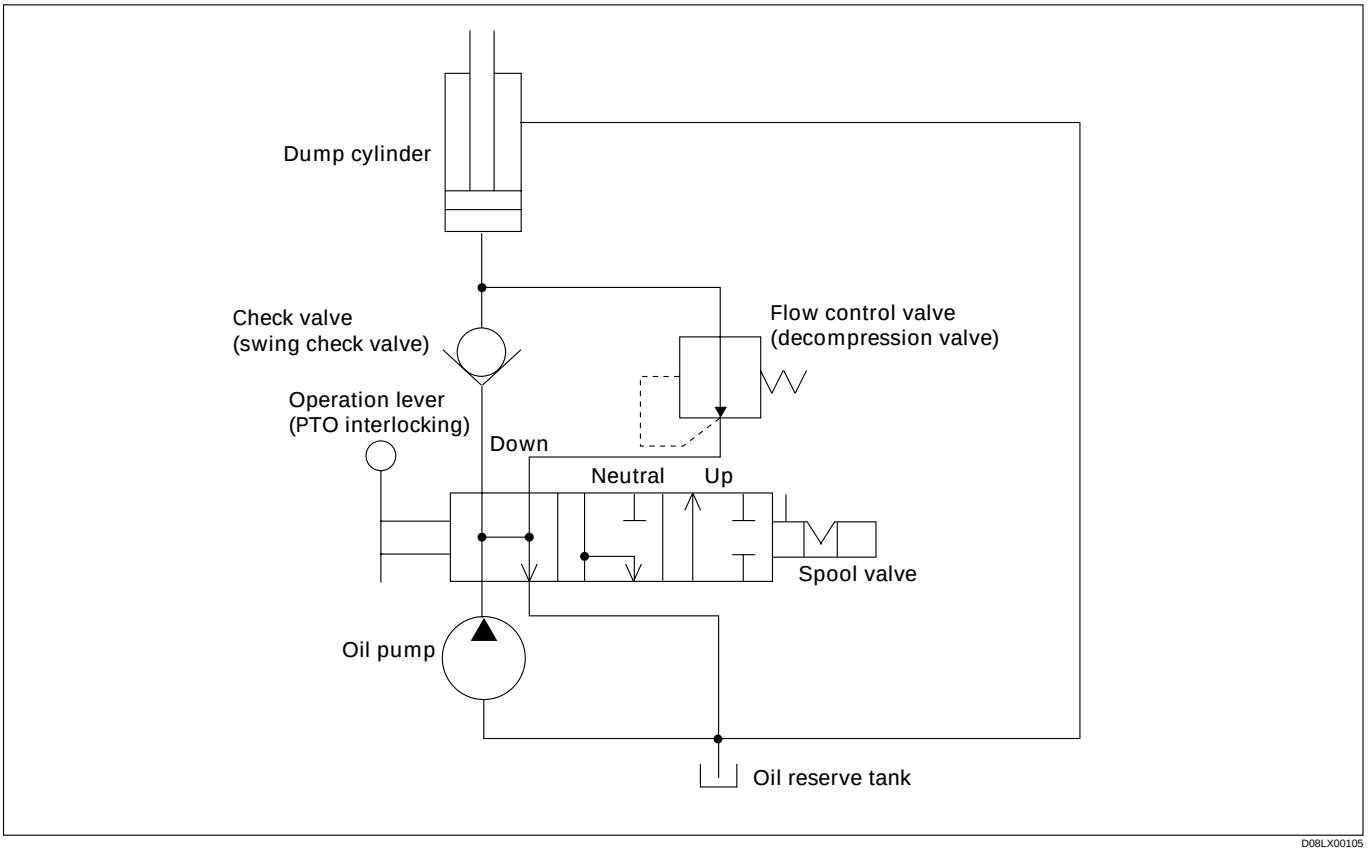
HYDRAULIC CIRCUIT DIAGRAM



D08LX00103

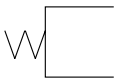
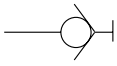
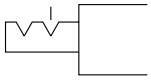
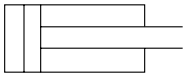
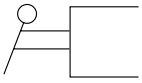
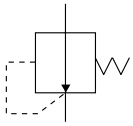
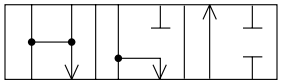


D08LX00104



D08LX00105

SYMBOL FOR HYDRAULIC CIRCUIT

Symbol	Meaning of symbol	Symbol	Meaning of symbol
 D08LX151	Spring	 D08LX156	Check valve (swing check valve)
 D08LX152	Detent (position stop system)	 D08LX157	Cylinder
 D08LX153	Manual lever (dump lever)	 D08LX158	Flow control valve (decompression valve) (internal pilot method)
D08LX154	Oil tank	 D08LX159	Hydraulic switching valve (three-position valve)
D08LX155	Oil pump (unidirectional flow)		

ON-VEHICLE SERVICE

Inspection and Supply of The Hydraulic Operating Fluid

NOTE:
When inspecting and supplying hydraulic operating fluid, you might have incurred danger. In that case, inspect and supply hydraulic operating fluid after having fully checked safety.

Symptoms Due to Insufficient Hydraulic Operating Fluid

The following symptoms might have occurred. In that case, inspect and supply hydraulic operating fluid because it may be insufficient.

(1) The body (cargo deck) is raised only immediately.
(2) The body (cargo deck) is lugged during rise.
(3) While the body (cargo deck) is being raised, the oil pump portion causes a large abnormal sound (such as caterwaul or grate).
(4) After the body (cargo deck) has been raised, it drops generating a knock.

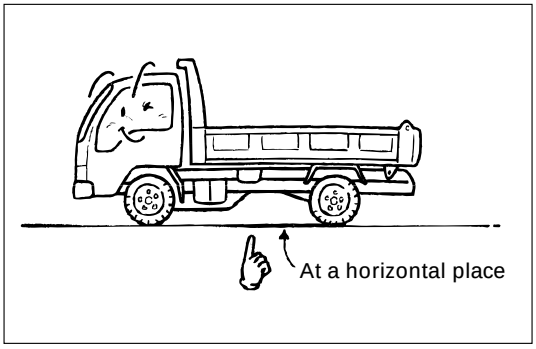
Preparing for Hydraulic Operating Fluid Supply

If there is loading, pull down the loading. Then supply hydraulic operating fluid after having safely and more carefully raised the body (cargo deck) and having firmly held the body (cargo deck) by the "safety rod" and the "safety strut" in accordance with the following "How to raise the body (cargo deck)".

How to Raise the Body (Cargo Deck)

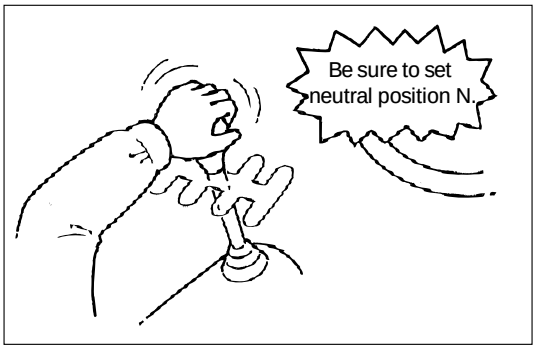
(1) Put a truck at a horizontal place.

NOTE:
Never raise the body (cargo deck) on tilted ground, soft ground, and unleveled ground. A truck may be inverted or warp may be generated in functional components.

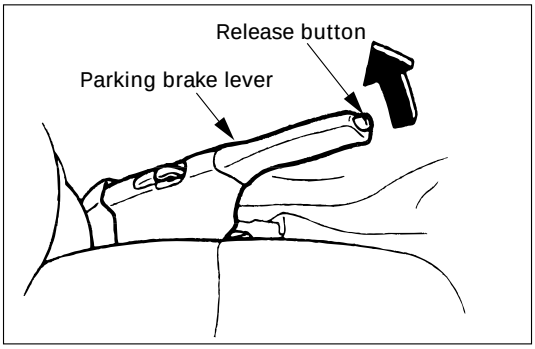


F05LX00008

(2) Set the shift lever to the "Neutral" position.

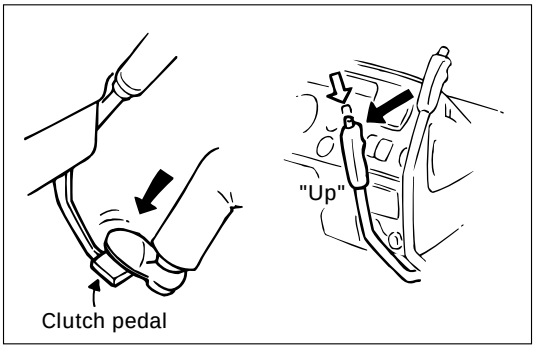


F05LX00009



F05LX00010

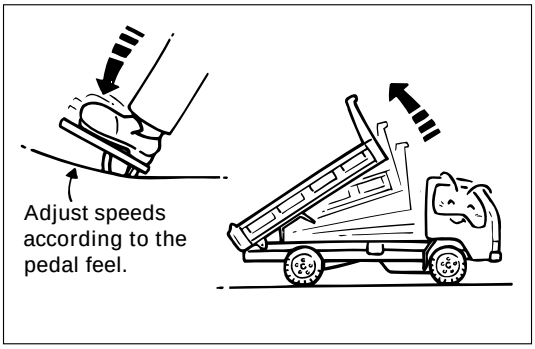
(3) Firmly actuate the parking brake and apply a scotch to the rear tire.



F05LX00011

(4) Start the engine and depress the clutch pedal to the floor. Push in the lock button of the dump lever and release the lock to set the "Up" position.

NOTE:
Fully check that there is no person or hindrance around a truck.
When the dump lever is operated, observe the notes of the Note label attached to the driver's seat.

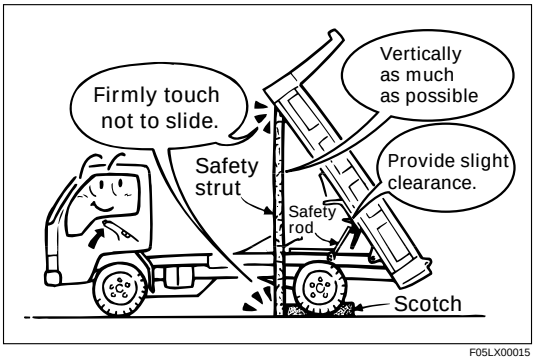


F05LX00012

(5) When the clutch pedal is slowly returned, the body (cargo deck) is raised.

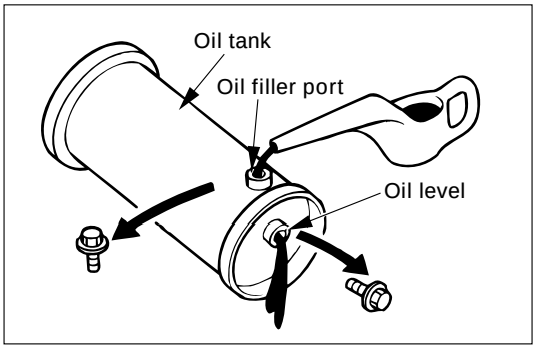
- Adjust raised speeds according to the pedal feel of the accelerator.
- When raising the body (cargo deck), be sure to check the lock of the dump lever.
- After having raised the body (cargo deck), held the body by the safety rod and the safety strut and stop the engine.

NOTE:
Suddenly returning the clutch pedal is very dangerous. Use the engine at about 1,000 to 1,500 rpm, and do not perform high-speed rotation, sudden acceleration and deceleration, and unnecessary idle rotation.

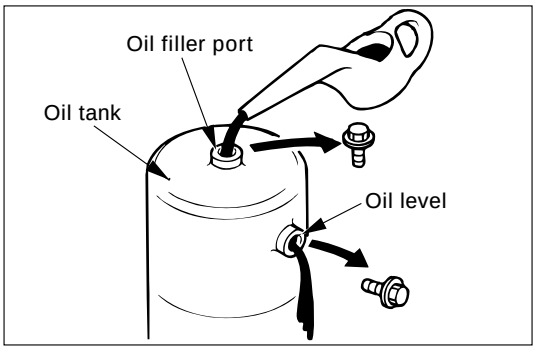


F05LX00015

NOTE:
Raise the body (cargo deck) paying full attention to safety and firmly hold the body (cargo deck) by the safety rod and safety strut.



F05LX00014



F08LX00003

Supply Procedure of Hydraulic Operating Fluid

NOTE:
Be sure to supply a specified amount (check it by the level plug) of hydraulic operating fluid using a cleaned oil supply container paying full attention so that dust or foreign matter will not be mixed in. After having supplied oil, firmly tighten each plug.
When replacing the total amount of hydraulic operating fluid, request a service network (SS store) of a body manufacturer.

(1) Remove the oil supply plug and level plug of the oil tank in the engine stopped state.
(2) While supplying hydraulic operating fluid from the oil filler port, supply it until the hydraulic operating fluid flows out from the level plug.
(3) Remove the "Safety strut" once and raise the body (cargo deck) to the most raised position, then re-hold it by the "Safety strut and safety rod".
(4) Additionally supply hydraulic operating fluid. When the hydraulic operating fluid flows out from the level plug, install and firmly tighten the level plug and the oil filler port plug.
(5) After having supplied hydraulic operating fluid, remove the "Safety strut" and store the "safety rod". Subsequently firmly drop the body (cargo deck) and stop the engine.

NOTE:
Supply the hydraulic operating fluid used with reference to the following table.

Hydraulic Operating Fluid (Turbine Oil)

Manufactured by ShinMaywa Industries Co., Ltd.	0 to 30°C: VG32
	20°C or more: VG56
	less than 10°C: VG22

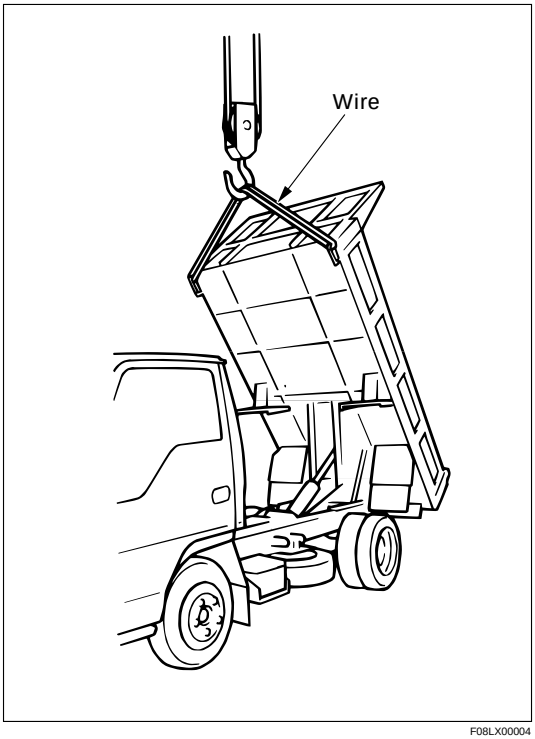
If the Dump Rise Operation is Disabled by Itself

If the body (cargo deck) is kept being dropped and the "Rise" operation of the body (cargo deck) is disabled by itself, inspect the cause of rise disabled, fully identify the status, and execute maintenance and repair in accordance with the flowchart of the "Defect 1". Dump body rise disabled" (Page 52) of Chapter "Troubleshooting".

After maintenance and repair, if there is a hindrance in subsequent work advance because the "Rise" operation is disabled by itself or when the hydraulic circuit is in the following states (1) and (2) after maintenance and repair, raise the body (cargo deck), take safety measures for preventing drop, and continue the work according to the following (item of the existence of hoist or crane equipment) methods.

(1) The body (cargo deck) rise is disabled due to the air mixture into the hydraulic circuit resulting from insufficient hydraulic operating fluid immediately after repair for oil pump replacement

(2) The body (cargo deck) rise is disabled due to the air mixture into the hydraulic circuit resulting from insufficient hydraulic operating fluid immediately after repair for leak of hydraulic operating fluid.



F08LX00004

When hoist or crane equipment is provided

(1) Firmly actuate the parking brake and apply a scotch to the rear tire.

(2) Set the engine to the stopped state.

(3) Set the dump lever to the "Up" position and apply a wire with ample strength to the front of the body (cargo deck).

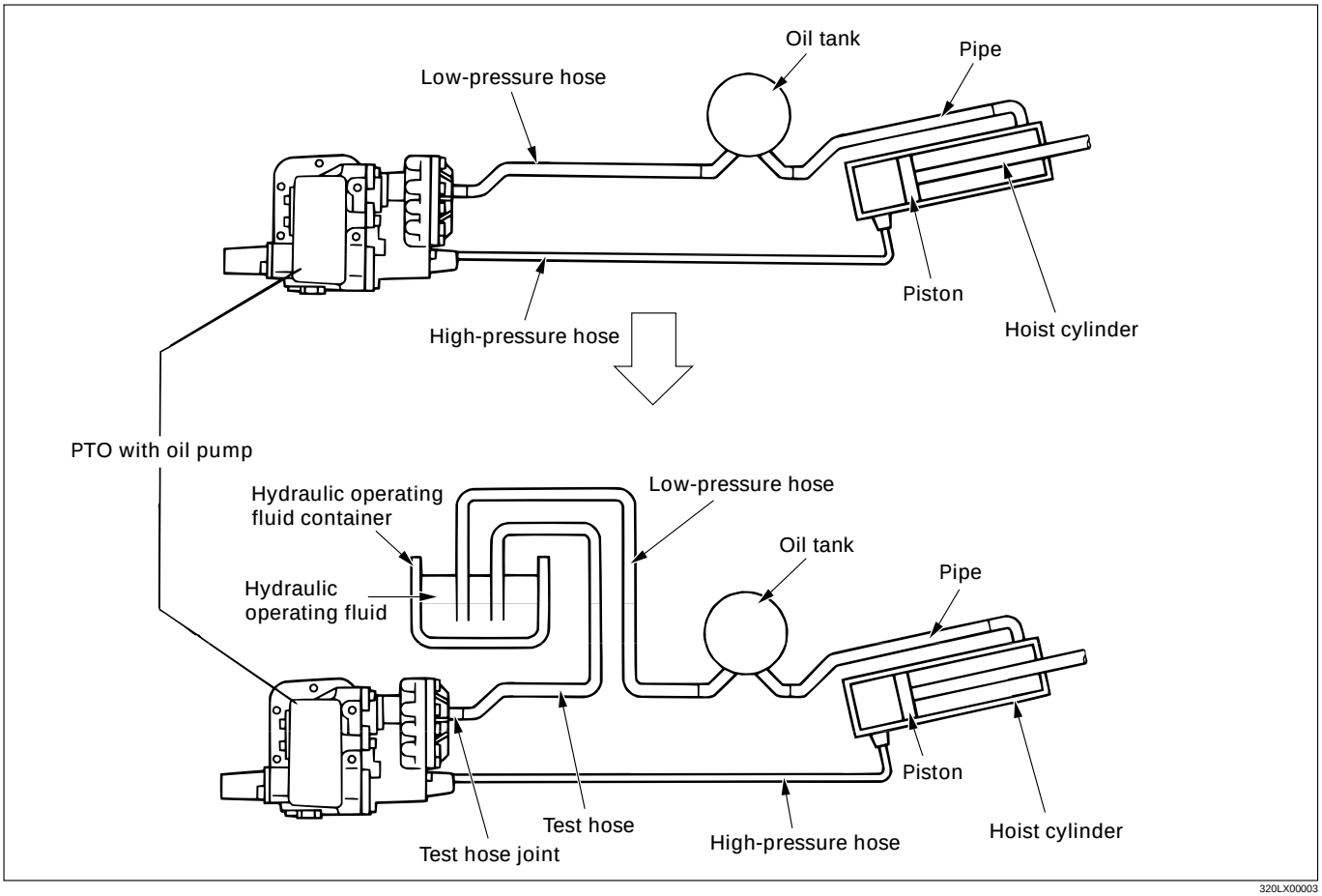
(4) Slowly hang a wire (tensile strength of 1,000 kg (9,807N)) by a hoist or crane.

(5) After having drawn up the body (cargo deck) to the most raised position, prevent the drop of the body (cargo deck) by the safety rod and the safety strut and check safety.

NOTE:
For the subsequent work procedure, supply hydraulic operating fluid or perform air bleeding of the hydraulic operating fluid in accordance with each item of the text in the "Supply Procedure of Hydraulic Operating Fluid" (Page 7) or the "Air Bleeding Procedure of Hydraulic Operating Fluid" (Page 12) in the next chapter.

If neither hoist nor crane is provided

If the body (cargo deck) is kept being dropped and the "Up" operation of the dump is disabled by itself or if neither hoist nor crane is provided, raise the body (cargo deck) according to the following work procedure.



Preparation

(1) Because removal of a spare tire makes work easier according to a truck, previously check the truck.

(2) Remove the intermediate fixed clip on the truck side between the oil pump and the oil tank of the low-pressure side hose and set the low-pressure hose free.

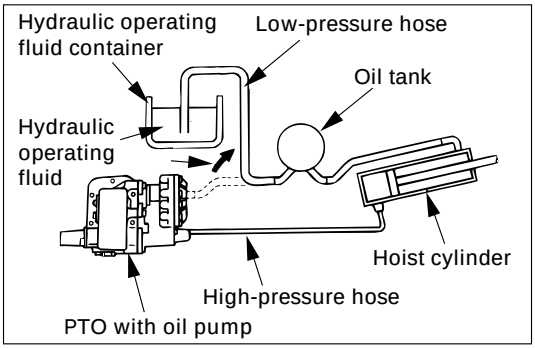
(3) Prepare a cleaned hydraulic operating fluid container (a 20ℓ can will do), a funnel, hydraulic operating fluid, a test hose for a special tool, and a test hose joint.

(4) Prepare the hydraulic operating fluid of about 10ℓ in the cleaned hydraulic operating fluid container.

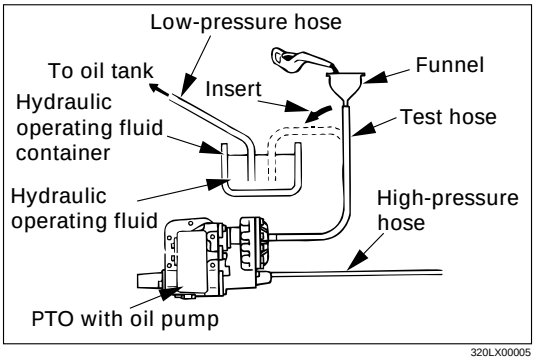
Hydraulic Operating Fluid (Turbine Oil)

Manufactured by ShinMaywa Industries Co., Ltd.	0 to 30°C: VG32
	20°C or more: VG56
	less than 10°C: VG22

NOTE:
Carefully control the prepared hydraulic operating fluid so that dust or foreign matter will not be mixed in it. Besides, if the dust or foreign matter is mixed in the hydraulic operating fluid, carefully handle it because it becomes the first cause of a dump mechanism fault.



320LX00004



320LX00005

Work Procedure

(1) With reference to the piping rough sketch on the preceding page, remove the low-pressure side hose of the oil pump and insert the port for removal in the prepared hydraulic operating fluid container.

NOTE:
Be sure to install the hydraulic oil fluid container at a higher position than the tank pump. If it is installed at a lower position, the oil pump may be damaged because the hydraulic operating fluid applied in Item (4) flows in the hydraulic operating fluid container and air is mixed in the hose.

NOTE:
When inserting the removed low-pressure hose in the hydraulic operating fluid, remove the hose band, be sure to clean the hose port, and handle the hose so that dust or foreign matter will not be mixed in the hydraulic operating fluid.

(2) Remove the low-pressure side hose joint of the oil pump.

(3) Install the test hose and connecting joint on the low-pressure side of the oil pump.

Joint (low-pressure side): 5-8840-2439-0
Test hose: 5-8840-2435-0

(4) Use the funnel from the fluid container insertion side of the test hose to fill the hose with the hydraulic operating fluid and insert the hose port in the hydraulic operating fluid container.

NOTE:
The test hose is filled with hydraulic operating fluid to minimize the mixture of air in the hydraulic circuit. Further, fix the two hoses inserted in the fluid container not to jump out from the hydraulic operating fluid.

(5) Start the engine and depress the clutch pedal in the idling state, then set the dump lever to the "Up" position.

(6) When slowly releasing the clutch pedal and operating the oil pump, the body (cargo deck) starts being raised.

NOTE:
At this time, check that the air mixed in the hydraulic circuit is discharged in the hydraulic operating fluid as blow holes.

(7) Raise the body (cargo deck) up to the most raised position in the idling state and apply the safety rod and the safety strut to the body (cargo deck). Then prevent drop and check safety.

(8) After having the body (cargo deck), stop the engine and remove the test hose installed in Item (3) from the oil pump, then release it from the fluid container.

(9) Remove the test hose connecting joint from the low-pressure side of the oil pump and install the joint for connecting the original low-pressure hose.

(10) Release the low-pressure side hose removed from the oil pump and soaked in the fluid container in Item (1) and install it on the low-pressure side of the oil pump as before, then firmly tighten the hose band.

NOTE:
For the subsequent work procedure, supply hydraulic operating fluid or perform the air bleeding of hydraulic operating fluid in accordance with each item of the text in the "Supply Procedure of Hydraulic Operating Fluid" (Page 7) or the "Air Bleeding Procedure of Hydraulic Operating Fluid" (Page 12) in the next chapter.
Be careful of excessive supply of hydraulic operating fluid.
If an excessive amount of hydraulic operating fluid exceeding the specified amount is supplied when supplying the hydraulic operating fluid at the rise of the body (cargo deck), the hydraulic circuit will be filled with the hydraulic operating fluid because the volume of the fluid in the oil tank is increased more than necessary at the drop of the body (cargo deck). According, the body (cargo deck) will not be dropped from a predetermined place. If it is dropped forcibly, excessive pressure applies to the hydraulic circuit (consisting of the hose, pipe, and tank) resulting in its damage or a leak of oil.

Total Replacement of Hydraulic Operating Fluid

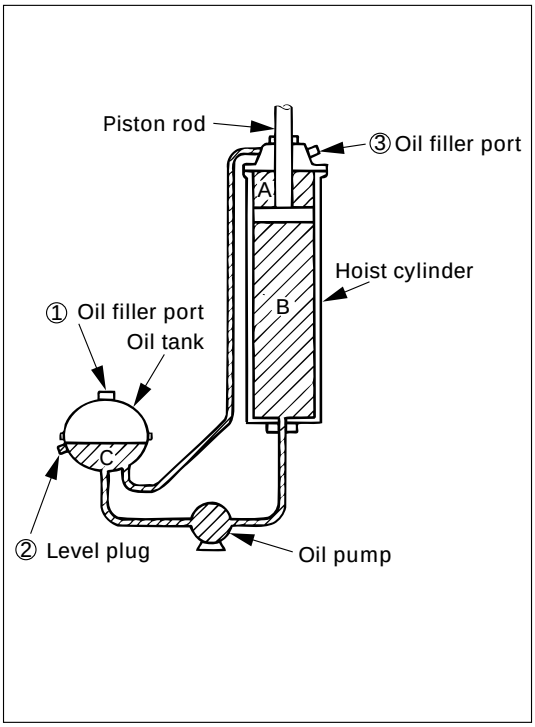
Request a service network (SS store) of a body manufacturer of the total replacement of hydraulic operating fluid.

Air Bleeding Procedure of Hydraulic Operating Fluid

NOTE:
Be sure to supply a specified amount of hydraulic operating fluid using a cleaned oil supply container paying full attention so that dust or foreign matter will not be mixed in. After having supplied oil, firmly tighten each plug.

[Rear Dump Truck]

<Manufactured by Shin Maywa Industries, Co., Ltd.>



320LX00006

Hydraulic Operating Fluid Supply

(1) Raise the body (cargo deck) in accordance with the "How to raise the body (cargo deck) (Page 5) described previously.

(2) Remove oil filler plug ① and level plug ② of the oil tank and supply oil from the oil filler port until the hydraulic operating fluid flows out from level plug ①, then tighten plug ②.

(3) Remove oil filler port plug ③ from the cylinder head, supply the hydraulic operating fluid to "Chamber A" so that no air will be left to fill the chamber with the fluid, and tighten oil filler port plug③.

Air Bleeding Method

(1) Raise the body (cargo deck) in accordance with the "How to raise the body (cargo deck) (Page 5) described previously.

(2) At the maximum rise, cylinder shaded portions "Chamber A" and "Chamber B" shown in the drawing are fully filled with hydraulic operating fluid and Section "C" is filled with the hydraulic operating fluid up to its level position.

NOTE:
Supplying hydraulic operating fluid more than necessary will cause a fault.

(3) First remove the oil tank oil filler port plug of ①. Then start the engine, operate the dump lever, and drop and raise the body (cargo deck) several times. Consequently, air is naturally released usually.

(4) Tighten the oil tank oil filler port plug of ①.

NOTE:
If the work of Item ② is performed with plug ① tightened, air may not be released.

NOTE:
When air is mixed in hydraulic operating fluid and becomes whitely foamy, the air will not be released. So raise the body (cargo deck) and remove plugs ① and ③. When the hydraulic operating fluid is left alone about for 30 to 60 minutes, the air is naturally separated. Re-supply oil in accordance with the procedure of Items (2) and (3) of the "Supply Procedure of Hydraulic Operating Fluid" (Page 7).

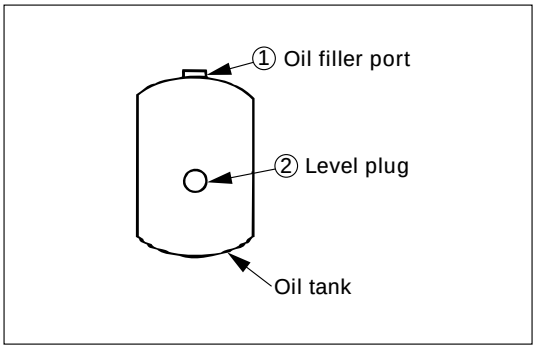
Principles Under Which Air ils Released

Between "B" and "C"

For Chamber "B" filled with hydraulic operating fluid, when the body (cargo deck) is dropped, the piston rod is dropped and the hydraulic operating fluid in "Chamber B" passes through the oil pump and is returned to the oil tank. At this time, if air is mixed in, it is discharged from "Surface C" in the oil tank as blow holes.

Between "A" and "C"

The hydraulic operating fluid pressurized and sent via the oil pump is sent from "Chamber C" to "Chamber B". The piston cylinder is raised and the hydraulic operating oil in "Chamber A" is sent to "Chamber C", and then the air is discharged for the same reason as between "B" and "C".



F08LX00005

[Three-Rotation Dump Truck]

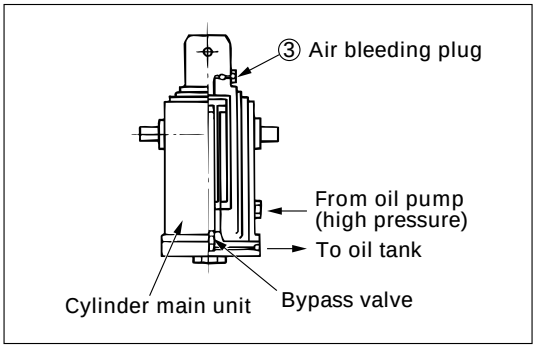
<Manufactured by Shin Maywa Industries, Co., Ltd.]

Hydraulic Operating Fluid Supply

(1) Raise the body (cargo deck) in accordance with the "How to raise the body (cargo deck) (Page 5) described previously.

(2) Remove oil filler plug ① and level plug ② of the oil tank and supply oil from the oil filler port until the hydraulic operating fluid flows out from level plug ②, then tighten plug ②.

NOTE:
Supplying hydraulic operating fluid more than necessary will cause a fault.



F08LX00006

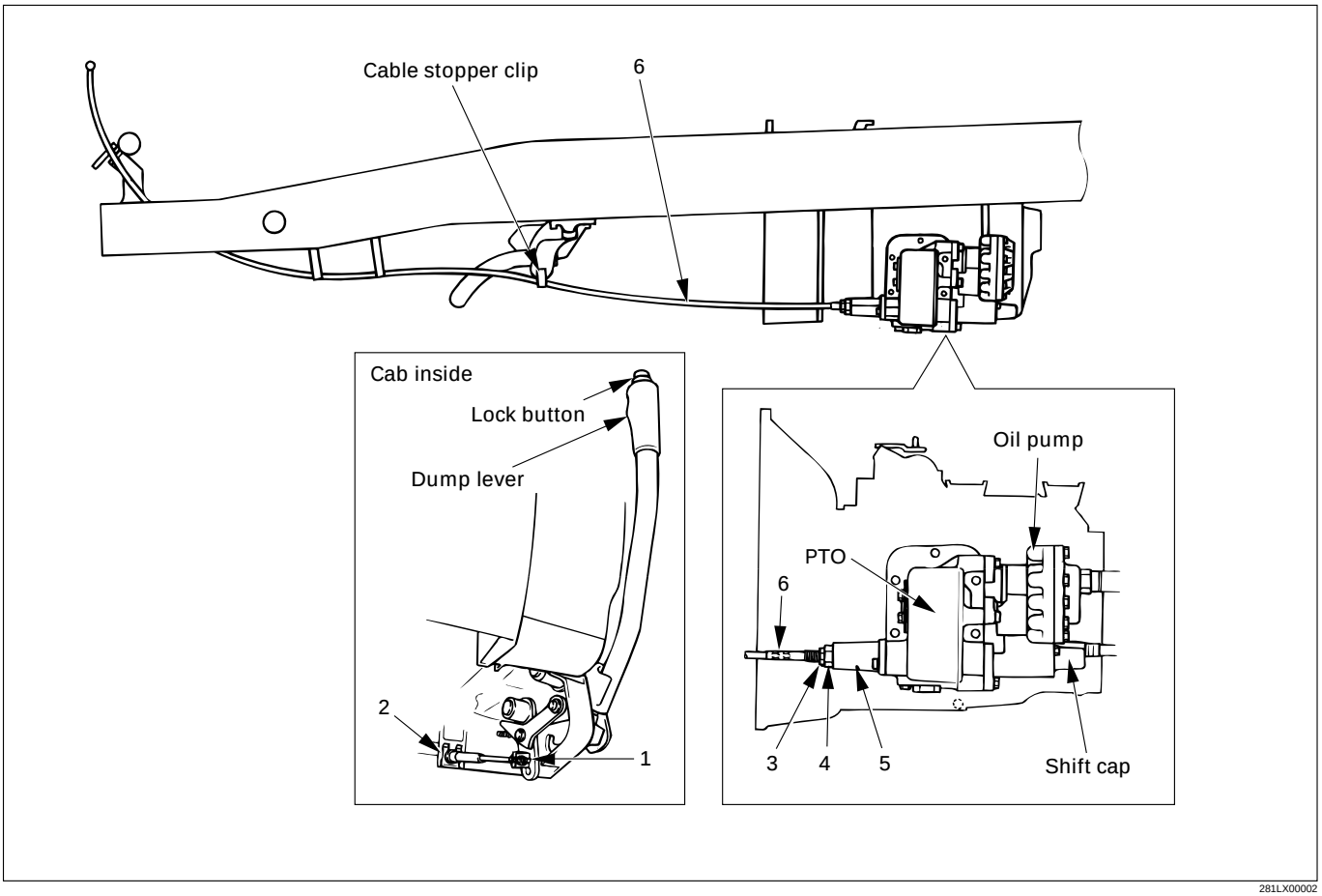
(3) Set the dump lever to the "Up" position with the engine in the idling state.

(4) When loosening the air bleeding plug ③ of the cylinder about once or twice, air is discharged and then hydraulic operating fluid is ejected. So quickly tighten the plug.

NOTE:
When air is mixed in hydraulic operating fluid and becomes whitely foamy, the air is not released. So raise the body (cargo deck) and leave the hydraulic operating fluid alone about for one hour. The air in the hydraulic operating fluid is naturally separated and subsequently air can be released.
Even when performing air bleeding work, raise the body (cargo deck) in accordance with the "How to Raise The Body (cargo deck") (Page 5) described previously.

CONTROL CABLE (FOR REAR DUMP TRUCK)

REMOVAL AND INSTALLATION



281LX00002

Removal Steps

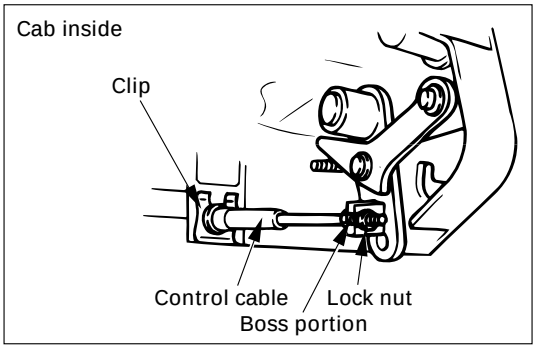
1. Lock nut (dump lever side)
2. Clip (inside cap)
3. Lock nut (PTO side)
4. Special nut
5. Cable holder
6. Control cable

Installation Steps

To install, follow the removal steps in the reverse order.

Removal Steps

NOTE:
Because a three-rotation dump truck differs in the wiring of a control cable from a rear dump truck, refer to the notes on the replacement and adjustment of the control cable for the three-rotation dump truck.



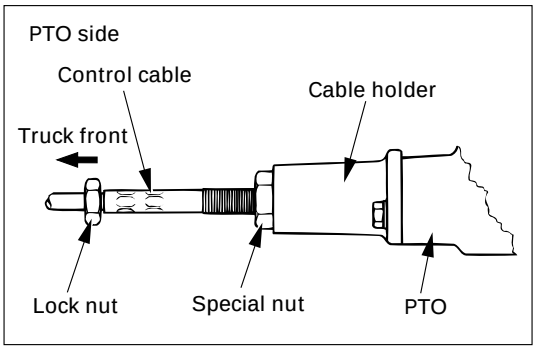
281LX00003

1. Lock Nut (Dump Lever Side)

- Set the dump lever to the "Down" position and firmly lock the lever.
- Loosen the lock nut of the control cable and remove the cable tip from the boss portion of the dump lever.

2. Clip (Inside Cab)

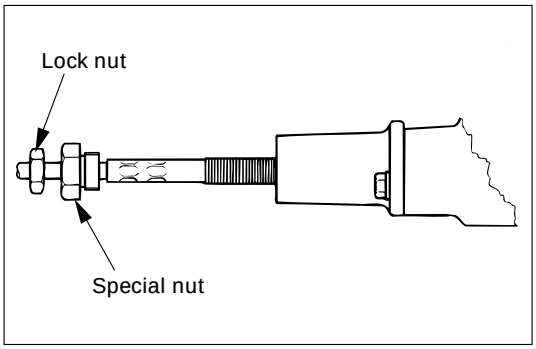
- Remove the clip from the instrument panel bottom inside the cab.



281LX00004

3. Lock Nut (PTO Side)

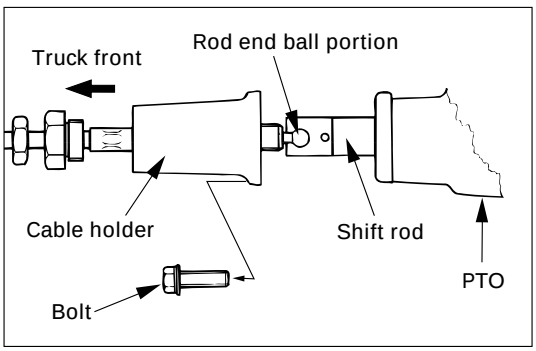
- Loosen the lock nut and move it toward the truck front.



281LX00005

4. Special Nut

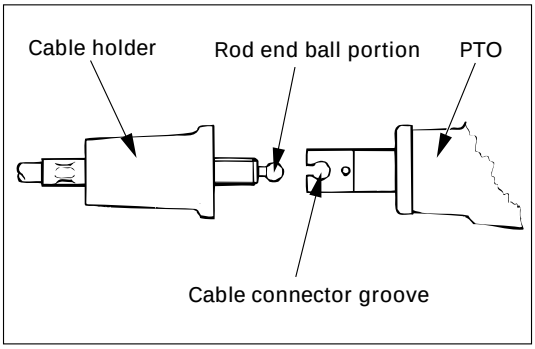
- Loosen the special nut and move it toward the truck front.



281LX00006

5. Cable Holder

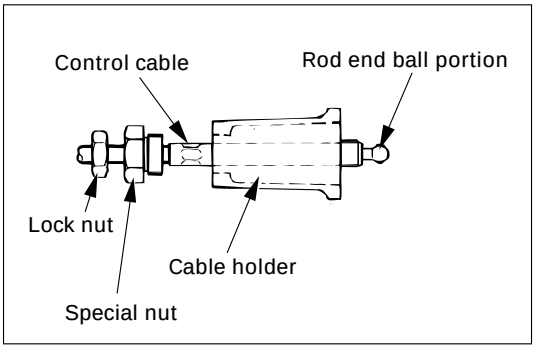
- Remove the bolt and remove the cable holder from the PTO.
- Move the cable holder to the truck front and provide clearance between the cable holder and PTO.



281LX00007

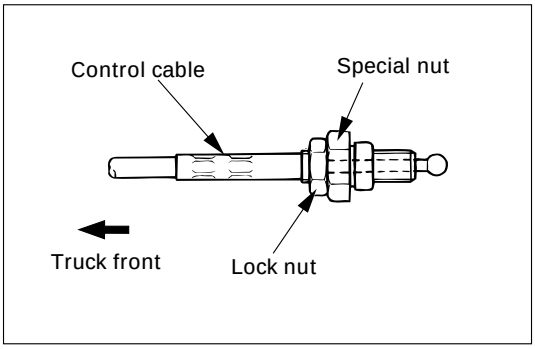
6. Control Cable

- Because the tip portion (PTO side) of the control cable is of a rod end ball type as shown in the drawing, remove the cable end portion from the cable connector groove on the PTO side sliding it along the groove.



281LX00008

- Remove the cable holder from the control cable.
- Remove the control cable assembly from the truck.

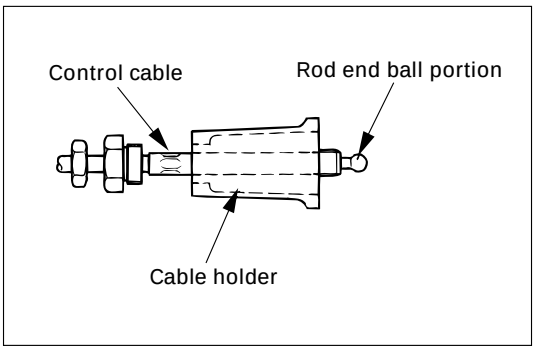


281LX00009

Installation Steps

6. Control Cable

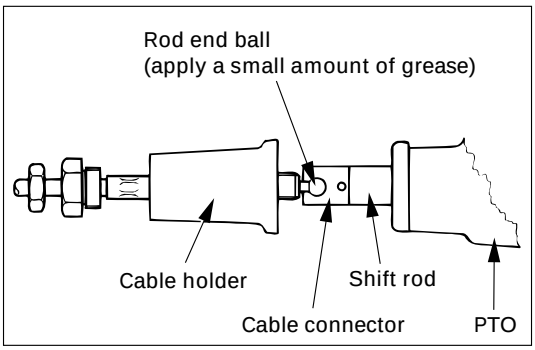
- Set the dump lever to the "Down" position and lock it.
- Install the control cable assembly in the truck.
- Move the lock nut (PTO side) and special nut of the cable top the truck front side.



281LX00010

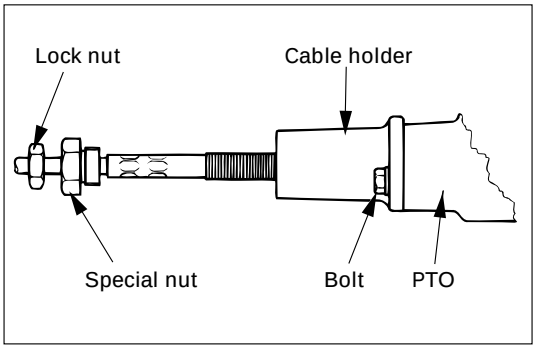
5. Cable Holder

- Assemble the cable holder in the control cable.



281LX00011

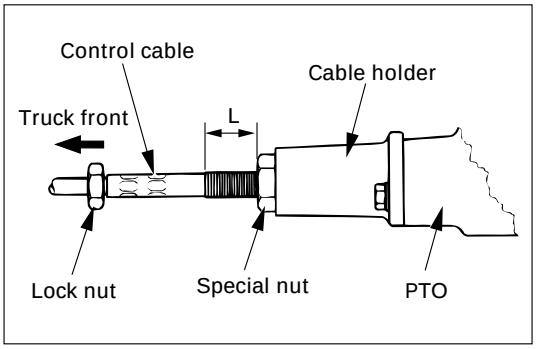
- Coat the rod end ball of the cable tip with a small amount of grease and assemble it in the groove of the control cable connector on the PTO side.



281LX00012

- Install the cable holder in the PTO and temporarily tighten the bolt.

NOTE:
Tighten the bolt after having adjusted it in accordance with the work procedure of the "Control Cable Adjustment" (Page 18) in the next item.



281LX00013

4. Special Nut

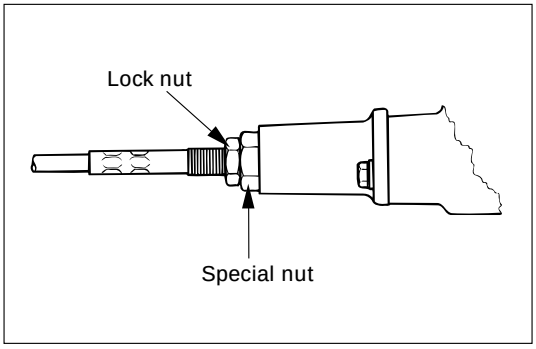
- Tighten the special nut to the cable holder at a specified torque pressing down the control cable to the PTO side lightly.

Special Nut Torque	N·m (kg·m / lb·ft)
	147 (15 / 108)

- At this time, check that the "L" dimension is 34±1 mm (1.339±0.039 inch.)
- If the "L" dimension does not satisfy the specified value, remove the cable holder from the PTO and rotate the cable holder to adjust the dimension.

NOTE:
Both "clockwise rotation" and "counterclockwise rotation" indicate that the cable moves by about 0.75 mm (0.0295 inch) every time the cable holder rotates by 180 degrees.

- Re-install the cable holder on the PTO and temporarily tighten the bolt.

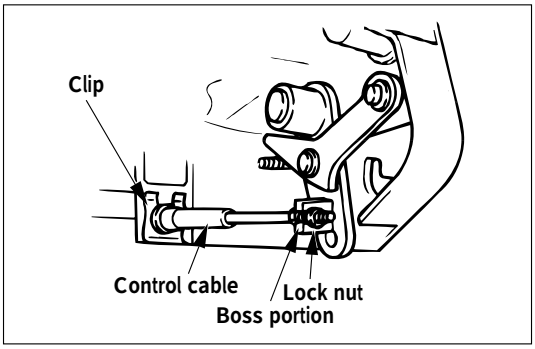


281LX00014

3. Lock Nut (PTO Side)

- After having checked the specified value dimensions of the cable outer threaded portion, temporarily tighten the lock nut.

NOTE:
Tighten the special nut and lock nut after having adjusted it in accordance with the work procedure of the "Control Cable Adjustment" (Page 18) in the next item.



281LX00015

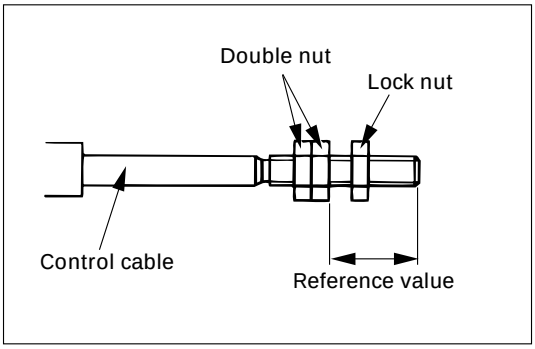
2. Clip (Cab Inside)

- Draw the control cable in the instrument panel bottom inside the cab and firmly install the grommet.
- Firmly install and fix the clip in the cable flange portion groove.

1. Lock Nut (Dump Lever Side)

- Assemble the control cable tip in the boss portion of the dump lever and tighten the lock nut at a specified torque.

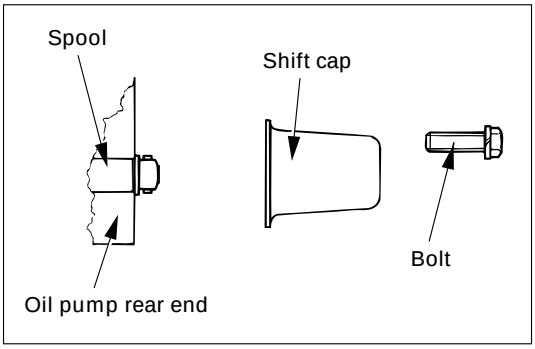
Lock Nut Torque	N·m (kg·m / lb·in)
6 (0.6 / 52)	



281LX00016

NOTE:
If the double nut position of the control cable is not fixed, it is fixed to a reference value.

Control Cable Length (Reference)	mm(in.)
18±1 (0.709±0.039)	



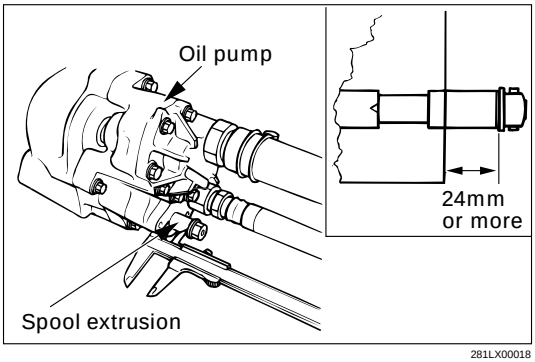
281LX00017

Control Cable Adjustment

Inspecting the Amount of Spool Extrusion

After having installed the control cable, inspect the amount of spool extrusion according to the following procedure.

(1) Remove the shift cap tightening bolt of the oil pump rear and remove the shift cap.

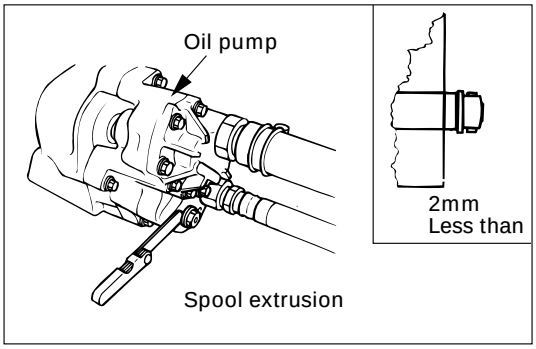


281LX00018

(2) Repeat the "Up" and "Down" operations of the dump lever twice or three times and slowly set the dump lever to the "Up" position as much as possible.

(3) Measure the amount of spool extrusion of the oil pump rear and check that it is a specified amount.

Amount of Spool Extrusion	mm(in.)
24 (0.945) or more	



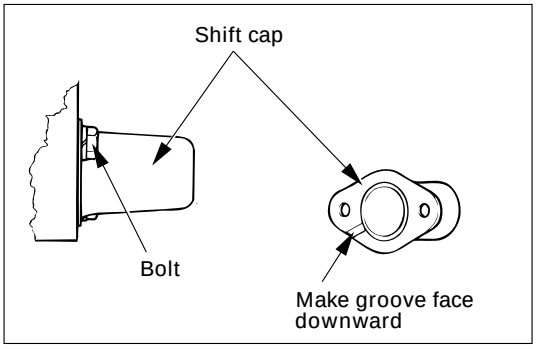
281LX00019

(4) Repeat the "Up" and "Down" operations of the dump lever twice or three times and slowly set the dump lever to the "Up" position as much as possible.

(5) Measure the amount of spool extrusion of the oil pump rear and check that it is a specified amount.

Amount of Spool Extrusion	mm(in.)
less than 2 (0.0787)	

NOTE:
Both amounts of spool extrusion at "Up" and "Down" shall be within a standard value.

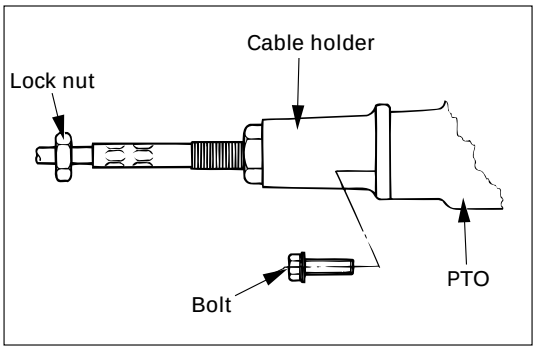


281LX00020

(6) If the amount of spool extrusion is within a specified dimension, install the shift cap and tighten the bolt at a specified torque.

Shift Cap Fixing Bolt Torque	N·m (kg·m / lb·ft)
24 (2.4 / 17)	

NOTE:
If the groove is not installed facing downward, the water intruded in the shift cap is not ejected but collected. Rusting and freezing will cause an incorrect actuation.



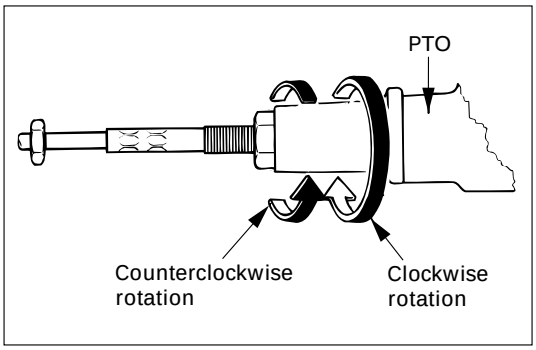
281LX00021

Cable Adjustment (PTO Side)

If no specified extrusion dimensions can be obtained as a result of measuring the amount of spool extrusion described previously, adjust (PTO side) the cable so that the specified amount of spool extrusion can be obtained according to the following procedure.

(1) Loosen the lock nut of the control cable.

(2) Remove the tightening bolt of the cable holder.

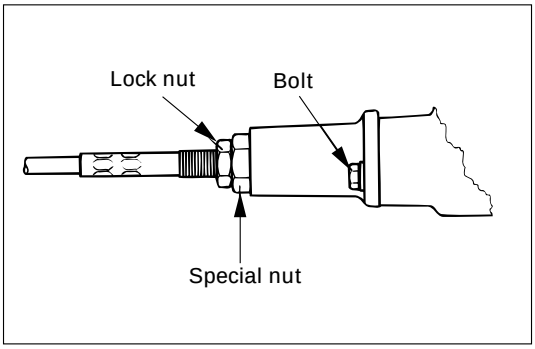


281LX00022

(3) Adjust the cable rotating the cable holder.

- If the amount of spool extrusion is improper (insufficient) at "Dump lever Up", rotate the cable holder toward "Counterclockwise rotation" shown by the arrow mark of the drawing.
- If the amount of spool extrusion is improper (excessive) at "Dump lever Down", rotate the cable holder toward "Clockwise rotation" shown by the arrow mark of the drawing.

NOTE:
Both "clockwise rotation" and "counterclockwise rotation" indicate that the cable moves by about 0.75 mm (0.0295 inch) every time the cable holder rotates by 180 degrees.



231LX00023

(4) If the cable is adjusted in the aforementioned method and the amount of spool extrusion cannot be obtained, repeat Items (2) and (3) and adjust the cable so that the amount of spool extrusion will reach a specified extrusion dimension.

(5) If a spool extrusion dimension can be obtained, tighten the cable holder tightening bolt and lock nut at a specified torque in this order.

Cable Holder Bolt Torque	N·m (kg·m / lb·ft)
23 (2.3/ 17)	

Lock Nut Torque	N·m (kg·m / lb·ft)
21 (2.1 / 15)	

Operability of the dump lever, rise of the body (cargo deck), and inspection and adjustment of the rise and fall reference times

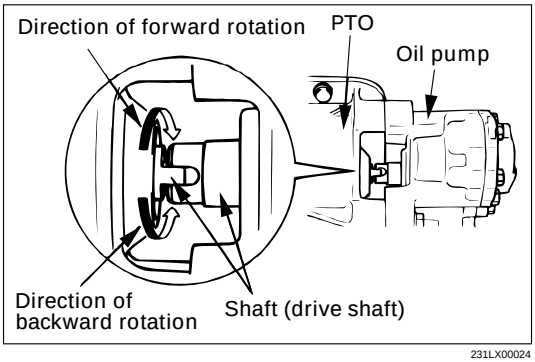
(1) Check that the engine revolution per minute is 1,250 rpm and the rise and fall operations of the body (cargo deck) are performed within the following reference times.

Rise Time And Fall Time	Rise	Fall (Sec.)
Single Cab	within 20	within 20
Double Cab		within 25

(2) Inspection of the dump lever control force and moderation

- Inspect that the operation of the dump lever can lightly and smoothly be performed.

Basic Value (On the Dump Lever Knob)	kgf (N)
10 (98)	



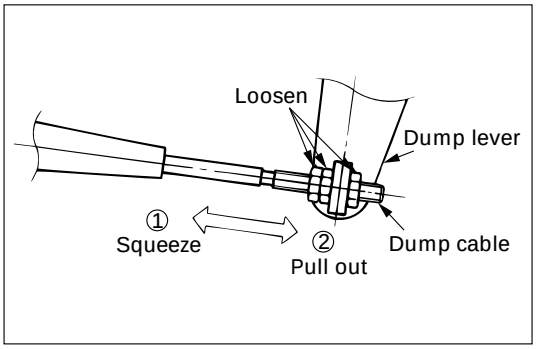
231LX00024

- When the dump lever is in the "Up" and "Down" positions, inspect that the lock operation can be performed without a feeling of physical disorder.

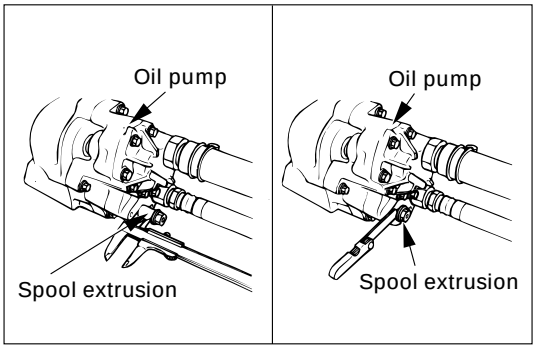
(3) After having repeated the "Up" and "Down" positions of the dump lever and slowly set them to the "Down" position as much as possible, inspect the shaft (driving shaft) between the PTO and oil pump.

- Inspect that the shaft (driving shaft) rotates forward or backward.

  If the shaft slowly rotates backward, it is normal.



231LX00025



231LX00026

Cable Adjustment (Dump Lever Side)

If a defect is found as a result of the inspection of the aforementioned items (1) to (3), adjust the control cable in the dump lever portion inside the cab according to the following procedure.

(1) Set the dump lever to the "Down" position.

(2) Loosen the lock nut of the control cable and adjust the cable as follows:

When the rise time is improper or when the shaft is inverted at "Down" time or when the dump lever is hard to lock at "Down" time, move the inner cable to Direction (1) of the drawing.

When the fall time is improper or when the dump lever is hard to lock at "Up" time or when the shaft rotates forward at "Down" time, move the inner cable to Direction (2) of the drawing.

NOTE:
If the cable is adjusted on the dump lever side, be sure to re-inspect the amount of spool extrusion.

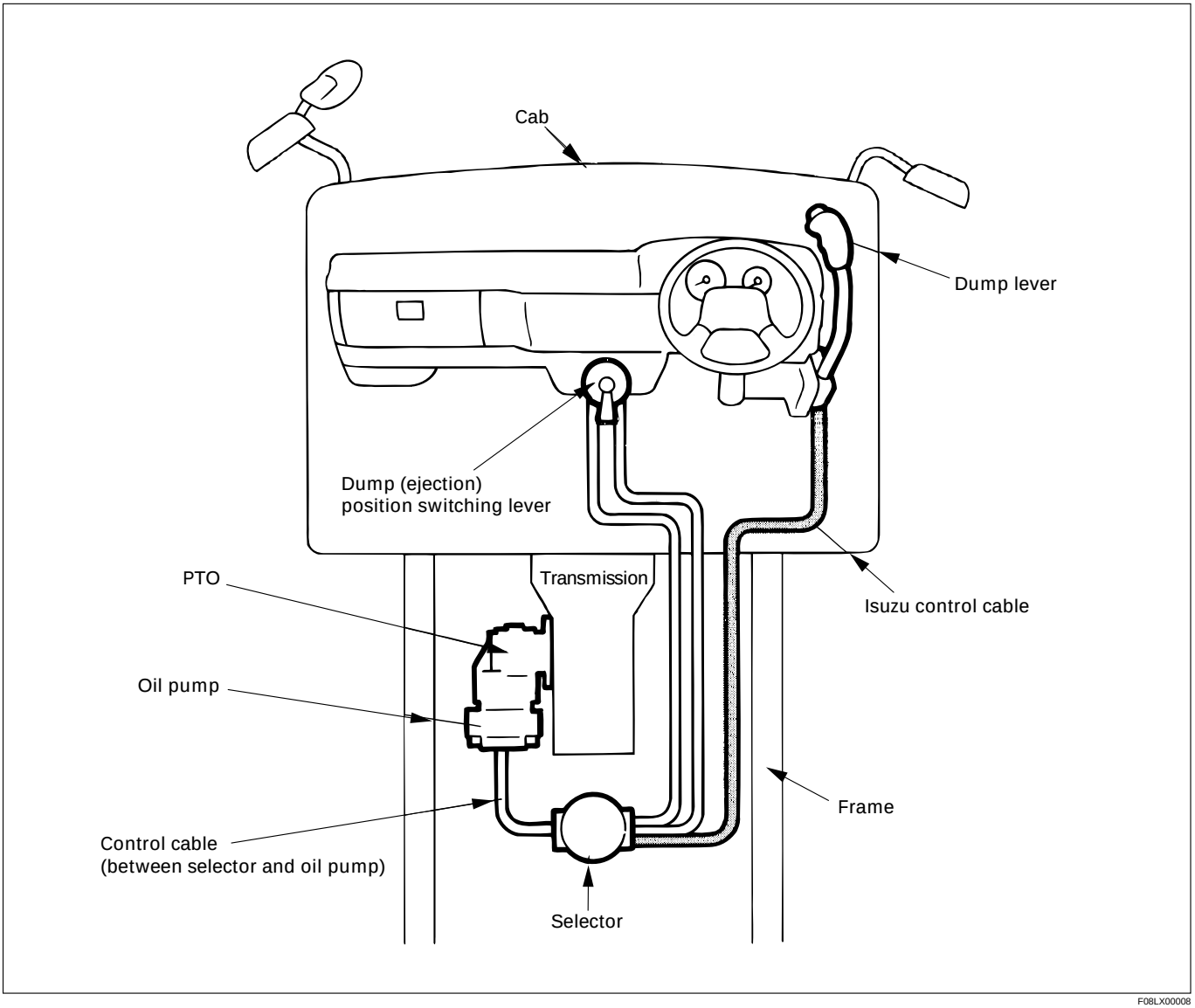
(3) After adjustment, tighten the lock nut at a specified torque.

Lock Nut Torque	N·m (kg·m / lb·in)
	6 (0.6 / 52)

NOTES ON REPLACING AND ADJUSTING CONTROL CABLE FOR THREE-ROTATION DUMP TRUCK

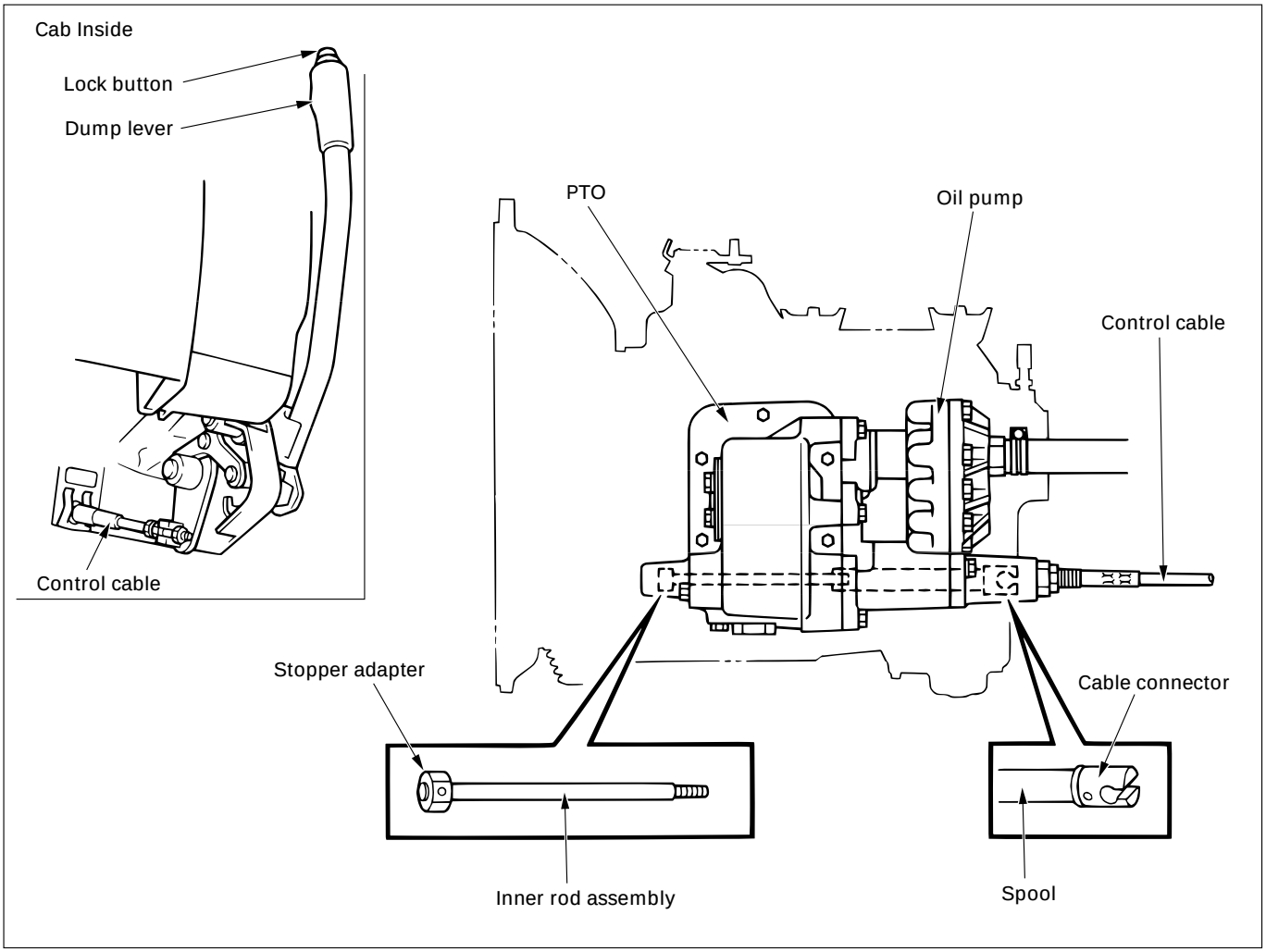
1. The control cable between the "Dump lever and selector" of the three-rotation dump truck is manufactured by ISUZU MOTORS LIMTED. This control cable is sent for (at replacement) in the Isuzu Motors Service Network, and because the selector need be disassembled, assembled, and adjusted, request a service network (SS store) of a body manufacturer of the replacement work.
2. The selector main unit for the three-rotation dump truck and the control cable between the "Selector and PTO (with oil pump) are manufactured by a body manufacturer. Request a service network (SS store) of a body manufacturer of the replacement work of the selector main unit and the aforementioned control cable.
3. First adjust the control cable at the dump lever bottom, adjust the control cable in the cable holder portion of the PTO (oil pump portion), and check that the shaft (driving shaft) of the oil pump will not rotate concurrently. Then because the adjustment of the selector main unit is necessary (only at down lever down, the ejection direction of the cargo deck can be selected. If this adjustment is improper, the cargo deck may fall off.), request a service network of a body manufacturer of the adjustment.

Control Cable Rough Layout Drawing for Three-Rotation Dump Truck

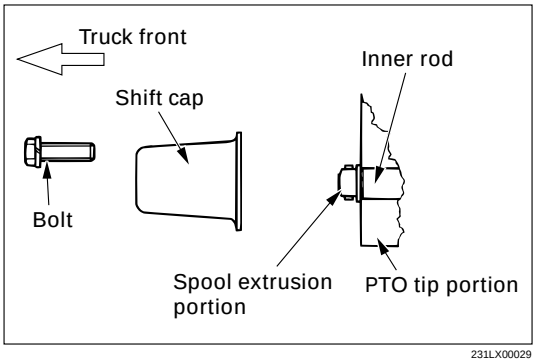


F08LX00008

CONTROL CABLE ADJUSTMENT FOR THREE-ROTATION DUMP TRUCK



281LX00028

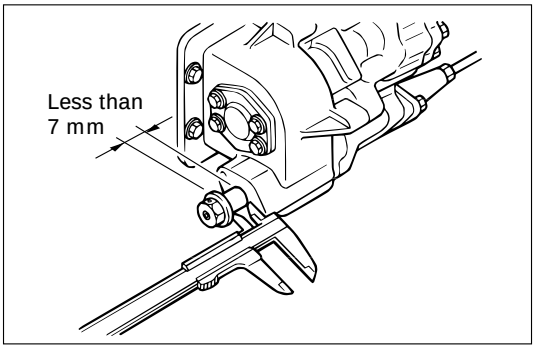


231LX00029

Replacement

(1) The control cable between the "Dump lever and selector" of the three-rotation dump truck is manufactured by Isuzu Motors Ltd. This control cable is sent for (at replacement) in the Isuzu Motors Service Network, and because the selector need be disassembled, assembled, and adjusted, request a service network (SS store) of a body manufacturer of the replacement work.

(2) The selector main unit for the three-rotation dump truck and the control cable between the "Selector and PTO (with oil pump) are manufactured by a body manufacturer. Request a service network (SS store) of a body manufacturer of the replacement work of the selector main unit and the aforementioned control cable.



231LX00030

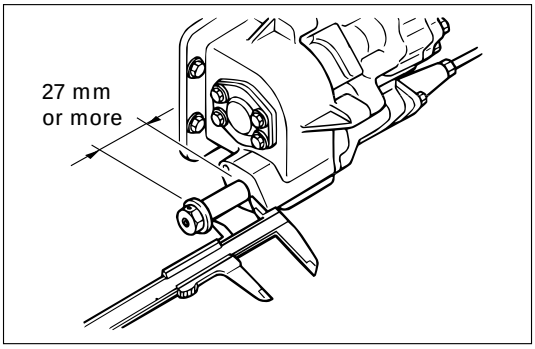
Measurement of the Amount of Spool Extrusion (PTO Tip Portion)

(1) Remove the shift cap tightening bolt of the PTO tip portion and remove the shift cap.

(2) Operate the dump lever twice or three times and slowly set it to the "Up" position as much as possible, then firmly lock the dump lever.

(3) Measure the amount of spool extrusion at "Up" time at the PTO tip portion and check that it is a basic value.

Amount of Spool Extrusion	mm (in.)
less than 7 (0.276)	



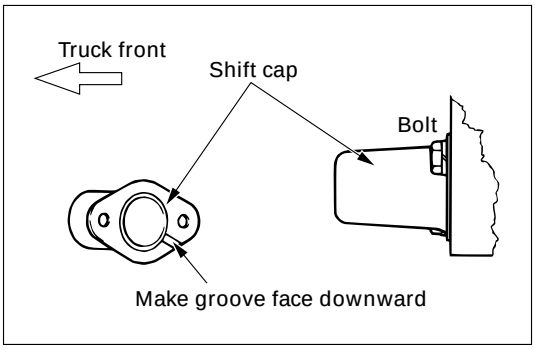
231LX00031

(4) Operate the dump lever twice or three times and slowly set it to the "Down" position as much as possible, then firmly lock the dump lever.

(5) Measure the amount of spool extrusion at "Down" time at the PTO tip portion and check that it is a basic value.

Amount of Spool Extrusion	mm (in.)
27 (1.063) or more	

NOTE:
Be sure check that both amounts of spool extrusion at "Up" and "Down" times are within basic values.



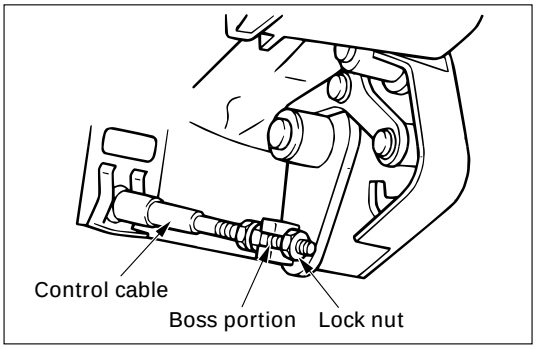
231LX00032

(6) As a result of measurement, if the amount of spool extrusion is within a basic value, install the shift cap and tighten the bolt at a specified torque.

- Install the shift cap so that the groove on the locating plane can locate downward.

Shift Cap Bolt Torque	N·m (kg·m / lb·ft)
24 (2.4 / 17)	

NOTE:
If the groove is not installed facing downward, the water intruded in the shift cap is not ejected but collected. Rusting and freezing will cause an incorrect actuation.



231LX00033

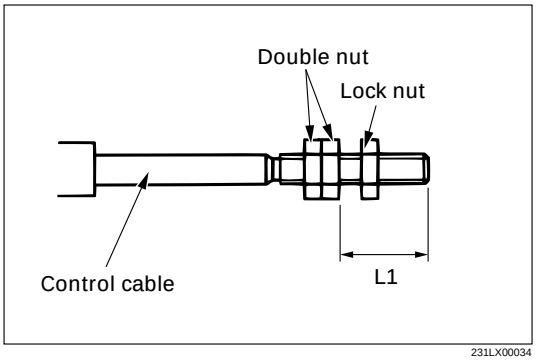
Adjustment of the Amount of Spool Extrusion (Control Cable Adjustment)

NOTE:
As a result of the "Measurement of The Amount of Spool Extrusion" described previously, if a specified extrusion dimension cannot be obtained, adjust the control cables on the dump lever side inside the cab and the dump lever side according to the following procedure.

Control Cable Adjustment (Dump Lever Side Inside Cab)

(1) Operate the dump lever twice or three times with the engine in the stopped state and slowly set it to the "Up" position, then firmly lock the dump lever.

(2) Measure the length "L1" on the control cable tip and double nut side shown in the drawing and check that it is within the following basic value.

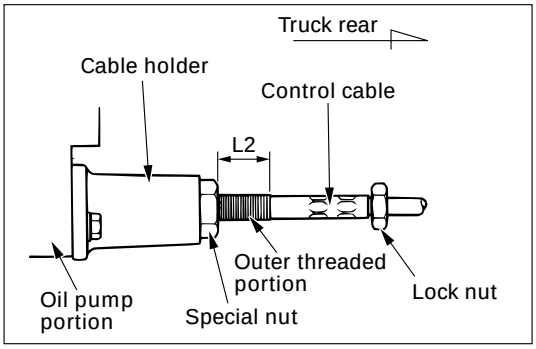


231LX00034

Length "L1"	mm (in.)
14±1 (0.55±0.039)	

(3) As a result of measurement, if the length "L1" does not satisfy a basic value, loosen the lock nut and adjust the control cable so that the length "L1" will be set to a specified length "L1", then tighten the lock nut at a specified torque.

Lock Nut Torque	N·m (kg·m / lb·in)
6 (0.6 / 52)	



231LX00035

Control Cable Adjustment (Oil Pump Side)

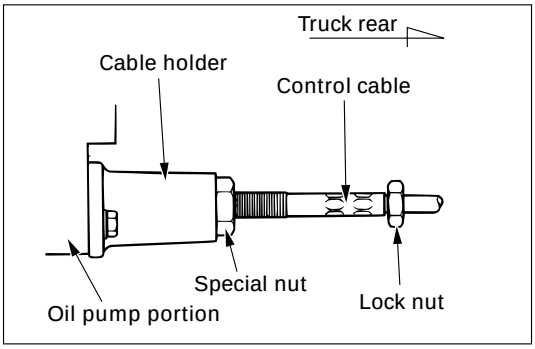
(1) Tighten the special nut in the cable holder loosening the lock nut, moving it to the truck rear, and lightly pushing the control cable against the PTO side.

(2) Measure the length "L2" between the outer screw tip portion and special nut end of the control cable shown in the drawing and check that it is within a basic value.

Length "L2" (Reference)	mm (in.)
$24\ ^{+1}_{-0}$ ($0.945\ ^{+0.039}_{-0}$)	

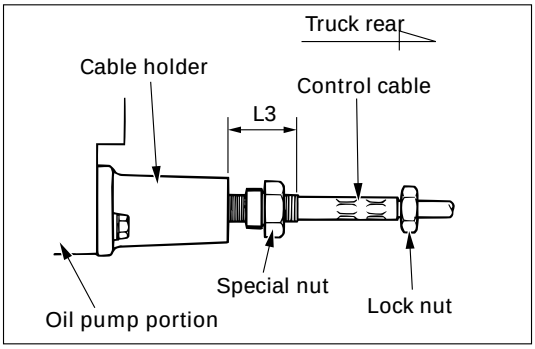
- As a result of check, if the length "L2" is satisfied, tighten the lock nut at a specified torque.

Lock Nut Torque	N·m (kg·m / lb·ft)
20 (2.0 / 14)	



231LX00036

3) As a result of measurement, if the length "L2" does not satisfy a basic value, adjust the control cable according to the following procedure.

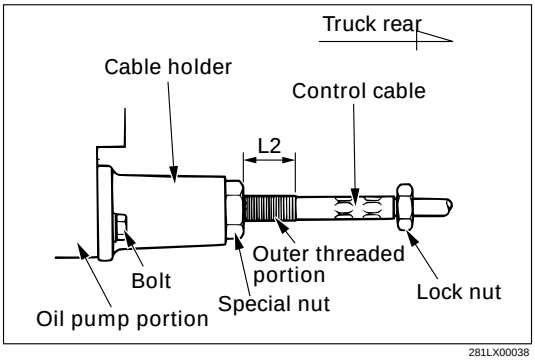


231LX00037

① Loosen the special nut and move it toward the truck rear, then set the control cable free.

② Manually holding the control cable, take in and out the cable to the front and rear. Obtain the length "L3" and temporarily tighten the special nut securing the control cable manually.

"L3" = "L2" basic value + Special Nut Thickness (10 mm)

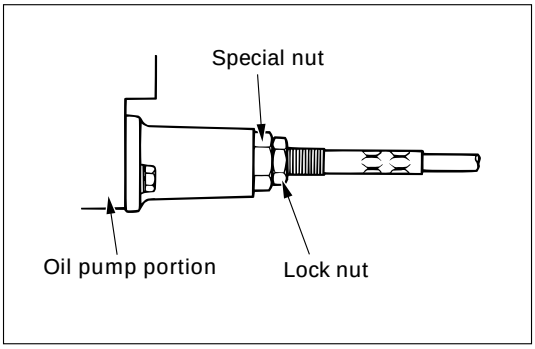


281LX00038

③ Measure the length "L2" in the state of ②. If the dimension does not satisfy a basic value, repeat Items ② and ③ and adjust so that the "L2" will be set to the basic value.

④ After having the length "L2", tighten the special nut at a specified torque.

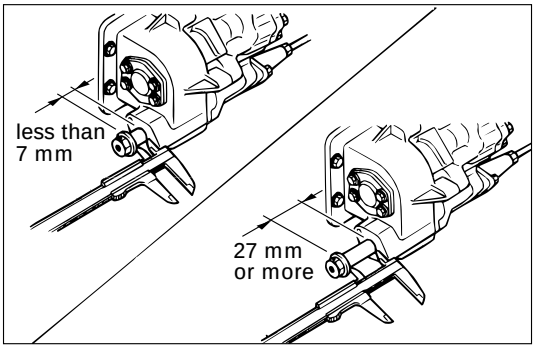
Special Nut Torque	N·m (kg·m / lb·ft)
142 (14.5 / 105)	



281LX00039

⑤ After having tightened the special nut, tighten the lock nut at a specified torque.

Lock Nut Torque	N·m (kg·m / lb·ft)
20 (2.0 / 14)	



281LX00040

(4) After having adjusted the control cable, slowly operate the dump lever twice or three times and recheck the spool extrusion dimension.

(Refer to the item of Measurement of The Amount of Spool Extrusion on Page 24.)

(5) After having completed all measurement and adjustments, set the dump lever to the "Down" position and start the engine.

Operability of the Dump Lever, Rise of the Body (Cargo Deck), and Inspection and Adjustment of the Rise and Fall Reference Times

(1) Check that the engine revolution per minute is 1,250 rpm and the rise and fall operations of the body (cargo deck) are performed within the following reference times.

Rise time = within 20 seconds

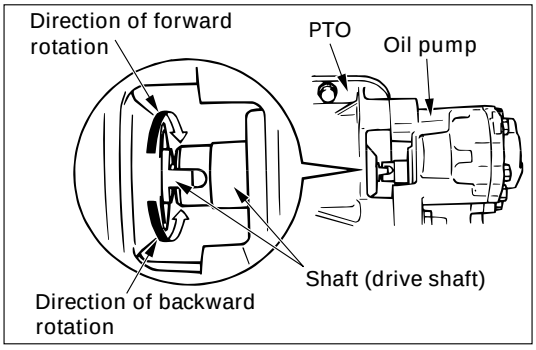
Fall time = within 20 seconds

(2) Inspection of the dump lever control force and moderation

- Inspect that the operation of the dump lever can lightly and smoothly be performed.

Basic value = less than 10 kgf (98N) on the dump lever knob

- When the dump lever is in the "Up" and "Down" positions, inspect that the lock operation can be performed without a feeling of physical disorder.

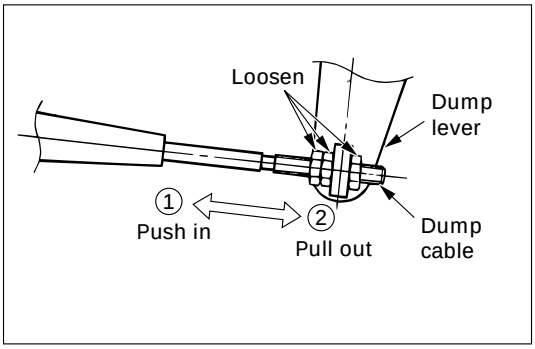


281LX00041

(3) After having repeated the "Up" and "Down" positions of the dump lever and slowly set them to the "Down" position as much as possible, inspect the shaft (driving shaft) between the PTO and oil pump.

- Inspect that the shaft (driving shaft) rotates forward or backward.

  If the shaft slowly rotates backward, it is normal.



(4) If a defect is found as a result of the inspection of the aforementioned items (1) to (3), adjust the control cable in the dump lever portion inside the cab according to the following procedure.

① Set the dump lever to the "Down" position.

② Loosen the lock nut of the control cable and adjust the cable as follows:

When the rise time is improper or when the dump lever is hard to lock at "Down" time, move the inner cable to Direction ② of the drawing on the preceding page.

When the fall time is improper or when the dump lever is hard to lock at "Up" time or when the shaft rotates forward at "Down" time, move the inner cable to Direction ① of the drawing on the preceding page.

NOTE:
If the cable is adjusted on the dump lever side, be sure to re-inspect the amount of spool extrusion.

After adjustment, tighten the lock nut at a specified torque.

Lock Nut Torque	N·m (kg·m / lb·in)
	6 (0.6 / 52)

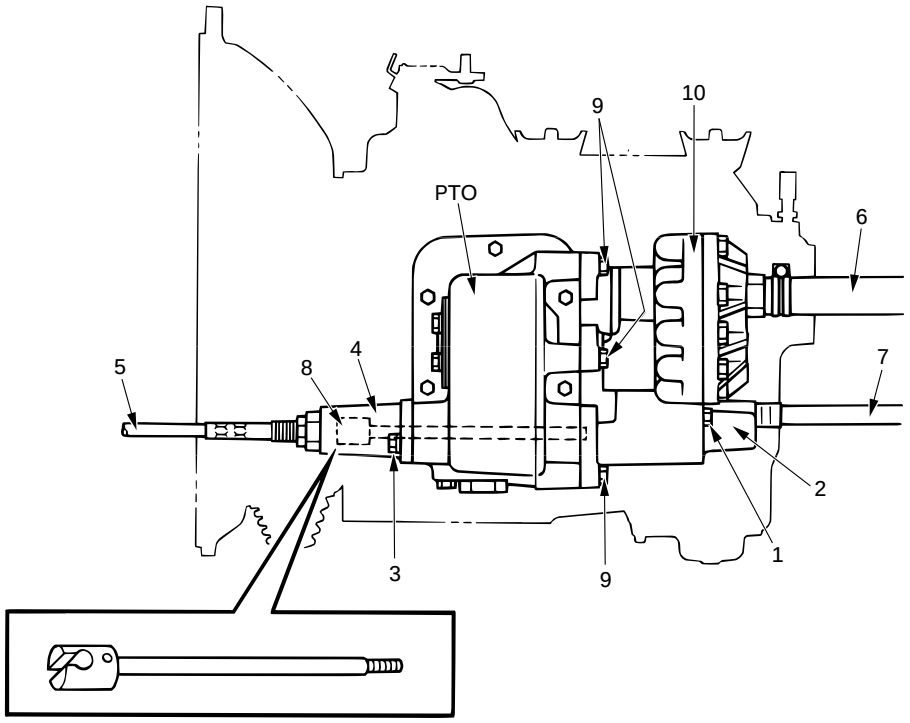
* Selector

The selector is adjusted so that the ejection direction of the cargo deck can be selected only at dump lever "Down". If this adjustment is improper, the cargo deck may slide from the truck at rise. Accordingly, because the adjustment of the selector main unit is also needed after the replacement, adjustment, and inspection of the control cable, request a nearest service network (SS store) of a body builder of the adjustment.

OIL PUMP UNIT (REPLACEMENT)

REMOVAL AND INSTALLATION

* This illustration is based on a rear dump truck model.



281LX080

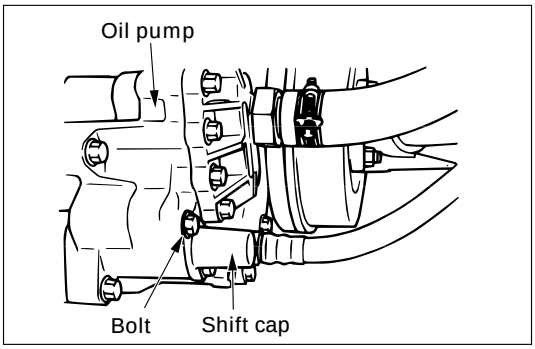
Removal Steps

1. Bolt (shift cap)
2. Shift cap
3. Bolt (cable holder)
4. Cable holder
5. Control cable
6. Low-pressure hose
7. High-pressure hose
8. Inner rod assembly
9. Bolt (oil pump)
10. Oil pump

Installation Steps

To install, follow the removal steps in the reverse order.

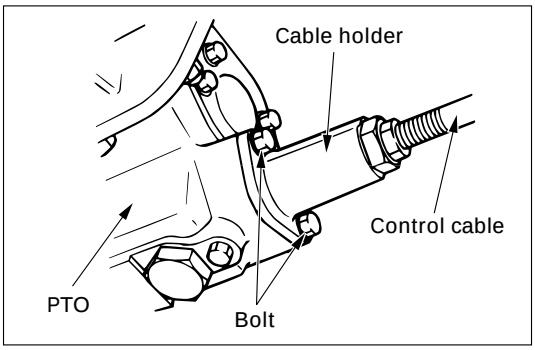
Removal Steps



285LX00001

NOTE:
Set the dump lever inside the cab to the "Down" position and check the lever lock.

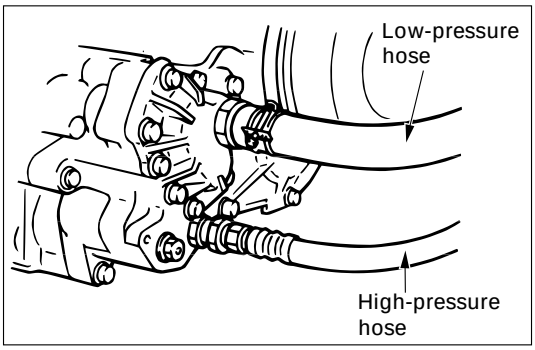
1. **Bolt (Shift Cap)**
2. **Shift Cap**
   - Remove the bolt and remove the shift cap from the oil pump.



285LX00002

3. **Bolt (Cable Holder)**
4. **Cable Holder**
5. **Control Cable**

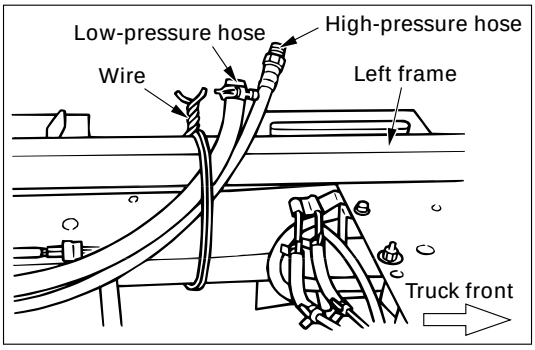
NOTE:
Before removing the control cable, be sure to refer to Items 3 to 6 of "Removal" of the "Control Cable Replacement and Adjustment for Rear Dump Truck" described previously and perform work in accordance with the items.



285LX00003

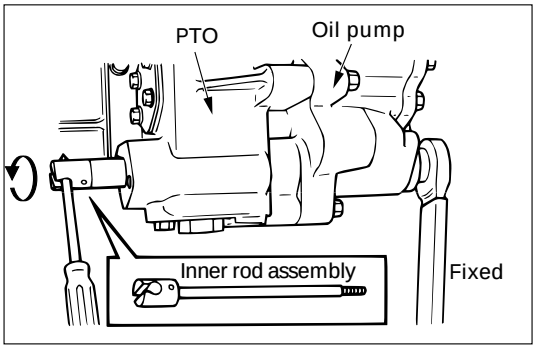
6. **Low-Pressure Hose**
   - Loosen the hose band and remove the hose from the oil pump.
7. **High-Pressure Hose**
   - Loosen the hose joint and remove the hose from the oil pump.

NOTE:
For the high-pressure hose, the joint may not be removed in the oil pump fixed state according to the type of the truck and equipment. In that case, slightly loosen the joint to set the state. At the stage where the rear oil pump is removed (Item 10), remove the high-pressure hose rotating the oil pump.

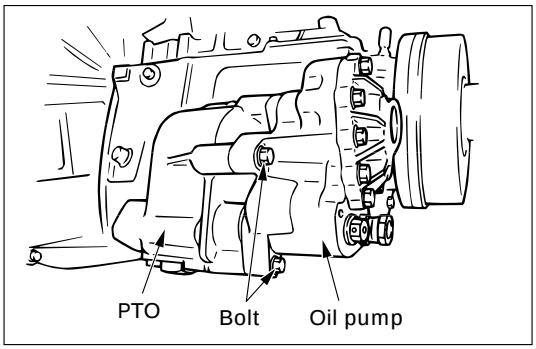


285LX00004

NOTE:
Because hydraulic operating fluid flows out when the hose is removed, quickly make the hose port face upward and protect the hose so that dust or foreign matter will not be mixed in, then fix it to the frame with a wire.



281LX00044



281LX00045

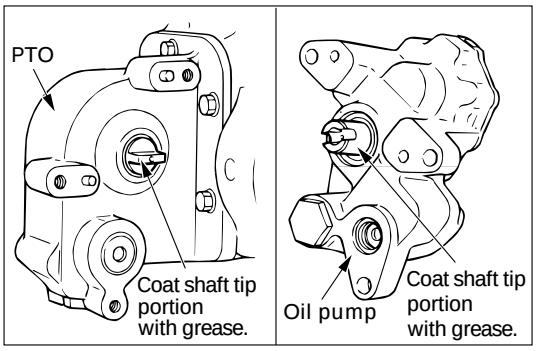
8. **Inner Rod Assembly**
   - To remove the inner rod assembly, as shown in the drawing, press the stopper adapter side by a wrench and insert a Phillips screwdriver (large) in the groove of the control cable connector. Then rotate it counterclockwise, loosen it, and remove it.

NOTE:
Be sure to press the stopper adapter side and loosen it on the control cable connector side. (Press the stopper adapter side not to rotate the spool valve. Besides, the three-rotation dump truck is in contrast with this.)

9. **Bolt (Oil Pump)**
10. **Oil Pump**
    - Remove three oil pump tightening bolts and strike them with a plastic hammer (or a wooden hammer) from the truck front side, then remove the oil pump from the PTO.
    - Remove the joint from the oil pump.

NOTE:
If the high-pressure hose could not be removed in Item 7 described previously, remove the oil pump from the high-pressure hose rotating the oil pump at this time.

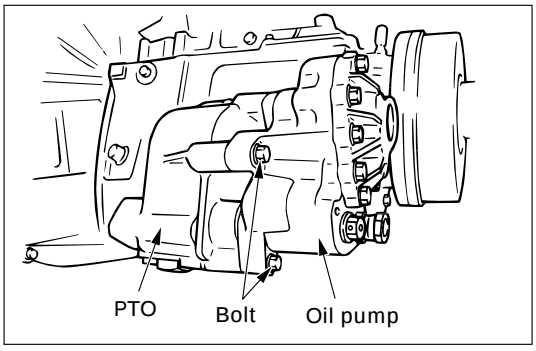
Installation Steps



281LX00046

10. **Oil Pump**
9. **Bolt (Oil Pump)**
   - Fully coat the oil pump shaft tip groove portion and PTO shaft tip with lithium grease (BESCO L-2 or equivalent).
   - Install the oil pump in the joint.

NOTE:
If the oil pump is rotated and removed from the high-pressure hose when the oil pump is removed, install the oil pump in the high-pressure hose rotating the oil pump and slightly tighten it.

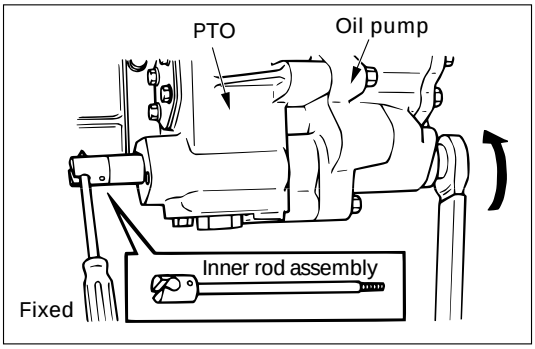


281LX00045

- Align and install the oil pump groove and the shaft width across flats of the PTO and tighten the bolt at a specified torque.

PTO Bolt Torque	N·m (kg·m / lb·ft)
	53 (5.4 / 39)

NOTE:
Be fully careful so that dust or foreign matter will not be mixed in from the hose installation port of the oil pump.

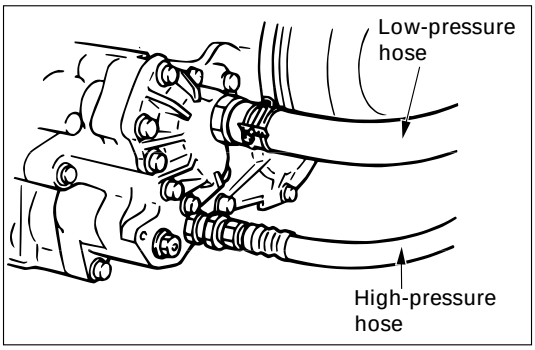


281LX00047

8. Inner Rod Assembly

- Coat the threaded portion of the inner rod assembly tip with liquid gasket (LOCTITE 242 or equivalent) and insert and screw the tip from the front side of the PTO, then tighten it at a specified torque.
- When tightening the inner rod assembly, insert a Phillips screwdriver (large) in the control cable connector groove, press it so that the spool valve will not rotate, then apply a wrench to the stopper adapter on the oil pump side to tighten it. (Besides, the three-rotation dump truck is in contrast with this.)

Inner Rod Torque	N·m (kg·m / lb·ft)
19 (1.9 / 14)	



285LX00003

7. High-Pressure Hose

- Install the high-pressure hose in the oil pump and firmly tighten the joint.

NOTE:
If the oil pump is rotated and installed in the high-pressure hose in Item 10 described previously, firmly tighten the joint.

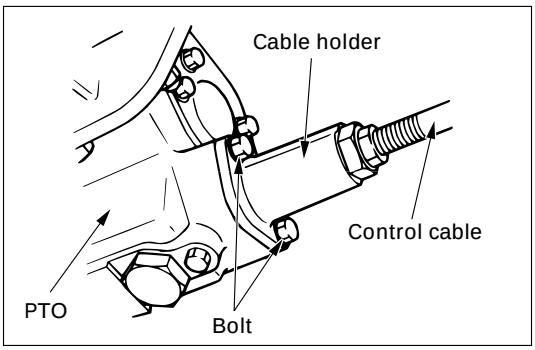
6. Low-Pressure Hose

- Install the hose and firmly tighten the hose band.

NOTE:
When installing both the high-pressure and low-pressure hoses, be fully careful so that dust or foreign matter will not be mixed in the hose port and oil pump.

Joint Torque		N·m (kg·m / lb·ft)
Item	Size	Torque
High-pressure side	PF1/2	103 (10.5 / 76)
Low-pressure side	PF3/4	147 (15 / 108)

* After having tightened the joint using a recommended value, additionally tighten it if there is a leak of oil.



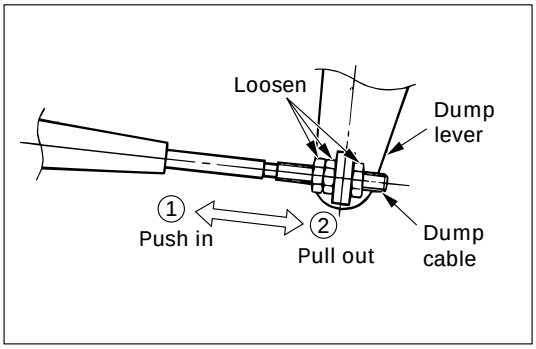
285LX00002

5. Control Cable

4. Cable Holder

3. Bolt (Cable Holder)

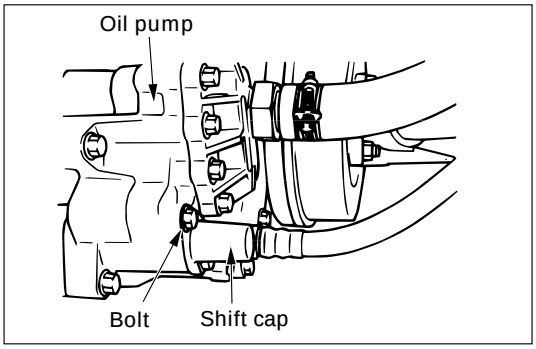
NOTE:
Install the control cable and cable holder in the PTO in accordance with Items 6 to 3 of "Installation Steps" (Page 16) of Removal and Installation of Control Cable for Rear Dump Truck, and after installation, inspect and adjust the spool amount in accordance with the "Amount of Spool Extrusion" (Page 18) described previously.



281LX00042

- After having adjusted the control cable and having inspected or adjusted the amount of spool extrusion, tighten the bolt and the special nut and lock nut of the control cable at a specified torque.

Tightening Torque	N·m (kg·m / lb·ft)
Bolt	24 (2.4 / 17)
Special Nut	206 (21 / 152)
Lock Nut	21 (2.1 / 15)



285LX00001

2. Shift Cap

1. Bolt (Shift Cap)

- Install the shift cap in the oil pump making its grooved side face upward and tighten the bolt at a specified torque

Shift Cap Bolt Torque	N·m (kg·m / lb·ft)
24 (2.4 / 17)	

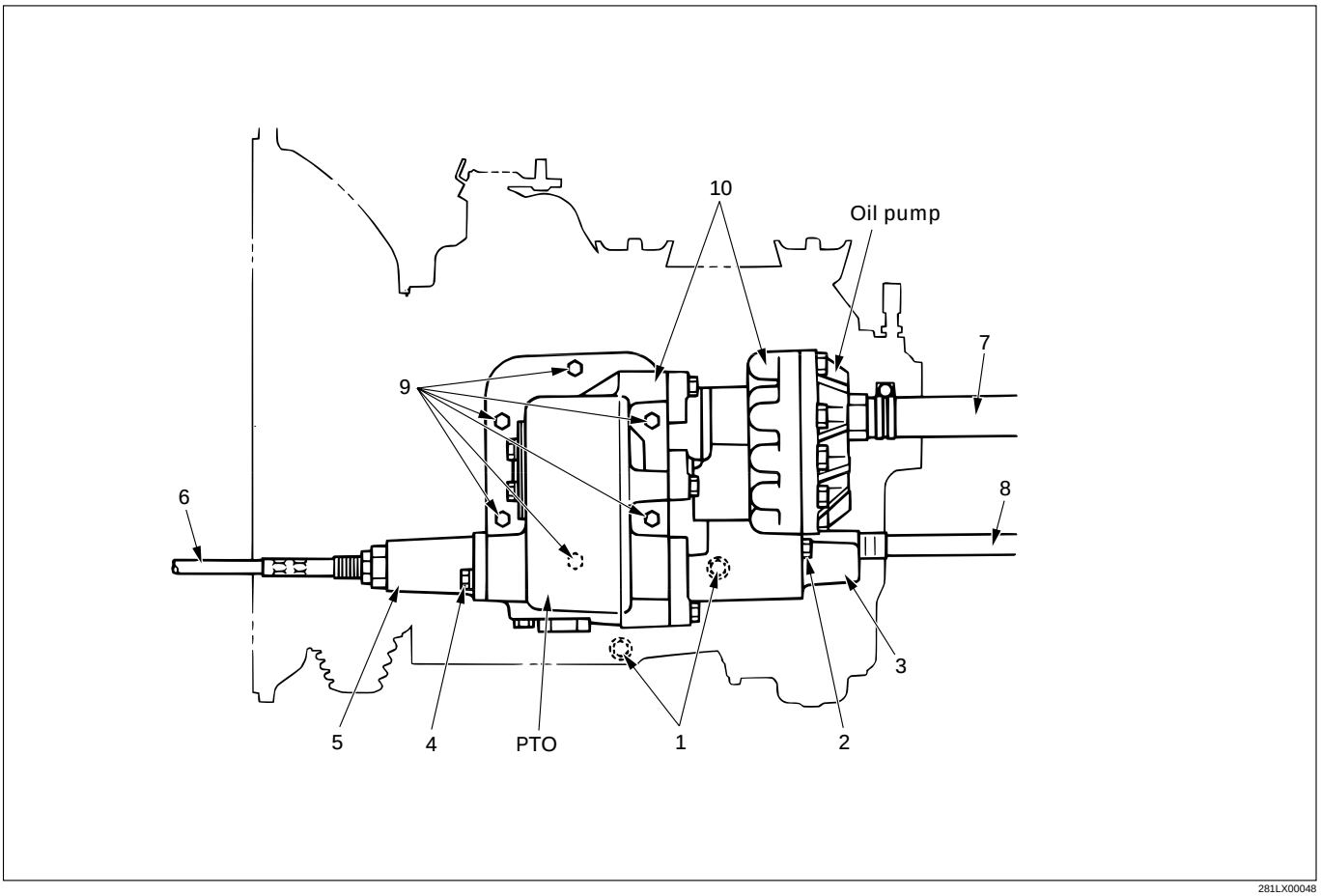
NOTE:
If the groove is not installed facing downward, the water intruded in the shift cap is not ejected but collected. Rusting and freezing will cause an incorrect actuation.

Supply and Air Bleeding of Hydraulic Operating Fluid

After having installed the oil pump, supply hydraulic operating fluid and release air as requested. Supply the hydraulic operating fluid and release air in accordance with the "Inspection and Supply of The Hydraulic Operating Fluid" (Page 5) and the "Air Bleeding Procedure of Hydraulic Operating Fluid" (Page 12) described previously.

PTO (With OIL PUMP) ASSEMBLY

REMOVAL AND INSTALLATION



281LX00048

Removal Steps

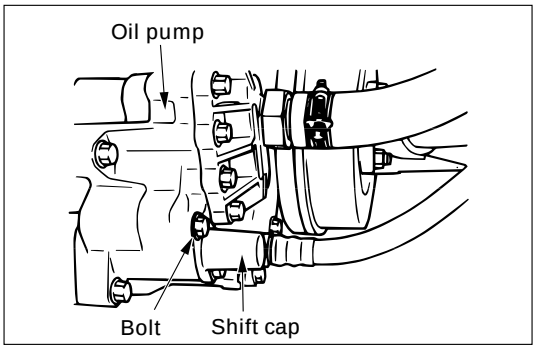
1. Drain plug, filler plug
2. Bolt (shift cap)
3. Shift cap
4. Bolt (cable holder)
5. Cable holder
6. Control cable
7. Low-pressure hose
8. High-pressure hose
9. Bolt (PTO)
10. PTO (with oil pump)

Installation Steps

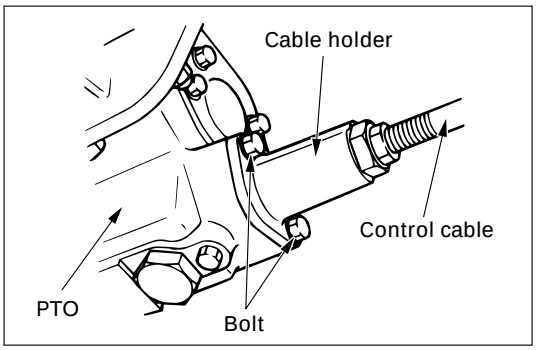
To install, follow the removal steps in the reverse order.

NOTE:
For the three-rotation dump truck, refer to the notes of the "Control Cable Adjustment for Three-Rotation Dump Truck" (Page 23) in the preceding chapter before that.

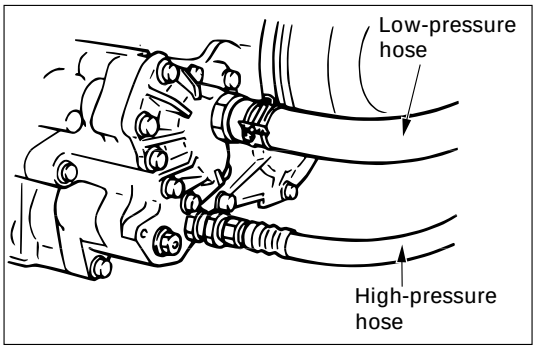
Removal Steps



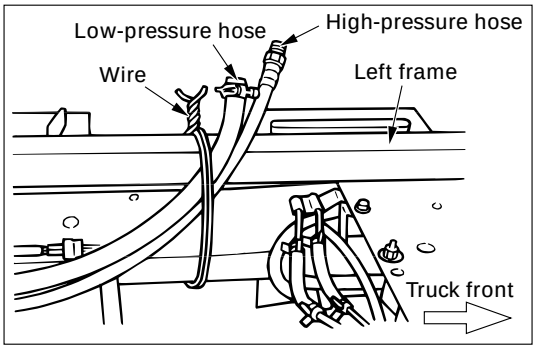
285LX00001



285LX00002



285LX00003



285LX00004

NOTE:
Set the dump lever inside the cab to the "Down" position and check the lever lock.

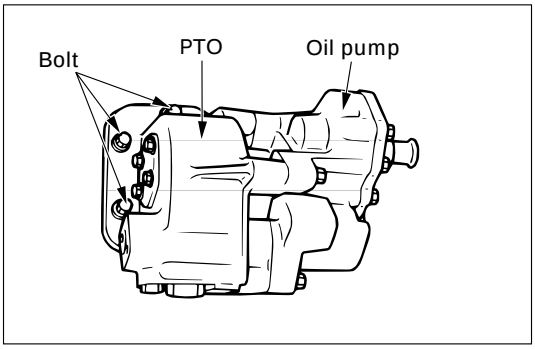
1. **Drain Plug, Filler Plug**
   - Remove the drain plug and filler plug of the transmission and remove the transmission oil.
2. **Bolt (Shift Cap)**
3. **Shift Cap**
   - Remove the bolt and remove the shift cap from the oil pump.
4. **Bolt (Cable Holder)**
5. **Cable Holder**
6. **Control Cable**

NOTE:
Before removing the control cable, be sure to refer to Items 3 to 6 of "Removal Steps" (Pages 15 and 16) in the "Removal and Installation of Control Cable for Rear Dump Truck" in the chapter described previously and perform work in accordance with the items.

7. **Low-Pressure Hose**
   - Loosen the hose band and remove the hose from the oil pump.
8. **High-Pressure Hose**
   - Loosen the hose joint and remove the hose from the oil pump.

NOTE:
For the high-pressure hose, a part of the joint may not be removed according to the type of the truck and equipment. In that case, slightly loosen the joint to set the state. At the stage where the rear PTO is removed (Item 10), remove the high-pressure hose rotating the PTO (with oil pump).

NOTE:
Because hydraulic operating fluid flows out when the hose is removed, quickly make the hose port face upward and protect the hose so that dust or foreign matter will not be mixed in, then fix it to the frame with a wire.



281LX00049

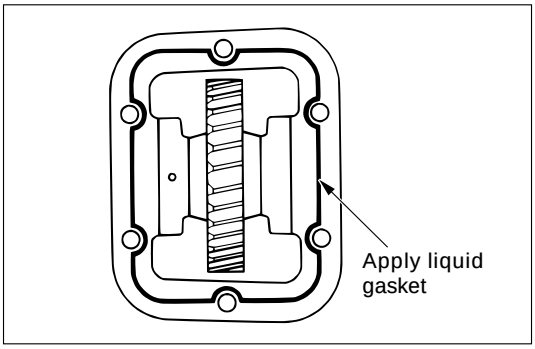
9. Bolt (PTO)

10. PTO (with Oil Pump)

- Remove the six tightening bolts around the PTO and remove the PTO (with oil pump) from the transmission.

NOTE:
If the high-pressure hose could not be removed in Item 8 described previously, remove the PTO (with oil pump) from the high-pressure hose rotating the PTO at this time.
Besides, because this PTO (with oil pump) weighs 15kg (147N), be fully careful of its drop at attachment and detachment.

Installation Steps



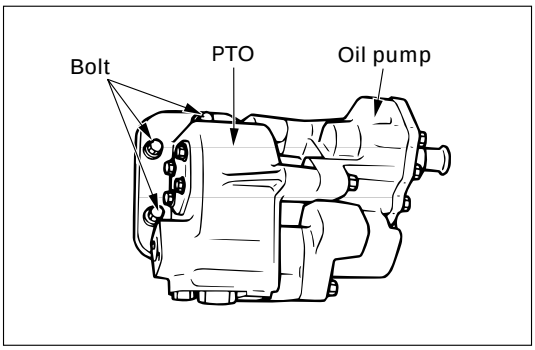
281LX00050

NOTE:
Before installing the PTO, cleanly remove the liquid gasket left on the PTO installation side of the transmission case and clean and degrease the transmission case by waste cloth so that oil will not adhere to it.

10. PTO (with Oil Pump)

- After having cleaned and fully degreased the transmission installation side of the PTO, coat it with liquid gasket (LOCTITE 17430 or equivalent).

NOTE:
When removing the PTO side from the high-pressure hose rotating the PTO side at PTO (with oil pump) removal, install the PTO (with oil pump) in the high-pressure hose and lightly tighten it.

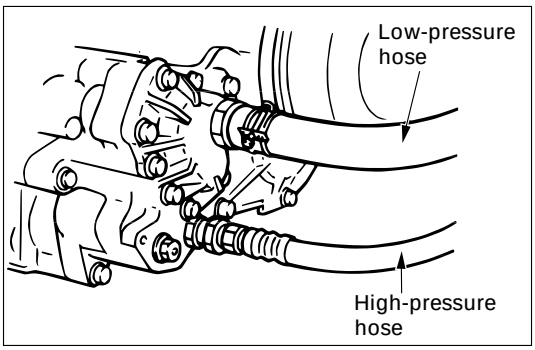


281LX00049

9. Bolt (PTO)

- Install the PTO (with oil pump) in the transmission and tighten the bolt at a specified torque.

PTO Bolt Torque	N·m (kg·m / lb·ft)
	45 (4.6 / 33)



285LX00003

8. High-Pressure Hose

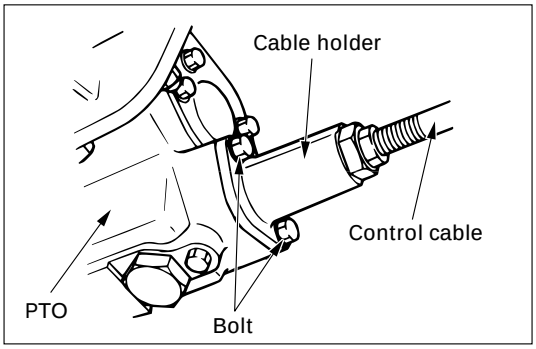
- Install the high-pressure hose in the oil pump and firmly tighten the joint.

NOTE:
When the PTO (with oil pump) is installed in the high-pressure hose rotating the PTO in Item 10 described previously, firmly tighten the joint.

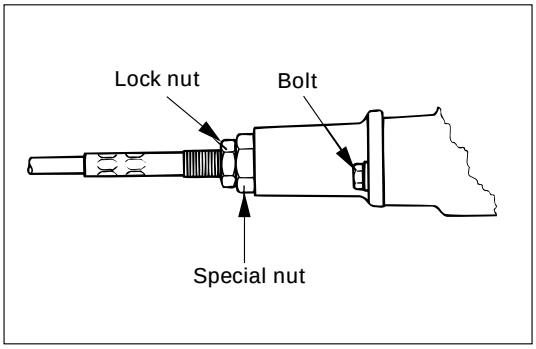
7. Low-Pressure Hose

- Install the hose and firmly tighten the hose band.

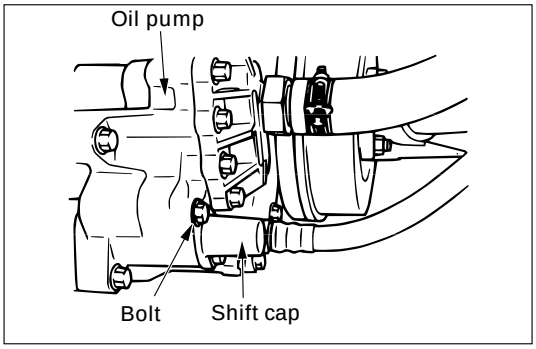
NOTE:
When installing the high-pressure hose and the low-pressure hose, be fully careful so that dust or foreign matter will not be mixed in the pose port and the oil pump.



285LX00002



281LX00023



285LX00001

6. **Control Cable**
5. **Cable Holder**
4. **Bolt (Cable Holder)**

NOTE:
Install the control cable and cable holder in the PTO in accordance with Items 6 to 3 of "Installation Steps" (Pages 16 and 17) in the "Removal and Installation of Control Cable for Rear Dump Truck", and after installation inspect and adjust it in accordance with the "Amount of Spool Extrusion" (Page 18).

- After having adjusted the control cable and having inspected or adjusted the amount of spool extrusion, tighten the bolt and the special nut and lock nut of the control cable at a specified torque.

Tightening Torque	N·m (kg·m / lb·ft)
Bolt	24 (2.4 / 17)
Special Nut	147 (15 / 108)
Lock Nut	20 (2.0 / 14)

3. **Shift Cap**
2. **Bolt (Shift Cap)**

- Install the shift cap in the oil pump making its grooved side face upward and tighten the bolt at a specified torque.

Shift Cap Bolt Torque	N·m (kg·m / lb·ft)
24 (2.4 / 17)	

1. **Drain Plug, Filler Plug**

- Firmly tighten the drain plug of the transmission.
- Supply the transmission oil (BESCO gear oil trans-axle (5W-30) or equivalent) until it flows out from the filler plug hole and firmly tighten the filler plug.

Amount of Oil (Reference)	Liters (US gal / Imp. gal)
5 speed	3.2 (0.85 / 0.70)
6 speed	4.0 (1.06 / 0.88)

Drain Plug and Filler Plug Torque	N·m (kg·m / lb·ft)
49 (5.0 / 36)	

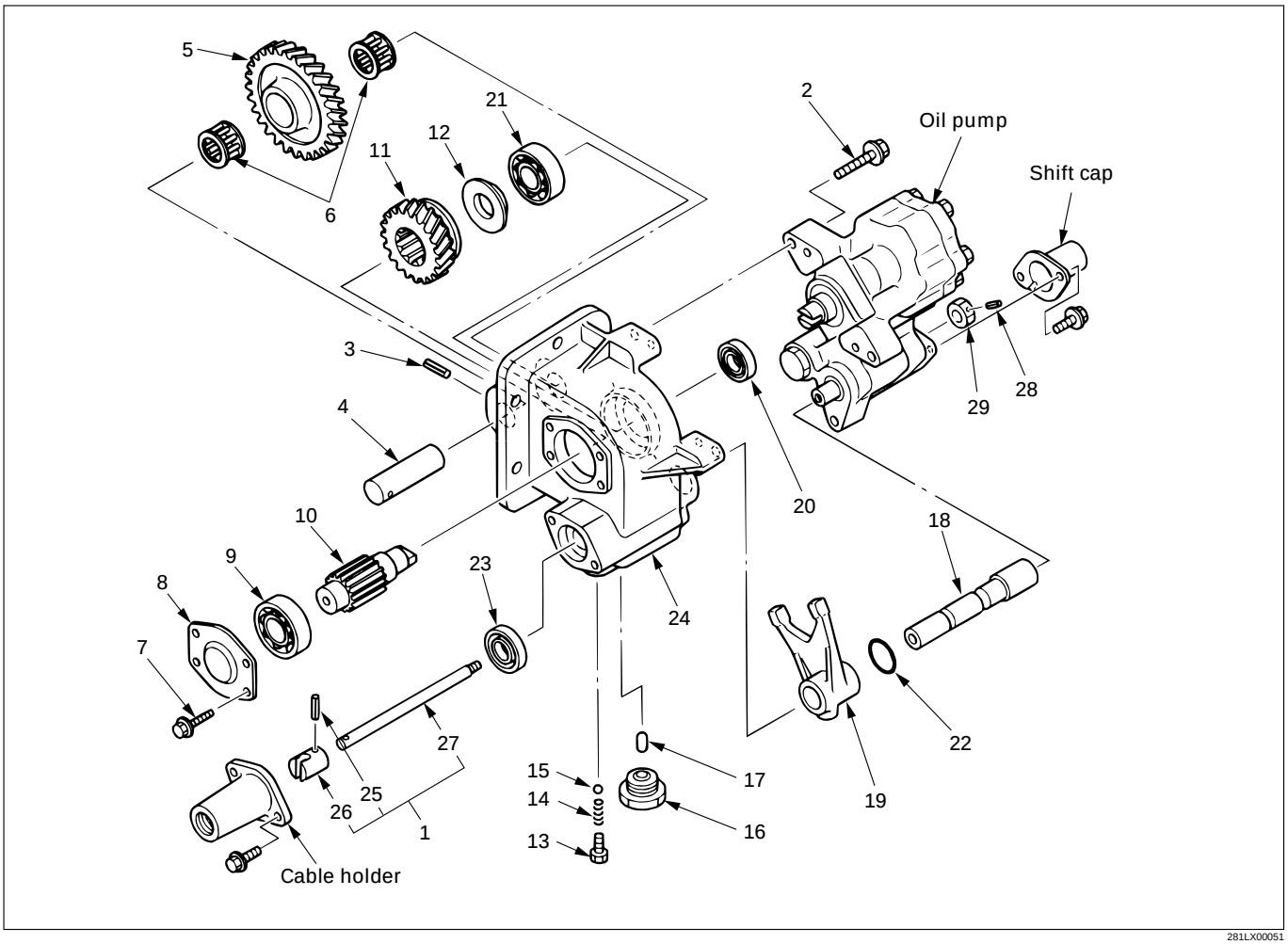
Supply and Air Bleeding of Hydraulic Operating Fluid

After having installed the oil pump, supply hydraulic operating fluid and release air as requested. Supply the hydraulic operating fluid and release air in accordance with the "Inspection and Supply of The Hydraulic Operating Fluid" (Page 5) and the "Air Bleeding Procedure of the Hydraulic Operating Fluid" (Page 12) described previously.

UNIT REPAIR

PTO ASSEMBLY

DISASSEMBLY

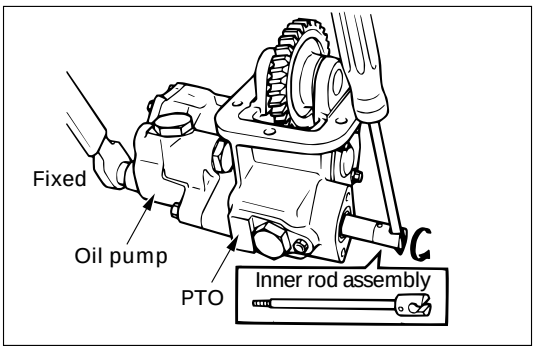


281LX00051

Disassembly Steps

1. Inner rod assembly
2. Bolt
3. Spring pin
4. Idle gear shift
5. Idle gear
6. Needle bearing
7. Bolt
8. Case cover
9. Front ball bearing
10. Output shaft
11. Output gear
12. Thrust collar
13. Spring set bolt
14. Spring
15. Ball
16. Interlock plug
17. Interlock pin
18. Shift rod
19. Shift arm
20. Oil seal (output shaft side)
21. Rear ball bearing
22. O-ring
23. Oil seal (shift rod side)
24. Gear case
25. Spring pin
26. Cable connector
27. Inner rod
28. Spring pin
29. Stopper adapter

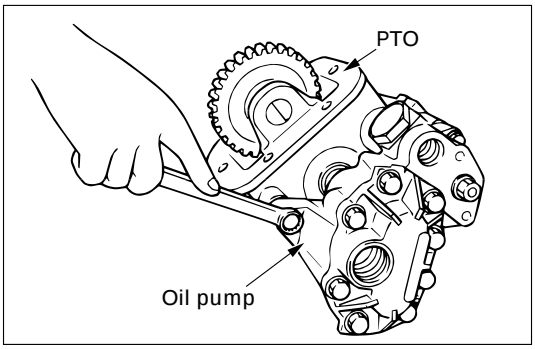
Disassembly Steps



281LX00052

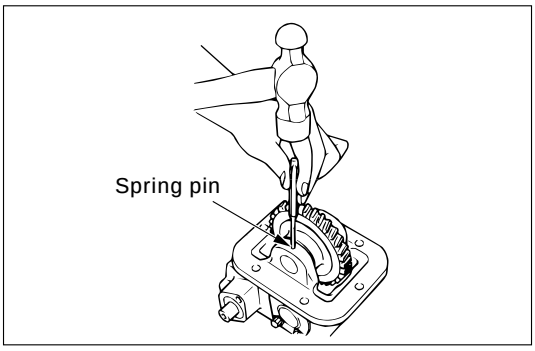
1. **Inner Rod Assembly**
   - Press the stopper adapter side by a wrench and insert a Phillips screwdriver (large) in the groove of the control cable connector. Then rotate it counterclockwise, loosen it, and remove it.

NOTE:
Be sure to press the stopper adapter side and loosen it on the control cable connector side. (Press the stopper adapter side not to rotate the spool valve. Besides, the three-rotation dump truck is in contrast with this.)



281LX00053

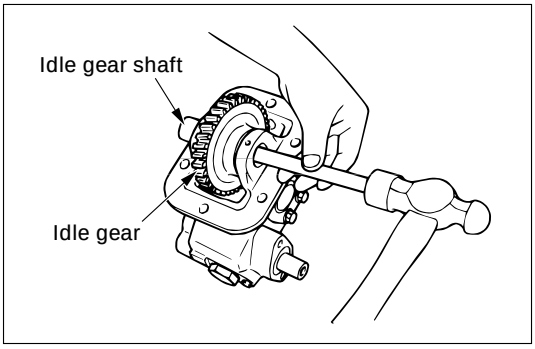
2. **Bolt**
   - Remove three bolts and separate the oil pump and PTO striking the oil pump by a plastic hammer (or wooden hammer).



281LX00054

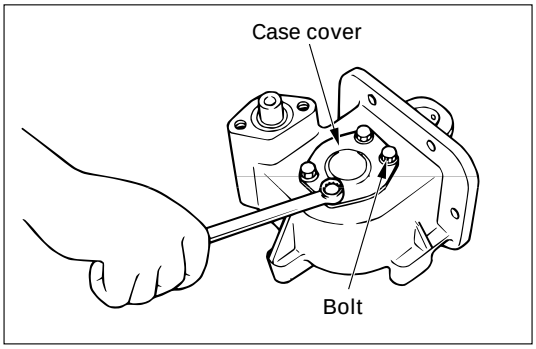
3. **Spring Pin**
   - Punch the spring pin in the idle gear shaft. (After having removed the idle gear shaft, punch the spring pin from the shaft.)

Spring pin bar: 9-8529-2201-0



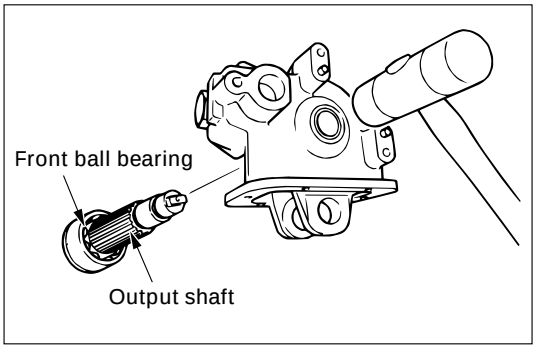
281LX00055

4. **Idle Gear Shaft**
5. **Idle Gear**
6. **Needle Bearing**
   - Strike and remove the idle gear shaft and remove the idle gear, then remove the needle bearing.



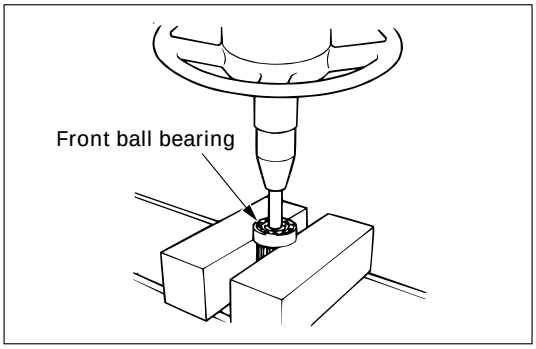
281LX00056

7. **Bolt**
8. **Case Cover**
   - Remove the bolt and remove the case cover.



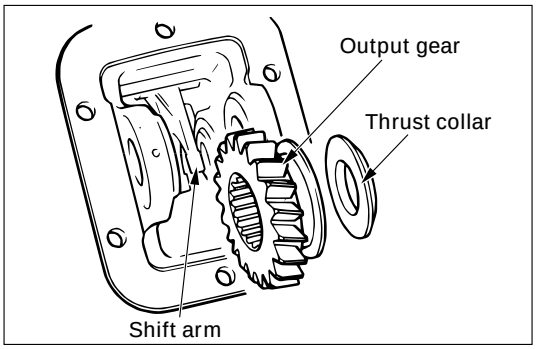
281LX00057

9. **Front Ball Bearing**
10. **Output Shaft**
    - Strike the end face of the output shaft from the rear side and remove the front ball bearing while it is being installed in the output shaft.



F08LX00002

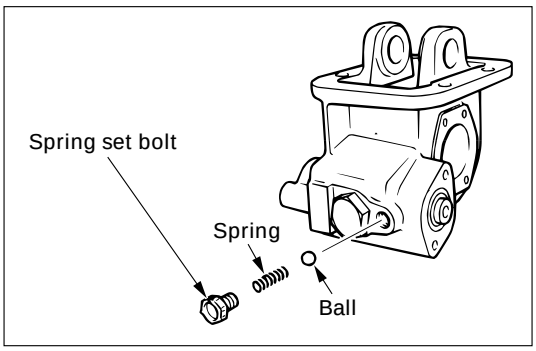
- Remove the front ball bearing from the output shaft.



281LX00058

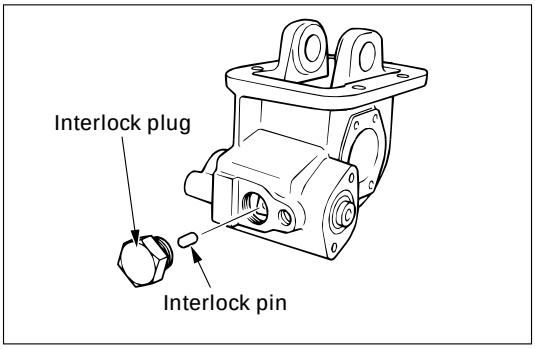
11. **Output Gear**
12. **Thrust Collar**
    - Remove the output gear and the thrust collar from the gear case.

NOTE:
Check the orientation of the output gear and the thrust collar. The side in which the shift arm groove of the gear and the taper of the thrust collar exist is the rear side.



281LX00059

13. **Spring Set Bolt**
14. **Spring**
15. **Ball**
    - Remove the spring set bolt and remove the spring and ball.

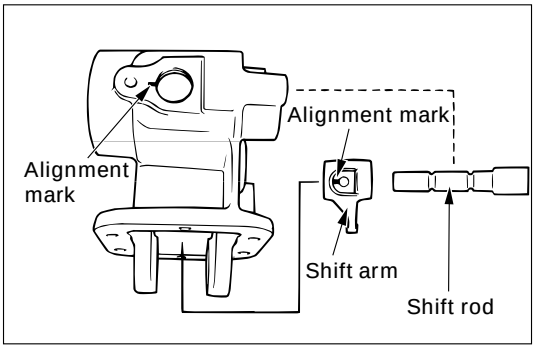


281LX00060

16. Interlock Plug

17. Interlock Pin

- Remove the interlock plug and remove the interlock pin from the shift arm.



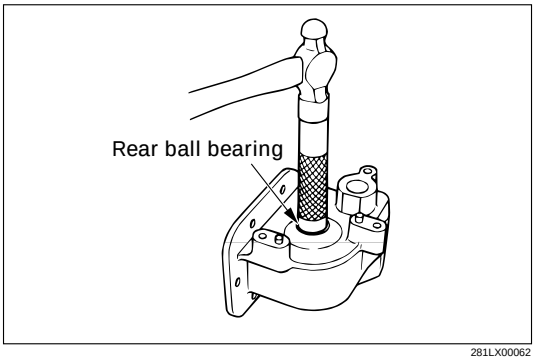
281LX00061

18. Shift Rod

19. Shift Arm

- Pull out the shift rod to the rear side of the gear case and remove the shift arm from the inside of the gear case.

NOTE:
When removing the shift arm, be sure to check the installation direction of the arm and apply the assignment mark. In that case, incorrect assembly can be prevented at subsequent assembly.



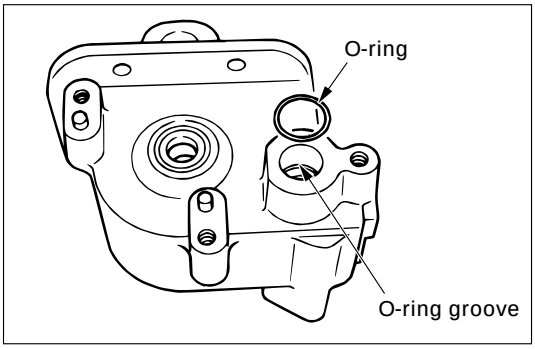
281LX00062

20. Oil Seal (Output Shaft Side)

21. Rear Ball Bearing

- Pry the oil seal by a screwdriver and remove it, then strike the rear ball bearing from the rear side of the gear case and remove it.

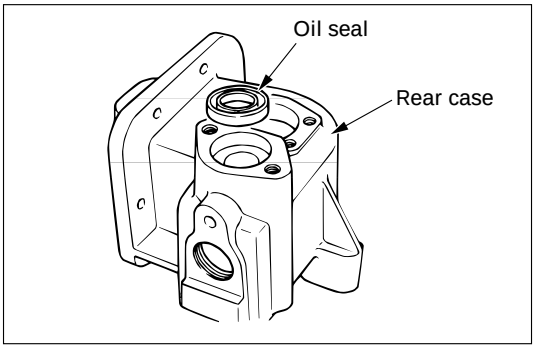
Bearing installer : 5-8840-2432-0



281LX00063

22. O-Ring

- Remove the O-ring from the shift rod hole of the gear case.



281LX00064

23. Oil Seal (Shift Rod Side)

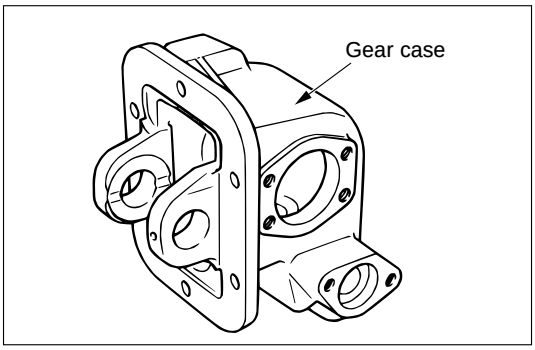
- Remove the oil seal from the gear case.

24. Gear Case

25. **Spring Pin**
26. **Cable Connector**
27. **Inner Rod**
28. **Spring Pin**
29. **Stopper Adapter**
    - Remove the cable connector or stopper adapter from the inner rod as requested.

INSPECTION AND REPAIR

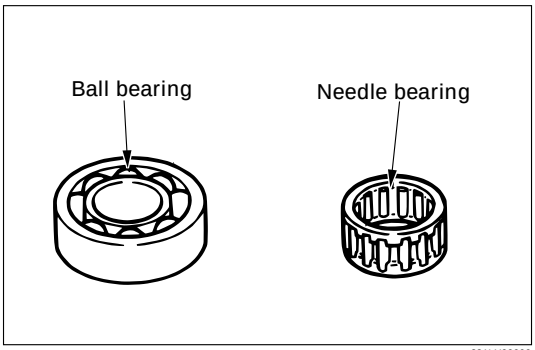
Make necessary correction or parts replacement if wear damage, or any other abnormal conditions are found through inspection.



281LX00065

Gear Case

- Inspect that there is a crack, a wear, or a scratch in each portion of the gear case and replace the gear case if there is a remarkable wear or scratch.



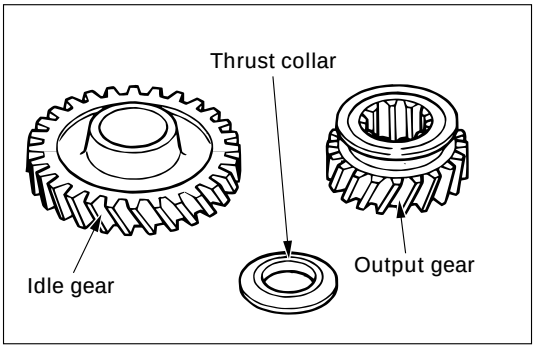
281LX00066

Bearings

- Inspect each bearing, and replace it if the following defects are found.

(1) The rotation is not smooth.
(2) A remarkable noise is generated.
(3) There is damage or rust in the inner and outer laces.
(4) There is an abnormal play in the thrust direction.
(5) There is discoloration, remarkable wear, or hitting on the body of rotation and surface of rotation of the needle roller.

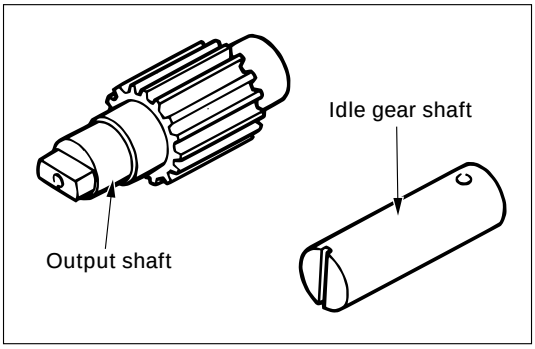
NOTE:
If the ball bearing is removed, replace it by a new one.



281LX00067

Gears and Thrust Collar

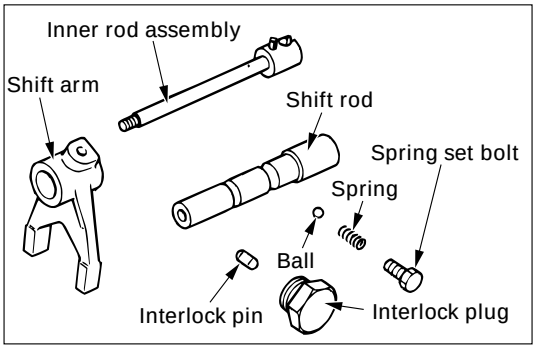
- Inspect the tooth surface of each gear and replace what has remarkable wear or damage. Further, correct lightly staged wear or a rough surface with an oil stone.
- Inspect both surfaces of the thrust collar and replace the thrust collar if there is a remarkable surface roughness or wear.



281LX00068

Shafts

- Inspect the damage and wear on the external surface of each shaft and the wear and damage of the spline portion and replace them if there are remarkable.



281LX00069

Shift Mechanism

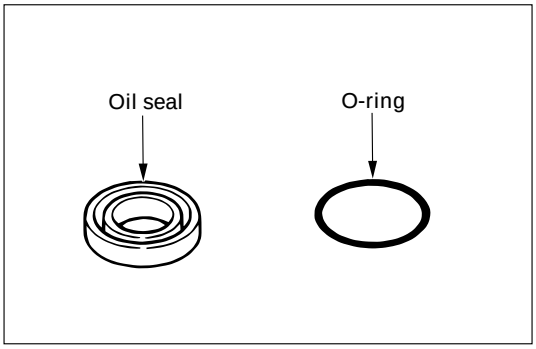
- Inspect each portion of the shift mechanism and replace it if there is remarkable damage, deflection, or staged wear.

(1) Deflection and wear of the shift rod
(2) Deformation and wear of the shift rod

Shift Arm Thickness mm (in.)

Standard	Limit
9.0 (0.354)	8.5 (0.335)

(3) The backlash or operation between the shift rod and gear case is not smooth.
(4) Wear of the ball for a detent of the shift rod and the fatigue of the spring
(5) Wear of the lock pin sliding portion for the lock pin and plug
(6) Deflection of the inter rod and wear of the cable connector portion

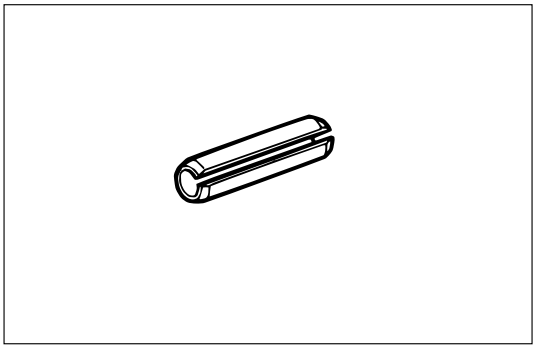


281LX00070

Oil Seal and O-ring

- Replace the oil seal and O-ring if there is damage, wear, or aging in the lip portion of the oil seal and the O-ring.

NOTE:
If the PTO is disassembled, replace the oil seal and the O-ring by new ones in principle. Further, if the oil seal and the O-ring are removed, they cannot be reused.

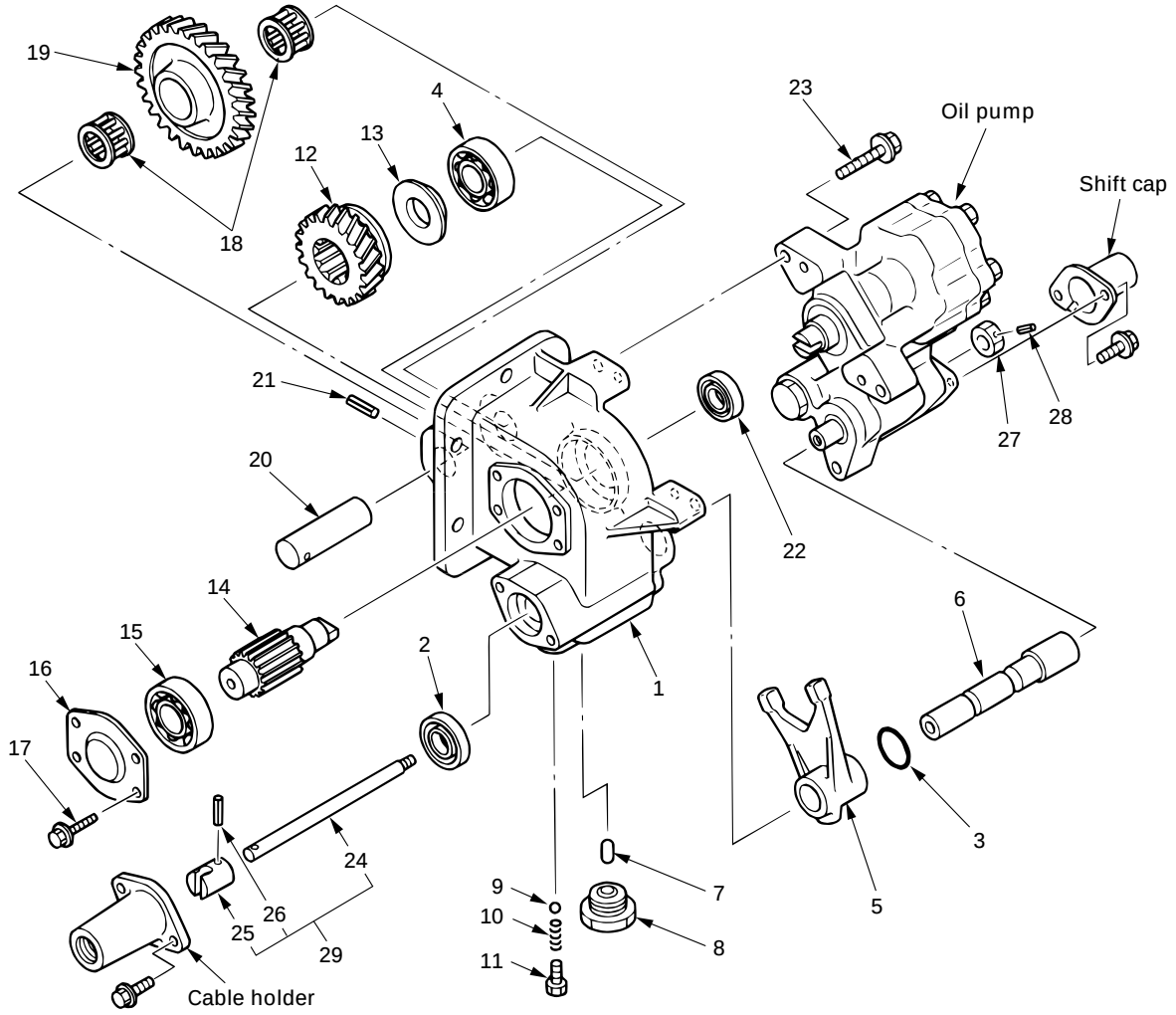

281LX046

Spring Pin

NOTE:
Be sure to replace the spring pin by a new one.

REASSEMBLY

* This illustration is based on a rear dump truck model.

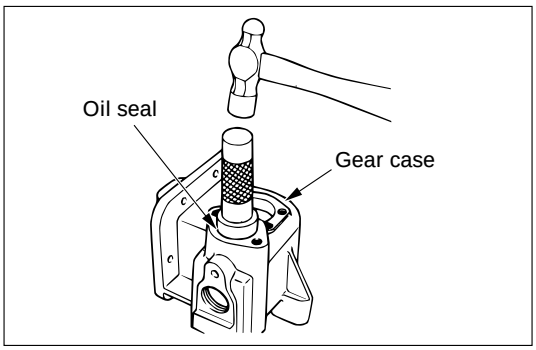


281LX00072

Reassembly Steps

1. Gear case
2. Oil seal (shift rod side)
3. O-ring
4. Rear ball bearing
5. Shift arm
6. Shift rod
7. Interlock pin
8. Interlock plug
9. Ball
10. Spring
11. Spring set bolt
12. Output gear
13. Thrust collar
14. Output shaft
15. Front ball bearing
16. Case cover
17. Bolt
18. Needle bearing
19. Idle gear
20. Idle gear shaft
21. Spring pin
22. Oil seal (output shaft side)
23. Bolt
24. Inner rod
25. Cable connector
26. Spring pin
27. Stopper adapter
28. Spring pin
29. Inner rod Assembly

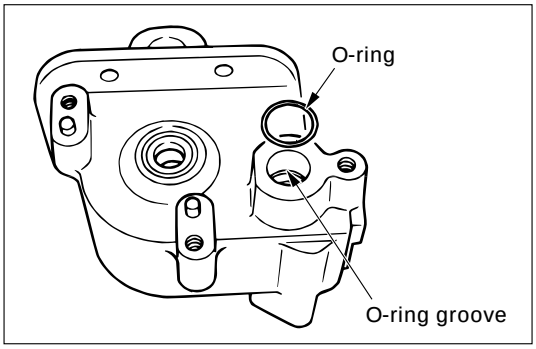
Reassembly Steps



281LX00073

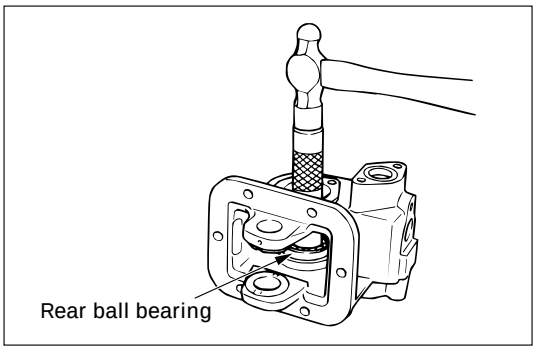
1. **Gear Case**
2. **Oil Seal (Shift Rod Side)**
   - Coat the lip portion of the oil seal with lithium grease (BESCO L-2 or equivalent), the periphery portion of the seal with liquid gasket (LOCTITE 518 or equivalent).
   - Install the lip portion of the oil seal in the shift rod side (front side) of the gear case so that the lip portion will not be damaged.

   Oil seal installer : 5-8840-2433-0



281LX00063

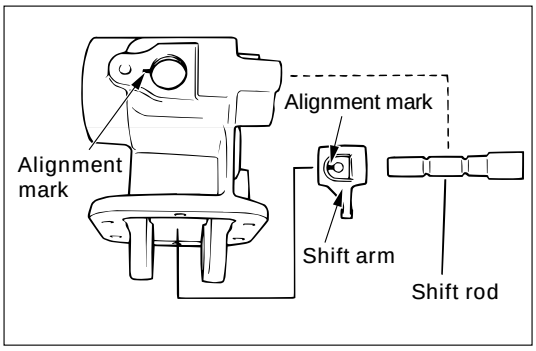
3. **O-Ring**
   - Thinly coat the O-ring and the O-ring groove of the gear case with lithium grease (BESCO L-2 or equivalent) and firmly assemble them in the groove so that there will be no damage and torsion.



281LX00074

4. **Rear Ball Bearing**
   - Strike and install the rear ball bearing in the gear case from the inner side of the case.

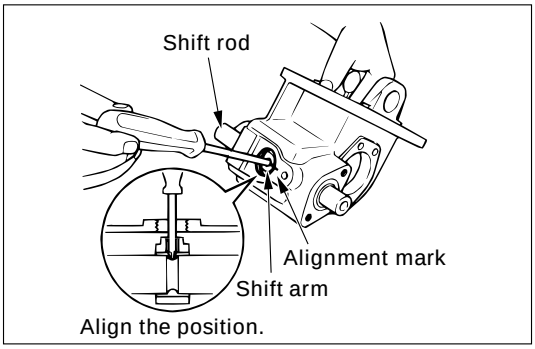
   Bearing installer : 5-8840-2432-0



281LX00075

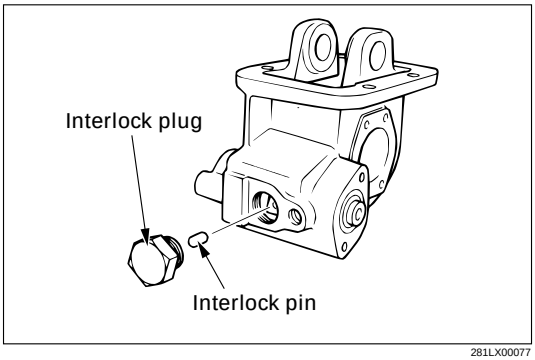
5. **Shift Arm**
   - Assemble the shift arm in the gear case.
6. **Shift Rod**
   - Thinly coat the shift rod with lithium grease (BESCO L-2 or equivalent) and insert it in the gear case, then assemble it in the shift arm.

NOTE:
Align the assembly direction of the shift arm to the alignment mark at disassembly.



281LX00076

- Align the position between the lock pin hole of the shift arm and the lock pin groove of the shift rod.

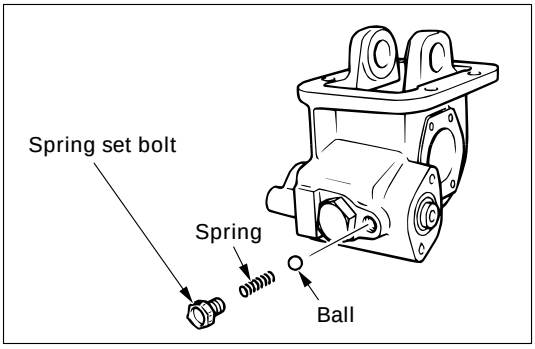


281LX00077

7. **Interlock Pin**
8. **Interlock Plug**
   - Assemble the interlock pin in the shift arm and coat the interlock plug threaded portion with liquid gasket (LOCTITE 242 or equivalent), then tighten the interlock plug at a specified torque.

Interlock Plug Torque	N·m (kg·m / lb·ft)
	60 (6.1 / 44)

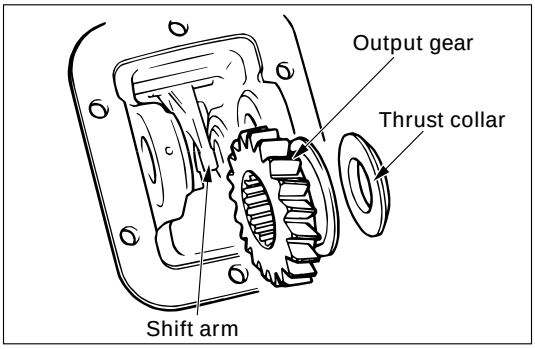
NOTE:
After having tightened the interlock plug, do not move the shift rod. Moving the shift rod may remove the interlock pin.



281LX00078

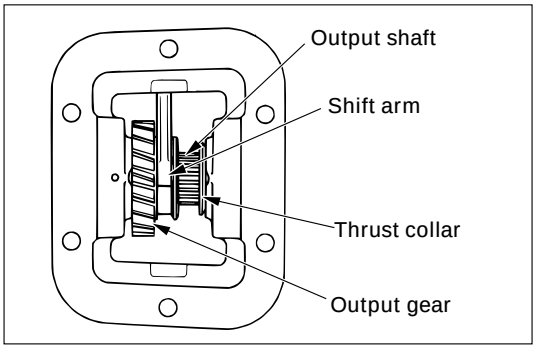
9. **Ball**
10. **Spring**
11. **Spring Set Bolt**
    - Assemble the ball and spring in the gear case and coat the spring set bolt threaded portion with liquid gasket (LOCTITE 242 or equivalent), then tighten the spring set bolt.

Set Bolt Torque	N·m (kg·m / lb·ft)
	19 (1.9 / 14)



281LX00079

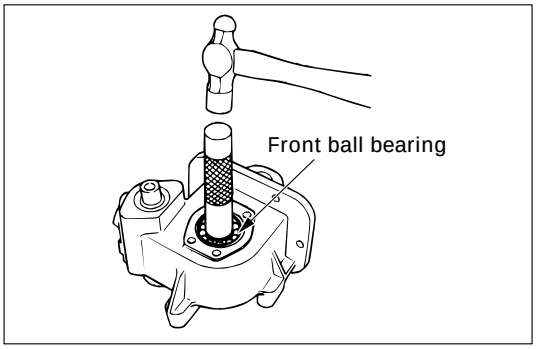
12. **Output Gear**
13. **Thrust Collar**
    - Assemble the groove (the orientation is the rear side) of the output gear in the shift arm and assemble the taper portion of the thrust collar facing the rear side.



281LX00080

14. Output Shaft

- Insert the output gear engaging its spline and align the output shaft tip to the inner lace of the rear bearing, then strike and install the output shaft by applying a splint to its front side head portion.

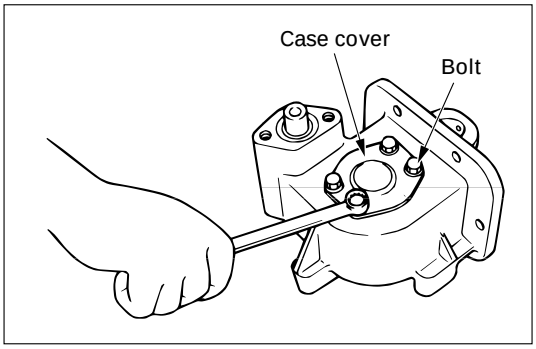


281LX00081

15. Front Ball Bearing

- Align the inner lace side of the front ball bearing to the output shaft and strike and install the outer side of the bearing aligning it to the gear case.

Bearing installer : 5-8840-2432-0



281LX00082

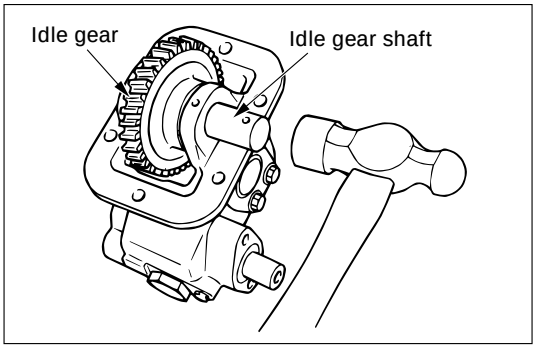
16. Case Cover

17. Bolt

- Assemble the bolt by coating the match line for the gear case of the case cover with liquid gasket (LOCTITE 518 or equivalent) and the bolt threaded portion with liquid gasket (LOCTITE 242 or equivalent), then tighten the bolt at a specified torque.

Case Cover Bolt Torque	N·m (kg·m / lb·ft)
	24 (2.4 / 17)

NOTE:
Cleanly remove the liquid gasket adhering to the cover installation side of the case cover and gear case and clean and fully degrease the case by waste cloth so that no oil will adhere to.



281LX00083

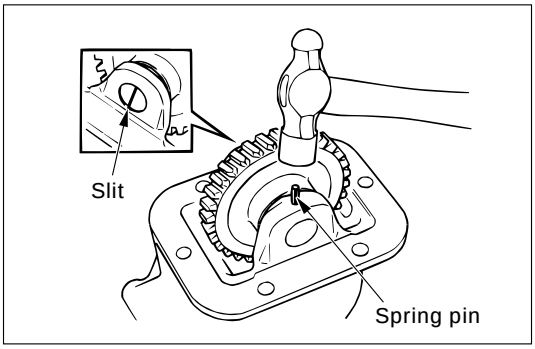
18. Needle Bearing

19. Idle Gear

- Coat the needle bearing with assembly all amount of lithium grease (BESCO L-2 or equivalent) and assemble the needle bearing in the idle gear.

20. Idle Gear Shaft

- Assemble the tooth round portion of the idle gear facing the front side and assemble the pin hole of the idle gear shaft facing the front side.

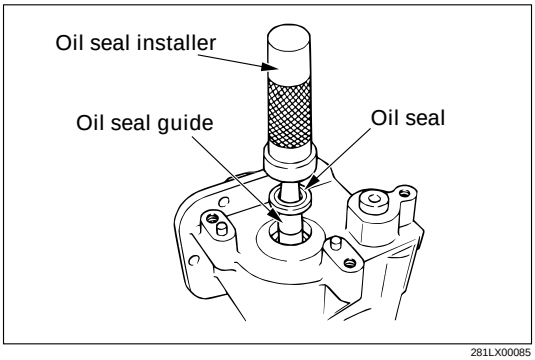


281LX00084

21. Spring Pin

- Align the spring pin hole of the gear case and the pin hole of the idle gear shaft and strike the spring pin.

NOTE:
When the slit on the rear side of the idle gear shaft is set in the vertical direction, the pin hole will be aligned.



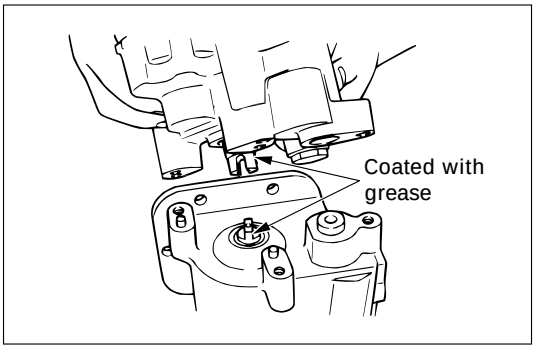
281LX00085

22. Oil Seal (Output Shaft Side)

- Coat the oil seal lip portion with lithium grease (BESCO L-2 or equivalent) and coat the seal periphery portion with liquid gasket (LOCTITE 518 or equivalent).
- To prevent the seal lip portion from being damaged, install it in the seal guide and press-fit it in the gear case by the oil seal installer.

Oil seal installer : 5-8840-2433-0

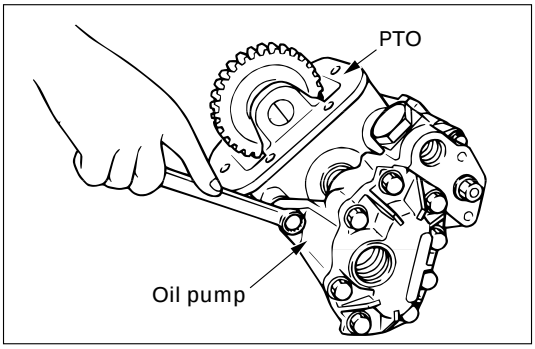
Oil seal guide : 5-8840-2564-0



281LX00086

23. Bolt

- To install the oil pump in the PTO, fully coat the shaft tip portion of the PTO and the oil pump shaft groove portion with the lithium grease (BESCO L-2 or equivalent) for rust prevention.



281LX00087

- Align and install the shaft width across flats portion on the PTO side and the shaft groove on the oil pump side and tighten the bolt at a specified torque.

PTO Bolt Torque	N·m (kg·m / lb·ft)
	53 (5.4 / 39)

24. Inner rod

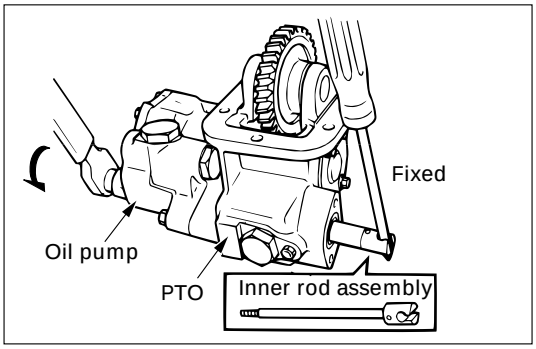
25. Cable connector

26. Spring pin

27. Stopper adapter

28. Spring pin

- If the cable connector or stopper adapter is removed, install it in the inner rod.



29. Inner rod assembly

- Coat the threaded portion of the inner rod tip with liquid gasket (LOCTITE 242 or equivalent) and insert and screw it from the front side of the PTO, and tighten the inner rod assembly at a specified torque.

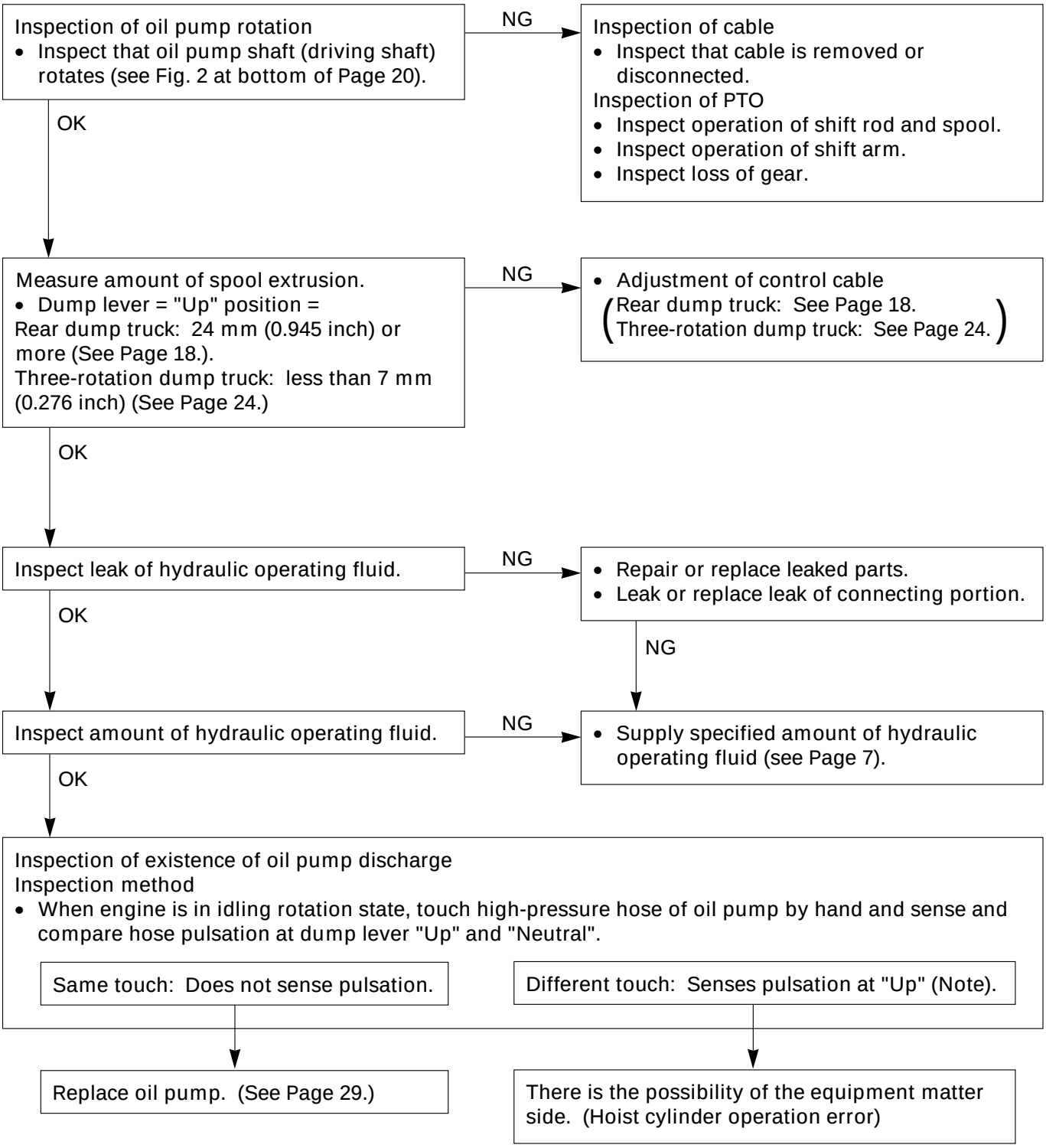
NOTE:
Tighten the inner rod assembly by inserting a Phillips screwdriver in the groove of the control cable connector and pressing it, then applying a wrench to the stopper adapter on the oil pump side. (The three-rotation dump truck is in contrast with this.)

Inner Rod Torque	N·m (kg·m / lb·ft)
	19 (1.9 / 14)

TROBLESHOOTING

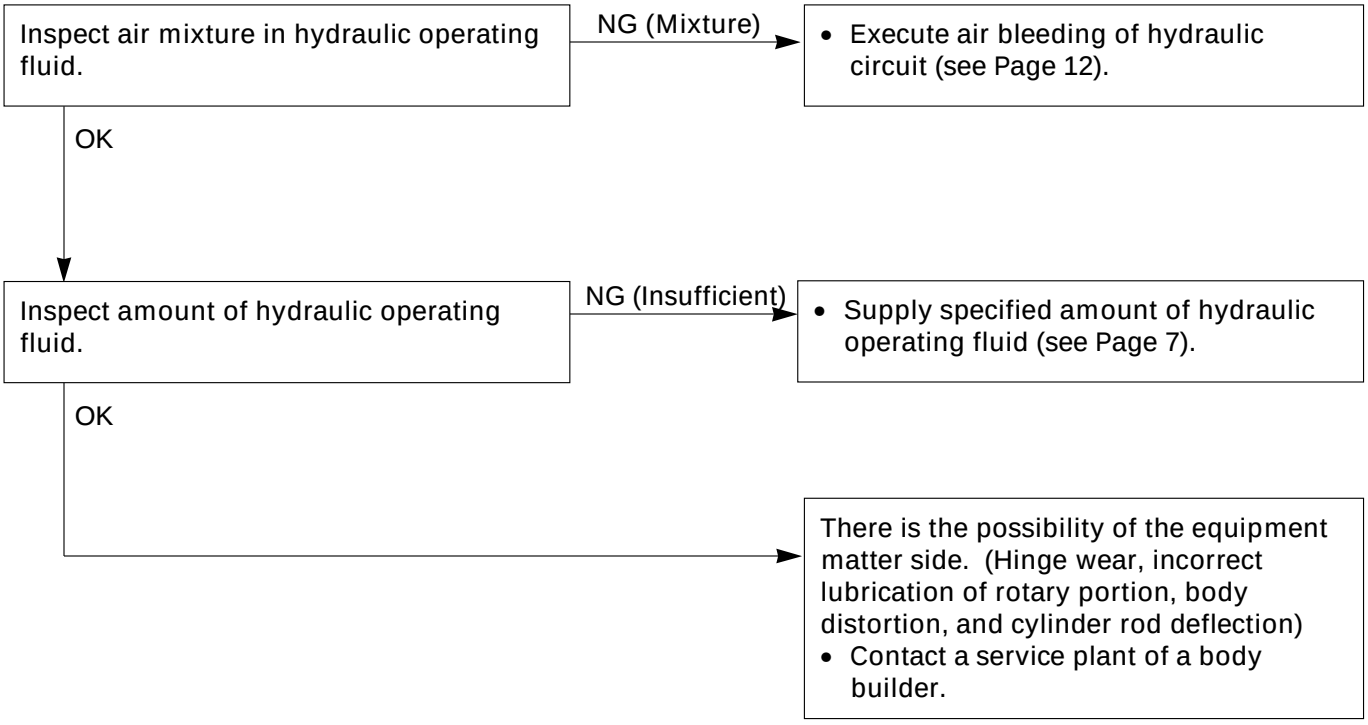
Inspection Based on Defect Symptoms

Defect 1. The Dump Body Rise is Disabled.

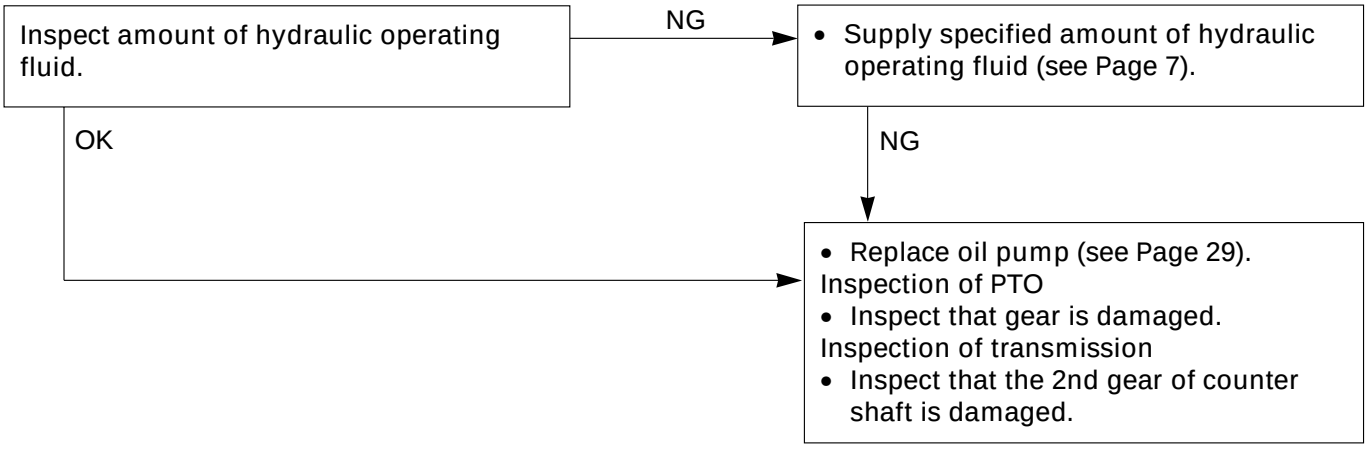


NOTE:
For examination by touch on hose, be careful not to mix this pulsation with engine vibration.

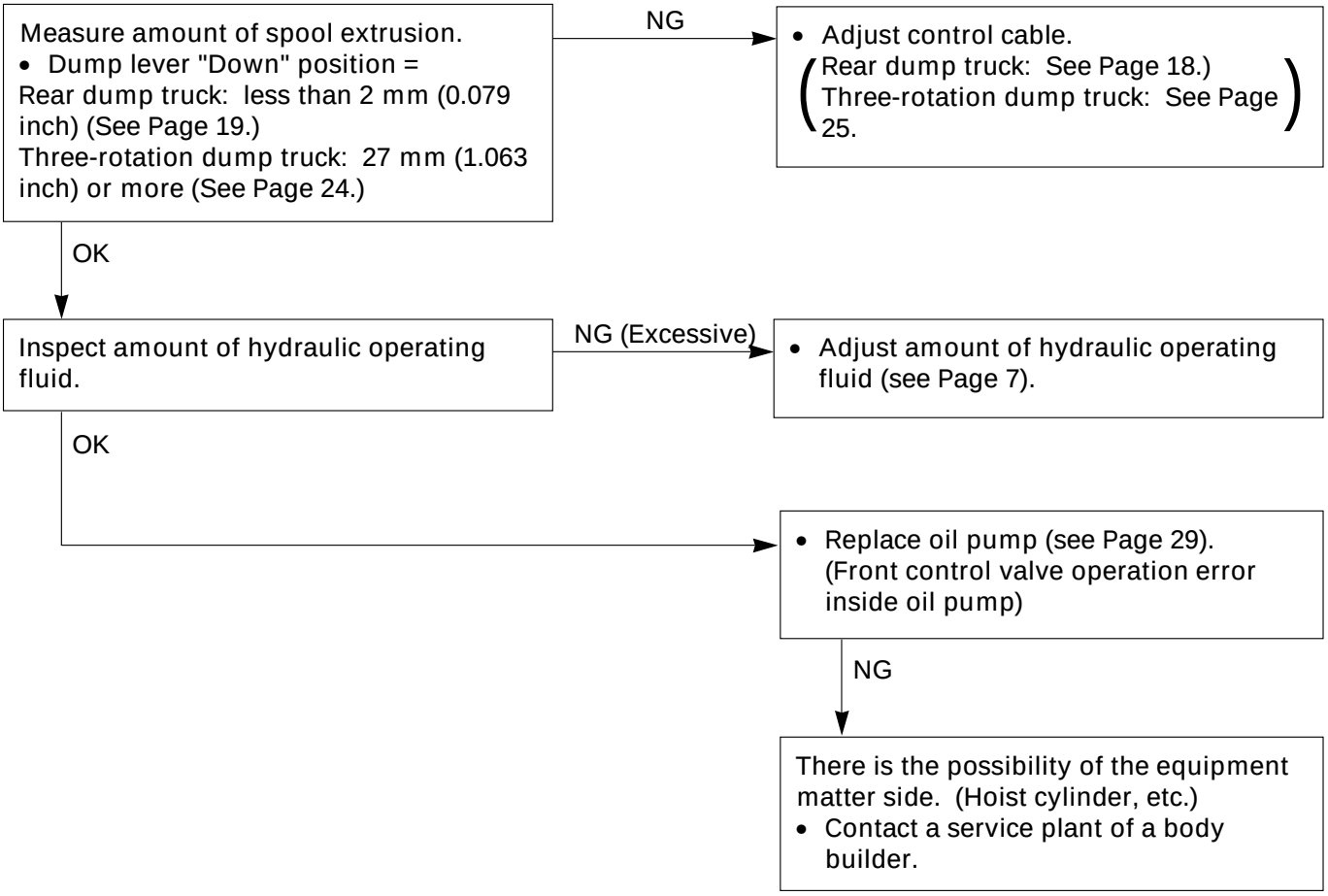
Defect 2. The Body (Cargo Deck) is Lugged During Rise.



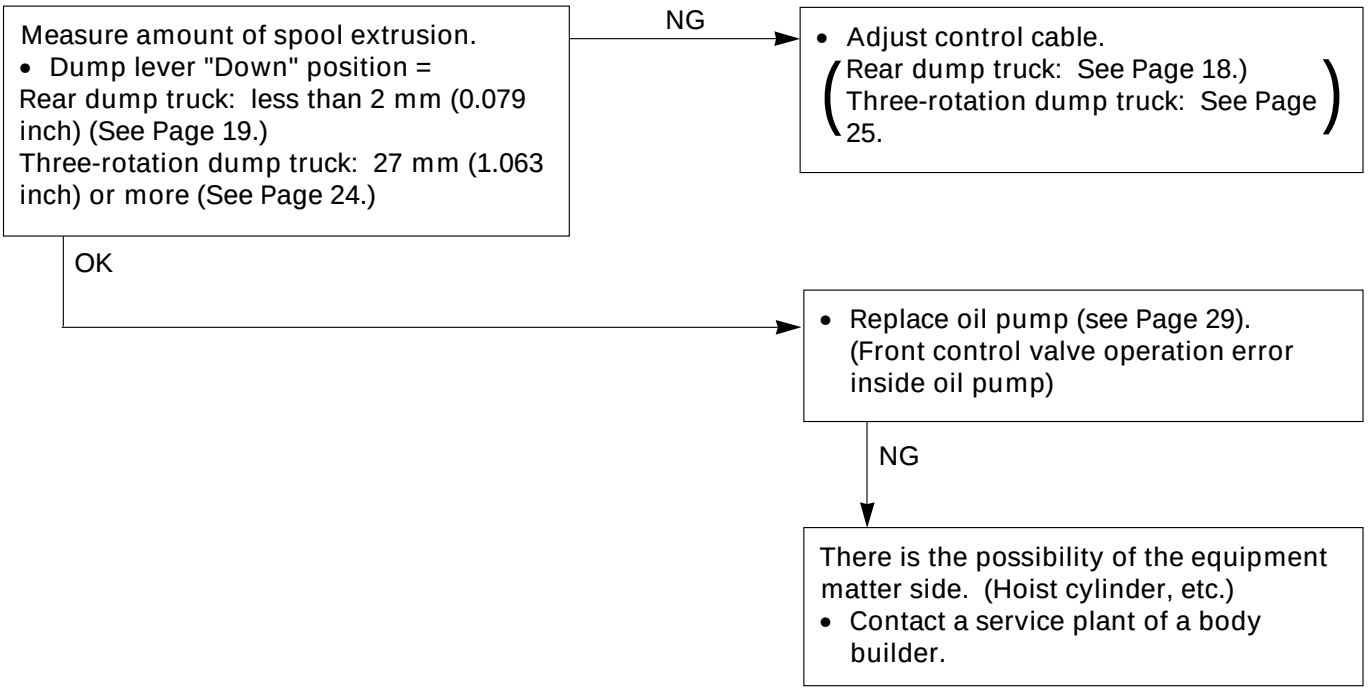
Defect 3. While the Body (Cargo Deck) is Being Raised, The Oil Pump Portion Causes a Large Abnormal Sound (Such As Caterwaul or Grate).



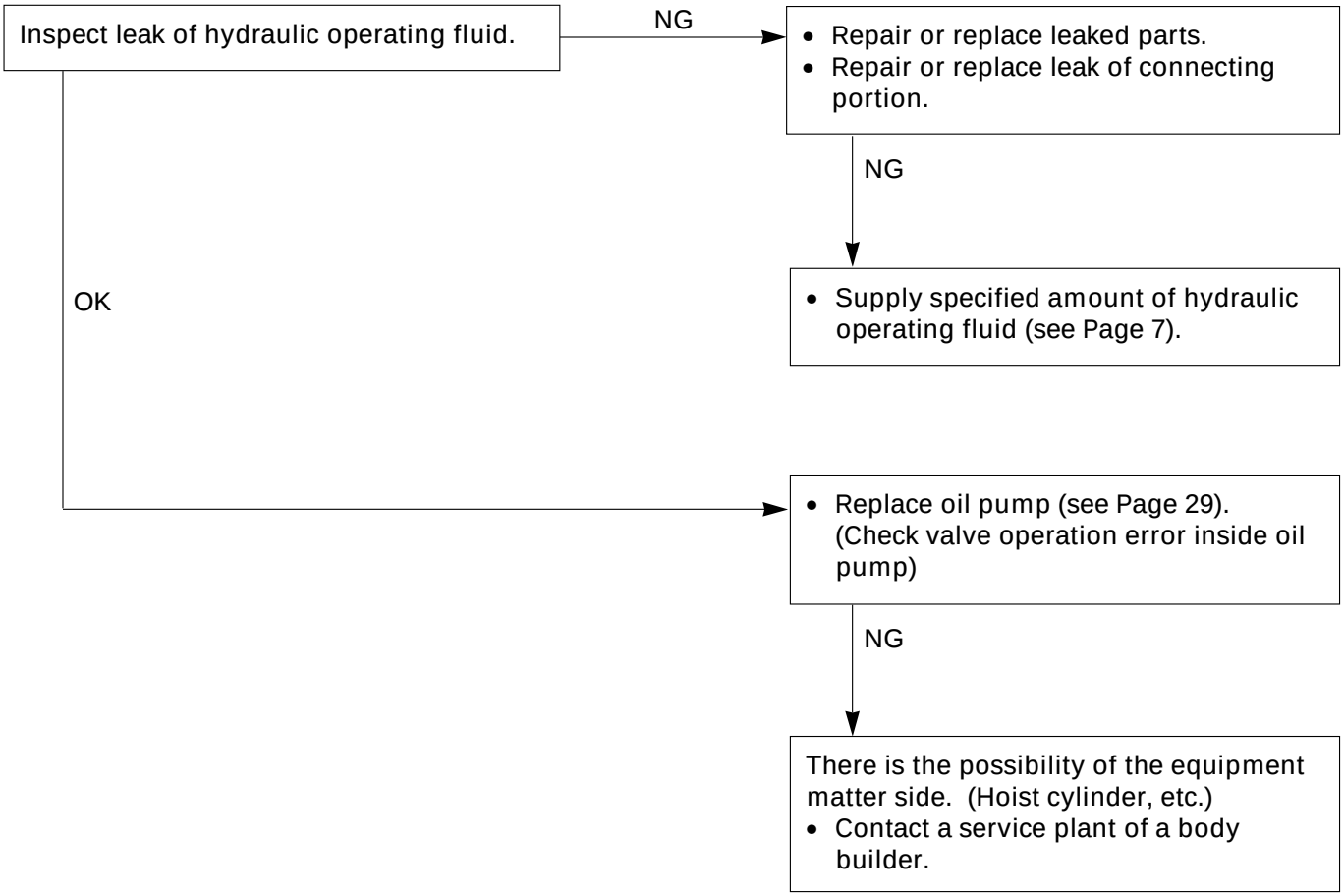
Defect 4. The Dump Body is Kept Being Raised or Does Not Drop Intermediately.



Defect 5. The Fall Speed of The Dump Body is Slow. (Basic Value: within 20 seconds for single cab, within 25 seconds for double cab (only for rear dump truck)



Defect 6. When a Load is Applied, The Dump Body Drops.



MAIN DATA AND SPECIFICATIONS

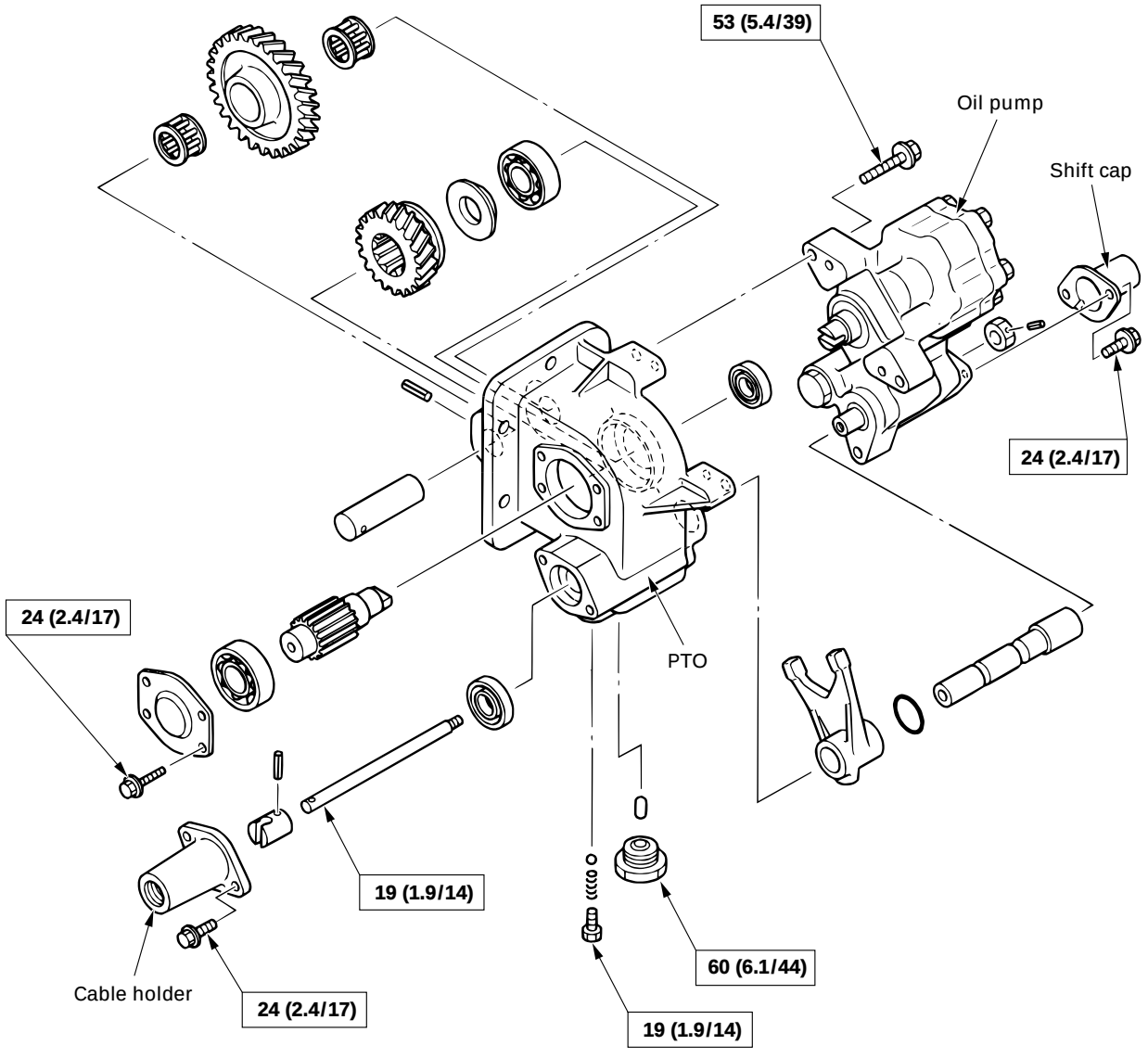
PTO with Oil Pump Assembly

Item	Specification
Allowable maximum output torque N·m/rpm (kg·m/rpm)	98/1000 (10/1000)
Deceleration ratio (speed ratio for engine)	0.678
Direction of rotation (viewed from the rear of the PTO)	Clockwise rotation

FIXING TORQUE

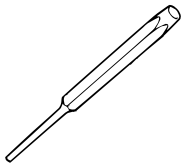
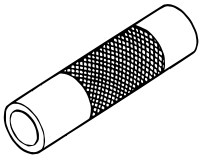
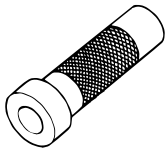
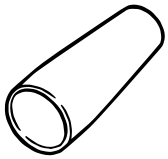
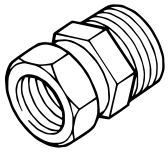
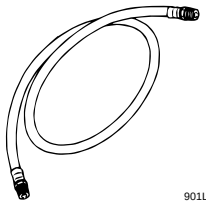
N·m (kg·m / lb·ft)

* This illustration is based on a rear dump truck model.



281LX00091

SPECIAL TOOLS

Illustration	Tool No.	Tool Name
 901LX084	9-8529-2201-0	Spring pin bar
 901LX085	5-8840-2432-0	Bearing installer
 901LX086	5-8840-2433-0	Oil seal installer
 901LX087	5-8840-2564-0	Oil seal guide
 901LX088	5-8840-2439-0	Joint (low-pressure side) PF3/4 male screw/PF1/2 nut
 901LX089	5-8840-2435-0	Test hose (2 m long) (Between oil pump and oil container) Metal cap PF1/2 male screw x 2)

MEMO

LGPTO-WE-0091

You are requested to order this manual using the manual number that is shown above.

This manual is applicable for vehicles in all countries except the USA and Canada.

All rights reserved. This manual may not be reproduced in whole or in part, without the permission in writing of ISUZU MOTORS LIMITED.

Issued by

ISUZU MOTORS LIMITED

INTERNATIONAL SERVICE DEPARTMENT

Tokyo, Japan

First edition Nov., 1999 0911-01K-1

No.LGPTO-WE-0091 PRINTED IN JAPAN

WORKSHOP MANUAL

NHR, NKR, NPR, NQR, NPS

STEERING, SUSPENSION, WHEELS AND TIRES

SECTION 3

ISUZU

ISUZU

International Service & Parts

Tokyo, Japan

NOTICE

Before using this Workshop Manual to assist you in performing vehicle service and maintenance operations, it is recommended that you carefully read and thoroughly understand the information contained in Section-0A under the headings "GENERAL REPAIR INSTRUCTIONS" and "HOW TO USE THIS MANUAL".

All material contained in this Manual is based on latest product information available at the time of publication.
All rights are reserved to make changes at any time without prior notice.

Applicable Model

N Series		
NHR55	NPR58	NPS66
NHR69	NPR59	NPS71
NKR55	NPR65	NQR66
NKR58	NPR66	NQR70
NKR66	NPR69	NQR71
NKR69	NPR70	
NPR55	NPR71	

This manual is applicable to 1994 year model and later vehicles.

THIS MANUAL INCLUDES THE FOLLOWING SECTIONS:

SECTION NO.	CONTENTS
00	Service Information
3A	Front End Alignment
3B1	Power Steering
3B2	Manual Steering
3B3	Steering Linkage
3B4	Steering Column
3C	Front Suspension
3D	Rear Suspension
3E	Wheels and Tires

SECTION 00
SERVICE INFORMATION

CONTENTS

	PAGE
Troubleshooting	00- 2
Main Data and Specifications	00- 9
Service Standard	00- 12
Servicing	00- 13
Fixing Torque	00- 28
Special Tools	00- 42

TROUBLESHOOTING

STEERING SYSTEM

PROBLEM	POSSIBLE CAUSE	CORRECTION
Objectionable "Hiss"	Noisy relief valve. There is some noise in all power steering systems. One of the most common is a hissing sound most evident at standstill parking. Hiss is a high frequency noise similar to that experienced while slowly closing a water tap. The noise is present in every valve and results from high velocity fluid passing valve orifice edges. There is no relationship between this noise and performance of the steering. "Hiss" may be expected when the steering wheel is at end of travel of when slowly turning at standstill.	Do not replace the valve unless "hiss" is extremely objectionable. A replacement valve will also exhibit slight noise and is not always a cure.
Rattle or Chuckle Noise in the Steering Gear	1. Gear housing loose on frame. 2. Steering linkage looseness. 3. Pressure house touching other parts of the truck. 4. Loose pitman shaft over center adjustment. A slight rattle may occur on turns because of increased clearance off the "high point." This is normal and clearance must not be reduced below specified limits to eliminate this slight rattle. 5. Loose pitman arm.	1. Check gear mounting. Torque the bolts to specifications. 2. Check linkage pivot points for wear. Replace if necessary. 3. Adjust the hose position. Do not bend tubing by hand. 4. Adjust. 5. Torque the pitman arm nut.
Groan Noise in the Steering Pump	1. Low oil level. 2. Air in the oil. Poor pressure house connection.	1. Fill the reservoir to the proper level. 2. Torque the connector. Bleed the system.
Rattle or Knock Noise in the Steering Pump	Loose pump gear nut.	Torque the nut.
Rattle Noise in the Steering Pump	1. Vanes not installed properly 2. Vanes sticking in the rotor slots.	1. Install properly 2. Repair or replace.
Swish Noise in the Steering Pump	Defective flow control valve.	Replace or repair.
Whine Noise in the Steering Pump	Pump shaft bearing scored.	Replace the housing and shaft. Flush and bleed the system.
Growl Noise in the Steering Pump	Excessive back pressure in houses or the steering gear caused by restriction.	Locate the restriction and correct. Replace the part if necessary.

STEERING SYSTEM (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Growl Noise in the Steering Pump (Particularly Noticeable at Standstill Parking)	1. Scored pressure plates, thrust plate or rotor. 2. Extreme wear of the cam ring.	1. Replace the parts and flush the system. 2. Replace the parts.
Excessive Play or Looseness in the Steering System (Steering Wanders)	1. Front wheel bearings loosely adjusted. 2. Worn coupling or steering shaft joints. 3. Worn steering linkage ball joints. 4. Worn upper or lower ball joints. 5. Steering wheel loose on the shaft, loose pitman arm, tie rods, steering arms, or steering linkage ball studs. 6. Steering gear worm bearing loosely adjusted. 7. Excessive pitman shaft to ball nut lash in the steering gear. 8. Toe-in out of adjustment or worn drag link or tie rod sockets. 9. Steering system out of alignment. 10. Tires badly worn, edge of the tires are rounded off. 11. Lack of lubrication in the linkage and kingpins. 12. Air in the system. 13. Steering gear mounting loose.	1. Adjust the bearings or replace with new parts as necessary. 2. Replace 3. Replace steering linkage. 4. Replace ball joints. 5. Torque the fasteners. 6. Adjust the preload. 7. Adjust the preload. 8. Replace the tie rod ends if worn, adjust to correct the toe-in, and inspect the steering arm and tie rod for bent condition. 9. Align caster, camber, and toe-in. Inspect spring components for condition and wear. Repair or replace as required. 10. Install new tires, and check alignment; abnormal tire wear indicates improper alignment. 11. Lubricate. Free up any components which are frozen and will not take lubrication. 12. Add oil to the pump reservoir and bleed the system. Check hose connectors for proper torque. 13. Tighten attaching bolts to the specified torque.
Vibration and Shimmy	1. Seal damage and leakage resulting in loss of lubricant, corrosion and excessive wear. 2. Tires, wheels, or brake drums out of balance. 3. Bent wheel or out of bound tire. Wheel nuts torqued unevenly. 4. Loose steering linkage components. 5. Worn steering linkage ball joints. 6. Worn upper or lower end ball joint. 7. Wheel loose on the hub.	1. Replace damaged parts as necessary. 2. Balance the tires and wheels, preferably with an on-vehicle type balancer, as this method balances the entire wheel and drum assembly. 3. Replace the wheel and remount the tire, or replace the assembly. 4. Adjust, torque, and repair the linkage as necessary. 5. Replace steering linkage. 6. Replace ball joints. 7. Inspect the wheel bolt holes for damage, and replace the wheel or torque the nuts.

STEERING SYSTEM (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Vibration and Shimmy (cont.)	8. Drive line universal joints rough or defective. This condition may be confused with steering vibration. 9. Engine misses or is out of balance, this may also be confused with steering shimmy. 10. Faculty shock absorbers.	8. Repair the drive line. 9. Correct the miss in the engine, or repair the out of balance condition, clutch, pressure plate, or harmonic balancer, etc. 10. Replace the shock absorbers.
Hard Steering or Excessive Effort Required at Steering Wheel	1. Low or uneven tire pressure. 2. Steering linkage kingpins or ball joints need lubrications. 3. Tight or frozen intermediate rod, tie rod or idler socket. 4. Steering gear to column misalignment. 5. Steering gear adjusted too tightly. 6. Front wheel alignment incorrect. 7. Steering gear adjusted too tight. 8. Frozen or tight shaft bearings. 9. Lower the U-joint flange rubbing against the adjuster. 10. Tight or binding conditions in steering column. 11. Power cylinder rod nicked or marred.	1. Inflate to specified pressures. 2. Lubricate, and free up kingpins or ball joints. Make certain all fittings take lubricant properly. 3. Lube or replace as necessary. 4. Align the column. 5. Adjust preload. 6. Check alignment and correct as necessary. 7. Adjust the steering gear. 8. Replace the bearings. 9. Loosen the bolt, assemble and torque properly. 10. Adjust the steering column. 11. Replace the cylinder.
Pump Inoperative, Poor, or No Assist (Hard Steering)	1. Low oil level. 2. Air in the oil. 3. Defective hoses or steering gear. 4. Flow control valve stuck. 5. Loose nut in end of flow control valve. 6. Pressure plate not flat against ring. 7. Extreme wear of pump ring. 8. Scored pressure plate, thrust plate. 9. Vanes not installed properly. 10. Vanes sticking in rotor slots. 11. Faulty flow control valve assembly.	1. Fill the reservoir to the proper level. 2. Locate the source of the air leak and correct it. 3. Repair or replace. 4. Repair or replace. 5. Torque nut. 6. Repair or replace. 7. Repair or replace. 8. Repair or replace. 9. Repair or replace. 10. Repair or replace. 11. Repair or replace.
Momentary Increase in Effort when Turning Wheel Fast to Right or Left	1. Low oil level in pump. 2. High internal leakage in hydraulic pump. 3. High internal leakage in steering gear.	1. Add power steering fluid as required. 2. Check the pump pressure. (See the pump pressure test). 3. Repair.
Steering Wheel Surges or Jerks when Turning with Engine Running Especially During Parking	1. Low oil level. 2. Insufficient pump pressure. 3. Defective gear relief valve. 4. Sticky flow control valve.	1. Fill as required. 2. Check pump pressure. (See pump pressure test). Replace relief valve if defective. 3. Replace the gear relief valve. 4. Repair or replace.

STEERING SYSTEM (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Steering Pulls to Left or Right	1. Camber incorrectly adjusted. Steering will generally pull to the side of the axle having the greatest positive camber. 2. Low air pressure in the right or left tire. Steering will pull to the side having the low air pressure. 3. Axle loose and shifted at the spring U-bolts. 4. Rear axle loose at the spring U-bolt. If shifted axle is shifted at one side, it will cause the steering to pull. 5. Unbalanced steering gear valve. If this is the cause, steering effort will be very light in the direction of the lead and heavy in the opposite direction.	1. Adjust camber. 2. Inflate the tire to the correct pressure, check for air leak and repair as required. 3. Align the axle, and torque the U-bolt nuts. Inspect for damaged parts. Replace if required. 4. Align the rear axle and replace the defective parts, if any. Torque the U-bolt. 5. Replace the valve.
Poor Return of the Steering Wheel	1. Lack of lubrication in the linkage. 2. Steering gear to column misalignment. 3. Tires not properly inflated. 4. Improper front wheel alignment. 5. Steering linkage binding. 6. Steering wheel rubbing against the directional signal housing. (Turn the steering wheel and listen for internal rubbing in the column.) 7. Tight steering shaft bearings. 8. Sticky or plugged valve spool. 9. Steering gear out of adjustment. 10. Tight kingpin bushings. 11. Lower U-joint flange rubbing against the steering gear adjust plug. 12. Upper or lower end ball joint binding.	1. Lube the linkage. 2. Align the steering column. 3. Inflate to the specified pressure. 4. Check and adjust as necessary. 5. Replace the pivots. 6. Adjust the steering jacket. 7. Replace the bearings. 8. Repair or replace valve. 9. Check adjustment. Adjust as required. 10. Lubricate or replace as required. 11. Loosen the pinch bolt and assemble it properly. 12. Replace ball joints.
Snapping or Chucking in the Steering Column or Wheel	1. Loose steering gear at the frame. 2. Worn steering shaft universal joints. 3. Worn steering linkage components. The effect of these components will telescope through the steering system and be felt in the steering wheel. 4. Steering gear incorrectly adjusted.	1. Torque the mounting bolts. 2. Replace and repair the joints as necessary. 3. Adjust, torque, and repair the components. 4. Adjust steering gear.
Excessive Road Shock	1. Tire air pressure too high. 2. Wheel bearings adjusted too loose. 3. Camber adjustment incorrect. 4. Weak or broken front spring. 5. Defective shock absorbers. 6. Loose suspension components.	1. Deflate to the correct pressure. 2. Adjust the bearings. 3. Adjust the camber. 4. Replace the spring. 5. Replace the shock absorbers. 6. Inspect, adjust or repair, and replace as necessary.

FRONT AND REAR SUSPENSION

PROBLEM	POSSIBLE CAUSE	CORRECTION
Spring Noise	1. Loose U-bolts. 2. Loose or worn eye bushings. 3. Lack of lubrication. 4. Defective shock absorber.	1. Tighten to recommended torque. 2. Replace eye bushings. 3. Lubricate as required. 4. Replace shock absorber.
Spring Sag or Bottom	1. Inoperative shock absorber. 2. Broken spring leaf. 3. Severe operation or overloading.	1. Replace shock absorbers. 2. Replace leaf or spring assembly. 3. Check road capacity rating.
Spring Breakage	1. Loose U-bolts. 2. Normal fatigue. 3. Overloading.	1. Tighten to recommended torque. 2. Replace springs. 3. Do not overload vehicle.
Excessive Road Shock	1. Tire air pressure too high. 2. Wheel bearings adjusted too loose. 3. Camber adjustment incorrect (Negative camber contributes to road shock). 4. Weak or broken spring. 5. Defective shock absorbers. 6. Loose suspension components.	1. Deflate to correct pressure. 2. Adjust bearings. 3. Adjust camber. 4. Replace springs. 5. Replace shock absorbers. 6. Inspect, adjust or repair and replace as necessary.

WHEELS

PROBLEM	POSSIBLE CAUSE	CORRECTION
Wheel Hop (Vehicle Vibration and Rough Steering)	**Wheels** 1. Rocks and debris wedged between dual disc wheels. 2. Out-of-balance tire and/or hub and drum/rotor assembly. 3. Improper positioning of the side rings split. **Vehicle** Loose or worn driveline or suspension.	1. Remove rocks and debris. 2. Determine the out-of-balance component and balance or replace. 3. Reassemble with ring split opposite (180 degrees) the valve opening to improve balance. Identify location of vibration carefully as it may be transmitted through the frame making a rear end vibration appear to come from the front. Then repair or replace loose or worn parts (Refer to PROPELLER SHAFT [SEC. 4B] for vehicle vibration.)
Stripped Threads	Excessive clamp load.	Replace studs — follow proper torque procedure.
Rust Streaks from Stud Holes Correction	Loose cap nuts.	Check complete assembly, replace damaged parts and follow proper torque procedure.

TIRES

PROBLEM	POSSIBLE CAUSE	CORRECTION
Wobble (Vehicle Vibrations and Rough Steering)	**Wheels** 1. Bent or distorted disc from overloading or improper handling. 2. Loose mountings, damaged studs, cap nuts, enlarged stud holes, worn or broken hub face, or foreign material on mounting surfaces. 3. Improper positioning of the side rings split. **Vehicle** 1. Improper alignment. 2. Loose, worn or broken suspension parts.	1. Replace wheel. 2. Replace worn or damaged parts. Clean mounting surfaces. 3. Reassemble with ring split opposite (180 degress) the valve opening to improve balance. 1. Have vehicle aligned. 2. Repair or replace.
Cracked or Broken Wheel Discs (Cracks Develop in the Wheel Disc from Handhole to Rim, or from Handhole to Stud)	Metal fatigue resulting from overloading.	Replace wheel. Check position of wheel on vehicle for working load specifications.
Damaged Stud Holes (stud Holes Become Worn, Elongated or Deformed, Metal Builds up Around Stud Hole Edges, Cracks Develop from Stud Hole to Stud Hole)	Loose wheel mounting.	Replace wheel and check for: • Installation of correct studs and nuts. • Cracked or broken studs — replace. • Worn hub face — replace. • Broken or cracked hub barrel — replace. • Clean mounting surfaces and retorque cap nuts periodically. • Rust streaks fanning out from stud holes indicate that the cap nuts are or have been loose.
Damaged Stud Threads	Sliding wheel across studs during assembly.	Replace stud following proper wheel installation.
Loose Drum	Improper drum bolt.	Replace with proper length bolt.
Loose Inner Wheel	1. Excessive stud standout from mounting face of hub allowing wheel nut to bottom out. 2. Improper torque.	1. Replace with proper length bolt. 2. Use recommended torque procedure.
Broken Wheel Studs	1. Loose cap nuts. 2. Overloading.	1. Replace stud and follow proper torque procedures. 2. Replace stud.

TIRES (Cont.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Tire Slippage on Rim	1. Improper storage or operating conditions. 2. Poor maintenance. 3. Rust, corrosion on bead seating. 4. Loss of pressure.	1. Correct as required. 2. Follow proper maintenance procedures. 3. Correct as required. 4. Follow proper maintenance procedures.
Tire Mounting Difficulties	1. Mismatch tire and rim sizes. 2. Defective or mismatched rings for rim use. 3. Overinflation of tires. 4. Corrosion and dirt.	1. Correct as required. 2. Correct as required. 3. Follow recommended tire pressure. 4. Correct as required.
Tires Show Excessive Wear on Edges of Tread	1. Underinflated tires. 2. Vehicle overloading. 3. High speed cornering. 4. Incorrect toe-in setting.	1. Properly inflate to recommended pressure. 2. Correct as required. 3. Correct as required. 4. Set to correct specifications.
Tires Show Excessive Wear in Center of Tread	Tires overinflated.	Properly inflate to recommended pressure.
Excessive Tire Wear	1. Improper tire pressure. 2. Incorrect tire/wheel usage. 3. Defective shock absorbers. 4. Front end out of alignment. 5. Loose, worn or damaged steering linkage, joints, suspension components, bushings and ball joints.	1. Properly inflate to recommended pressure. 2. Install correct tire/wheel combination. 3. Repair or replace. 4. Align front end. 5. Inspect, repair or replace as required.
Dual Tires Rubbing	Insufficient wheel spacing.	Check tire and wheel sizes.

MAIN DATA AND SPECIFICATIONS

Front End Alignment

1994 – 1997 Model

			Wishbone Suspension	NHR Rigid	NKR Rigid	NPR	NQR	NPS
Steering Angle								
Inner		(Deg.)	38°	46°	38°	47°	42.5°	38°
Outer		(Deg.)	35°	34°	30°	36°	34°	30°
Wheel alignment								
Toe-in	Bias Tire	mm(in.)	-2 – 2	3 – 7 (0.12 – 0.28)				-2 – 2
	Radial Tire	mm(in.)	(-0.08 – 0.08)	0 – 4 (0 – 0.16)				(-0.08 – 0.08)
Camber		(Deg.)	0°15′±45′	1°15′±45′				0°15′±45′
Caster		(Deg.)	1°00′±1°	1°30±1°				2°00′±1°
King Pin Inclination		(Deg.)	9°45′	7°15′				

1998~ Model

		Wishbone Suspension	NHR	NKR Rigid	NPR	NQR	NPS
Steering Angle							
Inner	(Deg.)	38.5° (7.00-15 Tire)	37.5°	38.5° (7.00-15 Tire)	47.5° (7.00-16 Tire)		38°
		35.5° (7.00-16 Tire)		35.5° (7.00-16 Tire)	42.5° (7.50-16 Tire)	42.5° (7.50-16 Tire)	
		31.5° (7.50-16 Tire)		31.5° (7.50-16 Tire)		36.5° (8.25-16 Tire)	
Outer	(Deg.)	29.5° (7.00-15 Tire)	33°	29.5 (7.00-15 Tire)	35° (7.00-16 Tire)		30°
		27.9° (7.00-16 Tire)		27.9° (7.00-16 Tire)	32.7° (7.50-16 Tire)	32.7° (7.50-16 Tire)	
		25.1° (7.50-16 Tire)		25.1° (7.50-16 Tire)		30.0° (8.25-16 Tire)	
Wheel alignment							
Toe-in	mm(in.)	-2 – 2 (-0.08 – 0.08)					
Camber	(Deg.)	0°15′±45′	1°15′±45′	0°15′±45′			0°15′±45′
Caster	(Deg.)	1°00′±1°	1°30±1°	3°±1°	2°45′±1°		2°00′±1°
King Pin Inclination	(Deg.)	9°45′±30′	7°15′	12°00′			7°15′

Power Steering Unit

	Right Hand Drive	Left Hand Drive
Type	Integral rotary valve type	
Numbers of Ball	28	30
Gear Ratio	22.6 NHR,NKR 20.9 NPR, NQR, NPS	21.9
Ball Screw Lead mm(in.)	9.912 (0.390) NHR,NKR 9.922 (0.391) NPR, NQR, NPS	10.319 (0.375)
Torsion Bar Spring Constant N·cm/deg (kg·cm/deg)	15.7 (16.0)	
Valve Operating Angle (Deg.)	±7°	±8.3°
Regulated Oil Pressure kPa (kg/cm^2 / psi)		
NHR, NKR	10,297 (105 / 1,493)	
NPR, NQR, NPS	10,787 (110 / 1,564)	
Regulated Oil Flow Volume liter/min (US gal/min / UK gal/min)	8 (2.11/1.76)	

Power Steering Oil Pump Unit

	4J Series Engine	4B Series Engine	4H Series Engine
Type	Vane type		
Theoretical Delivery (cm^3/rev)	7.2	12.2	9.6
Regulated Oil Flow Volume (liter/min)	8.5 – 6.5	8.0 – 6.5	8.0 – 6.5
Regulated Oil Pressure kPa(kg/cm^2 / psi)			
NHR, NKR	10,297 (105 / 1,493)	10,297 (105 / 1,493)	10,297 (105 / 1,493)
NPR, NPS			10,787 (110 / 1,564)
NQR			11,278 (115 / 1,635)
Maximum Allowable Speed (r.p.m.)	3,700	5,000	6,500

Tandem Hydraulic Pump

		Hydraulic Booster Pump	Power Steering Pump
Type		Vane type	
Theoretical Delivery	cm^3/rev	13	8.4
Regulated Oil Flow Volume	liter/min	8.0	8.0 – 6.5
Regulated Oil Pressure	kPa(kg/cm^2/psi)	11,770 (120/1,706)	10,790 (110/1,564)
Maximum Allowable Speed	r.p.m.	6,500	

Manual Steering Unit

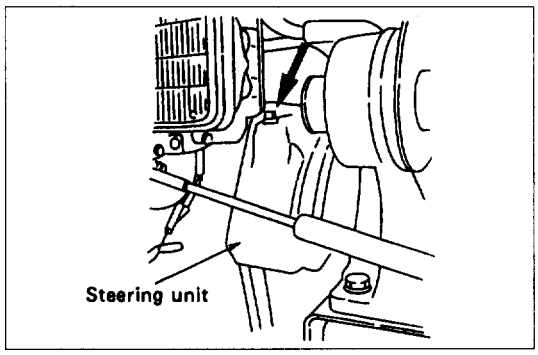
		NHR, NKR	NPR, NQR
Type		Recirculating ball type	
Sector Shaft Outside Diameter	mm(inch)	34.295	38.1
Numbers of Ball		28 × 2	50 × 2
Gear Ratio		24.5 – 28.5	27.7 – 31.7

SERVICE STANDARD

ITEMS	SERVICE STANDARD	SERVICE LIMIT
Power Steering		
Sector Shaft Outside Diameter mm(in)		
RHD	39.975 (1.574)	39.925 (1.572)
LHD	38.125 (1.501)	38.043 (1.498)
Play between Sector Shaft and Bearing mm(in)		
RHD	—	0.12 (0.0047)
LHD	—	0.20 (0.0080)
Backlash between Sector Shaft and Ball Nut mm(in)		
RHD	0.05 – 0.25 (0.0020 – 0.0098)	
LHD	0.33 (0.013) or less	
Steering Wheel Free Play mm(in)	10 – 50 (0.4 – 2.0)	
Power Steering Fluid Pressure (at idling engine speed) kPa(kg/cm^2/psi)		
NPR66, NQR66, NPS66	10,787 (110 / 1,564)	
except Above Models	10,297 (105 / 1,493)	
Manual Steering		
Sector Shaft Outside Diameter mm(in)		
NHR, NKR	34.925 (1.375)	34.825 (1.371)
NPR, NQR	38.100 (1.500)	38.000 (1.496)
Play between Sector Shaft and Needle Bearing mm(in)	—	0.2 (0.008)
Ball Nut Axial Play mm(in)	—	0.1 (0.004)
Worm Shaft Starting Torque N•m(kg•m/lb•ft)		
(Without Sector Shaft)		
NHR, NKR	0.34 – 0.64 (0.035 – 0.065 / 0.25 – 0.47)	
NPR, NQR	0.29 – 0.69 (0.030 – 0.070 / 0.22 – 0.51)	
(With Sector Shaft)		
NHR, NKR	0.54 –1.03 (0.055 – 0.105 / 0.40 – 0.76)	
NPR, NQR	0.98 (0.1 / 0.72) or less	
Backlash between Sector Shaft and Ball Nut mm(in)		
NHR, NKR	0.2 (0.0079) or less	
NPR, NQR	0.5 (0.0197) or less	
Steering Wheel Free Play mm(in)	10 – 30 (0.4 – 1.2)	
Suspension		
Spring Pin Outside Diameter mm(in)	25 (0.98)	24.7 (0.019)
Clearance between Shackle Pin and Bushing mm(in)	0.1 (0.0039)	0.5 (0.019)

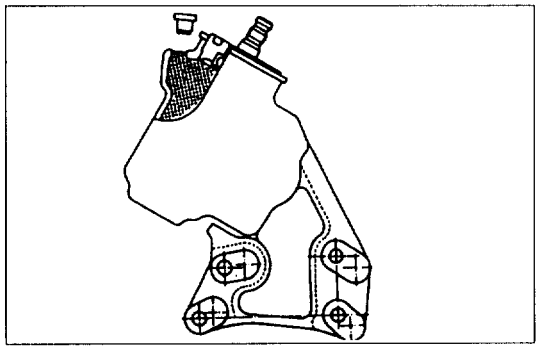
SERVICING

STEERING SYSTEM

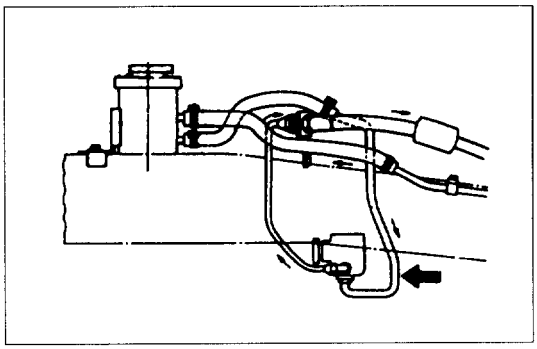


Manual Steering Gear Oil

1. Remove the filler plug on the steering unit.



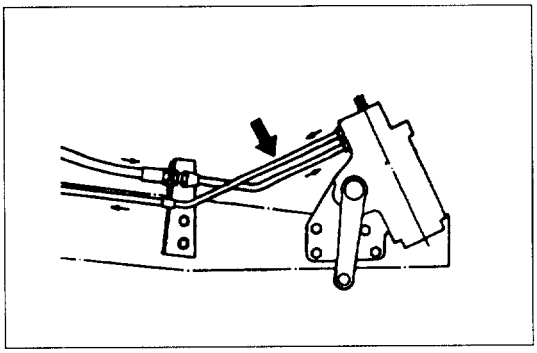
2. Fill the gear box to the level of filler plug with specified gear oil through the filler hole.
3. Install and tighten the filler plug.



Power Steering Fluid

Draining

1. Jack up the front wheels until they are clear of the ground.
2. Disconnect the fluid pipes between the steering unit and fluid reservoir, and the fluid hose between the pump and the fluid reservoir.
3. When draining is completed, remove remaining fluid within hydraulic system by turning the steering wheel to stop in both directions several times.



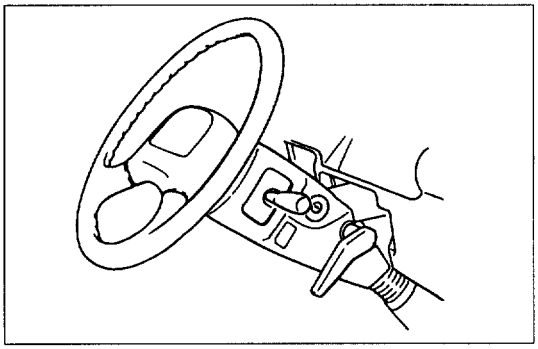
Hose Replacement

Replace the power steering hoses every second fluid change.

Refilling

1. Connect the fluid lines securely and fill the fluid reservoir with specified automatic transmission fluid.
2. When the fluid reservoir is filled to specified level, allow 2 or 3 minutes. While refilling, keep fluid reservoir replenished as necessary to prevent air from entering the hydraulic system.
3. Lower the front wheels to the ground. Start and let the engine idle for a few minutes.

   Recheck the fluid level and replenish if necessary.



Steering Wheel Free Play

Inspection

1. Check the amount of the steering wheel play by turning the wheel in both directions until the tires begin to move with the front wheels properly in the straight ahead position.

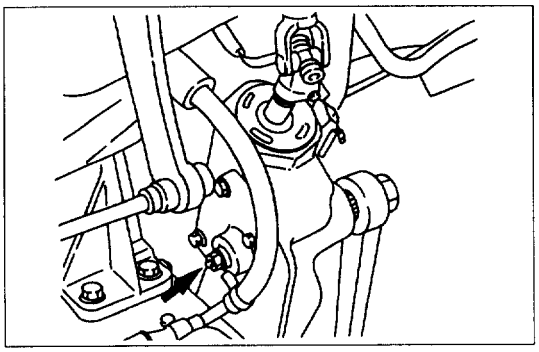
NOTE:

If the vehicle is equipped with a power steering unit, the wheel free play should be checked with the engine running.

Steering Wheel Free Play — mm(in)

Manual Steering	Power Steering
10 – 30 (0.4 – 1.2)	10 – 50 (0.4 – 2.0)

2. Also check the steering wheel for play and looseness in mount by moving it back and forth and sideways.While driving check for hard-steering, shimmy and tendency of steering to pull to one side.

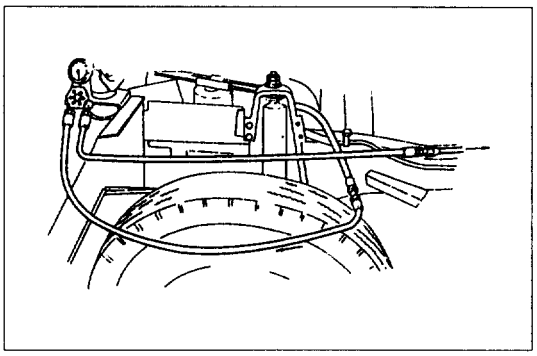


Adjustment

1. Align the front wheels properly in the straight ahead position.
2. Loosen the lock nut on the adjusting screw of the steering unit.
3. Turn the adjust screw clockwise to decrease free play or counter-clockwise to increase.
4. After check of specified free play, tighten the lock nut to specified torque.

Lock Nut Torque — N·m (kg·m / lb·ft)

Manual Steering	Power Steering
25 (2.5 / 18)	69 (7.0 / 51)



Power Steering Fluid Pressure

Preparation

1. Install Fthe power steering fluid pressure gauge between the pump and steering unit as figure.
   Gauge: 5-8840-0162-0
2. Start and let the engine idle until oil temperature reaches 50 – 60°C (122 – 140°F).
3. Take measurement of the pressure gauge when the steering wheel is turned clockwise or counterclockwise to lock.

Standard Pressure (at idle speed)	kPa (kg/cm^2 / psi)
NHR, NKR, NPR (except NPR66, 70, 71)	10,297 (105/1,493)
NPR66, 70, 71, NPS66, 71	10,787 (110/1,564)
NQR	11,278 (115/1,635)

Excess pressure means pump trouble.

Less pressure means steering unit trouble.

NOTE:

This test should be done within ten seconds.

- Steering wheel shake
- Steering shimmy
- Hard steering
- Turning radius
- Steering wheel return
- Steering pull to one side

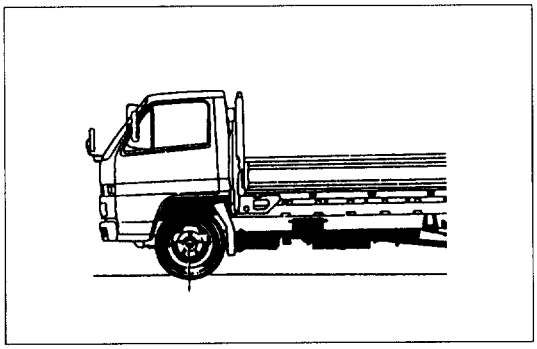
Steering Function

Check the following items.

- Tire pressure and abnormal wear
- Front hub bearings for axial play
- Ball joints on steering linkage for play
- Operation of shock absorbers
- Tightness of suspension parts
- King pin bearings for play

Inspection of Wheel Alignment

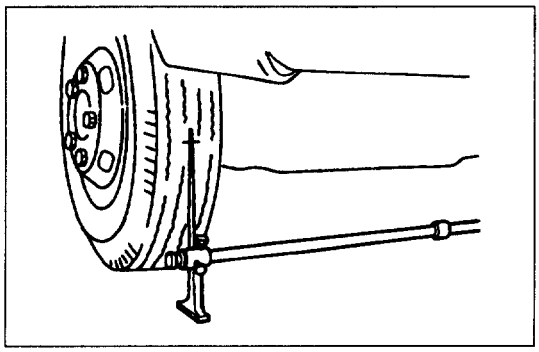
The points listed in table at left must be checked prior to inspecting front wheel alignment.



Toe-In

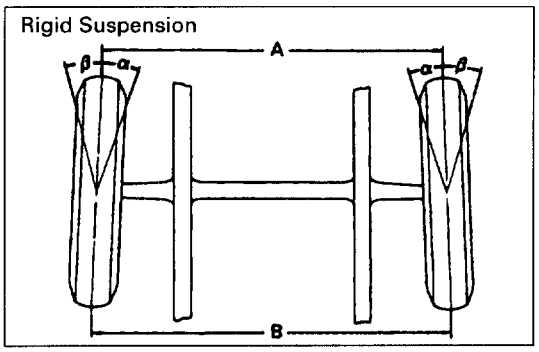
Measurement should be taken with the vehicle on a surface plate.

If a surface plate is not available, toe-in should be checked with the vehicle parked on a level floor.



1. Set front wheels to its straight ahead position.
2. Align the toe-in gauge with center height of each wheels at front end.
3. Apply center marks to each wheel, then take measurement of distance A between the center marks on each wheel.
4. Move slowly the vehicle rearward until center marks get its rear end position.
5. Take measurement of distance B between the center marks at rear end.

Rigid Suspension



The toe-in can be calculated with next formula.
Toe-in = B – A

Toe-in mm(in.)

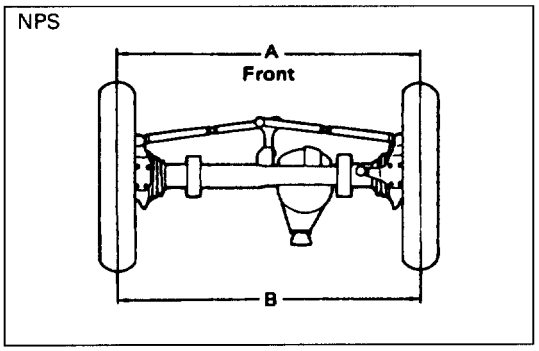
1994 – 1997 Model

Tire	Rigid	Wishbone, NPS
Bias	3 – 7 (0.12 – 0.28)	-2 – 2 (-0.08 – 0.08)
Radial	0 – 4 (0 – 0.16)	

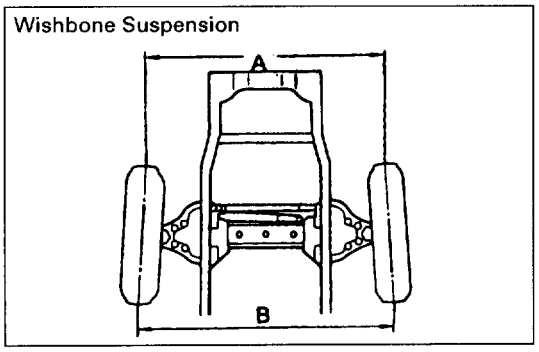
1998~ Model mm(in.)

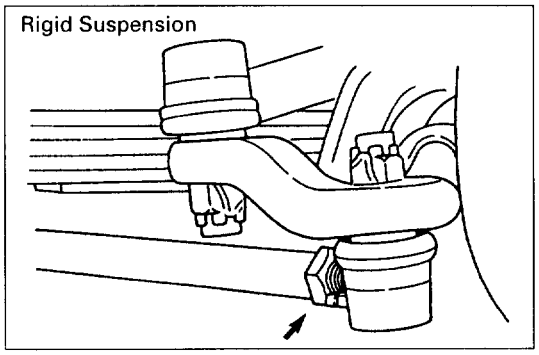
-2 – 2 (-0.08 – 0.08)

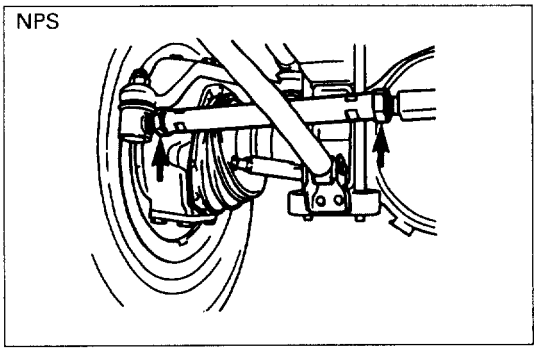
NPS

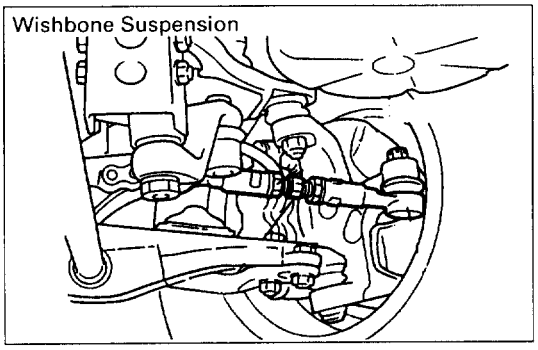


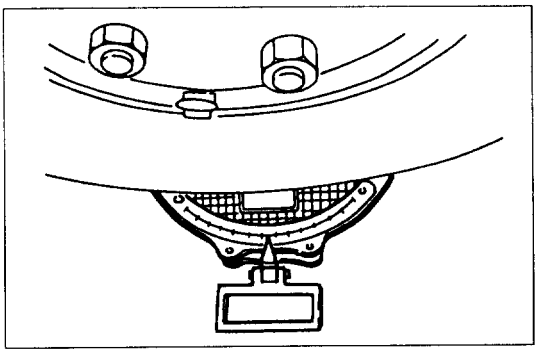
Wishbone Suspension











Adjustment

1. Loosen the lock nuts on the tie rod or outer truck rod ends.
2. Adjust length (L) of the tie rod by turning the connecting rod on outer truck rod.
3. Tighten the lock nuts to specified torque.

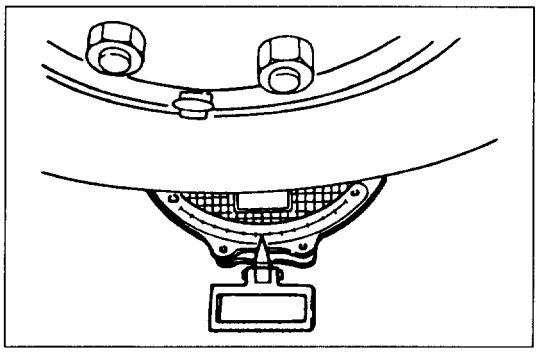
Lock Nut Torque	N·m (kg·m/lb·ft)
Rigid Suspension, NPS	113 (11.5 / 183)
Wishbone Suspension	167 (17.0 / 123)

Turning Radius

1. Position a suitable piece of wood equivalent in thickness to the turning radius gauge under each rear wheel.
2. Position each front wheel on a turning radius gauge by aligning the tire center line with the center of the turning radius gauge.
3. Turn the steering wheel clockwise or counterclockwise until the front wheels are locked.

NOTE:

Turn the steering wheel with the brake pedal depressed using brake pedal pusher.



Reading of the turning radius gauge directly indicates the steering angle.

Steering Angle

1994 – 1997 Model (Deg.)

Vehicle Model	Outer	Inner
Wishbone Suspension	35	38
NHR (Rigid Suspension)	34	46
NKR (Rigid Suspension)	30	38
NPR (Rigid Suspension)	36	47
NQR (Rigid Suspension)	34	42.5
NPS	30	38

1998 Wishbone Suspension Model (Deg.)

Vehicle Model	Outer	Inner
NKR (7.00-15 Tire)	29.5	38.5
NKR (7.00-16 Tire)	27.9	35.5
NKR (7.50-16 Tire)	25.1	31.5

1998 Rigid Suspension Model (Deg.)

Vehicle Model	Outer	Inner
NHR	33.0	37.5
NKR (7.00-15 Tire)	29.5	38.5
NKR (7.00-16 Tire)	27.9	35.5
NKR (7.50-16 Tire)	25.1	31.5
NPR, NQR (7.00-16 Tire)	35.0	47.5
NPR, NQR (7.50-16 Tire)	32.7	42.5
NPR, NQR (8.25-16 Tire)	30.0	36.5
NPS	30.0	38.0

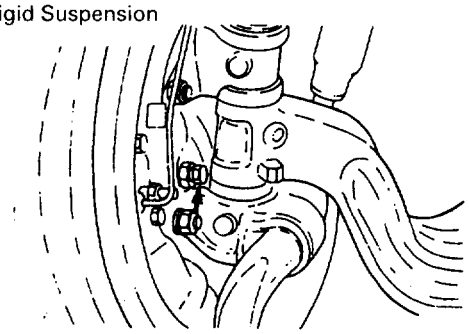
1999 Wishbone Suspension Model (Deg.)

Vehicle Model	Outer	Inner
NKR (7.00-15 Tire)	35.0	38.0

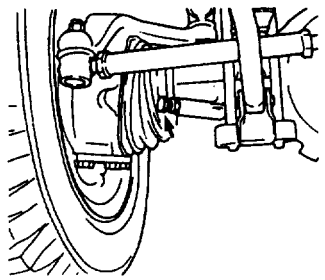
1999 Rigid Suspension Model (Deg.)

Vehicle Model	Outer	Inner
NHR	33.0	37.5
NKR (7.00-15 Tire)	29.5	38.5
NKR (7.00-16 Tire)	27.9	35.5
NKR (7.50-16 Tire)	25.1	31.5
NPR, NQR (7.00-16 Tire)	35.0	47.5
NPR, NQR (7.50-16 Tire)	32.7	42.5
NPR, NQR (8.25-16 Tire)	30.0	36.5
NPS	30.2	38.0

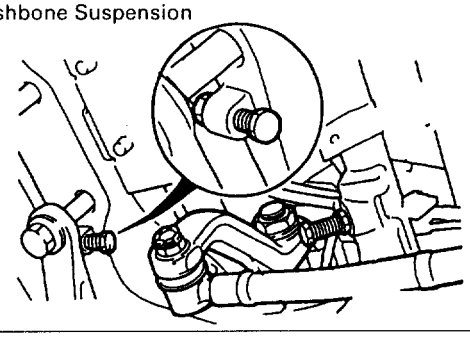
Rigid Suspension



NPS



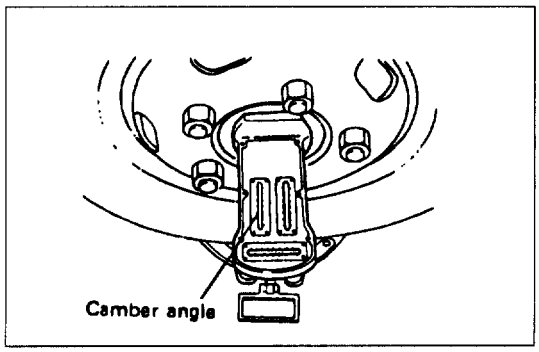
Wishbone Suspension



Adjustment

1. Loosen the lock nuts on the steering knuckle or the axle case.
2. Adjust projecting height of the stopper bolts.
3. Tighten the lock nuts to specified torque.

Stopper Bolt Torque	N·m (kg·m/lb·ft)
Rigid Suspension	186 (19.0 /137)
NPS	49 (5.1 / 36)
Wishbone Suspension	82 (8.4 / 61)



Camber Angle

All Model except NPS

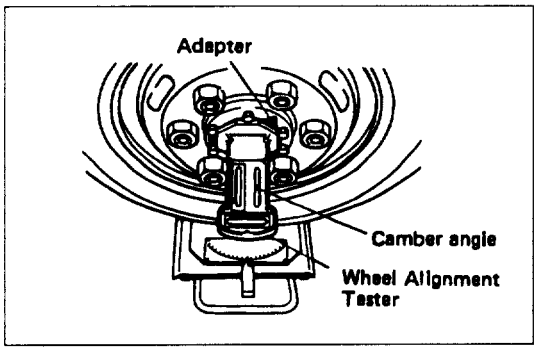
The toe-in can be checked on the gauge simultaneously.

1. When inspection of turning radius is completed, calibrate the scale of the turning radius gauge to zero.
2. Remove the front hub cap.

   Install camber, caster and king pin inclination gauge on end of the knuckle spindle horizontally.

NOTE:

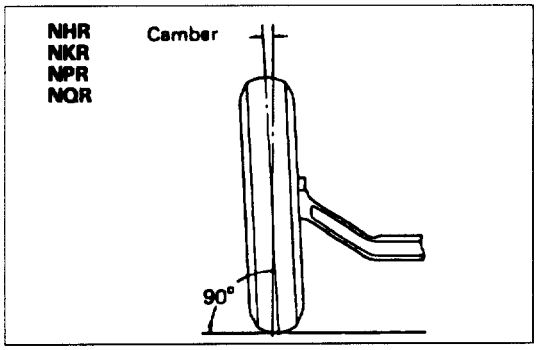
When removing hub cap, take care so as not to cause damage to gauge fitting face at end of the spindle. If end of the spindle has been scratched or damaged, correct before setting the gauge.



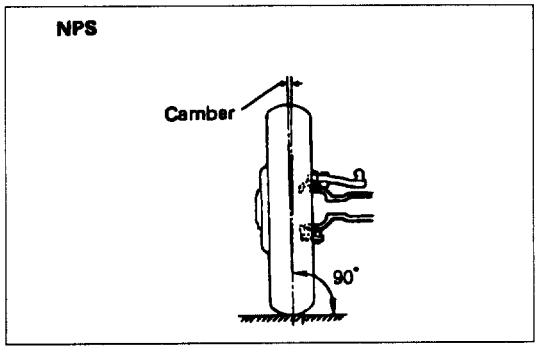
NPS

Remove the free wheel hub lock cover assembly then install gauge adapter on end of the knuckle spindle. Install camber, caster and king pin inclination gauge on end of gauge adapter.

Gauge Adapter: 5-8840-2188-0



3. Reading of the camber scale directly indicates the camber angle.

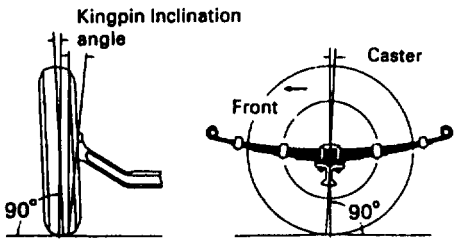


Camber Angle

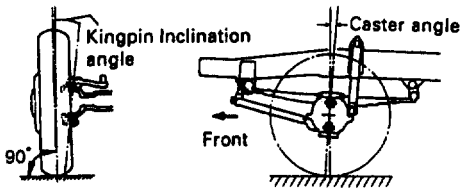
1994 – 1997 Model	(deg.)
Rigid Suspension	1°15′ ± 45′
Wishbone Suspension, NPS	0°15′ ± 45′

1998~ Model	(deg.)
NHR Rigid Suspension	1°15′ ± 45′
Rigid Suspension (except NHR)	0°15′ ± 45′
Wishbone Suspension, NPS	0°15′ ± 45′

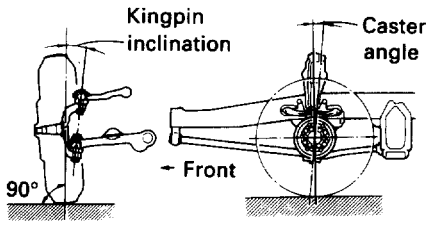
Rigid Suspension

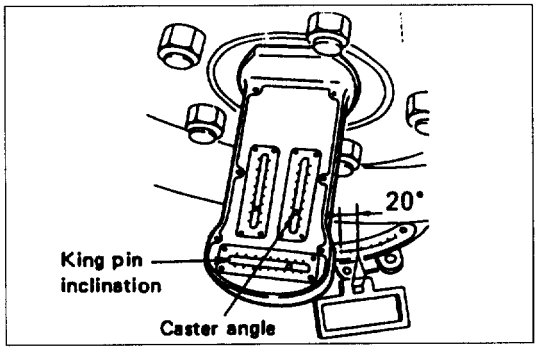


NPS



Wishbone Suspension





Caster Angle and King Pin Inclination

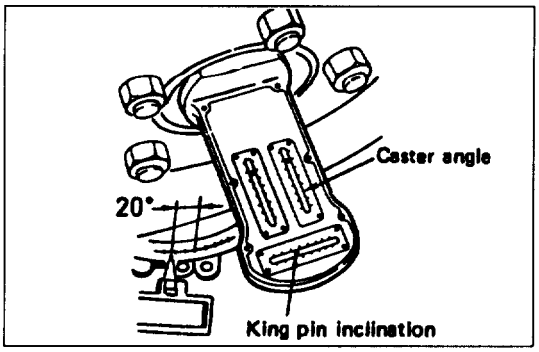
The caster angle and king pin inclination can be checked on the gauge simultaneously.

1. When inspection of camber angle is completed, calibrate the scale of the turning radius gauge to zero and turn the steering wheel clockwise (counterclockwise for checking caster angle and king pin inclination on the left side front wheel) until the front wheels are steered 20 degrees from the straight-ahead position.

NOTE:

Turn the steering wheel with the brake pedal depressed using brake pedal pusher.

2. When the front wheels are turned 20 degrees, calibrate the caster and king pin scales to zero turning the camber, caster and king pin gauge adjuster.



3. Turn the steering wheel in the opposite direction until the front wheels are steered 20 degrees in the opposite direction. Reading of the caster and king pin scales directly indicates the caster and king pin inclination angles being checked.

Caster Angle and King Pin Inclination

1994 – 1997 Model (deg.)

	Caster Angle	King Pin Inclination
Rigid Suspension	1°30'±1°	7°15'
Wishbone Suspension	1°00'±1°	9°45'±30'
NPS	2°00±1°	7°15'

1998~ Model (deg.)

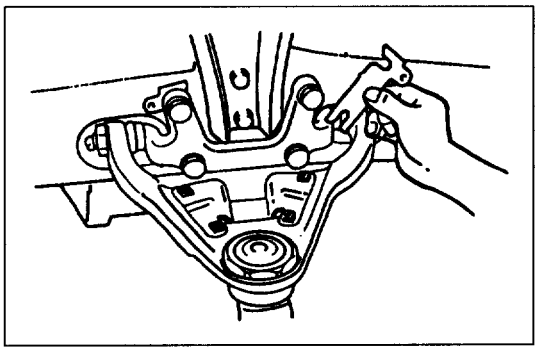
	Caster Angle	King Pin Inclination
NHR	1°30'±1°	7°15'
NKR Rigid Suspension	3°00'±1°	12°00'
NPR, NQR	2°45'±1°	12°00'
Wishbone Suspension	1°00'±1°	9°45'±30'
NPS	2°00'±1°	7°15'

- Front springs for weakening
- Front I-beam (axle case) for distortion
- Bushings in king pin, King pin bearings for wear or determination

Adjustment

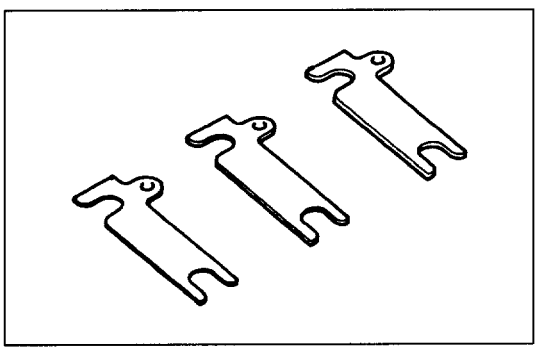
Rigid Suspension

The camber, caster and king pin inclination are built into front end and are not adjustable. If the camber, caster or king pin inclination is found to be out of alignment, check to locate the cause of trouble against the listing at left and replace the parts as necessary.



Wishbone Suspension

1) Set the jack under the cross member of the suspension and then raise the lower link with the jack and retain the jack with applied in the place.
2) Remove the shock absorber.
3) Attach the fulcrum pin and loosen the bolts to the degree that it will not fall a part to adjust the camber angle using the shims.



Camber Angle

If the number of shims are evenly increased both at fore and aft, the camber angle becomes acute, while if decreased, the angle becomes obtuse.

Caster Angle

When the caster angle is obtuse, increase the number of shims at the fore side, while the angle is acute, increase the number of shims at the aft side.

Thickness of Shims Available (mm)
0.8, 1.6, 3.2

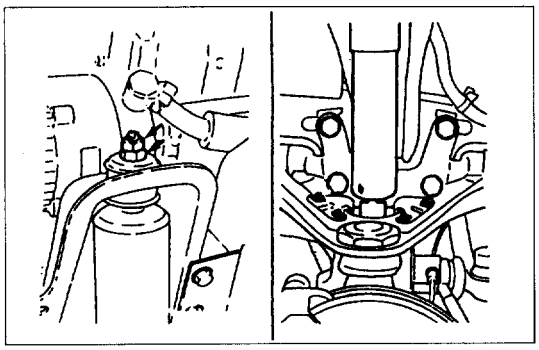
Conditions Where The Shims are Used

	Limit
Numbers of Shims	4 or less
Thickness mm (in)	9.6 (0.378) or less
Difference of Thickness (between Front and Rear) mm (in)	4.8 (0.189) or less

In case the shim has already reached at the limitation in its number or its thickness, decrease the number of shims at the aft side to adjust the obtuse caster angle, while decrease the number at the fore side to adjust the acute caster angle.

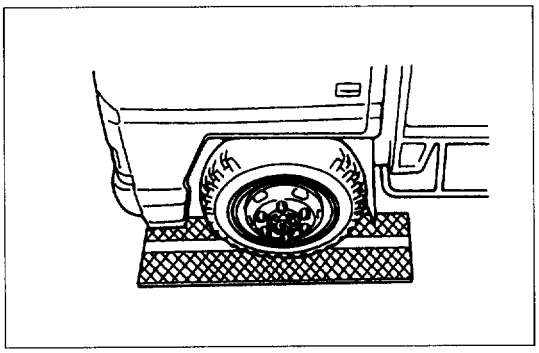
NOTE:

Since the number of shims needed for caster angle adjustment varies depending on the conditions of the car, perform the adjustment procedures which are the most suitable for the car conditions.



4) Tighten the mounting bolts of the front shock absorber.

Shock Absorber Bolt and Nut Torque	N·m (kg·m/lb·ft)
Upper	40 (4.1 / 30)
Lower	103 (10.5 / 76)



Measurement of Side Slippage

When inspection and adjustments of toe-in, camber, caster and king pin inclination are completed, check for side slippage using a side slip tester.

Roll the wheels over the side slip tester as slowly as possible and take reading on the tester. If the amount of side slippage is in excess of 5 mm per 1 m, recheck the wheel alignment.

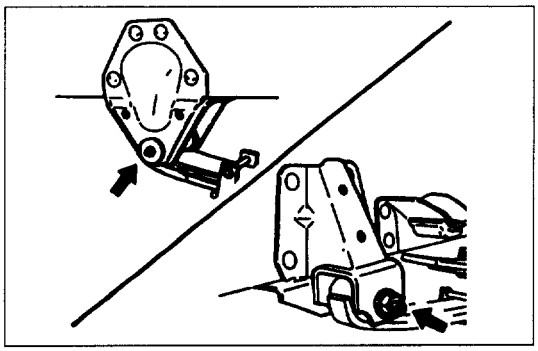
Side Slippage mm (in)
Limit
5.0 (0.197) Per 1m

FRONT AND REAR SUSPENSION

- Leaf spring breakage
- Body inclination
- Reduction of ground clearance

Suspension Function

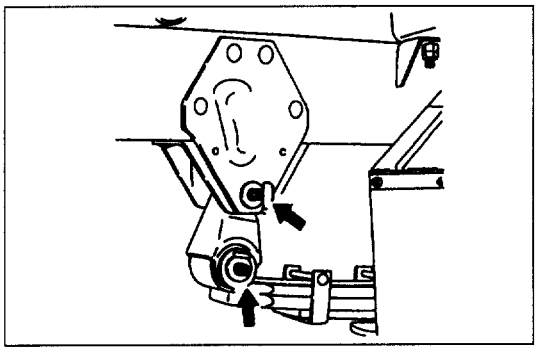
Check the following items.



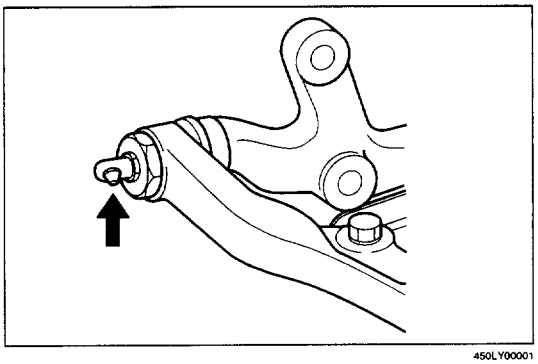
Lubrication

Lubricate the following points with multi-purpose type grease.

- Spring Pin



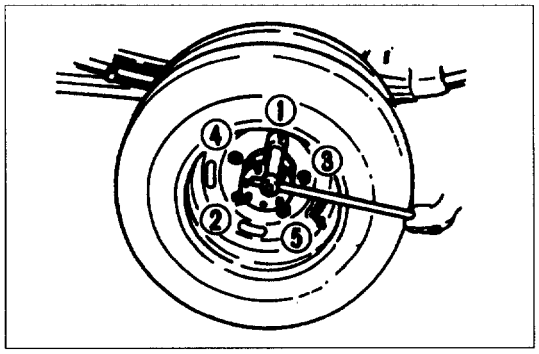
- Shackle Pin



- Upper Arm (for Wishbone Suspension)

450LY00001

WHEELS AND TIRES

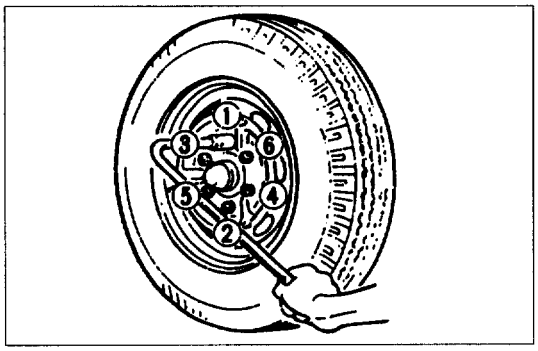


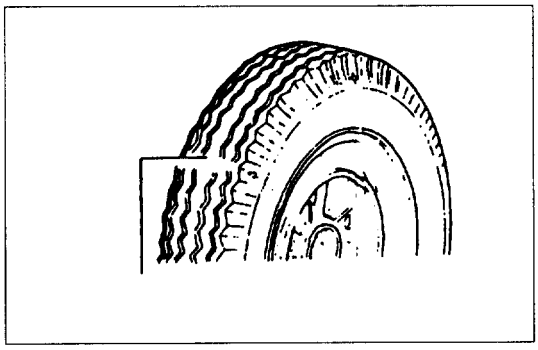
Wheel Nut Retightening

Retighten the wheel nuts in sequence as shown in the figure.to specified torque.

Front Wheel Nut Torque	N·m (kg·m / lb·ft)
NHR / NKR Single Tire, NKR Flat Low	167 (17 / 123)
Except Above Models	441 (45 / 325)

Rear Wheel Nut Torque	N·m (kg·m / lb·ft)
NHR / NKR Single Tire	167 (17 / 123)
NHR Dual Tire, NKR Flat Low	294 (30 / 217)
Except Above Models	441 (45 / 325)





Tread Wear Indicators

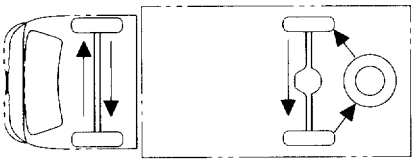
The original equipment tires have built-in tread wear indicators to show when tires need replacement.

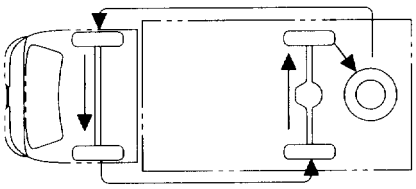
These indicators may appear as wide bands. When the indicators appear in two or more grooves at three rocations, tire replacement is recommended.

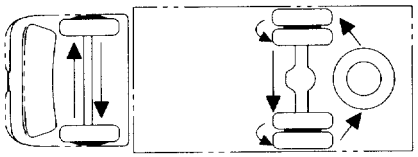
Tire Rotation

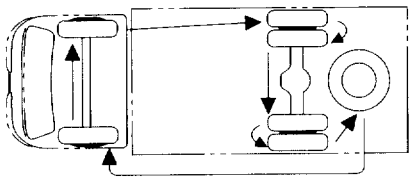
To allow the tires to wear evenly and to prolong their life exchange the front and rear tire locations as shown in the figure.

For bias tires

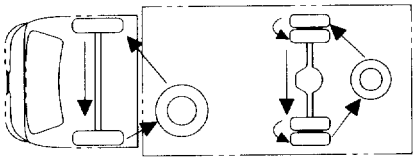




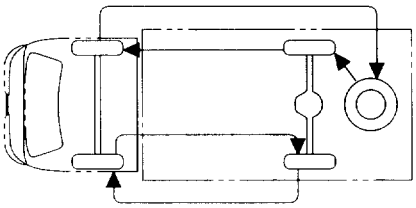


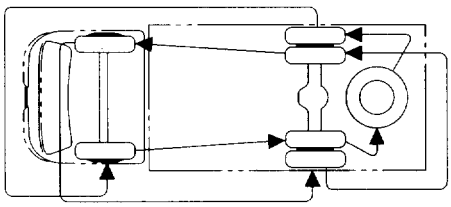


Flat low(Small dual tire)

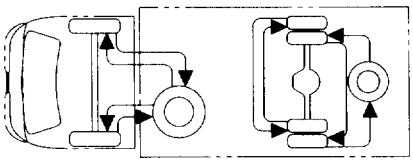


For radial tires

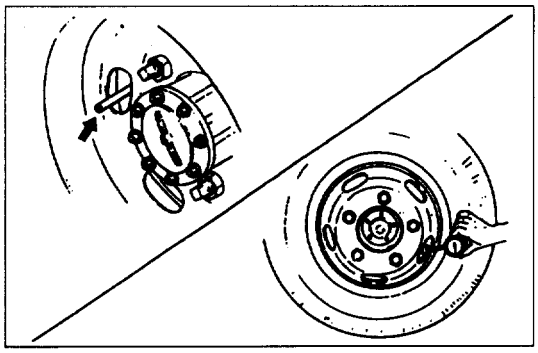


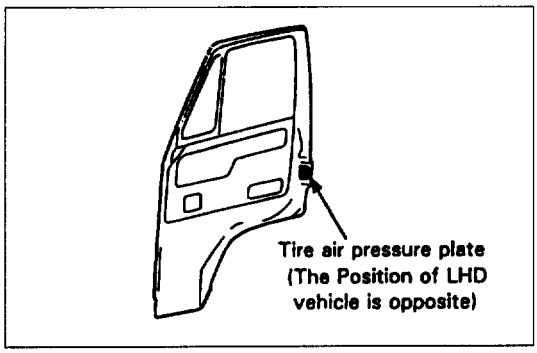


Flat low(Small dual tire)



480LY00001





Tire Inflation Pressure

Tire pressure, in cold condition (after vehicle has set for three hours or more, or driven less than one mile), should be checked monthly or before any extended trip. Tire pressure increases approx. 15% when the tires become hot during driving. The pressure specification is shown on the label as figure.

Tire Inflation Pressure — kPa (kg/cm^2 / psi)

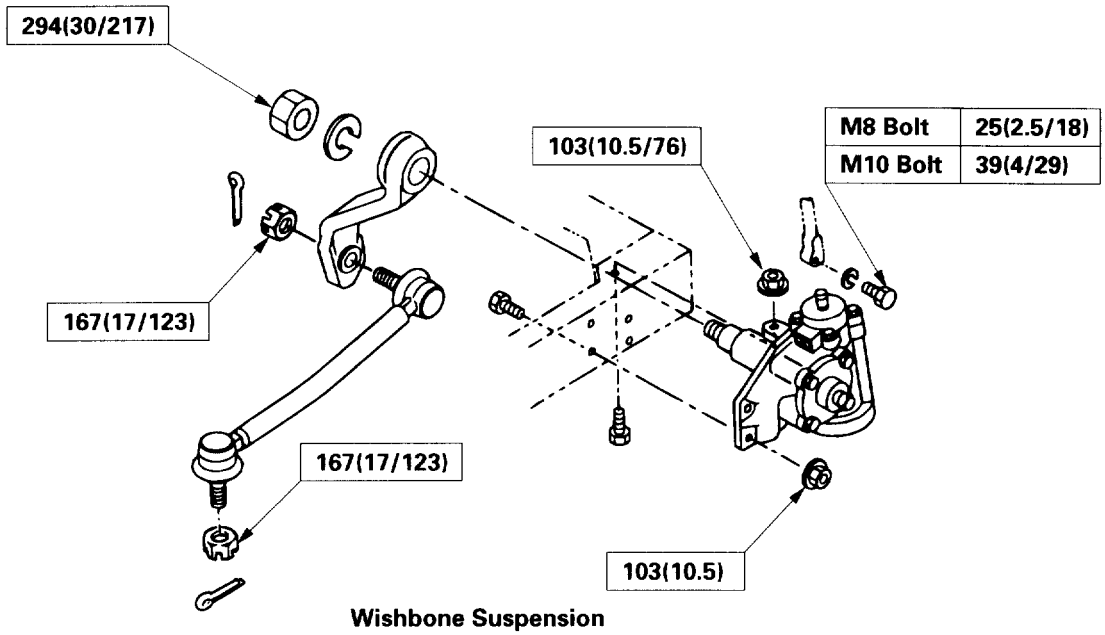
Tire Size	Inflation Pressure
6.50-15-6PR	319 (3.25 / 46)
7.00-15-6PR	
7.50-16-6PR	
5.00-12-8PR	392 (4.00 / 57)
5.50-13-8PR	
6.00-13-8PR	417 (4.25 / 60)
6.00-14-8PR	
6.00-15-8PR	
7.00-15-8PR	
7.00-16-8PR	
7.50-15-8PR	
7.50-16-8PR	
6.00R15-8PR	441 (4.50 / 64)
7.00R15-8PR	
7.00R16-8PR	
155R13-8	
205R16C8PR	
7.50R16-8PR	466 (4.75 / 68)
195/75R16C	
6.50-15-10PR	490 (5.00 / 71)
6.50-16-10PR	
7.00-15-10PR	
7.00-16-10PR	
8.25-16-12PR	
7.50-15-10PR	515 (5.25 / 75)
7.50-16-10PR	
7.00R15-10PR	
7.00R16-10PR	
215/75R16C	
6.50R16-10PR	540 (5.50 / 78)
7.00-15-12PR	564 (5.75 / 82)
7.00-16-12PR	
7.50R16-10PR	
8.25-16-14PR	
7.50-15-12PR	588 (6.00 / 85)
7.50-16-12PR	
7.00R15-12PR	
7.00R16-12PR	
215/75R-17.5	
7.50-15-14PR	637 (6.50 / 92)
7.50-16-14PR	
7.50R16-12PR	
7.00-16-14PR	711 (7.25 / 103)

FIXING TORQUE

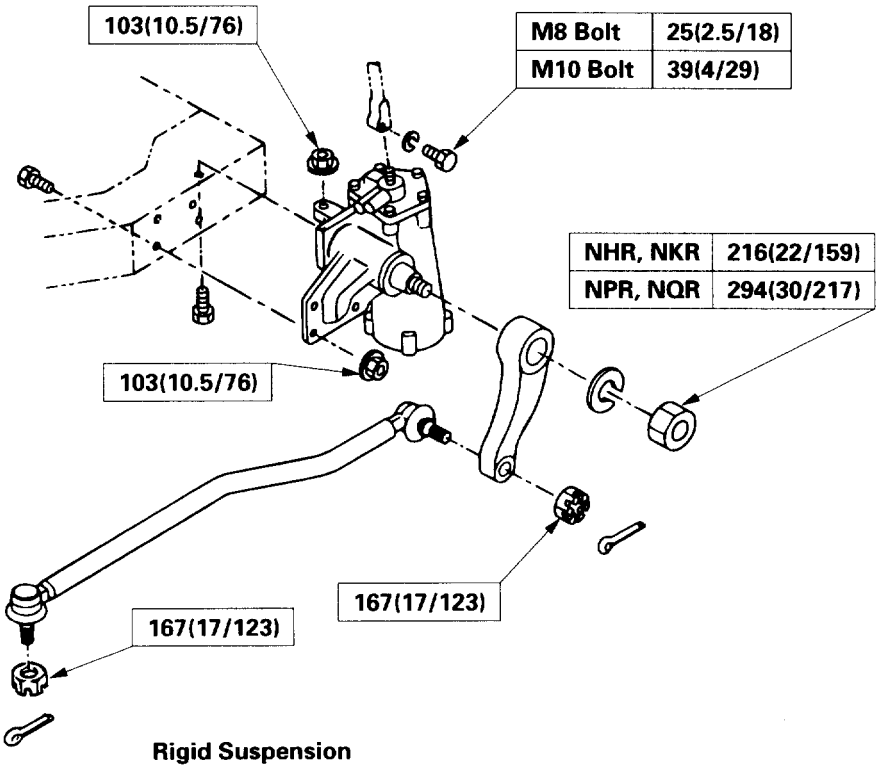
STEERING SYSTEM

Steering Unit, Pitman Arm and Drag Link

N•m (kg•m / lb•ft)



Wishbone Suspension

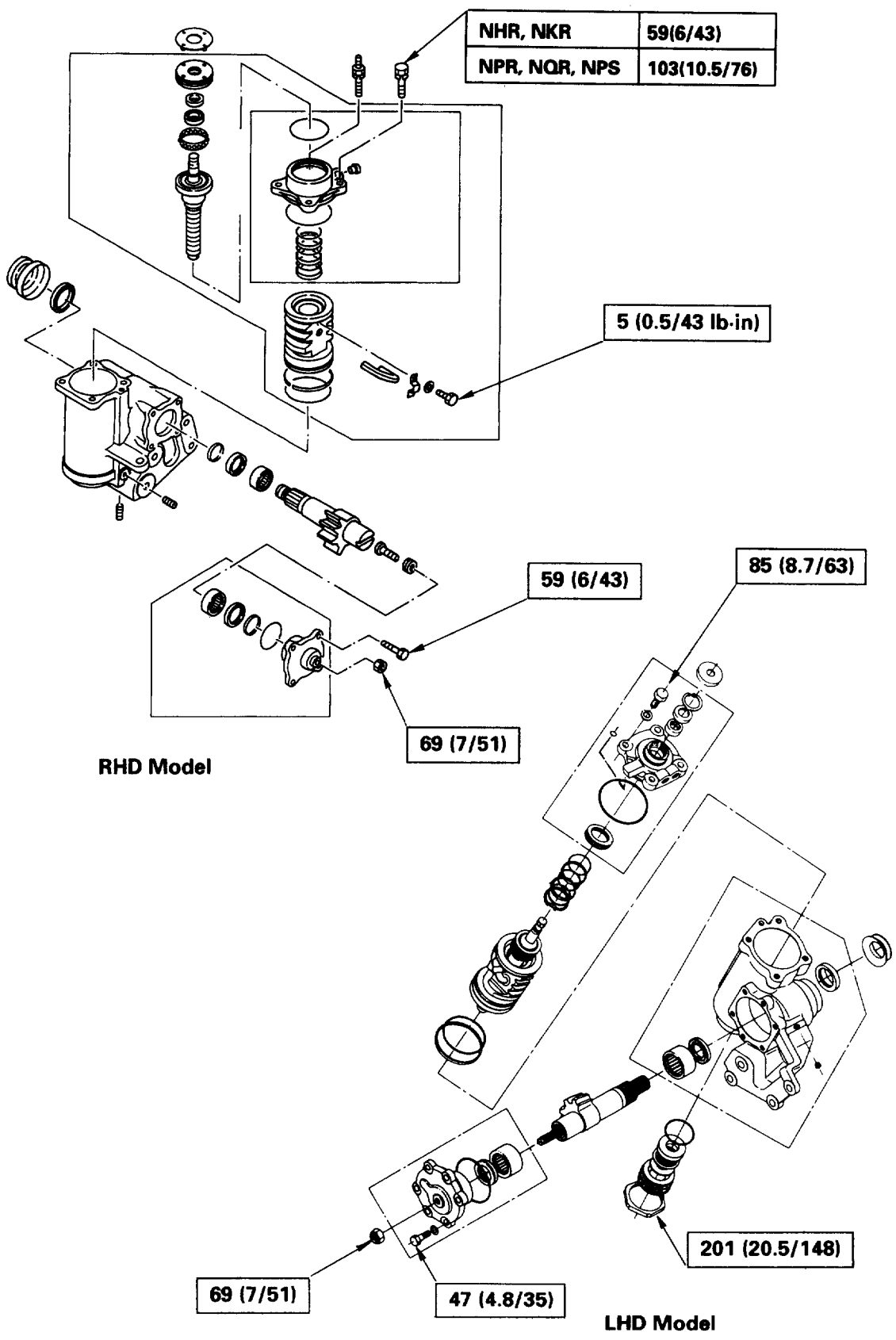


Rigid Suspension

440LY00001

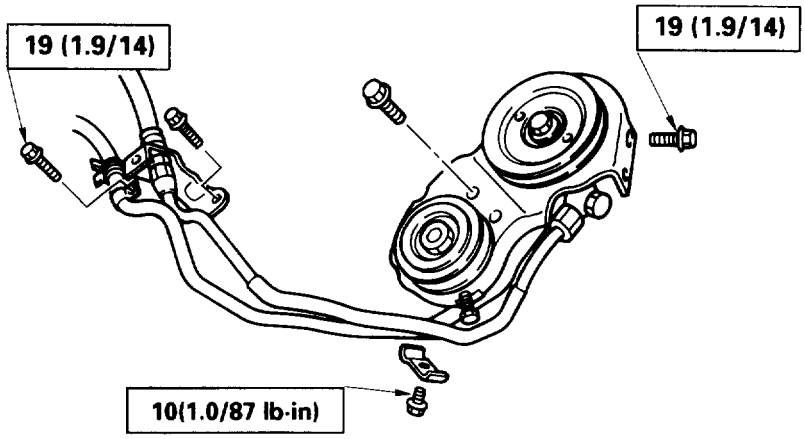
Power Steering Unit

N•m (kg•m / lb•ft)

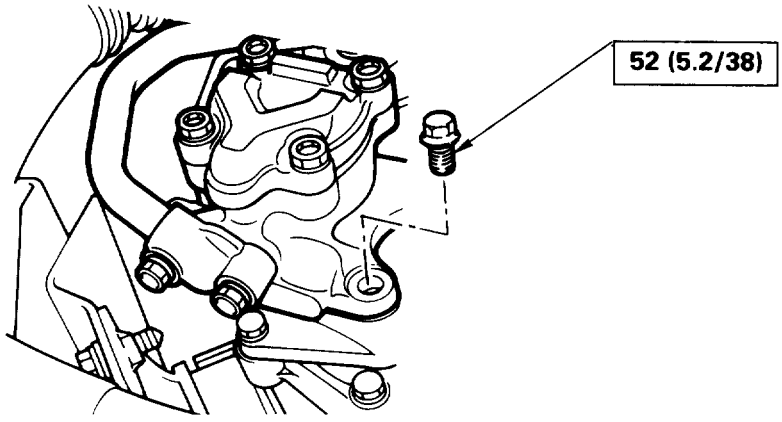


Power Steering Pump

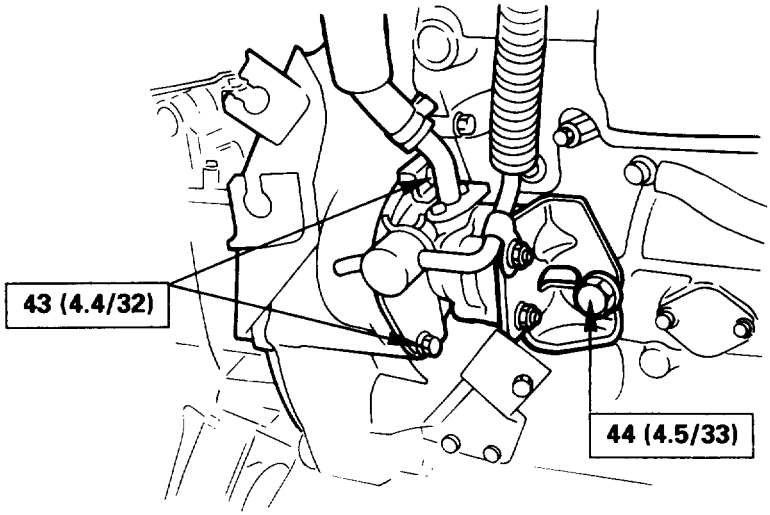
N•m (kg•m / lb•ft)



4J Series Engine



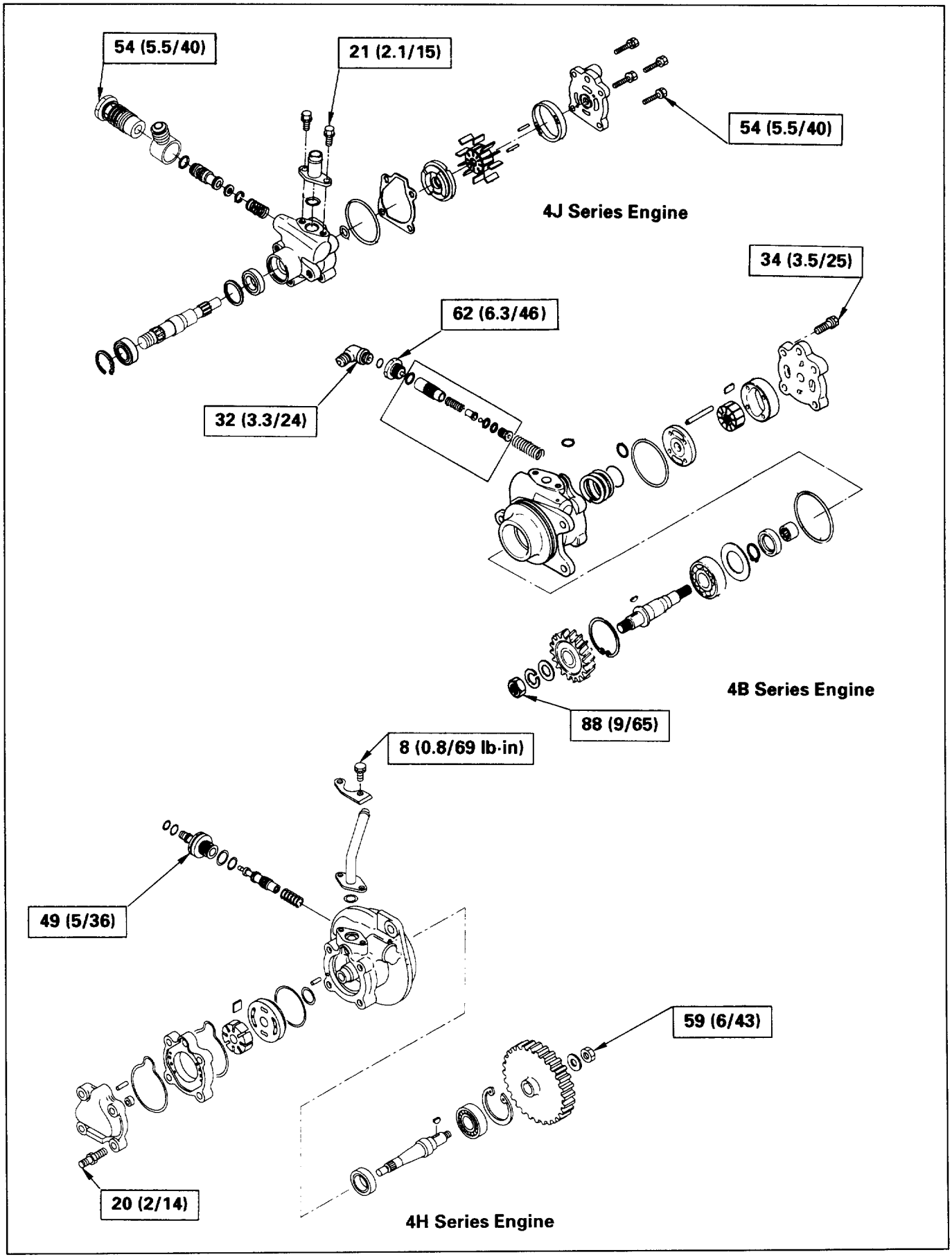
4B Series Engine



4H Series Engine

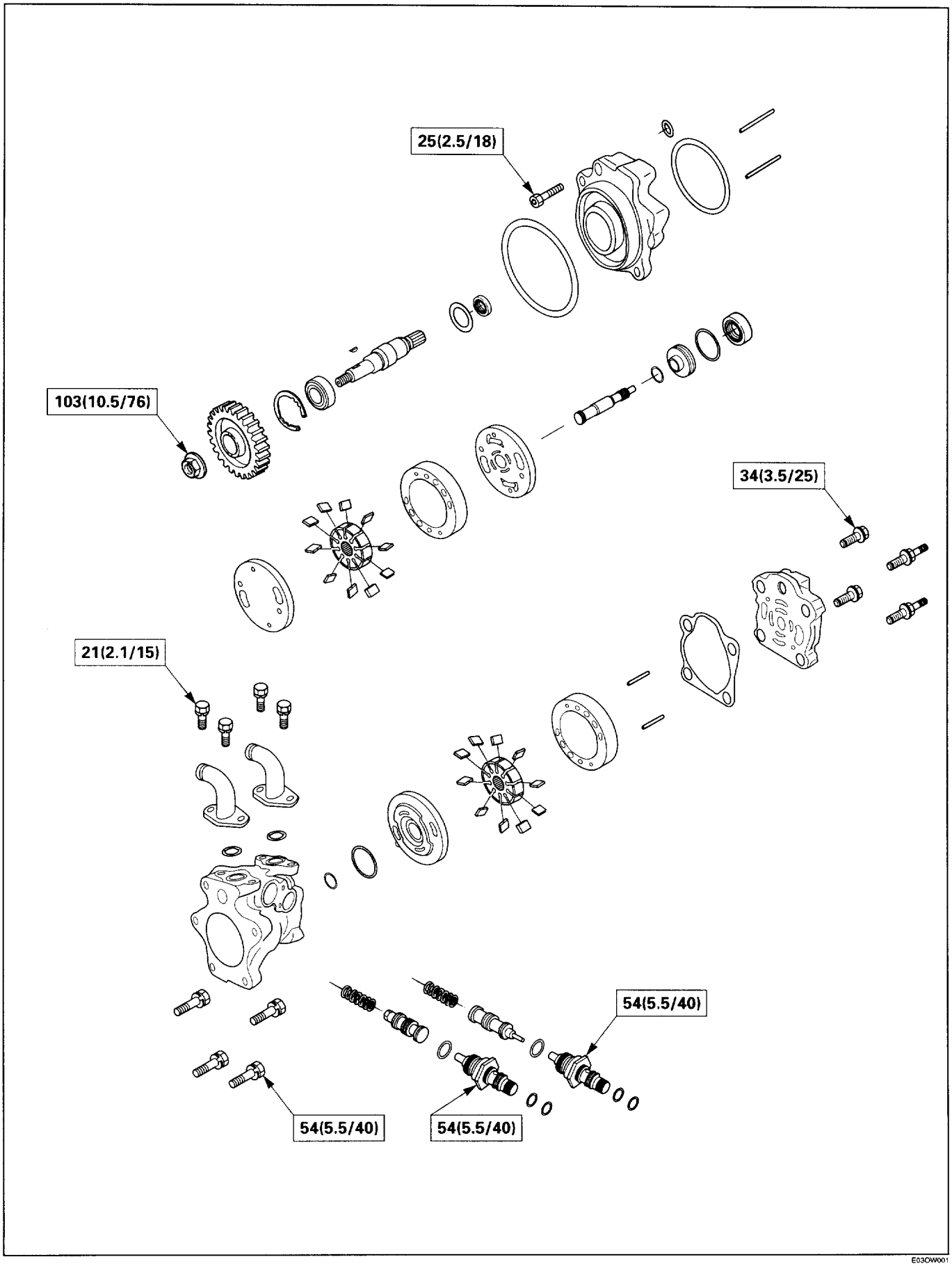
Power Steering Pump Assembly

N•m (kg•m / lb•ft)



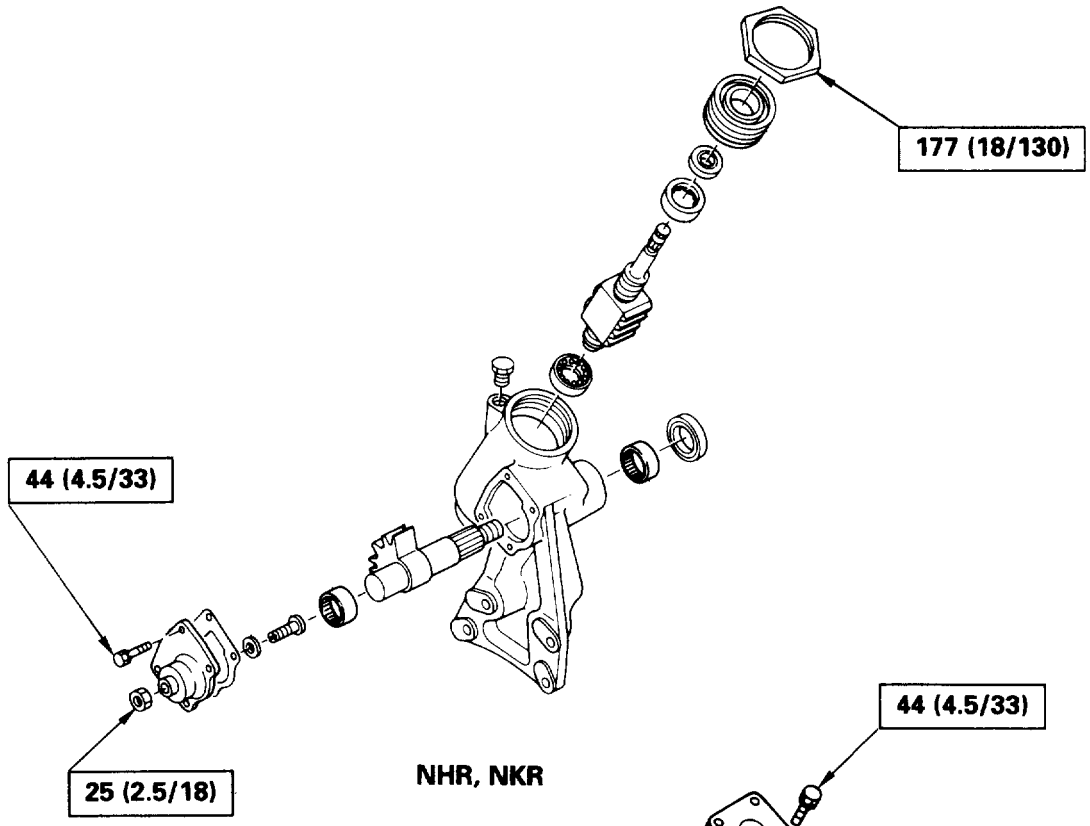
Tandem Hydraulic Pump

N•m (kg•m / lb•ft)

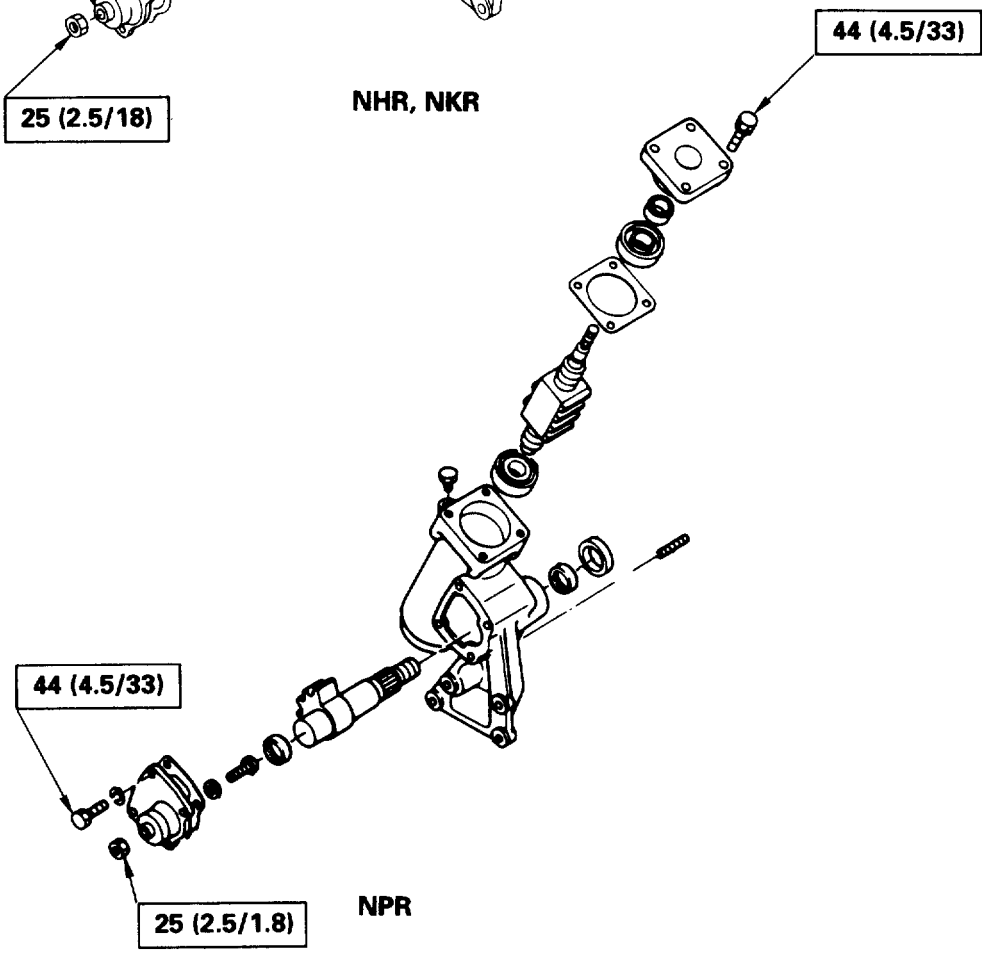


Manual Steering Unit

N•m (kg•m / lb•ft)



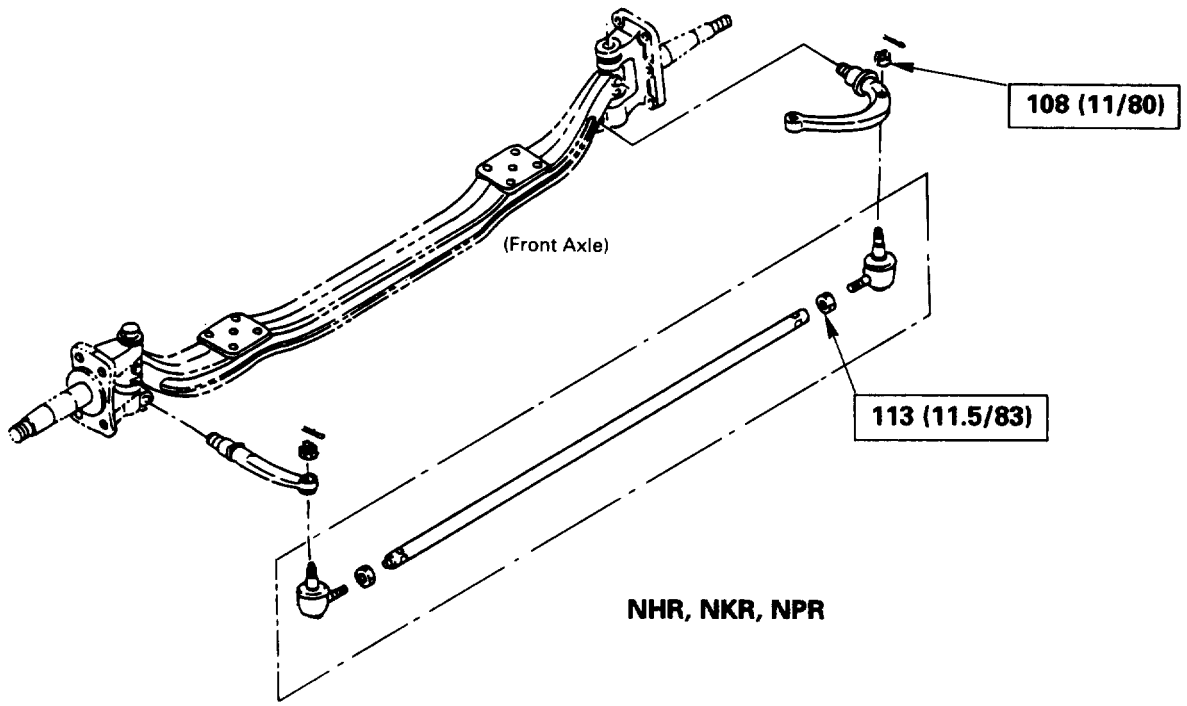
NHR, NKR



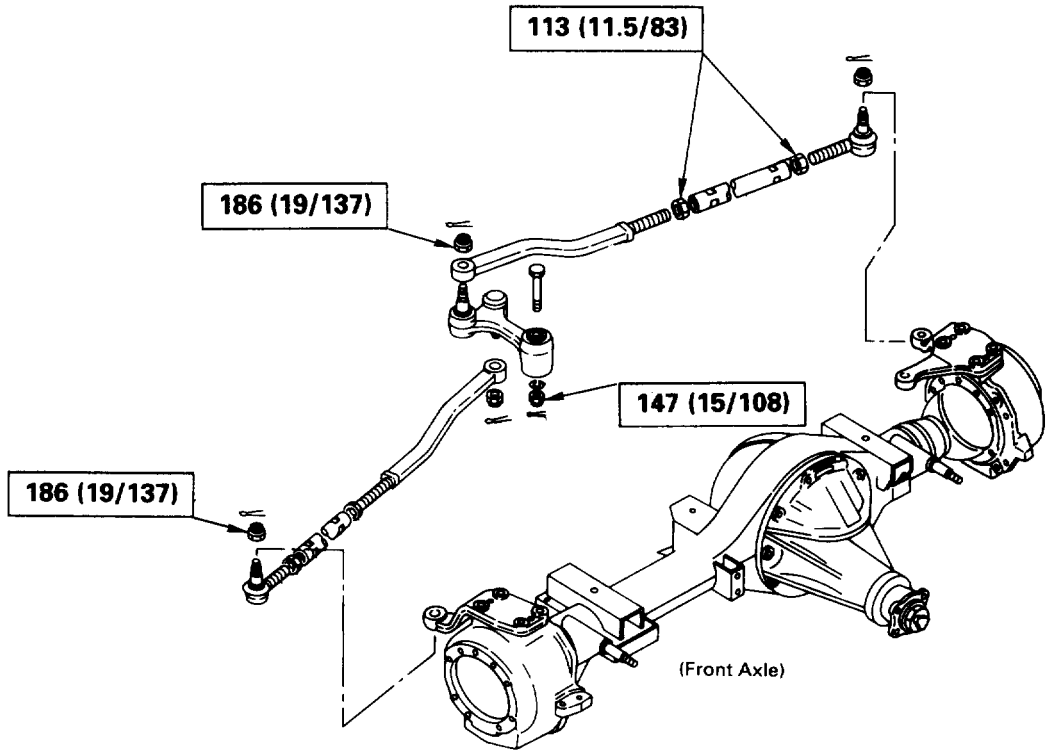
NPR

Steering Linkage (Rigid Suspension)

N•m (kg•m / lb•ft)



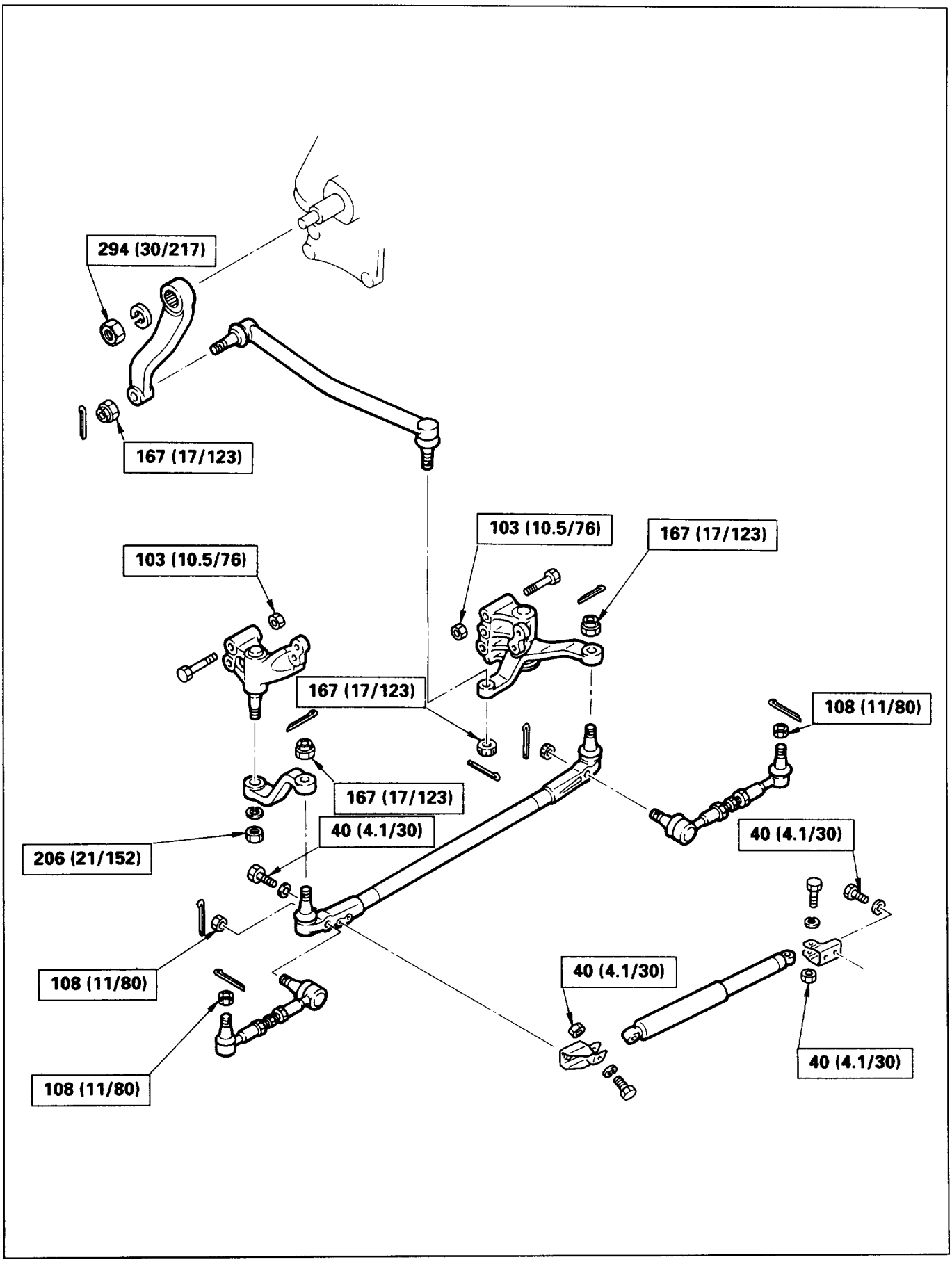
NHR, NKR, NPR



NPS

Steering Linkage (Wishbone Suspension)

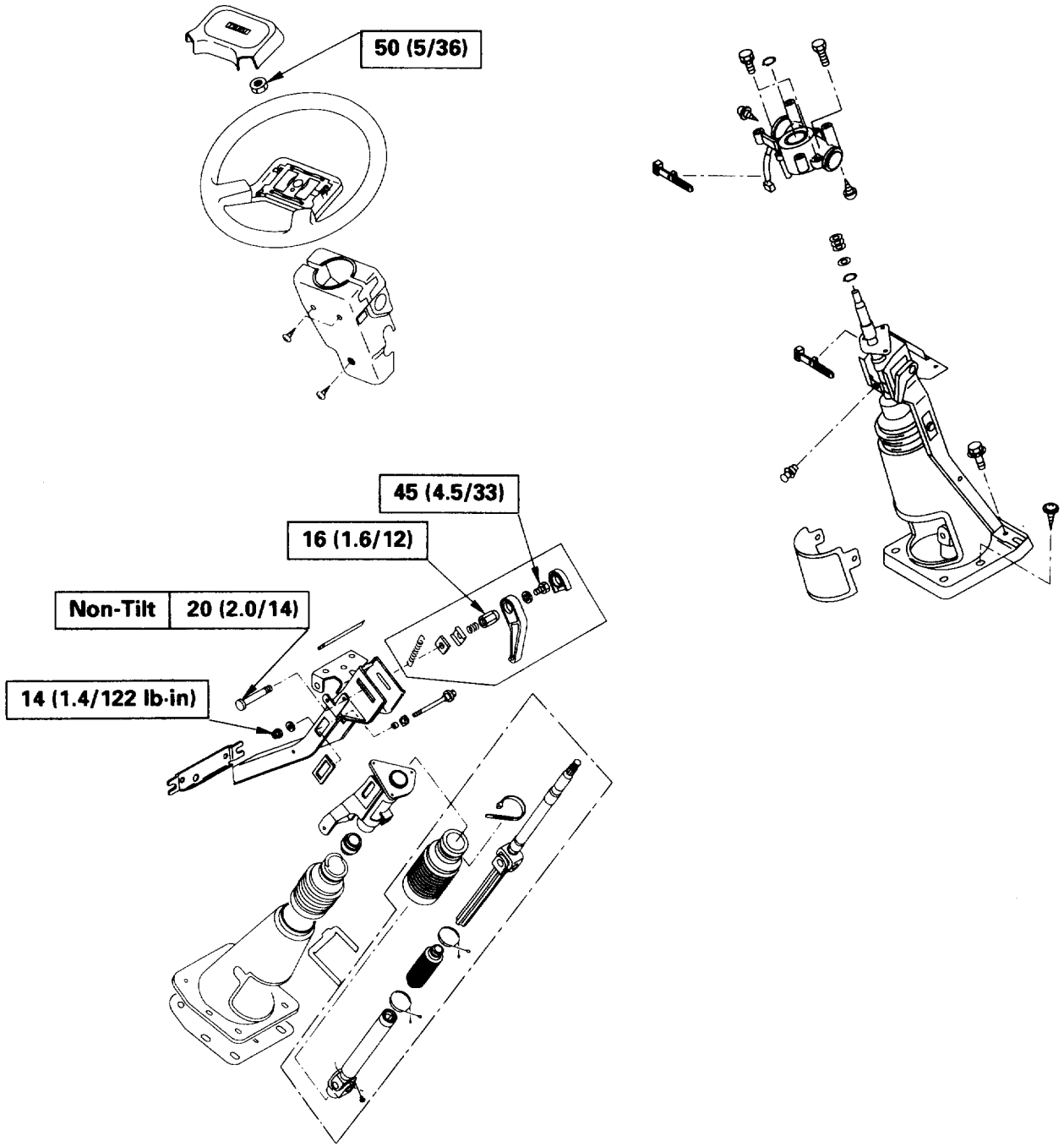
N•m (kg•m / lb•ft)



Steering Column

N•m (kg•m / lb•ft)

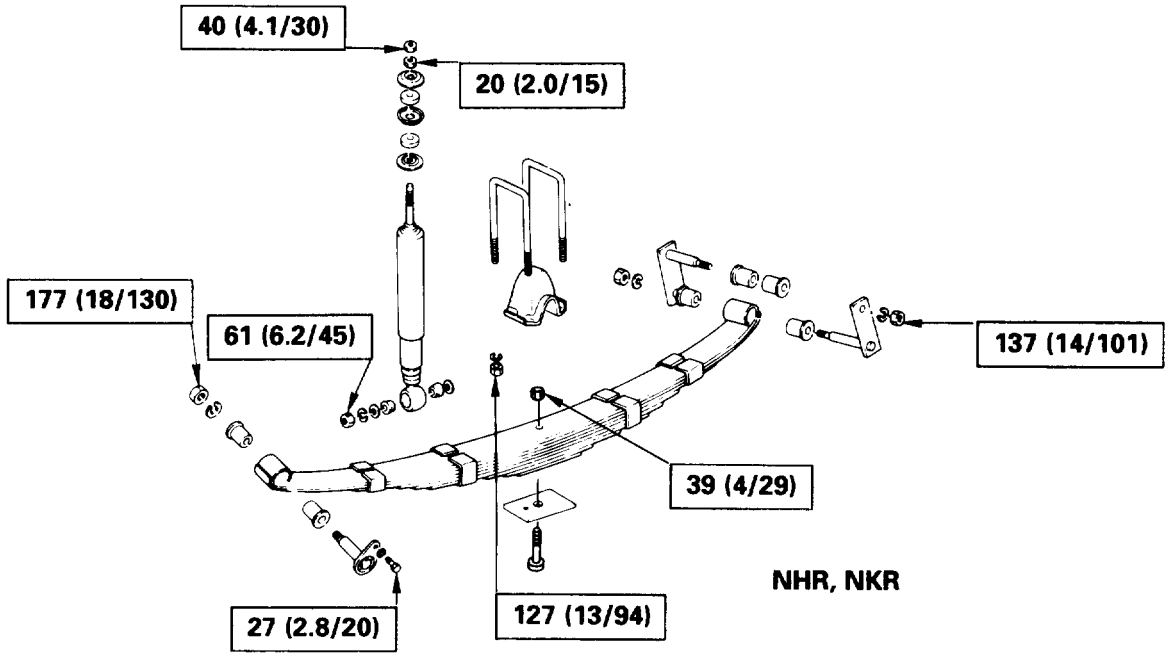
This illustration is based on tilt and telescopic control type.



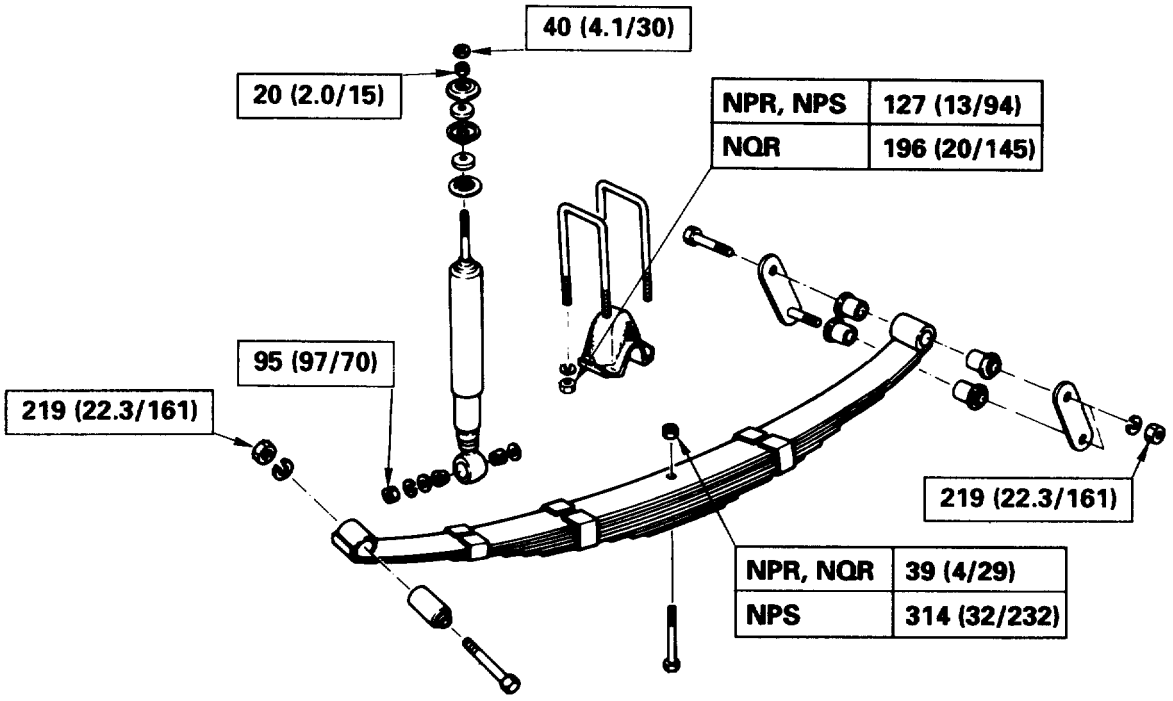
FRONT SUSPENSION

Front Leaf Spring and Shock Absorber

N•m (kg•m / lb•ft)



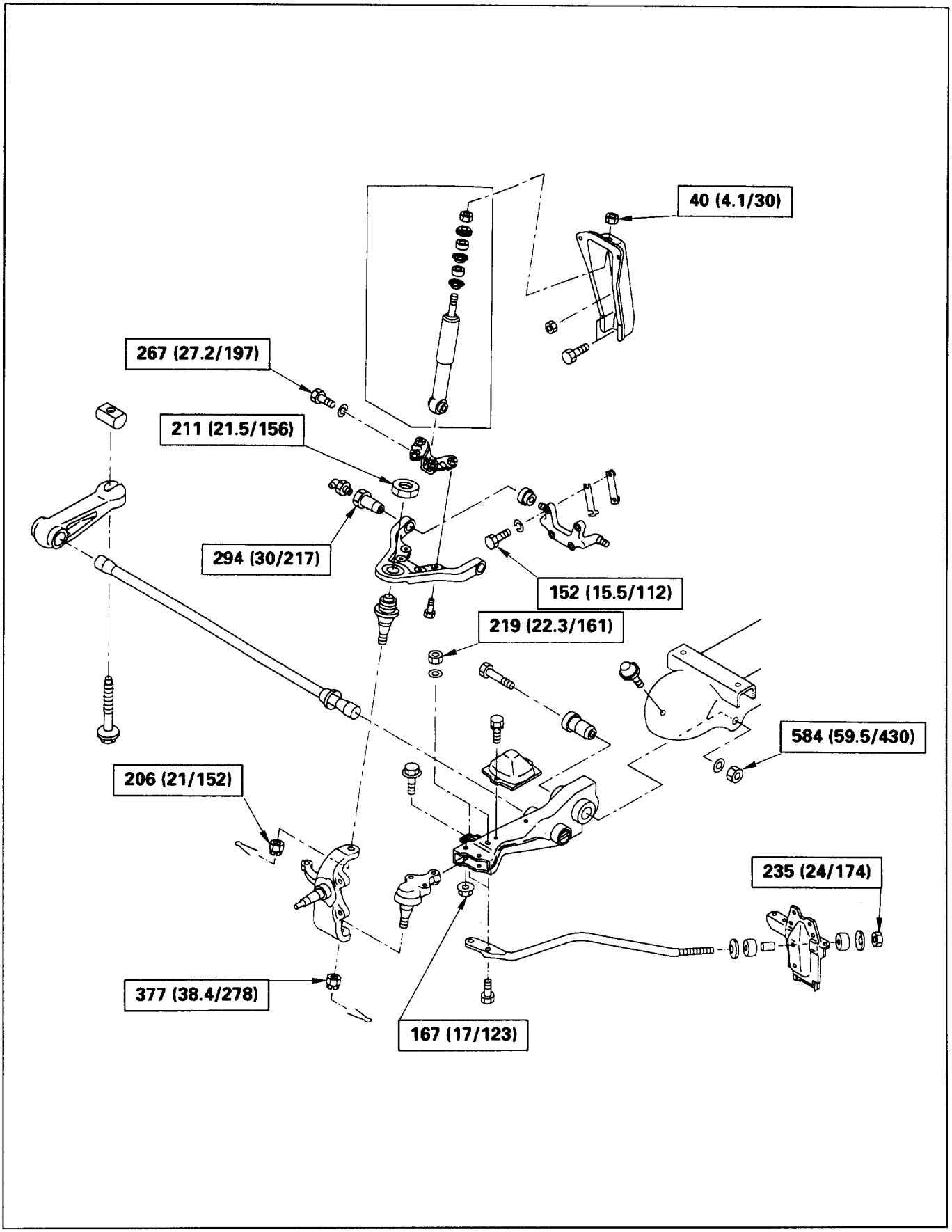
NHR, NKR



NPR, NQR, NPS

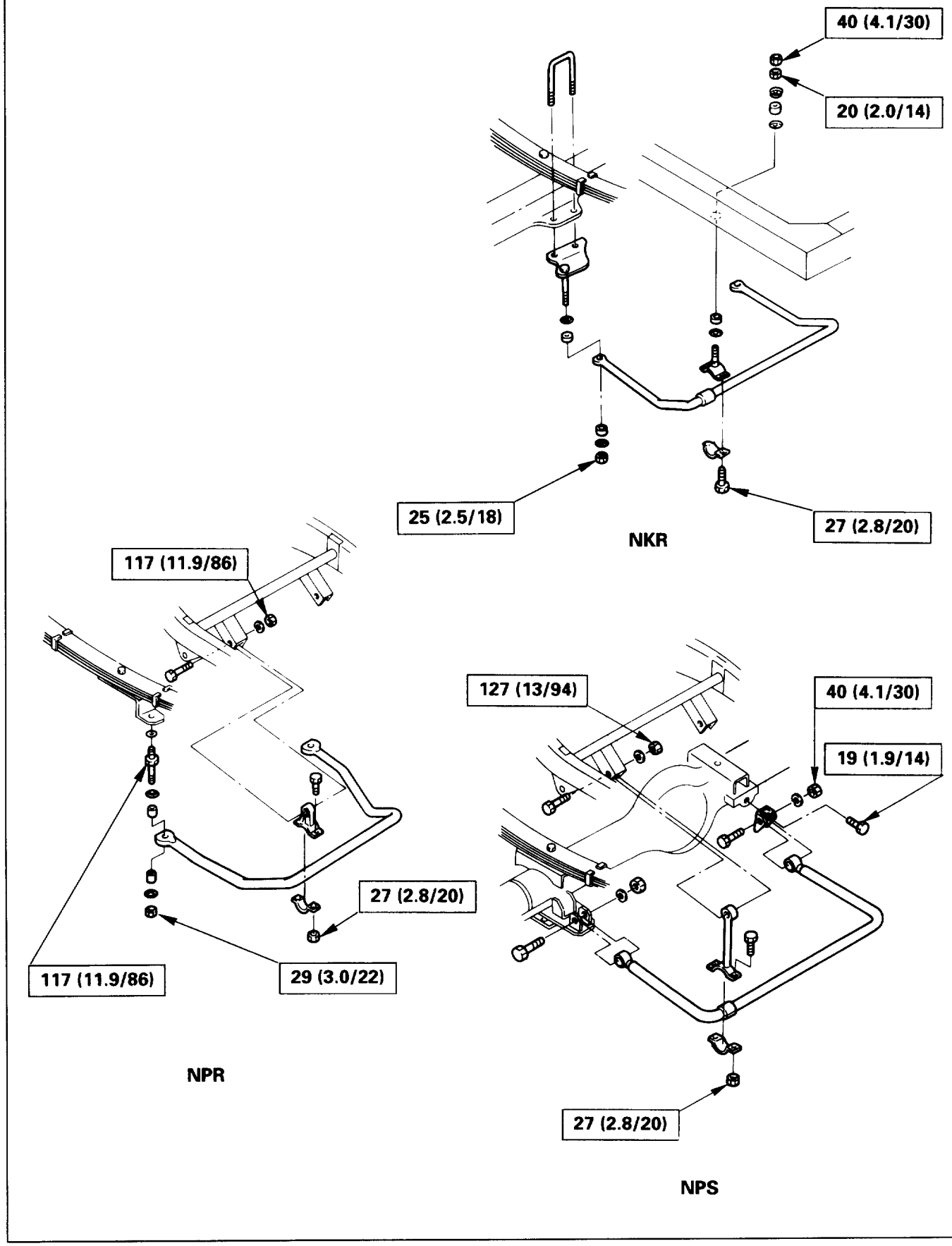
Upper, Lower Link, Torsion Bar and Strut Bar (Wishbone Suspension)

N•m (kg•m / lb•ft)



Front Stabilizer

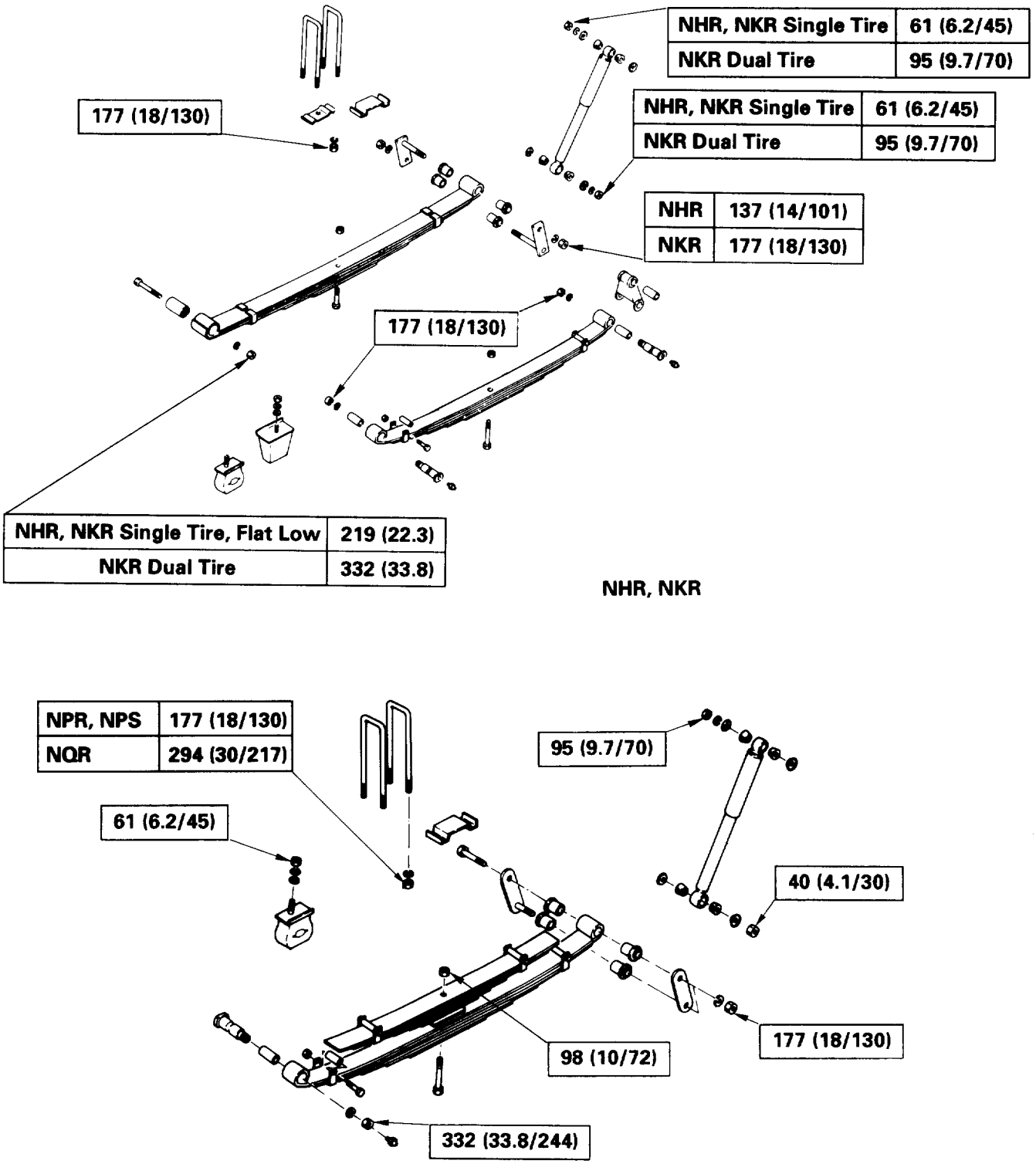
N•m (kg•m / lb•ft)



REAR SUSPENSION

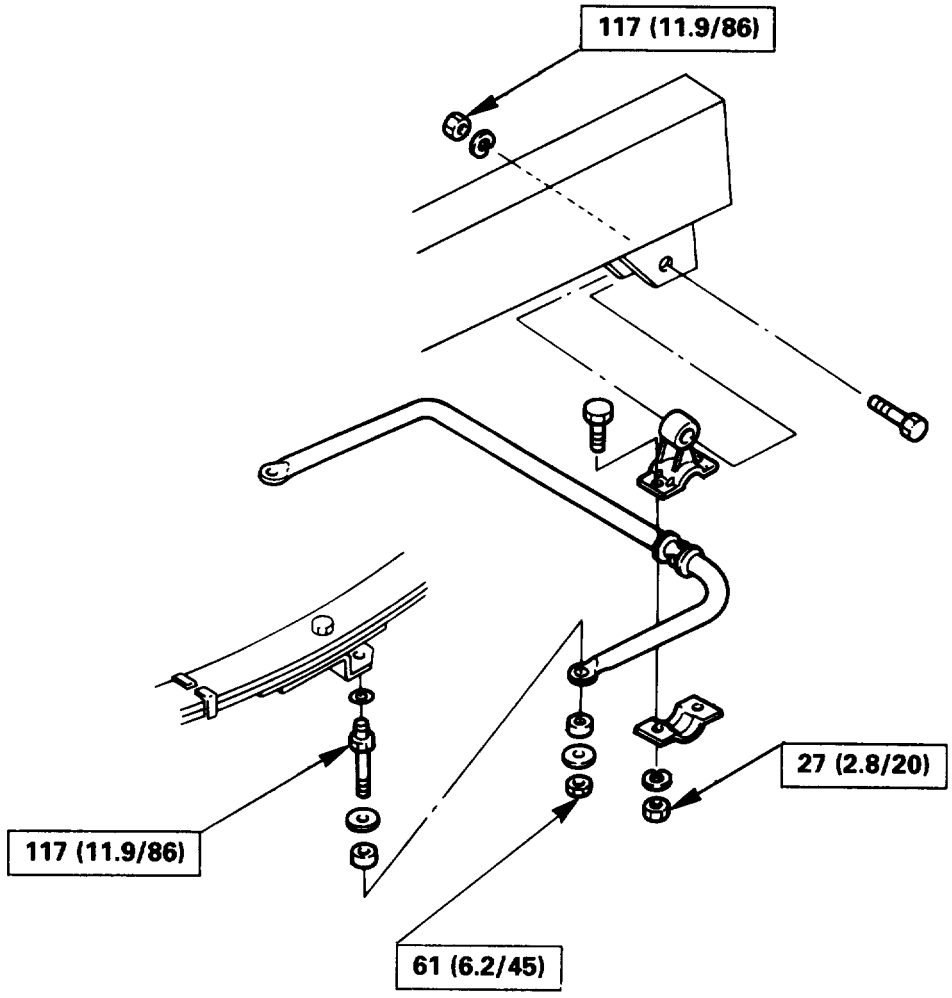
Rear Leaf Spring and Shock Absorber

N•m (kg•m / lb•ft)



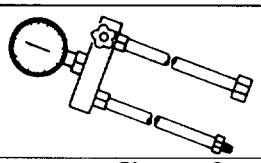
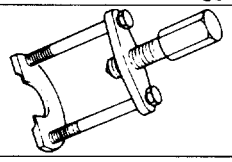
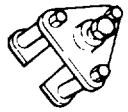
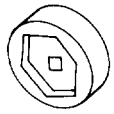
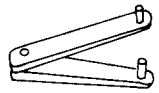
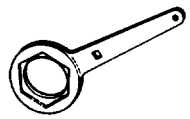
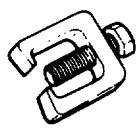
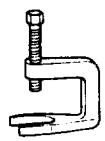
Rear Stabilizer

N•m (kg•m / lb•ft)

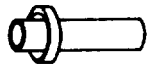
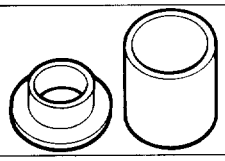
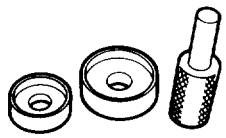


SPECIAL TOOLS

STEERING SYSTEM

ILLUSTRATION	PART NO.	PART NAME	REMARKS
	5-8840-0162-0	Power steering fluid pressure gauge	
	5-8840-2017-0	Ball joint remover	
	5-8840-2051-1	Pitman arm puller	
	5-8840-2059-0	Lock nut wrench	for Power steering (Left hand drive)
	5-8840-2060-0	End cover wrench	for Power steering (Left hand drive)
	5-8840-2054-0	Steering shaft driver	
	5-8840-2052-0	Steering lock nut wrench	for Manual steering (NHR, NKR)
	5-8840-2053-0	Wrench	for Manual steering (NHR, NKR)
	5-8840-2018-0	Tie rod end remover	for 2WD rigid suspension (assistant side)
	5-8840-2215-0	Steering wheel puller	

SUSPENSION

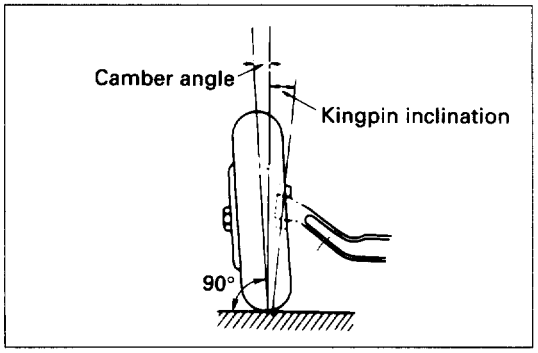
ILLUSTRATION	PART NO.	PART NAME	REMARKS
	5-8840-2048-0	Leaf spring bushing remover and installer	
	5-8840-2049-0	Leaf spring bushing remover and installer	for metal bushing
	5-8840-2366-0	Lower link ball joint remover	for wishbone suspension
	5-8840-2364-0	Upper link ball joint remover	for wishbone suspension
	5-8840-2365-0	Upper link ball joint installer	for wishbone suspension
	5-8840-2367-0	Lower link bushing remover and installer	for wishbone suspension

SECTION 3A
FRONT END ALIGNMENT

CONTENTS

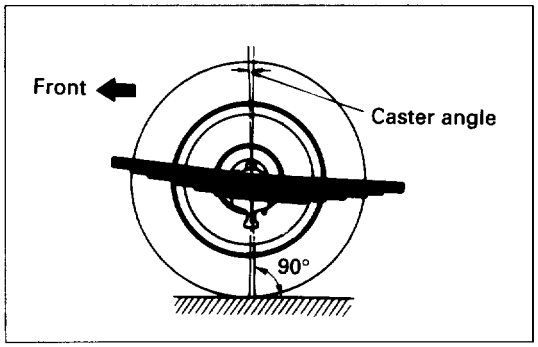
	PAGE
General Description	3A- 2
On-Vehicle Service	3A- 3
Inspection	3A- 3
Toe - In	3A- 3
Turning Radius	3A- 5
Camber Angle	3A- 8
Caster Angle and King Pin Inclination	3A- 9
Trim Height	3A- 12

GENERAL DESCRIPTION



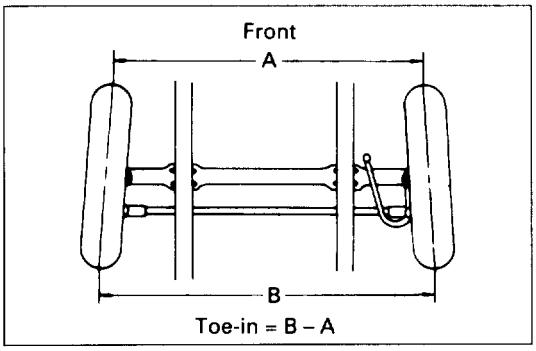
Camber Angle

The reason why the camber is so important in wheel alignment is that it affects greatly the tire wear and characteristics. The front wheels of most cars lean slightly either inward or outward when seen from the front. This tilt of the wheel is called the camber. When the center line of the tire is completely vertical to the road, the tire has "zero camber". In the positive camber, the wheels incline outward at the tops while in the negative camber they incline inward at the tops. Excessive positive camber causes the outer edge of tire to excessively wear. On the other hand, excessive negative camber causes the inner edge of tire to wear. Improper wheel camber setting will not only cause the tires' excessive wear, but also the tire will tend to move in the direction of the wheel which has a larger camber angle affecting the car's straight traveling ability.When measuring the camber, it is indicated by the angle.



Caster Angle

Caster is the angle between the rearward inclination of king pin axis and a vertical centerline of the wheel when the car is seen from its side. Like camber, it is also indicated by the angle. Caster angle affects greatly the straight traveling ability of the car, steering wheel maneuverability, self alignment effort and the returning ability of the car to the straight ahead position.



Toe-In

When seen from the top of the car, the front edges of the front wheels are slightly closer each other. The amount of this slight inward turning is called toe-in and usually expressed by millimeter.

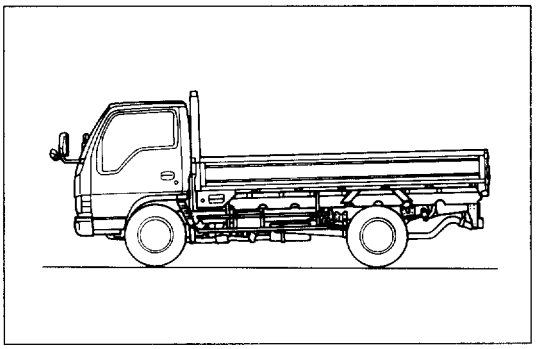
ON-VEHICLE SERVICE

INSPECTION

- Tire pressure and abnormal wear
- Front hub bearings for axial play
- Ball joints on steering linkage for play
- Operation of shock absorbers
- Tightness of suspension parts
- King pin bearings for play

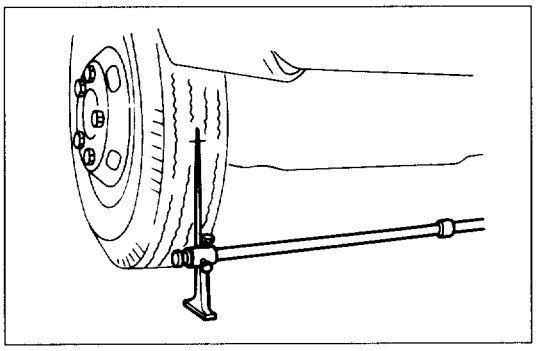
The points listed in table at left must be checked prior to inspecting front wheel alignment.

TOE-IN

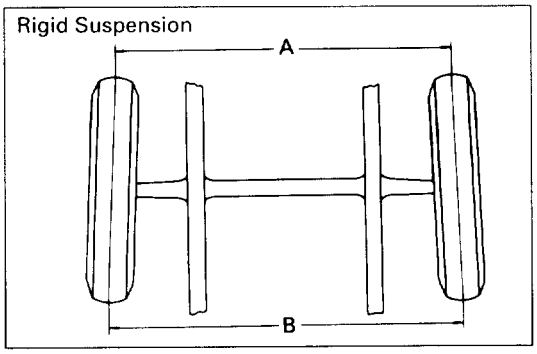


Measurement should be taken with the vehicle on a surface plate.

If a surface plate is not available, toe-in should be checked with the vehicle parked on a level floor.



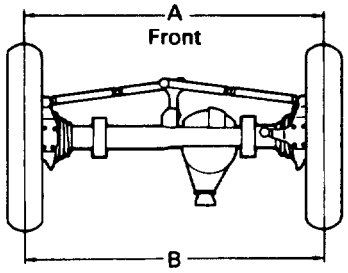
1. Set front wheels to its straight ahead position.
2. Align the toe-in gauge with center height of each wheels at front end.
3. Apply center marks to each wheel, then take measurement of distance A between the center marks on each wheel.
4. Move slowly the vehicle rearward until center marks get its rear end position.
5. Take measurement of distance B between the center marks at rear end.



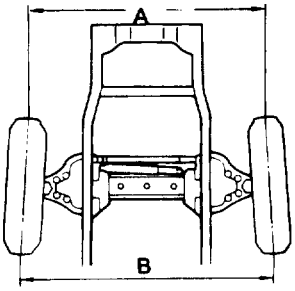
The toe-in can be calculated with next formula.

Toe-in = B – A

NPS



Wishbone Suspension



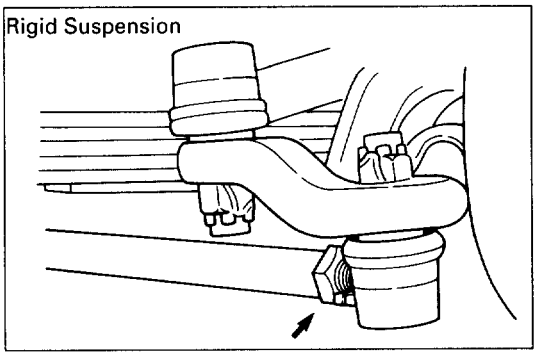
Toe-in

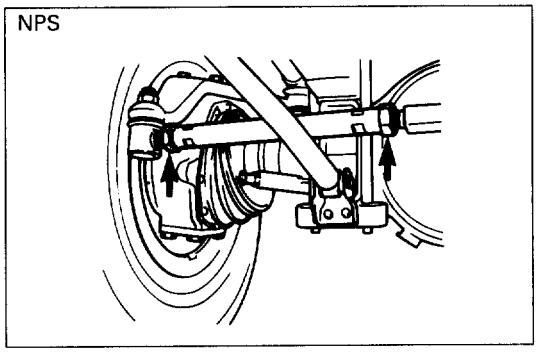
1994 – 1997 Model mm(in.)

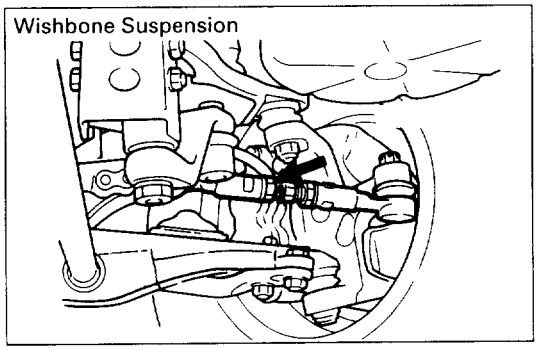
Tire	Rigid	Wishbone, NPS
Bias	3 – 7 (0.12 – 0.28)	-2 – 2 (-0.08 – 0.08)
Radial	0 – 4 (0 – 0.16)	

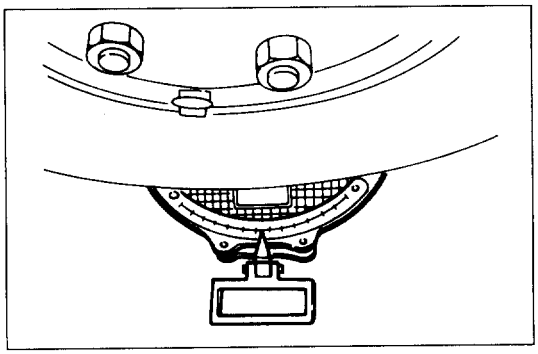
1998~ Model mm(in.)

-2 – 2 (-0.08 – 0.08)









Adjustment

1. Loosen the lock nuts on the tie rod or outer truck rod ends.
2. Adjust length (L) of the tie rod by turning the connecting rod on outer truck rod.
3. Tighten the lock nuts to specified torque.

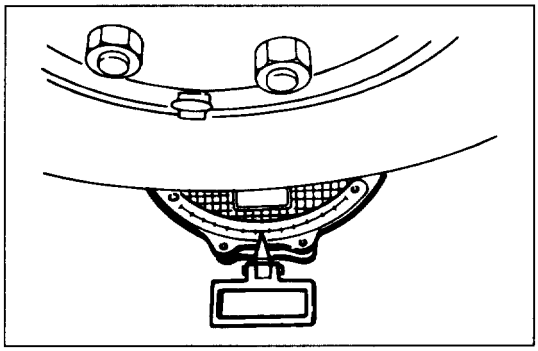
Lock Nut Torque	N·m (kg·m/lb·ft)
Rigid Suspension, NPS	113 (11.5/183)
Wishbone Suspension	167 (17.0/123)

TURNING RADIUS

1. Position a suitable piece of wood equivalent in thickness to the turning radius gauge under each rear wheel.
2. Position each front wheel on a turning radius gauge by aligning the tire center line with the center of the turning radius gauge.
3. Turn the steering wheel clockwise or counterclockwise until the front wheels are locked.

NOTE:

Turn the steering wheel with the brake pedal depressed using brake pedal pusher.



4

Reading of the turning radius gauge directly indicates the steering angle.

Steering Angle

1994 – 1997 Model (Deg.)

Vehicle Model	Outer	Inner
Wishbone Suspension	35	38
NHR (Rigid Suspension)	34	46
NKR (Rigid Suspension)	30	38
NPR (Rigid Suspension)	36	47
NQR (Rigid Suspension)	34	42.5
NPS	30	38

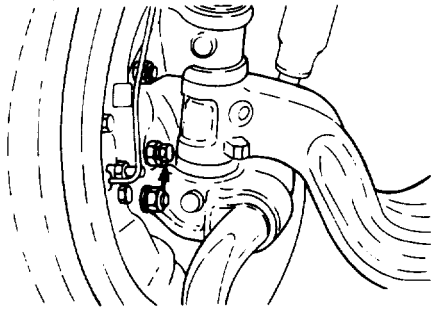
1998~ Wishbone Suspension Model (Deg.)

Vehicle Model	Outer	Inner
NKR (7.00-15 Tire)	29.5	38.5
NKR (7.00-16 Tire)	27.9	35.5
NKR (7.50-16 Tire)	25.1	31.5

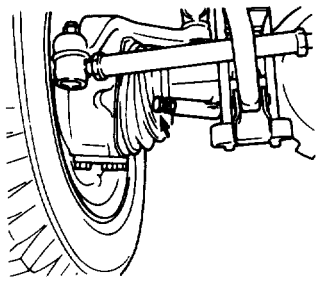
1998~ Rigid Suspension Model (Deg.)

Vehicle Model	Outer	Inner
NHR	33.0	37.5
NKR (7.00-15 Tire)	29.5	38.5
NKR (7.00-16 Tire)	27.9	35.5
NKR (7.50-16 Tire)	25.1	31.5
NPR, NQR (7.00-16 Tire)	35.0	47.5
NPR, NQR (7.50-16 Tire)	32.7	42.5
NPR, NQR (8.25-16 Tire)	30.0	36.5
NPS	30.0	38.0

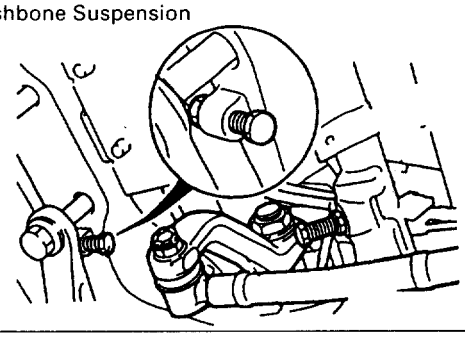
Rigid Suspension



NPS



Wishbone Suspension

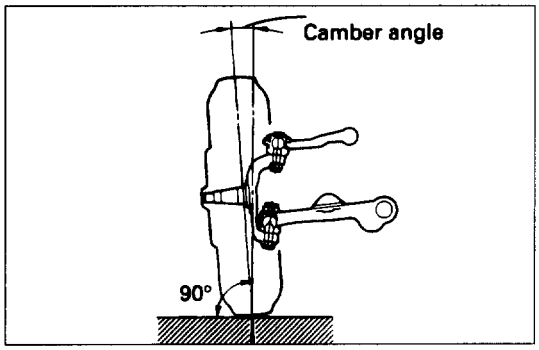


Adjustment

1. Loosen the lock nuts on the steering knuckle or the axle case.
2. Adjust projecting height of the stopper bolts.
3. Tighten the lock nuts to specified torque.

Stopper Bolt Torque	N•m (kg•m/lb•ft)
Rigid Suspension	186 (19.0 / 137)
NPS	49 (5.1 / 36)
Wishbone Suspension	82 (8.4 / 61)

CAMBER ANGLE



All Model except NPS

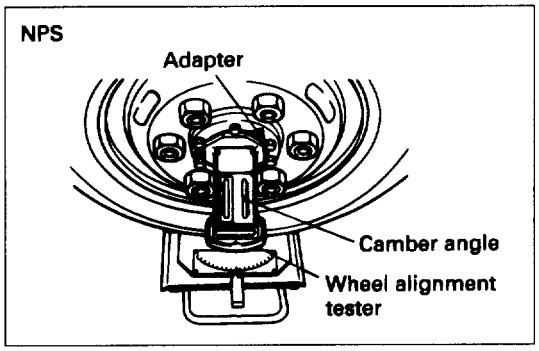
The toe-in can be checked on the gauge simultaneously.

1. When inspection of turning radius is completed, calibrate the scale of the turning radius gauge to zero.
2. Remove the front hub cap.

   Install camber, caster and king pin inclination gauge on end of the knuckle spindle horizontally.

NOTE:

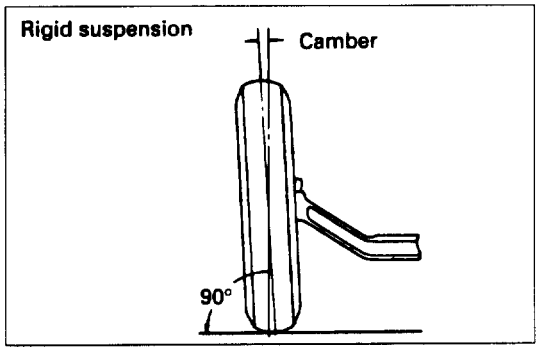
When removing hub cap, take care so as not to cause damage to gauge fitting face at end of the spindle. If end of the spindle has been scratched or damaged, correct before setting the gauge.



NPS

Remove the free wheel hub lock cover assembly then install gauge adapter on end of the knuckle spindle. Install camber, caster and king pin inclination gauge on end of gauge adapter.

Gauge Adapter: 5-8840-2188-0

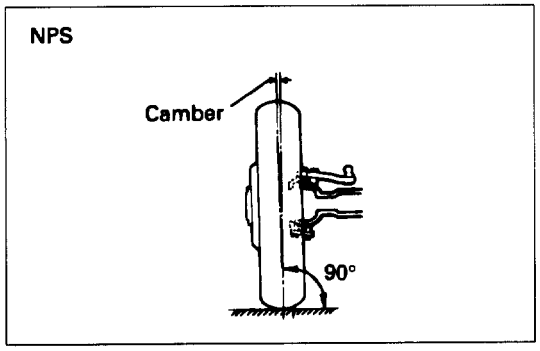


3. Reading of the camber scale directly indicates the camber angle.

Camber Angle

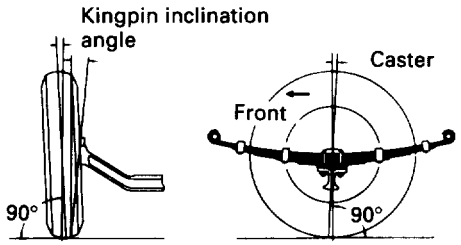
1994 – 1997 Model	(deg.)
Rigid Suspension	1°15′ ± 45′
Wishbone Suspension, NPS	0°15′ ± 45′

1998~ Model	(deg.)
NHR Rigid Suspension	1°15′ ± 45′
Rigid Suspension (except NHR)	0°15′ ± 45′
Wishbone Suspension, NPS	0°15′ ± 45′

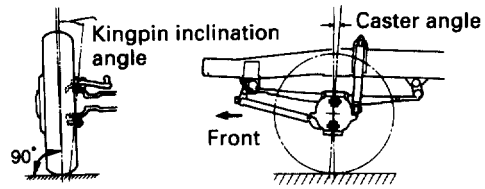


CASTER ANGLE AND KING PIN INCLINATION

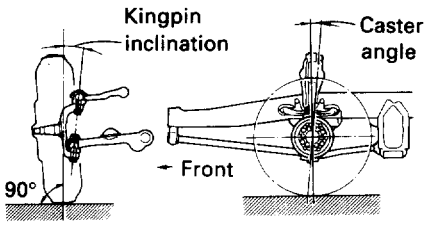
Rigid Suspension

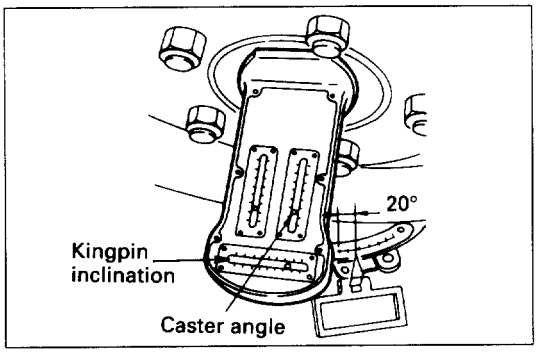


NPS



Wishbone Suspension





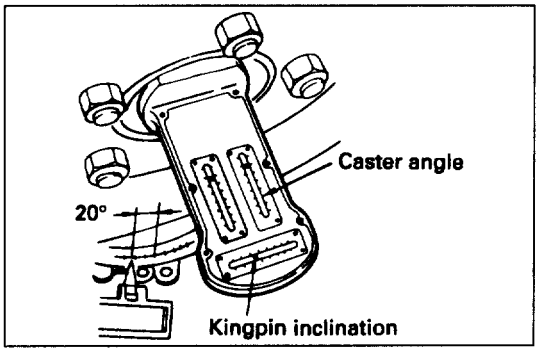
The caster angle and king pin inclination can be checked on the gauge simultaneously.

1. When inspection of camber angle is completed, calibrate the scale of the turning radius gauge to zero and turn the steering wheel clockwise (counterclockwise for checking caster angle and king pin inclination on the left side front wheel) until the front wheels are steered 20 degrees from the straight-ahead position.

NOTE:

Turn the steering wheel with the brake pedal depressed using brake pedal pusher.

2. When the front wheels are turned 20 degrees, calibrate the caster and kingpin scales to zero turning the camber, caster and king pin gauge adjuster.



3. Turn the steering wheel in the opposite direction until the front wheels are steered 20 degrees in the opposite direction. Reading of the caster and king pin scales directly indicates the caster and king pin inclination angles being checked.

Caster Angle and King Pin Inclination

1994 – 1997 Model (deg.)

	Caster Angle	King Pin Inclination
Rigid Suspension	1°30'±1°	7°15'
Wishbone Suspension	1°00'±1°	9°45'±30'
NPS	2°00±1°	7°15'

1998~ Model (deg.)

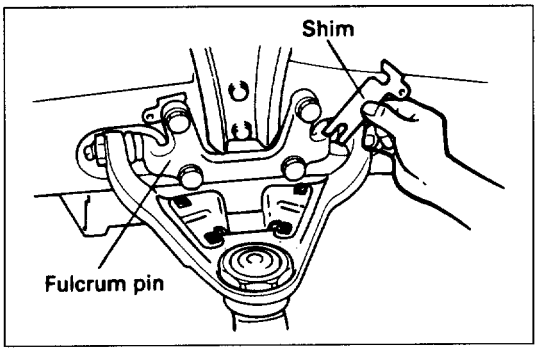
	Caster Angle	King Pin Inclination
NHR Rigid Suspension	1°30'±1°	7°15'
NKR Rigid Suspension	3°'±1°	12°00'
NPR, NQR	2°45'±1°	12°00'
Wishbone Suspension	1°00'±1°	9°45'±30'
NPS	2°00±1°	7°15'

- Front springs for weakening
- Front I-beam (axle case) for distortion
- Bushings in king pin, King pin bearings for wear or determination

Adjustment

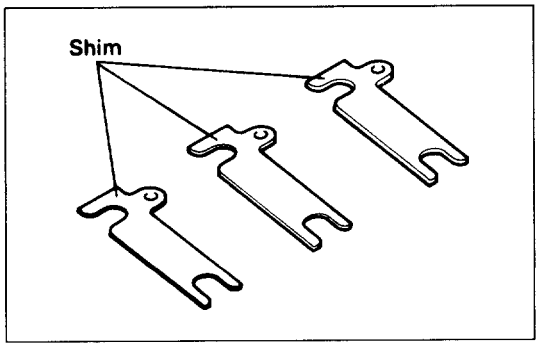
Rigid Suspension

The camber, caster and king pin inclination are built into front end and are not adjustable. If the camber, caster or king pin inclination is found to be out of alignment, check to locate the cause of trouble against the listing at left and replace the parts as necessary.



Wishbone Suspension

1) Set the jack under the cross member of the suspension and then raise the lower link with the jack and retain the jack with applied in the place.
2) Remove the shock absorber.
3) Attach the fulcrum pin and loosen the bolts to the degree that it will not fall a part to adjust the camber angle using the shims.



Camber Angle

If the number of shims are evenly increased both at fore and aft, the camber angle becomes acute, while if decreased, the angle becomes obtuse.

Caster Angle

When the caster angle is obtuse, increase the number of shims at the fore side, while the angle is acute, increase the number of shims at the aft side.

Thickness of Shims Available (mm)
0.8, 1.6, 3.2

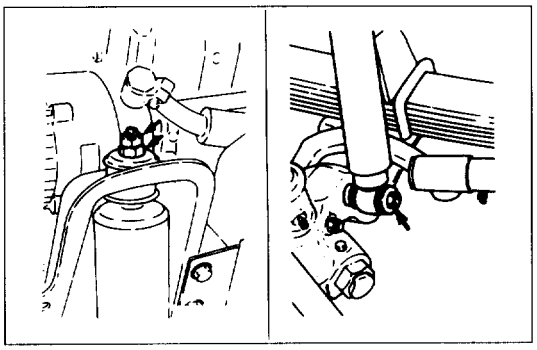
Conditions Where The Shims are Used

	Limit
Numbers of Shims	4 or less
Thickness mm (in)	9.6 (0.378) or less
Difference of Thickness (between Front and Rear) mm (in)	4.8 (0.189) or less

In case the shim has already reached at the limitation in its number or its thickness, decrease the number of shims at the aft side to adjust the obtuse caster angle, while decrease the number at the fore side to adjust the acute caster angle.

NOTE:

Since the number of shims needed for caster angle adjustment varies depending on the conditions of the car, perform the adjustment procedures which are the most suitable for the car conditions.

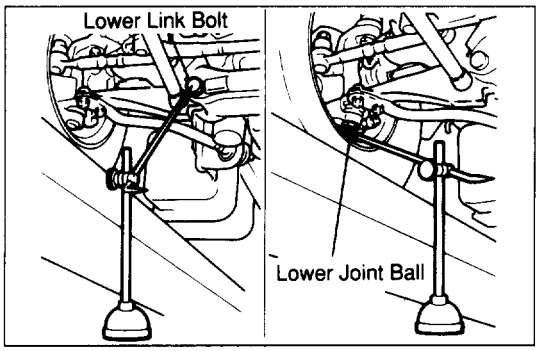


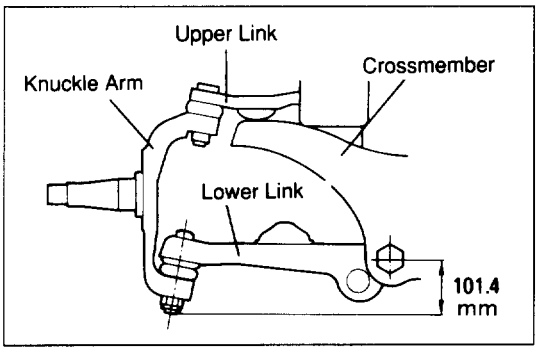
4) Tighten the mounting bolts of the front shock absorber.

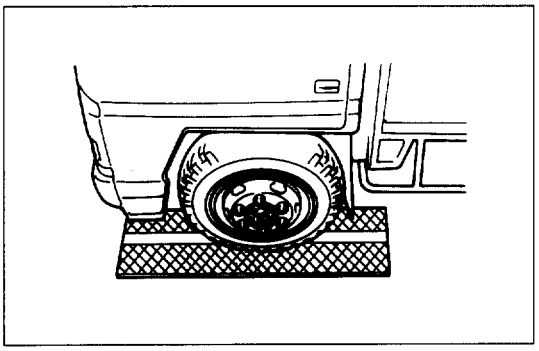
Shock Absorber Bolt and Nut Torque N·m (kg·m/lb·ft)

Upper	40 (4.1 / 30)
Lower	103 (10.5 / 76)

TRIM HEIGHT (WISHBONE SUSPENSION ONLY)







Adjustment

Adjust the trim height by means of adjusting bolt on the height control arms.

CAUTION:

When adjusting front end alignment, be sure to begin with trim height as trim height adjustment may change other adjusted alignments.

1. Check and adjust the tire inflation pressures.
2. Park the vehicle on a level ground and move the front of the vehicle up and down several times to settle the suspension.
3. Make necessary adjustment with the adjusting bolt on the height control arms.

Trim Height	mm(in)
101.4±5 (3.992±0.197)	

Measurement of Side Slippage

When inspection and adjustments of toe-in, camber, caster and kingpin inclination are completed, check for side slippage using a side slip tester.

Roll the wheels over the side slip tester as slowly as possible and take reading on the tester. If the amount of side slippage is in excess of 5 mm per 1 m, recheck the wheel alignment.

Side Slippage	mm (in)
Limit	
5.0 (0.197) Per 1m	

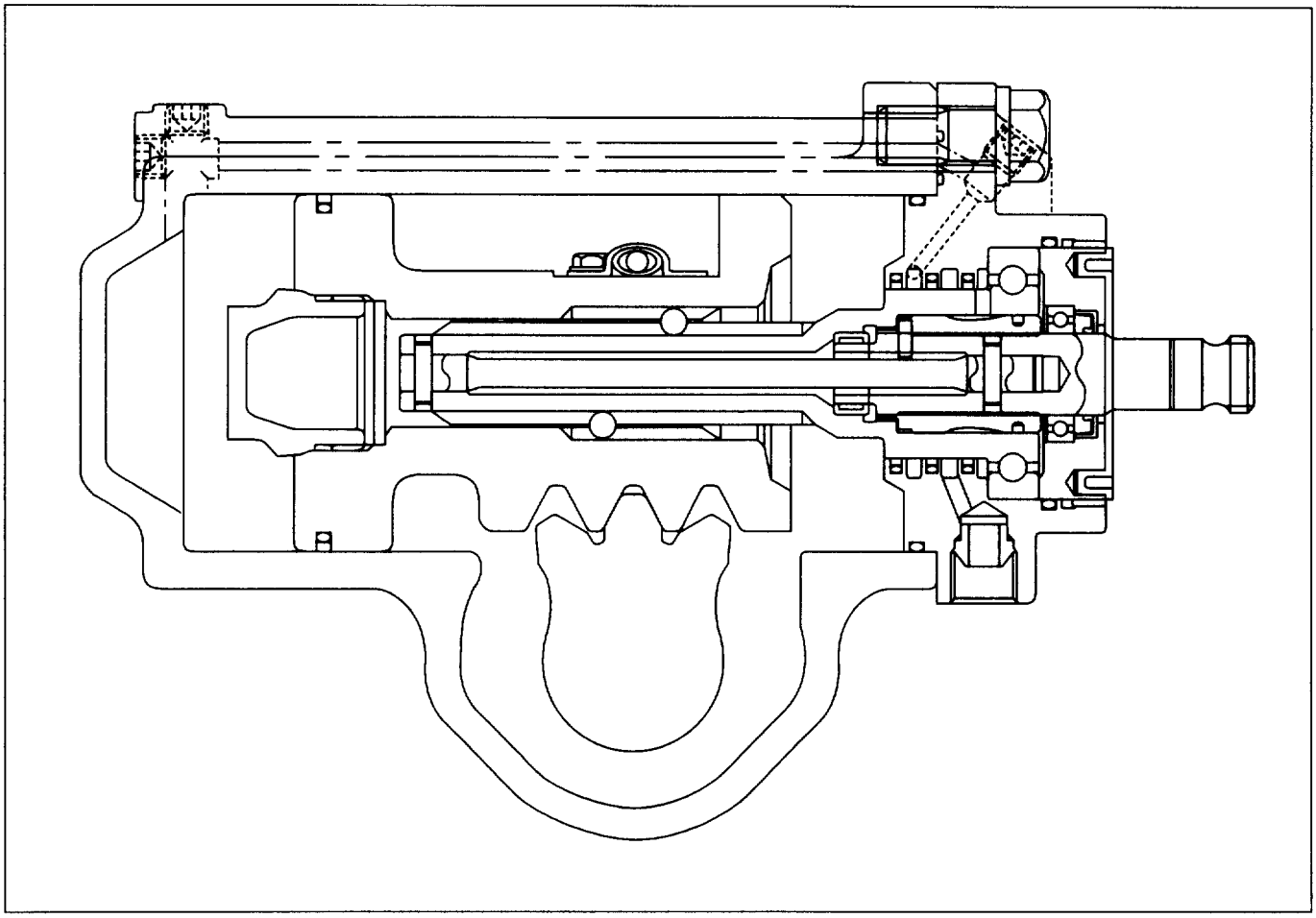
SECTION 3B1
POWER STEERING

CONTENTS

	PAGE
General Description	3B1- 2
On-Vehicle Service	3B1- 5
Power Steering System Test	3B1- 5
Power Steering System Bleeding	3B1- 7
Power Steering Unit	3B1- 8
Power Steering Pump	3B1-12
Tandem Hydraulic Pump	3B1-14
Unit Repair	3B1-15
Power Steering Unit (RHD Model)	3B1-15
Power Steering Unit (LHD Model)	3B1-37
Power Steering Pump (4J Series Engine)	3B1-51
Power Steering Pump (4B Series Engine)	3B1-56
Power Steering Pump (4HF1 Engine)	3B1-62
Tandem Hydraulic Pump	3B1-67

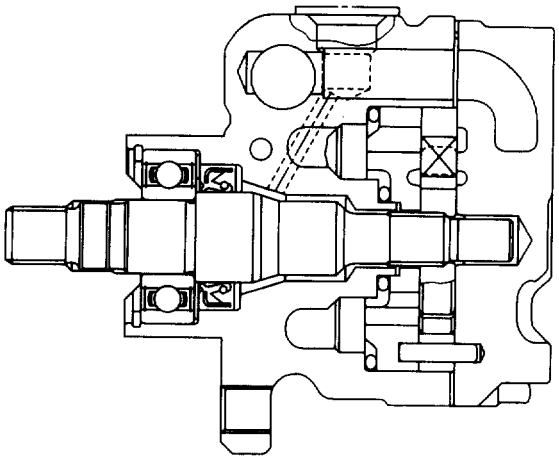
GENERAL DESCRIPTION

Power Steering Unit

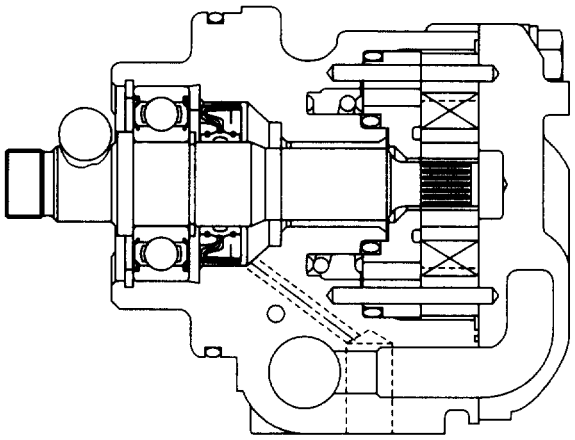


Power Steering Pump

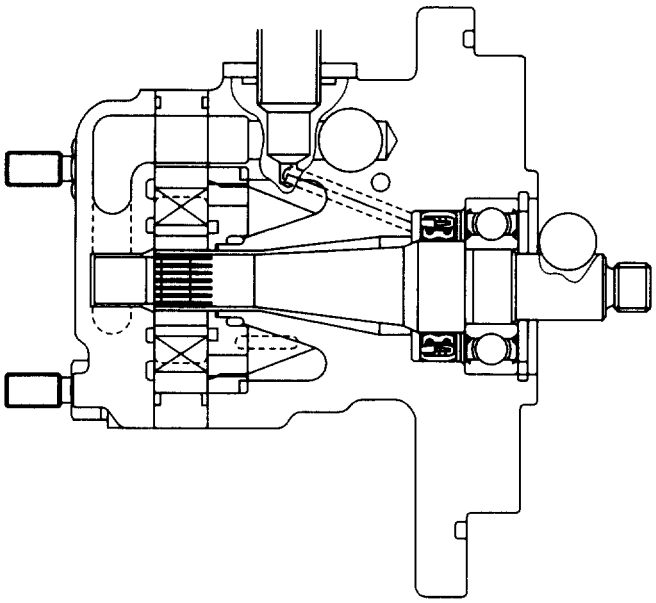
4J Series Engine



4B Series Engine



4HF1 Engine



Tandem Hydraulic Pump

A tandem hydraulic pump has two independent hydraulic pumps inside one casing. Its main parts can be classified into the following three.

— hydraulic pump (vane type)

— flow control valve

— pressure relief valve

The following is a description of the functions and operation of the main parts.

Hydraulic pump

Functions

The heart of the system, namely the part that supplies hydraulic pressure, which operates the hydro boost and the P/S. The hydraulic pump is installed directly to the engine and is driven by gears. It smoothly adapts itself to severe conditions of use, including a wide range of rotation speeds, changes in the temperature at which it is used, and frequent changes in load pressure, and it is able to fully perform its functions.

Operation

Its drive is transmitted by gears from the engine to the drive shaft of the oil pump, and it turns a rotor that is fitted into the spline part of the drive shaft. When the rotor rotates, the ten vanes built into the rotor groove fly out by centrifugal force, are pressed against the inside surface of the cam ring, and rotate along the inside surface so that the pump operates.

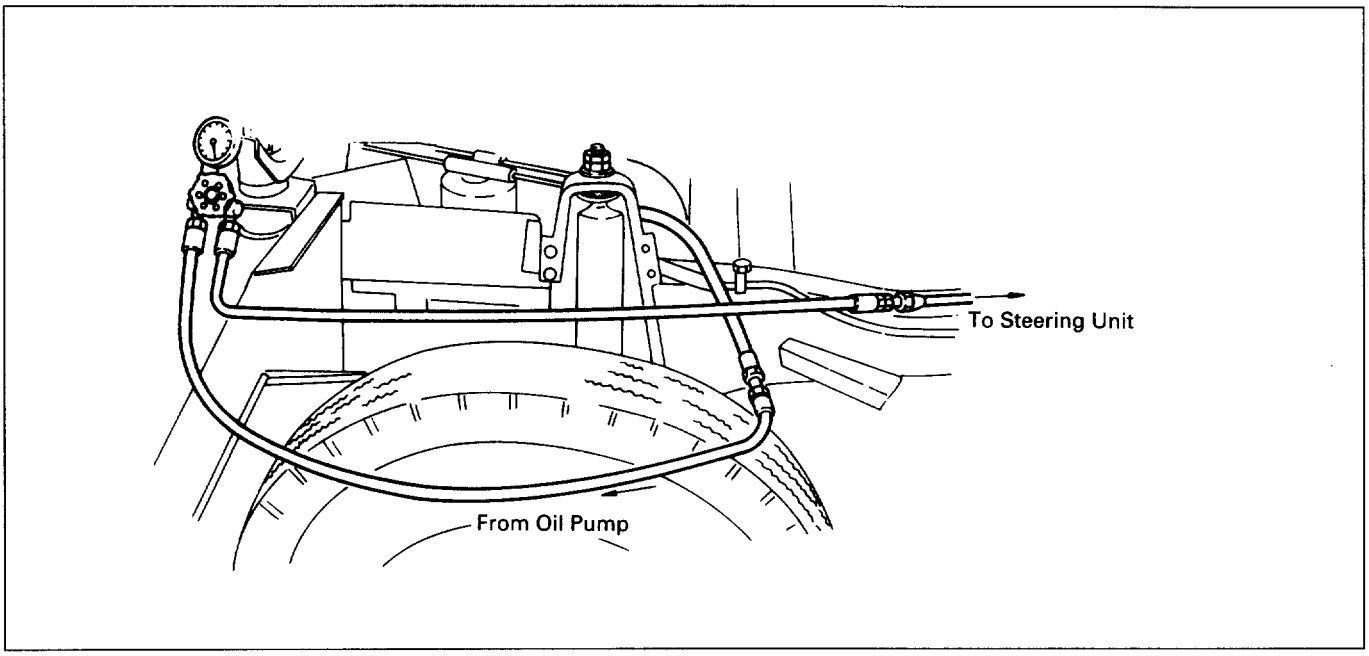
Suction and discharge of the hydraulic oil is done by a pressure plate and side plate attached to both ends of the cartridge.

Suction openings and discharge openings are provided in two locations each in symmetrical positions with respect to the axis of rotation, and because the load on the bearings due to the discharge pressure is balanced, a tandem oil pump is also called a balanced hydraulic pump.

Because it has a double pump effect per rotation, this pump provides large discharge flow in proportion to the space it occupies. Also, some of the hydraulic oil that is discharged is led to the base of the vanes and ensures the quality of the seal between the vane tips and the cam, and even if the vanes and cam rings become a little worn, the seal is hardly affected at all (with respect to discharge, oil tightness).

ON-VEHICLE SERVICE

POWER STEERING SYSTEM TEST



Preparation

- Inspect the fluid reservoir for proper fluid level.
- Inspect the pump belt for proper tension.

System Test Procedure

1. Place a container under the pump to catch the fluid when disconnecting or connecting the hoses.
2. With the engine NOT running, install the power steering fluid pressure gauge unit between the power steering unit and discharge side of oil pump.

   The gauge must be between the stop valve and oil pump.

   Gauge kit : 5-8840-0162-1
3. Check the fluid level. Fill the reservoir with Dexron®-IIE to "Full" mark. Check the connections at gauge kit for leakage.
4. Fully open the stop valve, and bleed the system.

   Refer to "Power Steering System Bleeding" of this section.
5. Start the engine and being idled, and raise oil temperature to 50 - 60°C (122 - 144°F). Check the fluid level again. Fill the reservoir with Dexron®-IIE to "Full" mark if required.
6. Hold the steering wheel in the forward position.

   Fully close the stop valve, and record the highest value of fluid pressure.

CAUTION:

Do not continue this test. It should be done within 10 seconds, because otherwise oil temperature would rise to excess to cause trouble.

Standard Operating Pressure	kPa (kg / cm^2 / psi)
NHR, NKR, NPR (except NPR66)	10,297 - 10,983 (105 - 112 / 1,493 - 1,593)
NPR66, NPS66	10,787 - 11,474 (110 - 117 / 1,564 - 1,664)

- If the pressure recorded is within specified range, the steering system is functioning within its specifications.
- If the pressure recorded is higher than specified range, oil pump relief valve is defective.
- If the pressure recorded is lower than specified range, oil pump or relief valve is defective.

7. Fully open the stop valve and keep engine idled.
   Turn and hold steering wheel to full left lock, and record the highest value of fluid pressure.
   Turn and hold steering wheel to full right lock, and record the highest value of fluid pressure.

CAUTION:

Do not continue this test. It should be done within 5 seconds.

Standard Operating Pressure	kPa (kg / cm^2 / psi)
NHR, NKR, NPR (except NPR66)	10,297 - 10,983 (105 - 112 / 1,493 - 1,593)
NPR66, NPS66	10,787 - 11,474 (110 - 117 / 1,564 - 1,664)

- If the pressure recorded is within specified range, the steering system is functioning within its specifications.
- If the pressure recorded is lower than specified range, steering unit is leaking internally and must be disassembled and repaired.

POWER STEERING SYSTEM BLEEDING

1. Raise the front wheels with a jack. (It is recommended that a turn-table should be placed under right hand and left hand side front wheels at this time.)
2. Replenish the fluid tank with ATF Dexron®-III, and repeat the full steering (turning to the extreme ends of the steering) in both right hand side and left hand side directions quietly with the engine stopped.

CAUTION:

Under this condition, the air trapped in the fluid piping will be released from the fluid tank to the atmosphere in the form of large air bubbles.

3. Whenever the fluid level in the tank is lowered, replenish the tank with ATF Dexron® -III in the amount equivalent to the consumption.

CAUTION:

Pay extra care over the fluid level so that fluid will not run out.

4. Start the engine and repeat the full steering several times quietly with the engine kept idling.

CAUTION:

The time needed for full steering should be less than five minutes. (Prolonged full steering of more than five seconds will cause the fluid temperature to raise significantly.)

5. Lower the front wheels and turn the steering wheel in both left hand and right hand sides several times with the engine run. If no abnormal noise can be heard at this time, air might be completely released.

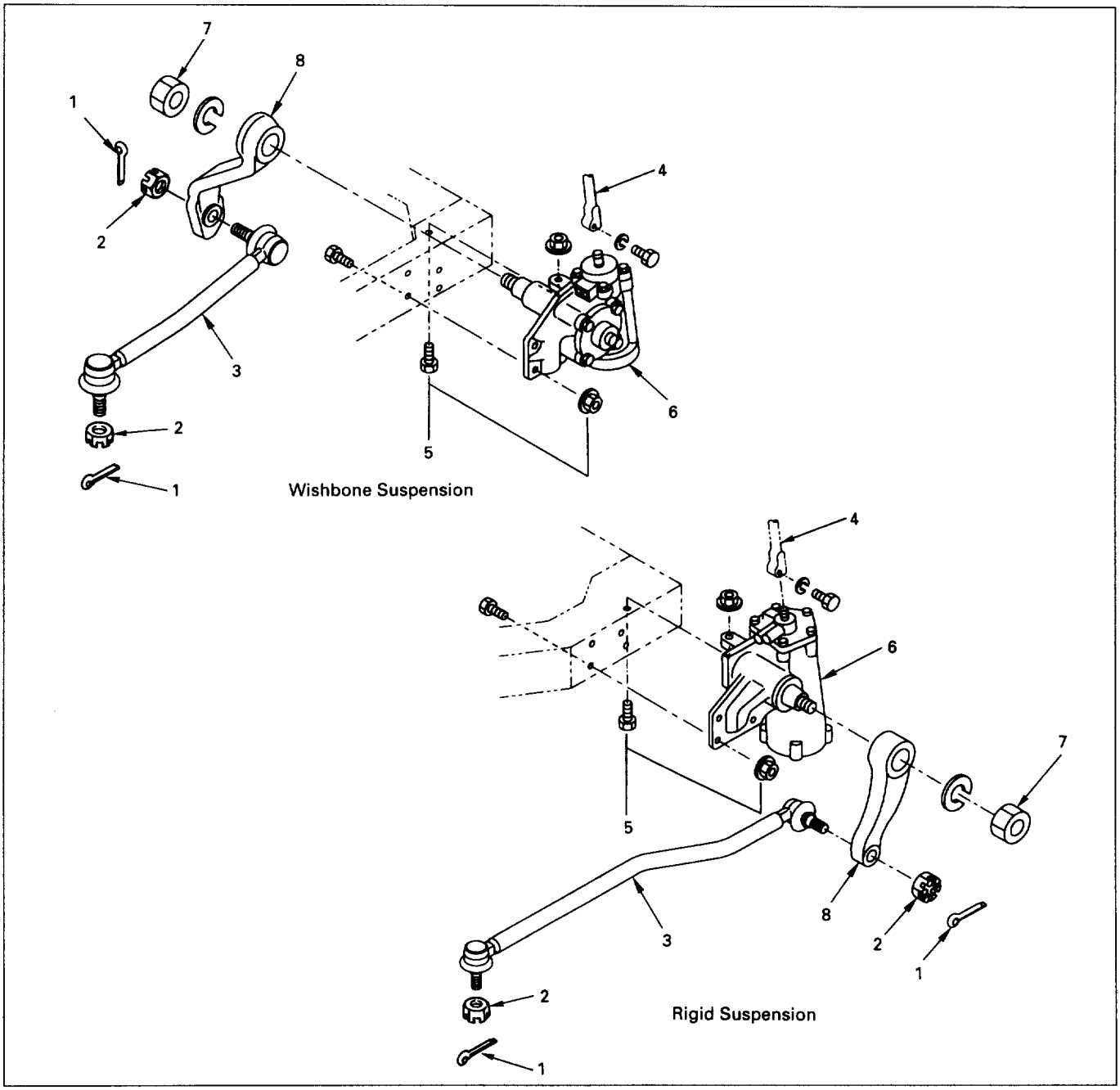
CAUTION:

If the abnormal noise (creaky, "zi-zi" sound etc.) can be heard in the piping after the step No.5 has been completed, the air is still trapped in the piping and air release has not been completed.

In this case, continue repetition of steering wheel turn in the both directions of left hand and right hand sides until the fluid temperature is increased up to around 50 - 80 degrees C. When the temperature reaches this degree, stop the engine and leave the engine for about five minutes. (Within five minutes, air bubbles can be collected.) Start the engine again and repeat the full steering several times.

6. After air release has been completed, check the fluid level in the tank and also confirm that the joints have no fluid leak.

POWER STEERING UNIT



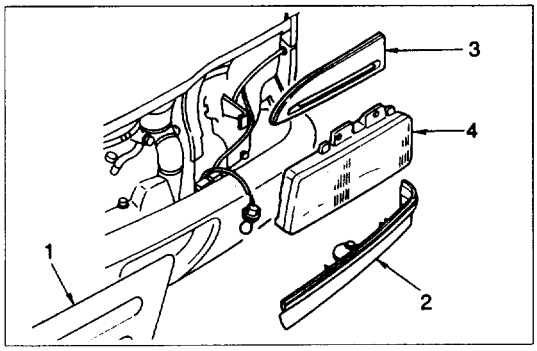
Removal Steps

1. Cotter pin
2. Nut
3. Drag link
4. Universal joint
5. Unit fixing nut and bolt
6. Power steering unit
7. Nut
8. Pitman arm

Installation Steps

8. Pitman arm
7. Nut
6. Power steering unit
5. Unit fixing nut and bolt
4. Universal joint
3. Drag link
2. Nut
1. Cotter pin

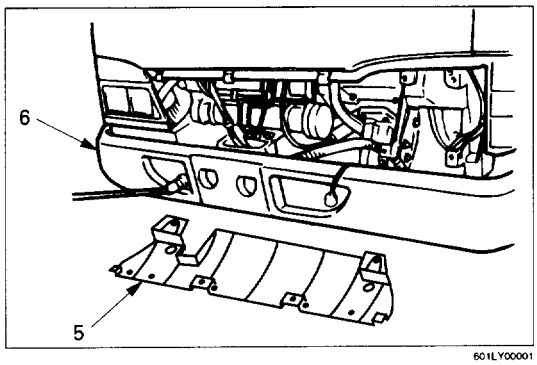
REMOVAL



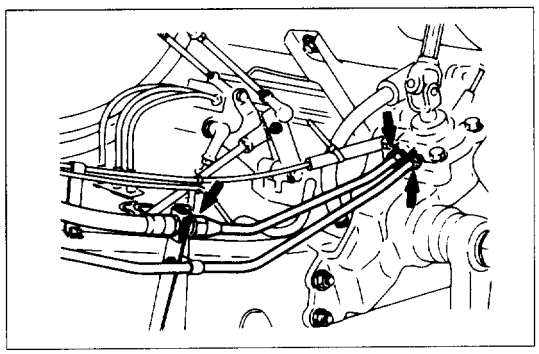
Preparation (for Non-Tilt Cab Model)

1) Remove the radiator grill.
2) Remove the head lamp grill. (driver side only)
3) Remove the head lamp ornament. (driver side only)
4) Remove the head lamp assembly. (driver side only)

   Be careful not to remove adjust screw.

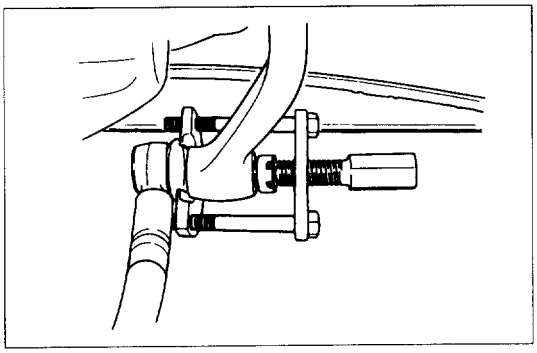


5) Remove the under panel.
6) Remove the front bumper assembly.



- Remove the oil pipe.

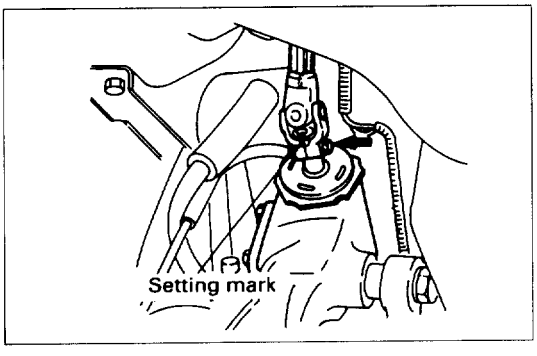
  Before disconnecting the oil pipe, clean the steering unit paying particular attention to the area around the joint and plug or tape the oil port after disconnecting the pipe to prevent entry of dust or other foreign matter.



1. **Cotter Pin**
2. **Nut**
3. **Drag Link**

   Disconnect the drag link at the knuckle arm and the pitman arm.

   Remover: 5-8840-2017-0

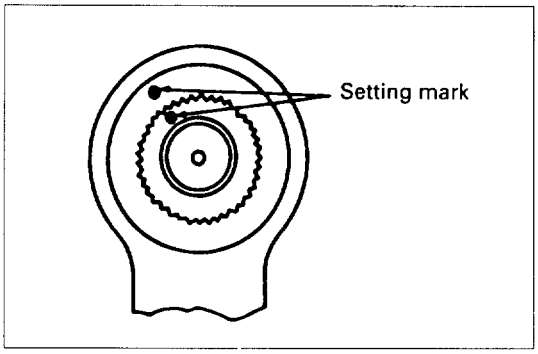


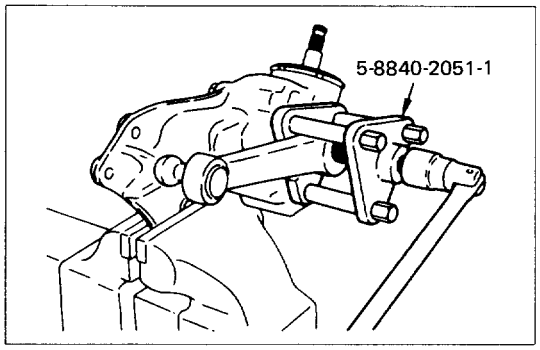
4. **Universal Joint**

   Apply a setting mark across the yoke and worm shaft in unit to ensure reassembly of the parts in the original position.

5. **Unit Fixing Bolt and Nut**
6. **Power Steering Unit**
7. **Nut**
8. **Pitman Arm**

Apply a setting mark across the pitman arm and worm shaft.



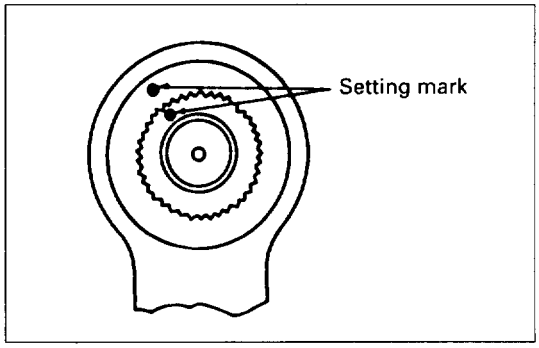


Puller: 5-8840-2051-1

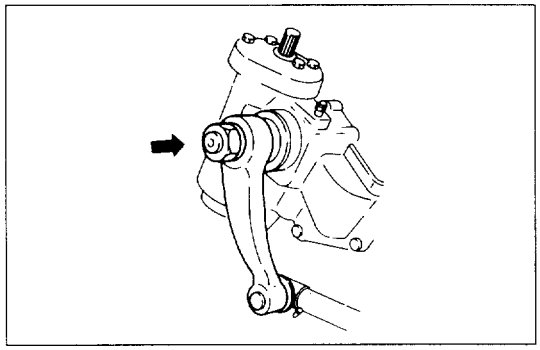
INSTALLATION

8. **Pitman Arm**

Align the setting mark applied at removal.



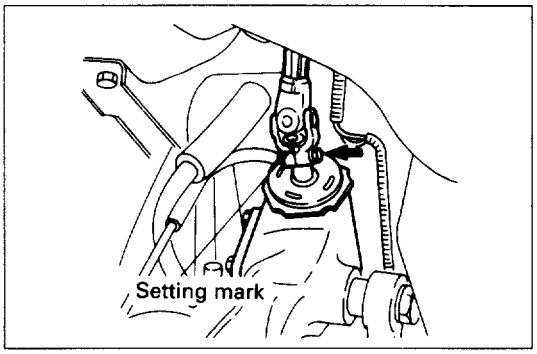
7. **Nut**



Pitman Arm Nut Torque	N•m (kg•m/lb•ft)
NHR, NKR Rigid Suspension	216 (22 / 159)
NPR, Wishbone Suspension	294 (30 / 217)

6. **Power Steering Unit**
5. **Unit Fixing Nut and Bolt**

Torque	N•m (kg•m/lb•ft)
103 (10.5 / 76)	



4. Universal Joint

Install the parts by aligning setting marks applied at removal.

Universal Joint Bolt Torque	N•m (kg•m/lb•ft)
M8 Bolt	25 (2.5 / 18)
M10 Bolt	39 (4.0 / 29)

3. Drag Link

2. Nut

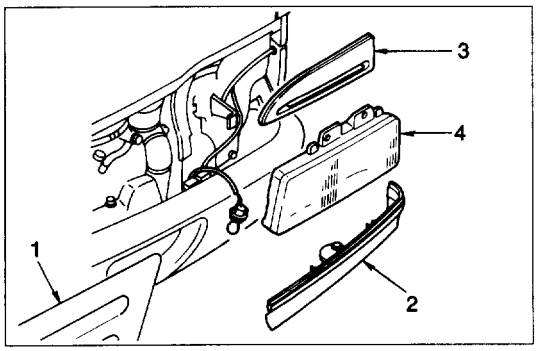
1. Cotter Pin

1) Install the drag link to the pitman arm and the knuckle arm.
2) Tighten nuts to specified torque, with just enough additional torque to align cotter pin holes. Install new cotter pin.

Nut Torque	N•m (kg•m/lb•ft)
167 (17 / 123)	

- Connect the oil pipe. Tighten flare nuts to specified torque.

Flare Nut Torque	N•m (kg•m/lb•ft)
44 (4.5 / 33)	

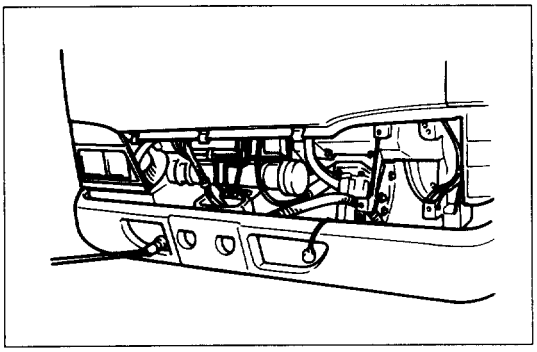


for Non-Tilt Cab Model

1) Install the bumper assembly.

Bumper Bolt Torque	N•m (kg•m/lb•ft)
40 (4.1 / 30)	

2) Install the under panel.



3) Install the head light assembly, ornament and grill.
4) Install the radiator grill.

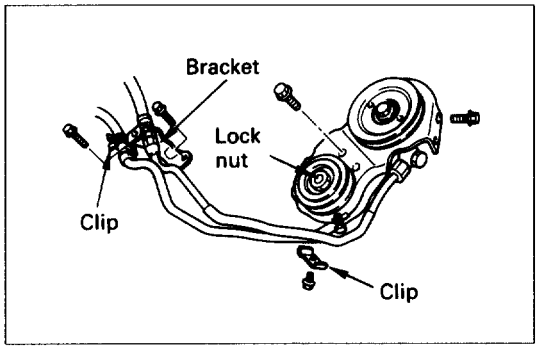
NOTE:

After installation, adjust head light aiming. Refer to "Chassis Electricals" in Section 8.

POWER STEERING PUMP

Preparation

- Drain the fluid through the pipe which is connected to the return board for the power steering pump.
- Disconnect the fluid piping.



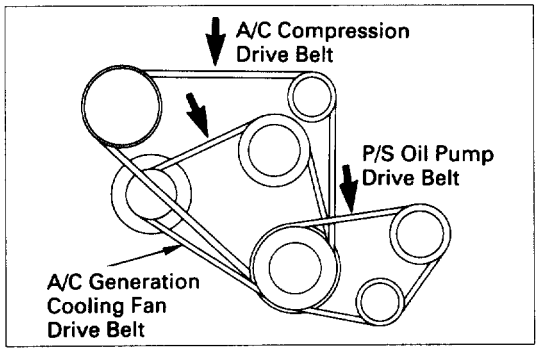
4J SERIES ENGINE

REMOVAL

- Loosen the idler pulley locking nuts for the power steering pump.
- Loosen the adjusting bolts for the drive belt and remove the drive belt.
- Remove the pipe brackets and clips on the alternator side.
- Remove the pump mounting brackets.

INSTALLATION

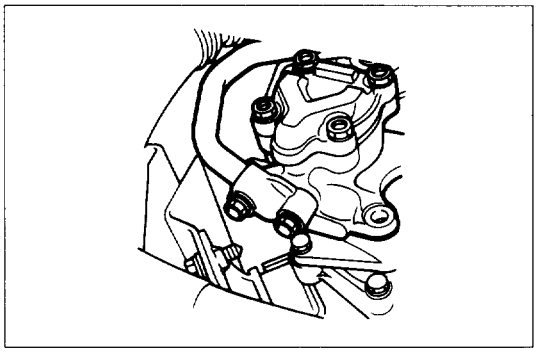
Bolt and Nut Torque	N•m (kg•m/lb•ft)
Pump and Bracket Assembly Oil Pipe Bracket	19 (1.9 / 14)
Clip Bolt	10 (1.0 / 87 lb·in)



- Install the drive belt for the power steering pump and adjust the belt tension. Press the middle of the belt with a 98N (10kg) weight to measure the deflection of the belt.

Belt Deflection	mm (in)
8 – 12 (0.315 – 0.472)	

4B SERIES ENGINE



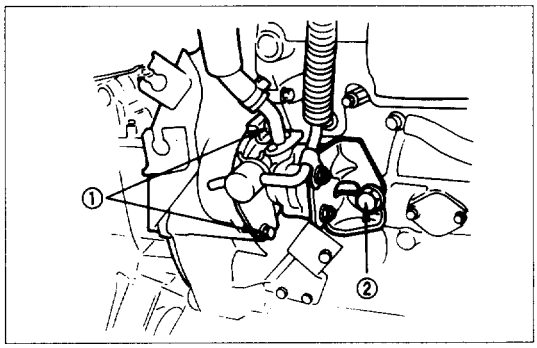
REMOVAL

- Loosen three retaining bolts for the power steering pump and remove the bolts.

INSTALLATION

- Apply grease over the timing gear case for the engine, and attach new O-rings and tighten them to the specified torque.

Power Steering Pump Bolt Torque	N•m (kg•m/lb•ft)
52 (5.2 / 38)	



4HF1 ENGINE

REMOVAL

- Loosen three fixing bolts for power steering pump (Two on the flywheel side and one on the cylinder body side) and remove them.

INSTALLATION

- Attach new O-rings and tighten them to the specified torque.

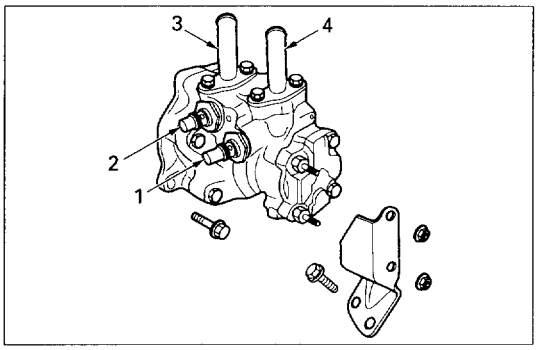
Power Steering Pump Bolt Torque	N•m (kg•m/lb•ft)
Flywheel side	43 (4.4 / 32)
Cylinder Body Side	44 (4.5 / 33)

TANDEM HYDRAULIC PUMP

REMOVAL

- Block the vehicle wheels and apply the parking brake.
- Battery ground cable.

1. Disconnect air intake hose at turbocharger side.
2. Raise the vehicle and remove front exhaust pipe with exhaust brake.
   - Remove bolts at manifold, silencer and support bracket.
3. Place a container under the hydraulic pump assembly to catch fluid when disconnecting hoses. Clean the surfaces around fittings before removing them.
4. Remove power steering outlet flexible hose (1) and nut.
5. Remove hydraulic booster outlet pipe nut.
6. Remove clips for hydraulic booster lines on the flywheel housing.
7. Remove clip for hydraulic booster lines on the left sidemember.
8. Hydraulic booster inlet hose (3).
9. Power steering inlet hose (4).
10. Remove hydraulic booster outlet pipe (2) from the pump.
11. Remove hydraulic pump assembly with bracket and O-ring.



436LW003

INSTALLATION

1. Attach new O-ring and install hydraulic pump assembly to the engine.
2. Install booster outlet pipe (2) and nut.

Bolt and Nut Torque	N•m (kg•m/lb•ft)
	23.5 (0.0/17)

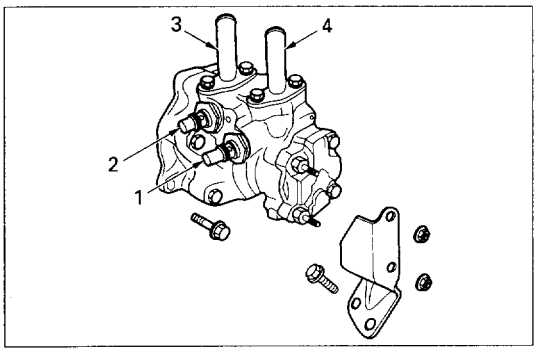
3. Install power steering outlet flexible hose (1) and nut.

Bolt and Nut Torque	N•m (kg•m/lb•ft)
	23.5 (0.0/17)

   - Put the cap on the eye joint and clamp the cap with the fastener.
4. Connect hydraulic booster inlet hose (3).
5. Connect power steering inlet hose (4).
6. Install clips for hydraulic booster lines.
7. Connect air intake hose.
8. Install exhaust pipe with exhaust brake.
9. Fill the power steering and hydraulic booster systems with ATF DEXRON®-III.

   Bleed the power steering system as outlined in this section.

   Bleed the hydraulic booster system. Refer to HYDRAULIC BOOSTER SYSTEM (SEC. 5A).



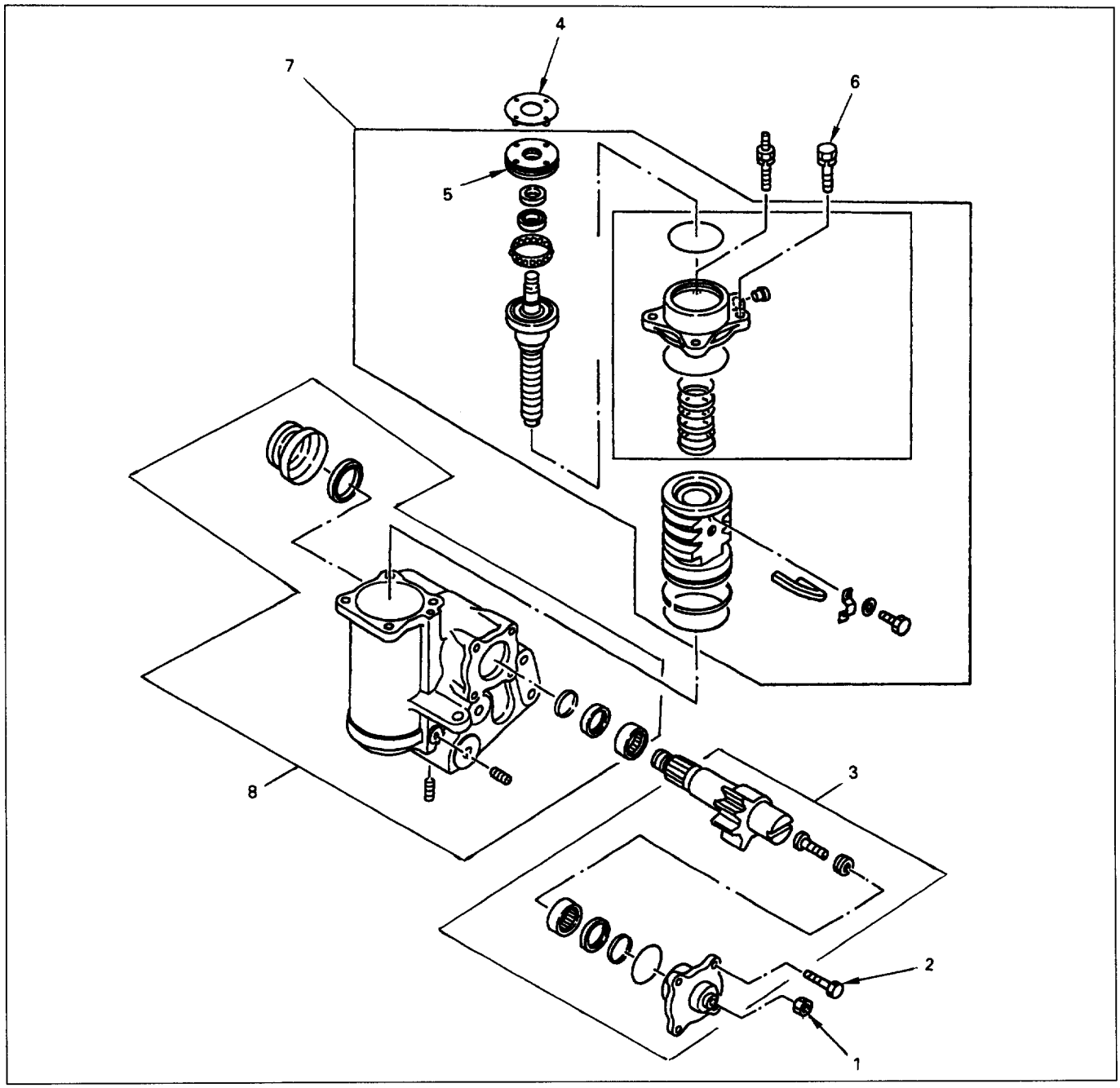
436LW003

UNIT REPAIR

POWER STEERING UNIT (RHD MODEL)

DISASSEMBLY

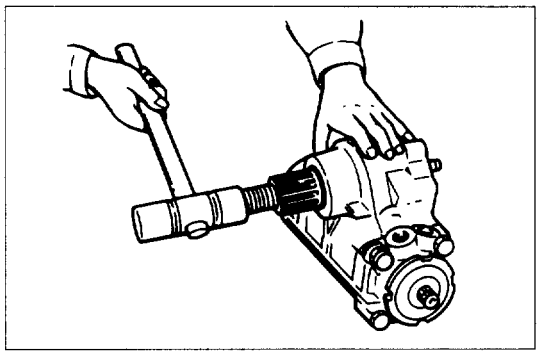
Power Steering Unit



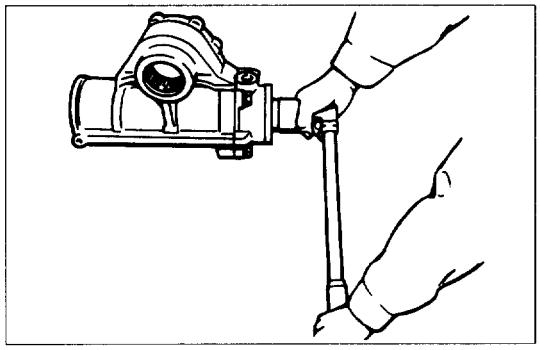
Disassembly Steps

1. Lock nut
2. Bolt
3. Sector shaft assembly and side cover assembly
4. Dust cover
5. Adjust plug
6. Bolt
7. Valve housing assembly
8. Body assembly

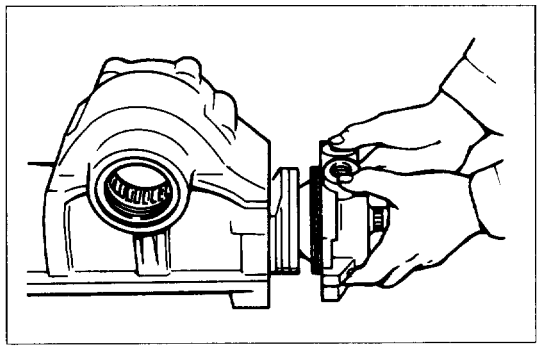
Disassembly Steps



1. **Lock Nut**
2. **Bolt**
3. **Sector Shaft Assembly and Side Cover Assembly**
   When removing, take care so as not to cause damage to the serrations, threads and oil seal.



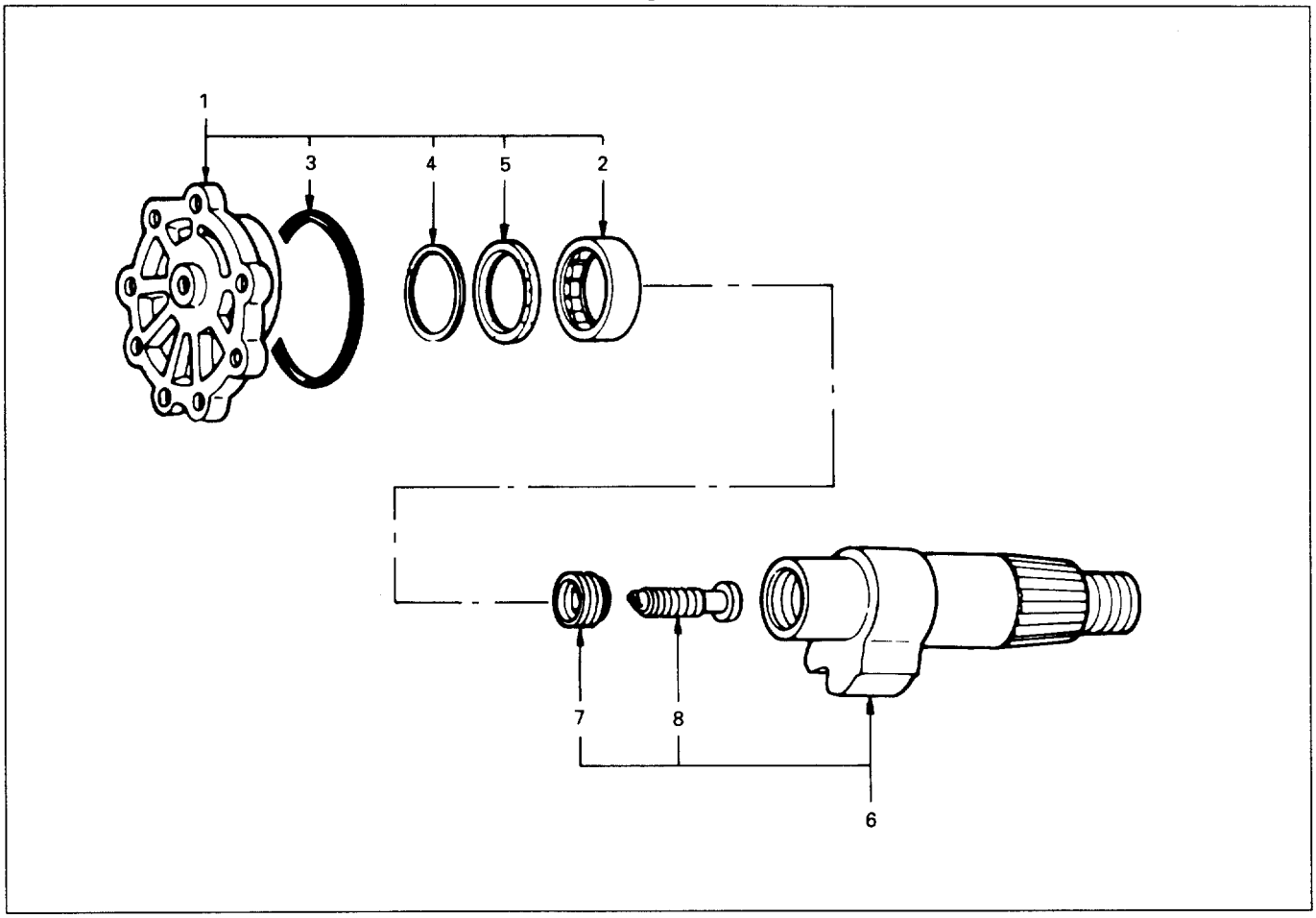
4. **Dust Cover**
5. **Adjust Plug**
   Using adjust plug wrench.
   Loosen the adjust plug, do not remove completely.



6. **Bolt**
7. **Valve Housing Assembly**
   Remove piston with valve housing.
   Always keep ball-nut assembly in a horizontal position and avoid holding it vertically.

8. **Body Assembly**

Side Cover and Sector Shaft Assembly

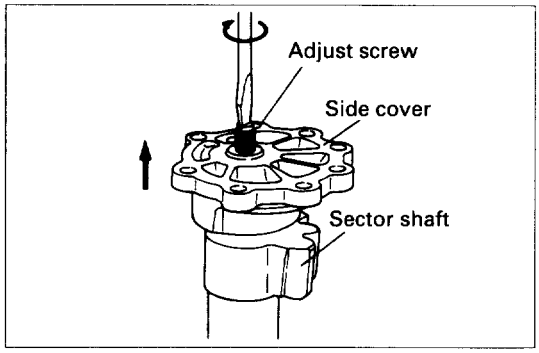


Disassembly Steps

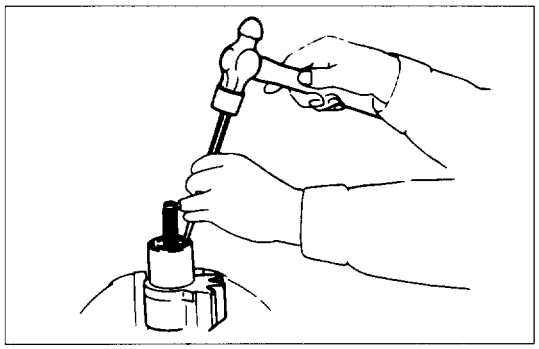
1. Side cover assembly
2. Bearing
3. O-ring
4. Back up ring
5. Y-gasket
6. Sector shaft assembly
7. Retainer
8. Adjust screw

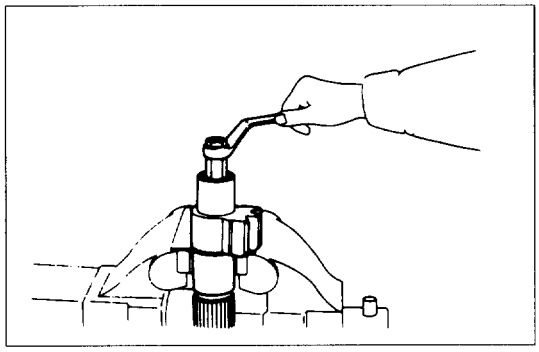
Disassembly Steps

If the sector shaft is going to be fixed on the bench vice during disassembly, be sure to protect the sector shaft with cloth or other soft material.



1. **Side Cover**
   Gradually turn the adjustment screw clockwise, and the side cover assembly will be lifted. Thus, you can separate the side cover assembly from the sector shaft assembly.
2. **Bearing**
   Unless otherwise a problem, it is not necessary to disassembly.
3. **O-ring**
4. **Back Up Ring**
5. **Y-Gasket**
   Using needle, scriber or equivalent.
6. **Sector Shaft Assembly**
   Unless otherwise a problem, it is not necessary to disassembly.
7. **Retainer**
   1) Raise the two lips of the retainer.

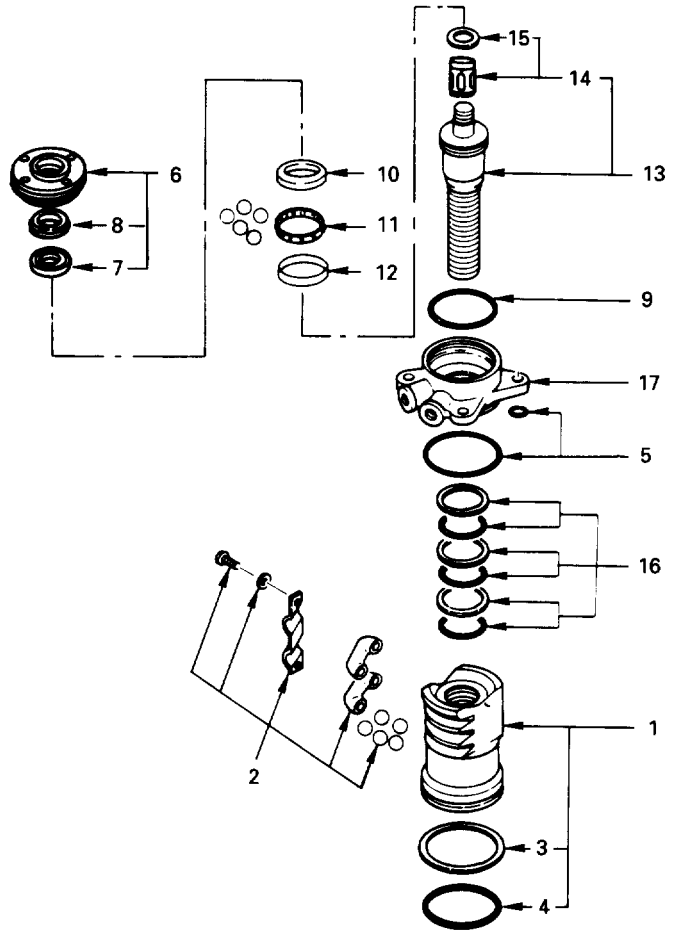




2) Using retaining bar.

8. **Adjust Screw**

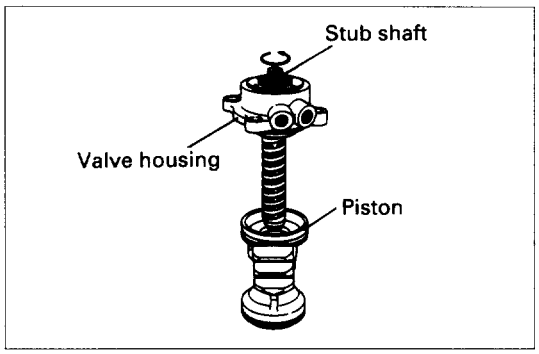
Valve Housing Assembly



Disassembly Steps

1. Piston assembly
2. Ball, tube, tube grip, screw and washer
3. Seal ring
4. O-ring
5. O-ring
6. Adjust plug assembly
7. Bearing
8. Oil seal
9. O-ring
10. Upper race
11. Cage and ball
12. Lower race
13. Worm shaft assembly
14. Rotor
15. O-ring
16. Seal ring and O-ring
17. Valve housing

Disassembly Steps

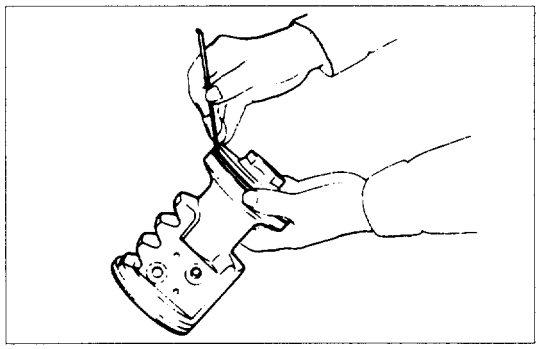


1. **Piston Assembly**
   Hold the housing with the piston end facing downward, and turn the stub shaft counterclockwise. Then, the worn shaft can be removed from the piston.

CAUTION:
The steel ball put in the ball race for the piston and worm shaft will drop inside of the piston. Be careful not to let the piston fall down.

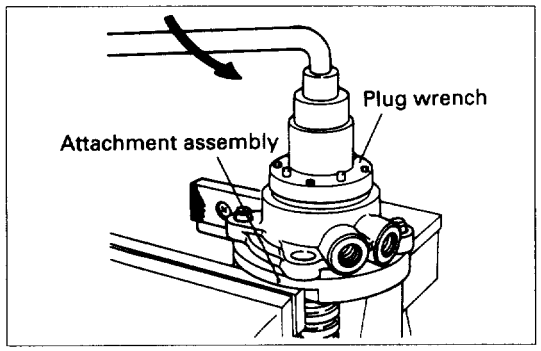
2. **Ball, Tube, Tube Grip, Screw and Washer**
   Be careful to lost the ball when remove the ball tube.
   Number of Balls

28



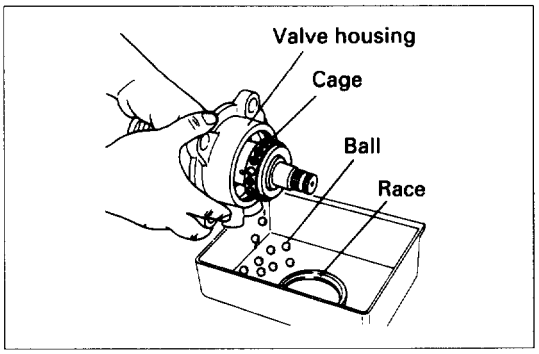
3. **Seal Ring**

4,5. **O-ring**
Using needle, scriber or equivalent.



6. **Adjust Plug**
Using adjust plug wrench.

7. **Bearing**
8. **Oil Seal**
9. **O-ring**
Using needle, scriber or equivalent
10. **Upper Race**



11. Cage and Ball

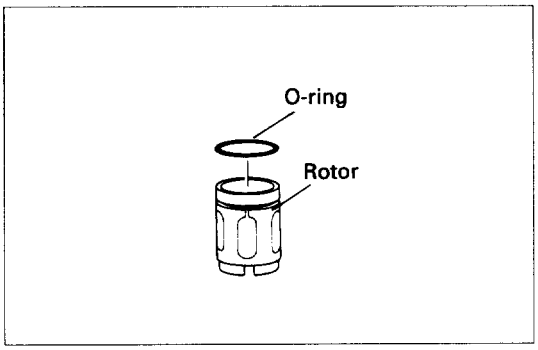
Be careful to lost the ball when remove the side race.

Number of Balls
17

12. Lower Race

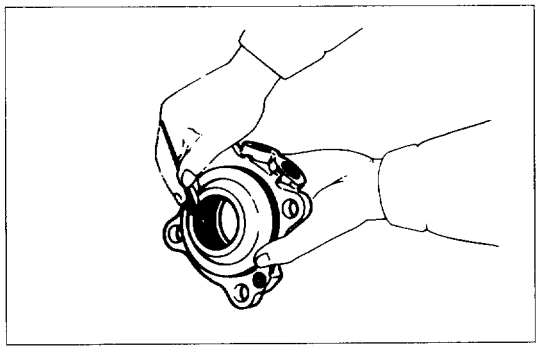
13. Worm Shaft Assembly

14. Rotor



15. O-ring

Using needle, scriber or equivalent.

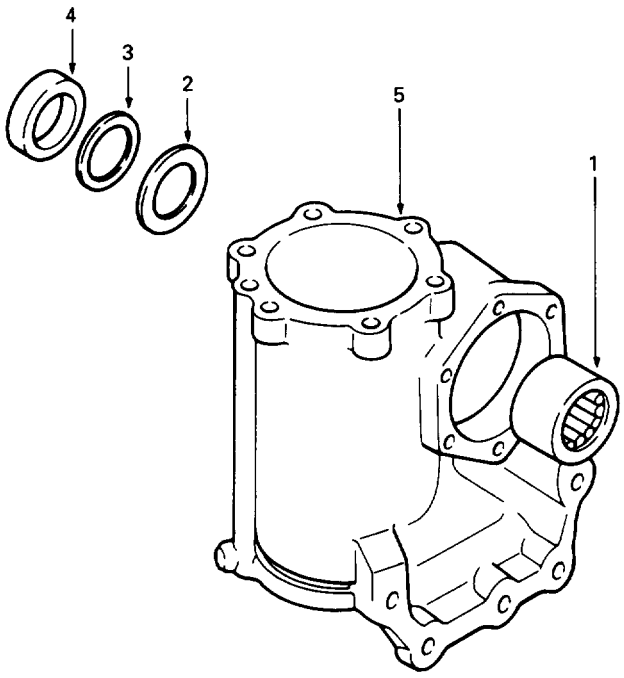


16. Seal Ring and O-ring

Using needle, scriber or equivalent.

17. Valve Housing

Body Assembly



Disassembly Steps

1. Bearing
2. Y-gasket
3. Back up ring
4. Oil seal
5. Body

Disassembly Steps

1. **Bearing**
   Unless otherwise a problem, it is not necessary to disassemble.
2. **Y-gasket**
3. **Back Up Ring**
4. **Oil Seal**
5. **Body**

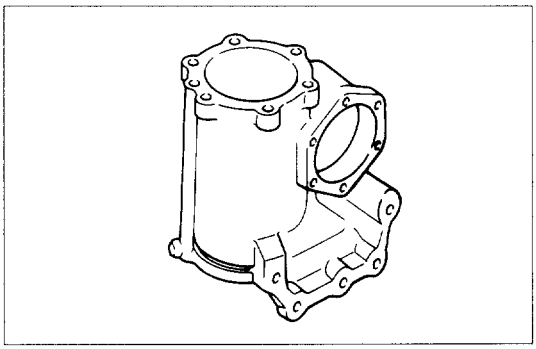
INSPECTION AND REPAIR

Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.

1. Gear box
2. Sector shaft
3. Needle roller bearing
4. Piston and worm shaft
5. Oil seal, Dust cover, Y-gasket, O-ring and seal ring

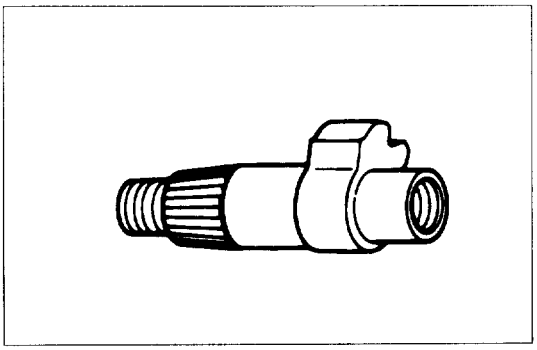
Visual Check

Inspect the following parts for wear, damage or other abnormal conditions.



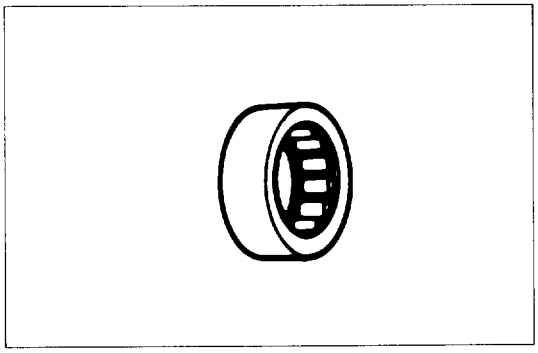
Gear Box

Check the body for cracks and body inner surface and piston sliding surface or scratches.



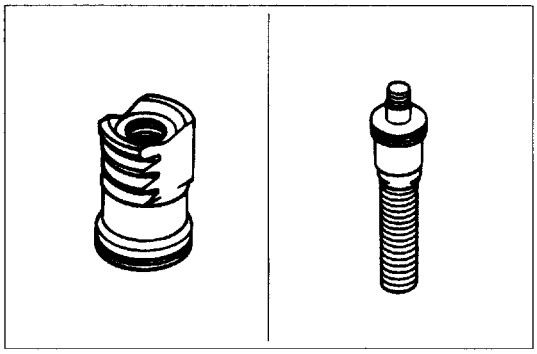
Sector Shaft

If the shaft is worn, twisted, scratched or partically worn, replace it with a new one.



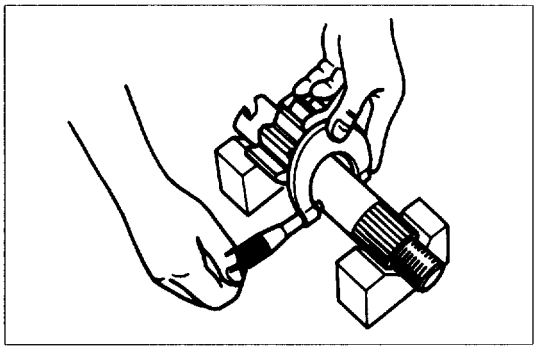
Bearing

If the bearing race surface is worn, scratched or seized, replace it with a new one.



Piston and Worm Shaft

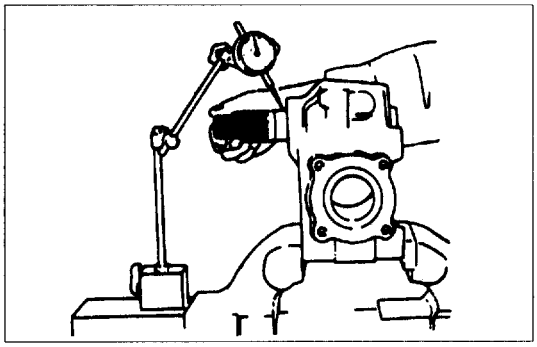
If the worm shaft inner surface, rotor outer surface or rotor pin is remarkable worn or play is excessive, replace with a new assembly.



Measurement of Sector Shaft Outside Diameter

mm (in)

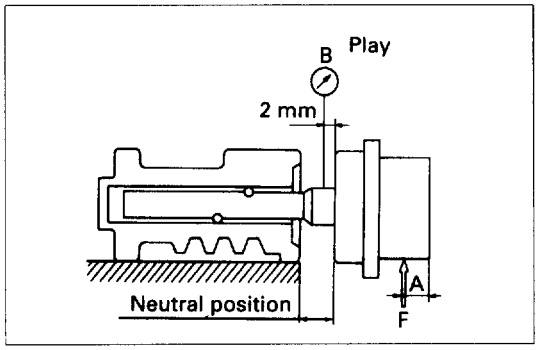
Standard	Limit
39.975 (1.574)	39.925 (1.572)



Measurement of Play between Sector Shaft and Needle Roller Bearing

mm (in)

Limit	0.12 (0.0047)



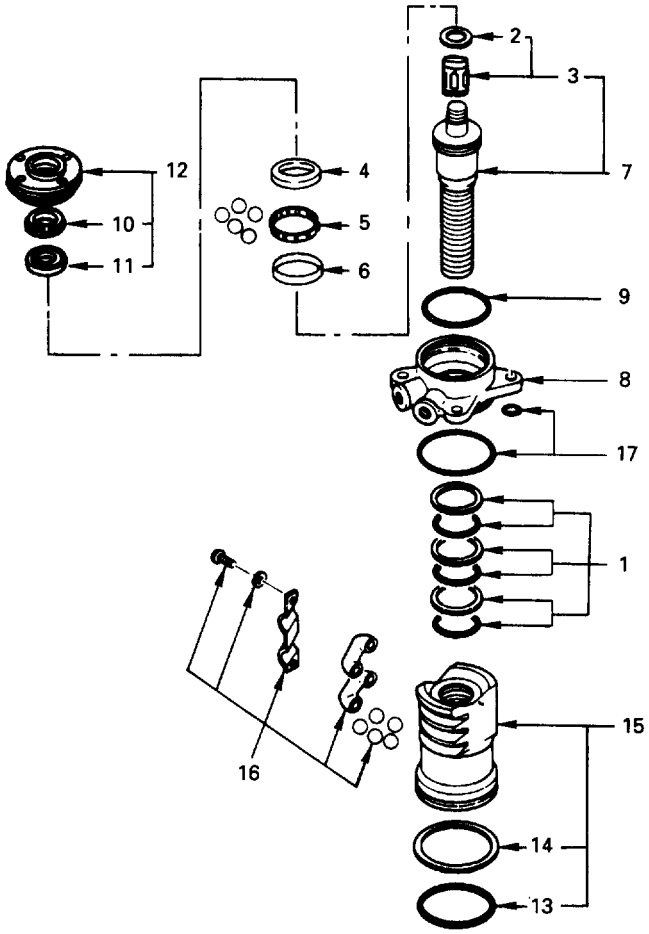
Valve Housing Assembly

Measure the end play of the ball screw in the axial direction.

A mm (in)	F N (kg / lb)	B (end play) mm (in)
16 (0.6299)	39 (4 / 11)	0.5 (0.0197) or less

REASSEMBLY

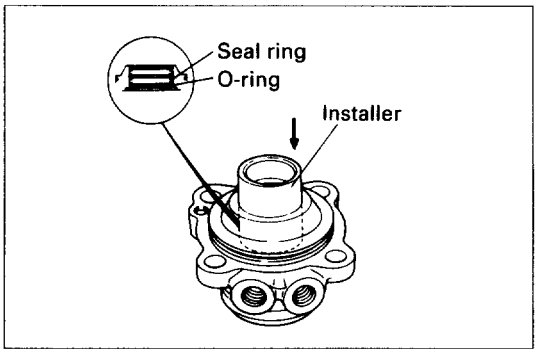
Valve Housing Assembly



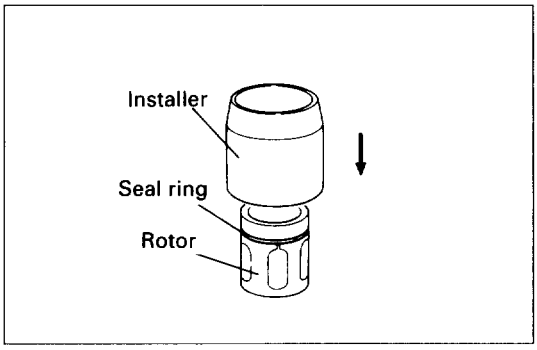
Reassembly Steps

1. Seal ring and O-ring
2. Seal ring
3. Rotor
4. Upper race
5. Cage and ball
6. Lower race
7. Worm shaft assembly
8. Valve housing
9. O-ring
10. Oil seal
11. Bearing
12. Adjust plug assembly
13. O-ring
14. Seal ring
15. Piston assembly
16. Ball, tube, tube grip, screw and washer
17. O-ring

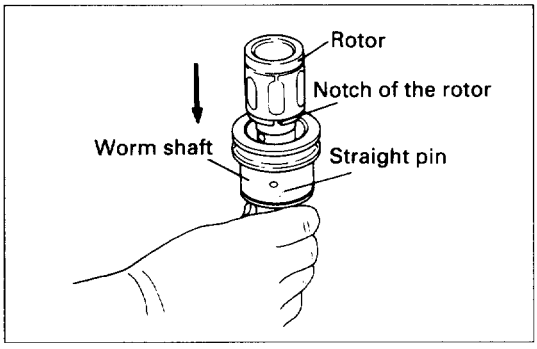
Reassembly Steps



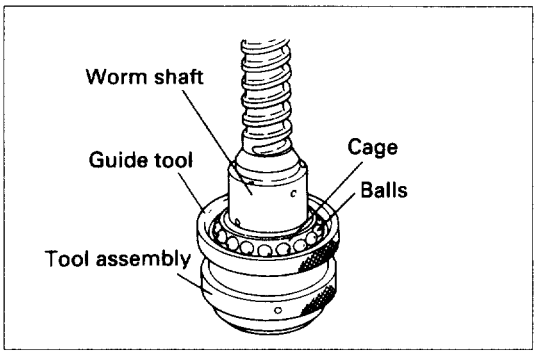
1. **Seal Ring and O-ring**
   There are five grooves inside the valve housing (at the piston side). Put a seal ring and O-ring into each of the three narrower grooves. For shaping and alignment of the seal rings, use the installer.

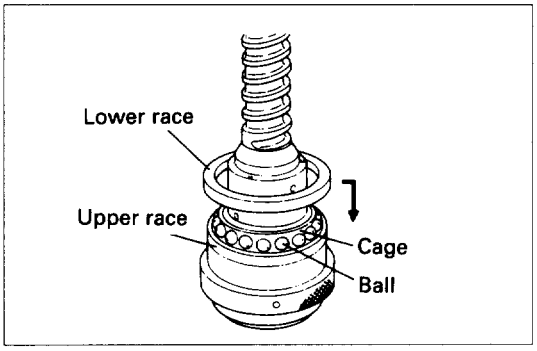


2. **Seal Ring**
   When the seal ring is installed, use installer for alignment.



3. **Rotor**
   Put the rotor between the stub shaft and worm shaft so that the notch in the rotor may be properly matched with the straight pin at the inmost part.

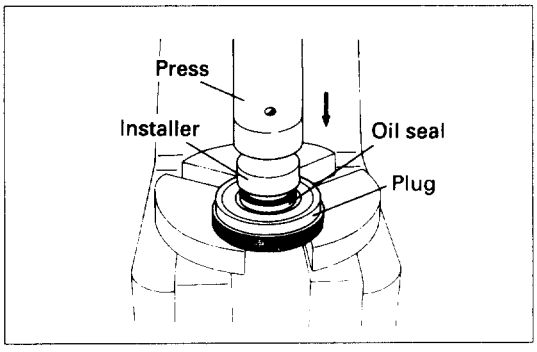


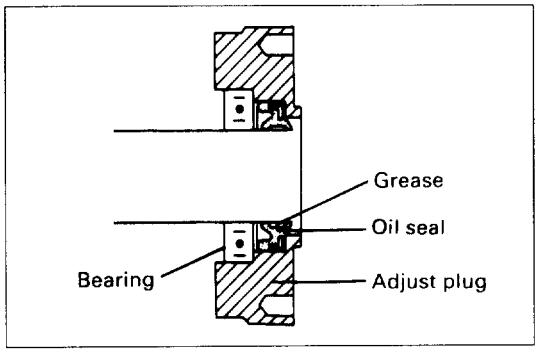


4. **Upper Race**
5. **Cage and Ball**
6. **Lower Race**
   1) Fix the guide tool to the tool assembly.
   2) Insert the worm shaft assembly into the tool with the input end of the worm shaft assembly facing downward.
   3) Mount the upper race, cage, and balls in that order.
   4) Slide the tool downward, and the balls will be put in their positions.
   5) Remove the guide tool, and mount the lower race.

7. **Worm Shaft Assembly**
8. **Valve Housing**
9. **O-ring**
10. **Oil Seal**

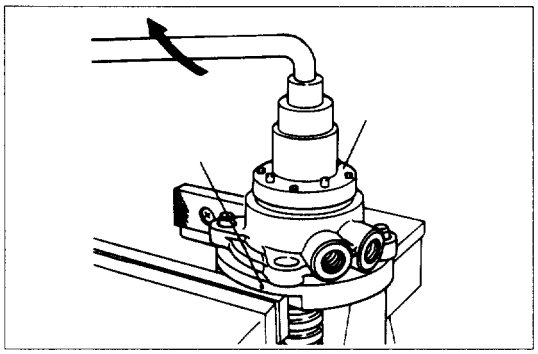
    Using an adequate installer.





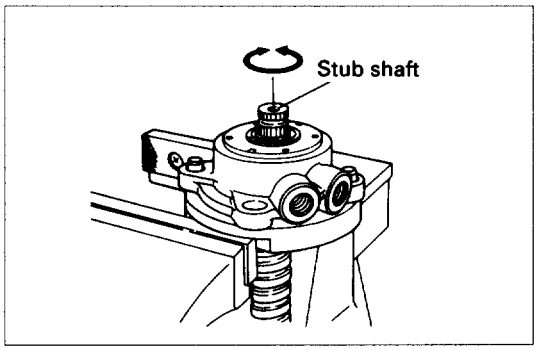
Note the setting direction.

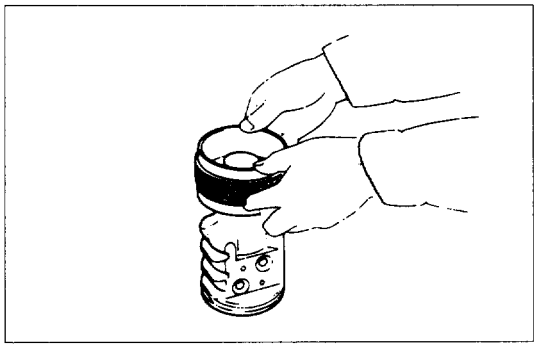
Apply bearing grease.



11. **Bearing**
12. **Adjust Plug Assembly**

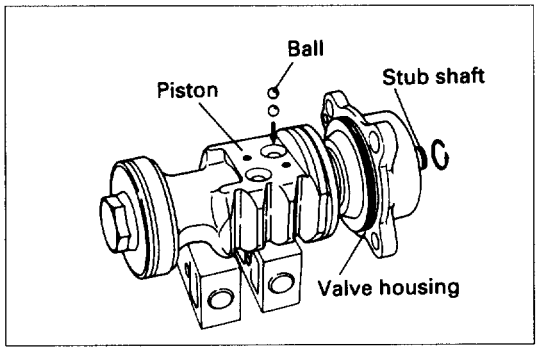
    Fasten the adjust plug with a plug wrench. Make certain that the stub shaft can be rotated smoothly and evenly. Then, loosen the adjustment plug by about 180°.



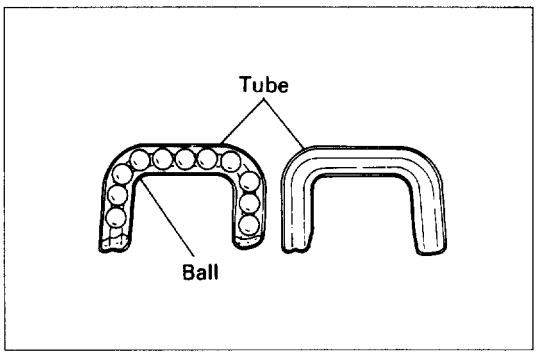


13. **O-ring**
14. **Seal Ring**

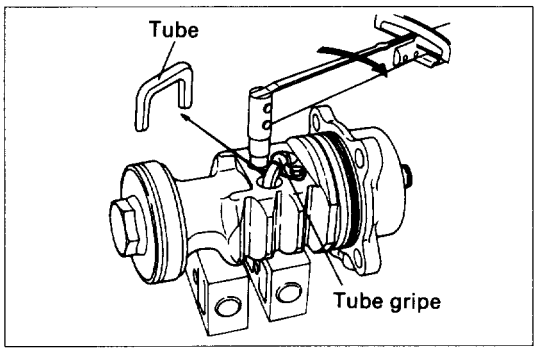
    When the O-ring and seal ring are installed, use installer for alignment.



15. **Piston Assembly**
16. **Ball, Tube, Tube Grip, Screw and Washer**
    1) Put the valve housing assembly horizontally. Insert the ball into the ball tube hole in the piston while rotating the stub shaft. Thus, the ball can be easily mounted.



2) Apply a sufficient amount of grease to the inner surface of the tube. Put and paste the balls to the inner surface of the tube. Then, put the other ball tube onto the tube to which grease has been applied and the balls have been pasted.

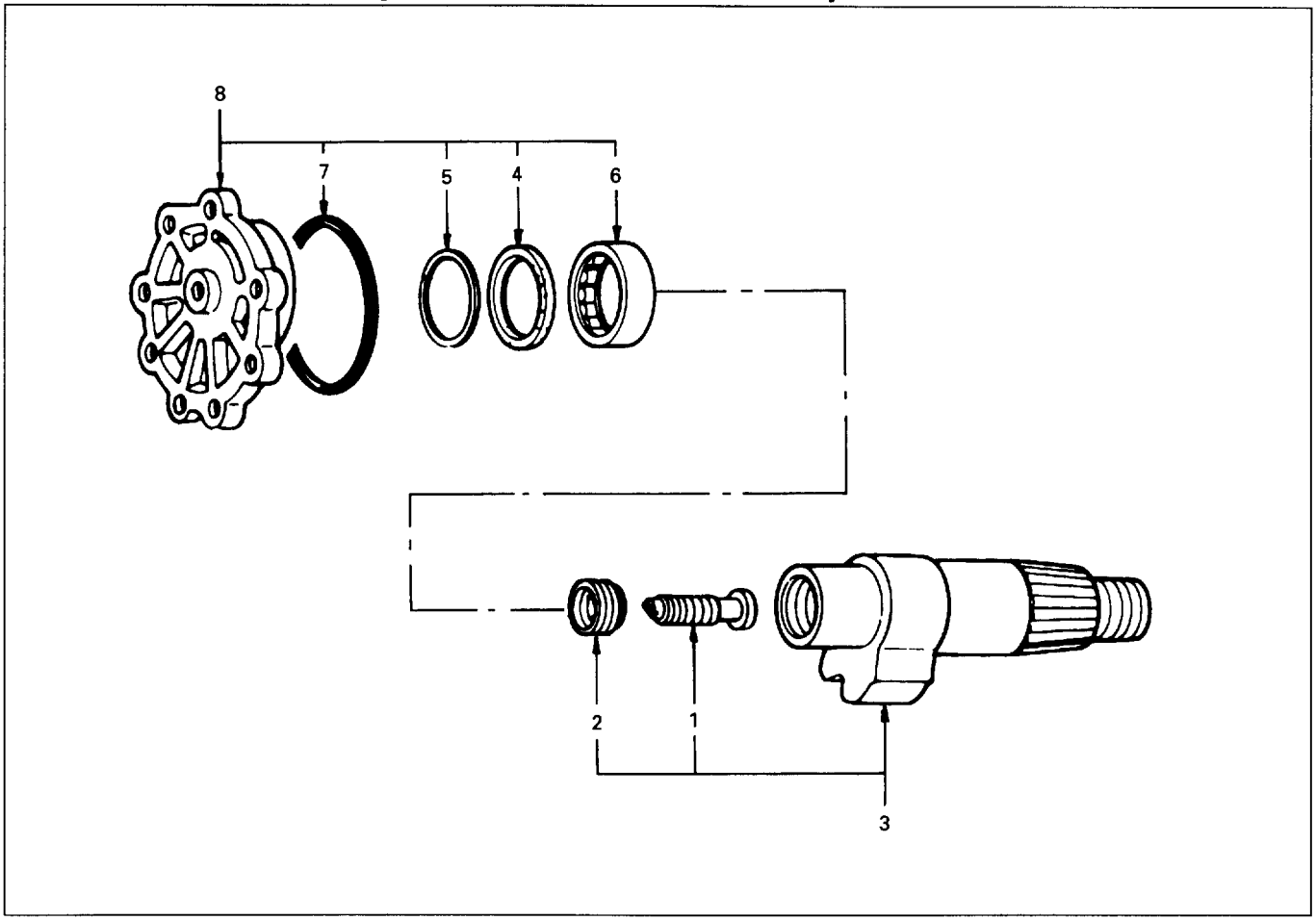


3) Then tighten the screw.

Tube Screw Torque	N•m (kg•m / lb•in)
	5 (0.5 / 43)

17. O-ring

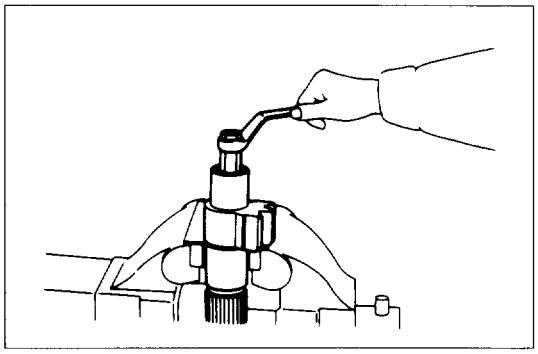
Sector Shaft Assembly and Side Cover Assembly



Reassembly Steps

1. Adjust screw
2. Retainer
3. Sector shaft assembly
4. Y-gasket
5. Back up ring
6. Bearing
7. O-ring
8. Side cover

Reassembly Steps

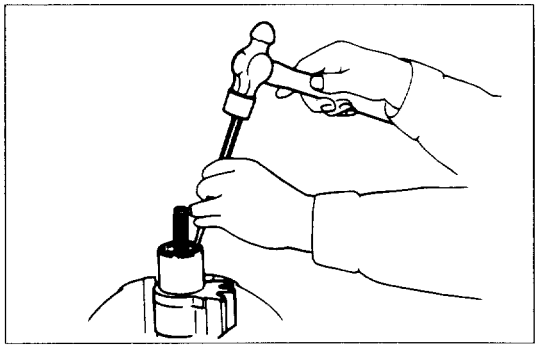


1. **Adjust Screw**
2. **Retainer**

Discard used retainer and install a new one.

Install and fully tighten the retainer and back off 180 degrees.

Retighten to a torque of 39N (4kg /44lb) and back off 20 degrees. Check that the adjusting screw turns smoothly.



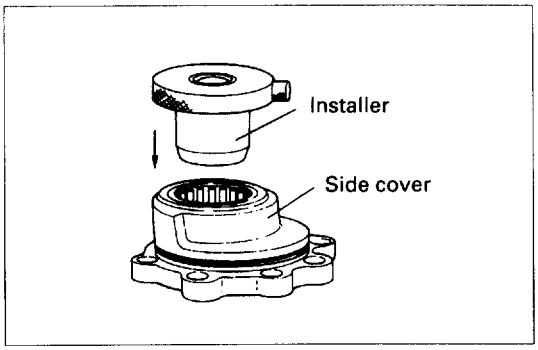
Caulk the retainer in position.

3. **Sector Shaft Assembly**
4. **Y-Gasket**

Install the gasket so that its lip faces to the bearing.

If the lip is deformed, correct.

Apply grease to Y-gasket.

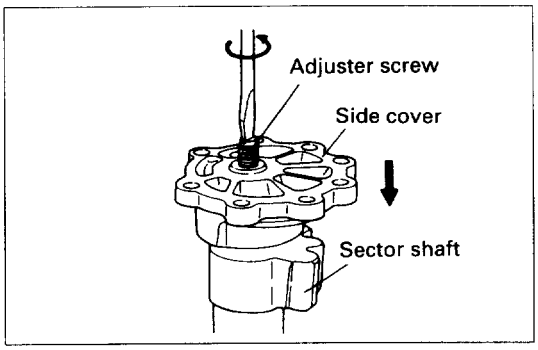


5. **Back Up Ring**

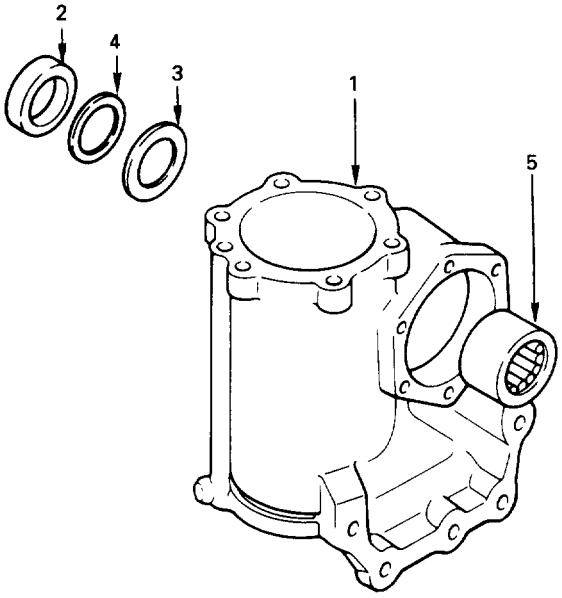
When the back up ring is installed, use installer for alignment.

6. **Bearing**
7. **O-ring**
8. **Side Cover Assembly**

Mate the screw hole at the center of the side cover with the adjust screw on the sector shaft assembly, and fix the side cover assembly to the sector shaft assembly by turning the adjust screw counterclockwise.



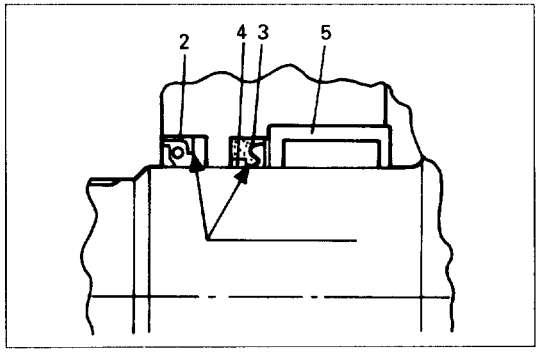
Body Assembly



Reassembly Steps

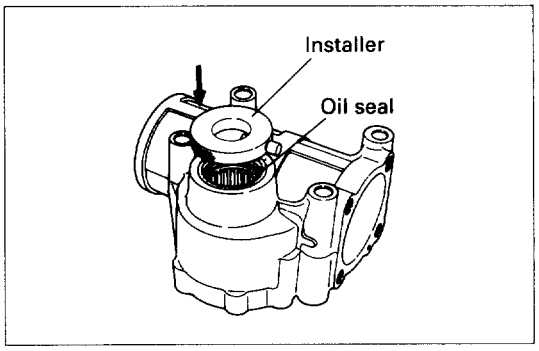
1. Body
2. Oil seal
3. Y-gasket
4. Back up ring
5. Bearing

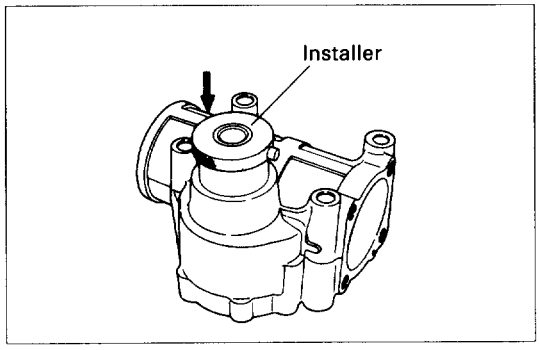
Reassembly Steps



Note the direction of installation.
Apply grease to these parts.

1. **Body**
2. **Oil Seal**
   Using installer.

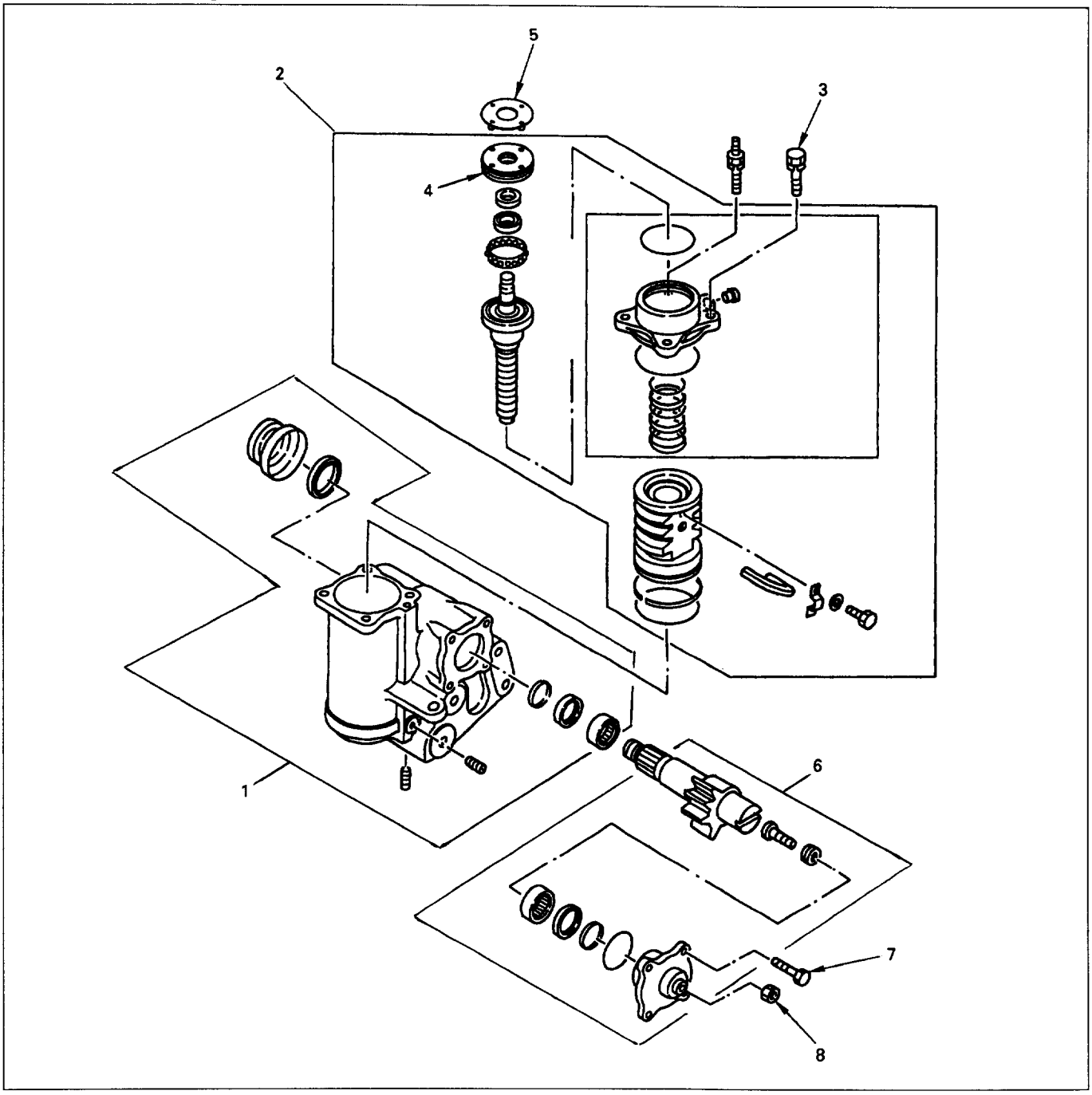




3. **Y-gasket**
4. **Back Up Ring**
   When the back up ring is installed, use installer for alignment.

5. **Bearing**

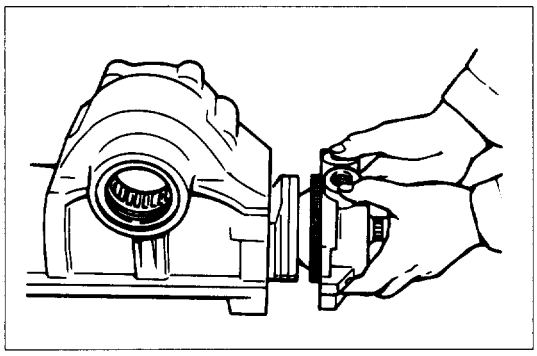
Power Steering Unit



Reassembly Steps

1. Body assembly
2. Valve housing assembly
3. Bolt
4. Adjust plug assembly
5. Dust cover
6. Sector shaft assembly and side cover assembly
7. Bolt
8. Lock nut

Reassembly Steps

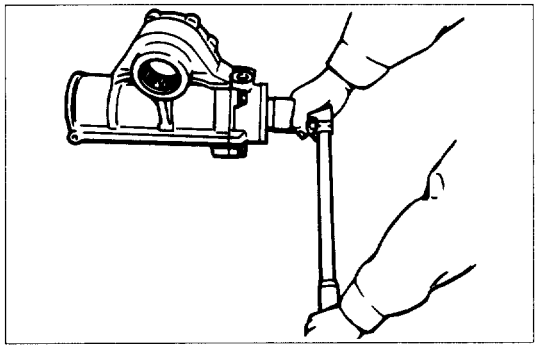


1. **Body Assembly**
2. **Valve Housing Assembly**

Valve Housing Assembly Bolt Torque

	N•m (kg•m/lb•ft)
NHR, NKR	59 (6.0 / 43)
NPR, NQR, NPS	103 (10.5 / 76)

Install the parts with the valve side turned to front and worm gear of piston toward the sector gear. Apply liquid to the valve housing contact surface.



3. **Bolt**
4. **Adjust Plug Assembly**

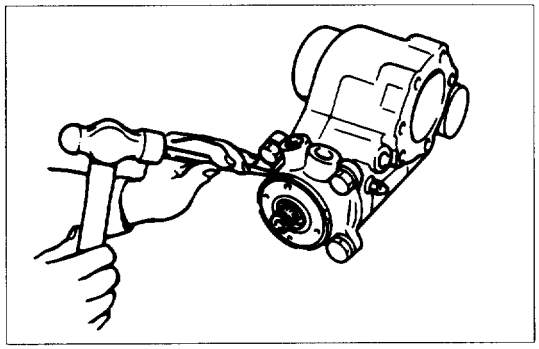
Before tightening the lock ring, tightening the adjust plug completely, then apply a locating mark across the adjust plug and body using a chalk.

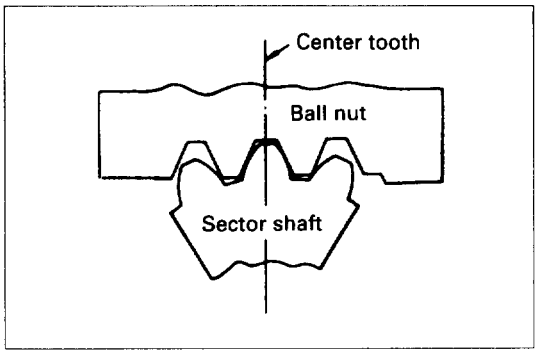
Adjust Plug Torque

N•m (kg•m/lb•ft)
157 (16 / 116)

After tightening the lock nut, check the mark applied previously to see if the adjust plug has been turned with lock nut.

Caulk the lock nut after tightening.



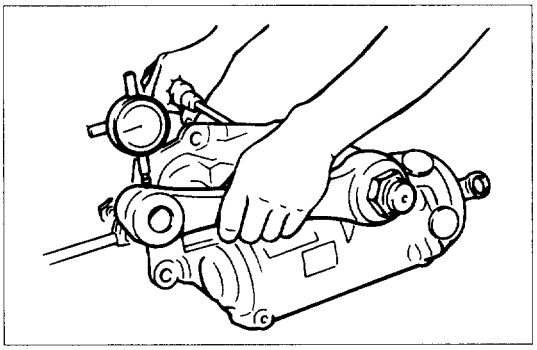


6. Sector Shaft Assembly and Side Cover Assembly

7. Bolt

Side Cover Bolt Torque	N•m (kg•m/lb•ft)
59 (6.0 / 43)	

Align the center tooth of piston (ball nut) with that of the sector shaft.



8. Lock Nut

1) Install drop arm.
2) Hold the sector shaft in a straight ahead position.
3) With the adjust screw, adjust the backlash to specification.

Backlash between Sector Shaft and Ball Nut	mm (in)
0.05 – 0.25 (0.0020 – 0.0098)	

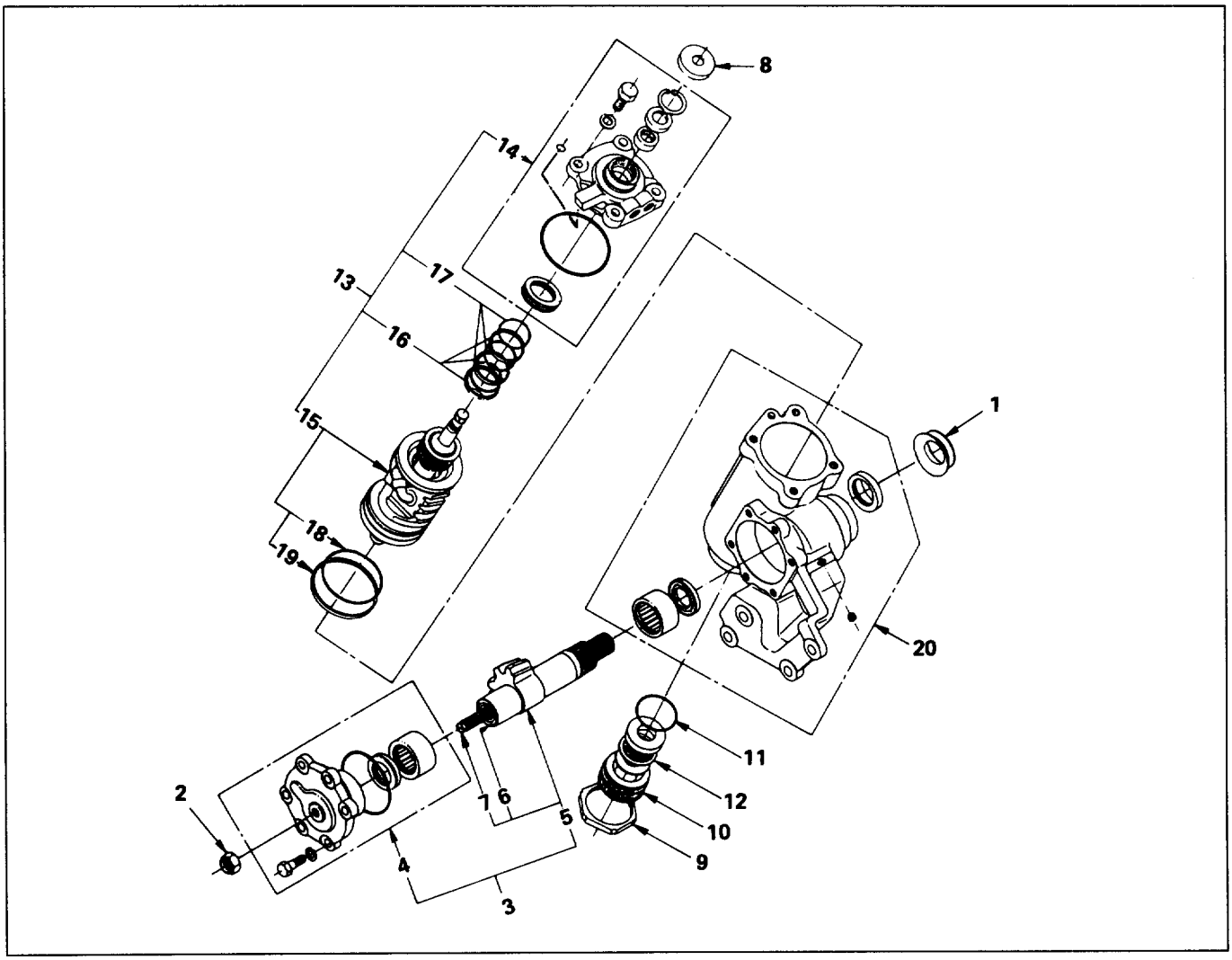
4) Tighten the lock nut.

Lock Nut Torque	N•m (kg•m/lb•ft)
69 (7.0 / 51)	

POWER STEERING UNIT (LHD MODEL)

DISASSEMBLY

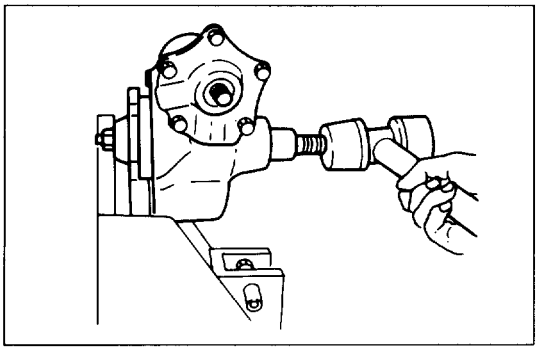
Power Steering Unit



Disassembly Steps

1. Dual seal
2. Lock nut
3. Side cover and sector shaft assembly
4. Side cover assembly
5. Sector shaft assembly
6. Retainer
7. Adjust screw
8. Dust seal
9. End cover lock nut
10. End cover
11. O-ring
12. Bearing
13. Valve housing and ball screw assembly
14. Valve housing assembly
15. Ball screw assembly
16. O-ring
17. Tefron ring
18. Tefron ring
19. O-ring
20. Gear box assembly

Disassembly Steps

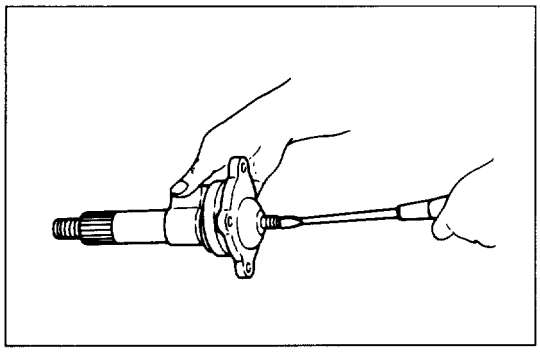


1. **Dual Seal**
2. **Lock Nut**
3. **Side Cover and Sector Shaft Assembly**

   Align the sector shaft to neutral position by turning the input shaft to lock and backing off approx. 2.5 turns.

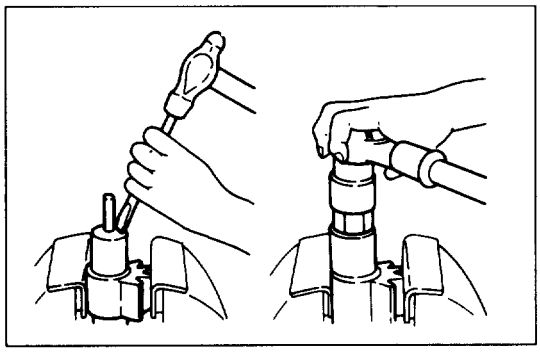
   Turn the adjust screw counter-clockwise slightly, then remove the side cover fixing bolts.

   Then remove the side cover and sector shaft assembly by tapping on the end of sector shaft with a plastic hammer.



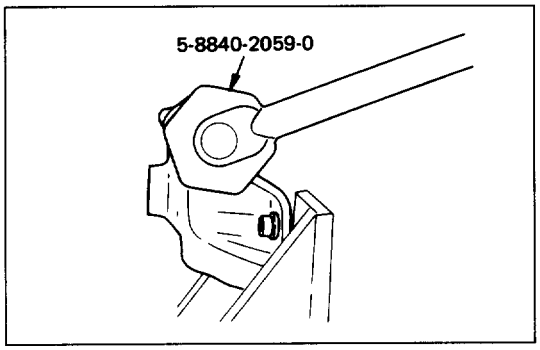
4. **Side Cover Assembly**
5. **Sector Shaft Assembly**

   Remove the sector shaft assembly from the side cover assembly by turning the adjust screw clockwise.



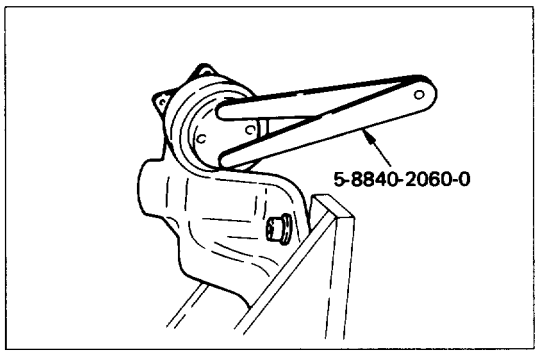
6. **Retainer**

   Flatten out caulked portion of the retainer.

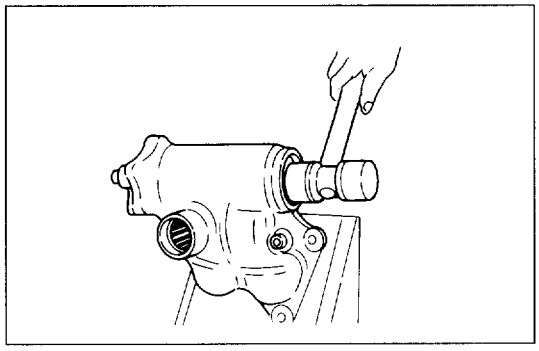


7. **Adjust Screw**
8. **Dust Seal**
9. **End Cover Lock Nut**

   Lock Nut Wrench : 5-8840-2059-0

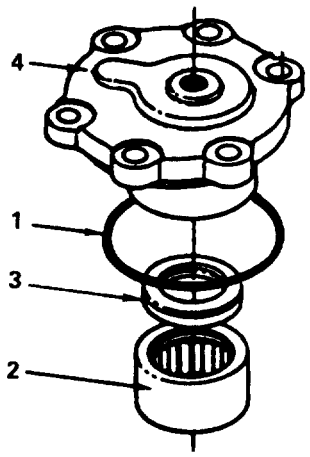


10. **End Cover**
    Wrench : 5-8840-2060-0



11. **O-ring**
12. **Bearing**
13. **Valve Housing and Ball Screw Assembly**
    Always keep the ball screw assembly in a horizontal position and avoid holding it vertically, or ball nut will slide out.
    Remove this assembly by tapping on the end of ball screw assembly with a plastic hammer.
14. **Valve Housing Assembly**
15. **Ball Screw Assembly**
16. **O-ring**
17. **Tefron Ring**
18. **Tefron Ring**
19. **O-ring**
20. **Gear Box Assembly**

Side Cover Assembly



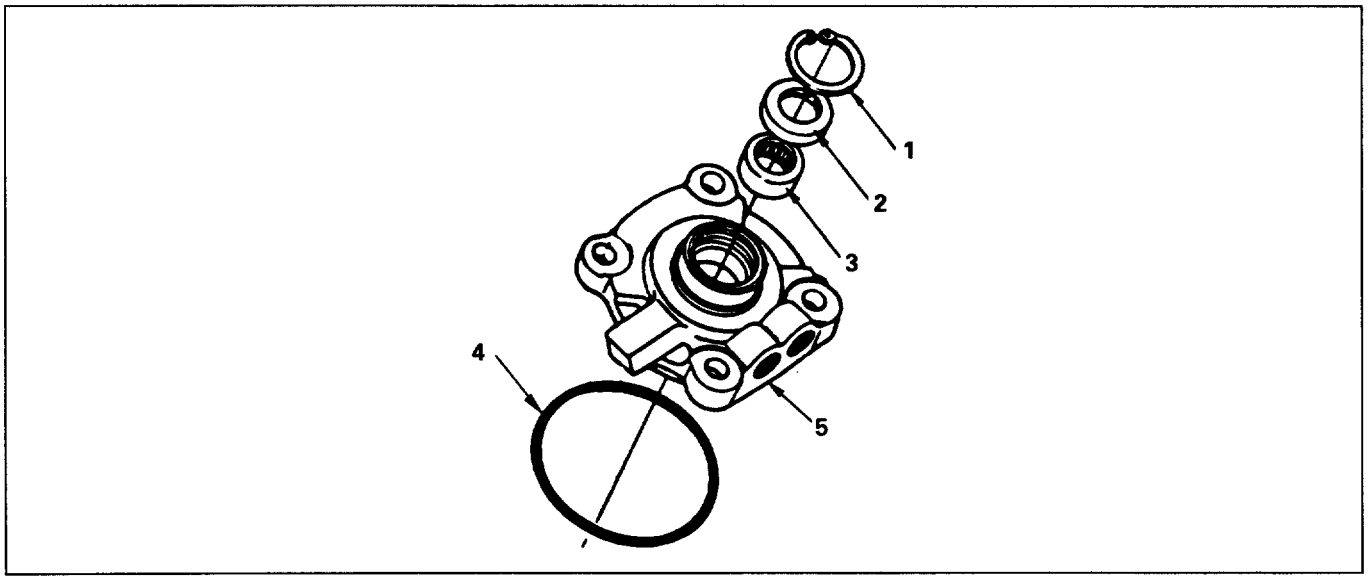
Disassembly Steps

1. O-ring
2. Needle bearing
3. U-packing
4. Side cover

Disassembly Steps

1. **O-ring**
2. **Needle Bearing**
3. **U-Packing**
4. **Side Cover**

Valve Housing Assembly



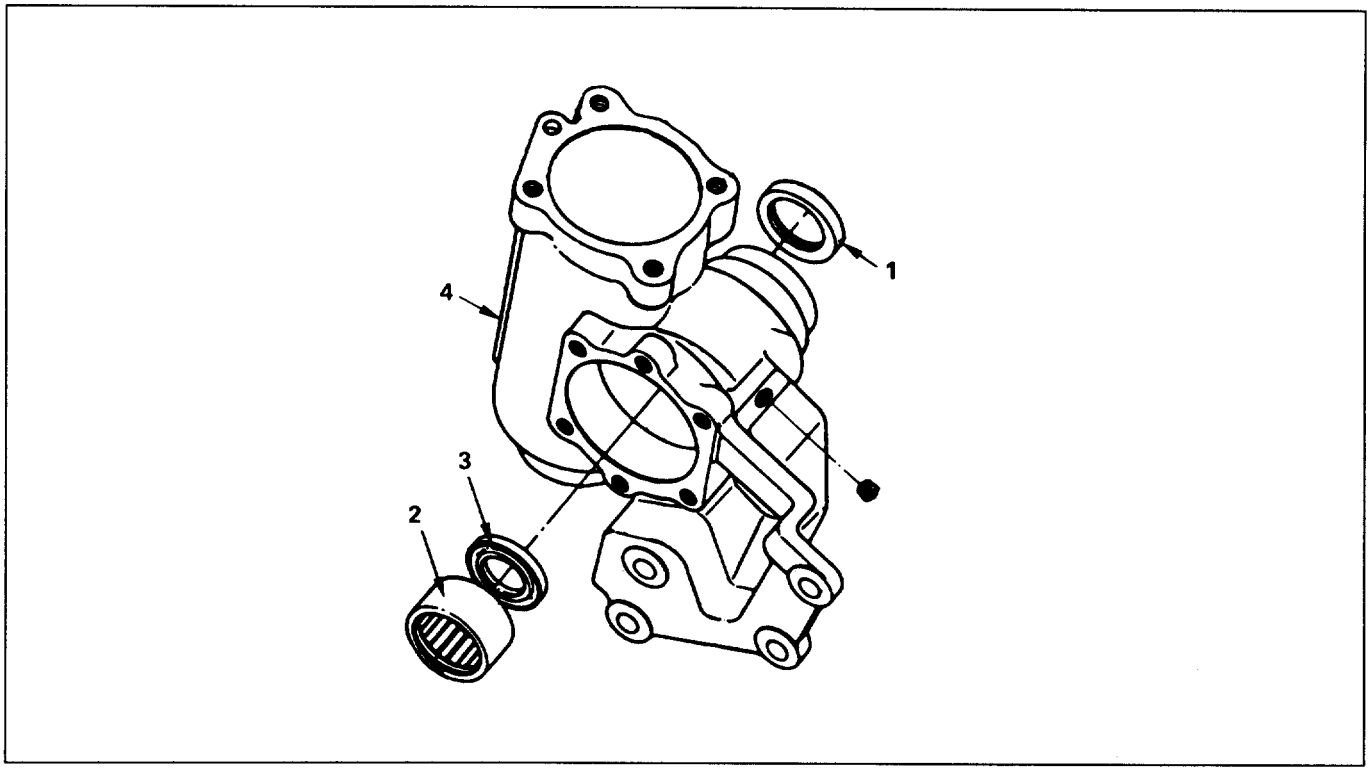
Disassembly Steps

1. Snap ring
2. Oil seal
3. Needle bearing
4. O-ring
5. Valve housing

Disassembly Steps

1. **Snap Ring**
2. **Oil Seal**
3. **Needle Bearing**
4. **O-ring**
5. **Valve Housing**

Gear Box Assembly



Disassembly Steps

1. Oil seal
2. Needle bearing
3. U-packing
4. Body

Disassembly Steps

1. **Oil Seal**
2. **Needle Bearing**
3. **U-Packing**
4. **Body**

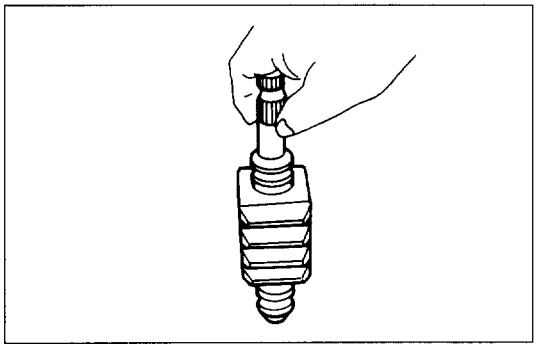
INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.

- Body
- Sector shaft
- Needle bearing
- Ball screw assembly
- Oil seal, dust cover, U-packing, O-ring and seal ring

Visual Checks

Inspect the following parts for wear damage or other abnormal conditions.

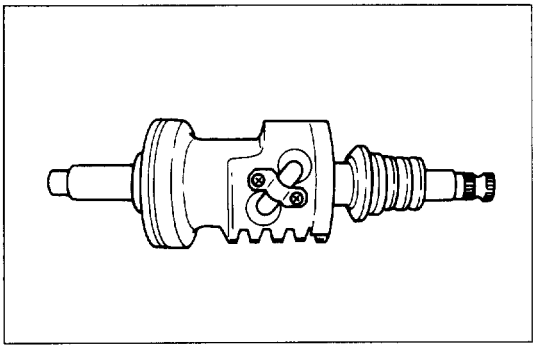


Ball Nut Rotation

Hold the worm shaft vertically and see if the ball nut lowers with turning motion smoothly. If lowering of the ball nut with its own weight is unsmooth, check the worm shaft for bending and ball-groove for burrs, dents and presence of foreign matter.

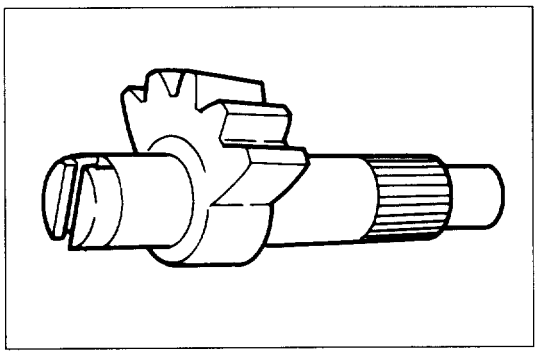
NOTE:

When making a test on the ball screw assembly, exercise care so as not to strike ball nut against end of worm shaft, or damage to the ball tubes will result.



Ball Screw Assembly

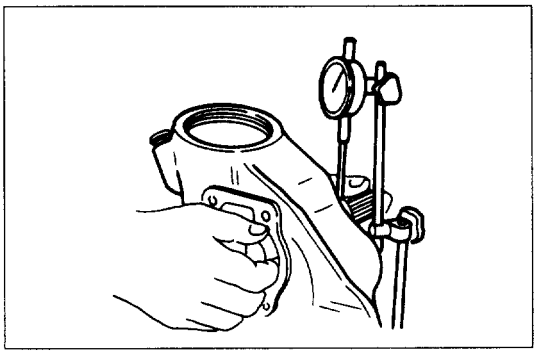
- Ball screw assembly and control valve assembly include precision finished parts of selective fitting. The entire assemblies should be replaced with new one.
- Always keep ball screw assembly in a horizontal position and avoid holding it vertically, or ball nut will slide out.



Measurement of Sector Shaft Outside Diameter

Sector Shaft Outside Diameter mm(in.)

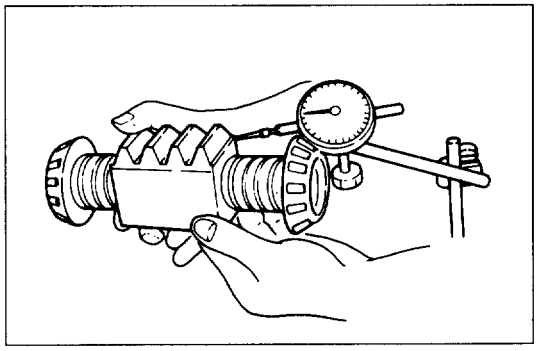
Standard	Limit
38.125 (1.501)	38.043 (1.4978)



Sector Shaft and Needle Bearing Play

mm(in.)

Limit
0.2 (0.008)



Ball Nut Axial Play

mm(in.)

Limit
0.12 (0.0047)

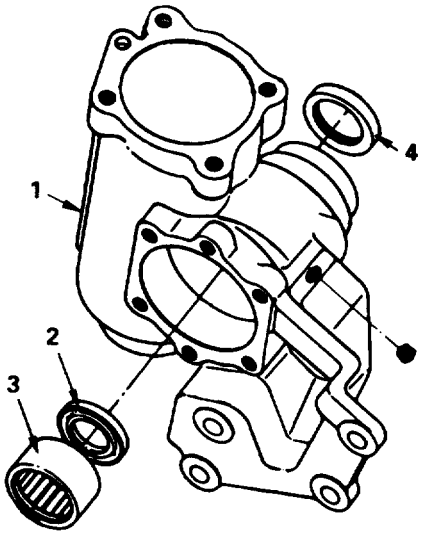
Clearance between Gear Box and Ball Nut Piston

mm(in.)

Standard	Limit
0.04 – 0.09 (0.0016 – 0.0035)	0.15 (0.0059)

REASSEMBLY

Gear Box Assembly



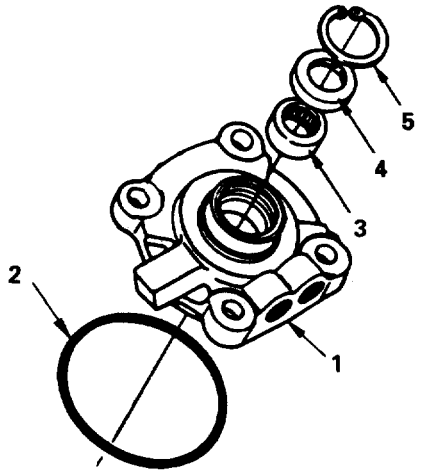
Reassembly Steps

1. Body
2. U-packing
3. Needle bearing
4. Oil seal

Reassembly Steps

1. **Body**
2. **U-Packing**
3. **Needle Bearing**
4. **Oil Seal**

Valve Housing Assembly



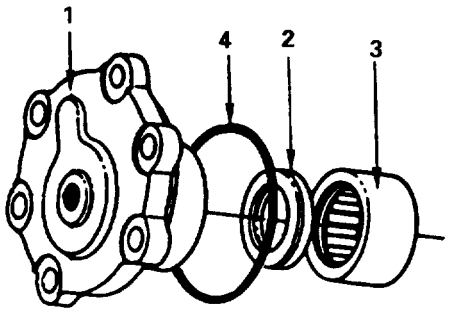
Reassembly Steps

1. Valve housing
2. O-ring
3. Needle bearing
4. Oil seal
5. Snap ring

Reassembly Steps

1. **Valve Housing**
2. **O-ring**
3. **Needle Bearing**
4. **Oil Seal**
5. **Snap Ring**

Side Cover Assembly



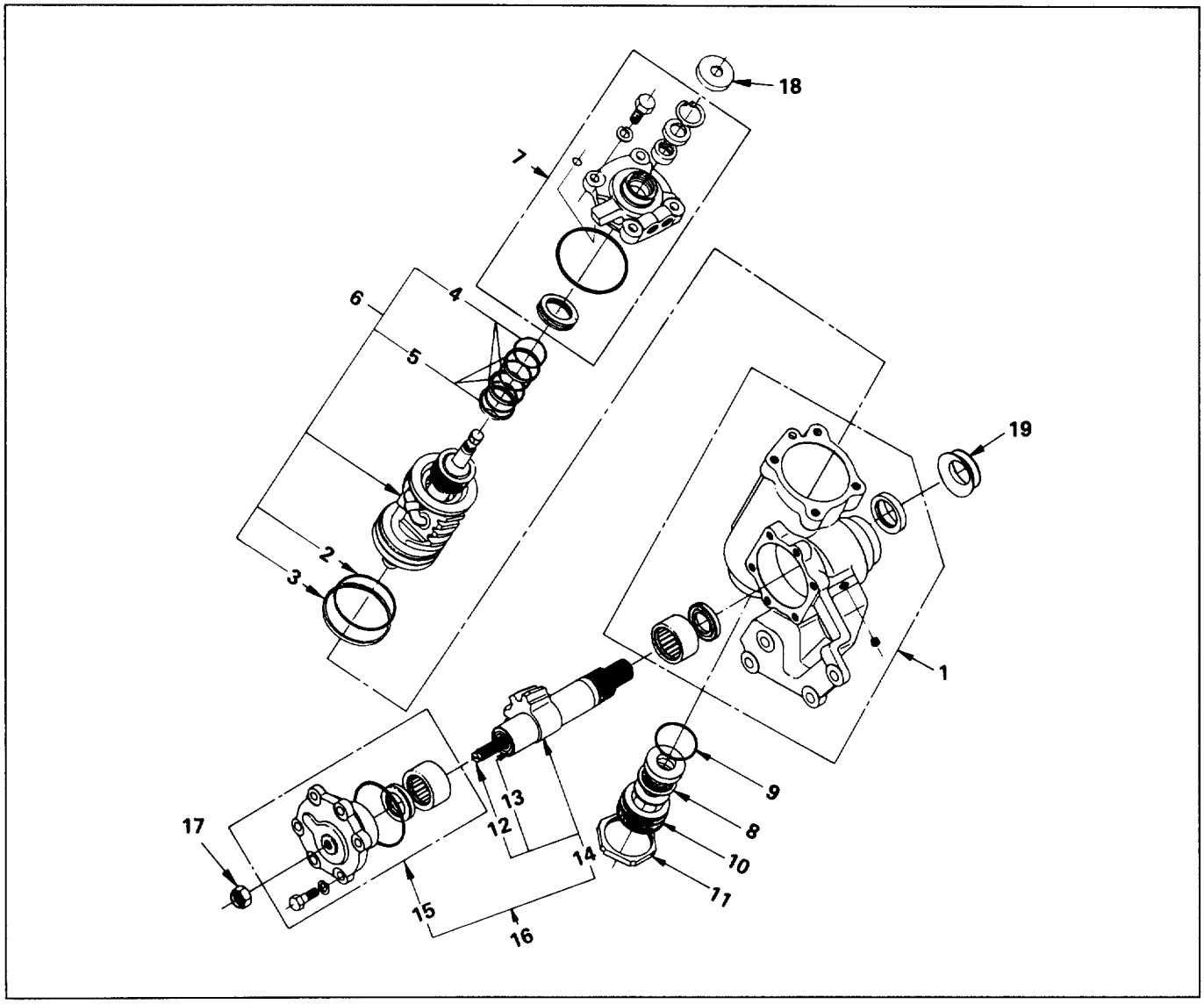
Reassembly Steps

1. Side cover
2. U-packing
3. Needle bearing
4. O-ring

Reassembly Steps

1. **Side Cover**
2. **U-Packing**
3. **Needle Bearing**
4. **O-ring**

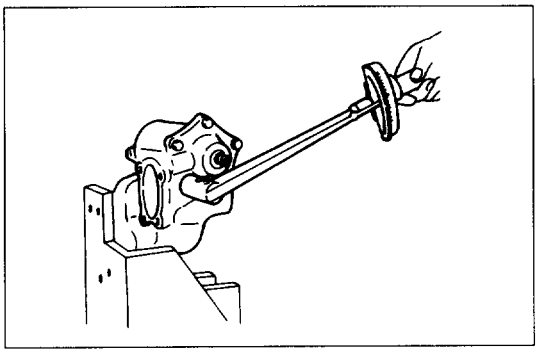
Power Steering Unit (LHD Model)



Reassembly Steps

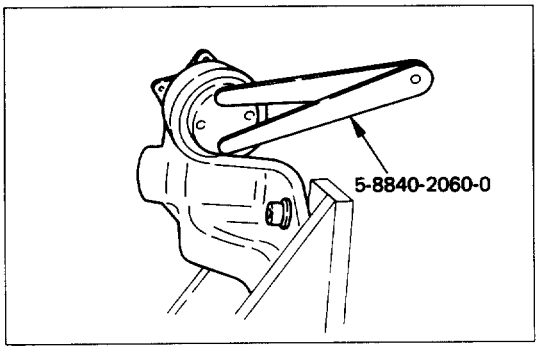
1. Gear box assembly
2. Tefron ring
3. O-ring
4. Tefron ring
5. O-ring
6. Ball screw assembly
7. Valve housing assembly
8. Bearing
9. O-ring
10. End cover
11. End cover lock nut
12. Adjust screw
13. Retainer
14. Sector shaft assembly
15. Side cover assembly
16. Side cover and sector shaft assembly
17. Lock nut
18. Dust seal
19. Dust seal

Reassembly Steps



1. **Gear Box Assembly**
2. **Tefron Ring**
3. **O-ring**
4. **Tefron Ring**
5. **O-ring**
6. **Ball Screw Assembly**
7. **Valve Housing Assembly**

Valve Housing Bolt Torque	N•m (kg•m/lb•ft)
85 (8.7 / 63)	

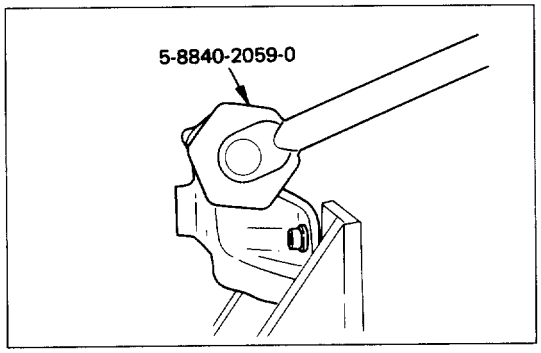


8. **Bearing**
9. **O-ring**
10. **End Cover**

Tighten the end cover with a special wrench until the starting torque of input shaft become within the specified range.

Wrench : 5-8840-2060-0

Starting Torque	N•m (kg•m/lb•ft)
0.29 – 0.49 (0.03 – 0.05 / 0.22 – 0.36)	

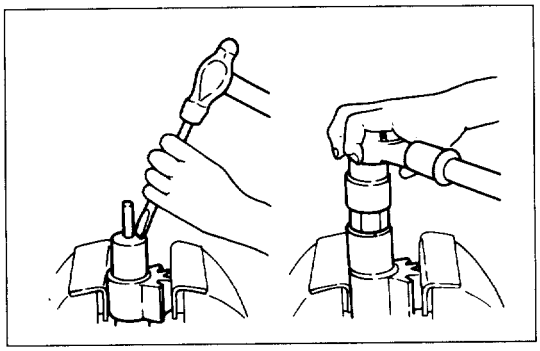


11. **End Cover Lock Nut**

Lock Nut Wrench : 5-8840-2059-0

Lock Nut Torque	N•m (kg•m/lb•ft)
201 (20.5 / 148)	

After tightening, recheck the starting torque of input shaft. Readjust the tightening of end cover if the starting torque is not within the specified range.

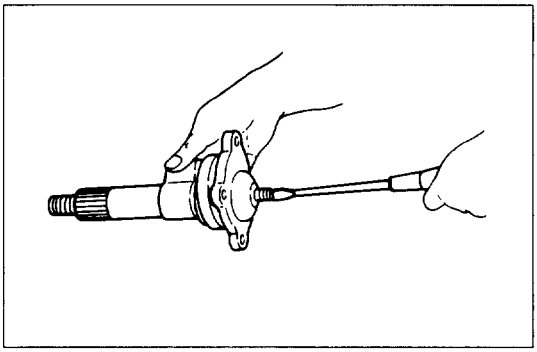


12. **Adjust Screw**
13. **Retainer**

Discard used retainer and install a new one.

Install and fully tighten the retainer and back off 180 degrees. Retighten to a torque of 39 N•m (4 kg•m/29 lb•ft) and back off 20 degrees. Check that the adjust screw turns smoothly.

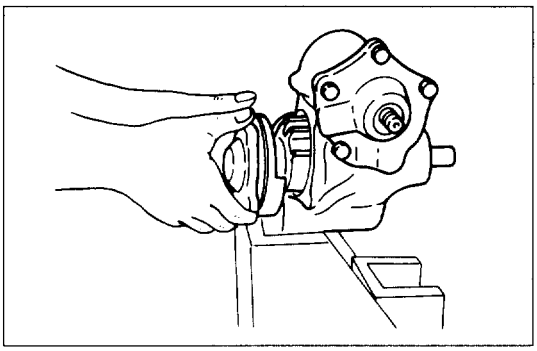
Caulk the retainer in position.



14. Sector Shaft Assembly

15. Side Cover Assembly

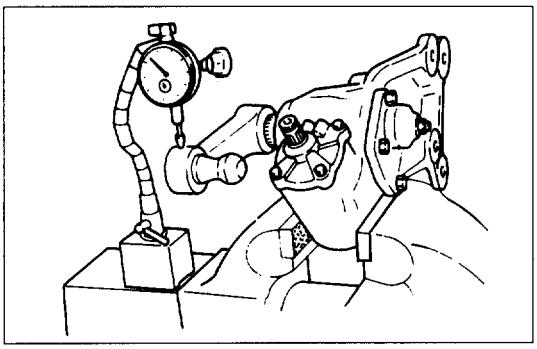
Turn the adjust screw counter-clockwise until the end of the sector shaft bottoms to the side cover, then back off 1 full turn.



16. Side Cover and Sector Shaft Assembly

Align the center tooth of ball nut with the center tooth of sector shaft.

Side Cover Bolt Torque	N•m (kg•m/lb•ft)
47 (4.8 / 35)	



17. Lock Nut

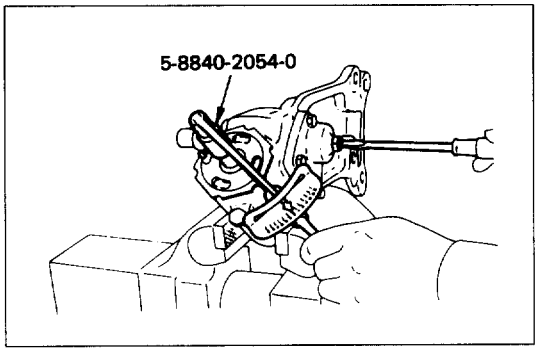
Adjust the backlash between the sector gear and ball screw.

1) Install the pitman arm.
2) Set the sector shaft in a straight ahead position.
3) With the adjust screw, adjust the backlash to the specification.

Backlash (at End of Pitman Arm)	mm(in.)
0.33 (0.013) or less	

4) Lock the adjust screw with the lock nut.

Lock Nut Torque	N•m (kg•m/lb•ft)
69 (7 / 51)	



5) Inspect the starting torque of the input shaft.

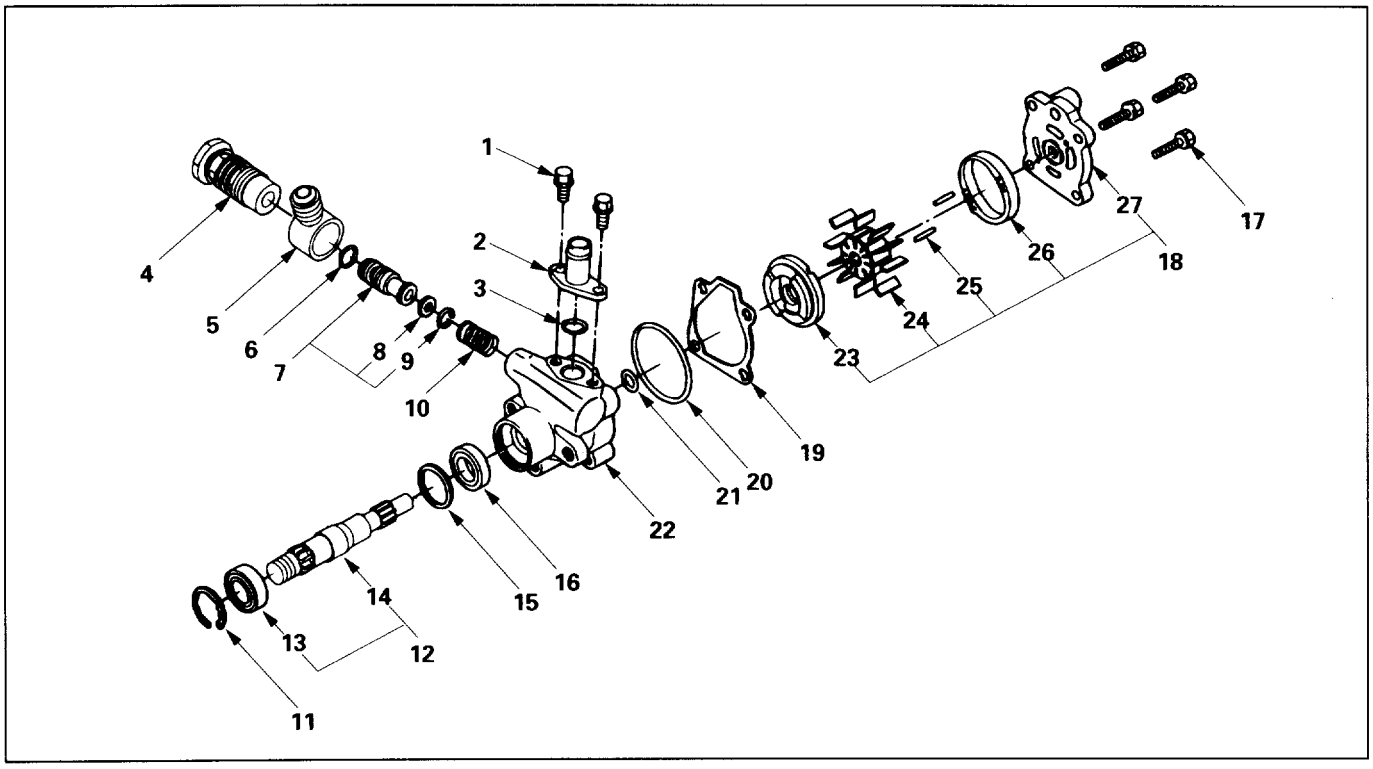
Starting Torque	N•m (kg•m/lb•ft)
0.49 – 0.88 (0.05 – 0.09 / 0.36 – 0.65)	

Steering Shaft Driver : 5-8840-2054-0

POWER STEERING PUMP

DISASSEMBLY

4J Series Engine



442LY00001

Disassembly Steps

1. Bolt
2. Pipe, suction
3. O-ring
4. Connector
5. Connector
6. O-ring
7. Valve
8. Retaining ring
9. Filter
10. Spring
11. Snap ring
12. Shaft assembly
13. Bearing
14. Shaft
15. Retaining ring
16. Oil seal
17. Bolt
18. Rear housing assembly and pump cartridge
19. Gasket
20. O-ring
21. O-ring
22. Front housing
23. Pressure plate
24. Rotor and vane
25. Cam
26. Pin
27. Rear housing

Disassembly Steps

Preparation:

Clean oil pump with solvent (its plug discharge and suction port to prevent the entry of solvent). Be careful not to expose the oil seal of shaft assembly to solvent.

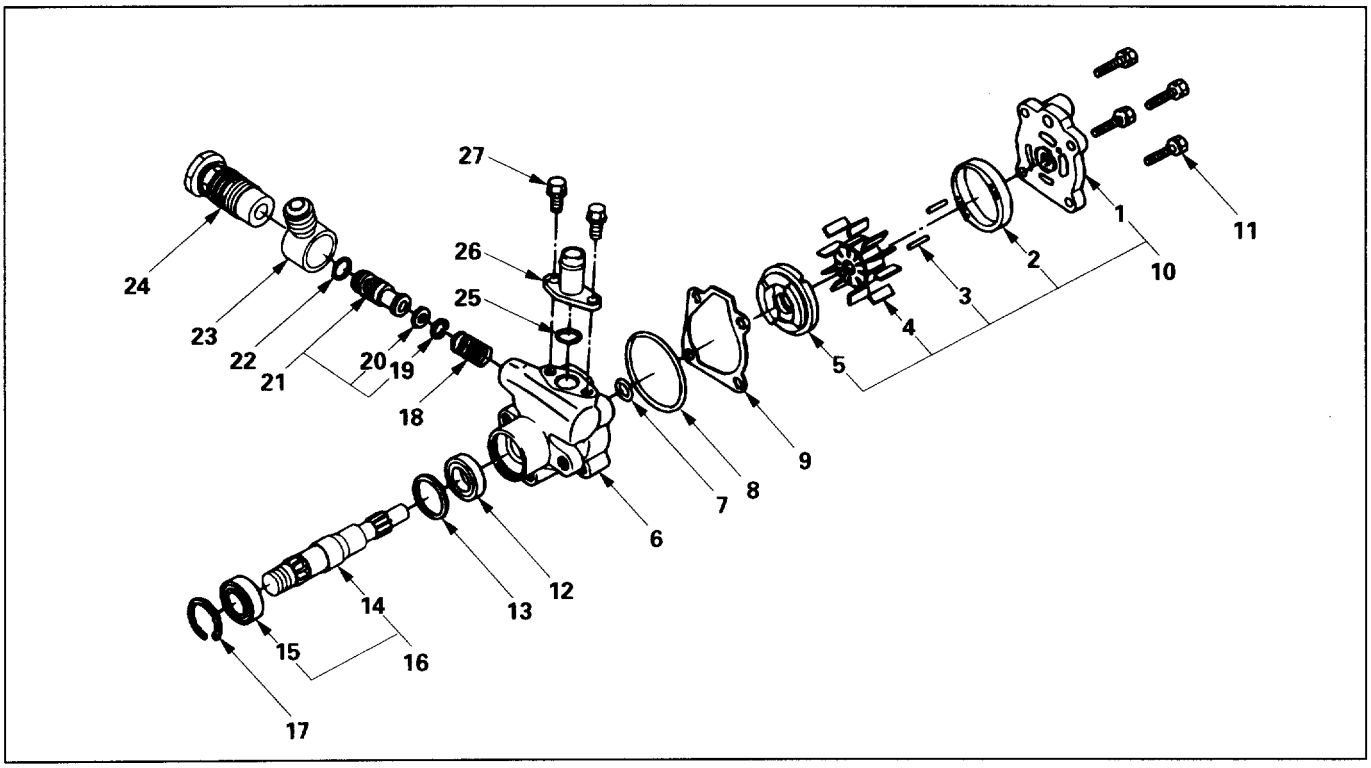
1. **Bolt**
2. **Pipe, Suction**
3. **O-ring**
4. **Connector**
5. **O-ring**
6. **Valve**
7. **Retaining Ring**
8. **Filter**
9. **Spring**
10. **Retaining Ring**
11. **Shaft Assembly**
12. **Bearing**
13. **Shaft**
14. **Retaining Ring**
15. **Oil Seal**

CAUTION:

When removing the oil seal, be careful not to damage the housing.

16. **Bolt**
17. **Rear Housing Assembly and Pump Cartridge**
18. **Gasket**
19. **O-ring**
20. **O-ring**
21. **Front Housing**
22. **Pressure Plate**
23. **Rotor and Vane**
24. **Cam**
25. **Pin**
26. **Rear Housing**

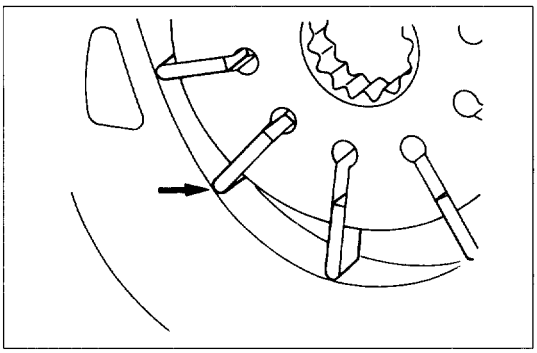
REASSEMBLY



442LY00002

Reassembly Steps

1. Rear housing
2. Pin
3. Cam
4. Rotor and vane
5. Pressure plate
6. Front housing
7. O-ring
8. O-ring
9. Gasket
10. Rear housing assembly and pump cartridge
11. Bolt
12. Oil seal
13. Retaining ring
14. Shaft
15. Bearing
16. Shaft assembly
17. Retaining ring
18. Spring
19. Filter
20. Retaining ring
21. Valve
22. O-ring
23. Connector
24. Connector
25. O-ring
26. Pipe, suction
27. Bolt



Reassembly Steps

1. **Rear Housing**
2. **Pin**
3. **Cam**
4. **Rotor and Vane**

   Install the vane with curved face in contact with the inner wall of the cam.
5. **Pressure Plate**

CAUTION:

When install pressure plate, be careful not to damage its inner surface. Damaged pressure plate may cause poor pump performance, pump seizure or oil leakage.

6. **Front Housing**
7. **O-ring**

   Be sure to discard used parts, and always used new parts for installation.
8. **O-ring**

   Be sure to discard used parts, and always used new parts for installation.
9. **Gasket**

   Be sure to discard used parts, and always used new parts for installation.
10. **Rear Housing Assembly and Pump Cartridge**
11. **Bolt**

Rear Housing Bolt Torque	N•m (kg•m/lb•ft)
	54 (5.5 / 40)

12. **Oil Seal**

    Be sure to discard used parts, and always used new parts for installation.

CAUTION:

When install pressure plate, be careful not to damage its inner surface. Damaged pressure plate may cause poor pump performance, pump seizure or oil leakage.

13. **Retaining Ring**
14. **Shaft**
15. **Bearing**
16. **Shaft Assembly**
17. **Retaining Ring**
18. **Spring**
19. **Filter**
20. **Retaining Ring**
21. **Valve**
22. **O-ring**

    Be sure to discard used parts, and always used new parts for installation.
23. **Connector**

Connector Torque	N•m (kg•m/lb•ft)
	54 (5.5 / 40)

24. **O-ring**

    Be sure to discard used parts, and always used new parts for installation.

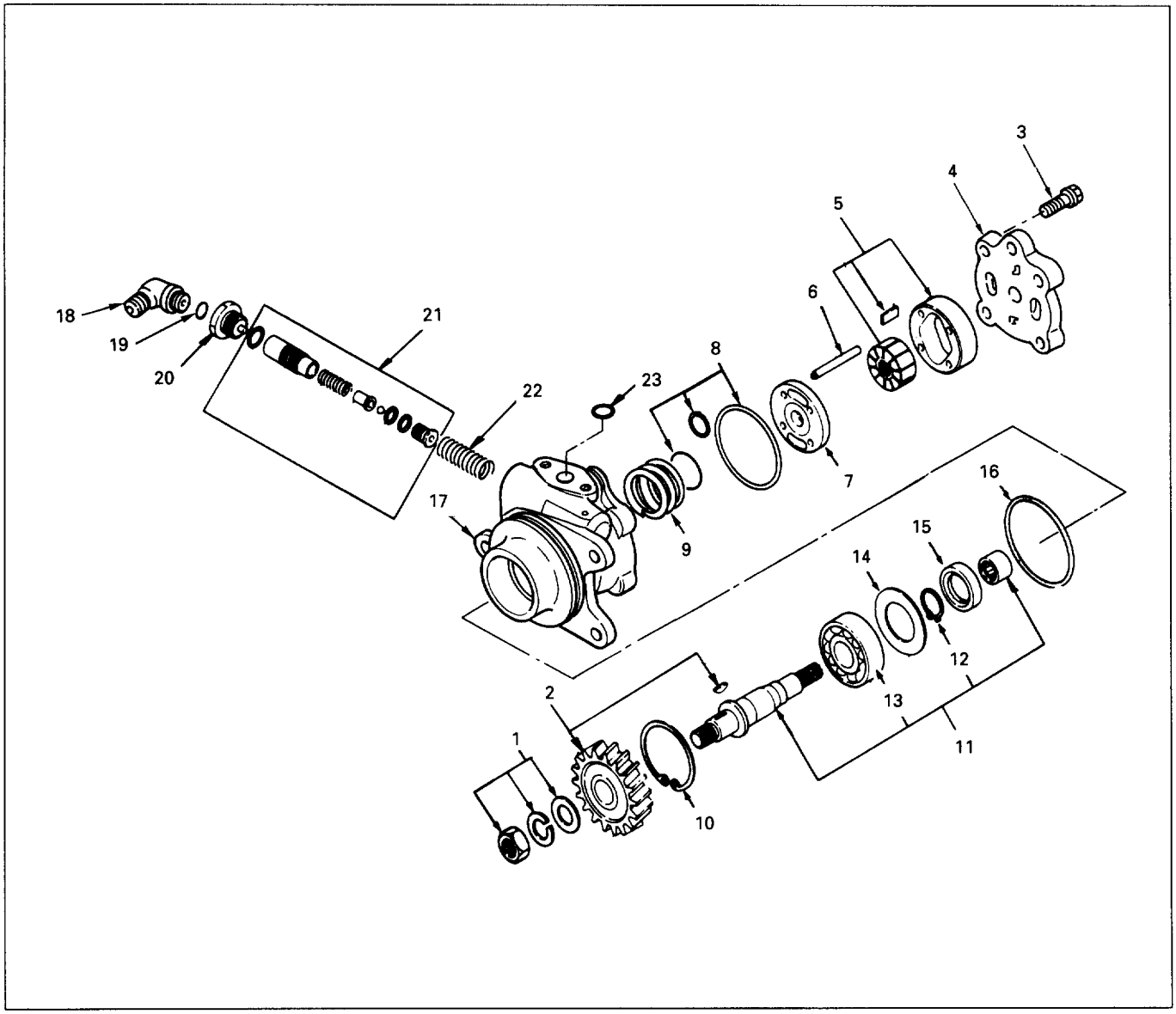
25. **Pipe, Suction**

26. **Bolt**

Suction Pipe Bolt Torque	N•m (kg•m/lb•ft)
	21 (2.1 / 15)

DISASSEMBLY

4B Series Engine

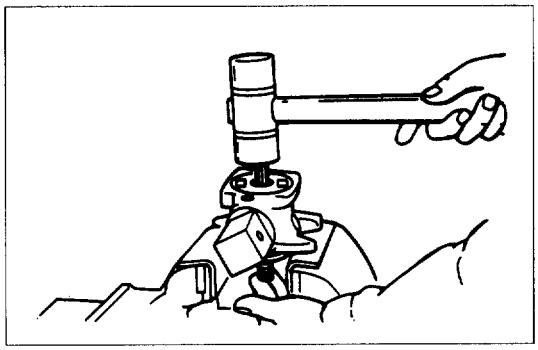


Disassembly Steps

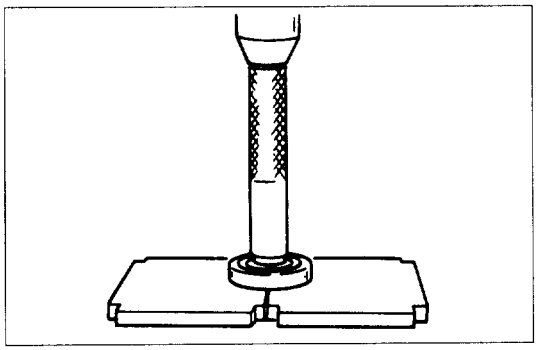
1. Nut and washers
2. Gear and key
3. Bolt
4. Cover
5. Cartridge assembly
6. Straight pin
7. Side plate
8. O-ring
9. Spring
10. Snap ring
11. Shaft with bushing, snap ring and bearing
12. Snap ring
13. Bearing
14. Retaining ring
15. Oil seal
16. O-ring
17. Body
18. Elbow
19. O-ring
20. Connector
21. Valve assembly and O-ring
22. Spring
23. O-ring

Disassembly Steps

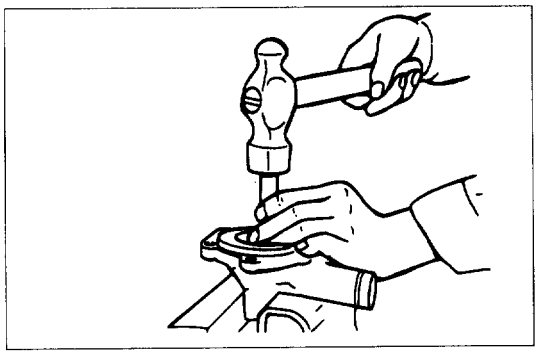
1. **Nut and Washers**
2. **Gear and Key**
3. **Bolt**
4. **Rear Cover**
5. **Cartridge Assembly**
6. **Straight Pin**
7. **Side Plate**
8. **O-ring**
9. **Spring**
10. **Snap Ring**
11. **Shaft with Bushing, Snap Ring and Bearing**
    Use a mallet for removal.



12. **Snap Ring**
13. **Bearing**
    Using a bench press and a suitable rod.



14. **Retaining Ring**
15. **Oil Seal**
    Using a adequate remover.

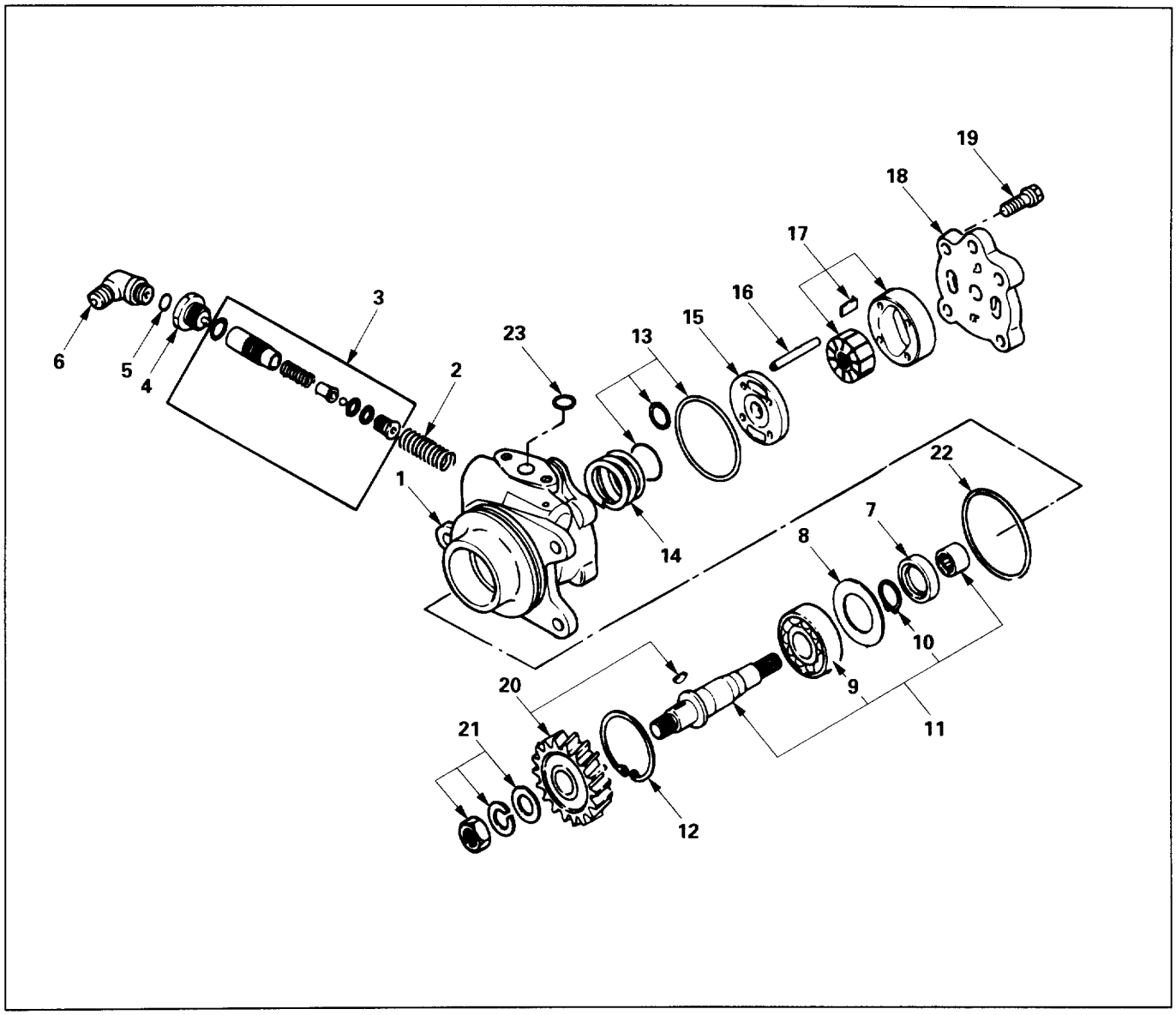


16. O-ring
17. Body
18. Elbow
19. O-ring
20. Connector
21. Valve Assembly and O-ring
22. Spring
23. O-ring

INSPECTION AND REPAIR

Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.

REASSEMBLY



442LY00003

Reassembly Steps

1. Rear body
2. Spring
3. Valve assembly
4. Connector
5. O-ring
6. Elbow
7. Oil seal
8. Retaining ring
9. Bearing
10. Snap ring
11. Shaft with bushing, retaining ring, Snap ring, Oil seal and bearing
12. Snap ring
13. O-ring
14. Spring
15. Side plate
16. Straight pin
17. Cartridge assembly
18. Rear cover
19. Bolt
20. Gear and key
21. Nut and washers
22. O-ring
23. O-ring

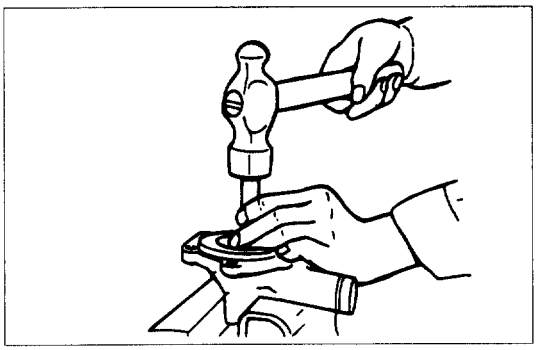
Reassembly Steps

1. **Body**
2. **Spring**
3. **Valve Assembly**
4. **Connector**

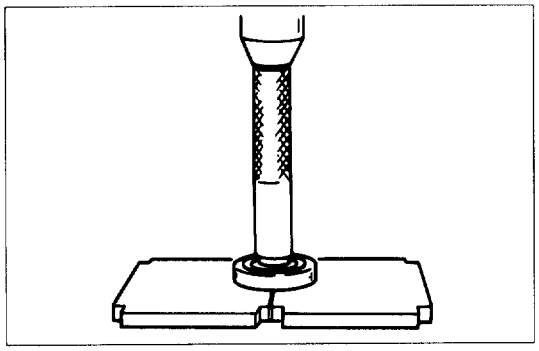
Connector Torque	N•m (kg•m/lb•ft)
	62 (6.3 / 46)

5. **O-ring**
6. **Elbow**

Elbow Torque	N•m (kg•m/lb•ft)
	32 (3.3 / 24)



7. **Oil Seal**
   Use a hammer and bar to install the oil seal.



8. **Retaining Ring**
9. **Bearing**
   Use a bench press to install the ball bearing.
10. **Snap Ring**
11. **Shaft with Bushing, Retaining Ring, Snap Ring, Oil Seal and Bearing**
12. **Snap Ring**
13. **O-ring**
14. **Spring**
15. **Side Plate**
16. **Straight Pin**
17. **Cartridge Assembly**
18. **Rear Cover**
19. **Bolt**

Bolt Torque	N•m (kg•m/lb•ft)
	34 (3.5 / 25)

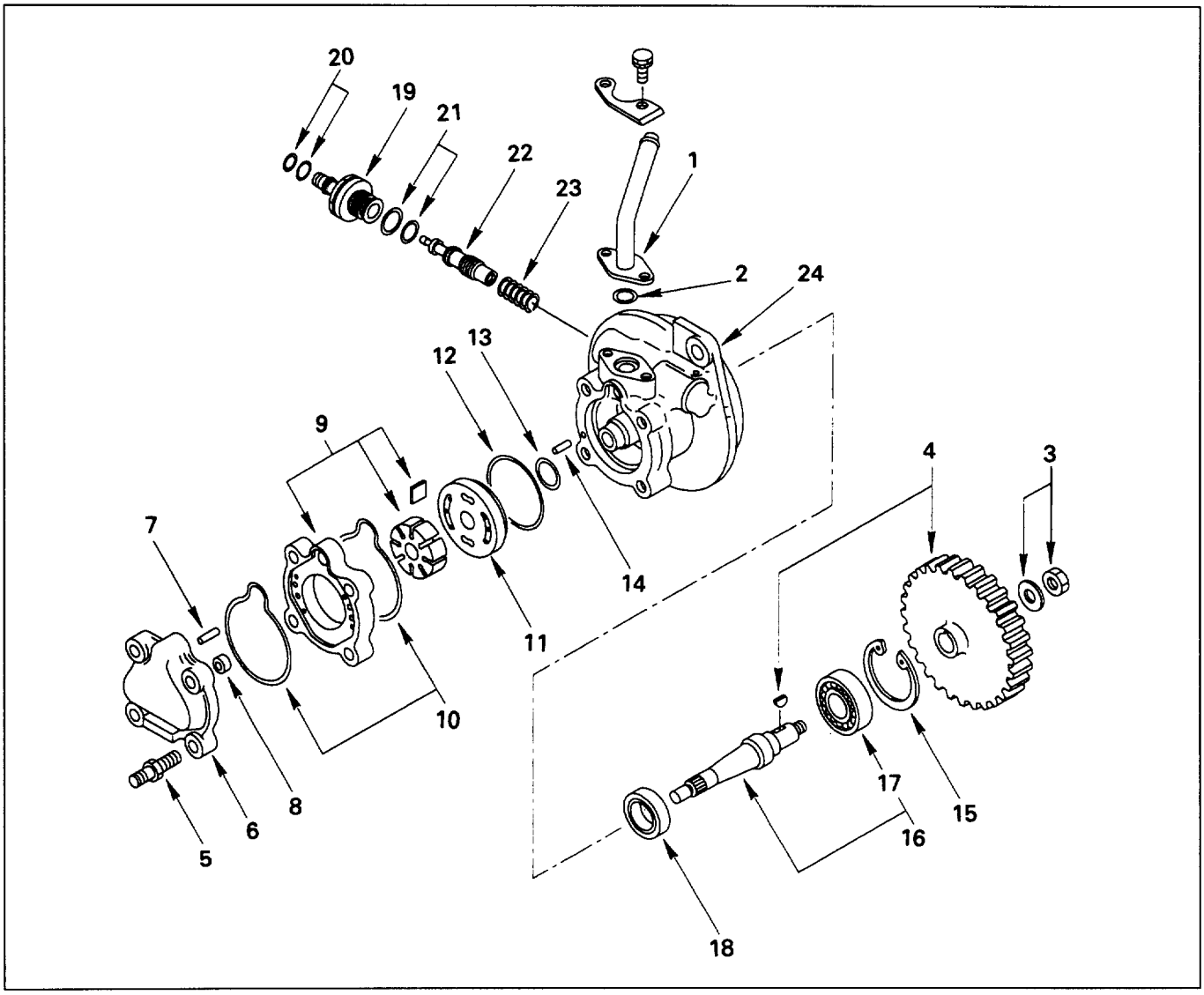
20. **Gear and Key**
21. **Nut and Washers**

Oil Pump Gear Nut Torque	N•m (kg•m/lb•ft)
	88 (9 / 65)

22. **O-ring**
23. **O-ring**

DISASSEMBLY

4HF1 Engine

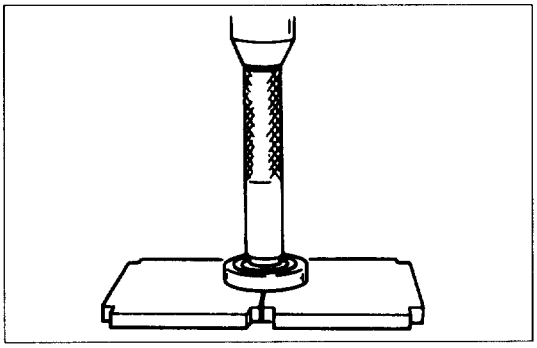


Disassembly Steps

1. Suction pipe
2. O-ring
3. Nut and washer
4. Gear and key
5. Bolt
6. Rear cover
7. Pin
8. Bushing
9. Cartridge assembly
10. O-ring
11. Side plate
12. O-ring
13. O-ring
14. Pin
15. Snap ring
16. Shaft assembly
17. Bearing
18. Oil seal
19. Connector
20. O-ring
21. O-ring
22. Valve assembly
23. Spring
24. Body

Disassembly Steps

1. **Suction Pipe**
2. **O-ring**
3. **Nut and Washer**
4. **Gear and Key**
5. **Bolt**
6. **Rear Cover**
7. **Pin**
8. **Bushing**
9. **Cartridge Assembly**
10. **O-ring**
11. **Side Plate**
12. **O-ring**
13. **O-ring**
14. **Pin**
15. **Snap Ring**
16. **Shaft Assembly**
17. **Bearing**



Using a bench press and a suitable remover.

18. **Oil Seal**

CAUTION:

When removing the oil seal, be careful not to damage the housing.

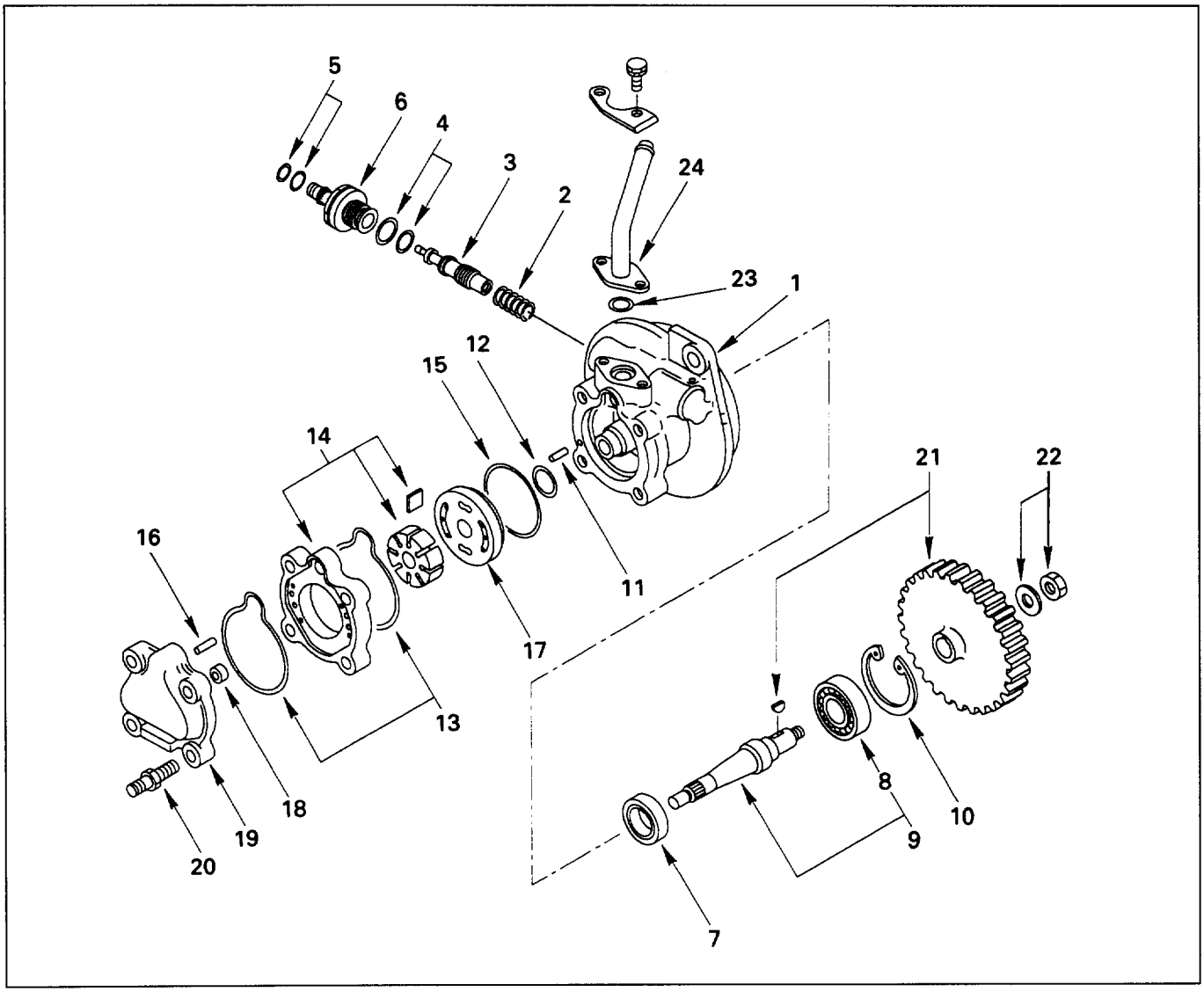
19. **Connector**
20. **O-ring**
21. **O-ring**
22. **Valve Assembly**
23. **Spring**
24. **Body**

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.

REASSEMBLY

4HF1 Engine



Reassembly Steps

1. Body
2. Spring
3. Valve assembly
4. O-ring
5. O-ring
6. Connector
7. Oil seal
8. Bearing
9. Shaft assembly
10. Snap ring
11. Pin
12. O-ring
13. O-ring
14. Cartridge assembly
15. O-ring
16. Pin
17. Side plate
18. Bushing
19. Rear cover
20. Bolt
21. Gear and key
22. Nut and washer
23. O-ring
24. Suction pipe

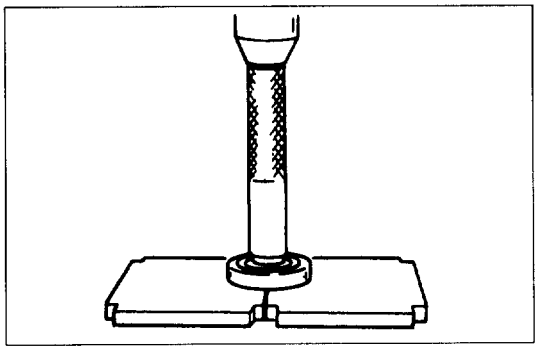
Reassembly Steps

1. **Body**
2. **Spring**
3. **Valve Assembly**
4. **O-ring**
5. **O-ring**
6. **Connector**

Connector Torque	N•m (kg•m/lb•ft)
	49 (5 / 36)

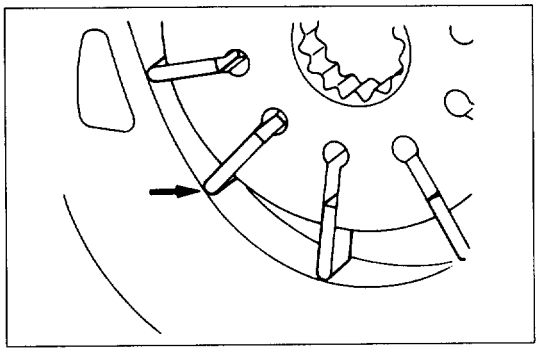
7. **Oil Seal**
8. **Bearing**

Use a bench press and suitable installer to install the bearing.



9. **Shaft Assembly**
10. **Snap Ring**
11. **Pin**
12. **O-ring**
13. **O-ring**
14. **Cartridge Assembly**

Install the vane with curved face in contact with the inner wall of the cam.



15. **O-ring**
16. **Pin**
17. **Side Plate**
18. **Bushing**
19. **Rear Cover**
20. **Bolt**

Rear Cover Bolt Torque	N•m (kg•m/lb•ft)
	20 (2 / 14)

21. **Gear and Key**
22. **Nut and Washer**

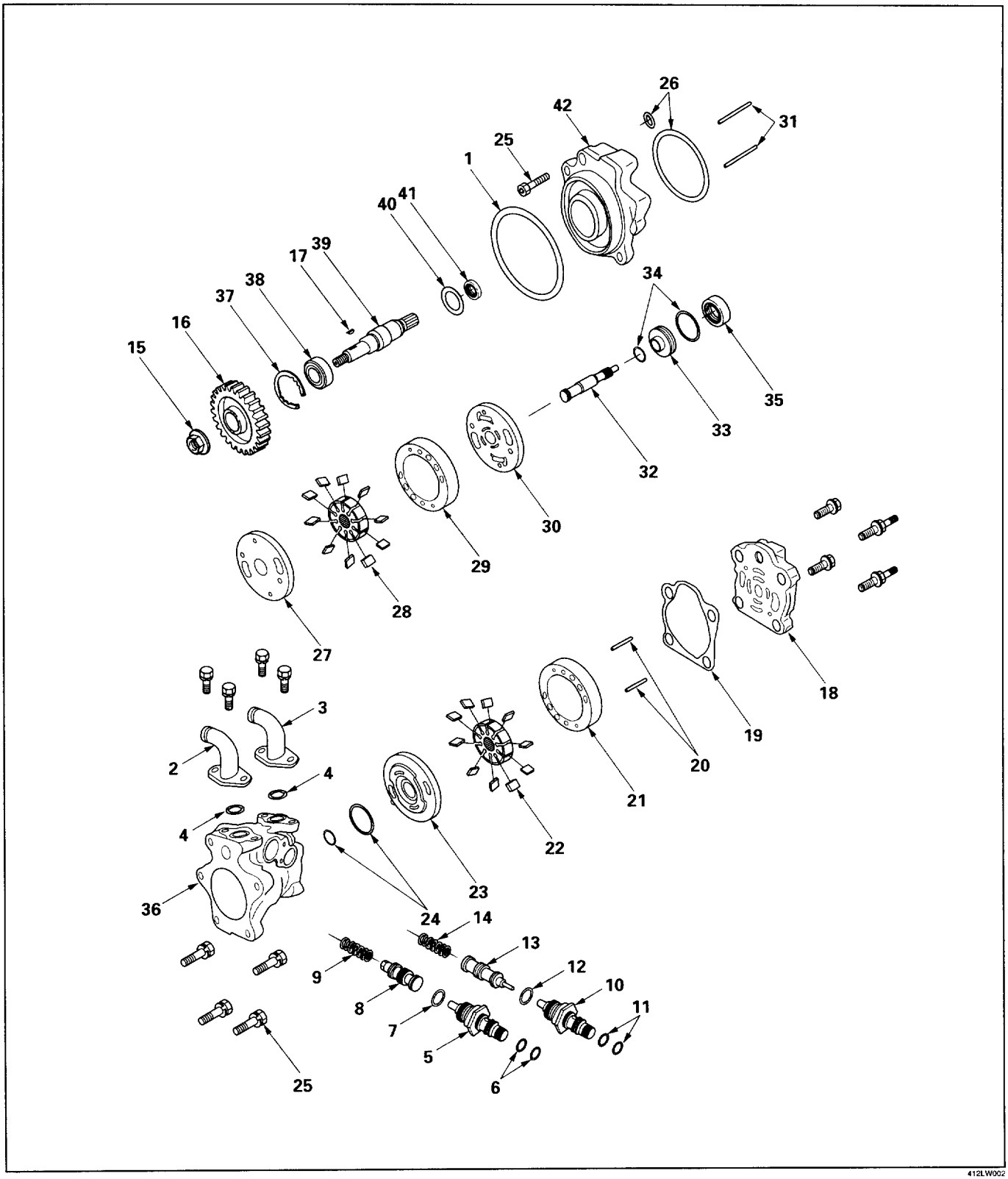
Oil Pump Gear Nut Torque	N•m (kg•m/lb•ft)
	59 (6 / 43)

23. **O-ring**
24. **Suction Pipe**

Suction Pipe Bolt Torque	N•m (kg•m/lb•in)
	8 (0.8 / 69)

TANDEM HYDRAULIC PUMP

DISASSEMBLY



412LW002

Disassembly Steps

1. O-ring
2. Hose Connector: HBB
3. Hose Connector: PS
4. O-ring
5. Connector: HBB
6. O-ring
7. O-ring
8. Valve
9. Spring
10. Connector: P/S
11. O-ring
12. O-ring
13. Valve
14. Spring
15. Nut
16. Gear
17. Key
18. Rear Body
19. Gasket
20. Pin
21. Cam
22. Rotor ad Vane: P/S
23. Pressure Plate
24. O-ring
25. Bolt
26. O-ring
27. Side Plate
28. Rotor and Vane: HBB
29. Cam
30. Pressure Plate
31. Pin
32. Shaft
33. Retainer
34. O-ring
35. Oil Seal
36. Pump Housing
37. Snap Ring
38. Ball Bearing
39. Shaft
40. Retainer Ring
41. Oil Seal
42. Front Body

P/S: Power Steering
HBB: Hydraulic Booster Brake

Disassembly Steps

1. **O-ring**
2. **Hose Connectors: HBB**
3. **Hose Connector: P/S**
4. **O-rings**
5. **Connector: HBB**
6. **O-ring**
7. **O-ring**
8. **Valve**
9. **Spring**
10. **Connector: P/S**
11. **O-ring**
12. **O-ring**
13. **Valve**
14. **Spring**
15. **Nut**
16. **Gear**
17. **Key**
18. **Rear Body**
19. **Gasket**
20. **Pin**
21. **Cam**
22. **Rotor and Vane: P/S**
23. **Pressure Plate**
24. **O-ring**
25. **Bolt**

26. **O-ring**
27. **Side Plate**
28. **Rotor and Vane: HBB**
29. **Cam**
30. **Pressure Plate**
31. **Pin**
32. **Shaft**
33. **Retainer**
34. **O-rings**
35. **Oil Seal**
36. **Pump Housing**
    - Use a brass drift to remove the oil seal from the pump housing.
37. **Snap Ring**
    - Use a mallet to remove the shaft assembly from the front body.
38. **Ball Bearing**
39. **Shaft**
    - A press and rod will be necessary to remove the ball bearing from the shaft.
40. **Retainer Ring**
41. **Oil Seal**
42. **Front Body**
    - Use a brass drift to remove the oil seal from the front body.

Clean

- All parts in a suitable solvent and blow dry with compressed air. Be sure to use clean solvent to clean internal parts.

INSPECTION

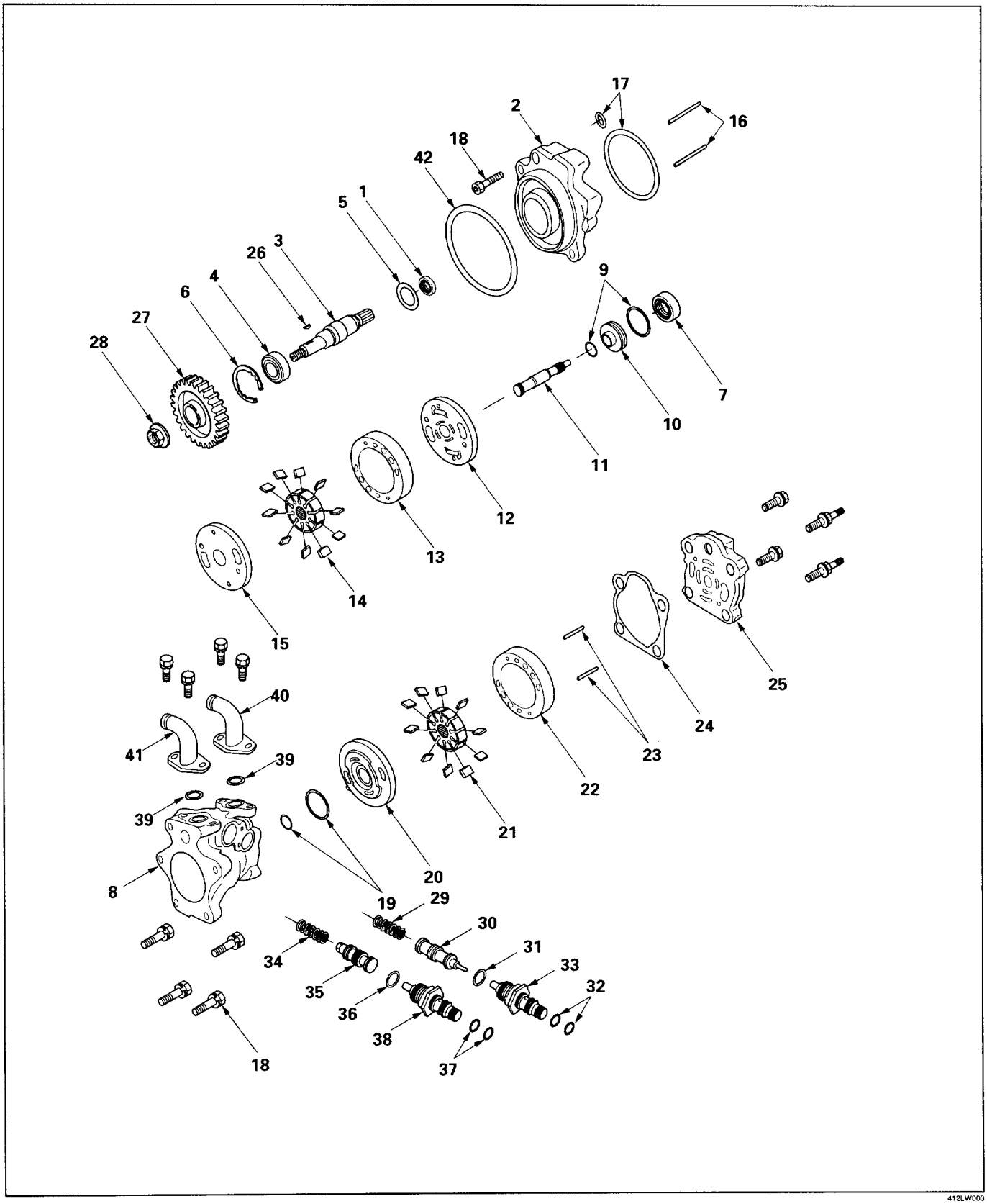
- Cartridge assembly
  - — Vane tips of cartridge assembly for wear.
  - — Vanes for scoring or wear.
  - — Inner surface of the ring for scoring, wear, damage, etc.
  - — Fit of the vanes in the rotor. The vanes must fit properly in the rotor slots, without sticking or excessive play. Also check for burrs in the rotor slots, and excessive wear at the thrust faces.
  - — If heavy wear is present, or if parts are damaged, replace the entire cartridge assembly.
- Side place for wear at the thrust faces.

Replace if excessive wear is evident.

- Ball bearing. If the bearing is rough or loose, replace it.
- Seal contact area of the shaft. If fretting or roughness is present, replace the shaft.
- Gear for rough or chipped teeth.
- Flow control valve assembly for scoring or burrs. Also, inspect the flow control valve bore in the pump housing for burrs.

If heavy damage is present, replace pump housing assembly together with valves.

REASSEMBLY

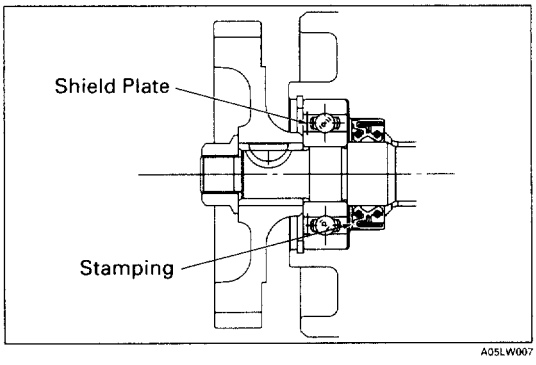


412LW003

Reassembly Steps

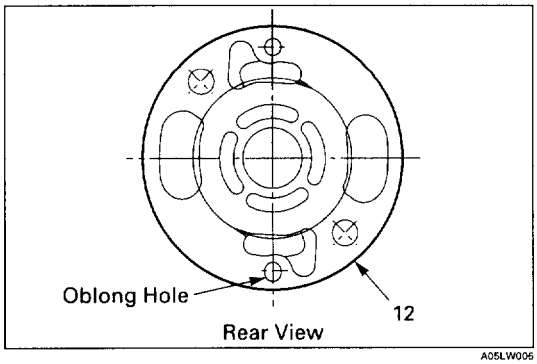
1. Oil Seal
2. Front Body
3. Shaft
4. Ball Bearing
5. Retaining Ring
6. Snap Ring
7. Oil Seal
8. Pump Housing
9. O-ring
10. Retainer
11. Shaft
12. Pressure Plate
13. Cam
14. Rotor and Vane: HBB
15. Side Plate
16. Pin
17. O-ring
18. Bolt
19. O-ring
20. Pressure Plate
21. Rotor and Vane: P/S
22. Cam
23. Pin
24. Gasket
25. Rear Body
26. Key
27. Gear
28. Nut
29. Spring
30. Valve
31. O-ring
32. O-ring
33. Connector: P/S
34. Spring
35. Valve
36. O-ring
37. O-ring
38. Connector: HBB
39. O-ring
40. Hose Connector: P/S
41. Hose Connector: HBB
42. O-ring

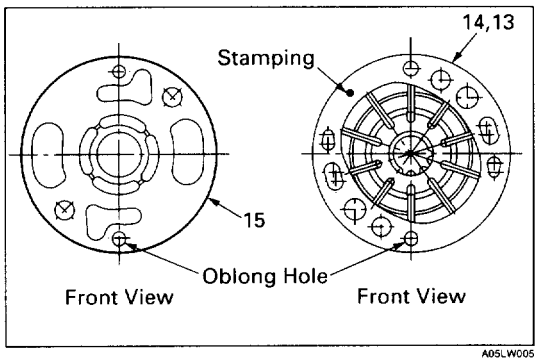
P/S: Power Steering
HBB: Hydraulic Booster Brake

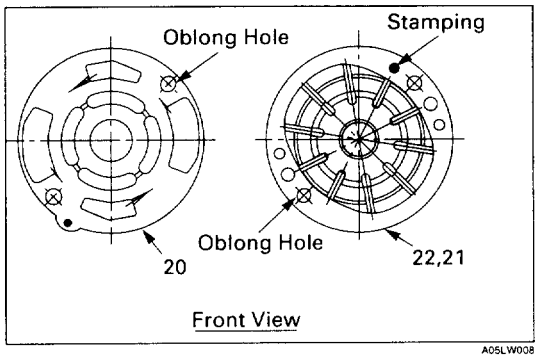


Reassembly Steps

1. **Oil Seal**
2. **Front Body**
   - Oil seal into the front body using a proper size rod and press or hammer.
3. **Shaft**
4. **Ball Bearing**
   - Press the shaft, into the ball bearing as illustration.
5. **Retaining Ring**
   - Place the retaining ring in the front body and install the shaft assembly into the front body using a press or hammer.
6. **Snap Ring**
   - Snap ring into front body.
7. **Oil Seal**
8. **Pump Housing**
   - Oil seal into pump housing using a proper size rod and press or hammer.
9. **O-ring**
10. **Retainer**
11. **Shaft**







12. **Pressure Plate**
13. **Cam**
14. **Rotor and Vane: HBB**
15. **Side Plate**
16. **Pin**
    - Set pressure plate, cam, rotor and vane, side plate, and pins into pump housing as illustration.
17. **O-ring**
18. **Bolt**
    - Attach O-rings into front body grooves and assemble front body and pump housing by tightening bolts.

Bolt and Nut Torque	N•m (kg•m/lb•ft)
4 (four) bolts	54 (5.5 / 40)
1 (one) bolt	25 (2.5 / 18)

19. **O-ring**
20. **Pressure Plate**
21. **Rotor and Vane: P/S**
22. **Cam**
23. **Pin**
    - Set pressure plate, rotor and vane, cam and pins into pump housing as illustration.
24. **Gasket**
25. **Rear Body**

Bolt and Nut Torque	N•m (kg•m/lb•ft)
34 (3.5 / 25)	

26. **Key**
27. **Gear**
28. **Nut**
    - Key, gear and nut onto shaft.
    - The long hub of the gear faces front body..

Bolt and Nut Torque	N•m (kg•m/lb•ft)
103 (10.5 / 76)	

29. **Spring**
30. **Valve**
31. **O-ring**
32. **O-ring**
33. **Connector: P/S**
    - Spring, valve, O-ring, O-rings and connector into pump housing.

Bolt and Nut Torque	N•m (kg•m/lb•ft)
54 (5.5 / 40)	

34. **Spring**
35. **Valve**
36. **O-ring**
37. **O-ring**
38. **Connector: HBB**
    - Spring, valve O-ring, O-rings and connectors into pump housing.

Bolt and Nut Torque	N•m (kg•m/lb•ft)
54 (5.5 / 40)	

39. **O-ring**
40. **Hose Connector: P/S**
41. **Hose Connector: HBB**

Bolt and Nut Torque	N•m (kg•m/lb•ft)
21 (2.1 / 15)	

42. **O-ring**

SECTION 3B2
MANUAL STEERING

CONTENTS

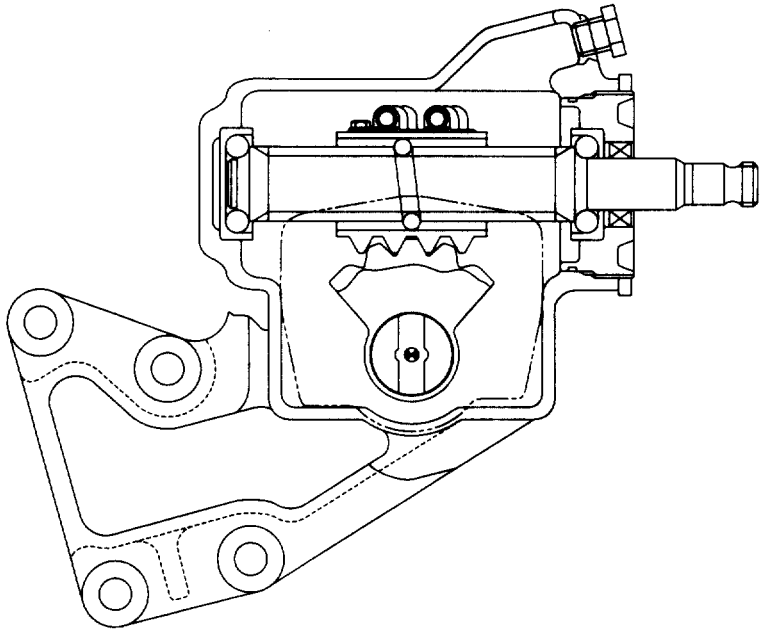
PAGE

General Description 3B2- 2
On-Vehicle Service 3B2- 3
Manual Steering Unit Replacement 3B2- 3
Unit Repair 3B2- 7
Manual Steering Unit (NHR, NKR) 3B2- 7
Manual Steering Unit (NPR, NQR) 3B2-14

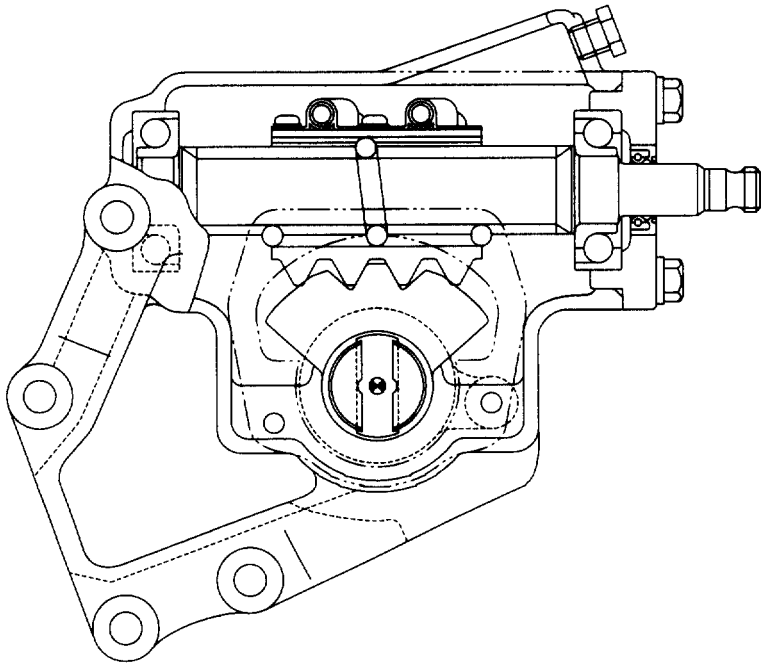
GENERAL DESCRIPTION

Manual Steering Unit

NHR, NKR

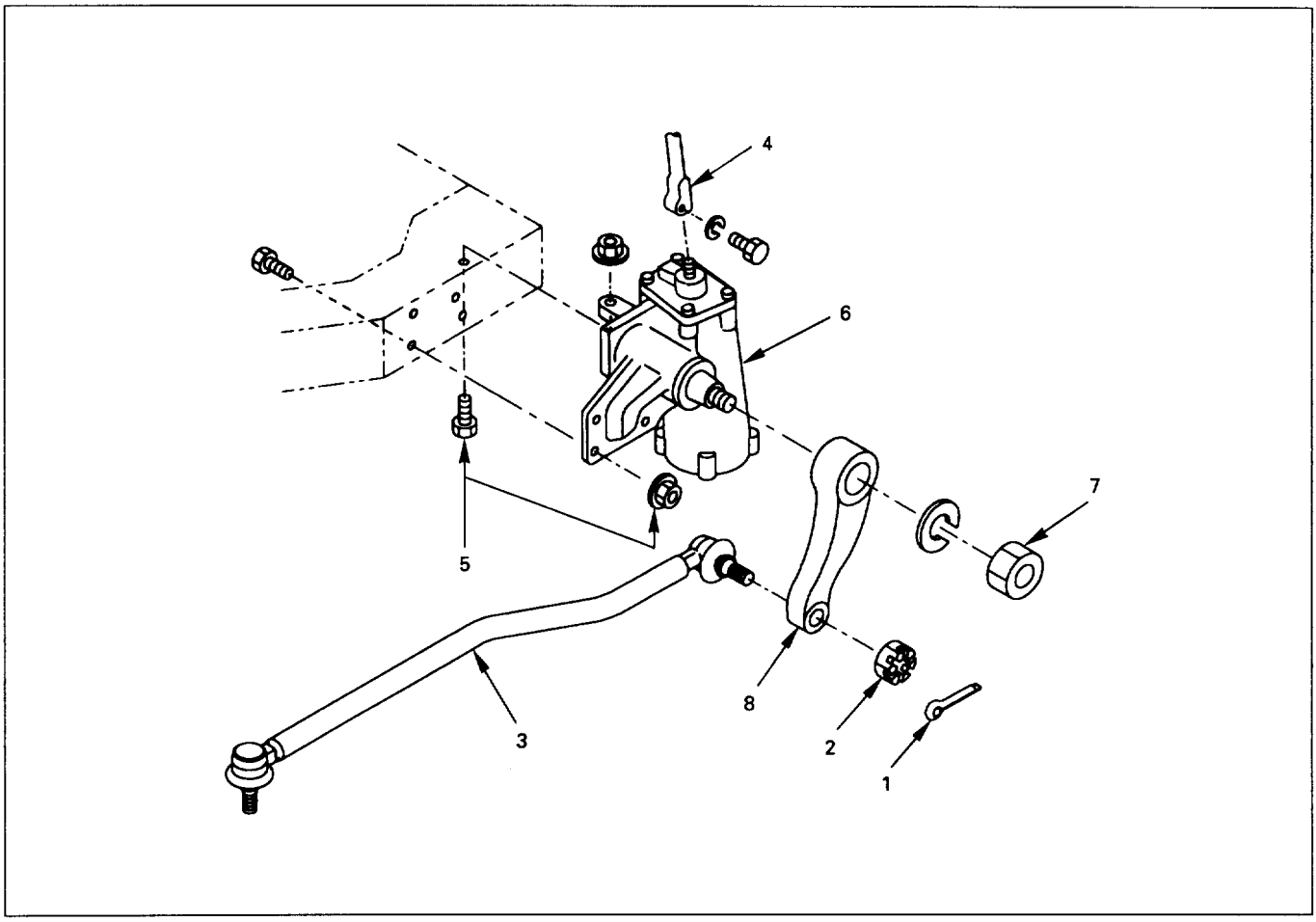


NPR, NQR



ON-VEHICLE SERVICE

MANUAL STEERING UNIT REPLACEMENT



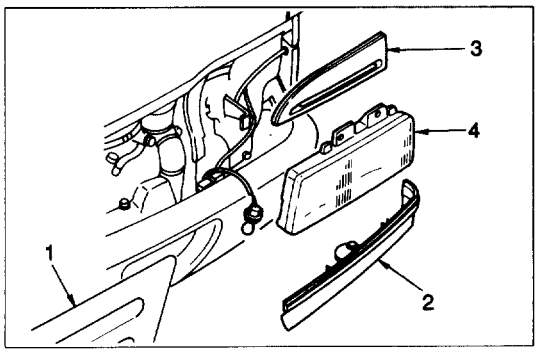
Removal Steps

1. Cotter pin
2. Nut
3. Drag link
4. Universal joint
5. Unit fixing nut and bolt
6. Steering unit
7. Pitman arm fixing nut
8. Pitman arm

Installation Steps

8. Pitman arm
7. Pitman arm fixing nut
6. Steering unit
5. Unit fixing nut and bolt
4. Universal joint
3. Drag link
2. Nut
1. Cotter pin

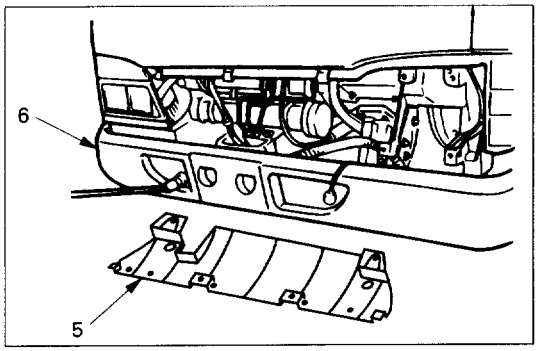
Removal



Preparation (for Non-Tilt Cab Model)

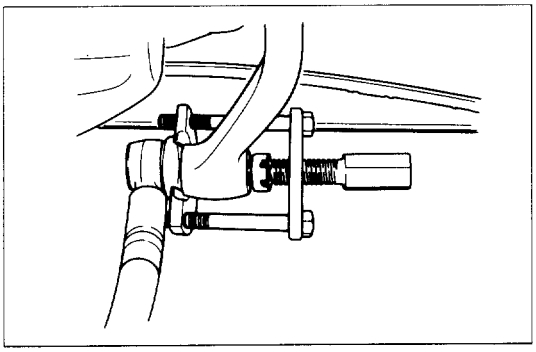
1) Remove the radiator grill.
2) Remove the head lamp grill. (driver side only)
3) Remove the head lamp ornament. (driver side only)
4) Remove the head lamp assembly. (driver side only)

   Be careful not to remove adjust screw.



601LY00001

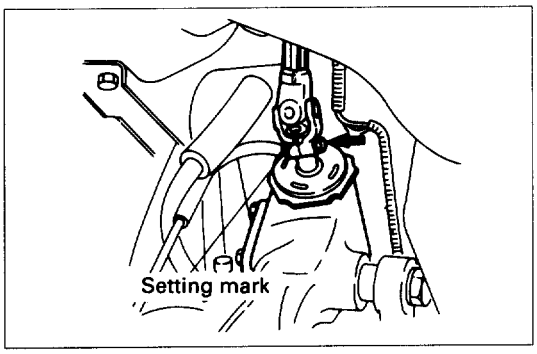
5) Remove the under panel.
6) Remove the front bumper assembly.



1. **Cotter Pin**
2. **Nut**
3. **Drag Link**

   Disconnect the drag link at the knuckle arm and the pitman arm.

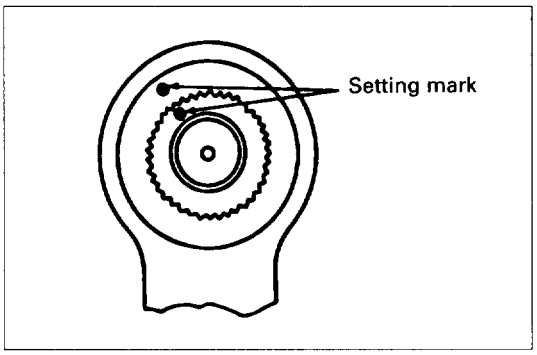
   Remover: 5-8840-2017-0



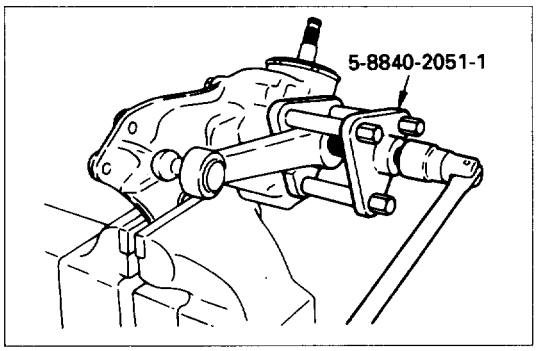
4. **Universal Joint**

   Apply a setting mark across the yoke and worm shaft in unit to ensure reassembly of the parts in the original position.

5. **Unit Fixing Nut and Bolt**
6. **Steering Unit**

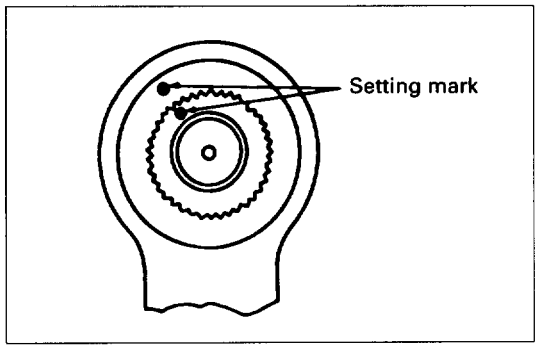


7. **Pitman Arm Fixing Nut**
8. **Pitman Arm**
   1) Apply a setting mark across the pitman arm and worm shaft.



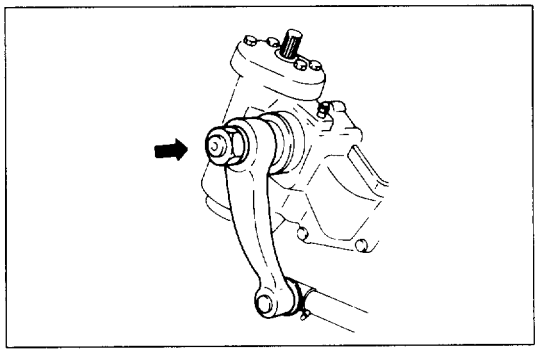
Puller: 5-8840-2051-1

INSTALLATION



8. **Pitman Arm**

   Align the setting mark applied at removal.

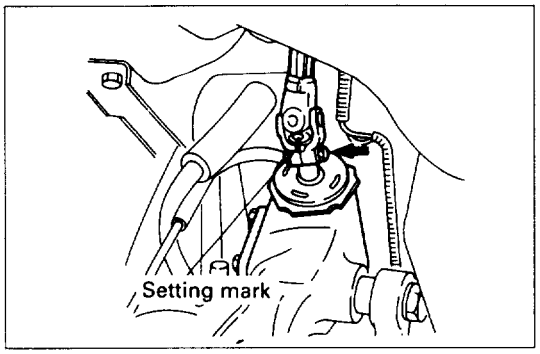


7. **Pitman Arm Fixing Nut**

Nut Torque	N•m (kg•m/lb•ft)
NHR, NKR	216 (22 / 159)
NPR, NQR	294 (30 / 217)

6. **Steering Unit**
5. **Unit Fixing Nut and Bolt**

Torque	N•m (kg•m/lb•ft)
103 (10.5 / 76)	



4. Universal Joint

Install the parts by aligning setting marks applied at removal.

Universal Joint Bolt Torque	N•m (kg•m/lb•ft)
M8 Bolt	25 (2.5 / 18)
M10 Bolt	39 (4.0 / 29)

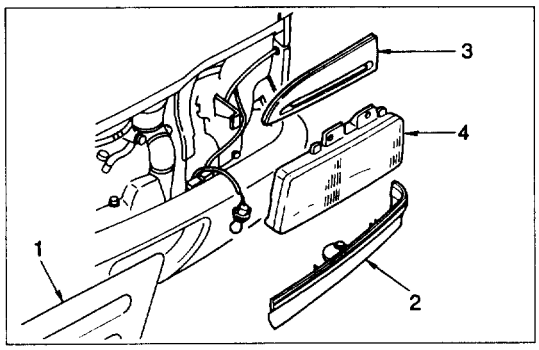
3. Drag Link

2. Nut

1. Cotter Pin

1) Install the drag link to the pitman arm and the knuckle arm.
2) Tighten nuts to specified torque, with just enough additional torque to align cotter pin holes.
   Install new cotter pin.

Nut Torque	N•m (kg•m/lb•ft)
167 (17 / 123)	

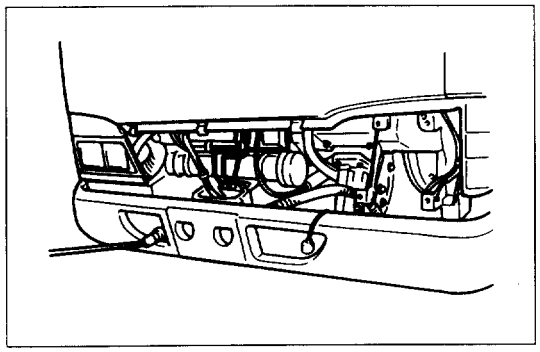


for Non-Tilt Cab Model

1) Install the bumper assembly.

Bumper Bolt Torque	N•m (kg•m/lb•ft)
40 (4.1 / 30)	

2) Install the under panel.



3) Install the head light assembly, ornament and grill.
4) Install the radiator grill.

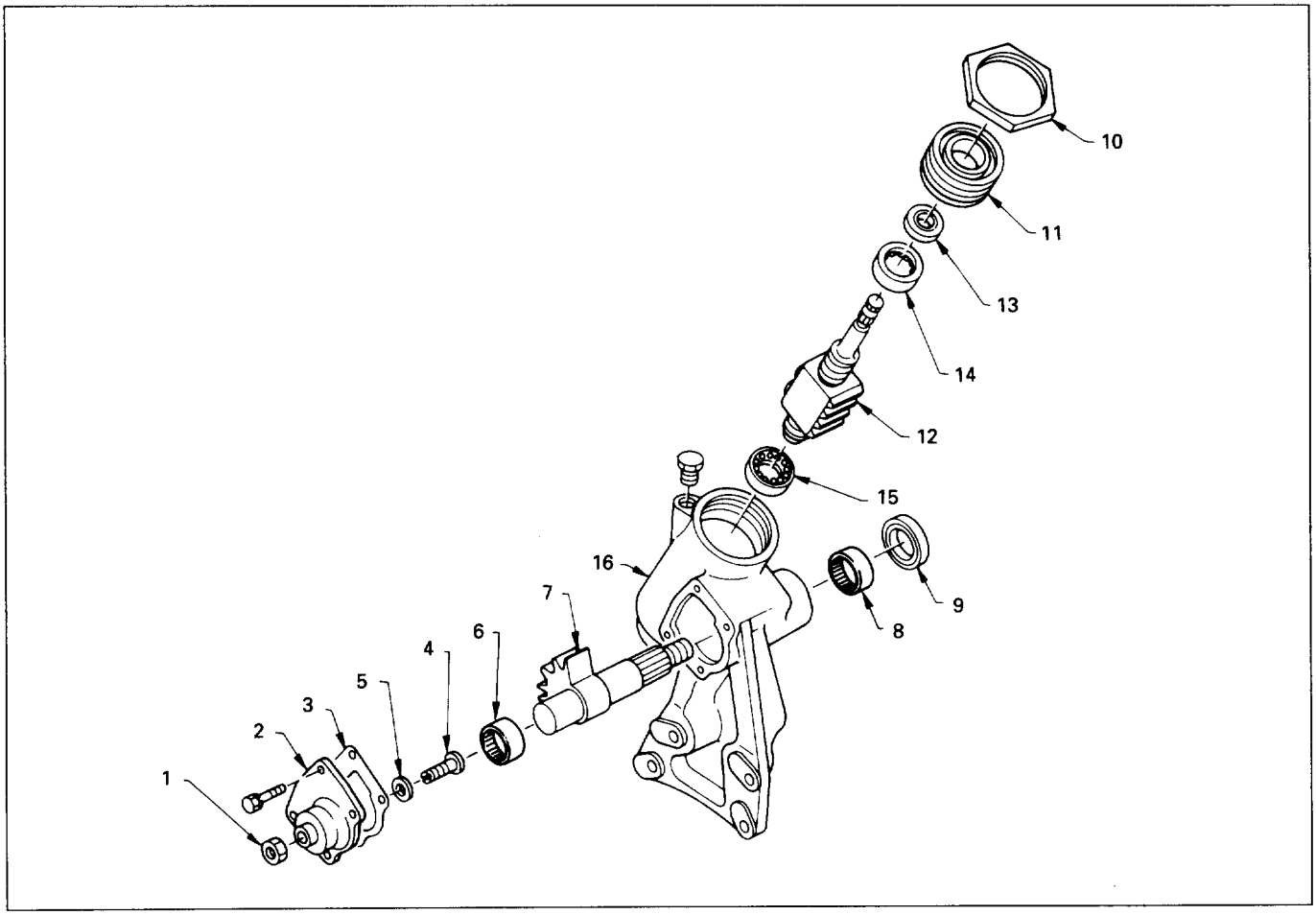
NOTE:

After installation, adjust head light aiming. Refer to "Chassis Electrical" in Section 8.

UNIT REPAIR

MANUAL STEERING UNIT (NHR, NKR)

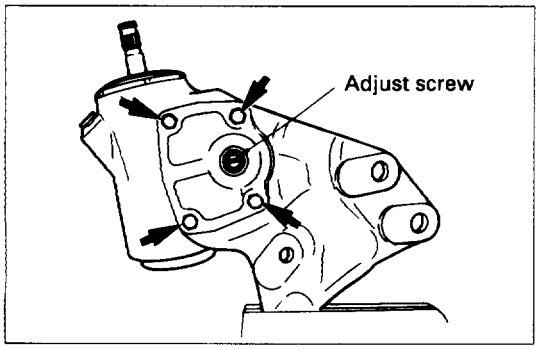
DISASSEMBLY



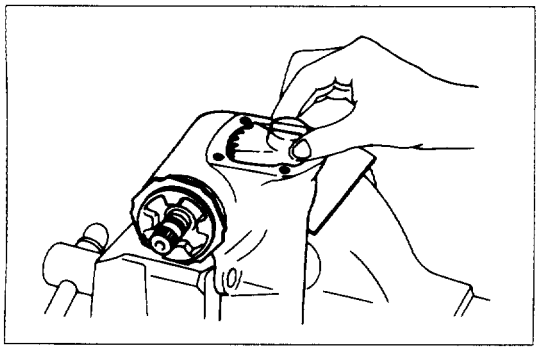
Disassembly Steps

1. Lock nut
2. Side cover
3. Gasket
4. Adjust screw
5. Adjust shim
6. Needle bearing
7. Sector shaft
8. Needle bearing
9. Oil seal
10. Lock nut
11. End cover
12. Ball nut and worm shaft
13. Oil seal
14. Bearing
15. Bearing
16. Gear box

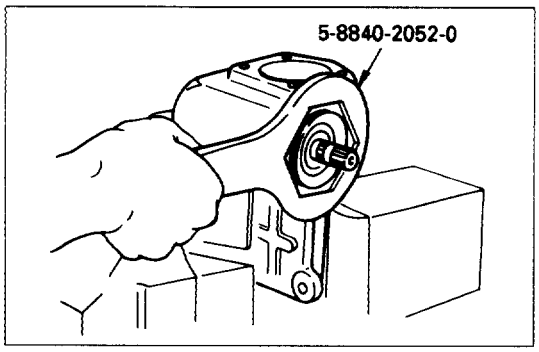
Disassembly Steps



1. **Lock Nut**
2. **Side Cover**
   1) Turn the adjust screw counter-clockwise slightly, then remove the side cover fixing bolt. (Arrowed in the left figure.)
   2) Turn the adjust screw clockwise with the side cover held from turning.

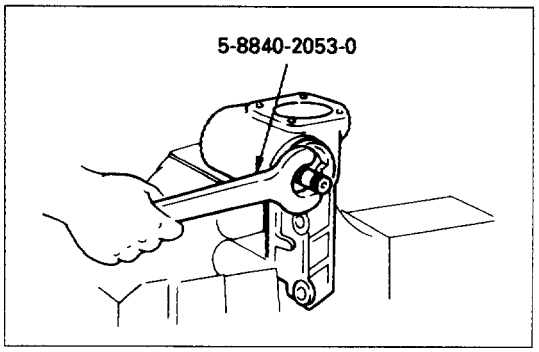


3. **Gasket**
4. **Adjust Screw**
5. **Adjust Shim**
6. **Needle Bearing**
7. **Sector Shaft**
   When removing, use care so as not to cause damage to the serrations, threads and oil seal.

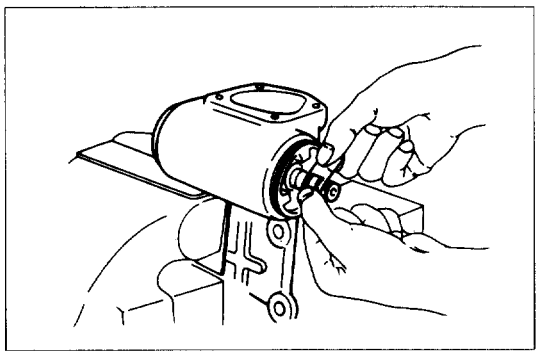


8. **Needle Bearing**
9. **Oil Seal**
10. **Lock Nut**

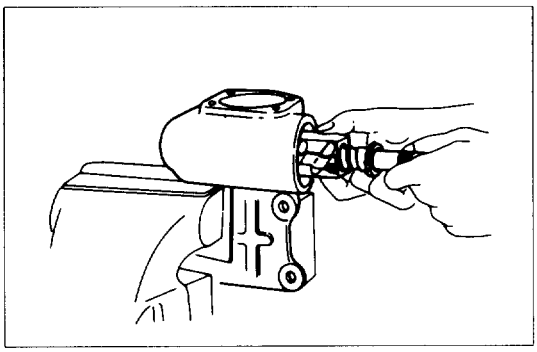
Steering Lock Nut Wrench : 5-8840-2052-0



11. **End Cover**
    1) Wrench : 5-8840-2053-0



2) When removing, use care so as not to cause damage to the oil seal.
   Taping the splines will provide some protection.



12. Ball Nut and Worm Shaft

Always keep ball nut assembly in a horizontal position and avoid holding it vertically, or ball nut will slide out.

13. Oil Seal
14. Bearing
15. Bearing
16. Gear Box

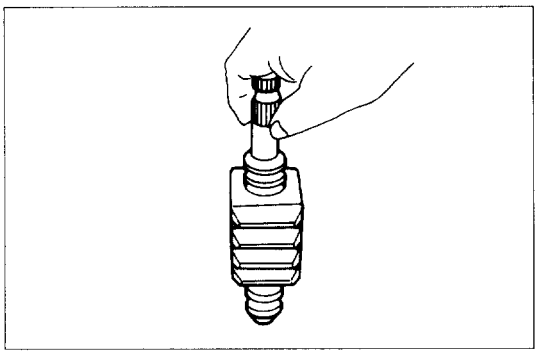
INSPECTION AND REPAIR

Make necessary correction or parts replacement if wear damage, or any other abnormal conditions are found through inspection.

- Bearing
- Sector shaft
- Ball nut and worm shaft

Visual Check

Inspect the following parts for wear damage or other abnormal conditions.

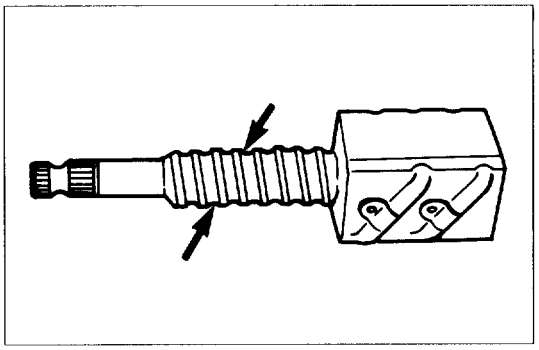


Ball Nut Rotation

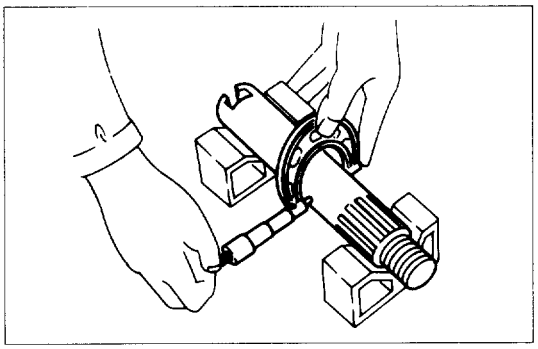
Hold the worm shaft vertically and see if the ball nut lowers with turning motion smoothly. If lowering of the ball nut with its own weight is unsmooth, check the worm shaft for bending and ball-groove for burrs, dents and presence of foreign matter.

NOTE:

When making a test on the ball nut assembly, exercise care so as not to strike ball nut against end of worm shaft, or damage to the ball tubes will result.



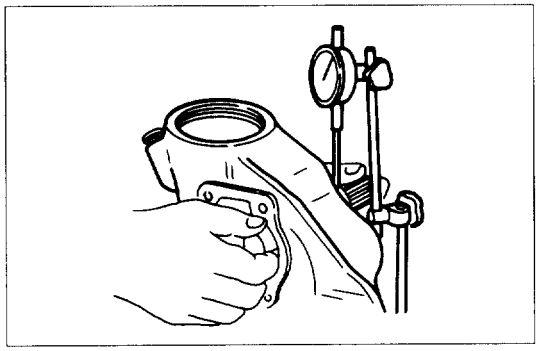
If any of the parts in the ball nut and worm shaft assembly is found to be defective, the entire parts should be replaced using a new worm shaft assembly. As these parts are of selective combination and are sealed to prohibit disassembly, the faulty parts should not be replaced individually.



Sector Shaft Outside Diameter

mm(in.)

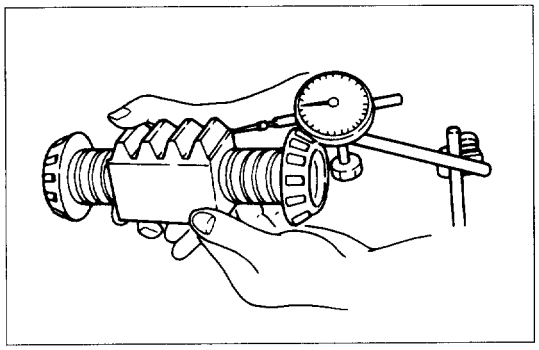
Standard	Limit
34.925 (1.375)	34.825 (1.371)



Sector Shaft and Needle Bearing Play

mm(in.)

Limit
0.2 (0.008)

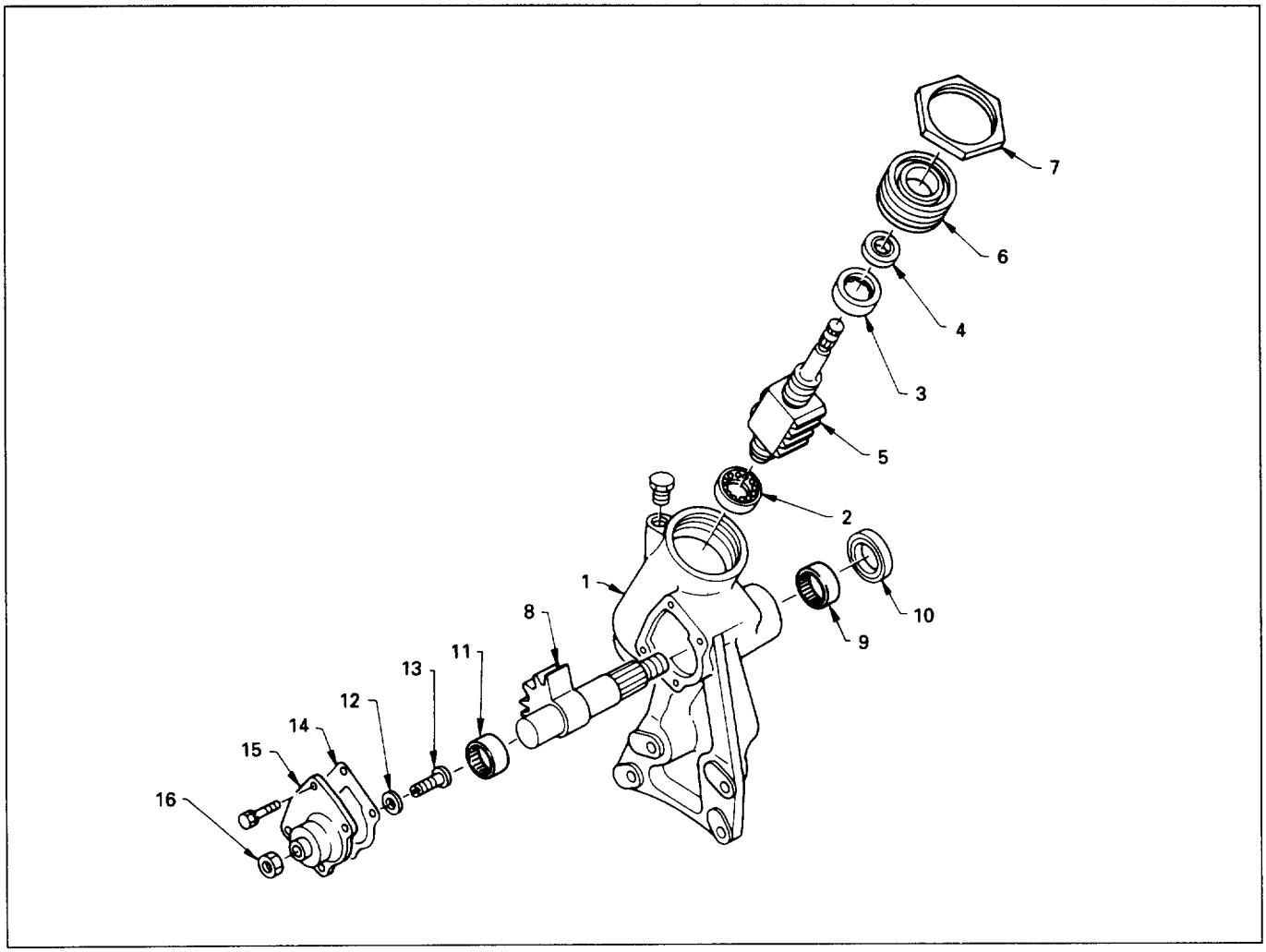


Ball Nut Axial Play

mm(in.)

Limit
0.1 (0.004)

REASSEMBLY

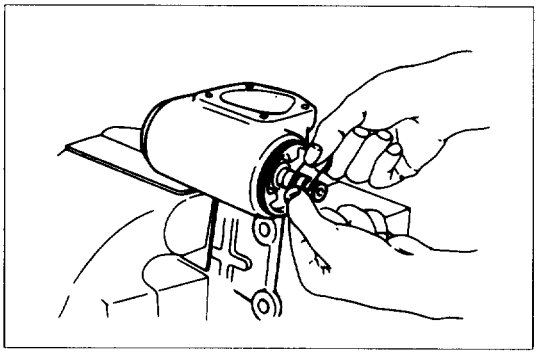


Reassembly Steps

1. Gear box
2. Bearing
3. Bearing
4. Oil seal
5. Ball nut and worm shaft
6. End cover
7. Lock nut
8. Sector shaft
9. Needle bearing
10. Oil seal
11. Needle bearing
12. Adjust shim
13. Adjust screw
14. Gasket
15. Side cover
16. Lock nut

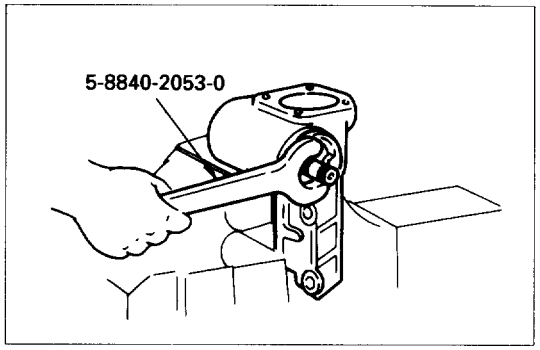
Reassembly Steps

1. **Gear Box**
2. **Bearing**
3. **Bearing**
4. **Oil Seal**
5. **Ball Nut and Worm Shaft**



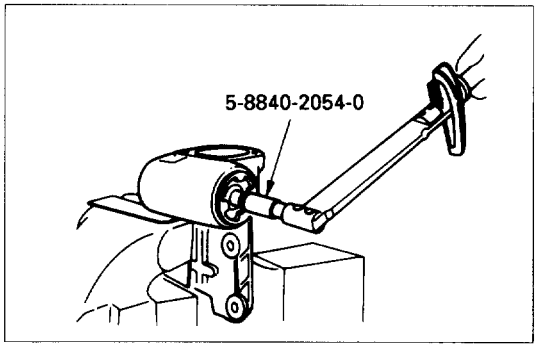
6. End Cover

1) When installing, use care so as not to cause damage to the oil seal.
   Taping the splines will provide some protection.

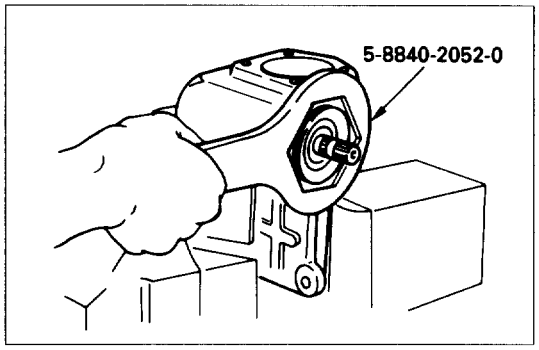


2) Adjust the starting torque of steering input shaft by turning the end cover with a special tool.
   Wrench : 5-8840-2053-0

Starting Torque	N•m (kg•m/lb•ft)
0.34 – 0.64 (0.035 – 0.065 / 0.25 – 0.47)	



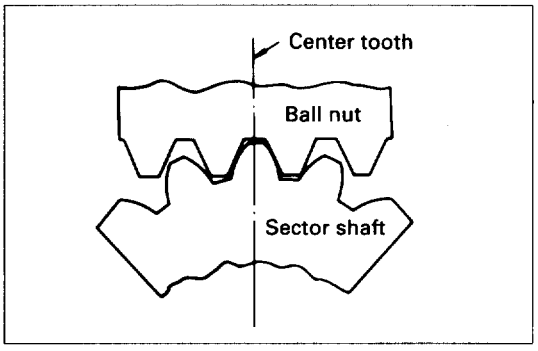
Steering Shaft Driver : 5-8840-2054-0



7. Lock Nut

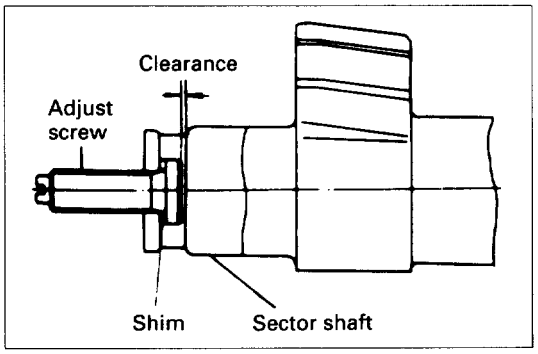
Steering Lock Nut Wrench : 5-8840-2052-0

Lock Nut Torque	N•m (kg•m/lb•ft)
177 (18 / 130)	



8. Sector Shaft

Align the center tooth of ball nut with the center tooth of the sector shaft.

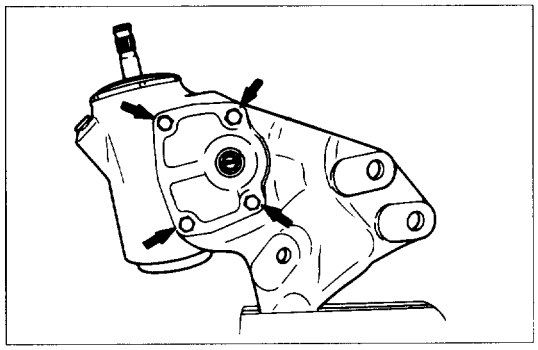


9. **Needle Bearing**
10. **Oil Seal**
11. **Needle Bearing**
12. **Adjust Shim**
13. **Adjust Screw**

Adjust the clearance and check that the adjust screw slides freely.

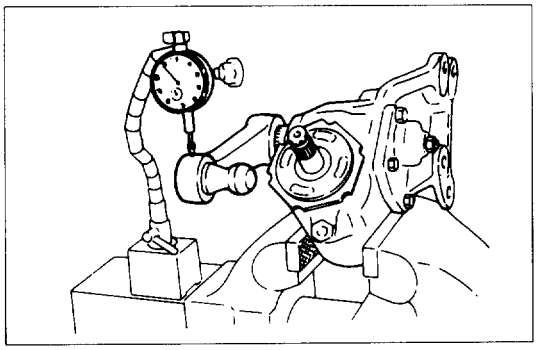
Clearance	mm(in.)
0.1 (0.0039)	

Adjust Shims Available	mm(in.)
1.53 (0.060), 1.56 (0.061), 1.59 (0.063), 1.62 (0.064), 1.65 (0.065)	



14. **Gasket**
15. **Side Cover**

Side Cover Bolt Torque	N•m (kg•m/lb•ft)
44 (4.5 / 33)	



16. **Lock Nut**

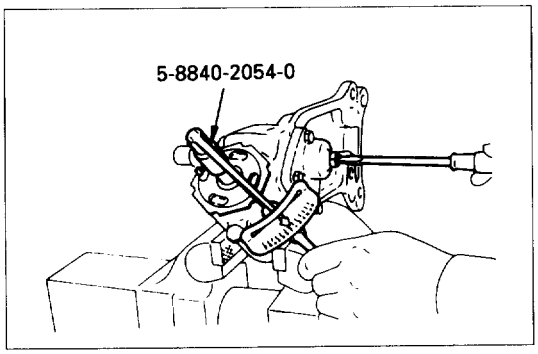
Adjust the backlash between the sector gear and ball nut.

1) Install the pitman arm.
2) Set the sector shaft in a straight ahead position.
3) With the adjusting screw, adjust the backlash to the specification.

Backlash (at End of Pitman Arm)	mm(in.)
0.2 (0.0079) or less	

4) Lock adjusting screw with lock nut.

Lock Nut Torque	N•m (kg•m/lb•ft)
25 (2.5 / 18)	



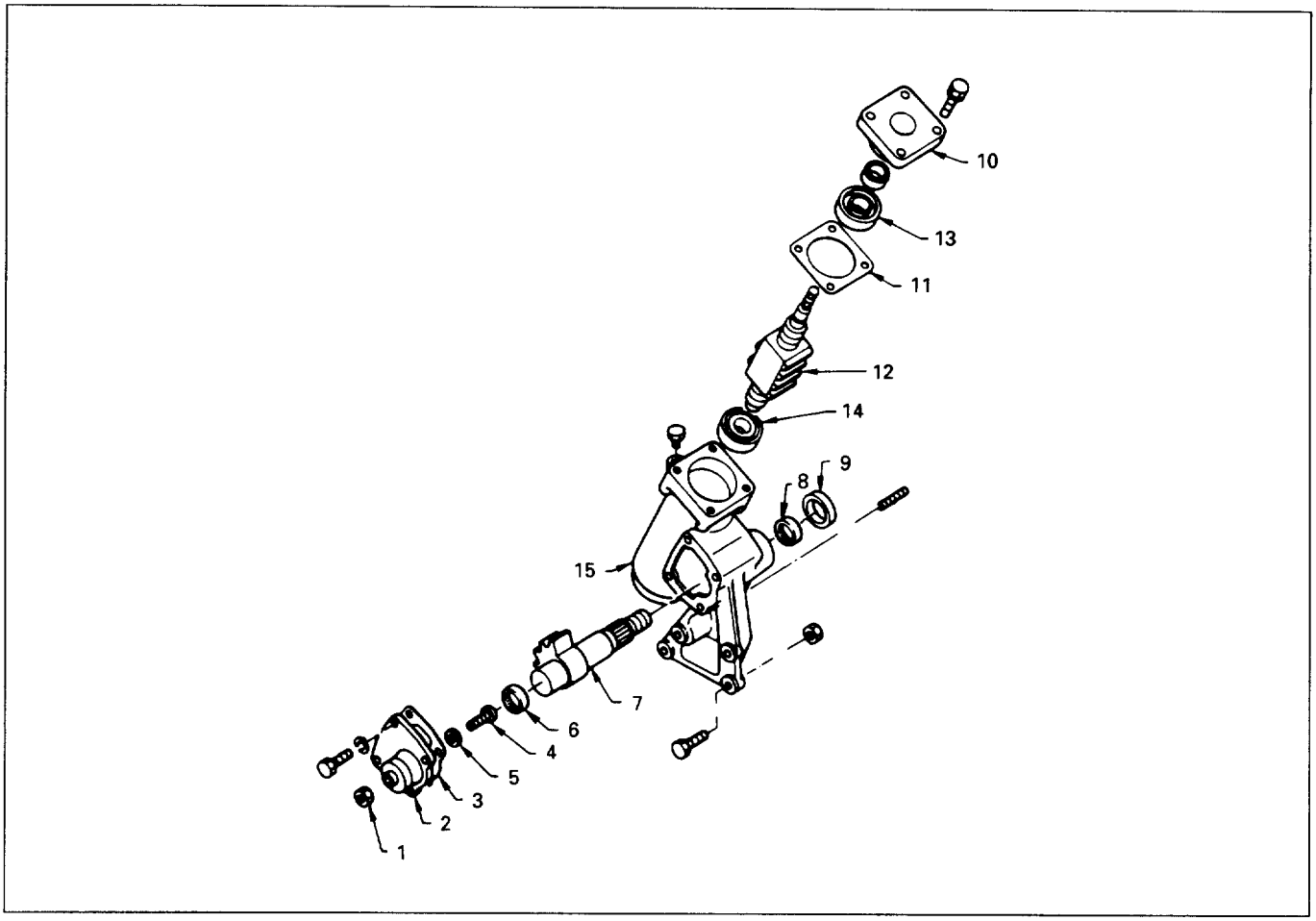
5) Inspect the starting torque of the steering input shaft.

Starting Torque	N•m (kg•m/lb•ft)
0.54 – 1.03 (0.055 – 0.105 / 0.40 – 0.76)	

Steering Shaft Driver : 5-8840-2054-0

MANUAL STEERING UNIT (NPR, NQR)

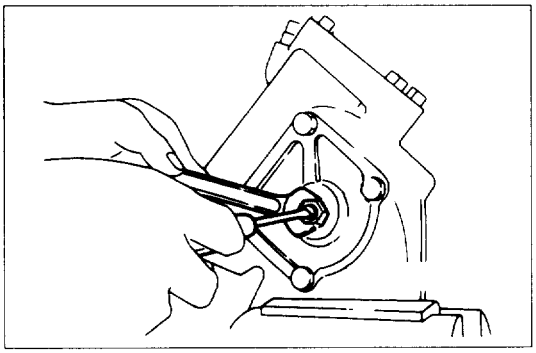
DISASSEMBLY



Disassembly Steps

1. Lock nut
2. Side cover
3. Gasket
4. Adjust screw
5. Adjust shim
6. Needle bearing
7. Sector shaft
8. Needle bearing
9. Oil seal
10. End cover
11. Adjust shim
12. Ball nut and worm shaft
13. Bearing
14. Bearing
15. Gear box

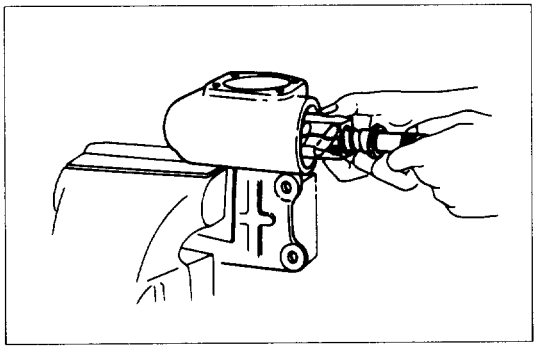
Disassembly Steps



1. **Lock Nut**
2. **Side Cover**
   1) Turn the adjust screw counter-clockwise slightly, then remove the side cover fixing bolt.
   2) Turn the adjust screw clockwise with the side cover held from turning.
3. **Gasket**
4. **Adjust Screw**
5. **Adjust Shim**
6. **Needle Bearing**
7. **Sector Shaft**

   When removing, use care so as not to cause damage to the serrations, threads and oil seal.
8. **Needle Bearing**
9. **Oil Seal**
10. **End Cover**
11. **Adjust Shim**
12. **Ball Nut and Worm Shaft**

    Always keep ball nut assembly in a horizontal position and avoid holding it vertically, or ball nut will slide out.



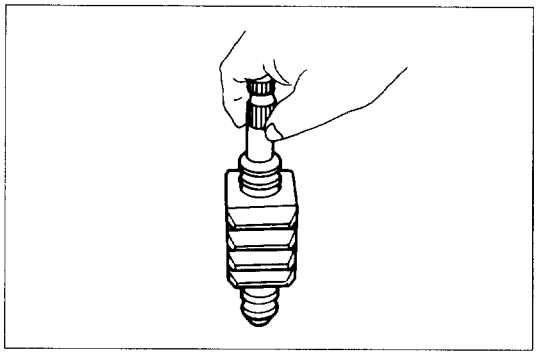
INSPECTION AND REPAIR

Make necessary correction or parts replacement if wear damage, or any other abnormal conditions are found through inspection.

- Bearing
- Sector shaft
- Ball nut and worm shaft

Visual Checks

Inspect the following parts for wear damage or other abnormal conditions.

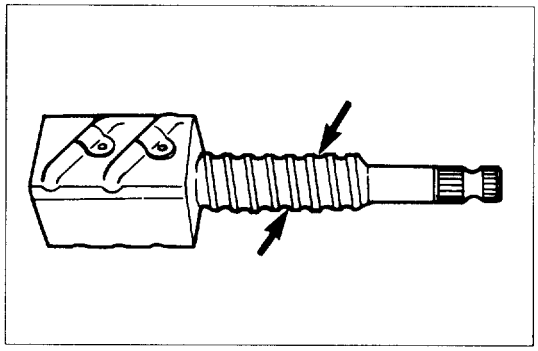


Ball Nut Rotation

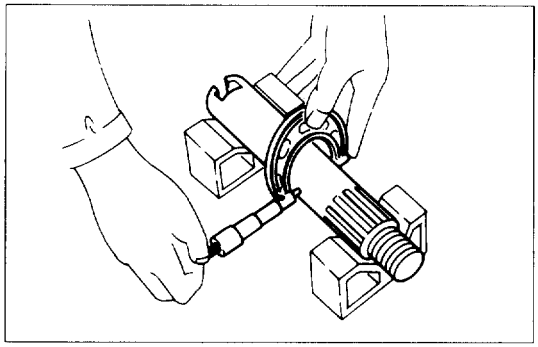
Hold the worm shaft vertically and see of the ball nut lowers with turning motion smoothly. If lowering of the ball nut with its own weight is unsmooth, check the worm shaft for bending and ball-groove for burrs, dents and presence of foreign matter.

NOTE:

When making a test on the ball nut assembly, exercise care so as not to strike ball nut against end of worm shaft, or damage to the ball tubes will result.



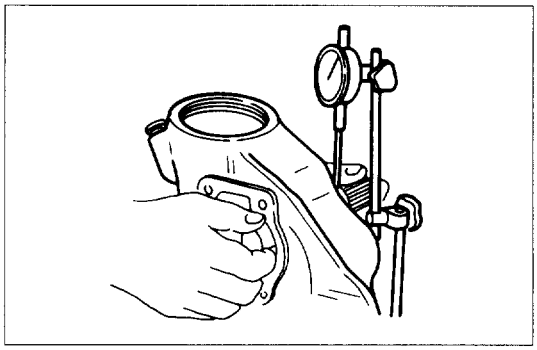
If any of the parts in the ball nut and worm shaft assembly is found to be defective, the entire parts should be replaced using a new worm shaft assembly. As these parts are of selective combination and are sealed to prohibit disassembly, the faulty parts should not be replaced individually.



Sector Shaft Outside Diameter

mm(in.)

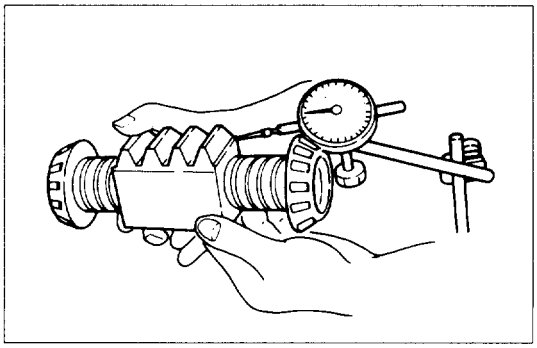
Standard	Limit
38.1 (1.50)	38.0 (1.496)



Sector Shaft and Needle Bearing Play

mm(in.)

Limit
0.2 (0.008)

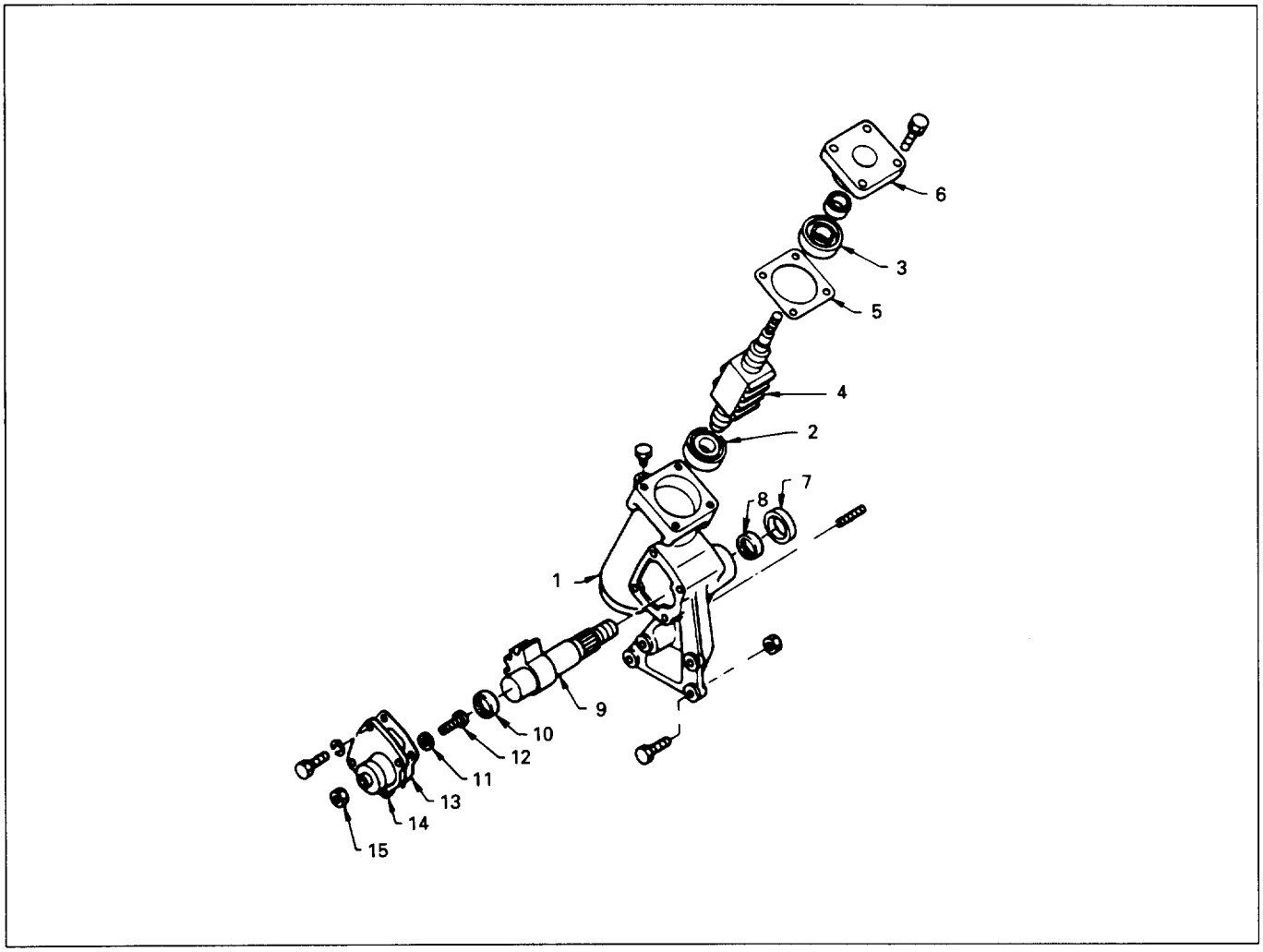


Ball Nut Axial Play

mm(in.)

Limit
0.1 (0.004)

REASSEMBLY

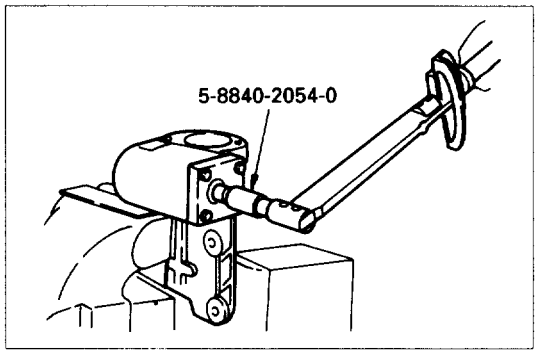


Reassembly Steps

1. Gear box
2. Bearing
3. Bearing
4. Ball nut and worm shaft
5. Adjust shim
6. End cover
7. Oil seal
8. Needle bearing
9. Sector shaft
10. Needle bearing
11. Adjust shim
12. Adjust screw
13. Gasket
14. Side cover
15. Lock nut

Reassembly Steps

1. **Gear Box**
2. **Bearing**
3. **Bearing**
4. **Ball Nut and Worm Shaft**



5. Adjust Shim

1) Adjust the starting torque of input shaft by varying shim thickness.

Steering Shaft Driver : 5-8840-2054-0

Starting Torque	N•m (kg•m/lb•ft)
0.29 – 0.69 (0.030 – 0.070 / 0.22 – 0.51)	

Adjust Shims Available	mm(in.)
0.01, 0.02, 0.05, 0.07, 0.08 (0.0004, 0.0008, 0.0020, 0.0028, 0.0031)	

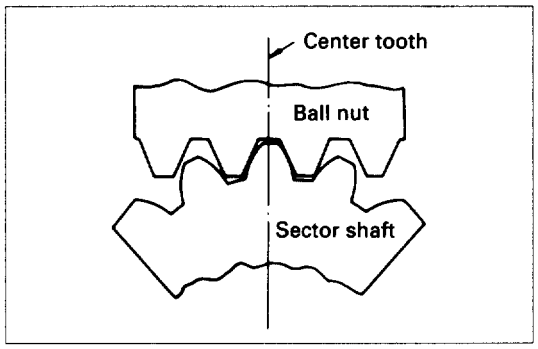
6. End Cover

Fixing Bolt Torque	N•m (kg•m/lb•ft)
44 (4.5 / 33)	

7. Oil Seal

8. Sector Shaft

Align the center tooth of ball nut with that of the sector shaft.



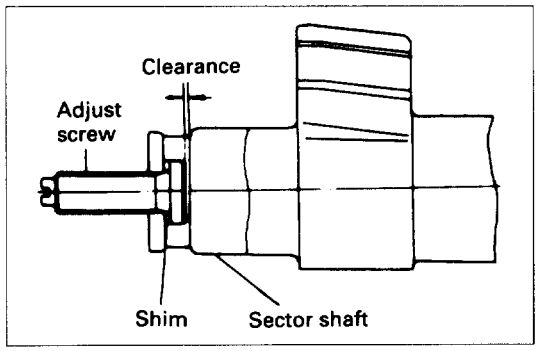
9. Sector Shaft

10. Needle Bearing

11. Adjust Shim

12. Adjust Screw

Adjust the clearance and check that the adjust screw slides freely.

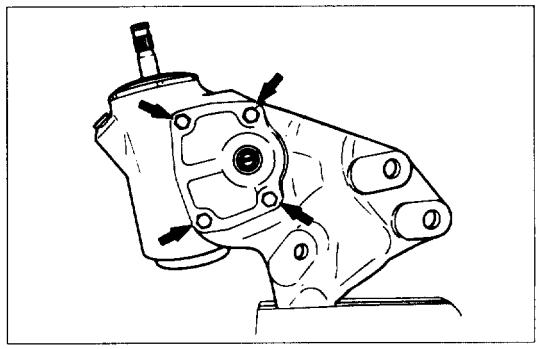


Clearance	mm(in.)
0.1 (0.0039)	

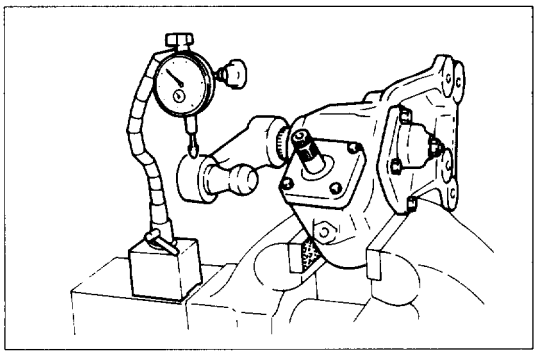
Adjust Shims Available	mm(in.)
1.53, 1.56, 1.59, 1.62, 1.65 (0.060, 0.061, 0.063, 0.064, 0.065)	

13. Gasket

14. Side Cover



Side Cover Bolt Torque	N•m (kg•m/lb•ft)
44 (4.5 / 33)	



15. Lock Nut

Adjust the backlash between the sector gear and ball nut.

1) Install the pitman arm.
2) Set the sector shaft in a straight ahead position.
3) With the adjusting screw, adjust the backlash to the specification.

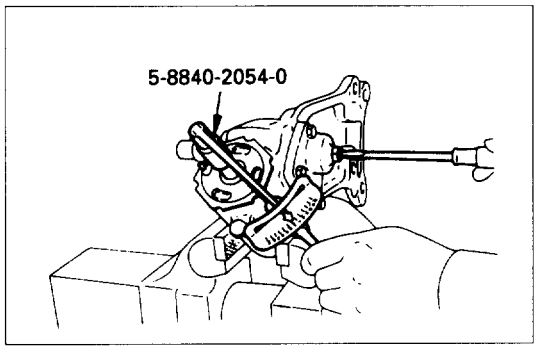
Backlash (at End of Pitman Arm)	mm(in.)
0.5 (0.0197) or less	

4) Lock adjusting screw with lock nut.

Lock Nut Torque	N•m (kg•m/lb•ft)
25 (2.5 / 1.8)	

5) Inspect the starting torque of the input shaft.

Starting Torque	N•m (kg•m/lb•ft)
0.98 (0.1 / 0.72) or less	



Steering Shaft Driver : 5-8840-2054-0

SECTION 3B3
STEERING LINKAGE

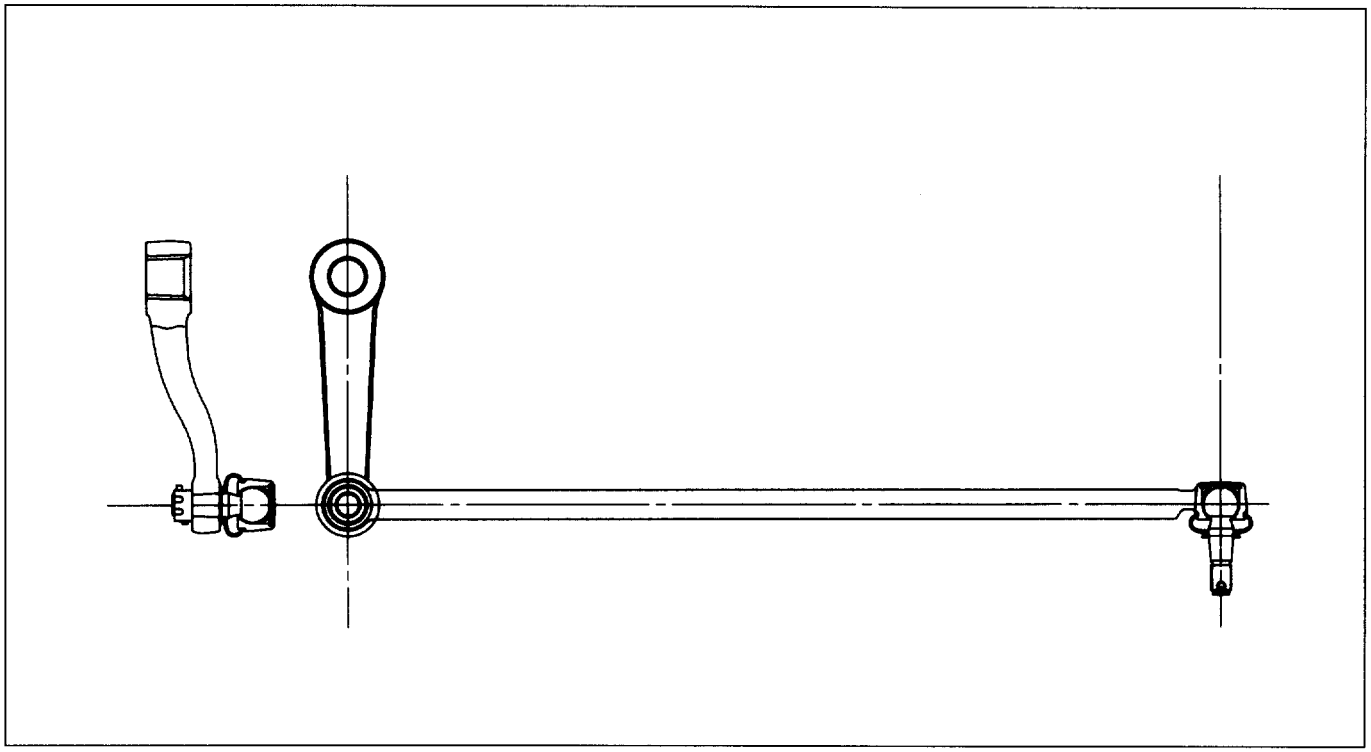
CONTENTS

PAGE

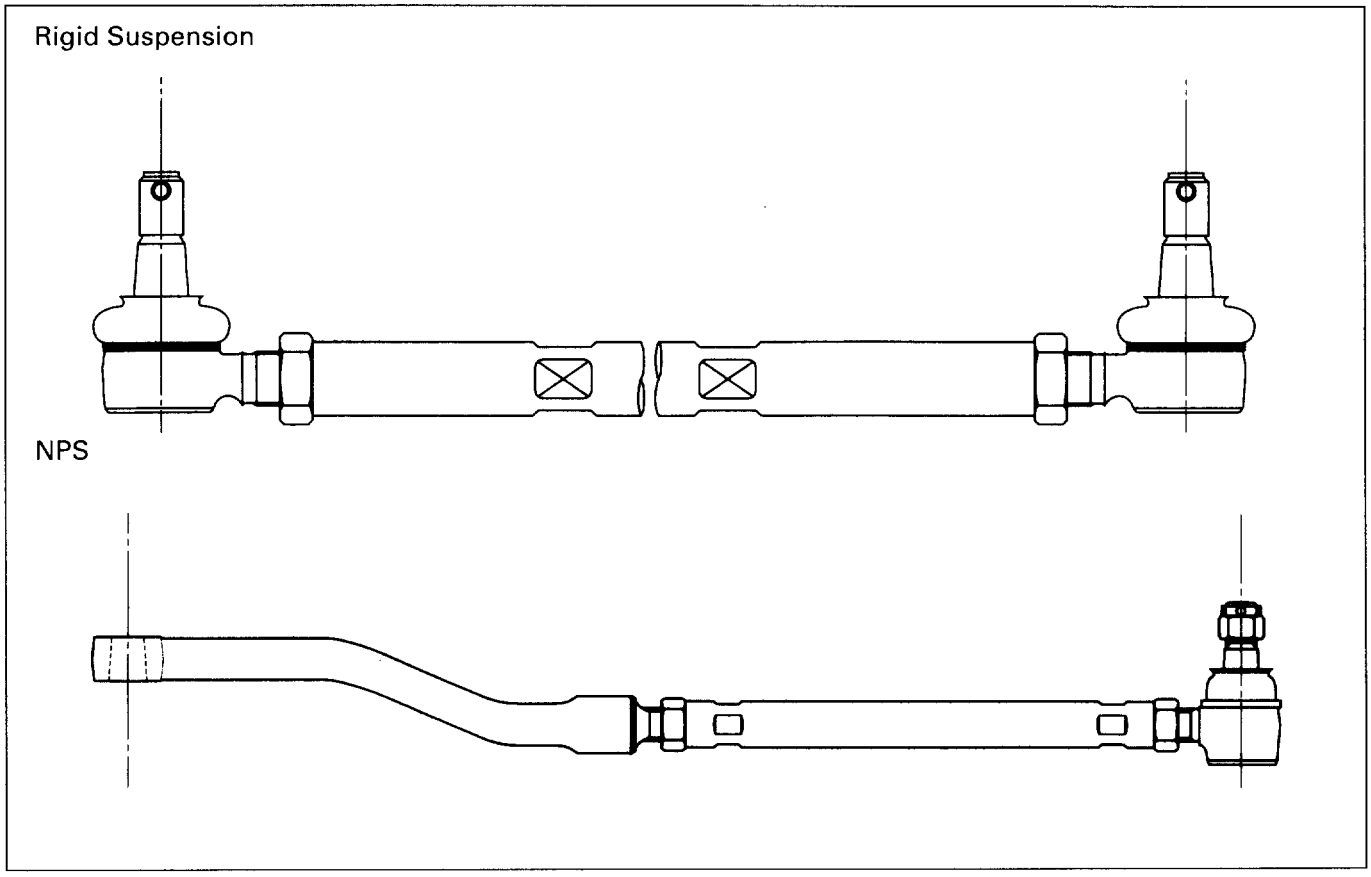
General Description 3B3- 2
On-Vehicle Service 3B3- 4
Drag Link Replacement 3B3- 4
Tie Rod Replacement (2WD Rigid Suspension) 3B3- 6
Tie Rod Replacement (NPS) 3B3- 9
Steering Link Replacement (Wishbone Suspension) 3B3-12

GENERAL DESCRIPTION

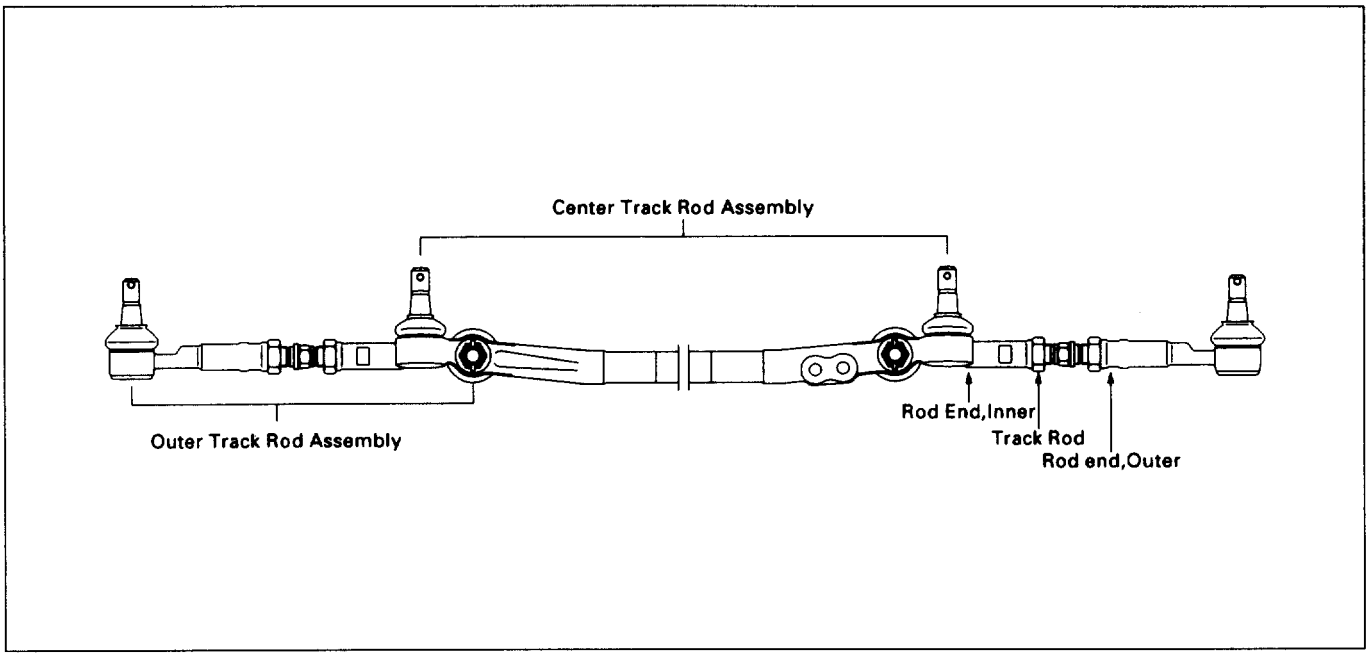
Drag Link and Pitman Arm



Tie Rod Assembly

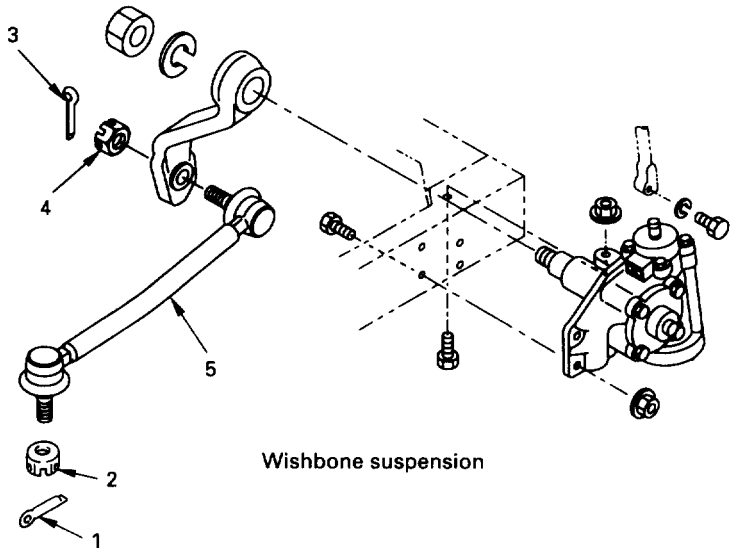


Steering Link Assembly

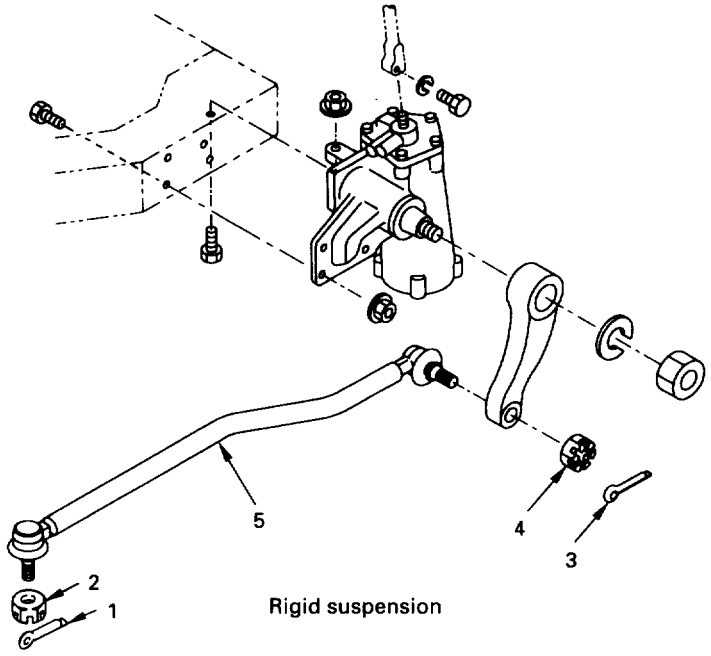


ON-VEHICLE SERVICE

DRAG LINK REPLACEMENT



Wishbone suspension



Rigid suspension

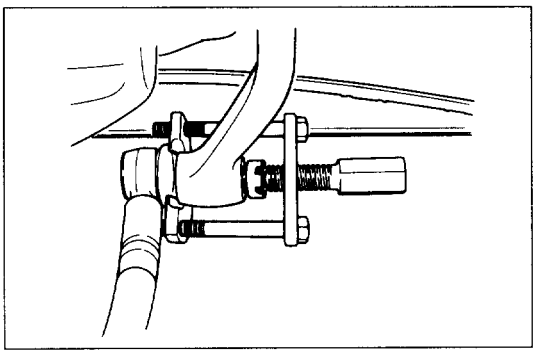
Removal Steps

1. Cotter pin
2. Nut
3. Cotter pin
4. Nut
5. Drag link

Installation Steps

5. Drag link
4. Nut
3. Cotter pin
2. Nut
1. Cotter pin

REMOVAL



1. **Cotter Pin**
2. **Nut**
3. **Cotter Pin**
4. **Nut**
5. **Drag Link**

   Remove the drag link using a special tool.

Remover : 5-8840-2017-0

CAUTION:

Be careful not to damage the ball joint boot.

INSPECTION AND REPAIR

Make necessary correction or parts replacement if wear, damage, corrosion, bending, deteriorations or any other abnormal conditions are found through inspection.

Check the following parts.

- Ball joint (Boot, screws and tapered surface)

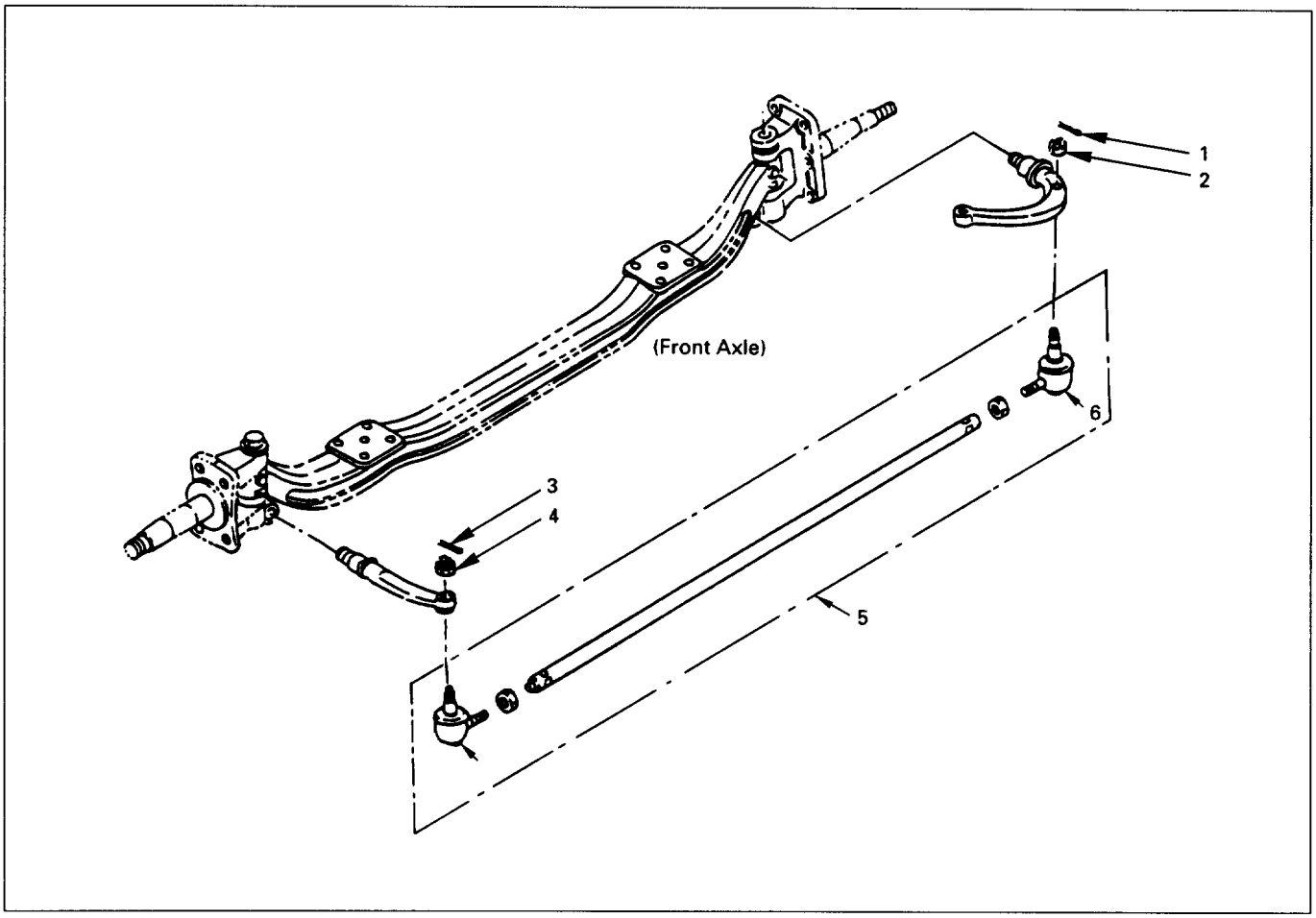
INSTALLATION

5. **Drag Link**
4. **Nut**
3. **Cotter Pin**
2. **Nut**
1. **Cotter Pin**

Tighten the nut to the specified torque, with just enough additional torque to align cotter pin holes. Install new cotter pin.

Drag Link Nut Torque	N·m (kg·m/lb·ft)
	17 (167 / 123)

TIE ROD REPLACEMENT (2WD RIGID SUSPENSION)



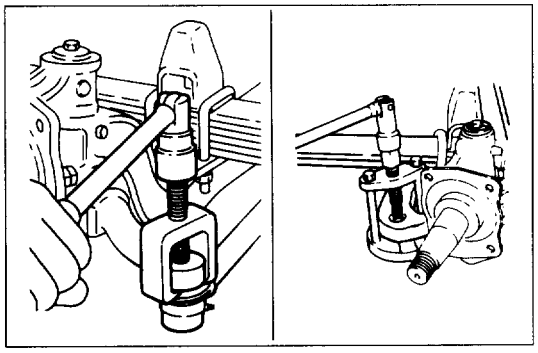
Removal Steps

1. Cotter pin
2. Nut
3. Cotter pin
4. Nut
5. Tie rod assembly
6. Tie rod end

Installation Steps

6. Tie rod end
5. Tie rod assembly
4. Nut
3. Cotter pin
2. Nut
1. Cotter pin

REMOVAL



1. **Cotter Pin**
2. **Nut**
3. **Cotter Pin**
4. **Nut**
5. **Tie Rod Assembly**

   Remove the tie rod assembly using a special tool.

   Remover

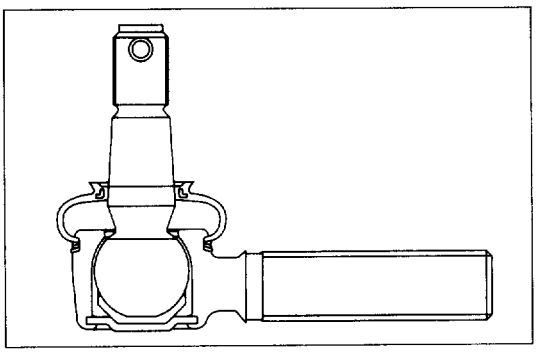
   Driver side : 5-8840-2017-0

   Assistant side : 5-8840-2018-0

6. **Tie Rod End**

INSPECTION AND REPAIR

Make necessary correction or parts replacement if wear damage, or any other abnormal conditions are found through inspection.



Tie Rod End

Inspect the ball joint taper fitting part for contact condition or abnormal wear.

Inspect the boot for damage or grease leak. Move the ball joint to confirm its normal movement.

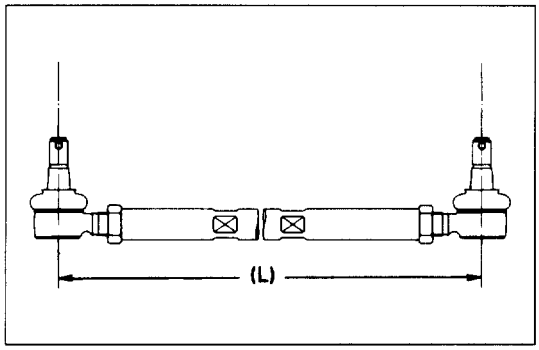
If abnormal condition is found, replace the assembly because it cannot be disassembled.

Tie Rod

Inspect the tie rod tube for bending, or damaged threads.

If abnormal condition is found, replace the assembly or correct if bending is small.

INSTALLATION



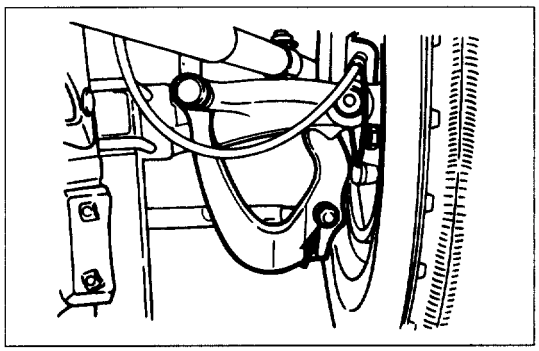
6. **Tie Rod End**
7. **Tie Rod Assembly**
   1) Install the tie rod end to the tie rod.
   2) Adjust length of tie rod by turning the connecting rod.

Tie Rod Length (L)

1994 – 1997 Model	mm(in.)
NHR, NKR	1153.5 (45.413)
NPR, NQR	1446.5 (56.949)

1998~ Model	mm(in.)
NHR	1153.5 (45.413)
NKR	1160.5 (45.925)
NPR, NQR	1446.5 (56.949)

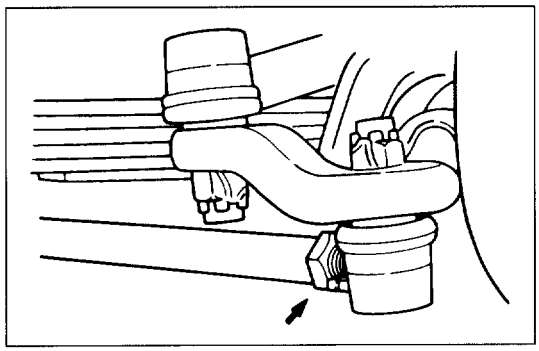
   3) After adjustment of length, temporarily tighten the tie rod end lock nut.



4. **Nut**
3. **Cotter Pin**
2. **Nut**
1. **Cotter Pin**
   1) Tighten the nut to specified torque, with just enough additional torque to align cotter pin hole.
      Install new cotter pin.

Tie Rod Nut	N·m (kg·m/lb·ft)
108 (11 / 80)	

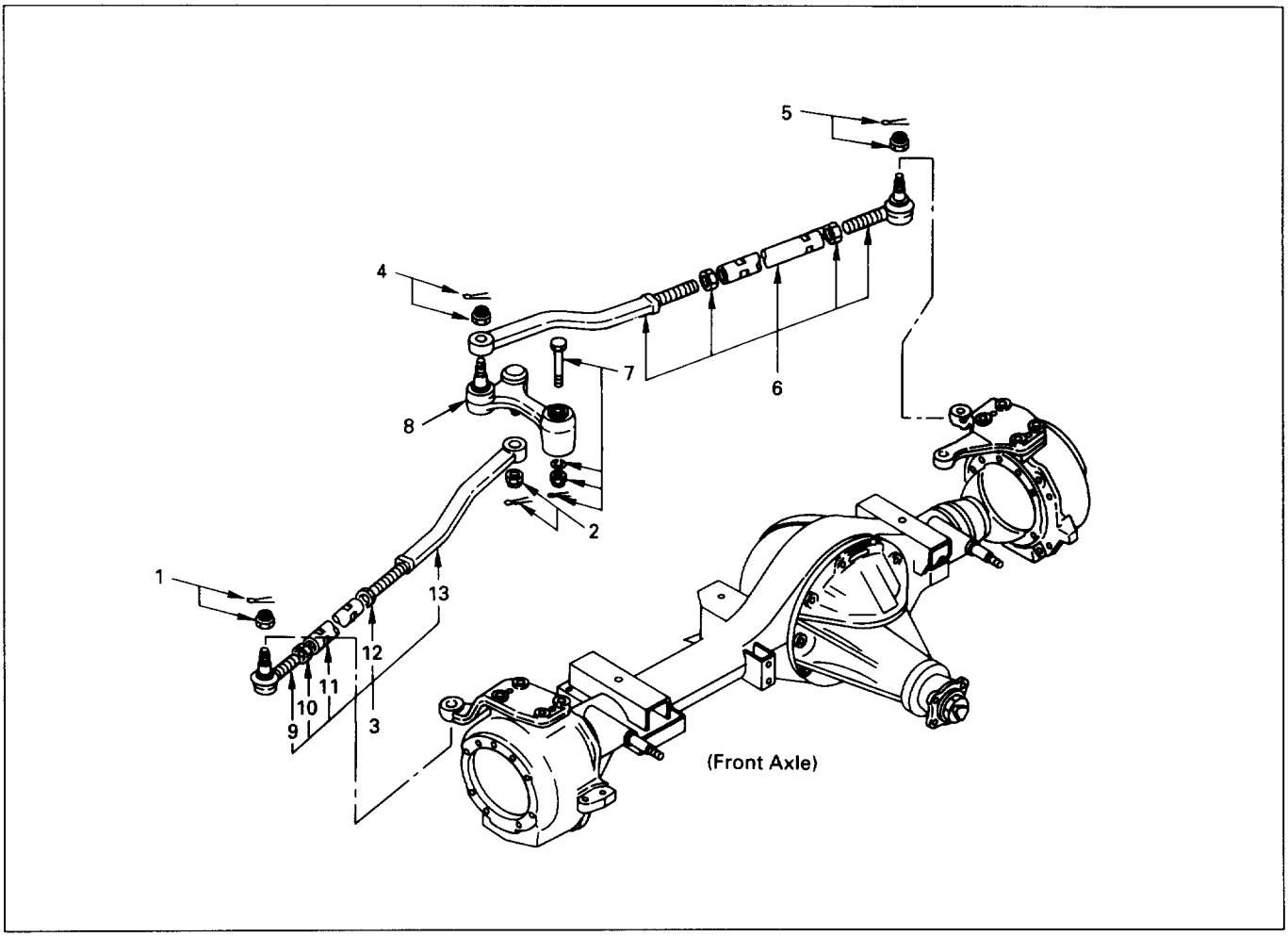
   2) Adjust the front end alignment after installation. Refer to "Front end alignment" in Section 3A.



   3) Tighten tie rod end lock nuts to specified torque after adjustment of front end alignment.

Lock Nut Torque	N·m (kg·m/lb·ft)
113 (11.5 / 83)	

TIE ROD REPLACEMENT (NPS)



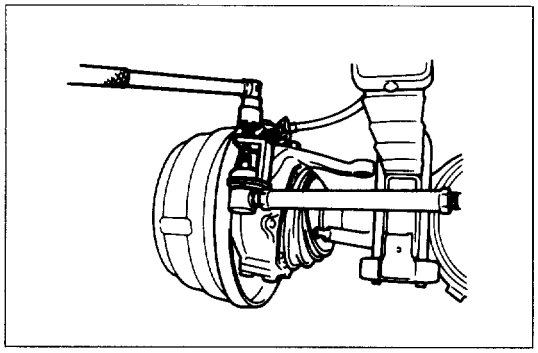
Removal Steps

1. Nut and cotter pin
2. Nut and cotter pin
3. Tie rod assembly
4. Nut and cotter pin
5. Nut and cotter pin
6. Tie rod assembly
7. Bolt, nut, washer and cotter pin
8. Relay lever
9. Tie rod end
10. Lock nut
11. Tie rod tube
12. Lock nut
13. Tie rod

Installation Steps

13. Tie rod
12. Lock nut
11. Tie rod tube
10. Lock nut
9. Tie rod end
8. Relay lever
7. Bolt, nut, washer and washer
6. Tie rod assembly
5. Nut and cotter pin
4. Nut and cotter pin
3. Tie rod assembly
2. Nut and cotter pin
1. Nut and cotter pin

REMOVAL



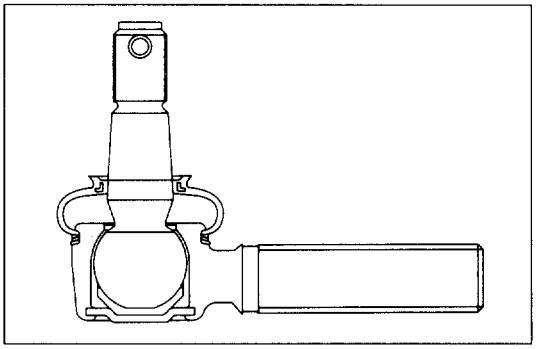
1. **Nut and Cotter Pin**
2. **Nut and Cotter Pin**
3. **Tie Rod Assembly**
4. **Nut and Cotter Pin**
5. **Nut and Cotter Pin**
6. **Tie Rod Assembly**

   Remover : 5-8840-2189-0

7. **Bolt, Nut, Washer and Cotter Pin**
8. **Relay Lever**
9. **Tie Rod End**
10. **Lock Nut**
11. **Tie Rod Tube**
12. **Lock Nut**
13. **Tie Rod**

INSPECTION AND REPAIR

Make necessary correction or parts replacement if wear damage, or any other abnormal conditions are found through inspection.



Tie Rod End

- Inspect the ball joint taper fitting part for contact condition or abnormal wear.
- Inspect the boot for damage or grease leak.
- Move the ball joint to confirm its normal movement.
- If abnormal condition is found, replace the assembly because it cannot be disassembled.

Tie Rod

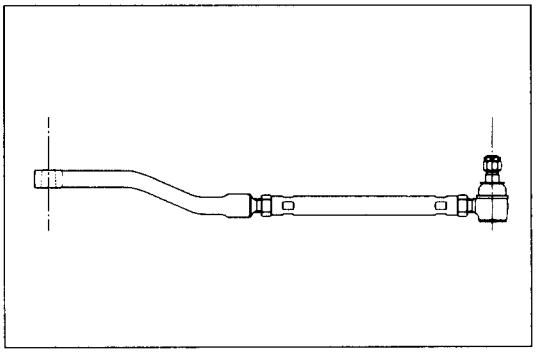
Inspect the tie rod tube for bending, or damaged threads.

If abnormal condition is found, replace the assembly or correct if bending is small.

Relay Lever

Inspect the relay lever bushing. If bushing is defective, replace the relay lever assembly.

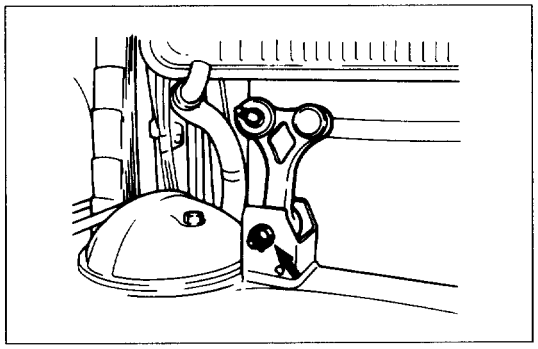
INSTALLATION



13. **Tie Rod**
12. **Lock Nut**
11. **Tie Rod Tube**
10. **Lock Nut**
9. **Tie Rod End**
    1) Install all parts and adjust tie rod length (L).

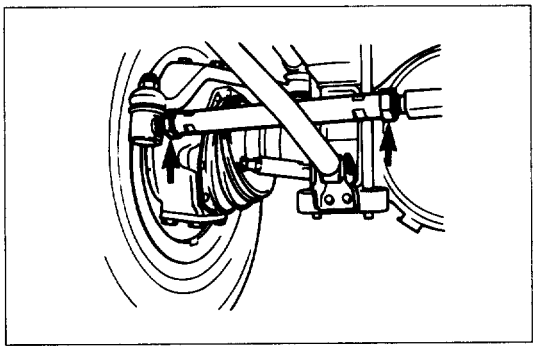
Tie Rod Length (L)	mm(in.)
781 (30.748)	

    2) After adjustment, tighten lock nuts temporarily.

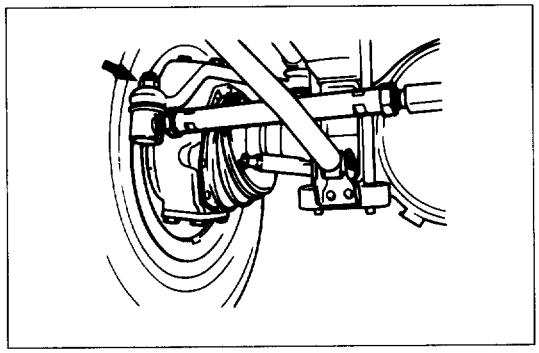


8. **Relay Lever**
7. **Bolt, Nut, Washer and Cotter Pin**
    1) Install the relay lever to the bracket.
    2) Tighten the nut to specified torque, with just enough additional torque to align cotter pin hole.
    3) Install new cotter pin.

Relay Lever Nut Torque	N·m (kg·m/lb·ft)
147 (15 / 108)	



6. **Tie Rod Assembly**
5. **Nut and Cotter Pin**
4. **Nut and Cotter Pin**
3. **Tie Rod Assembly**
2. **Nut and Cotter Pin**
1. **Nut and Cotter Pin**
    1) Tighten tie rod end nut to specified torque, with just enough additional torque to align cotter pin hole.
    Install new cotter pin.

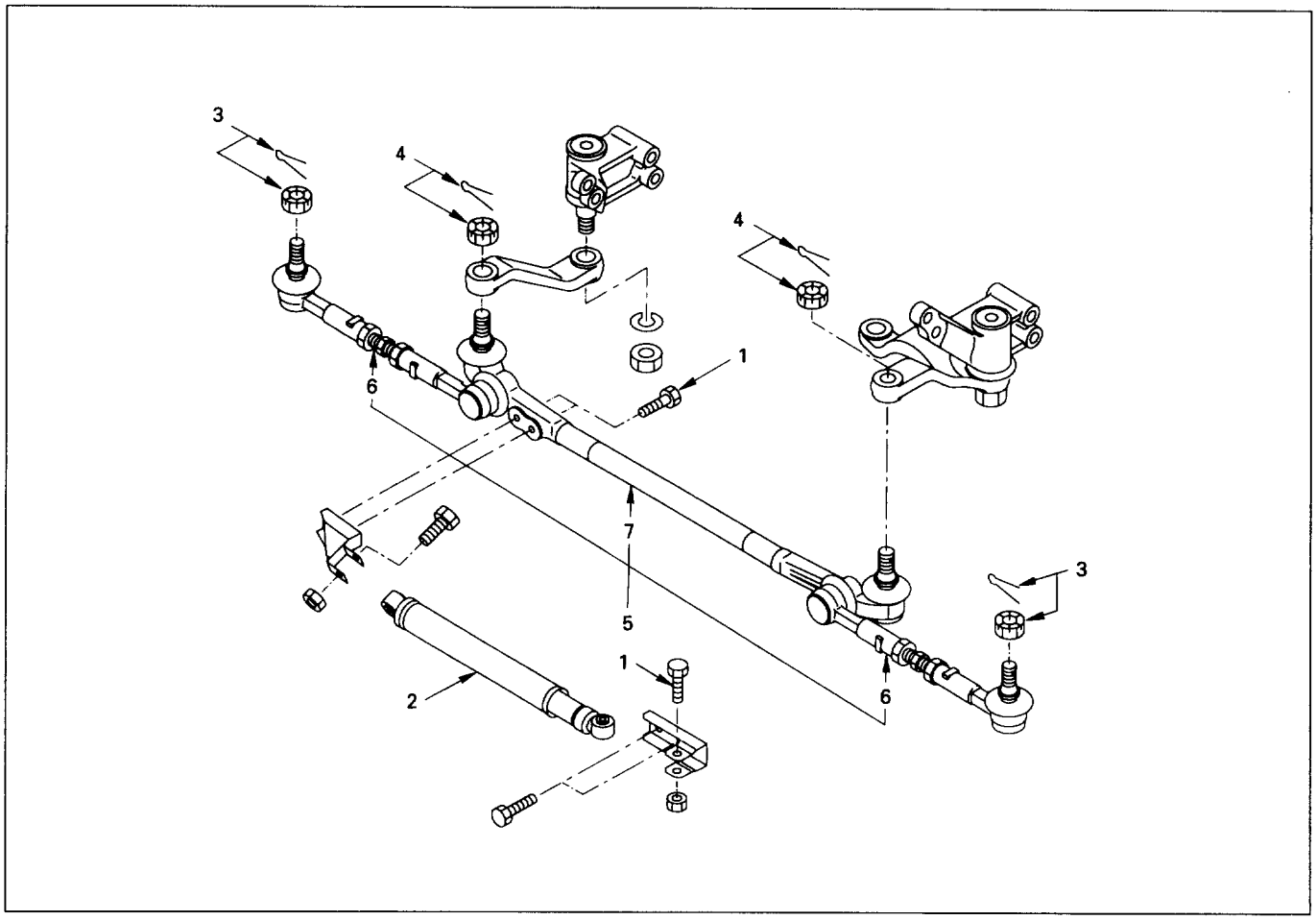


Tie Rod End Nut Torque	N·m (kg·m/lb·ft)
186 (19 / 137)	

    2) Adjust the front end alignment after installation. Refer to "Front end alignment" in Section 3A.
    3) After adjustment, tighten the lock nuts to specified torque.

Lock Nut Torque	N·m (kg·m/lb·ft)
113 (11.5 / 83)	

STEERING LINK REPLACEMENT (WISHBONE SUSPENSION)



Removal Steps

1. Bolt
2. Steering damper
3. Nut and cotter pin
4. Nut and cotter pin
5. Steering link assembly
6. Outer track rod
7. Center track rod

Installation Steps

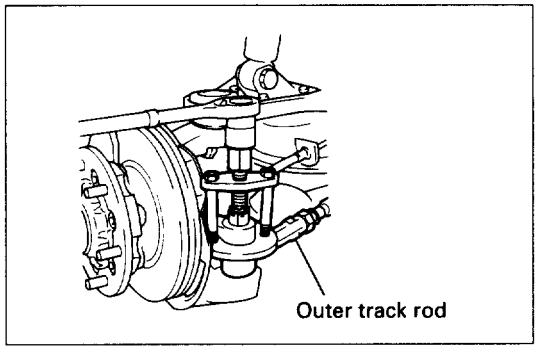
7. Center track rod
6. Outer track rod
5. Steering link assembly
4. Nut and cotter pin
3. Nut and cotter pin
2. Steering damper
1. Bolt

REMOVAL

Preparation:

Raise the vehicle and support the frame with suitable safety stands.

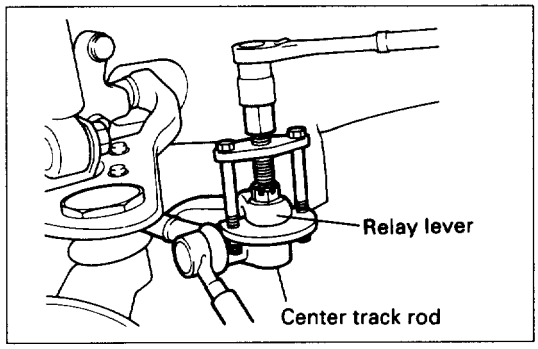
1. **Bolts**
2. **Steering Damper**



3. **Nut and Cotter Pin**

   Disconnect outer track rods from knuckle.

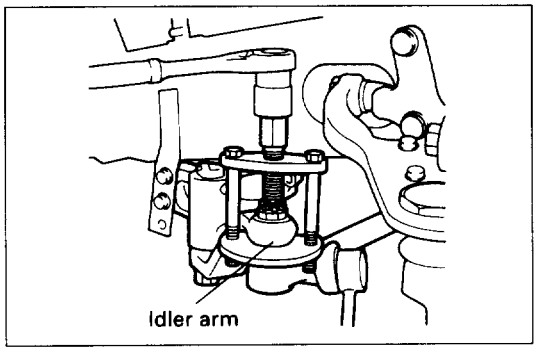
   Remover : 5-8840-2017-0



4. **Nut and Cotter Pin**

   1) Disconnect center track rod from relay lever.

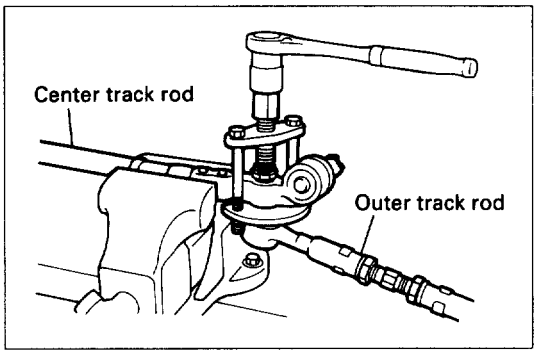
      Remover : 5-8840-2017-0



   2) Disconnect center track rod from idler arm.

      Remover : 5-8840-2017-0

5. **Steering Link Assembly**



6. **Outer Track Rod**
7. **Center Track Rod**

   Disconnect outer track rods from the center track rod.

   Remover : 5-8840-2017-0

INSPECTION

Make necessary correction or parts replacement if wear damage or any other abnormal conditions are found through inspection.

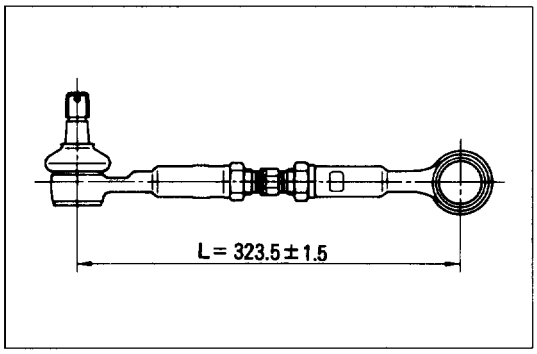
Outer Track Rod End

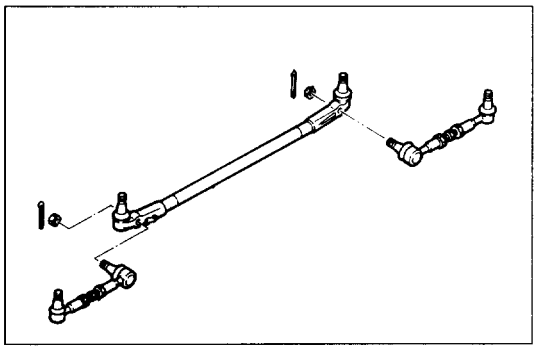
- Inspect the ball joint taper fitting part for contact condition or abnormal wear.
- Inspect the boot for damage or grease leak.
- Move the ball joint to confirm its normal movement.
  If abnormal condition is found, replace the rod end assembly because it cannot be disassembled.

Center Track Rod

- Inspect the center track rod for bending or any other abnormal conditions.
- Inspect the ball joint taper fitting part for contact condition or abnormal wear.
- Inspect the boot for damage or grease leak.
- Move the ball joint to confirm its normal movement.
  If abnormal condition is found, replace the center track rod assembly because it cannot be disassembled.

INSTALLATION





7. **Center Track Rod**
6. **Outer Track Rod**
   1) Adjust outer track rod length (L) to specified length.

Rod Length (L)	mm(in.)
323.5 (12.736)	

   2) After adjustment, tighten track rod end lock nut temporarily.
   3) Install outer track rods to the center track rod. Tighten nuts to specified torque, with just enough additional torque to align cotter pin hole. Install new cotter pin.

Outer Track Rod Nut Torque	N·m (kg·m/lb·ft)
108 (11 / 80)	

5. **Steering Link Assembly**
4. **Nut and Cotter Pin**
3. **Nut and Cotter Pin**
   1) Connect center track rod ends to the idler arm and relay lever.
   2) Connect outer track rod ends to knuckle.
   3) Tighten nuts to specified torque, with just enough additional torque to align cotter pin hole. Install new cotter pin.

Center Track Rod End Nut Torque	N·m (kg·m/lb·ft)
167 (17 / 123)	

Outer Track Rod End Nut Torque	N·m (kg·m/lb·ft)
108 (11 / 80)	

   4) Adjust the front end alignment after installation. Refer to "Front end alignment" in Section 3A.
   5) Tighten outer track rod end lock nuts to specified torque after adjustment of front end alignment.

Lock Nut Torque	N·m (kg·m/lb·ft)
167 (17 / 123)	

2. **Steering Damper**
1. **Bolt**

Steering Damper Bolt Torque	N·m (kg·m/lb·ft)
	40 (4.1 / 30)

SECTION 3B4
STEERING COLUMN

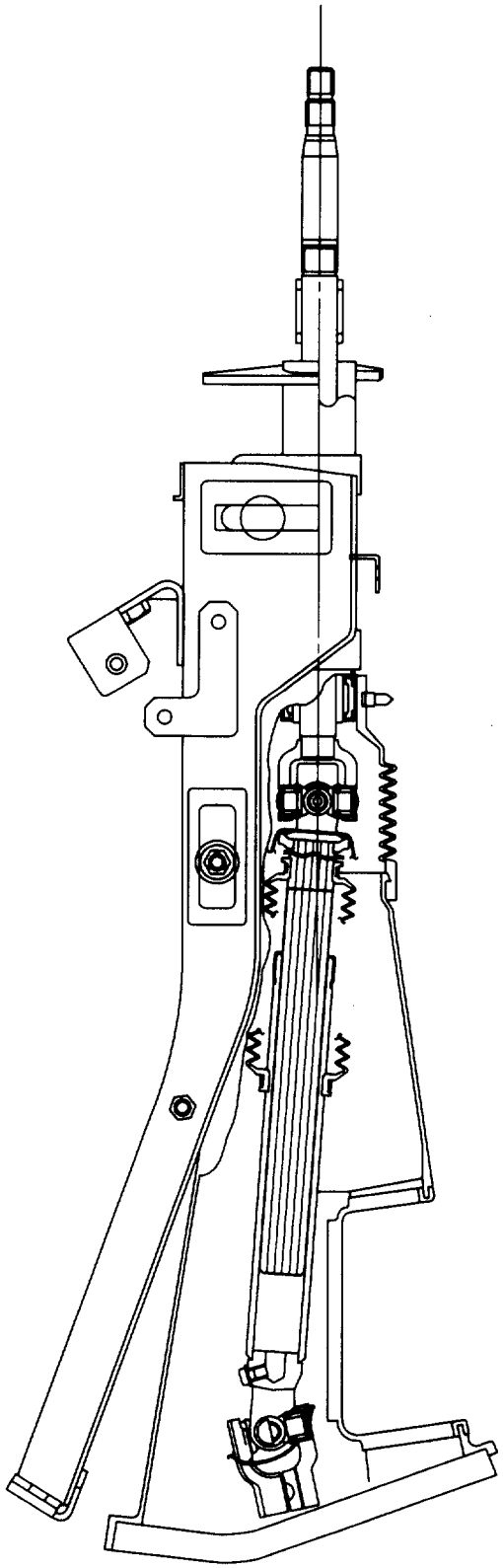
CONTENTS

PAGE

General Description 3B4- 2
On-Vehicle Service 3B4- 3
Steering Wheel, Shaft and Column 3B4- 3

GENERAL DESCRIPTION

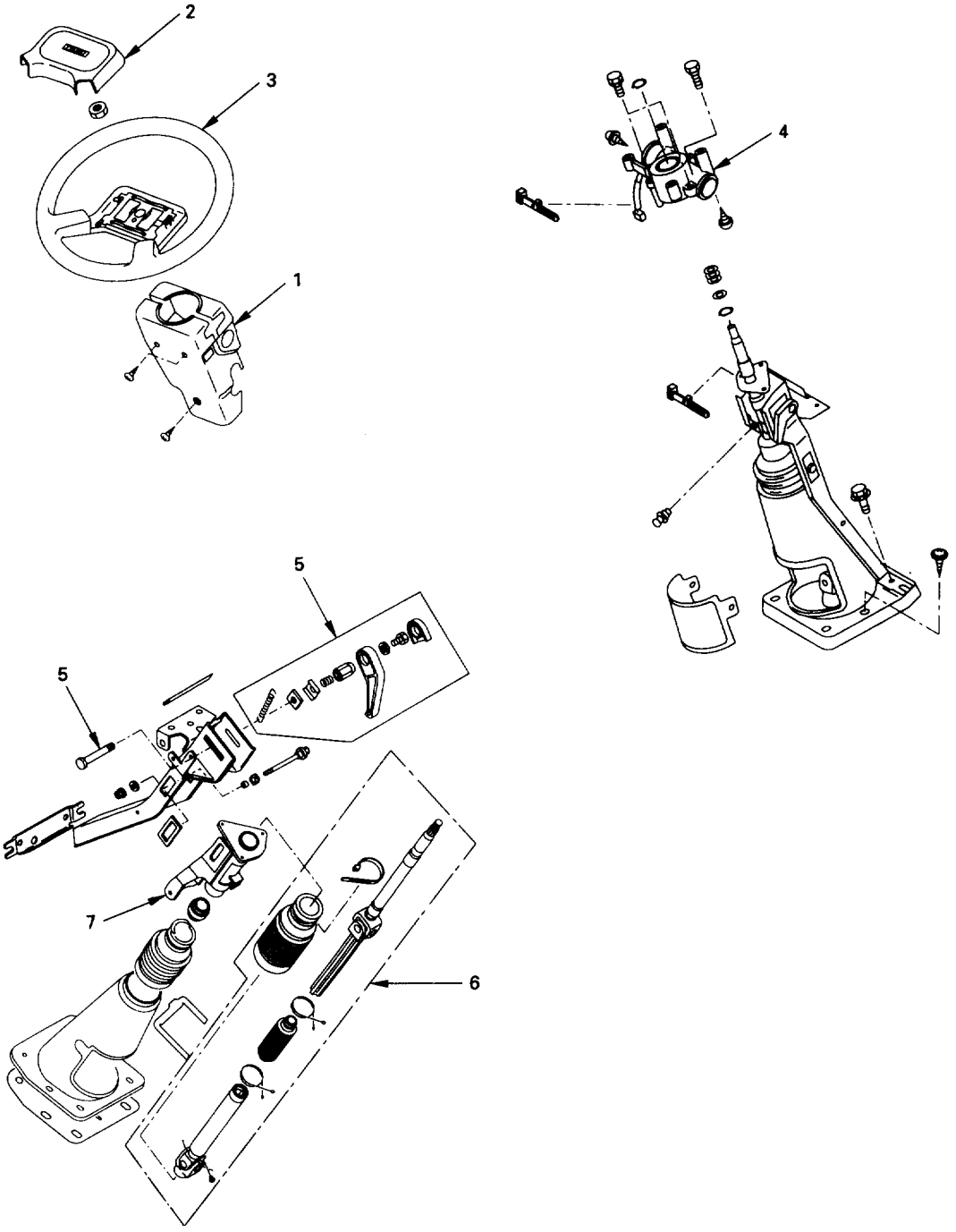
This illustration is based on tilt and telescopic control type.



ON-VEHICLE SERVICE

STEERING WHEEL, SHAFT AND COLUMN

This illustration is based on RHD tilt and telescopic control type.



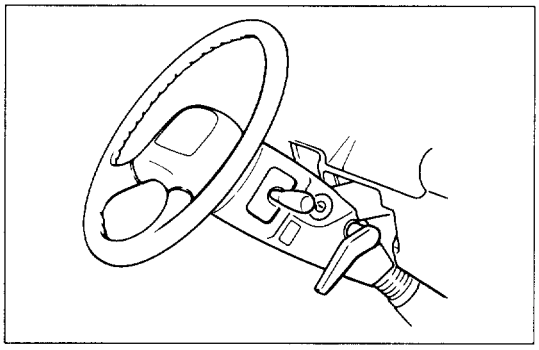
Removal Steps

1. Steering cowl
2. Horn button
3. Steering wheel
4. Starter switch and key cylinder assembly
5. Tilt control (or support bolt)
6. Steering shaft assembly
7. Steering column

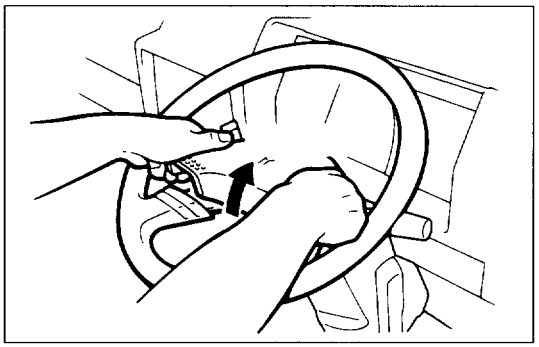
Installation Steps

7. Steering column
6. Steering shaft assembly
5. Tilt control (or support bolt)
4. Starter switch and key cylinder assembly
3. Steering wheel
2. Horn button
1. Steering cowl

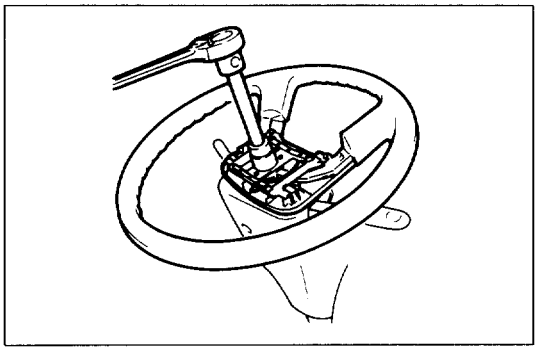
REMOVAL



1. Steering Cowl

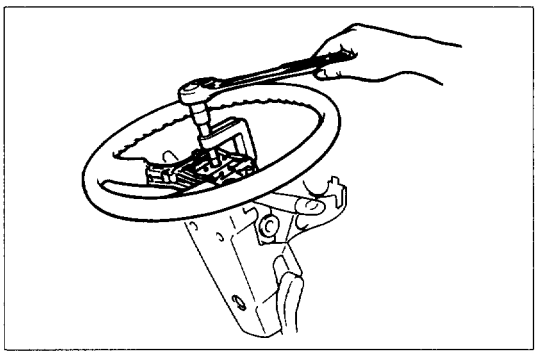


2. Horn Button

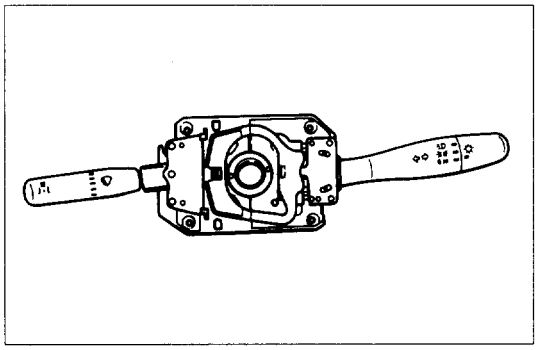


3. Steering Wheel

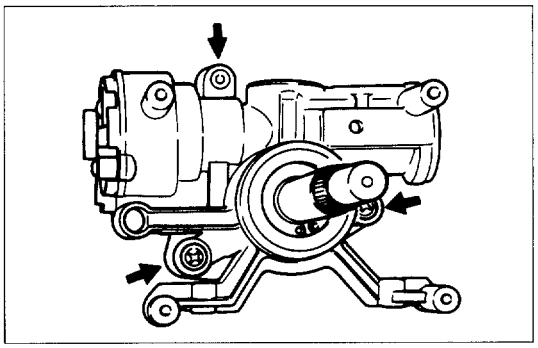
- Remove the locking nuts for the steering wheel.



- Remove the steering wheel using the special tool.
  Remover: 5-8840-2215-0

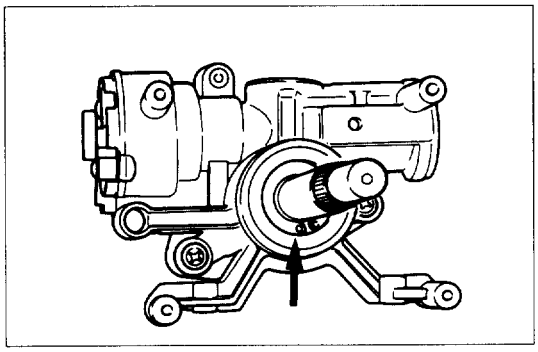


- Take out the combination switch.

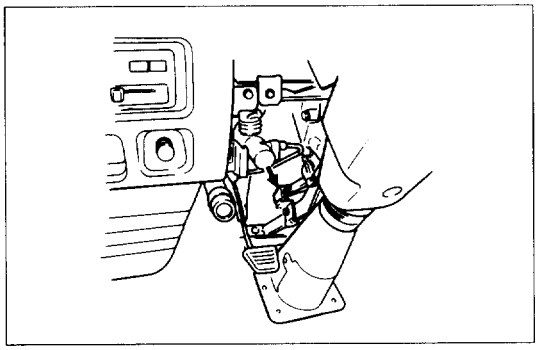


4. Starter Switch and Key Cylinder Assembly

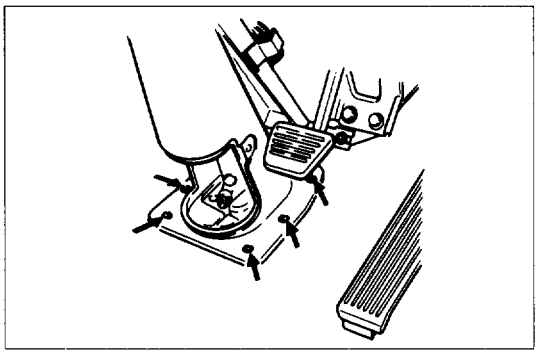
- Cut the steering lock with a hack saw to loosen the screws.



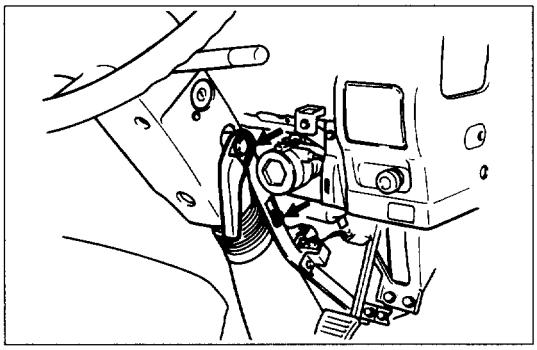
- Remove the snap rings and remove the steering lock assembly.



- Remove the harness connectors.

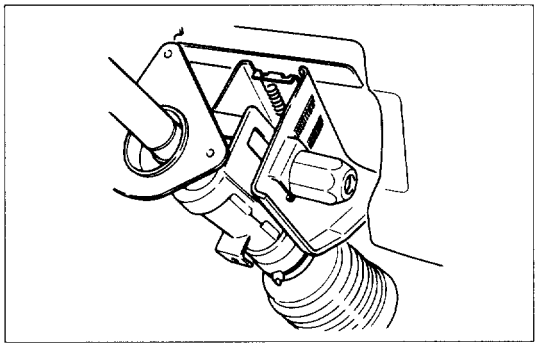


- Remove the inspection window in the boots to describe a mating mark on the steering shaft and the yolk of universal joint.



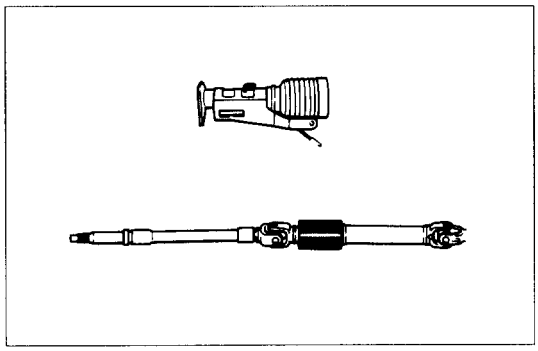
5. Tilt control

- Remove the tilt control and the support brackets retaining bolts for the steering wheel column.



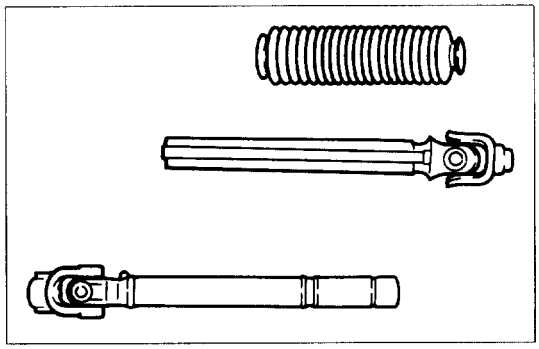
for Tilt Steering

- Remove the tilt spring.



6. Steering Shaft

- Pull the steering shaft out of the column.

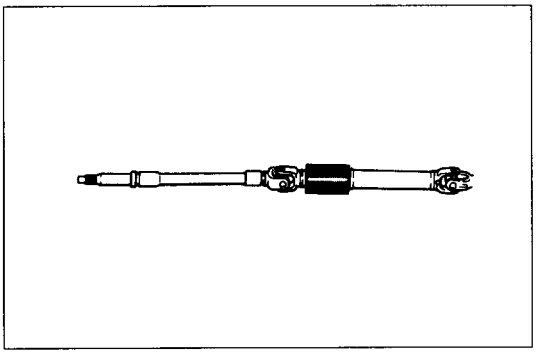


- Describe a mating mark on the spline shaft and steering shaft and dismantle them.

7. Steering Column

INSPECTION AND REPAIR

Clean up the dismantled components to perform inspection over each component.



Steering Shaft

- Inspect the bend.
- Inspect the universal joint.

  Check the yolk for crack and deformation.

  Chattering in the joint pairing.

CAUTION:

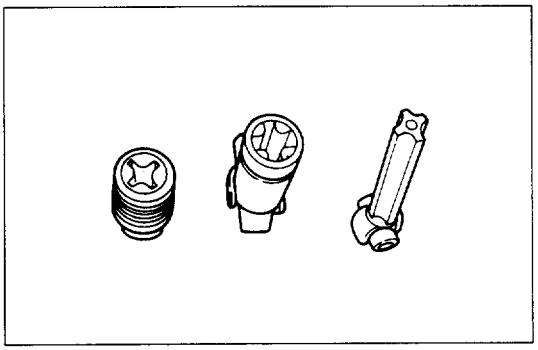
The universal joint is non-repairable type.

- Inspect the spline shaft.

  Significant chattering in the turning direction of steering shaft

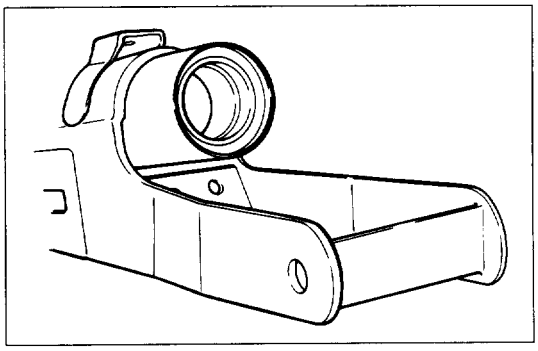
  Chattering in the joints

  Fracture and deterioration in the boots

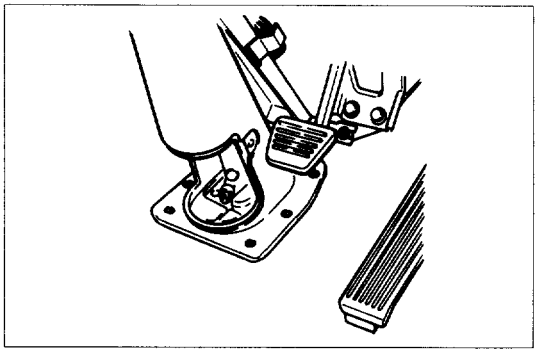


Steering Column

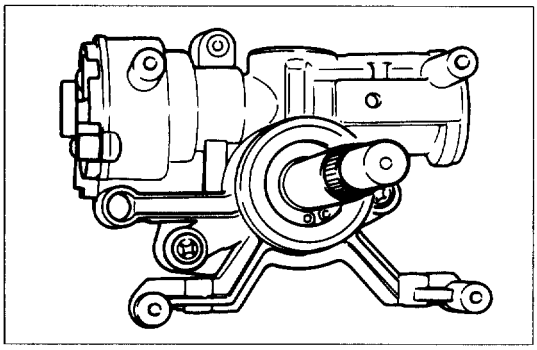
- Check to see if there is no significant deformation in the steering column.
- Check the boots for fracture and deterioration.
- Check the bushing for wear and deformation.



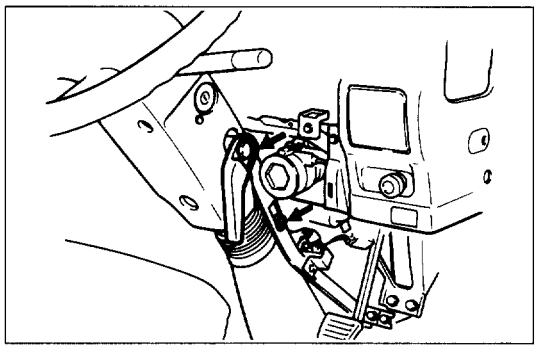
INSTALLATION



7. **Steering Column**
6. **Steering Shaft**
   - Assemble the steering shaft referring to the mating mark described at the time of dismantling and install the shaft.
   - Install the steering shaft to the steering unit referring to the mating mark described at the time of dismantling.



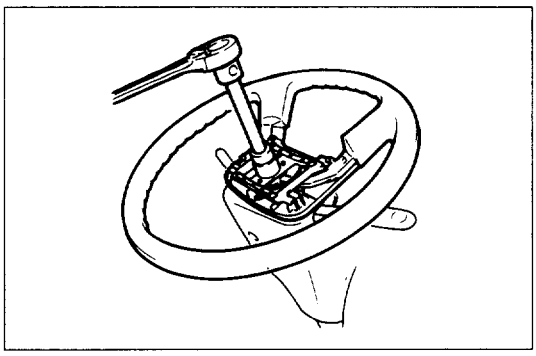
4. **Starter Switch and Key Cylinder Assembly**
   - Install the steering lock assembly and insert the snap ring positively.
   - Use new screws.



5. **Tilt Control (or Support Bolt)**
   - Tighten the retaining nuts for the lower steering column support brackets to the specified torque.
   - Tighten the nuts outside the tilt control to the specified torque to install the lever, and tighten the lever retaining bolts to the specified torque.

Lower Support Bolt and Nut Torque	N•m (kg•m/lb•ft)
14 (1.4 / 122)	

Tilt Control Bolt and Nut Torque	N•m (kg•m/lb•ft)
Bolt	45 (4.5 / 33)
Nut	16 (1.6 / 12)
Nut (Non-tilt)	20 (2.0 / 14)



3. **Steering Wheel**
   - Install the combination switch.
   - Install the steering wheel and tighten the nuts to the specified torque.

Steering Wheel Nut Torque	N•m (kg•m/lb•ft)
	50 (5 / 36)

2. **Horn Button**
1. **Steering Cowl**
   - Hook up the harness connectors and install the steering cowl.

SECTION 3C
FRONT SUSPENSION

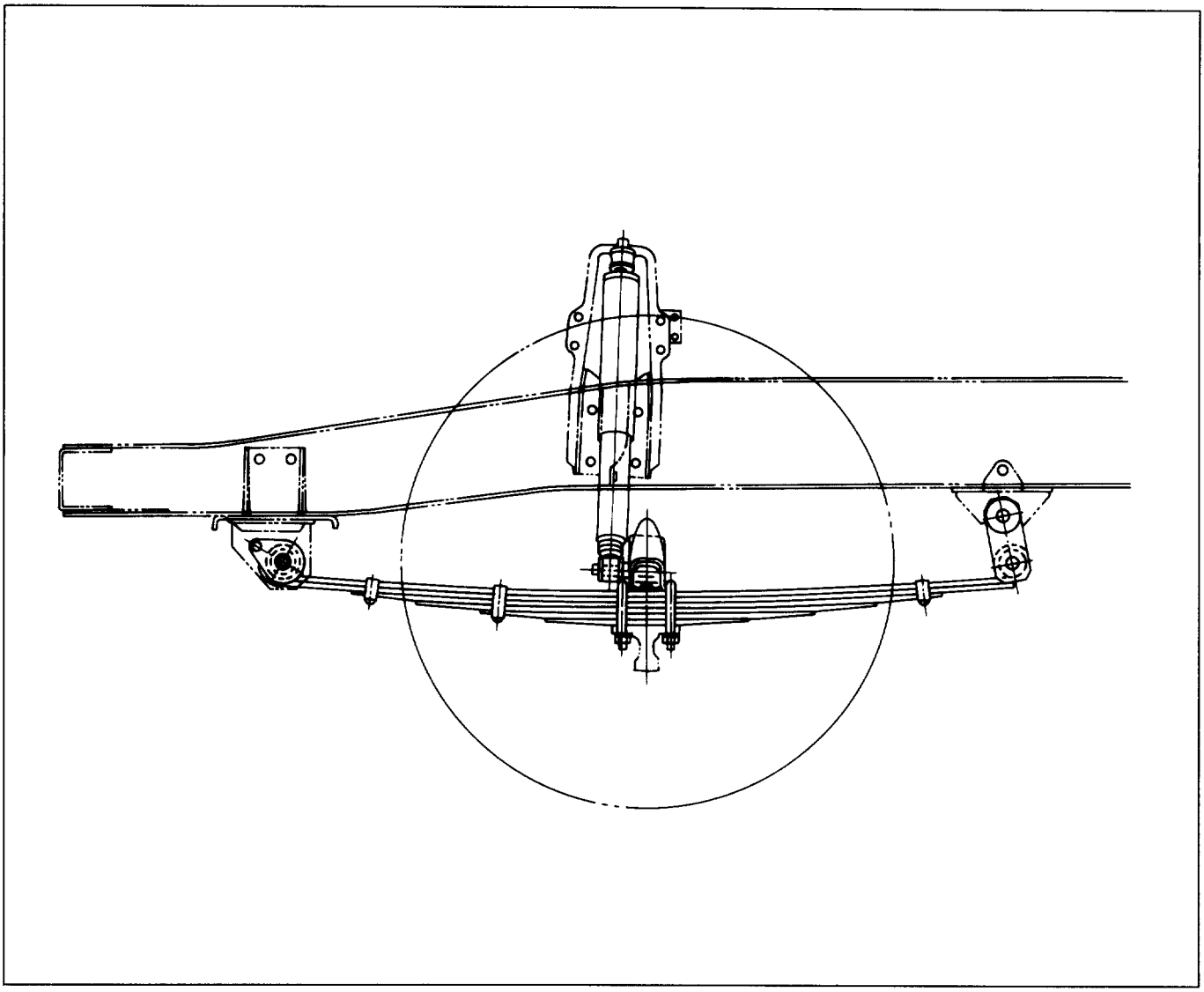
CONTENTS

PAGE

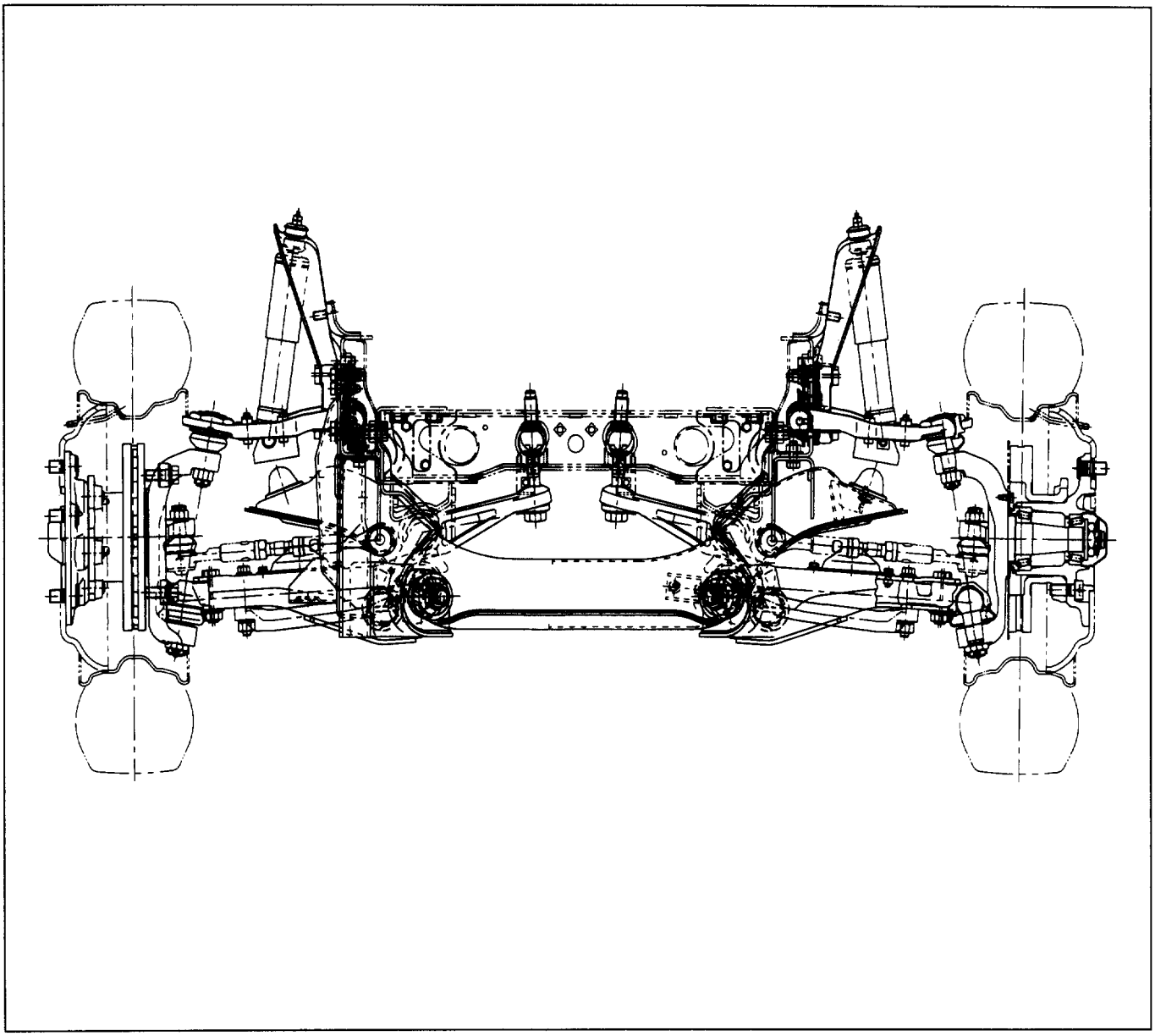
General Description 3C– 2
On-Vehicle Service 3C– 4
Front Suspension (Rigid Suspension) 3C– 4
Front Suspension (Wishbone Suspension) 3C– 20

GENERAL DESCRIPTION

Rigid Suspension



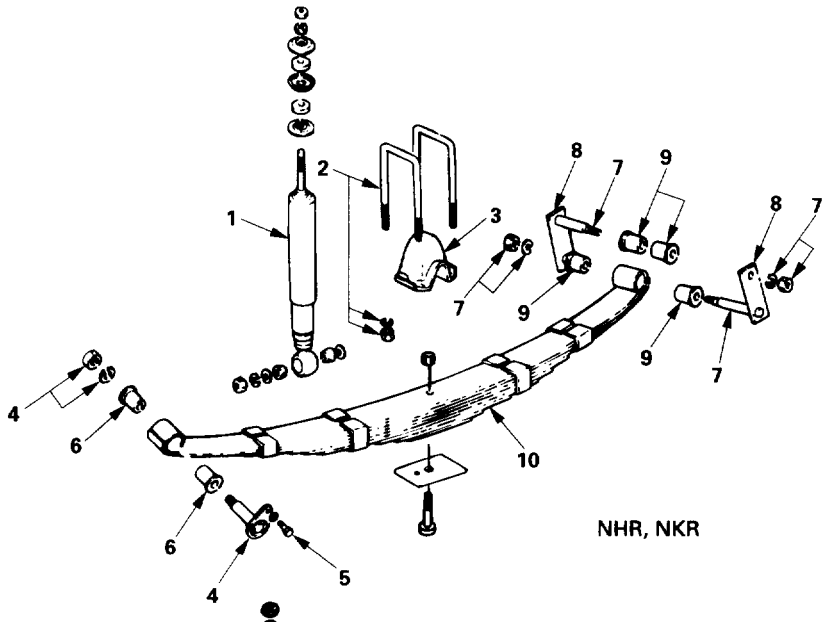
Wishbone Suspension



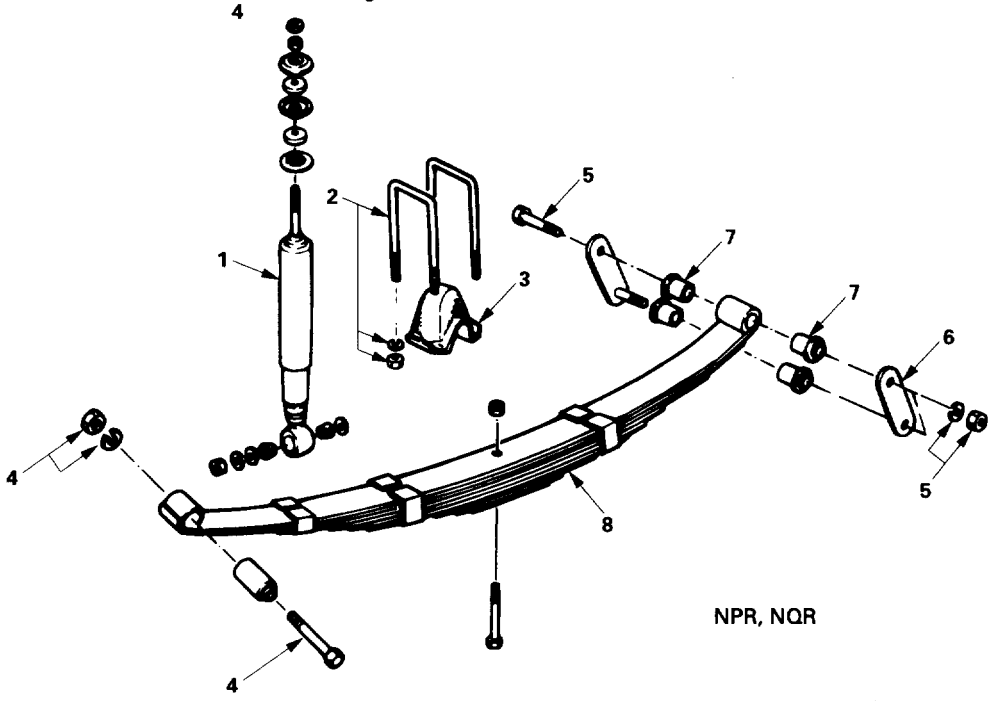
ON-VEHICLE SERVICE

FRONT SUSPENSION (RIGID SUSPENSION)

LEAF SPRING



NHR, NKR



NPR, NQR

450LY00002

Removal Steps

NHR and NKR

1. Shock absorber
2. U-bolt and nut
3. Helper rubber
4. Spring pin, nut and washer
5. Bolt
6. Rubber bushing
7. Shackle pin, nut and washer
8. Shackle
9. Rubber Bushing
10. Leaf Spring

NPR, NQR and NPS

1. Shock absorber
2. U-bolt and nut
3. Helper rubber
4. Spring pin, nut and washer
5. Shackle pin, nut and washer
6. Shackle
7. Rubber bushing
8. Leaf spring

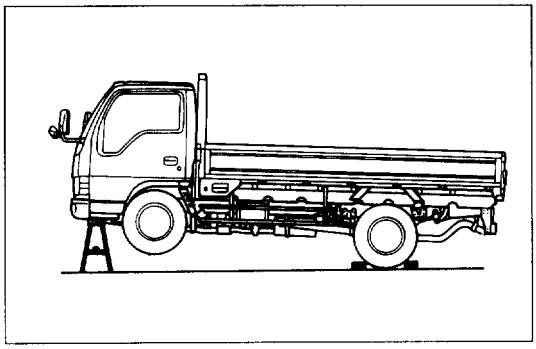
Installation Steps

NHR and NKR

10. Leaf spring
3. Helper rubber
2. U-bolt and nut
6. Rubber bushing
4. Spring pin, nut and washer
5. Bolt
9. Rubber bushing
8. Shackle
7. Shackle pin, nut and washer
1. Shock absorber

NPR, NQR and NPS

8. Leaf spring
3. Helper rubber
2. U-bolt and nut
4. Spring pin, nut and washer
7. Rubber bushing
6. Shackle
5. Shackle pin, nut and washer
1. Shock absorber



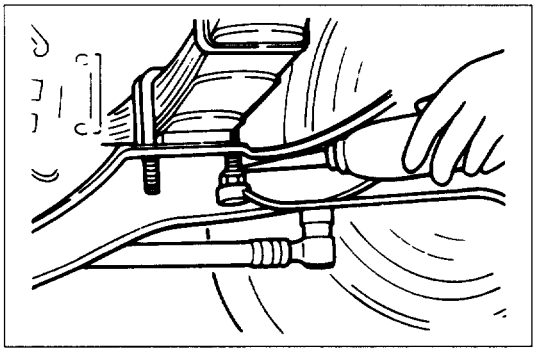
REMOVAL

Preparation

Make the following preparation before removing the leaf spring.

1) Brace the rear wheels.
2) Jack up the front axle until the front wheels are lifted off the ground and position safety stand under the chassis frame.

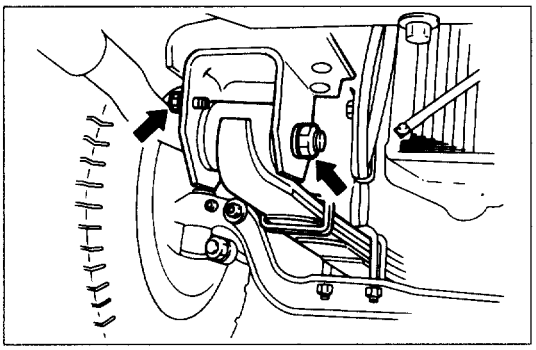
   Refer to "LIFTING INSTRUCTION" in SECTION 0 for acceptable lifting point and supportable point location.
3) Position a garage jack under the front axle.
4) For the vehicle model with a stabilizer, remove the mounting portion on the axle side of the stabilizer in advance before removing the leaf spring. (Refer to the removal procedure of the stabilizer.)



NHR and NKR

1. **Shock Absorber**
2. **U-bolt and Nut**
3. **Helper Rubber**

   If the U-bolts are heavily rusted, apply a generous amount of oil to the threads before loosening them to prevent seizure.



4. **Spring Pin, Nut and Washer**
5. **Bolt**
6. **Rubber Bushing**

   Take out the rubber bushings after removal of the spring pin.

7. **Shackle Pin, Nut and Washer**
8. **Shackle**
9. **Rubber Bushing**

   Take out the rubber bushings after removal of the shackle.

10. **Leaf Spring**

    Lower the garage jack slowly and remove the front spring assembly. When removing the front spring assembly, exercise care not to cause damage to the brake flexible hoses and drag link. Also, exercise care not to cause the spring to come down.

NPR, NQR and NPS

1. **Shock Absorber**
2. **U-bolt and Nut**
   Refer to page 3C-5.
3. **Helper Rubber**
4. **Spring Pin, Nut and Washer**
   Drive out the spring pin with a hammer using a brass bar after removal of the spring pin nut.
5. **Shackle Pin, Nut and Washer**
6. **Shackle**
   Drive out the shackle pin with a hammer using a brass bar after removal of the shackle pin nut.
7. **Rubber Bushing**
8. **Leaf Spring**
   Refer to page 3C-6.

INSPECTION AND REPAIR

Make the necessary adjustments, repairs and part replacements if excessive wear or damage is discovered during inspection.

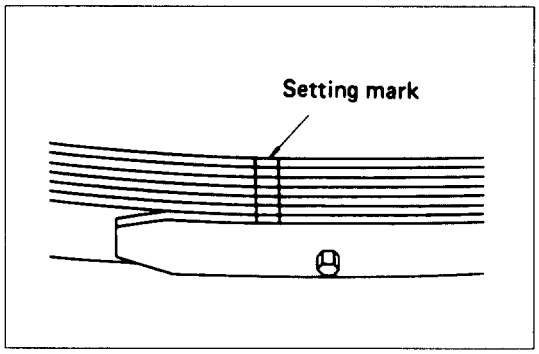
- Leaf spring assembly
- Clip
- Center bolt
- U-bolt
- Spring pin
- Shackle pin
- Helper rubber
- Rubber bushing

Visual Check

Inspect the following parts for wear, damage or other abnormal conditions.

Shock Absorber

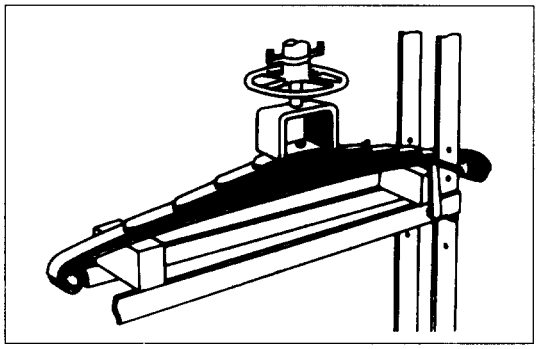
1. Inspect for extreme oil leakage.
   Slight oil leakage is allowed.
2. Inspect for temperature after running.
   Unchanged temperature indicates deteriorated function.
3. Inspect if large resistance is felt when the shock absorber is expanded and contracted by holding either end, or if play is eliminated after several times of expansion and contraction.
   The function has deteriorated if the above condition is not observed.
4. Inspect the bushing for wear or deterioration.
   Replace if abnormality is found.



Leaf Spring Assembly Replacement

- Apply a setting mark across the springs before disassembly the leaf spring assembly.
- Apply grease to both faces of each leaf spring at reassembly.
- Use a bench press for disassembly and reassembly.
- Discard center bolt removed and install a new one.

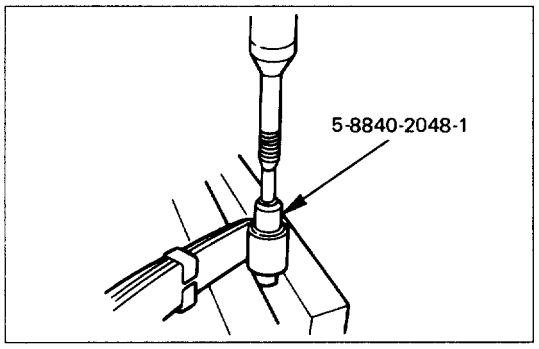
When replacing the leaf spring assembly, use the leaf spring with the same camber represented by "+, –, I" on both right and left sides.



Center Bolt

Tighten the center bolt nut to the specified torque.

Center Bolt Torque	N•m (kg•m / lb•ft)
NHR, NKR, NPR, NQR	39 (4 / 29)
NPS	314 (32 / 232)



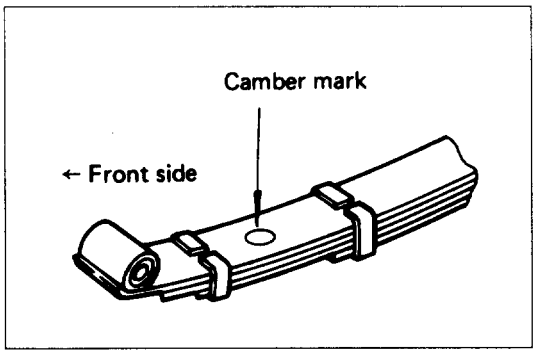
Bushing Replacement

When replacing bushing, drive out the bushing using a bench press.

Leaf Spring Rubber Bush Remover & Installer : 5-8840-2048-1

Leaf Spring Metal Bush Remover & Installer : 5-8840-2049-1

INSTALLATION



NHR, NKR

10. Leaf Spring

Install the leaf spring assembly with the camber mark turned to front side on the front axle.

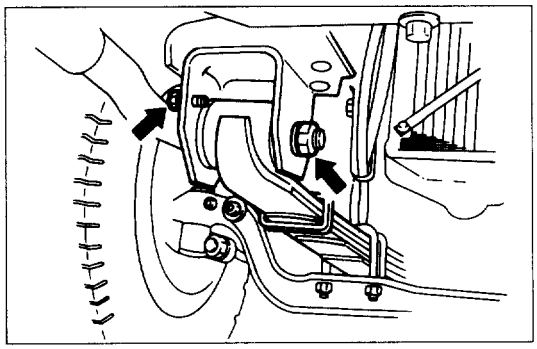
3. Helper Rubber

2. U-Bolt and Nut

Position the U-bolts and helper rubber on the leaf spring assemblies and jack up the front axle.

When tightening the nuts apply oil as necessary to prevent damaging the threads.

U-Bolt Nut Torque	N•m (kg•m / lb•ft)
	127 (13 / 94)



6. Rubber Bushing

4. Spring Pin, Nut and Washer

5. Bolt

Finger tighten first, and tighten to specified torque after lowering the vehicle to ground.

Spring Pin Nut Torque	N•m (kg•m / lb•ft)
Bolt	27 (2.8 / 20)
Nut	177 (18 / 130)

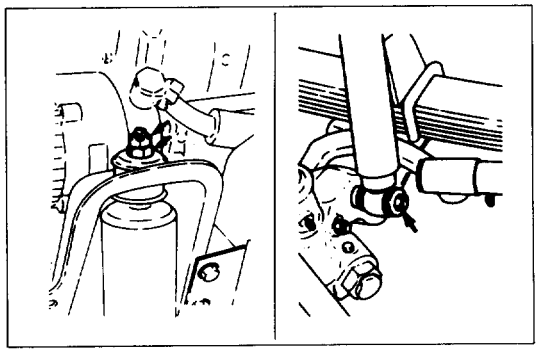
9. Rubber Bushing

8. Shackle

7. Shackle Pin, Nut and Washer

Finger tighten first, and tighten to specified torque after lowering the vehicle to ground.

Shackle Pin Nut Torque	N•m (kg•m / lb•ft)
	137 (14 / 101)



1. Shock Absorber

Shock Absorber Nut Torque	N•m (kg•m / lb•ft)
Upper Nut	20 (2.0 / 15)
Upper Safety Nut	40 (4.1 / 30)
Lower Nut	61 (6.2 / 45)

NPR, NQR and NPS

8. **Leaf Spring**
   Refer to page 3C- 9.
3. **Helper Rubber**
2. **U-Bolt and Nut**

U-bolt Nut Torque	N•m (kg•m / lb•ft)
NPR, NPS	127 (13 / 94)
NQR	196 (20 / 145)

4. **Spring Pin, Nut and Washer**
   Refer to page 3C- 9.

Spring Pin Nut Torque	N•m (kg•m / lb•ft)
219 (21.3 / 154)	

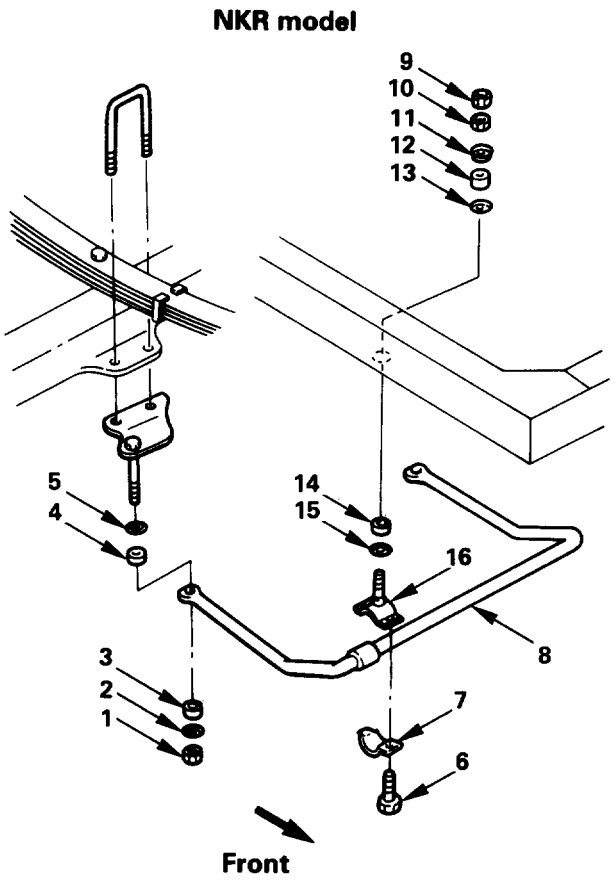
7. **Rubber Bushing**
6. **Shackle**
5. **Shackle Pin, Nut and Washer**
   Refer to page 3C- 9.

Shackle Pin Nut Torque	N•m (kg•m / lb•ft)
219 (21.3 / 154)	

1. **Shock Absorber**

Shock Absorber Nut Torque	N•m (kg•m / lb•ft)
Upper Nut	20 (2.0 / 15)
Upper Safety Nut	40 (4.1 / 30)
Lower Nut	95 (9.7 / 70)

FRONT STABILIZER (NKR)



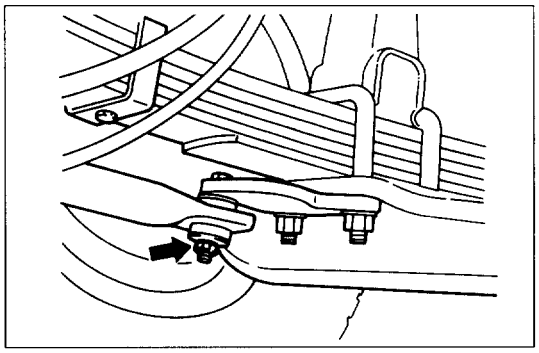
Removal Steps

1. Nut
2. Washer
3. Rubber bushing
4. Rubber bushing
5. Washer
6. Bolt
7. Rod link cap
8. Stabilizer bar
9. Nut
10. Nut
11. Washer
12. Rubber bushing
13. Washer
14. Rubber bushing
15. Washer
16. Rod link

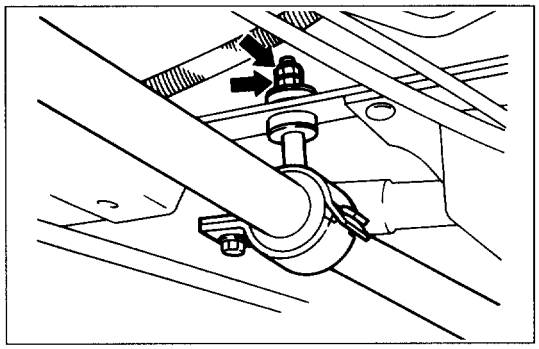
Installation Steps

8. Stabilizer bar
16. Rod link
7. Rod link cap
6. Bolt
15. Washer
14. Rubber bushing
13. Washer
12. Rubber bushing
11. Washer
10. Nut
9. Nut
5. Washer
4. Rubber bushing
3. Rubber bushing
2. Washer
1. Nut

REMOVAL



1. Nut
2. Washer
3. Rubber Bushing
4. Rubber Bushing
5. Washer



6. Bolt
7. Rod Link Cap
8. Stabilizer Bar
9. Nut
10. Nut
11. Washer
12. Rubber Bushing
13. Washer
14. Rubber Bushing
15. Washer
16. Rod Link

INSPECTION AND REPAIR

Make the necessary adjustments, repairs and part replacements if excessive wear or damage is discovered during inspection.

Stabilizer

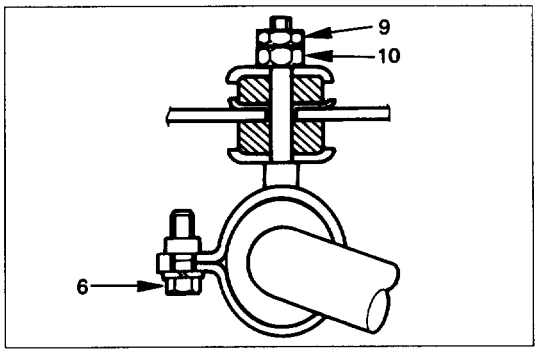
Inspect the stabilizer bar and attachments for the following conditions:

1. Cracks, bends or damage to the bar.
2. Worn bushings.
3. Damaged brackets.

- Replace any worn or damaged parts.

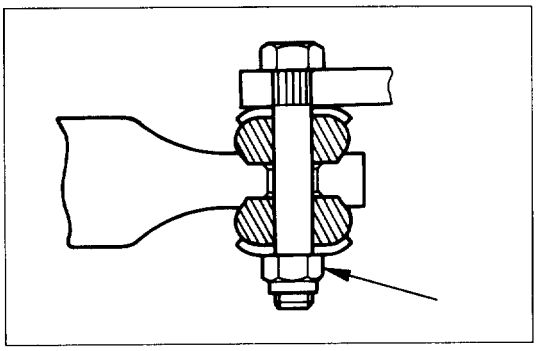
INSTALLATION

NOTE:
During installation, place the vehicle on flat ground and tighten each part to the specified torque.



8. **Stabilizer Bar**
16. **Rod Link**
7. **Rod Link Cap**
6. **Bolt**
15. **Washer**
14. **Rubber Bushing**
13. **Washer**
12. **Rubber Bushing**
11. **Washer**
10. **Nut**
9. **Nut**

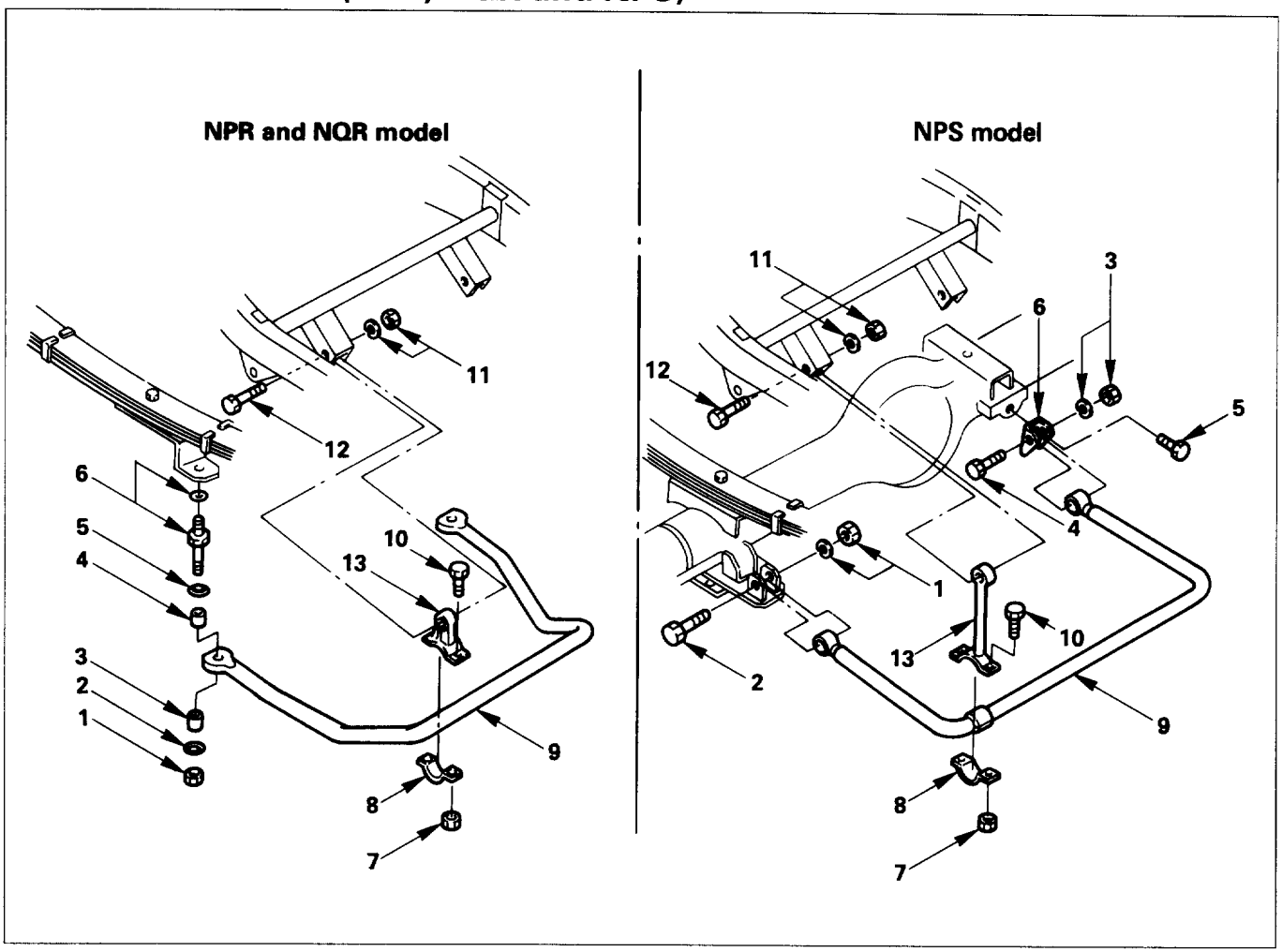
Rod Link Bolt and Nut Torque	N•m (kg•m / lb•ft)
6. Bolt	27 (2.8 / 20)
10. Nut	20 (2.0 / 14)
9. Nut	40 (4.1 / 30)



5. **Washer**
4. **Rubber Bushing**
3. **Rubber Bushing**
2. **Washer**
1. **Nut**

Nut Torque	N•m (kg•m / lb•ft)
25 (2.5 / 18)	

FRONT STABILIZER (NPR, NQR and NPS)



Removal Steps

NPR and NQR

1. Nut
2. Washer
3. Rubber bushing
4. Rubber bushing
5. Washer
6. Stud bolt and spring washer
7. Nut
8. Rod link cap
9. Stabilizer bar
10. Bolt
11. Nut and spring washer
12. Bolt
13. Rod link

Installation Steps

NPR and NQR

9. Stabilizer bar
13. Rod link
8. Rod link cap
10. Bolt
7. Nut
12. Bolt
11. Nut and spring washer
6. Stud bolt and spring washer
5. Washer
4. Rubber bushing
3. Rubber bushing
2. Washer
1. Nut

Removal Steps

NPS

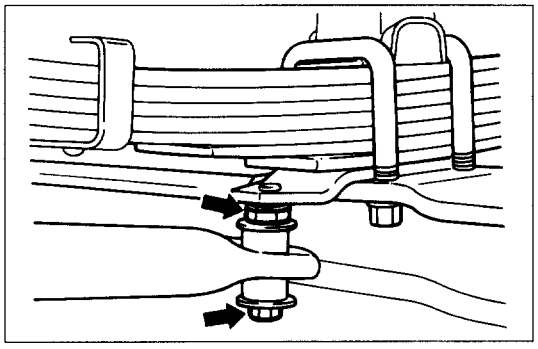
1. Nut and spring washer
2. Bolt
3. Nut and spring washer
4. Bolt
5. Bolt
6. Stabilizer bracket
7. Nut
8. Rod link cap
9. Stabilizer bar
10. Bolt
11. Nut and spring washer
12. Bolt
13. Rod link

Installation Steps

NPS

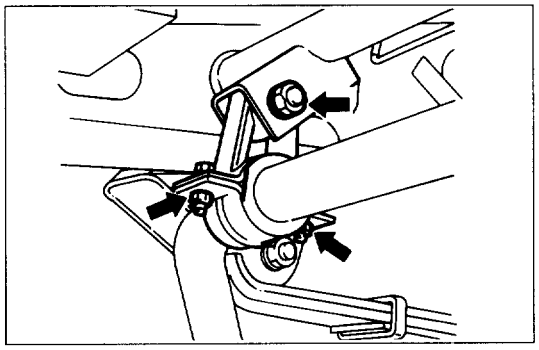
9. Stabilizer bar
13. Rod link
8. Rod link cap
10. Bolt
7. Nut
12. Bolt
11. Nut and spring washer
6. Stabilizer bracket
5. Bolt
4. Bolt
3. Nut and spring washer
2. Bolt
1. Nut and spring washer

REMOVAL

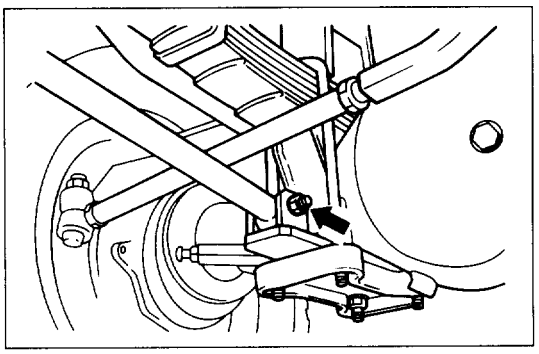


NPR and NQR

1. **Nut**
2. **Washer**
3. **Rubber Bushing**
4. **Rubber Bushing**
5. **Washer**
6. **Stud Bolt and Spring Washer**

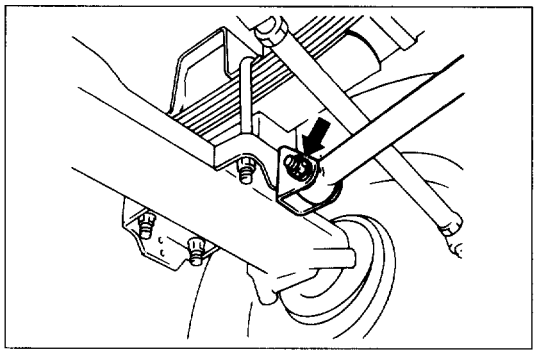


7. **Nut**
8. **Rod Link Cap**
9. **Stabilizer Bar**
10. **Bolt**
11. **Nut and Spring Washer**
12. **Bolt**
13. **Rod Link**

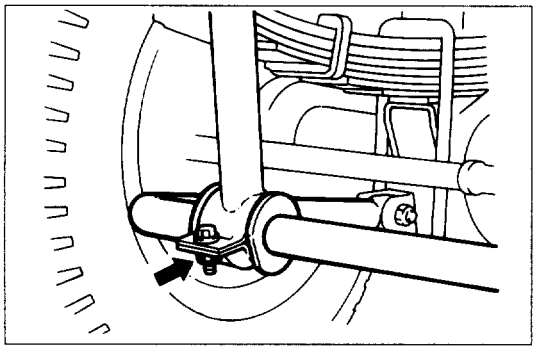


NPS

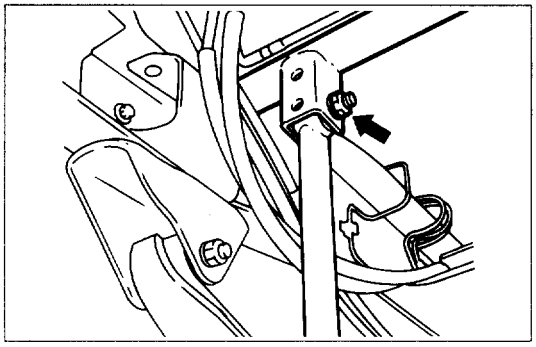
1. **Nut and Spring Washer**
2. **Bolt**



3. Nut and Spring Washer
4. Bolt
5. Bolt
6. Stabilizer Bracket



7. Nut
8. Rod Link Cap
9. Stabilizer Bar
10. Bolt



11. Nut and Spring Washer
12. Bolt
13. Rod Link

INSPECTION AND REPAIR

Make the necessary adjustments, repairs and part replacements if excessive wear or damage is discovered during inspection.

Stabilizer

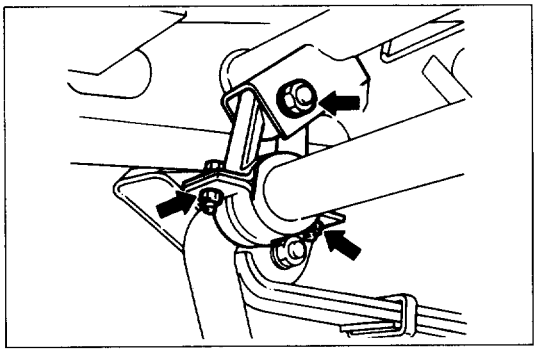
Inspect the stabilizer bar and attachments for the following conditions:

1. Cracks, bends or damage to the bar.
2. Worn bushings.
3. Damaged brackets.

- Replace any worn or damaged parts.

INSTALLATION

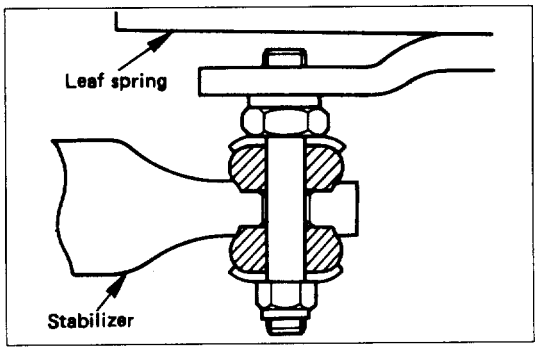
NOTE:
During installation, place the vehicle on flat ground and tighten each part to the specified torque.



NPR and NQR

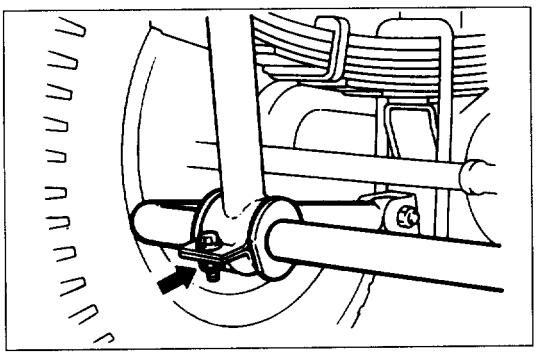
9. **Stabilizer Bar**
13. **Rod Link**
8. **Rod Link Cap**
10. **Bolt**
7. **Nut**
12. **Bolt**
11. **Nut and Spring Washer**

Rod Link Nut Torque	N•m (kg•m / lb•ft)
Rod Link Cap Nut	27 (2.8 / 20)
Rod Link Bracket Nut	117 (11.9 / 86)



6. **Stud Bolt and Spring Washer**
5. **Washer**
4. **Rubber Bushing**
3. **Rubber Bushing**
2. **Washer**
1. **Nut**

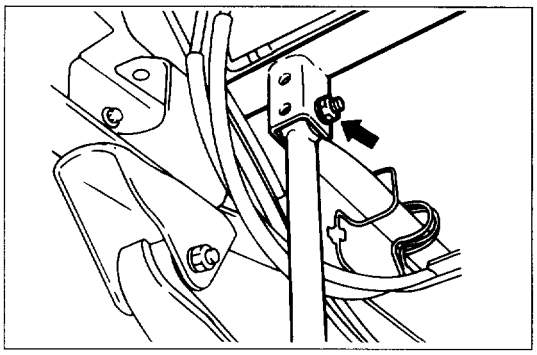
Stud Bolt and Nut Torque	N•m (kg•m / lb•ft)
Stud Bolt	117 (11.9 / 86)
Nut	29 (3.0 / 22)



NPS

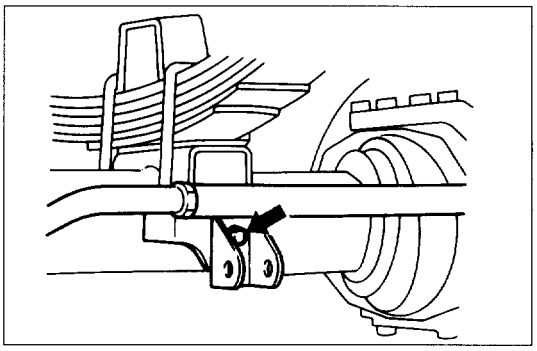
9. **Stabilizer Bar**
13. **Rod Link**
8. **Rod Link Cap**
10. **Bolt**
7. **Nut**

Nut Torque	N•m (kg•m / lb•ft)
27 (2.8 / 20)	



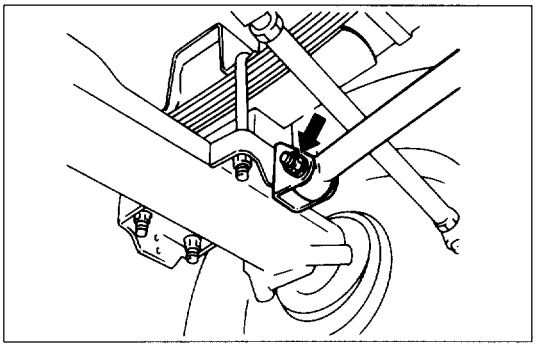
12. **Bolt**
11. **Nut and Spring Washer**

Nut Torque	N•m (kg•m / lb•ft)
	127 (13 / 94)



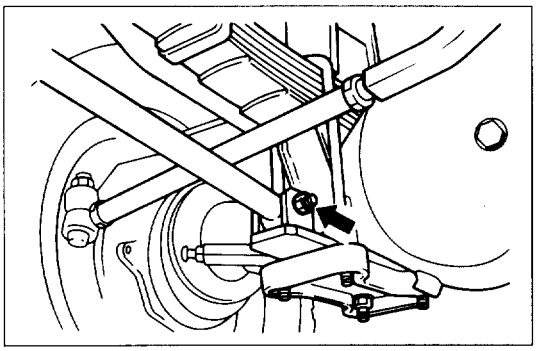
6. **Stabilizer Bracket**
5. **Bolt**

Bolt Torque	N•m (kg•m / lb•ft)
	19 (1.9 / 14)



4. **Bolt**
3. **Nut and Spring Washer**

Nut Torque	N•m (kg•m / lb•ft)
	40 (4.1 / 30)

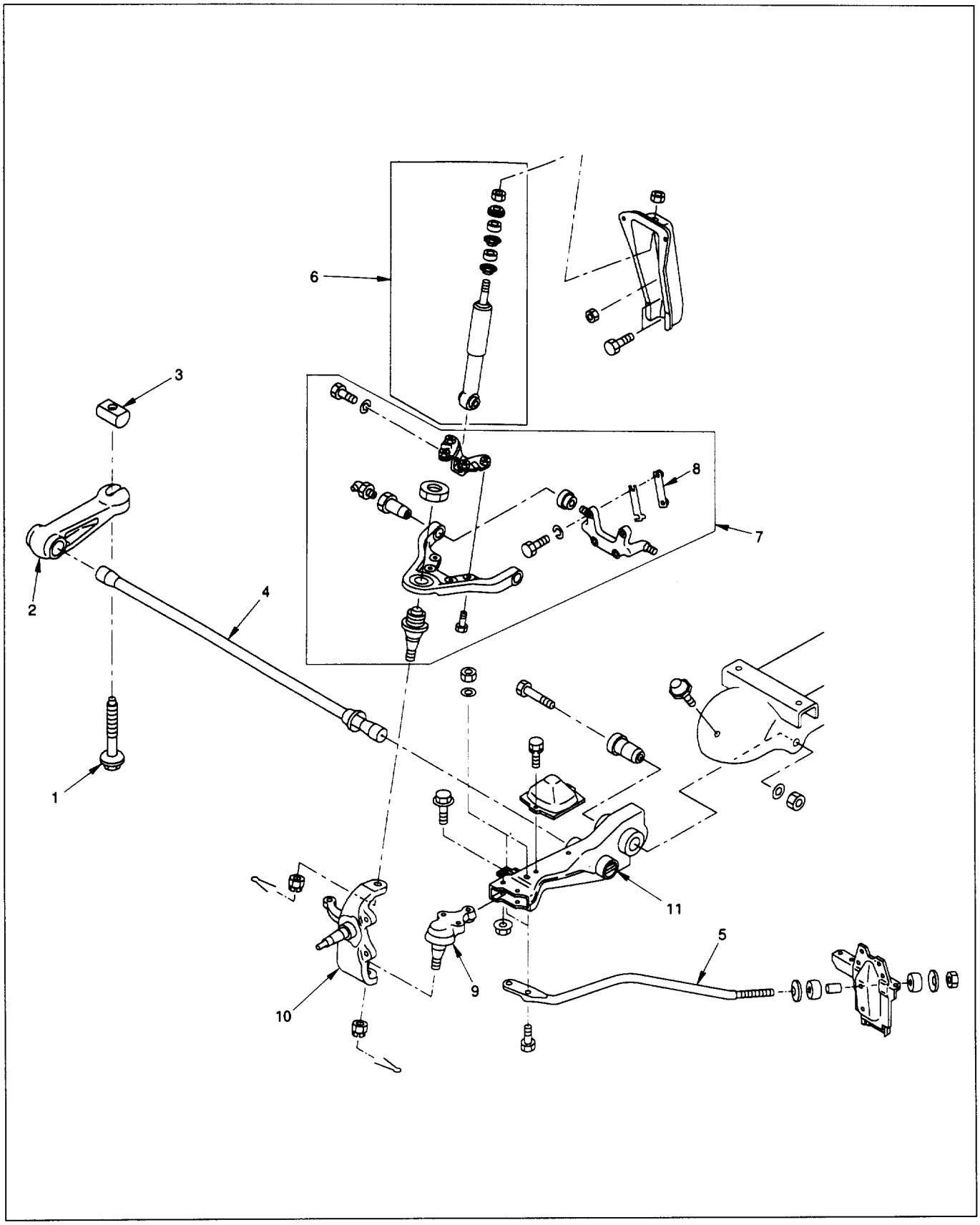


2. **Bolt**
1. **Nut and Spring Washer**

Nut Torque	N•m (kg•m / lb•ft)
	40 (4.1 / 30)

MEMO

FRONT SUSPENSION
(WISHBONE SUSPENSION)



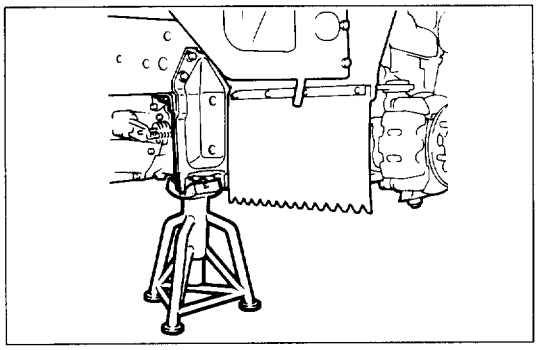
Removal Steps

1. Adjusting bolt
2. Height Control arm
3. End piece
4. Torsion bar
5. Strut bar assembly
6. Shock absorber assembly
7. Upper link assembly
8. Adjusting shim
9. Lower link ball joint
10 Knuckle
11. Lower link

Installation Steps

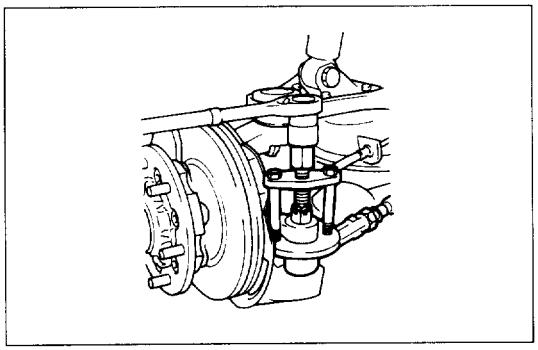
11. Lower link
9. Lower link ball joint
8. Adjusting shim
7. Upper link assembly
10. Knuckle
6. Shock absorber assembly
5. Strut bar assembly
4. Torsion bar
3. End piece
2. Height Control arm
1. Adjusting bolt

REMOVAL



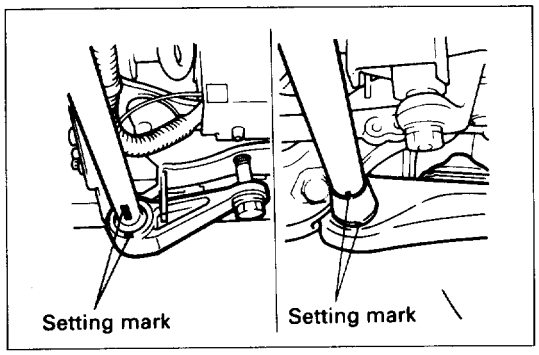
Preparations

- Raise the vehicle and support the jack up point with suitable safety stands. Refer to "Jack Up Point" in Section 00.
- Remove front tire and wheels. Refer to "Wheels and Tires" in Section 3E.
- Remove brake caliper assembly. Refer to "Disc and Drum Brake" in Section 5A2.
- Remove hub and rotor assembly. Refer to "Front Axle" in Section 4C.

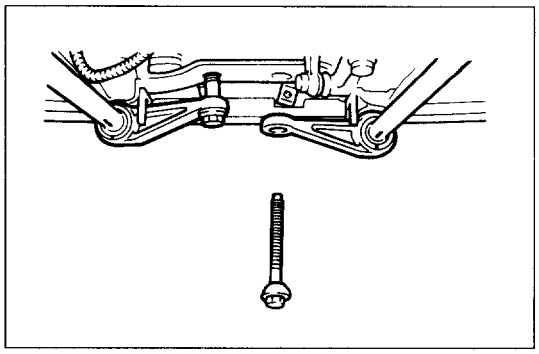


- Disconnect the outer track rod ball joint from the knuckle.

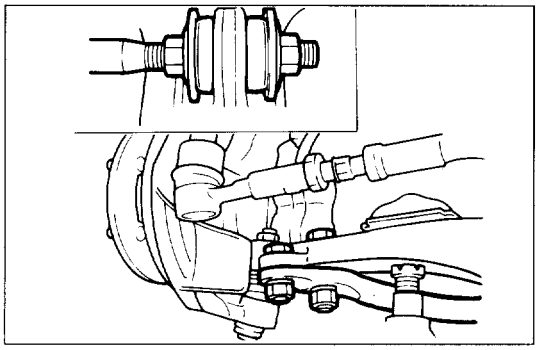
  Remover: 5-8840-2017-0



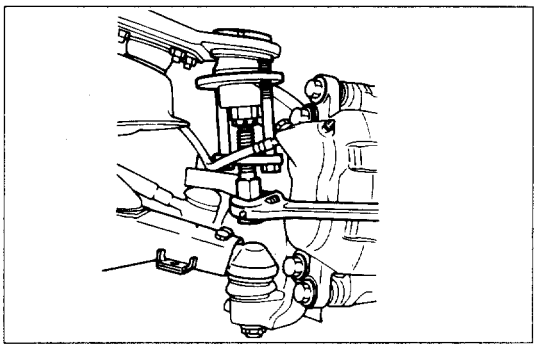
1. **Adjusting Bolt**
2. **Height Control Arm**
3. **End Piece**
4. **Torsion Bar**
   - Apply setting marks to torsion bar, height control arm and lower link to ensure installation of the parts in their original position.



Apply setting marks to adjusting bolt threads to ensure installation of the parts in their original position.



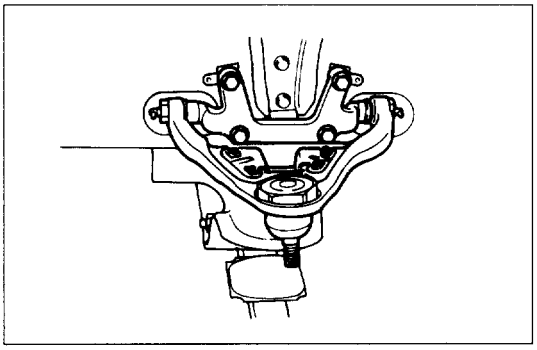
5. **Strut Bar Assembly**
   - Raise and support the lower link with a jack.
   - Loosen the rear side nut, and remove the nut, washer and rubber bushing.
   - Loosen two fixing bolts of lower link side and remove the strut bar to front side.



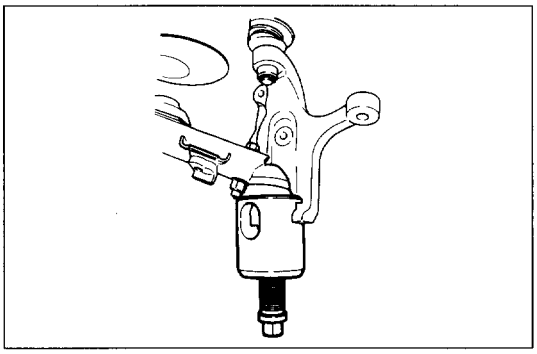
6. **Shock Absorber**
7. **Upper Link Assembly**
8. **Adjusting Shim**

   Disconnect upper link joint ball at the knuckle.

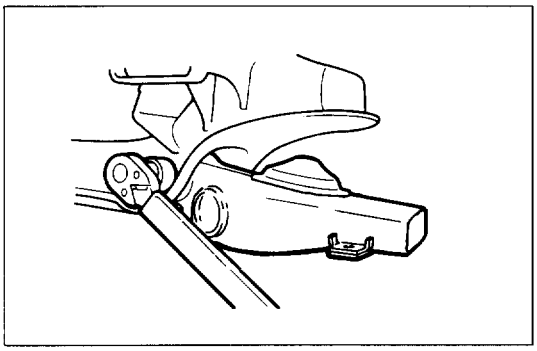
   Remover: 5-8840-2017-0



- Remove the fulcrum pin fixing bolt.
- Note the thickness and number of shims.



9. **Lower Link Ball joint**
10. **Knuckle**
    - Disconnect the lower link ball joint at the knuckle.
      Remover: 5-8840-2366-0
    - Remove two fixing bolts and the ball joint from lower link.



11. **Lower Link**

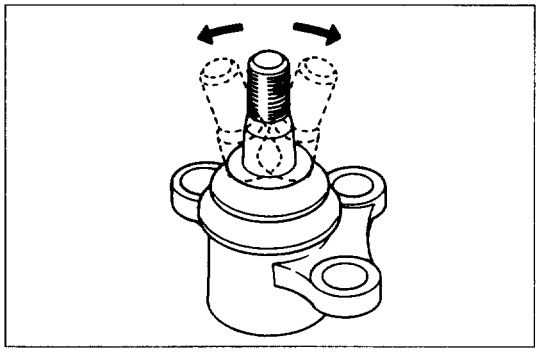
INSPECTION AND REPAIR

Make necessary correction or parts replacements if excessive wear, damage, corrosion or any other abnormal condition are found through inspection.

- Torsion Bar
- End Piece
- Height Control Arm
- Rubber Bushings
- Strut Bar
- Shock Absorber

Visual Check

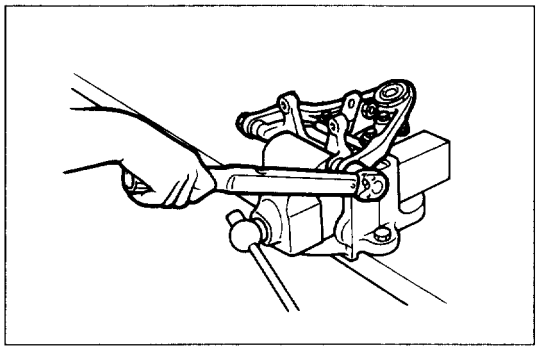
Inspect the following parts for excessive wear, damage, bending, oil leak or any other abnormal conditions.



Ball Joint

- Inspect the ball joint boot for damage or grease leak.
- Move the ball joint to confirm its normal movement.
- Inspect screw / taper area of ball for flaws.

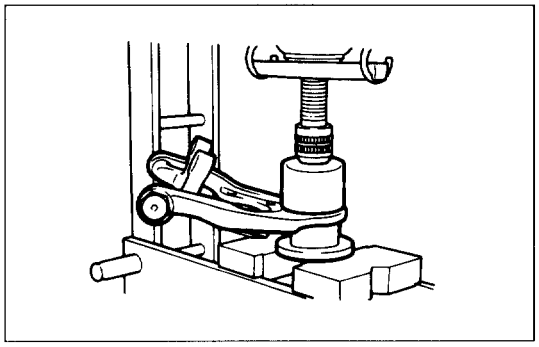
If any defects are found by the above inspections, replace the ball joint with new one.



Upper Ball Joint Replacement

- Remove the ball joint fixing nut (Hex. 63mm).
- Remove the ball joint from the upper link using a special tool.

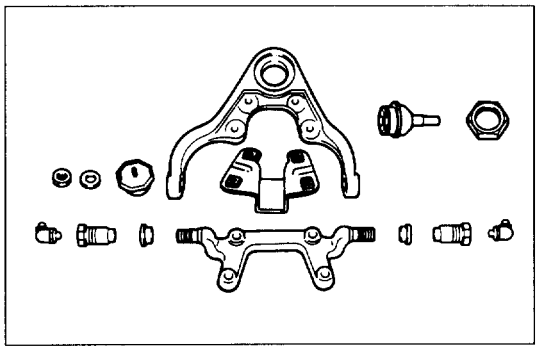
  Remover: 5-8840-2364-0



- Install the ball joint to the upper link using a bench press and special tool.

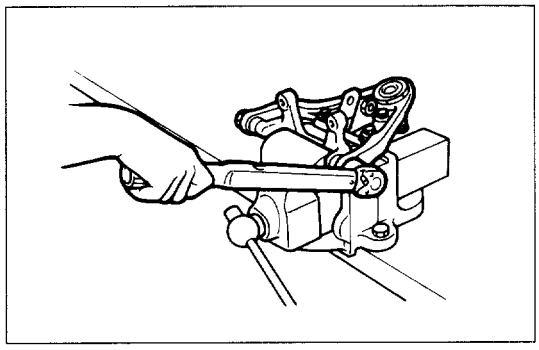
  Installer: 5-8840-2365-0
- Tighten nut to specified torque

Joint Ball Nut Torque	N•m (kg•m/lb•ft)
	211 (21.5 / 156)



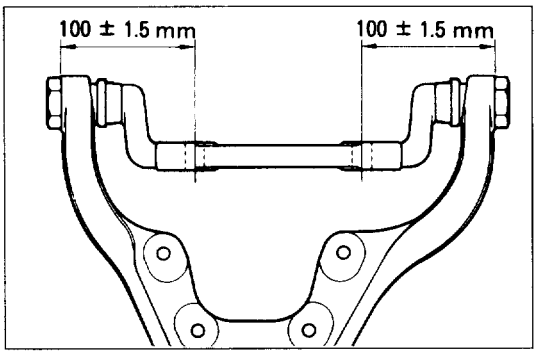
Upper Link Assembly

- Disassemble the upper link assembly.
- Inspect the following parts as shown in the figure for wear, damage, bending or any other abnormal conditions.

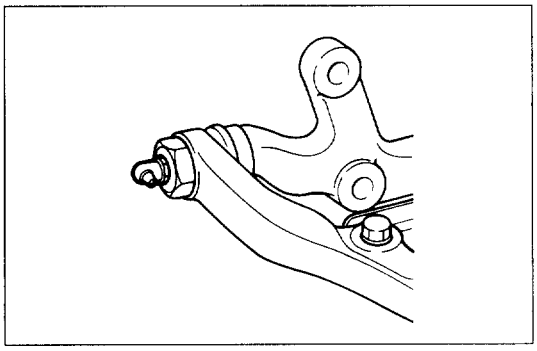


- Reassemble the upper link assembly.
- Apply multi-purpose with MoS_2 grease to the fulcrum pin threads.
- Fill multi-purpose with MoS_2 grease to bushings.
- Install the fulcrum pin to the upper link and tighten bushings to specified torque.

Bushing Torque	N•m (kg•m/lb•ft)
	294 (30 / 217)



- Adjust the fulcrum pin as shown in the figure.



- Install grease fitting to upper link in parallel with upper link.

Lower Link Bushing Replacement

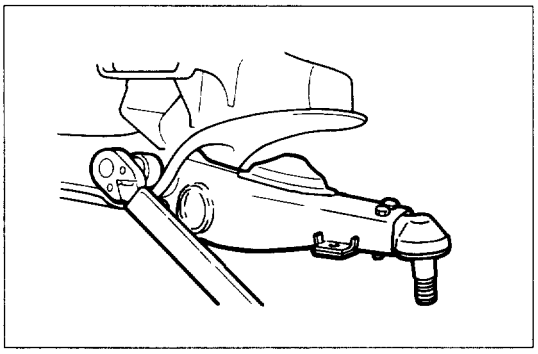
- Remove the lower link bushing using a bench press and special tool.

  Remover: 5-8840-2367-0

- Inspect the bushing for wear, damage or any other abnormal condition.
- Install the bushing to the lower link from vehicle forward direction.

  Installer: 5-8840-2367-0

INSTALLATION



11. Lower Link

- Install the lower link fixing bolt from the vehicle forward direction and set the bolt head to the bolt stopper completely.
- Tighten the nut temporarily.

NOTE:

Tighten nuts to specified torque after following steps;

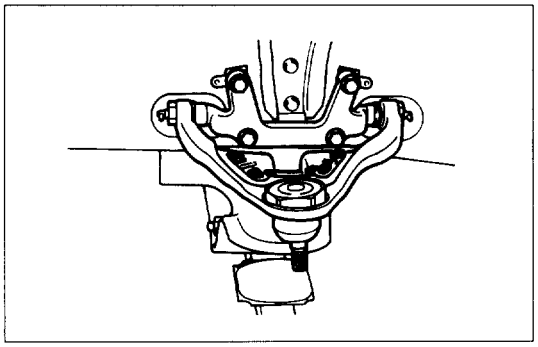
- **Park the vehicle on a level ground.**
- **Move the front of the vehicle up and down several times to settle the suspension.**

Lower Link Nut Torque	N•m (kg•m/lb•ft)
584 (59.5 / 430)	

9. Lower Link Joint Ball

Install the lower link ball joint to specified torque.

Lower Link Ball Joint Nut Torque	N•m (kg•m/lb•ft)
167 (17 / 123)	



8. Shim

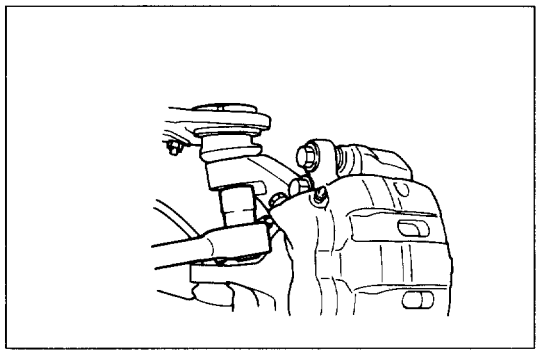
7. Upper Link Assembly

- Install shims and upper link assembly
- Tighten fixing bolts to specified torque.

Thickness of Shims Available	(mm)
0.8, 1.6, 3.2	

Upper Link Bolt Torque	N•m (kg•m/lb•ft)
152 (15.5 / 112)	

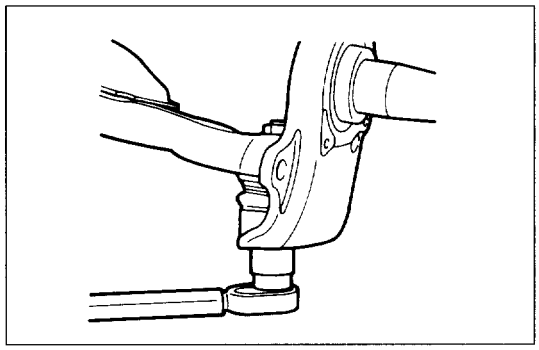
For adjustment of camber and caster angle, refer to "Front End Alignment" in Section 3A.



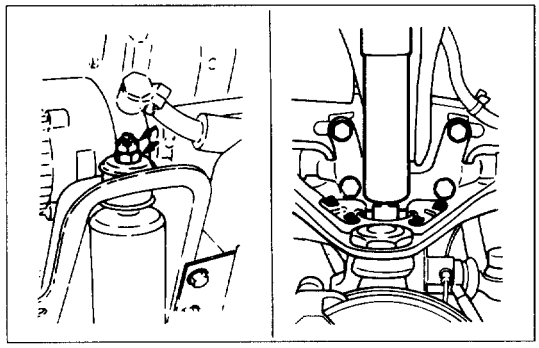
10. Knuckle

- Connect the upper ball joint, lower ball joint to the knuckle.
- Tighten fixing nuts temporarily.
- After installation of tie rod end and strut bar assembly,tighten fixing nuts to specified torque, with just enough additional torque to align cotter pin holes.

  Install new cotter pin.

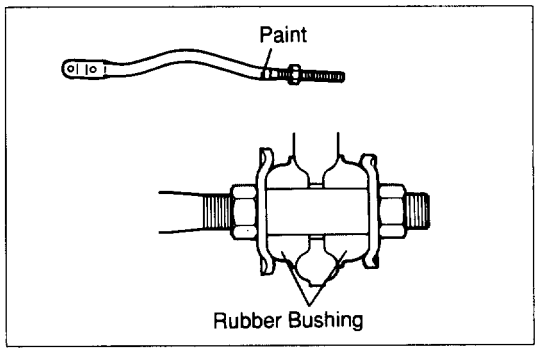


Ball Joint Nut Torque	N•m (kg•m/lb•ft)
Upper	206 (21.0 / 152)
Lower	377 (38.4 / 278)



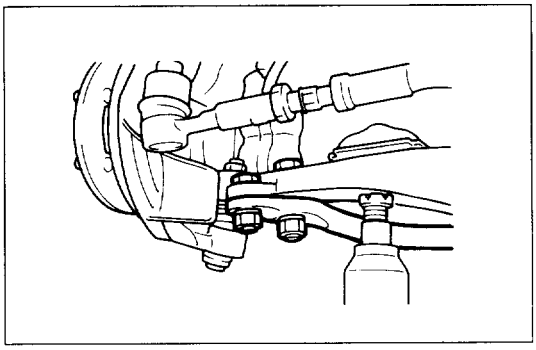
6. Shock Absorber Assembly

Shock Absorber Bolt and Nut Torque	N•m (kg•m/lb•ft)
Upper	40 (4.1 / 30)
Lower	267 (27.2 / 197)



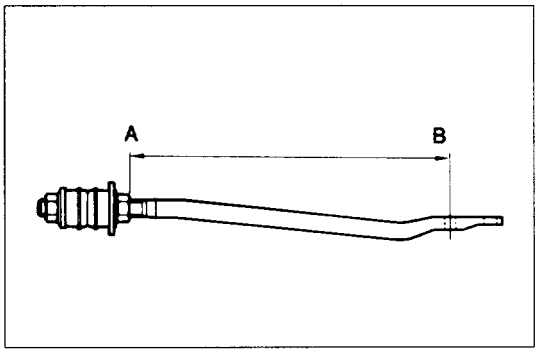
5. Strut Bar Assembly

- Install strut bar assembly.
- White paint is aligned to right side strut bar. Be careful not to install to the opposite side.
- Apply a thin coat of rubber grease to inside of the rubber bushing.
- Tighten rear side fixing nuts temporarily.



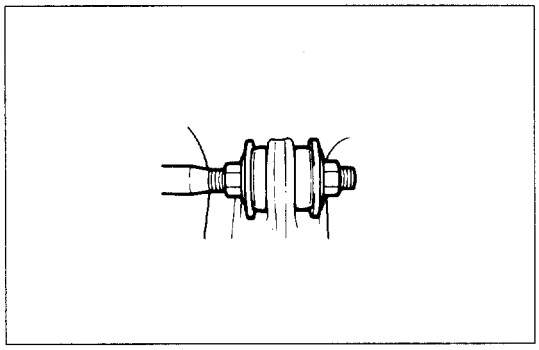
- Tighten lower link side fixing bolts to specified torque.

Strut Bar Bolt and Nut Torque	N•m (kg•m/lb•ft)
219 (22.3 / 161)	



- Adjust the strut bar length (L) after Installation.

Strut Bar Length (L)	mm(in)
485.0(19.095)	

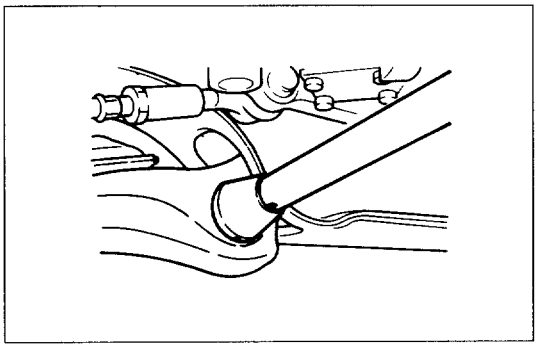


NOTE:

Tighten nuts to specified torque after following steps;

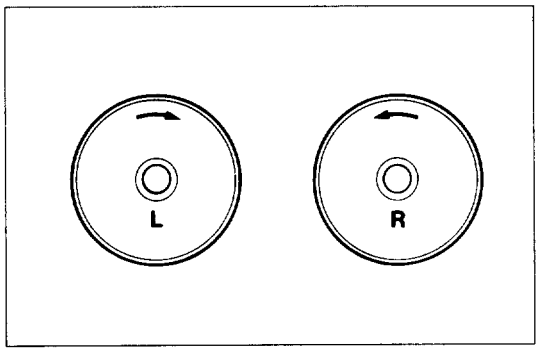
- **Park the vehicle on a level ground.**
- **Move the front of the vehicle up and down several times to settle the suspension.**

Strut Bar Nut Torque (Rear Side)	N•m (kg•m/lb•ft)
235 (24 / 174)	



4. **Torsion Bar**
3. **End Piece**
2. **Height Control Arm**
1. **Adjusting Bolt**

- Apply chassis type grease to serrated portions of torsion bar, lower arms, threaded portion of end piece.
- Make sure the bars are on their correct respective sides.



- Align the setting marks applied at removal.
- Tighten adjusting bolts to the original portion temporarily.
- Install the outer track rod end to the knuckle. Tighten nuts to specified torque, with just enough additional torque to align cotter pin holes. Install new cotter pin.

Strut Bar Nut Torque (Rear Side)	N•m (kg•m/lb•ft)
108 (11 / 80)	

- Park the vehicle on a level ground.
- Move the front of the vehicle up and down several times to settle the suspension.
- Tighten temporarily tightening bolts and nuts to specified torque.
- Install the hub and rotor assembly. Refer to "Front Axle" in Section 4C.

- Install the brake caliper assembly. Refer to "Disc and Drum Brake " in Section 5A2.

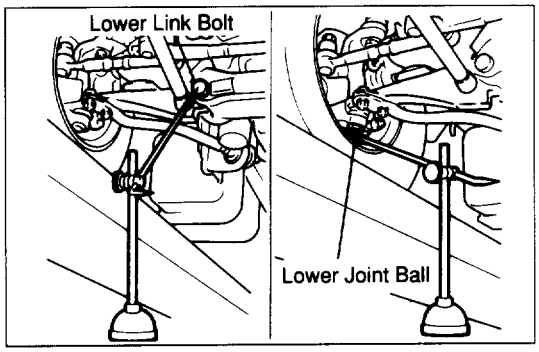
Brake Caliper Bolt Torque	N•m (kg•m/lb•ft)
219 (22.3 / 161)	

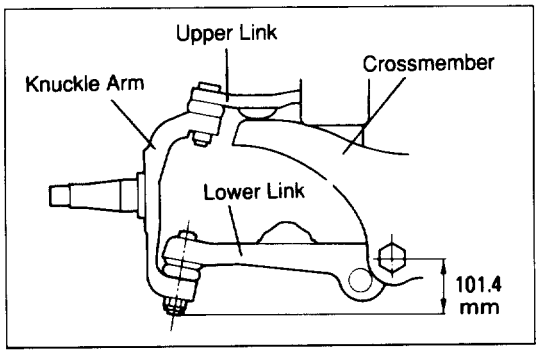
- Install front wheel and tire assembly. Refer to "Wheels and Tires" in Section 3E.
- Adjust the trim height.

NOTE:

Adjust the front end alignment. Refer to "Front End Alignment" in Section 3A.

Bleed brakes. Refer to "Hydraulic Brakes" in Section 5A.





Adjustment of Trim Height

Adjust the trim height by means of adjusting bolt on the height control arms.

CAUTION:

When adjusting front end alignment, be sure to begin with trim height as trim height adjustment may change other adjusted alignments.

1. Check and adjust the tire inflation pressures.
2. Park the vehicle on a level ground and move the front of the vehicle up and down several times to settle the suspension.
3. Make necessary adjustment with the adjusting bolt on the height control arms.

Trim Height	mm(in)
101.4±5 (3.992±0.197)	

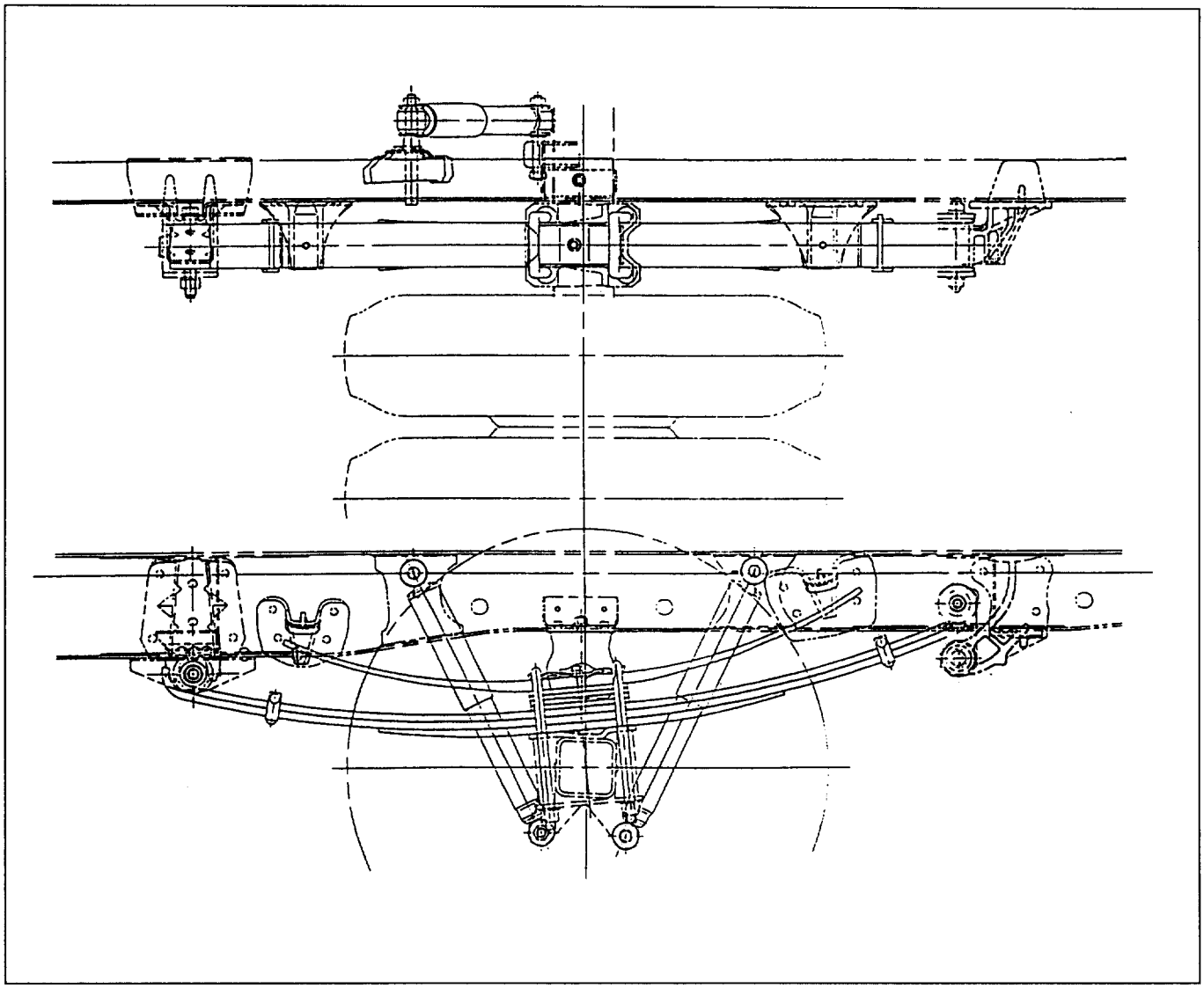
SECTION 3D
REAR SUSPENSION

CONTENTS

PAGE

General Description 3D– 2
On-Vehicle Service 3D– 3
Rear Suspension 3D– 3

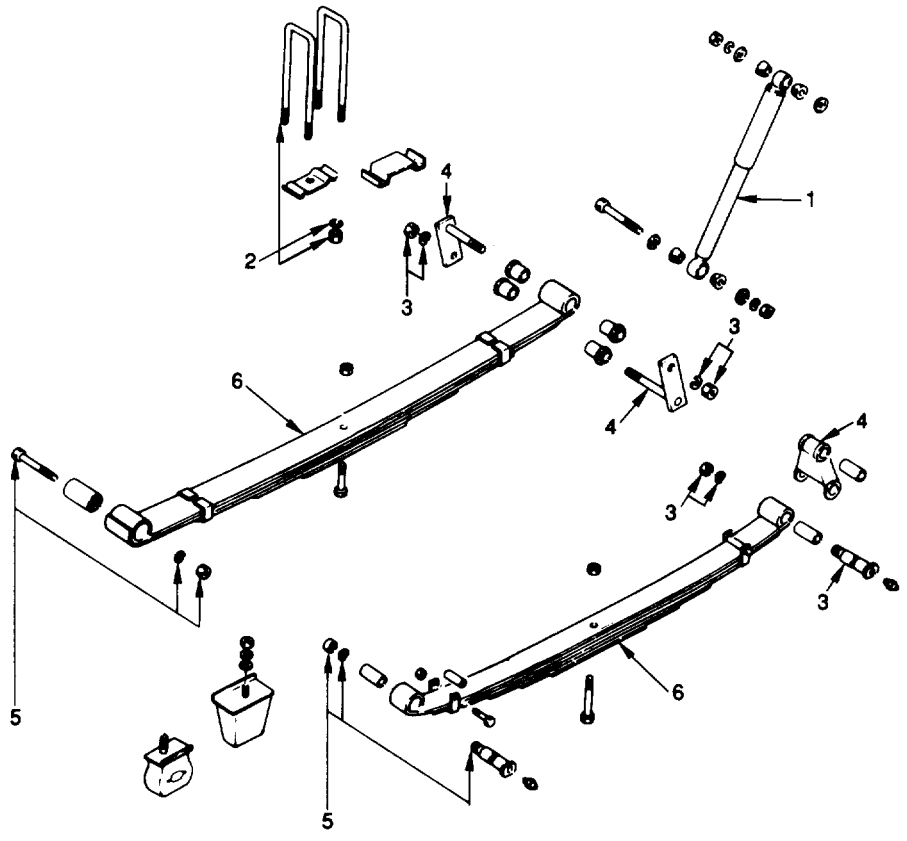
GENERAL DESCRIPTION



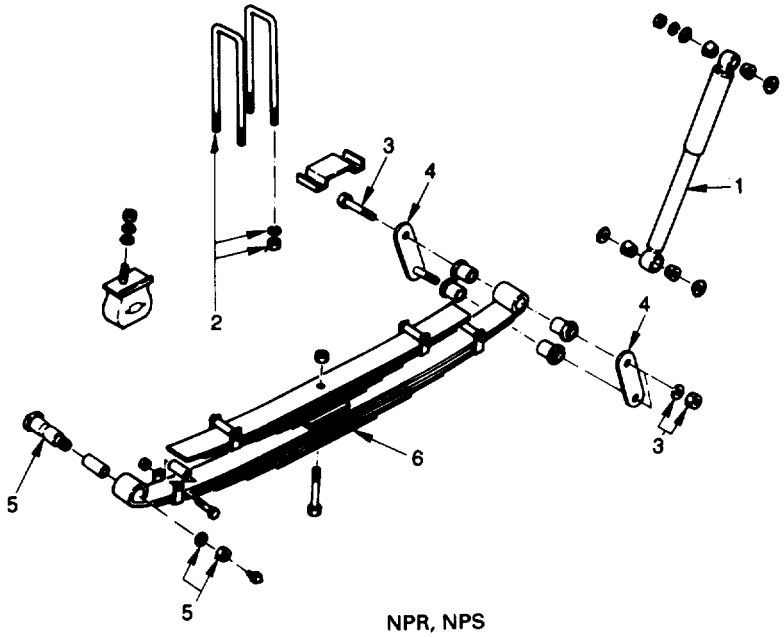
ON-VEHICLE SERVICE

REAR SUSPENSION

LEAF SPRING



NHR, NKR



NPR, NPS

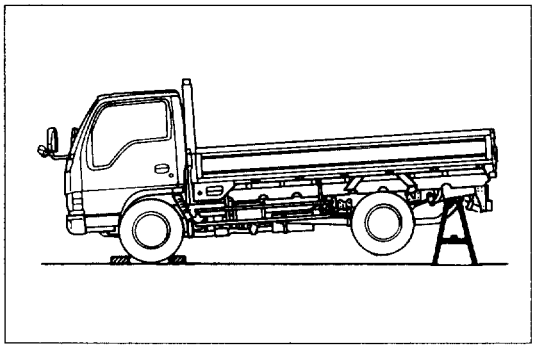
Removal Steps

1. Shock absorber
2. U-bolt, nut and washer
3. Shackle pin, nut and washer
4. Shackle
5. Spring pin, nut and washer
6. Leaf spring

Installation Steps

6. Leaf spring
2. U-bolt, nut and washer
5. Spring pin, nut and washer
4. Shackle
3. Shackle pin, nut and washer
1. Shock absorber

REMOVAL

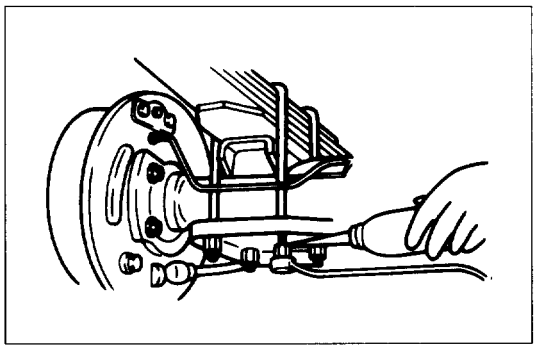


Preparation

Make the following preparation before removing the leaf spring.

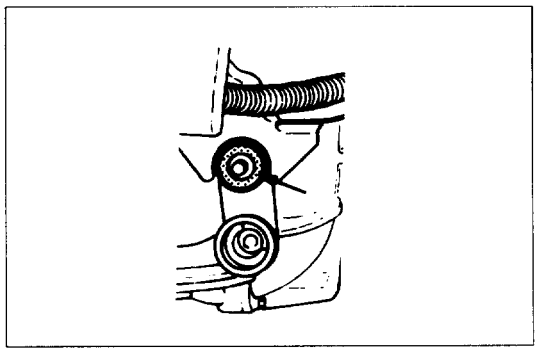
1) Brace the front wheels.
2) Jack up the rear axle until the rear wheels are lifted off the ground and position safety stand under the chassis frame.

   Refer to "Lifting Instruction" in Section 0 for acceptable lifting point and supportable point location.
3) Position a garage jack under the rear axle.
4) For the vehicle model with a stabilizer, remove the mounting portion on the axle side of the stabilizer in advance before removing the leaf spring. (Refer to the removal procedure of the stabilizer.)



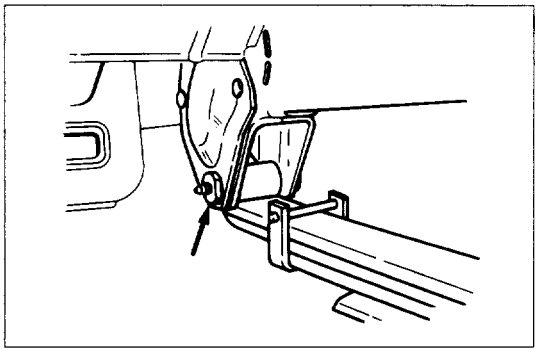
1. **Shock Absorber**
2. **U-bolt, Nut and Washer**

   If the U-bolt are heavily rusted, apply a generous amount of oil to the threads before loosening them to prevent seizure.



3. **Shackle Pin, Nut and Washer**
4. **Shackle**

   Take out the rubber bushings after removal of the shackle.



5. **Spring Pin, Nut and Washer**

   Drive out the shackle pin with a hammer using a brass bar after removal of the shackle pin nut.

6. **Leaf Spring**

   Lower the garage jack slowly and remove the rear spring assembly. When removing the rear spring assembly, exercise care not to cause damage to the brake flexible hoses. Also, exercise care not to cause the spring to come down.

INSPECTION AND REPAIR

Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.

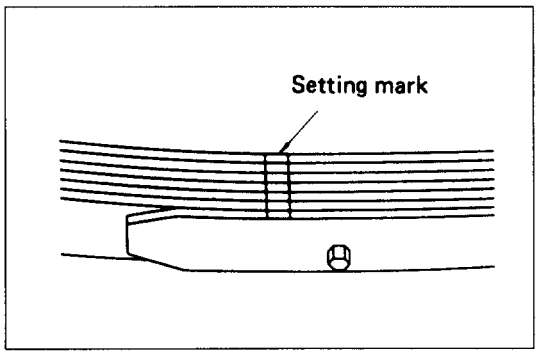
- Leaf spring assembly
- Clip
- Center bolt
- U-bolt
- Spring pin
- Shackle pin
- Shock absorber
- Helper rubber
- Rubber bushing
- Sub spring stopper rubber
- Helper rubber seat

Visual Check

Inspect the following parts for wear, damage or other abnormal conditions.

Shock Absorber

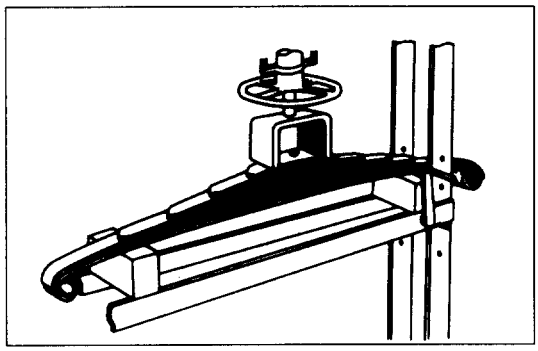
1. Inspect for extreme oil leakage. Slight oil leakage is allowed.
2. Inspect for temperature after running. Unchanged temperature indicates deteriorated function.
3. Inspect if large resistance is felt when the shock absorber is expanded and contracted by holding either end, or if play is eliminated after several times of expansion and contraction. The function has deteriorated if the above condition is not observed.
4. Inspect the bushing for wear or deterioration. Replace if abnormality is found.



Leaf Spring Assembly Replacement

- Apply a setting mark across the springs before disassembling the leaf spring assembly.
- Apply grease to both faces of each leaf spring at reassembly.
- Use a bench press for disassembly and reassembly.
- Discard center bolt removed and install a new one.

When replacing the leaf spring assembly, use the leaf spring with the same camber represented by "+, –, ○" on both right and leaf sides.

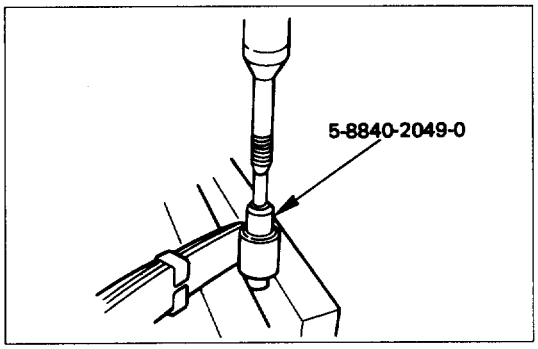


Center Bolt

Center Bolt Torque	N•m (kg•m / lb•ft)
98 (10 / 72)	

Clip Bolt

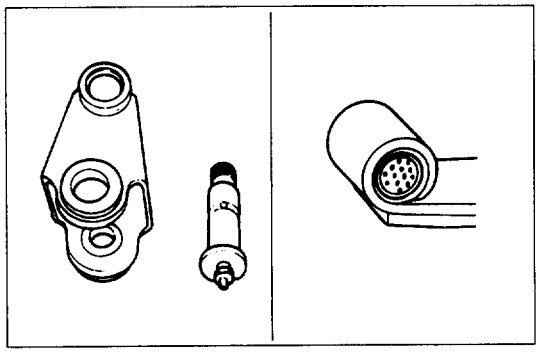
Clip Bolt Torque	N•m (kg•m / lb•ft)
20 (2 / 14)	



Bushing Replacement

When replacing bushing, drive out the bushing using a bench press.

Remover and Installer : 5-8840-2049-0



Measurement of Outer Diameter of Spring Pin

mm (in.)

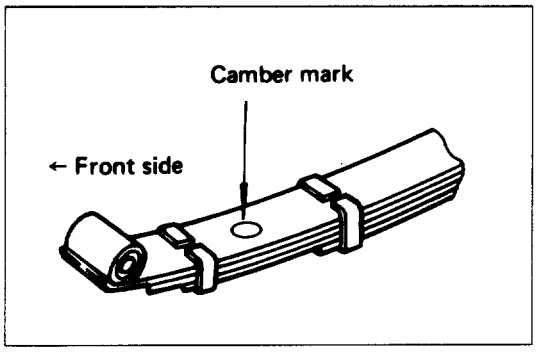
Standard	Limit
25 (0.98)	24.7 (0.97)

Clearance between Shackle Pin and Bushing

mm (in.)

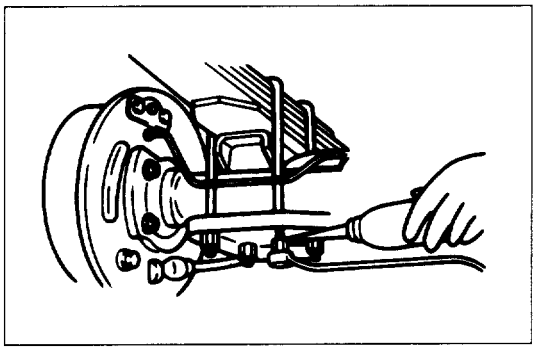
Standard	Limit
0.1 (0.0039)	0.5 (0.019)

INSTALLATION



6. Leaf Spring

Install the leaf spring assembly with the camber mark turned to front side on the rear axle.

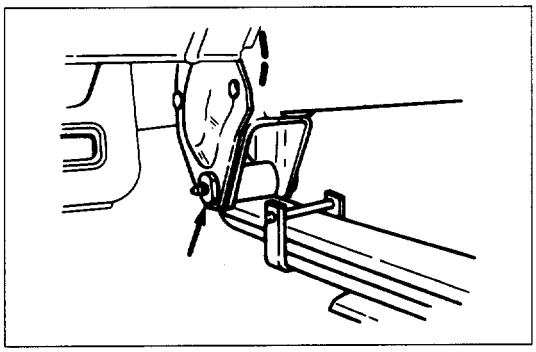


2. U-bolt, Nut and Washer

Position the U-bolts and clamp on the leaf spring assemblies and jack up the rear axle.

When tightening the nuts apply oil as necessary to prevent damaging the threads.

U-Bolt Nut Torque	N•m (kg•m / lb•ft)
NQR	294 (30 / 217)
except NQR	177 (18 / 130)

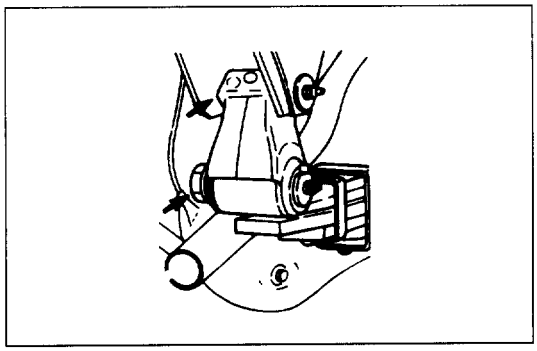


5. Spring Pin, Nut and Washer

4. Shackle

Finger tighten first, and tighten to specified torque after lowering the vehicle to ground.

Shackle Pin Nut Torque	N•m (kg•m / lb•ft)
NHR, NKR Single Tire,Flat Low	219 (22.3 / 161)
NKR Dual tire, NPR, NQR, NPS	332 (33.8 / 244)



3. Shackle Pin Nut and Washer

Finger tighten first, and tighten to specified torque after lowering the vehicle to ground.

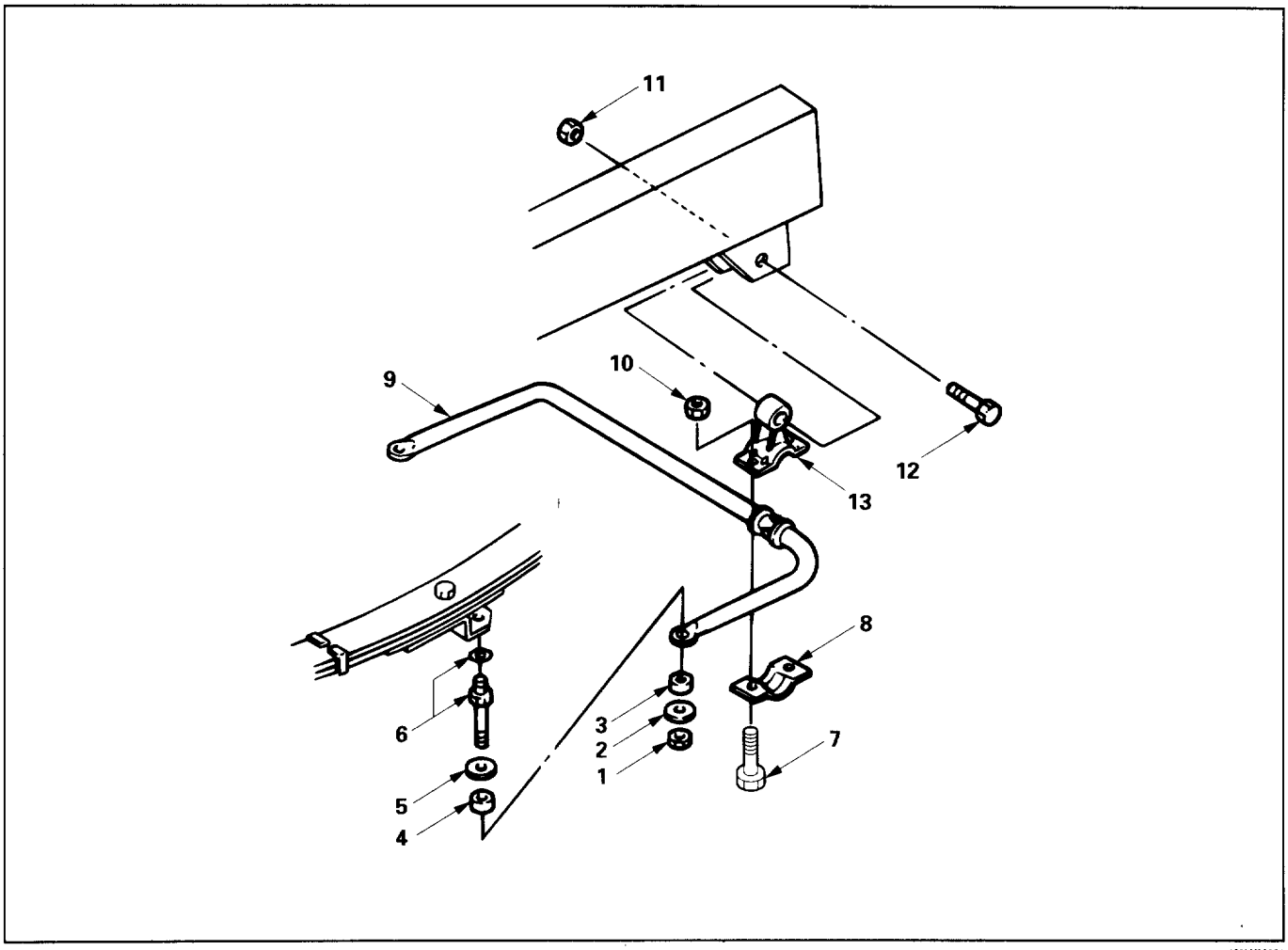
Spring Pin Nut Torque	N•m (kg•m / lb•ft)
NHR	137 (14 / 101)
NKR,NPR,NQR	196 (20 / 145)
NPS	177 (18 / 130)

1. Shock Absorber

Shock Absorber Upper Nut Torque	N•m (kg•m / lb•ft)
NHR, NKR Single Tire	61 (6.2 / 45)
except above models	95 (9.7 / 70)

Shock Absorber Lower Nut Torque	N•m (kg•m / lb•ft)
NHR, NKR Single Tire	61 (6.2 / 45)
NKR Dual Tire	95 (9.7 / 70)
NPR, NPS, NQR	40 (4.1 / 30)

STABILIZER



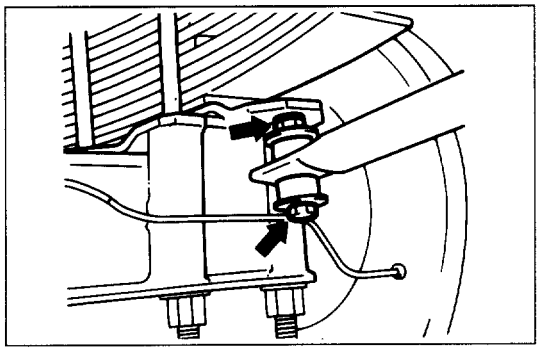
Removal Steps

1. Nut
2. Washer
3. Rubber bushing
4. Rubber bushing
5. Washer
6. Stud bolt and spring washer
7. Bolt
8. Rod link cap
9. Stabilizer bar
10. Nut
11. Nut
12. Bolt
13. Rod link

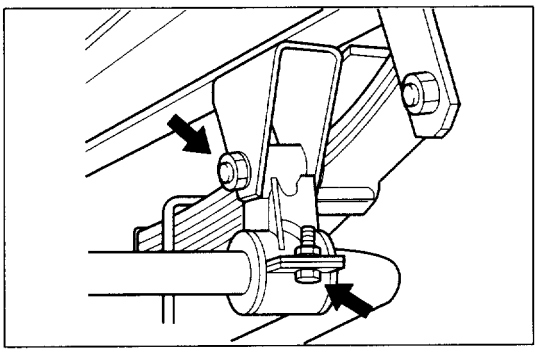
Installation Steps

9. Stabilizer bar
13. Rod link
8. Rod link cap
10. Nut
7. Bolt
12. Bolt
11. Nut
6. Stud bolt and spring washer
5. Washer
4. Rubber bushing
3. Rubber bushing
2. Washer
1. Nut

REMOVAL



1. Nut
2. Washer
3. Rubber Bushing
4. Rubber Bushing
5. Washer
6. Stud Bolt and Spring Washer



7. Bolt
8. Rod Link Cap
9. Stabilizer Bar
10. Nut
11. Nut
12. Bolt
13. Rod Link

INSPECTION AND REPAIR

Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.

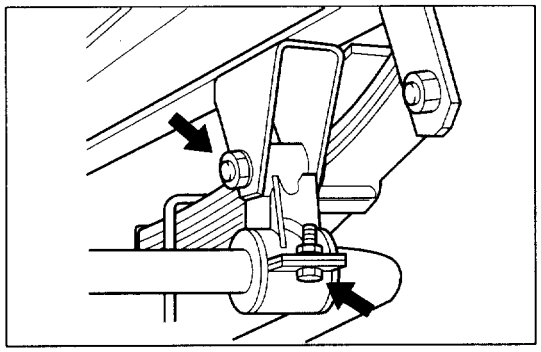
Stabilizer

Inspect the stabilizer bar and attachments for the following conditions:

1. Cracks, bends or damage to the bar.
2. Worn bushings.
3. Damaged brackets.

- Replace any worn or damaged parts.

INSTALLATION


460LY00002

NOTE:

During installation, place the vehicle on flat ground and tighten each part to the specified torque.

9. **Stabilizer Bar**
13. **Rod Link**
8. **Rod Link Cap**
7. **Bolt**
10. **Nut**
12. **Bolt**
11. **Nut**

Nut Torque	N•m (kg•m / lb•ft)
Rod Link Cap Nut	27 (2.8 / 20)
Rod Link Bracket Nut	117 (11.9 / 86)

6. **Stud Bolt and Spring Washer**
5. **Washer**
4. **Rubber Bushing**
3. **Rubber Bushing**
2. **Washer**
1. **Nut**

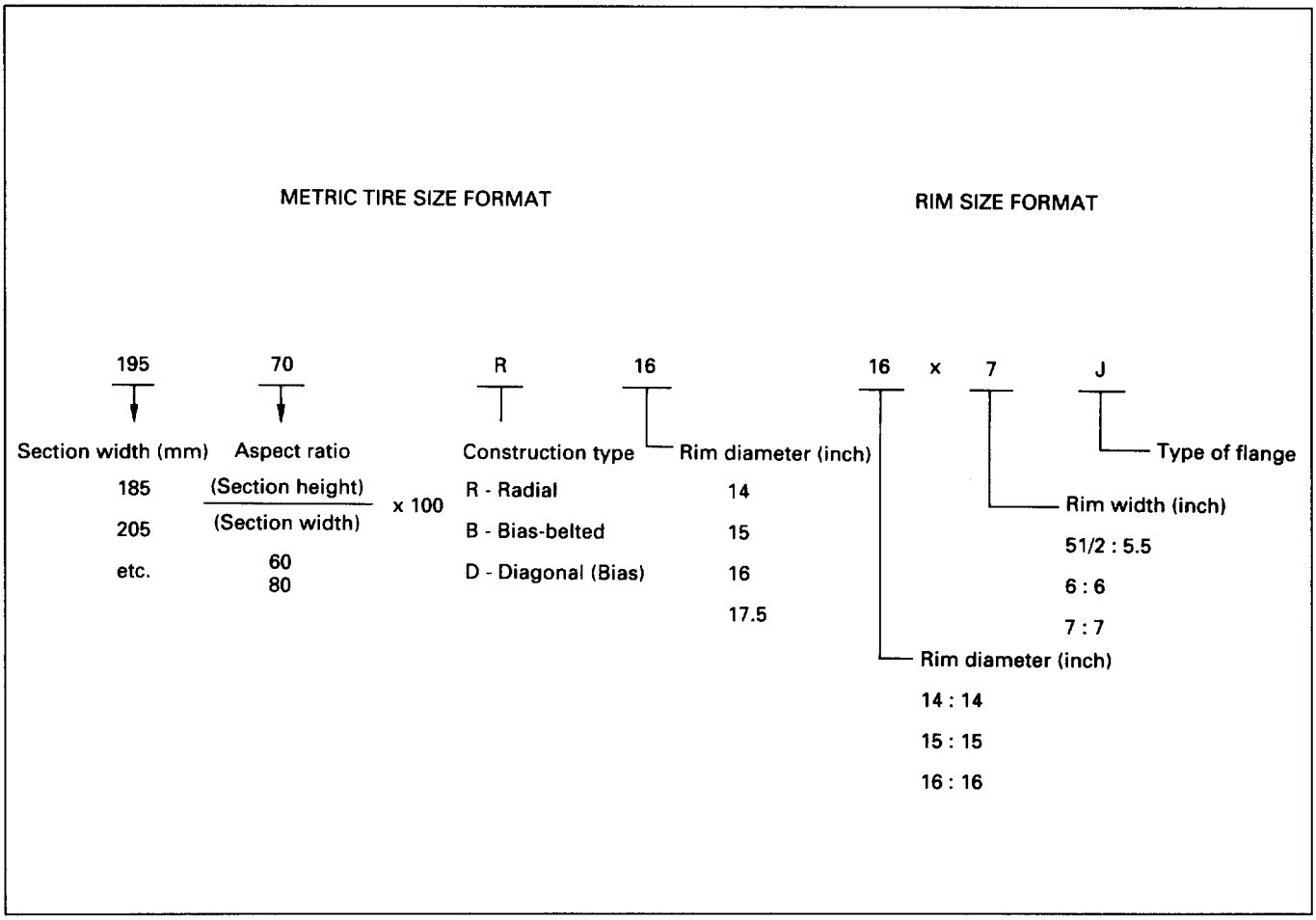
Stud Bolt and Nut Torque	N•m (kg•m / lb•ft)
Stud Bolt	117 (11.9 / 86)
Nut	61 (6.2 / 45)

SECTION 3E
WHEELS AND TIRES

CONTENTS

	PAGE
General Description	3E- 2
On-Vehicle Service	3E- 3
Wheel and Tire Assembly	3E- 3
Unit Repair	3E- 6
Tires	3E- 6
Wheels	3E- 8
General Balancing Procedure	3E- 8
Balancing Wheel and Tire	3E- 9

GENERAL DESCRIPTION



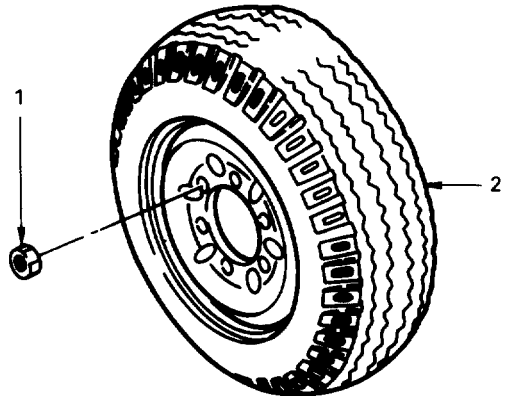
Replacement wheels or tires must be equivalent to the original one in load capacity, specified dimension and mounting configuration. Improper size or type may affect bearing life, brake performance, speedometer/odometer calibration, vehicle ground clearance and tire clearance to the body and chassis.

All model are equipped with metric sized steel belted radial tires. Correct tire pressures and driving habits have an important influence on tire life. Heavy cornering, excessively rapid acceleration and unnecessary sharp braking increase premature and uneven wear.

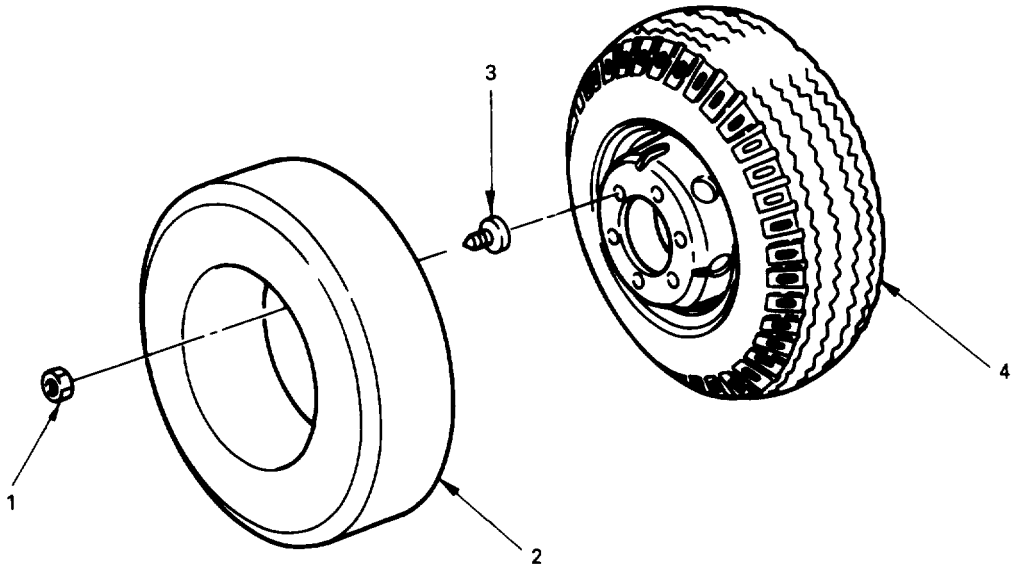
ON-VEHICLE SERVICE
WHEEL AND TIRE ASSEMBLY

Front Tire

Rear Single Tire



Rear Dual Tire



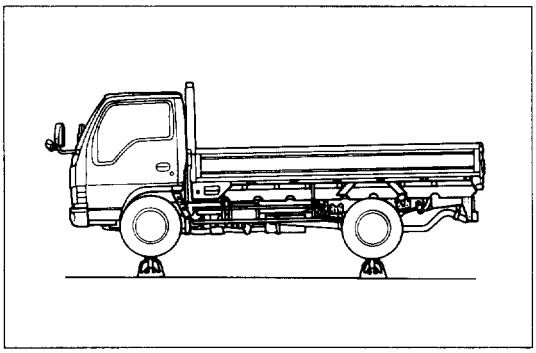
Removal Steps

1. Wheel nut (outer)
2. Wheel and tire assembly (front or outer)
3. Wheel nut (inner)
4. Wheel and tire assembly (inner)

Installation Steps

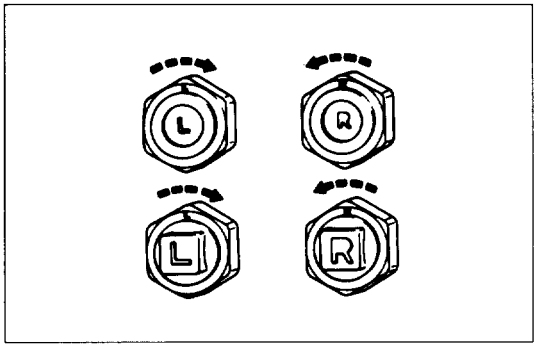
4. Wheel and tire assembly (inner)
3. Wheel nut (inner)
2. Wheel and tire assembly (front or outer)
1. Wheel nut (outer)

Removal Steps



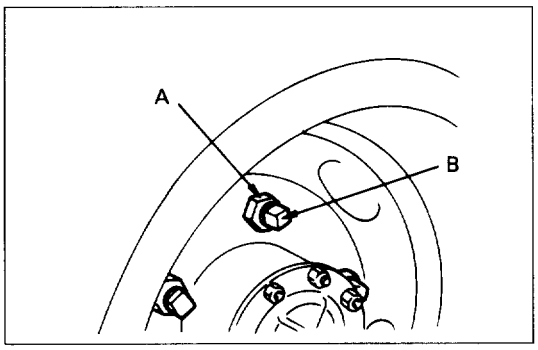
Preparations

- Raise the vehicle and support jack up point with suitable safety stands. Refer to "Jack Up Point" in Section 0A.



1. **Wheel Nut (Outer)**
2. **Wheel and Tire Assembly (Front or Outer)**
3. **Wheel Nut (Inner)**
4. **Wheel and Tire Assembly (Inner)**

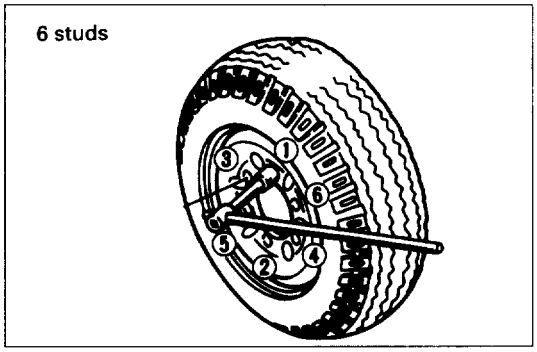
   Loosen the wheel nuts with the wheel nut wrench. The wheel nuts on the right side wheels have right-hand threads and the wheel nuts on the left side wheels have left-hand threads.

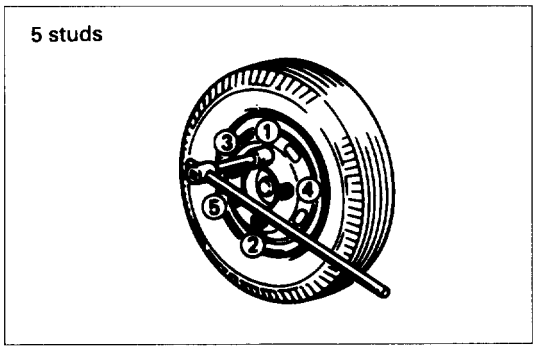


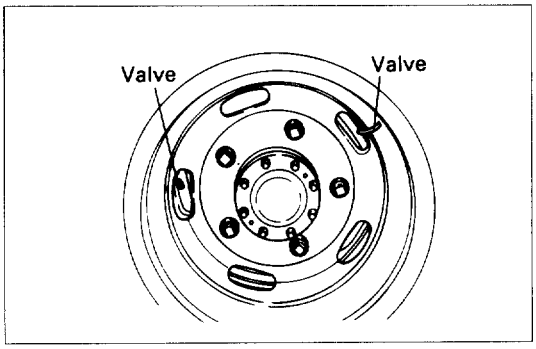
To change the inner wheel on either side of the rear of the vehicle:

1. Completely loosen the six-sided outer wheel nut (A) with the wheel wrench.
2. Using the opposite side of the wheel wrench, unscrew the four-sided inner wheel nut (B) approximately one full turn.
3. Repeat this procedure with the remaining outer and inner wheel nuts.

Installation Steps







4. **Wheel and Tire Assembly (Inner)**
3. **Wheel Nut (Inner)**
2. **Wheel and Tire Assembly (Front or Outer)**
1. **Wheel Nut (Outer)**

   Tighten wheel nuts in numerical sequence.

Front Wheel Nut Torque	N·m (kg·m/lb·ft)
NHR / NKR Single Tire, NKR Flat Low	167 (17 / 123)
except above models	441 (45 / 325)

Rear Wheel Nut Torque	N·m (kg·m/lb·ft)
NHR / NKR Single Tire,	167 (17 / 123)
NHR Dual Tire, NKR Flat Low	294 (30 / 217)
except above models	441 (45 / 325)

NOTE:

When installing the rear wheels, take care so that the dual tires' valves are dislocated or that the inner valve will not be hidden.

UNIT REPAIR

TIRES

REPLACEMENT

When replacement is necessary, the original metric the size should be used. Most metric tire sizes do not have exact corresponding alphanumeric tire sizes. It is recommended that new tires be installed in pairs on the same axle. If necessary to replace only one tire, it should be paired with tire having the most tread, to equalize braking traction.

⚠ **CAUTION:**

Do not mix different types of tires such as radial, bias and bias-belted tires except in emergencies, because car handling may be seriously affected and may result in loss of control.

TIRE MOUNTING

Remove valve cap on valve stem and deflate the air. Then use a tire changing machine to mount or dismount tires. Follow the equipment manufacturer's instruction. Do not use hand tools or tire lever alone to change tires as they may damage the tire beads or wheel rim.

TIRE DISMOUNTING

Rim bead seats should be cleaned with a wire brush or coarse steel wool to remove lubricants, and light rust. Before mounting a tire, the bead area should be well lubricated with an approved tire lubricant.

After moving, inflate the tire to 196kPa (28 psi) so that beads are completely seated. Inflate the air to specified pressure and install valve cap to the stem.

⚠ **WARNING:**

NEVER STAND OVER TIRE WHEN INFLATING. BEAD MAY BREAK WHEN BEAD SNAPS OVER RIM'S SAFETY HUMP AND CAUSE SERIOUS PERSONAL INJURY.

NEVER EXCEED SPECIFIED PRESSURE WHEN INFLATING. IF SPECIFIED PRESSURE WILL NOT SEAT BEADS, DEFLATE, RE-LUBRICATE AND RE-INFLATE. OVER INFLATION MAY CAUSE THE BEAD TO BREAK AND CAUSE SERIOUS PERSONAL INJURY.

TIRE REPAIR

There are many different materials on the market used to repair tires.

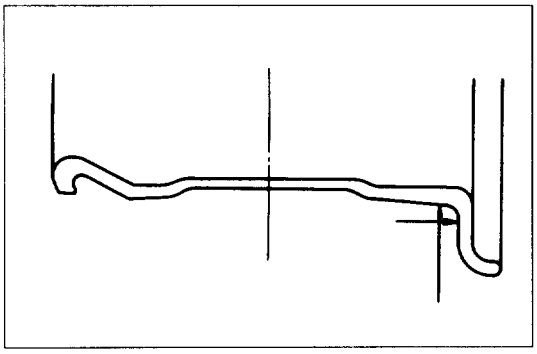
Manufacturers have published detailed instructions on how and when to repair tires. These instructions can be obtained from the tire manufacturer if they are not included with the repair kit.

Tire Inflation Pressure kPa (kg/cm^2 / psi)

Tire Size	Inflation Pressure
6.50-15-6PR	319 (3.25 / 46)
7.00-15-6PR	
7.50-16-6PR	
5.00-12-8PR	392 (4.00 / 57)
5.50-13-8PR	
6.00-13-8PR	417 (4.25 / 60)
6.00-14-8PR	
6.00-15-8PR	
7.00-15-8PR	
7.00-16-8PR	
7.50-15-8PR	
7.50-16-8PR	
6.00R15-8PR	441 (4.50 / 64)
7.00R15-8PR	
7.00R16-8PR	
155R13-8	
205R16C8PR	
7.50R16-8PR	466 (4.75 / 68)
195/75R16C	
6.50-15-10PR	490 (5.00 / 71)
6.50-16-10PR	
7.00-15-10PR	
7.00-16-10PR	
8.25-16-12PR	
7.50-15-10PR	515 (5.25 / 75)
7.50-16-10PR	
7.00R15-10PR	
7.00R16-10PR	
215/75R16C	
6.50R16-10PR	540 (5.50 / 78)
7.00-15-12PR	564 (5.75 / 82)
7.00-16-12PR	
7.50R16-10PR	
8.25-16-14PR	
7.50-15-12PR	588 (6.00 / 85)
7.50-16-12PR	
7.00R15-12PR	
7.00R16-12PR	
215/75R-17.5	
7.50-15-14PR	637 (6.50 / 92)
7.50-16-14PR	
7.50R16-12PR	
7.00-16-14PR	711 (7.25 / 103)

WHEELS

REPLACEMENT



Damaged wheels and wheels with excessive run-out must be replaced.

Wheel Run-out at Rim	mm (in)
1.5 (0.059) or less	

CAUTION:

Wheel repairs that use welding, heating or preening are not permitted. Replace wheel lug nuts if they are bent, dented, have excessive lateral or radial run-out, leak air through welds, have elongated bolt holes, will not stay tight, or if they are heavily rusted.

GENERAL BALANCE PROCEDURE

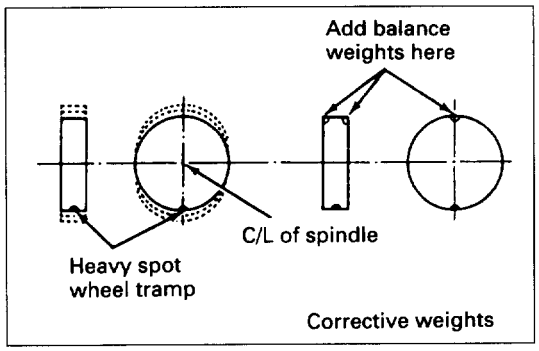
Deposits of mud, etc. must be cleaned from the inside of the rim.

The tire should be inspected for the following: match mount paint marks, bent rims, bulges, irregular tire wear, proper wheel size and inflation pressure. Then balance according to the equipment manufacturer's recommendations.

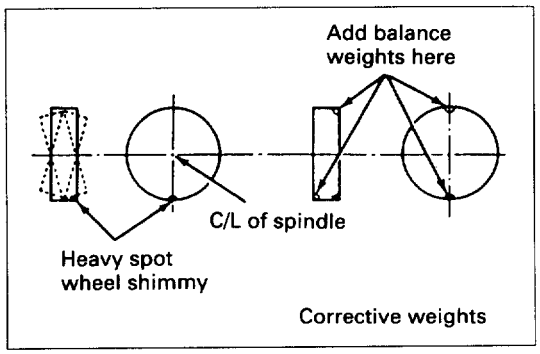
There are two types of wheel and tire balance.

Static balance is the equal distribution of weight around the wheel.

Assemblies that are statically unbalanced cause a bouncing action called tramp. This condition will eventually cause uneven tire wear.



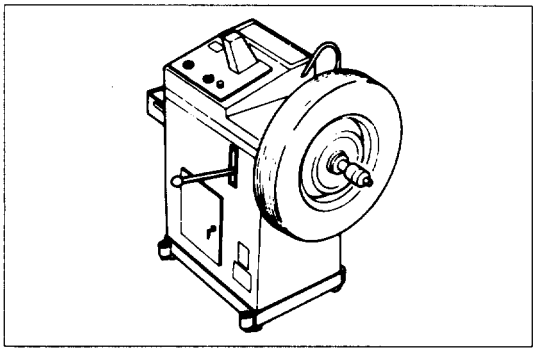
Dynamic balance is the equal distribution of weight on each side of the wheel center-line so that when the tire spins there is no tendency for the assembly to move from side to side. Assemblies that are dynamically unbalanced may cause shimmy.



WARNING:

STONES SHOULD BE REMOVED FROM THE TREAD TO AVOID OPERATOR INJURY DURING SPIN BALANCING AND TO OBTAIN A GOOD BALANCE.

BALANCING WHEEL AND TIRE



ON-VEHICLE BALANCING

On-Vehicle balancing methods vary with equipment and tool manufacturers. Be sure to follow each manufacturer's instructions during balancing operation.

OFF-VEHICLE BALANCING

Most electronic off-vehicle balancers are more accurate than the on-vehicle spin balancers. They are easy to use and give a dynamic balance. Although they do not correct for drum or disc unbalance (as on-vehicle spin balancing does), they are very accurate.

LGSTG-WE-0091

You are requested to order this manual using the manual number that is shown above.

This manual is applicable for vehicles in all countries except the USA and Canada.

All rights reserved. This manual may not be reproduced in whole or in part, without the permission in writing of ISUZU MOTORS LIMITED.

Issued by

ISUZU MOTORS LIMITED

INTERNATIONAL SERVICE DEPARTMENT

Tokyo, Japan

First edition Nov., 1999 0911-01K-3

No.LGSTG-WE-0091 PRINTED IN JAPAN