IMPORTANT

WARNING/CAUTION/NOTE

Please read this manual and follow its instructions carefully. To emphasize special information, the words **WARNING, CAUTION** and **NOTE** have special meanings. Pay special attention to the messages highlighted by these signal words.

WARNING:

Indicates a potential hazard that could result in death or injury.

CAUTION:

Indicates a potential hazard that could result in vehicle damage.

NOTE:

Indicates special information to make maintenance easier or instructions clearer.

WARNING:

This service manual is intended for authorized Suzuki dealers and qualified service mechanics only. Inexperienced mechanics or mechanics without the proper tools and equipment may not be able to properly perform the services described in this manual.
Improper repair may result in injury to the mechanic and may render the vehicle unsafe for the driver and passengers.

WARNING:

For vehicles equipped with a Supplemental Restraint (Air Bag) System:

- **Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to "Air Bag System Components and Wiring Location View" under "General Description" in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and "Service Precautions" under "On-Vehicle Service" in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.**
- **If the air bag system and another vehicle system both need repair, Suzuki recommends that the air bag system be repaired first, to help avoid unintended air bag system activation.**
- **Do not modify the steering wheel, instrument panel or any other air bag system component (on or around air bag system components or wiring). Modifications can adversely affect air bag system performance and lead to injury.**
- **If the vehicle will be exposed to temperatures over 93°C (200°F) (for example, during a paint baking process), remove the air bag system components (air bag (inflator) modules, SDM and/or seat belt with pretensioner) beforehand to avoid component damage or unintended activation.**

FOREWORD

This manual contains procedures for diagnosis, maintenance, adjustments, minor service operations, replacement of components (Service) and for disassembly and assembly of major components (Unit Repair-Overhaul).

Applicable model: RG413

The contents are classified into sections each of which is given a section number as indicated in the Table of Contents on following page. And on the first page of each individual section is an index of that section.
This manual should be kept in a handy place for ready reference of the service work.
Strict observance of the so specified items will enable one to obtain the full performance of the vehicle.

When replacing parts or servicing by disassembling, it is recommended to use SUZUKI genuine parts, tools and service materials (lubricant, sealants, etc.) as specified in each description.

All information, illustrations and specifications contained in this literature are based on the latest product information available at the time of publication approval. And used as the main subject of description is the vehicle of standard specifications among others.
Therefore, note that illustrations may differ from the vehicle being actually serviced.
The right is reserved to make changes at any time without notice.

Related Manual

Manual Name	Manual No.
RG413 Wiring Diagram Manual	99512-80G00-015

SUZUKI MOTOR CORPORATION

OVERSEAS SERVICE DEPARTMENT

TABLE OF CONTENTS

NOTE:

The screen toned Section 8A is in Wiring Diagram Manual mentioned in FOREWORD of this manual.

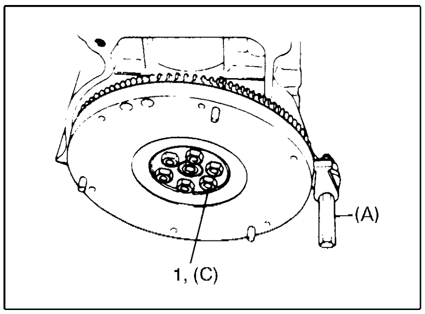
SECTION 0A

GENERAL INFORMATION

CONTENTS

HOW TO USE THIS MANUAL

1) There is a “TABLE OF CONTENTS” on the third page of this manual, whereby you can easily find the section that offers the information you need. Also, there is a CONTENTS on the first page of each section, where the main items in that section are listed.
2) Each section of this manual has its own pagination. It is indicated at the top of each page along with the Section name.
3) The special tool usage and torque specification are given as shown in the figure.



6) Install oil pump. Refer to “Oil pump” in this section.
7) Install flywheel (for M/T vehicle) or drive plate (for A/T vehicle). Using special tool, lock flywheel or drive plate, and tighten flywheel or drive plate bolts (1) to specified torque.

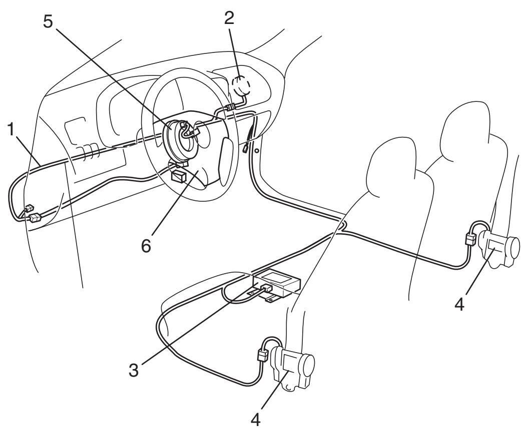
Special Tool
(A) : 09924-17810

Tightening Torque
(c) : 78 N·m (7.8 kg-m, 56.0 lb-ft)

4) A number of abbreviations and symbols are used in the text.For their full explanations, refer to “ABBREVIATIONS AND SYMBOLS MAY BE USED IN THIS MANUAL” in this section.
5) The SI, metric and foot-pound systems are used as units in this manual.
6) “DIAGNOSIS” are included in each section as necessary.
7) At the end of each section, there are descriptions of “SPECIAL TOOL”, “REQUIRED SERVICE MATERIAL” and “TIGHTENING TORQUE SPECIFICATION” that should be used for the servicing work described in that section.

PRECAUTIONS

PRECAUTION FOR VEHICLES EQUIPPED WITH A SUPPLEMENTAL RESTRAINT (AIR BAG) SYSTEM



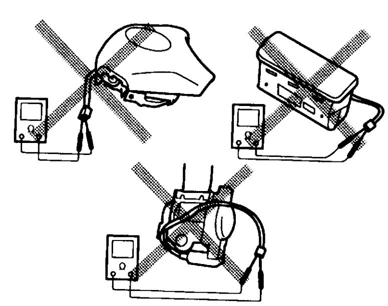
WARNING:

- **The configuration of air bag system parts are as shown in the figure. When it is necessary to service (remove, reinstall and inspect) these parts, be sure to follow procedures described in SECTION 10B. Failure to follow proper procedures could result in possible air bag system activation, personal injury, damage to parts or air bag system being unable to activate when necessary.**
- **If the air bag system and another vehicle system both need repair, SUZUKI recommends that the air bag system be repaired first, to help avoid unintended air bag system activation.**
- **Do not modify the steering wheel, dashboard, or any other air bag system components. Modifications can adversely affect air bag system performance and lead to injury.**
- **If the vehicle will be exposed to temperatures over 93°C (200°F) (for example, during a paint baking process), remove the air bag system components beforehand to avoid component damage or unintended air bag system activation.**

1. Air bag wire harness	4. Seat belt pretensioner
2. Passenger air bag (inflator) module	5. Contact coil
3. SDM	6. Driver air bag (inflator) module

DIAGNOSIS

- When troubleshooting air bag system, be sure to follow “DIAGNOSIS” in SECTION 10B. Bypassing these procedures may result in extended diagnostic time, incorrect diagnosis, and incorrect parts replacement.
- Never use electrical test equipment other than that specified in this manual.

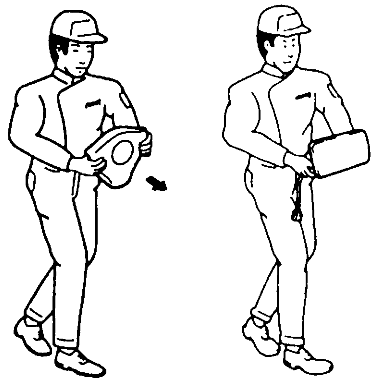


WARNING:

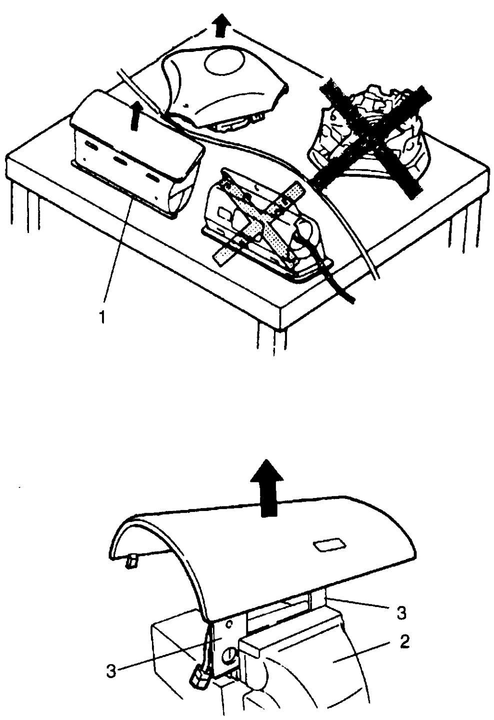
Never attempt to measure the resistance of the air bag (inflator) modules (driver and passenger) and seat belt pretensioners (driver and passenger). It is very dangerous as the electric current from the tester may deploy the air bag or activate the pretensioner.

SERVICING AND HANDLING

[A]



[B]



WARNING:

Many of service procedures require disconnection of "AIR BAG" fuse and all air bag (inflator) module(s) from initiator circuit to avoid an accidental deployment.

Driver and Passenger Air Bag (Inflator) Modules

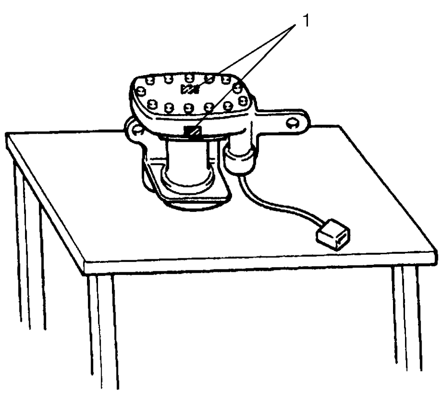
- **For handling and storage of a live air bag (inflator) module, select a place where the ambient temperature below 65°C (150°F), without high humidity and away from electric noise.**
- **When carrying a live air bag (inflator) module, make sure the bag opening is pointed away from you. In case of an accidental deployment, the bag will then deploy with minimal chance of injury. Never carry the air bag (inflator) module by the wires or connector on the underside of the module. When placing a live air bag (inflator) module on a bench or other surface, always face the bag up, away from the surface. As the live passenger air bag (inflator) module must be placed with its bag (trim cover) facing up, place it on the workbench with a slit or use the workbench vise to hold it securely at its lower mounting bracket. This is necessary so that a free space is provided to allow the air bag to expand in the unlikely event of accidental deployment. Otherwise, personal injury may result.**
- **Never dispose of live (undeployed) air bag (inflator) modules (driver and passenger). If disposal is necessary, be sure to deploy them according to deployment procedures described in SECTION 10B before disposal.**
- **The air bag (inflator) module immediately after deployment is very hot. Wait for at least half an hour to cool it off before proceeding the work.**
- **After an air bag (inflator) module has been deployed, the surface of the air bag may contain a powdery residue. This powder consists primarily of cornstarch (used to lubricate the bag as it inflates) and by-products of the chemical reaction. As with many service procedures, gloves and safety glasses should be worn.**

[A] :	ALWAYS CARRY AIR BAG (INFLATOR) MODULE WITH TRIM COVER (AIR BAG OPENING) AWAY FROM BODY.
[B] :	ALWAYS PLACE AIR BAG (INFLATOR) MODULE ON WORKBENCH WITH TRIM COVER (AIR BAG OPENING) UP, AWAY FROM LOOSE OBJECTS.
1.	Slit on workbench
2.	Workbench vise
3.	Lower mounting bracket

WARNING:

SDM

- **For handling and storage of a SDM, select a place where the ambient temperature below 65°C (150°F), without high humidity and away from electric noise.**
- **During service procedures, be very careful when handling a Sensing and Diagnostic Module (SDM). Never strike or jar the SDM.**
- **Never power up the air bag system when the SDM is not rigidly attached to the vehicle. All SDM and mounting bracket fasteners must be carefully torqued and the arrow must be pointing toward the front of the vehicle to ensure proper operation of the air bag system.**
  The SDM could be activated when powered while not rigidly attached to the vehicle which could cause deployment and result in personal injury.



WARNING:

Driver and Passenger Seat Belt Pretensioners (If equipped)

- **For handling and storage of a live seat belt pretensioner, select a place where the ambient temperature below 65°C (150°F), without high humidity and away from electric noise.**
- **Never carry seat belt pretensioner by wire or connector of pretensioner. When placing a live seat belt pretensioner on the workbench or some place like that, be sure not to lay it with its exhaust hole (1) provided side facing down. It is also prohibited to put something on its face with an exhaust hole or to put a seat belt pretensioner on top of another. Otherwise, personal injury may result.**
- **Never dispose of live (inactivated) seat belt pretensioners (drive and passenger). If disposal is necessary, be sure to activate them according to activation procedures described in SECTION 10B before disposal.**
- **The seat belt pretensioner immediately after activation is very hot. Wait for at least half an hour to cool it off before proceeding the work.**
- **With many service procedures, gloves and safety glasses should be worn to prevent any possible irritation of the skin or eyes.**

- **Even when the accident was light enough not to cause air bags to activate, be sure to inspect system parts and other related parts according to instructions under “REPAIR AND INSPECTION REQUIRED AFTER AN ACCIDENT” in SECTION 10B.**
- **When servicing parts other than air bag system, if shocks may be applied to air bag system component parts, remove those parts beforehand.**
- **When handling the air bag (inflator) modules (driver and passenger), seat belt pretensioners (driver and passenger) or SDM, be careful not to drop it or apply an impact to it. If an excessive impact was applied, never attempt disassembly or repair but replace it with a new one.**
- **When grease, cleaning agent, oil, water, etc. has got onto air bag (inflator) modules (driver and passenger) or seat belt pretensioners (drive and passenger), wipe off immediately with a dry cloth.**

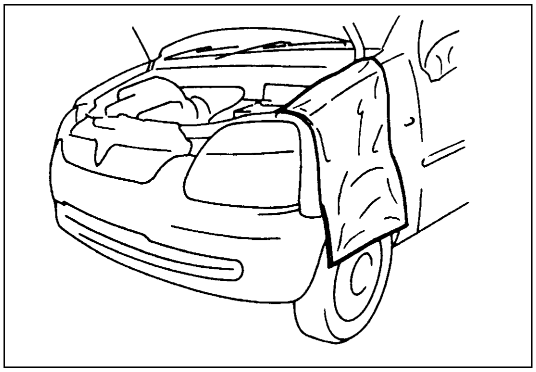
- **Air bag wire harness can be identified easily as it is covered with a yellow protection tube. Be very careful when handling it.**
- **When an open in air bag wire harness, damaged wire harness, connector or terminal is found, replace wire harness, connectors and terminals as an assembly.**
- **Do not apply power to the air bag system unless all components are connected or a diagnostic chart requests it, as this will set a diagnostic trouble code.**
- **Never use air bag system component parts from another vehicle.**
- **When using electric welding, be sure to temporarily disable air bag system referring to "DISABLING AIR BAG SYSTEM" in Section 10B.**
- **Never expose air bag system component parts directly to hot air (drying or baking the vehicle after painting) or flames.**
- **WARNING/CAUTION labels are attached on each part of air bag system components. Be sure to follow the instructions.**
- **After vehicle is completely repaired, perform "AIR BAG DIAGNOSTIC SYSTEM CHECK" in SECTION 10B.**

GENERAL PRECAUTIONS

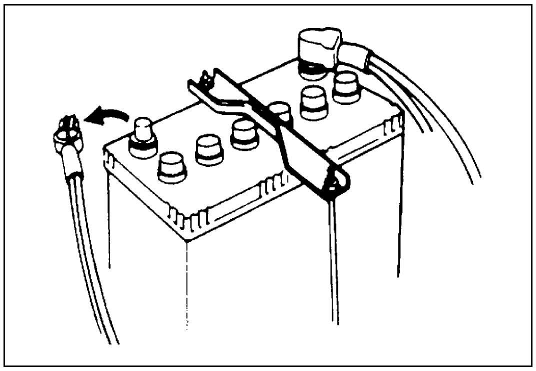
The WARNING and CAUTION below describe some general precautions that you should observe when servicing a vehicle. These general precautions apply to many of the service procedures described in this manual, and they will not necessarily be repeated with each procedure to which they apply.

WARNING:

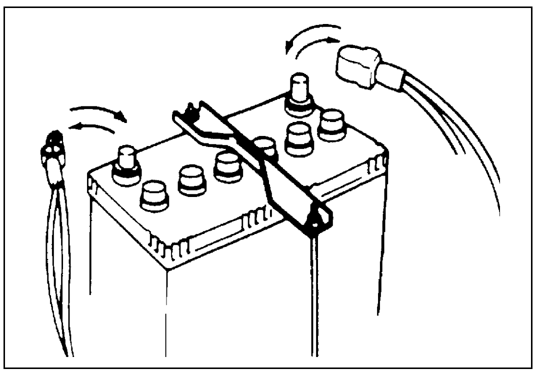
- **Whenever raising a vehicle for service, be sure to follow the instructions under "VEHICLE LIFTING POINTS" in this section.**
- **When it is necessary to do service work with the engine running, make sure that the parking brake is set fully and the transmission is in Neutral (for manual transmission vehicles) or Park (for automatic transmission vehicles), Keep hands, hair, clothing, tools, etc. away from the fan and belts when the engine is running.**
- **When it is necessary to run the engine indoors, make sure that the exhaust gas is forced outdoors.**
- **Do not perform service work in areas where combustible materials can come in contact with a hot exhaust system. When working with toxic or flammable materials (such as gasoline and refrigerant), make sure that the area you work in is well-ventilated.**
- **To avoid getting burned, keep away from hot metal parts such as the radiator, exhaust manifold, tail pipe, muffler, etc.**
- **New and used engine oil can be hazardous. Children and pets may be harmed by swallowing new or used oil. Keep new and used oil and used engine oil filters away from children and pets.**
  Continuous contact with used engine oil has been found to cause [skin] cancer in laboratory animals. Brief contact with used oil may irritate skin. To minimize your exposure to used engine oil, wear a long-sleeve shirt and moisture-proof gloves (such as dish washing gloves) when changing engine oil. If engine oil contacts your skin, wash thoroughly with soap and water. Launder any clothing or rags if wet with oil, recycle or properly dispose of used oil and filters.
- **Make sure the bonnet is fully closed and latched before driving. If it is not, it can fly up unexpectedly during driving, obstructing your view and resulting in an accident.**



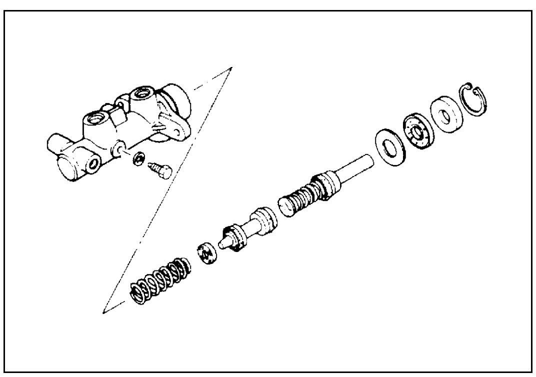
- **Before starting any service work, cover fenders, seats and any other parts that are likely to get scratched or stained during servicing. Also, be aware that what you wear (e.g, buttons) may cause damage to the vehicle's finish.**



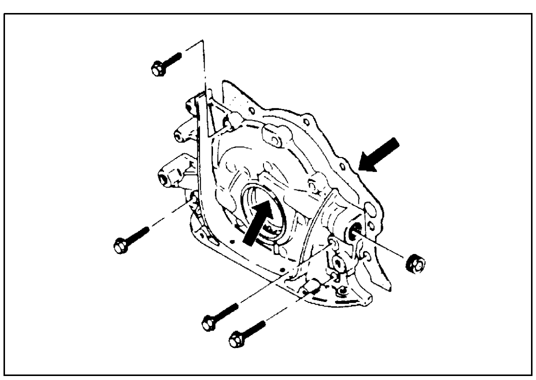
- **When performing service to electrical parts that does not require use of battery power, disconnect the negative cable of the battery.**



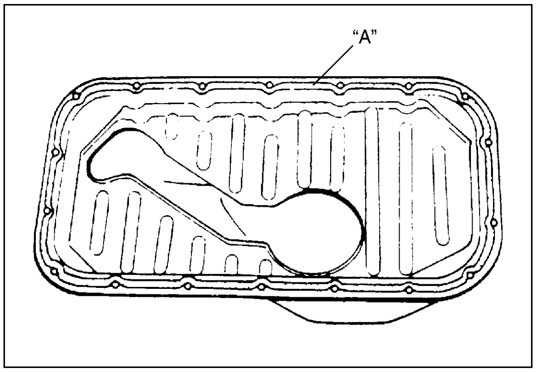
- **When removing the battery, be sure to disconnect the negative cable first and then the positive cable. When reconnecting the battery, connect the positive cable first and then the negative cable, and replace the terminal cover.**



- **When removing parts that are to be reused, be sure to keep them arranged in an orderly manner so that they may be reinstalled in the proper order and position.**

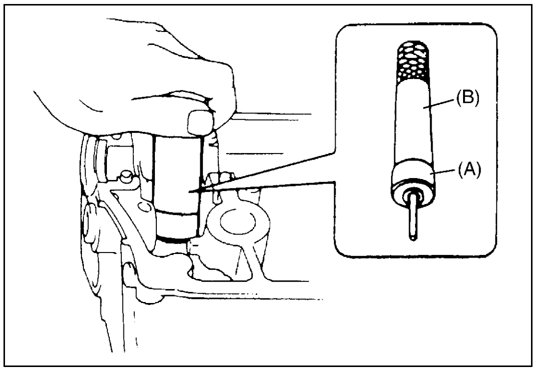


- **Whenever you use oil seals, gaskets, packing, O-rings, locking washers, split pins, self-locking nuts, and certain other parts as specified, be sure to use new ones. Also, before installing new gaskets, packing, etc., be sure to remove any residual material from the mating surfaces.**



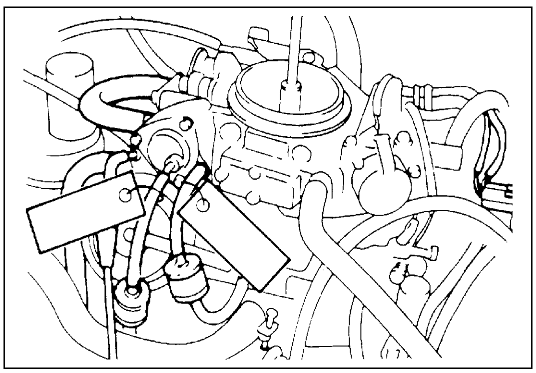
- Make sure that all parts used in reassembly are perfectly clean.
  When use of a certain type of lubricant, bond or sealant is specified, be sure to use the specified type.

"A" : Sealant 99000-31150

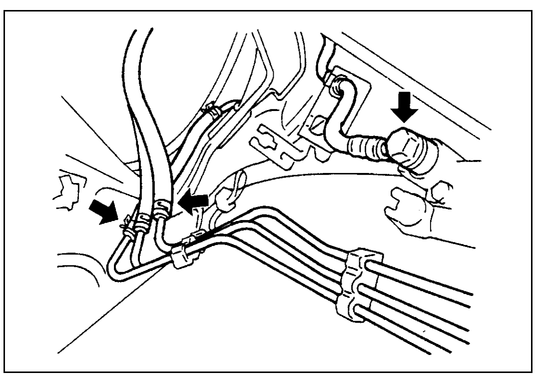


- Be sure to use special tools when instructed.

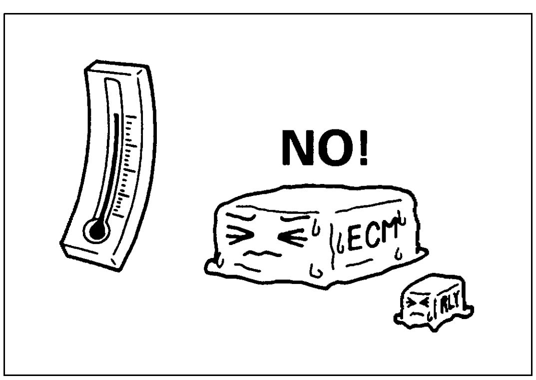
Special Tool
(A) : 09917-98221
(B) : 09916-58210



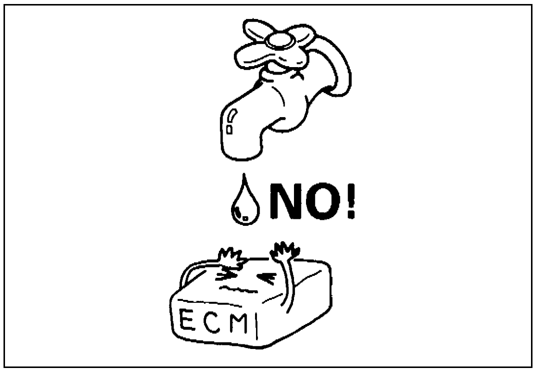
- When disconnecting vacuum hoses, attach a tag describing the correct installation positions so that the hoses can be reinstalled correctly.



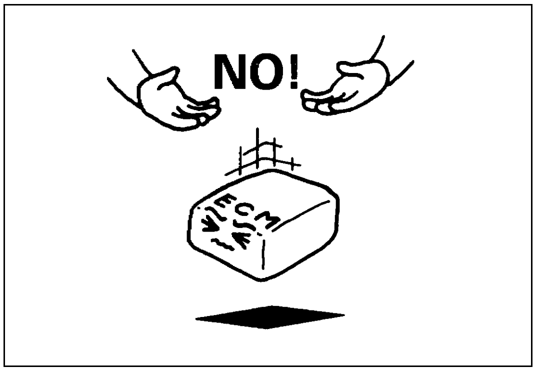
- After servicing fuel, oil, coolant, vacuum, exhaust or brake systems, check all lines related to the system for leaks.
- For vehicles equipped with fuel injection systems, never disconnect the fuel line between the fuel pump and injector without first releasing the fuel pressure, or fuel can be sprayed out under pressure.



- When performing a work that produces a heat exceeding 80°C (176°F) in the vicinity of the electrical parts, remove the heat sensitive electrical part(s) beforehand.



- Use care not to expose connectors and electrical parts to water which will be a cause of a trouble.



- Always be careful not to handle electrical parts (computer, relay, etc.) in a rough manner or drop them.

PRECAUTIONS FOR CATALYTIC CONVERTER

For vehicles equipped with a catalytic converter, use only unleaded gasoline and be careful not to let a large amount of unburned gasoline enter the converter or it can be damaged.

- Conduct a spark jump test only when necessary, make it as short as possible, and do not open the throttle.
- Conduct engine compression checks within the shortest possible time.
- Avoid situations which can result in engine misfire (e.g. starting the engine when the fuel tank is nearly empty.)

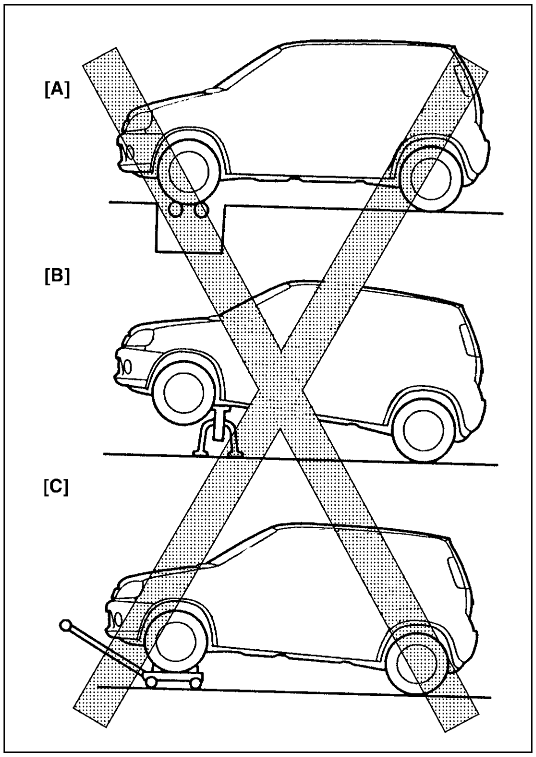
PRECAUTION FOR INSTALLING MOBILE COMMUNICATION EQUIPMENT

When installing mobile communication equipment such as CB (Citizens-Band)-radio or cellular-telephone, be sure to observe the following precautions.
Failure to follow cautions may adversely affect electronic control system.

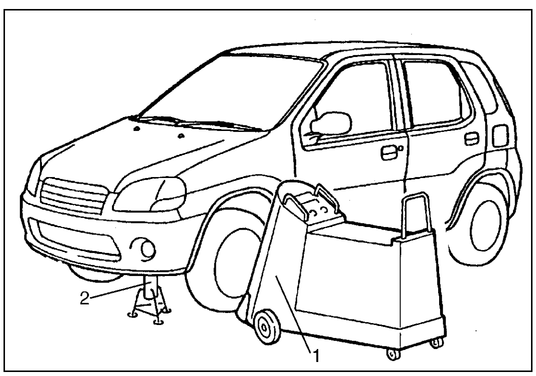
- Keep the antenna as far away as possible from the vehicle’s electronic control unit.
- Keep the antenna feeder more than 20 cm (7.9 in) away from electronic control unit and its wire harnesses.
- Do not run the antenna feeder parallel with other wire harnesses.
- Confirm that the antenna and feeder are correctly adjusted.

PRECAUTION IN SERVICING FULL-TIME 4WD VEHICLE

This full-time 4WD vehicle can not be converted to 2WD manually.
Observe the following caution in servicing. Otherwise, front wheels drive rear wheels or vise-versa and vehicle accidents, drivetrain damage and personal injury may result.



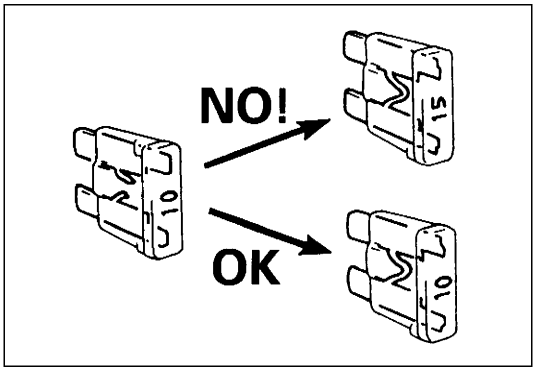
- **Never perform any of the following types of service work.**
  [A] : Testing with 2-wheel chassis dynamometer, speedometer tester or brake tester.
  [B] : Driving front wheels, which are jacked up.
  [C] : Towing under the condition where either front or rear wheels can not rotate.
- **When testing with 2-wheel chassis dynamometer, speedometer tester or brake tester, be sure to make the vehicle as front wheel drive by removing propeller shaft.**



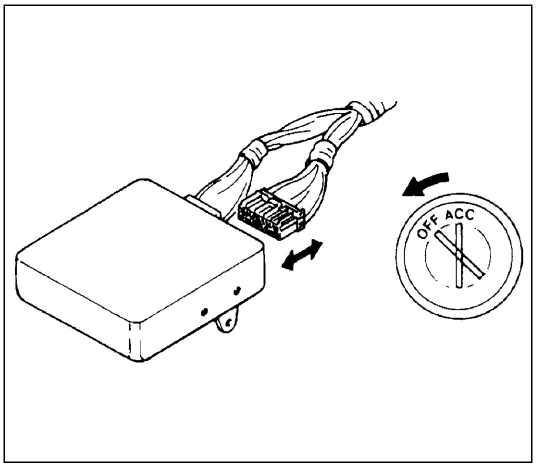
- **When using On-vehicle type wheel balancing equipment (1), be sure to jack up all four wheels, off the ground completely and support vehicle with safety stands (2).**
  Be careful of the other wheels, which will rotate at the same time.

- **This vehicle should be towed under one of the following conditions :**
  - **With all wheels on a flatbed truck.**
  - **With front or rear wheels lifted and a dolly under the other wheels.**

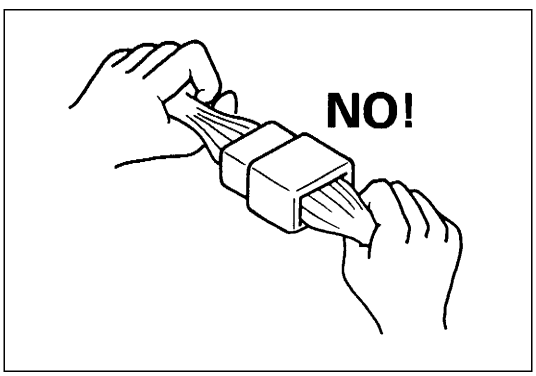
PRECAUTIONS FOR ELECTRICAL CIRCUIT SERVICE



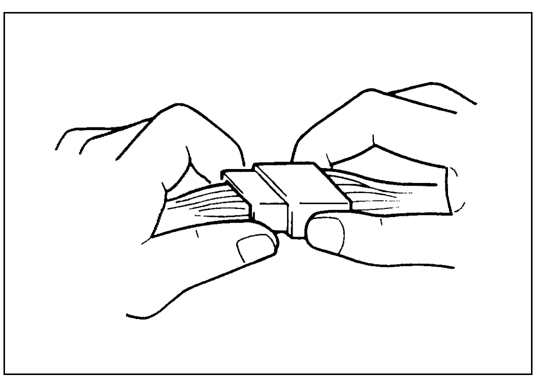
- When replacing a fuse, make sure to use a fuse of the specified capacity. Use of a fuse with a larger capacity will cause a damage to the electrical parts and a fire.



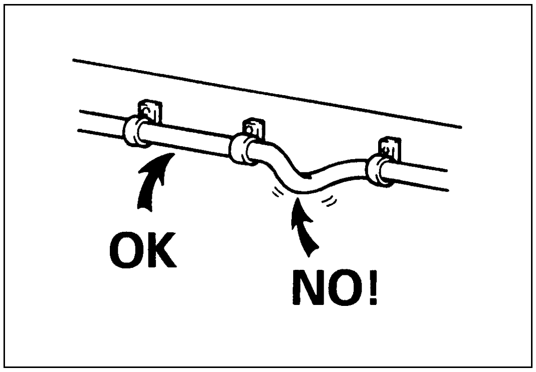
- When disconnecting and connecting coupler, make sure to turn ignition switch OFF, or electronic parts may get damaged.



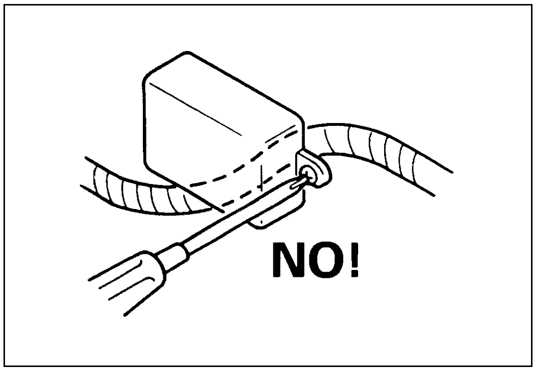
- When disconnecting connectors, never pull the wiring harness. Unlock the connector lock first and then pull them apart by holding connectors themselves.



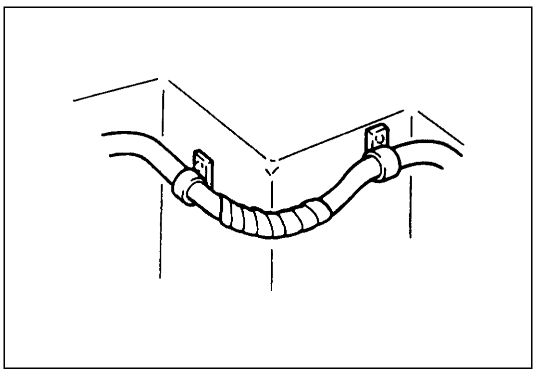
- When connecting connectors, also hold connectors and put them together until they lock securely (a click is heard).



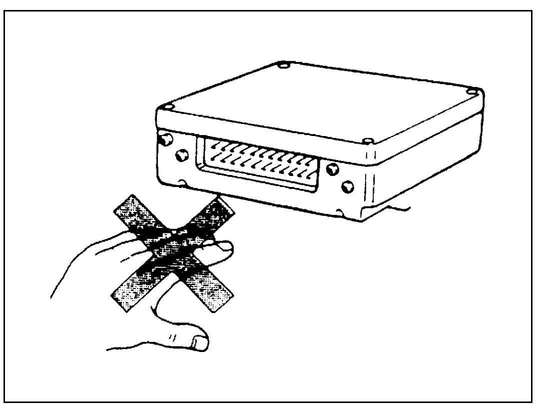
- When installing the wiring harness, fix it with clamps so that no slack is left.



- When installing vehicle parts, be careful so that the wiring harness is not interfered with or caught by any other part.

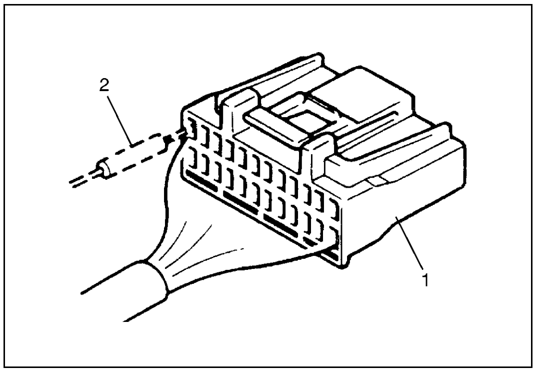


- To avoid damage to the harness, protect its part which may contact against a part forming a sharp angle by winding tape or the like around it.

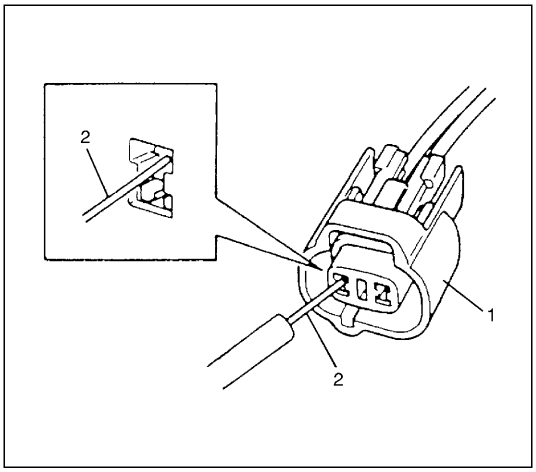


- Be careful not to touch the electrical terminals of parts which use microcomputers (e.g. electronic control unit like as ECM, PCM, P/S controller, etc). The static electricity from your body can damage these parts.
- Never connect any tester (voltmeter, ohmmeter, or whatever) to electronic control unit when its coupler is disconnected. Attempt to do it may cause damage to it.
- Never connect an ohmmeter to electronic control unit with its coupler connected to it. Attempt to do it may cause damage to electronic control unit and sensors.

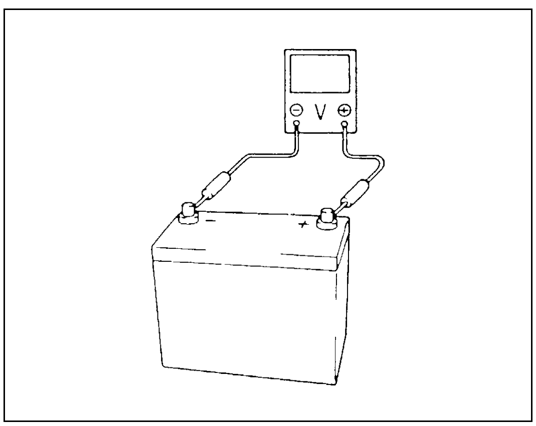
- Be sure to use a specified voltmeter/ohmmeter. Otherwise, accurate measurements may not be obtained or personal injury may result. If not specified, use a voltmeter with high impedance (M Ω/V minimum) or a digital type voltmeter.



- **When taking measurements at electrical connectors using a tester probe, be sure to insert the probe (2) from the wire harness side (backside) of the connector (1).**



- **When connecting meter probe (2) from terminal side of coupler (1) because it can't be connected from harness side, use extra care not to bend male terminal of coupler of force its female terminal open for connection.**
  In case of such coupler as shown connect probe as shown to avoid opening female terminal.
  Never connect probe where male terminal is supposed to fit.
- **When checking connection of terminals, check its male half for bend and female half for excessive opening and both for locking (looseness), corrosion, dust, etc.**



- **Before measuring voltage at each terminal, check to make sure that battery voltage is 11 V or higher. Such terminal voltage check at low battery voltage will lead to erroneous diagnosis.**

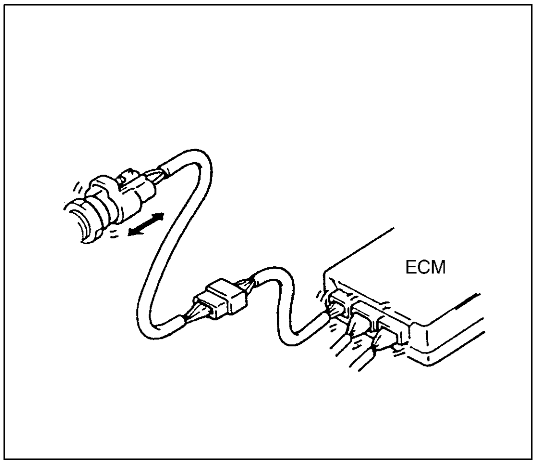
ELECTRICAL CIRCUIT INSPECTION PROCEDURE

While there are various electrical circuit inspection methods, described here is a general method to check its open and short circuit by using an ohmmeter and a voltmeter.

OPEN CIRCUIT CHECK

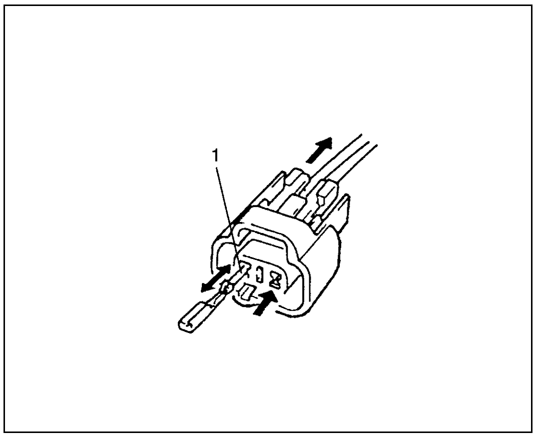
Possible causes for the open circuit are as follows. As the cause is in the connector or terminal in many cases, they need to be checked particularly carefully.

- Loose connection of connector
- Poor contact of terminal (due to dirt, corrosion or rust on it, poor contact tension, entry of foreign object etc.)
- Wire harness being open



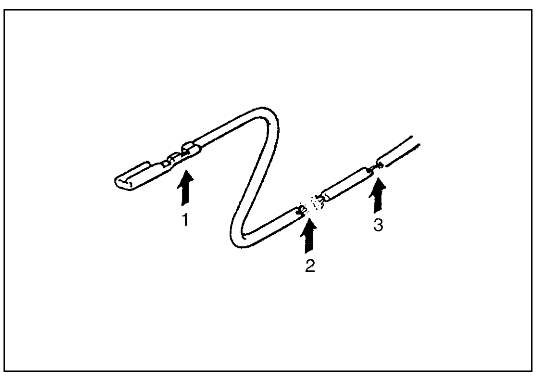
When checking system circuits including an electronic control unit such as ECM, TCM, ABS control module, etc., it is important to perform careful check, starting with items which are easier to check.

1) Disconnect negative (–) cable from battery
2) Check each connector at both ends of the circuit being checked for loose connection. Also check lock condition of connector if equipped with connector lock.



3) Using a test male terminal, check both terminals of the circuit being checked for contact tension of its female terminal.
   Check each terminal visually for poor contact (possibly caused by dirt, corrosion, rust entry of foreign object, etc.).
   At the same time, check to make sure that each terminal is locked in the connector fully.

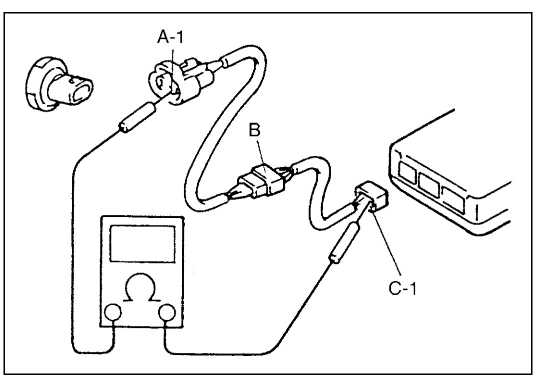
1. Check contact tension by inserting and removing just for once.



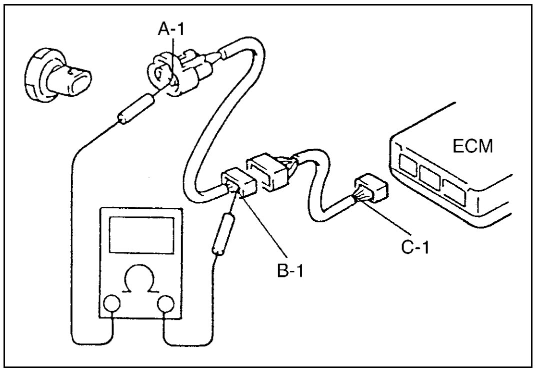
4) Using continuity check or voltage check the following procedure, check the wire harness for open circuit and poor connection with its terminals. Locate abnormality, if any.

1. Looseness of crimping
2. Open
3. Thin wire (single strand of wire)

CONTINUITY CHECK



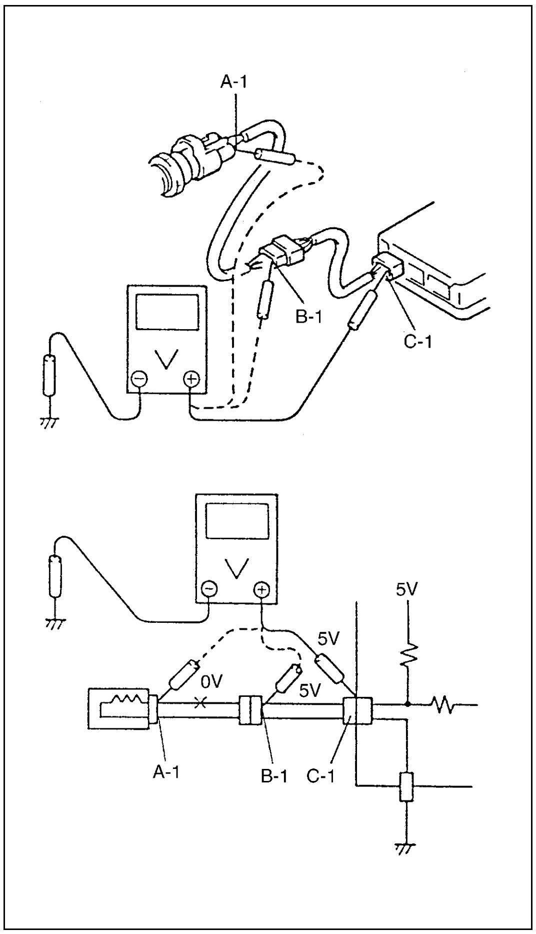
1) Measure resistance between connector terminals at both ends of the circuit being checked (between A-1 and C-1 in the figure). If no continuity is indicated (infinity or over limit), that means that the circuit is open between terminals A-1 and C-1.



2) Disconnect the connector included in the circuit (connector-B in the figure) and measure resistance between terminals A-1 and B-1.
   If no continuity is indicated, that means that the circuit is open between terminals A-1 and B-1. If continuity is indicated, there is an open circuit between terminals B-1 and C-1 or an abnormality in connector-B.

VOLTAGE CHECK

If voltage is supplied to the circuit being checked, voltage check can be used as circuit check.



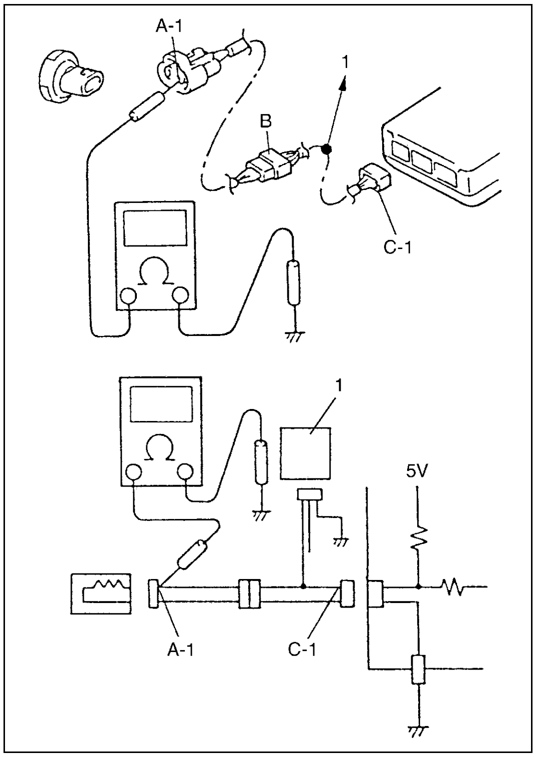
1) With all connectors connected and voltage applied to the circuit being checked, measure voltage between each terminal and body ground.
   a) If measurements were taken as shown in the figure and results were as listed below, it means that the circuit is open between terminals B-1 and A-1.

Voltage between
C-1 and body ground : Approx. 5 V
B-1 and body ground : Approx. 5 V
A-1 and body ground : 0 V

   b) Also, if measured values were as listed below, it means that there is a resistance (abnormality) of such level that corresponds to the voltage drop in the circuit between terminals A-1 and B-1.

Voltage between
C-1 and body ground : Approx. 5 V
B-1 and body ground : Approx. 5 V
A-1 and body ground : Approx. 3 V

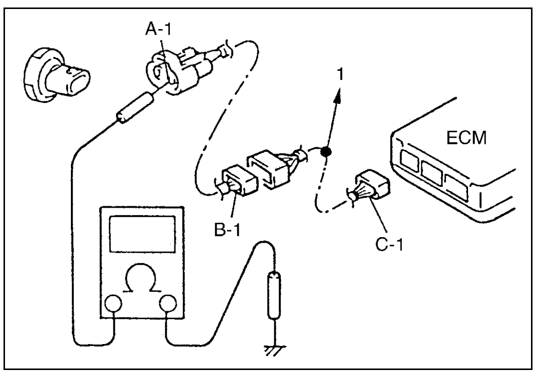
SHORT CIRCUIT CHECK (WIRE HARNESS TO GROUND)



1) Disconnect negative (–) cable at battery.
2) Disconnect connectors at both ends of the circuit to be checked.

NOTE:
If the circuit to be checked is connected to other parts (1), disconnect all connectors of those parts.
Otherwise, diagnosis will be misled.

3) Measure resistance between terminal at one end of circuit (A-1 terminal in the figure) and body ground. If continuity is indicated, it means that there is a short to ground between terminals A-1 and C-1 of the circuit.

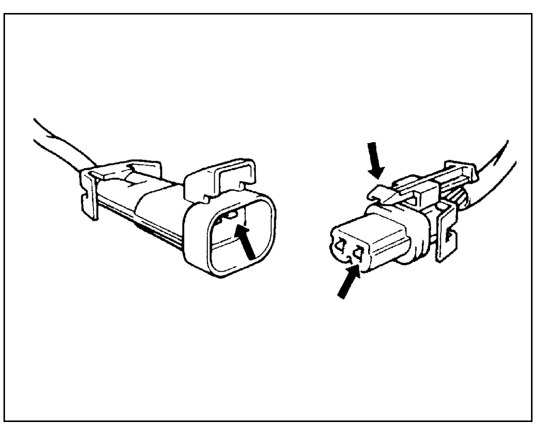


4) Disconnect the connector included in circuit (connector B) and measure resistance between A-1 and body ground.
If continuity is indicated, it means that the circuit is shorted to the ground between terminals A-1 and B-1.

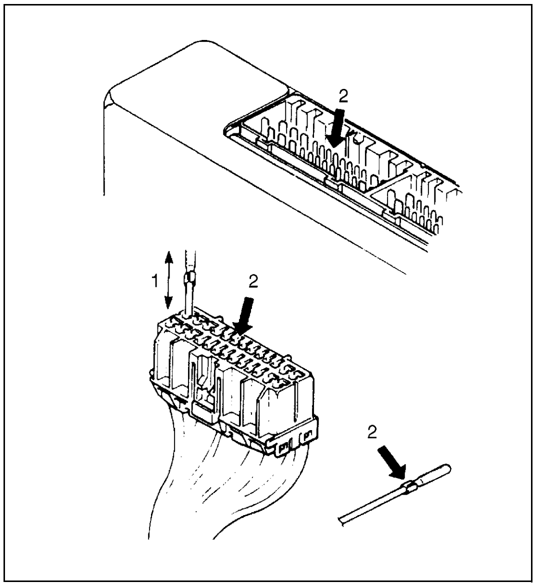
1. To other parts

INTERMITTENT AND POOR CONNECTION

Most intermittent are caused by faulty electrical connections or wiring, although a sticking relay or solenoid can occasionally be at fault. When checking it for proper connection, perform careful check of suspect circuits for :

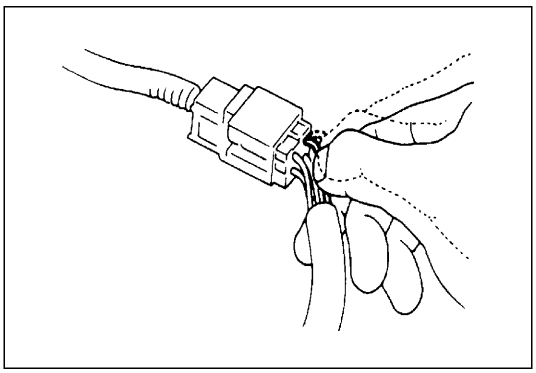


- Poor mating of connector halves, or terminals not fully seated in the connector body (backed out).
- Dirt or corrosion on the terminals. The terminals must be clean and free of any foreign material which could impede proper terminal contact. However, cleaning the terminal with a sand paper or the like is prohibited.
- Damaged connector body, exposing the terminals to moisture and dirt, as well as not maintaining proper terminal orientation with the component or mating connector.

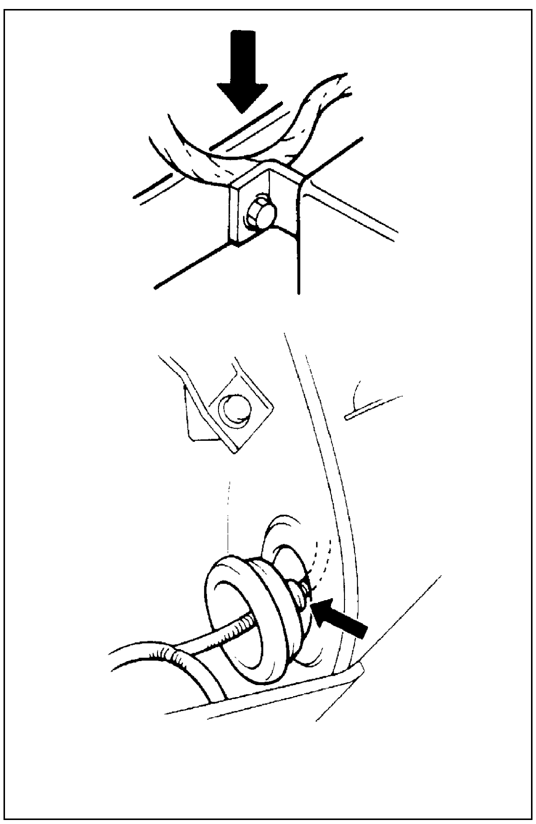


- Improperly formed or damaged terminals.
  Check each connector terminal in problem circuits carefully to ensure good contact tension by using the corresponding mating terminal.
  If contact tension is not enough, reform it to increase contact tension or replace.

1.	Check contact tension by inserting and removing just once.
2.	Check each terminal for bend and proper alignment.



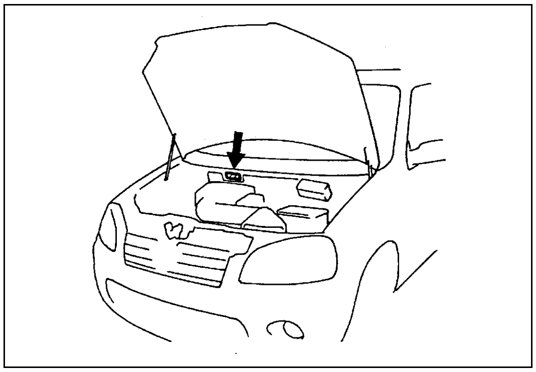
- Poor terminal-to-wire connection.
  Check each wire harness in problem circuits for poor connection by shaking it by hand lightly. If any abnormal condition is found, repair or replace.



- Wire insulation which is rubbed through, causing an intermittent short as the bare area touches other wiring or parts of the vehicle.
- Wiring broken inside the insulation. This condition could cause continuity check to show a good circuit, but if only 1 or 2 strands of a multi-strand-type wire are intact, resistance could be far too high.
  If any abnormality is found, repair or replace.

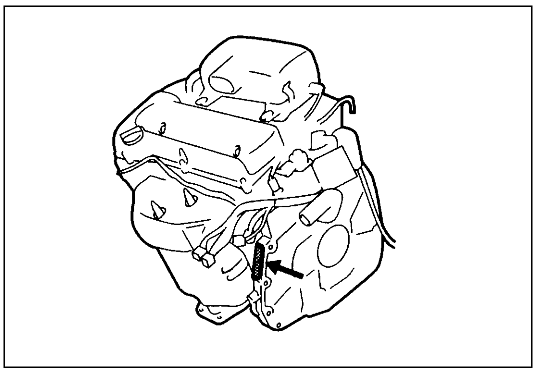
IDENTIFICATION INFORMATION

VEHICLE IDENTIFICATION NUMBER



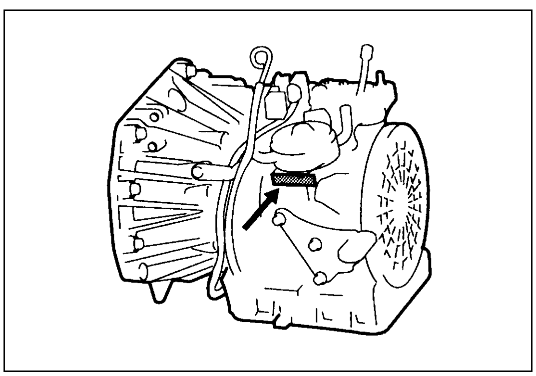
The number is punched on front dash panel in engine room.

ENGINE IDENTIFICATION NUMBER



The number is punched on cylinder block.

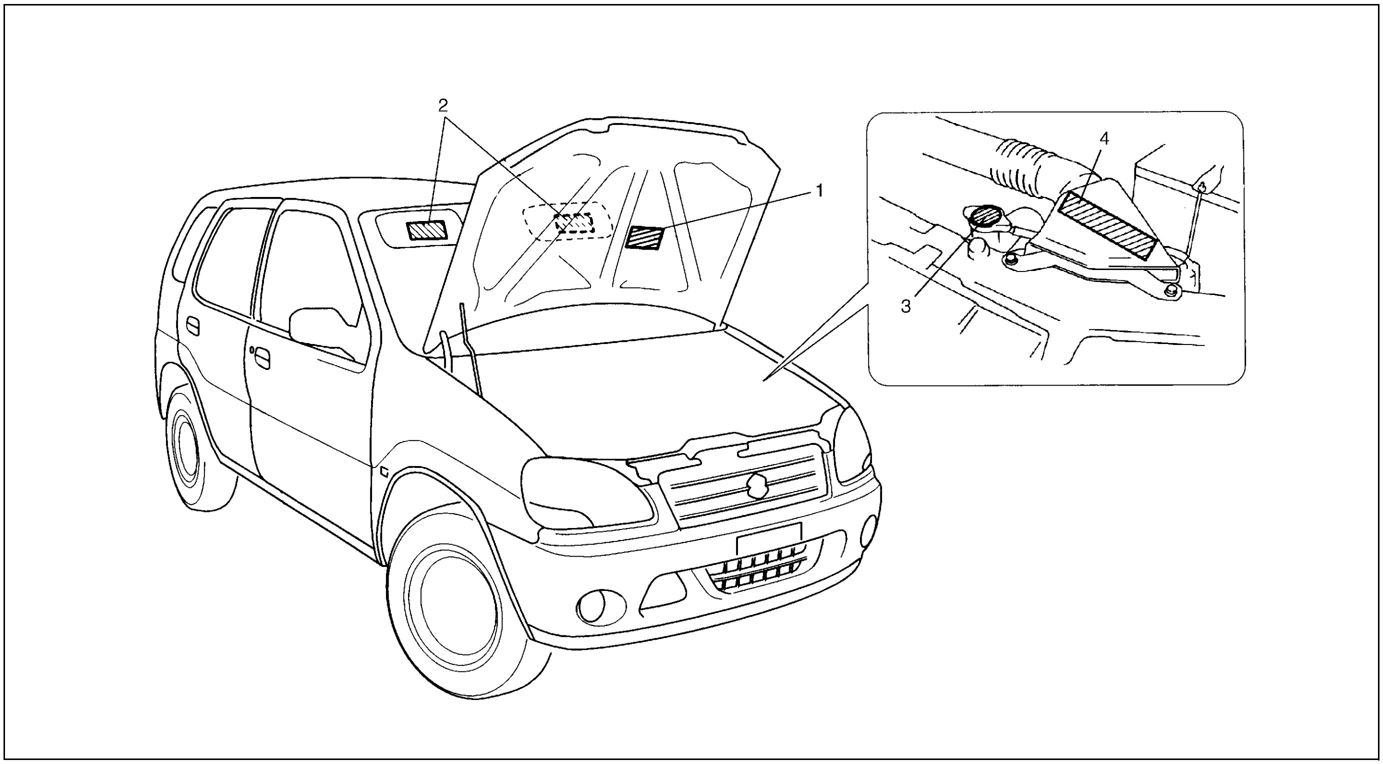
TRANSMISSION IDENTIFICATION NUMBER



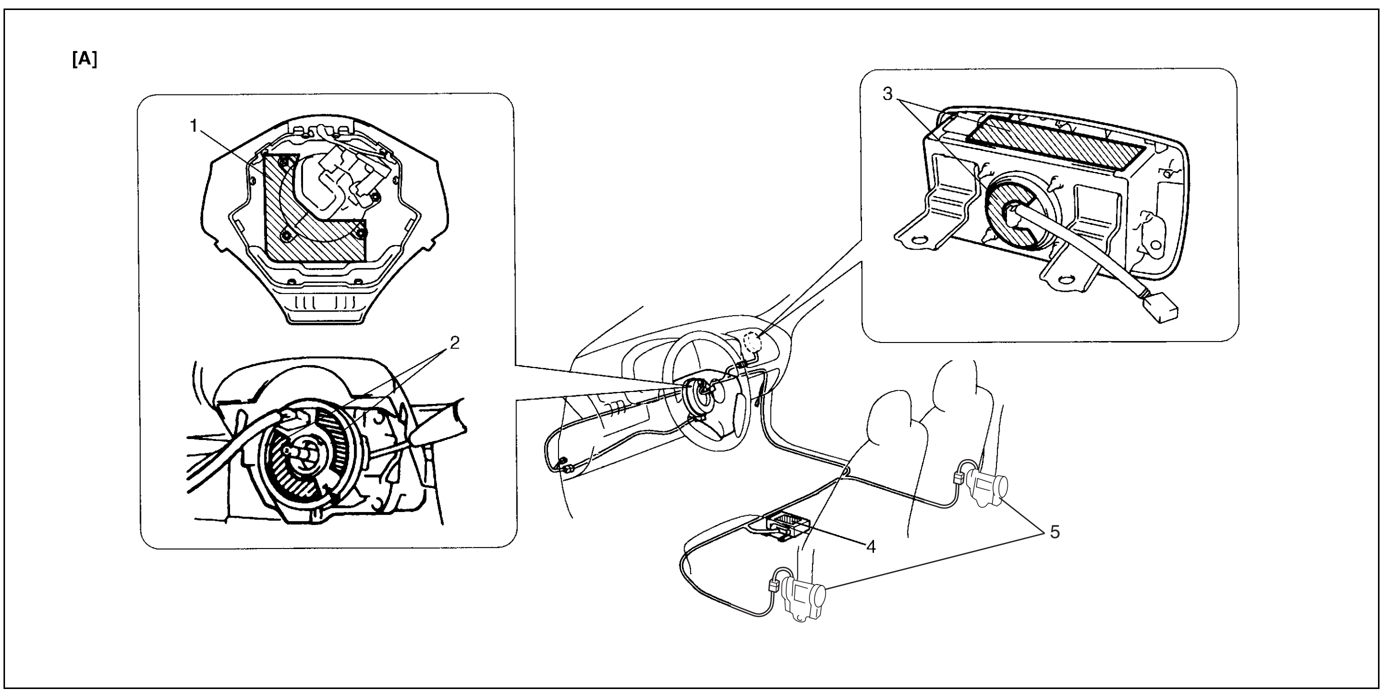
The automatic transmission identification number is located on transmission case.

WARNING, CAUTION AND INFORMATION LABELS

The figure below shows main labels among others that are attached to vehicle component parts.
When servicing and handling parts, refer to WARNING/CAUTION instructions printed on labels.
If any WARNING/CAUTION label is found stained or damaged, clean or replace it as necessary.



1.	Air bag label on back side of engine hood (if equipped)
2.	Air bag label on sun visor (if equipped)
3.	Radiator cap label
4.	Engine cooling fan label



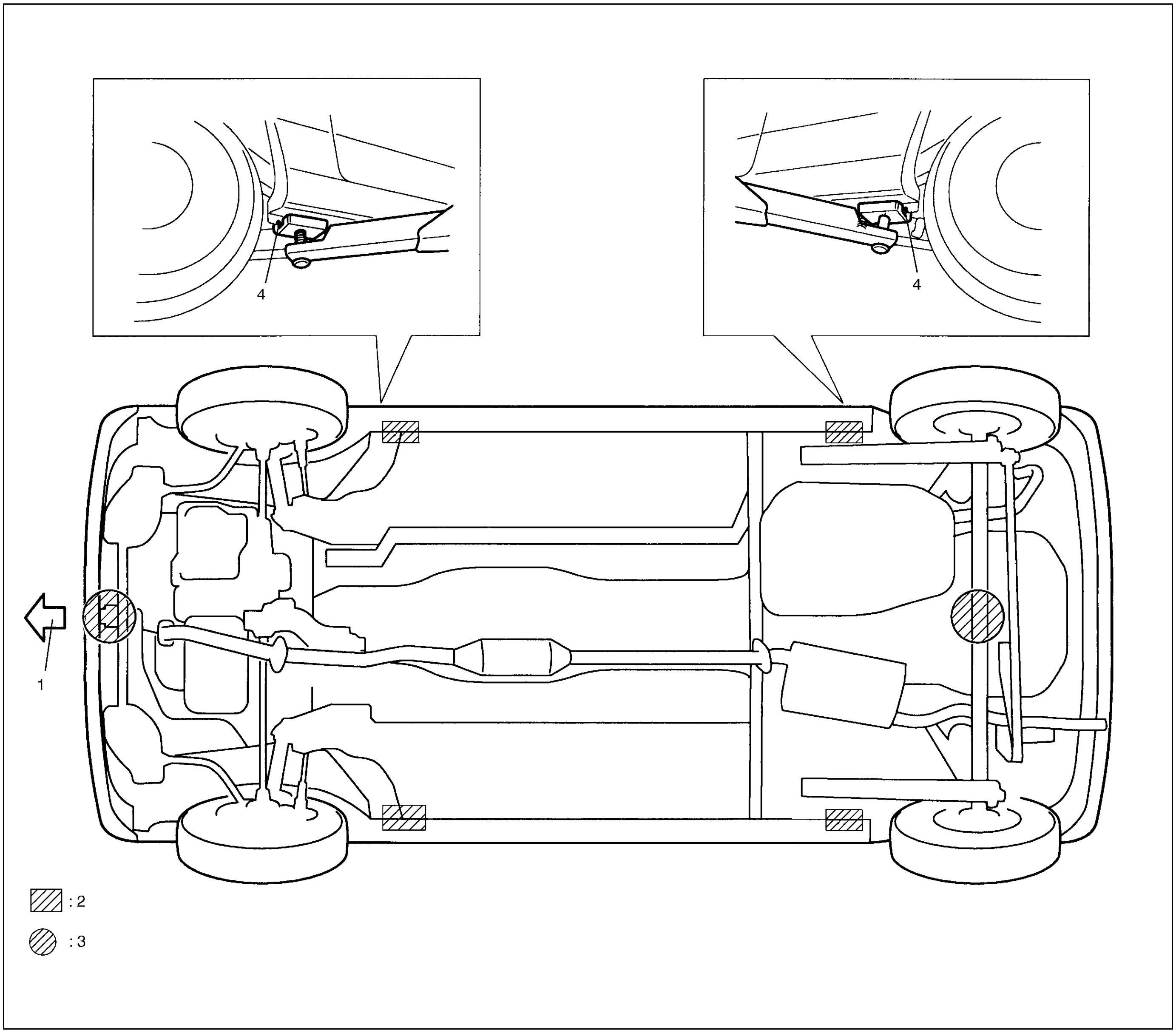
1.	Air bag label on driver air bag (inflator) module	4.	Air bag label on SDM
2.	Air bag label on combination switch and contact coil assembly	5.	Pretensioner label on seat belt retractor
3.	Air bag label on passenger air bag (inflator) module	[A] :	These labels are attached on vehicle equipped with air bag system only.

VEHICLE LIFTING POINTS

WARNING:

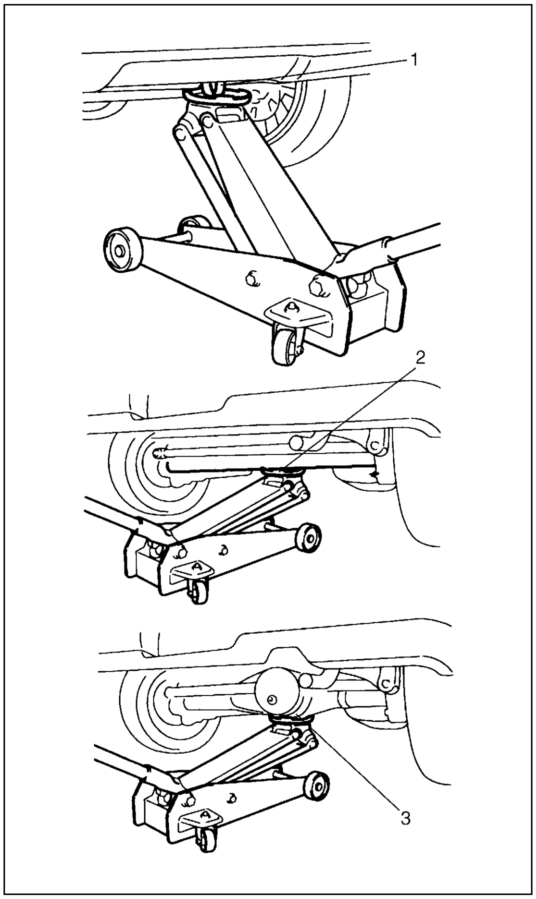
- **Before applying hoist to underbody, always take vehicle balance throughout service into consideration. Vehicle balance on hoist may change depending on what part to be removed.**
- **Before lifting up the vehicle, check to be sure that end of hoist arm is not in contact with brake pipe, fuel pipe, bracket or any other part.**
- **When using frame contact hoist, apply hoist as shown (right and left at the same position). Lift up the vehicle till 4 tires are a little off the ground and make sure that the vehicle will not fall off by trying to move vehicle body in both ways. Work can be started only after this confirmation.**
- **Make absolutely sure to lock hoist after vehicle is hoisted up.**

WHEN USING FRAME CONTACT HOIST



1.	Vehicle front
2.	Support position for frame contact hoist and safety stand
3.	Floor jack position
4.	Embossed-mark

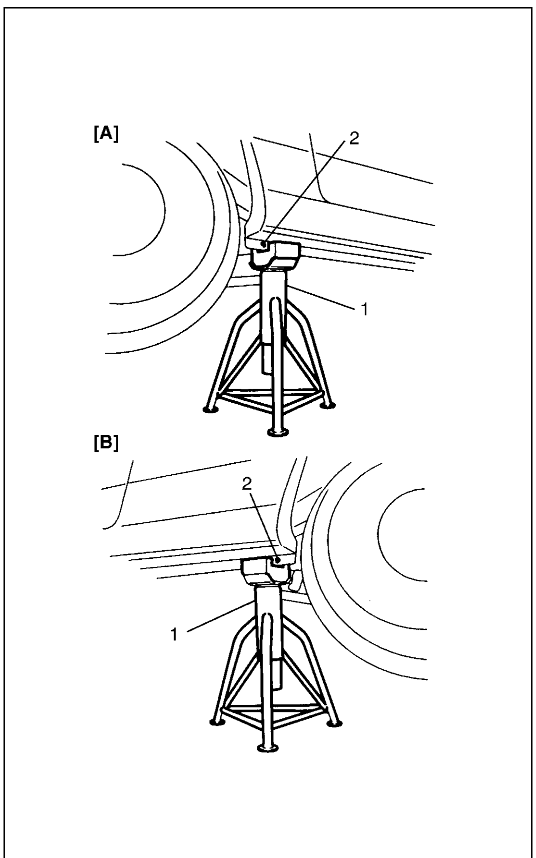
WHEN USING FLOOR JACK



> **WARNING:**
> **If the vehicle to be jacked up only at the front or rear end, be sure to block the wheels on ground in order to ensure safety.**
> **After the vehicle is jacked up, be sure to support it on stands. It is extremely dangerous to do any work on the vehicle raised on jack alone.**

> **CAUTION:**
> **Never apply jack against suspension parts (i.e., stabilizer, etc) or vehicle floor, or it may get deformed.**

In raising front or rear vehicle end off the floor by jacking, be sure to put the jack against the front jacking bracket (1), the center portion of rear axle (2) (2WD vehicle) or rear axle housing (3) (4WD vehicle).



To perform service with either front or rear vehicle end jacked up, be sure to place safety stands (1) under vehicle body so that vehicle body is securely supported. And then check to ensure that vehicle body does not slide on safety stands (1) and the vehicle is held stable for safety's sake.

[A] :	Front
[B] :	Rear
2.	Embossed mark

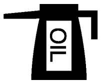
ABBREVIATIONS AND SYMBOLS MAY BE USED IN THIS MANUAL

ABBREVIATIONS

A	ABS	Anti-lock Brake System
	ATDC	After Top Dead Center
	API	American Petroleum Institute
	ATF	Automatic Transmission Fluid
	ALR	Automatic Locking Retractor
	AC	Alternating Current
	A/T	Automatic Transmission
	A/C	Air Conditioning
	ABDC	After Bottom Dead Center
	A/F	Air Fuel Mixture Ratio
	A-ELR	Automatic-Emergency Locking Retractor
B	B+	Battery Positive Voltage
	BTDC	Before Top Dead Center
	BBDC	Before Bottom Dead Center
C	CKT	Circuit
	CKP sensor	Crankshaft Position Sensor
	CMP sensor	Camshaft Position Sensor
	CO	Carbon Monoxide
	CPP switch	Clutch Pedal Position Switch (Clutch Switch, Clutch Start Switch)
	CPU	Central Processing Unit
	CRS	Child Restraint System
D	DC	Direct Current
	DLC	Data Link Connector (Assembly Line Diag. Link, ALDL, Serial Data Link, SDL)
	DOHC	Double Over Head Camshaft
	DOJ	Double Offset Joint
	DRL	Daytime Running Light
	DTC	Diagnostic Trouble Code (Diagnostic Code)
E	EBCM	Electronic Brake Control Module, ABS Control Module
	EBD	Electronic Brake Force Distribution
	ECM	Engine Control Module
	ECT sensor	Engine Coolant Temperature Sensor (Water Temp. Sensor, WTS)
	EGR	Exhaust Gas Recirculation
	EGRT sensor	EGR Temperature Sensor (Recirculated Exhaust Gas Temp. Sensor, REGTS)
	EFE Heater	Early Fuel Evaporation Heater (Positive Temperature Coefficient, PTC Heater)
	EPS	Electronic Power Steering
	EVAP	Evaporative Emission
	EVAP Canister	Evaporative Emission Canister (Charcoal Canister)
F	4WD	4 Wheel Drive
G	GEN	Generator
	GND	Ground
H	HC	Hydrocarbons
	HO2S	Heated Oxygen Sensor
I	IAC Valve	Idle Air Control Valve (Idle Speed Control Solenoid Valve ISC Solenoid Valve)
	IAT Sensor	Intake Air Temperature Sensor (Air temperature Sensor, ATS)
	ICM	Immobilizer Control Module
	IG	Ignition
	ISC Actuator	Idle Speed Control Actuator
L	LH	Left Hand
	LSPV	Load Sensing Proportioning Valve
M	MAF Sensor	Mass Air Flow Sensor (Air Flow Sensor, AFS, Air Flow Meter, AFM)
	MAP Sensor	Manifold Absolute Pressure Sensor (Pressure Sensor, PS)
	Max	Maximum
	MFI	Multiport Fuel Injection (Multipoint Fuel Injection)
	MIN	Minimum
	MIL	Malfunction Indicator Lamp (“SERVICE ENGINE SOON” Light)
	M/T	Manual Transmission
N	NOx	Nitrogen Oxides
O	OBD	On-Board Diagnostic System (Self-Diagnosis Function)
	O/D	Overdrive
	OHC	Over Head Camshaft
	O2S	Oxygen Sensor
P	PNP	Park/Neutral Position
	P/S	Power Steering

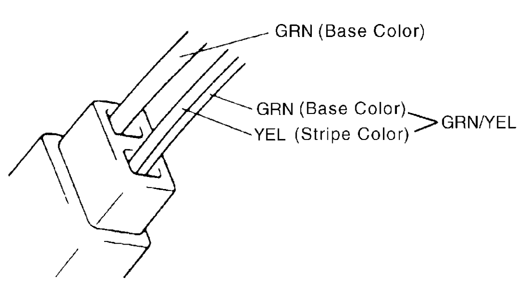
P	PSP Switch	Power Steering Pressure Switch (P/S Pressure Switch)
	PCM	Powertrain Control Module
	PCV	Positive Crankcase Ventilation
R	RH	Right Hand
S	SAE	Society of Automotive Engineers
	SDM	Sensing and Diagnostic Module (Air bag controller, Air bag control module)
	SFI	Sequential Multiport Fuel Injection
	SOHC	Single over Head Camshaft
T	TBI	Throttle Body Fuel Injection (Single-Point Fuel Injection, SPI)
	TCC	Torque Converter Clutch
	TCM	Transmission Control Module (A/T Controller, A/T Control Module)
	TP Sensor	Throttle Position Sensor
	TVV	Thermal Vacuum Valve (Thermal Vacuum Switching Valve, TVSV, Bimetal Vacuum Switching Valve, BVSV)
	TWC	Three Way Catalytic Converter (Three Way Catalyst)
	2WD	2 Wheel Drive
V	VIN	Vehicle Identification Number
	VSS	Vehicle Speed Sensor
W	WU-OC	Warm Up Oxidation Catalytic Converter
	WU-TWC	Warm Up Three Way Catalytic Converter

SYMBOLS

SYMBOL	DEFINITION	SYMBOL	DEFINITION
	Tightening torque		Apply SUZUKI BOND NO. 1216 99000-31160
	Apply oil (engine, transmission, transfer, differential)		Apply SILICONE SEALANT 99000-31120
	Apply fluid (brake, power steering or automatic transmission fluid)		Apply SEALING COMPOUND 366E 99000-31090
	Apply SUZUKI SUPER GREASE A 99000-25010		
	Apply SUZUKI SUPER GREASE C 99000-25030		Apply THREAD LOCK 1322 99000-32110
	Apply SUZUKI SUPER GREASE E 99000-25050		Apply THREAD LOCK 1333B 99000-32020
	Apply SUZUKI SUPER GREASE H 99000-25120		Apply THREAD LOCK 1342 99000-32050
	Apply SUZUKI SUPER GREASE I 99000-25210		
	Apply SUZUKI BOND NO. 1215 99000-31110		Do not reuse
	Apply SUZUKI BOND NO. 1207C 99000-31150		Note on reassembly

WIRE COLOR SYMBOLS

Symbol		Wire Color	Symbol		Wire Color
B	BLK	Black	O, Or	ORN	Orange
Bl	BLU	Blue	R	RED	Red
Br	BRN	Brown	W	WHT	White
G	GRN	Green	Y	YEL	Yellow
Gr	GRY	Gray	P	PNK	Pink
Lbl	LT BLU	Light blue	V	PPL	Violet
Lg	LT GRN	Light green			



There are two kinds of colored wire used in this vehicle. One is single-colored wire and the other is dual-colored (striped) wire.
The single-colored wire uses only one color symbol (i.e. “GRN”).
The dual-colored wire uses two color symbols (i.e. “GRN/YEL”). The first symbol represents the base color of the wire (“GRN” in the figure) and the second symbol represents the color of the stripe (“YEL” in the figure).

FASTENER INFORMATION

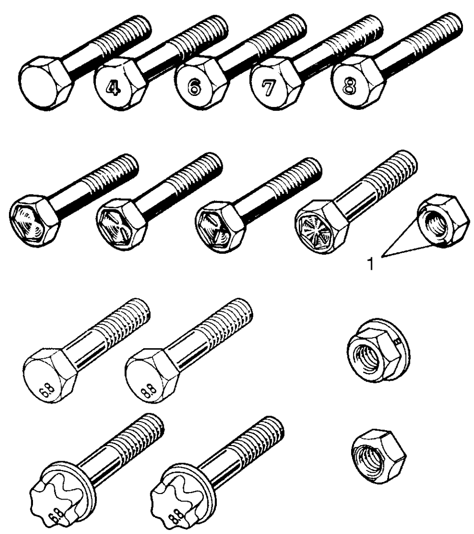
METRIC FASTENERS

Most of the fasteners used for this vehicle are metric. When replacing any fasteners, it is most important that replacement fasteners be the correct diameter, thread pitch and strength.

FASTENER STRENGTH IDENTIFICATION

Most commonly used metric fastener strength property classes are 4T, 6.8, 7T, 8.8 and radial line with the class identification embossed on the head of each bolt. Some metric nuts will be marked with punch, 6 or 8 mark strength identification on the nut face. Figure shows the different strength markings.
When replacing metric fasteners, be careful to use bolts and nuts of the same strength or greater than the original fasteners (the same number marking or higher). It is likewise important to select replacement fasteners of the correct diameter and thread pitch. Correct replacement bolts and nuts are available through the parts division.

Metric bolts : Identification class numbers or marks correspond to bolt strength (increasing numbers represent increasing strength).



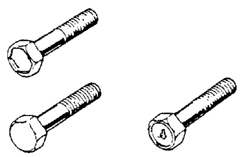
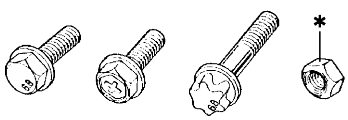
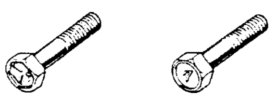
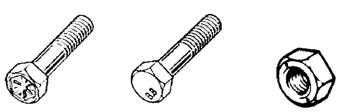
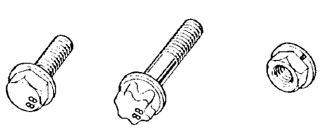
1. Nut strength identification

STANDARD TIGHTENING TORQUE

Each fastener should be tightened to the torque specified in each section of this manual. If no description or specification is provided, refer to the following tightening torque chart for the applicable torque for each fastener. When a fastener of greater strength than the original one is used, however, use the torque specified for the original fastener.

NOTE:
- **For the flanged bolt, flanged nut and self-lock nut of 4T and 7T strength, add 10% to the tightening torque given in the chart below.**
- **The chart below is applicable only where the fastened parts are made of steel light alloy.**

Tightening torque chart :

			Thread Diameter (Nominal Diameter) (mm)								
			4	5	6	8	10	12	14	16	18
Strength	A equivalent of 4T strength fastener 	N·m	1.5	3.0	5.5	13	29	45	65	105	160
		kg-m	0.15	0.30	0.55	1.3	2.9	4.5	6.5	10.5	16
		lb-ft	1.0	2.5	4.0	9.5	21.0	32.5	47.0	76.0	116.0
	A equivalent of 6.8 strength fastener without flange 	N·m	2.4	4.7	8.4	20	42	80	125	193	280
		kg-m	0.24	0.47	0.84	2.0	4.2	8.0	12.5	19.3	28
		lb-ft	2.0	3.5	6.0	14.5	30.5	58.0	90.5	139.5	202.5
	A equivalent of 6.8 strength fastener with flange  ✱	N·m	2.4	4.9	8.8	21	44	84	133	203	298
		kg-m	0.24	0.49	0.88	2.1	4.4	8.4	13.3	20.3	29.8
		lb-ft	2.0	3.5	6.5	15.5	32.0	61.0	96.5	147.0	215.5
	A equivalent of 7T strength fastener 	N·m	2.3	4.5	10	23	50	85	135	210	240
		kg-m	0.23	0.45	1.0	2.3	5.0	8.5	13.5	21	24
		lb-ft	2.0	3.5	7.5	17.0	36.5	61.5	98.0	152.0	174.0
	A equivalent of 8.8 strength fastener without flange 	N·m	3.1	6.3	11	27	56	105	168	258	373
		kg-m	0.31	0.63	1.1	2.7	5.6	10.5	16.8	25.8	37.3
		lb-ft	2.5	4.5	8.0	19.5	40.5	76.0	121.5	187.0	270.0
	A equivalent of 8.8 strength fastener with flange 	N·m	3.2	6.5	12	29	59	113	175	270	395
		kg-m	0.32	0.65	1.2	2.9	5.9	11.3	17.5	27	39.5
		lb-ft	2.5	5.0	9.0	21.0	43.0	82.0	126.5	195.5	286.0

✱: Self-lock nut

SECTION 0B

MAINTENANCE AND LUBRICATION

WARNING:

For vehicles equipped with Supplemental Restraint (Air Bag) System:

- **Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to "Air Bag System Components and Wiring Location View" under "General Description" in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and "Service Precautions" under "On-Vehicle Service" in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.**
- **Technical service work must be started at least 90 seconds after the ignition switch is turned to the "LOCK" position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).**

CONTENTS

MAINTENANCE SCHEDULE

MAINTENANCE SCHEDULE UNDER NORMAL DRIVING CONDITIONS

NOTE:

- **This interval should be judged by odometer reading or months, whichever comes first.**
- **This table includes service as scheduled up to 90,000 km (54,000 miles) mileage. Beyond 90,000 km (54,000 miles), carry out the same services at the same intervals respectively.**

Interval		Km (x 1,000)		15	30	45	60	75	90
		Miles (x 1,000)		9	18	27	36	45	54
		Months		12	24	36	48	60	72
ENGINE									
Drive belt				–	–	I	–	–	R
Valve lash (clearance)				–	I	–	I	–	I
Engine oil and oil filter				R	R	R	R	R	R
Engine coolant				–	–	R	–	–	R
Exhaust system				–	I	–	I	–	I
IGNITION SYSTEM									
✱Spark plugs	When unleaded fuel is used	Vehicle without HO2S	Nickel plug	–	R	–	R	–	R
			Iridium plug	–	–	–	R	–	–
		Vehicle with HO2S	Nickel plug	–	–	R	–	–	R
			Iridium plug	Replace every 105,000 km (63,000 miles) or 84 months					
	When leaded fuel is used, refer to “MAINTENANCE RECOMMENDED UNDER SEVERE DRIVING CONDTION” in this section.								
FUEL SYSTEM									
Air cleaner filter			Paved-road	I	I	R	I	I	R
			Dusty conditions	Refer to “MAINTENANCE RECOMMENDED UNDER SEVERE DRIVING CONDITIONS” in this section.					
Fuel lines and connections				–	I	–	I	–	I
Fuel filter				Replace every 105,000 km (63,000 miles)					
Fuel tank				–	–	I	–	–	I
EMISSION CONTROL SYSTEM									
✱PCV valve		Vehicle without HO2S		–	–	I	–	–	I
		Vehicle with HO2S		–	–	–	–	–	I
✱Fuel evaporative emission control system				–	–	–	–	–	I

NOTE:

- **“R” : Replace or change**
- **“I” : Inspect and correct, replace or lubricate if necessary**
- **For Sweden, items with ✱ (asterisk) should be performed by odometer reading only.**
- **For spark plugs, replace every 50,000 km if the local law requires.**
- **Nickel spark plug : BKR6E-11 (NGK) or K20PR-U11 (DENSO)**
- **Iridium spark plug : IFR5E11 (NGK)**

Interval								
Interval	Km (x 1,000)	15	30	45	60	75	90
	Miles (x 1,000)	9	18	27	36	45	54
	Months	12	24	36	48	60	72
BRAKE							
Brake discs and pads (thickness, wear, damage)		I	I	I	I	I	I
Brake drums and shoes (wear, damage)		–	I	–	I	–	I
Brake hoses and pipes (leakage, damage, clamp)		–	I	–	I	–	I
Brake fluid		–	R	–	R	–	R
Brake lever and cable (damage, stroke, operation)		Inspect at first 15,000 km (9,000 miles only)					
CHASSIS AND BODY							
Clutch (pedal height and travel)		–	I	–	I	–	I
Tires (wear, damage, rotation) /wheels (damage)		I	I	I	I	I	I
Suspension system (tightness, damage, rattle, breakage)		–	I	–	I	–	I
Steering system (tightness, damage, breakage, rattle)		–	I	–	I	–	I
Drive shaft (axle) boots/Propeller shafts (4WD)		–	–	I	–	–	I
Manual transmission oil (leakage, level) (I : 1st 15,000 km only)		I	–	R	–	–	R
Automatic transmission fluid	Fluid level	–	I	–	I	–	I
	Fluid change	Replace every 165,000 km (99,000 miles)					
Transfer oil (4WD) (leakage, level)		I	–	I	–	I	–
Rear differential oil (4WD) (leakage, level) (R : 1st 15,000 km only)		R or I	–	I	–	I	–
All latches, hinges and locks		–	I	–	I	–	I

NOTE:
- **“R” : Replace or change**
- **“I” : Inspect and correct or replace if necessary**

MAINTENANCE RECOMMENDED UNDER SEVERE DRIVING CONDITIONS

If the vehicle is usually used under the conditions corresponding to any severe condition code given below, IT IS RECOMMENDED that applicable maintenance operation be performed at the particular interval as shown in the following table.

Severe condition code :
A : Repeated short trips
B : Driving on rough and/or muddy roads
C : Driving on dusty roads
D : Driving in extremely cold weather and/or salted roads
E : Repeated short trips in extremely cold weather
F : Leaded fuel use
G : – – – – –
H : Towing a trailer (if admitted)

Severe Condition Code	Maintenance		Maintenance Operation	Maintenance Interval
– B C D – – – –	Drive belt		I	Every 15,000 km (9,000 miles) or 12 months
			R	Every 45,000 km (27,000 miles) or 36 months
A – C D E F – H	Engine oil and oil filter		R	Every 5,000 km (3,000 miles) or 4 months
– – C – – – – –	Air cleaner filter ✱1		I	Every 2,500 km (1,500 miles)
			R	Every 30,000 km (18,000 miles) or 24 months
A B C – E F – H	Spark plugs	Nickel spark plug	R	Every 10,000 km (6,000 miles) or 8 months
		Iridium spark plug	R	Every 30,000 km (18,000 miles) or 24 months
– B C D – – – H	Wheel bearings		I	Every 15,000 km (9,000 miles) or 12 months
– B – D E – – H	Drive shafts and propeller shafts (4WD)		I	Every 15,000 km (9,000 miles) or 12 months
– B – – E – – H	Manual transmission, transfer (4WD) and differential oil (4WD)		R	Every 30,000 km (18,000 miles) or 24 months
– B – – E – – H	Automatic transmission fluid		R	Every 30,000 km (18,000 miles) or 24 months

NOTE:
- **“I” : Inspect and correct or replace if necessary**
- **“R” : Replace or change**
- **✱1 : Inspect more frequently if the vehicle is used under dusty conditions.**

MAINTENANCE SERVICE

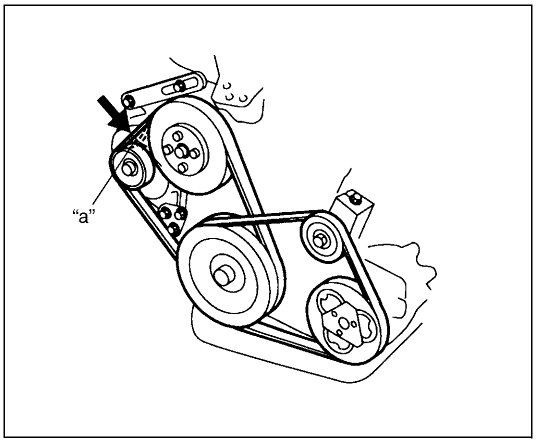
ENGINE

DRIVE BELT

WARNING:
All inspection and replacement are to be performed with ENGINE NOT RUNNING.

WATER PUMP AND GENERATOR DRIVE BELT INSPECTION

1) Disconnect negative (–) cable at battery.



2) Inspect belt for cracks, cuts, deformation, wear and cleanliness. If any defect exists, replace.
   Check belt for tension.

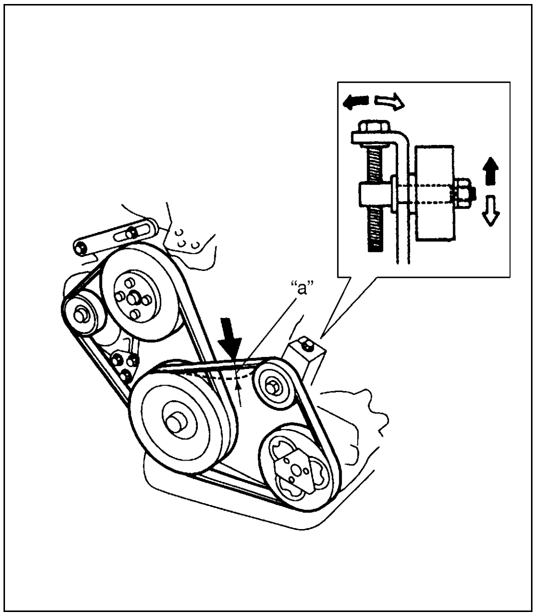
Water pump and generator belt tension
"a" : 4.5 - 5.5 mm (0.18 - 0.22 in.) deflection under 100 N (10 kg, 22 lb) pressure

NOTE:
When replacing belt with a new one, adjust belt tension to 3 - 4 mm (0.12 - 0.16 in.)

3) If belt is too tight or too loose, adjust it to specification by adjusting alternator position.
4) Tighten alternator adjusting bolts and pivot bolt.
5) Connect negative (–) cable to battery.

WATER PUMP AND GENERATOR DRIVE BELT REPLACEMENT

Replace belt with new one referring to "WATER PUMP BELT" in Section 6B.



A/C COMPRESSOR DRIVE BELT (IF EQUIPPED) INSPECTION

1) Disconnect negative (–) cable at battery.
2) Inspect belt for cracks, cuts, deformation, wear and cleanliness. If any defect exists, replace.
   Check belt for tension.
   If belt tension is out of specification, adjust it referring to "COMPRESSOR DRIVE BELT" in Section 1B.

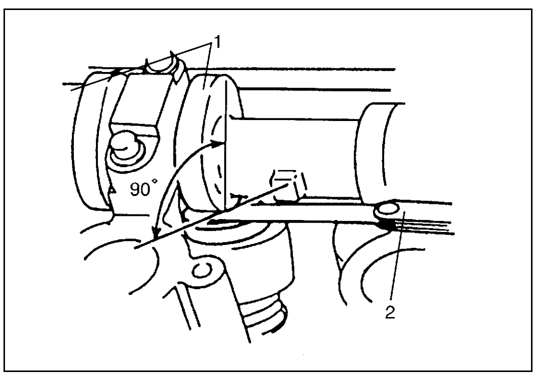
   A/C compressor drive belt tension
   "a" : 3 - 5 mm (0.12 - 0.20 in.) deflection under 100 N (10 kg, 22 lb) pressure
3) Connect negative (–) cable to battery.

REPLACEMENT

Replace belt with new one referring to "COMPRESSOR DRIVE BELT" in Section 1B.

VALVE LASH (CLEARANCE)

INSPECTION



1) Inspect intake and exhaust valve lash and adjust as necessary.
   Refer to "VALVE LASH" in Section 6A1 for valve lash inspection and adjustment procedure.

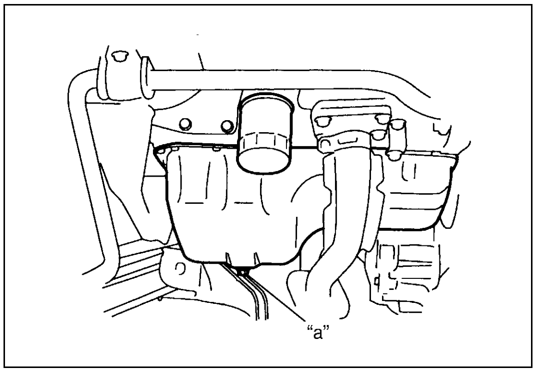
1.	Camshaft
2.	Thickness gauge

ENGINE OIL AND OIL FILTER

REPLACEMENT

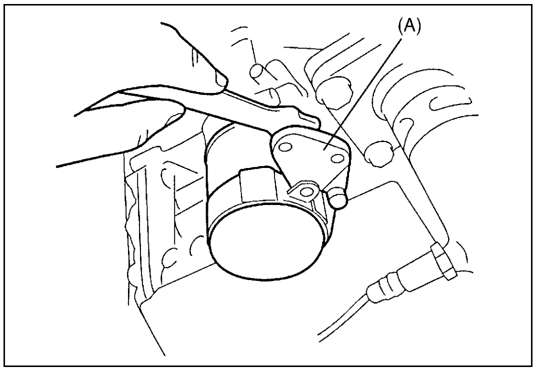
WARNING:
- **New and used engine oil can be hazardous.**
  Be sure to read "WARNING" in General Precaution in Section 0A and observe what in written there.
- **Step 1) - 7) outlined below must be performed with ENGINE NOT RUNNING. For step 8), be sure to have adequate ventilation while engine is running.**

Before draining engine oil, check engine for oil leakage. If any evidence of leakage is found, make sure to correct defective part before proceeding to the following work.



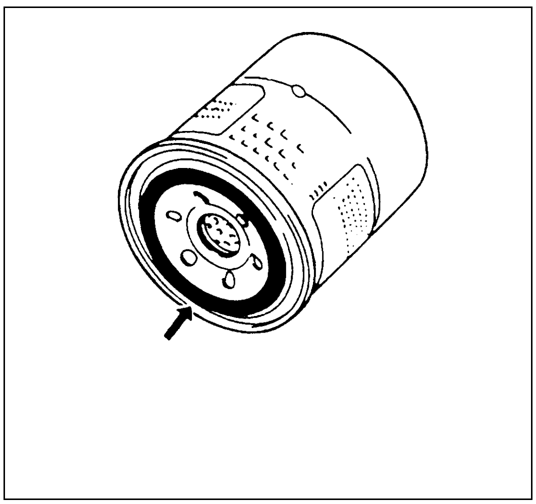
1) Drain engine oil by removing drain plug.
2) After draining oil, wipe drain plug clean. Reinstall drain plug, and tighten it securely as specified below.

Tightening torque
Engine oil drain plug (a) : 50 N·m (5.0 kg-m, 36.5 lb-ft)



3) Loosen oil filter by using oil filter wrench (special tool).

Special tool
(A) : 09915-47330



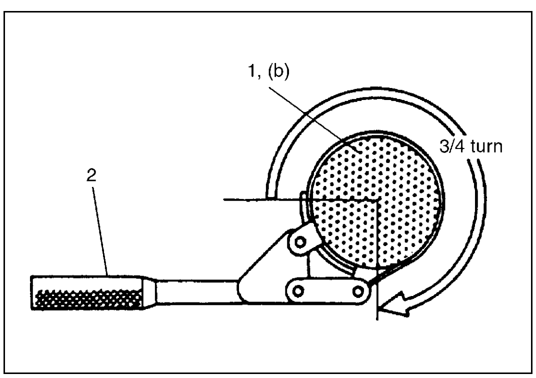
NOTE:

Before fitting new oil filter, be sure to oil its O-ring. Use engine oil for this purpose.

4) Screw new filter on oil filter stand by hand until the filter O-ring contacts the mounting surface.

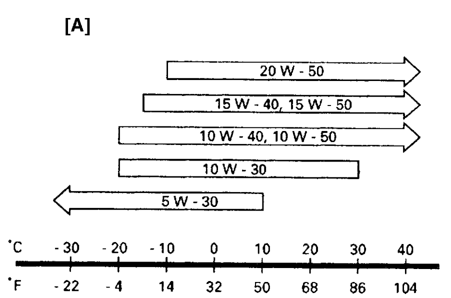
CAUTION:

To tighten oil filter properly, it is important to accurately identify the position at which filter O-ring first contacts the mounting surface.



5) Tighten the filter (1) 3/4 turn from the point of contact with the mounting surface using an oil filter wrench (2).

Tightening torque
Oil filter (b) : 14 N·m (1.4 kg-m, 10.5 lb-ft) (for reference)



6) Replenish oil until oil level is brought to FULL level mark on dipstick. (oil pan and oil filter capacity). The filler inlet is at the top of the cylinder head cover.
   It is recommended to use engine oil of SE, SF, SG, SH or SJ grade. Select the appropriate oil viscosity according to the proper engine oil viscosity chart [A].

NOTE:

For ambient temperature between –20°C (–4°F) and 30°C (86°F), it is highly recommended to use SAE 10W – 30 oil.

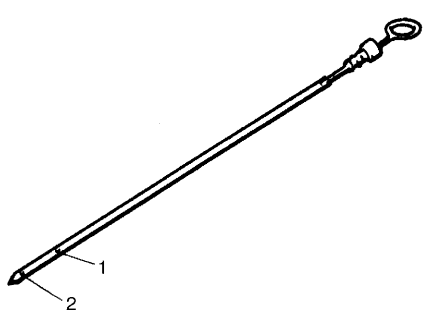
Engine oil specification

Oil pan capacity	About 3.6 liters (7.6/6.3 US/Imp pt.)
Oil filter capacity	About 0.2 liter (0.4/0.3 US/Imp pt.)
Others	About 0.3 liter (0.6/0.5 US/Imp pt.)
Total	About 4.1 liters (8.7/7.2 US/Imp pt.)

NOTE:

Engine oil capacity is specified. However, note that the amount of oil required when actually changing oil may somewhat differ from the data in the table depending on various conditions (temperature, viscosity, etc.)

7) Check oil filter and drain plug for oil leakage.



8) Start engine and run it for 3 minutes. Stop it and wait 5 minutes before checking oil level. Add oil, as necessary, to bring oil level to FULL level mark on dipstick.

1. Full level mark (hole)
2. Low level mark (hole)

ENGINE COOLANT

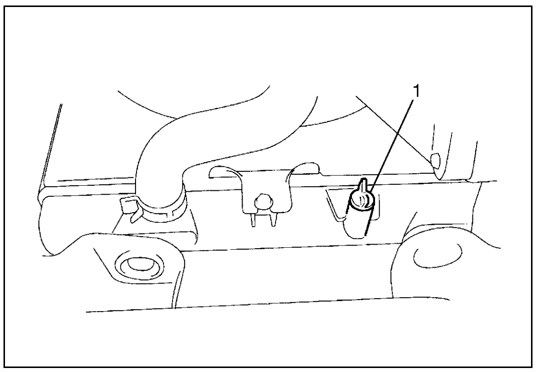
REPLACEMENT

WARNING:

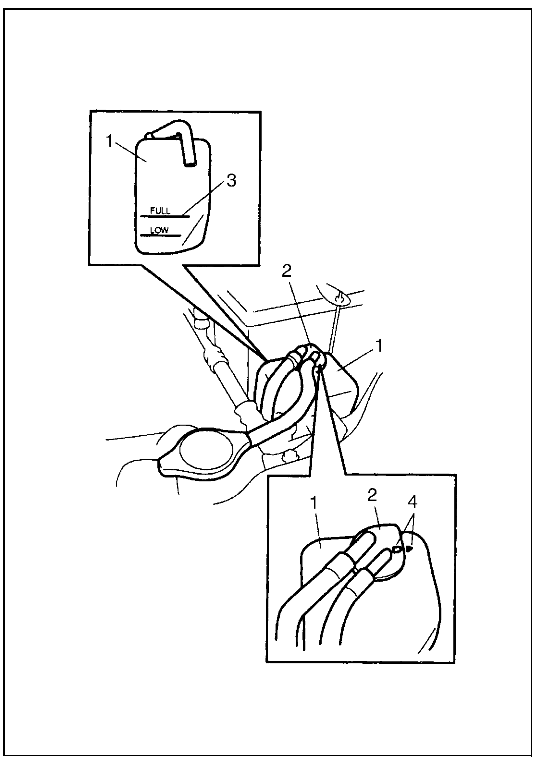
To help avoid danger of being burned, do not remove radiator cap while engine and radiator are still hot. Scalding fluid and steam can be blown out under pressure if cap is taken off too soon.

CAUTION:
When changing engine coolant, use mixture of 50% water and 50% ANTIFREEZE/ANTICORROSION COOLANT for the market where ambient temperature falls lower than –16°C (3°F) in winter, and mixture of 70% water and 30% ANTIFREEZE/ANTICORROSION COOLANT for the market where ambient temperature doesn't fall lower than –16°C (3°F).
Even in a market where no freezing temperature is anticipated, mixture of 70% water and 30% ANTIFREEZE/ANTICORROSION COOLANT should be used for the purpose of corrosion protection and lubrication.

1) Remove radiator cap when engine is cool.



2) Loosen radiator drain plug (1) to drain coolant.
3) Remove reservoir and drain.
4) Tighten plug securely. Also reinstall reservoir.
5) Fill radiator with specified amount of coolant, and run engine for 2 or 3 minutes at idle. This drives out any air which may still be trapped within cooling system. STOP ENGINE.
   Add coolant as necessary until coolant level reaches the filler throat of radiator. Reinstall radiator cap.



6) Add coolant to reservoir so that its level aligns with Full mark. Then, reinstall cap aligning arrow marks on reservoir and cap.

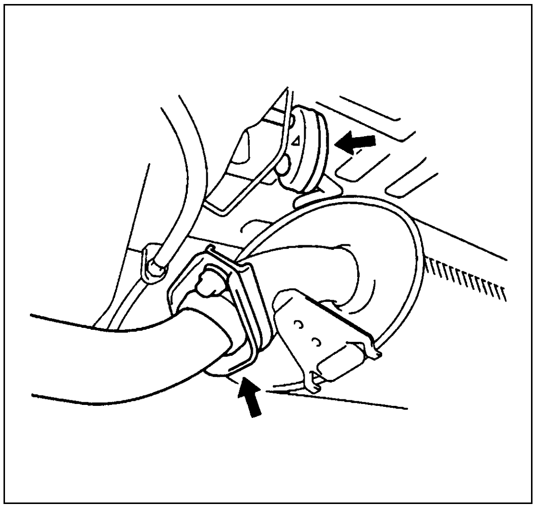
1. Reservoir
2. Reservoir cap
3. FULL level marks
4. Arrow marks

EXHAUST SYSTEM

INSPECTION

WARNING:
To avoid danger of being burned, do not touch exhaust system when it is still hot. Any service on exhaust system should be performed when it is cool.

When carrying out periodic maintenance, or the vehicle is raised for other service, check exhaust system as follows:



- Check rubber mountings for damage, deterioration, and out of position.
- Check exhaust system for leakage, loose connections, dents and damages.
  If bolts or nuts are loose, tighten them to specification.
- Check nearby body areas for damaged, missing, or mispositioned parts, open seams, holes, loose connections or other defects which could permit exhaust fumes to seep into the vehicle.
- Make sure that exhaust system components have enough clearance from the underbody to avoid overheating and possible damage to the floor carpet.
- Any defects should be fixed at once.

IGNITION SYSTEM

SPARK PLUGS

REPLACEMENT

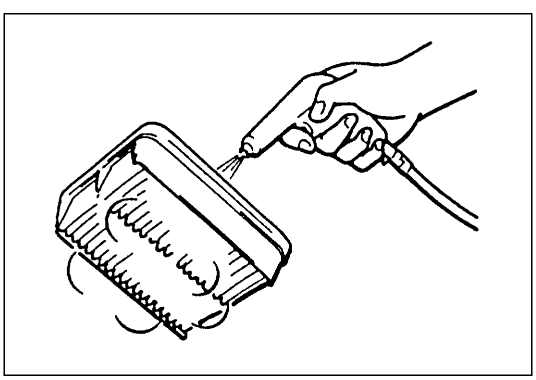
Replace spark plugs with new ones referring to "SPARK PLUG" in Section 6F1.

FUEL SYSTEM

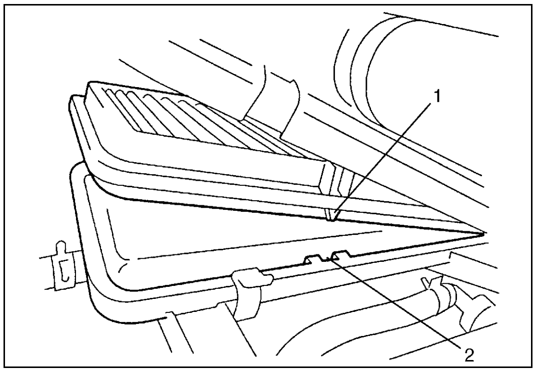
AIR CLEANER FILTER

INSPECTION

1) Remove air cleaner case clamps.
2) Take air cleaner filter out of case.



3) Check that filter is not excessively dirty, damaged or oily, clean filter with compressed air from air outlet side of filter.



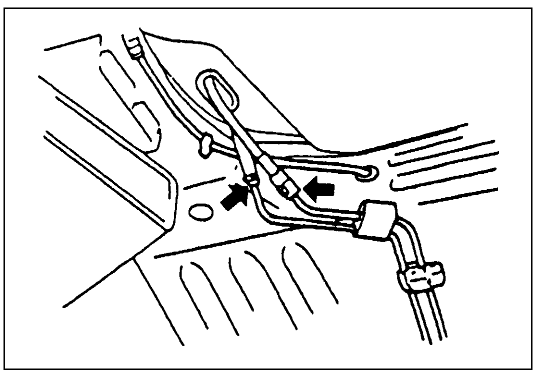
4) Install air cleaner filter fitting protrusion (1) of filter into groove (2) of case and clamp upper case securely.

REPLACEMENT

Replace air cleaner filter with new one according to steps 1), 2) and 4) of inspection procedure.

FUEL LINES AND CONNECTIONS

INSPECTION

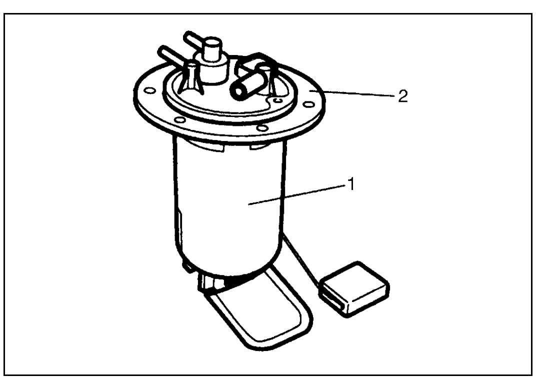


Visually inspect fuel lines and connections for evidence of fuel leakage, hose cracking and damage. Make sure all clamps are secure.
Repair leaky joints, if any.
Replace hoses that are suspected of being cracked.

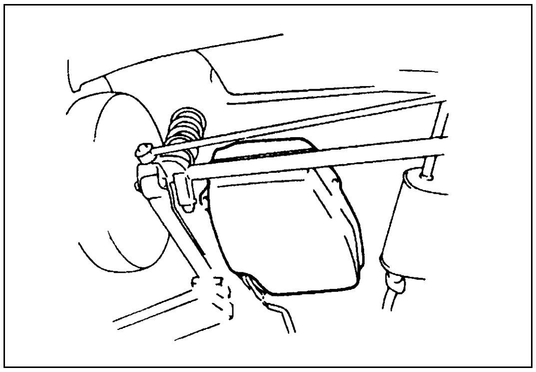
FUEL FILTER

REPLACEMENT

> **WARNING:**
> **This work must be performed in a well ventilated area and away from any open flames (such as gas hot water heaters).**



Fuel filter (1) is installed in fuel pump assembly (2) in fuel tank.
Replace fuel filter with new one, referring to “FUEL PUMP ASSEMBLY” in Section 6C for proper procedure.



FUEL TANK

INSPECTION

Check fuel tank damage, cracks, fuel leakage, corrosion and tank bolts looseness.
If a problem is found, repair or replace.

EMISSION CONTROL SYSTEM

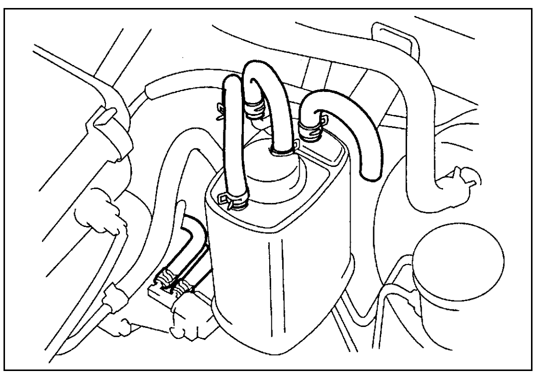
PCV VALVE

INSPECTION

Check crankcase ventilation hose and PCV hose for leaks, cracks or clog, and PCV valve for stick or clog. Refer to “PCV SYSTEM” of Section 6E1 for PCV valve checking procedure.

FUEL EVAPORATIVE EMISSION CONTROL SYSTEM

INSPECTION



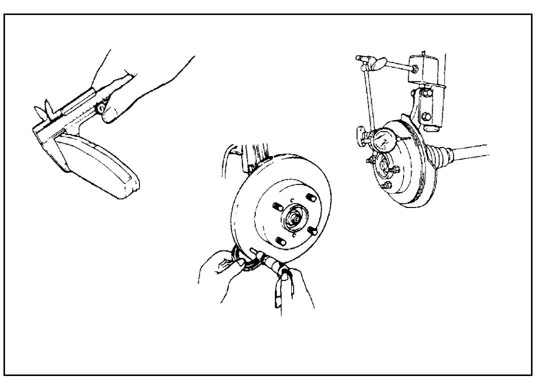
1) Visually inspect hoses for cracks, damage, or excessive bends. Inspect all clamps for damage and proper position.
2) Check EVAP canister for operation and clog, referring to “EVAP CONTROL SYSTEM” in Section 6E1.

If a malfunction is found, repair or replace.

BRAKE

BRAKE DISCS AND PADS (FRONT)

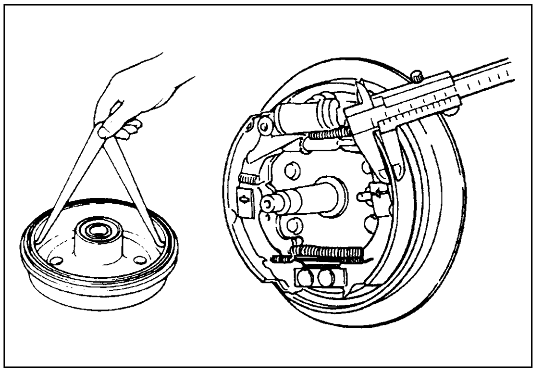
INSPECTION



1) Remove wheel and caliper but don’t disconnect brake hose from caliper.
2) Check front disc brake pads and discs for excessive wear, damage and deflection. Replace parts as necessary. For details, refer to “FRONT DISC BRAKE PAD” in Section 5.
   Be sure to torque caliper pin bolts to specification.

BRAKE DRUMS AND SHOES (REAR)

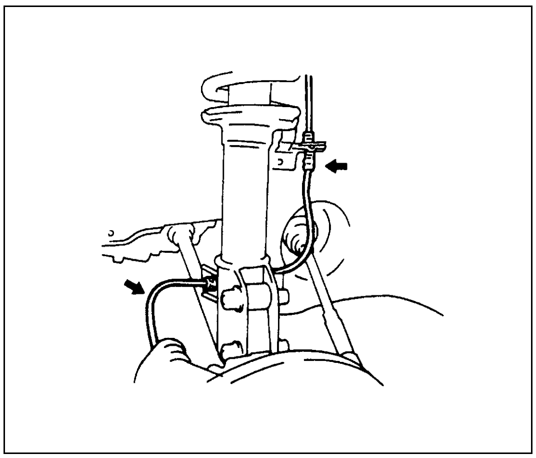
INSPECTION



1) Remove wheel and brake drum.
2) Check rear brake drums and brake linings for excessive wear and damage, while wheels and drums are removed. At the same time, check wheel cylinders for leaks. Replace these parts as necessary.
   For details, refer to “BRAKE DRUM” in Section 5.

BRAKE HOSES AND PIPES

INSPECTION



Perform this inspection where these is enough light and use a mirror as necessary.

- Check brake hoses and pipes for proper hookup, leaks, cracks, chafing and other damage.
- Check that hoses and pipes are clear of sharp edges and moving parts.

Repair or replace any of these parts as necessary.

CAUTION:
After replacing any brake pipe or hose, be sure to carry out air purge operation.

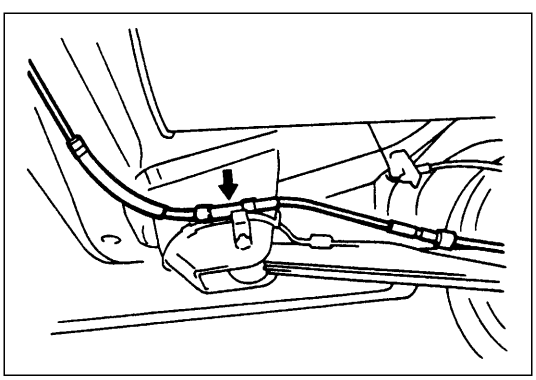
BRAKE FLUID

REPLACEMENT

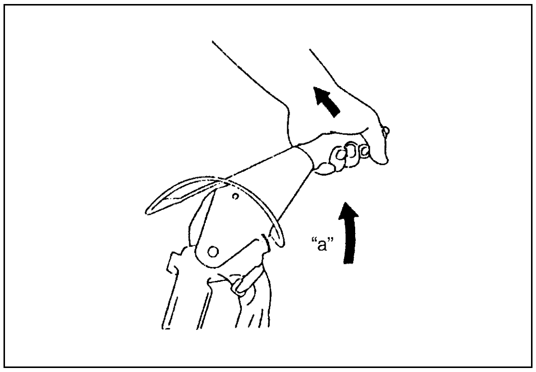
Change brake fluid as follows.
Drain existing fluid from brake system completely, fill system with specified fluid and carry out air purge operation.
For air purging procedure, refer to “BLEEDING BRAKES” in Section 5.

BRAKE LEVER AND CABLE

INSPECTION



1) Inspect brake cable for damage and smooth movement.
   Replace cable if it is in deteriorated condition.



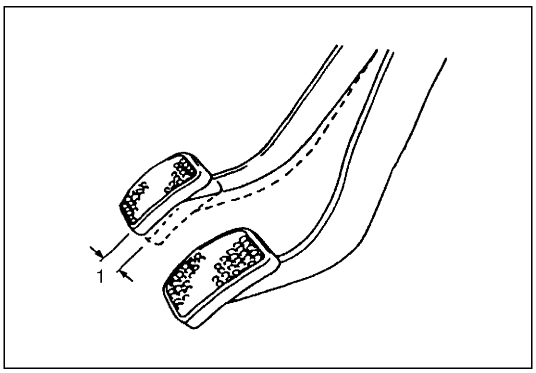
2) Check tooth tip of each notch for damage or wear. If any damage or wear is found, replace parking lever.
3) Check parking brake lever for proper operation and stroke, and adjust it if necessary.
   For checking and adjusting procedures, refer to "PARKING BRAKE INSPECTION AND ADJUSTMENT" in Section 5.

Parking brake lever stroke
"a" :4 - 9 notches (with 20 kg (44 lbs) of pull pressure)

CHASSIS AND BODY

CLUTCH

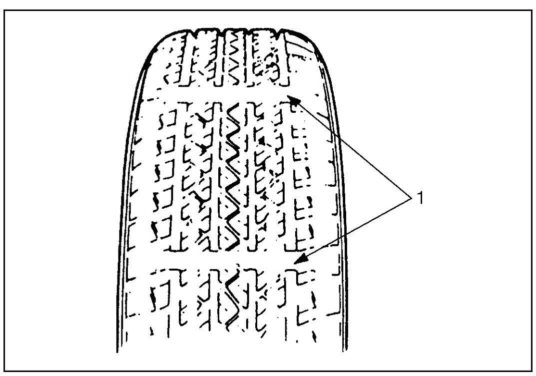
INSPECTION



Check clutch pedal for height and free travel (1) referring to "CLUTCH PEDAL HEIGHT CHECK" and "CLUTCH PEDAL FREE TRAVEL CHECK" in Section 7C. Adjust or correct if necessary.

TIRES / WHEELS

TIRES INSPECTION



1) Check tires for uneven or excessive wear, or damage.
   If defective, replace.
   Refer to "TIRE DIAGNOSIS" in Section 3 for details.

1. Wear indicator

2) Check inflating pressure of each tire and adjust pressure to specification as necessary.

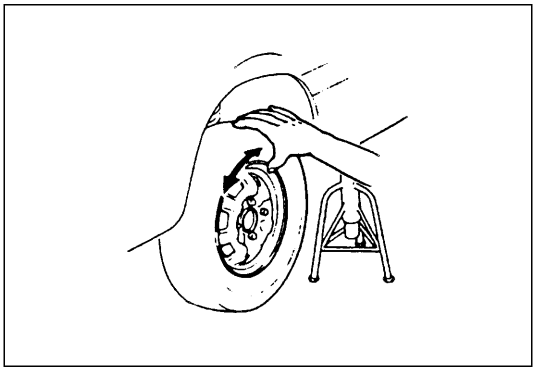
NOTE:
- **Tire inflation pressure should be checked when tires are cool.**
- **Specified tire inflation pressure should be found on tire placard or in owner's manual which came with the vehicle.**

3) Rotate tires.
   For details, refer to "TIRE ROTATION" in Section 3F.

WHEEL DISCS INSPECTION

Inspect each wheel disc for dents, distortion and cracks. A disc in badly damaged condition must be replaced.

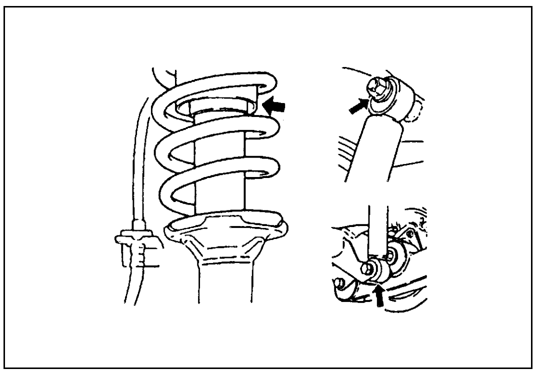
WHEEL BEARING INSPECTION



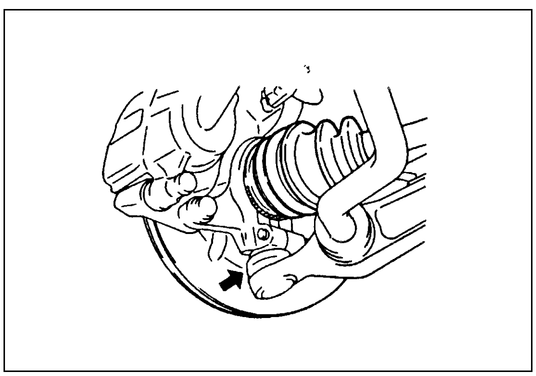
1) Check front wheel bearing for wear, damage, abnormal noise or rattles. For details, refer to “WHEEL DISC, NUT AND BEARING CHECK” in Section 3D.
2) Check rear wheel bearing for wear, damage, abnormal noise or rattles. For details, refer to “WHEEL DISC, NUT AND BEARING CHECK” in Section 3E.

SUSPENSION SYSTEM

INSPECTION



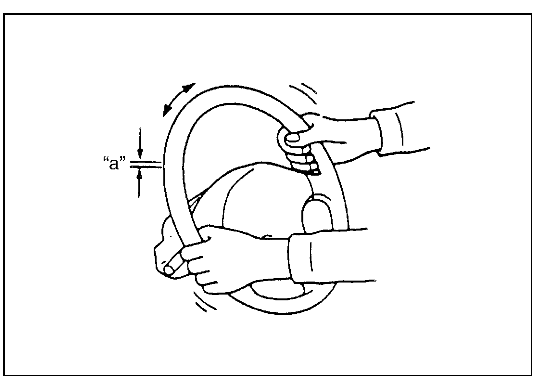
- Inspect front struts & rear shock absorbers for evidence of oil leakage, dents or any other damage on sleeves ; and inspect anchor ends for deterioration.
  Replace defective parts, if any.
- Check front and rear suspension systems for damaged, loose or missing parts ; also for parts showing signs of wear or lack of lubrication.
  Repair or replace defective parts, if any.



- Check front suspension arm ball joint stud dust seals for leakage, detachment, tear or any other damage.
  Replace defective boot, if any.

STEERING SYSTEM

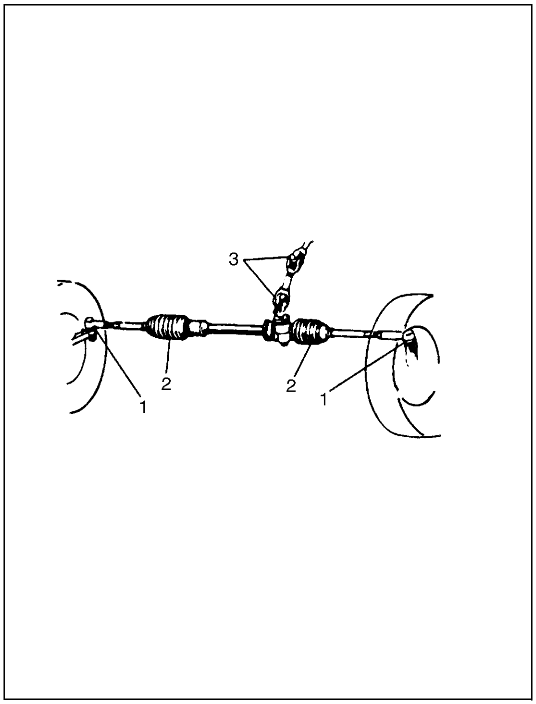
INSPECTION



1) Check steering wheel for play and rattle, holding vehicle straight on ground.

Steering wheel play
“a” : 0 – 30 mm (0 – 1.1 in.)

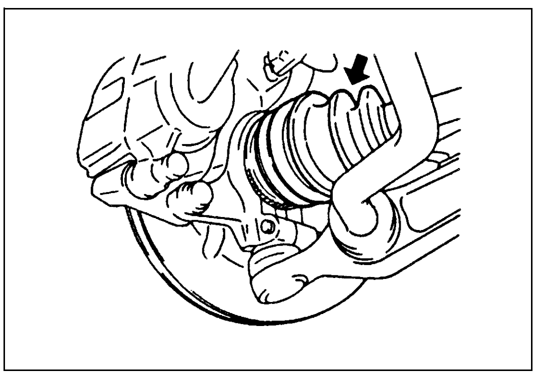
2) Check bolts and nuts for tightness and retighten them as necessary. Repair or replace defective parts, if any.



3) Check steering linkage for looseness and damage. Repair or replace defective parts, if any.
4) Check boots (1) and (2) of steering linkage and steering gear case for damage (leak, detachment, tear, etc.). If damage is found, replace defective boot with new one.
   If any dent is found on steering gear case boots, correct it to original shape by turning steering wheel to the right or left as far as it stops and holding it for a few seconds.
5) Check universal joints (3) of steering shaft for rattle and damage. If rattle or damage is found, replace defective part with a new one.
6) Check that steering wheel can be turned fully to the right and left. Repair or replace defective parts, if any.
7) If equipped with power steering system, check also, in addition to above check items, that steering wheel can be turned fully to the right and left more lightly when engine is running at idle speed than when it is stopped. Repair, if found faulty.
8) Check wheel alignment referring to Section 3A.

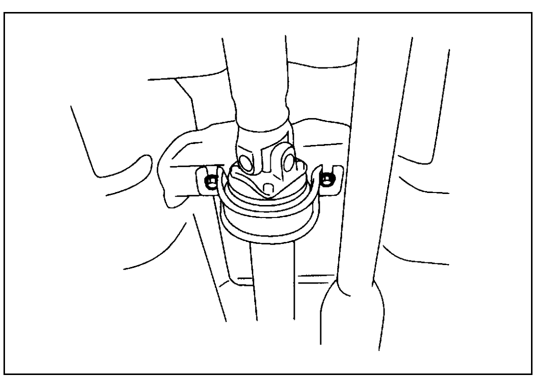
DRIVE SHAFT (AXLE) BOOTS / PROPELLER SHAFTS (4WD)

DRIVE SHAFT (AXLE) BOOTS INSPECTION



Check drive shaft boots (wheel side and differential side) for leaks, detachment, tear or other damage.
Replace boot as necessary.

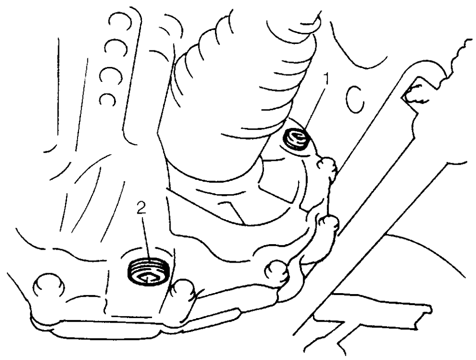
PROPELLER SHAFTS (4WD) INSPECTION



1) Check propeller shaft connecting bolts for looseness. If looseness is found, tighten to specified torque.
2) Check propeller shaft joints for wear, play and damage.
   If any defect is found, replace.
3) Check propeller shaft center support for biting of foreign matter, crack, abnormal noise and damage. If any defect is found, replace.

MANUAL TRANSMISSION OIL

INSPECTION



1) Inspect transmission case for evidence of oil leakage. Repair leaky point if any.
2) Make sure that vehicle is placed level for oil level check.
3) Remove oil filler/level plug (1) of transmission.
4) Check oil level.
   Oil level can be checked roughly by means of filler/level plug hole. That is, if oil flows out of level plug hole or if oil level is found up to hole when level plug is removed, oil is properly filled.
   If oil is found insufficient, pour specified oil up to level hole.
   For specified oil, refer to "MANUAL TRANSMISSION OIL CHANGE" in Section 7A.
5) Apply sealant to filler/level plug and tighten it to specified torque.

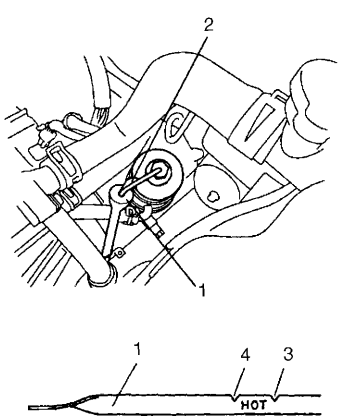
REPLACEMENT

1) Place the vehicle level and drain oil by removing drain plug (2).
2) Apply sealant to drain plug after cleaning it and tighten drain plug to specified torque.
3) Pour specified oil up to level hole.
4) Tighten filler plug to specified torque.
   For recommended oil, its amount and tightening torque data, refer to "MANUAL TRANSMISSION OIL CHANGE" in Section 7A.

AUTOMATIC TRANSMISSION FLUID

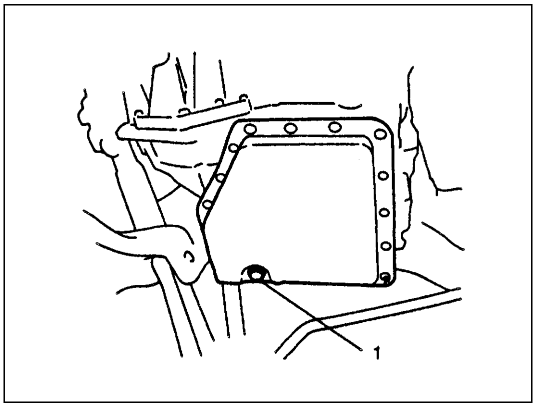
INSPECTION

1) Inspect transmission case for evidence of fluid leakage. Repair leaky point, if any.
2) Make sure that vehicle is placed level for fluid level check.



3) Pull out dipstick and check fluid level.
   For fluid level checking procedure, refer to "A/T FLUID LEVEL" in Section 7B and be sure to perform it under specified conditions. If fluid level is low, replenish specified fluid.

1.	Dipstick
2.	Clamp
3.	FULL HOT mark
4.	LOW HOT mark



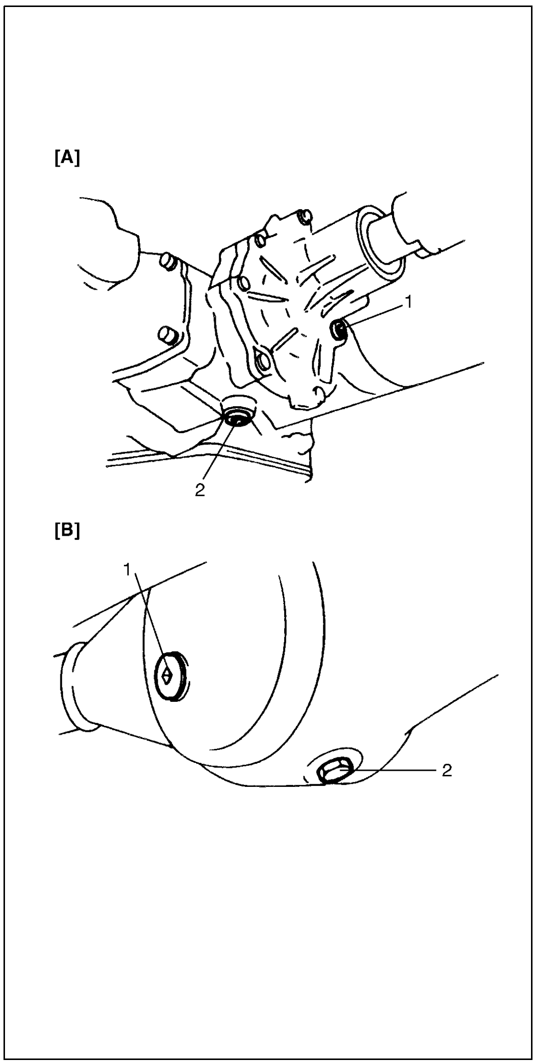
REPLACEMENT

1) Inspect transmission case for evidence of fluid leakage.
   Repair leaky point, if any.
2) Make sure that vehicle is placed level for fluid level check.
3) Change fluid. For its procedure, refer to “CHANGING A/T FLUID” in Section 7B.

1.	Drain plug

TRANSFER OIL (4WD) AND REAR DIFFERENTIAL OIL (4WD)

INSPECTION



1) Check transfer case or differential for evidence of oil leakage.
   Repair leaky point if any.
2) Make sure that vehicle is placed level for oil level check.
3) Remove level plug of transfer or differential and check oil level.
   Oil level can be checked roughly by means of level plug hole. That is, if oil flows out of level plug hole or if oil level is found up to hole when level plug is removed, oil is properly filled.
   If oil is found insufficient, pour specified amount of specified oil referring to “TRANSFER OIL CHANGE” in Section 7D or “DIFFERENTIAL OIL CHANGE” in Section 7F.

[A] :	Transfer
[B] :	Rear differential
1.	Oil level/filler plug
2.	Drain plug

4) Tighten level plug to specified torque referring to “TRANSFER OIL CHANGE” in Section 7D or “CHANGING DIFFERENTIAL OIL” in Section 7F.

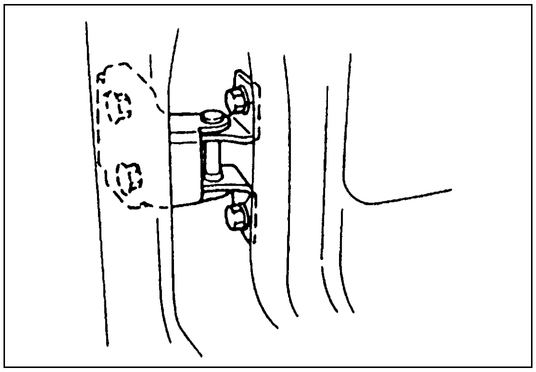
REPLACEMENT

Change transfer oil and differential oil with new specified oil referring to “TRANSFER OIL CHANGE” in Section 7D or “DIFFERENTIAL OIL CHANGE” in Section 7F.

ALL LATCHES, HINGES AND LOCKS

INSPECTION

DOORS



Check that each door of front, rear and back doors opens and closes smoothly and locks securely when closed.
If any malfunction is found, lubricate hinge and latch or repair door lock system.

ENGINE HOOD

Check that secondary latch operates properly (check that secondary latch keeps hood from opening all the way even when pulling hood release handle inside vehicle.) Also check that hood opens and closes smoothly and properly and hood locks securely when closed.
If any malfunction is found, lubricate hinge and latch, or repair hood lock system.

FINAL INSPECTION

WARNING:
When carrying out road tests, select a safe place where no man or no running vehicle is seen so as to prevent any accident.

SEATS

Check that seat slides smoothly and locks securely at any position. Also check that reclining mechanism of front seat back allows it to be locked at any angle.

SEAT BELT

Inspect belt system including webbing, buckles, latch plates, retractors and anchors for damage or wear.
Check that seat belt is securely locked. If “REPLACE BELT” label on front seat belt is visible, replace belt.

BATTERY ELECTROLYTE LEVEL CHECK

Check that the electrolyte level of all battery cells is between the upper and lower level lines on the case. If battery is equipped with built-in indicator, check battery condition by the indicator.

ACCELERATOR PEDAL OPERATION

Check that pedal operates smoothly without getting caught or interfered by any other part.

ENGINE START

Check engine start for readiness.

> **WARNING:**
> **Before performing the following check, be sure to have enough room around the vehicle. Then, firmly apply both the parking brake and the regular brakes. Do not use the accelerator pedal. If the engine starts, be ready to turn off the ignition promptly. Take these precautions because the vehicle could move without warning and possibly cause personal injury or property damage.**

On automatic transmission vehicles, try to start the engine in each select lever position. The starting motor should crank only in “P” (Park) or “N” (Neutral).
On manual transmission vehicles, place the shift lever in “Neutral,” depress clutch pedal fully any try to start.

EXHAUST SYSTEM CHECK

Check for leakage, cracks or loose supports.

CLUTCH (FOR MANUAL TRANSMISSION)

Check for the following.
- Clutch is completely released when depressing clutch pedal,
- No slipping clutch occurs when releasing pedal and accelerating.
- Clutch itself is free from any abnormal condition.

GEARSHIFT OR SELECT LEVER (TRANSMISSION)

Check gear shift or select lever for smooth shifting to all positions and for good performance of transmission in any position.
With automatic transmission equipped vehicle, also check that shift indicator indicates properly according to which position select lever is shifted to.
With automatic transmission equipped vehicle, make sure that vehicle is at complete stop when shifting select lever to “P” range position and release all brakes.

BRAKE

Foot Brake

Check the followings:
- that brake pedal has proper travel,
- that brake works properly,
- that it is free from noise,
- that vehicle does not pull to one side when brake is applied.
- and that brake do not drag.

Parking Brake

Check that lever has proper travel.

> **WARNING:**
> **With vehicle parked on a fairly steep slope, make sure nothing is in the way downhill to avoid any personal injury or property damage. Be prepared to apply regular brake quickly even if vehicle should start to move.**

Check to ensure that parking brake is fully effective when the vehicle is stopped on the safe slope and brake lever is pulled all the way.

STEERING

- Check to ensure that steering wheel is free from instability, or abnormally heavy feeling.
- Check that the vehicle does not wander or pull to one side.

ENGINE

- Check that engine responds readily at all speeds.
- Check that engine is free from abnormal noise and abnormal vibration.

BODY, WHEELS AND POWER TRANSMITTING SYSTEM

Check that body, wheels and power transmitting system are free from abnormal noise and abnormal vibration or any other abnormal condition.

METERS AND GAUGE

Check that speedometer, odometer, fuel meter, temperature gauge, etc. are operating accurately.

LIGHTS

Check that all lights operate properly.

WINDSHIELD DEFROSTER

Periodically check that air comes out from defroster outlet when operating heater or air conditioning.
Set mode control lever to defroster position and fan switch lever to “HI” position for this check.

RECOMMENDED FLUIDS AND LUBRICANTS

Engine oil	SE, SF, SG, SH or SJ grade (Refer to “ENGINE OIL AND OIL FILTER” in this section for engine oil viscosity.)
Engine coolant (Ethylene glycol base coolant)	“Antifreeze/Anticorrosion coolant”
Brake fluid	DOT 3
Manual transmission oil	Refer to “M/T OIL CHANGE” in Section 7A.
Transfer oil (4WD)	Refer to “TRANSFER OIL CHANGE” in Section 7D.
Differential oil (4WD)	Refer to “DIFFERENTIAL OIL CHANGE” in Section 7F.
Automatic transmission fluid	An equivalent of DEXRON®-III
Door hinges	Engine oil or water resistance chassis grease
Hood latch assembly	Engine oil or water resistance chassis grease
Key lock cylinder	Spray lubricant

SECTION 1A

HEATER AND VENTILATION

WARNING:

For vehicles equipped with Supplement Restraint (Air Bag) System

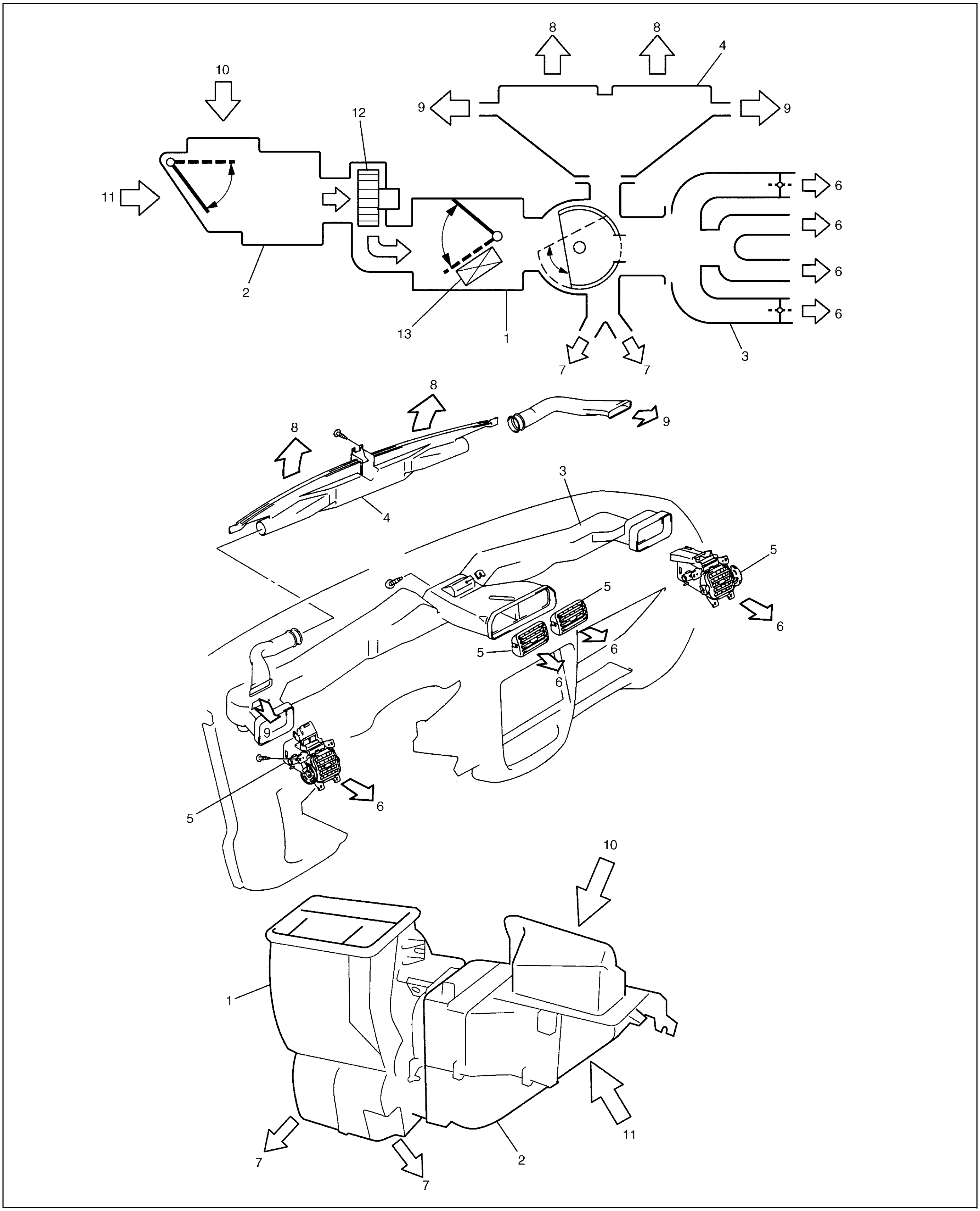
- **Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to “Air Bag System Components and Wiring Location View” under “General Description” in Section 10B in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and “Service Precautions” under “On-Vehicle Service” in Section 10B before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either or these two conditions may result in severe injury.**
- **Technical service work must be started at least 90 seconds after the ignition switch is turned to the “LOCK” position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).**

NOTE:

The link mechanism of the heater varies depending on the specifications.

CONTENTS

GENERAL DESCRIPTION



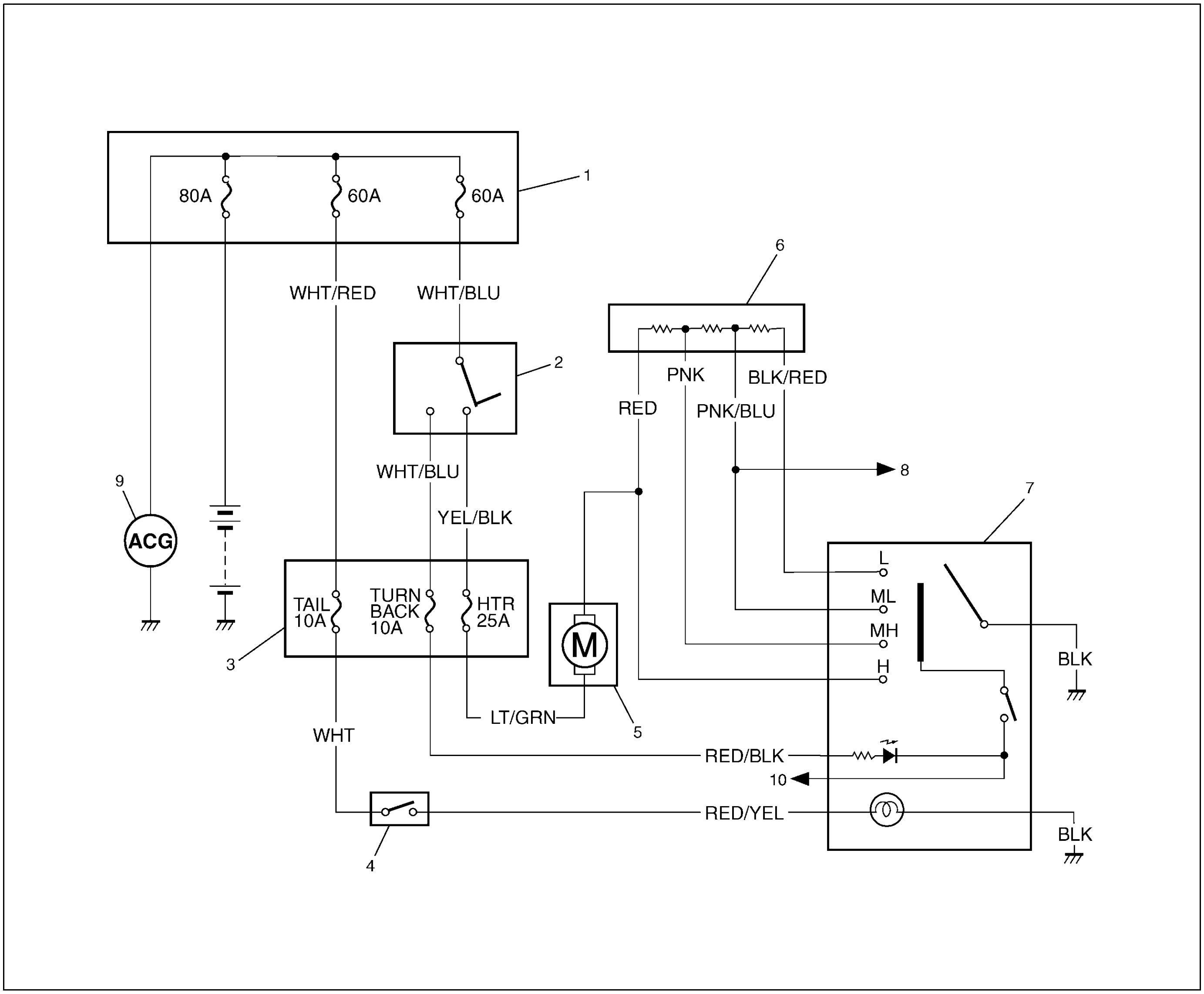
1. Heater unit	5. Ventilation louver	9. Demister air	13. Heater core
2. Air inlet box	6. Ventilation air	10. Fresh air	
3. Ventilator duct	7. Foot air	11. Recirculation air	
4. Defroster nozzle	8. Defroster air	12. Blower fan motor assembly	

DIAGNOSIS

DIAGNOSIS TABLE

Condition	Possible Cause	Correction
Heater blower fan motor won't work even when its switch is operating position.	Fuse blown	Check "HEATER" fuse, main heater fuse and check for short circuit to ground.
	Blower main relay faulty	Check blower main relay.
	Blower fan motor resistor faulty	Check resistor.
	Blower fan motor switch faulty	Check blower fan switch.
	Blower fan motor faulty	Replace motor.
	Wiring or grounding faulty	Repair as necessary.
Heater blower fan won't work when its switch is maximum position.	Blower maximum relay faulty	Check blower maximum relay.
	Blower fan motor switch faulty	Check blower fan switch.
	Wiring or grounding faulty	Check wiring, grounding and repair as necessary.
Incorrect temperature output.	Control cables broken or binding	Check cables.
	Temperature control lever faulty	Check control lever.
	Position of control cable clamp is faulty	Check and adjustment.
	Temperature door assembly broken	Repair temperature door assembly.
	Air ducts clogged	Repair air ducts.
	Heater core leaking or clogged	Replace core.
	Heater hoses leaking or clogged	Replace hoses.
	Thermostat faulty	Check thermostat by referring to Section 6B.
When mode control lever is changed, air outlet port is not changed or lever position disagree with air outlet port.	Control cable broken or binding	Check cable.
	Mode control lever faulty	Check control lever.
	Position of control cable clamp is faulty	Check and adjust clamp position.Check and adjustment.
	Air damper broken	Repair damper.
	Air ducts leaking or clogged	Repair air ducts.

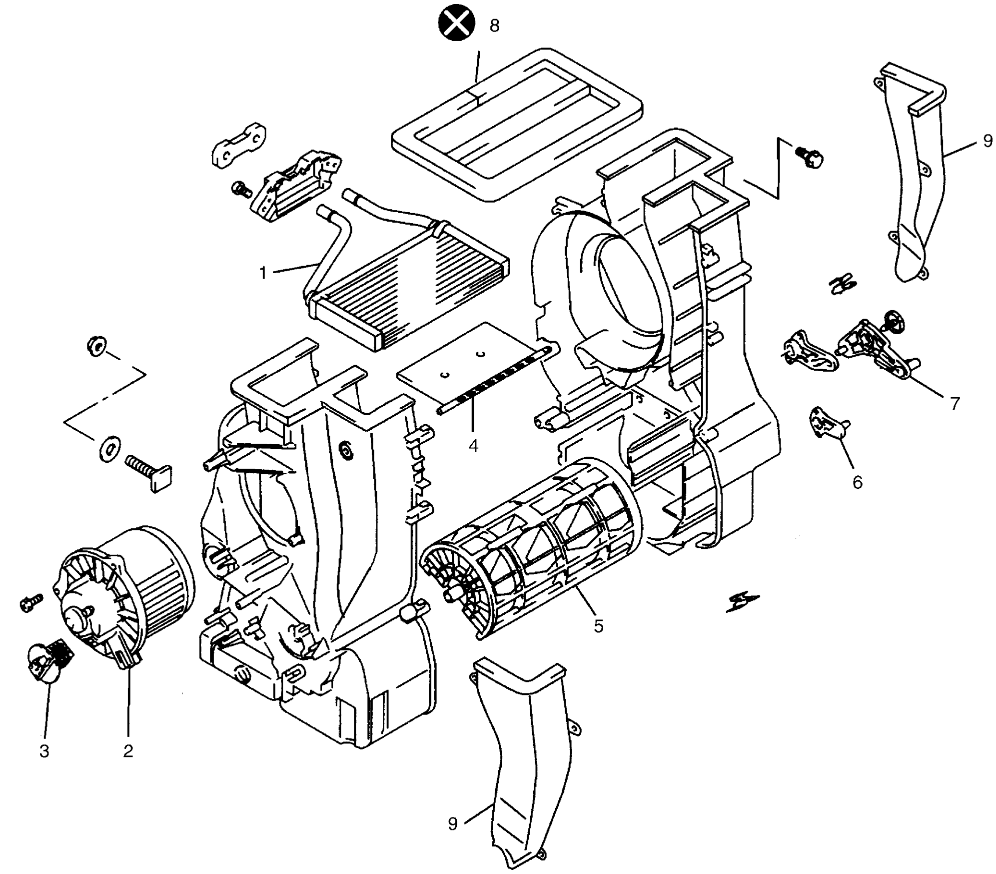
WIRING CIRCUIT



1. Main fuse box	4. Lighting switch	7. Blower fan switch	10. To ECM
2. Ignition switch	5. Blower fan motor	8. To ECM (idle up signal)	
3. Circuit fuse box	6. Blower fan motor resistor	9. Generator	

ON-VEHICLE SERVICE

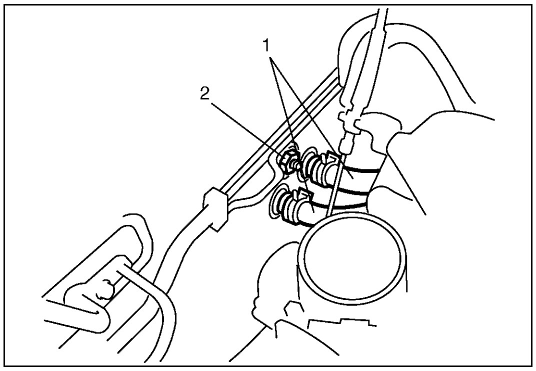
HEATER UNIT



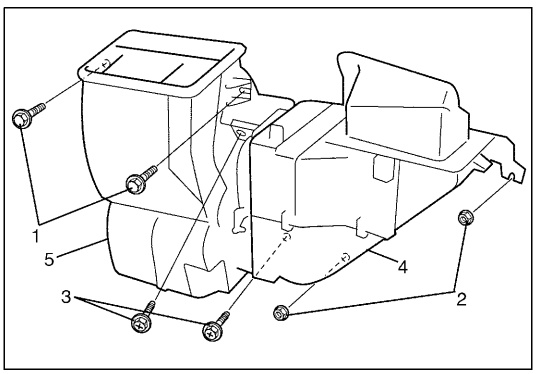
1. Heater core	4. Temperature door assembly	7. Temperature lever assembly	⊗ Do not reuse
2. Blower fan motor assembly	5. Air outlet control door assembly	8. Packing	
3. Blower fan motor resistor	6. Air outlet control lever assembly	9. Demistor air outlet case	

REMOVAL

1) Disconnect negative (–) cable at battery.



2) Drain engine coolant and disconnect heater hoses (1) from heater unit.
3) Remove heater unit mounting nut (2).
4) Remove instrument panel by referring to “INSTRUMENT PANEL” in Section 9.
5) Disconnect blower motor and resistor couplers from heater unit.



6) Remove bolts (1), nuts (2) and screws (3) as shown.
7) Remove cooling unit (4) and heater unit (5) from vehicle.

INSTALLATION

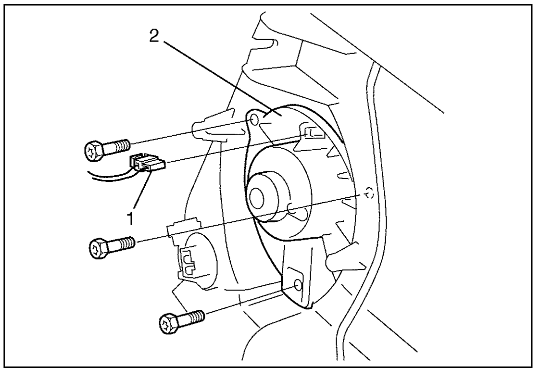
Reverse removal procedure to install heater unit noting the following instructions.

- When installing each part, be careful not to catch any cable or wiring harness.
- Adjust heater control cable by referring to “HEATER CONTROL LEVER ASSEMBLY” in this section.
- Fill engine coolant to radiator.

BLOWER FAN MOTOR

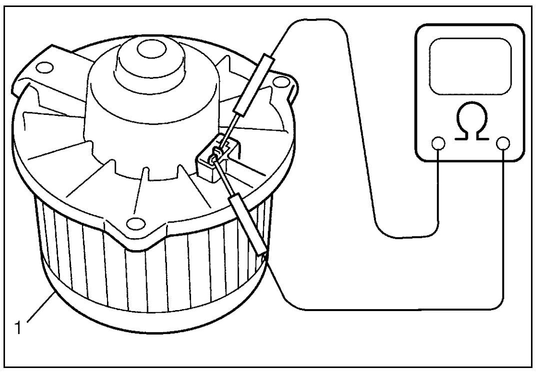
REMOVAL

1) Disconnect negative (–) cable at battery.
2) Remove steering column hole cover.
3) Remove brake and clutch pedals bracket from vehicle body.

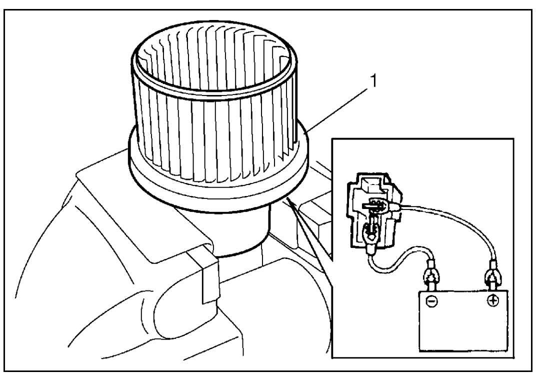


4) Disconnect blower motor coupler (1).
5) Remove blower fan motor (2).

INSPECTION



1) Check continuity between two terminal as shown.
   If check results are no continuity, replace blower fan motor assembly (1).



2) Check operate and current.
   a) Fix blower fan motor assembly (1) by using vise.
   b) Connect battery to blower fan motor assembly (1) as shown.
   c) Check that there is smoothly operates and no noise.
   d) Check that ammeter indicates specified current.
      If measure current is incorrect, replace blower fan motor.

Blower fan specified current at 12V
: 18 A maximum

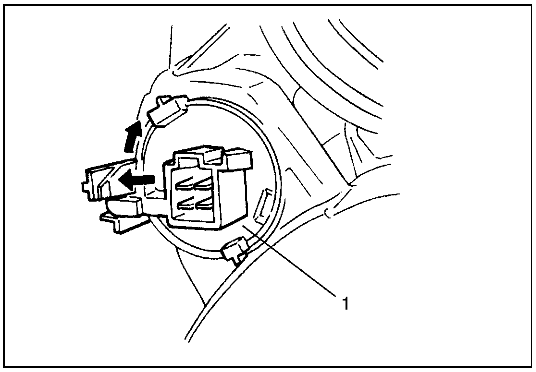
INSTALLATION

Reverse removal procedure for installation.

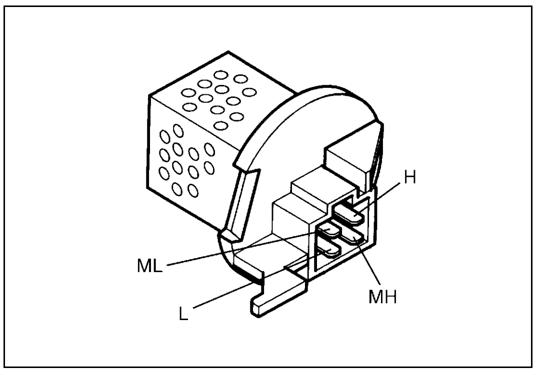
BLOWER FAN MOTOR RESISTOR

REMOVAL

1) Disconnect negative (–) cable at battery.
2) Disconnect blower fan motor resistor coupler.
3) Remove blower fan motor resistor (1) as shown.



INSPECTION

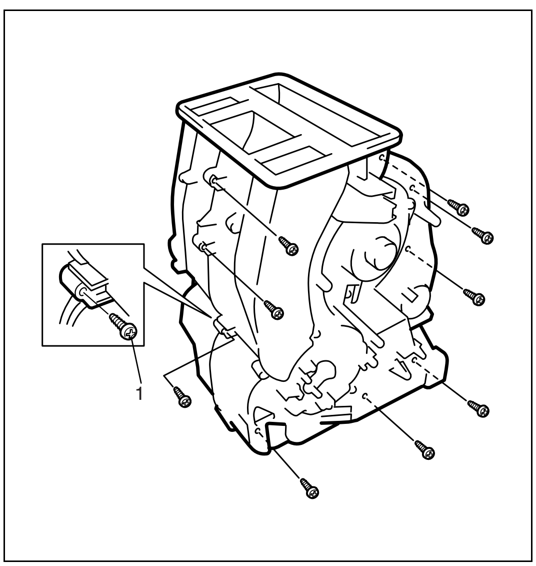


Measure each terminal-to-terminal resistance on resistor
If measured resistance is incorrect, replace blower motor resistor.

Blower fan motor resistor resistance
H–MH : approximately 0.5 Ω at 25°C (77°F)
H–ML : approximately 1.5 Ω at 25°C (77°F)
H–L : approximately 3.0 Ω at 25°C (77°F)

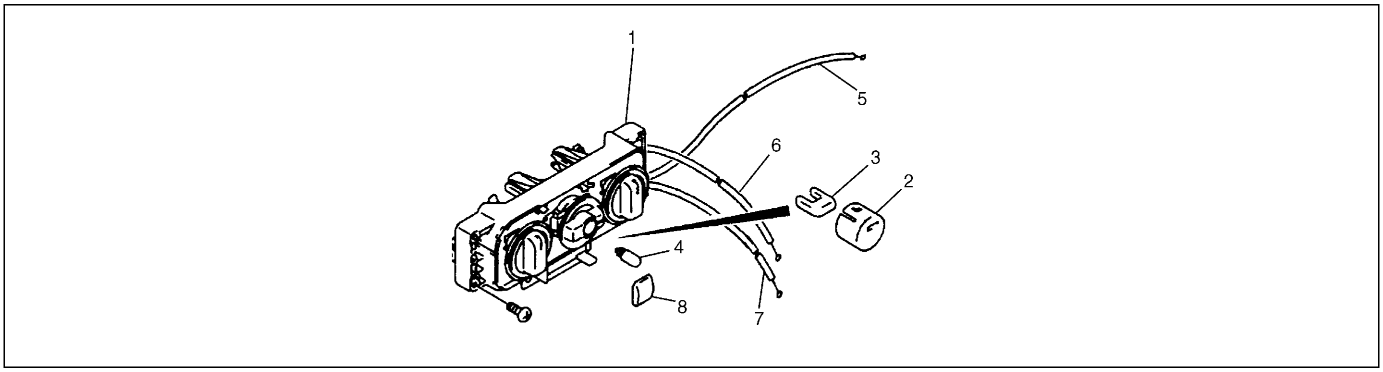
INSTALLATION

Reverse removal procedure for installation.



CAUTION:
When the heater unit is disassembled and reassembled, locking force of the heater case lock may reduce. In such a case, tighten the heater case with a tapping screw (1) of M4 x L16 as shown in the figure, or air may leak from its joint section.

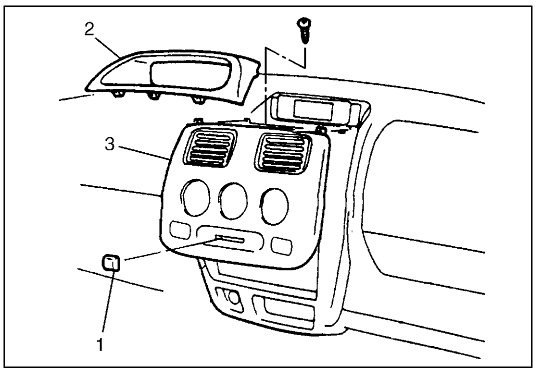
HEATER CONTROL ASSEMBLY



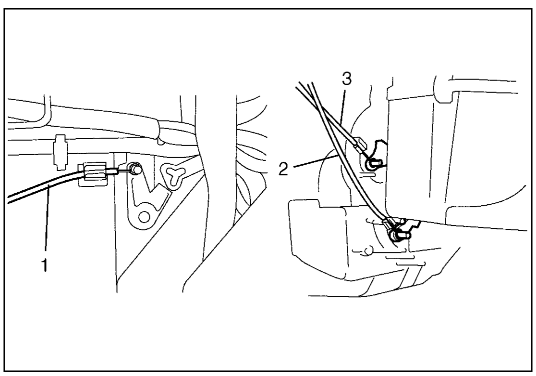
1. Heater control assembly	3. A/C switch LED (if equipped)	5. Fresh air control cable	7. Temperature control cable
2. A/C switch knob (if equipped)	4. Bulb	6. Air outlet control cable	8. Heater control knob

REMOVAL

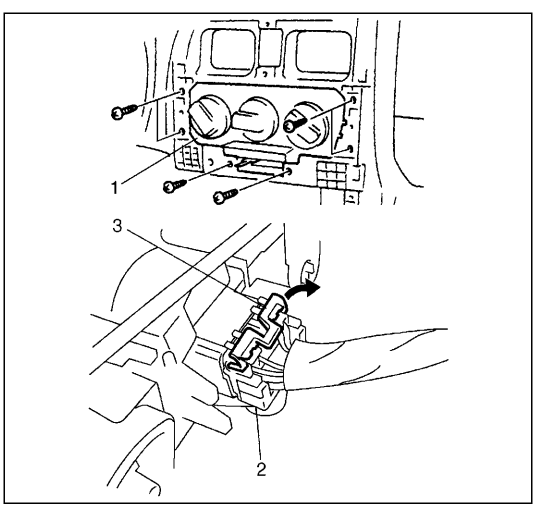
1) Disconnect negative (–) cable at battery.
2) Remove steering column hole cover.



3) Remove heater control knob (1), center upper garnish (2), center lower garnish (3) and glove box.



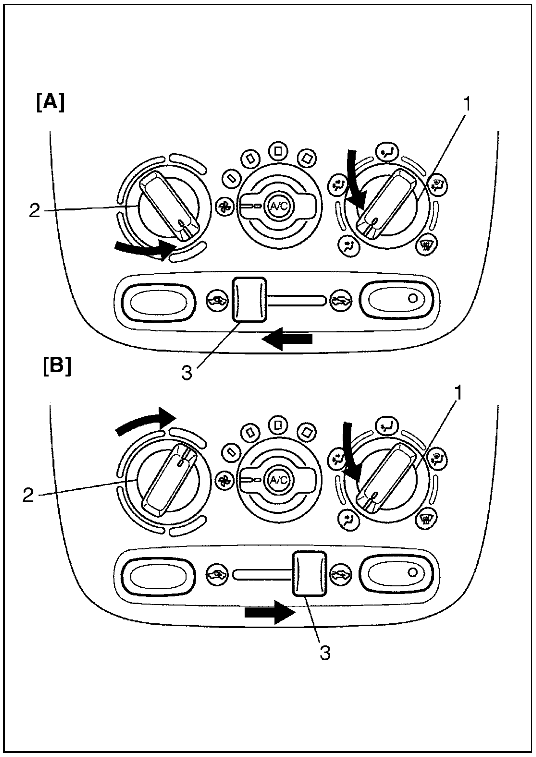
4) Disconnect air outlet control (3), temperature control (2) and fresh air control (1) cables.



5) Remove heater control assembly (1), and then disconnect blower fan switch connector (2) after unlock locking part (3) as shown.

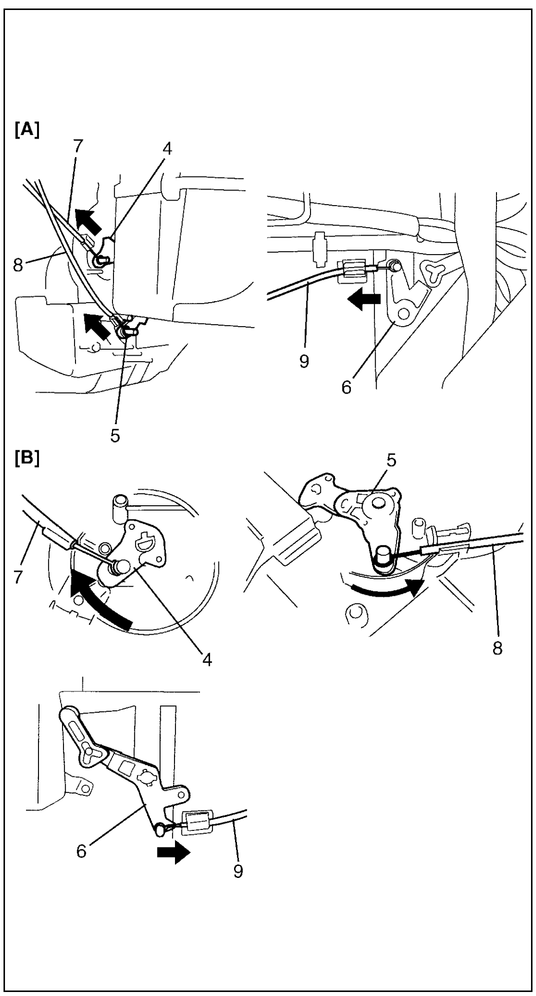
INSTALLATION

1) Reverse removal procedure for installation.
2) Adjust the following items.



a) Move air outlet control dial (1), temperature control dial (2) and fresh air control lever (3) fully in arrow direction as shown in figure.

[A] :	For LH model
[B] :	For RH model



b) Push air outlet lever (4), temperature lever (5) and door link (6) fully in arrow direction and fix air outlet control cable (7), temperature control cable (8) and fresh air control cable (9) with clamp in position as shown in figure.

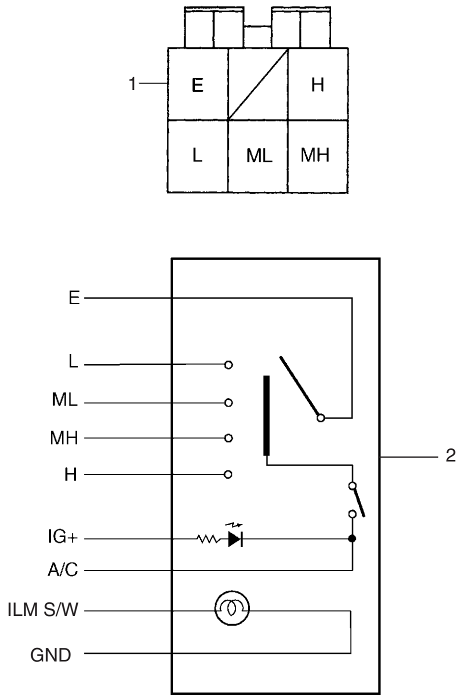
NOTE:

After installing control cables, be sure that control levers move smoothly and stop at proper position.

[A] :	For LH model
[B] :	For RH model

INSPECTION

Check blower fan switch for each terminal-to terminal continuity.

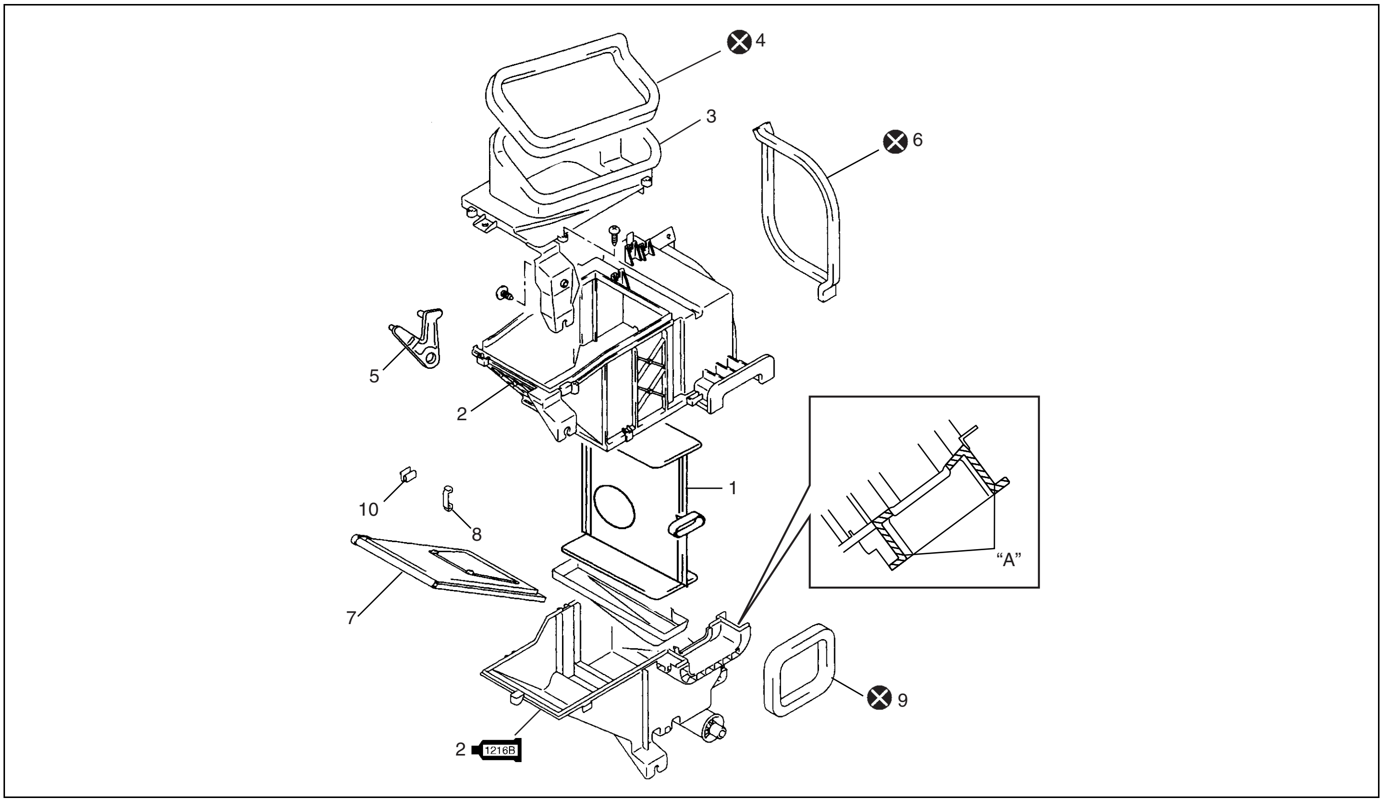


Circuit table of blower fan switch

POSITION \ TERMINAL	E	L	ML	MH	H
OFF	○				
L	○	○			
ML	○		○		
MH	○			○	
H	○				○

1.	Terminal arrangement of blower fan switch
2.	Blower fan switch

AIR INLET BOX



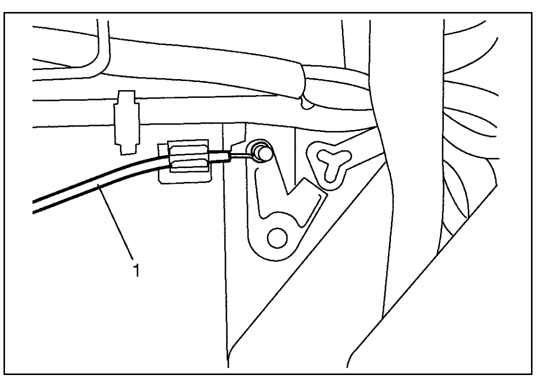
	1. Resistance board	4. Fresh air duct packing	7. Air inlet door	10. Cable clamp
1216B	2. Air inlet case : Apply sealant 99000 - 31160 to hatched part "A"	5. Door link	8. Clip	⊗ : Do not reuse
	3. Fresh air duct case	6. Heater unit packing	9. Dash packing	

REMOVAL

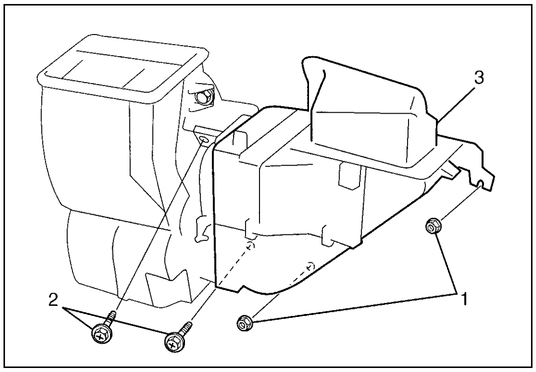
NOTE:

If vehicle equipped with A/C, refer to "COOLING UNIT" in Section 1B.

1) Disconnect negative (–) cable at battery.



2) Remove glove box.
3) Disable air bag system by referring to "DISABLING AIR BAG SYSTEM" in Section 10B. (if equipped)
4) Disconnect fresh air control cable (1) from air inlet box.



5) Remove air inlet box mounting nuts (1) and screws (2).
6) Remove air inlet box (3).

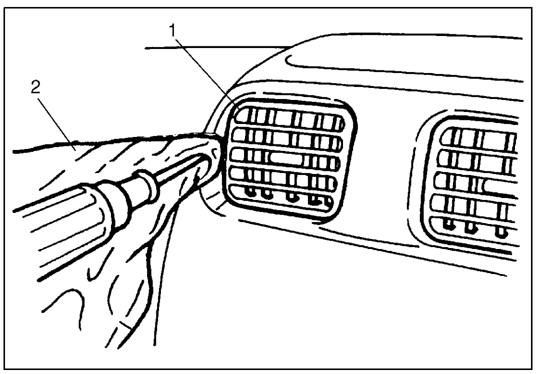
INSTALLATION

Reverse removal procedure to install air inlet box noting the following instructions.

- Adjust fresh air control cable referring to "INSTALLATION" under "HEATER CONTROL ASSEMBLY" in this section.
- Enable air bag system by referring to "ENABLING AIR BAG SYSTEM" in Section 10B. (if equipped)

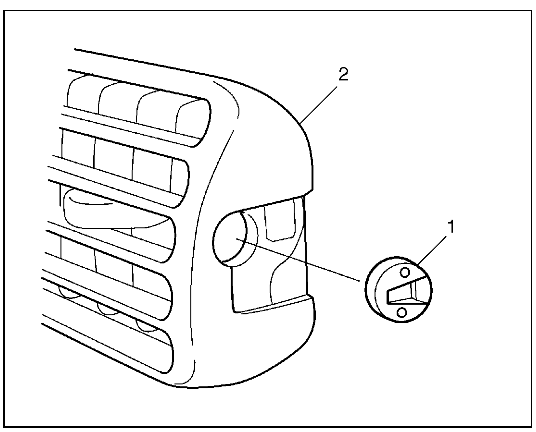
VENTILATION LOUVER

REMOVAL

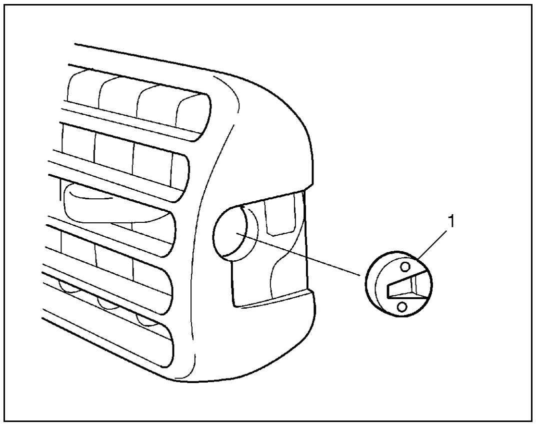


1) Remove ventilation louver (1) as shown in figure.

2: Rag



2) Remove ventilation louver holder (1) from ventilation louver (2).



INSTALLATION

Reverse removal procedure to install ventilation louver noting the following instruction.

- Be sure to install ventilation louver holder (1) to proper direction as shown.

REQUIRED SERVICE MATERIALS

Material	Recommended SUZUKI product (Part Number)	Use
Sealant	SUZUKI BOND No. 1216B 99000 – 31160	• Air inlet box

SECTION 1B

AIR CONDITIONING (OPTIONAL)

WARNING:

For vehicles equipped with Supplemental Restraint (Air Bag) System :

- **Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to "Air Bag System Components and Wiring Location View" under "General Description" in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and "Service Precautions" under "On-Vehicle Service" in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.**
- **Technical service work must be started at least 90 seconds after the ignition switch is turned to the "LOCK" position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).**

CAUTION:

The air conditioning system of this vehicle uses refrigerant HFC-134a (R-134a).
None of refrigerant, compressor oil and component parts is interchangeable between two types of A/C : one using refrigerant HFC-134a (R-134a) and the other using refrigerant CFC-12 (R-12).
Be sure to check which refrigerant is used before any service work including inspection and maintenance. For identification between these two types, refer to "REFRIGERANT TYPE" in this section.
When replenishing or changing refrigerant and compressor oil and when replacing parts, make sure that the material or the part to be used is appropriate to the A/C installed in the vehicle being serviced.
Use of incorrect one will result in leakage of refrigerant, damage in parts or other faulty condition.

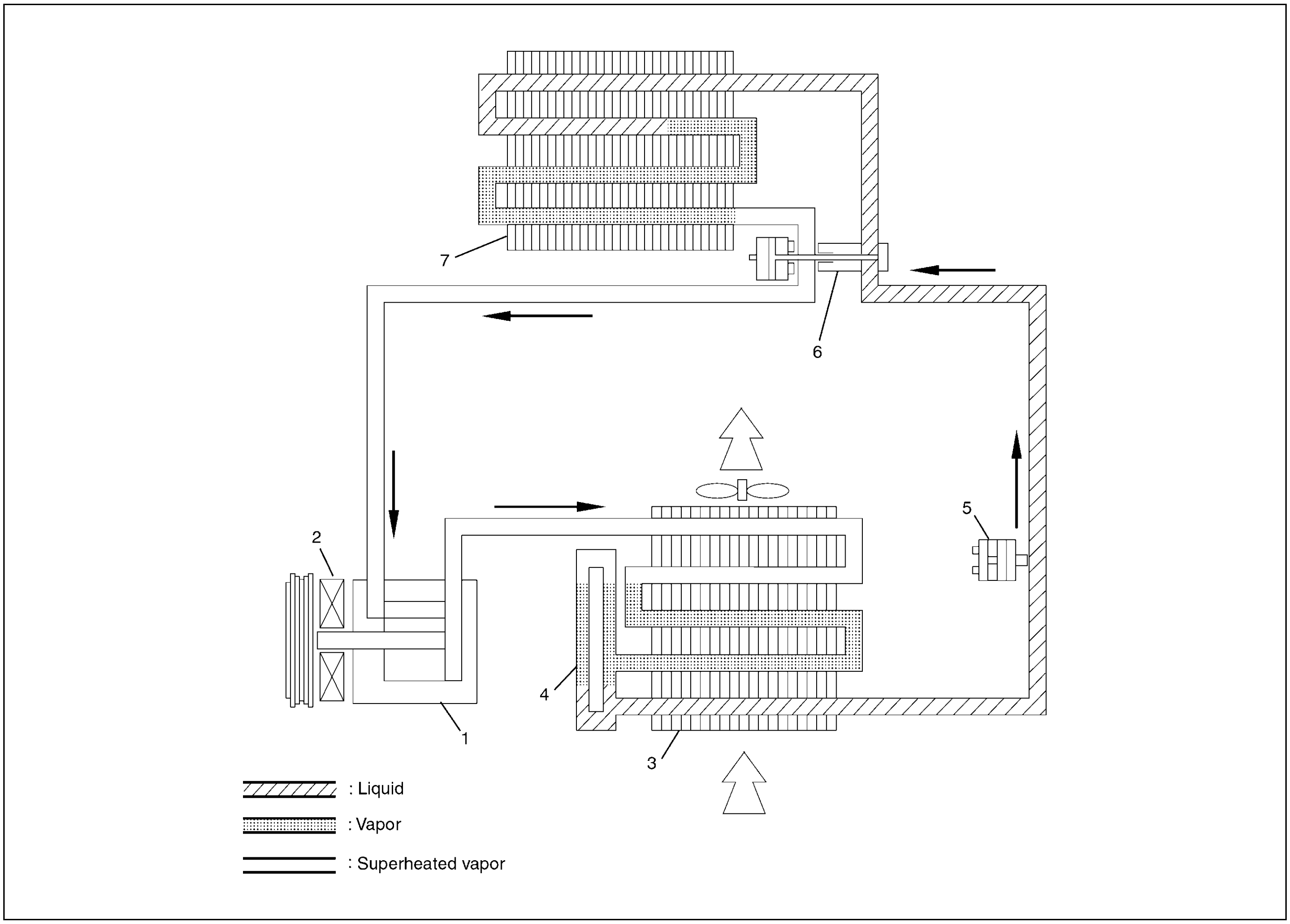
NOTE:

For basic servicing method of the air conditioning system that is not described in this section, refer to "AIR CONDITIONING BASIC MANUAL (Part number : 99520-02130)".

CONTENTS

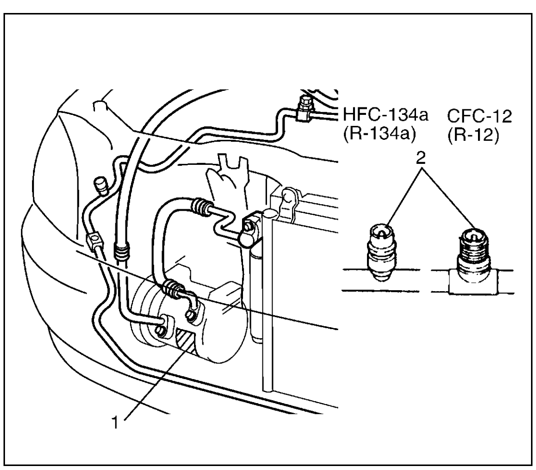
GENERAL DESCRIPTION

REFRIGERANT CIRCULATION



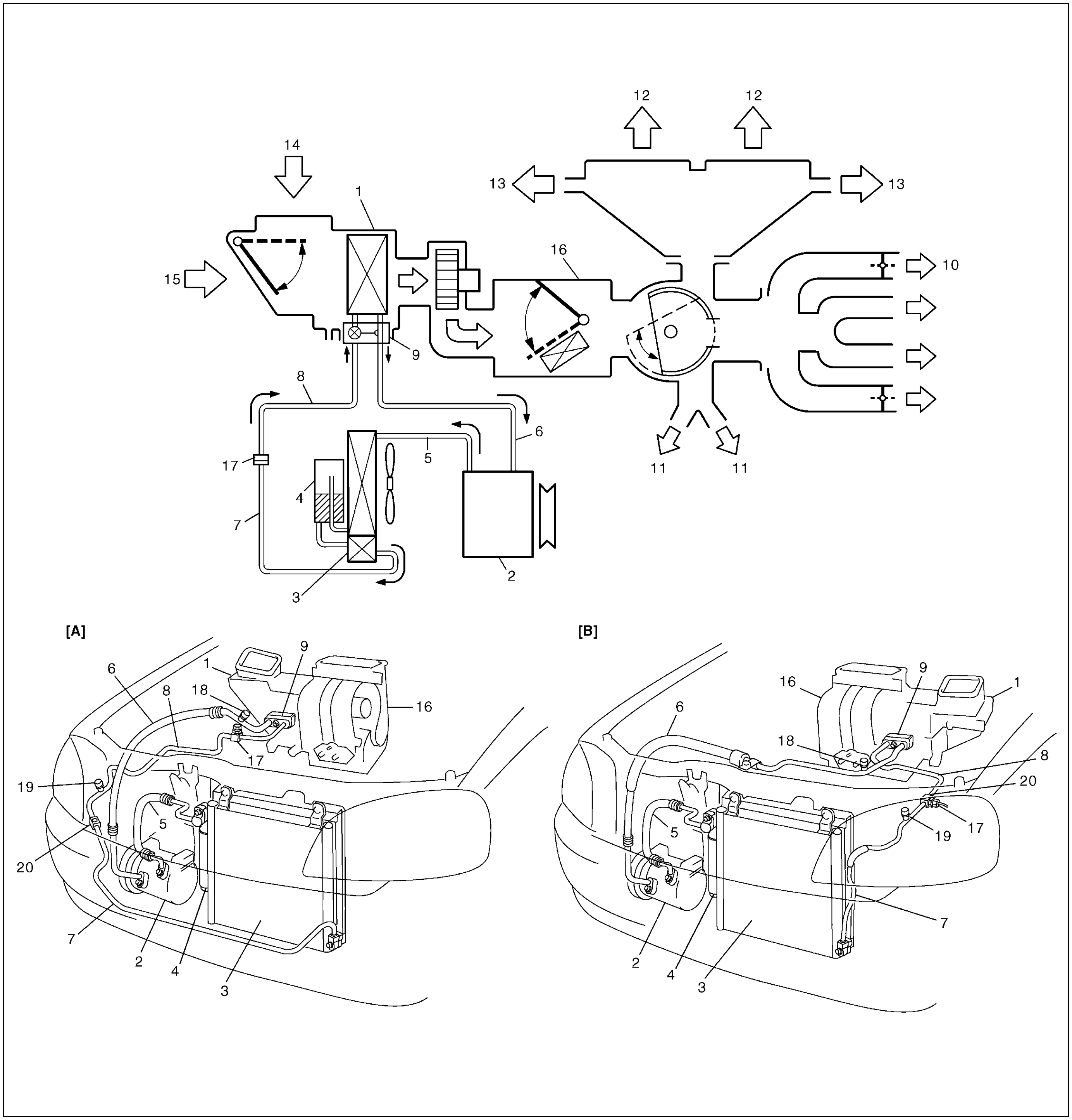
1. Compressor	4. Receiver/dryer	7. Evaporator
2. Magnet clutch	5. A/C refrigerant pressure switch	
3. Condenser assembly	6. Expansion valve	

REFRIGERANT TYPE



Whether the A/C in the vehicle being serviced uses HFC-134a (R-134a) or CFC-12 (R-12) is indicated on compressor label (1). Also, it can be checked by the shape of the service (charge) valve (2).

MAJOR COMPONENTS AND LOCATION



1. Cooling unit	7. Condenser outlet pipe	13. Demister air	19. High pressure charge valve
2. Compressor	8. Liquid pipe	14. Fresh air	20. Sight glass
3. Condenser assembly	9. Expansion valve	15. Recirculation air	[A] : LH model
4. Receiver/dryer	10. Ventilation air	16. Heater unit	[B] : RH model
5. Discharge hose	11. Foot air	17. A/C refrigerant pressure switch	
6. Suction pipe	12. Defroster air	18. Low pressure charge valve	

DIAGNOSIS

GENERAL DIAGNOSIS TABLE

Condition	Possible Cause	Correction
Cool air won't come out (A/C system won't operative)	No refrigerant	Perform recover, evacuation and charging.
	Fuse blown	Check fuses in circuit fuse and main fuse boxes, and check short circuit to ground.
	A/C switch faulty	Check A/C switch.
	Blower fan switch faulty	Check blower fan switch referring to Section 1A.
	A/C evaporator temperature sensor faulty	Check A/C evaporator temperature sensor.
	A/C refrigerant pressure switch faulty	Check A/C refrigerant pressure switch.
	Wiring or grounding faulty	Repair as necessary.
	ECT sensor faulty	Check ECT sensor referring to Section 6E1.
	ECM and its circuit faulty	Check ECM and its circuit referring to Section 6E1.
Cool air won't come out (A/C compressor won't operative)	ECM faulty	Check ECM and its circuit referring to Section 6E1.
	Magnet clutch faulty	Check magnet clutch.
	Compressor drive belt loosen or broken	Adjust or replace drive belt.
	Compressor faulty	Check compressor.
	Compressor thermal switch faulty	Check compressor thermal switch
Cool air won't come out (A/C condenser cooling fan motor won't operative)	Fuse blown	Check fuses in circuit fuse and main fuse boxes, and check short circuit to ground.
	Wiring or grounding faulty	Repair as necessary.
	Radiator/condenser cooling fan motor relay faulty	Check radiator/condenser cooling fan motor relay No.1, No.2 and No.3.
	Radiator/condenser cooling fan motor faulty	Check radiator/condenser cooling fan motor.
	ECM faulty	Check ECM and its circuit referring to Section 6E1.
Cool air won't come out (Blower fan motor won't operative)	Fuse blown	Check "HTR" fuse in circuit fuse box and main fuses, and check short circuit to ground.
	Blower fan motor resistor faulty	Check blower fan motor resistor to Section 1A.
	Blower fan switch faulty	Check blower fan switch referring to Section 1A.
	Wiring or grounding faulty	Repair as necessary.
	Blower fan motor faulty	Check blower fan motor referring to Section 1A.

Condition	Possible Cause	Correction
Cool air won't come out or insufficient cooling (A/C system normal operative)	Insufficient or excessive charge of refrigerant	Check charge of refrigerant and system for leaks.
	Condenser clogged	Check condenser.
	A/C evaporator clogged or frosted	Check A/C evaporator and A/C evaporator temperature sensor.
	A/C evaporator temperature sensor faulty	Check A/C evaporator temperature sensor.
	Expansion valve faulty	Check expansion valve.
	Receiver/dryer clogged	Check receiver/dryer.
	Compressor drive belt loosen or broken	Adjust or replace drive belt.
	Magnetic clutch faulty	Check magnetic clutch.
	Compressor faulty	Check compressor.
	Air in A/C system	Replace dryer, and perform evacuation and charging.
	Air leaking from cooling unit or air duct	Repair as necessary.
	Heater and ventilation system faulty	Check air inlet box (cooling unit), heater control assembly and heater unit referring to Section 1A.
	Blower fan motor faulty	Check blower fan motor referring to Section 1A.
	Excessive compressor oil existing in A/C system	Pull out compressor oil in A/C system circuit, and check compressor.
Cool air won't come out only intermittently	Wiring connection faulty	Repair as necessary.
	Expansion valve faulty	Check expansion valve.
	Excessive moisture in A/C system	Replace dryer, and perform evacuation and charging.
	Magnetic clutch faulty	Check magnetic clutch.
	Excessive charge of refrigerant	Check charge of refrigerant.
Cool air comes out only at high speed	Condenser clogged	Check condenser.
	Insufficient charge of refrigerant	Check charge of refrigerant.
	Air in A/C system	Replace dryer, and perform evacuation and charging.
	Compressor drive belt loosen or broken	Adjust or replace drive belt.
	Compressor faulty	Check compressor.
Cool air won't come out only at high speed	Excessive charge of refrigerant	Check charge of refrigerant.
	A/C evaporator frosted	Check A/C evaporator and A/C evaporator temperature sensor.
Insufficient velocity of cooled air	A/C evaporator clogged or frosted	Check A/C evaporator and A/C evaporator temperature sensor.
	Air leaking from cooling unit or air duct	Repair as necessary.
	Blower fan motor faulty	Check blower fan motor referring to Section 1A.
	Wiring or grounding faulty	Repair as necessary.

ABNORMAL NOISE DIAGNOSIS

There are various types of noise, ranging from those produced in the engine compartment to those from the passenger compartment, also from rumbling noises to whistling noises.

ABNORMAL NOISE FROM COMPRESSOR

Condition	Possible Cause	Correction
During compressor operation, a rumbling noise is heard proportional to engine revolutions.	Inadequate clearance in piston area (piston or swash-plate)	Repair or replace compressor as necessary.
A loud noise is heard at a certain rpm, disproportionately to engine revolution.	Loose or faulty compressor drive belt	Adjust drive belt tension, or replace drive belt.
	Loose compressor mounting bolts	Retighten mounting bolts.
A loud rattle is heard at low engine rpm.	Loose compressor clutch plate bolt	Retighten clutch plate bolt.
		Replace compressor if it was operated in this condition for a long time.

ABNORMAL NOISE FROM MAGNETIC CLUTCH

Condition	Possible Cause	Correction
A rumbling noise is heard when compressor is not operating.	Worn or damaged bearings	Replace magnet clutch assembly.
A chattering noise is heard when compressor is engaged.	Faulty clutch clearance (excessive)	Adjust clutch clearance.
	Worn clutch friction surface	Replace magnet clutch assembly.
	Compressor oil leaked from lip type seal, contaminating the friction surface	Replace compressor body assembly.

ABNORMAL NOISE FROM TUBING

Condition	Possible Cause	Correction
A droning noise is heard inside vehicle, but not particularly noticeable in engine compartment.	Faulty tubing clamps	Reposition clamps or increase the number of clamps.
	Resonance caused by pulsation from variations in refrigerant pressure	Attach a silencer to tubing, or modify its position and length.

ABNORMAL NOISE FROM CONDENSER

Condition	Possible Cause	Correction
Considerable vibration in condenser.	Resonance from condenser bracket and body	Firmly insert a silencer between condenser bracket and body.

ABNORMAL NOISE FROM CRANKSHAFT PULLEY

Condition	Possible Cause	Correction
A large rattling noise is heard at idle or sudden acceleration.	Loosen crankshaft pulley bolt	Retighten bolt.

ABNORMAL NOISE FROM TENSION PULLEY

Condition	Possible Cause	Correction
Clattering noise is heard from pulley.	Worn or damaged bearing	Replace tension pulley.
Pulley cranks upon contact.	Cracked or loose bracket	Replace or retighten bracket.

ABNORMAL NOISE FROM A/C EVAPORATOR

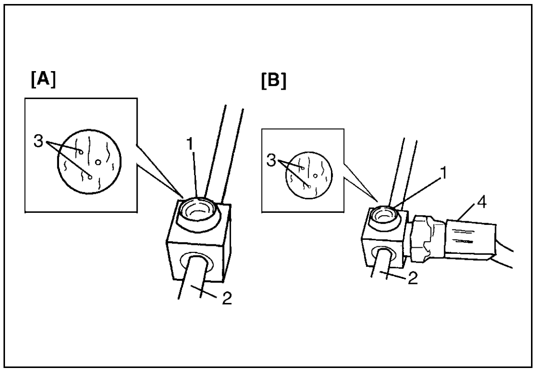
Condition	Possible Cause	Correction
Whistling sound is heard from A/C evaporator.	Depending on the combination of the interior/exterior temperatures, engine rpm and refrigerant pressure, the refrigerant flowing out of the expansion valve may, under certain conditions, make a whistling sound	At times, slightly decreasing refrigerant volume may stop this noise.
		Inspect expansion valve and replace if faulty.

ABNORMAL NOISE FROM BLOWER FAN MOTOR

Condition	Possible Cause	Correction
Blower fan motor emits a chirping sound in proportion to its speed of rotation.	Worn or damaged motor brushes or commutator	Repair or replace blower fan motor.
Fluttering noise or large droning noise is heard from blower fan motor.	Leaves or other debris introduced from fresh air inlet to blower fan motor	Remove debris and make sure that the screen at fresh air inlet is intact.

QUICKLY CHECKING OF REFRIGERANT CHARGE

The following procedure can be used for quickly checking whether the A/C system has a proper charge of refrigerant or not. Run engine at fast idle, and operate A/C at its maximum cooling capacity for a few minutes.



Then, look at the sight glass (1) on condenser outlet pipe (2) and compare what is observed with the symptoms listed in below.

[A] : LH model	3. Bubbles
[B] : RH model	4. A/C refrigerant pressure switch

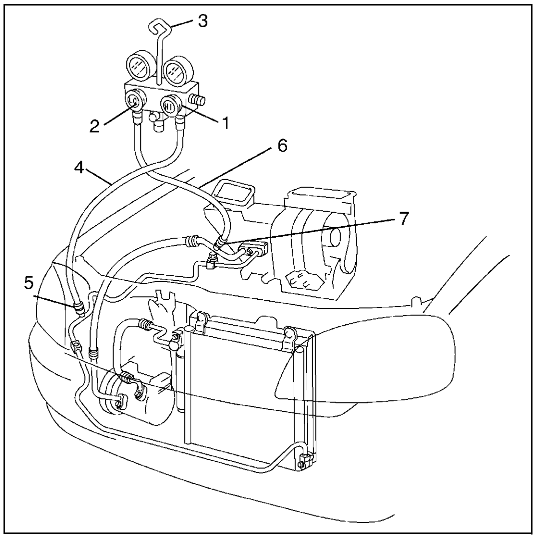
CHECKING REFRIGERANT CHARGE

Item No.	Symptom	Charge of refrigerant condition	Correction
1	Bubbles observed in sight glass	Insufficient charge of refrigerant in system	Check system for leaks with a leak tester.
2	No bubbles observed in sight glass	No or insufficient charge of refrigerant in system	Refer to the items 3 and 4.
3	No temperature difference between compressor inlet and outlet	Empty or nearly empty system	Evacuate and charge system and then check it for leaks with a leak tester.
4	Noticeable temperature difference between compressor inlet and outlet	Proper or too much charge of refrigerant in system	Refer to the items 5 and 6.
5	When A/C is turned OFF, refrigerant in sight glass clears immediately and remains clear	Too much charge of refrigerant in system	Recharge with specified amount of refrigerant.
6	When A/C is turned OFF, refrigerant in sight glass once produces bubbles and then clears	Proper charge of refrigerant in system	No correction needed because charge of refrigerant is normal.

NOTE:
For specified amount of refrigerant, refer to “OPERATION PROCEDURE FOR A/C WITH REFRIGERANT” in this section.

PERFORMANCE DIAGNOSIS

1) Confirm that vehicle and environmental conditions are as follows.
   - Vehicle is not exposed to direct sun.
   - Ambient temperature is within 15 – 35°C (59 – 95°F).



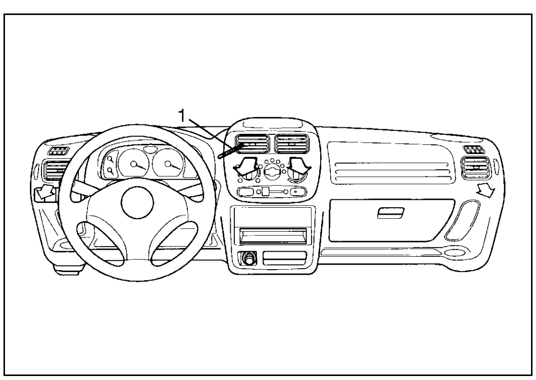
2) Make sure that high pressure valve (1) and low pressure valve (2) of manifold gauge set (3) are firmly closed.
3) Connect high pressure charging hose (4) to high pressure service valve (5), and connect low pressure charging hose (6) to low pressure service valve (7).
4) Bleed the air in charging hoses (4), (6) by loosening their respective nuts on manifold gauge set (3), utilizing the refrigerant pressure. When a hissing sound is heard, immediately tighten nut.

CAUTION:
Do not interchange high and low pressure charging hoses by mistake.

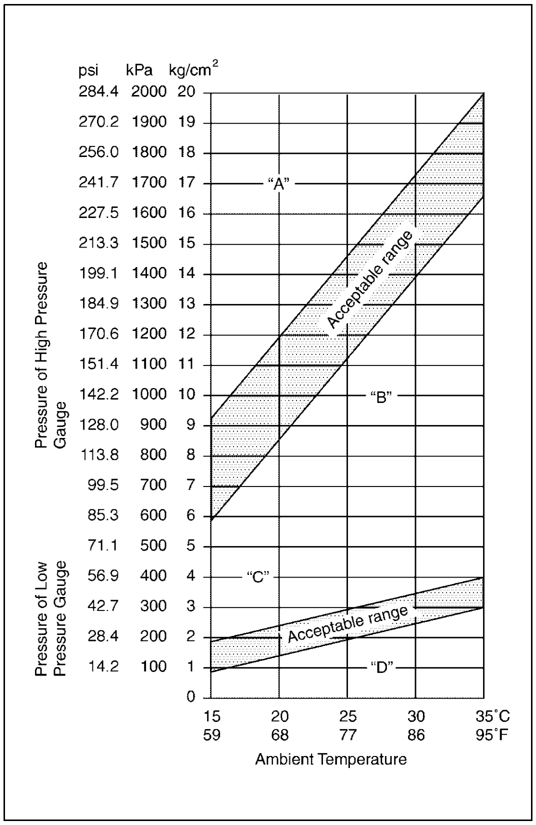
5) Warm up engine to normal operating temperature (engine coolant temperature at 80 – 90°C (176 – 194°F)) and keep it at specified idle speed. (Radiator cooling fan should not be working when checking pressure and temperature.)
6) Turn A/C switch to ON position, and set blower fan switch at "H" (4th position), temperature dial at "COOL", air outlet control dial at "FACE" and fresh/recirculation control dial at "RECIRCULATION". (Confirm that A/C compressor and radiator/condenser cooling fan are working.)
   Keep all windows, doors and engine food open.

Performance diagnosis condition

Ambient temperature	15 – 35°C (59 – 95°F)
Engine rpm	Keep to 1,500 rpm.
Blower fan switch	"H" (4th position)
Temperature control	"Cool"
Air outlet control	"Face"
Vehicle Doors	All open
Air inlet door position	Recirculation



7) With dry bulb thermometer (1) inserted into center duct air outlet and another one set near evaporator air inlet, read temperature indicated on each thermometer.



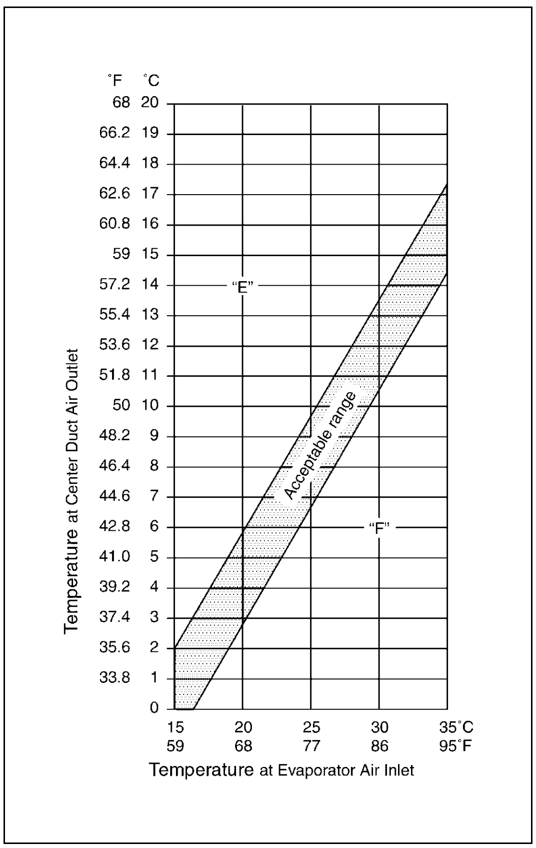
8) Check for each pressure of low side and high side if it is within shaded range of graph.
If each gauge reading is out of specified pressure, correct defective part referring to "PERFORMANCE DIAGNOSIS TABLE".

NOTE:

Pressure registered on gauge varies with ambient temperature. Therefore, use the graphs when determining if pressures are normal or not.

Low side and high side pressure example :

Gauges should read as follows when ambient temperature is 30°C (86°F).	
Pressure on high pressure gauge	**1400 – 1750 kPa** **14.0 – 17.5 kg/cm^2** **199.1 – 248.9 psi**
Pressure on low pressure gauge	**230 – 350 kPa** **2.3 – 3.5 kg/cm^2** **32.7 – 49.8 psi**



9) Check inlet port temperature-to-outlet port temperature relationship using graph.
For example, if evaporator inlet port temperature is 25°C (75°F) and center duct air outlet temperature is 8°C (46°F), their crossing point is within acceptable range as shown in graph.
If crossing point is out of acceptable range, diagnose trouble referring to "PERFORMANCE DIAGNOSIS TABLE".

PERFORMANCE DIAGNOSIS TABLE

NOTE:

If ambient temperature is approximately 30°C (86°F), it is possible to diagnose A/C system in detail referring to "DETAIL DIAGNOSIS TABLE (AMBIENT TEMPERATURE AT 30 °C (86°F))" under "PERFORMANCE DIAGNOSIS" in this section.

HIGH PRESSURE GAUGE

Condition	Possible Cause	Correction
Pressure high ("A" area of high side graph)	Refrigerant overcharged	Recharge.
	Expansion valve frozen or clogged	Check expansion valve.
	Clogged refrigerant passage of high side	Clean or replace.
	Radiator/condenser cooling fan malfunction (Insufficient cooling of condenser)	Check radiator/condenser cooling fan.
	Dirty or bent condenser fins (Insufficient cooling of condenser)	Clean or repair.
	Compressor malfunction (Insufficient oil etc.)	Check compressor.
	Engine overheat	Check engine cooling system referring to Section 6B.
Pressure low ("B" area of high side graph)	Insufficient refrigerant (Insufficient charge or leakage)	Check for leakage, repair if necessary and recharge.
	Expansion valve malfunction (valve opens too wide)	Check expansion valve.
	Compressor malfunction (Insufficient compression)	Check compressor.

LOW PRESSURE GAUGE

Condition	Possible Cause	Correction
Pressure high ("C" area of low side graph)	Expansion valve malfunction (valve opens too wide)	Check expansion valve.
	Compressor malfunction (Insufficient compression)	Check compressor.
Pressure low ("D" area of low side graph)	Insufficient refrigerant (Insufficient charge or leakage)	Check for leakage, repair if necessary and recharge.
	Expansion valve malfunction (valve opens too narrow)	Check expansion valve.
	Clogged refrigerant passage (crashed pipe)	Repair or replace.

THERMOMETER AT CENTER DUCT

Condition	Possible Cause	Correction
Outlet air temperature at center duct is high (Crossing point is in area "E")	Insufficient or excessive charge of refrigerant	Check refrigerant pressure.
	Dirty or bent A/C evaporator fins	Clean or repair.
	Air leakage from cooling (heater) unit or air duct	Repair or replace.
	Malfunctioning, switch over function of door in cooling (heater) unit	Repair or replace.
	Compressor malfunction	Check compressor.
Outlet air temperature at center duct is low (Crossing point is in area "F")	Insufficient air volume from center duct (Heater blower malfunction)	Check blower motor and fan.
	Compressor malfunction	Check compressor.

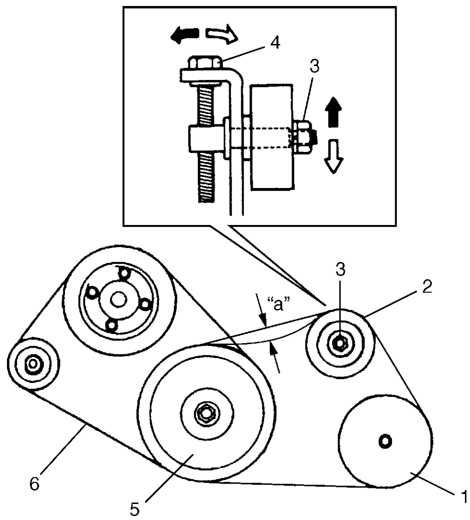
DETAIL DIAGNOSIS TABLE (AMBIENT TEMPERATURE AT 30°C (86°F))

Condition			Possible Cause	Correction
MANIFOLD GAUGE	MPa (kg/cm^2) (psi)	Detail		
Lo	Hi			
0.23 – 0.35 (2.3 – 3.5) (33 – 50)	**1.4 – 1.75 (14 – 17.5) (200 – 249)**	**Normal condition**	–	–
Negative pressure	**0.5 – 0.6 (5 – 6) (71.2 – 85.3)**	**The low pressure side reads a negative pressure, and the high pressure side reads an extremely low pressure. Presence of frost around tubing to and from receiver/ dryer and expansion valve.**	Dust particles or water droplets are either stuck or frozen inside expansion valve, preventing the refrigerant from flowing	Clean expansion valve. Replace it if it cannot be cleaned. Replace receiver/dryer. Evacuate the A/C system and recharge with fresh refrigerant.
Normal : 0.23 – 0.35 (2.3 – 3.5) (33 – 50) ↑↓ Abnormal : Negative pressure	**Normal : 1.4 – 1.75 (14 – 17.5) (200 – 249) ↑↓ Abnormal : 0.7 – 1.0 (7 – 10) (100 – 142)**	**During A/C operation, the low pressure side sometimes indicates negative pressure, and sometimes normal pressure. Also high pressure side reading fluctuates between the abnormal and normal pressure.**	Expansion valve is frozen due to moisture in the system, and temporarily shuts off the refrigeration cycle	Replace expansion valve. Replace receiver/dryer. Evacuate A/C system and recharge with fresh refrigerant.
0.05 – 0.15 (0.5 – 1.5) (4.2 – 21.3)	**0.7 – 1.0 (7 – 10) (100 – 142)**	**Both low and high pressure sides indicate low readings. Continuous air bubbles are visible through sight glass. Output air is slightly cold.**	Insufficient refrigerant in system (Refrigerant leaking)	Using leak detector, check for leaks and repair as necessary. Recharge refrigerant to a specified amount. If the pressure reading is almost 0 when the manifold gauges are attached, check for any leaks, repair them, and evacuate the system.
0.4 – 0.6 (4 – 6) (56.9 – 85.3)		**Pressure on low pressure side is high. Pressure on high pressure side is low. Both pressure becoming equal right after A/C is turned OFF.**	Internal leak in compressor	Inspect compressor and repair or replace as necessary.

Condition			Possible Cause	Correction
MANIFOLD GAUGE	MPa (kg/cm^2) (psi)	Detail		
Lo	Hi			
0.35 – 0.45 (3.5 – 4.5) (50 – 64)	**2.0 – 2.5 (20 – 25) (285 – 355)**	**High pressure reading on both low and high pressure sides. Air bubbles are not visible even when engine rpm is lowered.**	Overcharged A/C system Faulty condenser cooling operation Faulty radiator/condenser cooling fan operation	Adjust refrigerant to specified amount. Clean condenser. Inspect and repair radiator/ condenser cooling fan.
		High pressure reading on both low and high pressure sides. Low pressure side tubing is not cold when touched. Air bubbles are visible through sight glass.	Presence of air in A/C system (Improperly evacuated)	Replace receiver/dryer. Inspect quantity of compressor oil and presence of contaminants in oil. Evacuate system and recharge with fresh refrigerant.
0.45 – 0.55 (4.5 – 5.5) (64 – 78)		**High pressure reading on both low and high pressure sides. Large amount of frost or dew on the low pressure side tubing.**	Faulty expansion valve Refrigerant flow is not regulated properly	Replace expansion valve.

COMPRESSOR DRIVE BELT

INSPECTION



- Check compressor drive belt (6) for wear and cracks, and replace as required.
- Check compressor drive belt (6) tension by measuring how much it deflects when pushed at intermediate point between compressor pulley (1) and tension pulley (2) with about 100 N (10 kg) force after crankshaft pulley 1 rotating.
  If belt tension is without specification, adjust belt tension referring to below procedures.

Compressor drive belt tension
"a" : 3 – 5 mm (0.12 – 0.20 in.)
New compressor drive belt tension
"a" : 2 – 4 mm (0.08 – 0.16 in.)

ADJUSTMENT

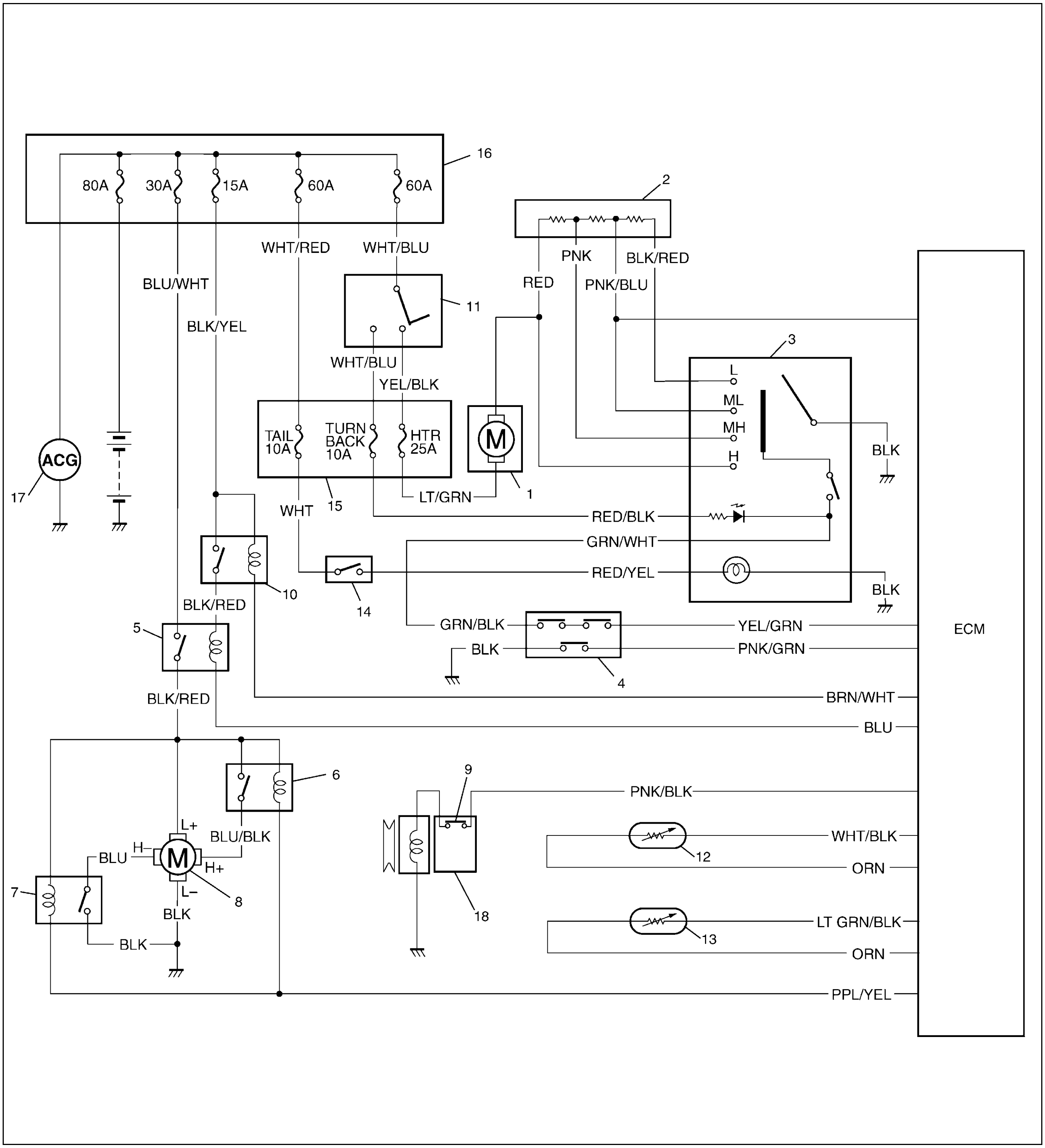
1) Loosen tension pulley nut (3).
2) Adjust belt tension by tighten or loosen tension pulley adjusting bolt (4).
3) Tighten tension pulley nut (3).
4) Turn the crank pulley (5) 1 revolution, then check belt tension.

REPLACEMENT

1) Loosen tension pulley nut (3).
2) Loosen belt tension by loosen tension pulley adjusting bolt (4).
3) Remove compressor drive belt (6).
4) Install new compressor drive belt.
5) Adjust belt tension referring to above procedure.

ELECTRICAL DIAGNOSIS

WIRING DIAGRAM

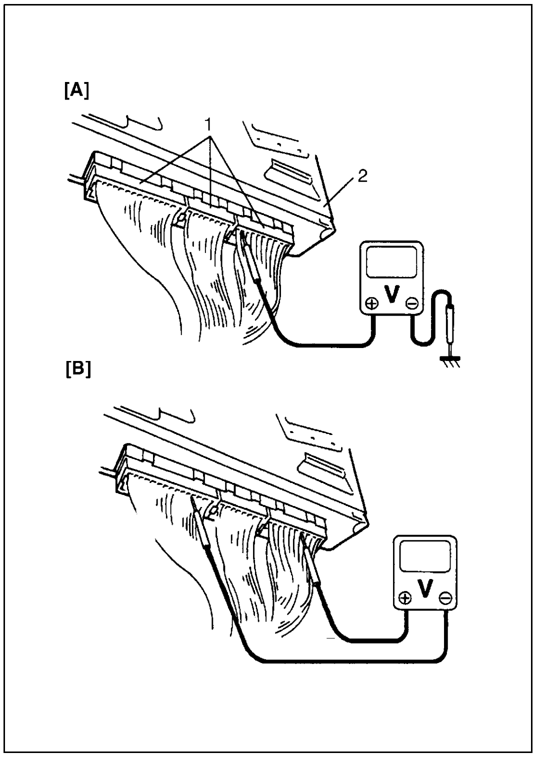


1. Blower fan motor	6. Radiator/condenser cooling fan relay No.2	11. Ignition switch	16. Main fuse box
2. Blower fan motor resistor	7. Radiator/condenser cooling fan relay No.3	12. A/C evaporator temperature sensor	17. Generator
3. Blower fan switch and A/C switch	8. Radiator/condenser cooling fan motor	13. ECT sensor	18. Compressor
4. A/C refrigerant pressure switch	9. Compressor thermal switch	14. Lighting switch	
5. Radiator/condenser cooling fan relay No.1	10. Main relay	15. Circuit fuse box	

A/C SYSTEM INSPECTION OF ECM AND ITS CIRCUITS

ECM and its circuits can be checked at ECM wiring couplers by measuring voltage.

> **CAUTION:**
> **ECM cannot be checked by itself. It is strictly prohibited to connect voltmeter or ohmmeter to ECM with couplers disconnected from it.**



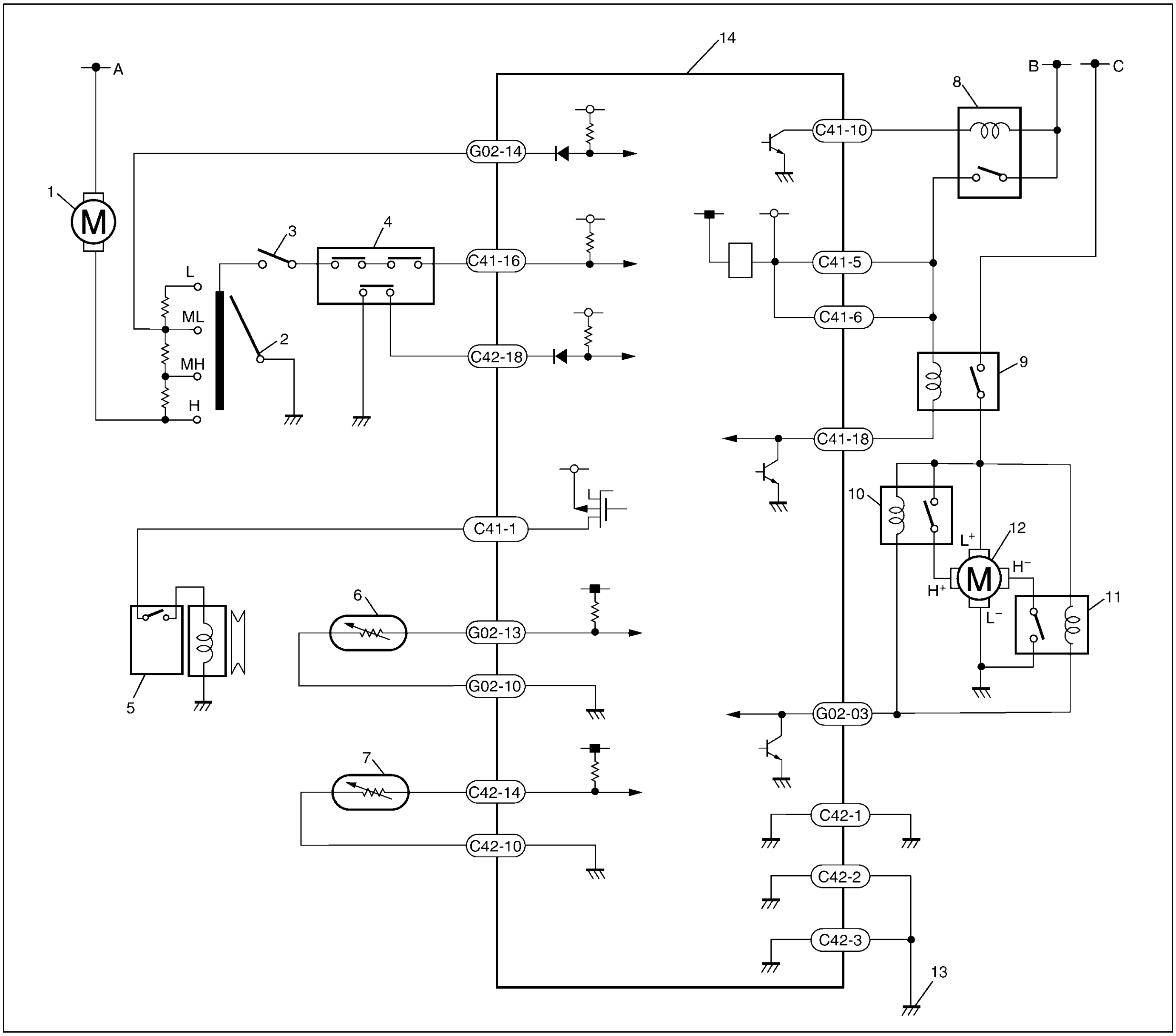
VOLTAGE CHECK

1) Remove ECM from vehicle by referring to "ECM (PCM) REMOVAL AND INSTALLATION" in Section 6E1.
2) Connect ECM couplers (1) to ECM (2).
3) Check voltage at each terminal of couplers connected.

NOTE:
As each terminal voltage is affected by the battery voltage, confirm that it is 11 V or more when ignition switch is ON position.

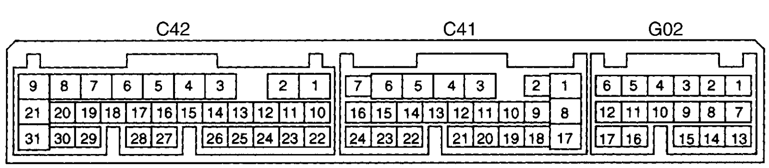
[A] :	Fig. A
[B] :	Fig. B

System Circuit



1. Blower fan motor	8. Main relay	A. To "HTR" fuse (25 A) in circuit fuse box
2. Blower fan switch	9. Radiator/condenser cooling fan motor relay No.1	B. To main fuse (15 A)
3. A/C switch	10. Radiator/condenser cooling fan motor relay No.2	C. To main fuse (30 A)
4. A/C refrigerant pressure switch	11. Radiator/condenser cooling fan motor relay No.3	
5. Compressor	12. Radiator/condenser cooling fan motor	
6. A/C evaporator temperature sensor	13. Engine earth	
7. ECT sensor	14. ECM	

Terminal arrangement of ECM coupler (Viewed from harness side)



ECM Voltage Values Table for Relation of A/C Control

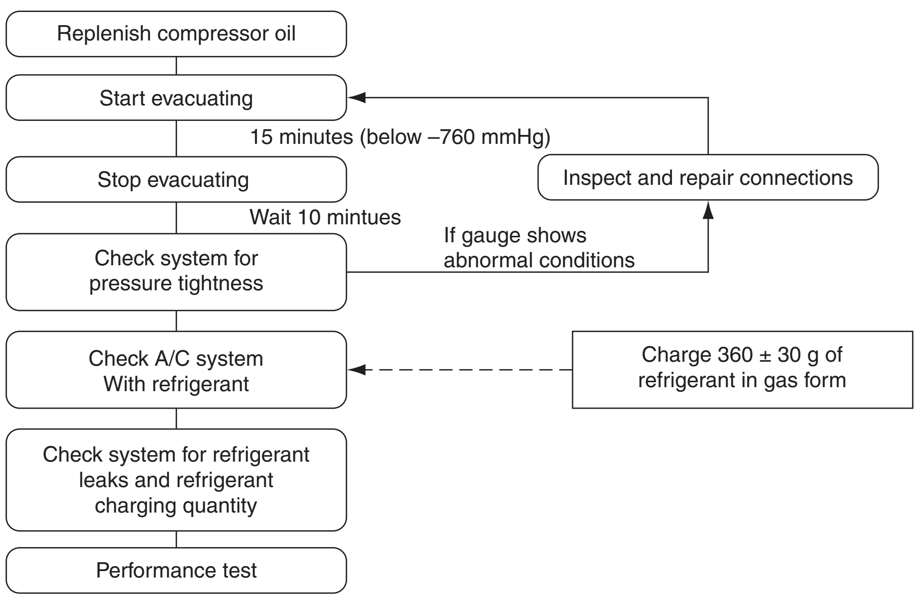
Terminal	Wire	Circuit	Measurement ground	Normal value	Condition
C41-1	PNK/BLK	Compressor magnet clutch output	Ground to engine (Fig B)	12 – 15 V	Except the above-mentioned condition with engine running
				0 – 1 V	Blower fan switch and A/C switch ON with engine running
C41-5	BLK/RED	Main power supply for ECM	Ground to engine (Fig B)	10 – 14 V	Ignition switch ON with engine stopped
C41-6	BLK/RED	Main power supply for ECM	Ground to engine (Fig B)	10 – 14 V	Ignition switch ON with engine stopped
C41-10	BRN/WHT	Main relay drive	Ground to engine (Fig B)	0.5 – 1.2 V	Ignition switch ON with engine stopped
				10 – 14 V	Ignition switch OFF
C41-16	YEL/GRN	A/C switch input	Ground to engine (Fig B)	12 – 15 V	Blower fan switch or A/C switch OFF with engine running
				0 – 1 V	Blower fan switch and A/C switch ON with engine running
C41-18	BLU	Radiator/condenser cooling fan relay output 1	Ground to engine (Fig B)	0 – 1 V	Blower fan switch and A/C switch ON
					Engine coolant temperature at more than 97.5°C (207.5°F) with engine running
				12 – 15 V	Blower fan motor switch or A/C switch OFF
					Engine coolant temperature at less than 97.5°C (207.5°F) with engine running
C42-1	BLK/ORN	Main ground for ECM	Ground to body (Fig A)	–0.5 – 1 V	Engine running
C42-2	BLK	ECM ground for power circuit	Ground to body (Fig A)	–0.5 – 1 V	Engine running
C42-3	BLK/ORN	ECM ground for power circuit	Ground to body (Fig A)	–0.5 – 1 V	Engine running
C42-10	ORN	Sensor ground for ECT sensor	Ground to body (Fig A)	–0.5 – 1 V	Engine running
C42-14	LT GRN/BLK	ECT sensor input	Ground to engine (Fig B)	0.71 – 0.75 V (298 – 320 Ω)	Engine coolant temperature at approximately 80°C (176°F) with engine running
				0.35 – 0.37 V (135 – 144 Ω)	Engine coolant temperature at Approximately 110°C (230°F) with engine running If the temperature is more than 114°C (232°F), compressor and condenser cooling fan should be stop (come back at less than 112°C (230°F))
C42-18	PNK/GRN	Medium pressure switch input	Ground to engine (Fig B)	–0.5 – 1 V	Medium pressure switch of A/C refrigerant pressure switch ON
				12 – 15 V	Medium pressure switch of A/C refrigerant pressure switch OFF
G02-3	PPL/YEL	Radiator/Condenser cooling fan relay output 2	Ground to engine (Fig B)	0 – 1 V	Blower fan motor switch ON, A/C switch ON and medium pressure switch OFF
					Engine coolant temperature at more than 102.5°C (216.5°F) with engine running
				12 – 15 V	Blower fan motor switch OFF, A/C switch OFF or medium pressure switch ON
					Engine coolant temperature at less than 102.5°C (216.5°F) with engine running
G02-10	ORN	Sensor ground for A/C evaporator temperature sensor	Ground to engine (Fig A)	–0.5 – 1 V	Engine running
G02-13	PNK/BLU	Blower fan speed input	Ground to engine (Fig B)	0 – 1 V	Blower fan motor switch “ML”, “MH”, or “H” with engine running
				4 – 7 V	Blower fan motor switch “L” position with engine running
				12 – 15 V	Blower fan motor switch OFF with engine running
G02-14	WHT/BLK	A/C evaporator temperature sensor input	Ground to engine (Fig B)	2.09 – 2.17 V (1940 – 2060 Ω)	A/C evaporator temperature at approximately 25°C (77°F) with engine running
				3.52 – 3.59 V (6450 – 6850 Ω)	A/C evaporator temperature at approximately 0°C (32°F) with engine running If the temperature is less than approximately 2.5°C (36.5°F), compressor and condenser cooling fan should be stop (come back at more than approximately 4°C (39.2°F)

REFRIGERANT RECOVERY, EVACUATING AND CHARGING

WARNING:

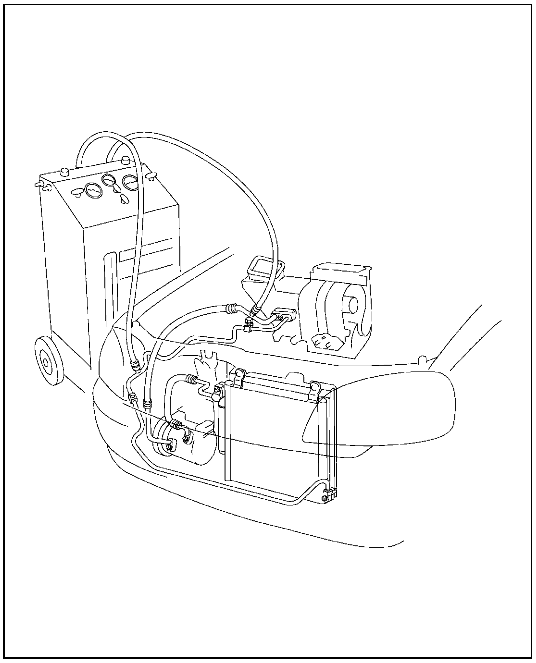
- **Your eyes should not be exposed to refrigerant (liquid).**
  Any liquid HFC-134a (R-134a) escaping by accident shows a temperature as low as approximately –6°C (32°F) below freezing point. Should liquid HFC-134a (R-134a) get into your eyes, it may cause a serious injury. To protect your eyes against such accident, it is necessary to always wear goggles. Should it occur that HFC-134a (R-134a) strikes your eyes, consult a doctor immediately.
  - **Do not use your hand to rub the affected eye(s). Instead, use quantities of fresh cold water to splash it over the affected area to gradually raise temperature of such area above freezing point.**
  - **Obtain proper treatment as soon as possible from a doctor or eye specialist.**
- **Should the HFC-134a (R-134a) liquid come into contact with your skin, the affected area should be treated in the same manner as when skin is frostbitten or frozen.**
- **Refrigerant must not be handled near where welding or steam cleaning is performed.**
- **Refrigerant should be kept at a cold and dark place. It should never be stored where a high temperature is anticipated, e.g. where exposed to direct sun light, close to fire or inside vehicle (including trunk room).**
- **Avoid breathing fumes produced when HFC-134a (R-134a) is burned. Such fumes may be hazardous to health.**

OPERATION PROCEDURE FOR REFRIGERANT CHARGING



RECOVERY

REFRIGERANT RECOVERY

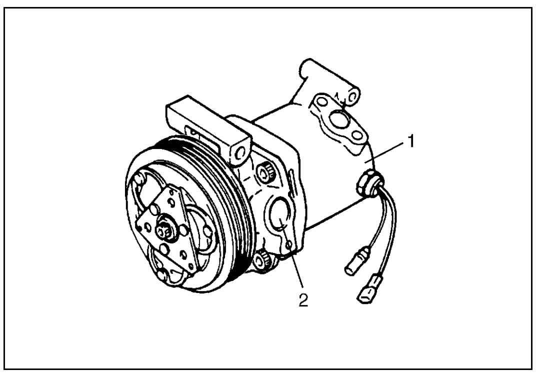


When discharging refrigerant out of A/C system, always recover it by using refrigerant recovery and recycling equipment. Discharging refrigerant HFC-134a (R-134a) into atmosphere would cause adverse effect to environments.

NOTE:

- **After recovery refrigerant from system, the amount of removed compressor oil must be measured for replenishing compressor oil.**
- **When handling recovery and recycling equipment, be sure to follow the instruction manual for the equipment.**

REPLENISHING COMPRESSOR OIL



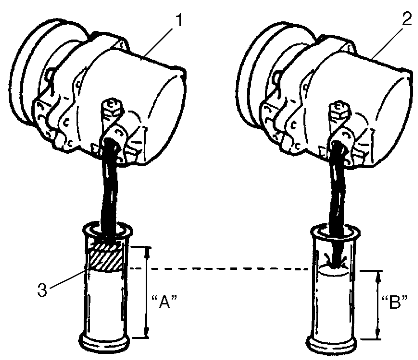
It is necessary to replenishing specified amount of compressor oil to compressor (1) from compressor suction side hole (2) before evacuating and charging refrigerant.

WHEN CHARGING REFRIGERANT ONLY

When charging refrigerant without replacing any component part, replenish the same amount of measured oil when recover refrigerant (if not measure, replenish 30 cc oil).

WHEN REPLACING COMPRESSOR

CAUTION:
Be sure to use HFC-134a (R-134a) compressor oil.



Compressor oil is sealed in each new compressor by the amount required for A/C system. Therefore, when using a new compressor for replacement, drain oil from it by the amount calculated as follows.

"C" = "A" – "B"
"C" : Amount of oil to be drained
"A" : Amount of oil sealed in a new compressor
"B" : Amount of oil remaining in removed compressor

NOTE:
Compressor assembly supplied from factory is filled up with the following amount of oil.

Oil amount in compressor
: 120 cm^3 (120 cc, 7.32 cu-in)

1.	New compressor
2.	Removed compressor
3.	Excess oil ("A" – "B")

WHEN REPLACING OTHER PART

Replenish the following amount of oil to compressor.

Amount of compressor oil to be replenished

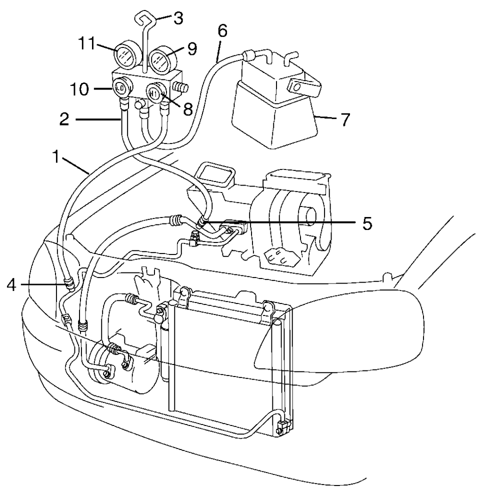
Replaced part	Amount of compressor oil
Evaporator	25 cm^3 (25 cc, 1.53 cu-in)
Condenser	15 cm^3 (15 cc, 0.92 cu-in)
Dryer	20 cm^3 (20 cc, 1.22 cu-in)
Hoses	10 cm^3 (10 cc, 0.61 cu-in) each
Pipes	10 cm^3 (10 cc, 0.61 cu-in) each

EVACUATING

EVACUATING PROCEDURE

CAUTION:
Do not evacuate before recovering refrigerant in system.

NOTE:
Whenever opened (exposed to atmospheric air), air conditioning system must be evacuated by using a vacuum pump. The A/C system should be attached with a manifold gauge set, and should be evacuated for approximately 15 minutes.



1) Connect high charging hose (1) and low charging hose (2) of manifold gauge set (3) respectively as follows :
   High charging hose (1) → High pressure charging valve (4) on condenser outlet pipe
   Low charging hose (2) → Low pressure charging valve (5) on suction pipe
2) Attach center charging hose (6) of manifold gauge set (3) to vacuum pump (7).
3) Operate vacuum pump (7), and then open discharge side valve (Hi) (8) of manifold gauge set (3).
   If there is no blockage in the system, there will be an indication on high pressure gauge (9).
   In this case, open the other side valve (Lo) (10) of the set and repair the system.
4) Approximately 10 minutes later, low pressure gauge (11) should show a vacuum lower than –760 mmHg providing no leakage exists.

NOTE:
- **If the system does not show a vacuum below –760 mmHg, close both valves, stop vacuum pump and watch movement of low pressure gauge.**
- **Increase in the gauge reading suggests existence of leakage. In this case, repair the system before continuing its evacuation.**
- **If the gauge shows a stable reading (suggesting no leakage), continue evacuation.**

5) Evacuation should be carried out for a total of at least 15 minutes.
6) Continue evacuation until low pressure gauge (9) indicates a vacuum less than –760 mmHg, and then close both valves (8), (10).
7) Stop vacuum pump (7). Disconnect center charging hose (6) from pump inlet. Now, the system is ready for charging refrigerant.

CHECKING SYSTEM FOR PRESSURE LEAKS

After completing the evacuation, close manifold gauge high pressure valve and low pressure valve and wait 10 minutes. Verify that low pressure gauge reading has not changed.

CAUTION:
If the gauge reading moves closer to “0”, there is a leak somewhere. Inspect the tubing connections, make necessary corrections, and evacuate system once again, making sure that there are no leaks.

CHARGING

CAUTION:

- **Always charge through low pressure side of A/C system at after the initial charging is performed from the high pressure side with the engine stopped.**
- **Never charge to high pressure side of A/C system with engine running.**
- **Do not charge while compressor is hot.**
- **When installing tap valve to refrigerant container to make a hole there through, carefully follow directions given by manufacturer.**
- **A pressure gauge should always be used before and during charging.**
- **The refrigerant container should be emptied of refrigerant when discarding it.**
- **The refrigerant container should not be heated up to 40°C (104°F) or over.**
- **Refrigerant container should not be reversed in direction during charging. Reversing in direction causes liquid refrigerant to enter compressor, causing troubles, such as compression of liquid refrigerant and the like.**

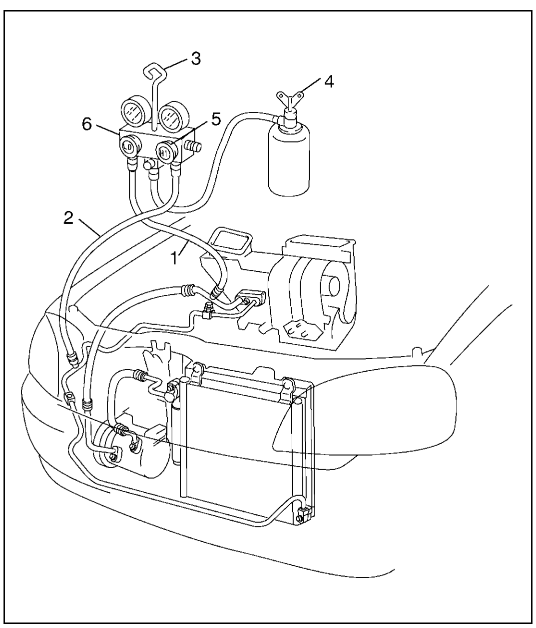
NOTE:

The air conditioning system contains HFC-134a (R-134a).
Described here is a method to charge the air conditioning system with refrigerant from the refrigerant service container.
When charging refrigerant recovered by using the refrigerant and recycling equipment (when recycling refrigerant), follow the procedure described in the equipment manufacturer's instruction manual.

CHARGING PROCEDURE

The initial charging of the A/C system is performed from the high pressure side with the engine stopped.
And next, this method must be followed by charging from the low pressure side with the engine running.

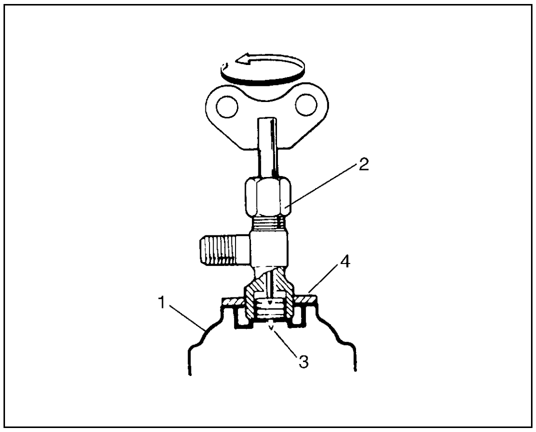
1) Check to make sure that hoses are routed properly after evacuating the system.



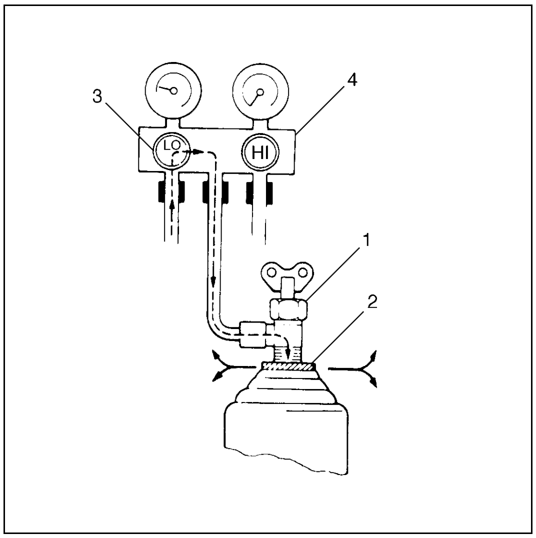
2) Connect Low charging hose (1) and High charging hose (2) of the manifold gauge set (3) in position. Thus open refrigerant container valve (4) to purge the charging line.
3) Open the high pressure side valve (5) and charge refrigerant to system.
4) After a while, open the low pressure side valve (6) and close the high pressure side valve (5).

WARNING:
Make sure that high pressure side valve is closed securely.

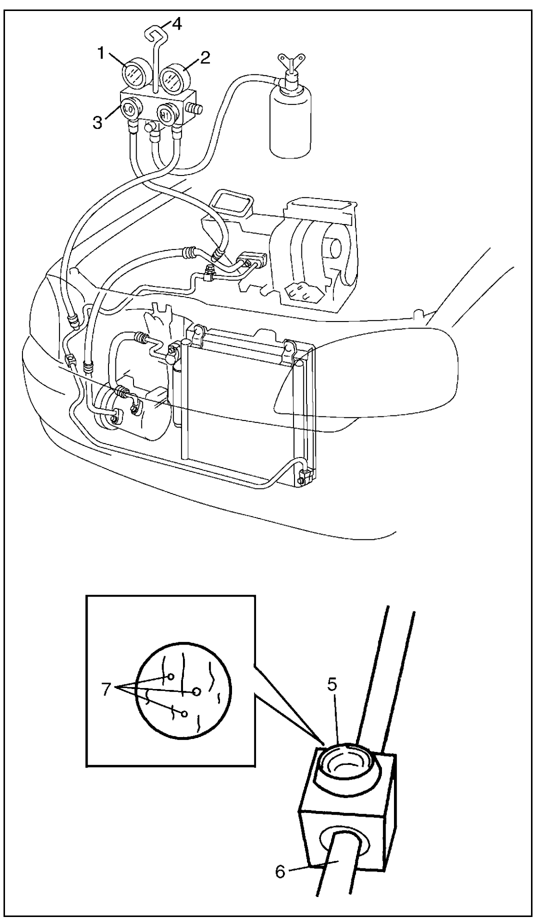
5) Start engine and keep engine speed at 1500 r/min. Then, operate air conditioning.
6) Charge A/C system with refrigerant in vapor state. At this time, refrigerant container (4) should be held upright.



7) When refrigerant container (1) is emptied, use the following procedure to replace it with a new refrigerant container (1).
   a) Close low pressure valve.
   b) Replace empty container (1) with a refrigerant container which has been charged with refrigerant. When using refrigerant container tap valve (2), use the following procedure for replacement.
      i) Retract needle (3) and remove refrigerant container tap valve (2) by loosening its plate nut (4).
      ii) Install previously-removed refrigerant container tap valve (2) to a new refrigerant container (1).



   c) Purge any air existing in center charging hose
      When using refrigerant container tap valve, use the following procedure to purge air.
      i) Once fully tighten refrigerant container tap valve (1), and then loosen (open) plate nut (2) slightly.
      ii) Open low pressure side valve (3) of manifold gauge set (4) a little.
      iii) As soon as refrigerant comes out with a “hiss” through a clearance between refrigerant container and tap valve, tighten plate nut (2) as well as low pressure side valve (3).
      iv) Turn handle of tap valve (1) clockwise so that its needle is screwed into the new container to make a hole for refrigerant flow.



8) After the system has been charged with specified amount (330 – 390 g) of refrigerant or when low pressure gauge (1) and high pressure gauge (2) have indicated the following specified amount, close low pressure side valve (3) on manifold gauge set (4). At this time, look into the sight glass (5) of condenser outlet pipe (6) and check that there are no bubbles (7) in it, which means that the system is fully charged.

Low side and high side pressure example

Gauges should read as follows when ambient temperature is 30°C (86 °F).	
Pressure on high pressure gauge	**1400 – 1750 kPa** **14.0 – 17.5 kg/cm^2** **199.1 – 248.9 psi**
Pressure on low pressure gauge	**230 – 350 kPa** **2.3 – 3.5 kg/cm^2** **32.7 – 49.8 psi**

REMOVING MANIFOLD GAUGE SET

WARNING:

High pressure side is naturally under high pressure. So, care must be used to protect your eyes and skin.

When A/C system has been charged with a specified amount of refrigerant, remove manifold gauge set as follows :

1) Close low pressure side valve of manifold gauge set. (The high pressure side valve is closed continuously during the process of charging.)
2) Close refrigerant container valve.
3) Stop engine.
4) Using shop rag, remove charging hoses from service valves. This operation must be performed rapidly.
5) Put caps on service valves.

LEAK TEST

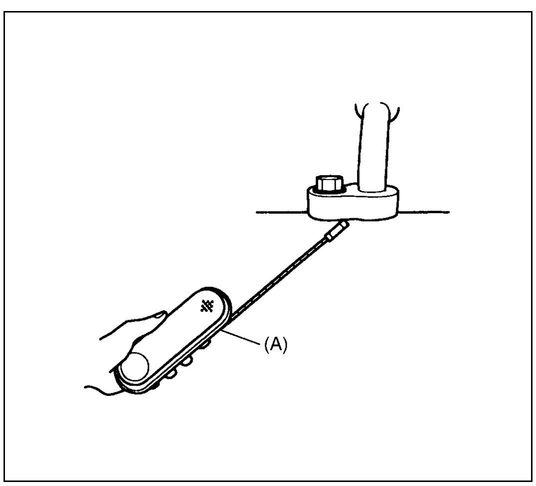
Whenever a refrigerant leak is suspected in the system or any service operation has been performed which may result in disturbing lines or connections, it is advisable to test for leaks.

Common sense should be used in performing any refrigerant leak test, since the need and extent of any such test will, in general, depend upon the nature of a complaint and the type of a service performed on the system.

LIQUID LEAK DETECTORS

WARNING:

- **To prevent explosions or fires, make sure that there are no flammables in the vicinity.**
- **When exposed to fire, the refrigerant turns into a poisonous gas (phosgene). Do not inhale this gas.**



There are a number of fittings and places throughout the air conditioning system where a liquid leak detector solution may be used to pinpoint refrigerant leaks.

By merely applying the solution to the area in question with a swab, such as attached to the cap of a vial, bubbles will form within seconds if there is a leak.

For confined areas, such as sections of the evaporator and condenser, an electronic (refrigerant) leak detector is more practical for determining leaks.

Special tool
(A) : 09990 - 86011

ON-VEHICLE SERVICE

WARNING:

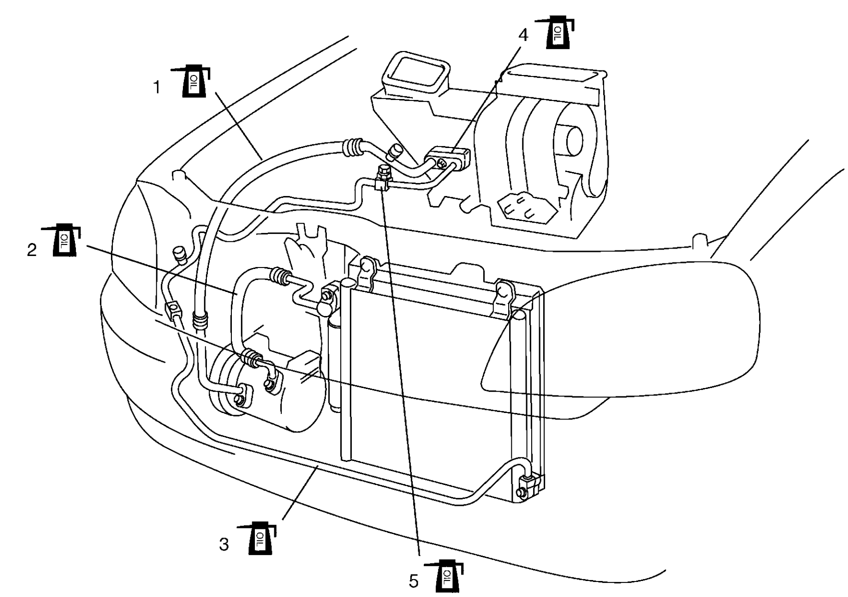
Should refrigerant HFC-134a (R-134a) strike your eye(s), consult a doctor immediately.

- **Do not use your hand to rub affected eye(s). Instead, use quantities of fresh cold water to splash it over affected area to thus gradually raise its temperature above the freezing point.**
- **Obtain proper treatment as soon as possible from a doctor or eye specialist. Should liquid refrigerant HFC-134a (R-134a) get on your skin, such affected part should be treated in the same manner as when skin is frostbitten or frozen.**

SERVICE PRECAUTION

When servicing air conditioning system, note the following instructions.

REFRIGERANT LINE



1. Suction hose: Apply compressor oil (refrigerant oil) to O-ring.	4. Expansion valve: Apply compressor oil (refrigerant oil) to O-ring.
2. Discharge hose: Apply compressor oil (refrigerant oil) to O-ring.	5. A/C refrigerant pressure switch: Apply compressor oil (refrigerant oil) to O-ring.
3. Condenser outlet pipe: Apply compressor oil (refrigerant oil) to O-ring.	

- Never use heat for bending pipes. When bending a pipe, try to make its bending radius as slight as possible.
- Keep internal parts of air conditioning free from moisture and dirt. When disconnecting any line from system, install a blind plug or cap to the fitting immediately.
- When connecting hoses and pipes, apply a few drops of compressor oil (refrigerant oil) to seats of coupling nuts and O-ring.
- When tightening or loosening a fitting, use two wrenches, one for turning and the other for support.
- Tighten flared nuts by the following specified torque.

Tightening torque
8 mm pipe : 13 N·m (1.3 kg-m, 9.5 lb-ft)
12 mm pipe : 23 N·m (2.3 kg-m, 16.6 lb-ft)
14.5 mm pipe : 33 N·m (3.3 kg-m, 23.8 lb-ft)

- Route drain hose so that drained water does not make any contact to vehicle components.
- If pipes or hoses are replaced, replenish specified amount of compressor oil to compressor suction side by referring to “REPLENISHING COMPRESSOR OIL” in this section.

HANDLING REFRIGERANT HFC-134a (R-134a)

- Always wear goggles to protect your eyes.
- Avoid you direct contact to liquid refrigerant.
- Do not heat refrigerant container higher than 40°C (104°F).
- Do not discharge refrigerant into atmosphere.
- Do not allow liquid refrigerant to touch bright metals. Refrigerant combined with moisture is corrosive and will tarnish surfaces of bright metals including chrome.

REFRIGERANT RECOVERY

When discharging refrigerant out of A/C system, always recover it by using refrigerant recovery and recycling equipment. Discharging refrigerant HFC-134a (R-134a) into atmosphere would cause adverse effect to environments.

REFRIGERANT CHARGE

After perform replenishing compressor oil and evacuating, charge a proper amount of refrigerant to A/C system referring to “CHARGING” in this section.

CAUTION:
Do not perform an additional refrigerant charging to A/C system. This cause it to overcharge.

CONDENSER ASSEMBLY

CAUTION:
Be careful not to damage condenser fins. If condenser fin is bent, straighten it by using flat head screwdriver or pair of pliers.

INSPECTION

Check the following.

- Clog of condenser fins.
  If, any clogs are found, condenser fins should be washed with water, and should be dried with compressed air.
- Condenser fins for leakage and breakage.
  If any defects are found, repair or replace condenser.
- Condenser fittings for leakage.
  If any defects are found, repair or replace condenser.

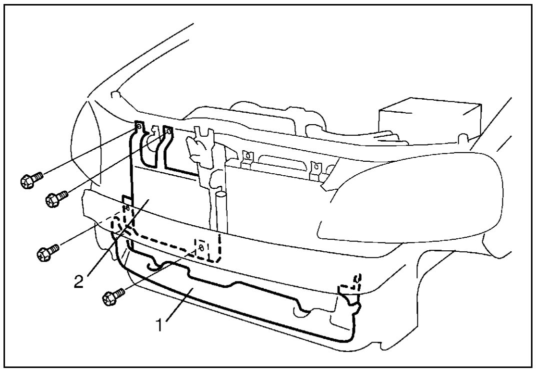
REMOVAL

1) Disconnect negative (–) cable at battery.
2) Recover refrigerant from A/C system by referring to "RECOVERY" in this section.

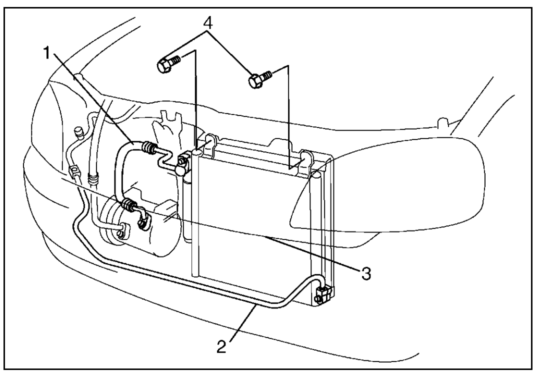
NOTE:

The amount of removed compressor oil must be measured for replenishing compressor oil.

3) Remove front bumper referring to "FRONT BUMPER" in Section 8.



4) Remove front cross member cover (1) and engine food cover (2) from vehicle body.



5) Disconnect discharge hose (1) and condenser outlet pipe (2) from condenser (3).
6) Remove condenser mounting bolts (4).
7) Remove condenser (3).

INSTALLATION

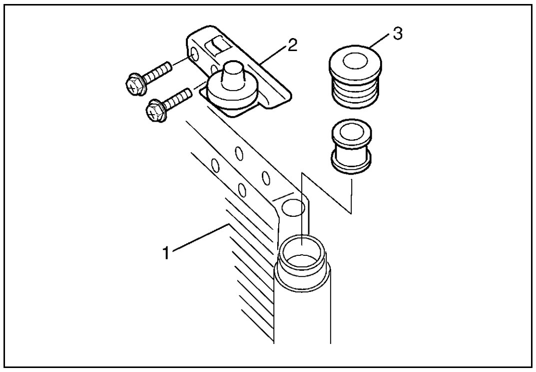
Reverse removal procedure to install condenser noting the following instructions.

- Replenish specified amount of compressor oil to compressor suction side by referring to "REPLENISHING COMPRESSOR OIL" in this section.
- Evacuate and charge refrigerant by referring to "EVACUATING" and "CHARGING" in this section.

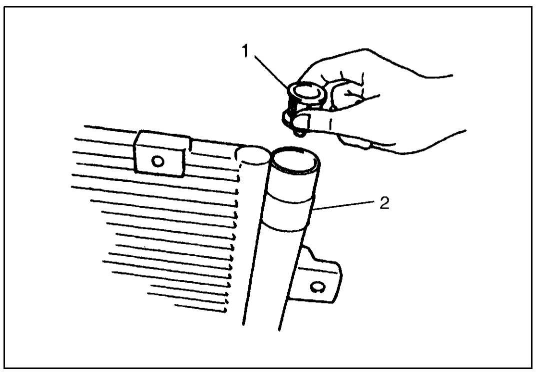
RECEIVER/DRYER

REMOVAL

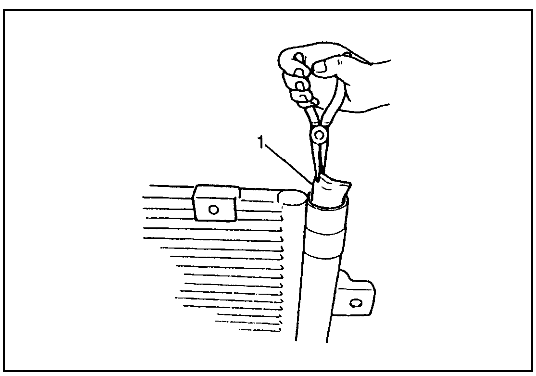
1) Remove condenser assembly referring to “CONDENSER ASSEMBLY” in this section.



2) Remove condenser mounting bracket (1) from condenser (2) as shown.
3) Remove receiver/dryer cap (3) using a hexagon wrench.



4) Remove filter (1) from the receiver/dryer (2).

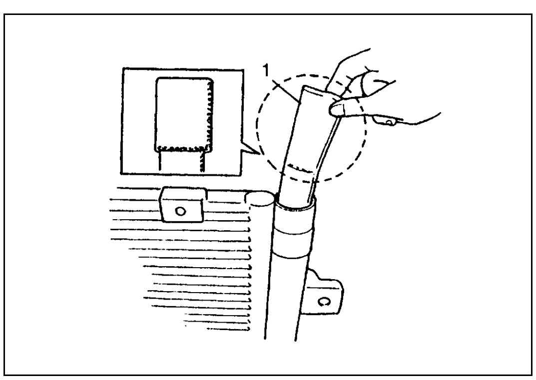


5) Remove dryer (1) using a plier.

INSTALLATION

Reverse removal procedure to install receiver/dryer noting the following instructions.

- Do not remove dryer from the plastic bag until just before inserting it into the receiver.



- Install dryer (1) with its double-layer portion facing the bottom of the receiver.

- Tighten receiver/dryer cap to specified torque

Tightening torque
Receiver / dryer cap : 13 N·m (1.3 kg-m, 9.5 lb-ft)

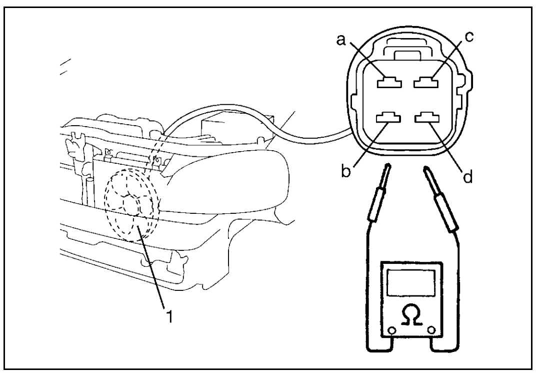
- Replenish specified amount of compressor oil to compressor suction side by referring to “REPLENISHING COMPRESSOR OIL” in this section.

RADIATOR/CONDENSER COOLING FAN MOTOR

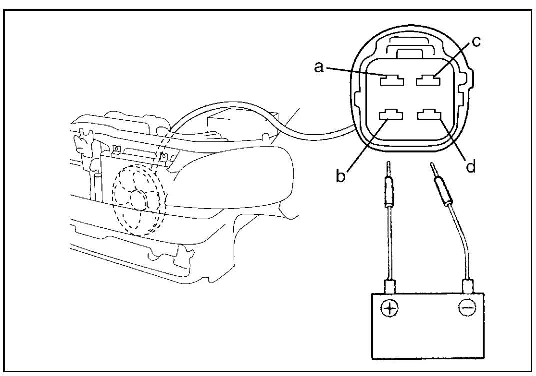
REMOVAL AND INSTALLATION

For details, refer to “RADIATOR” in Section 6B.

INSPECTION



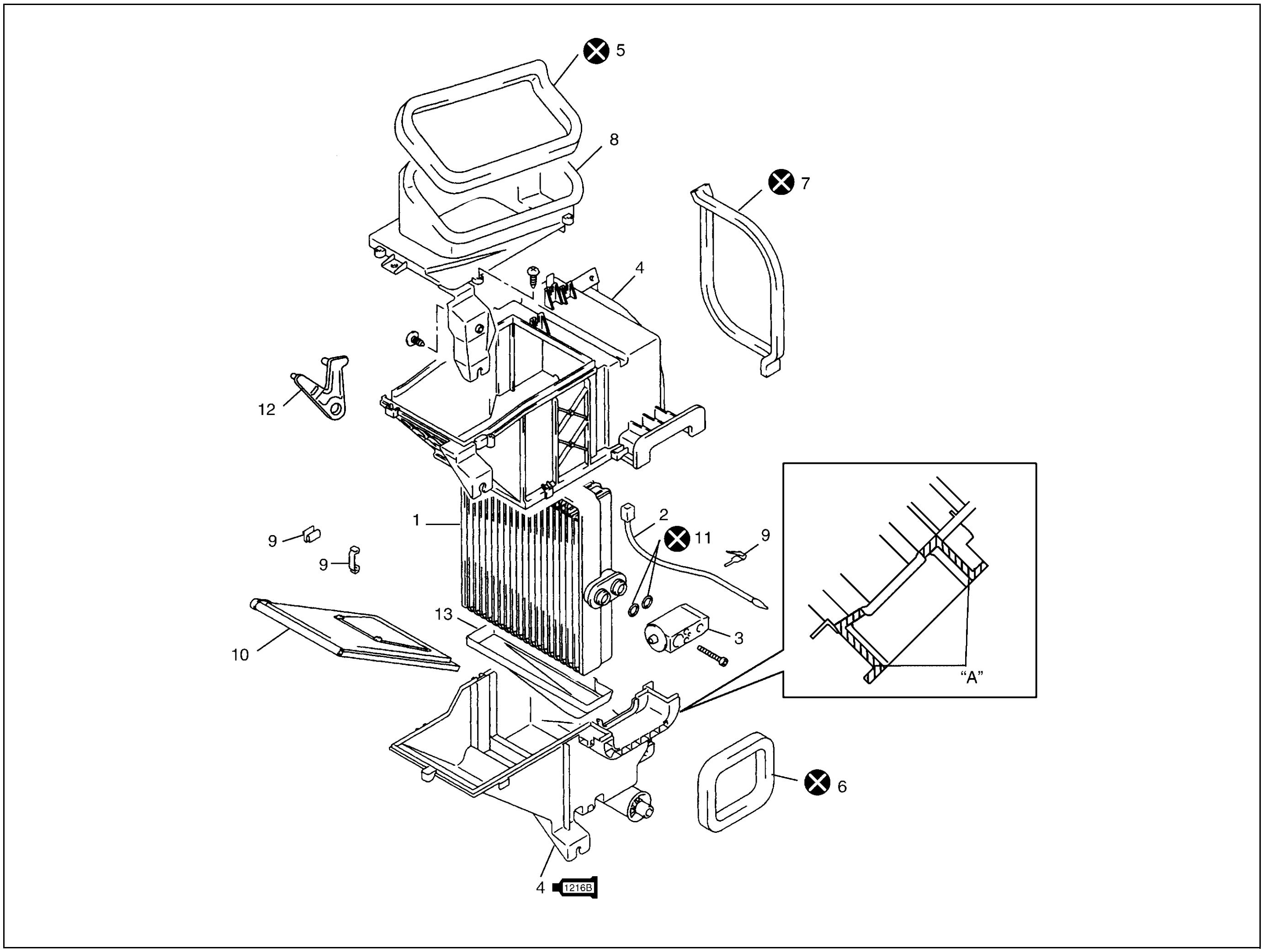
1) Check continuity terminal “a” – “b” and “c” – “d” about the radiator/condenser cooling fan motor (1).
   If check results are no continuity, replace radiator/condenser cooling fan motor.
2) Check no continuity “a” – “c” and “b” – “d” about the radiator/condenser cooling fan motor (1).
   If check result are continuity, replace radiator/condenser cooling fan motor.



3) Connect battery to radiator/condenser cooling fan motor terminal “a” – “b” and “c” – “d” as shown in figure, then check that the radiator/condenser cooling fan motor operates smoothly.

Reference current of radiator/condenser cooling fan motor at 12 V
“a” – “b” : 7.8 – 11.8 A
“c” – “d” : 4.8 – 8.8 A

COOLING UNIT (EVAPORATOR)



	1. A/C evaporator	6. Dash packing	11. O-ring
	2. A/C evaporator temperature sensor	7. Packing	12. Door link
	3. Expansion valve	8. Fresh air duct case	13. Lower packing
1216B	4. Evaporator case : Apply sealant 99000-31160 to hatched part "A".	9. Clamp	⊗ Do not reuse.
	5. Cooling unit packing	10. Air inlet door	

CAUTION:

Be careful not to damage A/C evaporator fins. If A/C evaporator fin is bent, straighten it by using flat head screwdriver or pair of pliers.

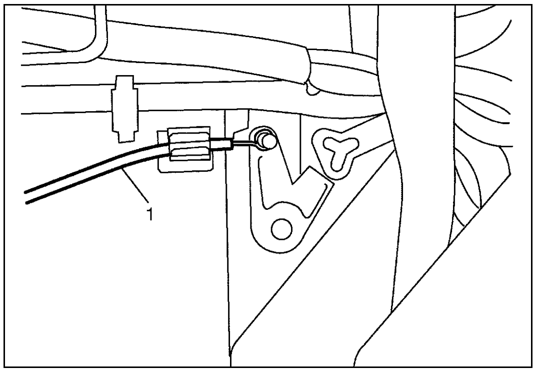
REMOVAL

1) Disconnect negative (–) cable at battery.
2) Recover refrigerant from A/C system by referring to "RECOVERY" in this section.

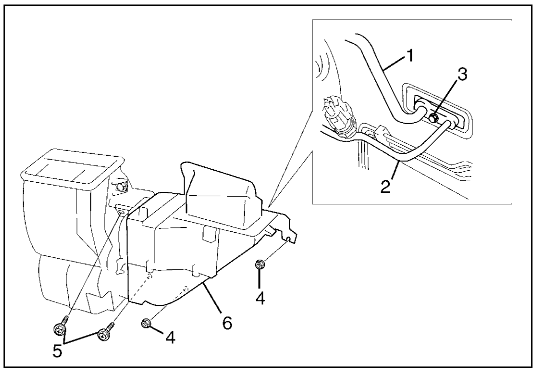
NOTE:

The amount of removed compressor oil must be measured for replenishing compressor oil.

3) Remove glove box.



4) Remove fresh air control cable (1) and A/C evaporator temperature sensor coupler.



5) Disconnect suction hose (1) and condenser outlet hose (2) by removing attaching bolt (3).
6) Remove cooling unit mounting nuts (4) and screws (5).
7) Remove cooling unit (6).

INSPECTION

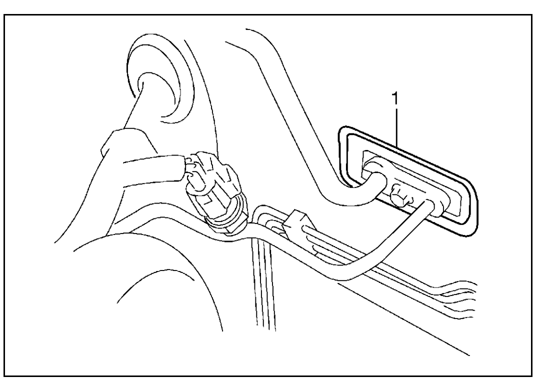
Check the following.

- Clog of A/C evaporator fins.
  If any clogs are found, A/C evaporator fins should be washed with water, and should be dried with compressed air.
- A/C evaporator fins for leakage and breakage.
  If any defects are found, repair or replace A/C evaporator.
- A/C evaporator fittings for leakage.
  If any defects are found, repair or replace A/C evaporator.

INSTALLATION

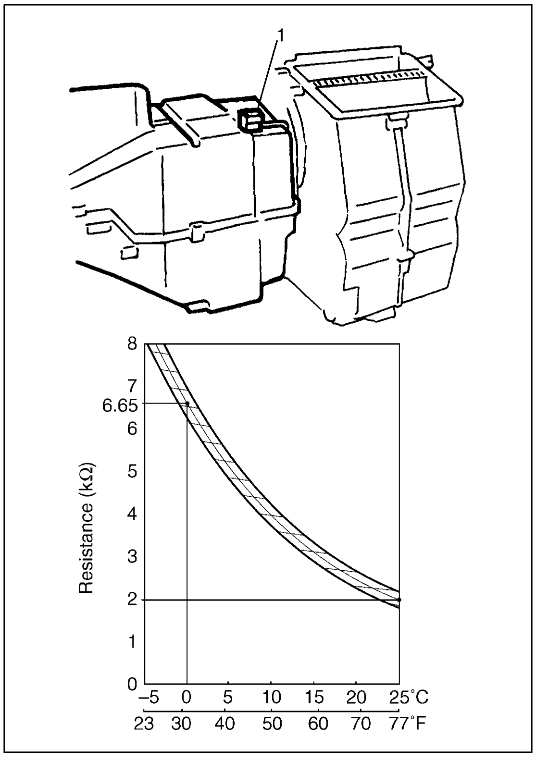
Reverse removal procedure to install cooling unit noting the following instructions.

- If A/C evaporator temperature sensor removed, its should be reinstalled in original position.
- Replenish specified amount of compressor oil to compressor suction side by referring to “REPLENISHING COMPRESSOR OIL” in this section.



- Install uniformly the packing (1) to installation hole.
- Evacuate and charge refrigerant by referring to “EVACUATING” and “CHARGING” in this section.
- Adjust fresh air control cable, refer to “HEATER LEVER ASSEMBLY” in Section 1A.

A/C EVAPORATOR TEMPERATURE SENSOR



Check resistance between terminals for A/C evaporator temperature sensor (1).
If check results are as not specified, replace A/C evaporator temperature sensor.

A/C evaporator temperature sensor resistance

Sensor Temperature	Resistance
0°C (32°F)	6.4 – 6.9 kΩ
25°C (77°F)	1.8 – 2.2 kΩ

NOTE:

When A/C evaporator temperature sensor removed, its should be reinstalled in original position.

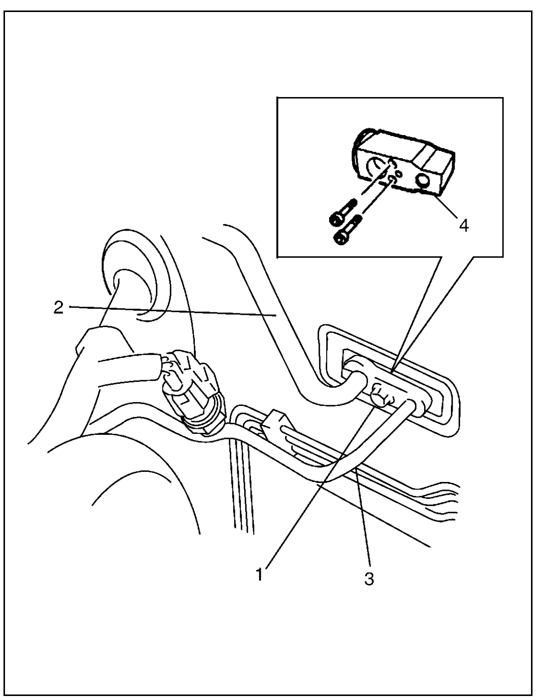
EXPANSION VALVE

REMOVAL

1) Disconnect negative (–) cable at battery.
2) Recover refrigerant from A/C system by referring to “RECOVERY” in this section.

NOTE:

The amount of removed compressor oil must be measured for replenishing compressor oil.



3) Remove attaching bolt (1).
4) Remove suction hose (2) and receiver/dryer outlet pipe (3) from expansion valve (4).
5) Remove expansion valve (4).

INSTALLATION

Reverse removal procedure to install expansion valve noting the following instructions.

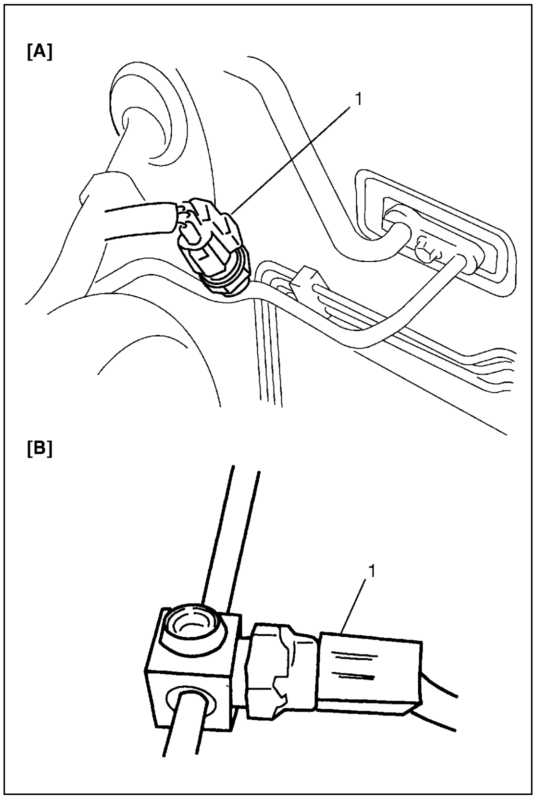
- Replenish specified amount of compressor oil to compressor suction side by referring to “REPLENISHING COMPRESSOR OIL” in this section.
- Evacuate and charge refrigerant by referring to “EVACUATING” and “CHARGING” in this section.

INSPECTION

Refer to “PERFORMANCE DIAGNOSIS” in this section.

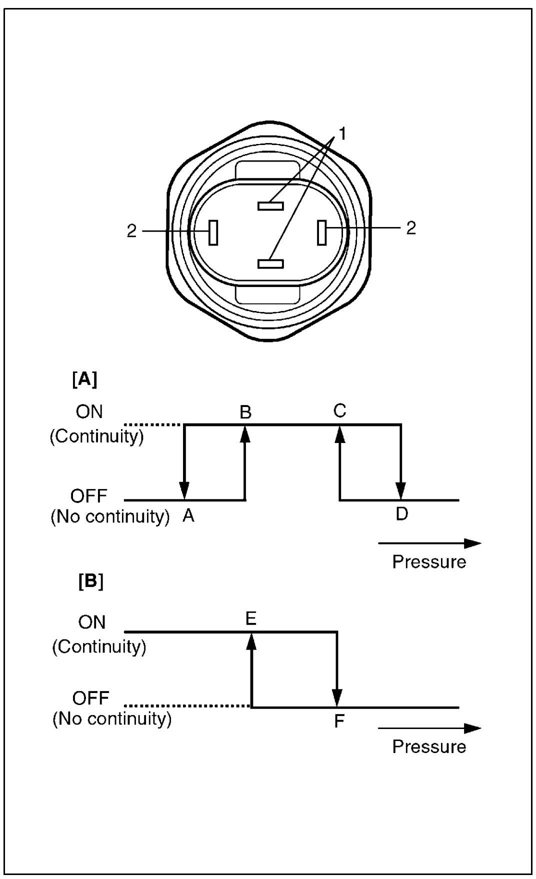
A/C REFRIGERANT PRESSURE SWITCH

INSPECTION



1) Check A/C refrigerant pressure switch (1) for continuity at normal temperature (approximately 25°C (77°F)) when A/C system has a proper charge of refrigerant and A/C system (compressor) is under operation. In each of these cases, switch should show proper continuity.

[A] :	LH model
[B] :	RH model



2) Check continuity between high and low pressure switch terminals (1) at specified pressure as shown.

High and low pressure switch specification

A : Approximately 200 kPa (2.0 kg/cm^2, 28.5 psi)

B : Approximately 230 kPa (2.3 kg/cm^2, 32.5 psi)

C : Approximately 2600 kPa (26 kg/cm^2, 370 psi)

D : Approximately 3200 kPa (32 kg/cm^2, 455 psi)

3) Check continuity between medium pressure switch terminals (2) at specified pressure as shown as shown.

Medium pressure switch specification

E : Approximately 1100 kPa (11 kg/cm^2, 156 psi)

F : Approximately 1500 kPa (15 kg/cm^2, 213 psi)

Tightening torque
A/C refrigerant pressure switch :
11 N·m (1.1 kg-m, 8.0 lb-ft)

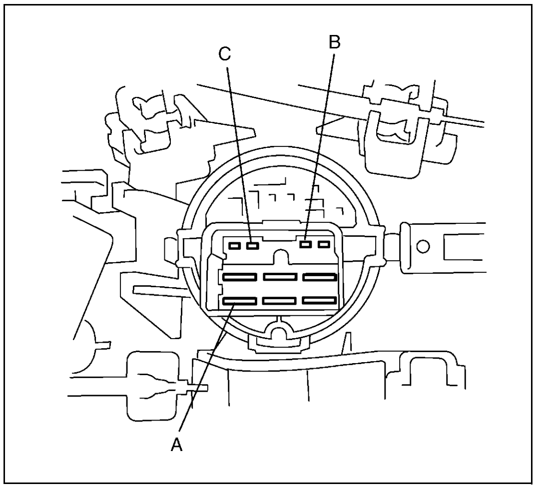
[A] :	High and low pressure
[B] :	Middle pressure

A/C SWITCH

REMOVAL AND INSTALLATION

Refer to “HEATER CONTROL ASSEMBLY” in Section 1A.

INSPECTION



- Press A/C switch button and check if there is continuity between terminals “A” and “B”.
- Connect battery voltage (+) to terminal “C” and (–) to terminal “A”, and then press A/C Switch button and check if indicator lamp lights.

RADIATOR/CONDENSER COOLING FAN MOTOR RELAY No.1, No.2 and No.3

INSPECTION

Refer to “RADIATOR FAN RELAY” in Section 6B.

COMPRESSOR

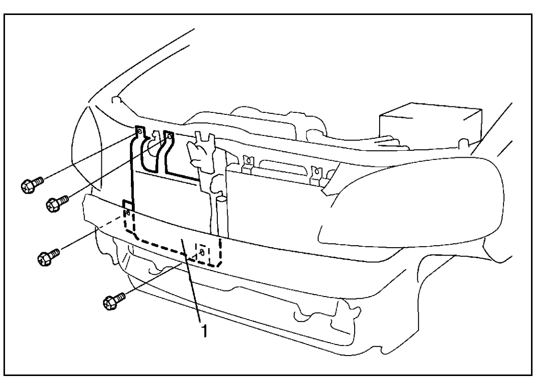
REMOVAL

1) Run engine at idle speed with air conditioning ON for 10 minutes. After that stop the engine.
2) Disconnect negative (–) cable at battery.
3) Recover refrigerant from refrigeration system by referring to “RECOVERY” in this section.

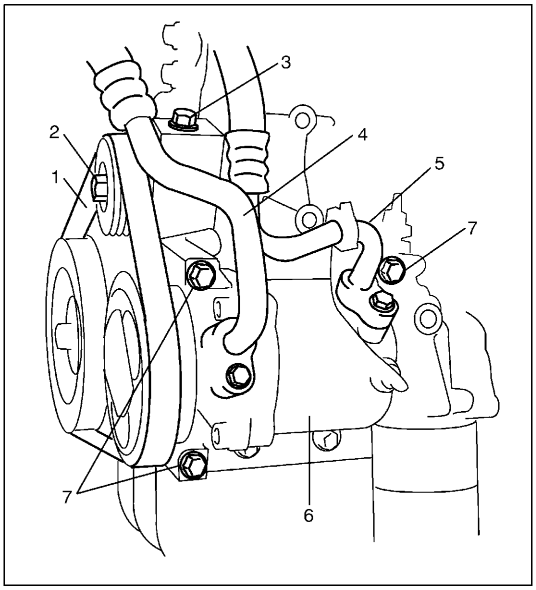
NOTE:

The amount of removed compressor oil must be measured for replenishing compressor oil.

4) Remove front bumper by referring to “FRONT BUMPER” in Section 8.



5) Remove engine food cover (1) from vehicle body.



6) Remove compressor drive belt (1) by loosening tension pulley nut (2) and adjusting bolt (3).
7) Disconnect magnet clutch lead wire coupler.
8) Disconnect suction pipe (4) and discharge hose (5) from compressor (6).

NOTE:

Cap open fittings immediately to keep moisture out of system.

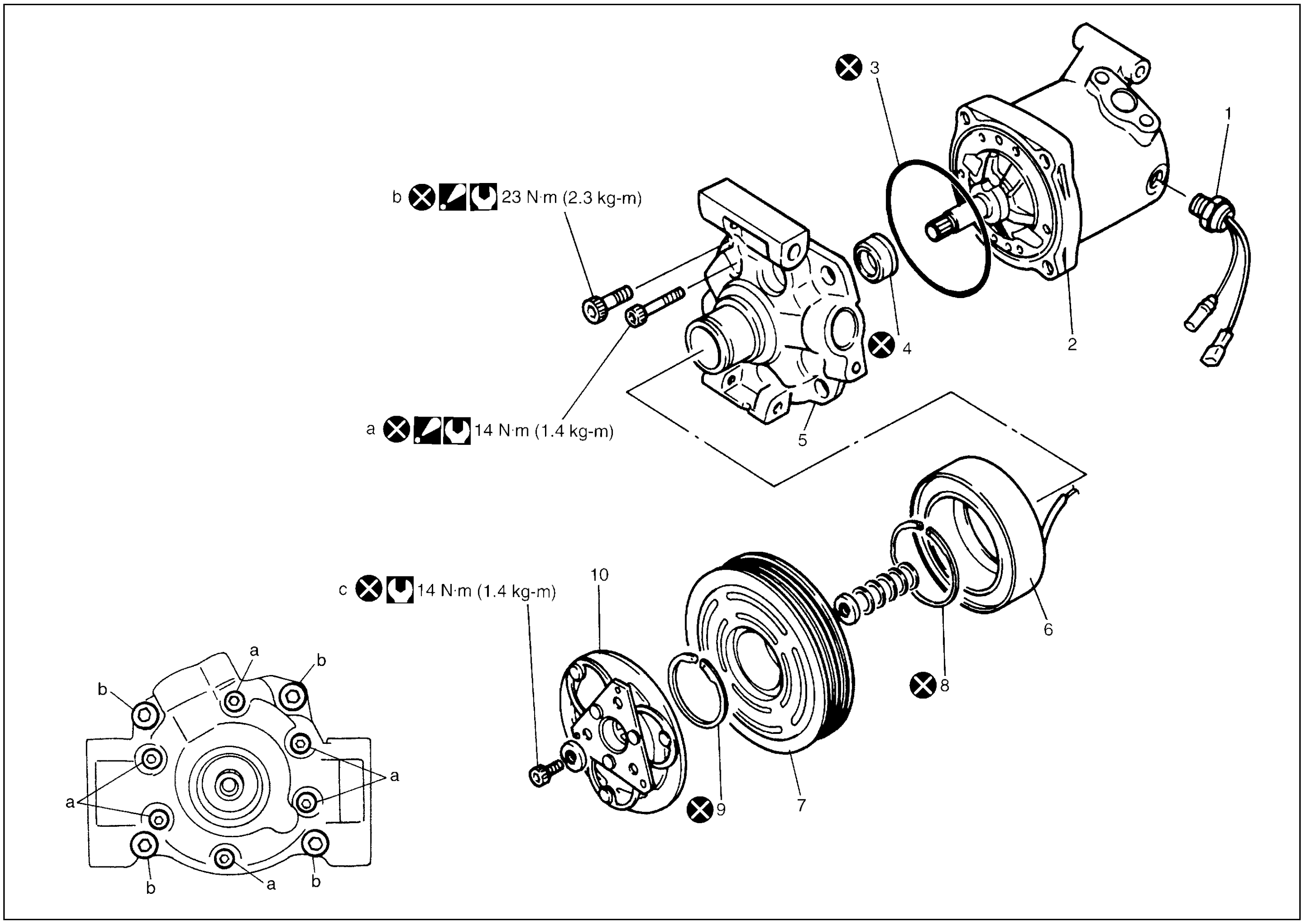
9) Remove compressor mounting bolts (7), and then remove compressor (6) from its bracket.

INSTALLATION

Reverse removal procedure to install compressor noting the following instructions.

- If compressor is replaced, pour new compressor oil by referring to “REPLENISHING COMPRESSOR OIL” in this section.
- Evacuate and charge system by referring to “RECOVERY” in this section.
- Adjust drive belt tension by referring to “COMPRESSOR DRIVE BELT” in this section.

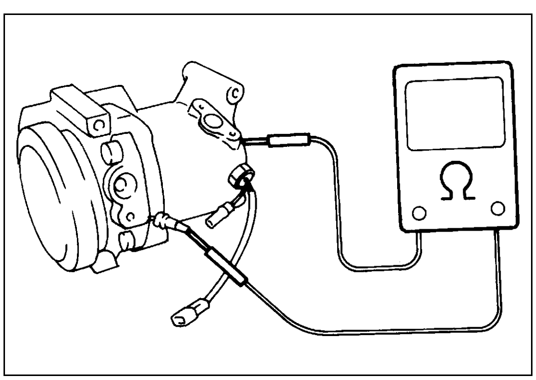
MAGNET CLUTCH



1. Compressor thermal switch	6. Clutch coil	a. Front head bolt : Tighten bolt (a) first, and next (b)
2. Compressor body	7. Clutch pulley	b. Front head bolt : Tighten bolt (a) first, and next (b)
3. O-ring	8. Circlip	c. Clutch plate bolt
4. Lip type seal	9. Circlip	Tightening torque
5. Front head	10. Clutch plate	Do not reuse.

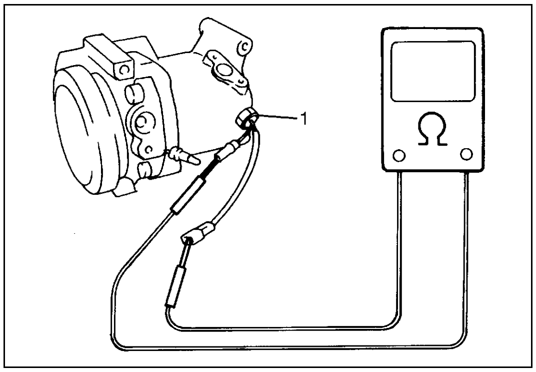
INSPECTION

- Check clutch plate and clutch pulley for wear and oil soaked conditions respectively.
- Check clutch pulley bearing for noise, wear and grease leakage.



- Measure clutch coil for resistance at 20°C (68°F).
  If the measured resistance does not remain within tolerance, replace magnet clutch assembly.

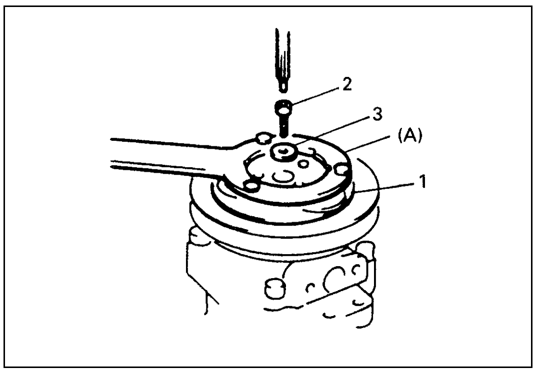
Clutch coil resistance
: 3.4 – 4.1 Ω



- Use an ohmmeter to check thermal switch (1) for continuity. If it is no continuity, replace it.

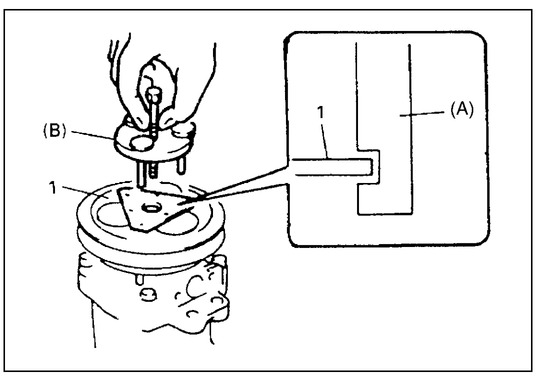
REMOVAL

1) Remove compressor from vehicle. Refer to “COMPRESSOR” in this section.



2) Fix clutch plate (1) with special tool and remove clutch plate bolt (2) and washer (3).

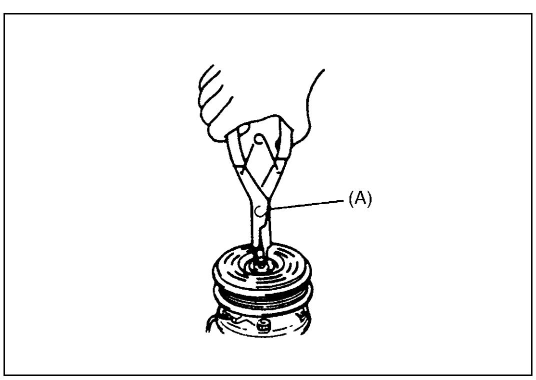
Special tool
(A) : 09991-06020



3) Using special tool, remove clutch plate (1).

Special tool
(A) : 09991-06030

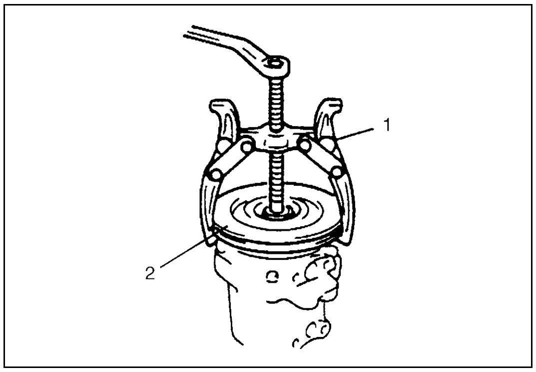
4) Remove shims from shaft.



5) Using special tool, remove circlip.

Special tool
(A) : 09900-06107

6) Remove clutch coil lead wire clamp by loosening its screw and disconnect clutch coil lead wire from thermal switch lead wire.

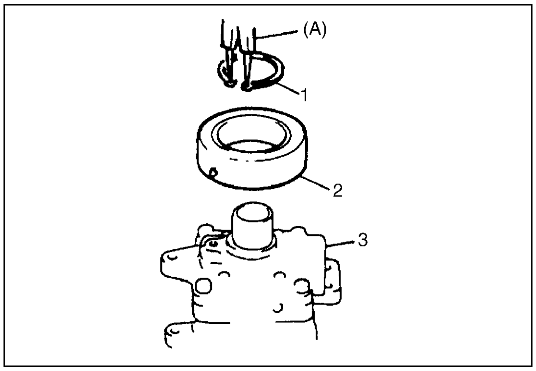


7) Remove clutch pulley (2) with puller (1).

NOTE:

- **Be careful not to damage pulley when tapping clutch pulley.**
- **Be careful not to scratch bearing.**

8) Remove clutch coil.

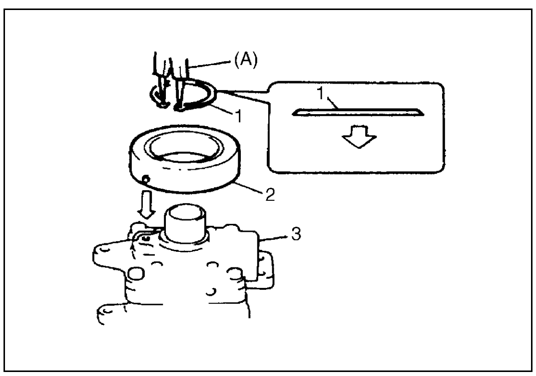


9) Remove circlip (1) by using special tool.

Special tool
(A) : 09900-06107

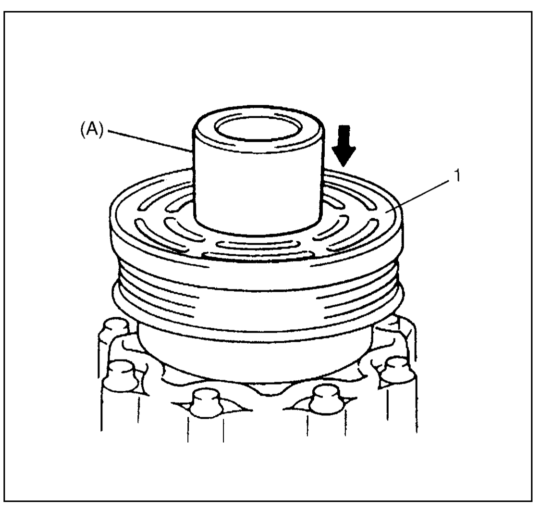
10) Remove clutch coil (2) from compressor (3).

INSTALLATION



1) Install clutch coil (2).
   Protrusion on under side of clutch coil must match hole in compressor (3) to prevent movement ant correctly locate lead wire.
2) Using special tool, install new circlip (1) as shown.

Special tool
(A) : 09900-06107

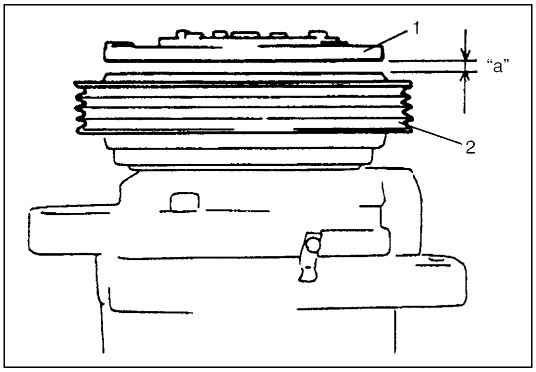


3) Install clutch pulley (1).
   a) Set clutch pulley (1) squarely over clutch pulley installation boss.
   b) Place special tool onto clutch coil bearing.
      Ensure that edge rests only on inner race of bearing.

Special tool
(A) : 09991-06010

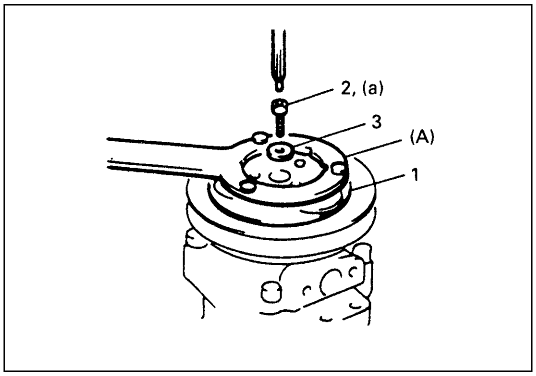
   c) Install circlip.

CAUTION:
Be careful not to scratch bearing seal.



4) Adjust clearance, between clutch plate (1) and clutch pulley (2) by putting shim on compressor shaft.

Clearance between clutch plate and clutch pulley
"a" : 0.3 – 0.6 mm (0.012 - 0.024 in.)



5) Tighten new clutch plate bolt (2) to specified torque as shown.

Tightening torque
Clutch plate bolt (a) : 14 N·m (1.4 kg-m, 10.5 lb-ft)

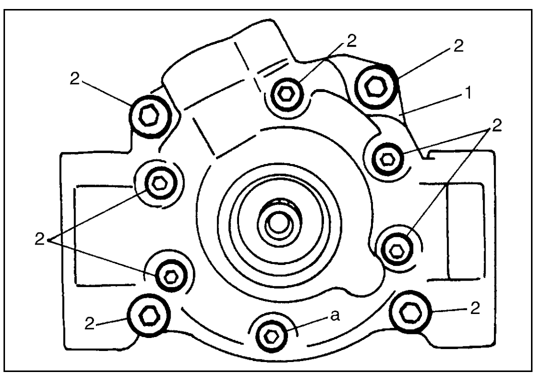
Special tool
(A) : 09991-06020

1.	Clutch plate
3.	Washer

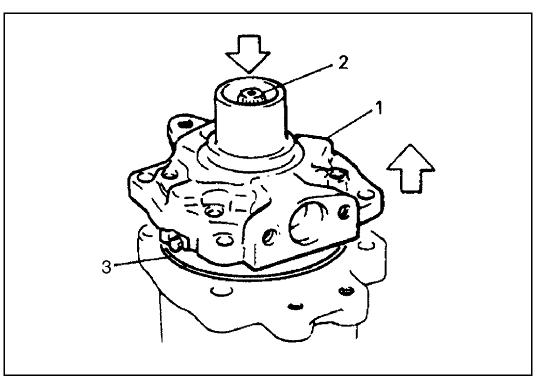
LIP TYPE SEAL

REMOVAL

1) Remove magnet clutch referring to "MAGNET CLUTCH" in this section.



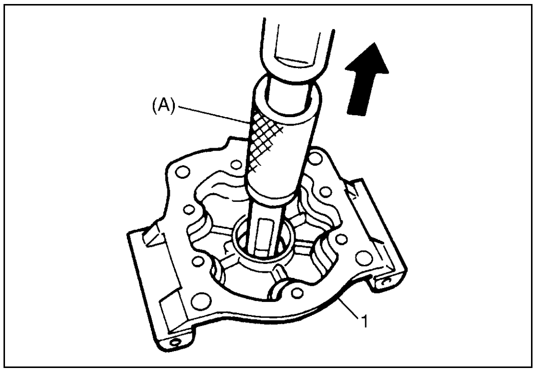
2) Remove front head (1) mounting bolts (2).



3) Remove front head (1) by pushing cylinder shaft (2).

NOTE:
Be careful not to remove cylinder from front head.

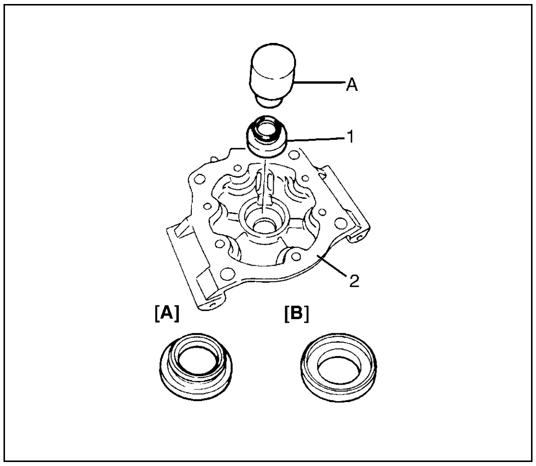
4) Remove O-ring (3).



5) Remove lip type seal from front head (1) using special tool.

Special tool
(A) : 09923-73210

INSTALLATION

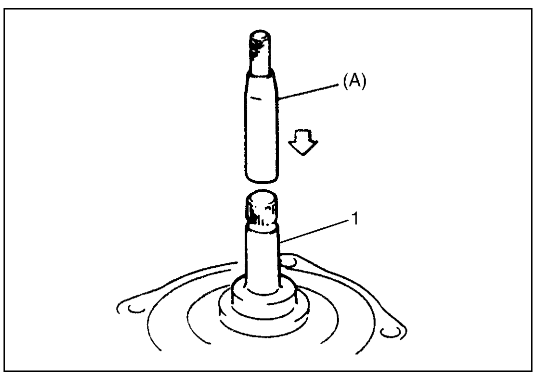


1) Press-fit new lip type seal (1) into front head (2) using special tool.

Special tool
(A) : 09991-06050

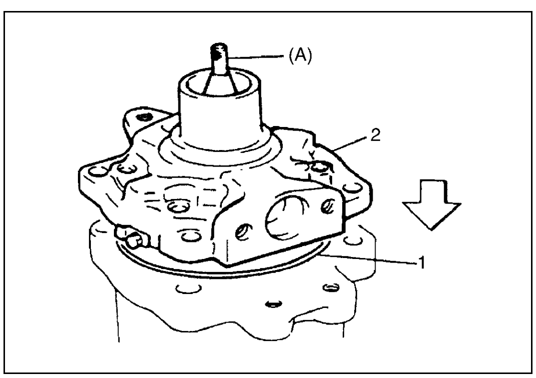
CAUTION:
Do not reuse lip type seal (1) once removed from compressor.

[A] :	Obverse side
[B] :	Back side



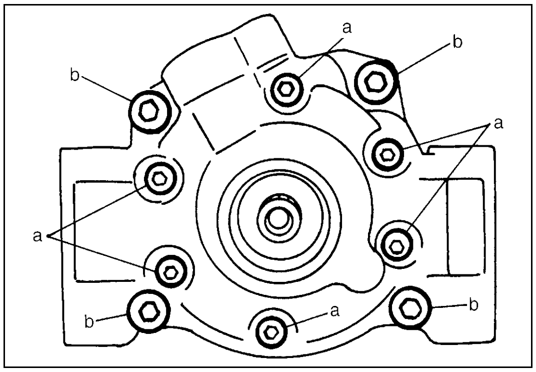
2) Coat special tool surface with oil and place it on cylinder shaft (1).

Special tool
(A) : 09991-06040



3) Install new O-ring (1) to case.
4) Apply compressor oil to lip type seal and O-ring (1).
5) Install front head (2).

Special tool
(A) : 09991-06040



6) Tighten new front head mounting bolts (a), (b).

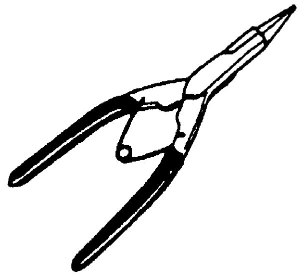
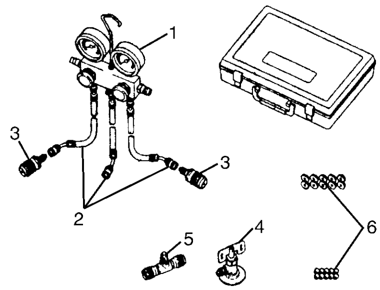
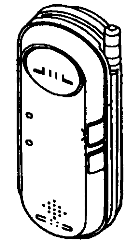
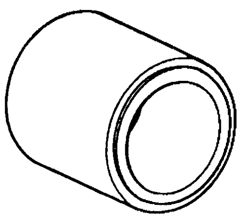
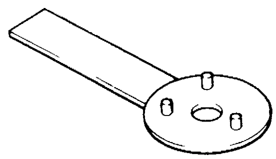
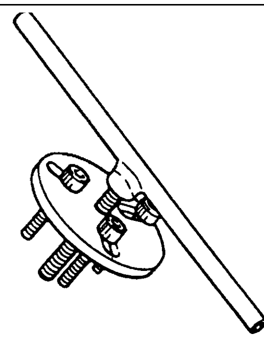
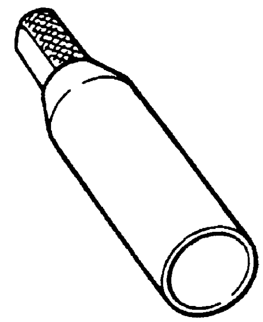
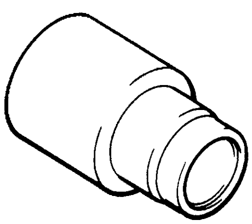
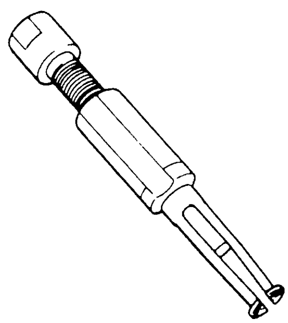
Tightening torque
Front head bolt (a) : 9 N·m (0.9 kg-m, 6.5 lb-ft)
Front head bolt (b) : 22 N·m (2.2 kg-m, 16.0 lb-ft)

NOTE:
- **Be sure to use new front head mounting bolts.**
- **Tighten bolt (a) first, and next (b).**

REQUIRED SERVICE MATERIAL

Material	Recommended SUZUKI product (Part Number)	Use
Compressor oil (Refrigerant oil)	COMPRESSOR OIL RS20 (150 cc) 99000-99088	• O-ring • Each component
Refrigerant	REFRIGERANT DRUM (200 g) 95794-50G00	• Refrigerant charge
Sealant	SUZUKI BOND No.1216B 99000-31160	• Cooling unit

SPECIAL TOOL

 09900-06107 Snap ring pliers (Opening type)	 09990-06010 Manifold gauge set See NOTE below.		 09990 -86011 Gas leak detector
 09991-06010 Magnet clutch pulley installer	 09991-06020 Armature plate spanner	 09991-06030 Armature plate remover	 09991-06040 Lip type seal protector
 09991-06050 Lip type seal installer	 09923-73210 Bearing remover		

NOTE:

This kit includes the following items.

1. Manifold gauge, 2. Changing hose, 3. Quick connector, 4. Refrigerant container tap valve,
5. Refrigerant container T joint, 6. Packing set

SECTION 3

STEERING, SUSPENSION, WHEELS AND TIRES

CONTENTS

DIAGNOSIS

GENERAL DIAGNOSIS

Since the problems in steering, suspension, wheels and tires involve several systems, they must all be considered when diagnosing a complaint. To avoid using the wrong symptom, always road test the vehicle first. Proceed with the following preliminary inspection and correct any defects which are found.

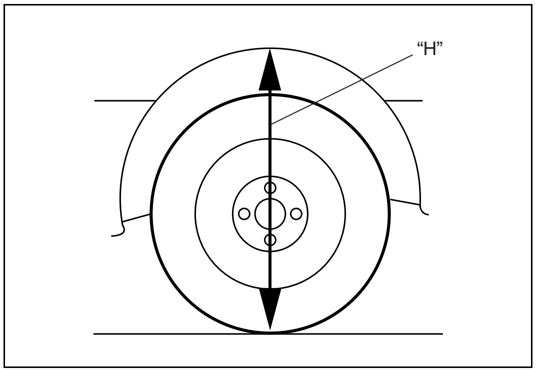
1) Inspect tires for proper pressure and uneven wear.
2) Raise vehicle on a hoist and inspect front and rear suspension and steering system for loose or damaged parts.
3) Spin front wheels. Inspect for out-of-round tires, out-of-balance tires, bent rims, loosen and/or rough wheel bearings.

DIAGNOSIS TABLE

Condition	Possible Cause	Correction
Vehicle Pulls (Leads)	Mismatched or uneven tires	Replace tire.
	Tires not adequately inflated	Adjust tire pressure.
	Broken or sagging springs	Replace spring.
	Radial tire lateral force	Replace tire.
	Disturbed front end alignment	Check and adjust front end alignment.
	Brake dragging in one road wheel	Repair brake.
	Loose, bent or broken front or rear suspension parts	Tighten or replace suspension parts.
Abnormal or Excessive Tire Wear	Sagging or broken spring	Replace spring.
	Tire out of balance	Adjust balance or replace tire.
	Disturbed front end alignment	Check and adjust front end alignment.
	Faulty strut (shock absorber)	Replace strut.
	Hard driving	Replace tire.
	Overloaded vehicle	Replace tire.
	Not rotating tire	Replace or rotate tire.
	Worn or loose wheel bearing	Replace wheel bearing.
	Wobbly wheel or tire	Replace wheel or tire.
	Tires not adequately inflated	Adjust tire pressure.
Wheel Tramp	Blister or bump on tire	Replace tire.
	Improper strut (shock absorber) action	Replace strut.
Shimmy, Shake or Vibration	Tire or wheel out of balance	Balance wheels or replace tire and/or wheel.
	Loosen wheel bearings	Replace wheel bearing.
	Worn tie rod ends	Replace tie rod end.
	Worn lower ball joints	Replace front suspension arm.
	Excessive wheel runout	Repair or replace wheel and/or tire.
	Blister or bump on tire	Replace tire.
	Excessively loaded radial runout of tire/wheel assembly	Replace tire or wheel.
	Disturbed front end alignment	Check and adjust front end alignment.
	Loose or worn steering linkage	Tighten or replace steering linkage.
	Loose steering gear case bolts	Tighten case bolts.

Condition	Possible Cause	Correction
Hard Steering	Tire not adequately inflated	Inflate tires to proper pressure.
	Malfunction of power steering system	Check and correct.
	Bind in tie rod end ball studs or lower ball joints	Replace tie rod end or front suspension arm.
	Disturbed front end alignment	Check and adjust front end alignment.
	Rack and pinion adjustment	Check and adjust rack and pinion torque.
	Bind in steering column	Repair or replace.
Too Much Play in Steering	Wheel bearings worn	Replace.
	Loose steering gear case bolts	Tighten.
	Rack and pinion adjustments	Check and adjust rack and pinion torque.
	Worn steering shaft joints	Replace joint.
	Worn tie rod ends or tie rod inside ball joints	Replace tie rod end or tie rod.
	Worn lower ball joints	Replace front suspension control arm.
Poor Returnability	Bind in tie rod end ball studs	Replace tie rod end.
	Bind in ball joints	Replace.
	Bind in steering column	Repair or replace.
	Poorly lubricated rack and pinion	Check, repair or lubricate rack and pinion.
	Disturbed front end alignment	Check and adjust front end alignment.
	Rack and pinion adjustment	Check and adjust rack and pinion torque.
	Tires not adequately inflated	Adjust tire pressure.
Rack and Pinion Noise (Rattle or Chuckle)	Loose steering gear case bolts	Tighten.
	Worn rack bush	Replace.
	Rack and pinion adjustment	Check and adjust rack and pinion torque.
Abnormal Noise, Front End	Worn, sticky or loose tie rod ends, lower ball joints, tie rod inside ball joints or drive shaft joints	Replace tie rod end, suspension arm, tie rod or drive shaft joint.
	Damaged struts or mountings	Repair or replace.
	Worn suspension arm bushings	Replace.
	Loose stabilizer bar	Tighten bolts or nuts, replace bushes.
	Loose wheel nuts	Tighten wheel nuts.
	Loose suspension bolts or nuts	Tighten suspension bolts or nuts.
	Broken or otherwise damaged wheel bearings	Replace.
	Broken suspension springs	Replace.
	Poorly lubricated or worn strut bearings	Replace strut bearing.

Condition	Possible Cause	Correction
Wander or Poor Steering Stability	Mismatched or uneven tires	Replace or inflate tires to proper pressure.
	Loosen ball joints and tie rod ends	Replace suspension arm or tie rod end.
	Faulty struts or mountings	Replace strut or repair mounting.
	Loose stabilizer bar	Tighten or replace stabilizer bar or bush.
	Broken or sagging springs	Replace spring.
	Rack and pinion adjustment	Check and adjust rack and pinion torque.
	Disturbed front end alignment	Check and adjust front end alignment.
Erratic Steering When Braking	Worn wheel bearings	Replace.
	Broken or sagging springs	Replace coil spring.
	Wheel tires are inflated unequally	Inflate tires to proper pressure.
	Disturbed front end alignment	Check and adjust front end alignment.
	Brakes not working in unison	Check and adjustment brake system.
	Leaking wheel cylinder or caliper	Repair or replace wheel cylinder or caliper.
	Warped discs	Replace brake disc.
	Badly worn brake linings	Replace brake shoe lining.
	Drum is out of round in some brakes	Replace brake drum.
	Defective wheel cylinders	Replace or repair wheel cylinder.
Low or Uneven Trim Height NOTE: See NOTE *1.	Broken or sagging springs	Replace.
	Over loaded	Check loading.
	Incorrect springs	Replace.
Ride Too Soft	Faulty struts (shock absorber)	Replace strut.
Suspension Bottoms	Overloaded	Check loading.
	Faulty struts (shock absorber)	Replace strut.
	Incorrect, broken or sagging springs	Replace.
Body Leans or Sways in Corners	Loose stabilizer bar	Tighten stabilizer bar bolts or nuts, or replace bushes.
	Faulty struts (shock absorbers) or mountings	Replace strut or tighten mounting.
	Broken or sagging springs	Replace.
	Overloaded	Check loading.
Cupped Tires	Front struts defective	Replace.
	Worn wheel bearings	Replace.
	Excessive tire or wheel run-out	Replace tire or wheel disc.
	Worn ball joints	Replace front suspension arm.
	Tire out of balance	Adjust tire balance.

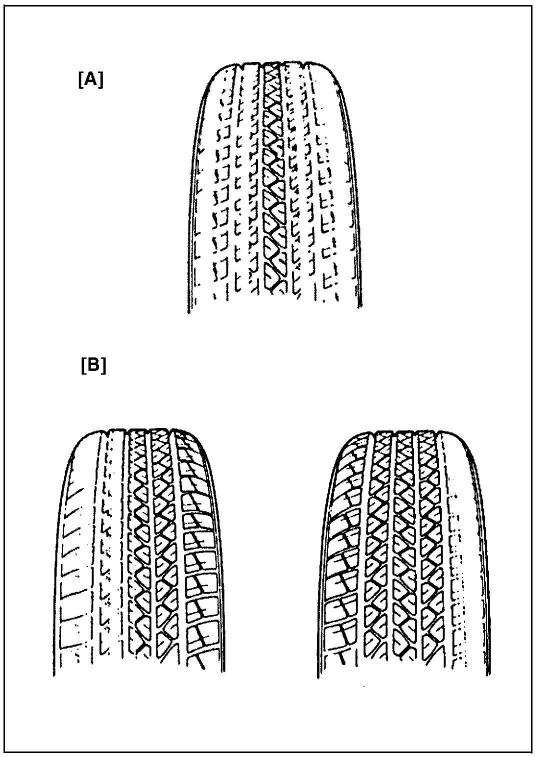


NOTE:

***1: Right-to-left trim height ("H") difference should be within 15 mm (0.6 in.) with curb weight. (same with rear side.)**

TIRE DIAGNOSIS

IRREGULAR AND/OR PREMATURE WEAR



Irregular and premature wear has many causes. Some of them are: incorrect inflation pressures, lack of tire rotation, driving habits, improper alignment.

If the following conditions are noted, rotation is necessary:

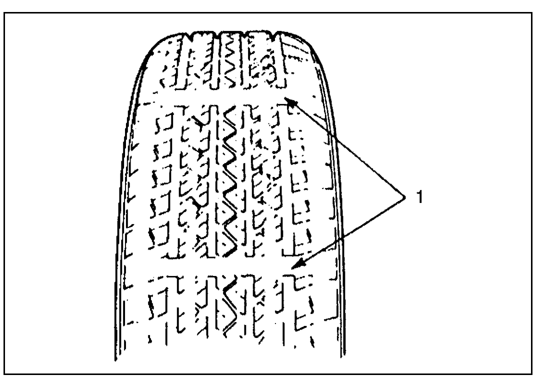
- Front tire wear is different from rear.
- Uneven wear exists across the tread of any tire.
- Front tire wear is unequal between the right and left.
- Rear tire wear is unequal between the right and left.
- There is cupping, flat spotting, etc.

A wheel alignment check is necessary if following conditions are noted:

- Front tire wear is unequal between the right and left.
- Wear is uneven across the tread of any front tire.
- Front tire treads have scuffed appearance with "feather" edges on one side of tread ribs or blocks.

[A] :	Hard Cornering, under inflation or lack of tire rotation
[B] :	Incorrect wheel alignment, tire construction not uniform or wheel heavy acceleration

WEAR INDICATORS

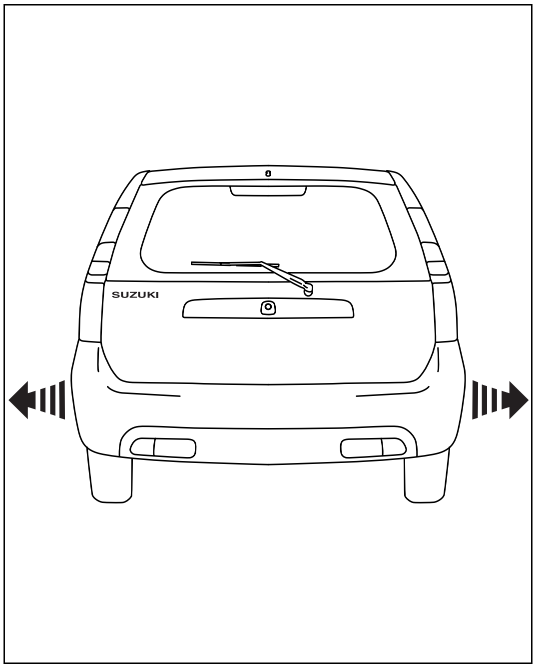


Original equipment tires have built-in tread wear indicators (1) to show when they need replacement.

These indicators (1) will appear as 12 mm (0.47 in) wide bands when the tire tread depth becomes 1.6 mm (0.063 in).

When the indicators (1) appear in 3 or more grooves at 6 locations, tire replacement is recommended.

RADIAL TIRE WADDLE



Waddle is side to side movement at the front and/or rear of the vehicle. It is caused by the steel belt not being straight within the tire. It is most noticeable at a low speed, 8 to 48 kph (5 to 30 mph).
It is possible to locate the faulty tire by road testing the vehicle. If it is on the rear, the rear end of the vehicle shakes from side to side or “waddles”. To the driver in the seat, it feels as though someone is pushing on the side of vehicle.
If the faulty tire is on the front, waddling is more visual. The front sheet metal appears to be moving back and forth and the driver feels as though he is at the pivot point in vehicle.
Waddle can be quickly diagnosed by using Tire Problem Detector (TPD) and following the equipment manufacture’s recommendations.
If TPD is not available, an alternative method of substituting known-good tire/wheel assemblies can be used as follows, although it takes a longer time.

1) Ride vehicle to determine whether the front or rear waddles.
2) Install tires and wheels that are known to be good (on similar vehicle) in place of those on waddling end of vehicle. If waddling end cannot be identified, substitute rear ones.
3) Road test again. If improvement is noted, reinstall originals one at a time till waddle causal tire is found. If no improvement is noted, install known-good tires in place of all four. Then reinstall originals in the same manner as above.

EQUIPMENT MANUFACTURE’S RECOMMENDATIONS

In flate tires to recommended pressure

Road test vehicle on level unrowned road in both directions

Switch front tires side to side and road test again

- Leads in same direction
  - Put tires back in original position and check alignment
- Lead corrected, if roughness results, replace tires
- Leads reverses direction
  - Install a known-good tire on one front side
    - Lead corrected replace tire
    - Lead remains install a known-good tire in place of other front tire
      - Lead corrected replace tire
      - Lead remains known-good tires are not good

RADIAL TIRE LEAD

"Lead" is the deviation of the vehicle from a straight path on a level rod even with no pressure on the steering wheel.

Lead is usually caused by:

- Incorrect alignment.
- Uneven brake adjustment.
- Tire construction.

The way in which a tire is built can produce lead in a vehicle. An example of this is placement of the belt. Off center belts on radial tires can cause the tire to develop a side force while rolling straight down the road. If one side of the tire has a little larger diameter than the other, the tire will tend to roll to one side. This will develop a side force which can produce vehicle lead.

The procedure in above figure (Lead Diagnosis) should be used to make sure that front alignment is not mistaken for tire lead.

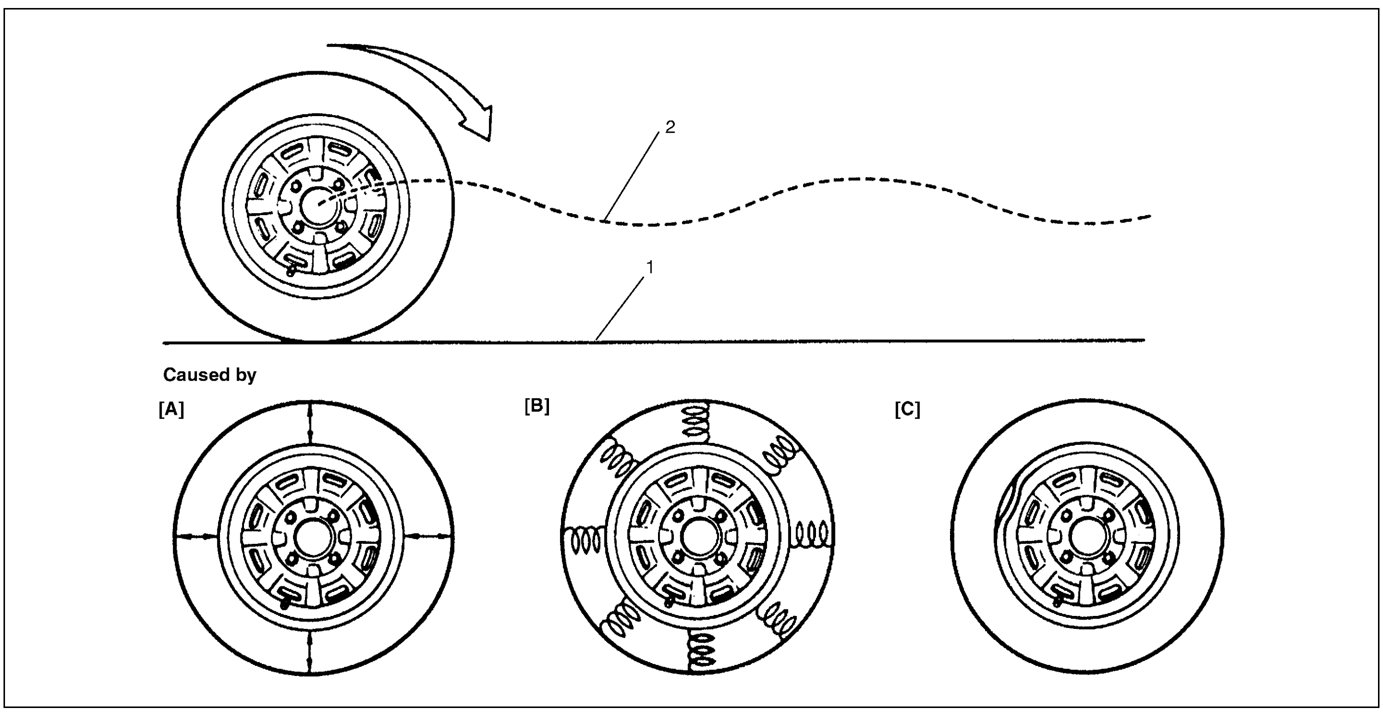
- Part of the lead diagnosis procedure is different from the proper tire rotation pattern currently in the owner and service manuals. If a medium to high mileage tire is moved to the other side of the vehicle, be sure to check that ride roughness has not developed
- Rear tires will not cause lead.

VIBRATION DIAGNOSIS

Wheel unbalance causes most of the highway speed vibration problems. If a vibration remains after dynamic balancing, its possible causes are as follows.

- Tire runout.
- Wheel runout.
- Tire stiffness variation.

Measuring tire and/or wheel free runout will uncover only part of the problem. All three causes, known as loaded radial runout, must be checked by using a Tire Problem Detector (TPD). If TPD is not available, alternative method of substituting known-good tire and wheel assemblies on the problem vehicle can be used, although it takes a longer time.



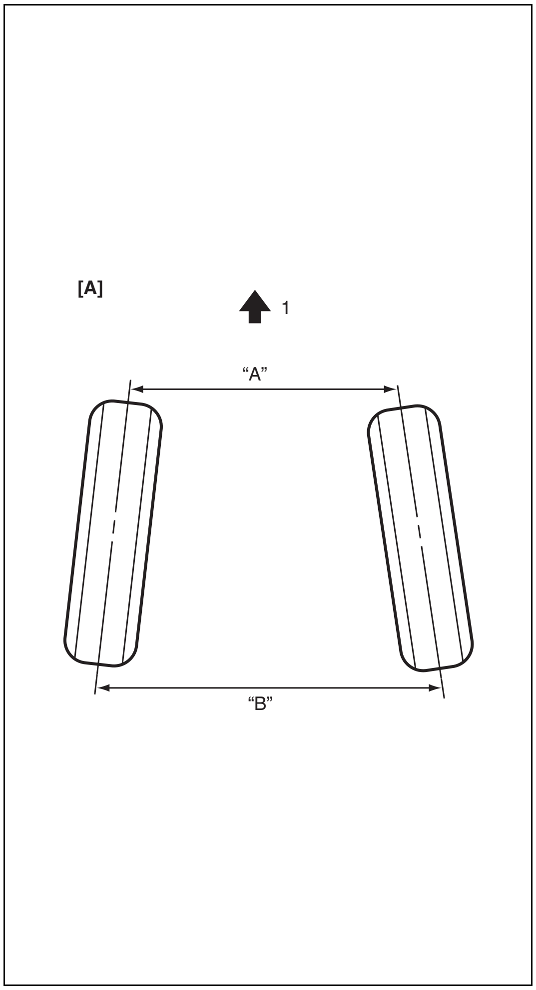
[A] : Tire out of round	1. Smooth road
[B] : Tire stiffness variation	2. Suspension movement (loaded runout)
[C] : Rim bent or out of round	

SECTION 3A

FRONT END ALIGNMENT

CONTENTS

GENERAL DESCRIPTION



Front alignment refers to the angular relationship between the front wheels, the front suspension attaching parts and the ground. Generally, the only adjustment required for front alignment is toe setting.
Camber and caster can't be adjusted. Therefore, should camber or caster be out of specification due to the damage caused by hazardous road conditions or collision, whether the damage is in body or in suspension should be determined. If the body is damaged, it should be repaired and if suspension is damaged, it should be replaced.

TOE SETTING

Toe is the turning in or out of the front wheels. The purpose of a toe specification is to ensure parallel rolling of the front wheels (Excessive toe-in or toe-out may increase tire wear).

Toe-in
"B"-"A" : 0 ± 1 mm (0 ± 0.039 in.)

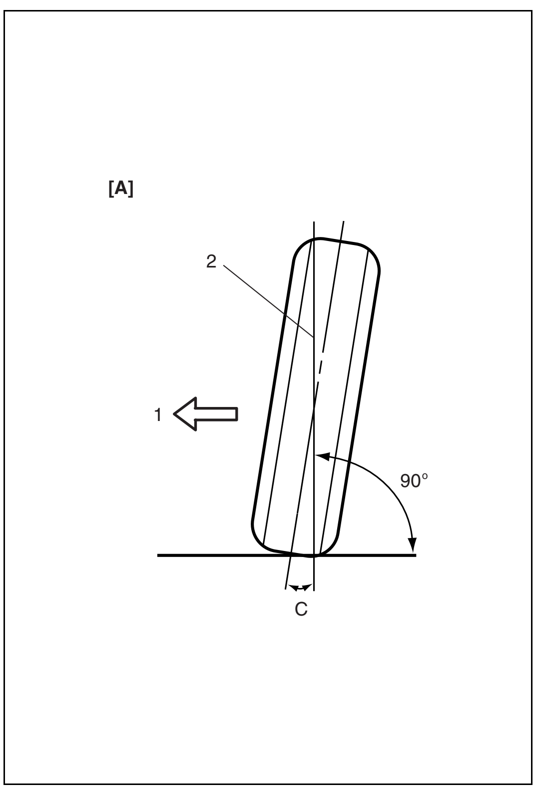
NOTE:

Toe-in value was measured by using a toe-in gauge.

For adjusting toe setting, refer to "TOE ADJUSTMENT" in this section.

[A]:	Wheel top view
1.	Forward

CAMBER



Camber is the tilting of the front wheels from the vertical, as viewed from the front of the vehicle. When the wheels tilt outward at the top, the camber is positive. When the wheels tilt inward at the top, the camber is negative. The amount of tilt is measured in degrees.

Camber "C"
2WD vehicle : –0° 20' ± 1°
4WD vehicle : 0° ± 1°

ALIGNMENT SERVICE DATA (REFERENCE)

Caster
2WD vehicle : 3° 25' ± 2°
4WD vehicle : 3° 35' ± 2°

Kingpin inclination
2WD vehicle : 12° 40' ± 2°
4WD vehicle : 12° 15' ± 2°

1. Body center	[A]: Front view
2. Center line of wheel	

DIAGNOSIS

DIAGNOSIS TABLE

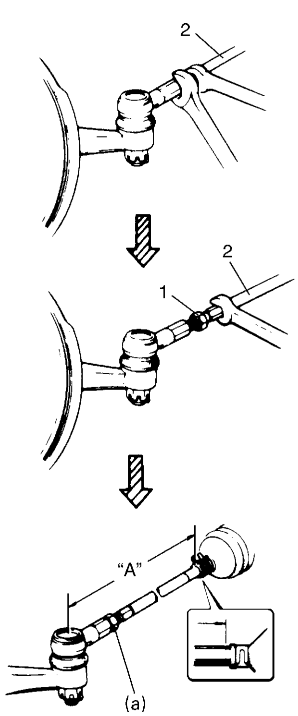
For the details, refer to Section 3.

PRELIMINARY CHECKS PRIOR TO ADJUSTING FRONT ALIGNMENT

Steering and vibration complaints are not always the result of improper alignment. An additional item to be checked is the possibility of tire lead due to worn or improperly manufactured tires. “Lead” is the deviation of the vehicle from a straight path on a level road without hand pressure on the steering wheel. Procedure for determining the presence of a tire lead problem contains in SECTION 3. Before making any adjustment affecting toe setting, the following checks and inspections should be made to ensure correctness of alignment readings and alignment adjustments:

1) Check all tires for proper inflation pressures and approximately the same tread wear.
2) Check for loose of ball joints. Check tie rod ends; if excessive looseness is noted, it must be corrected before adjusting.
3) Check for run-out of wheels and tires.
4) Check vehicle trim heights; if out of limits and a correction is to be made, it must be made before adjusting toe.
5) Check for loose of suspension arms.
6) Check for loose or missing stabilizer bar attachments.
7) Consideration must be given to excess loads, such as tool boxes. If this excess load is normally carried in vehicle, it should remain in vehicle during alignment checks.
8) Consider condition of equipment being used to check alignment and follow manufacturer's instructions.
9) Regardless of equipment used to check alignment, vehicle must be on a level surface both fore and aft and transversely.

TOE ADJUSTMENT



1) Loosen right and left tie rod end lock nuts (1) first.
2) Rotate right and left tie rods (2) by the same amount to align toe-in to specification. In this adjustment, right and left tie rods (2) should become equal in length “A”.

NOTE:

Before rotating tie rods (2), apply grease between tie rods and rack boots so that boots won't be twisted.

3) After adjustment, tighten lock nuts (1) to specified torque.

Tightening torque
Tie rod end lock nuts (a) : 45 N·m (4.5 kg-m, 32.5 lb-ft)

NOTE:

Make sure that rack boots are not twisted.

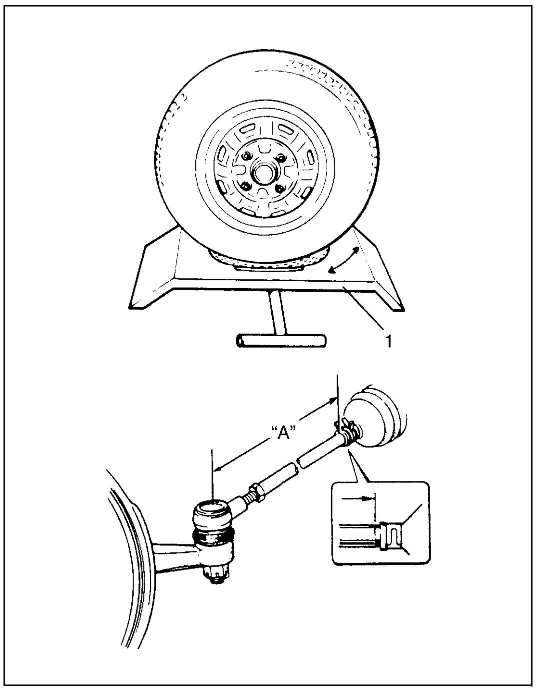
CAMBER AND CASTER CHECK AND ADJUSTMENT

Should camber or caster be found out of specifications upon inspection, locate its cause first.
If it is in damaged, loose, bent, dented or worn suspension parts, they should be replaced.
If it is in vehicle body, repair it so as to attain specifications.

NOTE:

To prevent possible incorrect reading of camber or caster, vehicle front end must be moved up and down a few times before inspection.

STEERING ANGLE CHECK AND ADJUSTMENT



When tie rod or tie rod end was replaced, check toe and then also steering angle with turning radius gauge (1).
If steering angle is not correct, check if right and left tie rods are equal in length "A".

NOTE:

If tie rod lengths were changed to adjust steering angle, reinspect toe-in.

Steering angle
Inside : 35° ± 3°
Outside : 31° ± 3°

SIDE SLIP (REFERENCE)

For inspecting front wheel side slip with side slip tester:

Side slip limit
IN : 2 mm/m (0.079 in/3.3 ft)
OUT : 1 mm/m (0.039 in/3.3 ft)

If side slip exceeds above limit, toe-in or front wheel alignment may not be correct.

SECTION 3B

MANUAL RACK AND PINION

WARNING:

For vehicles equipped with a Air Bag System

- **Service on or around air bag system components or wiring must be performed only by an authorized suzuki dealer. Please observe all WARNINGS and CAUTIONS in SECTION 10B and Precautions, Air Bag System Components and Wiring Location view in Section 10B before performing service on or around air bag system components or wiring. Failure to follow WARNINGS could result in unintended activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.**
- **Technical service work must be started at least 90 seconds after the ignition switch is turned to the "LOCK" position and the negative cable is disconnected from the battery. Otherwise, the system may be deployed by reserve energy in the Sensing and Diagnostic Module (SDM).**

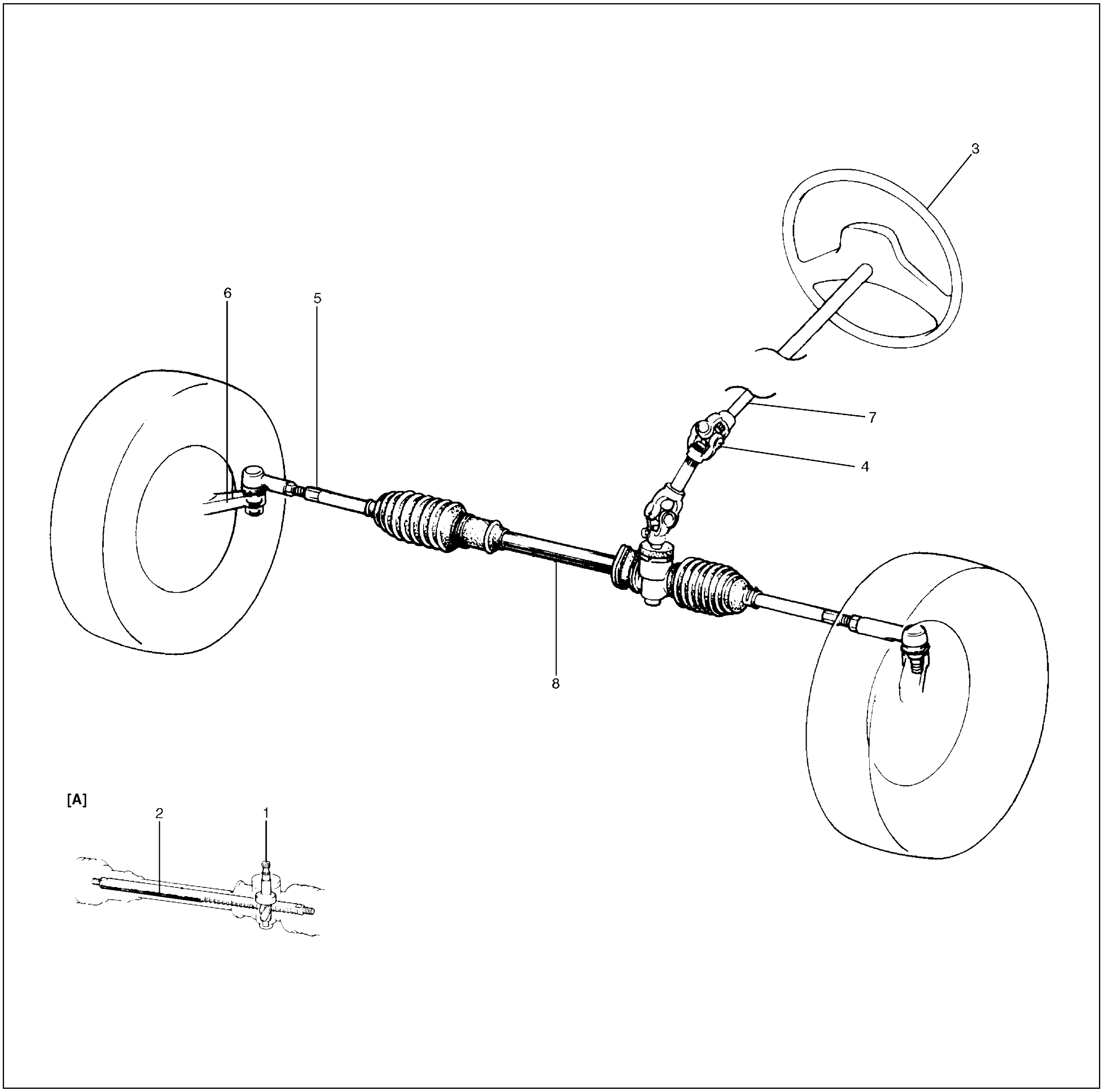
NOTE:

All steering gear fasteners are important attaching parts in that they could affect the performance of vital parts and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.

CONTENTS

GENERAL DESCRIPTION

The rack and pinion steering system consists of two components, the rack (2) and the pinion (1). When the steering wheel (3) is turned, the motion is transmitted to the steering shaft joint (4) and then to the pinion.
Since the pinion teeth mesh with teeth on rack, the motion is further transferred to the rack and changed to linear motion. The force is then transmitted through the tie rods (5) to the steering knuckles (6) which turn wheels.

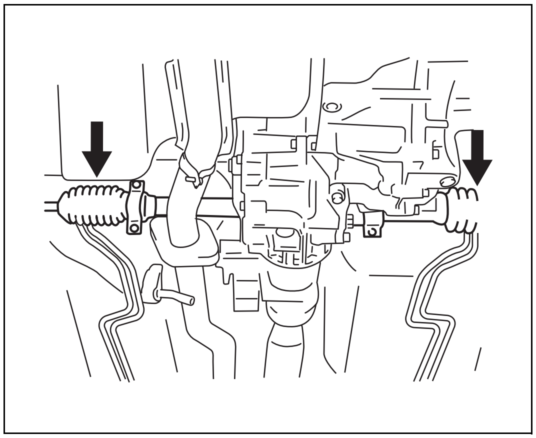


7.	Steering shaft
8.	Steering gear case
[A]:	Rack and Pinion

DIAGNOSIS

DIAGNOSIS TABLE

Refer to Section 3.

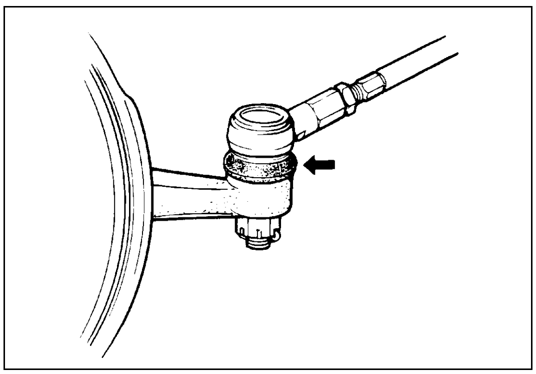


STEERING RACK BOOT CHECK

Hoist vehicle.
Inspect each boot for tear. A torn boot allows entry of dust and water which can cause wear to steering rack and pinion to produce noise as well as rust to result in malfunction of steering system.
If even a small tear is noted, replace with new one.

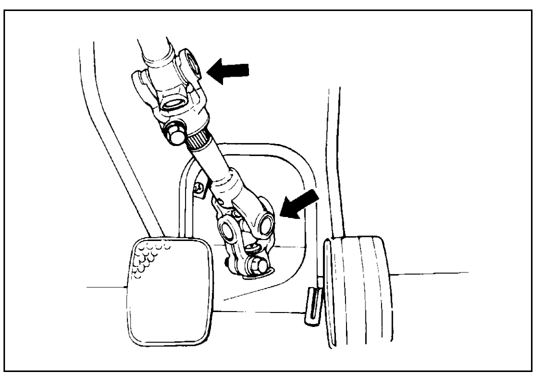
Boots should be visually inspected for any damage and tear during every periodical inspection at specified intervals and whenever vehicle is hoisted for any other purpose.

TIE ROD END BOOTS CHECK



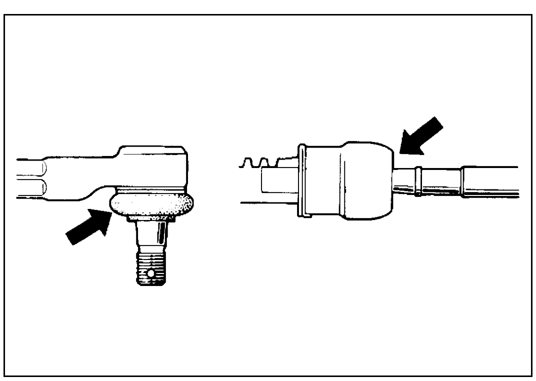
Inspect each boot for tear. If even a small tear is noted, replace with new one.

STEERING SHAFT JOINT CHECK

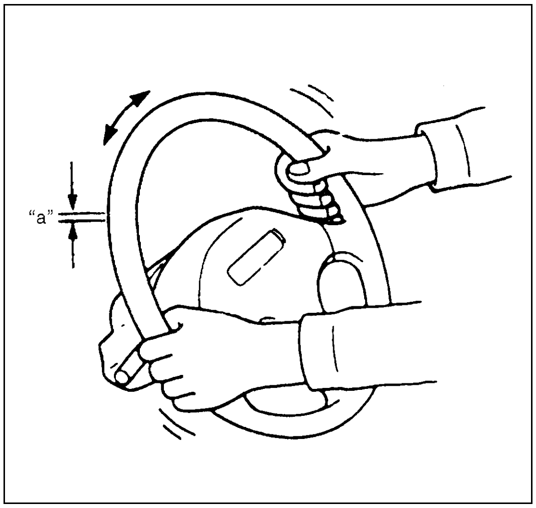


Check shaft joint for wear, breakage and other damage and replace if any defect exists.

THE ROD END CHECK



1) Inspect for play in ball joint.
2) Inspect for play in rack end ball joint.
   In either case, if found defective, replace.



STEERING WHEEL CHECK

Check steering wheel for play and rattle, holding vehicle in straight forward condition on the ground.

Steering wheel play
"a" : 0 – 30 mm (0 – 1.1 in.)

If steering wheel play is not within specification, inspect as follows and replace if found defective.

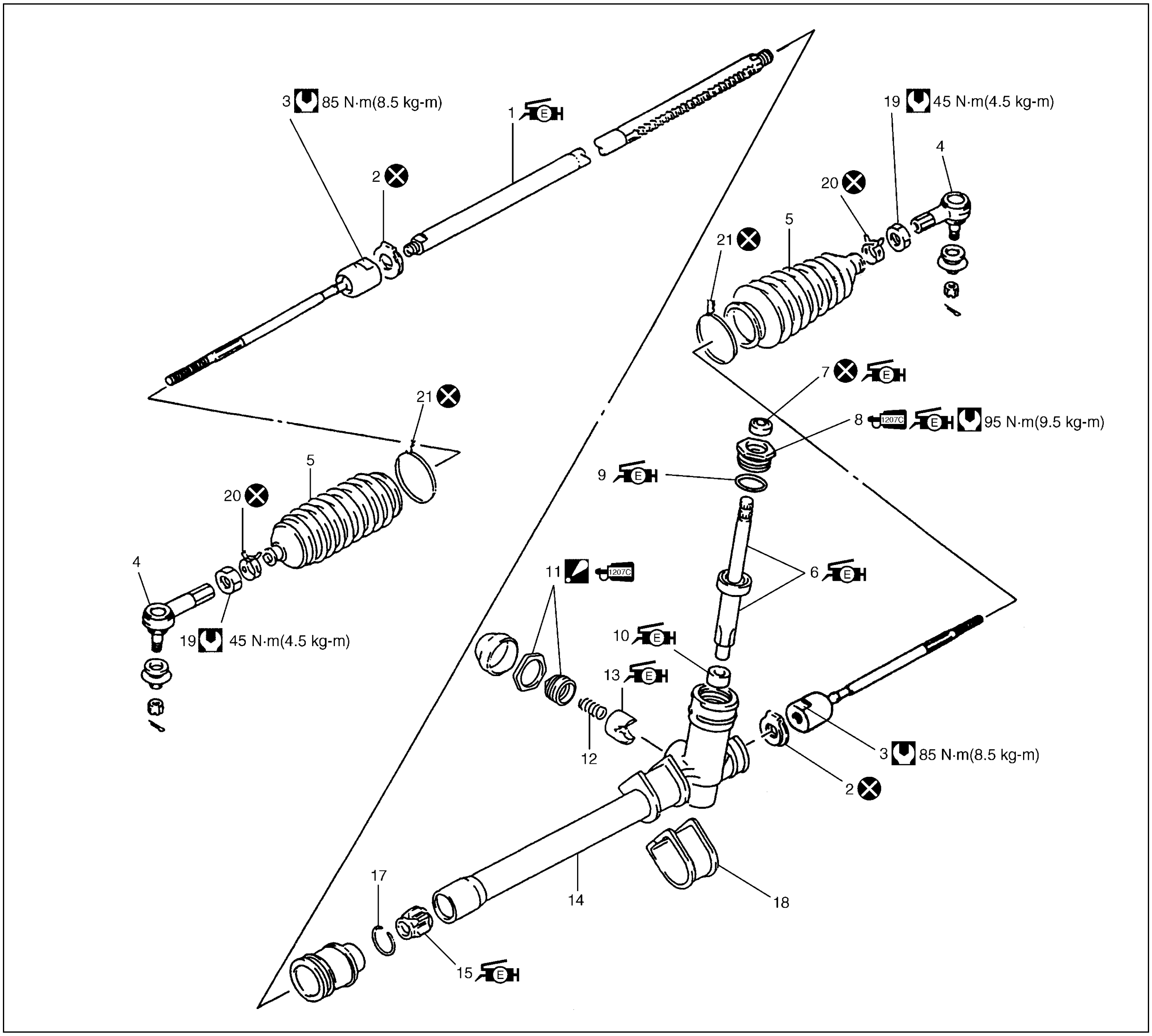
- Tie-rod end ball stud for wear (ball stud should move when more than 2 kg-cm torque is applied.)
- Lower ball joint for wear
- Steering shaft joint for wear
- Steering pinion or rack gear for wear or breakage
- Each part for looseness

ON-VEHICLE SERVICE

LUBRICATION

When inner parts of the steering gear case were disassembled, they should be washed clean before reassembly. It is recommended to use the grease as given below where grease application is indicated in the text.

✱ SUZUKI SUPER GREASE (E) 99000-25050, or Lithium grease (applicable for –40°C ~ 130°C or 104°F ~ 266°F)

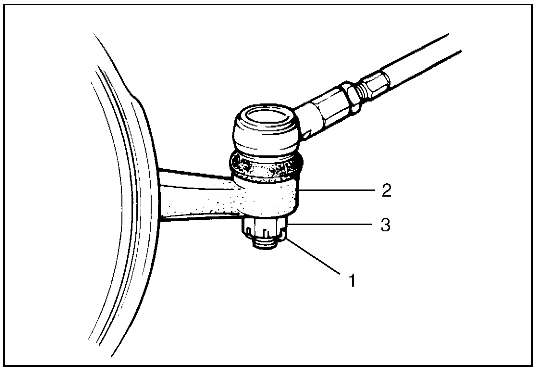


	1. Steering rack : Apply grease 9900-25050 to teeth surface of rack.		12. Rack plunger spring
	2. Tie rod lock washer		13. Steering rack plunger : Apply grease 99000-25050 to sliding part of plunger.
	3. Steering tie rod		14. Steering rack housing and gear case
	4. Tie rod end		15. Steering rack bushing : Apply grease 99000-25050 to lightly to entire surface of bushing.
	5. Boot		17. Snap ring
	6. Steering pinion : Apply grease 99000-25050 to pinion shaft.		18. Steering pinion side mount
	7. Steering gear case oil seal : Apply grease 99000-25050 to oil seal lip.		19. Tie rod end lock nut
1207C	8. Pinion bearing plug : Apply grease 99000-25050 to inside of pinion bearing plug. : Apply sealant No. 1207C 99000-31150 to plug thread.		20. Rack boot clip
	9. O-ring : Apply grease 99000-25050 to O-ring		21. Wire
	10. Steering pinion needle bearing : Apply grease 99000-25050 to rollers of bearing.		Tightening torque
1207C	11. Rack damper screw : Tighten rack damper screw so that rotation torque becomes as specified. : Apply sealant No. 1207C 99000-31150 to all around thread part of rack damper screw.		Do not reuse.

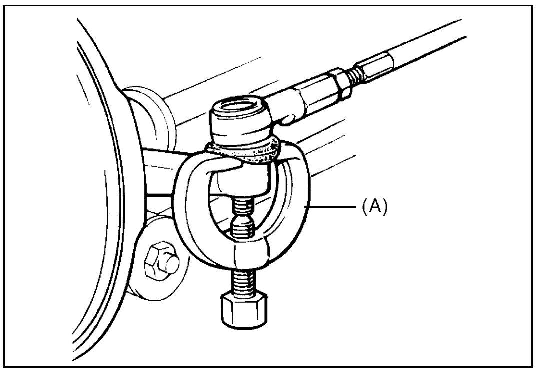
TIE ROD END

REMOVAL

1) Hoist vehicle and remove wheel.

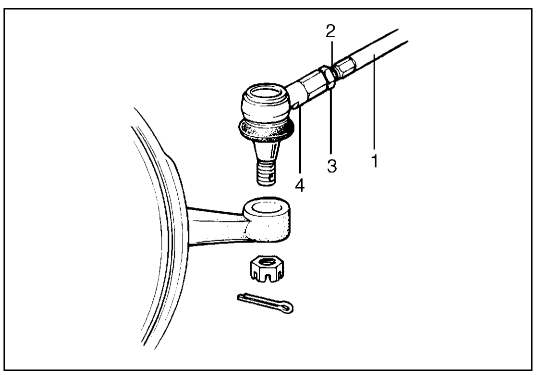


2) Remove split pin (1) and tie rod end castle nut (3) from steering knuckle (2).



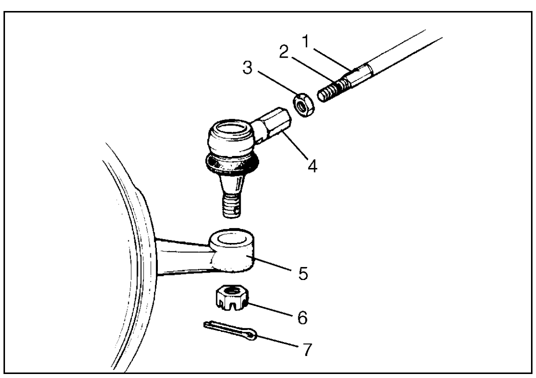
3) Disconnect tie rod end from knuckle, using special tool.

Special tool
(A) : 09913-65210



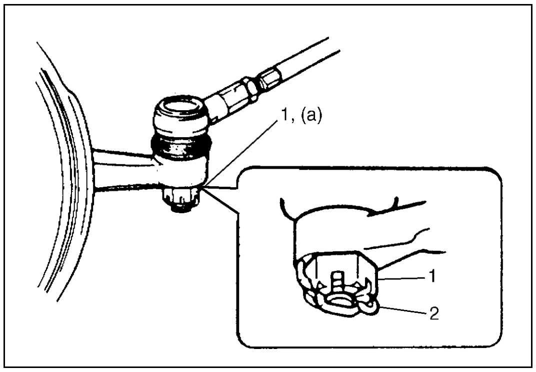
4) For ease of adjustment after installation, make marking (2) of tie rod end lock nut (3) position on tie rod end thread. Then loosen lock nut and remove tie rod end (4) from tie rod (1).

INSTALLATION



1) Install tie rod end lock nut (3) and tie rod end (4) to tie rod (1). Align lock nut with mar (2) on tie rod thread.

5. Knuckle
6. Castle nut
7. Split pin



2) Connect tie rod end to knuckle. Tighten castle nut (1) until holes for split pin (2) are aligned, but only within specified torque.

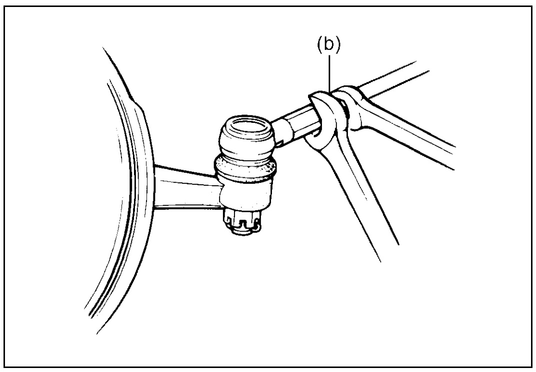
Tightening torque
Castle nut (a) : 43 N·m (4.3 kg-m, 31.5 lb-ft)

3) Bend new split pin as shown.

4) Tighten wheel nuts to specified torque and lower hoist.

Tightening torque
Wheel nut : 85 N·m (8.5 kg-m, 61.5 lb-ft)

5) Inspect for proper toe (Refer to Section 3A).



6) After confirming proper toe, tighten tie rod end lock nut to specified torque.

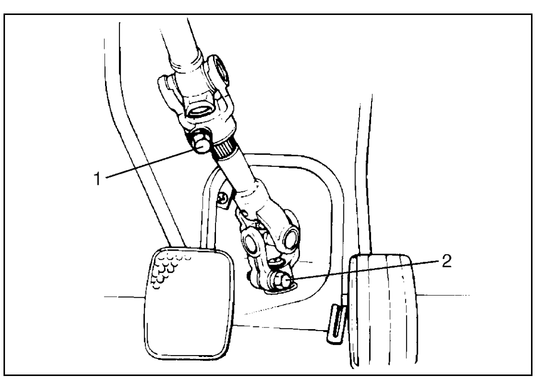
Tightening torque
Tie rod end lock nut (b) : 45 N·m (4.5 kg-m, 32.5 lb-ft)

MANUAL RACK AND PINION ASSEMBLY (STEERING GEAR CASE)

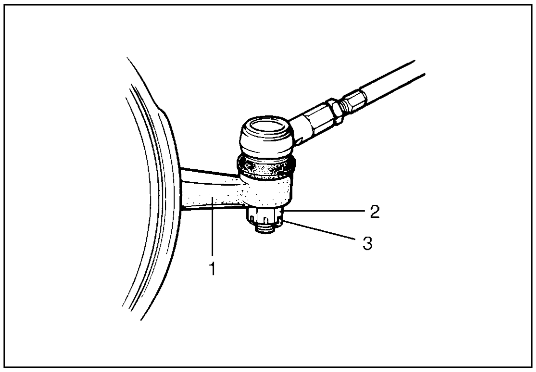
REMOVAL

CAUTION:
Be sure to set front wheels in straight direction and remove ignition key from key cylinder before these steps, otherwise contact coil of air bag system may get damaged.

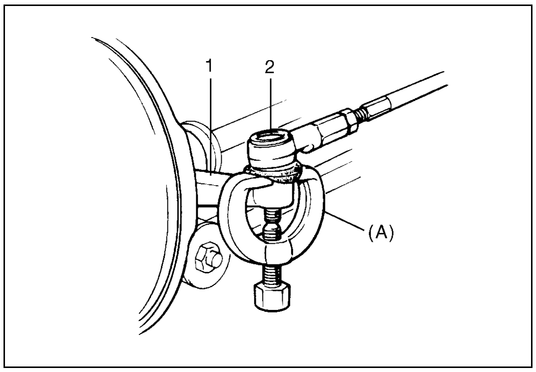
1) Slide driver's seat as far back as possible.
2) Pull off front part of floor mat on driver's side and remove steering shaft joint cover.



3) For ease of installation, loosen steering shaft upper joint bolt (1) but don't remove.
4) Remove steering shaft lower joint bolt (2) and disconnect lower joint from pinion.

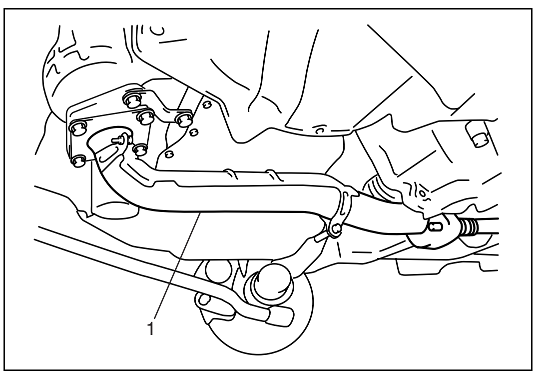


5) Hoist vehicle and remove both wheels.
6) Remove split pins (3) and tie rod castle nuts (2) from both knuckles (1).

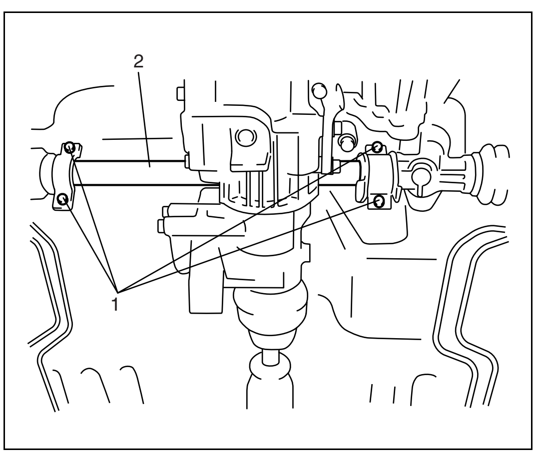


7) Disconnect both tie rod ends (2) from knuckles (1), using special tool.

Special tool
(A) : 09913-65210



8) Remove exhaust No.1 pipe (1).
9) For ease of adjustment after installation, make marking of tie rod end lock nut position on tie rod end thread. Then loosen lock nut and remove tie rod end.

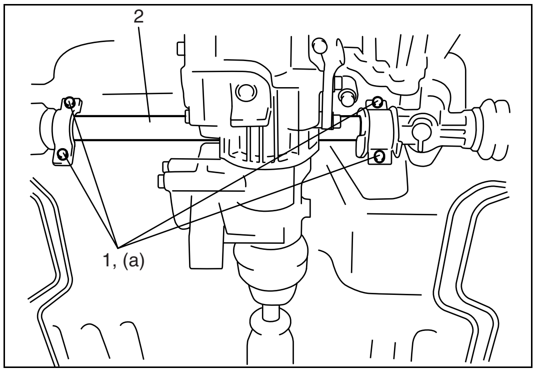


10) Remove steering gear case mount bolts (1) and gear case brackets, then remove gear case (2).

NOTE:

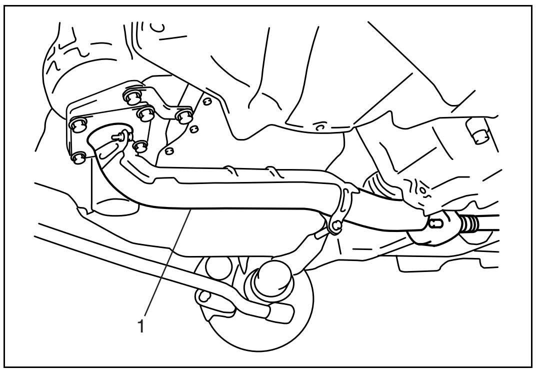
For right-hand steering 4WD vehicle, before removing steering gear case, remove transfer assembly referring to Section 7D if necessary.

INSTALLATION

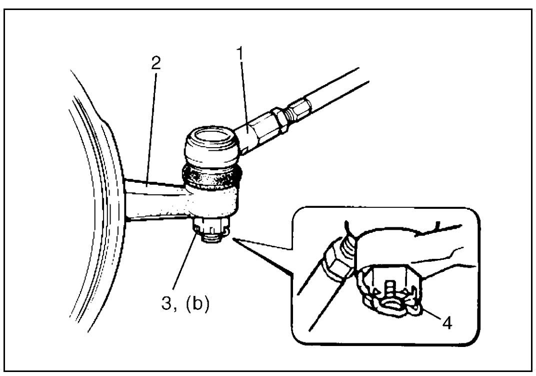


1) Mount steering gear case (2) to body and tighten gear case mount bolts (1) to specified torque.

Tightening torque
Gear case mount bolt (a) : 25 N·m (2.5 kg-m, 18.0 lb-ft)



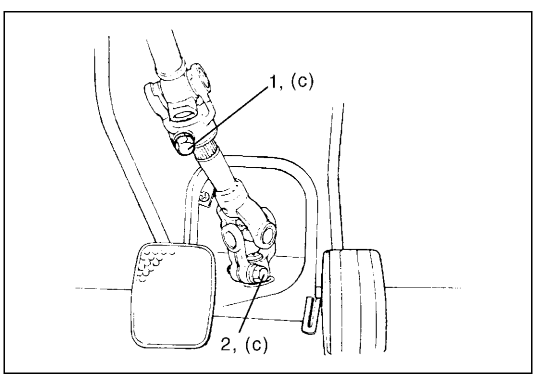
2) Install exhaust No.1 pipe (3).



3) Install both tie rod ends (1) to knuckles (2). Tighten each castle nut (3) until holes for split pin (4) align but within specified torque and then bend new split pin as shown.

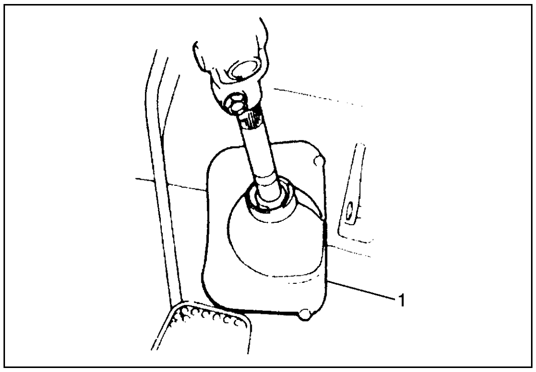
Tightening torque
Castle nut (b) : 43 N·m (4.3 kg-m, 31.5 lb-ft)

4) Be sure that steering wheel and both brake discs are all straight ahead driving state and then insert steering lower joint into steering pinion shaft.



5) Tighten steering shaft joint bolts to specified torque (Lower side (2) first and then upper side (1)).

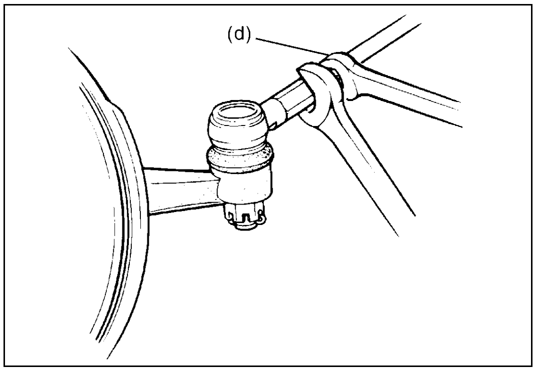
Tightening torque
Steering shaft joint bolt (c) : 25 N·m (2.5 kg-m, 18.0 lb-ft)



6) Reinstall cover (1) removed previously to steering shaft joint.
7) Put back floor mat as it was.
8) Install both wheels and tighten wheel nuts to specified torque.

Tighting torque
Wheel nut : 85 N·m (8.5 kg-m, 61.5 lb-ft)

9) Lower hoist.
10) Check toe setting. Adjust as required (refer to Section 3A).



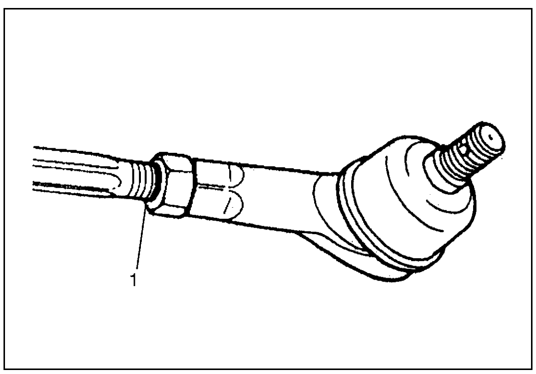
11) Tighten both tie rod end lock nuts to specified torque.

Tightening torque
Tie rod end lock nut (d) : 45 N·m (4.5 kg-m, 32.5 lb-ft)

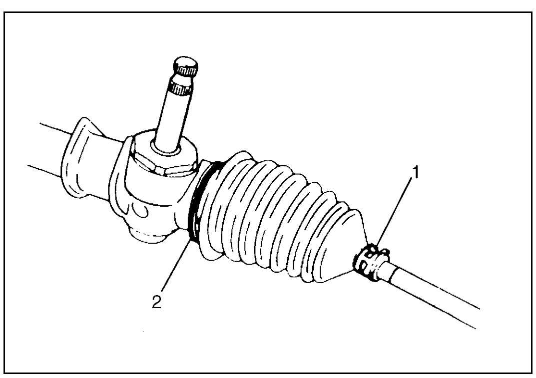
RACK BOOT/TIE ROD

REMOVAL

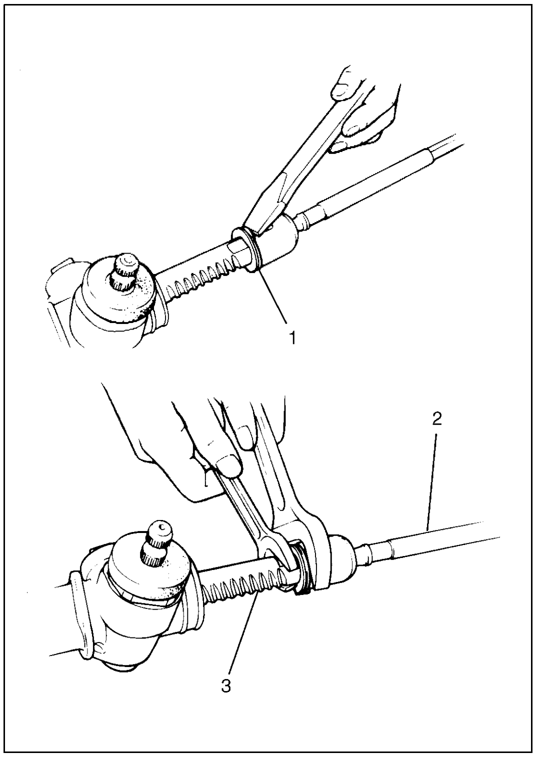
1) Remove steering gear case by performing “MANUAL RACK AND PINION ASSEMBLY REMOVAL” of this section.



2) For ease of adjustment after installation, make marking (1) of tie rod end lock nut position of tie rod end thread.
3) Loosen tie rod end lock nut and remove tie rod end.

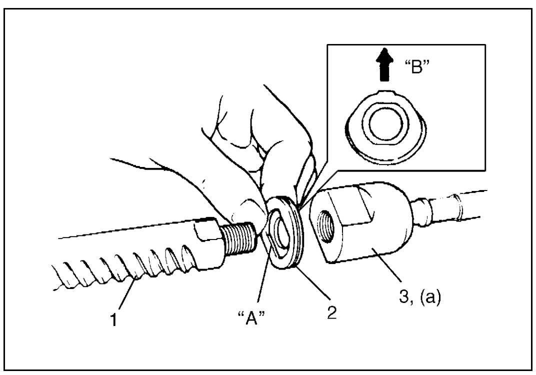


4) Remove boot wire (2) and clip (1).
5) Remove boot from tie rod.



6) Unbend bent part of tie rod lock washer (1) and remove tie rod (2) from rack (3).

INSTALLATION



1) Install new tie rod lock washer (2) and tie rod (3) to rack (1). Align straight part "A" of washer with flat part "B" of rack.

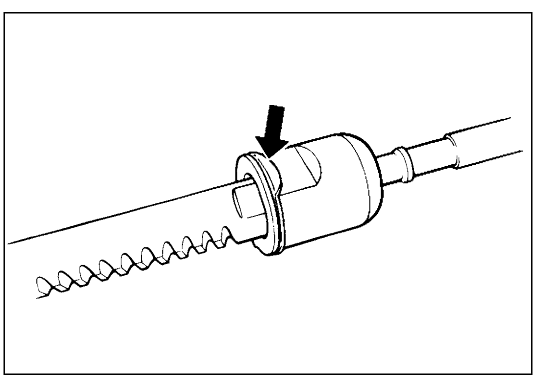
NOTE:

For correct installation of tie rod lock washer, referring to the figure.

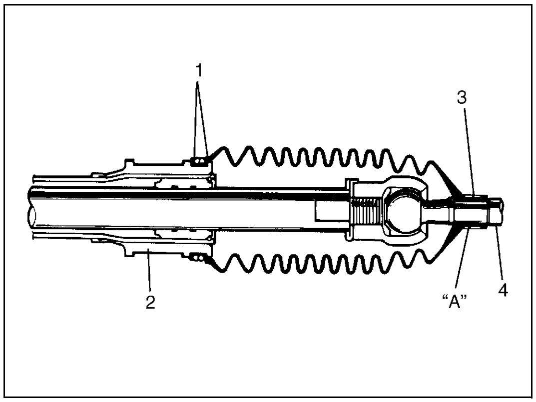
"B": Upper

2) Tighten tie rod inside ball nut to specified torque.

Tightening torque
Tie rod inside ball nut (a) : 85 N·m (8.5 kg-m, 61.5 lb-ft)

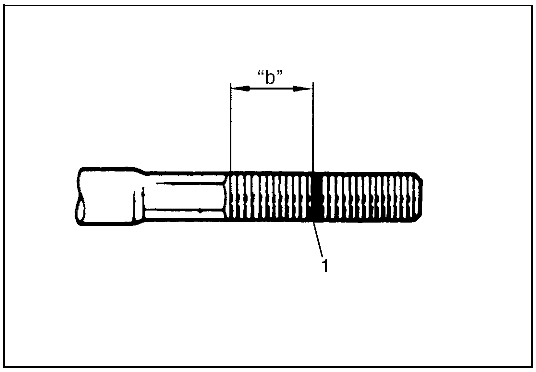


3) Bend new lock washer to tie rod side as shown.



4) Position boot properly in grooves of gear case and tie rod (4) and clamp it with wire (1) and clip (3).
   Wire should be new and should go around twice and be tightened with its both ends twisted together. The twisted ends should be bent in the circumferential direction.
   After this, check to ensure that boot is free from twist and dent.

2.	Rack side mount
"A":	Apply grease here.



5) Install tie rod end lock nut and tie rod end to tie rod.
   Position lock nut to marking (1) made in removal.

NOTE:

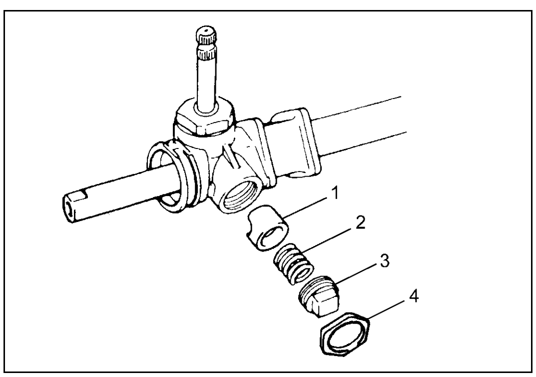
When tie rod end was replaced, measure length "b" on removed tie rod end and use it on new replacement tie rod end so as to position lock nut properly.

6) Install steering gear case referring to "MANUAL RACK AND PINION ASSEMBLY INSTALLATION" of this section.

STEERING RACK PLUNGER

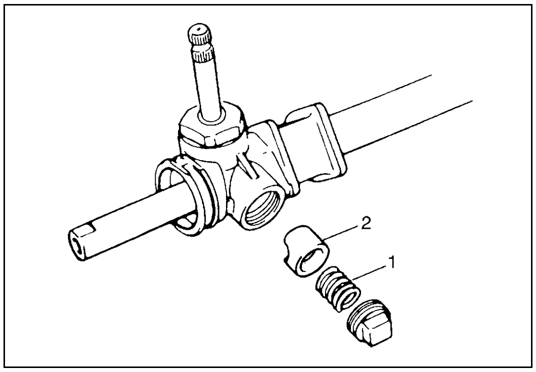
REMOVAL

1) Remove steering gear case by performing "MANUAL RACK AND PINION ASSEMBLY REMOVAL" of this section.
2) Remove rack boots and tie rods by performing "RACK BOOT/TIE ROD REMOVAL" of this section.



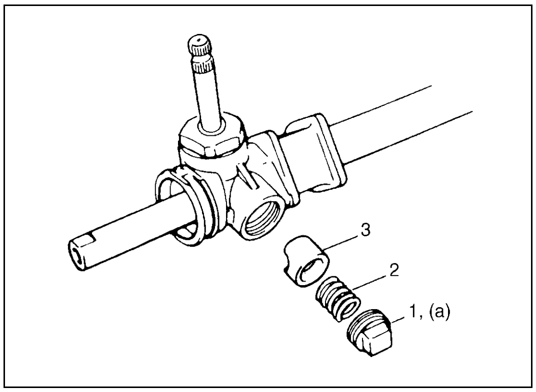
3) Remove rack damper screw lock nut (4), rack damper screw (3), rack damper spring (2) and rack plunger (1).

INSPECTION



- Inspect rack plunger (2) for wear or damage.
- Inspect rack plunger spring (1) for deterioration.
  In either case, if found defective, replace.

INSTALLATION



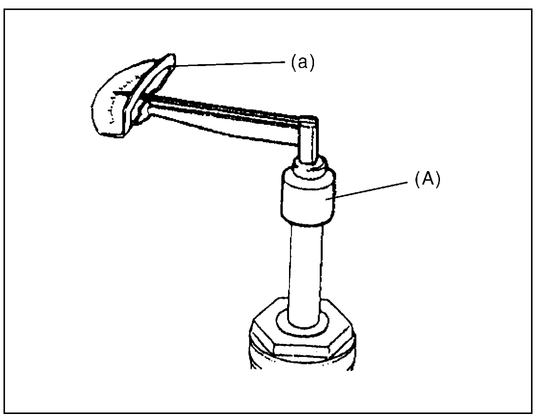
1) Apply grease lightly to sliding part of plunger against rack.

   Grease : 99000-25050

2) Install rack plunger (3), rack plunger spring (2), rack damper screw (1) to steering case in direction shown. Tighten rack damper screw to specified torque.

   Tightening torque
   Rack damper screw (a) : 12N·m (1.2 kg-m, 8.5 lb-ft)

   "A" : Sealant 99000-31150

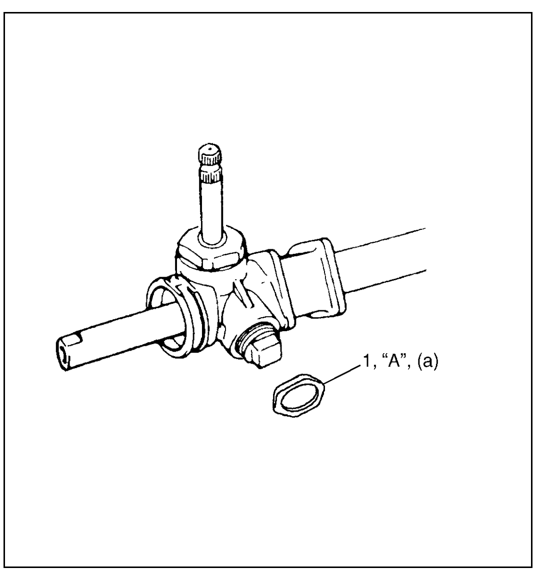


3) After tightening rack damper screw to specified torque, turn it back by 30° ~ 50° and check for rotation torque of pinion. If it is not as specified below, adjust so that it will be within specified torque range.

   Special tool
   (A) : 09944-18211

   Rotation Torquer of pinion
   (a) : 0.4 – 1.1 N·m (0.04 – 0.11 kg-m, 0.29 – 0.79 lb-ft)

Also, check if rack as a whole moves smoothly.



4) Apply sealant to thread part of rack damper screw lock nut (1) and tighten it to specified torque by not turning damper screw position adjusted in step 4).

   "A" : Sealant 99000-31150

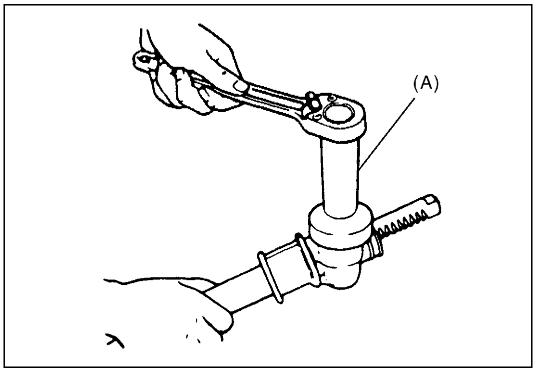
   Tightening torque
   Rack damper screw lock nut
   (a) : 40 N·m (4.0 kg-m, 29.0 lb-ft)

5) After adjustment, put rack damper screw cap as deeply as possible.
6) Install rack boots and tie rods refer to "RACK BOOT/TIE ROD INSTALLATION" of this section.
7) Install steering gear case refer to "MANUAL RACK AND PINION ASSEMBLY" of this section.

STEERING PINION

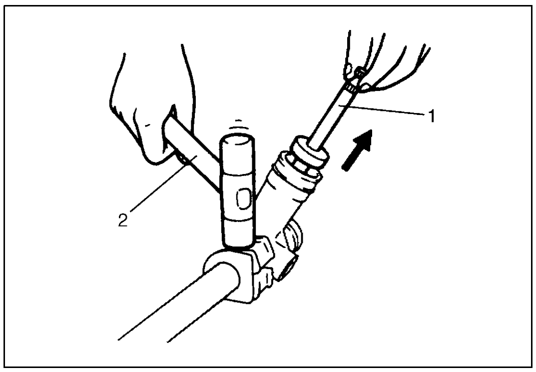
REMOVAL

1) Remove rack plunger as shown in STEERING RACK PLUNGER.

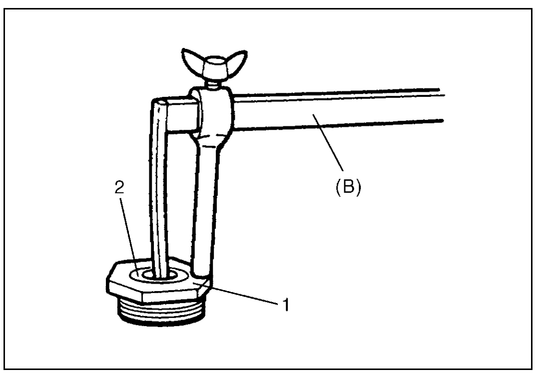


2) Remove bearing plug with special tool.

Special tool
(A) : 09944-26011



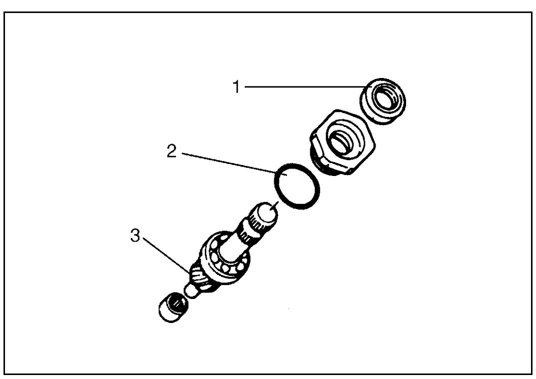
3) Tap on position as shown with plastic hammer (2) to separate pinion assembly (1) from housing, and remove pinion assembly.



4) Remove oil seal (2) with special tool from pinion bearing plug (1).

Special tool
(B) : 09913-50121

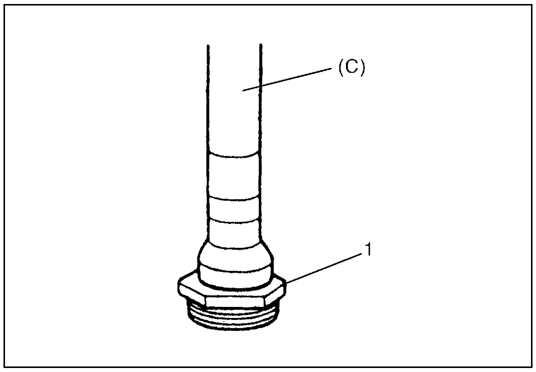
INSPECTION



- Inspect pinion teeth surface (3) for wear or damage.
- Inspect oil seal (1) for damage.
- Replace any part found defective.
- Check rotation condition of bearing and inspect for wear. If found defective, replace.

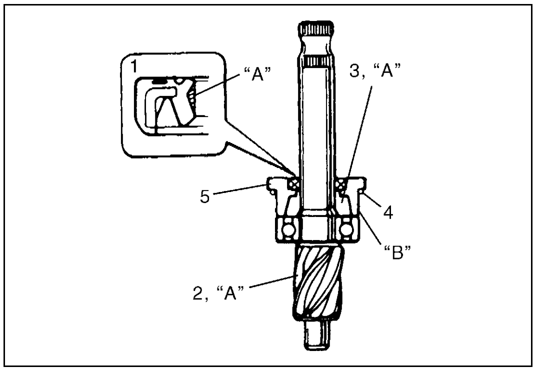
2. Case seal

INSTALLATION



1) Install new oil seal with special tool to pinion bearing plug (1).

Special tool
(C) : 09925-98210

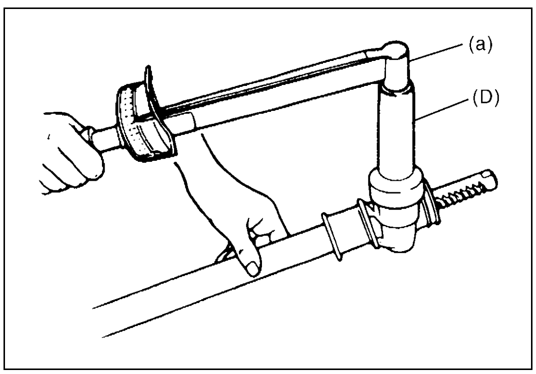


2) Apply grease to all around pinion teeth (2), pinion needle bearing, gear case O-ring (4) and gear case oil seal lip (1). Fill inside of pinion bearing plug (3) with grease.

"A" : Grease 99000-25050

3) Install pinion assembly and after applying sealant to pinion bearing plug (5) thread as shown.

"B" : Sealant 99000-31150



4) Tighten pinion bearing plug to specified torque.

Tightening torque
Pinion bearing plug (a) : 95 N·m (9.5 kg-m, 69.0 lb-ft)

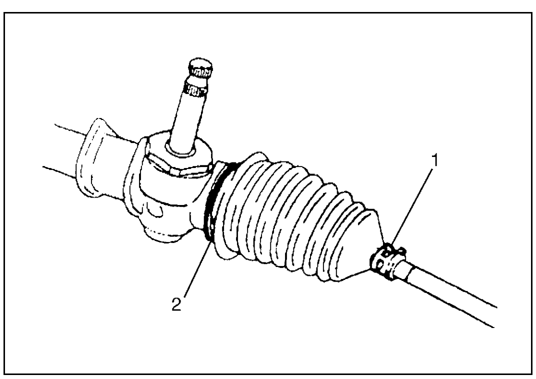
Special tool
(D) : 09944-26011

5) Install rack plunger in STEERING RACK PLUNGER.

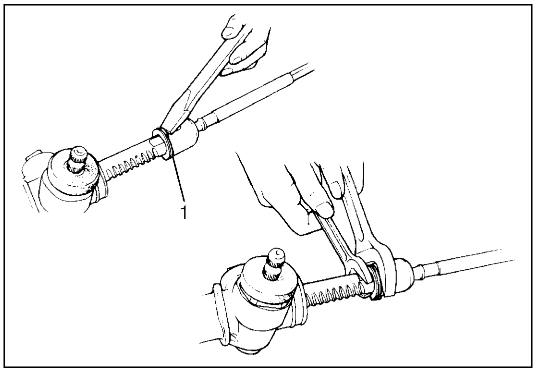
STEERING RACK

REMOVAL

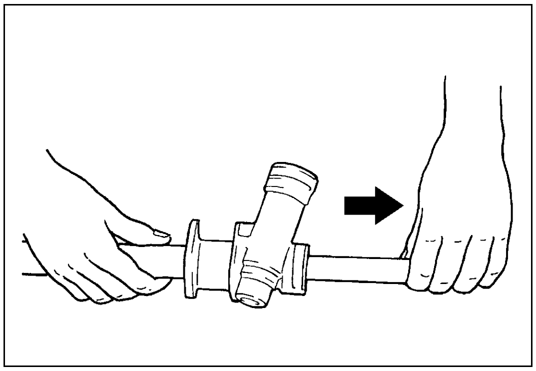
1) Remove steering gear case.



2) Remove boot wires (2) and clips (1).
3) Move both boots toward tie rod end.



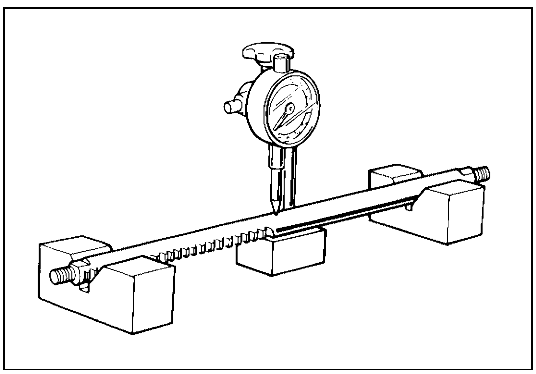
4) Unbend bend part of tie rod lock washers (1) and remove tie rods from right and left sides of steering rack.
5) Mark left and right tie rods accordingly.
6) Remove rack plunger and pinion assembly from gear case by performing Steps 1) – 3) in STEERING PINION REMOVAL of this section.



7) Remove rack from gear case. Direction for rack removal is as shown.

CAUTION:
Inside of steering rack bushing is coated with special coating. As it is damageable, be very careful not to cause damage to it when removing rack from steering gear case.

INSPECTION

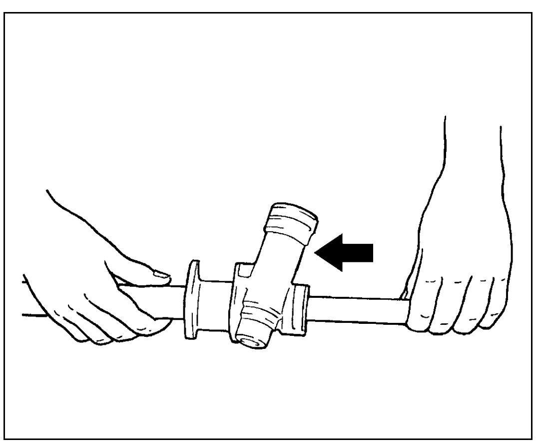


Inspect for deflection, teeth wear, or damage, back surface wear or damage.
If deflection exceeds limit, replace rack.

Limit of rack deflection
: 0.4 mm (0.016 in.)

INSTALLATION

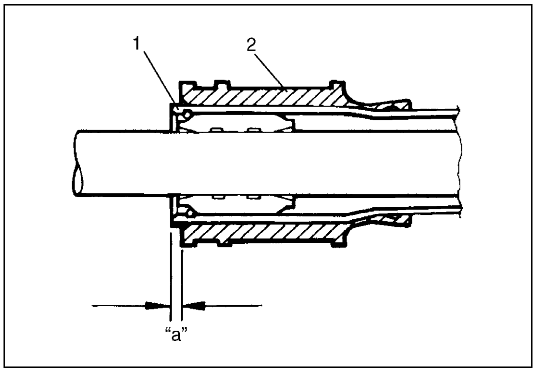
1) Apply grease to entire teeth surface of rack and its periphery.



2) Slide rack into steering gear case in the direction as shown.

CAUTION:
Inside of steering rack bushing is coated with special coating. As it is damageable, be very careful not to cause damage to it when inserting rack into steering gear case.

3) Install pinion assembly to gear case by performing Steps 2) – 4) in STEERING PINION INSTALLATION of this section.4)
4) Perform Step 1) – 4) in STEERING RACK PLUNGER INSTALLATION of this section.



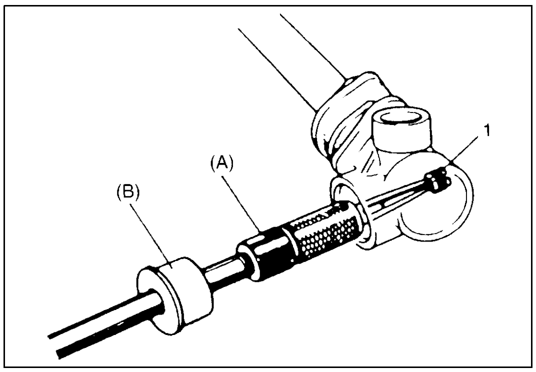
5) Before installing boot to steering rack housing (1), make sure that rack side mount (2) is positioned as shown. Install tie rods to rack by performing Steps 1) – 6) in RACK BOOT/TIE ROD INSTALLATION of this section.

Rack side mount installing position
"a" : 5.1 mm (0.2 in.)

PINION BEARING

REMOVAL

1) Remove rack from steering gear case, referring to STEERING RACK REMOVAL of this section.

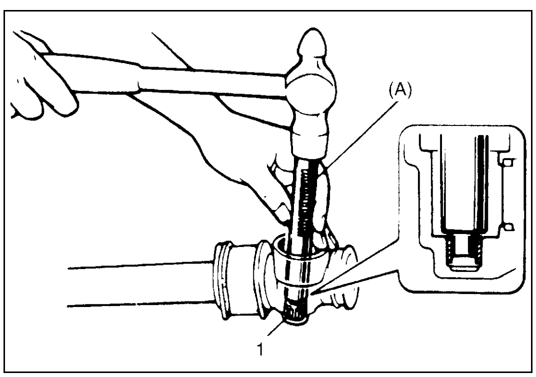


2) Remove pinion bearing (1) from gear case with special tools as shown.

Special tool
(A) : 09921-20200
(B) : 09930-30102

INSTALLATION

1) Apply grease to rollers of pinion bearing.



2) Press-fit pinion bearing (1) into gear case with special tool as shown.
After press-fitting, make sure that bearing rollers are installed properly.

Special tool
(A) : 09943-88211

3) Follow Steps 1) – 5) in STEERING RACK INSTALLATION of this section to complete installation.

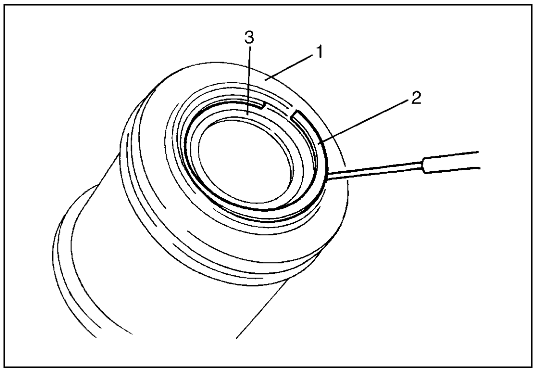
RACK BUSHING

REMOVAL

NOTE:

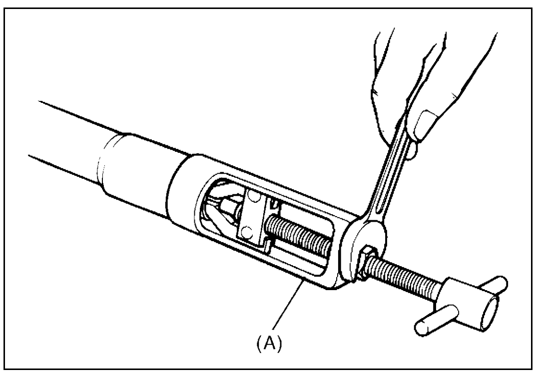
When removing rack bushing, be careful not to pull out bushing by holding gear case in a vise. Or housing (pipe) may come off gear case. For this work, be sure to use the below specified special tool.

1) Remove rack from steering gear case, referring to STEERING RACK REMOVAL of this section.



2) Remove snap ring (2).

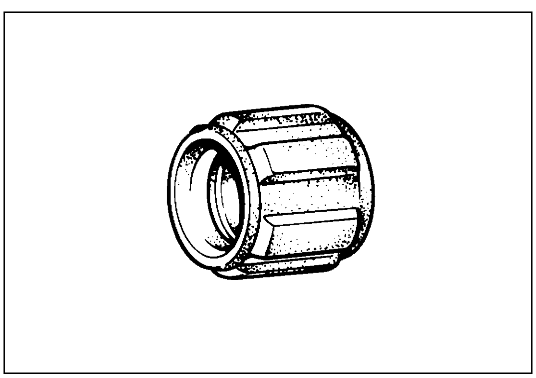
1.	Rack housing
3.	Bushing



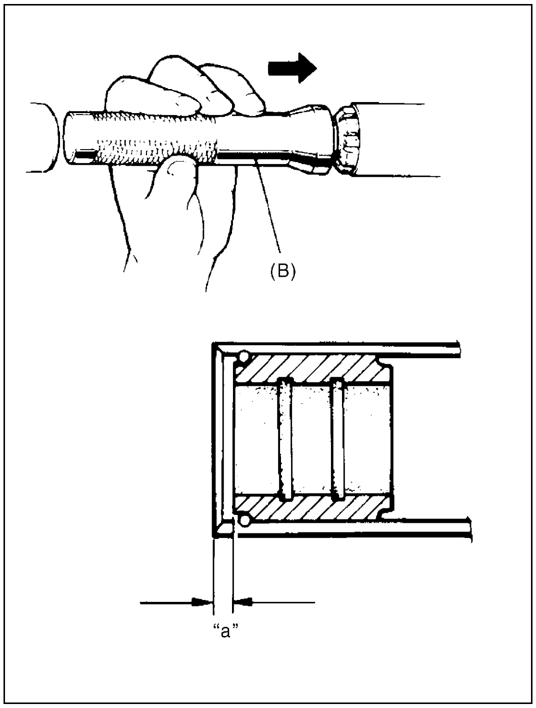
3) Pull out bushing from rack housing with special tool as shown.

Special tool
(A) : 09944-48210

INSPECTION



Inspect rack bushing for wear or damage.
If found defective, replace.



INSTALLATION

1) Apply grease lightly to entire inner surface of bushing.
2) Press-fit bushing as far into rack housing as shown by using special tool.

CAUTION:
Inside of bushing is coated with special coating. As it is damageable, be sure to use special tool and special care not to cause damage to inside of bushing when press-fitting it.

Special tool
(B) : 09943-78210

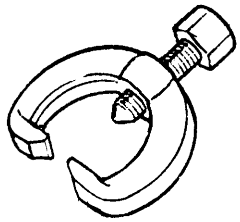
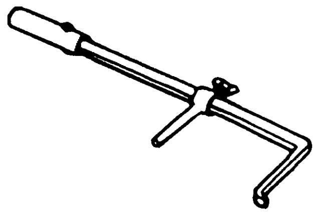
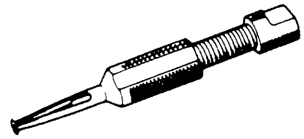
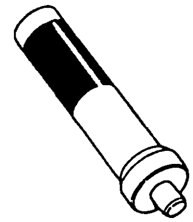
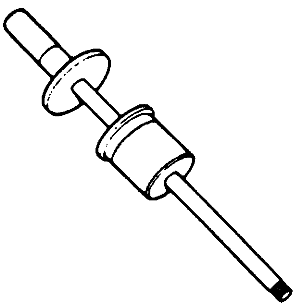
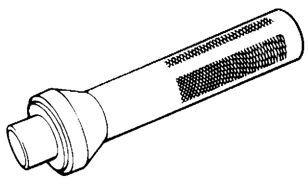
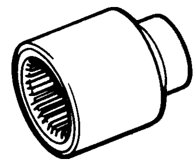
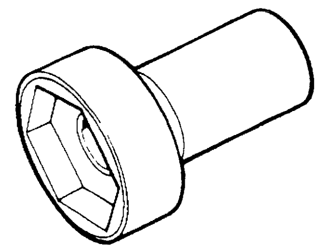
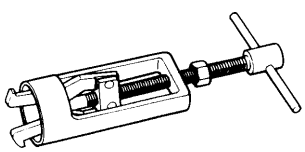
Bush installing position
"a" : 4.5 – 5.5 mm (0.18 – 0.22 in.)

3) Install snap ring.
4) Follow Steps 1) – 5) in STEERING RACK INSTALLATION of this section to complete installation.

REQUIRED SERVICE MATERIAL

Material	Recommended SUZUKI product (Part Number)	Use
Lithium Grease (Should be applicable for –40C° ~ 130°C)	SUZUKI SUPER GREASE (E) (99000-25050)	• Sliding part of rack against steering housing (All around rack plunger, rack bushing and rack) • Sliding part against steering pinion (Oil seal lip, needle bearing) • Steering rack and pinion gear teeth • Filled into pinion bearing cap • Contacting parts of tie-rod and rack side boots • Rack end ball joint
Sealant	SUZUKI BOND NO. 1207C (99000-31150)	• Rack damper screw nut • Pinion bearing plug thread

SPECIAL TOOL

 09913-65210 Tie-rod end remover	 09913-50121 Oil seal remover	 09921-20200 Pinion bearing remover	 09925-98210 Bearing installer
 09930-30102 Sliding shaft	 09943-78210 Rack bush installer	 09944-18211 Pinion torque checking socket	 09944-26011 43 mm Socket (Pinion bearing plug remover)
 09944-48210 Rack bush remover			

SECTION 3B1

ELECTRICAL POWER STEERING (P/S) SYSTEM

WARNING:

For vehicles equipped with Supplemental Restraint (Air Bag) System :

- **Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to "Air Bag System Components and Wiring Location View" under "General Description" in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and "Service Precautions" under "On-Vehicle Service" in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.**
- **Technical service work must be started at least 90 seconds after the ignition switch is turned to the "LOCK" position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).**

CONTENTS

GENERAL DESCRIPTION

SYSTEM COMPONENTS

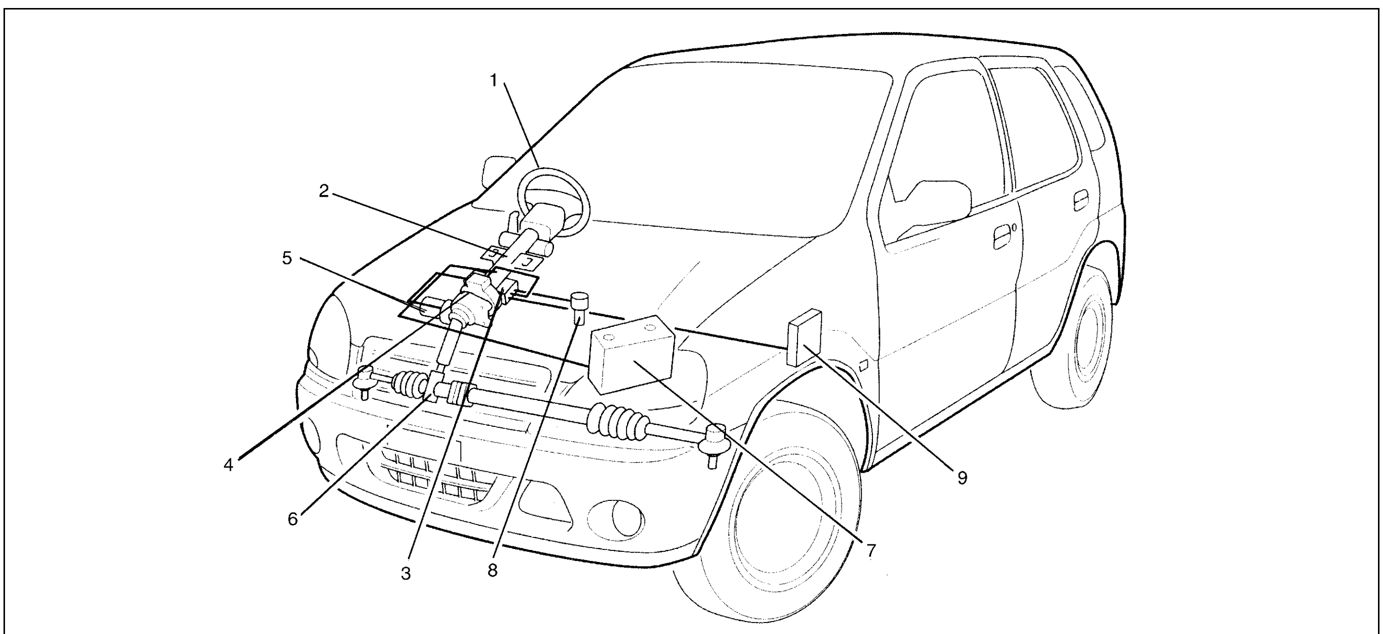
This power steering (P/S) system consists of a P/S control module, a torque sensor, a motor and clutch installed to the steering column.
In this system, the P/S control module determines the level and direction of the assist force for the steering wheel according to the signals from the torque sensor and the vehicle speed, runs the motor so as to assist operation of the steering wheel.

P/S control module diagnoses troubles which may occur in the area including the following components when the ignition switch is ON and the engine is running. When P/S control module detects malfunction, it stops the motor and clutch control.

- Torque sensor
- Vehicle speed sensor (VSS) circuit
- Engine speed signal circuit
- Motor
- Clutch
- P/S control module

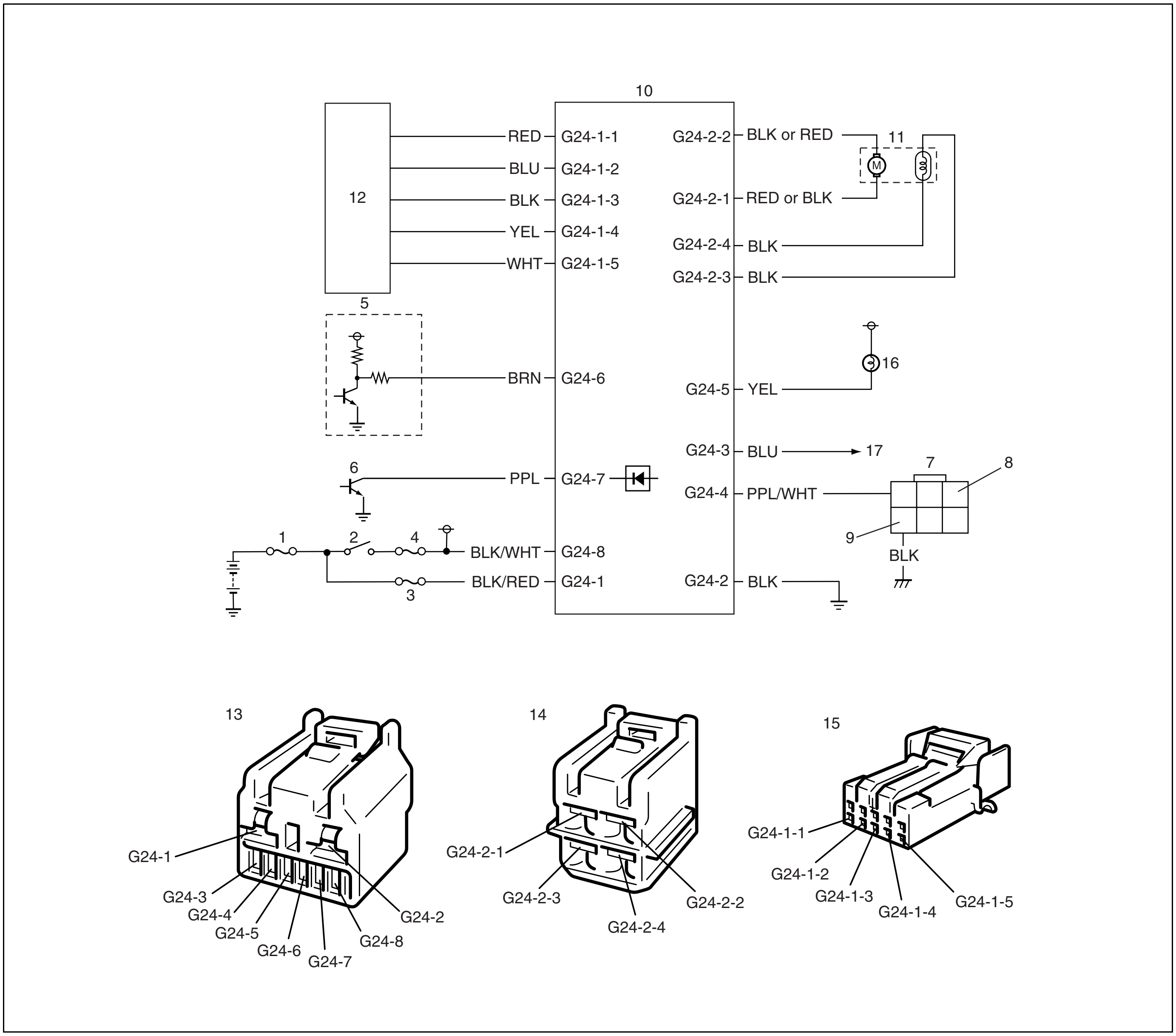
NOTE:

The location of steering wheel/column and ECM to RH steering vehicle are opposite to those location to LH steering vehicle.



1. Steering wheel	4. Torque sensor	7. Battery
2. Steering column assembly	5. Motor and clutch	8. VSS
3. P/S control module	6. Steering gear box	9. ECM

WIRING DIAGRAM

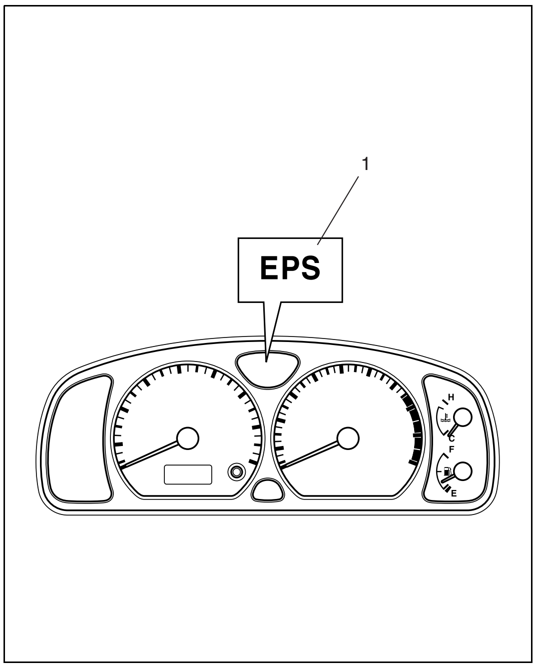


1. Main fuse	7. Monitor coupler (for A/T, ABS, P/S system)	13. Connector “G24”
2. Ignition switch	8. Diagnosis switch terminal (for P/S system)	14. Connector “G24-2”
3. “P/S” fuse (30A) in fuse box	9. Ground terminal	15. Connector “G24-1”
4. “IG METER” fuse (15A) in fuse box	10. P/S control module	16. “EPS” warning lamp
5. ECM	11. Motor and clutch	17. DLC
6. VSS	12. Torque sensor	

DIAGNOSIS

The P/S system in this vehicle is controlled by P/S control module. P/S control module has an on-board diagnostic system which detects a malfunction in this system.
When diagnosing troubles, be sure to have full understanding of the outline of “ON-BOARD DIAGNOSTIC SYSTEM” and each item in “PRECAUTION IN DIAGNOSING TROUBLE” and execute diagnosis according to “SYSTEM CHECK FLOW TABLE”.

ON-BOARD DIAGNOSTIC SYSTEM



P/S control module performs on-board diagnosis (self-diagnosis) on the system and operates “EPS” warning lamp (1) (malfunction indicator lamp) as follows.

- Malfunction indicator lamp (“EPS” warning lamp) lights when the ignition switch is turned to ON position (but the engine at stop) regardless of the condition of P/S control system. This is only to check the malfunction indicator lamp (“EPS” warning lamp) bulb and its circuit.
- If the areas monitored by P/S control module is free from any trouble after the engine start (while engine is running), malfunction indicator lamp (“EPS” warning lamp) turns OFF.
- When P/S control module detects a trouble which has occurred in the areas it monitors, malfunction indicator lamp (“EPS” warning lamp) turns ON while the engine is running to warn the driver of such occurrence of trouble and at the same time it stores the exact trouble area in memory inside of P/S control module.

PRECAUTIONS IN DIAGNOSING TROUBLES

- Take a note of DTC indicated first.
- Be sure to read “PRECAUTIONS FOR ELECTRONIC CIRCUIT SERVICE” in Section 0A before inspection and observe what is written there.
- When two or more troubles have occurred, their DTCs are indicated 3 times each starting with the smallest code number and up.
- DTC C1122 (DTC No.22) (engine speed signal failure) is indicated when ignition switch is ON position and engine is not running but if indication changes to a normal one when engine is started, it means nothing abnormal.
- As DTC is stored in memory of P/S control module, be sure to clear memory after repair by performing the procedure described in “DTC CLEARANCE”.

SYSTEM CHECK FLOW TABLE

Step	Action	Yes	No
1	1) Record details of the problem (failure, complaint) and how it occurred as described by the customer. For this purpose, use of such a questionnaire from as shown below will facilitate collecting information to the point required for proper analysis and diagnosis. 2) Check if what the customer claimed in "CUSTOMER QUESTIONNAIRE" is actually found in the vehicle and if that symptom is found, whether it is identified as a failure. (This step should be shared with the customer if possible.) 3) Check malfunction indicator lamp ("EPS" warning lamp) operation referring to "MALFUNCTION INDICATOR LAMP ("EPS" LIGHT) CHECK". 4) Check DTC referring to "DTC CHECK" in this section and record the DTC(s). 5) Clear DTC if any malfunction DTC exists referring to "DTC CLEARANCE" in this section, then recheck DTC. Is any malfunction DTC detected?	Go to Step 2.	Go to Step 3.
2	1) Inspect and repair referring to applicable "DTC TABLE" in this section. 2) Clear DTC referring to "DTC CLEARANCE" in this section. Does the trouble recur?	Go to Step 5.	Go to Step 4.
3	1) Test drive the vehicle and turn steering wheel fully to the right and left during test driving. See WARNING. Check if any trouble exists. 2) Inspect and repair basic parts referring to "DIAGNOSIS CHART" in SECTION 3. 3) If the trouble cannot be repaired in Step 3-2), inspect and repair referring to "TROUBLE DIAGNOSIS (FOR TROUBLE NOT INDICATED BY ON-BOARD DIAGNOSTIC SYSTEM)" in this section. Does the trouble recur?	Go to Step 5.	Go to Step 4.
4	1) Confirm that the problem symptom has gone and P/S system is free from any abnormal conditions. If what has been repaired is related to the malfunction DTC, clear the DTC once and perform test driving as in Step 3-1) and confirm that no DTC is indicated. Is any malfunction DTC detected?	Go to Step 5.	END
5	1) Check DTC referring to "DTC CHECK" in this section. Is any malfunction DTC detected?	Go to Step 2.	Go to Step 3.

WARNING:

Carry out test in very little traffic area to prevent an accident.

NOTE:

- **As execution of "DTC CLEARANCE" will clear all malfunction DTCs, be sure to record all DTCs before servicing.**
- **When 2 or more codes are indicated, the lowest numbered code will appear first.**
- **If a code not listed on "DTC TABLE" is displayed, then the P/S control module is faulty.**
- **DTC C1122 or DTC No.22 (flashing pattern : 22) is indicated when ignition switch is ON and engine is not running but if DTC No.12 (flashing pattern : 12) is indicated when engine is started, it means nothing abnormal.**
- **Current DTC and history DTC can be identified by lighting and flashing of "EPS" warning lamp. "EPS" warning lamp operates as follow depending on the trouble condition.**

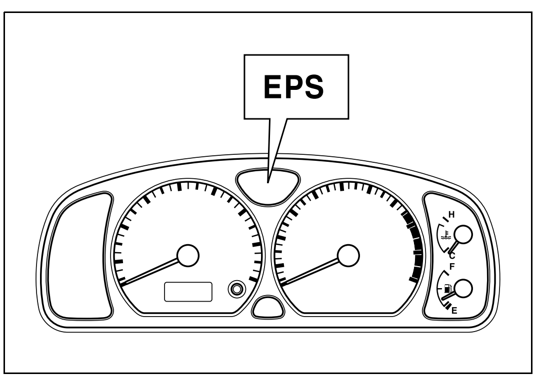
	Current DTC is set. (Abnormality exists at present.)	History DTC is set only. (Faulty condition occurred once in the past but normal condition is restored at present.)	Current DTC and history DTC exist.
"EPS" warning lamp after engine started	Remains ON.	Turn OFF.	Remains ON.
"EPS" warning lamp when shorting diagnosis switch terminal and ground terminal	Displays current DTC.	Displays history DTC.	Displays current DTC and history DTC.

For identify current DTC, clear history DTC referring to "DTC CLEARANCE" in this section.

CUSTOMER QUESTIONNAIRE (EXAMPLE)

Customer's name:	Model:	VIN:	
Date of issue:	Date Reg.	Date of problem:	Mileage:

Problem Symptoms	• Steering wheel feels heavy • Vehicle pulls to one side during straight driving • Poor recovery from turns • Too much play in steering • Abnormal noise while vehicle is running: from motor, from rack and pinon, other________________ • Other________________
Frequency of Occurrence	• Continuous/Intermittent (times a day, a month)/ other________________
Conditions for Occurrence of Problem	• Vehicle at stop & ignition switch ON: • When starting: at initial start only/at every start/Other________________ • Vehicle speed: while: while accelerating/while decelerating/at stop/ while turning/while running at constant speed/ other________________ • Road surface condition: Paved road/rough road/snow-covered road/other________________ • Chain equipment:
Environmental Condition	• Weather: fair/cloudy/rain/snow/other________________ • Temperature: °F (°C)
DTC	• First check: Normal code/malfunction code ( ) • Second check after driving test: Normal code/malfunction code ( )

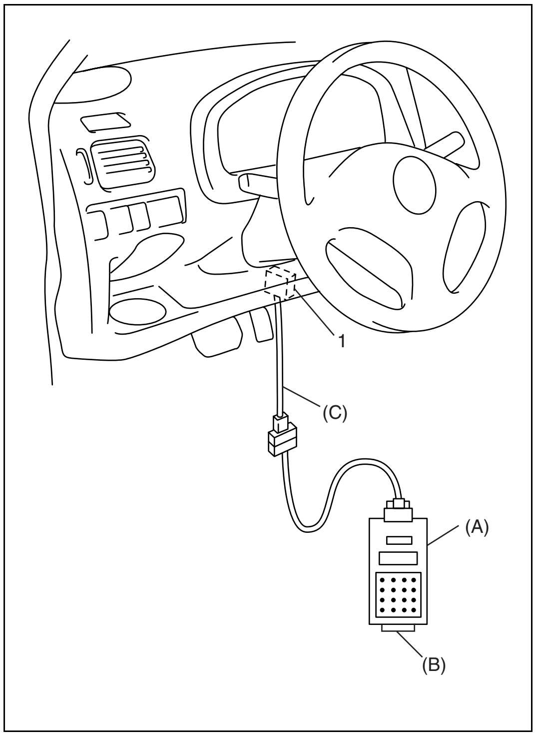


MALFUNCTION INDICATOR LAMP ("EPS" WARNING LAMP) CHECK

1) Turn ignition switch to ON position (but without running engine), check that malfunction indicator lamp ("EPS" warning lamp) lights up. If lamp does not light up, go to "TABLE A". If lamp flashes, go to "TABLE B".
2) Start engine and check that malfunction indictor lamp ("CHECK ENGIE" light) turns OFF.
   If lamp comes OFF, P/S system is in good condition.

DTC CHECK

USING SUZUKI SCAN TOOL



1) Turn ignition switch to OFF position.
2) After setting cartridge connect SUZUKI scan tool to data link connector (DLC) (1) located on underside of instrument panel at driver's seat side.

Special tool
(A) : 09931-76011
(B) : Master storage cartridge
(C) : 09931-76030

3) Turn ignition switch to ON position.
4) Read DTC according to instructions displayed on SUZUKI scan tool and print it or write it down referring to SUZUKI SCAN TOOL OPERATOR'S MANUAL for further details.

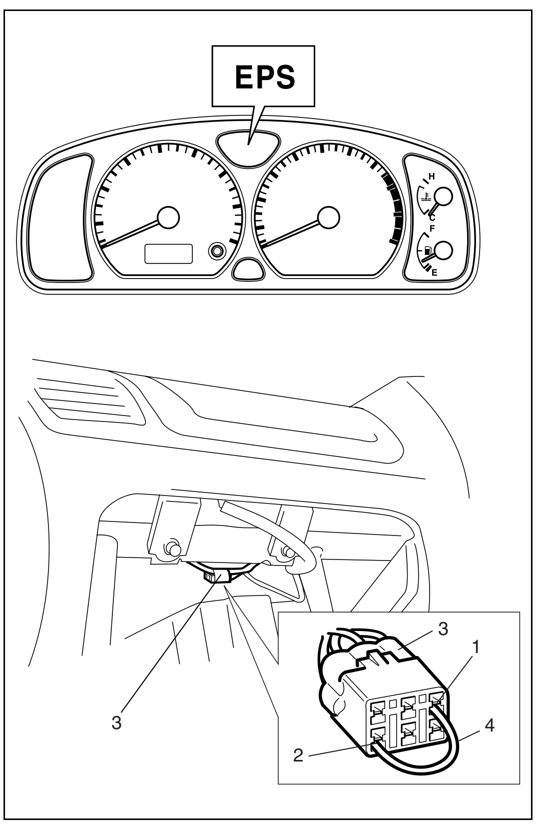
NOTE:

If Suzuki scan tool cannot display DTC, perform "SERIAL DATA LINK CIRCUIT CHECK" described in this section.

5) After completing the check, turn ignition switch to OFF position and disconnect SUZUKI scan tool from DLC.

NOT USING SUZUKI SCAN TOOL

1) Remove glove box.
2) Apply chocks to wheels, set shift lever to neutral position and pull parking brake fully.
3) Start engine.



4) Using jumper wire (4), short diagnosis switch terminal (1) to ground terminal (2) of monitor coupler (3).
5) Read flashing of "EPS" warning lamp which represents DTC and write it down. When more than 2 DTCs are stored in memory, each DTC is repeated 3 times starting with the smallest DTC number in increasing order.
   For details and example of DTC, refer to "DTC TABLE".

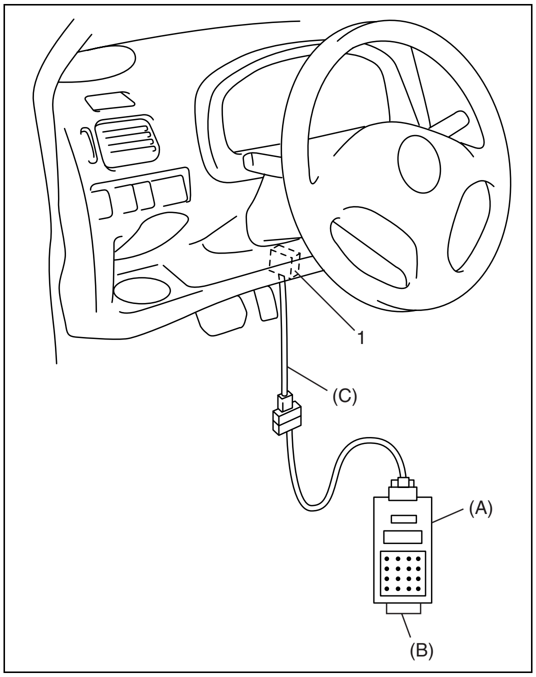
NOTE:

DTC No.22 is indicated when ignition switch is ON and engine is not running but if DTC No.12 is indicated when engine is started, it means nothing abnormal.

6) After completing the check, turn ignition switch to OFF position and disconnect jumper wire (4) from monitor coupler.

DTC CLEARANCE

USING SUZUKI SCAN TOOL

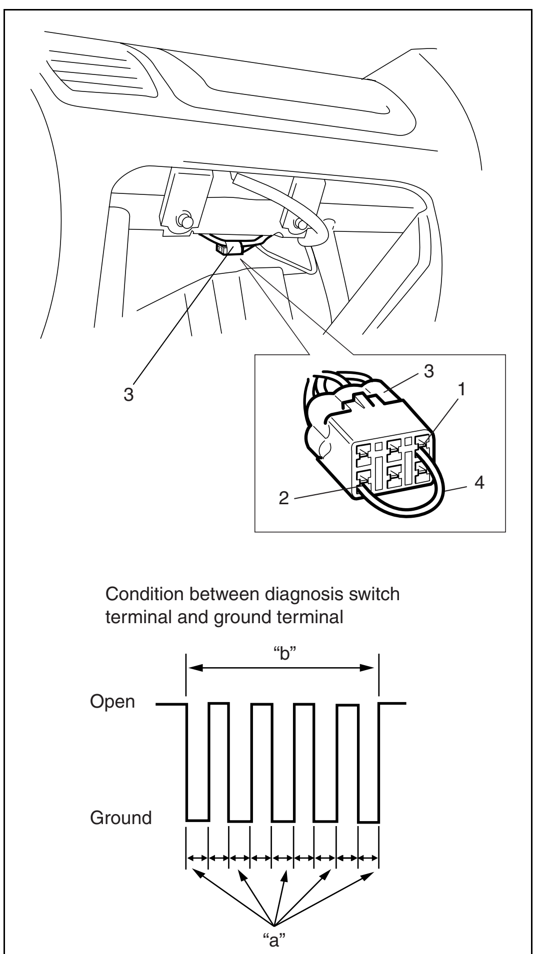


1) Turn ignition switch to OFF position.
2) After setting cartridge connect SUZUKI scan tool, connect scan tool to data link connector (DLC) (1) located on underside of instrument panel at driver's seat side.

Special tool
(A) : 09931-76011
(B) : Master storage cartridge
(C) : 09931-76030

3) Turn ignition switch to ON position.
4) Erase DTC according to instructions displayed on SUZUKI scan tool referring to "SUZUKI SCAN TOOL OPERATOR'S MANUAL" for further details.
5) After completing the check, turn ignition switch to OFF position and disconnect SUZUKI scan tool from DLC.

NOT USING SUZUKI SCAN TOOL



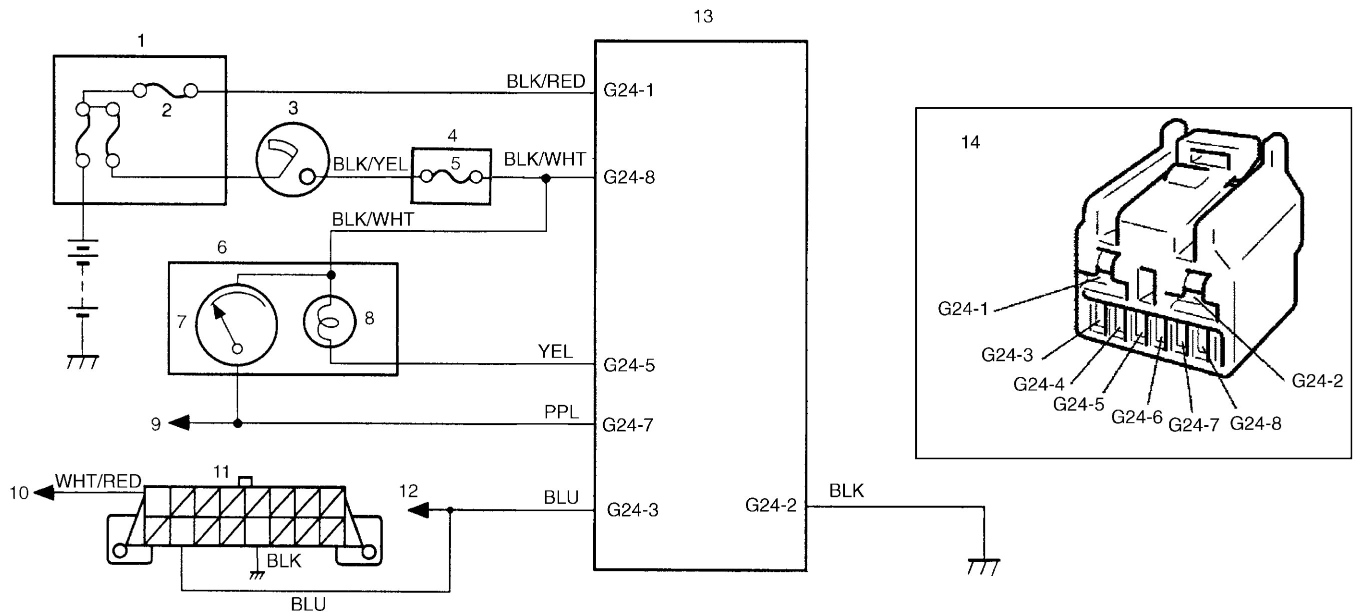
1) Remove glove box.
2) Turn ignition switch to ON position.
3) Using jumper wire, short diagnosis switch terminal (1) to ground terminal (2) of monitor coupler (3).
4) Make the disconnected end of jumper wire (4) contact where disconnected (short) and repeat these actions (open and short) at least 5 times within 10 seconds.

DTC clearance procedure specification
"a" : about 1 second
"b" : within 10 seconds

5) Perform "DTC CHECK" and confirm that normal DTC (DTC No.12) is displayed and not malfunction DTC.

SERIAL DATA LINK CIRCUIT CHECK

CAUTION:
Be sure to perform "SYSTEM CHECK FLOW TABLE" before starting diagnosis according to flow table.



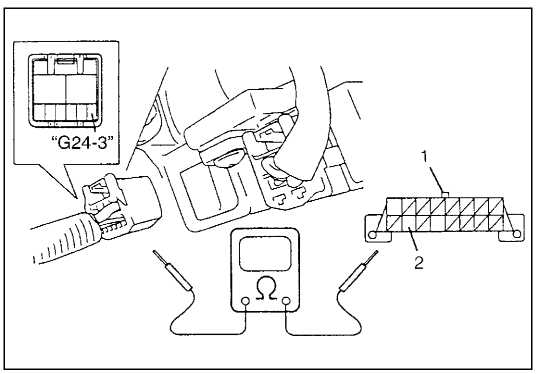
1. Main fuse box	6. Combination meter	11. Data link connector (DLC)
2. "EPS" fuse (30 A)	7. Speedometer	12. To ECM, SDM and ABS hydraulic unit/control module assembly (if equipped)
3. Ignition switch	8. "EPS" warning lamp	13. P/S control module
4. Circuit fuse box	9. To vehicle speed sensor (VSS)	14. Connector "G24"
5. "IG coil" fuse (15 A)	10. To main fuse box	

DIAGNOSTIC FLOW TABLE

Step	Action	Yes	No
1	Was "SYSTEM CHECK FLOW TABLE" performed?	Go to Step 2.	Go to "SYSTEM CHECK FLOW TABLE" in this section.
2	1) Make sure that SUZUKI scan tool free from malfunction and correct cartridge for P/S system is used. 2) Turn ignition switch to OFF position. 3) Check proper connection of SUZUKI scan tool to DLC. Is connection in good condition?	Go to Step 3.	Properly connect SUZUKI scan tool to DLC.

Step	Action	Yes	No
3	1) Check if communication is possible by trying communication with other controller (ECM, ABS hydraulic unit/control module assembly (if equipped) or SDM). Is it possible to communicate with other controller?	Go to Step 4.	Repair open in common section of serial data circuit (“BLU” wire circuit) used by all controllers or short to ground or power circuit which has occurred somewhere in serial data circuit (“BLU” wire circuit).
4	1) With ignition switch is OFF position, disconnect 8-pin (“G24”) connector from P/S control module. 2) Check proper connection at “G24-3” (“BLU” wire) terminal for serial data circuit. 3) If OK, then check resistance between “G24-3” (“BLU” wire) terminal and “BLU” wire terminal for serial data circuit in DLC. Is resistance 1 Ω or less?	Substitute a known-good P/S control module and recheck.	Repair high resistance or open in “BLU” wire circuit for P/S system.

Fig. for Step 4

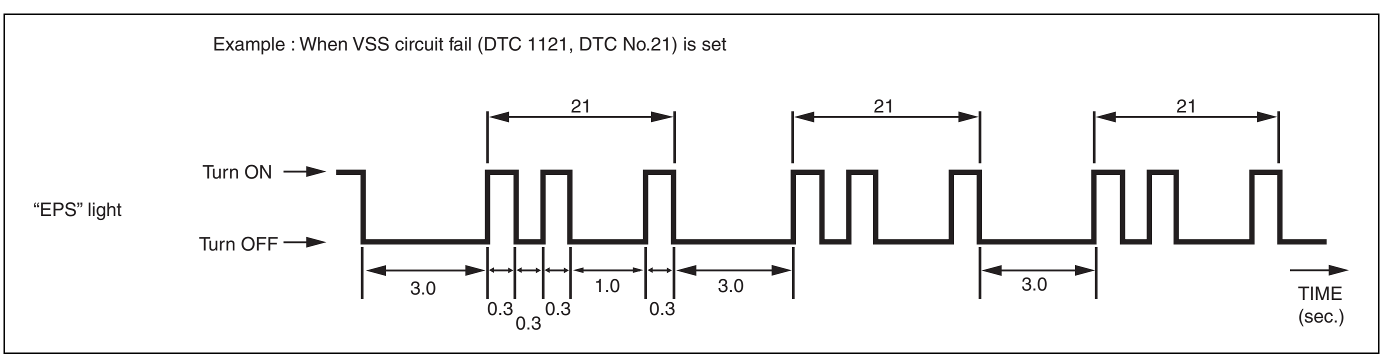


1.	DLC
2.	“BLU” wire terminal

DTC TABLE

CAUTION:

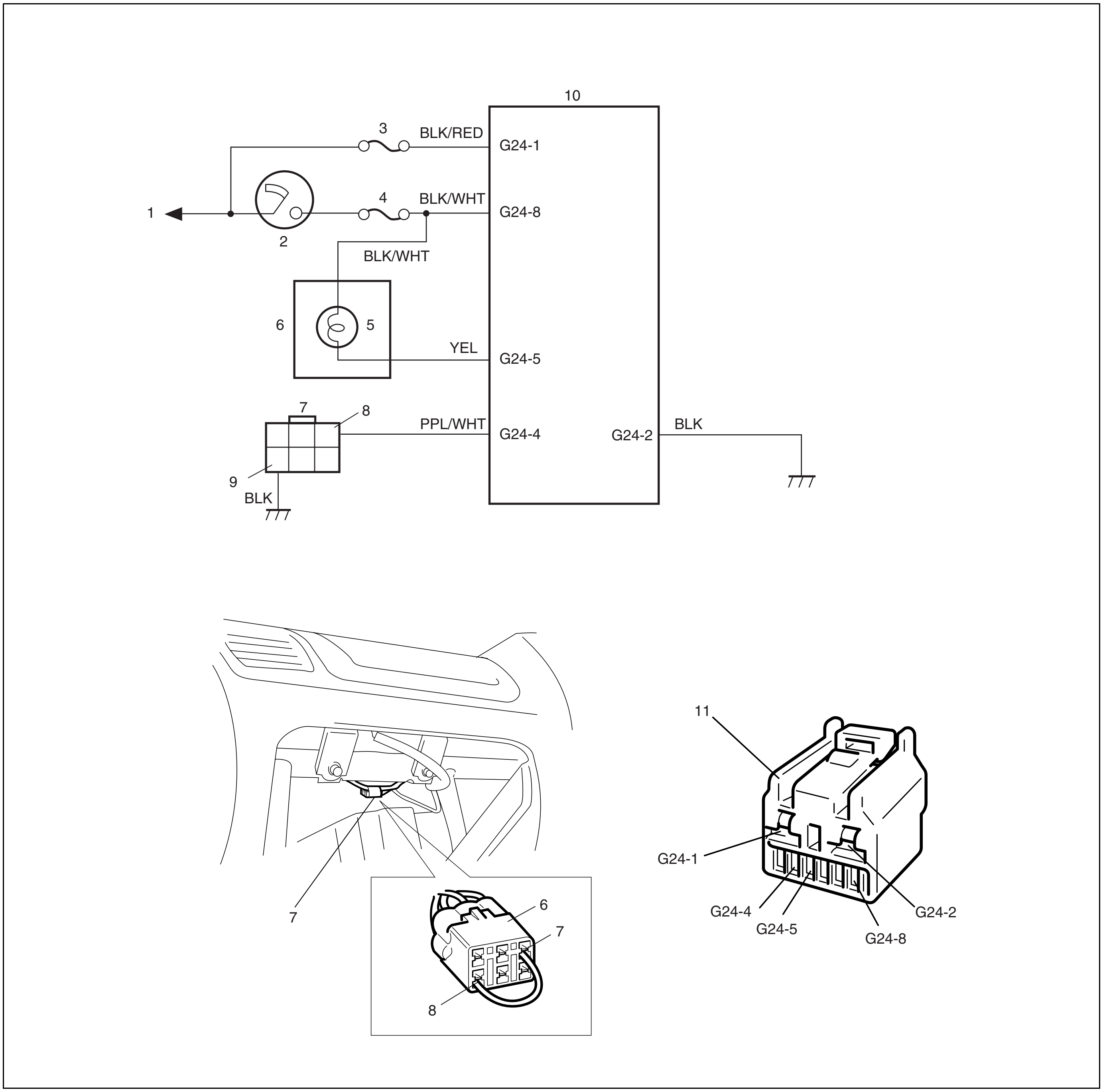
Be sure to perform “SYSTEM CHECK FLOW TABLE” before starting diagnosis according to flow table of each DTC.



DTC (displayed on SUZUKI scan tool)	"EPS" light flashing pattern		DIAGNOSTIC ITEM	DIAGNOSIS
	DTC (indicated by "EPS" light flashing pattern)	Model		
NO DTC	12		Normal	This code appears when none of the other codes are identified.
C1111	11		Torque sensor	Diagnose trouble according to "DIAG-NOSTIC FLOW TABLE" corresponding to each code No.
C1113	13			
C1114	14			
C1115	15			
C1116	16			
C1121	21		VSS signal	
C1123	23			
C1124	24			
C1122	22		Engine speed signal	
C1141	41		Motor	
C1142	42			
C1143	43			
C1144	44			
C1145	45			
C1151	51		Clutch	
C1152	52		P/S control module	
C1154	54			
C1155	55			
C1153	53		P/S control module power supply	

TABLE A - MALFUNCTION INDICATOR LAMP DOES NOT COME ON AT IGNITION SWITCH ON BUT LEAVING ENGINE OFF

CIRCUIT



1. To main fuse	5. “EPS” warning lamp	9. Ground terminal
2. Ignition switch	6. Combination meter	10. P/S control module
3. “P/S” fuse (30A) in fuse box	7. Monitor coupler	11. Connector “G24”
4. “IG METER” fuse (15A) in fuse box	8. Diagnosis switch terminal	

INSPECTION

Step	Action	Yes	No
1	1) Set parking brake. 2) Note combination meter when ignition switch is turned to ON position. Does the “BRAKE” indicator (warning lamp) come ON?	Go to Step 2.	“BLK/YEL”, “BLK/WHT” wire circuit or “IG METER” fuse open or short to ground.
2	1) Ignition switch OFF. 2) Remove and inspect “P/S” fuse. Is fuse in good condition?	Go to Step 3.	Check “BLK/RED” wire circuit for short to ground. If OK, replace “P/S” fuse.
3	1) With ignition switch OFF, reinstall fuse and disconnect P/S control module connector (“G24”). 2) Check proper connection to P/S control module at “G24-1” terminal. 3) If OK, check voltage between “G24-1” (“BLK/RED” wire) terminal and body ground with ignition switch ON. Is it 10 – 14 V?	Go to Step 4.	“BLK/RED” wire circuit open or short to ground.
4	1) Check proper connection to P/S control module at “G24-8” terminal. 2) If OK, check voltage between “G24-8” (“BLK/WHT” wire) terminal and body ground with ignition switch ON. Is it 10 – 14 V?	Go to Step 5.	“BLK/WHT” wire circuit open or short to ground.
5	1) Check proper connection to P/S control module at “G24-5” terminal. 2) If OK, check voltage between “G24-5” (“YEL” wire) terminal and body ground with ignition switch ON. Is it 10 – 14 V?	Substitute a known-good P/S control module and recheck.	Go to Step 6.
6	1) Remove combination meter. Refer to “COMBINATION METER” in Section 8. 2) Remove and inspect “EPS” light bulb. Is bulb in good condition?	“YEL”, “BLK/WHT” wire circuit or inside of combination meter open or short to other circuit.	Check “YEL” wire circuit for short to ground. If OK, replace “EPS” light bulb.

TABLE B - MALFUNCTION INDICATOR LAMP FLASHES AT IGNITION SWITCH ON

CIRCUIT

Refer to TABLE-A for System Circuit Diagram.

Step	Action	Yes	No
1	1) Check monitor coupler. Is it connected diagnosis switch terminal (“8”) and ground terminal (“9”) in monitor connector by jumper wire?	Disconnect jumper wire from monitor coupler.	Go to Step 2.
2	1) Check voltage between diagnosis switch terminal of monitor coupler and body ground with ignition switch ON. Is it 10 – 14 V?	Substitute a known-good P/S control module and recheck.	“PPL/WHT” wire circuit short to ground.

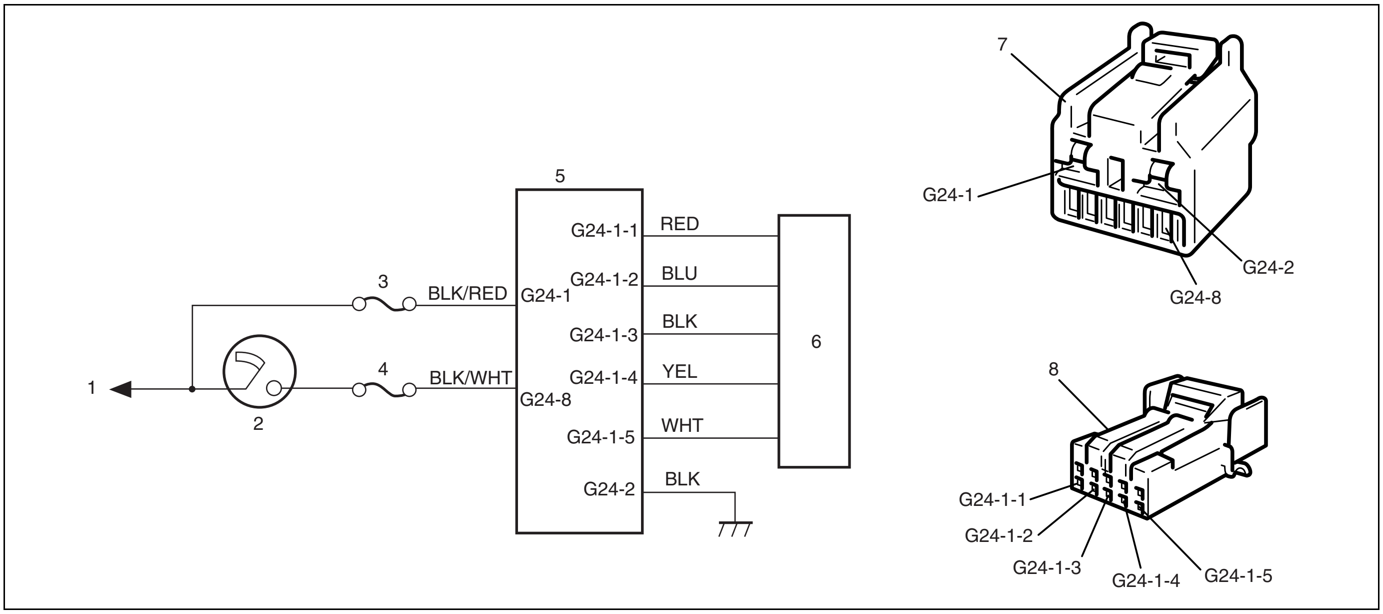
TABLE C - MALFUNCTION INDICATOR LAMP DOES NOT FLASH, JUST REMAINS ON OR JUST REMAINS OFF EVEN WITH DIAGNOSIS SWITCH TERMINAL GROUNDED

CIRCUIT

Refer to TABLE-A for System Circuit Diagram.

Step	Action	Yes	No
1	1) Inspect connection between diagnosis switch and ground terminals on monitor coupler by jumper wire. Is it securely connected between them by jumper wire?	Go to Step 2.	Properly connection diagnosis switch and ground terminals on monitor coupler by jumper wire.
2	1) With ignition switch OFF, disconnect P/S control module connector (“G24”). 2) Check proper connection to P/S control module at “G24-4” terminal. 3) If OK, check resistance between “G24-4” (“PPL/WHT” wire) terminal and diagnosis switch terminal of monitor coupler. Is there continuity?	Go to Step 3.	“PPL/WHT” wire circuit open.
3	1) Check proper connection to P/S control module at “G24-2” terminal. 2) If OK, check resistance between “G24-2” (“BLK” wire) terminal and body ground. Is there continuity?	Go to Step 4.	“BLK” wire circuit open.
4	1) Check proper connection to P/S control module at “G24-5” terminal. 2) If OK, check voltage between “G24-5” (“YEL” wire) terminal and body ground with ignition switch ON. Is it 10 – 14 V?	Substitute a known-good P/S control module and recheck.	“YEL” wire circuit or inside of combination meter short to other circuit or ground.

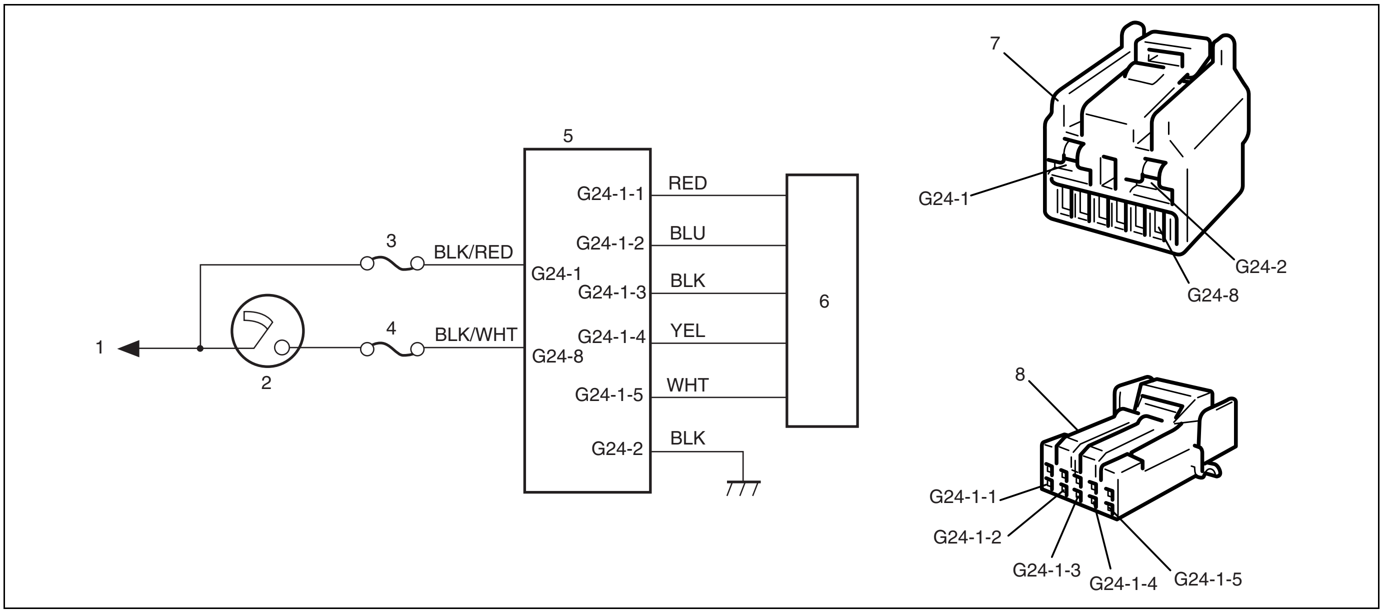
DTC C1111 (DTC No.11) TORQUE SENSOR MAIN CIRCUIT FAILURE
DTC C1113 (DTC No.13) TORQUE SENSOR MAIN AND SUB CIRCUIT FAILURE
DTC C1115 (DTC No.15) TORQUE SENSOR SUB CIRCUIT FAILURE



1. To main fuse	4. “IG METER” fuse (15A) in fuse box	7. Connector “G24”
2. Ignition switch	5. P/S control module	8. Connector “G24-1”
3. “P/S” fuse (30A) in fuse box	6. Torque sensor	

Step	Action	Yes	No
1	1) Was “SYSTEM CHECK FLOW TABLE” performed?	Go to STEP 2.	Go to “SYSTEM CHECK FLOW TABLE”.
2	1) Is DTC C1114 (DTC No.14) or C1116 (DTC No.16) indicated, too?	Go to flow table corresponding to each DTC No.	Go to STEP 3.
3	1) Check proper connection for 5-terminals connector (“G24-1”) to P/S control module. 2) If OK, check torque sensor and its circuit. Refer to “TORQUE SENSOR”. Is torque sensor in good condition?	Substitute a known-good P/S control module and recheck.	Replace steering column assembly and recheck.

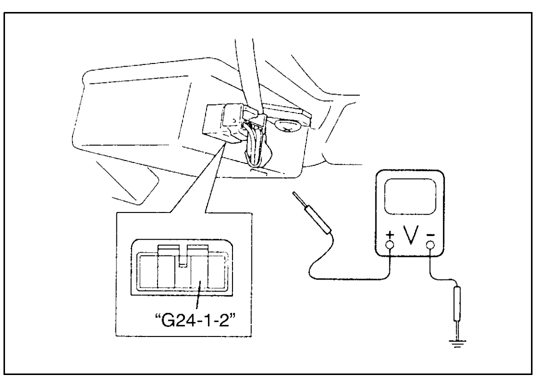
DTC C1114 (DTC No.14) TORQUE SENSOR 5V POWER SUPPLY CIRCUIT FAILURE



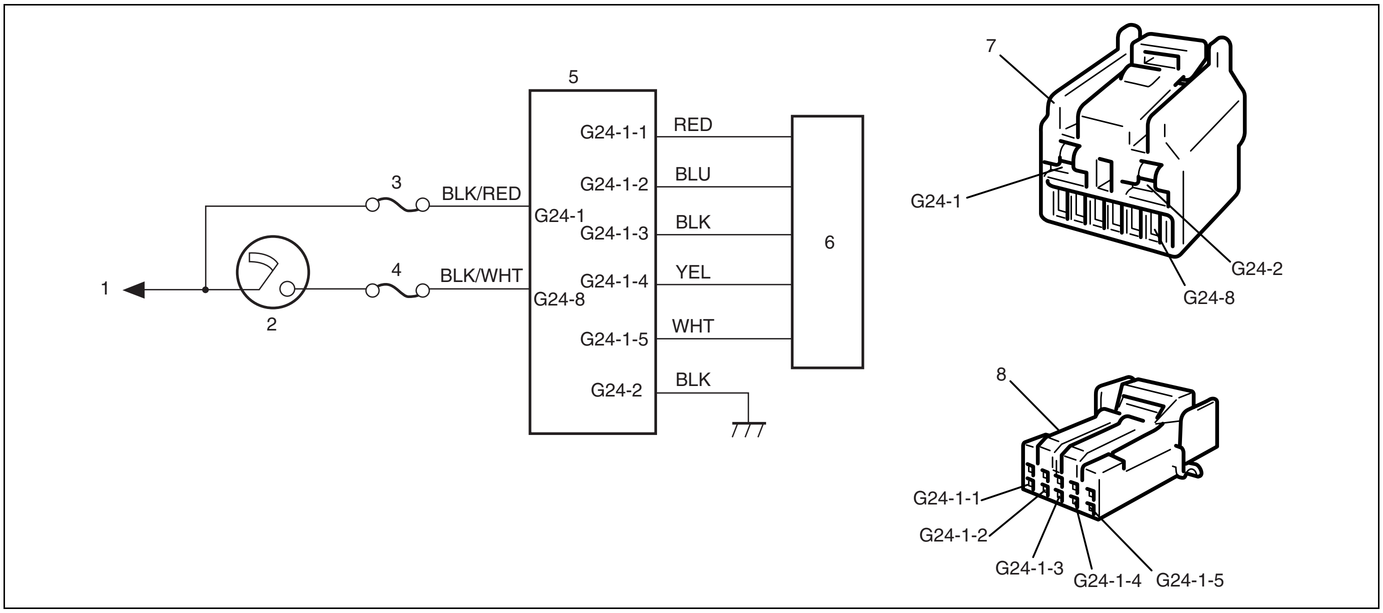
1. To main fuse	4. "IG METER" fuse (15A) in fuse box	7. Connector "G24"
2. Ignition switch	5. P/S control module	8. Connector "G24-1"
3. "P/S" fuse (30A) in fuse box	6. Torque sensor	

Step	Action	Yes	No
1	Was "SYSTEM CHECK FLOW TABLE" performed?	Go to STEP 2.	Go to "SYSTEM CHECK FLOW TABLE".
2	1) Remove steering column hole cover. 2) Check proper connection for 5-terminals connector ("G24-1") to P/S control module. 3) If OK, turn ignition switch ON. 4) Check voltage between "G24-1-2" ("BLU" wire) terminal of 5-terminals connector ("G24-1") and body ground with connector ("G24-1") connected to P/S control module. Is it about 5 V?	Go to STEP 3.	Repair high resistance, open or short to power circuit or ground in 5V power supply ("BLU" wire) circuit.
3	1) Check torque sensor and its circuit. Refer to "TORQUE SENSOR". Is torque sensor in good condition?	Substitute a known-good P/S control module and recheck.	Replace steering column assembly and recheck.

Fig. for Step 2



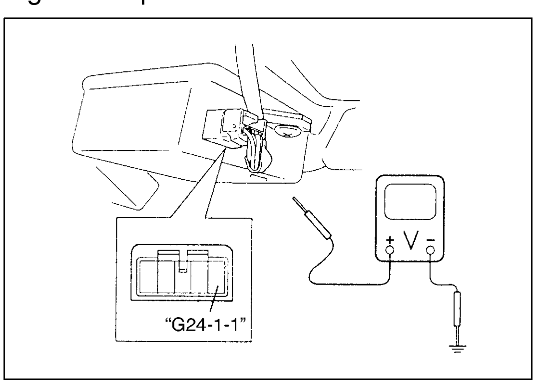
DTC C1116 (DTC No.16) TORQUE SENSOR 8V POWER SUPPLY CIRCUIT FAILURE



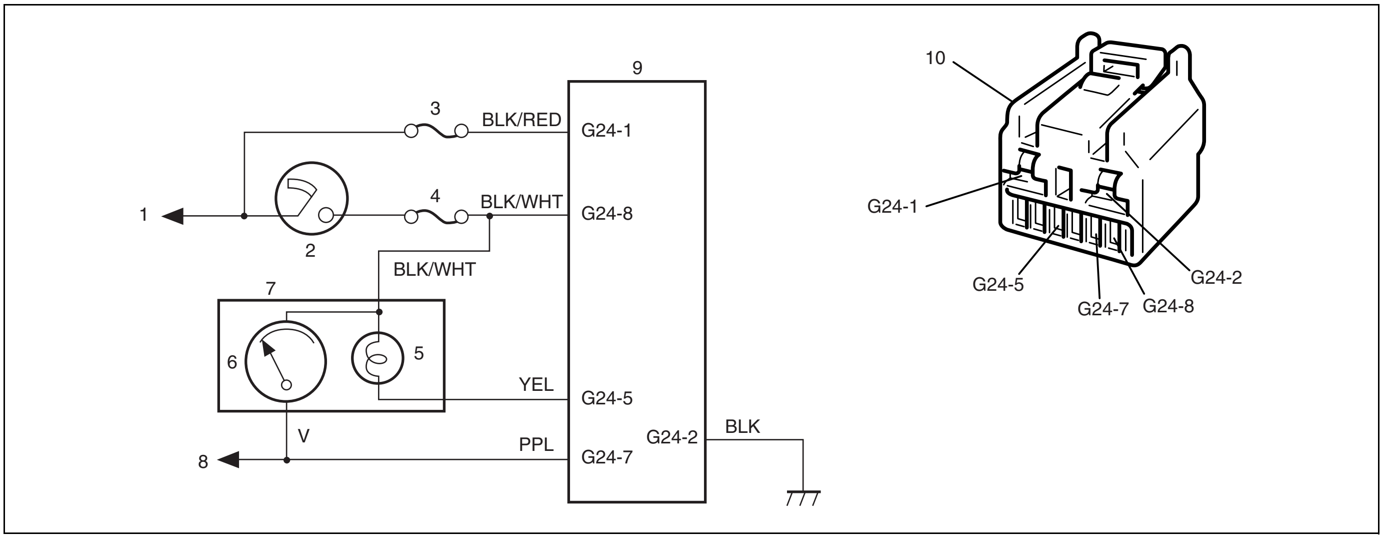
1. To main fuse	4. "IG METER" fuse (15A) in fuse box	7. Connector "G24"
2. Ignition switch	5. P/S control module	8. Connector "G24-1"
3. "P/S" fuse (30A) in fuse box	6. Torque sensor	

Step	Action	Yes	No
1	Was "SYSTEM CHECK FLOW TABLE" performed?	Go to STEP 2.	Go to "SYSTEM CHECK FLOW TABLE".
2	1) Remove steering column hole cover. 2) Check proper connection for 5-terminals connector ("G24-1") to P/S control module. 3) If OK, turn ignition switch ON. 4) Measure voltage between "G24-1-1" ("RED" wire) terminal of 5-terminals connector ("G24-1") and body ground with connector ("G24-1") connected to P/S control module. Is it about 8 V?	Go to STEP 3.	Repair high resistance, open or short to power circuit or ground in 8V power supply ("RED" wire) circuit.
3	1) Check torque sensor and its circuit. Refer to "TORQUE SENSOR". Is torque sensor in good condition?	Substitute a known-good P/S control module and recheck.	Replace steering column assembly and recheck.

Fig. for Step 2



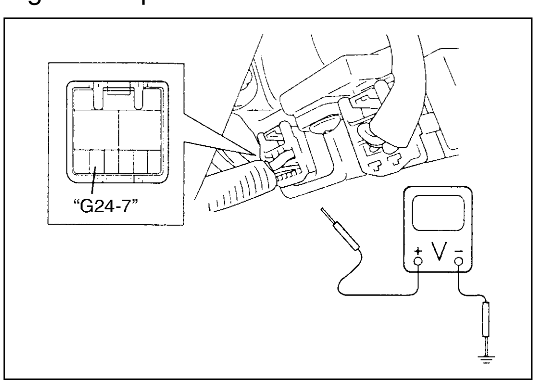
DTC C1121/C1123/C1124 (DTC No.21/23/24) VSS CIRCUIT FAILURE



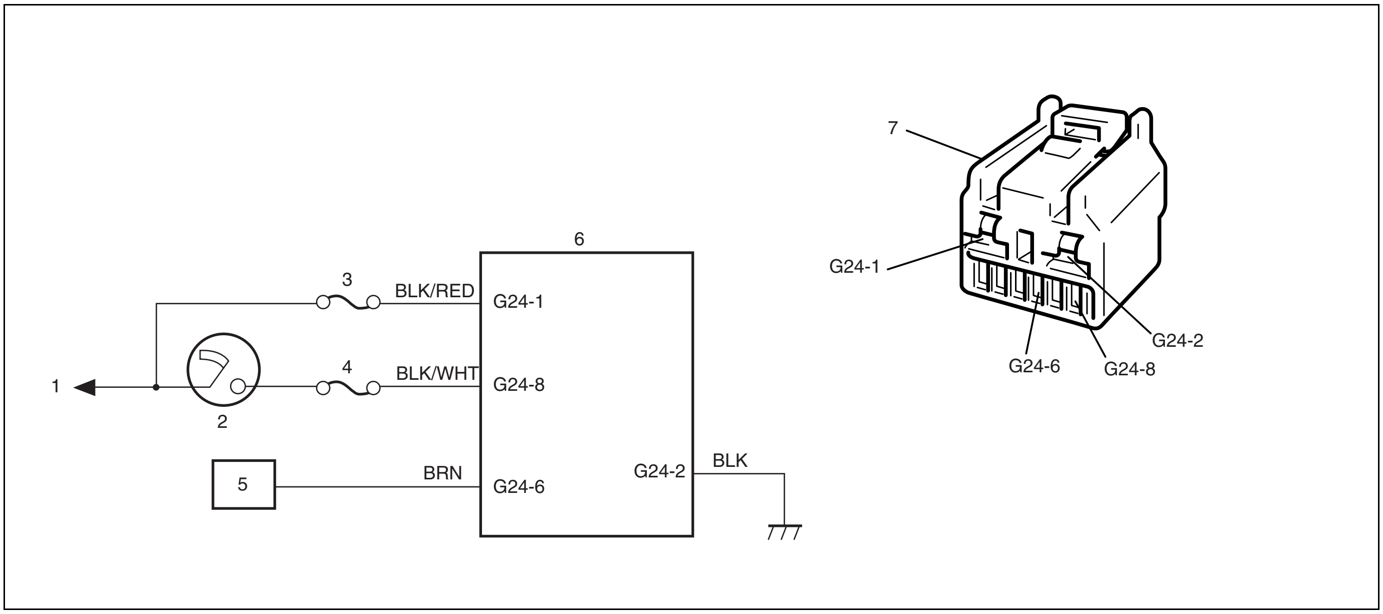
1. To main fuse	5. "EPS" warning lamp	9. P/S control module
2. Ignition switch	6. Speedometer	10. Connector "G24"
3. "P/S" fuse (30A) in fuse box	7. Combination meter	
4. "IG METER" fuse (15A) in fuse box	8. To VSS	

Step	Action	Yes	No
1	Was "SYSTEM CHECK FLOW TABLE" performed?	Go to STEP 2.	Go to "SYSTEM CHECK FLOW TABLE".
2	1) Ignition switch OFF. 2) Remove steering column lower cover. 3) Disconnect 8-terminals connector ("G24") from P/S control module. 4) Check proper connection to P/S control module at "G24-7" ("PPL" wire) terminal. 5) If OK, connect voltmeter between "G24-7" ("PPL" wire) terminal and body ground with connector ("G24") connected. 6) Hoist rear end of vehicle and lock rear right tire. 7) Turn rear left tire quickly with ignition switch ON. Does voltmeter indicate deflection between 0 – 1 V and 9 – 11 V a few times while tire is turned one revolution?	Check intermittent trouble. Refer to "INTERMITTENT TROUBLE" in SECTION 0A. If OK, substitute a known-good P/S control module and recheck.	Repair VSS or its ("PPL" wire) circuit.

Fig. for Step 2



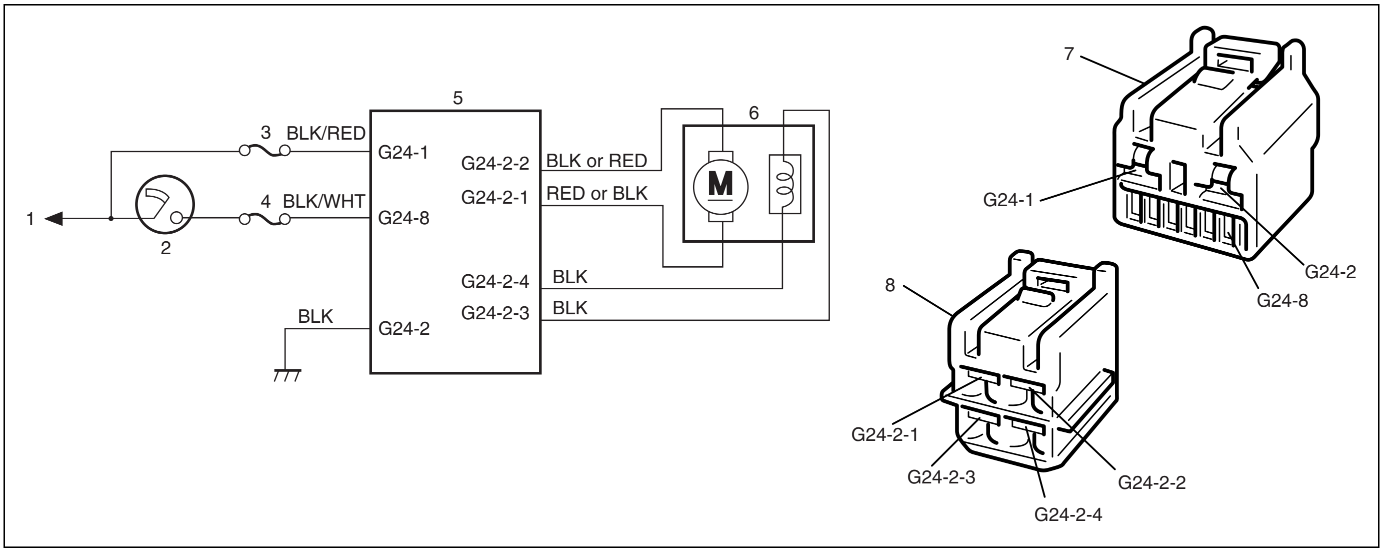
DTC C1122 (DTC No.22) ENGINE SPEED SIGNAL CIRCUIT FAILURE



1. To main fuse	4. "IG METER" fuse (15A) in fuse box	7. Connector "G24"
2. Ignition switch	5. ECM	
3. "P/S" fuse (30A) in fuse box	6. P/S control module	

Step	Action	Yes	No
1	Was "SYSTEM CHECK FLOW TABLE" performed?	Go to STEP 2.	Go to "SYSTEM CHECK FLOW TABLE".
2	1) Recheck DTC with engine running. Is DTC C1122 (DTC No.22) indicated?	Go to STEP 3.	It is nothing abnormal for DTC C1122 (DTC No.22). P/S system is in normal condition.
3	1) Check proper connection to P/S control module and ECM at each "BRN" wire terminal (P/S control module side: "G24-6" terminal, ECM side : Refer to in SECTION 6E), then check intermittent trouble. Refer to "INTERMITTENT TROUBLE" in SECTION 0A. 2) If they are OK, check high resistance, open or short to power circuit or ground in "BRN" wire circuit. Is check result in good condition?	Substitute a known-good P/S control module and recheck.	Repair.

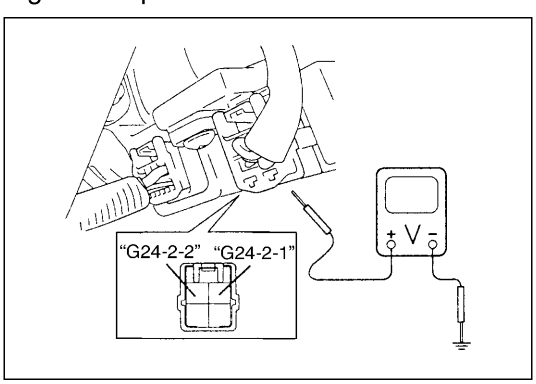
DTC C1141/C1142/C1143/C1144/C1145 (DTC No.41/42/43/44/45) MOTOR CIRCUIT FAILURE



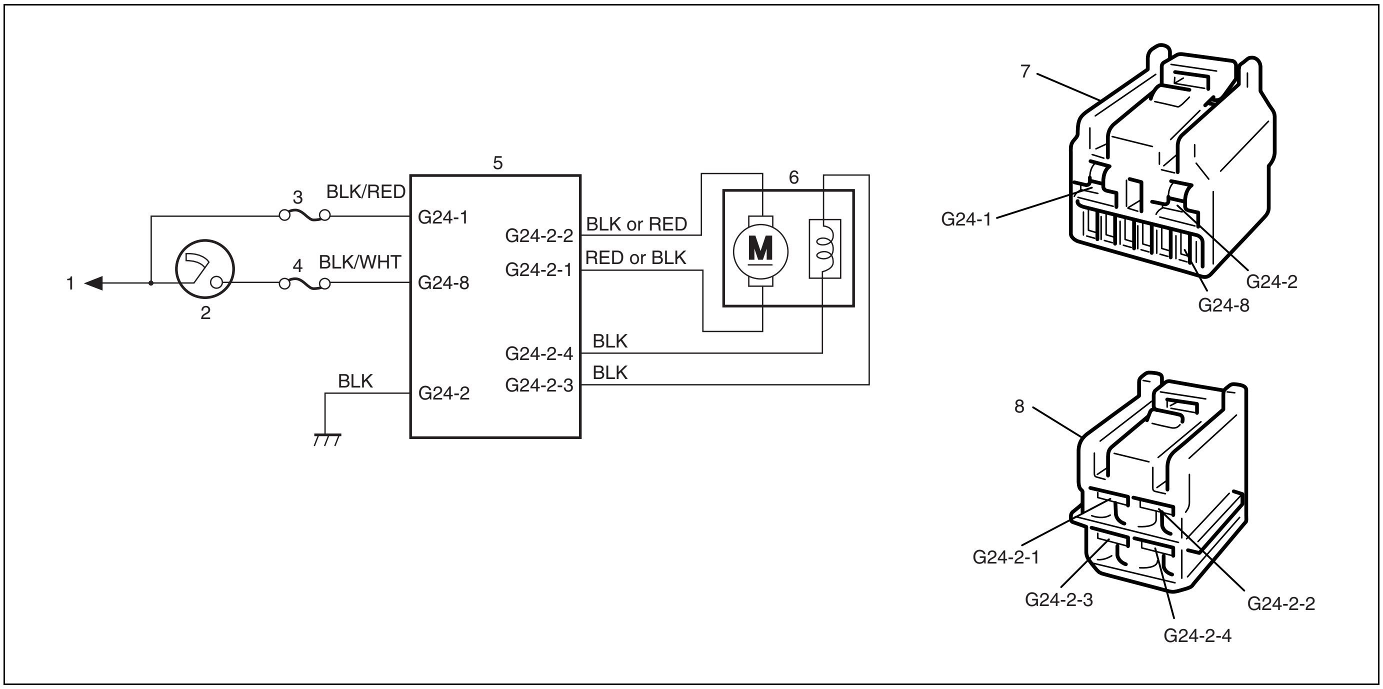
1. To main fuse	4. "IG METER" fuse (15A) in fuse box	7. Connector "G24"
2. Ignition switch	5. P/S control module	8. Connector "G24-1"
3. "P/S" fuse (30A) in fuse box	6. Motor and clutch	

Step	Action	Yes	No
1	Was "SYSTEM CHECK FLOW TABLE" performed?	Go to STEP 2.	Go to "SYSTEM CHECK FLOW TABLE".
2	1) Remove steering column hole cover. 2) Check proper connection for 4-terminals connector ("G24-2") to P/S control module. 3) If OK, start engine. 4) Check voltage between "G24-2-2" ("BLK" wire or "RED wire) terminal and body ground and "G24-2-1" ("RED" wire or "BLK" wire) terminal and body ground with connector ("G24-2") connected to P/S control module. Are they 5 – 7 V with steering wheel held at position for vehicle to run straight?	Go to STEP 3.	Repair poor connection, high resistance, open or short to power circuit or ground in "G24-2" ("BLK" wire or "RED" wire) or "G24-2-1" ("RED" wire or "BLK" wire) circuit.
3	1) Check motor and its circuit. Refer to "MOTOR AND CLUTCH". Is motor and clutch in good condition?	Substitute a known-good P/S control module and recheck.	Replace steering column assembly and recheck.

Fig. for Step 2



DTC C1151 (DTC No.51) CLUTCH CIRCUIT FAILURE



1. To main fuse	4. “IG METER” fuse (15A) in fuse box	7. Connector “G24”
2. Ignition switch	5. P/S control module	8. Connector “G24-2”
3. “P/S” fuse (30A) in fuse box	6. Motor and clutch	

Step	Action	Yes	No
1	Was “SYSTEM CHECK FLOW TABLE” performed?	Go to STEP 2.	Go to “SYSTEM CHECK FLOW TABLE”.
2	1) Remove steering column lower cover. 2) Check proper connection for 4-terminals connector (“G24-2”) to P/S control module. 3) If OK, start engine. 4) Check voltage between “G24-2-4” (“BLK” wire) terminal and body ground with connector (“G24-2”) connected to P/S control module. Is it 0 V?	Go to STEP 3.	Repair poor connection, high resistance, open or short to power circuit or ground in “G24-2-4” (“BLK” wire) circuit.
3	1) Check voltage between “G24-2-3” (“BLK” wire) terminal and body ground with connector (“G24-2”) connected to P/S control module. Is it 10 – 14 V with steering wheel held at position for vehicle to run straight?	Go to STEP 4.	Repair poor connection, high resistance, open or short to power circuit or ground in “G24-2-3” (“BLK” wire) circuit.
4	1) Check motor and its circuit. Refer to “MOTOR AND CLUTCH”. Is motor and clutch in good condition?	Substitute a known-good P/S control module and recheck.	Replace steering column assembly and recheck.

Fig. for Step 2

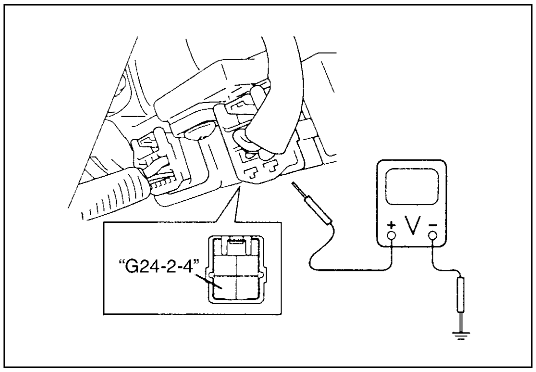
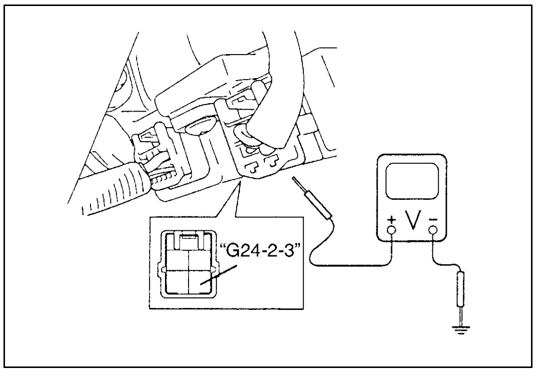
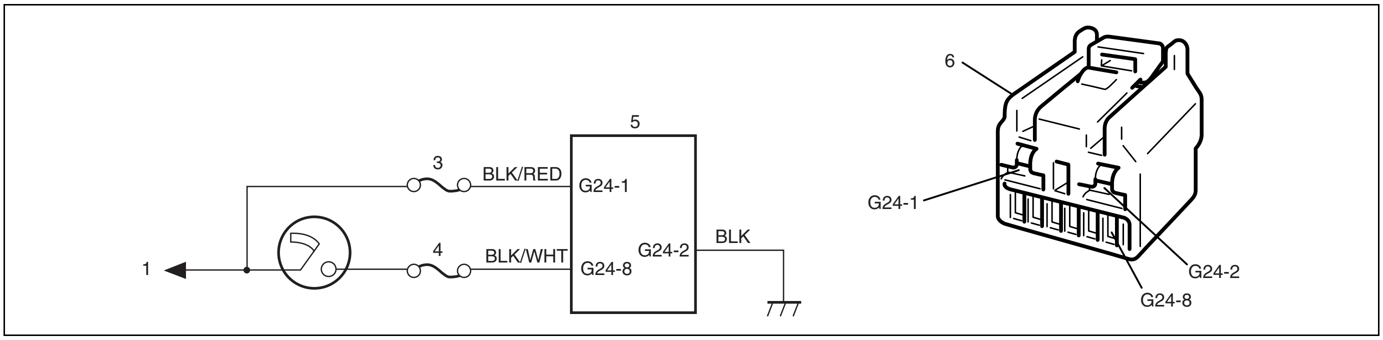


Fig. for Step 3



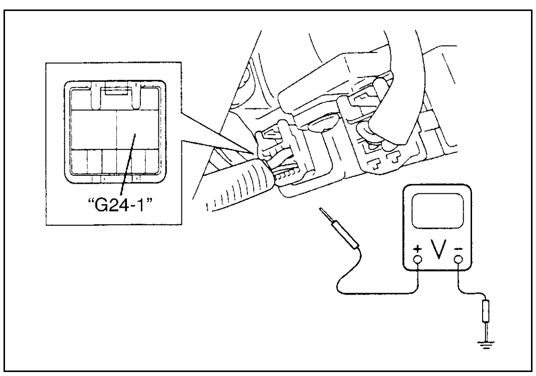
DTC C1153(DTC No.53) P/S CONTROL MODULE POWER SUPPLY CIRCUIT FAILURE



1. To main fuse	3. "P/S" fuse (30A) in fuse box	5. P/S control module
2. Ignition switch	4. "IG METER" fuse (15A) in fuse box	6. Connector "G24"

Step	Action	Yes	No
1	Was "SYSTEM CHECK FLOW TABLE" performed?	Go to STEP 2.	Go to "SYSTEM CHECK FLOW TABLE".
2	1) Remove steering column lower cover. 2) Check "P/S" fuse and proper connection to P/S control module at "G24-1" ("BLK/WHT" wire) terminal. 3) If OK, check voltage between "G24-1" terminal and body ground with connector ("G24") connected to P/S control module. Is it 10 – 14 V?	Check intermittent trouble. Refer to "INTERMITTENT TROUBLE" in SECTION 0A. If OK, substitute a known-good P/S control module and recheck.	Repair poor connection or high resistance in "G24-1" ("BLK/RED" wire) circuit.

Fig. for Step 2



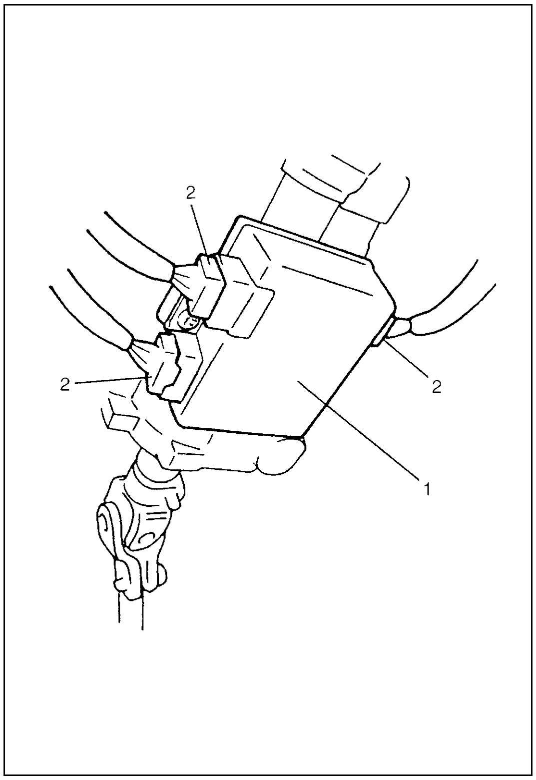
DTC C1152/C1154/C1155 (DTC No.52/54/55) P/S CONTROL MODULE FAILURE

Substitute a known-good P/S control module and recheck.

TROUBLE DIAGNOSIS (FOR TROUBLE NOT INDICATED BY ON BOARD DIAGNOSTIC SYSTEM)

This section describes trouble diagnosis of P/S system parts whose trouble is not indicated by the on-board diagnostic system (self-diagnostic function).
When DTC No.12 is indicated by the on-board diagnostic system (self-diagnosis function) and assuredly those steering basic parts as described in “DIAGNOSIS TABLE” in Section 3 are all in good condition, check the following power steering system parts which may be a possible cause for each symptom of the steering.

Condition	Possible Cause	Correction
Steering wheel feels heavy (Perform STEERING FORCE INSPECTION before diagnosis.)	Steering wheel installed improperly (twisted)	Install steering wheel correctly.
	Poor performance of torque sensor	Check torque sensor. Refer to “TORQUE SENSOR”.
	Poor performance of motor and clutch	Check motor and clutch. Refer to “MOTOR AND CLUTCH”.
	Faulty steering column	Replace.
	Poor performance of VSS	Check VSS. Refer to Section 6E.
Vehicle pulls to one side during straight driving	Poor performance of torque sensor	Check torque sensor. Refer to “TORQUE SENSOR”.
Poor recovery from turns	Poor performance of torque sensor	Check torque sensor. Refer to “TORQUE SENSOR”.
	Faulty steering column	Replace.



INSPECTION OF P/S CONTROL MODULE AND ITS CIRCUITS

P/S control module (1) and its circuits can be checked at P/S control module wiring couplers (2) by measuring voltage and resistance.

CAUTION:

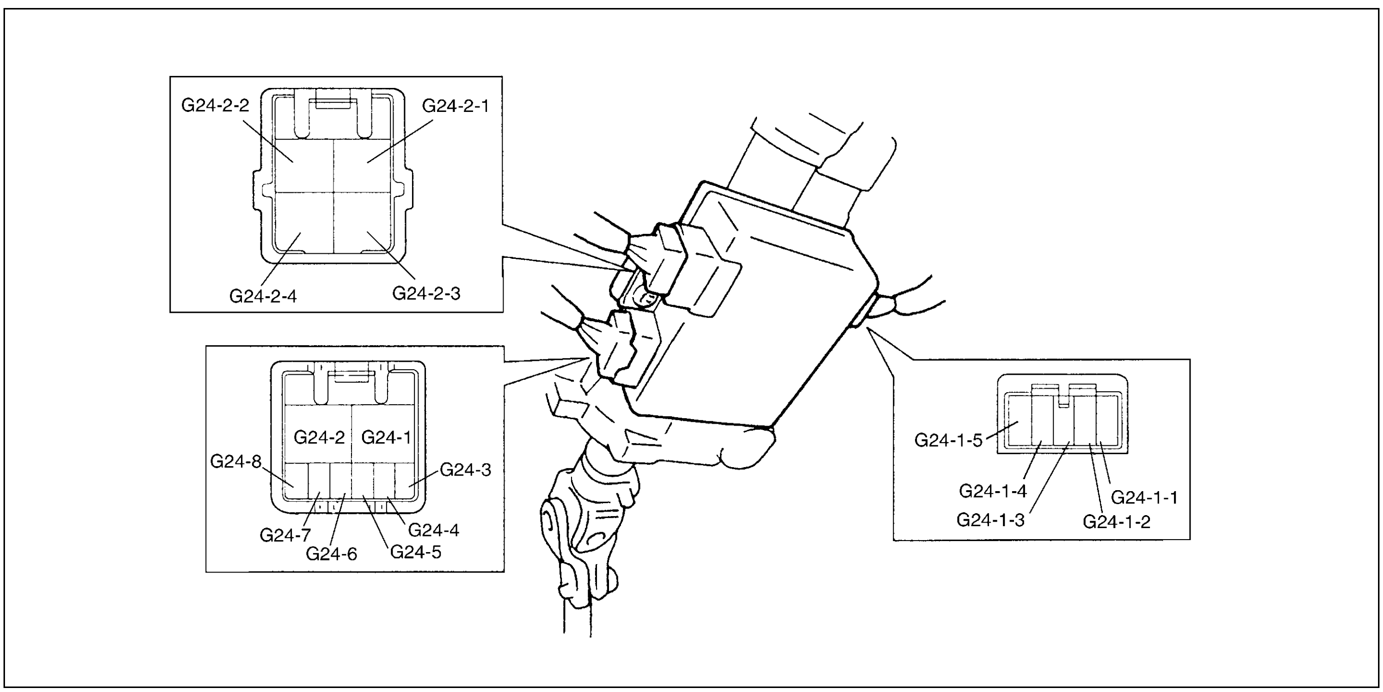
P/S control module cannot be checked by itself. It is strictly prohibited to connect voltmeter or ohmmeter to P/S control module with connector disconnected from it.

Voltage Check

1) Remove steering column lower cover with ignition switch OFF position.
2) Check voltage at each terminal with connectors (2) connected P/S control module.

NOTE:

As each terminal voltage is affected by the battery voltage, confirm that it is 11V or more when ignition switch is ON.



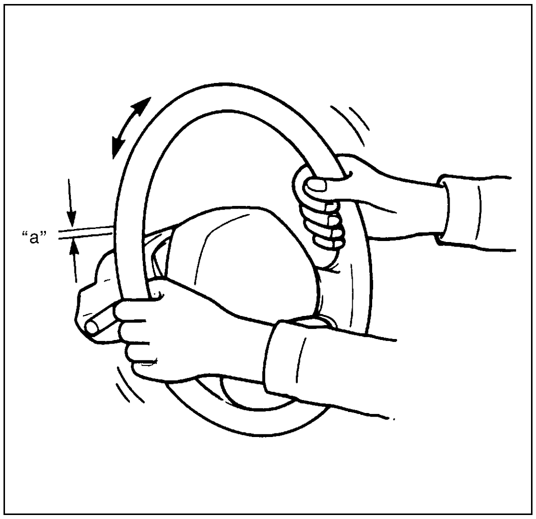
TERMINAL NO.	CIRCUIT	NORMAL VOLTAGE	CONDITION
G24-2	Ground	–	–
G24-1	P/S control module power supply from battery	10 – 14V	–
G24-8	P/S control module power supply from ignition switch	10 – 14V	Ignition switch ON
G24-7	VSS	✱ Indicator deflection repeated 0 – 1V and 9 – 11V	Ignition switch ON Front left tire turned quickly with right tire locked
G24-6	Engine speed signal	✱ Indicator deflection repeated 0 – 1V and 10 – 14V	Engine idling
G24-5	“EPS” light	0V	“EPS” warning lamp ON
G24-4	Diagnosis switch terminal	0 – 14V	Ignition switch ON
G24-3	Data link connector	–	–
G24-2-2	Motor output 2	5 – 7V	Engine idling and steering wheel held at position for vehicle to run straight
G24-2-1	Motor output 1	5 – 7V	Engine idling and steering wheel held at position for vehicle to run straight
G24-2-4	Clutch output 2	0V	–
G24-2-3	Clutch output 1	10 – 14V	Engine idling
G24-1-5	Torque sensor (Main)	About 2.5V	Ignition switch ON and steering wheel held at position for vehicle to run straight Check voltage between “G24-1-5” and “G24-1-3” terminals
G24-1-4	Torque sensor (Sub)	About 2.5V	Ignition switch ON and steering wheel held at position for vehicle to run straight Check voltage between “G24-1-4” and “G24-1-3” terminals
G24-1-3	Torque sensor (GND)	0V	–
G24-1-2	5V power supply for torque sensor	About 5V	Ignition switch ON Check voltage between “G24-1-2” and “G24-1-3” terminals
G24-1-1	8V power supply for torque sensor	About 8V	Ignition switch ON Check voltage between “G24-1-1” and “G24-1-3” terminals

NOTE:

✱ : The voltage of this circuit may fail to check by voltmeter.
If so, use oscilloscope.

STEERING WHEEL PLAY INSPECTION

Check steering wheel for looseness or rattle by trying to move it in its shaft direction and lateral direction.
If found defective, repair or replace.



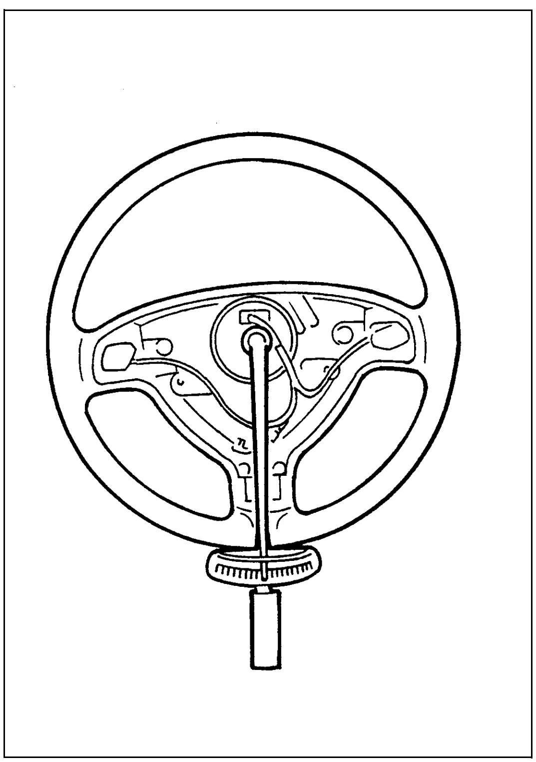
Check steering wheel play, holding vehicle in straight forward condition on the ground and with engine stopped.
If steering wheel play is not within specification, inspect as follows and replace if found defective.

- Tie rod end ball stud for wear
- Lower ball joint for wear
- Steering shaft joint for wear
- Steering pinion or rack gear for wear or breakage
- Each part for looseness

Steering wheel play
“a”: 0 - 30 mm (0 - 1.2 in.)

STEERING FORCE INSPECTION

1) Place vehicle on level road and set steering wheel at straight-ahead position.
2) Check that tire inflation pressure is as specified. (Refer to “TIRE PLACARD” on vehicle.)
3) Remove driver air bag (inflator) module referring to DRIVER AIR BAG (INFLATOR) MODULE in Section 3C.
4) Start engine.



5) With engine idling, measure steering force by turning torque wrench.

Steering force
: Less than 6.4 N·m (0.64 kg·m, 4.6 lb-ft)

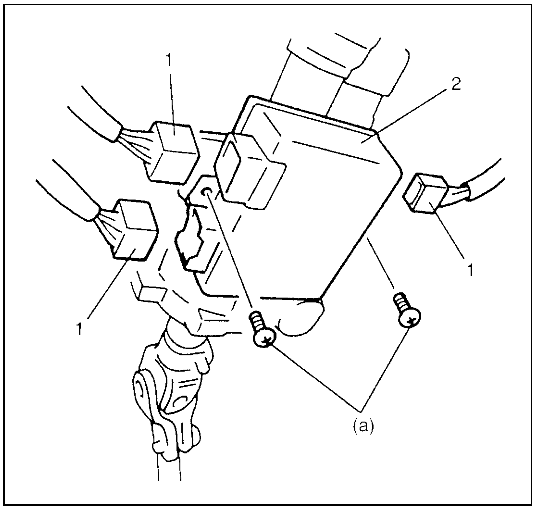
6) Install drive air bag (inflator) module referring to DRIVER AIR BAG (INFLATOR) MODULE in Section 3C.

ON-VEHICLE SERVICE

P/S CONTROL MODULE

REMOVAL

1) Disconnect negative cable at battery.
2) Remove steering column hole cover.



3) Disconnect connectors (1) from P/S control module.
4) Remove P/S control module (2) from steering column assembly.

INSTALLATION

Reverse removal procedure for installation, noting the following.

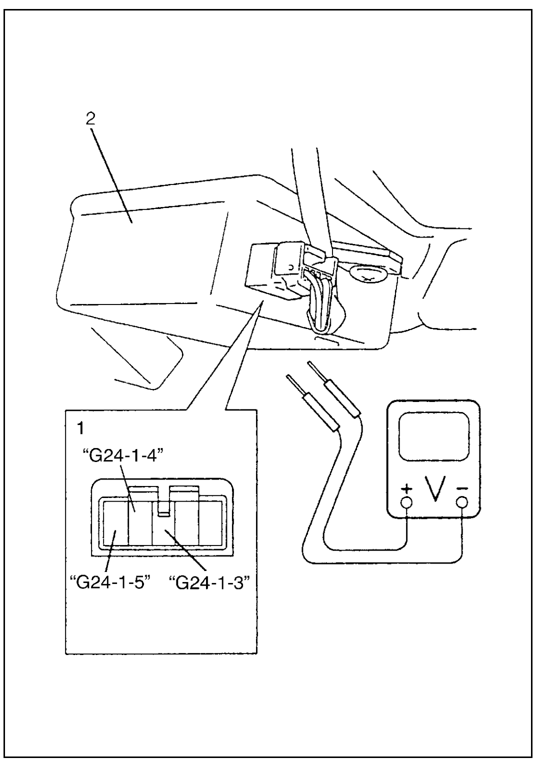
- Tighten P/S control module screw to specified torque.

Tightening torque
P/S control module screw
(a) : 3 N·m (0.3 kg-m, 2.0 lb-ft)

TORQUE SENSOR

ON-VEHICLE INSPECTION

1) Remove steering column hole cover.
2) Turn ignition switch to ON position.



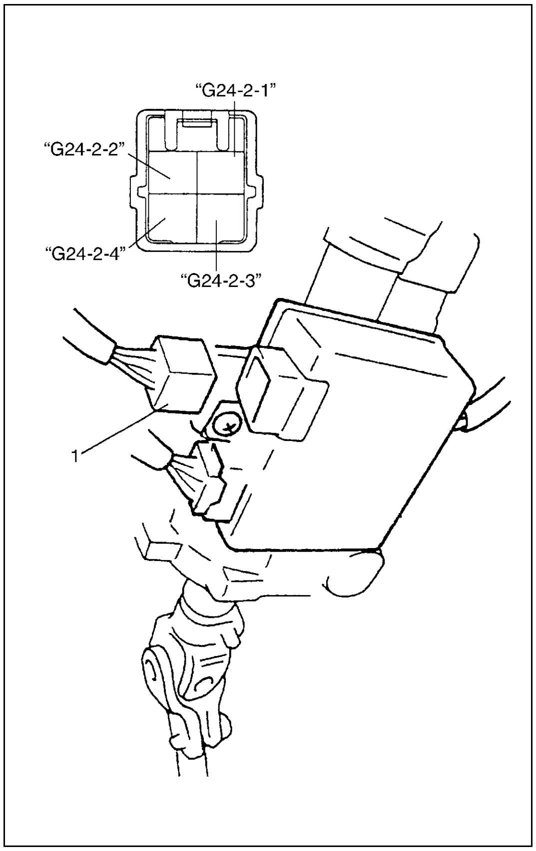
3) Check voltage between terminals of torque sensor connector with connecting it to P/S control module and not running engine.
   If check result is not satisfactory, replace steering column assembly.

Torque sensor specification

	Steering wheel turned fully left	Steering wheel held at position for vehicles torque straight	Steering wheel turned fully right
Main sensor ("G24-1-4" – "G24-1-3")	1.5 V below	About 2.5 V	Above 3.5 V
Sub sensor ("G24-1-5" – "G24-1-3")	1.5 V below	About 2.5 V	Above 3.5 V

MOTOR AND CLUTCH

ON-VEHICLE INSPECTION



1) Remove steering column hole cover.
2) Disconnect motor and clutch connector (1) from P/S control module with ignition switch OFF.
3) Check resistance between terminals of motor and clutch connector (1)
   If check result is not as specified above, replace steering column assembly.

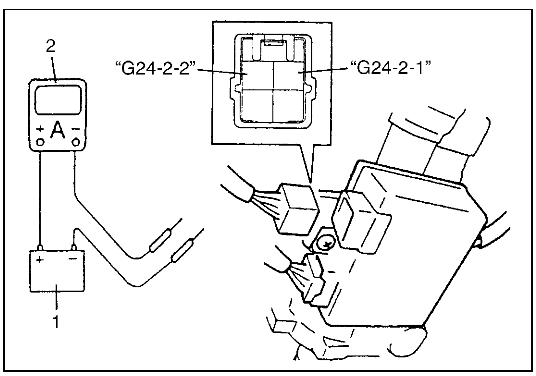
Motor and clutch circuit resistance

"G24-2-2" and "G24-2-1" (For motor)	**About 1 Ω**
"G24-2-4" and "G24-2-3" (For clutch)	**About 12 Ω (at 20°C (68°F))**

4) Check continuity between terminal of motor and clutch connector (1) and body ground.
   If check result is not as specified above, replace steering column assembly.

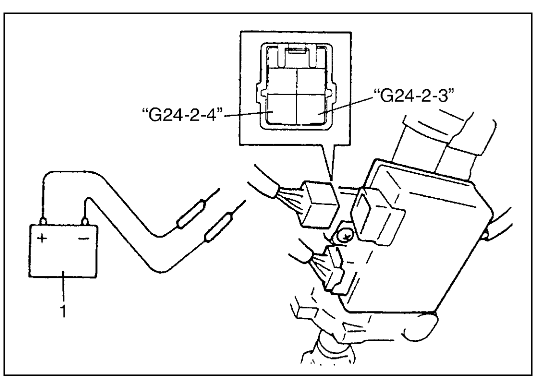
Motor and clutch circuit resistance (to body ground)

"G24-2-4" and body ground	**No continuity**
"G24-2-2" and body ground	**No continuity**



5) Connect battery (1) between "G24-2-2" and "G24-2-1". Check that motor rotates smoothly, then measure current between "G24-2-1" and "G24-2-2" using ammeter (2) as shown in figure.
   If check result is not satisfactory, replace steering column assembly.

Motor and clutch circuit current (reference value)
Standard : About 0.65 A



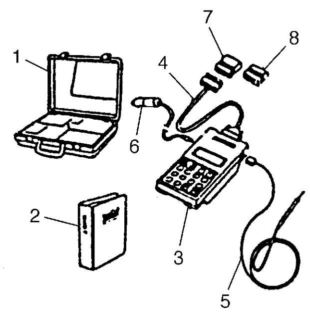
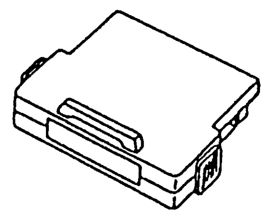
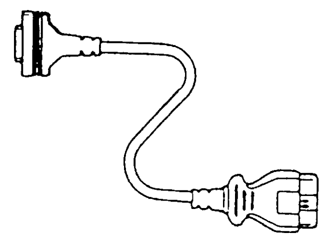
6) Connect battery (1) between "G24-2-4" and "G24-2-3", then check that clutch operation sound is heard.
   If check result is not satisfactory, replace steering column assembly.

STEERING COLUMN ASSEMBLY

Refer to Section 3C for removal and installation of steering column assembly but perform the following step beforehand.

- Disconnect all connectors from P/S control module.

SPECIAL TOOL

		
09931-76011 Tech 1A kit See NOTE below.	Mass storage cartridge	09931-76030 16/14 pin DLC cable

NOTE:

This kit includes the following items.

1. Storage case, 2. Operator's manual, 3. Tech 1A, 4. DLC cable, 5. Test lead/probe,
6. Power source cable, 7. DLC cable adapter, 8. Self-test adapter

SECTION 3C

STEERING WHEEL AND COLUMN

WARNING:

For vehicles equipped with Supplemental Restraint (Air Bag) System:

- **Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Please observe all WARNINGS and "Service Precautions" under "On-Vehicle Service" in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.**
- **The procedures in this section must be followed in the order listed to temporarily disable the air bag system and prevent false diagnostic codes from setting. Failure to follow procedures could result in possible air bag system activation, personal injury or otherwise unneeded air bag system repairs.**

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 value must be used when installing fasteners that require it. If the above procedures are not followed, parts or system damage could result.

CONTENTS

GENERAL DESCRIPTION

STEERING COLUMN

This double tube type steering column has following three important features in addition to the steering function :

- The column is energy absorbing, designed to compress in a front-end collision.
- The ignition switch and lock are mounted conveniently on this column.
- With the column mounted lock, the ignition and steering operations can be locked to inhibit theft of the vehicle.

To insure the energy absorbing action, it is important that only the specified screws, bolts, and nuts be used as designated and that they are tightened to the specified torque.
When the column assembly is removed from the vehicle, special care must be taken in handling it. Use of a steering wheel puller other than the one recommended in this manual or a sharp blow on the end of the steering shaft, leaning on the assembly, or dropping the assembly could shear the plastic shear pins which maintain column length and position.

STEERING WHEEL AND DRIVER AIR BAG (INFLATOR) MODULE

The driver air bag (inflator) module is one of the supplemental restraint (air bag) system components and is mounted to the center of the steering wheel. During certain frontal crashes, the air bag system supplements the restraint of the driver's and passenger's seat belts by deploying the air bags.
The air bag (inflator) module should be handled with care to prevent accidental deployment. When servicing, be sure to observe all WARNINGS and CAUTIONS and "SERVICE PRECAUTIONS" under "ON-VEHICLE SERVICE" in Section 10B.

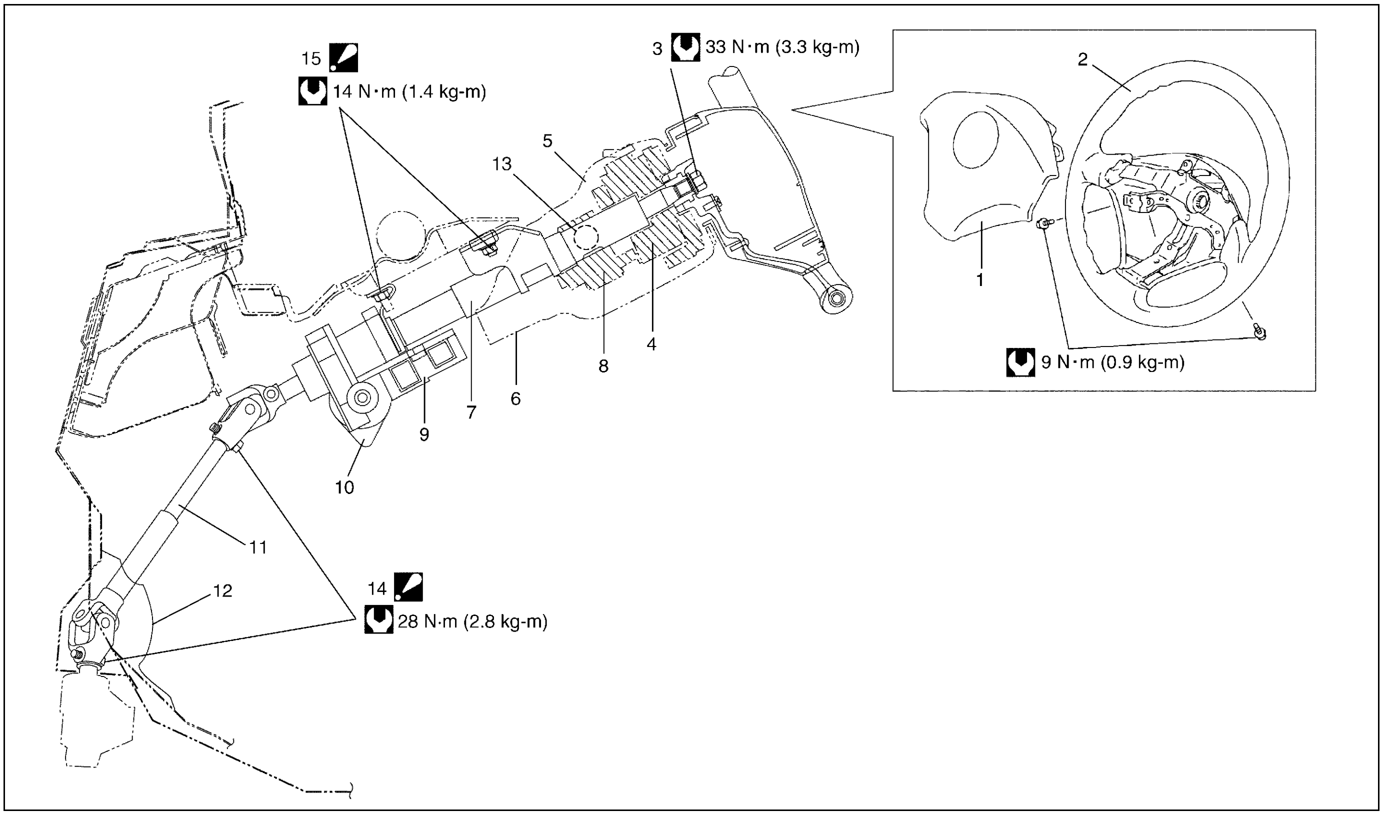
DIAGNOSIS

For maintenance service of the steering wheel and column, refer to Section 0B.
For diagnosis of the steering wheel and column, refer to Section 3.
For diagnosis of the air bag system, refer to Section 10B.

INSPECTION AND REPAIR REQUIRED AFTER ACCIDENT

After an accident, whether the air bag has been deployed or not, be sure to perform checks, inspections and repairs described under "CHECKING STEERING COLUMN ASSEMBLY AND LOWER SHAFT FOR ACCIDENT DAMAGE" as well as "REPAIRS AND INSPECTIONS REQUIRED AFTER ACCIDENT" under "DIAGNOSIS" in Section 10B.

ON-VEHICLE SERVICE



1. Driver air bag (inflator) module	7. Steering column assembly		13.	Immobilizer control module (if equipped)
2. Steering wheel	8. Steering lock assembly (ignition switch)		14.	Upper and lower joint bolt : After tightening lower joint bolt, tighten upper joint bolt.
3. Steering wheel nut	9. P/S control module (if equipped)		15.	Steering column mounting nut : After tightening lower nut, tightening upper nut.
4. Contact coil and combination switch assembly	10. Motor for P/S system (if equipped)			Tightening torque
5. Steering column upper cover	11. Steering lower shaft			
6. Steering column lower cover	12. Steering joint cover			

SERVICE PRECAUTIONS

For service precautions, refer to “SERVICE PRECAUTIONS” under “ON-VEHICLE SERVICE” in Section 10B.

SERVICE AND DIAGNOSIS

For diagnosis and servicing, refer to “SERVICE AND DIAGNOSIS” under “SERVICE PRECAUTIONS” in Section 10B.

DISABLING AIR BAG SYSTEM

For disabling air bag system, refer to “DISABLING AIR BAG SYSTEM” under “SERVICE PRECAUTIONS” in Section 10B.

ENABLING AIR BAG SYSTEM

For enabling air bag system, refer to “ENABLING AIR BAG SYSTEM” under “SERVICE PRECAUTIONS” in Section 10B.

HANDLING AND STORAGE

For handling and storage, refer to “HANDLING AND STORAGE” under “SERVICE PRECAUTIONS” in Section 10B.

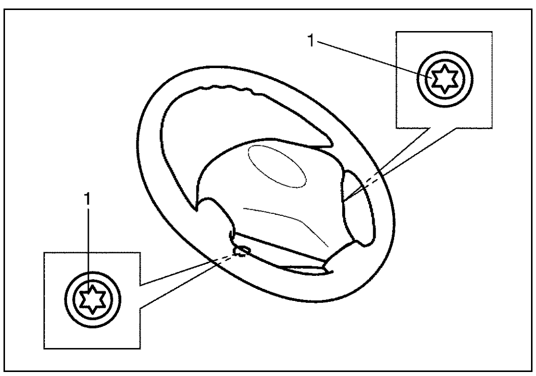
DISPOSAL

For disposal, refer to “DISPOSAL” under “SERVICE PRECAUTIONS” in Section 10B.

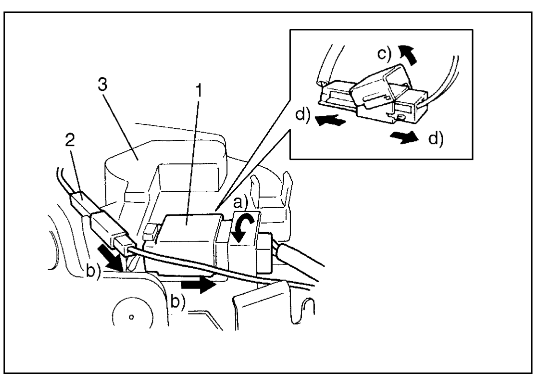
DRIVER AIR BAG (INFLATOR) MODULE

WARNING:
When handling an air bag (inflator) module, be sure to read “SERVICE PRECAUTIONS” in Section 10B and observe each instruction. Failure to follow them could cause a damage to the air bag (inflator) module or result in personal injury.

REMOVAL

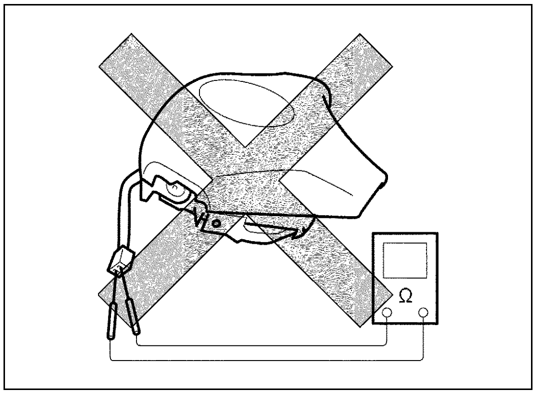


1) Disconnect negative cable at battery.
2) Disable air bag system. Refer to “DISABLING AIR BAG SYSTEM” under “SERVICE PRECAUTIONS” in Section 10B.
3) Loosen 2 bolts (1) mounting driver air bag (inflator) module on its both side.



4) Remove driver air bag (inflator) module (3) from steering wheel.
5) Disconnect yellow connector (1) of driver air bag (inflator) module and horn connector (2) in order a) – d) shown in figure.

INSPECTION

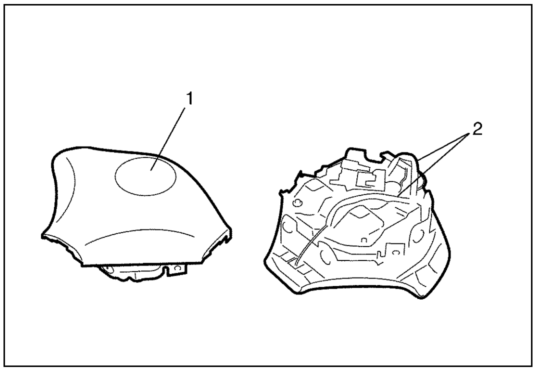


WARNING:

Never disassemble driver air bag (inflator) module or measure its resistance. Otherwise, personal injury may result.

CAUTION:

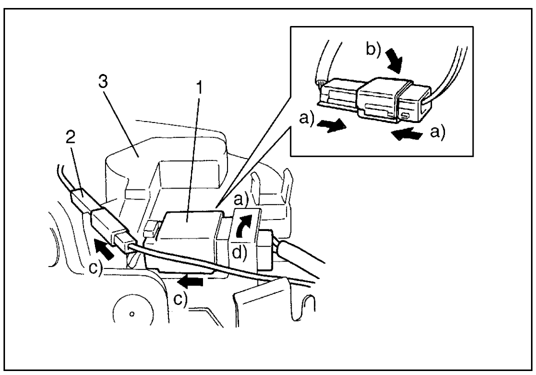
If air bag (inflator) module was dropped from a height of 90 cm (3 ft) or more, it should be replaced.



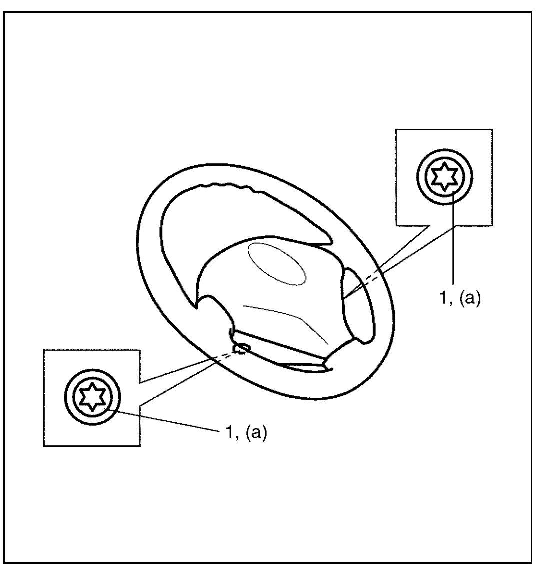
Check air bag (inflator) module visually and if any of the following is found, replace it with a new one.

- Air bag being deployed
- Trim cover (pad surface) (1) being cracked
- Wire harness or connector (2) being damaged
- Air bag (inflator) module being damaged or having been exposed to strong impact (dropped)

INSTALLATION



1) Check that horn wire is connected to horn connector (2) securely.
2) Connect yellow connector (1) of driver air bag (inflator) module (3) and horn connector in order a) – d) shown in figure securely.



3) Install driver air bag (inflator) module to steering wheel, taking care so that no part of wire harness is caught between them.
4) Make sure that clearance between module and steering wheel is uniform all the way.
5) Tighten driver air bag (inflator) module mounting bolts (1) to specified torque.

Tightening torque
Driver air bag (inflator) module mounting bolt
(a) : 9 N·m (0.9 kg-m, 6.5 lb-ft)

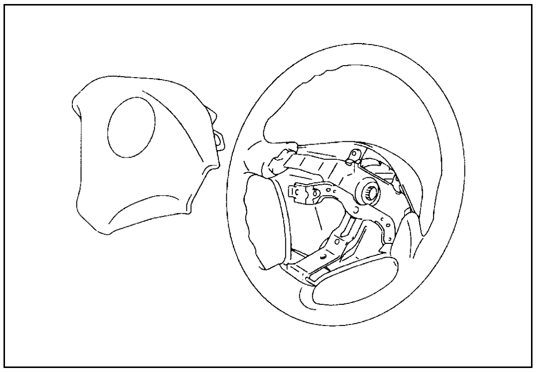
6) Connect negative cable at battery.
7) Enable air bag system. Refer to “ENABLING AIR BAG SYSTEM” under “SERVICE PRECAUTIONS” in Section 10B.

STEERING WHEEL

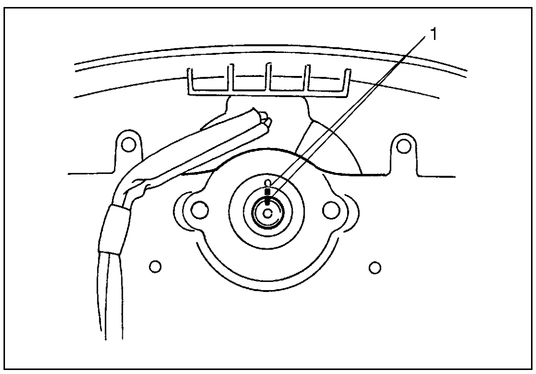
CAUTION:

Removal of the steering wheel allows the contact coil to turn freely but do not turn the contact coil (on the combination switch) more than allowable number of turns (about two and a half turns from the center position clockwise or counterclockwise respectively), or coil will break.

REMOVAL



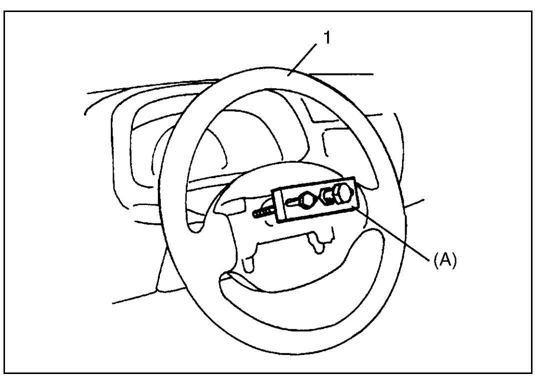
1) Remove driver air bag (inflator) module from steering wheel. Refer to “DRIVER AIR BAG (INFLATOR) MODULE”.



2) Remove steering shaft nut.
3) Make alignment marks (1) on steering wheel and shaft for a guide during reinstallation.

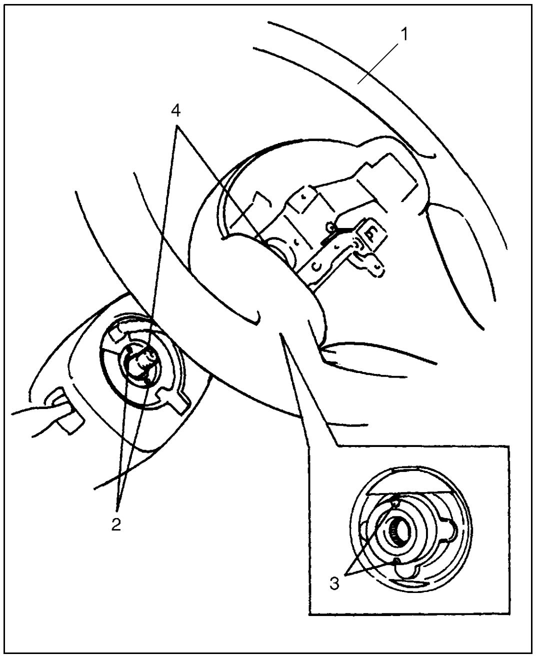
CAUTION:

Do not hammer the end of the shaft. Hammering it will loosen the plastic shear pins which maintain the column length and impair the collapsible design of the column.



4) Remove steering wheel (1) with special tool.

Special tool
(A) : 09944-36011

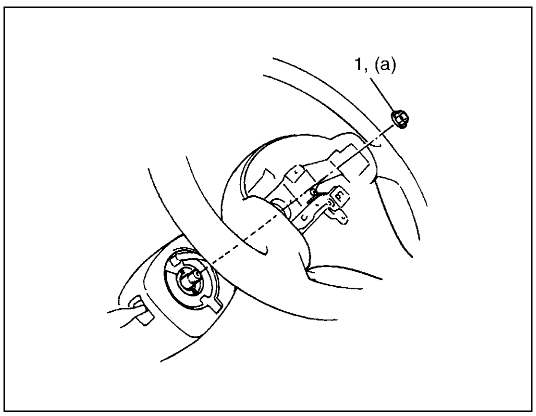


INSTALLATION

1) Check that vehicle's front tires are at straight-ahead position and contact coil is centered. Refer to "CENTERING CONTACT COIL".

CAUTION:
These two conditions are prerequisite for installation of steering wheel. If steering wheel has been installed without these conditions, contact coil will break when steering wheel is turned.

2) Install steering wheel (1) to steering shaft with 2 lugs (2) on contact coil fitted in two grooves (3) in the back of steering wheel and also aligning marks (4) on steering wheel and steering shaft.



3) Tighten steering shaft nut (1) to specified torque.

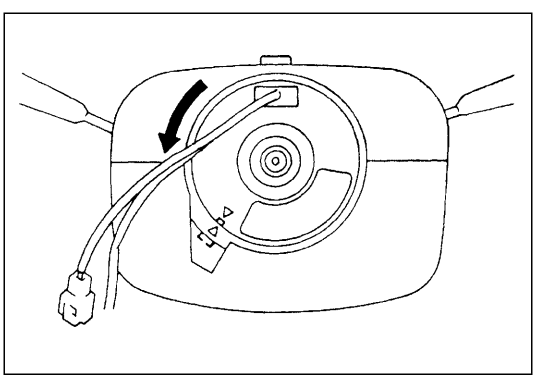
Tightening torque
Steering shaft nut (a) : 33 N·m (3.3 kg-m, 24.0 lb-ft)

NOTE:
After installing the steering wheel, turn the steering wheel about 1 full rotation so that the cancel cam pin fits into the pin hole in the steering wheel and then check the turn signal lever for proper function.

4) Install driver air bag (inflator) module to steering wheel. Refer to "DRIVER AIR BAG (INFLATOR) MODULE".

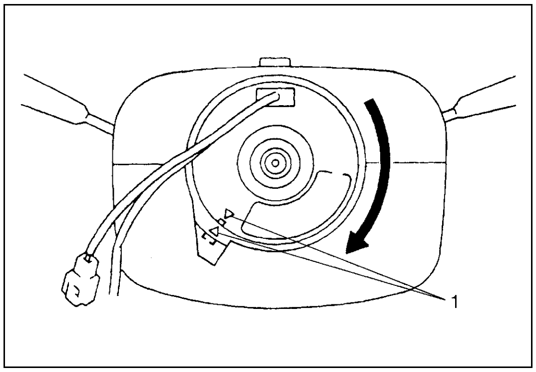
CENTERING CONTACT COIL

1) Check that vehicle's wheels (front tires) are set at straight-ahead position.
2) Check that ignition switch is at "LOCK" position.



3) Turn contact coil counterclockwise slowly with a light force till contact coil will not turn any further.

NOTE:
Contact coil can turn about 5 turns at maximum, that is, if it is at the center position, can turn about two and a half turns both clockwise and counterclockwise.



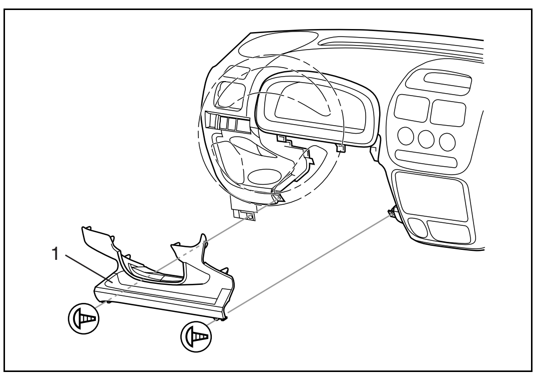
4) From the position where contact coil became unable to turn any further (it stopped), turn it back clockwise about two and a half rotations and align center mark (1) with alignment mark.

CONTACT COIL AND COMBINATION SWITCH ASSEMBLY

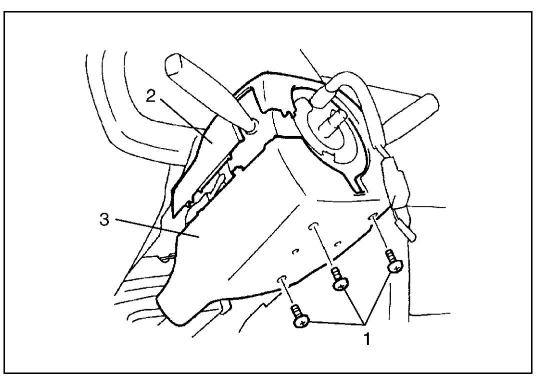
CAUTION:
Do not turn contact coil (on combination switch) more than allowable number of turns (about two and a half turns from the center position clockwise or counter-clockwise respectively), or coil will break.

REMOVAL

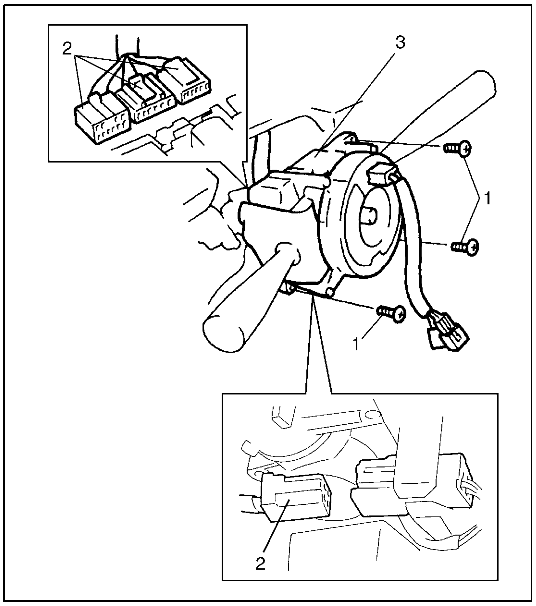
1) Remove steering wheel from steering column referring to “STEERING WHEEL” in this section.



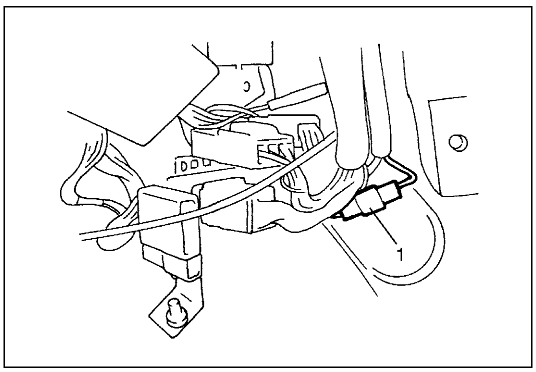
2) Remove steering column hole cover (1).



3) Remove steering column cover screws (1).
4) Separate upper cover (2) and lower cover (3), then remove them.



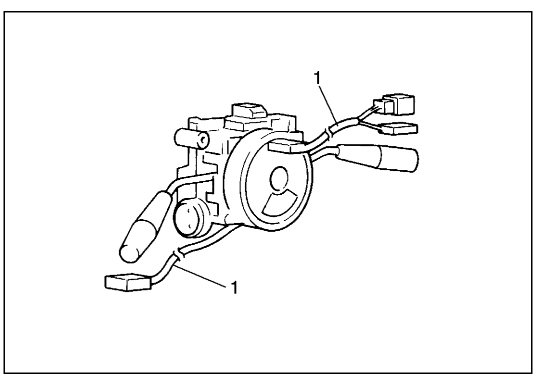
5) Remove contact coil and combination switch assembly screws (1) and disconnect connectors (2) from combination switch (3).



6) Disconnect horn connector (1) from instrument panel harness.

7) Remove contact coil and combination switch assembly from steering column.

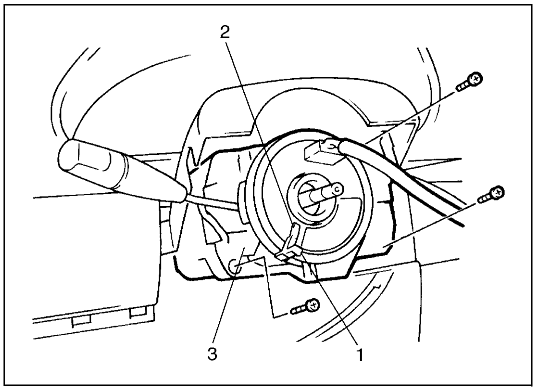
INSPECTION



Check contact coil harness (1) for any signs of scorching, melting or other damage.
If it is damaged, replace.

INSTALLATION

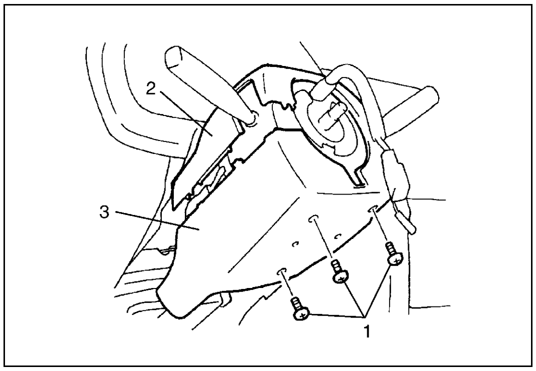
1) Check to make sure that vehicle's front tires are set at straight-ahead position and then ignition switch is at "LOCK" position.
2) Connect all connectors disconnected in REMOVAL.



3) Install contact coil and combination switch assembly (3) to steering column.

NOTE:

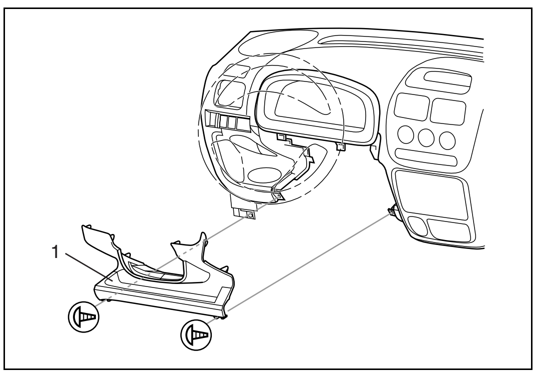
New contact coil and combination switch assembly is supplied with contact coil set and held at its center position with a lock pin (1) and seal (2). Remove this lock pin after installing contact coil and combination switch assembly to steering column.



4) Install steering column upper cover (2) and lower cover (3), and then tighten steering column cover screws (1).

CAUTION:

When installing lower cover (3) and upper cover (2), be careful so that contact coil and combination switch lead wire is not caught between covers.



5) Install steering column hole cover (1).
6) Install steering wheel to steering column. Refer to “STEERING WHEEL”.

STEERING COLUMN ASSEMBLY

CAUTION:

Once the steering column is removed from the vehicle, the column is extremely susceptible to damage.

- **Dropping the column assembly on its end could collapse the steering shaft or loosen the plastic shear pins which maintain column length.**
- **Leaning on the column assembly could cause it to bend or deform.**

Any of the above damage could impair the column’s collapsible design.

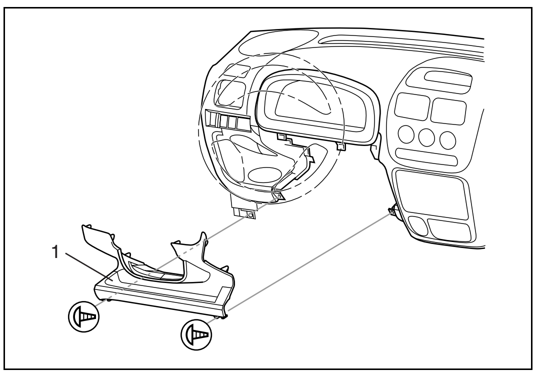
NOTE:

When servicing steering column or any column-mounted component, remove steering wheel. But when removing steering column simply to gain access to instrument panel components, leave steering wheel installed on steering column.

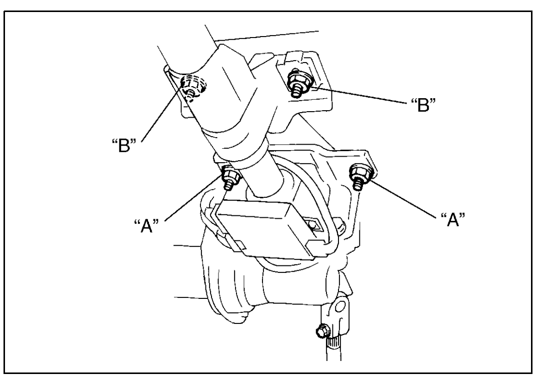
REMOVAL

> **WARNING:**
> **Never rest a steering column assembly on the steering wheel with the air bag (inflator) module face down and column vertical. Otherwise, personal injury may result.**

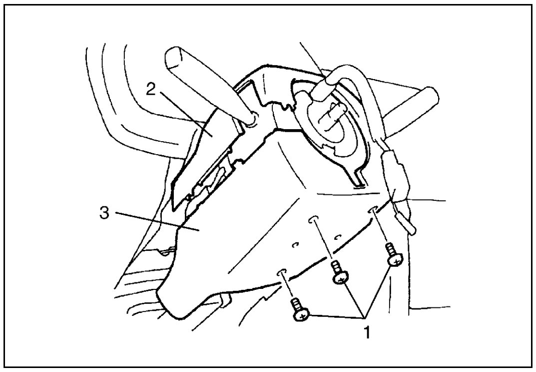
1) Disconnect negative cable at battery.
2) Disable air bag system. Refer to “DISABLING AIR BAG SYSTEM” under “SERVICE PRECAUTIONS” in Section 10B.
3) If it is necessary to remove steering wheel and contact coil and combination switch assembly, remove them, referring to “STEERING WHEEL” and “CONTACT COIL AND COMBINATION SWITCH ASSEMBLY”.
   If it is not necessary to remove steering wheel and contact coil and combination switch assembly, perform the following procedure.
   a) Turn steering wheel so that vehicle’s front tires are at straight-ahead position.
   b) Turn ignition switch to “LOCK” position and remove key.



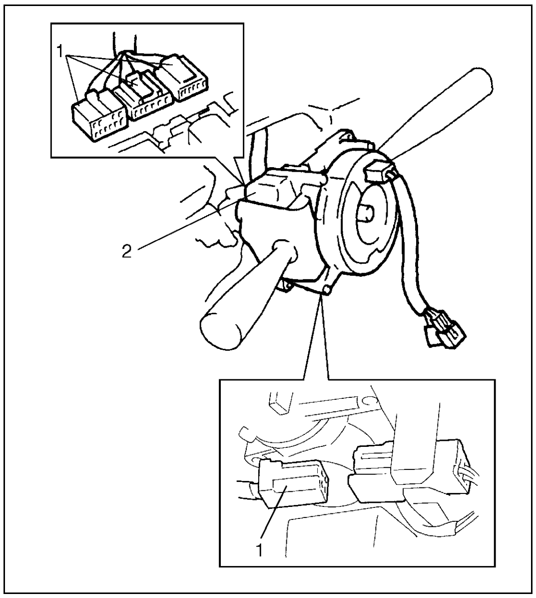
4) Remove steering column hole cover (1).



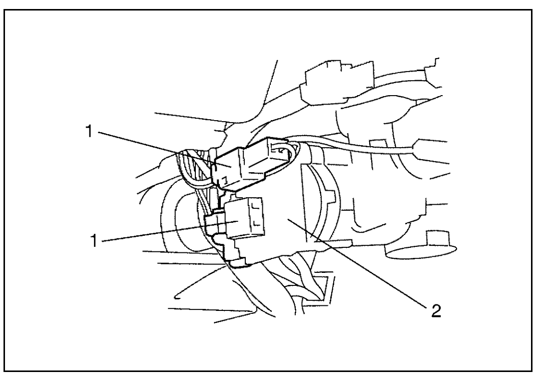
5) Loosen steering column mounting nuts (“A”, “B”).



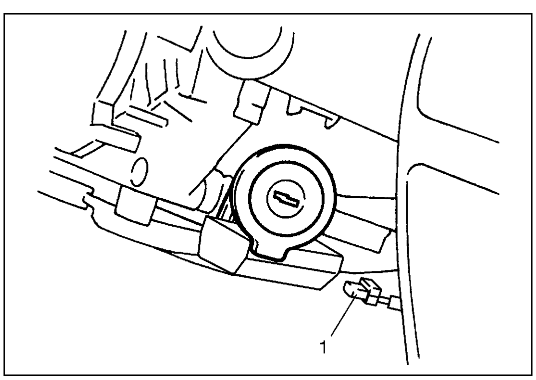
6) Remove steering column cover screws (1).
7) Separate upper column cover (2) and lower column cover (3), then remove them.



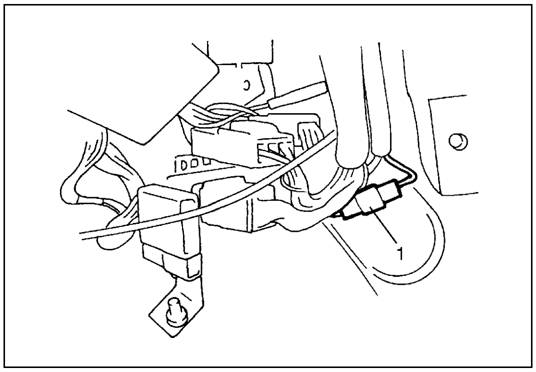
8) Disconnect connectors (1) from combination switch assembly (2).



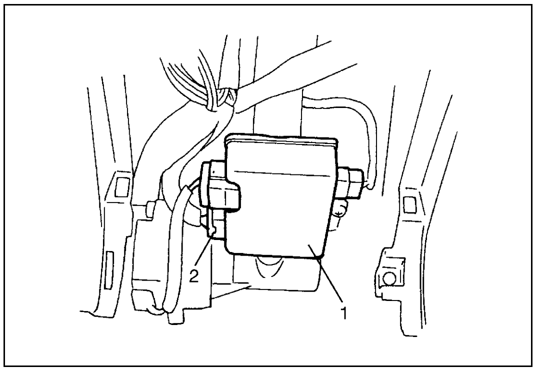
9) Disconnect ignition switch connectors (1) from ignition switch (2).



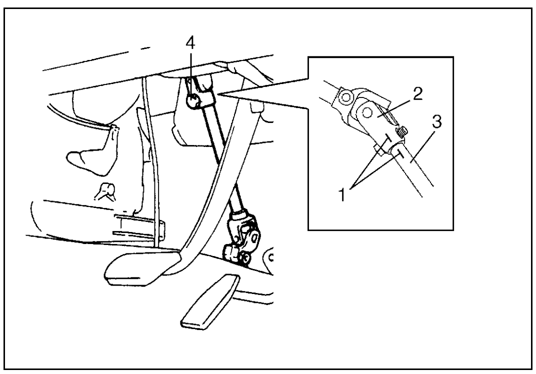
10) Disconnect immobilizer controller connector (1) (if equipped).



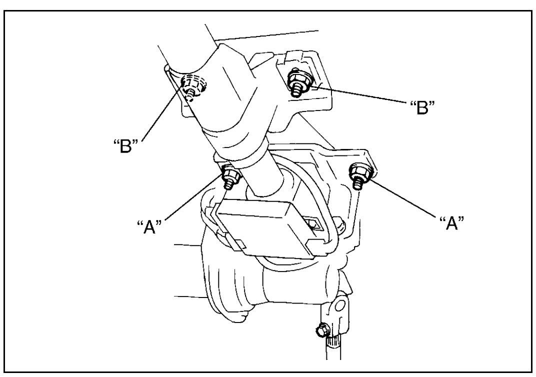
11) Disconnect horn connector (1) from instrument panel harness.



12) If equipped with power steering (P/S) system, disconnect connector (2) from P/S control module (1).



13) Remove steering joint cover.
14) Make alignment marks (1) on joint (2) of steering column and steering lower shaft (3) for a guide during reinstallation.
15) Remove joint bolt (steering column side) (4).



16) Remove steering column mounting nuts ("A", "B").
17) Remove steering column assembly from vehicle.

> **CAUTION:**
> **Don't separate steering column assembly into steering column and shaft. If column or shaft is defective, replace as an assembly.**

18) If it is necessary to remove steering lock assembly (ignition switch), remove it, referring to "STEERING LOCK ASSEMBLY (IGNITION SWITCH)" in this section.

INSPECTION

NOTE:

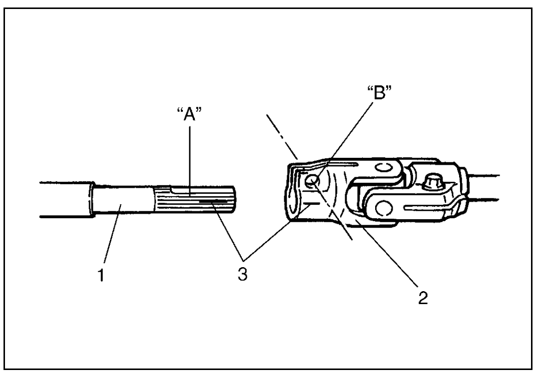
Vehicles involved in accidents resulting in body damage, where steering column has been impacted (or air bag deployed), may have a damaged or misaligned steering column. For checking procedure of steering column assembly, refer to "CHECKING STEERING COLUMN ASSEMBLY AND LOWER SHAFT FOR ACCIDENT DAMAGE".

INSTALLATION

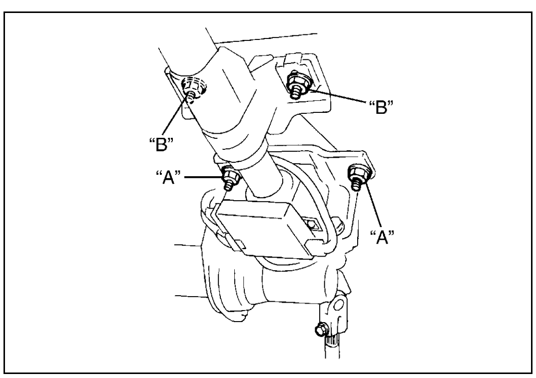
CAUTION:

After tightening steering column mounting nuts, shaft joint bolts should be tightened. Wrong tightening order above could cause a damage to shaft joint.

1) Be sure that front wheels and steering wheel are in straight forward state.
   If steering lock assembly (ignition switch) is removed, install it, referring to "STEERING LOCK ASSEMBLY (IGNITION SWITCH)" in this section.



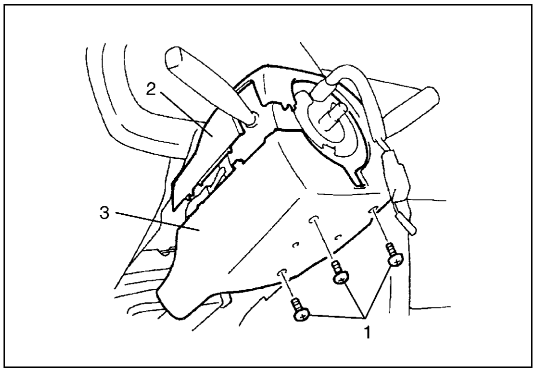
2) Align flat part "A" of steering lower shaft (1) with bolt hole "B" of joint (2) of steering column as shown. Then insert steering lower shaft (1) into shaft joint (2) of steering column with matching marks (3) made before removal.



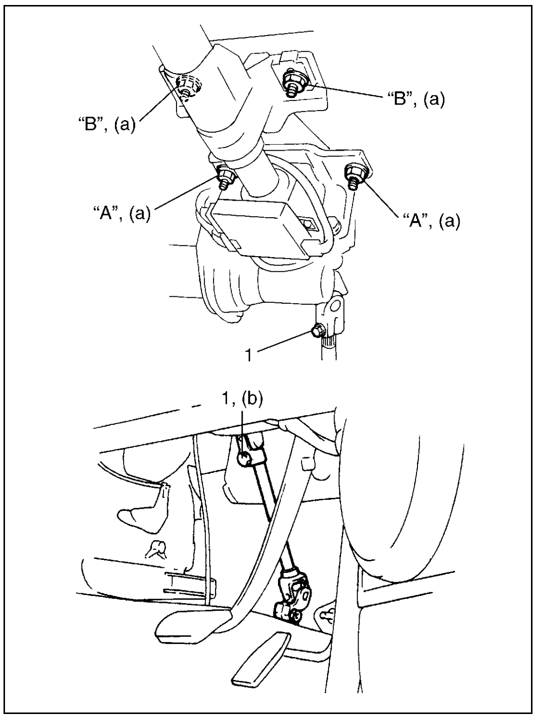
3) Install steering column and tighten steering column mounting nuts ("A", "B") by hand.

4) Connect all connectors disconnected in REMOVAL.
   - Ignition switch
   - Combination switch
   - P/S control module (if equipped)
   - Horn
   - Immobilizer control module (if equipped)

5) If contact coil and combination switch assembly is removed, install it.
   Refer to "CONTACT COIL AND COMBINATION SWITCH ASSEMBLY".



6) Install upper and lower column covers (2 and 3) to steering column assembly by screws (1).



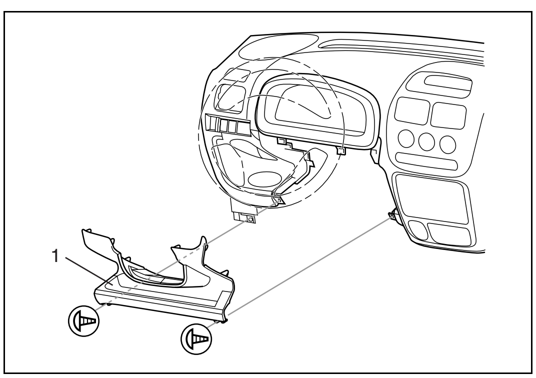
7) Tighten mounting nuts to specified torque in the order "A" – "B" indicated in figure.

Tightening torque
Steering column mounting nut
(a) : 14 N·m (1.4 kg-m, 10.5 lb-ft)

8) Tighten joint bolt (1) (steering column side) to specified torque.

Tightening torque
Steering shaft joint bolt (steering column side)
(b) : 28 N·m (2.8 kg-m, 20.0 lb-ft)

9) Install steering joint cover.

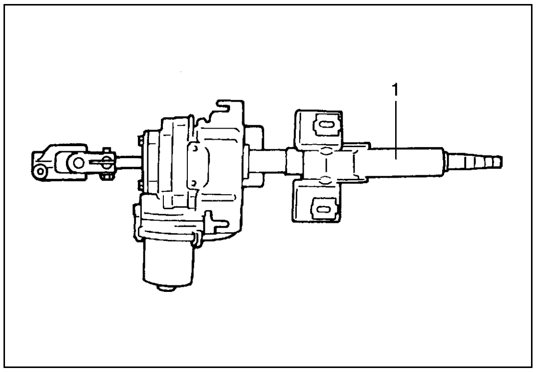


10) Install steering column hole cover (1).

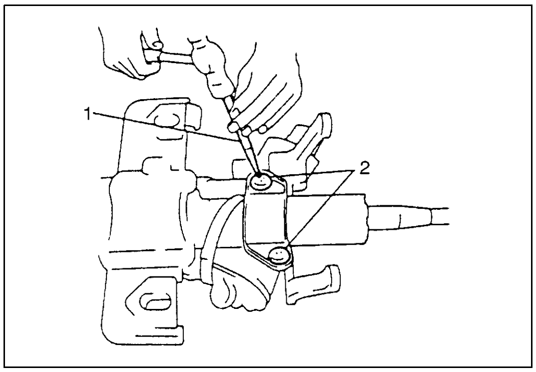
11) If steering wheel is removed, install steering wheel. Refer to "STEERING WHEEL".
12) Enable air bag system. Refer to "ENABLING AIR BAG SYSTEM" under "SERVICE PRECAUTIONS" in Section 10B.
13) Connect negative cable at battery.

STEERING LOCK ASSEMBLY (IGNITION SWITCH)

REMOVAL



1) Remove steering column (1). Refer to “STEERING COLUMN”.



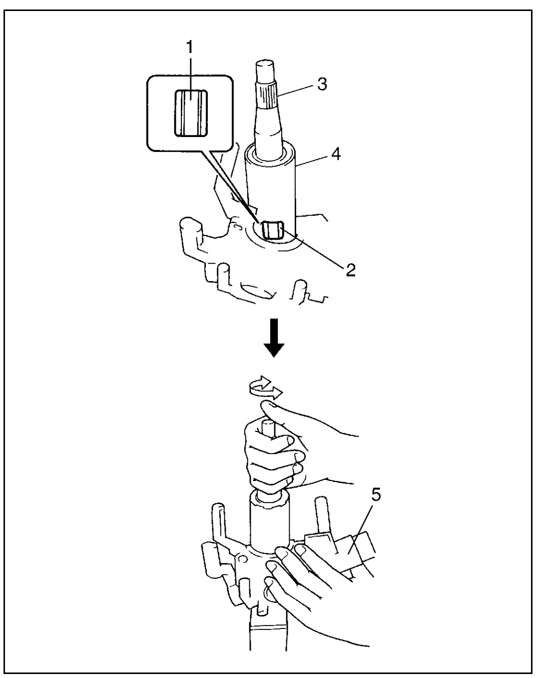
2) Using center punch (1), loosen and remove steering lock mounting bolts (2).

NOTE:

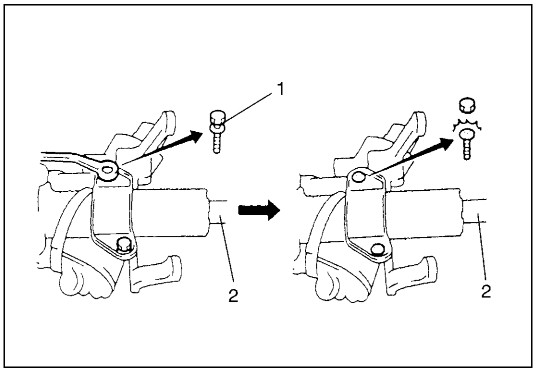
Use care not to damage aluminum part of steering lock body with center punch.

3) Turn ignition key to “ACC” or “ON” position and remove steering lock assembly from steering column.

INSTALLATION



1) Position oblong hole (1) of steering shaft (2) in the center of hole (3) in column (4).
2) Turn ignition key to “ACC” or “ON” position and install steering lock assembly (5) onto column (4).
3) Now turn ignition key to “LOCK” position and pull it out.
4) Align hub on lock with oblong hole (1) of steering shaft (2) and rotate shaft to assure that steering shaft (4) is locked.



5) Tighten new bolts (1) until head of each bolt is broken off.
6) Turn ignition key to “ACC” or “ON” position and check to be sure that steering shaft (2) rotates smoothly. Also check for lock operation.

7) Install steering column. Refer to “STEERING COLUMN”.

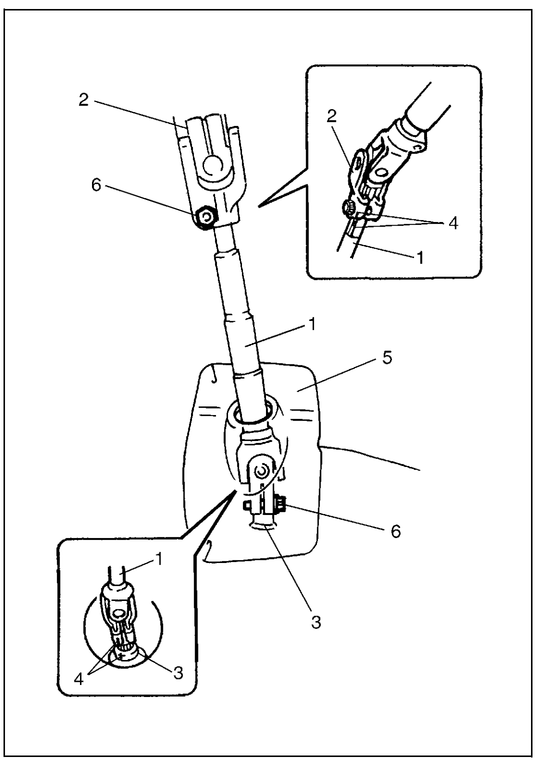
STEERING LOWER SHAFT

CAUTION:

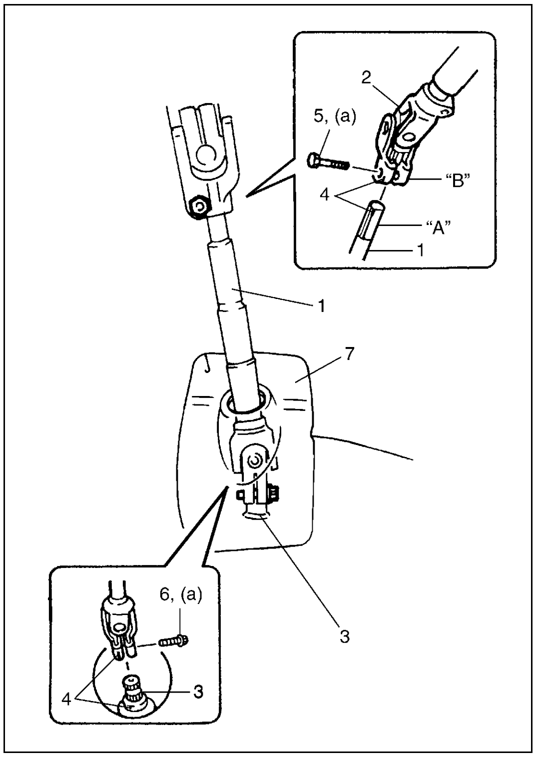
Never turn steering wheel while steering lower shaft is removed.

Should it have been turned and contact coil (on combination switch) have got out of its centered position, it needs to be centered again. Also, turning steering wheel more than about two and a half turns will break contact coil.

REMOVAL



1) Turn steering wheel so that vehicle’s front tires are at straight-ahead position.
2) Turn ignition switch to “LOCK” position and remove key.
3) Remove steering joint cover (5).
4) Make alignment marks (4) on lower shaft (1) and shaft joint of steering column (2) and lower shaft (1) and pinion shaft (3) for a guide during reinstallation.
5) Remove lower shaft joint bolts (6).
6) Remove steering lower shaft (1).



INSTALLATION

1) Be sure that front wheels and steering wheel are in straight forward state.
2) Align flat part "A" of steering lower shaft (1) with bolt hole "B" of shaft joint (2) of column as shown. Then insert lower shaft into shaft joint of steering column with matching marks (4).
3) Insert lower shaft (1) into pinion shaft (3) with matching marks (4).
4) Tighten joint bolt (pinion shaft side) (6) to specified torque first and then joint bolt (steering column side) (5) to specified torque.

Tightening torque
Steering shaft joint bolt (a) : 28 N·m (2.8 kg-m, 20.0 lb-ft)

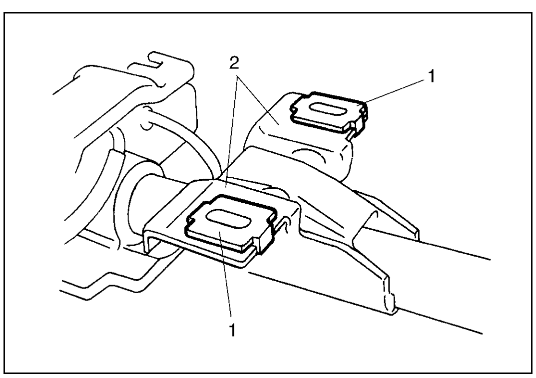
5) Install steering joint cover (7).

CHECKING STEERING COLUMN ASSEMBLY AND LOWER SHAFT FOR ACCIDENT DAMAGE

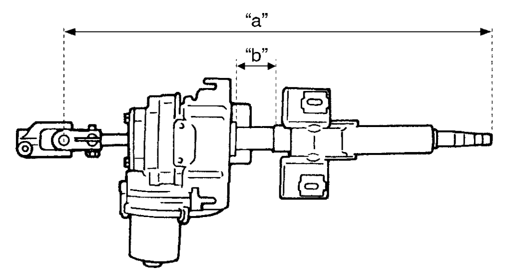
NOTE:

Vehicles involved in accidents resulting in body damage, where steering column has been impacted (or air bag deployed) may have a damaged or misaligned steering column.

CHECKING PROCEDURE



1) Check that each capsule (1) is attached to steering column bracket (2) securely.
   If capsules are loosen, replace steering column assembly.
2) Check two capsules for any damages such as crack or breakage.
   If anything is found faulty, replace as steering column assembly.

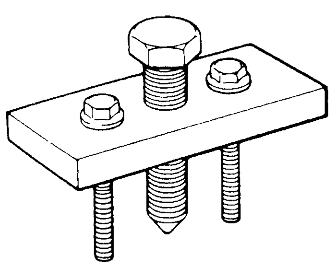


3) Take measurement "a", "b" as shown.
   If it is shorter than specified length, replace column assembly with new one.

   Steering shaft and column length
   "a" : 518 - 521 mm (20.4 - 20.5 in.)
   "b" : 50 mm (1.97 in.)

4) Check steering shaft joints and shaft for any damages such as crack, breakage, malfunction or excessive play.
   If anything is found faulty, replace as lower shaft assembly or column assembly.
5) Check steering shaft for smooth rotation.
   If found defective, replace as column assembly.
6) Check steering shaft and column for bend, cracks or deformation.
   If found defective, replace.

SPECIAL TOOL



09944-36011
Steering wheel remover

SECTION 3D

FRONT SUSPENSION

NOTE:

- **All front suspension fasteners are an important attaching part in that it could affect the performance of vital parts and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.**
- **Never attempt to heat, quench or straighten any front suspension part. Replace it with a new part or damage to the part may result.**

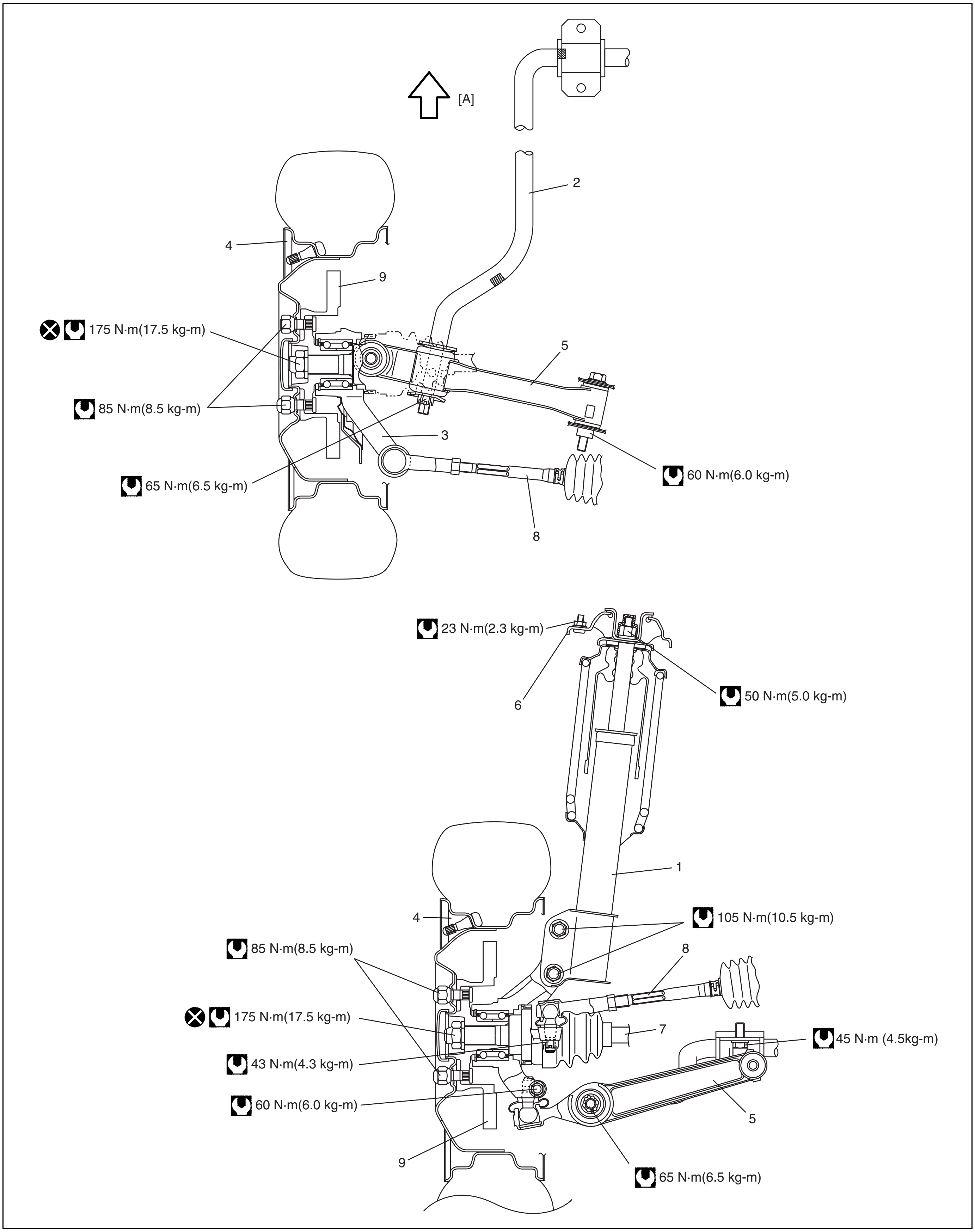
CONTENTS

GENERAL DESCRIPTION

The front suspension is the strut type independent suspension. The upper end of a strut is anchored to the vehicle body by a strut support. The strut and strut support are isolated by a rubber mount. A strut bearing is also installed a little lower to the rubber mount.

The lower end of the strut is connected to the upper end of a steering knuckle and lower end of knuckle is attached to the stud of a ball joint which is incorporated in a unit with a suspension control arm. And connected to this steering knuckle is the tie rod end.

Thus, movement of the steering wheel is transmitted to the tie rod end and then to the knuckle, eventually causing the wheel-and-tire to move. In this operation, with the movement of the knuckle, the strut also rotates by means of the strut bearing and lower ball joint.

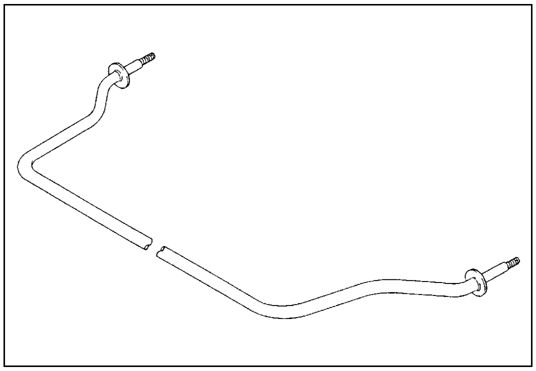


1. Strut assembly	4. Wheel	7. Drive shaft	[A] : FORWARD
2. Stabilizer bar	5. Suspension control arm	8. Tie rod	Tightening torque
3. Steering knuckle	6. Vehicle body	9. Brake disc	Do not reuse.

DIAGNOSIS

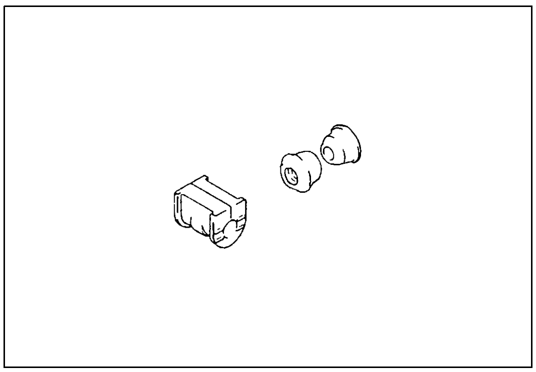
STABILIZER BAR AND/OR BUSHING CHECK

Bar



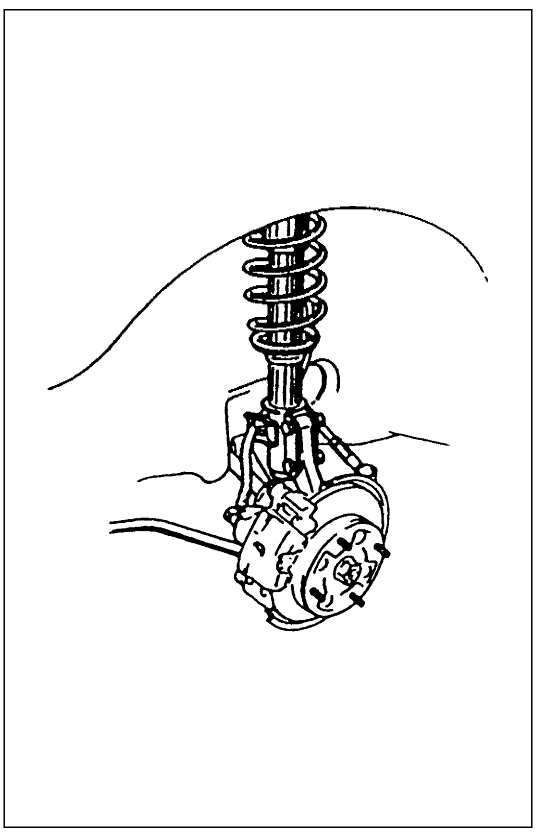
Inspect for damage or deformation.
If defective, replace.

Bushing



Inspect for damage, wear or deterioration.
If defective, replace.

STRUT ASSEMBLY CHECK



- Inspect strut for oil leakage, damage or deformation.
- If strut is found faulty, replace it as an assembly unit, because it can not be disassembled.
- Inspect strut function refer to the following procedures.

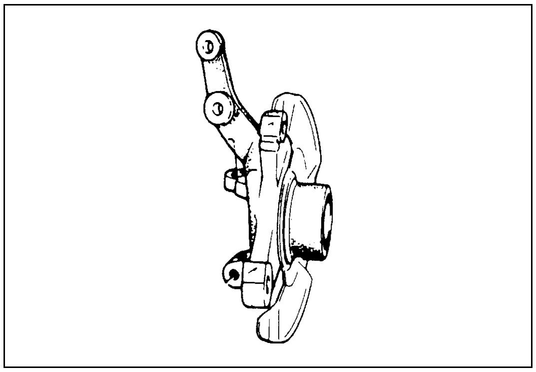
1) Check and adjust tire pressures as specified.
2) Bounce vehicle body 3 or 4 times continuously by pushing front end on the side with strut to be checked.
3) Apply the same amount of force at each push and note strut resistance both when pushed and rebounding.
4) Also, note how many times vehicle body rebounds before coming to stop after hands are off. Do the same for strut on the other side.
5) Compare strut resistance and number of rebalance on the right with those on the left. And they must be equal in both. With proper strut, vehicle body should come to stop the moments hands are off or after only one or two small rebalances.

If conditions of struts are in doubt, compare them with known-good vehicle or strut.

- Inspect bearing for wear, abnormal noise or gripping.
  If defective, replace.

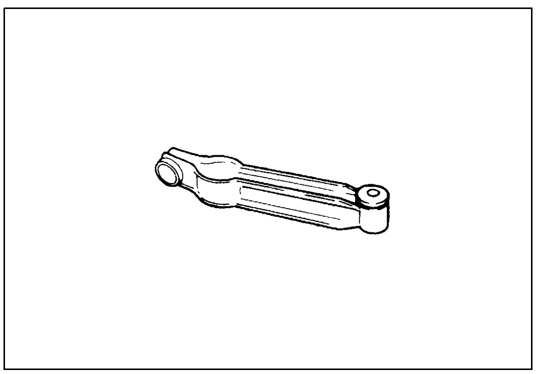
- Inspect spring seat for cracks or deformation.
  If defective, replace.
- Inspect bump stopper for deterioration.
  If defective, replace.
- Inspect rebound stopper and strut mount for wear, cracks or deformation.
  If defective, replace.

SUSPENSION CONTROL ARM / STEERING KNUCKLE CHECK



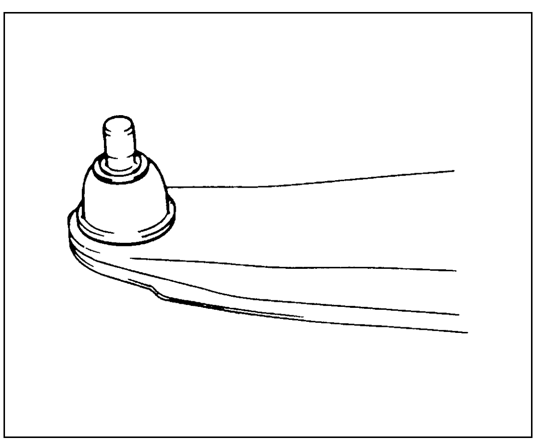
Inspect for cracks, deformation or damage.
If defective, replace.

SUSPENSION CONTROL ARM BUSHING CHECK



Inspect for damage, wear or deterioration.
If defective, replace.

SUSPENSION CONTROL ARM JOINT CHECK



- Check for smooth rotation.
- Inspect ball stud for damage.
- Inspect dust cover for damage.

NOTE:

Suspension control arm and arm joint cannot be separated.

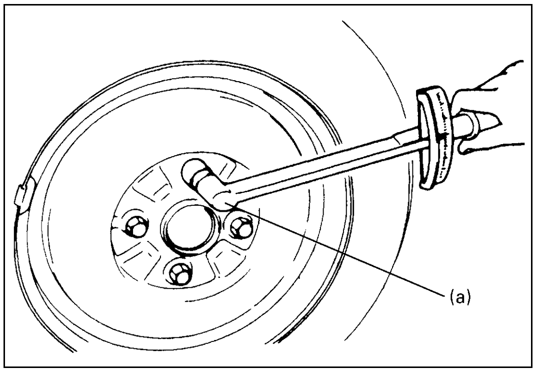
If there is any damage to either, control arm assembly must be replaced as a complete unit.

FRONT SUSPENSION FASTENERS CHECK

Check each bolt and nut fastening suspension parts for tightness. Tighten loose one, if any, to specified torque, referring to “GENERAL DESCRIPTION” in this section.

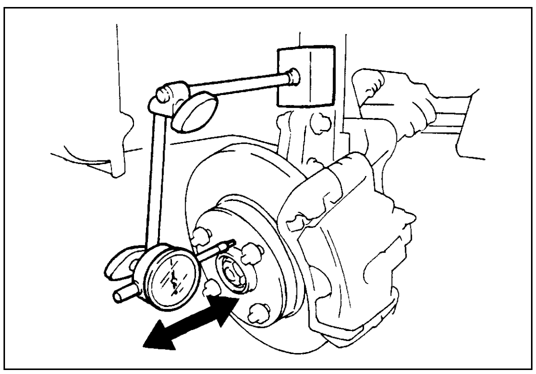
WHEEL DISC, NUT AND BEARING CHECK

- Inspect each wheel disc for dents, distortion and cracks.
  A disc in badly damaged condition must be replaced.



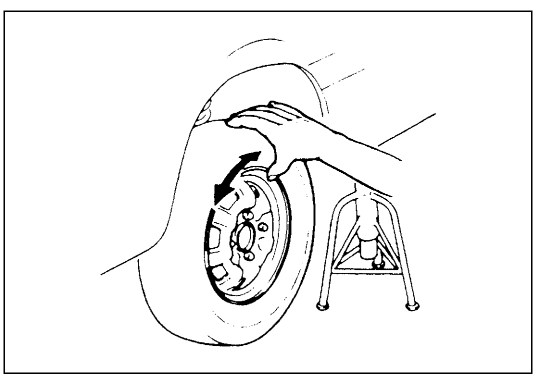
- Check wheel nuts for tightness and, as necessary, retighten them to specification.

Tightening torque
Wheel nut (a) : 85 N·m (8.5 kg-m, 61.5 lb-ft)



- Check wheel bearing for wear. When measuring thrust play, apply a dial gauge to wheel hub.

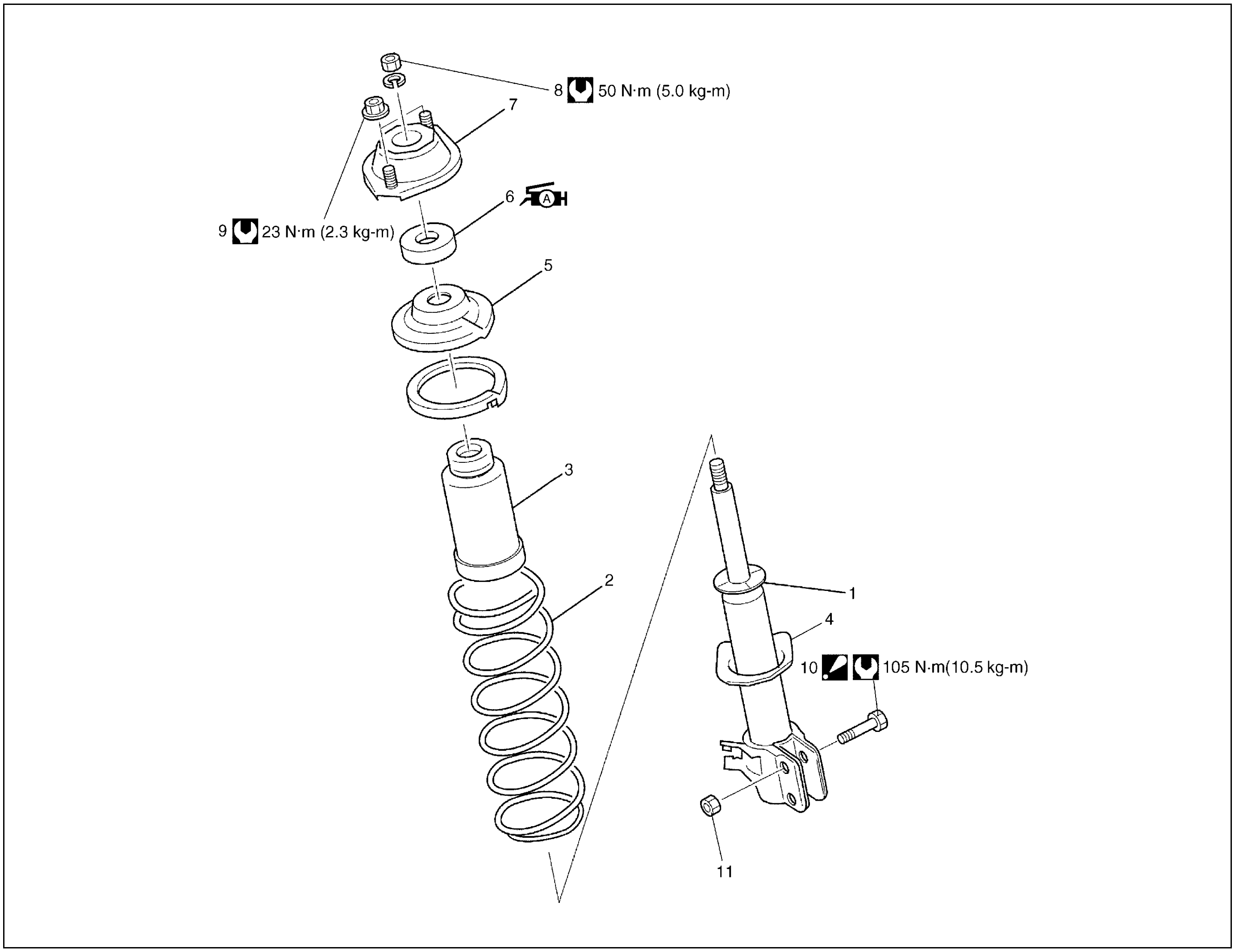
Thrust play limit
: 0.1 mm (0.004 in.)



- By rotating wheel actually, check wheel bearing for noise and smooth rotation.
  If defective, replace bearing.

ON-VEHICLE SERVICE

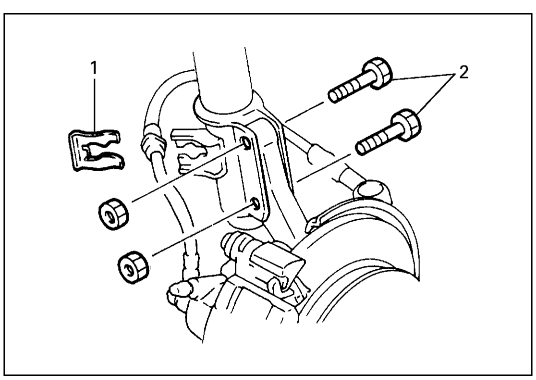
STRUT ASSEMBLY



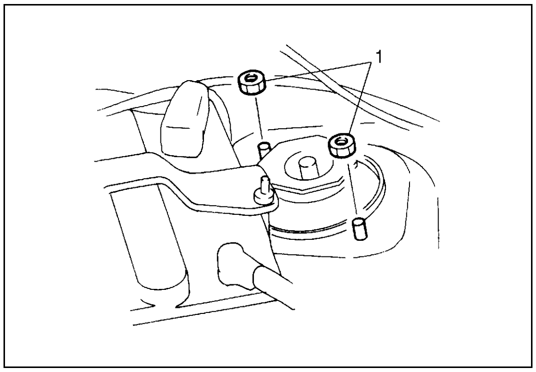
1. Strut assembly	5. Coil spring upper seat	9. Strut support nut
2. Coil spring	6. Strut bearing : Apply grease (99000-25010) to all around bearing.	10. Strut bracket bolt : Insert from vehicle rear side.
3. Bump stopper	7. Strut support	11. Strut bracket nut
4. Coil spring lower seat	8. Strut nut	Tightening torque

REMOVAL

1) Hoist vehicle, allowing front suspension to hang free.
2) Remove wheel.



3) Remove E-ring (1) securing brake hose and take brake hose off strut bracket as shown.
4) Remove strut bracket bolts (2).

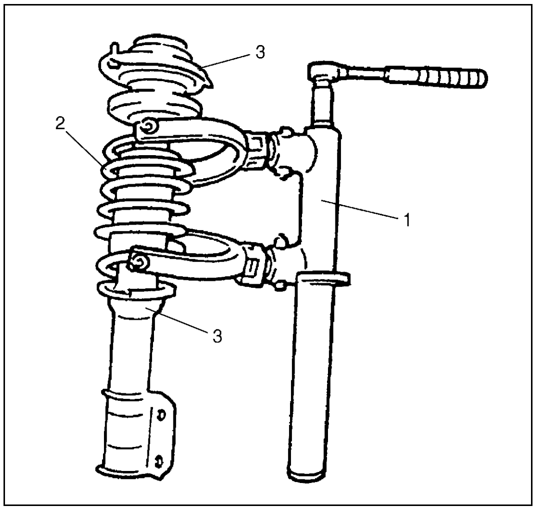


5) Remove strut support nuts (1).

NOTE:
Hold strut by hand so that it will not fall off.

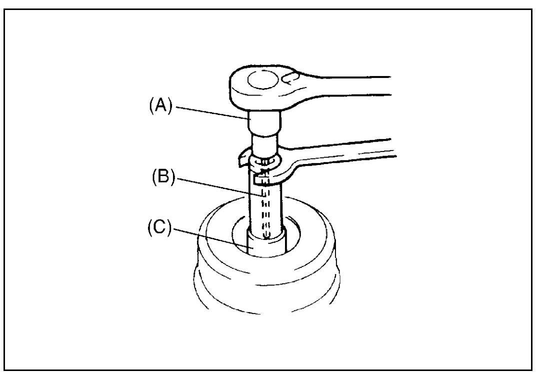
6) Remove strut assembly.

DISASSEMBLY



1) Using a spring compressor (1), compress the strut spring (2) till its force pressing the spring seat (3) is released.

WARNING:
Use a commercially available spring compressor (1) and follow the operation procedure described in the Instruction Manual supplied with that spring compressor (1).



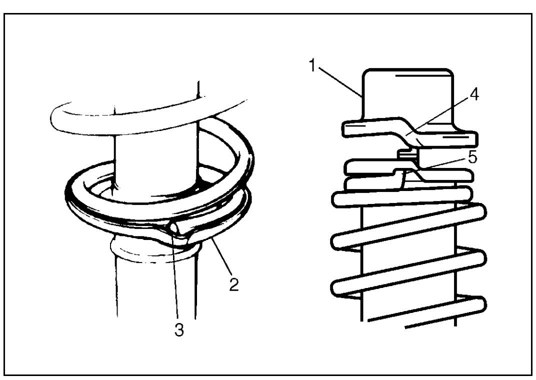
2) Remove strut nut with special tools while coil spring is compressed.

Special tool
(A) : 09900-00411
(B) : 09900-00414
(C) : 09945-26010

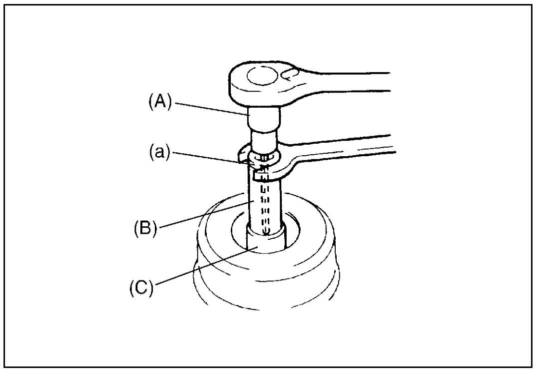
3) Disassemble strut assembly.

ASSEMBLY

For assembly, reverse disassembly procedure, noting the following instructions.



- Mate spring end with stepped part (3) of spring lower seat (2) as shown.
- Install spring upper seat (1), mating stepped part (4) of seat with spring upper end (5) as shown.



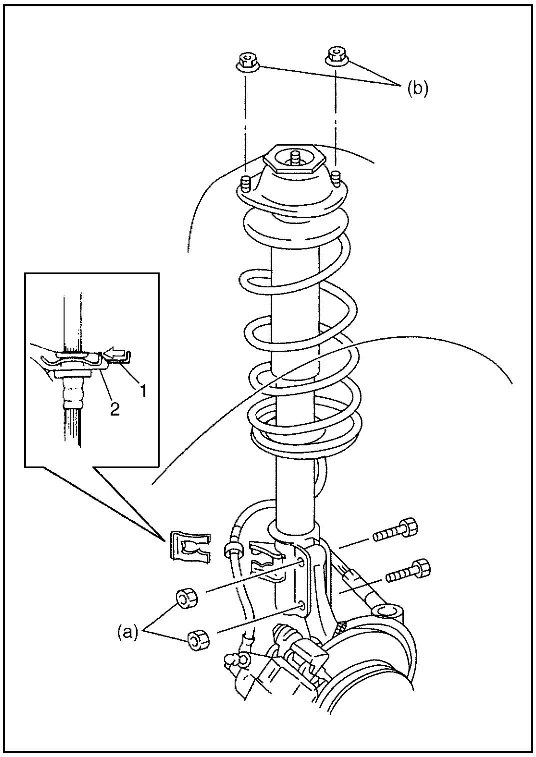
- Tighten strut nut to specified torque by using special tools.

Tightening torque
Strut nut (a) : 50 N·m (5.0 kg-m, 36.5 lb-ft)

Special tool
(A) : 09900-00411
(B) : 09900-00414
(C) : 09945-26010

INSTALLATION

Install strut assembly by reversing removal procedure, noting the following instructions.



- Insert bolts in such direction as shown in figure.
- Tighten all fasteners to specified torque.

Tightening torque
Strut bracket nut (a) : 105 N·m (10.5 kg-m, 76.0 lb-ft)
Strut support nut (b) : 23 N·m (2.3 kg-m, 17.0 lb-ft)

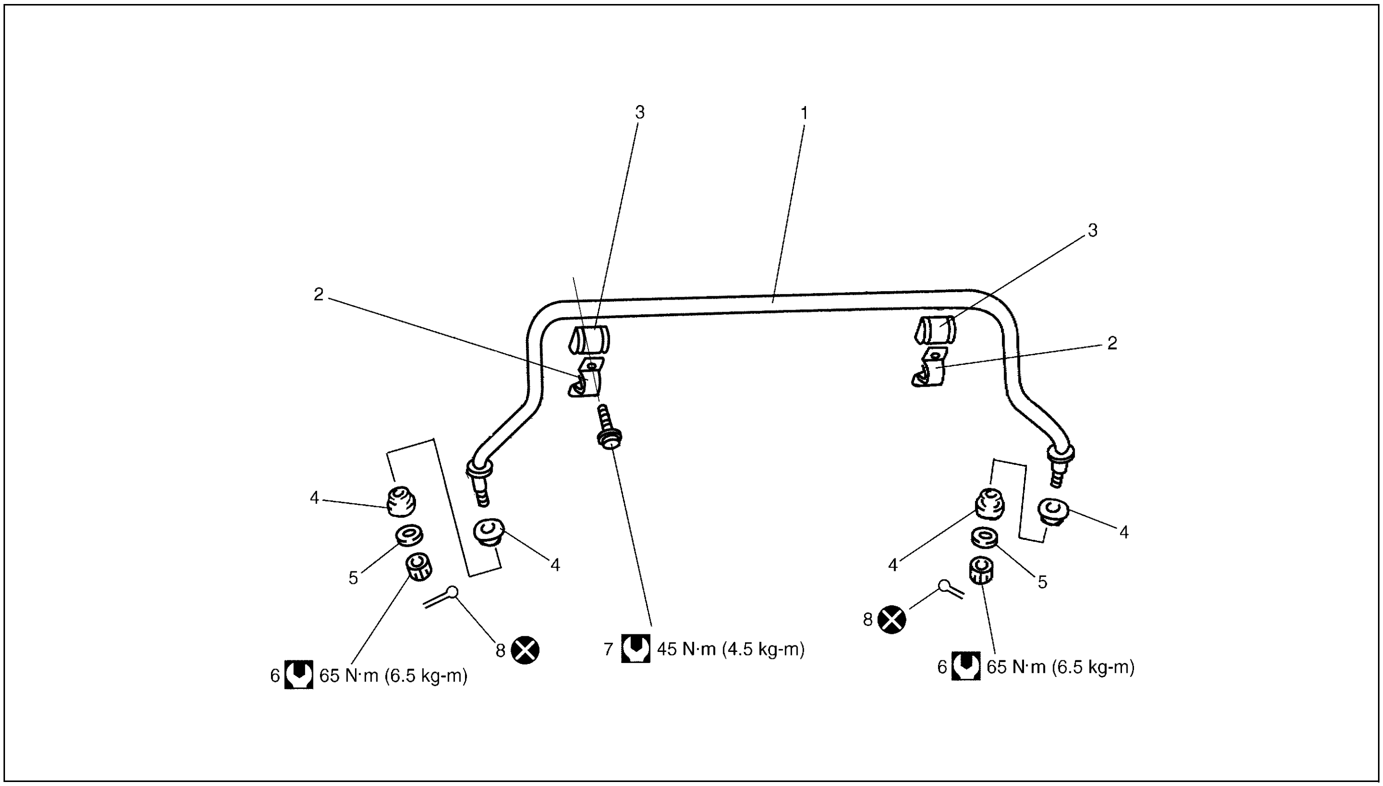
NOTE:
- **Don't twist brake hose when installing it.**
- **Install E-ring (1) as far as it fits to bracket (2) as shown in figure.**

- Tighten wheel nut to specified torque.

Tightening torque
Wheel nut : 85 N·m (8.5 kg-m, 61.5 lb-ft)

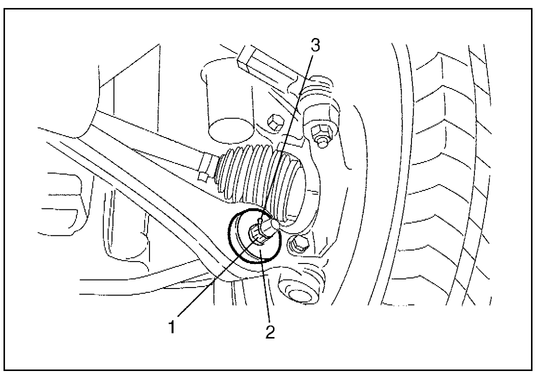
- After installation, confirm front end (wheel) alignment referring to Section 3A.

STABILIZER BAR AND/OR BUSHINGS

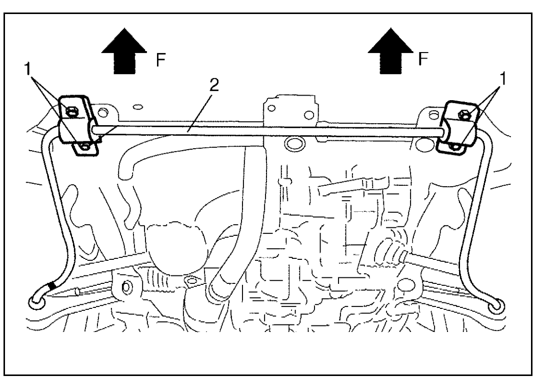


1. Stabilizer bar	4. Bushing	7. Stabilizer bar mounting bracket bolt	Tightening torque
2. Mount bracket	5. Washer	8. Sprit pin	Do not reuse.
3. Mount bushing	6. Stabilizer bar nut		

REMOVAL



1) Hoist vehicle and allow front suspension control arms to hang free.
2) Remove front wheels.
3) Remove, stabilizer bar sprit pin (3) and nut (1) and washer (2).



4) Remove stabilizer bar mounting bracket bolts (1).
5) Remove stabilizer bar (2).

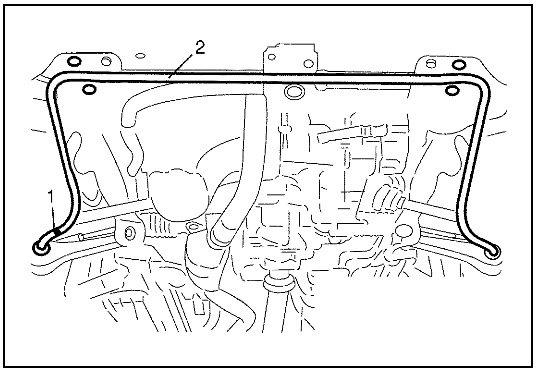
NOTE:

If it is hard to remove stabilizer bar, set tires in contact with ground (with suspension compressed).

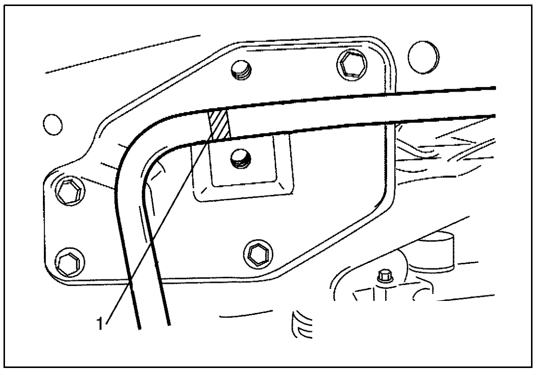
F. FORWARD

INSTALLATION

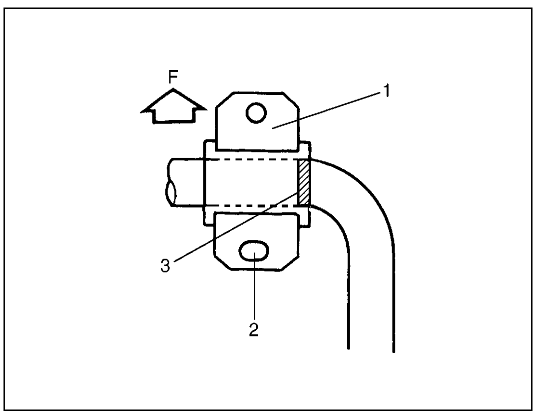
For installation, reverse removal procedure, noting the following instructions.



- Install stabilizer bar (2) so that paint mark (1) on it comes to the right side of vehicle.



- There is a paint mark (1) of stabilizer bar. Install stabilizer bar mount bracket to inside of stabilizer bar at that mark.

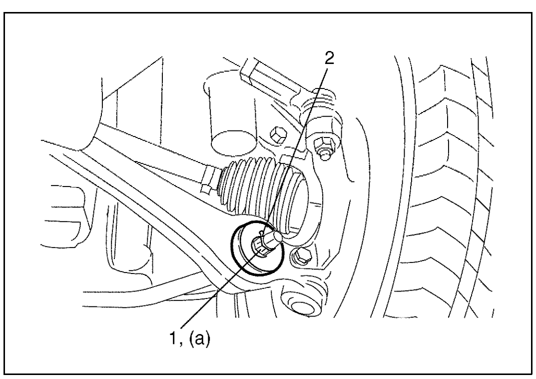


- Install mount bracket (1) so that its oblong hole side (2) comes to the rear.

3.	Mark
F:	Forward

- Tighten stabilizer bar mounting bracket bolts to specified torque.

Tightening torque
Stabilizer bar mounting bracket bolt
: 45 N·m (4.5 kg-m, 32.5 lb-ft)



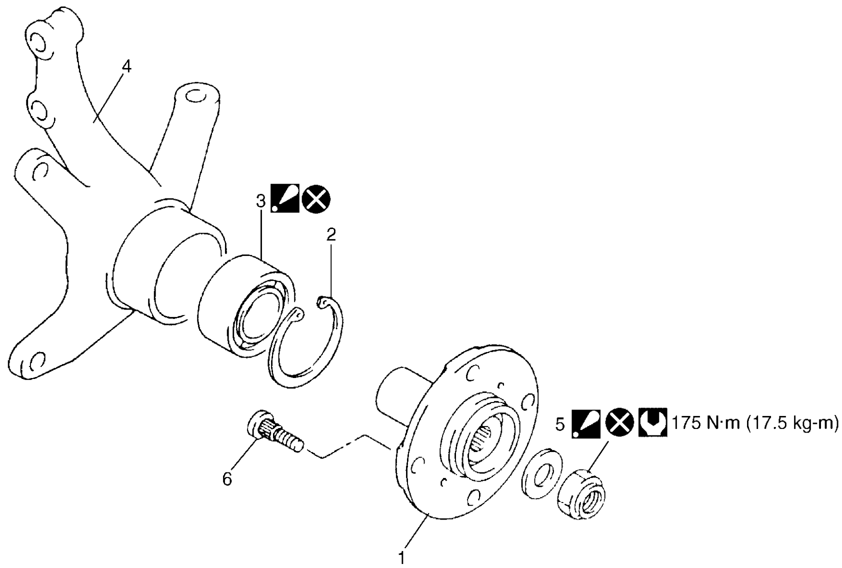
- Tighten stabilizer bar nut (1) to specified torque.

Tightening torque
Stabilizer bar nut (a) : 65 N·m (6.5 kg-m, 47.0 lb-ft)

- Install new sprit pin (2).
- Tighten wheel nut to specified torque.

Tightening torque
Wheel nut : 85 N·m (8.5 kg-m, 61.5 lb-ft)

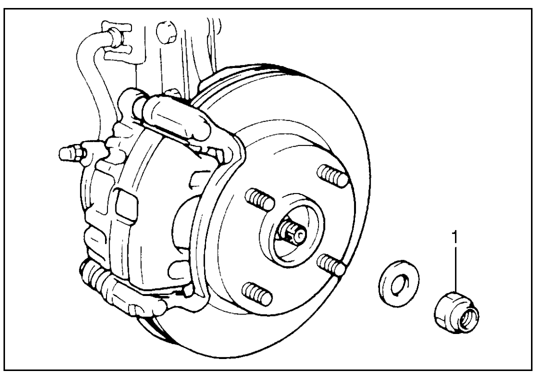
WHEEL HUB AND STEERING KNUCKLE



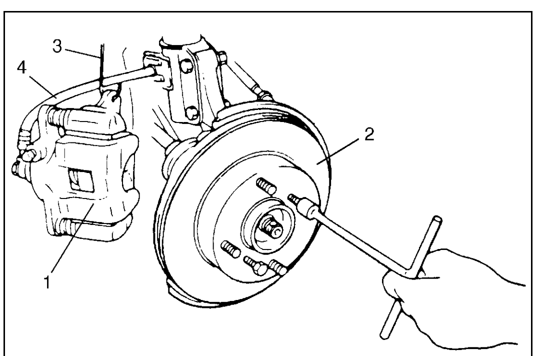
	1. Front wheel hub		4. Steering knuckle		Tightening torque
	2. Circlip		5. Drive shaft nut : Calk, after tightening.		Do not reuse.
	3. Wheel bearing : Face grooved rubber seal side to wheel hub.		6. Hub bolt		

REMOVAL

1) Hoist vehicle and remove wheel.



2) Uncaulk drive shaft nut (1).
3) Depress foot brake pedal and hold it there. Remove drive shaft nut (1).
4) Remove caliper carrier bolts.

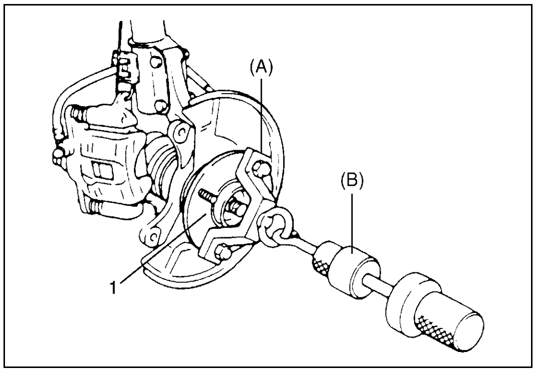


5) Remove caliper (1) with carrier.

NOTE:

Hang removed caliper with a wire hook or the like (3) so as to prevent brake hose (4) from bending and twisting excessively or being pulled.
Don’t operate brake pedal with pads removed.

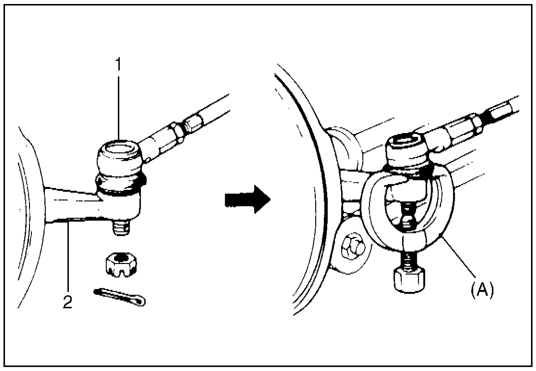
6) Pull brake disc (2) off by using two 8 mm bolts.



7) Pull out wheel hub (1) with special tools.

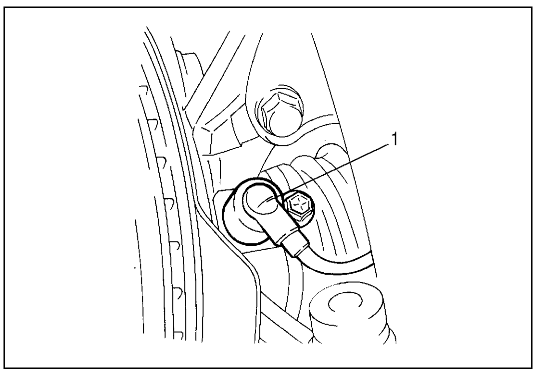
Special tool
(A) : 09943-17912
(B) : 09942-15510

> **CAUTION:**
> **When wheel hub is removed, replace wheel bearing as a set.**

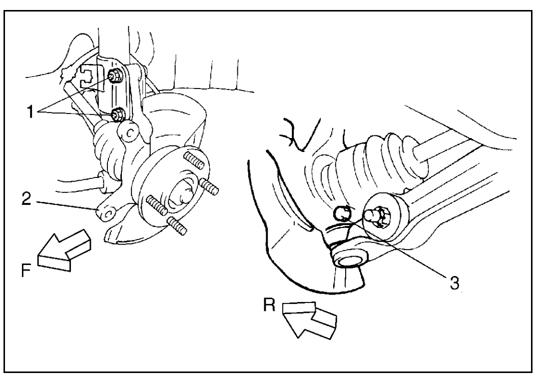


8) Disconnect tie rod end (1) from steering knuckle (2) with special tool.

Special tool
(A) : 09913-65210



9) Remove wheel speed sensor (1) from knuckle (if equipped with ABS).

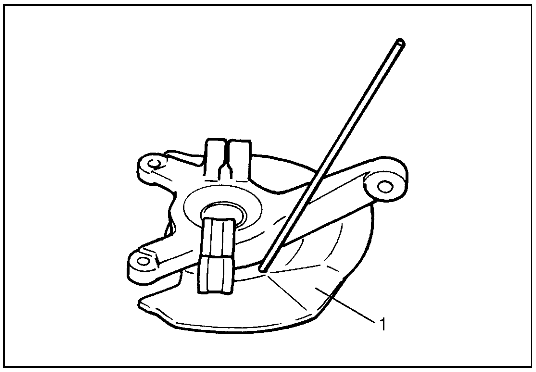


10) Loosen strut bracket nuts (1).

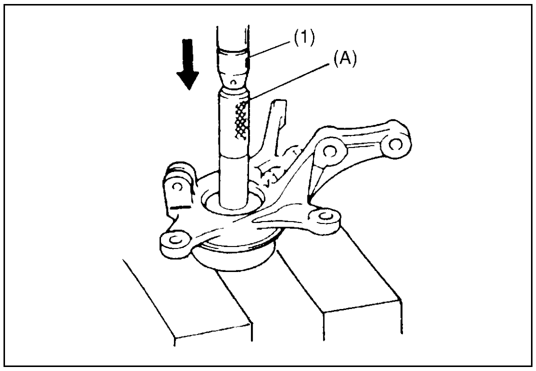
F:	Forward
R:	Rearward

11) Remove ball joint bolt (3).
12) Remove strut bracket bolts from strut bracket and then steering knuckle (2).

DISASSEMBLY



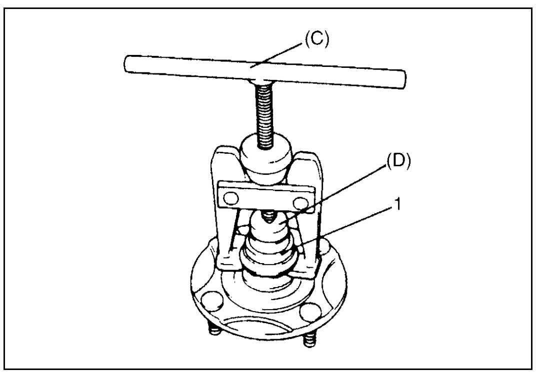
1) Uncaulk and remove dust cover (1).
2) Remove circlip.



3) Using hydraulic press (1) and special tool, remove wheel bearing.

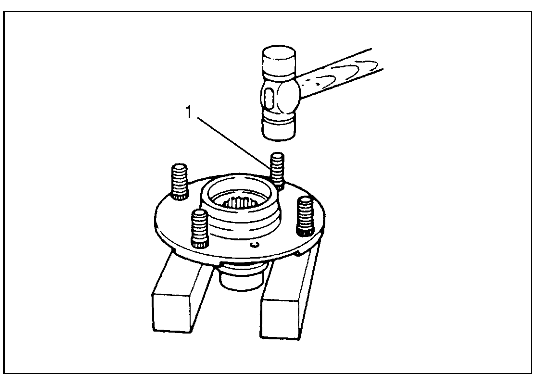
Special tool
(A) : 09913-75810

> **CAUTION:**
> **When installing wheel bearing, replace it with new one.**



4) Remove wheel bearing outside inner race (1).

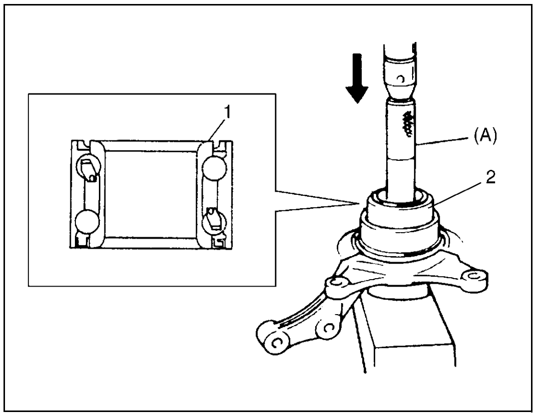
Special tool
(C) : 09913-61110
(D) : 09925-88210



5) Remove hub bolts (1).

> **CAUTION:**
> **Never remove bolt unless replacement is necessary.**
> **Be sure to use a new bolt for replacement.**

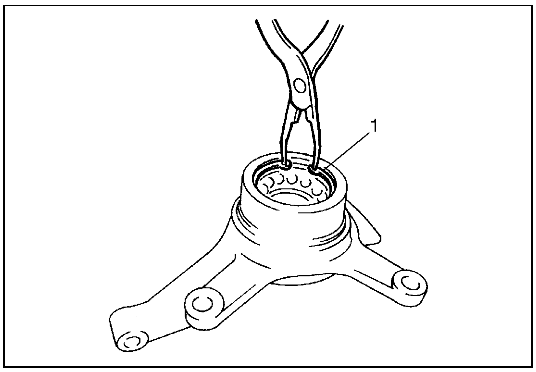
ASSEMBLY



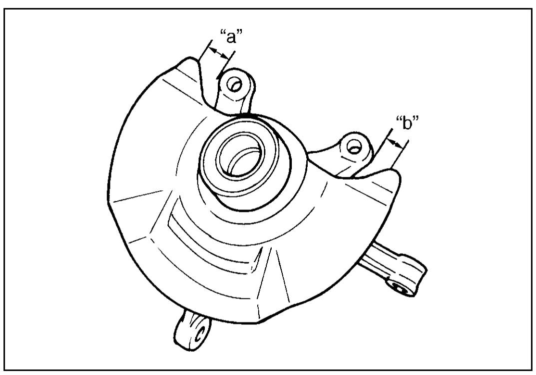
1) Face grooved rubber seal side (1) of new wheel bearing (2) upward as shown in figure and press-fit it into knuckle using special tool.

Special tool
(A) : 09913-75520

> **CAUTION:**
> **When replacing bearing, inner races or outer race, be sure to replace them with new ones as a set.**

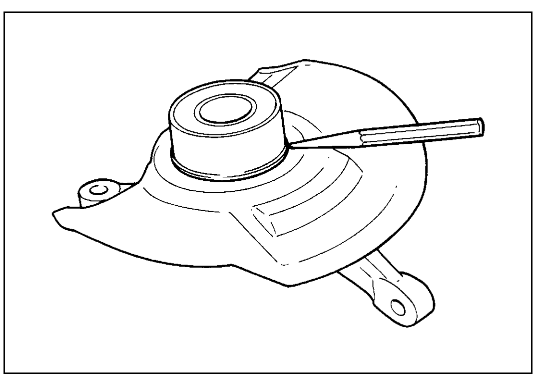


2) Install circlip (1).

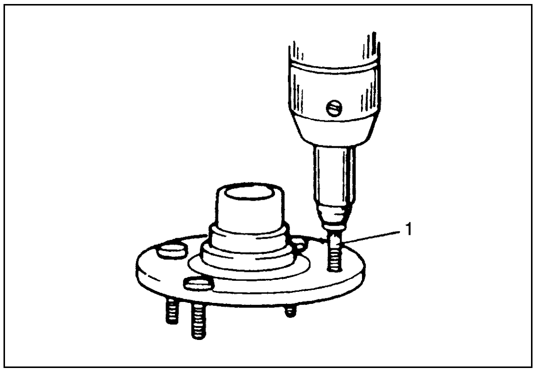


3) Drive in dust cover so that dimensions “a” and “b” become equal as shown in figure.

> **CAUTION:**
> **When drive in dust cover, be careful not to deform it.**



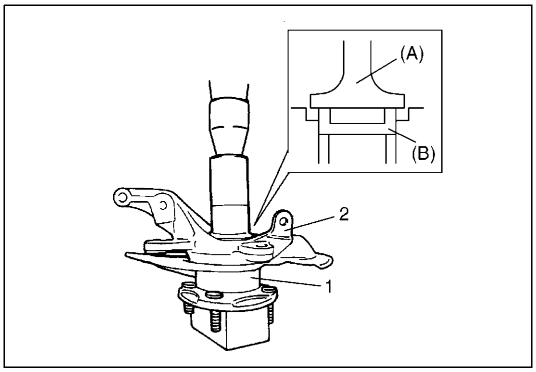
4) Caulk with a punch.



5) Insert new stud bolt (1) in hub hole. Rotate stud bolt slowly to assure that serrations are aligned with those made by original bolt.

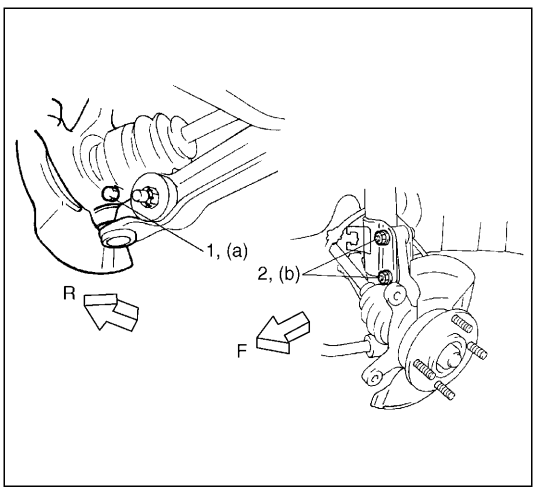
INSTALLATION

For installation, reverse removal procedure, noting the following instructions.



- Using special tool, drive wheel hub (1) into steering knuckle (2) and then install steering knuckle (2).

Special tool
(A) : 09913-75520
(B) : 09944-66020



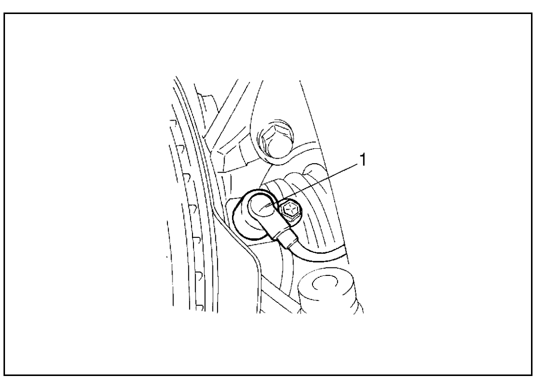
- Install ball joint bolt (1) from the direction as shown.
- Tighten suspension arm ball joint bolt (1) to specified torque.

Tightening torque
Suspension arm ball joint bolt
(a) : 60 N·m (6.0 kg-m, 43.5 lb-ft)

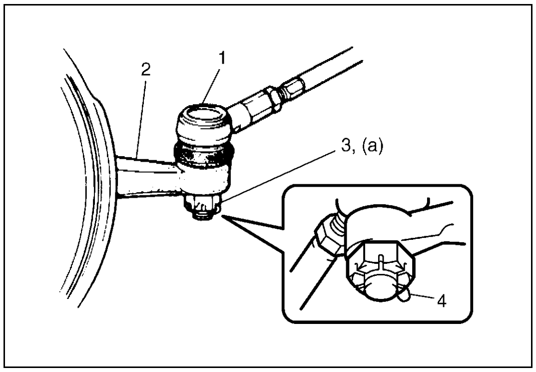
- Tighten strut bracket nuts (2) to specified torque.

Tightening torque
Strut bracket bolt (b) : 105 N·m (10.5 kg-m, 76.0 lb-ft)

F:	Forward
R:	Rearward



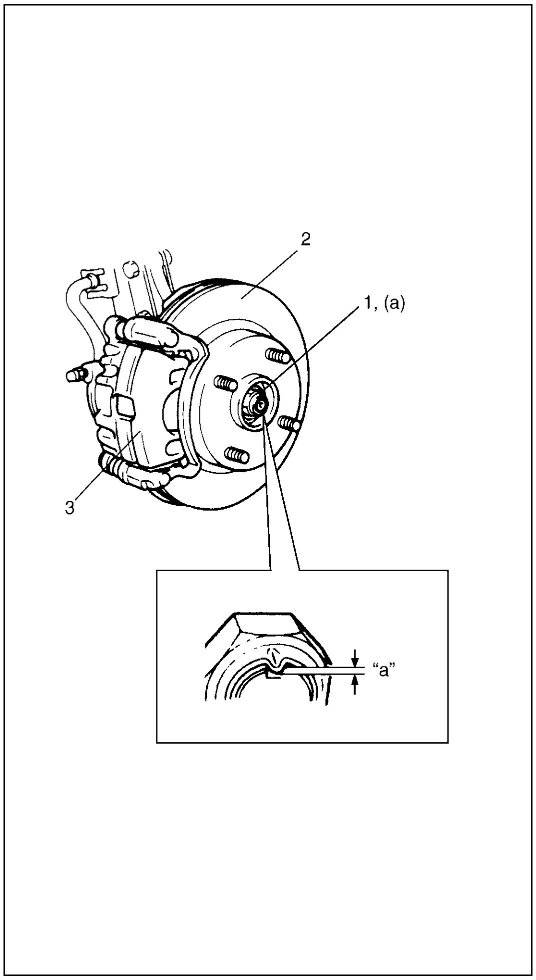
- Install wheel speed sensor (1) (if equipped with ABS).



- Connect tie rod end (1) to steering knuckle (2) and tighten tie rod end castle nut (3) to specified torque.

Tighting torque
The rod end castle nut (a) : 43 N·m (4.3 kg-m, 31.5 lb-ft)

- Install new split pin (4).



- Install brake disc (2) and brake caliper (3).
- Tighten brake caliper bolt to specified torque.

Tightening torque
Brake caliper bolt : 85 N·m (8.5 kg-m, 61.5 lb-ft)

- Depress foot brake pedal and hold it there.
  Tighten new drive shaft nut (1) to specified torque.

Tightening torque
Drive shaft nut (a) : 175 N·m (17.5 kg-m, 127.0 lb-ft)

CAUTION:
Never reuse drive shaft nut (1).

- Caulk drive shaft nut (1) as shown.

Caulking specification
"a" : 0.5 mm (0.02 in.) or more

CAUTION:
Be careful while caulking nut so that no crack will occur in caulked part of nut. Cracked nut must be replaced with new one.

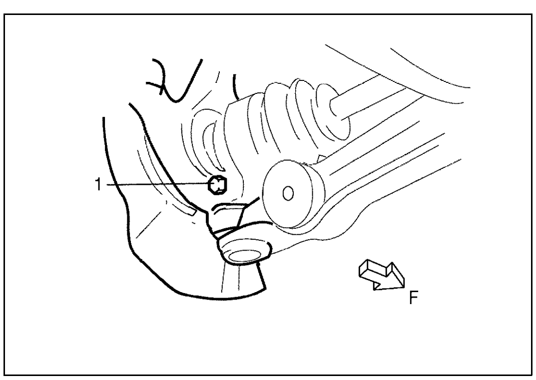
- Tightening wheel nut to specified torque.

Tightening torque
Wheel nut : 85 N·m (8.5 kg-m, 61.5 lb-ft)

SUSPENSION CONTROL ARM / BUSHING

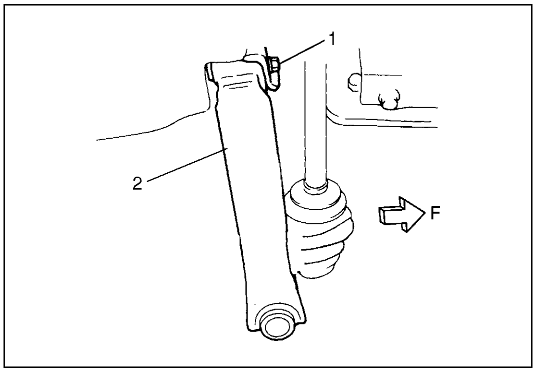
REMOVAL

1) Remove stabilizer bar. Refer to "STABILIZER BAR AND/OR BUSHINGS" in this section.



2) Remove suspension control arm ball joint bolt (1).

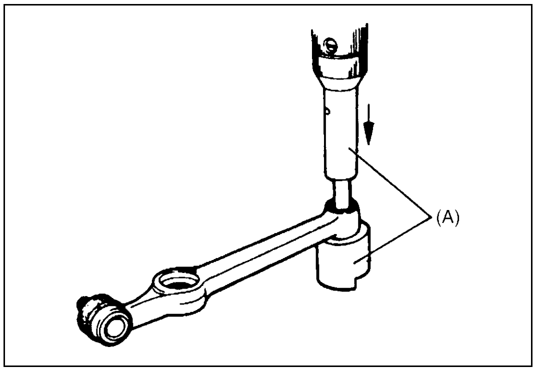
F: Forward



3) Remove suspension control arm bolt (1).
4) Remove suspension control arm (2).

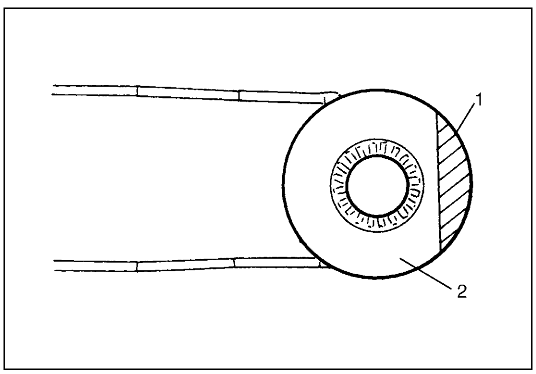
F: Forward

DISASSEMBLY



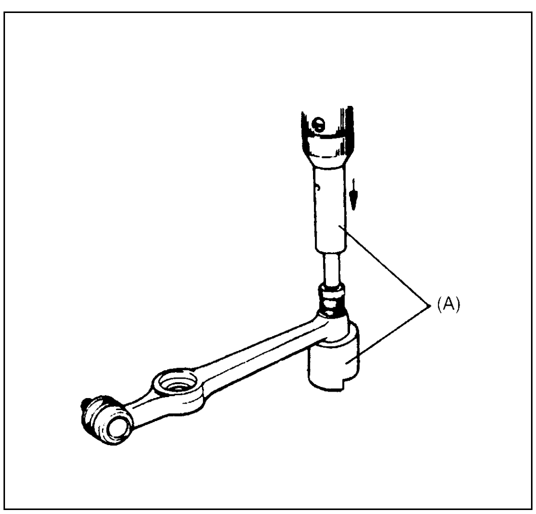
1) Remove bushing.
   Place suspension control arm onto flat surface side of special tool and push out bushing with special tool and oil hydraulic press as shown.

Special tool
(A) : 09943-77910



NOTE:
If it is impossible to remove bushing as shown above procedure, cut portion (1) of bushing (2) as shown in figure.

ASSEMBLY

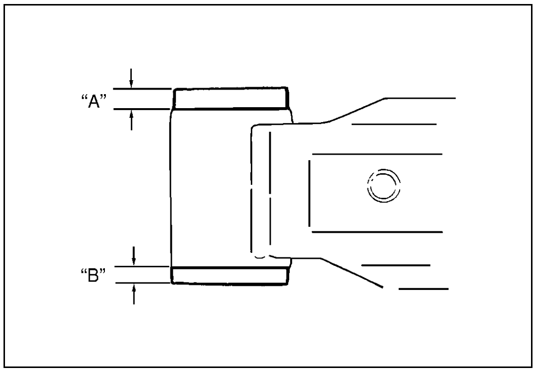


1) Press-fit bushing by using special tool and press.

Special tool
(A) : 09943-77910

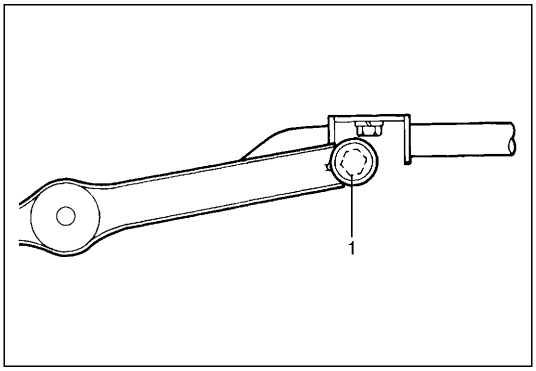
CAUTION:
Be sure to use new bushing.

NOTE:
- **Before installing bushing, apply soap water on its circumference to facilitate installation.**
- **When installed, bush should be equal on the right and left of arm as shown.**

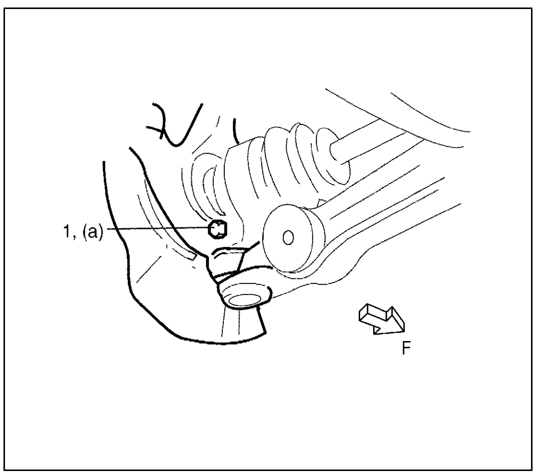


2) Press-fit bushing so that dimensions "A" and "B" in figure become equal.

INSTALLATION



1) Install body side of suspension control arm but tighten suspension control arm bolt (1) only temporarily.

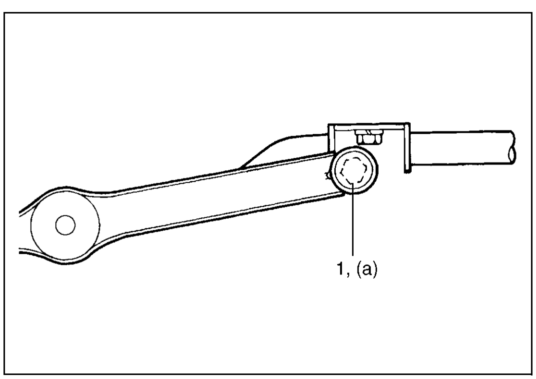


2) Install suspension control arm ball joint to steering knuckle. Align ball stud groove with steering knuckle bolt hole. Then install ball joint bolt (1) from the direction as shown in figure. Tighten suspension arm ball joint bolt (1) to specified torque.

Tightening torque
Suspension arm ball joint bolt
(a) : 60 N·m (6.0 kg-m, 43.5 lb-ft)

3) Install stabilizer bar, referring to "STABILIZER BAR AND/OR BUSHINGS" in this section.

F: Forward



4) Lower hoist and vehicle in non-loaded condition, tighten control arm bolt (1) to specified torque.

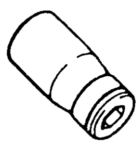
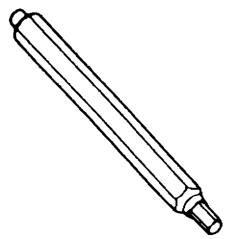
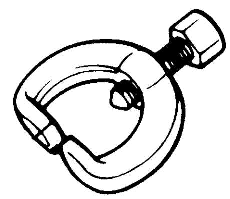
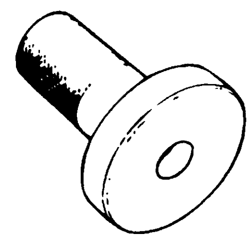
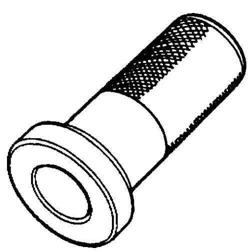
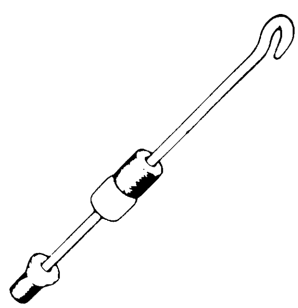
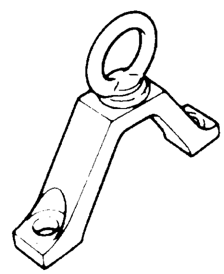
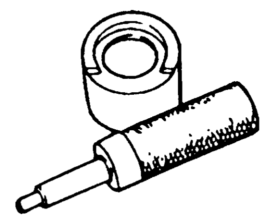
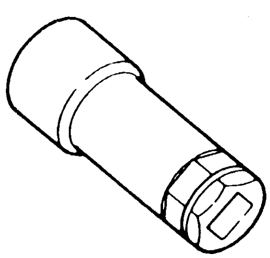
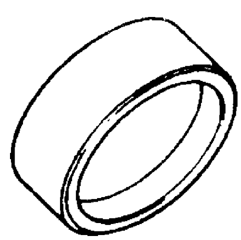
Tightening torque
Control arm bolt (a) : 60 N·m (6.0 kg-m, 43.5 lb-ft)

5) Confirm front end (wheel) alignment referring to Section 3A.

REQUIRED SERVICE MATERIAL

Material	Recommended SUZUKI product (Part Number)	Use
Lithium grease	SUZUKI SUPER GREASE A (99000-25010)	• Strut bearing

SPECIAL TOOL

 09900-00411 Hexagon wrench socket	 09900-00414 Hexagon wrench bit 6 mm	 09913-65210 Tie rod end remover	 09913-75520 Bearing installer
 09913-75810 Bearing installer	 09942-15510 Sliding hammer	 09943-17912 Front wheel hub remover	 09943-77910 Bushing remover
 09945-26010 Socket wrench 17 mm	 09944-66020 Bearing installer		

SECTION 3E

REAR SUSPENSION

NOTE:

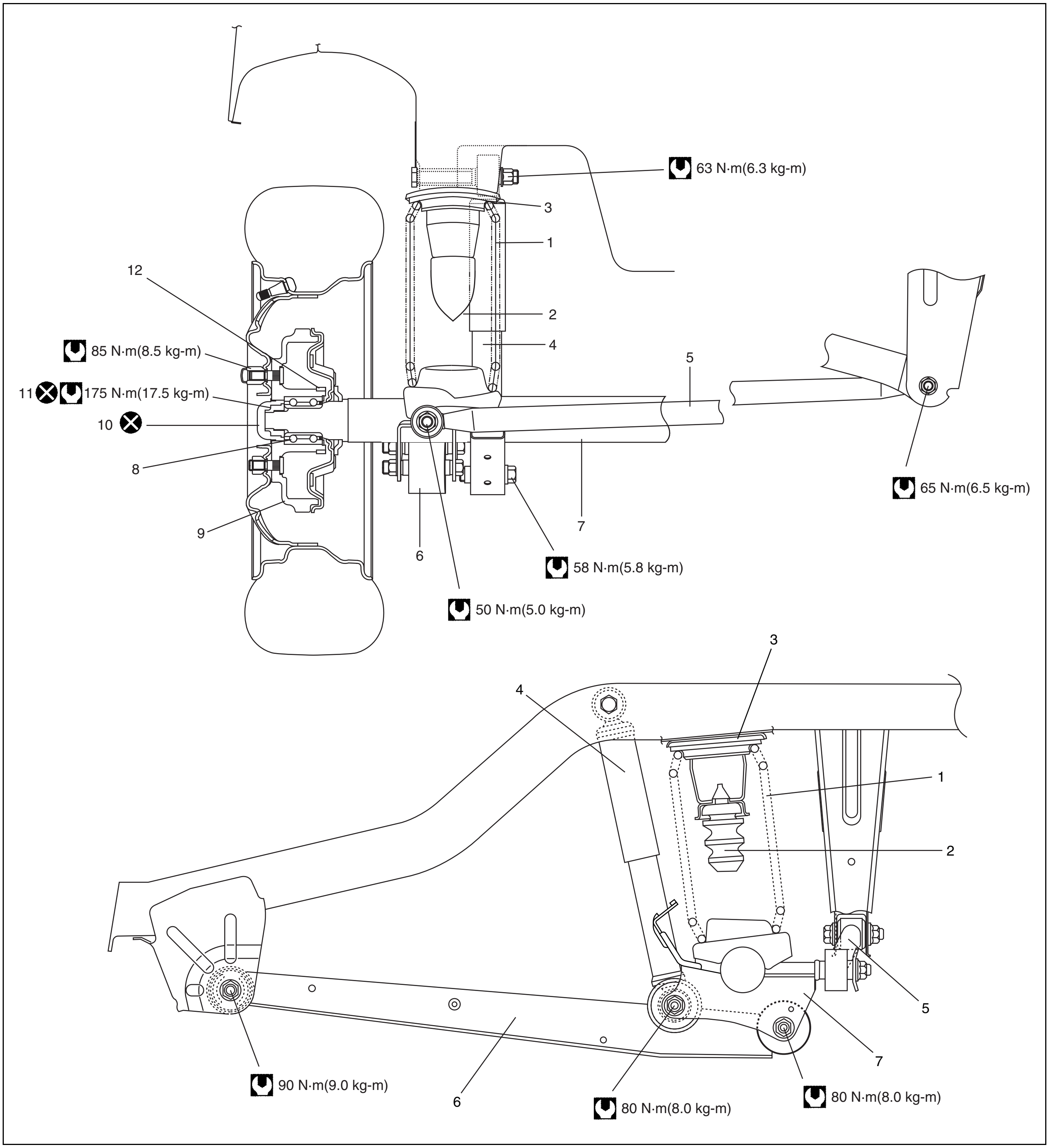
- **All suspension fasteners are an important attaching part in that it could affect the performance of vital parts and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.**
- **Never attempt to heat, quench or straighten any front suspension part. Replace it with a new part, or damage to the part may result.**

CONTENTS

GENERAL DESCRIPTION

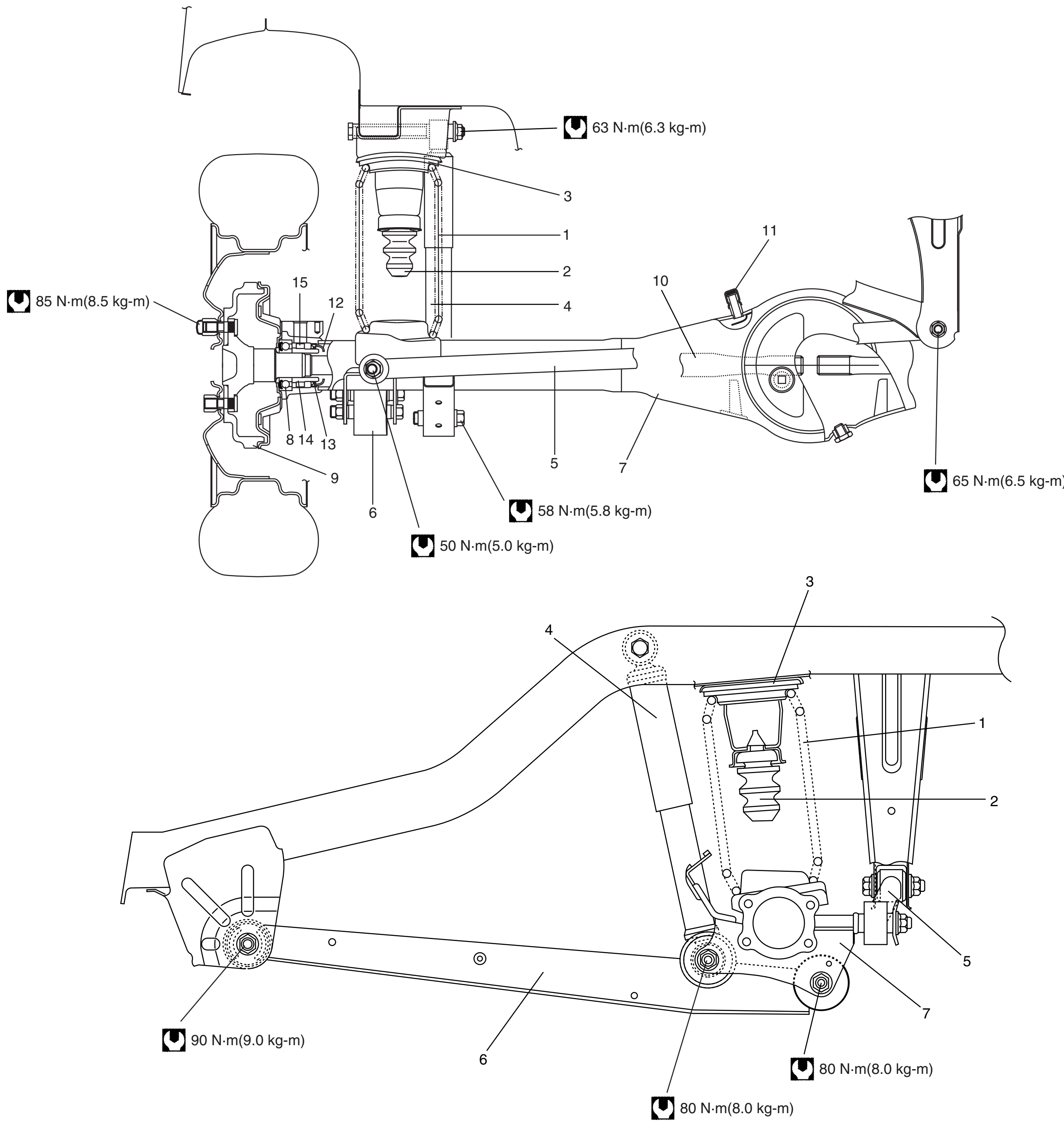
Rear suspension is Isolated Trailing Link (I.T.L.) type which consists of coil springs, rear axle, rear axle housing, shock absorbers, lateral rod and trailing arms.

2WD vehicle



1. Rear coil spring	5. Lateral rod	9. Brake drum	Tightening torque
2. Rear bump stopper	6. Trailing arm	10. Spindle cap	Do not reuse.
3. Rear spring upper seat	7. Rear axle	11. Spindle nut	
4. Rear shock absorber	8. Wheel Bearing	12. Rear wheel sensor ring (if equipped with ABS)	

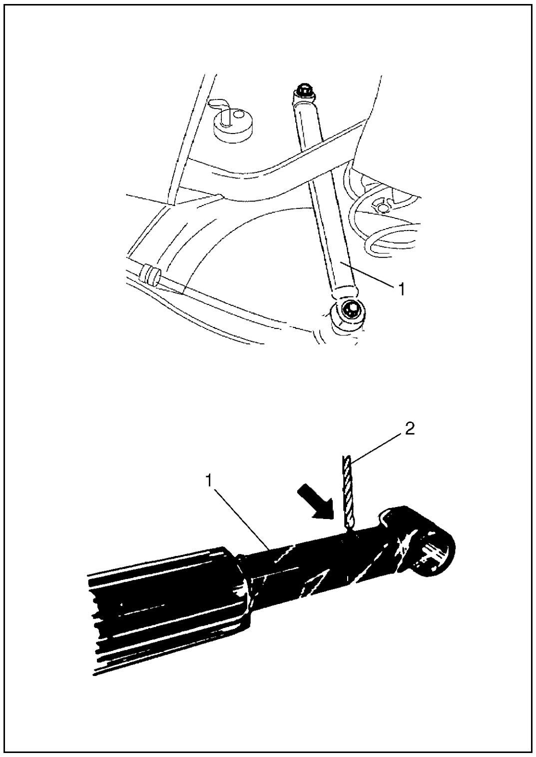
4WD vehicle



1. Rear coil spring	5. Lateral rod	9. Brake drum	13. Oil seal
2. Rear bump stopper	6. Trailing arm	10. Rear axle shaft	14. Wheel bearing retainer ring
3. Rear spring upper seat	7. Rear axle housing	11. Breather cap	15. Rear wheel sensor ring (if equipped with ABS)
4. Rear shock absorber	8. Wheel bearing	12. Oil seal protector	Tightening torque

DIAGNOSIS

REAR SHOCK ABSORBER CHECK



- Inspect for deformation or damage.
- Inspect bushings for wear or damage.
- Inspect for evidence of oil leakage.

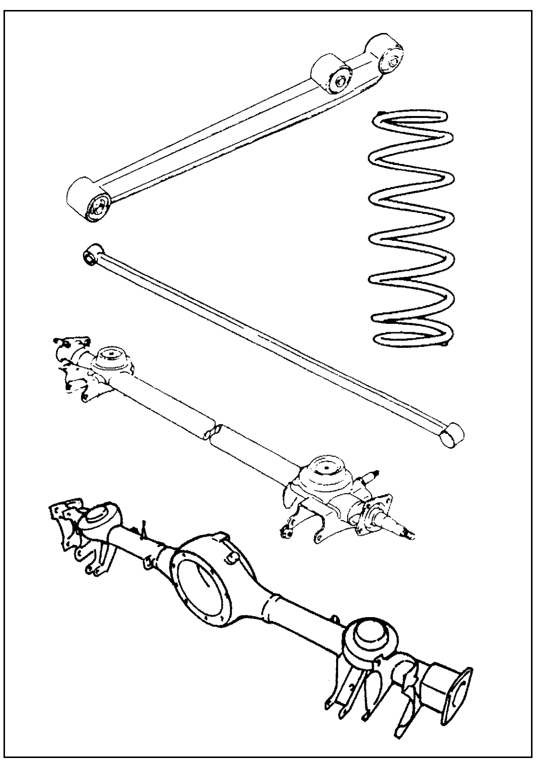
Replace any defective part.

WARNING:

When handling rear shock absorber (1) in which high-pressure gas is sealed, make sure to observe the following precautions.

- **Don't disassemble it.**
- **Don't put it into the fire.**
- **Don't store it where it gets hot.**
- **Before disposing it, be sure to drill a hole (approximately 3 mm (0.12 in.) diameter) (2) in it where shown by an arrow in figure and let gas and oil out.**
  Lay it down sideways for this work. The gas itself is harmless but it may issue out of the hole together with chips generated by the drill. Therefore, be sure to wear goggle.

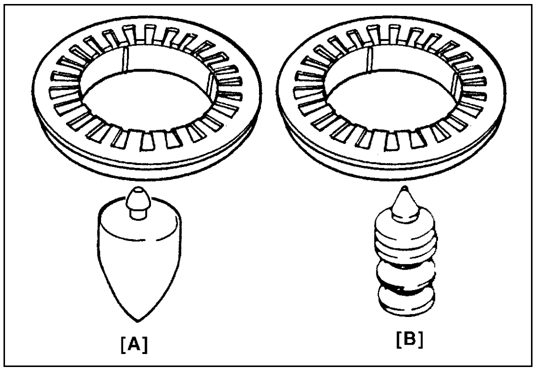
TRAILING ARM, LATERAL ROD, REAR AXLE, PEAR AXLE HOUSING AND COIL SPRING CHECK



- Inspect for cracks, deformation or damage.
- Inspect bushing for damage, wear or breakage.

Replace any defective part.

BUMP STOPPER/SPRING UPPER SEAT CHECK



- Inspect for cracks, deformation or damage.

Replace any defective part.

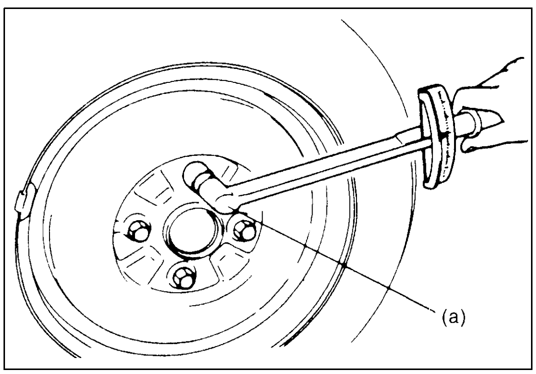
[A] :	2WD VEHICLE
[B] :	4WD VEHICLE

REAR SUSPENSION FASTENERS

Check each bolt and nut fastening suspension parts for tightness. Tighten loose one, if any, to specified torque referring to the figure in “GENERAL DESCRIPTION” in this section.

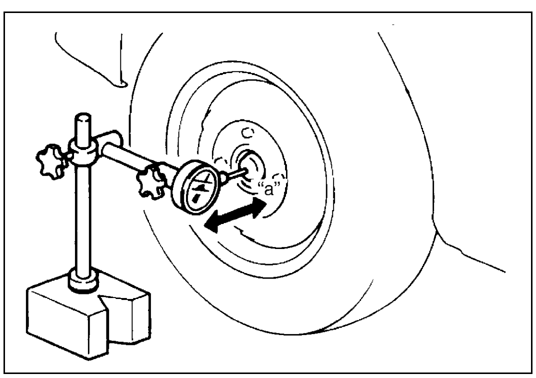
WHEEL DISC, NUT AND BEARING CHECK

- Inspect each wheel disc for dents, distortion and cracks. A disc in badly damaged condition must be replaced.



- Check wheel nuts for tightness and, as necessary, retighten to specification.

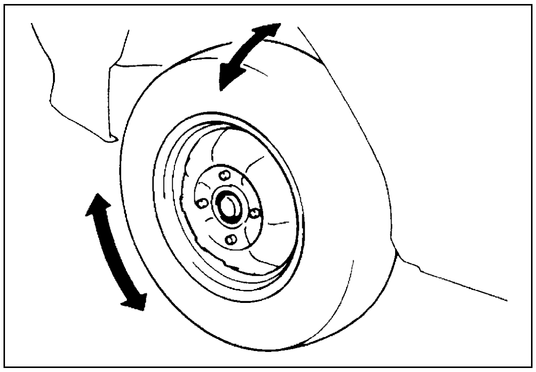
Tightening torque
Wheel nuts (a) : 85 N·m (8.5 kg-m, 61.5 lb-ft)



- Check wheel bearings for wear. When measuring thrust play, apply a dial gauge to spindle cap center (2WD) or axle shaft center (4WD).

Thrust play limit
“a” : 0.1 mm (0.004 in.)

When measurement exceeds limit, replace bearing.



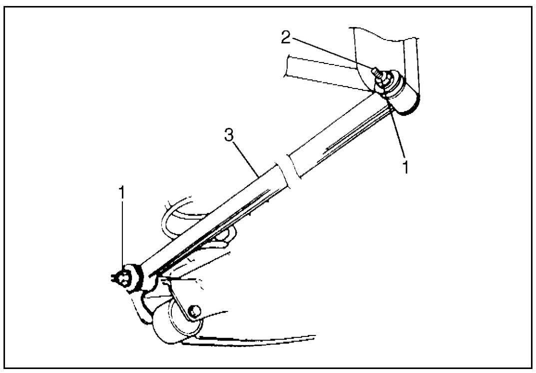
- By rotating wheel actually, check wheel bearing for noise and smooth rotation. If it is defective, replace bearing.

ON-VEHICLE SERVICE

LATERAL ROD

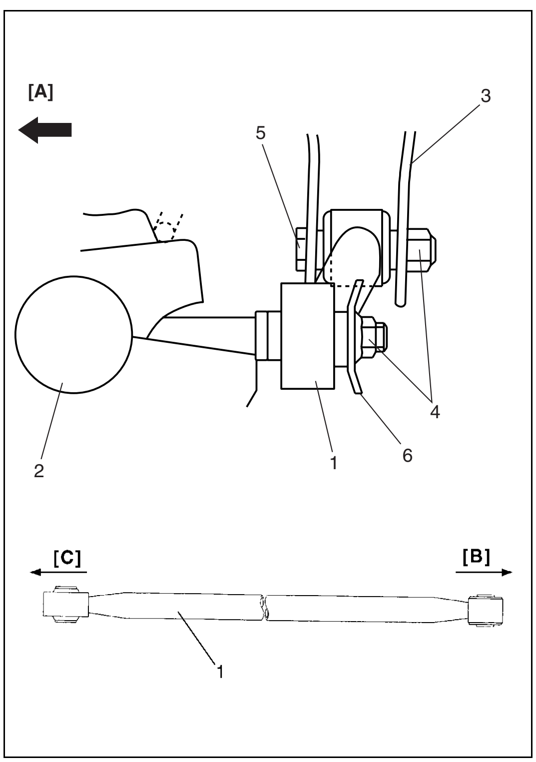
REMOVAL

1) Hoist vehicle.



2) Remove lateral rod nuts (1) and bolt (2).
3) Remove lateral rod (3).

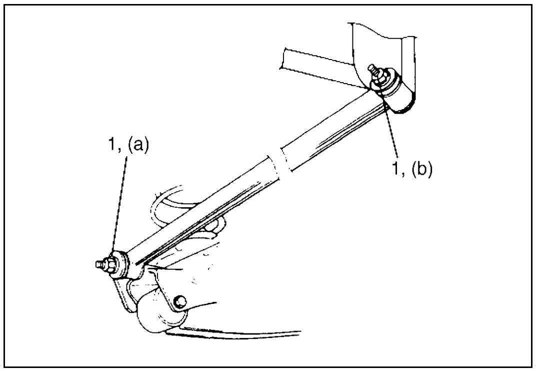
INSTALLATION



1) Install lateral rod (1) to rear axle (2) (2WD vehicle) or rear axle housing (4WD vehicle) and vehicle body (3) referring to figure for proper installing direction of nuts (4), bolt (5) and washer (6).
   Tighten nuts temporarily at this step.

[A] :	Forward
[B] :	Body side
[C] :	Rear axle (2WD vehicle) or rear axle housing (4WD vehicle) side

2) Lower hoist.



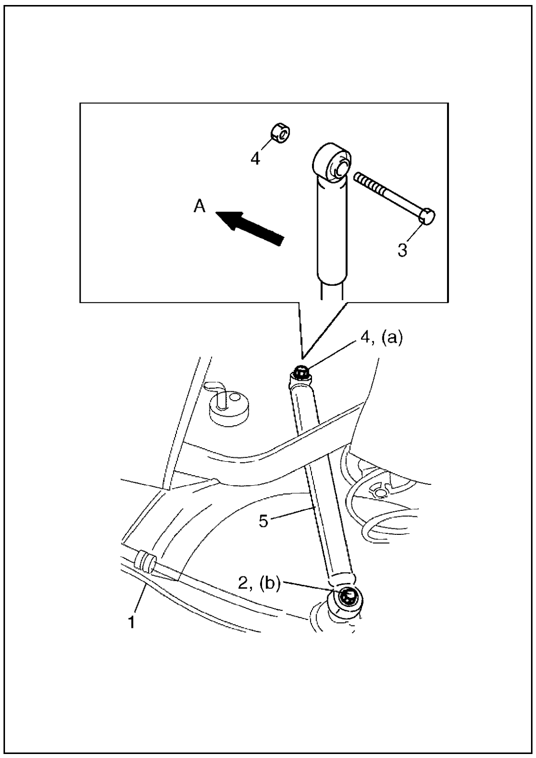
3) Tighten lateral rod nuts (1) to specified torque. It is the most desirable to have vehicle off hoist and in no-loaded condition when tightening them.

Tightening torque
Lateral rod left side nut (a) : 50 N·m (5.0 kg-m, 36.5 lb-ft)
Lateral rod right side nut (b) : 65 N·m (6.5 kg-m, 47.0 lb-ft)

REAR SHOCK ABSORBER

REMOVAL

1) Hoist vehicle.
2) Support rear axle (1) (2WD vehicle) or rear axle housing (4WD vehicle) using floor jack to prevent it from lowering.



3) Remove lower bolt (2).
4) Remove upper bolt (3) and nut (4). Then remove shock absorber (5).

INSTALLATION

1) Install shock absorber (5) referring to the figure.
   Tighten bolt and nut temporarily at this step.
2) Remove floor jack from rear axle (2WD vehicle) or rear axle housing (4WD vehicle) (1) and lower hoist.
3) Tighten bolt and nut to specified torque.

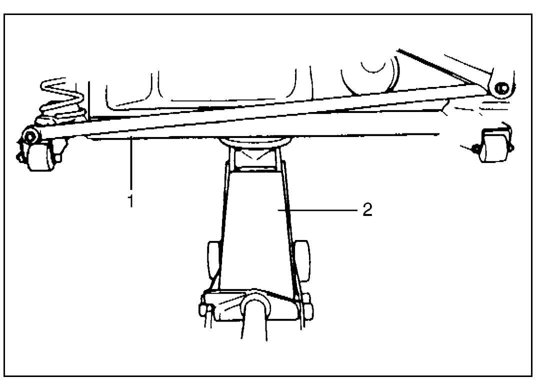
Tightening torque
Rear shock absorber upper nut
(a) : 63 N·m (6.3 kg-m, 46.0 lb-ft)
Rear shock absorber lower nut
(b) : 58 N·m (5.8 kg-m, 42.0 lb-ft)

A : Vehicle inside

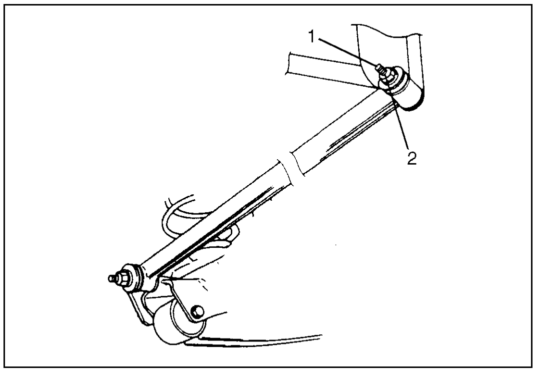
COIL SPRING

REMOVAL

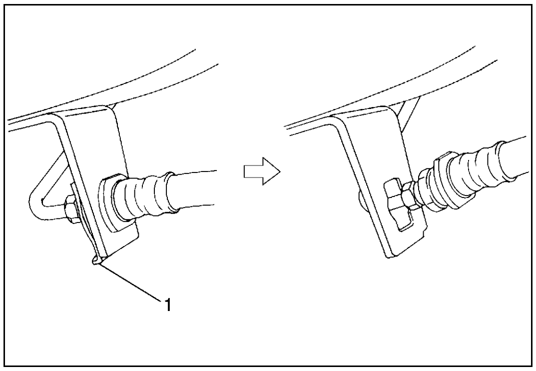
1) Hoist vehicle and remove rear wheel (s).



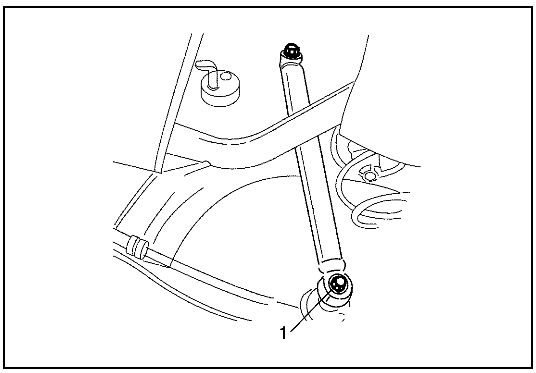
2) Support rear axle (1) (2WD vehicle) or rear axle housing (4WD vehicle) using floor jack (2) to prevent it from lowering.



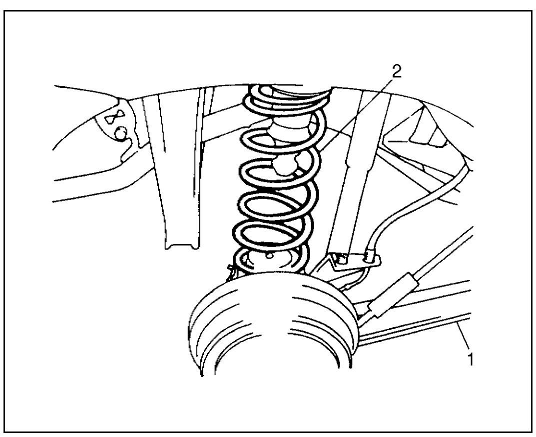
3) Remove lateral rod right side bolt (1) and nut (2).
4) Detach lateral rod right side from vehicle body.



5) Remove brake flexible hose E-ring (1).
6) Remove LSPV adjust nut and detach spring end from rear axle (2WD vehicle) or axle housing (4WD vehicle) (if equipped with LSPV).



7) Remove shock absorber lower bolt (1).
8) Detach shock absorber lower side from rear axle (2WD vehicle) or rear axle housing (4WD vehicle).



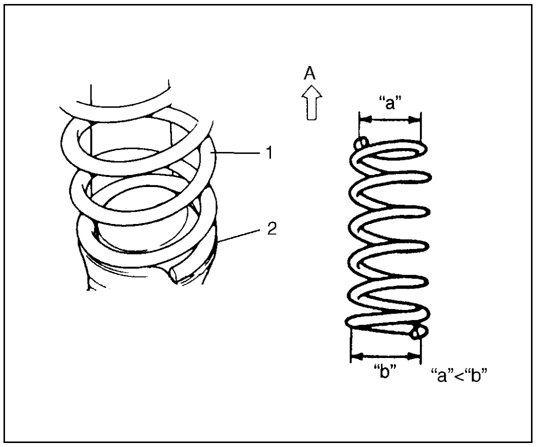
9) Lower rear axle (1) (2WD vehicle) or rear axle housing (4WD vehicle) gradually as far down as where coil springs (2) can be removed.

CAUTION:

Be careful not to let rear axle (2WD vehicle) or rear axle housing (4WD vehicle) down too much.
It may cause damage to brake flexible hose.

10) Remove coil spring.

INSTALLATION

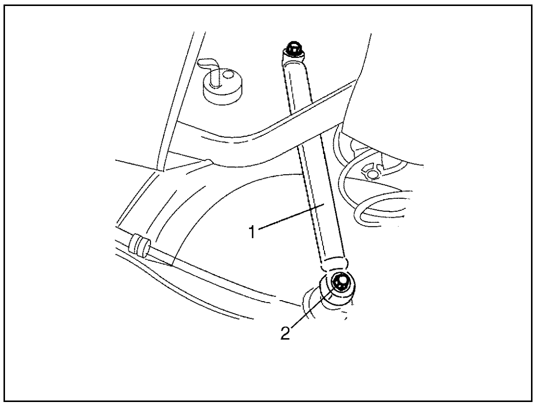


1) Install coil springs (1) (right & left) on spring seat (2) of rear axle (2WD vehicle) or rear axle housing (4WD vehicle) and raise rear axle (2WD vehicle) or rear axle housing (4WD vehicle).

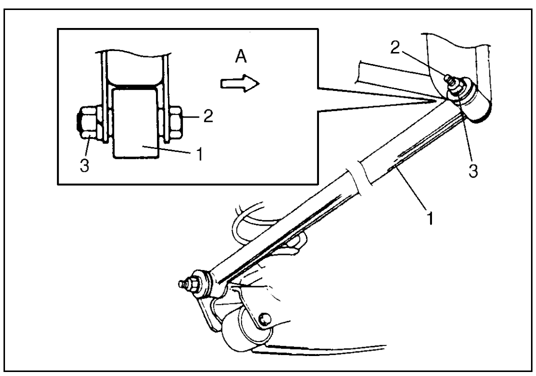
NOTE:

Upper and lower diameters of coil spring are different. Bring larger diameter end at bottom and set its open end in place on spring seat.

A : Upper side

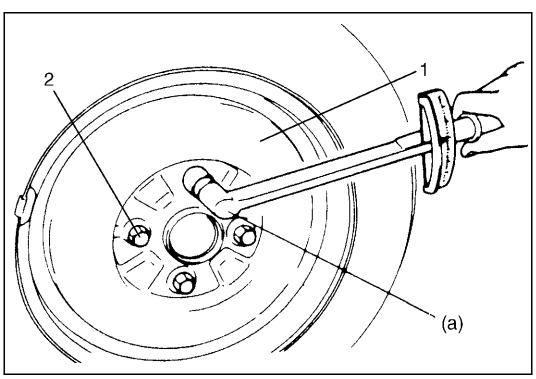


2) Install shock absorber (1) lower side to rear axle (2WD vehicle) or rear axle housing (4WD vehicle).
   Tighten shock absorber lower bolt (2) temporarily at this step.
3) Remove floor jack from rear axle (2WD vehicle) or axle housing (4WD vehicle).
4) Install brake flexible hose E-ring.
5) Install LSPV spring to rear axle (2WD vehicle) or axle housing (4WD vehicle). Tighten LSPV adjust nut temporarily at this step (if equipped with LSPV).



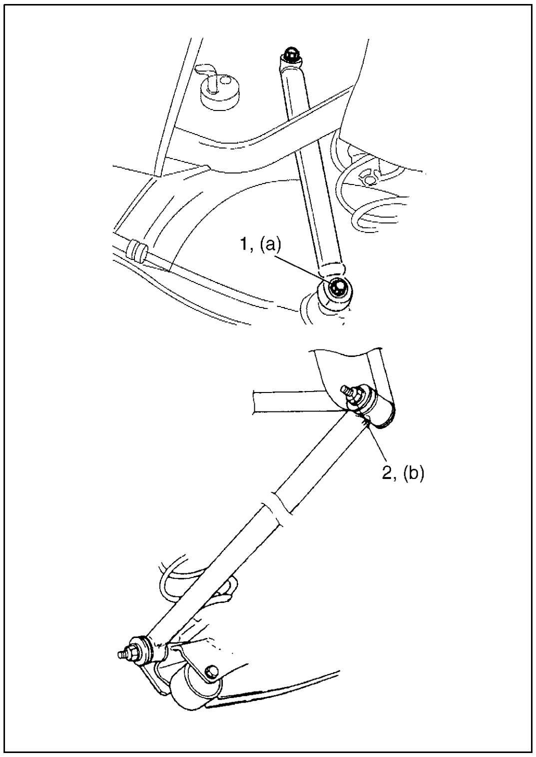
6) Install lateral rod (1) right side to vehicle body, refer to the figure for proper installing direction of bolt (2).
   Tighten nut (3) temporarily at this step.
7) Remove floor jack from rear axle (2WD vehicle) or rear axle housing (4WD vehicle).

A : Forward



8) Install wheel (1) and tighten wheel nuts (2) to specified torque.

Tightening torque
Wheel nuts (a) : 85 N·m (8.5 kg-m, 61.5 lb-ft)



9) Lower hoist and vehicle in non-loaded condition, tighten absorber lower bolt (1) and lateral rod right side nut (2) to specified torque.

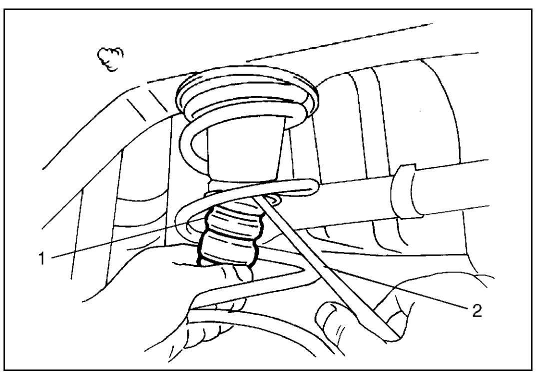
Tightening torque
Rear shock absorber lower bolt
(a) : 58 N·m (5.8 kg-m, 42.0 lb-ft)
Lateral rod right side nut
(b) : 65 N·m (6.5 kg-m, 47.0 lb-ft)

10) If equipped with LSPV, check and adjust LSPV spring referring to “LSPV INSPECTION AND ADJUSTMENT” and perform “FLUID PRESSURE TEST” in Section 5.

BUMP STOPPER

REMOVAL

1) Hoist vehicle and remove rear wheel.

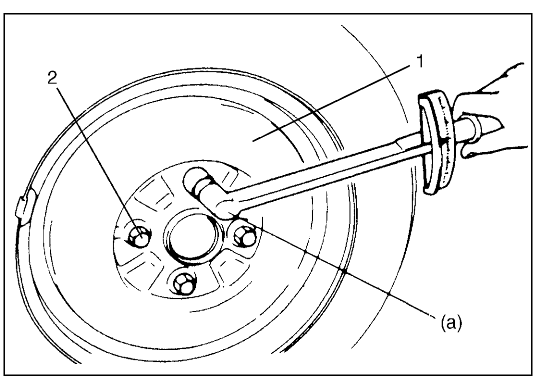


2) Remove bump stopper (1) using flat tip rod or the like (2).

INSTALLATION

1) Install bumper stopper.

NOTE:
Before installing bushing, apply soap water on it.



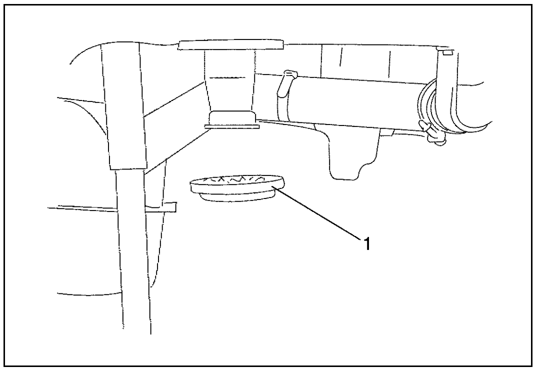
2) Install wheel (1) and tighten wheel nuts (2) to specified torque.

Tightening torque
Wheel nuts (a) : 85 N·m (8.5 kg-m, 61.5 lb-ft)

SPRING UPPER SEAT

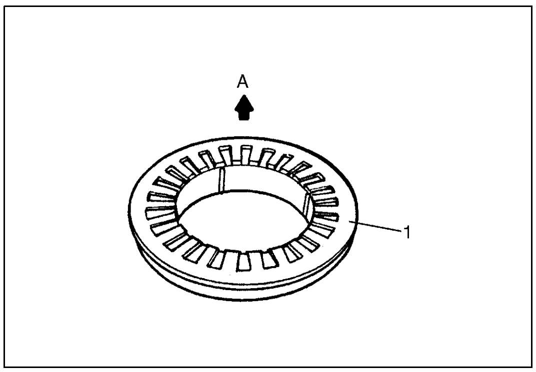
REMOVAL

1) Removal coil spring. Refer to “COIL SPRING” in this section.



2) Remove spring upper seat (1).

INSTALLATION



1) Install spring upper seat (1).

NOTE:

For proper installing direction of spring upper seat (1), refer to the figure.

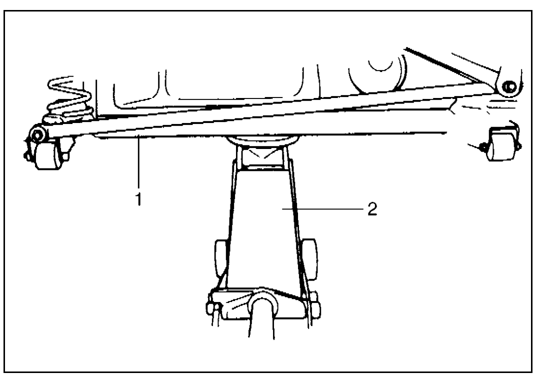
A :	Vehicle body side (Upper side)

2) Install coil spring. Refer to “COIL SPRING” in this section.

TRAILING ARM

REMOVAL

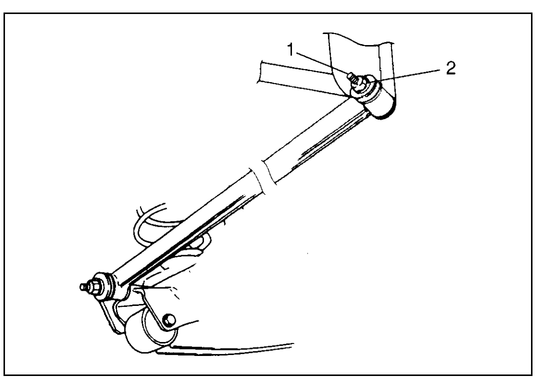
1) Hoist vehicle and remove rear wheel.



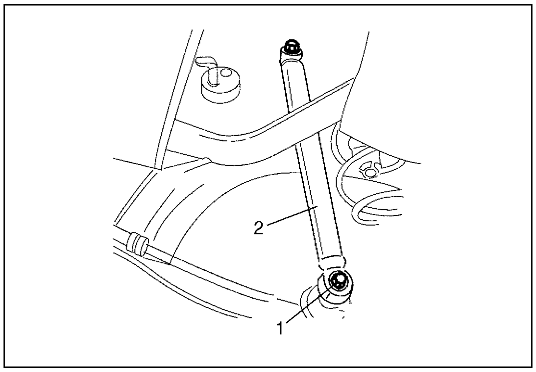
2) Support rear axle (1) (2WD vehicle) or rear axle housing (4WD vehicle) using floor jack (2).

CAUTION:

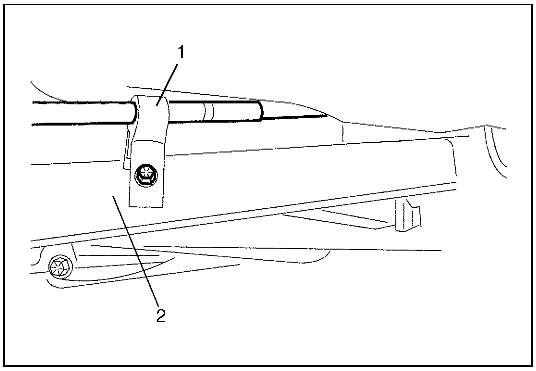
Never apply floor jack against lateral rod as it may get deformed.



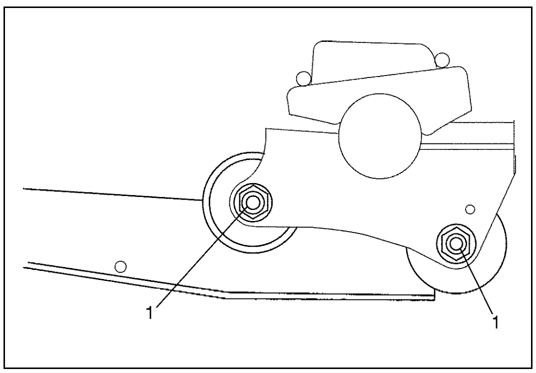
3) Remove lateral rod right side bolt (1) and nut (2).



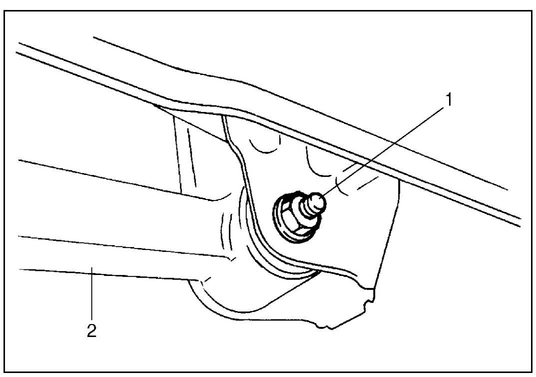
4) Remove shock absorber lower bolt (1).
5) Detach shock absorber (2) lower side from rear axle (2WD vehicle) or rear axle housing (4WD vehicle).



6) Remove parking brake cable clamp (1) from trailing arm (2).
7) Release wheel speed sensor lead wire clamps (right & left) from trailing arm (if equipped with ABS).

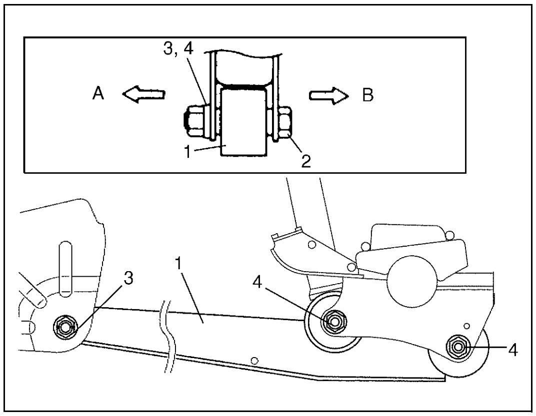


8) Remove trailing arm rear bolts (1).



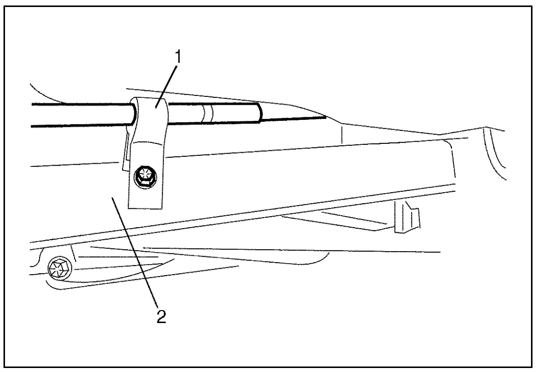
9) Remove trailing arm front bolt (1) and then remove trailing arm (2).

INSTALLATION

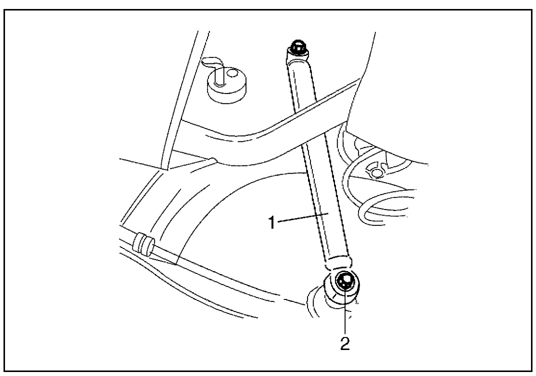


1) Install trailing arm (1) to vehicle body and rear axle (2WD vehicle) or rear axle housing (4WD vehicle), referring to figure for proper installing direction of bolts (2).
   Tighten front nut (3) and rear nuts (4) temporarily at this step.

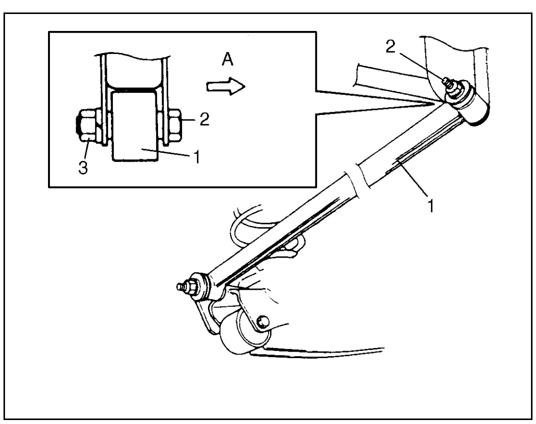
A :	Vehicle out side
B :	Vehicle center side



2) Install parking brake cable clamp (1) to trailing arm (2).
3) Clamp wheel speed sensor lead wire (right & left) to trailing arm securely (if equipped with ABS).



4) Install shock absorber (1) lower side to rear axle (2WD vehicle) or rear axle housing (4WD vehicle).
   Tighten shock absorber lower bolt (2) temporarily at this step.

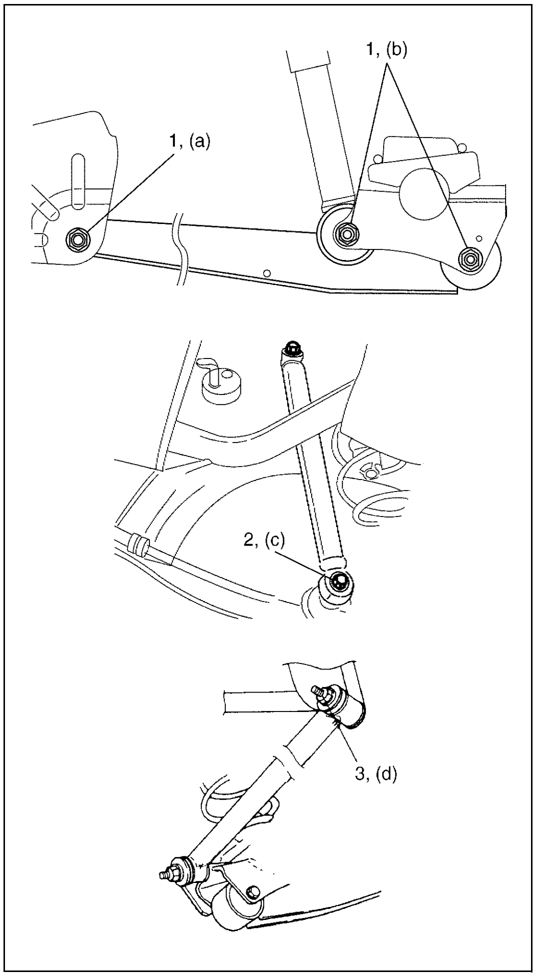


5) Install lateral rod (1) to vehicle body, refer to the figure for proper installing direction of bolt (2).
   Tighten nut (3) temporarily at this step.
6) Remove floor jack from rear axle.
7) Install wheel and tighten wheel nuts to specified torque.

Tightening torque
Wheel nuts : 85 N·m (8.5 kg-m, 61.5 lb-ft)

A :	Forward

8) Lower hoist.



9) Tighten front and rear trailing arm nuts (1), shock absorber lower bolts (2) and lateral rod right nut (3) to specified torque (right and left).

NOTE:

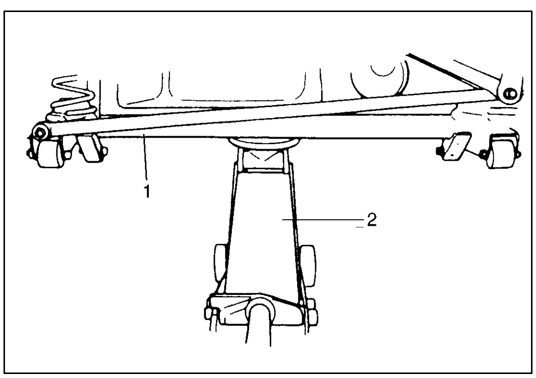
When tightening these nuts, be sure that vehicle is off hoist and in no-loaded condition.

Tightening torque
Front trailing arm nut (a) : 90 N·m (9.0 kg-m, 65.0 lb-ft)
Rear trailing arm nuts (b) : 80 N·m (8.0 kg-m, 58.0 lb-ft)
Rear shock absorber lower bolts
(c) : 58 N·m (5.8 kg-m, 42.0 lb-ft)
Lateral rod right nut (d) : 65 N·m (6.5 kg-m, 47.0 lb-ft)

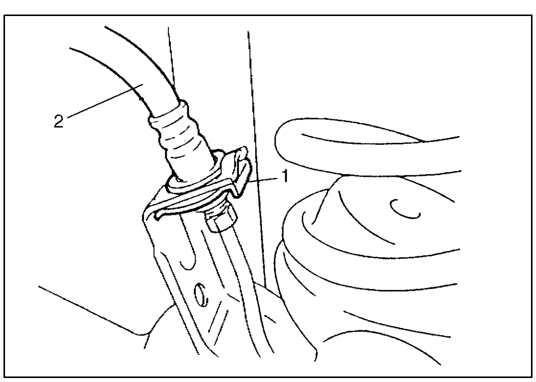
REAR AXLE (2WD VEHICLE)

REMOVAL

1) Hoist vehicle and remove rear wheels (right & left).



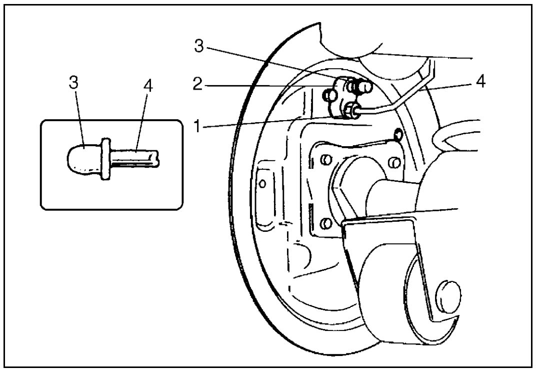
2) Support rear axle (1) using floor jack (2).
3) Remove rear brake drums (right & left). Refer to “BRAKE DRUM” in Section 5.



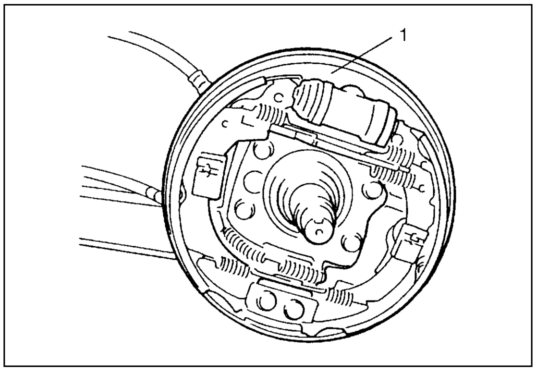
4) Remove E-ring (1) (right & left) securing brake hose (2).

CAUTION:

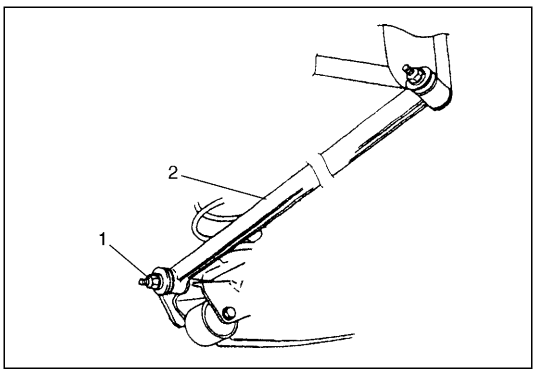
Do not allow brake fluid to get on painted surfaces.



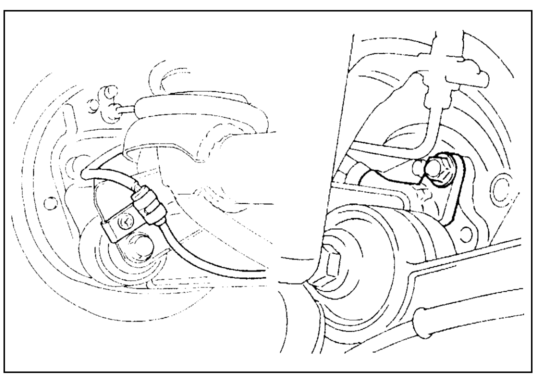
5) Disconnect brake pipe flare nuts (1) from wheel cylinders (2) (right & left) and put bleeder plug cap (3) onto brake pipe (4) to prevent fluid from spilling.



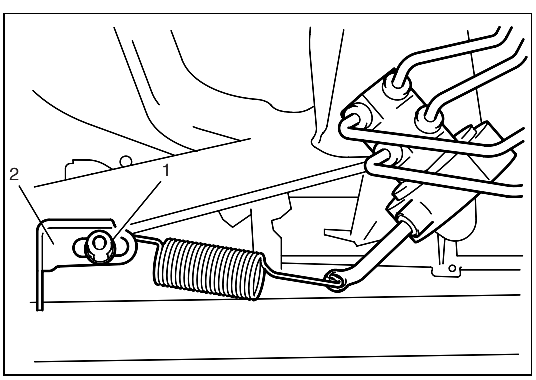
6) Remove brake back plates (1) (right & left) from rear axle and hang removed back plate with a wire hook.



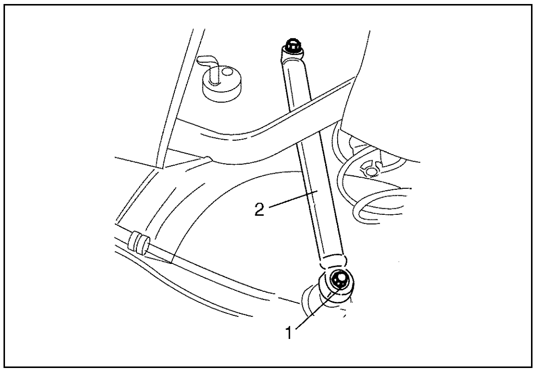
7) Remove lateral rod left side nut (1).
8) Detach lateral rod (2) left side from rear axle.



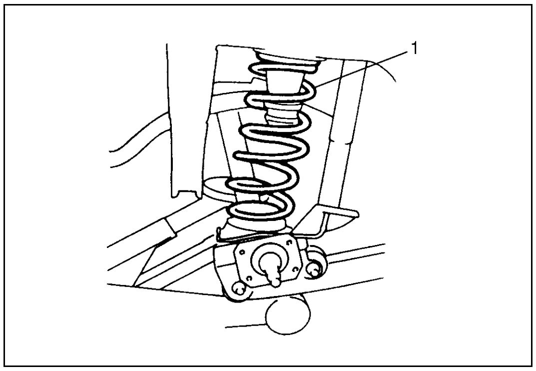
9) Remove wheel speed sensor and release clamps (right & left) (if equipped with ABS).



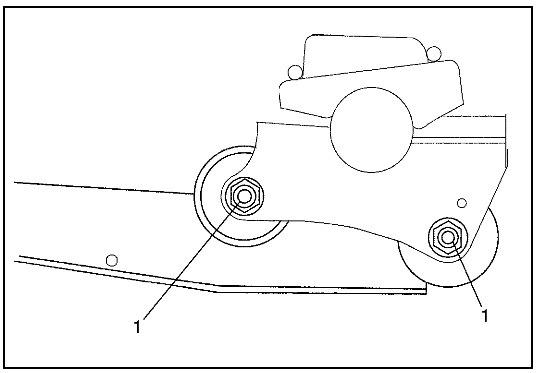
10) Remove nut (1) and detach spring end from rear axle (2) (if equipped with LSPV).



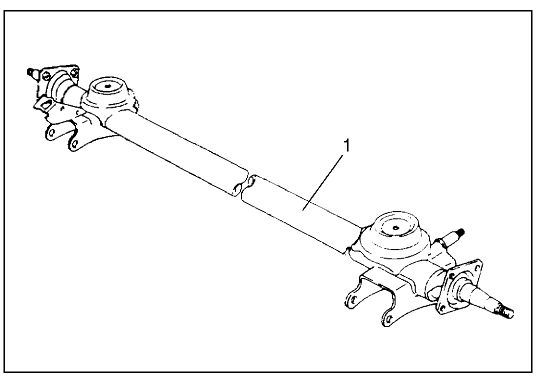
11) Remove shock absorber lower bolts (1) (right & left).
12) Detach shock absorber (2) lower sides (right & left) from rear axle.
13) Lower rear axle gradually as far down as where coil springs (1) (right & left) can be removed.



14) Remove coil springs (right & left).



15) Loosen rear trailing arm nuts (1) from trailing arm but don't remove bolts (right & left).

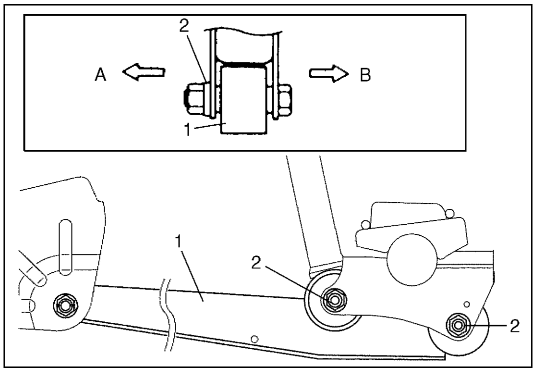


16) While supporting rear axle (1) at both ends (right & left), remove rear trailing arm bolts (right & left) and then remove rear axle (1) from chassis by lowering floor jack gradually.

INSTALLATION

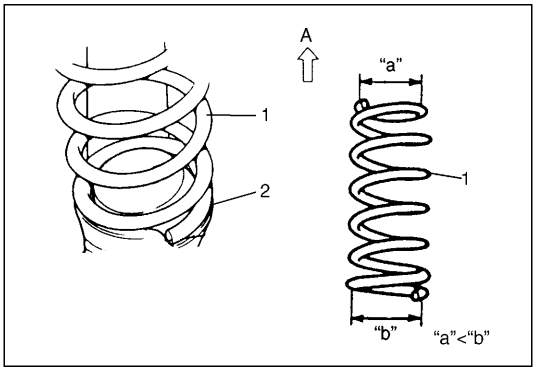
Install removed parts in reverse order of removal, noting the following points.

1) Place rear axle on floor jack.
   Then install lateral rod to rear axle and tighten nut temporarily at this step.



2) Install trailing arms (1) (right & left) to rear axle in proper direction as shown in figure.
   Tighten rear trailing arm nuts (2) temporarily at this step.

A :	Vehicle outside
B :	Vehicle center side

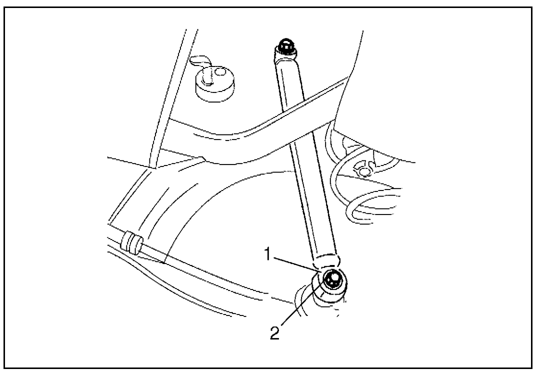


3) Install coil springs (1) (right & left) on spring seat (2) of rear axle and raise rear axle.

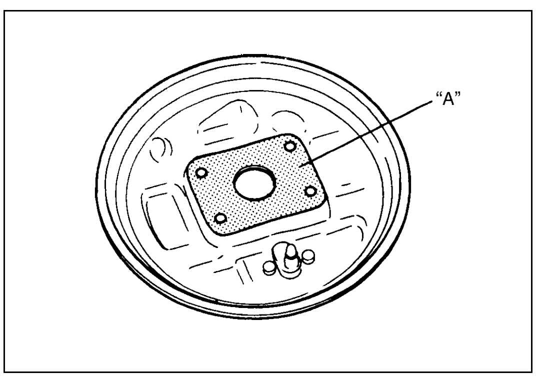
NOTE:

Upper and lower diameters of coil spring are different. Bring larger diameter end at bottom and set its open end in place on spring seat.

A :	Upper side

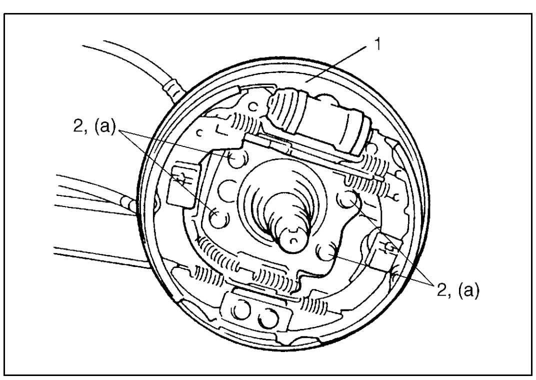


4) Install shock absorber (1) lower sides (right & left) to rear axle.
   Tighten shock absorber lower bolts (2) temporarily at this step.
5) Remove floor jack from rear axle.



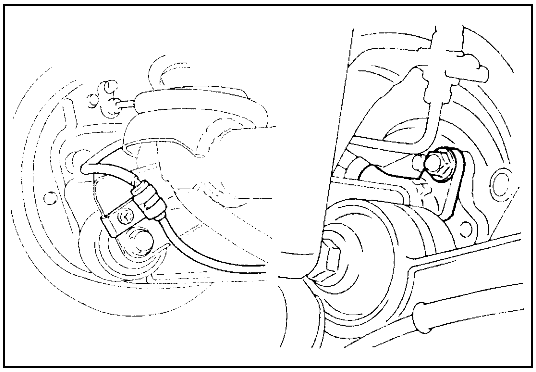
6) Clean mating surfaces (right and left) of rear axle with brake back plate and apply water tight sealant as shown in figure.

"A" : Sealant 99000-31090

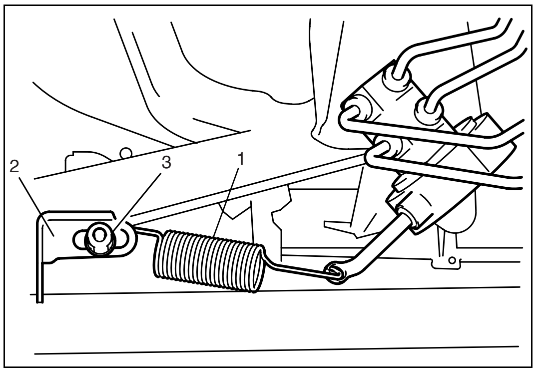


7) Install brake back plates (1) (right and left) and tighten back plate bolts (2) to specified torque.

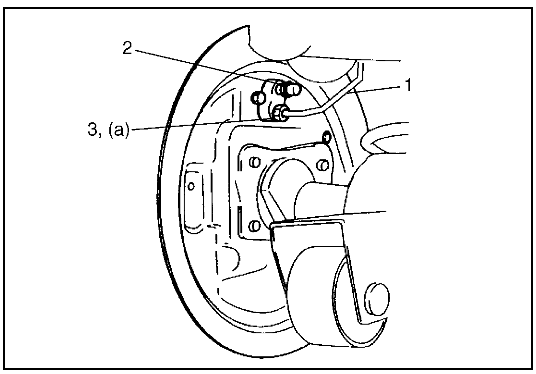
Tightening torque
Brake back plate bolts (a) : 23 N·m (2.3 kg-m, 17.0 lb-ft)



8) Install wheel speed sensor and clamp wire securely (right & left) (if equipped with ABS).

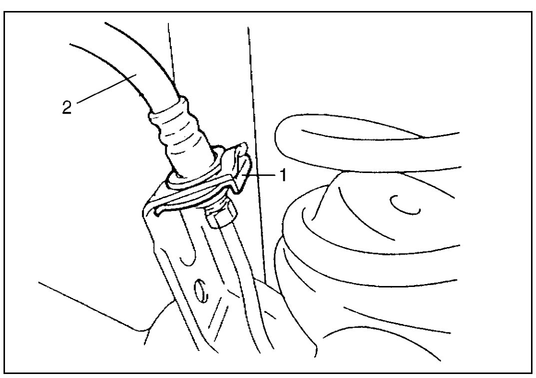


9) Install LSPV spring (1) to rear axle (2).
   Tighten nut (3) temporarily at this step (if equipped with LSPV).

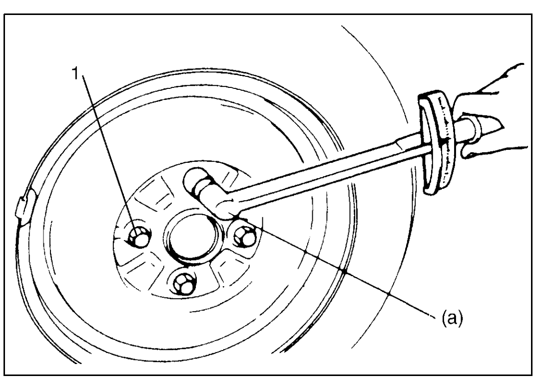


10) Connect brake pipes (1) (right & left) to wheel cylinders (2) and tighten brake pipe flare nuts (3) to specified torque.

Tightening torque
Brake pipe flare nuts (a) : 16 N·m (1.6 kg-m, 11.5 lb-ft)



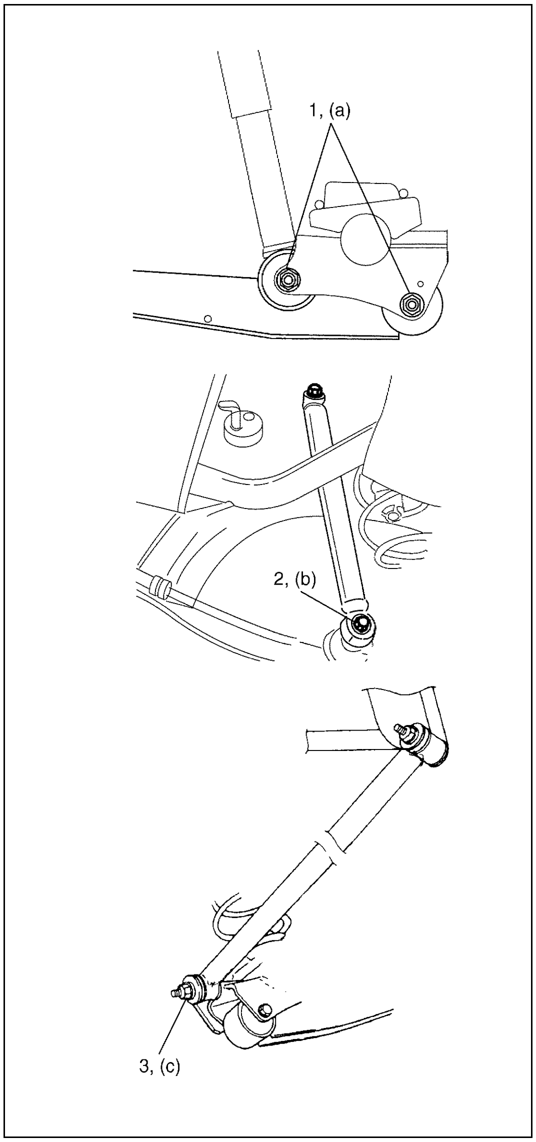
11) Connect brake flexible hoses (1) to bracket on rear axle and secure it with E-rings (2).
12) Install brake drums (right & left). Refer to “BRAKE DRUM” in Section 5.
13) Fill reservoir with brake fluid and bleed brake system (For bleeding operation, refer to Section 5.)



14) Install wheel and tighten wheel nuts (1) to specified torque.

Tightening torque
Wheel nuts (a) : 85 N·m (8.5 kg-m, 61.5 lb-ft)

15) Upon completion of all jobs, depress brake pedal with about 30 kg (66 lbs) load three to five times so as to obtain proper drum-to-shoe clearance.
    Adjust parking brake cable. Refer to Section 5.
16) Install console box.
17) Lower hoist and bounce vehicle up and down several times to stabilize suspension.
    Be sure that vehicle is off hoist and in non loaded condition.



18) Tighten rear trailing arm nuts (1), shock absorber lower bolts (2) and lateral rod left side nut (3) to specified torque (right and left).

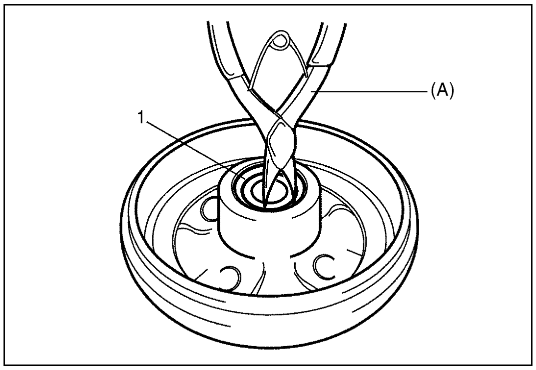
Tightening torque
Rear trailing arm nuts (a) : 80 N·m (8.0 kg-m, 58.0 lb-ft)
Rear shock absorber lower bolts
(b) : 58 N·m (5.8 kg-m, 42.0 lb-ft)
Lateral rod left side nut (c) : 50 N·m (5.0 kg-m, 36.5 lb-ft)

19) Check to ensure that brake drum is free from dragging and proper braking is obtained.
20) If equipped with LSPV, check and adjust LSPV spring referring to "LSPV INSPECTION AND ADJUSTMENT" and perform "FLUID PRESSURE TEST" in Section 5.
21) Perform brake operation test (foot brake and parking brake).

WHEEL BEARING AND WHEEL STUD (2WD VEHICLE)

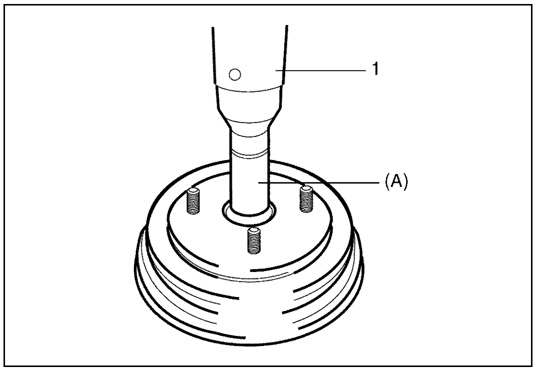
REMOVAL

1) Remove rear brake drum. Refer to "REAR BRAKE DRUM" in Section 5.
2) Remove wheel sensor ring (if equipped with ABS). Refer to "REAR WHEEL SENSOR RING" of Section 5E.



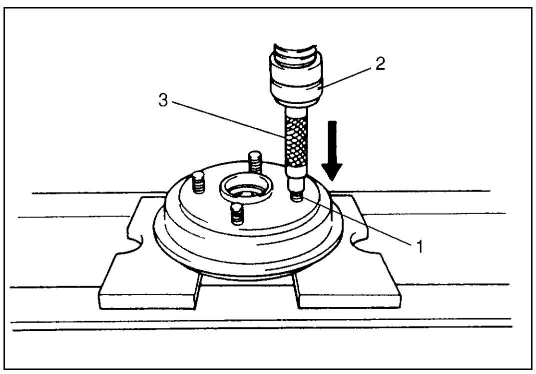
3) Remove bearing circlip (1) using special tool.

Special tool
(A) : 09900-06108



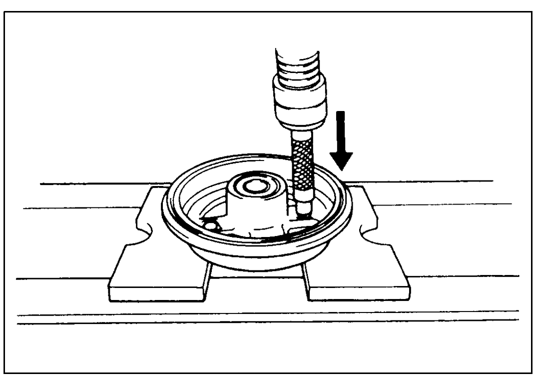
4) Remove wheel bearing using special tool and hydraulic press (1).

Special tool
(A) : 09913-76010

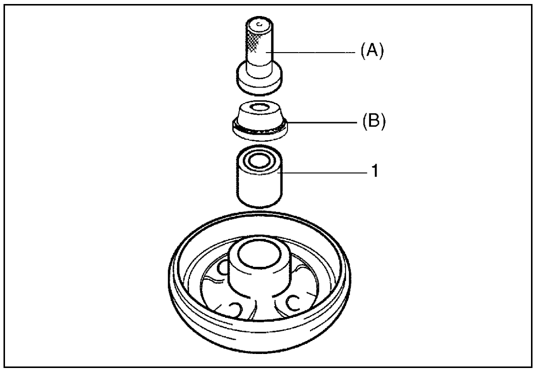


5) Remove wheel stud bolts (1) using hydraulic press (2) and general rod (3).

INSTALLATION

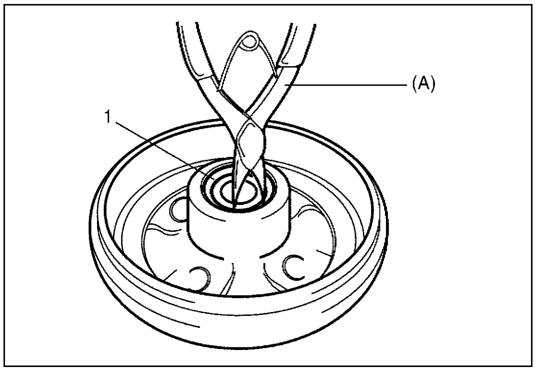


1) Insert new stud in drum hole and rotate it slowly to assure serrations are aligned with those made by replaced bolt.



2) Press-fit wheel bearing (1) with it's seal side facing back plate side using special tools and hydraulic press.

Special tool
(A) : 09913-76010
(B) : 09924-84510-004



3) Install bearing circlip (1) using special tool.

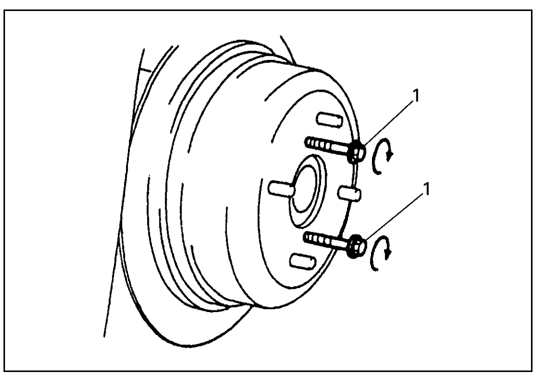
Special tool
(A) : 09900-06108

4) Install wheel sensor ring (if equipped with ABS).
Refer to "REAR WHEEL SENSOR RING" of Section 5E.
5) Install brake drum and wheel. For details, refer to "REAR BRAKE DRUM" in Section 5.

REAR AXLE SHAFT AND WHEEL BEARING (4WD VEHICLE)

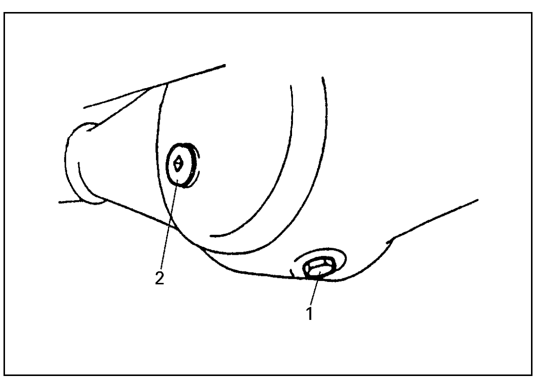
REMOVAL

1) Hoist vehicle and remove rear wheels.
2) Remove rear brake drum. For details referring to Section 5.

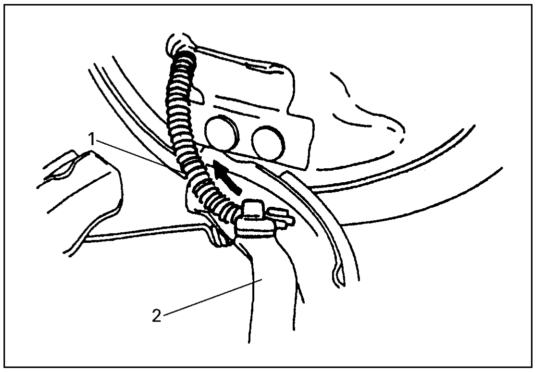


1. 8mm bolt

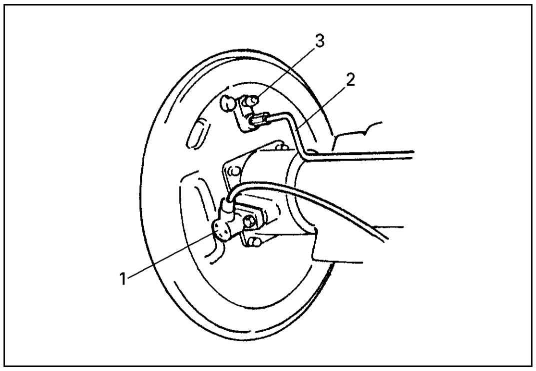
3) Drain gear oil from rear axle housing by loosening drain plug (1).



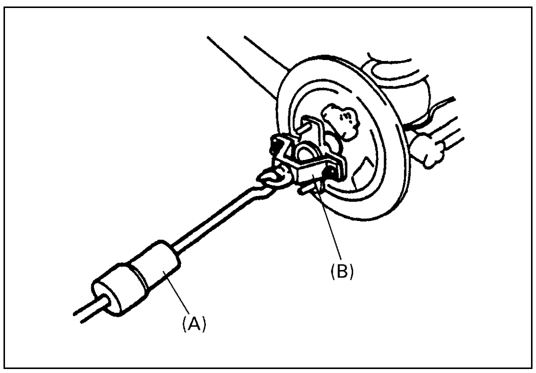
2. Level plug



4) Disconnect parking brake cable from parking brake shoe lever (2) and remove parking brake cable (1) from brake back plate.
5) Remove brake back plate bolts from axle housing.



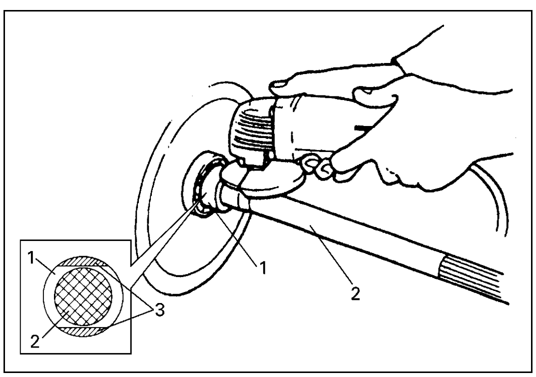
6) Disconnect brake pipe(s) (2) from wheel cylinder and put wheel cylinder bleeder plug (3) cap onto pipe to prevent fluid from spilling.
7) Remove wheel speed sensor (1) from axle housing (if equipped with ABS).



8) Using special tools indicated, draw out axle shaft with brake back plate.

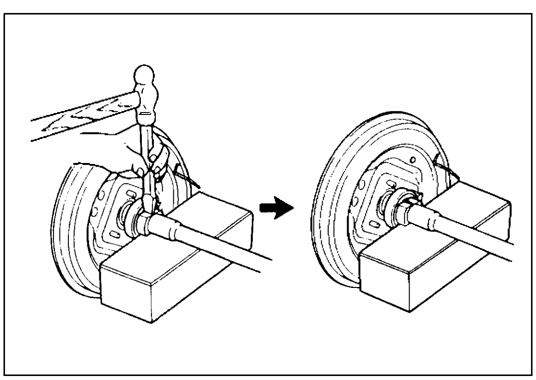
Special tool
(A) : 09942-15510
(B) : 09943-17912

9) Remove wheel sensor ring (if equipped with ABS). Refer to "REAR WHEEL SENSOR RING" of Section 5E.

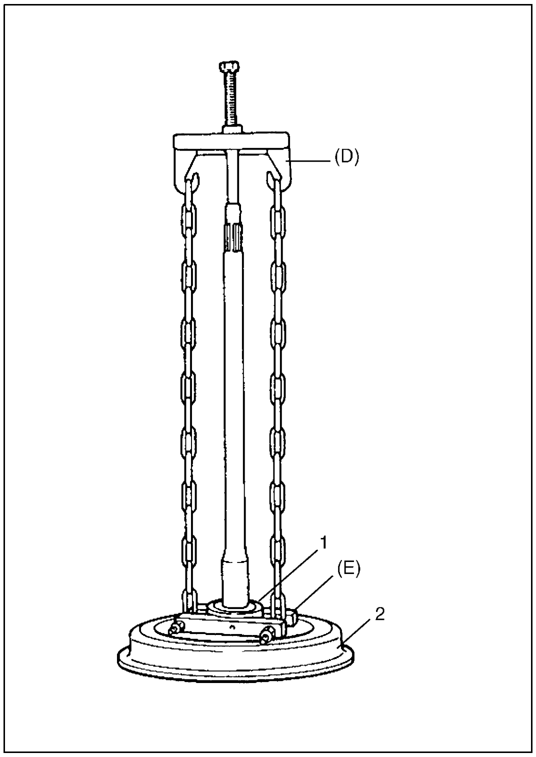


10) In order to remove the retainer ring (1) from the axle shaft (2), grind (3) with a grinder two parts of the bearing retainer ring as illustrated till it becomes thin.

CAUTION:
Be careful not to go so far as to grind the shaft.

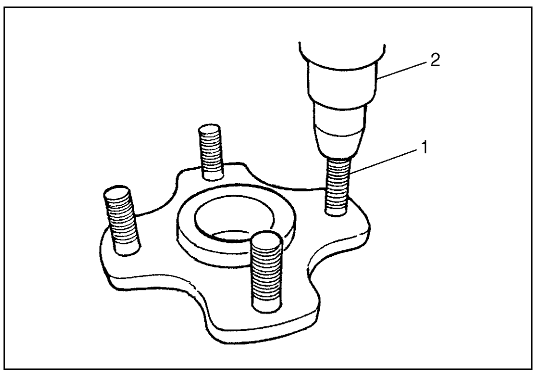


11) Break with a chisel the thin ground retainer ring, and it can be removed.



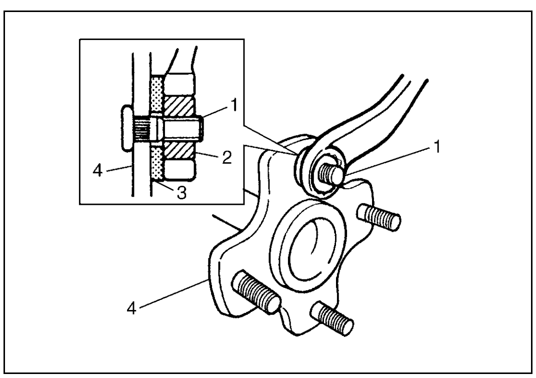
12) Using special tools, remove bearing (1) from shaft and then remove brake back plate (2).

Special tool
(D) : 09927-18411
(E) : 09921-57810



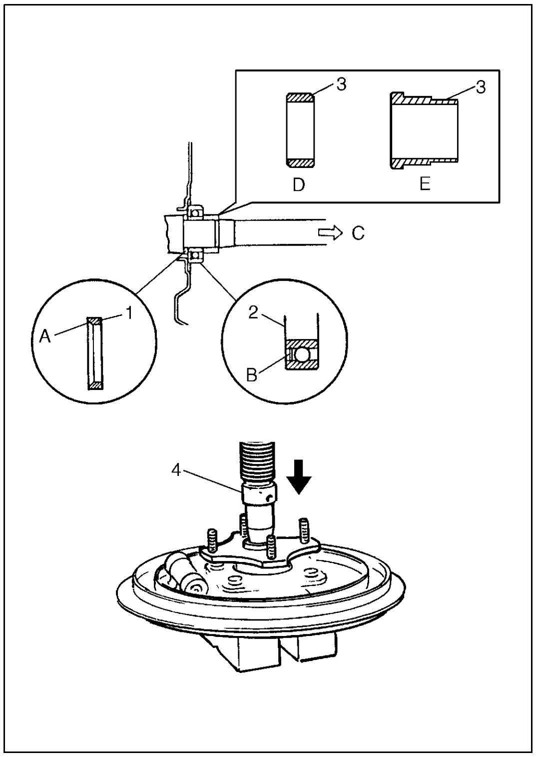
13) Remove stud bolts (1) by using hydraulic press (2).

INSTALLATION



1) Aligning serrations between new stud bolts (1) and flange (4), install new stud bolts by tightening nut as shown.

2.	Nut
3.	Washer



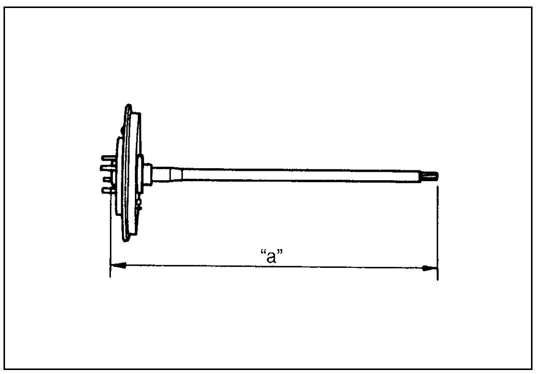
2) Press in a new bearing (2) and retainer ring (3) in order by using an hydraulic press (4).

NOTE:

- **Install wheel bearing spacer (1) with the tapered side of its inner diameter directed toward outside, or brake drum side.**
- **Install wheel bearing with its sealed side directed toward brake drum side.**
- **Use care not to cause any damage to outside of retainer ring.**

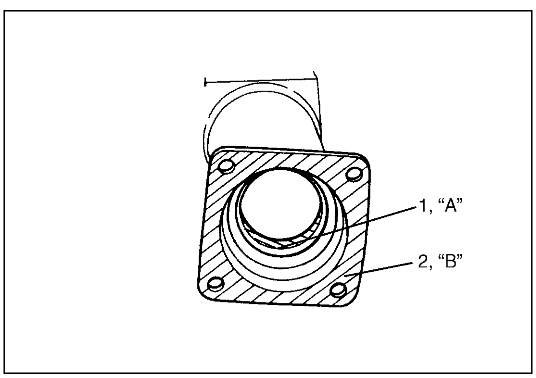
3) Install wheel sensor ring (if equipped with ABS).
   Refer to "REAR WHEEL SENSOR RING" of Section 5E.

A :	Tapered side
B :	Sealed side
C :	Differential side
D :	Without ABS
E :	With ABS



4) Inspect axle shaft length.

Rear axle shaft length "a"
Left side : 657.5 mm (25.9 in.)
Right side : 785.5 mm (30.9 in.)



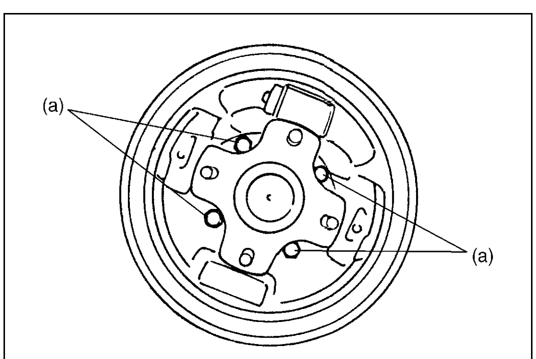
5) Apply grease to axle shaft oil seal (1) lip as shown.

"A" : Grease 99000-25010

6) Apply sealant to mating surface of axle housing (2) with brake back plate.

NOTE:
Make sure to remove old sealant before applying it anew.

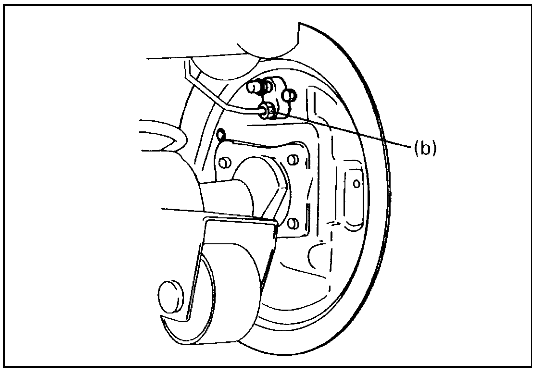
"B" : Sealant 99000-31090



7) Install rear axle shaft to rear axle housing and tighten brake back plate bolts to specified torque.

NOTE:
When installing rear axle shaft, be careful not to cause damage to oil seal lip in axle housing.

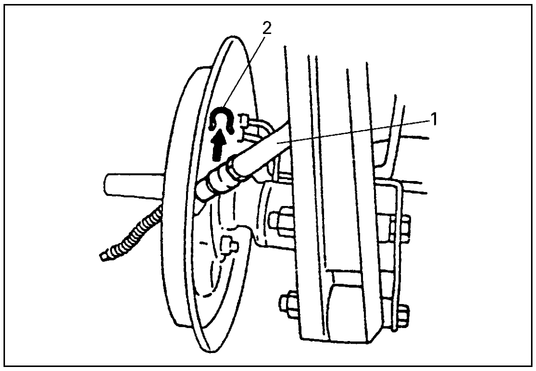
Tightening torque
Brake back plate bolts (a) : 23 N·m (2.3 kg-m, 17.0 lb-ft)



8) Connect brake pipe to wheel cylinder and tighten brake pipe flare nut to specified torque.

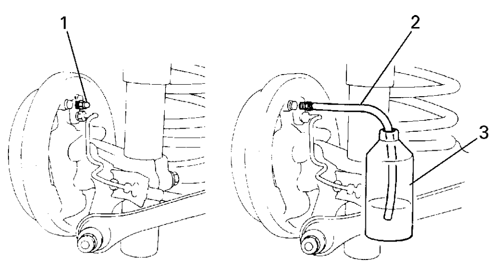
Tightening torque
Brake pipe flare nut (b) : 16 N·m (1.6 kg-m, 11.5 lb-ft)

9) Refill rear axle (differential) housing with new specified gear oil. Refer to Section 7F for refill.
10) Install brake drum. For details, refer to "BRAKE DRUM" of Section 5.



11) Connect parking brake cable (1) to parking brake shoe lever. Secure parking brake cable to brake back plate with clip (2). Install wheel speed sensor (if equipped with ABS).

CAUTION:
Check to ensure that clip is in good condition before installing it. If deformed or broken, replace.



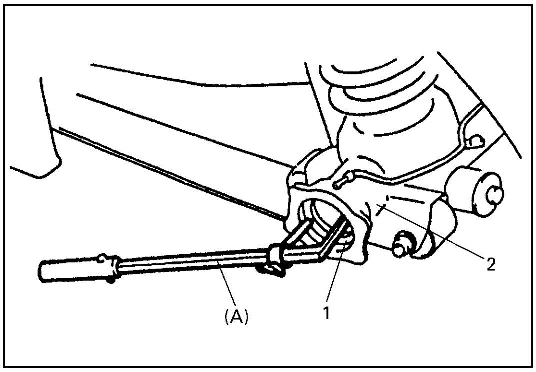
12) Fill reservoir with brake fluid and bleed brake system. (For bleeding operation, refer to "BLEEDING BRAKES" in Section 5.)
13) Install wheel and tighten wheel nuts to specified torque.
14) Upon completion of all jobs, pull parking brake lever with about 20 kg, (44 lbs) load three to five times so as to obtain proper drum-to-shoe clearance.
    Adjust parking brake cable (for adjustment, refer to "PARKING BRAKE INSPECTION AND ADJUSTMENT" in Section 5).
15) Check to ensure that brake drum is free from dragging and proper braking is obtained.
16) Perform brake test (foot brake and parking brake).
    (For brake test, see Section 5.)
17) Check each installed part for oil leakage.

1. Plug cap
2. Vinyl tube (See-through tube)
3. Container

REAR AXLE SHAFT OIL SEAL (4WD VEHICLE)

REMOVAL

1) Remove rear axle shaft. For details, refer to steps 1) to 8) of "REAR AXLE SHAFT AND WHEEL BEARING" in this section.

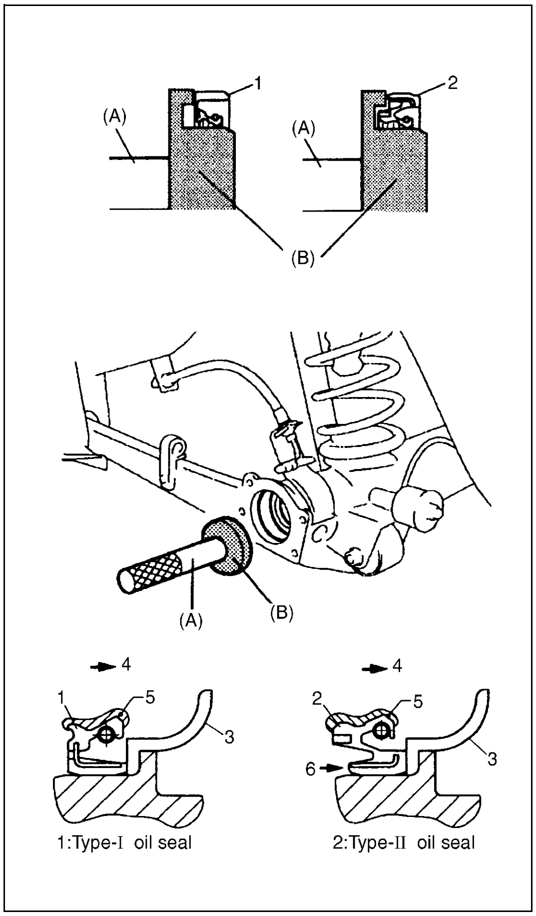


2) Remove rear axle shaft oil seal (1) by using special tool.

Special tool
(A) : 09913-50121

2. Axle housing

INSTALLATION



1) Using special tools, drive in oil seal (1) or (2) until it contacts oil seal protector (3) in axle housing.

NOTE:
- **There are 2 types of oil seal ((1) & (2)). Their shapes are different as shown in the figure but they are both usable.**
- **Special Tool (B) can be used for both oil seals (1) and (2).**
- **Make sure that oil seal is free from inclination as it is installed.**
- **Refer to the figure to check that oil seal is installed in proper direction.**

CAUTION:
When installing oil seal (2), never hit any part other than the position indicated as (6) in the figure. Make sure to use special tools indicated below. Failure to observe this caution will cause oil seal to be deformed and oil leakage to occur.

Special tools
(A) : 09924-74510
(B) : 09944-67010
"A" : Grease 99000-25010

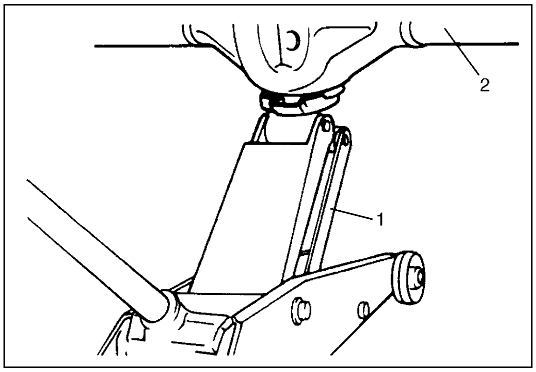
4. Differential side
5. Apply grease here
6. Press-fitting point

2) For procedure hereafter, refer to steps 5) to 7) of "REAR AXLE SHAFT AND WHEEL BEARING" in this section.

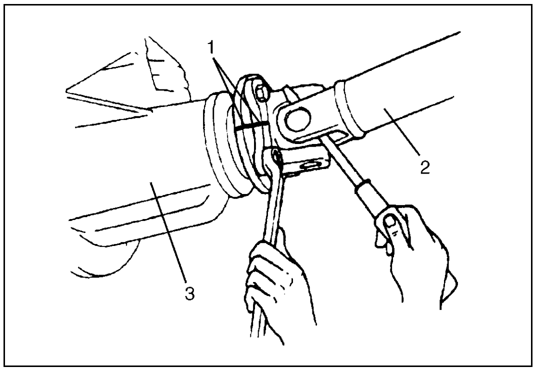
REAR AXLE HOUSING (4WD VEHICLE)

REMOVAL

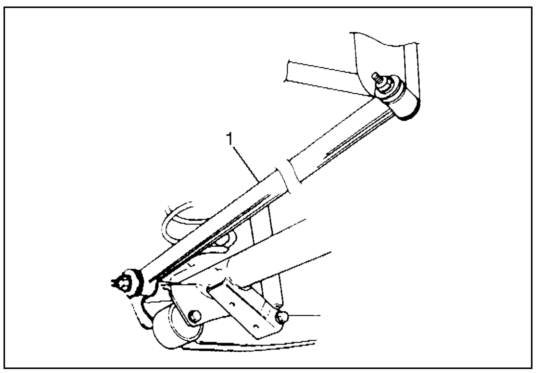
1) Hoist vehicle.
2) Remove rear axle shaft referring to item 2) to 8) of "REAR AXLE SHAFT AND WHEEL BEARING" in this section.
3) Disconnect brake pipe from flexible hose and remove E-ring.
4) Remove brake pipe clamps and pipes from axle housing.
5) Remove parking brake cable clamps and disconnect parking brake cable from axle housing.
6) Remove wheel speed sensor and release clamps from axle housing (if equipped with ABS).
7) Remove LSPV adjust nut and detach spring end from rear axle housing (if equipped with LSPV).



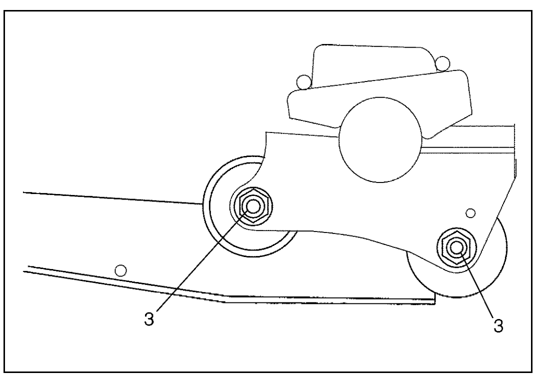
8) For jobs hereafter, support rear axle housing by using floor jack (1) under axle housing (2).



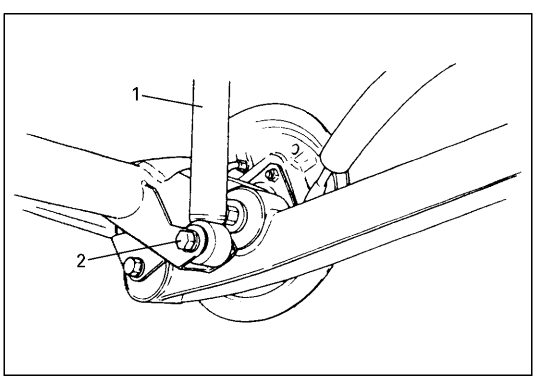
9) Before removing propeller shaft, give match marks (1) on joint flange and propeller shaft (2) as shown.
   Remove propeller shaft.
10) Remove differential carrier assembly (3).



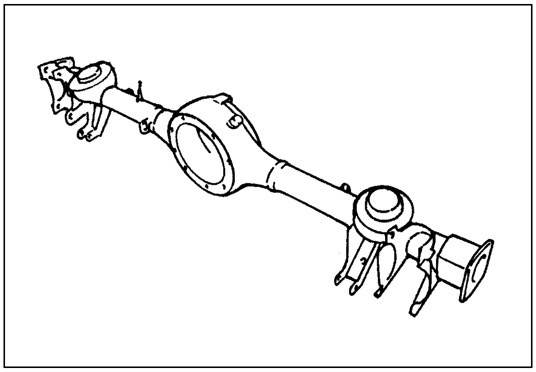
11) Remove lateral rod (1).



12) Loosen front and rear mounting nuts (3) of trailing arm but don't remove bolts.



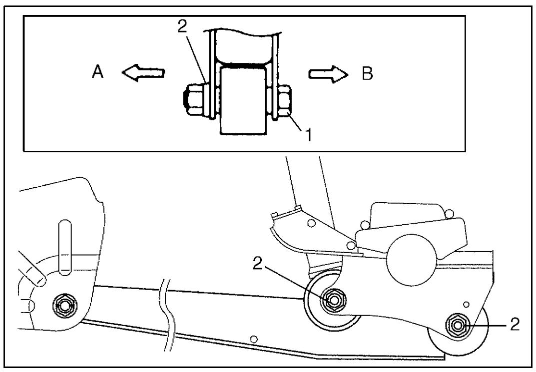
13) Remove shock absorber (1) lower mounting bolt (2).
14) Lower floor jack until tension of suspension coil spring becomes a little loose and remove rear mount bolts of trailing arm.
15) Lower rear axle housing gradually and remove coil spring.



16) Remove axle housing.

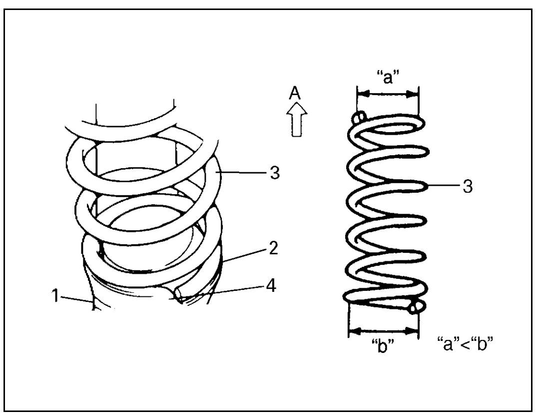
INSTALLATION

Install removed parts in reverse order of removal, noting the following.



1) Place rear axle housing on floor jack. Then install rear trailing arm bolts (1) (right & left) in proper direction as shown. At this time, mount nuts (2) but don't tighten them.

A :	Vehicle out side
B :	Vehicle center side

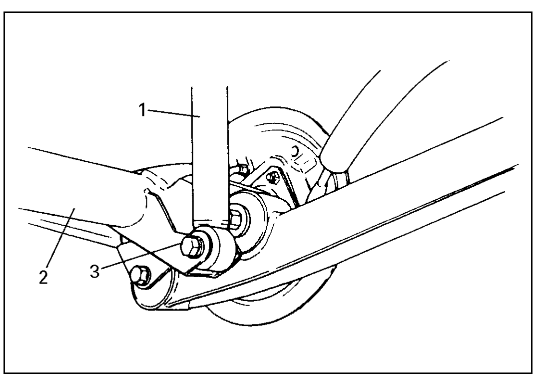


2) Install coil springs (3) (right & left) on spring seat (2) of axle housing (1) and raise axle housing.

NOTE:

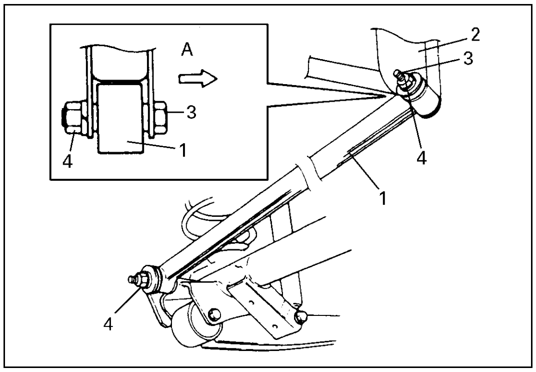
Upper and lower diameters of coil spring are different. Bring lager diameter end at bottom and set its open end in place on spring seat.

4.	Stopped part
A :	Upper side



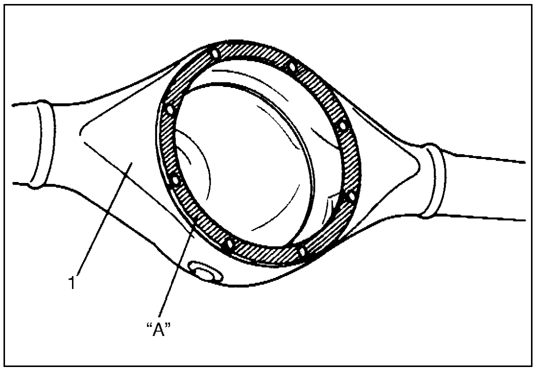
3) Install lower part of shock absorber (1) to right and left sides of axle housing and install bolts in proper direction as shown. At this time, mount bolts (3) (right & left) but don't tighten them.

2. Rear axle housing



4) Install lateral rod (1) and install bolt (3) in proper direction as shown. At this time, mount bolt and nut (4) but don't tighten them.

2.	Vehicle body
A :	Forward

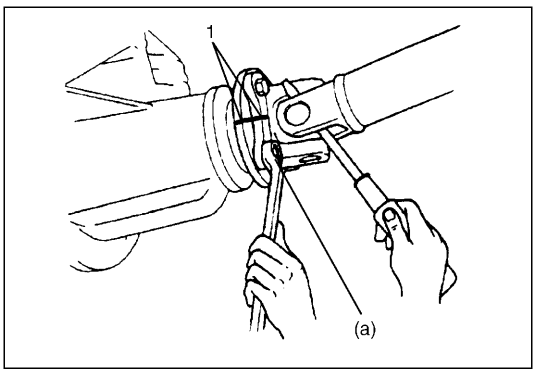


5) Clean mating surfaces of axle housing (1) and differential carrier and apply sealant to housing side.

"A" : Sealant 99000-31110

6) Install differential carrier assembly to axle housing and tighten carrier nuts to specified torque.

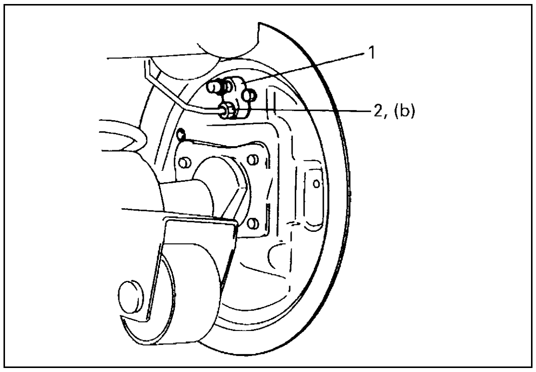
Tighting torque
Rear differential carrier nuts : 23 N·m (2.3 kg-m, 17.0 lb-ft)



7) Install propeller shaft to joint flange aligning match marks (1) and tighten flange bolts to specified torque.

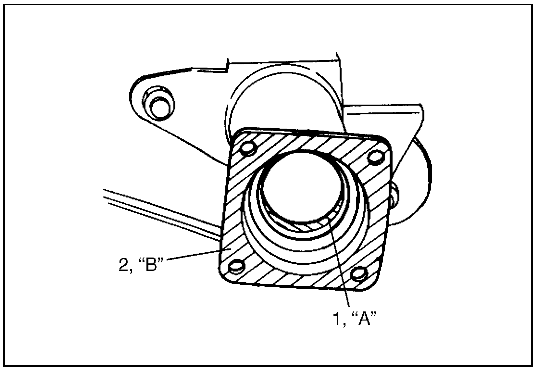
Tightening torque
Companion flange bolts (a) : 23 N·m (2.3 kg-m, 17.0 lb-ft)

8) Install LSPV spring to rear axle.
   Tighten LSPV adjust nut temporarily at this step. (if equipped with LSPV).
9) Install wheel speed sensor and clamp wire securely (right & left) (if equipped with ABS).
10) Remove floor jack from axle housing.
11) Connect brake pipes and parking brake cable and clamp them securely.
    For clamping positions, refer to Section 5.
12) Connect brake flexible hose to bracket and secure it with E-ring.



13) Connect brake pipe to wheel cylinder (1) and tighten brake pipe flare nut (2) to specified torque.

Tightening torque
Brake pipe flare nut (b) : 16 N·m (1.6 kg-m, 11.5 lb-ft)

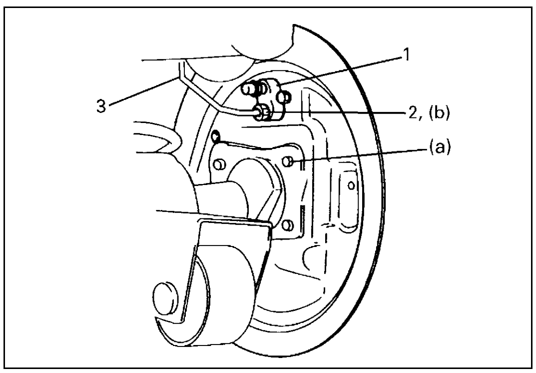


14) Clean mating surface of axle housing (2) (right & left) with brake back plate and apply sealant as shown.

"B" : Sealant 99000-31090

15) Apply grease to axle shaft oil seals (1) lip (right & left) as shown.

"A" : Grease 99000-25010

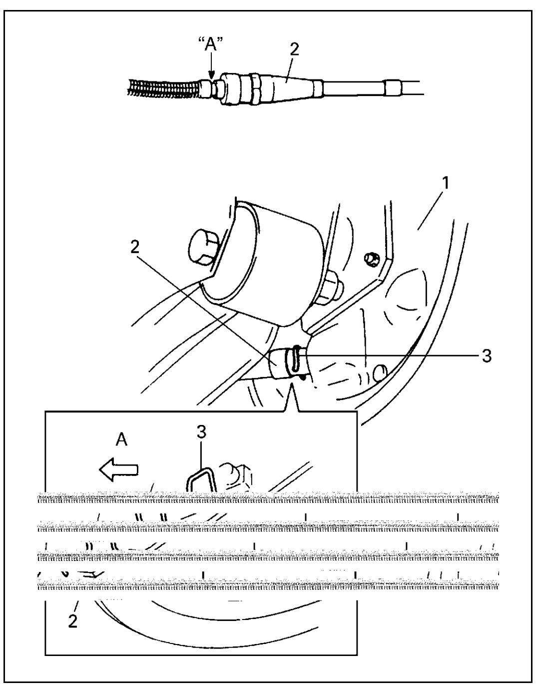


16) Install rear axle shaft (right & left) to rear axle housing and tighten brake back plate bolts to specified torque.

Tightening torque
Brake back plate bolts (a) : 23 N·m (2.3 kg-m, 17.0 lb-ft)

17) Connect brake pipes (3) to wheel cylinders (1) (right & left) and tighten brake pipe flare nuts (2) to specified torque.

Tightening torque
Brake pipe flare nuts (b) : 16 N·m (1.6 kg-m, 11.5 lb-ft)



18) Connect parking brake cable (2) to parking brake shoe lever (right & left) and secure it with clip (3).
Apply water tight sealant where brake back plate (1) and parking brake cable contact.

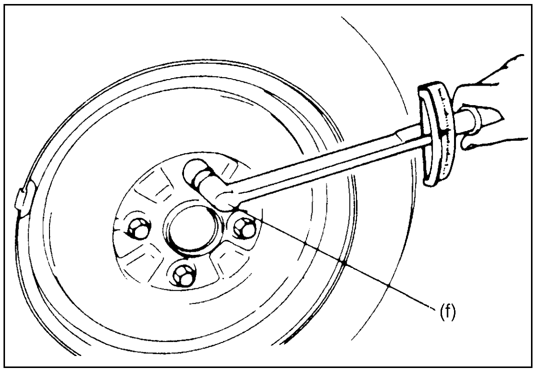
"A" : Sealant 99000-31090

NOTE:

Check to ensure that clip is in good condition before installing it. If deformed or broken, replace.

19) Fill reservoir with brake fluid and bleed brake system. (For bleeding operation, see Section 5.)
20) Refill differential gear housing with new specified gear oil. Refer to Section 7F.

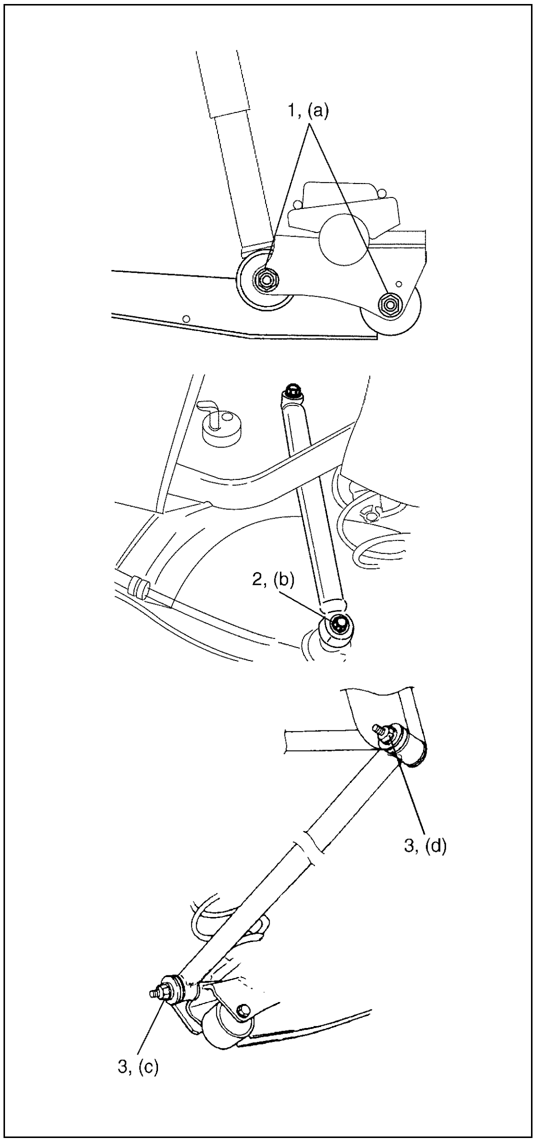
A : Forward



21) Install wheel and tighten wheel nuts to specified torque.

Tightening torque
Wheel nuts (f) : 85 N·m (8.5 kg-m, 61.5 lb-ft)

22) Upon completion of all jobs, pull parking brake lever with about 20 kg, (44 lbs) load three to five times so as to obtain proper drum-to-shoe clearance.
Adjust parking brake cable (for adjustment, see Section 5.)
23) Lower hoist.



24) Tighten right and left trailing arm bolts and nuts (1) and shock absorber lower bolts (2) to specified torque.
Tighten lateral rod bolt and nut (3) to specified torque.

NOTE:
When tightening these bolts and nuts, be sure that vehicle is off hoist and in non loaded condition.

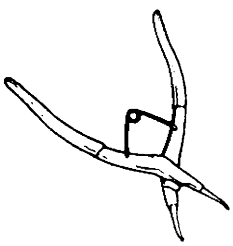
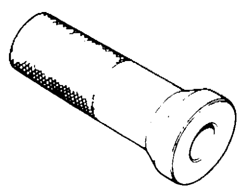
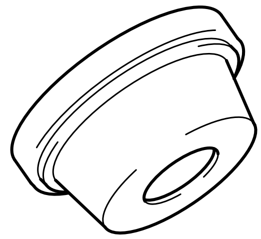
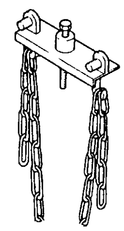
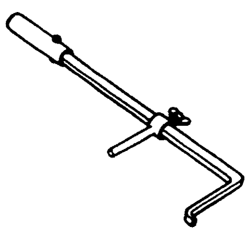
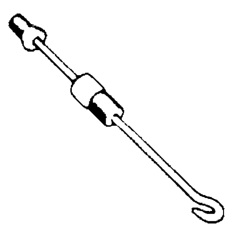
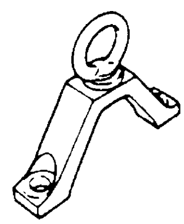
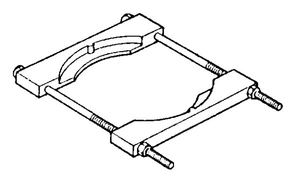
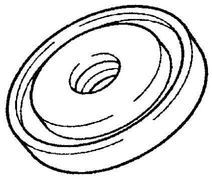
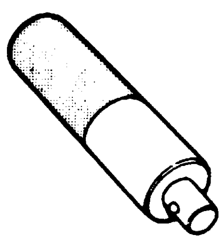
Tightening torque
Rear trailing arm bolts (a) : 80 N·m (8.0 kg-m, 58.0 lb-ft)
Rear shock absorber lower bolts
(b) : 58 N·m (5.8 kg-m, 42.0 lb-ft)
Lateral rod axle housing side nut
(c) : 50 N·m (5.0 kg-m, 36.5 lb-ft)
Lateral rod body side nut (d) : 65 N·m (6.5 kg-m, 47.0 lb-ft)

25) Check to ensure that brake drum is free from dragging and proper braking is obtained.
26) Perform brake test (foot brake and parking brake).
(For brake test, see Section 5.)
27) If equipped with LSPV, check and adjust LSPV spring referring to “LSPV INSPECTION AND ADJUSTMENT” and perform “FLUID PRESSURE TEST” in Section 5.
28) Check each installed part for oil leakage.

REQUIRED SERVICE MATERIAL

Material	Recommended SUZUKI product (Part Number)	Use
Lithium grease	SUZUKI SUPER GREASE (A) (99000-25010)	• Axle shaft oil seal • Wheel bearing
Sealant	SUZUKI BOND NO. 1215 (99000-31110)	• Joint seam of differential carrier and axle housing
Gear oil	For gear oil information, refer to Section 7F.	• Differential gear (Rear axle housing)
Water tight sealant	SUZUKI SEALING COMPOUND 366E (99000-31090)	• Joint seam of axle housing (4WD) or rear axle (2WD) and brake back plate

SPECIAL TOOL

 09900-06108 Snap ring pliers	 09913-76010 Rear wheel bearing installer	 09924-84510-004 Bearing installer attach-ment	 09927-18411 Universal puller
 09913-50121 Oil seal remover	 09942-15510 Sliding hammer	 09943-17912 Brake drum remover	 09921-57810 Bearing remover
 09944-67010 Oil seal installer	 09924-74510 Bearing installer handle		

SECTION 3F

WHEELS AND TIRES

NOTE:

All wheel fasteners are important attaching parts in that they could affect the performance of vital parts and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of all parts.
There is to be no welding as it may result in extensive damage and weakening of the metal.

CONTENTS

GENERAL DESCRIPTION

TIRES

This vehicle is equipped with the following tire.

Tire size
: 165/70R14

The tire is of tubeless type. The tire is designed to operate satisfactorily with loads up to the full rated load capacity when inflated to the recommended inflation pressures.
Correct tire pressures and driving habits have an important influence on tire life. Heavy cornering, excessively rapid acceleration, and unnecessary sharp braking increase tire wear.

WHEELS

Standard equipment wheels are the following steel wheel.

Wheel size
: 14 x 4 1/2 J

REPLACEMENT TIRES

When replacement is necessary, the original equipment type tire should be used. Refer to the “Tire Placard”. Replacement tires should be of the same size, load range and construction as those originally on the vehicle. Use of any other size or type tire may affect ride, handling, speedometer/odometer calibration, vehicle ground clearance and tire or snow chain clearance to the body and chassis.
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 the tire having the most tread, to equalize braking traction.

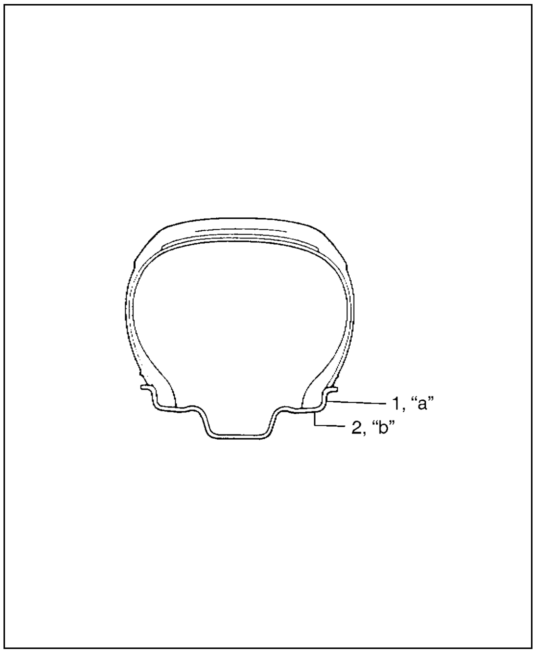
WARNING:
Do not mix different types of tires on the same vehicle such as radial, bias and bias-belted tires except in emergencies, because handling may be seriously affected and may result in loss of control.

kPa	kgf/cm²	pis
160	1.6	23
180	1.8	26
200	2.0	29
220	2.2	32
240	2.4	35
260	2.6	38
280	2.8	41
300	3.0	44

The metric term for tire inflation pressure is the kilo pascal (kPa).
Tire pressures is usually printed in both kPa and psi on the “Tire Placard”.
Metric tire gauges are available from tool suppliers.
The chart, shown the table, converts commonly used inflation pressures from kPa to psi.

REPLACEMENT WHEELS

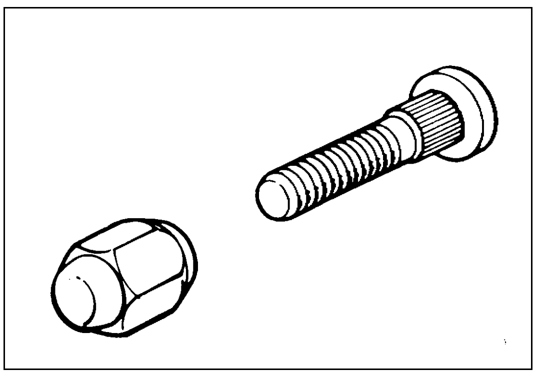
Wheels must be replaced if they are bent, dented, have excessive lateral or radial runout, air leak through welds, have elongated bolt holes, if lug nuts won’t stay tight, or if they are heavily rusted. Wheels with greater runout than shown in figure below may cause objectional vibrations.
Replacement wheels must be equivalent to the original equipment wheels in load capacity, diameter, rim with offset and mounting configuration. A wheel of improper size or type may affect wheel and bearing life, brake cooling, speedometer/odometer calibration, vehicle ground clearance and tire clearance to body and chassis.



HOW TO MEASURE WHEEL RUNOUT

To measure the wheel runout, it is necessary to use an accurate dial indicator. The tire may be on or off the wheel. The wheel should be installed to the wheel balancer of the like for proper measurement.
Take measurements of both lateral runout (1) and radial runout (2) at both inside and outside of the rim flange. With the dial indicator set in place securely, turn the wheel one full revolution slowly and record every reading of the indicator.
When the measured runout exceeds the specification and correction by the balancer adjustment is impossible, replace the wheel. If the reading is affected by welding, paint or scratch, it should be ignored.

Lateral runout limit
"a" : 0.90 mm (0.035 in.)
Radial runout limit
"b" : 0.70 mm (0.028 in.)



METRIC LUG NUTS AND WHEEL STUDS

All models use metric lug nuts and wheel studs.

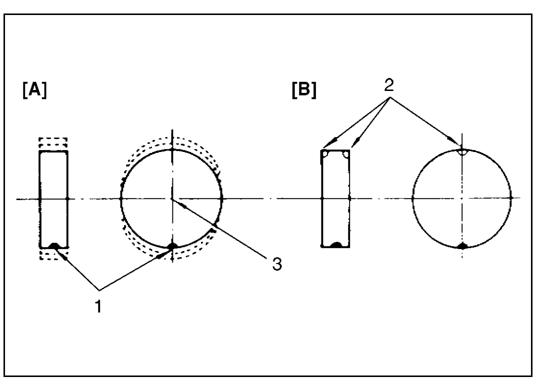
Metric lug nuts and wheel studs size
: M12 x 1.25

DIAGNOSIS

DIAGNOSIS TABLE

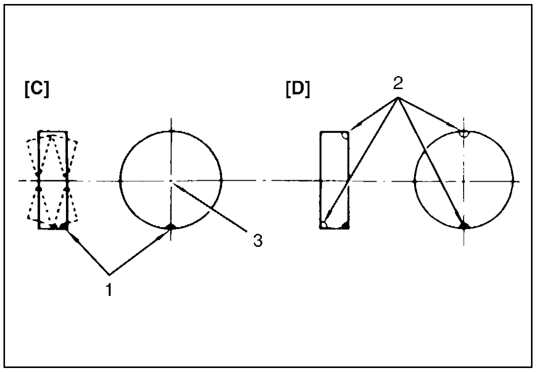
Refer to Section 3.

BALANCING WHEELS



There are two types of wheel and tire balance : static and dynamic. Static balance, as shown in left figure, is the equal distribution of weight around the wheel. Wheels that are statically unbalanced cause a bouncing action called tramp. This condition will eventually cause uneven tire wear.

1. Heavy spot wheel tramp	[A] : Before correction
2. Balance weights addition point	[B] : Corrective weights
3. C/L of spindle	



Dynamic balance, as shown in left figure, is the equal distribution of weight on each side of the wheel centerline so that when the tire spins there is no tendency for the assembly to move from side to side. Wheels that are dynamically unbalanced may cause shimmy.

1. Heavy spot wheel shimmy	[C] : Before correction
2. Balance weights addition point	[D] : Corrective weights
3. C/L of spindle	

GENERAL BALANCE PROCEDURES

Deposits of mud, etc. must be cleaned from inside of rim.

WARNING:

Stones should be removed from the tread in order to avoid operator injury during spin balancing and to obtain good balance.

Each tire should be inspected for any damage, then balanced according to equipment manufacturer's recommendation.

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 (two plane) balance. Although they do not correct for drum or disc unbalance as does on-vehicle spin balancing, this is overcome by their accuracy, usually to within 1/8 ounce.

ON-VEHICLE BALANCING

On-vehicle balancing methods vary with equipment and tool manufacturers. Be sure to follow each manufacturer's instructions during balancing operation.

WARNING:

Wheel spin should be limited to 35 mph (55 km/h) as indicated on speedometer.
This limit is necessary because speedometer only indicates one-half of actual wheel speed when one drive wheel is spinning and the other drive wheel is stopped.
Unless care is taken in limiting drive wheel spin, spinning wheel can reach excessive speeds. This can result in possible tire disintegration or differential failure, which could cause serious personal injury or extensive vehicle damage.

CAUTION:

For vehicle equipped with ABS, using on-vehicle balancing method with ignition switch ON may set malfunction diagnostic trouble code (DTC) of ABS even when system is in good condition.
Never turn ignition switch ON while spinning wheel.

MAINTENANCE AND MINOR ADJUSTMENTS

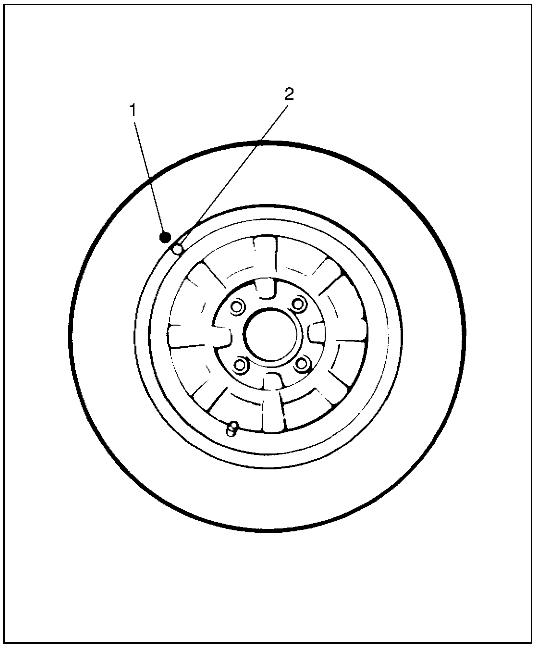
WHEEL MAINTENANCE

Wheel repairs that use welding, heating, or peening are not approved. All damaged wheels should be replaced.

WHEEL ATTACHING STUDS

If a broken stud is found, see Section 3E (rear) or Section 3D (front) for Note and Replacement procedure.

MATCHED TIRES AND WHEELS



Tires and wheels are match mounted at the assembly plant.
This means that the radially stiffest part of the tire, or "high spot", is matched to the smallest radius or "low spot" of the wheel.
This is done to provide the smoothest possible ride.
The "high spot" of the tire is originally marked by paint dot (1) on the outboard sidewall. This paint dot will eventually wash off the tire.
The "ow spot" of the wheel is originally marked by paint dot (2) on the wheel rim-flange. Properly assembled, the wheel rims' paint dot should be aligned with the tires' paint dot as shown in left figure.
Whenever a tire is dismounted from its wheel, it should be remounted so that the tire and wheel are matched. If the tire's paint dot cannot be located, a line should be scribed on the tire and wheel before dismounting to assure that it is remounted in the same position.

TIRE MAINTENANCE

TIRE PLACARD

The "Tire Placard" is located on the left door (right door for right-hand side steering vehicle) lock pillar and should be referred to tire information.
The placard lists the maximum load, tire size and cold tire pressure where applicable.

NOTE:
Whether rim size and/or maximum load are listed or not depends on regulations of each country.

INFLATION OF TIRES

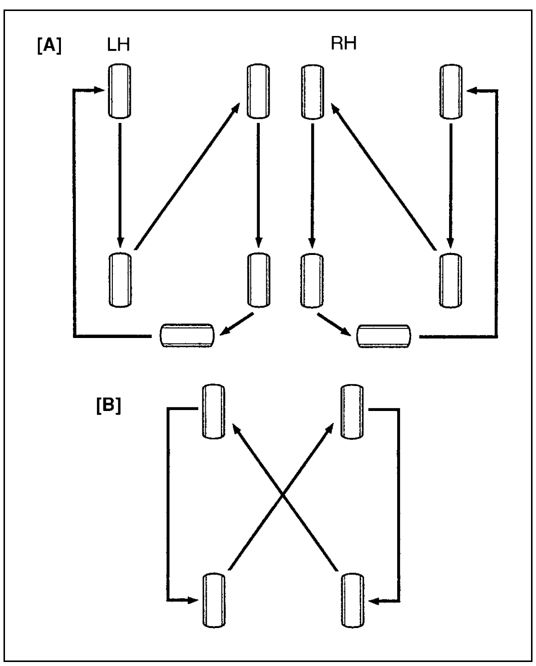
The pressure recommended for any model is carefully calculated to give a satisfactory ride, stability, steering, tread wear, tire life and resistance to bruises.
Tire pressure, with tires cold, (after vehicle has set for 3 hours or more, or driven less than one mile) should be checked monthly or before any extended trip. Set to the specifications on the "Tire Placard" located on the left door (right door for right-hand side steering vehicle) lock pillar.
It is normal for tire pressure to increase when the tires become hot during driving.
Do not bleed or reduce tire pressure after driving. Bleeding reduces the "Cold Inflation Pressure".

Higher than recommended pressure can cause :
- Hard ride
- Tire bruising or carcass damage
- Rapid tread wear at center of tire

Unequal pressure on same axle can cause :
- Uneven braking
- Steering lead
- Reduced handling
- Swerve on acceleration

Lower than recommended pressure can cause :
- Tire squeal on turns
- Hard Steering
- Rapid and uneven wear on the edges of the tread
- Tire rim bruises and rupture
- Tire cord breakage
- High tire temperature
- Reduced handling
- High fuel consumption

TIRE ROTATION



To equalize wear, rotate tires according to left figure. Radial tires should be rotated periodically. Set tire pressure.

NOTE:

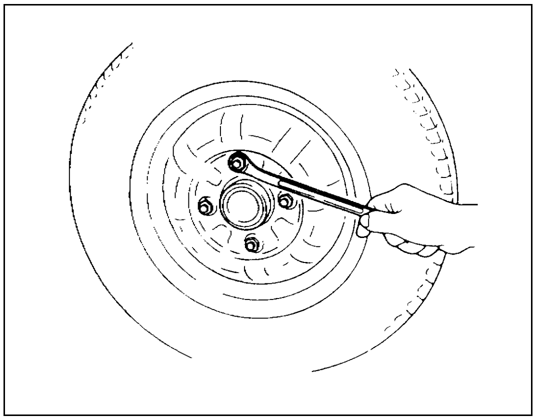
Due to their design, radial tires tend to wear faster in the shoulder area, particularly in front positions. This makes regular rotation especially necessary.

[A] :	5-tire rotation
[B] :	4-tire rotation
LH :	Left-hand drive
RH :	Right-hand drive

ON-VEHICLE SERVICE

WHEEL

REMOVAL

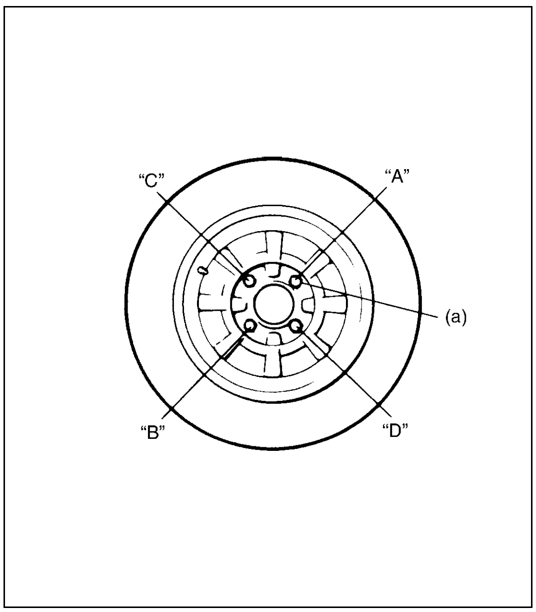


1) Loosen wheel nuts by approximately 180° (half a rotation).
2) Hoist vehicle.
3) Remove wheel.

CAUTION:

Never use heat to loosen tight wheel because application of heat to wheel can shorten life of wheel and damage wheel bearings.

INSTALLATION



For installation, reverse removal procedure, noting the followings.

- Wheel nuts must be tightened in sequence and to proper torque to avoid bending wheel or brake disc.

NOTE:

Before installing wheels, remove any build-up of corrosion on wheel mounting surface and brake disc mounting surface by scraping and wire brushing. Installing wheels without good metal-to-metal contact at mounting surfaces can cause wheel nuts to loosen, which can later allow a wheel to come off while vehicle is moving.

Tightening order
: "A"-"B"-"C"-"D"

Tightening torque
Wheel nut (a) : 85 N·m (8.5 kg-m, 61.5 lb-ft)

TIRE

MOUNTING AND DISMOUNTING

Use a tire changing machine to mount or dismount tires. Follow equipment manufacturer's instructions. Do not use hand tools or tire irons alone to change tires as they may damage tire beads or wheel rim.
Rim bead seats should be cleaned with a wire brush or coarse steel wool to remove lubricants, old rubber and light rust. Before mounting or dismounting a tire, bead area should be well lubricated with approved tire lubricant.
After mounting, inflate to specified pressure shown on tire placard so that beads are completely seated.

WARNING:
Do not stand over tire when inflating. Bead may break when bead snaps over rim's safety hump and cause serious personal injury.
Do not exceed specified pressure when inflating. If specified pressure will not seat beads, deflate, relubricate and reinflate.
Over inflation may cause bead to break and cause serious personal injury.

Install valve core and inflate to proper pressure.

REPAIR

There are many different materials and techniques on the market to repair tires. As not all of these work on all types of tires, tire manufacturers have published detailed instructions on how and when to repair tires. These instructions can be obtained from each tire manufacturer.

SECTION 4A

FRONT DRIVE SHAFT

CONTENTS

GENERAL DESCRIPTION

COMPONENT

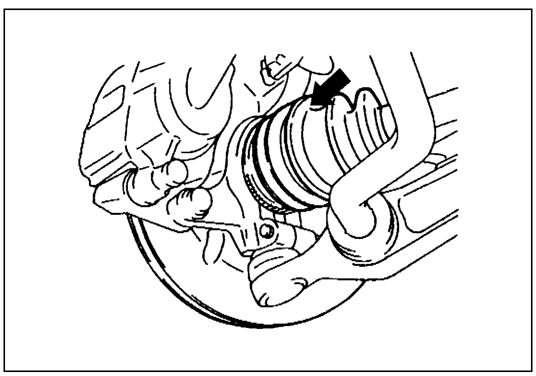
A constant velocity ball joint is used on the wheel side of front drive shaft. For right side drive shaft of 2WD vehicle, a constant velocity tripod joint on the differential side. For left side drive shaft of every type vehicles and right side drive shaft of 4WD vehicle, a constant velocity double offset joint is used on the differential or transfer side. The drive shaft can slide through the tripod joint or the double offset joint in the extension/contraction direction.

DIAGNOSIS

DIAGNOSIS TABLE

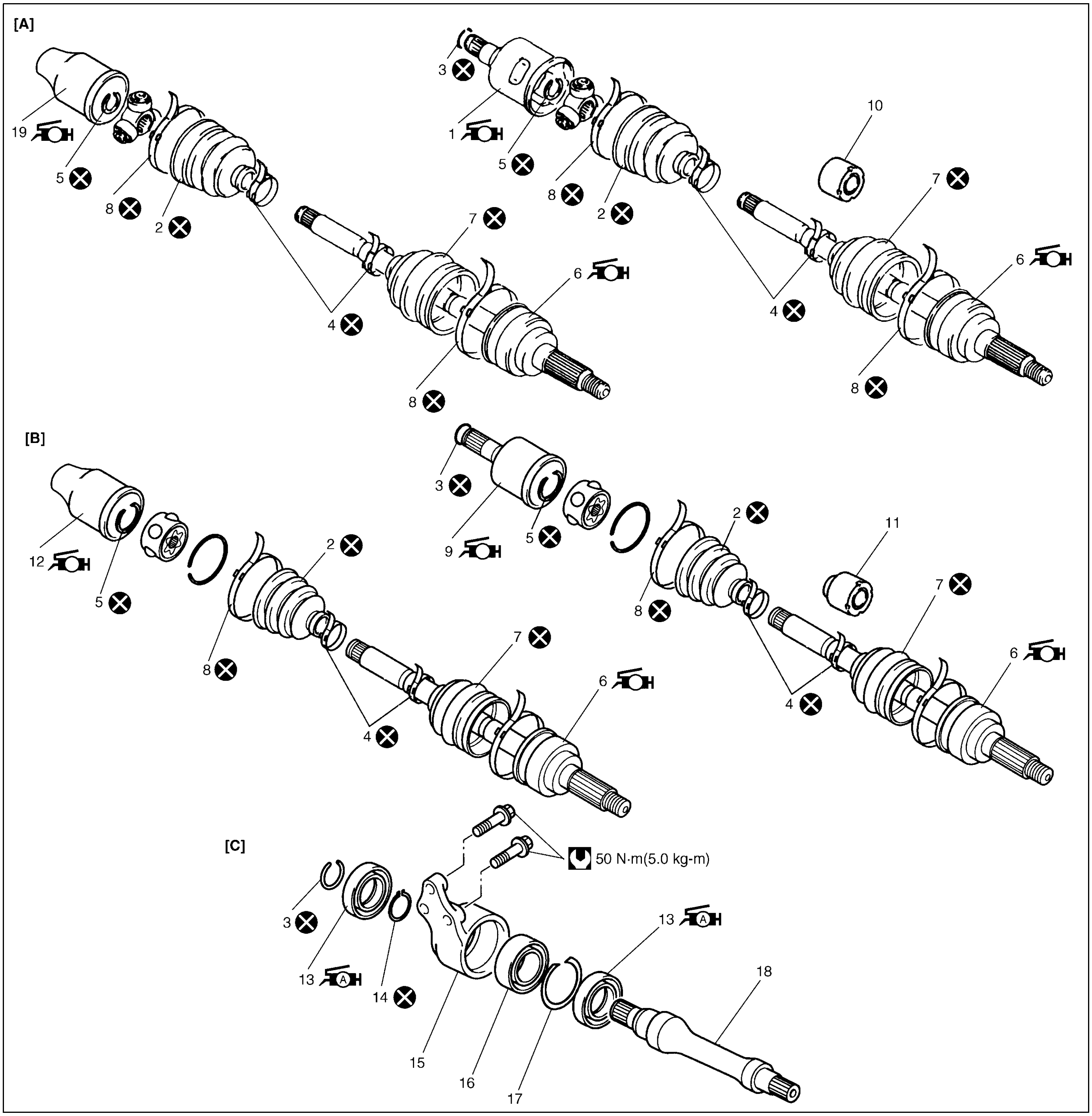
Condition	Possible Cause	Correction
Abnormal Noise	• Worn or breakage drive shaft joint	Replace.
	• Worn or breakage center bearing	Replace.

DRIVE SHAFT BOOT CHECK



Inspect drive shaft boot for tear.
If even a small tear is noted, replace with new one.

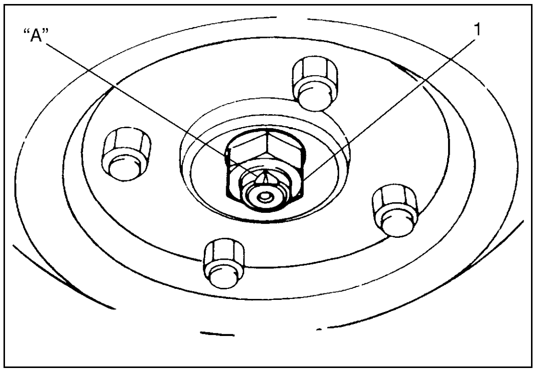
ON-VEHICLE SERVICE



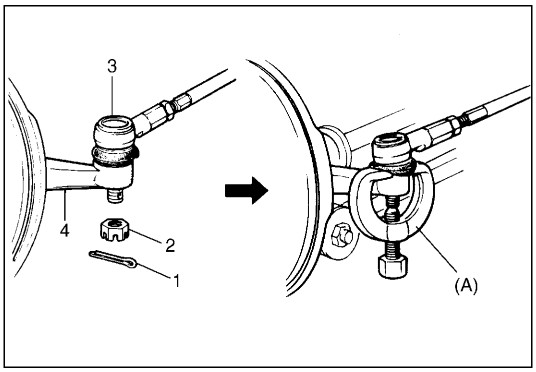
	1. Differential side joint (RH of 2WD M/T vehicle) : Apply orange grease included in spare part to joint.		9. Differential (or transfer) side joint (LH of every type vehicles) : Apply black grease included in spare part to joint.	17.	Circlip
	2. Boot (Differential, transfer or center shaft side)		10. Dynamic damper (RH of 2WD M/T vehicle)	18.	Center shaft
	3. Circlip		11. Dynamic damper (LH of 2WD A/T vehicle)	19.	Center shaft side joint (RH of 2WD A/T vehicle)
	4. Boot band (Small)		12. Transfer side joint (RH of 4WD vehicle) : Apply black grease included in spare part to joint.	[A] :	Constant velocity tripod joint type
	5. Snap ring		13. Oil seal : Apply grease 99000-25010 to oil seal lip.	[B] :	Constant velocity double offset joint type
	6. Wheel side joint (Constant velocity joint) : Apply black grease included in spare part to joint.		14. Circlip	[C] :	Center shaft for 2WD A/T vehicle
	7. Boot (Wheel side)		15. Center bearing support		Tightening torque
	8. Boot band (Large)		16. Center bearing		Do not reuse.

DRIVE SHAFT ASSEMBLY

REMOVAL

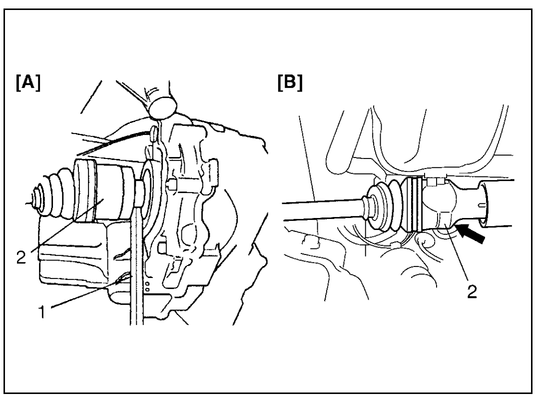


1) Undo caulking ("A") and remove drive shaft nut (1) and washer.
2) Hoist vehicle.
3) Remove wheel.
4) Drain transmission oil or transfer oil.



5) Remove tie rod end split pin (1) and castle nut (2).
6) Disconnect tie rod end (3) from steering knuckle (4) by using special tool.

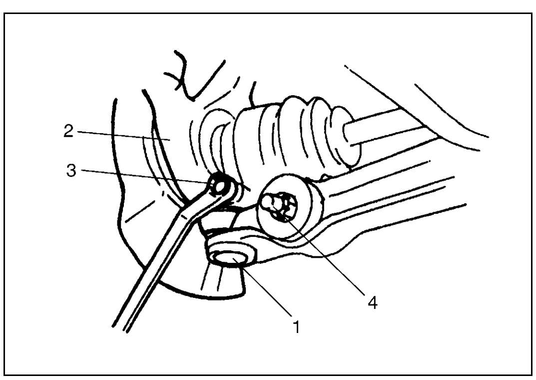
Special tool
(A) : 09913-65210



7) (For vehicle without center shaft or 4WD model)
   Using tire lever (1), pull out drive shaft joint (2) so as to release snap ring fitting of joint spline at differential side.
   (For vehicle with center shaft or 4WD model)
   Using plastic hammer, drive out drive shaft joint (2) so as to release snap ring fitting of joint spline at center shaft or intermediate shaft of transfer.

[A] :	Vehicle without center shaft or 4WD model
[B] :	Vehicle with center shaft or 4WD model

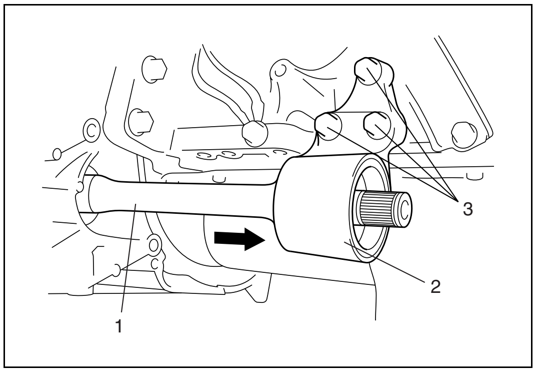
8) Remove two stabilizer mount brackets from vehicle body.



9) Disconnect front suspension control arm ball stud (1) from steering knuckle (2) by pushing down stabilizer bar (4) after removing ball stud bolt (3).

10) Remove drive shaft assembly.

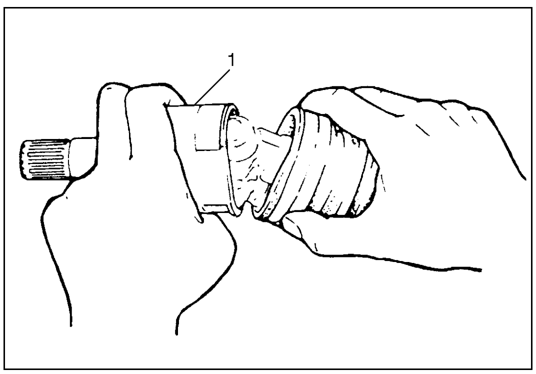
CAUTION:
To prevent breakage of boots, be careful not to bring them into contact with other parts, when removing drive shaft assembly.



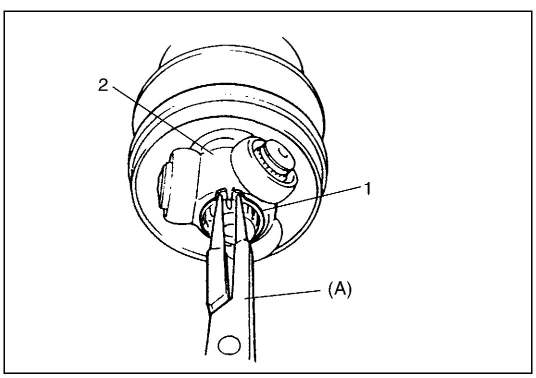
11) For vehicle with center shaft
Remove center bearing support bolts (3) and remove center bearing support (2) with center shaft (1) from differential side gear.

DISASSEMBLY

For Tripod Joint Type Drive Shaft



1) Remove differential side boot band, then take out tripod joint housing (1).



2) Remove grease from shaft and take off snap ring (1) by using special tool, then pull out spider (2) from shaft.

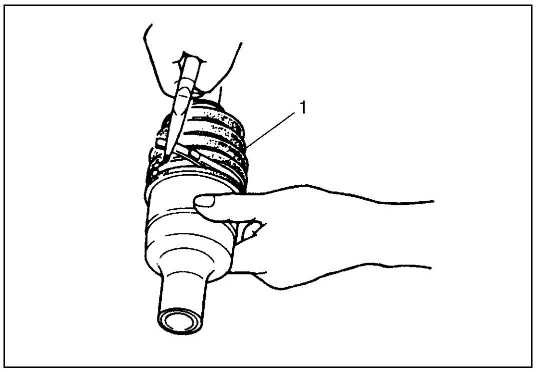
Special tool
(A) : 09900-06107

CAUTION:
To prevent needle bearing of joint from being degreased, do not wash it if it is to be reused.

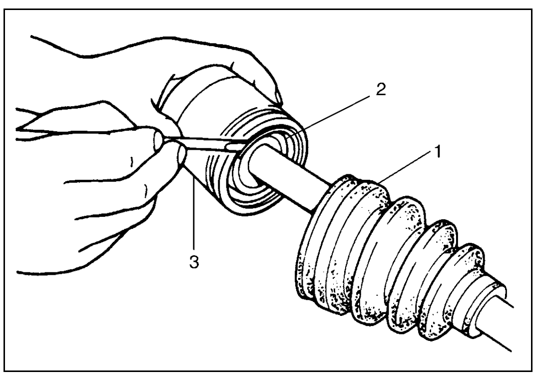
3) Remove boot band, then pull out differential side boot from shaft.
4) Pull out damper through shaft. (if equipped)
5) Undo boot bands of wheel side joint boot, then pull out boot through shaft.

CAUTION:
- **Disassembly of wheel side joint is not allowed. If noise or damage exists in it, replace it as assembly.**
- **Do not disassemble tripod joint spider. If any malcondition is found in it, replace it as differential side joint assembly.**

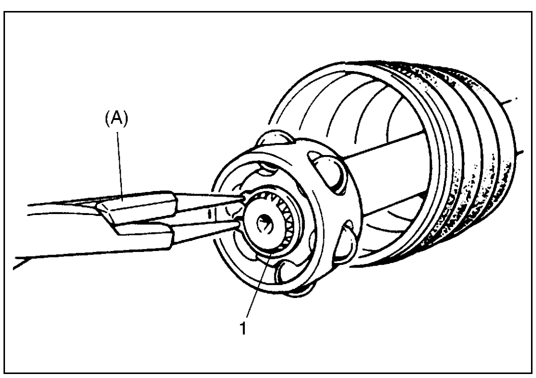
For DOJ Type Drive Shaft



1) Remove boot band (1) of differential side joint.

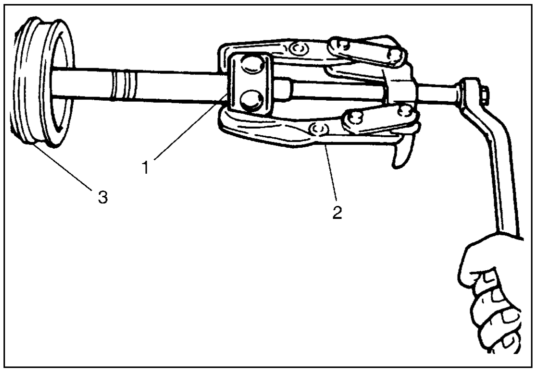


2) Slide boot (1) toward the center of shaft and remove snap ring (2) from outer race, then take shaft out of outer race (3).



3) Wipe off grease and remove circlip (1) used to fix cage by using special tool (A).

Special tool
(A) : 09900-06107

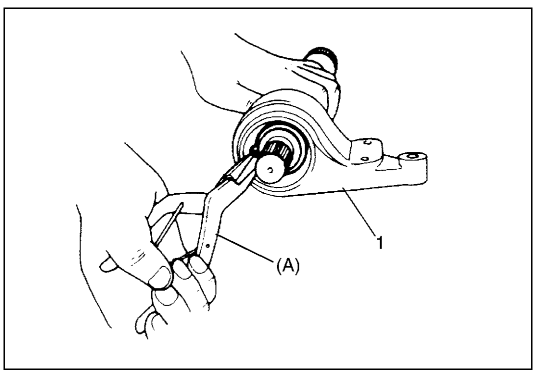


4) Draw away cage (1) by using bearing puller (2), and remove boot (3) from shaft.

5) Remove boot band, then pull out differential side boot from shaft.
6) Pull out damper through shaft. (if equipped)
7) Undo boot bands of wheel side joint boot, then pull out boot through shaft.

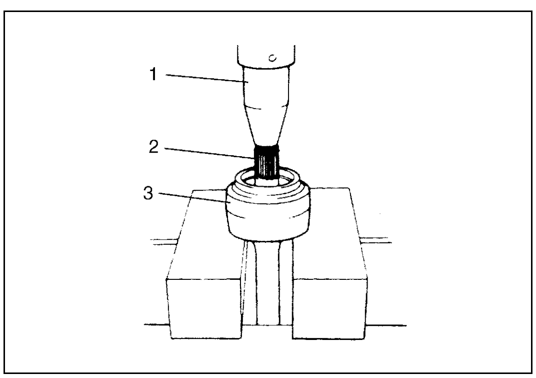
CAUTION:
Do not disassemble wheel side joint. If any malcondition is found in any joint, replace it as assembly.

For Center Shaft and Center Bearing Support

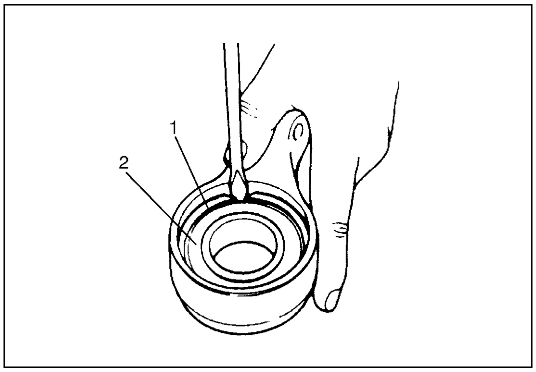


1) Remove right side oil seal from center bearing support (1).
2) Remove circlip by using special tool.

Special tool
(A) : 09900-06108



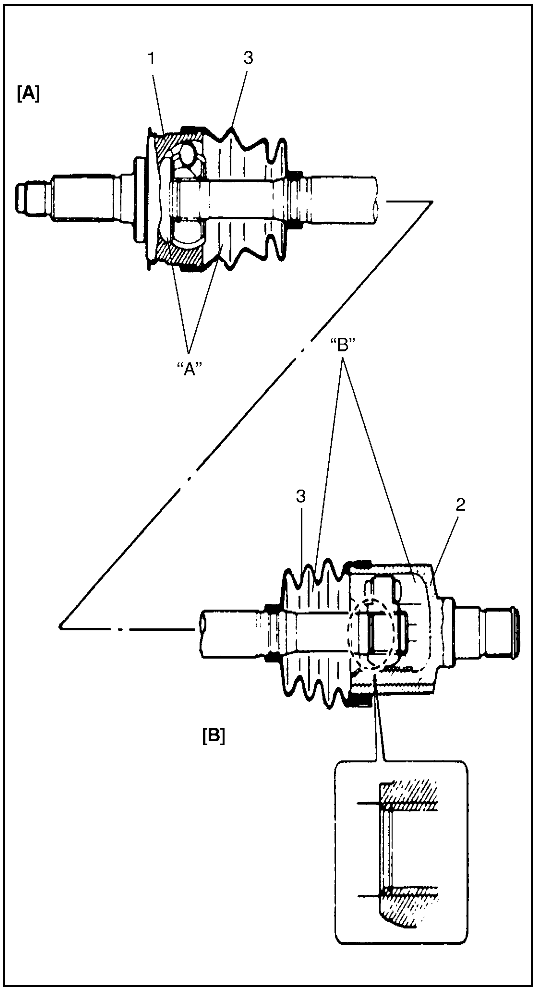
3) Using hydraulic press (1), draw out center shaft (2) from center bearing.
4) Remove left side oil seal from center bearing support (3).



5) Remove circlip (1) by using flat end rod or the like.
6) Remove center bearing (2) from center bearing support.

ASSEMBLY

For Tripod Joint Type Drive Shaft



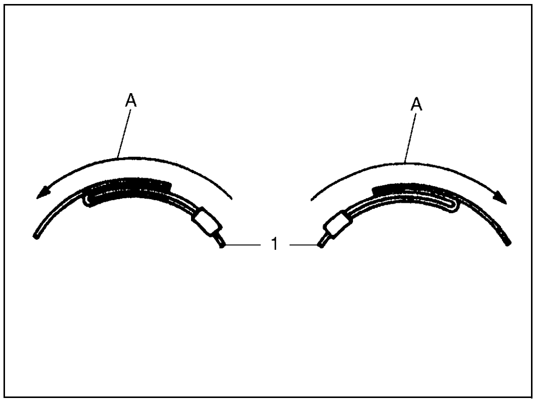
Judging from abnormality noted before disassembly and what is found through visual check of component parts after disassembly, prepare replacing parts and proceed to reassembly.
Make sure that wheel side joint assembly (1) and tripod joint housing (2) are washed thoroughly and air dried, and boots (3) are cleaned with cloth if they are to be reused.

CAUTION:
To ensure full performance of joint as designed, be sure to distinguish between two types of grease in repair set and apply specified volume to respective joint. Refer to the followings for identification of the grease.

"A" : Black grease (about 60 - 80 g/2.1 - 2.8 oz)
"B" : Orange grease (about 85 - 105 g/3.0 - 3.7 oz)

[A] :	Wheel side
[B] :	Differential side

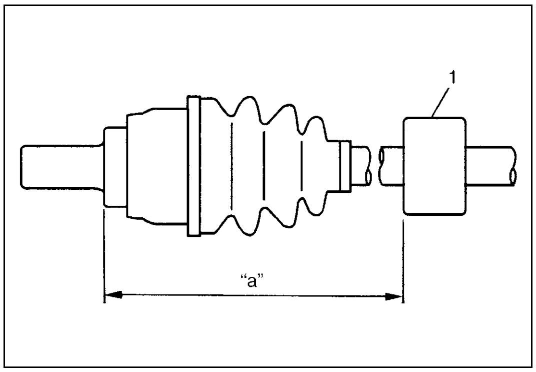
1) Wash disassembled parts (except boots). After washing, dry parts completely by blowing air.
2) Clean boots with cloth. DO NOT wash boots in degreaser, such as gasoline or kerosene, etc. Washing in degreaser causes deterioration of boot.
3) Apply grease to wheel side joint. Use specified grease in tube in wheel side boot set.
4) Install wheel side boot on shaft.



5) Fill up boot inside with specified grease and then fasten boot with bands (1).

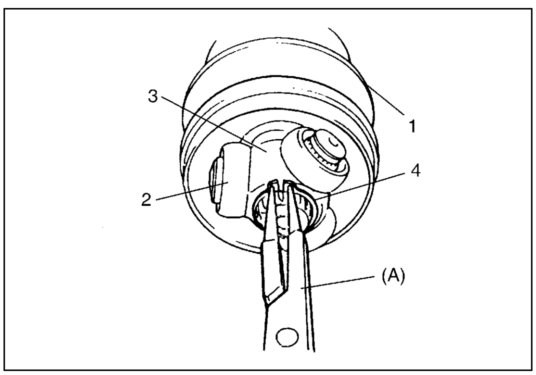
CAUTION:

- **Bend each boot band against forward rotation (A).**
- **Do not squeeze or distort boot when fastening it with bands.**
  Distorted boot caused by squeezing air may reduce its durability.



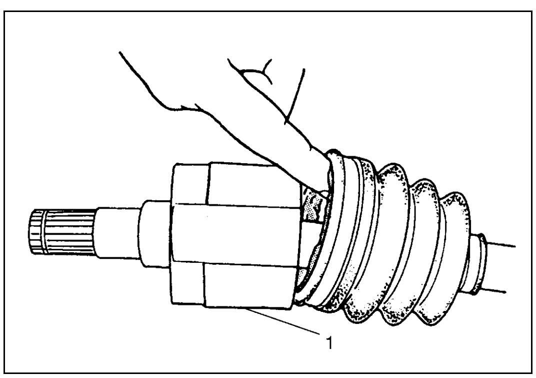
6) Install dynamic damper (1) on drive shaft according to dimension specified below.

Drive shaft dynamic damper installing position
"a" : 347 - 353 mm (13.7 - 13.9 in.)

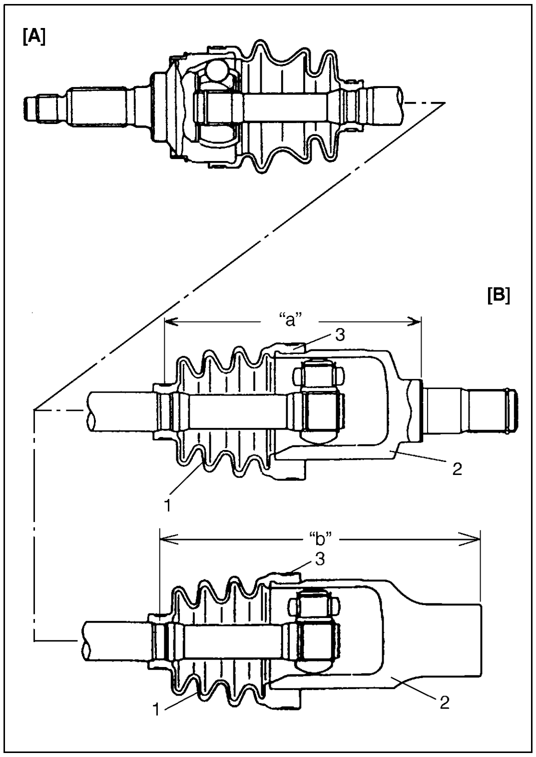


7) Set new differential side small band and differential side boot (1) on shaft temporarily.
   Apply grease to tripod joint (2). Use specified grease in tube included in spare parts.
8) Install tripod joint spider (3) on shaft, facing its chamfered spline inward (wheel side), then fasten it with snap ring (4).

Special tool
(A) : 09900-06107



9) Apply grease to inside of outer race (1), then install housing, joint it with boot and fit boot to outer race.
   After fitting boot, insert screwdriver into boot on outer race side and allow air to enter boot so that air pressure in boot becomes the same as atmospheric pressure.

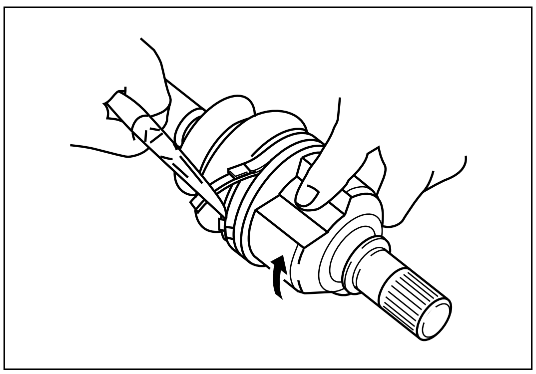


10) When fixing boot (1) to outer race (2) with differential side big band (3), adjust so that measured dimensions become as indicated below.

Drive shaft boot fixing position
"a" : 155.5 mm (6.12 in.) for M/T vehicle
"b" : 189.3 mm (7.45 in.) for A/T vehicle

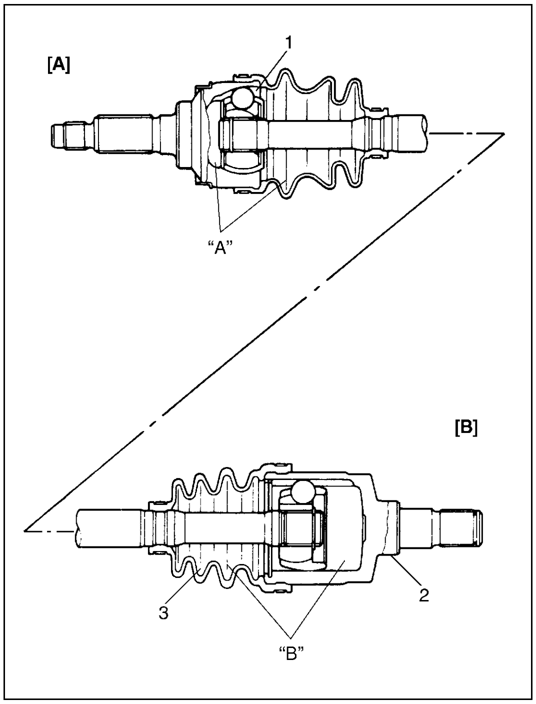
CAUTION:
To prevent any problem caused by washing solution, do not wash joint boots and tripod joint except its housing. Degreasing of those parts with cloth is allowed.

[A] :	Wheel side
[B] :	Differential side



CAUTION:
- **Bend each boot band against forward rotation.**
- **Do not squeeze or distort boot when fastening it with bands.**
  Distorted boot caused by squeezing air may reduce its durability.

For DOJ Type Drive Shaft



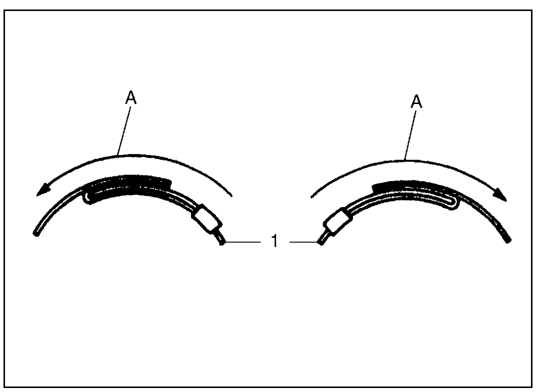
Judging from abnormality noted before disassembly and what is found though visual check of component parts after disassembly, prepare replacing parts and proceed to reassembly.
Make sure that wheel side joint assembly (1) and DOJ housing (2) are washed thoroughly and air dried, and boots (3) are cleaned with cloth if they are to be reused.

> **CAUTION:**
> **To ensure full performance of joint as designed, be sure to distinguish between two types of grease in repair set and apply specified volume to respective joint.**

"A" : Black grease (about 60 - 80 g/2.1 - 2.8 oz)
"B" : Black grease (rather light than "A")
(about 70 - 90 g/2.5 - 3.2 oz)

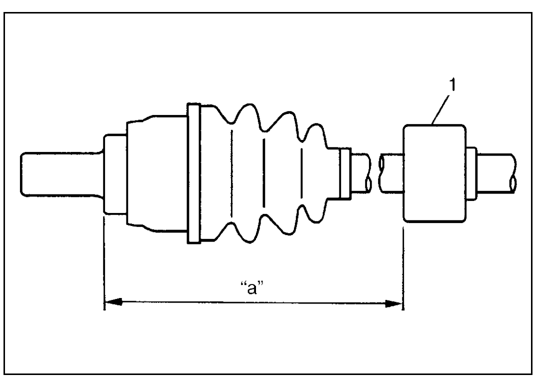
[A] :	Wheel side
[B] :	Differential side

1) Wash disassembled parts (except boots). After washing. dry parts completely by blowing air.
2) Clean boots with cloth. Do not wash boots in degreaser, such as gasoline or kerosene, etc.
   Washing in degreaser causes deterioration of boot.
3) Apply grease to wheel side joint. Use specified grease in tube included in wheel side boot set.



4) Install wheel side boot on shaft, fill up boot inside with grease and then fasten boot with bands (1).

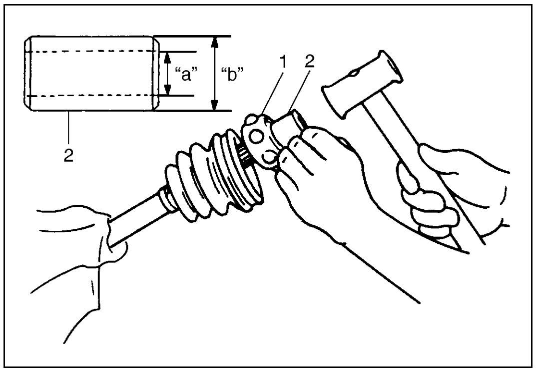
> **CAUTION:**
> - **Bend each boot band against forward rotation (A).**
> - **Do not squeeze or distort boot when fastening it with bands.**
>   **Distorted boot caused by squeezing air may reduce its durability.**



5) Install dynamic damper (1) on left side drive shaft according to dimension specified below. (For A/T model of 2WD vehicle)

Dynamic damper installing position
"a" : 151 - 157 mm (5.9 - 6.2 in.)

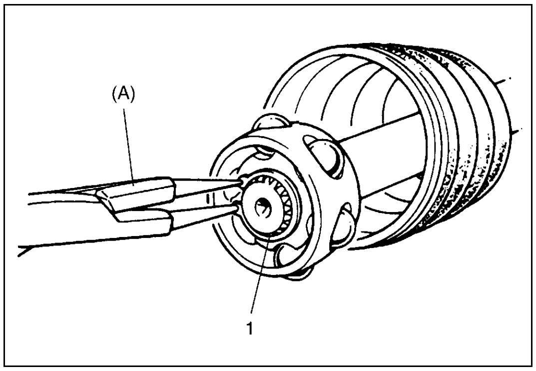
6) Set new differential side small bend and differential side boot on shaft temporarily.



7) Driver in the cage (1) by using a pipe (2).

Drive shaft joint cage installing pipe diameter
“a” : 22.5 mm (0.886 in.) or more
“b” : 30.0 mm (1.181 in.) or less

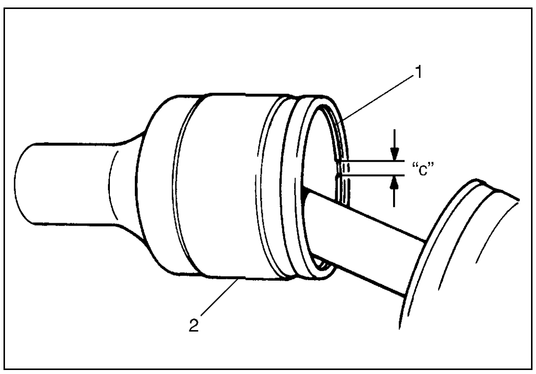
CAUTION:
Install cage directing smaller outside diameter side to wheel side.



8) Install circlip (1) by using special tool (A).

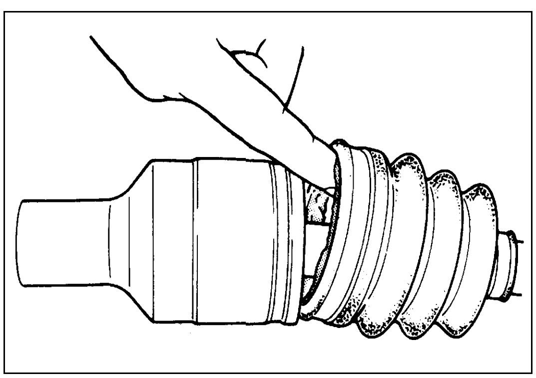
Special tool
(A) : 09900-06107

9) Apply grease to entire surface of cage.
Use specified grease in tube included in spare parts.

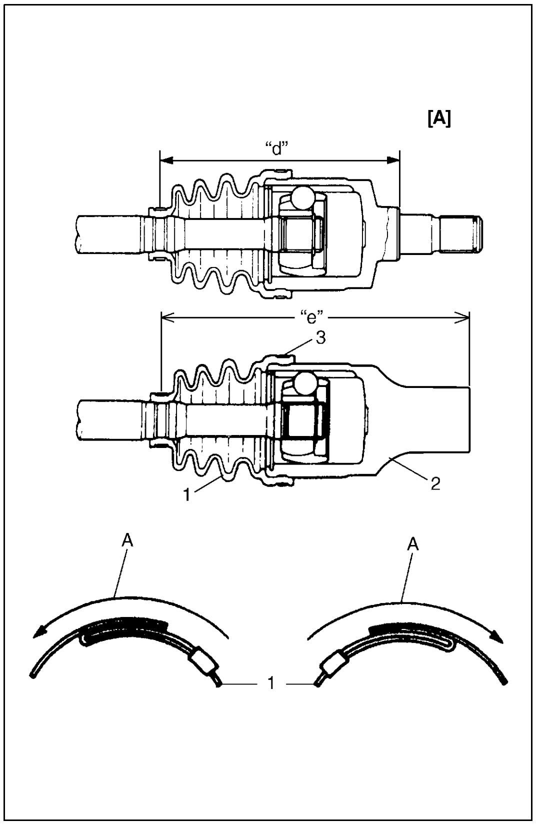


10) Insert cage into outer race and fit snap ring (1) into groove of outer race (2).

CAUTION:
Position opening of snap ring “c” so that it will not be lined up with a ball.



11) Apply grease to inside of outer race, and fit boot to outer race. After fitting boot, insert screwdriver into boot on outer race side and allow air to enter boot so that air pressure in boot becomes the same as atmospheric pressure.



12) When fixing boot (1) to outer race (2) with differential side big band (3), adjust so that measurements become as indicated below.

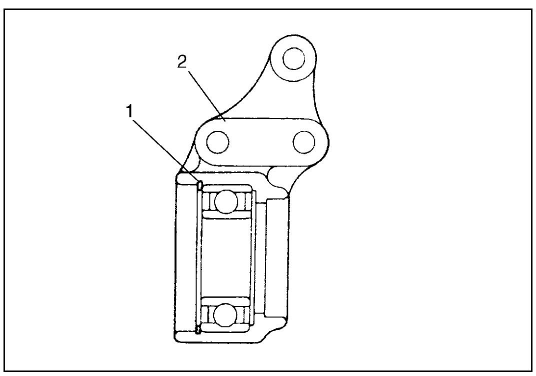
Drive shaft boot fixing position
"d" : 157.8 mm (6.21 in.) for left side
"e" : 192.9 mm (7.59 in.) foe right side

CAUTION:
To prevent any problem caused by washing solution, do not wash joint boots. Degreasing of those parts with cloth is allowed.

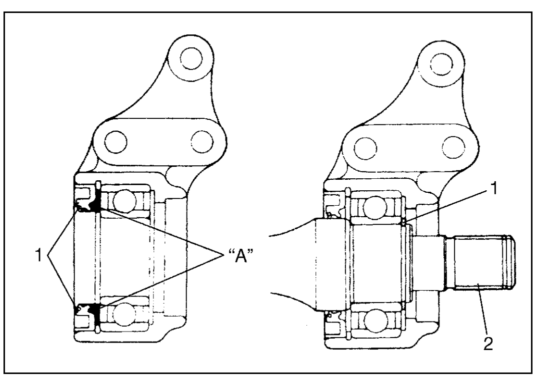
CAUTION:
- **Bend each boot band against forward rotation (A).**
- **Do not squeeze or distort boot when fastening it with bands.**
  Distorted boot caused by squeezing air may reduce its durability.

[A] : Differential side

For Center Shaft and Center Bearing Support



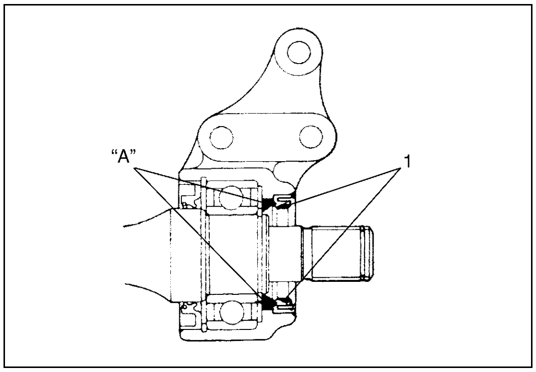
Install center shaft by reversing removal procedure and noting following points
- When installing bearing support circlip (1), make sure that if fits in circlip groove in center bearing support (2) securely as shown.



- When installing left oil seal (1), use care so that oil seal in proper direction as shown figure.
- Be sure to apply grease to oil seal lip and bearing side space indicated in figure.

"A" : Grease 99000-25010

- After press-fit center shaft (2) from left oil seal side, install circlip to groove of center shaft securely.



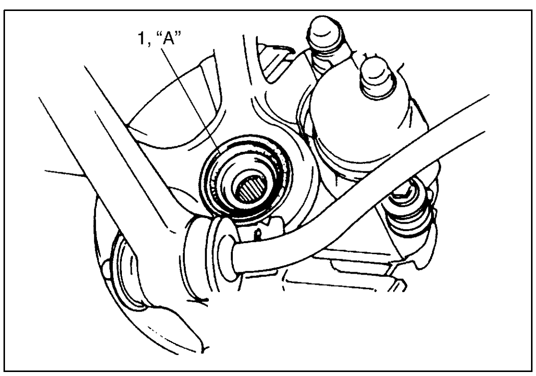
- When installing right oil seal (1), use care so that oil seal in proper direction as shown figure.
- Be sure apply grease to oil seal lip and bearing side space indicated in figure.

"A" : Grease 99000-25010

INSTALLATION

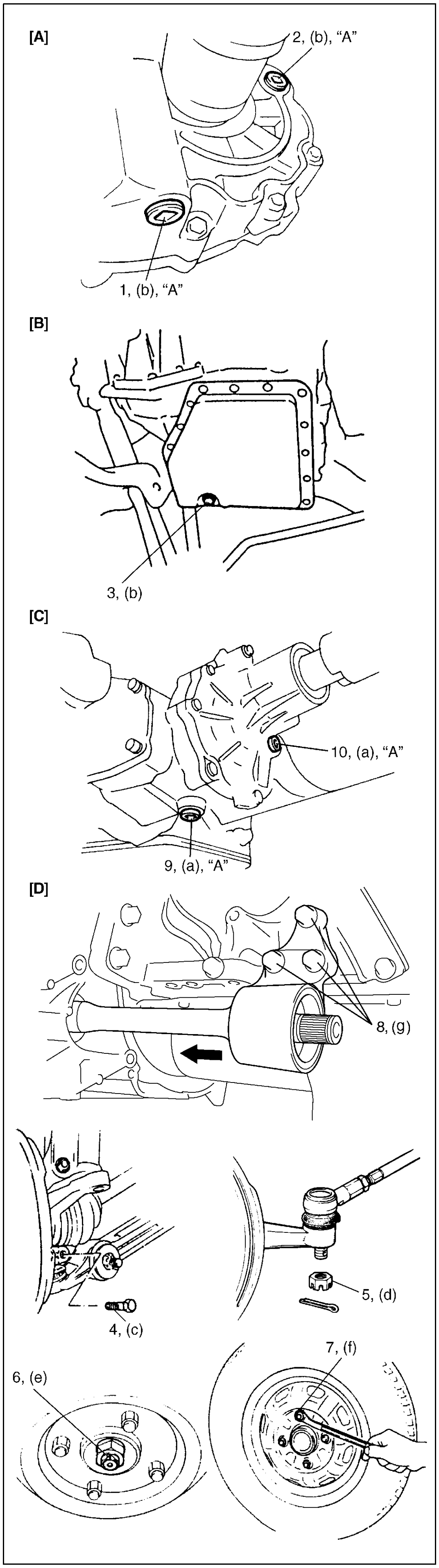
CAUTION:
- **To avoid excessive expansion of boot and consequential disconnection of joint in boot, do not pull differential side joint housing.**
- **Protect oil seals and boots from any damage, preventing them from unnecessary contact while installing drive shaft.**
- **Do not hit joint boot with hammer. Inserting joint only by hands is allowed.**
- **Make sure that differential side joint is inserted fully and its snap ring is seated as it was.**

Install drive shaft assembly by reversing removal procedure and noting following points.



- Clean front wheel bearing oil seal (1) and then apply grease. Replace it if required.

"A" : Grease 99000-25010



- Tighten each bolt and nut to the specified torque.

Tightening torque
Transfer oil filler/level and drain plugs (a) :
21 N·m (2.1 kg-m, 15.5 lb-ft)
Transmission oil filler/level and drain plugs (b) :
23 N·m (2.3 kg-m, 17.0 lb-ft)
Ball stud bolt (c) : 60 N·m (6.0 kg-m, 43.5 lb-ft)
Tie rod end castle nut (d) :
35 - 50 N·m (3.5 - 5.0 kg-m, 25.5 - 36.0 lb-ft)
Drive shaft nut (e) : 175 N·m (17.5 kg-m, 127.0 lb-ft)
Wheel nut (f) : 85 N·m (8.5 kg-m, 61.5 lb-ft)
Center bearing support bolts (g) :
50 N·m (5.0 kg-m, 36.0 lb-ft)

- Apply sealant to drain plug (1) and filler/level plug (2) for manual transmission.

“A” : Sealant 99000-31110

- Apply sealant to drain plug (9) and filler/level plug (10) for transfer. (For 4WD model)

“A” : Sealant 99000-31110

- Fill transmission or transfer with oil as specified. (Refer to Section 7A, 7B or 7D.)

[A] :	For M/T vehicle
[B] :	For A/T vehicle
[C] :	For 4WD model
[D] :	For vehicle equipped with center shaft
3.	Drain plug (for A/T vehicle)
4.	Ball stud bolt
5.	Castle nut
6.	Drive shaft nut
7.	Wheel nut
8.	Center bearing support bolt

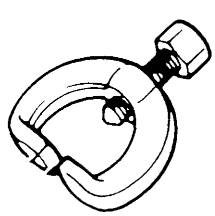
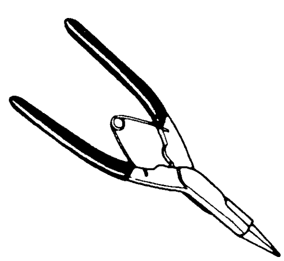
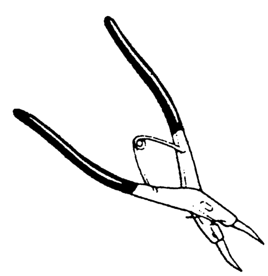
TIGHTENING TORQUE SPECIFICATION

Fastening portion	Tightening torque		
	N•m	kg-m	lb-ft
Transfer oil filler/level and drain plugs	21	2.1	15.5
Transmission oil filler/level and drain plugs	23	2.3	17.0
Ball stud bolt	60	6.0	43.5
Tie rod end castle nut	35 - 50	3.5 - 5.0	25.5 - 36.0
Drive shaft nut	175	17.5	127.0
Wheel nut	85	8.5	61.5
Center bearing support bolts	50	5.0	36.0

REQUIRED SERVICE MATERIAL

Material	Recommended SUZUKI product (Part Number)	Use
Lithium grease	SUZUKI SUPER GREASE A (99000-25010)	• Oil seal lips
Sealant	SUZUKI BOND NO. 1215 (99000-31110)	• Oil drain and filler plug for manual transmission or transfer

SPECIAL TOOL

		
09913-65210 Tie-rod end remover	09900-06107 Snap ring pliers (Open type)	09900-06108 Snap ring pliers (Closing type)

SECTION 4B

PROPELLER SHAFTS

CONTENTS

GENERAL DESCRIPTION

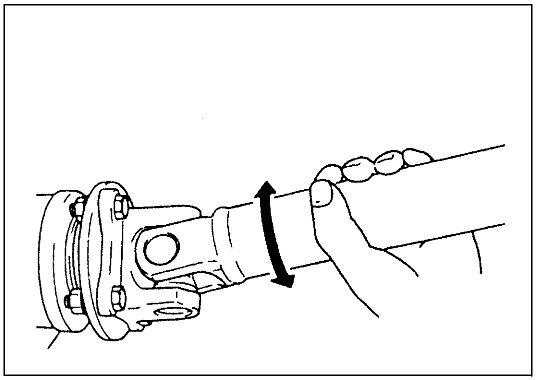
Most universal and constant velocity joints require no maintenance. They are lubricated for life and can not be lubricated on the vehicle. If universal and constant velocity joints becomes noisy or worn, it must be replace.
The propeller shaft is a balanced unit. Handle it carefully so that balance can be maintained.

DIAGNOSIS

DIAGNOSIS TABLE

Condition	Possible Cause	Correction
Abnormal noise	• Loose universal joint bolt	Tighten universal joint bolt.
	• Spider bearing worn out or stuck	Replace.
	• Wear spider	Replace propeller shaft.
Vibration	• Performed propeller shaft	Replace.

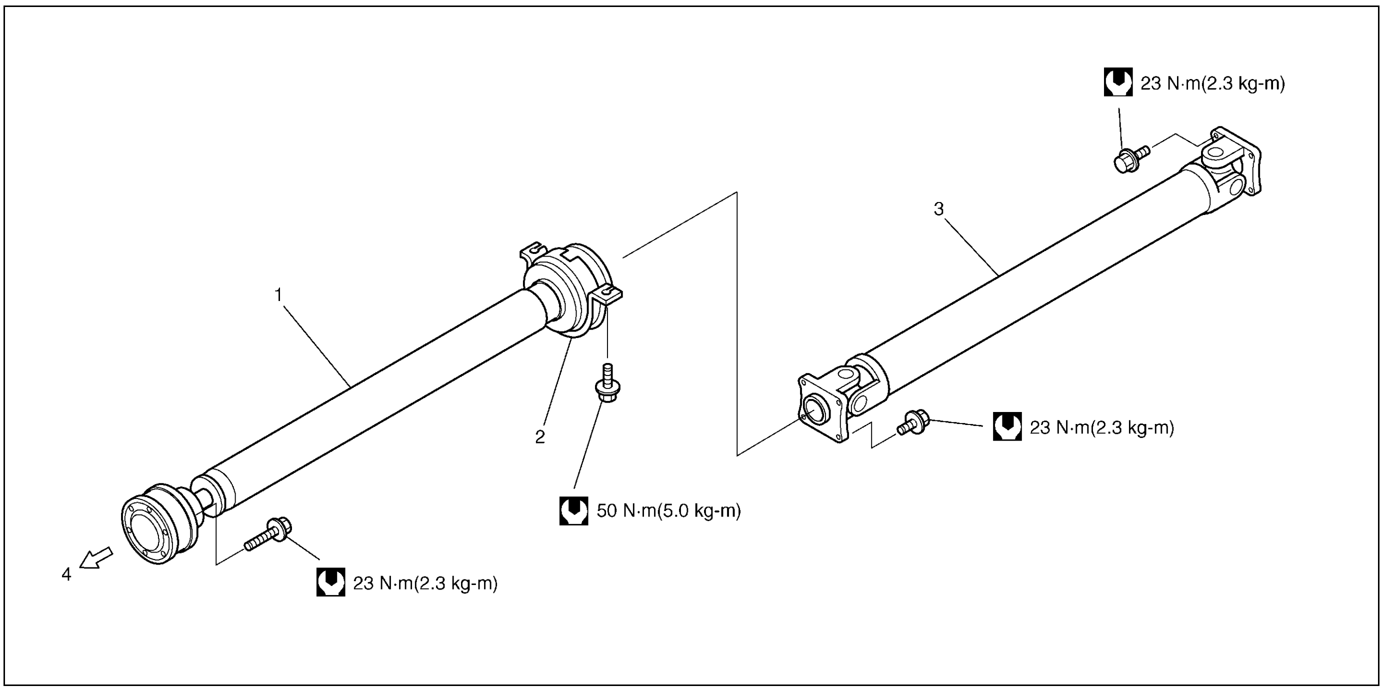
PROPELLER SHAFT JOINT CHECK



If universal joints are suspected of producing chattering or rattling noise, inspect them for wear. Check to see if cross spider rattles in yokes or if splines are worn down and replace defective propeller shaft with new one.

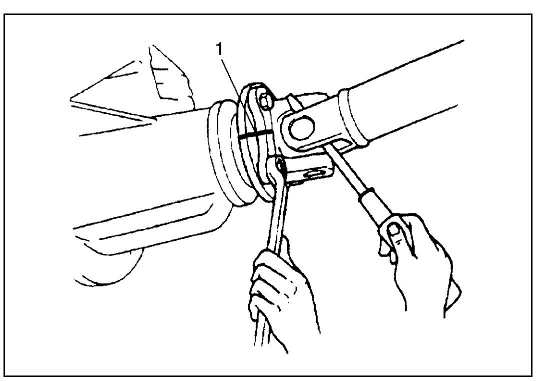
Noise coming from universal joint can be easily distinguished from other noises because rhythm of chattering or rattling is in step with cruising speed. Noise is pronounced particularly on standing start or in coasting condition (when braking effect of engine is showing in the drive line).

ON-VEHICLE SERVICE



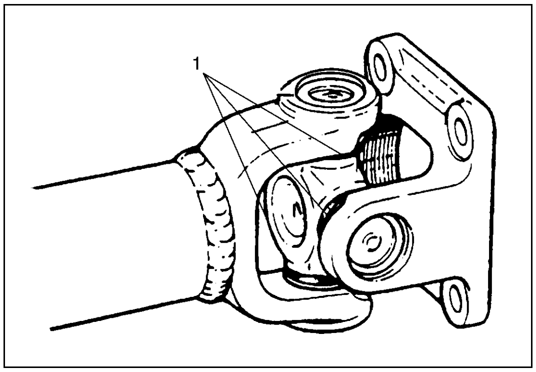
1.	Propeller shaft No.1
2.	Center support
3.	Propeller shaft No.2
4.	Forward
(torque symbol)	Tightening torque

REMOVAL

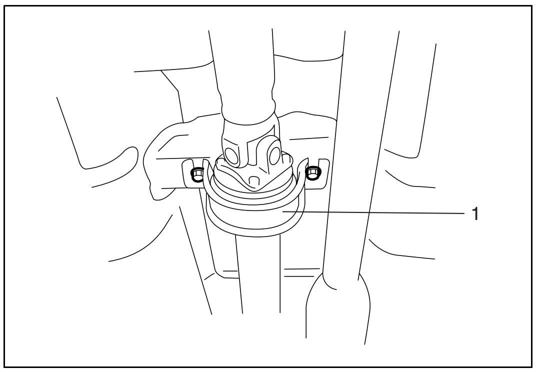


1) Hoist vehicle.
2) Before removing propeller shaft, give match mark (1) on propeller shaft and companion flange as shown. Also give match mark (1) on propeller shaft No.2 and center support flange of propeller shaft No.1.
3) Loosen propeller shaft bolt at front and rear end, and separate propeller shaft from transfer and rear differential.

4) Loosen propeller shaft bolt connecting propeller shaft No.1 with propeller shaft No.2, but keeping their connection provisionally.



CAUTION:
Don't damage joint seal (1) to prevent lubrication defect of joint.

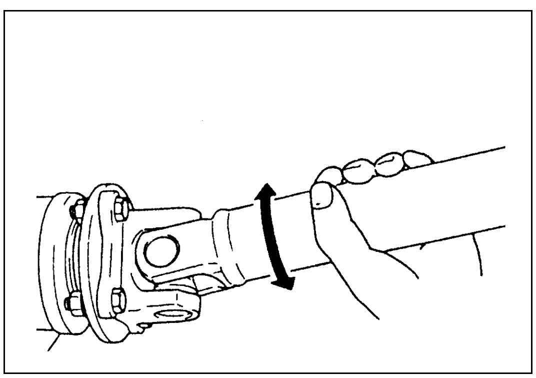


5) Loosen center support bolt, then remove propeller shaft No.1 with No.2.

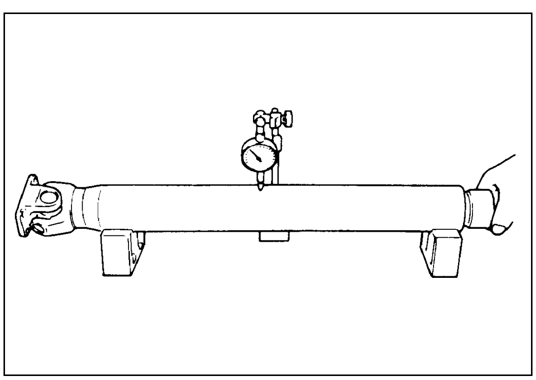
1. Center support

6) Disconnect propeller shaft No.1 from propeller shaft No.2.

INSPECTION



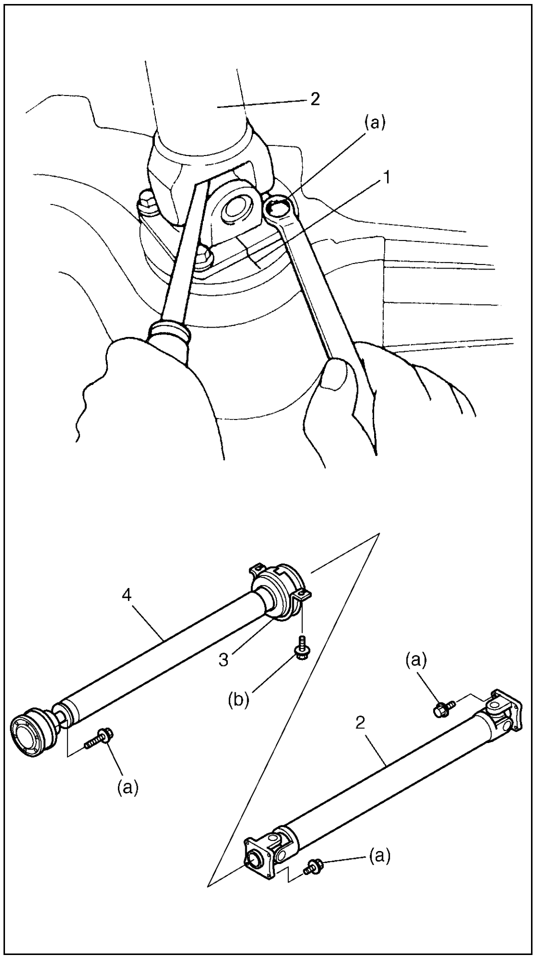
- Check propeller shaft connecting bolts for looseness. If looseness is found, tighten to specified torque.
- Check propeller shaft joints for wear, rattle and damage. If any defect is found, replace.
- Check propeller shaft center support for biting of foreign matter, crack, abnormal noise and damage. If any defect is found, replace.



- Inspect propeller shaft and flange yoke for damage, and propeller shaft for runout.
  If damage is found or shaft runout exceeds its limit, replace.

Propeller shaft runout
Limit : 0.7 mm (0.028 in.)

INSTALLATION



1) Reverse removal procedure to install propeller shaft noting following point.
   - When installing propeller shaft, align the match marks (1). Otherwise, vibration may occur during driving.
   - Use following specification to torque bolts.

Tightening torque
Propeller shaft bolt (a) : 23 N·m (2.3 kg-m, 17.0 lb-ft)
Center support bolt (b) : 50 N·m (5.0 kg-m, 36.5 lb-ft)

2. Propeller shaft No.2
3. Propeller shaft center support
4. Propeller shaft No.1

TIGHTENING TORQUE SPECIFICATION

Fastening portion	Tightening torque		
	N•m	kg-m	lb-ft
Propeller shaft bolt	23	2.3	17.0
Center support bolt	50	5.0	36.5

SECTION 5

BRAKES

NOTE:

All front fasteners are important attaching parts in that they could affect the performance of vital parts and systems, and/or could result in major repair expense. They must be replaced with one of same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of all parts. There is to be no welding as it may result in extensive damage and weakening of the metal.

CONTENTS

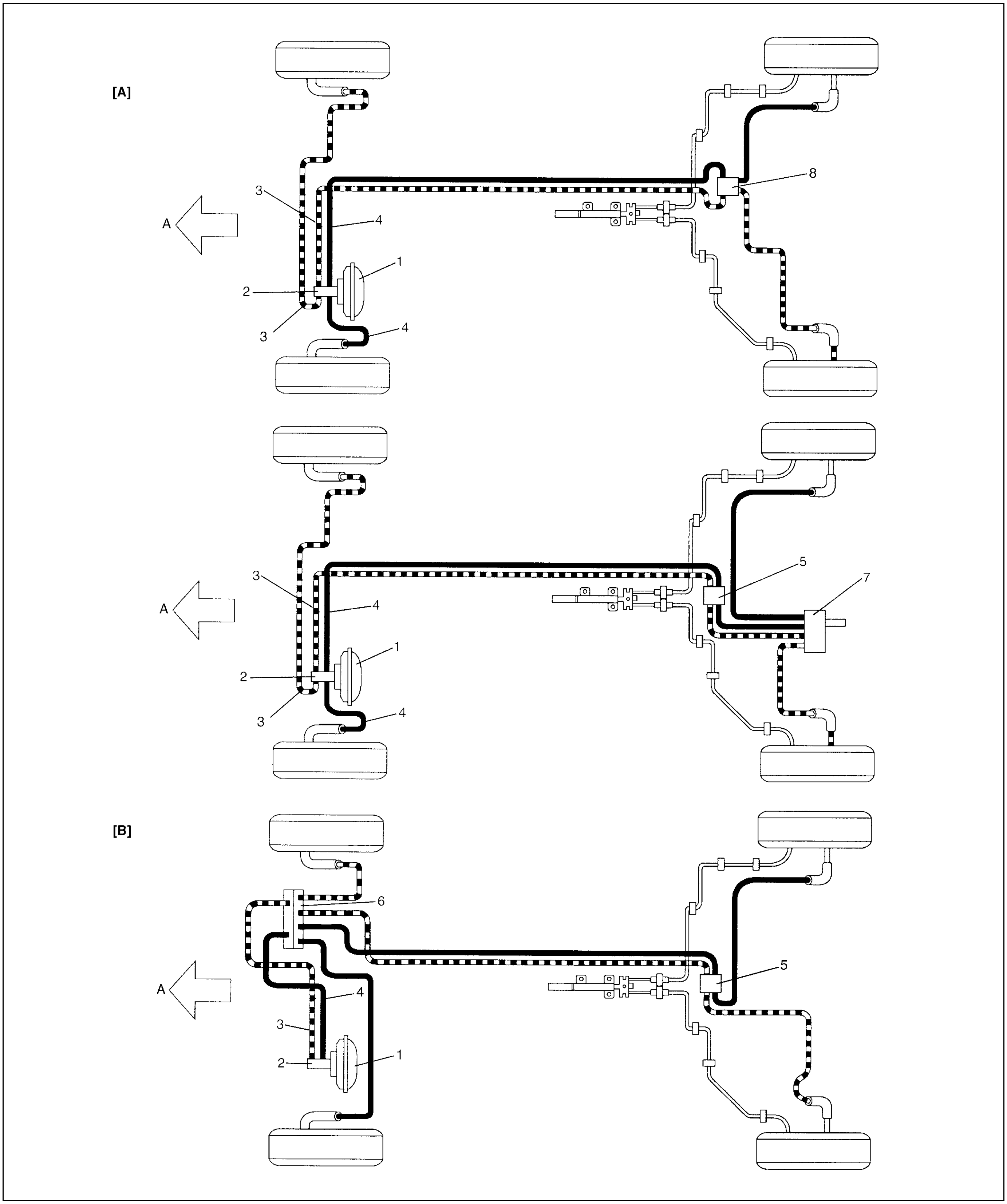
5

GENERAL DESCRIPTION

When the foot brake pedal is depressed, hydraulic pressure is developed in the master cylinder to actuate pistons (two in front and four in rear).
The master cylinder is a tandem master cylinder. Brake pipes are connected to the master cylinder and they make two independent circuits. One connects front right & rear left brakes and the other connects front left & rear right brakes.
The load sensing proportioning valve (LSPV) or the proportioning valve (P valve) is included in these circuits between the master cylinder and the rear brake for the vehicle without ABS.
In this brake system, the disc brake type is used for the front wheel brake and a drum brake type (leading/trailing shoes) for the rear brake.
The parking brake system is mechanical. It applies brake force to only rear wheels by means of the cable and mechanical linkage system. The same brake shoes are used for both parking and foot brakes.

NOTE:

The figures shows left-hand steering vehicle.



[A] :	For vehicle without ABS	3.	Secondary side	7.	LSPV (Load Sensing Proportioning valve)
[B] :	For vehicle with ABS	4.	Primary side	8.	P (Proportioning) valve
1.	Brake booster	5.	4-way joint	A:	Forward
2.	Master cylinder	6.	ABS hydraulic unit/control module assembly		

DIAGNOSIS

ROAD TESTING BRAKES

Brakes should be tested on dry, clean, smooth and reasonably level roadway which is not crowned. Road test brakes by making brake applications with both light and heavy pedal forces at various speeds to determine if the vehicle stops evenly and effectively. Also drive vehicle to see if it leads to one side or the other without brake application. If it does, check the tire pressure, front end alignment and front suspension attachments for looseness. See diagnosis table for other causes.

BRAKE FLUID LEAKS

Check the master cylinder fluid levels. While a slight drop in reservoir level does result from normal lining wear, an abnormally low level indicates a leak in the system. In such a case, check the entire brake system for leakage. If even a slight evidence of leakage is noted, the cause should be corrected or defective parts should be replaced.

SUBSTANDARD OR CONTAMINATED BRAKE FLUID

Improper brake fluid, mineral oil or water in the fluid may cause the brake fluid to boil or the rubber components in the hydraulic system to deteriorate.

If primary piston cups are swollen, then rubber parts have deteriorated. This deterioration may also be evidenced by swollen wheel cylinder piston cups on the drum brake wheels.

If deterioration of rubber is evident, disassemble all hydraulic parts and wash with alcohol. Dry these parts with compressed air before assembly to keep alcohol out of the system. Replace all rubber parts in the system, including hoses. Also, when working on the brake mechanisms, check for fluid on the linings.
If excessive fluid is found, replace the pads.

If master cylinder piston seals are satisfactory, check for leakage or excessive heat conditions. If leakage is not found, drain fluid, flush with brake fluid, refill and bleed system.

The system must be flushed if there is any doubt as to the grade of fluid in the system or if fluid has been used which contained parts that have been subjected to contaminated fluid.

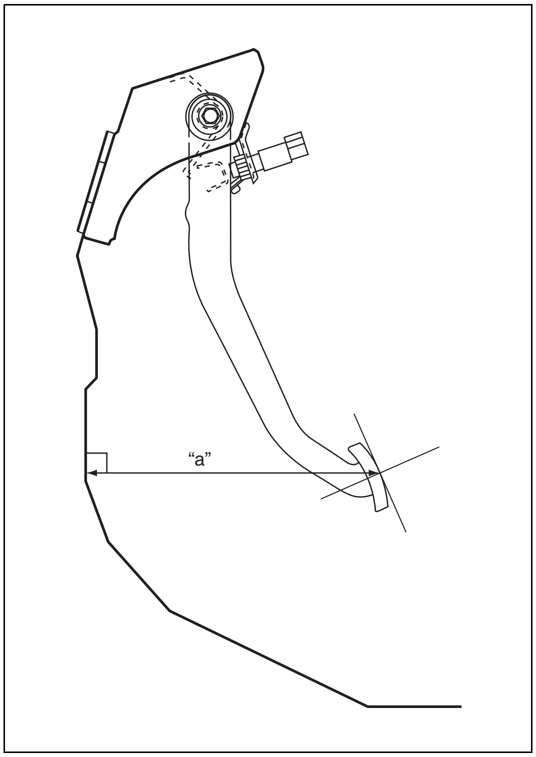
DIAGNOSIS TABLE

Condition	Possible Cause	Correction
Not enough braking force	Brake oil leakage from brake lines	Locate leaking point and repair.
	Brake disc or pads stained with oil	Clean or replace.
	Overheated brakes	Determine cause and repair.
	Poor contact of shoes on brake drum	Repair for proper contact.
	Brake shoes linings stained with oil or wet with water	Replace.
	Badly worn brake pad linings	Replace.
	Defective wheel cylinders	Repair or replace.
	Malfunctioning caliper assembly	Repair or replace.
	Air in system	Bleed system.
	Maladjusted sensor spring length of LSPV, if equipped	Check or adjust.
	Broken sensor spring of LSPV, if equipped	Replace.
	Defective LSPV, if equipped	Replace.
	Malfunctioning ABS (Antilock brake system), if equipped	Check system and replace as necessary.
Brake pull (Brakes not working in unison)	Pad linings and/or shoe linings are wet with water or stained with oil in some brakes	Replace.
	Drum-to-shoe clearance out of adjustment in some brakes (Malfunctioning auto adjusting mechanism)	Check for inoperative auto adjusting mechanism.
	Disc and/or drum is out of round in some brakes	Replace.
	Wheel tires are inflated unequally	Inflate equally.
	Malfunction in wheel cylinders	Repair or replace.
	Disturbed front end alignment	Adjust as prescribed.
	Unmatched tires on same axle	Tires with approximately the same amount of tread should be used on the same axle.
	Restricted brake pipes or hoses	Check for soft hoses and damaged lines. Replace with new hoses and new double-walled steel brake tubing.
	Malfunctioning caliper assembly	Check for stuck or sluggish pistons and proper lubrication of caliper slide bush. Caliper should slide.
	Loose suspension parts	Check all suspension mountings.
	Loose calipers	Check and torque bolts to specifications.
Noise (high pitched squeak without brake applied)	Front lining worn out	Replace linings.
	Contact wear indicator to brake disc	Replace pads.
Rear brake locked prematurely	Maladjusted sensor spring length of LSPV, if equipped	Check or adjust.
	Malfunction LSPV assembly, if equipped	Replace assembly.

Condition	Possible Cause	Correction
Excessive pedal travel (Pedal stroke too large)	Partial brake system failure	Check brake systems and repair as necessary.
	Insufficient fluid in master cylinder reservoirs	Fill reservoirs with approved brake fluid. Check for leaks and air in brake system. Check warning light. Bleed system if required.
	Air in system (soft/spongy pedal)	Bleed system.
	Rear brake system not adjusted (malfunctioning auto adjusting mechanism)	Repair auto adjusting mechanism. Adjust rear brakes.
	Bent brake shoes	Replace brake shoes.
	Worn rear brake shoes	Replace brake shoes.
Brake locked (For vehicle equipped with ABS)	Malfunctioning ABS	Check system referring to Section 5E1.
Dragging brakes (A very light drag is present in all brakes immediately after pedal is released)	Master cylinder pistons not returning correctly	Replace master cylinder.
	Restricted brake pipes or hoses	Check for soft hoses or damaged pipes and replace with new hoses and/or new double-walled steel brake piping.
	Incorrect parking brake adjustment on rear brakes	Check and adjust to correct specifications.
	Weakened or broken return springs in the brake	Replace.
	Sluggish parking brake cables or linkage	Repair or replace.
	Wheel cylinder or caliper piston sticking	Repair as necessary.
	Badly worn piston seal in caliper	Replace piston seal.
Pedal pulsation (Pedal pulsates when depressed for braking)	Damaged or loose wheel bearings	Replace wheel bearings.
	Distorted steering knuckle or rear wheel spindle	Replace knuckle or rear wheel spindle.
	Excessive disc lateral runout	Check per instructions. If not within specifications, replace or machine disc.
	Parallelism between pad and disc not within specifications	Check per instructions. If not within specifications, replace or machine disc.
	Rear drums out of round	Check runout. Repair or replace drum as necessary.
Braking noise	Glazed shoe linings, or foreign matters stuck to linings	Repair or replace shoe linings.
	Worn or distorted shoe linings	Replace shoe lining (or pad).
	Loose front wheel bearings	Replace wheel bearing.
	Distorted backing plates or loose mounting bolts	Replace or retighten securing bolts.
	Contact wear indicator to brake disc	Replace pads.

Condition	Possible Cause	Correction
Brake warning lamp lights after engine start	Parking brake applied	Release parking brake and check that brake warning lamp turns off.
	Insufficient amount of brake fluid	Add brake fluid.
	Brake fluid leaking from brake line	Investigate leaky point, correct it and add brake fluid.
	Brake warning lamp circuit faulty	Repair circuit.
	Malfunctioning EBD system, if equipped with ABS.	Check system referring to Table-E of Section 5E1.
Brake warning lamp turns on when brake is applied	Brake fluid leaking from brake line	Investigate leaky point, correct it and add brake fluid.
	Insufficient amount of brake fluid	Add brake fluid.
Brake warning lamp fails to turn on even when parking brake is applied	Brake warning lamp circuit faulty	Replace bulb or repair circuit.
ABS warning lamp turns on after engine start (If equipped)	Malfunctioning ABS	Check system referring to DIAGNOSIS of Section 5E1.
ABS warning lamp turns on when brake is applied (If equipped)	Malfunctioning ABS	Check system referring to DIAGNOSIS of Section 5E1.
ABS warning lamp does not turn on for 2 sec. after ignition switch has turned ON	Bulb burnt out	Replace bulb.
	Malfunctioning ABS	Check system referring to DIAGNOSIS of Section 5E1.
ABS warning lamp flashes	New ABS hydraulic unit/control module assembly installed.	Perform “ABS Hydraulic Unit Operation Check”.

BRAKE PEDAL FREE HEIGHT ADJUSTMENT

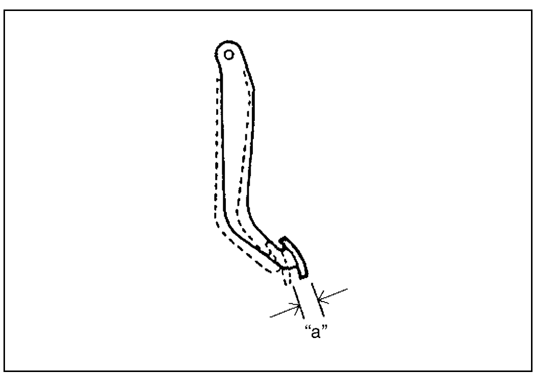


1) Check brake pedal free height.
   If it is not within specification, check and adjust following item 1) and 2).

   Brake pedal free height "a" from dash silencer
   LH steering vehicle : 205 – 225 mm (8.08 – 8.85 in.)
   RH steering vehicle : 217 – 237 mm (8.55 – 9.33 in.)

2) Check measurement between booster mounting surface and center of clevis pin hole. When booster push rod clevis has been reinstalled, it is important that the measurement is adjusted (refer to BRAKE BOOSTER INSPECTION AND ADJUSTMENT).
3) Check stop light switch position. Adjust it if it is out of specification.

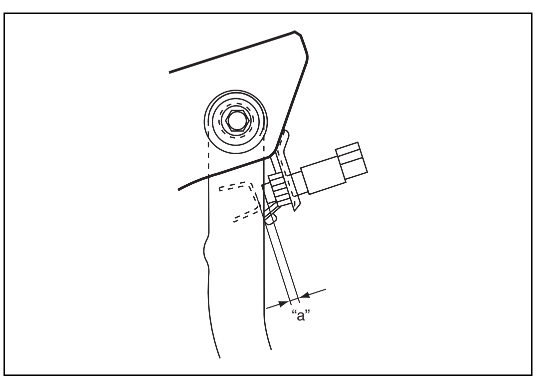
BRAKE PEDAL PLAY INSPECTION



Pedal play should be within specification below. If out of specification, check stop light switch for proper installation position and adjust if necessary.
Also check pedal shaft bolt and master cylinder pin installation for looseness and replace if defective.

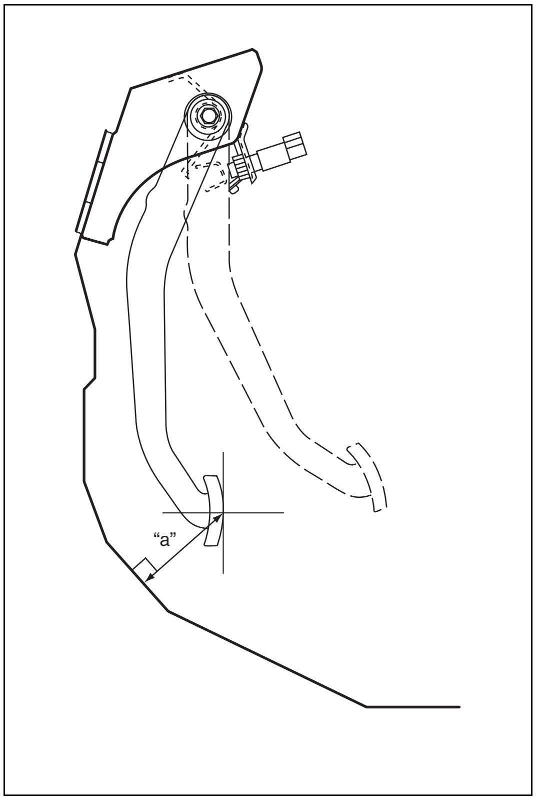
Brake pedal play
"a" : 1 - 8 mm (0.04 - 0.31 in.)

STOP LIGHT SWITCH ADJUSTMENT



Adjustment should be made as follows when installing switch. Pull up brake pedal toward you and while holding it there, adjust switch position so that clearance between end of thread and brake pedal is as specified. Then adjust stop light switch assembly position and lock it by turning clockwise.

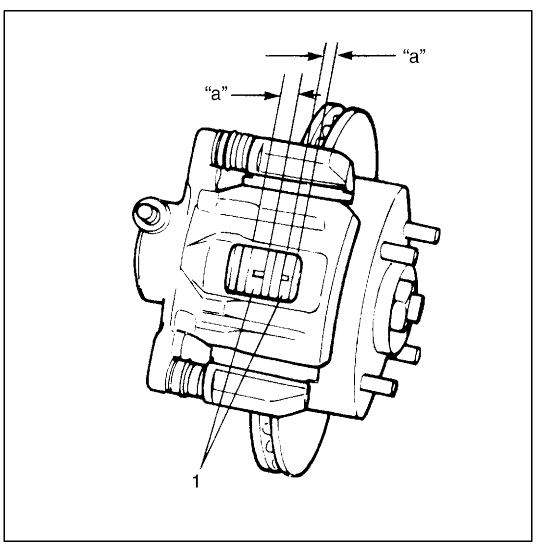
Clearance between brake pedal and stop light switch
"a" : 0.5 - 1.5 mm (0.02 -0.06 in.)



EXCESSIVE PEDAL TRAVEL INSPECTION

1) Start engine.
2) Depress brake pedal a few times.
3) With brake pedal depressed with approximately 30 kg (66 lbs) load, measure brake pedal to wall (dash panel silencer) clearance "a".
   If clearance "a" is less than specification, the most possible cause is either rear brake shoes are worn out beyond limit or air is in lines.
   Should clearance "a" remain less than specification even after replacement of brake shoes and bleeding of system, other possible but infrequent cause is malfunction of rear brake shoe adjusters or booster push rod length out of adjustment.
   – Bleed brake system. Refer to "AIR BLEEDING OF BRAKE SYSTEM".
   – Remove brake drums for adjuster inspection. (Refer to "REAR BRAKE".) If defective, correct or replace.

Clearance "a" between brake pedal and dash panel silencer
LH steering vehicle : over 135 mm (5.32 in.)
RH steering vehicle : over 140 mm (5.52 in.)



FRONT BRAKE PAD INSPECTION

Inspect pad linings (1) periodically according to maintenance schedule whenever wheels are removed (for tire rotation or other reason). Take a look through each end (or hole) of caliper and check lining thickness of outside and inside pads.
If lining is worn and its thickness ("a" in figure) is less than limit, all pads must be replaced at the same time.

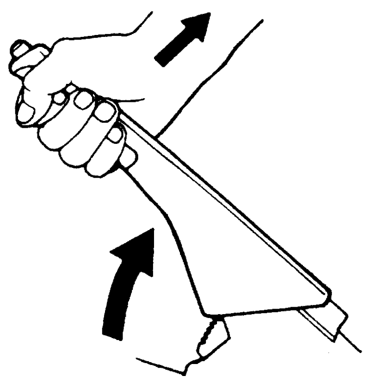
Front brake pad thickness "a" (lining thickness)
Standard : 10 mm (0.40 in.)
Limit : 2 mm (0.08 in.)

BRAKE DISC INSPECTION

Refer to "BRAKE DISC" for inspection point and procedure.

PARKING BRAKE INSPECTION AND ADJUSTMENT

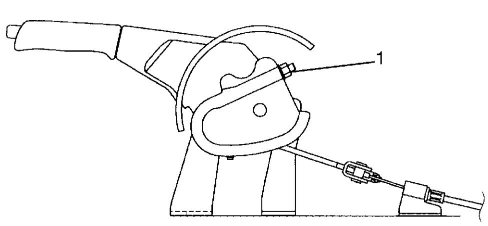
INSPECTION



Hold center of parking brake lever grip and pull it up with 200 N (20 kg, 44 lbs) force.
With parking brake lever pulled up as shown, count ratchet notches. There should be 4 to 9 notches.
Also, check if both right and left rear wheels are locked firmly.
To count number of notches easily, listen to click sounds that ratchet makes while pulling parking brake lever without pressing its button.
One click sound corresponds to one notch.
If number of notches is out of specification, adjust cable referring to adjustment procedure so as to obtain specified parking brake store.

NOTE:
Check tooth tip of each notch for damage or wear.
If any damage or wear is found, replace parking brake lever.

ADJUSTMENT



NOTE:
Make sure for the following conditions before cable adjustment.

- **No air is trapped in brake system.**
- **Brake pedal travel is proper.**
- **Brake pedal has been depressed a few times with about 100 N (10 kg, 22 lbs) load.**
- **Parking brake lever is pulled up a few times with about 500 N (50 kg, 110 lbs) load.**
- **Rear brake shoes are not worn beyond limit, and self adjusting mechanism operates properly.**
- **If parking brake lever stroke is less than specification, loosen adjusting nut (1) as far as end of bolt. Then depress brake pedal repeatedly with about 300 N (30 kg, 66 lbs) load until adjuster actuator clicking sound can not be heard from drum brake.**

After confirming that above conditions are all satisfied, adjust parking brake lever stoke by loosening or tightening adjust nut (1).

NOTE:
Check brake drum for dragging after adjustment.

Parking brake stroke (When lever is pulled up at 200 N (20 kg, 44 lbs)
: 4 to 9 notches

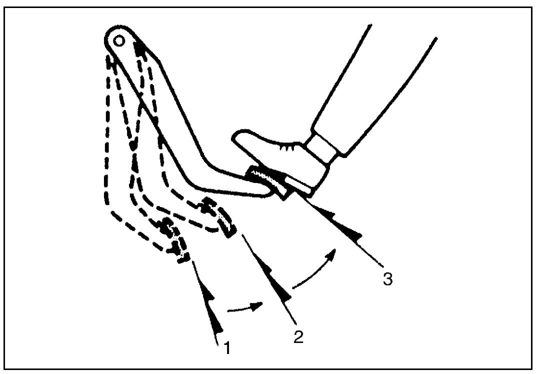
BOOSTER OPERATION INSPECTION

There are two ways to perform this inspection, with and without a tester. Ordinarily, it is possible to roughly determine its condition without using a tester.

NOTE:
For this check, make sure that no air is in hydraulic line.

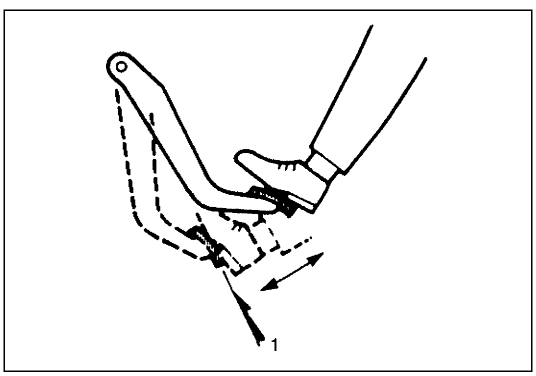
CHECK AIR TIGHTNESS

1) Start engine.
2) Stop engine after running for 1 to 2 minutes.



3) Depress brake pedal several times with the same load as in ordinary braking and observe pedal travel. If pedal goes down deep the first time but its travel decreases as it is depressed the second and more times, air tightness is obtained.

1.	1st
2.	2nd
3.	3rd

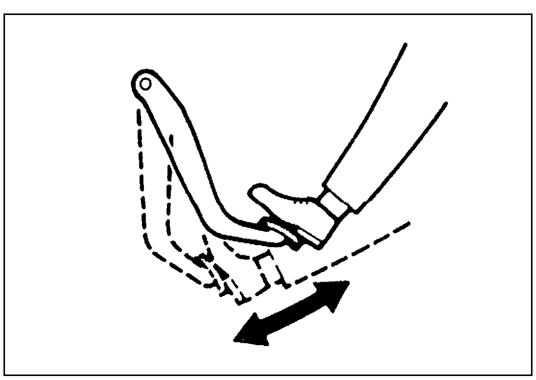


4) If pedal travel doesn’t change, air tightness isn’t obtained.

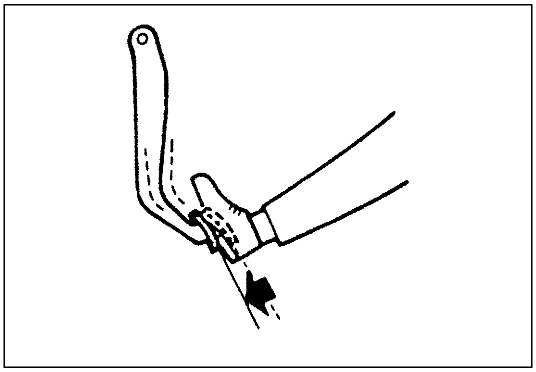
NOTE:
If defective, inspect vacuum lines and sealing parts, and replace any faulty part.When this has been done, repeat the entire test.

1.	1st, 2nd, 3rd

CHECK OPERATION

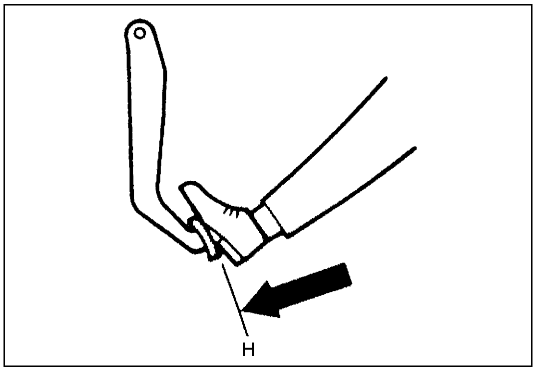


1) With engine stopped, depress brake pedal several times with the same load and make sure that pedal travel doesn’t change.



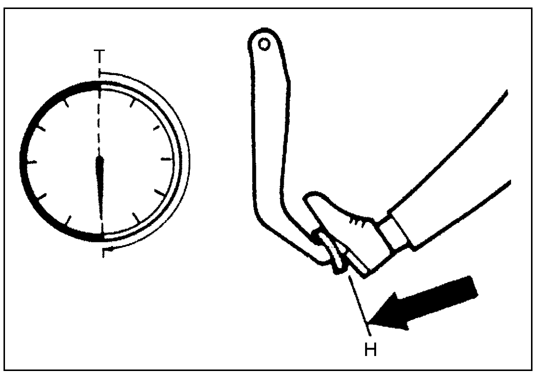
2) Start engine while depressing brake pedal. If pedal travel increases a little, operation is satisfactory. But no change in pedal travel indicates malfunction.

CHECK AIR TIGHTNESS UNDER LOAD



1) With engine running, depress brake pedal. Then stop engine while holding brake pedal depressed.

H:	Hold



2) Hold brake pedal depressed for 30 seconds. If pedal height does not change, condition is good. But it isn't if pedal rises.

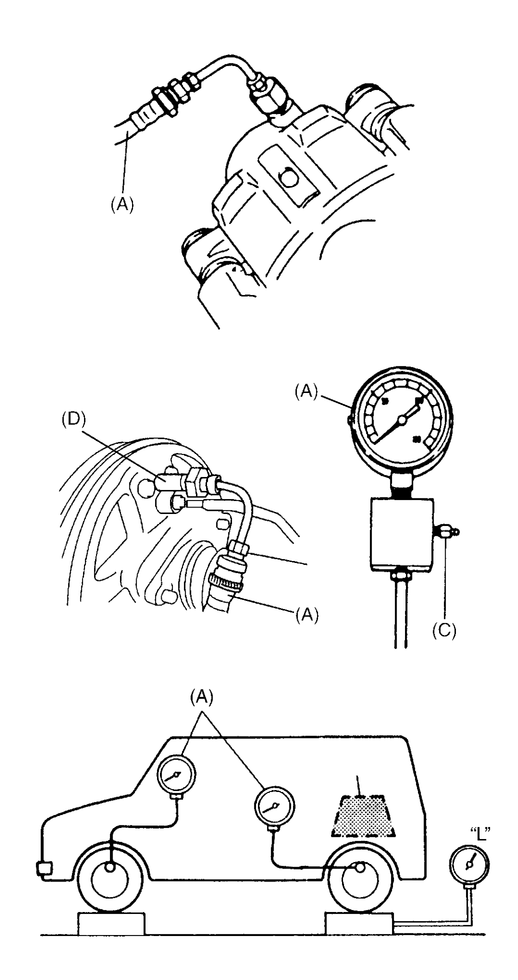
H:	Hold
T:	30 seconds

FLUID PRESSURE TEST (IF EQUIPPED WITH LSPV)

Test procedure for LSPV assembly is as follows.

Before testing, confirm the following.

- Fuel tank is filled with fuel fully.
- Vehicle is equipped with spare tire, tools, jack and jack handle.



1) Stop vehicle on level floor and place approximately about 1,000 N (100 kg, 220 lbs) weight (1) on rear housing so that rear axle weighs 4,500 N (450 kg, 992 lbs).

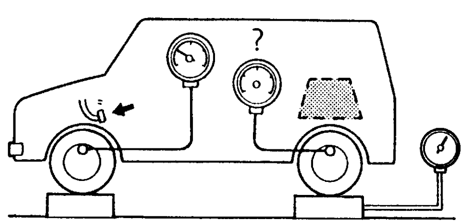
Rear axle weight
"L" : 4,500 N (450 kg, 992 lbs)

2) Install special tool to front and rear brake.

NOTE:

Pressure gauge should be connected to bleeder plug hole of front (left side brake) and rear (right side brake). After testing front left side and rear right side, test front right side and rear left side in the same way.

For front wheel
Special tool
(A) : 09956-02310
(C) : 55473-82030 (Air bleeder plug as a spare part)
For rear wheel
Special tool
(A) : 09956-02310
(C) : 55473-82030 (Air bleeder plug as a spare part)
(D) : 09952-48320



3) Depress brake pedal gradually till fluid pressure of front brake becomes as specified below and check corresponding pressure of rear brake then. It should be within specification given below.

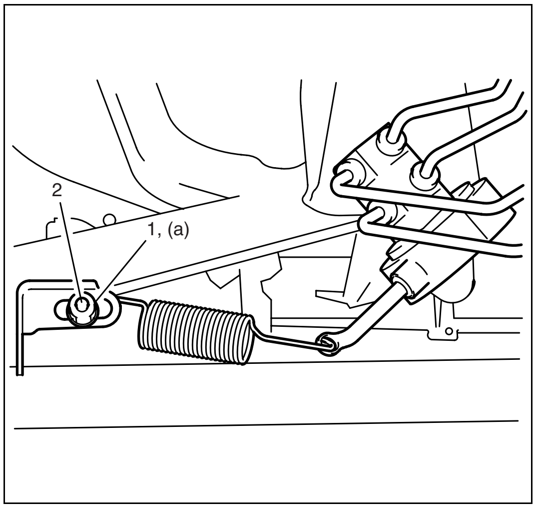
LSPV specification

Front brake	Rear brake
7,500 kPa 75 kg/cm^2 1,067 psi	4,700 – 6,900 kPa 47 – 69 kg/cm^2 669 – 981 psi

4) As done above, apply 100 kg/cm^2 pressure to front brake and check that rear brake pressure then is within specification as given below.

LSPV specification (apply 100 kg/cm^2 pressure to front brake)

Front brake	Rear brake
10,000 kPa 100 kg/cm^2 1,422 psi	5,400 – 7,700 kPa 54 – 77 kg/cm^2 768 – 1,094 psi

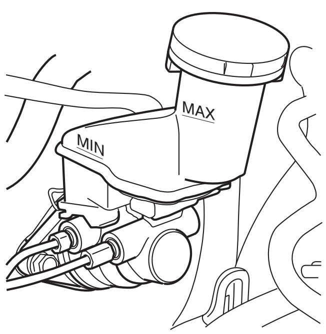


5) If rear brake pressure is not within specification, adjust it by changing bolt (2) position as follows.
   - If rear brake pressure is higher than specification, move bolt (2) center side and if it is lower, out side.
   - Repeat steps 3) and 4) until rear brake pressure is within specification.
   - After adjustment, be sure to torque nut (1) to specification.

Tightening torque
LSPV nut (a) : 25 N·m (2.5 kg-m, 18.0 lb-ft)

6) Upon completion of fluid pressure test, bleed brake system and perform brake test.

MASTER CYLINDER AND BRAKE FLUID LEVEL INSPECTION



1) Check master cylinder and reservoir tank for crack, damage and brake fluid leakage. If any faulty condition exists, correct or replace.
2) Check that brake fluid level is between MAX and MIN marks on reservoir tank.

NOTE:

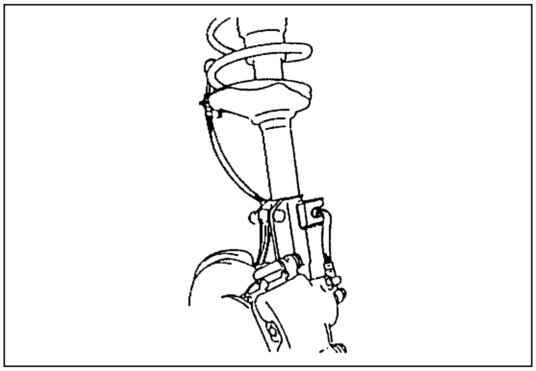
Be sure to use particular brake fluid either as indicated on reservoir cap of that vehicle or recommended in owner's manual which comes along with that vehicle. Use of any other fluid is strictly prohibited.
Fluid level should be between MIN and MAX lines marked on reservoir.
When brake warning lamp lights sometimes during driving, replenish fluid to MAX level.
When fluid decreases quickly, inspect brake system for leakage. Correct leaky points and then refill to specified level.

CAUTION:

Do not use shock absorber fluid or any other fluid which contains mineral oil. Do not use a container which has been used for mineral oil or a container which is wet from water. Mineral oil will cause swelling and distortion of rubber parts in hydraulic brake system and water mixed into brake fluid will lower fluid boiling point. Keep all fluid containers capped to prevent contamination.

BRAKE HOSE AND PIPE INSPECTION

HOSE



The brake hose assembly should be checked for road hazard damage, for cracks and chafing of outer cover, for leaks and blisters. A light and mirror may be needed for an adequate inspection. If any of above conditions are observed on brake hose, it is necessary to replace it.

PIPE

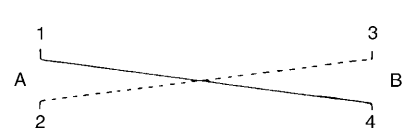
Inspect the pipe for damage, cracks, dents and corrosion. If any defect is found, replace it.

ON-VEHICLE SERVICE

AIR BLEEDING OF BRAKE SYSTEM

CAUTION:

Brake fluid is extremely damaging to paint. If fluid should accidentally touch painted surface, immediately wipe fluid from paint and clean painted surface.



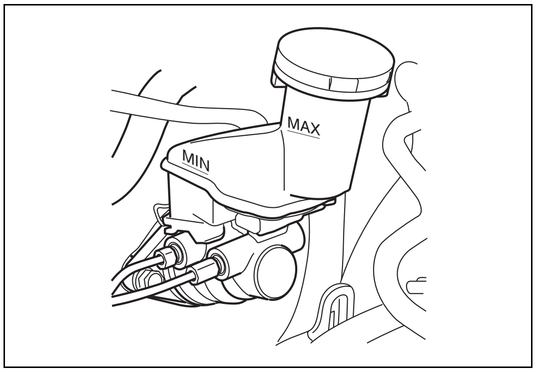
Bleeding operation is necessary to remove air whenever it entered hydraulic brake system.

Hydraulic lines of brake system are based on the diagonal split system. When a brake pipe or hose was disconnected at the wheel, bleeding operation must be performed at both ends of the line of the removed pipe or hose. When any joint part of the master cylinder of other joint part between the master cylinder and each brake (wheel) was removed, the hydraulic brake system must be bled at all 4 wheel brakes.

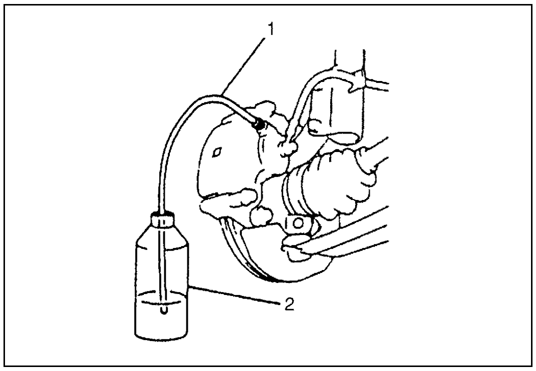
NOTE:

Perform bleeding operation starting with wheel cylinder farthest from master cylinder and then at front caliper of the same brake line. Do the same on the other brake line.

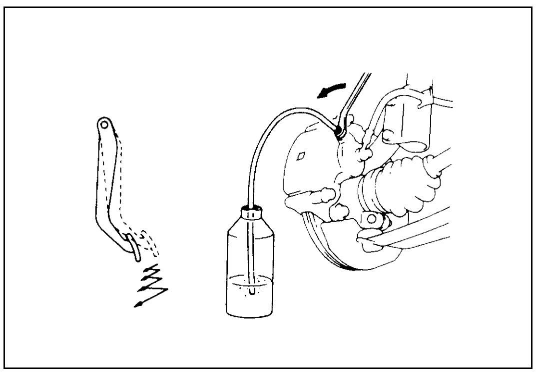
1. Right brake caliper	4. Left wheel cylinder
2. Left brake caliper	A : FRONT
3. Right wheel cylinder	B : REAR



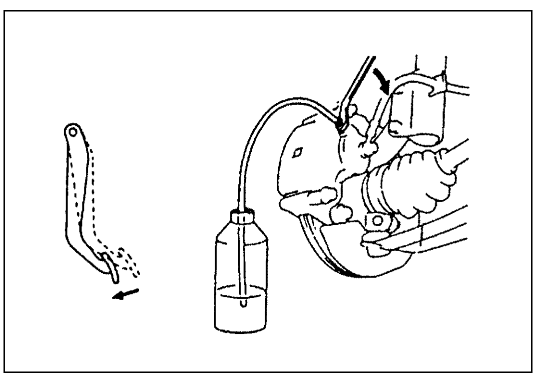
1) Fill master cylinder reservoir with brake fluid and keep at least one-half full of fluid during bleeding operation.



2) Remove bleeder plug cap.
   Attach a vinyl tube (1) to bleeder plug, and insert the other end into container (2).



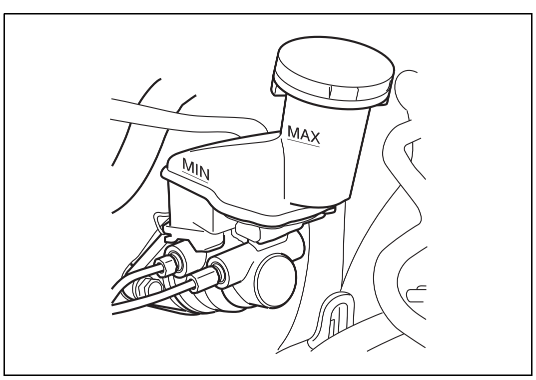
3) Depress brake pedal several times, and then while holding it depressed, loosen bleeder plug about one-third to one-half turn.
4) When fluid pressure in cylinder is almost depleted, retighten bleeder plug.
5) Repeat this operation until there are no more air bubbles in hydraulic line.



6) When bubbles stop, depress and hold brake pedal and tighten bleeder plug.

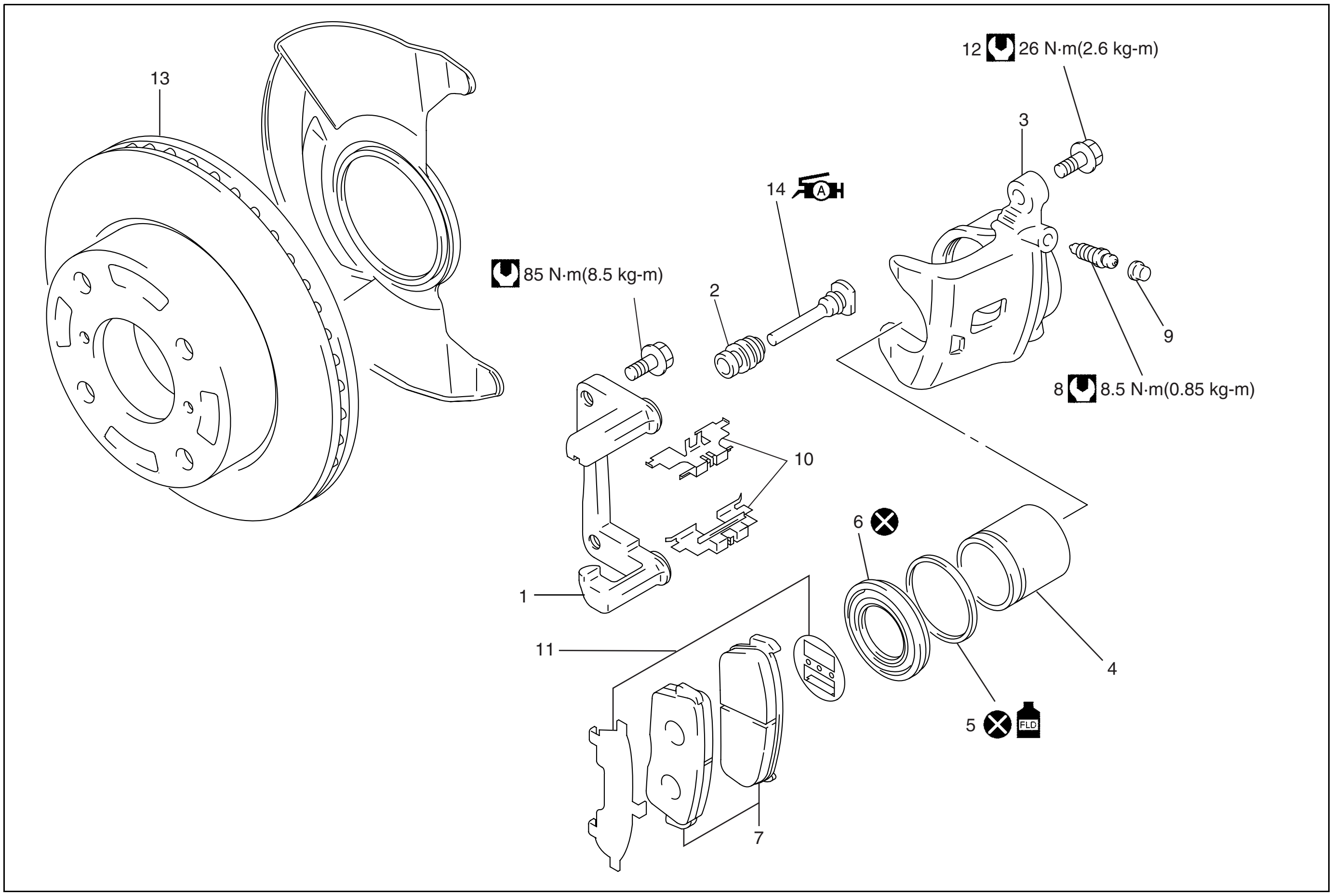
Tighting torque
Front bleeder plug : 11.0 N·m (1.1 kg-m, 8.0 lb-ft)
Rear bleeder plug : 8.0 N·m (0.8 kg-m, 6.0 lb-ft)

7) Then attach bleeder plug cap.



8) After completing bleeding operation, apply fluid pressure to pipe line and check for leakage.
9) Replenish fluid into reservoir up to specified level.
10) Check brake pedal for sponginess. If found spongy, repeat entire procedure of bleeding.

FRONT BRAKE

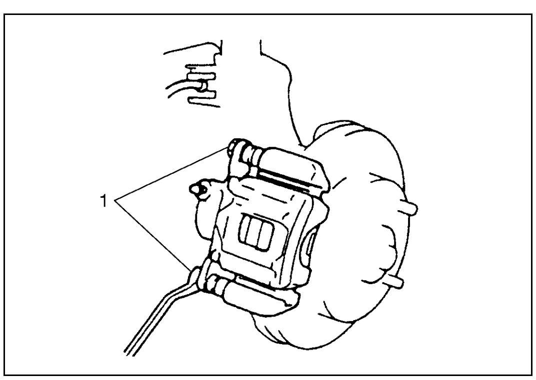


	1. Brake caliper carrier		9. Bleeder plug cap
	2. Boot		10. Pad spring
	3. Caliper		11. Anti noise shim
	4. Disc brake piston		12. Caliper pin bolt
FLD	5. Piston seal : Apply fluid (Brake, power steering or automatic transmission fluid).		13. Brake disc
FLD	6. Cylinder boot : Apply fluid (Brake, power steering or automatic transmission fluid).	A H	14. Slide pin : Apply lithium grease (99000-25010).
	7. Brake pad		Tightening torque
	8. Bleeder plug		Do not reuse.

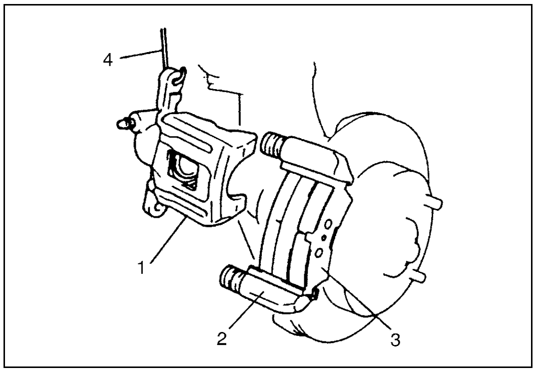
BRAKE PAD

REMOVAL

1) Loosen wheel nuts and with vehicle lifted up, remove wheels.



2) Remove caliper pin bolts (1).



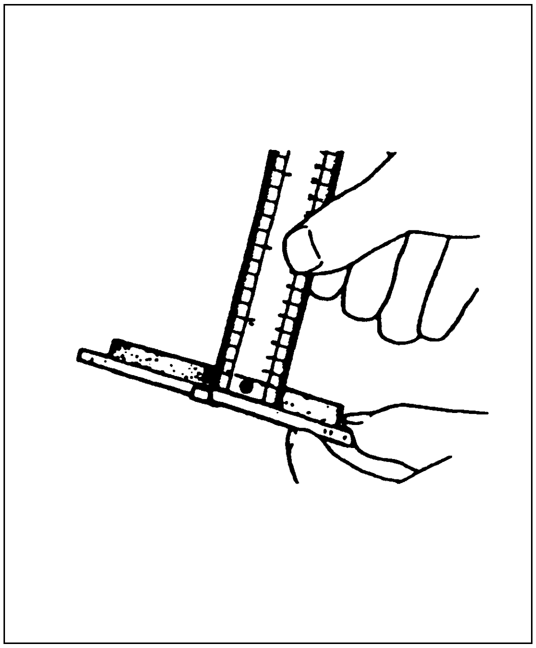
3) Remove caliper (1) from caliper carrier (2).

NOTE:

Hang removed caliper (1) with a wire hook (4) or the like so as to prevent brake hose from bending and twisting excessively or being pulled.
Don't operate brake pedal with brake pads removed.

4) Remove brake pads (3).

INSPECTION



Check pad lining for wear. When wear exceeds limit, replace with new one.

CAUTION:

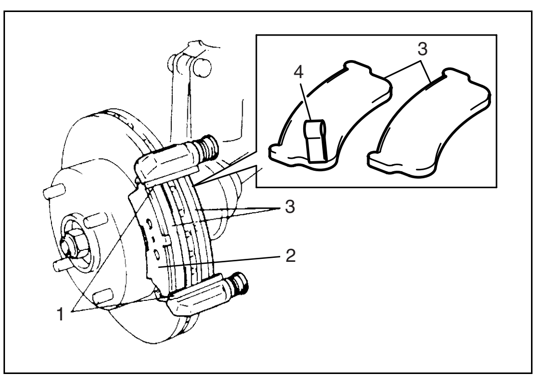
Never polish pad lining with sandpaper. If lining is polished with sandpaper, hard particles of sandpaper will be deposited in lining and may damage disc. When pad lining requires correction, replace it with a new one.

Brake pad thickness (lining thickness)
Standard : 10 mm (0.40 in.)
Limit : 1 mm (0.04 in.)

NOTE:

When pads are removed, visually inspect caliper for brake fluid leak. Correct leaky point, if any.

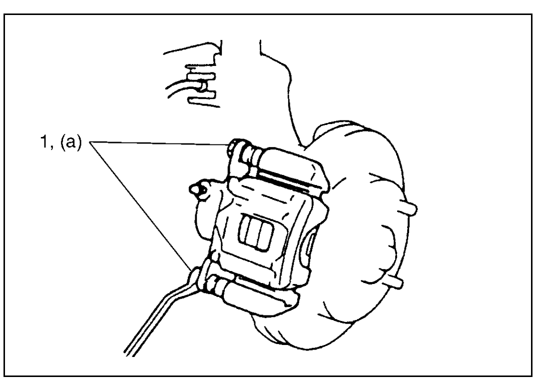
INSTALLATION



1) Set brake pad springs (1) and shim (2) and install brake pads (3).

NOTE:

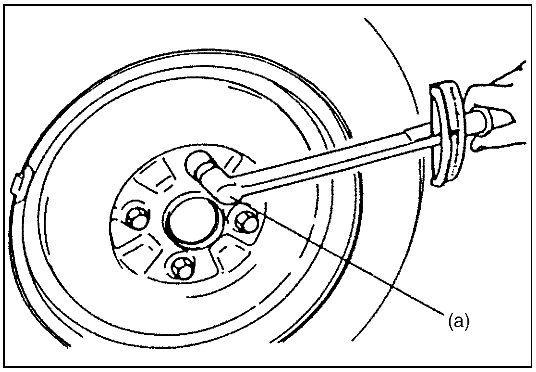
For right side brake, install pad with wear indicator (4) to vehicle center side.



2) Install caliper and tighten caliper pin bolts (1) to specified torque.

Tightening torque
Caliper pin bolts (a) : 26 N·m (2.6 kg-m, 19.0 lb-ft)

3) Tighten wheel temporarily and lower lift.



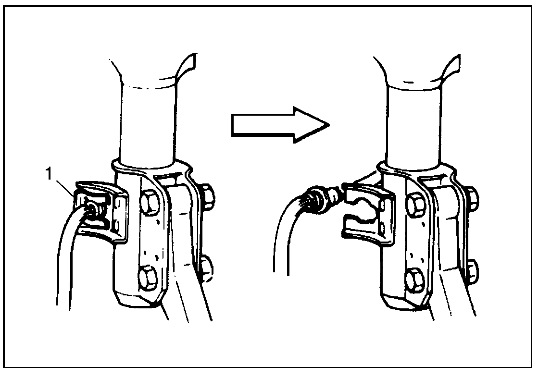
4) Tighten wheel nuts to specified torque.

Tightening torque
Wheel nuts (a) : 85 N·m (8.5 kg-m, 61.5 lb-ft)

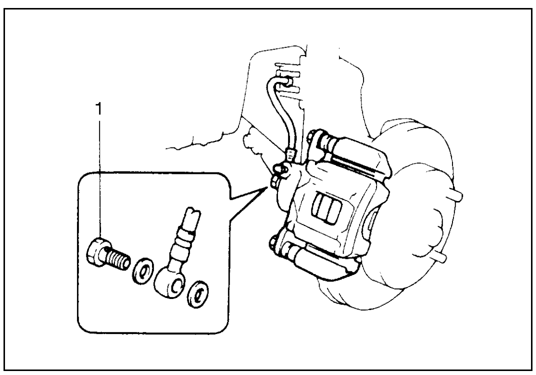
5) After completion of installation, check for brake effectiveness.

CALIPER ASSEMBLY

REMOVAL

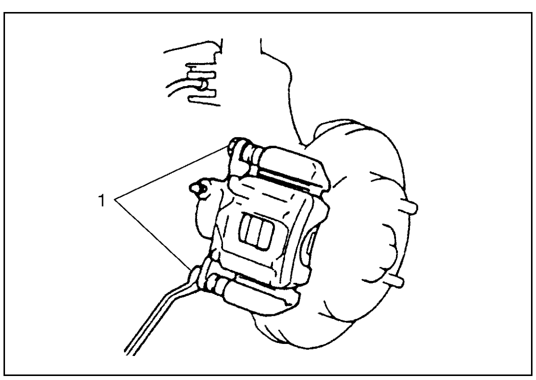


1) Hoist vehicle and remove wheel.
2) Remove E-ring (1).



3) Loosen flexible hose joint bolt (1) a little at caliper.

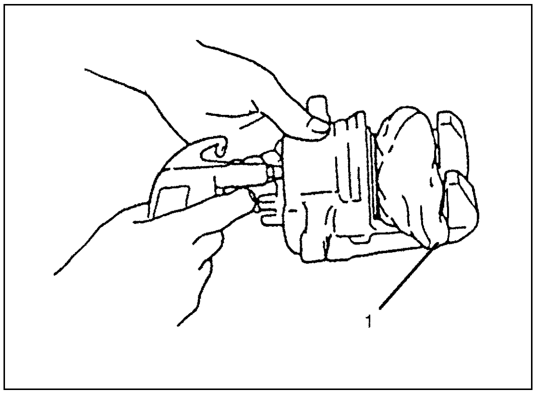
CAUTION:
Be careful not to twist flexible hose while loosening the bolt.



4) Remove caliper pin bolts (1).
5) Remove caliper from caliper carrier.
6) Disconnect flexible hose from caliper using care not to twist it. As this will allow brake fluid to flow out of flexible hose, have a container ready beforehand.

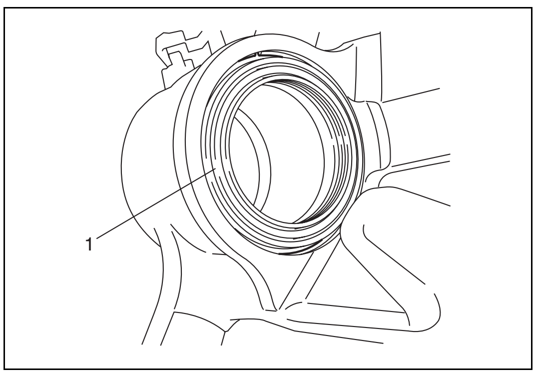
DISASSEMBLY

CAUTION:
Clean around caliper with brake fluid before disassembly.



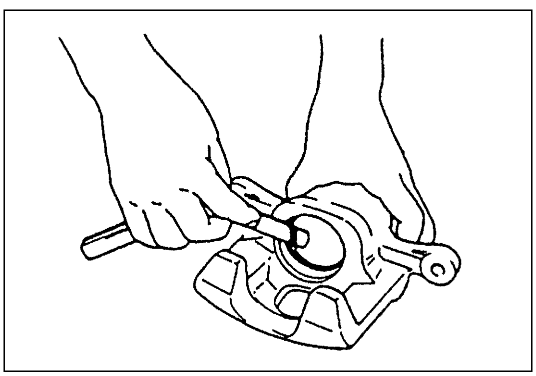
1) Remove piston with air blown into flexible hose bolt installation hole.

WARNING:
Do not apply too highly compressed air which will cause piston to jump out of cylinder. Place a cloth (1) to prevent piston from damage. It should be taken out gradually with moderately compressed air. Do not place your fingers in front of piston when using compressed air.



2) Remove cylinder boot (1).

CAUTION:
Use care not to cause damage to cylinder boot.



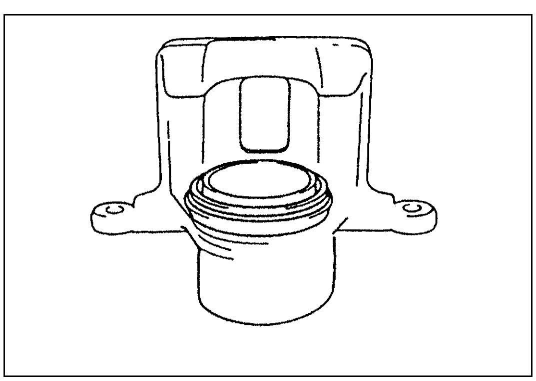
3) Remove piston seal using a thin blade like a thickness gauge, etc.

CAUTION:
Be careful not to damage inside (bore side) of cylinder.

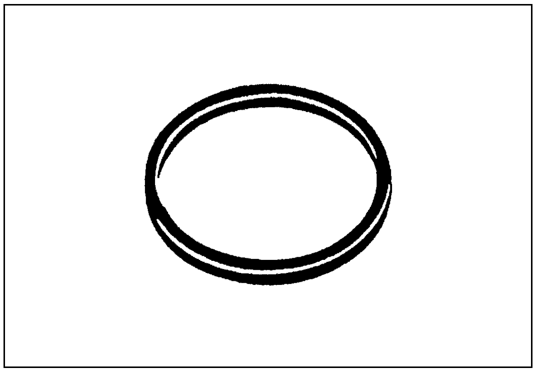
4) Remove bleeder plug and cap from caliper.

INSPECTION

Pin Boot and Cylinder Boot

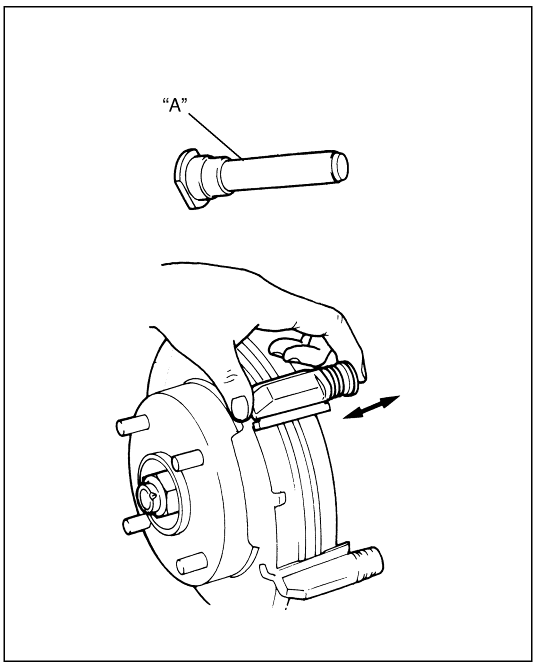


Check boots for breakage, crack and damage.
If defective, replace.



Piston Seal

Excessive or uneven wear of pad lining may indicate unsmooth return of piston.
In such case, replace rubber seal.



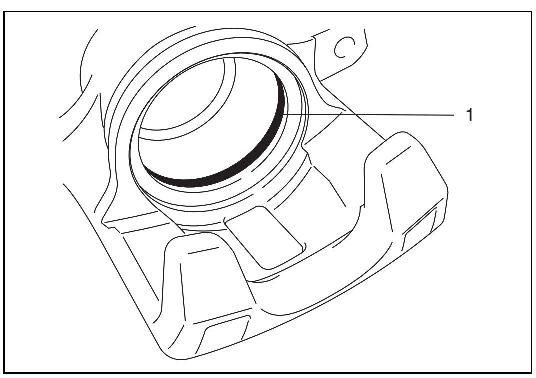
ASSEMBLY

Assemble parts in reverse order of disassembly, observing the following instructions.

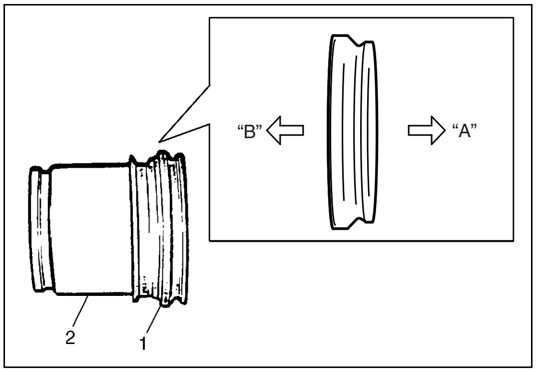
CAUTION:
- **Wash each part cleanly before installation in the same fluid as the one used in master cylinder reservoir.**
- **Never use other fluid or thinner.**
- **Before installing piston and piston seal to cylinder, apply fluid to them.**
- **After reassembling brake lines, bleed air from them.**
- **Install a new piston seal into groove in cylinder securely making sure that it is not twisted.**
- **Before installing caliper to carrier, install slide pin with grease applied into caliper carrier hole and check for its smooth movement in thrust direction.**

"A" : Grease 99000-25010

- Install piston seal to caliper referring to the following instructions.

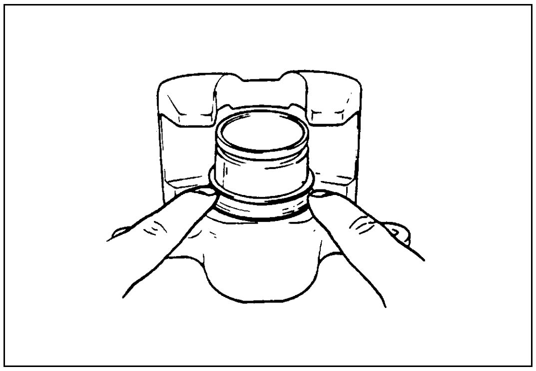


a) Replace with a new one at every overhaul. Fit piston seal (1) into groove in cylinder taking care not to twist it.

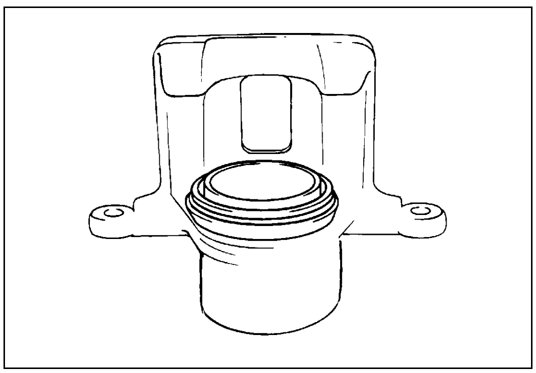


b) Before inserting piston (2) into cylinder, install boot (1) onto piston as shown.

"A" : 1-grooved side directed cylinder side
"B" : 2-grooved side directed pad side



c) Fit boot as it is in figure into boot groove in cylinder with fingers.



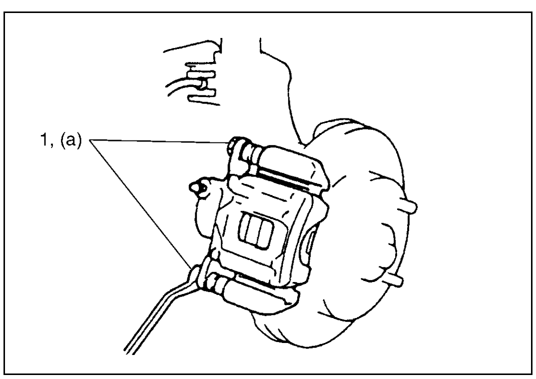
d) Insert piston into cylinder by hand and fit boot in boot groove in piston.

NOTE:

Check that boot is fitted in boot groove securely all around piston.

INSTALLATION

1) Connect caliper to flexible hose.
2) Apply grease to slide pin, then install caliper to caliper carrier.

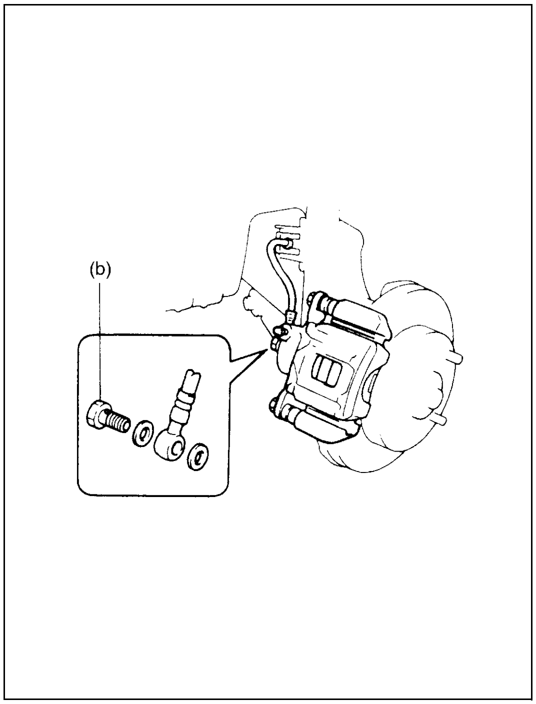


3) Torque caliper pin bolts (1) to specification.

NOTE:

Make sure that boots are fit into groove securely.

Tightening torque
Caliper pin bolts (a) : 26 N·m (2.6 kg-m, 19.0 lb-ft)



4) Torque flexible hose joint bolt to specification.

Tightening torque
Flexible hose joint bolt (b) : 23 N·m (2.3 kg-m, 17.0 lb-ft)

WARNING:
Make sure that flexible hose is not twisted when tightening joint bolt. If it is twisted, reconnect it using care not to twist it.

5) Install E-ring to strut securely.
6) Lower hoist.
7) Torque wheel nuts to specifications.

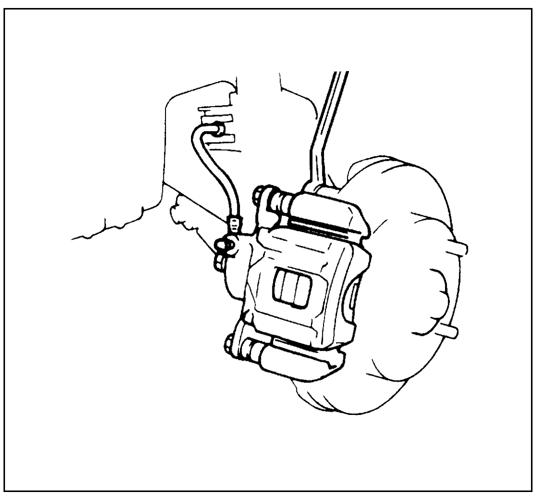
Tightening torque
Wheel nuts : 85 N·m (8.5 kg-m, 61.5 lb-ft)

8) After completing installation, fill reservoir with brake fluid and bleed air from brake system. Perform brake test and check each installed part for oil leakage.

BRAKE DISC

REMOVAL

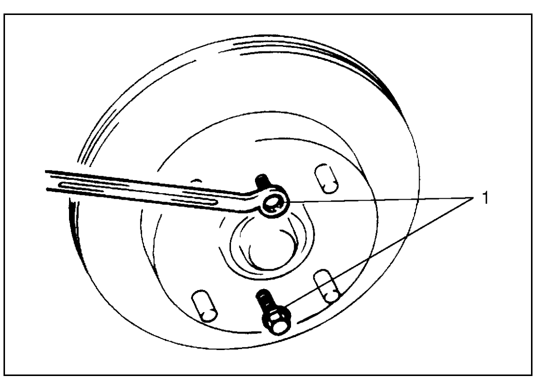
1) Hoist vehicle and remove wheel.



2) Remove caliper assembly by removing caliper carrier bolts (2 pcs)

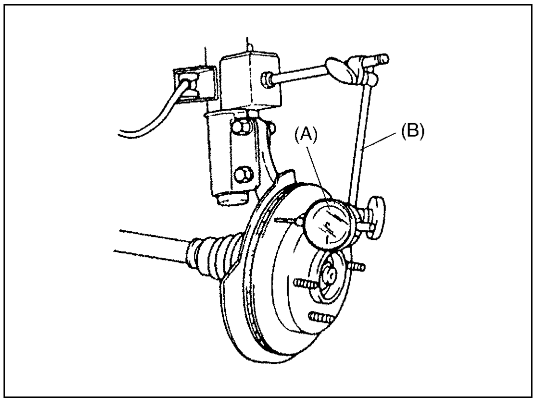
CAUTION:
During removal, be careful not to damage brake flexible hose and not to depress brake pedal.

NOTE:
Hang removed caliper with a wire hook or the like so as to prevent brake hose from bending and twisting excessively or being pulled.
Don’t operate brake pedal with brake pads removed.



3) Pull brake disc off by using 8 mm bolts (1) (2 pcs).

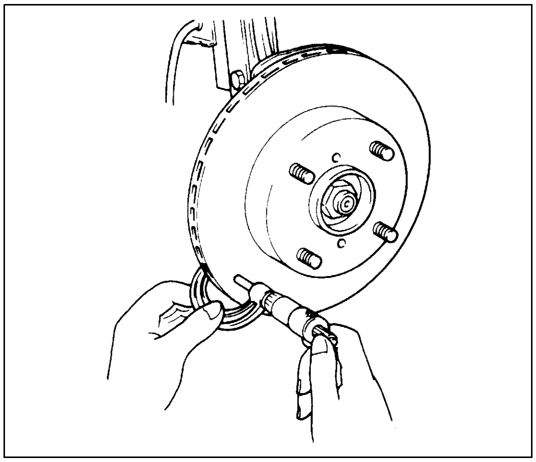
INSPECTION



- Using magnetic stand and with dial gauge positioned at about 10 mm (0.39 in.) inward from periphery of disc, measure deflection of disc.
  If limit value is exceeded, replace correct or replace.

Disc deflection
Limit : 0.10 mm (0.004 in.) max.

Special tool
(A) : 09900-20606
(B) : 09900-20701

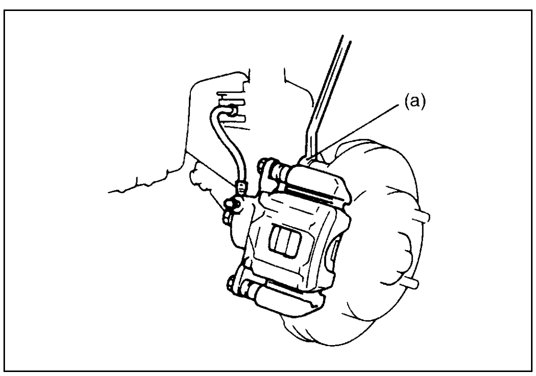


- Using micrometer, measure thickness of brake disc.
  If limit value is exceeded, replace brake disc.

Brake disc thickness
Standard : 17.0 mm (0.67 in.)
Limit : 15.0 mm (0.59 in.)

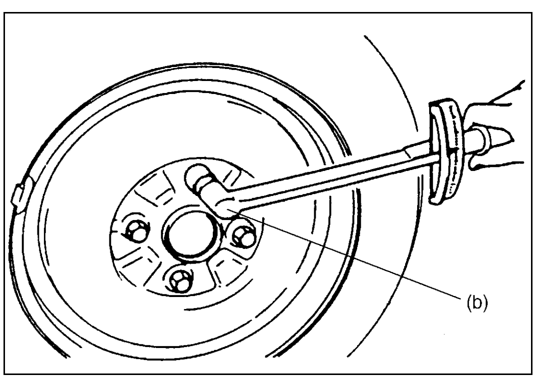
INSTALLATION

1) Install disc to wheel hub.
2) Install caliper assembly to steering knuckle.



3) Torque caliper carrier bolts to specification.

Tightening torque
Caliper carrier bolts (a) : 85 N·m (8.5 kg-m, 61.5 lb-ft)

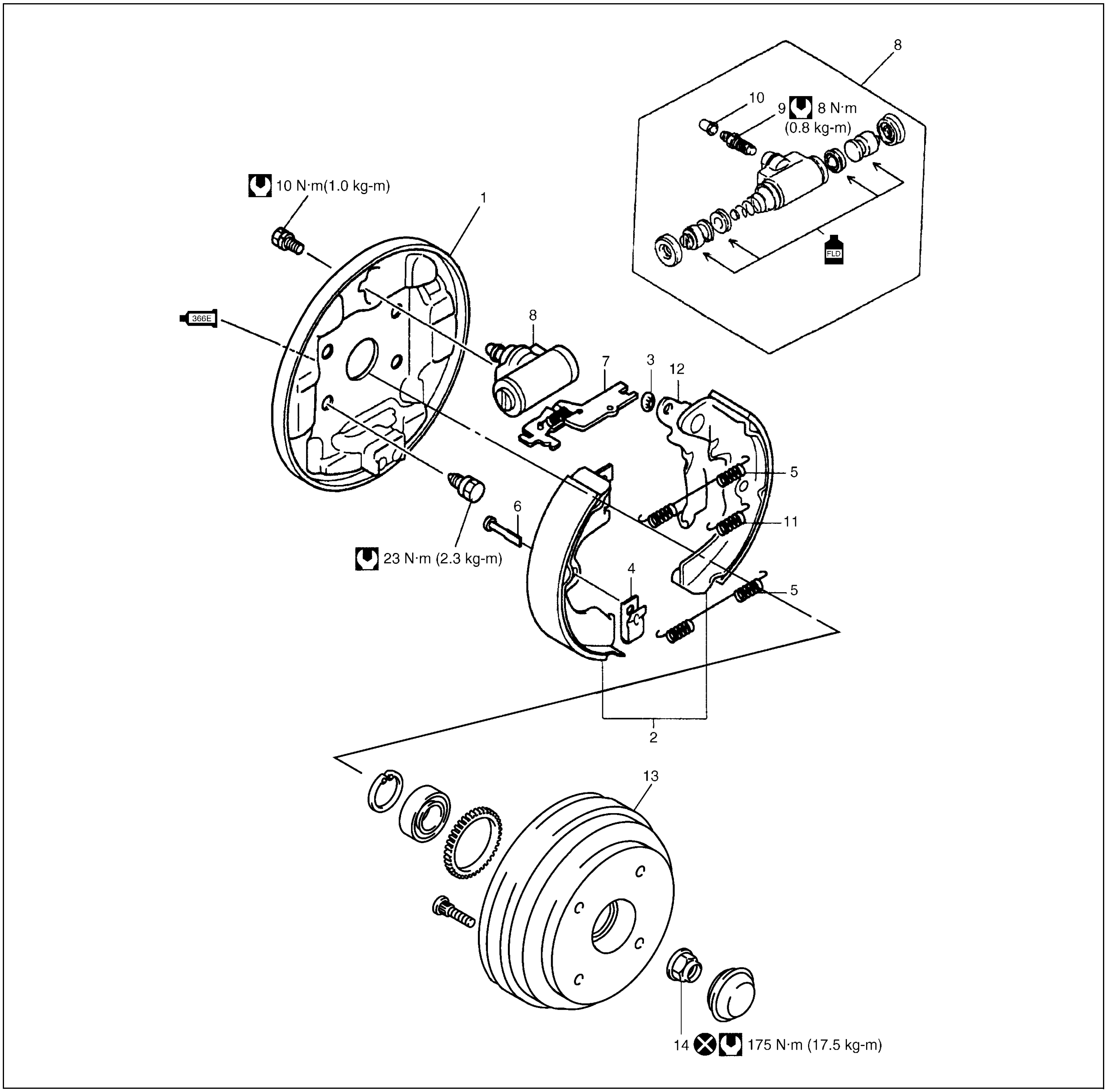


4) Torque front wheel nuts to specification.

Tightening torque
Wheel nuts (b) : 85 N·m (8.5 kg-m, 61.5 lb-ft)

5) Upon completion of installation, perform brake test.

REAR BRAKE

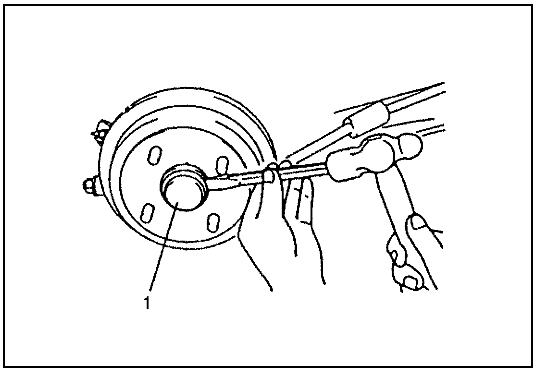


FLD	1. Brake back plate : Apply water tight sealant (99000-31090) to joint seam of brake back plate and rear axle	9.	Bleeder plug
	2. Brake shoe	10.	Bleeder plug cap
	3. Push nut	11.	Parking lever spring
	4. Shoe hold down spring	12.	Parking brake shoe lever
	5. Shoe return upper spring	13.	Brake Drum
	6. Shoe hold down pin	14.	Spindle nut (For 2WD vehicle only) : Calk spindle nut after tightening
	7. Brake strut		Tightening torque
FLD	8. Wheel cylinder : Apply brake fluid to piston cup		Do not reuse.

BRAKE DRUM

REMOVAL

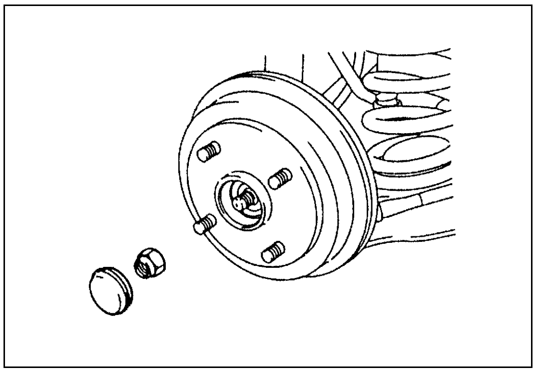
1) With parking brake pulled up, lift vehicle and remove wheels.



2) Remove spindle cap (1). (For 2WD vehicle only)

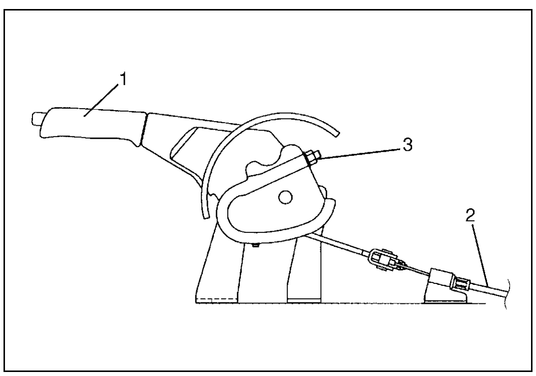
NOTE:

When removing cap with a chisel, tap it lightly at about 3 locations using care not to damage seat face of cap.



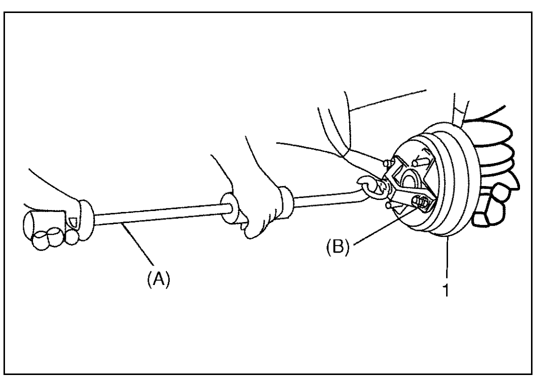
3) Uncaulk spindle nut, remove spindle nut. (For 2WD vehicle only)

4) Release parking brake lever (1).
5) Remove console box.



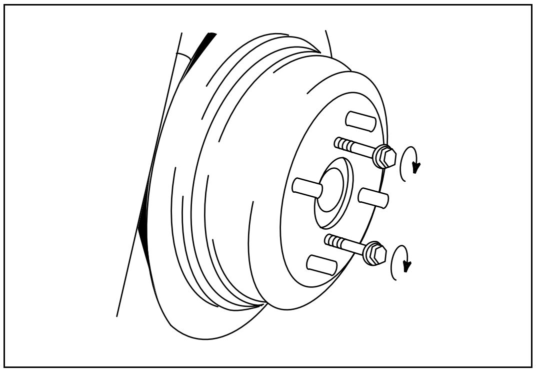
6) Loosen adjusting nut (3) for parking brake cable (2).

7) Remove brake drum.



a) For 2WD vehicle :
Pull brake drum (1) off by using special tools.

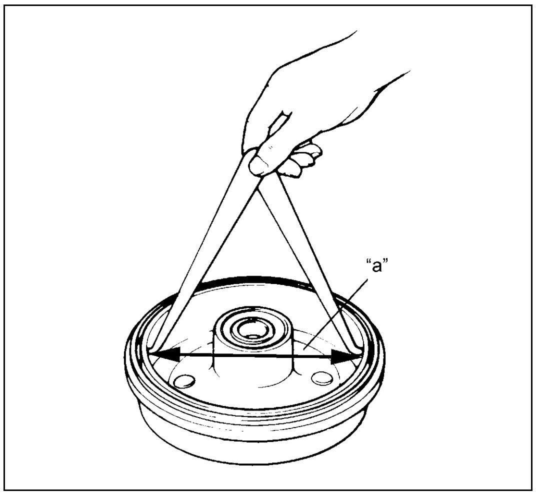
Special tool
(A) : 09942-15510
(B) : 09943-17912



b) For 4WD vehicle :
   Pull brake drum off by using 8 mm bolts.

INSPECTION

Brake Drum

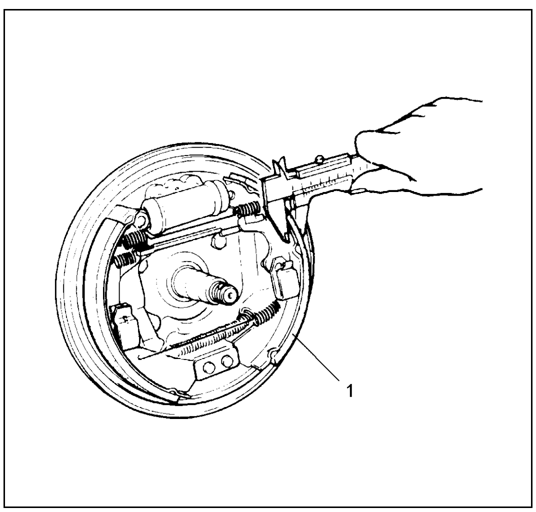


Inspect brake drum for wear.
If limit value of drum inner diameter is exceeded or uneven or stepped wear is excessive, replace drum.

Drum inner diameter “a”
Standard : 180 mm (7.09 in.)
Limit : 182 mm (7.17 in.)

NOTE:
When drum is removed, visually inspect wheel cylinder for brake fluid leakage. Correct leaky point, if any.

Brake Shoe

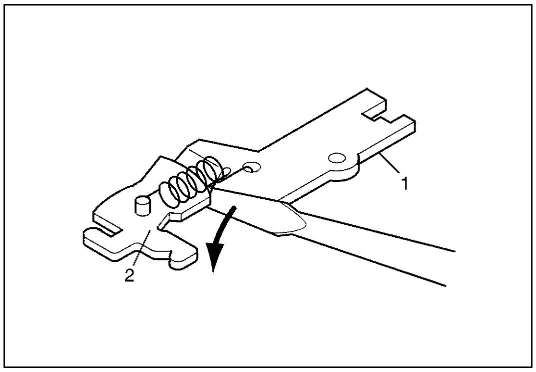


Measure thickness of brake shoe (1) (not including backing metal). Also, check surface of lining for hardening, excessive wear and oil.

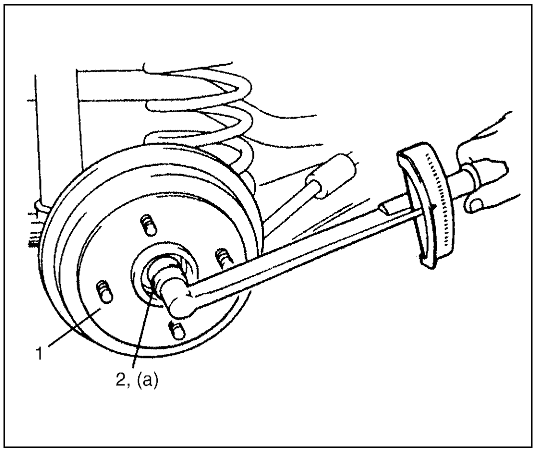
Brake shoe thickness
Standard : 3.9 mm (0.15 in.)
Limit : 1.0 mm (0.04 in.)

CAUTION:
Never polish lining with sandpaper. If lining is polished with sandpaper, hard particles of sandpaper will be deposited in lining and may damage drum. When it is required to correct lining, replace it with a new one.

INSTALLATION



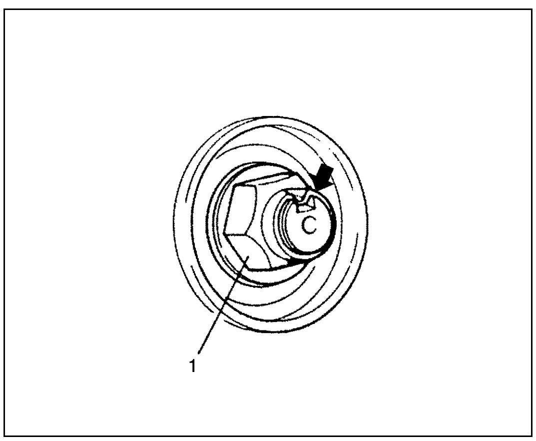
1) Put flat end rod or the like between rod (1) and ratchet (2) and pull ratchet as shown to maximize clearance between shoe and drum.



2) Install brake drum (1) after making sure that inside of brake drum and brake shoes are free from dirt and oil.
3) Install new spindle nut (2). (For 2WD vehicle only)
4) Tighten spindle nut (2) to specified torque. (For 2WD vehicle only)

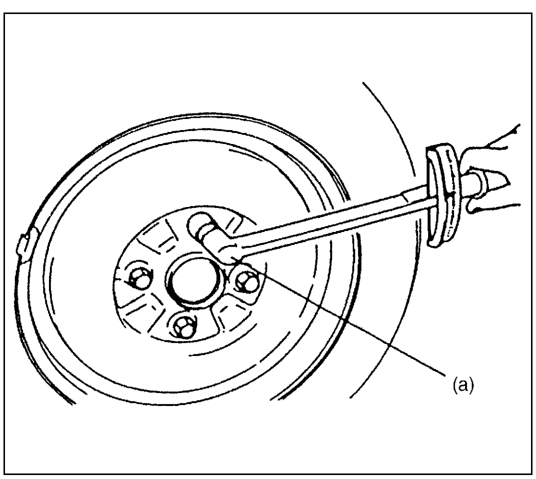
Tightening torque
Spindle nut (a) : 175 N·m (17.5 kg-m, 127.0 lb-ft)

NOTE:
Removed spindle nut should be replaced with new one.



5) Calk spindle nut (1) as shown in figure. (For 2WD vehicle only)
6) Install spindle cap. (For 2WD vehicle only)

NOTE:
- **When installing spindle cap, hammer lightly several locations on the collar of cap until collar comes closely into contact with brake drum.**
- **If fitting part of cap is deformed or damaged or if it is fitted loosely, replace with new one.**



7) Tighten wheel nuts to specified torque.

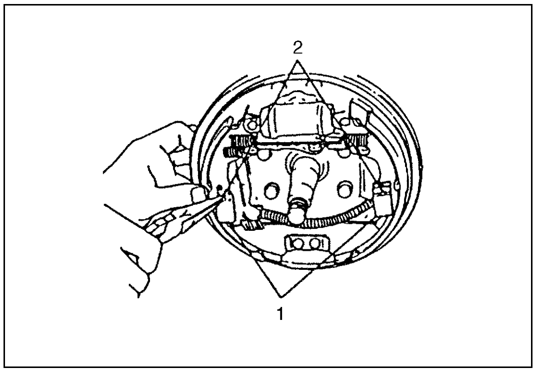
Tightening torque
Wheel nuts (a) : 85 N·m (8.5 kg-m, 61.5 lb-ft)

8) Upon completion of all jobs, depress brake pedal with about 30 kg (66 lbs) load 3 to 5 times so as to obtain proper drum-to-shoe clearance.
9) Adjust parking brake cable. Refer to “PARKING BRAKE INSPECTION AND ADJUSTMENT”.
10) Check to make sure that brake drum is free of dragging and brake works properly. Then remove vehicle from lift and perform brake test.

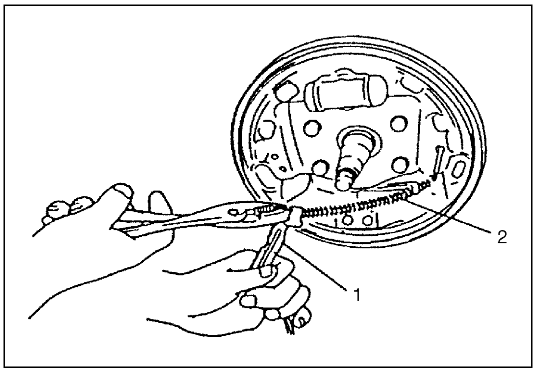
BRAKE SHOE

REMOVAL

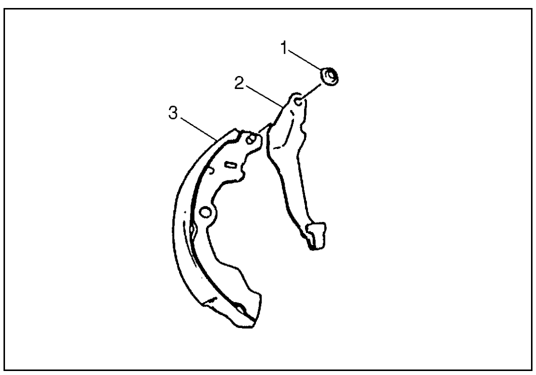
1) Remove brake drum referring to “BRAKE DRUM”.



2) Remove shoe hold down springs (1) by turning shoe hold down pins (2).
3) Remove return springs, brake shoes and strut.

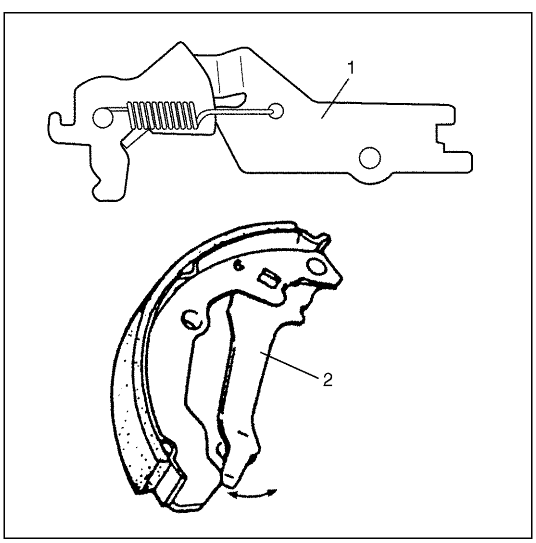


4) Disconnect parking brake shoe lever (1) from parking brake cable (2).



5) Remove push nut (1).
6) Remove parking brake shoe lever (2) from shoe rim (3).

INSPECTION

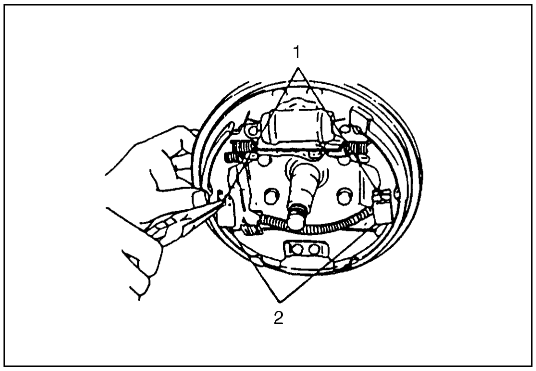


- Check ratchet of brake strut (1) assembly for wear or damage.
- Check shoe return spring, strut shoe return spring and shoe hold down spring for damage, corrosion and weakening.
- Check for smooth movement of brake shoe lever (2) along shoe rim.

CAUTION:
Use a new push nut.

INSTALLATION

Install parts in reverse order of removal, noting the followings.

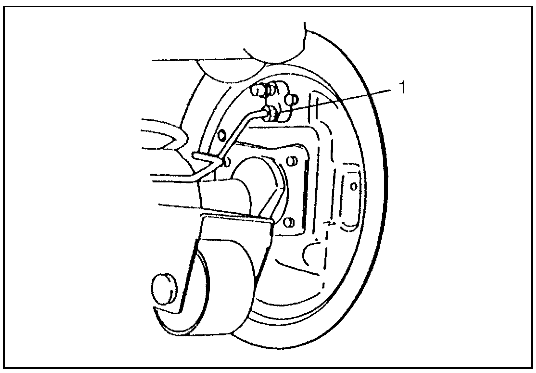


- Install shoe hold down springs (2) by pushing them down in place and turning hold down pins (1).
- For procedure hereafter referring to “BRAKE DRUM”.

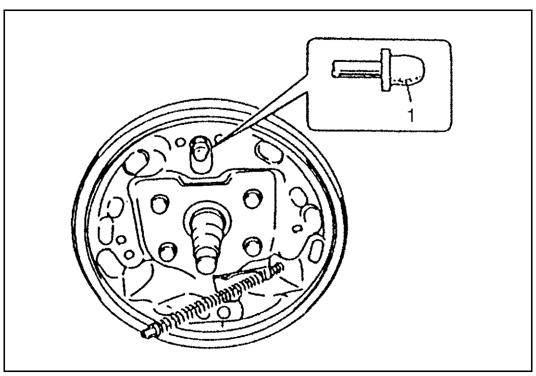
WHEEL CYLINDER

REMOVAL

1) Remove brake drum referring to “BRAKE DRUM”.
2) Remove break shoe referring to “BRAKE SHOE”.

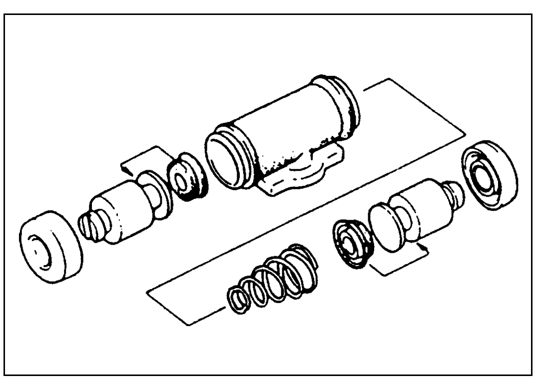


3) Loosen brake pipe flare nut (1) but only within the extent that fluid does not leak.



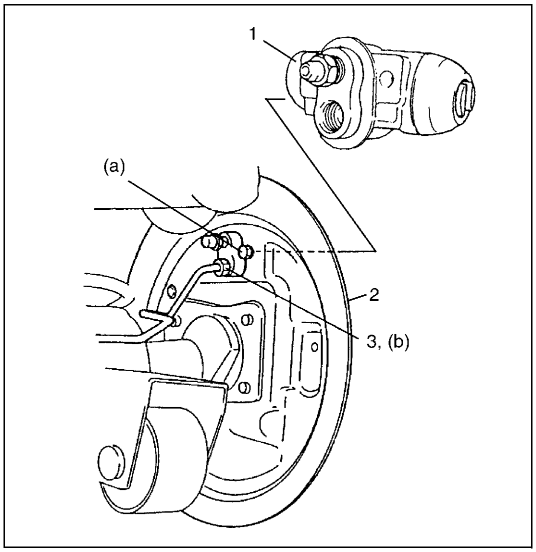
4) Remove wheel cylinder mounting bolts. Disconnect brake pipe from wheel cylinder and put bleeder plug cap (1) onto pipe to prevent fluid from spilling.

INSPECTION



Inspect wheel cylinder disassembled parts for wear, cracks, corrosion or damage.

NOTE:
Clean wheel cylinder components with brake fluid.



INSTALLATION

1) Take off bleeder plug cap from brake pipe and connect pipe to wheel cylinder (1) just enough to prevent fluid from leaking.
2) Install wheel cylinder (1) to brake back plate (2) to specified torque.

Tightening torque
Cylinder mounting bolts (a) : 10 N·m (1.0 kg-m, 7.5 lb-ft)

3) Tighten flare nut (3) of brake pipe to specified torque.

Tightening torque
Rear brake pipe flare nut (b) : 16 N·m (1.6 kg-m, 11.5 lb-ft)

4) Install bleeder plug cap.
5) Install brake shoes. (Refer to “BRAKE SHOE”.)
6) Install brake drum. (Refer to “BRAKE DRUM”.)
7) Fill reservoir with brake fluid and bleed brake system. (For bleeding operation referring to “AIR BLEEDING OF BRAKE SYSTEM”.)
8) Upon completion of all jobs, depress brake pedal with about 30 kg (66 lbs) load 3 to 5 times so as to obtain proper drum-to-shoe clearance.
   Adjust parking brake cable.
9) Install wheel and tighten wheel nuts to specified torque.

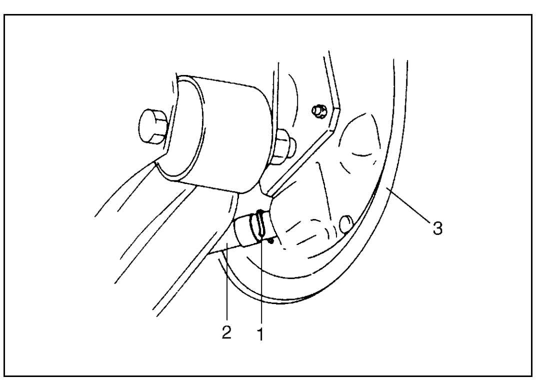
Tightening torque
Wheel nuts : 85 N·m (8.5 kg-m, 61.5 lb-ft)

10) Check to ensure that brake drum is free from dragging and proper braking is obtained. Then remove vehicle from hoist and perform brake test (foot brake and parking brake).
11) Check each installed part for oil leakage.

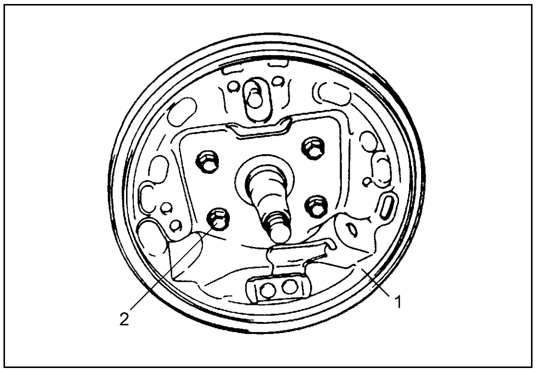
BRAKE BACK PLATE (FOR 2WD VEHICLE)

REMOVAL

1) Remove brake drum referring to “BRAKE DRUM”.
2) Remove brake shoe referring to “BRAKE SHOE”.
3) Remove wheel cylinder referring to “WHEEL CYLINDER”.

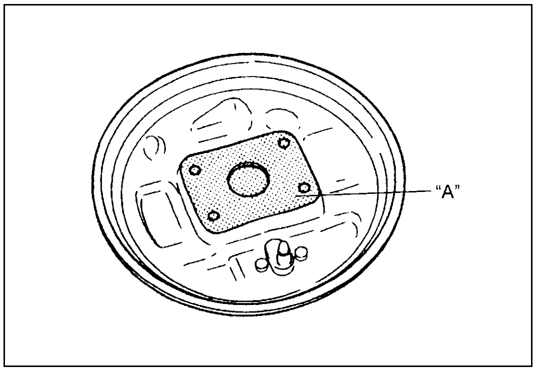


4) Remove parking brake cable securing clip (1) and disconnect brake cable (2) from brake back plate (3).



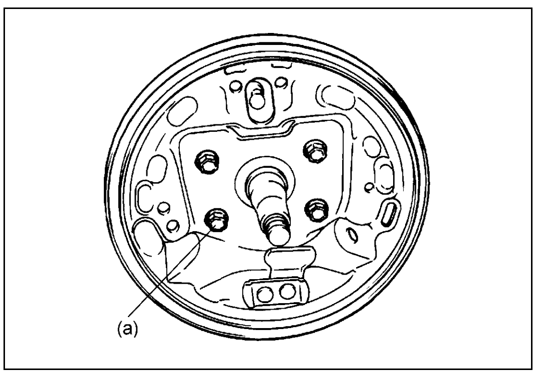
5) Remove brake back plate (1) by removing bolts (2).

INSTALLATION



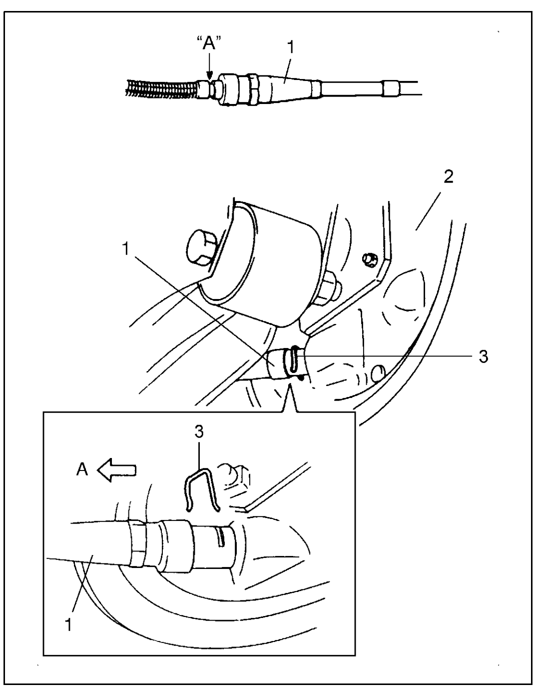
1) Apply water tight sealant to mating surfaces of brake back plate and rear axle.

"A" : Sealant 99000-31090



2) Install brake back plate and tighten back plate bolts to specified torque.

Tightening torque
Brake back plate bolts (a) : 23 N·m (2.3 kg-m, 17.0 lb-ft)



3) Apply water tight sealant where plate and cable contact, and run parking brake cable (1) through brake back plate (2) and secure it with clip (3).

"A" : Sealant 99000-31090

4) Install wheel cylinder, and tighten wheel cylinder bolts and brake pipe flare nut to specified torque. (Refer to "WHEEL CYLINDER".)
5) For procedure hereafter referring to "WHEEL CYLINDER".

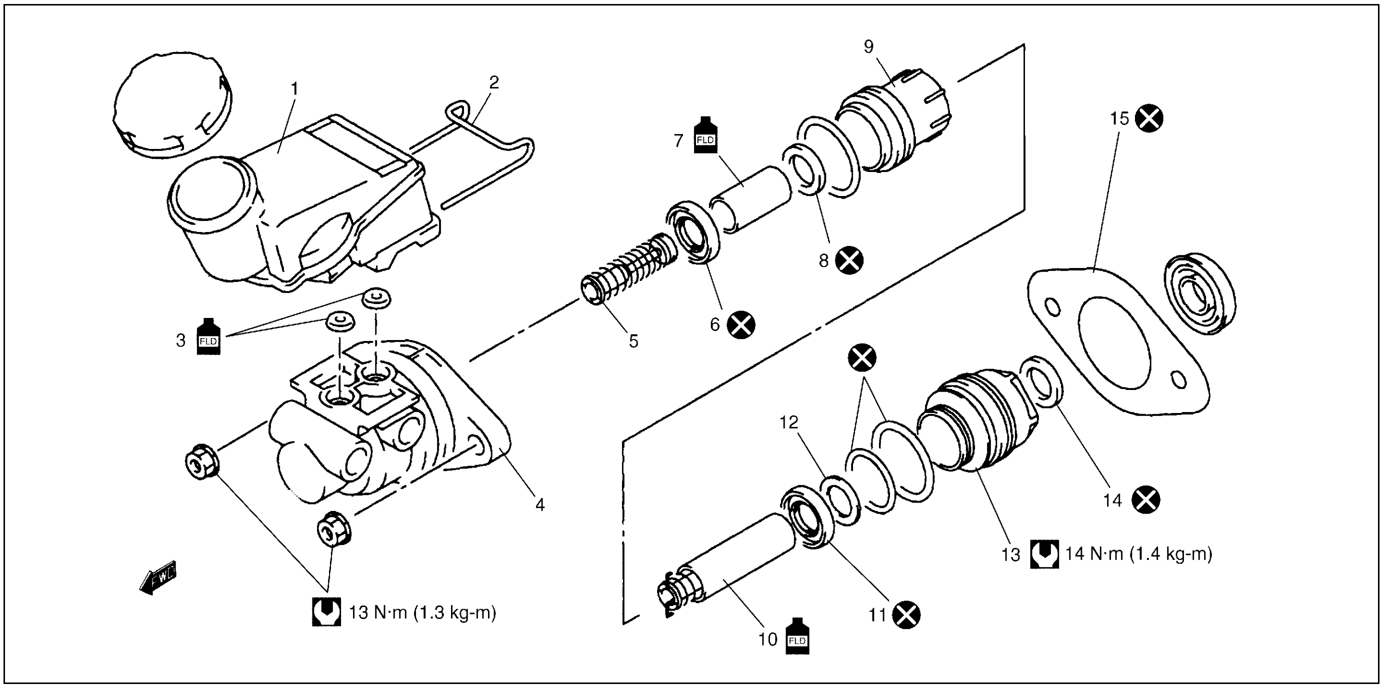
A: Forward

BRAKE BACK PLATE (FOR 4WD VEHICLE)

REMOVAL AND INSTALLATION

Refer to "REAR AXLE SHAFT AND WHEEL BEARING (4WD VEHICLE)" in Section 3E.

MASTER CYLINDER

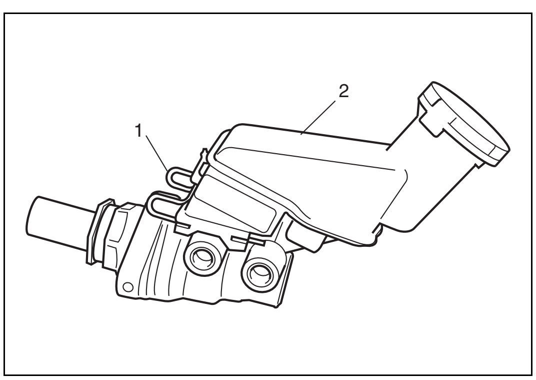


1. Reservoir tank	9. Sleeve	Tightening torque	
2. Retainer	10. Primary piston : Apply brake fluid to contact surface of cup.	Do not reuse.	
3. Grommet : Apply brake fluid.	11. Primary cup : Confirm installing direction.		
4. Master cylinder body	12. Washer		
5. Secondary return spring	13. Cap		
6. Secondary cup : Confirm installing direction Size of cup : 6=11>14>8 .	14. Cap cup : Confirm installing direction.		
7. Secondary piston : Apply brake fluid to contact surface of cup.	15. Master cylinder gasket		
8. Sleeve cup : Confirm installing direction.			

MASTER CYLINDER RESERVOIR

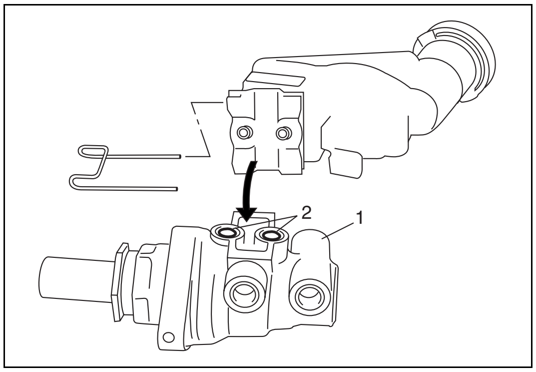
REMOVAL

1) Remove master cylinder.



2) Pull out retainer (1) and remove reservoir (2).

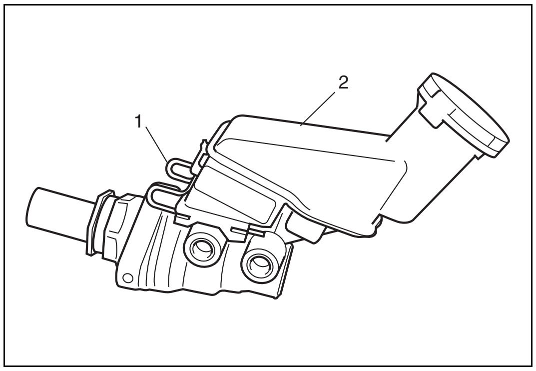
INSTALLATION



1) Apply brake fluid to new grommets and attach grommets (2) to master cylinder (1).

NOTE:

Be sure to use new grommets.

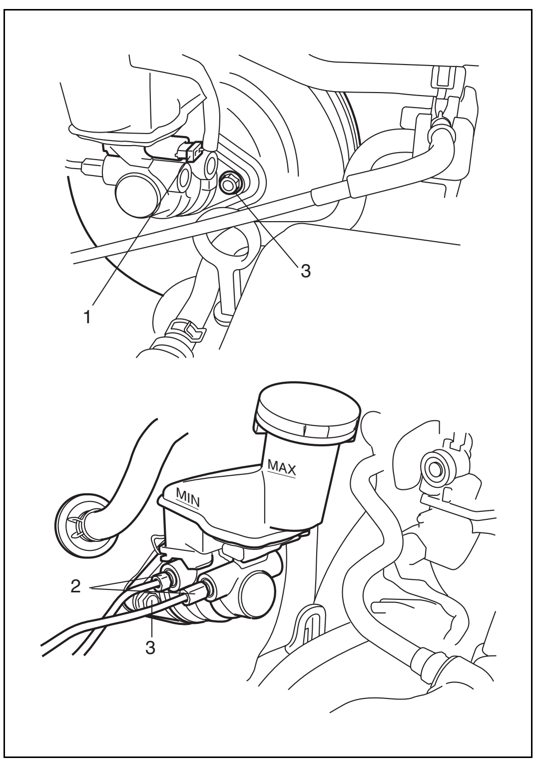


2) Install reservoir (2) to master cylinder and insert retainer (1).
3) Install master cylinder.
4) Fill reservoir with specified brake fluid up to MAX mark on it.
5) After installation, purge air and check for brake fluid leakage.

MASTER CYLINDER ASSEMBLY

REMOVAL

1) Clean outside of master cylinder.
2) Drain brake fluid in reservoir.

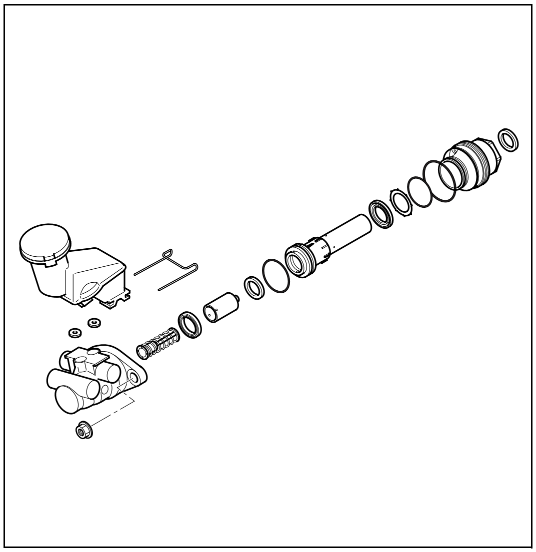


3) Disconnect fluid level switch coupler (1) on reservoir.
4) Disconnect brake pipes (2) connected to master cylinder.

CAUTION:

Do not allow brake fluid to get on painted surface. Painted surface will be damaged by brake fluid, flush it with water immediately if any fluid is spilled.

5) Remove master cylinder fixing nuts (3).
6) Remove master cylinder and master cylinder gasket.



INSPECTION

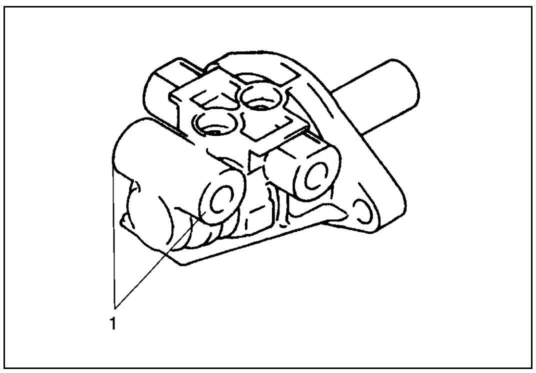
1) Check all disassembled parts for wear and damage.
   If anything faulty is found, replace.

> **CAUTION:**
> - **Wash disassembled parts with brake fluid.**
> - **Do not reuse piston cups.**

2) Check screw hole in master cylinder for gall or corrosion.
   If anything faulty is found, replace.

> **CAUTION:**
> **Wash master cylinder with new brake fluid. Do not use cloth to dry cylinder so as to avoid fibers being attached to internal surface of cylinder.**

DISASSEMBLY



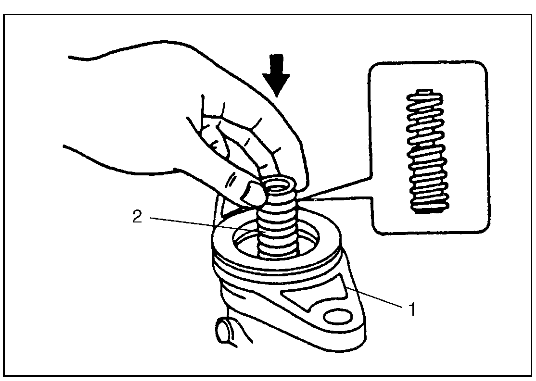
1) Loosen cap and remove it.

NOTE:
For this work, apply a cloth to outlet port at the tip end (1) of master cylinder body and secure cylinder using soft jawed vise.

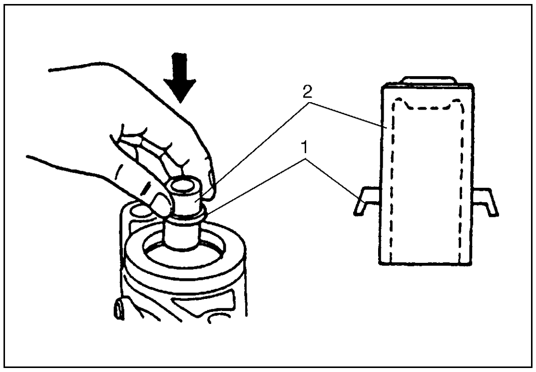
2) Remove component parts from master cylinder body.

ASSEMBLY

> **CAUTION:**
> - **Never use any mineral oil such as kerosene oil and gasoline when washing and assembling parts.**
> - **Check inside of cylinder wall, pistons and cup seals are free from any foreign objects such as dust and dirt and use case not to cause any damage with a tool during assembly.**
> - **Do not drop parts. Do not use any part which has been dropped.**



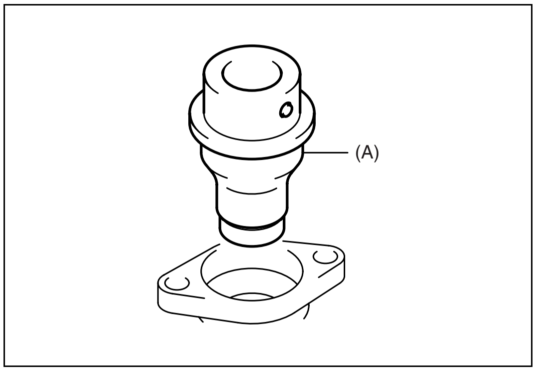
1) Apply brake fluid to inside of cylinder and contact surface of piston assembly.
   Install secondary return spring (2) to cylinder body (1) with noting spring direction.



2) Attach secondary cup (1) to secondary piston (2), they install it to cylinder body such a direction as shown.

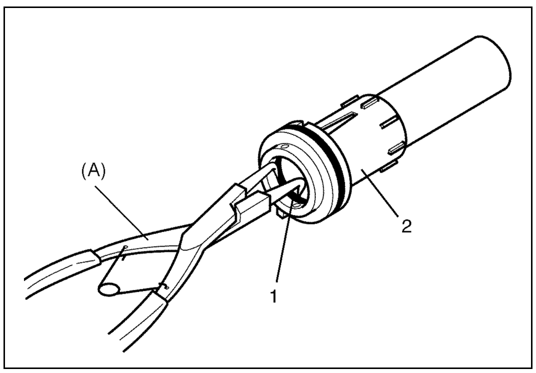
NOTE:

- **Secondary cup is the same as primary cup.**
- **Diameter of secondary cup is the largest compared with sleeve cup and cap cup.**



3) Push secondary cup to the bottom by using special tool.

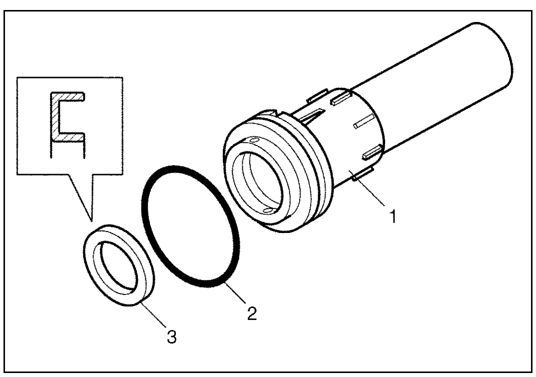
Special tool
(A) : 09951-18220



4) Remove O-ring (1) from sleeve (2).

Special tool
(A) : 09900-06106

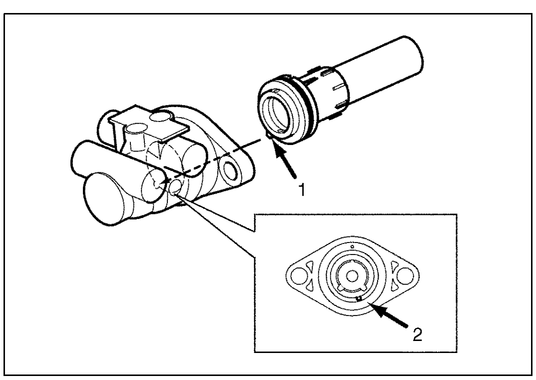
CAUTION:
Do not cause any damage to inside of sleeve.
If caused, replace primary piston assembly.



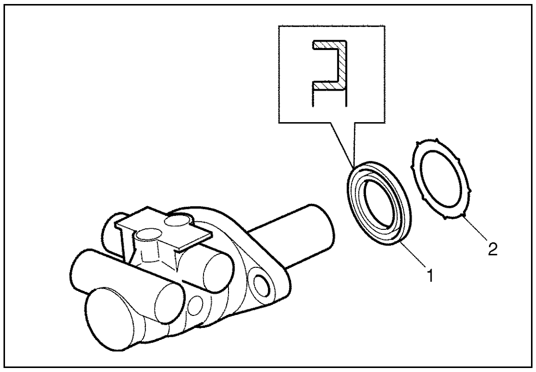
5) Install sleeve cup (3) and O-ring (2) to sleeve (1) such a direction as shown.

NOTE:

- **Diameter of sleeve cup and O-ring are smaller than those of cap.**
- **O-ring is the same as that of smaller one of cap O-ring.**



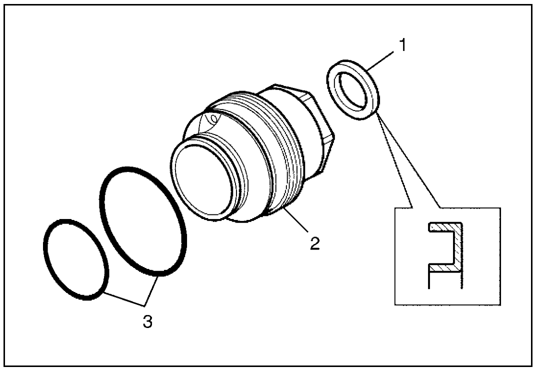
6) Install sleeve assembly with aligning protrusion (1) of sleeve and dent (2) of cylinder body.



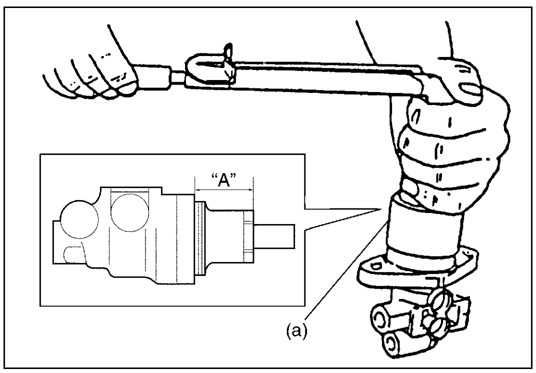
7) Install cup (1) and washer (2) such a direction as shown.

NOTE:

- **Primary cup is the same as secondary cup.**
- **Primary cup is the largest compared with that of cap and sleeve.**



8) Remove cap cup (1) from cap with caring not to cause any damage to inside of cap (2).
9) Install cap cup and O-rings (3) to cap such a direction as shown.

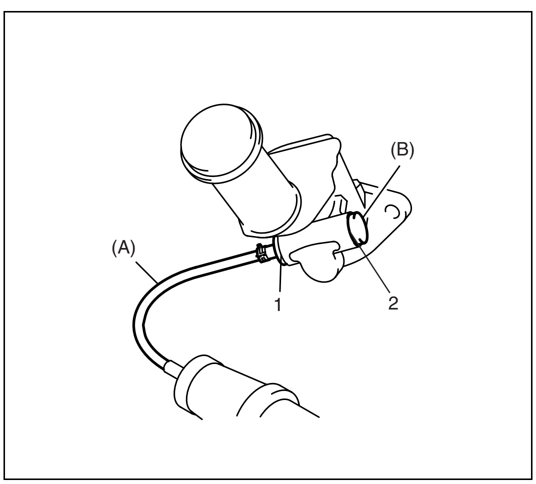


10) Install cap and tighten it to specified torque, then confirm the length "A".

Tightening torque
Cap (a) : 14 N·m (1.4 kg-m, 10.5 lb-ft)

Cap installation position
"A" : Less than 26 mm (1.02 in.)

INSPECTION AFTER ASSEMBLY

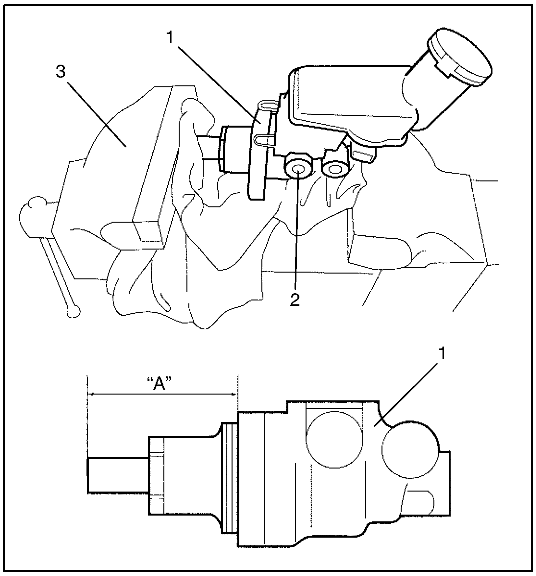


1) Install radiator cap test with special tool to master cylinder port (1).

NOTE:
For without ABS vehicle, install special tool (B) to opposite side port (2).

Special tool
(A) : 09952-46010
(B) : 09952-26020

2) Apply air and confirm that pressure is not applied.



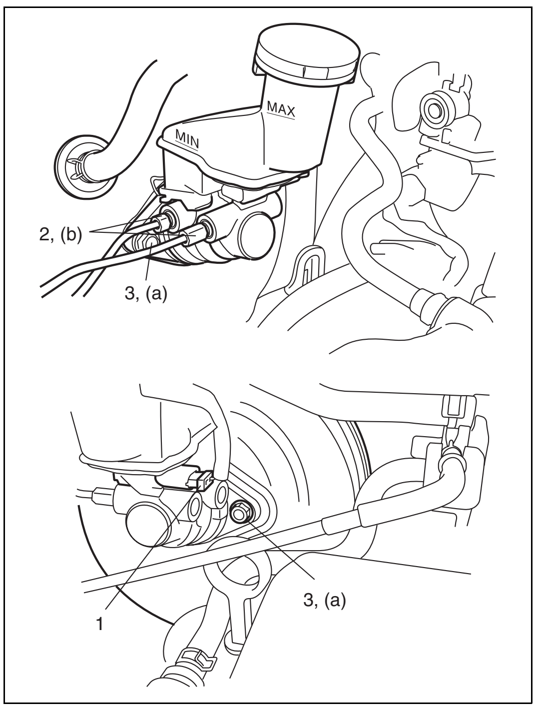
3) Set master cylinder (1) on vise (3) and adjust "A" to be the following.

Cap adjustment position
"A" : 50 mm (1.97 in.)

4) Apply air with radiator cap tester, and confirm that 50 kPa pressure is applied.
5) Perform same steps 1)-4) for port (2).

INSTALLATION

1) Install new master cylinder gasket to booster.



2) Install master cylinder to booster and tighten master cylinder fixing nuts (3) to specified torque.

Tightening torque
Master cylinder fixing nuts (a) : 13 N·m (1.3 kg-m, 9.5 lb-ft)

3) Connect brake pipe to master cylinder and tighten flare nut (2) to specified torque.

Tightening torque
Brake pipe flare nuts (b) : 16 N·m (1.6 kg-m, 11.5 lb-ft)

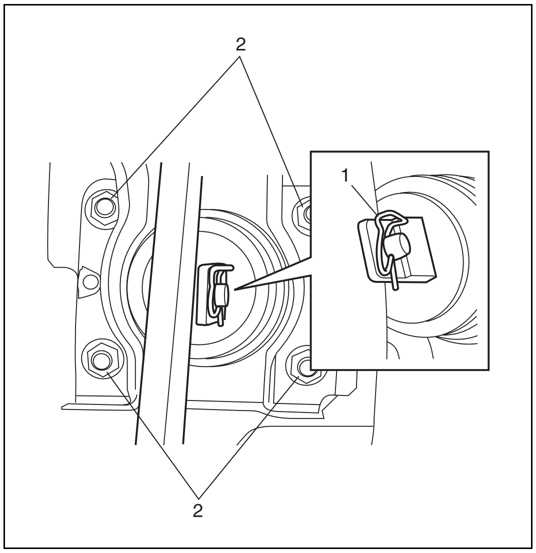
4) Connect fluid level switch connector (1) of reservoir.
5) Fill reservoir with specified brake fluid up to its MAX mark.
6) After completing above work, bleed air and check brake pedal for play.

BRAKE BOOSTER

CAUTION:
Never disassemble brake booster. Disassembly will spoil its original function. If faulty condition is found, replace it with new one.

REMOVAL

1) Remove master cylinder assembly from booster. Refer to "MASTER CYLINDER".
2) Disconnect vacuum hose from booster.

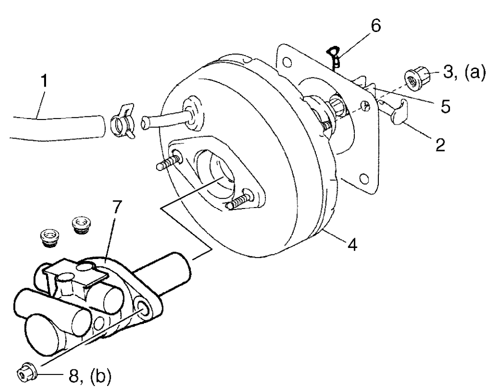


3) Remove push rod clevis pin (1).
4) Remove wiper motor. (For right-hand steering vehicle only)
5) Remove booster mounting nuts (2) and then booster.

INSTALLATION

NOTE:

- **Adjust clearance between booster piston rod and master cylinder piston. (Refer to "INSPECTION AND ADJUSTEMENT" of "BRAKE BOOSTER".)**
- **Check length of push rod clevis.**



1) Install booster (4) to dash panel. Then connect push rod clevis (5) to pedal arm with clevis pin (2) and clip (6).
2) Tighten booster mounting nuts (3) to specified torque.

Tightening torque
Booster mounting nuts (a) : 13 N·m (1.3 kg-m, 9.5 lb-ft)

3) Install new master cylinder gasket to booster.
4) Install master cylinder (7) to booster and tighten mounting nuts (8) to specified torque.

Tightening torque
Master cylinder mounting nuts (b) :
13 N·m (1.3 kg-m, 9.5 lb-ft)

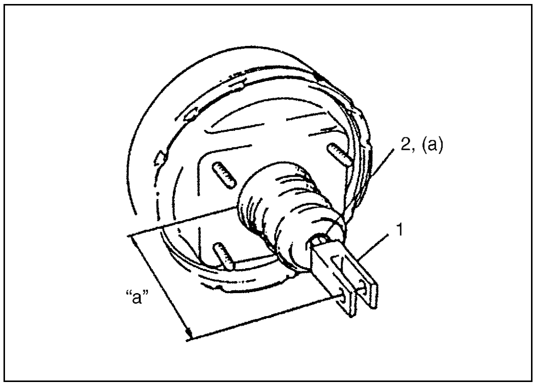
5) Connect brake pipes and tighten flare nuts to specified torque.

Tightening torque
Brake pipe flare nuts : 16 N·m (1.6 kg-m, 11.5 lb-ft)

6) Connect reservoir lead wire connector and booster vacuum hose (1).
7) Fill reservoir with specified fluid.
8) Bleed air from brake system.
9) Perform brake test and check each installed part for fluid leakage.

INSPECTION AND ADJUSTMENT

Installation Position Of Push Rod

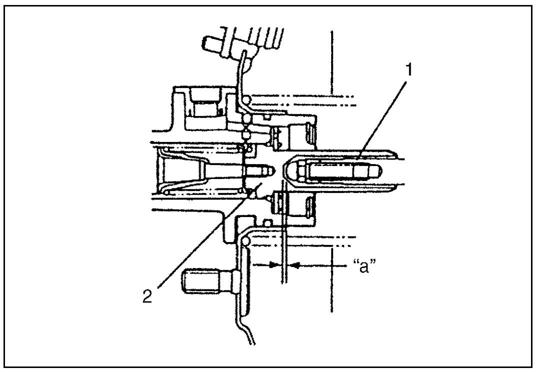


If push rod clevis (1) has been removed, adjust distance between booster installation surface (without including packing) and the center of clevis pin hole to standard value "a" and tighten nut (2) to specified torque.

Distance "a" between center of booster clevis pin hole and booster surface
Standard : 97 - 98 mm (3.82 - 3.86 in.)

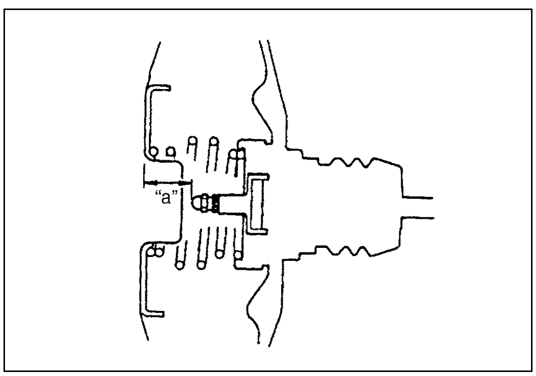
Tightening torque
Clevis pin lock nut (a) : 19 N·m (1.9 kg-m, 14.0 lb-ft)

Clearance Between Booster Piston Rod And Master Cylinder Piston



The length of booster piston rod (1) is adjusted to provide specified clearance "a" between piston rod (1) end and master cylinder piston (2).

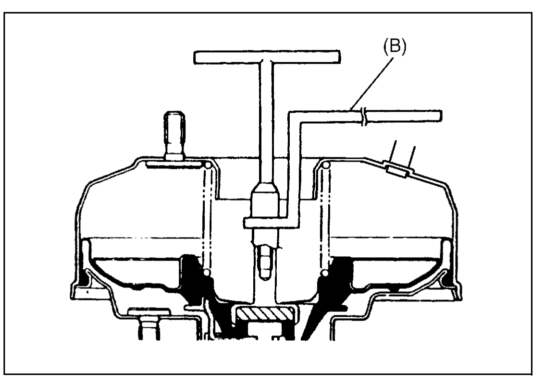
- Before measuring clearance, push piston rod several times so as to make sure reaction disc is in place.
- Keep inside of booster at atmospheric pressure for measurement.



Measure length "a" of piston rod, i.e. distance between piston rod and mating surface of booster-to-master cylinder.

Length "a" of piston rod
: 30.3 - 30.5 mm (1.193 - 1.200 in.)

NOTE:
Remove gasket from booster, if equipped.



If measurement is out of specification, adjust piston rod by turning adjusting screw of piston rod.

Special tool
(B) : 09952-16020

BRAKE HOSE/PIPE

FRONT BRAKE HOSE/PIPE

REMOVAL

1) Raise and support vehicle properly. Remove tire and wheel.

NOTE:
This operation is not necessary when removing pipes connecting master cylinder.

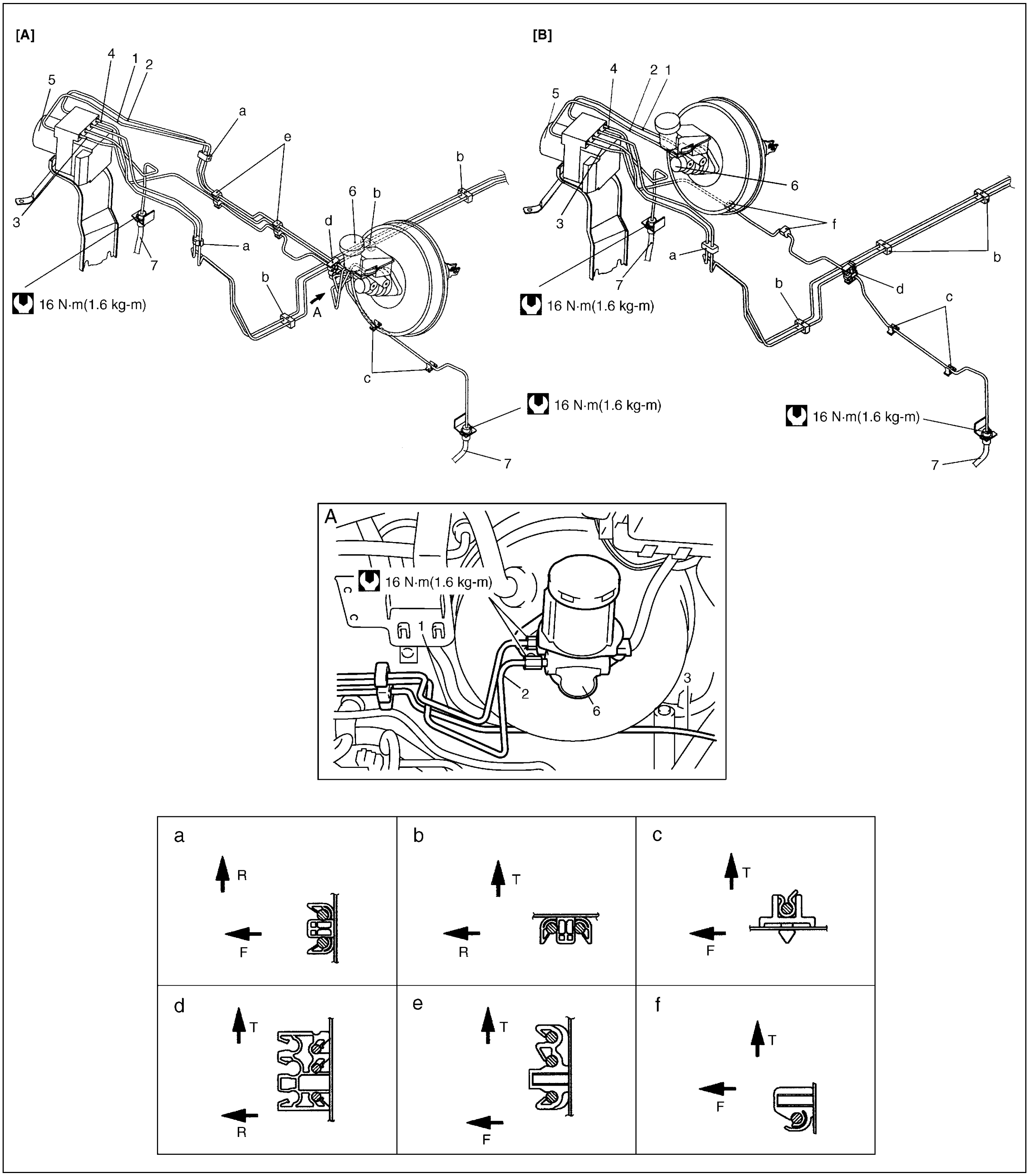
2) Clean dirt and foreign material from both flexible hose end and pipe end fittings.
3) Remove brake flexible hose or pipe.

INSTALLATION

Reverse brake flexible hose installation procedure, noting the followings.

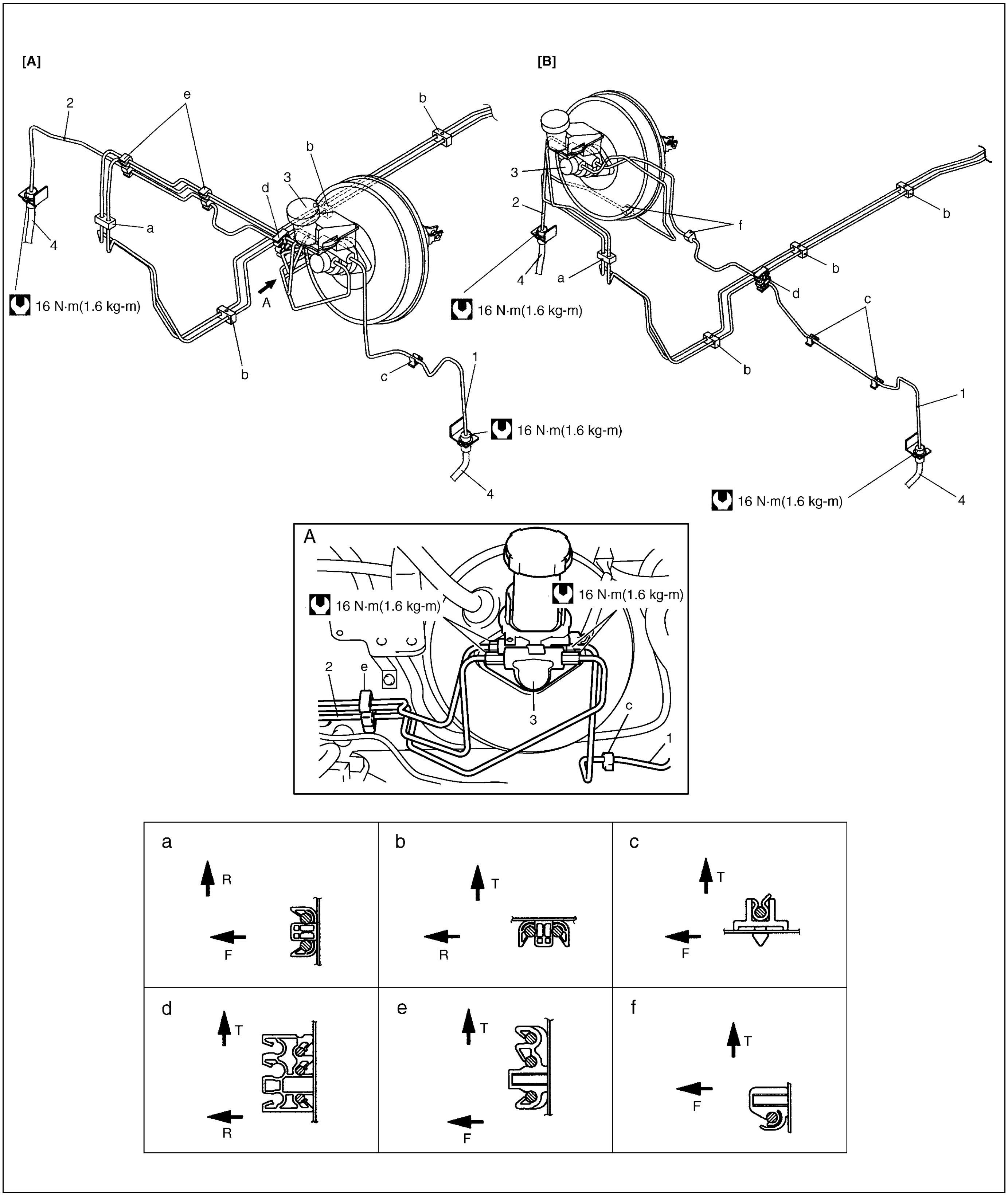
- Make sure that steering wheel is in straight-forward position and flexible hose has not twist or kink.
- Check to make sure that flexible hose doesn’t contact any part of suspension, both in extreme right and extreme left turn conditions. If it does at any point, remove and correct. Fill and maintain brake fluid level in reservoir.
- Bleed brake system. Refer to “AIR BLEEDING OF BRAKE SYSTEM”.
- Perform brake test and check installed part for fluid leakage.

For vehicle with ABS



T :	Top side	[A] :	For left-hand steering vehicle	4.	From ABS hydraulic unit to right front brake
F :	Front side	[B] :	For right-hand steering vehicle	5.	ABS hydraulic unit
R :	Right side	1.	From master cylinder primary to ABS hydraulic unit	6.	Master cylinder
A :	View A	2.	From master cylinder secondary to ABS hydraulic unit	7.	Front brake hose
a-f:	Clamp	3.	From ABS hydraulic unit to left front brake	(torque symbol)	Tightening torque

For vehicle without ABS



T : Top side	1. From master cylinder primary to left front brake	[A] : For left-hand steering vehicle
F : Front side	2. From master cylinder secondary to right front brake	[B] : For right-hand steering vehicle
R : Right side	3. Master cylinder	a-g: Clamp
A : View A	4. Front brake hose	Tightening torque

REAR BRAKE HOSE/PIPE

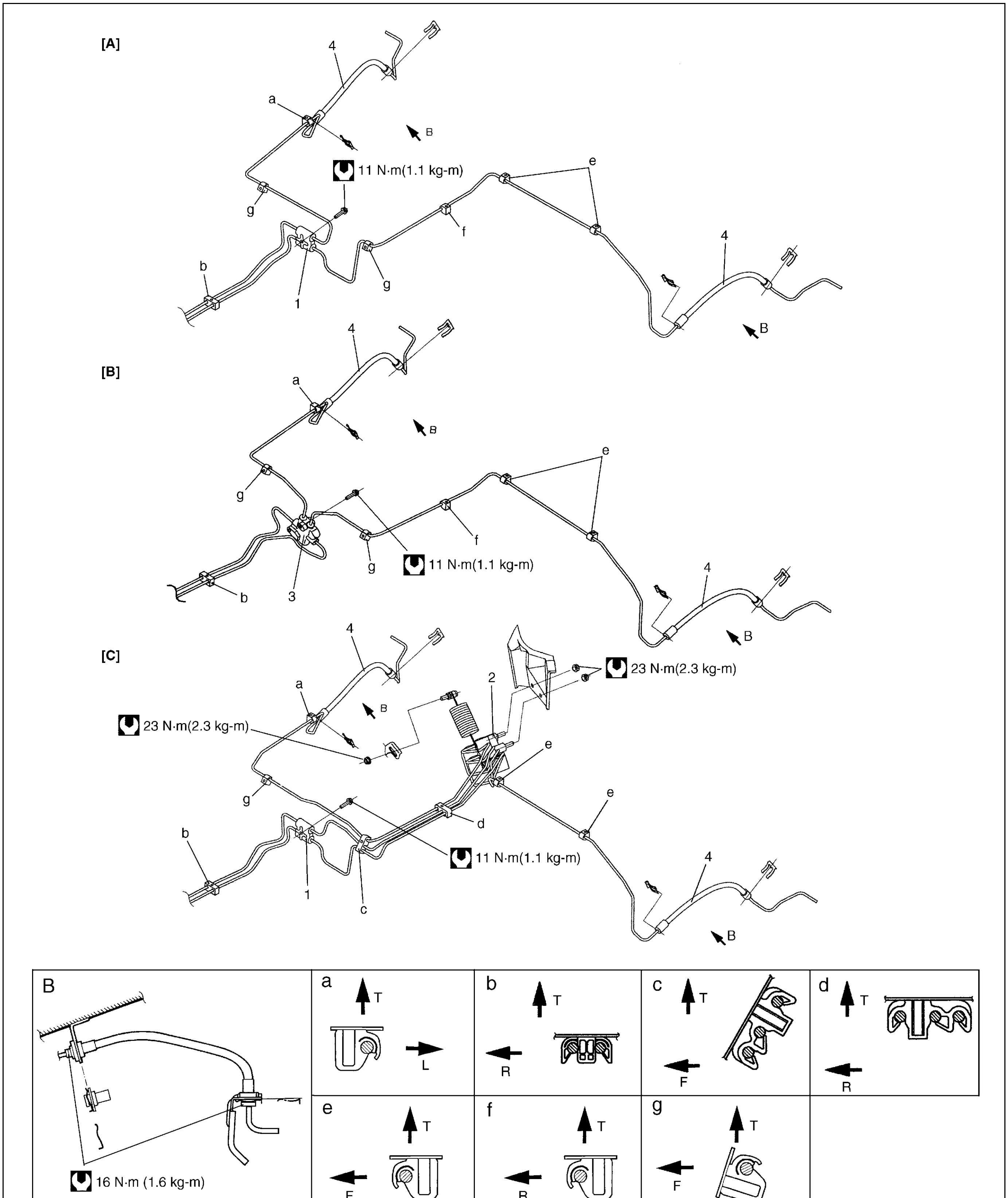
REMOVAL

1) Raise and support vehicle properly. Remove tire and wheel.
2) Clean dirt and foreign material from both flexible hose end and pipe end fittings.
3) Remove brake flexible hose or pipe.

INSTALLATION

Reverse brake flexible hose installation procedure, nothing the followings.

- Fill and maintain brake fluid level in reservoir.
- Bleed brake system. Refer to “AIR BLEEDING OF BRAKE SYSTEM”.
- Perform brake test and check each installed part for fluid leakage.
- Never reuse protector nut once removed. Be sure to use a new one.
- Install clamps properly referring to figure below and tighten bolts.
- When installing hose, make sure that it has no twist or kink.



T : Top side	1. 4 way joint	[A] : with ABS
F : Front side	2. LSPV assembly	[B] : without ABS
R : Right side	3. P valve	[C] : with LSPV
L : Left side	4. Rear brake hose	Tightening torque
B : View B	a-g: Clamp	

PARKING BRAKE CABLE

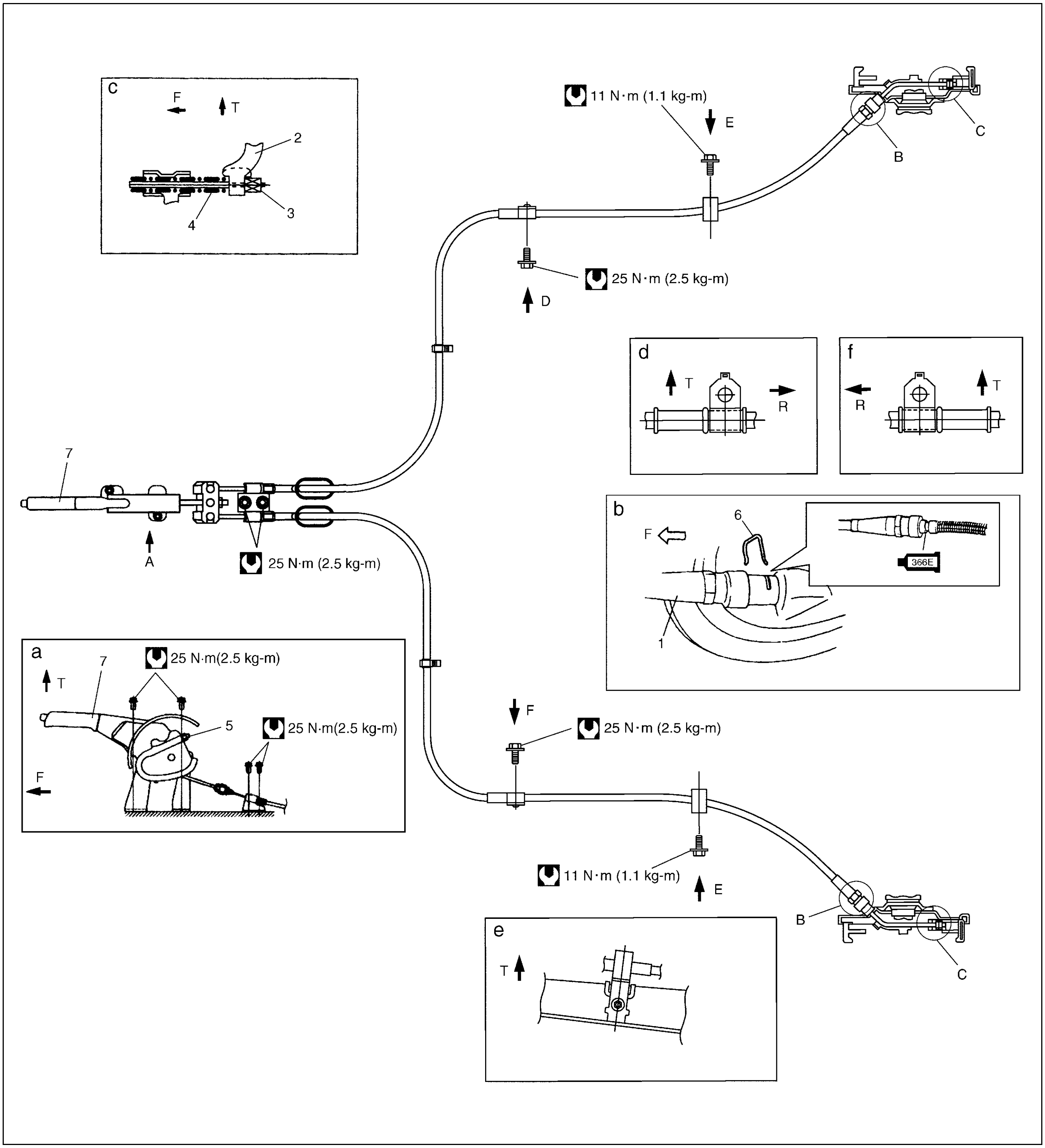
REMOVAL

1) Raise, suitably support vehicle and remove wheel.
2) Remove parking brake cable.

INSTALLATION

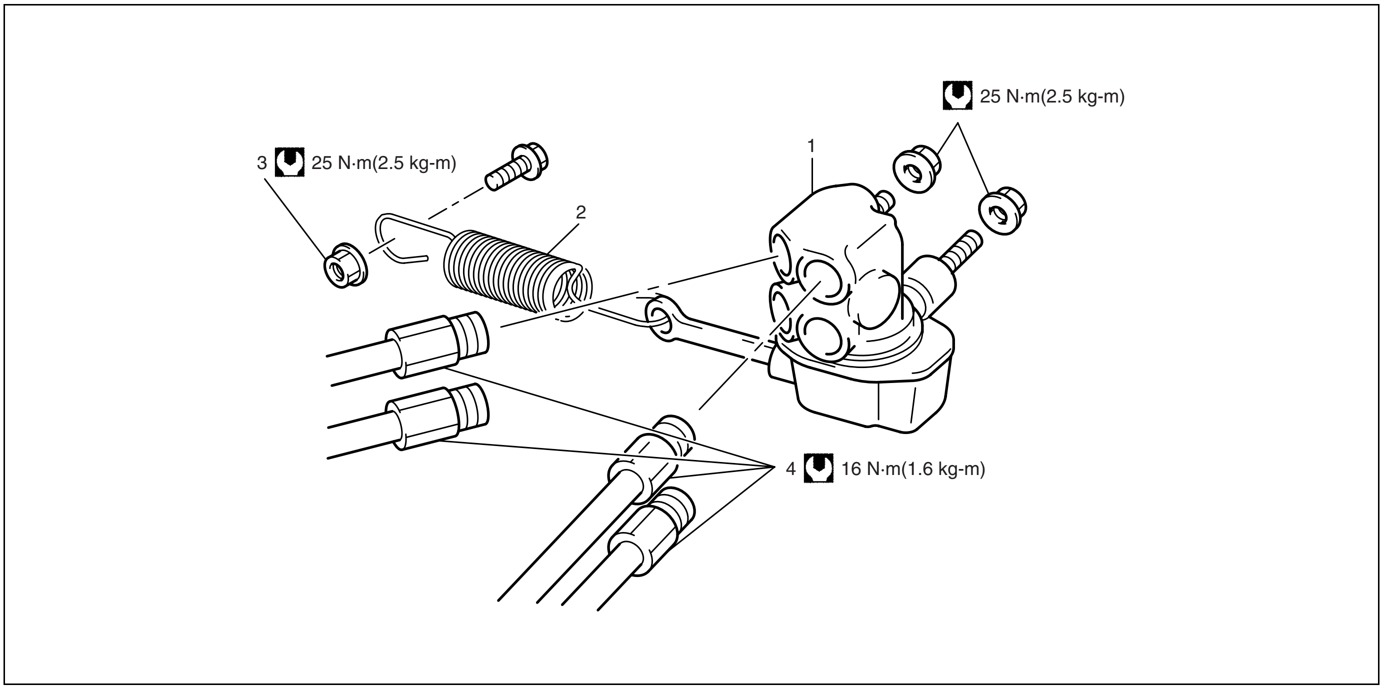
Install it by reversing removal procedure, noting the following points.

- Install clamps properly referring to figure below.
- Tighten bolts and nuts to specified torque.
- Adjust parking brake cable. (Refer to “PARKING BRAKE INSPECTION AND ADJUSTMENT”.)
- Check brake drum for dragging and brake system for proper performance. After removing vehicle from hoist, brake test should be performed.



T : Top side	3. Inner cable end	a : View A	f : View F
F : Front side	4. Spring	b : View B	Tightening torque
R : Rear side	5. Adjusting nut	c : View C	
1. Cable : Apply water tight sealant (99000-31090)	6. Clip	d : View D	
2. Parking brake shoe lever	7. Parking brake lever	e : View E	

LSPV (LOAD SENSING PROPORTIONING VALVE) ASSEMBLY (IF EQUIPPED)



1. LSPV assembly	3. Adjust nut	Tightening torque
2. Spring	4. Brake pipe	

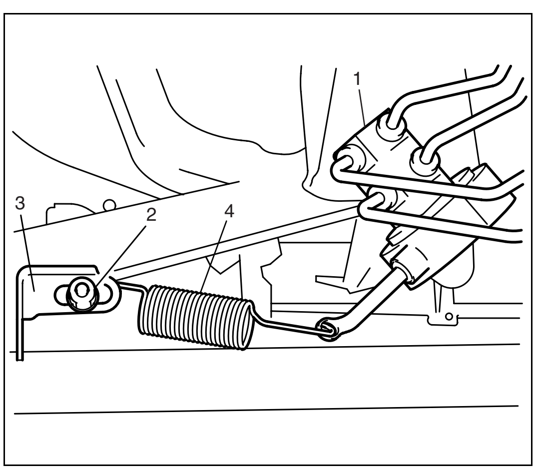
CAUTION:

Never disassemble LSPV assembly. Disassembly will spoil its original performance. Replace with new one if detective.

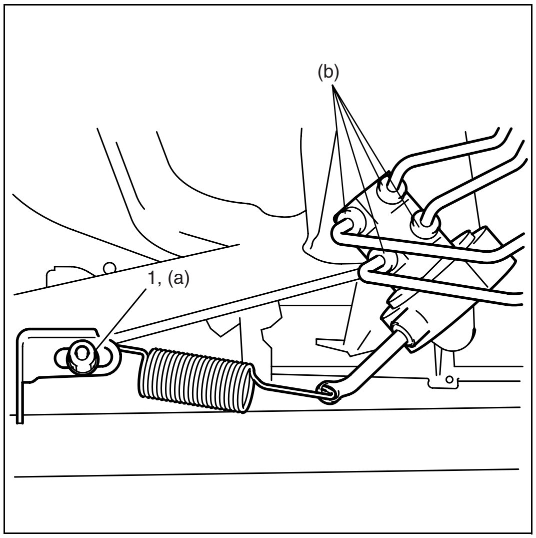
REMOVAL

1) Clean around reservoir cap and take out fluid with syringe or such.
2) Hoist vehicle.
3) Disconnect brake pipes from LSPV assembly.

Special tool
09950-78230 (10 x 11 mm)



4) Remove nut (2) and detach spring end from rear axle (3).
5) Remove LSPV assembly (1) with spring (4) from vehicle body.



INSTALLATION

1) Install LSPV assembly with spring to vehicle body.
2) Torque each bolt and nut (1) to specification as indicated respectively in figure.

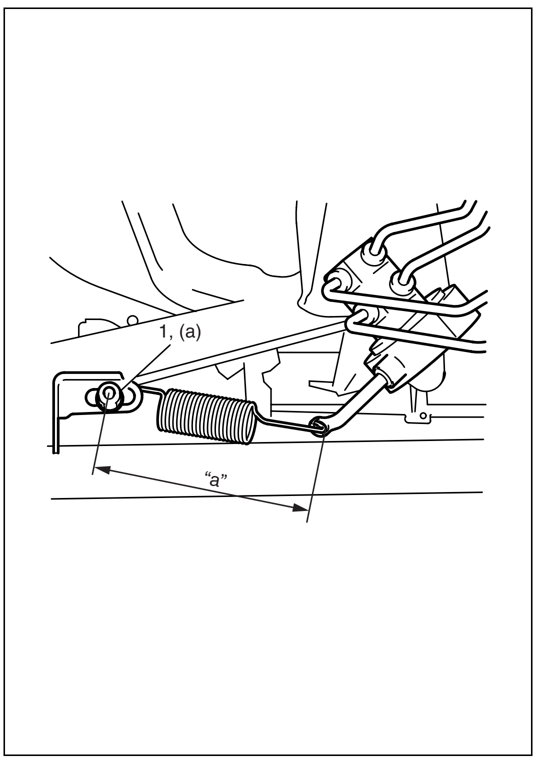
Special tool
(A) : 09950-78230 (10 x 11 mm)

Tightening torque
LSPV adjust nut (a) : 25 N·m (2.5 kg-m, 18.0 lb-ft)
Brake pipe flare nuts (b) : 16 N·m (1.6 kg-m, 11.5 lb-ft)

3) Fill reservoir with specified fluid and bleed air from brake system.
4) After bleeding air, check that LSPV is installed properly referring to following “INSPECTION & ADJUSTMENT”.

INSPECTION AND ADJUSTMENT

1) Confirm the following before inspection and adjustment.
   - Fuel tank is filled with fuel fully.
   - Vehicle is equipped with spare tire, tools, jack and jack handle.
   - Vehicle is free from any other load.
   - Vehicle is placed on level floor.



2) Push up LSPV lever with finger till it stops and measure length of coil spring (“a” in figure).
3) Spring length “a” should be as specified.

Spring length “a”
2WD : 144 mm (5.67 in.)
4WD : 148 mm (5.83 in.)

4) If it isn’t, adjust it to specification by changing spring position as shown in figure. After adjustment, tighten nut (1) to specified torque.

Tightening torque
LSPV adjust nut (a) : 25 N·m (2.5 kg-m, 18.0 lb-ft)

NOTE:

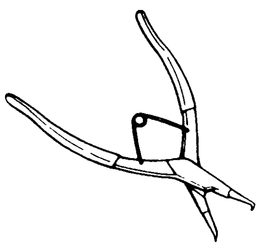
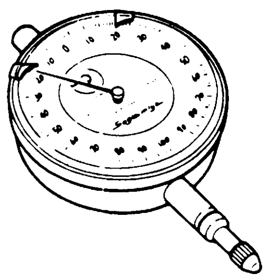
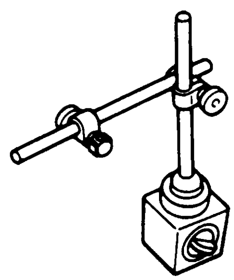
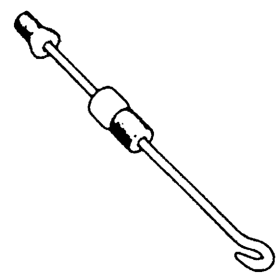
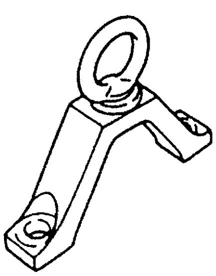
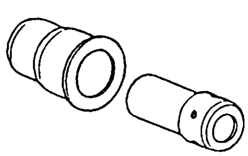
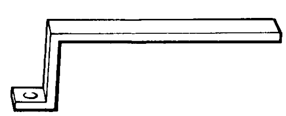
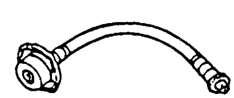
Check to make sure that LSPV body and brake pipe joints are free from fluid leakage. Replace defective parts, if any.

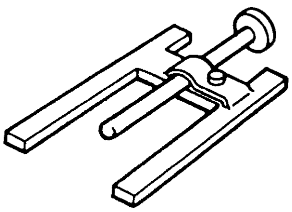
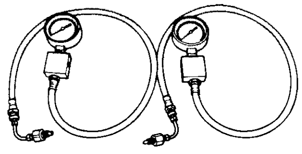
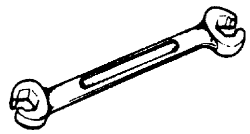
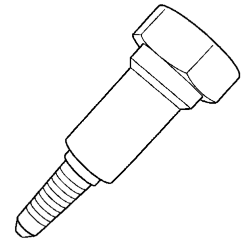
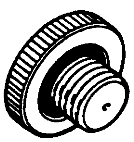
5) Confirm fluid pressure referring to “Fluid Pressure Test”.

REQUIRED SERVICE MATERIAL

Material	Recommended SUZUKI product (Part Number)	Use
Brake fluid	DOT 3 or SAE J1703	• To fill master cylinder reservoir. • To clean and apply to inner parts of master cylinder caliper and wheel cylinder when they are disassembled.
Water tight sealant	SEALING COMPOUND 366E (99000-31090)	• To apply to mating surfaces of brake back plate and rear axle (2WD vehicle) or rear axle housing (4WD vehicle). • To apply to mating surfaces of brake back plate and parking brake cable.
Lithium grease	SUZUKI SUPER GREASE A (99000-25010)	• To apply to slide pin of brake caliper carrier.

SPECIAL TOOL

 09900-06106 Snap ring remover	 09900-20606 Dial gauge	 09900-20701 Dial gauge chuck	 09942-15510 Sliding hammer
 09943-17912 Brake drum remover (Front wheel hub remover)	 09951-18220 Secondary cup installer set	 09952-16020 Booster piston rod adjuster	 09952-46010 Master cylinder attachment

 09950-96010 Booster piston rod gauge	 09956-02310 Fluid pressure gauge	 09950-78230 Flare nut wrench (10 x 11 mm)	 09952-48320 Pressure gauge attach-ment
 09952-26020 Master cylinder plug			

SECTION 5E

ANTILOCK BRAKE SYSTEM (ABS)

WARNING:

For vehicles equipped with Supplemental Restraint (Air Bag) System :

- **Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to "Air Bag System Components and Wiring Location View" under "General Description" in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and "Service Precautions" under "On-Vehicle Service" in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.**
- **Technical service work must be started at least 90 seconds after the ignition switch is turned to the "LOCK" position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).**

NOTE:

All brake fasteners are important attaching parts in that they could affect the performance of vital parts and systems, and/or could result in major repair expense. They must be replaced with one of same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of all parts. There is to be no welding as it may result in extensive damage and weakening of the metal.

CONTENTS

GENERAL DESCRIPTION

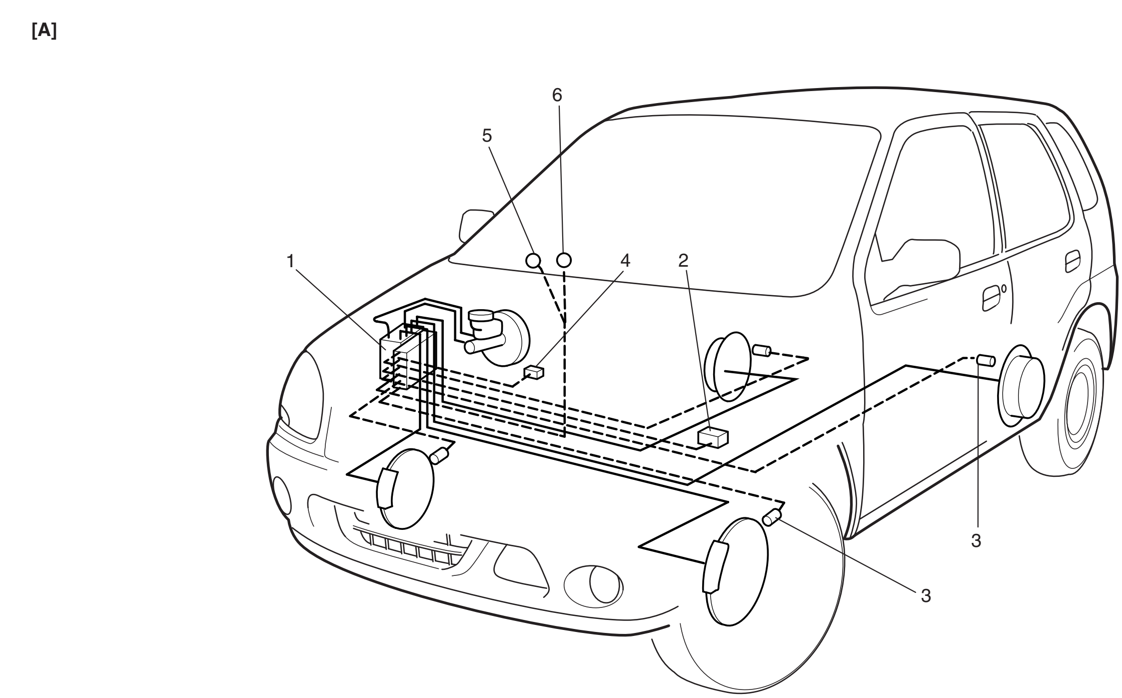
COMPONENTS/PARTS LOCATION AND BRAKE HOSE/PIPE ROUTING

The ABS (Antilock Brake System) controls the fluid pressure applied to the Wheel cylinder of each brake from the master cylinder so that each wheel is not locked even when hard braking is applied.
This ABS has also the following function.
While braking is applied, but before ABS control becomes effective, braking force is distributed between the front and rear so as to prevent the rear wheels from being locked too early for better stability of the vehicle.

The main component parts of this ABS include the following parts in addition to those of the conventional brake system.

- Wheel speed sensor which senses revolution speed of each wheel and outputs its signal.
- ABS warning lamp which lights to inform abnormality when system fails to operate properly.
- ABS hydraulic unit/control module assembly is incorporated ABS control module, ABS hydraulic unit (actuator assembly), fail-safe relay and pump motor relay.
  – ABS control module which sends operation signal to ABS hydraulic unit to control fluid pressure applied to each wheel cylinder based on signal from each wheel speed sensor so as to prevent wheel from locking.
  – ABS hydraulic unit which operates according to signal from ABS control module to control fluid pressure applied to wheel cylinder of each 4 wheels.
  – Fail-safe relay (solenoid valve) relay which supplies power to solenoid valve in ABS hydraulic unit and pump motor relay.
  – Pump motor relay which supplies power to pump motor in ABS hydraulic unit.
- G sensor which detects body deceleration speed. (For 4WD model only)]

This ABS is equipped with Electronic Brake force Distribution (EBD) system that controls a fluid pressure of rear wheels to best condition, which is the same function as that of proportioning valve, by the signal from wheel sensor independently of change of load due to load capacity and so on. And if the EBD system fails to operate properly, the brake warning lamp lights to inform abnormality.

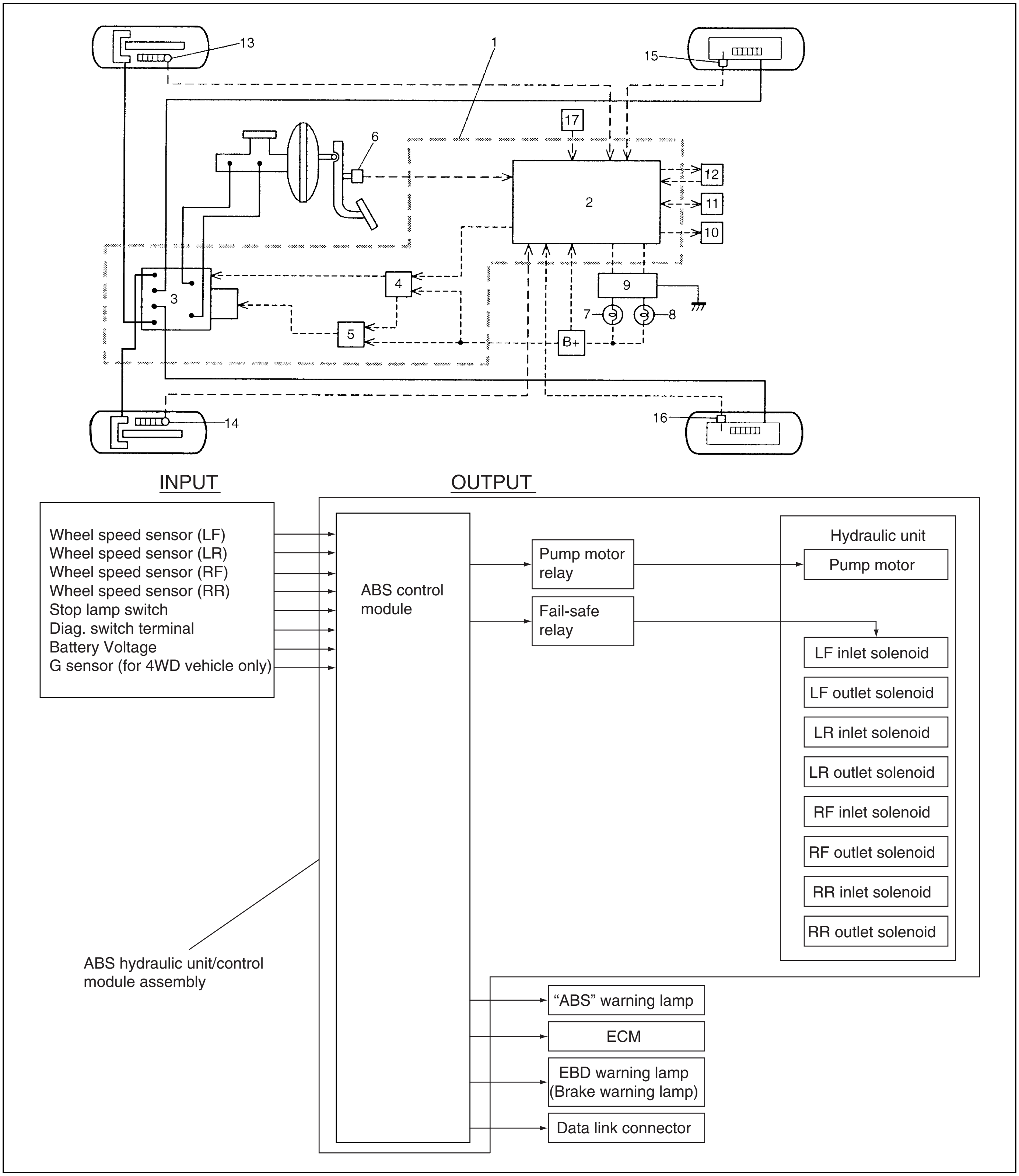


[A] :	RH steering vehicle shown	4.	Stop lamp switch
1.	ABS hydraulic unit/control module assembly	5.	ABS warning lamp
2.	G sensor (For 4WD vehicle only)	6.	EBD warning lamp (Brake warning lamp)
3.	Wheel speed sensors		

NOTE:

As for the difference of RH steering vehicle and LH steering vehicle, the location of the combination meter and the brake master cylinder assembly only changes.

SYSTEM SCHEMATIC



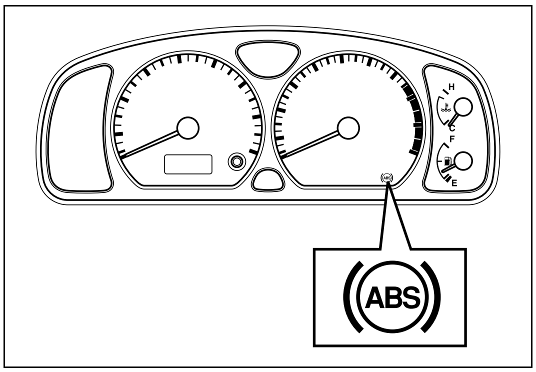
1. ABS hydraulic unit/control module assembly	7. “ABS” warning lamp	13. Wheel speed sensor (Right-front)
2. ABS control module	8. “EBD” warning lamp (Brake warning lamp)	14. Wheel speed sensor (Left-front)
3. ABS hydraulic unit	9. Lamp driver module	15. Wheel speed sensor (Right-rear)
4. Fail safe relay	10. ECM	16. Wheel speed sensor (Left-rear)
5. Pump motor relay	11. Data link connector	17. G sensor (For 4WD vehicle only)
6. Stop lamp switch	12. Monitor coupler	

ABS HYDRAULIC UNIT/CONTROL MODULE ASSEMBLY

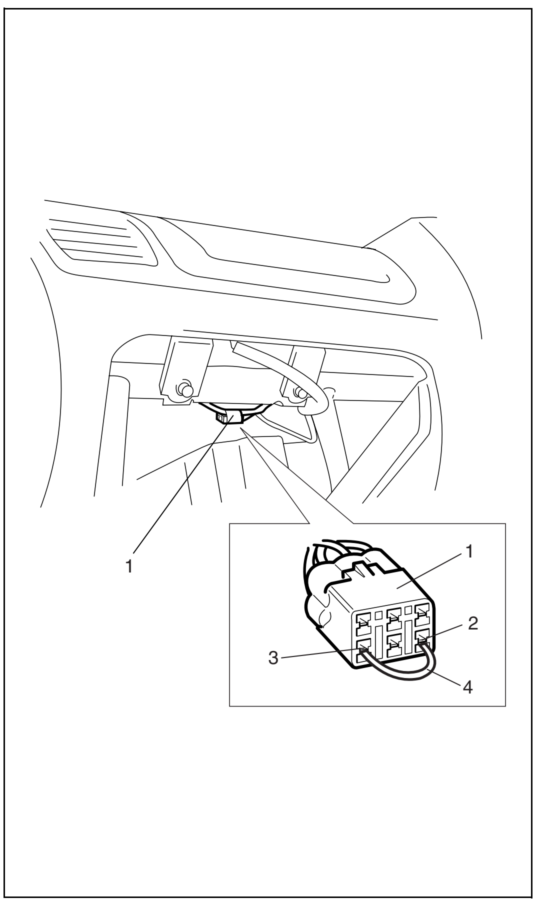
ABS control module is a component of ABS hydraulic unit/control module assembly and has the following functions.

SELF-DIAGNOSIS FUNCTION

ABS control module diagnoses conditions of the system component parts (whether or not there is any abnormality) all the time and indicates the results (warning of abnormality occurrence and DTC) through the ABS warning lamp as described below.



1) When ignition switch is turned ON, ABS warning lamp lights for 2 seconds to check its bulb and circuit.
2) When no abnormality has been detected (the system is in good condition), ABS warning lamp turns OFF after 2 seconds.
3) When an abnormality in the system is detected, ABS warning lamp lights and the area where that abnormality lies is stored in the memory of EEPROM in ABS control module.



4) When Diag. switch terminal (2) of diagnosis connector (1) (monitor connector) is grounded, the abnormal area is output as DTC. It is indicated by flashing of ABS warning lamp. (Refer to the table below.)

SYSTEM CONDITION		ABS WARNING LAMP	
		Diag. switch terminal is not grounded	Diag. switch terminal is grounded
In good condition at present	No trouble in the past	OFF	DTC 12
	Trouble occurred in the past	OFF	History DTC
Abnormality exists at present	No trouble in the past	ON	Current DTC
	Trouble occurred in the past	ON	Current and history DTCs

5) For procedure to clear all DTC's, refer to "DIAGNOSTIC TROUBLE CODE CLEARANCE" in this section.

3.	Ground terminal
4.	Service wire

Also ABS control module turns ON EBD warning lamp (brake warning lamp) depending on the trouble that detected by the module and EBD warning lamp does not indicate DTC as well as ABS warning lamp.

FAIL-SAFE FUNCTION

When an abnormality occurs (an abnormal DTC is detected), ABS control module turns OFF the fail-safe relay which supplies power to ABS hydraulic unit. Thus, with ABS not operating, brakes function just like the brake system of the vehicle without ABS.

SYSTEM CIRCUIT

1. Battery	9. ABS hydraulic unit/control module assembly	17. Left-rear wheel speed sensor
2. Main fuses	10. Terminal arrangement of connector E19 for ABS hydraulic unit/control module assembly	18. Right-front wheel speed sensor
3. Ignition switch	11. ABS fail-safe relay (Solenoid valve relay)	19. Left-front wheel speed sensor
4. Circuit fuses	12. ABS pump motor relay	20. Data link connector
5. Combination meter	13. Pump motor	21. To ECM, SDM and EPS controller (if equipped)
6. ABS warning lamp	14. Solenoid valves	22. Stop lamp
7. Brake warning lamp (“EBD” warning lamp)	15. Diagnosis monitor coupler	23. Stop lamp switch
8. Warning lamp driver module (for ABS)	16. Right-rear wheel speed sensor	24. G sensor (For 4WD vehicle only)

Wire color					
BLK :	Black	LT GRN/BLK :	Light Green/Black	RED/BLU :	Red/Blue
BLK/ORN :	Black/Orange	LT GRN/RED :	Light Green/Red	WHT :	White
BLK/YEL :	Black/Yellow	ORN :	Orange	WHT/BLK :	White/Black
BLU :	Blue	PNK :	Pink	WHT/BLU :	White/Blue
BRN :	Brown	PNK/BLU	Pink/Blue	WHT/RED :	White/Red
GRN :	Green	RED :	Red	YEL :	Yellow
GRN/ORN :	Green/Orange	RED/BLK :	Red/Black		

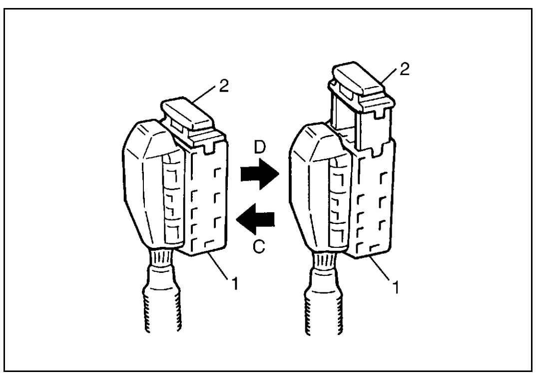
TERMINAL		CIRCUIT
E19	1	–
	2	Stop lamp switch
	3	Right-front wheel speed sensor (+)
	4	Right-front wheel speed sensor (–)
	5	–
	6	Right-rear wheel speed sensor (–)
	7	Right-rear wheel speed sensor (+)
	8	–
	9	–
	10	Brake warning lamp (EBD warning lamp)
	11	G sensor (For 4WD vehicle only)
	12	Diagnosis switch terminal
	13	Ground (For G sensor) (For 4WD vehicle only)
	14	ABS warning lamp
	15	Left-front wheel speed sensor (+)
	16	Left-front wheel speed sensor (–)
	17	–
	18	Ignition switch
	19	Left-rear wheel speed sensor (+)
	20	Left-rear wheel speed sensor (–)
	21	Data link connector
	22	Ground (for ABS pump motor)
	23	ABS pump motor relay
	24	Ground (for ABS control module)
	25	ABS fail-safe relay

DIAGNOSIS

To ensure that the trouble diagnosis is done accurately and smoothly, observe "PRECAUTIONS IN DIAGNOSING TROUBLES" and follow "ABS DIAGNOSTIC FLOW TABLE".

PRECAUTION IN DIAGNOSING TROUBLES

- If the vehicles was operated in any of the following ways, ABS warning lamp may light momentarily but this does not indicate anything abnormal in ABS.
  - The vehicle was driven with parking brake pulled.
  - The vehicle was driven with brake dragging.
  - The vehicle was stuck in mud, sand, etc.
  - Wheel spin occurred while driving.
  - Wheel(s) was rotated while the vehicle was jacked up.
- Be sure to read "PRECAUTIONS FOR ELECTRONIC CIRCUIT SERVICE" in Section 0A before inspection and observe what is written there.
- Be sure to use the trouble diagnosis procedure as described in the flow table. Failure to follow the flow table may result in incorrect diagnosis. (Some other diagnosis trouble code may be stored by mistake in the memory of ABS control module during inspection.)



- When disconnecting ABS hydraulic unit/control module connector (1), pull up lock (2) of connector.
  When connecting, set the connector on ABS hydraulic unit/control module assembly and push the lock (2) down.

D :	Disconnect
C :	Connect

ABS DIAGNOSTIC FLOW TABLE

Refer to the following pages for the details of each step.

Step	Action	Yes	No
1	1) Perform “Customer Complaint Analysis”. 2) Perform “Problem Symptom Confirmation”. 3) Perform “Diagnostic Trouble Code Check, Record and Clearance”. Is there any malfunction DTC?	Go to Step 2.	Go to Step 5.
2	1) Perform “DRIVING TEST”. Is trouble symptom identified?	Go to Step 3.	Go to Step 6.
3	1) Check diagnostic trouble code. Is it malfunction code?	Go to Step 4.	Go to Step 5.
4	1) Inspect and repair referring to applicable diagnostic trouble code table in this section. 2) Perform “FINAL CONFIRMATION TEST” after cleared DTC. Does trouble recur?	Go to Step 7.	End.
5	1) Inspect and repair referring to “DIAGNOSIS” in “BRAKES” section. 2) Perform “FINAL CONFIRMATION TEST”.	–	–
6	1) Check intermittent troubles referring to “INTERMITTENT AND POOR CONNECTION” in “GENERAL INFORMATION” section and related circuit of trouble code recorded in Step 2. 2) Perform “FINAL CONFIRMATION TEST” after cleared diagnostic trouble code. Does trouble recur?	Go to Step 7.	End.
7	1) Perform “Diagnostic Trouble Code Check, Record and Clearance”. Is there any malfunction code?	Go to Step 2.	Go to Step 5.

1) MALFUNCTION ANALYSIS
a) Customer Complaint Analysis
Record details of the problem (failure, complaint) and how it occurred as described by the customer.
For this purpose, use of such a questionnaire form as shown below will facilitate collecting information to the point required for proper analysis and diagnosis.

CUSTOMER QUESTIONNAIRE (EXAMPLE)

Customer's name:	Model:	VIN:	
Date of issue:	Date of Reg:	Date of problem:	Mileage:

Problem Symptoms	• ABS warning lamp abnormal: fails to turn on/fails to go off/flashes • Abnormal noise while vehicle is running: from motor, from valve, other ________ • Wheel is locked at braking: • Pump motor does not stop (running): • Braking does not work: • Other:
Frequency of occurrence	• Continuous/Intermittent (times a day, a month)/ other ________
Conditions for Occurrence of Problem	• Vehicle at stop & ignition switch ON: • When starting: at initial start only/at every start/Other ________ • Vehicle speed: while accelerating/while decelerating/at stop/ while turning/while running at constant speed/ other ________ • Road surface condition: Paved road/rough road/snow-covered road/ other ________ • Chain equipment:
Environmental Condition	• Weather: fair/cloudy/rain/snow/other ________ • Temperature: °F (°C)
Diagnostic Trouble Code	• First check: Normal code/malfunction code ( ) • Second check after test drive: Normal code/malfunction code ( )

b) Problem Symptom Confirmation
Check if what the customer claimed in "CUSTOMER QUESTIONNAIRE" is actually found in the vehicle and if that symptom is found, whether it is identified as a failure. (This step should be shared with the customer if possible.) Check warning lamps related to brake system referring to "EBD WARNING LAMP (BRAKE WARNING LAMP) CHECK" and "ABS WARNING LAMP CHECK" in this section.

c) Diagnostic Trouble Code (DTC) Check, Record and Clearance
Perform “DIAGNOSTIC TROUBLE CODE CHECK” procedure in this section, record it and then clear it referring to “DIAGNOSTIC TROUBLE CODE CLEARANCE” in this section.
If the malfunction DTC which was once displayed and then cleared cannot be detected (indicated) again when the ignition switch is turned ON, attempt to diagnose the trouble based on the DTC recorded in this step may mislead the diagnosis or make diagnosing difficult. Proceed to Step 2) to check control module for proper self-diagnosis function.
If the malfunction DTC which was once displayed and then cleared can be detected (indicated) again when ignition switch is turned ON, proceed to Step 3).

2) DRIVING TEST
Test drive the vehicle at 40 km/h for more than a minute and check if any trouble symptom (such as abnormal lighting of ABS warning light) exists.
If the malfunction DTC is confirmed again at ignition switch ON, driving test as described in above is not necessary. Proceed to Step 3).

3) DIAGNOSTIC TROUBLE CODE CHECK
Recheck diagnostic trouble code referring to “DTC CHECK” as shown in the following page.

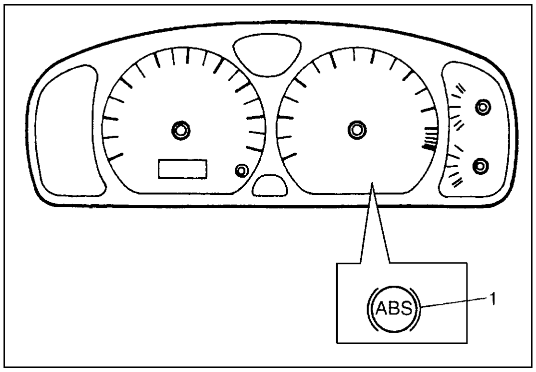
4) DIAGNOSTIC TROUBLE CODE FLOW TABLE
According to Diagnostic flow table for the diagnostic trouble code confirmation in Step 3), locate the cause of the trouble, namely in a sensor, switch, wire harness, connector, actuator assembly or other part and repair or replace faulty parts.

5) “DIAGNOSIS” IN “BRAKES” SECTION
Check the parts or system suspected as a possible cause referring to “DIAGNOSIS” in “BRAKES” section and based on symptoms appearing on the vehicle (symptom obtained through Steps 1)-a, 1)-b and 2) and repair or replace faulty parts, if any).

6) CHECK FOR INTERMITTENT PROBLEM
Check parts where an intermittent trouble is easy to occur (e.g., wire harness, connector, etc.), referring to “INTERMITTENT TROUBLE” in “GENERAL INFORMATION” section and related circuit of trouble code recorded in Step 1)-c.

7) FINAL CONFIRMATION TEST
Confirm that the problem symptom has gone and the ABS is free from any abnormal conditions. If what has been repaired is related to the malfunction DTC, clear the DTC once and perform test driving and confirm that no DTC is indicated.

ABS WARNING LAMP CHECK

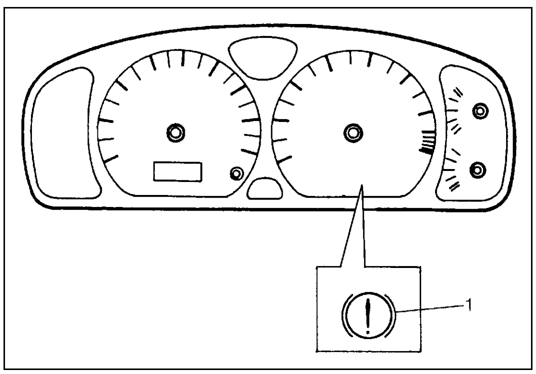


1) Turn ignition switch ON.
2) Check that ABS warning lamp (1) comes ON for about 2 seconds and then goes off.
   If any faulty condition is found, advance to Diagnostic Flow Table-A, B, C or D.

EBD WARNING LAMP (BRAKE WARNING LAMP) CHECK

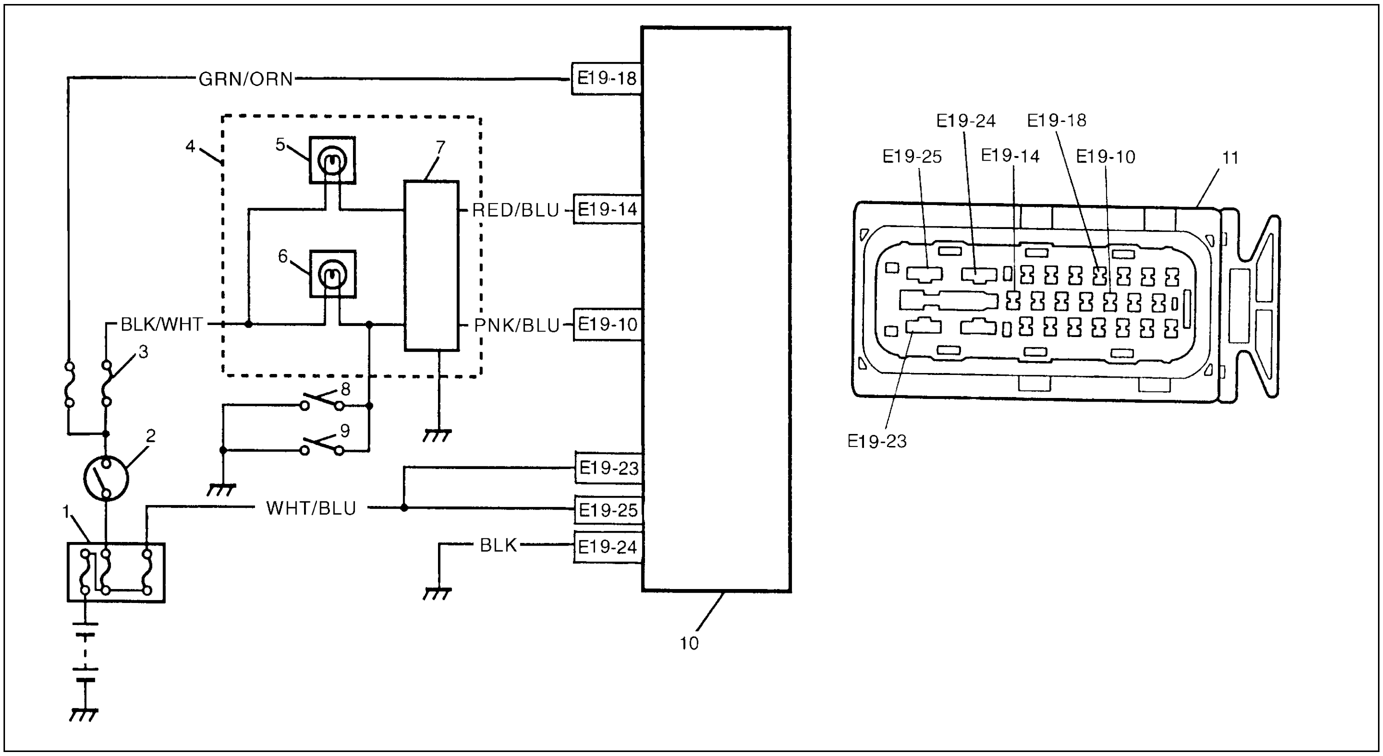
NOTE:

Perform this check on a level place.



1) Turn ignition switch ON with parking brake applied.
2) Check that EBD warning lamp (brake warning lamp) (1) is turned ON.
3) Release parking brake with ignition switch ON and check that EBD warning lamp (brake warning lamp) goes off.
   If it doesn't go off, go to "TABLE-E" in this section.

TABLE – A ABS WARNING LAMP CIRCUIT CHECK – LAMP DOES NOT COME "ON" AT IGNITION SWITCH ON



1. Main fuse	5. ABS warning lamp	9. Brake fluid level switch
2. Ignition switch	6. Brake warning lamp	10. ABS hydraulic unit/control module assembly
3. Circuit fuse	7. Lamp driver module	11. ABS hydraulic unit/control module connector
4. Combination meter	8. Parking brake switch	

CIRCUIT DESCRIPTION

Operation (ON/OFF) of ABS warning lamp is controlled by ABS control module through lamp driver module in combination meter.
If the Antilock brake system is in good condition, ABS control module turns ABS warning lamp ON at the ignition switch ON, keeps it ON for 2 seconds and then turns it OFF. If an abnormality in the system is detected, ABS warning lamp is turned ON continuously by ABS control module. Also, it is turned ON continuously by lamp driver module when the connector of ABS control module is disconnected.

INSPECTION

Step	Action	Yes	No
1	1) Turn ignition switch ON. Do other warning lamp come ON?	Go to Step 2.	Go to Step 4.
2	1) Disconnect ABS hydraulic unit/control module connector. Does ABS warning lamp light with ignition switch ON?	Substitute a known-good ABS hydraulic unit/control module assembly and recheck.	Go to Step 3.
3	1) Remove combination meter. Is bulb of ABS warning lamp in good condition?	"RED/BLU" circuit shorted to ground. If OK, replace combination meter (lamp driver module).	Replace bulb.
4	Is IG fuse in good condition?	Open in "BLK/WHT" wire to combination meter or poor connection.	Repair and replace.

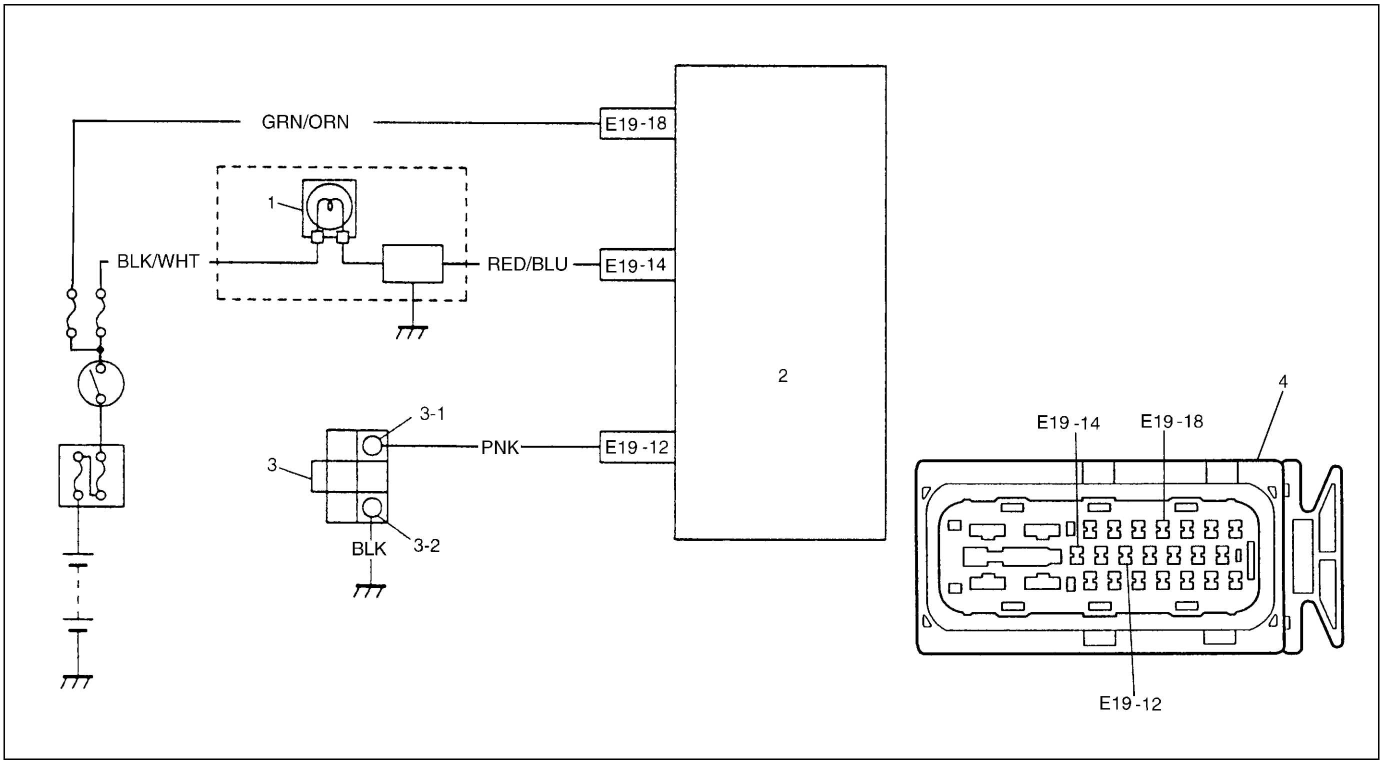
TABLE – B ABS WARNING LAMP CIRCUIT CHECK – LAMP COMES “ON” STEADY

Refer to TABLE – A for System Circuit Diagram and Circuit Description.

INSPECTION

Step	Action	Yes	No
1	Perform diagnostic trouble code check. Is there any DTC (including code No.12, NO CODES on SUZUKI scan tool) exists?	Go to Step 2.	Go to Step 3.
2	Does malfunction DTC (other than code No.12) exist at Step 1?	Go to Step 7 of “ABS DIAGNOSTIC FLOW TABLE” in this section.	Go to Step 3.
3	1) Disconnect ABS hydraulic unit/control module connector. 2) Check for proper connection to ABS hydraulic unit/control module connector at terminals “E19-14”, “E19-18” and “E19-24”. 3) If OK then ignition switch ON and measure voltage at terminal “E19-18” of connector. Is it 10 – 14 V?	Go to Step 4.	“GRN/ORN” circuit open.
4	1) With ABS hydraulic unit/control module connector disconnected, turn ignition switch ON and light ABS warning lamp. 2) Connect terminal “E19-14” of disconnected connector to ground using service wire. Does ABS warning lamp turn off?	Go to Step 5.	“RED/BLU” circuit open. If wire and connection are OK, replace combination meter (lamp driver module).
5	1) Measure resistance from connector terminal “E19-24” to body ground. Is continuity indicated?	Substitute a known-good ABS hydraulic unit/control module assembly and recheck.	“BLK” circuit open.

TABLE – C ABS WARNING LAMP CIRCUIT CHECK – THE LAMP FLASHES CONTINUOUSLY WHILE IGNITION SWITCH IS ON



1. "ABS" warning lamp in combination meter	3. Diagnosis monitor coupler	3-2. Diagnosis ground terminal
2. ABS hydraulic unit/control module assembly	3-1. Diagnosis switch terminal	4. ABS hydraulic unit/control module connector

CIRCUIT DESCRIPTION

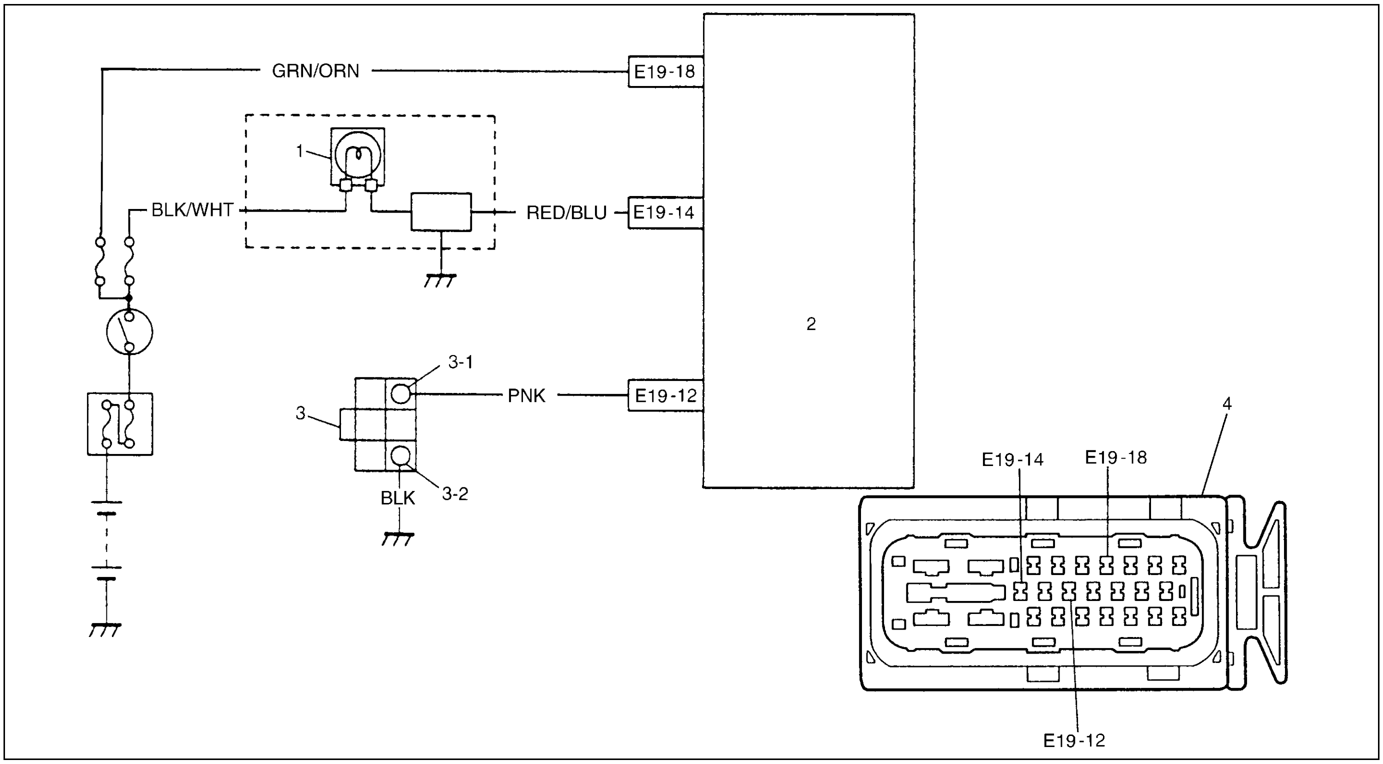
When diagnosis switch terminal is shorted or connected to the ground with ignition switch ON, diagnosis trouble code (DTC) is indicated by flashing of ABS warning lamp only in the following cases.

- Normal DTC (12) is indicated if no malfunction DTC is detected in the ABS.
- A history malfunction DTC is indicated by flashing of the lamp if a current malfunction DTC is not detected at that point although a history malfunction DTC is stored in memory.

INSPECTION

Step	Action	Yes	No
1	Is diagnosis switch terminal connected to ground via service wire?	Go to Step 3.	Go to Step 2.
2	1) Ignition switch ON. 2) Measure voltage between diagnosis switch terminal and ground. Is it 10 – 14 V?	Substitute a known-good ABS hydraulic unit/control module assembly and recheck.	"PNK" wire circuit shorted to ground.
3	1) Ignition switch ON. 2) Does flashing of ABS warning lamp indicate DTC?	Go to Step 7 of "ABS DIAGNOSTIC FLOW TABLE" in this section.	Substitute a known-good ABS hydraulic unit/control module assembly and recheck.

TABLE – D CODE (DTC) IS NOT OUTPUTTED EVEN WITH DIAGNOSIS SWITCH TERMINAL CONNECTED TO GROUND



1. ABS warning lamp in combination meter	3. Diagnosis monitor coupler	3-2. Diagnosis ground terminal
2. ABS hydraulic unit/control module assembly	3-1. Diagnosis switch terminal	4. ABS hydraulic unit/control module connector

CIRCUIT DESCRIPTION

When diagnosis switch terminal is connected to ground with ignition switch turned ON, the ABS control module outputs diagnostic trouble code by flashing ABS warning lamp.

INSPECTION

Step	Action	Yes	No
1	Is it shorted diagnosis switch terminal and ground terminal by service wire properly?	Go to Step 2.	Connect service wire securely.
2	1) Disconnect service wire. 2) Disconnect ABS hydraulic unit/control module connector. 3) Measure resistance between diagnosis switch terminal and connector terminal "E19-12". Is it infinite (∞)?	"PNK" circuit open.	Go to Step 3.
3	1) Measure resistance between ground terminal of monitor coupler and body ground. Is continuity indicated?	Go to Step 4.	"BLK" circuit open or poor connection.
4	1) Check for proper connection to ABS hydraulic unit/control module at terminal "E19-12". 2) If OK, then check ABS warning lamp circuit referring to TABLE A, B and C. Is it in good condition?	Substitute a known-good ABS hydraulic with/control module assembly and recheck.	Repair "ABS" warning lamp circuit.

TABLE – E EBD WARNING LAMP (BRAKE WARNING LAMP) CHECK – LAMP COMES "ON" STEADY

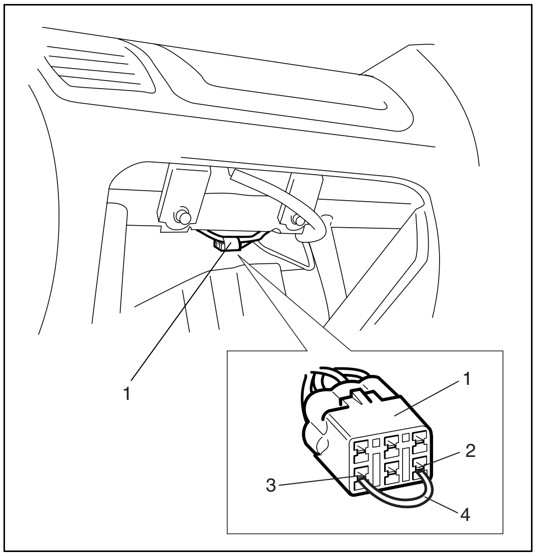
CIRCUIT DESCRIPTION

EBD warning lamp (brake warning lamp) is controlled by parking brake switch, brake fluid level switch and ABS control module/hydraulic unit assembly through lamp driver module in combination meter. Refer to "TABLE – A" for circuit diagram.

INSPECTION

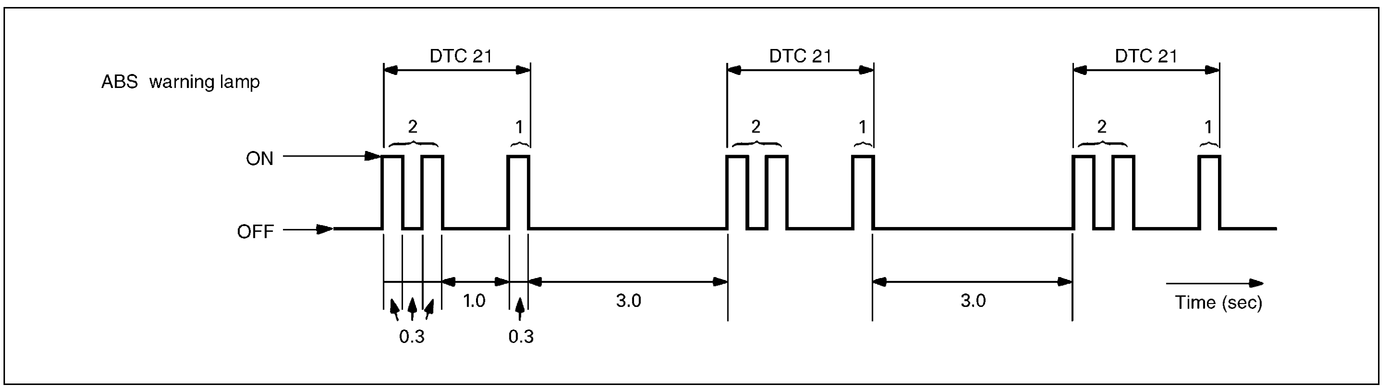
Step	Action	Yes	No
1	1) Make sure that : • Parking brake is completely released. • Brake fluid level is upper than the minimum level. Are the check results OK?	Go to Step 2.	Release parking brake completely and/or replenish brake fluid.
2	Does "ABS" warning lamp come on?	Perform "TABLE – B" previously outlined.	Go to Step 3.
3	1) Disconnect ABS hydraulic unit/control module connector. 2) Check for proper connection to ABS hydraulic unit/control module connector at terminals "E19-10". 3) If OK, apply chocks to wheels and select gear in neutral position (P range for A/T). 4) Keep brake pedal depressed and start engine. Release parking brake. 5) Connect terminal "E19-10" of disconnected connector to ground using service wire. Does EBD warning lamp (brake warning lamp) turn off?	Substitute a known-good ABS hydraulic unit/control module assembly and recheck.	"PNK/BLU" circuit open. If wire and connection are OK, replace combination meter.

DIAGNOSTIC TROUBLE CODE (DTC) CHECK (USING ABS WARNING LAMP)



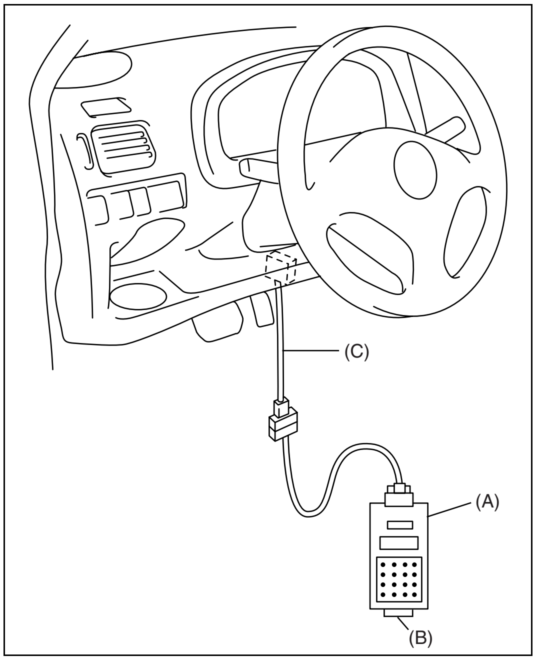
1) Perform ABS WARNING LAMP CHECK described above.
2) Using service wire (4), connect diagnosis switch terminal (2) of monitor coupler (1) to ground (3).
3) Turn ignition switch ON.
4) Read flashing of ABS warning lamp which represents DTC as shown in example below and write it down. When more than 2 DTCs are stored in memory, flashing for each DTC is repeated three times starting with the smallest DTC number in increasing order.
   For details of DTC, refer to “DTC TABLE”.

Example : When right-front wheel speed sensor circuit opens (DTC 21)



5) After completing the check, turn ignition switch off, disconnect service wire from monitor coupler.

DIAGNOSTIC TROUBLE CODE (DTC) CHECK (USING SUZUKI SCAN TOOL)



1) After setting cartridge for ABS to SUZUKI scan tool, connect SUZUKI scan tool to data link connector.

   Special tool
   (A) : 09931-76011 (SUZUKI scan tool)
   (B) : Mass storage cartridge
   (C) : 09931-76030 (16/14 pin DLC cable)

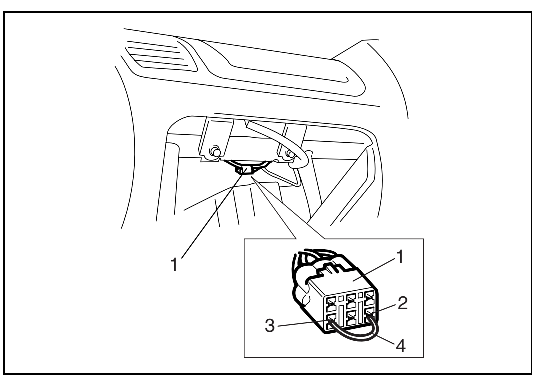
2) Turn ignition switch ON.
3) Read DTC according to instructions displayed on SUZUKI scan tool and print it or write it down. Refer to SUZUKI scan tool operator's manual for further details.
4) After completing the check, turn ignition switch off and disconnect SUZUKI scan tool from DLC.

DIAGNOSTIC TROUBLE CODE (DTC) CLEARANCE

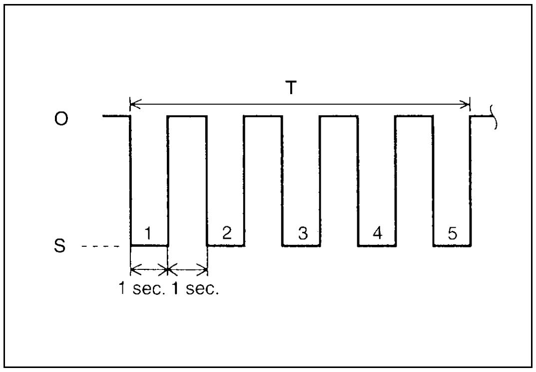
> **WARNING:**
> **When performing a driving test, select a safe place where there is neither any traffic nor any traffic accident possibility and be very careful during testing to avoid occurrence of an accident.**

After repair or replace malfunction part(s), clear all DTCs by performing the following procedure.

1) Turn ignition switch OFF.



2) Using service wire (4), connect diagnosis switch terminal (2) of diagnosis monitor coupler (1) to ground terminal (3).
3) With connection described in above Step 2) maintained, turn ignition switch ON.



4) Repeat disconnecting and reconnecting of service wire between diagnosis and ground terminals 5 times or more at about 1sec. interval within 10 seconds.

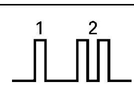
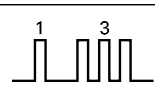
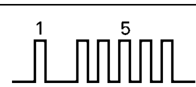
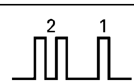
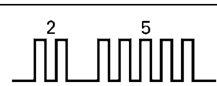
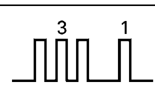
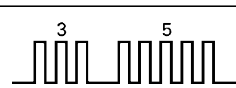
O :	Open
S :	Short
T :	About 10 seconds

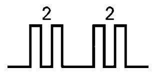
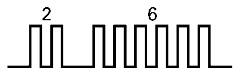
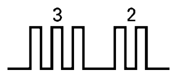
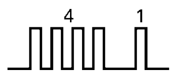
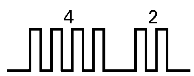
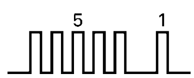
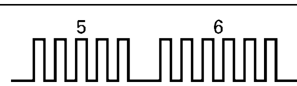
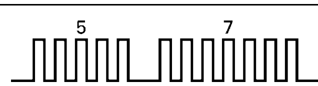
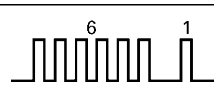
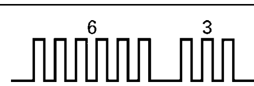
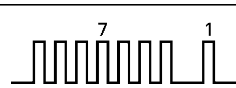
5) Turn ignition switch OFF and disconnect service wire from monitor coupler.
6) Perform "DRIVING TEST" (Step 2 of "ABS DIAGNOSTIC FLOW TABLE" in this section) and "DTC CHECK" and confirm that normal DTC (DTC 12) is displayed ; not malfunction DTC.

NOTE:
It is also possible to clear DTC by using SUZUKI scan tool. Refer to Cartridge Manual for procedure to clear DTC.

DIAGNOSTIC TROUBLE CODE (DTC) TABLE

CAUTION:
Be sure to perform "ABS DIAGNOSTIC FLOW TABLE" before starting diagnosis.

DTC (displayed on SUZUKI scan tool)	DTC (indicated by ABS warning lamp)	ABS warning lamp flashing pattern	DIAGNOSTIC ITEMS	
NO DTC	12		Normal	
C1013	13		ABS control module	
C1015	15		G sensor circuit	
C1021	21		RF	Wheel speed sensor circuit
C1025	25		LF	
C1031	31		RR	
C1035	35		LR	

DTC (displayed on SUZUKI scan tool)	DTC (indicated by ABS warning lamp)	ABS warning lamp flashing pattern	DIAGNOSTIC ITEMS	
C1022	22		RF	Wheel speed sensor circuit or sensor ring
C1026	26		LF	
C1032	32		RR	
C1036	36		LR	
C1041	41		RF	Inlet solenoid valve circuit
C1042	42			Outlet solenoid valve circuit
C1045	45		LF	Inlet solenoid valve circuit
C1046	46			Outlet solenoid valve circuit
C1051	51		RR	Inlet solenoid valve circuit
C1052	52			Outlet solenoid valve circuit
C1055	55		LR	Inlet solenoid valve circuit
C1056	56			Outlet solenoid valve circuit
C1057	57		Power source	
C1061	61		ABS pump motor and/or motor relay circuit	
C1063	63		Fail safe-relay	
C1071	71		ABS control module	

DTC C1013 (DTC 13) – SYSTEM SPECIFICATIONS DIFFERENT FROM ABS CONTROL MODULE SPECIFICATIONS

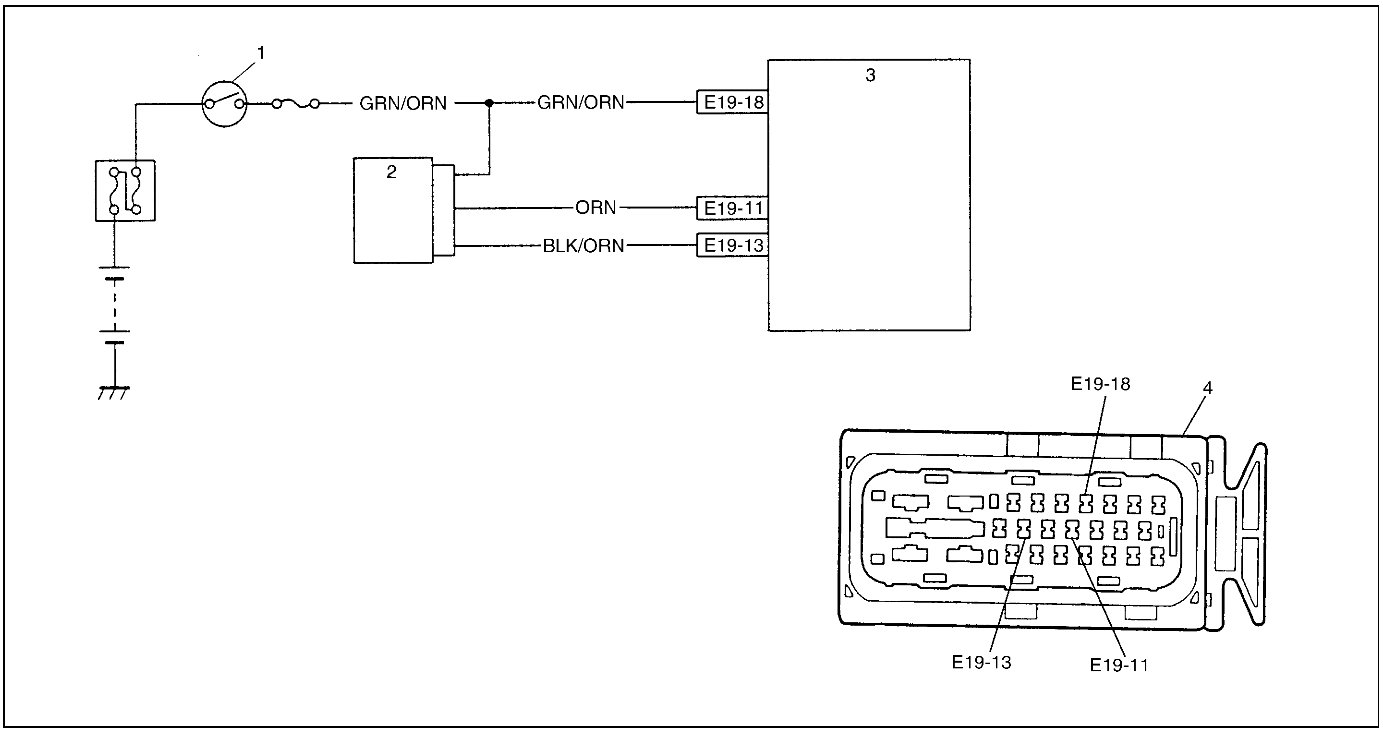
DESCRIPTION

When abnormal signal is inputted to a no-used terminal of control module white running or wrong ABS hydraulic unit/control module assembly is installed, this DTC will be set.

INSPECTION

1) Ignition switch OFF.
2) Check for proper connection from harness to control module.
3) If OK, substitute a known-good and correct specifications ABS hydraulic unit/control module assembly.
4) Recheck system.

DTC C1015 (DTC 15) – G SENSOR CIRCUIT



1. Ignition switch	3. ABS hydraulic unit/control module assembly
2. G sensor	4. ABS hydraulic unit/control module connector

DESCRIPTION

While a vehicle is at stop or running, if the potential difference between the sensor signal terminal “E19-11” and the sensor ground terminal “E19-13” is not within the specified voltage value, or if the signal voltage while at a stop does not vary from that while running, this DTC is set.
Therefore, this DTC may be set when a vehicle is lifted up and its wheel(s) is turned. In such case, clear the DTC and check again.

NOTE:

When ABS hydraulic unit/control module assembly for 4WD vehicle is installed to 2WD vehicle, this DTC is set. Before preforming the INSPECTION as shown below, check part number for supply of ABS hydraulic unit/control module assembly referring to parts catalogue.

INSPECTION

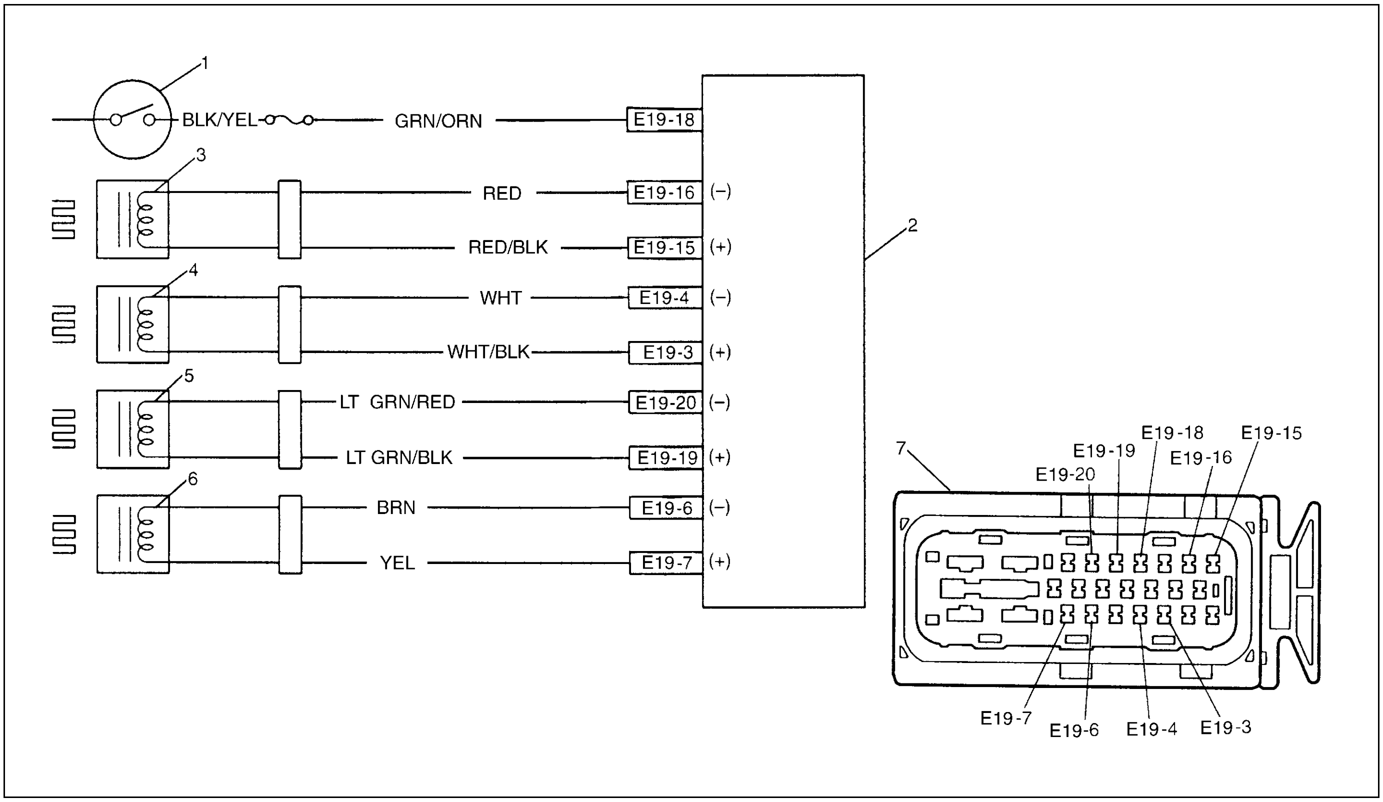
Step	Action	Yes	No
1	Is G sensor installed floor securely?	Go to Step 2.	Tighten sensor or bracket screw securely. If not, using new screw.
2	1) Ignition switch OFF. 2) Remove G sensor with bracket. 3) Check for proper connection to G sensor. 4) If OK then check G sensor referring to INSPECTION of “G SENSOR”. Is it in good condition?	Go to Step 3.	Replace G sensor.
3	1) Disconnect connectors from ABS hydraulic unit/control module assembly and G sensor. 2) Check for proper connection to ABS control module at terminals “E19-11” and “E19-13”. 3) If OK, then turn ignition switch ON and measure voltage between “GRN/ORN” terminal of sensor connector and body ground. It is 10 – 14 V?	Go to Step 4.	“GRN/ORN” circuit open.
4	Measure voltage between “ORN” terminal of sensor connector and body ground. Is it 0 V?	Go to Step 5.	“ORN” circuit shorted to power circuit.
5	1) Ignition switch OFF. 2) Check that “ORN” circuit is free from open or short to ground and “BLK/ORN” circuit. Is it in good condition?	“BLK/ORN” circuit open. If circuit is OK, substitute a known-good ABS hydraulic unit/control module assembly.	“ORN” circuit open or shorted to ground or “BLK/ORN” circuit.

DTC C1021 (DTC 21), DTC C1022 (DTC 22) – RIGHT-FRONT WHEEL SPEED SENSOR CIRCUIT OR SENSOR RING

DTC C1025 (DTC 25), DTC C1026 (DTC 26) – LEFT-FRONT WHEEL SPEED SENSOR CIRCUIT OR SENSOR RING

DTC C1031 (DTC 31), DTC C1032 (DTC 32) – RIGHT-REAR WHEEL SPEED SENSOR CIRCUIT OR SENSOR RING

DTC C1035 (DTC 35), DTC C1036 (DTC 36) – LEFT-REAR WHEEL SPEED SENSOR CIRCUIT OR SENSOR RING



1. Ignition switch	4. Right-front wheel speed sensor	7. ABS hydraulic unit/control module connector
2. ABS control module/hydraulic unit assembly	5. Left-rear wheel speed sensor	
3. Left-front wheel speed sensor	6. Right-rear wheel speed sensor	

DESCRIPTION

The ABS control module monitors the voltage at the terminal of each sensor while the ignition switch is ON. When the voltage is not within the specified range, an applicable DTC will be set. Also, when no sensor signal is inputted at starting or while running, an applicable DTC will be set.

NOTE:

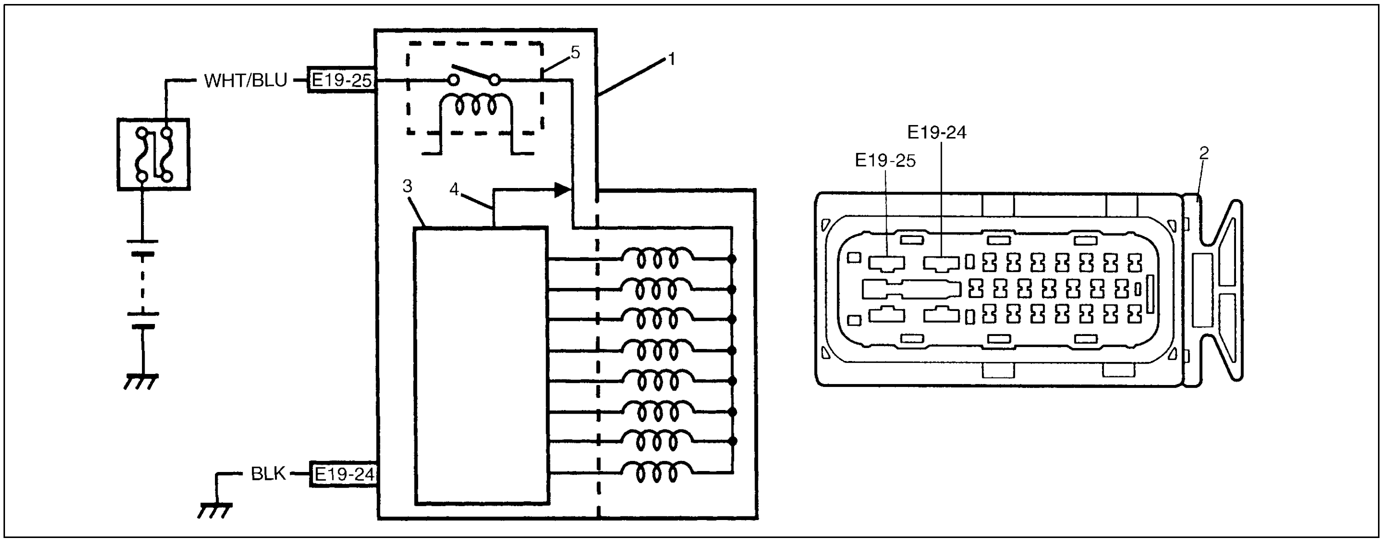
When the vehicle was operated in any of the following ways, one of these DTCs may be set even when the sensor is in good condition. If such possibility is suspected, repair the trouble (dragging of brake, etc.) of the vehicle, clear DTC once and then after performing the driving test as described in Step 2 of "ABS DIAGNOSIS FLOW TABLE", check whether or not any abnormality exists.

- **The vehicle was driven with parking brake pulled.**
- **The vehicle was driven with brake dragging.**
- **Wheel spin occurred while driving.**
- **Wheel(s) was turned while the vehicle was jacked up.**
- **The vehicle was stuck.**

INSPECTION

Step	Action	Yes	No
1	1) Disconnect applicable ABS wheel speed sensor coupler with ignition switch OFF. 2) Measure resistance between terminals of ABS wheel speed sensor. Refer to “FRONT WHEEL SPEED SENSOR” and/or “REAR WHEEL SPEED SENSOR” in this section. Is measured resistance value as specified?	Go to Step 2.	Replace ABS wheel speed sensor assembly.
2	1) Turn ignition switch OFF. 2) Disconnect ABS hydraulic unit/control module connector. 3) Check for proper connection to ABS control module at each sensor terminal. 4) If OK, then turn ignition switch ON and measure voltage between sensor terminal of module connector and body ground. Is it 0V?	Go to Step 3.	ABS wheel speed sensor circuit shorted to power.
3	1) Turn ignition switch OFF. 2) Connect ABS wheel speed sensor coupler. 3) Measure resistance between the following points. • Both ABS hydraulic unit/control module connector terminals of the corresponding sensor. This check result should be the same as above Step 1. • Either terminal of wheel speed sensor coupler and body ground. This check result should be no continuity. Are both check results OK?	Go to Step 4.	Circuit open or shorted to ground.
4	1) Remove applicable ABS wheel speed sensor. 2) Check sensor for damage or foreign material attached. Is it in good condition?	Go to Step 5.	Clean, repair or replace.
5	Check front and/or rear sensor ring for the following (remove rear drum as necessary) : • Rotor serration (teeth) neither missing nor damaged. • No foreign material being attached. • Rotor not being eccentric. • Wheel bearing free from excessive play. Are they in good condition?	Go to Step 6.	Clean, repair or replace.
6	1) Install ABS wheel speed sensor to knuckle. 2) Tighten sensor bolt to specified torque and check that there is no clearance between sensor and knuckle. Is it OK?	Go to Step 7.	Replace ABS wheel speed sensor.
7	Referring to “Reference” of “FRONT WHEEL SPEED SENSOR” and/or “Reference” of “REAR WHEEL SPEED SENSOR” in this section, check output voltage or waveform. Is specified voltage and/or waveform obtained?	Substitute a known-good ABS hydraulic unit/control module assembly and recheck.	Replace sensor and recheck.

DTC C1041 (DTC 41) – RIGHT-FRONT INLET SOLENOID CIRCUIT
DTC C1045 (DTC 45) – LEFT-FRONT INLET SOLENOID CIRCUIT
DTC C1051 (DTC 51) – RIGHT-REAR INLET SOLENOID CIRCUIT
DTC C1055 (DTC 55) – LEFT-REAR INLET SOLENOID CIRCUIT
DTC C1042 (DTC 42) – RIGHT-FRONT OUTLET SOLENOID CIRCUIT
DTC C1046 (DTC 46) – LEFT-FRONT OUTLET SOLENOID CIRCUIT
DTC C1052 (DTC 52) – RIGHT-REAR OUTLET SOLENOID CIRCUIT
DTC C1056 (DTC 56) – LEFT-REAR OUTLET SOLENOID CIRCUIT



1. ABS hydraulic unit/control module assembly	3. ABS control module	5. Fail-safe relay
2. ABS hydraulic unit/control module assembly connector	4. Signal	

DESCRIPTION

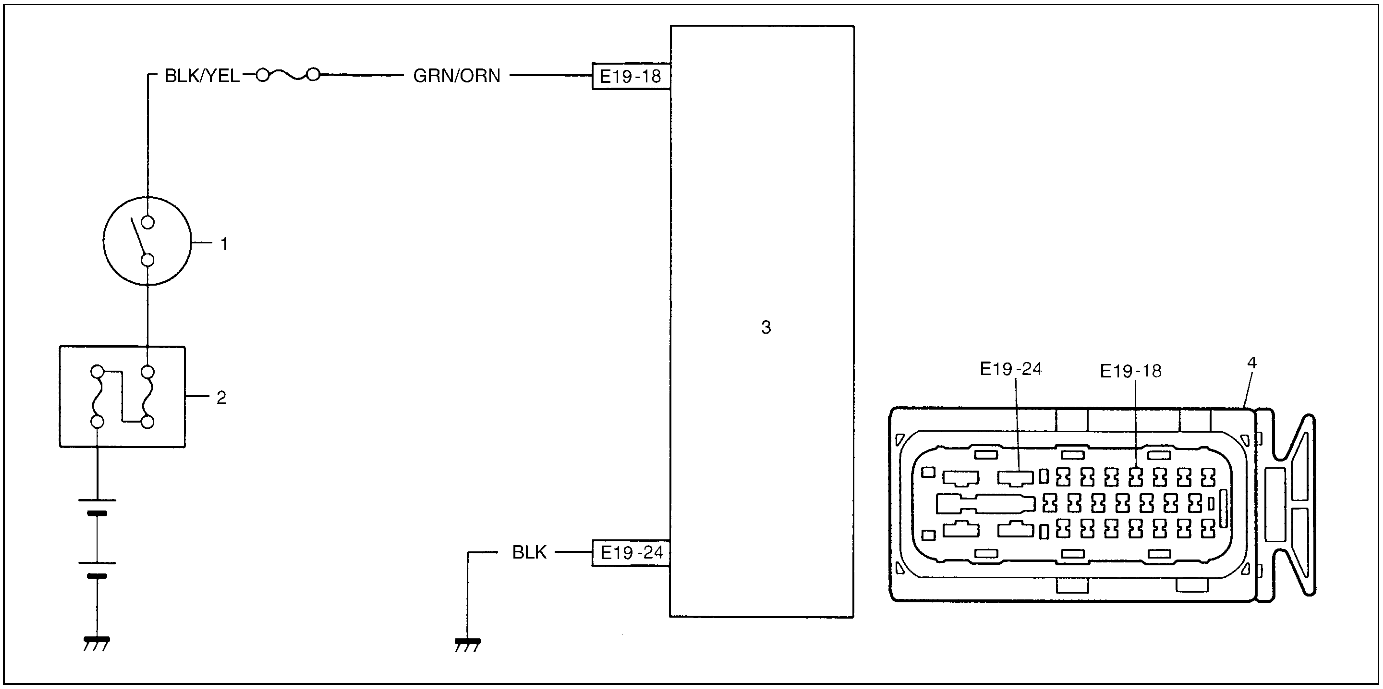
The ABS control module monitors the output from the valve.

When the output of each valve exceeds the specified value compared with the signal sent from ABS control module, this DTC is set.

INSPECTION

Step	Action	Yes	No
1	1) Check solenoid operation referring to item "ABS HYDRAULIC UNIT OPERATION CHECK" in this section. Is it in good condition?	Check terminal "E19-25" connection. If connection is OK, substitute a known-good ABS hydraulic unit/control module assembly and recheck.	Go to Step 2.
2	1) Ignition switch OFF. 2) Disconnect ABS hydraulic unit/control module connector. 3) Check for proper connection to ABS hydraulic unit/ control module connector at terminal "E19-25". 4) If OK, then measure voltage between terminal "E19-25" of module connector and "E19-24". Is it 10 – 14 V?	Substitute a known-good ABS hydraulic unit/control module assembly and recheck.	"WHT/BLU" or "BLK" circuit open.

DTC C1057 (DTC 57) – POWER SOURCE CIRCUIT



1. Ignition switch	3. ABS hydraulic unit/control module assembly
2. Main fuse	4. ABS hydraulic unit/control module connector

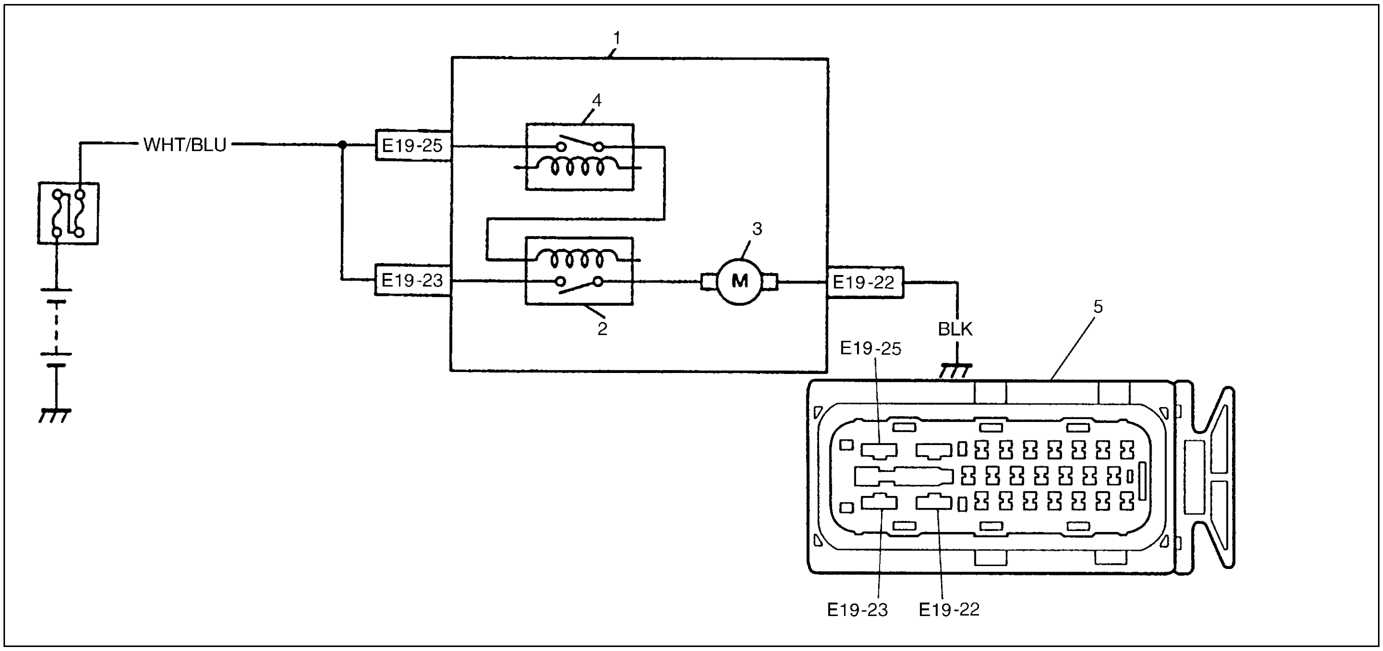
DESCRIPTION

The ABS control module monitors the power source voltage at terminal “E19-18”. When the power source voltage becomes extremely high or low, this DTC will be set. As soon as the voltage rises or lowers to the specified level, the set DTC will be cleared.

INSPECTION

Step	Action	Yes	No
1	1) Connect a voltmeter between battery positive (+) terminal and body ground. 2) Start the engine and measure the maximum voltage when racing the engine. Is it over 18V?	Check charging system referring to “CHARGING SYSTEM” section.	Go to Step 2.
2	1) Disconnect ABS hydraulic unit/control module connector. 2) Keep the engine idling, measure the voltage between terminal “E19-18” of ABS control module and body ground. Is it always under 9V?	Check charging system referring to “CHARGING SYSTEM” section. Imperfect short between wire “GRN/ORN” and ground.	Poor connection of terminal “E19-18” or “E19-24” of the ABS control module. If the above are in good condition, substitute a known-good ABS hydraulic unit/control module and recheck.

DTC C1061 (DTC 61) – ABS PUMP MOTOR CIRCUIT



1. ABS hydraulic unit/control module assembly	3. ABS pump motor	5. ABS hydraulic unit/control module connector
2. ABS pump motor relay	4. ABS fail safe relay	

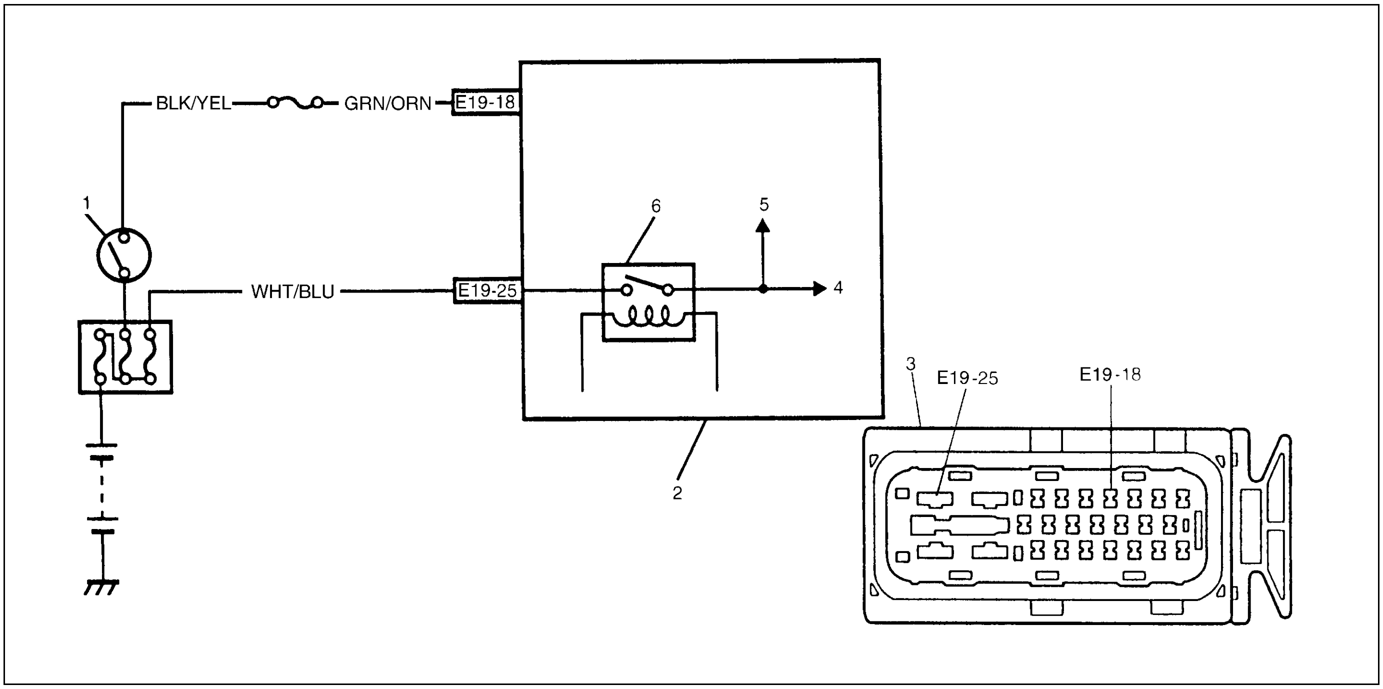
DESCRIPTION

The ABS control module monitors the voltage at monitor terminal of pump motor circuit constantly with the ignition switch turned ON. It sets this DTC when the voltage at the monitor terminal does not become high/low according to ON/OFF commands to the motor relay of the module (does not follow these commands).

INSPECTION

Step	Action	Yes	No
1	1) Check pump motor referring to “ABS HYDRAULIC UNIT OPERATION CHECK” in this section. Is it in good condition?	Check terminals “E19-25” and “E19-23” connection. If connections OK, substitute a known-good ABS hydraulic unit/control module assembly and recheck.	Go to Step 2.
2	1) Ignition switch OFF. 2) Disconnect ABS hydraulic unit/control module connector. 3) Check for proper connection to ABS hydraulic unit/control module connector at terminal “E19-23”. 4) If OK, then measure voltage between terminal “E19-23” of module connector and body ground. Is it 10 – 14 V?	Go to Step 3.	“WHT/BLU” circuit open.
3	Measure resistance between terminal “E19-22” of ABS hydraulic unit/control module connector and body ground. Is it infinite (∞)?	“BLK” circuit open.	Substitute a known-good ABS hydraulic unit/control module assembly and recheck.

DTC C1063 (DTC 63) – ABS FAIL-SAFE RELAY CIRCUIT



1. Ignition switch	3. ABS hydraulic unit/control module connector	5. To pump motor relay
2. ABS hydraulic unit/control module assembly	4. To solenoid valves	6. Fail-safe relay

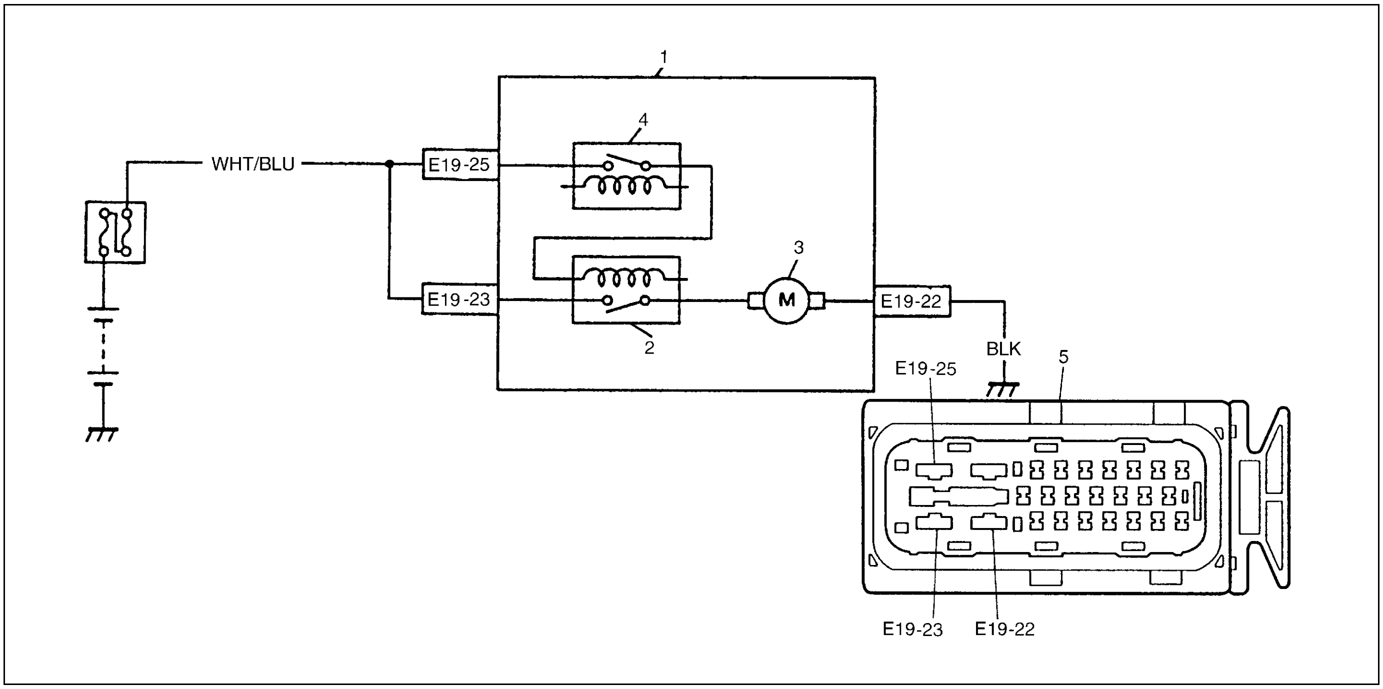
DESCRIPTION

ABS control module monitors the voltage at the terminal of solenoid circuit constantly with ignition switch turned ON. Also, immediately after ignition switch is turned ON, perform initial check as follows.
Switch fail-safe relay in the order of OFF → ON and check if voltage changes to Low → High. If anything faulty is found in the initial check and when the voltage is low with ignition switch turned ON, this DTC will be set.

INSPECTION

Step	Action	Yes	No
1	Check battery voltage. Is it about 11 V or higher?	Go to Step 2.	Check charging system referring to “CHARGING SYSTEM” section.
2	Check ABS main fuse and connection. Is it in good condition?	Go to Step 3.	Repair and/or replace fuse.
3	1) Ignition switch OFF. 2) Disconnect ABS hydraulic unit/control module connector. 3) Check proper connection to ABS hydraulic unit/control module at terminal “E19-25”. 4) If OK, then measure voltage between connector terminal “E19-25” and body ground. Is it 10 – 14 V?	Substitute a known-good ABS hydraulic unit/control module assembly and recheck.	“WHT/BLU” circuit open or short to ground.

DTC C1071 (DTC 71) – ABS CONTROL MODULE



1. ABS hydraulic unit/control module assembly	3. ABS pump motor	5. ABS hydraulic unit/control module connector
2. ABS pump motor relay	4. ABS fail safe relay	

DESCRIPTION

This DTC will be set when an internal malfunction is detected in the ABS control module.

INSPECTION

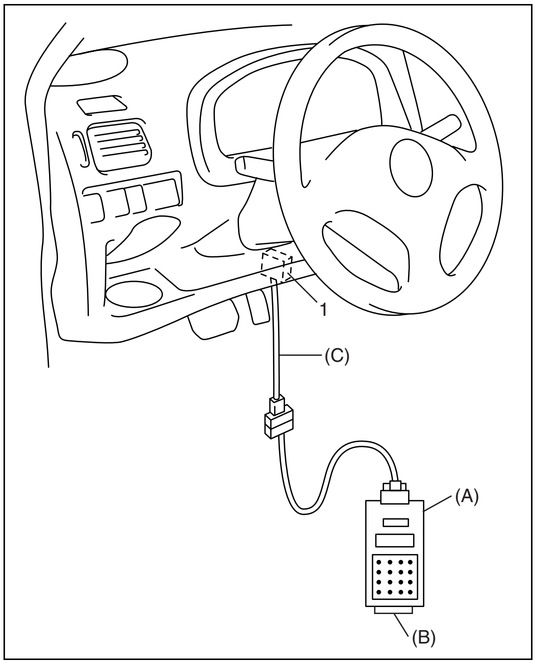
Step	Action	Yes	No
1	Clear all DTCs and check DTC. Is it DTC 71?	Go to Step 2.	Could be a temporary malfunction of the ABS control module.
2	1) Check proper connection of ABS hydraulic unit/control module connector. 2) If OK, disconnect ABS hydraulic unit/control module connector and check the followings. • Voltage “E19-25” terminal : 10 – 14 V • Resistance between “E19-22” and body ground : Continuity Are the check result as specified above?	Replace ABS hydraulic unit/control module assembly.	Repair and recheck.

ON-VEHICLE SERVICE

PRECAUTIONS

When connector is connected to ABS hydraulic unit/control module assembly, do not disconnect connectors of sensors with ignition switch ON. Then DTC will be set in ABS control module.

ABS HYDRAULIC UNIT OPERATION CHECK (USING SUZUKI SCAN TOOL)



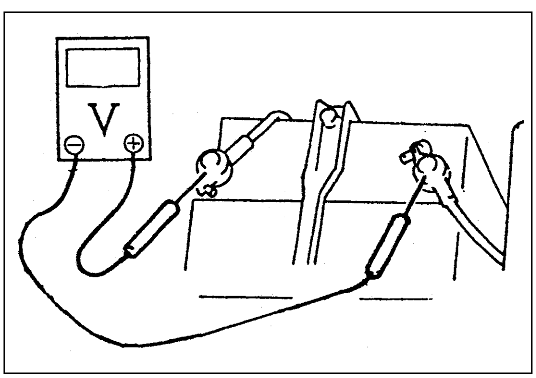
1) Connect SUZUKI scan tool to data link connector (DLC) (1) with ignition switch OFF.

   Special tool
   (A) : 09931-76011 (SUZUKI scan tool)
   (B) : Mass storage cartridge
   (C) : 09931-76030 (16/14 pin DLC cable)

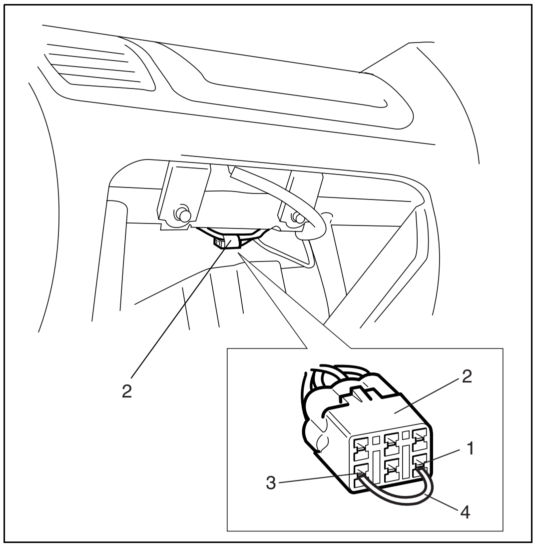
2) Turn ignition switch to ON position and check actuator operation using “HYDRAULIC CONTROL TEST” under “miscellaneous test” (“MISC. TEST”) mode of SUZUKI scan tool.

ABS HYDRAULIC UNIT OPERATION CHECK (NOT USING SUZUKI SCAN TOOL)

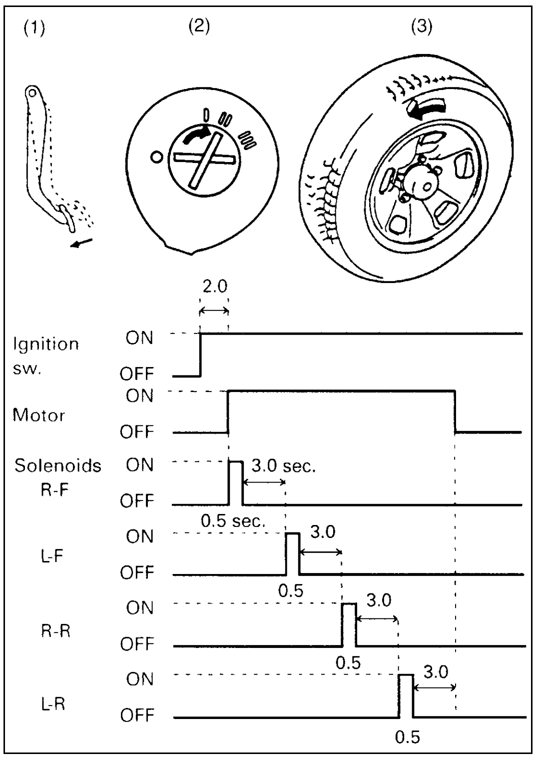
1) Check that basic brake system other than ABS is in good condition.



2) Check that battery voltage is 11 V or higher.
3) With ABS warning lamp, check that no abnormality is detected in ABS. Refer to “DIAGNOSTIC TROUBLE CODE (DTC) CHECK” in this section.
4) Lift up vehicle.
5) Set transmission to neutral and release parking brake.
6) Turn each wheel gradually by hand to check if brake dragging occurs. If it does, correct.



7) With diagnosis switch terminal (1) of monitor coupler (2) connected to ground terminal (3) using service wire (4), turn ignition switch ON and check if ABS warning lamp indicates DTC 12.
   If malfunction DTC is indicated, repair it first.
8) Turn ignition switch OFF.

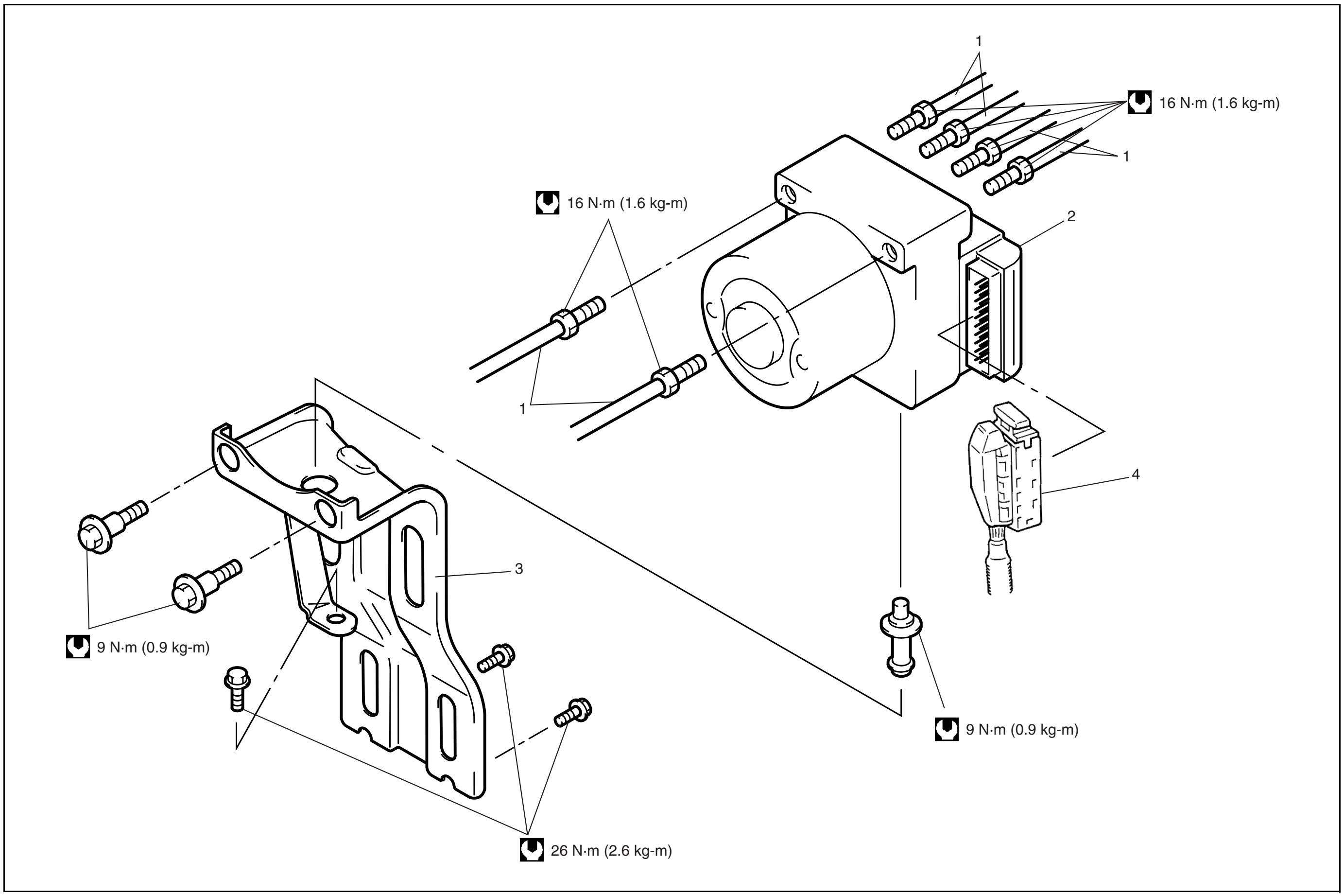


9) Perform the following checks with help of another person.
   Brake pedal (1) should be depressed and then ignition switch (2) turned ON by one person and wheel (3) should be turned by another person's hand. At this time, check that :
   - Operation sound of solenoid is heard and wheel turns only about 0.5 sec. (Brake force is depressurized).
   - Operation sound of pump motor is heard and pulsation is felt at brake pedal.
10) If all 4-wheels cannot be checked during one ignition cycle (OFF → ON), repeat Steps 8) and 9) till all 4 wheels are checked.
   If a faulty condition is found in Steps 9) and 10), replace hydraulic unit/control module assembly.
11) Turn ignition switch OFF and remove service wire from monitor coupler.

ABS HYDRAULIC UNIT/CONTROL MODULE ASSEMBLY

CAUTION:

Never disassemble ABS hydraulic unit/control module assembly, loosen blind plug or remove motor. Performing any of these prohibited services will affect original performance of ABS hydraulic unit/ control module assembly.



1. Brake pipe	3. Bracket
2. ABS hydraulic unit/control module assembly	4. Connector

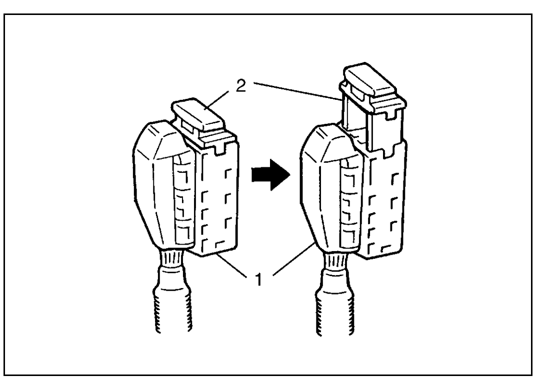
HYDRAULIC UNIT INSPECTION

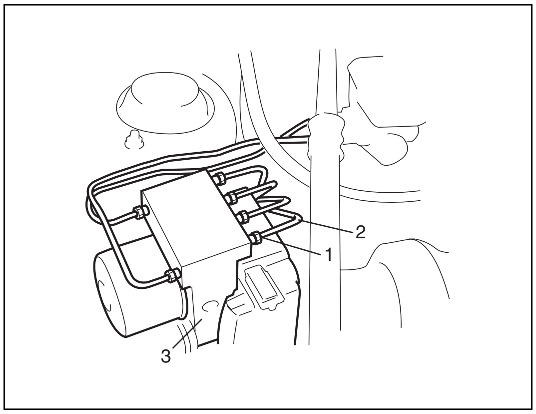
Check hydraulic unit for fluid leakage.
If any, repair or replace.

REMOVAL

1) Disconnect negative cable from battery.

2) Disconnect ABS hydraulic unit/control module assembly connector (1) by pulling up lock (2).



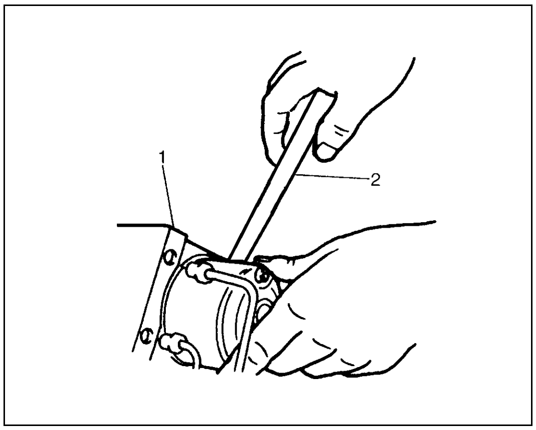


3) Using special tool, loosen flare nuts (1) and disconnect brake pipes (2) from ABS hydraulic unit/control module assembly (3).

Special tool
09950-78220

NOTE:

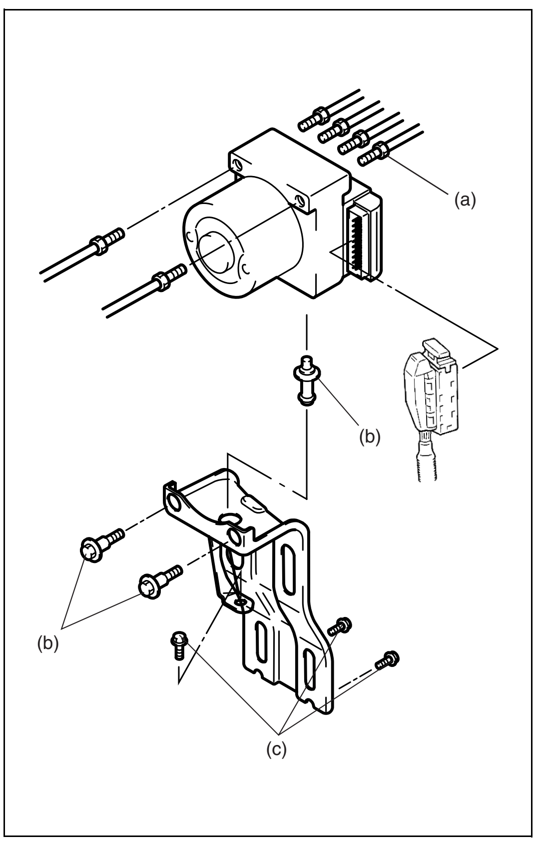
Put bleeder plug cap onto pipe to prevent fluid from spilling. Do not allow brake fluid to get on painted surfaces.



4) Remove two nuts and disconnect take out ABS hydraulic unit/control module assembly (1) from bracket using flat end rod or the like (2).

CAUTION:
- **Do not give an impact to hydraulic unit.**
- **Use care not to allow dust to enter hydraulic unit.**
- **Do not place hydraulic unit on its side or upside down. Handling it in inappropriate way will affect its original performance.**

INSTALLATION



1) Install hydraulic unit/control module assembly by reversing removal procedure.

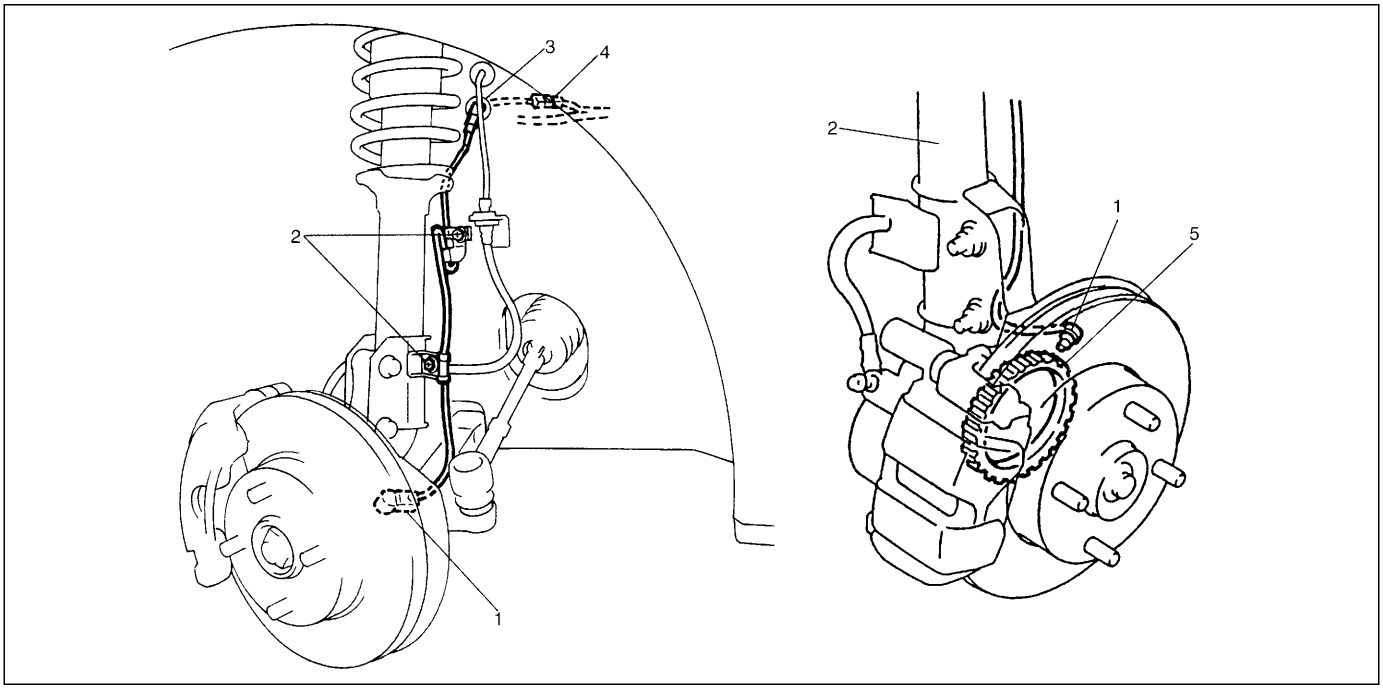
Tightening torque
Brake pipe flare nut (a) :
16 N·m (1.6 kg-m, 11.5 lb-ft)
ABS hydraulic unit/control module assembly bolt (b) :
9 N·m (0.9 kg-m, 6.5 lb-ft)
ABS hydraulic unit/control module assembly bracket bolt (c) : 26 N·m (2.6 kg-m, 18.0 lb-ft)

2) Bleed air from brake system referring to “BRAKES” section.
3) Check each installed part for fluid leakage and perform “ABS HYDRAULIC UNIT OPERATION CHECK” in this section.

NOTE:

For new ABS hydraulic unit/control module assembly, if “ABS HYDRAULIC UNIT OPERATION CHECK” procedure has not been performed, “ABS” warning lamp may flash when ignition switch is turned ON position.
Accordingly preform “ABS HYDRAULIC UNIT OPERATION CHECK” to stop flashing of ABS warning lamp.

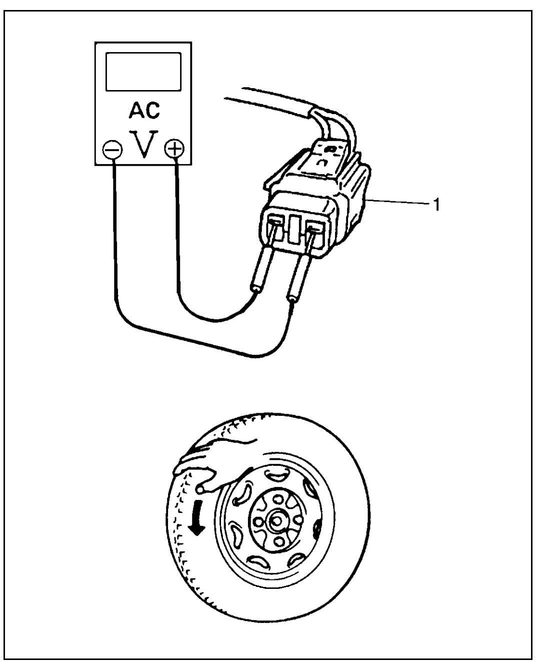
FRONT WHEEL SPEED SENSOR



1. Left front wheel speed sensor	3. Grommet	5. Sensor ring
2. Clamp bolt	4. Connector	

OUTPUT VOLTAGE INSPECTION

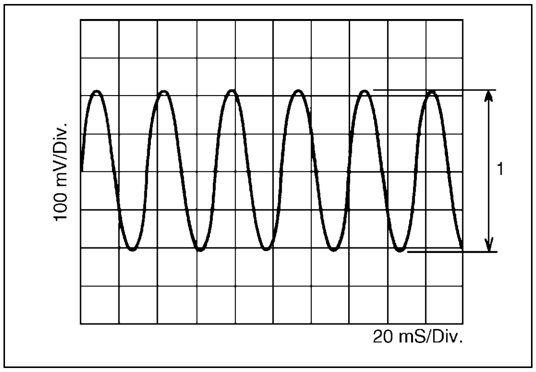
1) Turn ignition switch OFF.
2) Hoist vehicle a little.
3) Disconnect wheel speed sensor connector.
4) Disconnect wheel speed sensor grommet from vehicle body.



5) Connect voltmeter between connector (1) terminals.
6) While turning wheel by hand at a speed of approximately 1/2 rotation to 1 rotation per second, check AC voltage of sensor.

Output AC voltage at 1/2 to 1 rotation per second
: 106 mV or more

7) If measured voltage is not as specified, check sensor, rotor and their installation conditions.



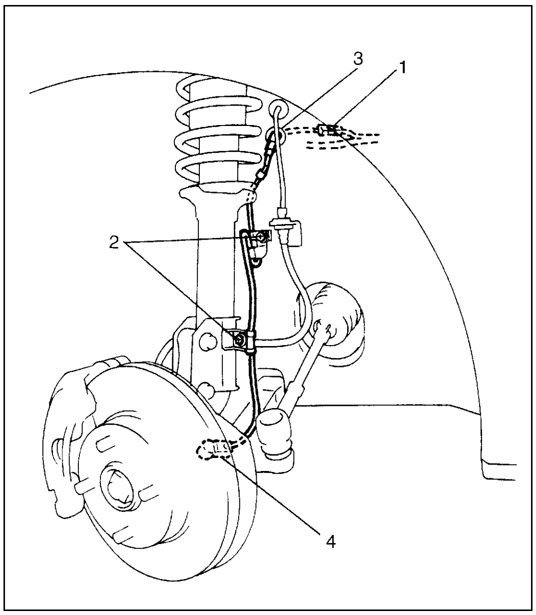
Reference

When using oscilloscope for this check, check if peak-to-peak voltage (1) meets specification and waveform is complete.

Peak-to-peak voltage at 1/2 to 1 rotation per second
: 150 mV or more at 20 Hz

REMOVAL

1) Disconnect negative cable at battery.

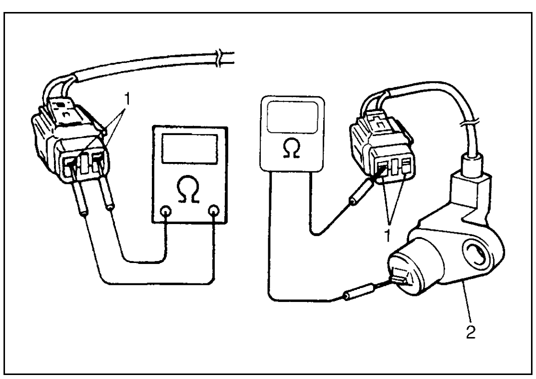


2) Disconnect front wheel speed sensor coupler (1).
3) Hoist vehicle and remove wheel.
4) Remove harness clamp bolts (2) and grommet (3).
5) Remove front wheel speed sensor (4) from knuckle.

CAUTION:
- **Do not pull wire harness when removing front wheel speed sensor.**
- **Do not cause damage to surface of front wheel speed sensor and do not allow dust, etc. to enter its installation hole.**

SENSOR INSPECTION

- Check sensor for damage.

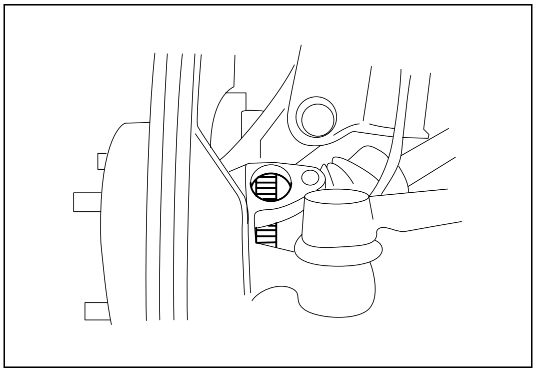


- Check sensor for resistance and continuity.

Between both terminals (1) sensor
: 1.2 – 1.6 kΩ at 20°C (68°F)

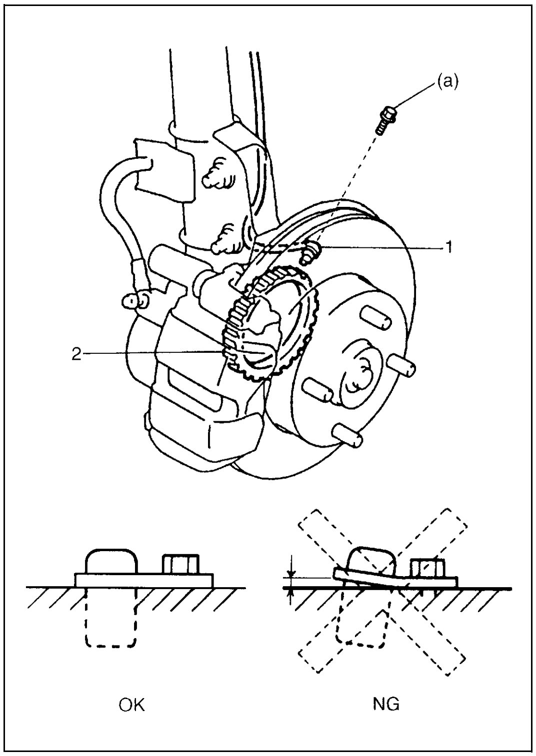
Between sensor terminal and sensor body (2)
: No continuity

- If the check result is not as specified and any malcondition is found, replace.



SENSOR ROTER INSPECTION

- Check rotor for being missing, damaged or deformed.
- Turn drive shaft and check if rotor rotation is free from eccentricity and looseness.
- Check that no foreign material is attached.
  If any faulty is found, repair or replace. Refer to "WHEEL HUB" in Section 3D.



INSTALLATION

1) Check that no foreign material is attached to sensor (1) and sensor ring (2).
2) Install it by reversing removal procedure.

Tightening torque
Front wheel speed sensor bolt (a) :
10 N·m (1.0 kg-m, 7.5 lb-ft)

CAUTION:
Do not pull or twist wire harness more than necessary when installing front wheel speed sensor.

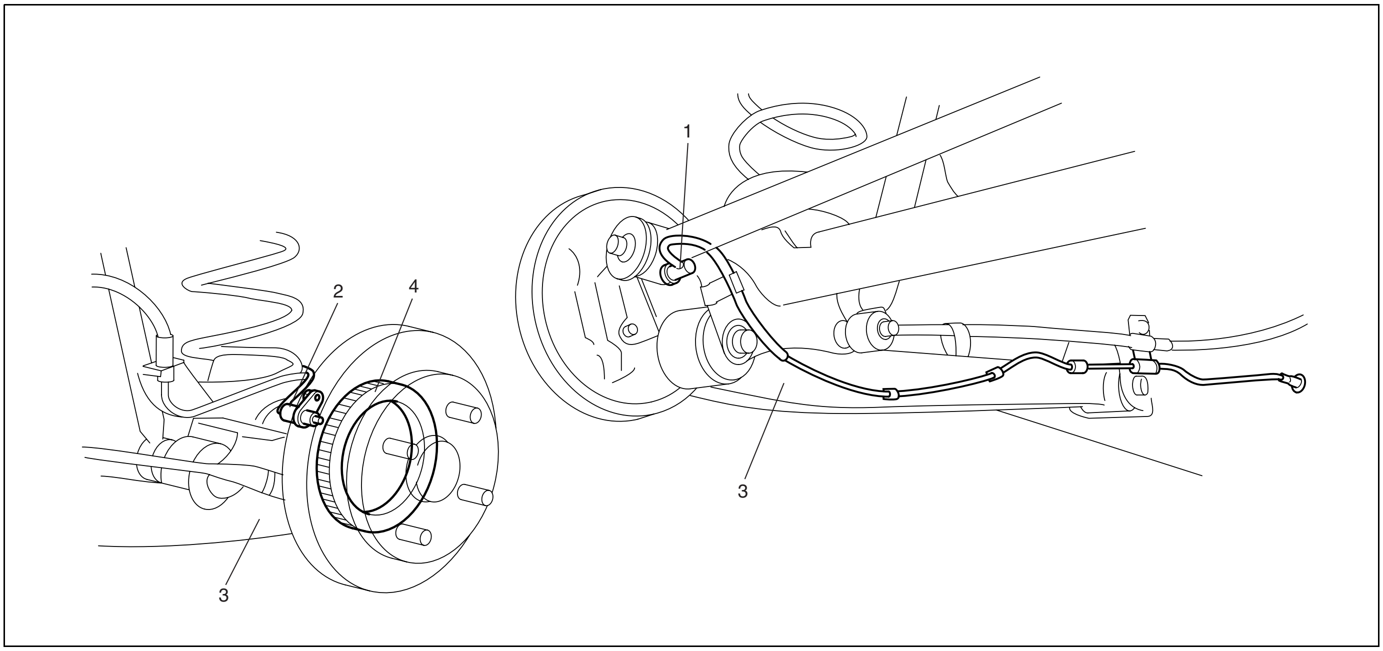
3) Check that there is no clearance between sensor and knuckle.

FRONT WHEEL SPEED SENSOR RING

NOTE:
The front wheel sensor ring can not be removed or replaced alone. If front wheel sensor ring needs to be replaced, replace it as a wheel side joint assembly of drive shaft.

For removal and installation of wheel side joint assembly of drive shaft, refer to "FRONT DRIVE SHAFT" section.

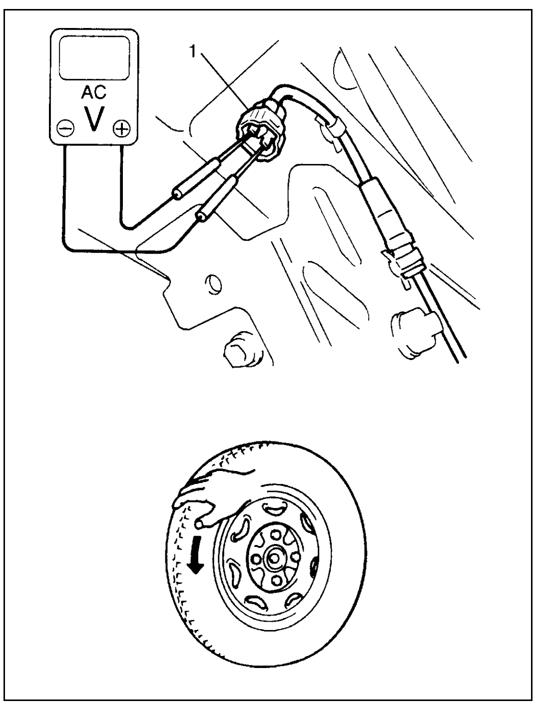
REAR WHEEL SPEED SENSOR



1. Left rear wheel speed sensor	3. Trailing arm
2. Right rear wheel speed sensor	4. Sensor ring

OUTPUT VOLTAGE INSPECTION

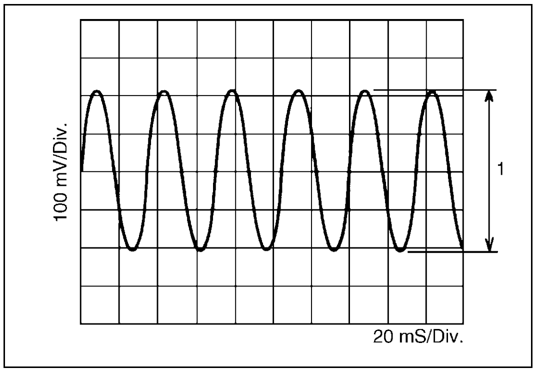
1) Turn ignition switch OFF.
2) Remove rear seat referring to Section 9.
3) Turn over floor carpet.
4) Hoist vehicle.
5) Disconnect connector of wheel speed sensor.



6) Connect voltmeter between connector (1) terminals.
7) While turning wheel at a speed of approximately 1/2 rotation to 1 rotation per second, check AC voltage of sensor.

Output AC voltage at 1/2 to 1 rotation per second
2WD vehicle : 85 mV or more
4WD vehicle : 106 mV or more

8) If measured voltage is not as specified, check sensor, rotor and their installation conditions.



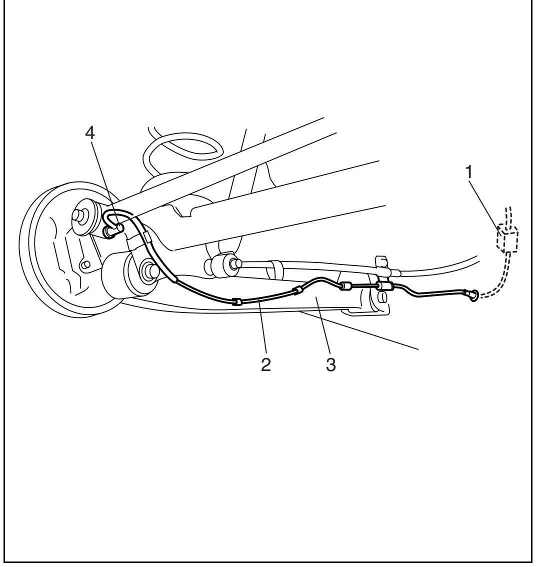
Reference

When using oscilloscope for this check, check if peak-to-peak voltage (1) meets specification and waveform is complete.

Peak-to-peak voltage at 1/2 to 1 rotation per second
2WD vehicle : 120 mV or more at 20 Hz
4WD vehicle : 150 mV or more at 20 Hz

REMOVAL

1) Disconnect negative cable at battery.
2) Remove rear seat referring to Section 9.
3) Turn over floor carpet.
4) Hoist vehicle.



5) Disconnect rear wheel speed sensor coupler (1).
6) Detach ABS wheel sensor wire harness (2) from suspension frame (3).

NOTE:

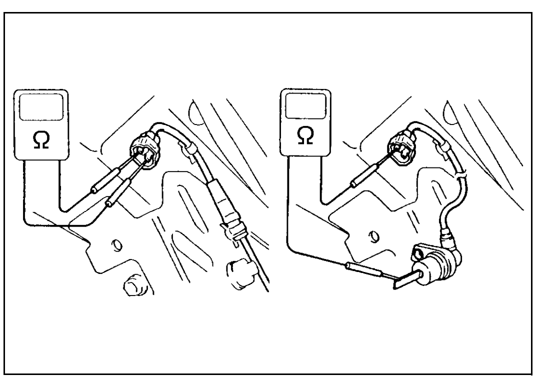
Do not detach crip of rear wheel speed sensor connector from vehicle body unless replacement is necessary.

7) Remove rear wheel speed sensor (4) from rear axle housing.

CAUTION:

- **Do not pull wire harness when removing rear wheel speed sensor.**
- **Do not cause damage to surface of rear wheel speed sensor and do not allow dust, etc. to enter its installation hole.**

SENSOR INSPECTION



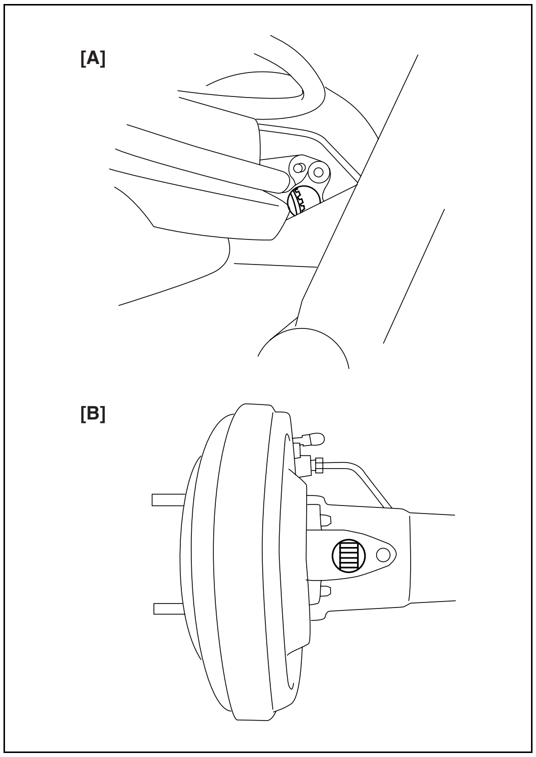
- Check sensor for damage.
- Check sensor for resistance and continuity.

Between both terminals of sensor
2WD vehicle : 0.9 – 1.3 kΩ at 20°C (68°F)
4WD vehicle : 1.2 – 1.6 kΩ at 20°C (68°F)

Between sensor terminal and sensor body
: No continuity

- If the check result is not as specified and any malcondition is found, replace.

SENSOR ROTOR INSPECTION



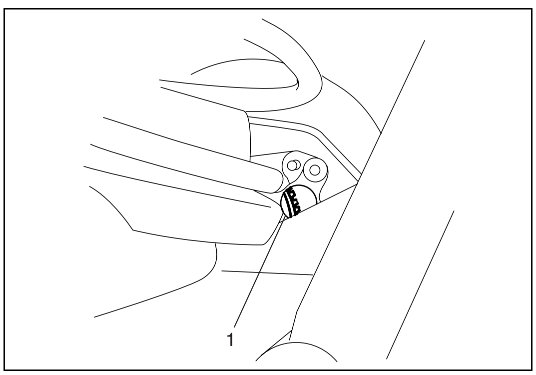
- Check rotor serration (teeth) for being missing, damaged or deformed.

[A] :	For 2WD
[B] :	For 4WD

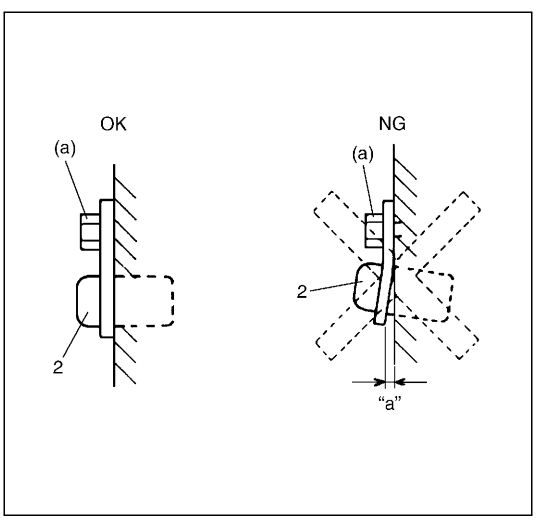
- Turn wheel and check if rotor rotation is free from eccentricity and looseness.
- Check that no foreign material is attached.
- If any faulty is found, repair or replace.

INSTALLATION

Reverse removal procedure for installation noting the following.



- Check that no foreign material is attached to sensor (1) and ring.



- Be sure to install wheel speed sensor and its bolt at the correct (upper) position as shown in figure.
  Tighten sensor bolt to specified torque.

Tightening torque
Sensor bolt (a) : 10 N·m (1.0 kg-m, 7.5 lb-ft)

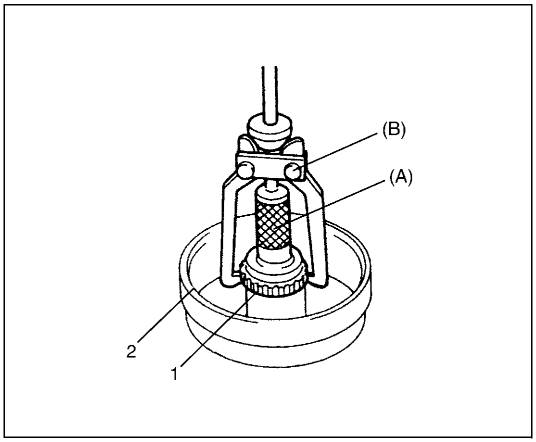
CAUTION:
Do not pull or twist wire harness more than necessary when installing rear wheel speed sensor.

- Check that there is no clearance between sensor and rear axle shaft.

REAR WHEEL SPEED SENSOR RING (FOR 2WD VEHICLE)

REMOVAL

1) Remove rear wheel sensor from rear axle housing.
2) Remove brake drum referring to Section 5.

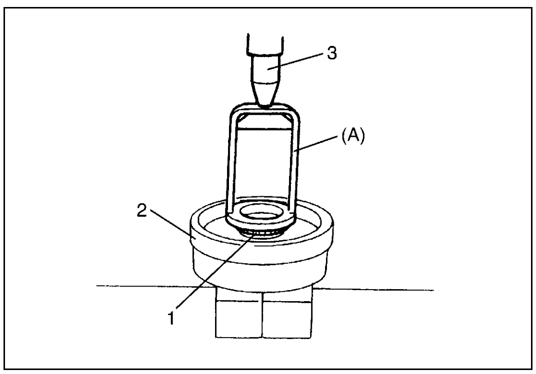


3) Remove sensor ring (1) from brake drum (2) using special tools.

Special tool
(A) : 09913-75520
(B) : 09913-65135

CAUTION:
Pull out sensor ring from brake drum gradually and evenly. Attempt to pull it out partially may cause it to be deformed.

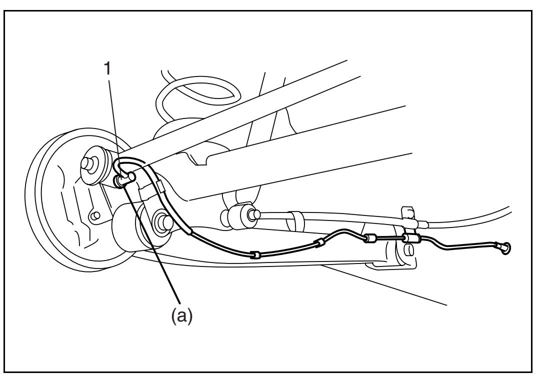
INSTALLATION



NOTE:
Do not reuse (reinstall) removed sensor ring.

1) Install new sensor ring (1) to brake drum (2) using special tool and hydraulic press (3).

Special tool
(A) : 09913-75840

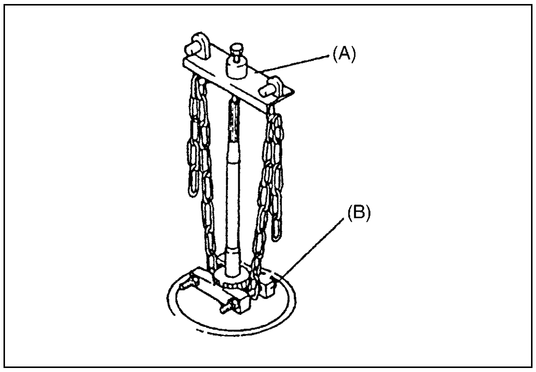


2) Install brake drum. Refer to Section 5.
3) Install rear wheel speed sensor (1) to rear axle housing.

Tightening torque
Rear wheel speed sensor (a) : 10 N·m (1.0 kg-m, 7.5 lb-ft)

REAR WHEEL SPEED SENSOR RING (FOR 4WD VEHICLE)

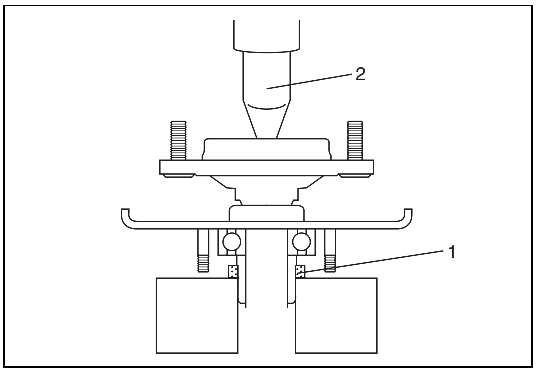
REMOVAL



1) Remove rear axle shaft referring to Section 3E.
2) Remove rear wheel sensor ring from axle shaft by using special tools.

Special tool
(A) : 09927-18411
(B) : 09921-57810

INSTALLATION



NOTE:
- **Do not reuse (reinstall) removed sensor ring.**
- **Do not damage to retainer ring when press fitting wheel sensor ring.**

1) Install new wheel sensor ring (1) by using hydraulic press (2).

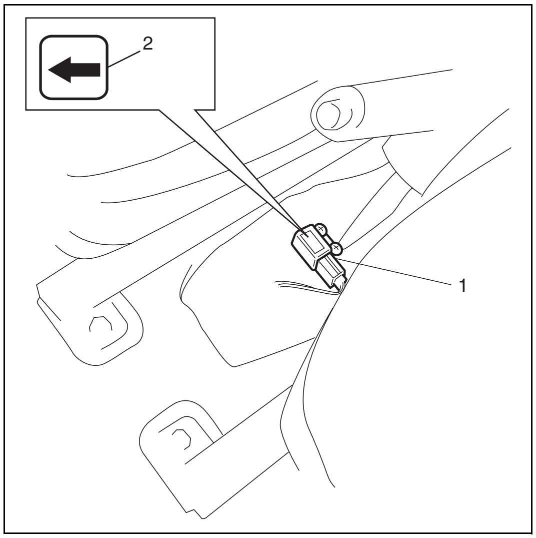
2) Install rear axle shaft referring to Section 3E.
3) Install wheel speed sensor to rear axle housing.

Tightening torque
Wheel sensor ring bolt : 10 N·m (1.0 kg-m, 7.5 lb-ft)

G SENSOR (FOR 4WD VEHICLE ONLY)

REMOVAL

1) Turn ignition switch OFF and disconnect battery negative cable.
2) Remove ABS fuse from fuse box.
3) Disconnect ABS hydraulic unit/control module assembly connector by pulling up lock.
4) Remove center console box.

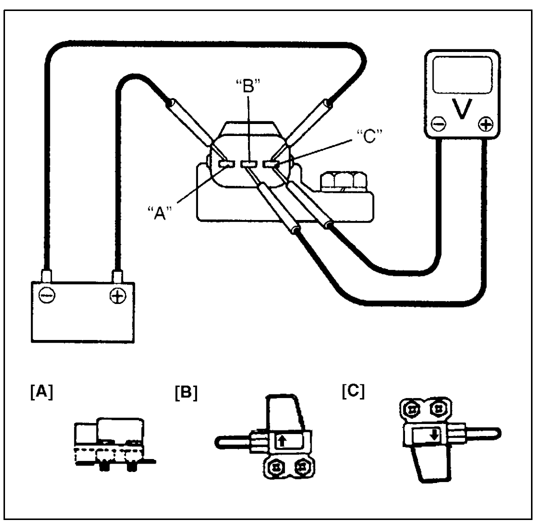


5) Remove G sensor (1) from floor.
6) Disconnect connector from sensor.

> **CAUTION:**
> **Sensor must not be dropped or shocked. It will affect its original performance.**

2. Label

INSPECTION



Connect positive cable of 12 volt battery to "A" terminal of sensor and ground cable to "C" terminal. Then using voltmeter, check voltage between "B" terminal and "C" terminal.

G sensor specification
When placed horizontally : 2 – 3 V
When placed upright with arrow upward : 3 – 4 V
When placed upright with arrow downward : 1 – 2 V

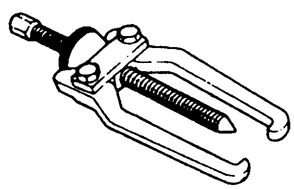
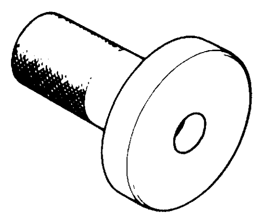
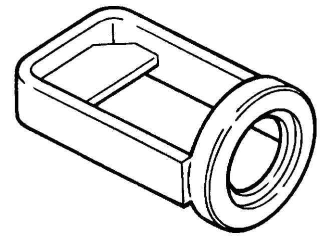
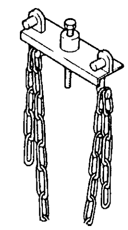
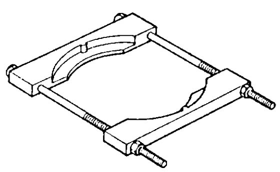
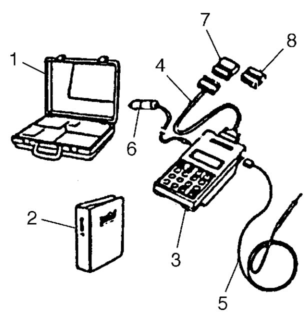
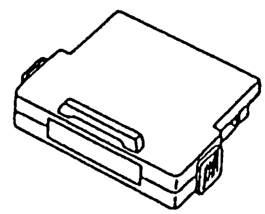
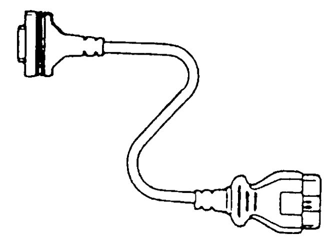
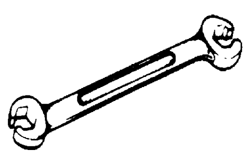
If measured voltage is not as specified, replace sensor.

[A] :	Horizontal
[B] :	Upright with arrow upward
[C] :	Upright with arrow downward

INSTALLATION

1) Connect connector to sensor securely.
2) Install sensor onto floor so that arrow mark directs vehicle forward.
3) Connect ABS hydraulic unit/control module assembly connector.
4) Install ABS fuse to fuse box.
5) Install rear console box.

SPECIAL TOOL

 09913-65135 Bearing puller	 09913-75520 Bearing installing tool	 09913-75840 Sensor ring installer	 09927-18411 Universal puller
 09921-57810 Countershaft holder	 09931-76011 Tech 1A kit (See NOTE below.)	 Mass storage cartridge	 09931-76030 16/14 pin DLC cable
 09950-78220 Flare nut wrench (10 mm)			

NOTE:

This kit includes the following items.

1. Storage case, 2. Operator's manual, 3. Tech 1A, 4. DLC cable, 5. Test lead/probe,
6. Power source cable, 7. DLC cable adaptor, 8. Self-test adaptor

SECTION 6

ENGINE GENERAL INFORMATION AND DIAGNOSIS

WARNING:

For vehicles equipped with Supplemental Restraint (Air Bag) System :

- **Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to "Air Bag System Components and Wiring Location View" under "General Description" in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and "Service Precautions" under "On-Vehicle Service" in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.**
- **Technical service work must be started at least 90 seconds after the ignition switch is turned to the "LOCK" position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).**

NOTE:

Whether the following systems (parts) are used in the particular vehicle or not depends on vehicle specifications. Be sure to bear this in mind when performing service work.

- **EGR valve**
- **Heated oxygen sensor(s) or CO adjusting resistor**
- **Three way catalytic converter**
- **Immobilizer indicator lamp (vehicle with immobilizer indicator lamp can be identified also by HO2S-2)**
- **Knock sensor**

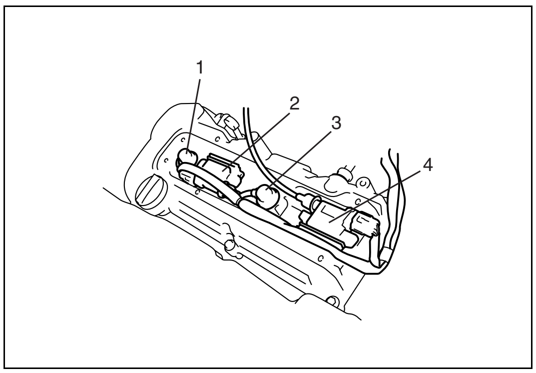
CONTENTS

GENERAL INFORMATION

STATEMENT ON CLEANLINESS AND CARE

An automobile engine is a combination of many machined, honed, polished and lapped surfaces with tolerances that are measured in the thousands of an millimeter (ten thousands of an inch).
Accordingly, when any internal engine parts are serviced, care and cleanliness are important.
Throughout this section, it should be understood that proper cleaning and protection of machined surfaces and friction areas is part of the repair procedure. This is considered standard shop practice even if not specifically stated.

- A liberal coating of engine oil should be applied to friction areas during assembly to protect and lubricate the surfaces on initial operation.
- Whenever valve train components, pistons, piston rings, connecting rods, rod bearings, and crankshaft journal bearings are removed for service, they should be retained in order.
  At the time of installation, they should be installed in the same locations and with the same mating surfaces as when removed.
- Battery cables should be disconnected before any major work is performed on the engine.
  Failure to disconnect cables may result in damage to wire harness or other electrical parts.



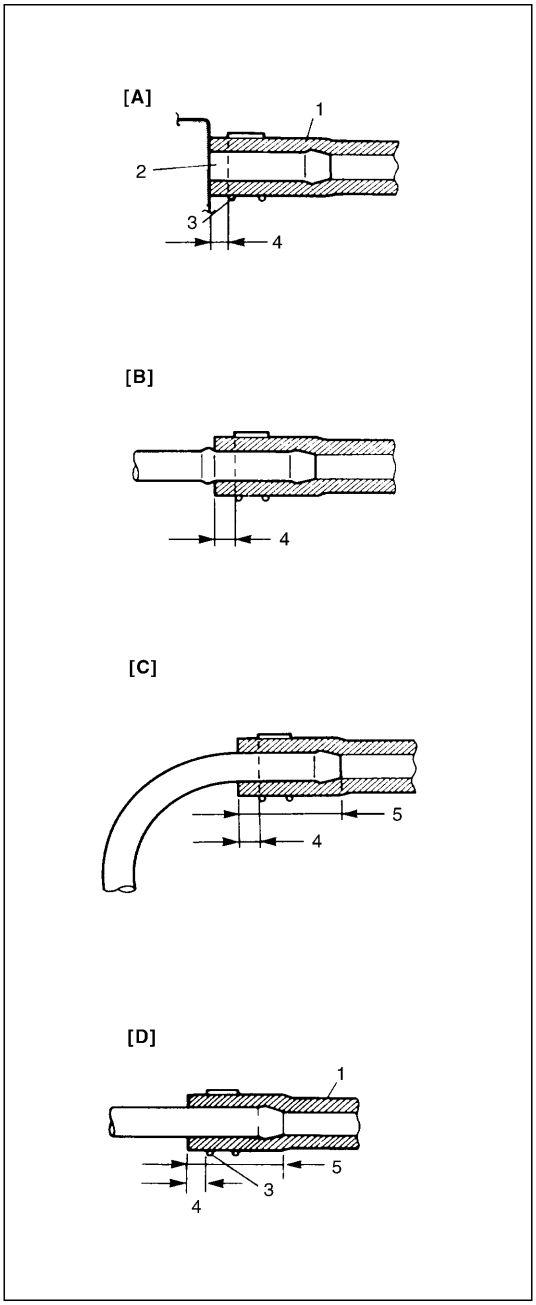
- Throughout this manual, the four cylinders of the engine are identified by numbers; No.1 (1), No.2 (2), No.3 (3) and No.4 (4) counted from crankshaft pulley side to flywheel side.

GENERAL INFORMATION ON ENGINE SERVICE

THE FOLLOWING INFORMATION ON ENGINE SERVICE SHOULD BE NOTED CAREFULLY, AS IT IS IMPORTANT IN PREVENTING DAMAGE, AND IN CONTRIBUTING TO RELIABLE ENGINE PERFORMANCE.

- When raising or supporting engine for any reason, do not use a jack under oil pan. Due to small clearance between oil pan and oil pump strainer, jacking against oil pan may cause it to be bent against strainer resulting in damaged oil pick-up unit.
- It should be kept in mind, while working on engine, that 12-volt electrical system is capable of violent and damaging short circuits.
  When performing any work where electrical terminals can be grounded, ground cable of the battery should be disconnected at battery.
- Any time the air cleaner, throttle body or intake manifold is removed, the intake opening should be covered. This will protect against accidental entrance of foreign material which could follow intake passage into cylinder and cause extensive damage when engine is started.

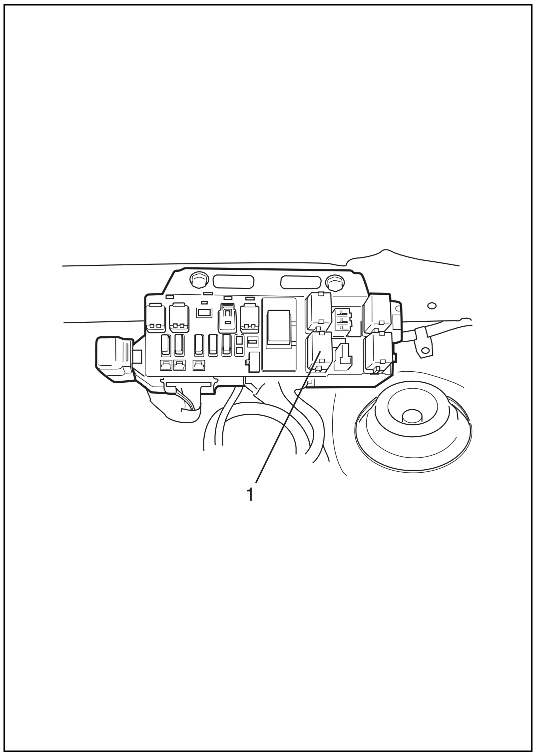
PRECAUTION ON FUEL SYSTEM SERVICE



- Work must be done with no smoking, in a well-ventilated area and away from any open flames.
- As fuel feed line (between fuel pump and fuel delivery pipe) is still under high fuel pressure even after engine was stopped, loosening or disconnecting fuel feed line directly may cause dangerous spout of fuel to occur where loosened or disconnected.
  Before loosening or disconnecting fuel feed line, make sure to release fuel pressure according to "FUEL PRESSURE RELIEF PROCEDURE". A small amount of fuel may be released after the fuel line is disconnected. In order to reduce the chance of personal injury, cover the fitting to be disconnected with a shop cloth. Put that cloth in an approved container when disconnection is completed.
- Never run engine with fuel pump relay disconnected when engine and exhaust system are hot.
- Fuel or fuel vapor hose connection varies with each type of pipe. When reconnecting fuel or fuel vapor hose, be sure to connect and clamp each hose correctly referring to figure Hose Connection.
  After connecting, make sure that it has no twist or kink.
- When installing injector or fuel delivery pipe, lubricate its O-ring with spindle oil or gasoline.
- When connecting fuel pipe flare nut, first tighten flare nut by hand and then tighten it to specified torque.

[A] :	With short pipe, fit hose as far as it reaches pipe joint as shown.
[B] :	With following type pipe, fit hose as far as its peripheral projection as shown.
[C] :	With bent pipe, fit hose as its bent part as shown or till pipe is about 20 to 30 mm (0.79–1.18 in.) into the hose.
[D] :	With straight pipe, fit hose till pipe is, about 20 to 30 mm (0.79–1.18 in.) into the hose.
1.	Hose
2.	Pipe
3.	Clamp
4.	Clamp securely at a position 3 to 7 mm (0.1 2–0.27 in.) from hose end.
5.	20 to 30 mm (0.79–1.18 in.)

FUEL PRESSURE RELIEF PROCEDURE



CAUTION:

This work must not be done when engine is hot. If done so, it may cause adverse effect to catalyst.

After making sure that engine is cold, release fuel pressure as follows.

1) Place transmission gear shift lever in “Neutral” (Shift selector lever to “P” range for A/T model), set parking brake, and block drive wheels.
2) Remove relay box cover.
3) Disconnect fuel pump relay (1) from relay box.
4) Remove fuel filler cap to release fuel vapor pressure in fuel tank and then reinstall it.
5) Start engine and run it till it stops for lack of fuel. Repeat cranking engine 2-3 times for about 3 seconds each time to dissipate fuel pressure in lines. Fuel connections are now safe for servicing.
6) Upon completion of servicing, connect fuel pump relay (1) to relay box and install relay box cover.

FUEL LEAKAGE CHECK PROCEDURE

After performing any service on fuel system, check to make sure that there are no fuel leakages as follows.

1) Turn ON ignition switch for 3 seconds (to operate fuel pump) and then turn it OFF.
   Repeat this (ON and OFF) 3 or 4 times and apply fuel pressure to fuel line. (till fuel pressure is felt by hand placed on fuel feed hose.)
2) In this state, check to see that there are no fuel leakages from any part of fuel system.

ENGINE DIAGNOSIS

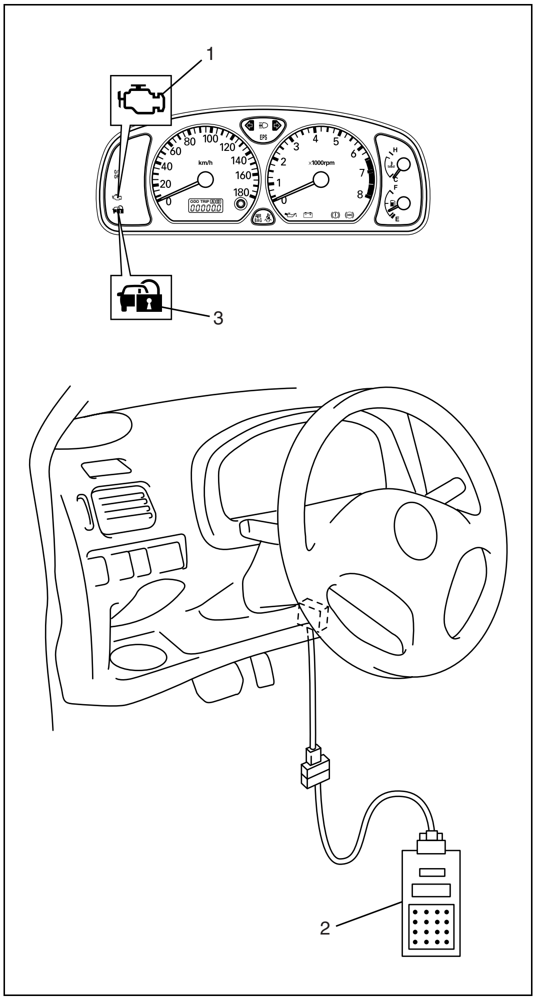
GENERAL DESCRIPTION

This vehicle is equipped with an engine and emission control system which are under control of ECM.

The engine and emission control system in this vehicle are controlled by ECM. ECM has an On-Board Diagnostic system which detects a malfunction in this system and abnormality of those parts that influence the engine exhaust emission. When diagnosing engine troubles, be sure to have full understanding of the outline of “On-Board Diagnostic System” and each item in “Precaution in Diagnosing Trouble” and execute diagnosis according to “ENGINE DIAGNOSTIC FLOW TABLE”.

There is a close relationship between the engine mechanical, engine cooling system, ignition system, exhaust system, etc. and the engine and emission control system in their structure and operation. In case of an engine trouble, even when the malfunction indicator lamp (MIL) doesn’t turn ON, it should be diagnosed according to this flow table.

ON-BOARD DIAGNOSTIC SYSTEM (VEHICLE WITH IMMOBILIZER INDICATOR LAMP)



ECM in this vehicle has following functions.

- When the ignition switch is turned ON with the engine at a stop, malfunction indicator lamp (MIL) (1) turns ON to check the bulb of the malfunction indicator lamp (1).
- When ECM detects a malfunction which gives an adverse effect to vehicle emission while the engine is running, it makes the malfunction indicator lamp (1) in the meter cluster of the instrument panel turn ON or flash (flashing only when detecting a misfire which can cause damage to the catalyst) and stores the malfunction area in its memory.
  (If it detects that continuously 3 driving cycles are normal after detecting a malfunction, however, it makes MIL (1) turn OFF although DTC stored in its memory will remain.)
- As a condition for detecting a malfunction in some areas in the system being monitored by ECM and turning ON the malfunction indicator lamp (1) due to that malfunction, 2 driving cycle detection logic is adopted to prevent erroneous detection.
- When a malfunction is detected, engine and driving conditions then are stored in ECM memory as freeze frame data. (For the details, refer to description on Freeze frame data.)
- It is possible to communicate by using not only SUZUKI scan tool (Tech-1) (2) but also generic scan tool. (Diagnostic information can be accessed by using a scan tool.)

3. Immobilizer indicator lamp

WARM-UP CYCLE

A warm-up cycle means sufficient vehicle operation such that the coolant temperature has risen by at least 22°C (40°F) from engine starting and reaches a minimum temperature of 70°C (160°F).

DRIVING CYCLE

A “Driving Cycle” consists of engine startup, driving mode where a malfunction would be detected if present, and engine shutoff.

2 DRIVING CYCLES DETECTION LOGIC

The malfunction detected in the first driving cycle is stored in ECM memory (in the form of pending DTC and freeze frame data) but the malfunction indicator lamp does not light at this time. It lights up at the second detection of same malfunction also in the next driving cycle.

PENDING DTC

Pending DTC means a DTC detected and stored temporarily at the first driving cycle of the DTC which is detected in the 2 driving cycle detection logic.

[A]

1.	Trouble Code	P0102	(1st)
2.	Engine Speed	782 RPM	
3.	Eng Cool Tmp	80°C	
4.	Vehicle Spd.	0 km/h	
5.	MAP Sensor	39kPa	
6.	St. Term FT1	–0.8% Lean	
7.	Lg. Term FT1	–1.6% Lean	
8.	Fuel 1 Stat.	Closed Loop	
9.	Fuel 2 Stat.	Not used	
10.	Load value	25.5%	[B]

FREEZE FRAME DATA

ECM stores the engine and driving conditions (in the from of data as shown in the figure) at the moment of the detection of a malfunction in its memory. This data is called "Freeze frame data".
Therefore, it is possible to know engine and driving conditions (e.g., whether the engine was warm or not, whether the vehicle was running or stopped, whether air/fuel mixture was lean or rich) when a malfunction was detected by checking the freeze frame data. Also, ECM has a function to store each freeze frame data for three different malfunctions in the order as the malfunction is detected. Utilizing this function, it is possible to know the order of malfunctions that have been detected. Its use is helpful when rechecking or diagnosing a trouble.

Priority of freeze frame data :

ECM has 4 frames where the freeze frame data can be stored. The first frame stores the freeze frame data of the malfunction which was detected first. However, the freeze frame data stored in this frame is updated according to the priority described below. (If malfunction as described in the upper square "1" below is detected while the freeze frame data in the lower square "2" has been stored, the freeze frame data "2" will be updated by the freeze frame data "1".)

[A] :	An Example of Freeze Frame Data
[B] :	1st, 2nd or 3rd in parentheses here represents which position in the order the malfunction is detected.

PRIORITY	FREEZE FRAME DATA IN FRAME 1
1	Freeze frame data at initial detection of malfunction among misfire detected (P0300-P0304), fuel system too lean (P0171) and fuel system too rich (P0172)
2	Freeze frame data when a malfunction other than those in "1" above is detected

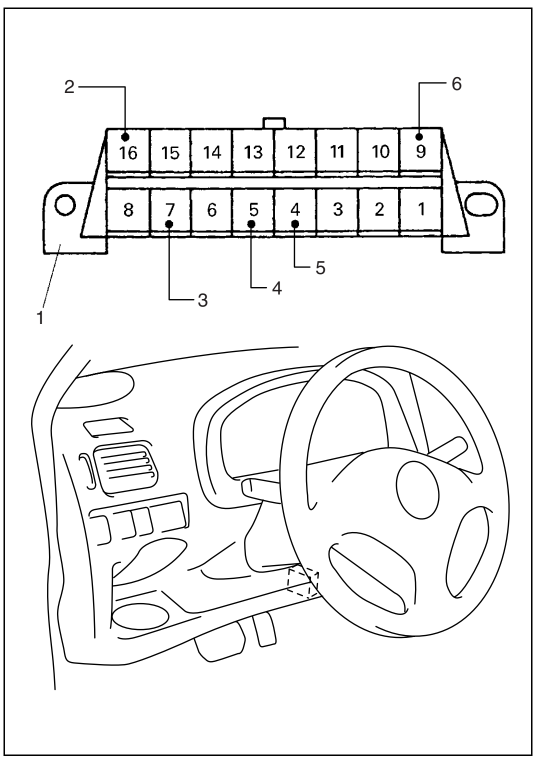
In the 2nd through the 4th frames, the freeze frame data of each malfunction is stored in the order as the malfunction is detected.
These data are not updated.
Shown in the table below are examples of how freeze frame data are stored when two or more malfunctions are detected.

			FRAME			
			FRAME 1	FRAME 2	FRAME 3	FRAME4
			FREEZE FRAME DATA to be updated	1st FREEZE FRAME DATA	2nd FREEZE FRAME DATA	3rd FREEZE FRAME DATA
MALFUNCTION DETECTED ORDER		No malfunction	No freeze frame data			
	1	P0400 (EGR) detected	Data at P0400 detection	Data at P0400 detection	–	–
	2	P0171 (Fuel system) detected	Data at P0171 detection	Data at P0400 detection	Data at P0171 detection	–
	3	P0300 (Misfire) detected	Data at P0171 detection	Data at P0400 detection	Data at P0171 detection	Data at P0300 detection
	4	P0301 (Misfire) detected	Data at P0171 detection	Data at P0400 detection	Data at P0171 detection	Data at P0300 detection

Freeze Frame Data Clearance :

The freeze frame data is cleared at the same time as clearance of diagnostic trouble code (DTC).

DATA LINK CONNECTOR (DLC)

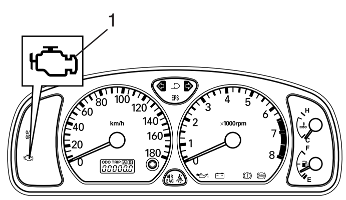


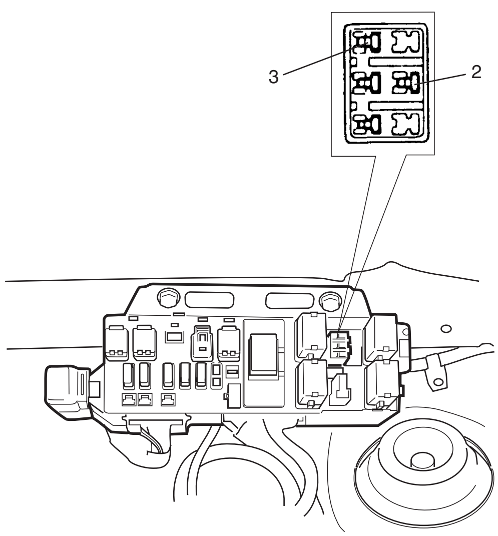
DLC (1) is in compliance with SAEJ1962 in its installation position, the shape of connector and pin assignment.

Serial data line (K line of ISO 9141) is used for SUZUKI scan tool (Tech-1) or generic scan tool to communicate with ECM, TCM, ABS control module and Air bag SDM.
SUZUKI serial data line is used for SUZUKI scan tool (Tech -1) to communicate with immobilizer control module.

2.	B+
3.	Serial data line (K line of ISO 9141)
4.	ECM ground
5.	Body ground
6.	SUZUKI serial data line

ON-BOARD DIAGNOSTIC SYSTEM (VEHICLE WITHOUT IMMOBILIZER INDICATOR LAMP)





ECM diagnosis troubles which may occur in the area including the following parts when the ignition switch is ON and the engine is running, and indicates the result by turning on or flashing malfunction indicator lamp (1).

- Heated oxygen sensor (if equipped)
- ECT sensor
- TP sensor
- IAT sensor
- MAP sensor
- CMP sensor
- CKP sensor
- Knock sensor (if equipped)
- VSS
- CPU (Central Processing Unit) of ECM

ECM and malfunction indicator lamp (1) operate as follows.

- Malfunction indicator lamp (1) lights when the ignition switch is turned ON (but the engine at stop) with the diagnosis switch terminal ungrounded regardless of the condition of Engine and Emission control system. This is only to check the malfunction indicator lamp (1) bulb and its circuit.
- If the above areas of Engine and Emission control system are free from any trouble after the engine start (while engine is running), malfunction indicator lamp (1) turns OFF.
- When ECM detects a trouble which has occurred in the above areas, it makes malfunction indicator lamp (1) turn ON while the engine is running to warn the driver of such occurrence of trouble and at the same time it stores the trouble area in ECM back-up memory. (The memory is kept as it is even if the trouble was only temporary and disappeared immediately. And it is not erased unless the power to ECM is shut off for specified time below.)

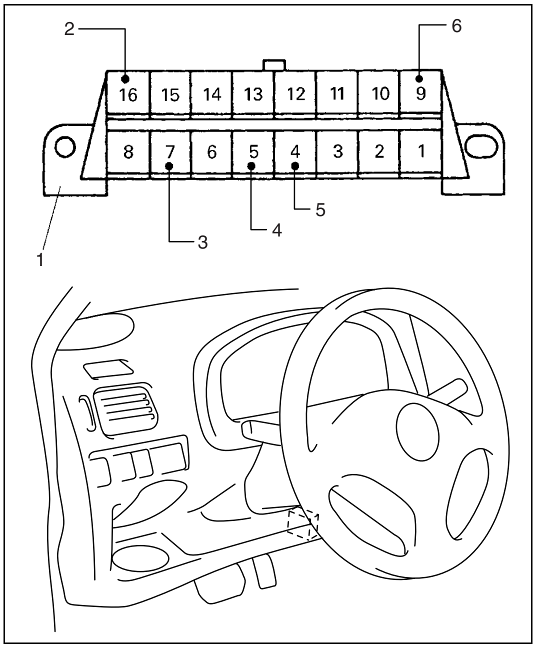
  ECM also indicates trouble area in memory by means of flashing of malfunction indicator lamp (1) at the time of inspection. (i.e. when diagnosis switch terminal (2) is connected to ground terminal (3) with a service wire and ignition switch is turned ON.)

NOTE:

- **When a trouble occurs in the above areas and disappears soon while the diagnosis switch terminal is ungrounded and the engine is running, malfunction indicator lamp (1) lights and remains ON as long as the trouble exists but it turns OFF when the normal condition is restored.**
- **Time required to erase diagnostic trouble code memory thoroughly varies depending on ambient temperature as follows.**

AMBIENT TEMPERATURE	TIME TO CUT POWER TO ECM
Over 0°C (32°F)	60 sec. or longer
Under 0°C (32°F)	Not specifiable. Select a place with temperature higher than 0°C (32°F).

DATA LINK CONNECTOR (DLC)



ELC (1) is in compliance with SAEJ1962 in its installation position, the shape of connector and pin assignment.

Serial data line (K line of ISO 9141) is used for SUZUKI scan tool (Tech-1) to communicate with ECM, TCM, ABS control module and Air bag SDM.
SUZUKI serial data line is used for SUZUKI scan tool (Tech -1) to communicate with immobilizer control module.

2.	B+
3.	Serial data line (K line of ISO 9141)
4.	ECM ground
5.	Body ground
6.	SUZUKI serial data line

PRECAUTION IN DIAGNOSING TROUBLE

- Do not disconnect couplers from ECM, battery cable from battery, ECM ground wire harness from engine or main fuse before confirming diagnostic information (DTC, freeze frame data, etc.) stored in ECM memory. Such disconnection will erase memorized information in ECM memory.
- Diagnostic information stored in ECM memory can be cleared as well as checked by using SUZUKI scan tool (Tech-1) or generic scan tool (Vehicle with immobilizer indicator lamp). Before using scan tool, read its Operator’s (Instruction) Manual carefully to have good understanding as to what functions are available and how to use it.
- Priorities for diagnosing troubles (Vehicle with immobilizer indicator lamp).
  If two or more DTCs are stored, proceed to the flow table of the DTC which has detected earliest in the order (it can be identified by referring to freeze frame data) and follow the instruction in that table.
  If no instructions are given, troubleshoot diagnostic trouble codes according to the following priorities.
  – Diagnostic trouble codes (DTCs) other than DTC P0171/P0172 (Fuel system too lean/too rich), DTC P0300/P0301/P0302/P0303/P0304 (Misfire detected) and DTC P0400 (EGR flow malfunction)
  – DTC P0171/P0172 (Fuel system too lean/too rich) and DTC P0400 (EGR flow malfunction)
  – DTC P0300/P0301/P0302/P0303/P0304 (Misfire detected)
- Be sure to read “Precautions for Electrical Circuit Service” in Section 0A before inspection and observe what is written there.
- ECM Replacement
  When substituting a known-good ECM, check for following conditions. Neglecting this check may cause damage to a known-good ECM.
  – Resistance value of all relays, actuators is as specified respectively.
  – MAP sensor and TP sensor are in good condition and none of power circuits of these sensors is shorted to ground.

ENGINE DIAGNOSTIC FLOW TABLE

Refer to the following pages for the details of each step.

<table>
<tr><th>Step</th><th>Action</th><th>Yes</th><th>No</th></tr>
<tr><td>1</td><td>Customer Complaint Analysis
1) Perform customer complaint analysis referring to the followings.
Was customer complaint analysis performed?</td><td>Go to Step 2.</td><td>Perform customer complaint analysis.</td></tr>
<tr><td>2</td><td>DTC and Freeze Frame Data Check, Record and Clearance
1) Check for DTC (including pending DTC) referring to the followings.
Is there any DTC(s)?</td><td>Print DTC and freeze frame data or write them down and clear them by referring to “DTC Clearance” section.
Go to Step 3.</td><td>Go to Step 4.</td></tr>
<tr><td>3</td><td>Visual Inspection
1) Perform visual inspection referring to the followings.
Is there any faulty condition?</td><td rowspan="2">Repair or replace malfunction part.
Go to Step 11.</td><td>Go to Step 5.</td></tr>
<tr><td>4</td><td>Visual Inspection
1) Perform visual inspection referring to the followings.
Is there any faulty condition?</td><td>Go to Step 8.</td></tr>
<tr><td>5</td><td>Trouble Symptom Confirmation
1) Confirm trouble symptom referring to the followings.
Is trouble symptom identified?</td><td>Go to Step 6.</td><td>Go to Step 7.</td></tr>
<tr><td>6</td><td>Rechecking and Record of DTC/Freeze Frame Data
1) Recheck for DTC and freeze frame data referring to “DTC Check” section.
Is there any DTC(s)?</td><td rowspan="2">Go to Step 9.</td><td>Go to Step 8.</td></tr>
<tr><td>7</td><td>Rechecking and Record of DTC/Freeze Frame Data
1) Recheck for DTC and freeze frame data referring to “DTC Check” section.
Is there any DTC(s)?</td><td>Go to Step 10.</td></tr>
<tr><td>8</td><td>Engine Basic Inspection and Engine Diagnosis Table
1) Check and repair according to “Engine Basic Check” and “Engine Diagnosis Table” section.
Are check and repair complete?</td><td rowspan="2">Go to Step 11.</td><td rowspan="2">Check and repair malfunction part(s).
Go to Step 11.</td></tr>
<tr><td>9</td><td>Trouble shooting for DTC
1) Check and repair according to applicable DTC diag. flow table.
Are check and repair complete?</td></tr>
<tr><td>10</td><td>Check for Intermittent Problems
1) Check for intermittent problems by referring to the followings.
Is there any faulty condition?</td><td>Repair or replace malfunction part(s).
Go to Step 11.</td><td>Go to Step 11.</td></tr>
<tr><td>11</td><td>Final Confirmation Test
1) Clear DTC if any.
2) Perform final confirmation test by referring to the followings.
Is there any problem symptom, DTC or abnormal condition?</td><td>Go to Step 6.</td><td>End.</td></tr>
</table>

1. CUSTOMER COMPLAINT ANALYSIS

Record details of the problem (failure, complaint) and how it occurred as described by the customer. For this purpose, use of such an inspection form will facilitate collecting information to the point required for proper analysis and diagnosis.

2. DTC/FREEZE FRAME DATA CHECK, RECORD AND CLEARANCE

First, check DTC (including pending DTC), referring to “DTC check” section. If DTC is indicated, print it and freeze frame data or write them down and then clear them by referring to “DTC clearance” section. DTC indicates malfunction that occurred in the system but does not indicate whether it exists now or it occurred in the past and the normal condition has been restored now. To check which case applies, check the symptom in question according to Step 4 and recheck DTC according to Step 5.
Attempt to diagnose a trouble based on DTC in this step only or failure to clear the DTC in this step will lead to incorrect diagnosis, trouble diagnosis of a normal circuit or difficulty in troubleshooting.

NOTE:

If only Automatic transmission DTCs (P0702-P1709) or Immobilizer DTCs (P1620-P1623) are indicated in this step, perform trouble diagnosis according to “Diagnosis” in Section 7B or Section 8G.

3. and 4. VISUAL INSPECTION

As a preliminary step, be sure to perform visual check of the items that support proper function of the engine referring to “Visual Inspection” section.

5. TROUBLE SYMPTOM CONFIRMATION

Based on information obtained in Step 1 Customer complaint analysis and Step 2 DTC/freeze frame data check, confirm trouble symptoms. Also, reconfirm DTC according to “DTC Confirmation Procedure” described in each DTC Diagnosis section.

6. and 7. RECHECKING AND RECORD OF DTC/FREEZE FRAME DATA

Refer to “DTC check” section for checking procedure.

8. ENGINE BASIC INSPECTION AND ENGINE DIAGNOSIS TABLE

Perform basic engine check according to the “Engine Basic Inspection Flow Table” first. When the end of the flow table has been reached, check the parts of the system suspected as a possible cause referring to ENGINE DIAGNOSIS TABLE and based on symptoms appearing on the vehicle (symptoms obtained through steps of customer complaint analysis, trouble symptom confirmation and/or basic engine check) and repair or replace faulty parts, if any.

9. TROUBLESHOOTING FOR DTC (See each DTC Diag. Flow Table)

Based on the DTC indicated in Step 5 and referring to the applicable DTC diag. flow table in this section, locate the cause of the trouble, namely in a sensor, switch, wire harness, connector, actuator, ECM or other part and repair or replace faulty parts.

10. CHECK FOR INTERMITTENT PROBLEM

Check parts where an intermittent trouble is easy to occur (e.g., wire harness, connector, etc.), referring to “INTERMITTENT AND POOR CONNECTION” in Section 0A and related circuit of DTC recorded in Step 2.

11. FINAL CONFIRMATION TEST

Confirm that the problem symptom has gone and the engine is free from any abnormal conditions. If what has been repaired is related to the DTC, clear the DTC once, perform DTC confirmation procedure and confirm that no DTC is indicated.

CUSTOMER PROBLEM INSPECTION FORM (EXAMPLE)

User name:	Model:	VIN:	
Date of issue:	Date Reg.	Date of problem:	Mileage:

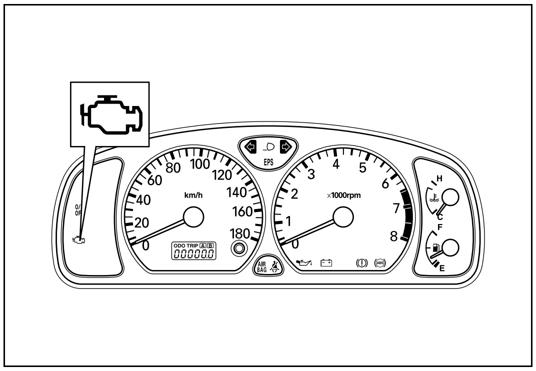
PROBLEM SYMPTOMS	
☐ **Difficult Starting** ☐ No cranking ☐ No initial combustion ☐ No combustion ☐ Poor starting at (☐cold ☐warm ☐always) ☐ Other________	☐ **Poor Driveability** ☐ Hesitation on acceleration ☐ Back fire/☐After fire ☐ Lack of power ☐ Surging ☐ abnormal knocking ☐ Other________
☐ **Poor Idling** ☐ Poor fast idle ☐ Abnormal idling speed (☐High ☐Low) (r/min.) ☐ Unstable ☐ Hunting (r/min. to r/min.) ☐ Other________	☐ **Engine Stall when** ☐ Immediately after start ☐ Accel. pedal is depressed ☐ Accel. pedal is released ☐ Load is applied ☐ A/C ☐Electric load ☐P/S ☐ Other________ ☐ Other________
☐ OTHERS:	

VEHICLE/ENVIRONMENTAL CONDITION WHEN PROBLEM OCCURS	
Environmental Condition	
Weather	☐Fair ☐Cloudy ☐Rain ☐Snow ☐Always ☐Other________
Temperature	☐Hot ☐Warm ☐Cool ☐Cold (°F/ °C) ☐Always
Frequency	☐Always ☐Sometimes (times/ day, month) ☐Only once ☐Under certain condition
Road	☐Urban ☐Suburb ☐Highway ☐Mountainous (☐Uphill ☐Downhill) ☐Tarmacadam ☐Gravel ☐Other________
Vehicle Condition	
Engine condition	☐Cold ☐Warming up phase ☐Warmed up ☐Always ☐Other at starting ☐Immediately after start ☐Racing without load ☐Engine speed (r/min)
Vehicle condition	During driving: ☐Constant speed ☐Accelerating ☐Decelerating ☐Right hand corner ☐Left hand corner ☐When shifting (Lever position) ☐At stop ☐Vehicle speed when problem occurs (km/h, Mile/h) ☐Other

Malfunction indicator lamp condition	☐Always ON ☐Sometimes ON ☐Always OFF ☐Good condition	
Diagnostic trouble code	First check:	☐No code ☐Malfunction code ( )
	Second check:	☐No code ☐Malfunction code ( )

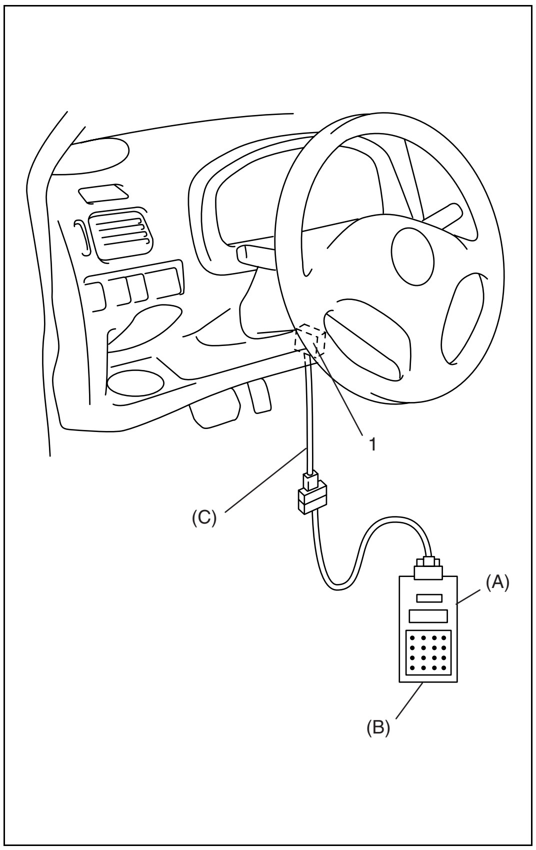
NOTE:

The above form is a standard sample. It should be modified according to conditions characteristic of each market.



MALFUNCTION INDICATOR LAMP (MIL) CHECK

1) Turn ON ignition switch (but the engine at stop) and check that MIL lights.
   If MIL does not light up (or MIL dims), go to "Diagnostic Flow Table A-1" for troubleshooting.
   If MIL flushes, go to "Diagnostic Flow Table A-3" (vehicle without immobilizer indicator lamp).
2) Start engine and check that MIL turns OFF.
   If MIL remains ON and no DTC is stored in ECM, go to "Diagnostic Flow Table A-2" for troubleshooting.



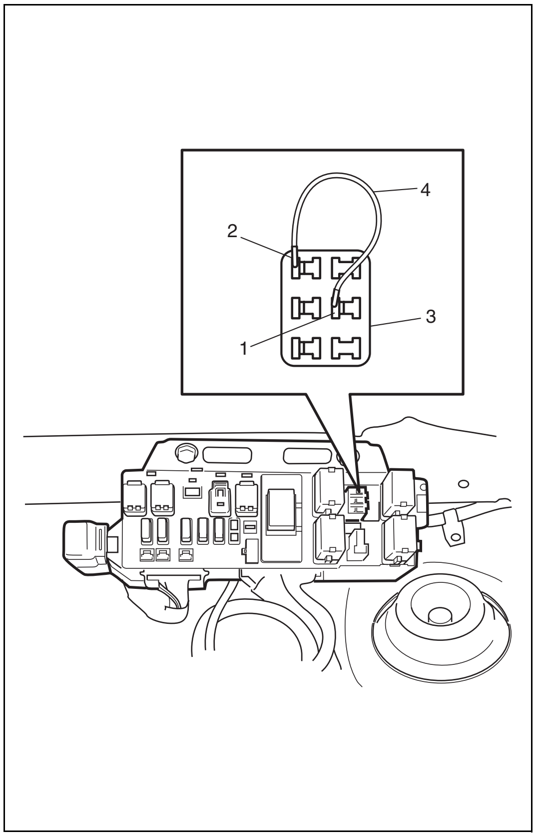
DIAGNOSTIC TROUBLE CODE (DTC) CHECK

[Using SUZUKI Scan Tool]

1) Prepare SUZUKI scan tool (Tech-1).
2) With ignition switch OFF, connect it to data link connector (DLC) (1) located on underside of instrument panel at driver's seat side.

   Special tool
   (A) : SUZUKI scan tool
   (B) : Mass storage cartridge
   (C) : 16/14 pin DLC cable

3) Turn ignition switch ON and confirm that MIL lights.
4) Read DTC, pending DTC and freeze frame data according to instructions displayed on scan tool and print it or write it down.
   Refer to scan tool operator's manual for further details.
   If communication between scan tool and ECM is not possible, check if scan tool is communicable by connecting it to ECM in another vehicle. If communication is possible in this case, scan tool is in good condition. Then check data link connector and serial data line (circuit) in the vehicle with which communication was not possible.
5) After completing the check, turn ignition switch off and disconnect scan tool from data link connector.



[Without Using SUZUKI Scan Tool] (Vehicle without Immobilizer Indicator Lamp)

1) Check malfunction indicator lamp referring to "Malfunction Indicator Lamp Check" in this section.
2) With the ignition switch OFF position, disconnect SUZUKI scan tool if connected and using service wire (4), connect diagnosis switch terminal (1) to ground terminal (2) in monitor coupler (3).
3) With the ignition switch ON position and leaving engine OFF, read DTC from flashing pattern of malfunction indicator lamp. Refer to "Diagnostic Trouble Code Table".
   If lamp remains ON, go to "Diagnostic Flow Table A-4".

NOTE:

- **If abnormality or malfunction lies in two or more areas, malfunction indicator lamp indicates applicable codes three times each.**
  And flashing of these codes is repeated as long as diagnosis terminal is grounded and ignition switch is held at ON position.
- **Take a note of diagnostic trouble code indicated first.**

4) After completing the check, turn the ignition switch OFF position and disconnect service wire from monitor coupler.

DIAGNOSTIC TROUBLE CODE (DTC) CLEARANCE

Using Scan Tool

1) Connect SUZUKI scan tool (Tech-1) or generic scan tool (Vehicle with immobilizer indicator lamp) to data link connector in the same manner as when making this connection for DTC check.
2) Turn ignition switch ON.
3) Erase DTC and pending DTC according to instructions displayed on scan tool. Refer to scan tool operator's manual for further details.
4) After completing the clearance, turn ignition switch off and disconnect scan tool from data link connector.

NOTE:

DTC and freeze frame data stored in ECM memory are also cleared in following cases. Be careful not to clear them before keeping their record.

- **When power to ECM is cut off (by disconnecting battery cable, removing fuse or disconnecting ECM connectors)**
- **When the same malfunction (DTC) is not detected again during 40 engine warm-up cycles. (Vehicle with immobilizer indicator lamp)**

Without Using Scan Tool

1) Turn the ignition switch OFF position.
2) Disconnect battery negative cable for specified time below to erase diagnostic trouble code stored in ECM memory and reconnect it.

Time required to erase DTC :

Ambient temperature	Time to cut power to ECM
Over 0°C (32°F)	30 sec. or longer
Under 0°C (32°F)	Not specifiable. Select a place with higher than 0°C (32°F) temperature.

DIAGNOSTIC TROUBLE CODE (DTC) TABLE

DTC NO.	DETECTING ITEM	DETECTING CONDITION (DTC will set when detecting :)	MIL (vehicle with immobilizer indicator lamp)	MIL (vehicle without immobilizer indicator lamp)
P0105 (No.11)	Manifold absolute pressure circuit malfunction	Low pressure-high vacuum-low voltage (or MAP sensor circuit shorted to ground) High pressure-low vacuum-high voltage (or MAP sensor circuit open)	1 driving cycle	1 driving cycle
P0110 (No.18)	Intake air temp. circuit malfunction	Intake air temp. circuit low input Intake air temp. circuit high input	1 driving cycle	1 driving cycle
P0115 (No.19)	Engine coolant temp. circuit malfunction	Engine coolant temp. circuit low input Engine coolant temp. circuit high input	1 driving cycle	1 driving cycle
P0120 (No.13)	Throttle position circuit malfunction	Throttle position circuit low input Throttle position circuit high input	1 driving cycle	1 driving cycle
P0121	Throttle position circuit performance problem	Poor performance of TP sensor	2 driving cycles	Not applicable
P0130 (No.14)	HO2S circuit malfunction (Sensor-1)	Min. output voltage of HO2S-higher than specification Max. output voltage of HO2S-lower than specification	2 driving cycle	1 driving cycle
P0133	HO2S circuit slow response (Sensor-1)	Response time of HO2S-1 output voltage between rich and lean is longer than specification.	2 driving cycles	Not applicable
P0134	HO2S circuit no activity detected (Sensor-1)	Output voltage of HO2S-1 fails to go above specification (or HO2S-1 circuit shorted to ground).	2 driving cycles	1 driving cycle
P0135 (No.14)	HO2S heater circuit malfunction (Sensor-1)	Terminal voltage is lower than specification at heater OFF or it is higher at heater ON.	2 driving cycles	1 driving cycle
P0136	HO2S circuit malfunction (Sensor-2)	Max. voltage of HO2S-2 is lower than specification or its min. voltage is higher than specification	2 driving cycles	Not applicable

DTC NO.	DETECTING ITEM	DETECTING CONDITION (DTC will set when detecting :)	MIL (vehicle with immobilizer indicator lamp)	MIL (vehicle without immobilizer indicator lamp)
P0141	HO2S heater circuit malfunction (Sensor-2)	Terminal voltage is lower than specification at heater OFF or it is higher at heater ON. (or heater circuit or short)	2 driving cycles	Not applicable
P0171	Fuel system too lean	Short term fuel trim or total fuel trim (short and long terms added) is larger than specification for specified time or longer. (fuel trim toward rich side is large.)	2 driving cycles	Not applicable
P0172	Fuel system too rich	Short term fuel trim or total fuel trim (short and long term added) is smaller than specification for specified time or longer. (fuel trim toward lean side is large.)	2 driving cycles	Not applicable
P0300 P0301 P0302 P0303 P0304	Random misfire detected Cylinder 1 misfire detected Cylinder 2 misfire detected Cylinder 3 misfire detected Cylinder 4 misfire detected	Misfire of such level as to cause damage to three way catalyst	MIL flashing during misfire detection	Not applicable
		Misfire of such level as to deteriorate emission but not to cause damage to three way catalyst	2 driving cycles	Not applicable
P0325 (No.17)	Knock sensor circuit malfunction	Knock sensor circuit low input Knock sensor circuit high input	1 driving cycle	1 driving cycle
P0335 (No.23)	Crankshaft position sensor circuit malfunction	No signal for 2 sec. during engine cranking	1 driving cycle	1 driving cycle
P0340 (No.15)	Camshaft position sensor circuit malfunction	No signal during engine running	1 driving cycle	1 driving cycle
P0400	Exhaust gas recirculation flow malfunction detected	Excessive or insufficient EGR flow	2 driving cycles	Not applicable
P0420	Catalyst system efficiency below threshold	Output waveforms of HO2S-1 and HO2S-2 are similar. (Time from output voltage change of HO2S-1 to that of HO2S-2 is shorter than specification.)	2 driving cycles	Not applicable
P0443	Purge control valve circuit malfunction	Purge control valve circuit is open or shorted to ground	2 driving cycles	Not applicable
P0480	Radiator fan control circuit malfunction	Radiator cooling fan relay terminal voltage is low when cooling temp. is lower than specification	2 driving cycles	Not applicable
P0500 (No.16)	Vehicle speed sensor malfunction	No signal while running in “D” range or during fuel cut at decelerating	2 driving cycles	1 driving cycle
P0505	Idle control system malfunction	No closed signal to IAC valve is detected	2 driving cycles	Not applicable
P0601 (No.71)	Internal control module memory check sum error	Data write error (or check sum error) when written into ECM	2 driving cycles	1 driving cycle
P1450 (No.29)	Barometric pressure sensor circuit malfunction	Barometric pressure is lower or higher than specification. (or sensor malfunction)	1 driving cycle	1 driving cycle

DTC NO.	DETECTING ITEM	DETECTING CONDITION (DTC will set when detecting :)	MIL (vehicle with immobilizer indicator lamp)	MIL (vehicle without immobilizer indicator lamp)
P1451	Barometric pressure sensor performance problem	Difference between manifold absolute pressure (MAP sensor value) and barometric pressure (barometric pressure sensor value) is larger than specification during cranking.	2 driving cycles	Not applicable
P1500	Starter signal circuit malfunction	Starter signal is not inputted from engine cranking till its start and after or it is always inputted	2 driving cycles	Not applicable
P1510	ECM backup power source malfunction	No backup power after starting engine	1 driving cycle	Not applicable
P1600	Serial communication problem between ECM and TCM	No signal or check sum error while engine running	1 driving cycle	Not applicable
P1717	AT D-range signal circuit malfunction	No “D” range (park/neutral position signal) is inputted while vehicle running	2 driving cycles	Not applicable

DTC NO.	DETECTING ITEM	DETECTING CONDITION (DTC will set when detecting :)	MIL
✱P0702	Transmission Control System Electrical	Refer to Section 7B	
✱P0705	Transmission Range Sensor Circuit Malfunction		
✱P0710	Transmission Fluid Temperature Sensor Circuit Malfunction		
✱P0715	Input/turbine Speed Sensor Circuit Malfunction		
✱P0720	Output Shaft Speed Sensor Circuit Malfunction		
✱P0725	Engine Speed Input Circuit Malfunction		
✱P0730	Incorrect Gear Ratio		
✱P0741	Torque Converter Clutch System Performance or Stuck Off		
✱P0743	Torque Converter Clutch System Electrical		
✱P0753	Shift Solenoid A Electrical		
✱P0758	Shift Solenoid B Electrical		
✱P0763	Shift Solenoid C Electrical		
✱P0768	Shift Solenoid D Electrical		
✱P0773	Shift Solenoid E Electrical		
✱P1700	Throttle Position Signal Input Malfunction		
✱P1702	Internal Control Module Memory Check Some Error		
✱P1709	Engine Coolant Temperature Signal Input Malfunction		

DTC NO.	DETECTING ITEM	DETECTING CONDITION (DTC will set when detecting :)	MIL
P1620 (No.84)	ECU code not registered	Refer to Section 8G	
P1621 (No.83)	No ECU code transmitted from Immobilizer Control Module		
P1622 (No.82)	Fault in ECM		
P1623 (No.81)	ECU code not matched		

NOTE:
- **For ( ) marked No. in DTC column, it is used for vehicle without immobilizer indication lamp.**
- **DTC No.12 appears when none of the other codes is identified.**
- **For vehicle with immobilizer indication lamp, star (✱) marked DTCs can be read with SUZUKI scan tool ECM application.**

FAIL-SAFE TABLE

When any of the following DTCs is detected, ECM enters fail-safe mode as long as malfunction continues to exist but that mode is canceled when ECM detects normal condition after that.

DTC NO.	TROUBLE AREA	FAIL-SAFE OPERATION	SYMPTOM
P0105 (No.11)	MAP SENSOR	ECM uses value determined by throttle opening and engine speed. ECM stops EGR, EVAP purge and idle air control.	Hard starting/ rough or incorrect idle/ excessive fuel consumption/ hesitation/ poor acceleration/ surge/ detonation or spark knock
P0110 (No.18)	IAT SENSOR	ECM controls actuators assuming that intake air temperature is 20°C.	Hard starting/ rough or incorrect idle/ excessive fuel consumption/ hesitation poor acceleration/ detonation or spark knock
P0115 (No.19)	ECT SENSOR	ECM controls actuators assuming that engine coolant temperature is 80°C. Radiator fan motor ON.	Hard starting/ rough or incorrect idle/ excessive fuel consumption/ hesitation poor acceleration/ detonation or spark knock
P0120 (No.13)	TP SENSOR	ECM controls actuators assuming that throttle opening is 20°.	Rough or incorrect idle/ excessive fuel consumption/ hesitation/ poor acceleration
P0130, P0134 (No.14)	HEATED OXYGEN SENOR-1	–	Hard starting/rough or incorrect idle/ excessive fuel consumption/ hesitation/ poor acceleration
P0325 (No.17)	KNOCK SENSOR	–	Detonation/ spark knock
P0335 (No.23)	CKP SENSOR	• Fix ignition timing. • ECM changes injection control system from sequential injection to simultaneous one.	Hard staring/ engine stall

DTC NO.	TROUBLE AREA	FAIL-SAFE OPERATION	SYMPTOM
P0340 (No.15)	CMP SENSOR	ECM changes injection control system from sequential injection to simultaneous one.	Hard starting
P0400	EGR VALVE	–	Hard starting/rough or incorrect idle/ excessive fuel consumption/ hesitation/ poor acceleration/ surge/ detonation or spark knock/ engine stall
P0420	CATALYST	–	–
P0443	PURGE CONTROL VALVE	–	Rough or incorrect idle/ surge/ hard starting/ engine stall
P0480	RADIATOR FAN CONTROL SYSTEM	–	Engine overheating
P0500 (No.16)	VEHICLE SPEED SENSOR	ECM stops idle air control.	Rough or incorrect idle
P0505	IDLE CONTROL SYSTEM	–	Engine stall/ rough or incorrect idle
P0601 (No.71)	ECM INTERNAL	–	Hard starting/ rough or incorrect idle/ excessive fuel consumption/ detonation or spark knock/ hesitation poor acceleration/
P1450 (No.29)	BAROMETRIC PRESSURE SENSOR	ECM controls actuators assuming that barometric pressure is 100 kPa (760 mmHg).	Hard starting/ rough or incorrect idle

VISUAL INSPECTION

Visually check following parts and systems.

INSPECTION ITEM	REFERRING SECTION
• Engine oil – level, leakage	Section 0B
• Engine coolant – level, leakage	Section 0B
• Fuel – level, leakage	Section 0B
• A/T fluid – level, leakage	Section 0B
• Air cleaner element – dirt, clogging	Section 0B
• Battery – fluid level, corrosion of terminal	
• Water pump belt – tension, damage	Section 0B
• Throttle cable – play, installation • Vacuum hoses of air intake system – disconnection, looseness, deterioration, bend • Connectors of electric wire harness – disconnection, friction	Section 6E1
• Fuses – burning	Section 8
• Parts – installation, bolt – looseness	
• Parts – deformation	
• Other parts that can be checked visually	
• Check following items at engine start, if possible – Malfunction indicator lamp – Operation – Charge warning lamp – Operation – Engine oil pressure warning lamp – Operation – Engine coolant temp. meter – Operation – Fuel level meter – Operation – Tachometer, if equipped – Operation – Abnormal air being inhaled from air intake system – Exhaust system – leakage of exhaust gas, noise	 Section 6 Section 6H Section 8 (Section 6 for pressure check) Section 8 Section 8

ENGINE BASIC INSPECTION

This check is very important for troubleshooting when ECM has detected no DTC and no abnormality has been found in visual inspection.
Follow the flow table carefully.

Step	Action	Yes	No
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Check battery voltage. Is it 11 V or more?	Go to Step 3.	Charge or replace battery.
3	Is engine cranked?	Go to Step 4.	Go to "DIAGNOSIS" in Section 6G.
4	Does engine start?	Go to Step 5.	Go to Step 7.
5	Check idle speed as follows : 1) Warm up engine to normal operating temp. 2) Shift transmission to neutral position for M/T ("P" position for A/T). 3) All of electrical loads are switched off. 4) Check engine idle speed with scan tool. See Fig. 1. Is it 650 – 750 r/min (700 – 800 r/min. for A/T vehicle)?	Go to Step 6.	Go to "ENGINE DIAGNOSIS TABLE".
6	Check ignition timing as follows : 1) When SUZUKI scan tool is not available, disconnect scan tool from DLC and connect test switch terminal of monitor connector to ground. See Fig. 2. When using SUZUKI scan tool, select "MISC" mode on SUZUKI scan tool and fix ignition timing to initial one. See Fig. 3. 2) Using timing light (1), check initial ignition timing. See Fig. 4. Is it 5° ± 3° BTDC at specified idle speed?	Go to "ENGINE DIAGNOSIS TABLE".	Check ignition control related parts referring to Section 6F1.
7	Is immobilizer control system equipped?	Go to Step 8.	Go to Step 9.
8	Check immobilizer system malfunction as follows. 1) Check immobilizer indicator lamp or MIL (malfunction indicator lamp) for flashing. Is it flashing when ignition switch is turned to ON position?	Go to "DIAGNOSIS" in Section 8G.	Go to Step 9.
9	Check fuel supply as follows : 1) Check to make sure that enough fuel is filled in fuel tank. 2) Turn ON ignition switch for 2 seconds and then OFF. See Fig. 5. Is fuel pressure felt from fuel feed hose (1) when ignition switch is turned ON?	Go to Step 11.	Go to Step 10.
10	Check fuel pump for operating. Was fuel pump operating sound heard from fuel filler for about 10 seconds after ignition switch ON and stop?	Go to "DIAG. FLOW TABLE B-3".	Go to "DIAG. FLOW TABLE B-2".

Step	Action	Yes	No
11	Check ignition spark as follows : 1) Disconnect injector couplers. 2) Remove spark plugs and connect them to high tension cords. 3) Ground spark plugs. 4) Crank engine and check if each spark plug sparks. Is it in good condition?	Go to Step 12.	Go to “DIAGNOSIS” in Section 6F1.
12	Check fuel injector for operation as follows : 1) Install spark plugs and connect injector connectors. 2) Using sound scope (1), check operating sound of each injector (2) when cranking engine. See Fig. 6. Was injector operating sound heard from all injectors?	Go to “ENGINE DIAGNOSIS TABLE”.	Go to “DIAG. FLOW TABLE B-1”.

Fig. 1 for Step 5

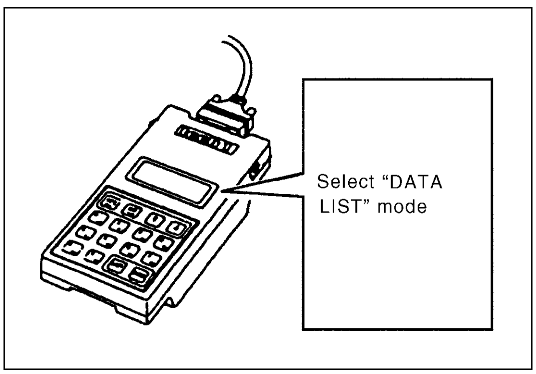
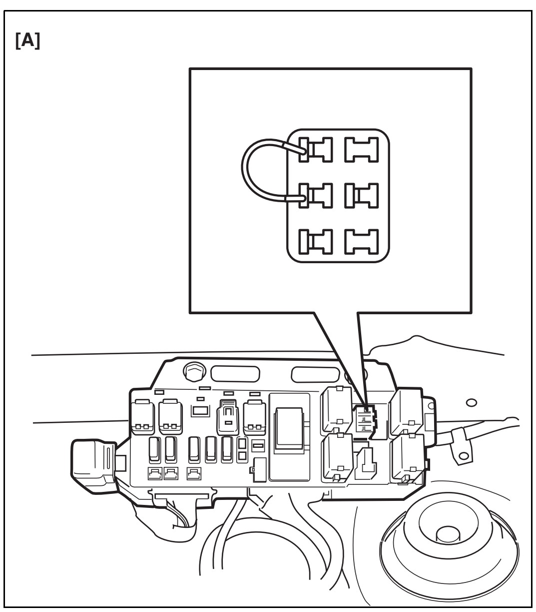
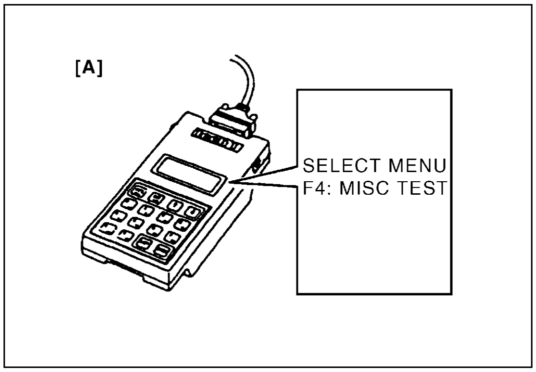


Fig. 2 for Step 6



[A] : When not using SUZUKI scan tool:

Fig. 3 for Step 6



[A] : When using SUZUKI scan tool

Fig. 4 for Step 6

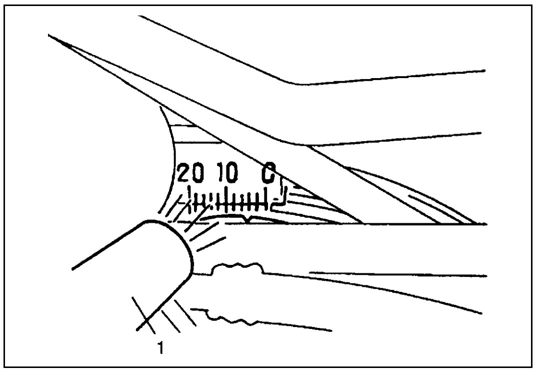


Fig. 5 for Step 9

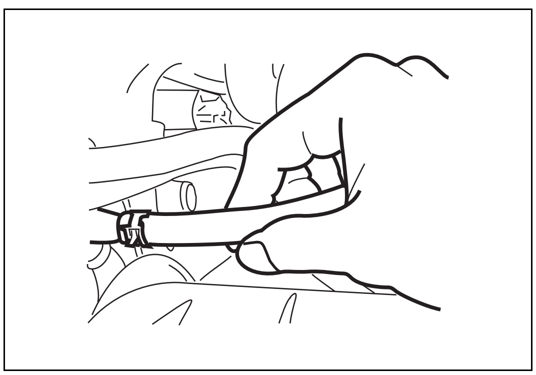
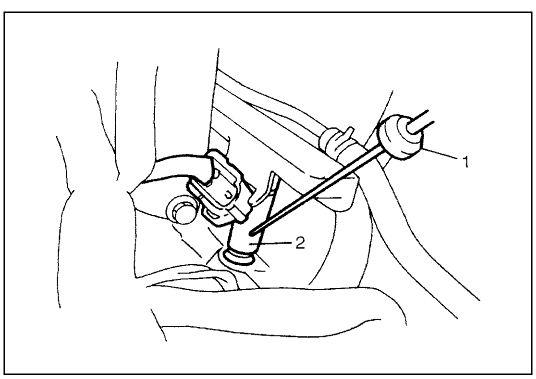


Fig. 6 for Step 12



ENGINE DIAGNOSIS TABLE

Perform troubleshooting referring to following table when ECM has detected no DTC and no abnormality has been found in visual inspection and engine basic inspection previously.

Condition	Possible Cause	Correction
Hard Starting (Engine cranks OK)	Faulty spark plug	Spark plugs in Section 6F1.
	Leaky high-tension cord	High-tension cords in Section 6F1.
	Loose connection or disconnection of high-tension cords or lead wires	High-tension cords in Section 6F1.
	Faulty ignition coil	Ignition coil in Section 6F1.
	Dirty or clogged fuel hose or pipe	Diagnostic Flow Table B-3.
	Malfunctioning fuel pump	Diagnostic Flow Table B-3.
	Air inhaling from intake manifold gasket or throttle body gasket	
	Faulty idle air control system	Diagnostic Flow Table B-4.
	Faulty ECT sensor or MAP sensor	ECT sensor or MAP sensor in Section 6E1.
	Faulty ECM	
Hard Starting (Engine cranks OK)	Poor spark plug tightening or faulty gasket	Spark plugs in Section 6F1.
	Compression leak from valve seat	Valves inspection in Section 6A1.
	Sticky valve stem	Valves inspection in Section 6A1.
	Weak or damaged valve springs	Valve springs inspection in Section 6A1.
	Compression leak at cylinder head gasket	Cylinder head inspection in Section 6A1.
	Sticking or damaged piston ring	Cylinders, pistons and piston rings inspection in Section 6A1.
	Worn piston, ring or cylinder	Cylinders, pistons and piston rings inspection in Section 6A1.
	Malfunctioning PCV valve	PCV system in Section 6E1.
	Low compression	Compression check in Section 6A1.
Low oil pressure	Improper oil viscosity	Engine oil and oil filter change in Section 0B.
	Malfunctioning oil pressure switch	Oil pressure switch inspection in Section 8.
	Clogged oil strainer	Oil pan and oil pump strainer cleaning in Section 6A1.
	Functional deterioration of oil pump	Oil pump in Section 6A1.
	Worn oil pump relief valve	Oil pump in Section 6A1.
	Excessive clearance in various sliding parts	

Condition	Possible Cause	Correction
Engine noise **Note : Before checking mechanical noise, make sure that :** **Specified spark plug is used.** **Specified fuel is used.**	Improper valve lash	Valve lash in Section 6A1.
	Worn valve stem and guide	Valves inspection in Section 6A1.
	Weak or broken valve spring	Valve springs inspection in Section 6A1.
	Warped or bent valve	Valves inspection in Section 6A1.
	Worn piston, ring and cylinder bore	Pistons and cylinders inspection in Section 6A1.
	Worn rod bearing	Crank pin and connecting rod bearing inspection in Section 6A1.
	Worn crank pin	Crank pin and connecting rod bearing inspection in Section 6A1.
	Loose connecting rod nuts	Connecting rod installation in Section 6A1.
	Low oil pressure	Previously outlined.
	Low oil pressure	Previously outlined.
	Worn bearing	Crankshaft and bearing inspection in Section 6A1.
	Worn crankshaft journal	Crankshaft and bearing inspection in Section 6A1.
	Loose bearing cap bolts	Crankshaft inspection in Section 6A1.
	Excessive crankshaft thrust play	Crankshaft thrust play inspection in Section 6A1.
Overheating	Inoperative thermostat	Thermostat in Section 6B.
	Poor water pump performance	Water pump in Section 6B.
	Clogged or leaky radiator	Radiator in Section 6B.
	Improper engine oil grade	Engine oil and oil filter change in Section 0B.
	Clogged oil filter or oil strainer	Oil pressure check in Section 6A1.
	Poor oil pump performance	Oil pressure check in Section 6A1.
	Faulty radiator fan control system	Radiator fan control system in Section 6E1.
	Dragging brakes	Trouble diagnosis in Section 5.
	Slipping clutch	Trouble diagnosis in Section 7C.
	Blown cylinder head gasket	Cylinder head in Section 6A1.

Condition	Possible Cause	Correction
Poor gasoline mileage	Leaks or loose connection of high-tension cord	High-tension cords in Section 6F1.
	Faulty spark plug (improper gap, heavy deposits and burned electrodes, etc.)	Spark plugs in Section 6F1.
	Malfunctioning EGR valve (if equipped)	EGR system in Section 6E1.
	High idle speed	Refer to item “Improper engine idle speed” previously outlined.
	Poor performance of TP sensor, ECT sensor or MAP sensor	TP sensor, ECT sensor or MAP sensor in Section 6E1.
	Faulty EGR valve (if equipped)	EGR system in Section 6E1.
	Faulty fuel injector(s)	Diagnostic Flow Table B-1.
	Faulty ECM	
	Poor valve seating	Valves inspection in Section 6A1.
	Dragging brakes	Trouble diagnosis in Section 5.
	Slipping clutch	Trouble diagnosis in Section 7C.
	Thermostat out of order	Thermostat in Section 6B.
	Improper tire pressure	Refer to Section 3F.
	Low Compression	Previously outlined
Excessive engine oil consumption	Blown cylinder head gasket	Cylinder head in Section 6A1.
	Leaky camshaft oil seals	Camshaft in Section 6A1.
	Sticky piston ring	Piston cleaning in Section 6A1.
	Worn piston and cylinder	Pistons and cylinders inspection in Section 6A1.
	Worn piston ring groove and ring	Pistons inspection in Section 6A1.
	Improper location of piston ring gap	Pistons assembly in Section 6A1.
	Worn or damaged valve stem seal	Valves removal and installation in Section 6A1.
	Worn valve stem	Valves inspection in Section 6A1.
Engine hesitates (Momentary lack of response as accelerator is depressed. Can occur at all vehicle speeds. Usually most severe when first trying to make vehicle move, as from a stop sign.)	Spark plug faulty or plug gap out of adjustment	Spark plugs in Section 6F1.
	Leaky high-tension cord	High-tension cords in Section 6F1.
	Fuel pressure out of specification	Diagnostic Flow Table B-3.
	Malfunctioning EGR valve (if equipped)	EGR system in section 6E1.
	Poor performance of TP sensor, ECT sensor or MAP sensor	TP sensor, ECT sensor or MAP sensor in Section 6E1.
	Faulty fuel injector	Diagnostic Flow Table B-1.
	Faulty ECM	
	Engine overheating	Refer to “Overheating” section.
	Low compression	Previously outlined.
Surge (Engine power variation under steady throttle or cruise. Feels like vehicle speeds up and down with no change in accelerator pedal.)	Leaky or loosely connected high-tension cord	High-tension cords in Section 6F1.
	Faulty spark plug (excess carbon deposits, improper gap, and burned electrodes, etc.)	Spark plugs in Section 6F1.
	Variable fuel pressure	Diagnostic Flow Table B-3.
	Kinky or damaged fuel hose and lines	
	Faulty fuel pump (clogged fuel filter)	
	Malfunctioning EGR valve	EGR system in Section 6E1.
	Poor performance of MAP sensor	MAP sensor in Section 6E1.
	Faulty fuel injector	Diagnostic Flow Table B-1.
	Faulty ECM	

Condition	Possible Cause	Correction
Excessive detonation (Engine makes continuously sharp metallic knocks that change with throttle opening. Sounds like pop corn popping.)	Faulty spark plug	Spark plugs in Section 6F1.
	Loose connection of high-tension cord	High-tension cords in Section 6F1.
	Engine overheating	Refer to “Overheating” section.
	Clogged fuel filter (faulty fuel pump) or fuel lines	Diagnostic Flow Table B-1 or B-2.
	Air inhaling from intake manifold or throttle body gasket	
	Malfunctioning EGR valve (if equipped)	EGR system in Section 6E1.
	Poor performance of knock sensor, ECT sensor or MAP sensor	Knock sensor in Section 6, ECT sensor or MAP sensor in Section 6E1.
	Faulty fuel injector(s)	Diagnostic Flow Table B-1.
	Faulty ECM	
	Excessive combustion chamber deposits	Piston and cylinder head cleaning in Section 6A1.
Engine has no power	Faulty spark plug	Spark plugs in Section 6F1.
	Faulty ignition coil with ignitor	Ignition coil in Section 6F1.
	Leaks, loose connection or disconnection of high-tension cord	High-tension cords in Section 6F1.
	Faulty knock sensor	Knock sensor malfunction in this section.
	Clogged fuel hose or pipe	Diagnostic Flow Table B-3.
	Malfunctioning fuel pump	Diagnostic Flow Table B-2.
	Air inhaling from intake manifold gasket or throttle body gasket	
	Engine overheating	Refer to “Overheating” section.
Engine has no power	Malfunctioning EGR valve (if equipped)	EGR system inspection in Section 6E1.
	Maladjusted accelerator cable play	Accelerator cable play in Section 6E1.
	Poor performance of TP sensor, ECT sensor or MAP sensor	TP sensor, ECT sensor or MAP sensor in Section 6E1.
	Faulty fuel injector(s)	Diagnostic Flow Table B-1.
	Faulty ECM	
	Dragging brakes	Trouble diagnosis in Section 5.
	Slipping clutch	Trouble diagnosis in Section 7C.
	Low compression	Previously outlined.

Condition	Possible Cause	Correction
Improper engine idling or engine fails to idle	Faulty spark plug	Spark plugs in Section 6F1.
	Leaky or disconnected high-tension cord	High-tension cords in Section 6F1.
	Faulty ignition coil with ignitor	Ignition coil in Section 6F1.
	Fuel pressure out of specification	Diagnostic Flow Table B-3.
	Leaky manifold, throttle body, or cylinder head gasket	
	Malfunctioning EGR valve (if equipped)	EGR system in Section 6E1.
	Faulty idle air control system	Diagnostic Flow Table B-4.
	Faulty evaporative emission control system	EVAP control system in Section 6E1.
	Faulty EGR system (if equipped)	EGR system in Section 6E1.
	Faulty fuel injector(s)	Diagnostic Flow Table B-1.
	Poor performance of ECT sensor, TP sensor or MAP sensor	ECT sensor, TP sensor or MAP sensor in Section 6E1.
	Faulty ECM	
	Loose connection or disconnection of vacuum hoses	
	Malfunctioning PCV valve	PCV system in Section 6E1.
	Engine overheating	Refer to “Overheating” section.
	Low compression	Previously outlined.
Excessive hydrocarbon (HC) emission or carbon monoxide (CO)	Faulty spark plug	Spark plugs in Section 6F1.
	Leaky or disconnected high-tension cord	High-tension cords in Section 6F1.
	Faulty ignition coil with ignitor	Ignition coil assembly in Section 6F1.
	Low compression	Refer to “Low compression” section.
	Lead contamination of three way catalytic converter	Check for absence of filler neck restrictor.
	Faulty evaporative emission control system	EVAP control system in Section 6E1.
	Fuel pressure out of specification	Diagnostic Flow Table B-3.
	Closed loop system (A/F feed back compensation) fails • Faulty TP sensor • Poor performance of ECT sensor or MAP sensor	 TP sensor in Section 6E1. ECT sensor or MAP sensor in Section 6E1.
	Faulty injector(s)	Diagnostic Flow Table B-1
	Faulty ECM	
	Engine not at normal operating temperature	
	Clogged air cleaner	
	Vacuum leaks	
Excessive nitrogen oxides (NOx) emission	Improper ignition timing	See section 6F1.
	Lead contamination of catalytic converter	Check for absence of filler neck restrictor.
	Faulty EGR system (if equipped)	EGR system in Section 6E1.
	Fuel pressure out of specification	Diagnostic Flow Table B-3.
	Closed loop system (A/F feed back compensation) fails • Faulty TP sensor • Poor performance of ECT sensor or MAP sensor	 TP sensor in Section 6E1. ECT sensor or MAP sensor in Section 6E1.
	Faulty injector(s)	Diagnostic Flow Table B-1
	Faulty ECM	

SCAN TOOL DATA

As the data values given below are standard values estimated on the basis of values obtained from the normally operating vehicles by using a scan tool, use them as reference values. Even when the vehicle is in good condition, there may be cases where the checked value does not fall within each specified data range. Therefore, judgment as abnormal should not be made by checking with these data alone.
Also, conditions in the below table that can be checked by the scan tool are those detected by ECM and output from ECM as commands and there may be cases where the engine or actuator is not operating (in the condition) as indicated by the scan tool. Be sure to use the timing light to check the ignition timing.

NOTE:
- **With the generic scan tool, only star (✱) marked data in the table below can be read.**
- **The triangle (△) marked data in the table below can not be read for vehicle without immobilizer indicator lamp.**
- **When checking the data with the engine running at idle or racing, be sure to shift M/T gear to the neutral gear position and A/T gear to the "Park" position and pull the parking brake fully. Also, if nothing or "no load" is indicated, turn OFF A/C, all electric loads, P/S and all the other necessary switches.**

		SCAN TOOL DATA	VEHICLE CONDITION	NORMAL CONDITION/ REFERENCE VALUES
	✱	FUEL SYSTEM B1 (FUEL SYSTEM STATUS)	At specified idle speed after warming up	CLOSED (closed loop)
	✱	CALC LOAD (CALCULATED LOAD VALUE)	At specified idle speed with no load after warming up	3 – 9%
			At 2500 r/min with no load after warming up	12 – 17%
	✱	COOLANT TEMP. (ENGINE COOLANT TEMP.)	At specified idle speed after warming up	80 – 100°C, 176 – 212°F
	✱	SHORT FT B1 (SHORT TERM FUEL TRIM)	At specified idle speed after warming up	– 20 – +20%
	✱	LONG FT B1 (LONG TERM FUEL TRIM)	At specified idle speed after warming up	– 15 – +15%
	✱	MAP (INTAKE MANIFOLD ABSOLUTE PRESSURE)	At specified idle speed with no load after warming up	30 – 37 kPa, 220 – 280 mmHg
	✱	ENGINE SPEED	At idling with no load after warming up	Desired idle speed ±50 r/min
	✱	VEHICLE SPEED	At stop	0 km/h, 0 MPH
	✱	IGNITION ADVANCE (IGNITION TIMING ADVANCE FOR NO.1 CYLINDER)	At specified idle speed with no load after warming up	6 – 16° BTDC
	✱	INTAKE AIR TEMP.	At specified idle speed after warming up	Ambient temp. : +15°C (59°F) –5°C (23°F)
	✱	MAF (MASS AIR FLOW RATE)	At specified idle speed with no load after warming up	1 – 4 gm/sec
			At 2500 r/min with no load after warming up	4 – 9 gm/sec

		SCAN TOOL DATA	VEHICLE CONDITION		NORMAL CONDITION/ REFERENCE VALUES	
	✱	THROTTLE POS (ABSOLUTE THROTTLE POSITION)	Ignition switch ON/engine stopped	Throttle valve fully closed	7 – 18%	
				Throttle valve fully open	70 – 90%	
	✱	O2S B1 S1 (HEATED OXYGEN SENSOR-1)	At specified idle speed after warming up		0.01 – 0.95 V	
Δ	✱	O2S B1 S2 (HEATED OXYGEN SENSOR-2)	When engine is running at 2000 r/min. for 3 min or longer after warming up.		0.01 – 0.95 V	
Δ	✱	O2S FT B1 S1	At specified idle speed after warning up		– 20 – +20%	
Δ	✱	DIS. WITH MIL ON	–		–	
		DESIRED IDLE (DESIRED IDLE SPEED)	At idling with no load after warming up, M/T at neutral, A/T at “P” range		M/T	700 r/min
					A/T	750 r/min
		TP SENSOR VOLT (THROTTLE POSITION SENSOR OUTPUT VOLTAGE)	Ignition switch ON/engine stopped	Throttle valve fully closed	More than 0.2 V	
				Throttle valve fully open	Less than 4.8 V	
		INJ PULSE WIDTH (FUEL INJECTION PULSE WIDTH)	At specified idle speed with no load after warming up		2.0 – 3.6 msec.	
			At 2500 r/min with no load after warming up		2.0 – 3.6 msec.	
		IAC FLOW DUTY (IDLE AIR CONTROL FLOW DUTY)	At idling with no load after warming up		5 – 25%	
		TOTAL FUEL TRIM	At specified idle speed after warming up		– 35 – +35%	
		BATTERY VOLTAGE	Ignition switch ON/engine stop		12 – 14 V	
		CANIST PRG DUTY (EVAP CANISTER PURGE FLOW DUTY)	–		0 – 100%	
		CLOSED THROT POS (CLOSED THROTTLE POSITION)	Throttle valve at idle position		ON	
			Throttle valve opens larger than idle position		OFF	
		FUEL CUT	When engine is at fuel cut condition		ON	
			Other than fuel cut condition		OFF	
		RADIATOR FAN (RADIATOR FAN CONTROL RELAY)	Ignition switch ON	Engine coolant temp. : Lower than 95°C (203°F)	OFF	
				Engine coolant temp. : 97.5°C (208°F) or higher	ON	
		ELECTRIC LOAD	Ignition switch ON/Headlight, small light and rear window defogger all turned OFF		OFF	
			Ignition switch ON/Headlight, small light or rear window defogger turned ON		ON	
		A/C SWITCH	Engine running after warming up, A/C not operating		OFF	
			Engine running after warming up, A/C operating		ON	

		SCAN TOOL DATA	VEHICLE CONDITION		NORMAL CONDITION/ REFERENCE VALUES
		PNP SIGNAL (PARK/NEUTRAL POSITION SIGNAL) A/T only	Ignition switch ON	Selector lever in “P” or “N” position	P/N Range
				Selector lever in “R”, “D”, “2” or “L” position	D Range
		EGR VALVE	At specified idle speed after warming up		0%
∆		FUEL TANK LEVEL	–		0 – 100%
		BAROMETRIC PRESS	–		Display the barometric pressure
		FUEL PUMP	Within 3 seconds after ignition switch ON or engine running		ON
			Engine stop at ignition switch ON.		OFF
		BRAKE SW	Ignition switch ON	Brake pedal is depressing	ON
				Brake pedal is releasing	OFF
		BLOWER FAN	Ignition switch ON	Blower fan switch ON	ON
				Blower fan switch OFF	OFF
		A/C MAG CLUTCH	Ignition switch ON	A/C switch ON	ON
				A/C switch OFF	OFF

SCAN TOOL DATA DEFINITIONS :

FUEL SYSTEM (FUEL SYSTEM STATUS)

Air/fuel ratio feedback loop status displayed as either open or closed loop. Open indicates that ECM ignores feedback from the exhaust oxygen sensor.
Closed indicates final injection duration is corrected for oxygen sensor feedback.

CALC LOAD (CALCULATED LOAD VALUE, %)

Engine load displayed as a percentage of maximum possible load. Value is calculated mathematically using the formula : actual (current) intake air volume ÷ maximum possible intake air volume x 100%.

COOLANT TEMP. (ENGINE COOLANT TEMPERATURE, °C, °F)

It is detected by engine coolant temp. sensor

SHORT FT B1 (SHORT TERM FUEL TRIM, %)

Short term fuel trim value represents short term corrections to the air/fuel mixture computation. A value of 0 indicates no correction, a value greater than 0 means an enrichment correction, and a value less than 0 implies an enleanment correction.

LONG FT B1 (LONG TERM FUEL TRIM, %)

Long term fuel trim Value represents long term corrections to the air/fuel mixture computation. A value of 0 indicates no correction, a value greater than 0 means an enrichment correction, and a value less than 0 implies an enleanment correction.

MAP (INTAKE MANIFOLD ABSOLUTE PRESSURE, kPa, inHg)

It is detected by manifold absolute pressure sensor and used (among other things) to compute engine load.

ENGINE SPEED (rpm)

It is computed by reference pulses from crankshaft position sensor.

VEHICLE SPEED (km/h, MPH)

It is computed based on pulse signals from vehicle speed sensor.

IGNITION ADVANCE (IGNITION TIMING ADVANCE FOR NO.1 CYLINDER, °)

Ignition timing of NO.1 cylinder is commanded by ECM. The actual ignition timing should be checked by using the timing light.

INTAKE AIR TEMP. (°C, °F)

It is detected by intake air temp. sensor and used to determine the amount of air passing into the intake manifold as air density varies with temperature.

MAF (MASS AIR FLOW RATE, gm/s, lb/min)

It represents total mass of air entering intake manifold which is computed based on signals from MAP sensor, IAT sensor, TP sensor, etc.

THROTTLE POS (ABSOLUTE THROTTLE POSITION, %)

When throttle position sensor is fully closed position, throttle opening is indicated as 0% and 100% full open position.

OXYGEN SENSOR B1 S1 (HEATED OXYGEN SENSOR-1, V)

It indicates output voltage of HO2S-1 installed on exhaust manifold (pre-catalyst).

OXYGEN SENSOR B1 S2 (HEATED OXYGEN SENSOR-2, V)

It indicates output voltage of HO2S-2 installed on exhaust pipe (post-catalyst). It is used to detect catalyst deterioration.

DESIRED IDLE (DESIRED IDLE SPEED, rpm)

The Desired Idle Speed is an ECM internal parameter which indicates the ECM requested idle. If the engine is not running, this number is not valid.

TP SENSOR VOLT (THROTTLE POSITION SENSOR OUTPUT VOLTAGE, V)

The Throttle Position Sensor reading provides throttle valve opening information in the form of voltage.

INJ PULSE WIDTH (FUEL INJECTION PULSE WIDTH, msec.)

This parameter indicates time of the injector drive (valve opening) pulse which is output from ECM (but injector drive time of NO.1 cylinder for multiport fuel injection).

IAC FLOW DUTY (IDLE AIR (SPEED) CONTROL DUTY, %)

This parameter indicates current flow time rate within a certain set cycle of IAC valve (valve opening rate) which controls the amount of bypass air (idle speed).

TOTAL FUEL TRIM (%)

The value of Total Fuel Trim is obtained by putting values of short Term Fuel Trim and Long Term Fuel Trim together. This value indicates how much correction is necessary to keep the air/fuel mixture stoichiometrical.

BATTERY VOLTAGE (V)

This parameter indicates battery positive voltage inputted from main relay to ECM.

CANIST PURGE DUTY (EVAP CANISTER PURGE FLOW DUTY, %)

This parameter indicates valve ON (valve open) time rate within a certain set cycle of EVAP purge solenoid valve which controls the amount of EVAP purge.
0% means that the purge valve is completely closed while 100% is a fully open valve.

CLOSED THROTTLE POSITION (ON/OFF)

This parameter will read ON when throttle valve is fully closed, or OFF when the throttle is not fully closed.

FUEL CUT (ON/OFF)

ON : Fuel being cut (output signal to injector is stopped)
OFF : Fuel not being cut

RADIATOR FAN (RADIATOR FAN CONTROL RELAY, ON/OFF)

ON : Command for radiator fan control relay operation being output.
OFF : Command for relay operation not being output.

ELECTRIC LOAD (ON/OFF)

ON : Headlight, small light or rear window defogger ON signal inputted.
OFF : Above electric loads all turned OFF.

A/C SWITCH (ON/OFF)

ON : Command for A/C operation being output from ECM to A/C compressor magnet clutch.
OFF : Command for A/C operation not being output.

FUEL TANK LEVEL (%)

This parameter indicates approximate fuel level in the fuel tank. As the detectable range of the fuel level sensor is set as 0 to 100%, however, with some models whose fuel tank capacity is smaller, the indicated fuel level may be only 70% even when the fuel tank is full.

PNP SIGNAL (PARK/NEUTRAL POSITION SIGNAL, P/N RANGE or D RANGE)

It is detected by signal from TCM.
D range : A/T is in “R”, “D”, “2” or “L” range.
P/N range : A/T is in “P” or “N” range or the above signal is not inputted from TCM.

EGR VALVE (%)

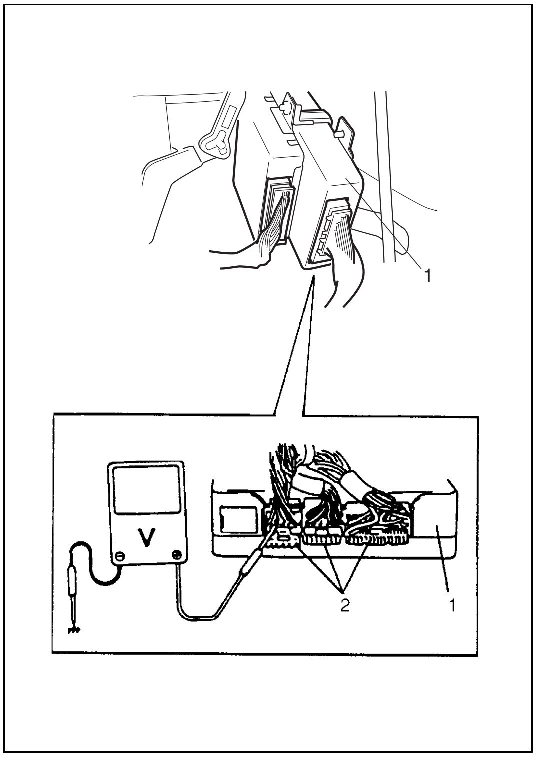
This parameter indicates opening rate of EGR valve which controls the amount of EGR flow.

INSPECTION OF ECM AND ITS CIRCUITS

ECM and its circuits can be checked at ECM wiring couplers by measuring voltage and resistance.

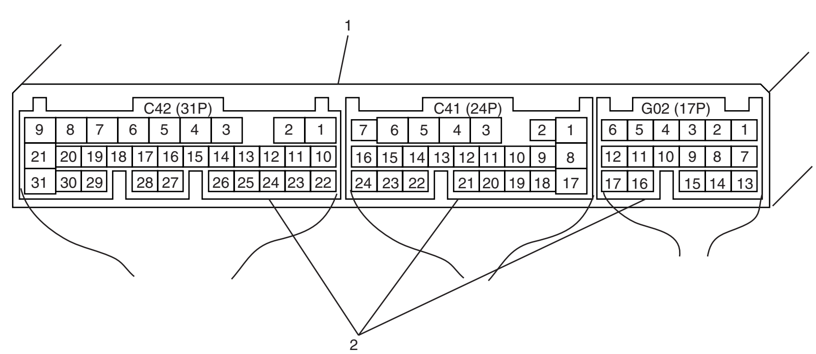
> **CAUTION:**
> **ECM cannot be checked by itself. It is strictly prohibited to connect voltmeter or ohmmeter to ECM with coupler disconnected from it.**

VOLTAGE CHECK



1) Remove ECM (1) from vehicle body referring to Section 6E.
2) Check voltage at each terminal of couplers (2) connected.

NOTE:
As each terminal voltage is affected by the battery voltage, confirm that it is 11 V or more when ignition switch is ON.



1.	ECM
2.	ECM couplers (Viewed from harness side)

ECM VOLTAGE VALUES TABLE

For TYPE A (See NOTE)

NOTE:

Type A is other than follows.
Type B is right hand steering vehicle equipped with fasten seat belt light and immobilizer control system.

TERMINAL NO.		CIRCUIT	NORMAL VOLTAGE	CONDITION
C42	1	Ground	–	–
	2	Ground	–	–
	3	Ground	–	–
	4	EVAP canister purge valve	10 – 14 V	Ignition switch ON
	5	Engine coolant temp. and barometric pressure signal for TCM (A/T)	Indication deflection repeated 0 V and 10 – 14 V	Ignition switch ON
	6	Idle air control valve	0 – 13 V	At specified idle speed after engine warmed up
	7	Heater of HO2S-1 (if equipped)	10 – 14 V	Ignition switch ON
	8	Fuel injector NO.4	10 – 14 V	Ignition switch ON
	9	Fuel injector NO.1	10 – 14 V	Ignition switch ON
	10	Sensor ground	–	–
	11	Camshaft position sensor	0 – 0.8 V and 4 – 6 V	Ignition switch ON
	12	Knock sensor (if equipped)	2.1 - 2.9 V	Ignition switch ON
	13	Heated oxygen sensor-1 (if equipped)	Refer to DTC P0130 diag. flow table	
		CO adjusting resistor (if equipped)	–	–
	14	Engine coolant temp. sensor	0.55 - 0.95 V	Ignition switch ON Engine coolant temp. : 80°C (176°F)
	15	Intake air temp. sensor	2.0 – 2.7 V	Ignition switch ON Intake air temp. : 20°C (68°F)
	16	Test switch terminal (Vehicle without immobilizer indicator lamp)	4 – 6 V	Ignition switch ON
	17	Electric load signal (+)	0V	Ignition switch ON Small light and rear defogger OFF
			10 – 14 V	Ignition switch ON Small light and rear defogger ON
	18	A/C triple pressure switch	10 – 14 V	A/C not operated
	19	Ignition coil #2	–	–
	20	Ignition coil #1	–	–
	21	Fuel injector NO.2	10 – 14 V	Ignition switch ON
	22	Power source for sensor	4.75 – 5.25 V	Ignition switch ON
	23	Crankshaft position sensor	–	–
	24	–	–	–
	25	Shield ground	–	–
	26	Manifold absolute pressure sensor	3.3 – 4.0 V	Ignition switch ON Barometric pressure : 100 kPa (760 mmHg)
	27	Diag. Switch terminal (Vehicle without immobilizer indicator lamp)	4 – 6 V	Ignition switch ON
	28	Monitor output (Vehicle without immobilizer indicator lamp)	–	–
	29	Blank	–	–
	30	Blank	–	–
	31	Fuel injector NO.3	10 – 14 V	Ignition switch ON

TERMINAL NO.		CIRCUIT	NORMAL VOLTAGE	CONDITION
C41	1	A/C compressor clutch	0 V	Ignition switch ON
	2	EGR valve (stepper motor coil 1) (if equipped)	10 – 14 V	Ignition switch ON
	3	Throttle position sensor	0.2 – 1.0 V	Ignition switch ON Throttle valve at idle position
			2.8 – 4.8 V	Ignition switch ON Throttle valve at full open position
	4	Heater of HO2S-2 (Vehicle with immobilizer indicator lamp)	10 – 14 V	Ignition switch ON
	5	Power source	10 – 14 V	Ignition switch ON
	6	Power source	10 – 14 V	Ignition switch ON
	7	Engine start switch (Engine start signal)	6 – 12 V	While engine cranking
			0 V	Other than above
	8	EGR valve (stepper motor coil 3) (if equipped)	10 – 14 V	Ignition switch ON
	9	EGR valve (stepper motor coil 2) (if equipped)	10 – 14 V	Ignition switch ON
	10	Main relay	10 – 14 V	Ignition switch OFF
			0.4 – 1.5 V	Ignition switch ON
	11	Blank	–	–
	12	Blank	–	–
	13	Heated oxygen sensor-2 (Vehicle with immobilizer indicator lamp)	Refer to DTC P0130 diag. flow table	
	14	D-range ID-up signal (A/T)	10 – 14 V	Ignition switch ON
	15	R-range signal (A/T)	0 V	Ignition switch ON
	16	A/C (input) signal	10 – 14 V	Ignition switch ON A/C switch OFF
			0 – 2 V	Ignition switch ON A/C switch ON
	17	EGR valve (stepper motor coil 4) (if equipped)	10 – 14 V	Ignition switch ON
	18	Radiator fan control relay	10 – 14 V	Ignition switch ON Engine coolant temp. : 9.5°C or lower (203°F)
			0 – 1 V	Ignition switch ON Engine coolant temp. : 97.5°C (208°F) or higher
	19	Fuel pump relay	0 – 1 V	For 2 seconds after ignition switch ON
			10 – 14 V	After the above time
	20	–	–	–

TERMINAL NO.		CIRCUIT	NORMAL VOLTAGE	CONDITION
C41	21	Throttle opening signal for TCM (A/T)	Indication deflection repeated 0 V and 10 – 14 V	Ignition switch ON
	22	Fuel level sensor (gauge) (Vehicle with immobilizer indicator lamp)	0 – 2 V	Ignition switch ON Fuel tank fully filled
			4.5 – 7.5 V	Ignition switch ON Fuel tank emptied
	23	Serial data for TCM	10 – 14 V and 0 – 1 V	Ignition switch ON
	24	Blank	–	–

TERMINAL NO.		CIRCUIT	NORMAL VOLTAGE	CONDITION
G02	1	Malfunction indicator lamp	0 – 1 V	Ignition switch ON
			10 – 14 V	When engine running
	2	Vehicle speed sensor	Indicator deflection repeated 0 V and 4 – 6 V	Ignition switch ON Front left tire turned slowly with front right tire locked
	3	Radiator fan control relay	10 – 14 V	Ignition switch ON and Engine coolant temp. : 100°C (212°F) or lower
			0 – 1 V	Ignition switch ON and Engine coolant temp. : 102.5°C (216.5°F) or higher
	4	Blank	–	–
	5	Data link connector (K line of ISO9141)	10 – 14 V	Ignition switch ON
	6	Ignition switch	10 – 14 V	Ignition switch ON
	7	Data link connector (SUZUKI serial data line)	4 – 6 V	Ignition switch ON
	8	Blank	–	–
	9	Stop lamp switch	0 V	Ignition switch ON Stop lamp switch OFF
			10 – 14 V	Ignition switch ON Stop lamp switch ON
	10	Sensor ground	–	–
	11	Blank	–	–
	12	Immobilizer indicator lamp	0 – 1 V	Ignition switch ON
			10 – 14 V	When engine running
	13	Electric load signal (–)	0 – 2 V	Ignition switch ON Blower fan turned OFF
			10 – 14 V	Ignition switch ON Blower fan turned ON
	14	A/C evaporator temp. sensor	–	–
	15	Blank	–	–
	16	Tachometer (if equipped)	0 – 1 V	Ignition switch ON

TERMINAL NO.		CIRCUIT	NORMAL VOLTAGE	CONDITION
G02	17	Power source for back-up	10 – 14 V	Anytime

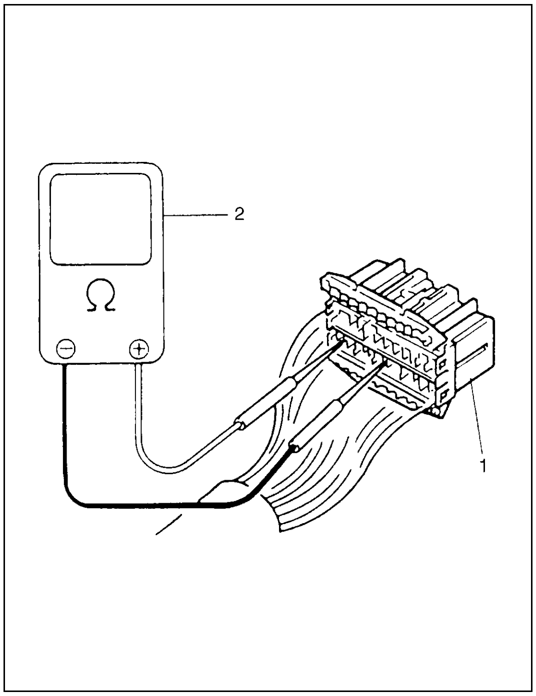
For TYPE B (For applicable mode, refer to NOTE in "ECM VOLTAGE VALUES TABLE")

TERMINAL NO.		CIRCUIT	NORMAL VOLTAGE	CONDITION
C42	1	Ground	–	–
	2	Ground	–	–
	3	Ground	–	–
	4	EVAP canister purge valve	10 – 14 V	Ignition switch ON
	5	–	–	–
	6	Idle air control valve	0 – 13 V	At specified idle speed after engine warmed up
	7	Heater of HO2S-1 (if equipped)	10 – 14 V	Ignition switch ON
	8	Fuel injector NO.4	10 – 14 V	Ignition switch ON
	9	Fuel injector NO.1	10 – 14 V	Ignition switch ON
	10	Sensor ground	–	–
	11	Camshaft position sensor	0 – 0.8 V and 4 – 6 V	Ignition switch ON
	12	Shield ground	–	–
	13	Heated oxygen sensor-1 (if equipped)	Refer to DTC P0130 diag. flow table	
		CO adjusting resistor (if equipped)	–	–
	14	Engine coolant temp. sensor	0.55 - 0.95 V	Ignition switch ON Engine coolant temp. : 80°C (176°F)
	15	Intake air temp. sensor	2.0 – 2.7 V	Ignition switch ON Intake air temp. : 20°C (68°F)
	16	Throttle position sensor	0.2 – 1.0 V	Ignition switch ON Throttle valve at idle position
			2.8 – 4.8 V	Ignition switch ON Throttle valve at full open position
	17	EGR valve (stepper motor coil 3) (if equipped)	10 – 14 V	Ignition switch ON
	18	EGR valve (stepper motor coil 1) (if equipped)	10 – 14 V	Ignition switch ON
	19	Ignition coil #2	–	–
	20	Ignition coil #1	–	–
	21	Fuel injector NO.2	10 – 14 V	Ignition switch ON
	22	Power source for sensor	4.75 – 5.25 V	Ignition switch ON
	23	Crankshaft position sensor	–	–
	24	–	–	–
	25	knock sensor (if equipped)	2.1 – 2.9 V	Ignition switch ON
	26	Manifold absolute pressure sensor	3.3 – 4.0 V	Ignition switch ON Barometric pressure : 100 kPa (760 mmHg)
	27	–	–	–
	28	EGR valve (stepper motor coil 4) (if equipped)	10 – 14 V	Ignition switch ON
	29	EGR valve (stepper motor coil 2) (if equipped)	10 – 14 V	Ignition switch ON
	30	A/C triple pressure switch	10 – 14 V	A/C not operated
	31	Fuel injector NO.3	10 – 14 V	Ignition switch ON

TERMINAL NO.		CIRCUIT	NORMAL VOLTAGE	CONDITION
C41	1	A/C compressor clutch	0 V	Ignition switch ON
	2	–	–	–
	3	–	–	–
	4	–	–	–
	5	Power source	10 – 14 V	Ignition switch ON
	6	Power source	10 – 14 V	Ignition switch ON
	7	Power source for back-up	10 – 14V	Anytime
	8	Monitor output (Vehicle without immobilizer indicator lamp)	–	–
	9	Radiator fan control relay	10 – 14 V	Ignition switch ON and Engine coolant temp. : 100°C (212°F)or lower
			0 – 1 V	Ignition switch ON and Engine coolant temp. : 102.5°C (216.5°F) or higher
	10	Main relay	10 – 14 V	Ignition switch OFF
			0.4 – 1.5 V	Ignition switch ON
	11	Ignition switch	10 – 14 V	Ignition switch ON
	12	Blank	–	–
	13	–	–	–
	14	Diag. Switch terminal (Vehicle without immobilizer indicator lamp)	4 – 6 V	Ignition switch ON
	15	Test switch terminal (Vehicle without immobilizer indicator lamp)	4 – 6 V	Ignition switch ON
	16	A/C (input) signal	10 – 14 V	Ignition switch ON A/C switch OFF
			0 – 2 V	Ignition switch ON A/C switch ON
	17	Electric load signal (+)	0 V	Ignition switch ON Small light and rear defogger OFF
			10 – 14 V	Ignition switch ON Small light and rear defogger OFF
	18	Radiator fan control relay	10 – 14 V	Ignition switch ON Engine coolant temp. : 9.5°C or lower (203°F)
			0 – 1 V	Ignition switch ON Engine coolant temp. : 97.5°C (208°F) or higher
	19	Fuel pump relay	0 – 1 V	For 2 seconds after ignition switch ON
			10 – 14 V	After the above time
	20	Engine start switch (Engine start signal)	6 – 12 V	While engine cranking
			0 V	Other than above

TERMINAL NO.		CIRCUIT	NORMAL VOLTAGE	CONDITION
C41	21	Stop lamp switch	0 V	Ignition switch ON Stop lamp switch OFF
			10 – 14 V	Ignition switch ON Stop lamp switch ON
	22	Vehicle speed sensor	Indication deflection repeated 0 V and 10 – 14 V	Ignition switch ON Front left tire turned slowly with front right tire locked
	23	–	–	–
	24	–	–	–

TERMINAL NO.		CIRCUIT	NORMAL VOLTAGE	CONDITION
G02	1	A/C evaporator temp. sensor	–	–
	2	R-range signal (A/T)	0 V	Ignition switch ON
	3	–	–	–
	4	–	–	–
	5	Engine coolant temp. and barometric pressure signal for TCM (A/T)	Indication deflection repeated 0 V and 10 – 14 V	Ignition switch ON
	6	D-range ID-up signal (A/T)	10 – 14 V	Ignition switch ON
	7	Data link connector (SUZUKI serial data line)	4 – 6 V	Ignition switch ON
	8	Blank	–	–
	9	Malfunction indicator lamp	0 – 1 V	Ignition switch ON
			10 – 14 V	When engine running
	10	–	–	–
	11	Data link connector (K line of ISO9141)	10 – 14 V	Ignition switch ON
	12	Blank	–	–
	13	Electric load signal (–)	0 – 2 V	Ignition switch ON Blower fan turned OFF
			10 – 14 V	Ignition switch ON Blower fan turned ON
	14	Sensor ground	–	–
	15	Throttle opening signal for TCM (A/T)	Indication deflection repeated 0 V and 10 – 14 V	Ignition switch ON
	16	Tachometer (if equipped)	0 – 1 V	Ignition switch ON
	17	–	–	–



Resistance Check

1) Disconnect ECM couplers from ECM with ignition switch OFF.

CAUTION:
Never touch terminals of ECM itself or connect voltmeter or ohmmeter.

2) Check resistance between each terminal of connectors disconnected.

CAUTION:
- **Be sure to connect ohmmeter probe from wire harness side of coupler.**
- **Be sure to turn OFF ignition switch for this check.**
- **Resistance in table below represents that when parts temperature is 20°C (68°F).**

1.	ECM coupler disconnected
2.	Ohmmeter

TERMINAL RESISTANCE TABLE

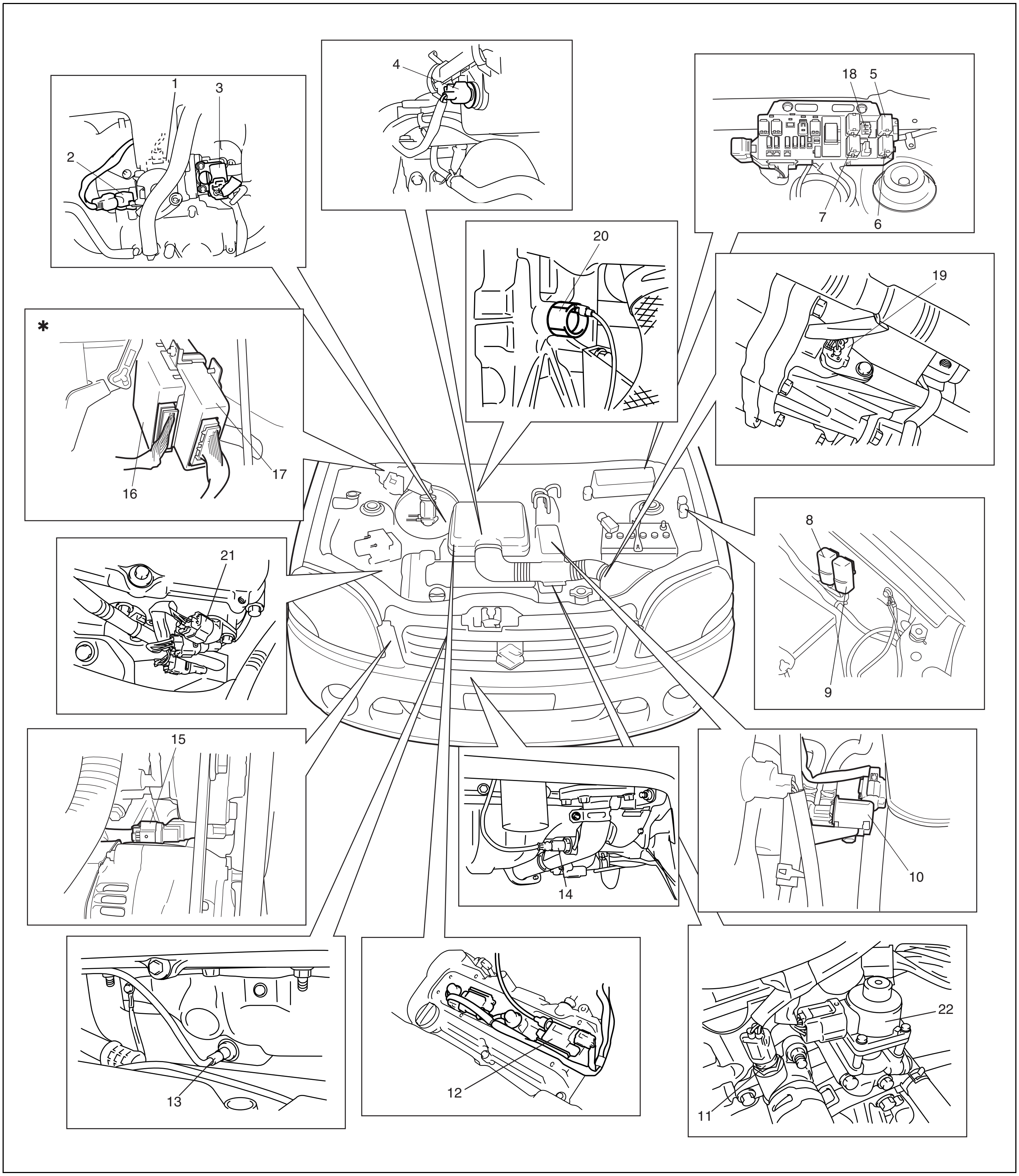
For TYPE A (Refer to NOTE in “ECM VOLTAGE VALUES TABLE” for applicable model)

TERMINALS	CIRCUIT	STANDARD RESISTANCE
C42-7 to G02-6	HO2S-1 heater (if equipped)	5.0 – 6.4 Ω
C41-4 to G02-6	HO2S-2 heater (if equipped)	12.0 – 14.3 Ω
C42-9 to C41-5/6	No.1 injector	11.3 – 13.8 Ω
C42-21 to C41-5/6	No.2 injector	11.3 – 13.8 Ω
C42-31 to C41-5/6	No.3 injector	11.3 – 13.8 Ω
C42-8 to C41-5/6	No.4 injector	11.3 – 13.8 Ω
C41-2 to C41-5/6	EGR valve (stepper motor coil 1) (if equipped)	20 – 24 Ω
C41-9 to C41-5/6	EGR valve (stepper motor coil 2) (if equipped)	20 – 24 Ω
C41-8 to C41-5/6	EGR valve (stepper motor coil 3) (if equipped)	20 – 24 Ω
C41-17 to C41-5/6	EGR valve (stepper motor coil 4) (if equipped)	20 – 24 Ω
C42-4 to C41-5/6	EVAP canister purge valve	30 – 34 Ω
C41-19 to G02-6	Fuel pump relay	56 – 146 Ω
C41-1 to Body ground	A/C compressor clutch	3 – 5.5 Ω
C41-18 to C41-5/6	Radiator fan control relay No.1	56 – 146 Ω
C41-10 to G02-17	Main relay	56 – 146 Ω
C42-1 to Body ground	Ground	Continuity
C42-2 to Body ground	Ground	Continuity
C42-3 to Body ground	Ground	Continuity

For TYPE B (Refer to NOTE in “ECM VOLTAGE VALUES TABLE” for applicable model.)

TERMINALS	CIRCUIT	STANDARD RESISTANCE
C42-7 to C41-11	HO2S-1 heater (if equipped)	5.0 – 6.4 Ω
C41-4 to C41-11	HO2S-2 heater (if equipped)	12.0 – 14.3 Ω
C42-9 to C41-5/6	No.1 injector	11.3 – 13.8 Ω
C42-21 to C41-5/6	No.2 injector	11.3 – 13.8 Ω
C42-31 to C41-5/6	No.3 injector	11.3 – 13.8 Ω
C42-8 to C41-5/6	No.4 injector	11.3 – 13.8 Ω
C42-18 to C41-5/6	EGR valve (stepper motor coil 1) (if equipped)	20 – 24 Ω
C42-29 to C41-5/6	EGR valve (stepper motor coil 2) (if equipped)	20 – 24 Ω
C42-17 to C41-5/6	EGR valve (stepper motor coil 3) (if equipped)	20 – 24 Ω
C42-28 to C41-5/6	EGR valve (stepper motor coil 4) (if equipped)	20 – 24 Ω
C42-4 to C41-5/6	EVAP canister purge valve	30 – 34 Ω
C41-19 to G02-6	Fuel pump relay	56 – 146 Ω
C41-1 to Body ground	A/C compressor clutch	3 – 5.5 Ω
C41-18 to C41-5/6	Radiator fan control relay No.1	56 – 146 Ω
C41-10 to C41-7	Main relay	56 – 146 Ω
C42-1 to Body ground	Ground	Continuity
C42-2 to Body ground	Ground	Continuity
C42-3 to Body ground	Ground	Continuity

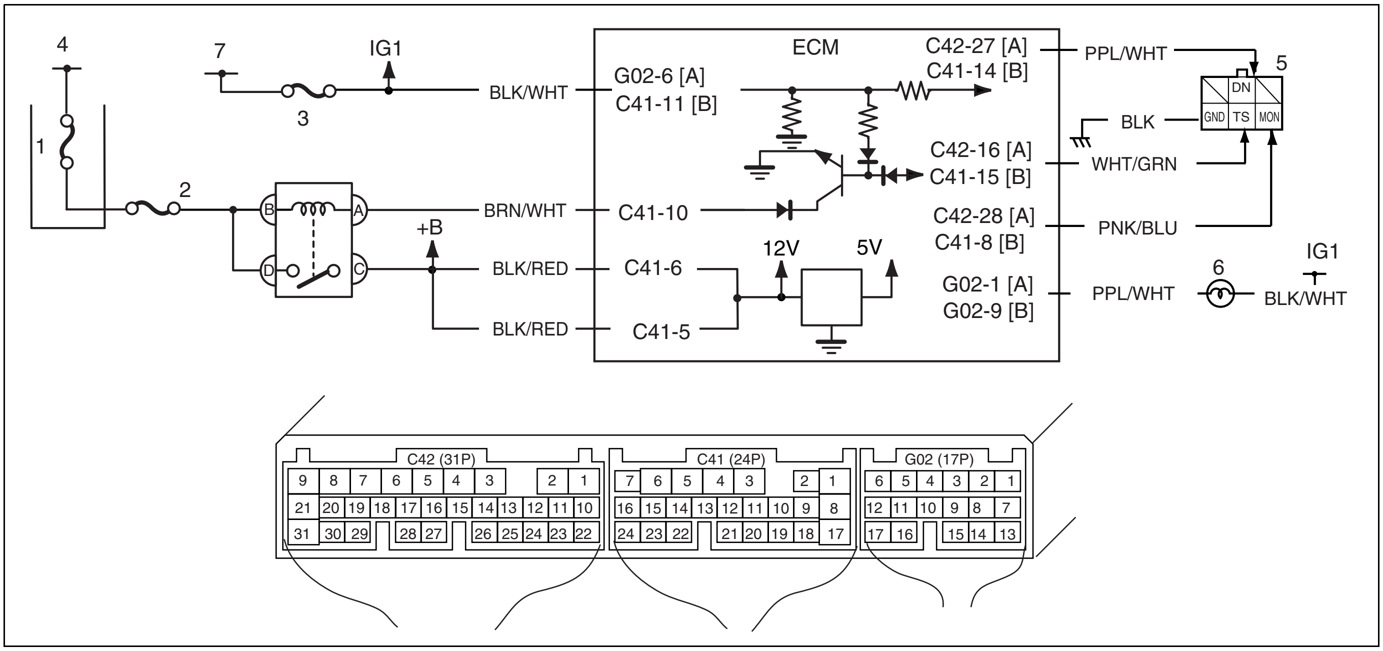
COMPONENT LOCATION



1. TP sensor	9. Radiator fan control relay No.3	17. ECM
2. MAP sensor	10. EVAP canister purge valve	18. Monitor connector
3. IAC valve	11. ECT sensor	19. VSS
4. IAT sensor	12. Ignition coil with igniter	20. Knock sensor (if equipped)
5. Radiator fan control relay No.1	13. HO2S-1 (if equipped)	21. CMP sensor
6. Main relay	14. HO2S-2 (if equipped)	22. EGR valve (if equipped)
7. Fuel pump relay	15. CKP sensor	* : This figure shows left-hand steering vehicle, these parts are installed at the other side for right-hand steering vehicle.
8. Radiator fan control relay No.2	16. TCM	

TABLE A-1 MALFUNCTION INDICATOR LAMP CIRCUIT CHECK - LAMP DOES NOT COME “ON” AT IGNITION SWITCH ON (BUT ENGINE AT STOP)

WIRING DIAGRAM



1. BATT fuse	3. IG METER fuse	5. Monitor connector	7. To ignition switch
2. Main fuse box	4. To battery	6. MIL	
[A] : Case of TYPE A is shown (See NOTE)	[B] : Case of TYPE B is shown (See NOTE)		

NOTE:

For TYPE A and TYPE B, refer to NOTE in “ECM VOLTAGE VALUES TABLE” for applicable model.

CIRCUIT DESCRIPTION

When the ignition switch is turned ON, ECM causes the main relay to turn ON (close the contact point). Then, ECM being supplied with the main power, turns ON the malfunction indicator lamp (MIL). When the engine starts to run and no malfunction is detected in the system, MIL goes OFF but if a malfunction was or is detected, MIL remains ON even when the engine is running.

INSPECTION

Step	Action	Yes	No
1	MIL Power Supply Check 1) Turn ignition switch ON. Do other indicator/warning lights in combination meter comes ON?	Go to Step 2.	“IG METER” fuse blown, main fuse blown, ignition switch malfunction, “BLK/WHT” circuit between “IG METER” fuse and combination meter or poor coupler connection at combination meter.
2	ECM Power and Ground Circuit Check Does engine start?	Go to Step 3.	Go to TABLE A-5 ECM POWER AND GROUND CIRCUIT CHECK. If engine is not cranked, go to DIAGNOSIS in Section 6G.

Step	Action	Yes	No
3	MIL Circuit Check 1) Turn ignition switch OFF and disconnect connectors from ECM. 2) Check for proper connection to ECM at terminal G02-1 (Case of TYPE A. See NOTE) or G02-9 (Case of TYPE B. See NOTE). 3) If OK, then using service wire, ground terminal G02-1 (Case of TYPE A. See NOTE) or G02-9 (Case of TYPE B. See NOTE) in connector disconnected. Does MIL turn on at ignition switch ON?	Substitute a known-good ECM and recheck.	Bulb burned out or “PPL/YEL” (Case of TYPE A. See NOTE) or “PPL/WHT” (Case of TYPE B. See NOTE) wire circuit open. Test switch terminal circuit grounded (vehicle without immobilizer indicator lamp)

TABLE A-2 MALFUNCTION INDICATOR LAMP CIRCUIT CHECK - LAMP REMAINS “ON” AFTER ENGINE STARTS

WIRING DIAGRAM / CIRCUIT DESCRIPTION

Refer to table A-1.

NOTE:

For TYPE A and TYPE B, refer to NOTE in “ECM VOLTAGE VALUES TABLE” for applicable model.

INSPECTION

Step	Action	Yes	No
1	Diagnostic Trouble Code (DTC) Check 1) Check DTC referring to DTC CHECK section. Is there any DTC(s)?	Go to Step 2 of ENGINE DIAG. FLOW TABLE.	Go to Step 2.
2	DTC Check 1) Start engine and recheck DTC while engine running. Is there any DTC(s)?		Go to Step 3.
3	MIL Circuit Check 1) Turn OFF ignition switch. 2) Disconnect connectors from ECM. Does MIL turn ON at ignition switch ON?	“PPL/YEL” (Case of TYPE A. See NOTE) or “PPL/WHT” (Case of TYPE B. See NOTE) wire circuit shorted to ground.	Substitute a known-good ECM and recheck.

TABLE A-3 MIL CHECK - MIL FLASHES AT IGNITION SWITCH ON (VEHICLE WITHOUT IMMOBILIZER INDICATOR LAMP)

WIRING DIAGRAM / CIRCUIT DESCRIPTION

Refer to TABLE A-1.

NOTE:
For TYPE A and TYPE B, refer to NOTE in "ECM VOLTAGE VALUES TABLE" for applicable model.

INSPECTION

Step	Action	Yes	No
1	MIL Flashing Pattern Check 1) Turn ignition switch ON. Does lamp flashing pattern indicate diagnostic trouble code?	Go to Step 2.	Substitute a known-good ECM and recheck.
2	Diag. Switch Circuit Check Is diag. switch terminal connected to ground via service wire?	System is in good condition.	"PPL/WHT" circuit for monitor connector shorted to ground. If circuit is OK substitute a known-good ECM and recheck.

TABLE A-4 MIL CHECK - MIL DOES NOT FLASH OR JUST REMAINS ON EVEN WITH GROUNDING DIAGNOSIS SWITCH TERMINAL (VEHICLE WITHOUT IMMOBILIZER INDICATOR LAMP)

WIRING DIAGRAM / CIRCUIT DESCRIPTION

Refer to TABLE A-1.

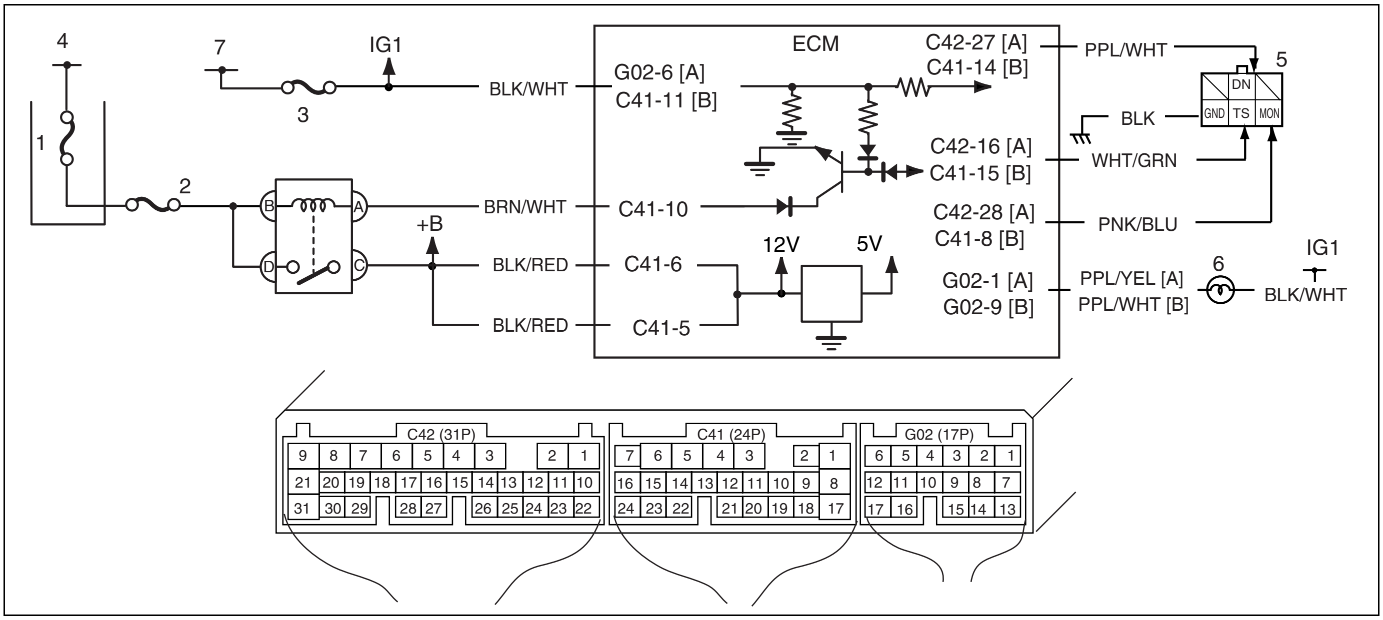
NOTE:
For TYPE A and TYPE B, refer to NOTE in "ECM VOLTAGE VALUES TABLE" for applicable model.

INSPECTION

Step	Action	Yes	No
1	MIL Circuit Check 1) Turn ignition switch OFF and disconnect connectors from ECM. Does MIL turn ON at ignition switch ON?	"PPL/YEL" (Case of TYPE A. See NOTE) or "PPL/WHT" (Case of TYPE B. See NOTE) circuit shorted to ground.	Go to Step 2.
2	ECM/PCM Connection Check 1) Turn ignition switch OFF. Is connector (C42-27 (Case of TYPE A. See NOTE) or C41-14 (Case of TYPE B. See NOTE) connection) connected to ECM/PCM properly?	Go to Step 3.	Poor connector connection.
3	Diag. Switch Terminal Circuit Check 1) Connect connectors to ECM. 2) Using service wire, ground C42-27 (Case of TYPE A. See NOTE) or C41-14 (Case of TYPE B. See NOTE) connection) terminal with connectors connected to ECM. 3) Turn ignition switch ON. Does MIL flash?	"PPL/WHT" or "BLK" circuit in monitor connector is open.	Substitute a known-good ECM and recheck.

TABLE A-5 ECM POWER AND GROUND CIRCUIT CHECK - MIL DOESN'T LIGHT AT IGNITION SWITCH ON AND ENGINE DOESN'T START THOUGH IT IS CRANKED UP

WIRING DIAGRAM



1. BATT fuse	3. IG METER fuse	5. Monitor connector
2. Main fuse box	4. To battery	6. MIL (if equipped)
[A] : Case of TYPE A is shown (See NOTE)	[B] : Case of TYPE B is shown (See NOTE)	

NOTE:

For TYPE A and TYPE B, refer to NOTE in "ECM VOLTAGE VALUES TABLE" for applicable model.

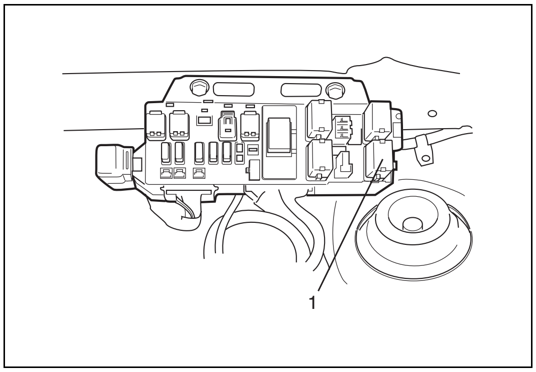
CIRCUIT DESCRIPTION

When the ignition switch tuned ON, the main relay turns ON (the contact point closes) and the main power is supplied to ECM.

INSPECTION

Step	Action	Yes	No
1	Main Relay Operating Sound Check Is operating sound of main relay heard at ignition switch ON?	Go to Step 5.	Go to Step 2.
2	Main Relay Check 1) Turn OFF ignition switch and remove main relay (1). 2) Check for proper connection to main relay (1). 3) Check resistance between each two terminals. See Fig. 1 and 2. Between terminals C and D : Infinity Between terminals A and B : 56 – 146 Ω 4) Check that there is continuity between terminals C and D when battery is connected to terminals A and B. See Fig. 3. Is main relay in good condition?	Go to Step 3.	Replace main relay.
3	Fuse Check Is main fuse in good condition? See Fig. 4.	Go to Step 4.	Check for short in circuits connected to this fuse.
4	ECM Power Circuit Check 1) Turn OFF ignition switch, disconnect connectors from ECM and install main relay. 2) Check for proper connection to ECM at terminals G02-6 (Case of TYPE A. See NOTE) or C41-11 (Case of TYPE B. See NOTE), C41-10, C41-5 and C41-6. 3) If OK, then measure voltage between terminal G02-6 (Case of TYPE A. See NOTE) or C41-11 (Case of TYPE B. See NOTE) and ground, C41-10 and ground with ignition switch ON. Is each voltage 10 – 14 V?	Go to Step 5.	“BLK/WHT”, “BLK/YEL” or “BRN/WHT” circuit open.
5	ECM Power Circuit Check 1) Using service wire, ground terminal C41-10 and measure voltage between terminal C41-5 and ground at ignition switch ON. Is it 10 – 14 V?	Check ground circuits “BRN/WHT” and “BLK/YEL” for open. If OK, then substitute a known-good ECM and recheck.	Go to Step 6.
6	Is operating sound of main relay heard in Step 1?	Go to Step 7.	“BLK/YEL” or “BLK/RED” wire open.
7	Main relay check 1) Check main relay according to procedure in Step 2. Is main relay in good condition?	“BLK/YEL” or “BLK/RED” wire open.	Replace main relay.

Fig. 1 for Step 2



1. Main relay

Fig. 2 for Step 2

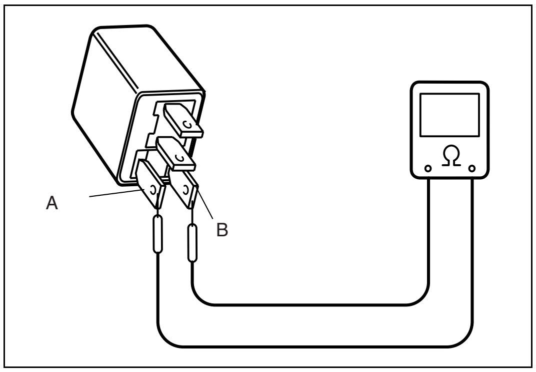


Fig. 3 for Step 2

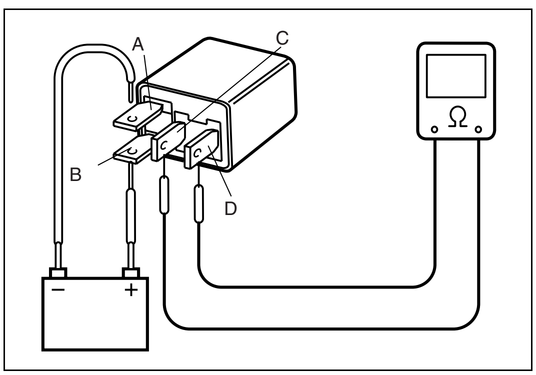
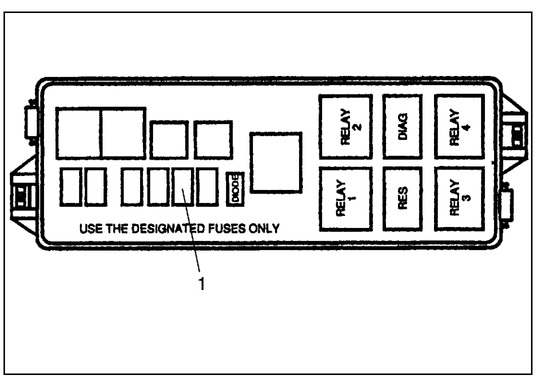


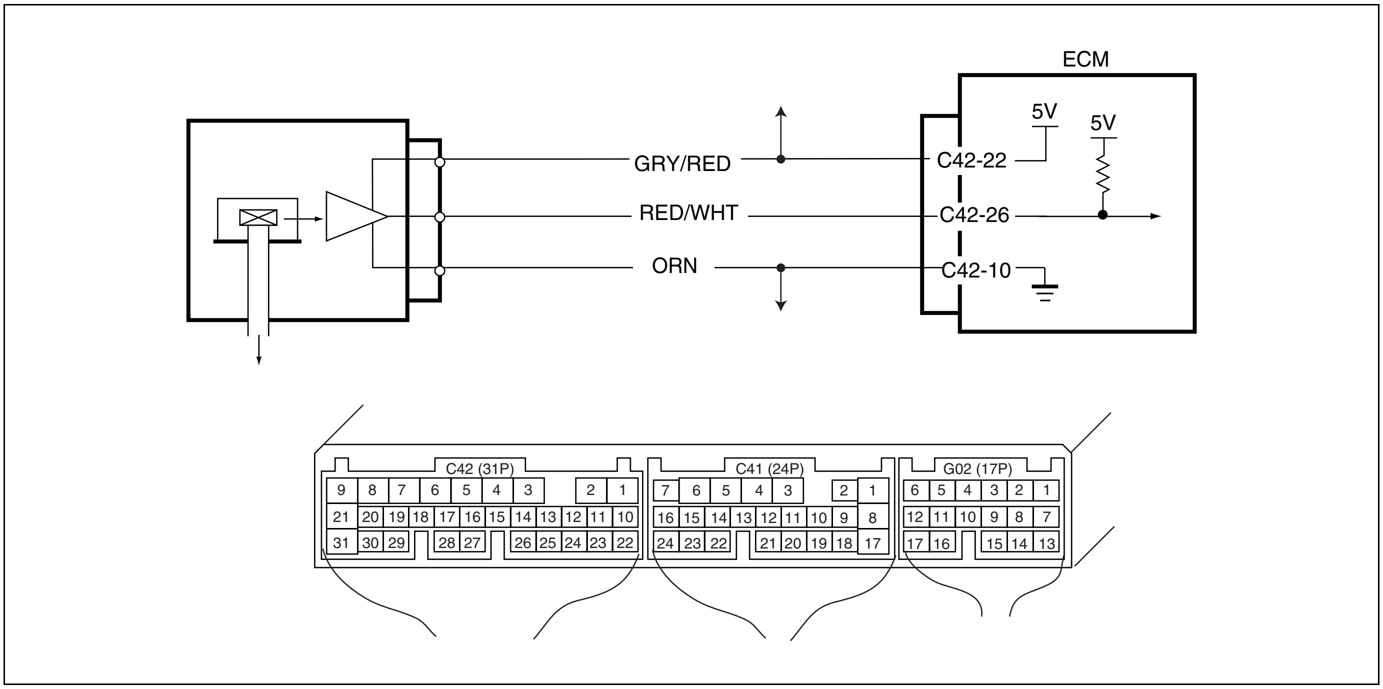
Fig. 4 for Step 3



1. Fuse

DTC P0105 (DTC NO.11) MANIFOLD ABSOLUTE PRESSURE (MAP) CIRCUIT MALFUNCTION

WIRING DIAGRAM / CIRCUIT DESCRIPTION



DTC DETECTING CONDITION	POSSIBLE CAUSE
• MAP sensor signal is 0.19 V or lower (Low pressure – High vacuums – Low voltage) or • MAP sensor signal is 4.5 V or higher (High pressure – Low vacuums – High voltage)	• "ORN" circuit open • "GRY/RED" circuit open or shorted to ground • "RED/WHT" circuit open or shorted to ground • MAP sensor malfunction • ECM malfunction

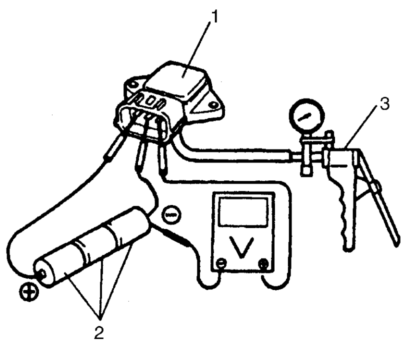
NOTE:

- **When this DTC and DTC P0120 (No.13) are indicated together, it is possible that "GRY/RED" circuit is open.**
- **When DTC P0105 (No.11), P0110 (No.18), P0115 (No.19) and P0120 (No.13) are indicated together, it is possible that "ORN" circuit is open.**

DTC CONFIRMATION PROCEDURE

1) Clear DTC, start engine and keep it at idle for 1 min.
2) Select "DTC" mode on scan tool and check DTC.

MAP SENSOR INDIVIDUAL CHECK



1) Disconnect connector from MAP sensor (1).
2) Remove MAP sensor (1).
3) Arrange 3 new 1.5 V batteries (2) in series (check that total voltage is 4.5 – 5.0 V) and connect its positive terminal to "Vin" terminal of sensor and negative terminal to "Ground" terminal. Then check voltage between "Vout" and "Ground". Also, check if voltage reduces when vacuum is applied up to 400 mmHg by using vacuum pump (3).

Output voltage (When input voltage is 4.5 – 5.5 V, ambient temp. 20 – 30°C, 68 – 86°F)

ALTITUDE (Reference)		BAROMETRIC PRESSURE		OUTPUT VOLTAGE
(ft)	(m)	(mmHg)	(kPa)	(V)
0 | 2 000	0 | 610	760 | 707	100 | 94	3.3 – 4.3
2 001 | 5 000	611 | 1 524	Under 707 over 634	94 | 85	3.0 – 4.1
5 001 | 8 000	1 525 | 2 438	Under 634 over 567	85 | 76	2.7 – 3.7
8 001 | 10 000	2 439 | 3 048	Under 567 over 526	76 | 70	2.5 – 3.3

If check result is not satisfactory, replace MAP sensor (1).

4) Install MAP sensor (1) securely.
5) Connect MAP sensor (1) connector securely.

INSPECTION

Step	Action	Yes	No
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Check MAP Sensor and Its Circuit. 1) Connect scan tool to DLC with ignition switch OFF. 2) Turn ignition switch ON. 3) Check intake manifold pressure. See Fig. 1. Is it 114 kPa or more or 43 kPa or less?	Go to Step 3.	Intermittent trouble. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A.

Step	Action	Yes	No
3	Check Wire Harness. 1) Disconnect MAP sensor connector with ignition switch OFF. 2) Check for proper connection of MAP sensor at “RED/WHT” and “GRY/RED” wire terminals. 3) If OK, then with ignition switch ON, check voltage between each of “GRY/RED” or “RED/WHT” wire terminals and body ground. See Fig. 2. Is voltage about 4 – 6 V at each terminal?	Go to Step 4.	“GRY/RED” wire open or shorted to ground circuit or shorted to power circuit (See NOTE), “RED/WHT” wire open or shorted to ground, poor C42-26 connection or C42-22 connection. If wire and connection are OK, confirm that MAP sensor is normal and then substitute a known-good ECM and recheck.
4	Check MAP sensor. Check MAP sensor according to “MAP Sensor Individual Check” mentioned previously. Is it in good condition?	“GRY/RED” wire shorted to “ORN” wire, “RED/WHT” wire open, poor C42-10 connection. If wire and connection are OK, substitute a known-good ECM and recheck.	Replace MAP sensor.

NOTE:

When battery voltage is applied to “GRY/RED” wire, it is possible that MAP sensor is also faulty.

Fig. 1 for Step 2

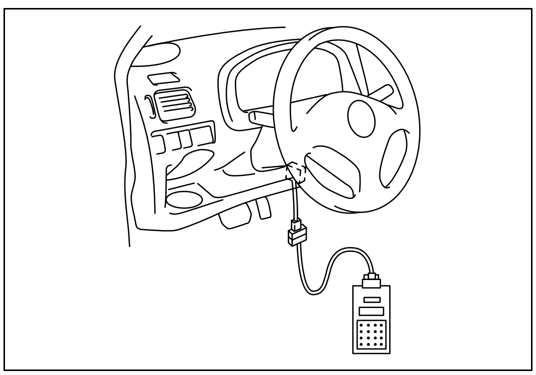
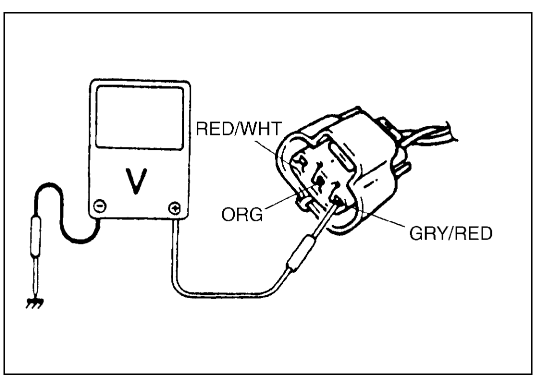
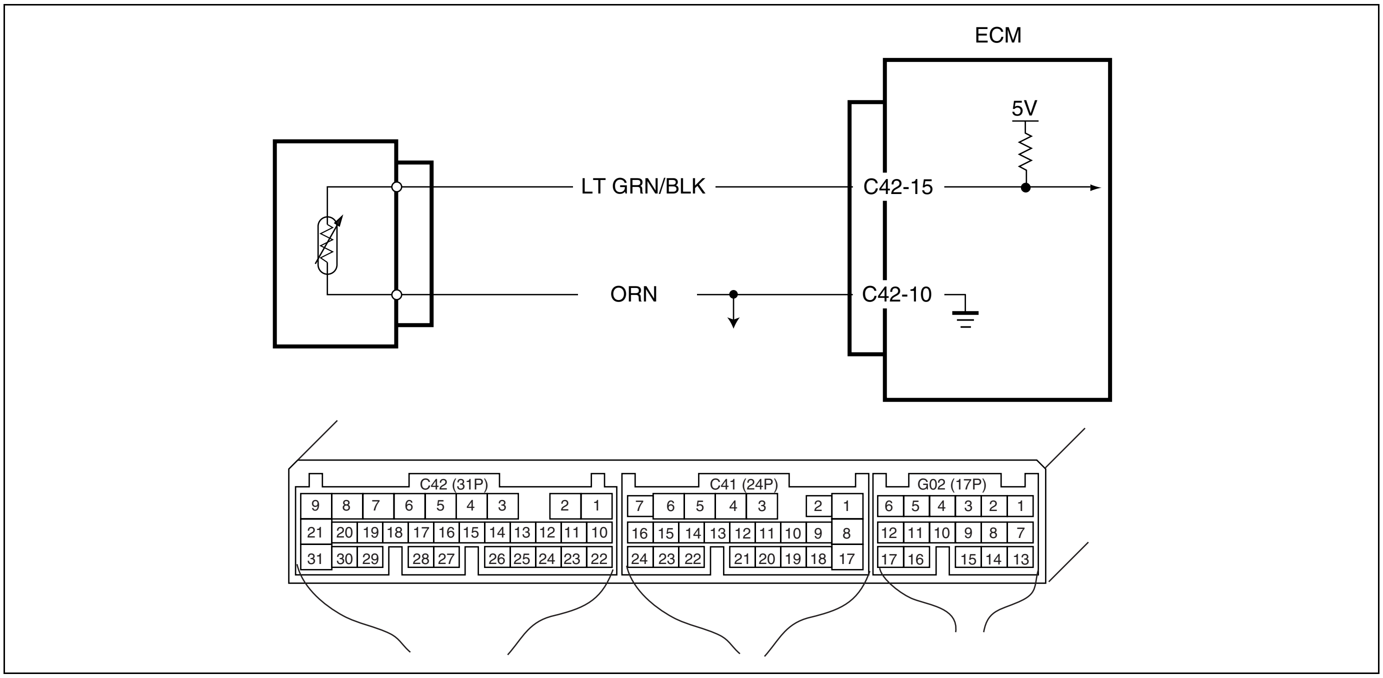


Fig. 2 for Step 3



DTC P0110 (DTC NO.18) INTAKE AIR TEMP. (IAT) CIRCUIT MALFUNCTION

WIRING DIAGRAM / CIRCUIT DESCRIPTION



DTC DETECTING CONDITION	POSSIBLE CAUSE
• Low intake air temperature (High voltage-High resistance) or • High intake air temperature (Low voltage-Low resistance)	• "LT GRN/BLK" circuit open or shorted to power. • "ORN" circuit open • IAT sensor malfunction • ECM malfunction

NOTE:

- **When DTC P0105 (No.11), P0110 (No.18), P0115 (No.19) and P0120 (No.13) are indicated together, it is possible that "ORN" circuit is open.**
- **Before inspecting, be sure to check that ambient temperature is higher than – 40°C (– 40°F).**

DTC CONFIRMATION PROCEDURE

1) Clear DTC, start engine and keep it at idle for 1 min.
2) Select "DTC" mode no scan tool and check DTC.

INSPECTION

Step	Action	Yes	No
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Check IAT Sensor and Its Circuit. 1) Connect scan tool to DLC with ignition switch OFF. 2) Turn ignition switch ON. 3) Check intake air temp. displayed on scan tool. See Fig. 1. Is – 40°C (– 40°F) or 119°C (246°F) indicated?	Go to Step 3.	Intermittent trouble. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A.

Step	Action	Yes	No
3	Check Wire Harness. 1) Disconnect IAT sensor connector with ignition switch OFF. 2) Check for proper connection to IAT sensor at “LT GRN/BLK” and “ORN” wire terminals. 3) If OK, then with ignition switch ON, is voltage applied to “LT GRN/BLK” wire terminal about 4 – 6 V? See Fig. 2.	Go to Step 5.	“LT GRN/BLK” wire open or shorted to power, or poor C42-15 connection. If wire and connection are OK, substitute a known-good ECM and recheck.
4	Does scan tool indicate – 40°C (– 40°F) at Step 2.	Go to Step 6.	Go to Step 5.
5	Check Wire Harness 1) Check intake air temp. displayed on scan tool with ignition switch ON. Is – 40°C (– 40°F) indicated?	Replace IAT sensor.	“LT GRN/BLK” wire shorted to ground. If wire is OK, substitute a known-good ECM and recheck.
6	Check Wire Harness. 1) Using service wire, connect IAT sensor connector terminals. 2) Check intake air temp. displayed on scan tool with ignition switch ON. See Fig. 3. Is 119°C (246°F) indicated?	Replace IAT sensor.	“LT GRN/BLK” wire open or poor C42-10 connection. If wire and connection are OK, substitute a known-good ECM and recheck.

Fig. 1 for Step 2

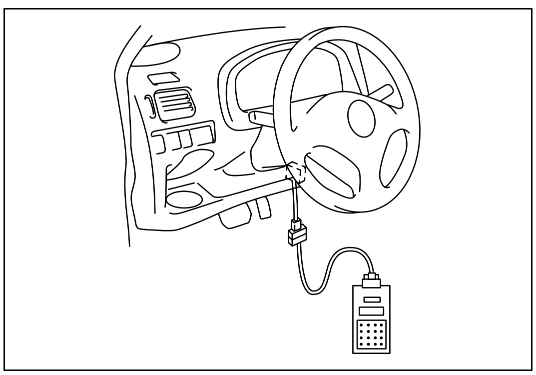


Fig. 2 for Step 3

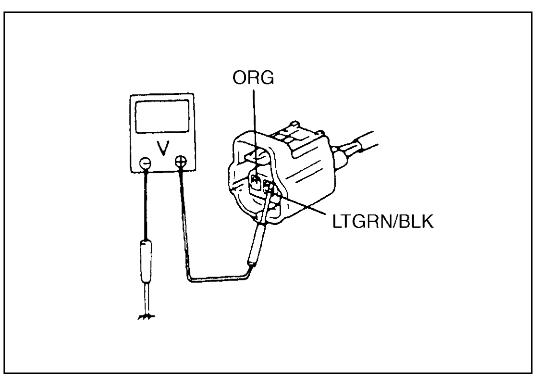
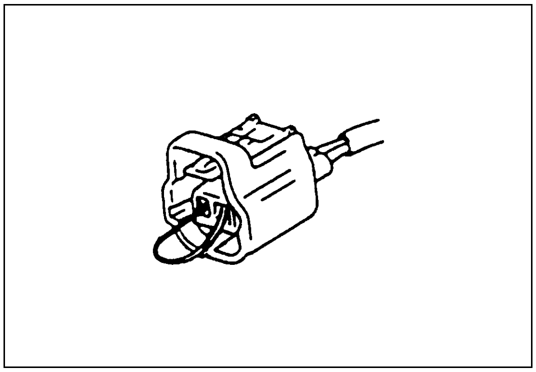
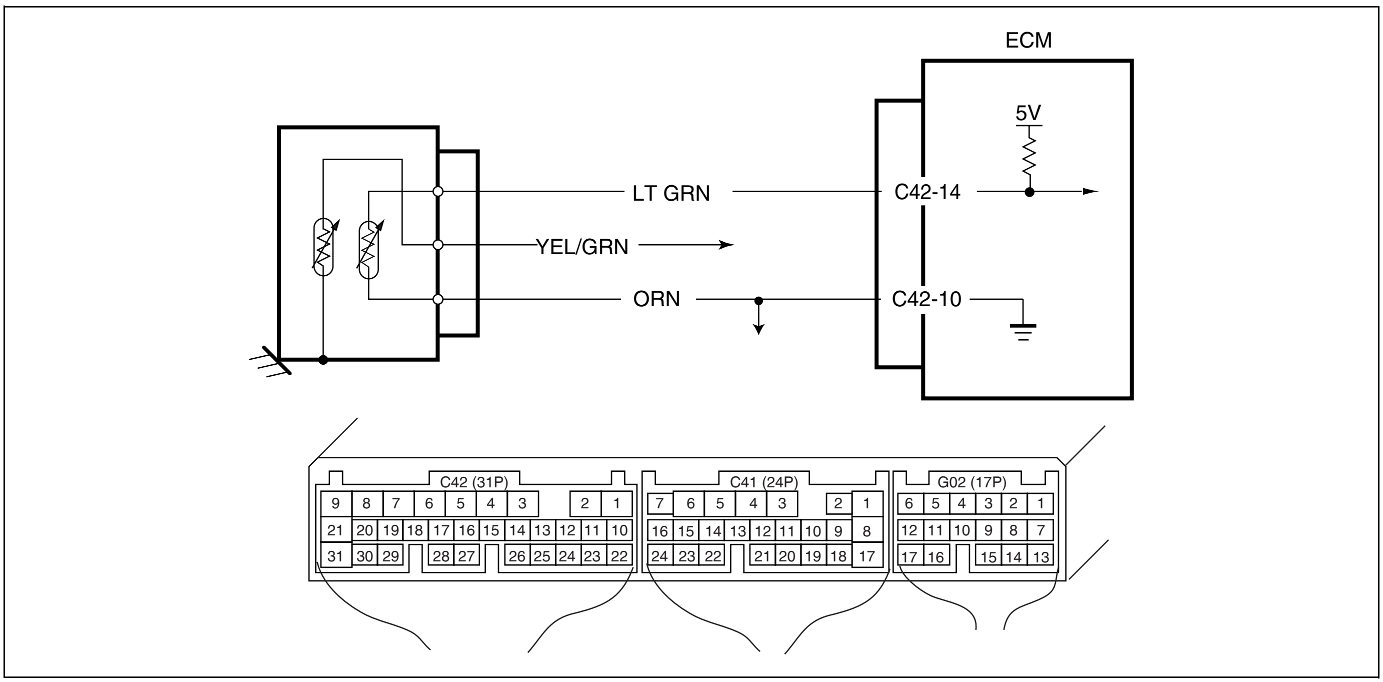


Fig. 3 for Step 4



DTC P0115 (DTC NO.19) ENGINE COOLANT TEMPERATURE (ECT) CIRCUIT MALFUNCTION

WIRING DIAGRAM / CIRCUIT DESCRIPTION



DTC DETECTING CONDITION	POSSIBLE CAUSE
• Low engine coolant temperature (High voltage-High resistance) or • High engine coolant temperature (Low voltage-Low resistance)	• "LT GRN" circuit open or shorted to power • "ORN" circuit open • ECT sensor malfunction • ECM malfunction

NOTE:

- **Before inspecting, be sure to check that coolant temp. meter in combination meter indicates normal operating temperature (Engine is not overheating).**
- **When this DTC and P1709 are stored together, also clear DTC stored in TCM after completion of repair.**
- **When DTC P0105 (No.11), P0110 (No.18), P0115 (No.19) and P0120 (No.13) are indicated together, it is possible that "ORN" circuit open.**

DTC CONFIRMATION PROCEDURE

1) Clear DTC, start engine and keep it at idle for 1 min.
2) Select “DTC” mode no scan tool and check DTC.

INSPECTION

Step	Action	Yes	No
1	Was “ENGINE DIAG. FLOW TABLE” performed?	Go to Step 2.	Go to “ENGINE DIAG. FLOW TABLE”.
2	Check ECT Sensor and its Circuit. 1) Connect scan tool with ignition switch OFF. 2) Turn ignition switch ON. 3) Check engine coolant temp. displayed on scan tool. See Fig. 1. Is – 40°C (– 40°F) or 119°C (246°F) indicated?	Go to Step 3.	Intermittent trouble. Check for intermittent referring to “Intermittent and Poor Connection” in Section 0 A.
3	Check Wire Harness. 1) Disconnect ECT sensor connector. 2) Check engine coolant temp. displayed on scan tool. Is – 40°C (– 40°F) indicated?	Replace ECT sensor.	“LT GRN” wire shorted to ground. If wire is OK, substitute a known-good ECM and recheck.
4	Does scan tool indicate – 40°C (– 40°F) at Step 2.	Go to Step 6.	Go to Step 5.
5	Check Wire Harness. 1) Disconnect ECT sensor connector with ignition switch OFF. 2) Check for proper connection to ECT sensor at “ORN” and “LT GRN” wire terminals. If OK, then with ignition switch ON, is voltage applied to “LT GRN” wire terminal about 4 – 6 V? See Fig. 2.	Go to Step 4.	“LT GRN” wire open or shorted to power, or poor C42-14 connection. If wire and connection are OK, substitute a known-good ECM and recheck.
6	Check Wire Harness. 1) Using service wire, connect ECT sensor connector terminals. See Fig. 3. 2) Turn ignition switch ON and check engine coolant temp. displayed on scan tool. Is 119°C (246°F) indicated?	Replace ECT sensor.	“ORN” wire open or poor C42-10 connection. If wire and connection are OK, substitute a known-good ECM and recheck.

Fig. 1 for Step 2

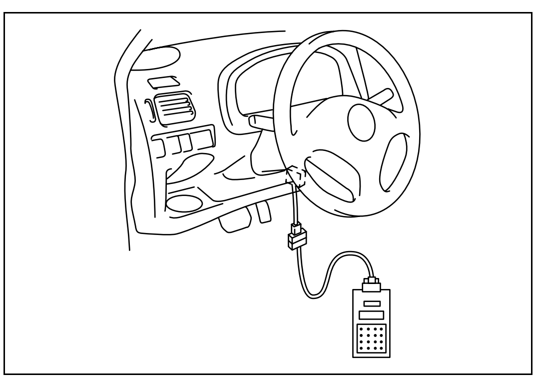


Fig. 2 for Step 3

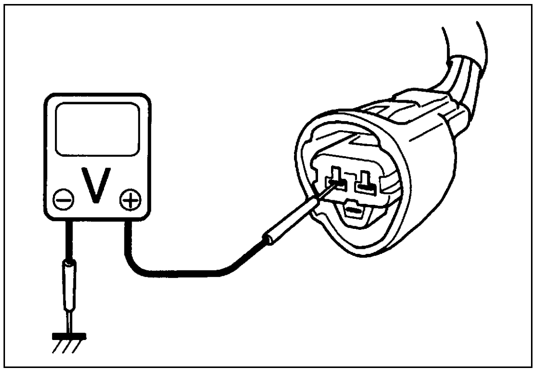
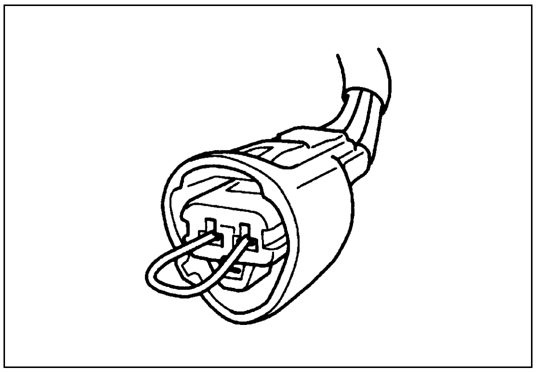
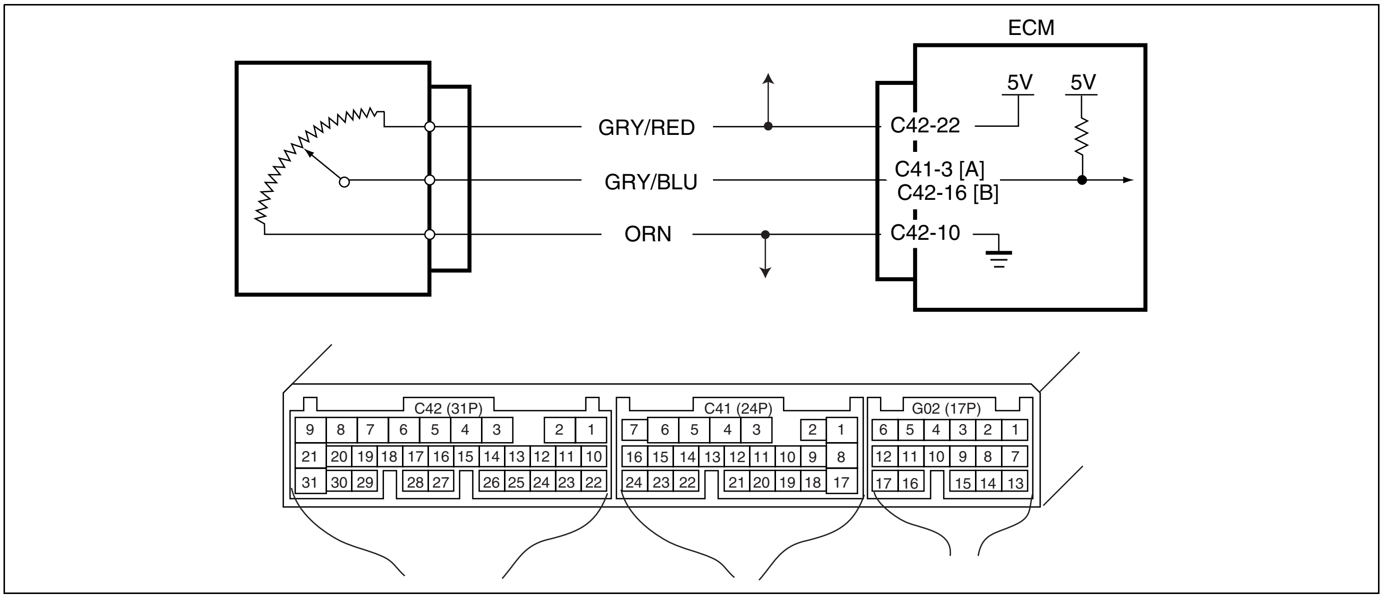


Fig. 3 for Step 4



DTC P0120 (DTC NO.13) THROTTLE POSITION CIRCUIT MALFUNCTION

WIRING DIAGRAM / CIRCUIT DESCRIPTION



[A] : Case of TYPE A is shown (See NOTE)	[B] : Case of TYPE B is shown (See NOTE)

DTC DETECTING CONDITION	POSSIBLE CAUSE
• Signal voltage high or • Signal voltage low	• "ORN" circuit open • "GRY/BLU" circuit open or shorted to ground • "GRY/RED" circuit open or shorted to power or ground • TP sensor malfunction • ECM malfunction

NOTE:
- **For TYPE A and TYOE B, refer to NOTE in "ECM VOLTAGE VALUES TABLE" for applicable model.**
- **When DTC P0105 (No.11), P0110 (No.18), P0115 (No.19) and P0120 (No.13) are indicated together, it is possible that "ORN" or "GRY/RED" circuit is open.**
- **When this DTC and P1700 are stored together, also clear DTC stored in TCM after completion of repair.**
- **When this DTC and DTC P0105 (No.11) are indicated together, it is possible that "GRY/RED" circuit is open.**

DTC CONFIRMATION PROCEDURE

1) Clear DTC, start engine and keep it at idle for 1 min.
2) Select "DTC" mode no scan tool and check DTC.

INSPECTION

Step	Action	Yes	No
1	Was “ENGINE DIAG. FLOW TABLE” performed?	Go to Step 2.	Go to “ENGINE DIAG. FLOW TABLE”.
2	Check TP Sensor and Its Circuit. 1) Connect scan tool to DLC with ignition switch OFF and then turn ignition switch ON. 2) Check throttle valve opening percentage displayed on scan tool. See Fig. 1. Is it displayed 2% or less? 3) Check throttle valve opening percentage displayed on scan tool while opening throttle valve from idle position to full open position. See Fig. 1. Is it displayed 96% or higher?	Go to Step 3.	Intermittent trouble. Check for intermittent referring to “Intermittent and Poor Connection” in Section 0 A.
3	Check Wire Harness. 1) Disconnect connector from TP sensor with ignition switch OFF. 2) Check for proper connection to TP sensor at “GRY/RED”, “GRY/BLU” and “ORN” wire terminals. 3) If OK, then with ignition switch ON, check voltage between each of “GRY/RED” or “GRY/BLU” wire terminals and body ground. See Fig. 2. Is voltage about 4 – 6 V at each terminal?	Go to Step 4.	“GRY/RED” wire open, “GRY/RED” wire shorted to ground circuit or power circuit or “GRY/BLU” wire, “ORN” wire open or shorted to ground circuit or poor C42-22 or C41-3 (For TYPE A, See NOTE) or C42-16 (For TYPE B, See NOTE) connection. If wire and connection are OK, substitute a known-good ECM and recheck.
4	Check TP Sensor. 1) Check resistance between terminals of TP sensor. See Fig. 3. Between 1 and 2 : 2.5 – 6.0 kΩ Between 1 and 3 : 100 Ω – 20 kΩ varying according to throttle valve opening Are measured values within specifications?	“ORN” wire open or poor C42-10 connection. If wire and connection are OK, substitute a known-good ECM and recheck.	Replace TP sensor.

Fig. 1 for Step 2

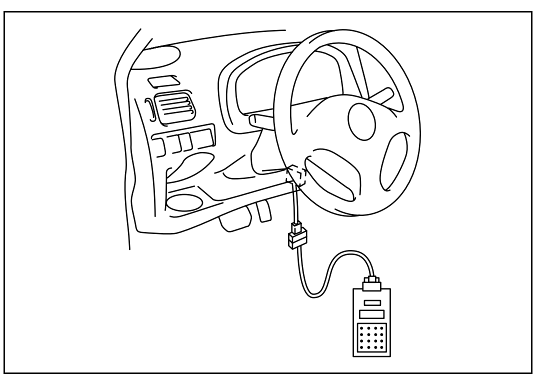


Fig. 2 for Step 3

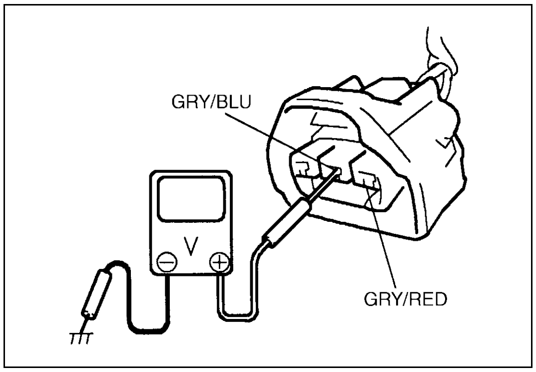
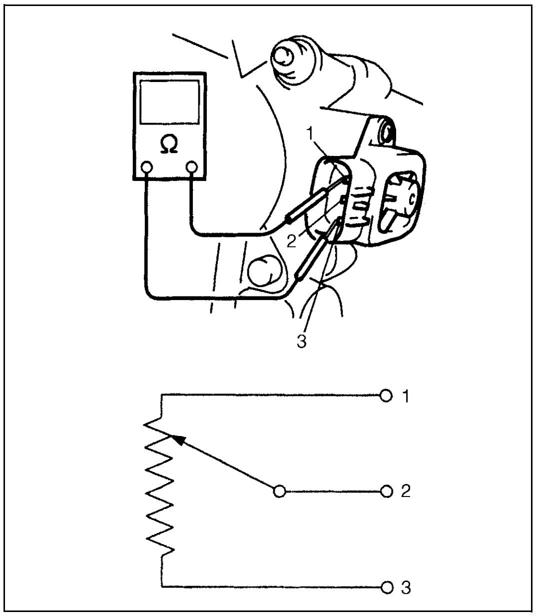
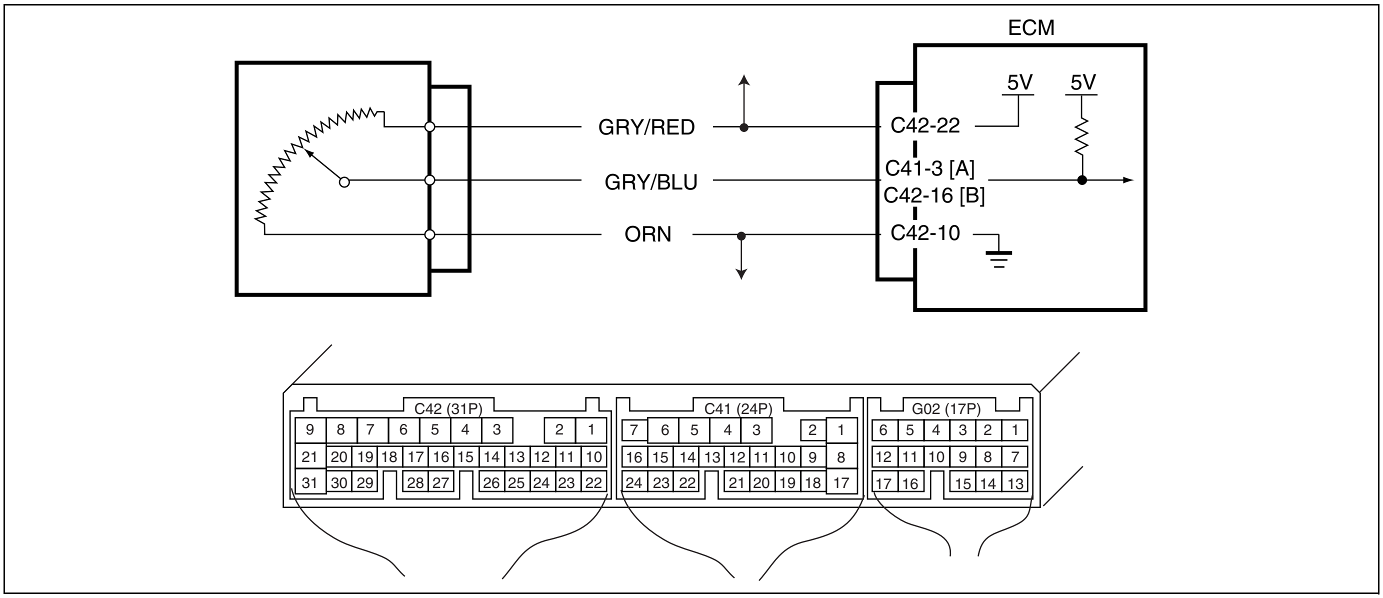


Fig. 3 for Step 4



DTC P0121 THROTTLE POSITION CIRCUIT RANGE/PERFORMANCE PROBLEM

WIRING DIAGRAM / CIRCUIT DESCRIPTION



[A] : Case of TYPE A is shown (See NOTE)	[B] : Case of TYPE B is shown (See NOTE)

NOTE:
For TYPE A and TYPE B, refer to NOTE in "ECM VOLTAGE VALUES TABLE" for applicable model.

DTC DETECTING CONDITION	POSSIBLE CAUSE
• DTC will set when the following conditions are detected. • After engine warmed up. • While vehicle running at specified engine speed. • No change in intake manifold pressure (constant throttle opening) • Difference between actual throttle opening (detected from TP sensor) and opening calculated by ECM (Obtained on the basis of engine speed and intake manifold pressure) in larger than specified value. ✱2 driving cycle detection logic, continuous monitoring	• TP sensor malfunction • High resistance in the circuit • ECM malfunction

DTC CONFIRMATION PROCEDURE

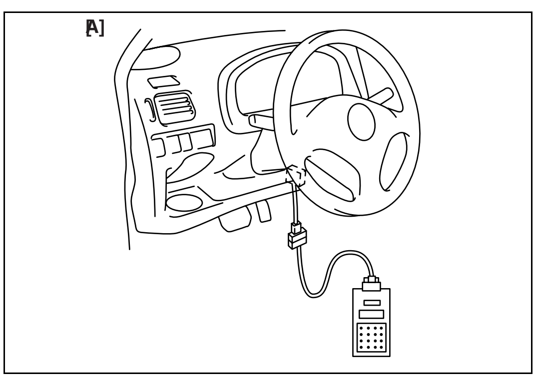
WARNING:
- **When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident.**
- **Road test should be carried out with 2 persons, a driver and a tester, on a level road.**

1) Turn ignition switch OFF. Clear DTC with ignition switch ON, check vehicle and environmental condition for :
   – Altitude (barometric pressure) : 2400 m, 8000 ft or less (560 mmHg, 75 kPa or more)
   – Ambient temp. : –10°C, 14°F or higher
   – Intake air temp. : 70°C, 158°F or lower
   – Engine coolant temp. : 70 – 110°C, 158 – 230°F
2) Warm up engine to normal operating temperature.
3) Increase vehicle speed to 30 – 40 mph, 50 – 60 km/h in 3rd gear or "D" range and hold throttle valve at that opening position for 1 min.
4) Stop vehicle.
5) Check DTC in "DTC" mode and pending DTC in "ON BOARD TEST" or "PENDING DTC" mode.

INSPECTION

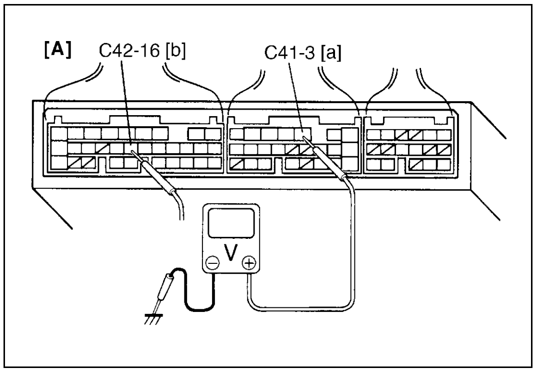
Step	Action	Yes	No
1	Was “ENGINE DIAG. FLOW TABLE” performed?	Go to Step 2.	Go to “ENGINE DIAG. FLOW TABLE”.
2	Is SUZUKI scan tool available?	Go to Step 3.	Go to Step 4.
3	Check TP Sensor and its Circuit. 1) Turn ignition switch OFF and connect SUZUKI scan tool to DLC. 2) Turn ignition switch ON and check TP sensor output voltage when throttle valve is at idle position and fully opened. See Fig. 1 and 3. Dose voltage vary within specified value linearly as shown in figure?	If voltmeter was used, check terminal C41-3 (For TYPE A, See NOTE) or C42-16 (For TYPE B, See NOTE) for poor connection. If OK, substitute a known-good ECM and recheck.	Go to Step 5.
4	Check TP Sensor and Its Circuit. 1) Turn ignition switch ON. 2) Check voltage at terminal C41-3 (For TYPE A, See NOTE) or C42-16 (For TYPE B, See NOTE) of ECM connector connected, when throttle valve is at idle position and fully opened. See Fig. 2 and 3. Dose voltage vary within specified value linearly as shown in figure?	If voltmeter was used, check terminal C41-3 (For TYPE A, See NOTE) or C42-16 (For TYPE B, See NOTE) for poor connection. If OK, substitute a known-good ECM and recheck.	Go to Step 5.
5	Check TP Sensor. 1) Turn ignition switch OFF. 2) Disconnect TP sensor connector. 3) Check for proper connection to TP sensor at each terminal. 4) If OK, then measure resistance between terminals and check if each measured value is as specified below. See Fig. 4. Between 1 and 2 : 4.0 – 6.0 kΩ Between 1 and 3 : 0.02 – 6.0 kΩ, varying according to throttle valve opening. Are measured values as specified?	High resistance in “GRY/RED”, “GRY/BLU” or “ORN” circuit. If wire and connection are OK, substitute a known-good ECM and recheck.	Replace TP sensor.

Fig. 1 for Step 3



[A] : When using SUZUKI scan tool:

Fig. 2 for Step 4



[A] :	When not using SUZUKI scan tool:
[a] :	Case of TYPE A is shown (See NOTE)
[b] :	Case of TYPE B is shown (See NOTE)

Fig. 3 for Step 3 and 4

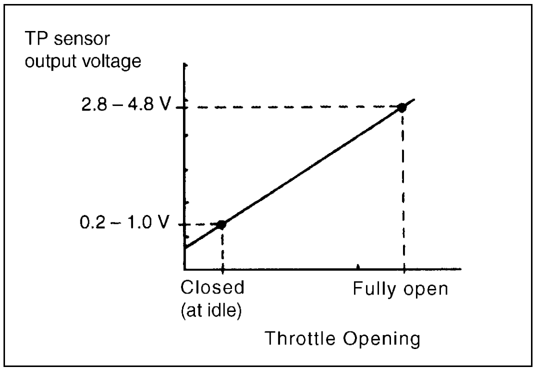
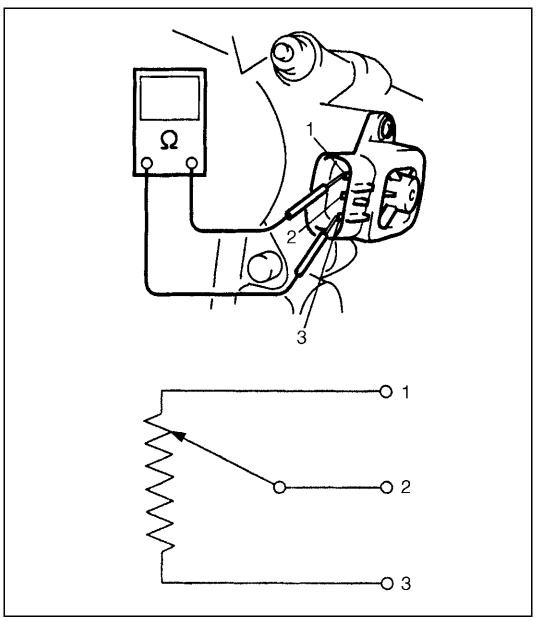
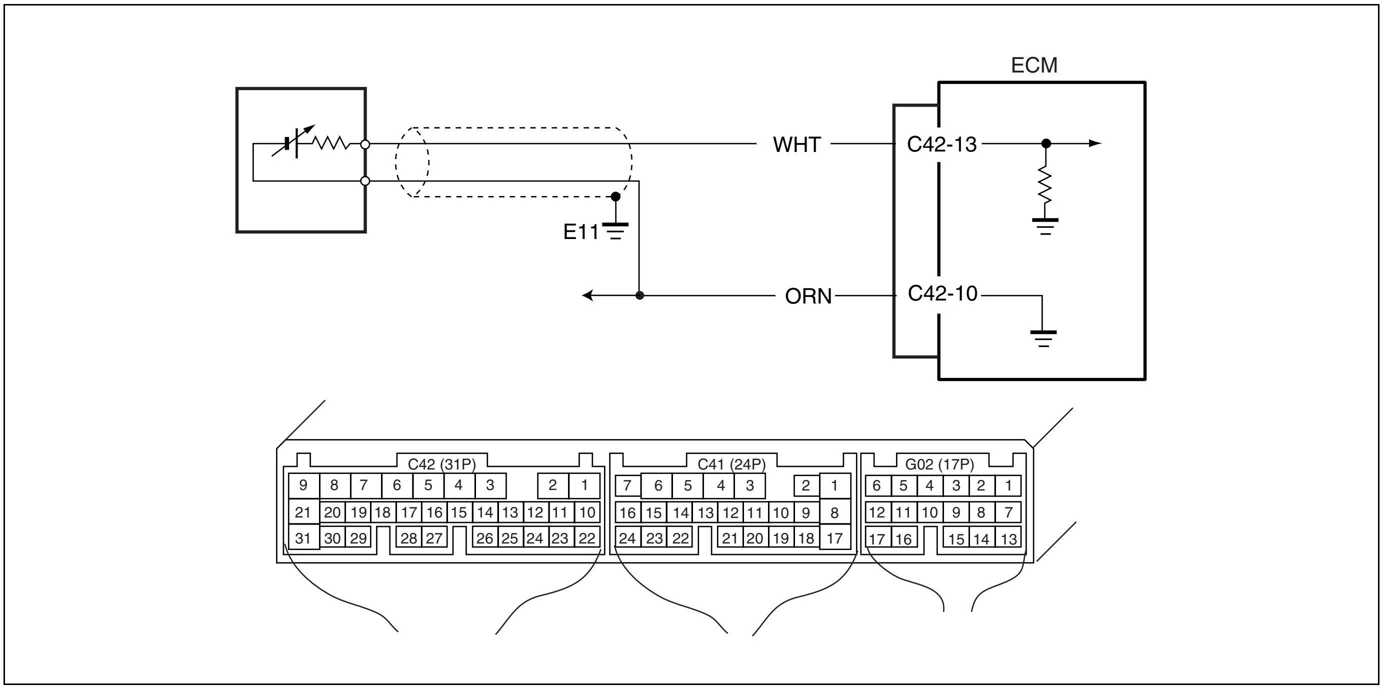


Fig. 4 for Step 5



DTC P0130 (DTC NO.14) HEATED OXYGEN SENSOR (HO2S) CIRCUIT MALFUNCTION (SENSOR-1)

WIRING DIAGRAM / CIRCUIT DESCRIPTION



DTC DETECTING CONDITION	POSSIBLE CAUSE
• When running at idle speed after engine warmed up and running at specified vehicle speed, HO2S-1 output voltage does not go below 0.3 V or over 0.6 V. ✱2 driving cycle detection logic, Monitoring once/1 driving.	• Heated oxygen sensor-1 malfunction • “WHT” or “ORN” circuit open (poor connection) or short

DTC CONFIRMATION PROCEDURE

WARNING:
- **When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident.**
- **Road test should be carried out with 2 persons, a driver and a tester.**

1) Turn ignition switch OFF. Clear DTC with ignition switch ON, check vehicle and environmental condition for :
   – Altitude (barometric pressure) : 2400 m, 8000 ft or less (560 mmHg, 75 kPa or more)
   – Ambient temp. : –10°C, 14°F or higher
   – Intake air temp. : 70°C, 158°F or lower
2) Warm up engine to normal operating temperature.
3) Drive vehicle at 30 – 40 mph, 50 – 60 km/h for 2 min.
4) Stop vehicle and run engine at idle for 2 min.
5) Check DTC in “DTC” mode and pending DTC in “ON BOARD TEST” or “PENDING DTC” mode.

INSPECTION

Step	Action	Yes	No
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Is there DTC(s) other than HO2S-1 (DTC P0130)?	Go to applicable DTC Diag. Flow Table.	Go to Step 3.
3	Check HO2S-1 signal. 1) Connect scan tool to DLC with ignition switch OFF. 2) Warm up engine to normal operating temperature and keep it at 2000 r/min. for 60 sec. 3) Repeat racing engine (Repeat depressing accelerator pedal 5 to 6 times continuously and take foot off from pedal to enrich and enlean A/F mixture). See Fig. 1 and 2. Does HO2S-1 output voltage deflect between 0.3 V and over 0.6 V repeatedly?	Intermittent trouble. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A.	Check "WHT" and "ORN" wires for open and short, and connections for poor connection. If wires and connections are OK, replace HO2S-1.

Fig. 1 for Step 3

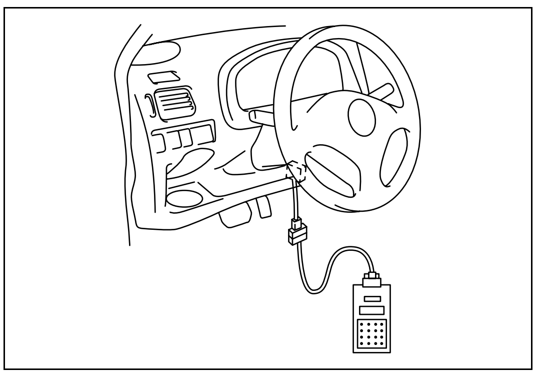
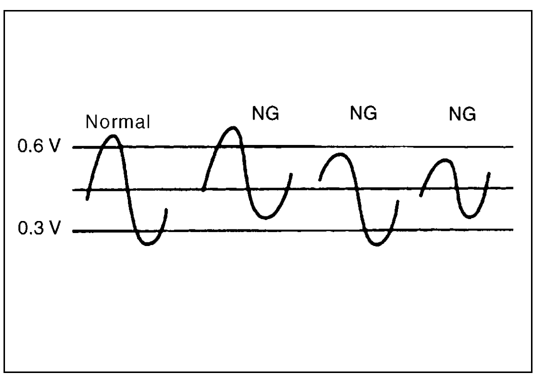


Fig. 2 for Step 3



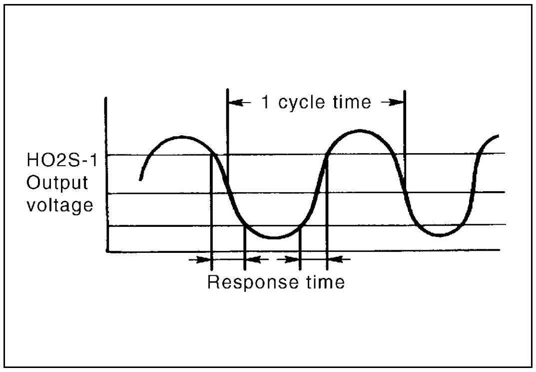
DTC P0133 HEATED OXYGEN SENSOR (HO2S) CIRCUIT SLOW RESPONSE (SENSOR-1)

WIRING DIAGRAM / CIRCUIT DESCRIPTION

Refer to DTC P0130 section.

DTC DETECTING CONDITION	POSSIBLE CAUSE
• When running at specified idle speed after engine warmed up and running at specified vehicle speed, response time (time to change from lean to rich or from rich to lean) of HO2S-1 output voltage is about 1 sec. at minimum or average time of 1 cycle is 5 sec. at minimum. See. Fig. 1 ✱2 driving cycle detection logic, Monitoring once/1 driving.	• Heated oxygen sensor-1 malfunction

Fig. 1



DTC CONFIRMATION PROCEDURE

Refer to DTC P0130 section.

INSPECTION

Step	Action	Yes	No
1	Was “ENGINE DIAG. FLOW TABLE” performed?	Go to Step 2.	Go to “ENGINE DIAG. FLOW TABLE”.
2	Is there DTC(s) other than HO2S-1 (DTC P0133)?	Go to applicable DTC Diag. Flow Table.	Replace HO2S-1.

DTC P0134 HEATED OXYGEN SENSOR (HO2S) CIRCUIT NO ACTIVITY DETECTED (SENSOR-1)

WIRING DIAGRAM / CIRCUIT DESCRIPTION

Refer to DTC P0130 section.

DTC DETECTING CONDITION	POSSIBLE CAUSE
• Engine warmed up. • While running under other than high load and high engine speed conditions or at specified idle speed (engine is in closed loop condition), HO2S-1 output voltage is high or low continuously. ✱2 driving cycle detection logic, Continuous monitoring.	• "WHT" or "ORN" circuit open or short • Heated oxygen sensor malfunction • Fuel system malfunction • Exhaust gas leakage

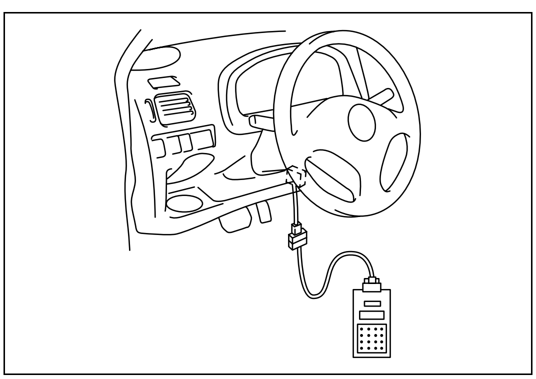
DTC CONFIRMATION PROCEDURE

Refer to DTC P0131 section.

INSPECTION

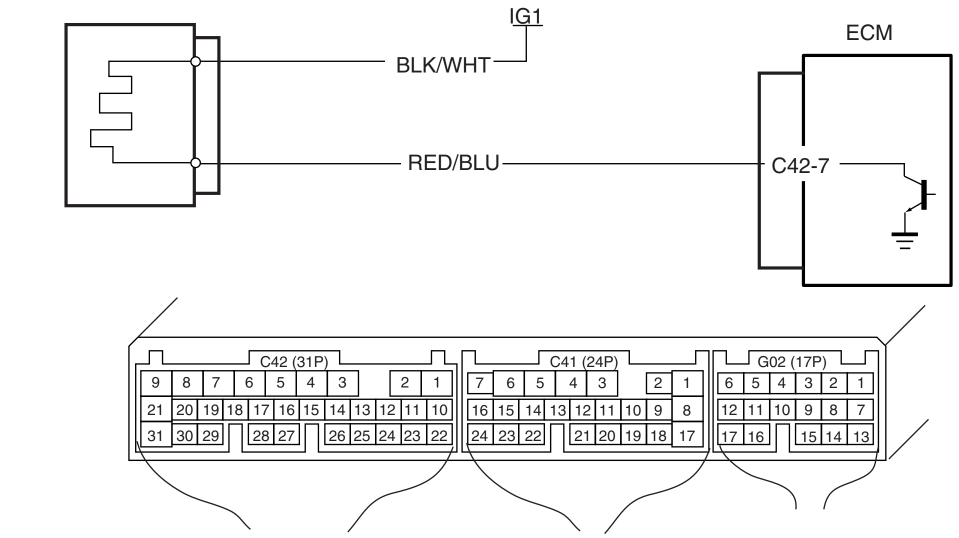
Step	Action	Yes	No
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Is there DTC(s) other than Fuel system (DTC P0171/P0172) and HO2S-1 (DTC P0134)?	Go to applicable DTC Diag. Flow Table.	Go to Step 3.
3	Check HO2S-1 and Its Circuit. 1) Connect scan tool to DLC with ignition switch OFF. 2) Warm up engine to normal operating temperature and keep it at 2000 r/min. for 60 sec. 3) Repeat racing engine (Repeat depressing accelerator pedal 5 to 6 times continuously and take foot off from pedal to enrich and enlean A/F mixture). See Fig. 1. Does HO2S-1 output voltage deflect between 0.3V and over 0.6V repeatedly?	Go to DTC P0171 and P0172 Diag. Flow Table (Fuel System Check).	Check "WHT" and "ORN" wires for open and short, and connections for poor connection. If wires and connections are OK, replace HO2S-1.

Fig. 1 for Step 3



DTC P0135 (DTC NO.14) HEATED OXYGEN SENSOR (HO2S) HEATER CIRCUIT MALFUNCTION (SENSOR-1)

WIRING DIAGRAM / CIRCUIT DESCRIPTION



DTC DETECTING CONDITION	POSSIBLE CAUSE
DTC will set when one of the following conditions is met. • Low voltage at terminal C42-7 when engine is running at high load. • High voltage at terminal C42-7 when engine is running under condition other than above. ✱2 driving cycle detection logic, Continuous monitoring.	• HO2S-1 heater circuit open or shorted to ground • ECM malfunction

DTC CONFIRMATION PROCEDURE

WARNING:
- **When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident.**
- **Road test should be carried out with 2 persons, a driver and a tester.**

1) Turn ignition switch OFF.
2) Clear DTC with ignition switch ON, start engine and keep it at idle for 1 min.
3) Start vehicle and depress accelerator pedal fully for 5 sec. or longer.
4) Stop vehicle.
5) Check DTC in “DTC” mode and pending DTC in “ON BOARD TEST” or “PENDING DTC” mode.

INSPECTION

Step	Action	Yes	No
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Check Heater for operation. 1) Check voltage at terminal C42-7. See Fig. 1. 2) Warm up engine to normal operating temperature. 3) Stop engine. 4) Turn ignition switch ON and Check voltage at terminal C42-7. See Fig. 1. Voltage should be over 10 V. 5) Start engine, run it at idle and check voltage at the same terminal. Voltage should be below 1.9 V. Are check results are specified?	Intermittent trouble Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A.	Go to Step 3.
3	Check Heater of Sensor-1. 1) Disconnect HO2S-1 coupler with ignition switch OFF. 2) Check for proper connection to HO2S-1 at "BLK/WHT" and "RED/BLU" wire terminals. 3) If OK, then check heater resistance. See Fig. 2. Is it 5.0 – 6.4 Ω at 20°C, 68°F?	"RED/BLU" wire open or shorted to ground or poor connection at C42-7. If wire and connection are OK, substitute a known-good ECM and recheck.	Replace HO2S-1.

Fig. 1 for Step 2

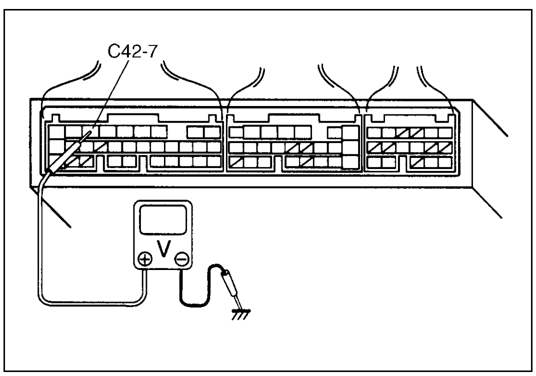
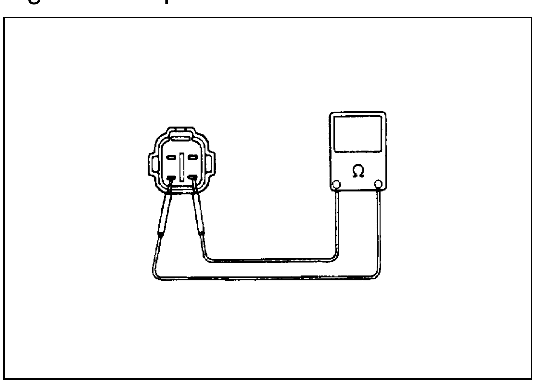
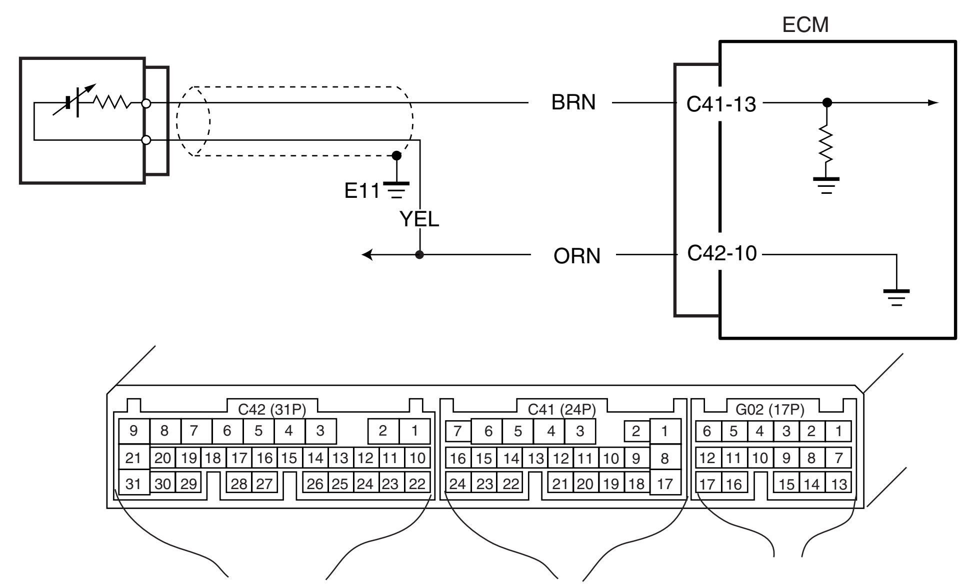


Fig. 2 for Step 3



DTC P0136 HEATED OXYGEN SENSOR (HO2S) CIRCUIT MALFUNCTION (SENSOR-2)

WIRING DIAGRAM / CIRCUIT DESCRIPTION



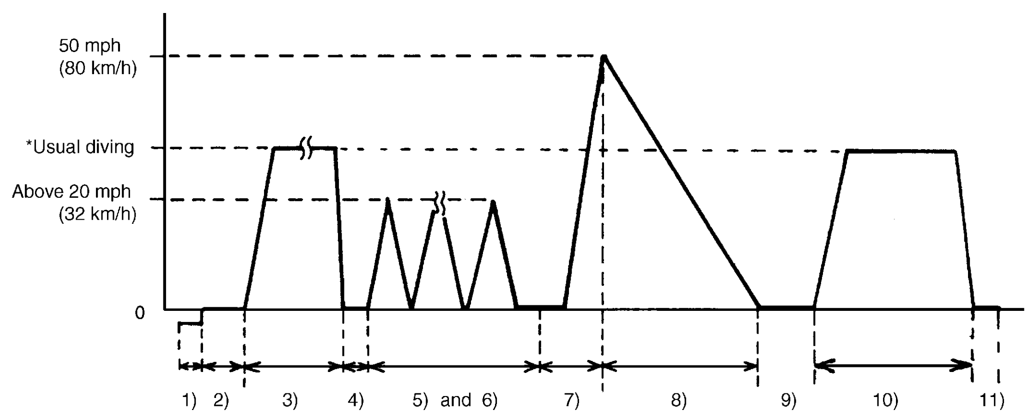
DTC DETECTING CONDITION	POSSIBLE CAUSE
DTC will set when one of the following conditions is detected. • Max. output voltage of HO2S-2 is lower than specified value or Min. output voltage is higher than specified value while vehicle driving. • Engine is warmed up and HO2S-2 voltage is 4.5 V or more. (circuit open) ✱2 driving cycle detection logic, monitoring once/1 driving.	• Exhaust gas leakage • “BRN”, “YEL” or “ORN” circuit open or short • Heated oxygen sensor-2 malfunction • Fuel system malfunction

DTC CONFIRMATION PROCEDURE

WARNING:
- **When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident.**
- **Road test should be carried out with 2 persons, a driver and a tester, on a level road.**

1) Turn ignition switch OFF.
   Clear DTC with ignition switch ON, check vehicle and environmental condition for :
   – Altitude (barometric pressure) : 2400 m, 8000 ft or less (560 mmHg, 75 kPa or more)
   – Ambient temp. : –10°C, 14°F or higher
   – Intake air temp. : 70°C, 158°F or lower
   – No exhaust gas leakage and loose connection
2) Warm up engine to normal operating temperature.
3) Drive vehicle under usual driving condition for 5 min. and check HO2S-2 output voltage and “short term fuel trim” with “Data List” mode on scan tool, and write it down.
4) Stop vehicle (don’t turn ignition switch OFF).
5) Increase vehicle speed to higher than 20 mph, 32 km/h and then stop vehicle.

6) Repeat above steps 5) 4 times.
7) Increase vehicle speed to about 50 mph (80 km/h) in 3rd gear or 2 range.
8) Release accelerator pedal and with engine brake applied, keep vehicle coasting (fuel cut condition) for 10sec. or more.
9) Stop vehicle (don't turn ignition switch OFF) and run engine at idle for 2 min.
   After this step 9), if "Oxygen Sensor Monitoring TEST COMPLETED" is displayed in "READINESS TESTS" mode and DTC is not displayed in "DTC" mode, confirmation test is completed.
   If "TEST NOT COMPLTD" is still being displayed, proceed to next step 10).
10) Drive vehicle under usual driving condition for 10 min. (or vehicle is at a stop and run engine at idle for 10 min. or longer)
11) Stop vehicle (don't turn ignition switch OFF). Confirm test results according to "Test Result Confirmation Flow Table" in "DTC CONFIRMATION PROCEDURE" of DTC P0420.



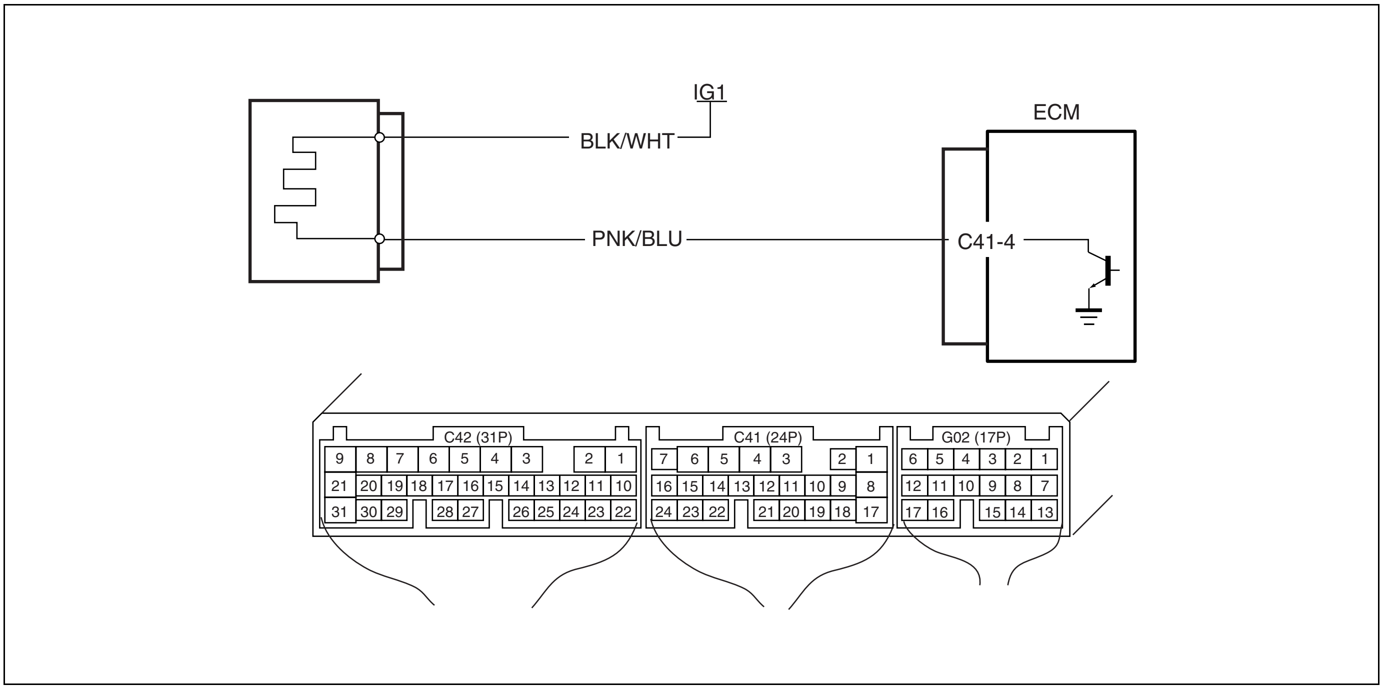
★Usual driving : Driving at 30 – 40 mph, 50 – 60 km/h including short stop according to traffic signal. (under driving condition other than high-load, high-engine speed, rapid accelerating and decelerating)

INSPECTION

Step	Action	Yes	No
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Check Exhaust System for leakage, loose connection and damage. Is it good condition?	Go to Step 3.	Repair or replace.
3	Check HO2S-2 and Its Circuit. Was HO2S-2 output voltage indicated on scan tool in step 3) of DTC confirmation test less than 1.275 V?	Go to Step 4.	"BRN", "YEL" or "ORN" circuit short to power supply circuit or HO2S-2 malfunction.
4	Check Short Term Fuel Trim. Did short term fuel trim very within – 20 – + 20% range in step 3) of DTC confirmation test?	Check "BRN", "YEL" or "ORN" wire for open and short, and connection for poor connection. If wire and connection are OK, replace HO2S-2.	Check fuel system. Go to DTC P0171/P0172 Diag. Flow Table.

DTC P0141 HEATED OXYGEN SENSOR (HO2S) HEATER CIRCUIT MALFUNCTION (SENSOR-2)

WIRING DIAGRAM / CIRCUIT DESCRIPTION



DTC DETECTING CONDITION	POSSIBLE CAUSE
DTC will set when any one of the following conditions is met. • Low voltage at terminal C41-4 for specified time after engine start or while engine running at high load. • High voltage at terminal C41-4 while engine running under other than above condition. ✱2 driving cycle detection logic, continuous monitoring.	• HO2S-2 heater circuit open or shorted to ground • ECM malfunction

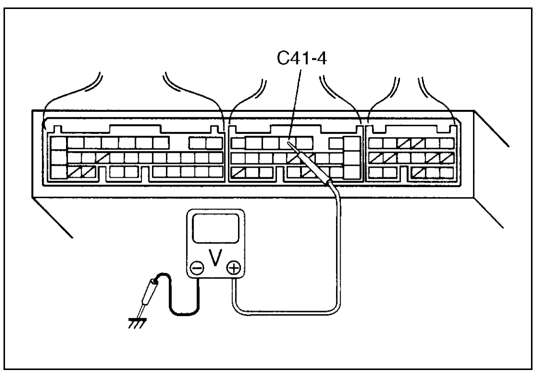
DTC CONFIRMATION PROCEDURE

1) Turn ignition switch OFF once and then ON.
2) Clear DTC, start engine and warm up engine to normal operating temperature.
3) Keep it at 2000 r/min for 2 min.
4) Check pending DTC in “ON BOARD TEST” or “PENDING DTC” mode and DTC in “DTC” mode.

INSPECTION

Step	Action	Yes	No
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Check HO2S-2 Heater and Its Circuit. 1) Warm up engine to normal operating temperature. 2) Stop engine. 3) Turn ignition switch ON and check voltage at terminal C41-4 See Fig. 1. Voltage should be over 10 V. 4) Start engine, run it at idle and check voltage at the same terminal after 1 min. from engine start. Voltage should be below 1.9 V. Are check result as specified?	Intermittent trouble. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A.	Go to Step 3.
3	Check Heater of Sensor-2. 1) Disconnect HO2S-2 coupler with ignition switch OFF. 2) Check for proper connection to HO2S-2 at "BLK/WHT" and "PNK/BLU" wire terminals. 3) If OK, then check heater resistance. Is it 12.0 – 14.3 Ω at 20°C, 68°F?	"PNK/BLU" wire open or shorted to ground or poor connection at C41-4. If wire and connection are OK, substitute a known-good ECM and recheck.	Replace HO2S-2.

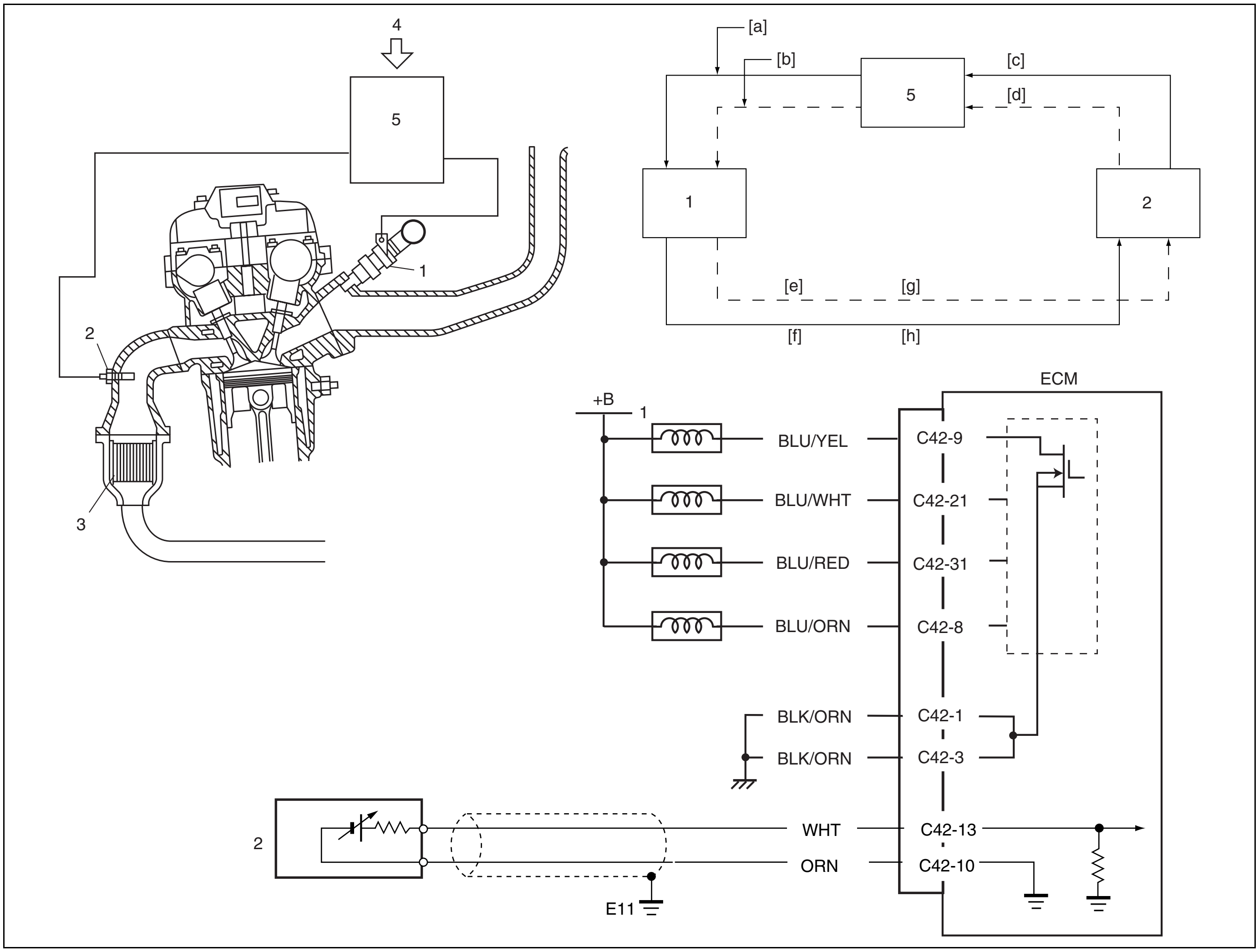
Fig. 1 for Step 2



DTC P0171 FUEL SYSTEM TOO LEAN

DTC P0172 FUEL SYSTEM TOO RICH

WIRING DIAGRAM / CIRCUIT DESCRIPTION



1. Injector	[a] : Signal to decrease amount of fuel injection	[f] : A/F mixture becomes leaner
2. HO2S-1	[b] : Signal to increase amount of fuel injection	[g] : Oxygen concentration decreases
3. WU-TWC (Warm up-three way catalytic convector)	[c] : High voltage	[h] : Oxygen concentration increases
4. Sensed information	[d] : Low voltage	
5. ECM	[e] : A/F mixture becomes richer	

DTC DETECTING CONDITION	POSSIBLE CAUSE
When one of the following conditions occurs while engine running under closed loop condition. • Air/fuel ratio too lean (Total fuel trim (short and long terms added) is more than 30%) • Air/fuel ratio too rich (Total fuel trim is less than – 30%) ✱2 driving cycle detection logic, continuous monitoring.	• Vacuum leaks (air drawn in). • Exhaust gas leakage. • Heated oxygen sensor-1 circuit malfunction. • Fuel pressure out of specification. • Fuel injector malfunction (clogged or leakage). • MAP sensor poor performance. • ECT sensor poor performance. • IAT sensor poor performance. • TP sensor poor performance. • EVAP control system malfunction. • PCV valve malfunction.

DTC CONFIRMATION PROCEDURE

WARNING:

- **When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident.**
- **Road test should be carried out with 2 persons, a driver and a tester, on a level road.**

1) Turn ignition switch OFF.
2) Clear DTC with ignition switch ON.
3) Check vehicle and environmental condition for :
   – Altitude (barometric pressure) : 2400 m, 8000 ft or less (560 mmHg, 75 kPa or more)
   – Ambient temp. : –10°C, 14°F or higher
   – Intake air temp. : 70°C, 158°F or lower
4) Start engine and drive vehicle under usual driving condition (described in DTC confirmation procedure of DTC P0136) for 5 min. or longer and until engine is warmed up to normal operating temperature.
5) Keep vehicle speed at 30 – 40 mph, 50 – 60 km/h in 5th gear or “D” range for 5 min. or more.
6) Stop vehicle (do not turn ignition switch OFF).
7) Check pending DTC in “ON BOARD TEST” or “PENDING DTC” mode and DTC in “DTC” mode.

INSPECTION

Step	Action	Yes	No
1	Was “ENGINE DIAG. FLOW TABLE” performed?	Go to Step 2.	Go to “ENGINE DIAG. FLOW TABLE”.
2	Is there DTC(s) other than fuel system (DTC P0171/P0172)?	Go to applicable DTC Diag. Flow Table.	Go to Step 3.
3	Check HO2S-1 Output Voltage. 1) Connect scan tool to DLC with ignition switch OFF. 2) Warm up engine to normal operating temperature and keep it at 2000 r/min. for 60 sec. 3) Repeat racing engine (Repeat depressing accelerator pedal 5 to 6 times continuously and take foot off from pedal to enrich and enlean A/F mixture). See Fig. 1. Does HO2S-1 output voltage deflect between below 0.3 V and over 0.6 V repeatedly?	Go to Step 4.	Go to DTC P0130 Diag. Flow Table (HO2S-1 circuit check).
4	Check Fuel Pressure (Refer to section 6E1 for details). 1) Release fuel pressure from fuel feed line. 2) Install fuel pressure gauge. 3) Check fuel pressure. See Fig. 2. With fuel pump operating and engine at stop : 270 – 310 kPa, 2.7 – 3.1 kg/cm^2, 38.4 – 44.0 psi. At specified idle speed : 270 – 310 kPa, 2.7 – 3.1 kg/cm^2, 38.4 – 44.0 psi. Is measured value as specified?	Go to Step 5.	Go to Diag. Flow Table B-3 Fuel Pressure Check.

Step	Action	Yes	No
5	Check Fuel Injectors and Circuit. 1) Using sound scope (1) or such, check operating sound of each injector (2) when engine is running. Cycle of operating sound should vary according to engine speed. See Fig. 3. If no sound or an unusual sound is heard, check injector circuit (wire or coupler) or injector. 2) Turn ignition switch OFF and disconnect a fuel injector connector. 3) Check for proper connection to fuel injector at each terminal. See Fig. 4. 4) If OK, then check injector resistance. Injector Resistance : 11.3 – 13.8 ohm at 20°C (68°F) 5) Carry out steps 1) and 3) on each injector. 6) Check each injector for injected fuel volume (1) referring to Section 6E1. See Fig. 5. Injected Fuel Volume : 43 – 47 cc/15 sec 1.45/1.51 – 1.58/1.65 US/Imp.oz/15 sec) 7) Check each injector for fuel leakage after injector closed. Fuel Leakage : Less than 1 drop/min. Is check result in step 1) and 3) to 7) satisfactory?	Go to Step 6.	Check injector circuit or replace fuel injector(s).
6	Check EVAP Canister Purge Valve. 1) Disconnect purge hose from EVAP canister purge valve. 2) Place finger against the end of EVAP canister purge valve. 3) Check that vacuum is not felt there when engine is cool and running at idle. See Fig. 6. Is vacuum felt?	Check EVAP control system (See Section 6E1).	Go to Step 7.
7	Check Intake manifold absolute pressure sensor for performance (See DTC P0105 (No.11) Diag. Flow Table). Is it in good condition?	Go to Step 8.	Repair or replace.
8	Check Engine Coolant Temp. Sensor for performance (See Section 6E1). Is it in good condition?	Go to Step 9.	Replace engine coolant temp. sensor.
9	Check Intake Air Temp. Sensor for performance (See Section 6E1). Is it in good condition?	Go to Step 10.	Replace intake air temp. sensor.
10	Check Throttle Position Sensor for performance (See Step 4 of DTC P0121 Diag. Flow Table). Is it in good condition?	Go to Step 11.	Replace throttle position sensor.
11	Check PCV Valve for valve clogging (See Section 6E1). Is it good condition?	Substitute a known-good ECM and recheck.	Replace PCV valve.

Fig. 1 for Step 3

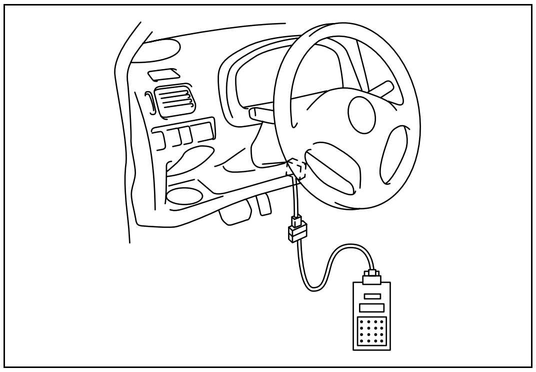


Fig. 2 for Step 4

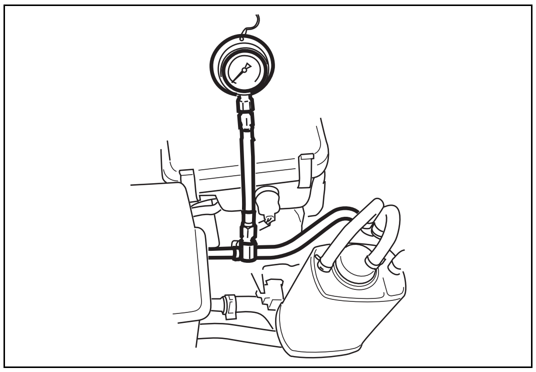


Fig. 3 for Step 5

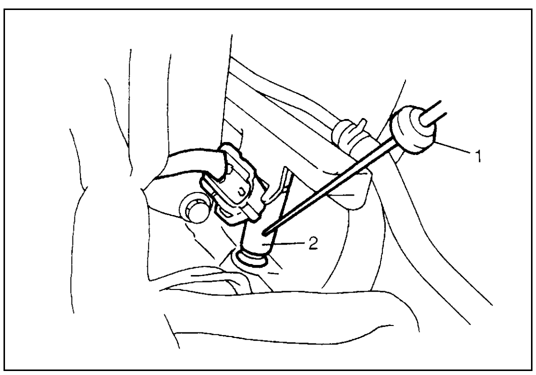


Fig. 4 for Step 5

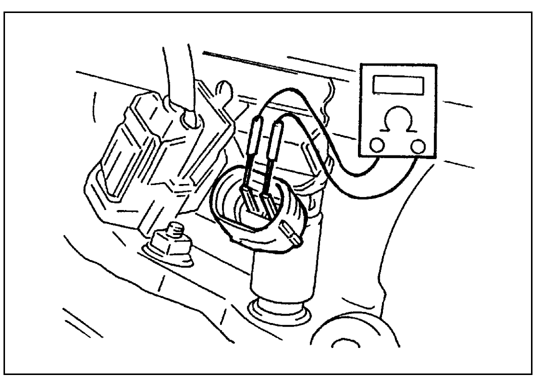


Fig. 5 for Step 5

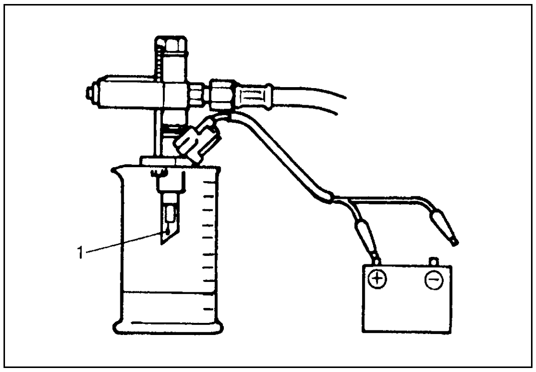
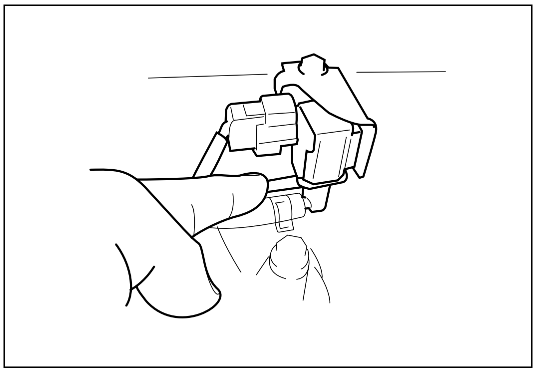


Fig. 6 for Step 6



DTC P0300 RANDOM MISFIRE DETECTED (MISFIRE DETECTED AT 2 OR MORE CYLINDERS)

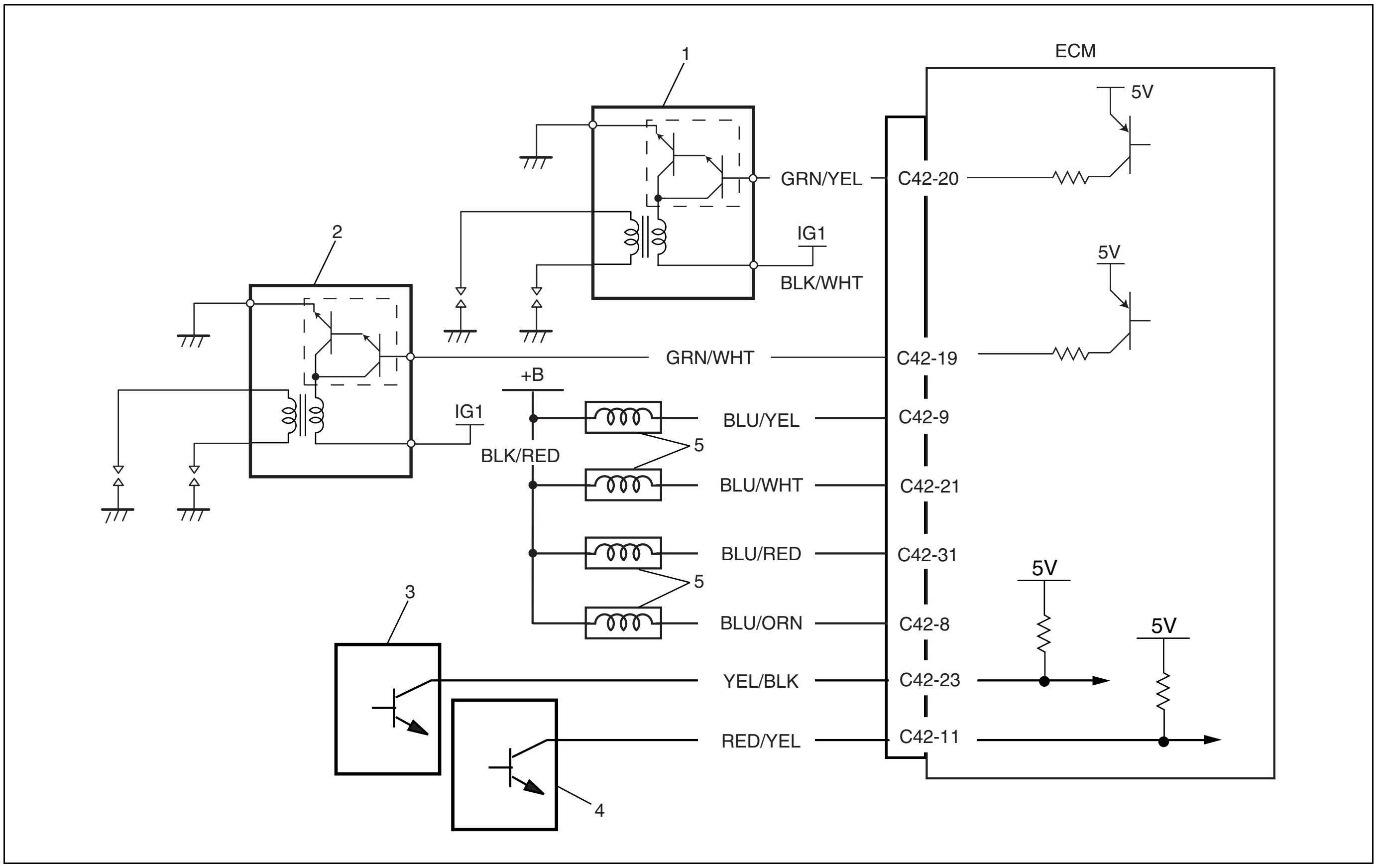
DTC P0301 CYLINDER 1 MISFIRE DETECTED

DTC P0302 CYLINDER 2 MISFIRE DETECTED

DTC P0303 CYLINDER 3 MISFIRE DETECTED

DTC P0304 CYLINDER 4 MISFIRE DETECTED

WIRING DIAGRAM



1.	Ignition coil No. 1
2.	Ignition coil No. 2
3.	CKP sensor
4.	CMP sensor
5.	Fuel injector

CIRCUIT DESCRIPTION

ECM monitors crankshaft revolution speed and engine speed via the crankshaft position sensor and cylinder No. via the camshaft position sensor. Then it calculates the change in the crankshaft revolution speed and from how many times such change occurred in every 200 or 1000 engine revolutions, it detects occurrence of misfire.

When ECM detects a misfire (misfire rate per 200 revolutions) which can cause overheat and damage to the three way catalytic converter, it makes the malfunction indicator lamp (MIL) flash as long as misfire occurs at that rate.

After that, however, when the misfire rate drops, MIL remains ON until it has been judged as normal 3 times under the same driving conditions.

Also, when ECM detects a misfire (misfire rate per 1000 revolutions) which will not cause damage to three way catalytic converter but can cause exhaust emission to be deteriorated, it makes MIL light according to the 2 driving cycle detection logic.

DTC DETECTING CONDITION	POSSIBLE CAUSE
• Engine under other than high revolution condition • Not on rough road • Engine speed changing rate (Below specified value) • Manifold absolute pressure changing rate (Below specified value) • Throttle opening changing rate (Below specified value) • Misfire rate per 200 or 1000 engine revolutions (how much and how often crankshaft revolution speed changes) is higher than specified value	• Engine overheating • Vacuum leaks (air inhaling) from air intake system • Ignition system malfunction (spark plug(s), high-tension cord(s), ignition coil assembly) • Fuel pressure out of specification • Fuel injector malfunction (clogged or leakage) • Engine compression out of specification • Valve lash (clearance) out of specification • Manifold absolute pressure sensor malfunction • Engine coolant temp. sensor malfunction • PCV valve malfunction • EVAP control system malfunction • EGR system malfunction

DTC CONFIRMATION PROCEDURE

NOTE:

Among different types of random misfire, if misfire occurs at cylinders 1 and 4 or cylinders 3 and 2 simultaneously, it may not possible to reconfirm DTC by using the following DTC confirmation procedure. When diagnosing the trouble of DTC P0300 (Random misfire detected) of the engine which is apparently misfiring, even if DTC P0300 cannot be reconfirmed by using the following DTC confirmation procedure, proceed to the following Diag. Flow Table.

WARNING:

- **When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident.**
- **Road test should be carried out with 2 persons, a driver and a tester.**

1) Turn ignition switch OFF.
2) Clear DTC with ignition switch ON.
3) Check vehicle and environmental condition for :
   – Altitude (barometric pressure) : 2400 m, 8000 ft or less (560 mmHg, 75 kPa or more)
   – Ambient temp. : –10°C, 14°F or higher
   – Intake air temp. : 70°C, 158°F or lower
   – Engine coolant temp. : – 10 – 110°C, 14 – 230°F
4) Start engine and keep it at idle for 2 min. or more.
5) Check DTC in “DTC” mode and pending DTC in “ON BOARD TEST” or “PENDING DTC” mode.
6) If DTC is not detected at idle, consult usual driving based on information obtained in “Customer complaint analysis” and “Freeze frame data check”.

INSPECTION

CAUTION:

For iridium spark plugs, do not adjust air gap or clean.

Step	Action	Yes	No
1	Was “ENGINE DIAG. FLOW TABLE” performed?	Go to Step 2.	Go to “ENGINE DIAG. FLOW TABLE”.

Step	Action	Yes	No
2	Is there DTC other than Fuel system (DTC P0171/ P0172) and misfire (DTC P0300-P0304)?	Go to applicable DTC Diag. Flow Table.	Go to Step 3.
3	Check Ignition System. 1) Remove spark plugs and check them for; • Air gap : 1.0 – 1.1 mm (0.040 – 0.043 in.) See Fig. 1. • Carbon deposits/Insulator damage/Plug type If abnormality is found, adjust, clean or replace. 2) Disconnect all injector connectors. 3) Connect spark plugs to high tension cords and then ground spark plugs. 4) Crank engine and check that each spark plug sparks. Are above check results satisfactory?	Go to Step 4.	Check ignition system parts (Refer to Section 6F1)
4	Check Fuel Pressure (Refer to Section 6E1 for details). 1) Release fuel pressure from fuel feed line. 2) Install fuel pressure gauge. See Fig. 2. 3) Check fuel pressure. With fuel pump operating and engine at stop : 270 – 310 kPa, 2.7 – 3.1 kg/cm^2, 38.4 – 44.0 psi. At specified idle speed : 270 – 310 kPa, 2.7 – 3.1 kg/cm^2, 38.4 – 44.0 psi. Is measured value as specified?	Go to Step 5.	Go to Diag. Flow Table B-3 fuel pressure check.
5	Check Fuel Injectors and Circuit. 1) Using sound scope (1) or such, check operating sound of each injector (2) when engine is running. Cycle of operating sound should very according to engine speed. See Fig 3. If no sound or an unusual sound is heard, check injector circuit (wire or connector) or injector. 2) Turn ignition switch OFF and disconnect a fuel injector connector. 3) Check for proper connection to fuel injector at each terminal. See Fig. 4. 4) If OK, then check injector resistance. Injector Resistance : 11.3 – 13.8 ohm at 20°C (68°F) 5) Carry out steps 1) and 3) on each injector. 6) Check each injector for injected fuel volume referring to Section 6E1. See Fig. 5. Injected Fuel Volume : 43 – 47 cc/15 sec (1.45/1.51 – 1.58/1.65 US/Imp. oz/15 sec) 7) Check each injector for fuel leakage after injector closed. Fuel Leakage : Less than 1 drop/min. Is check result in step 1) and 3) to 7) satisfactory?	Go to Step 6.	Check injector circuit or replace fuel injector(s).
6	Check PCV Valve for clogging (See Section 6E1). Is it in good condition?	Go to Step 7.	Replace PCV valve.

Step	Action	Yes	No
7	Check EVAP Canister Purge Valve for Closing. 1) Disconnect purge hose from EVAP canister purge valve. 2) Place finger against the end of EVAP canister purge valve. 3) Check that vacuum is not felt there, when engine is cool and running at idle. See Fig. 6. Is vacuum felt?	Check EVAP control system (See Section 6E1).	Go to Step 8.
8	Check MAP Sensor for performance (See DTC P0105 Diag. Flow Table). Is it in good condition?	Go to Step 9.	Repair or replace.
9	Check ECT Sensor for performance (See Section 6E1). Is it in good condition?	Go to Step 10.	Replace engine coolant temp. sensor.
10	Check Parts or System which can cause engine rough idle or poor performance. • Engine compression (See Section 6A1). • Valve lash (See Section 6A1). • Valve timing (Timing belt installation. See Section 6A1). Are they in good condition?	Check wire harness and connection of ECM ground, ignition system and fuel injector for intermittent open and short.	Repair or replace.

Fig. 1 for Step 3

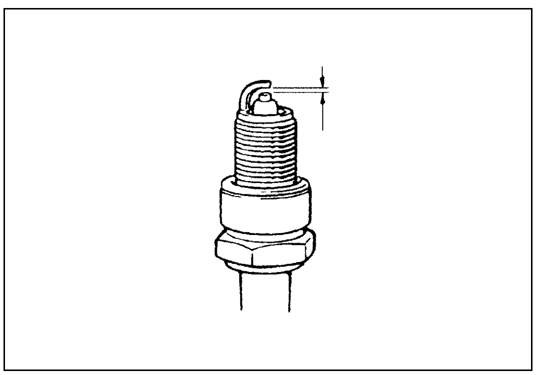
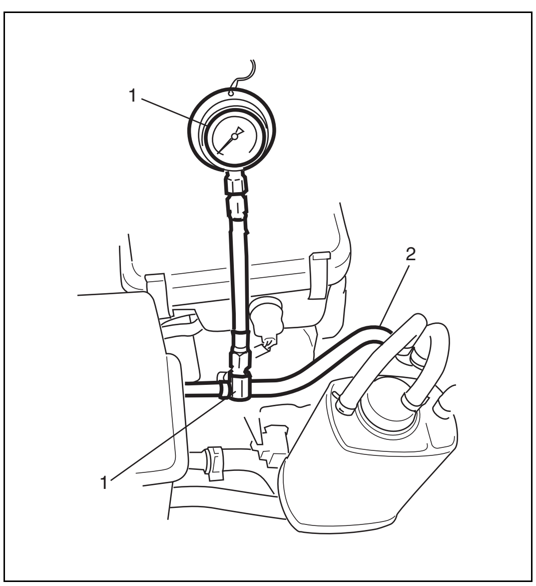


Fig. 2 for Step 4



1.	Fuel pressure gauge & 3 way joint
2.	Fuel feed hose

Fig. 3 for Step 5

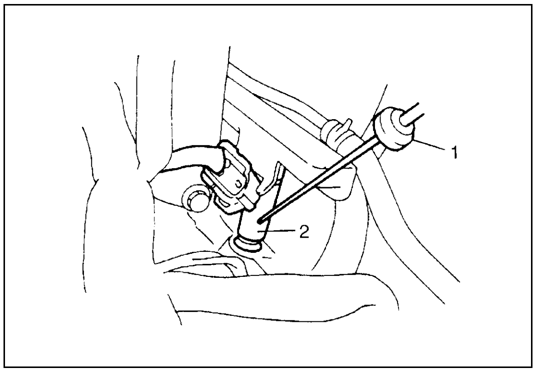


Fig. 4 for Step 5

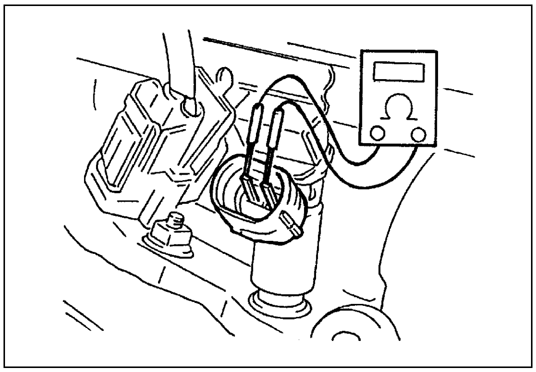


Fig. 5 for Step 5

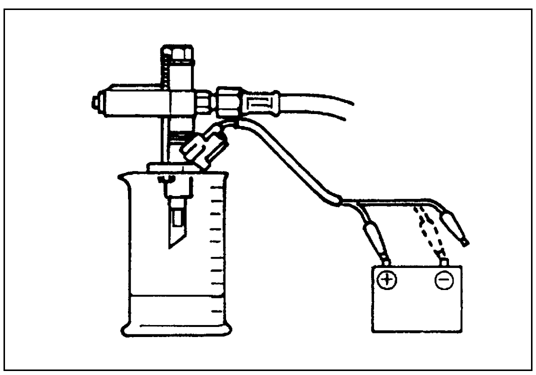
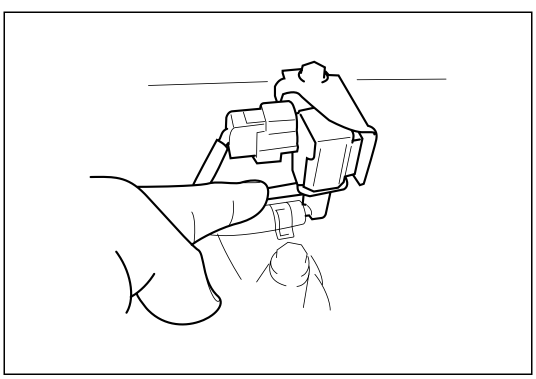
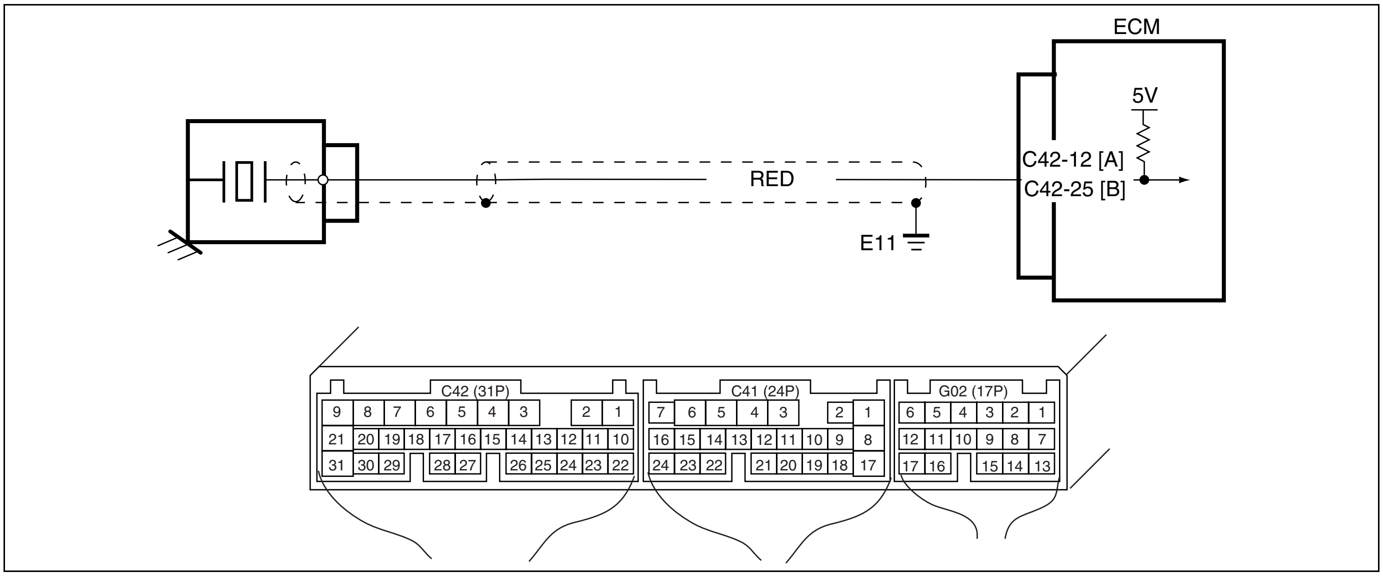


Fig. 6 for Step 7



DTC P0325 (DTC NO.17) KNOCK SENSOR CIRCUIT MALFUNCTION

WIRING DIAGRAM / CIRCUIT DESCRIPTION



[A] : Case of TYPE A is shown (See NOTE)	[B] : Case of TYPE B is shown (See NOTE)

NOTE:

For TYPE A and TYPE B, refer to NOTE in "ECM VOLTAGE VALUES TABLE" for applicable model.

DTC DETECTING CONDITION	POSSIBLE CAUSE
• Knock sensor voltage is 3.91 V or more or • Knock sensor voltage is 1.23 V or less	• "RED" circuit open or shorted to ground • Knock sensor malfunction • ECM malfunction

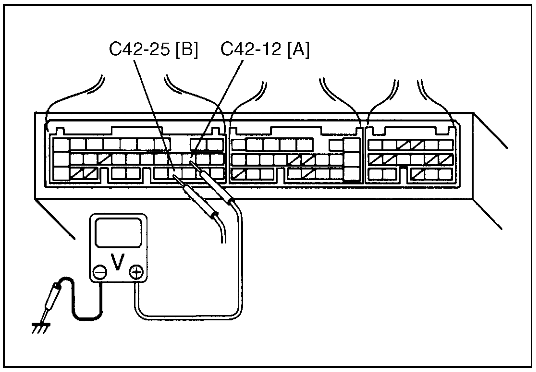
DTC CONFIRMATION PROCEDURE

1) Clear DTC, start engine and keep it at idle for 1 min.
2) Select "DTC" mode on scan tool and check DTC.

INSPECTION

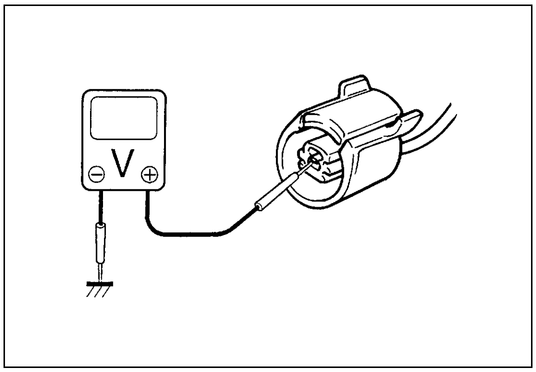
Step	Action	Yes	No
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Check Knock Sensor Signal. 1) With engine running, check voltage from C42-12 terminal of ECM connector to body ground. See Fig. 1. Is voltage about 1.23 – 3.91 V?	Knock sensor and its circuit are in good condition. Intermittent trouble or faulty ECM. Recheck, referring to Intermittent Trouble in Section 0A.	Go to Step 3.
3	Check Knock Sensor Output. 1) Stop engine. 2) With ignition switch at OFF position, disconnect knock sensor connector. 3) With ignition switch at ON position, check voltage from "RED" terminal of knock sensor connector to body ground. See Fig. 2. Is it 4 – 5 V?	Faulty knock sensor. Substitute a known-good knock sensor and recheck.	"RED" wire open, shorted to ground circuit or poor C42-12 (Case of TYPE A. See NOTE) or 42-25 (Case of TYPE B. See NOTE) connection. If wire and connection are OK, substitute a known-good ECM and recheck.

Fig. 1 for Step 2



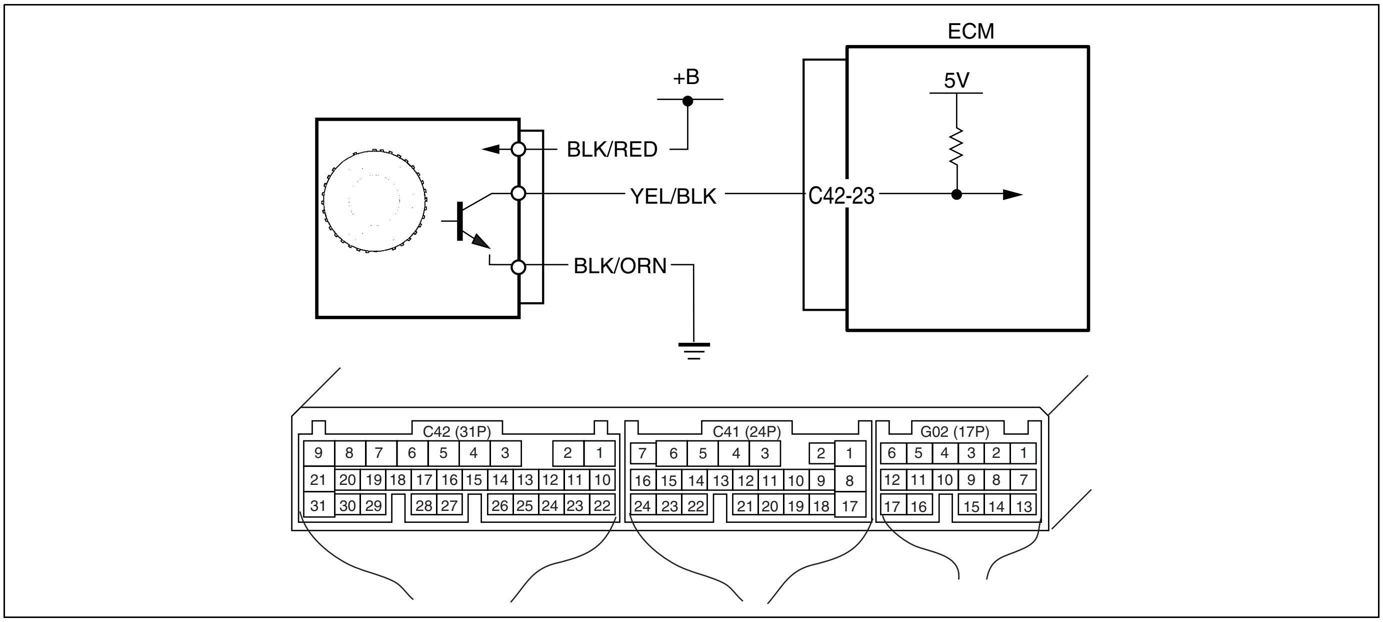
[A] :	Case of TYPE A is shown (See NOTE)
[B] :	Case of TYPE B is shown (See NOTE)

Fig. 2 for Step 2



DTC P0335 (DTC NO.23) CRANKSHAFT POSITION (CKP) SENSOR CIRCUIT MALFUNCTION

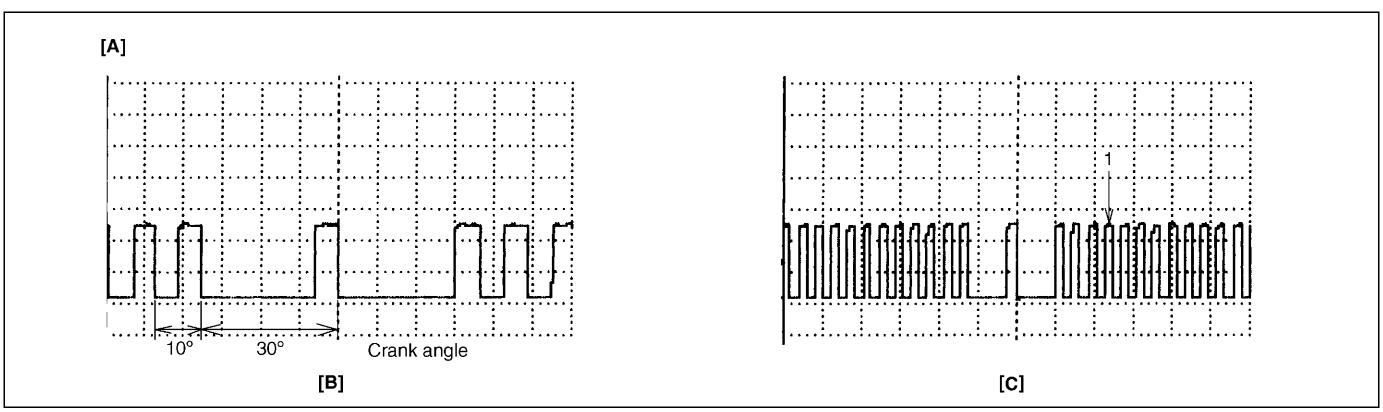
WIRING DIAGRAM / CIRCUIT DESCRIPTION



DTC DETECTING CONDITION	POSSIBLE CAUSE
• No CKP sensor signal for 2 seconds at engine cranking.	• CKP sensor circuit open or short. • Crankshaft timing belt pulley teeth damaged. • CKP sensor malfunction, foreign material being attached or improper installation. • ECM malfunction.

REFERENCE

Connect oscilloscope between terminals C42-23 of ECM connector connected to ECM and ground and check CKP sensor signal.



1. BTDC 5° (Crank angle)	[B] : Waveforms at specified idle speed
[A] : Oscilloscope Waveforms	[C] : Waveforms at 2000 r/min

DTC CONFIRMATION PROCEDURE

1) Clear DTC and crank engine for 2 sec.
2) Select "DTC" mode on scan tool and check DTC.

INSPECTION

Step	Action	Yes	No
1	Was “ENGINE DIAG. FLOW TABLE” performed?	Go to Step 2.	Go to “ENGINE DIAG. FLOW TABLE”.
2	Check CKP Sensor and Connector for proper installation. Is CKP sensor installed properly and connector connected securely?	Go to Step 3.	Correct.
3	Check Wire Harness and Connection. 1) Disconnect connector from CKP sensor. 2) Check for proper connection to CKP sensor at each terminal. 3) If OK, turn ignition switch ON and check for voltage at each terminal of sensor connector disconnected. See Fig. 1. Terminal “B+” : 10 – 14 V Terminal “Vout” : 4 – 5 V Terminal “GND” : – 0 V Is check result satisfactory?	Go to Step 5.	Go to Step 4.
4	Was terminal “Vout” voltage out of specification in Step 3 check?	“YEL/BLK” wire open, short or poor connection. If wire and connection are OK, substitute a known-good ECM and recheck.	“BLK/RED” or “BLK/ORN” wire open, short or poor connection.
5	Check Ground Circuit for open. 1) Turn ignition switch OFF. 2) Check for continuity between “GND” terminal of CKP sensor connector and engine ground. Is continuity indicated?	Go to Step 6.	“BLK/ORN” wire open or poor ground connection.
6	Check CKP Sensor for operation. 1) Remove CKP sensor from sensor case. 2) Remove metal particles on end face of CKP sensor, if any. 3) Connect each connector to ECM and CKP sensor. 4) Turn ignition switch ON. 5) Check for voltage at terminal C42-23 of connector connected to ECM by passing magnetic substance (iron) while keeping approximately 1 mm (0.03 in.) gap with respect to end face of CKP sensor. See Fig. 2 and 3. Does voltage vary from low (0 –1 V) to high (4 – 5 V) or from high to low?	Go to Step 7.	Replace CKP sensor.
7	Check Signal Rotor for the following. See Fig. 4. • Damage • No foreign material attached Is it in good condition?	Intermittent trouble or faulty ECM. Check for intermittent referring to “Intermittent and Poor Connection” in Section 0A.	Clean rotor teeth or replace CMP sensor.

Fig. 1 for Step 3

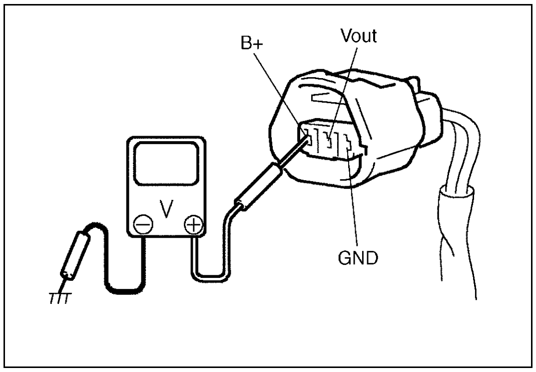


Fig. 2 for Step 6

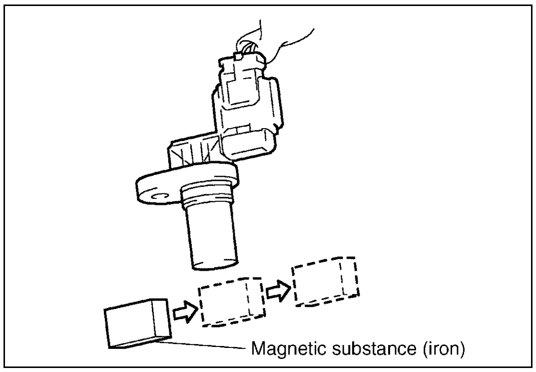


Fig. 3 for Step 6

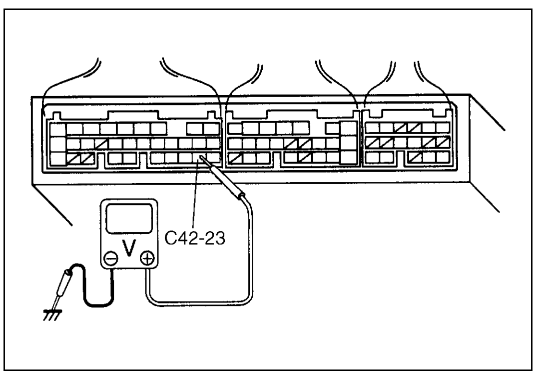
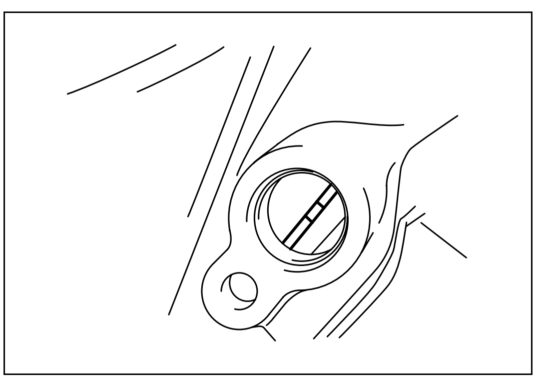
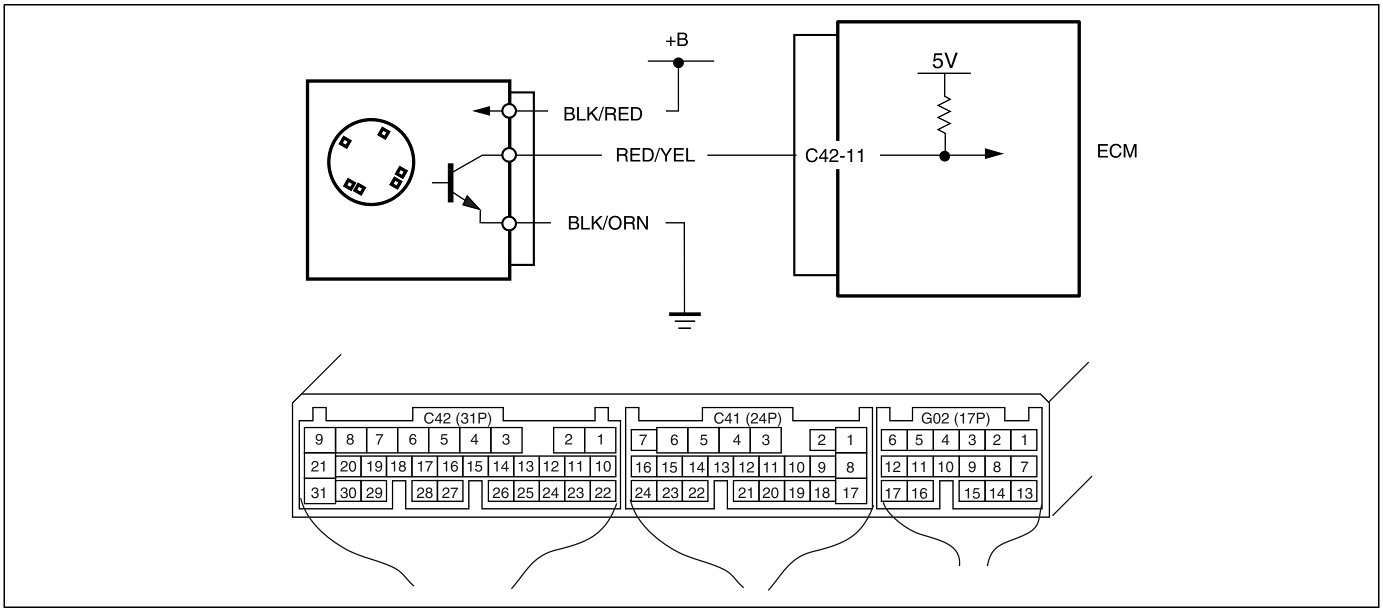


Fig. 4 for Step 7



DTC P0340 (DTC NO.15) CAMSHAFT POSITION (CMP) SENSOR CIRCUIT MALFUNCTION

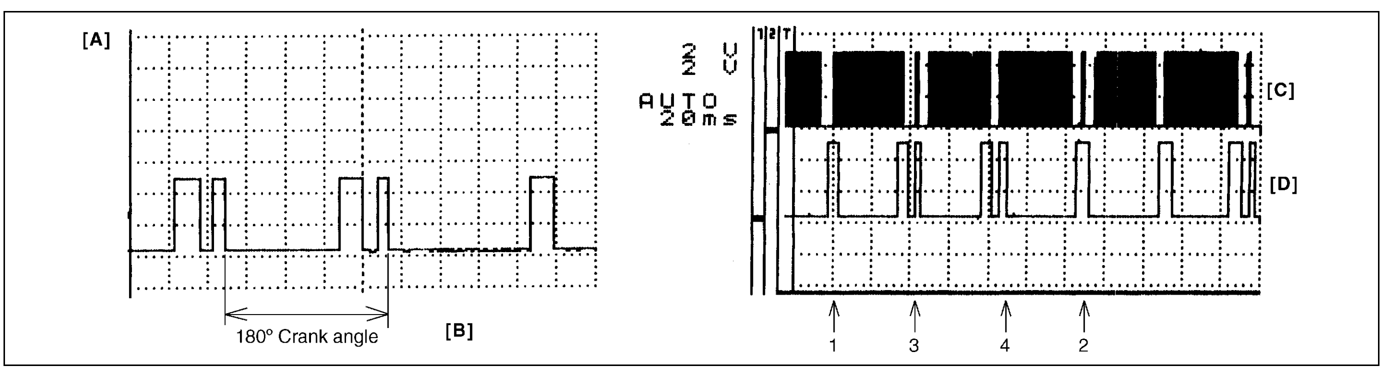
WIRING DIAGRAM / CIRCUIT DESCRIPTION



DTC DETECTING CONDITION	POSSIBLE CAUSE
• No CMP sensor signal during engine running (CKP sensor signal is inputted).	• CMP sensor circuit open or short. • Signal rotor teeth damaged. • CMP sensor malfunction, foreign material being attached or improper installation. • Incorrect starter signal. • ECM malfunction.

REFERENCE

Connect oscilloscope between terminals E21-11 of ECM connector connected to ECM and body ground and check CMP sensor signal. When CKP circuit is failed (open or short), ECM identify the cylinder only by CMP sensor signal.



1. No.1 cylinder	3. No.3 cylinder	[A] : Oscilloscope Waveforms	[C] : CKP sensor signal
2. No.2 cylinder	4. No.4 cylinder	[B] : Waveforms at specified idle speed	[D] : CMP sensor signal

DTC CONFIRMATION PROCEDURE

1) Clear DTC.
2) Start engine and keep it at idle for 1 min.
3) Select “DTC” mode on scan tool and check DTC.

INSPECTION

Step	Action	Yes	No
1	Was “ENGINE DIAG. FLOW TABLE” performed?	Go to Step 2.	Go to “ENGINE DIAG. FLOW TABLE”.
2	Check CMP Sensor and connector for proper installation. Is CMP sensor installed properly and connector connected securely?	Go to Step 3.	Correct.
3	Check Wire Harness and Connection. 1) Disconnect connector from CMP sensor. 2) Check for proper connection to CMP sensor at each terminal. 3) If OK, turn ignition switch ON and check for voltage at each terminal of sensor connector disconnected. See Fig. 1. Terminal “B+” : 10 – 14 V Terminal “Vout” : 4 – 5 V Terminal “GND” : 0 V Is check result satisfactory?	Go to Step 5.	Go to Step 4.
4	Was terminal “Vout” voltage out of specification in Step 3 check?	“RED/YEL” wire open, short or poor connection. If wire and connection are OK, substitute a known-good ECM and recheck.	“BLK/RED” or “BLK/ORN” wire open, short or poor connection.
5	Check Ground Circuit for open. 1) Turn ignition switch OFF. 2) Check for continuity between “GND” terminal of CMP sensor connector and engine ground. Is continuity indicated?	Go to Step 6.	“BLK/ORN” wire open or poor ground connection.
6	Check CMP Sensor for operation. 1) Remove CMP sensor from sensor case. 2) Remove metal particles on end face of CMP sensor, if any. 3) Connect each connector to ECM and CMP sensor. 4) Turn ignition switch ON. 5) Check for voltage at terminal C42-11 of connector connected to ECM by passing magnetic substance (iron) while keeping approximately 1 mm (0.03 in.) gap with respect to end face of CMP sensor. See Fig. 2 and 3. Does voltage vary from low (0 – 1 V) to high (4 – 5 V) or from high to low?	Go to Step 7.	Replace CMP sensor.
7	Check Signal Rotor for the following. See Fig. 4. • Damage • No foreign material attached Is it in good condition?	Intermittent trouble or faulty ECM. Check for intermittent referring to “Intermittent and Poor Connection” in Section 0A.	Clean rotor teeth or replace CMP sensor.

Fig. 1 for Step 3

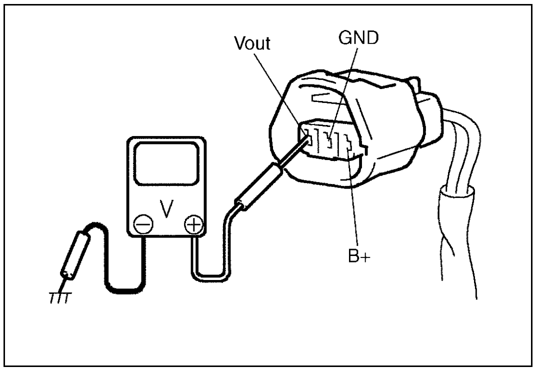


Fig. 2 for Step 6

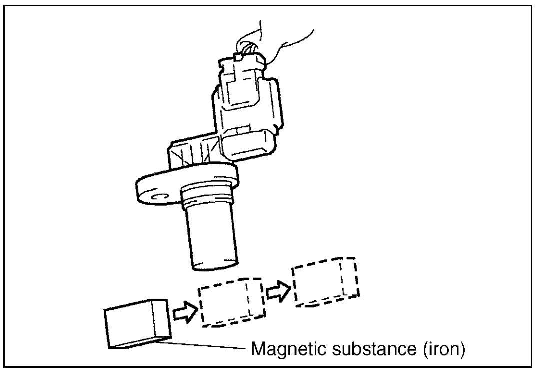


Fig. 3 for Step 6

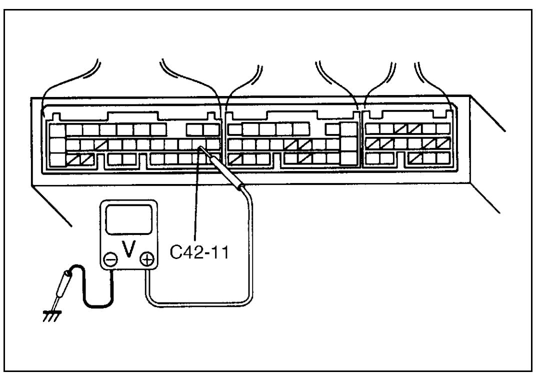
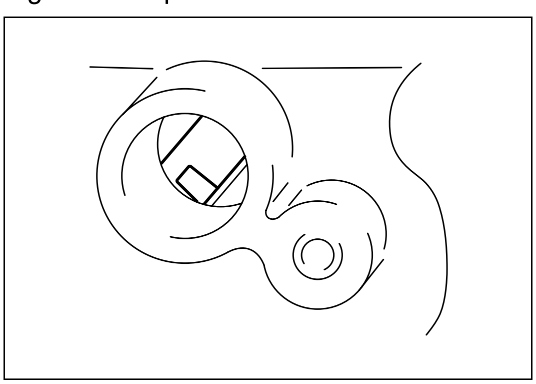
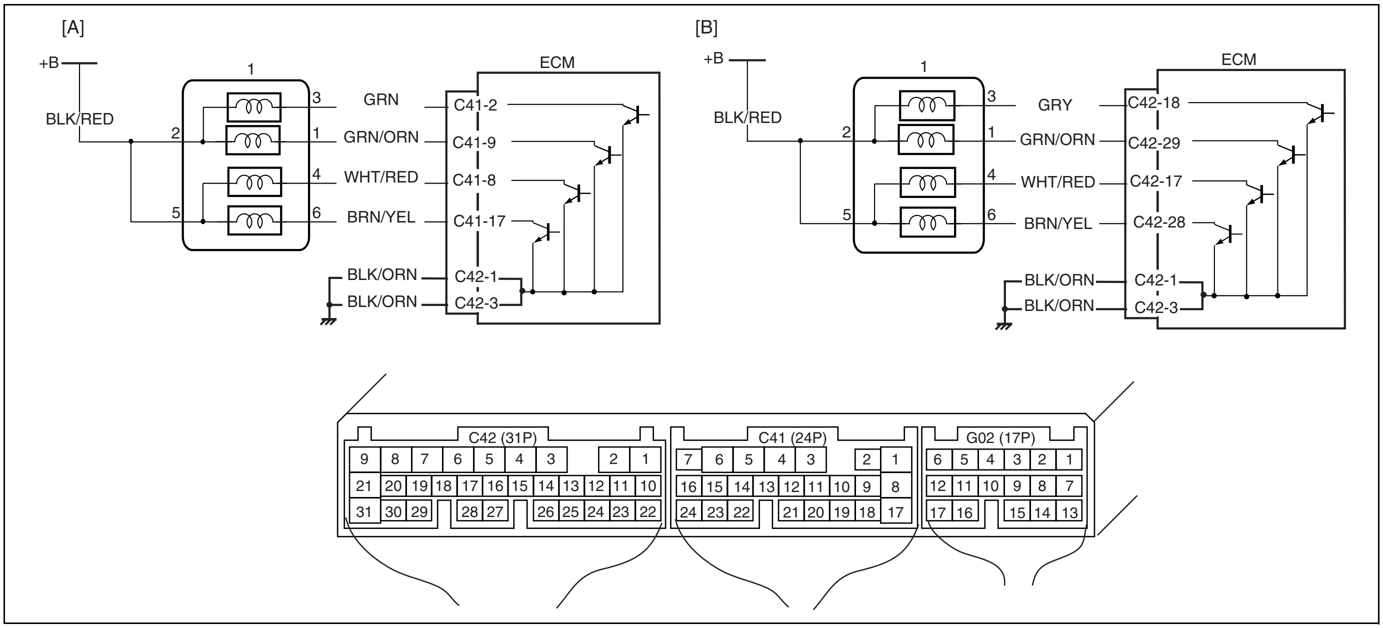


Fig. 4 for Step 7



DTC P0400 EXHAUST GAS RECIRCULATION FLOW MALFUNCTION

WIRING DIAGRAM / CIRCUIT DESCRIPTION



1. EGR valve	[A] : Case of TYPE A is shown (See NOTE)	[B] : Case of TYPE B is shown (See NOTE)

NOTE:

For TYPE A and TYPE B, refer to NOTE in "ECM VOLTAGE VALUES TABLE" for applicable model.

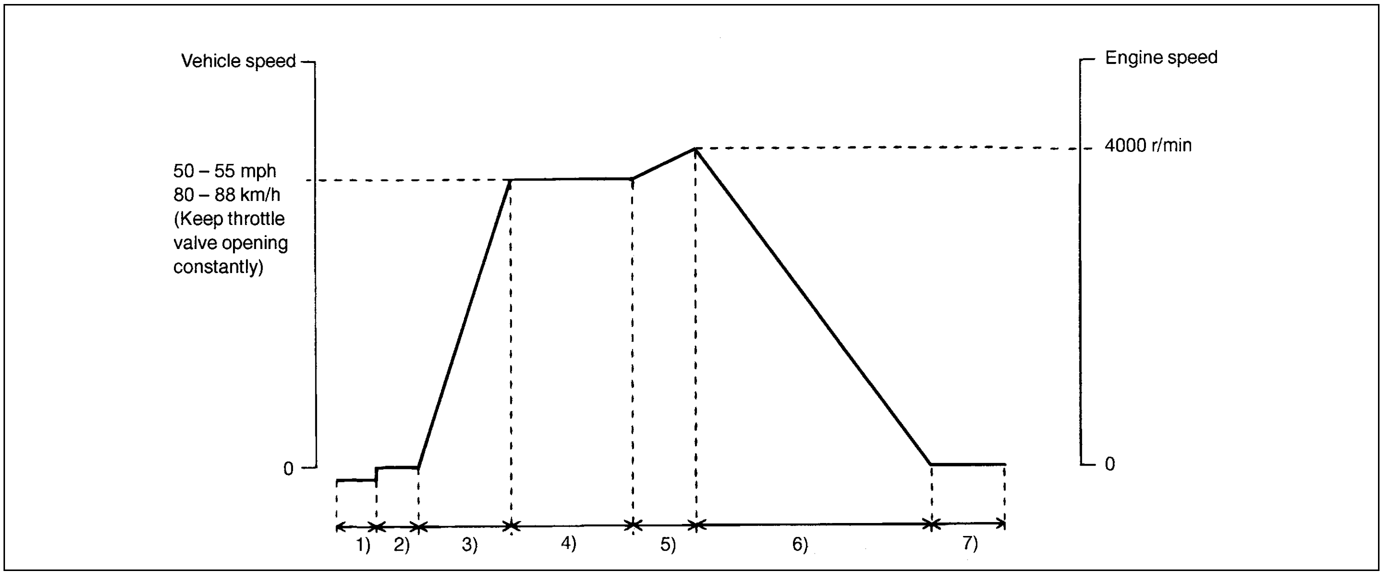
DTC DETECTING CONDITION	POSSIBLE CAUSE
• While running at specified vehicle speed after engine warm-up • During deceleration (engine speed high with closed throttle position ON) in which fuel cut is involved, difference in intake manifold absolute pressure between when EGR valve is opened at specified value and when it is closed is larger or smaller than specified value. ✱2 driving cycle detection logic, monitoring once/1 driving	• EGR valve or its circuit • EGR passage • ECM

DTC CONFIRMATION PROCEDURE

WARNING:
- **When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident.**
- **Road test should be carried out with 2 persons, a driver and a tester, on a level road.**

1) Turn ignition switch OFF.
   Clear DTC with ignition switch ON, check vehicle and environmental condition for :
   – Altitude (barometric pressure) : 2400 m, 8000 ft or less (560 mmHg, 75 kPa or more)
   – Ambient temp. : –10°C, 14°F or higher
   – Intake air temp. : 70°C, 122°F or lower
2) Start engine and warm it up to normal operating temperature (70 – 110°C, 158 – 230°F) and run it at idle for 5 min.
3) Increase vehicle speed to 50 – 55 mph, 80 – 88 km/h in 5th gear or in "D" range.
4) Hold throttle valve at that opening position for 2 min. or longer.
5) Increase engine speed to 4000 r/min. in 3rd gear or in "2" range.
6) Release accelerator pedal and with engine brake applied, keep vehicle coasting (fuel cut condition) till engine speed reaches 1500 r/min.

7) Stop vehicle (don't turn ignition switch OFF) and confirm test results according to following "Test Result Confirmation Flow Table".



TEST RESULT CONFIRMATION FLOW TABLE

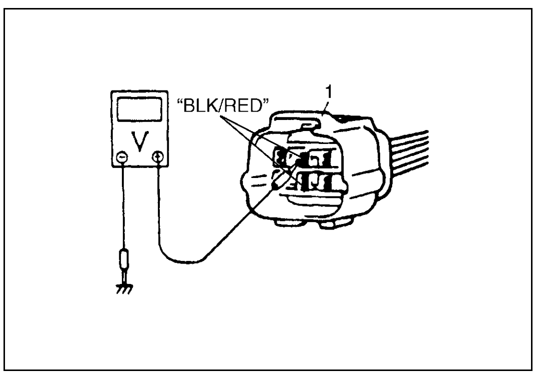
Step	Action	Yes	No
1	Check DTC in "DTC" mode and pending DTC in "ON BOARD TEST". Is DTC or pending DTC displayed?	Proceed to applicable DTC flow table.	Go to Step 2.
2	Set scan tool to "READINESS TESTS" mode and check if testing has been completed. Is test completed?	No DTC is detected. (Confirmation test is completed)	Repeat DTC confirmation procedure.

INSPECTION

Step	Action	Yes	No
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Do you have SUZUKI scan tool?	Go to Step 4.	Go to Step 5.
3	EGR Valve Operation Check : 1) With ignition switch OFF, install SUZUKI scan tool. 2) Check EGR system referring to Section 6E1. Is it in good condition?	Go to Step 4.	Go to Step 5.
4	MAP Sensor Check : 1) Check MAP sensor for performance referring to Section 6E1. Is check result satisfactory?	Intermittent trouble or faulty ECM. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A.	Repair or replace.

Step	Action	Yes	No
5	EGR Valve Power Supply Circuit Check : 1) With ignition switch OFF, disconnect EGR valve coupler. 2) With ignition switch ON, check voltage between terminal 2 and ground terminal 5 of EGR valve connector and ground. Is each voltage 10 – 14 V?	Go to Step 7.	Faulty “BLK/RED” wire.
6	EGR Valve Stepper Motor Coil Circuit Check : 1) With ignition switch OFF, connect EGR valve coupler and disconnect ECM couplers. 2) Check resistance between C41-5 and C41-2, 9, 8, 17 (Case of TYPE A. See NOTE) or C42-17, 18, 28, 29 (Case of TYPE B. See NOTE). Is each resistance 20 – 24 Ω at 20°C, 68°F?	Go to Step 8.	Faulty “GRN” (Case of TYPE A. See NOTE) or “GRY” (Case of TYPE B. See NOTE), “GRN/ORN”, “WHT/RED”, “BRN/YEL” wire or EGR valve.
7	MAP sensor Check : 1) Check MAP sensor for performance referring to Section 6E1. Is check result satisfactory?	EGR passage clogged or EGR valve malfunction. If all above are OK, intermittent trouble or faulty ECM. Check for intermittent referring to “Intermittent and Poor Connection” in Section 0A.	Repair or replace.

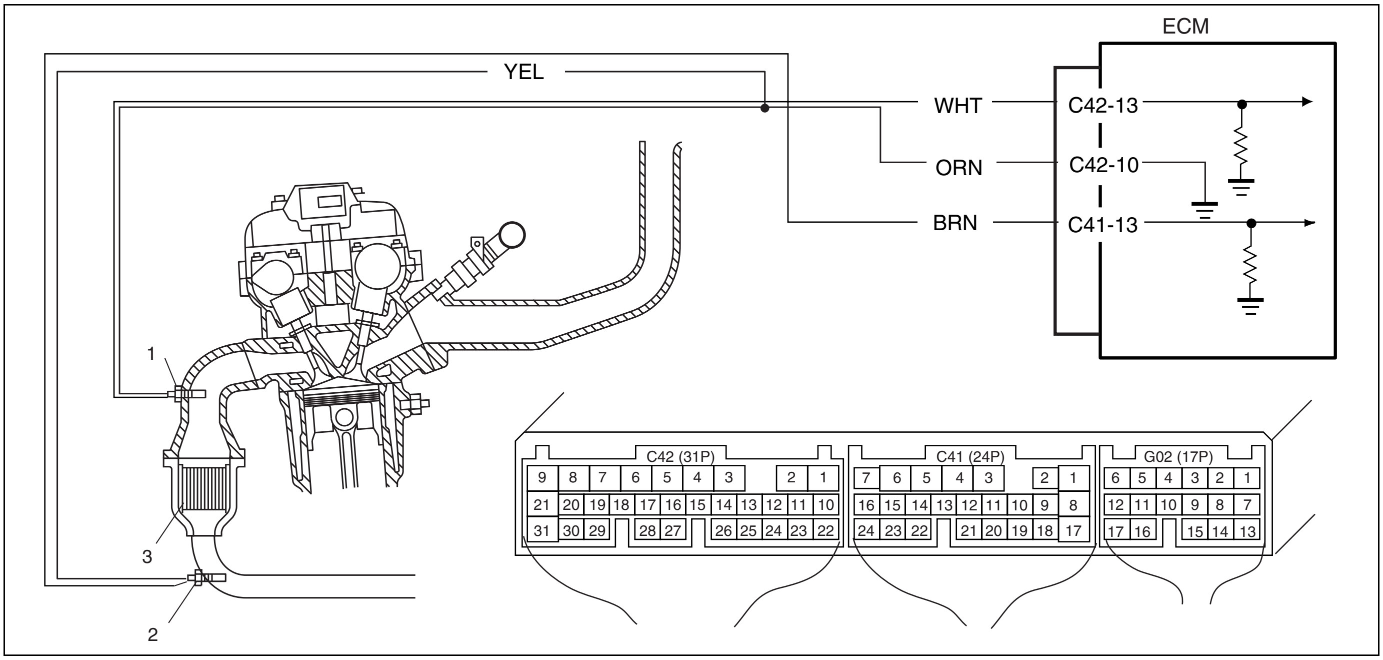
Fig. 1 for Step 5



1. EGR valve connector

DTC P0420 CATALYST SYSTEM EFFICIENCY BELOW THRESHOLD

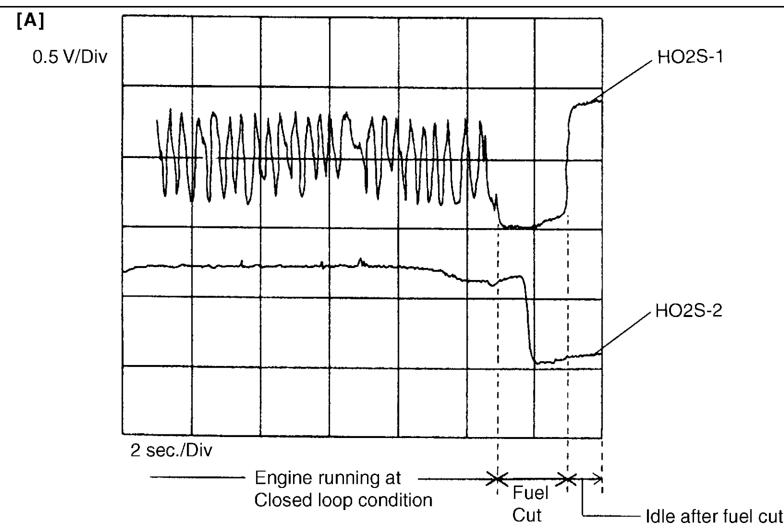
WIRING DIAGRAM / CIRCUIT DESCRIPTION



ECM monitors oxygen concentration in the exhaust gas which has passed the three way catalytic converter by HO2S-2 (2).

When the catalyst is functioning properly, the variation cycle of HO2S-2 (2) output voltage (oxygen concentration) is slower than that of HO2S-1 (1) output voltage because of the amount of oxygen in the exhaust gas which has been stored in the catalyst (3).

REFERENCE



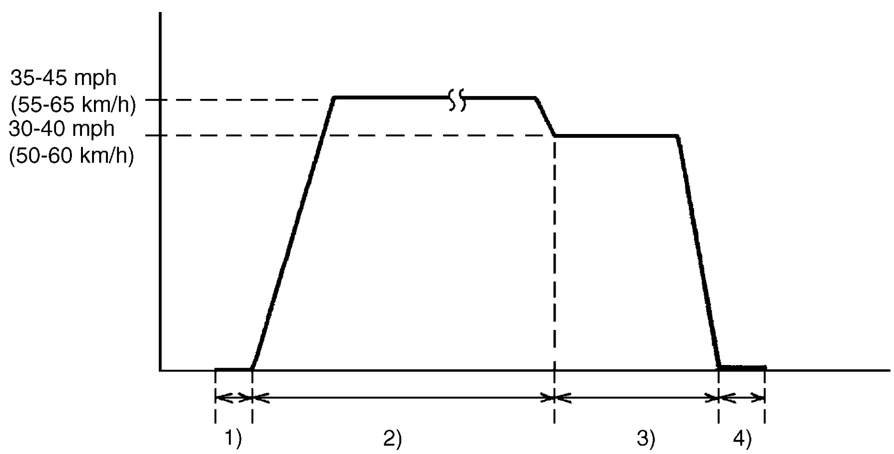
[A] : Oscilloscope Waveforms

DTC DETECTING CONDITION	POSSIBLE CAUSE
• While vehicle running at constant speed under other than high load. • Time from rich or lean switching command is output till HO2S-2 output voltage crosses 0.45 V is less than specified value. ✱2 driving cycle detection logic, monitoring once/1 driving	• Exhaust gas leak • Three way catalytic converter malfunction • Fuel system malfunction • HO2S-2 malfunction • HO2S-1 malfunction

DTC CONFIRMATION PROCEDURE

WARNING:
- **When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident.**
- **Road test should be carried out with 2 persons, a driver and tester, on a level road.**

1) Turn ignition switch OFF.
   Clear DTC with ignition switch ON, check vehicle and environmental condition for :
   – Altitude (barometric pressure) : 2400 m, 8000 ft or less (560 mmHg, 75 kPa or more)
   – Ambient temp. : –10°C, 14°F or higher
   – Intake air temp. : 70°C, 158°F or lower
   – Engine coolant temp. : 70 – 110°C, 158 – 230°F
2) Start engine and drive vehicle at 35 – 45 mph, 55 – 65 km/h for 8 min. or longer.
   While this driving, if "Catalyst Monitoring TEST COMPLETED" is displayed in "READINESS TESTS" mode and DTC is not displayed in "DTC" mode, confirmation test is completed.
   If "TEST NOT COMPLETE" is still being displayed, continue test driving.
3) Decrease vehicle speed at 30 – 40 mph, 50 – 60 km/h, and hold throttle valve at that opening position for 2 min. and confirm that short term fuel trim vary within – 20% – +20% range.
4) Stop vehicle (do not turn ignition switch OFF) and confirm test results according to following "Test Result Confirmation Flow Table".



TEST RESULT CONFIRMATION FLOW TABLE

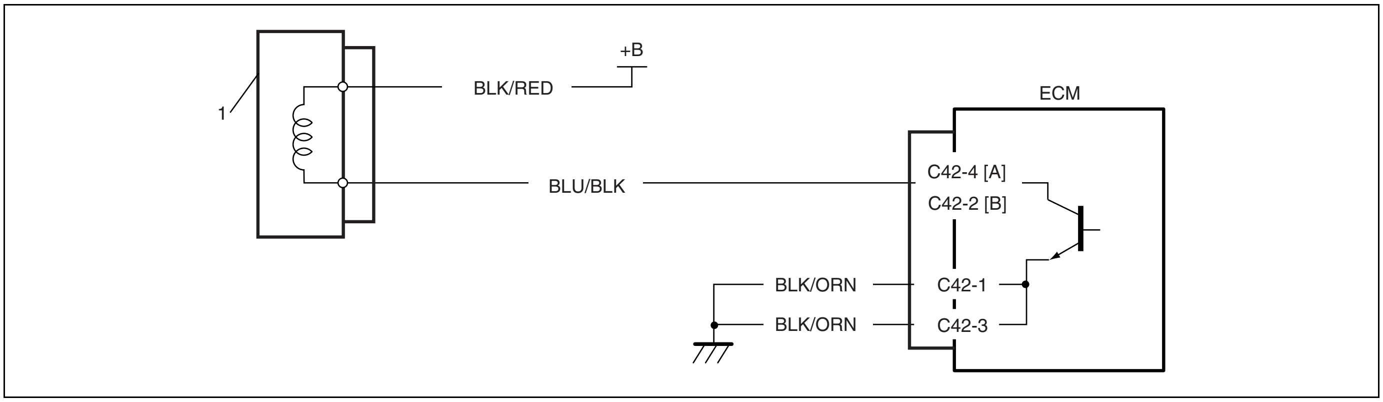
Step	Action	Yes	No
1	Check DTC in "DTC" mode and pending DTC in "ON BOARD TEST" or "PENDING DTC" mode. Is DTC or pending DTC displayed?	Proceed to applicable DTC Diag. Flow Table.	Go to Step 2.
2	Set scan tool to "READINESS TESTS" mode and check if testing has been completed. Is test completed?	No DTC is detected (confirmation test is completed).	Repeat DTC confirmation procedure.

INSPECTION

Step	Action	Yes	No
1	Was “ENGINE DIAG. FLOW TABLE” performed?	Go to Step 2.	Go to “ENGINE DIAG. FLOW TABLE”.
2	Check Short Term Fuel Trim. Did short term fuel trim vary within – 20% – +20% range in step 3) of DTC confirmation test?	Go to Step 3.	Check fuel system. Go to DTC P0171/P0172 Diag. Flow Table.
3	Check HO2S-2 for Output Voltage. Perform steps 1) through 9) of DTC confirmation procedure for DTC P0136 (HO2S-2 malfunction) and check output voltage of HO2S-2 then. Is over 0.6 V and below 0.3 V indicated?	Replace three way catalytic converter.	Check “BRN” and “YEL” wires for open and short, and connections for poor connection. If wires and connections are OK, replace HO2S-2.

DTC P0443 PURGE CONTROL VALVE CIRCUIT MALFUNCTION

WIRING DIAGRAM / CIRCUIT DESCRIPTION



1. EVAP canister purge valve	[A] : Case of TYPE A is shown (See NOTE)	[B] : Case of TYPE B is shown (See NOTE)

NOTE:

For TYPE A and TYPE B, refer to NOTE in “ECM VOLTAGE VALUES TABLE” for applicable model.

DTC DETECTING CONDITION	POSSIBLE CAUSE
Canister Purge control valve circuit is opened or shorted.	• “BLU/BLK” circuit open or short • “BLK/RED” circuit open or short • Canister purge valve malfunction

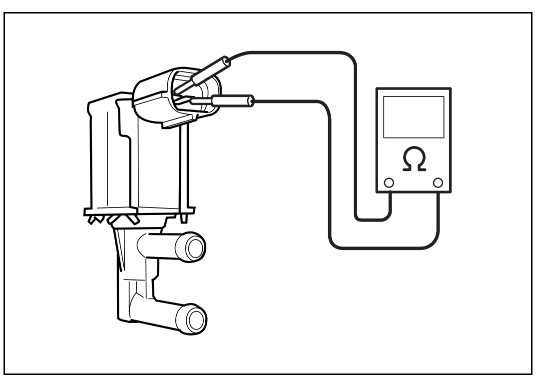
DTC CONFIRMATION PROCEDURE

1) Clear DTC with ignition switch ON.
2) Select “DTC” mode on scan tool and check DTC.

INSPECTION

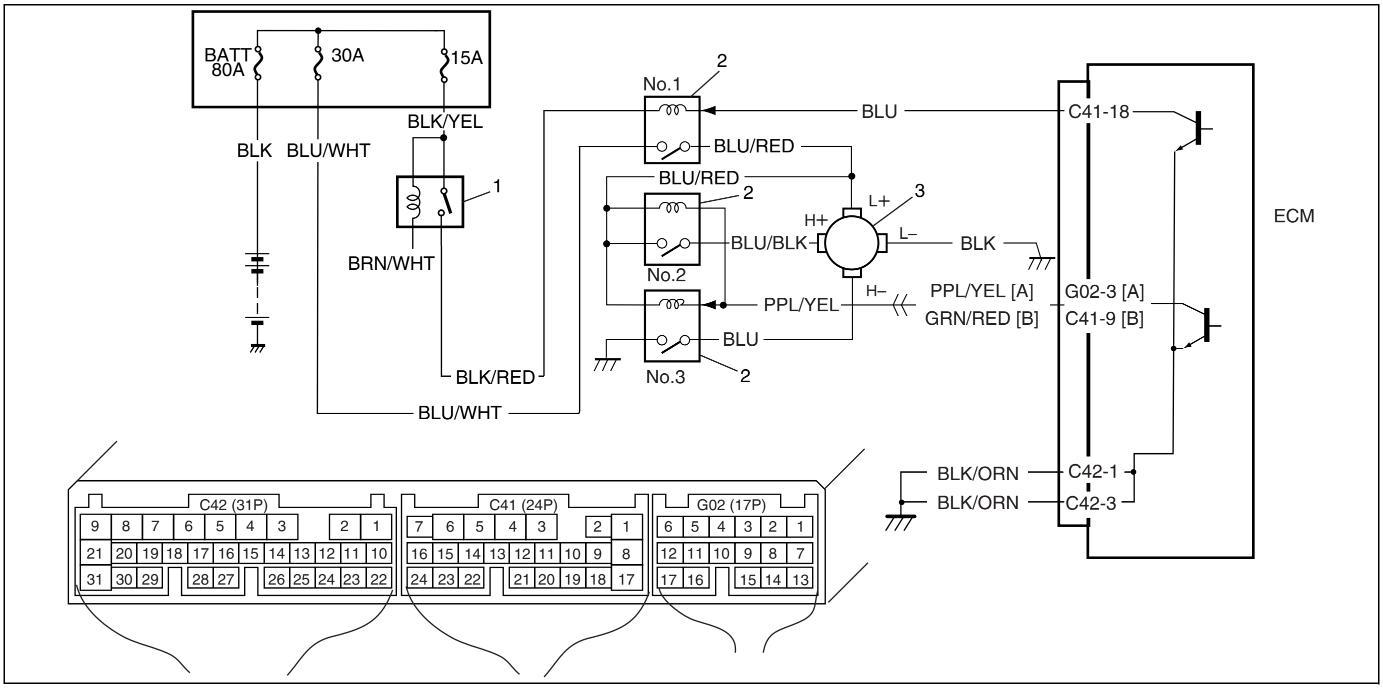
Step	Action	Yes	No
1	Check EVAP Canister Purge Valve operation. 1) With ignition switch OFF, disconnect coupler from canister purge valve. 2) Check resistance of EVAP canister purge valve. Resistance between two terminals : 30 – 34 Ω at 20°C (68°F) Resistance between terminal and body : 1 MΩ or higher Is it as specified?	“BLU/BLK” circuit open or short. “BLK/RED” circuit open or short.	Replace EVAP canister purge valve.

Fig. 1 for Step 1



DTC P0480 RADIATOR COOLING FAN CONTROL SYSTEM MALFUNCTION

WIRING DIAGRAM / CIRCUIT DESCRIPTION



1. Main relay	[A] : Case of TYPE A is shown (See NOTE)
2. Radiator fan relay	[B] : Case of TYPE B is shown (See NOTE)
3. Radiator fan motor	

NOTE:

For TYPE A and TYPE B, refer to NOTE in "ECM VOLTAGE VALUES TABLE" for applicable model.

DTC DETECTING CONDITION	POSSIBLE CAUSE
Low voltage at terminal C41-18 when engine coolant temp. is below 97.5°C, 207.5°F. ✱2 driving cycle detection logic, continuous monitoring.	• "BLK/RED" or "BLU" circuit open or short • Radiator cooling fan relay malfunction • ECM malfunction

DTC CONFIRMATION PROCEDURE

1) Turn ignition switch OFF.
2) Clear DTC with ignition switch ON.
3) Warm up engine until radiator cooling fan starts to operate.
4) Check pending DTC in "ON BOARD TEST" or "PENDING DTC" mode and DTC in "DTC" mode.

INSPECTION

Step	Action	Yes	No
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Check Radiator Cooling Fan Relay and Its Circuit. 1) Turn ignition switch ON. 2) Check for voltage at terminal C41-18 of ECM connector connected, under following condition. See Fig. 1. When engine coolant temp. is lower than 97.5°C, 207.5°F and A/C switch turns OFF : 10 – 14 V Is voltage as specified?	Intermittent trouble or faulty ECM. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A.	Go to Step 3.

Step	Action	Yes	No
3	Check Radiator Cooling Fan Control Relay. 1) Turn ignition switch OFF and remove radiator cooling fan relay. 2) Check for proper connection to the relay at "BLK/RED", "BLU", "BLU/RED" and "BLU/BLK" wire terminals. 3) If OK, then measure resistance between terminals a and b. See Fig. 2 and 3. Is it 56 – 146 Ω?	"BLK/RED" or "BLU" circuit open or short. If wires and connections are OK, substitute a known-good ECM and recheck.	Replace radiator cooling fan relay.

Fig. 1 for Step 2

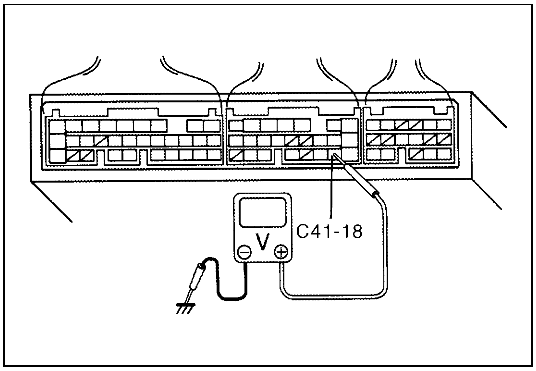
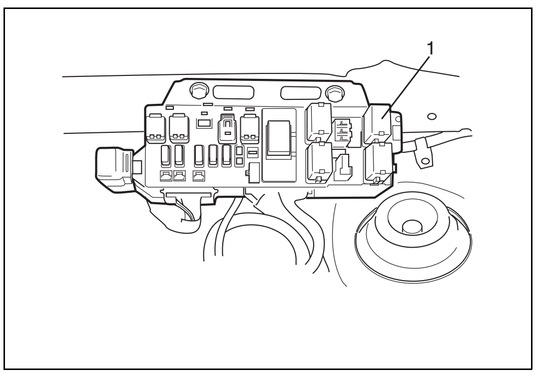
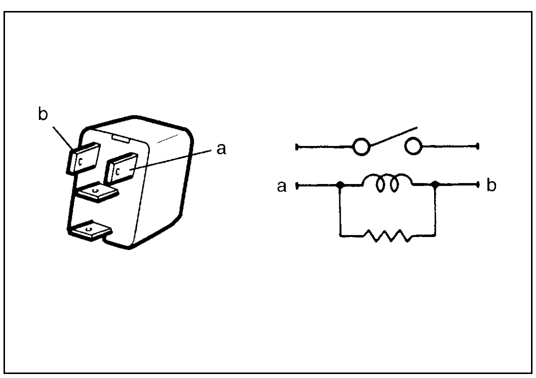


Fig. 2 for Step 3



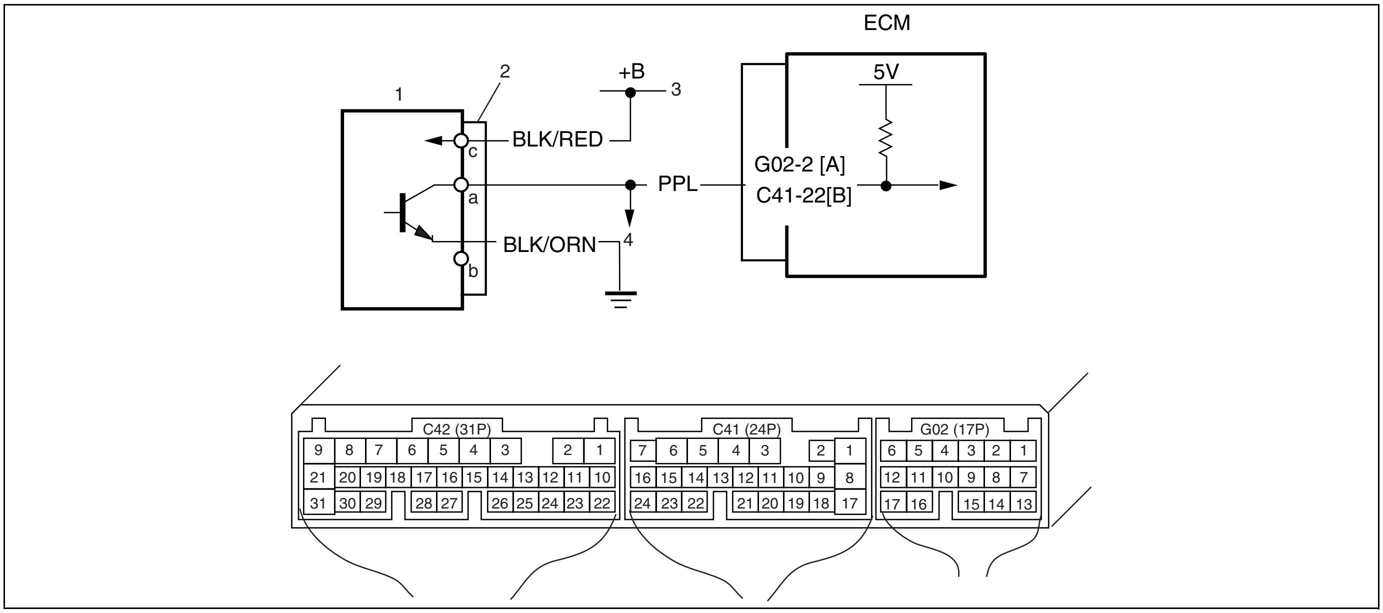
1. Radiator fan relay No.1

Fig. 3 for Step 3



DTC P0500 (DTC NO.16) VEHICLE SPEED SENSOR (VSS) MALFUNCTION

WIRING DIAGRAM / CIRCUIT DESCRIPTION



1.	VSS (vehicle speed sensor)	3.	Power supply from ignition switch
2.	VSS connector	4.	Speedometer, P/S control module and multi information display
[A] :	Case of TYPE A is shown (See NOTE)	[B] :	Case of TYPE B is shown (See NOTE)

NOTE:

For TYPE A and TYPE B, refer to NOTE in “ECM VOLTAGE VALUES TABLE” for applicable model.

DTC DETECTING CONDITION	POSSIBLE CAUSE
• VSS signal not inputted while vehicle running in “D” range or during fuel cut at deceleration. ✱2 driving cycle detection logic, continuous monitoring	• “BLK/ORN” circuit open • “PPL” or “BLK/RED” circuit open or short • VSS malfunction • ECM malfunction • Speedometer malfunction

DTC CONFIRMATION PROCEDURE

WARNING:
- **When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident.**
- **Road test should be carried out with 2 persons, a driver and a tester.**

1) Clear DTC and warm up engine to normal operating temperature.
2) Increase vehicle speed to 50 mph, 80 km/h in 3rd gear or “2” range while observing vehicle speed displayed on scan tool.
3) Release accelerator pedal and with engine brake applied, keep vehicle coasting (fuel cut condition) for 4 sec. or more.
4) Check pending DTC and DTC.

INSPECTION

Step	Action	Yes	No
1	Was “ENGINE DIAG. FLOW TABLE” performed?	Go to Step 2.	Go to “ENGINE DIAG. FLOW TABLE”.
2	Does speedometer indicate vehicle speed?	Go to Step 3.	Go to Step 5.

Step	Action	Yes	No
3	Check Vehicle Speed Signal. Is vehicle speed displayed on scan tool in step 2) and 3) of DTC confirmation procedure?	Intermittent trouble or faulty ECM. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A.	Go to Step 4.
4	Check VSS Signal Circuit. 1) Turn ignition switch to OFF position. 2) Disconnect combination meter connectors. Refer to Section 8. 3) Disconnect P/S control module connector (if equipped). 4) Turn ignition switch to ON position, without running engine. 5) Measure voltage from terminal "a" of VSS connector to ground. Is voltage within 4 – 5 V?	Faulty speedometer. Faulty P/S control module. Faulty multi information display.	"PPL" wire open or short. Poor connection of ECM connector terminal. If OK, substitute a known-good ECM and recheck.
5	Check VSS Power Supply. 1) With ignition switch at OFF position, disconnect VSS connector. 2) Turn ignition switch to ON position, without running engine. 3) Measure voltage from terminal "b" to "c" of VSS connector. See Fig. 1. Is voltage within 10 – 14 V?	Go to Step 6.	"BLK/RED" or "BLK/ORN" wire open or short.
6	Check VSS Signal Circuit. 1) Measure voltage from terminal "a" of VSS connector to ground. Is voltage more than 4 V?	Go to Step 7.	"PPL" wire open or short. Poor connection of ECM connector terminal. If OK, substitute a known-good ECM and recheck.
7	Check Signal Rotor. 1) Remove VSS. 2) Visually inspect VSS sensor signal rotor for damage. Was any damage found?	Faulty VSS signal rotor.	Poor connection of VSS connector terminal. If OK, substitute a known-good VSS and recheck.

Fig. 1 for Step 5

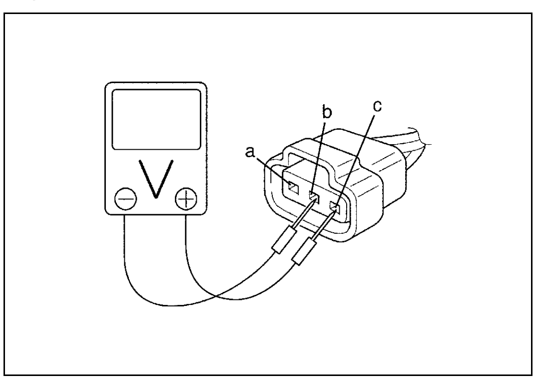
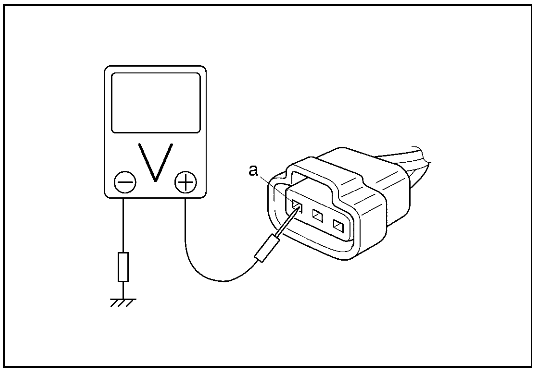
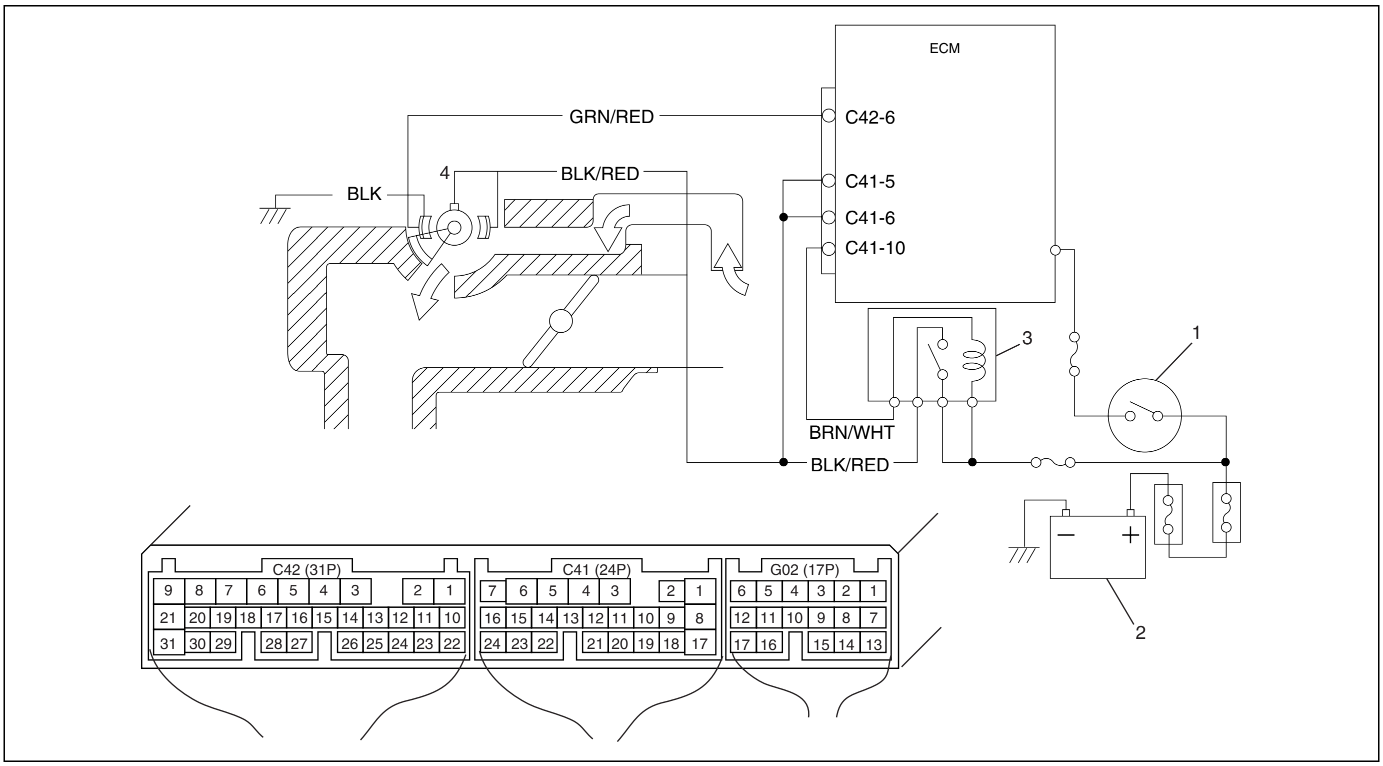


Fig. 2 for Step 4 and Step 6



DTC P0505 (DTC NO.26) IDLE CONTROL SYSTEM MALFUNCTION

CIRCUIT DESCRIPTION



1. Ignition switch	3. Main relay
2. Battery	4. IAC valve

DTC DETECTING CONDITION	POSSIBLE CAUSE
• No closed signal to IAC valve is detected after engine start. ✱2 driving cycle detection logic, continuous monitoring.	• "BLK/RED", "GRN/RED" or "BLK" circuit open or short • IAC valve malfunction • ECM malfunction

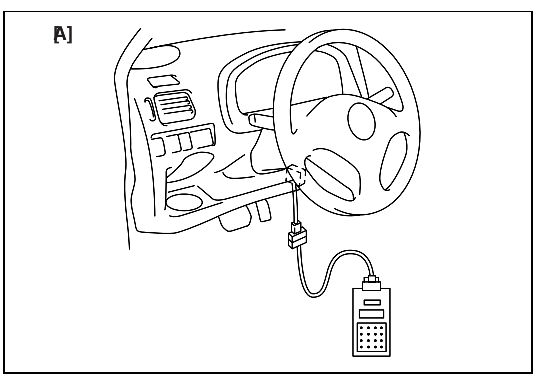
DTC CONFIRMATION PROCEDURE

1) Turn ignition switch OFF.
2) Clear DTC with ignition switch ON.
3) Start engine and run it at idle for 1 min.
4) Check DTC and pending DTC.

INSPECTION

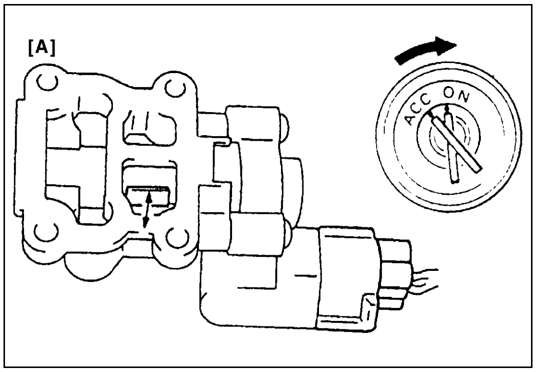
Step	Action	Yes	No
1	Was “ENGINE DIAG. FLOW TABLE” performed?	Go to Step 2.	Go to “ENGINE DIAG. FLOW TABLE”.
2	Is SUZUKI scan tool available?	Go to Step 3.	Go to Step 4.
3	Check Idle Air Control System. 1) Connect SUZUKI scan tool to DLC with ignition switch OFF, set parking brake and block drive wheels. 2) Warm up engine to normal operating temperature. 3) Clear DTC and select “MISC TEST” mode on SUZUKI scan tool. See Fig. 1. Is it possible to control (increase and reduce) engine idle speed by using SUZUKI scan tool?	Intermittent trouble or faulty ECM. Check for intermittent referring to “Intermittent and Poor Connection” in Section 0A.	Go to Step 5.
4	Check Idle Air Control System. 1) Remove IAC valve from throttle body referring to “IAC Valve Removal” in Section 6E1. 2) Check IAC valve for operation referring to “IAC Valve Inspection” in Section 6E1. See Fig. 2. Is check result satisfactory?	Intermittent trouble or faulty ECM. Check for intermittent referring to “Intermittent and Poor Connection” in Section 0A.	Go to Step 5.
5	Check Wire Harness for open and short. 1) Turn ignition switch OFF. 2) Disconnect IAC valve connector. 3) Check for proper connection to IAC valve at each terminals. 4) If OK, disconnect ECM connector. 5) Check for proper connection to ECM at C42-6 terminal. 6) If OK, check “BLK/RED”, “GRN/RED” and “BLK” circuit for open and short. Are they in good condition?	Replace IAC valve and recheck.	Repair or replace.

Fig. 1 for Step 3



[A] : When using SUZUKI scan tool:

Fig. 2 for Step 4



[A] : Without using SUZUKI scan tool:

DTC P1450 BAROMETRIC PRESSURE SENSOR LOW/HIGH INPUT

DTC P1451 BAROMETRIC PRESSURE SENSOR PERFORMANCE PROBLEM

WIRING DIAGRAM / CIRCUIT DESCRIPTION

Barometric pressure sensor is installed in ECM.

DTC DETECTING CONDITION	POSSIBLE CAUSE
DTC P1450 : Barometric pressure : Sensor voltage is 4.7 V or higher, or 1.6 V or lower	• ECM (barometric pressure sensor) malfunction
DTC P1451 : • Vehicle stopped • Engine cranking • Difference between barometric pressure and intake manifold absolute pressure is 26 kPa, 200 mmHg or more • Difference between intake manifold absolute pressure at engine start and the pressure after engine start is 1.3 kPa, 10 mmHg or less. ✱2 driving cycle detection logic, monitoring once/1 driving.	• Manifold absolute pressure sensor and its circuit malfunction • ECM (barometric pressure sensor) malfunction

DTC CONFIRMATION PROCEDURE

1) Turn ignition switch OFF.
2) Clear DTC with ignition switch ON.
3) Turn ignition switch ON for 2 sec., crank engine for 2 sec. and run it at idle for 1 min.
4) Check pending DTC in “ON BOARD TEST” or “PENDING DTC” mode and DTC in “DTC” mode.

INSPECTION

DTC P1450 :

Substitute a known-good ECM and recheck.

DTC P1451 :

NOTE:

Note that atmospheric pressure varies depending on weather conditions as well as altitude. Take that into consideration when performing these check.

Step	Action	Yes	No
1	Check Barometric Pressure Valve. 1) Connect scan tool to DLC with ignition switch OFF. 2) Turn ignition switch ON and select “DATA LIST” mode on scan tool. 3) Check manifold absolute pressure. See Fig. 1. Is it barometric pressure (approx. 100 kPa, 760 mmHg) at sea level?	Substitute a known-good ECM and recheck.	Go to Step 2.

Step	Action	Yes	No
2	Check MAP Sensor. 1) Remove MAP sensor from intake manifold and connect vacuum pump gauge to MAP sensor. See Fig. 2. 2) Connect scan tool to DLC and turn ignition switch ON. 3) Check intake manifold absolute pressure displayed on scan tool for specified valve. See Table 1. Is check result satisfactory?	Check air intake system for air being drawn in and engine compression. If OK, then substitute a known-good ECM and recheck.	Replace MAP sensor.

Table 1

Applying Vacuum	Displayed Value on Scan Tool
0	Barometric pressure (Approx. 100 kPa, 760 mmHg)
27 kPa 200 mmHg	Barometric pressure – 27 kPa (Approx. 73 kPa, 560 mmHg)
67 kPa 500 mmHg	Barometric pressure – 67 kPa (Approx. 33 kPa, 260 mmHg)

Fig. 1 for Step 1

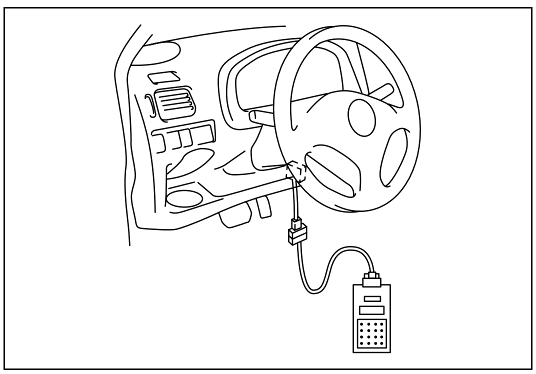
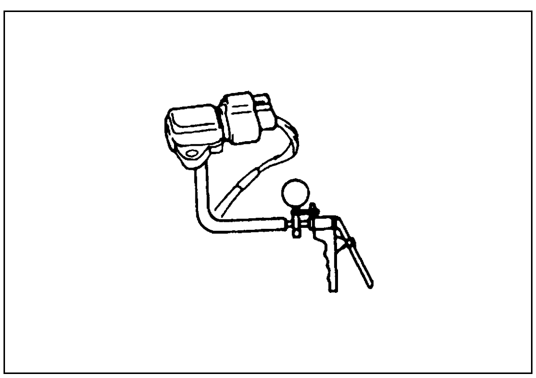
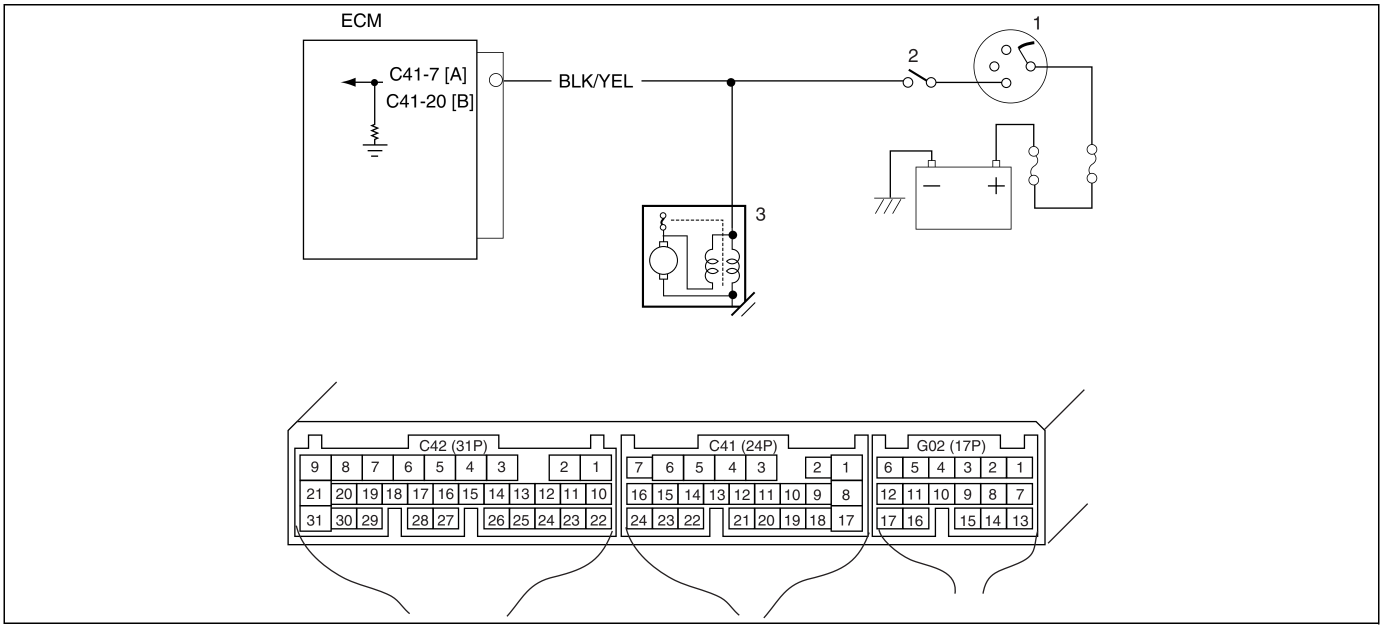


Fig. 2 for Step 2



DTC P1500 ENGINE STARTER SIGNAL CIRCUIT MALFUNCTION

CIRCUIT DESCRIPTION



1. Ignition switch	2. Transmission range switch (A/T)	3. Starter motor
[A] : Case of TYPE A is shown (See NOTE)	[B] : Case of TYPE B is shown (See NOTE)	

NOTE:

For TYPE A and TYPE B, refer to NOTE in "ECM VOLTAGE VALUES TABLE" for applicable model.

DTC DETECTING CONDITION	POSSIBLE CAUSE
• Low voltage at terminal C41-7 (Case of TYPE A. See NOTE) or C41-20 (Case of TYPE B. See NOTE) when cranking engine or • High voltage at terminal C41-7 (Case of TYPE A. See NOTE) or C41-20 (Case of TYPE B. See NOTE) after starting engine. ✱2 driving cycle detection logic, continuous monitoring.	• "BLK/YEL" circuit open • ECM malfunction

DTC CONFIRMATION PROCEDURE

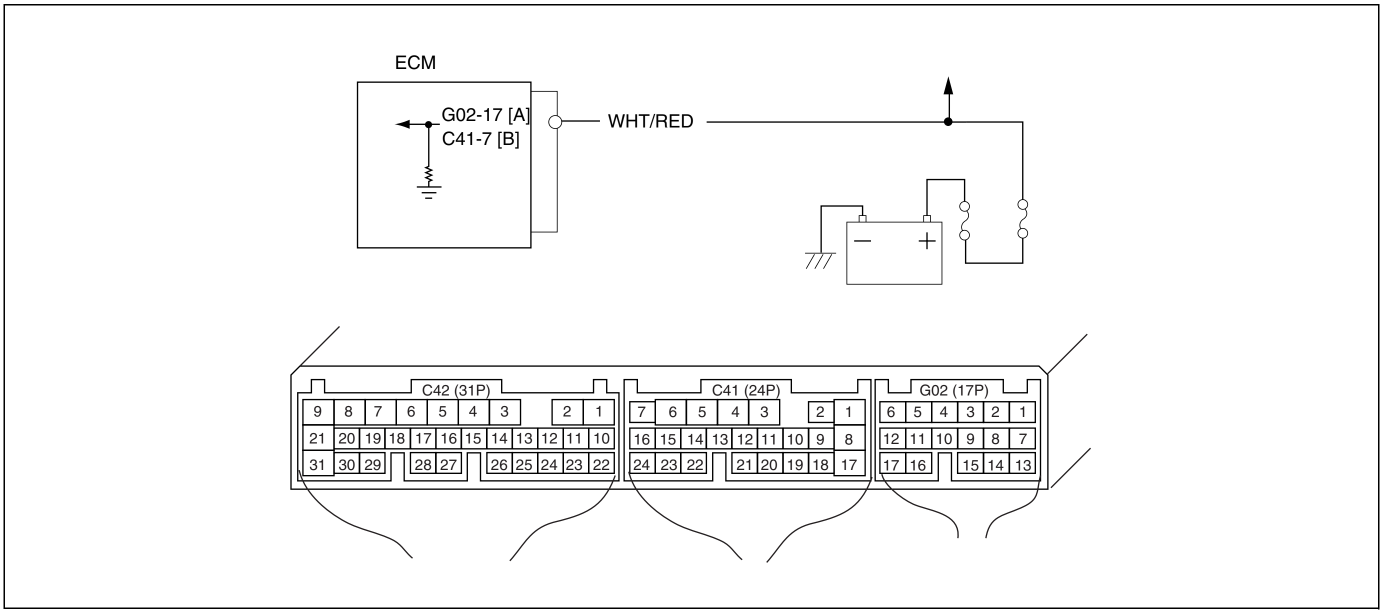
1) Turn ignition switch OFF.
2) Clear DTC with ignition switch ON, crank engine and run it at idle for 3 min.
3) Check pending DTC in "ON BOARD TEST" or "PENDING DTC" mode and DTC in "DTC" mode.

INSPECTION

Step	Action	Yes	No
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Check Terminal Voltage. 1) Check for voltage at terminal C41-7 (Case of TYPE A. See NOTE) or C41-20 (Case of TYPE B. See NOTE) of ECM connector connected, under following condition. **While engine cranking : 6 – 10 V** **After starting engine : 0 V** Is voltage as specified?	Poor C41-7 (Case of TYPE A. See NOTE) or C41-20 (Case of TYPE B. See NOTE) connection or intermittent trouble. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A. If wire and connections are OK, substitute a known-good ECM and recheck.	"BLK/YEL" circuit open.

DTC P1510 ECM BACK-UP POWER SUPPLY MALFUNCTION

WIRING DIAGRAM / CIRCUIT DESCRIPTION



[A] : Case of TYPE A is shown (See NOTE)	[B] : Case of TYPE B is shown (See NOTE)

Battery voltage is supplied so that diagnostic trouble code memory, values for engine control learned by ECM, etc. are kept in ECM even when the ignition switch is turned OFF.

NOTE:

For TYPE A and TYPE B, refer to NOTE in "ECM VOLTAGE VALUES TABLE" for applicable model.

DTC DETECTING CONDITION	POSSIBLE CAUSE
• Low voltage at terminal G02-17 (Case of TYPE A. See NOTE) or C41-7 (Case of TYPE B. See NOTE) after starting engine.	• "WHT/RED" circuit open • ECM malfunction

DTC CONFIRMATION PROCEDURE

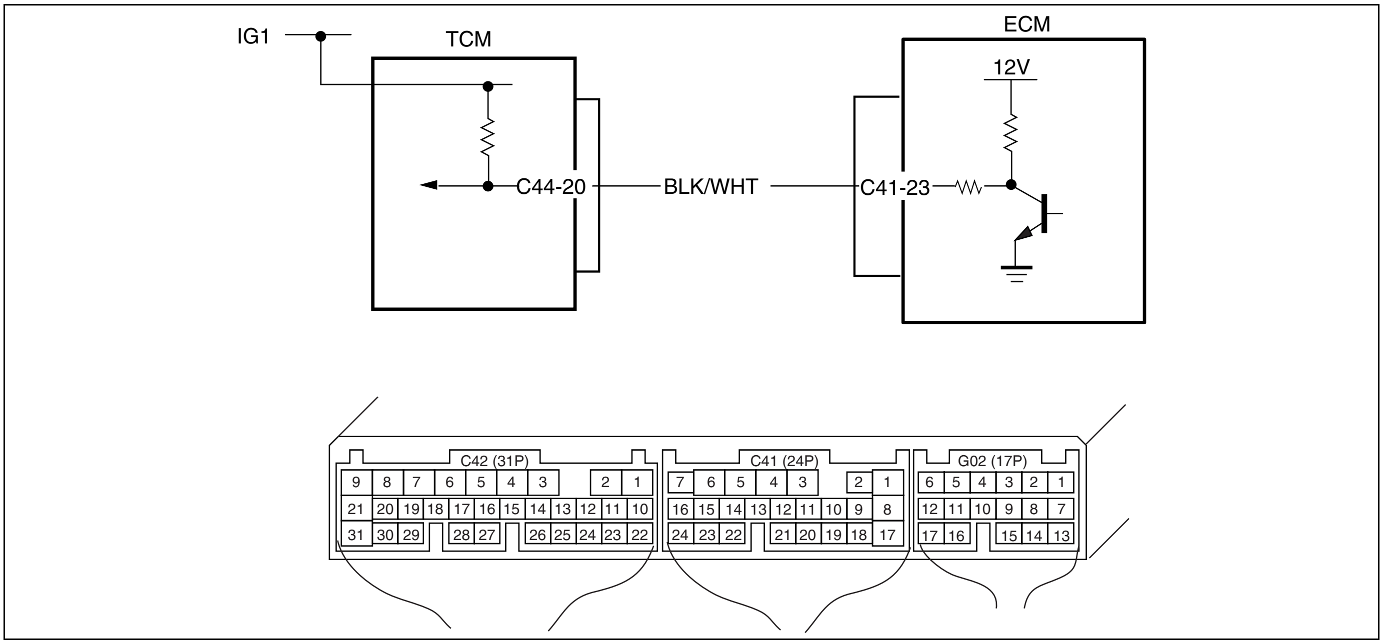
1) Clear DTC, start engine and run it at idle for 1 min.
2) Select "DTC" mode on scan tool and check DTC.

INSPECTION

Step	Action	Yes	No
1	Check Terminal Voltage. 1) Check for voltage at terminal G02-17 (Case of TYPE A. See NOTE) or C41-7 (Case of TYPE B. See NOTE) of ECM connector connected, under each condition, ignition switch OFF and engine running. Is it 10 – 14 V at each condition?	Poor G02-17 (Case of TYPE A. See NOTE) or C41-7 (Case of TYPE B. See NOTE) connection or intermittent trouble. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A. If wire and connections are OK, substitute a known- good ECM and recheck.	"WHT/RED" circuit open.

DTC P1600 SERIAL COMMUNICATION PROBLEM BETWEEN ECM AND TCM

WIRING DIAGRAM



CIRCUIT DESCRIPTION

The serial data line is pulled up to about 12 V by ECM and TCM transmits information to ECM through it by controlling its grounding.
TCM constantly sends information while ignition switch is ON as to whether judgement was made or not with respect to all detectable DTCs as well as whether or not abnormality exists after judgement.

DTC DETECTING CONDITION	POSSIBLE CAUSE
No signal inputted from TCM to ECM or check sum error while engine running	• "BLK/WHT" circuit open or short • TCM power or ground circuit open • TCM malfunction • ECM malfunction

DTC CONFIRMATION PROCEDURE

1) Turn ignition switch OFF.
2) Clear DTC with ignition switch ON.
3) Start engine and run it at idle for 1 min.
4) Select "DTC" mode on scan tool and check DTC.

INSPECTION

Step	Action	Yes	No
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Check Signal Voltage. Check voltage between terminal C41-23 and body ground with ignition switch ON. Does it change between 0 – 12 V? See Fig. 1.	Intermittent trouble or faulty ECM or TCM. Check for intermittent trouble referring to "Intermittent and poor connection" in Section 0A.	Go to Step 3.

Step	Action	Yes	No
3	Is it about 12 V at Step 2?	"BLK/WHT" wire open, poor C44-20 connection or TCM power or ground circuit open. If wires and connections are OK, substitute a known-good TCM and recheck.	Go to Step 4.
4	Check Signal Circuit. 1) Disconnect TCM coupler with ignition switch OFF. 2) Check voltage between C44-20 terminal and body ground with ignition switch ON. See Fig. 2. Is it about 12 V?	Check TCM power and ground circuit for open. If OK, substitute a known-good TCM and recheck.	"BLK/WHT" wire shorted to ground or poor C44-23 terminal connection. If wire and connection are OK, substitute a known-good ECM and recheck.

Fig. 1 for Step 2

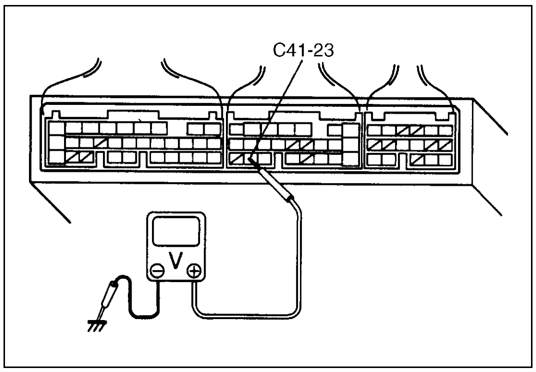
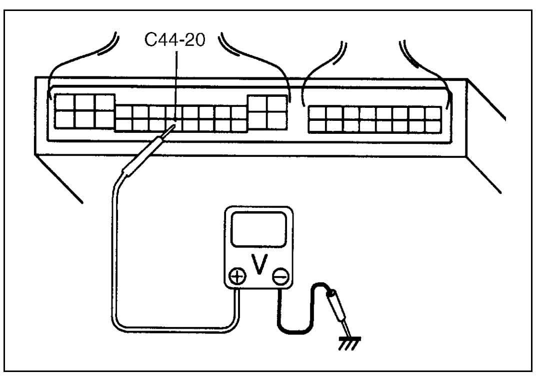
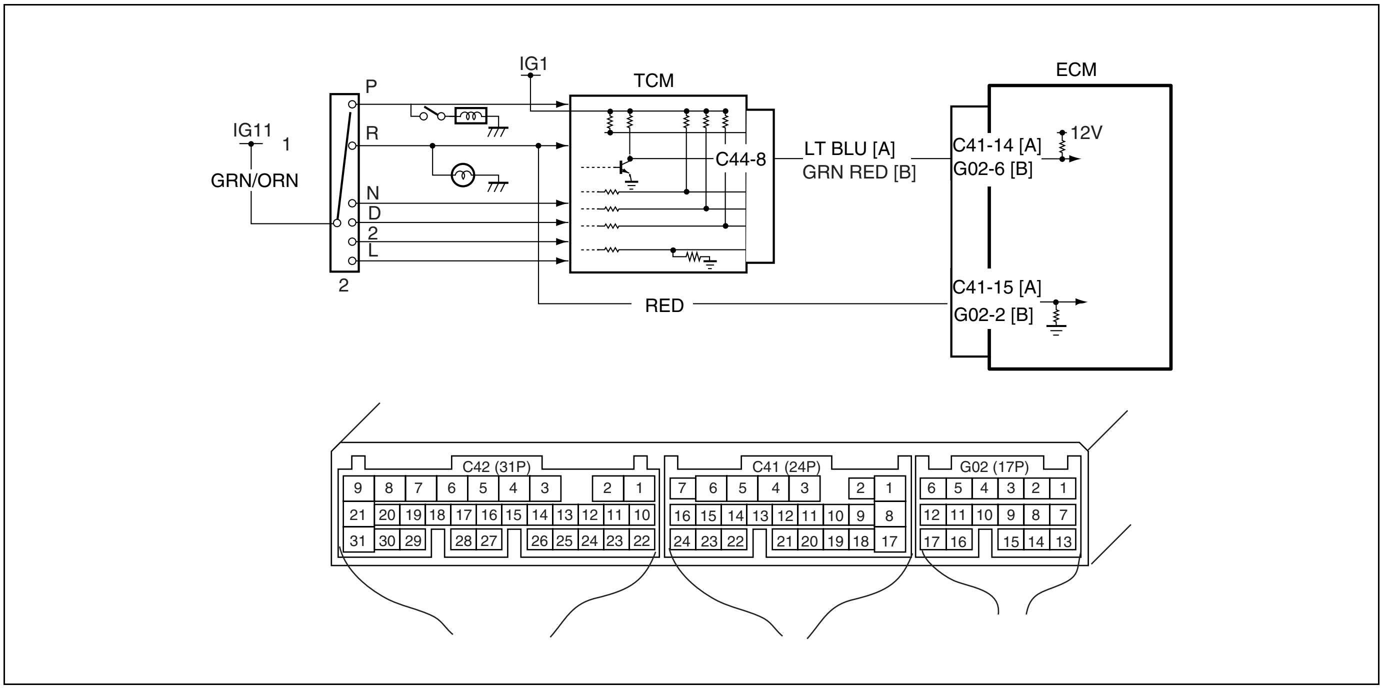


Fig. 2 for Step 4



DTC P1717 A/T DRIVE RANGE (PARK/NEUTRAL POSITION) SIGNAL CIRCUIT MALFUNCTION

WIRING DIAGRAM / CIRCUIT DESCRIPTION



1. From ignition switch	2. Transmission range switch
[A] : Case of TYPE A is shown (See NOTE)	[B] : Case of TYPE B is shown (See NOTE)

NOTE:

For TYPE A and TYPE B, refer to NOTE in “ECM VOLTAGE VALUES TABLE” for applicable model.

DTC DETECTING CONDITION	POSSIBLE CAUSE
• “D” range signal not inputted (Park/Neutral position signal inputted) to ECM while vehicle running ✱2 driving cycle detection logic, continuous monitoring.	• “LT BLU” circuit open • Transmission range switch malfunction • “R”, “D”, “2” or “L” range signal circuit open • TCM power or ground circuit open • TCM malfunction • ECM malfunction

DTC CONFIRMATION PROCEDURE

WARNING:

- **When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident.**
- **Road test should be carried out with 2 persons, a driver and a tester.**

1) Turn ignition switch OFF.
2) Clear DTC with ignition switch ON.
3) Start engine and shift selector lever to “D” range.
4) Increase vehicle speed to higher than 20 mph, 32 km/h and then stop vehicle.
5) Repeat above step 4) 9 times.
6) Shift selector lever to “2” range and repeat above step 4) and 5).
7) Shift selector lever to “L” range and repeat above step 4) and 5).
8) Check DTC in “DTC” mode and pending DTC in “ON BOARD TEST” or “PENDING DTC” mode.

INSPECTION

Step	Action	Yes	No
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Is SUZUKI scan tool available?	Go to Step 3.	Go to Step 4.
3	Check PNP Signal ("D" range signal). 1) Connect SUZUKI scan tool to DLC with ignition switch OFF. See Fig. 1. 2) Turn ignition switch ON and check PNP signal ("P/N" or "D" range) on display when shifting selector lever to each range. Is "D" range on display (Is 0 – 1 V indicated) no matter which of "R", "D", "2" and "L" range positions selector lever may be at? See Table 1.	Intermittent trouble or faulty ECM. Check for intermittent referring to "Intermittent and poor connection" in Section 0A.	Go to Step 5.
4	Check PNP Signal ("D" range signal). 1) Turn ignition switch ON. 2) Check voltage at terminal C41-14 (Case of TYPE A. See NOTE) or G02-6 (Case of TYPE B. See NOTE) of ECM connector connected. See Fig. 2. Is "D" range on display (Is 0 – 1 V indicated) no matter which of "R", "D", "2" and "L" range positions selector lever may be at? See Table 1.	Intermittent trouble or faulty ECM. Check for intermittent referring to "Intermittent and poor connection" in Section 0A.	Go to Step 5.
5	Is "P/N range on display (Is 10 – 14 V indicated) when selector lever is at one of "R", "D", "2" and "L" range positions only?	Check transmission range switch and circuits referring to section 7B.	Go to Step 6.
6	Check PNP Signal Circuit. 1) Turn ignition switch OFF. 2) Disconnect TCM connectors. 3) Check for proper connection to TCM at terminal C44-8. 4) If OK, then check voltage at terminal C44-8 in TCM connector disconnected, with ignition switch ON. Is it 10 – 14 V? See Fig. 3	"GRN/ORN" circuit open, poor transmission range switch connector connection, select cable maladjusted, transmission range sensor maladjusted or transmission range sensor malfunction. If all above are OK, substitute a known-good TCM and recheck.	"LT BLU" (Case of TYPE A. See NOTE) or "GRN RED" (Case of TYPE B. See NOTE) circuit open or poor C41-14 (Case of TYPE A. See NOTE) or G02-6 (Case of TYPE B. See NOTE) connection. If wire and connection are OK, substitute a known-good ECM and recheck.

Fig. 1 for Step 3

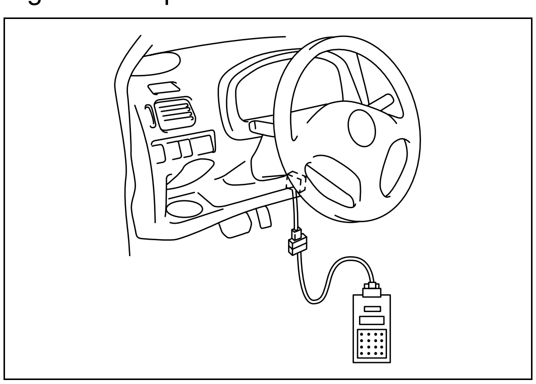
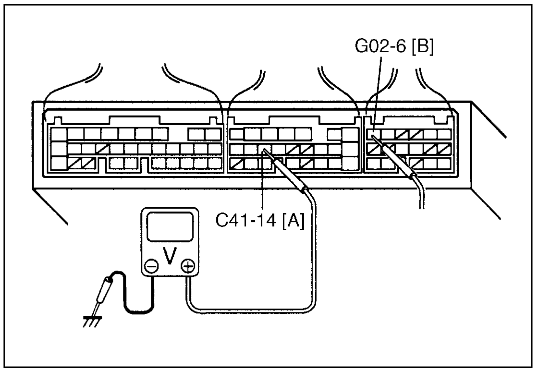


Fig. 2 for Step 4



[A] :	Case of TYPE A is shown (See NOTE)
[B] :	Case of TYPE B is shown (See NOTE)

Table 1 for Step 3 and 4

		Scan tool or voltmeter	
		SUZUKI SCAN TOOL	VOLTAGE AT C41-14
Selector lever position	“P” and “N” range	P/N range	10 – 14V
	“R”, “D”, “2” and “L” range	D range	0 – 1V

Fig. 3 for Step 6

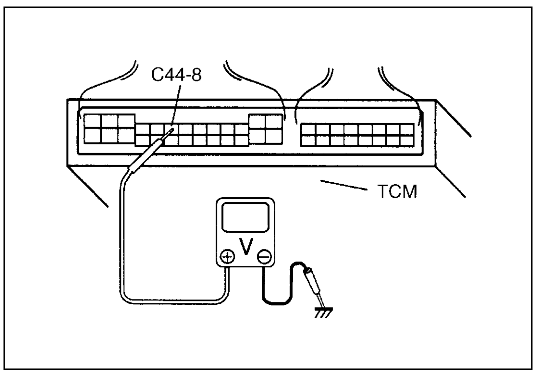
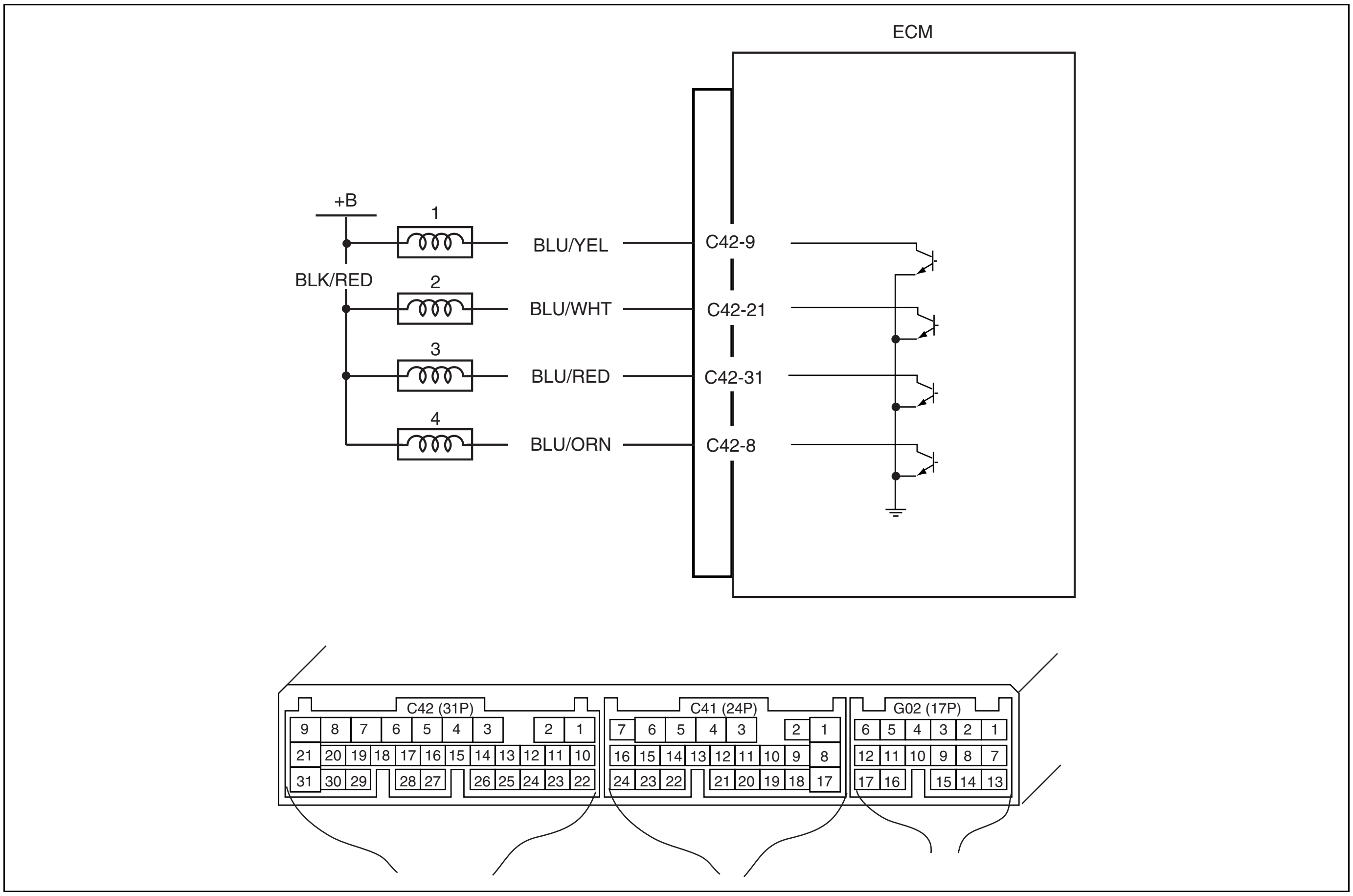


TABLE B-1 FUEL INJECTOR CIRCUIT CHECK

WIRING DIAGRAM



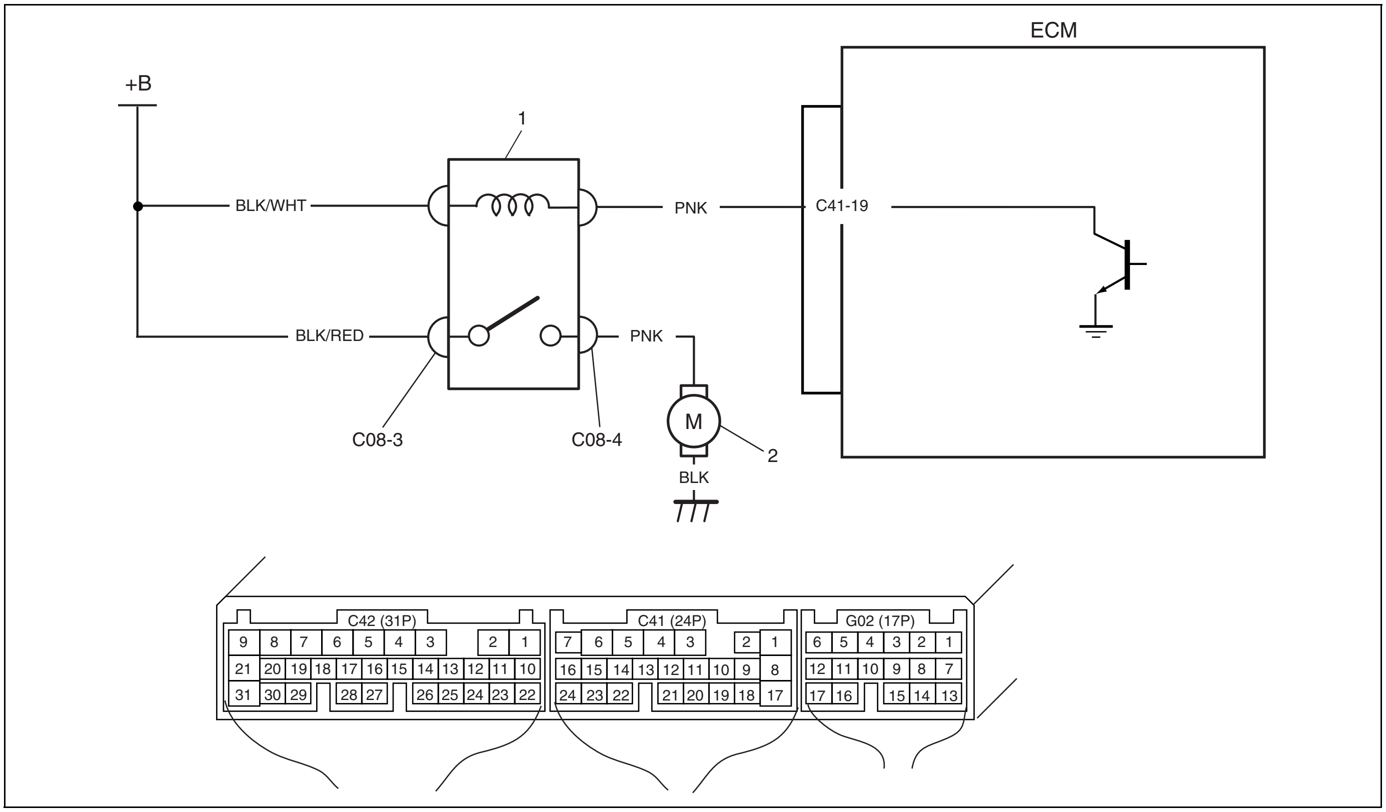
1. No.1 injector	3. No.3 injector
2. No.2 injector	4. No.4 injector

INSPECTION

Step	Action	Yes	No
1	Was “ENGINE DIAG. FLOW TABLE” performed?	Go to Step 2.	Go to “ENGINE DIAG. FLOW TABLE”.
2	Check Injector for operating sound. Using sound scope, check each injector for operating sound at engine cranking. Do all 4 injector make operating sound?	Fuel injector circuit is in good condition.	Go to Step 3.
3	Dose none of 4 injectors make operating sound at Step 2?	Go to Step 4.	Check coupler connection and wire harness of injector not making operating sound and injector itself (Refer to Section 6E1).
4	Check power circuit of injectors for open and short. Is it normal?	Check all 4 injectors for resistance respectively. If resistance is OK, substitute a known-good ECM and recheck.	Power circuit open or short.

TABLE B-2 FUEL PUMP AND ITS CIRCUIT CHECK

WIRING DIAGRAM



1. Fuel pump relay	2. Fuel pump

INSPECTION

CAUTION:

Check to make sure that connection is made between correct terminals. Wrong connection can cause damage to ECM, wire harness, etc.

Step	Action	Yes	No
1	Was “ENGINE DIAG. FLOW TABLE” performed?	Go to Step 2.	Go to “ENGINE DIAG. FLOW TABLE”.
2	Check Fuel Pump Control System for operation. See Fig. 1. Is fuel pump heard to operate for 2 sec. after ignition switch ON?	Fuel pump circuit is in good condition.	Go to Step 3.
3	Check Fuel Pump for operation. 1) Remove fuel pump relay from relay box with ignition switch OFF. 2) Check for proper connection to relay at each terminal. 3) If OK, using service wire, connect terminals C08-3 and C08-4 of relay connector. See Fig. 2. Is fuel pump heard to operate at ignition switch ON?	Go to Step 4.	“PNK”, “BLK” or “BLK/RED” circuit open or fuel pump malfunction.

Step	Action	Yes	No
4	Check Fuel Pump Relay for operation. 1) Check resistance between each two terminals of fuel pump relay. See Fig.3. **Between terminals "c" and "d" : Infinity** **Between terminals "a" and "b" : 56 – 146 Ω** 2) Check that there is continuity between terminals "c" and "d" when battery is connected to terminals "a" and "b". See Fig. 3. Is fuel pump relay in good condition?	"PNK" circuit open or poor C41-19 connection. If wire and connection are OK, substitute a known-good ECM and recheck.	Replace fuel pump relay.

Fig. 1 for Step 2

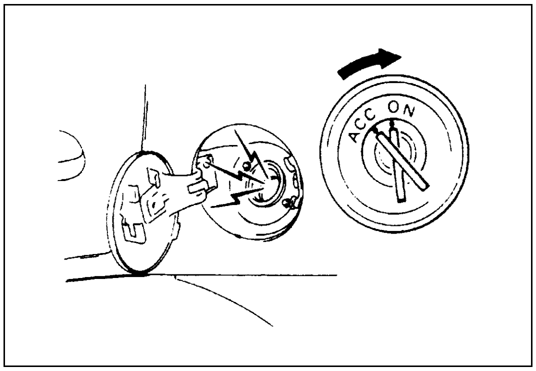


Fig. 2 for Step 3

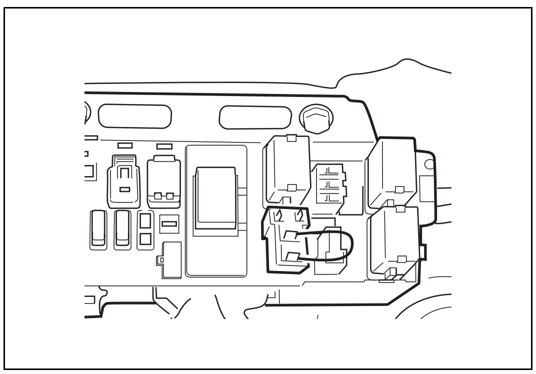


Fig. 3 for Step 4

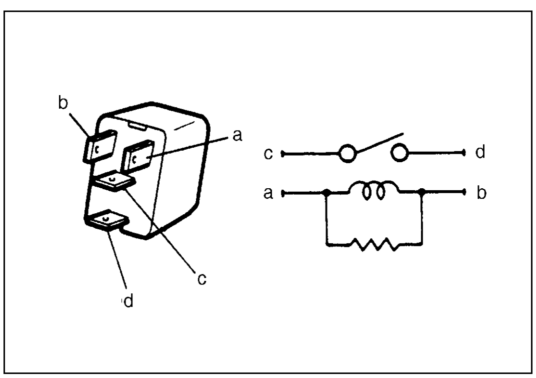
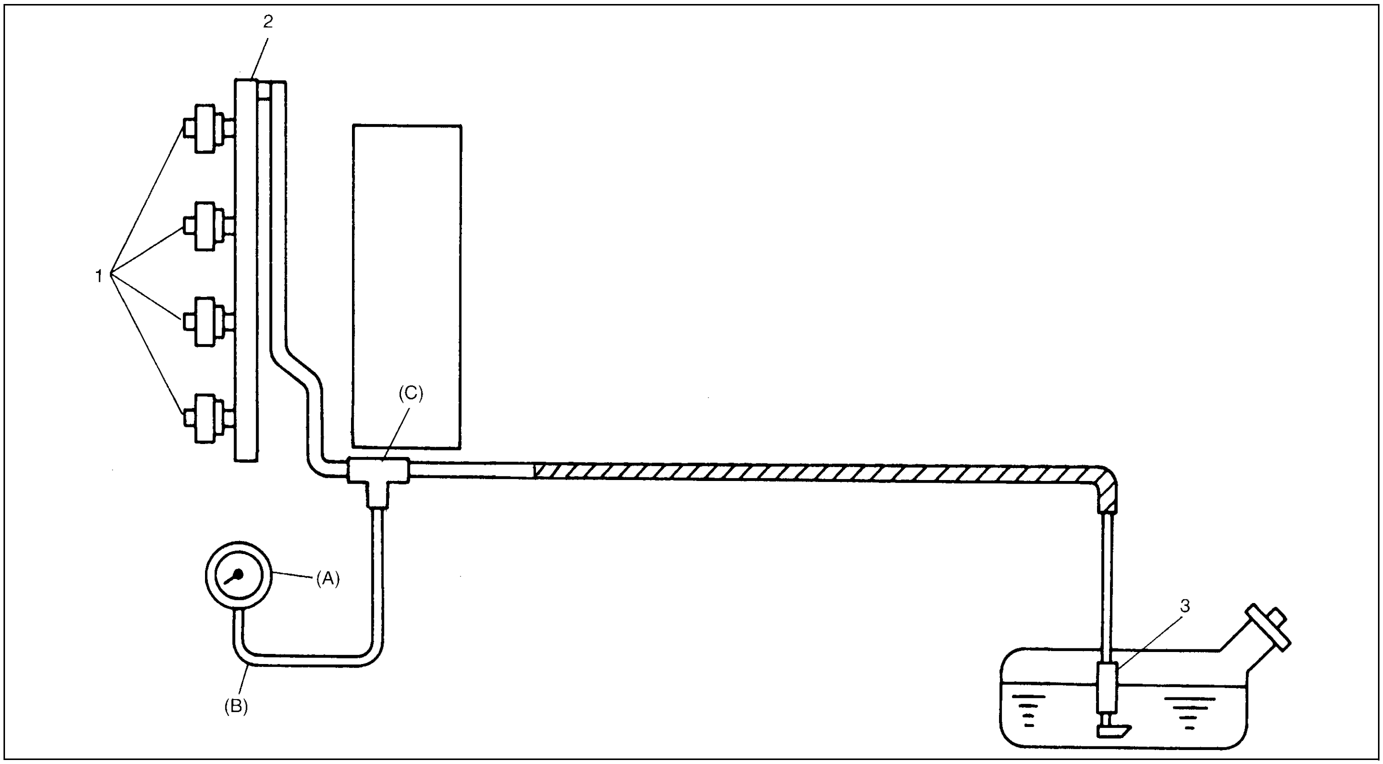


TABLE B-3 FUEL PRESSURE CHECK

WIRING DIAGRAM

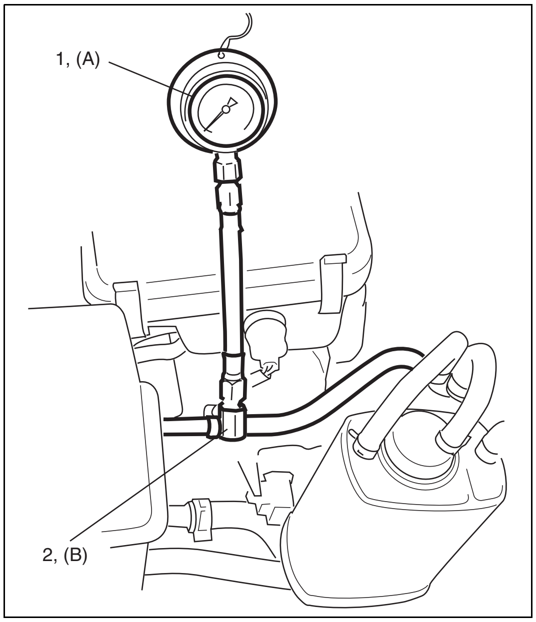


1.	Injector	(A) :	Fuel pressure gauge
2.	Delivery pipe	(B) :	Hose
3.	Fuel pump	(C) :	Attachment

INSPECTION

Step	Action	Yes	No
1	Check Fuel Pressure (Refer to Section 6E for details). 1) Release fuel pressure from fuel feed line. 2) Install fuel pressure gauge. 3) Check fuel pressure by repeating ignition switch ON and OFF. See Fig. 1. Is fuel pressure then 270 – 310 kPa (2.7 – 3.1 kg/cm^2, 38.4 – 44.0 psi)?	Go to Step 2.	Go to Step 4.
2	Is 250 kPa (2.5 kg/cm^2, 35.6 psi) or higher fuel pressure retained for 1 minute after fuel pump is stopped at Step 1?	Normal fuel pressure.	Go to Step 3.
3	Is there fuel leakage from fuel feed line hose, pipe or their joint?	Fuel leakage from hose, pipe or joint.	Faulty fuel pressure regulator.
4	Was fuel pressure higher than spec. in Step 1?	Faulty fuel pressure regulator.	Clogged fuel filter, Restricted fuel feed hose or pipe, Faulty fuel pump or Fuel leakage from hose connection in fuel tank.

Fig. 1 for Step 1



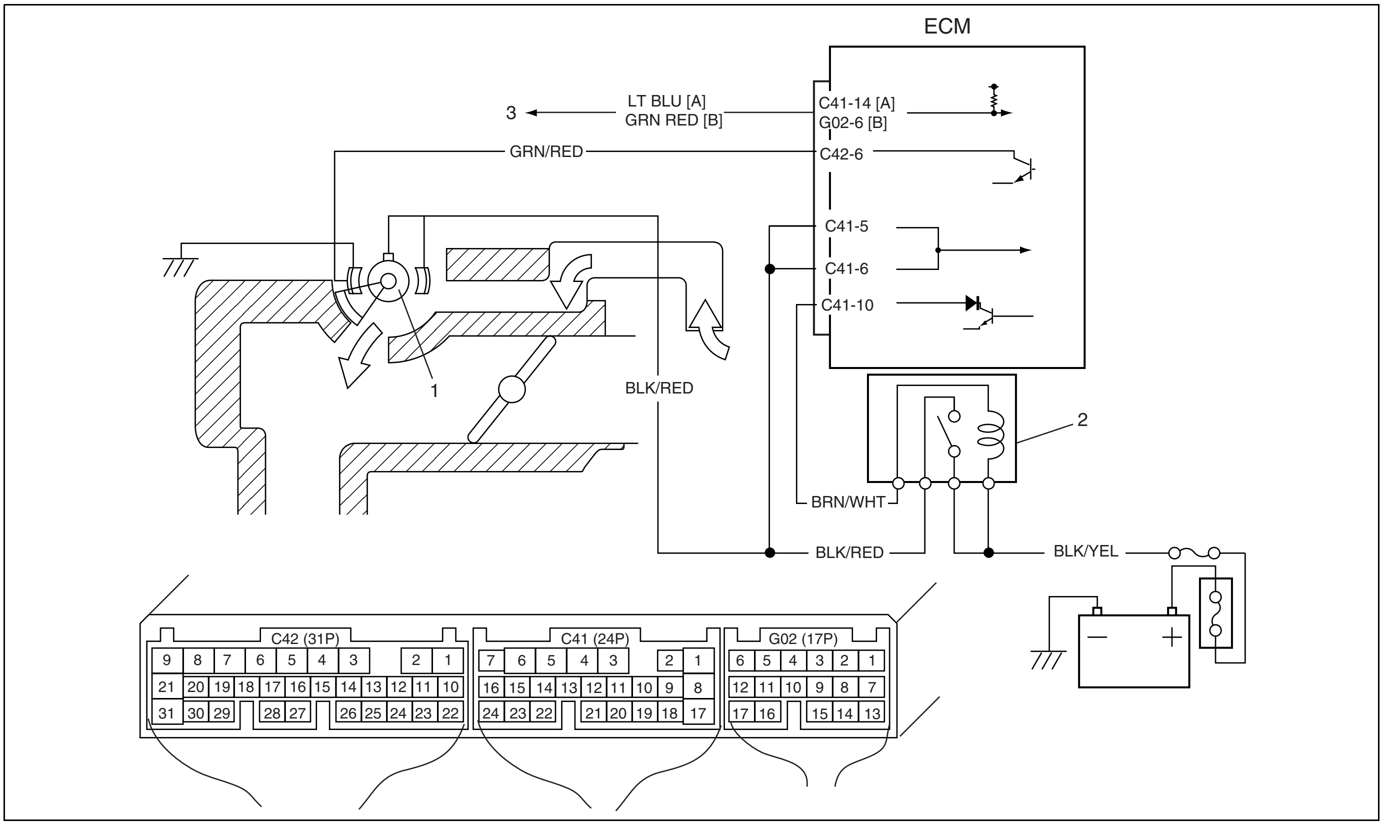
1.	Fuel pressure gauge
2.	3 way joint

Special tool

(A) : 09912-58441

(B) : 09912-58490

TABLE B-4 IDLE AIR CONTROL SYSTEM CHECK



1. IAC valve	2. Main relay	3. To TCM
[A] : Case of TYPE A is shown (See NOTE)	[B] : Case of TYPE B is shown (See NOTE)	

NOTE:

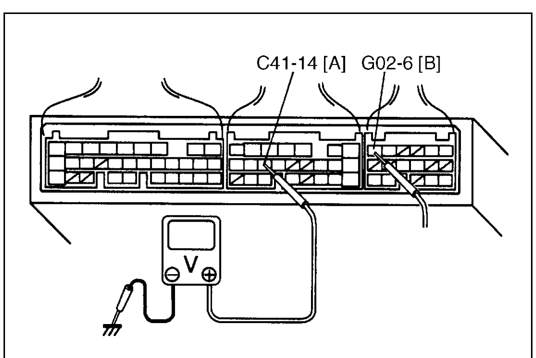
For TYPE A and TYPE B, refer to NOTE in “ECM VOLTAGE VALUES TABLE” for applicable model.

INSPECTION

Step	Action	Yes	No
1	Check engine idle speed and IAC duty referring to “Idle Speed/IAC Duty Inspection” in Section 6E1. Is idle speed within specification?	Go to Step 2.	Go to Step 4.
2	Is IAC duty within specification in Step 1?	Go to Step 3.	Check for followings : Vacuum leak EVAP canister purge control system Clog of IAC air passage Accessory engine load Closed throttle position (TP sensor) Stuck of PCV valve
3	Is engine idle speed kept specified speed even with headlight ON?	System is in good condition.	Check IAC system for operation referring to Step 2 of DTC P0505 Diag. Flow Table.
4	Was idle speed higher than specification in Step 1?	Go to Step 5.	Go to Step 8.

Step	Action	Yes	No
5	Check A/C (input) signal circuit referring to Step 1 of Table B-5 A/C Signal Circuit Check, if equipped. (A/C signal can be also checked by using SUZUKI scan tool.) Is it in good condition?	Go to Step 6.	Repair or replace A/C signal circuit or A/C system.
6	Check IAC system referring to Step 2 of DTC P0505 Diag. Flow Table. Is check result satisfactory?	Go to Step 7.	Go to Step 3 of DTC P0505 Diag. Flow Table.
7	Was IAC duty less than about 3% (or more than about 97% for OFF duty meter) in Step 1 of this table?	Check abnormal air inhaling from air intake system, PCV valve and EVAP canister purge control system.	Check TP sensor (closed throttle position) and ECT sensor for performance. If sensors are OK, substitute a known-good ECM.
8	Is SUZUKI scan Tool available?	Go to Step 9.	Go to Step 10.
9	Check PNP signal (“D” range signal). 1) Connect SUZUKI scan tool to DLC with ignition switch OFF. 2) Turn ignition switch ON and check PNP signal (“P/N” and “D” range) on display when shifting selector lever to each range. See Table 1. Is check result satisfactory?	Go to Step 11.	Repair or replace.
10	Check PNP signal (“D” range signal). 1) Turn ignition switch ON. 2) Check voltage at terminal C41-14 (Case of TYPE A. See NOTE) or G02-6 (Case of TYOE B. See NOTE) of ECM connector connected. See Fig. 1 and Table 1. Is check result satisfactory?	Go to Step 11.	Repair or replace.
11	Check IAC system referring to Step 2 of DTC P0505 Diag. Flow Table. Is check result satisfactory?	Go to Step 10.	Go to Step 3 of DTC P0505 Diag. Flow Table.
12	Was IAC duty more than about 30% (or less than 70% for OFF duty meter) in Step 1 of this table?	Check parts or system which can cause engine low idle. Accessory engine load Clog of air passage Etc.	Substitute a known-good ECM and recheck.

Fig. 1 for Step 10

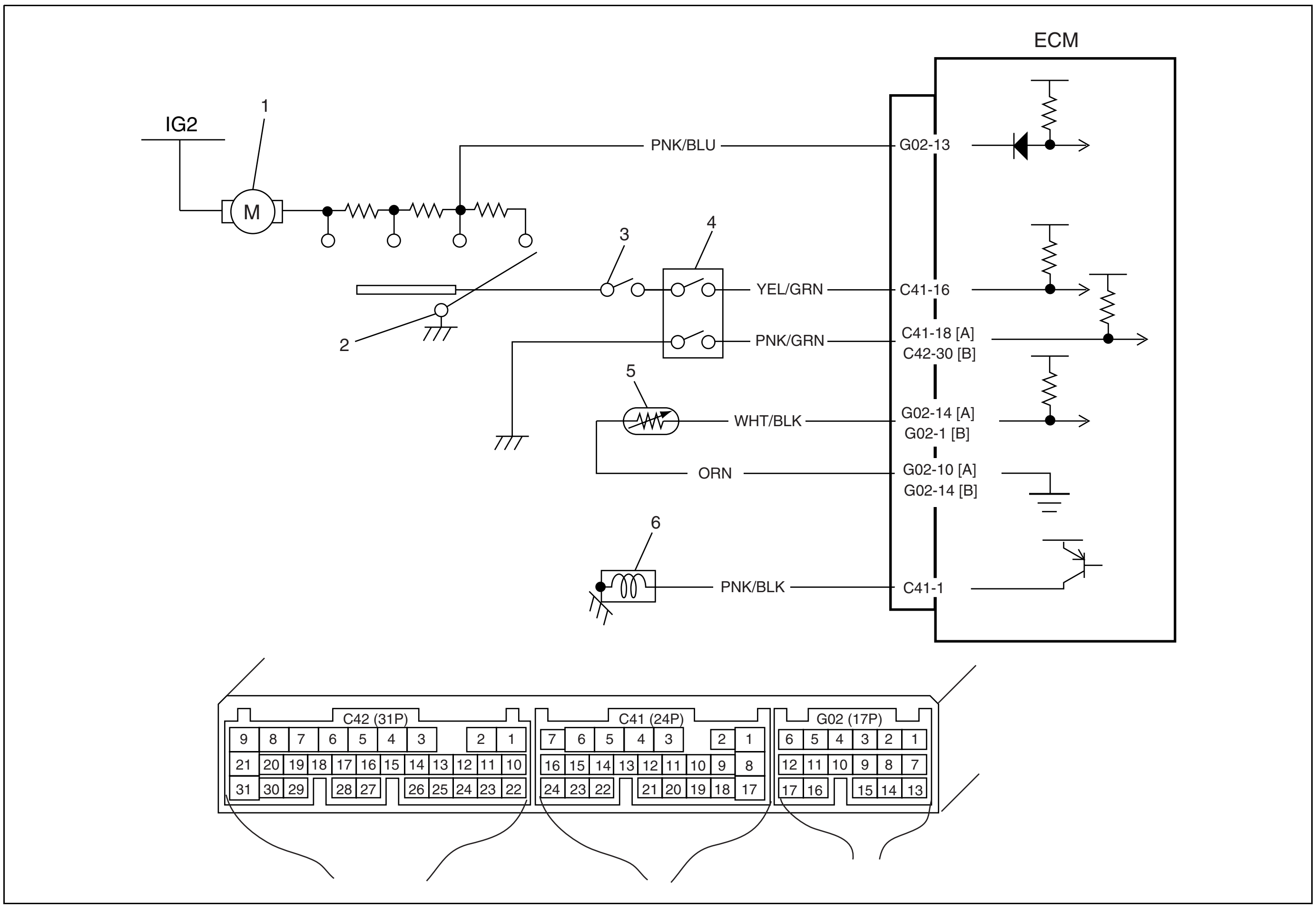


[A] :	Case of TYPE A is shown (See NOTE)
[B] :	Case of TYPE B is shown (See NOTE)

Table 1 for Step 9 and 10

		Scan tool or voltmeter	
		SUZUKI SCAN TOOL DISPLAY	VOLTAGE AT C41-14
Selector lever position	“P” and “N” range	P/N range	10 – 14V
	“R”, “D”, “2” and “L” range	D range	0 – 1V

TABLE B-5 A/C SIGNAL CIRCUITS CHECK (VEHICLE WITH A/C)



1. Blower fan motor	3. A/C switch	5. A/C evaporator temp. sensor
2. Blower fan switch	4. A/C pressure switch	6. A/C compressor clutch
[A] : Case of TYPE A is shown (See NOTE)	[B] : Case of TYPE B is shown (See NOTE)	

NOTE:

For TYPE A and TYPE B, refer to NOTE in “ECM VOLTAGE VALUES TABLE” for applicable model.

INSPECTION

Step	Action	Yes	No
1	Check evaporator temp. sensor resistance. 1) Disconnect ECM connectors with ignition switch at OFF position. 2) Check resistance between G02-14 terminal and G02-10 terminal (Case of TYPE A. See NOTE) or between G02-1 terminal and G02-14 terminal (Case of TYPE B. See NOTE). See Fig. 1. Is it within specification? **At 0°C 6.3 – 6.9 kΩ** **At 25°C 1.8 – 2.2 kΩ**	Go to Step 2.	Faulty A/C evaporator temp. sensor or its circuit.
2	Check A/C switch signal. 1) Check voltage at C41-16 terminal under each condition given below. **Ignition switch ON A/C switch OFF** **: 10 – 14V** **Ignition switch ON A/C switch ON** **: 0 – 1V** Is check result satisfactory?	Go to Step 3.	"YEL/GRN" wire open or short Poor C41-16 terminal connection If wire and connection are OK, substitute a known-good ECM and recheck. Go to Step 3.
3	1) Check voltage at C41-1 terminal under each condition given below. **While engine running, A/C switch OFF** **: 0 V** **While engine running, A/C switch ON** **: 10 – 14V** Is check result satisfactory?	A/C control system circuits are in good condition.	"PNK/BLK" wire open or short Poor C41-1 terminal connection If wire and connection are OK, substitute a known-good ECM and recheck.

NOTE:

When A/C evaporator thermistor temp. is below 2.5°C (36.5°F), A/C remain OFF (C41-1 terminal voltage become 0 – 1 V). This condition is not abnormal.

Fig. 1 for Step 1

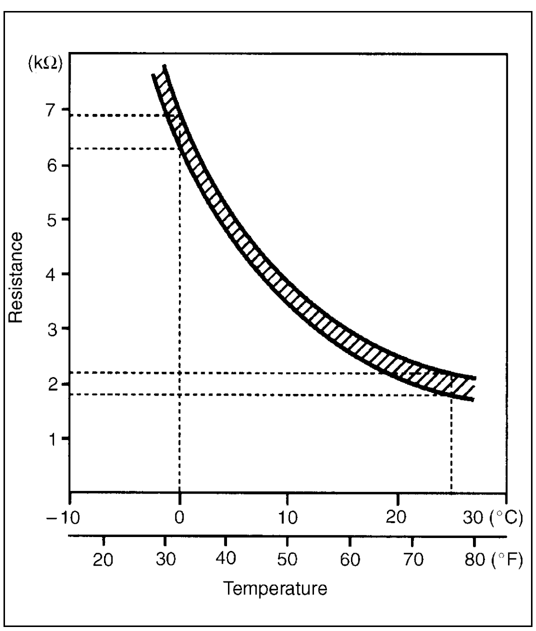
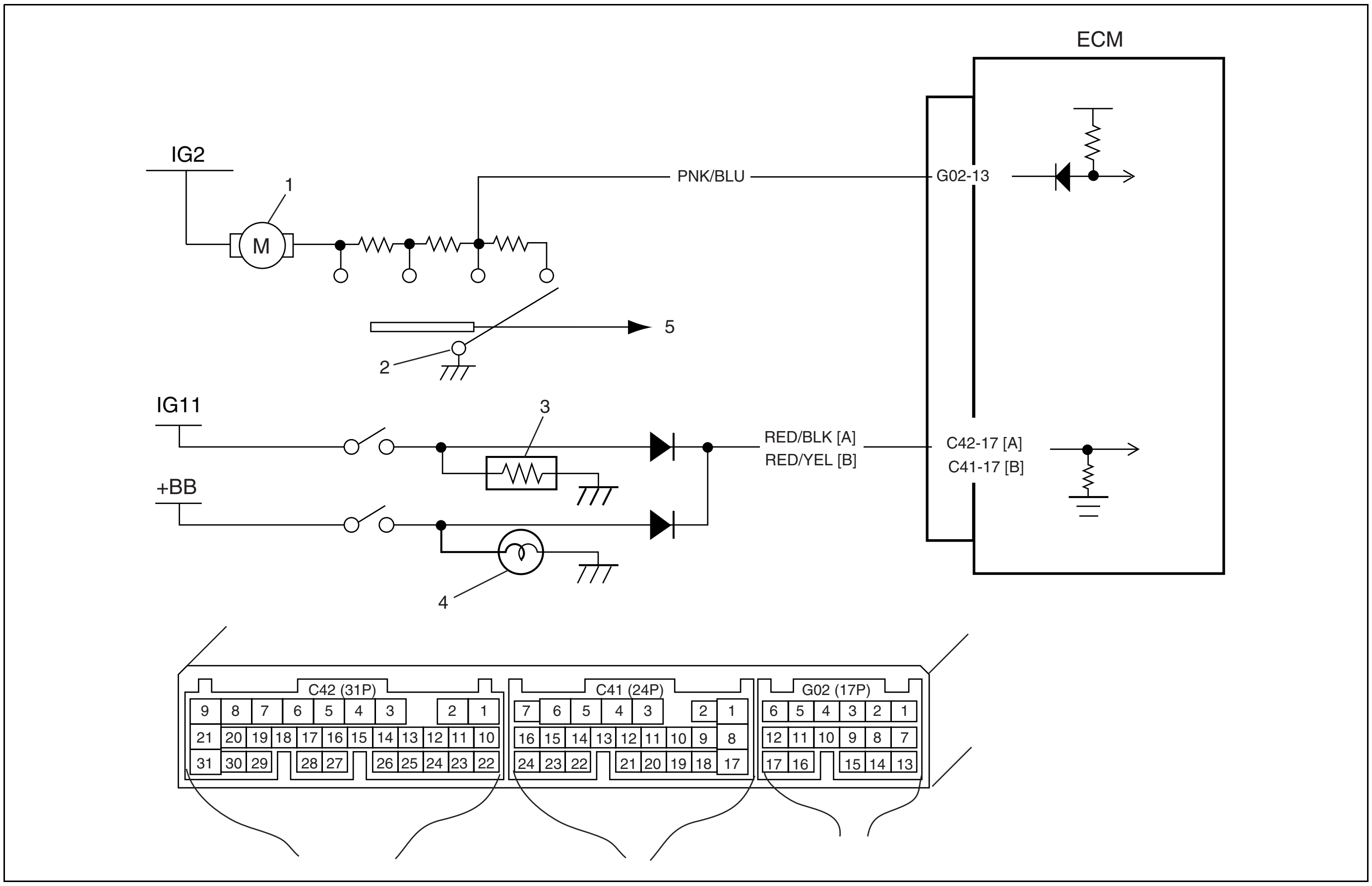


TABLE B-6 ELECTRIC LOAD SIGNAL CIRCUIT CHECK



1. Blower fan motor	3. Rear defogger	5. To A/C switch
2. Blower fan switch	4. Position lamp	
[A] : Case of TYPE A is shown (See NOTE)	[B] : Case of TYPE B is shown (See NOTE)	

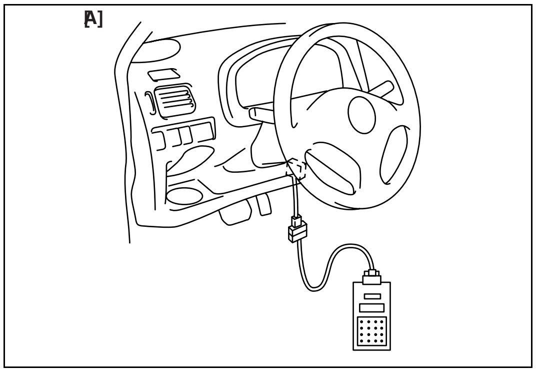
NOTE:

For TYPE A and TYPE B, refer to NOTE in "ECM VOLTAGE VALUES TABLE" for applicable model.

INSPECTION

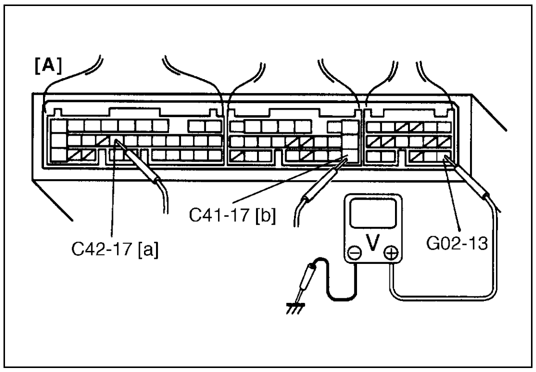
Step	Action	Yes	No
1	Is SUZUKI scan tool available?	Go to Step 2.	Go to Step 3.
2	Check Electric Load Signal Circuit. 1) Connect SUZUKI scan tool to DLC with ignition switch OFF. 2) Start engine and select "DATA LIST" mode on scan tool. 3) Check electric load signal under following each condition. See Fig. 1 and Table 1. Is check result satisfactory?	Electric load signal circuit is in good condition.	"RED/BLK" (Case of TYPE A. See NOTE) or C41-17 (Case of TYPE B. See NOTE) and/or "PNK/BLU" circuit open or short, Electric load diodes malfunction or Each electric load circuit malfunction.
3	Check Electric Load Signal Circuit. 1) Turn ignition switch ON. 2) Check voltage at each terminals C42-17 (Case of TYPE A. See NOTE) or C41-17 (Case of TYPE B. See NOTE) and G02-13 of ECM connector connected, under above each condition. See Fig. 2 and Table 1. Is each voltage as specified?	Electric load signal circuit is in good condition.	"RED/BLK" (Case of TYPE A. See NOTE) or C41-17 (Case of TYPE B. See NOTE) and/or "PNK/BLU" circuit open or short, Electric load diodes malfunction or Each electric load circuit malfunction.

Fig. 1 for Step 2



[A] :	When using SUZUKI scan tool:

Fig. 2 for Step 3

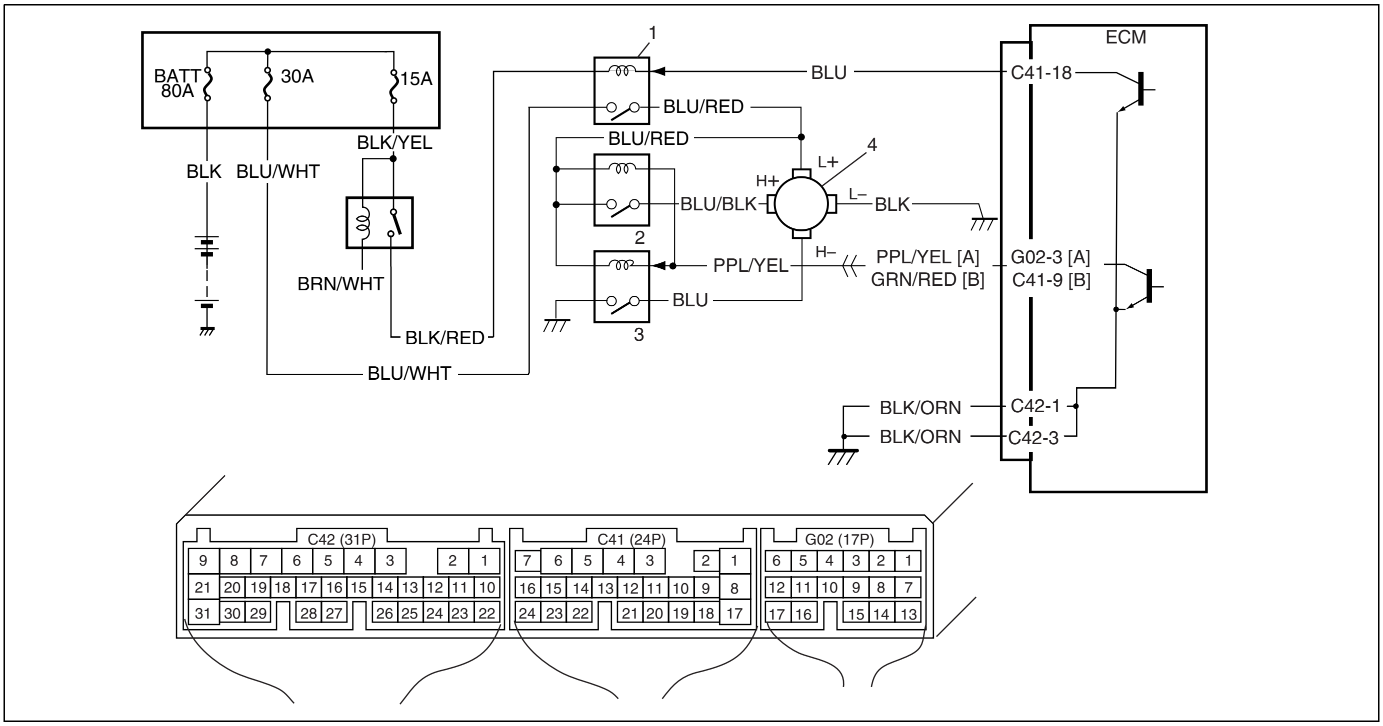


[A] :	When not using SUZUKI scan tool:
[a] :	Case of TYPE A is shown (See NOTE)
[b] :	Case of TYPE B is shown (See NOTE)

Table 1 for Step 2 and 3

		Scan tool or voltmeter		
		SUZUKI SCAN TOOL	VOLTAGE AT C42-17	VOLTAGE AT G02-13
Ignition switch ON, Small light, heater blower fan and rear defogger all turned	OFF	OFF	0V	10 – 14V
	ON	ON	10 – 14V	0V

TABLE B-7 RADIATOR FAN CONTROL SYSTEM CHECK



1. Radiator fan relay No.1	3. Radiator fan relay No.3	[A] : Case of TYPE A is shown (See NOTE)
2. Radiator fan relay No.2	4. Radiator fan	[B] : Case of TYPE B is shown (See NOTE)

NOTE:

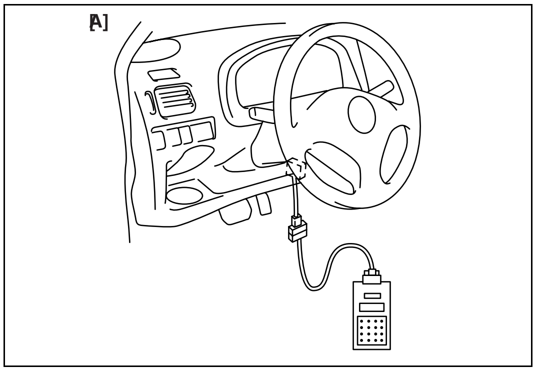
For TYPE A and TYPE B, refer to NOTE in “ECM VOLTAGE VALUES TABLE” for applicable model.

INSPECTION

Step	Action	Yes	No
1	Check Fan Control System. 1) Connect scan tool to DLC with ignition switch OFF. 2) Start engine and select “DATA LIST” mode on scan tool. 3) Warm up engine until coolant temp. is 97.5°C, 208°F or higher and A/C switch turn OFF. (If engine coolant temp. does not rise, check engine cooling system or ECT sensor.) See Fig. 1. Is radiator cooling fan started when engine coolant temp. reached above temp.?	Radiator cooling fan control system is in good condition.	Go to Step 2.
2	Check Radiator Fan Relay and Its Circuit. 1) Check DTC and pending DTC with scan tool. Is DTC P0480 displayed?	Go to DTC P0480 Diag. Flow Table.	Go to Step 3.
3	Check Radiator Fan Relays. 1) Turn ignition switch OFF and remove radiator cooling fan relays. (No.1 – No.3) 2) Check for proper connection to relay at terminals “c” and “d”. 3) If OK, check that there is continuity between “c” and “d” when battery is connected to terminals “a” and “b”. See Fig. 2. Is check result satisfactory?	Go to Step 4.	Replace radiator fan relay(s).

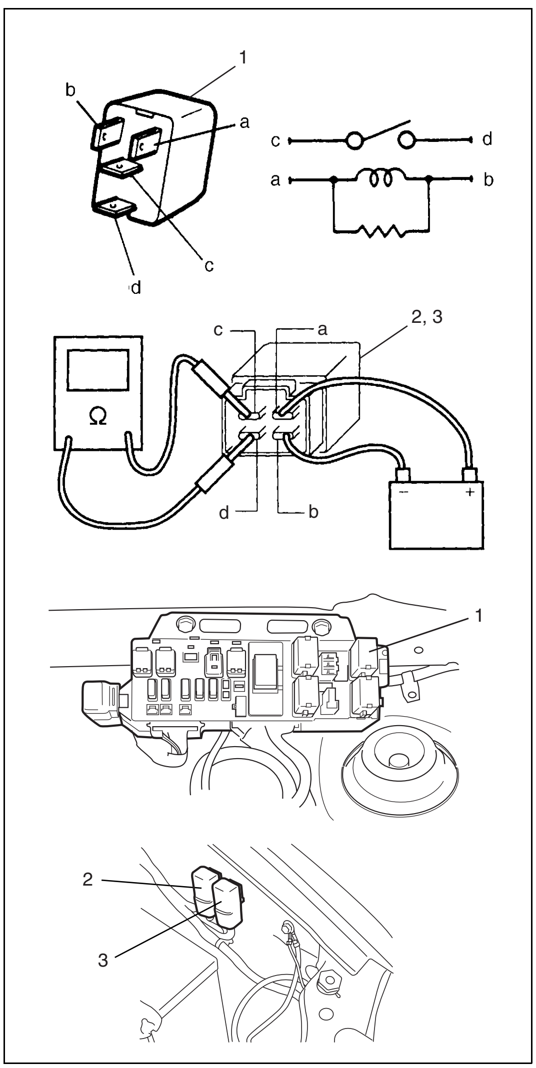
Step	Action	Yes	No
4	Check Radiator Fan. 1) Turn ignition switch OFF. 2) Disconnect cooling fan motor connector. 3) Check for proper connection to motor at “BLU/RED” and “BLK” terminals. 4) If OK, connect battery to motor and check for operation. See Fig. 3. Is it in good condition?	“BLU/WHT”, “BLU/RED” or “BLK” circuit open.	Replace radiator fan motor.

Fig. 1 for Step 1



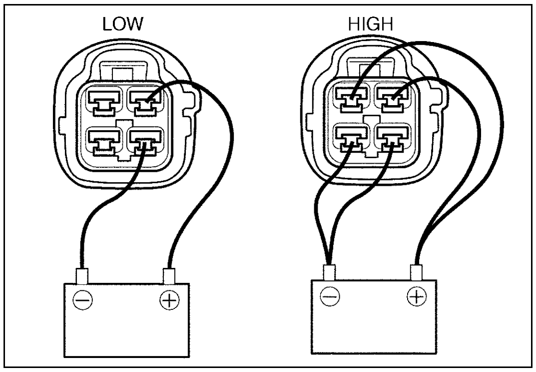
[A] : When using SUZUKI scan tool:

Fig. 2 for Step 3

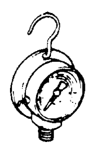
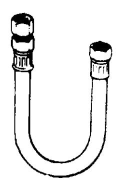
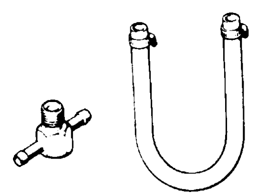
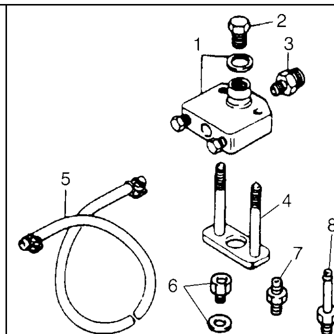
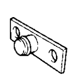
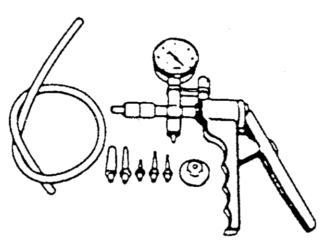
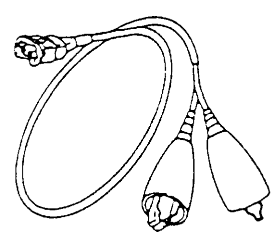
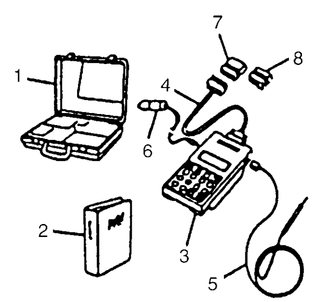


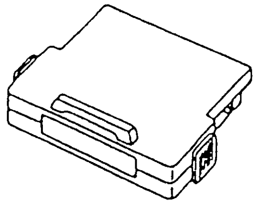
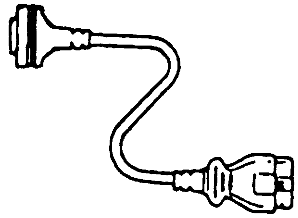
1.	Radiator fan No.1
2.	Radiator fan No.2
3.	Radiator fan No.3

Fig. 3 for Step 4



SPECIAL TOOL

			
09912-58441 Pressure gauge	09912-58431 Pressure hose	09912-58490 3-way joint & hose	09912-58421 Checking tool set (See NOTE “A”.)
			
09912-57610 Checking tool plate	09917-47010 Vacuum pump gauge	09930-88530 Injector test lead	09931-76011 Tech 1 A kit (See NOTE “B”.)

	
Mass storage cartridge	09931-76030 16/14 pin DLC cable

NOTE:

- **"A" : This kit includes the following items.**
  1. Tool body & washer, 2. Body plug, 3. Body attachment, 4. Holder, 5. Return hose & clamp, 6. Body attachment-2 & washer, 7. Hose attachment-1, 8. Hose attachment-2
- **"B" : This kit includes the following items.**
  1. Storage case, 2. Operator's manual, 3. Tech 1A, 4. DLC cable, 5. Test lead/probe, 6. Power source cable, 7. DLC cable adaptor, 8. Self–test adaptor

SECTION 6A1

ENGINE MECHANICAL (M13 ENGINE)

WARNING:

For vehicles equipped with Supplemental Restraint (Air Bag) System :

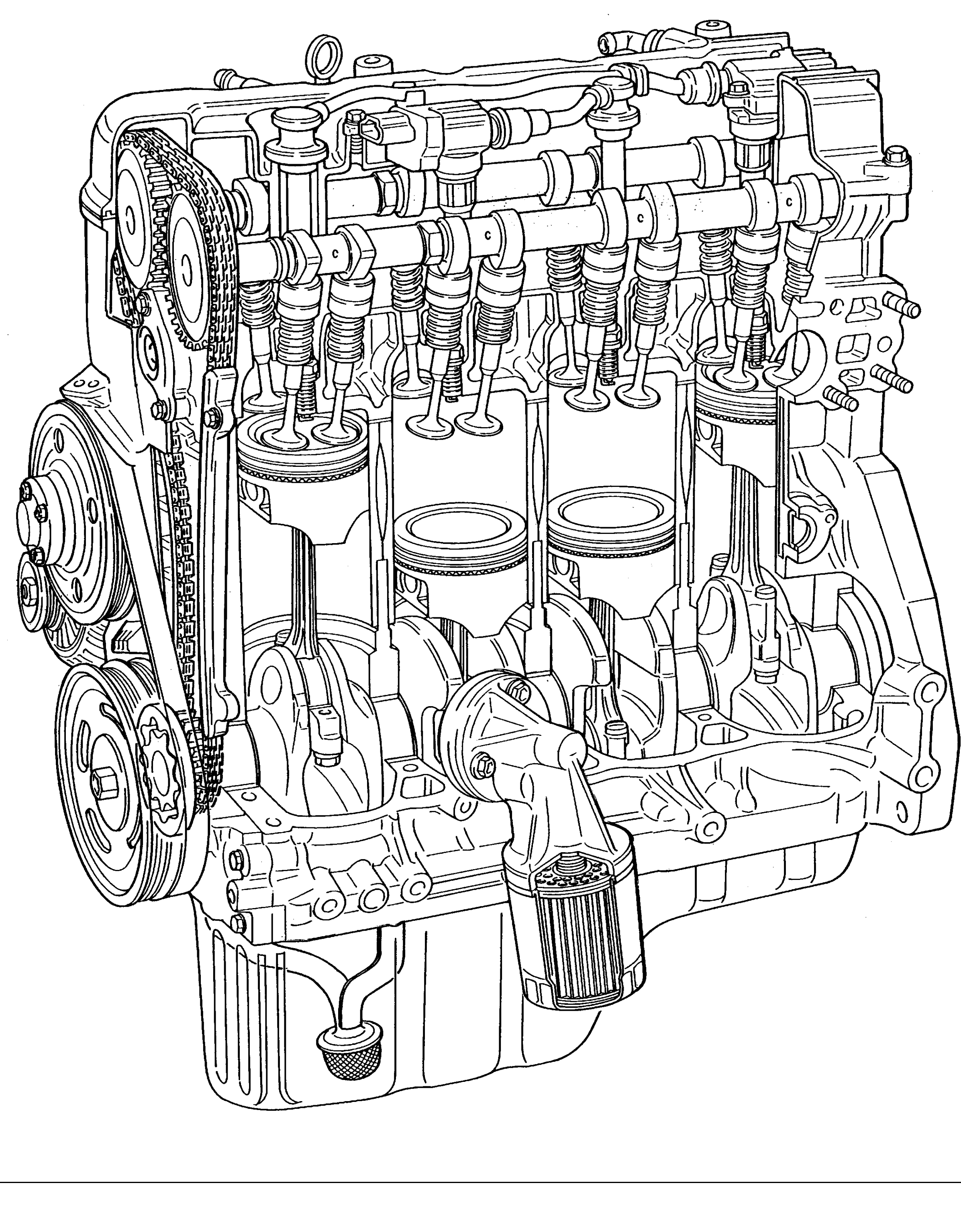
- **Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to "Air Bag System Components and Wiring Location View" under "General Description" in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and "Service Precautions" under "On-Vehicle Service" in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.**
- **Technical service work must be started at least 90 seconds after the ignition switch is turned to the "LOCK" position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).**

CONTENTS

GENERAL DESCRIPTION

ENGINE

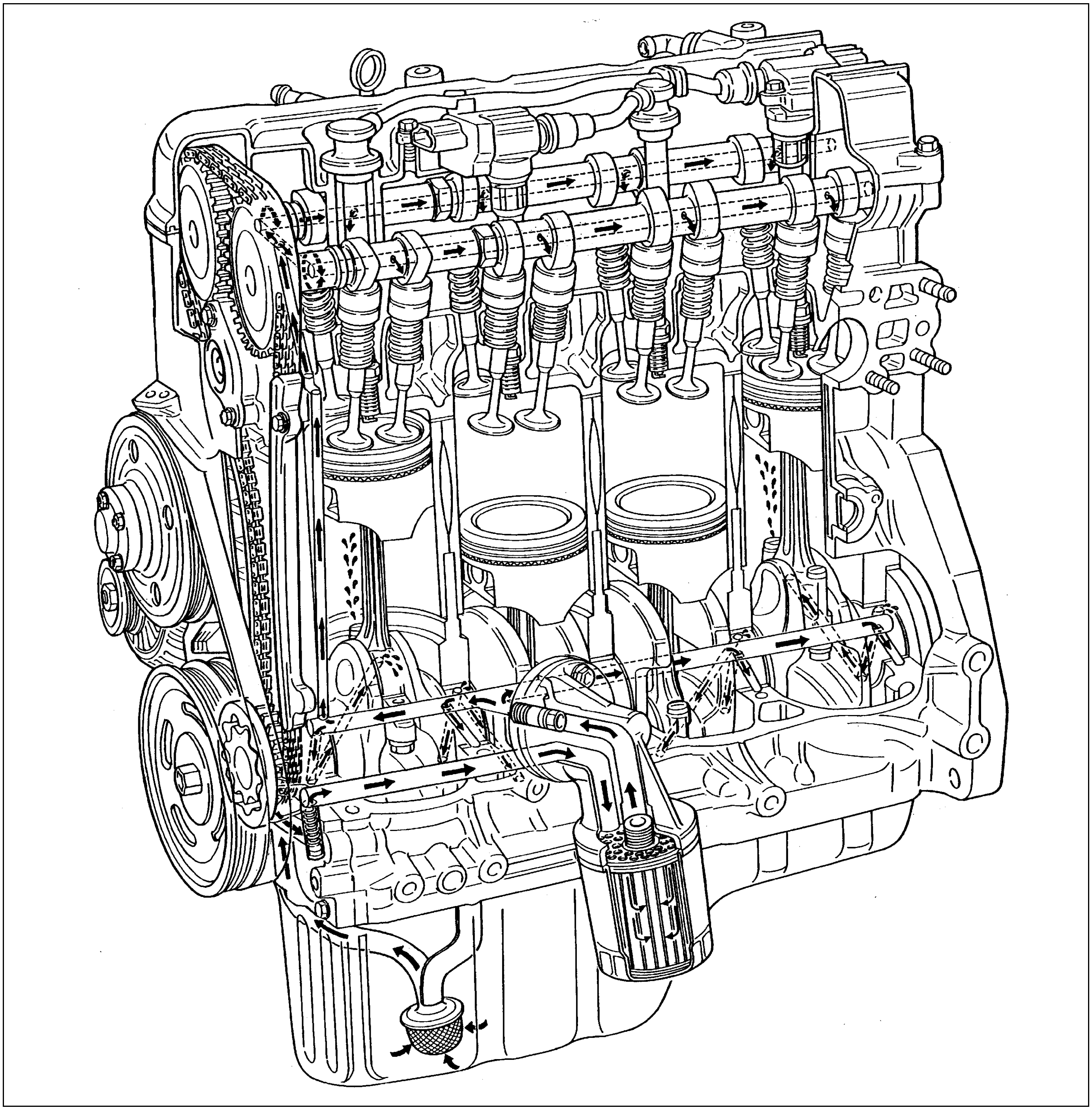
The engine is water-cooled, in line 4 cylinders, 4 stroke cycle gasoline unit with its DOHC (Double overhead camshaft) valve mechanism arranged for “V” type valve configuration and 16 valves (4 valves/one cylinder). The double overhead camshaft is mounted over the cylinder head; it is driven from crankshaft through timing chain, and no push rods are provided in the valve train system.



ENGINE LUBRICATION

The oil pump is of a trochoid type, and mounted on the crankshaft. Oil is drawn up through the oil pump strainer and passed through the pump to the oil filter.
The filtered oil flows into 2 paths in cylinder block.
In one path, oil reaches the crankshaft journal bearings. Oil from the crankshaft journal bearings is supplied to the connecting rod bearings by means of intersecting passages drilled in the crankshaft, and then injected from the big end of connecting rod to lubricate piston, rings, and cylinder wall.
In other path oil goes up to the cylinder head and lubricates valves and camshafts, etc., after passing through the internal oilway of camshafts.

An oil relief valve is provided on the oil pump. This valve starts relieving oil pressure when the pressure exceeds about 400 kPa (4.0 kg/cm^2, 56.9 psi).



DIAGNOSIS

DIAGNOSIS TABLE

Refer to "ENGINE MECHANICAL DIAGNOSIS TABLE" in Section 6.

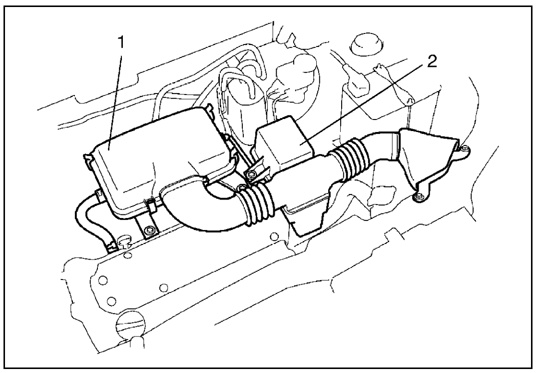
COMPRESSION CHECK

Check compression pressure on all 4 cylinders as follows:

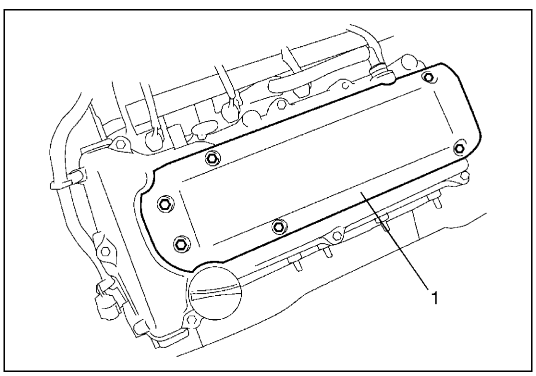
1) Warm up engine to normal operating temperature.
2) Stop engine after warming up.

NOTE:

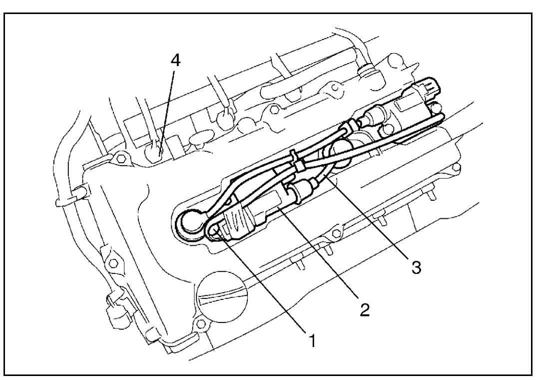
After warming up engine, place transmission gear shift lever in "Neutral" (shift selector lever to "P" range for A/T model), and set parking brake and block drive wheels.



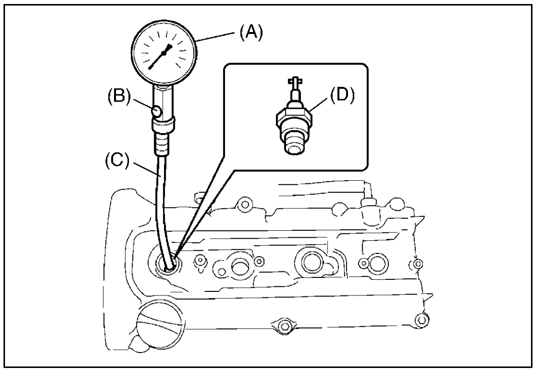
3) Remove air cleaner assembly (1), resonator (2) and hoses. Refer to "AIR CLEANER ASSEMBLY AND RESONATOR".



4) Remove cylinder head upper cover (1).

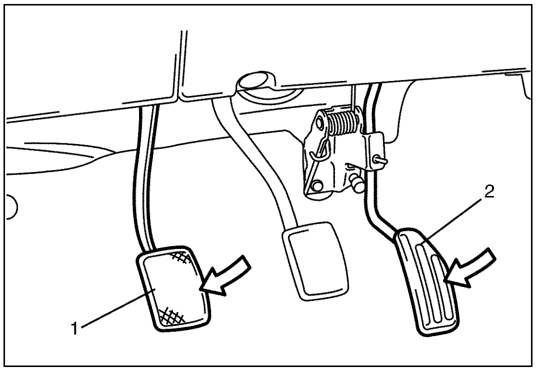


5) Disconnect ignition coil couplers (1).
6) Remove ignition coil assemblies (2) with high-tension cord (3).
7) Remove all spark plugs.
8) Disconnect fuel injector wires (4) at the coupler.



9) Install special tools (compression gauge) into spark plug hole.

Special tool
(A) : 09915-64510-001
(B) : 09915-64510-002
(C) : 09915-64530
(D) : 09915-67010



10) Disengage clutch (1) (to lighten starting load on engine) for M/T vehicle, and depress accelerator pedal (2) all the way to make throttle fully open.

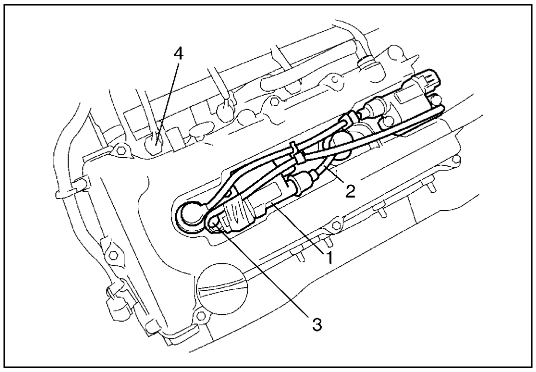
11) Crank engine with fully charged battery, and read the highest pressure on compression gauge.

NOTE:
- **For measuring compression pressure, crank engine at least 250 rpm by using fully charged battery.**
- **If measured compression pressure is lower than limit value, check installation condition of special tool. If it is properly installed, possibility is compression pressure leakage from where piston ring and valve contact.**

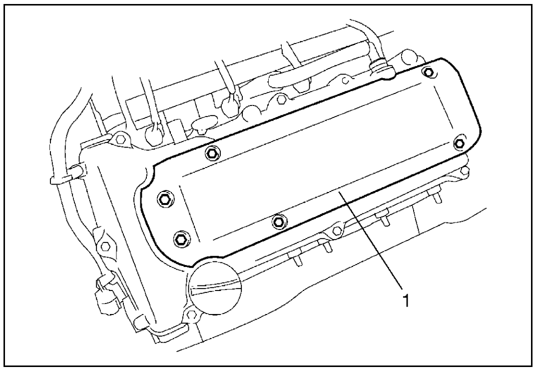
Compression pressure

Standard	**1400 kPa (14.0 kg/cm^2, 199.0 psi)**
Limit	**1100 kPa (11.0 kg/cm^2, 156.0 psi)**
Max. difference between any two cylinders	**100 kPa (1.0 kg/cm^2, 14.2 psi)**

12) Carry out Steps 9) through 11) on each cylinder to obtain 4 readings.



13) After checking, install spark plugs and ignition coil assemblies (1) with high-tension cord (2).
14) Connect ignition coil couplers (3).
15) Connect fuel injector wires(4) at the coupler.



16) Check cylinder head upper cover gasket for deterioration and then install it into groove of cylinder head upper cover (1) securely.
17) Install cylinder head upper cover with gasket on to cylinder head cover.
18) Install air cleaner assembly, resonator and hoses referring to "AIR CLEANER ASSEMBLY AND RESONATOR".

ENGINE VACUUM CHECK

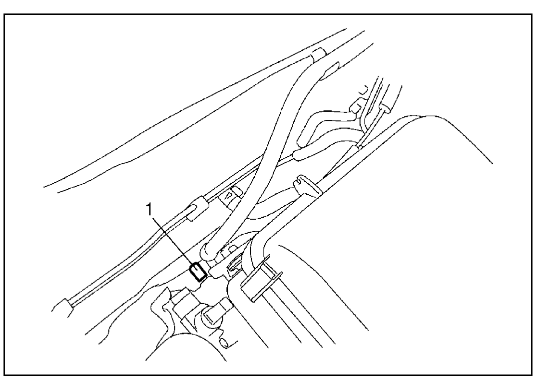
The engine vacuum that develops in the intake line is a good indicator of the condition of the engine. The vacuum checking procedure is as follows :

1) Warm up engine to normal operating temperature.

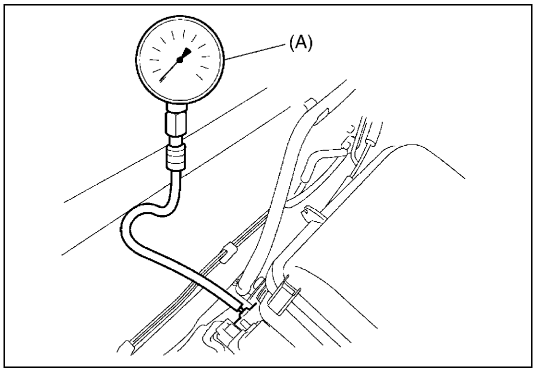
NOTE:

After warming up engine, be sure to place transmission gear shift lever in "Neutral" (shift selector lever to "P" range for A/T model), and set parking brake and block drive wheels.

2) Stop engine and turn off the all electric switches.



3) Remove cap (1) from intake manifold.



4) Connect special tool (Vacuum gauge) to intake manifold.

Special tool
(A) : 09915-67310

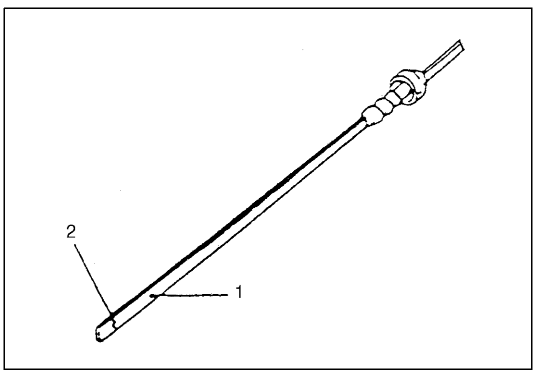
5) Run engine at specified idle speed and read vacuum gauge. Vacuum should be within specification.

Vacuum specification (at sea level)
: 59 – 73 kPa (45 – 55 cmHg, 17.7 – 21.6 inHg)
at specified idle speed

6) After checking, disconnect special tool (Vacuum gauge) from intake manifold.
7) Install cap to intake manifold.

OIL PRESSURE CHECK

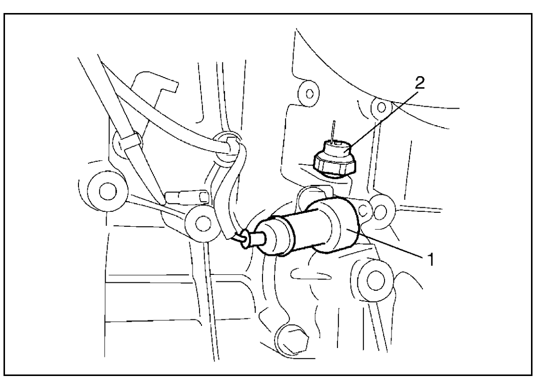
NOTE:
Prior to checking oil pressure, check the following items.



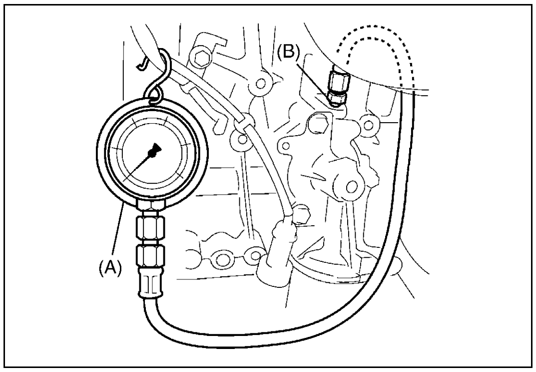
- Oil level in oil pan
  If oil level is low, add oil up to Full level mark (hole) on oil level gauge.

1.	Full level mark (hole)
2.	Low level mark (hole)

- Oil quality
  If oil is discolored, or deteriorated, change it.
  For particular oil to be used referring to the table in Section 0B.
- Oil leaks
  If leak is found, repair it.



1) Disconnect oil pressure switch coupler (1) and remove oil pressure switch (2) from cylinder block.



2) Install special tools (Oil pressure gauge) to vacated threaded hole.

Special tool
(A) : 09915-77310
(B) : 09915-78211

3) Start engine and warm it up to normal operating temperature.

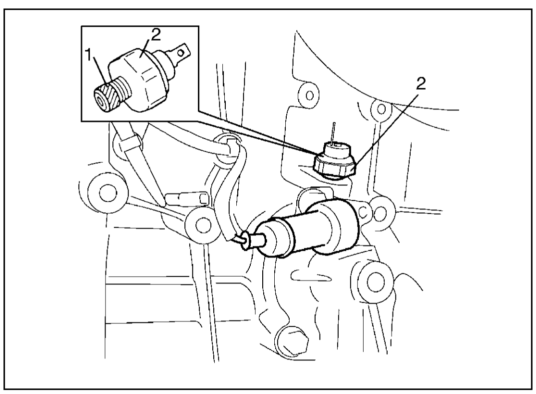
NOTE:

Be sure to place transmission gear shift lever in "Neutral" (shift selector lever to "P" range for A/T model), and set parking brake and block drive wheels.

4) After warming up, raise engine speed to 4,000 rpm and measure oil pressure.

Oil pressure specification
: 280 – 430 kPa (2.8 – 4.3 kg/cm^2, 39.8 – 61.1 psi) at 4,000 rpm

5) Stop engine and remove oil pressure gauge and attachment.

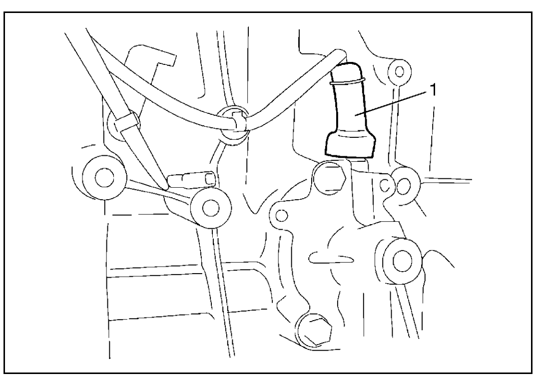


6) Before reinstalling oil pressure switch (2), be sure to wrap its screw threads with sealing tape (1) and tighten switch to specified torque.

NOTE:

If sealing tape edge is bulged out from screw threads of switch, cut it off.

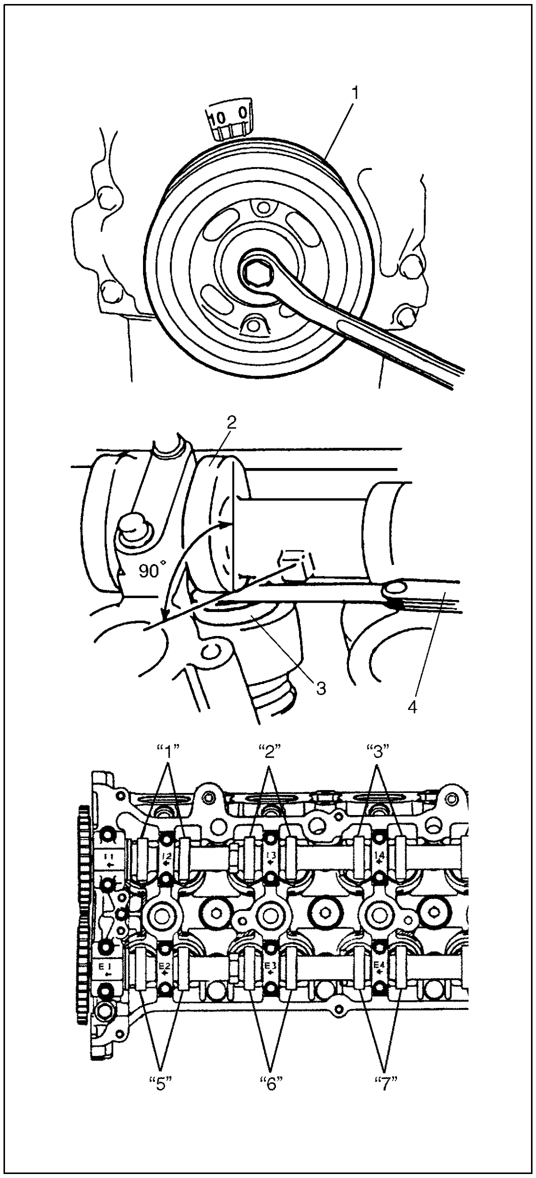
Tightening torque
Oil pressure switch (a) : 14 N·m (1.4 kg-m, 10.5 lb-ft)



7) Start engine and check oil pressure switch for oil leakage. If oil leakage is found, repair it.
8) Connect oil pressure switch coupler (1).

VALVE LASH (CLEARANCE)

INSPECTION



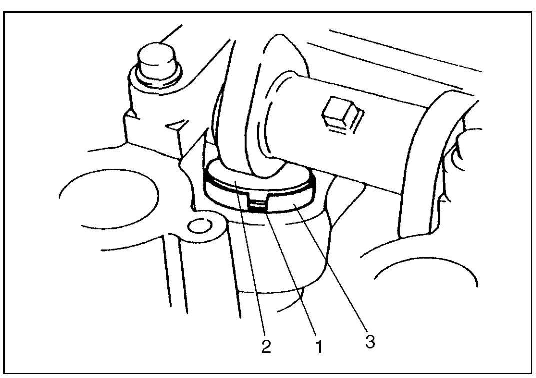
1) Remove negative cable at battery.
2) Remove cylinder head cover referring to "CYLINDER HEAD COVER".
3) Remove right side engine cover if necessary.
4) Using 17 mm wrench, turn crankshaft pulley (1) clockwise until cam lobes (2) become perpendicular to shim faces (3) at valves "1" and "7" as shown in figure.
5) Check valve lashes with thickness gauge (4) according to the following procedure.
   a) Check valve lashes at valves "1" and "7".
   b) Turn camshafts by 90° (by turning crankshaft with wrench).
   c) Make sure that cam lobes are perpendicular to shim faces at valves to be checked (in this case, "3" and "8"), if not, adjust it by turning crankshaft. Check valve lashes.
   d) In the same manner as b) – c), check valve lashes at valves "4" and "6".
   e) In the same manner as b) – c) again, check valve lashes at valves "2" and "5".

Valve clearance specification

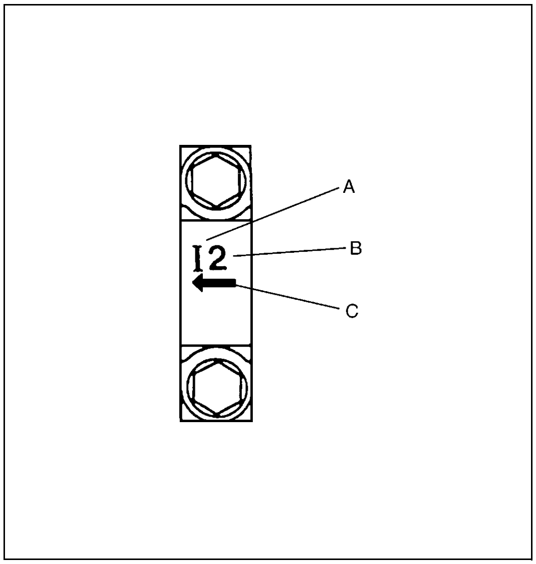
	When cold (Coolant temperature is 15 – 25°C (59 – 77°F))	When hot (Coolant temperature is 60 – 68°C (140 – 154°F))
Intake	0.18 – 0.22 mm (0.007 – 0.009 in.)	0.21 – 0.27 mm (0.008 – 0.011 in.)
Exhaust	0.28 – 0.32 mm (0.011 – 0.013 in.)	0.30 – 0.36 mm (0.012 – 0.014 in.)

If valve lash is out of specification, record valve lash and adjust it to specification by replacing shim.

REPLACEMENT OF SHIM



1) Close the valve whose shim (2) is to be replaced by turning crankshaft, then turn tappet (3) till its cut section (1) faces inside as shown in figure.
2) Lift down the it valve by turning crankshaft to 180°.
3) Hold tappet at that position using special tool as follows.
   a) Remove its housing bolts.

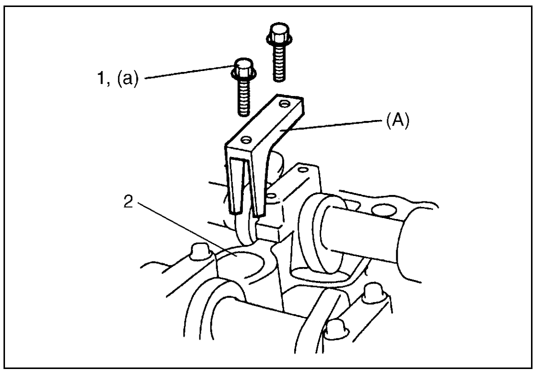


b) Check housing No. and select special tool corresponding to housing No., referring to “special tool selection table”.

Special tool selection table

No. on camshaft housing	Embossed mark on special tool
I2	IN2
I3, I4, I5	IN345
E2	EX2
E3, E4, E5	EX345

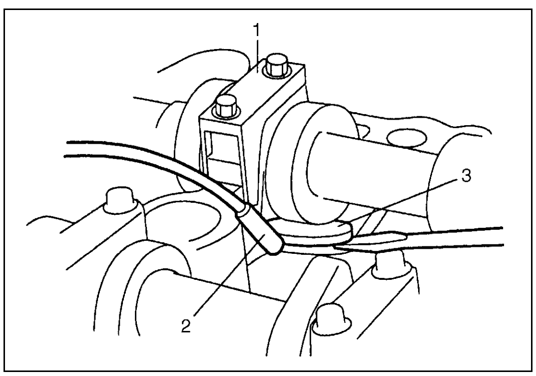
A:	I : Intake side or E : Exhaust side
B:	Position from timing chain side
C:	Pointing to timing chain side



c) Hold down the tappet so as not to hang to the shim with special tool by installing it on camshaft housing with housing bolt (1) to specified torque.

Special tool
(A) : 09916-67020

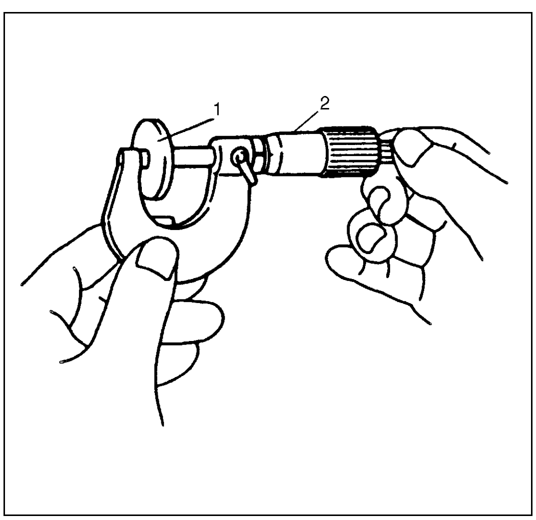
Tightening torque
Camshaft housing bolts (for tightening of special tool)
(a) : 8 N·m (0.8 kg-m, 6.0 lb-ft)



4) Turn camshaft by approximately 90° clockwise and remove shim (3).

WARNING:
Never put in the hand between cam shaft and tappet.

1.	Special tool
2.	Magnet



5) Using a micrometer (2), measure the thickness of the removed shim (1), and determine replacement shim by calculating the thickness of new shim with the following formula and table.

Intake side:
A = B + (C – 0.20 mm (0.008 in.))
Exhaust side:
A = B + (C – 0.30 mm (0.012 in.))

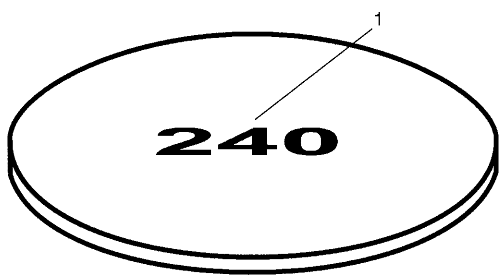
A : Thickness of new shim
B : Thickness of removed shim
C : Measured valve clearance

For example of intake side :

When thickness of removed shim is 2.40 mm (0.095 in.), and measured valve clearance is 0.45 mm (0.018 in.).

A = 2.40 mm (0.094 in.) + (0.45 mm (0.018 in.) – 0.20 mm (0.008 in.)) = 2.65 mm (0.104 in.)

Calculated thickness of new shim = 2.65 mm (0.104 in.)

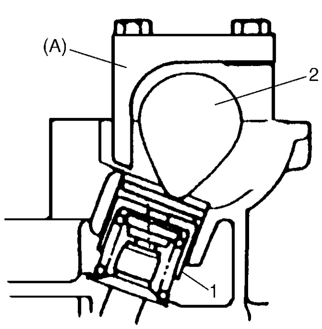


6) Select new shim No. (1) with a thickness as close as possible to calculated valve.

Available new shims No.

Thickness mm (in.)	Shim No.	Thickness mm (in.)	Shim No.
2.18 (0.0856)	218	2.68 (0.1055)	268
2.20 (0.0866)	220	2.70 (0.1063)	270
2.23 (0.0878)	223	2.73 (0.1075)	273
2.25 (0.0886)	225	2.75 (0.1083)	275
2.28 (0.0898)	228	2.78 (0.1095)	278
2.30 (0.0906)	230	2.80 (0.1102)	280
2.33 (0.0917)	233	2.83 (0.1114)	283
2.35 (0.0925)	235	2.85 (0.1122)	285
2.38 (0.0937)	238	2.88 (0.1134)	288
2.40 (0.0945)	240	2.90 (0.1142)	290
2.43 (0.0957)	243	2.93 (0.1154)	293
2.45 (0.0965)	245	2.75 (0.1161)	295
2.48 (0.0976)	248	2.98 (0.1173)	298
2.50 (0.0984)	250	3.00 (0.1181)	300
2.53 (0.0996)	253		
2.55 (0.1004)	255		
2.58 (0.1016)	258		
2.60 (0.1024)	260		
2.63 (0.1035)	263		
2.65 (0.1043)	265		

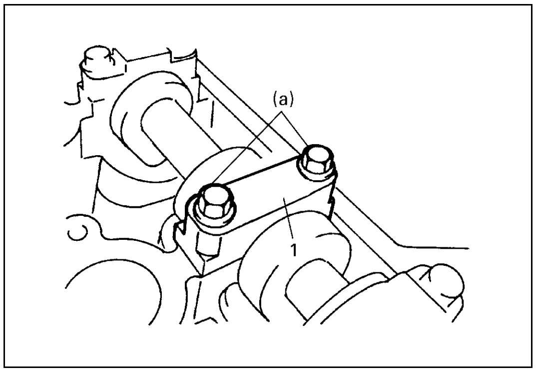
7) Install new shim facing shim No. side with tappet.



8) Lift valve by turning crankshaft counterclockwise (in opposite direction against above Step 4) and remove special tool.

Special tool
(A) : 09916-6702

1.	Tappet
2.	Camshaft



9) Install camshaft housing (1) and tighten bolts to specified torque.

Tightening torque
Camshaft housing bolt (a) : 11 N·m (1.1 kg-m, 8.0 lb-ft)

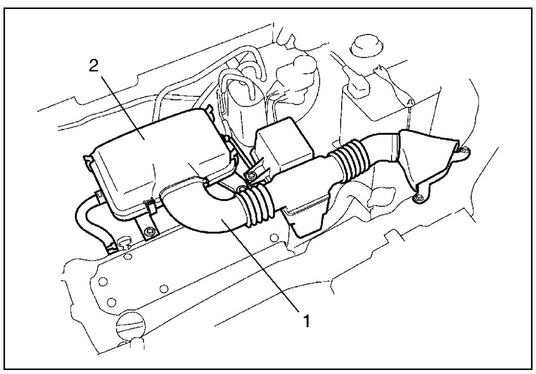
10) Check valve clearance again after adjusting it.

11) After checking and adjusting all valves.
12) Install cylinder head cover, referring to "CYLINDER HEAD COVER".

ON-VEHICLE SERVICE

AIR CLEANER ELEMENT

REMOVAL



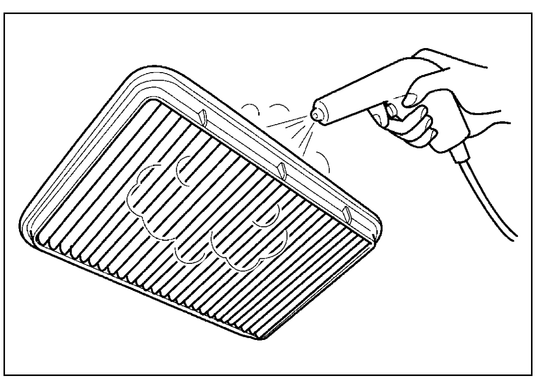
1) Disconnect air cleaner inlet hose (1) from air cleaner case (2).
2) Open air cleaner case by unhooking its clamps.
3) Remove air cleaner element from case.

INSTALLATION

Reverse removal procedure for installation.

INSPECTION AND CLEANING

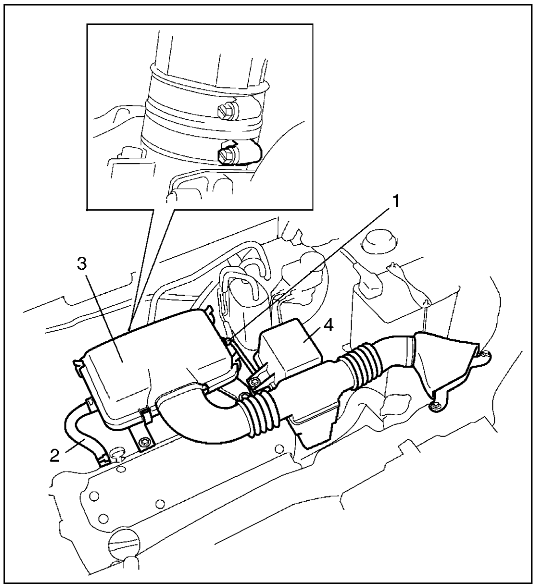
- Check air cleaner element for dirt. Replace excessively dirty element.
- Blow off dust by compressed air from air outlet side of element.



AIR CLEANER ASSEMBLY AND RESONATOR

REMOVAL

1) Disconnect negative cable at battery.



2) Disconnect IAT sensor coupler (1).
3) Disconnect breather hose (2) from cylinder head cover.
4) Remove air cleaner assembly (3), resonator (4) and their hoses.

INSTALLATION

Reverse removal procedure for installation.

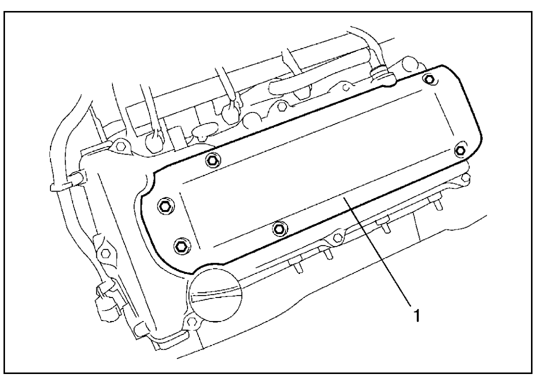
KNOCK SENSOR

Refer to "KNOCK SENSOR" in Section 6E.

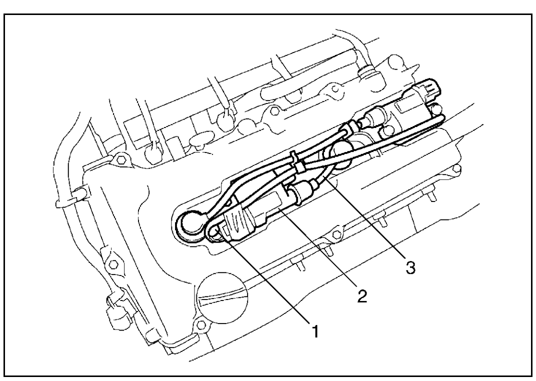
CYLINDER HEAD COVER

REMOVAL

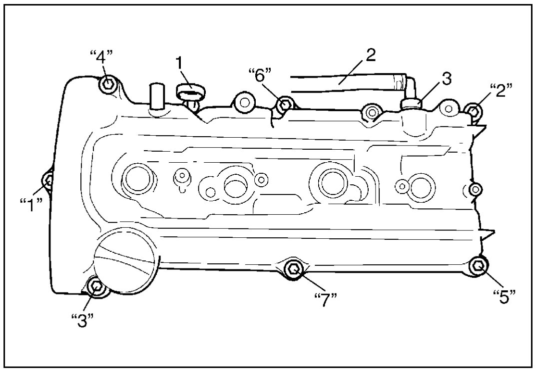
1) Disconnect negative cable at battery.
2) Remove air cleaner assembly, resonator and hoses by referring to "AIR CLEANER ASSEMBLY AND RESONATOR".



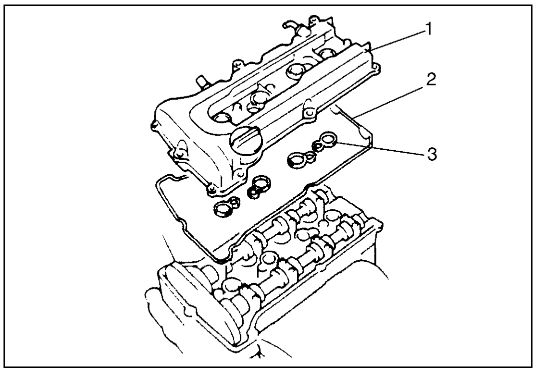
3) Remove cylinder head upper cover (1).



4) Disconnect ignition coil couplers (1).
5) Remove ignition coil assemblies (2) with high-tension cord (3).

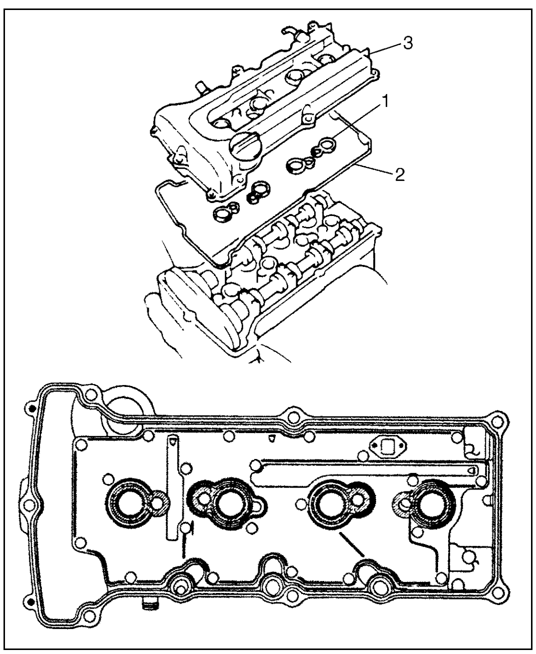


6) Remove oil level gauge (1).
7) Disconnect PCV hose (2) from PCV valve (3) and release harness clamp.
8) Remove cylinder head cover mounting bolts in such order as indicated in figure.

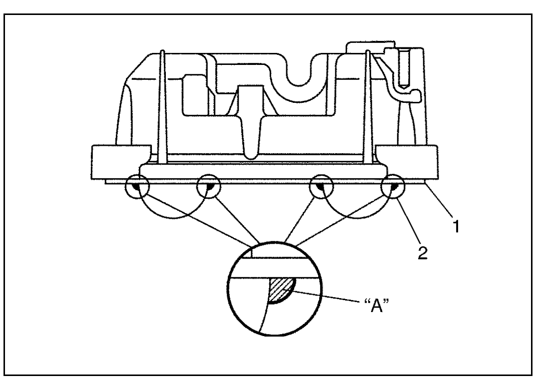


9) Remove cylinder head cover (1) with cylinder head cover gasket (2) and spark plug hole gasket (3).

INSTALLATION

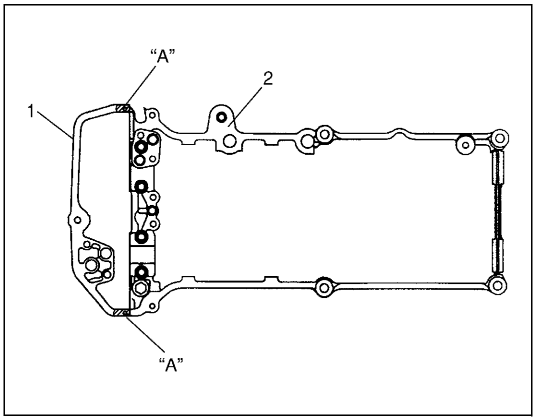


1) Install new spark plug hole gaskets (1) and new cylinder head cover gasket (2) to cylinder head cover (3) as shown in figure.
2) Remove oil, old sealant, and dust from sealing surface on cylinder head and cover. After cleaning, apply sealant "A" to the following point.



- Cylinder head gasket (1) sealing surface area (2) as shown.

"A" : Sealant 99000-31150



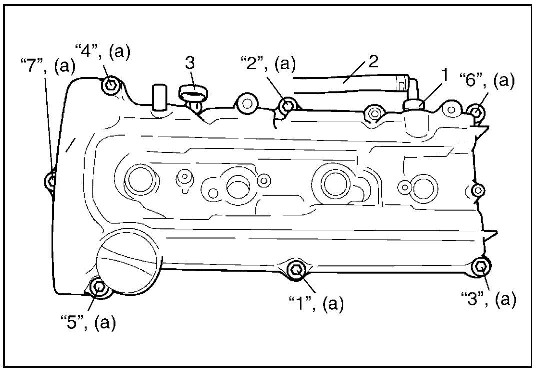
- Timing chain cover (1) and cylinder head (2) matching surface as shown.

"A" : Sealant 99000-31150

3) Install cylinder head cover to cylinder head.

NOTE:

When installing cylinder head cover, use care so that cylinder head cover gasket or spark plug hole gaskets will not get out of place or fall off.



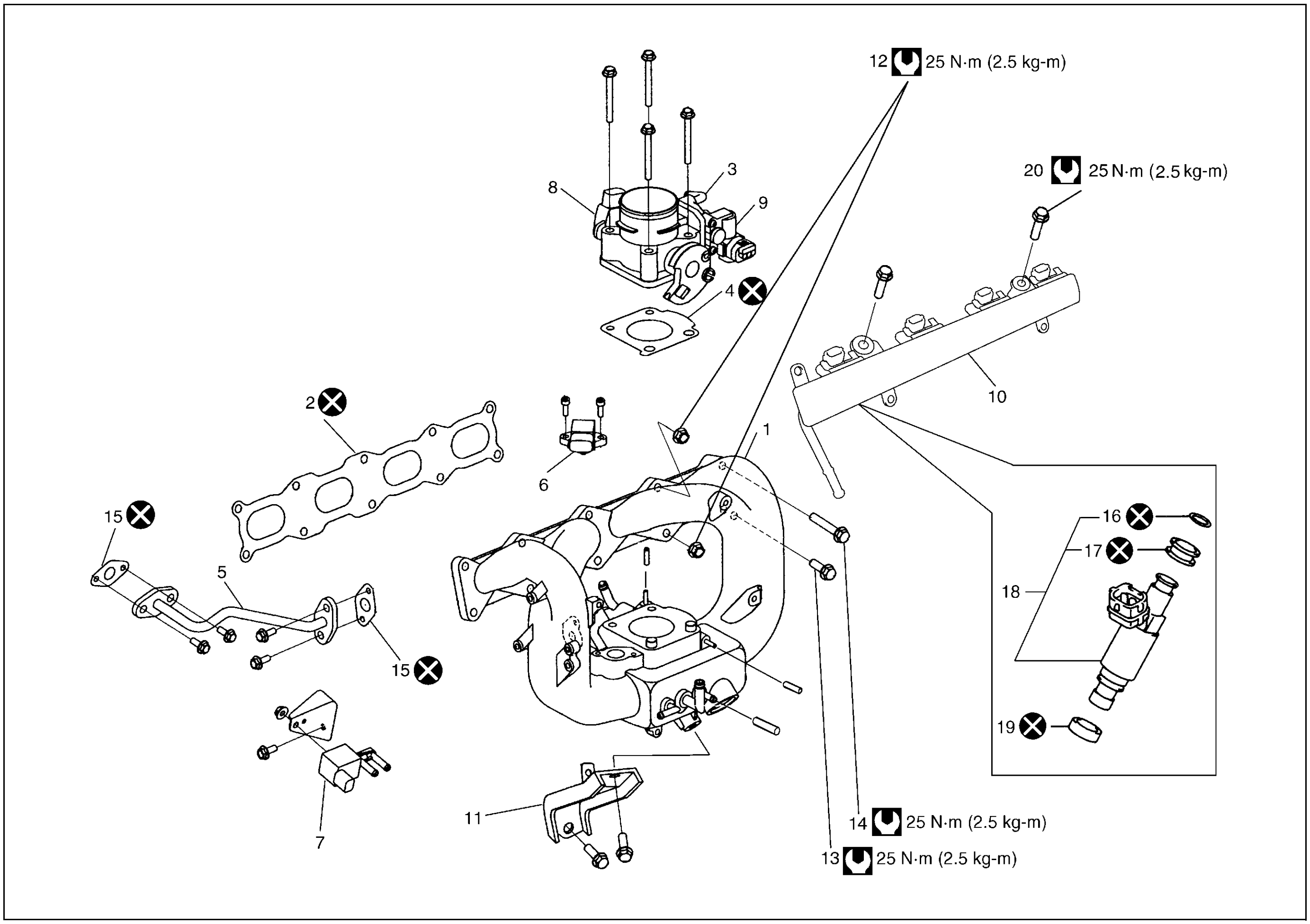
4) Tighten bolts in such order as indicated in figure a little at a time till they are tightened to specified torque.

Tightening torque
Cylinder head cover bolts (a) : 8 N·m (0.8 kg-m, 6.0 lb-ft)

5) Connect PCV hose (2) to PCV valve (1).
6) Install oil level gauge (3).

7) Install ignition coil assemblies with high-tension cord.
8) Connect ignition coil couplers and clamp harness securely.
9) Install cylinder head upper cover.
10) Install air cleaner assembly, resonator and hoses referring to "AIR CLEANER ASSEMBLY AND RESONATOR".
11) Connect negative cable at battery.

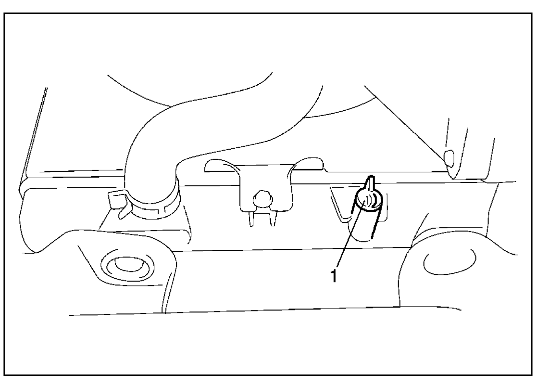
THROTTLE BODY AND INTAKE MANIFOLD



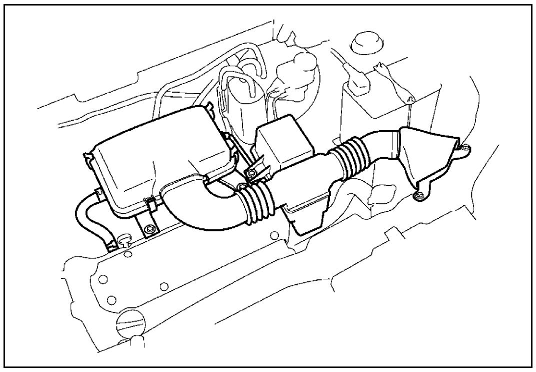
1. Intake manifold	7. EVAP canister purge valve	13. Intake manifold mounting bolt (short)	19. Cushion
2. Intake manifold gasket	8. TP sensor	14. Intake manifold mounting bolt (long)	20. Fuel delivery pipe mounting bolt
3. Throttle body	9. IAC valve	15. EGR pipe gasket	Tightening torque
4. Gasket	10. Fuel delivery pipe	16. O-Ring	Do not reuse.
5. EGR pipe	11. Intake manifold stiffener	17. Grommet	
6. MAP sensor	12. Intake manifold mounting nut	18. Injector assembly	

REMOVAL

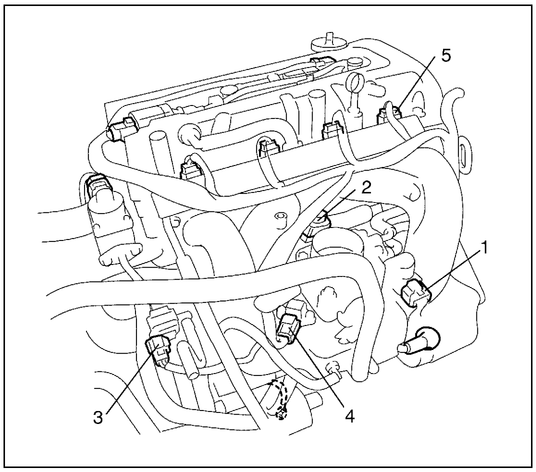
1) Relieve fuel pressure according to fuel pressure relief procedure described in Section 6.
2) Disconnect negative cable at battery.
3) Drain coolant by loosening drain plug (1).



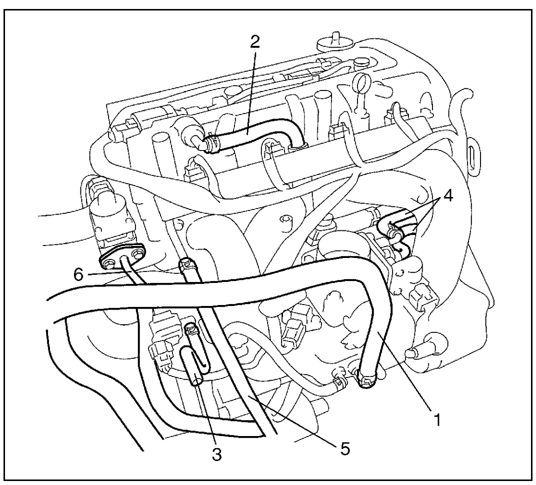
> **WARNING:**
> **To help avoid danger of being burned, do not remove drain plug (1) and radiator cap while engine and radiator are still hot. Scalding fluid and steam can be blown out under pressure if plug and cap are taken off too soon.**



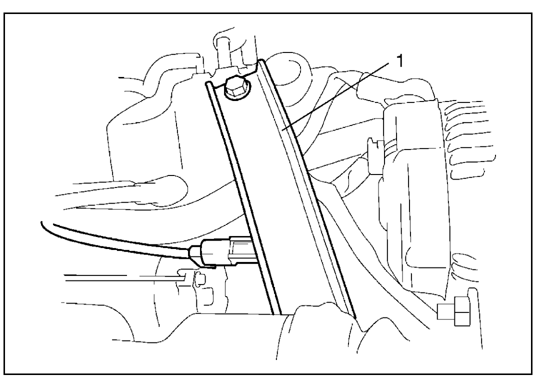
4) Remove air cleaner assembly, resonator and hoses by referring to “AIR CLEANER ASSEMBLY AND RESONATOR”.



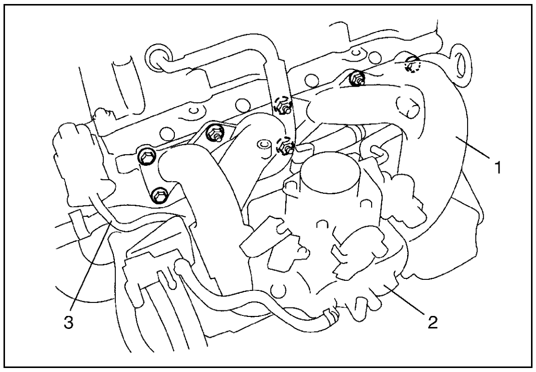
5) Disconnect the following electric lead wires :
   - IAC valve (1)
   - TP sensor (2)
   - EVAP canister purge valve (3)
   - MAP sensor (4)
   - Fuel injector wire harness at couplers (5)
   - Each wire harness clamps
6) Disconnect accelerator cable from throttle body.



7) Disconnect the following hoses :
   - Brake booster hose (1) from intake manifold
   - PCV hose (2) from PCV valve
   - Canister purge hose (3) from EVAP canister purge valve
   - Water hoses (4) from throttle body and thermostat case
   - Fuel feed hose (5) from fuel delivery pipe
8) Remove fuel delivery pipe with fuel injectors from cylinder head.
9) Disconnect EGR pipe (6) from EGR valve.



10) Remove intake manifold stiffener (1).

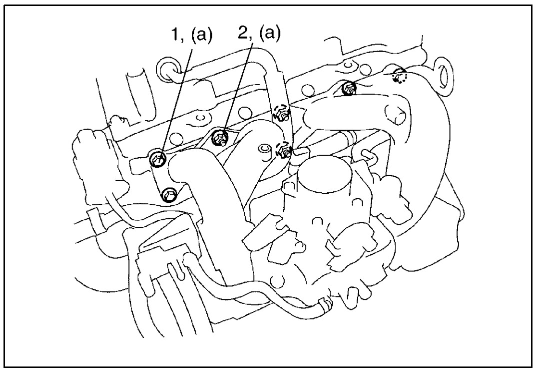


11) Remove intake manifold (1) with throttle body (2) and EGR pipe (3) from cylinder head, and then its gasket.

INSTALLATION

Reverse removal procedure for installation noting the followings.

- Use new intake manifold gasket and EGR pipe gasket.

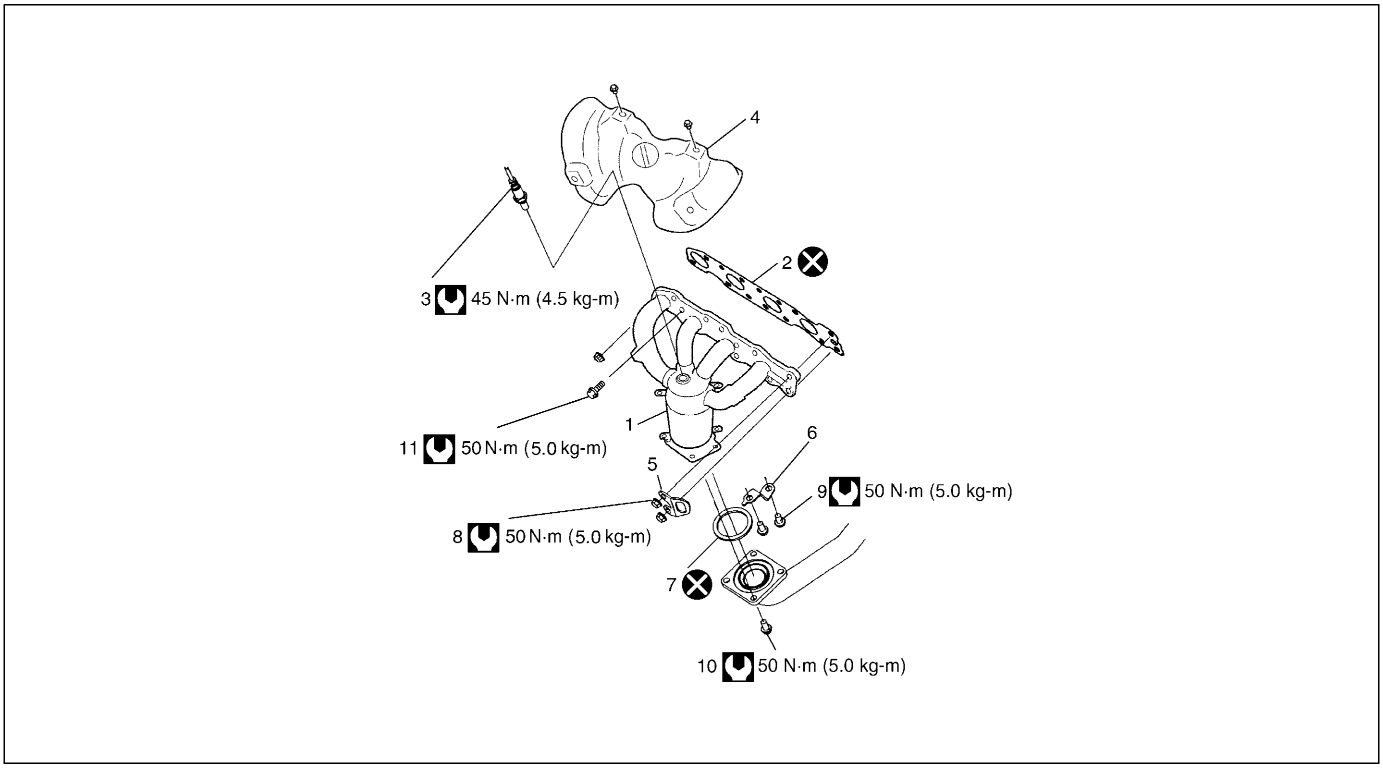


- Tighten bolts (1) and nuts (2) to specified torque.

Tightening torque
Intake manifold bolts and nuts
(a) : 25 N·m (2.5 kg-m, 18.0 lb-ft)

- Check to ensure that all removed parts are back in place. Reinstall any necessary parts which have not been reinstalled.
- Adjust accelerator cable play referring in Section 6E1.
- Refill cooling system referring in Section 6B.
- Upon completion of installation, turn ignition switch ON but engine OFF and check for fuel leaks.
- Finally, start engine and check for engine coolant leaks.

EXHAUST MANIFOLD

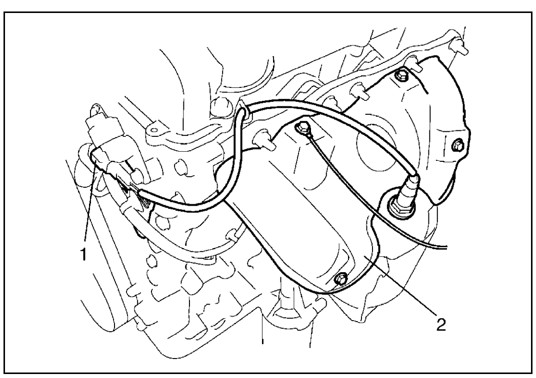


1. Exhaust manifold	6. Exhaust manifold stiffener	11. Exhaust manifold mounting bolt
2. Exhaust manifold gasket	7. Gasket	Tightening torque
3. Heated oxygen sensor (if equipped)	8. Exhaust manifold mounting nut	Do not reuse.
4. Exhaust manifold cover	9. Exhaust manifold stiffener bolt	
5. Engine hook	10. Exhaust pipe bolt	

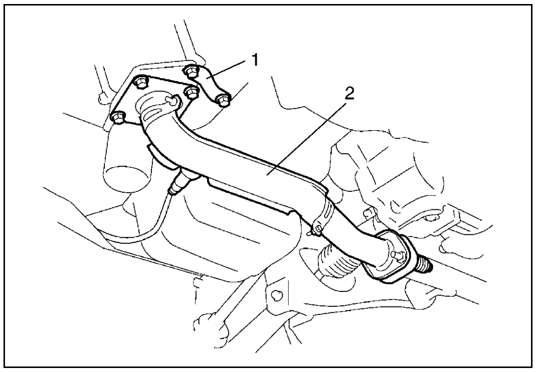
WARNING:
To avoid danger of being burned, do not service exhaust system while it is still hot. Service should be performed after system cools down.

REMOVAL

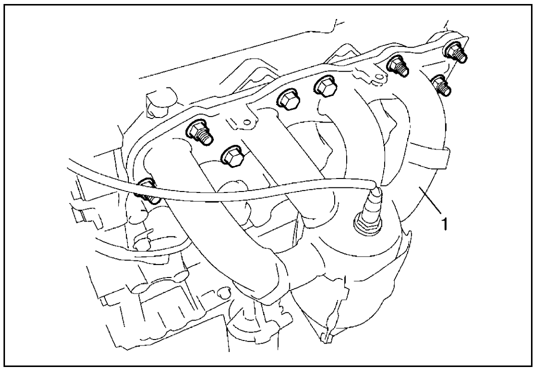
1) Disconnect negative cable at battery.



2) Disconnect heated oxygen sensor coupler (1) (if equipped) and detach it from its stay.
3) Remove front bumper with front grille and heat insulator panel by referring to Section 9.
4) Remove exhaust manifold cover (2).

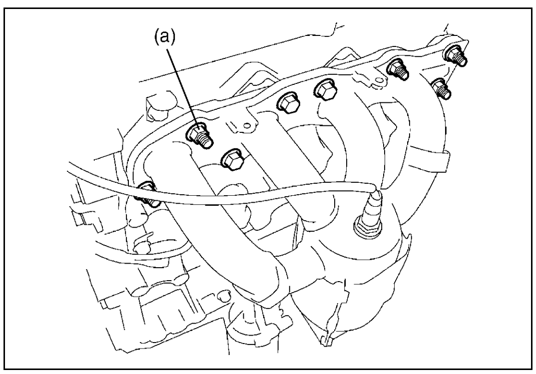


5) Remove exhaust manifold stiffener (1).
6) Disconnect exhaust No.1 pipe (2) from exhaust manifold.



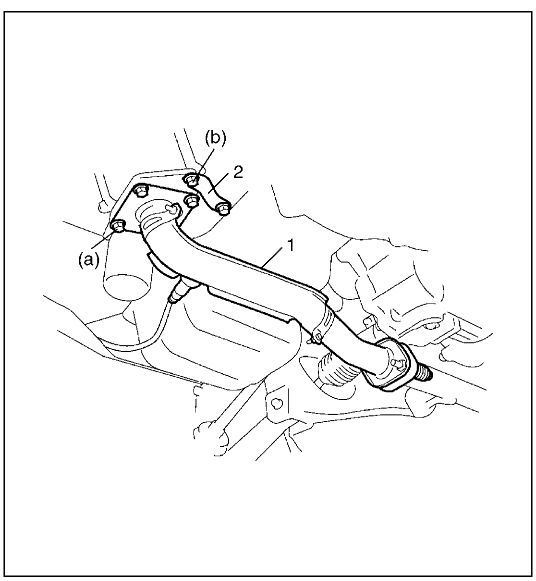
7) Remove exhaust manifold (1) and its gasket from cylinder head.

INSTALLATION



1) Install new gasket to cylinder head.
   Then install exhaust manifold.
   Tighten manifold bolts and nuts to specified torque.

Tightening torque
Exhaust manifold bolts and nuts
(a) : 50 N·m (5.0 kg-m, 40.0 lb-ft)

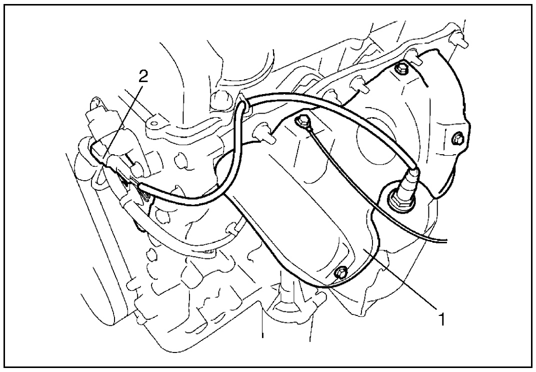


2) Install seal ring and connect exhaust No.1 pipe (1) to exhaust manifold.
   Before installing seal ring, check it for deterioration or damage, and replace as necessary.
   Tighten pipe fasteners to specified torque.

Tightening torque
Exhaust No.1 pipe bolts (a) : 50 N·m (5.0 kg-m, 36.5 lb-ft)

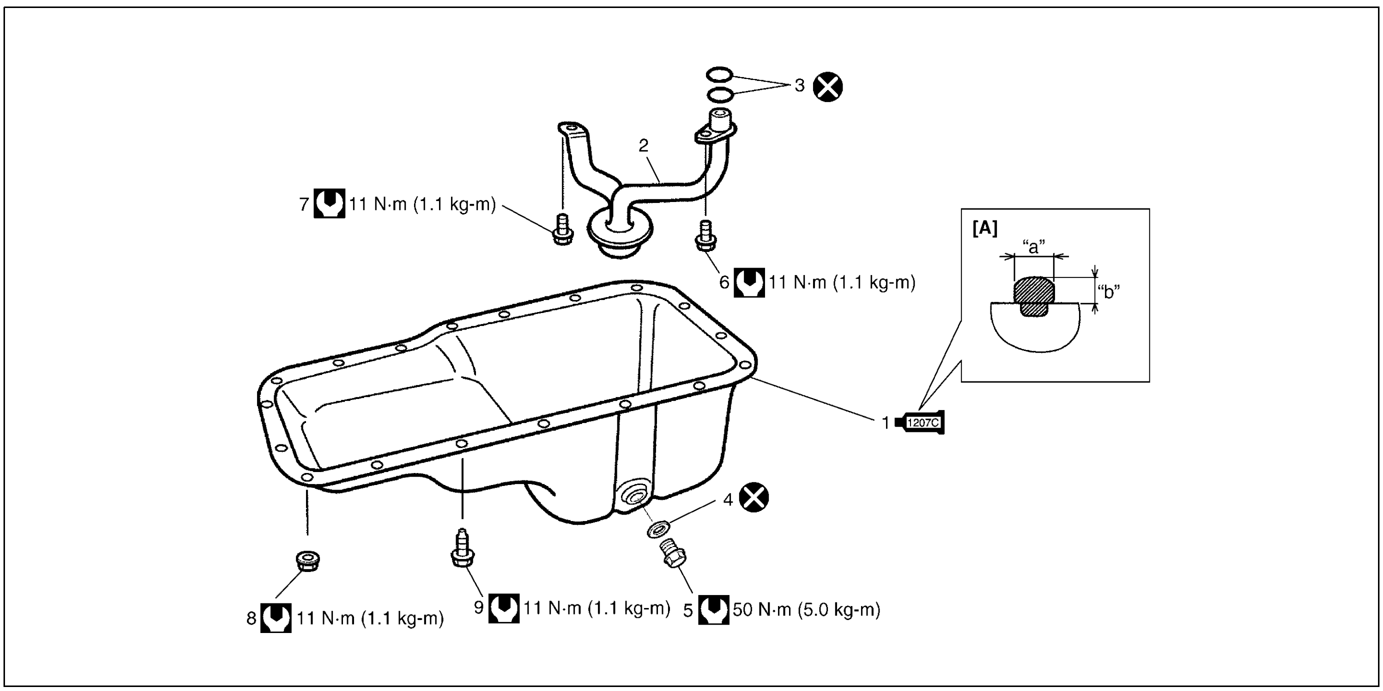
3) Install exhaust manifold stiffener (2).
   Tighten exhaust manifold stiffener bolts to specified torque.

Tightening torque
Exhaust manifold stiffener bolts
(b) : 50 N·m (5.0 kg-m, 36.5 lb-ft)



4) Install exhaust manifold cover (1) .
5) Connect heated oxygen sensor coupler (2) and fit coupler to bracket securely (if equipped).
6) Install heat insulator panel and front bumper with front grille by referring to Section 9.
7) Connect negative cable at battery.
8) Check exhaust system for exhaust gas leakage.

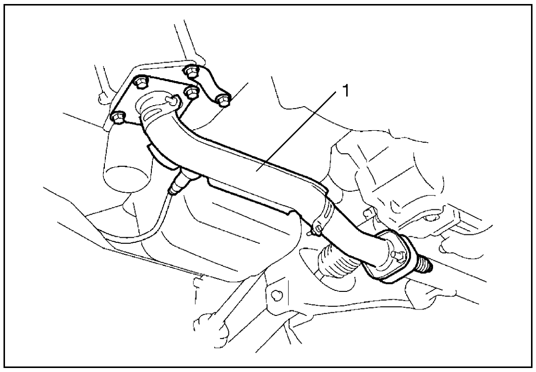
OIL PAN AND OIL PUMP STRAINER



[A] : Sealant application amount	3. O-ring	8. Oil pan nut
"a" : 3 mm (0.12 in.)	4. Gasket	9. Oil pan bolt
"b" : 2 mm (0.08 in.)	5. Drain plug	Tightening torque
1207C 1. Oil pan : Apply sealant 99000-31150 to mating surface.	6. Strainer bolt	Do not reuse.
2. Strainer	7. Bracket bolt	

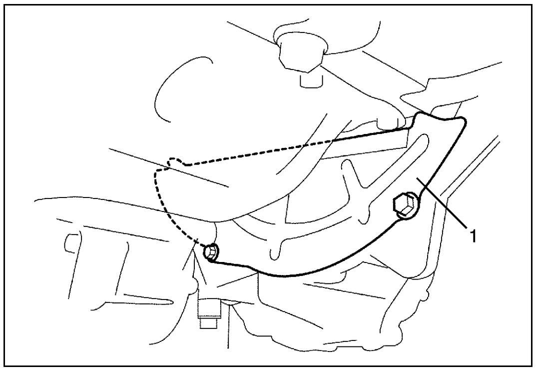
REMOVAL

1) Disconnect negative cable at battery.
2) Disconnect heated oxygen sensor coupler and detach it from its stay.
3) Remove oil level gauge.

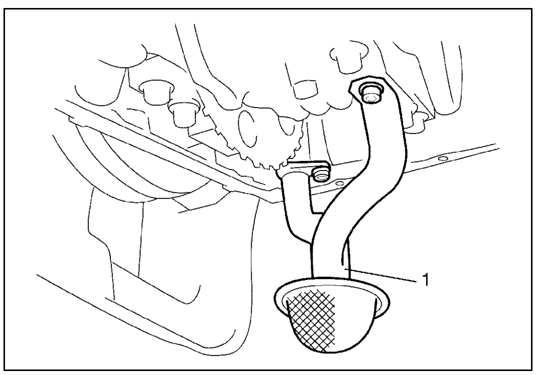


4) Remove exhaust No.1 pipe (1).

5) Drain engine oil by removing drain plug.

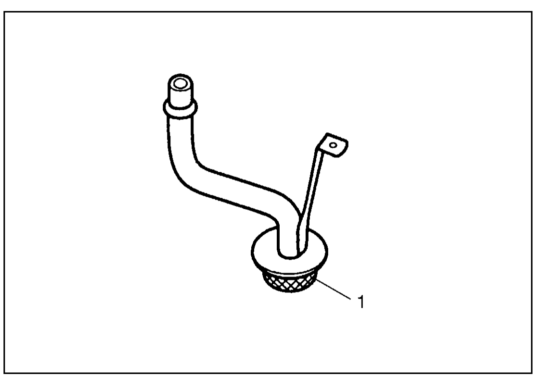


6) Remove clutch housing (torque converter housing for A/T vehicle) lower plate (1).
7) For 4WD vehicle, remove transfer referring to Section 7D.

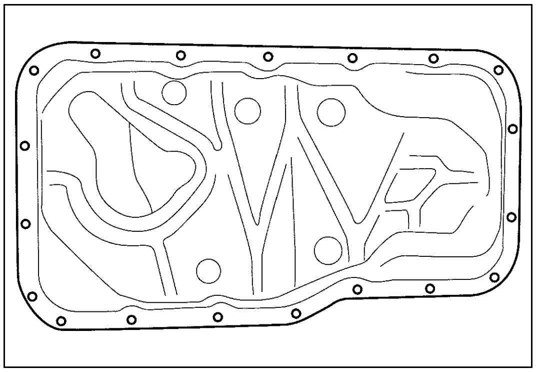


8) Remove oil pan and then oil pump strainer (1) from cylinder block.

CLEAN

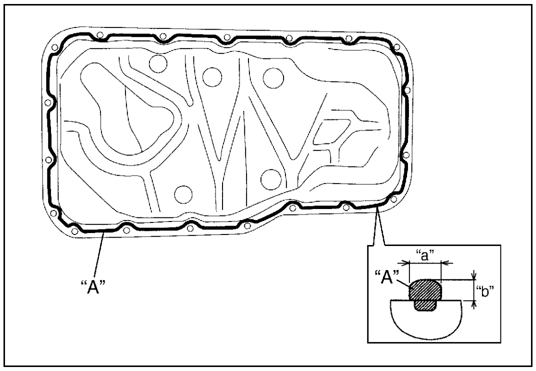


- Clean oil pump strainer screen (1).



- Clean sealing surface on oil pan and cylinder block. Remove oil, old sealant and dust from sealing surface.

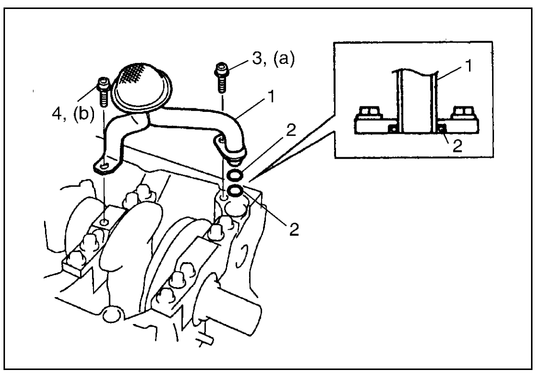
INSTALLATION



1) Apply sealant continuously to oil pan mating surface as shown in figure.

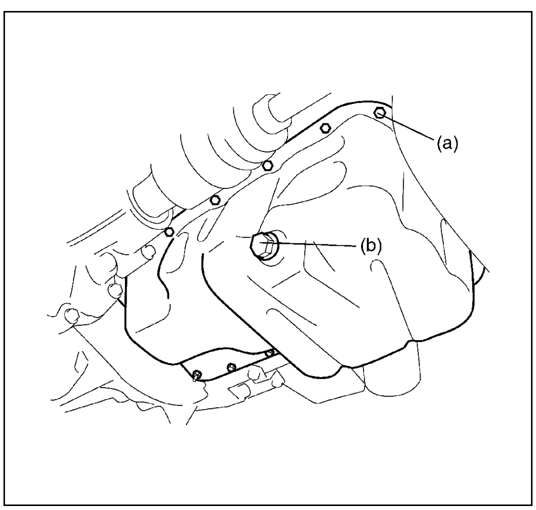
"A" : sealant 99000-31150

Sealant amount for oil pan
Width "a" : 3 mm (0.12 in.)
Height "b" : 2 mm (0.08 in.)



2) Install new O-rings (2) in the position as shown in figure and install oil pump strainer (1).
   Tighten strainer bolt (3) first and then bracket bolt (4) to specified torque.

Tightening torque
Oil pump strainer bolt (a) : 11 N·m (1.1 kg-m, 8.0 lb-ft)
Oil pump strainer bracket bolt
(b) : 11 N·m (1.1 kg-m, 8.0 lb-ft)

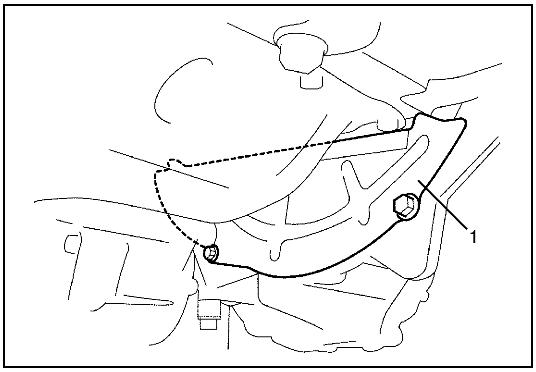


3) After fitting oil pan to cylinder block, run in securing bolts and start tightening at the center :
   move wrench outward, tightening one bolt at a time. Tighten bolts and nuts to specified torque.

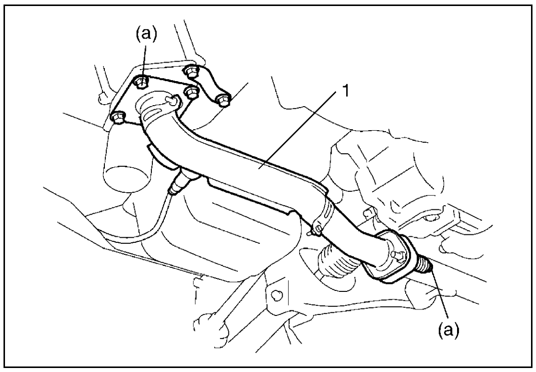
Tightening torque
Oil pan bolts and nuts (a) : 11 N·m (1.1 kg-m, 8.0 lb-ft)

4) Install new gasket and drain plug to oil pan.
   Tighten drain plug to specified torque.

Tightening torque
Oil pan drain plug bolt (b) : 50 N·m 5.0 kg-m, 36.5 lb-ft)



5) Install clutch housing (torque converter housing for A/T vehicle) lower plate (1).
6) For 4WD vehicle, install transfer by referring to Section 7D.

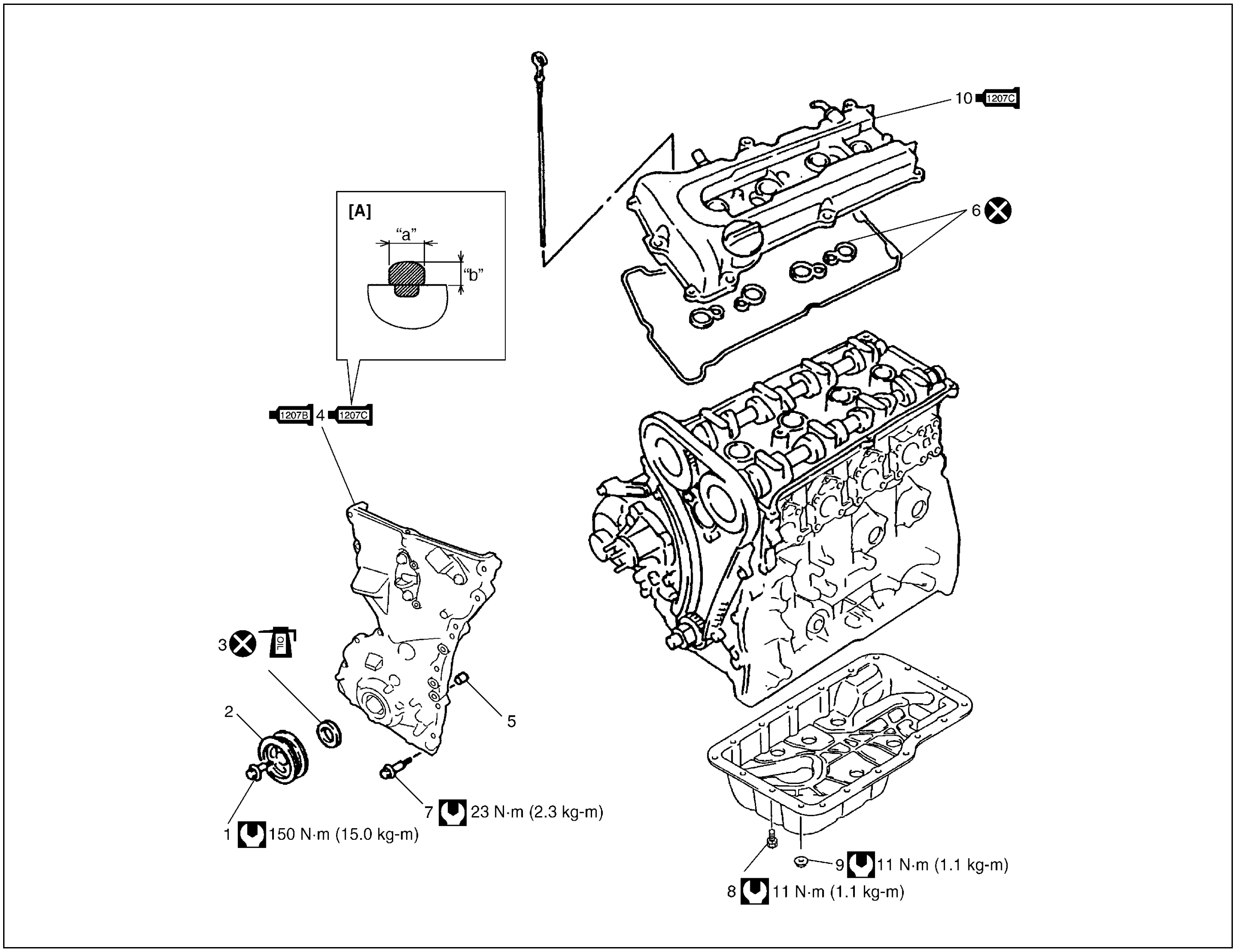


7) Install exhaust No.1 pipe (1).
   Tighten bolts to specified torque.

Tightening torque
Exhaust No.1 pipe bolts (a) : 50 N·m 5.0 kg-m, 36.5 lb-ft)

8) Install oil level gauge.
9) Refill engine with engine oil referring to “ENGINE OIL CHANGE” in Section 0B.
10) Verify that there is no engine oil leakage and exhaust gas leakage at each connection.

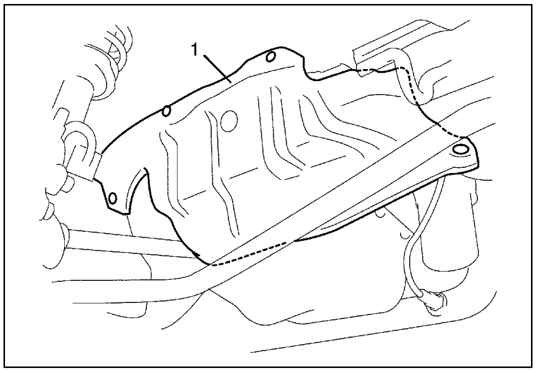
TIMING CHAIN COVER



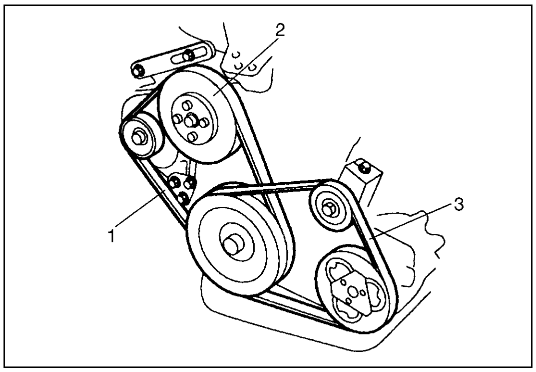
[A] : Sealant application amount	OIL 3. Oil seal : Apply engine oil to oil seal lip.		8. Oil pan mounting bolt
"a" : 3 mm (0.12 in.)	1207B 1207C 4. Timing chain cover : Apply sealant 99000-31140 to the mating surface of cylinder and cylinder head. : Apply sealant 99000-31150 to the mating surface of timing chain cover referring to the figure of Step 1) in INSTALLATION.		9. Oil pan mounting nut
"b" : 2 mm (0.08 in.)	5. Pin	1207C	10. Cylinder head cover : Apply sealant 99000-31150 to the sealing point for timing chain cover mating surface and cylinder head gasket sealing point. Refer to "CYLINDER HEAD COVER INSTALLATION".
1. Crankshaft pulley bolt	6. Cylinder head gasket		Tightening torque
2. Crankshaft pulley	7. Timing chain cover mounting bolts		Do not reuse.

REMOVAL

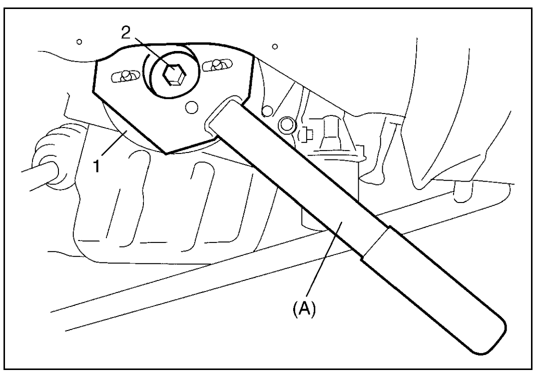
1) Disconnect negative cable at battery.
2) Disconnect the following electric lead wires, and remove these connector bracket.
   - CMP sensor
   - Heated oxygen No.1 and No.2 sensors
   - Engine oil pressure switch



3) Remove right side engine under cover (1).

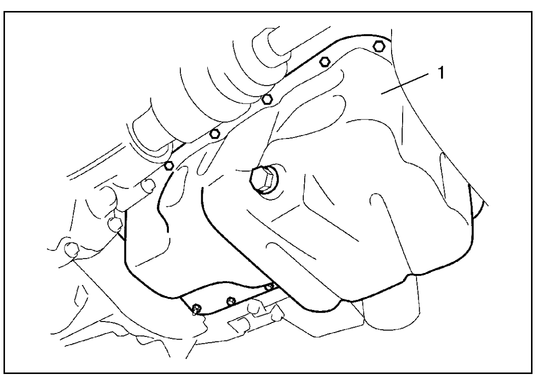


4) Remove A/C compressor belt (3) (if equipped).
5) Remove water pump belt (1).
6) Remove water pump pulley (2).
7) Drain engine oil.



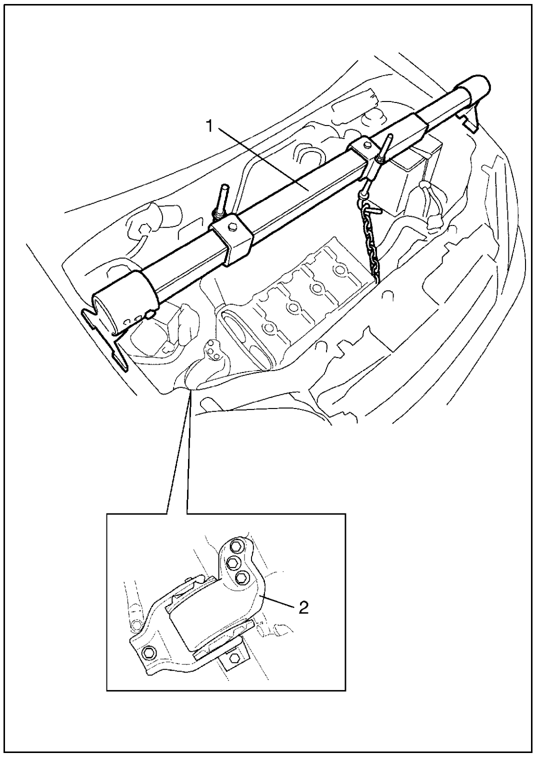
8) Remove crankshaft pulley bolt (2).
   To lock crankshaft pulley (1), use special tool with it as shown in figure.

Special tool
(A) : 09917-68221

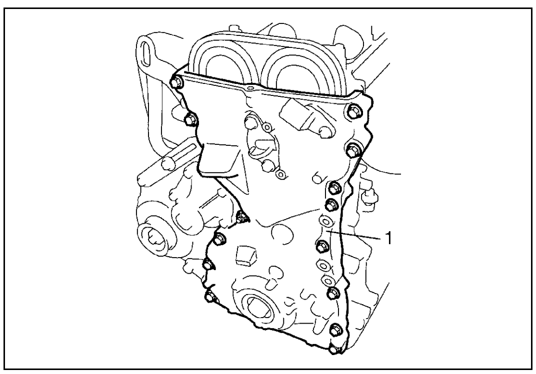


9) Remove oil pan (1) referring to “OIL PAN AND OIL PUMP STRAINER”.

10) Remove cylinder head cover referring to “CYLINDER HEAD COVER”.



11) Support engine with supporting device (1).
12) Remove engine right side mounting (2) with bracket from timing chain cover and body.

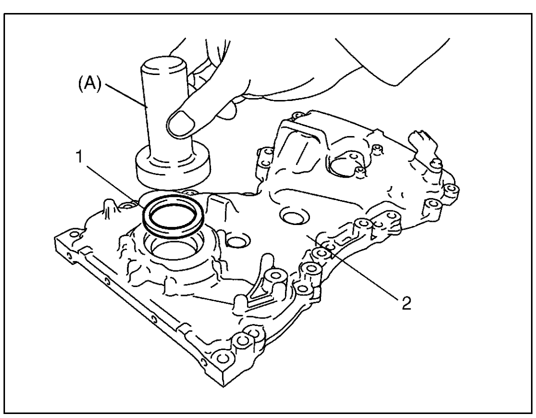


13) Remove timing chain cover (1).

CLEAN

- Clean sealing surface on timing chain cover, cylinder block and cylinder head.
  Remove oil, old sealant and dust from sealing surface.

INSPECTION



- Check oil seal (1) lip for fault or other damage.
  Replace as necessary.

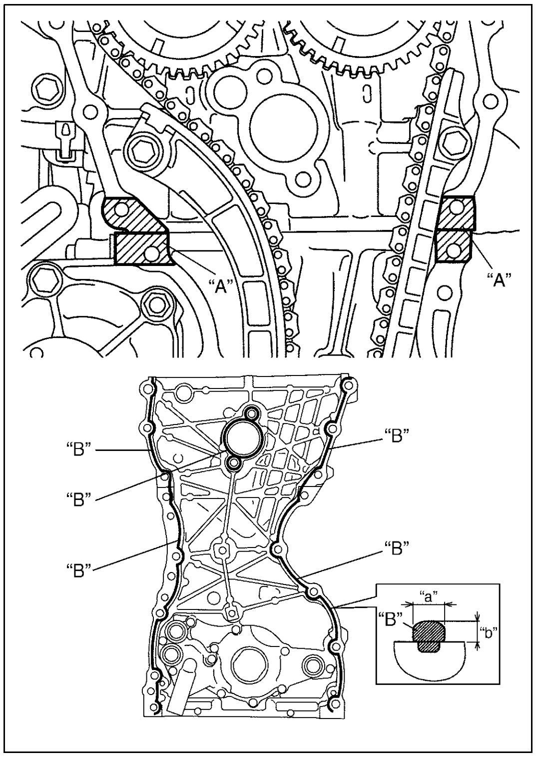
NOTE:

When installing new oil seal, tap it in until its surface is flash with edge of timing chain cover (2).
To install oil seal, use special tool (Bearing installer).

Special tool
(A) : 09913-75520

INSTALLATION

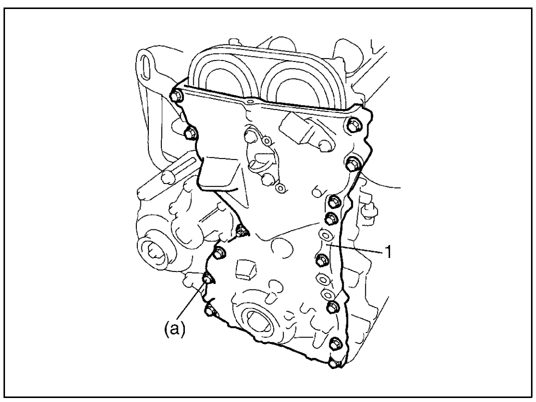
Reverse removal procedure to install timing chain cover, noting the following points.



1) Apply sealant "A" to mating surface of cylinder and cylinder head and "B" to mating surface of timing chain cover as shown in figure.

"A" : Sealant 99000-31140
"B" : Sealant 99000-31150

Sealant amount for timing chain cover
Width "a" : 3 mm, 0.12 in.
Height "b" : 2 mm, 0.08 in.

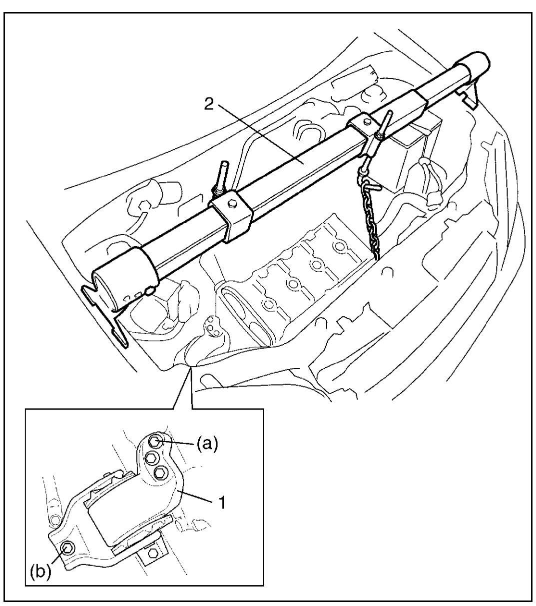


2) Apply engine oil to oil seal lip, then install timing chain cover (1).
   Tighten bolts and nut to specified torque.

NOTE:

Before installing timing chain cover, check that pin is securely fitted.

Tightening torque
Timing chain cover bolts (a) : 23 N·m (2.3 kg-m, 17.0 lb-ft)

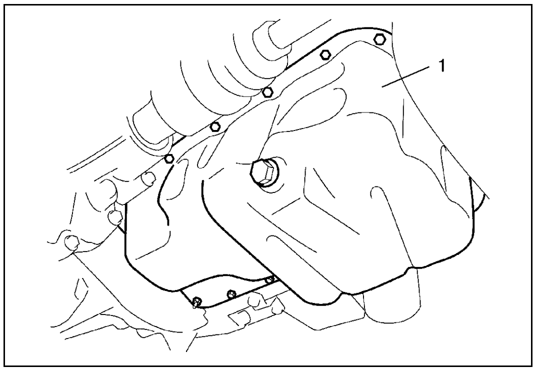


3) Install engine right mounting (1) with bracket to timing chain cover and body.
   Tighten bolts to specified torque.

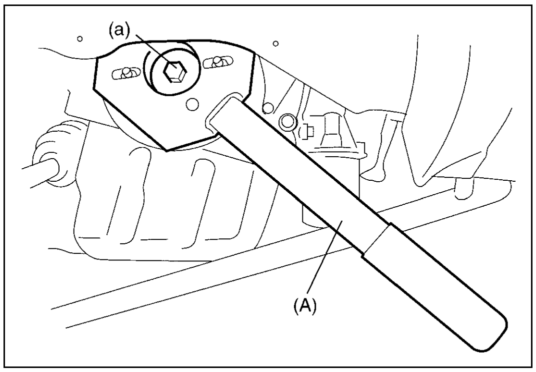
Tightening torque
Engine mounting bolt (a) : 75 N·m (7.5 kg-m, 54.5 lb-ft)
Engine mounting bracket bolt
(b) : 55 N·m (5.5 kg-m, 40.0 lb-ft)

4) Remove support device (2).

5) Install cylinder head cover referring to “CYLINDER HEAD COVER”.



6) Install oil pan (1) referring to “OIL PAN AND OIL PUMP STRAINER”.



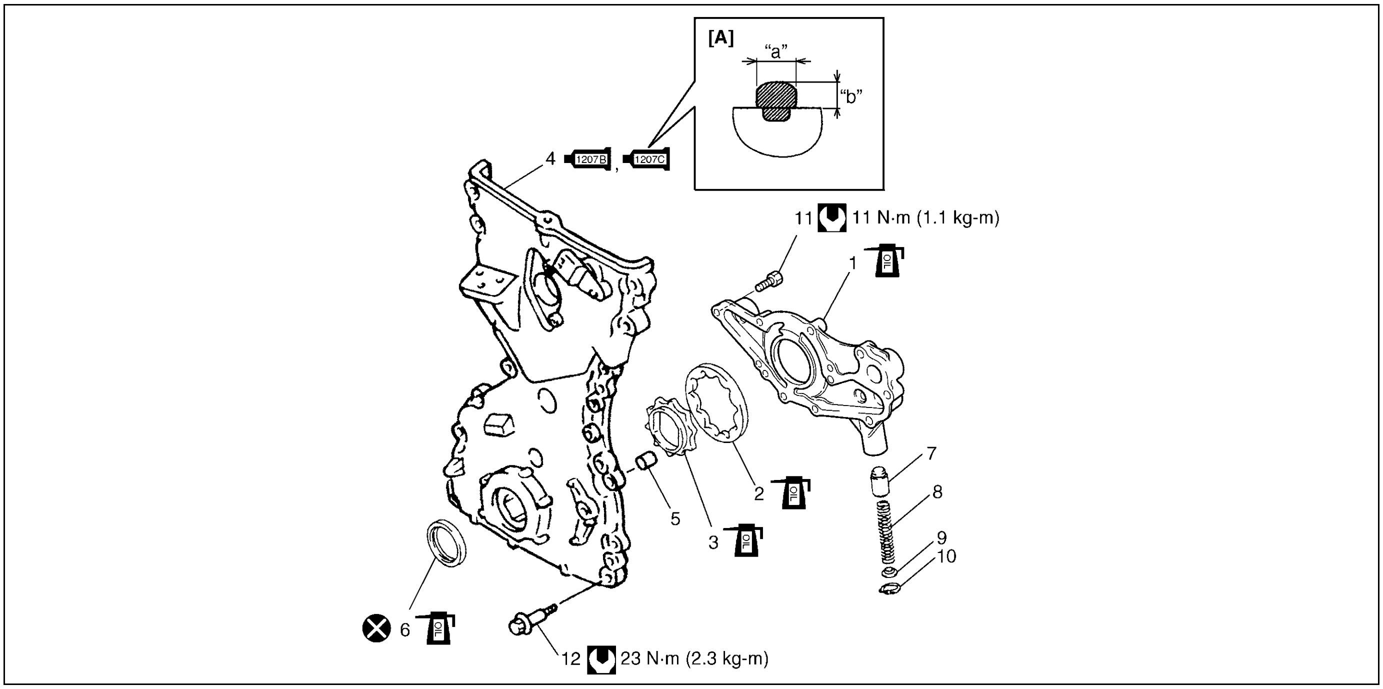
7) Install crankshaft pulley (1). Tighten bolt (2) to specified torque. To lock crankshaft pulley, use special tool with it as shown in the figure.

Special tool
(A) : 09917-68221

Tightening torque
Crankshaft pulley bolt (a) : 150 N·m (15.0 kg-m, 108.5 lb-ft)

8) Adjust water pump belt tension referring to Section 0B for adjusting procedure.
9) Adjust A/C compressor belt tension (if equipped) referring to Section 1B for adjusting procedure.
10) Install right side engine under cover.
11) Connect disconnected electric lead wires securely.
12) Refill engine with engine oil.
13) Verify that there is no oil leakage and exhaust gas leakage at each connection.

OIL PUMP

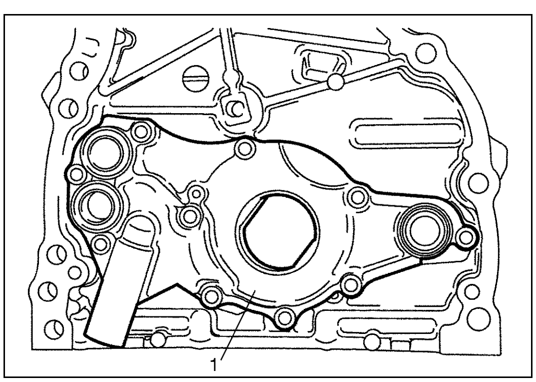


[A] : Sealant application amount	1207B 1207C 4. Timing chain cover : Apply sealant 99000-31140 to the mating surface of cylinder and cylinder head. : Apply sealant 99000-31150 to mating surface of timing chain cover referring to the figure of Step 1) in "TIMING CHAIN COVER INSTALLATION".	10. Circlip
"a" : 3 mm (0.12 in.)	5. Pin	11. Oil pump mounting bolt
"b" : 2 mm (0.08 in.)	6. Oil seal	12. Timing chain cover mounting bolts
1. Rotor plate	7. Relief valve	Tightening torque
2. Outer rotor	8. Spring	Do not reuse.
3. Inner rotor	9. Retainer	Apply thin coat of engine oil to sliding surface of each parts.

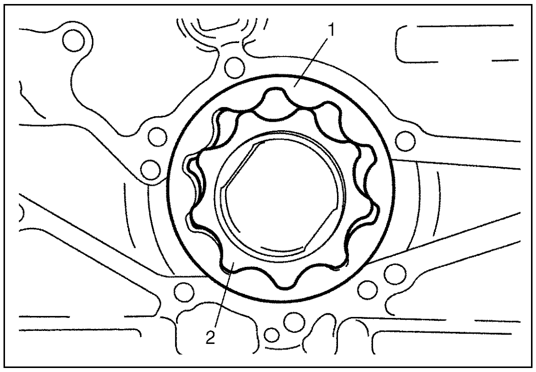
REMOVAL

1) Disconnect negative cable at battery.
2) Remove timing chain cover, referring to "TIMING CHAIN COVER".

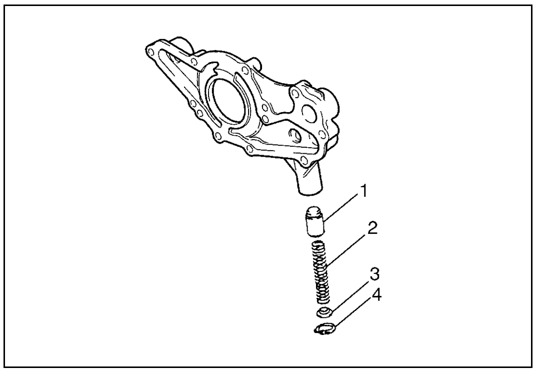
DISASSEMBLY



1) Remove rotor plate (1) by removing its mounting bolts.

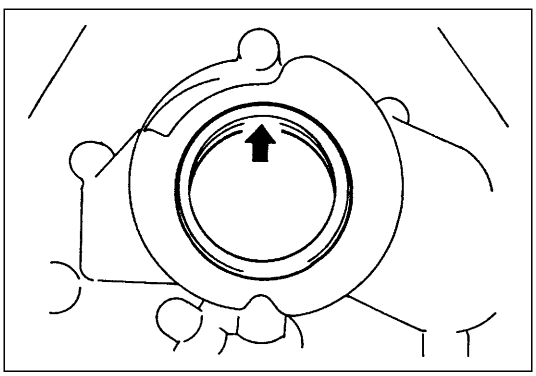


2) Remove outer rotor (1) and inner rotor (2).

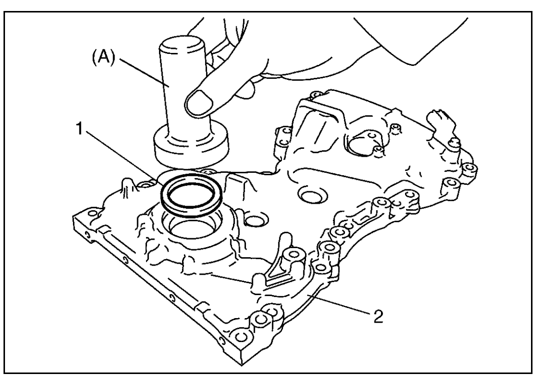


3) Remove relief valve (1), spring (2) and retainer (3) by removing circlip (4).

INSPECTION



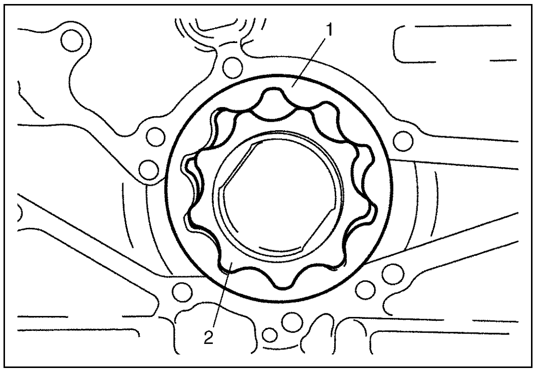
- Check oil seal lip for fault or other damage. Replace as necessary.



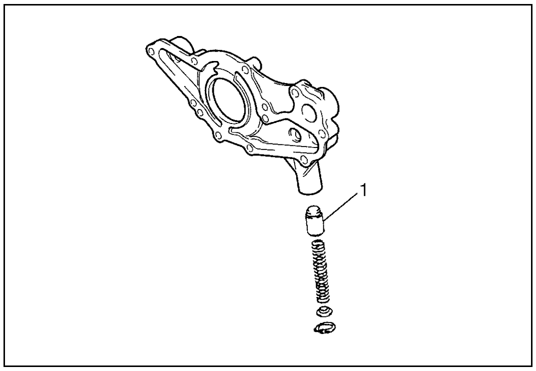
NOTE:

When installing new oil seal (1), press-fit it till its end face is flush with oil pump case (2) end face.

Special tool
(A) : 09913-75520



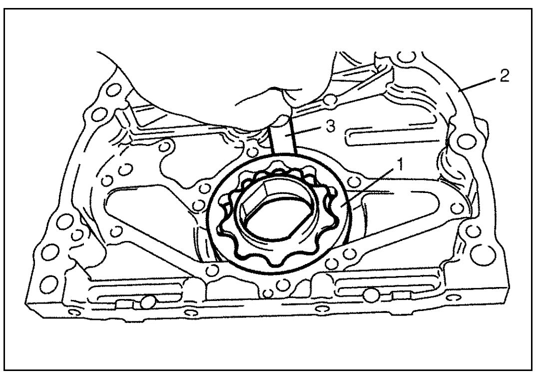
- Check outer (1) and inner rotors (2), rotor plate, and oil pump case for excessive wear or damage.



- Check relief valve (1) for excessive wear or damage and operates smoothly.

MEASUREMENT

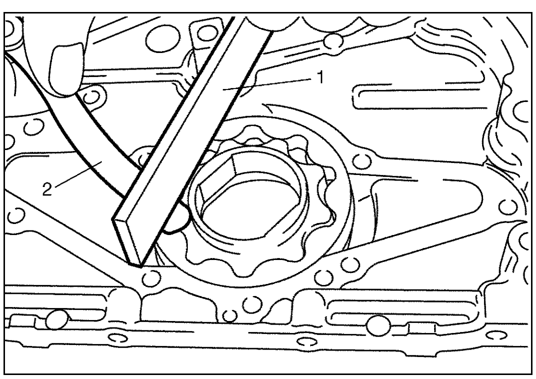
Radial Clearance



Check radial clearance between outer rotor (1) and case (2), using thickness gauge (3).
If clearance exceeds its limit, replace outer rotor or case.

Limit on radial clearance between outer rotor and case for oil pump
: 0.310 mm (0.0122 in.)

Side Clearance

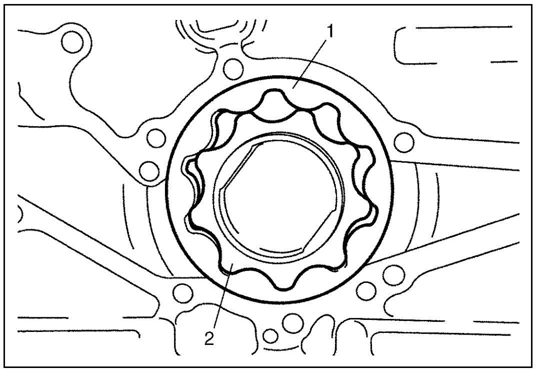


Using straight edge (1) and thickness gauge (2), measure side clearance.

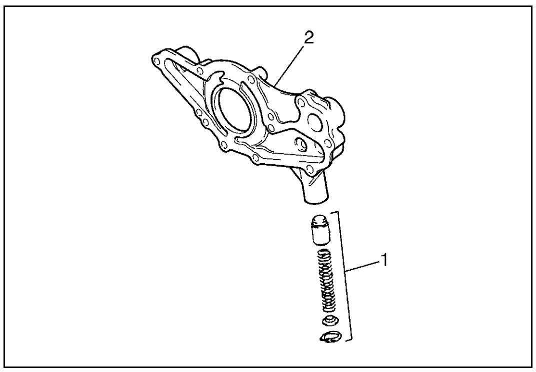
Limit on side clearance for oil pump inner rotor
: 0.15 mm (0.0059 in.)

ASSEMBLY

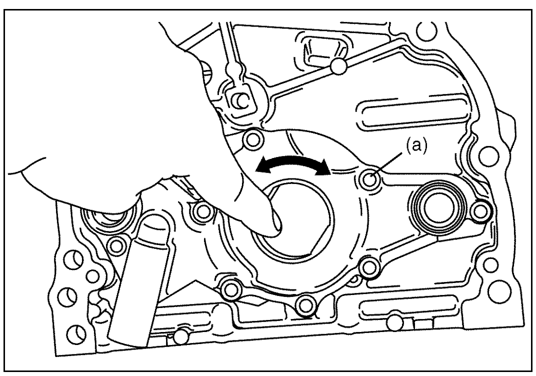
1) Wash, clean and then dry all disassembled parts.
2) Apply thin coat of engine oil to inner and outer rotors, oil seal lip portion, and inside surfaces of oil pump case and plate.



3) Install outer (1) and inner rotors (2) to oil pump case.



4) Install relief valve component (1) to rotor plate (2).



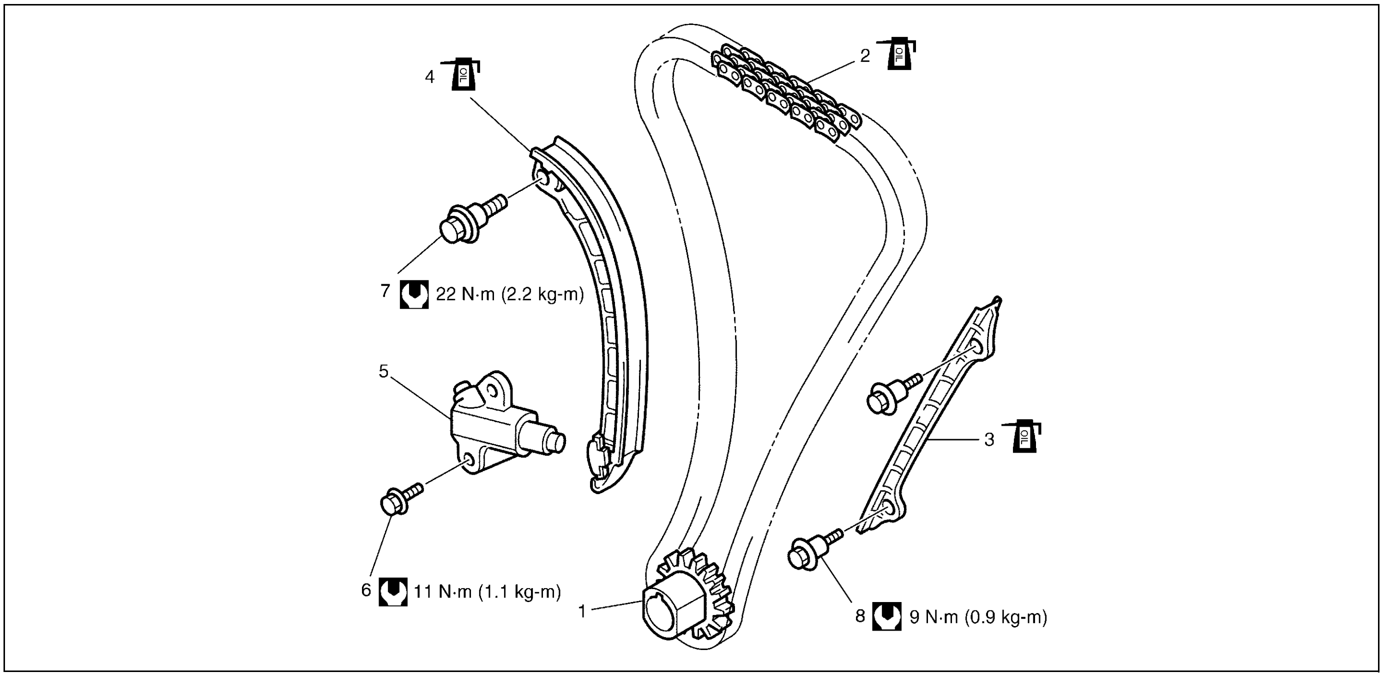
5) Install rotor plate and tighten all bolts to specified torque. After installing plate, check to be sure that rotors turn smoothly by hand (0.3 N·m (0.03 kg-m, 0.25 lb-ft) torque or below).

Tightening torque
Oil pump rotor plate bolts (a) : 11 N·m (1.1 kg-m, 8.0 lb-ft)

INSTALLATION

For installation referring to “TIMING CHAIN COVER”.

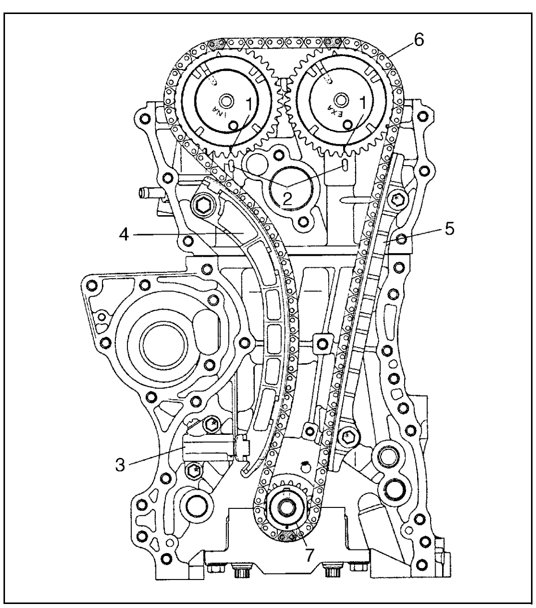
TIMING CHAIN AND CHAIN TENSIONER



1. Crankshaft timing sprocket	4. Timing chain tensioner : Apply engine oil to sliding surface.	7. Chain tensioner mounting bolt
2. Timing chain : Apply engine oil.	5. Timing chain tensioner adjuster assembly	8. Chain guide mounting bolt
3. Timing chain No.1 guide : Apply engine oil to sliding surface.	6. Chain tensioner adjuster mounting bolt	Tightening torque

REMOVAL

1) Disconnect negative cable at battery.
2) Drain engine oil.
3) Remove oil pan referring to "OIL PAN AND OIL PUMP STRAINER".
4) Remove cylinder head cover referring to "CYLINDER HEAD COVER".
5) Remove timing chain cover referring to "TIMING CHAIN COVER".

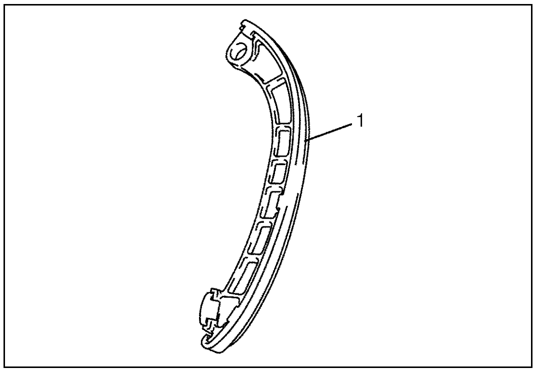


6) Align both intake and exhaust camshaft timing sprocket marks (1) with notches (2) of cylinder head respectively by turning crankshaft.
7) Remove timing chain tensioner adjuster assembly (3).
8) Remove timing chain tensioner (4).
9) Remove timing chain No.1 guide (5).
10) Remove timing chain (6) with crankshaft timing sprocket (7).

CAUTION:

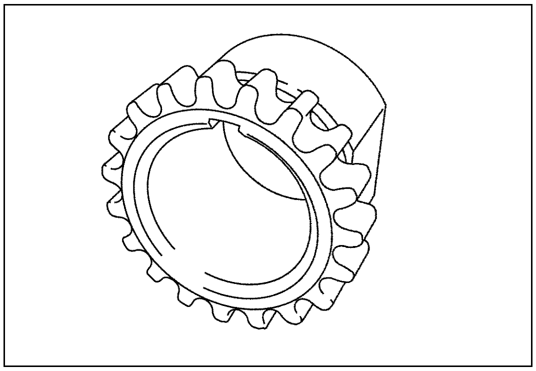
After timing chain is removed, never turn crankshaft and camshafts independently more than its allowable turning range described in "INSTALLATION" section.
If turned, interference may occur between piston and valves and valves themselves, and parts related to piston and valves may be damaged.

INSPECTION



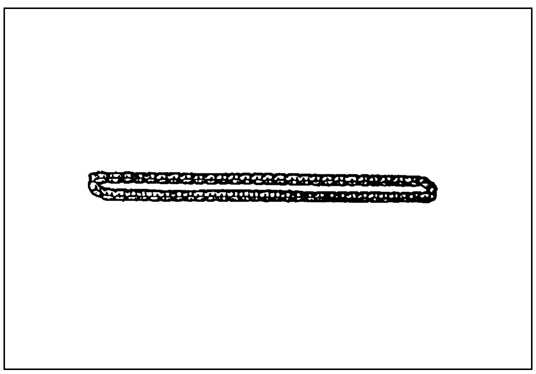
Timing chain tensioner

- Check shoe (1) for wear or damage.



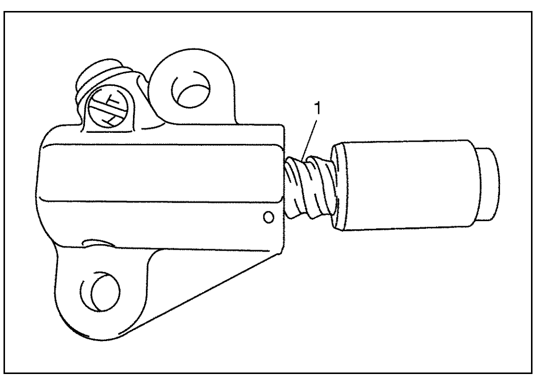
Crankshaft timing sprocket

- Check teeth of sprocket for wear or damage.



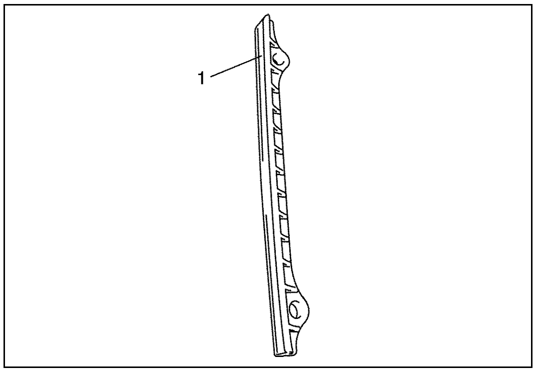
Timing chain

- Check timing chain for wear or damage.



Timing chain tensioner adjuster

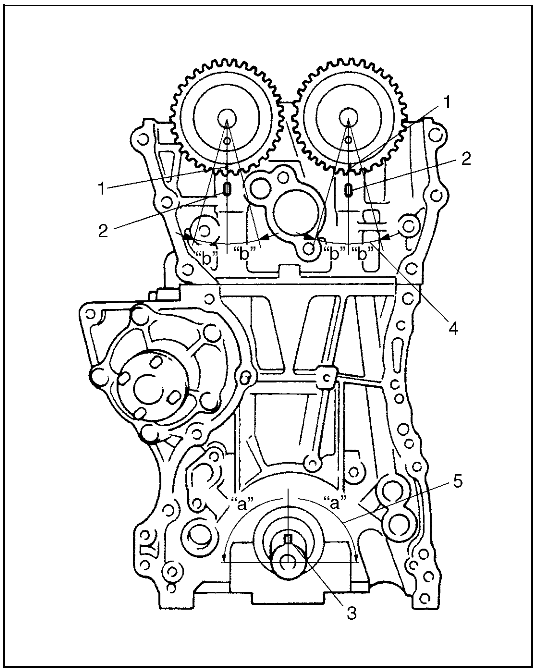
- Check that tooth surface (1) are free from damage.



Timing chain No.1 guide

- Check shoe (1) for wear or damage.

INSTALLATION



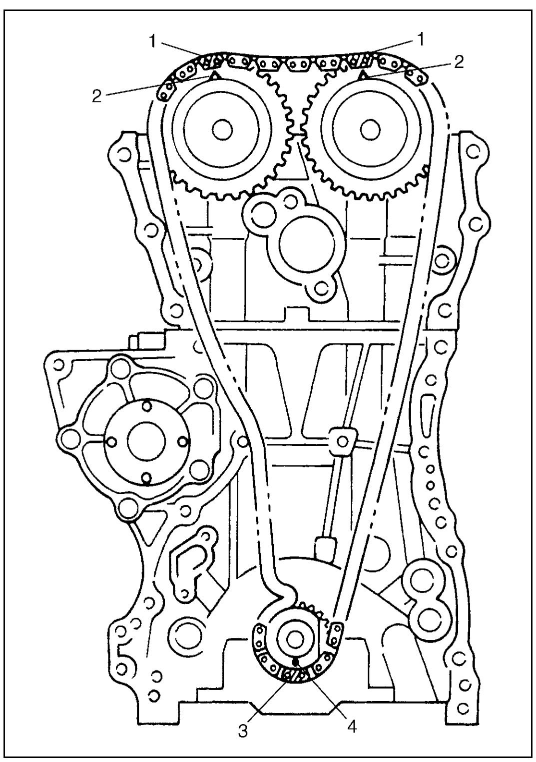
CAUTION:

After timing chain is removed, never turn crankshaft and camshafts independently more than such an extent ("a", "b") as shown in figure.

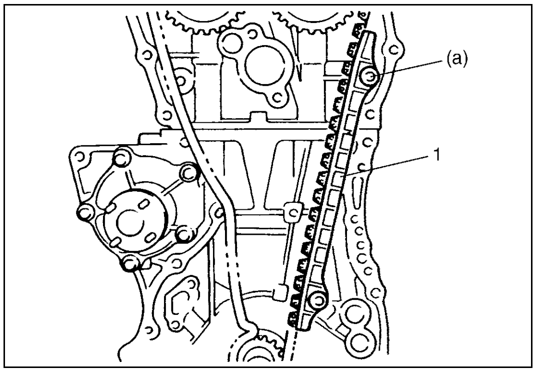
If turned, interference may occur between piston and valves and valves themselves, and parts related to piston and valves may be damaged.

1) Check that match marks (1) on intake and exhaust camshaft timing sprockets are in match with notches (2) on cylinder head as shown in figure.
2) Set key (3) and turn crankshaft to position key on upside of crankshaft.

"a" : 90°	4. Camshaft (IN and EX) allowable turning range. By marks on camshaft timing sprocket within 15° from notches on cylinder head on both right and left.
"b" : 15°	5. Crankshaft allowable turning range. By key on crankshaft, within 90° from top on both right and left.

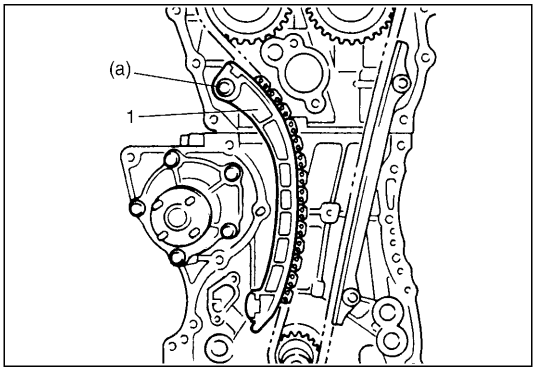


3) Install timing chain by aligning dark blue plate (1) of timing chain and triangle mark (2) on camshaft timing sprocket as shown in figure.
4) Fit crankshaft timing sprocket to timing chain by aligning gold plate (3) of timing chain and mark (4) on crankshaft timing sprocket. Then install crankshaft timing sprocket fitted with chain to crankshaft.



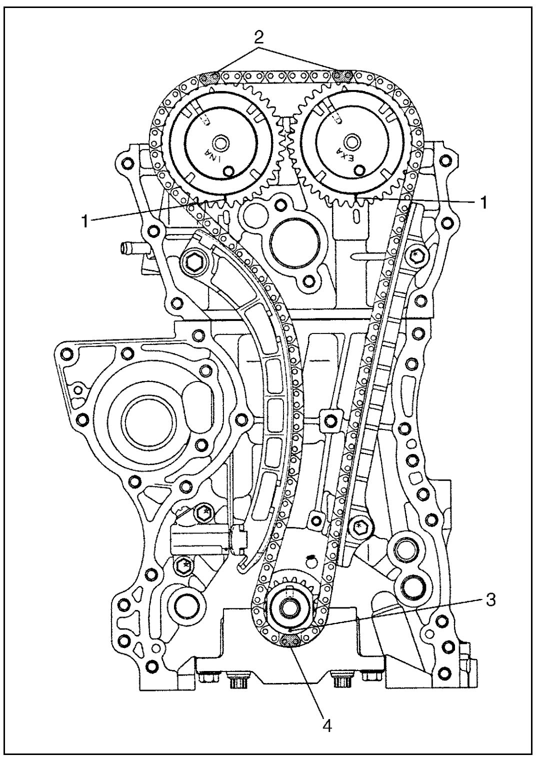
5) Apply engine oil to sliding surface of timing chain No.1 guide (1) and install it as shown in figure.
   Tighten guide bolts to specified torque.

Tightening torque
Timing chain No.1 guide bolt
(a) : 9 N·m (0.9 kg-m, 6.5 lb-ft)

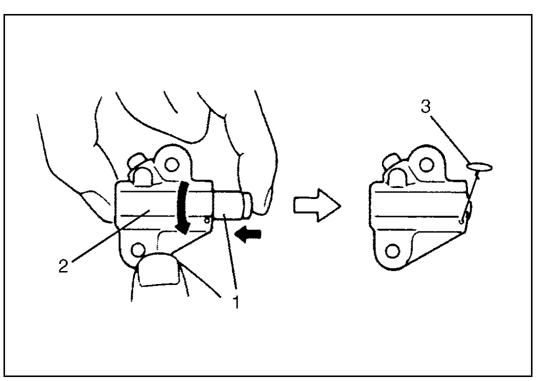


6) Apply engine oil to sliding surface of chain tensioner (1) and install chain tensioner and spacer.
   Tighten tensioner bolt to specified torque

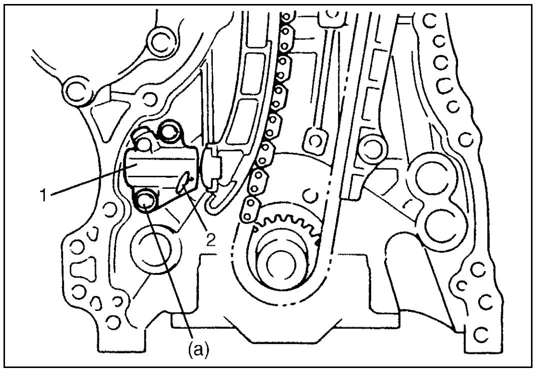
Tightening torque
Timing chain tensioner bolt
(a) : 22 N·m (2.2 kg-m, 16.0 lb-ft)



7) Check that match marks (1) on intake and exhaust camshaft timing sprockets are in match with making timing chain (2) and match mark on crankshaft timing sprocket (3) are in with marking timing chain(4).

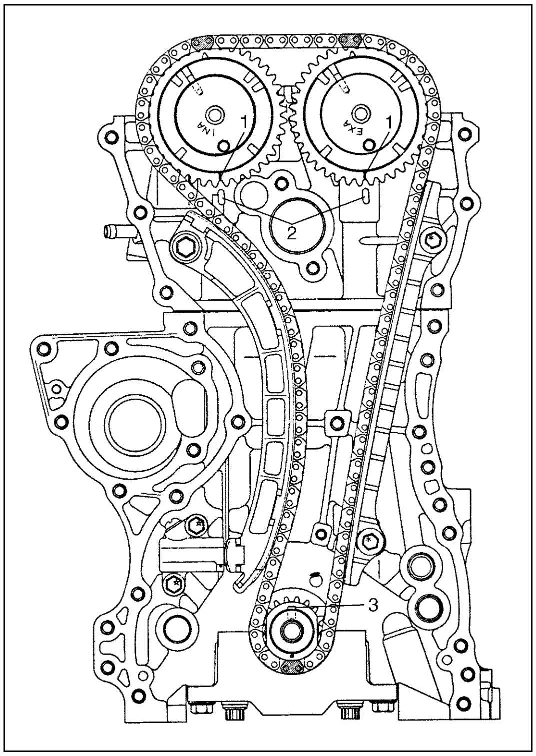


8) Screw in plunger (1) by turning body (2) in arrow direction and install a retainer (3) (wire) to hold plunger in place.



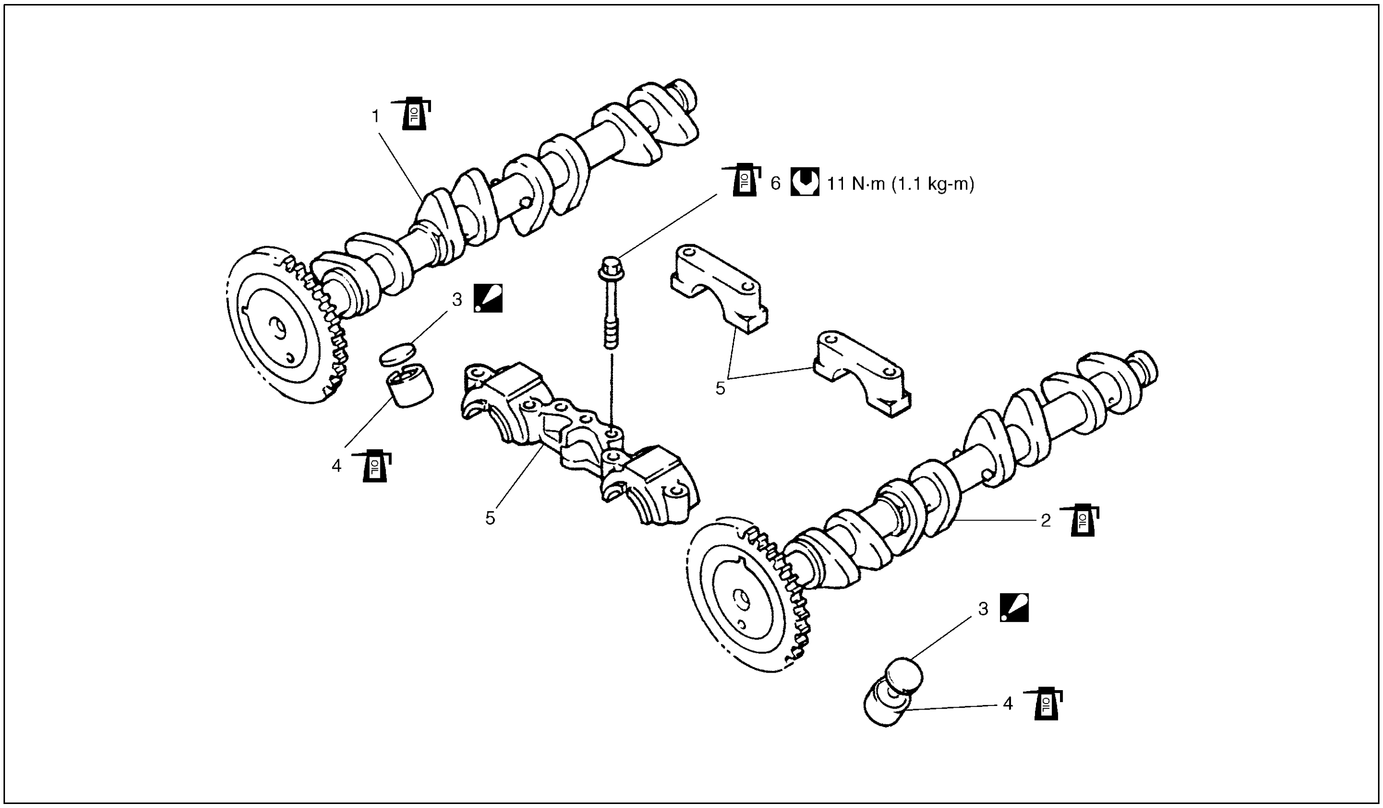
9) Install timing chain tensioner adjuster assembly (1) with a retainer (2).
   Tighten adjuster bolts to specified torque and then remove a retainer from chain tensioner adjuster assembly.

Tightening torque
Timing chain tensioner adjuster bolts
(a) : 11 N·m (1.1 kg-m, 8.0 lb-ft)



10) Apply engine oil to timing chain and then turn crankshaft clockwise by 2 revolutions and check that match marks (1) on intake and exhaust camshaft timing sprockets are in match with notches (2) on cylinder head and key (3) is on upside of crankshaft as shown in figure.
    If each marking chain and each match mark are no matches, adjust each sprockets and timing chain.
11) Install timing chain cover referring to “TIMING CHAIN COVER”.
12) Install cylinder head cover referring to “CYLINDER HEAD COVER”.
13) Install oil pan referring to “OIL PAN AND OIL PUMP STRAINER”.
14) Adjust water pump belt tension referring to Section 6B.
15) Adjust A/C compressor belt tension (if equipped) referring to Section 1B.
16) Refill engine with engine oil.
17) Verify that there is no oil leakage and exhaust gas leakage at each connection.

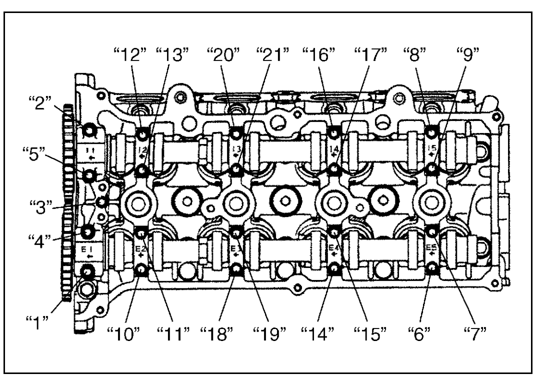
CAMSHAFT, TAPPET AND SHIM



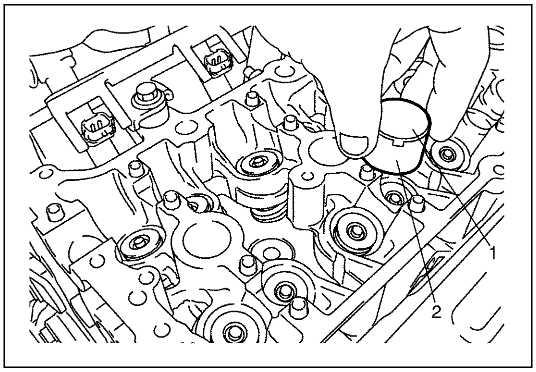
1. Intake camshaft	4. Tappet	Tightening torque
2. Exhaust camshaft	5. Camshaft housing	Apply engine oil to sliding surface of each part.
3. Shim : Shim No. on it faces tappet side.	6. Camshaft housing bolt	

REMOVAL

1) Remove cylinder head cover and oil pan as previously outlined.
2) Remove timing chain cover referring to “TIMING CHAIN COVER”.
3) Remove timing chain referring to “TIMING CHAIN AND CHAIN TENSIONER”.

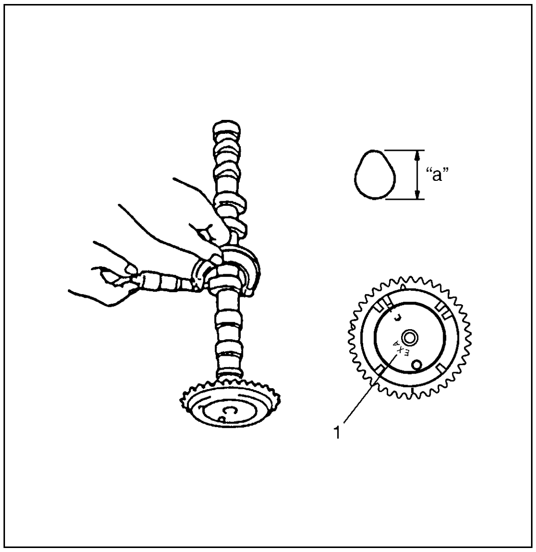


4) Loosen camshaft housing bolts in such order as indicated in figure and remove them.
5) Remove camshaft housings.
6) Remove intake and exhaust camshafts.



7) Remove tappets (2) with shims (1).

INSPECTION

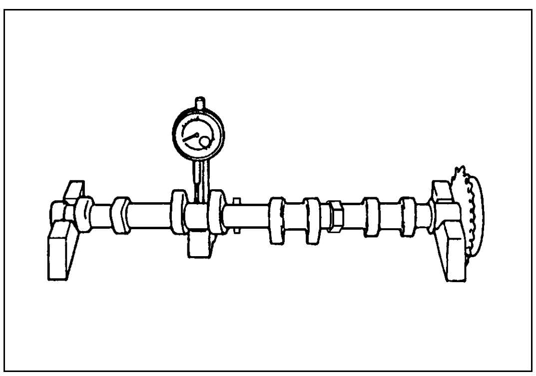


Cam Wear

Using a micrometer, measure cam height "a". If measured height is below its limit, replace camshaft.

Cam height "a" of camshaft

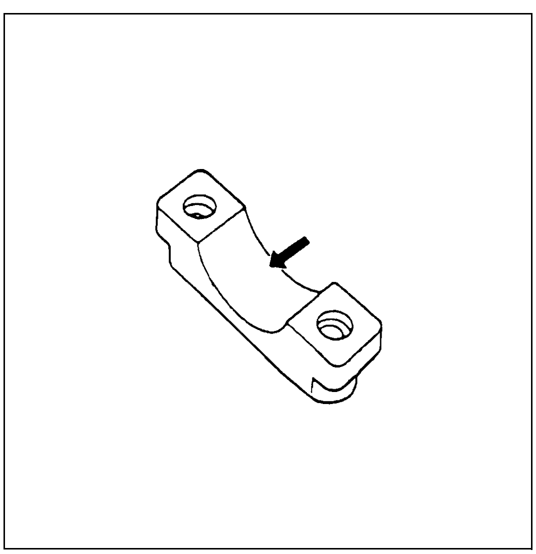
	Standard	Limit
Intake cam	**44.919 – 45.089 mm (1.768 – 1.775 in.)**	**44.81 mm (1.764 in.)**
Exhaust cam (ID mark (1) on sprocket: EXA)	**44.202 – 44.362 mm (1.740 – 1.747 in.)**	**44.08 mm (1.735 in.)**
Exhaust cam (ID mark (1) on sprocket: EXB)	**44.399 – 44.559 mm (1.748 – 1.754 in.)**	**44.28 mm (1.743 in.)**



Camshaft Runout

Set camshaft between two "V" blocks, and measure its runout by using a dial gauge.
If measured runout exceeds below limit, replace camshaft.

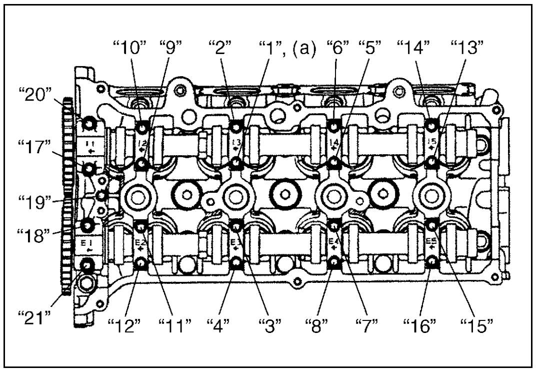
Camshaft runout limit
: 0.10 mm (0.0039 in.)



Camshaft Journal Wear

Check camshaft journals and camshaft housings for pitting, scratches, wear or damage.
If any malcondition is found, replace camshaft or cylinder head with housing. Never replace cylinder head without replacing housings.
Check clearance by using gaging plastic. Checking procedure is as follows.

1) Clean housings and camshaft journals.
2) Remove all tappets with shims.
3) Install camshafts to cylinder head.
4) Place a piece of gaging plastic to full width of journal of camshaft (parallel to camshaft).
5) Install camshaft housing.

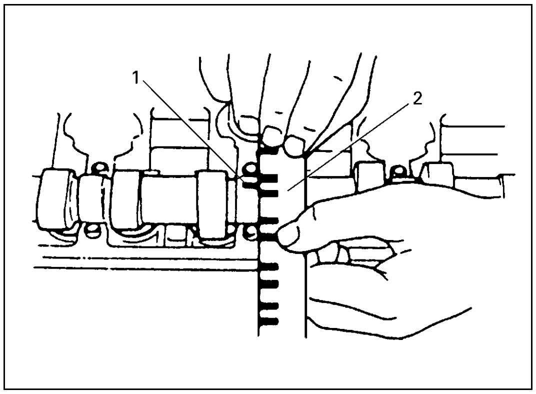


6) Tighten camshaft housing bolts in such order as indicated in figure a little at a time till they are tightened to specified torque.

NOTE:

Do not rotate camshaft while gaging plastic is installed.

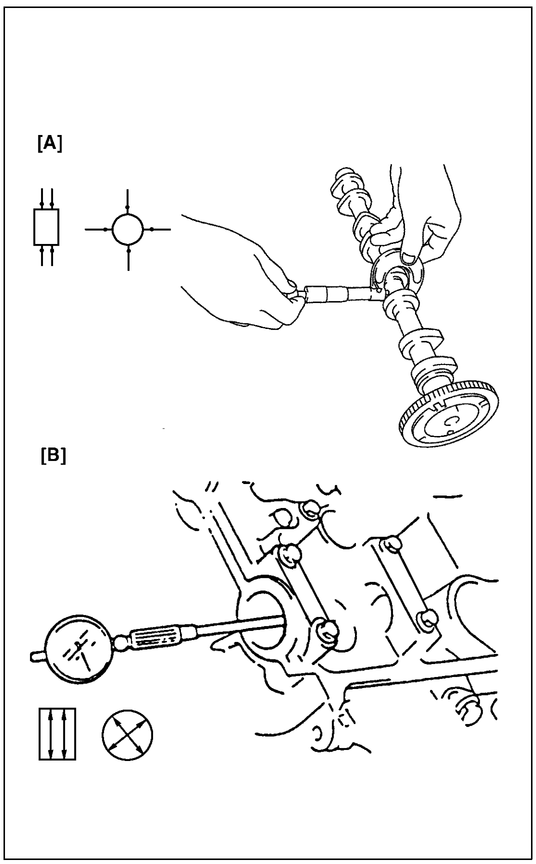
Tightening torque
Camshaft housing bolts (a) : 11 N·m (1.1 kg-m, 8.0 lb-ft)



7) Remove housing, and using scale (2) on gaging plastic (1) envelop, measure gaging plastic width at its widest point.

Camshaft journal clearance

	Standard	Limit
Intake No.1	**0.020 – 0.072 mm (0.0008 – 0.0028 in.)**	**0.12 mm**
Other	**0.045 – 0.087 mm (0.0018 – 0.0034 in.)**	



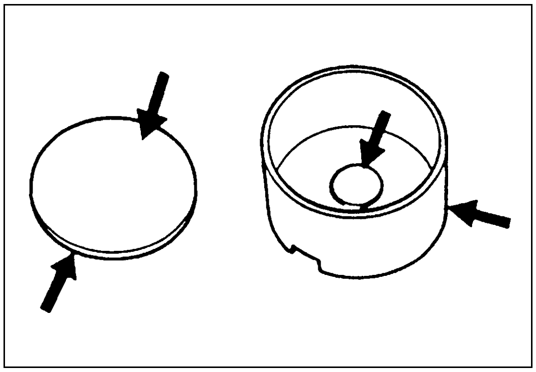
If measured camshaft journal clearance exceeds limit, measure journal (housing) bore and outside diameter of camshaft journal. Replace camshaft or cylinder head assembly whichever the difference from specification is greater.

Camshaft journal diameter [A]

Item	Standard
Intake No.1	**26.940 – 26.955 mm (1.0606 – 1.0612 in.)**
Exhaust No.1	**26.934 – 26.955 mm (1.0604 – 1.0612 in.)**
Other	**22.934 – 22.955 mm (0.9029 – 0.9037 in.)**

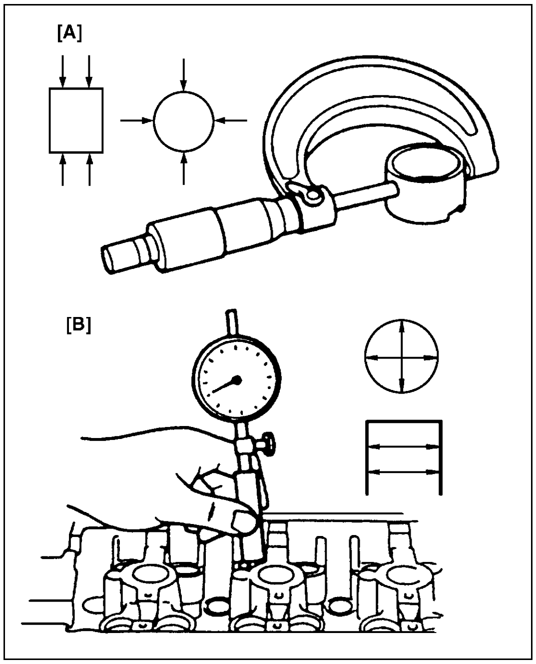
Camshaft journal bearing bore [B]

Item	Standard
Exhaust No.1	**27.000 – 27.021 mm (1.0630 – 1.0638 in.)**
Other	**23.000 – 23.021 mm (0.9055 – 0.9063 in.)**



Wear of tappet and shim

Check tappet and shim for pitting, scratches or damage.
If any malcondition is found, replace.



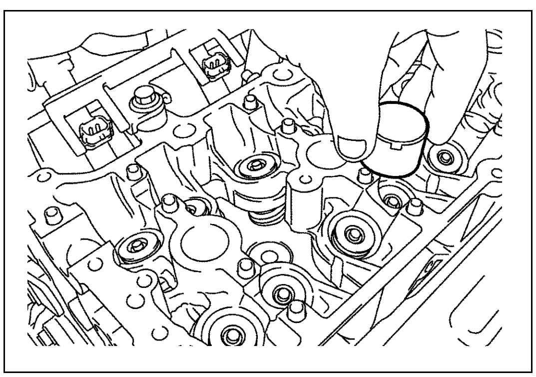
Measure cylinder head bore and tappet outside diameter to determine cylinder head-to-tappet clearance. If clearance exceeds limit, replace tappet or cylinder head.

Cylinder head to tappet clearance
Standard : 0.025 – 0.066 mm (0.0010 – 0.0026 in.)
Limit : 0.15 mm (0.0059 in.)

Tappet outside diameter [A]
Standard : 30.959 – 30.975 mm (1.2189 – 1.2195 in.)

Cylinder head tappet bore [B]
Standard : 31.000 – 31.025 mm (1.2205 – 1.2215 in.)

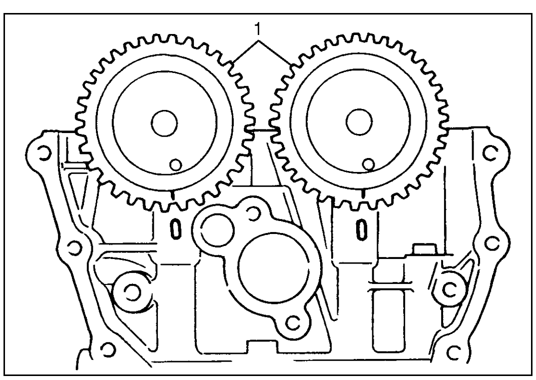
INSTALLATION



1) Install tappets and shims to cylinder head.
   Apply engine oil around tappet and then install it to cylinder head.

NOTE:

When installing shim, make sure to direct shim No. side toward tappet.

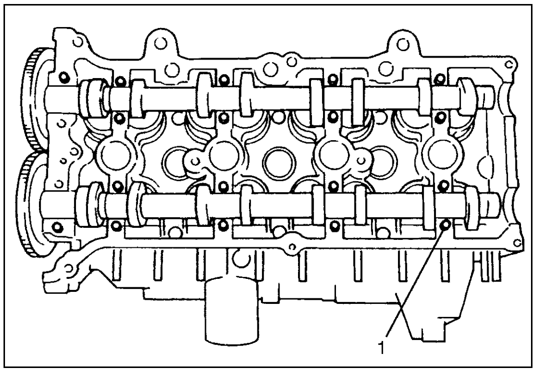


2) Install camshafts (1).

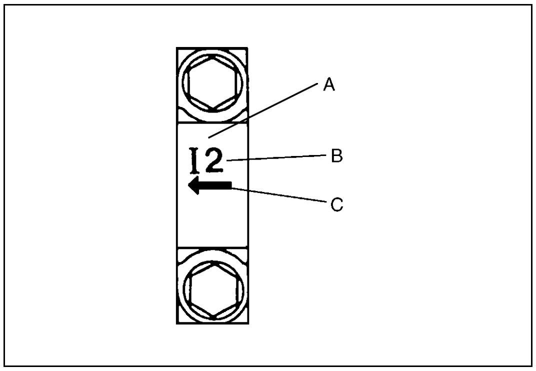
NOTE:

Before installing camshafts, turn crankshaft until key position faces upward. Refer to "TIMING CHAIN AND CHAIN TENSIONER".

Apply engine oil to sliding surface of each camshaft and camshaft journal then install them as shown in figure.

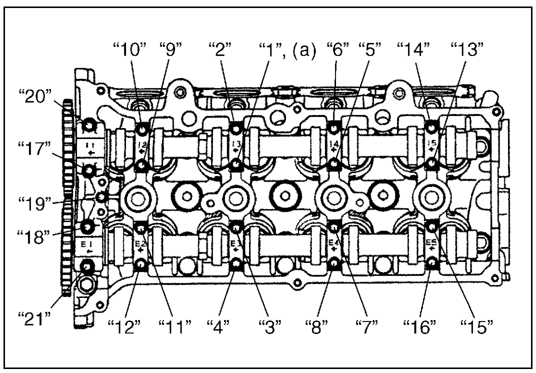


3) Install camshaft housing pins (1) as shown in figure.



4) Check position of camshaft housings.
   Embossed marks are provided on each camshaft housing, indicating position and direction for installation. Install housings as indicated by these marks.

A.	I : Intake side or E : Exhaust side
B.	Position from timing chain side
C.	Pointing to timing chain side

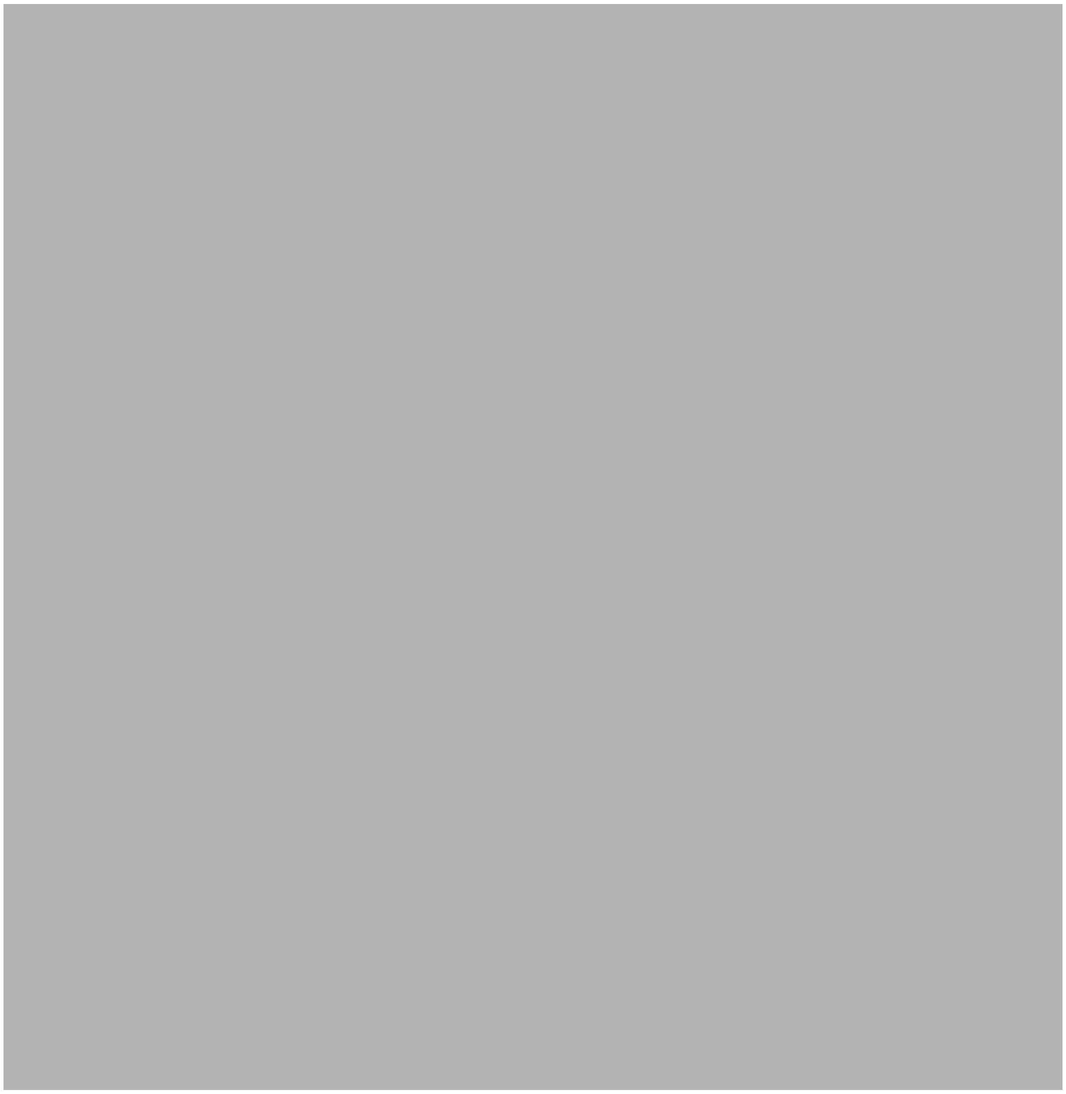


5) After applying engine oil to housing bolts, tighten them temporarily first. Then tighten them by the following numerical order in figure. Tighten a little at a time and evenly among bolts and repeat tightening sequence two or three times before they are tightened to specified torque.

Tightening torque
Camshaft housing bolts (a) : 11 N·m (1.1 kg-m, 8.0 lb-ft)

6) Install timing chain with crankshaft sprocket referring to “TIMING CHAIN AND CHAIN TENSIONER”.
7) Install timing chain cover referring to “TIMING CHAIN COVER”.
8) Check valve lashes as previously outlined.
9) Install cylinder head cover and oil pan as previously outlined.
10) Adjust water pump belt tension referring to Section 6B.
11) Adjust A/C compressor belt tension (if equipped) referring to Section 1B.
12) Refill engine with engine oil.
13) Verify that there is no, oil leakage and exhaust gas leakage at each connection.

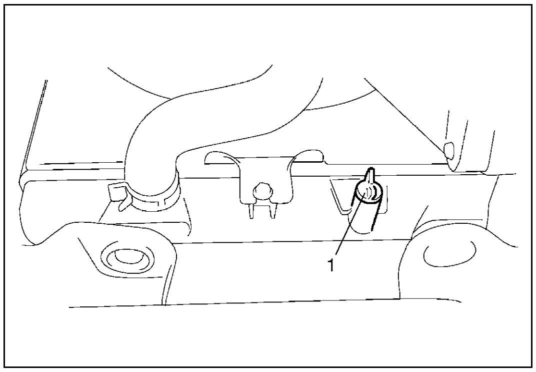
VALVES AND CYLINDER HEAD



[A]✱ 1) Tighten all bolts at 40 N·m (4.0 kg-m) 2) Turn all bolts at 60° 3) Then, Turn all bolt at 60° once again	6. Intake valve	12. Knock pin
1. Valve cotters	7. Exhaust valve	Tightening torque
2. Valve spring retainer	8. Valve guide	Do not reuse.
3. Valve spring	9. Cylinder head bolt : Never reuse it due to plastic deformation tightening bolt.	Apply engine oil to sliding surface of each part.
4. Valve stem seal	10. Cylinder head	
5. Valve spring seat	11. Cylinder head gasket : "TOP" mark provided on gasket comes to crankshaft pulley side, facing up.	

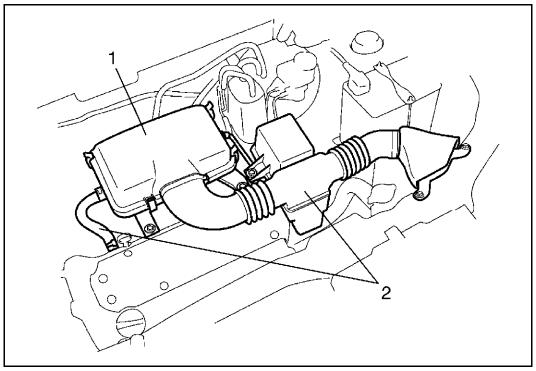
REMOVAL

1) Relieve fuel pressure according to procedure described in Section 6.
2) Disconnect negative cable at battery.
3) Drain engine oil.

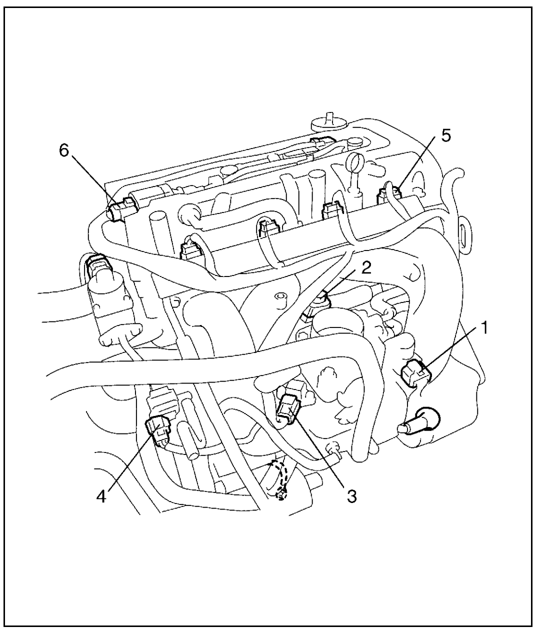


4) Drain coolant by loosening drain plug (1).

WARNING:
To help avoid danger of being burned, do not remove drain plug (1) and radiator cap while engine and radiator are still hot. Scalding fluid and steam can be blown out under pressure if plug and cap are taken off too soon.



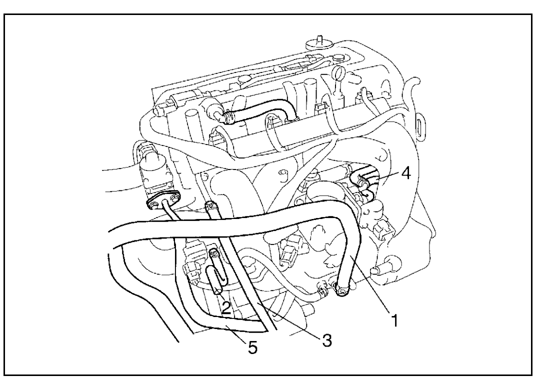
5) Remove air cleaner assembly (1), resonator and hoses (2) referring to “AIR CLEANER ASSEMBLY AND RESONATOR”.



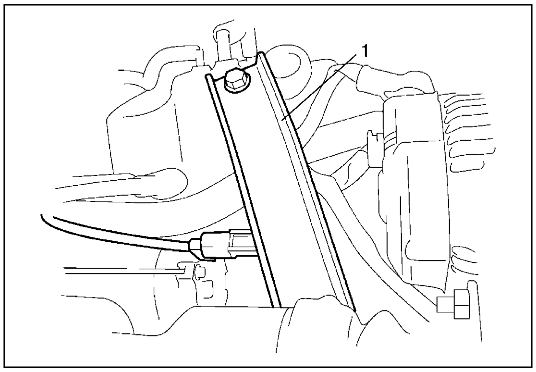
6) Disconnect the following electric lead wires :
- EGR valve (if equipped)
- IAC valve (1)
- TP sensor (2)
- MAP sensor (3)
- CMP sensor
- ECT sensor
- EVAP canister purge valve (4)
- Injectors (5)
- Ignition coils
- Heated oxygen sensors
- Ground terminal from exhaust manifold
- Each wire harness clamps

7) Remove heated oxygen sensor bracket from timing chain cover and detach heated oxygen sensor couplers from its bracket.

8) Disconnect accelerator cable from throttle body.

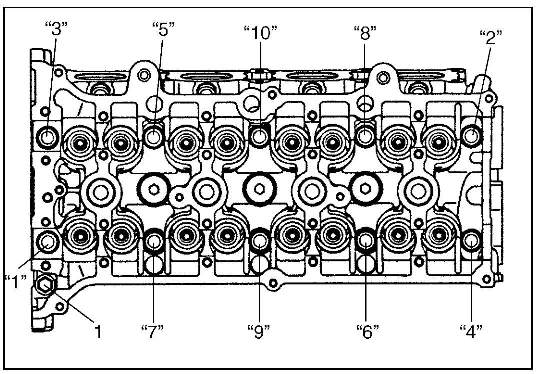


9) Disconnect the following hoses :
- Brake booster hose (1) from intake manifold
- Canister purge hose (2) from EVAP canister purge valve
- Fuel feed and return hose (3) from each pipe
- Water hose (4) from thermostat case
- Heater inlet hose (5) from its pipe



10) Remove intake manifold stiffener (1).

11) Remove oil pan referring to “OIL PAN AND OIL PUMP STRAINER”.
12) Remove cylinder head cover referring to “CYLINDER HEAD COVER”.
13) Remove timing chain cover referring to “TIMING CHAIN COVER”.
14) Remove timing chain referring to “TIMING CHAIN AND CHAIN TENSIONER”.
15) Remove intake and exhaust camshafts referring to “CAM-SHAFT, TAPPET AND SHIM”.



16) Loosen cylinder head bolts in such order as indicated in figure by using a 12 corner socket wrenches and remove them.

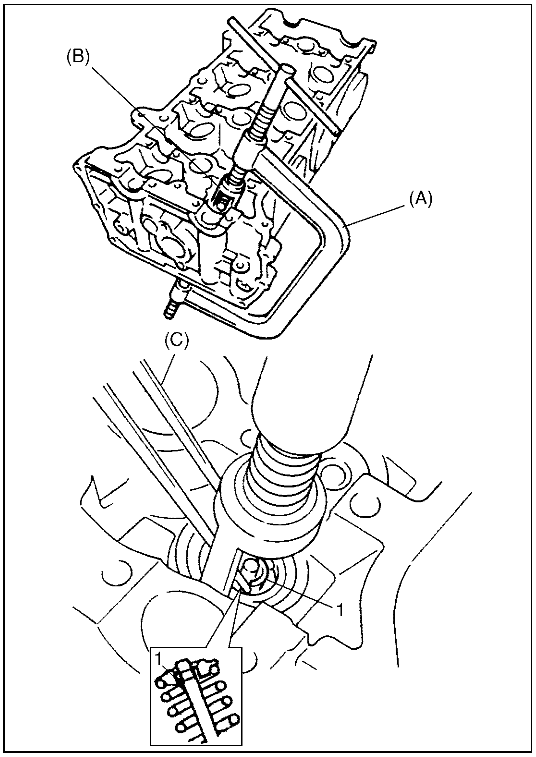
NOTE:

- **Don’t forget to remove bolt (M8) (1) as shown in figure.**
- **Never reuse cylinder head bolts once disassembled it due to plastic deformation tightening. Be sure to use new cylinder head bolts when installing.**

17) Check all around cylinder head for any other parts required to be removed or disconnected and remove or disconnect whatever necessary.
18) Remove exhaust manifold, if necessary, referring to “EXHAUST MANIFOLD”.
19) Remove cylinder head with intake manifold and exhaust manifold. Use lifting device, if necessary.

DISASSEMBLY

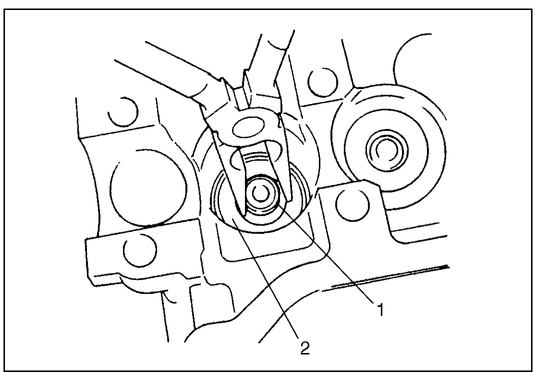
1) For ease in servicing cylinder head, remove intake manifold, injectors and exhaust manifold from cylinder head.



2) Using special tools (Valve lifter), compress valve spring and then remove valve cotters (1) by using special tool (Forceps).

Special tool
(A) : 09916-14510
(B) : 09916-14910
(C) : 09916-84511

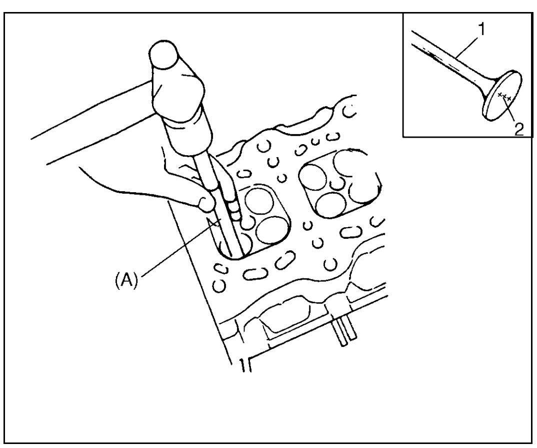
3) Release special tool, and remove spring retainer and valve spring.
4) Remove valve from combustion chamber side.



5) Remove valve stem seal (1) from valve guide, and then valve spring seat (2).

NOTE:

Do not reuse seal once disassembled. Be sure to use new oil seal when assembling.



6) Using special tool (valve guide remover), drive valve guide out from combustion chamber side to valve spring side.

Special tool
(A) : 09916-46020 for engine equipped with 69G type valve
(A) : 09916-44910 for engine equipped with 54G type valve

NOTE:

Do not reuse valve guide once disassembled. Be sure to use new valve guide (Oversize) when assembling.

1.	Valve
2.	Emboss mark 54G or 69G

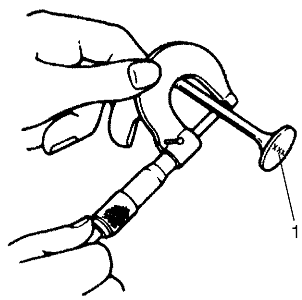
7) Place disassembled parts except valve stem seal and valve guide in order so that they can be installed in their original position.

INSPECTION

Valve Guides

Using a micrometer and bore gauge, take diameter readings on valve stems and guides to check stem-to-guide clearance. Be sure to take reading at more than one place along the length of each stem and guide.
If clearance exceeds limit, replace valve and valve guide.

[A]



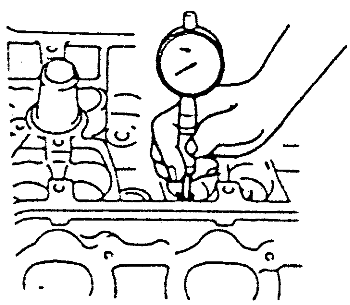
Valve stem-to-guide clearance

Valve type		Standard	Limit
69G	In	0.020 – 0.047 mm (0.0008 – 0.0019 in.)	0.07 mm (0.0028 in.)
	Ex	0.045 – 0.072 mm (0.0018 – 0.0028 in.)	0.09 mm (0.0035 in.)
54G	In	0.020 – 0.030 mm (0.0008 – 0.0012 in.)	0.05 mm (0.0017 in.)
	Ex	0.045 – 0.055 mm (0.0018 – 0.0022 in.)	0.07 mm (0.0028 in.)

Valve stem diameter [A]

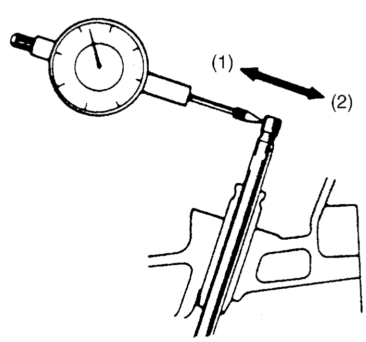
Valve type		Standard
69G	In	5.965 – 5.980 mm (0.2348 – 0.2354 in.)
	Ex	5.940 – 5.955 mm (0.2339 – 0.2344 in.)
54G	In	5.465 – 5.480 mm (0.2152 – 0.2157 in.)
	Ex	5.440 – 5.455 mm (0.2142 – 0.2148 in.)

[B]



Valve guide bore [B] standard
In and Ex : 6.000 – 6.012 mm (0.2362 – 0.2367 in.) for 69G type valve
In and Ex : 5.485 – 5.510 mm (0.2159 – 0.2169 in.) for 54G type valve

1. Emboss mark 54G or 69G

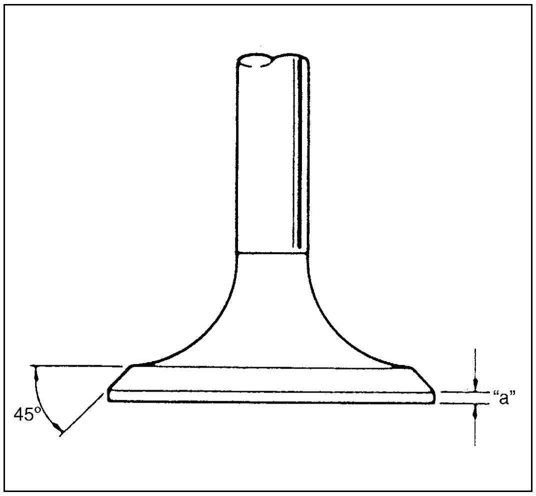


If bore gauge is not available, check end deflection of valve stem with a dial gauge instead.
Move stem end in directions (1) and (2) to measure end deflection.
If deflection exceeds its limit, replace valve stem and valve guide.

Valve stem end deflection limit
In : 0.14 mm (0.005 in.)
Ex : 0.18 mm (0.007 in.)

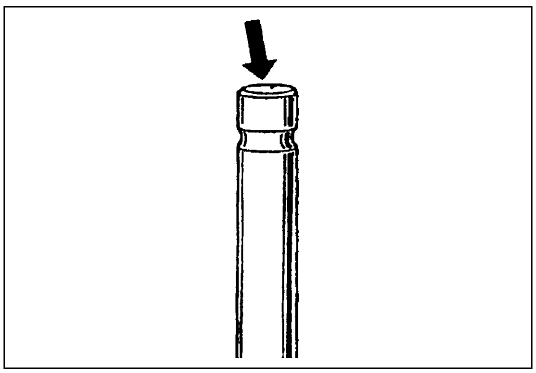
Valves

- Remove all carbon from valves.
- Inspect each valve for wear, burn or distortion at its face and stem end, as necessary, replace it.

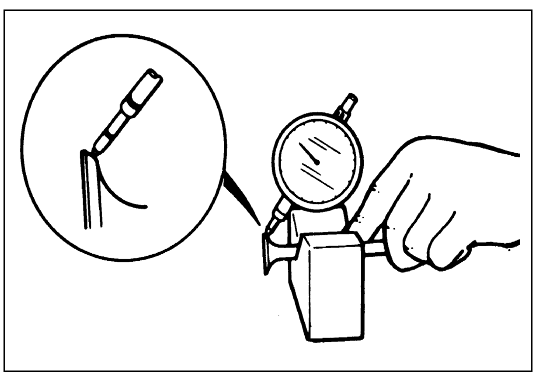


- Measure thickness “a” of valve head. If measured thickness exceeds limit, replace valve.

Valve head thickness (In and Ex)
Standard : 1.22 – 1.55 mm (0.048 – 0.061 in.)
Limit : 0.9 mm (0.035 in.)

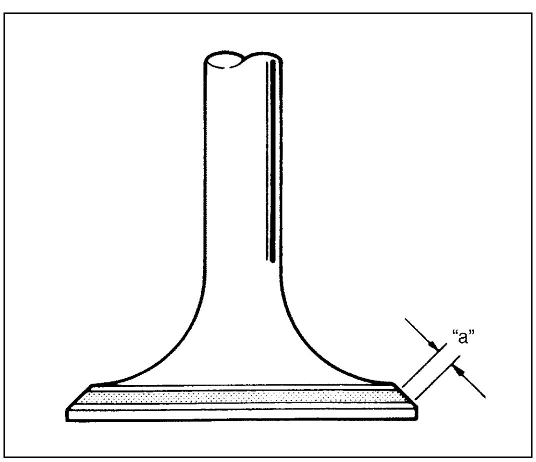


- Inspect valve stem end face for pitting and wear. If pitting or wear is found there, valve stem end may be resurfaced, but not too much to grind off its chamber. When it is worn out too much that its chamber is gone, replace valve.



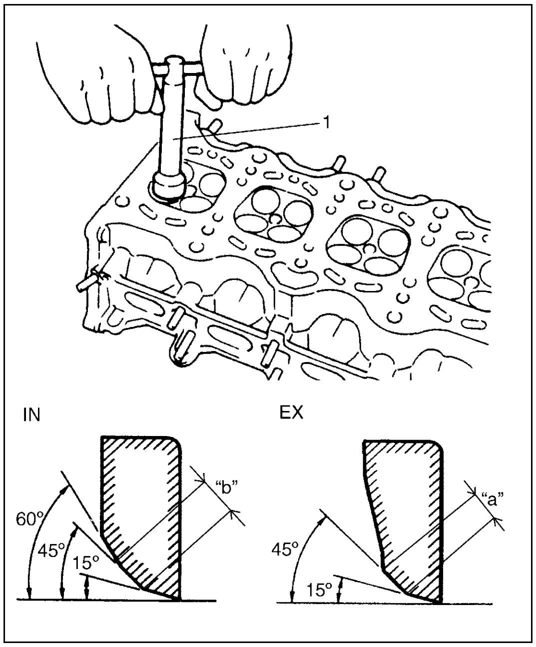
- Check each valve for radial runout with a dial gauge and “V” block. To check runout, rotate valve slowly. If runout exceeds its limit, replace valve.

Limit on valve head radial runout
: 0.08 mm (0.003 in.)



- Seating contact width:
  Create contact pattern on each valve in the usual manner, i.e. by giving uniform coat of marking compound to valve seat and by rotatingly tapping seat with valve head. Valve lapper (tool used in valve lapping) must be used.
  Pattern produced on seating face of valve must be a continuous ring without any break, and the width of pattern must be within specified range.

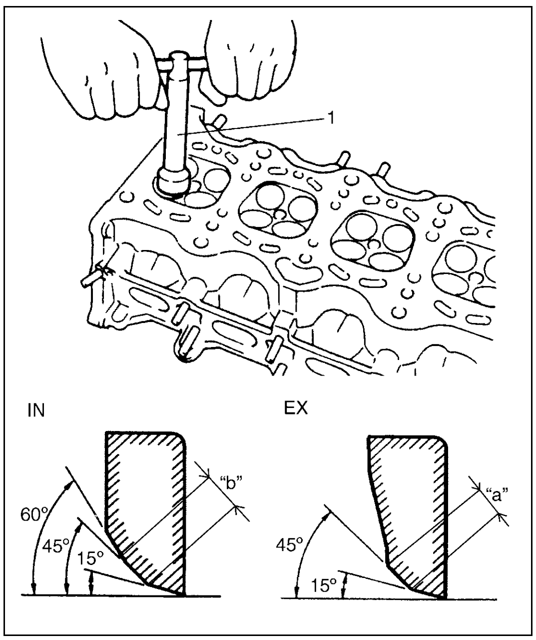
Standard seating width “a” revealed by contact pattern on valve face
In and Ex : 1.1 - 1.3 mm (0.0433 - 0.0512 in.)



- Valve seat repair:
  A valve seat not producing a uniform contact with its valve or showing width of seating contact that is out of specified range must be repaired by regrinding or by cutting and regrinding and finished by lapping.

a) EXHAUST VALVE SEAT : Use valve seat cutters (1) to make two cuts as illustrated in figure. Two cutters must be used: the first for making 15° angle, and the second for making 45° angle. The second cut must be made to produce desired seat width.

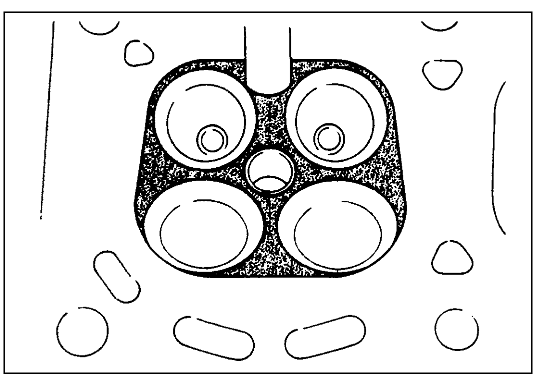
Seat width for exhaust valve seat
"a" : 1.1 – 1.3 mm (0.0433 – 0.0512 in.)



b) INTAKE VALVE SEAT : Use valve seat cutters to make three cuts as illustrated in figure. Three cutters must be used: the 1st for making 15° angle, the 2nd for making 60° angle, and 3rd for making 45° angle. The 3rd cut (45°) must be made to produce desired seat width.

Seat width for intake valve seat
"b" : 1.1 – 1.3 mm (0.0433 – 0.0512 in.)

c) VALVE LAPPING : Lap valve on seat in two steps, first with coarse size lapping compound applied to face and the second with fine-size compound, each time using valve lapper according to usual lapping method.

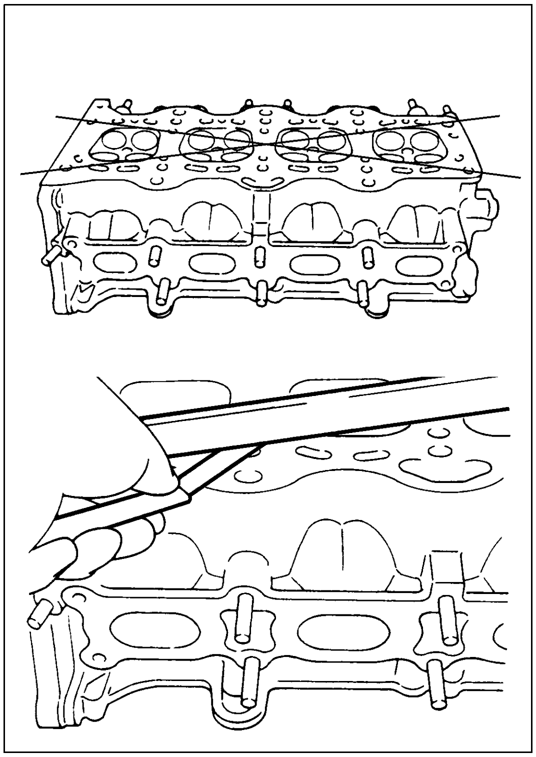


Cylinder Head

- Remove all carbon deposits from combustion chambers.

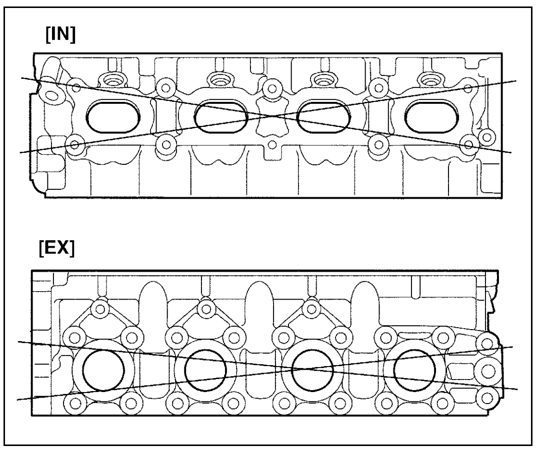
NOTE:

Do not use any sharp-edged tool to scrape off carbon deposits. Be careful not to scuff or nick metal surfaces when decarbonizing. The same applies to valves and valve seats, too.



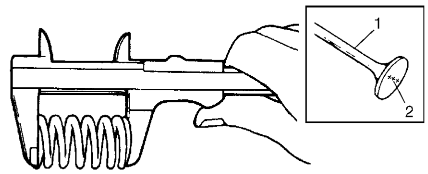
- Check cylinder head for cracks on intake and exhaust ports, combustion chambers, and head surface.
  Using a straightedge and thickness gauge, check flatness of gasketed surface at a total of 2 locations. If distortion limit, given below, is exceeded, correct gasketed surface with a surface plate and abrasive paper of about #400 (Waterproof silicon carbide abrasive paper): place abrasive paper on and over surface plate, and rub gasketed surface against paper to grind off high spots. Should this fail to reduce thickness gauge readings to within limit, replace cylinder head.
  Leakage of combustion gases from this gasketed joint is often due to warped gasketed surface: such leakage results in reduced power output.

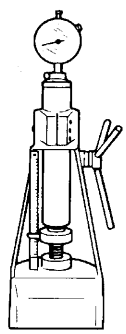
Limit of distortion for cylinder head surface on piston side
: 0.03 mm (0.001 in.)



- Distortion of manifold seating faces:
  Check seating faces of cylinder head for manifolds, using a straightedge and thickness gauge, in order to determine whether these faces should be corrected or cylinder head replaced.

Limit of distortion for cylinder head surface on intake and exhaust manifold
: 0.05 mm (0.002 in.)





Valve Springs

- Referring to data given below, check to be sure that each spring is in sound condition, free of any evidence of breakage or weakening. Remember, weakened valve springs can cause chatter, not to mention possibility of reducing power output due to gas leakage caused by decreased seating pressure.

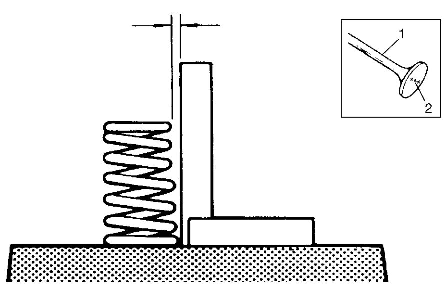
Valve spring free length for engine equipped with 69G type valve
Standard : 43.00 mm (1.693 in.)
Limit : 42.00 mm (1.652 in.)

Valve spring free length for engine equipped with 54G type valve
Standard : 36.83 mm (1.450 in.)
Limit : 35.83 mm (1.410 in.)

Valve spring preload for engine equipped with 69G type valve
Standard : 110 – 126 N (11.2 – 12.8 kg) for 39.50 mm (24.7 – 28.2 lb/1.555 in.)
Limit : 105 N (10.7 kg) for 39.5 mm (23.6 lb/1.555 in.)

Valve spring preload for engine equipped with 54G type valve
Standard : 107 – 125 N (10.7 – 12.5 kg) for 31.50 mm (23.6 – 27.6 lb/1.240 in.)
Limit : 102 N (10.4 kg) for 31.50 mm (22.9 lb/1.240 in.)

1. Valve
2. Emboss mark 54G or 69G

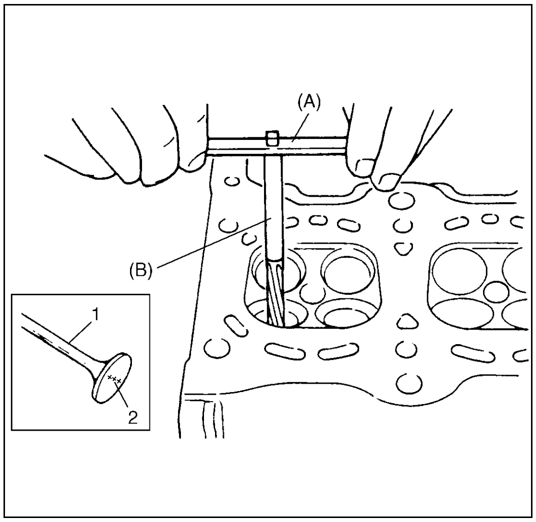


- Spring skewness:
  Use a square and surface plate to check each spring for skewness in terms of clearance between end of valve spring and square. Valve springs found to exhibit a larger clearance than limit given below must be replaced.

Valve spring skewness
Limit : 2.0 mm (0.079 in.) for engine equipped with 69G type valve
Limit : 1.6 mm (0.063 in.) for engine equipped with 54G type valve

1. Valve
2. Emboss mark 54G or 69G

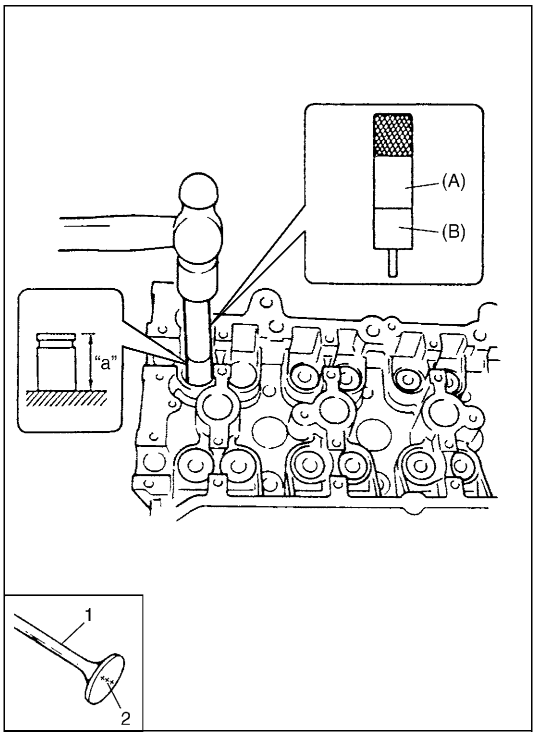
ASSEMBLY



1) Before installing valve guide into cylinder head, ream guide hole with special tool (11 mm reamer for engine equipped with 69G type valve or 10.5 mm reamer for engine equipped with 54G type valve) so as to remove burrs and make it truly round.

Special tool
(A) : 09916-34542
(B) : 09916-38210 (11 mm) for engine equipped with 69G type valve
(B) : 09916-37320 (10.5 mm) for engine equipped with 54G type valve

1.	Valve
2.	Emboss mark 54G or 69G



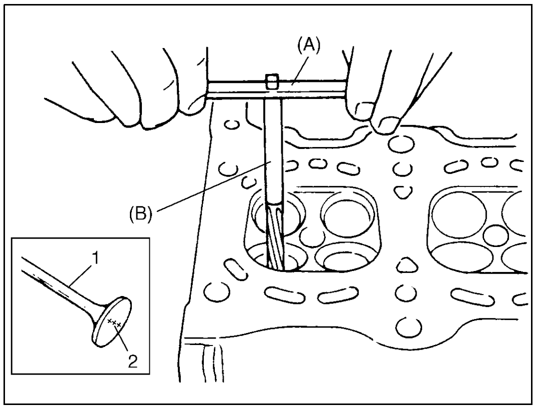
2) Install valve guide to cylinder head.
Heat cylinder head uniformly to a temperature of 80 to 100 °C (176 to 212 °F) so that head will not be distorted, and drive new valve guide into hole with special tools. Drive in new valve guide until special tool (Valve guide installer) contacts cylinder head.
After installing, make sure that valve guide protrudes by specified dimension "a" from cylinder head.

Special tool
(A) : 09916-57350 (For engine equipped with 69G type valve)
(A) : 09916-58210 (For engine equipped with 54G type valve)
(B) : 09917-88240 (For Intake side of engine equipped with 69G type valve)
(B) : 09917-88250 (For Exhaust side of engine equipped with 69G type valve)
(B) : 09916-56011 (For both sides of engine equipped with 54G type valve)

NOTE:
- **Never reuse once-disassembled valve guide. Make sure to install new valve guide.**
- **Intake and exhaust valve guides are identical.**

Specification for valve guide protrusion "a"
Intake side of engine equipped with 69G type valve
: 17.5 mm (0.71 in.)
Exhaust side of engine equipped with 69G type valve
: 14.5 mm (0.57 in.)
Both sides of engine equipped with 54G type valve
: 11.1 – 11.5 mm (0.44 – 0.45 in.)

1.	Valve
2.	Emboss mark 54G or 69G

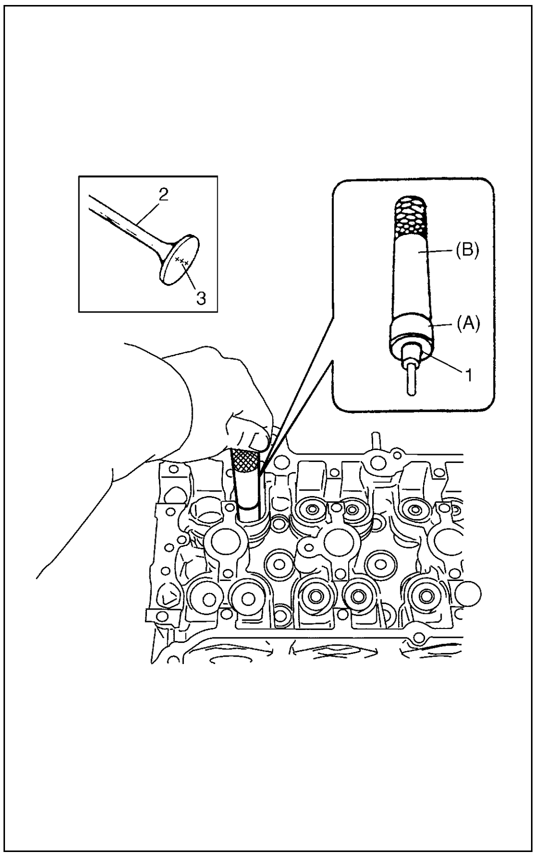


3) Ream valve guide bore with special tool (6.0 mm reamer for engine equipped with 69G type valve or 5.5 mm reamer for engine equipped with 54G type valve). After reaming, clean bore.

Special tool
(A) : 09916-34542
(B) : 09916-37810 (6 mm) for engine equipped with 69G type valve
(B) : 09916-34550 (5.5 mm) for engine equipped with 54G type valve

1.	Valve
2.	Emboss mark 54G or 69G

4) Install valve spring seat to cylinder head.

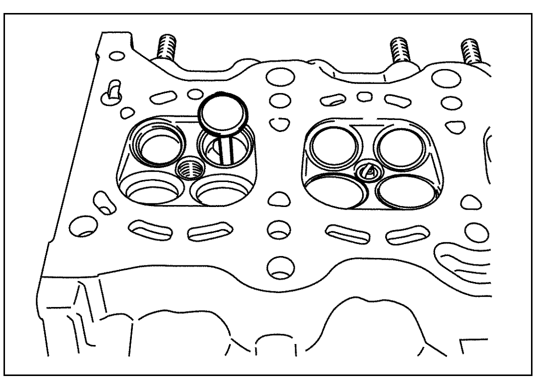


5) Install new valve stem seal (1) to valve guide.
After applying engine oil to seal and spindle of special tool (Valve guide installer handle), fit oil seal to spindle, and then install seal to valve guide by pushing special tool by hand.
After installing, check to be sure that seal is properly fixed to valve guide.

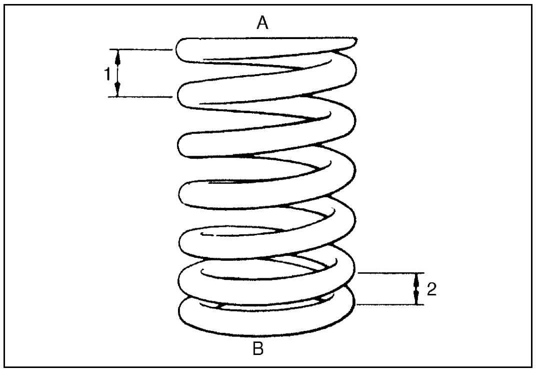
Special tool
(A) : 09917-98221
(B) : 09916-57350 (For engine equipped with 69G type valve)
(B) : 09916-58210 (For engine equipped with 54G type valve)

NOTE:
- **Do not reuse once-disassembled seal. Be sure to install new seal.**
- **When installing, never tap or hit special tool with a hammer or else. Install seal to guide only by pushing special tool by hand. Tapping or hitting special tool may cause damage to seal.**

2.	Valve
3.	Emboss mark 54G or 69G

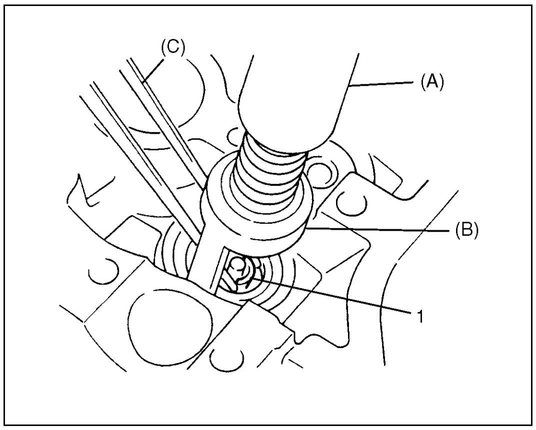


6) Install valve to valve guide.
Before installing valve to valve guide, apply engine oil to stem seal, valve guide bore and valve stem.



7) Install valve spring and spring retainer.
   Each valve spring has top end (large-pitch end (1)) and bottom end (small-pitch end (2)). Be sure to position spring in place with its bottom end (small-pitch end) facing the bottom (valve spring seat side).

A :	Valve spring retainer side
B :	Valve spring seat side



8) Using special tools (Valve lifter), compress valve spring and fit two valve cotters (1) into groove in valve stem.

Special tool
(A) : 09916-14510
(B) : 09916-14910
(C) : 09916-84511

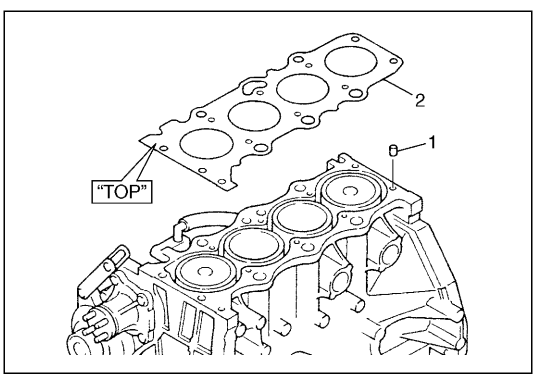
NOTE:

When compressing the valve spring, be carefully to free from damage in inside face of tappet installing hole.

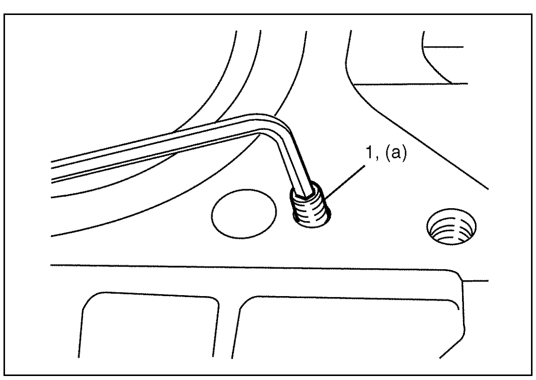
9) Install intake manifold, injectors and exhaust manifold to cylinder head.

INSTALLATION

1) Clean mating surface of cylinder head and cylinder block. Remove oil, old gasket and dust from mating surface.

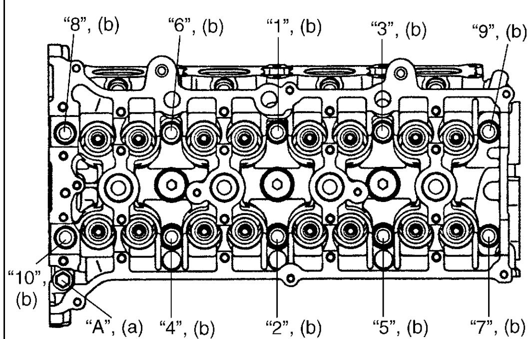


2) Install knock pins (1) to cylinder block.
3) Install new cylinder head gasket (2) to cylinder block.
   "TOP" mark provided on gasket comes to crankshaft pulley side, facing up (toward cylinder head side).



4) Make sure that oil jet (venturi plug) (1) is installed and if it is, that it is not clogged.
   When installing it, be sure to tighten to specified torque.

Tightening torque
Venturi plug (a) : 5 N·m (0.5 kg-m, 3.5 lb-ft)



5) Install cylinder head to cylinder block.
   Apply engine oil to new cylinder head bolts and tighten them gradually as follows.
   a) Tighten cylinder head bolts ("1" – "10") to 20 N·m (2.0 kg-m, 14.5 lb-ft) according to numerical order as shown by using a 12 corner socket wrenches.
   b) In the same manner as in Step a), tighten them to 40 N·m (4.0 kg-m, 29.0 lb-ft).
   c) Turn all bolts 60° according to numerical order in figure.
   d) Repeat Step c).
   e) Tighten bolt "A" to specified torque.

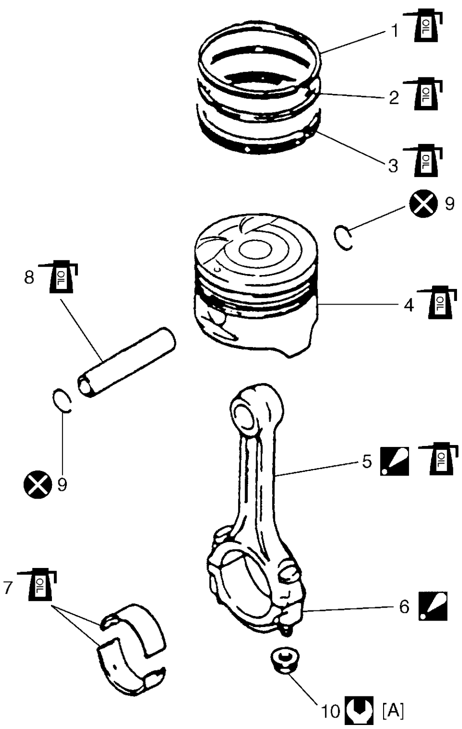
NOTE:

- **Never reuse cylinder head bolts ("1" – "10") once disassembled it due to plastic deformation tightening.**
  Be sure to use new cylinder head bolts.
- **Be sure to tighten M8 bolt ("A") after securing the other bolt.**

Tightening torque
Cylinder head bolt for M8 (a) : 22 N·m (2.2 kg-m, 16.0 lb-ft)
Cylinder head bolts for M10
(b) : 40 N·m (4.0 kg-m, 29.0 lb-ft) and then turn to 60° twice

6) Install exhaust manifold stiffener and exhaust No.1 pipe referring to "EXHAUST MANIFOLD".
7) Install camshafts, timing chain and chain cover as previously outlined.
8) Install cylinder head cover and oil pan as previously outlined.
9) Install intake manifold stiffener and connect each hoses and electric lead wires securely.
10) Install air cleaner assembly, resonator and hoses referring to "AIR CLEANER ASSEMBLY AND RESONATOR".
11) Adjust water pump belt tension referring to Section 6B.
12) Adjust A/C compressor belt tension (if equipped) referring to Section 1B.
13) Adjust accelerator cable play referring to Section 6E1.
14) Check to ensure that all removed parts are back in place. Reinstall any necessary parts which have not been reinstalled.
15) Refill cooling system with coolant, engine with engine oil.
16) Connect negative cable at battery.
17) Verify that there is no fuel leakage, coolant leakage, oil leakage and exhaust gas leakage at each connection.

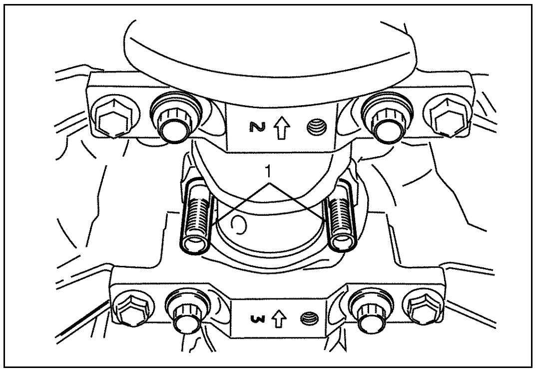
PISTONS, PISTON RINGS, CONNECTING RODS AND CYLINDERS



	[A] :	1) Tighten all nuts to 15 N·m (1.5 kg-m) 2) Turn all nuts to 45° 3) Then, Turn all nuts to 45° one again	7.	Connecting rod bearing
	1.	Top ring	8.	Piston pin
	2.	2nd ring	9.	Piston pin circlip
	3.	Oil ring	10.	Bearing cap nut
	4.	Piston		Tightening torque
	5.	Connecting rod : Apply engine oil to sliding surface except inner surface of big end, and rod bolts. Make sure rod bolt diameter when reuse it due to plastic deformation tightening. Refer to “INSPECTION” of “CONNECTING ROD”.		Apply engine oil to sliding surface of each parts.
	6.	Connecting rod bearing cap : Point arrow mark on cap to crankshaft pulley side.		Do not reuse.

REMOVAL

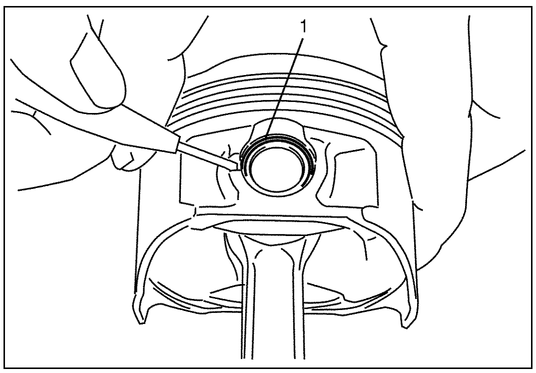
1) Relieve fuel pressure according to procedure described in Section 6.
2) Disconnect negative cable at battery.
3) Drain engine oil.
4) Drain coolant.
5) Remove cylinder head referring to “VALVES AND CYLINDER HEAD”.
6) Mark cylinder number on all pistons, connecting rods and connecting rod caps using silver pencil or quick drying paint.
7) Remove rod bearing caps.



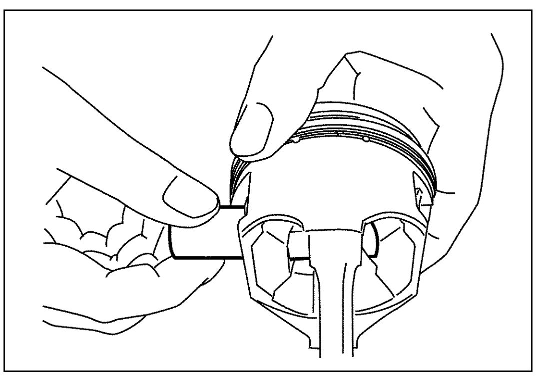
8) Install guide hose (1) over threads of rod bolts.
   This prevents damage to bearing journal and rod bolt threads when removing connecting rod.
9) Decarbonize top of cylinder bore before removing piston from cylinder.
10) Push piston and connecting rod assembly out through the top of cylinder bore.

DISASSEMBLY

1) Using piston ring expander, remove two compression rings (Top and 2nd) and oil ring from piston.
2) Remove piston pin from connecting rod.



- Ease out piston pin circlips (1), as shown.



- Force piston pin out.

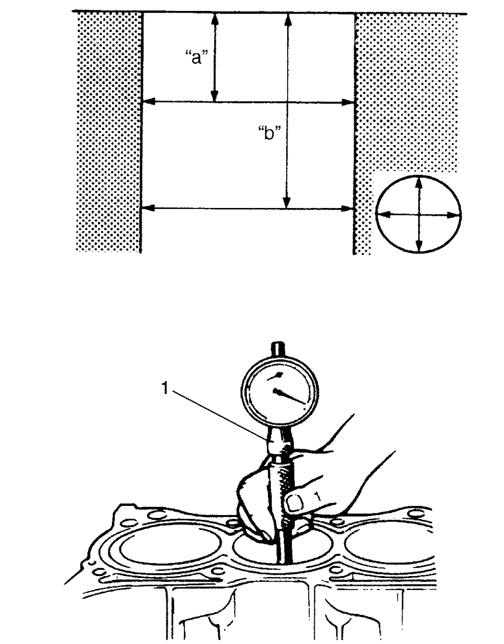
CLEANING

Decarbonize piston head and ring grooves, using a suitable tool.

INSPECTION

Cylinder

- Inspect cylinder walls for scratches, roughness or ridges which indicate excessive wear. If cylinder bore is very rough or deeply scratched or ridged, rebore cylinder and use oversize piston.



- Using a cylinder gauge (1), measure cylinder bore in thrust and axial directions at two positions ("a" and "b") as shown in figure.
  If any of the following conditions is noted, rebore cylinder.

1) Cylinder bore dia. exceeds limit.
2) Difference of measurements at two positions exceeds taper limit.
3) Difference between thrust and axial measurements exceeds out-of-round limit.

Cylinder bore diameter
Limit : 78.15 mm (3.077 in.)

Cylinder taper and out-of-round
Limit : 0.10 mm (0.004 in.)

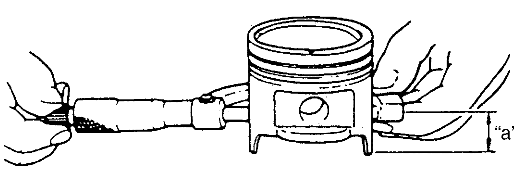
"a" : 50 mm (1.96 in.)
"b" : 95 mm (3.74 in.)

NOTE:

If any one of four cylinders has to be rebored, rebore all four to the same next oversize. This is necessary for the sake of uniformity and balance.

Pistons

- Inspect piston for faults, cracks or other damaged.
  Damaged or faulty piston should be replaced.

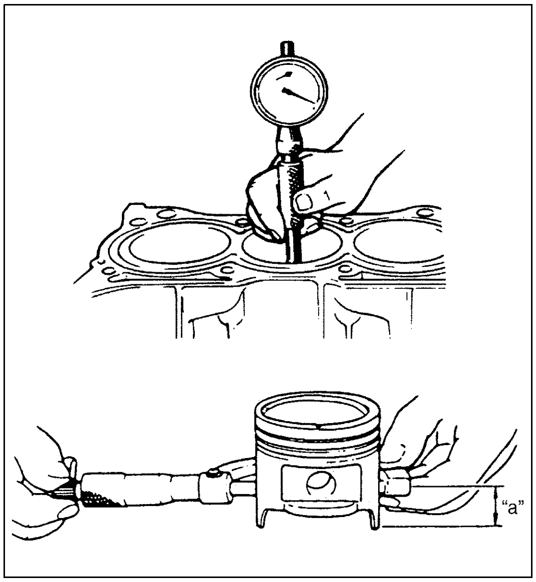


- Piston diameter :
  As indicated in figure, piston diameter should be measured at a position 19.5 mm (0.77 in.) from piston skirt end in the direction perpendicular to piston pin.

Piston diameter specification

Standard size	**77.953 – 77.968 mm (3.0690 – 3.0696 in.) with coating 77.969 – 77.984 mm (3.0696 – 3.0702 in.)**
Oversize 0.25 mm (0.0098 in.)	**78.203 – 78.218 mm (3.0789 – 3.0794 in.)**
Oversize 0.50 mm (0.0196 in.)	**78.453 – 78.468 mm (3.0887 – 3.0893 in.)**

"a" : 19.5 mm (0.77 in.)



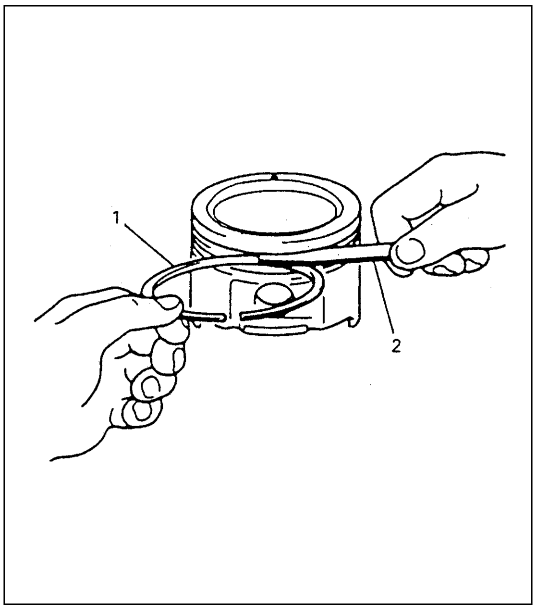
- Piston clearance:
  Measure cylinder bore diameter and piston diameter to find their difference which is piston clearance. Piston clearance should be within specification as given below. If it is out of specification, rebore cylinder and use oversize piston.

Piston clearance
: 0.032 – 0.061 mm (0.0013 – 0.0024 in.)
: 0.016 – 0.045 mm (0.0006 – 0.0018 in.) with coating

NOTE:

Cylinder bore diameters used here are measured in thrust direction at two positions.

“a” : 19.5 mm (0.77 in.)

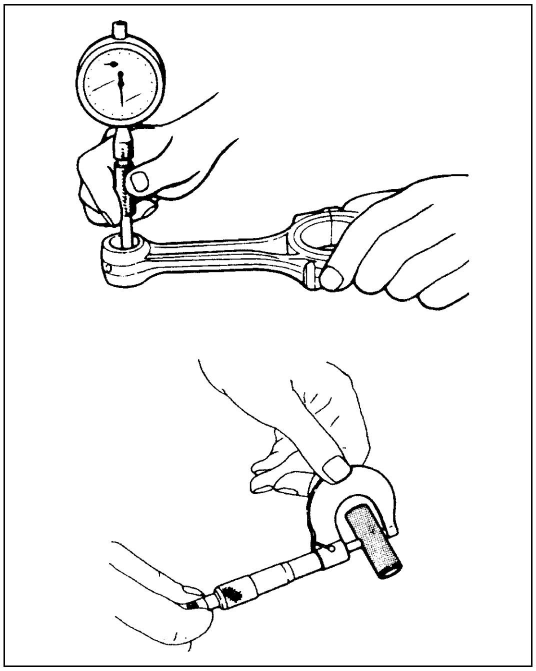


- Ring groove clearance:
  Before checking, piston grooves must be clean, dry and free of carbon deposits.
  Fit new piston ring (1) into piston groove, and measure clearance between ring and ring land by using thickness gauge (2). If clearance is out of limit, replace piston.

Ring groove clearance
Top ring
Standard : 0.03 – 0.07 mm (0.0012 – 0.0028 in.)
Limit : 0.12 mm (0.0047 in.)
2nd ring
Standard : 0.02 – 0.06 mm (0.0008 – 0.0024 in.)
Limit : 0.10 mm (0.0039 in.)
Oil ring
Standard : 0.03 – 0.17 mm (0.0012 – 0.0067 in.)

Piston Pin

- Check piston pin, connecting rod small end bore and piston bore for wear or damage, paying particular attention to condition of small end bore bush. If pin, connecting rod small end bore or piston bore is badly worn or damaged, replace pin, connecting rod and/or piston.



- Piston pin clearance :
  Check piston pin clearance in small end and piston. Replace connecting rod and/or piston if its small end is badly worn or damaged or if measured clearance exceeds limit.

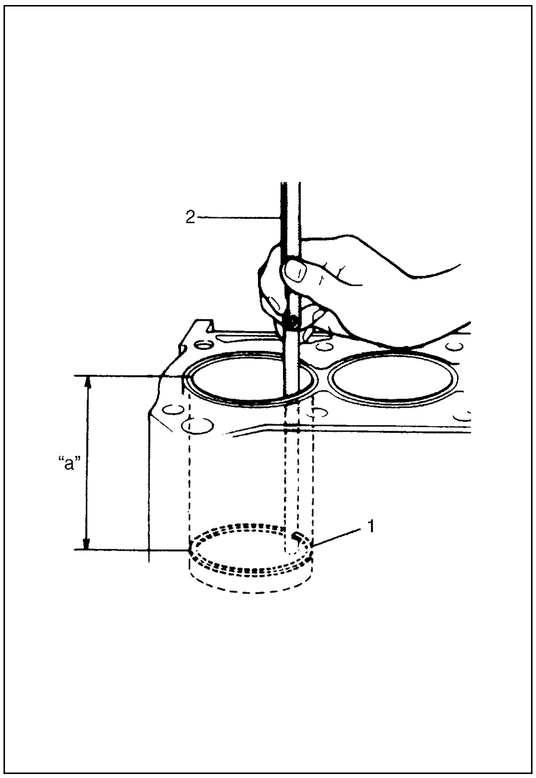
Piston pin clearance in connecting rod small end
: 0.003 – 0.014 mm (0.0001 – 0.0006 in.)

Piston pin clearance in piston
: 0.006 – 0.017 mm (0.00026 – 0.00067 in.)

Small-end bore
: 20.003 – 20.011 mm (0.7875 – 0.7878 in.)

Piston pin dia.
: 19.997 – 20.000 mm (0.7873 – 0.7874 in.)

Piston bore
: 20.006 – 20.014 mm (0.7870 – 0.7874 in.)



Piston Rings

To measure end gap, insert piston ring (1) into cylinder bore and then measure the gap by using thickness gauge (2).
If measured gap is out of specification, replace ring.

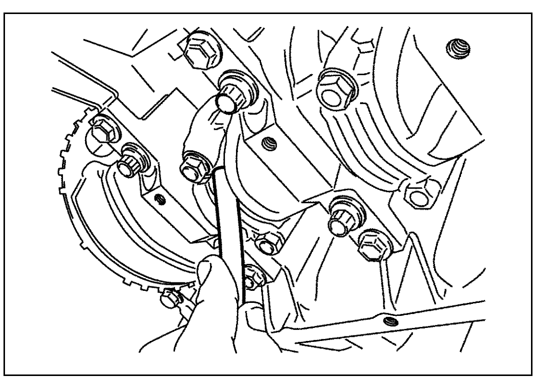
NOTE:
Decarbonize and clean top of cylinder bore before inserting piston ring.

Piston ring end gap

Item	Standard	Limit
Top ring	0.20 – 0.35 mm (0.0079 – 0.0138 in.)	0.7 mm (0.0276 in.)
2nd ring	0.30 – 0.45 mm (0.0118 – 0.0177 in.)	1.0 mm (0.0039 in.)
Oil ring	0.20 – 0.70 mm (0.0079 – 0.0276 in.)	1.5 mm (0.059 in.)

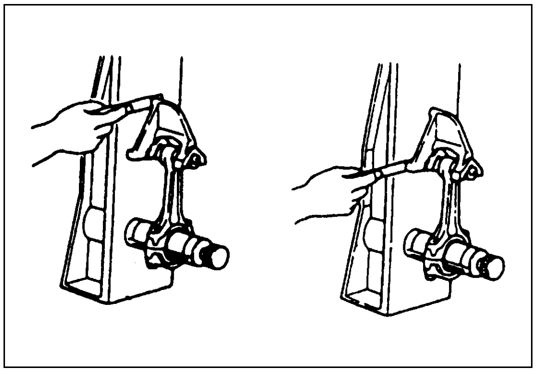
"a" : 120 mm (4.72 in.)

Connecting Rod



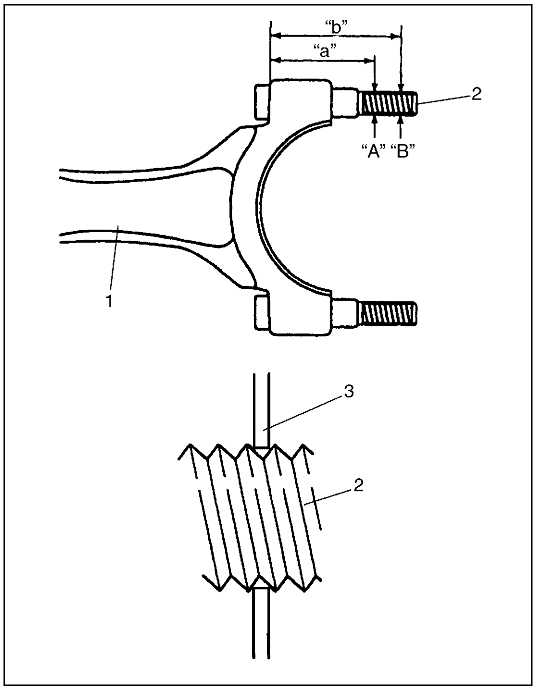
- Big-end side clearance:
  Check big-end of connecting rod for side clearance, with rod fitted and connected to its crank pin in the normal manner. If measured clearance is found to exceed its limit, replace connecting rod.

Big-end side clearance
Standard : 0.25 - 0.40 mm (0.0098 - 0.0157 in.)
Limit : 0.35 mm (0.0138 in.)



- Connecting rod alignment :
  Mount connecting rod on aligner to check it for bow and twist. If limit is exceeded, replace it.

Connecting rod alignment
Limit on bow : 0.05 mm (0.0020 in.)
Limit on twist : 0.10 mm (0.0039 in.)

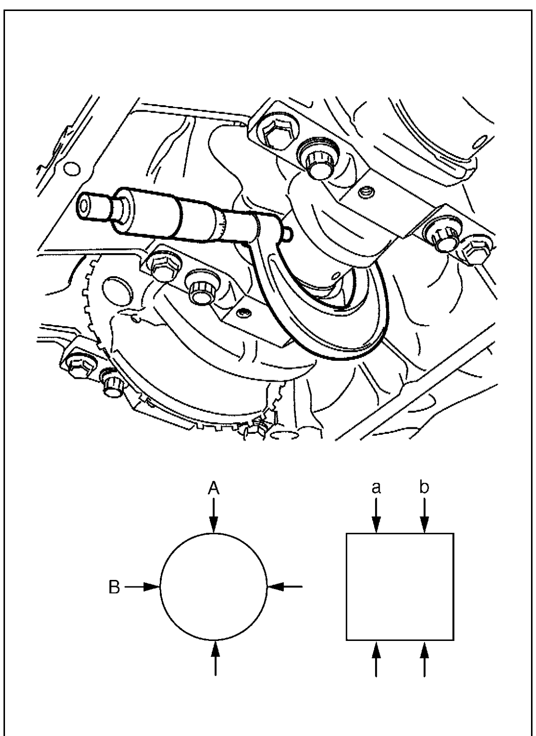


- Connecting rod bolt deformation (Plastic deformation tightening bolt)
  Measure connecting rod (1) bolt (2) for diameter "A" on 32 mm (1.25 in.) from bolt mounting surface and diameter "B" on 40 mm (1.57 in.) from bolt mounting surface by using a micrometer (3).
  Bolt diameter difference should be specification as given below. If it is out of specification, replace connecting rod.

Connecting rod bolt diameter difference
limit ("A" – "B") : 0.1 mm (0.004 in.)

Connecting rod bolt measurement distance
"a" : 32 mm (1.25 in.)
"b" : 40 mm (1.57 in.)

Crank Pin and Connecting Rod Bearings

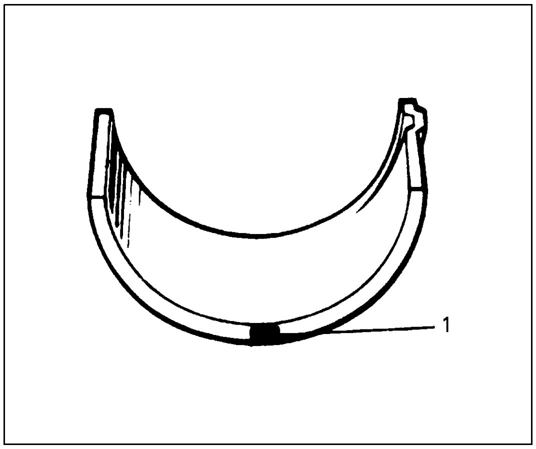


- Inspect crank pin for uneven wear or damage. Measure crank pin for out-of-round or taper with a micrometer. If crank pin is damaged or out-of round or taper is out of limit, replace crankshaft or regrind crank pin to undersize and use undersize bearing.

Crank pin diameter

Connecting rod bearing size	Crank pin diameter
Standard	41.982 – 42.000 mm (1.6528 – 1.6535 in.)
Undersize 0.25 mm (0.0098 in.)	41.732 – 41.750 mm (1.6430 – 1.6437 in.)

Crank pin taper and out-of-round
Limit : 0.01 mm (0.0004 in.)
Out-of-round : A – B
Taper : a – b

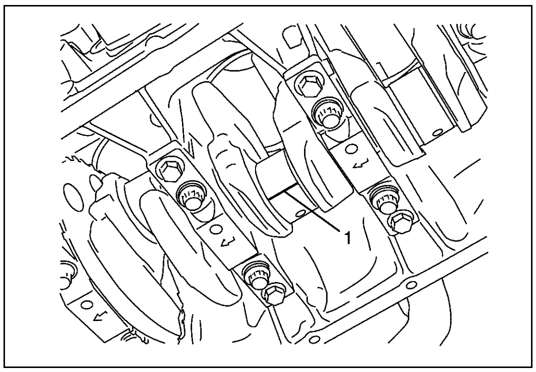


- Rod bearing :
  Inspect bearing shells for signs of fusion, pitting, burn or flaking and observe contact pattern. Bearing shells found in defective condition must be replaced.
  Two kinds of rod bearing are available; standard size bearing and 0.25 mm (0.0098 in.) undersize bearing. For identification of undersize bearing, it is painted red at the position as indicated in figure, undersize bearing thickness is 1.605 – 1.615 mm (0.0632 – 0.0635 in.) at the center of it.

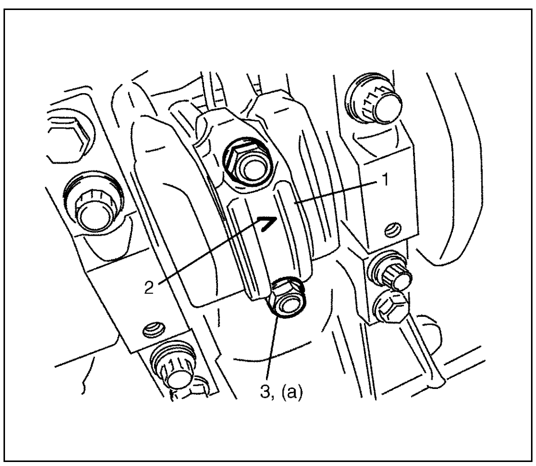
1. Red paint

- Rod bearing clearance :

1) Before checking bearing clearance, clean bearing and crank pin.
2) Install bearing in connecting rod and bearing cap.

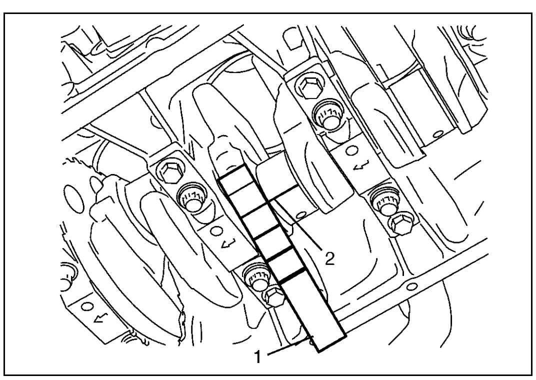


3) Place a piece of gaging plastic (1) to full width of crank pin as contacted by bearing (parallel to crankshaft), avoiding oil hole.



4) Install rod bearing cap (1) to connecting rod.
   When installing cap, be sure to point arrow mark (2) on cap to crankshaft pulley side, as shown in figure. After applying engine oil to rod bolts and tighten cap nuts (3) gradually as follows.
   a) Tighten all cap nuts to 15 N·m (1.5 kg-m, 11.0 lb-ft).
   b) Retighten them to 45°.
   c) Repeat step b) once again.

Tightening torque
Connecting rod bearing cap nuts
(a) : 15 N·m (1.5 kg-m, 11.0 lb-ft) and extra tighten 90°



5) Remove cap and using a scale (1) on gaging plastic (2) envelope, measure gaging plastic width at the widest point (clearance).
   If clearance exceeds its limit, use a new standard size bearing and remeasure clearance.

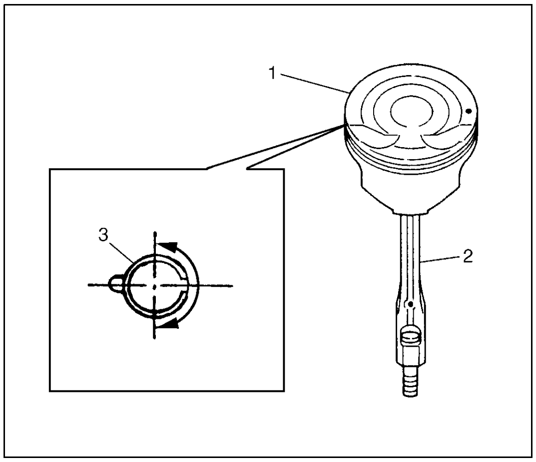
Connecting rod bearing clearance
Standard : 0.029 – 0.047 mm (0.0011 – 0.0019 in.)
Limit : 0.065 mm (0.0026 in.)

6) If clearance can not be brought to within its limit even by using a new standard size bearing, regrind crankpin to undersize and use 0.25 mm undersize bearing.

NOTE:

After checking the rod bearing clearance, make sure that checking for Connecting rod bolt deformation.
Refer to "INSPECTION" of "CONNECTING ROD".

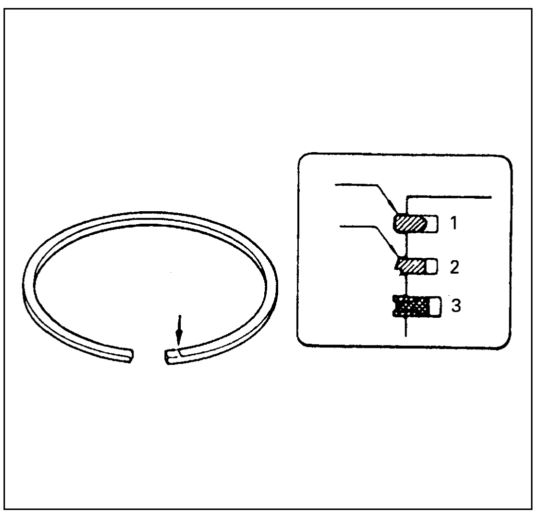
ASSEMBLY



1) Install piston pin to piston (1) and connecting rod (2) :
   a) After applying engine oil to piston pin and piston pin holes in piston and connecting rod.
   b) Fit connecting rod as shown in figure.
   c) Insert piston pin to piston and connecting rod.
   d) Install piston pin circlips (3).

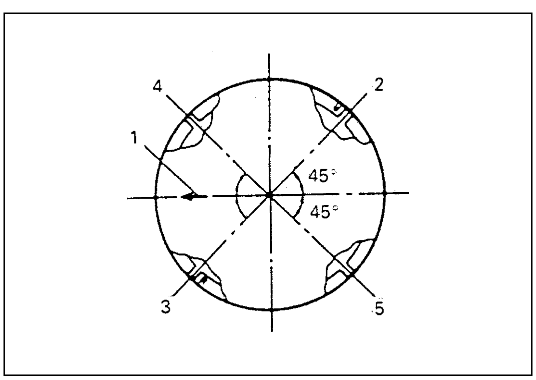
NOTE:

Circlip should be installed with its cut part facing as shown in figure. Install so that circlip end gap comes within such range as indicated by arrow.



2) Install piston rings to piston :
   a) As indicated in figure, 1st and 2nd rings have "T" mark respectively. When installing these piston rings to piston, direct marked side of each ring toward top of piston.
   b) 1st ring (1) differs from 2nd ring (2) in thickness, shape and color of surface contacting cylinder wall.
      Distinguish 1st ring from 2nd ring by referring to figure.
   c) When installing oil ring (3) install spacer first and then two rails.

1.	1st ring
2.	2nd ring
3.	Oil ring



3) After installing three rings (1st, 2nd and oil rings), distribute their end gaps as shown in figure.

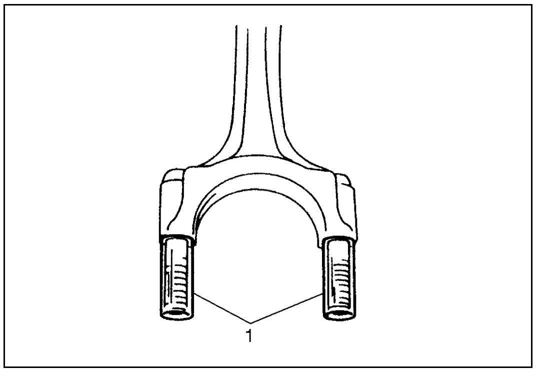
1.	Arrow mark
2.	1st ring end gap
3.	2nd ring end gap and oil ring spacer gap
4.	Oil ring upper rail gap
5.	Oil ring lower rail gap

INSTALLATION

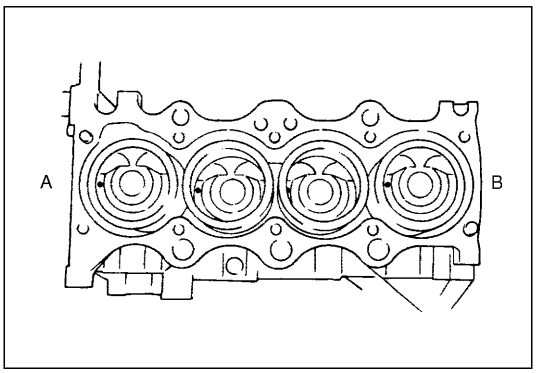
1) Apply engine oil to pistons, rings, cylinder walls, connecting rod bearings and crankpins.

NOTE:

Do not apply oil between connecting rod and bearing or between bearing cap and bearing.

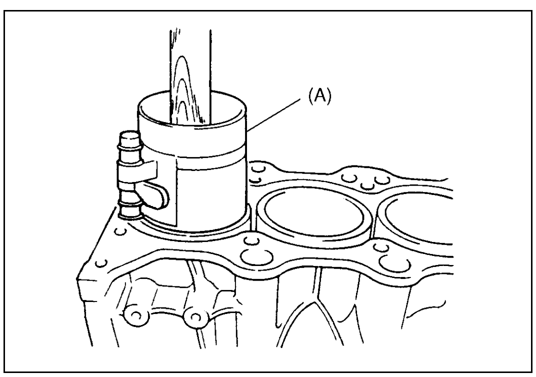


2) Install guide hoses (1) over connecting rod bolts.
These guide hoses protect crank pin and threads of rod bolt from damage during installation of connecting rod and piston assembly.



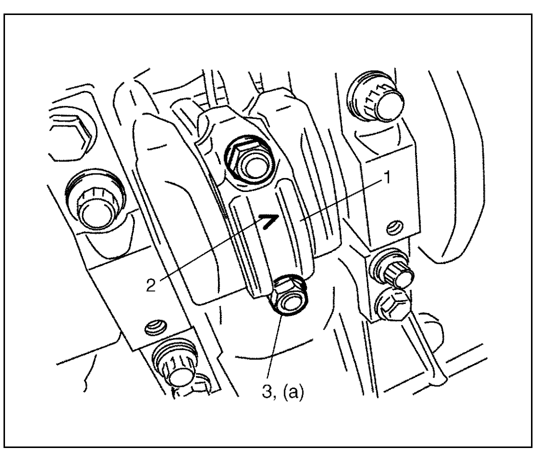
3) When installing piston and connecting rod assembly into cylinder bore, point front mark on piston head to crankshaft pulley side.

A :	Crankshaft pulley side
B :	Flywheel side



4) Install piston and connecting rod assembly into cylinder bore. Use special tool (Piston ring compressor) to compress rings. Guide connecting rod into place on crankshaft.
Using a hammer handle, tap piston head to install piston into bore. Hold ring compressor firmly against cylinder block until all piston rings have entered cylinder bore.

Special tool
(A) : 09916-77310



5) Install bearing cap (1):
Point arrow mark (2) on cap to crankshaft pulley side.
After applying oil to rod bolts and tighten cap nuts (3) gradually as follows.

a) Tighten all cap nuts to 15 N·m (1.5 kg-m, 11.0 lb-ft).
b) Retighten them to 45°.
c) Repeat Step b) once again.

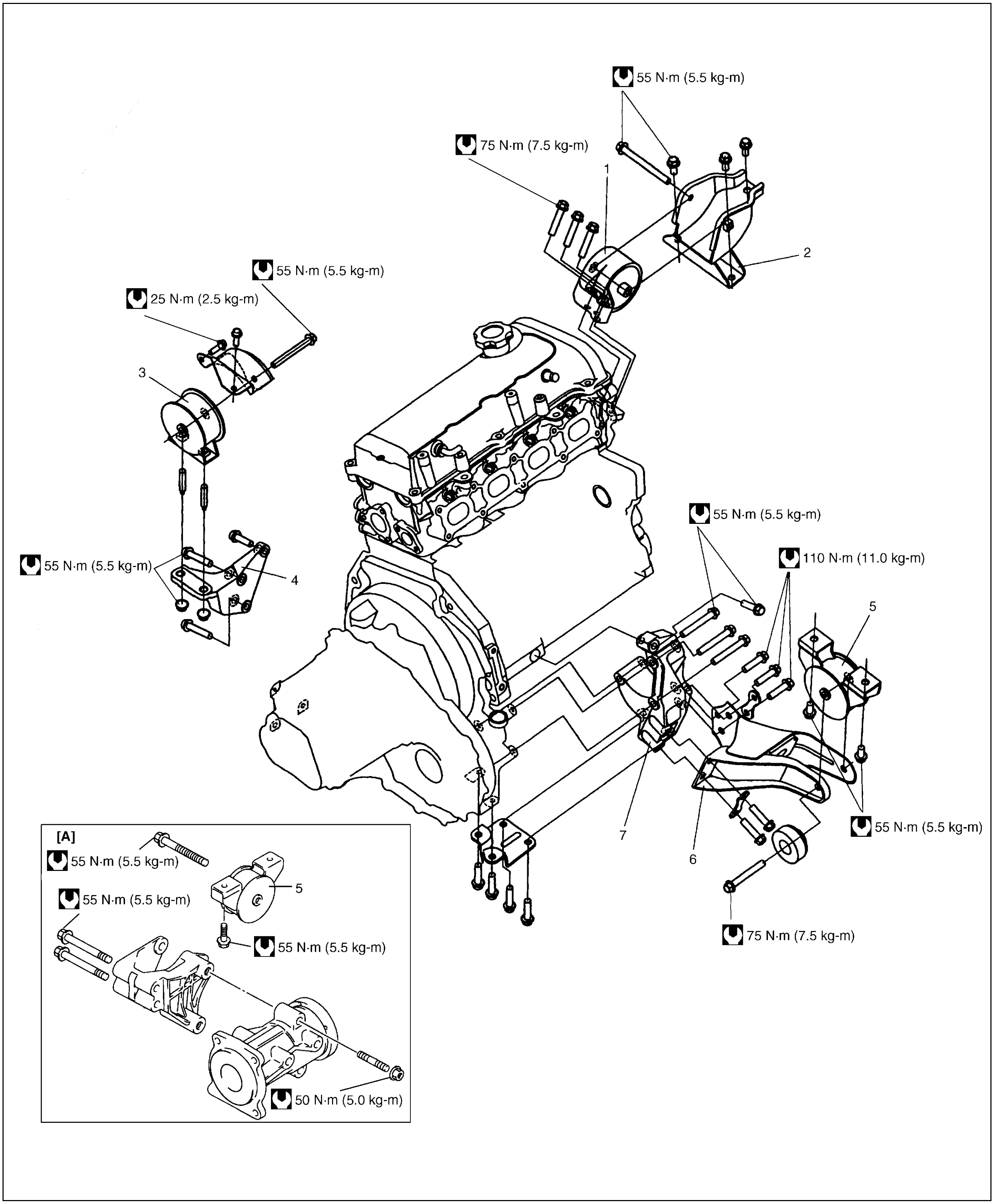
Tightening torque
Connecting rod bearing cap nuts
(a) : 15 N·m (1.5 kg-m, 11.0 lb-ft) and then turn to 45° twice.

NOTE:

Before installing bearing cap, make sure that checking for connecting rod bolt deformation.
Refer to "INSPECTION" of "CONNECTING ROD".

6) Reverse removal procedure for installation as previously outlined.
7) Adjust water pump belt tension referring to Section 6B.
8) Adjust A/C compressor belt tension (if equipped) referring to Section 1B.
9) Adjust accelerator cable play referring to Section 6E1.
10) Check to ensure that all removed parts are back in place. Reinstall any necessary parts which have not been reinstalled.
11) Refill cooling system with coolant engine with engine oil.
12) Connect negative cable at battery.
13) Verify that there is no fuel leakage, coolant leakage, oil leakage and exhaust gas leakage at each connection.

ENGINE MOUNTINGS



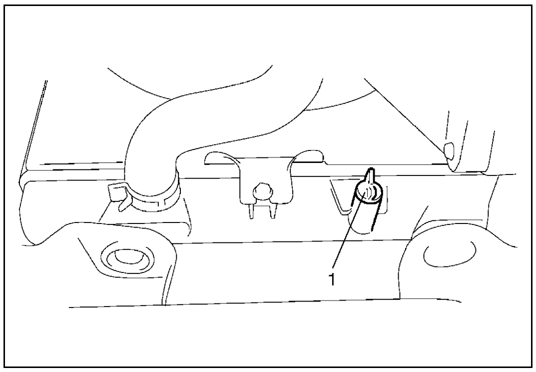
[A] : 4WD MODEL	3. Engine left mounting	6. Engine rear mounting No.1 bracket
1. Engine right mounting	4. Engine left mounting bracket	7. Engine rear mounting No.2 bracket
2. Engine right body side bracket	5. Engine rear mounting	Tightening torque

UNIT REPAIR OVERHAUL

ENGINE ASSEMBLY

REMOVAL

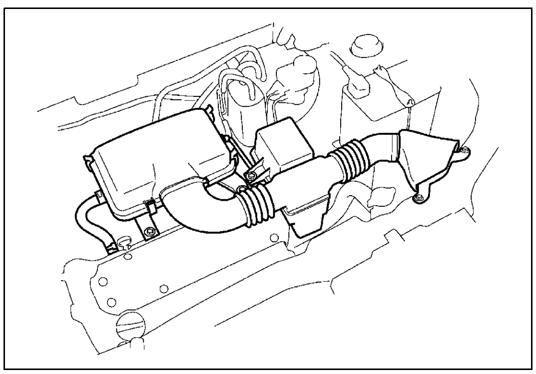
1) Relieve fuel pressure according to procedure described in Section 6.
2) Disconnect negative and positive cables at battery.
3) Remove engine hood after disconnecting windshield washer hose.
4) Remove right and left side engine under covers.
5) Remove A/C compressor belt (if equipped).
6) Remove water pump belt.
7) Drain engine oil, transmission oil or A/T fluid (for A/T vehicle) and transfer oil (for 4WD vehicle).



8) Drain coolant.

WARNING:

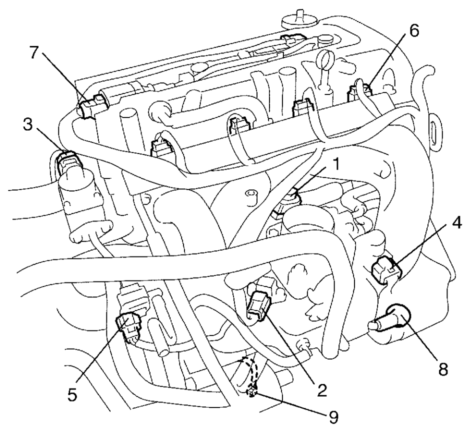
To help avoid danger of being burned, do not remove drain plug (1) and radiator cap while engine and radiator are still hot. Scalding fluid and steam can be blown out under pressure if plug and cap are taken off too soon.

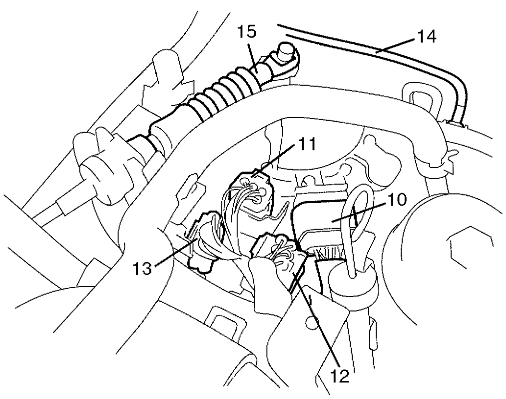


9) Remove air cleaner assembly, resonator and hoses referring to "AIR CLEANER ASSEMBLY AND RESONATOR".
10) With hose connected, detach A/C compressor from its bracket (if equipped).

NOTE:

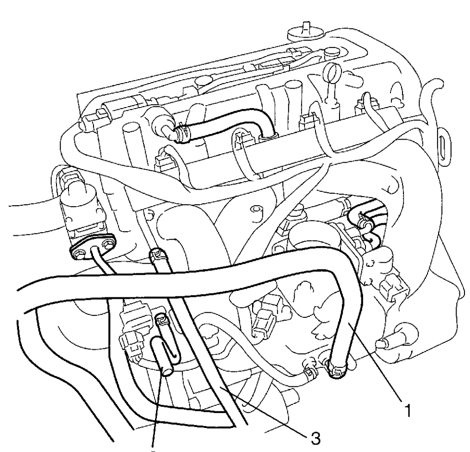
Suspend removed A/C compressor at a place where no damage will be caused during removal and installation of engine assembly.



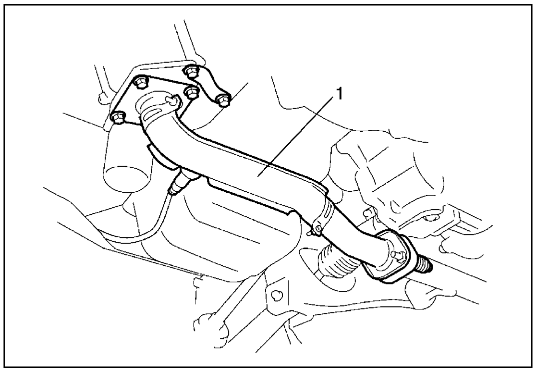


11) Disconnect the following electric lead wires:
- TP sensor (1)
- MAP sensor (2)
- ECT sensor
- CMP sensor
- CKP sensor
- Knock sensor
- Heated oxygen sensors
- EGR valve (3)
- IAC valve (4)
- EVAP canister purge valve (5)
- Injectors (6)
- Ignition coil assembly (7)
- Engine oil pressure switch
- Generator (8)
- Starting motor
- Magnet clutch switch of A/C compressor (if equipped)
- Ground terminal (9) from exhaust manifold and cylinder block
- VSS
- Back up light switch (For M/T vehicle)
- Transmission range switch (10) (For A/T vehicle)
- A/T VSS (11) (For A/T vehicle)
- Dropping resistor (12) (For A/T vehicle)
- A/T shift solenoid and A/T temp. sensor (13) (For A/T vehicle)
- Battery ground cable (14) from transmission
- Each wire harness clamps

12) Remove fuse box from its bracket.
13) Disconnect the following cables :
- Accelerator cable
- Gear select control cable (For M/T vehicle)
- Gear shift control cable (For M/T vehicle)
- Clutch cable (For M/T vehicle)
- Gear select cable (15) (For A/T vehicle)

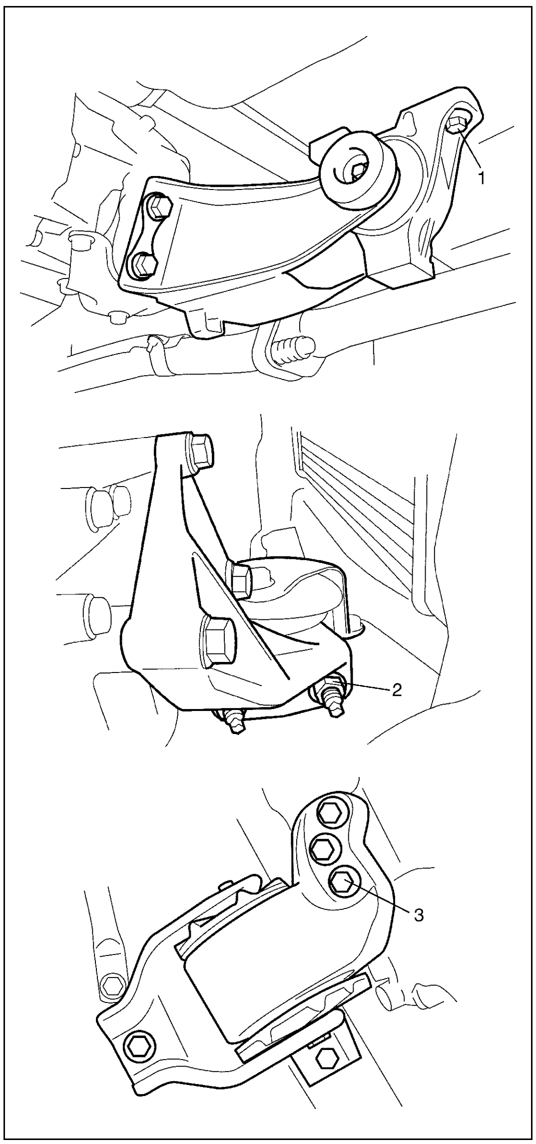


14) Disconnect the following hoses :
- Brake booster hose (1) from intake manifold
- Canister purge hose (2) from EVAP canister purge valve
- Fuel feed hose (3) from fuel delivery pipe
- Heater inlet and outlet hoses from each pipe
- Radiator inlet and outlet hoses from each pipe

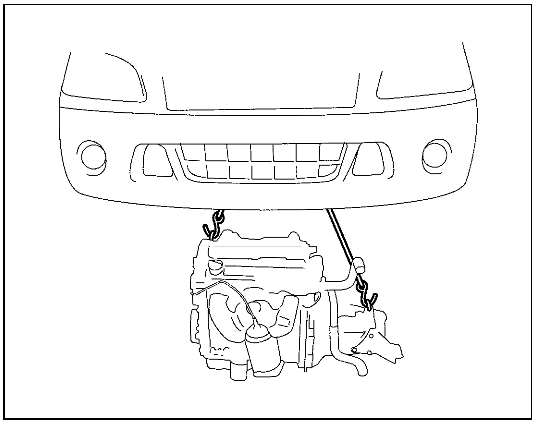


15) Remove exhaust No.1 pipe (1).

16) Disconnect right and left drive shaft joints from differential gear referring to Section 4.
    For engine and transmission removal, it is not necessary to remove drive shafts from steering knuckle.
17) For 4WD vehicle, remove propeller shaft referring to Section 4B.
18) Remove generator referring to Section 6H.



19) Install lifting device.
20) Remove engine rear mounting bolts (1), engine left mounting bracket nuts (2) and engine right mounting bolts (3).



21) Before removing engine with transmission from body, recheck to make sure all hoses, electric wires and cables are disconnected from engine and transmission.
22) Lower engine with transmission from body.

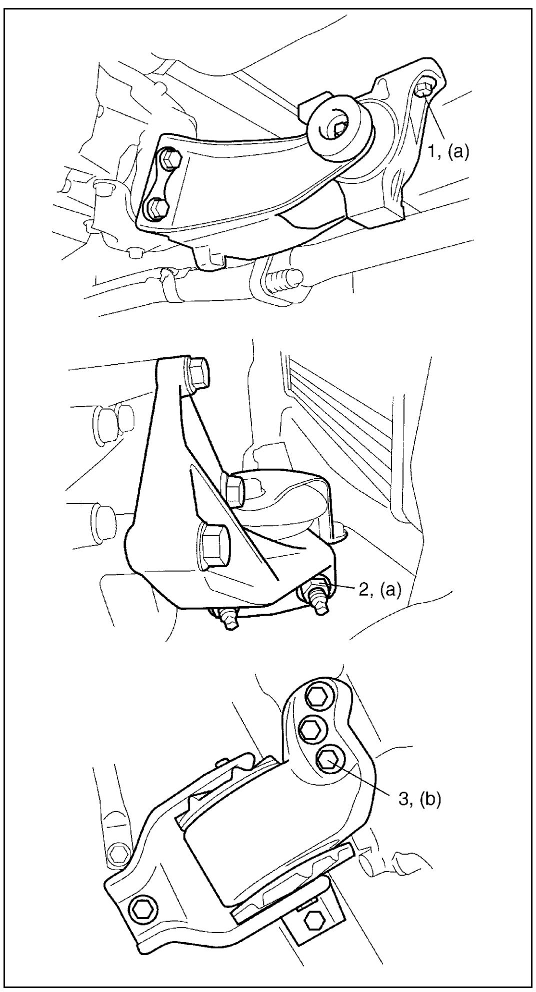
NOTE:

Before lowering engine, to avoid damage to A/C compressor, raise it through clearance made on engine crankshaft pulley side. At this time, use care so that no excessive force is applied to hoses.

23) Disconnect transmission from engine, referring to Section 7A or 7B.
24) Remove clutch cover and clutch disk, referring to Section 7C (M/T).

INSTALLATION

1) Install clutch cover and clutch disk referring to Section 7C.
2) Connect transmission to engine referring to Section 7A or 7B.
3) Lift engine with transmission into engine compartment, but do not remove lifting device.

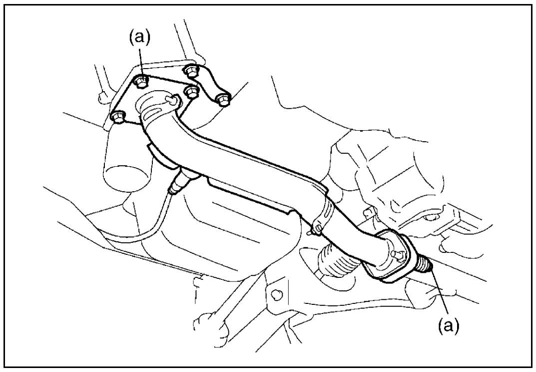


4) Install engine rear mounting bolts (1), engine left mounting bracket nuts (2) and engine right mounting bolts (3).
Tighten these bolts and nuts to specified torque.

Tightening torque
Engine mounting bolts and nuts for M10
(a) : 55 N·m (5.5 kg-m, 40.0 lb-ft)
Engine mounting bolt for M12
(b) : 75 N·m (7.5 kg-m, 54.5 lb-ft)

5) Remove lifting device.

6) Install generator referring to Section 6H.
7) For 4WD vehicle, install propeller shaft referring to Section 4B.
8) Connect drive shaft joints referring to Section 4.

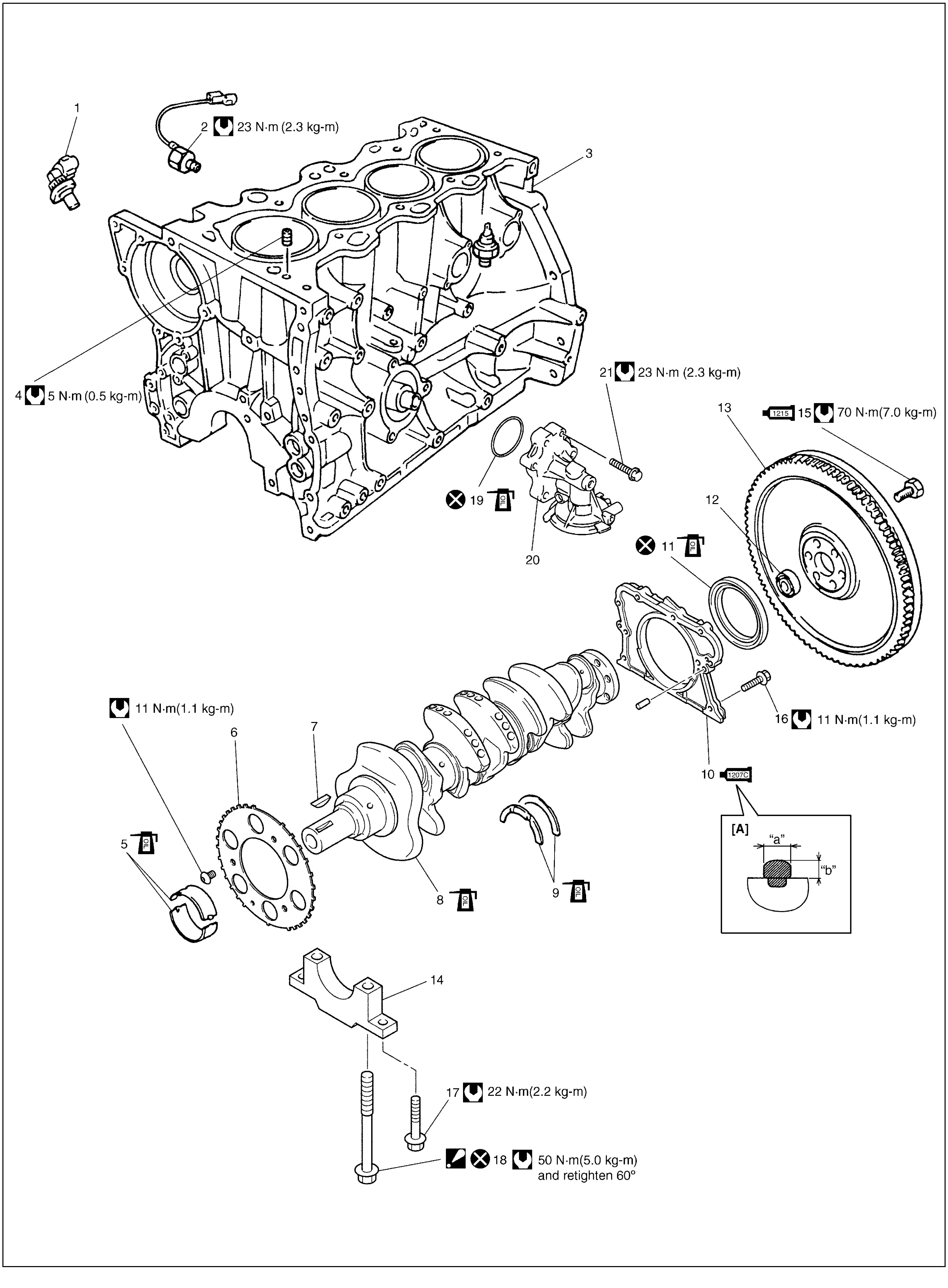


9) Install exhaust No.1 pipe and tighten pipe fasteners to specified torque.

Tightening torque
Exhaust No.1 pipe bolts (a) : 50 N·m (5.0 kg-m, 36.5 lb-ft)

10) Reverse disconnected hoses, cables and electric wires for connection.
11) Install air cleaner assembly, resonator and hoses referring to “AIR CLEANER ASSEMBLY AND RESONATOR”
12) Install A/C compressor to bracket (if equipped).
13) Adjust water pump belt tension referring to Section 6B.
14) Adjust A/C compressor belt tension (if equipped) referring to Section 1B.
15) Adjust accelerator cable play referring to Section 6E1.
16) Check to ensure that all removed parts are back in place. Reinstall any necessary parts which have not been reinstalled.
17) Refill cooling system with coolant engine with engine oil and A/T with specified A/T fluid (vehicle with A/T).
18) Connect negative cable at battery.
19) Verify that there is no fuel leakage, coolant leakage, oil leakage, A/T fluid leakage (vehicle with A/T) and exhaust gas leakage at each connection.

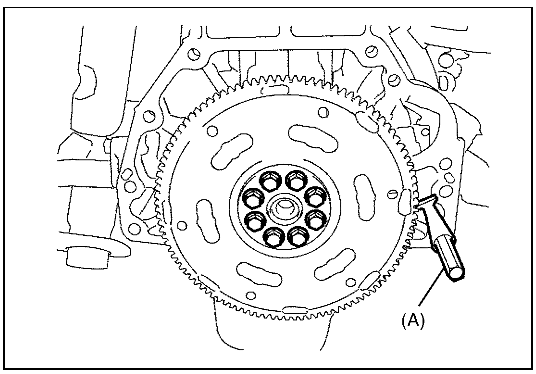
MAIN BEARINGS, CRANKSHAFT AND CYLINDER BLOCK



[A] :	Sealant application amount	4.	Venturi plug	14.	Main bearing cap
[B] :	1) Tighten all bolts to 50 N·m (5.0 kg-m) 2) Then, turn all bolts to 60°	5.	Main bearing	1215 15.	Flywheel mounting bolt
	Tightening torque	6.	Sensor plate	16.	Rear oil seal housing mounting bolt
	Do not reuse.	7.	Crankshaft timing sprocket key	17.	Main bearing mounting No.2 bolt
	Apply engine oil to inside / sliding surface.	8.	Crankshaft	18.	Main bearing mounting No.1 bolt Never reuse it due to plastic deformation tightening bolt.
“a” :	3 mm (0.12 in.)	9.	Thrust bearing	19.	O-ring
“b” :	2 mm (0.08 in.)	1207C 10.	Rear oil seal housing : Apply sealant 99000-31150 to mating surface.	20.	Oil filter adapter case
1.	CKP sensor (if equipped)	11.	Rear oil seal	21.	Oil filter adapter bolt
2.	Knock sensor	12.	Input shaft bearing		
3.	Cylinder block	13.	Flywheel		

REMOVAL

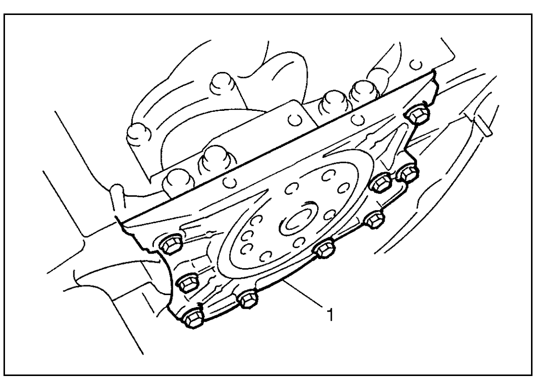
1) Remove engine assembly from vehicle as previously outlined.



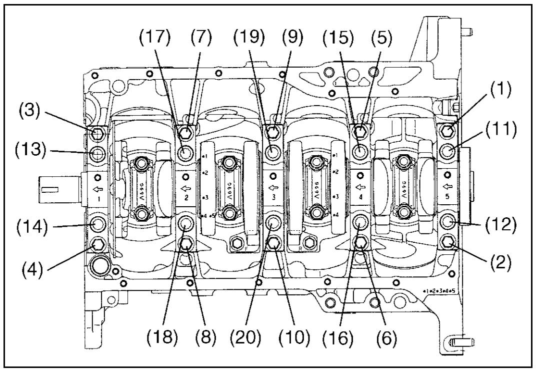
2) Remove clutch flywheel (drive plate for A/T) by using special tool.

Special tool
(A) : 09924-17810

3) Remove the following parts from engine as previously outlined.
- Oil pan and oil pump strainer
- Intake manifold and exhaust manifold
- Cylinder head cover
- Timing chain cover
- Timing chain guide, chain tensioner adjuster, chain tensioner, timing chain and crankshaft timing sprocket
- Camshaft, tappet and shim
- Cylinder head assembly
- Piston and connecting rod



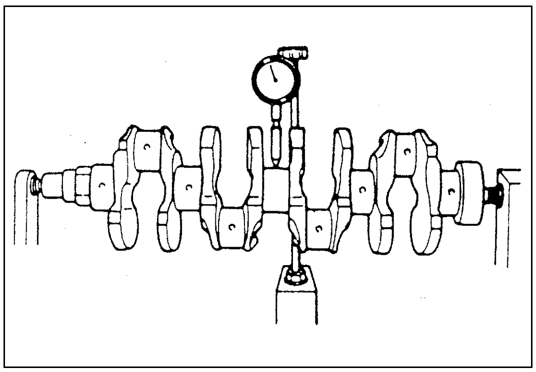
4) Remove rear oil seal housing (1).



5) Loosen bearing cap No.1 and No.2 bolts in such order as indicated in figure and remove them.
6) Remove crankshaft from cylinder block.

INSPECTION

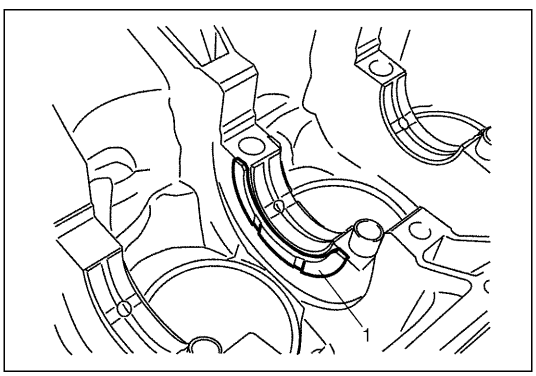
Crankshaft



Crankshaft runout

Using a dial gauge, measure runout at center journal. Rotate crankshaft slowly. If runout exceeds its limit, replace crankshaft.

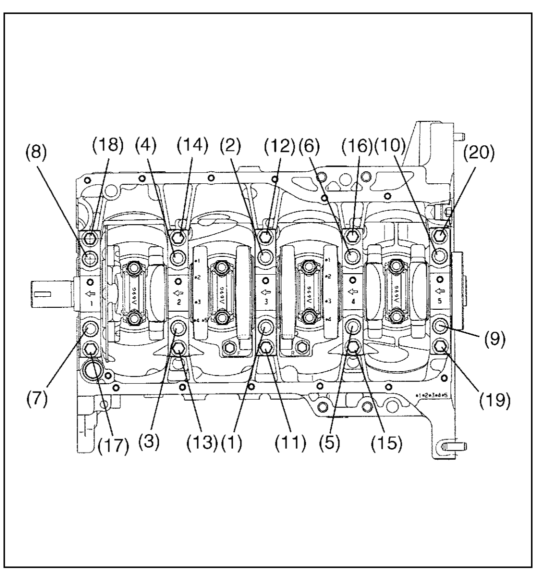
Crankshaft runout
Limit : 0.04 mm (0.0016 in.)



Crankshaft thrust play

Measure this play with crankshaft set in cylinder block in the normal manner, that is with thrust bearing (1) and journal bearing caps installed.

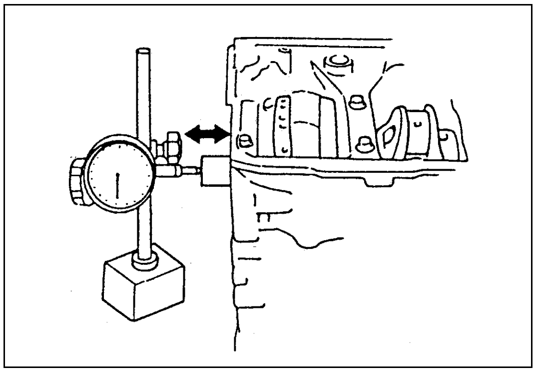
Thickness of crankshaft thrust bearing
Standard : 2.500 mm (0.0984 in.)
Oversize (0.125 mm (0.0049 in.)) : 2.563 mm (0.1009 in.)



Tighten bearing cap No.1 bolts (1) – (10) and No.2 bolts (11) – (20) gradually as follows.

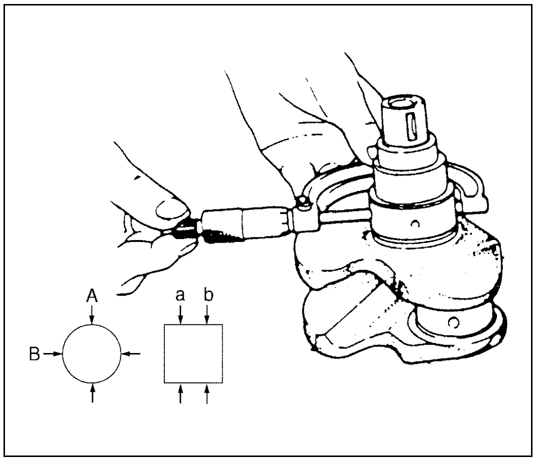
1) Tighten bolts (1) – (10) to 30 N·m (3.0 kg-m, 22.0 lb-ft) according to numerical order in figure.
2) In the same manner as in Step 1), tighten them to 50 N·m (5.0 kg-m, 36.5 lb-ft).
3) Tighten bolts (11) – (20) to 22 N·m (2.2 kg-m, 16.0 lb-ft) according to numerical order in figure.

Tightening torque
Crank shaft bearing cap No.1 bolts (1) – (10)
: 50 N·m (5.0 kg-m, 36.5 lb-ft)
Crank shaft bearing cap No.2 bolts (11) – (20)
: 22 N·m (2.2 kg-m, 16.0 lb-ft)



Use a dial gauge to read displacement in axial (thrust) direction of crankshaft.
If its limit is exceeded, replace thrust bearing with new standard one or oversize one to obtain standard thrust play.

Crankshaft thrust play
Standard : 0.11 – 0.31 mm (0.0043 – 0.0122 in.)
Limit : 0.35 mm (0.0138 in.)



Out-of-round and taper (uneven wear) of journals

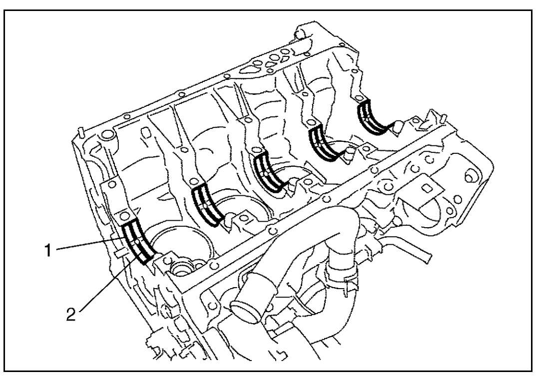
An unevenly worn crankshaft journal shows up as a difference in diameter at a cross section or along its length (or both). This difference, if any, is determined by taking micrometer readings. If any one of journals is badly damaged or if amount of uneven wear in the sense explained above exceeds its limit, regrind or replace crankshaft.

Crankshaft out-of-round and taper
Limit : 0.01 mm (0.0004 in.)
Out-of-round : A – B
Taper : a – b

Main Bearings

General information

- Service main bearings are available in standard size and 0.25 mm (0.0098 in.) undersize, and each of them has 5 kinds of bearings differing in tolerance.



- Upper half of bearing (1) has an oil groove (2) as shown in figure.
  Install this half with oil groove to cylinder block.
- Lower half of bearing does not have an oil groove.

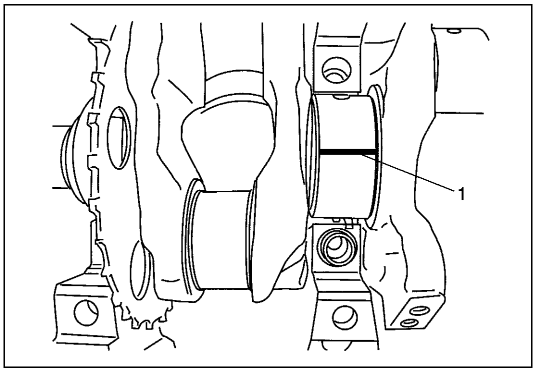
Visual inspection

Check bearings for pitting, scratches, wear or damage.
If any malcondition is found, replace both upper and lower halves.
Never replace either half without replacing the other half.

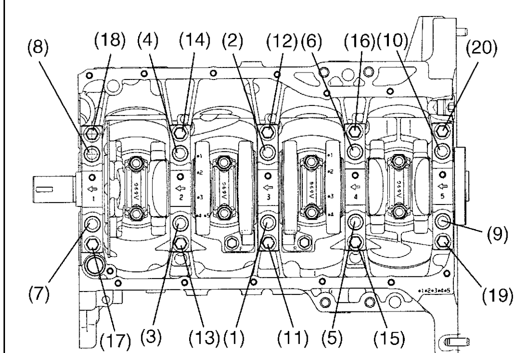
Main bearing clearance

Check clearance by using gaging plastic according to the following procedure.

1) Remove bearing caps.
2) Clean bearings and main journals.



3) Place a piece of gaging plastic (1) the full width of bearing (parallel to crankshaft) on journal, avoiding oil hole.

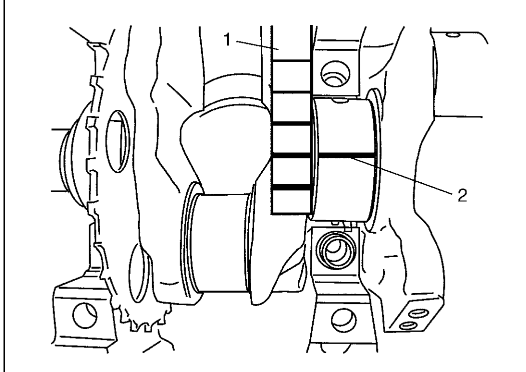


4) Tighten bearing cap No.1 bolts (1) – (10) and No.2 bolts (11) – (20) gradually as follows.
   a) Tighten bolts (1) – (10) to 30 N·m (3.0 kg-m, 22.0 lb-ft) according to numerical order in figure.
   b) In the same manner as in Step a), tighten them to 50 N·m (5.0 kg-m, 36.5 lb-ft).
   c) In the same manner as in step a), retighten them to 60°.
   d) Tighten bolts (11) – (20) to 22 N·m (2.2 kg-m, 16.0 lb-ft) according to numerical order in figure.

Tighting torque
Crank shaft bearing No.1 bolts (1) – (10)
: 50 N·m (5.0 kg-m, 36.5 lb-ft) and extra tighten 60°
Crank shaft bearing No.2 bolts (11) – (20)
: 22 N·m (2.2 kg-m, 16.0 lb-ft)

NOTE:

Do not rotate crankshaft while gaging plastic is installed.



5) Remove bearing caps and using scale (1) on gaging plastic (2) envelop, measure gaging plastic width at its widest point. If clearance exceeds its limit, replace bearing. Always replace both upper and lower inserts as a unit.
   A new standard bearing may produce proper clearance. If not, it will be necessary to regrind crankshaft journal for use of 0.25 mm undersize bearing.
   After selecting new bearing, recheck clearance.

Main bearing clearance
Standard : 0.025 – 0.045 mm (0.0010 – 0.0018 in.)
Limit : 0.065 mm (0.0026 in.)

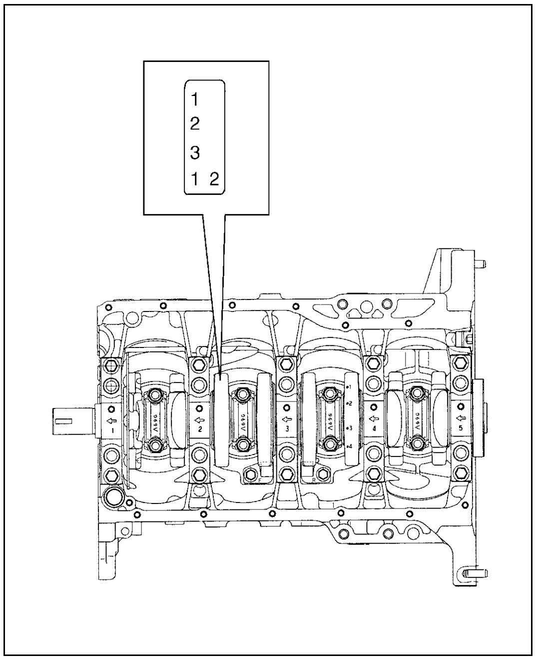
NOTE:

After checking main bearing clearance, make sure that replace bearing cap No.1 bolts new one.

Selection of main bearings

STANDARD BEARING :

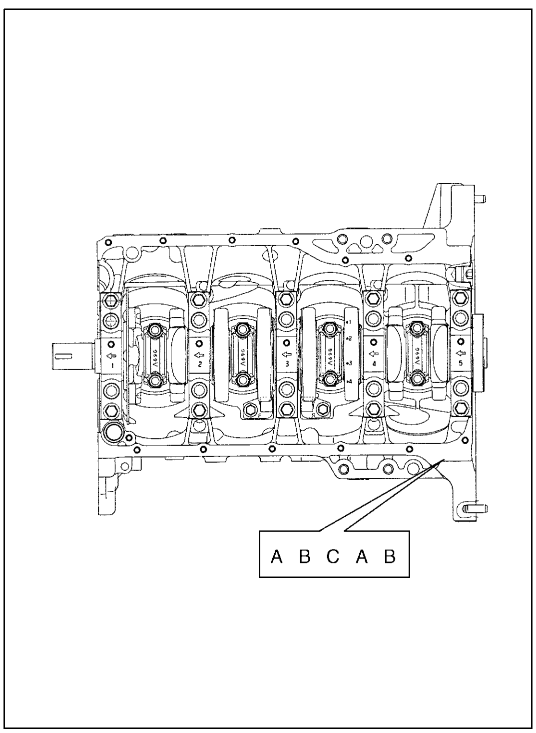
If bearing is in malcondition, or bearing clearance is out of specification, select a new standard bearing according to the following procedure and install it.



1) First check journal diameter. As shown in figure, crank web No.2 has stamped numbers.
   Three kinds of numbers (“1”, “2” and “3”) represent the following journal diameters.
   Stamped numbers on crank web No.2 represent journal diameters marked with an arrow in figure respectively.
   For example, stamped number “1” indicates that corresponding journal diameter is 44.994 – 45.000 mm (1.7714 – 1.7717 in.).

Crankshaft journal diameter

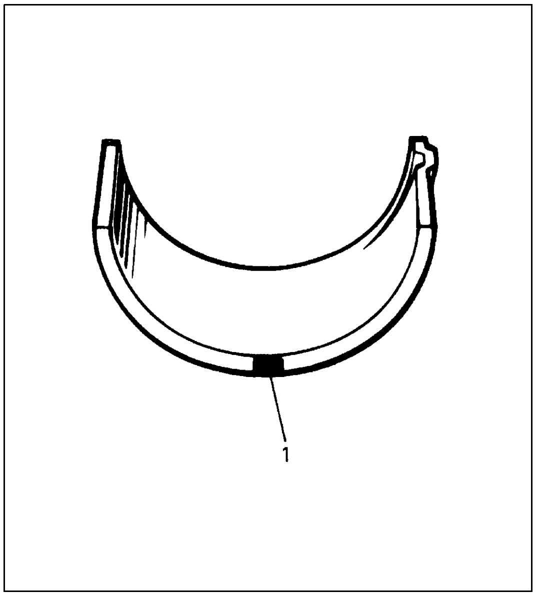
Stamped numbers	Journal diameter
1	44.994 – 45.000 mm (1.7714 – 1.7717 in.)
2	44.988 – 44.994 mm (1.7712 – 1.7714 in.)
3	44.982 – 44.988 mm (1.7709 – 1.7712 in.)



2) Next, check bearing cap bore diameter without bearing. On mating surface of cylinder block, five alphabets are stamped as shown in figure.
   Three kinds of alphabets (“A”, “B” and “C”) represent the following cap bore diameters.
   Stamped alphabets on cylinder block represent bearing cap bore diameter marked with an arrow in figure respectively.
   For example, stamped “A” indicates that corresponding bearing cap bore diameter is 49.000 – 49.006 mm (1.9291 – 1.9294 in.).

Crankshaft bearing cap bore

Stamped alphabet	Bearing cap bore diameter (without bearing)
A	49.000 - 49.006 mm (1.9291 - 1.9294 in.)
B	49.006 - 49.012 mm (1.9294 - 1.9296 in.)
C	49.012 - 49.018 mm (1.9296 - 1.9298 in.)



3) There are five kinds of standard bearings differing in thickness. To distinguish them, they are painted in the following colors at the position as indicated in figure.
   Each color indicated the following thickness at the center of bearing.

Standard size of crankshaft main bearing thickness

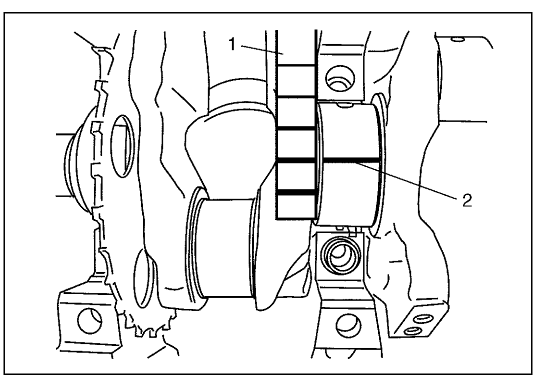
Color painted	Bearing thickness
Pink	1.990 – 1.994 mm (0.0783 – 0.0785 in.)
Purple	1.993 – 1.997 mm (0.0785 – 0.0786 in.)
Brown	1.996 – 2.000 mm (0.0786 – 0.0787 in.)
Green	1.999 – 2.003 mm (0.0787 – 0.0789 in.)
Black	2.002 – 2.006 mm (0.0788 – 0.0790 in.)

1. Paint

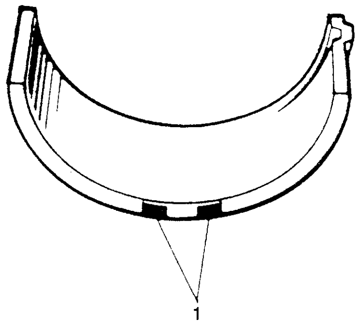
4) From number stamped on crank web No.2 and alphabets stamped on cylinder block, determine new standard bearing to be installed to journal, by referring to table shown below.
   For example, if number stamped on crank web No.2 is “1” and alphabet stamped on cylinder block is “B”, install a new standard bearing painted in “Purple” to its journal.

Specification of new standard crankshaft main bearing size

		Number stamped on crank web No.2 (Journal diameter)		
		1	2	3
Alphabet stamped on cylinder block (Cap bore dia.)	A	Pink	Purple	Brown
	B	Purple	Brown	Green
	C	Brown	Green	Black
		New standard bearing to be installed.		



5) Using scale (1) on gaging plastic (2), check bearing clearance with newly selected standard bearing.
   If clearance still exceeds its limit, use next thicker bearing and recheck clearance.
6) When replacing crankshaft or cylinder block due to any reason, select new standard bearings to be installed by referring to number stamped on new crankshaft or alphabets stamped on new cylinder block.



UNDERSIZE BEARING (0.25 mm) :

- 0.25 mm undersize bearing is available, in five kinds varying in thickness.
  To distinguish them, each bearing is painted in the following colors at such position as indicated in figure.
  Each color represents the following thickness at the center of bearing.

Undersize of crankshaft main bearing thickness

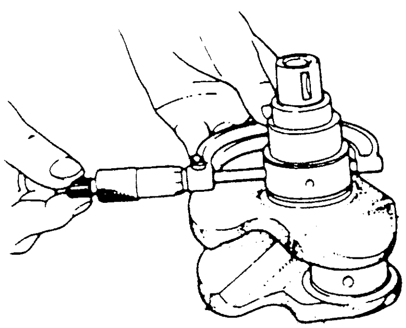
Color painted	Bearing thickness
Red and Pink	2.115 - 2.119 mm (0.0833 - 0.0834 in.)
Red and Purple	2.118 - 2.122 mm (0.0834 - 0.0835 in.)
Red and Brown	2.121 - 2.125 mm (0.0835 - 0.0837 in.)
Red and Green	2.124 - 2.128 mm (0.0836 - 0.0838 in.)
Red and Black	2.127 - 2.131 mm (0.0837 - 0.0839 in.)

1. Paint

- If necessary, regrind crankshaft journal and select undersize bearing to use with it as follows.

a) Regrind journal to the following finished diameter.

Finished diameter
: 44.732 – 44.750 mm (1.7611 – 1.7618 in.)

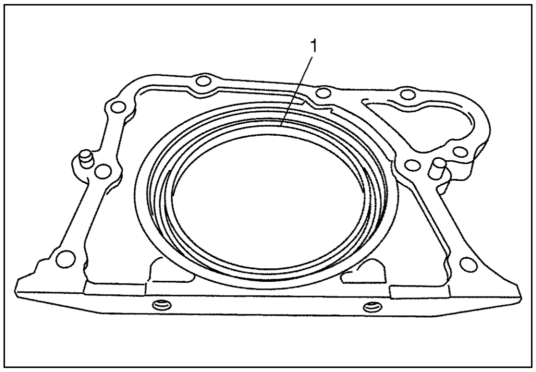


1) Using micrometer, measure reground journal diameter. Measurement should be taken in two directions perpendicular to each other in order to check for out-of-round.
2) Using journal diameter measured above and alphabets stamped on cylinder block, select an undersize bearing by referring to table given below.
   Check bearing clearance with newly selected undersize bearing.

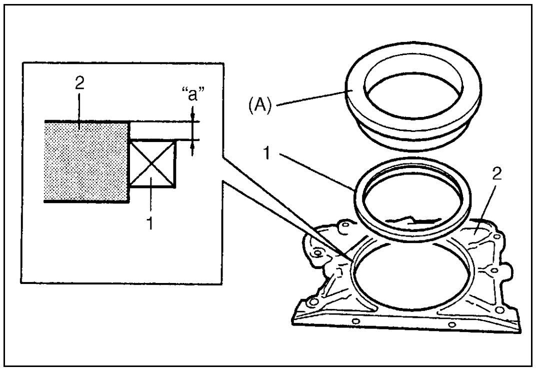
Specification of new standard undersize crankshaft main bearing

		Measured journal diameter		
		44.744 – 44.750 mm (1.7616 – 1.7618 in.)	44.738 – 44.744 mm (1.7613 – 1.7616 in.)	44.732 – 44.738 mm (1.7611 – 1.7613 in.)
Alphabets stamped on cylinder block	A	Red and Pink	Red and Purple	Red and Brown
	B	Red and Purple	Red and Brown	Red and Green
	C	Red and Brown	Red and Green	Red and Black
		Undersize bearing to be installed		

Rear Oil Seal



Carefully inspect oil seal (1) for wear or damage.
If its lip is worn or damaged, replace it.



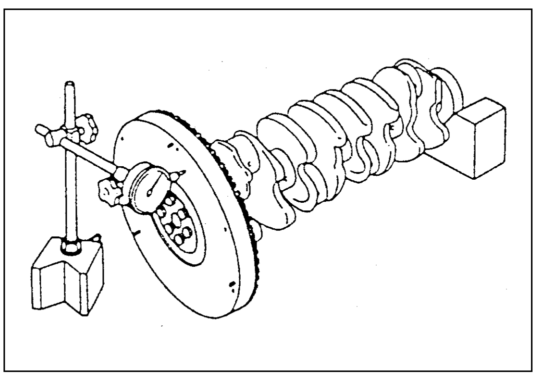
For oil seal installation, press-fit rear oil seal (1) to oil seal housing (2) by using special tool as shown in the figure.

Special tool
(A) : 09911-97820

Drive in dimension
"a" : 3 mm (0.12 in.)

Flywheel

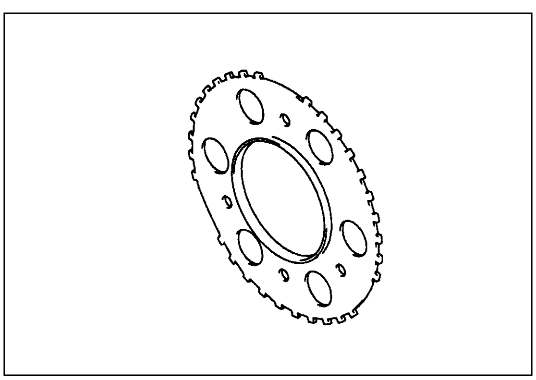
- If ring gear is damaged, cracked or worn, replace flywheel.
- If the surface contacting clutch disc is damaged, or excessively worn, replace flywheel.



- Check flywheel for face runout with a dial gauge.
  If runout exceeds its limit, replace flywheel.

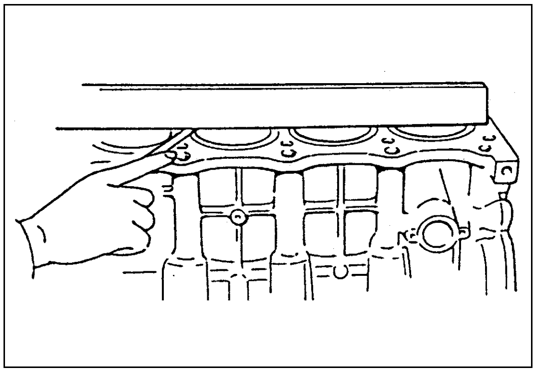
Flywheel on runout
Limit : 0.2 mm (0.0079 in.)

Sensor plate



- Check sensor plate for crack or damage. If malcondition is found, replace it.

Cylinder Block



Distortion of gasketed surface

- Using straightedge and thickness gauge, check gasketed surface for distortion and, if flatness exceeds its limit, correct it.

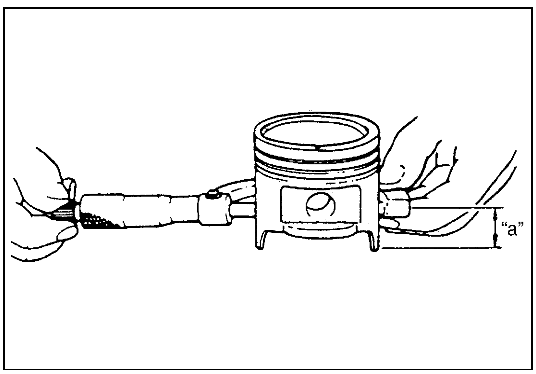
Cylinder block flatness
Limit : 0.05 mm (0.0020 in.)

Honing or reboring cylinders

1) When any cylinder needs reboring, all other cylinders must also be rebored at the same time.
2) Select oversized piston according to amount of cylinder wear.

Oversize piston diameter

Size	Piston diameter
Oversize 0.25	78.203 - 78.218 mm (3.0789 - 3.0794 in.)
Oversize 0.50	78.453 - 78.468 mm (3.0887 - 3.0893 in.)



3) Using micrometer, measure piston diameter.

Measurement position for piston diameter
"a" : 19.5 mm (0.77 in.)

4) Calculate cylinder bore diameter to be rebored as follows.
   D = A + B – C
   D : Cylinder bore diameter to be rebored.
   A : Piston diameter as measured.
   B : Piston clearance = 0.02 – 0.04 mm (0.0008 – 0.0016 in.)
   C : Allowance for honing = 0.02 mm (0.0008 in.)
5) Rebore and hone cylinder to calculated dimension.

NOTE:

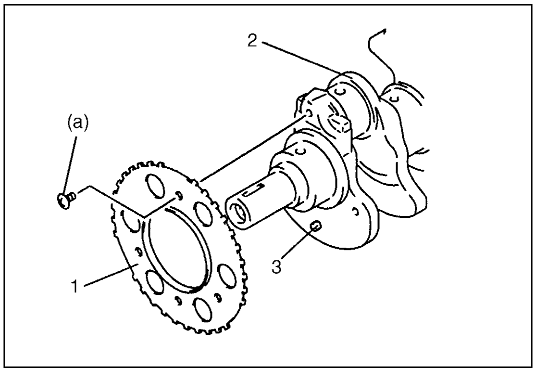
Before reboring, install all main bearing caps in place and tighten to specification to avoid distortion of bearing bores.

6) Measure piston clearance after honing

INSTALLATION

NOTE:

- **All parts to be installed must be perfectly clean.**
- **Be sure to oil crankshaft journals, journal bearings, thrust bearings, crankpins, connecting rod bearings, pistons, piston rings and cylinder bores.**
- **Journal bearings, bearings caps, connecting rods, rod bearings, rod bearing caps, pistons and piston rings are in combination sets. Do not disturb such combination and make sure that each part goes back to where it came from, when installing.**

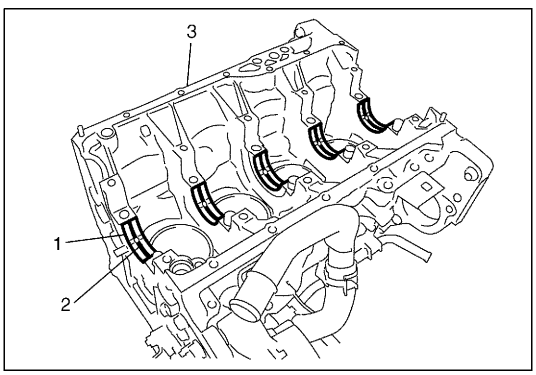


1) Install sensor plate (1) to crankshaft (2) and tighten bolts to specified torque.

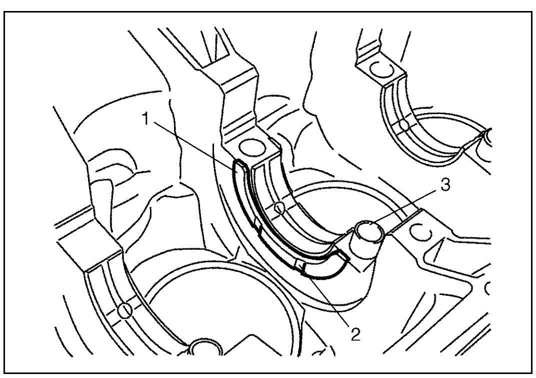
NOTE:

When installing sensor plate, align spring pin (3) on crankshaft and hole of sensor plate.

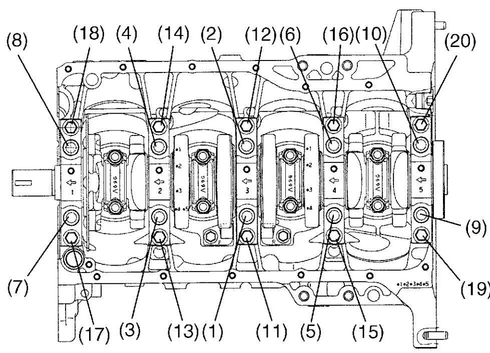
Tightening torque
Sensor plate bolts (a) : 11 N·m (1.1 kg-m, 8.0 lb-ft)



2) Install main bearings to cylinder block.
   Upper half of bearing (1), has an oil groove (2).
   Install it to cylinder block (3), and the other half without oil groove to bearing cap.
   Make sure that two halves are painted in the same color.



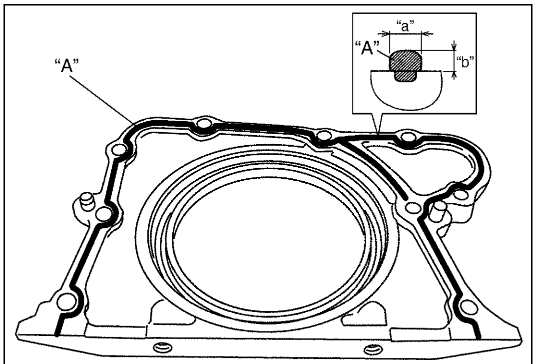
3) Install thrust bearings (1) to cylinder block between No.2 and No.3 cylinders. Face oil groove (2) sides to crank webs.
4) Confirm that dowel pins (3) are installed to intake side of each journal.
5) Install crankshaft to cylinder block.



6) Install bearing cap to cylinder block, making sure to point arrow mark (on each cap) to crankshaft pulley side. Fit them sequentially in ascending order, 1, 2, 3, 4 and 5, starting from pulley side.
   After applying engine oil to new bearing cap No.1 bolts ((1) – (10)) and bearing cap No.2 bolts ((11) – (20)), tighten them gradually as follows.
   a) Tighten bolts (1) – (10) to 30 N·m (3.0 kg-m, 22.0 lb-ft) according to numerical order as shown by using a 12 corner socket wrenches.
   b) In the same manner as in Step a), tighten them to 50 N·m (5.0 kg-m, 36.5 lb-ft).
   c) In the same manner as in Step a), retighten them to 60°.
   d) Tighten bolts (11) – (20) to 22 N·m (2.2 kg-m, 16.0 lb-ft) according to numerical order as shown.

Tightening torque
Crankshaft bearing cap No.1 bolts (1) – (10)
: 50 N·m (5.0 kg-m, 36.5 lb-ft) and then turn to 60°
Crankshaft bearing cap No.2 bolts (11) – (20)
: 22 N·m (2.2 kg-m, 16.0 lb-ft)

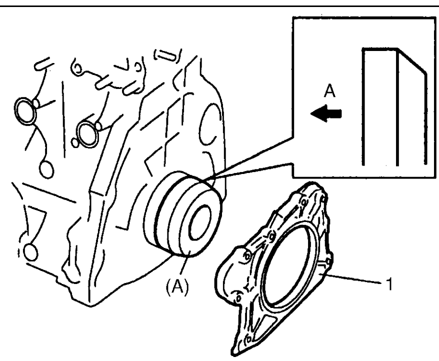
NOTE:
- **Never reuse bearing cap NO.1 bolts (1) - (10) once disassembled it due to plastic deformation tightening.**
- **After tightening cap bolts, check to be sure that crankshaft rotates smoothly when turning it by 12 N·m (1.2 kg-m, 9.0 lb-ft) torque or below.**



7) Apply sealant to mating surface of rear oil seal housing (1).

"A" : Sealant 99000-31150

Sealant amount for rear oil seal housing
Width "a" : 3 mm, 0.12 in.
Height "b" : 2 mm, 0.08 in.

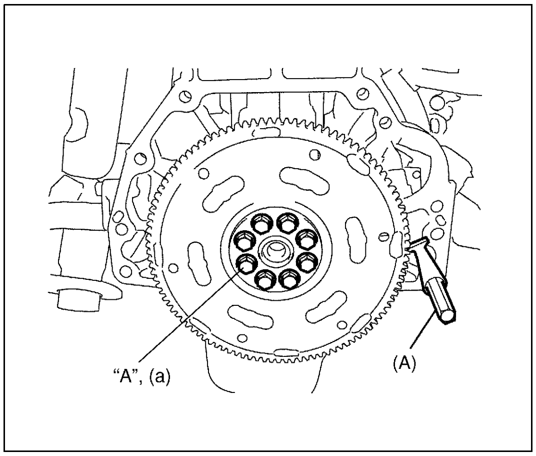


8) Install rear oil seal housing (1) and tighten bolts to specified torque by using special tool.

Special tool
(A) : 09911-97720

Tightening torque
Rear oil seal housing bolts : 11 N·m (1.1 kg-m, 8.0 lb-ft)

A : Crankshaft side



9) Install flywheel (drive plate for A/T).
   Using special tool, lock flywheel or drive plate, and tighten flywheel or drive plate bolts applied with sealant to specification.

   "A" : Sealant 99000-31110

   Special tool
   (A) : 09924-17810

   Tightening torque
   Flywheel or drive plate bolts
   (a) : 70 N·m (7.0 kg-m, 51.0 lb-ft)

10) Install the following parts to engine as previously outlined.
    - Piston and connecting rod
    - Cylinder head assembly
    - Camshaft, tappet and shim
    - Timing chain guide, chain tensioner adjuster, chain tensioner, timing chain and crankshaft timing sprocket
    - Timing chain cover
    - Cylinder head cover
    - Intake manifold and exhaust manifold
    - Oil pan and oil pump strainer
11) Install clutch to flywheel (vehicle with M/T) referring to Section 7C.
12) Install engine assembly to vehicle as previously outlined.

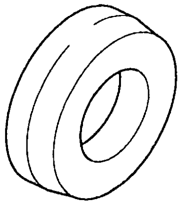
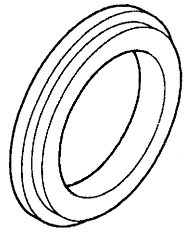
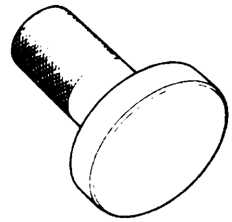
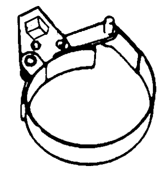
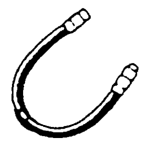
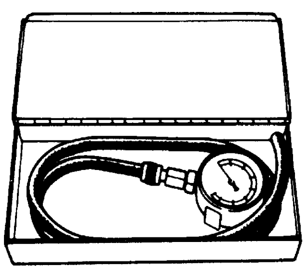
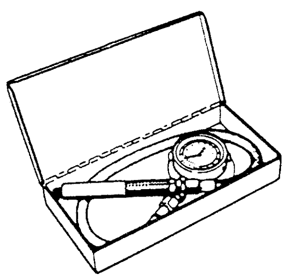
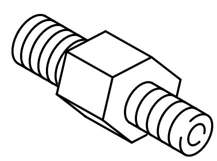
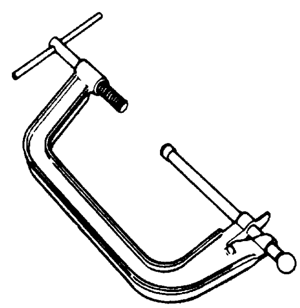
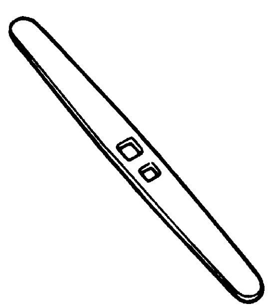
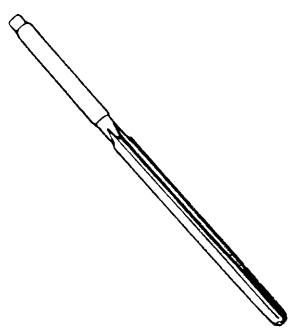
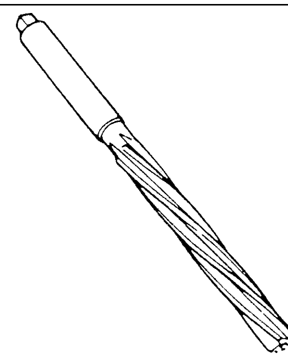
REQUIRED SERVICE MATERIAL

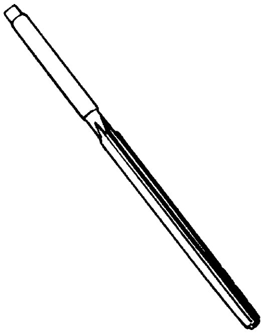
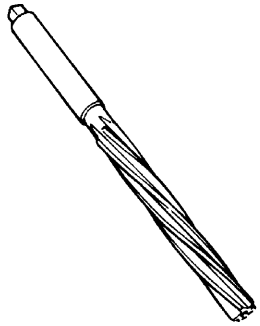
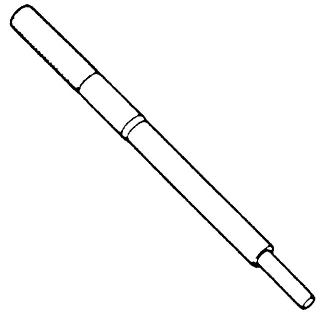
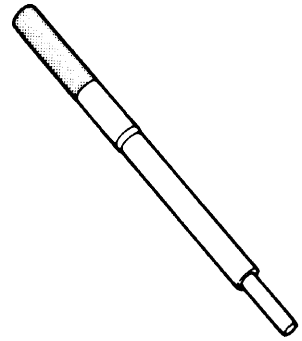
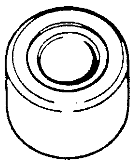
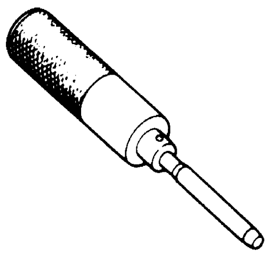
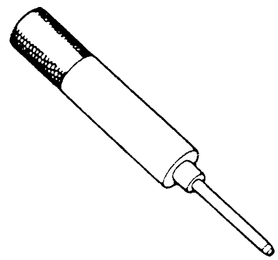
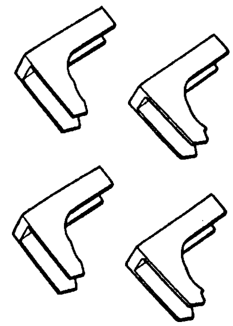
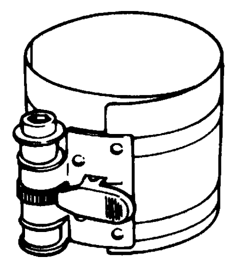
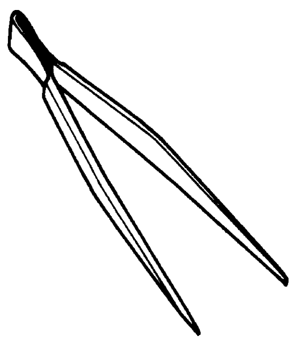
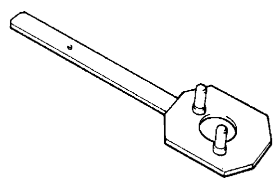
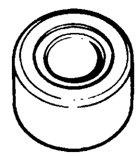
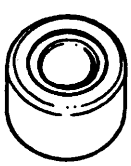
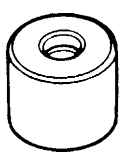
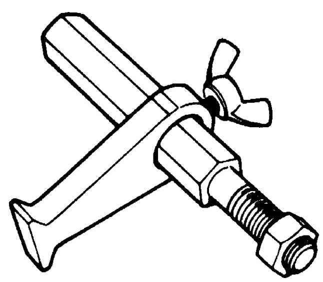
Material	Recommended SUZUKI product (Part Number)	Use
Sealant	Sealant 1207C (99000-31150)	• To apply to mating surfaces of cylinder block and oil pan. • To apply to mating surfaces of cylinder block and timing chain cover. • To apply to sealing surfaces of cylinder head cover. • To apply to mating surfaces to rear oil seal housing.
	Sealant 1207B (99000-31140)	• To apply to mating surface of cylinder block, cylinder head and timing chain cover.
	Sealant 1215 (99000-31110)	• To apply to the thread of the bolt of water outlet pipe. • To flywheel (M/T) or drive plate (A/T) bolts.

TIGHTENING TORQUE SPECIFICATION

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Oil pressure switch	14.0	1.4	10.5
Camshaft housing bolts (for replacement of shim)	8.0	0.8	6.0
Camshaft housing bolts	11.0	1.1	8.0
Cylinder head cover bolts	8.0	0.8	6.0
Intake manifold bolts and nuts	25.0	2.5	18.0
Exhaust manifold bolts and nuts	50.0	5.0	36.5
Exhaust No.1 pipe bolts	50.0	5.0	36.5
Exhaust manifold stiffener bolts	50.0	5.5	36.5
Oil pump strainer bolt	11.0	1.1	8.0
Oil pump strainer bracket bolt	11.0	1.1	8.0
Oil pan bolts and nuts	11.0	1.1	8.0
Oil pan drain plug bolt	50.0	5.0	36.5
Timing chain cover bolts	23.0	2.3	17.0
Engine mounting bolts	75.0	7.5	54.5
Engine mounting bracket bolts	55.0	5.5	40.0
Crank shaft pulley bolt	150.0	15.0	108.5
Oil pump rotor plate bolts	11.0	1.1	8.0
Timing chain No.1 guide bolts	9.0	0.9	6.5
Timing chain tensioner adjuster bolt	11.0	1.1	8.0
Venturi plug	5.0	0.5	3.5
Cylinder head bolts for M8	22.0	2.2	16.0
Cylinder head bolts for M10	a) Tighten 40 N·m b) Turn 60° c) Turn 60°	a) Tighten 4.0 kg-m b) Turn 60° c) Turn 60°	a) Tighten 29.0 lb-ft b) Turn 60° c) Turn 60°
Connecting rod bearing cap nuts	a) Tighten 15 N·m b) Turn 45° c) Turn 45°	a) Tighten 1.5 kg-m b) Turn 45° c) Turn 45°	a) Tighten 11.0 lb-ft b) Turn 45° c) Turn 45°
Engine mounting bolts and nuts for M10	55.0	5.5	40.0
Engine mounting bolts and nuts for M12	75.0	7.5	54.5
Crankshaft bearing cap No.1 bolts (for inspection of crankshaft thrust play)	50.0	5.0	36.5
Crankshaft bearing cap No.2 bolts	22.0	2.2	16.0
Sensor plate bolts	11.0	1.1	8.0
Crankshaft bearing cap No.1 bolts	a) Tighten 50 N·m b) Turn 60°	a) Tighten 5.0 kg-m b) Turn 60°	a) Tighten 36.5 lb-ft b) Turn 60°
Rear oil seal housing bolts	11.0	1.1	8.0
Flywheel or drive plate bolts	70.0	7.0	51.0

SPECIAL TOOL

 09911-97720 Oil seal guide	 09911-97820 Oil seal installer	 09913-75520 Bearing installer	 09915-47330 Oil filter wrench
 09915-64510-001 Compression gauge	 09915-64510-002 Connector	 09915-64530 Hose	 09915-67010 Attachment
 09915-67310 Vacuum gauge	 09915-77310 Oil pressure gauge	 09915-78211 Oil pressure gauge attachment	 09916-14510 Valve lifer
 09916-14910 Valve lifer attachment	 09916-34542 Reamer handle	 09916-34550 Reamer (5.5 mm)	 09916-37320 Reamer (10.5 mm)

 09916-37810 Reamer (6 mm)	 09916-38210 Reamer (11 mm)	 09916-44910 Valve guide remover	 09916-46020 Valve guide remover
 09916-56011 Valve guide installer attachment	 09916-57350 Valve guide installer handle	 09916-58210 Valve guide installer handle	 09916-67020 Tappet holder
 09916-77310 Piston ring compressor	 09916-84511 Forceps	 09917-98221 Camshaft lock holder	 09917-88240 Valve guide installer
 09917-88250 Valve guide installer	 09917-98221 Valve stem seal installer	 09924-17810 Flywheel holder	

SECTION 6B

ENGINE COOLING

CONTENTS

GENERAL DESCRIPTION

The cooling system consists of the radiator cap, radiator, coolant reservoir tank, hoses, water pump, cooling fan and thermostat. The radiator is of tube-and-fin type.

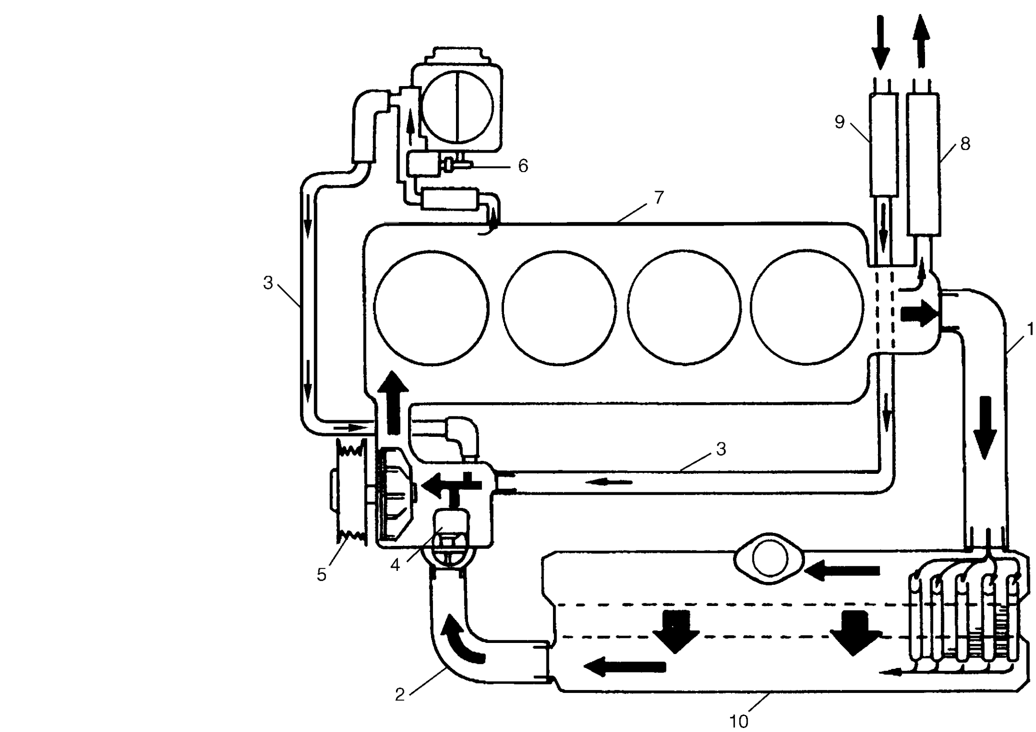
COOLING SYSTEM CIRCULATION

While the engine is warmed up (thermostat closed), coolant circulates as follows.

Water pump → Cylinder block → Cylinder head → Throttle body / Heater unit → Water intake pipe

Thermostat closed (Water intake pipe → Water pump)

When coolant is warmed up to normal temperature and the thermostat opens, coolant passes through the radiator core to be cooled as well as the above flow circuit.



1. Radiator inlet hose	5. Water pump	9. Heater outlet hose
2. Radiator outlet hose	6. Throttle body (Fast idle control plunger)	10. Radiator
3. Water inlet pipe	7. Engine	
4. Thermostat	8. Heater inlet hose	

COOLANT

The coolant recovery system is standard. The coolant in the radiator expands with heat, and the overflow is collected in the reservoir.
When the system cools down, the coolant is drawn back into the radiator.

The cooling system has been filled at the factory with a quality coolant that is a 50/50 mixture of water and ethylene glycol antifreeze (70/30; in a market where no freezing temperature is anticipated).

This 50/50 mixture coolant solution provides freezing protection to –36°C (–33°F).
- Maintain cooling system freeze protection at –36°C (–33°F) to ensure protection against corrosion and loss of coolant from boiling. This should be done even if freezing temperatures are not expected.
- Add ethylene glycol base coolant when coolant has to be added because of coolant loss or to provide added protection against freezing at temperature lower than –36°C (–33°F).

NOTE:
- **Alcohol or methanol base coolant or plain water alone should not be used in cooling system at any time as damage to cooling system could occur.**
- **Even in a market where no freezing temperature is anticipated, mixture of 70% water and 30% ethylene glycol antifreeze (Antifreeze/Anticorrosion coolant) should be used for the purpose of corrosion protection and lubrication.**

Anti-freeze proportioning table

Freezing temperature	°C	–16	–36
	°F	3	–33
Anti-freeze/Anti-corrosion coolant concentration	%	30	50
Ratio of compound to cooling water	ltr.	1.38/3.22	2.30/2.30
	US pt.	2.92/6.80	4.86/4.86
	Imp pt.	2.43/5.67	4.05/4.05

Coolant capacity

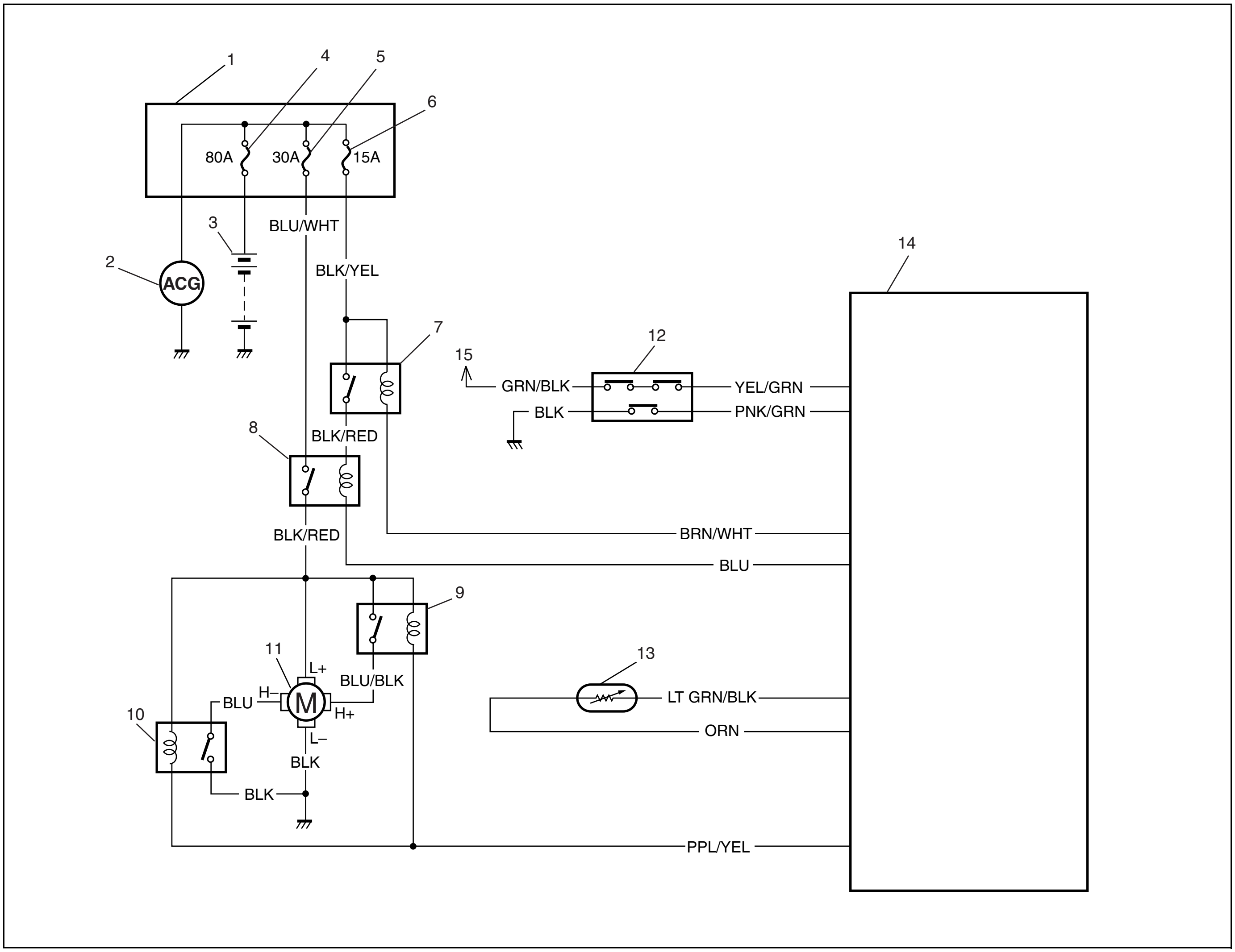
Engine radiator and heater	4.20 liters (8.87/7.39 US/Imp. pt.)
Reservoir tank	0.40 liters (0.85/0.70 US/Imp. pt.)
Total	4.60 liters (9.72/8.10 US/Imp. pt.)

DIAGNOSIS

DIAGNOSIS TABLE

Condition	Possible Cause	Correction
Engine overheats (It is in case that radiator fan operates)	Loose or broken water pump belt	Adjust or replace.
	Not enough coolant	Check coolant level and add as necessary.
	Faulty thermostat	Replace.
	Faulty water pump	Replace.
	Dirty or bent radiator fins	Clean or remedy.
	Coolant leakage on cooling system	Repair.
	Clogged radiator	Check and replace radiator as necessary.
	Faulty radiator cap	Replace.
	Improper ignition timing	Adjust.
	Dragging brakes	Adjust brake.
	Slipping clutch	Adjust or replace.
	Poor charge battery	Check and replace as necessary.
	Poor generation generator	Check and repair.
	ECT sensor faulty	Check and replace as necessary.
	Radiator cooling fan relay No.2 and/or No.3 faulty	Check and replace as necessary.
	ECM faulty	Check and replace as necessary.
	Wiring or grounding faulty	Repair and necessary.
	Equipped with too much electric load part	Dismount.
	Radiator cooling fan motor faulty	Check and replace as necessary.
Engine overheats (It is in case that radiator fan won't operates)	Fuse blown	Check "RADTR fan" fuse and check for short circuit to ground.
	Radiator cooling fan relay No.1	Check and replace as necessary.
	ECT sensor faulty	Check and replace as necessary.
	Radiator cooling fan motor faulty	Check and replace as necessary.
	Wiring or grounding faulty	Repair as necessary
	ECM faulty	Check and replace as necessary.

SYSTEM CIRCUIT



1. Main fuse box	6. ECM main fuse	11. Radiator and condenser cooling fan motor
2. Generator	7. ECM main relay	12. Refrigerant pressure triple switch (if equipped with A/C)
3. Battery	8. Radiator and condenser cooling fan relay No.1	13. ECT sensor
4. Battery fuse	9. Radiator and condenser cooling fan relay No.2	14. ECM
5. RADTR fuse	10. Radiator and condenser cooling fan relay No.3	15. TO A/C switch

SYSTEM CIRCUIT INSPECTION

Refer to “RADIATOR COOLINGFAN CONTROL SYSTEM CHECK” in Section 6

MAINTENANCE

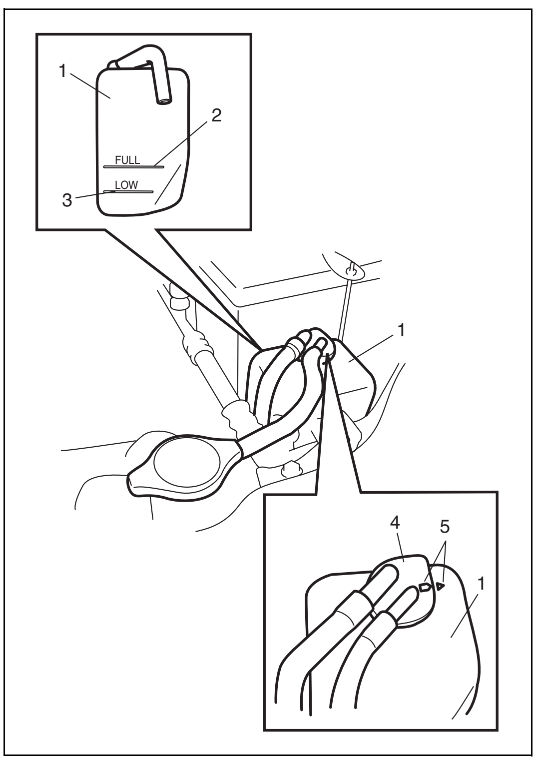
WARNING:
- **Do not remove radiator cap to check engine coolant level; check coolant visually at the see-through coolant reservoir.**
  Coolant should be added only to reservoir as necessary.
- **As long as there is pressure in the cooling system, the temperature can be considerably higher than the boiling temperature of the solution in the radiator without causing the solution to boil. Removal of the radiator cap while engine is hot and pressure is high will cause the solution to boil instantaneously and possibly with explosive force, spewing the solution over engine, fenders and person removing cap. If the solution contains flammable anti-freeze such as alcohol (not recommended for use at any time), there is also the possibility of causing a serious fire.**

COOLANT LEVEL CHECK

To check level, lift hood and look at "see-through" coolant reservoir tank.
It is not necessary to remove radiator cap to check coolant level.

WARNING:
To help avoid danger of being burned :
- **do not remove reservoir tank cap while coolant is boiling, and**
- **do not remove radiator cap while engine and radiator are still hot.**

Scalding fluid and steam can be blown out under pressure if either cap is taken off too soon.



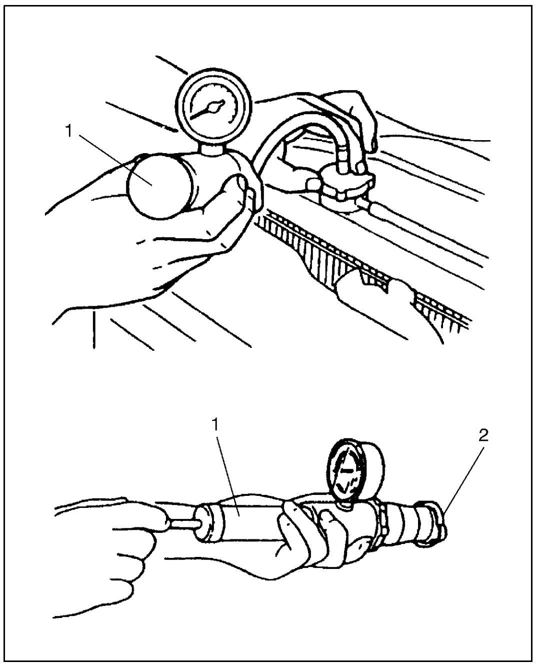
When engine is cool, check coolant level in reservoir tank (1).
A normal coolant level should be between FULL mark (2) and LOW mark (3) on reservoir tank (1).
If coolant level is below LOW mark (3), remove reservoir tank cap (4) and add proper coolant to tank to bring coolant level up to FULL mark (2). Then, reinstall cap (4) and align match marks (5) on tank and cap (4).

NOTE:
- **If proper quality antifreeze is used, there is no need to add extra inhibitors or additives that claim to improve system.**
  They may be harmful to proper operation of system, and are unnecessary expense.
- **When installing reservoir cap, align arrow marks on reservoir and cap.**

ENGINE COOLING SYSTEM INSPECTION AND SERVICE

WARNING:
To help avoid danger of being burned, do not remove radiator cap while engine and radiator are still hot.
Scalding fluid and steam can be blown out under pressure if cap is taken off too soon.

1) Check cooling system for leakage or damage.
2) Wash radiator cap and filler neck with clean water by removing radiator cap when engine is cold.
3) Check coolant for proper level and freeze protection.



4) Using a pressure tester (1), check system and radiator cap (2) for proper pressure holding capacity.
   If replacement of cap is required, use a proper cap for this vehicle.

Cooling system and radiator cap holding pressure (for inspection)
: 110 kPa (1.1 kg/cm^2, 15.6 psi)

NOTE:
After installing radiator cap to radiator, make sure that the ear of cap lines is parallel to radiator.

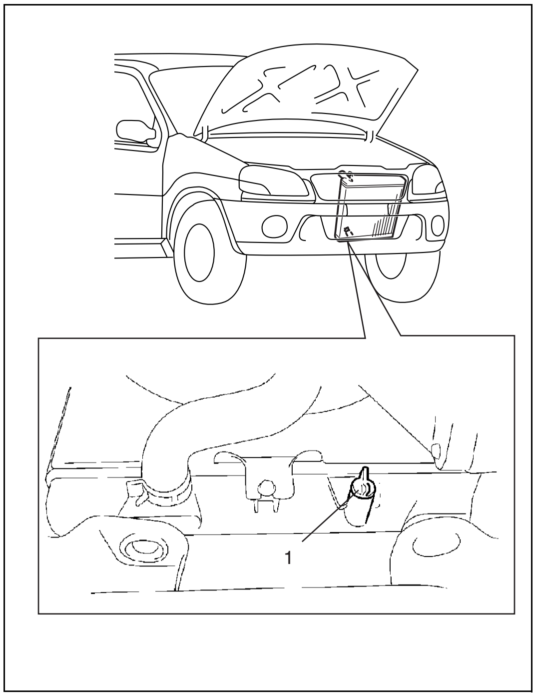
5) Tighten hose clamps and inspect all hoses. Replace hoses whenever cracked, swollen or otherwise deteriorated.
6) Clean frontal area of radiator core.

COOLING SYSTEM FLUSH AND REFILL

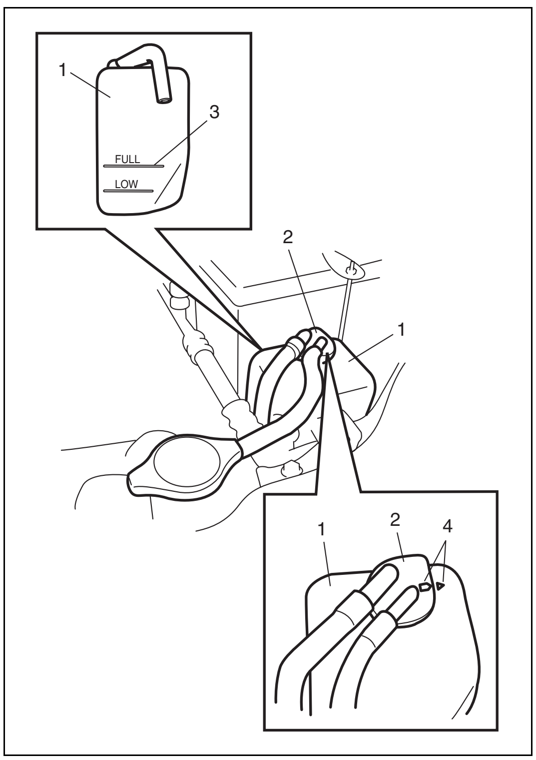
1) Remove radiator cap when engine is cool.
   a) Turn cap counterclockwise slowly until it reaches a “stop”. (Do not press down while turning it).
   b) Wait until pressure is relieved (indicated by a hissing sound) then press down on cap and continue to turn it counterclockwise.

WARNING:
To help avoid danger of being burned, do not remove radiator cap while engine and radiator are still hot.
Scalding fluid and steam can be blown out under pressure if cap is taken off too soon.

2) With radiator cap removed, run engine until upper radiator hose is hot (this shows that thermostat is open and coolant is flowing through system).



3) Stop engine and drain coolant.
4) Close drain plug. Add water until system is filled and run engine until upper radiator hose is hot again.
5) Repeat Steps 3) and 4) several times until drained liquid is nearly colorless.
6) Drain system and then close radiator drain plug (1) tightly.



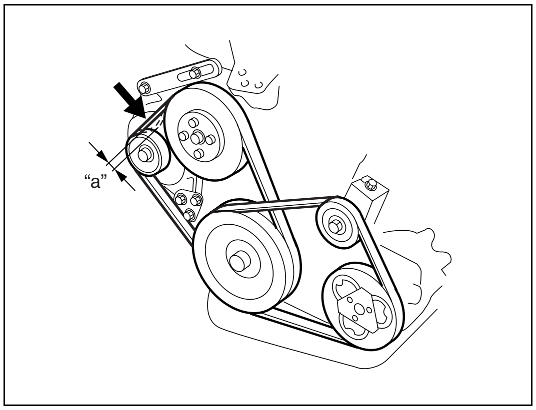
7) Remove reservoir tank (1) and remove cap (2) from reservoir tank (1) and pour out any fluid, scrub and clean inside of tank with soap and water.
   Flush it well with clean water and drain. Reinstall tank.
8) Add coolant that is a mixture of good quality ethylene glycol antifreeze and water to radiator and reservoir tank. For coolant concentration referring to "COOLANT".
   Fill radiator to the bottom of filler neck and reservoir tank to FULL level mark (3).
9) Reinstall reservoir tank cap and align match marks (4) on reservoir tank and its tank cap.

10) Run engine with radiator cap removed, until radiator inlet hose is hot.
11) With engine idling, add coolant to radiator until level reaches the bottom of filler neck. Install radiator cap, making sure that the ear of cap lines is parallel to radiator.

WATER PUMP/GENERATOR DRIVE BELT TENSION INSPECTION AND ADJUSTMENT

WARNING:
- **Disconnect negative cable at battery before checking and adjusting belt tension.**
- **To help avoid danger of being burned, do not remove radiator cap while engine and radiator are still hot. Scalding fluid and steam can be blown out under pressure if cap is taken off too soon.**

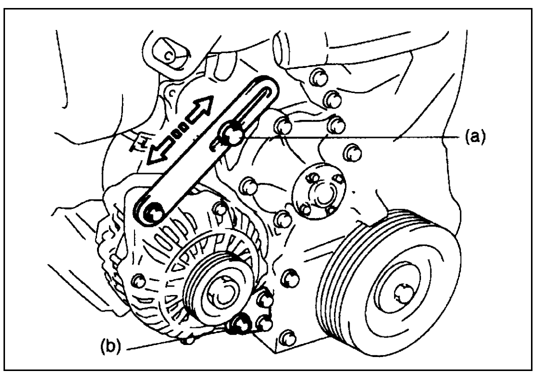
1) Inspect belt for cracks, cuts, deformation, wear and cleanliness. If it is necessary to replace belt, refer to “WATER PUMP/GENERATOR DRIVE BELT” in this section.



2) Check belt for tension. Belt is in proper tension when it deflects 4.5 to 5.5 mm (0.18 – 0.22 in.) under thumb pressure (about 10 kg or 22 lb.).

Water pump / generator drive belt tension “a”
4.5 – 5.5 mm (0.18 – 0.22 in.) as deflection/10 kg (22 lbs)

NOTE:
When replacing belt with a new one, adjust belt tension to 3 – 4 mm (0.12 – 0.16 in.).



3) If belt is too tight or too loose, adjust it to proper tension by displacing generator position.
4) Tighten generator adjusting bolt and pivot bolts as specified torque.

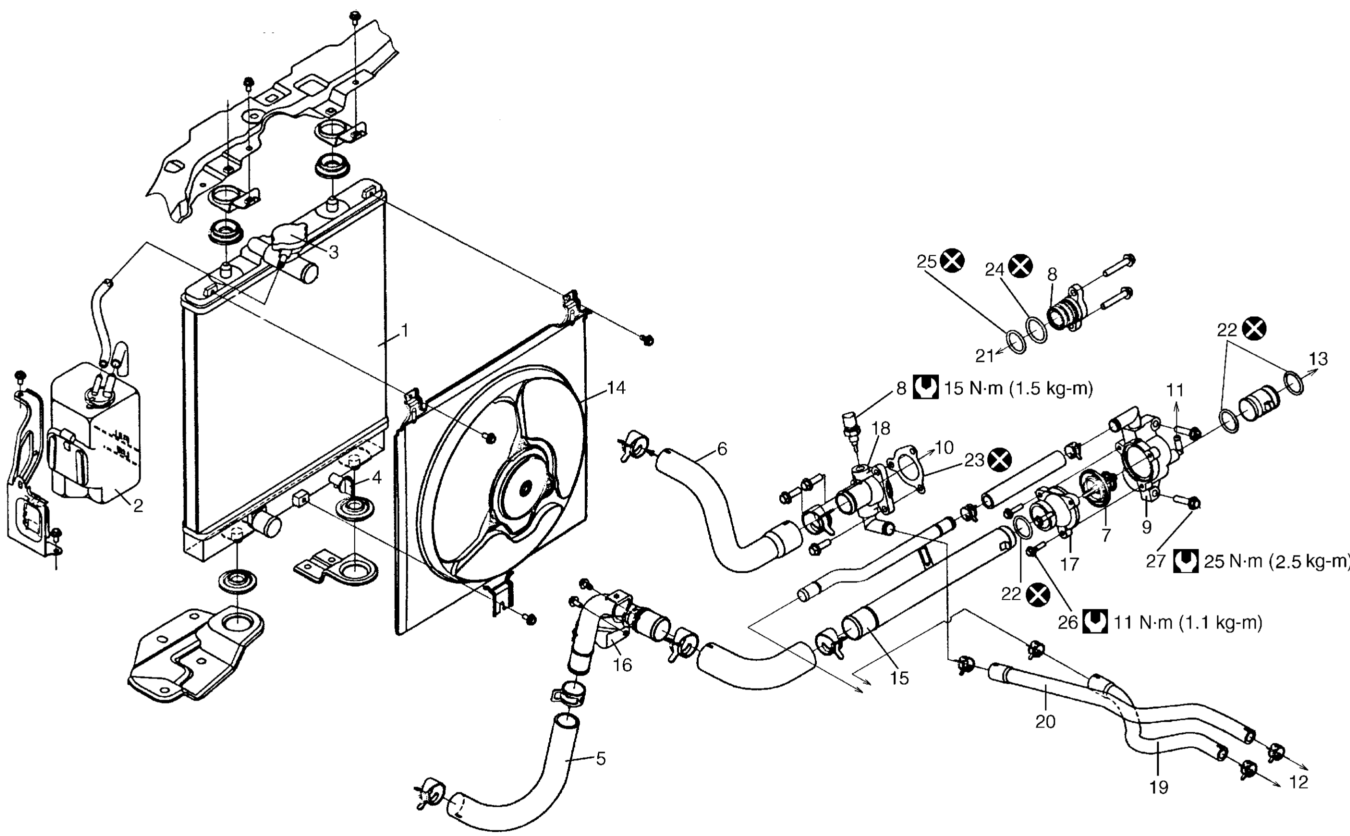
Tightening torque
Generator adjusting bolt (a) : 23 N·m (2.3 kg-m, 17.0 lb-ft)
Generator pivot bolt (b) : 50 N·m (5.0 kg-m, 36.0 lb-ft)

5) Connect negative cable at battery.

ON-VEHICLE SERVICE

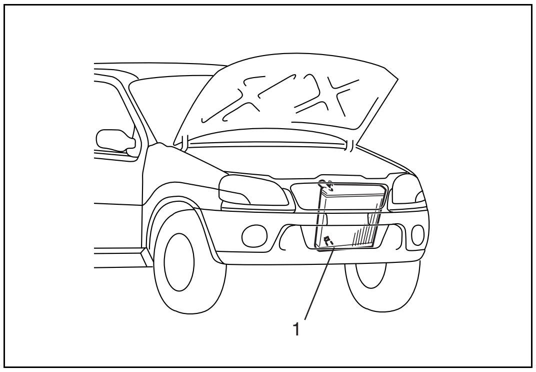
> **WARNING:**
> - **Check to make sure that engine coolant temperature is cold before removing any part of cooling system.**
> - **Also be sure to disconnect negative cord from battery terminal before removing any part.**

SYSTEM COMPONENTS



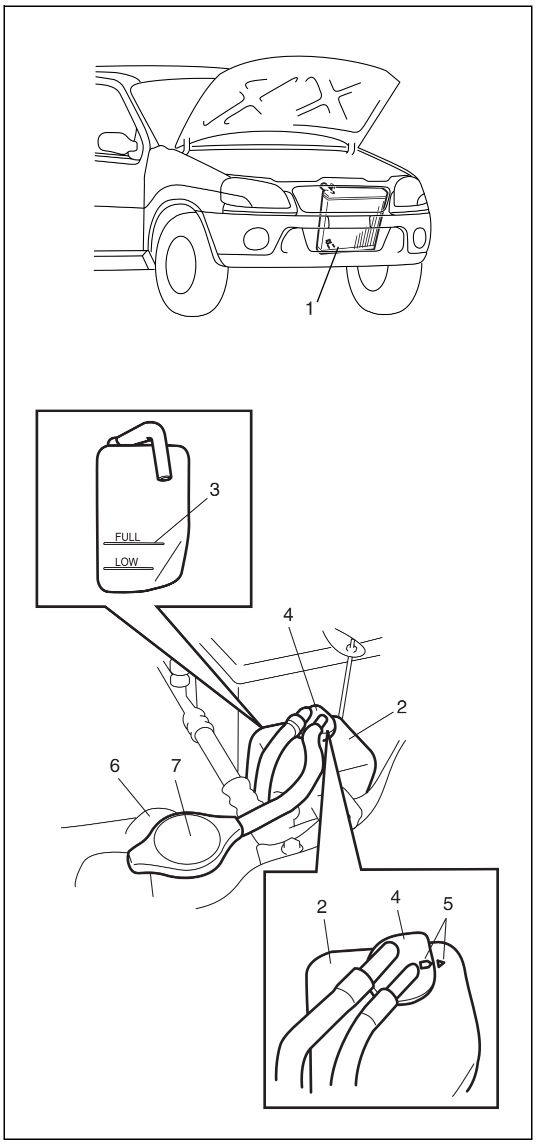
1. Radiator	11. To throttle body	21. To timing chain cover
2. Reservoir tank	12. To heater unit	22. O-Ring
3. Radiator cap	13. To water pump	23. Gasket
4. Drain plug	14. Radiator and condenser cooling fan assembly	24. Water outlet cap O-ring No.1
5. Radiator outlet hose	15. Water inlet pipe No.1	25. Water outlet cap O-ring No.2
6. Radiator inlet hose	16. Water inlet pipe No.2	26. Thermostat cap bolts
7. Thermostat	17. Thermostat cap	27. Thermostat case bolts
8. ECT sensor	18. Water outlet cap	Tightening torque
9. Thermostat case	19. Heater inlet hose	Do not reuse.
10. To cylinder head	20. Heater outlet hose	

COOLING SYSTEM DRAINING



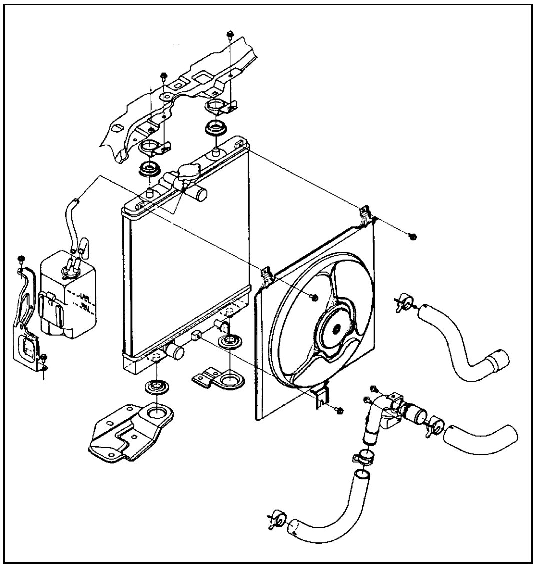
1) Remove radiator cap.
2) Loosen drain plug (1) of radiator to drain coolant.
3) After draining coolant, be sure to tighten drain plug securely.

COOLING SYSTEM REFILL



1) Be sure to tighten drain plug (1) securely.
2) Add coolant that is a mixture of good quality ethylene glycol antifreeze and water to radiator and reservoir tank (2). For coolant concentration, referring to “COOLANT”.
   Fill radiator to the bottom of filler neck and reservoir tank (2) to FULL level mark (3).
3) Reinstall reservoir tank cap (4) and align match marks (5) on reservoir tank (2) and its tank cap (4).
4) Run engine with radiator cap (7) removed, until radiator inlet hose (6) is hot.
5) With engine idling, add coolant to radiator until level reaches the bottom of filler neck.
6) Install radiator cap (7) make sure that the ear of radiator cap (7) lines is parallel to radiator.

COOLING WATER PIPES OR HOSES



REMOVAL

1) Drain cooling system.
2) To remove these pipes or hoses, loosen clamp on each hose and pull hose end off.

INSTALLATION

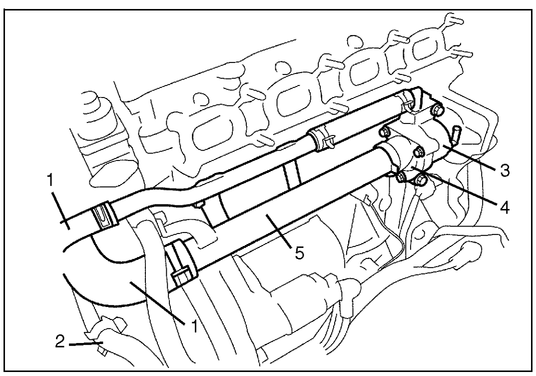
Install removed parts in reverse order of removal procedure, noting the following.

- Tighten each clamp securely.
- Refill cooling system with proper coolant referring to “COOLING SYSTEM REFILL”.

THERMOSTAT

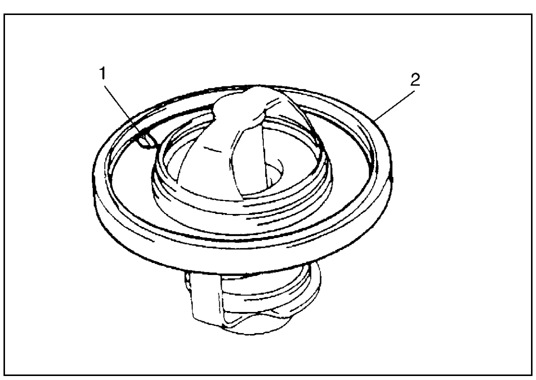
REMOVAL

1) Drain cooling system by loosening drain plug of radiator referring to “COOLING SYSTEM DRAINING”.
2) Remove air cleaner assembly and resonator referring to section 6A1
3) Remove intake manifold referring to Section 6A1.
4) Remove generator referring to Section 6H.

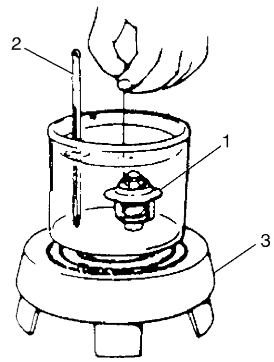


5) Disconnect water hose (1) and heater hose (2) from each pipe.
6) Remove thermostat case (3) with thermostat cap (4) and water inlet pipe (5).
7) Remove water inlet pipe with thermostat cap from thermostat case.
8) Remove thermostat.

INSPECTION



- Make sure that air bleed valve (1) of thermostat is clean. Should this valve be clogged, engine would tend to overheat.
- Check to make sure that valve seat is free from foreign matters which would prevent valve from seating tight.
- Check thermostat seal (2) for breakage, deterioration or any other damage.



- Check thermostatic movement of wax pellet as follows :

a) Immerse thermostat (1) in water, and heat water gradually.
b) Check that valve starts to open at specific temperature.

Temperature at which valve begins to open
: 80 – 84°C (176 – 183°F)

Temperature at which valve become fully open
: 95 – 97°C (203°F)

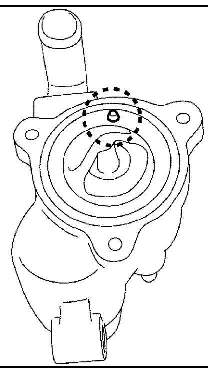
Valve lift
: More than 8 mm at 95°C (203°F)

If valve starts to open at a temperature substantially below or above specific temperature, thermostat unit should be replaced with a new one. Such a unit, if reused, will bring about overcooling or overheating tendency.

2. Thermometer
3. Heater

INSTALLATION

Reverse removal procedure for installation noting the following points.



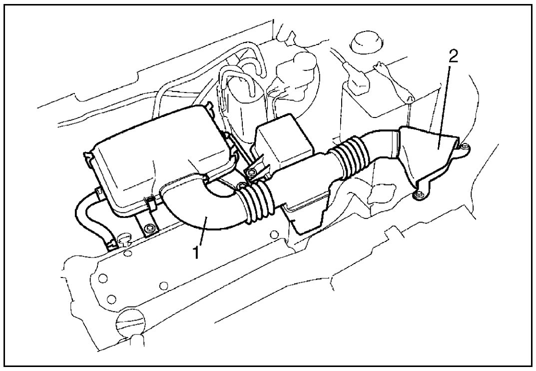
- When positioning thermostat (1) on thermostat case (2), be sure to position it so that air bleed valve (3) comes at position as shown in figure.

- Use new O-rings when installing.
- Adjust water pump belt tension referring to WATER PUMP/ GENERATOR DRIVE BELT TENSION INSPECTION AND ADJUSTMENT in this section.
- Adjust A/C compressor belt tension (if equipped) referring to Section 1B.
- Refill cooling system with proper coolant referring to “COOLING SYSTEM REFILL”.
- Verify that there is no coolant leakage at each connection.

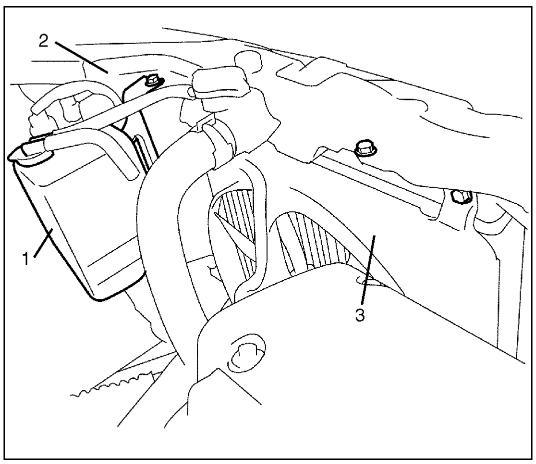
RADIATOR

REMOVAL

1) Disconnect negative cable at battery.
2) Drain cooling system by loosening drain plug of radiator. Refer to “COOLING SYSTEM DRAINING”.
3) Disconnect connector of cooling fan motor.

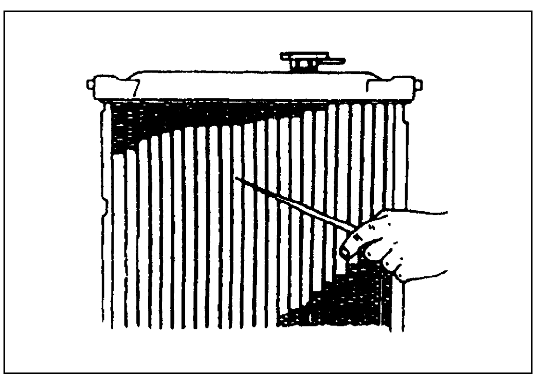


4) Remove air cleaner inlet hose (1) and suction pipe (2).



5) Remove reservoir tank (1) and then its bracket (2).
6) Disconnect radiator inlet and outlet hoses from radiator.
7) Remove cooling fan assembly (3).
8) Remove radiator.

INSPECTION



Check radiator for leakage or damage. Straighten bent fins, if any.

CLEANING

Clean frontal area of radiator cores.

INSTALLATION

Reverse removal procedures, noting the followings.

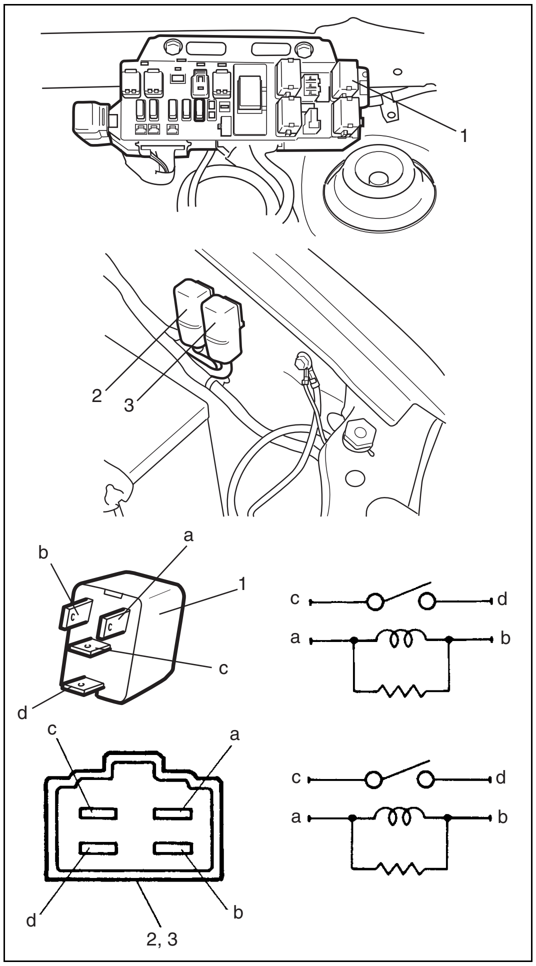
- Refill cooling system with proper coolant referring to “COOLING SYSTEM REFILL”.
- After installation, check each joint for leakage.

RADIATOR AND CONDENSER COOLING FAN

Refer to "RADIATOR AND CONDENSER COOLING FAN" in Section 1B for removal, inspection and installation.

RADIATOR AND CONDENSER COOLING FAN RELAY

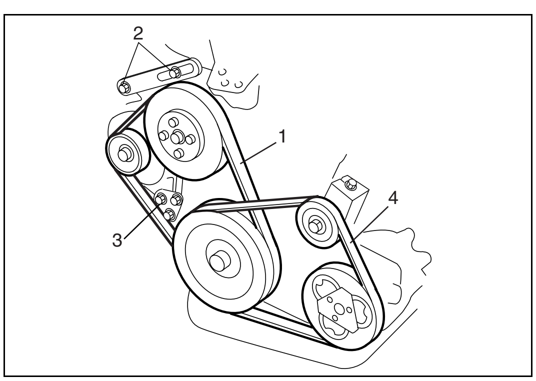
INSPECTION



1) Disconnect negative (–) cable at battery.
2) Remove radiator and condenser cooling fan relay No.1 (1), No.2 (2) and No.3 (3) from vehicle.
3) Check that there is no continuity between terminal "c" and "b". If there is continuity, replace relay.
4) Connect battery positive (+) terminal to terminal "b" of relay. Connect battery negative (–) terminal "a" of relay. Check continuity between terminal "c" and "d". If there is no continuity when relay is connected to the battery, replace relay.

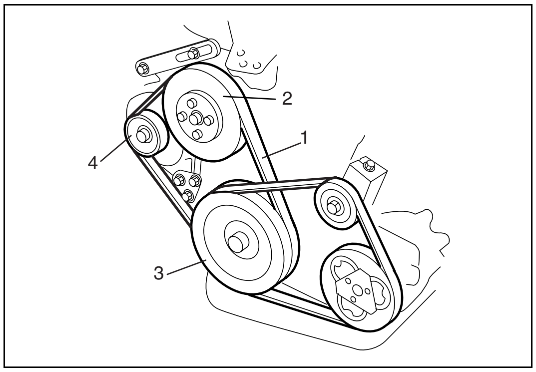
WATER PUMP/GENERATOR DRIVE BELT

REMOVAL

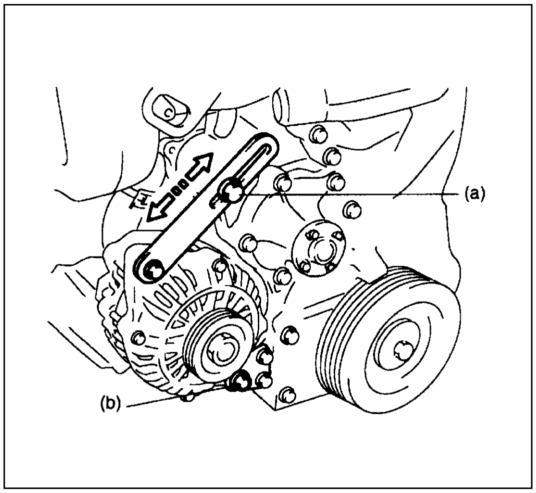


1) Disconnect negative cable at battery.
2) Loosen drive belt adjusting bolt (2) and generator pivot bolt (3).
   When servicing car equipped with A/C, remove compressor drive belt (4) before removing water pump belt (1).
   Refer to "COMPRESSOR DRIVE BELT" in Section 1B.
3) Slacken belt by displacing generator and then remove it.

INSTALLATION



1) Install belt (1) to water pump pulley (2), crankshaft pulley (3) and generator pulley (4).
   When servicing car equipped with A/C, install compressor drive belt, too.



2) Adjust belt tension by referring to "WATER PUMP/GENERATOR DRIVE BELT TENSION INSPECTION AND ADJUSTMENT" in this section.
   For adjustment of compressor drive belt tension, refer to COMPRESSOR DRIVE BELT in Section 1B.
3) Tighten water pump belt adjusting bolt and pivot bolt to specified torque.

   Tightening torque
   Generator adjusting bolt (a) : 23 N·m (2.3 kg-m, 17.0 lb-ft)
   Generator pivot bolt (b) : 50 N·m (5.0 kg-m, 36.0 lb-ft)

4) Connect negative cable at battery.

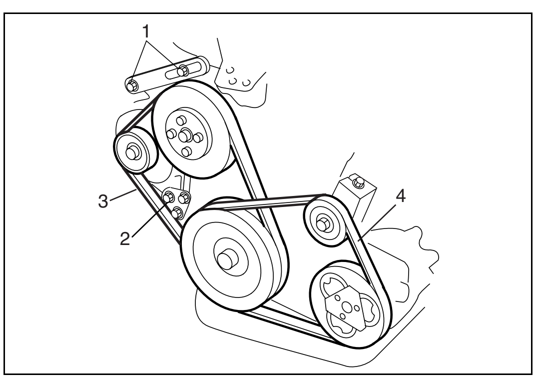
WATER PUMP BELT TENSION INSPECTION AND ADJUSTMENT

For this inspection or adjustment, refer to "WATER PUMP GENERATOR DRIVE BELT TENSION INSPECTION AND ADJUSTMENT".

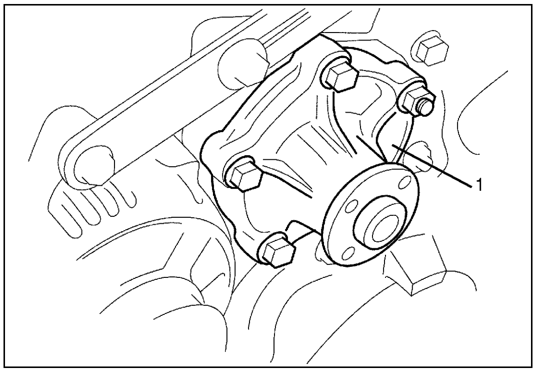
WATER PUMP

REMOVAL

1) Disconnect negative cable at battery.
2) Drain coolant. Refer to "COOLING SYSTEM DRAINING".



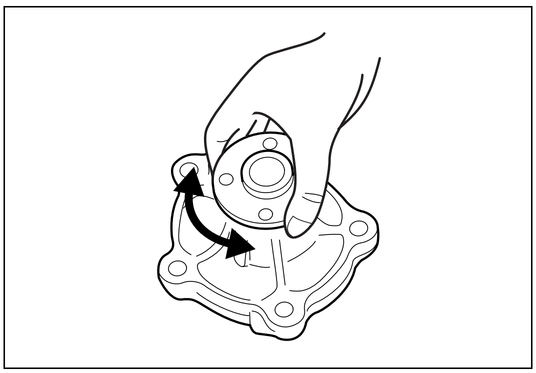
3) Remove A/C compressor belt (4) by referring to "COMPRESSOR DRIVE BELT" in Section 1B. (if equipped).
4) Loosen water pump/generator drive belt adjusting bolt (1) and generator pivot bolt (2). Then remove water pump/generator drive belt (3) and water pump pulley.
   Refer to "WATER PUMP BELT" in this section.



5) Remove water pump assembly (1).

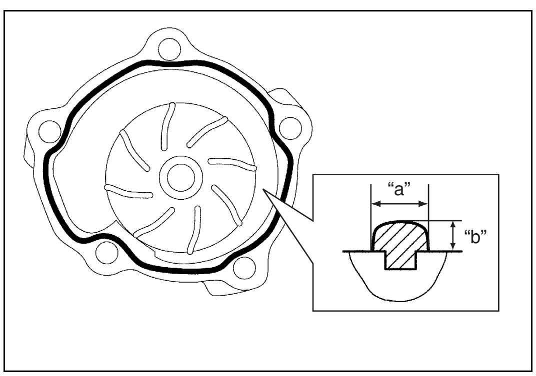
INSPECTION

> **CAUTION:**
> **Do not disassemble water pump.**
> **If any repair is required on pump, replace it as assembly.**



- Rotate water pump by hand to check for smooth operation. If pump does not rotate smoothly or makes abnormal noise, replace it.

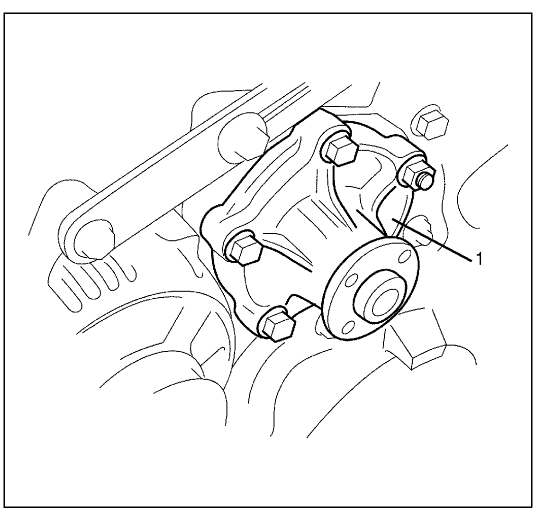
INSTALLATION



1) Apply sealant to mating surface of water pump as shown in figure.

   "A" : Sealant 99000-31150

   Sealant quantity (to mating surface of water pump)
   Width "a" : 3mm (0.12 in.)
   Height "b" : 2mm (0.08 in.)



2) Install water pump assembly (1) to cylinder block and tighten bolts and nut to specified torque.

   Tightening torque
   Water pump bolts and nut (a) : 22 N·m (2.2 kg-m, 16.0 lb-ft)

3) Install water pump pulley.
4) Install water pump/generator drive belt. Refer to "WATER PUMP/GENERATOR DRIVE BELT" in this Section.
5) Install A/C compressor belt (if equipped). Refer to "COMPRESSOR DRIVE BELT" in Section 1B.
6) Fill coolant. Refer to "COOLING SYSTEM REFILL".
7) Connect negative cable at battery.
8) Check each part for leakage.

ECT SENSOR

Refer to “ECT SENSOR” in Section 6E1.

REQUIRED SERVICE MATERIAL

Material	Recommended SUZUKI product (Part Number)	Use
Ethylene glycol base coolant (Anti-freeze/ Anti-corrosion coolant)	—	Additive to engine cooling system for improving cooling efficiency and for protection against rusting.
Sealant	SUZUKI BOND NO. 1207C (99000-31150)	To apply to mating surface of water pump

TIGHTENING TORQUE SPECIFICATION

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Generator adjusting bolt	23	2.3	17
Generator pivot bolt	50	5	36
Water pump bolt and Nuts	22	2.2	16

SECTION 6C

ENGINE FUEL

WARNING:

For vehicles equipped with Supplemental Restraint (Air Bag) System:

- **Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to “Air Bag System Components and Wiring Location View” under “General Description” in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and “Service Precautions” under “On-Vehicle Service” in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.**
- **Technical service work must be started at least 90 seconds after the ignition switch is turned to the “LOCK” position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).**

CAUTION:

The engine of this vehicle requires the use of unleaded fuel only. Use of leaded and/or low lead fuel can result in engine damage and reduce the effectiveness of the emission control system.

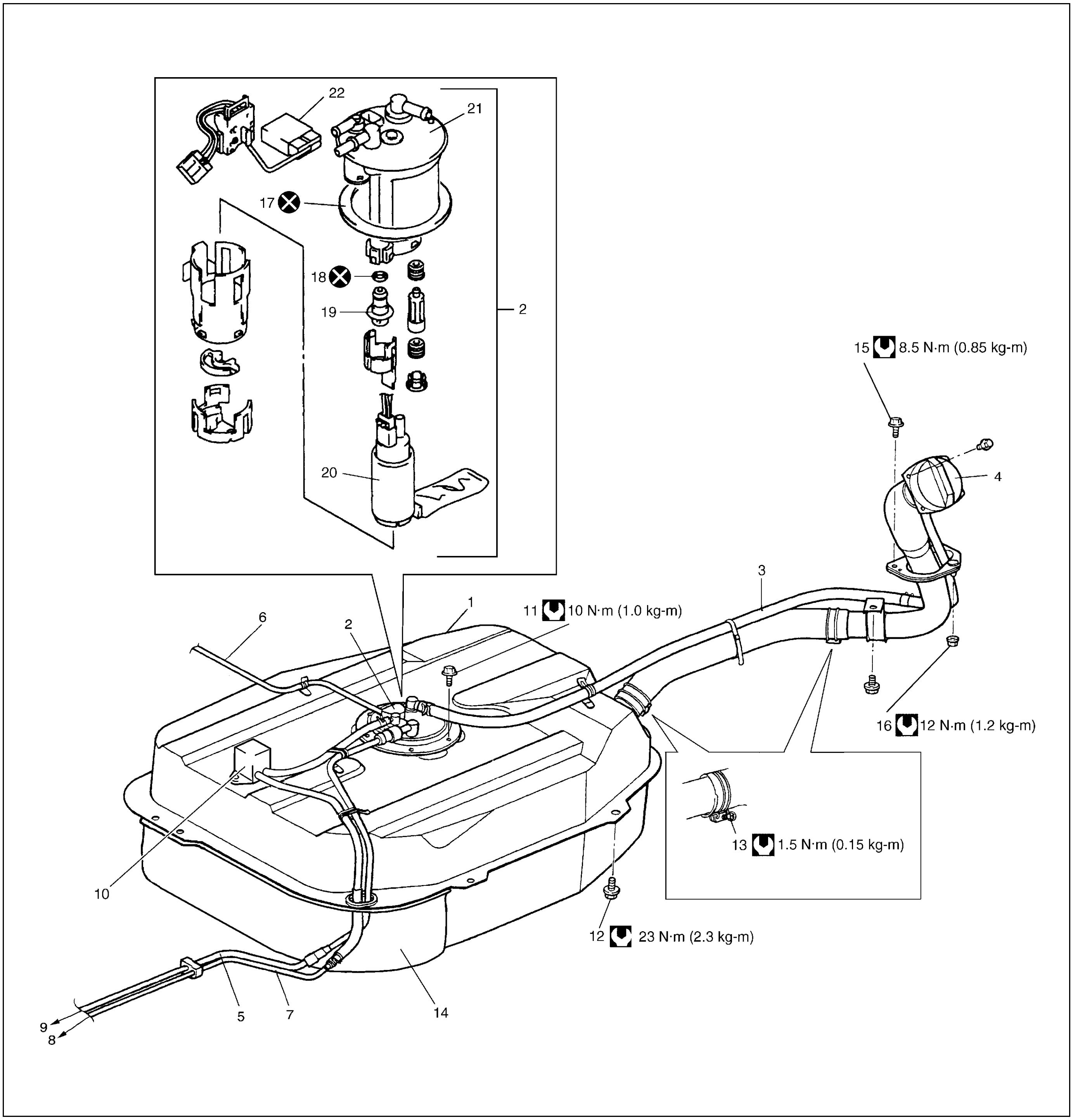
CONTENTS

GENERAL DESCRIPTION

The main components of the fuel system are fuel tank, fuel pump assembly (with fuel filter, fuel level gauge, fuel pressure regulator and tank pressure control valve), fuel/vapor separator fuel feed line and fuel vapor line.
For the details of fuel flow and fuel vapor flow, refer to “GENERAL DESCRIPTION” in Section 6E.

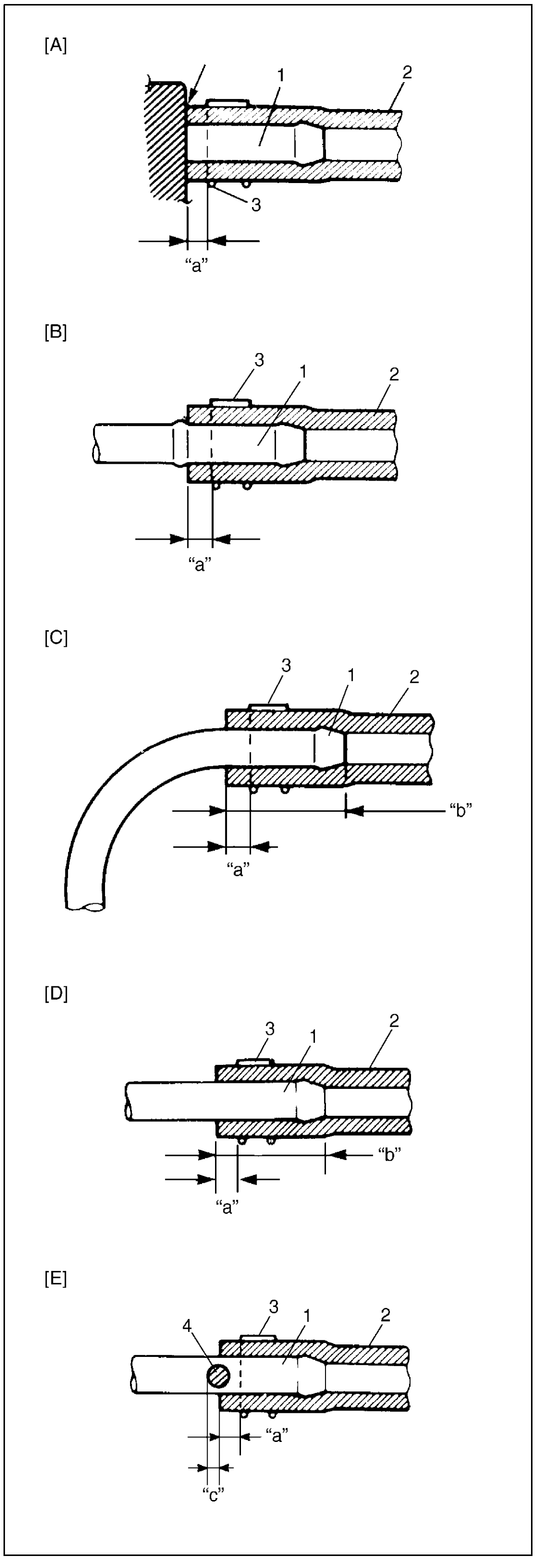
ON-VEHICLE SERVICE

COMPONENTS



1. Fuel tank	7. Fuel vapor line	13. Fuel filler hose clamp screw	19. Fuel pressure regulator
2. Fuel pump assembly	8. EVAP canister	14. Tank cover	20. Fuel pump
3. Breather hose	9. Delivery pipe	15. Fuel filler bracket screw	21. Fuel filter assembly
4. Fuel filler cap	10. Fuel/vapor separator	16. Fuel filler bracket nut	22. Fuel level gauge (Fuel sender gauge)
5. Fuel feed line	11. Fuel pump bolt (6 pcs.)	17. Gasket	⊗ Do not reuse.
6. Wire harness for fuel pump	12. Fuel tank bolt (4 pcs.)	18. O-ring	Tightening torque

PRECAUTIONS



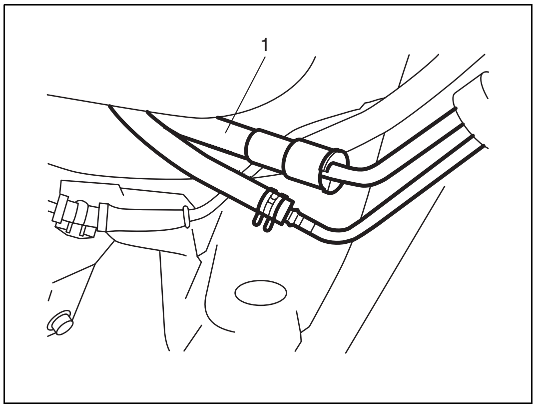
WARNING:

Before attempting service of any type on fuel system, the followings should be always observed in order to reduce the risk or fire and personal injury.

- **Disconnect negative cable at battery.**
- **Do not smoke, and place no smoking signs near work area.**
- **Be sure to have CO_2 fire extinguisher handy.**
- **Be sure to perform work in a well-ventilated area and away from any open flames (such as gas hot heater).**
- **Wear safety glasses.**
- **To relieve fuel vapor pressure in fuel tank, remove fuel filler cap from fuel filler neck and then reinstall it.**
- **As fuel feed line is still under high fuel pressure even after engine was stopped, loosening or disconnecting fuel feed line directly may cause dangerous spout of fuel to occur where loosened or disconnected.**
  Before loosening or disconnecting fuel feed line, make sure to relieve fuel pressure "FUEL PRESSURE RELIEF PROCEDURE" in Section 6.
- **A small amount of fuel may be released after the fuel line is disconnected. In order to reduce the chance of personal injury, cover the fitting to be disconnected with a shop cloth. Be sure to put that cloth in an approved container when disconnection is completed.**
- **Note that fuel hose connection varies with each type of pipe. Be sure to connect and clamp each hose correctly referring to the figure.**

[A] :	With short pipe, fit hose as far as it reaches pipe joint as shown.
[B] :	With the following type pipe, fit hose as far as its peripheral projection as shown.
[C] :	With bent pipe, fit hose as far as its bent part as shown or till depth "b".
[D] :	With straight pipe, fit hose till depth "b".
[E] :	With red marked pipe, fit hose end reaches red mark on pipe.
1.	Pipe
2.	Hose
3.	Clamp
4.	Ped mark
"a" :	Clamp securely at a position 3 to 7 mm (0.12 – 0.27 in.) from hose end.
"b" :	20 to 30 mm (0.79 – 1.18 in.)
"c" :	0 to 5 mm (0 – 0.19 in.)

FUEL LINES



CAUTION:

Due to the fact that fuel feed line (1) is under high pressure, use special care when servicing it.

INSPECTION

Visually inspect fuel lines for evidence of fuel leakage, hose crack and deterioration, or damage.
Make sure all clamps are secure.
Replace parts as needed.

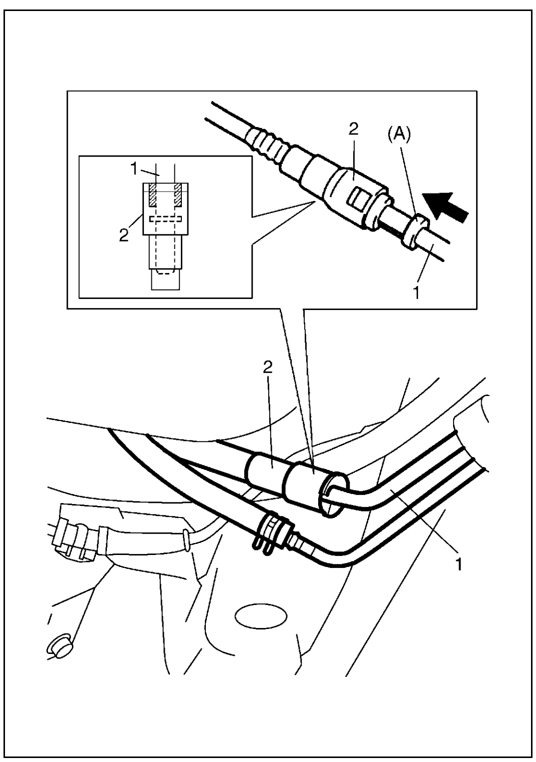
FUEL PIPE

WARNING:

A small amount of fuel may be released after fuel hose is disconnected. In order to reduce the chance of personal injury, cover hose and pipe to be disconnected with a shop cloth.
Be sure to put that cloth in an approved container when disconnection is completed.

REMOVAL

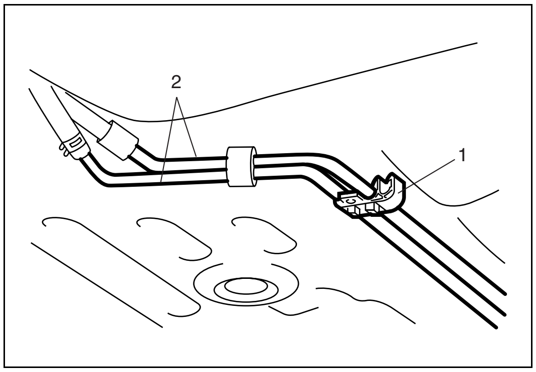
1) Relieve fuel pressure in fuel feed line according to "FUEL PRESSURE RELIEF PROCEDURE" in Section 6.
2) Disconnect negative cable at battery.



3) Disconnect fuel pipe joint and fuel hose from fuel pipe at the front and rear of each fuel pipe.
   For quick joint (2), disconnect it as follows :
   a) Remove mud, dust and/or foreign material between pipe (1) and joint by blowing compressed air.
   b) Unlock joint lock by inserting special tool between pipe and joint.

Special tool
(A) : 09919-47020

   c) Disconnect joint (2) from pipe (1).



4) Mark the location of clamps (1) on fuel pipes (2), so that the clamps can be reinstalled to where they were.
5) Remove pipes (2) with clamp (1) from vehicle.
6) Remove clamp (1) from pipes (2).

INSTALLATION

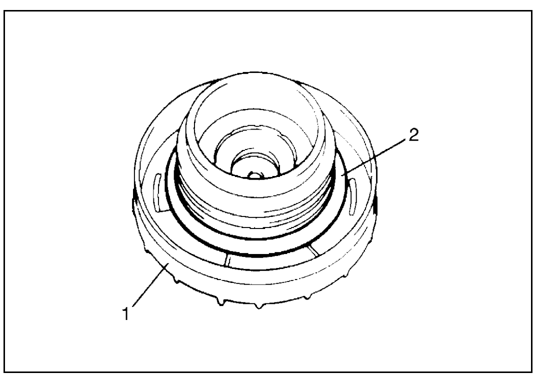
1) Install clamps to marked location on pipes. If clamp is deformed or its claw is bent or broken, replace it with new one.
2) Install pipes with pipe clamps to vehicle.
3) Connect fuel hoses and pipes to each pipe.

CAUTION:
When connecting joint, clean outside surfaces of pipe where joint is to be inserted, push joint into pipe till joint lock clicks and check to ensure that pipes are connected securely, or fuel leak may occur.

4) With engine OFF, turn ignition switch to ON position and check for fuel leaks.

FUEL FILLER CAP

INSPECTION



Remove cap (1), and check gasket for even filler neck imprint, and deterioration or any damage. If gasket (2) is in malcondition, replace cap.

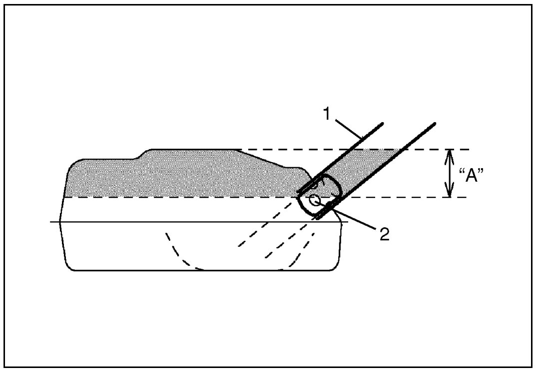
NOTE:
If cap requires replacement, only a cap with the same features should be used. Failure to use correct cap can result in critical malfunction of system.

FUEL TANK INLET VALVE

WARNING:
Refer to the WARNING at the beginning of ON-VEHICLE SERVICE in this section.

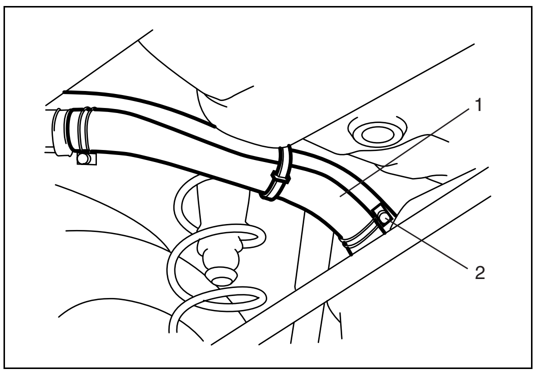
REMOVAL

1) Remove fuel filler cap.

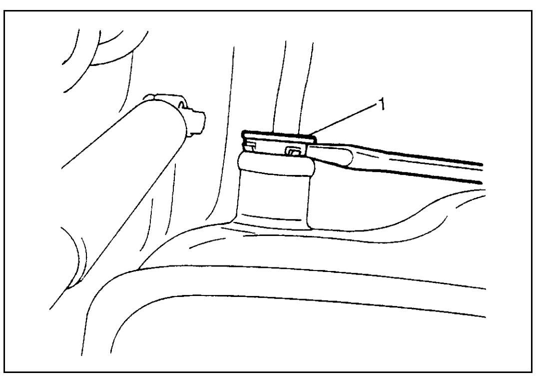


2) Insert hose of a hand operated pump into fuel filler hose (1) and drain fuel in space "A" in the figure.

CAUTION:
Do not force pump hose into fuel tank, or pump hose may damage fuel tank inlet valve (2).



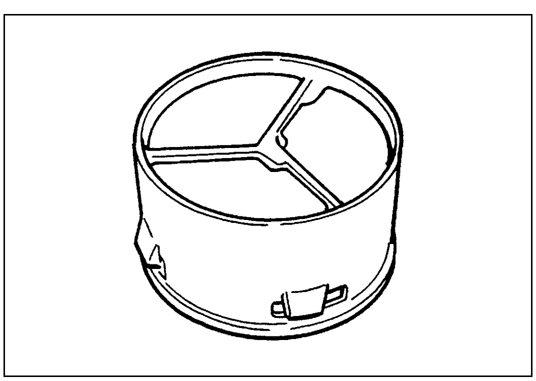
3) Hoist vehicle and remove clamp (2) and fuel filler hose (1) from fuel tank.



4) Remove fuel tank inlet valve (1) using flat-bladed screw-driver.

CAUTION:
Be careful not to damage fuel tank inlet valve (1) with flat-bladed screwdriver.

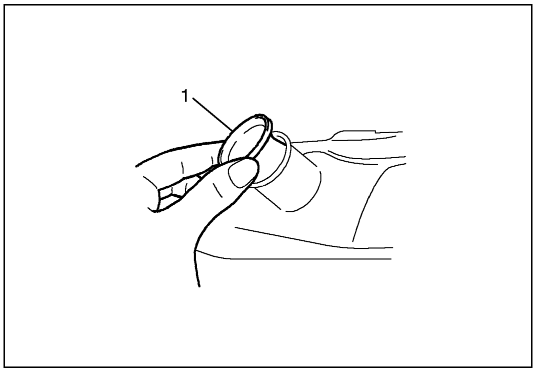
INSPECTION



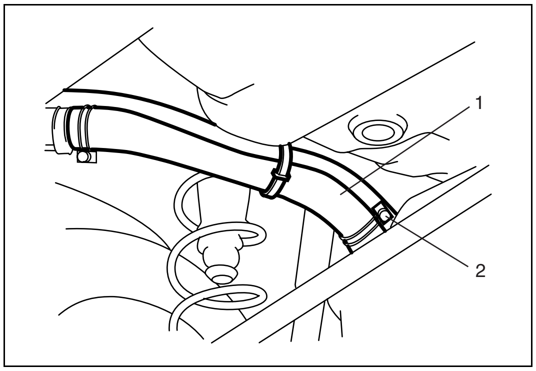
Check fuel tank inlet valve for the followings.
- Damage
- Smooth opening and closing

If any damage or malfunction is found, replace.

INSTALLATION



1) Install fuel tank inlet valve (1) to fuel tank.



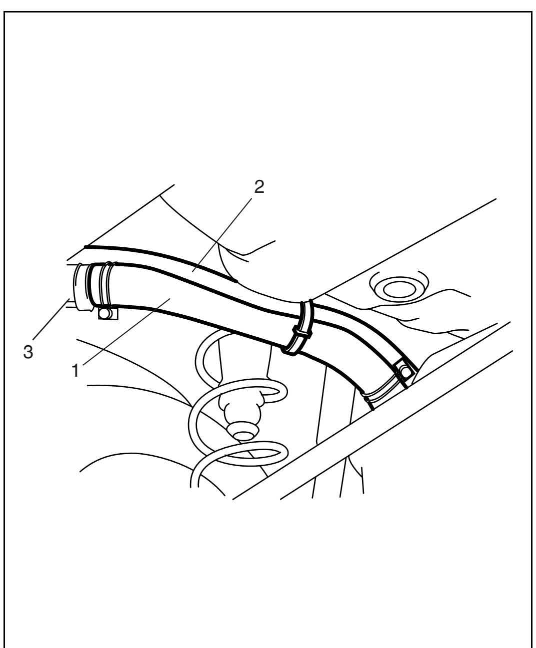
2) Install fuel filler hose (1) to fuel tank and secure it with clamp (2).
   For proper installation, refer to "COMPONENTS" under "ON-VEHICLE SERVICE".
3) Lower vehicle and install fuel filler cap.

FUEL TANK

REMOVAL

> **WARNING:**
> **Before starting the following procedure, be sure to observe "PRECAUTIONS".**

1) Relieve fuel pressure in fuel feed line according to "FUEL PRESSURE RELIEF PROCEDURE" in Section 6.
2) Disconnect negative cable at battery.
3) Hoist vehicle.

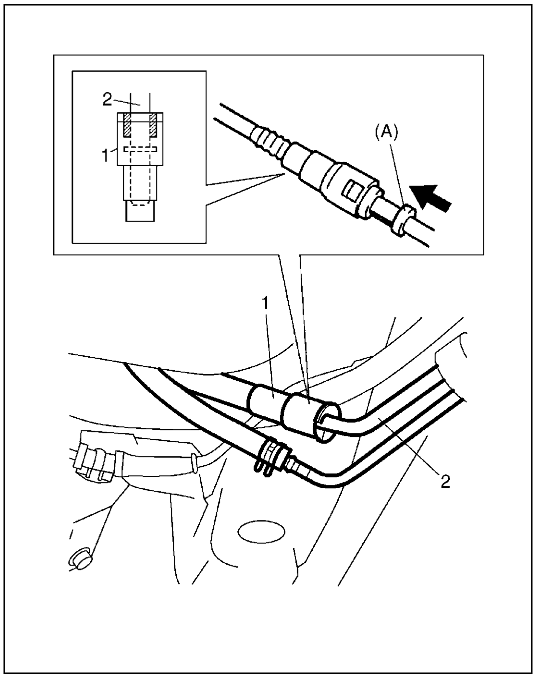


4) Disconnect fuel filler hose (1) and breather hose (2) from filler neck (3).

> **CAUTION:**
> **Never disconnect fuel filler hose (1) from fuel tank inlet. If half or more of fuel is remaining to fuel tank, fuel over flows in this case and come out.**

5) Due to absence of fuel tank drain plug, drain fuel tank by pumping fuel out through fuel tank filler.
   Use hand operated pump device to drain fuel tank.

> **CAUTION:**
> - **Do not force pump hose into fuel tank, or pump hose may damage fuel tank inlet valve.**
> - **Never drain or store fuel in an open container due to possibility of fire or explosion.**

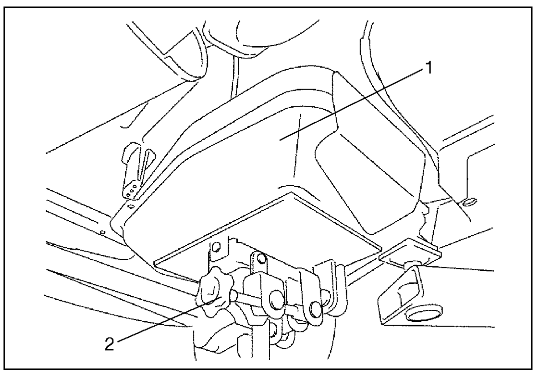


6) Disconnect fuel pipe joint and fuel hoses from pipes.
   For quick joint, disconnect it as follows :
   a) Remove mud, dust and/or foreign material between pipe and joint by blowing compressed air.
   b) Unlock joint (1) lock by inserting special tool between pipe (2) and joint (1).

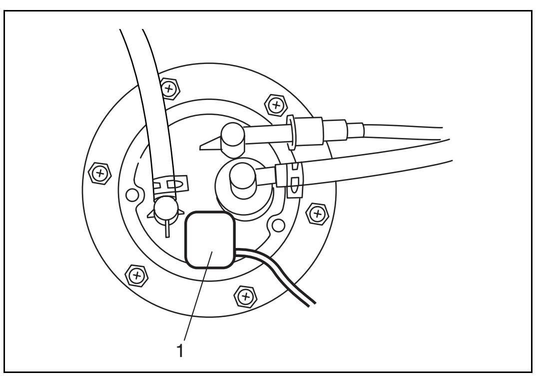
Special tool
(A) : 09919-47020

   c) Disconnect joint from pipe.

WARNING:
A small amount of fuel may be released after the fuel hose is disconnected. In order to reduce the chance of personal injury, cover the hose and pipe to be disconnected with a shop cloth. Be sure to put that cloth in an approved container when disconnection is completed.



7) Support fuel tank (1) with jack (2) and remove its mounting bolts.



8) Lower fuel tank a little as to disconnect wire harness at connector (1), then remove fuel tank.

INSPECTION

After removing fuel tank, check hoses and pipes connected to fuel tank for leaks, loose connections, deterioration or damage. Also check fuel pump assembly gaskets for leaks, visually inspect fuel tank for leaks and damage.
Replace any damaged or malconditioned parts.

FUEL TANK PURGING PROCEDURE

WARNING:

This purging procedure will not remove all fuel vapor. Do not attempt any repair on tank using heat of flame as an explosion resulting in personal injury could occur.

The following procedure is used for purging fuel tank.

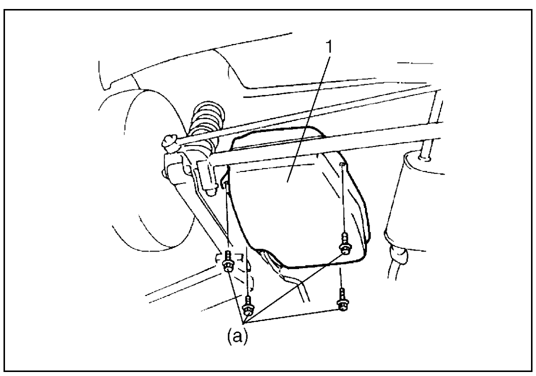
1) After removing fuel tank, remove all hoses, pipes, fuel pump assembly from fuel tank.
2) Drain all remaining fuel from tank.
3) Move tank to flushing area.
4) Fill tank with warm water or tap water, and agitate vigorously and drain. Repeat this washing until inside of tank is clean. Replace tank if its inside is rusty.
5) Completely flush out remaining water after washing.

CAUTION:

Never remain water in fuel tank after washing, or fuel tank inside will get corrosion.

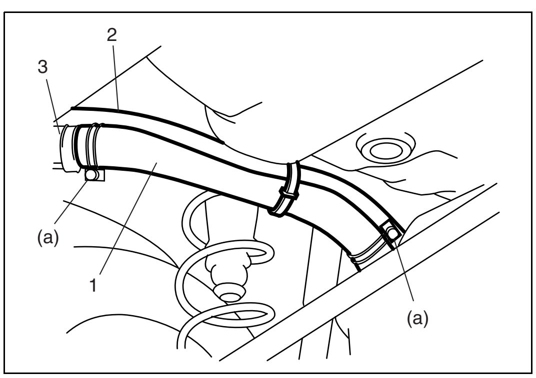
INSTALLATION

1) If parts have been removed from fuel tank, install them before installing fuel tank to vehicle.



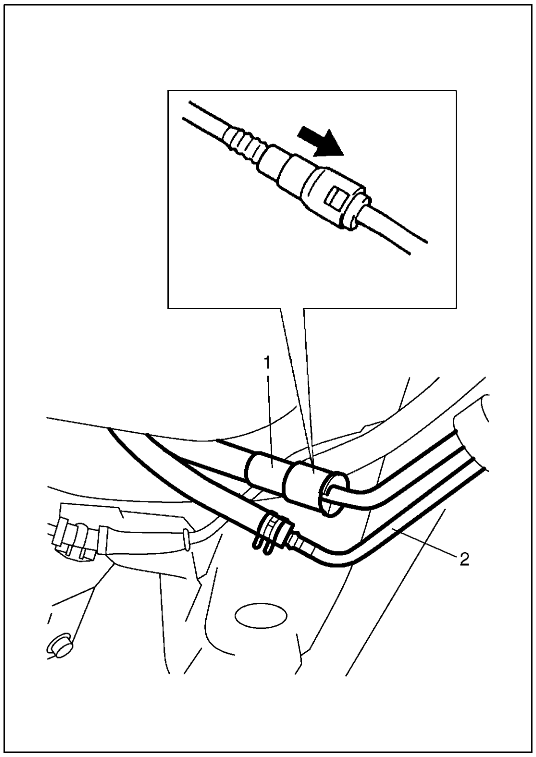
2) Raise fuel tank (1) with jack and connect connector of fuel pump and gauge and clamp wire harness.
3) Install fuel tank to vehicle.

Tightening torque
Fuel tank bolt (a) : 23 N·m (2.3 kg-m, 17.0 lb-ft)



4) Connect fuel filler hose (1) and breather hose (2) to filler neck (3) as shown in figure and clamp them securely.

Tightening torque
Fuel filler hose clamp (a) : 1.5 N·m (0.15 kg-m, 1.0 lb-ft)



5) Connect fuel feed hose (1) and vapor hose (2) to each pipe as shown in figure and clamp them securely.

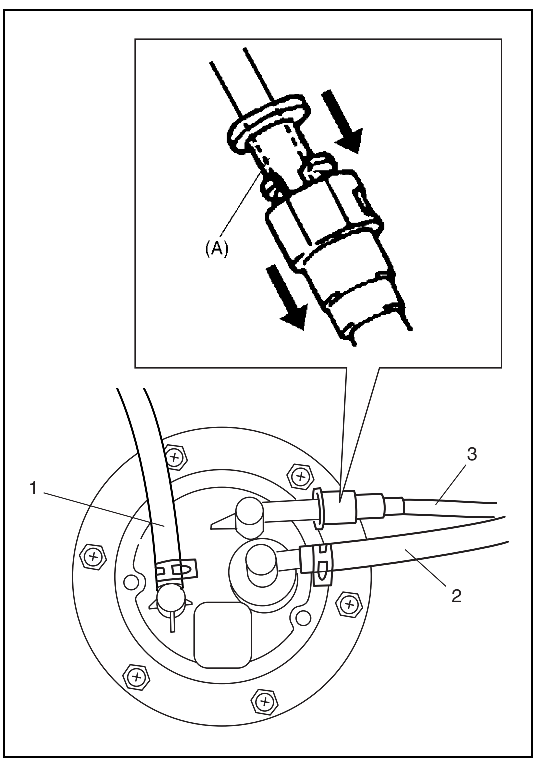
CAUTION:
- **When connecting joint, clean outside surfaces of pipe where joint is to be inserted, push joint into pipe till joint lock clicks and check to ensure that pipes are connected securely, or fuel leak may occur.**
- **Never let the fuel hoses touch the ABS sensor harness (if equipped).**

6) Connect negative cable at battery.
   With engine OFF, turn ignition switch to ON position and check for fuel leaks.

FUEL PUMP ASSEMBLY

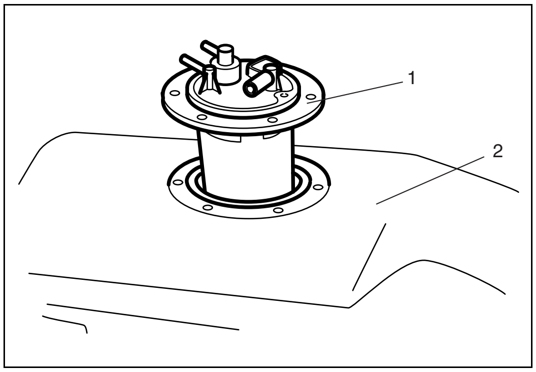
WARNING:
Refer to the PRECAUTIONS at the beginning of ON-VEHICLE SERVICE.

REMOVAL



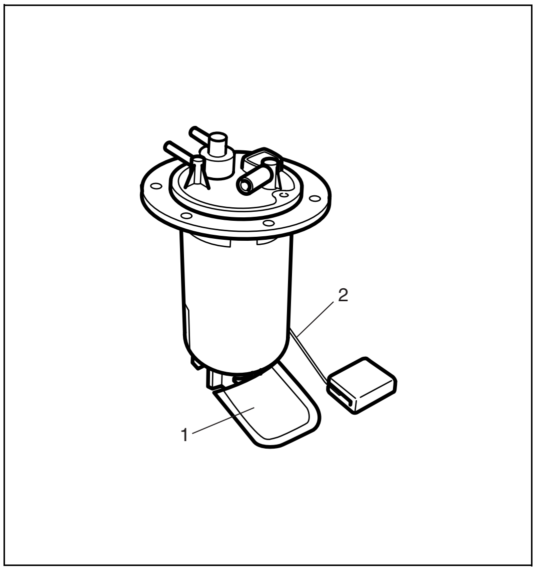
1) Remove fuel tank from vehicle. Refer to “FUEL TANK”.
2) Disconnect fuel breather hose (1), fuel vapor hose (2) and pipes from fuel pump assembly.
   When disconnecting joint of fuel feed line (3) from pipe, unlock joint by inserting special tool between pipe and joint lock first.

Special tool
(A) : 09919-47020



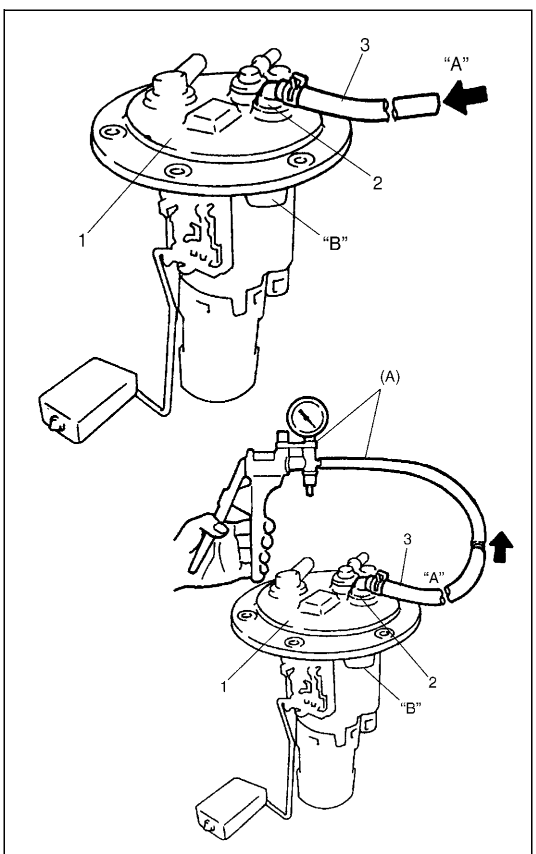
3) Remove fuel pump assembly (1) from fuel tank (2).

INSPECTION



- Check fuel pump assembly for damage.
- Check fuel suction filter (1) for evidence of dirt and contamination.
  If present, replace or clean and check for presence of dirt in fuel tank.
- For operation or electrical circuit inspection by referring to Section 6E1.
- For inspection of fuel level gauge (2) by referring to Section 8.
- Check tank pressure control valve referring to the following procedures.

WARNING:
Do not such air through fuel vapor line hose. Fuel vapor inside valve is harmful.

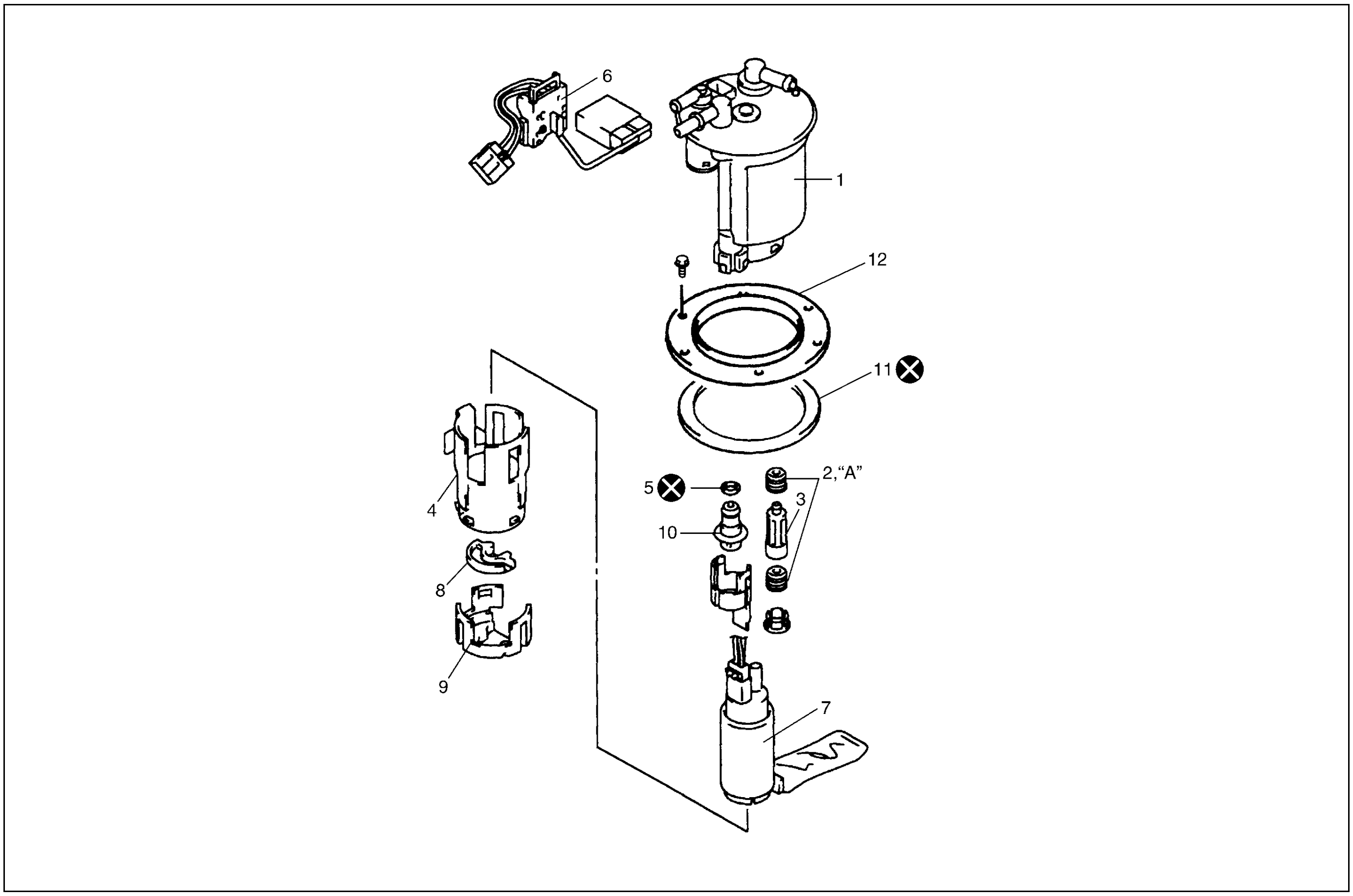


a) Air should pass through valve (2) smoothly from fuel vapor line hose (3) "A" to "B" when blown hard.
b) Also, when vacuum pump (4) is connected to fuel vapor hose and pump air through valve, air should pass from "B" to "A".

Special tool
(A) : 09917-47910

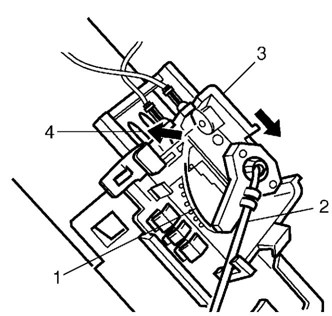
If air doesn't pass through valve in Step a) or vacuum is maintained in Step b), replace fuel filter assembly (1).

DISASSEMBLY AND REASSEMBLY



“A” : Apply oil	5. O-ring	10. Fuel pressure regulator
1. Fuel filter assembly (including check valve)	6. Fuel level sensor (Fuel sender gauge)	11. Gasket
2. Grommet	7. Fuel pump	12. Fuel pump plate
3. Tube	8. Cushion	⊗ Do not reuse.
4. Housing	9. Bracket	

Disassemble and reassemble fuel pump assembly, noting the followings.



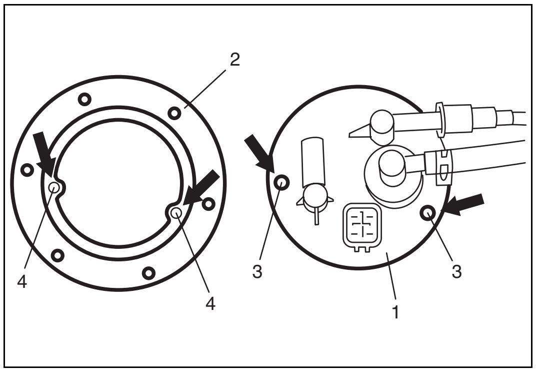
CAUTION:

- **While removing fuel level gauge, do not contact resistor plate (1) or deform arm (2). It may cause fuel level gauge to fail.**
- **When removing grommet from fuel tube or bracket sub assembly, be very careful not to cause damage to grommet installed section (sealed section in bore). Should it be damaged, replace it with new one, or fuel will leak from that part.**

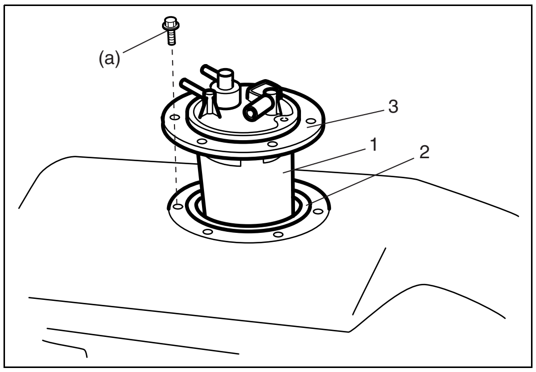
- When removing fuel level sensor (3), press snap-fit part (4) and slide it in the arrow direction as shown in figure.
- When installing fuel level sensor to housing, fit fuel level sensor securely.

INSTALLATION

1) Clean mating surfaces of fuel pump assembly (1) and fuel tank.

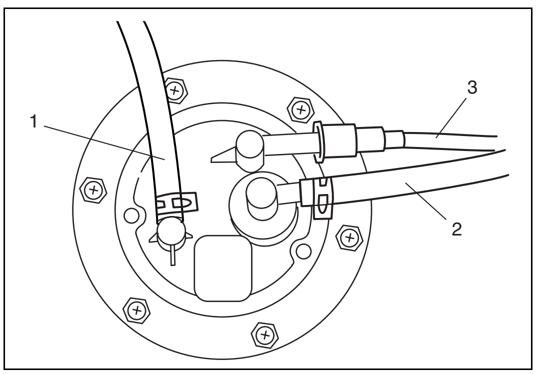


2) Put plate (2) on fuel pump assembly (1) by matching the protrusion of fuel pump assembly (3) to plate hole (4) as shown.



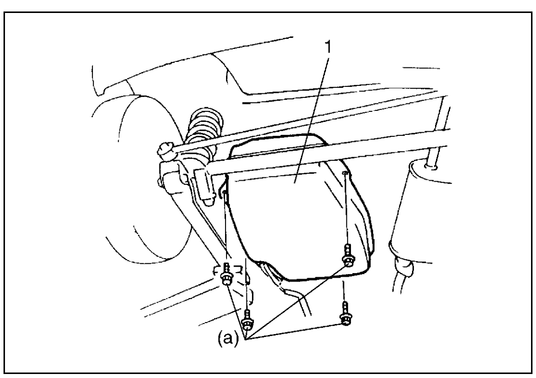
3) Install new gasket (2) and fuel pump assembly (1) with plate (3) to fuel tank.

Tightening torque
Fuel pump assembly bolts (a) : 10 N·m (1.0 kg-m, 7.5 lb-ft)



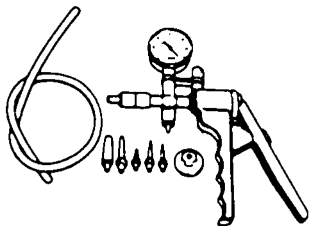
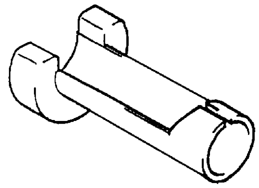
4) Connect fuel breather hose (1), fuel vapor hose (2) and fuel feed line (3) (pipe joint) to fuel pump assembly.

> **CAUTION:**
> **When connecting joint, clean outside surface of pipe where joint is to be inserted, push joint into pipe till joint lock clicks and check to ensure that pipes are connected securely, or fuel leak may occur.**



5) Install fuel tank (1) to vehicle. Refer to “FUEL TANK” in this section.

SPECIAL TOOL

	
09917-47010 Vacuum pump gauge	09919-47020 Quick joint remover

TIGHTENING TORQUE SPECIFICATION

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Fuel tank bolts	23	2.3	17
Fuel filler hose clamps	1.5	0.15	1
Fuel pump assembly bolts	10	1	7.5

SECTION 6E1

ENGINE AND EMISSION CONTROL SYSTEM

WARNING:

For vehicles equipped with Supplemental Restraint (Air Bag) System :
- **Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to "Air Bag System Components and Wiring Location View" under "General Description" in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and "Service Precautions" under "On-Vehicle Service" in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.**
- **Technical service work must be started at least 90 seconds after the ignition switch is turned to the "LOCK" position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).**

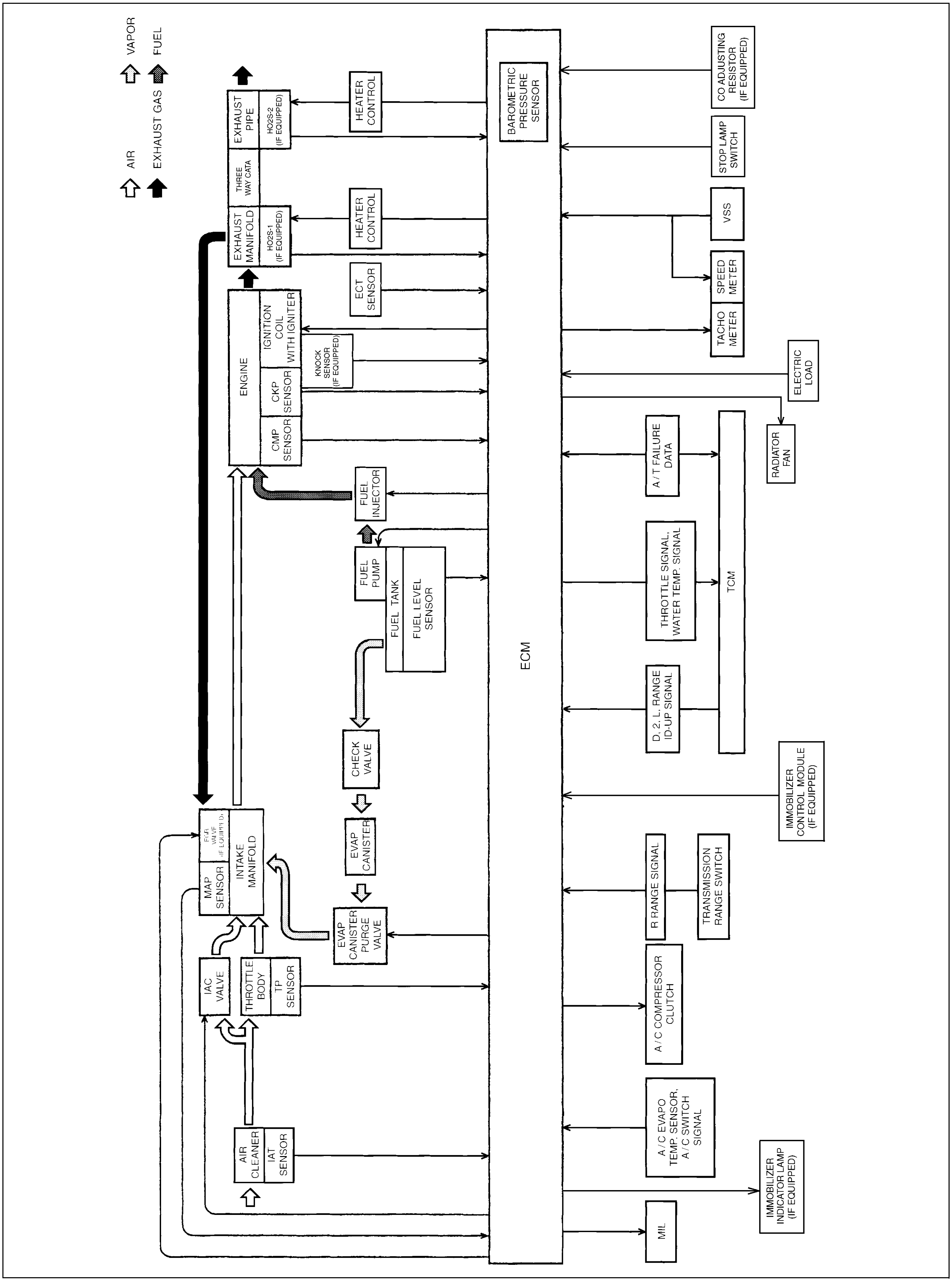
NOTE:

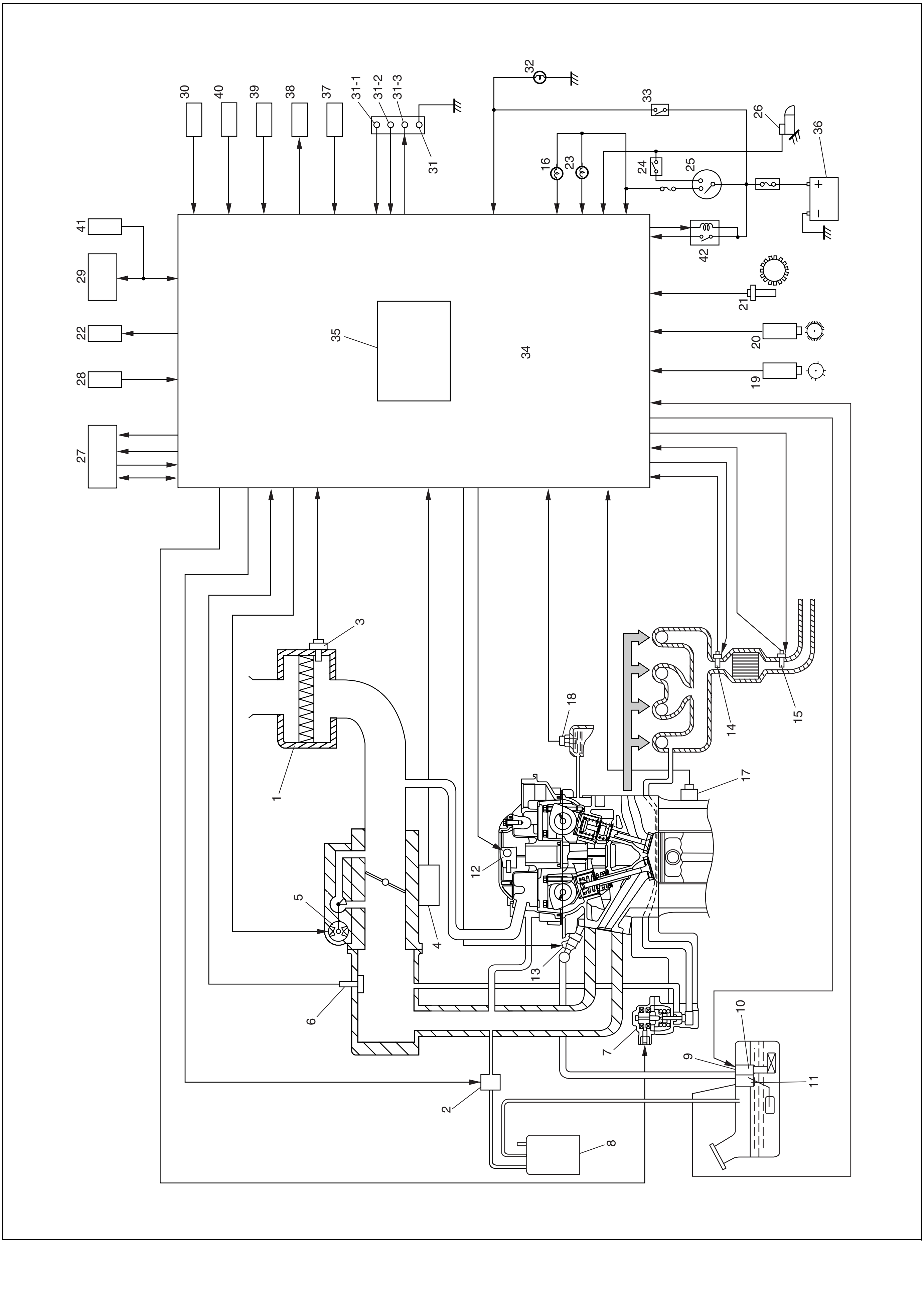
Whether the following system (parts) are used in the particular vehicle or not depends on vehicle specifications. Be sure to bear this in mind when performing service work.
- **EGR valve**
- **Heated oxygen sensor(s) or CO adjusting resistor**
- **Three way catalytic converter**
- **Immobilizer indicator lamp**
- **Knock sensor**

CONTENTS

GENERAL DESCRIPTION

The engine and emission control system is divided into 4 major sub-systems : air intake system, fuel delivery system, electronic control system and emission control system.
Air intake system includes air cleaner, throttle body, IAC valve and intake manifold.
Fuel delivery system includes fuel pump, delivery pipe, fuel pressure regulator, etc. Electronic control system includes ECM, various sensors and controlled devices.
Emission control system includes EGR, EVAP and PCV system.


AIR
VAPOR
EXHAUST GAS
FUEL
EXHAUST PIPE
HO2S-2 (IF EQUIPPED)
THREE WAY CATA
EXHAUST MANIFOLD
HO2S-1 (IF EQUIPPED)
HEATER CONTROL
HEATER CONTROL
ECT SENSOR
ENGINE
IGNITION COIL WITH IGNITER
KNOCK SENSOR (IF EQUIPPED)
CKP SENSOR
CMP SENSOR
FUEL INJECTOR
FUEL PUMP
FUEL TANK
FUEL LEVEL SENSOR
CHECK VALVE
EVAP CANISTER
EVAP CANISTER PURGE VALVE
INTAKE MANIFOLD
MAP SENSOR
IAC VALVE
THROTTLE BODY
TP SENSOR
AIR CLEANER
IAT SENSOR
ECM
BAROMETRIC PRESSURE SENSOR
CO ADJUSTING RESISTOR (IF EQUIPPED)
STOP LAMP SWITCH
VSS
SPEED METER
TACHO METER
ELECTRIC LOAD
RADIATOR FAN
A / T FAILURE DATA
THROTTLE SIGNAL, WATER TEMP. SIGNAL
TCM
D. 2. L. RANGE ID-UP SIGNAL
IMMOBILIZER CONTROL MODULE (IF EQUIPPED)
R RANGE SIGNAL
TRANSMISSION RANGE SWITCH
A / C COMPRESSOR CLUTCH
A / C EVAPO TEMP. SENSOR, A / C SWITCH SIGNAL
IMMOBILIZER INDICATOR LAMP (IF EQUIPPED)
MIL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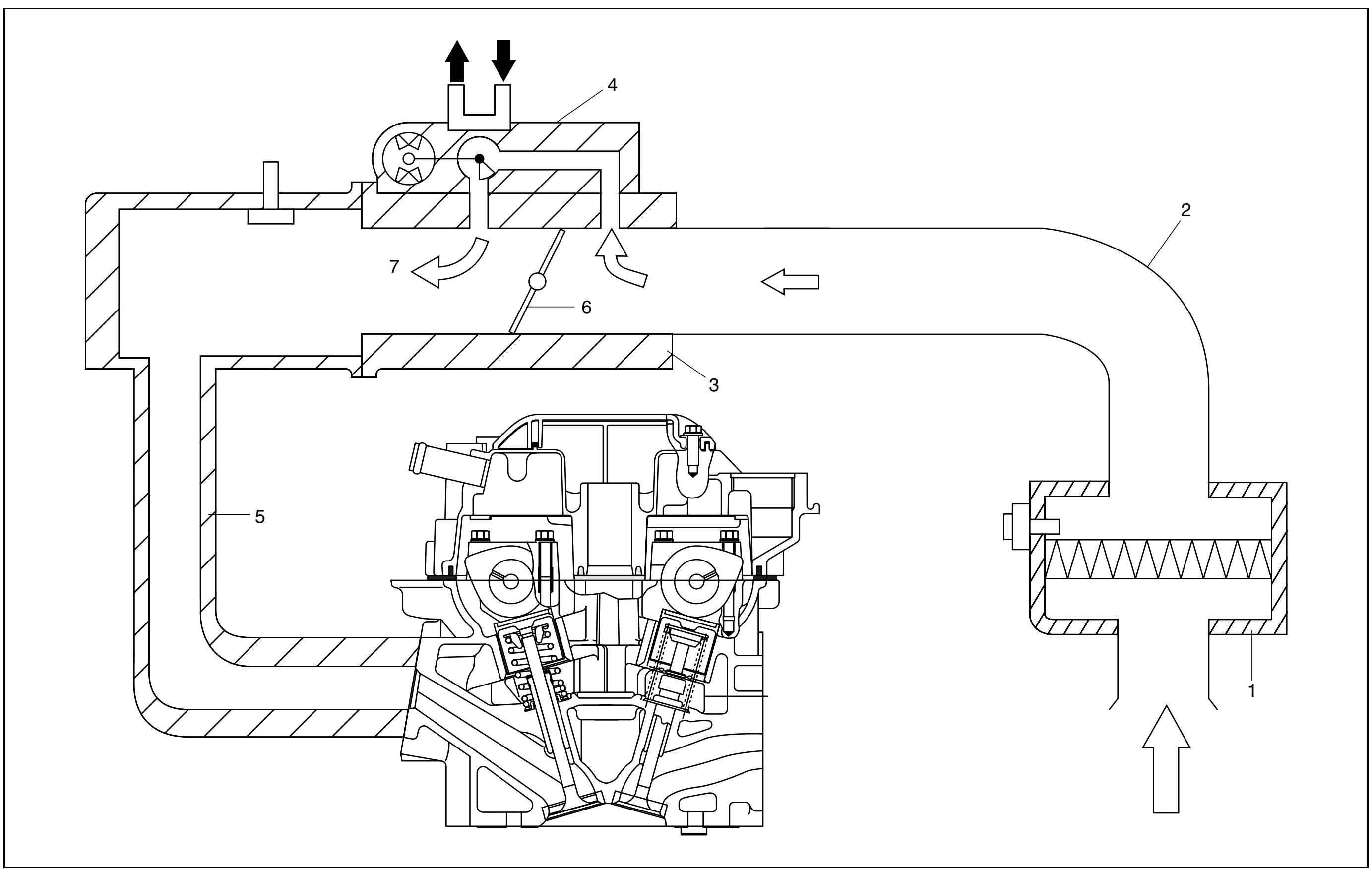
1. Air Cleaner	16. Immobilizer indicator lamp (if equipped)	31. Monitor connector (vehicle without immobilizer indicator lamp)
2. EVAP canister purge valve	17. Knock sensor (if equipped)	31-1. Diagnosis switch terminal (vehicle without immobilizer indicator lamp)
3. IAT sensor	18. ECT sensor	31-2. Test switch terminal (vehicle without immobilizer indicator lamp)
4. TP sensor	19. CMP sensor	31-3. Duty output terminal (vehicle without immobilizer indicator lamp)
5. IAC valve	20. CKP sensor	32. Stop lamp
6. MAP sensor	21. VSS	33. Stop lamp switch
7. EGR valve (if equipped)	22. Radiation fan	34. ECM
8. EVAP canister	23. Malfunction indicator lamp in combination meter	35. Barometric pressure sensor (if equipped)
9. Tank pressure control valve (built-in fuel pump)	24. Park/Neutral position switch (A/T)	36. Battery
10. Fuel pump (with pressure regulator)	25. Ignition switch	37. CO adjusting resistor (if equipped)
11. Fuel level sensor (vehicle with immobilizer indicator lamp)	26. Starter magnetic switch	38. A/C compressor clutch (if equipped)
12. Ignition coil assembly	27. TCM	39. A/C switch (if equipped)
13. Fuel injector	28. Transmission range switch (A/T)	40. A/C evaporator temp. sensor (if equipped)
14. Heated Oxygen Sensor (HO2S)-1 (if equipped)	29. DLC	41. Immobilizer control module (if equipped)
15. Heated Oxygen Sensor (HO2S)-2 (if equipped)	30. Electric load	42. Main relay

AIR INTAKE SYSTEM

The main components of the air intake system are air cleaner (1), air cleaner outlet hose (2), throttle body (3), idle air control valve (4) and intake manifold (5).

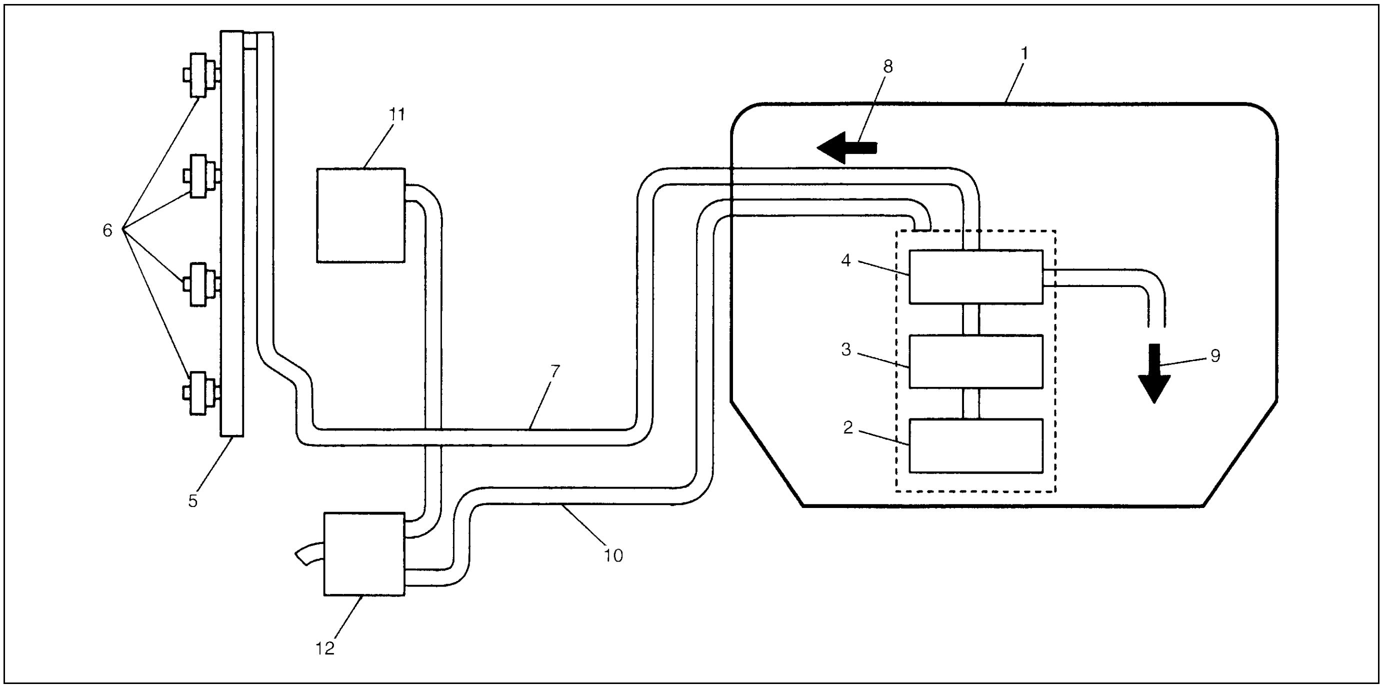
The air (by the amount corresponding to the throttle valve (6) opening and engine speed) is filtered by the air cleaner (1), passes through the throttle body (3), is distributed by the intake manifold (5) and finally drawn into each combustion chamber.

When the idle air control valve (4) is opened according to the signal from ECM, the air (7) bypasses the throttle valve (6) through bypass passage and is finally drawn into the intake manifold (5).



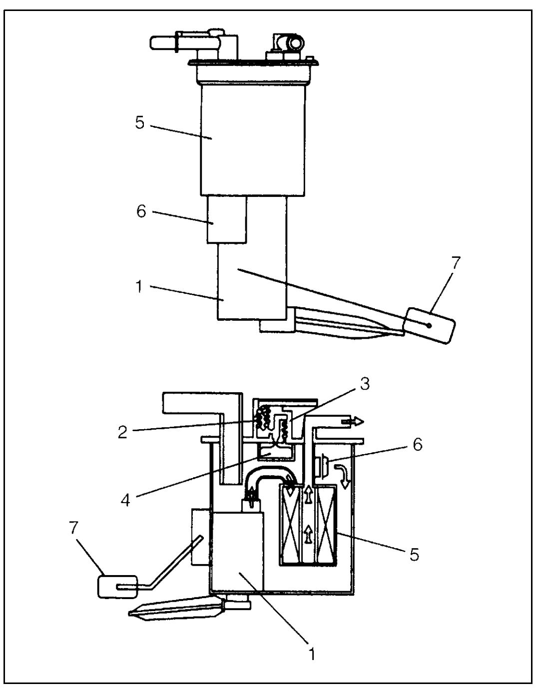
FUEL DELIVERY SYSTEM

The fuel system consists of fuel tank (1), fuel pump (2) (with built-in fuel filter (3) and fuel pressure regulator (4)), delivery pipe (5), injectors (6) and fuel feed line (7).
The fuel (8) in the fuel tank (1) is pumped up by the fuel pump (2), sent into delivery pipe (5) and injected by the injectors (6).
As the fuel pump assembly is equipped with built-in fuel filter (3) and fuel pressure regulator (4), the fuel (8) is filtered and its pressure is regulated before being sent to the delivery pipe (5).
The excess fuel from fuel pressure regulation process is returned back (9) into the fuel tank.
Also, fuel vapor generated in fuel tank is led through the fuel vapor line (10) into the EVAP canister (12).



11. Intake manifold

FUEL PUMP



An in-tank type electric pump has been adopted for the fuel pump (1). Incorporated in the pump assembly are;

- Tank pressure control valve (2) which keeps the pressure in the fuel tank constant, and prevents the fuel from spouting and tank itself from being deformed.
- Relief valve (3) which prevents the pressure in tank from rising excessively.
- Fuel cut valve (4) which closes as the float rises so that the fuel will not enter the canister when the fuel level in the tank rises high depending on the fuel level in the tank and the vehicle tilt angle.

Also, a fuel filter (5) and a fuel pressure regulator (6) are included and a fuel level gauge (7) is attached.
Addition of the fuel pressure regulator (6) to the fuel pump makes it possible to maintain the fuel pressure at constant level and ECM controls compensation for variation in the intake manifold pressure.

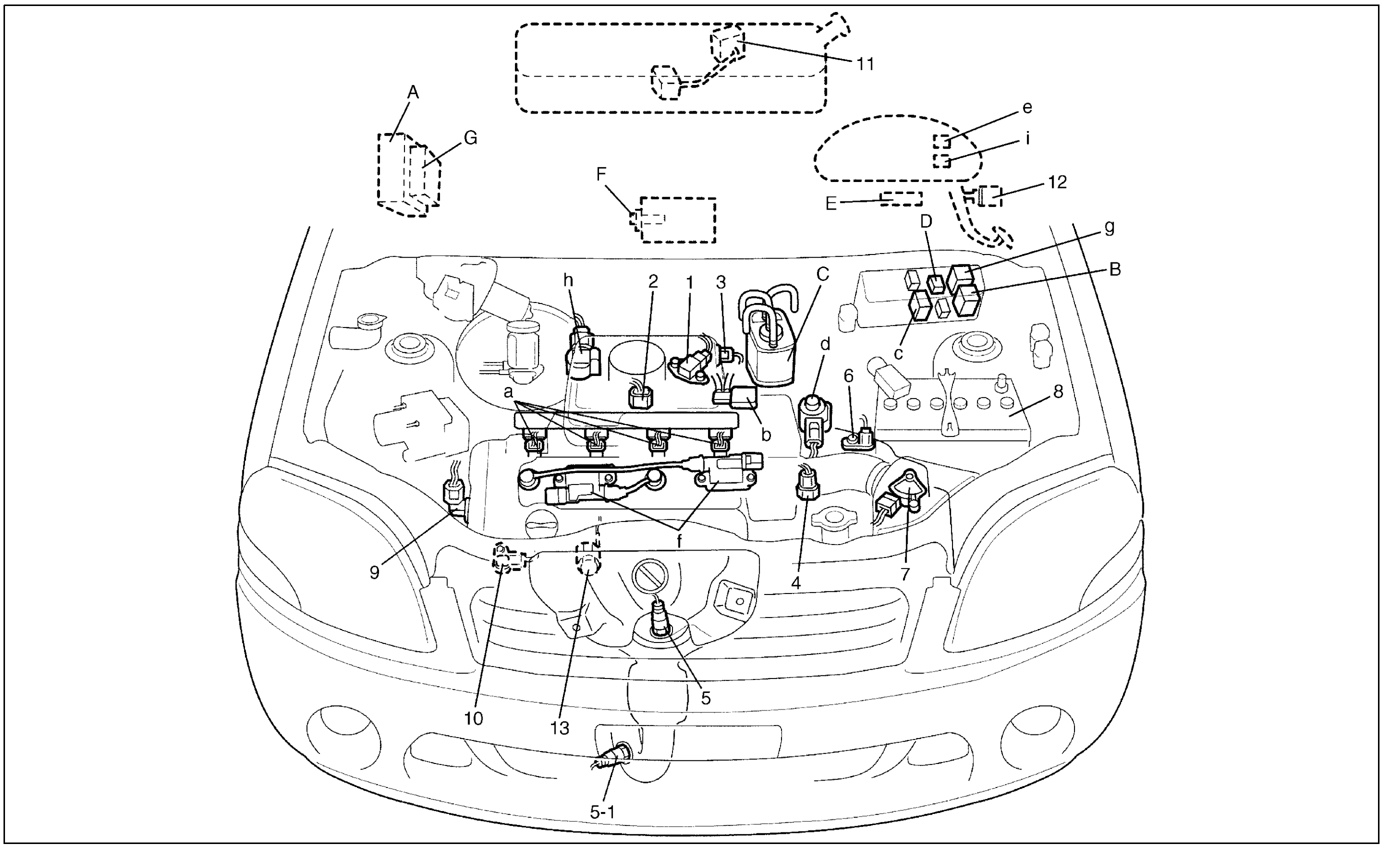
ELECTRONIC CONTROL SYSTEM

The electronic control system consists of 1) various sensors which detect the state of engine and driving conditions, 2) ECM which controls various devices according to the signals from the sensors and 3) various controlled devices.

Functionally, it is divided into nine sub systems :

- Fuel injection control system
- Idle speed control system
- Fuel pump control system
- A/C control system (if equipped)
- Radiator fan control system
- EGR system (if equipped)
- Evaporative emission control system
- Oxygen sensor heater control system (if equipped)
- Ignition control system

Also, with A/T model, ECM sends throttle valve opening signal and coolant temp. signal to transmission control module to control A/T.



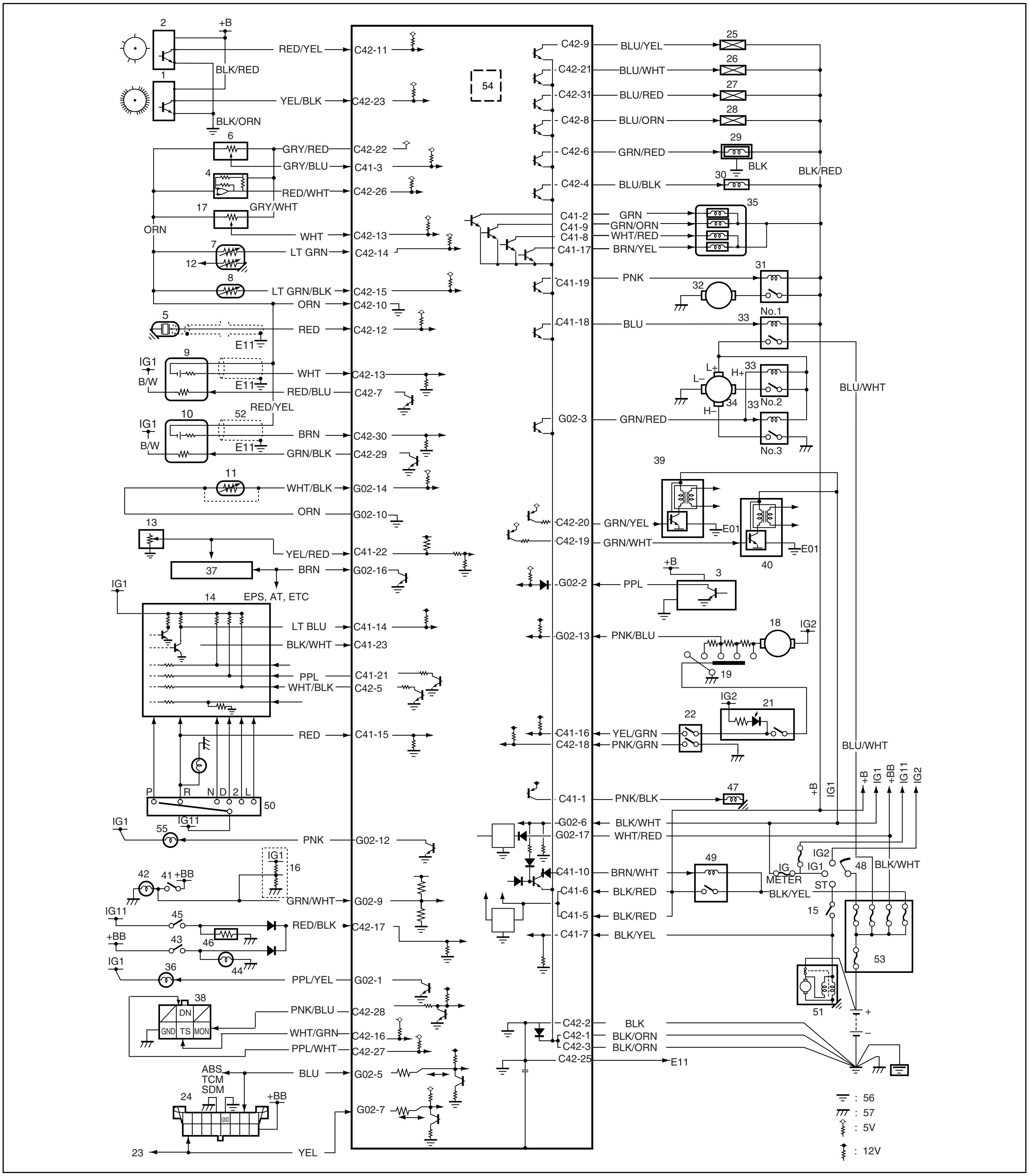
INFORMATION SENSORS	CONTROL DEVICES	OTHERS
1. MAP sensor	a : Fuel injector	A : ECM
2. TP sensor	b : EVAP canister purge valve	B : Main relay
3. IAT sensor	c : Fuel pump relay	C : EVAP canister
4. ECT sensor	d : EGR valve (step motor) (if equipped)	D : Monitor connector
5. Heated oxygen sensor-1 (if equipped)	e : Malfunction indicator lamp	E : Data link connector
5-1. Heated oxygen sensor-2 (if equipped)	f : Ignition coil assembly	F : A/C EVAP thermistor (if equipped)
6. VSS	g : Radiator fan control relay	G : TCM (A/T)
7. Transmission range switch (A/T)	h : IAC valve	
8. Battery	i : Immobilizer indicator lamp	
9. CMP sensor		
10. CKP sensor		
11. Fuel level sensor (gauge) (in fuel tank)		
12. Stop lamp switch		
13. Knock sensor (if equipped)		

ENGINE & EMISSION CONTROL INPUT/OUTPUT TABLE

INPUT		OUTPUT — ELECTRIC CONTROL DEVICE: FUEL PUMP RELAY	FUEL INJECTOR	HO2S HEATER	IAC VALVE	IGNITION COIL WITH IGNITER	EGR VALVE (IF EQUIPPED)	EVAP CANISTER PURGE VALVE	A/C COMPRESSOR CLUTCH	RADIATOR FAN RELAY	MIL	MAIN RELAY	TRANSMISSION CONTROL MODULE
SIGNAL FROM SENSOR, SWITCH AND CONTROL MODULE	DIAGNOSIS SWITCH (VEHICLE WITHOUT IMMOBILIZER INDICATOR LAMP)										○		
	FUEL LEVEL SENSOR (VEHICLE WITH IMMOBILIZER INDICATOR LAMP)	For detecting fuel level											
	BAROMETRIC PRESSURE SENSOR (VEHICLE WITH EGR VALVE)		○		○						○		○
	STOP LAMP SWITCH				○								
	START SWITCH	○	○		○				○		○		
	IGNITION SWITCH	○	○	○	○	○	○	○	○	○		○	○
	LIGHTING SWITCH				○								
	REAR DEFOGGER SWITCH				○								
	BLOWER SWITCH				○				○		○		
	A/C SWITCH				○				○	○			
	A/C EVAP TEMP. SENSOR				○				○				
	VSS				○				○	○	○		○
	HEATED OXYGEN SENSOR-1 (VEHICLE WITH EGR VALVE)		○					○			○		
	HEATED OXYGEN SENSOR-2 (VEHICLE WITH IMMOBILIZER INDICATOR LAMP)	For detecting deterioration of three way catalytic convertor									○		
	IAT SENSOR		○		○	○	○	○	○		○		
	ECT SENSOR		○	○	○	○	○	○	○	○	○		○
	TP SENSOR		○		○	○			○		○		○
	MAP SENSOR		○	○	○	○	○	○	○		○		
	CMP SENSOR	○	○	○	○	○	○	○	○		○		
	CKP SENSOR	○	○	○	○	○	○	○	○		○		
	TEST SWITCH TERMINAL (VEHICLE WITHOUT IMMOBILIZER INDICATOR LAMP)					○							
	KNOCK SENSOR (VEHICLE WITH EGR VALVE)					○					○		

ECM INPUT/OUTPUT CIRCUIT DIAGRAM

For TYPE A (See NOTE)



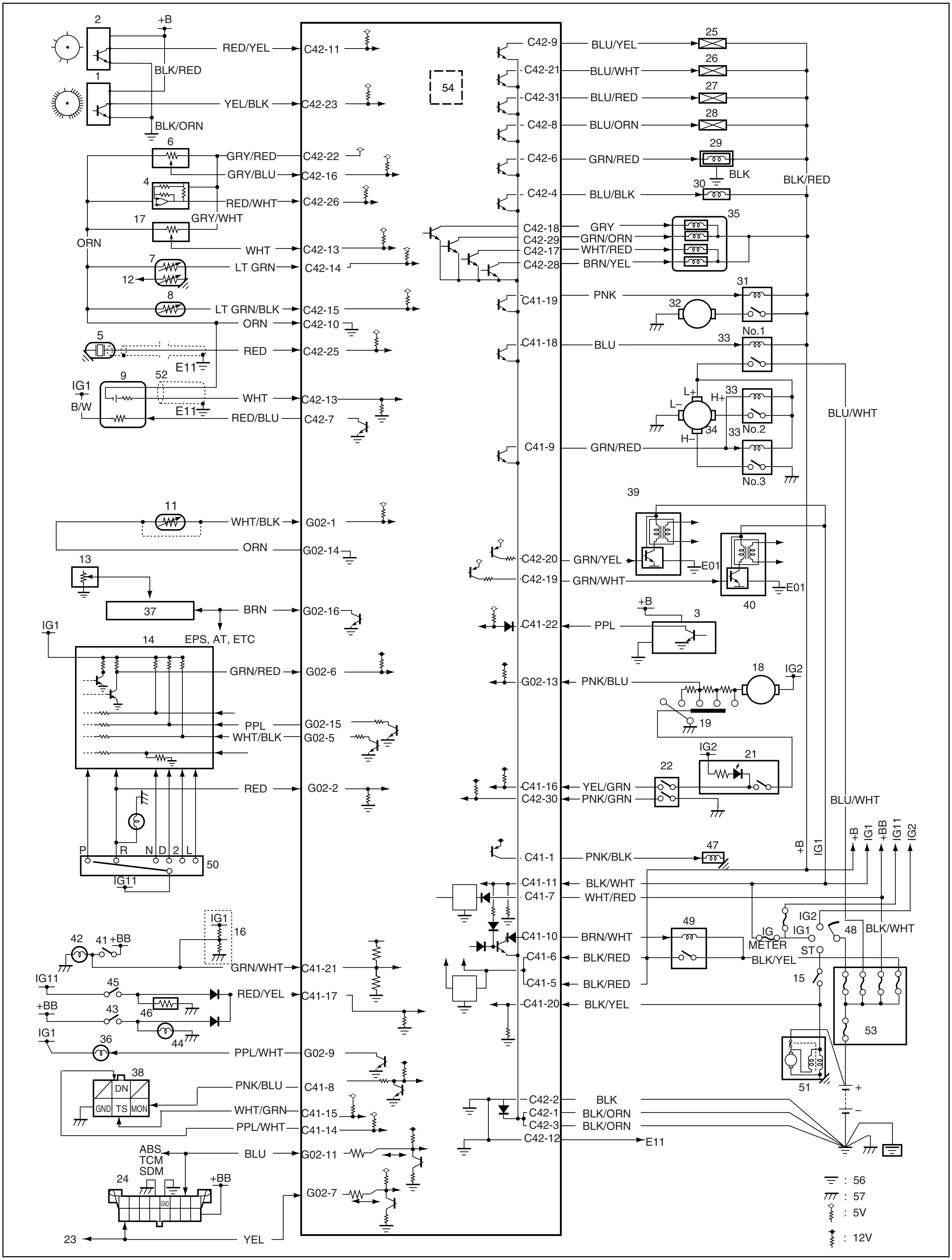
NOTE:

Type A is other than follows.

Type B is right hand steering vehicle equipped with fasten seat belt light and immobilizer control system.

1. CKP sensor	20. Blank	39. Ignition coil assembly (for No.1 and No.4 spark plugs)
2. CMP sensor	21. A/C switch	40. Ignition coil assembly (for No.2 and No.3 spark plugs)
3. VSS	22. A/C pressure switch	41. Stop lamp switch
4. MAP sensor	23. Immobilizer control module	42. Stop lamp
5. Knock sensor (if equipped)	24. Data link connector	43. Lighting switch
6. TP sensor	25. Injector No.1	44. Position lamp
7. ECT sensor	26. Injector No.2	45. Rear defogger switch
8. IAT sensor	27. Injector No.3	46. Rear defogger
9. Heated oxygen sensor-1 (if equipped)	28. Injector No.4	47. A/C compressor clutch (if equipped)
10. Heated oxygen sensor-2 (if equipped)	29. IAC valve	48. Ignition switch
11. A/C evaporator temp. sensor	30. EVAP canister purge valve	49. Main relay
12. Combination meter	31. Fuel pump relay	50. Transmission range switch (A/T)
13. Fuel level sensor (vehicle with immobilizer indicator lamp)	32. Fuel pump	51. Starting motor
14. TCM	33. Radiator fan relay	52. Shield wire
15. Transmission range switch	34. Radiator fan motor	53. Main fuse
16. ABS control module	35. EGR valve (if equipped)	54. Barometric pressure sensor
17. CO adjusting resistor (if equipped)	36. Malfunction indicator lamp	55. Immobilizer indicator lamp (if equipped)
18. Heater fan motor	37. Tachometer	56. Engine ground
19. Heater fan switch	38. Monitor connector (vehicle without immobilizer indicator lamp)	57. Body ground

For TYPE B (Refer to NOTE in "ECM INPUT/OUTPUT CIRCUIT DIAGRAM" for applicable model.)

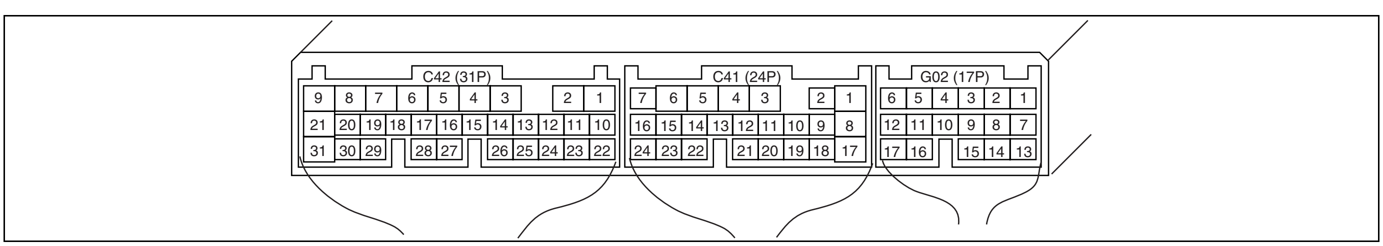


1. CKP sensor	20. Blank	39. Ignition coil assembly (for No.1 and No.4 spark plugs)
2. CMP sensor	21. A/C switch	40. Ignition coil assembly (for No.2 and No.3 spark plugs)
3. VSS	22. A/C pressure switch	41. Stop lamp switch
4. MAP sensor	23. Immobilizer control module	42. Stop lamp
5. Knock sensor (if equipped)	24. Data link connector	43. Lighting switch
6. TP sensor	25. Injector No.1	44. Position lamp
7. ECT sensor	26. Injector No.2	45. Rear defogger switch
8. IAT sensor	27. Injector No.3	46. Rear defogger
9. Heated oxygen sensor-1 (if equipped)	28. Injector No.4	47. A/C compressor clutch (if equipped)
10. Blank	29. IAC valve	48. Ignition switch
11. A/C evaporator temp. sensor	30. EVAP canister purge valve	49. Main relay
12. Combination meter	31. Fuel pump relay	50. Transmission range switch (A/T)
13. Fuel level sensor (vehicle with immobilizer indicator lamp)	32. Fuel pump	51. Starting motor
14. TCM	33. Radiator fan relay	52. Shield wire
15. Transmission range switch	34. Radiator fan motor	53. Main fuse
16. ABS control module	35. EGR valve (if equipped)	54. Barometric pressure sensor
17. CO adjusting resistor (if equipped)	36. Malfunction indicator lamp	55. Immobilizer indicator lamp (if equipped)
18. Heater fan motor	37. Tachometer	56. Engine ground
19. Heater fan switch	38. Monitor connector (vehicle without immobilizer indicator lamp)	57. Body ground

ECM TERMINAL ARRANGEMENT TABLE

For TYPE A (Refer to NOTE in page "ECM INPUT/OUTPUT CIRCUIT DIAGRAM" for applicable model.)

CONNECTOR	TERMINAL	WIRE COLOR	CIRCUIT
C42	1	BLK/ORN	Ground for ECM
	2	BLK	Ground for drive circuit
	3	BLK/ORN	Ground for drive circuit
	4	BLU/BLK	Canister purge valve
	5	WHT/BLK	Coolant temp. signal output
	6	GRN/RED	IAC valve
	7	RED/BLU	Heater of HO2S-1
	8	BLU/ORN	No.4 fuel injector
	9	BLU/YEL	No.1 fuel injector
	10	ORN	Ground for sensor circuit
	11	RED/YEL	CMP sensor
	12	RED	Knock sensor (if equipped)
	13	WHT	Heated oxygen sensor-1 (if equipped) CO adjusting resistor (if equipped)
	14	LT GRN	Coolant temp. sensor
	15	LT GRN/BLK	Intake air temp. sensor
	16	WHT/GRN	Test switch terminal (if equipped)
	17	RED/BLK	Electric load (+)
	18	PNK/GRN	A/C switch
	19	GRN/WHT	IG coil assembly for No.2 and 3 spark plugs
	20	GRN/YEL	IG coil assembly for No.1 and 4 spark plugs
	21	BLU/WHT	No.2 fuel injector
	22	GRY/RED	Power supply for sensor
	23	YEL/BLK	CKP sensor (+)
	24	–	–
	25	–	Ground for sensor shield wire
	26	RED/WHT	MAP sensor
	27	PPL/WHT	Diagnosis switch terminal (if equipped)
	28	PNK/BLU	Duty output terminal (if equipped)
	29	BRN	Heater of HO2S-2
	30	GRN/BLK	Heated oxygen sensor-2
	31	BLU/RED	No.3 fuel injector
C41	1	PNK/BLK	A/C compressor clutch
	2	GRN	EGR valve (stepper motor coil 1)
	3	GRY/BLU	Throttle position (TP) sensor
	4	–	Heater of HO2S-2
	5	BLK/RED	Power source
	6	BLK/RED	Power source
	7	BLK/YEL	Engine start signal
	8	WHT/RED	EGR valve (stepper motor coil 3)
	9	GRN/ORN	EGR valve (stepper motor coil 2)
	10	BRN/WHT	Ground for main relay
	11	–	–
	12	–	–
	13	–	Heated oxygen sensor-2
	14	LT BLU	"D", "2", "L"-range ID-UP signal
	15	RED	"R"-range signal
	16	YEL/GRN	A/C SW signal
	17	BRN/YEL	EGR valve (stepper motor coil 4)
	18	BLU	Radiator fan relay 1
	19	PNK	Fuel pump relay
	20	–	–
	21	PPL	Throttle opening signal output for A/T
	22	YEL/RED	Fuel level gauge
	23	BLK/WHT	TCM serial data line
	24	–	–
G02	1	PPL/WHT	Malfunction indicator lamp
	2	PPL	Vehicle speed sensor
	3	PPL/YEL	Radiator fan relay 2
	4	–	–
	5	BLU	Data link connector
	6	BLK/WHT	Ignition switch signal
	7	YEL	Data link connector
	8	–	–
	9	GRN/WHT	Stop lamp switch (Brake pedal switch)
	10	ORN	GND for sensor
	11	–	–
	12	PNK	Immobilizer indicator lamp (if equipped)
	13	PNK/BLU	Electrical load (-)
	14	WHT/BLK	A/C evaporator temp. sensor
	15	–	–
	16	BRN	Tachometer signal
	17	WHT/RED	Backup power source

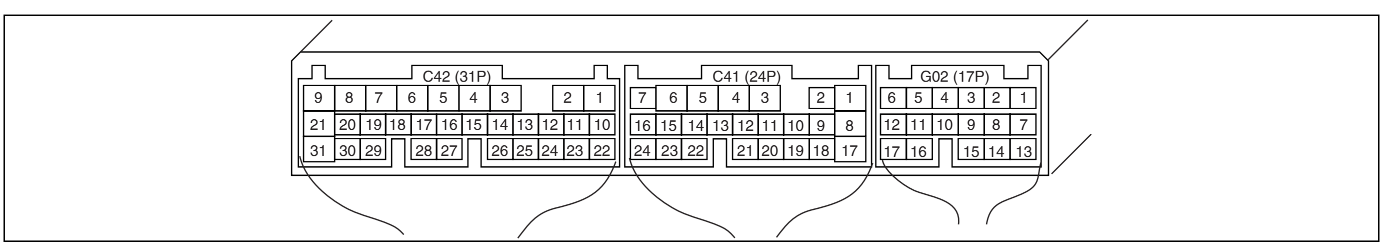


NOTE:

For abbreviation of wire color, refer to Section 0A.

For TYPE B (Refer to NOTE in page “ECM INPUT/OUTPUT CIRCUIT DIAGRAM” for applicable model.)

CONNEC-TOR	TERMINAL	WIRE COLOR	CIRCUIT
C42	1	BLK/ORN	Ground for ECM
	2	BLK	Ground for drive circuit
	3	BLK/ORN	Ground for drive circuit
	4	BLU/BLK	Canister purge valve
	5	–	–
	6	GRN/RED	IAC valve
	7	RED/BLU	Heater of HO2S-1
	8	BLU/ORN	No.4 fuel injector
	9	BLU/YEL	No.1 fuel injector
	10	ORN	Ground for sensor circuit
	11	RED/YEL	CMP sensor
	12	Or	Grand for shield wire
	13	WHT	Heated oxygen sensor-1 (if equipped)
			CO adjusting resistor (if equipped)
	14	LT GRN	Coolant temp. sensor
	15	LT GRN/BLK	Intake air temp. sensor
	16	GRY/BLU	Throttle position (TP) sensor
	17	WHT/RED	EGR valve (stepper motor coil 3)
	18	GRY	EGR valve (stepper motor coil 1)
	19	GRN/WHT	IG coil assembly for No.2 and 3 spark plugs
	20	GRN/YEL	IG coil assembly for No.1 and 4 spark plugs
	21	BLU/WHT	No.2 fuel injector
	22	GRY/RED	Power supply for sensor
	23	YEL/BLK	CKP sensor (+)
	24	–	–
	25	RED	Knock sensor (if equipped)
	26	RED/WHT	MAP sensor
	27	–	–
	28	BRN/YEL	EGR valve (stepper motor coil 4)
	29	GRN/ORN	EGR valve (stepper motor coil 2)
	30	PNK/GRN	A/C switch
	31	BLU/RED	No.3 fuel injector
C41	1	PNK/BLK	A/C compressor clutch
	2	–	–
	3	–	–
	4	–	–
	5	BLK/RED	Power source for drive circuit
	6	BLK/RED	Power source for main circuit
	7	WHT/RED	Power source for memory circuit
	8	PNK/BLU	Duty signal output terminal
	9	GRN/RED	Radiator fan drive relay No.2
	10	BRN/WHT	Ground for main relay
	11	BLK/WHT	Ignition switch signal
C41	12	–	–
	13	–	–
	14	PPL/WHT	Diagnosis switch terminal
	15	WHT/GRN	Test switch terminal
	16	YEL/GRN	A/C SW signal
	17	RED/YEL	Electric load (+)
	18	BLU	Radiator fan relay 1
	19	PNK	Fuel pump relay
	20	BLK/YEL	Cranking signal
	21	GRN/WHT	Stop lamp switch (Brake pedal switch)
	22	PPL	Vehicle speed sensor
	23	–	–
	24	–	–
G02	1	WHT/BLK	A/C evaporator temp. sensor
	2	RED	“R” range signal
	3	–	–
	4	–	–
	5	WHT/BLK	Engine coolant temp. signals output
	6	GRN/RED	“D”, “2”, “L” range ID-UP signal
	7	YEL	Data link connector
	8	–	–
	9	PPL/WHT	Malfunction indicator lamp
	10	–	–
	11	BLU	Data link connector
	12	–	–
	13	PNK/BLU	Electrical load (-)
	14	ORN	Ground for sensor
	15	PPL	Throttle opening signal output for A/T
	16	BRN	Tachometer signal
	17	–	–

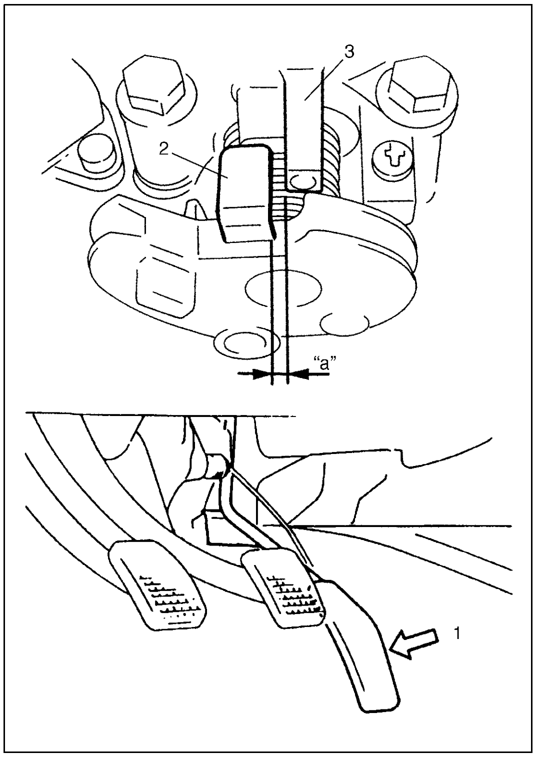


NOTE:

For abbreviation of wire color, refer to Section 0A.

ON-VEHICLE SERVICE

ACCELERATOR CABLE ADJUSTMENT



With accelerator pedal depressed fully (1), check clearance between throttle lever (2) and lever stopper (3) (throttle body) which should be within following specification.
If measured value is out of specification, adjust it to specification with cable adjusting nut (4).

Accelerator cable adjustment clearance (with pedal depressed fully)
"a" : 0.5 – 2.0 mm (0.02 – 0.07 in.)

IDLE SPEED/IDLE AIR CONTROL (IAC) DUTY INSPECTION

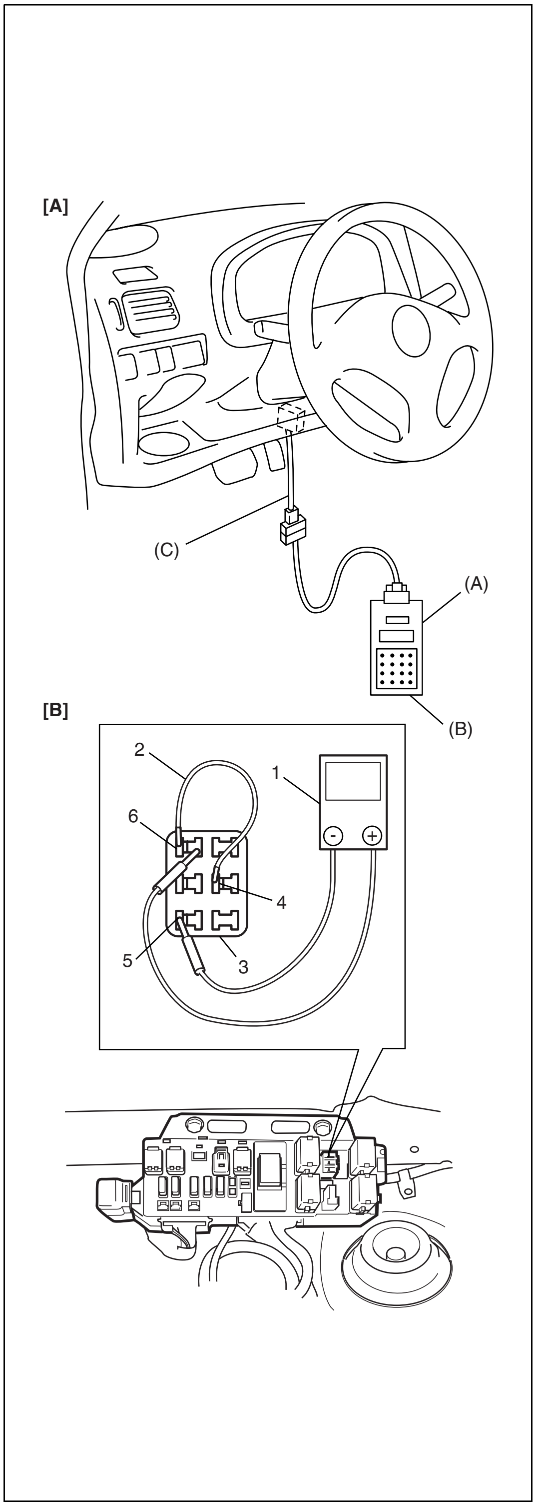
Before idle speed/IAC duty check, make sure of the following.

- Lead wires and hoses of Electronic Fuel Injection and engine emission control systems are connected securely.
- Accelerator cable has some play, that is, it is not tight.
- Valve lash is checked and adjusted according to maintenance schedule.
- Ignition timing is within specification.
- All accessories (wipers, heater, lights, A/C, etc.) are out of service.
- Air cleaner has been properly installed and is in good condition.
- No abnormal air inhaling from air intake system.

After above items are all confirmed, check idle speed and IAC duty as follows.

NOTE:

Before starting engine, place transmission gear shift lever in "Neutral" (shift selector lever to "P" range for A/T vehicle), and set parking brake and block drive wheels.



1) Connect SUZUKI scan tool (1) to DLC with ignition switch OFF, if it is available.
2) Warm up engine to normal operating temperature.
3) Check engine idle speed and “IAC duty” as follows :
4) When using SUZUKI scan tool :
   a) Select “Data List” mode on scan tool to check “IAC duty”.

(A) : 09931-76011 (SUZUKI scan tool)
(B) : Mass storage cartridge
(C) : 09931-76030 (16/14 pin DLC cable)

[A] :	When using SUZUKI scan tool
[B] :	When using duty meter (Vehicle without immobilizer indicator lamp)

5) When using duty meter (vehicle without immobilizer indicator lamp) :

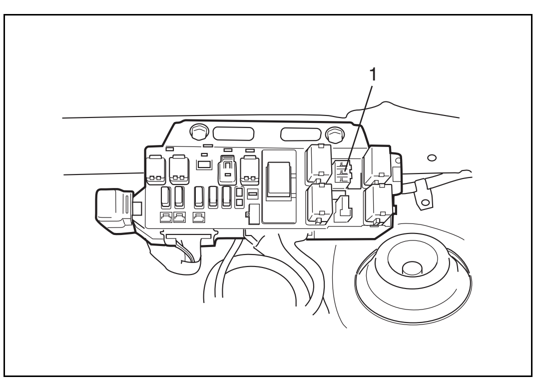
NOTE:
IAC duty can be checked using monitor connector only for vehicle not equipped with immobilizer indicator lamp.

   a) Set tachometer.
   b) Using service wire (2), ground “Diag. switch terminal” (4) in monitor connector (3) and connect duty meter between “Duty output terminal” (5) and “Ground terminal” (6) of monitor connector (3).
6) If duty and/or idle speed is out of specifications, inspect idle air control system referring to Diagnostic Flow Table B-4 Idle Air Control System Check in Section 6.

Engine idle speed and IAC duty

	A/C OFF	A/C ON
M/T vehicle	**700 ± 50 r/min (rpm)** **5 – 25 %**	**850 ± 50 r/min (rpm)**
A/T vehicle at P/N range	**750 ± 50 r/min (rpm)** **5 – 25 %**	**850 ± 50 r/min (rpm)**

NOTE:
Above duty values are ON duty (low voltage rate) meter indications.



7) Remove service wire from monitor connector (1).
8) Check that specified engine idle speed is obtained with A/C ON if vehicle is equipped with A/C.
   If not, check A/C ON signal circuit and idle air control system.

IDLE MIXTURE INSPECTION / ADJUSTMENT (VEHICLE WITHOUT HEATED OXYGEN SENSOR)

All vehicles not equipped with heated oxygen sensor are shipped with their CO % factory adjusted as follows.

Engine idle mixture (CO %)
0.5 – 1.5 % at specified idle speed

Idle mixture adjustment should never be changed from the original factory setting. However, if during diagnosis, the check indicates idle mixture to be the cause of a driver performance complaint or emission failure, the idle mixture can be adjusted using the following procedures.

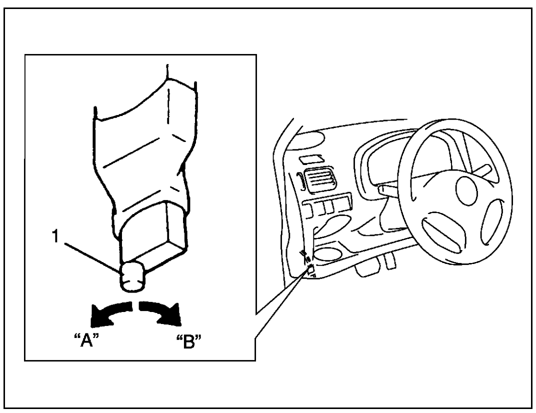
NOTE:

For this inspection and adjustment, exhaust gas tester (CO meter) and engine tachometer are necessary.

1) Check idle speed according to "Idle Speed Inspection" section.
2) Using exhaust gas tester, check that idle mixture CO % is within above specification. If it is out of specification, adjust it to specification by turning resistor knob.

NOTE:

Turning CO adjusting resistor knob to "A" increases CO % (A/F mixture becomes rich) and turning it to "B" decreases CO % (A/F mixture becomes lean).

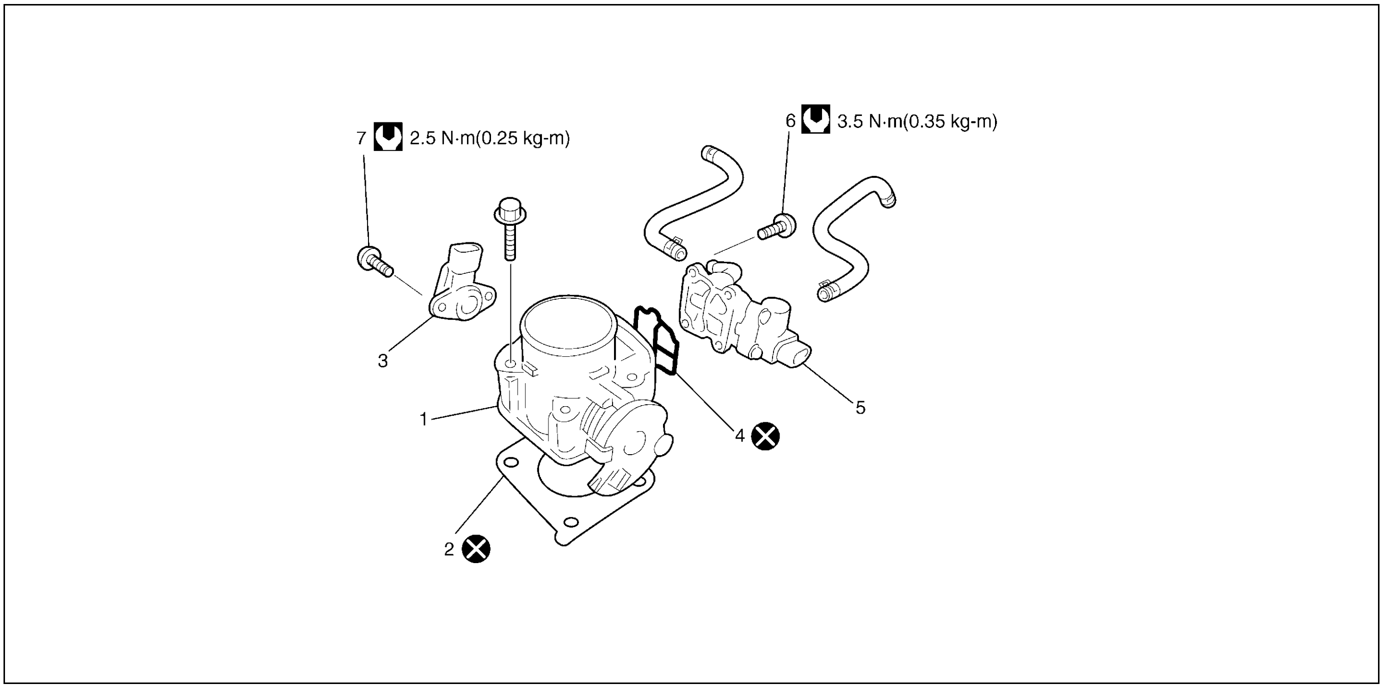


1. CO adjusting resistor

3) If idle mixture has been adjusted, confirm that idle speed is within specification.

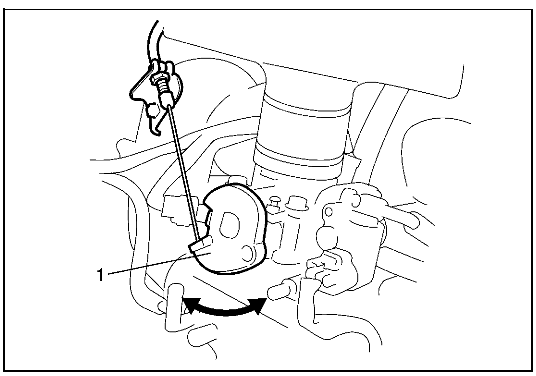
AIR INTAKE SYSTEM

THROTTLE BODY



1. Throttle body	4. Gasket	7. TP sensor screws
2. Throttle stop screw	5. Idle air control valve	Tightening torque
3. TP sensor	6. IAC valve screws	Do not reuse.

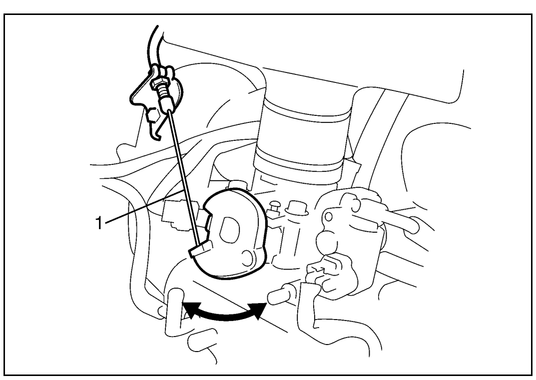
ON-VEHICLE INSPECTION



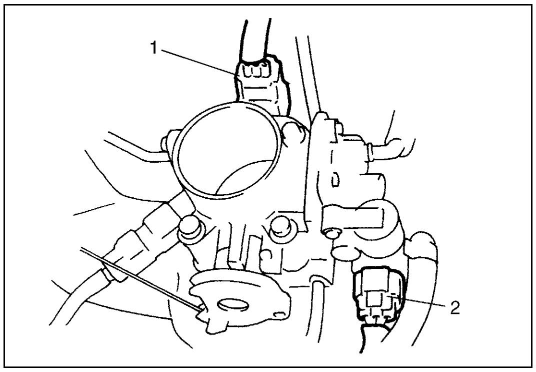
- Check that throttle valve lever (1) moves smoothly.

REMOVAL

1) Disconnect negative cable at battery.
2) Drain cooling system.



3) Disconnect accelerator cable (1) from throttle valve lever.
4) Disconnect IAT sensor connector and remove air cleaner assembly with air cleaner outlet hose.



5) Disconnect electric connector from TP sensor (1) and IAC valve (2).
6) Remove throttle body from intake manifold.
7) Disconnect engine coolant hoses from throttle body.

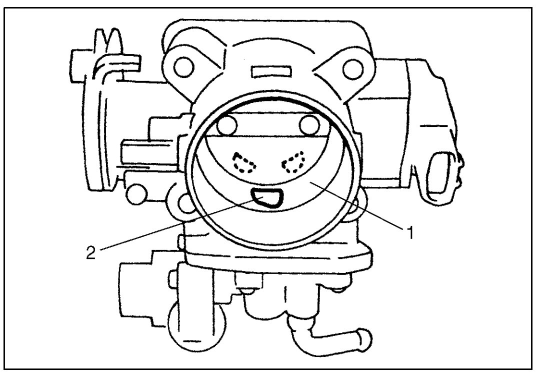
DISASSEMBLY

Remove TP sensor and IAC valve from throttle body.

NOTE:

While disassembling and assembling throttle body, use special care not to deform levers on throttle valve shaft or cause damage to any other parts.

CLEANING



Clean throttle body bore (1) and idle air passage (2) by blowing compressed air.

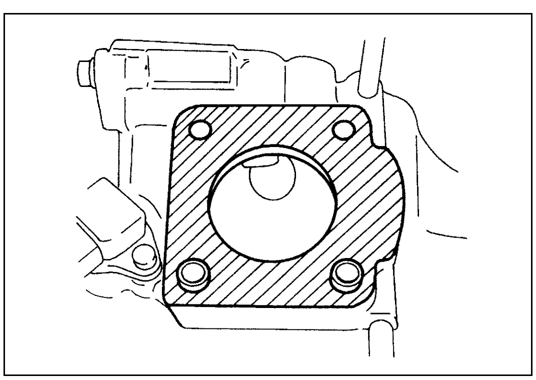
NOTE:

TP sensor, idle air control valve or other components containing rubber must not be placed in a solvent or cleaner bath. A chemical reaction will cause these parts to swell, harden or get distorted.

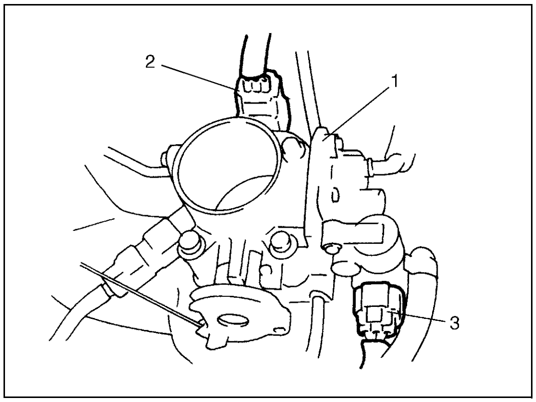
REASSEMBLY

1) Install IAC valve to throttle body referring to “IAC valve Installation” section.
2) Install TP sensor to throttle body referring to “TP sensor Installation” section.

INSTALLATION



1) Clean mating surfaces and install throttle body gasket to intake manifold.
   Use new gasket.
2) Connect engine coolant hoses.



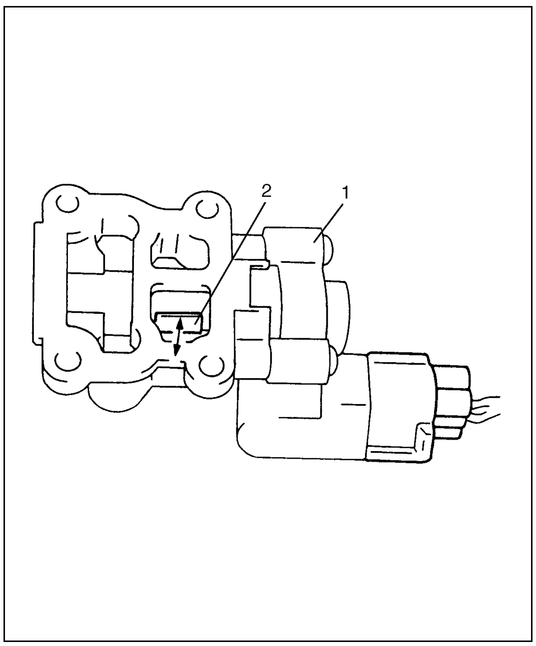
3) Install throttle body (1) to intake manifold.
4) Connect connector to TP sensor (2) and IAC valve (3) securely.
5) Connect accelerator cable and adjust cable play to specification.
6) Install air cleaner assembly with air cleaner outlet hose and connect IAT sensor connector.
7) Refill cooling system.
8) Connect negative cable at battery.

IDLE AIR CONTROL VALVE (IAC VALVE)

REMOVAL

1) Remove throttle body from intake manifold referring to “Throttle Body Removal” section.
2) Remove IAC valve from throttle body.

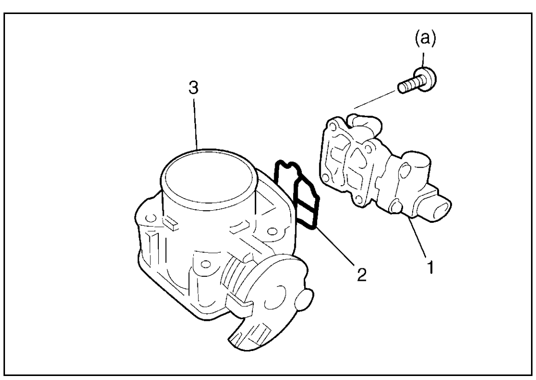
INSPECTION



1) Connect each connector to IAC valve (1), TP sensor and IAT sensor.
2) Check that rotary valve (2) of IAC valve opens and closes once and then stops in about 60 ms as soon as ignition switch is turned ON.

NOTE:
- **This check should be performed by two people, one person turns on ignition switch while the other checks valve operation.**
- **As valve operation is momentary, it may be overlooked. To prevent this, perform this operation check 3 times or more continuously.**
  If rotary valve of IAC valve does not operate at all, check wire harness for open and short. If wire harness is in good condition, replace IAC valve and recheck.

INSTALLATION



1) Install new gasket (2) to IAC valve (1).
2) Install IAC valve (1) to throttle body (3).
   Tighten IAC valve screws to specified torque.

Tightening torque
IAC valve screw (a) : 3.5 N·m (0.35 kg-m, 2.5 lb-ft)

3) Install throttle body to intake manifold referring to “Throttle Body Installation” section.

FUEL DELIVERY SYSTEM

FUEL PRESSURE INSPECTION

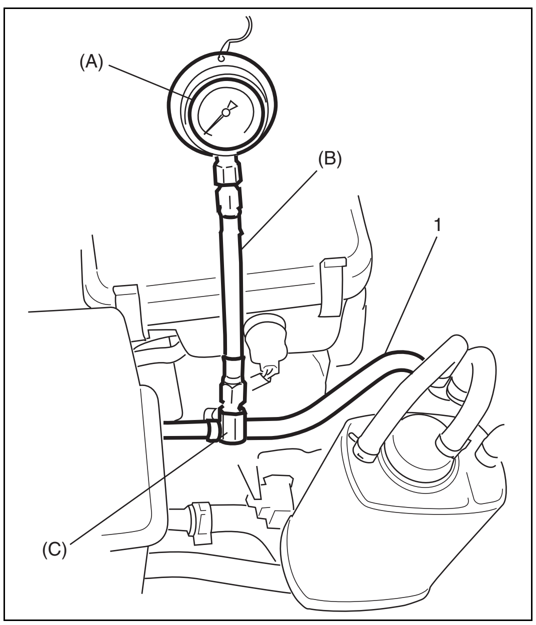
WARNING:

Be sure to perform work in a well-ventilated area and away from any open flames, or there is a risk of a fire breaking out.

1) Relieve fuel pressure in fuel feed line referring to “Fuel Pressure Relief Procedure” in Section 6.
2) Disconnect fuel feed hose from fuel delivery pipe.

CAUTION:

A small amount of fuel may be released when fuel hose is disconnected. Place container under the joint with a shop cloth so that released fuel is caught in container or absorbed in cloth. Place that cloth in an approved container.



3) Connect special tools and hose between fuel delivery pipe and fuel feed hose (1) as shown in figure, and clamp hoses securely to ensure no leaks occur during checking.

Special tool
(A) : 09912-58441
(B) : 09912-58431
(C) : 09912-58490

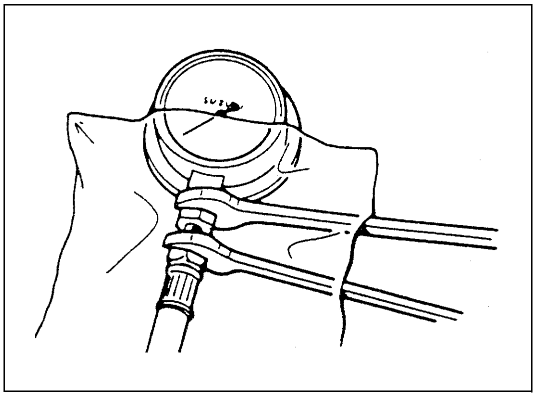
4) Check that battery voltage is above 11 V.

5) Turn ignition switch ON to operate fuel pump and after 2 seconds turn it OFF. Repeat this 3 or 4 times and then check fuel pressure.

Fuel pressure specification

<table>
<tr><th>CONDITION</th><th>FUEL PRESSURE</th></tr>
<tr><td>With fuel pump operating and engine stopped</td><td rowspan="2">270 – 310 kPa
(2.7 – 3.1 kg/cm^2,
38.4 – 44.0 psi)</td></tr>
<tr><td>At specified idle speed</td></tr>
<tr><td>With 1 min. after engine (fuel pump) stop (Pressure reduces as time passes)</td><td>over 250 kPa
(2.5 kg/cm^2, 35.6 psi)</td></tr>
</table>

6) Start engine and warm it up to normal operating temperature.
7) Measure fuel pressure at idling.
   If measured pressure does not satisfy specification, refer to "Diagnostic Flow Table B-3" in "Engine Diagnosis" section and check each possibly defective part. Replace if found defective.



8) After checking fuel pressure, remove fuel pressure gauge.

CAUTION:
As fuel feed line is still under high fuel pressure, make sure to release fuel pressure according to following procedures.
- **Place fuel container under joint.**
- **Cover joint with rag and loosen joint nut slowly to release fuel pressure gradually.**

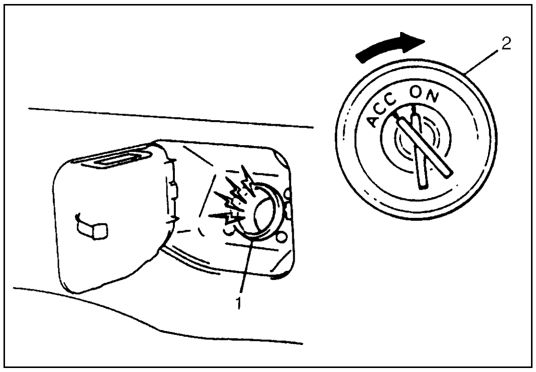
9) Remove special tools from fuel delivery pipe.
10) Connect fuel feed hose to fuel delivery pipe and clamp it securely.
11) With engine "OFF" and ignition switch "ON", check for fuel leaks.

FUEL PUMP WITH PRESSURE REGULATOR

ON-VEHICLE INSPECTION

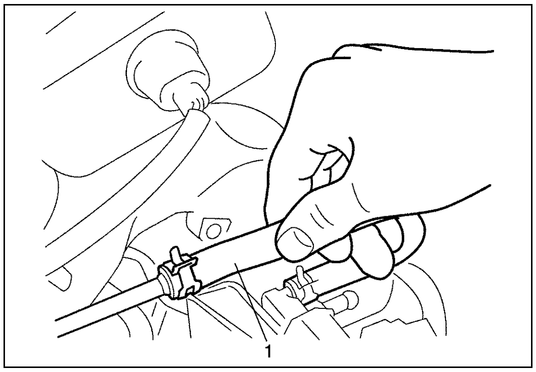
CAUTION:
When fuel filler cap is removed in any procedure, work must be done in a well-ventilated area, keep away from any open flames and without smoking.

NOTE:
The fuel pressure regulator is the one body with the fuel pump assembly so individual inspection of it is impossible.



1) Remove filler cap and turn ON ignition switch. Then fuel pump operating sound should be heard from fuel filler for about 2 seconds and stop. Be sure to reinstall fuel filler cap after checking.
   If above check result is not satisfactory, advance to "Diagnostic Flow Table B-2".

1.	Fuel filler
2.	Ignition switch



2) Turn OFF ignition switch and leave over 10 minutes as it is.
3) Fuel pressure should be felt at fuel feed hose (1) for about 2 seconds after ignition switch ON.
   If fuel pressure is not felt, advance to "Diagnostic Flow Table B-3".

REMOVAL

Remove fuel tank from body according to procedure described in Section 6C and remove fuel pump from fuel tank.

INSPECTION

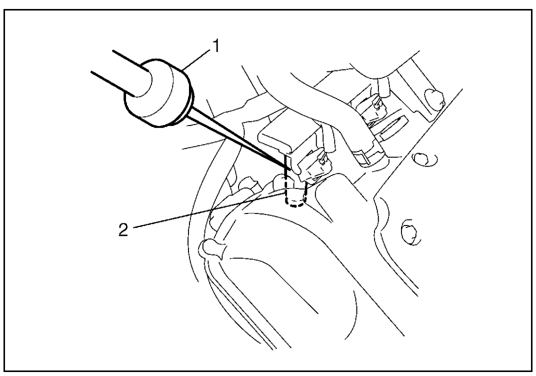
Check fuel pump filter for evidence of dirt and contamination. If present, clean and check for presence of dirt in fuel tank.

INSTALLATION

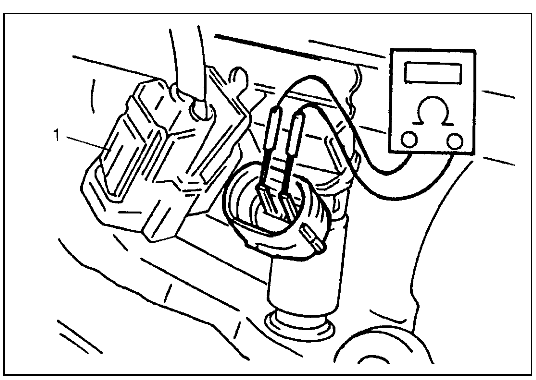
1) Install fuel pump to its bracket.
2) Install fuel pump to fuel tank and then install fuel tank to body according to procedure described in Section 6C.

FUEL INJECTOR

ON-VEHICLE INSPECTION



1) Using sound scope (1) or such, check operating sound of injector (2) when engine is running or cranking.
   Cycle of operating sound should vary according to engine speed.
   If no sound or an unusual sound is heard, check injector circuit (wire or connector) or injector (2).

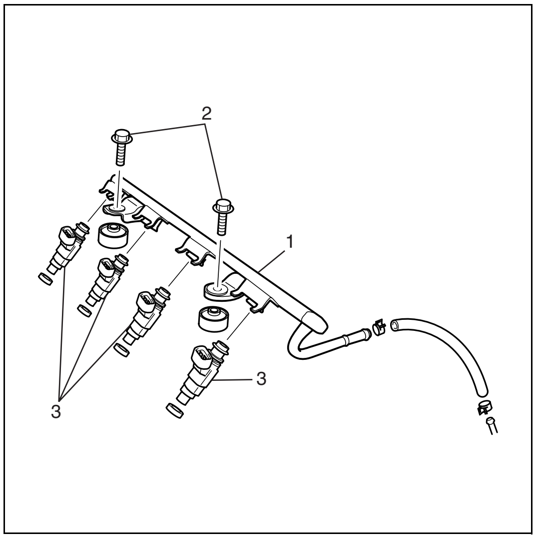


2) Disconnect connector (1) from injector, connect ohmmeter between terminals of injector and check resistance.
   If resistance is out of specification, replace.

   Resistance of fuel injector
   : 11.3 – 13.8 Ω at 20°C (68°F)

3) Connect connector (1) to injector securely.

REMOVAL

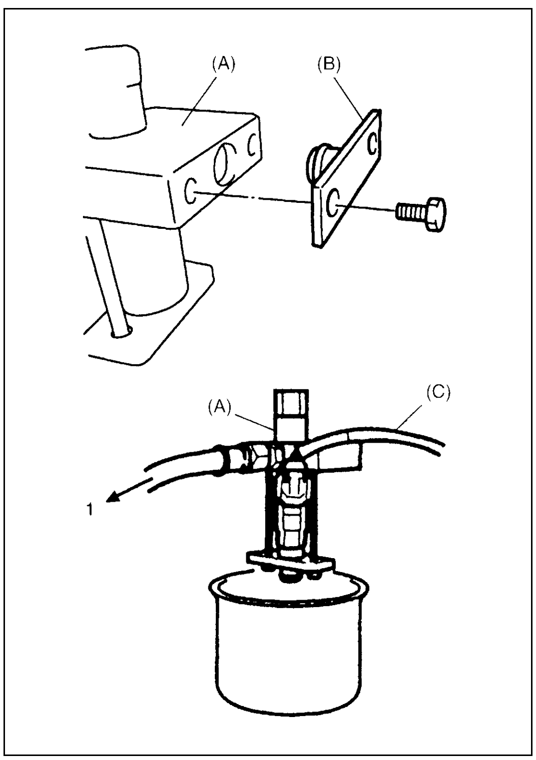


1) Relieve fuel pressure according to procedure described in Section 6.
2) Disconnect battery negative cable at battery.
3) Disconnect IAT sensor connector and remove air cleaner assembly with air cleaner outlet hose.
4) Disconnect fuel injector couplers.
5) Disconnect fuel feed hose from fuel delivery pipe (1).
6) Remove fuel delivery pipe bolts (2).
7) Remove fuel injector(s) (3).

CAUTION:
A small amount of fuel may come out after removal of fuel injectors, cover them with shop cloth.

INSPECTION

WARNING:
As fuel is injected in this inspection, perform in a well ventilated area and away from open flames.
Use special care to prevent sparking when connecting and disconnecting test lead to and from battery.

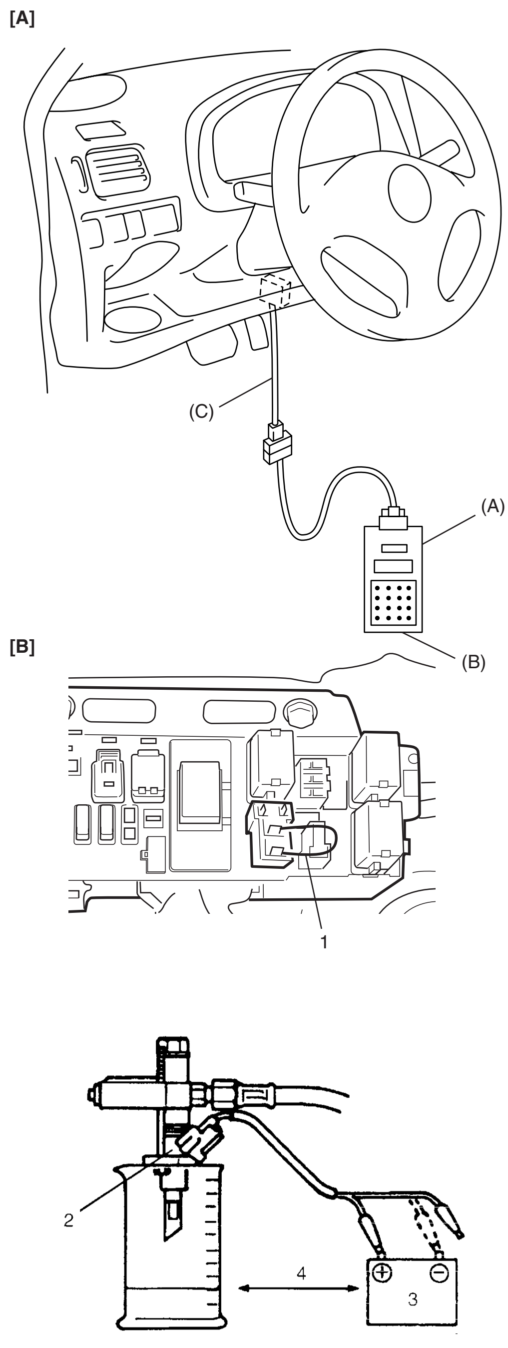


1) Install injector to special tool (injector checking tool).

Special tool
(A) : 09912-58421
(B) : 09912-57610

2) Connect special tools (hose and attachment) to fuel feed pipe (1) of vehicle.
3) Connect special tool (test lead) to injector.

Special tool
(C) : 09930-88530



4) Install suitable vinyl tube onto injector nozzle to prevent fuel from splashing out when injecting.
5) Put graduated cylinder under injector as shown.
6) Operate fuel pump and apply fuel pressure to injector as follows:
7) When using SUZUKI scan tool :
   a) Connect SUZUKI scan tool to DLC with ignition switch OFF.
   b) Turn ignition switch ON, clear DTC and select “MISC TEST” mode on SUZUKI scan tool.
   c) Turn fuel pump ON by using SUZUKI scan tool.

(A) : 09931-76011 (SUZUKI scan tool)
(B) : Mass storage cartridge
(C) : 09931-76030 (16/14 pin DLC cable)

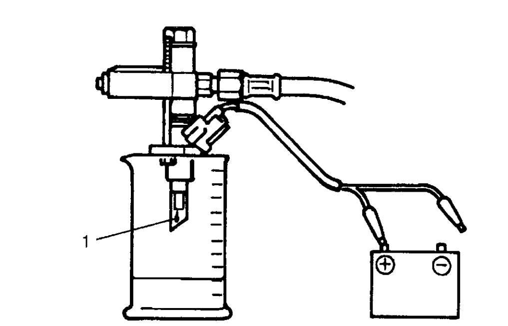
8) Without using SUZUKI scan tool :
   a) Remove fuel pump relay from connector.
   b) Connect two terminals of relay connector using service wire (1) as shown in figure.

CAUTION:
Check to make sure that connection is made between correct terminals. Wrong connection can cause damage to ECM, wire harness, etc.

   c) Turn ignition switch ON.
9) Apply battery voltage (3) to injector (2) for 15 seconds and measure injected fuel volume with graduated cylinder.
   Test each injector two or three times.
   If not within specification, replace injector.

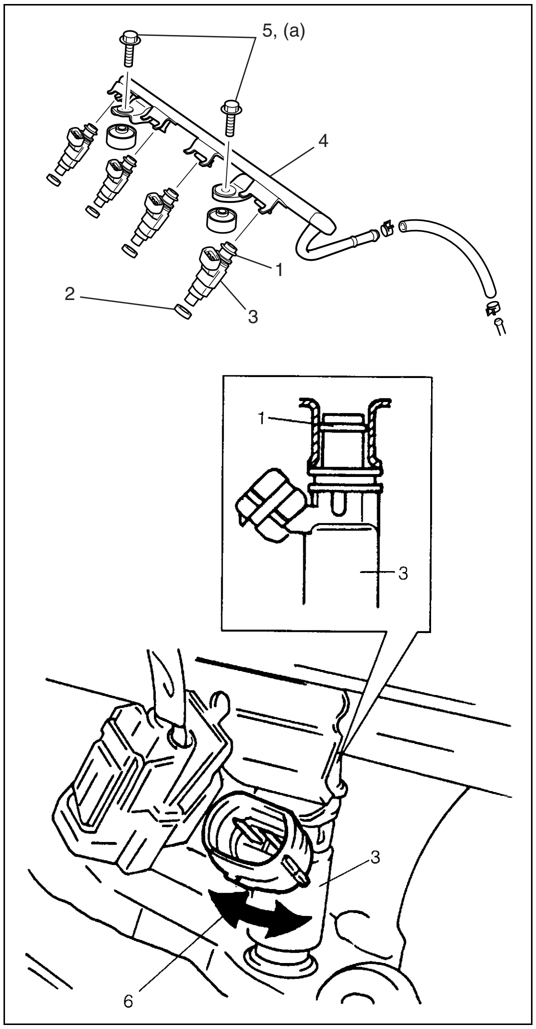
Injected fuel volume
: 43 – 47 cc/15 sec. (1.45/1.51 – 1.58/ 1.65 US/Imp. oz/15 sec.)

4.	Keep as far apart as possible
[A] :	When using SUZUKI scan tool
[B] :	When not using SUZUKI scan tool



10) Check fuel leakage from injector nozzle. Do not operate injector for this check (but fuel pump should be at work).
    If fuel leaks (1) more than following specifications, replace.

Fuel leakage (1)
: Less than 1 drop/min.



INSTALLATION

For installation, reverse removal procedure and note following precautions.

- Replace injector O-ring (1) with new one using care not to damage it.
- Check if cushion (2) is scored or damaged. If it is, replace with new one.
- Apply thin coat of fuel to O-rings (1) and then install injectors (3) into delivery pipe (4) and intake manifold.
  Make sure that injectors (3) rotate smoothly (6). If not, probable cause is incorrect installation of O-ring (1). Replace O-ring (1) with new one.
- Tighten delivery pipe bolts (5) and make sure that injectors (3) rotate smoothly (6).

Tightening torque
Delivery pipe bolts (a) : 28 N·m (2.8 kg-m, 20.5 lb-ft)

- After installation, with engine “OFF” and ignition switch “ON”, check for fuel leaks around fuel line connection.

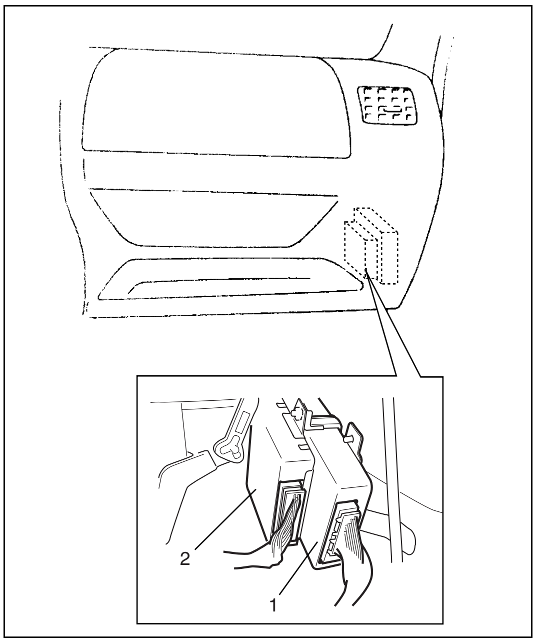
ELECTRONIC CONTROL SYSTEM

ENGINE CONTROL MODULE (ECM)

CAUTION:
As ECM consists of precision parts, be careful not to expose it to excessive shock.

REMOVAL

1) Disconnect battery negative cable at battery.
2) Disable air bag system, referring to "Disabling The Air Bag System" in Section 10B if equipped.



3) Disconnect ECM (1) and TCM (2) (if equipped) connectors.
4) Remove bolt and nuts, remove ECM and TCM (if equipped).

INSTALLATION

Reverse removal procedure noting the following:

- Connect connectors to ECM and TCM (if equipped) securely.

MANIFOLD ABSOLUTE PRESSURE SENSOR (MAP SENSOR)

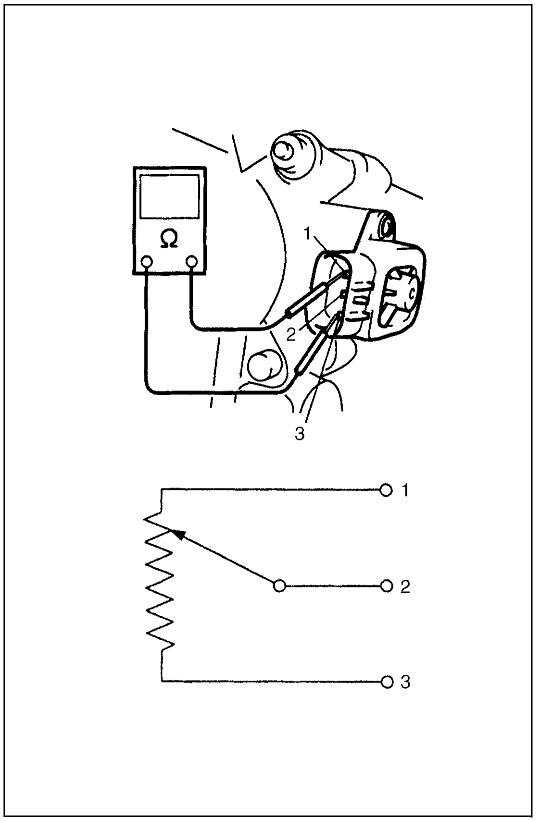
INSPECTION

Check MAP sensor referring to "MAP Sensor Individual Check" in DTC P0105 (No.11) Flow Table. If malfunction is found, replace.

THROTTLE POSITION SENSOR (TP SENSOR)

INSPECTION

1) Disconnect negative cable at battery and connector from IAT sensor.
2) Remove air cleaner assembly with air cleaner outlet hose and disconnect TP sensor connector.



3) Using ohmmeter, check resistance between terminals under each condition given in table below.
   If check result is not satisfactory, replace TP sensor.

TP sensor resistance

TERMINALS	RESISTANCE
Between 1 and 3 terminals	**4.0 – 6.0 kΩ**
Between 2 and 3 terminals	**20 Ω – 6.0 kΩ, varying according to throttle valve opening.**

NOTE:

There should be more than 2 kΩ resistance difference between when throttle valve is at idle position and when it is fully open.

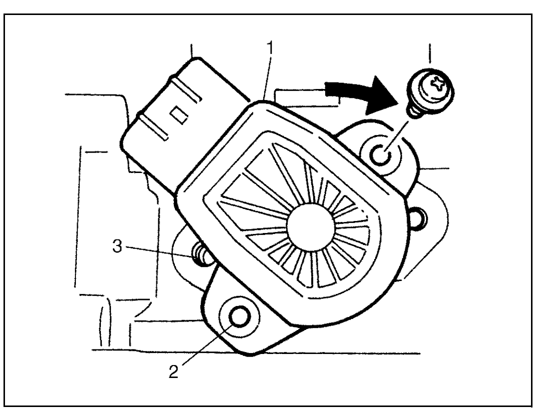
4) Connect TP sensor connector securely.
5) Connect negative cable to battery.

1.	Reference voltage terminal
2.	Output voltage terminal
3.	Ground terminal

REMOVAL

1) Disconnect battery negative cable at battery.
2) Remove throttle body from intake manifold referring to “Throttle Body Removal” in this section.
3) Remove TP sensor from throttle body.

INSTALLATION



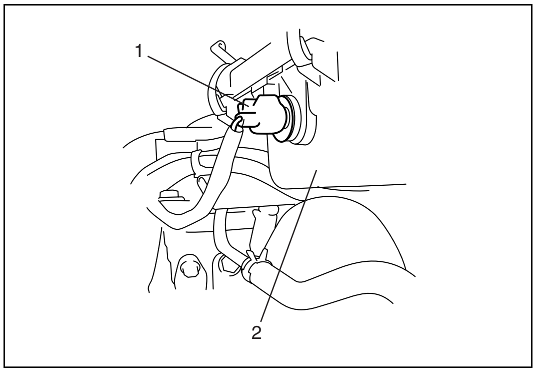
1) Install TP sensor (1) to throttle body.
   Fit TP sensor to throttle body in such way that its holes (3) are a little away from TP sensor screw holes (2) as shown in left figure and turn TP sensor clockwise so that those holes align (4).

Tightening torque
TP sensor screw (a) : 2.5 N·m (0.25 kg-m, 1.8 lb-ft)

2) Connect connector to TP sensor securely.
3) Connect battery negative cable to battery.

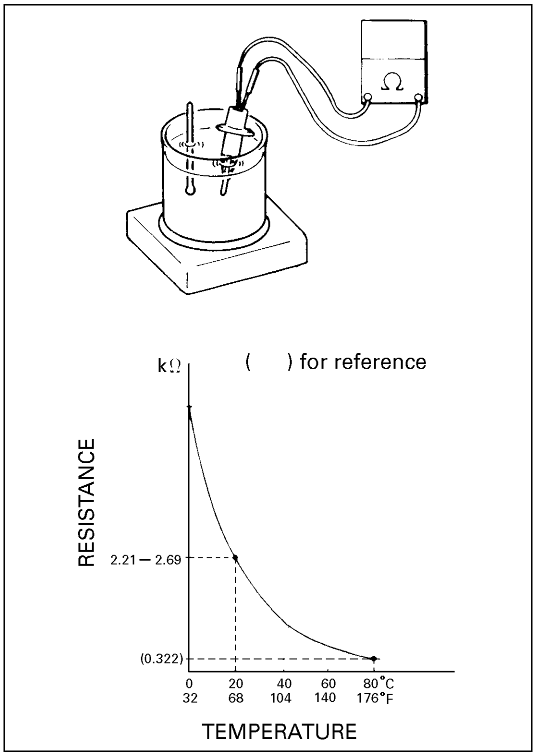
INTAKE AIR TEMPERATURE SENSOR (IAT SENSOR)

REMOVAL



1) Disconnect battery negative cable at battery.
2) Disconnect coupler (1) from IAT sensor.
3) Remove IAT sensor from air cleaner case (2).

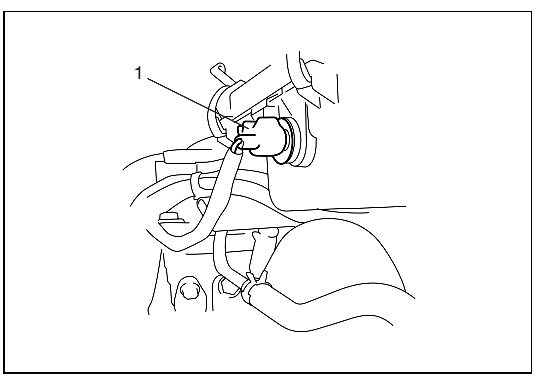
INSPECTION



Immerse temperature sensing part of IAT sensor in water (or ice) and measure resistance between sensor terminals while heating water gradually.

If measured resistance does not show such characteristic as shown in left figure, replace IAT sensor.

INSTALLATION

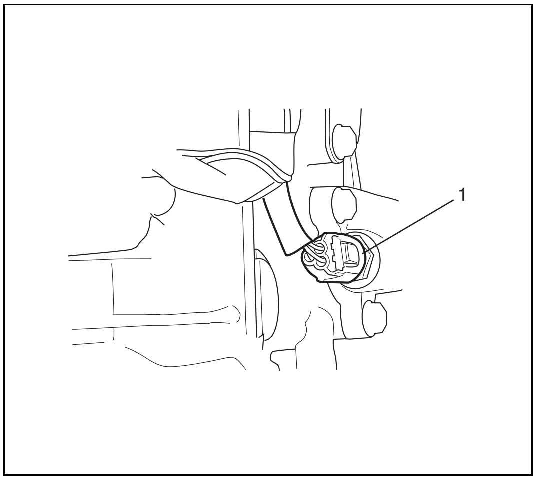


Reverse removal procedure noting the following.

- Clean mating surfaces of IAT sensor and air cleaner case.
- Connect IAT sensor connector (1) securely.

ENGINE COOLANT TEMPERATURE SENSOR (ECT SENSOR)

REMOVAL

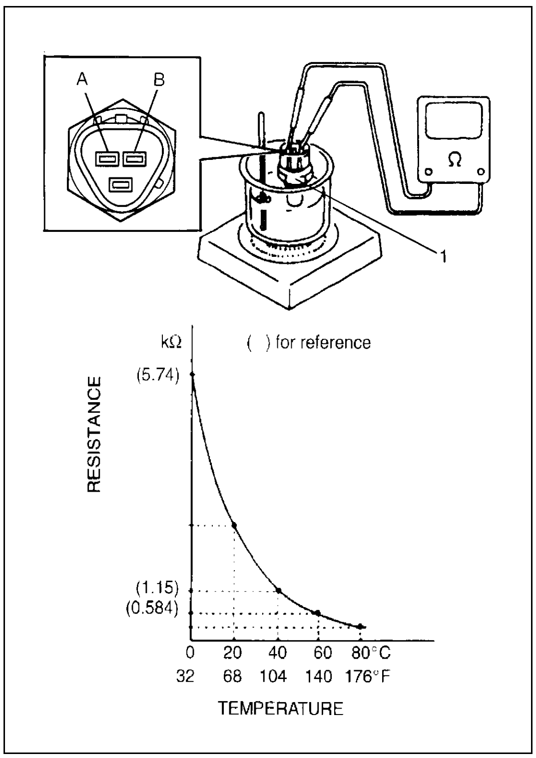


1) Disconnect battery negative cable at battery.
2) Drain coolant referring to Section 6B.

> **WARNING:**
> **To help avoid danger of being burned, do not remove radiator cap while engine and radiator are still hot. Scalding fluid and steam can be blown out under pressure if cap is taken off too soon.**

3) Remove air intake pipe.
4) Disconnect connector from ECT sensor.
5) Remove ECT sensor (1) from thermostat case.

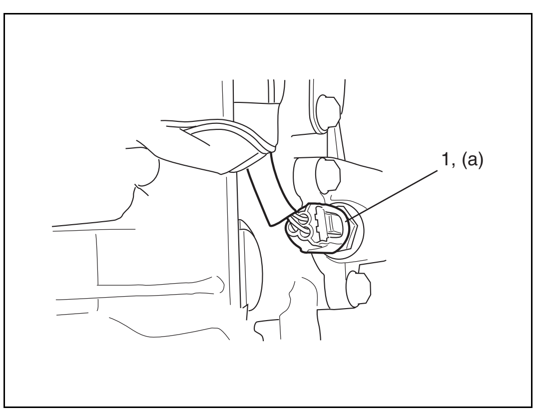
INSPECTION



Immerse temperature sensing part of ECT sensor (1) in water (or ice) and measure resistance between terminal "A" and "B" while heating water gradually.

If measured resistance does not show such characteristic as shown in left figure, replace ECT sensor (1).

INSTALLATION



Reverse removal procedure noting the following:

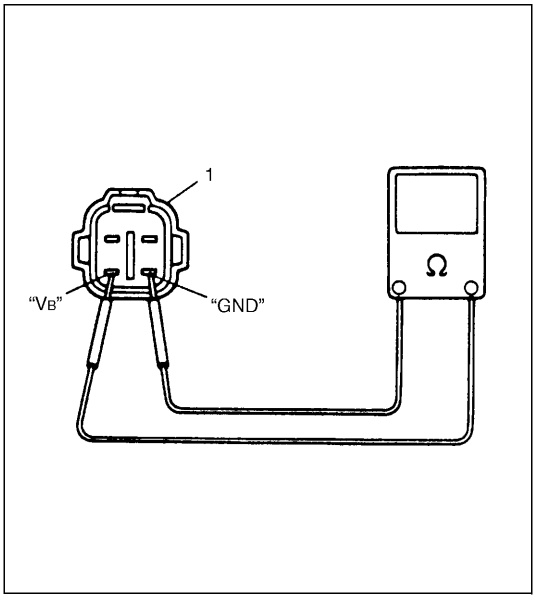
- Clean mating surfaces of ECT sensor (1) and thermostat case.
- Check O-ring for damage and replace if necessary.
- Tighten ECT sensor (1) to specified torque.

Tightening torque
ECT sensor (a) : 15 N·m (1.5 kg-m, 11.5 lb-ft)

- Connect connector to ECT sensor (1) securely.
- Refill coolant referring to Section 6B.

HEATED OXYGEN SENSOR (HO2S-1 AND HO2S-2)

OXYGEN SENSOR HEATER INSPECTION



1) Disconnect sensor connector.
2) Using ohmmeter, measure resistance between terminals “V_B” and “GND” of sensor connector.
   If found faulty, replace oxygen sensor.

NOTE:
Temperature of sensor affects resistance value largely. Make sure that sensor heater is at correct temperature.

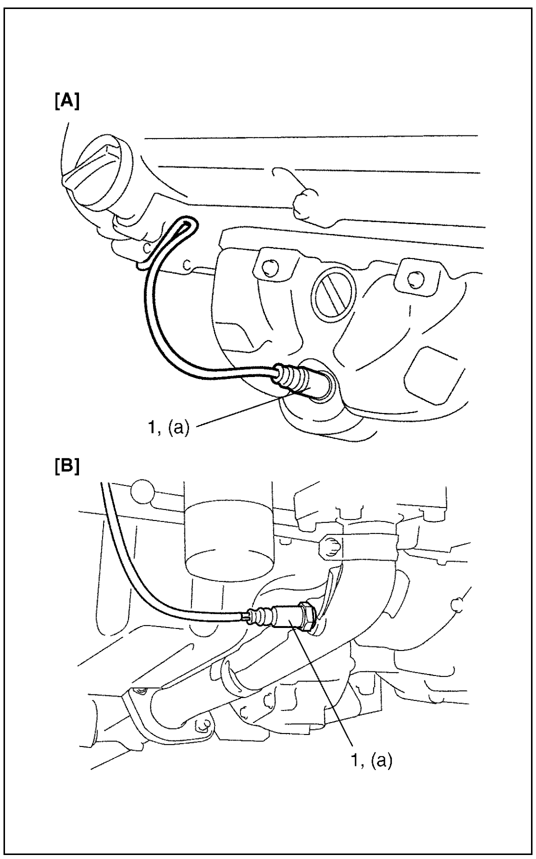
Resistance of oxygen sensor heater
HO2S-1 : 5.0 – 6.4 Ω at 20°C (68°F)
HO2S-2 : 11.7 – 14.3 Ω at 20°C (68°F)

3) Connect sensor connector securely.

1. Viewed from terminal side

REMOVAL

WARNING:
To avoid danger of being burned, do not touch exhaust system when system is hot. Oxygen sensor removal should be performed when system is cool.



1) Disconnect negative cable at battery.
2) For HO2S-1, disconnect connector of heated oxygen sensor and release its wire harness from clamps, then remove front bumper and heat insulator panel.
3) For HO2S-2, disconnect connector of heated oxygen sensor and release its wire harness from clamp and hoist vehicle.
4) Remove heated oxygen sensor (1) from exhaust manifold or exhaust pipe.

INSTALLATION

Reverse removal procedure noting the following.
- Tighten heated oxygen sensor (1) to specified torque.

Tightening torque
Heated oxygen sensor (a) : 45 N·m (4.5 kg-m, 32.5 lb-ft)

- Connect connector of heated oxygen sensor (1) and clamp wire harness securely.
- After installing heated oxygen sensor (1), start engine and check that no exhaust gas leakage exists.

[A] :	HO2S-1
[B] :	HO2S-2

CAMSHAFT POSITION SENSOR

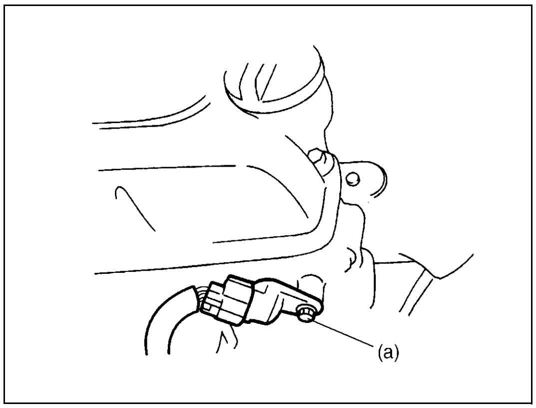
INSPECTION

Check camshaft position sensor referring to DTC P0340 (No.15) Diag. Flow Table in Section 6. If malfunction is found, replace.

REMOVAL

1) Disconnect negative cable at battery.
2) Disconnect connector from camshaft position sensor.
3) Remove camshaft position sensor from cylinder head.

INSTALLATION



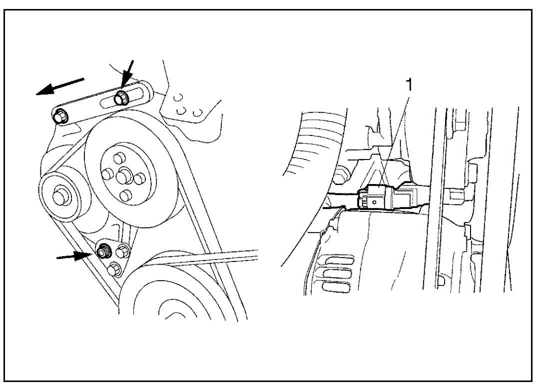
1) Check that O-ring is free from damage.
2) Check that camshaft position sensor and signal rotor teeth are free from any metal particles and damage.
3) Install camshaft position sensor to cylinder head.

Tightening torque
Camshaft position sensor bolt
(a) : 10 N·m (1.0 kg-m, 7.5 lb-ft)

4) Connect connector to it securely.
5) Connect negative cable to battery.

CRANKSHAFT POSITION SENSOR

INSPECTION

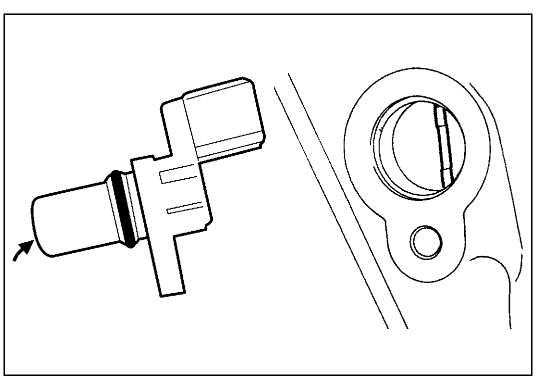


Check crankshaft position sensor referring to step 1 and 2 of DTC P0335 (No.23) Flow Table. If malfunction is found, replace.

REMOVAL

1) Disconnect negative cable at battery.
2) Remove generator drive belt, loosen pivot bolt and move generator outward.
3) Disconnect connector from crankshaft position sensor.
4) Remove crankshaft position sensor (1) from cylinder block.

INSTALLATION



1) Check to make sure that crankshaft position sensor and pulley teeth are free from any metal particles and damage.
2) Install crankshaft position sensor to cylinder block.
3) Connect connector to it securely.
4) Adjust generator belt tension, refer to Section 6B.
5) Connect negative cable to battery.

VEHICLE SPEED SENSOR (VSS)

INSPECTION

Check vehicle speed sensor referring to step 3 of DTC P0500 (No.16) Flow Table. If malfunction is found, replace.

REMOVAL/INSTALLATION

Refer to Section 7A.

FUEL LEVEL SENSOR (GAUGE)

INSPECTION

Refer to Section 8.

REMOVAL/INSTALLATION

Refer to Section 6C.

KNOCK SENSOR (IF EQUIPPED)

INSPECTION

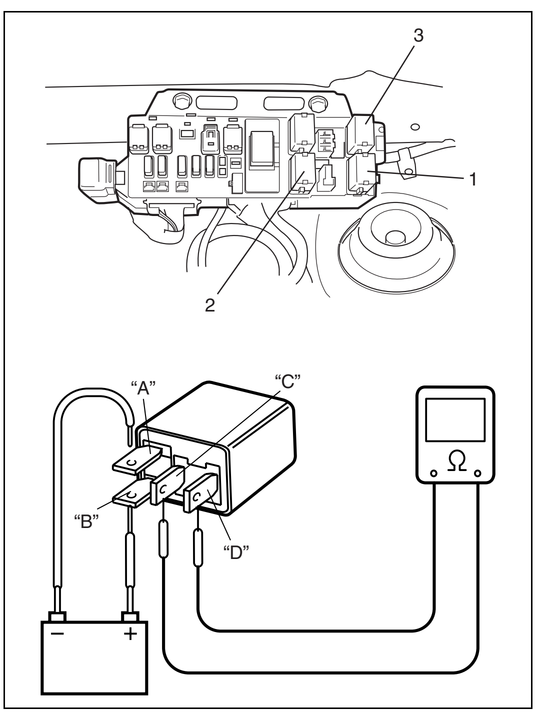
Check knock sensor referring to DTC P0325 (No.17) Flow Table. If malfunction is found, replace.

REMOVAL/INSTALLATION

Refer to Section 6A.

MAIN RELAY, FUEL PUMP RELAY AND RADIATOR FAN RELAY NO.1

INSPECTION



1) Disconnect negative cable at battery.
2) Remove main relay (1), fuel pump relay (2) and radiator fan control relay No.1 (3) from vehicle.
3) Check that there is no continuity between terminal "C" and "D". If there is continuity, replace relay.
4) Connect battery positive (+) terminal to terminal "B" of relay.
   Connect battery negative (–) terminal "A" of relay.
   Check continuity between terminal "C" and "D".
   If there is no continuity when relay is connected to the battery, replace relay.

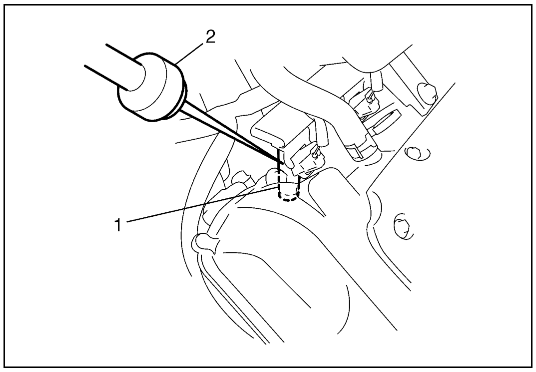
FUEL CUT OPERATION

INSPECTION

NOTE:

Before inspection, check to make sure that gear shift lever is in neutral position (with A/T model, selector lever in "P" range), A/C is OFF and that parking brake lever is pulled all the way up.

1) Warm up engine to normal operating temperature.



2) While listening to sound of injector (1) by using sound scope (2) or such, increase engine speed to higher than 3,000 r/min.
3) Check to make sure that sound to indicate operation of injector stops when throttle valve is closed instantly and it is heard again when engine speed is reduced to less than about 2,000 r/min.

RADIATOR FAN CONTROL SYSTEM

SYSTEM INSPECTION

WARNING:

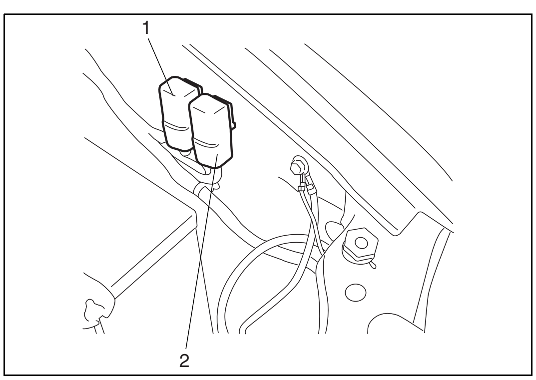
Keep hands, tools, and clothing away from engine cooling fan to help prevent personal injury. This fan is electric and can come on whether or not the engine is running. The fan can start automatically in response to the ECT sensor with the ignition switch in the "ON" position.

Check system for operation referring to Flow Table B-7 in Section 6.

If radiator fan fails to operate properly, check relay, radiator fan and electrical circuit.

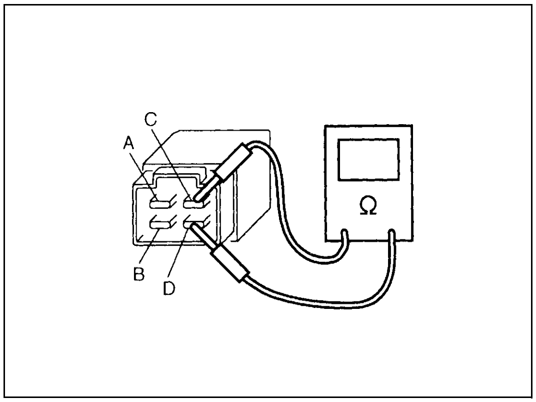
RADIATOR FAN RELAY NO. 2 AND NO.3

INSPECTION



1) Disconnect negative cable at battery.
2) Remove relay(s) from connector(s).

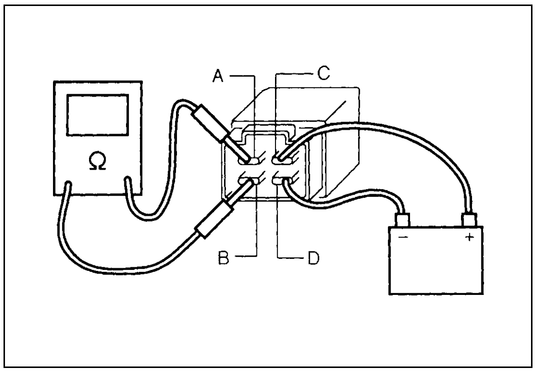
1.	Radiator fan relay No. 2
2.	Radiator fan relay No. 3



3) Check resistance between each two terminals as in table below.
   If check results are as specified, proceed to next operation check. If not, replace.

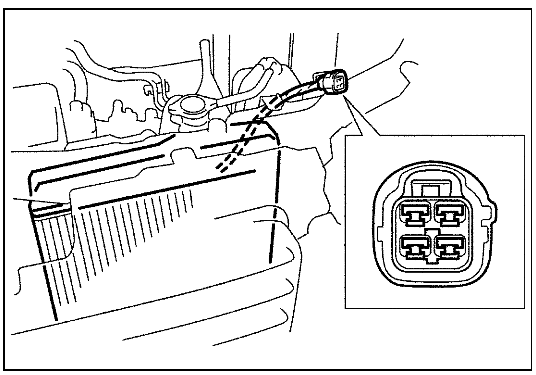
Radiator fan relay No.2 and No.3 resistance

TERMINALS	RESISTANCE
Between A and B	**∞ (Infinity)**
Between C and D	**70 – 110 Ω at 20°C (68°F)**

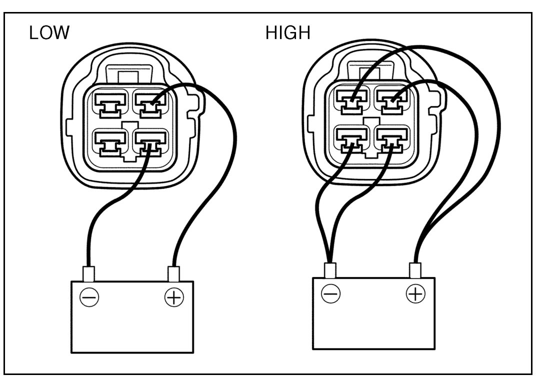


4) Check that there is continuity between terminals “A” and “B” when battery is connected to terminals “C” and “D”.
   If malfunction is found, replace.

RADIATOR FAN INSPECTION



1) Check continuity between each terminals.
   If there is no continuity, replace radiator fan motor.



2) Connect battery to radiator fan motor coupler as shown in figure, then check that the radiator fan motor operates smoothly and that fan speed varies.
   If radiator fan motor does not operate smoothly, replace motor.

OUTPUT SIGNALS OF THROTTLE VALVE OPENING AND ENGINE COOLANT TEMP. (VEHICLE WITH A/T ONLY)

THROTTLE VALVE OPENING SIGNAL INSPECTION

Check throttle valve opening (throttle position) signal referring to step 1 of DTC P1700 (No.32 or 33) Flow Table in Section 7B. If check result is not satisfactory, check each wire harness, circuit connections and TP sensor.

ENGINE COOLANT TEMP. SIGNAL INSPECTION

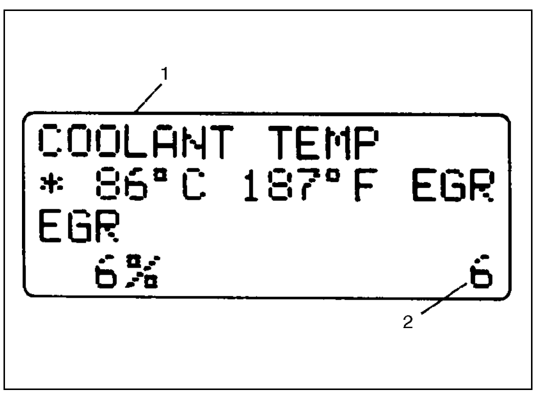
Check engine coolant temp. signal referring to step 1 of DTC P1705 (NO.51) Flow Table in Section 7B.
If check result is not satisfactory, check each wire harness, circuit connection and ECT sensor.

EMISSION CONTROL SYSTEM

EGR SYSTEM

SYSTEM INSPECTION (USING SUZUKI SCAN TOOL)

1) Connect SUZUKI scan tool to DLC with ignition switch OFF.
2) Turn ignition switch ON and then select “DATA LIST” mode on scan tool.
3) Make sure that vehicle condition is as following.
   • Vehicle speed = 0 km/h (0 KPH)
   • Engine speed ≤ 3000 rpm
4) Clear DTC by using “CLEAR INFO” mode.



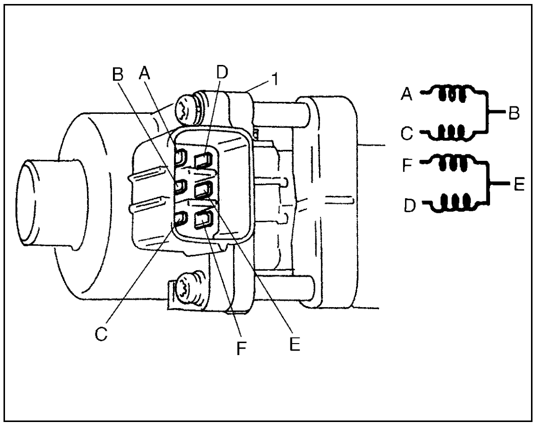
5) With engine idling (without depressing accelerator pedal), open EGR valve by using “STEP EGR” mode in “MISC TEST” menu. In this state, according as EGR valve opening increases engine idle speed drops. If not, possible cause is clogged EGR gas passage, stuck or faulty EGR valve, poor performance of ECT sensor or TP sensor or DTC and/or pending DTC is (are) stored in ECM memory.

1.	SUZUKI scan tool display
2.	EGR valve opening (0: Close, 100: Full Open)

REMOVAL

1) Disconnect negative cable at battery.
2) Remove air intake pipe.
3) Remove EGR pipe.
4) Disconnect EGR valve connector.
5) Remove EGR valve and gasket from intake manifold.

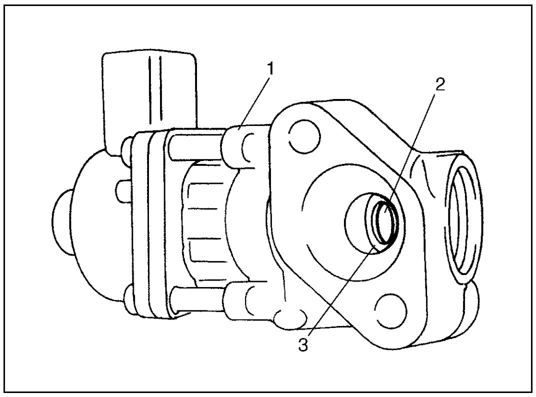
INSPECTION



1) Check resistance between following terminals of EGR valve (1) in each pair.
   If found faulty, replace EGR valve assembly.

EGR valve resistance

Terminal	Standard resistance
A – B C – B F – E D – E	20 – 24 Ω



2) Remove carbon from EGR valve gas passage.

NOTE:
Do not use any sharp–edged tool to remove carbon.
Be careful not to damage or bend EGR valve (1), valve seat (3) and rod.

3) Inspect valve (2), valve seat and rod for fault, cracks, bend or other damage.
   If found faulty, replace EGR valve assembly.

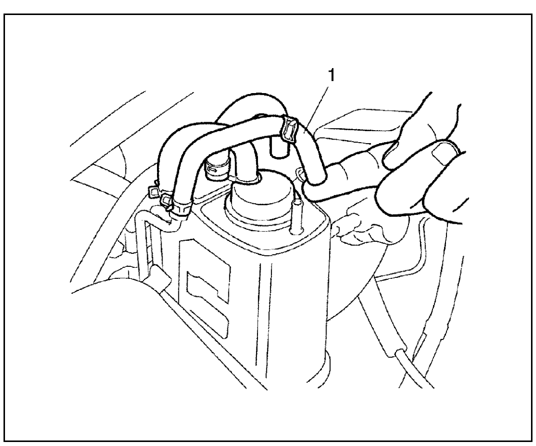
INSTALLATION

Reverse removal procedure noting following.
- Clean mating surface of valve and intake manifold.
- Use new gaskets.

EVAPORATIVE EMISSION CONTROL SYSTEM

EVAP CANISTER PURGE INSPECTION

NOTE:
Before inspection, check to make sure that gear shift lever is in neutral position (with A/T model, selector lever in “P” range) and that parking brake lever is pulled all the way up.



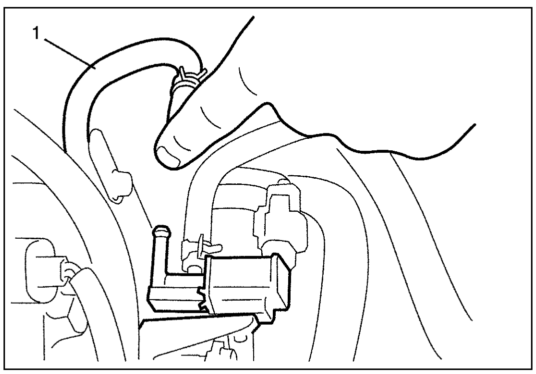
1) Disconnect purge hose (1) from EVAP canister.
2) Place finger against the end of disconnected hose and check that vacuum is not felt there when engine is cool and running at idle speed.

3) Connect purge hose to EVAP canister and warm up engine to normal operating temperature.
4) Disconnect purge hose from EVAP canister.
5) Also check that vacuum is felt when engine is running at idle speed.
   If check result is not satisfactory, check vacuum passage, hoses, EVAP canister purge valve, wire harness and ECM.

NOTE:

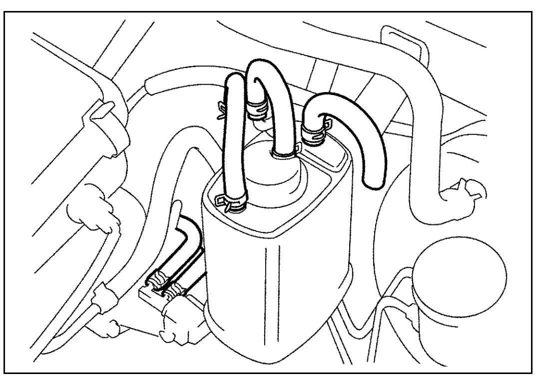
The EVAP canister purge system does not perform purging (vacuum is not detected at the purge hose) unless the engine is sufficiently warmed up and the heated oxygen sensor is activated fully. Also, when the purge hose is disconnected in Step 4), the air is drawn into the purge line. As a result, ECM detects a change in the purge gas concentration and sometimes stops purging but this indicates nothing abnormal.

VACUUM PASSAGE INSPECTION



Start engine and run it at idle speed. Disconnect vacuum hose (1) from EVAP canister purge valve (2). With finger placed against hose disconnected, check that vacuum is applied.
If it is not applied, clean vacuum passage by blowing compressed air.

VACUUM HOSE INSPECTION



Check hoses for connection, leakage, clog and deterioration. Replace as necessary.

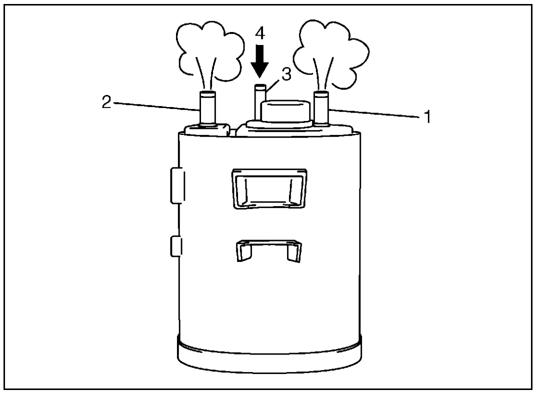
EVAP CANISTER PURGE VALVE INSPECTION

Check EVAP canister purge valve referring to step 1 of DTC P0443 Flow Table.
If found malfunction, replace.

EVAP CANISTER INSPECTION

WARNING:
DO NOT SUCK nozzles on EVAP canister. Fuel vapor inside EVAP canister is harmful.

1) Check outside of EVAP canister visually.
2) Disconnect vacuum hoses from EVAP canister.



3) Check that there should be no restriction of flow through purge pipe (1) and air pipe (2) when air is blown (4) into tank pipe (3).
   If any faulty condition is found in above inspection, replace.

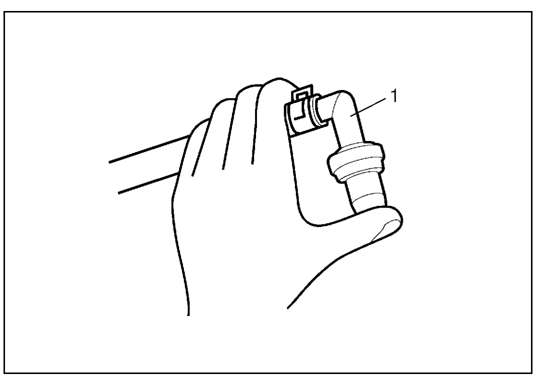
PCV SYSTEM

NOTE:
Be sure to check that there is no obstruction in PCV valve or its hoses before checking IAC duty, for obstructed PCV valve or hose hampers its accurate adjustment.

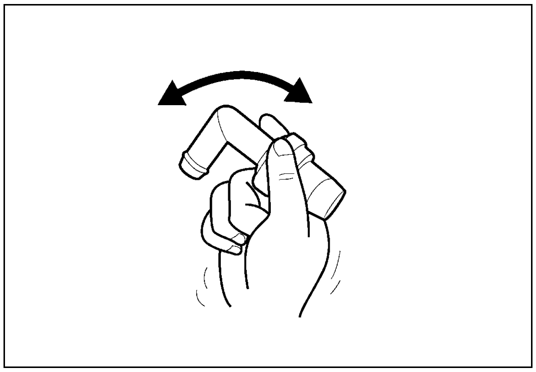
PCV HOSE INSPECTION

Check hoses for connection, leakage, clog and deterioration. Replace as necessary.

PCV VALVE INSPECTION

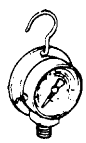
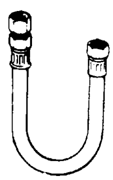
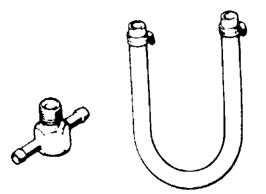
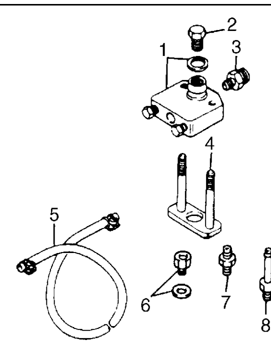
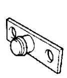
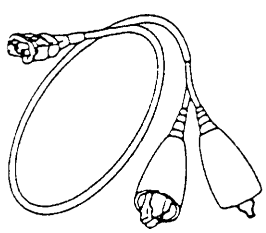
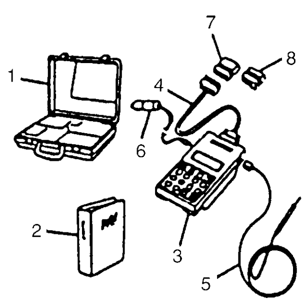
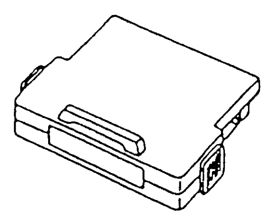


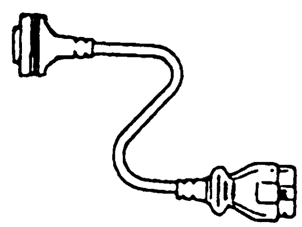
1) Disconnect PCV valve (1) from cylinder head cover and install plug to head cover hole.
2) Run engine at idle.
3) Place your finger over end of PCV valve (1) to check for vacuum.
   If there is no vacuum, check for clogged valve. Replace as necessary.



4) After checking vacuum, stop engine and remove PCV valve (1).
   Shake valve and listen for the rattle of check needle inside the valve. If valve does not the rattle, replace valve.
5) After checking, remove plug and install PCV valve (1).

SPECIAL TOOL

			
09912-58441 Pressure gauge	09912-58431 Pressure hose	09912-58490 3-way joint & hose	09912-58421 Checking tool set (See NOTE “A”.)
			
09912-57610 Checking tool plate	09930-88530 Injector test lead	09931-76011 Tech 1A kit (See NOTE “B”.)	Mass storage cartridge



09931-76030
16/14 pin DLC cable

NOTE:

- **"A": This kit includes the following items.**
  1. Tool body & washer, 2. Body plug, 3. Body attachment-1, 4. Holder, 5. Return hose & clamp, 6. Body attachment-2 & washer, 7. Hose attachment-1, 8. Hose attachment-2
- **"B": This kit includes the following items.**
  1. Storage case, 2. Operator's manual, 3. Tech 1A, 4. DLC cable (14/26 pin, 09931-76040), 5. Test lead/probe, 6. Power source cable, 7. DLC cable adaptor, 8. Self-test adaptor

TIGHTENING TORQUE SPECIFICATION

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
TP sensor mounting screw	2.5	0.25	1.8
IAC valve	3.5	0.35	2.5
ECT sensor	15	1.5	11.5
Heated oxygen sensor-1 and -2	45	4.5	32.5
Camshaft position sensor	10	1.0	7.5

SECTION 6F1

IGNITION SYSTEM (ELECTRONIC IGNITION SYSTEM)

WARNING:

For vehicles equipped with Supplemental Restraint (Air Bag) System:

- **Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to “Air Bag System Components and Wiring Location View” under “General Description” in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and “Service Precautions” under “On-Vehicle Service” in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.**
- **Technical service work must be started at least 90 seconds after the ignition switch is turned to the “LOCK” position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).**

CONTENTS

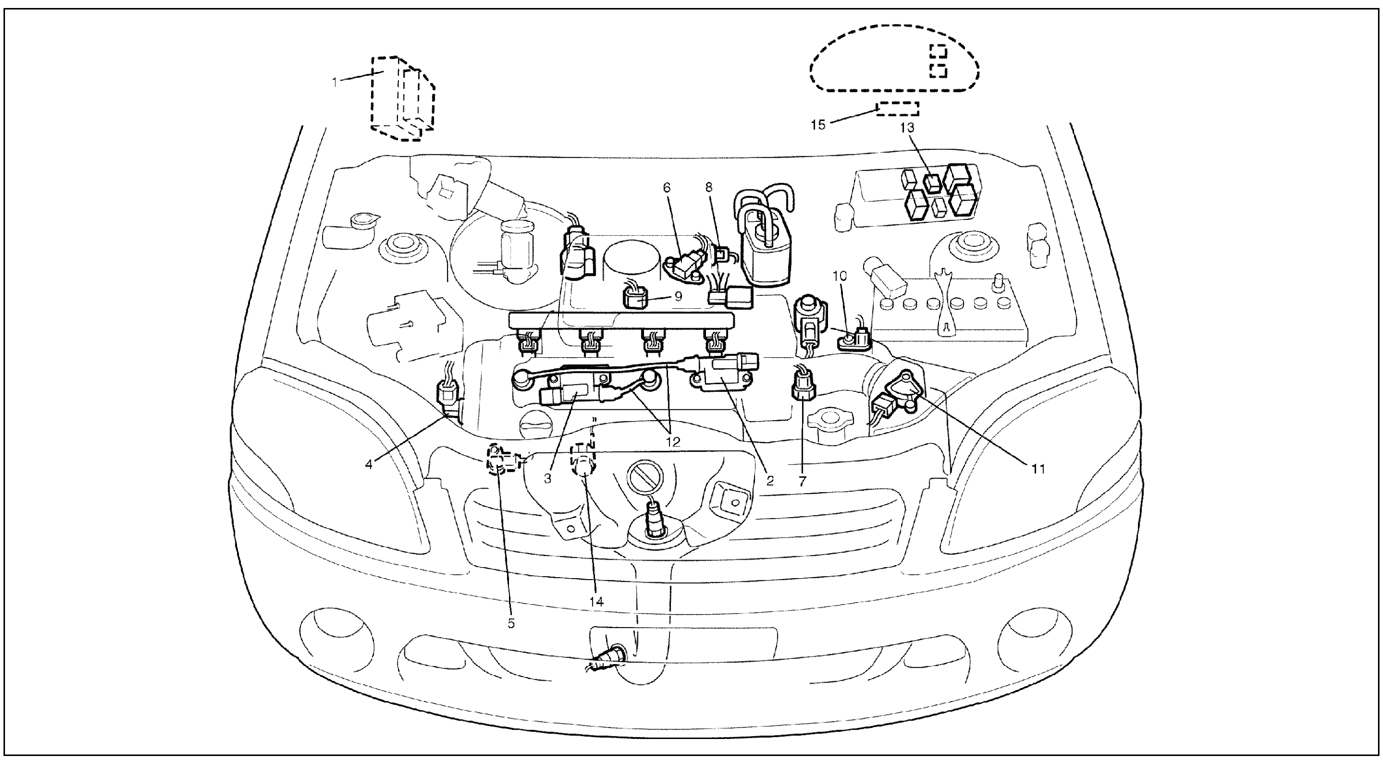
GENERAL DESCRIPTION

The ignition system is an electronic (distributorless) ignition system. Its consists of the parts as described below and has an electronic ignition control system.

- ECM
  It detects the engine and vehicle conditions through the signals from the sensors, determines the most suitable ignition timing and time for electricity to flow to the primary coil and sends a signal to the ignitor (power unit) in the ignition coil assembly.
- Ignition coil assembly (including an igniter)
  The ignition coil assembly has a built-in ignitor which turns ON and OFF the current flow to the primary coil according to the signal from ECM. When the current flow to the primary coil is turned OFF, a high voltage is induced in the secondary coil.
- High tension cords and spark plugs.
- CMP sensor (Camshaft position sensor) and CKP sensor (Crankshaft position sensor)
  Using signals from these sensors, ECM identifies the specific cylinder whose piston is in the compression stroke, detects the crank angle and adjusts initial ignition timing automatically.
- TP sensor, ECT sensor, MAP sensor and other sensors/switches
  Refer to Section 6E1 for details.

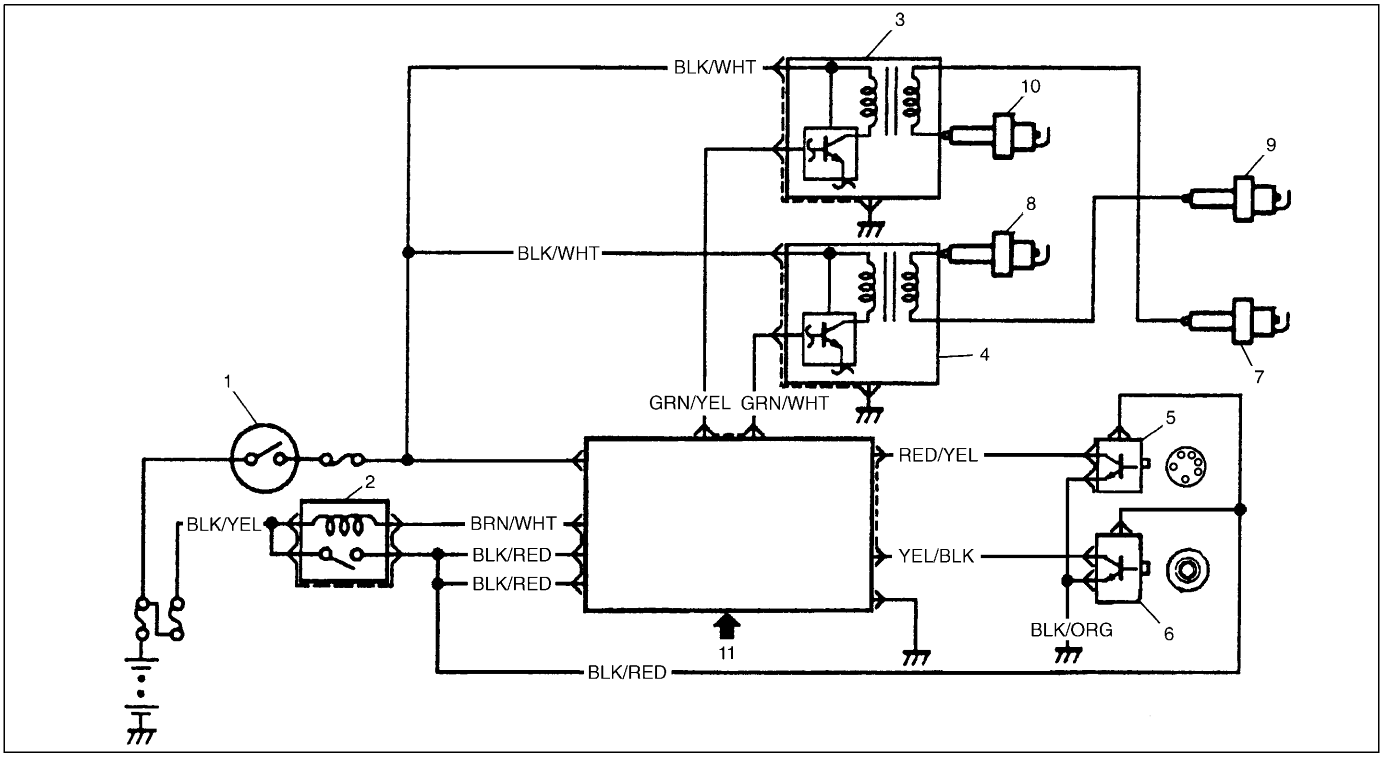
Although this ignition system does not have a distributor, it has two ignition coil assemblies (one is for No.1 and No.4 spark plugs and the other is for No.2 and No.3 spark plugs). When an ignition signal is sent from ECM to the ignitor in the ignition coil assembly for No.1 and No.4 spark plugs, a high voltage is induced in the secondary coil and that passes through the high-tension cords and causes No.1 and No.4 spark plugs to spark simultaneously. Likewise, when an ignition signal is sent to the ignitor in the other ignition coil assembly, No.2 and No.3 spark plugs spark simultaneously.

SYSTEM COMPONENTS



1. ECM	6. MAP sensor	11. Transmission range switch (A/T)
2. Ignition coil assembly for No.1 and No.4 spark plugs	7. ECT sensor	12. High-tension cords
3. Ignition coil assembly for No.2 and No.3 spark plugs	8. IAT sensor	13. Monitor connector
4. CMP sensor	9. TP sensor	14. Knock sensor (if equipped)
5. CKP sensor	10. VSS	15. Data link connector

SYSTEM WIRING DIAGRAM



1. Ignition switch	7. No.1 spark plug
2. Main relay	8. No.2 spark plug
3. Ignition coil assembly for No.1 and No.4 spark plugs	9. No.3 spark plug
4. Ignition coil assembly for No.2 and No.3 spark plugs	10. No.4 spark plug
5. CMP sensor	11. Sensed information (MAP sensor, ECT sensor, IAT sensor, TP sensor, Knock sensor (if equipped), VSS, Park/Neutral position signal, Electric load signal, Engine start signal, Test switch terminal (Vehicle without immobilizer indicator lamp))
6. CKP sensor	

DIAGNOSIS

Condition	Possible Cause	Correction
Engine cranks, but will not start or hard to start (No spark)	Blown fuse for ignition coil	Replace.
	Loose connection or disconnection of lead wire or high-tension cord(s)	Connect securely.
	Faulty high-tension cord(s)	Replace.
	Faulty spark plug(s)	Adjust, clean or replace.
	Faulty ignition coil	Replace ignition coil assembly.
	Faulty CKP sensor or CKP sensor plate	Clean, tighten or replace.
	Faulty ECM	Replace.
Poor fuel economy or engine performance	Incorrect ignition timing	Check related sensors and CKP sensor plate.
	Faulty spark plug(s) or high-tension cord(s)	Adjust, clean or replace.
	Faulty ignition coil assembly	Replace.
	Faulty CKP sensor or CKP sensor plate	Clean, tighten or replace.
	Faulty ECM	Replace.

IGNITION SYSTEM DIAGNOSTIC FLOW TABLE

Step	Action	Yes	No
1	Was "ENGINE DIAG. FLOW TABLE" in Section 6 performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE" in Section 6.
2	Ignition Spark Test 1) Check all spark plugs for condition and type referring to "Spark Plugs" section. 2) If OK, perform ignition spark test, referring to "Ignition Spark Test" in this section. Is spark emitted from all spark plugs?	Go to Step 11.	Go to Step 3.
3	Diagnostic Trouble Code (DTC) Check Is DTC stored in ECM?	Go to applicable DTC Diag. Flow Table in Section 6.	Go to Step 4.
4	Electrical Connection Check 1) Check ignition coil assemblies and high-tension cords for electrical connection. Are they connected securely?	Go to Step 5.	Connect securely.
5	High-tension Cords Check 1) Check high-tension cord for resistance referring to "High-Tension Cords" in this section. Is check result satisfactory?	Go to Step 6.	Replace high-tension cord(s).
6	Ignition Coil Assembly Power Supply and Ground Circuit Check 1) Check ignition coil assembly power supply and ground circuits for open and short. Are circuits in good condition?	Go to Step 7.	Repair or replace.
7	Ignition Coil Assembly Check 1) Check ignition coil for resistance referring to "Ignition Coil Assembly" in this section. Is check result satisfactory?	Go to Step 8.	Replace ignition coil assembly.
8	Crankshaft Position (CKP) Sensor Check 1) Check crankshaft position sensor referring to Step 3 and 4 of "DTC P0335 (No.23) Diag. Flow Table" in Section 6. Is check result satisfactory?	Go to Step 9.	Tighten CKP sensor bolt, replace CKP sensor or CKP sensor plate.
9	Ignition Trigger Signal Circuit Check 1) Check ignition trigger signal wire for open, short and poor connection. Is circuit in good condition?	Go to Step 10.	Repair or replace.
10	A Known-good Ignition Coil Assembly Substitution 1) Substitute a known-good ignition coil assembly and then repeat Step 2. Is check result of Step 2 satisfactory?	Go to Step 11.	Substitute a known-good ECM and then repeat Step 2.
11	Ignition Timing Check 1) Check initial ignition timing and ignition timing advance referring to "Ignition Timing" in this section. Is check result satisfactory?	System is in good condition.	Check CKP sensor, CKP sensor plate and input signals related to this system.

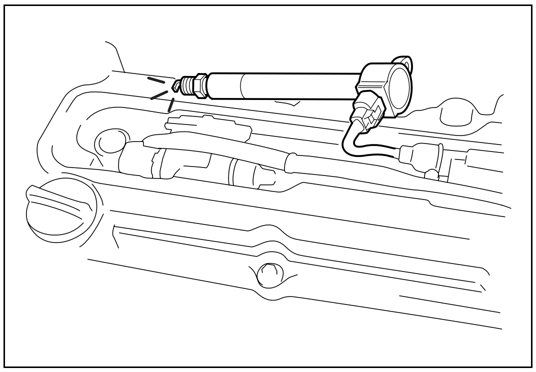
ON-VEHICLE SERVICE

IGNITION SPARK TEST

1) Disconnect all injector couplers (1) from injectors.

WARNING:
Without disconnection of injector couplers, combustible gas may come out from spark plug holes during this test and may get ignited in engine room.

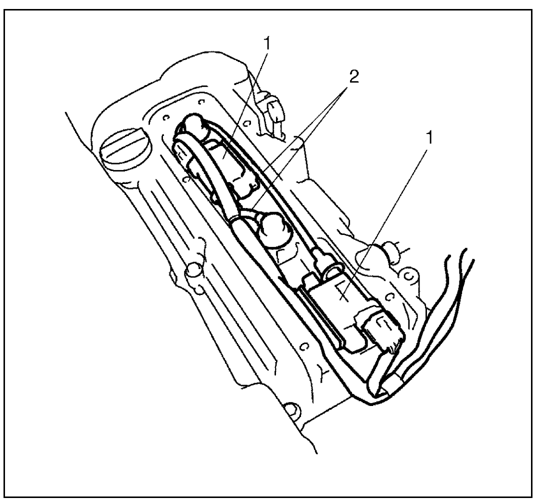
2) Remove spark plug and check it for condition and type referring to “Spark Plugs” in this section.



3) If OK, connect ignition coil coupler to ignition coil assembly and connect spark plug to ignition coil assembly or high-tension cord. Ground spark plug.
4) Crank engine and check if each spark plug sparks.
5) If no spark is emitted, inspect the related parts as described under “Diagnosis” earlier in this section.

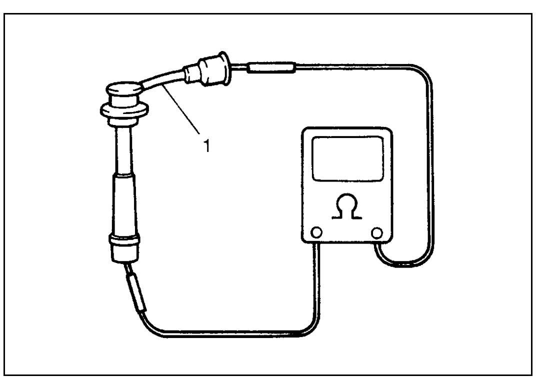
HIGH-TENSION CORDS

1) Remove air intake pipe and cylinder head upper cover.



2) Disconnect high-tension cords (2) from ignition coil assemblies (1) while gripping each cap.
3) Pull out high-tension cords from spark plugs while gripping each cap.

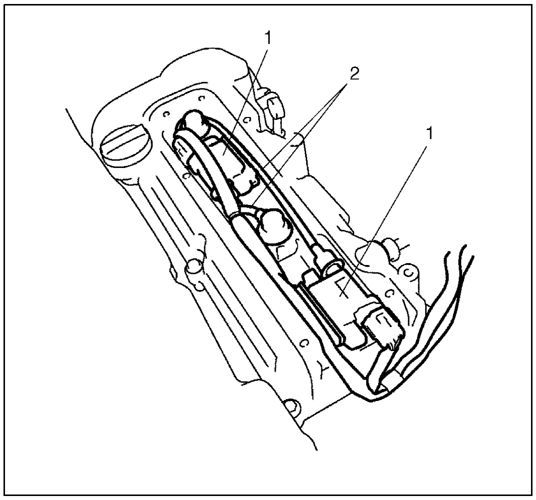
CAUTION:
- **Removal of high-tension cords together with clamps will be recommended so as not to damage their inside wire (resistive conductor).**
- **For the same reason, pull out each connection by gripping cap portion.**



4) Measure resistance of high-tension cord (1) by using ohmmeter.

High-tension cord resistance
: 4 -10 kΩ/m (1.2 - 3.0 kΩ/ft)

5) If resistance exceeds specification, replace high-tension cord(s).

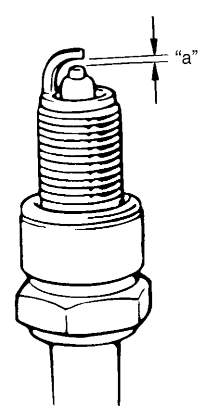


6) Install high-tension cords (2) to spark plugs and ignition coil assemblies (1) while gripping each cap.

CAUTION:
- **Never attempt to use metal conductor high-tension cords as replacing parts.**
- **Insert each cap portion fully when installing high-tension cords.**

SPARK PLUGS

1) Remove air intake pipe and cylinder head upper cover.
2) Pull out high-tension cords by gripping their caps and then remove ignition coil assemblies referring to IGNITION COIL ASSEMBLY in this section.
3) Remove spark plugs.
4) Inspect them for:
- Electrode wear
- Carbon deposits
- Insulator damage



5) If any abnormality is found, adjust air gap, clean with spark plug cleaner or replace them with specified new plugs.
For iridium/platinum spark plugs, replace them with new plugs.

Spark plug air gap
“a” : 1.0 - 1.1 mm (0.040 - 0.043 in.)

Spark plug type
NGK : BKR6E-11, IFR5E11
DENSO : K20PR-U11

NOTE:
NGK IFR5E11 is highly recommended for better engine starting performance under -25°C(-13°F).

CAUTION:
- **When servicing the iridium/platinum spark plugs (slender center electrode type plugs), do not touch the center electrode to avoid damage to it. The electrode is not strong enough against mechanical force as it is slender and its material is not mechanically tough**
- **Do not clean or adjust gap for the iridium/platinum spark plugs.**

6) Install spark plugs and torque them to specification.

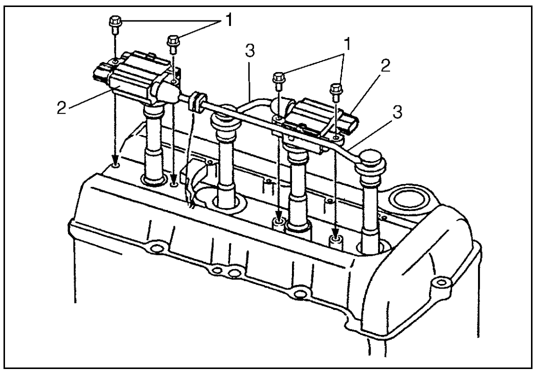
Tightening torque
Spark plug : 25 N·m (2.5 kg-m, 18.0 lb-ft)

7) Install ignition coil assemblies referring to IGNITION COIL ASSEMBLY in this section.
8) Install high-tension cords securely by gripping their caps.
9) Install cylinder head upper cover and air intake pipe.

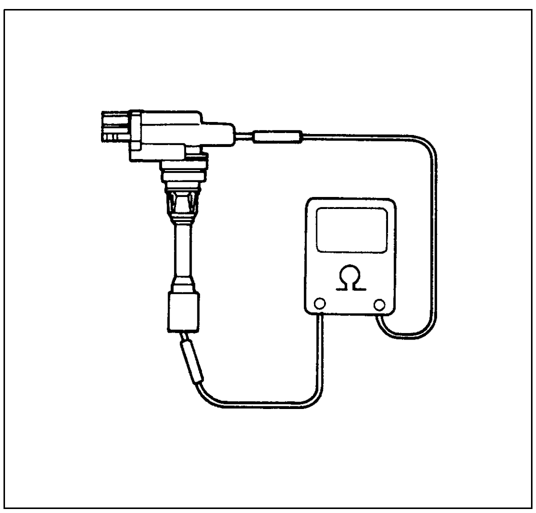
IGNITION COIL ASSEMBLY (INCLUDING IGNITOR)

Inspection

1) Disconnect negative cable at battery.
2) Remove air intake pipe and cylinder head upper cover.
3) Disconnect ignition coil coupler.



4) Disconnect high-tension cord (3) from ignition coil assembly (2).
5) Remove ignition coil bolts (1) and then pull out ignition coil assembly.



6) Measure secondary coil for resistance.
   If resistance is out of specification, replace ignition coil assembly.

Secondary coil resistance
: 7.6 - 10.2 kΩ at 20°C, 68°F

7) Install ignition coil assembly.
8) Tighten ignition coil bolts, and then connect ignition coil coupler.
9) Install high-tension cord to ignition coil assembly while gripping its cap.
10) Install cylinder head upper cover and air intake pipe.

CRANKSHAFT POSITION SENSOR (CKP SENSOR)

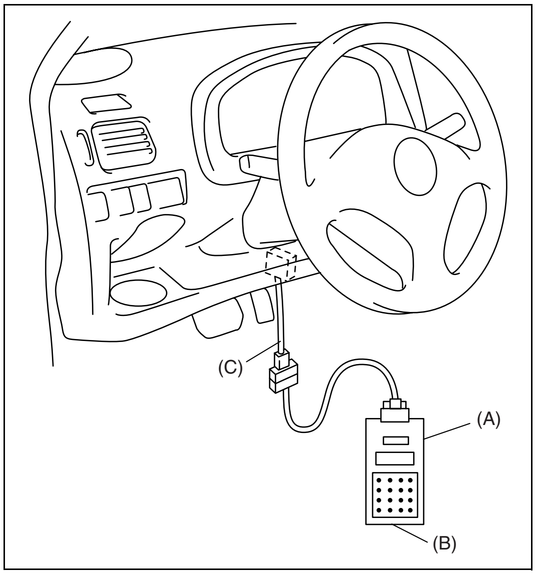
Refer to Section 6E1 for removal, inspection and installation.

IGNITION TIMING

NOTE:

- **Ignition timing is not adjustable. If ignition timing is out of specification, check system related parts.**
- **Before starting engine, place transmission gear shift lever in "Neutral" (shift selector lever to "P" range for A/T model), and set parking brake.**

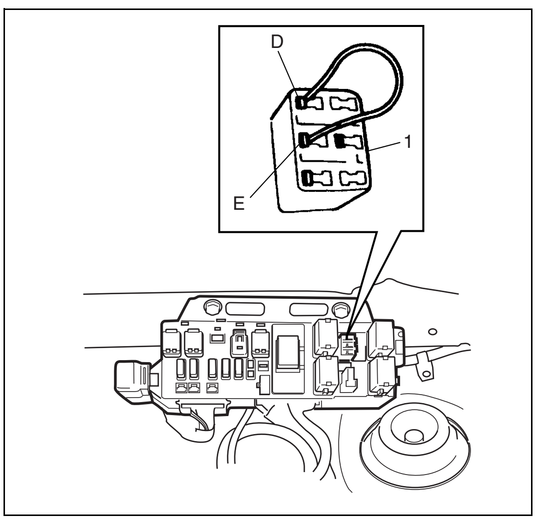
INSPECTION



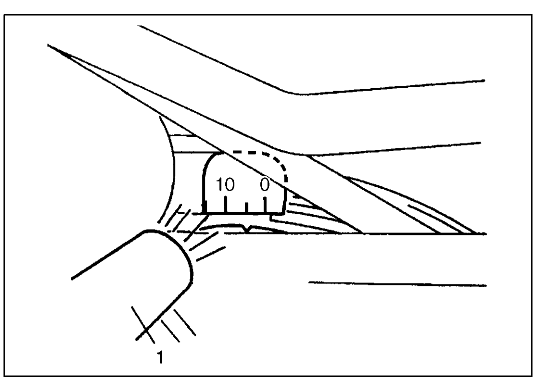
1) When using SUZUKI scan tool, connect SUZUKI scan tool to DLC with ignition switch OFF.

Special tool
(A) : 09931-76011 (SUZUKI scan tool)
(B) : Mass storage cartridge
(C) : 09931-76030 (16/14 pin DLC cable)

2) Start engine and warm it up to normal operating temperature.
3) Make sure that all of electrical loads except ignition are switched off.
4) Check to be sure that idle speed is within specification. (Refer to Section 6E1)



5) Fix ignition timing to initial one as follows.
Select "MISC" mode on SUZUKI scan tool and fix ignition timing to initial one.
If scan tool is not available (vehicle without immobilizer indicator lamp), connect D and E terminals of monitor connector (1) by using service wire so that ignition timing is fixed on initial one.



6) Using timing light (1), check that ignition timing is within specification.

Initial ignition timing (test switch terminal grounded or fixed with SUZUKI scan tool)
: 5 ± 3° BTDC at idle speed

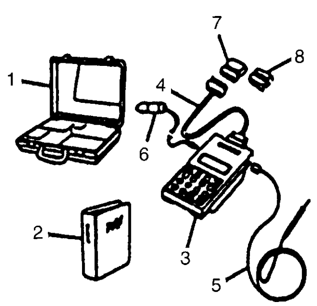
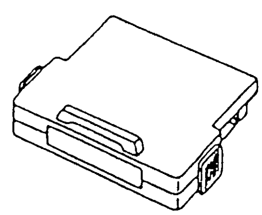
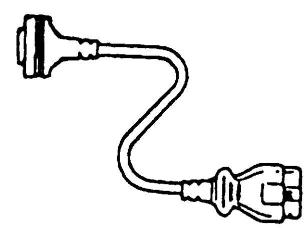
Ignition order
: 1-3-4-2

7) If ignition timing is out of specification, check the followings:
- CKP sensor
- CKP sensor plate
- TP sensor
- Test switch signal circuit
- VSS
- Timing chain cover installation

8) After checking Initial Ignition Timing, release ignition timing fixation by using SUZUKI scan tool or disconnect service wire from monitor connector.

9) With engine idling (test switch terminal ungrounded, throttle opening at closed position and car stopped), check that ignition timing is about 7°–17° BTDC. (Constant variation within a few degrees from 7°–17° indicates no abnormality but proves operation of electronic timing control system.) Also, check that increasing engine speed advances ignition timing. If above check results are not satisfactory, check CKP sensor, test switch terminal circuit and ECM.

SPECIAL TOOL

		
09931-76011 SUZUKI scan tool kit (See NOTE.)	Mass storage cartridge	09931-76030 16/14 pin DLC cable

NOTE:

This kit includes the following items.

1. Storage case, 2. Operator's manual, 3. Tech 1A, 4. DLC cable (14/26 pin, 09931-76040), 5. Test lead/probe, 6. Power source cable, 7. DLC cable adaptor, 8. Self-test adaptor

SECTION 6G

CRANKING SYSTEM

WARNING:

For vehicles equipped with Supplement Restraint (Air Bag) System:

- **Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to AIR BAG SYSTEM COMPONENTS and WIRING LOCATION VIEW under DIAGNOSIS in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and SERVICE PRECAUTIONS under PRECAUTIONS in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.**
- **Technical service work must be started at least 90 seconds after the ignition switch is turned to the "LOCK" position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).**

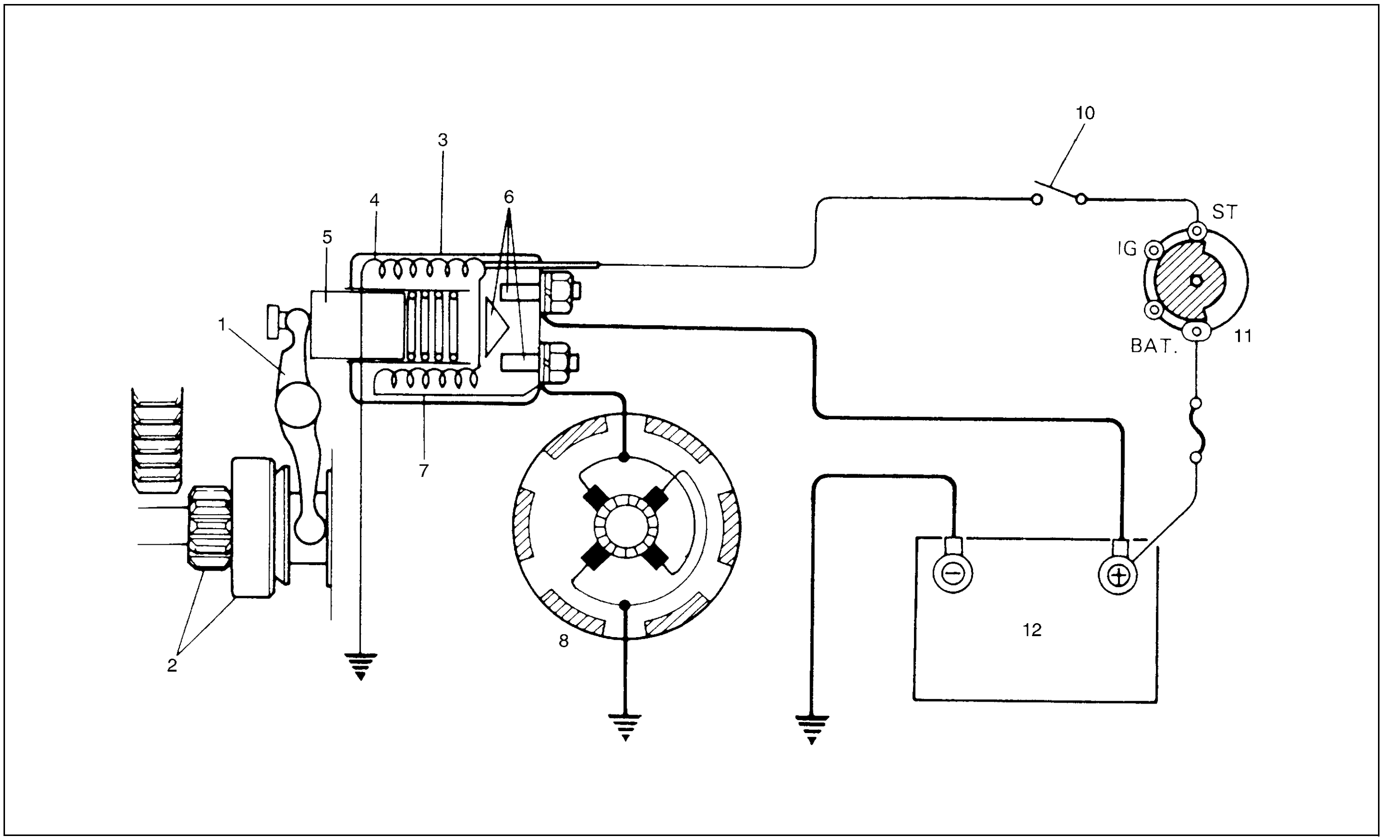
NOTE:

Starting motor varies depending on specifications, etc. Therefore, be sure to check model and specification of the vehicle being serviced before replacing parts.

CONTENTS

GENERAL DESCRIPTION

CRANKING CIRCUIT



1. Pinion drive lever	5. Plunger	9. Blank
2. Pinion & Over-running clutch	6. Magnetic switch contacts	10. A/T: Transmission range switch (shift lever switch)
3. Magnetic switch	7. Pull-in coil	11. Ignition & Starter switch
4. Hold-in coil	8. Starting motor	12. Battery

DIAGNOSIS

DIAGNOSIS TABLE

Possible symptoms due to starting system trouble would be as follows:

- Starting motor does not run (or runs slowly)
- Starting motor runs but fails to crank engine
- Abnormal noise is heard

Proper diagnosis must be made to determine exactly where the cause of each trouble lies.....in battery, wiring harness, (including starting motor switch), starting motor or engine.
Do not remove motor just because starting motor does not run. Check following items and narrow down scope of possible causes.

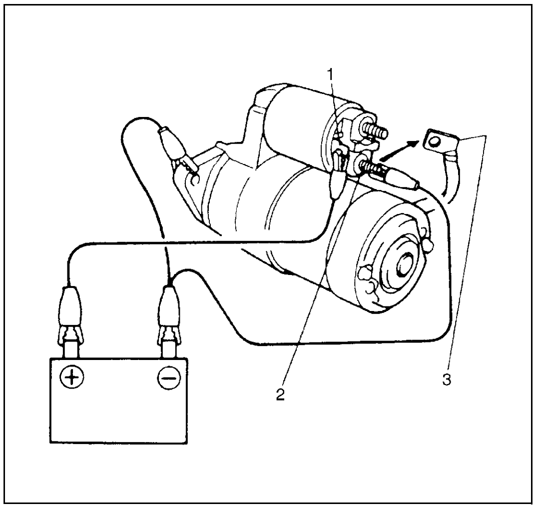
1) Condition of trouble
2) Tightness of battery terminals (including ground cable connection on engine side) and starting motor terminals
3) Discharge of battery
4) Mounting of starting motor

Condition	Possible Cause	Correction
Motor not running (No operating sound of magnetic switch)	Shift lever switch is not in P or N, or not adjusted (A/T)	Shift in P or N, or adjust switch.
	Battery run down	Recharge battery.
	Battery voltage too low due to battery deterioration	Replace battery.
	Poor contact in battery terminal connection	Retighten or replace.
	Loose grounding cable connection	Retighten.
	Fuse set loose or blown off	Tighten or replace.
	Poor contacting action of ignition switch and magnetic switch	Replace.
	Lead wire coupler loose in place	Retighten.
	Open-circuit between ignition switch and magnetic switch	Repair.
	Open-circuit in pull-in coil	Replace magnetic switch.
	Brushes are seating poorly or worn down	Repair or replace.
	Poor sliding of plunger and/or pinion	Repair.
Motor not running (Operating sound of magnetic switch heard)	Battery run down	Recharge battery.
	Battery voltage too low due to battery deterioration	Replace battery.
	Loose battery cable connections	Retighten.
	Burnt main contact point, or poor contacting action of magnetic switch	Replace magnetic switch.
	Brushes are seating poorly or worn down	Repair or replace.
	Weakened brush spring	Replace.
	Burnt commutator	Replace armature.
	Layer short-circuit of armature	Replace.
	Crankshaft rotation obstructed	Repair.
Starting motor running but too slow (small torque) (If battery and wiring are satisfactory, inspect starting motor)	Insufficient contact of magnetic switch main contacts	Replace magnetic switch.
	Layer short-circuit of armature	Replace.
	Disconnected, burnt or worn commutator	Repair commutator or replace armature.
	Worn brushes	Replace brush.
	Weakened brush springs	Replace spring.
	Burnt or abnormally worn end bush	Replace bush.
Starting motor running, but not cranking engine	Worn pinion tip	Replace over-running clutch.
	Poor sliding of over-running clutch	Repair.
	Over-running clutch slipping	Replace over-running clutch.
	Worn teeth of pinion gear	Replace flywheel.
Noise	Abnormally worn bush	Replace bush.
	Worn pinion or worn teeth of pinion gear	Replace pinion or flywheel.
	Poor sliding of pinion (failure in return movement)	Repair or replace.
	Worn internal or planetary gear teeth	Replace.
	Lack of oil in each part	Lubricate.
Starting motor does not stop running	Fused contact points of magnetic switch	Replace magnetic switch.
	Short-circuit between turns of magnetic switch coil (layer short-circuit)	Replace magnetic switch.
	Failure of returning action in ignition switch	Replace.

PERFORMANCE TEST

CAUTION:
Each test must be performed within 3 - 5 seconds to avoid coil from burning.

PULL-IN TEST

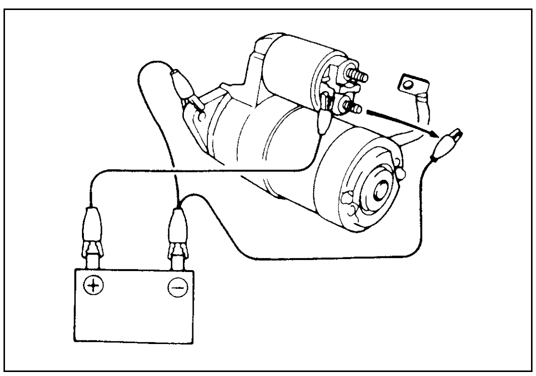


Connect battery to magnetic switch as shown.
Check that plunger and pinion move outward.
If plunger and pinion don't move, replace magnetic switch.

NOTE:
Before testing, disconnect lead wire from terminal M.

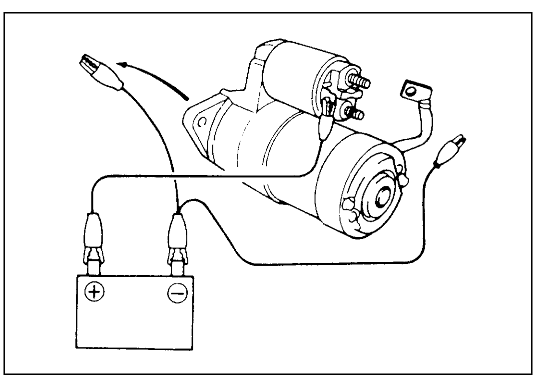
1.	Terminal "S"
2.	Terminal "M"
3.	Lead wire (switch to motor)

HOLD-IN TEST

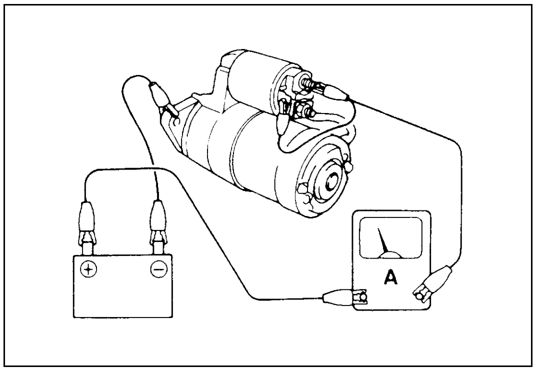


While connected as above with plunger out, disconnect negative lead from terminal "M".
Check that plunger and pinion remain out.
If plunger and pinion return inward, replace magnetic switch.

PLUNGER AND PINION RETURN TEST



Disconnect negative lead from starting motor body.
Check that plunger and pinion return inward.
If plunger and pinion don't return, replace magnetic switch.



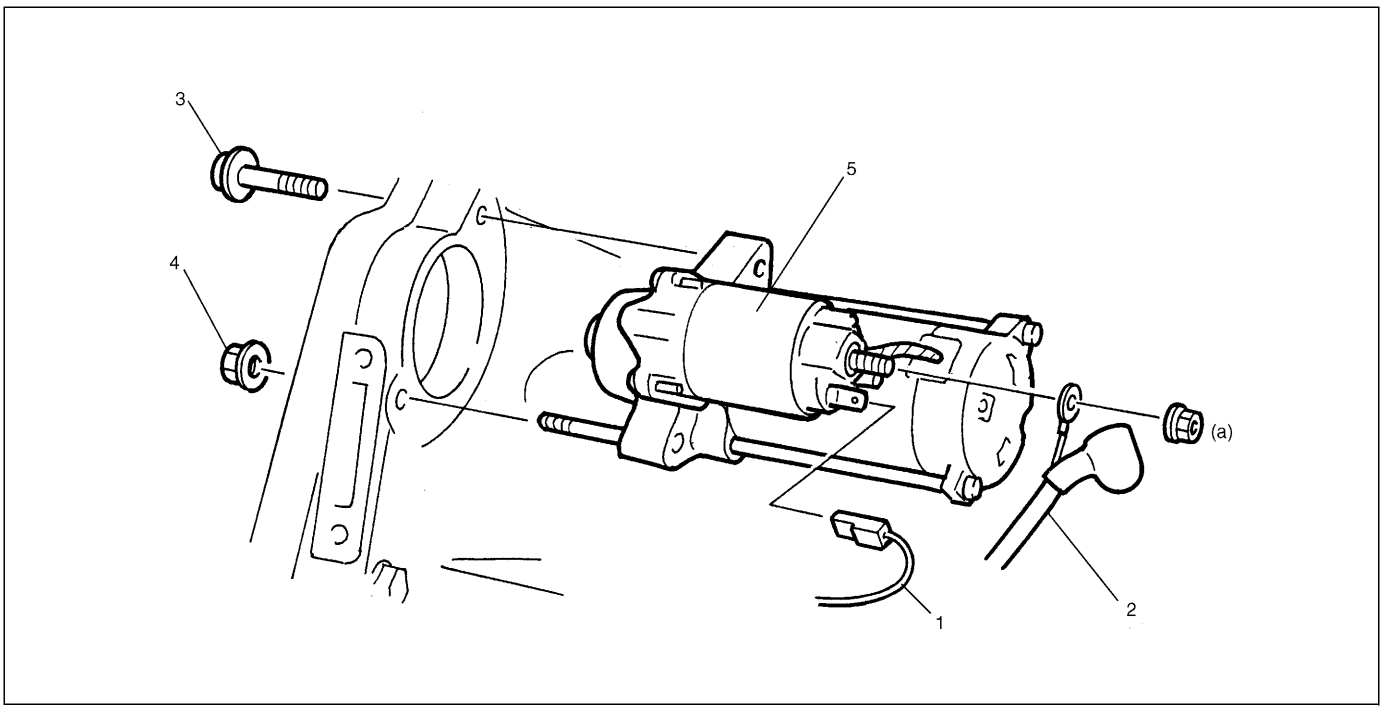
NO-LOAD PERFORMANCE TEST

Connect battery and ammeter to starter as shown.
Check that starter rotates smoothly and steadily with pinion moving out. Check that ammeter indicates specified current.

Specified current (No-load performance test)
: 90 A MAX. at 11 V

ON-VEHICLE SERVICE

STARTING MOTOR



DISMOUNTING

1) Disconnect negative (–) battery lead at battery.
2) Disconnect magnetic switch lead wire (1) and battery cable (2) from starting motor terminals.
3) Remove starting motor mount bolt (3) and nut (4).
4) Remove starting motor (5).

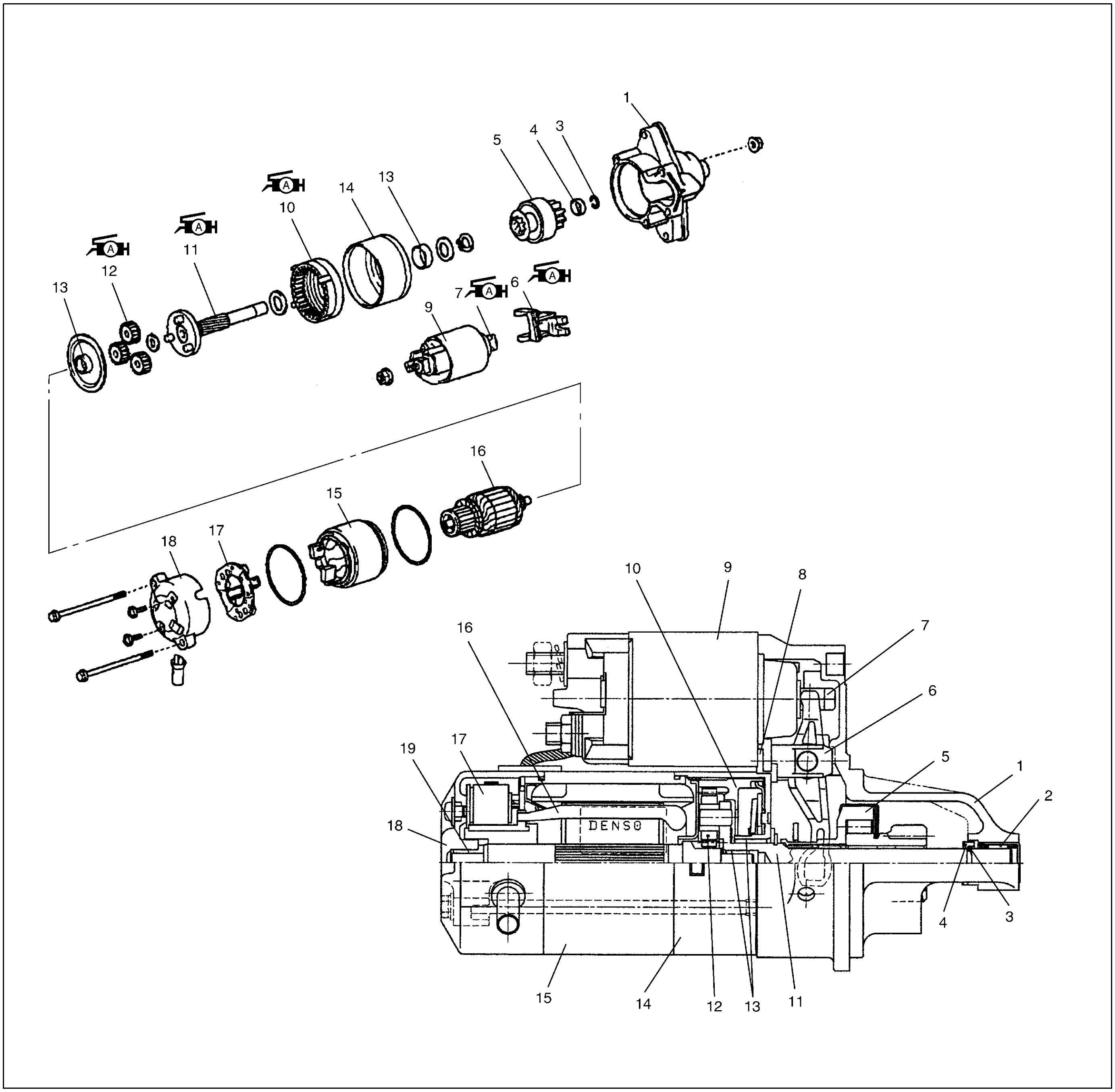
REMOUNTING

Reverse the dismounting procedure.

Tightening torque
Starting motor battery cable nut (a) : 10 N·m (1.0 kg-m, 7.5 lb-ft)

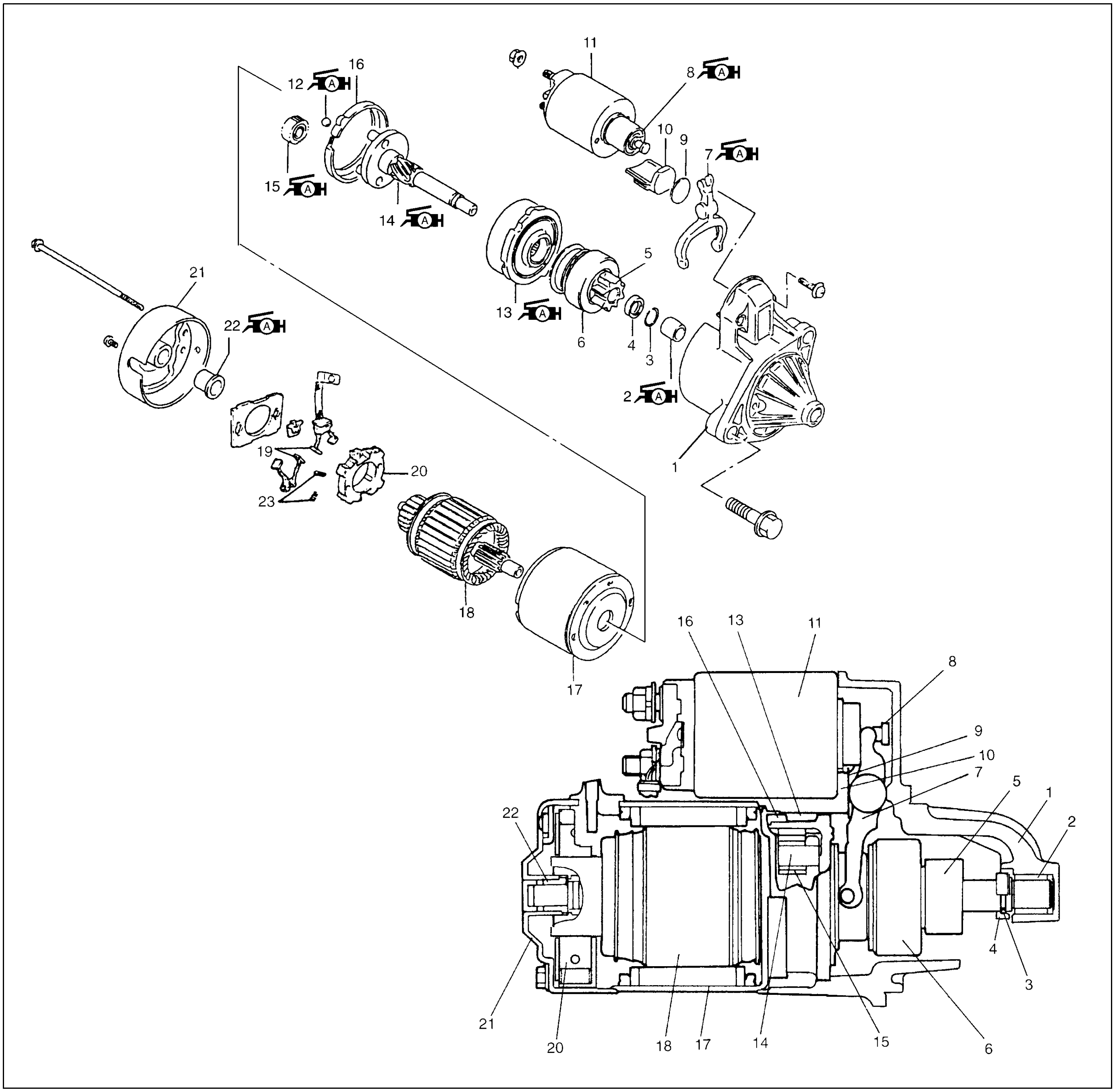
DISASSEMBLY AND REASSEMBLY

1.0 kW TYPE



1.	Front housing	6.	Lever	11.	Planetary carrier shaft	16.	Armature
2.	Needle bearing	7.	Plunger	12.	Planetary gear	17.	Brush holder
3.	Snap ring	8.	Seal rubber	13.	Oilless bearing	18.	Rear bracket
4.	Pinion stop ring	9.	Magnetic switch	14.	Center bearing with shock absorber	19.	Rear bush
5.	Over-running clutch	10.	Internal gear	15.	Yoke		

1.2 kW TYPE



1.	Front housing	7.	Lever	13.	Internal gear	19.	Brush
2.	Bush	8.	Plunger	14.	Planetary carrier shaft	20.	Brush holder
3.	Snap ring	9.	Plate	15.	Planetary gear	21.	Rear bracket
4.	Pinion stop ring	10.	Seal rubber	16.	Packing	22.	Rear bush
5.	Pinion gear	11.	Magnetic switch	17.	Yoke	23.	Brush spring
6.	Over-running clutch	12.	Ball	18.	Armature		

SPECIFICATION

1.0 kW TYPE

Voltage			12 volts	
Output			1.0 kW	
Rating			30 seconds	
Direction of rotation			Clockwise as viewed from pinion side	
Brush length			Standard: 14.0 mm (0.55 in.)	Limit: 9.0 mm (0.35 in.)
Number of pinion teeth			8	
Performance		Condition	Guarantee	
Around at 20°C (68°F)	No load characteristic	11.5 V	90 A maximum 3,000 rpm minimum	
	Load characteristic	8.7 V 230 A	6.9 N·m (0.69 kg-m, 5.0 lb-ft) minimum 1130 rpm minimum	
	Locked rotor current	2.5 V	325 A maximum 8.2 N·m (0.82 kg-m, 6.0 lb-ft) minimum	
	Magnetic switch operating voltage		8 volts maximum	

1.2 kW TYPE

Voltage			12 volts	
Output			1.2 kW	
Rating			30 seconds	
Direction of rotation			Clockwise as viewed from pinion side	
Brush length			Standard: 12.3 mm (0.48 in.)	Limit: 7.0 mm (0.27 in.)
Number of pinion teeth			8	
Performance		Condition	Guarantee	
Around at 20°C (68°F)	No load characteristic	11.0 V	90 A maximum 2,500 rpm minimum	
	Load characteristic	7.5 V 300 A	10.5 N·m (1.05 kg-m, 7.59 lb-ft) minimum 880 rpm minimum	
	Locked characteristic	4.0 V	760 A maximum 19.5 N·m (1.95 kg-m, 14.1 lb-ft) minimum	
	Magnetic switch operating voltage		8 volts maximum	

REQUIRED SERVICE MATERIAL

Material	Recommended SUZUKI product (Part Number)	Use
Lithium grease	SUZUKI SUPER GREASE A (99000-25010)	• Front and rear bush (for 1.2 kW type only) • Plunger • Pinion drive lever • Internal gear • Planetary carrier shaft • Planetary gear • Ball

SECTION 6H

CHARGING SYSTEM

WARNING:

For vehicles equipped with Supplemental Restraint (Air Bag) System:

- **Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to "Air Bag System Components and Wiring Location View" under "General Description" in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and "Service Precautions" under "On-Vehicle Service" in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.**
- **Technical service work must be started at least 90 seconds after the ignition switch is turned to the "LOCK" position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).**

CONTENTS

GENERAL DESCRIPTION

BATTERY

The battery has three major functions in the electrical system.

- It is a source of electrical energy for cranking the engine.
- It acts as a voltage stabilizer for the electrical system.
- It can, for a limited time, provide energy when the electrical load exceeds the output of the generator.

CARRIER AND HOLD-DOWN

The battery carrier should be in good condition so that it will support the battery securely and keep it level.
Before installing the battery, the battery carrier and hold-down clamp should be clean and free from corrosion and make certain there are no parts in carrier.
To prevent the battery from shaking in its carrier, the hold-down bolts should be tight enough but not over-tightened.

ELECTROLYTE FREEZING

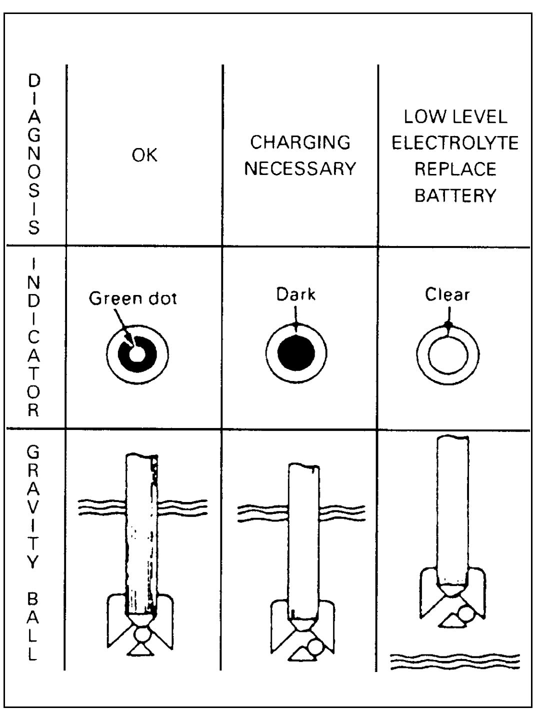
The freezing point of electrolyte depends on its specific gravity. Since freezing may ruin a battery, it should be protected against freezing by keeping it in a fully charged condition. If a battery is frozen accidentally, it should not be charged until it is warmed.

SULFATION

If the battery is allowed to stand for a long period in discharged condition, the lead sulfate becomes converted into a hard, crystalline substance, which will not easily turn back to the active material again during the subsequent recharging. “Sulfation” means the result as well as the process of that reaction. Such a battery can be revived by very slow charging and may be restored to usable condition but its capacity is lower than before.

BUILT-IN INDICATOR (IF EQUIPPED)

The battery has a built-in temperature compensated indicator in the top of the battery. This indicator is to be used with the following diagnostic procedure. When checking the indicator, make sure that the battery has a clean top. A light may be needed in some poorly-lit areas.



Three types of indication available under normal operation are as follows.

- Green Dot
  Battery is sufficiently charged for testing.
- Dark
  Battery must be charged before testing.
  If there is a cranking complaint, battery should be tested as described in Diagnosis section. Charging and electrical systems should also be checked at this time.
- Clear or Light Yellow
  This means that fluid level is below the bottom of hydrometer. Its possible cause is excessive or prolonged charging, a broken case, excessive tipping or normal battery deterioration. When the battery is found in such condition, it is possible that high charging voltage is caused by the faulty charging system and therefore, charging and electrical systems need to be checked. If there is a trouble in cranking and its cause lies in the battery, it should be replaced.

CARE OF BATTERY

WARNING:
- **Never expose battery to open flame or electric spark because of battery generate gas which is flammable and explosive.**
- **Do not allow battery fluid to contact eyes, skin, fabrics, or painted surfaces as fluid is a corrosive acid. Flush any contacted area with water immediately and thoroughly.**
- **Batteries should always be kept out of reach of children.**

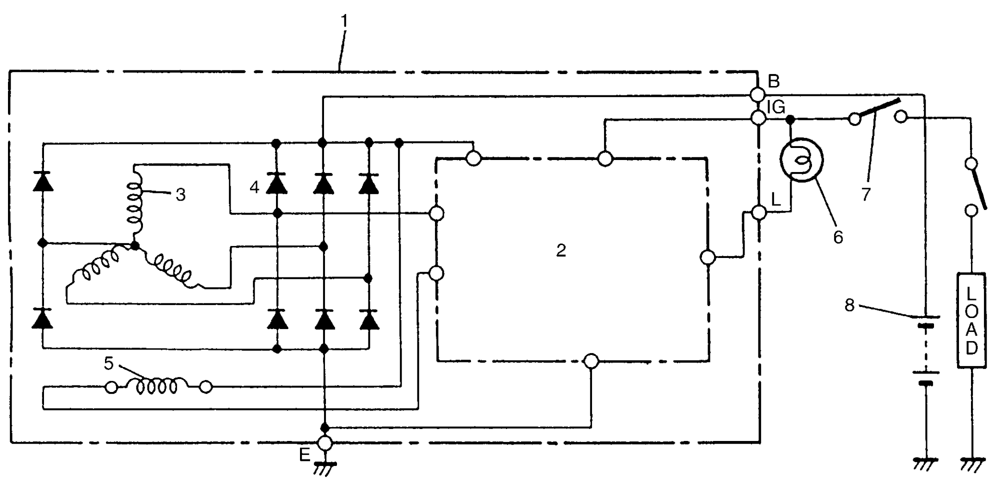
1) The battery is a very reliable component, but needs periodical attentions.
   - Keep the battery carrier clean
   - Prevent rust formation on the terminal posts
   - Keep the electrolyte up to the upper level uniformly in all cells.
   - When keeping battery on vehicle over a long period of time, follow instructions given below.
     – Weekly, start the engine and run it until it reaches normal operating temperature with engine speed of 2000 to 3000 rpm. Make sure all electric switches are off before storing the vehicle.
     – Recharge the battery twice a month to prevent it from discharging excessively. This is especially important when ambient temperature is low.
     The battery discharges even when it is not used, while vehicles are being stored. Battery electrolyte can freeze and battery case can crack at cold ambient condition if battery is not properly charged.
2) Keep the battery cable connections clean.
   The cable connections, particularly at the positive (+) terminal post, tend to become corroded. The product of corrosion, or rust, on the mating faces of conductors resists the flow of current.
   Clean the terminals and fittings periodically to ensure good metal-to-metal contact, and grease the connections after each cleaning to protect them against rusting.
3) Be always in the know as to the state of charge of the battery. The simplest way to tell the state of charge is to carry out a hydrometer test. The hydrometer is an instrument for measuring the specific gravity (S.G.) of the battery electrolyte. The S.G. of the electrolyte is indicative of the state of charge. Refer to “DIAGNOSIS” of BATTERY in this section.

GENERATOR

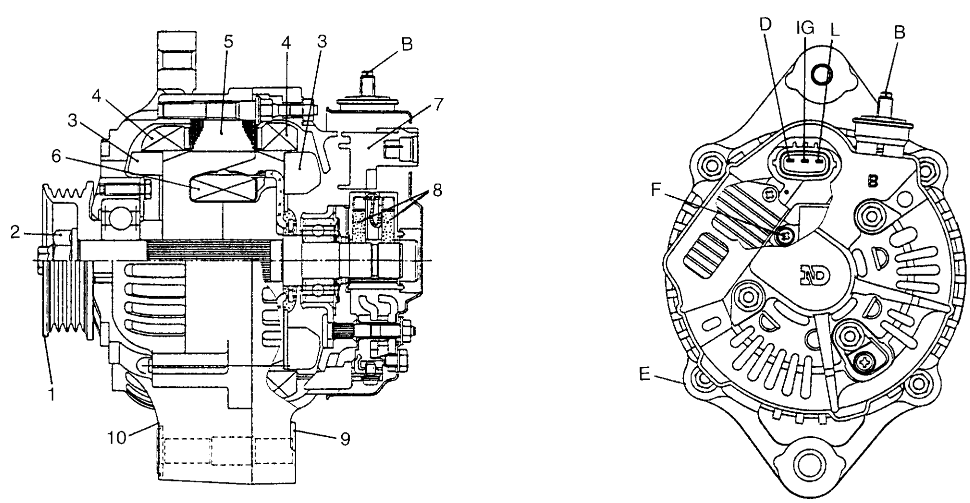
The generator is a small and high performance type with an IC regulator incorporated.
The internal components are connected electrically as shown below figure.

The generator features are as follows:

- Solid state regulator is mounted inside the generator.
- All regulator components are enclosed into a solid mold.
- This unit along with the brush holder assembly is attached to the rear housing.
- The IC regulator uses integrated circuits and controls the voltage produced by the generator, and the voltage setting cannot be adjusted.
- The generator rotor bearings contain enough grease to eliminate the need for periodic lubrication. Two brushes carry current through the two slip rings to the field coil mounted on the rotor, and under normal conditions will provide long period of attention-free service.
- The stator windings are assembled on the inside of a laminated core that forms part of the generator frame.
- A condenser mounted in the rear housing suppresses radio noise.



1. Generator with regulator ass'y	3. Stator coil	5. Field coil (rotor coil)	7. Main switch
2. I.C. regulator	4. Diode	6. Charge indicator light	8. Battery



1. Pulley	5. Stator core	9. Rear end frame	E: Ground
2. Pulley nut	6. Field coil	10. Drive end frame	F: Field coil terminal
3. Rotor fan	7. Regulator	B: Generator output (Battery terminal)	IG: Ignition terminal
4. Stator coil	8. Brush	D: Dummy terminal	L: Lamp terminal

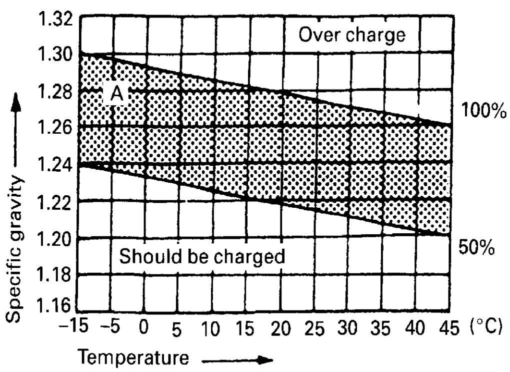
DIAGNOSIS

BATTERY

VISUAL INSPECTION

Check for obvious damage, such as cracked or broken case or cover, that could permit loss of electrolyte. If obvious damage is noted, replace battery. Determine cause of damage and correct as needed.

HYDROMETER TEST



The direct method of checking the battery for state of charge is to carry out a high rate discharge test, which involves a special precise voltmeter and an expensive instrument used in the service shops, but not recommendable to the user of the vehicle.

At 20 °C of battery temperature (electrolyte temperature):

- The battery is in FULLY CHARGED STATE if the electrolyte S.G. is 1.280.
- The battery is in HALF CHARGED STATE if the S.G. is 1.220.
- The battery is in NEARLY DISCHARGED STATE if the S.G. is 1.150 and is in danger of freezing.

As the S.G. varies with the temperature, if battery temperature is not at 20°C (68°F), you have to correct your S.G. reading (taken with your hydrometer) to the value at 20°C (68°F) and apply the corrected S.G. value to the three-point guide stated value.

For the manner of correction, refer to the graph showing the relation between S.G. value and temperature at the left.

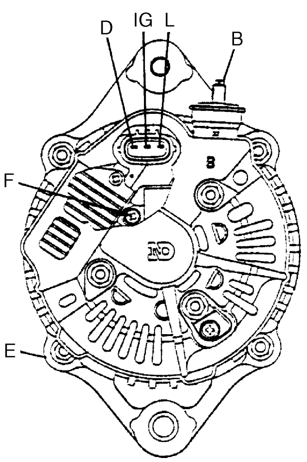
How to use the temperature-corrected state-of-charge graph

Suppose your S.G. reading is 1.28 and the battery temperature is –5°C (23°F). Locate the intersection of the –5°C line and the 1.28 S.G. line.

The intersection is within the “A” zone (shaded area in the graph) and that means CHARGED STATE.

To know how much the battery is charged, draw a line parallel to the zone demarcation line and extend it to the right till it meets with the percentage scale. In the present example, the line meets at about 85% point on the percentage scale. Therefore, the battery is charged up to the 85% level.

GENERATOR



CAUTION:
- **Do not mistake polarities of IG terminal and L terminal.**
- **Do not create short circuit between IG and L terminals. Always connect these terminals through a lamp.**
- **Do not connect any load between L and E.**
- **When connecting charger or booster battery to vehicle battery, refer to this section describing battery charging.**

Trouble in charging system will show up as one or more of the following conditions:
1) Faulty indicator lamp operation.
2) An undercharged battery as evidenced by slow cranking or indicator dark.
3) An overcharged battery as evidenced by excessive spewing of electrolyte from vents.

Noise from generator may be caused by loose drive pulley, loose mounting bolts, worn or dirty bearings, defective diode, or defective stator.

B:	Generator output (Battery terminal)
D:	Dummy terminal
E:	Ground
F:	Field coil terminal
IG:	Ignition terminal
L:	Lamp terminal

CHARGING INDICATOR LAMP OPERATION

Condition	Possible Cause	Correction
Charge light does not light with ignition ON and engine off	Fuse blown	Check fuse.
	Light burned out	Replace light.
	Wiring connection loose	Tighten loose connection.
	IC regulator or field coil faulty	Check generator.
	Poor contact between brush and slip ring	Repair or replace.
Charge light does not go out with engine running (battery requires frequent recharging)	Drive belt loose or worn	Adjust or replace drive belt.
	IC regulator or generator faulty	Check charging system.
	Wiring faulty	Repair wiring.

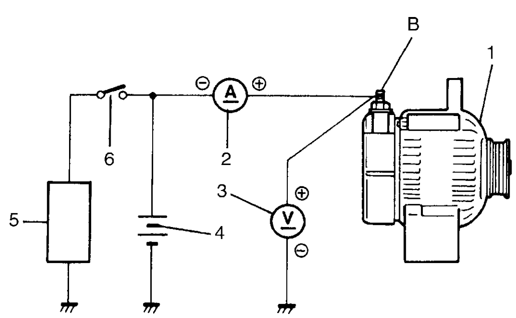
UNDERCHARGED BATTERY

This condition, as evidenced by slow cranking or indicator clear with red dot can be caused by one or more of the following conditions even though indicator lamp may be operating normal.

Following procedure also applies to cars with voltmeter and ammeter.

- Make sure that undercharged condition has not been caused by accessories left on for extended period of time.
- Check drive belt for proper tension.
- If battery defect is suspected, refer to BATTERY section.
- Inspect wiring for defects. Check all connections for tightness and cleanliness, battery cable connections at battery, starting motor and ignition ground cable.

NO-LOAD CHECK

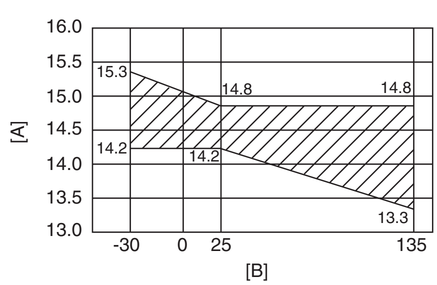


1) Connect voltmeter and ammeter as shown in left figure.

NOTE:

Use fully charged battery.

1.	Generator
2.	Ammeter (between generator (B) terminal and battery (+) terminal)
3.	Voltmeter (between generator (B) terminal and ground)
4.	Battery
5.	Load
6.	Switch



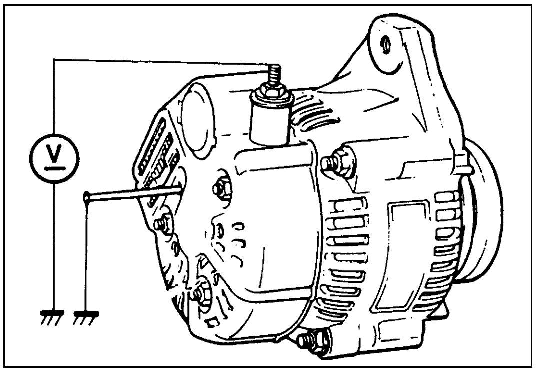
2) Run engine from idling up to 2,000 rpm with all accessories turned off and read meters.
   If voltage is higher than standard value, check ground of brushes.
   If brushes are not grounded, replace IC regulator.
   If voltage is lower than standard value, proceed to following check.

Specification for undercharged battery (No-load check)
Current: 10 A
Voltage: 14.2 – 14.8 V (at 25°C, 77°F)

NOTE:

Consideration should be taken that voltage will differ somewhat with regulator case temperature as shown in left figure.

A:	Regulated voltage (V)
B:	Heatsink temperature (°C)



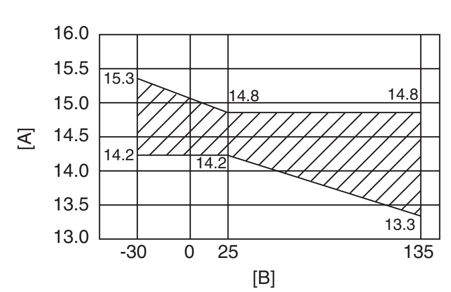
3) Ground F terminal and start engine, then measure voltage at B terminal as shown in left figure.
   - Voltage is higher than standard value
     It is considered that generator itself is good but IC regulator has been damaged, replace IC regulator.
   - Voltage is lower than standard value
     Generator itself has problem, check the generator.

LOAD CHECK

1) Run engine at 2,000 rpm and turn on head light and heater motor.
2) Measure current and if it is less than 20 A repair or replace generator.

OVERCHARGED BATTERY

1) To determine battery condition, refer to Battery section.
2) If obvious overcharge condition exists as evidenced by excessive spewing of electrolyte, measure generator B terminal voltage at engine 2000 rpm.
3) If measured voltage is higher than upper limit value, disassemble generator.
4) Check ground of brushes. If brushes are not grounded, replace IC regulator. Then check field coil for grounds and shorts.



A:	Regulated voltage (V)
B:	Heatsink temperature (°C)

ON-VEHICLE SERVICE

BATTERY

JUMP STARTING IN CASE OF EMERGENCY

WITH AUXILIARY (BOOSTER) BATTERY

CAUTION:

If vehicle is manual transmission model and has a catalytic converter, do not push or tow it to start. Damage to its emission system and/or to other parts may result.

Both booster and discharged battery should be treated carefully when using jumper cables. Follow procedure outlined below, being careful not to cause sparks.

WARNING:

- **Departure from these conditions or procedure described below could result in:**
  - **Serious personal injury (particularly to eyes) or property damage from such causes as battery explosion, battery acid, or electrical burns.**
  - **Damage to electronic components of either vehicle.**
- **Remove rings, watches, and other jewelry. Wear approved eye protection.**
- **Be careful so that metal tools or jumper cables do not contact positive battery terminal (or metal in contact with it) and any other metal on vehicle, because a short circuit could occur.**

WARNING:

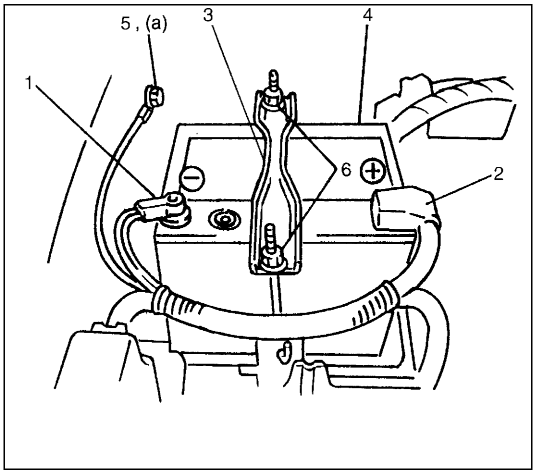
Do not connect negative cable directly to negative terminal of dead battery.

1) Set parking brake and place automatic transmission in PARK (NEUTRAL on manual transmission). Turn off ignition, turn off lights and all other electrical loads.
2) Check electrolyte level. If it is below low level line, add distilled water.
3) Attach end of one jumper cable to positive terminal of booster battery and the other end of the same cable to positive terminal of discharged battery. (Use 12-volt battery only to jump start engine).
4) Attach one end of the remaining negative cable to negative terminal of booster battery, and the other end to a solid engine ground (such as exhaust manifold) at least 45 cm (18 in.) away from battery of vehicle being started.
5) Start engine of vehicle with booster battery and turn off electrical accessories. Then Start engine of the vehicle with discharged battery.
6) Disconnect jumper cables in the exact reverse order.

WITH CHARGING EQUIPMENT

CAUTION:

When jump starting engine with charging equipment, be sure equipment used is 12-volt and negative ground. Do not use 24-volt charging equipment. Using such equipment can cause serious damage to electrical system or electronic parts.



DISMOUNTING

1) Disconnect negative cable (1).
2) Disconnect positive cable (2).
3) Remove retainer (3).
4) Remove battery (4).

5.	Body ground bolt
6.	Nut

HANDLING

When handling battery, following safety precautions should be followed:

- Hydrogen gas is produced by battery. A flame or spark near battery may cause the gas to ignite.
- Battery fluid is highly acidic. Avoid spilling on clothing or other fabric. Any spilled electrolyte should be flushed with large quantity of water and cleaned immediately.

REMOUNTING

1) Reverse removal procedure.
2) Torque battery cables to specification.

NOTE:

Check to be sure that ground cable has enough clearance to hood panel by terminal.

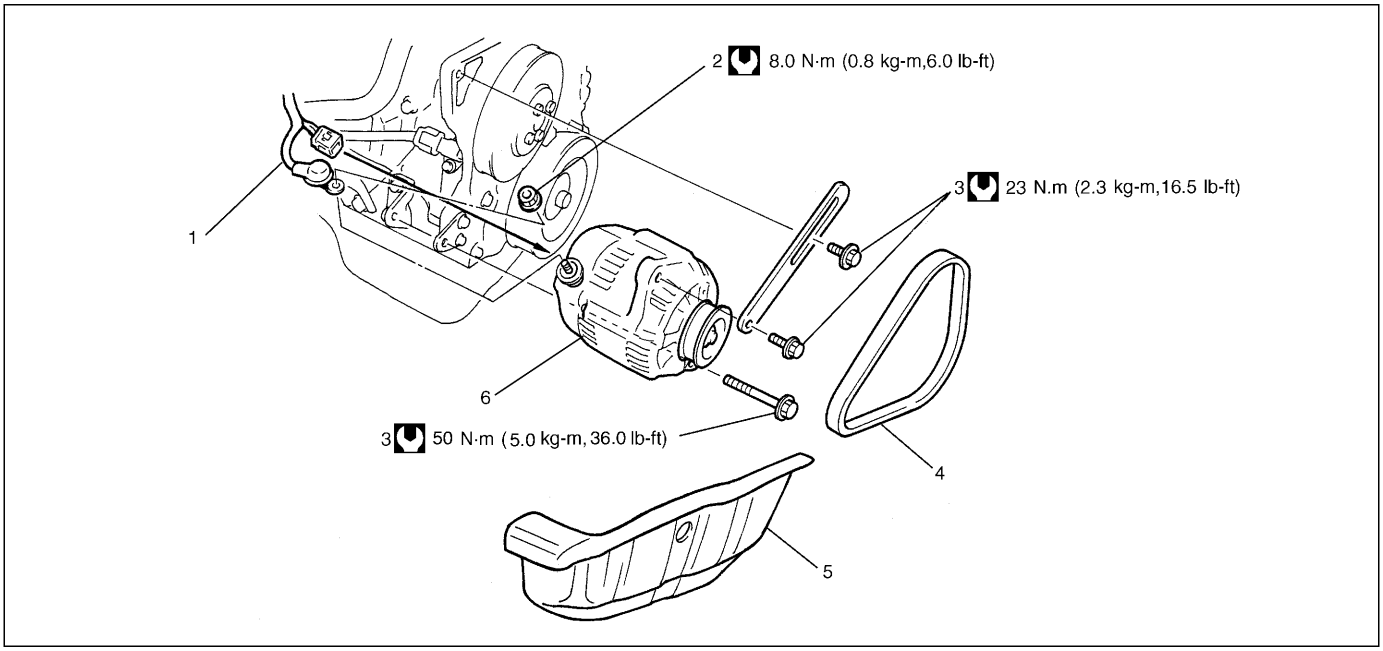
Tightening torque
Body ground bolt (a): 8.0 N·m (0.8 kg-m, 6.0 lb-ft)

GENERATOR

GENERATOR BELT

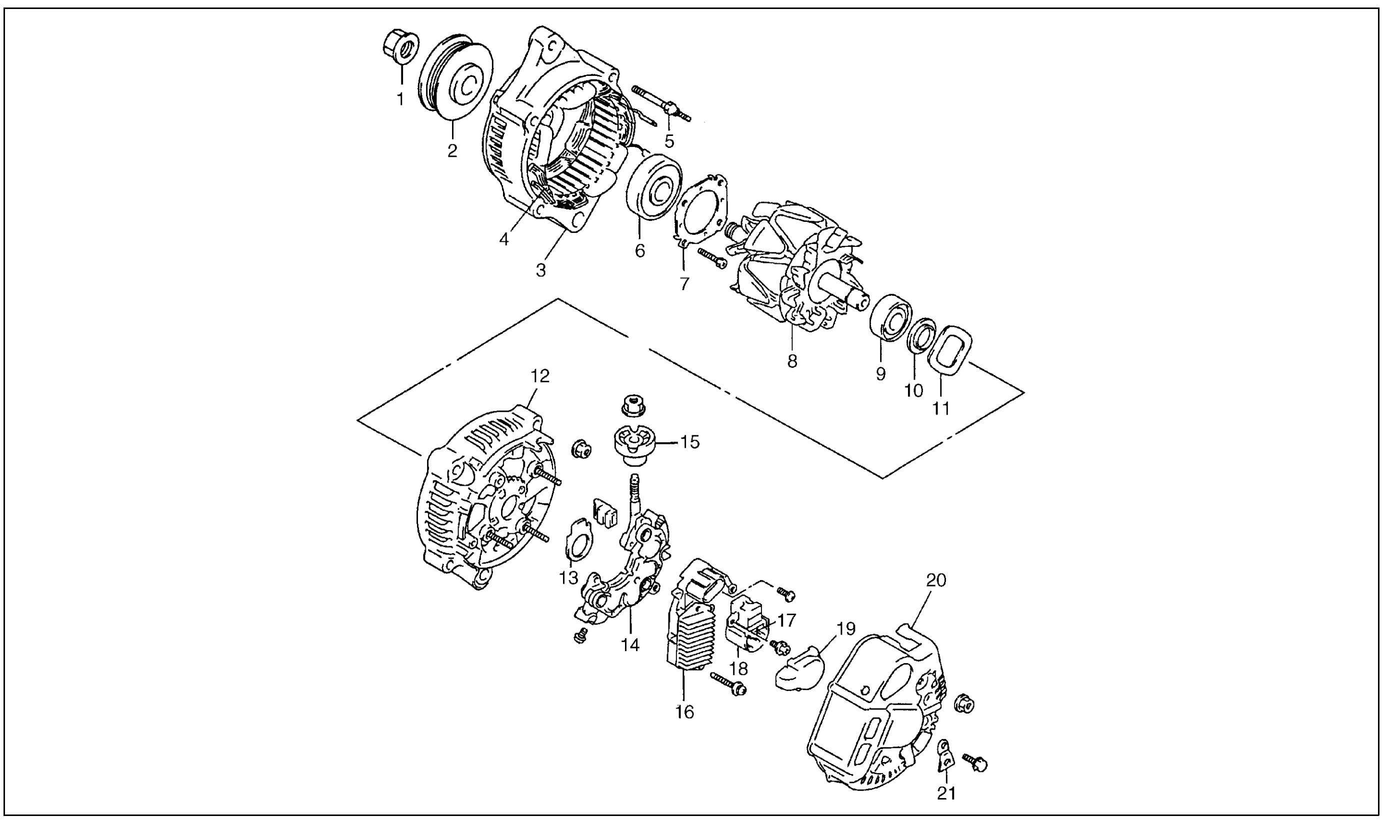
Refer to “WATER PUMP BELT” in Section 6B “ENGINE COOLING”.

DISMOUNTING AND REMOUNTING



1. "B" terminal wire	3. Generator bolt	5. Splash cover (Right)	Tightening torque
2. "B" terminal nut	4. Generator belt	6. Generator	

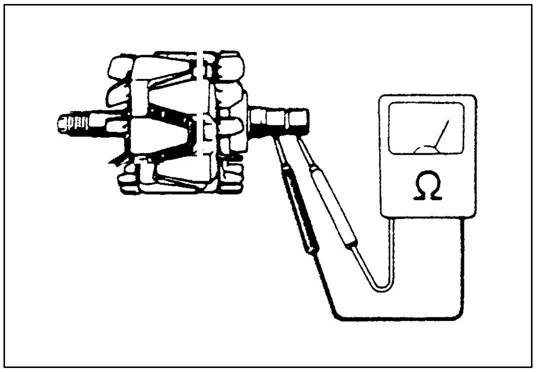
DISASSEMBLY AND REASSEMBLY



1. Pulley nut	7. Bearing retainer	13. Seal plate	19. Brush holder cover
2. Pulley	8. Rotor	14. Rectifier	20. Rear end cover
3. Drive end frame	9. End housing bearing	15. Insulator	21. Terminal plate
4. Stator	10. Bearing cover	16. Regulator	
5. Stud bolt	11. Wave washer	17. Brush	
6. Drive end bearing	12. Rear end frame	18. Brush holder	

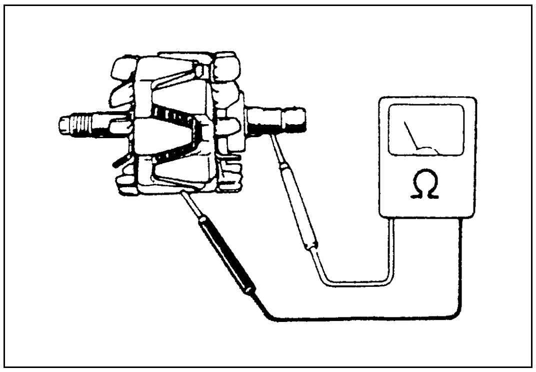
INSPECTION

ROTOR

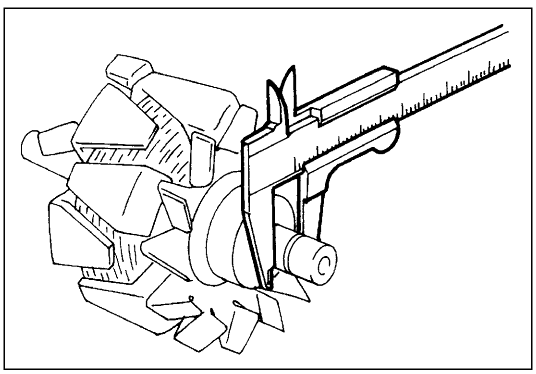


1) Using ohmmeter, check for continuity between slip rings of rotor. If there is no continuity, replace rotor.

Standard resistance between slip rings of rotor
: 2.7 – 3.1 Ω at 20°C (68°F)



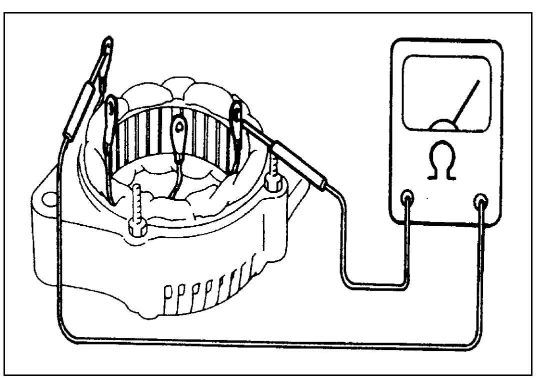
2) Using ohmmeter, check that there is no continuity between slip ring and rotor. If there is continuity, replace rotor.



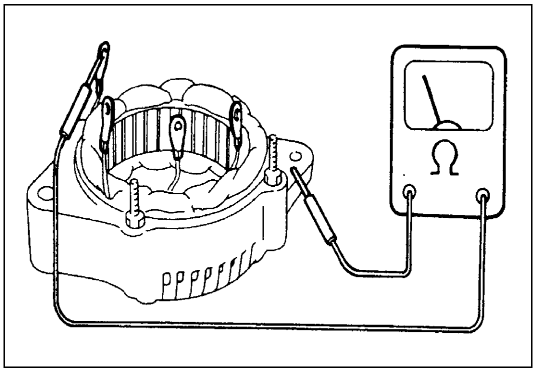
3) Check slip rings for roughness or scoring. If rough or scored, replace rotor.
   Using a vernier caliper, measure the slip ring diameter.
   If the diameter is less than minimum, replace the rotor.

Slip ring diameter
Standard: 14.2 – 14.4 mm (0.557 – 0.567 in.)
Limit: 12.8 mm (0.504 in.)

STATOR

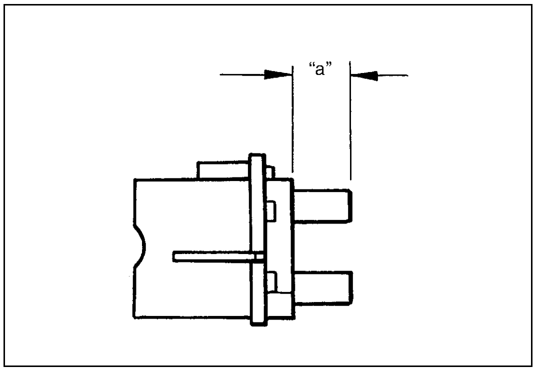


1) Using an ohmmeter, check all leads for continuity. If there is no continuity, replace stator.



2) Using ohmmeter, check that there is no continuity between coil leads and stator core. If there is continuity, replace stator.

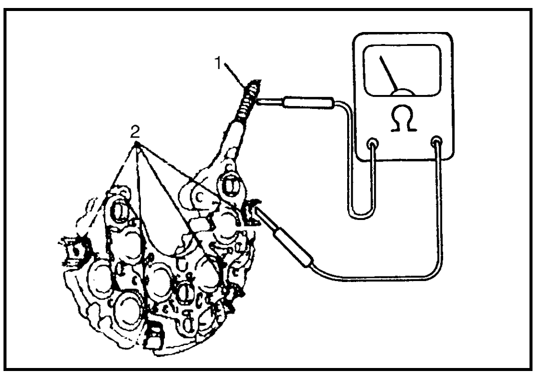
BRUSH AND BRUSH HOLDER



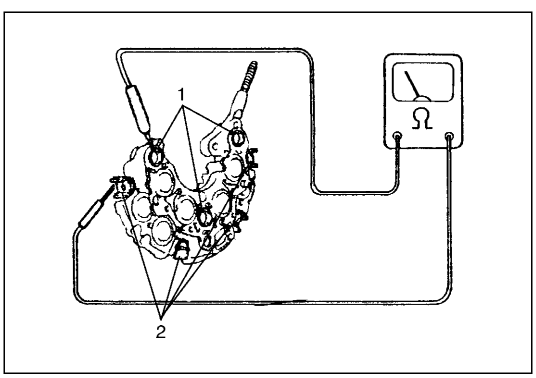
Check each brush for wear by measuring its length as shown. If brush is found worn down to service limit, replace brush.

Exposed brush length "a"
Standard: 10.5 mm (0.41 in.)
Limit: 1.5 mm (0.06 in.)

RECTIFIER



1) Using an ohmmeter, connect one tester probe to the "B" terminal (1) and the other to each rectifier terminal (2).
2) Reverse the polarity of the tester probes and repeat step 1).
3) Check that one shows continuity and the other shows no continuity.
   If there is continuity, replace the rectifier.



4) Using an ohmmeter, connect one tester probe to each negative terminal (1) and the other to each rectifier terminal (2).
5) Reverse the polarity of the tester probes and repeat step 4).
6) Check that one shows continuity and the other shows no continuity.
   If there is continuity, replace the rectifier.

SPECIFICATION

BATTERY

NOTE:
The battery used in each vehicle is one of the following two types, depending on specification.

Battery type		38B20L	55B24L
Rated capacity	AH/5HR, 12 Volts	28	38
Electrolyte	L (US/Imp. pt)	2.1 (4.44/3.70)	2.8 (5.92/4.93)
Electrolyte S.G.		1.28 when fully charged at 20°C (68°F)	

GENERATOR

Type	75 A type
Rated voltage	12 V
Nominal output	75 A
Permissible max. speed	18000 r/min.
No-load speed	1020 r/min (rpm)
Setting voltage	14.2 to 14.8 V
Exposed brush length	Standard: 10.5 mm (0.41 in.) Limit: 1.5 mm (0.06 in.)
Permissible ambient temperature	–30 to 90°C (–22 to 194°F)
Polarity	Negative ground
Rotation	Clockwise viewed from pulley side

TIGHTENING TORQUE SPECIFICATION

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Body ground bolt	8	0.8	6.0
Generator bolts	23	2.3	16.5
“B” terminal inner nut	4.2	0.42	3.0
“B” terminal outer nut	8	0.8	6.0
Pulley nut	111	11.1	80.5
Rear end frame nuts	4.5	0.45	3.5
Rear end cover nuts	4.5	0.45	3.5
Rectifier “B” bolt	3.9	0.39	3.0
Stator stud bolts	8.8	0.88	6.5
Drive end bearing plate screws	2.6	0.26	2.0
Rectifier screws	2.0	0.20	1.5
Regulator and brush holder screws	2.0	0.20	1.5
Terminal plate bolt	3.8	0.38	3.0

SECTION 6K

EXHAUST SYSTEM

CONTENTS

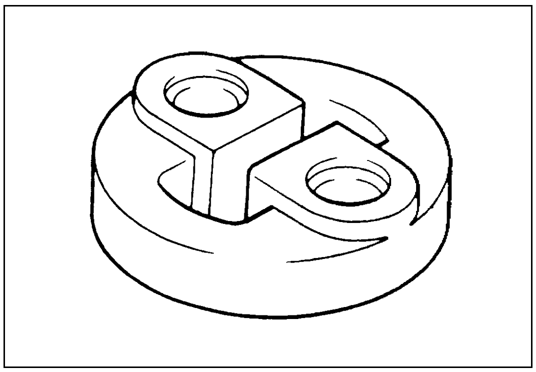
GENERAL DESCRIPTION

The exhaust system consists of an exhaust manifold, three-way catalytic converter (TWC) in catalyst case, exhaust pipes, a muffler and seals, gasket and etc.
The three-way catalytic converter is an emission control device added to the exhaust system to lower the levels of Hydrocarbon (HC), Carbon Monoxide (CO), and Oxides of Nitrogen (NOx) pollutants in the exhaust gas.

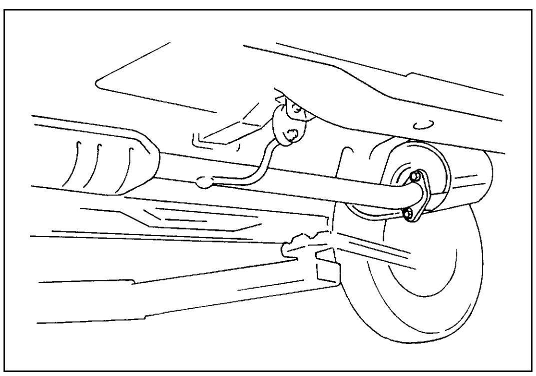
MAINTENANCE

WARNING:
To avoid the danger of being burned, do not touch the exhaust system when the system is hot. Any service on the exhaust system should be performed when the system is cool.

At every interval of periodic maintenance service, and when vehicle is raised for other service, check exhaust system as follows:

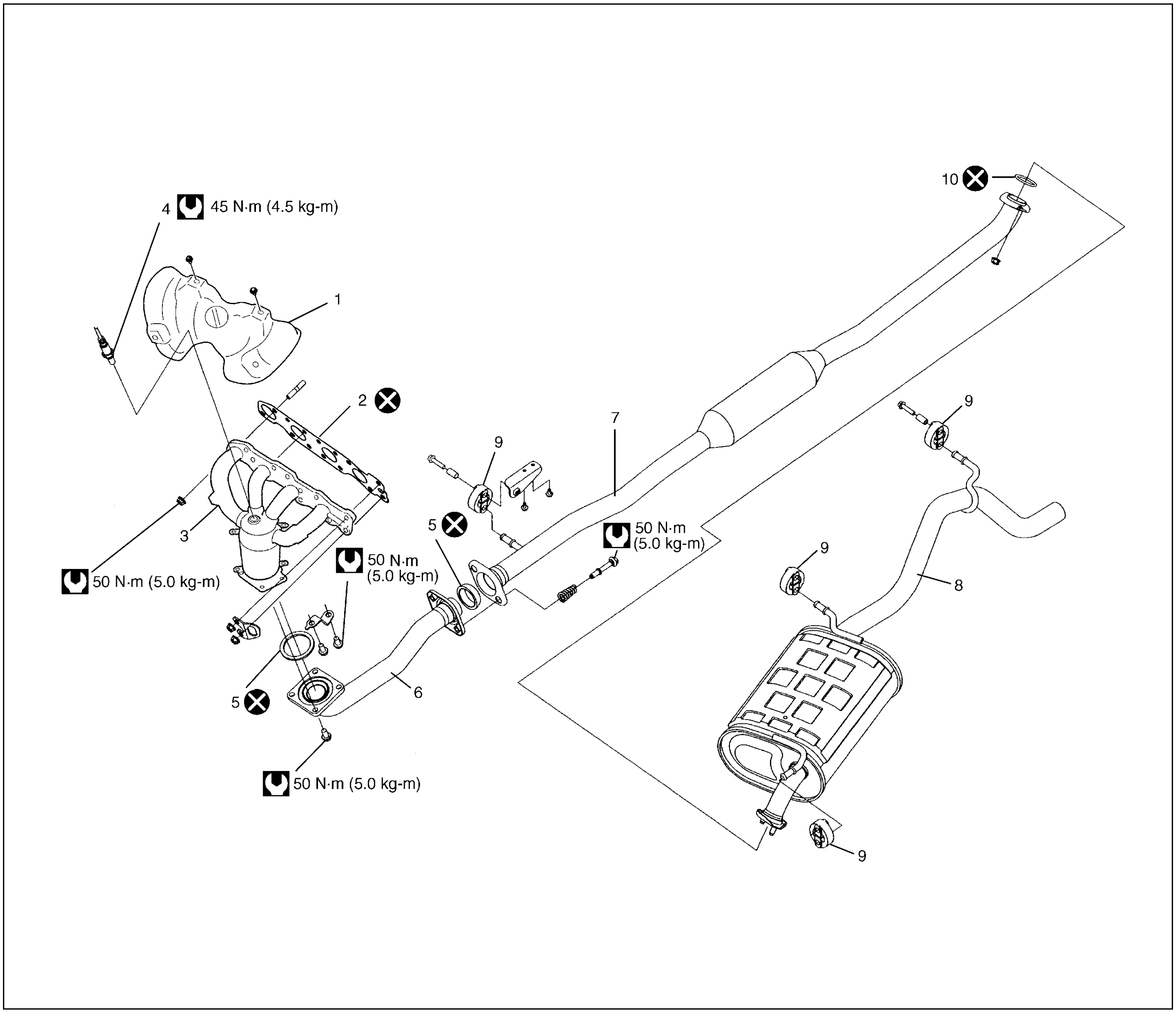


- Check rubber mountings for damage, deterioration, and out of position.



- Check exhaust system for leakage, loose connection, dent and damage.
- If bolts or nuts are loosened, tighten them to specified torque.
  Refer to “GENERAL DESCRIPTION”.
- Check nearby body areas damaged, missing, or mispositioned part, open seam, hole connection or any other defect which could permit exhaust fumes to seep into vehicle.
- Make sure that exhaust system components have enough clearance from underbody to avoid overheating and possible damage to passenger compartment carpet.
- Any defect should be fixed at once.

ON-VEHICLE SERVICE



1. Exhaust manifold cover	5. Seal ring	9. Muffler mounting
2. Gasket	6. Exhaust No.1 pipe	10. Gasket
3. Exhaust manifold	7. Exhaust No.2 pipe	Tightening torque
4. Oxygen sensor	8. Muffler	Do not reuse.

WARNING:

To avoid the danger of being burned, do not touch the exhaust system when the system is hot. Any service on the exhaust system should be performed when the system is cool.

EXHAUST MANIFOLD

REMOVAL AND INSTALLATION

Refer to Section 6A1 for removal and installation procedures of exhaust manifold.

INSPECTION

Check gasket and seal for deterioration or damage.
Replace them as necessary.

EXHAUST PIPE

REMOVAL AND INSTALLATION

For replacement of exhaust pipe, be sure to hoist vehicle and observe WARNING under “MAINTENANCE” and the following.

CAUTION:

Exhaust pipe have three way catalytic converter in it, it should not be exposed to any impulse.
Be careful not to drop it or hit it against something.

- Tighten bolts and nuts to specified torque when reassembling. Refer to “GENERAL DESCRIPTION” for location of bolts and nuts.
- After installation, start engine and check each joint of exhaust system for leakage.