



# Terracan

## Shop Manual

### FOREWORD

This shop manual is intended for use by service technicians of authorized Hyundai dealers to help them provide efficient and correct service and maintenance on Hyundai vehicle.

To ensure customer satisfaction with Hyundai products, proper service and maintenance by Hyundai technicians is essential. Consequently, it is important that service personnel fully understand the contents of this manual, which should be kept in a handy place for quick and easy reference.

All the contents of this manual, including photographs, drawings, and specifications, are the latest available at the time of printing. As modifications affecting service occur, dealers will be provided technical service bulletins or supplementary volumes. This manual should be kept carefully up-to date upon receipt of the new information.

Hyundai Motor Company reserves the right to make changes in design or to make additions to or improvements in its products without imposing any obligations upon itself to install them on its products previously manufactured.

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JAN. 2001, Printed in Korea

**CAUTION :**

**Severe engine and transaxle damage may result from the use of poor quality fuels and lubricants that do not meet Hyundai specifications. You must always use high quality fuels and lubricants that meet the specifications listed in the Recommended Lubricants and Capacities Chart on Page GI-12 in the General Information Section of the Shop Manual.**

**NOTE :** Regarding the groups in small characters, refer to Electrical Troubleshooting Manual. (Pub. No : AH1E-EG11A)

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# Transaxle/ Transmission

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## GENERAL

SPECIFICATION EKMB0010

Engine		2.5D TCI	2.9D TCI	3.5 V6	
Manual transmission		V5MT1	M5SR1		
Automatic transmission		03 - II	30 - 40 LEI		
4WD Drive type		PART & FULL TIME 4WD		FULL TIME 4WD	
M/T	CLUTCH	COVER	DIAPHRAM SPRING		
		DISC	Dry single plate		
	CHANGE CONTROL TYPE		FLOOR DIRECT TYPE		
	TRANSMISSION TYPE		Forward 5th, Reverse 1st, Constant Synchromesh		
	Gear ratio	1st	3.918	3.915	
		2nd	2.261	2.126	
		3rd	1.395	1.338	
		4th	1.000	1.000	
		5th	0.829	0.801	
		Reverse	3.925	4.270	
Oil	Gear ratio	API GL-4, SAE 75W-90	API GL-4, SAE 75W-90		
	Capacity (ℓ)	2.5 ℓ	3.2 ℓ		
A/T	Gear ratio	1st	2.826	2.804	
		2nd	1.493	1.531	
		3rd	1.000	1.000	
		4th	0.730	0.705	
		Reverse	2.703	2.393	
	Oil	Gear ratio	ATF DEXRON II	ATF DEXRON II	
Capacity (ℓ)		8.2	10.44	10.46	
Transfer case	Gear ratio	HIGH	1.000		
		LOW	2.480		
	Oil	Gear ratio	ATF DEXRON III		
		Capacity (ℓ)	1.42		

**TIGHTENING TORQUE (M/T)** EMMB0020

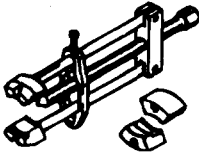

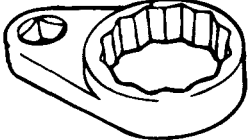




Model	Item	N-m	Kg-cm	lb-ft
V5MT1	Engine to transmission (10 X 80 Bolt)	43 - 55	430 - 550	31 - 40
	Engine to transmission (10 X 45 Bolt)	43 - 55	430 - 550	31 - 40
	Transmission to back plate (8 X 30 Bolt)	20 - 27	200 - 270	14 - 20
	Bell housing cover	30 - 42	300 - 420	22 - 30
	Clutch release cylinder	30 - 42	300 - 420	22 - 30
	Transmission control housing assembly	17 - 26	170 - 260	12 - 19
	Transmission control lever assembly	15 - 22	150 - 220	11 - 15
	Filler plug	55 - 85	550 - 850	40 - 62
	Drain plug	55 - 85	550 - 850	40 - 62
	Main shaft lock nut	250 - 340	2500 - 3400	185 - 250
Lock arm pivot	58	580	42	
M5SR1	Engine to transmission (12 X 40)	65 - 85	650 - 850	48 - 62
	Engine to transmission (12 X 55)	80 - 100	800 - 1000	59 - 74
	Poppet spring seal bolt	30 - 42	300 - 420	22 - 30
	Front bearing retainer	20 - 25	200 - 250	14 - 18
	Back-up lamp switch	30 - 35	300 - 350	22 - 25
	Main shaft lock nut	250 - 270	2500 - 2700	185 - 200
	Count shaft lock nut	250 - 270	2500 - 2700	185 - 200
	Clutch release cylinder	30 - 42	300 - 420	22 - 30


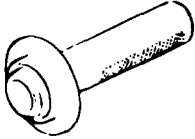
**TIGHTENING TORQUE (A/T)** EKMB0020

Item	N-m	Kg-cm	lb-ft
Transmission housing to case (10mm)	35	350	25
Transmission housing to case (12mm)	58	580	42
Extension housing to T/M case	37	370	27
O/D case to T/M case	26	260	19
Oil pump to T/M case	22	220	16
Oil pump body to stator shaft	10	100	7
Valve body	10	100	7
Oil strainer	10	100	7
Oil pan	7.5	75	5
Speed sensor	7.5	75	5
Speedometer driven gear lock plate	16	160	11
Union	30	300	22
Transaxle range switch bolt	13	130	9
Transaxle range switch nut	7	70	5
Control shaft lever	16	160	11
Shift knob screw	2	20	1
Shift lever bracket	14 - 20	140 - 200	10 - 14

## SPECIAL TOOL (M/T) - V5MT1

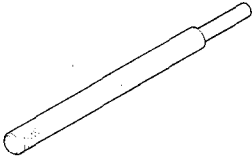
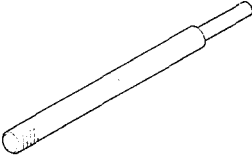



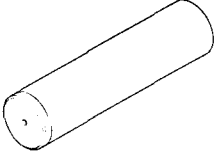
EMMB0030

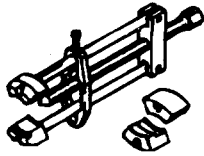
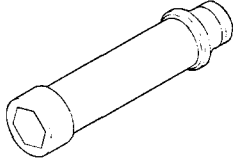
Tool (P/NO & P/Name)	Illustration	Use
HSG 2001 (09432-11000) Bearing puller	 <p style="text-align: right;">D3211000</p>	Removal of bearing Removal of synchronizer hub
HSG2006 Lock pin installer	 <p style="text-align: right;">HSG2006</p>	Installation of spring pin
HSG2008 Lock nut wrench	 <p style="text-align: right;">HSG2008</p>	Removal and installation of main shaft lock nut
HSG2002 (09432-11100) Bearing puller adapter	 <p style="text-align: right;">D3211100</p>	Use with HSG2001
HSG2009 Installer cap	 <p style="text-align: right;">HSG2009</p>	Use with HSG2010, 09430-M2020, 09430-M2050
HSG2010 Installer	 <p style="text-align: right;">HSG2010</p>	Use with 09430-M2020, 09430-M2050
09430-M2020 Installer adapter	 <p style="text-align: right;">D30M2020</p>	Installation of counter shaft rear bearing and drive pinion

Tool (P/NO & P/Name)	Illustration	Use
09430-M2050 Installer adapter	 <small>D30M2050</small>	Installation of main shaft bearing
09431 - H1000 Oil seal installer	 <small>HSG2013</small>	Inserting of clutch housing oil seal

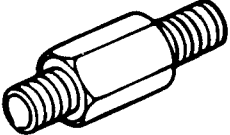

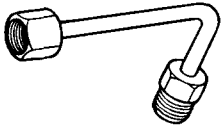

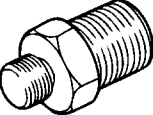
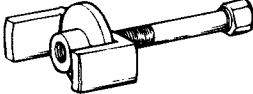
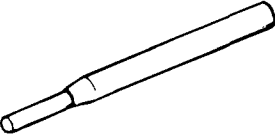
**SPECIALTOOL (M/T) - M5SR1**

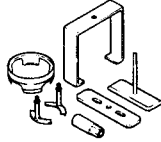
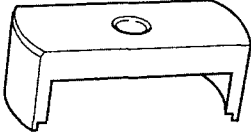
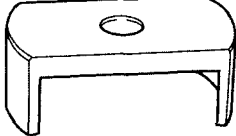
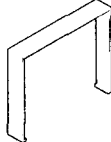
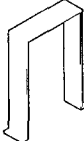
EMMA0030

Tool (P/NO & P/Name)	Illustration	Use
09414-H1000 Lock pin remover	 D14H1000	Removal of shift fork and inter lock body pin
09414-H1100 Lock pin installer	 D14H1100	Installation of shift fork and inter lock body pin
09455-21200 Counter shaft bearing installer (Front)	 Y45-007G	Installation of counter shaft bearing (Front)
09455-H1000 Counter shaft bearing installer (Rear)	 Y45-007G	Installation of counter shaft bearing (Rear)
09432-33800 Counter shaft bearing installer	 A7MT006D	Installation of counter shaft center bearing sleeve Installation of main shaft bearing sleeve
09432-H1000 Main shaft bearing installer	 D32H1000	Installation of main shaft bearing

Tool (P/NO & P/Name)	Illustration	Use
09430-M2020 Bearing puller	 <p style="text-align: right; margin-right: 20px;">D3211000</p>	Removal of bearing
09432-H1100 Lock nut wrench	 <p style="text-align: right; margin-right: 20px;">D32H1100</p>	Removal of main shaft lock nut

SPECIAL TOOLS (A/T) EKMB0030

Tool (Number and name)	Illustration	Application
09452-21000 Oil pressure gauge adapter	 <p style="text-align: right; font-size: small;">D5221000</p>	Measurement of the oil pressure (use with 09452-21500, 09452-21600, 09452-32300)
09452-21500 Oil pressure gauge	 <p style="text-align: right; font-size: small;">EKAA006C</p>	Measurement of the oil pressure (use with 09452-21000, 09452-21600, 09452-32300)
09452-21600 Oil pressure gauge adapter	 <p style="text-align: right; font-size: small;">D5221600</p>	Measurement of the oil pressure (use with 09452-21000, 09452-21500, 09452-32300)
09452-32100 Oil seal installer	 <p style="text-align: right; font-size: small;">D523210A</p>	Installation of the oil pump oil seal
09452-32300 Oil pressure gauge adapter	 <p style="text-align: right; font-size: small;">D5232300</p>	Measurement of the oil pressure (use with 09452-21000, 09452-21500, 09452-21600)
09453-32100 Piston spring compressor	 <p style="text-align: right; font-size: small;">D5332100</p>	Removal of the clutch piston
09414-11000 Lock pin extractor	 <p style="text-align: right; font-size: small;">D1411000</p>	Removal of the pin in the lock pawl rod

Tool (Number and name)	Illustration	Application
09455-38000 Spring compressor	 <p style="text-align: right; font-size: small;">D5538000</p>	Removal of the overdrive return spring Removal of the forward clutch spring Removal of the direct clutch spring
09454-38000 Second brake spring compressor	 <p style="text-align: right; font-size: small;">D5438000</p>	Removal of second brake spring
09454-38100 First & reverse brake spring compressor	 <p style="text-align: right; font-size: small;">D5438100</p>	Removal of first & reverse brake spring
09454-38200 Reverse brake piston remover	 <p style="text-align: right; font-size: small;">D5438200</p>	Removal of reverse brake piston
09454-38300 Reaction sleeve remover	 <p style="text-align: right; font-size: small;">D5438300</p>	Removal of reaction sleeve

**TROUBLESHOOTING (M/T)** EMMB0040

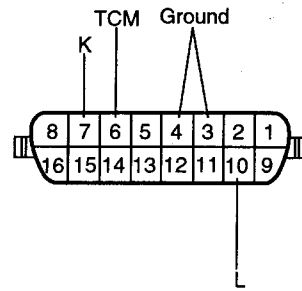
Symptom	Probable cause	Remedy
Gear will not be shifted or is hard to be shifted	Bent shift lever Faulty control cable Excessively worn return spring Clutch dose not release correctly	Repair or replace Replace parts Replace Adjust or replace
Jumps out of gear or has too much play	Shift rod malfunction Worn bush Bent lever Clutch dose not release correctly	Replace Replace Replace Replace
Lever is hard to be operated	Insufficient grease of shift lever assembly Insufficient grease of control cable	Replace Replace
Emits abnormal sound when operating	Worn bush	Replace



# AUTOMATIC TRANSAXLE SYSTEM

## SELF-DIAGNOSIS DESCRIPTION EKMB0040

1. When malfunction is detected in the electronic control system, the concerned parts and wires should be inspected individually. It takes a lot of time resulting in automotive engineers and drivers to inconvenience. To cope with it, computer detects the malfunctions and generates them as code so that engineer can troubleshoot easily.
2. Not all malfunctions of the vehicle are detected by Self-diagnosis. When the malfunction is completely presented like faulty parts of sensor or short/open wiring, detection will be easy. But when intermittent abnormality or short wiring occurs, self-diagnosis can't detect the errors even though the vehicle has problem.
3. The above 2 is caused by timing difference between outputs of input signal for controlling by computer and self-diagnosis. So while using self-diagnosis, be careful not to make a mistake.

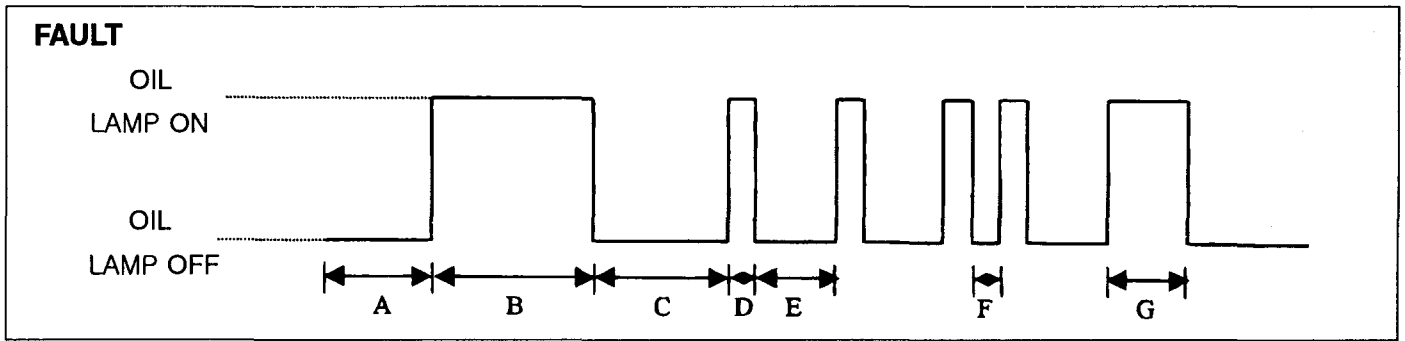


EKMB004A

## SELF-DIAGNOSIS PROCEDURE

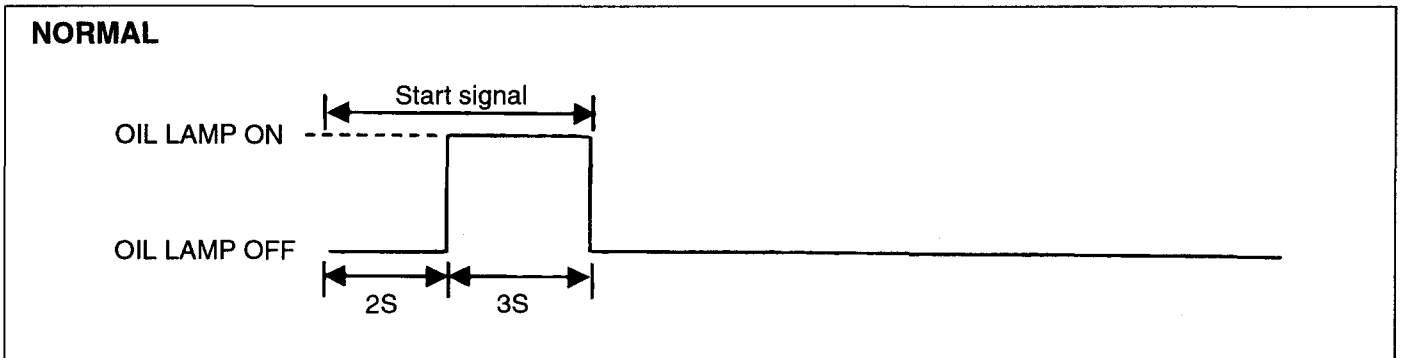
### SELF-DIAGNOSIS USING HI-SCAN & OBD

1. Using Hi-scan
  - 1) Connect a Hi-scan to the self-diagnosis connector on the interior [in-car] fuse box (the lower inside of crash pad in driver's side).
  - 2) Check and select the model of vehicle and system, when malfunction occurs, error code is output.  
(Self-diagnosis procedure is the same as passenger car)
  - 3) Refer to self-diagnosis chart for self-diagnosis codes.
2. Using OBD(ON BOARD DIAGNOSIS)  
OBD has a self-diagnosis function using terminal "L" of TCU and OIL LAMP without a Hi-scan.
  - a. Turn on the ignition key.
  - b. Ground the terminal "L" of diagnosis connector on the upper side of interior fuse box to itself for min.2 seconds using a wire.
  - c. After 2 seconds, OIL LAMP on a cluster is illuminated for 3 seconds (This is starting signal. If an abnormality is not found, there is no more signal).
  - d. Starting signal is ceased and 3 seconds after. If an abnormality is found, should read 1 or 0 which is illuminated for 0.5 or 1.5 seconds.



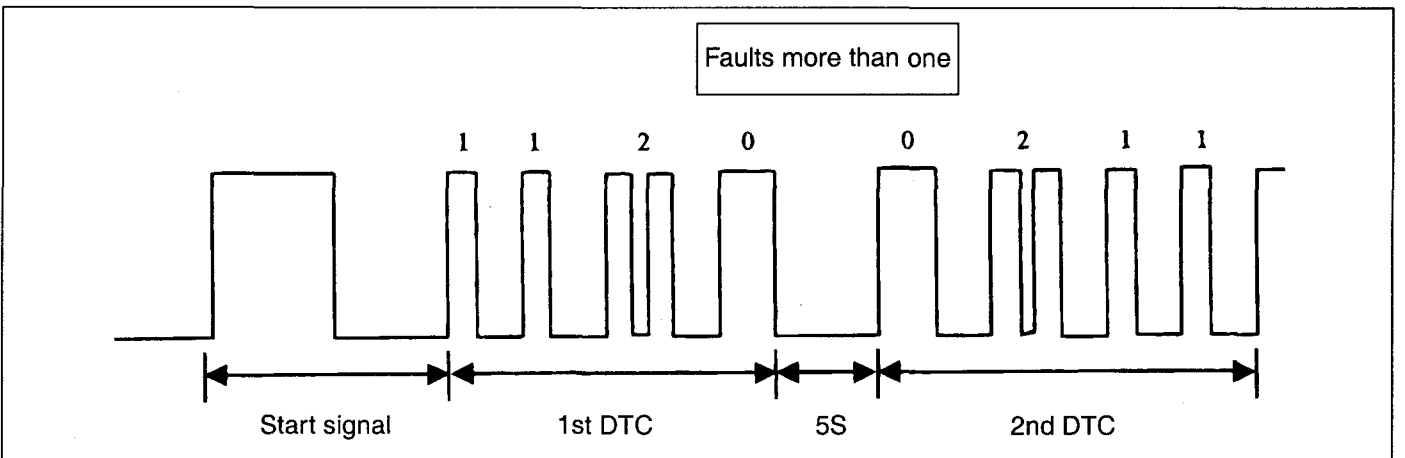
EKMB004B

Symbol	Description	Data
A	Time from start of "L" low to start of warning lamp on	2.0 sec
B	Warning lamp on time prior to flashing of DTC	3.0 sec
C	Warning lamp off time prior to flashing of DTC	3.0 sec
D	Warning lamp on time or one digit except for "O"	0.5 sec
E	Time between digit and digit in one DTC	1.5 sec
F	Warning lamp off time in one digit display	0.5 sec
G	Warning lamp on time of "O" display	1.5 sec



EKMB004C

- OIL LAMP plays an role in oil lamp warning light (lighting when oil temperature is high) and DTC warning (jump flickering).
- Be careful that if an error list is found one or more, signal will be detected continuously.
- In addition, the first error list is with starting signal, but from the next, starting signal is not indicated, only error list is output 5 seconds after from the first error code.
- When terminal "L" is grounded, error signal must be output continuously.



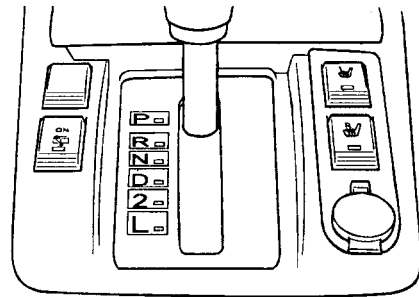
EKMB004D

## 3. Diagnostic Troubleshooting code chart

NO	DTC	Description	2.5TCI	2.9TCI	3.5G
1	P0712	Fluid temperature sensor - Short	-	B	-
2	P0713	Fluid temperature sensor - Open	-	B	-
3	P0705	Transaxle range slw - Malfunction	C	B	C
4	P0710	Fluid temperature sensor circuit - Malfunction	C	-	C
5	P0715	Input speed sensor (PG-A) - Malfunction	B	B	B
6	P0722	output speed sensor (PG-B) - Malfunction	B	-	B
7	P0720	output speed sensor signal - Abnormal	-	B	-
8	P1701	TPS - Malfunction	-	B	-
9	P0743	TCCSV - Open/Short	C	B	C
10	P0750	SCSV A(LR SOL) - Malfunction	-	B	-
11	P0753	SCSV A(LR SOL) - Open/Short	A	-	A
12	P0755	SCSV B(LR SOL) - Malfunction	-	B	-
13	P0758	SCSV B(LR SOL) - Open/Short	A	-	A
14	P1121	Throttle position input - Abnormal	B	-	B
15	P1780	Torque reduction request signal - Abnormal	B	-	B
16	P0748	PCSV circuit - Malfunction	A	B	A

 **CAUTION**

- **Type A** : Oil - lamp blinking on the 1st driving cycle with a fail store DTC
- **Type B** : Oil - lamp blinking on the 2nd consecutive driving cycle with a fail store DTC
- **Type C** : Oil - lamp blinking store DTC on 2nd consecutive driving cycle with a fail



**AUTOMATIC TRANSMISSION FLUID** EKMB0050

KKMA005A

## 1. Inspection

- 1) Apply the parking brake and position wheel chocks to prevent the car from rolling forward.

 **NOTE**

Place the car on a flat, level surface.

- 2) Run the engine to heat the automatic transmission fluid to 70 ~ 80°C (158 ~ 176°C)  
While the engine is idling, shift the selector lever from "P" to "L" and back again.
- 3) Let the engine idle.

- 5) Check that the ATF level is in the hot range. Add ATF to specification if necessary.

## 2. Condition

- 1) Check the ATF for discoloration.
- 2) Check the ATF for any unusual smell.

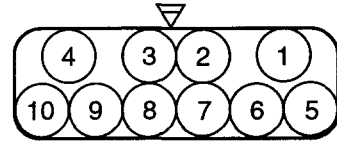
 **NOTE**

Determine whether or not the automatic transmission should be disassembled, by carefully observing the condition of fluid.  
If the fluid is muddy and varnished, it indicates burned drive plates.

**TRANSAXLE RANGE SWITCH** EKMB0060

1. Operating inspection

- 1) Check that the starter turns with the ignition switch at START position and the selector in the "P" and "N" range only.
- 2) Check that the back-up (reverse) lights illuminate when shifted to the "R" range with the ignition switch in the ON position.
- 3) Check the transaxle range switch if it is not working properly.



KKMB006B

2. Adjustment

- 1) Shift the selector lever to the "N" range.
- 2) Loosen the transaxle range switch mounting bolts.
- 3) Disconnect the transaxle range switch connector.
- 4) Check the continuity of the terminals using ohmmeter.
- 5) Adjust the switch to the point where there is continuity between the terminals.

**(GASOLINE)**

Position	Connector pin									
	4	1	2	10	3	9	7	8	6	
P	○—○		○—○							
R			○—○		○—○					
N	○—○		○—○		○—○					
D			○—○		○—○		○—○			
2			○—○		○—○		○—○		○—○	
L			○—○		○—○		○—○		○—○	

○—○ : Continuity

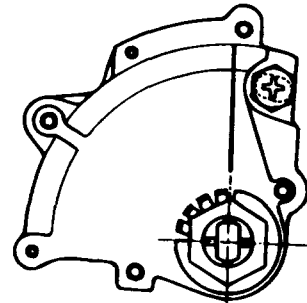
EKMB006A

**(DIESEL)**

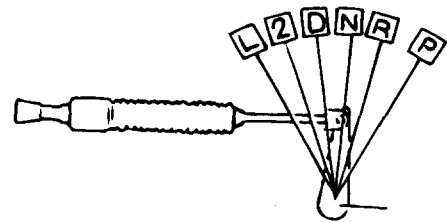
Position	Connector pin									
	4	1	2	5	3	9	7	8	6	
P				○—○		○—○			○—○	
R	○—○			○—○						
N		○—○		○—○		○—○			○—○	
D				○—○		○—○		○—○		
2			○—○		○—○					
L				○—○		○—○			○—○	

○—○ : Continuity

EKMB006B



EKLA003G



EKLA003H

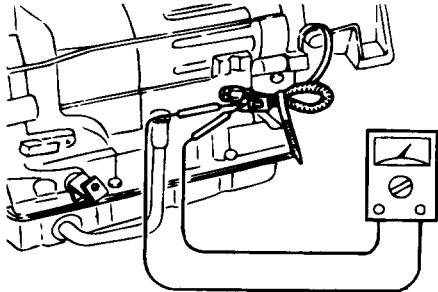
**SPEED SENSOR (OUTPUT)** EKMB0090

1. Disconnect the speed sensor connector.
2. Measure the resistance between pin 1 and pin 2.

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Resistance : 430 ± 40Ω

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EKLA004B

**LINE PRESSURE** EKMB0140

1. Connect a tachometer to the engine and SST to line pressure inspection port of transmission case.
2. Shift the selector lever to "D" range.

**EVALUATION OF LINE PRESSURE TEST**

Condition		Possible cause
Below standard	In "D" and "R" ranges	Defective or stuck the throttle valve Defective or stuck the regulator valve Defective the oil pump OD clutch slipping
	In "D" range only	Fluid leakage in the "D" range line pressure hydraulic circuit Forward clutch slipping OD clutch slipping
	In "R" range only	Fluid leakage in the "R" range line pressure hydraulic circuit Direct clutch slipping Defective low & reverse brake
Excessive line pressure at idle		Defective or stuck the throttle valve Defective or stuck the regulator valve

3. Read the oil pressure at engine idle speed.
4. Depress the brake pedal firmly with the left and gradually depress the accelerator pedal with the right foot.
5. Read the oil pressure as soon as the engine speed becomes constant, then release the accelerator pedal.

**NOTE**

*Steps 4 to 5 must be accomplished within 5 seconds.*

6. Shift the selector lever to "N" range and run the engine at idle speed for at least one minute.
7. Read the line pressures at engine idle and stall speed for "R" range in the procedure described above.

Shift position	Engine speed	Pressure (kg/cm <sup>2</sup> )
D	Idle	3.5 - 4.2
	Stall	12.7 - 14.5
R	Idle	5.1 - 5.2
	Stall	16.3 - 19.6

**STALL TEST** EKMB0120

The object of this test is to check the overall performance of the transmission and engine by measuring the stall speeds in the D and R ranges.

 **CAUTION**

***During this test, make sure that no one stands in front of or behind vehicle.***

1. Check transaxle fluid level. Fluid should be at normal operating temperature [70 - 80°C(158 - 176°C)]. Engine coolant should also be at normal operating temperature [80 - 90°C (176 - 194°C)].
2. Apply chocks to both rear wheels.
3. Attach an engine tachometer.
4. Apply the parking and service brakes fully.

5. Start the engine.
6. With the selector lever in the "D" position, depress the accelerator pedal fully to read maximum engine rpm. Do not hold the throttle wide open any longer than is necessary to obtain maximum engine rpm reading, and never longer than 5 seconds at a time. If more than one stall test is required, operate the engine at approximately 1,000 rpm in neutral for minutes to cool the transaxle fluid between tests.
7. Place the selector lever in the "R" position and perform the stall test by the same procedure as previously described.

Engine type	Stall rpm
2.5 TCI	2350
2.9 TCI	2630
3.5 Gas.	2520

**EVALUATION OF STALL TEST**

Condition		Possible cause
Above standard	In "D" and "R" ranges	Line pressure too low OD clutch slipping OD one-way clutch not operating properly
	In "D" range only	Forward clutch slipping Rear one-way clutch not operating properly Line pressure too low OD clutch slipping OD one-way clutch not operating properly
	In "R" range only	Direct clutch slipping Low & reverse clutch slipping Line pressure too low OD clutch slipping OD one-way clutch not operating properly
Within standard		All shift control elements within transmission functioning normally
Below standard		Engine out of tune Slipping of one way clutch within torque converter

**TIME LAG TEST** EKMB0130

 **NOTE**

*If selector lever is shifted while the engine is idling, there will be a certain time lapse or time lag before shift shock can be felt. This is used for checking condition of the OD clutch, forward clutch, direct clutch and low & reverse brake.*

**PRECAUTION**

Engage the parking brake and apply wheel chocks to the front and rear wheels.

1. Shift the selector lever from "N" to "D" range.
2. Using stop watch, measure the time it takes from the moment the lever is shifted until shift shock is felt.
3. Measure the time lag for "N" to "R" : in same manner.

**NOTE**

Make thee measurements and take the average value. Be sure to permit at least one minute interval between measurements.

**STANDARD TIME LAG :**

Shift range position	Time lag
N→D	1.2 second or less
N→R	1.5 second or less

**EVALUATION OF TIME LAG TEST**

Shift range position	Time lag
Longer in "N" to "D"	Line pressure too low Forward clutch worn OD clutch worn
Longer in "N" to "R"	Direct clutch worn Low & reverse bake worn Line pressure too low OD clutch worn

**SOLENOID VALVE** EKMB0100

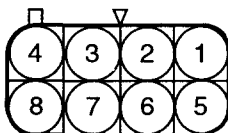
1. Disconnect the solenoid valve connector.
2. Measure the resistance between each terminal and ground.

---

Resistance : 11 ~ 15Ω

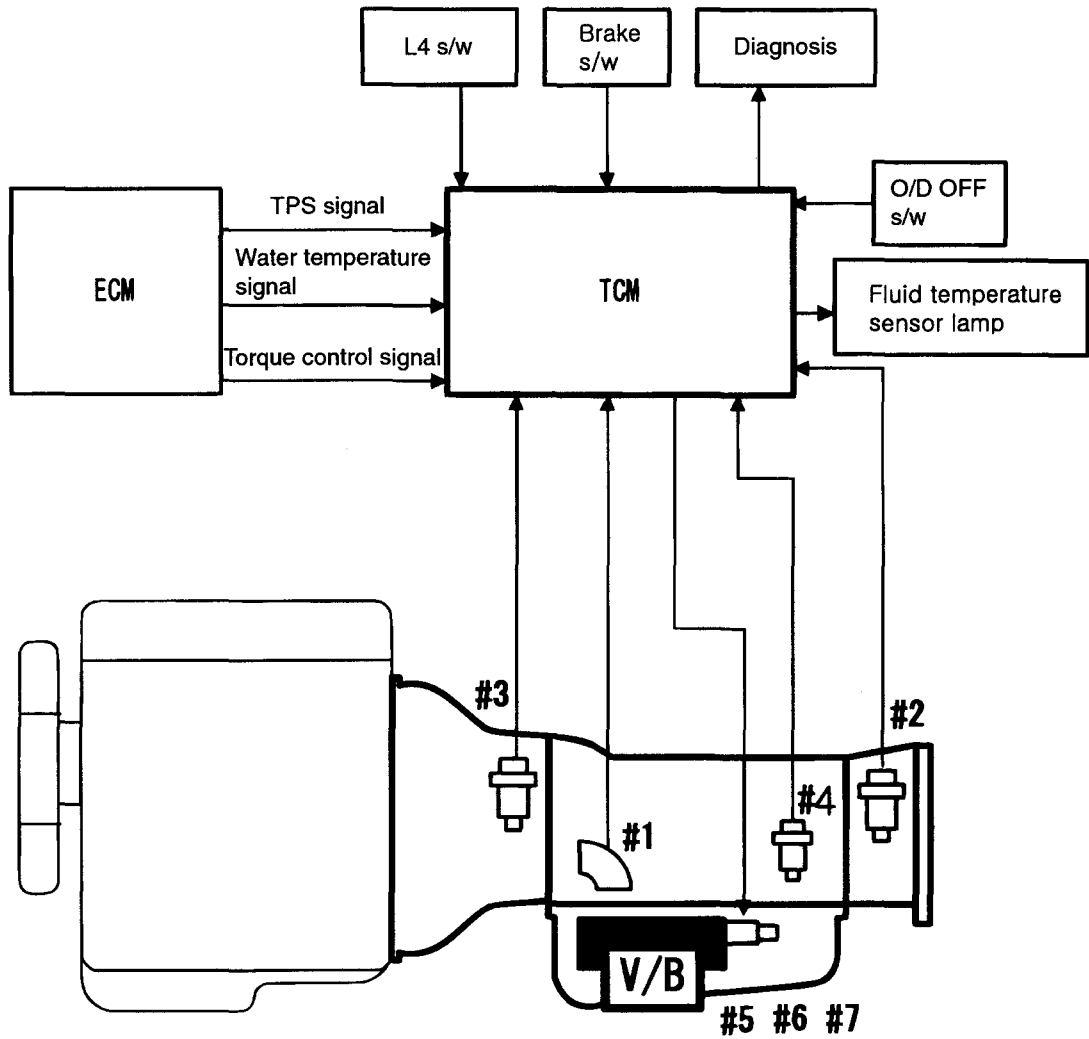
---

3. If not corrected, replace the sloenoid valve.
  - 1) Solenoid valve NO.1
  - 2) Solenoid valve NO.2
  - 3) Line pressure sol.valve
  - 4) Lock-up solenoid valve



AUTOMATIC TRANSAXLE

SYSTEM DIAGRAM EKMB0180



#1 : Transaxle range s/w  
#2 : Output speed sensor  
#3 : Input speed sensor

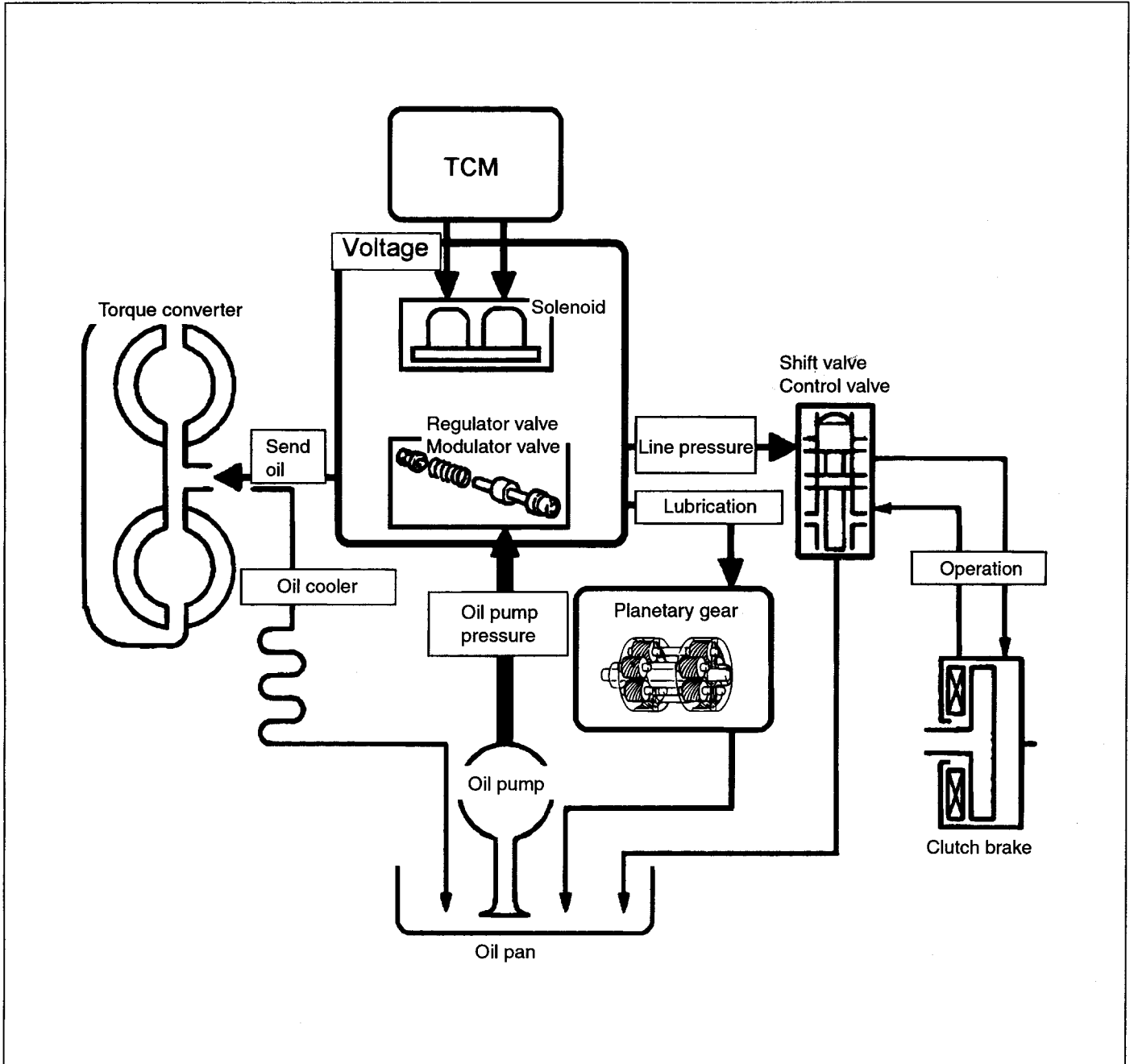
#4 : Fluid temperature sensor  
#5 : Shift solenoid NO.1, NO.2  
#6 : Line-pressure control solenoid  
#7 : Lock-up solenoid



**HYDRAULIC CONTROL SYSTEM** EKMA0180

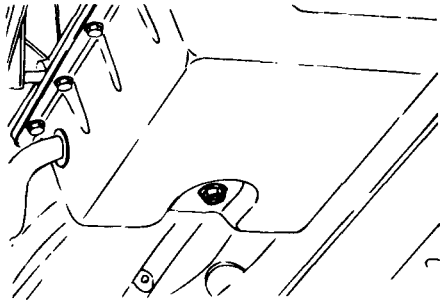
governs the hydraulic pressure acting on the torque converter, planetary gear, clutches and brakes in accordance with the vehicle driving conditions.

Based on the hydraulic created by the oil pump, TCM sends signals to solenoid and hydraulic control system



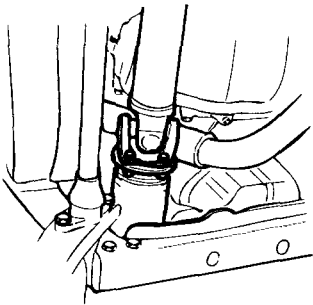
**REMOVAL** EKMB0190

1. Remove the battery (-) terminal.
2. Drain the automatic transmission fluid.

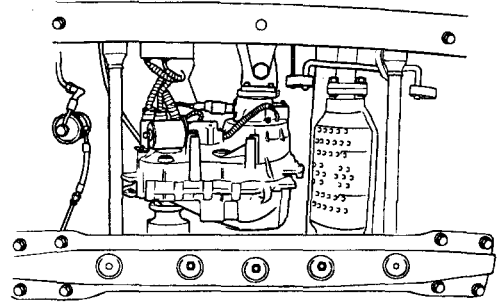


EKLA001B

3. Remove the control cable.
4. Remove the under cover.
5. Remove the front propellar shaft. (4WD)

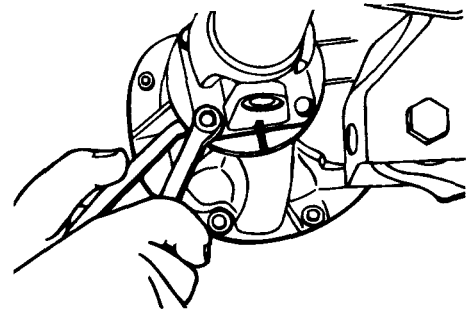


KMMB009H



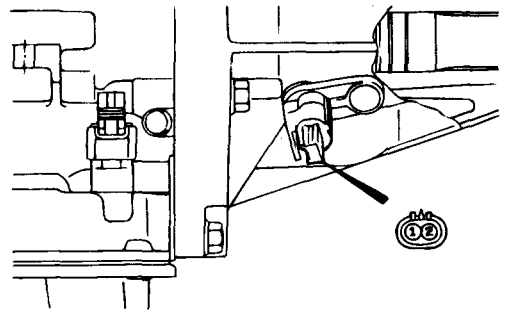
KMMB009K

8. Remove the rear propellar shaft.



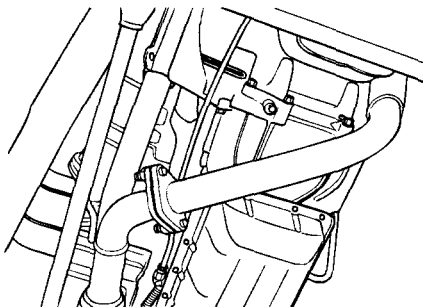
EKLA001E

9. Remove the oil cooler pipe.
10. Remove the speed sensor connector.



KKMB019A

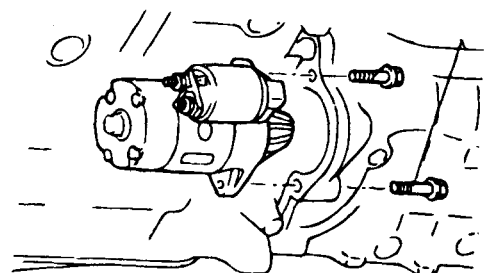
6. Remove the front muffler and the heater protector.



KDMB001D

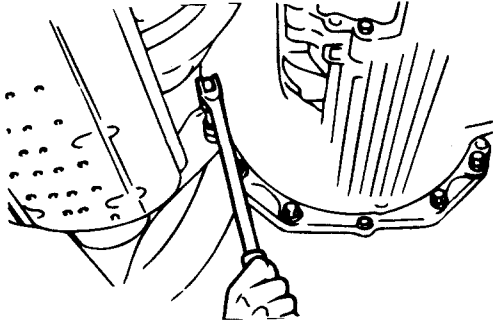
7. Remove the transfer case connector. (4WD)

11. Remove the back-up lamp switch connector.
12. Remove the starter motor.



EKLA001G

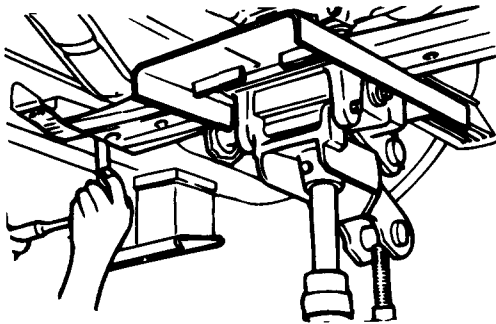
13. Remove the transmission mounting bolt.



EKLA001H

14. Support the transmission on the sack.

15. Remove the transmission assembly.



EKLA001I

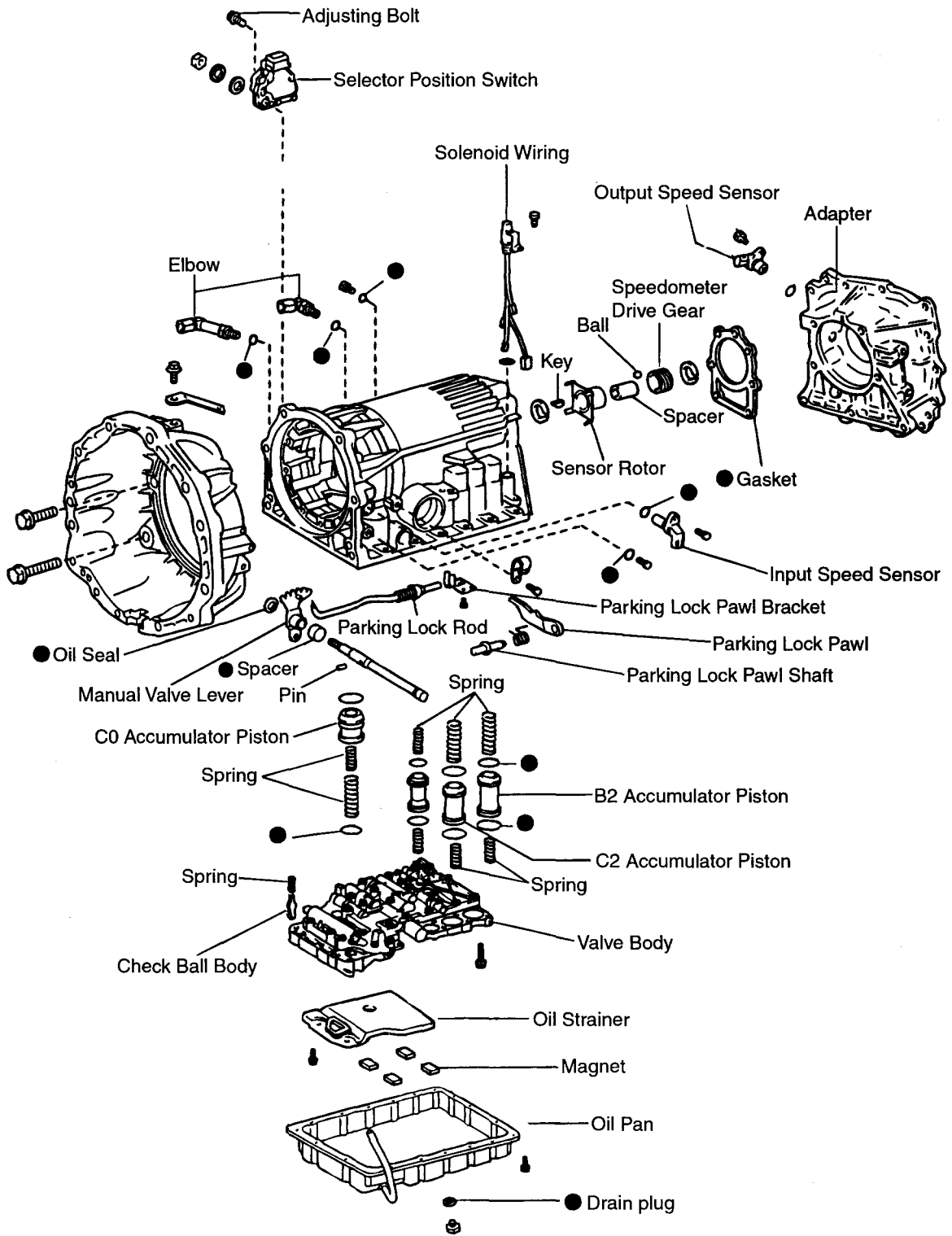
## INSTALLATION EKMB0200

1. Installation is the reverse of the removal.

## AUTOMATIC TRANSMISSION

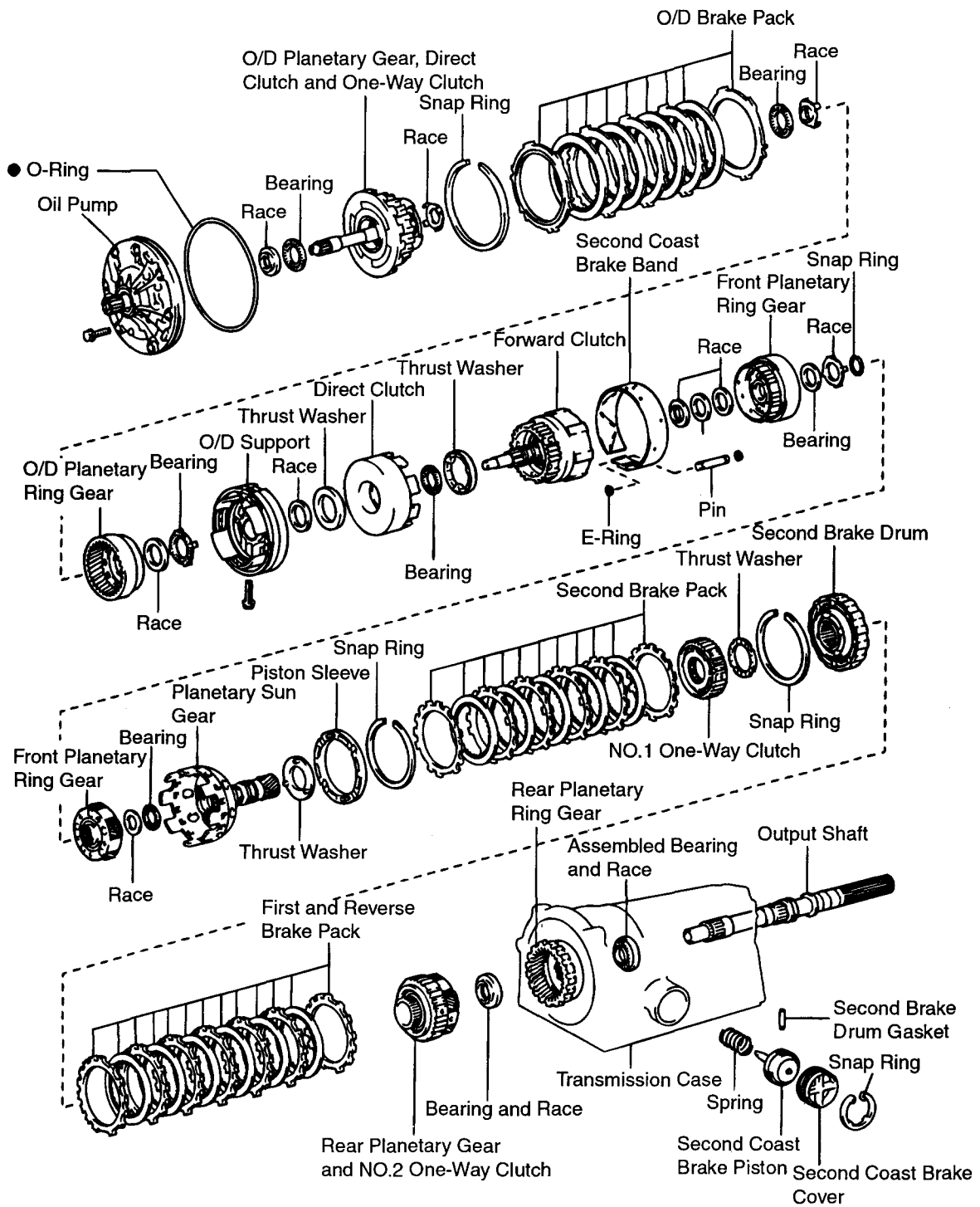
(30-40LE) EKMB0210

### COMPONENTS (1)



● Non-reusable part

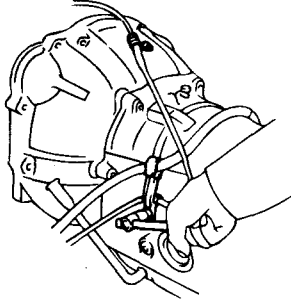
COMPONENTS (2)



● Non-reusable part

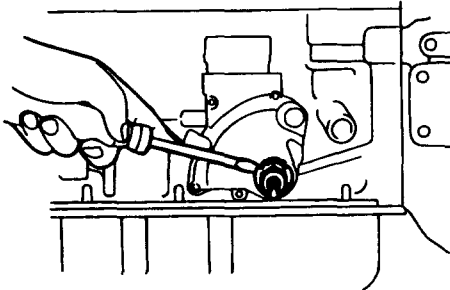
**DISASSEMBLY** EKMB0220

1. Remove the torque converter.
2. Remove the oil filler gauge.
3. Remove the wire harness clamp.



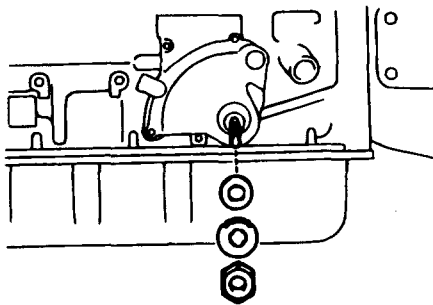
EKLA004A

4. Remove the control shaft lever.



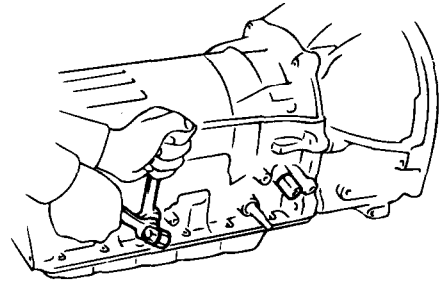
KKMB003A

5. Remove the transaxle range switch.



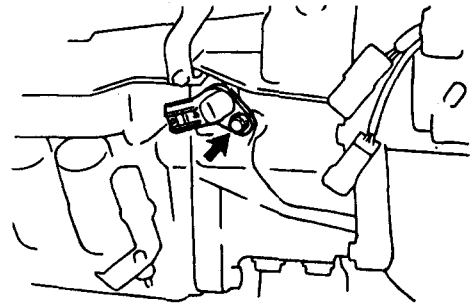
KKMB003B

6. Remove the union.



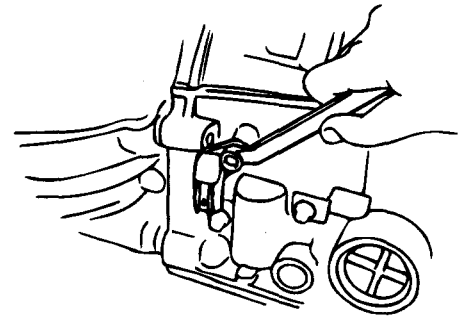
EKLA007A

7. Remove the output speed sensor.



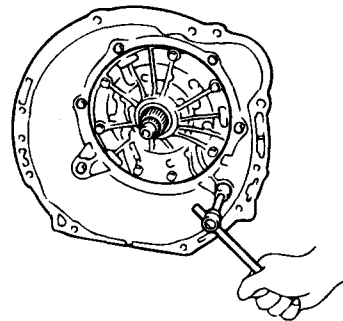
KKMB003C

8. Remove the input speed sensor.



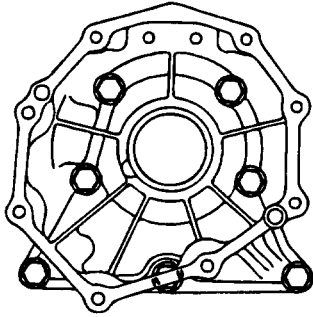
KKMB003D

9. Remove the transmission housing.



EKLA011A

10. Remove the extension housing.

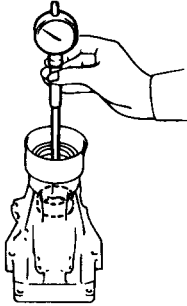


KKMB003E

11. Using a dial indicator, measure the inside diameter of the extension housing bushing.

Max. : 40.09mm (1.5783in.)

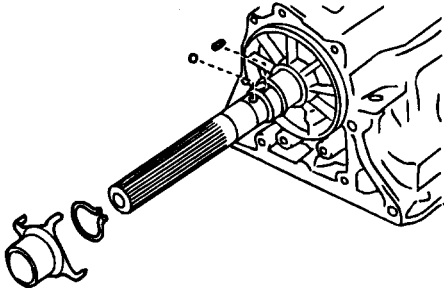
If the inside diameter is greater than maximum, replace the extension housing.



EKLA013A

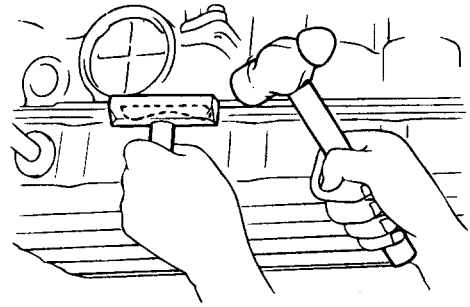
12. Remove the speedometer drive gear.

13. Remove the sensor rotor and key.



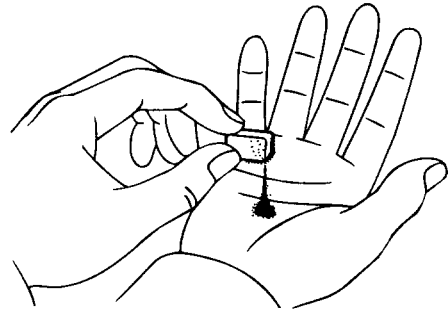
KKMB022B

14. Remove the oil pan.



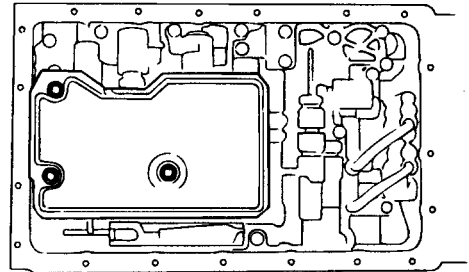
EKLA016A

15. Remove the magnets and use them to collect steel particles.



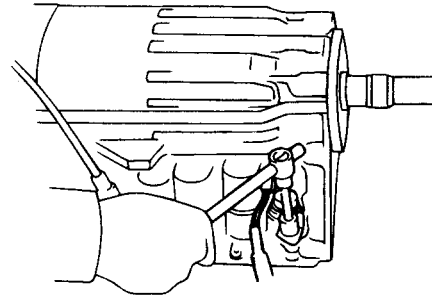
EKLA017A

16. Remove the oil strainer and gasket.



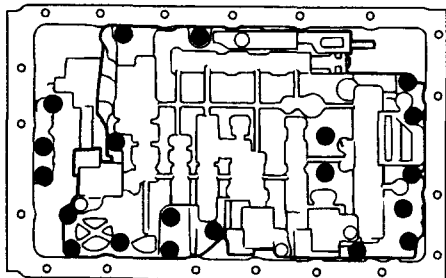
EKLA018A

17. Remove the stopper plate.

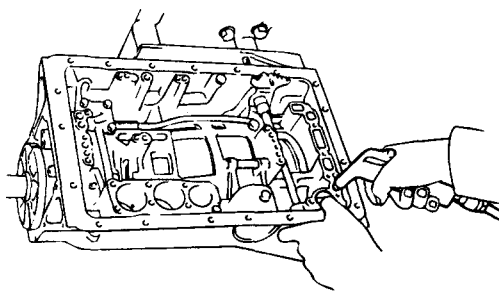


EKLA023A

18. Remove the valve body mounting bolts.

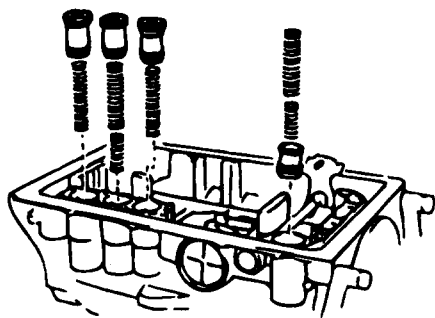


KKMB005C



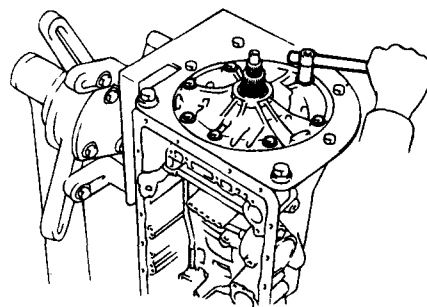
EKLA029A

19. Remove the check ball body, springs(4EA)and pins(2EA).



KKMB005A

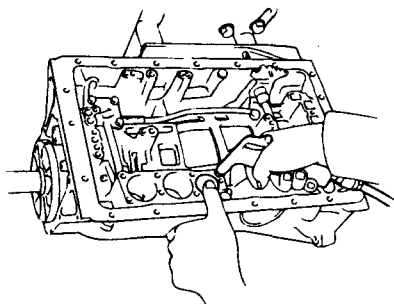
21. Remove the oil pump.



EKLA031A

20. REMOVE ACCUMULATOR SPRINGS AND PISTONS

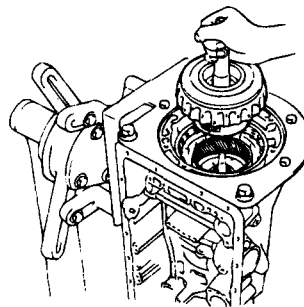
- 1) Applying compressed air to the ATF hole, remove Bo accumulator piston and spring.



EKLA028A

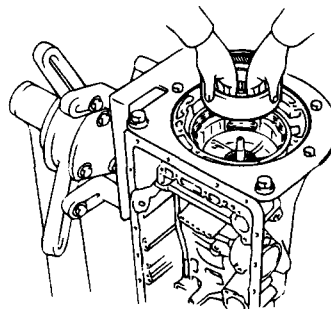
- 2) Applying compressed air to the ATF hole, remove the Co accumulator piston and spring.

22. Remove the overdrive planetary and the overdrive direct clutch.



EKLA034A

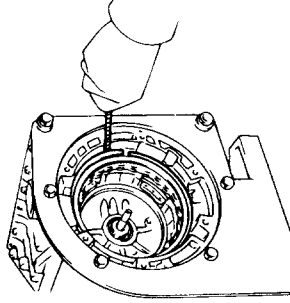
23. Remove the overdrive ring gear.



EKLA037A

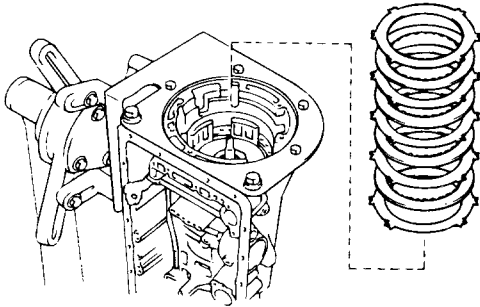


24. Remove the snap ring.



EKLA040A

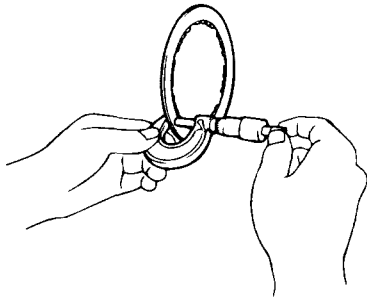
25. Remove the flanges, the plates and the discs.



EKLA041A

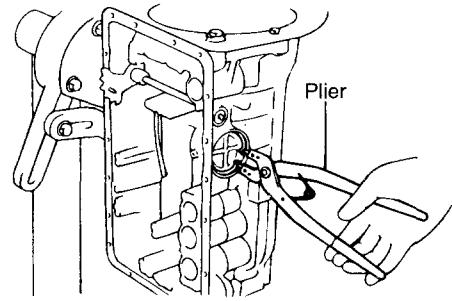
26. Using the micrometer, measure the thickness of the disc.

Minimum thickness: 1.84mm (0.0724in.)



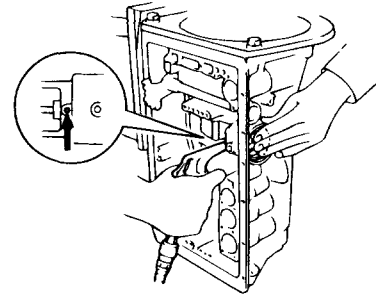
EKLA042A

27. Remove the snap ring.



EKMB022C

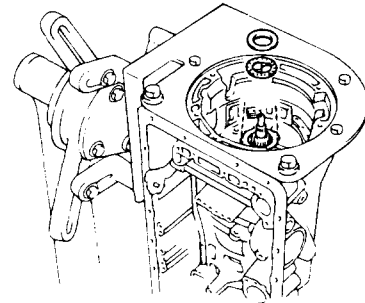
28. Applying compressed air to the ATF hole, remove the second coast brake piston.



EKLA046A

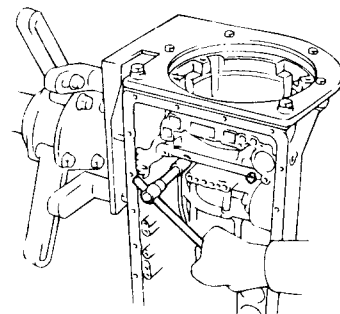
29. REMOVE OVERDRIVE SUPPORT

1) Remove the thrust bearing and race.



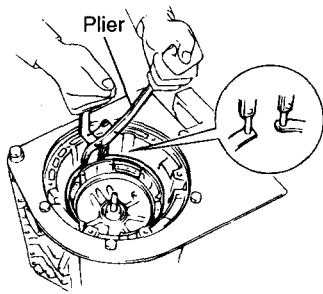
KKMB022A

2) Remove the overdrive support mounting bolts.



EKLA049A

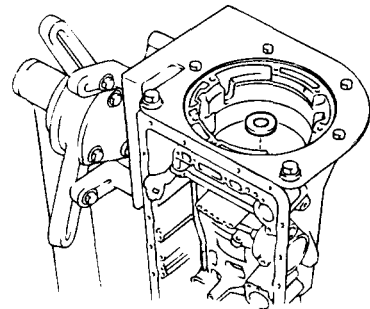
- 3) After removing the snap ring, remove the over-drive support.



EKMB022A

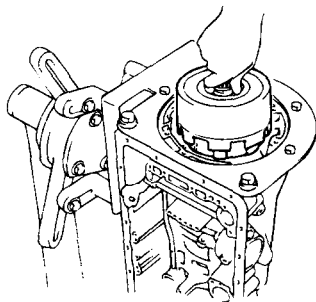
**32. FRONT PLANETARY RING GEAR**

- 1) Remove the race.



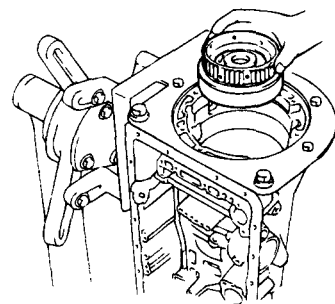
EKLA057A

30. Remove the direct clutch and the forward clutch.



EKLA053A

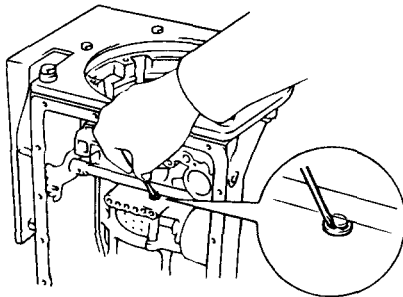
- 2) Remove the front planetary ring gear.



EKLA058A

**31. SECOND COAST BRAKE BAND**

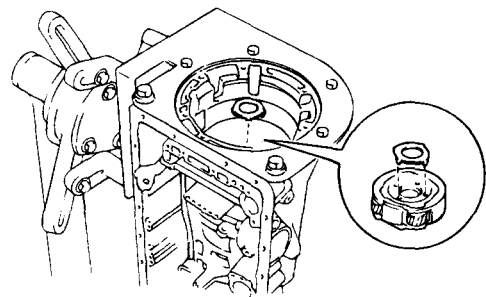
- 1) Remove the E-ring and pin.



EKLA055A

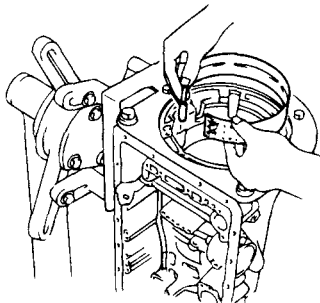
**33. FRONT PLANETARY GEAR**

- 1) Remove the race.



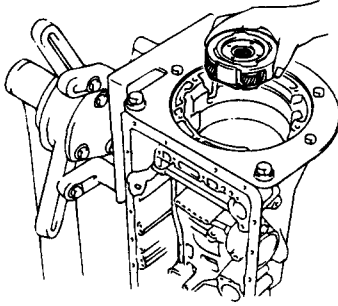
EKLA060A

- 2) Remove the second coast brake band.

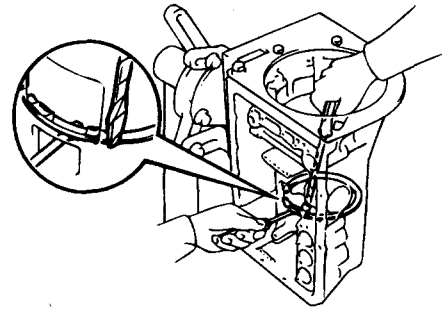


EKLA056A

2) Remove the front planetary gear.



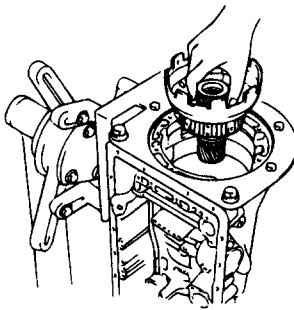
EKLA063A



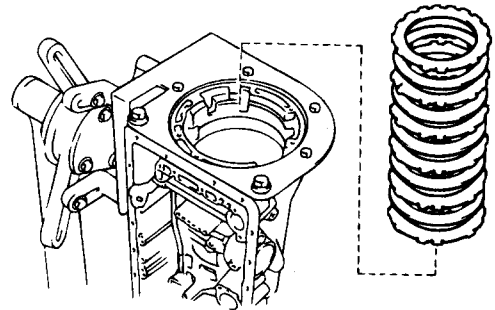
EKLA066A

2) Remove the flange(1), discs(4) and plates(4).

34. Remove the sun gear input drum and the oneway clutch.



EKLA064A

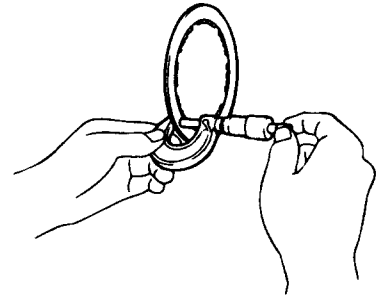


EKLA067A

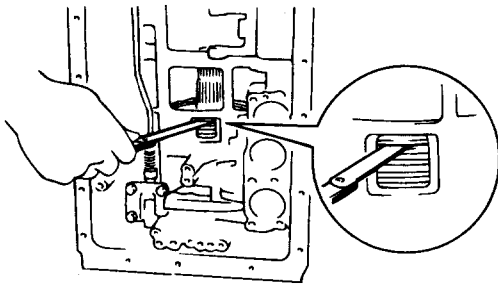
37. Using the micrometer, measure the thickness of disc.

35. Using the thickness gauge, measure the clearance between the second brake snap ring and the flange.

Standard value : 0.62 ~ 1.98 mm



EKLA068A



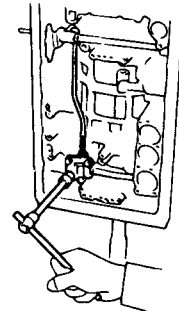
EKLA065A

36. FLANGE, PLATE, DISC

1) Remove the snap ring.

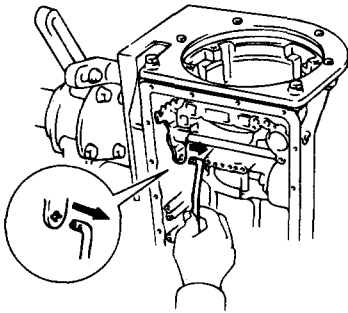
38. PARKING LOCK ROD

1) Remove the parking lock pawl bracket.



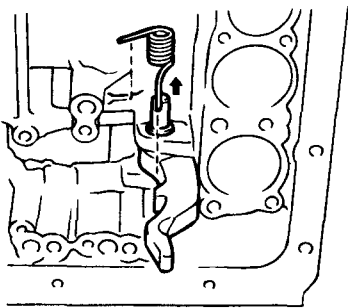
EKLA069A

- 2) Remove the parking lock rod from the manual valve lever.



EKLA070A

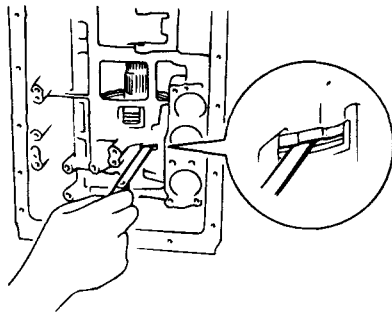
39. Remove the parking lock pawl and shaft.



EKLA071A

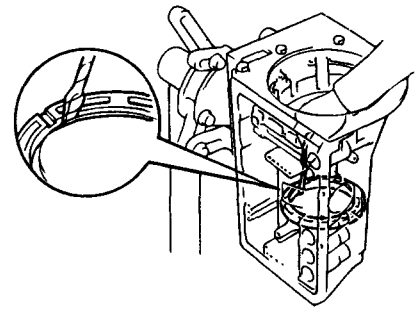
40. Measure the clearance between the plate and the second brake drum.

Standard value : 0.60 ~ 0.90 mm



EKLA072A

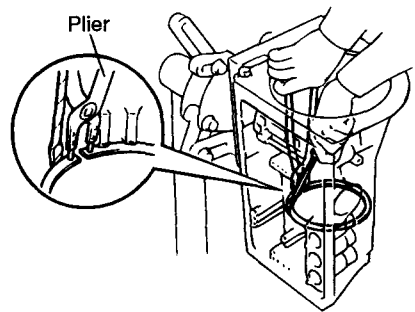
41. Remove the second brake piston sleeve.



EKLA073A

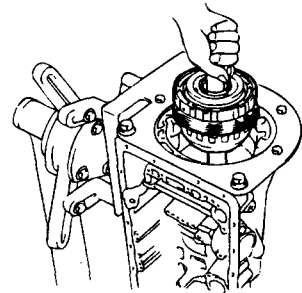
42. REAR PLANETARY, SECOND BRAKE DRUM

- 1) Remove the snap ring.



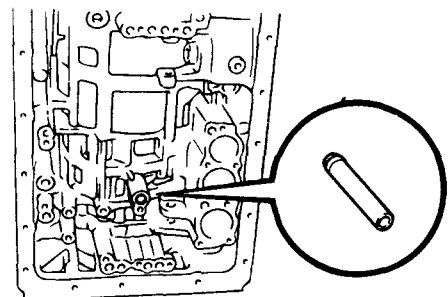
EKMB022B

- 2) Remove the rear planetary gear, the second brake drum and the output shaft.



EKLA075A

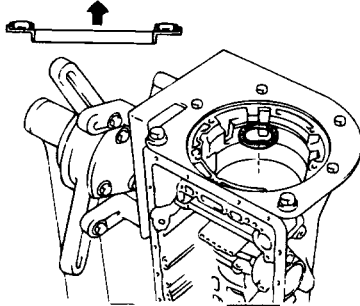
43. Using the screw driver, remove the gasket.



**REASSEMBLY** EKMB0690

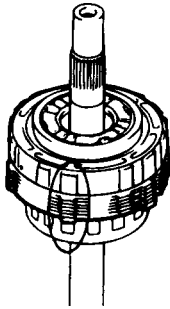
1. Install the rear planetary gear, the second brake drum and the output shaft.

- 1) Install the bearing and race.



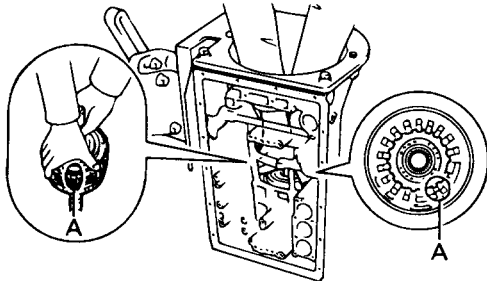
EKLA414A

- 2) Install the second brake drum, flange, disc and plate.



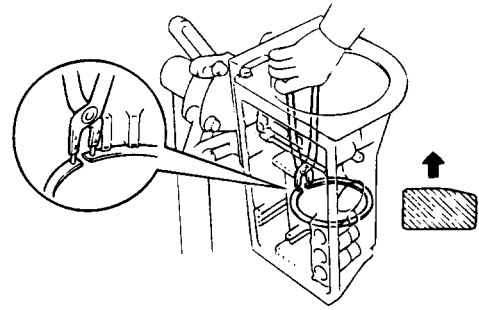
EKLA415A

- 3) Align the rear planetary gear, second brake drum and output shaft.



EKLA416A

- 4) Install the snap ring.



EKLA417A

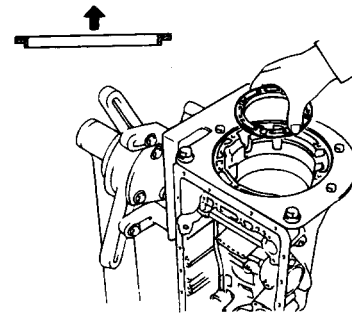
2. Measure the clearance between the plate and the second brake drum.

---

Clearance : 0.6 ~ 0.9 mm

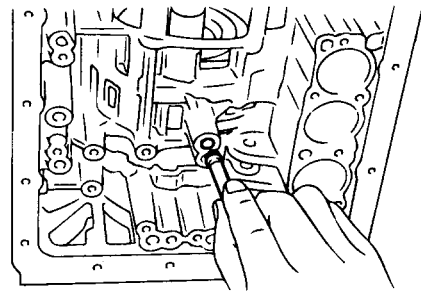
---

3. Install the second brake piston sleeve.



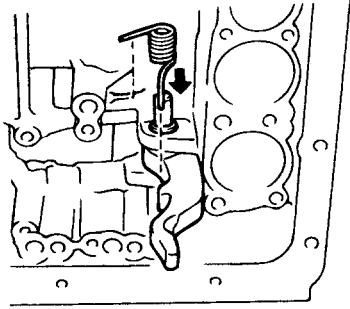
EKLA419A

4. Install the brake drum gasket.

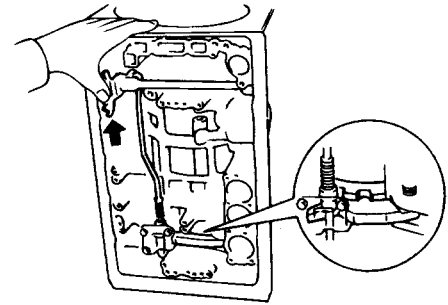


EKLA420A

5. Install the parking lock pawl and shaft.



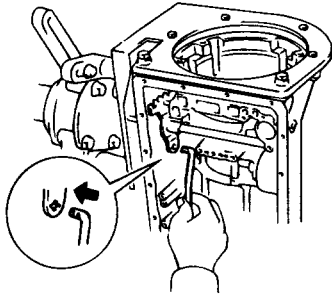
EKLA421A



EKLA424A

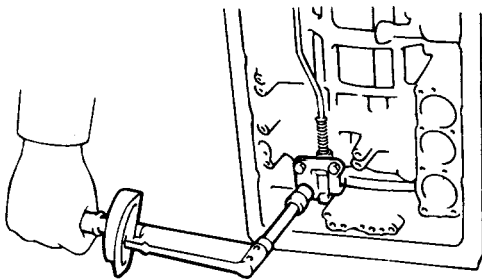
6. INSTALL PARKING LOCK ROD

1) Connect the parking lock rod to the manual valve lever.



EKLA422A

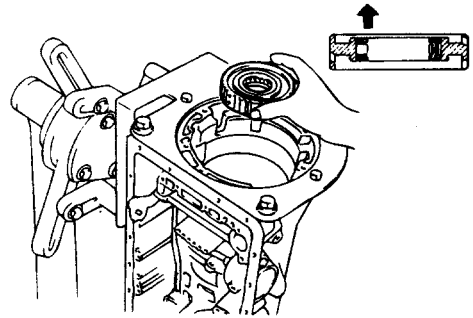
2) Install the parking lock pawl bracket.



EKLA423A

3) Confirm that the planetary ring gear is correctly fixed.

7. Install the one-way clutch.

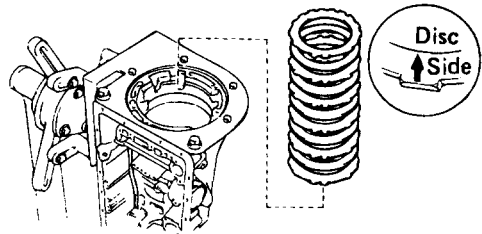


EKLA425A

8. INSTALL FLANGE, DISC, PLATE

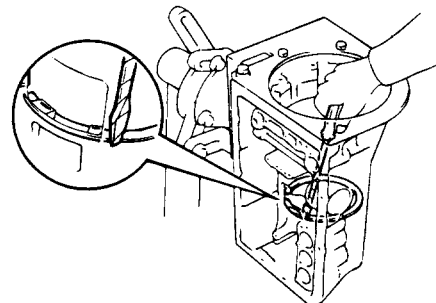
1) Install the plate with the rounded edge side of the plate facing the disc.

2) Alternately install discs and plates (Disc first)



EKLA426A

3) Install the flange and snap ring.



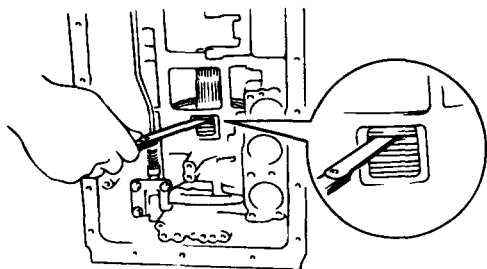
EKLA427A

9. Using the thickness gauge, measure the clearance between snap ring and flange.

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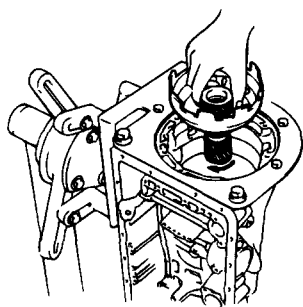
Clearance : 0.62 ~ 1.98 mm

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EKLA428A

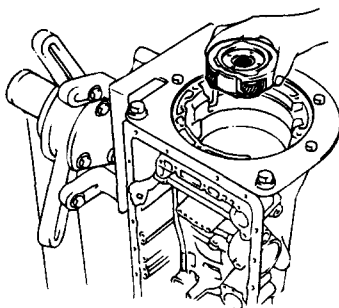
10. Install the sun gear input drum.



EKLA429A

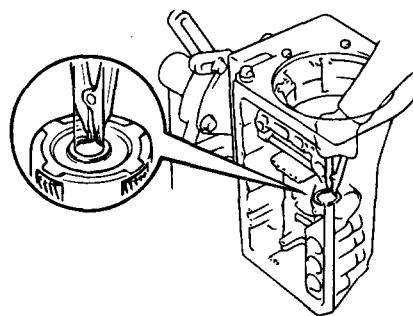
### 11. FRONT PLANETRAY GEAR

- 1) Install the front planetary gear on the sun gear.



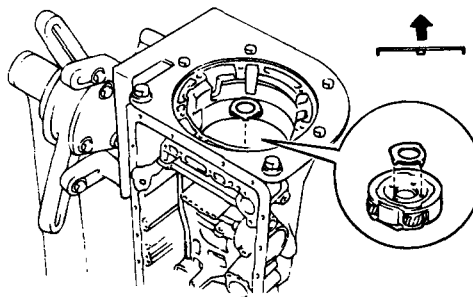
EKLA430A

- 2) Install the snap ring.



EKLA432A

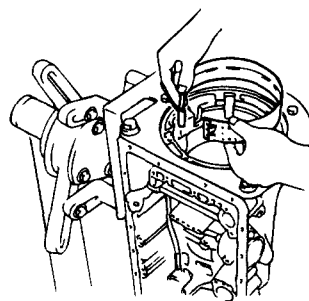
- 3) Install the bearing race on the front planetary gear.



EKLA433A

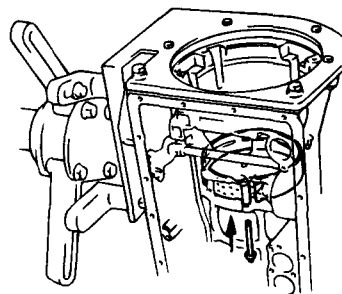
### 12. INSTALL SECOND COAST BRAKE BAND

- 1) Insert the second coast brake band to the case.



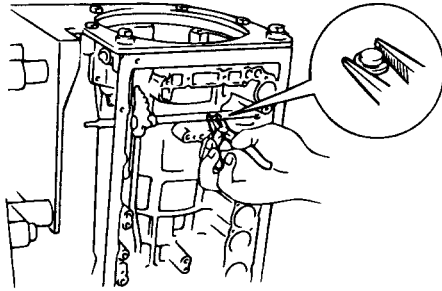
EKLA434A

- 2) Install the pin through the brake band.



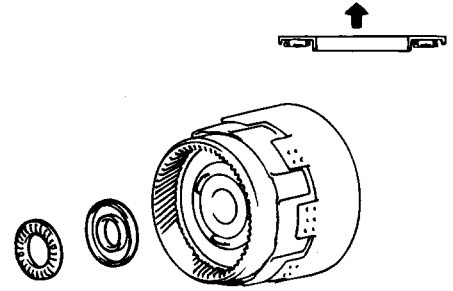
EKLA435A

3) Install the E-ring to the pin



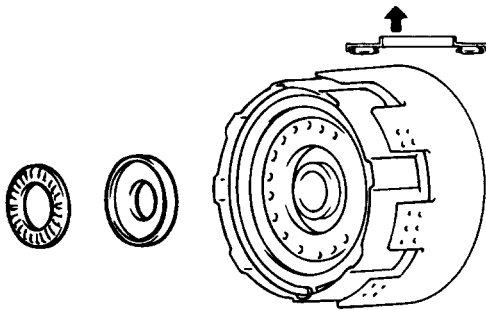
EKLA436A

1) Install the bearing and race.



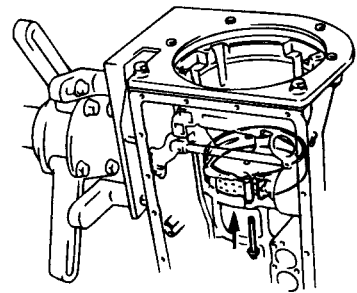
EKLA441A

13. Install the bearing and race onto the forward clutch.



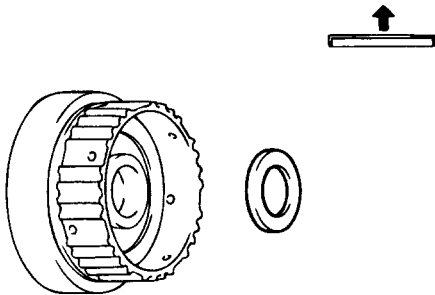
EKLA437A

2) Install the direct clutch, the forward clutch and the front ring gear to the case.



EKLA435A

14. Install the race onto the front planetary gear.

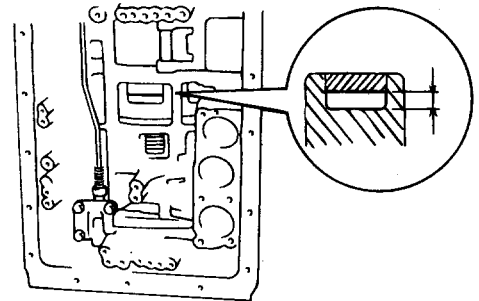


EKLA438A

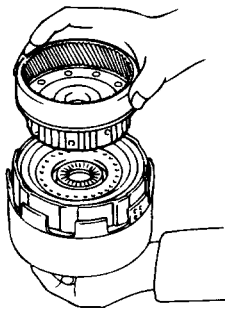
3) Using the vernier caliper, measure the distance between the sun gear.

Standard value : 5.3 ~ 7.3 mm

15. Install the forward clutch onto the front planetary ring gear.



EKLA443A

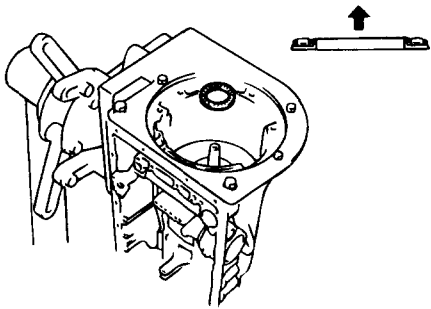


EKLA440A

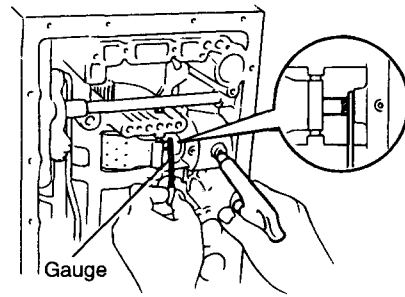
16. INSTALL DIRECT CLUTCH, FORWARD CLUTCH



- 4) Install the bearing and race onto the forward clutch.



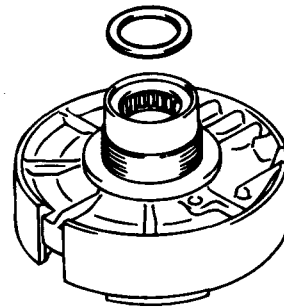
EKLA444A



EKMB069B

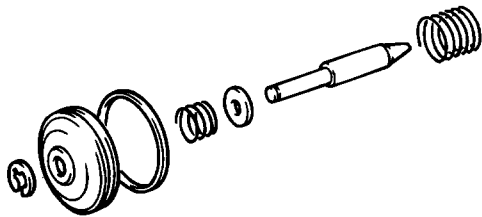
20. OVERDRIVE SUPPORT

- 1) Install the race onto the overdrive support.



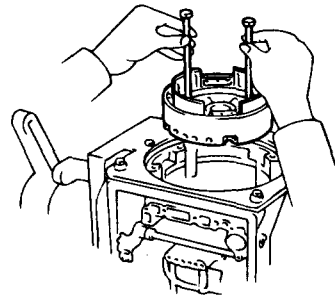
EKLA449A

17. Reassemble the second coast brake piston.



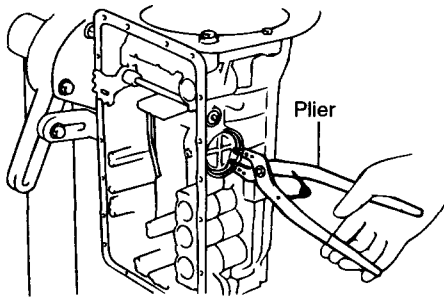
EKLA445A

- 2) Aim the bolt and oil holes of the overdrive support toward the valve hole side, and align then with the bolt hole of the transmission case and insert.



EKLA450A

18. After installing the piston cover, install the snap ring.

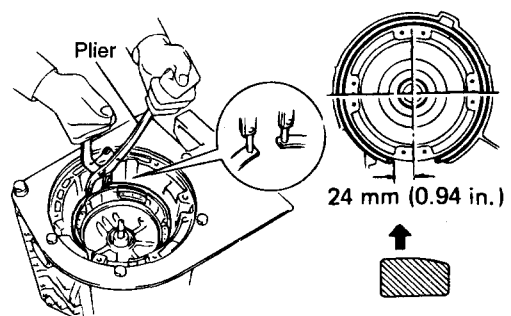


EKMB069A

19. Measure the stroke applying the compressed air.

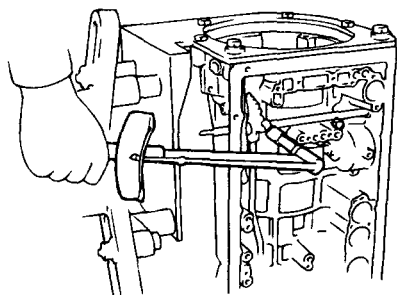
Stroke : 2.0 ~ 3.0 mm

- 3) Install the snap ring.

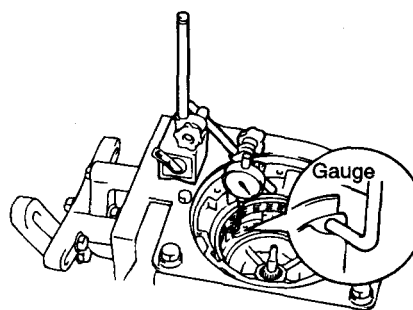


EKMB069C

- 4) Install the bolts(2EA).



EKLA452A



EKMB069D

- 2) Measure the stroke applying and releasing the compressed air.

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Piston stroke : 1.40 ~ 1.70 mm

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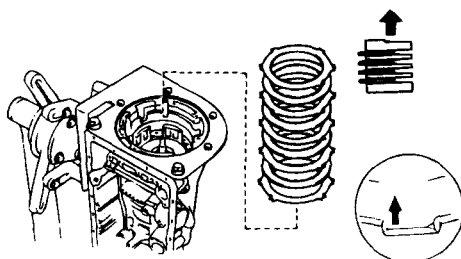
21. Measure the end-play of the output shaft.

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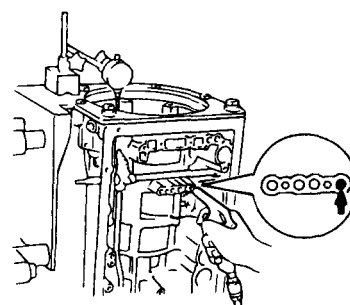
Standard value : 0.27 ~ 0.86 mm

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22. Install the flange with the rounded edge side of the flange facing the disc.



EKLA454A

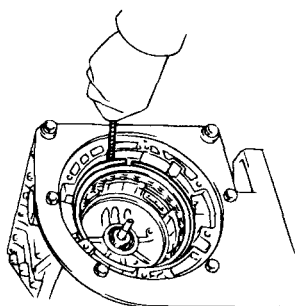


EKLA457A

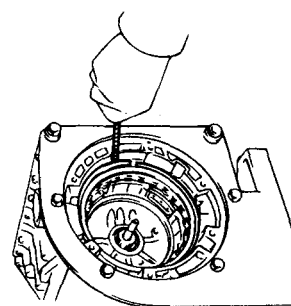
25. REMOVE FLANGE, PLATE, DISC

- 1) Remove the snap ring.

23. Install the snap ring.



EKLA455A

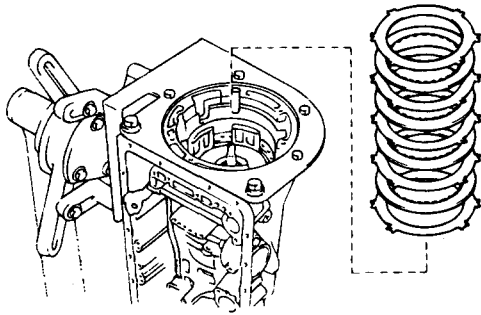


EKLA458A

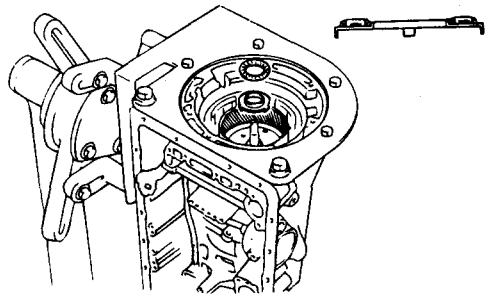
24. PISTON STROKE OF OVERDRIVE BRAKE

- 1) Place the dial indicator onto the overdrive brake piston.

- 2) Remove the flanges(2EA), plates(3EA) and discs(4EA).



EKLA459A

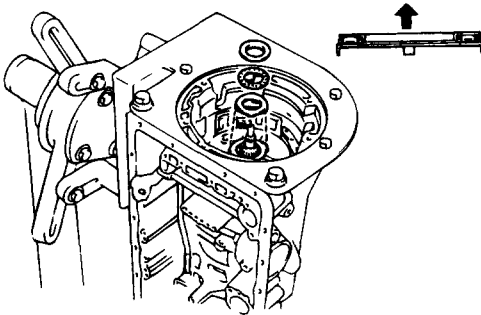


EKLA462A

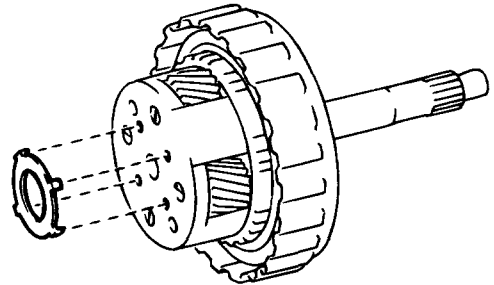
- 2) Install the race onto the planetary gear.

26. OVERDRIVE RING GEAR

- 1) Install the bearing and the race onto the overdrive support.



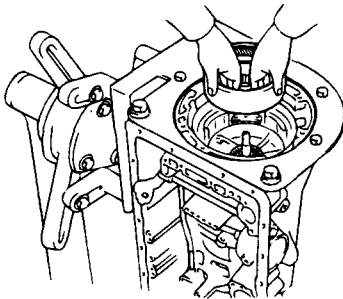
EKLA460A



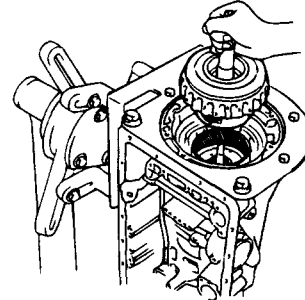
EKLA463A

- 3) Install the overdrive planetary gear and the direct clutch.

- 2) Install the overdrive planetary ring gear.



EKLA461A

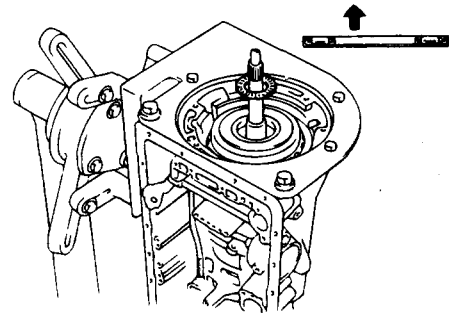


EKLA464A

- 4) Install the bearing and the race onto the direct clutch.

27. INSTALL OVERDRIVE PLANETARY GEAR

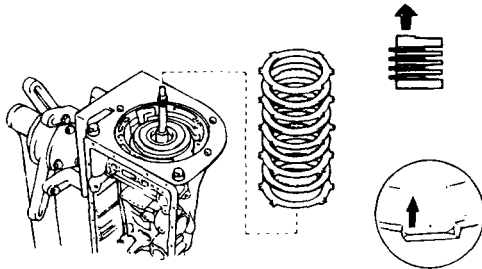
- 1) Install the bearing and the race onto the planetary ring gear.



EKLA465A

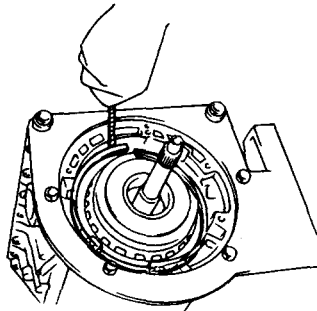
**28. INSTALL FLANGE, DISC, PLATE**

- 1) Install the flange with the rounded edge side of the flange facing the disc.
- 2) Alternately install discs and plates.



EKLA466A

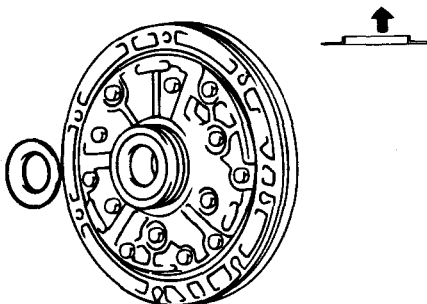
- 3) Install the flange and the snap ring.



EKLA467A

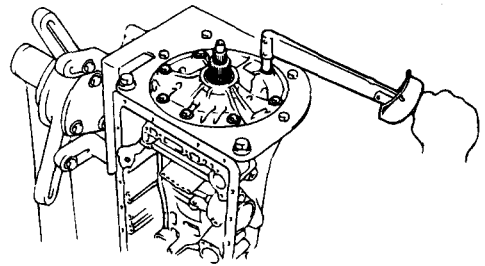
**29. INSTALL OIL PUMP**

- 1) Install the race onto the oil pump.



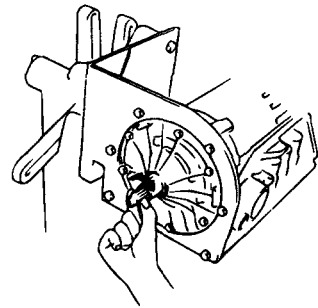
EKLA468A

- 2) Install the oil pump onto the transmission case.



EKLA469A

30. Make sure the input shaft rotates smoothly.



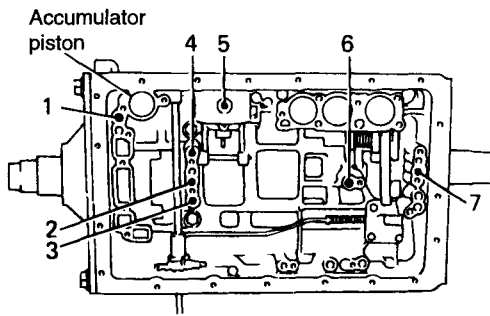
EKLA470A

31. Check for the sound of operation while injecting compressed air into the oil hole indicated in the figure.

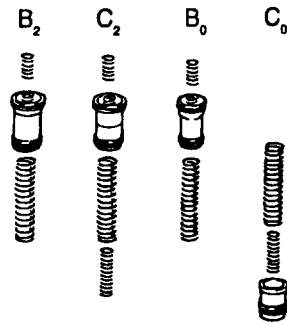
- 1) Overdrive direct clutch
- 2) Direct clutch
- 3) Forward clutch
- 4) Overdrive brake
- 5) Second coast brake
- 6) Second brake
- 7) First and reverse brake

**NOTE**

*When inspecting the OD direct clutch, check with the Co accumulator piston hole closed. If there is no noise, disassemble and check the condition of the parts.*



EKMB069F



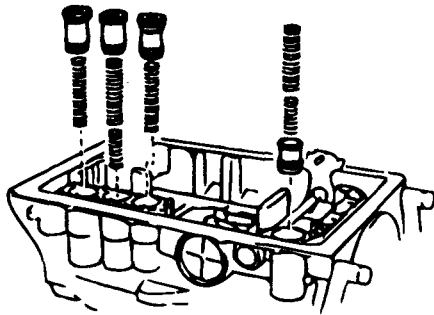
KKMB005B

32. INSTALL ACCUMULATOR PISTON

- 1) Install the accumulator piston.

**CAUTION**

- C0 : Overdrive direct clutch**
- C2 : Direct clutch**
- B0 : Overdrive brake**
- B2 : Second brake**



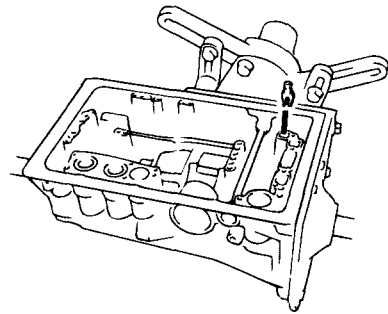
KKMB005A

- 2) Install the spring

Spring		Free length	Outer diameter	Color
(1)B2	Upper	70.50	19.70	Yellow
(2)B2	Lower	22.0	14.00	Pink
(3)C2	Upper inner	42.06	14.70	Pink
(4)C2	Upper outer	64.00	20.20	Green
(5)C2	Lower	26.00	11.96	Green
(6)B0	Upper	62.00	16.00	Green
(7)B0	Upper	17.50	14.00	Green
(8)C0	Inner	46.00	14.02	Yellow
(9)C0	Outer	74.60	20.90	Orange

Unit : mm

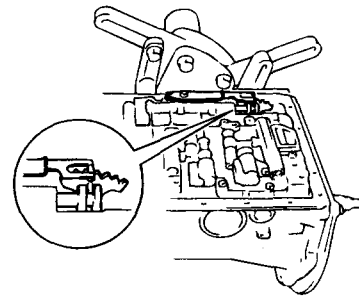
33. Install the check ball body and the spring.



EKLA476A

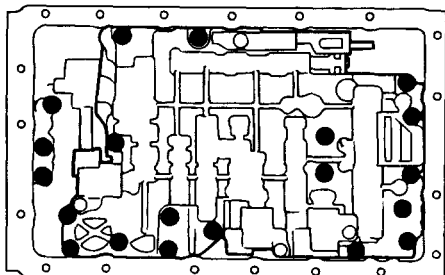
34. INSTALL VALVE BODY

- 1) Align the groove of the manual valve to the pin of the lever.

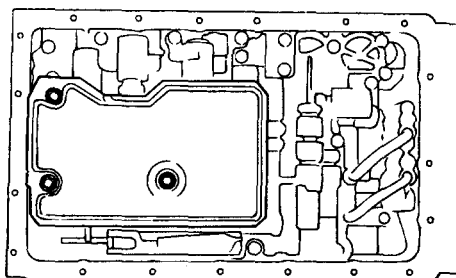


EKLA477A

- 2) Confirm the spring into the accumulator piston are installed correctly.
- 3) Install the valve body.



KKMB005C

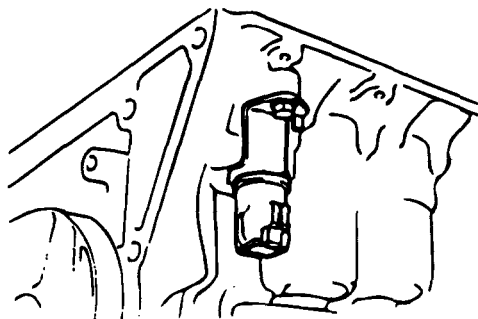


EKLA484A

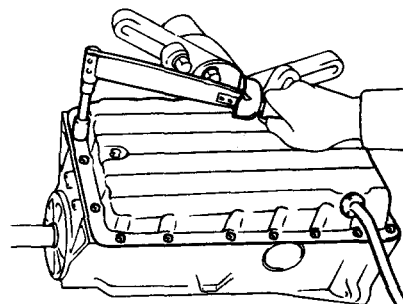
37. Install the oil pan.

**35. INSTALL SOLENOID CONNECTOR**

- 1) Install the stopper plate.

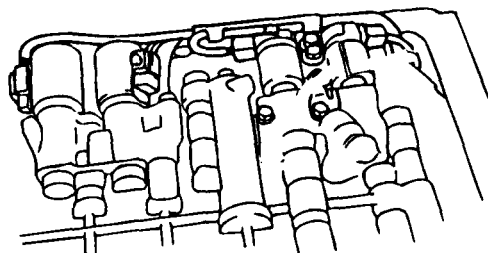


KKMB005D



EKLA489A

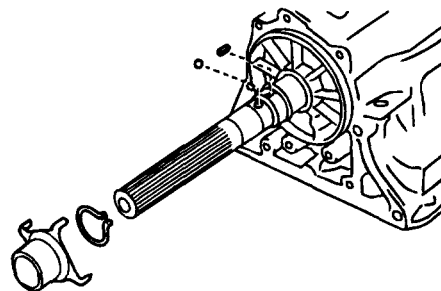
- 2) Connect the solenoid connect.
- 3) Install the clamp bolt.



KKMB005E

**38. INSTALL ROTOR SENSOR**

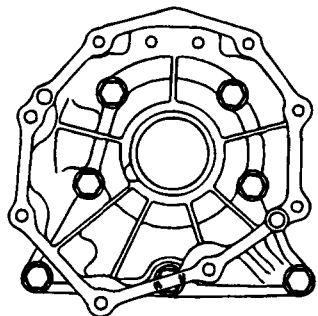
- 1) Install the key.
- 2) Install the snap ring.
- 3) Install the spacer and the sensor rotor.
- 4) Install the snap ring.



KKMB022B

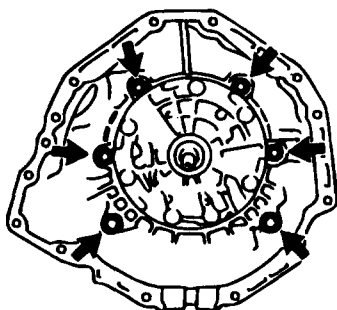
36. Install the oil strainer.

39. Install the extension housing.



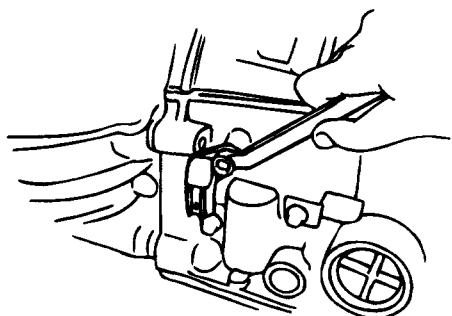
KKMB003E

40. Install the transmission housing.



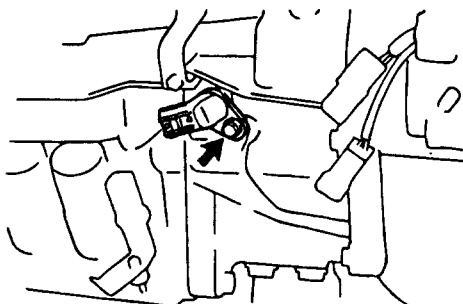
KKMB005F

41. Install the input speed sensor.



KKMB003D

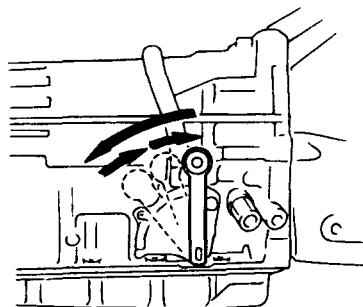
42. Install the output speed sensor.



KKMB003C

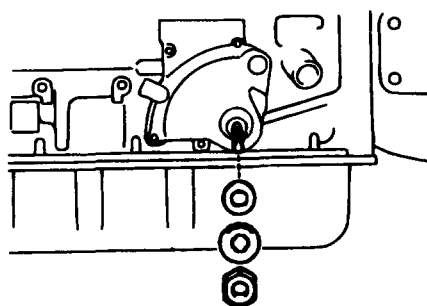
43. INSTALL TRANSAXLE RANGE SWITCH

1) Install the transaxle range switch onto the manual valve shaft and temporarily tighten the adjusting nut.



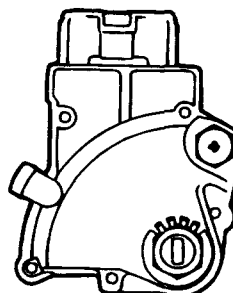
EKLA501A

2) Install the washer and the nut.



KKMB003B

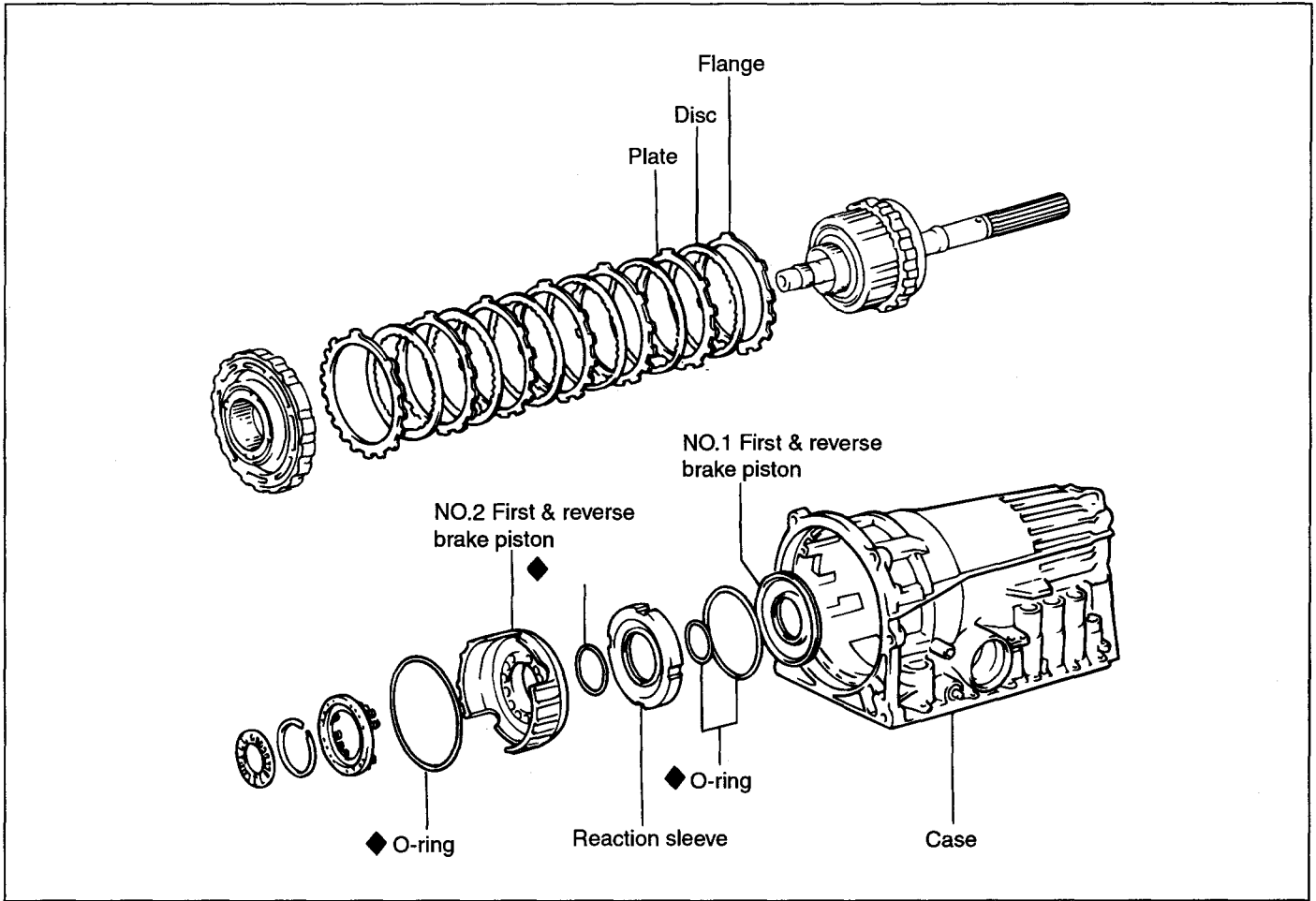
44. Tighten the adjusting bolt.



KKMB005G

LOW REVERSE BRAKE

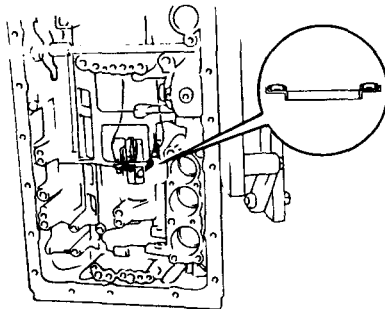
FIRST(OR LOW) REVERSE BRAKE EKMB0560



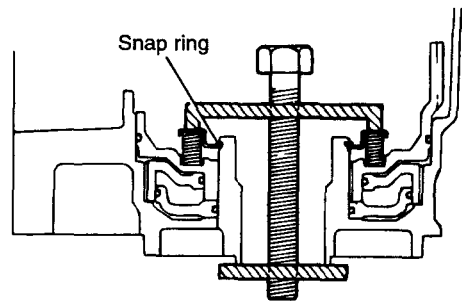
EKMB056A

DISASSEMBLY EKMB0570

1. Remove the bearing and the race.



EKLA282A

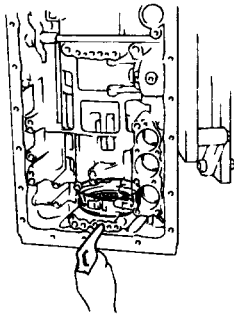


EKMB057A

2. Remove the snap ring and the piston return spring.

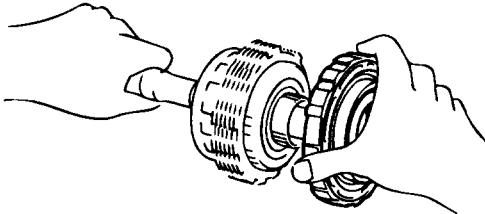


3. Apply the compressed air to the transmission case to remove the NO.2 first reverse brake piston.



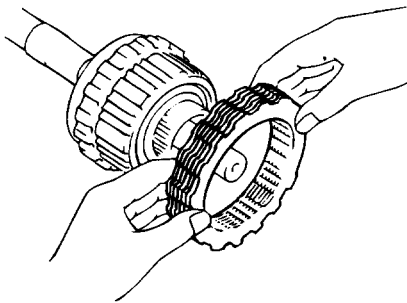
EKLA285A

4. Remove the second brake from the output shaft.



EKLA288A

5. Remove the discs(6EA), plates(6EA) and flange.



EKLA289A

## INSPECTION

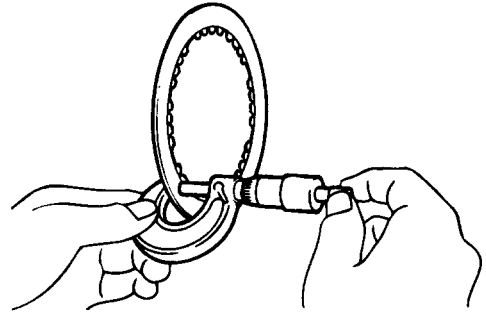
EKMB0580

1. Using a micrometer, measure the thickness of the discs.  
If the thickness is less than the minimum, replace the disc.

---

Minimum thickness : 1.51 mm

---

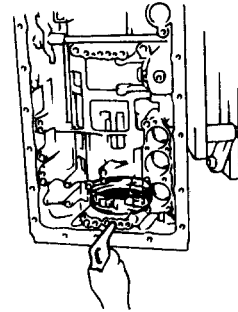


EKLA290A

## REASSEMBLY

EKMB0590

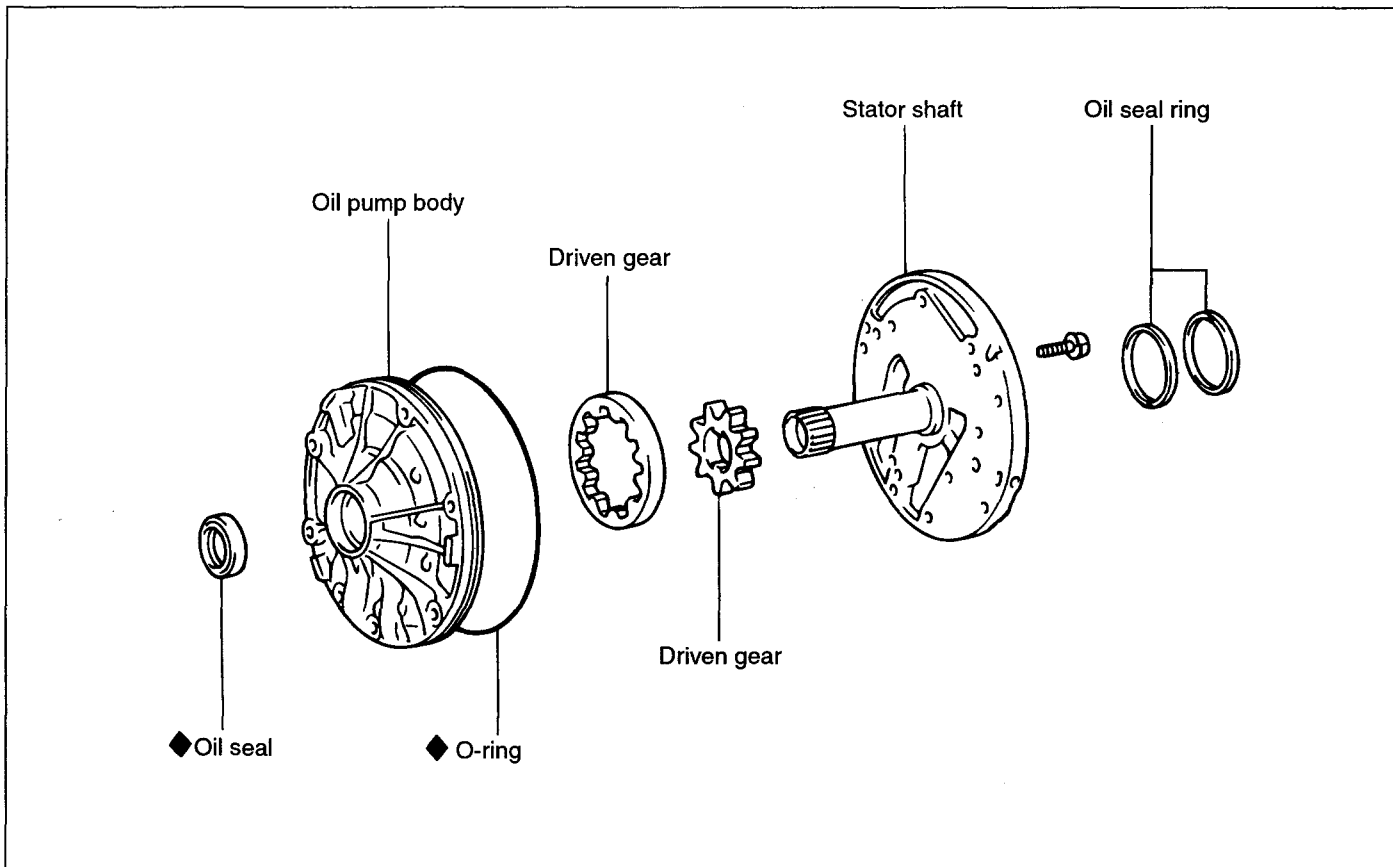
1. Make sure the first and reverse brake piston moves smoothly when applying and releasing the compressed air into the transmission case.



EKLA299A

# OIL PUMP (A/T)

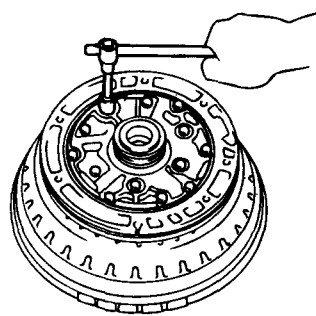
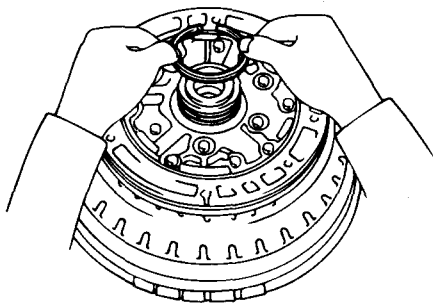
## OIL PUMP EKMB0230



EKMB023A

## DISASSEMBLY EKMB0240

1. Remove the oil seal ring.

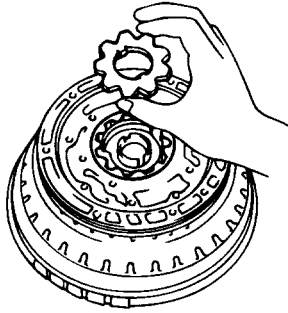


EKLA090A

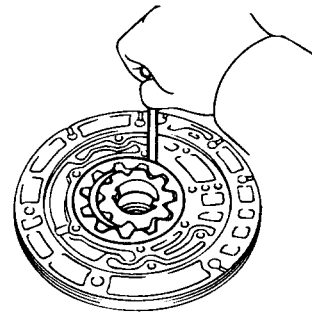
EKLA089A

2. Remove the stator shaft.

- Remove the driven and the drive gear.



EKLA091A

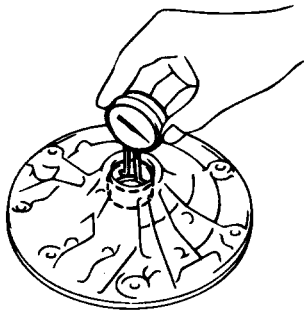


EKLA094A

**INSPECTION** EKMB0250

- Measure the inner diameter of the oil pump bushing.

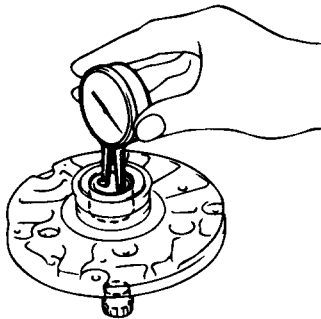
Standard value : 38.19 mm



EKLA092A

- Measure the inner diameter of the stator shaft bushing.

Front : 21.58 mm  
Rear : 27.08 mm



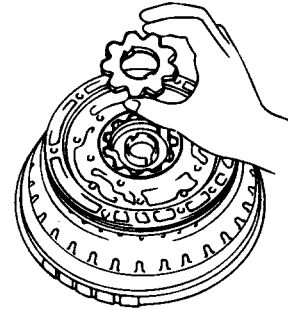
EKLA093A

- Using a filler gauge, measure the clearance of the driven gear.

Standard value : 0.07 ~ 0.15 mm

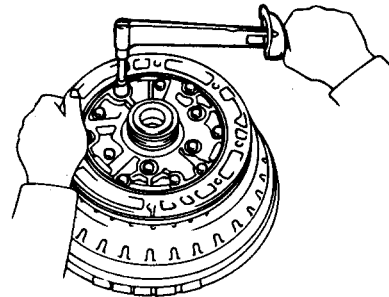
**REASSEMBLY** EKMB0260

- Install the driven gear and the drive gear after coating them with ATF.



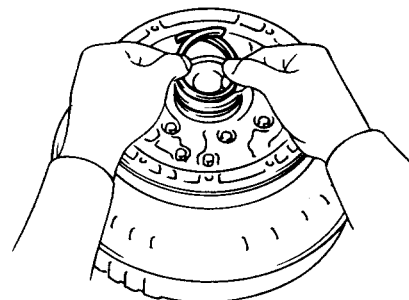
EKLA099A

- Install the stator shaft to the oil pump.



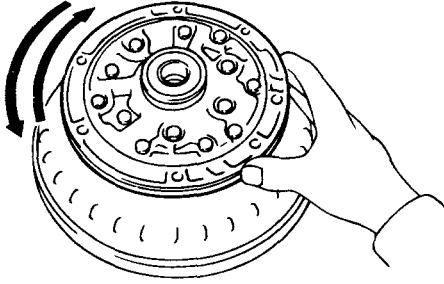
EKLA100A

- Install the oil seal ring.



EKLA101A

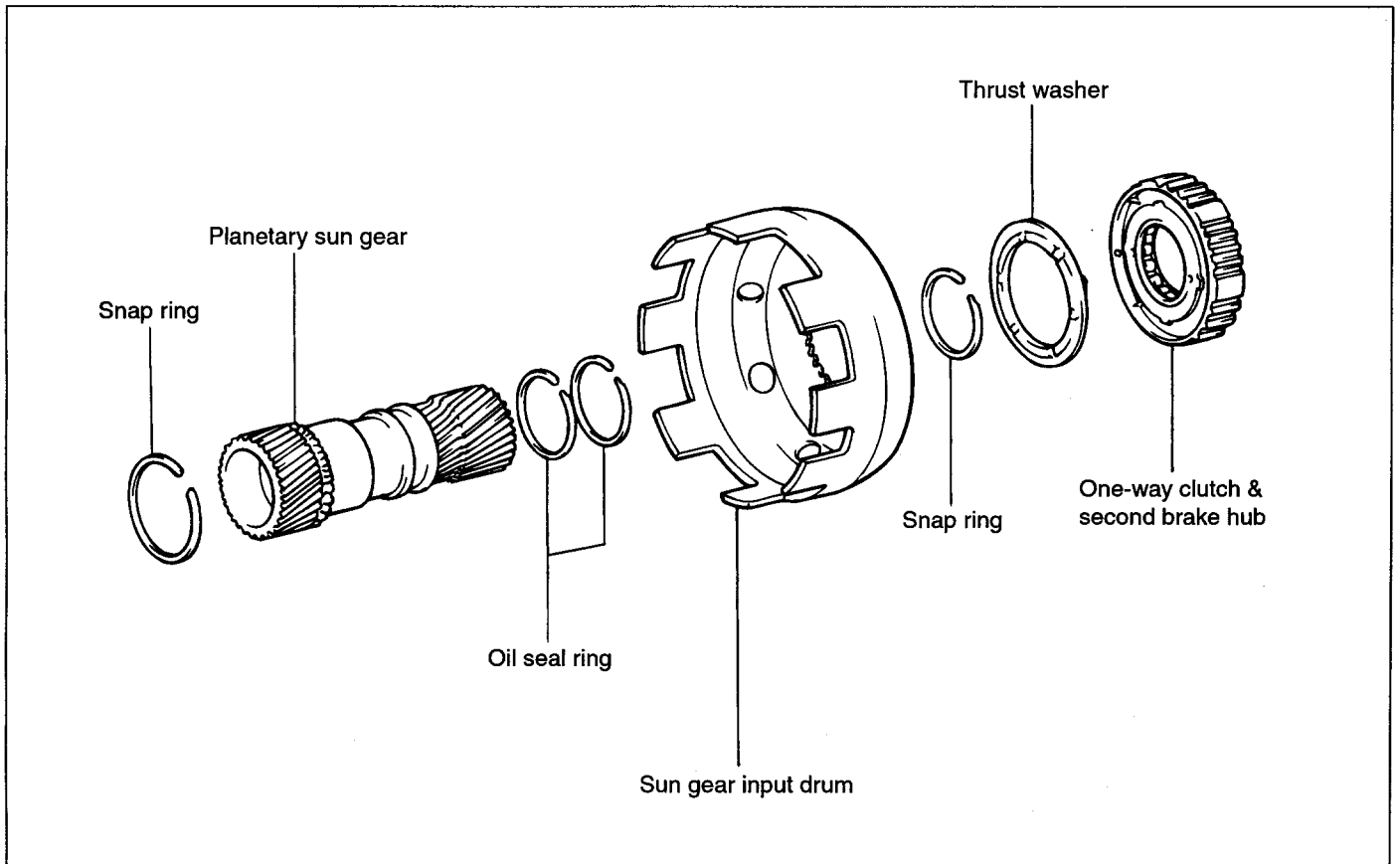
4. Make sure the drive gear rotates smoothly when installed to the torque converter.



EKLA103A

## ONE WAY CLUTCH

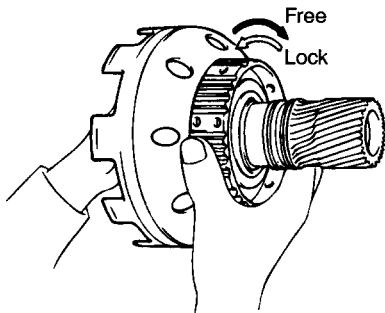
EKMB0450



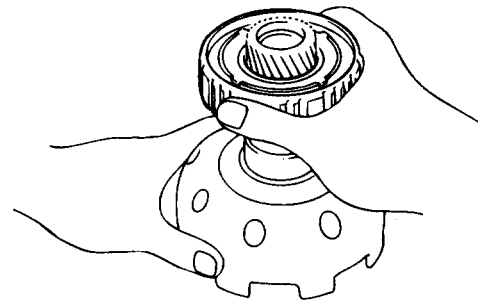
EKMB045A

## DISASSEMBLY EKMB0460

1. Hold the planetary sun gear and turn the brake hub. The brake hub should turn freely clockwise and should lock counterclockwise.



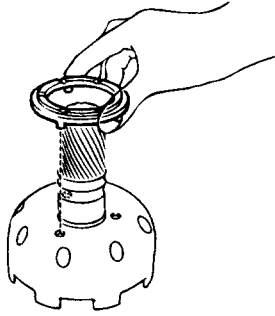
EKLA227A



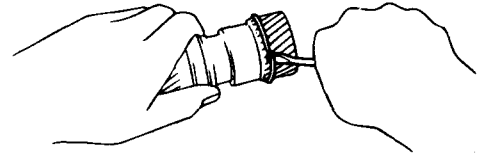
EKLA228A

2. Separate the one-way clutch from the brake hub.

3. Remove the thrust washer.

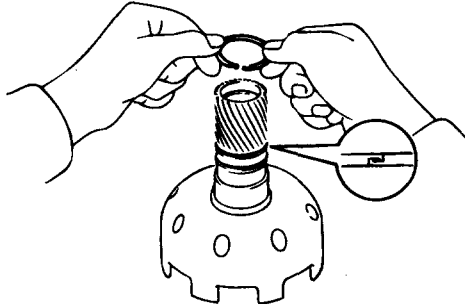


EKLA229A



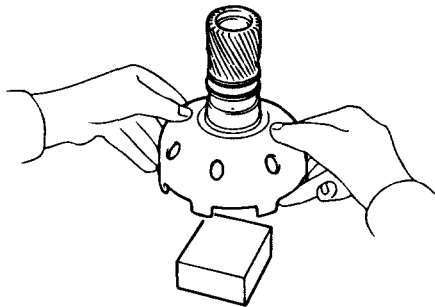
EKLA233A

4. Remove the oil seal ring.



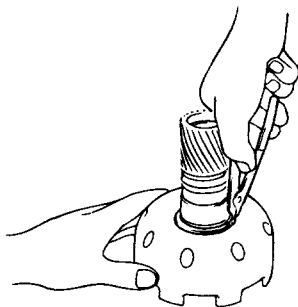
EKLA230A

5. Remove the snap ring.



EKLA231A

6. Remove the sun gear input drum.



EKLA232A

7. Remove the snap ring of the planetary sun gear.

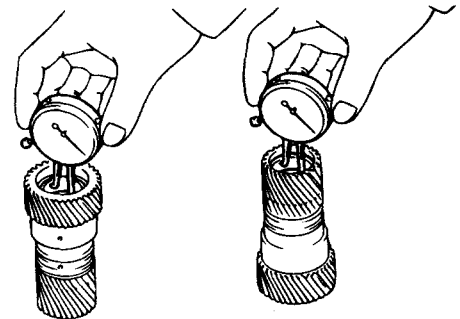
**INSPECTION** EKMB0470

1. Using a dial indicator, measure the inner diameter of the planetary sun gear.

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Maximum diameter : 27.08 mm

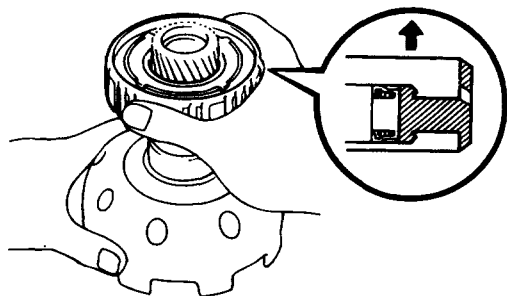
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EKLA234A

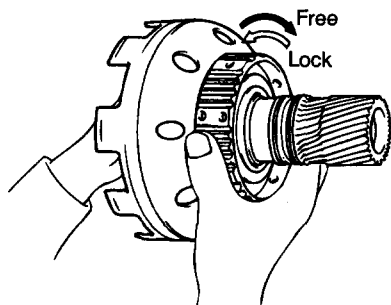
**REASSEMBLY** EKMB0480

1. Install the one-way clutch and the brake hub.



EKLA240A

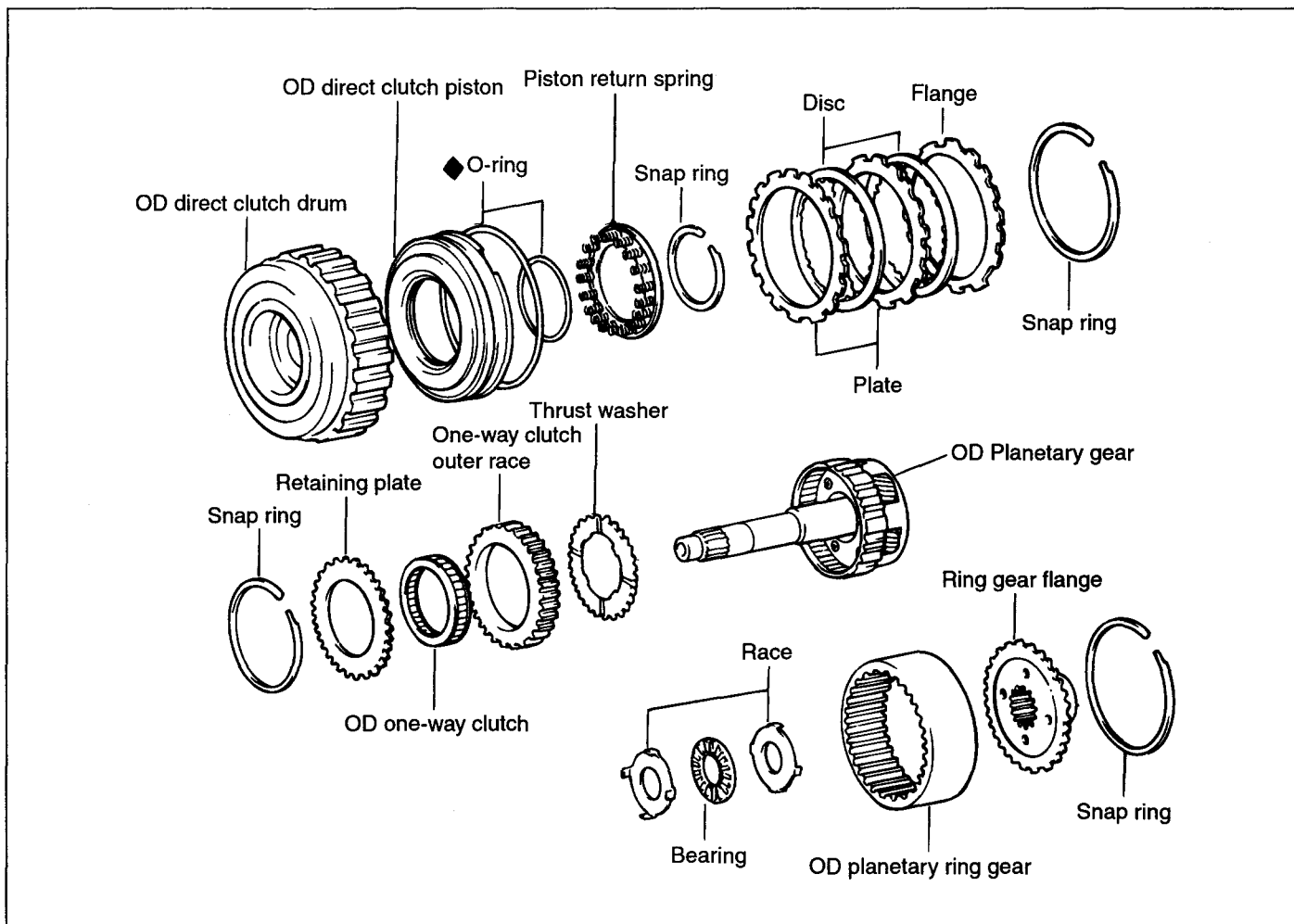
2. Hold the planetary sun gear and turn the hub. The brake hub should turn freely clockwise and should lock counterclockwise.



EKLA241A

REVERSE & OVERDRIVE CLUTCH

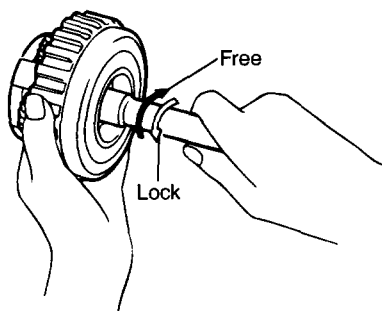
KKMB0270



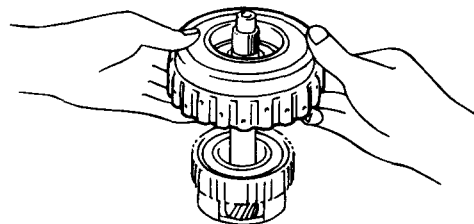
EKMB027A

DISASSEMBLY EKMB0280

1. Hold the OD direct clutch drum and turn the input shaft. The input shaft should turn freely clockwise and should lock counterclockwise.



2. Remove the overdrive direct clutch from the overdrive planetary gear.



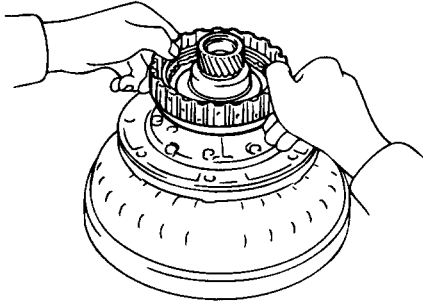
EKLA106A

EKLA105A



### 3. CHECK PISTON STROKE OF OVERDRIVE DIRECT CLUTCH (Co)

- 1) Place the oil pump onto the torque converter, and then place the OD direct clutch assembly onto the oil pump.



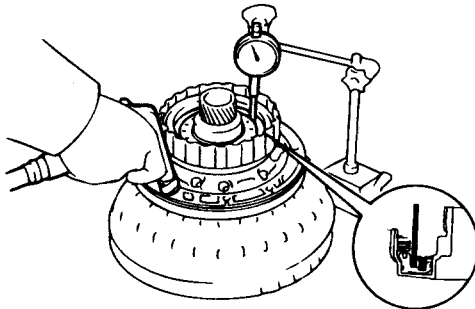
EKLA108A

- 2) Using a dial indicator, measure the overdrive direct clutch piston stroke applying and releasing the compressed air.

---

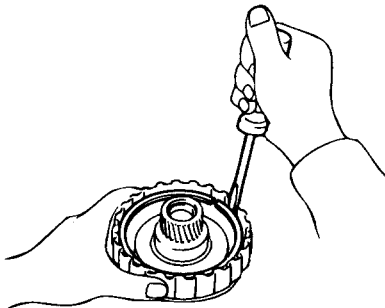
Standard value : 1.40 ~ 1.70 mm

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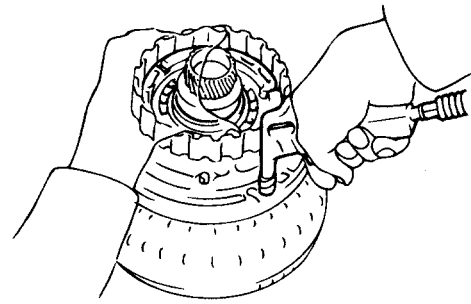
EKLA109A

4. Remove the snap ring and the piston return spring.



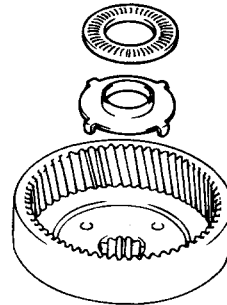
EKLA110A

5. Remove the overdrive direct clutch piston.



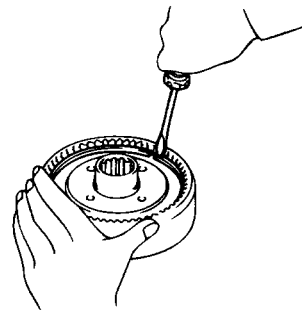
EKLA112A

6. Remove the bearing and the race from the planetary ring gear.



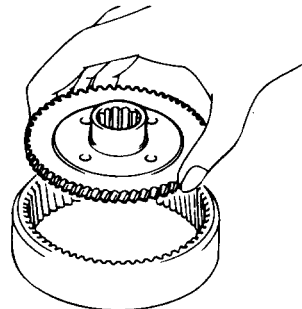
EKLA113A

7. Remove the snap ring.



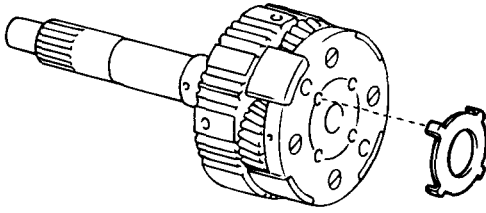
EKLA114A

8. Remove the ring gear flange.

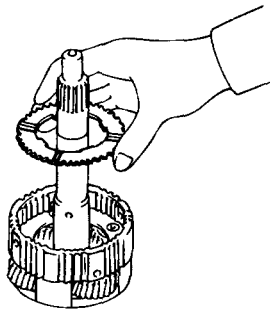


EKLA115A

9. Remove the race from the overdrive planetary gear.

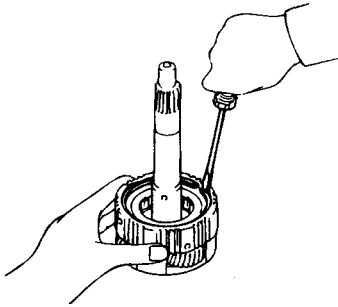


EKLA116A



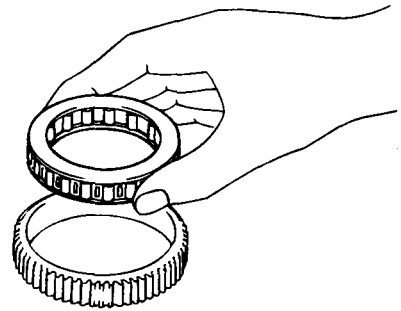
EKLA120A

10. Remove the snap ring.



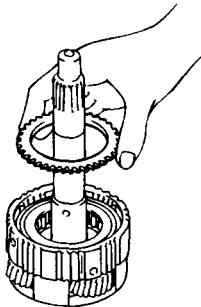
EKLA117A

14. Remove the one-way clutch.



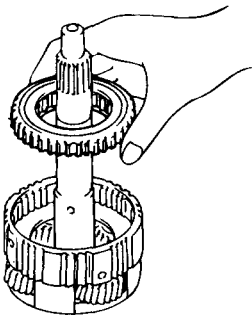
EKLA121A

11. Remove the retaining plate.



EKLA118A

12. Remove the overdrive one-way clutch with the outer race.



EKLA119A

13. Remove the thrust washer.

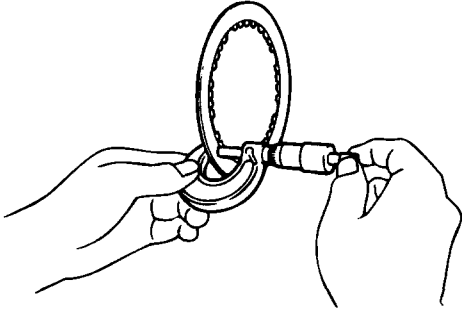
**INSPECTION** EKMB0290

1. Using a micrometer, measure the thickness of the disc.

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Standard value : 1.84 mm

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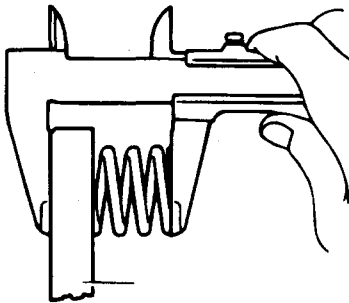
EKLA122A

2. CHECK PISTON RETURN SPRING  
Using calipers, measure the free length of the return spring.

---

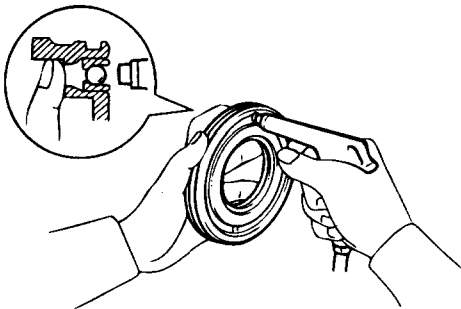
Standard length : 15.8 mm

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EKLA123A

3. CHECK OVERDRIVE DIRECT CLUTCH PISTON
  - a. Check that check ball is free by shaking the piston.
  - b. Check that the valve does not leak by applying low pressure compressed air.



EKLA124A

4. CHECK OVERDRIVE DIRECT CLUTCH DRUM BUSHINGS

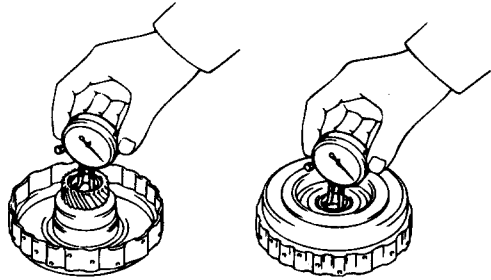
Using a dial indicator, measure the inside diameter of the clutch drum bushings.

---

Maximum inside diameter : 27.11 mm

---

If the inside diameter is greater than the maximum, replace the clutch drum.



EKLA125A

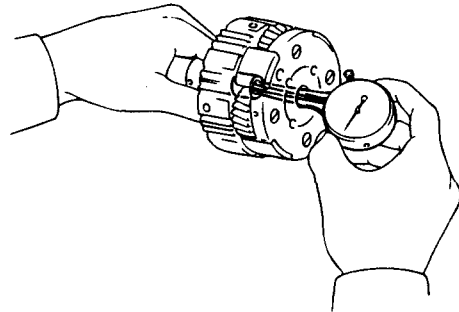
5. CHECK OVERDRIVE PLANETARY GEAR BUSHING  
Using a dial indicator, measure the inside diameter of the planetary gear bushing.

---

Maximum inside diameter : 11.27 mm

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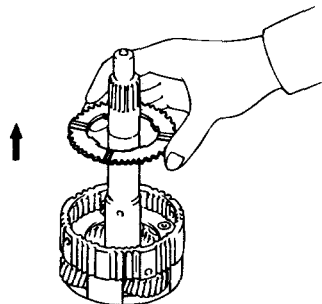
If the inside diameter is greater than the maximum, replace the planetary gear.



EKLA126A

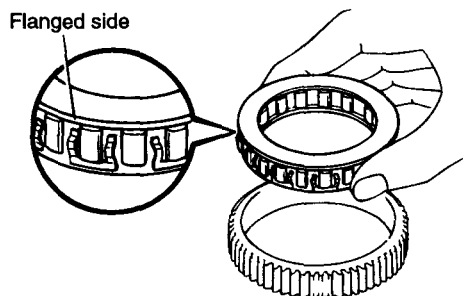
**REASSEMBLY** EKMB0300

1. Install the thrust washer to the overdrive planetary gear, facing the grooved side upward.



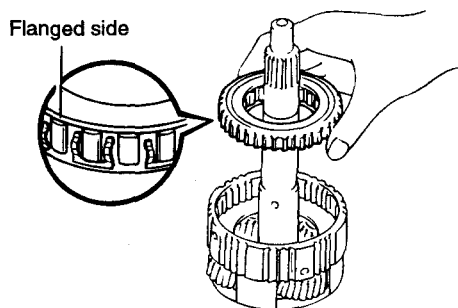
EKLA127A

2. Install the one-way clutch into the outer race, facing the flanged side of the one-way clutch upward.



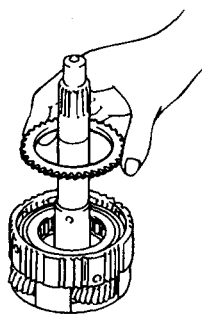
EKMB030B

3. Install overdrive one-way clutch with outer race to overdrive planetary gear.



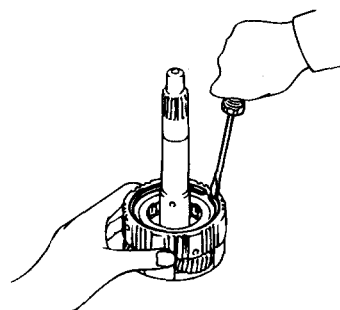
EKMB030A

4. Install retaining plate.



EKLA130A

5. Install snap ring.



EKLA131A

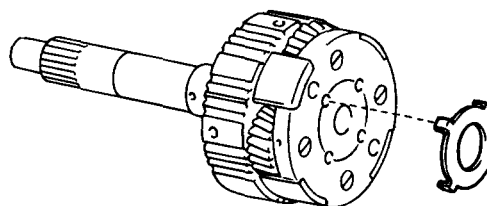
6. Coat the race with petroleum jelly and install it to the planetary gear.

**NOTE**

**Race diameter**

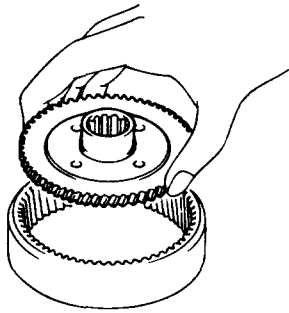
*Inside diameter : 27.1mm (1.067in.)*

*Outside diameter : 41.8mm (1.646in.)*



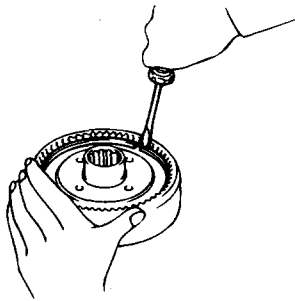
EKLA132A

7. Install ring gear flange to overdrive planetary ring gear.



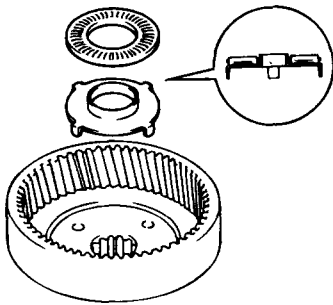
EKLA133A

8. Install snap ring.



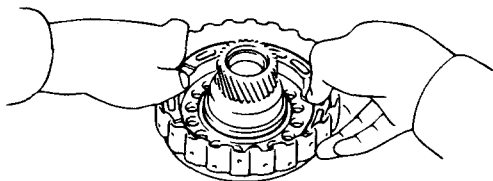
EKLA134A

9. Install race and bearing.



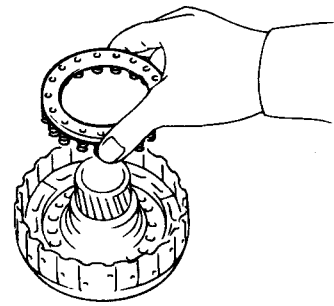
EKLA135A

10. Install the race on the planetary gear.



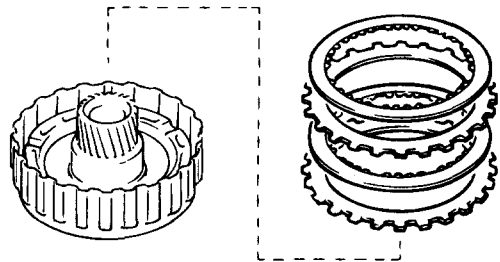
EKLA136A

11. Install the piston return spring.



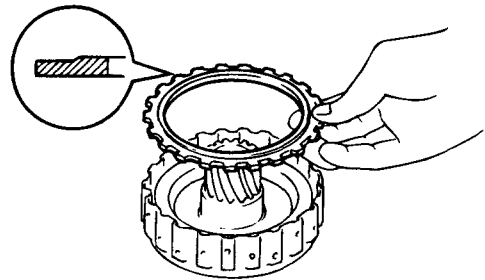
EKLA137A

12. Install the plate and the disc.



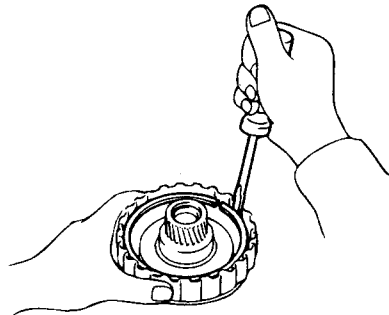
EKLA139A

13. Install the flange.



EKLA140A

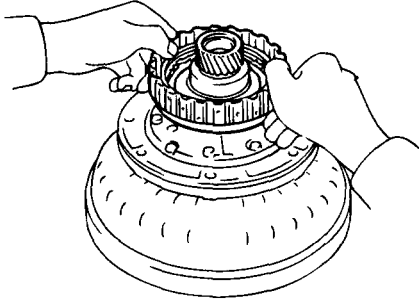
14. Install the snap ring.



EKLA141A

**15. CHECK PISTON STROKE OF THE DIRECT CLUTCH PISTON**

- 1) Place the oil pump onto the torque converter, and then place the OD direct clutch assembly onto the oil pump.



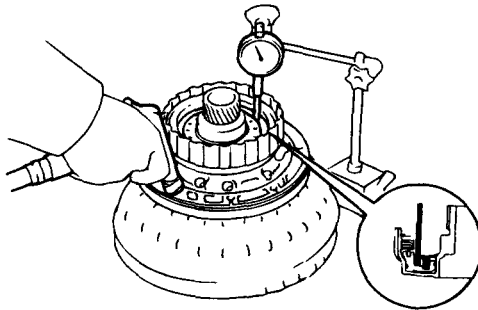
EKLA142A

- 2) Using a dial indicator, measure the overdrive direct clutch piston stroke applying and releasing the compressed air.

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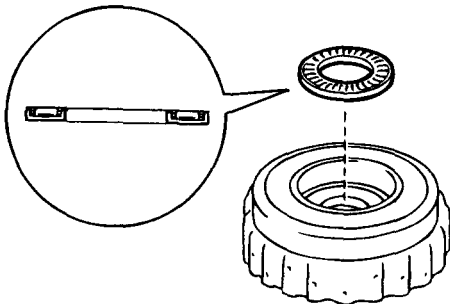
Piston stroke : 1.4 ~ 1.7 mm

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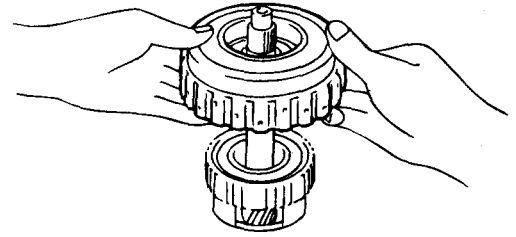
EKLA143A

**16. Install the bearing and the race.**



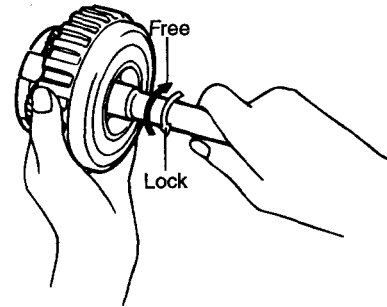
EKLA144A

**17. Install the direct clutch assembly onto the OD planetary gear.**



EKLA145A

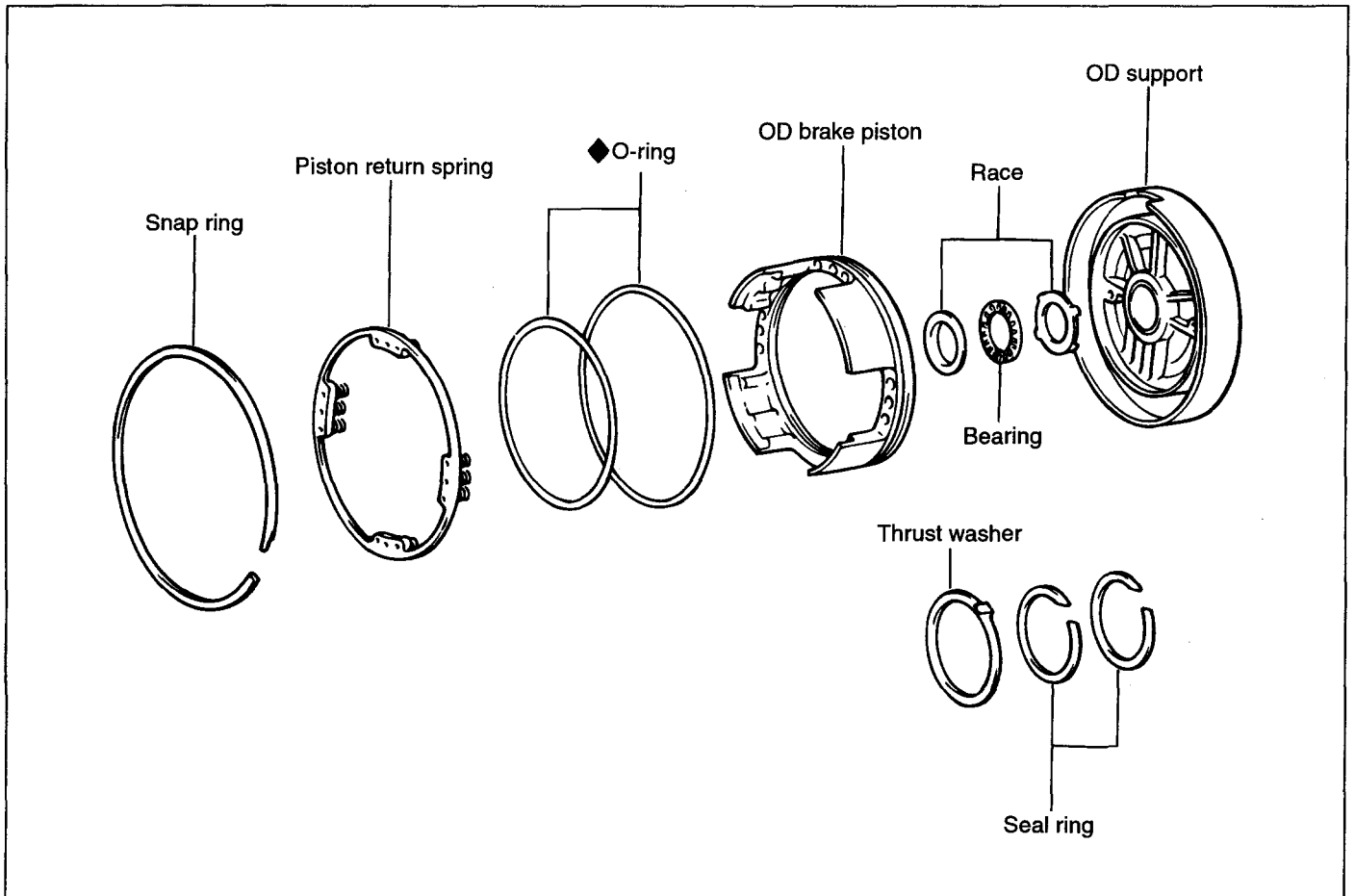
18. Hold the OD direct clutch drum and turn the input shaft. The input shaft should turn freely clockwise and should lock counterclockwise.



EKLA146A

# OVERDRIVE BRAKE

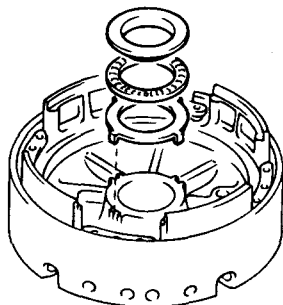
EKMB0310



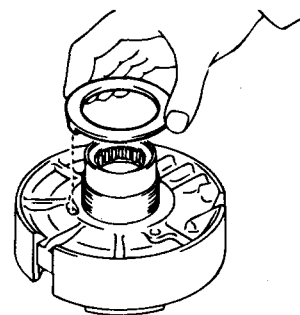
EKMB031A

## DISASSEMBLY EKMB0320

1. Remove the bearing and the race.



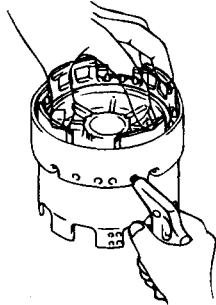
EKLA150A



EKLA152A

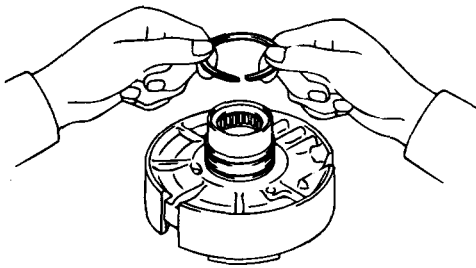
2. Remove the clutch drum washer.

3. Hold the OD brake piston so it is not slanted and apply compressed air into the passage to remove the OD brake piston.
4. Remove the OD brake piston.



EKLA155A

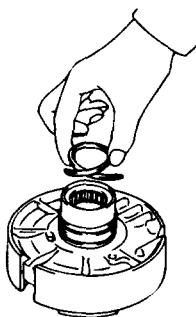
5. Remove the oil seal ring.



EKLA156A

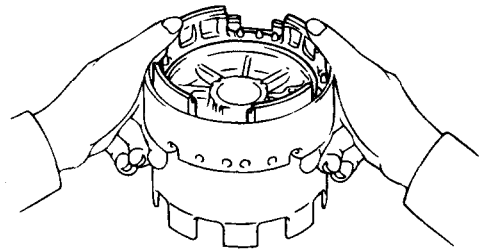
**REASSEMBLY** EKMB0340

1. Install the oil seal ring.



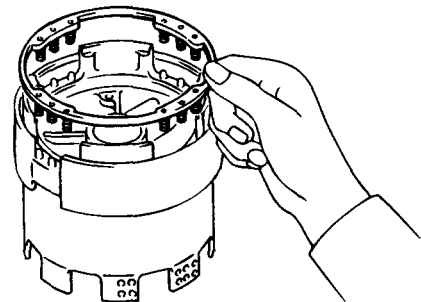
EKLA158A

2. Install the overdrive brake piston.



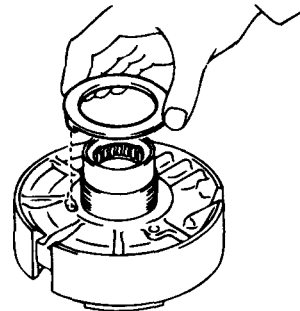
EKLA159A

3. Install the return spring.



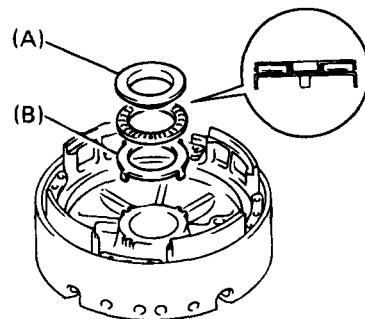
EKLA160A

4. Install the clutch drum washer onto the OD support.



EKLA162A

5. Install the race.

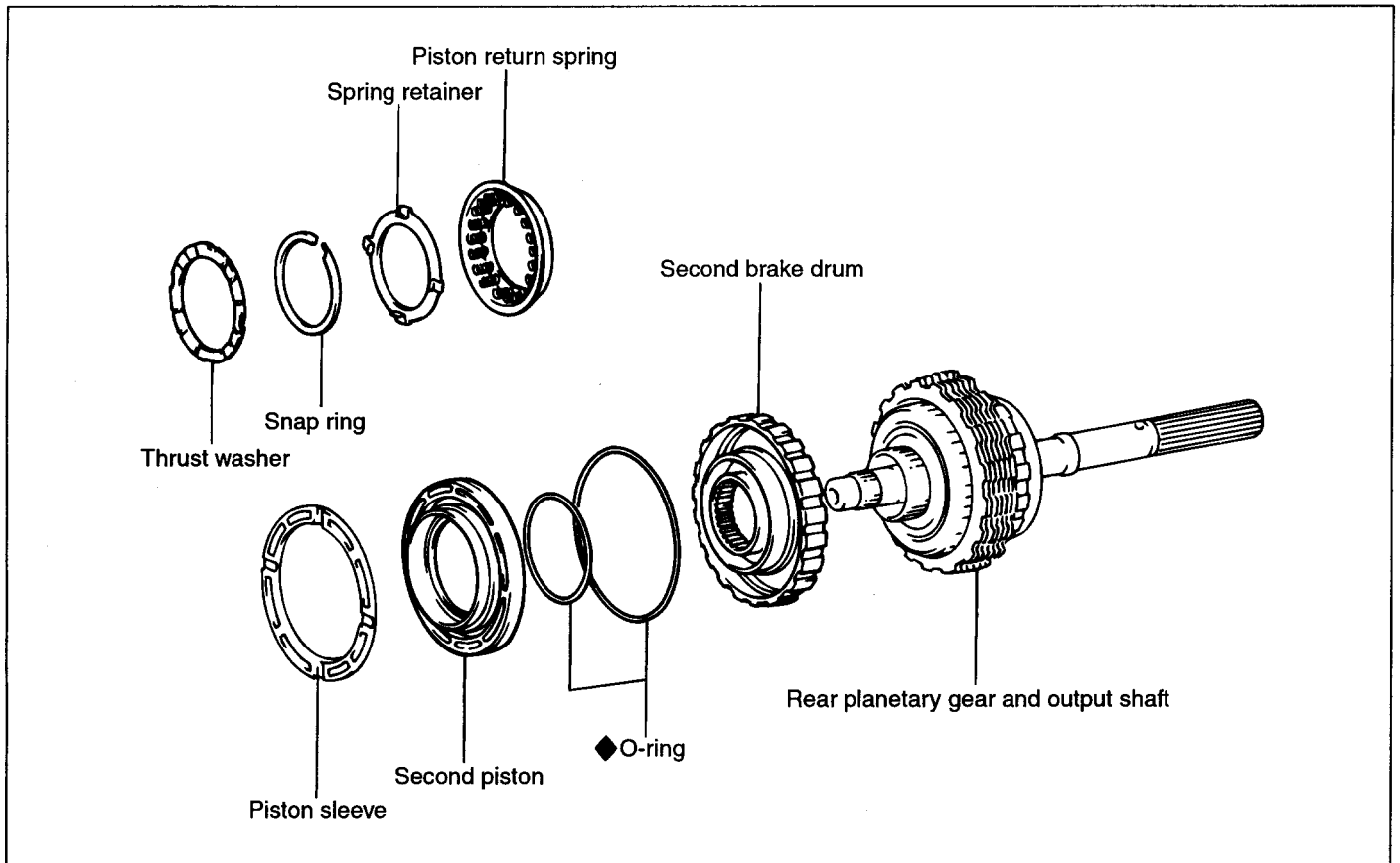


EKLA164A



## SECOND BRAKE

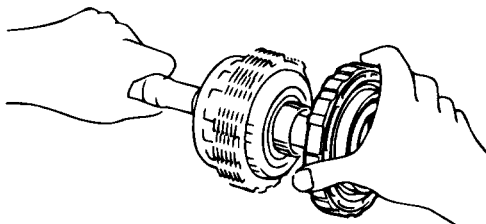
EKMB0490



EKMB049A

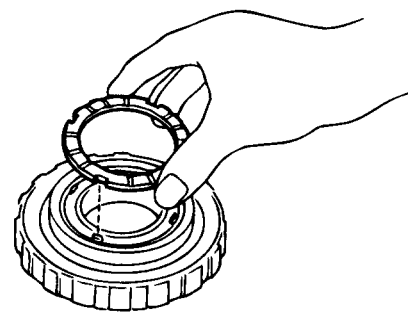
### DISASSEMBLY EKMB0500

1. Remove the second brake assembly from the output shaft.



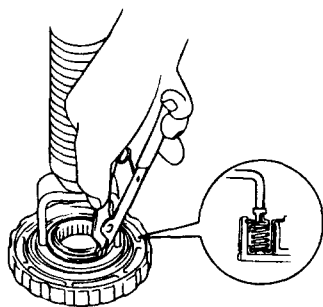
EKLA243A

2. Remove the thrust washer.



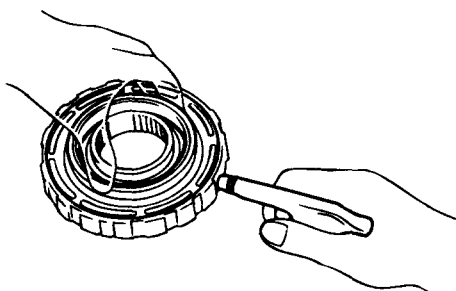
EKLA244A

3. Remove the snap ring, the spring and the piston return spring.



EKLA245A

4. Remove the second brake piston.



EKLA247A

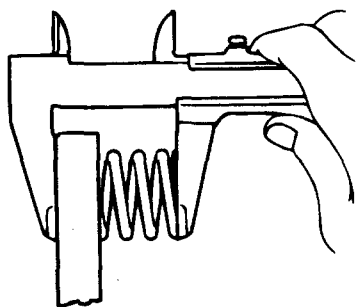
**INSPECTION** EKMB0510

1. Check the free length of the return spring.

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Standard length : 19.64 mm

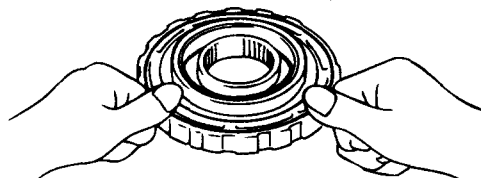
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EKLA248A

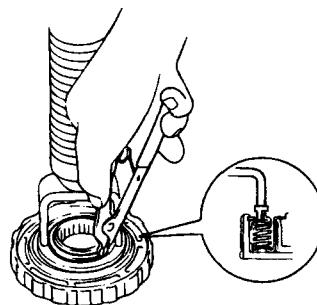
**REASSEMBLY** EKMB0520

1. Being careful not to damage the O-ring, press in the second brake piston into the second brake drum.



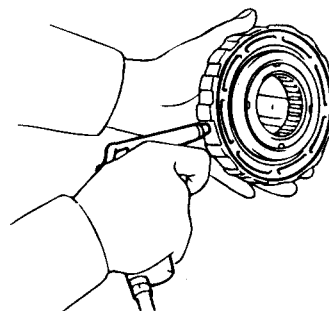
EKLA249A

2. Install the return spring, the spring retainer and the snap ring.



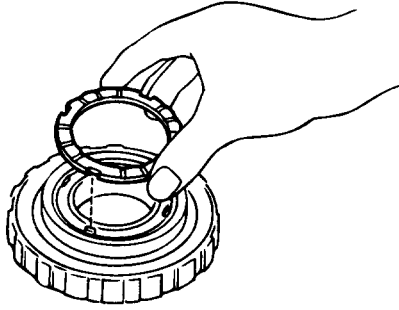
EKLA251A

3. Make sure the second brake piston moves smoothly when applying and releasing the low compressed air to the second brake drum.



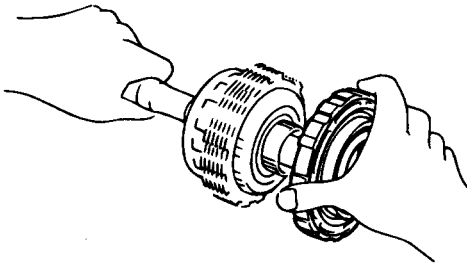
EKLA252A

4. Install the thrust washer.



EKLA253A

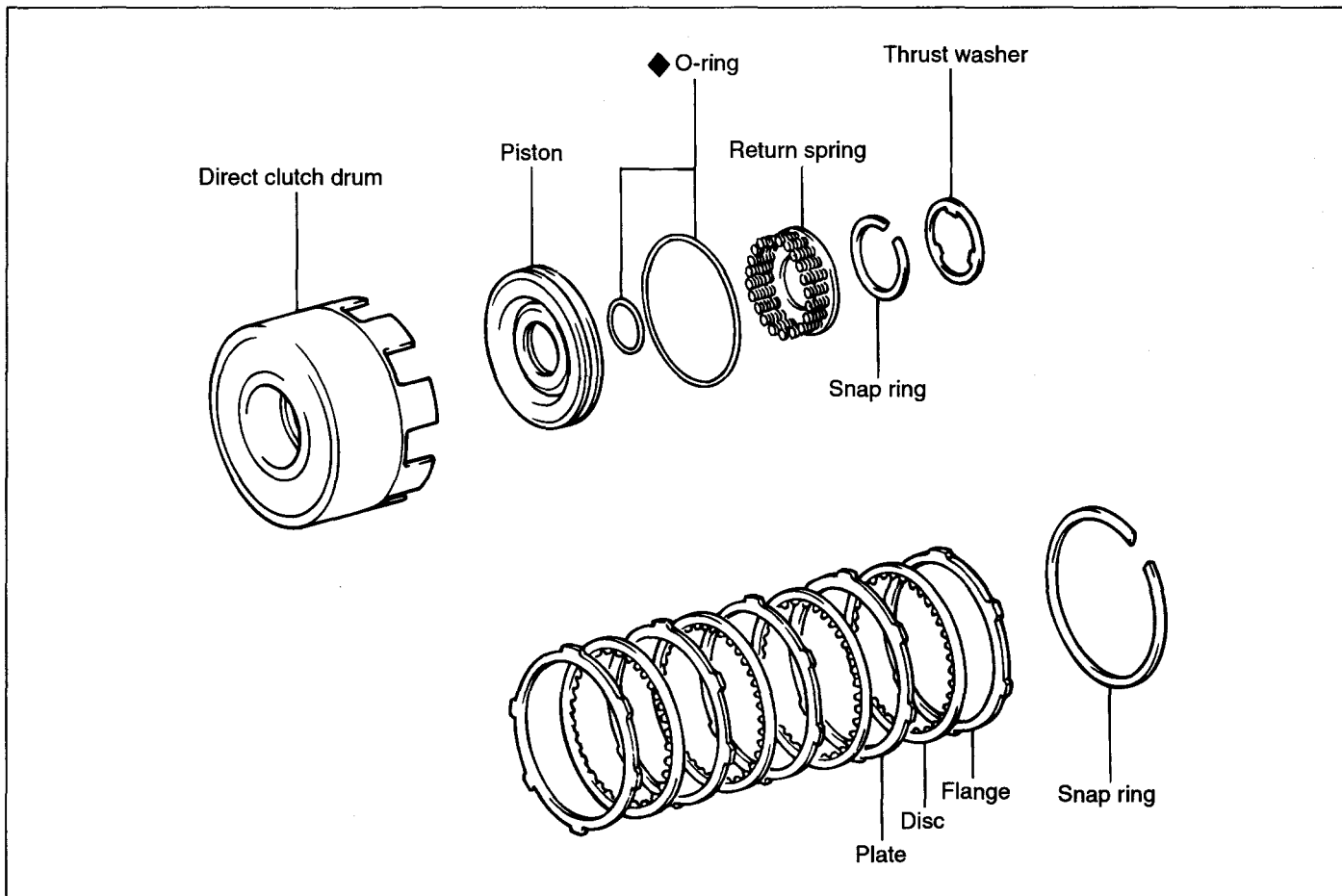
5. Install the second brake assembly to the output shaft.



EKLA254A

**DIRECT CLUTCH**

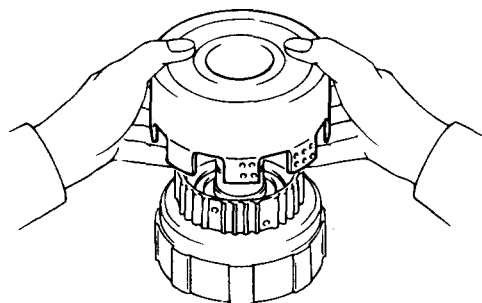
EKMB0350



EKMB035A

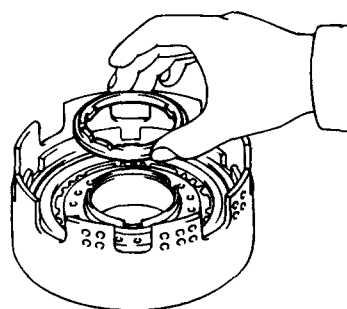
**DISASSEMBLY** EKMB0360

1. Remove the direct clutch drum from the forward clutch.



EKLA168A

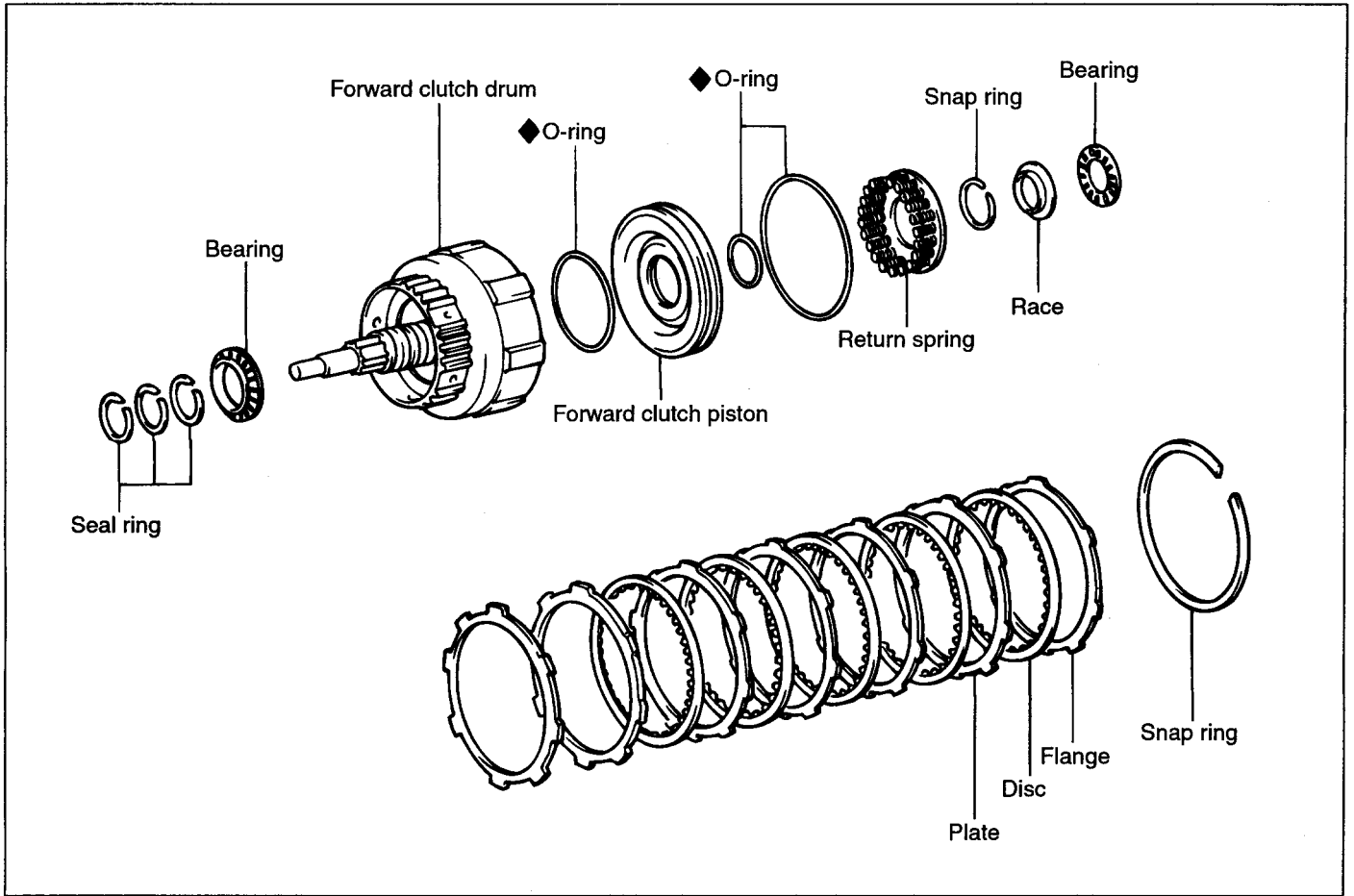
2. Remove the thrust washer from the direct clutch.



EKLA169A

# FORWARD CLUTCH & FRONT CLUTCH

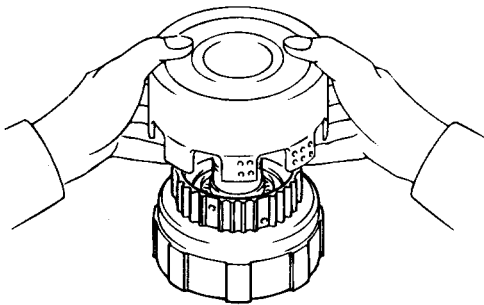
EKMB0370



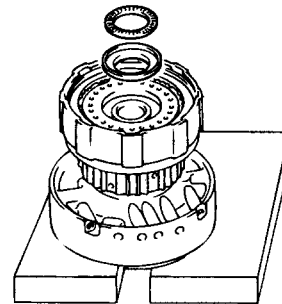
EKMB037A

## DISASSEMBLY EKMB0380

1. Remove the direct clutch and the forward clutch.



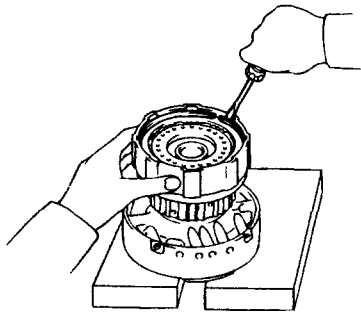
EKLA190A



EKLA191A

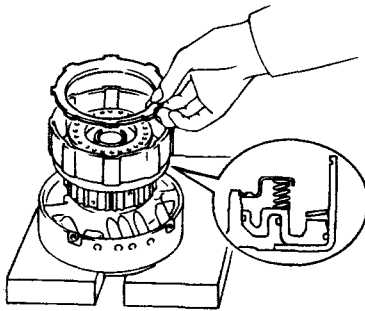
2. Remove the bearing and the race.

- 3. Remove the snap ring, the flange, the disc and the plate.



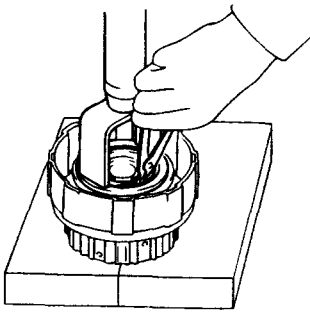
EKLA193A

- 4. Remove the cushion plate.



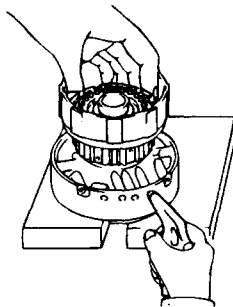
EKLA194A

- 5. Remove the piston return spring and the snap ring.



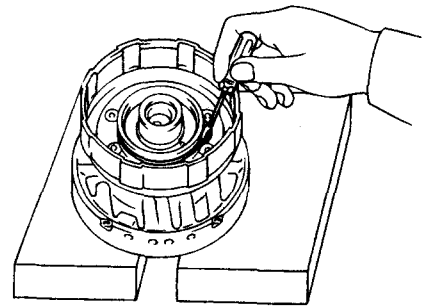
EKLA195A

- 6. Remove the forward clutch piston.



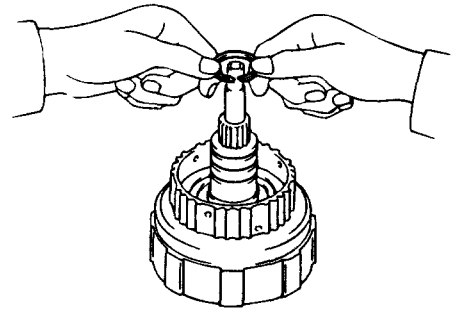
EKLA196A

- 7. Remove the O-ring from the forward clutch.



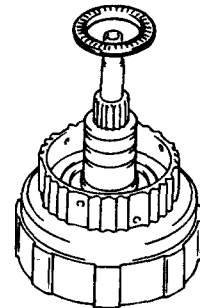
EKLA197A

- 8. Remove the oil seal ring.



EKLA198A

- 9. Remove the bearing and the race.



EKLA199A

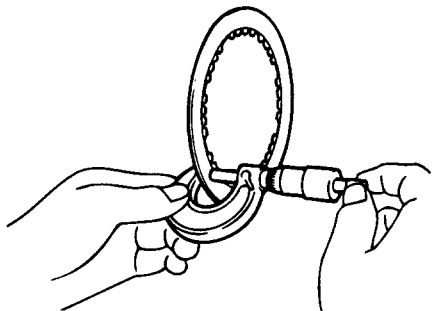
**INSPECTION** EKMB0390

1. Using a micrometer, measure the thickness of the disc.

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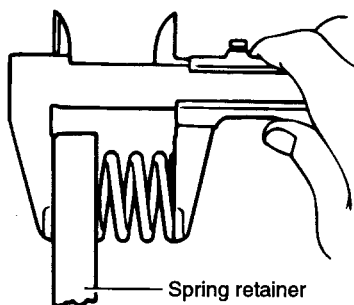
Minimum : 1.84 mm

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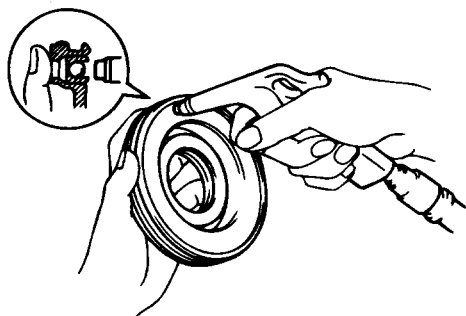
EKLA200A

2. Measure the free length of the return spring.



EKMB039A

3. Check that check ball is free by shaking the piston.



EKLA202A

4. Measure the inner diameter of the forward clutch drum bushing.

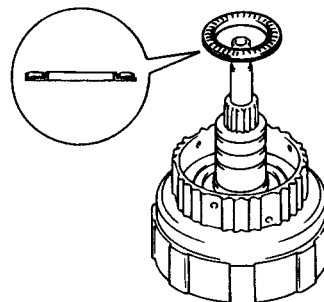
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Maximum I.D : 24.08 mm

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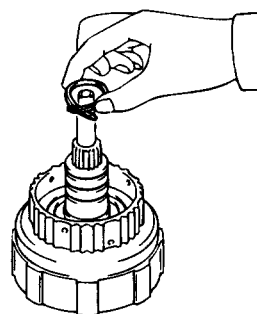
**REASSEMBLY** EKMB0400

1. Reassemble the bearing and the race.



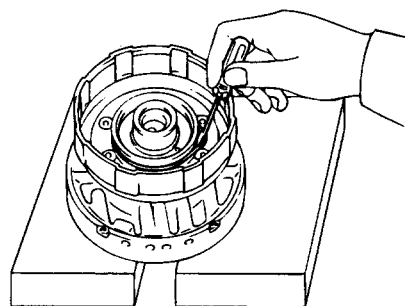
EKLA204A

2. Install the oil seal onto the forward clutch.



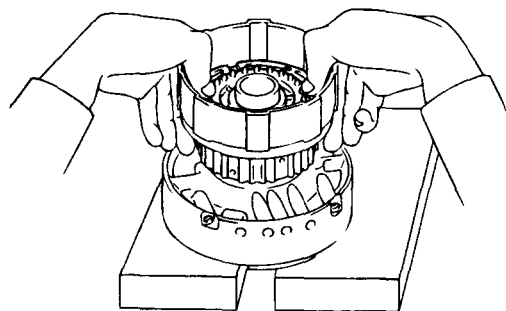
EKLA205A

3. Install the O-ring on the forward clutch drum and the piston.



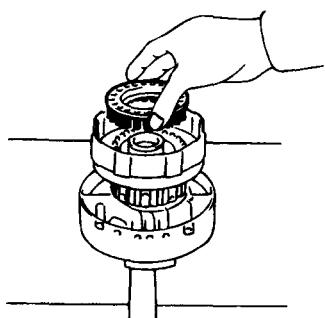
EKLA206A

4. Being careful not to damage the O-rings, press the clutch piston into the forward clutch drum.



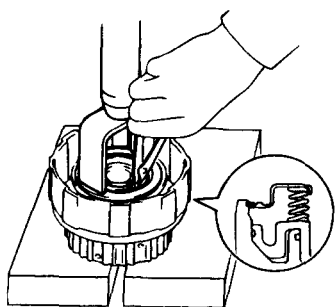
EKLA207A

5. Install the piston return spring and the snap ring.



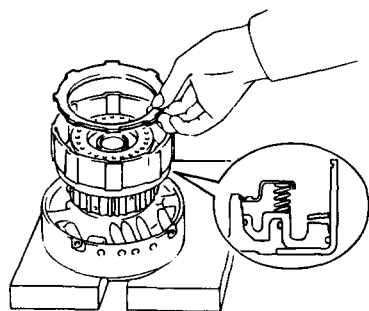
EKLA208A

6. Install the piston return spring and the snap ring.



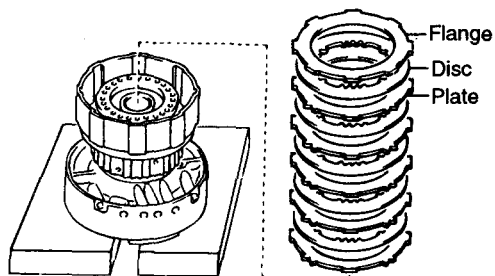
EKLA209A

7. Install the cushion plate.



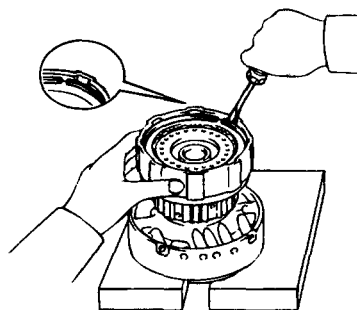
EKLA210A

8. Install the disc, the flange and the plate.



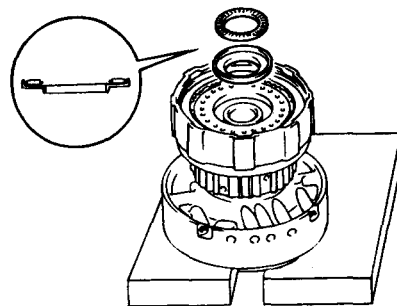
EKMB040A

9. Install the snap ring.



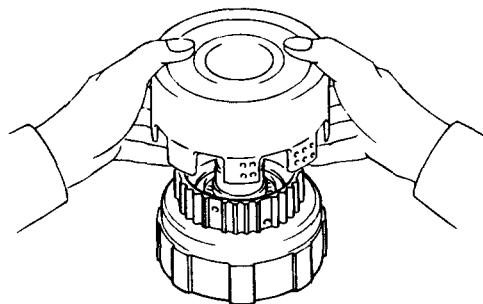
EKLA212A

10. Install the race and the bearing.



EKLA214A

11. Install the direct clutch onto the forward clutch assembly.

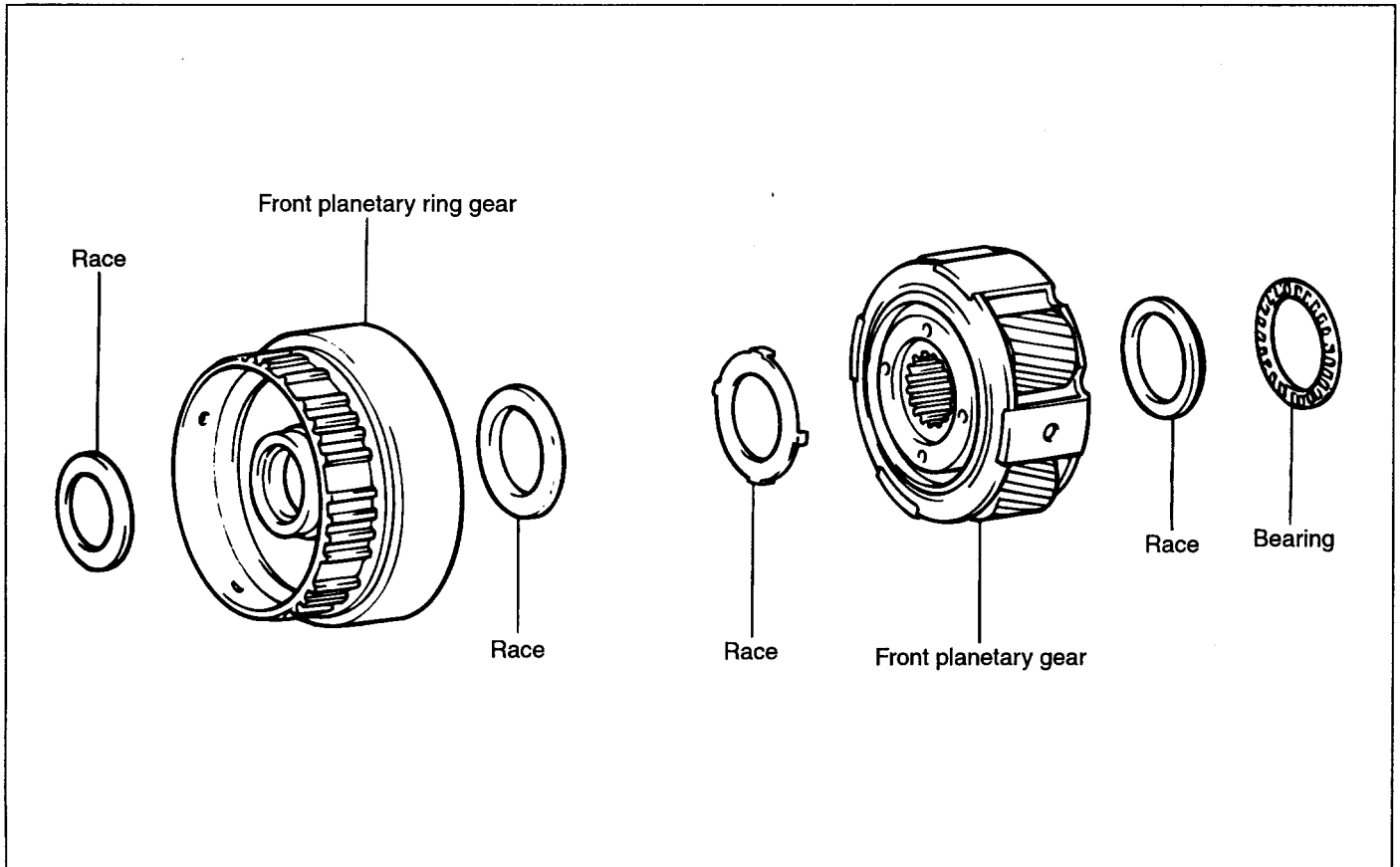


EKLA215A



# FRONT PLANETARY GEAR

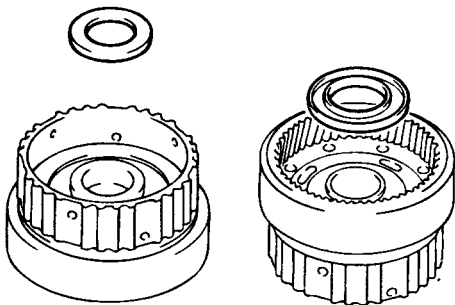
EKMB0410



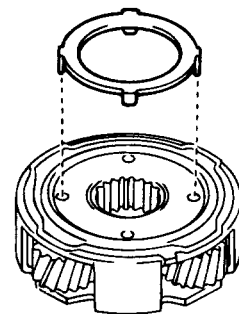
EKMB041A

## DISASSEMBLY EKMB0420

1. Remove the bearing and the race from the front planetary ring gear.



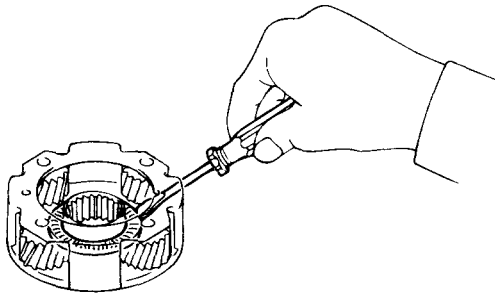
KKMB042A



EKLA219A

2. Remove the race from the front planetary gear.

3. Turn over the planetary gear and remove the bearing and the race.



EKLA220A

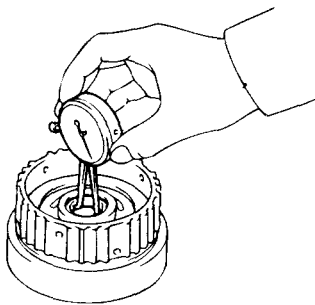
**INSPECTION** EKMB0430

1. Measure the inner diameter of the front planetary ring gear bushing.

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Maximum I.D : 24.08 mm

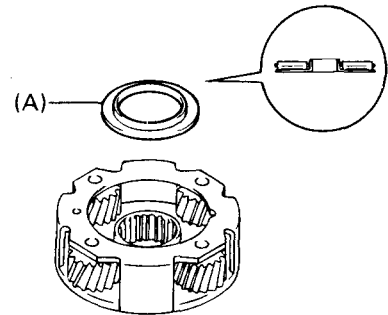
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EKLA221A

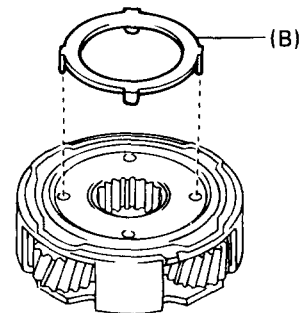
**REASSEMBLY** EKMB0440

1. Install the race onto the planetary gear.



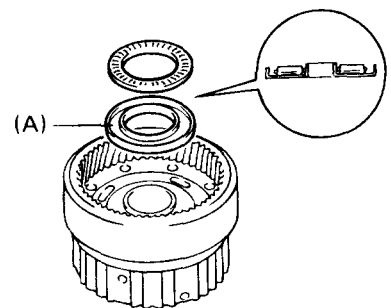
KKMB044A

2. Turn over the planetary gear and install the race.



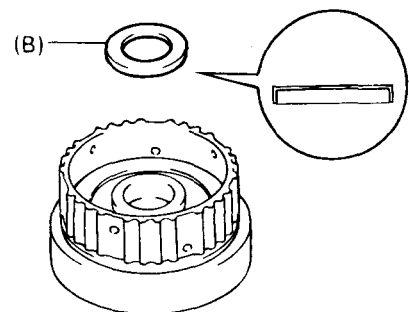
EKLA223A

3. Install the race and the bearing onto the front planetary gear.



EKLA224A

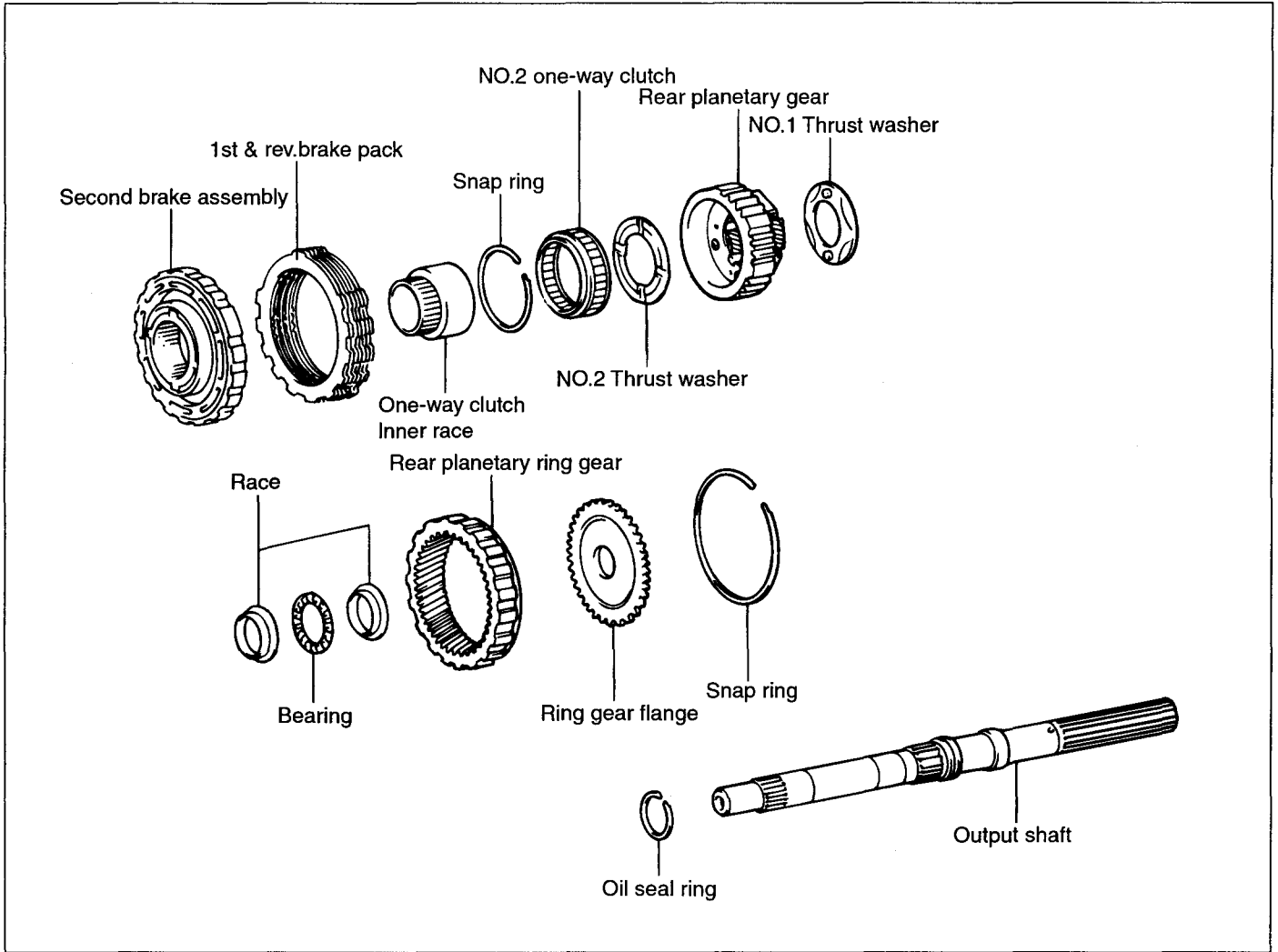
4. Turn over the planetary ring gear and install the race.



EKLA225A

# OUTPUT SHAFT

EKMB0530

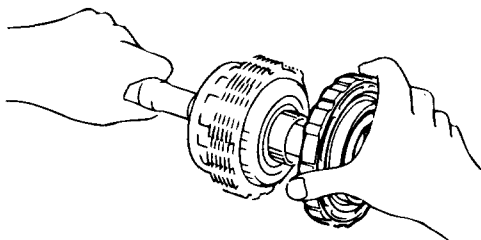


EKMB053A

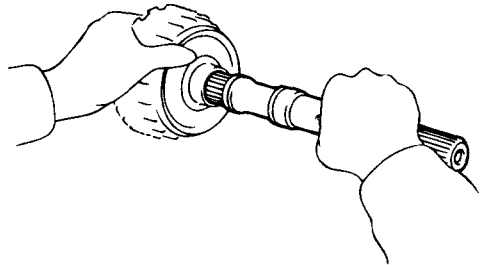
## DISASSEMBLY

EKMB0540

1. Remove the second brake assembly from the output shaft.



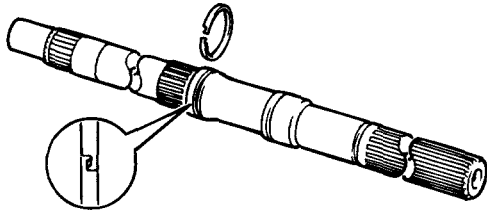
2. Remove the output shaft from the rear planetary gear.



EKLA257A

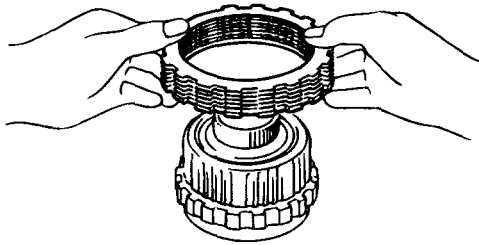
EKLA256A

3. Remove the oil seal from the output shaft.



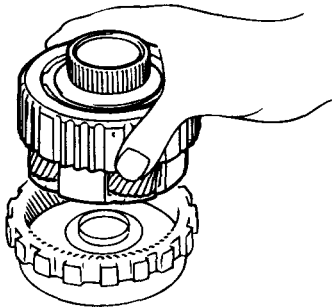
EKLA258A

4. Remove first and reverse brake discs, plates and flange.



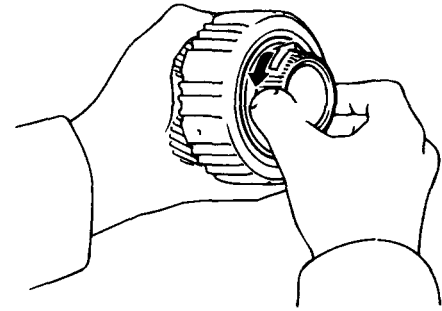
EKLA259A

5. Remove rear planetary gear from rear planetary ring gear.



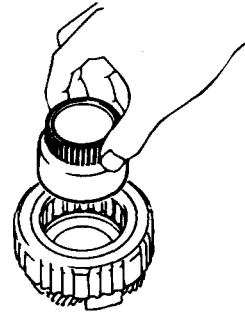
EKLA260A

6. Hold the planetary gear and turn the one-way clutch inner race. The one-way clutch inner race should turn freely counterclockwise and should lock clockwise.



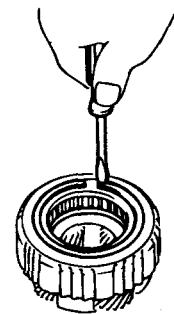
EKLA261A

7. Remove the one-way clutch inner race from the rear planetary gear.



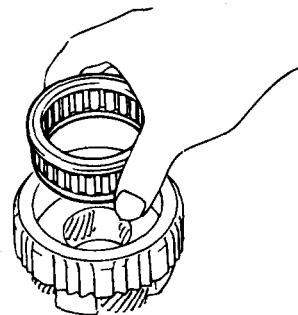
EKLA262A

8. Remove the snap ring with a screwdriver.



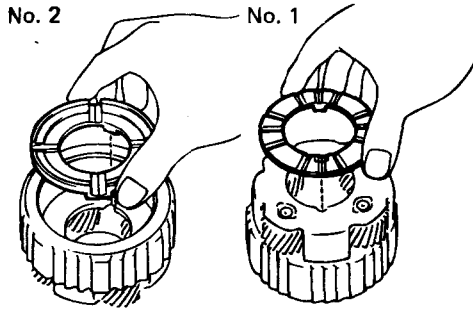
EKLA263A

9. Remove the NO.2 one-way clutch with retainers from the planetary gear.



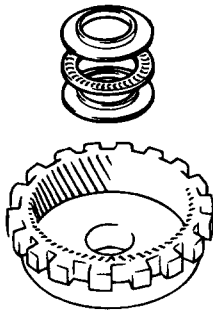
EKLA264A

10. Remove NO.2 and NO.1 thrust washers.



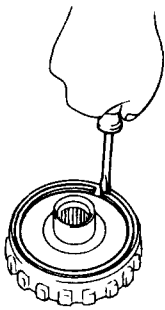
EKLA265A

11. Remove races and bearing from rear planetary ring gear.



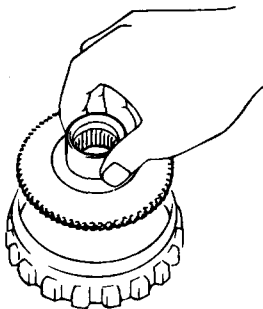
EKLA266A

12. Remove the snap ring.



EKLA267A

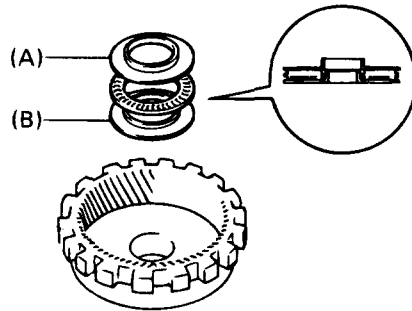
13. Remove the ring gear flange.



EKLA268A

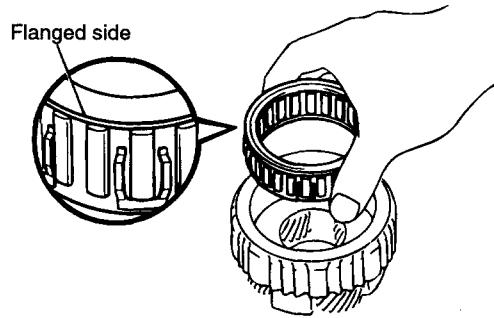
**REASSEMBLY** KKMB0550

1. Install the race and the bearing.



EKLA270A

2. Install the NO.2 one-way clutch.

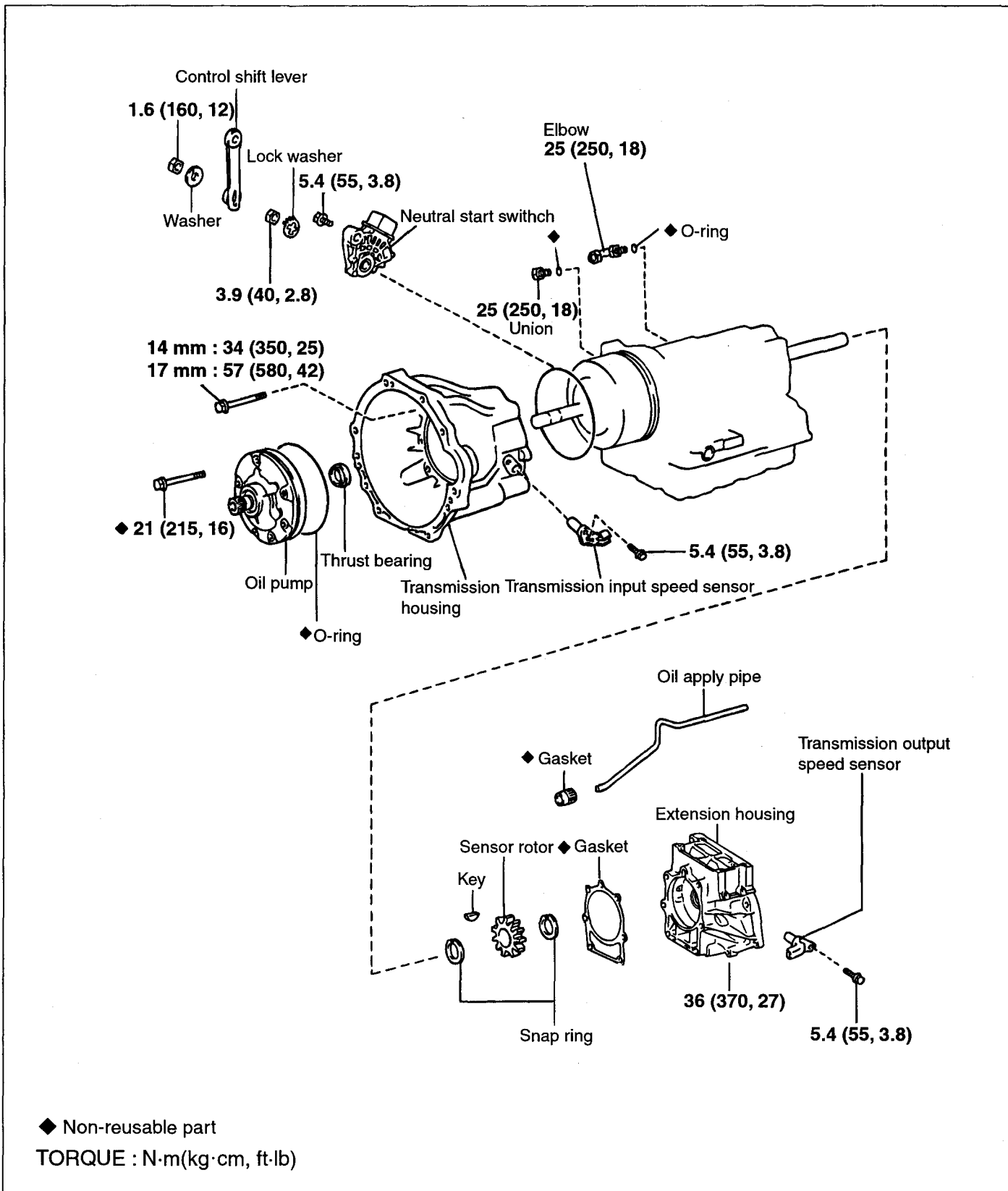


EKMB055A

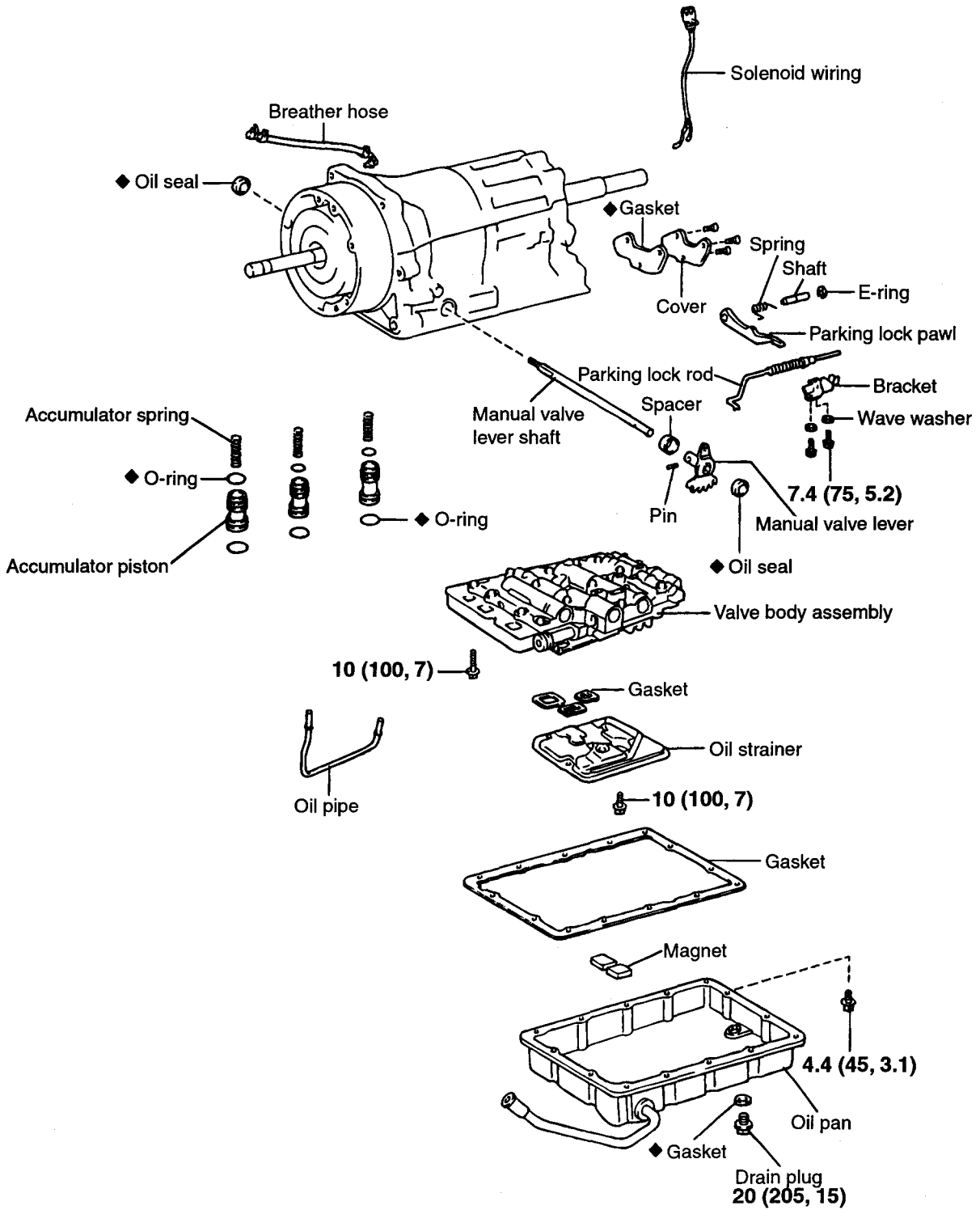
**AUTOMATIC TRANSMISSION**

**(03-II MODEL)** EKMB0700

**COMPONENTS (1)**



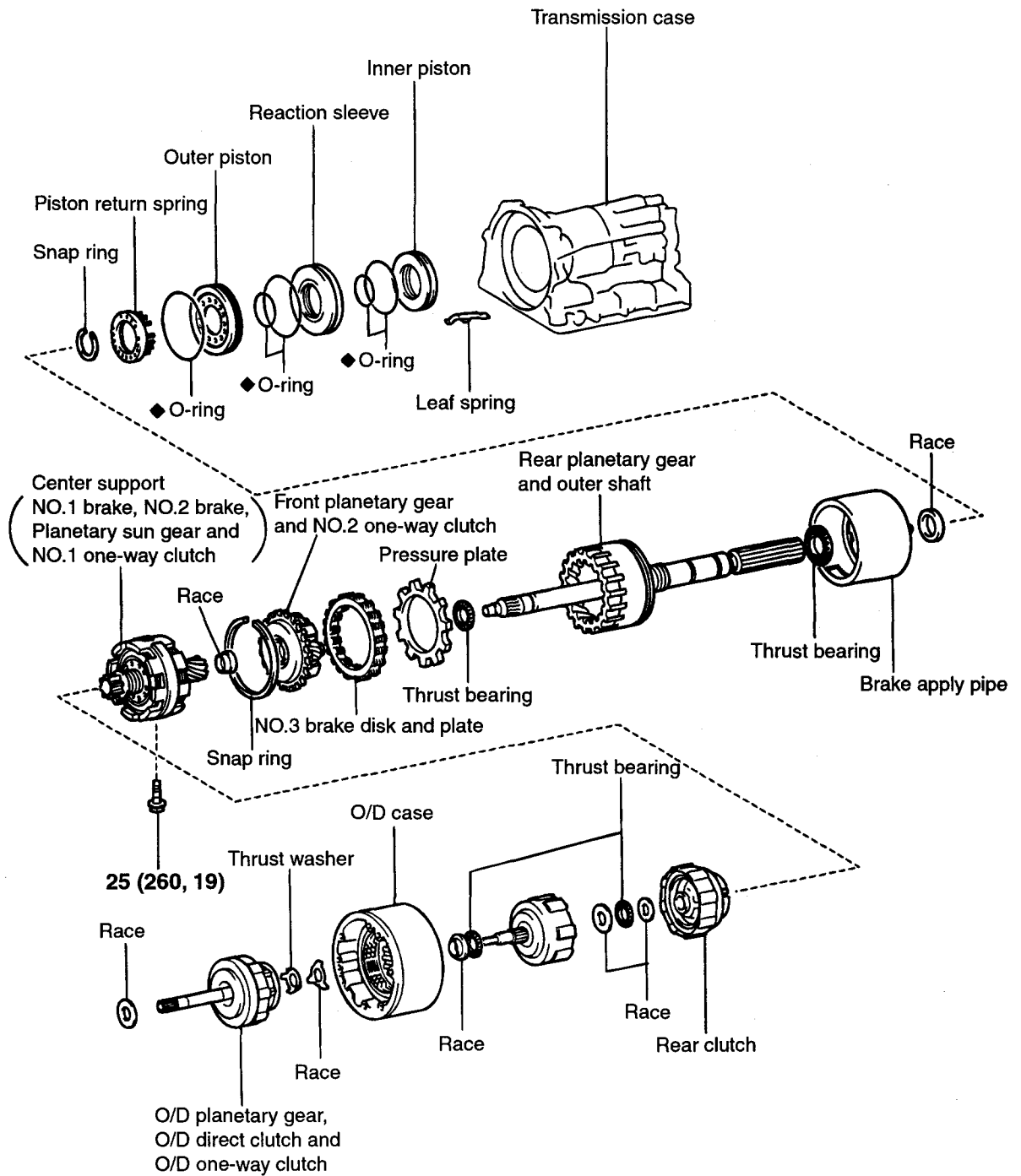
COMPONENTS (2)



◆ Non-reusable part

TORQUE : N·m(kg·cm, ft·lb)

**COMPONENTS (3)**



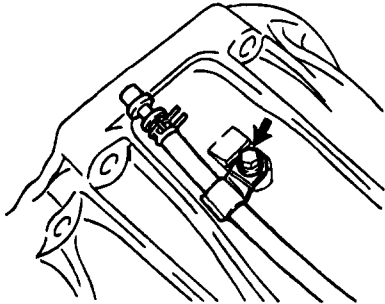
◆ Non-reusable part

TORQUE : N·m (kg·cm, ft·lb)



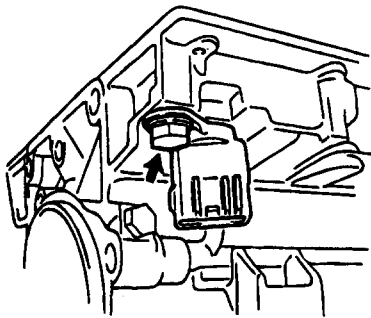
**DISASSEMBLY** EKMB0710

1. Remove breather hose.



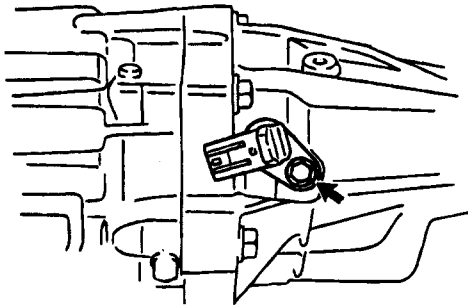
KKMB011A

2. Remove solenoid wire retaining bolt.



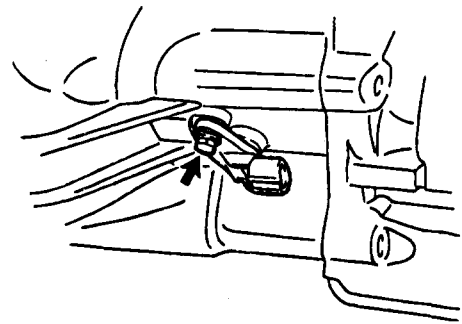
KKMB011B

3. Remove transmission output speed sensor.
  - a. Remove the bolt and transmission output speed sensor.
  - b. Remove the O-ring from the sensor.



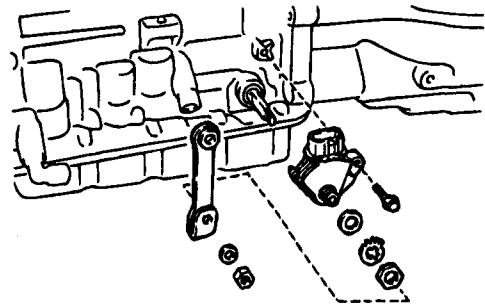
KKMB011C

4. Remove transmission input speed sensor.
  - a. Remove the bolt and transmission input speed sensor.
  - b. Remove the O-ring from the sensor.



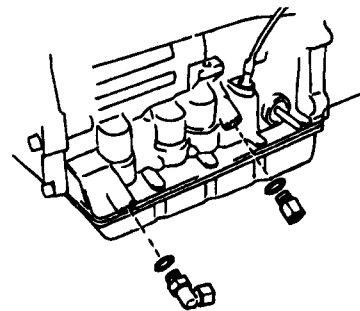
KKMB011D

5. Remove transmission control shift lever.
6. Remove neutral start switch.
  - a. Unstake the lock washer.
  - b. Remove the lock washer.
  - c. Remove the nut and bolt, and then remove the neutral start switch.



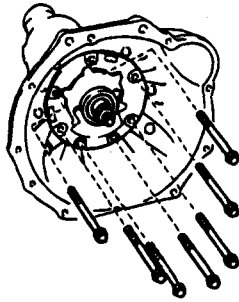
KKMB011E

7. Remove union and elbow.
  - a. Remove the union and elbow.
  - b. Remove the 2 O-rings from the union and elbow.



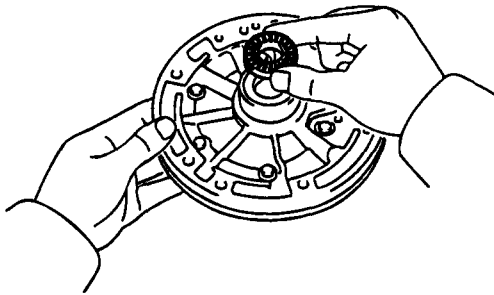
KKMB011F

8. Remove the 7 bolts holding the oil pump to the transmission case.



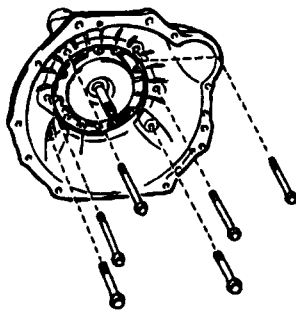
KKMB011G

9. Remove assembled bearing and race from oil pump.



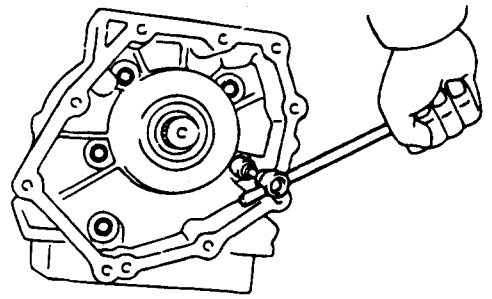
KKMB012A

10. Remove transmission housing.  
 a. Remove the 6 bolts.  
 b. While holding the input shaft, remove the transmission housing.  
 c. Remove the O-ring from the O/D case.



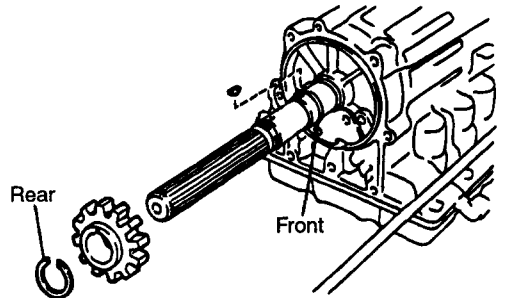
KKMB012B

11. Remove extension housing and gasket.  
 a. Remove the 6 bolts and extension housing.  
 b. Remove the gasket.



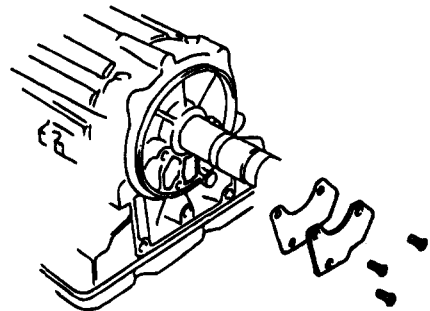
KKMB012C

12. Remove sensor rotor and key.  
 a. Using a snap ring expander, remove the rear side snap ring.  
 b. Remove the sensor rotor and key.  
 c. Using a snap ring expander, remove the front side snap ring.



EKMB071A

13. Remove governor oil strainer.  
 a. Remove the 3 screws, cover and gasket.  
 b. Remove the governor oil strainer from the transmission case.



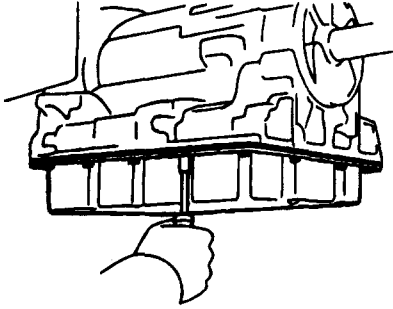
KKMB012E

## 14. Remove oil pan.

**NOTE**

Do not turn the transmission over as this will contaminate the valve body with any foreign matter at the bottom on the pan.

- Remove the 14 bolts.
- Remove the pan by lifting the transmission case.
- Remove the oil pan gasket.



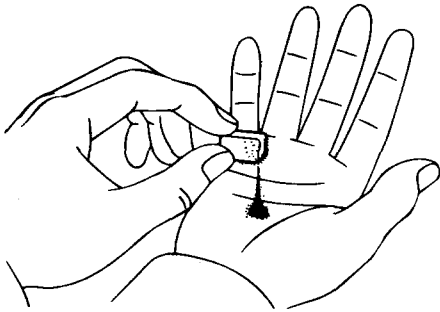
KKMB012F

## 15. Examine particles in pan.

Remove the magnets and use them to collect any steel chips.

Look carefully at the chips and particles in the pan and the magnet to anticipate what type of wear you will find in the transmission.

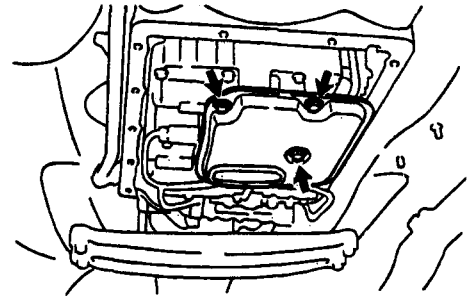
Steel(magnetic) : bearing, gear and plate wear  
Brass(non-magnetic) : bushing wear



EKLA017A

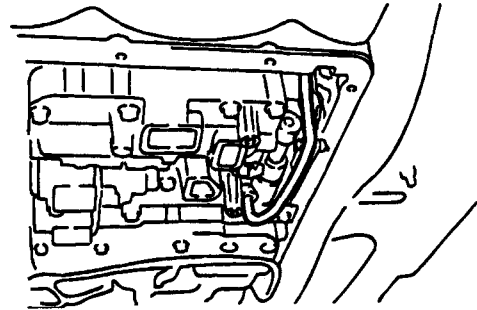
## 16. Remove oil strainer.

- Remove the 3 bolts and oil strainer.
- Remove the 3 gaskets.



KKMB012H

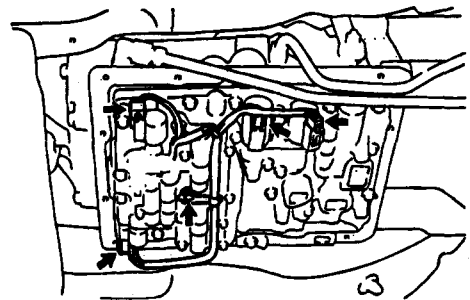
## 17. Pry up both oil pipe ends with a large screwdriver and remove the oil pipe.



KKMB012I

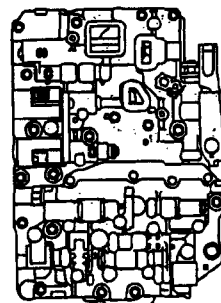
## 18. Remove solenoid wiring.

- Remove the bolt.
- Remove the bolt and clamp.
- Disconnect the 4 connectors from the solenoid.



KKMB013A

## 19. Remove valve body.



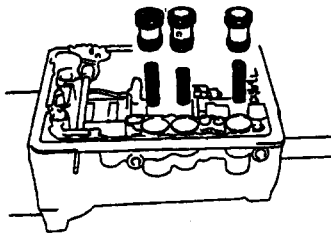
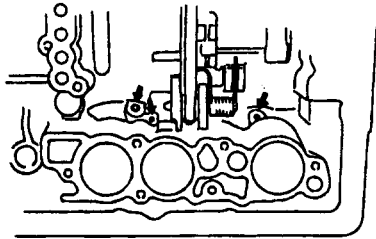
KKMB013B

20. Remove accumulator piston and spring.

**CAUTION**

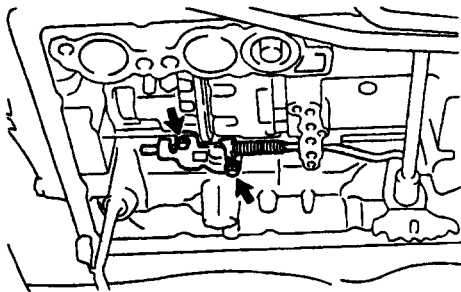
**Keep face away to avoid injury. Do not use regular high-pressure air.**

- a. Position a rag to catch each piston.
- b. Applying compressed air to the oil holes shown, and remove the 3 pistons and springs.
- c. Remove the 2 O-rings from each piston.



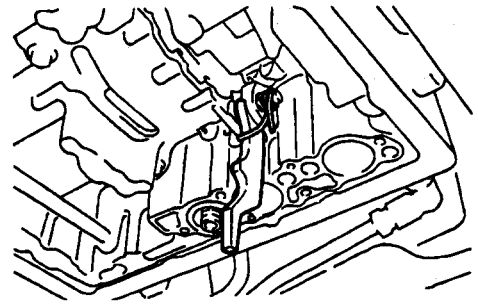
KKMB013C

21. Remove parking lock pawl bracket.



KKMB013D

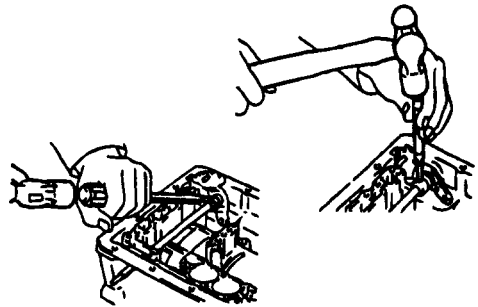
22. Remove spring, parking lock pawl pin and parking lock pawl.



KKMB013E

23. Remove manual valve lever shaft.

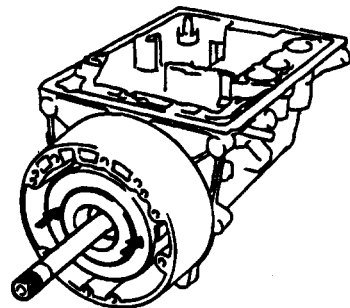
- a. Using a hammer and screwdriver, pry and shift the spacer.
- b. Using a hammer and pin punch, drive out the pin.
- c. Slide the manual valve lever shaft out case and remove the manual valve lever and spacer.



KKMB013F

24. Measure installation distance of O/D direct clutch

- a. Push the input shaft and drum toward the rear to make sure the O/D direct clutch is installed correctly.

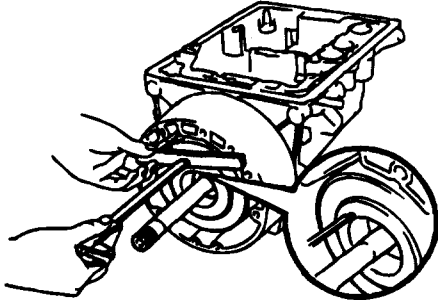


KKMB013G

- b. Using calipers, measure distance between the tops of tool and clutch drum.

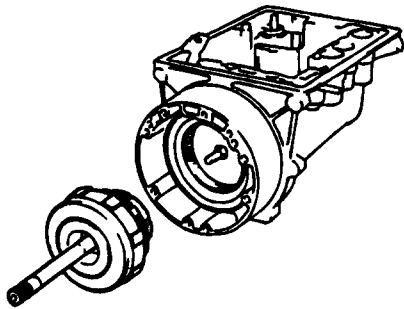
 **NOTE**

Make a note of the measurement for the reference at assembly.



KKMB014A

25. Remove O/D planetary gear unit with O/D direct clutch and one-way clutch.

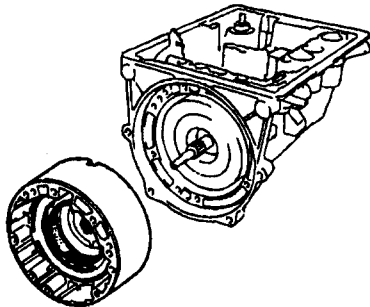


KKMB014B

26. Remove O/D case.

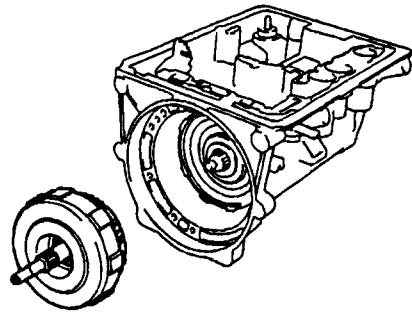
 **NOTE**

When the O/D case is removed, the front clutch sometimes adheres to it.



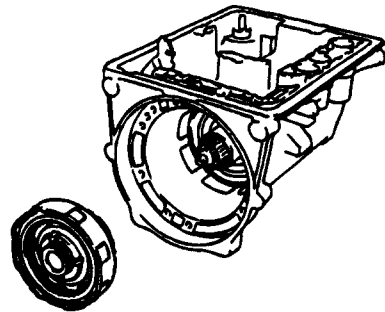
KKMB014C

27. Remove front clutch.



KKMB014D

28. Remove rear clutch.



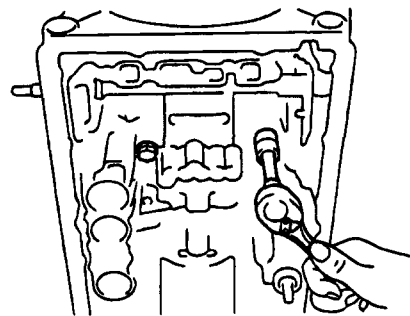
KKMB014E

29. Remove center support.

- a. Remove the 2 center support bolts and wave washers.

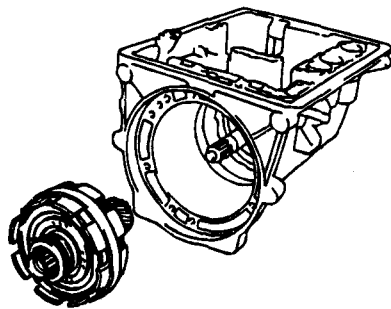
 **NOTE**

After removing 1 bolt, the other 1 will be loose.

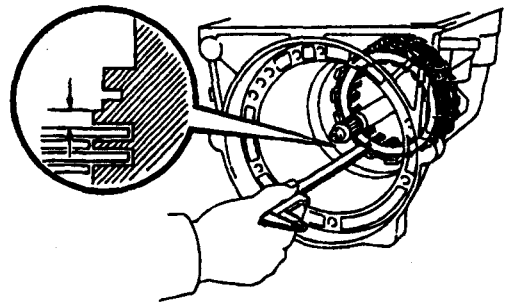


KKMB014F

- b. Remove the center support from the transmission case.



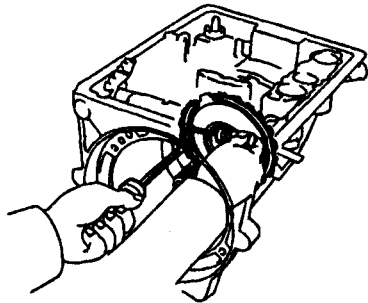
KKMB014G



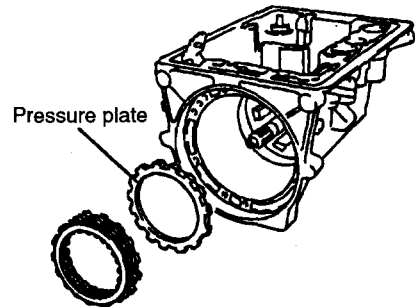
KKMB015B

- 32. Remove NO.3 brake pack and pressure plate.
  - a. Remove the 5 discs and 4 plates.
  - b. Remove the pressure plate.

- 30. Remove front planetary gear unit.
  - a. Using 2 screwdrivers, remove the snap ring.



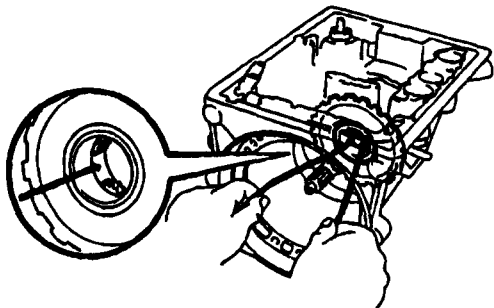
KKMB014H



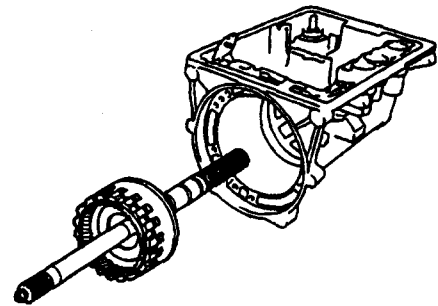
EKMB071B

- b. Insert the 2 wires into the planetary gear and remove it.

- 33. Remove rear planetary gear unit and output shaft.



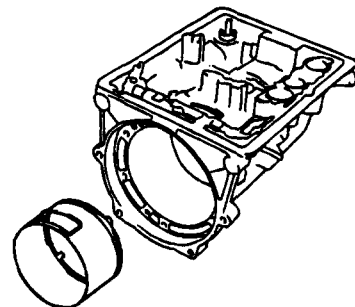
KKMB015A



KKMB015D

- 34. Remove brake apply pipe.

- 31. Check pack clearance of NO.3 brake. Using calipers, measure the clearance between the disc and transmission case, as shown.



KKMB015E

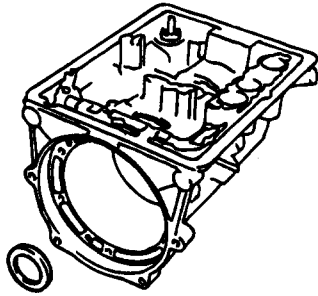
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Clearance : 0.52 - 1.27mm

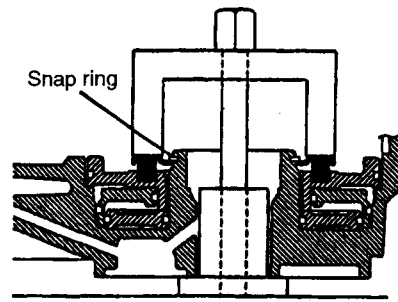
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If the values are non-standard, inspect the discs.

35. Remove race.

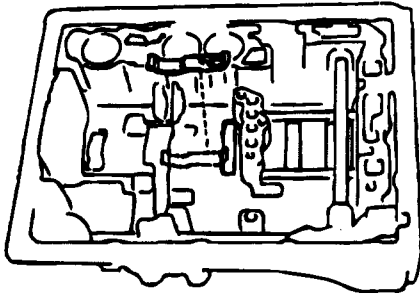


KKMB015F



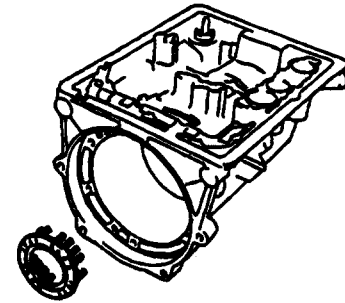
EKMB071C

36. Remove leaf spring.



KKMB015G

c. Remove the piston return spring.



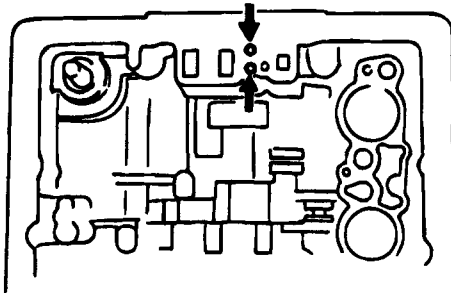
KKMB015J

37. Check NO.3 brake piston moving.

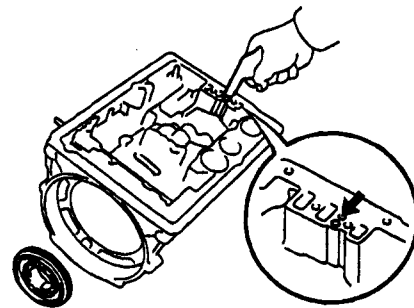
Make sure the NO.3 brake pistons move smoothly when applying and releasing the compressed air into the transmission case.

d. Hold outer piston with hand, apply compressed air to the transmission case to remove the outer piston. If the piston does not pop out with compressed air, lift the piston out with needle-nose pliers.

e. Remove the O-ring from the outer piston.



KKMB015H

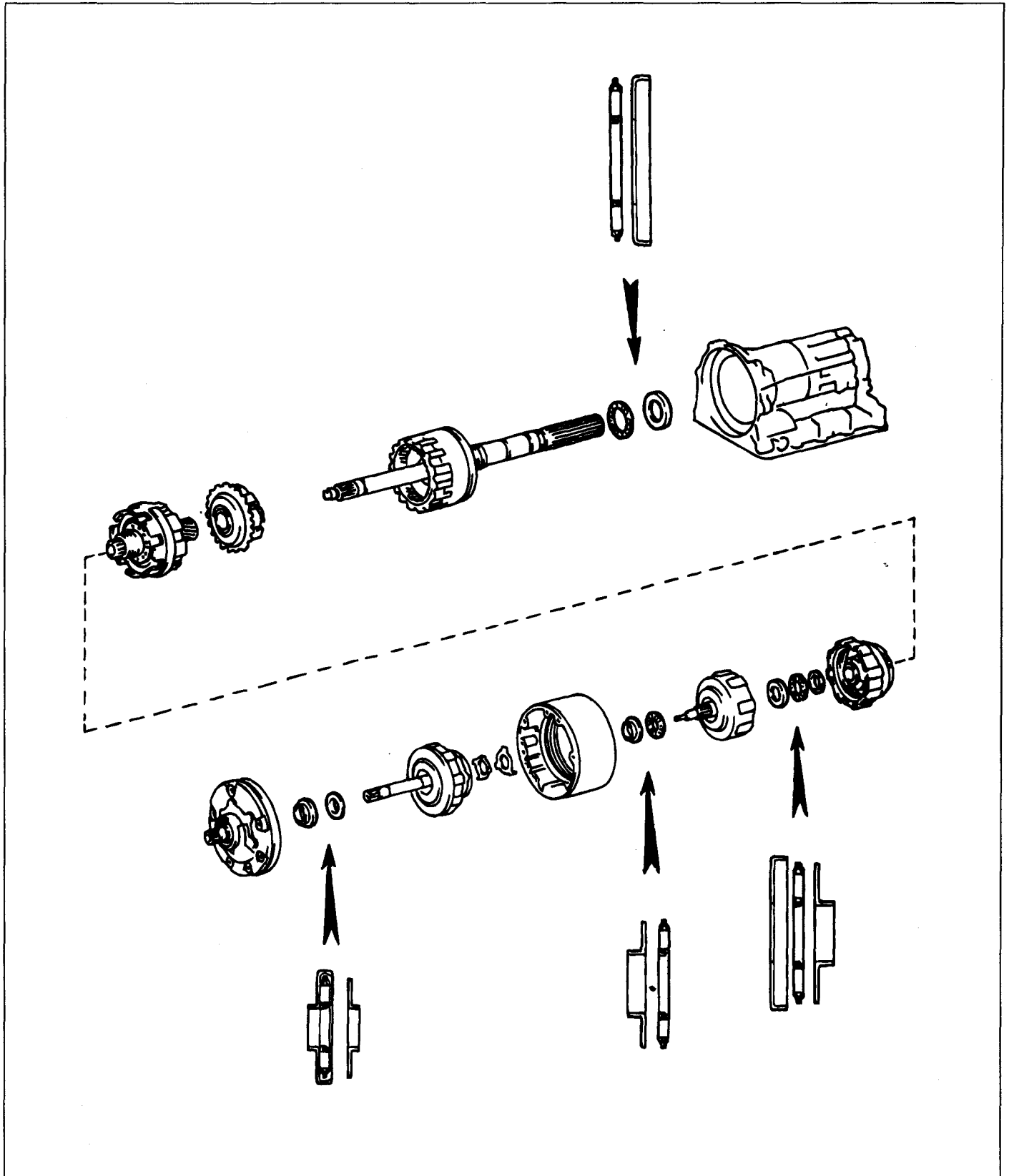


KKMB015K

38. Remove components of NO.3 brake piston.

- a. Set SST on the spring retainer, and compress the return springs
- b. Using a snap ring expander, remove the snap ring.

BEARING AND RACES INSTALLATION POSITION AND DIRECTION

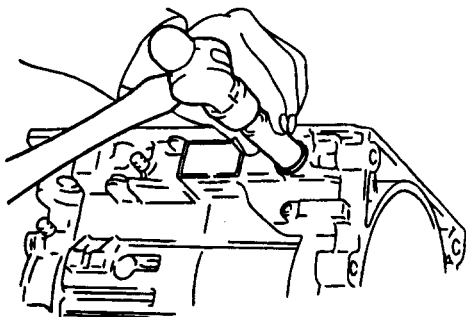




**INSTALLATION**

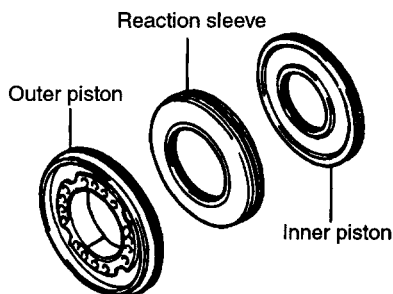
EKMB0720

1. Install manual valve lever, shaft and oil seal.
  - a. Drive in 2 new oil seals as far as they will go.
  - b. Coat the oil seal lips with grease.



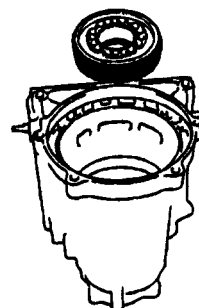
KKMB017A

- b. Assemble the inner piston, reaction sleeve and outer piston.



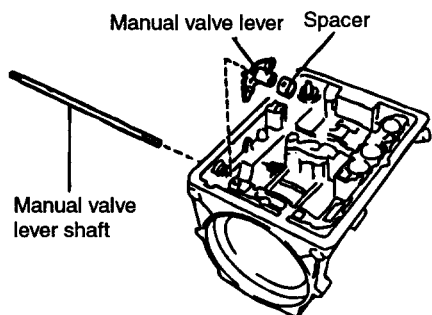
EKMB072B

- c. Stand up the transmission case.
- d. Being careful not to damage the O-rings, press in the assembled pistons into the transmission case with hand.



KKMB017E

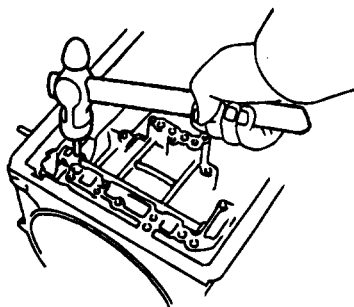
- c. Assembled a new spacer to the manual valve lever.
- d. Install the manual valve lever shaft to the transmission case through the manual valve lever.



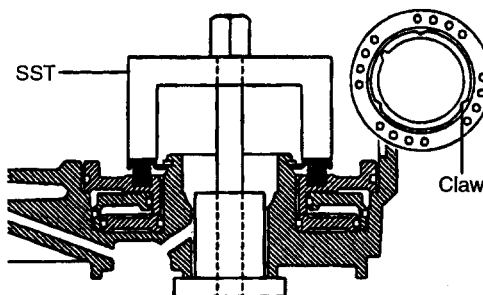
EKMB072A

- e. Set SST as shown, and compress the return springs with SST.
- f. Install the snap ring with a snap ring expander. Be sure that the end gap of the snap ring is not aligned with the spring seat claw.

- e. Drive in the pin to the shaft.



KKMB017C



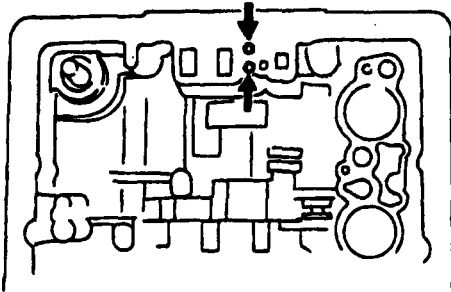
EKMB072C

2. Install components of NO.3 brake piston.
  - a. Coat 5 new O-ring goes on the inner piston, reaction sleeve and outer piston.

**NOTE**

The thinner O-ring goes on the outside of the reaction sleeve.

3. Check NO.3 brake pistons moving.  
Make sure that the NO.3 brake pistons move smoothly when applying and releasing the compressed air into the transmission case.

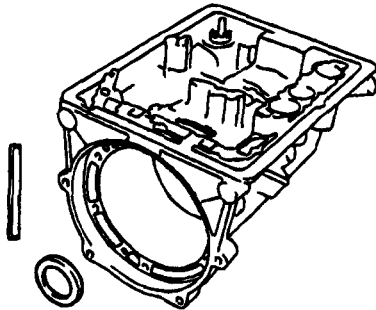


KKMB017G

4. Install race.  
Coat the race with petroleum jelly and install it onto the transmission case.

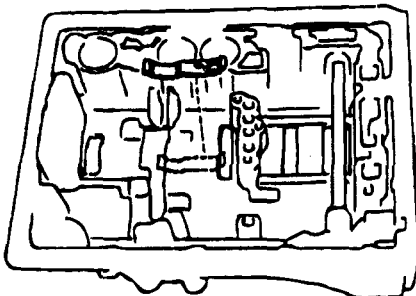
**RACE DIAMETER :**

	Inside mm (in.)	Outside mm (in.)
Race	39.2 (1.543)	57.5 (2.264)



KKMB017H

5. Install leaf spring.



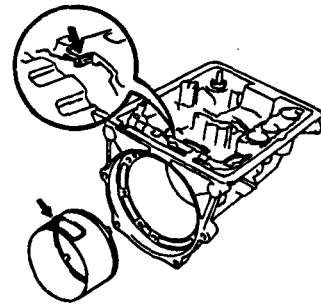
KKMB018A

6. Install break apply pipe.



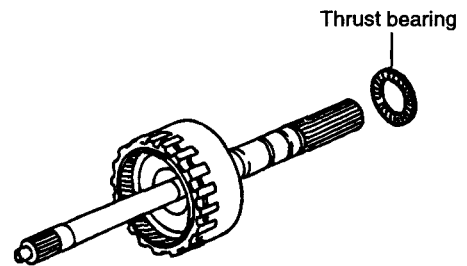
**NOTE**

Make sure that the lips of the pipe end are completely inserted into the outer piston.



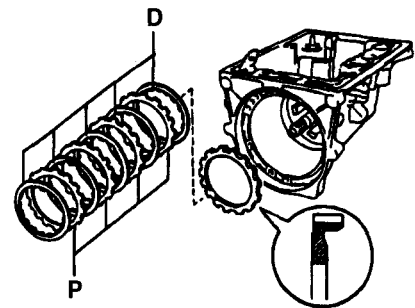
KKMB018B

7. Install rear planetary gear unit and output shaft.



EKMB072D

8. Install pressure plate, disc and plate.
  - a. Install the pressure plate, the flat surface facing forward.
  - b. Install the 5 discs and 4 plates.  
**Install in order : P=Plate D=Disc  
D-P-D-P-D-P-D-P-D**

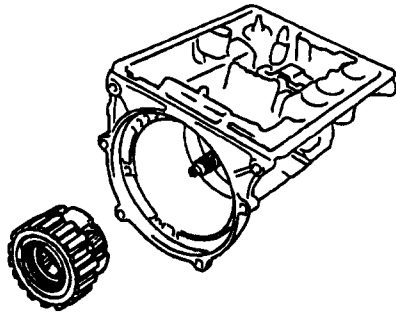


KKMB018D

9. Install front planetary gear unit.
  - a. Remove the one-way clutch inner race from the planetary gear unit.
  - b. Install the front planetary gear unit.

**NOTE**

Mesh the splines of the planetary gear with the flukes of the discs by rotating and pushing the planetary gear.

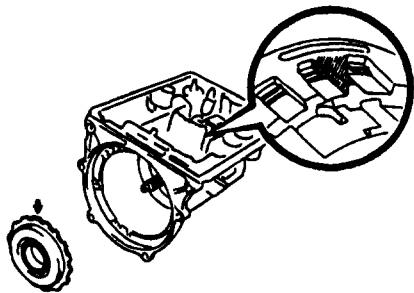


KKMB018E

- c. Position the notched tooth of the inner race toward the valve body side of the case. Push it into place.

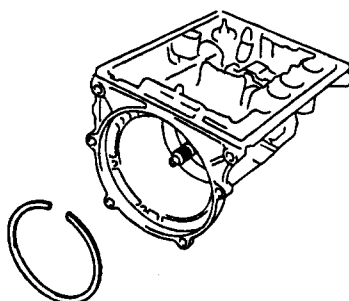
**NOTE**

The inner race is correctly installed if the snap rings groove is fully visible.



KKMB018F

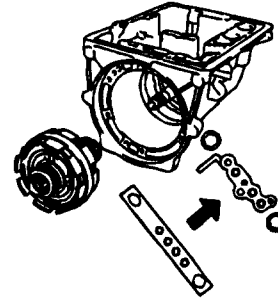
- d. Using a screwdriver, install the snap ring.



KKMB018G

10. Install center support.
 

Aim the bolt and oil holes of the center support toward the valve body side, and align them with the bolt and oil holes of the transmission case and insert.



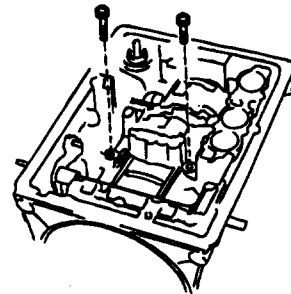
KKMB018H

11. Install the 2 wave washers and bolts.

**NOTE**

First tighten the accumulator piston side.

**Torque : 25 N·m (260 kgf·cm, 19 ft·lbf)**

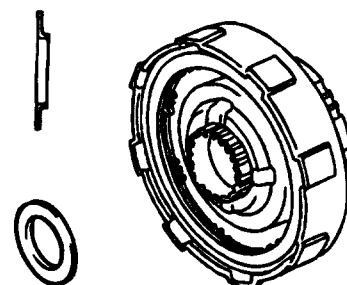


KKMB019I

12. Install rear clutch.
  - a. Coat the race with petroleum jelly and install it onto the rear clutch.

**RACE DIAMETER :**

	Inside mm (in.)	Outside mm (in.)
Race	27.6 (1.087)	44.5 (1.752)

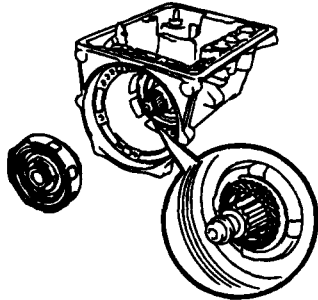


KKMB019B

b. Install the rear clutch.

**NOTE**

- Mesh the splines of the rear clutch with the flukes of the disc by rotating and pushing the rear clutch.
- If the rear clutch is fully meshed with the center support, the splined center of the clutch will be flush with the end of the sun gear shaft.



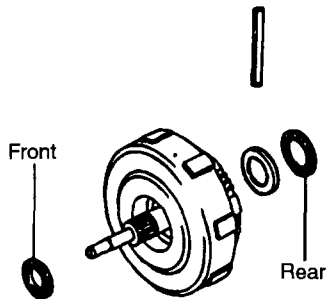
KKMB019C

13. Install front clutch.

- a. Coat the bearings and race with petroleum jelly and install them onto the front clutch.

**BEARING AND RACE DIAMETER :**

	Inside mm (in.)	Outside mm (in.)
Bearing Front)	23.4 (0.921)	37.5 (1.476)
Race	30.1 (1.185)	48.5 (1.909)
Bearing Gear)	28.4 (1.118)	46.4 (1.827)

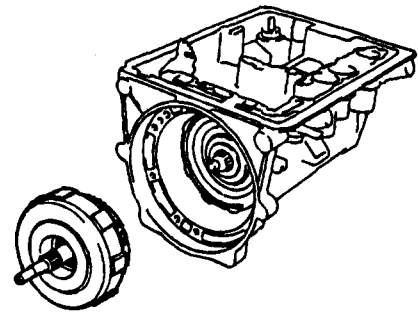


EKMB072E

b. Install the front clutch.

**NOTE**

Mesh the splines of the front clutch with the flukes of the discs by rotating and pushing the front clutch.

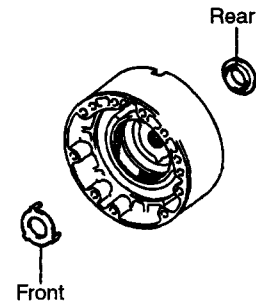


KKMB019E

14. Coat the races with petroleum jelly and install them onto the O/D case.

**RACES DIAMETER :**

	Inside mm (in.)	Outside mm (in.)
Bearing (Front)	23.0 (0.906)	48.0 (1.890)
Bearing (Gear)	24.1 (0.946)	37.3 (1.469)



EKMB072F

15. Install O/D planetary gear unit with O/D direct clutch and one-way clutch.

- a. Coat the thrust washer with petroleum jelly and install it onto the O/D planetary gear.
- b. Coat the race with petroleum jelly and install it onto the O/D planetary gear.

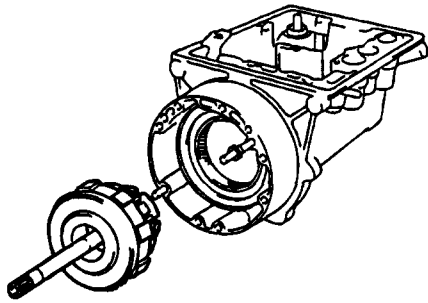
**RACE DIAMETER :**

	Inside mm (in.)	Outside mm (in.)
Race	24.3 (0.957)	39.1 (1.539)

c. Install the O/D planetary gear with the O/D direct clutch and one-way clutch.

**NOTE**

Mesh the splines of the O/D planetary gear with the flukes of the discs by rotating and pushing the O/D planetary gear.

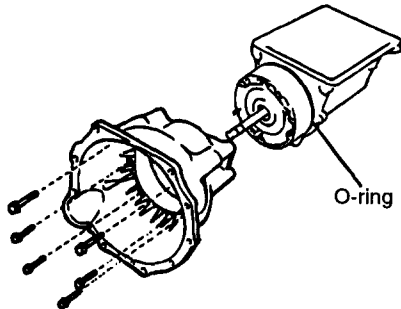


KKMB019H

16. Install transmission housing.
  - a. Coat a new O-ring with ATF and install it around the O/D case.
  - b. Install the transmission housing and 6 bolts.
  - c. Tighten the bolts.

**Torque :**

**10 mm bolt : 34 N·m (345 kgf·cm, 25 ft·lbf)**  
**12 mm bolt : 57 N·m (580 kgf·cm, 42 ft·lbf)**

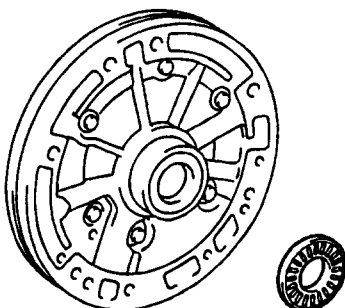


EKMB072H

17. Install oil pump.
  - a. Coat the assembled bearing and race with petroleum jelly and install it onto the oil pump.

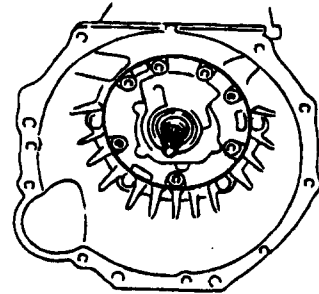
**ASSEMBLED BEARING AND RACE DIAMETER :**

	Inside mm (in.)	Outside mm (in.)
Bearing and race	24.3 (0.957)	43.2 (1.701)



KKMB020B

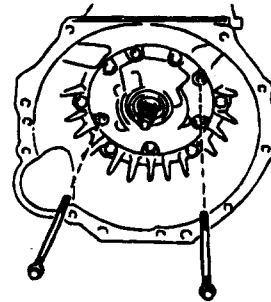
- b. Coat a new O-ring with ATF and install it around the pump body.



KKMB020C

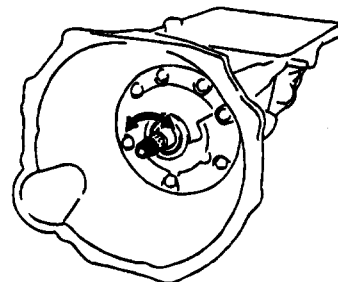
- c. Temporarily install the 2 bolts.
- d. Tighten the all bolts.

**Torque : 21 N·m (215 kgf·cm, 16 ft·lbf)**



KKMB020D

18. Check input shaft rotation.  
 Make sure the input shaft rotates smoothly.



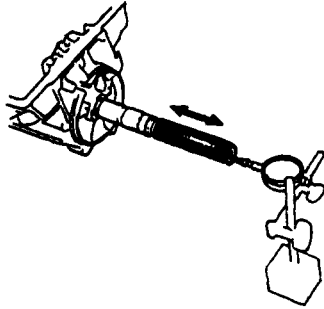
KKMB020E

19. Check output shaft.
  - a. Using a dial indicator, measure the end play of the output shaft with hand.

**End play : 0.3 - 0.9 mm (0.012 - 0.035 in.)**

If the values are non-standard, check for an improper installation.

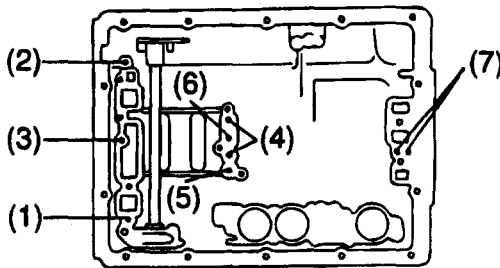
- b. Check to see that output shaft rotates smoothly.



KKMB020F

20. Check for the sound of operation while applying compressed air into the oil holes indicated in the illustration.
- a. O/D direct clutch
  - b. O/D brake
  - c. Rear clutch
  - d. Front clutch
  - e. NO.1 brake
  - f. NO.2 brake
  - g. NO.3 brake

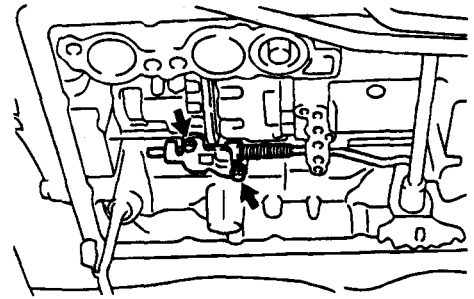
If there is no noise, disassembled and check the installation condition of the parts.



KKMB020G

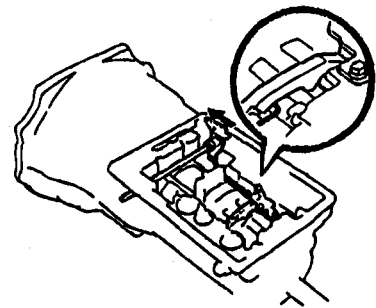
21. Install parking lock pawl and rod.
- a. Install the E-ring to the shaft.
  - b. Install the parking lock pawl, shaft and spring.
  - c. Connect the parking lock rod to the manual valve lever.
  - d. Install the parking lock pawl bracket.
  - e. Install the 2 bolts with the wave washer.

**Torque : 7.4 N·m (75 kgf·cm, 5.2 lb·ft)**



KKMB021C

22. Shift the manual valve lever to the P range, and confirm the planetary ring gear is correctly locked up by the lock pawl.



KKMB021D

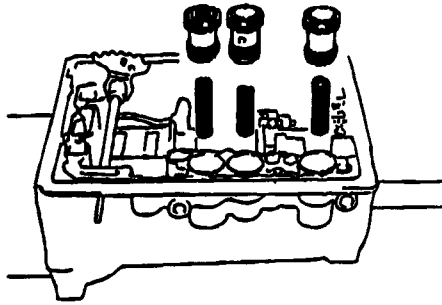
23. Install accumulator spring and piston.
- a. Coat new O-rings with ATF and install them to the pistons.
  - b. Install the 3 springs and 3 accumulator pistons to the bore, as shown.

**PISTON**

Piston	Outer diameter mm (in.)
C1	31.8 (1.252)
C2	31.8 (1.252)
B2	34.8 (1.370)

**SPRING**

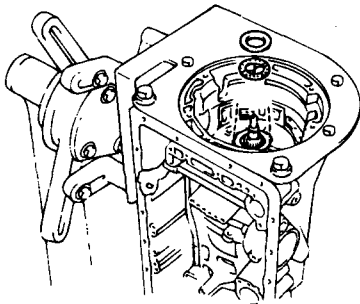
Spring (Color)	Free length (mm)	Outer diameter (mm)
C1 (White & Blue)	75.03	17
C2 (Green)	55.18	15.22
B2	Outer (Orange)	55.18
	Inner (Red)	35.13



KKMB021E

## 24. Install valve body.

- a. Align the groove of the manual valve to the pin of the lever.



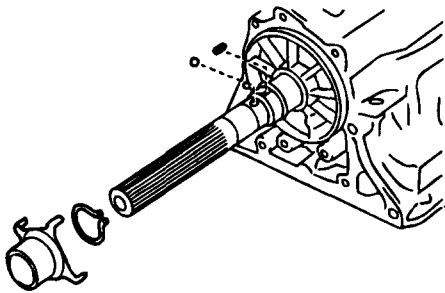
KKMB022A

- b. Install the 17 bolts.

---

**Torque : 10 N·m (100 gf·cm, 7 lb·ft)**

---



KKMB022B

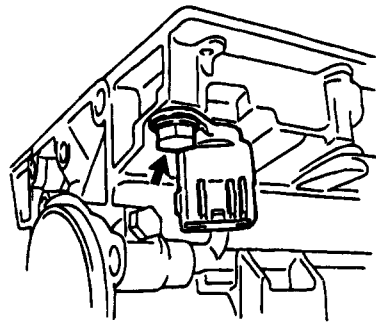
## 25. Install solenoid wire.

- Install the solenoid wire retaining bolt with the bolt.

---

**Torque : 5.4 N·m (55 kgf·cm, 3.8 lb·ft)**

---



KKMB022C

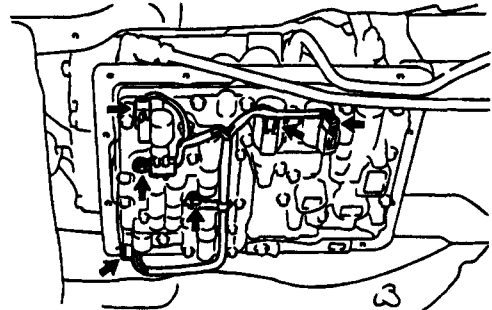
## 26. Install solenoid wiring.

- a. Install the clamp.
- b. Connect the 4 connectors to the solenoid.
- c. Install the clamp and bolt.

---

**Torque : 10 N·m (100 kgf·cm, 7 lb·ft)**

---

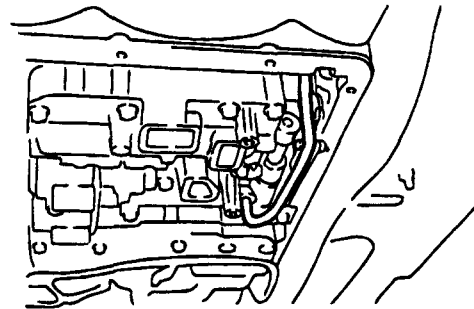


KKMB022D

## 27. Using a plastic hammer, install the oil pipe into position.

 **NOTE**

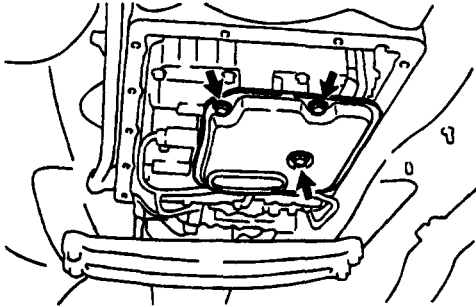
*Be careful not to bend or damage the pipe.*



KKMB022E

28. Install oil strainer.
  - a. Install a new gasket to the oil strainer.
  - b. Install the oil strainer, oil stainer cover and 6 bolts.

**Torque : 5.5 N·m (55 kgf·cm, 7 lb·ft)**

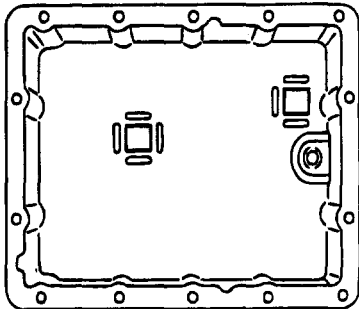


KKMB022F

29. Install oil pan.
  - a. Install the 2 magnets in the oil pan.

**NOTE**

*Make sure that the magnets do not interfere with the oil pipes.*

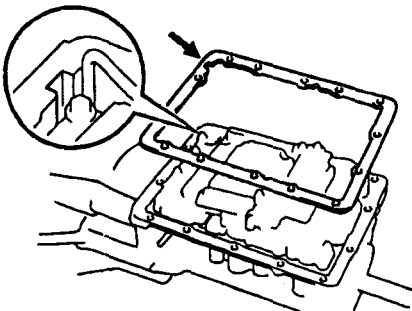


KKMB022G

- b. Install a new gasket to the transmission case.

**NOTE**

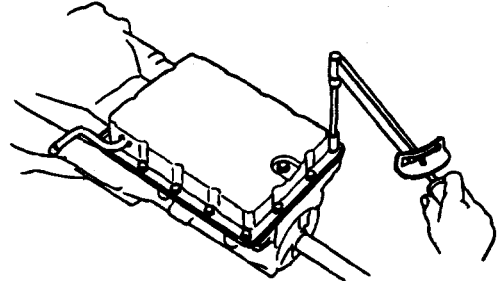
*Align the cut part of the gasket and case.*



KKMB022H

- c. Install the 14 bolts.

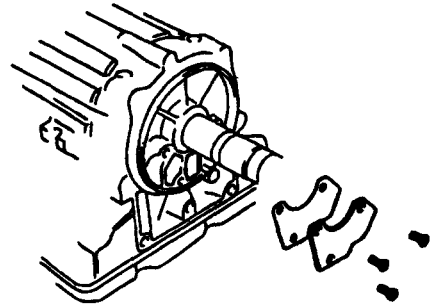
**Torque : 4.4 N·m (45 kgf·cm, 3.1 lb·ft)**



KKMB023A

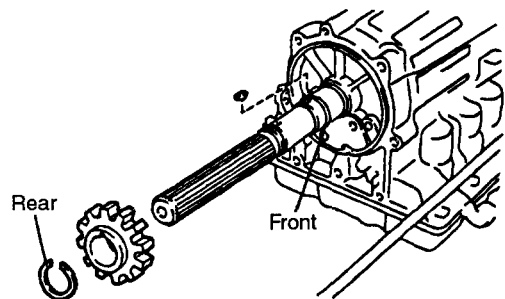
30. Install governor oil strainer.
  - a. Install the governor oil strainer into the transmission case.
  - b. Install a new gasket and cover.
  - c. Install the 3 screws.

**Torque : 7.5 N·m (75 kgf·cm, 5.2 lb·ft)**



KKMB023B

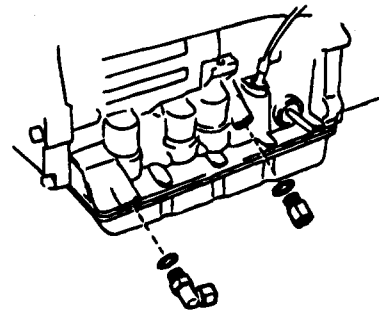
31. Install key and sensor rotor.
  - a. Using a snap ring expander, install the front side snap ring.
  - b. Install the key and sensor rotor.
  - c. Using a snap ring expander, install the rear side snap ring.



EKMB072I



32. Install extension housing.
- Install the extension housing with a new gasket to the case.
  - Apply sealant to the bolt A.
  - Install the 6 bolts.



**NOTE**

The 2 lower bolts are shorter.

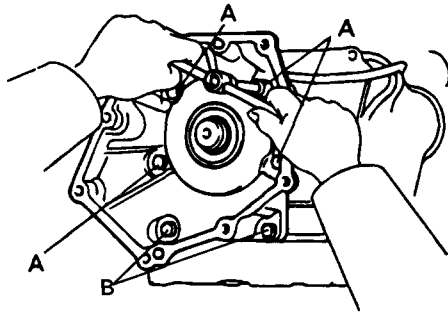
**Torque : 36 N·m (370 kgf·cm, 27 ft·lbf)**

KKMB023F

Bolt length :

Bolt A 40 mm (1.77 in.)

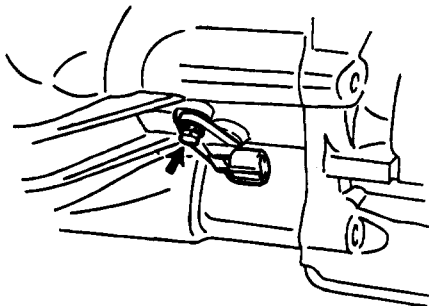
Bolt B 76 mm (1.38 in.)



EKMB072J

33. Install transmission input speed sensor.
- Coat a new O-ring with ATF and install it to the transmission input speed sensor.
  - Install the transmission input speed sensor and bolt.

**Torque : 5.4 N·m (55 kgf·cm, 3.8 lb·ft)**



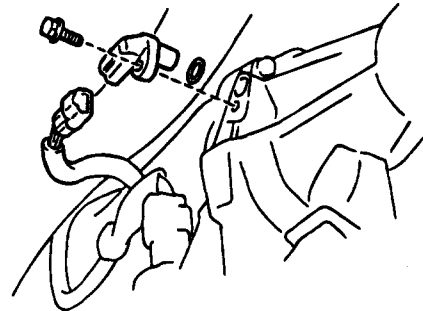
KKMB023E

34. Install union and elbow.
- Coat new 2 O-rings with ATF and install them to union and elbow.
  - Install the union and elbow.

**Torque : 25 N·m (250 kgf·cm, 18 ft·lbf)**

35. Install transmission output speed sensor.
- Coat a new O-ring with ATF and install it to the transmission output speed sensor.
  - Install the transmission output speed sensor and bolt.

**Torque : 5.4 N·m (55 kgf·cm, 3.8 lb·ft)**

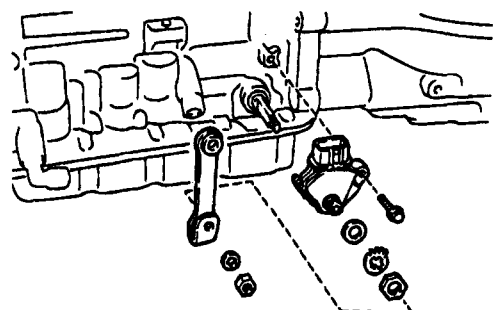


KKMB023G

36. Install neutral start switch.
- Insert the neutral start switch onto the manual valve lever shaft and temporarily install the adjusting bolt.
  - Install a new lock washer.
  - Install and tighten the nut.

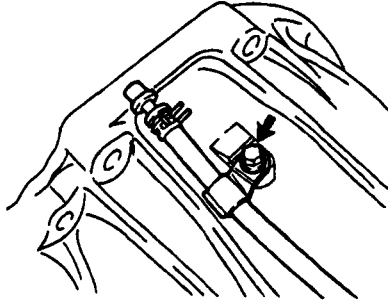
**Torque : 5.4 N·m (55 kgf·cm, 3.8 lb·ft)**

- Using the control shaft leer, fully turn the manual valve lever shaft back and return 2 notches. It is now in neutral.



KKMB024A

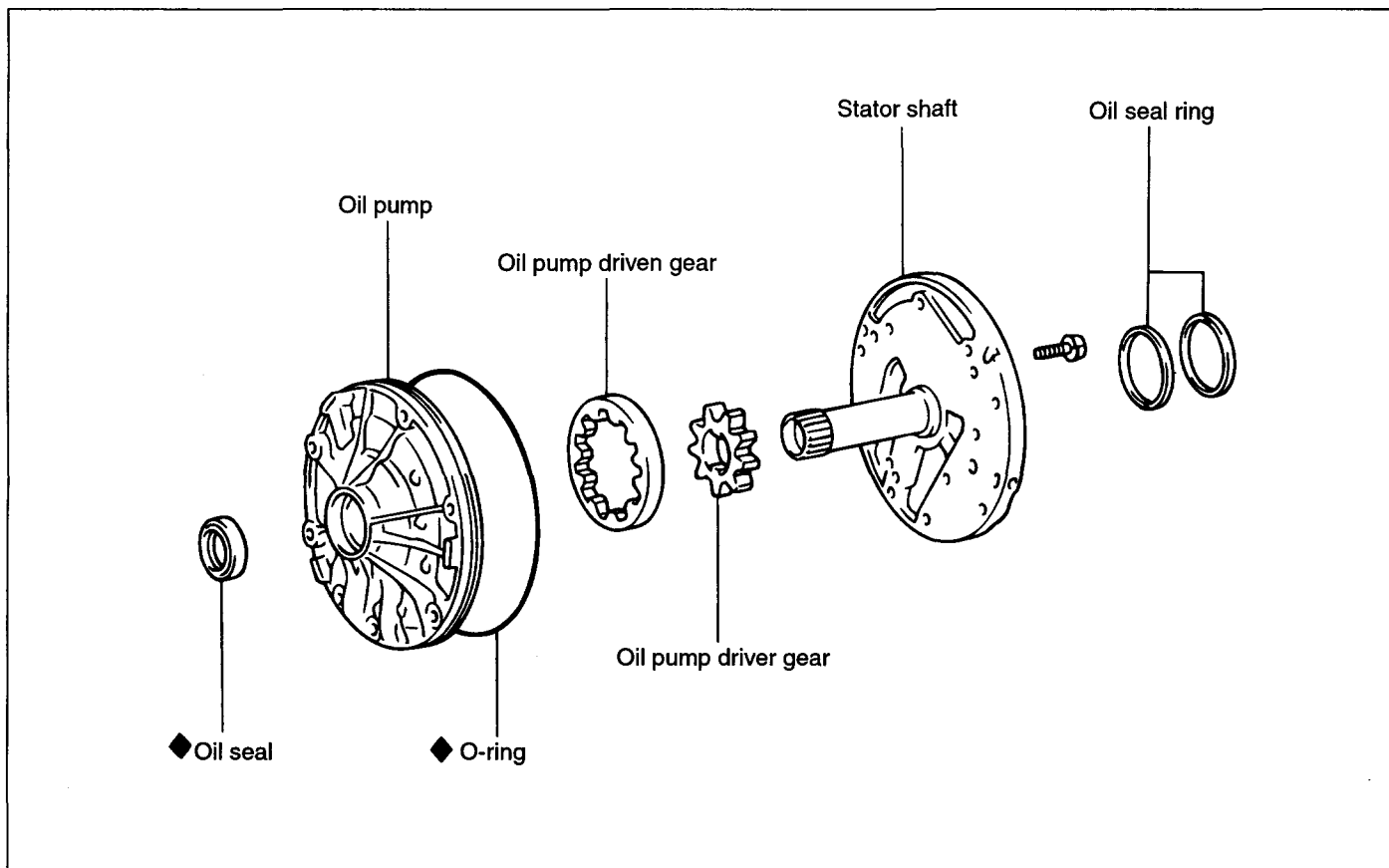
37. Install the breather hose with the bolt.



KKMB024B

**OIL PUMP**

EKMB0730

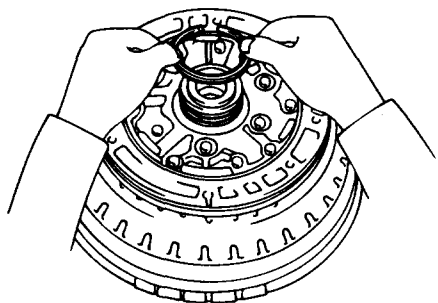


EKMB073A

**DISASSEMBLY**

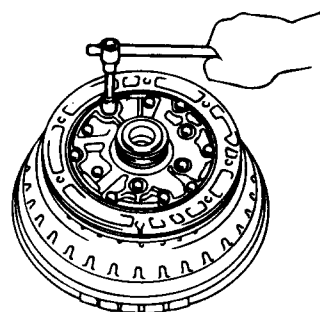
EKMB0740

1. Remove the oil seal ring.



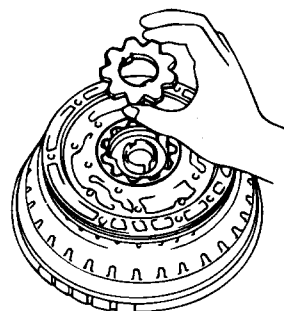
EKLA089A

2. Remove the stator shaft.



EKLA090A

3. Remove the drive and driven gear.



EKLA091A

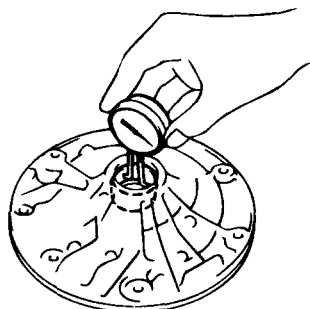
**INSPECTION** EKMB0750

1. Measure the inside diameter of the oil pump bushing.

---

Max. ID : 38.19 mm

---



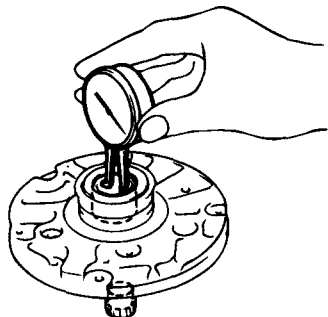
EKLA092A

2. Measure the inside diameter of the stator shaft bushing.

---

Front : 23.11 mm  
Rear : 23.11 mm

---



EKLA093A

3. Using a feeler gauge, measure the clearance of the driven gear.

---

Standard value : 0.07 ~ 0.15 mm

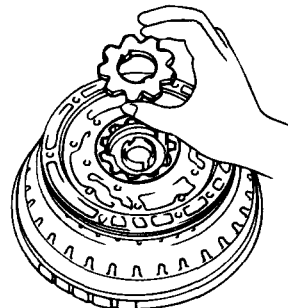
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EKLA094A

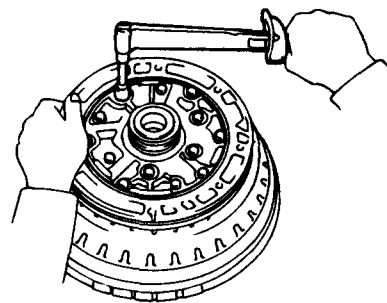
**REASSEMBLY** EKMB0760

1. Install the driven gear and the drive gear to the oil pump body.



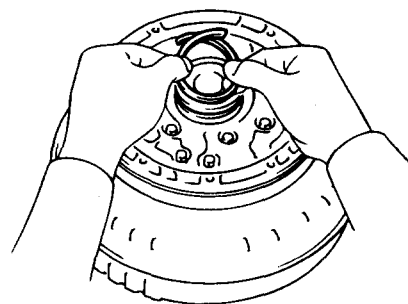
EKLA099A

2. Install the stator shaft to the oil pump.



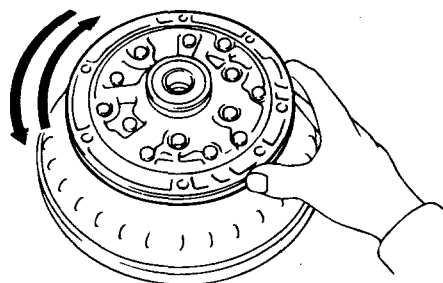
EKLA100A

3. Install the oil seal ring.



EKLA101A

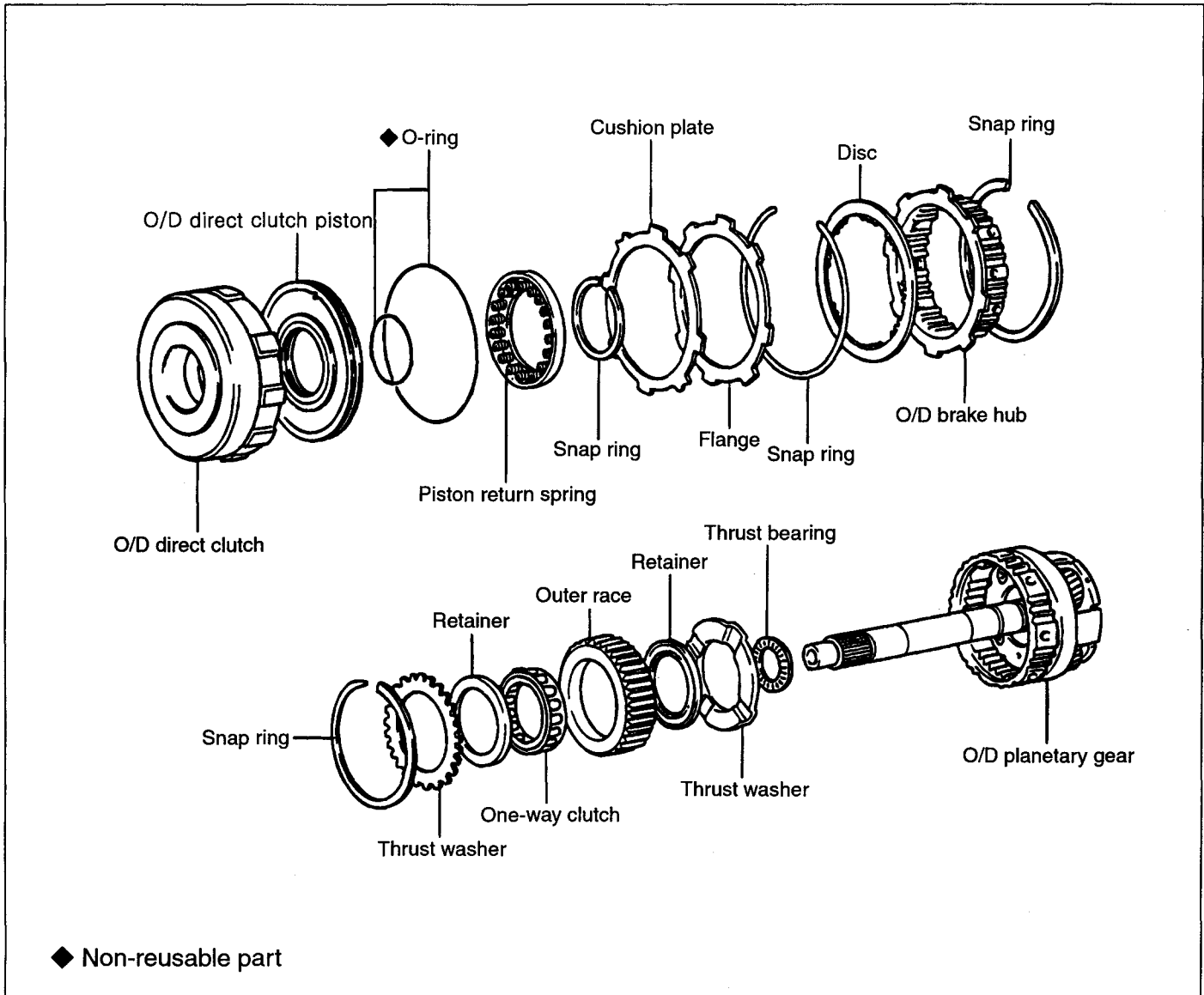
4. Make sure the drive gear rotates smoothly.



EKLA103A

**DIRECT CLUTCH** EKMB0770

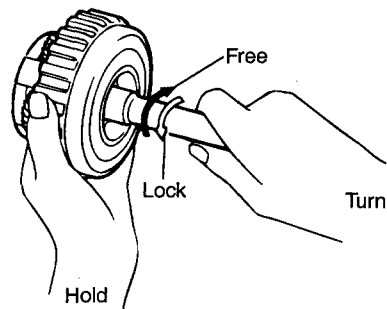
**COMPONENTS**



EKMB077A

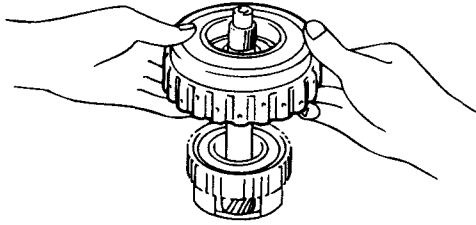
**DISASSEMBLY** EKMB0780

1. Hold the O/D direct clutch drum and turn the input shaft. The input shaft turns freely clockwise and locks counterclockwise.



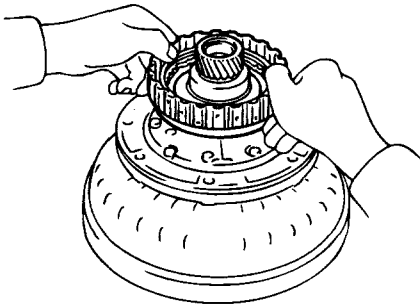
EKMB078A

2. Remove O/D direct clutch assembly from O/D planetary gear.



EKLA106A

3. Check piston stroke of O/D direct clutch.
  - a. Place the O/D direct clutch assembly onto the oil pump.



EKLA108A

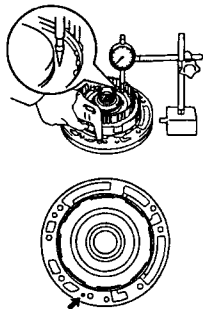
- b. Using a dial indicator, measure the O/D direct clutch piston stroke applying and releasing the compressed air (392 - 785 kPa, 4 - 8 kgf/cm<sup>2</sup>, 57 - 114 psi), as shown.

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Piston stroke: 1.74 - 2.44 mm

---

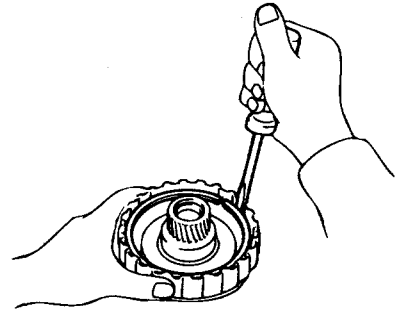
- c. Remove the O/D direct clutch assembly from the oil pump.



KKMB024D

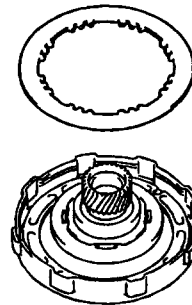
4. Remove O/D brake hub.
  - a. Using a screwdriver, remove the snap ring.

- b. Remove the O/D brake hub.



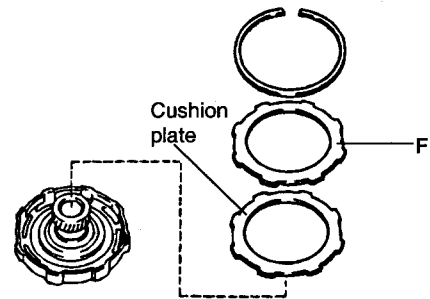
EKLA110A

5. Remove disc.



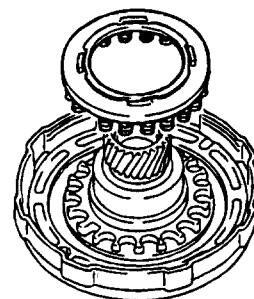
EKMB024F

6. Remove flange and cushion plate.
  - a. Using a screwdriver, remove the snap ring.
  - b. Remove the flange and cushion plate.



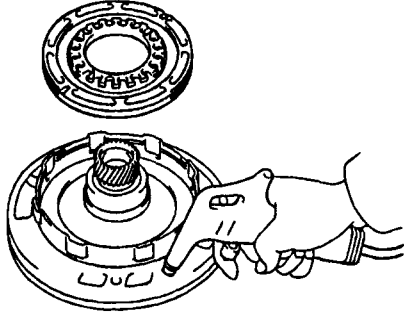
EKMB024G

7. Remove the piston return spring.

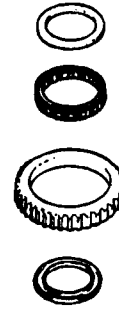


EKMB024H

8. Remove O/D direct clutch piston.
  - a. Place the O/D direct clutch onto the oil pump.
  - b. Hold the O/D direct clutch piston and apply compressed air to the oil pump to remove the O/D direct clutch piston.
  - c. Remove the 2 O-rings from the piston.

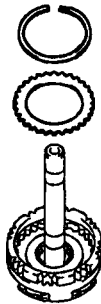


EKMB024I



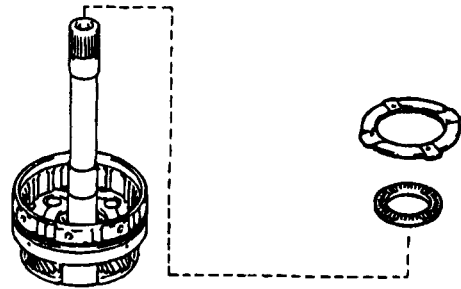
EKMB024L

9. Remove thrust washer.
  - a. Using a screwdriver, remove the snap ring.
  - b. Remove the thrust washer.



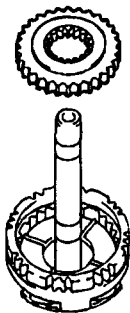
EKMB024J

12. Remove thrust washer.
13. Remove assembled bearing and race.



EKMB024M

10. Remove one-way clutch assembly.



EKMB024K

11. Disassemble one-way clutch.
  - a. Remove the 2 retainers from the both sides.
  - b. Remove the one-way clutch from the outer race.

**INSPECTION**

EKMB0790

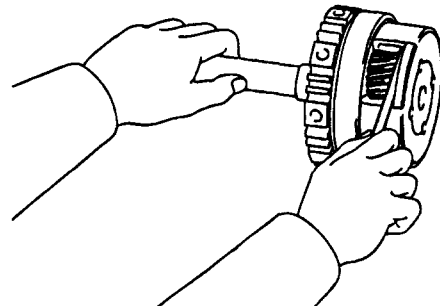
1. Measure planetary pinion gear thrust clearance. Using a feeler gauge, measure the planetary pinion gear thrust clearance.

---

Standard clearance :  
0.20 - 0.50 mm (0.0079 - 0.0197 in.)

---

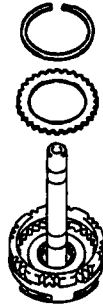
If the clearance is non-standard, inspect the planetary gear thrust washer. If necessary, replace the planetary gear assembly.



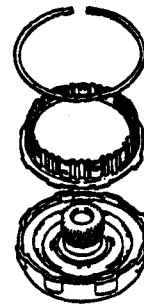
KKMB024E

**REASSEMBLY** EKMB0800

1. Install thrust washer.
  - a. Install the thrust washer.
  - b. Using a screwdriver, install the snap ring.

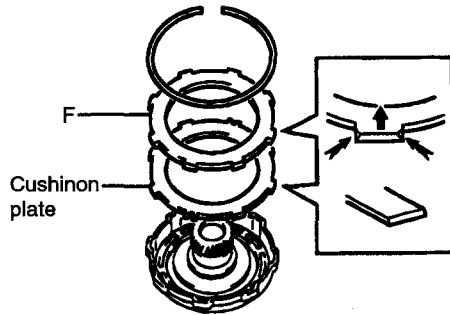


KKMB025A



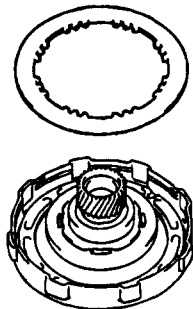
KKMB025D

2. Install cushion plate and flange.
  - a. Install the cushion plate.
  - b. Install flange, the rounded edge facing upward.
  - c. Using a screwdriver, install the snap ring. Be sure the end gap of the snap ring is not aligned with the cutout portion of the drum.



EKMB078B

3. Install disc.



KKMB025C

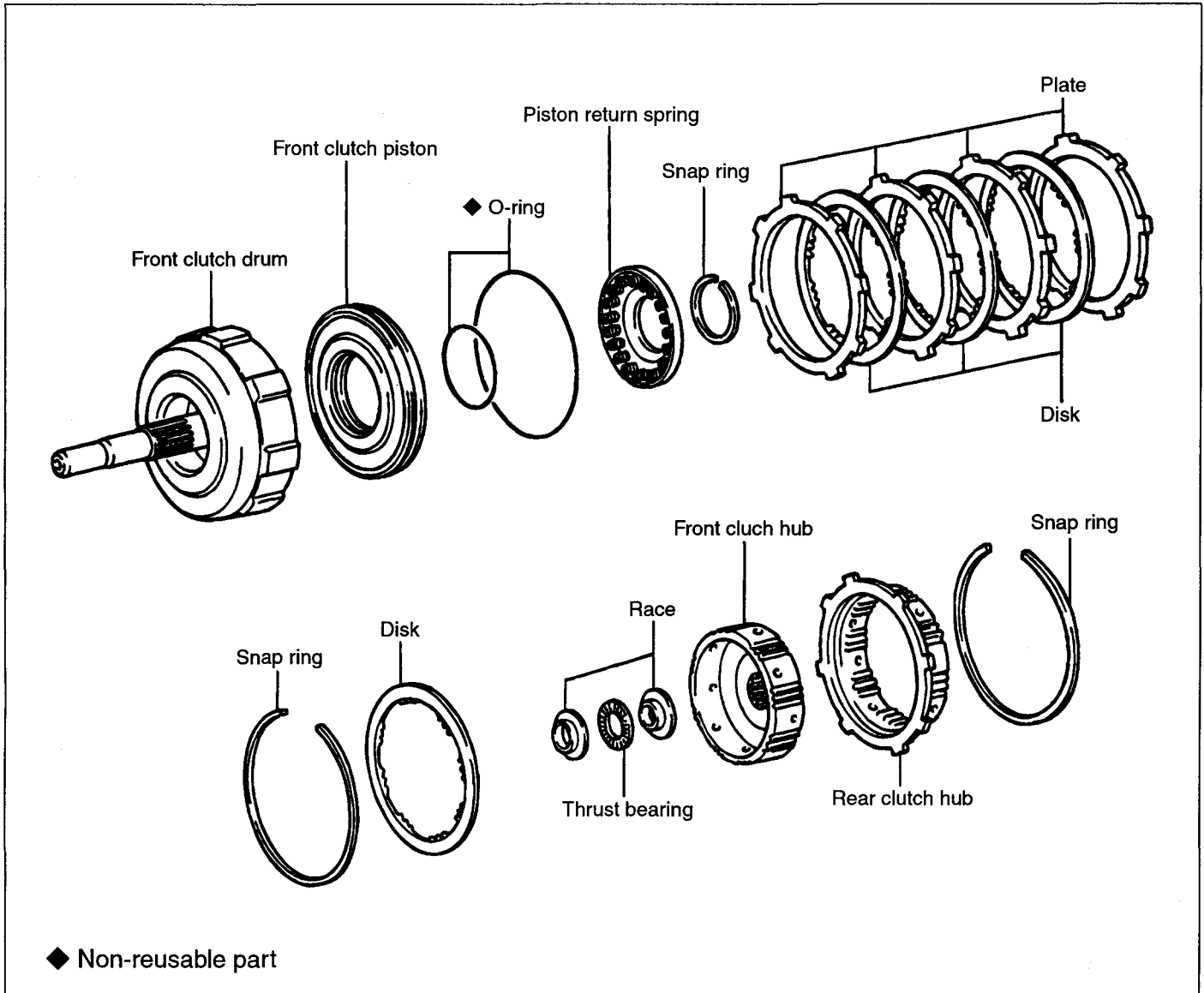
4. Install O/D brake hub.
  - a. Install the O/D brake hub.
  - b. Using a screwdriver, install the snap ring. Be sure the end gap of the snap ring is not aligned with the cutout portion of the drum.



# FRONT CLUTCH

EKMB0840

## COMPONENTS

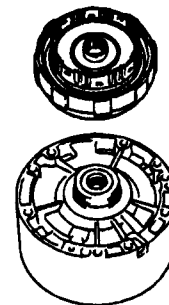


EKMB084A

## DISASSEMBLY

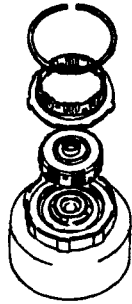
EKMB0850

1. Install front clutch assembly to O/D case.

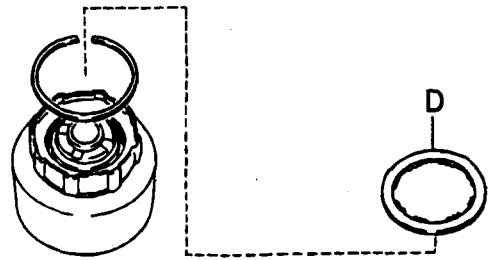


KKMB028B

2. Remove rear clutch hub and front clutch hub.
  - a. Using a screwdriver, remove the snap ring.
  - b. Remove the rear clutch hub and front clutch hub.



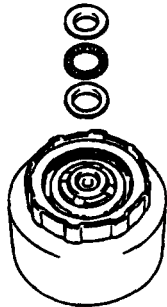
KKMB028C



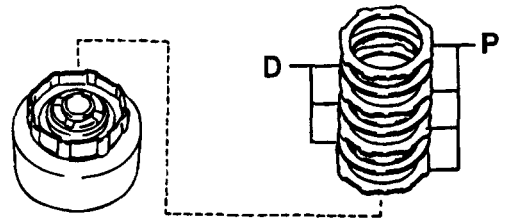
KKMB028F

- c. Remove the 5 plates and 5 discs.

- c. Remove the bearing and 2 races.



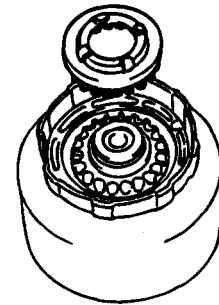
KKMB028D



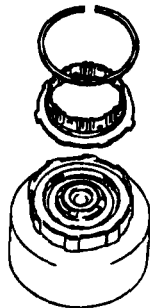
KKMB028G

5. Remove the piston return spring.

3. Check piston stroke of front clutch.
  - a. For check of piston stroke, install the rear clutch hub.
  - b. Install the snap ring.



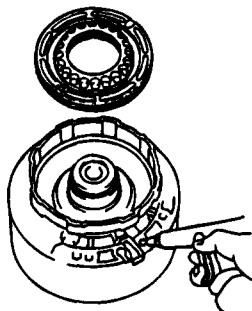
KKMB028H



KKMB028E

4. Remove plate and disc.
  - a. Remove the disc.
  - b. Using a screwdriver, remove the snap ring.

6. Remove front clutch piston.
  - a. Place the front clutch drum onto the O/D case.
  - b. Hold the front clutch piston with hand and apply compressed air to the O/D case to remove the front clutch piston.
  - c. Remove the 2 O-rings from the piston.



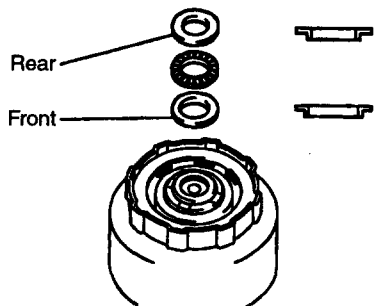
KKMB0281

**REASSEMBLY** EKMB0860

1. Coat the bearing and races with petroleum jelly and install them onto the front clutch drum.

**BEARING AND RACES DIAMETER :**

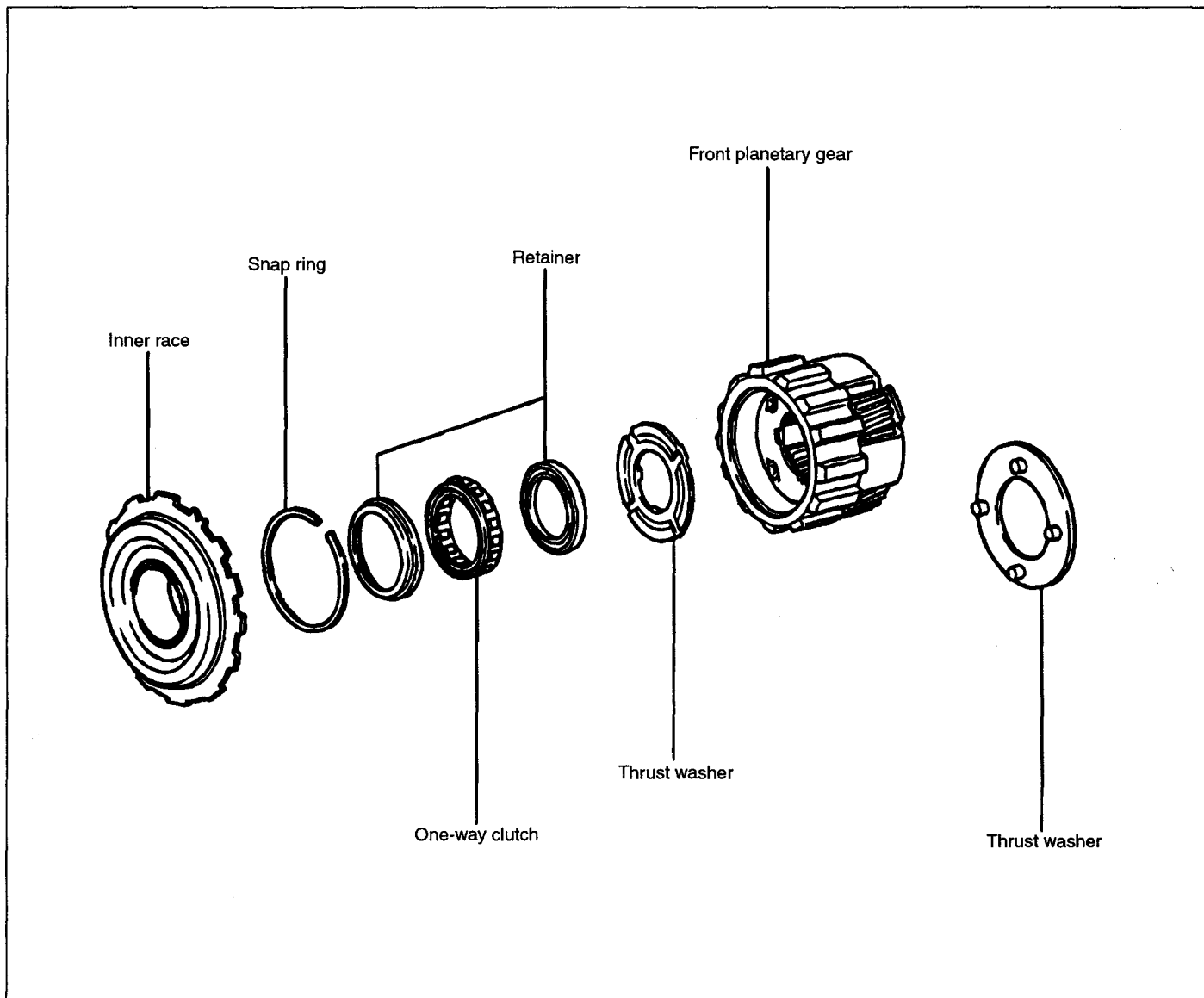
	Inside mm (in)	Outside mm (in.)
Race (Rear)	21.4 (0.843)	37.3 (1.469)
Bearing	23.4 (0.921)	37.5 (1.476)
Race (Front)	24.1 (0.949)	37.3 (1.469)



EKMB086A

FRONT PLANETARY GEAR EKMB0980

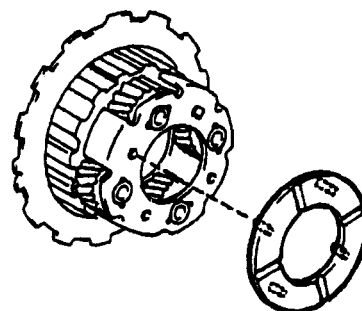
COMPONENTS



EKMB098A

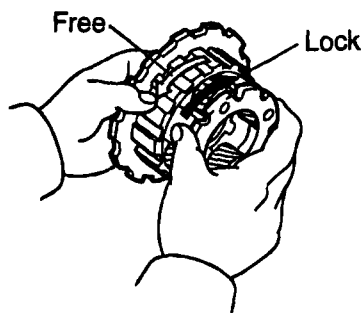
DISASSEMBLY EKMB0990

1. Remove thrust washer from front planetary carrier.



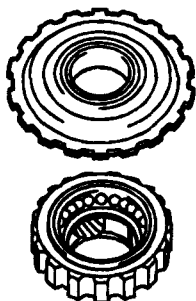
KKMB032C

2. Hold the one-way clutch inner race and turn the planetary gear. The planetary gear turns freely counter-clockwise and locks clockwise.



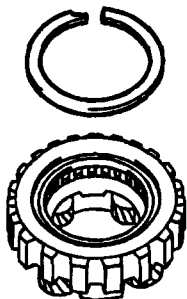
KKMB032D

3. Remove one-way clutch inner race.



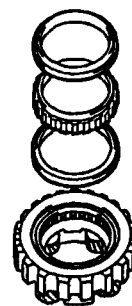
KKMB032E

4. Remove NO.2 one-way clutch.
  - a. Using a screwdriver, remove the snap ring.



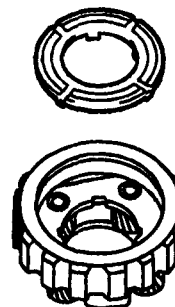
KKMB032F

- b. Remove the one-way clutch and 2 retainers from the planetary gear.



KKMB032G

5. Remove thrust washer.



KKMB032H

**INSPECTION** EKMB1000

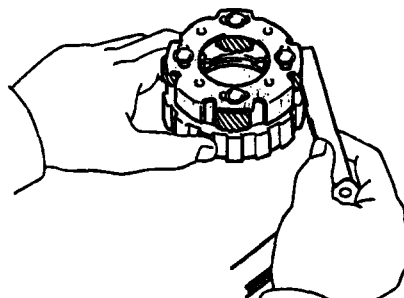
1. Measure planetary pinion gear thrust clearance. Using a feeler gauge, measure the planetary pinion gear thrust clearance.

---

Standard clearance :  
0.20 - 0.50 mm (0.0079 - 0.0197 in.)

---

If the clearance is non-standard, inspect the planetary gear thrust washer. If necessary, replace the planetary gear assembly.



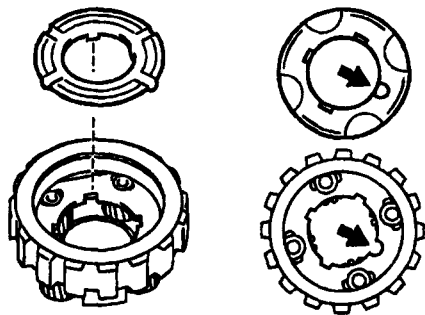
KKMB032I

**REASSEMBLY** EKMB1010

1. Install thrust washer.
  - a. Coat the thrust washer with petroleum jelly.
  - b. Install the thrust washer into the front planetary gear.

 **NOTE**

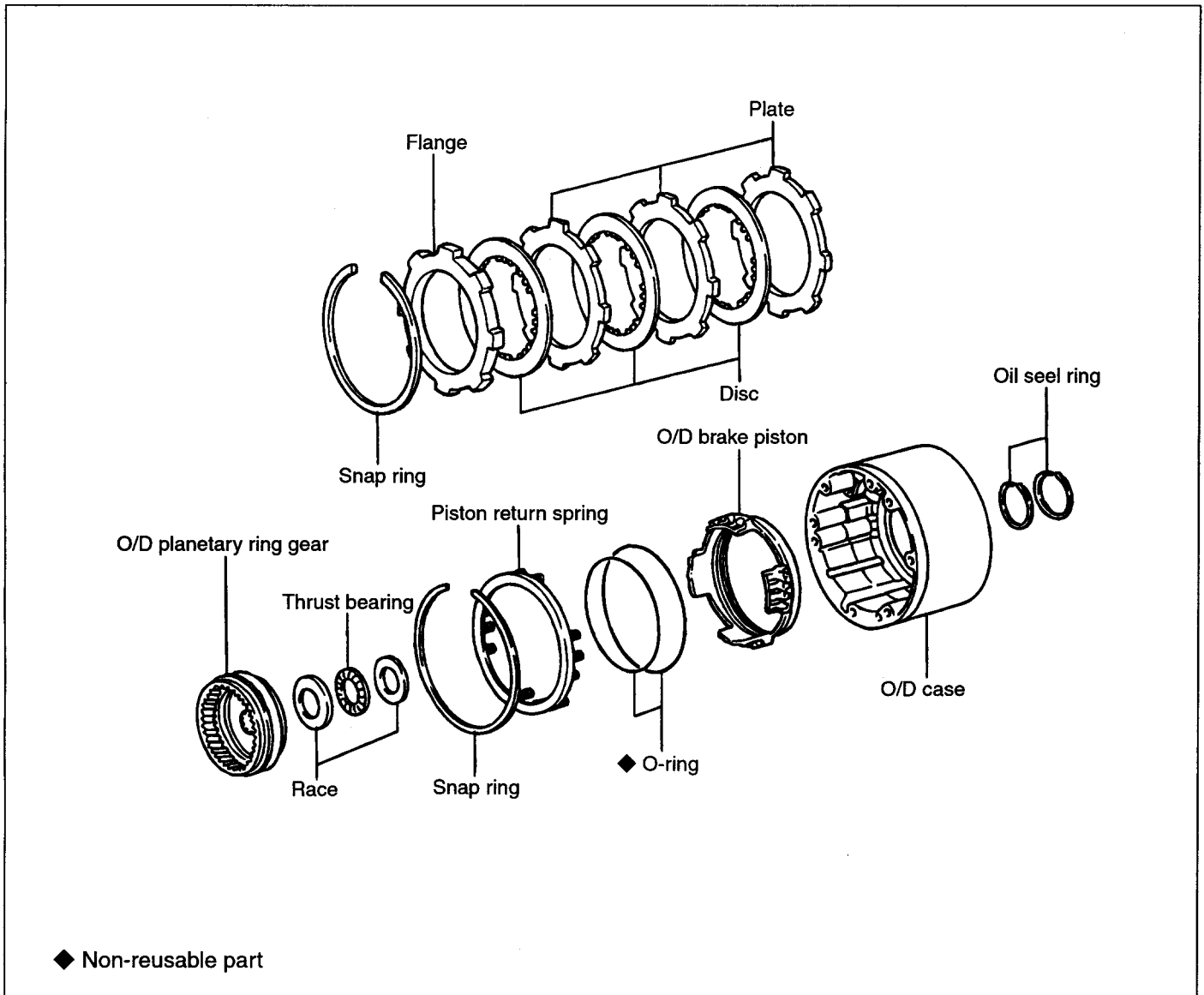
*Make sure that the lug shapes match the cutout portions on the front planetary gear.*



KKMB032J

**OVERDRIVE BRAKE** EKMB0810

**COMPONENTS**

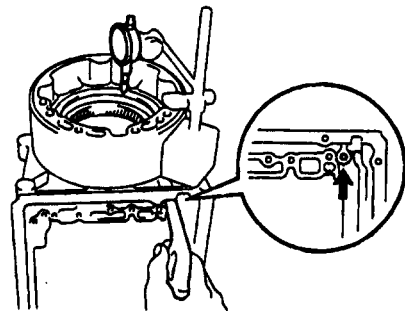


EKMB081A

**DISASSEMBLY** EKMB0820

1. Using a dial indicator, measure the O/D brake pack clearance applying and releasing the compressed air (.392 - 785 kPa, 4 - 8 kgf/cm<sup>2</sup>, 57 - 114 psi), as shown.

Pack clearance : 0.75 - 1.25 mm

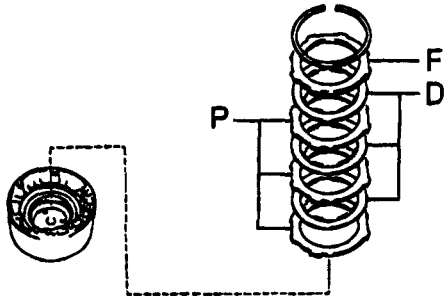


If the values are nonstandard, inspect the discs.

2. Remove the O/D case from the transmission case.

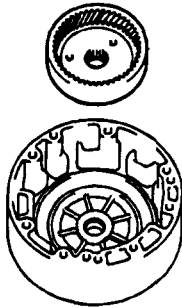
KKMB026A

3. Remove flange, disc and plate.
  - a. Using a screwdriver, remove the snap ring.
  - b. Remove the flange, 3 discs and 3 plates.



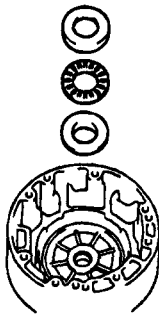
KKMB026B

4. Remove the O/D planetary rign gear.



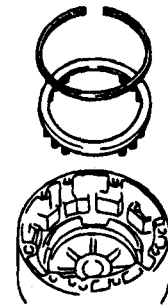
KKMB026C

5. Remvoe the bearing and 2 races.



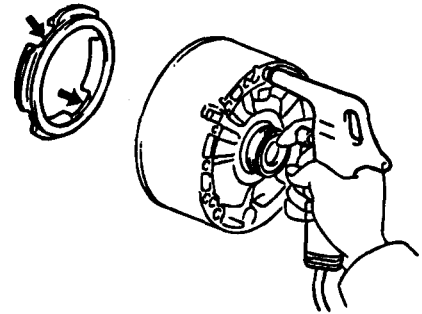
KKMB026D

6. Remove piston return spring.
  - a. Using a screwcdriver, remove the snap ring.
  - b. Remove the piston return spring.



KKMB026E

7. Remove O/D brake piston.
  - a. Hold the O/D brake piston with hand, apply compressed air into the passage to remove the O/D brake piston.
  - b. Remove the 2 O-rings from the piston.



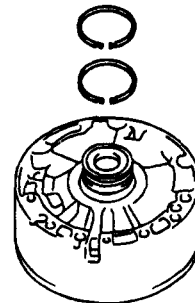
KKMB026F

**REASSEMBLY** EKMB0830

1. Install oil seal ring.
  - a. Coat the 2 oil seal rings with ATF.
  - b. Contact the oil seal rings and install them onto the O/D case.

**NOTE**

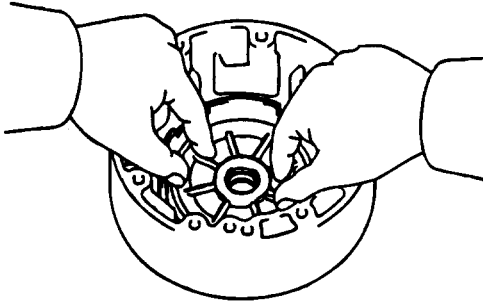
- Do not spread the ring ends more than necessary.
- After installing the oil seal rings, check that they rotate smoothly.



KKMB027G



2. Install O/D brake piston.
  - a. Coat 2 new O-rings with ATF and install them on the O/D brake piston.
  - b. Being careful not to damage the O-rings, press in the brake piston into the O/D case with both hands.

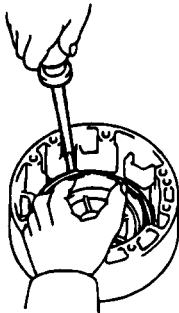


KKMB027B

3. Pushing the piston return spring and using a screwdriver, install the snap ring. Be sure the end gap of the snap ring is not aligned with the cutout portion of the O/D case.

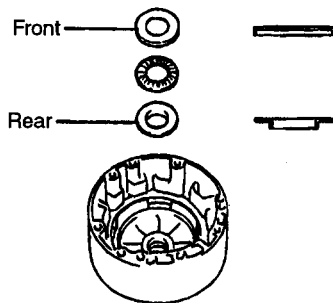
**NOTE**

*Make sure that the snap ring is inserted into its groove.*



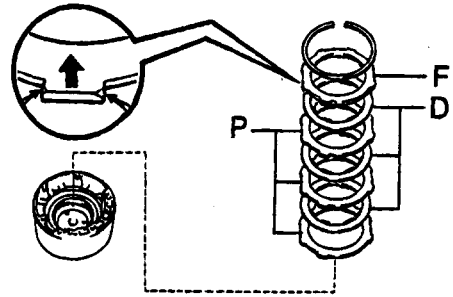
KKMB027C

4. Install the O/D planetary ring gear.



EKMB083A

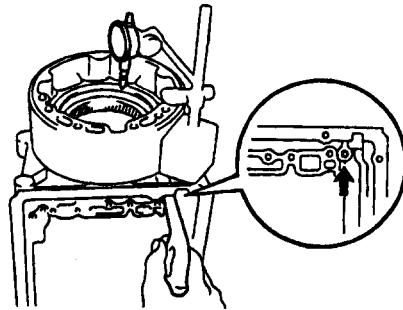
5. Install the flange, the disc and the plate.



KKMB027E

6. Measure the clearance of the O/D brake.

Clearance : 0.75 - 1.25 mm

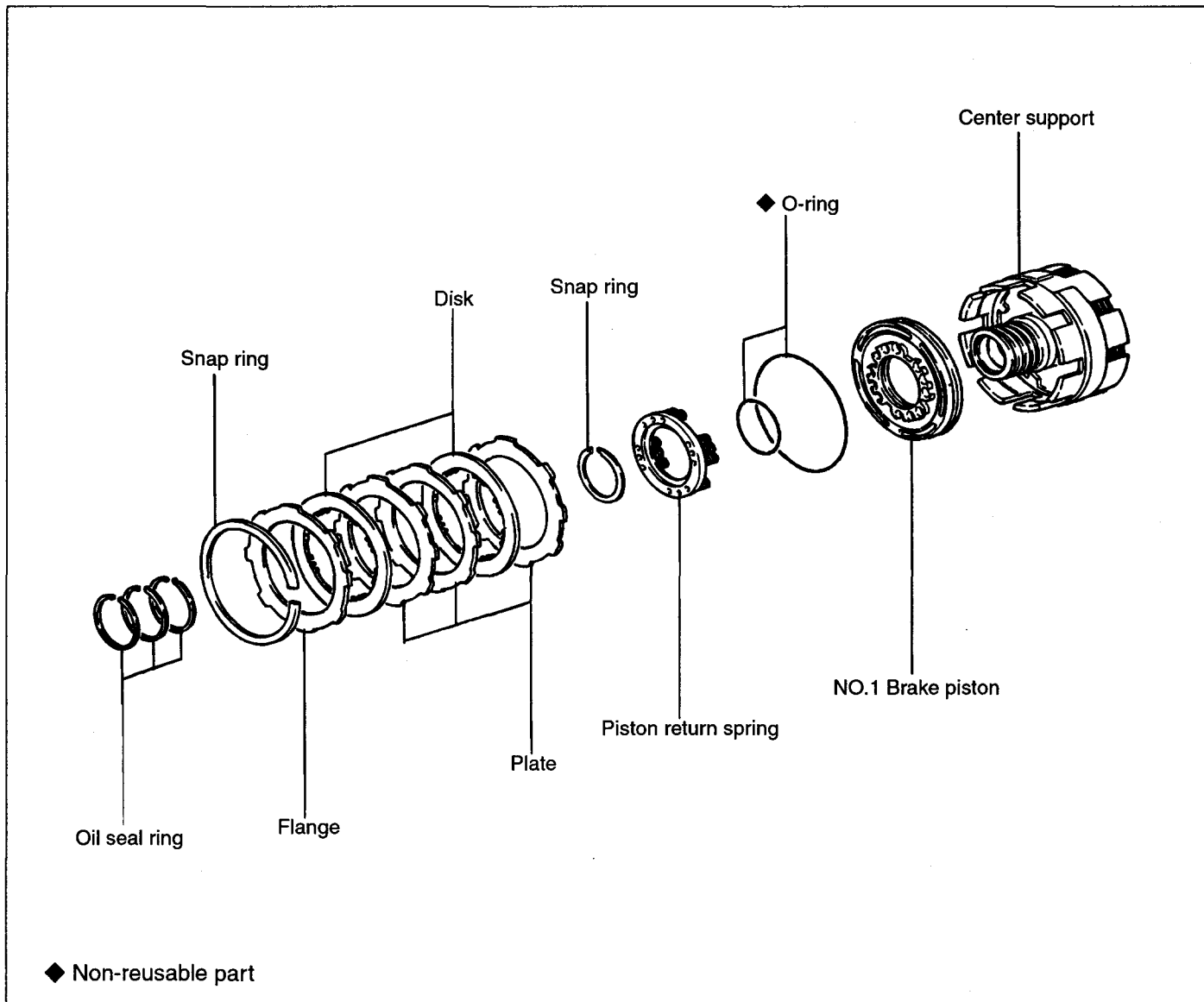


KKMB027F

# NO.1 BRAKE

EKMB0900

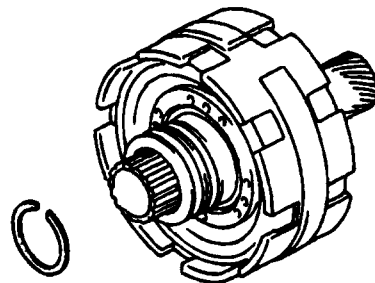
## COMPONENTS



EKMB090A

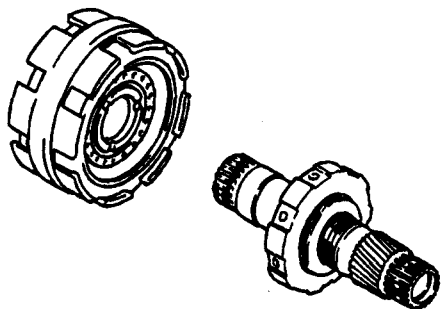
## DISASSEMBLY EKMB0910

1. Remove planetary sun gear and NO.1 one-way clutch.



KKMB030B

2. Remove the planetary sun gear with the NO.1 one-way clutch.

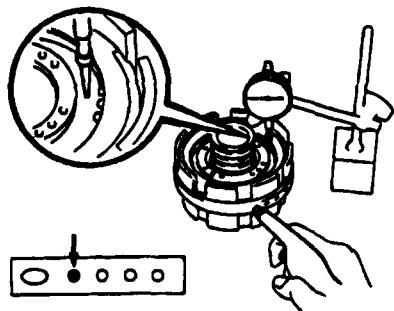


KKMB030C

3. Check piston stroke of NO.1 brake.  
Using a dial indicator, measure the NO.1 brake piston stroke applying and releasing the compressed air (392 - 785 kPa, 4 - 8 kgf/cm<sup>2</sup>, 57 - 114 psi), as shown.

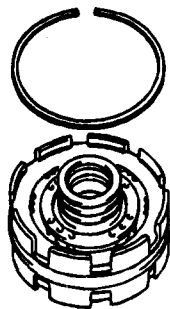
Piston stroke : 0.97 ~ 1.64 mm

If the values are non-standard, inspect the disc.



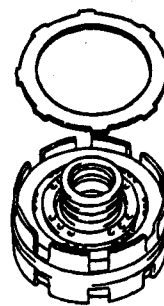
KKMB030D

4. Remove flange.
  - a. Using a screwdriver, remove the snap ring.



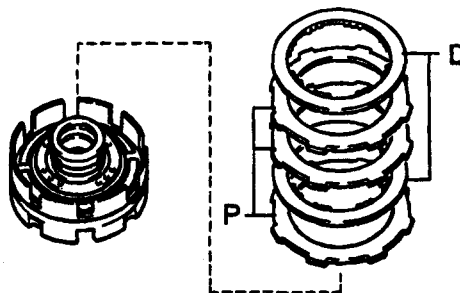
KKMB030E

- b. Remove the flange.



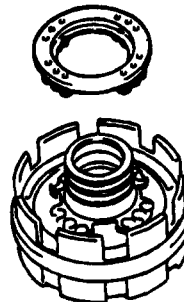
KKMB030F

5. Remove the 2 discs and 3 plates.



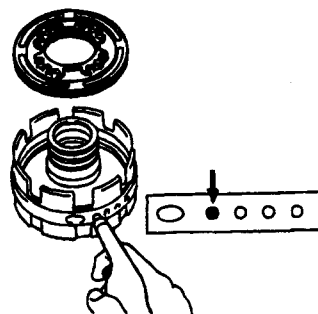
KKMB030G

6. Remove the piston return spring.



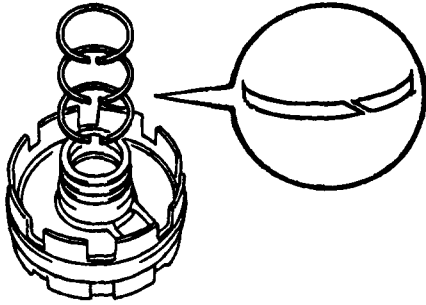
KKMB030H

7. Remove NO.1 brake piston.
  - a. Hold the NO.1 brake piston with hand and apply compressed air to the center support to remove the NO.1 brake piston.
  - b. Remove the 2 O-rings from the piston.



KKMB030I

8. Remove the 3 oil seal rings.



KKMB030J

## INSPECTION EKMB0920

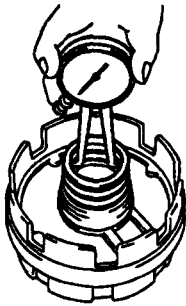
1. Using a dial indicator, measure the inside diameter of the center support bushing.

---

Maximum inside diameter : 36.46 mm (1.4354 in.)

---

If the inside diameter is greater than the maximum, replace the center support.

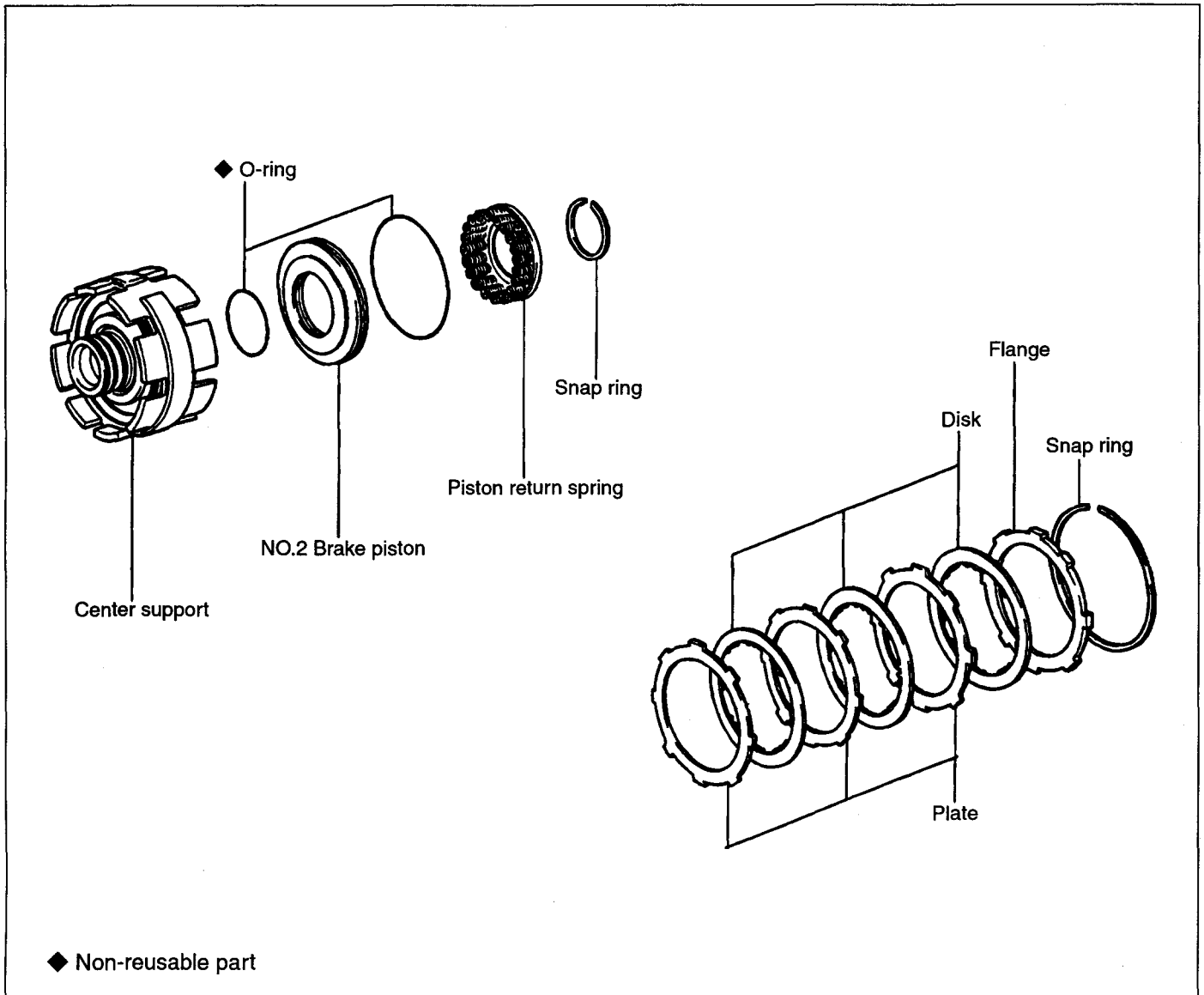


KKMB030K

## NO.2 BRAKE

EKMB0940

## COMPONENTS



EKMB094A

## DISASSEMBLY

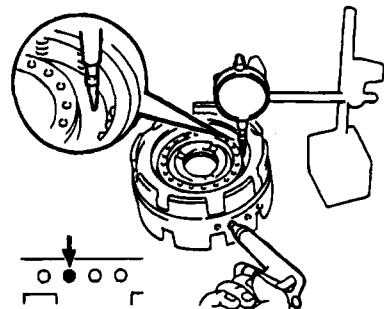
EKMB0950

1. Check piston stroke of NO.2 brake.  
Using dial indicator, measure the NO.2 brake piston stroke applying and releasing the compressed air (392 - 782 kPa, 4 - 8 kgf/cm<sup>2</sup>, 57 - 114 psi), as shown.

---

Piston stroke : 0.97 - 1.64 mm

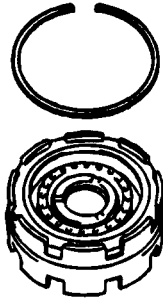
---



If the values are non-standard, inspect the discs.

KKMB031B

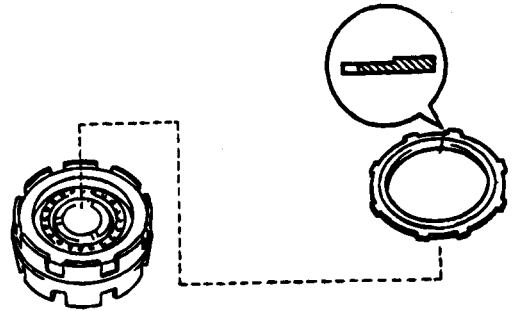
2. Remove flange.
  - a. Using a screwdriver, remove the snap ring.



KKMB031C

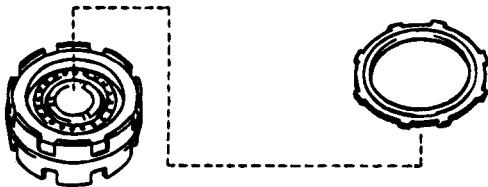
**REASSEMBLY** EKMB0960

1. Install the flange, the flat end facing downward.



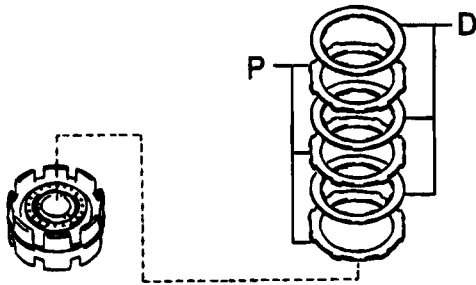
KKMB031G

- b. Remove the flange.



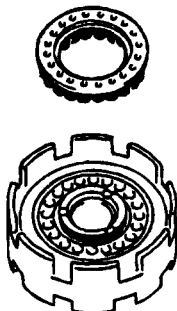
KKMB031D

3. Remove the 3 discs and 3 plates.



KKMB031E

4. Remove the piston return spring.

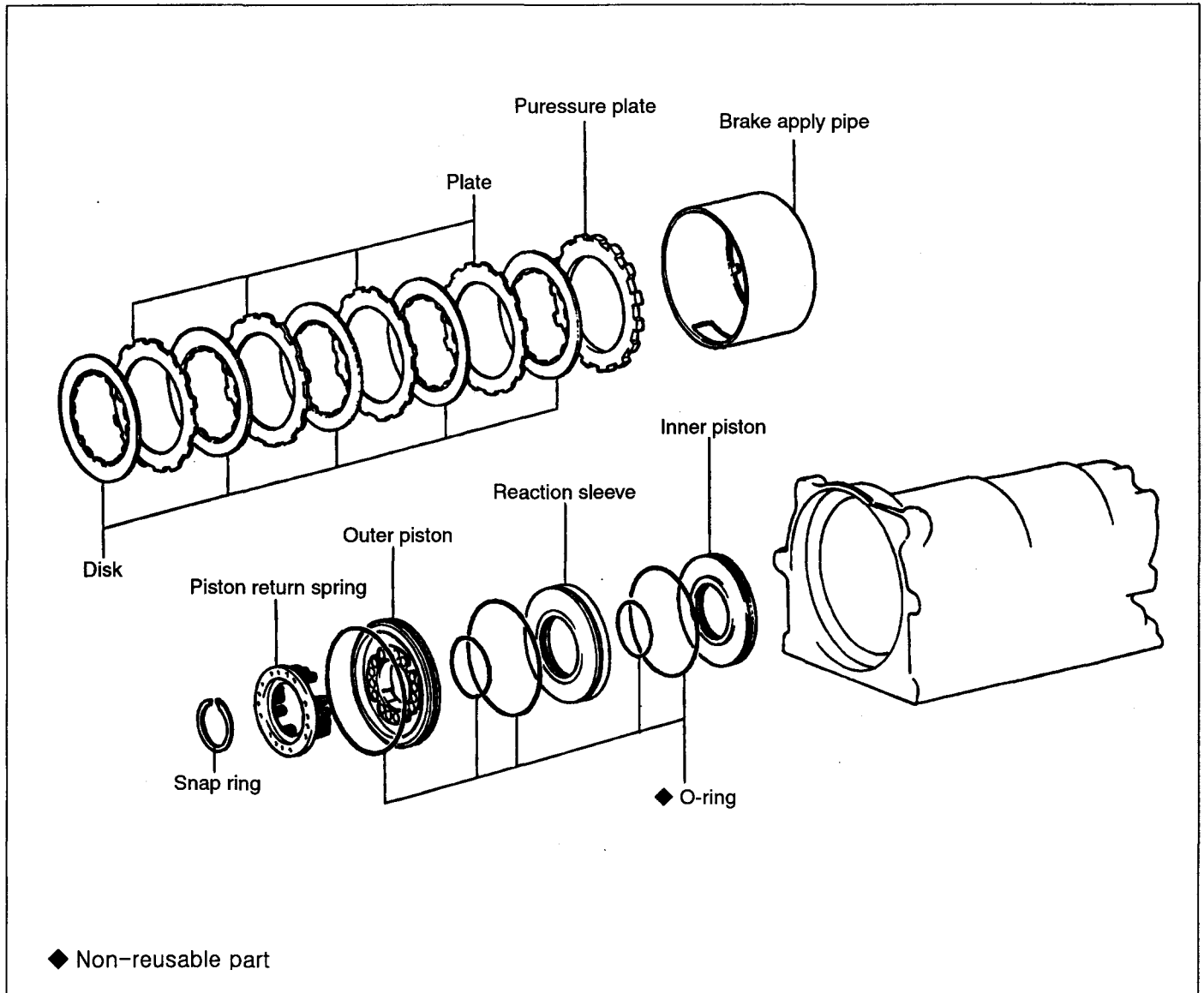


KKMB031F

# NO.3 BRAKE

EKMB0970

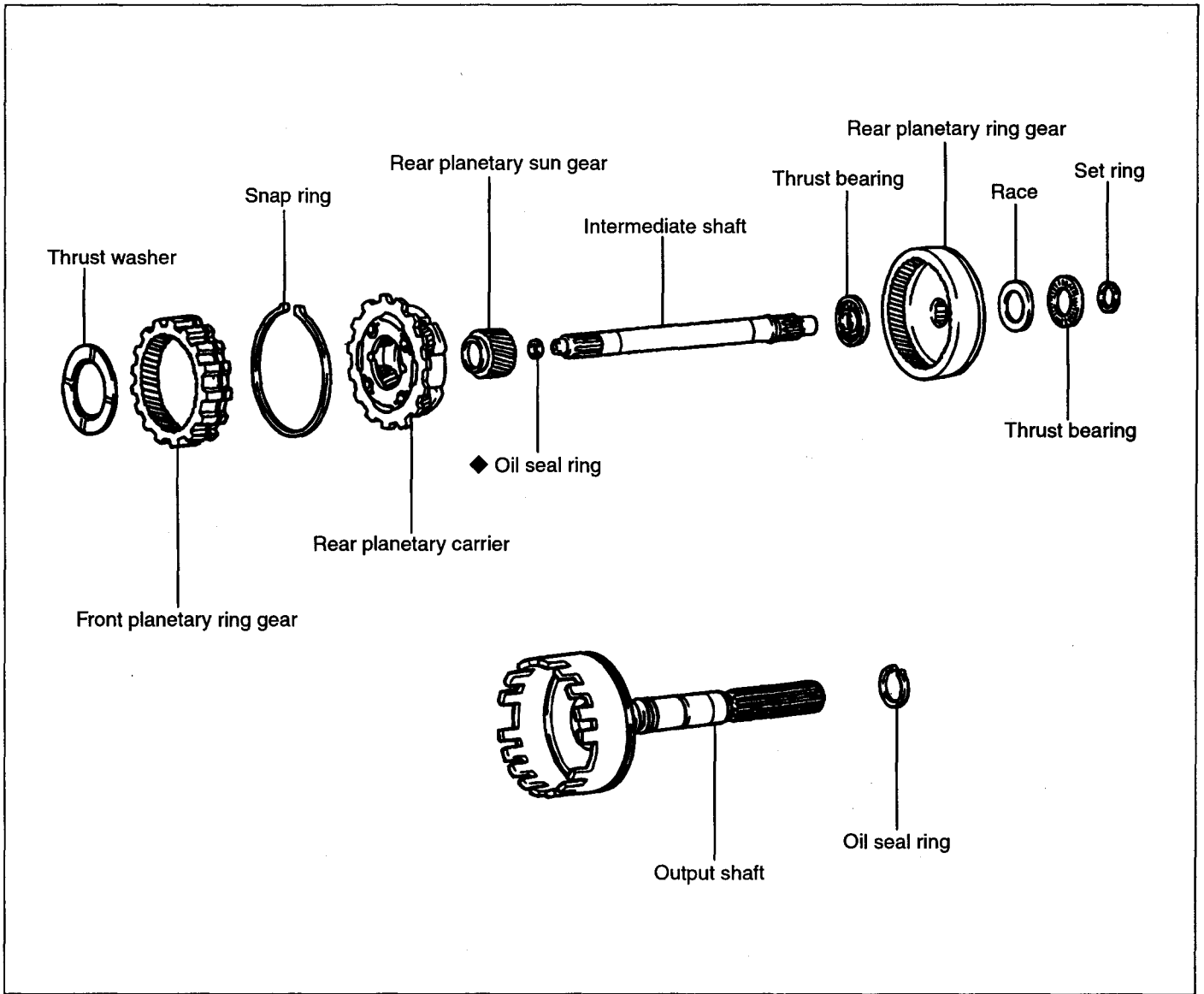
## COMPONENTS



# REAR PLANETARY GEAR

EKMB1020

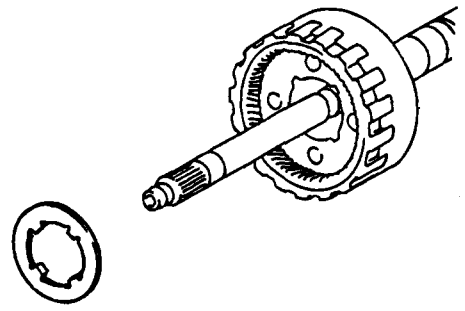
## COMPONENTS



EKMB102A

## DISASSEMBLY EKMB1030

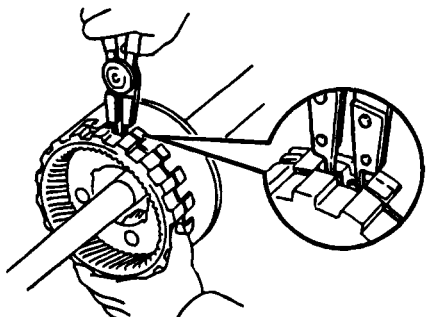
1. Remove thrust washer from front planetary ring gear.



KKMB033B

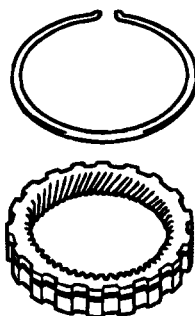


2. Remove front planetary ring gear.
  - a. Using a snap ring expander, pull out the ring gear while compressing the snap ring.



KKMB033C

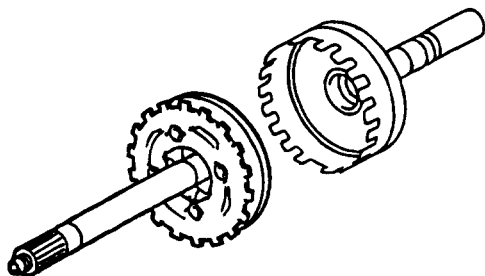
- b. Using a screwdriver, remove the snap ring from the ring gear.



KKMB033D

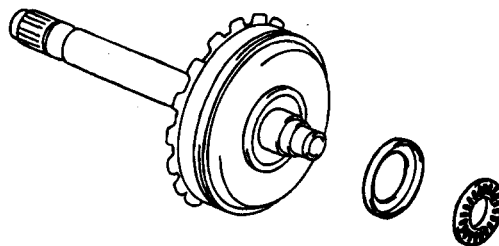
3. Remove rear planetary gear assembly from output shaft.

- a. Pull out the rear planetary gear assembly.



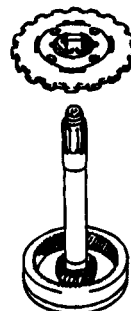
KKMB033E

- b. Remove the bearing and race.



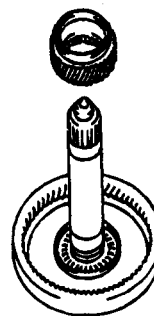
KKMB033F

4. Remove rear planetary carrier from planetary ring gear.



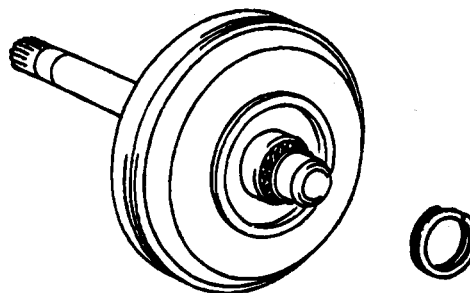
KKMB033G

5. Remove planetary sun gear from planetary ring gear.



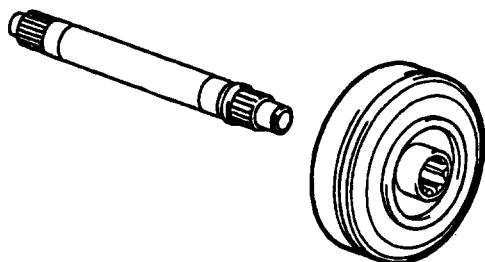
KKMB033H

6. Remove planetary ring gear.
  - a. Using a screwdriver, remove the set ring.



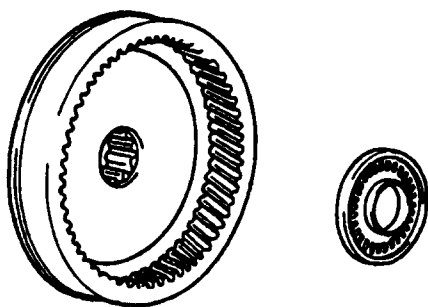
KKMB033I

- b. Remove the planetary ring gear.



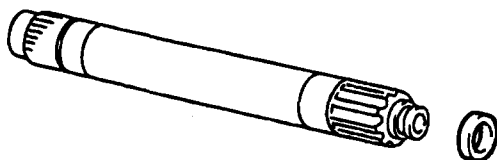
KKMB033J

- c. Remove the assembled bearing from the ring gear.



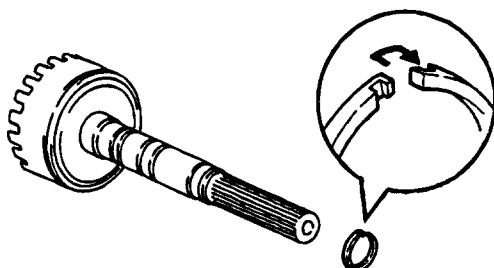
KKMB033K

7. Remove oil seal ring from intermediate shaft. Using a screwdriver, remove the oil seal ring.



KKMB033L

8. Remove oil seal ring from output shaft.



KKMB033M

**INSPECTION** EKMB1040

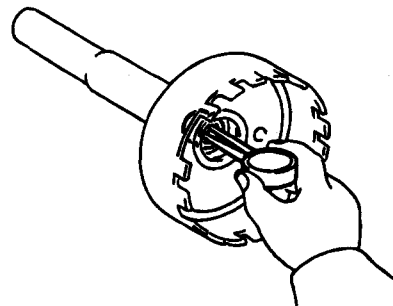
1. Check output shaft bushing.  
Using a dial indicator, measure the inside diameter of the output shaft bushing.

---

Maximum inside diameter : 18.08 mm (0.7118 in.)

---

If the inside diameter is greater than the maximum, replace the output shaft.



KKMB033N

2. Measure planetary pinion gear thrust clearance.  
Using a feeler gauge, measure the planetary pinion gear thrust clearance.

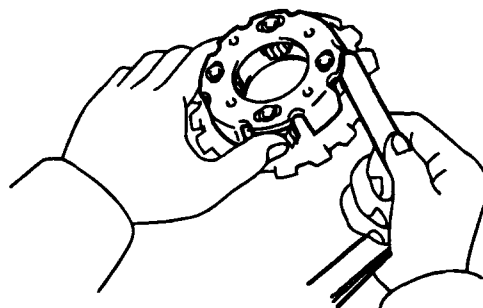
---

Standard clearance :  
0.20 - 0.50 mm (0.0079 - 0.0197 in.)

---

If the clearance is non-standard, inspect the planetary gear thrust washer.

If necessary, replace the planetary gear assembly.



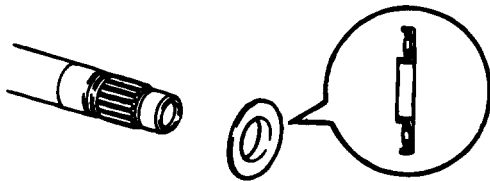
KKMB033O

**REASSEMBLY** EKMA1050

1. Coat the assembled bearing and race with petroleum jelly and install it onto the ring gear.

**ASSEMBLED BEARING AND RACE DIAMETER :**

	Inside mm (in.)	Outside mm (in.)
Assembled bearing and race	21.4 (0.843)	47.3 (1.862)

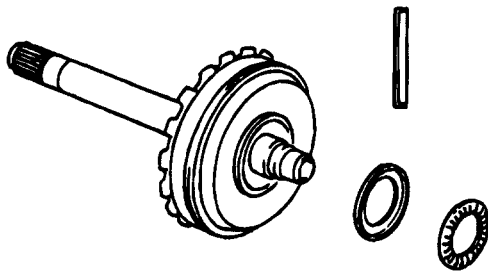


KKMB033P

2. Coat the bearing and race with petroleum jelly and install them onto the ring gear

**BEARING AND RACE DIAMETER :**

	Inside mm (in.)	Outside mm (in.)
Race	30.1 (1.185)	48.5 (1.909)
Bearing	28.4 (1.118)	46.3 (1.823)

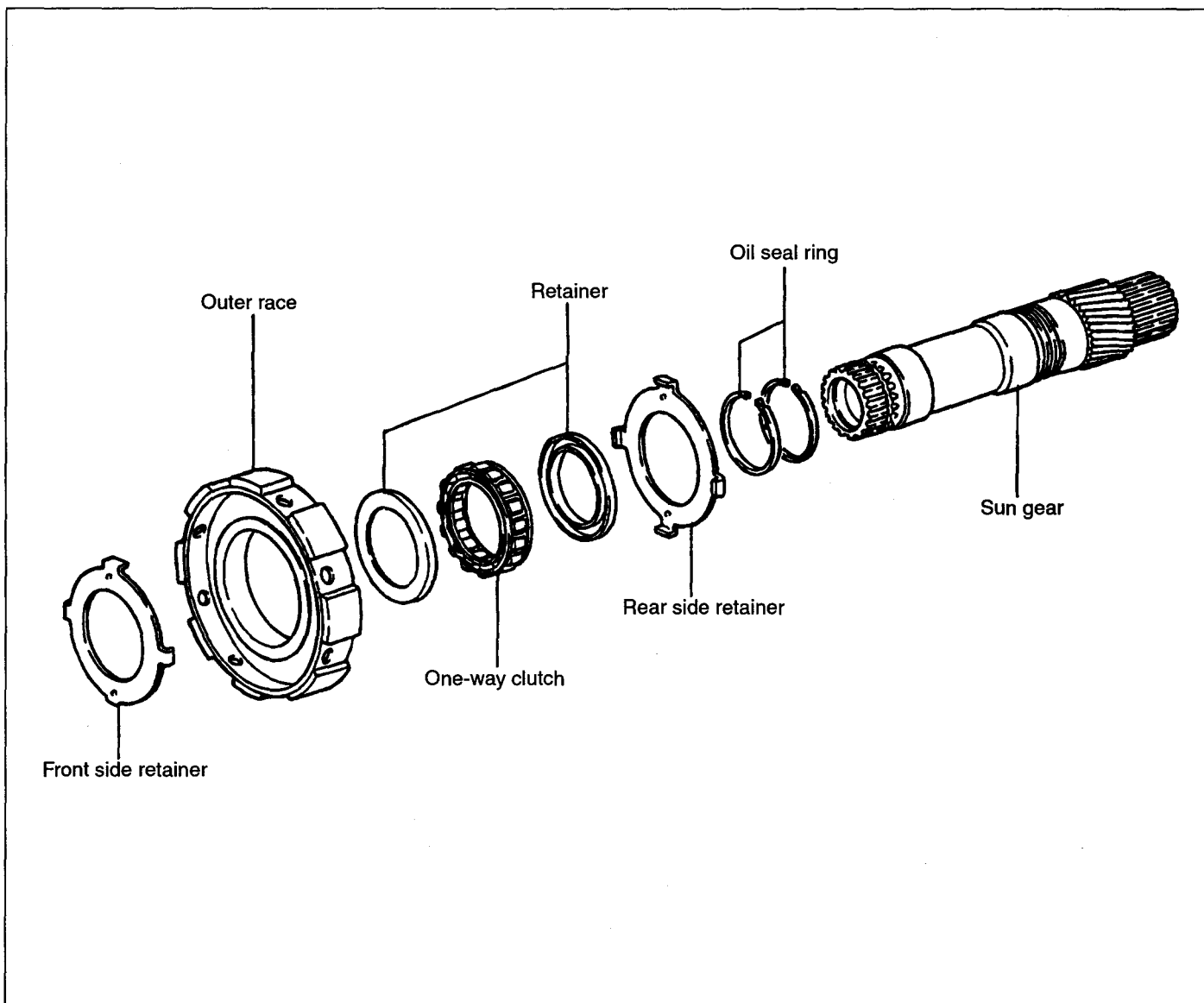


KKMB033Q

# PLANETARY GEAR SET

## PLANETARY SUN GEAR EKMB1050

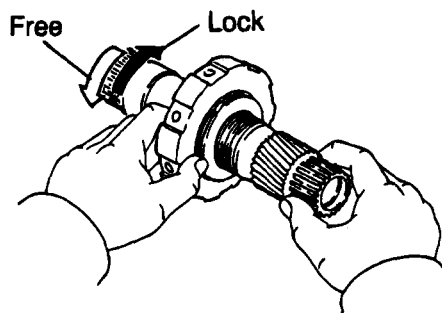
### COMPONENTS



EKMB105A

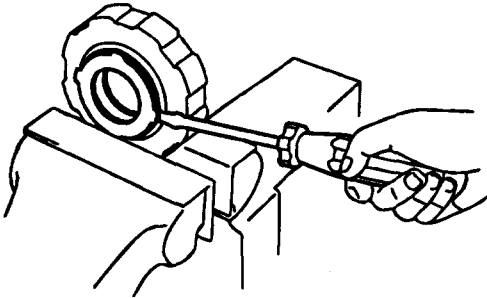
### DISASSEMBLY EKMB1060

1. Hold NO.1 one-way clutch and turn the planetary sun gear. The planetary sun gear turns freely counter-clockwise and locks clockwise.



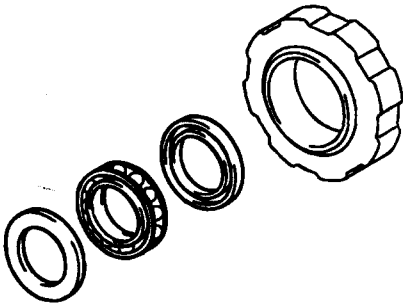
KKMB034B

2. Disassemble NO.1 one-way clutch.
  - a. Using a screwdriver, loosen the staked parts of the rear side retainer.
  - b. Remove the retainer.



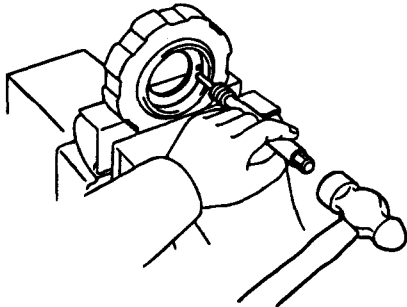
KKMB034C

3. Remove the one-way clutch and 2 retainers from the outer race.



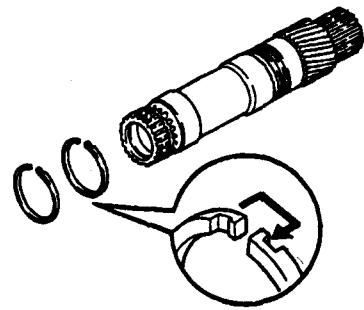
KKMB034D

4. Using a pin punch and hammer, remove the front side retainer.



KKMB034E

5. Remove the 2 oil seal rings.



KKMB034F

## INSPECTION

EKMB1070

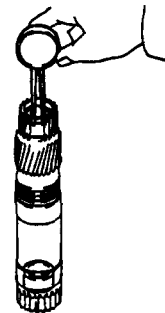
1. Check planetary sun gear bushing.  
Using a dial indicator, measure the inside diameter of the planetary sun gear bushings.

---

Maximum inside diameter : 21.58 mm (0.896 in.)

---

If the inside diameter is greater than the maximum, replace the planetary sun gear.

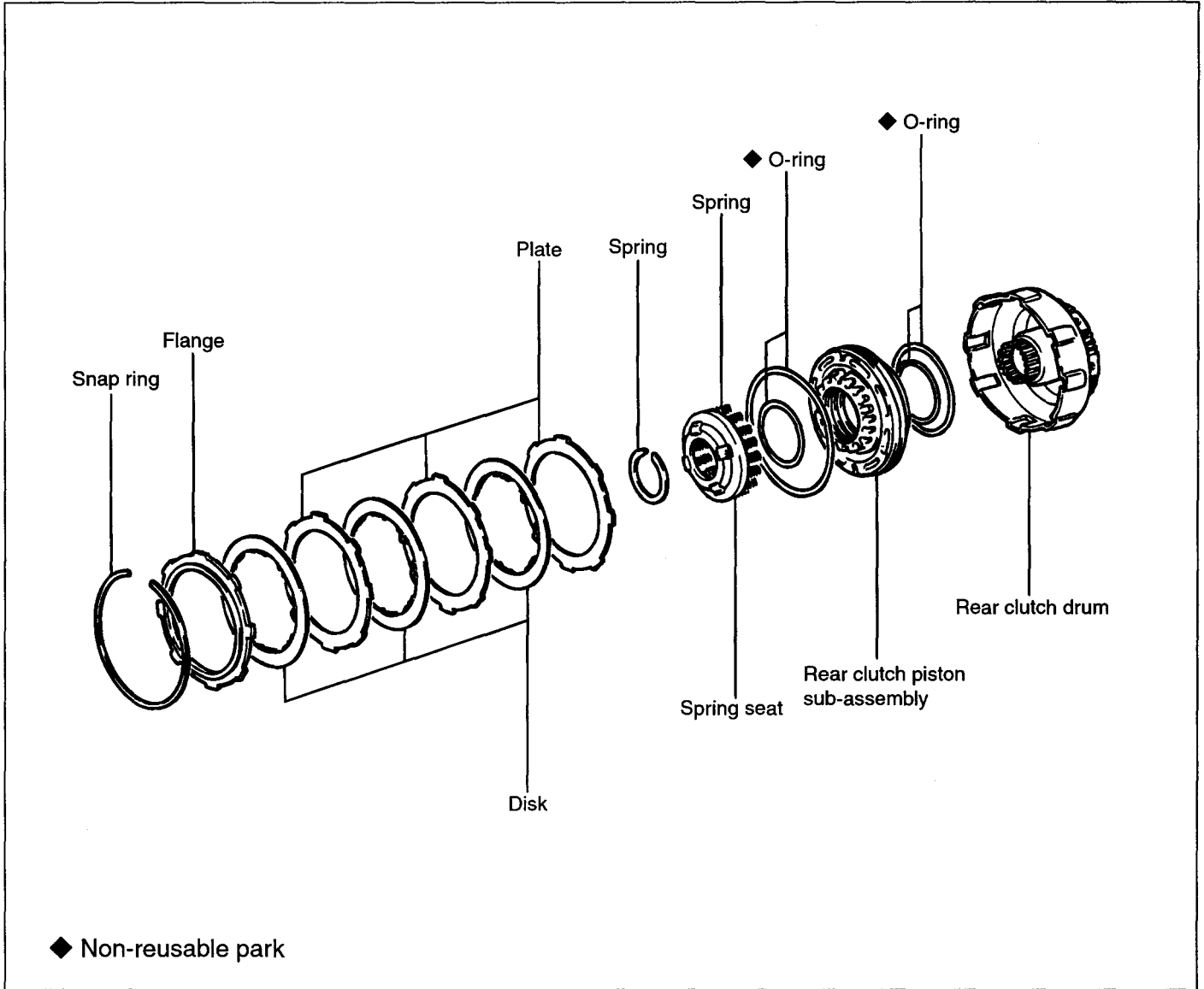


KKMB034G

# REAR CLUTCH

EKMB0870

## COMPONENTS

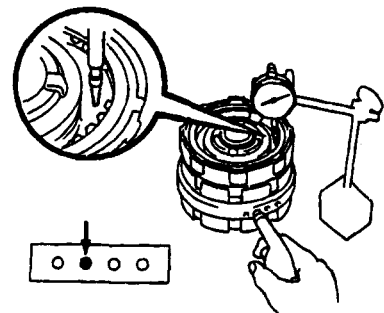


EKMB087A

## DISASSEMBLY EKMB0880

- Using a dial indicator, measure the rear clutch piston stroke applying and releasing the compressed air (392 - 785 kPa, 4 - 8 kgf/cm<sup>2</sup>, 57 - 114 psi), as shown.

Piston stroke : 0.90 - 1.30 mm

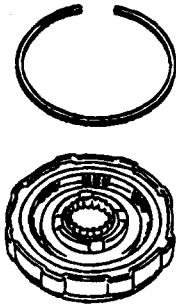


If the values are non-standard, inspect the discs.

KKMB029C

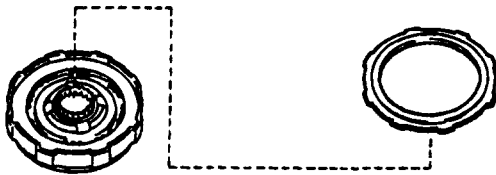
2. Remove flange.

- 1) Using a screwdriver, remove the snap ring.



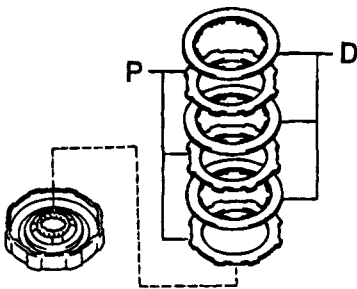
KKMB029D

- 2) Remove the flange.



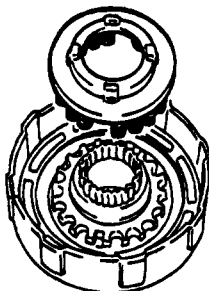
KKMB029E

3. Remove disc and plate.



KKMB029F

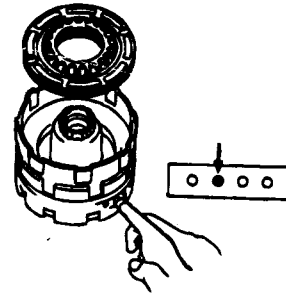
4. Remove the piston return spring.



KKMB029G

5. Remove rear clutch piston.

- a. Place the rear clutch drum onto the center support.
- b. Hold the rear clutch piston with hand, apply compressed air to the center support to remove the rear clutch piston.
- c. Remove the 4 O-rings from the piston.

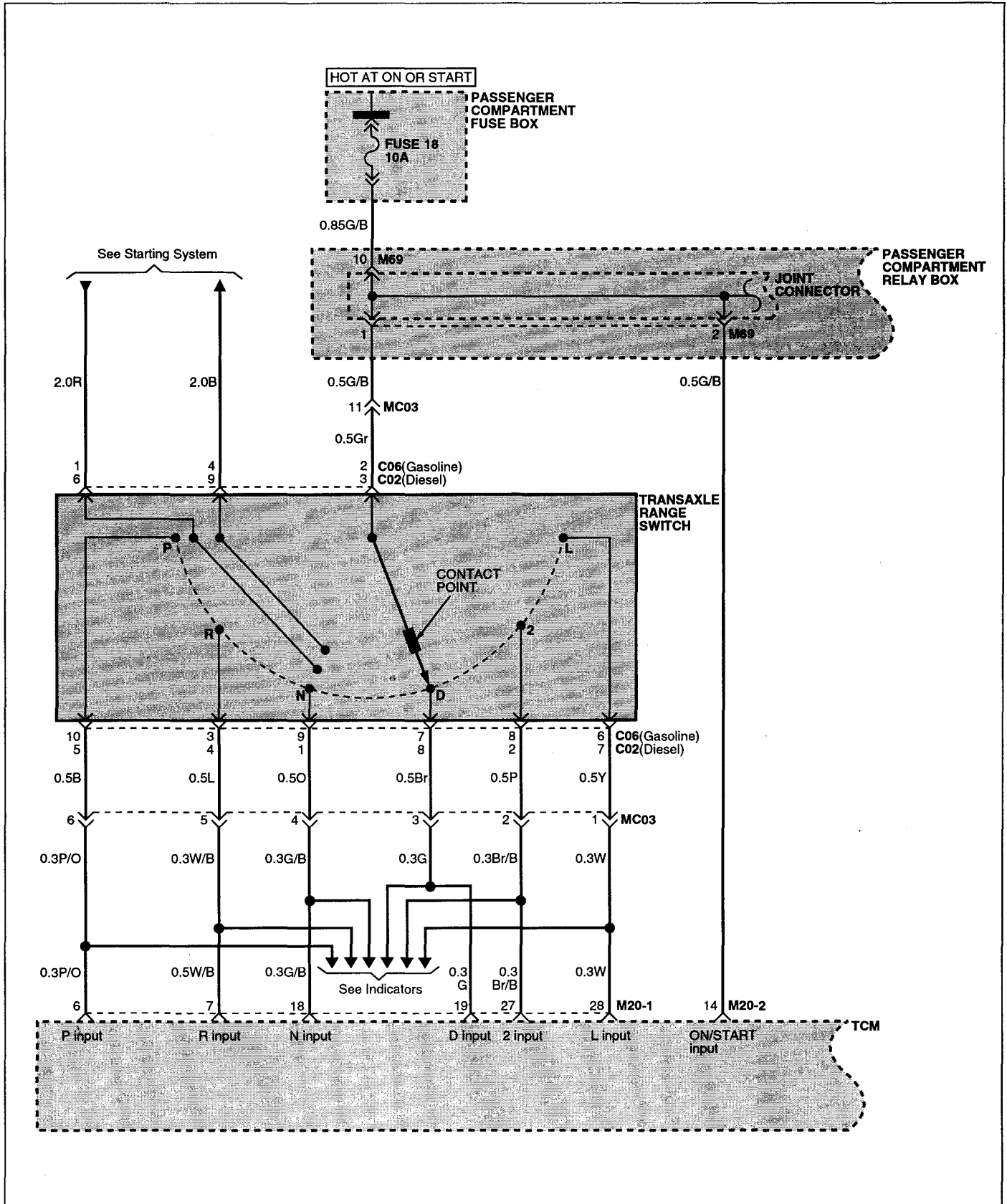


KKMB029H

TCM

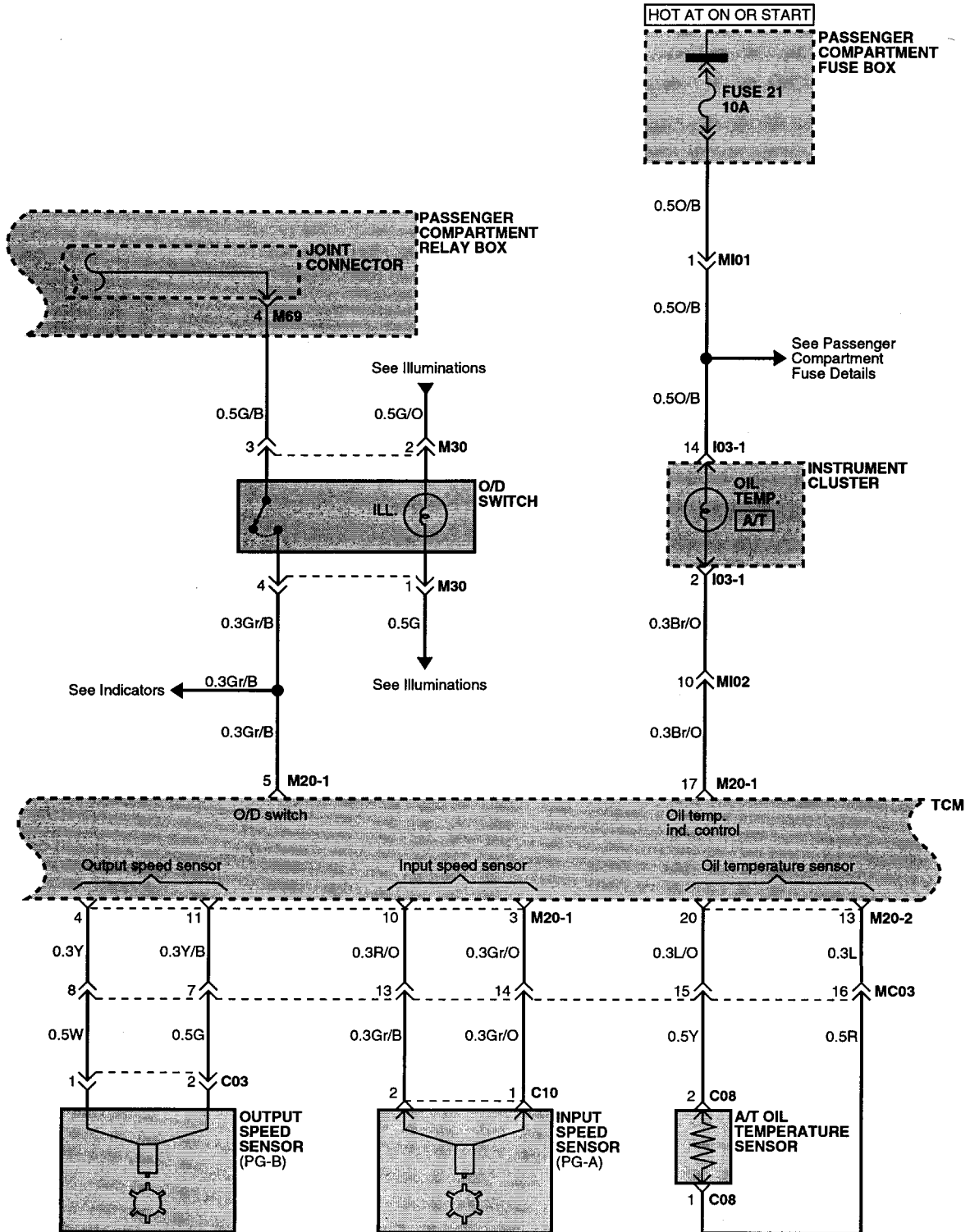
EKMB1080

TCM CIRCUIT DIAGRAM (1)

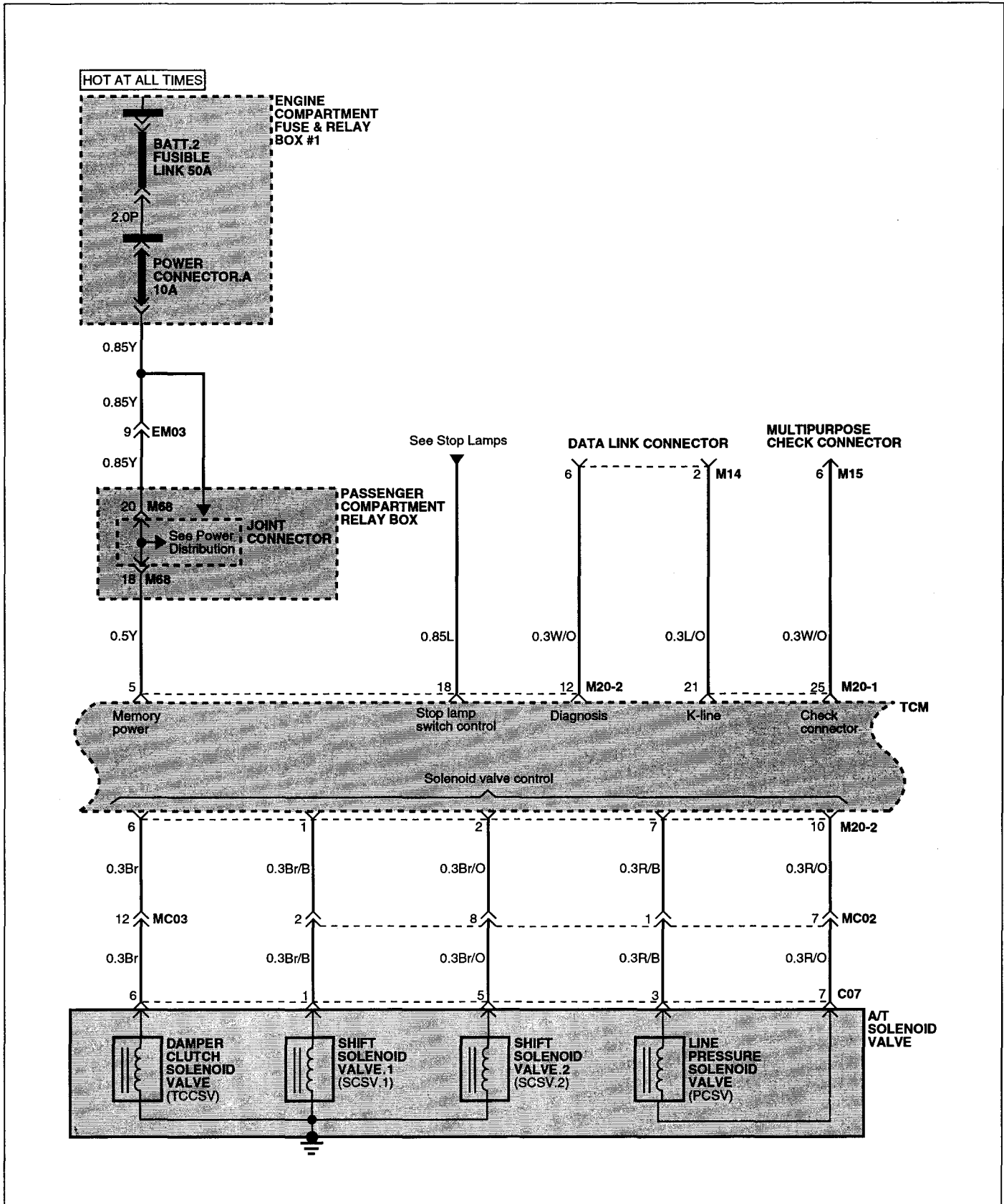




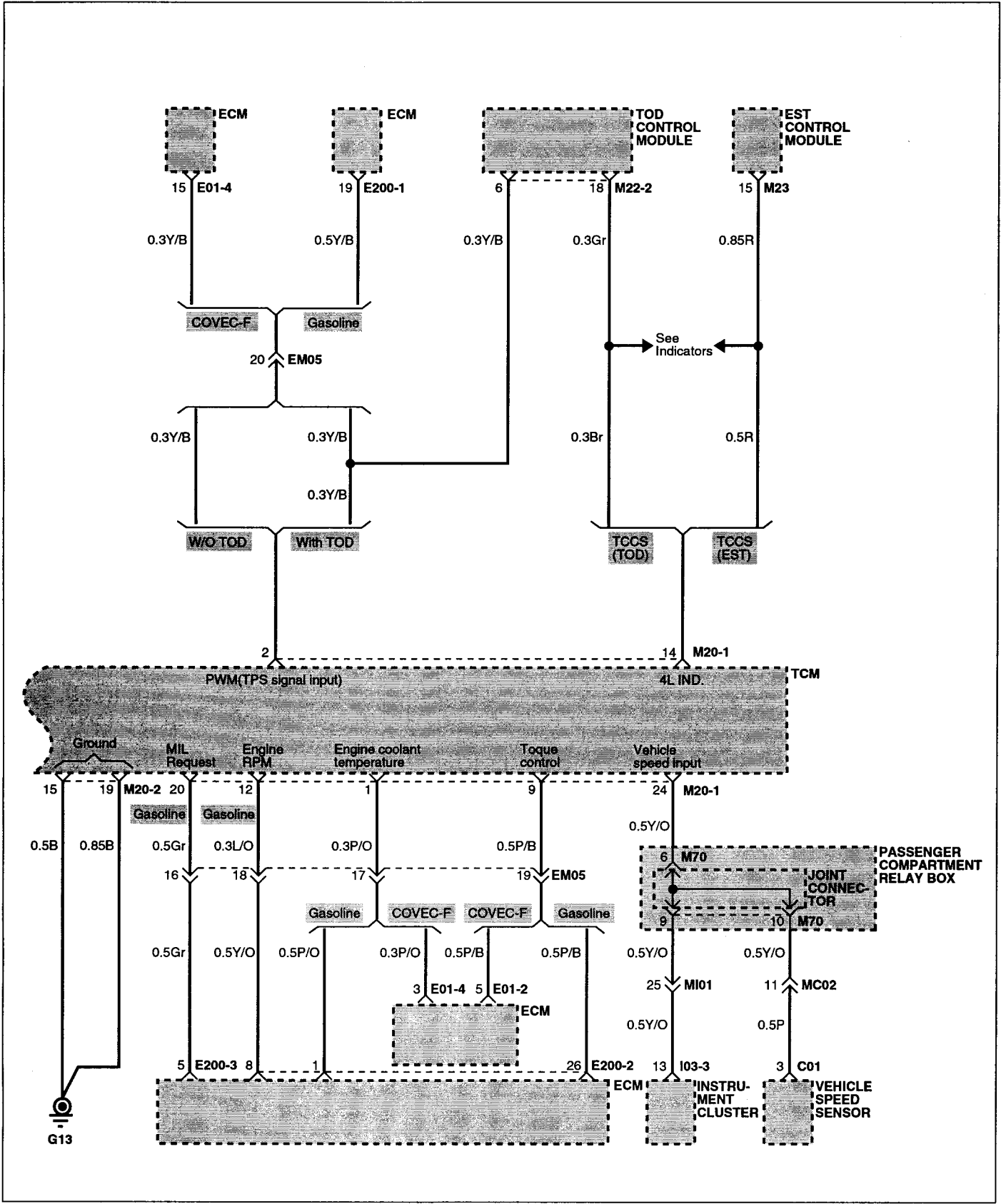
TCM CIRCUIT DIAGRAM (2)



TCM CIRCUIT DIAGRAM (3)

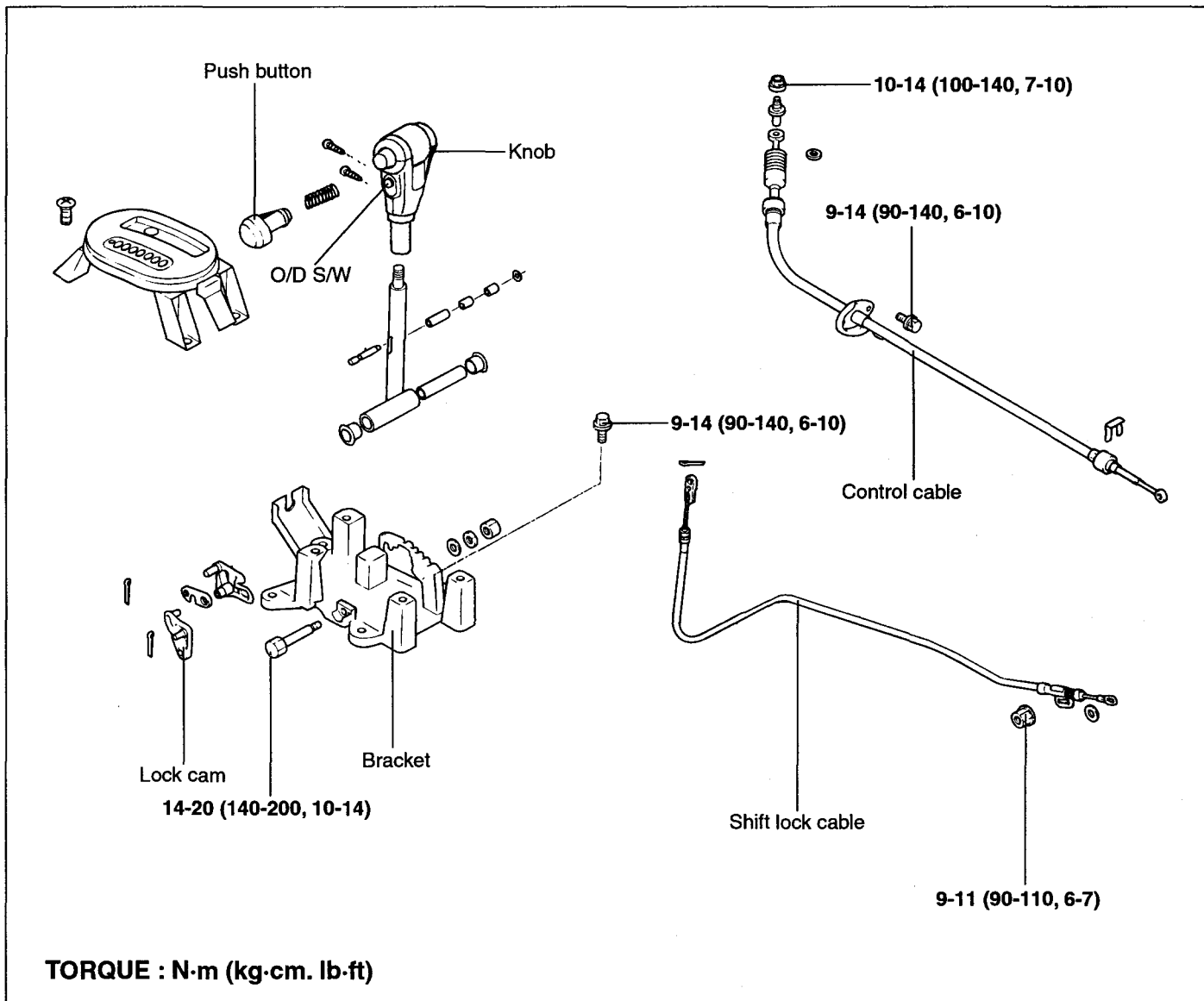


TCM CIRCUIT DIAGRAM (4)



SHIFT LEVER

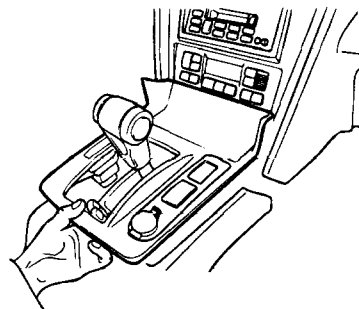
EKMB1100



EKMB110A

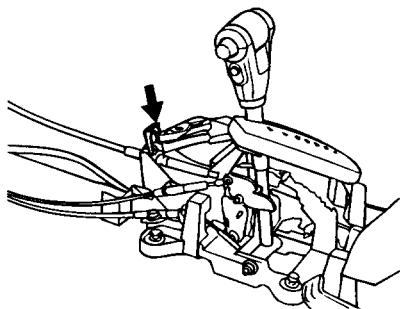
**REMOVAL** EKMB1110

1. Remove the console upper cover plate.

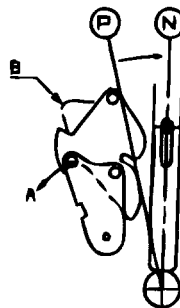


KKMB111A

2. Remove the clips of the control cable, the shift lock cable and the key lock cable.



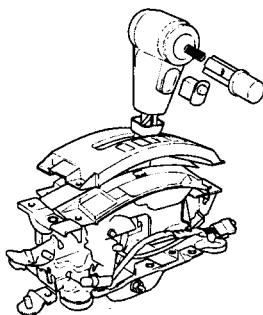
KKMB111D



< FIG. 1 >

3. Remove the bracket bolt.
4. Remove the control lever assembly.

EKA9060A



KKMB111B

2. Procedure for adjusting shift lock and key lock cable.

- 1) Check that each lock cam is located in position as figure 2.
- 2) Install shift lock cable and key lock cable in position. In this case, key lock cable must be fixed to key cylinder and shift lock cable must be fixed to brake pedal in position.

**INSPECTION**

EKMB1120

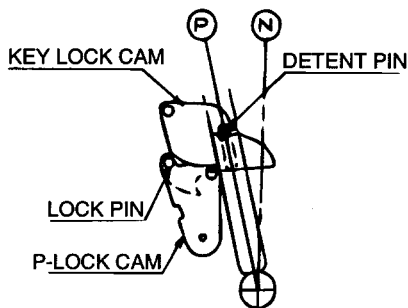
- Check the detent place for wear.
- Check the bushing for wear or damage.
- Check the spring for damage or deterioration.
- Check the pin at the end of the rod assembly for wear.

**SHIFT LOCK DEVICE INSTALLATION INSTRUCTIONS**

**NOTE**

When servicing the shift lock device, follow the service instructions and procedures described below in order to operate it normally.

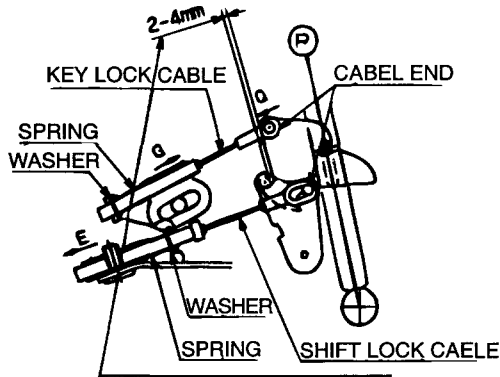
1. Procedure to install the lock cam.
  - 1) Move the P-lock cam to direction "A" and hold it with hand (Refer to figure 1).
  - 2) Check that key lock cam is located at "B" by detent pin (Refer to figure 1,2).



< FIG. 2 >

EKA9060B

- 3) Temporarily install each cable to A/T lever assembly as shown in figure 3. Securely insert cable end into fixing pin of each cam.
- 4) Keep the gap of 2 - 4 mm between key lock cam and P-lock cam to eliminate the cable slack by pulling the shift lock cable slightly in the direction of "E" (Refer to figure 3).



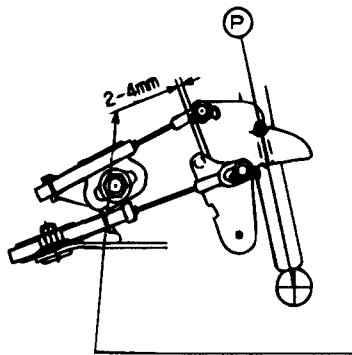
< FIG. 3 >

EKA9060C

**CAUTION**

**If the gap is not maintained between 2 and 4 mm, the brake pedal should be depressed more than required when operating the push button of the shift lever.**

- 5) After checking that a portion of cable end touches cable fixing pin of P-lock cam, fix shift lock cable to A/T lever with nut and fix the shift lock cable end with the washer and snap pin (Refer to figure 4).



< FIG. 4 >

EKA9060D

- 6) Slightly push key lock cam in the direction of "Q".
- 7) Performing the work of 6), slightly pull the key lock cable in the direction of "G" to stretch the cable tight and then fix it with a nut (Refer to figure 3,4).

- 8) Be sure to check whether the key lock cable is inserted into the fixing pin of key lock cam, and then fix it with the washer and snap pin. At this time, check if the P-lock cam is fixed to the shift lock cable as shown in the figure 4.

3. Checking that procedure for installing the shift lock is correct.

- 1) When the brake pedal is not depressed, push button of the shift lever at "P" position cannot be operated. (Shift lever cannot be shifted at the other positions from "P"). Push button can be operated at the other positions except "P".

- 2) When brake pedal stroke is 15 - 25 mm (with shift lever at "P" position), push button should be operated without catching and shift lever can be shifted smoothly to other from "P".

- 3) When brake pedal is not depressed, shift lever should be shifted smoothly to "P" position from other positions.

- 4) Brake pedal must be operated smoothly without catching at all positions.

- 5) When the ignition key is at "LOCK" position, although brake pedal is depressed, the push button should be operated.

- 6) Ignition key must not be turned to "LOCK" position except "P" position.

- 7) If shift lever is shifted to "P" position, ignition key must be turned to "LOCK" position smoothly.

4. Caution in service.

- 1) Keep the gap of 2 - 4 mm between key lock cam and P-lock cam by pulling the shift lock cable in the direction of "E" slightly and then fix the cable with a nut. After this, work be sure to check that the gap is within 2 - 4 mm.

**NOTE**

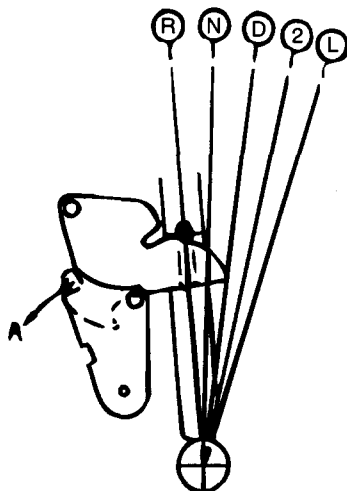
*If the gap is not maintained between 2 and 4 mm, the brake pedal should be depressed more than required in order to shift the lever from "P" to other positions even though the brake pedal is prepsed.*

- 2) To be sure that the key lock cable slack should be eliminated.

**NOTE**

If slack of the key lock cable is not eliminated, the ignition key cannot be removed from the key cylinder and shift lever can be shifted from "P" to other positions although the key is in the "LOCK" position.

- 3) Before and after the relating work, the key lock cam and P-lock cam should not be in the same condition as the figure 5 and 6.



&lt; FIG.5 &gt;

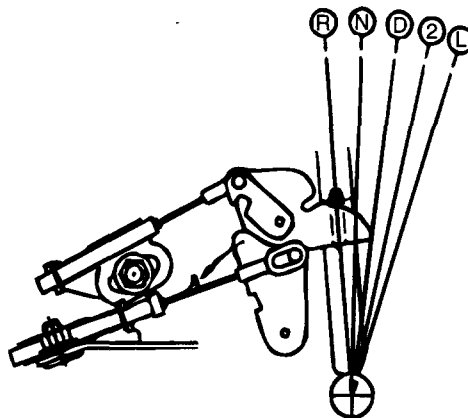
KKMB112D

**NOTE**

When the key lock cam and P-lock cam are in the same condition as the figure 5 and 6, shifting the shift lever from D, 2, L positions to P, R, N by force may cause a malfunction of relating parts.

Under the condition in the figure 5, shift the shift lever from D, 2, L to P, R, N after rotating the P-lock cam in the direction of "A".

Under the condition in the figure 6, shift the shift lever from D, 2, L to P, R, N after rotating the P-lock cam in the direction of "A" depressing the brake pedal.



&lt; FIG.6 &gt;

KKMB112E

**KEY INTER LOCK DEVICE IN STALL ALL ATIONING TRUCTIONS**

If it is expected that the ignition key may not be removed from the key cylinder due to mis-assembly of the key inter lock cable.

To prevent above problem, keep the following installation instructions for key inter lock cable when servicing.

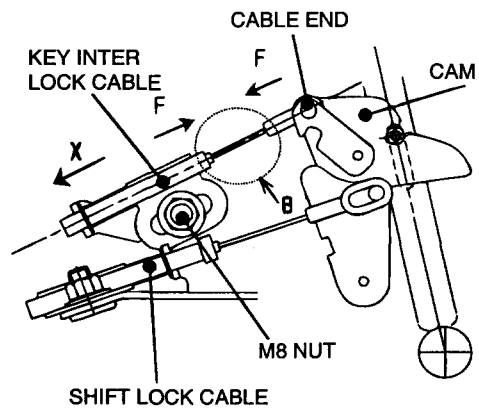
1. Assembly of key inter lock cable and ignition lock.
  - 1) Ignition lock is in the state assembled with the steering column.  
Set the ignition lock to the lock position.
  - 2) Assemble the key inter lock cable and the ignition lock with the set screw.
2. Assembly of key inter lock cable and shift lever.
  - 1) Set the shift lever to parking position.
  - 2) After setting the key inter lock cable as shown in the figure 7, temporarily assemble the key inter lock cable with a M8 nut enough to move the key inter lock cable plate by its spring force.
  - 3) Holding the cable and the key inter lock cable plate, push them into the direction of "F" so as not to create any bending or slack on the "B" point of the key inter lock cable.

**NOTE**

Do not pull the cable in the direction of "X" holding the cable to remove the slack.

*This may cause key not to remove from the key cylinder.*

- 4) Tighten the key inter lock cable installed temporarily firmly with a M8 nut.



**< FIG. 7 >**

EKA9060G



# MANUAL TRANSAXLE SYSTEM

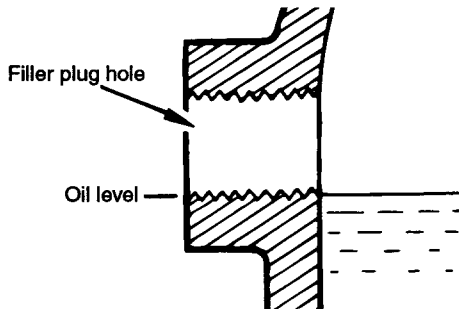
## MANUAL TRANSAXLE

### SERVICE ADJUSTMENT PROCEDURES

EMMB0070

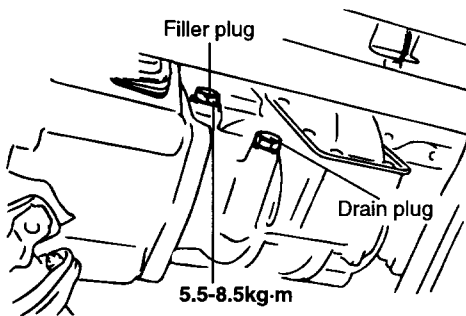
### OIL INSPECTION AND REPLACEMENT

1. Raise vehicle on hoist and remove the filler plug and check the oil level.



EMMB007A

2. In case of the oil replacement, remove the drain plug and drain the oil and tighten the drain plug.
3. Fill the specified transmission oil to the level.
4. Tighten the filler plug.

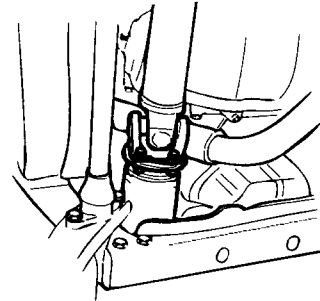


EMMB007B

### REMOVAL

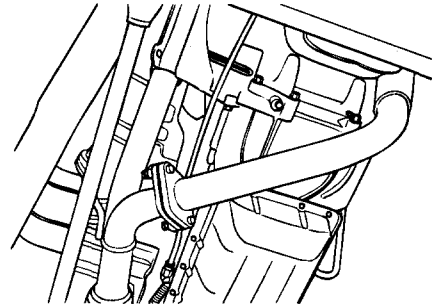
EMMB0090

1. Remove the battery (-) terminal.
2. Remove the knob and the control lever.
3. Raise the vehicle.
4. Remove the transmission under cover.
5. Remove the clutch release cylinder.
6. Remove the front propellar shaft (4WD vehicle).



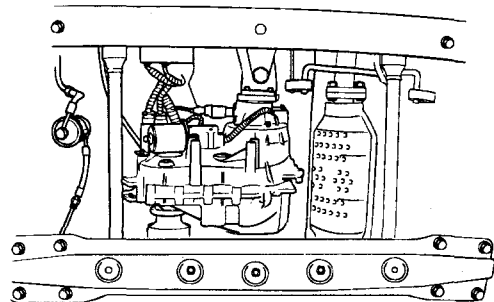
KMMB009H

7. Remove the front muffler and the heater protector.



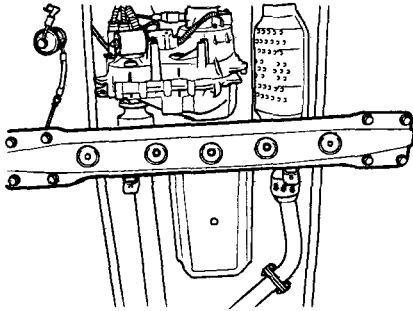
KDMB001D

8. Remove the transfer case connector (4WD vehicle).



KMMB009K

9. Remove the rear propellar shaft.
10. Support the transmission by the jack.
11. Remove the rear cross member.

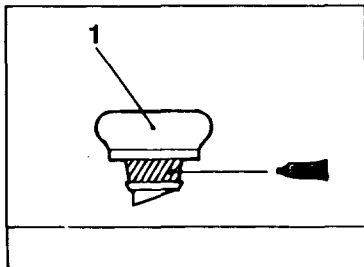
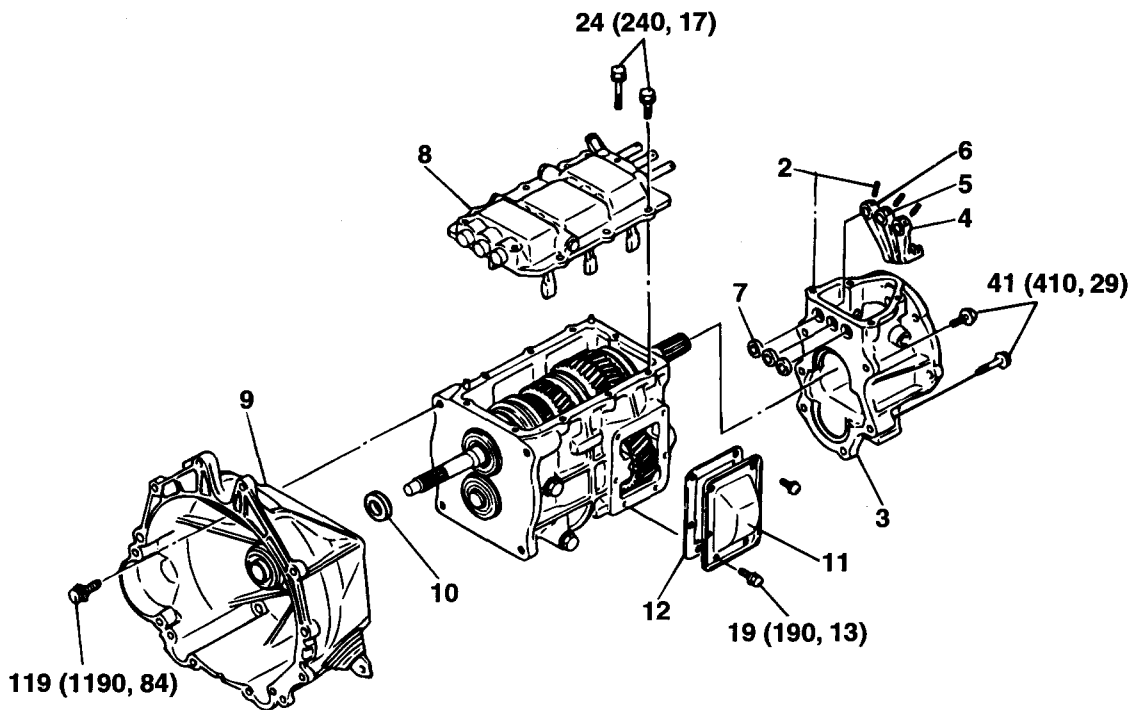
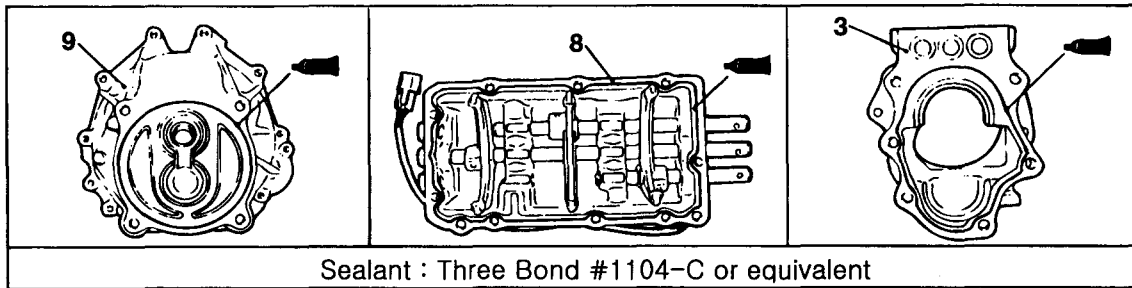


KMMB009J

12. Remove the transmission with transfer case (4WD vehicle).

V5MT1 MODEL (2.5TCI) EMMB0100

COMPONENTS (1)

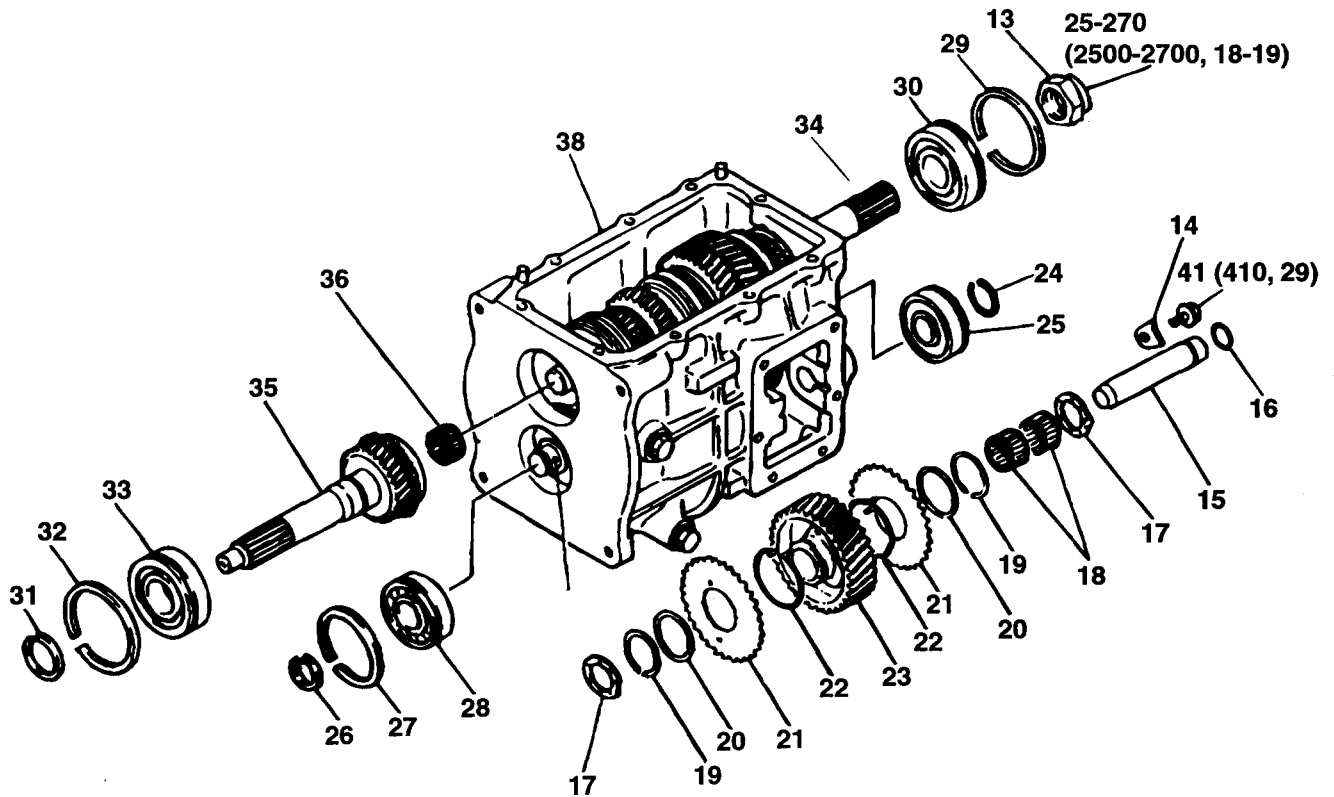


<Disassembly procedure>

- |                   |                      |
|-------------------|----------------------|
| 1. Air breather   | 7. Seal ring         |
| 2. Spring pin     | 8. Lower case        |
| 3. Adapter        | 9. Clutch housing    |
| 4. 1-2 shift rail | 10. Oil seal         |
| 5. 3-4 shift rail | 11. PTO cover        |
| 6. 5-R shift rail | 12. PTO cover gasket |

TORQUE : N·m (kg·cm, lb·ft)

COMPONENTS (2)



<Disassembly procedure>

- |                    |                   |
|--------------------|-------------------|
| 13. Locking nut    | 26. Snap ring     |
| 14. Lock piece     | 27. Snap ring     |
| 15. Reverse shaft  | 28. Ball bearing  |
| 16. O-ring         | 29. Snap ring     |
| 17. Side washer    | 30. Ball bearing  |
| 18. Needle bearing | 31. Snap ring     |
| 19. Snap ring      | 32. Snap ring     |
| 20. Spacer         | 33. Ball bearing  |
| 21. Sub gear       | 34. Main shaft    |
| 22. Spring         | 35. Drive pinion  |
| 23. Reverse gear   | 36. Pilot bearing |
| 24. Snap ring      | 37. Counter shaft |
| 25. Ball bearing   | 38. Case          |

**TORQUE : N·m (kg·cm, lb·ft)**

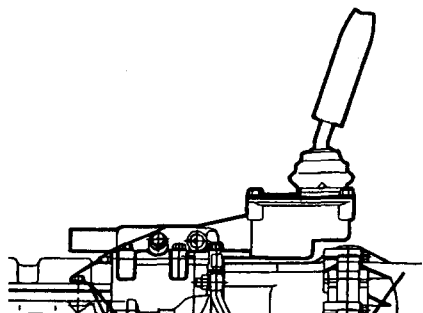
**DISASSEMBLY** EMMB0110

1. Remove the transmission control housing assembly.

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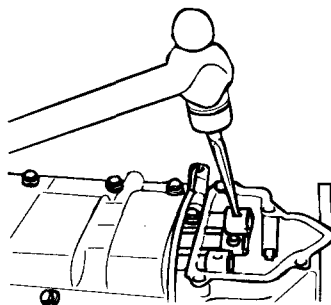
**Torque : 1.7 - 2.6 kg·m**

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KMMB007A

2. Using a pin remover, remove the spring pin.



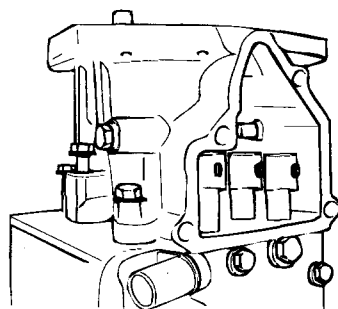
KMMB008A

3. Remove the transfer case adapter.

---

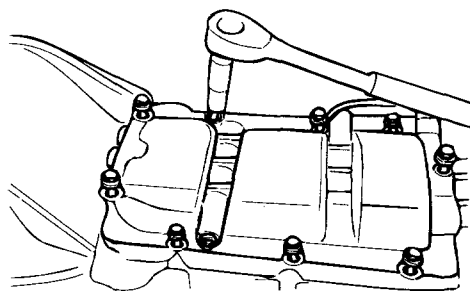
**Torque : 3.0 - 4.2 kg·m**

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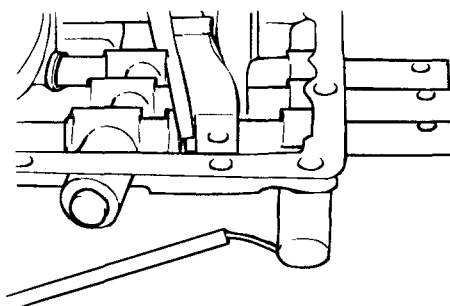
KMMB008B

4. Remove the gear shift lower case assembly.



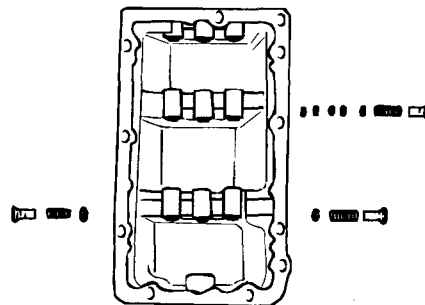
KMMB008C

5. Remove the back-up lamp switch from the gear shift lower case.



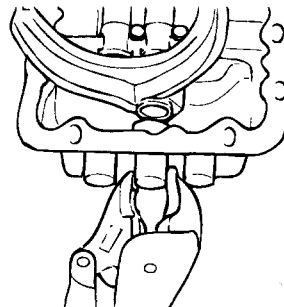
KMMB008D

6. Remove the screw plug, the poppet spring and the steel ball.



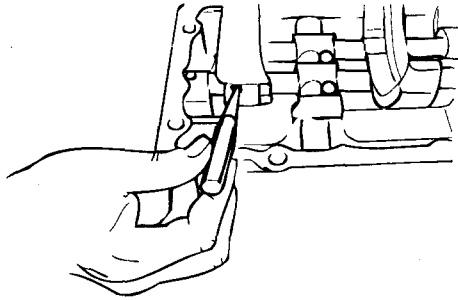
KMMB008E

7. Remove the dust plug.



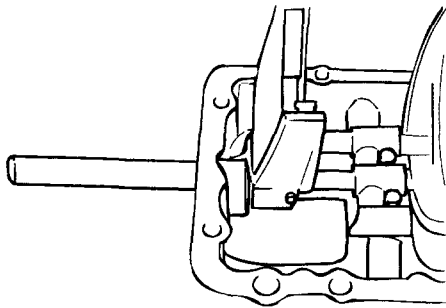
KMMB009A

8. Remove the spring pin of the 3rd & 4th shift rail.



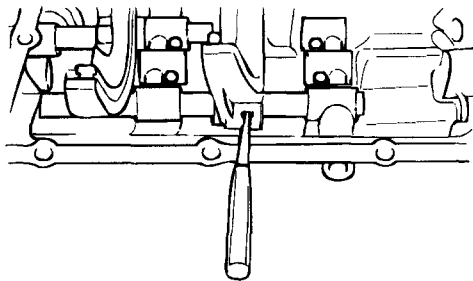
KMMB009B

9. Remove the 3rd & 4th shift rail and fork.



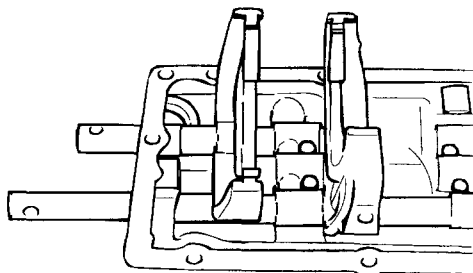
KMMB009C

10. Remove the spring pin of the 1st & 2nd shift rail.



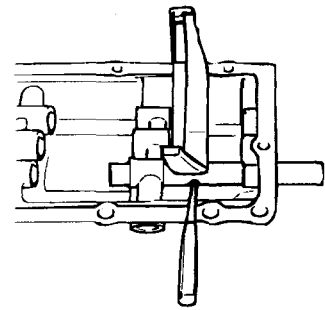
KMMB009D

11. Remove the 1st & 2nd shift rail and fork.



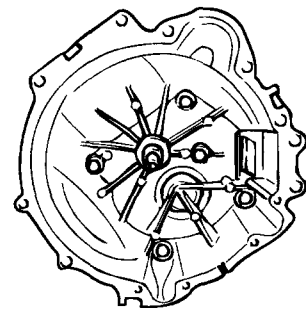
KMMB009E

12. After removing the spring pin of the 5th & rev. shift rail.



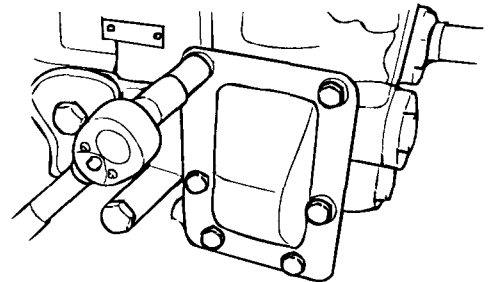
KMMB009F

13. Remove the clutch housing.



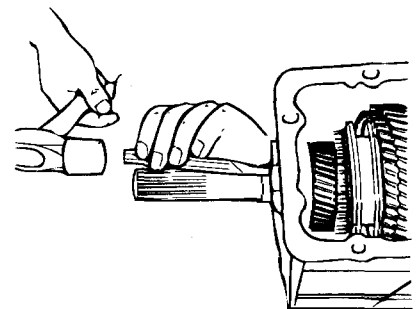
KMMB010A

14. Remove the PTO cover.



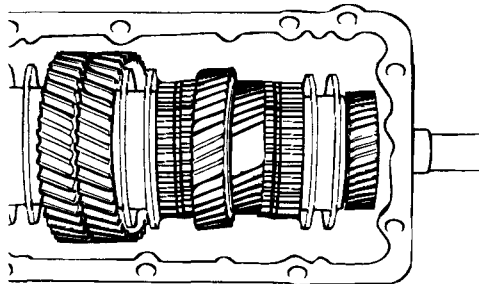
KMMB010B

15. Remove the lock nut.



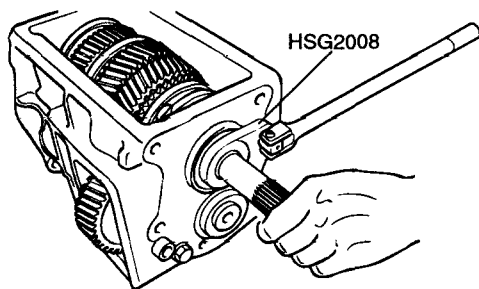
KMMB010C

16. Slide the 1st & 2nd speed synchronizer sleeve to the 1st speed side and then 5th & reverse synchronizer sleeve to the reverse side for double meshing.



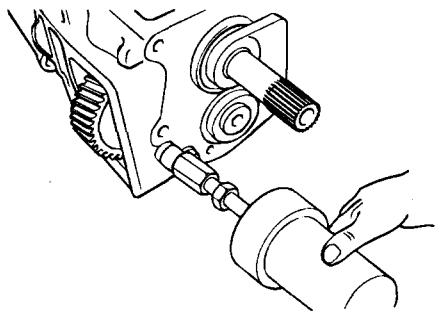
KMMB010D

17. Remove the lock nut.



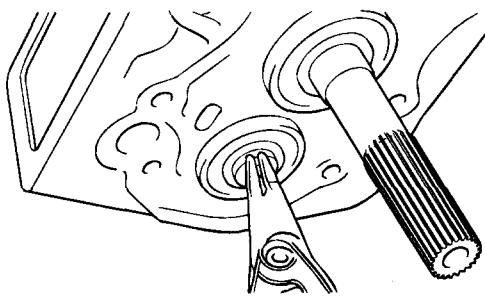
KMMB010E

18. Install the slide to the reverse shaft to operate the slide hammer and remove the reverse shaft and the reverse gear.

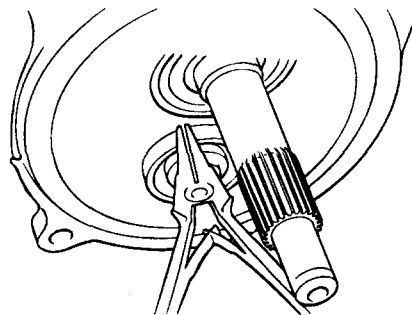


KMMB010F

19. Remove the front & rear snap ring of the counter shaft.

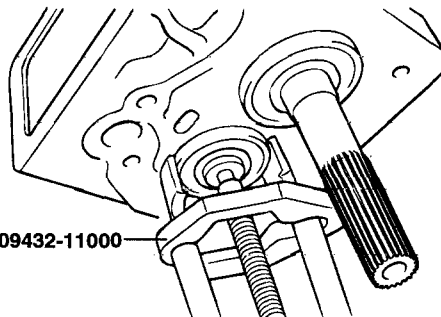


KMMB010G

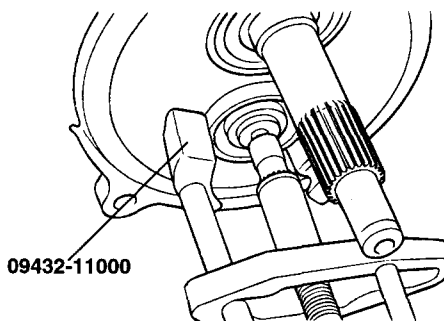


KMMB010H

20. Using SST remove the counter shaft front and rear bearing.

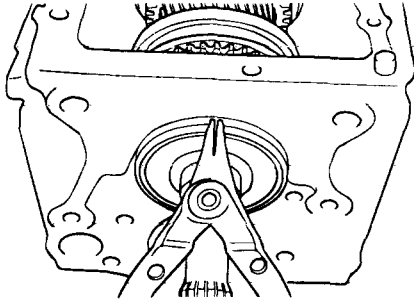


KMMB011A



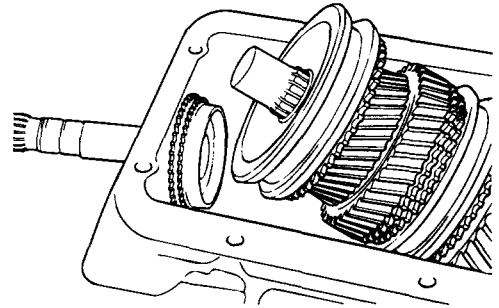
KMMB011B

21. Remove the main shaft snap ring.



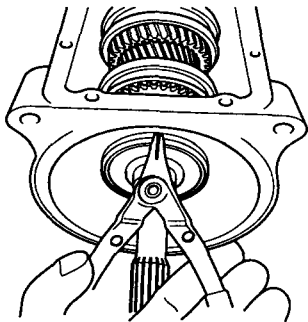
KMMB011C

After that, remove it by pulling upward.



KMMB012A

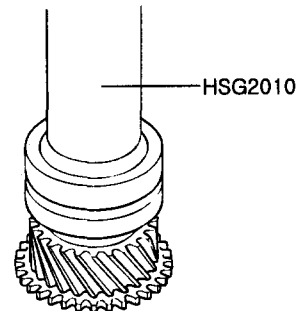
22. Remove the drive pinion shaft snap ring.



KMMB011D

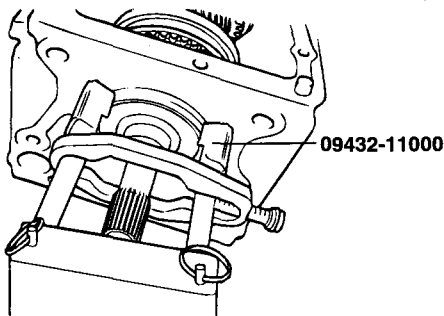
**REASSEMBLY** EMMB0120

1. Reassembly is the reverse order of the disassembly.
2. Insert the ball bearing to the drive pinion.



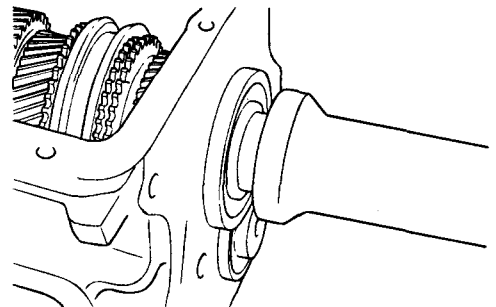
KMMB012B

23. Using SST, remove the main shaft ball bearing.



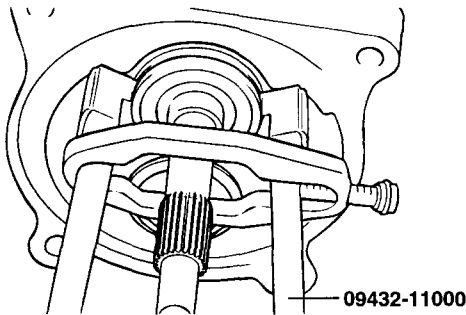
KMMB011E

3. Install the main shaft ball bearing and the counter shaft ball bearing.



KMMB012C

24. Using SST, remove the drive pinion ball bearing.



KMMB011F

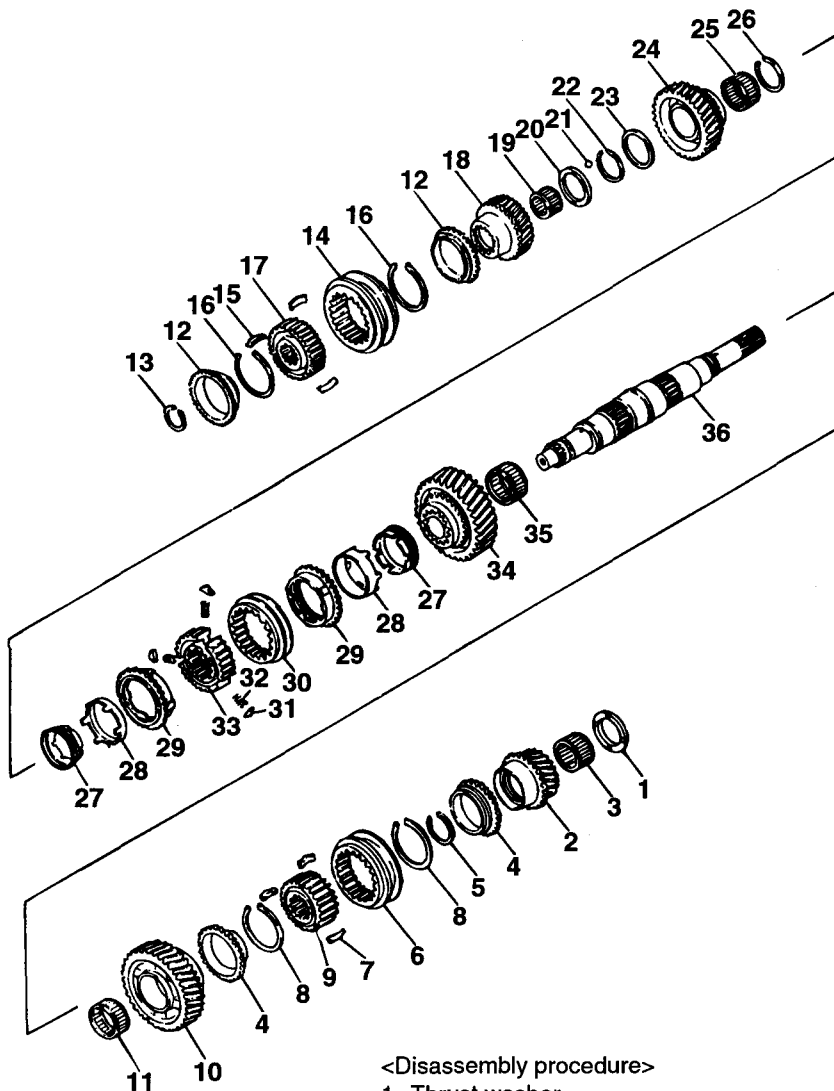
25. Disconnect the main shaft from the drive pinion shaft, and then slightly pull it backward.



## MAIN SHAFT

EMMB0130

## COMPONENTS



## &lt;Disassembly procedure&gt;

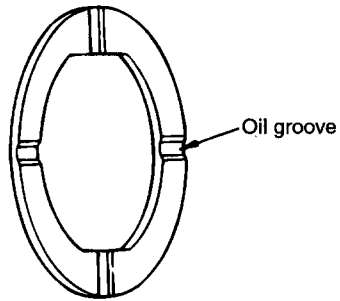
- |                         |                         |
|-------------------------|-------------------------|
| 1. Thrust washer        | 19. Needle bearing      |
| 2. Overdrive gear       | 20. Thrust washer       |
| 3. Needle bearing       | 21. Steel ball          |
| 4. Synchronizer ring    | 22. Snap ring           |
| 5. Snap ring            | 23. Thrust washer       |
| 6. Synchronizer sleeve  | 24. 2nd speed gear      |
| 7. Synchronizer key     | 25. Needle bearing      |
| 8. Synchronizer spring  | 26. Snap ring           |
| 9. Synchronizer hub     | 27. Synchronizer ring   |
| 10. Reverse gear        | 28. Synchronizer cone   |
| 11. Needle bearing      | 29. Synchronizer ring   |
| 12. Synchronizer sleeve | 30. Synchronizer sleeve |
| 13. Snap ring           | 31. Synchronizer key    |
| 14. Synchronizer sleeve | 32. Synchronizer spring |
| 15. Synchronizer key    | 33. Synchronizer hub    |
| 16. Synchronizer spring | 34. 1st speed gear      |
| 17. Synchronizer hub    | 35. Needle bearing      |
| 18. 3rd speed gear      | 36. Main shaft          |

**DISASSEMBLY** EMMB0140

1. Using the SST(09432-11000),remove the synchronizer hub.

**REASSEMBLY** EMMB0150

1. Install the thrust washer so that the oil groove faces is toward the gear side.

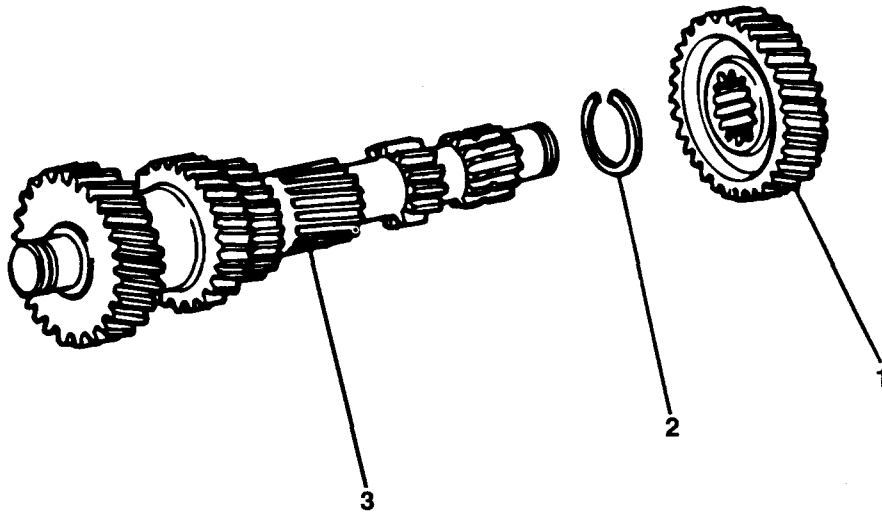


EMMB014A

# COUNT SHAFT

EMMB0160

## COMPONENTS



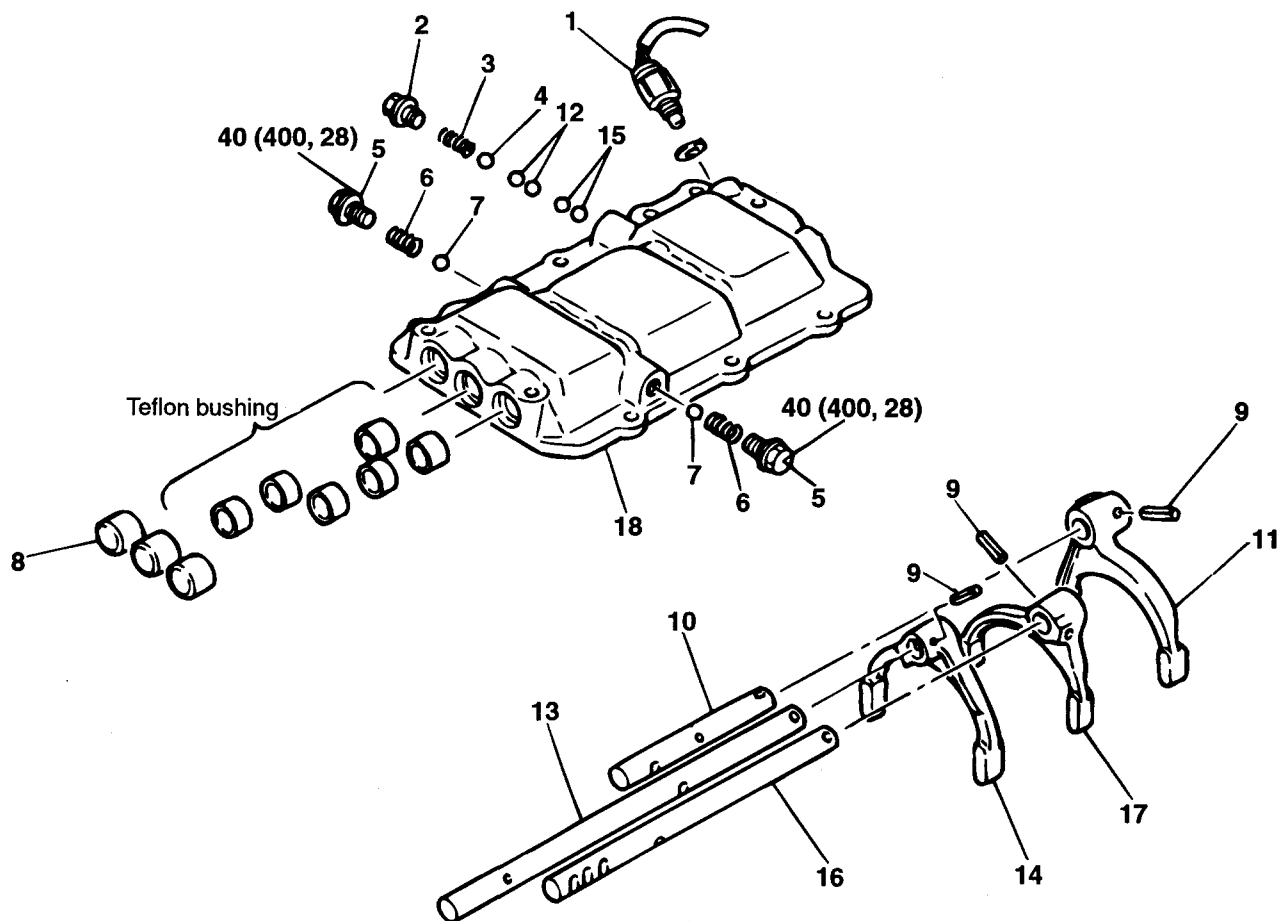
<Disassembly procedure>

1. Overdrive gear
2. Snap ring
3. Counter shaft

# GEAR SHIFT CASE

EMMB0170

## COMPONENTS



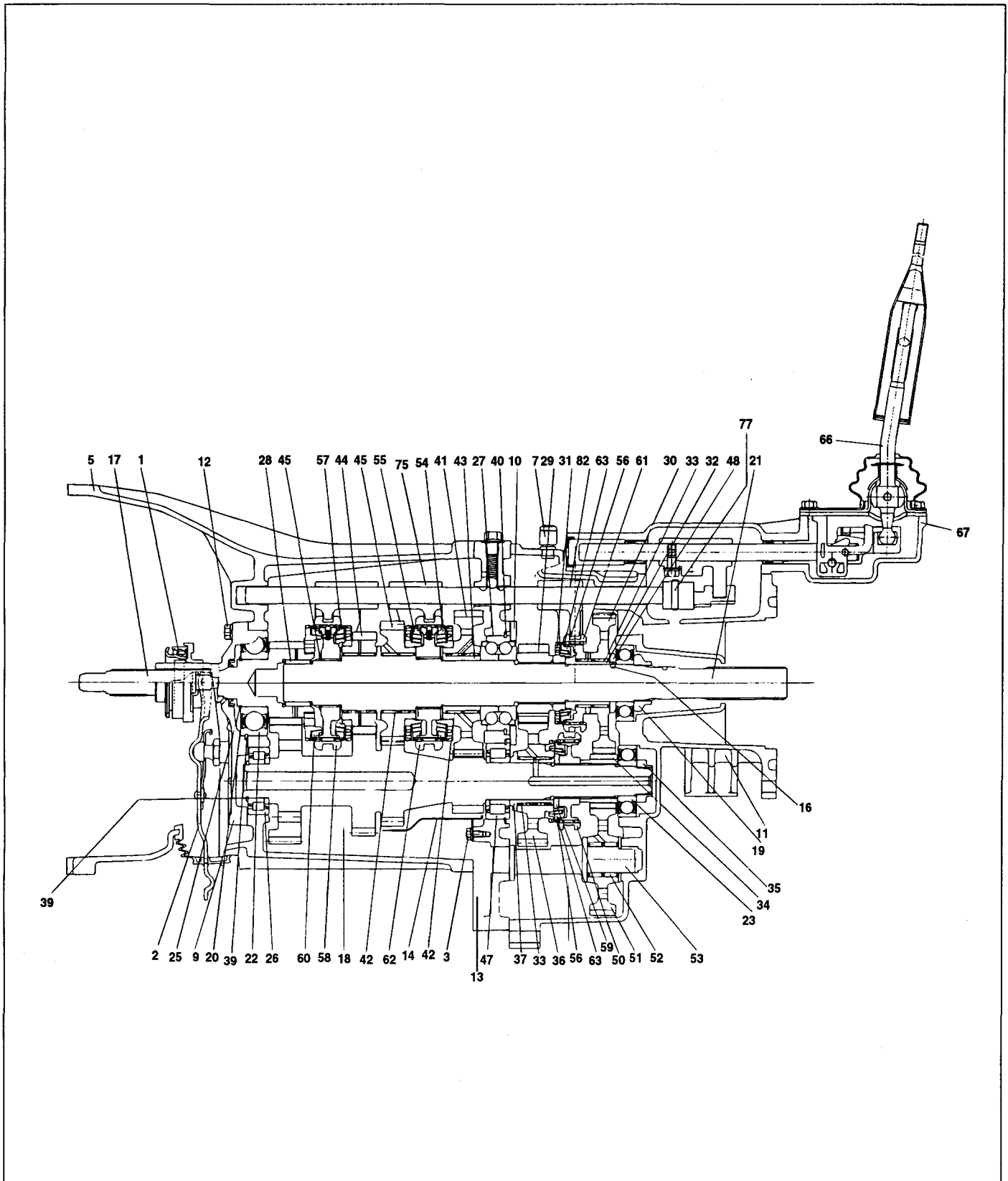
<Disassembly procedure>

- |                        |                           |
|------------------------|---------------------------|
| 1. Back-up lamp switch | 10. 5th & Rev. shift rail |
| 2. Plug                | 11. 5th & Rev. shift fork |
| 3. Poppet spring       | 12. Steel ball            |
| 4. Steel ball          | 13. 3rd & 4th shift rail  |
| 5. Plug                | 14. 3rd & 4th shift fork  |
| 6. Poppet spring       | 15. Steel ball            |
| 7. Steel ball          | 16. 1st & 2nd shift rail  |
| 8. Dust plug           | 17. 1st & 2nd shift fork  |
| 9. Spring pin          | 18. Shift case            |

**TORQUE : N·m (kg·cm, lb·ft)**

M5SR1 MODEL (2.9TCI, 3.5V6) EMMB0180

COMPONENTS (1)

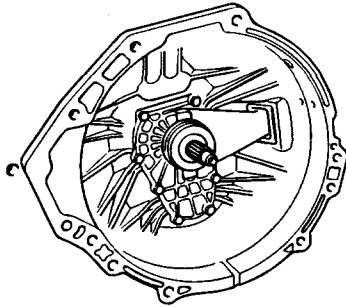


## COMPONENTS (2)

1. Clutch release bearing
2. Release fork assembly
3. Bolt
4. Bolt
5. Bolt
6. Transmission case
7. Air breather
8. Magnet
9. Front bearing retainer
10. Rear bearing retainer
11. Adapter
12. Seal bolt
13. Intermediate plate
14. Oil guide
15. Seal bolt
16. Steel ball
17. Main drive pinion
18. Counter shaft cluster
19. Locking nut
20. Spacer
21. Main shaft
22. Ball bearing
23. Rear ball bearing
24. Ball bearing
25. Snap ring
26. Roller bearing
27. Double angular ball bearing
28. Needle roller bearing
29. Overtop gear
30. Reverse gear
31. Clutch gear
32. Reverse gear sleeve
33. Needle roller bearing
34. Counter shaft reverse gear
35. Locking nut
36. Overtop gear
37. Overtop gear sleeve
38. Snap ring
39. Snap ring
40. Snap ring
41. 1st speed gear
42. Needle roller bearing
43. 1st speed gear sleeve
44. 3rd speed gear
45. 3rd & 4th speed gear snap ring
46. 2nd speed gear
47. Roller bearing
48. Thrust washer
49. Spacer
50. Reverse idler gear
51. Needle roller bearing
52. Reverse spacer
53. Reverse idler gear shaft
54. Triple cone (1st)
55. Triple cone (2nd)
56. Double cone
57. Double cone (3rd)
58. Synchronizer hub & sleeve (3&4)
59. Synchronizer hub & sleeve (5th)
60. Synchronizer ring (4th)
61. Synchronizer sleeve (5th & Rev.)
62. Synchronizer hub & sleeve (1st & 2nd)
63. Synchronizer spring
64. Bolt washer
65. Linear ball bearing
66. Control lever
67. Transmission control housing
68. Shift rail sub (1&2)
69. Shift rail sub (3&4)
70. Shift rail
71. Shift rail sub (5&R)
72. Steel ball
73. Poppet spring
74. Seal bolt
75. Shift fork (1&2)
76. Spring pin
77. Spring pin
78. Inter lock plunger
79. Shift lever (5th)
80. Shift fork (3&4)
81. Shift fork (5&R)

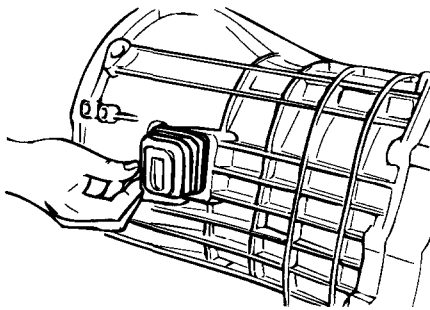
**DISASSEMBLY** EMMB0190

1. Remove the clutch release fork and bearing.



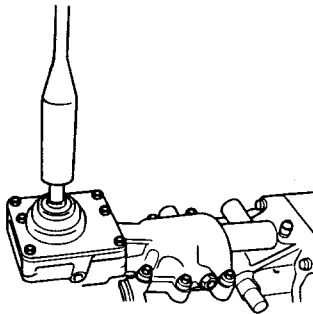
KMMB040A

2. Remove the clutch release fork boot.



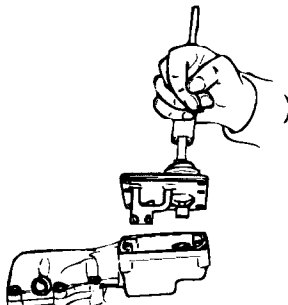
KMMB041B

3. Remove the shift lever mounting bolt.



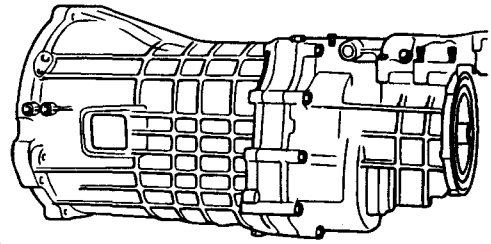
KMMB042A

4. Remove the shift lever.



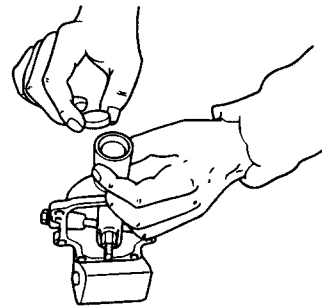
KMMB043A

5. Remove the transmission control housing.



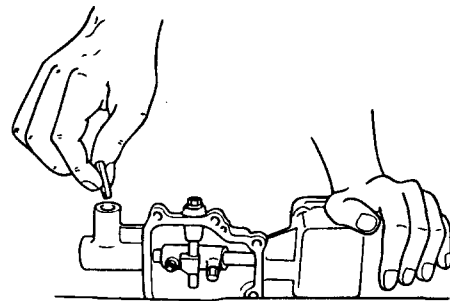
KMMB044A

6. Remove the rail rod.



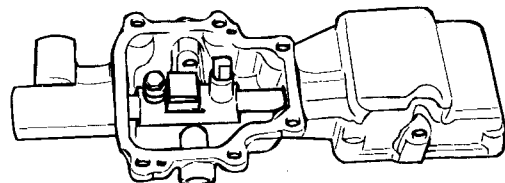
KMMB045A

7. Remove the spring pin.



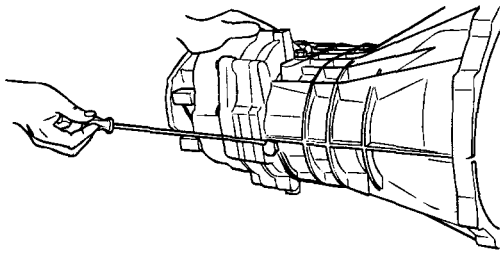
KMMB046A

8. Remove the rail fork bolt.

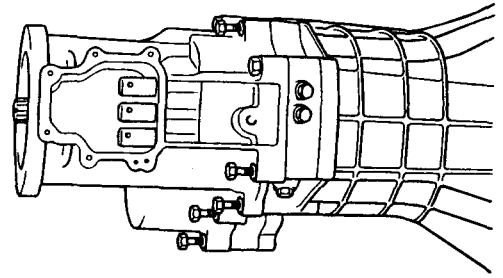


KMMB048A

9. Remove the oil drain plug.

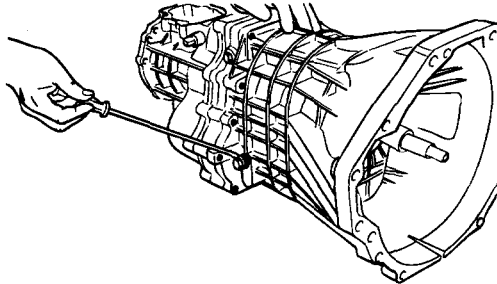


KMMB049A



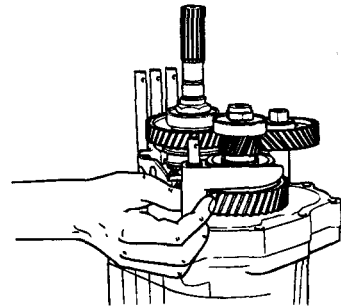
KMMB050A

10. Remove the oil filler plug.



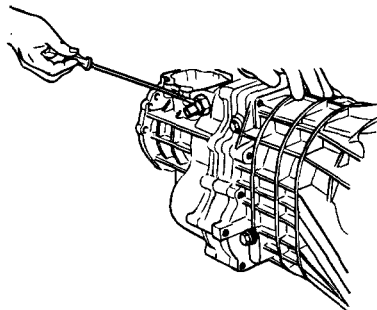
KMMB049B

14. Remove the shift fork.



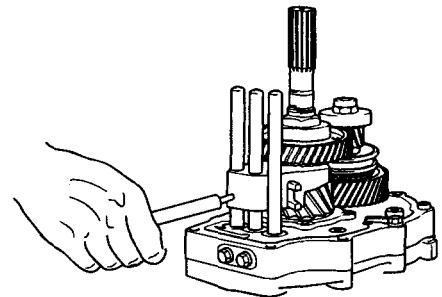
KMMB050B

11. Remove the back-up lamp.



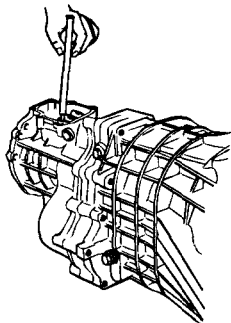
KMMB049C

15. Remove the spring pin.



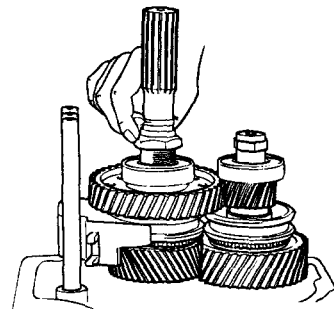
KMMB051B

12. Remove the shaft rail sub pin.



KMMB049D

16. Remove the main shaft locking nut and the counter shaft locking nut.



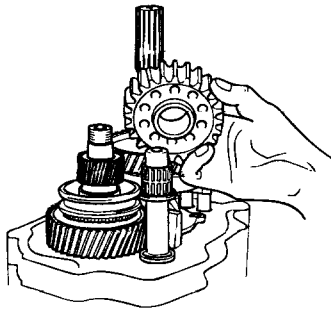
KMMB051C

13. Remove the extension housing mounting bolt and the housing.



17. Remove the ball bearing and the spacer.

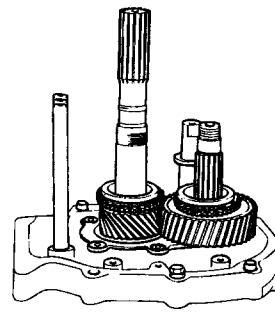
18. Remove the reverse idler gear.



KMMB052A

22. Remove the main shaft sleeve.

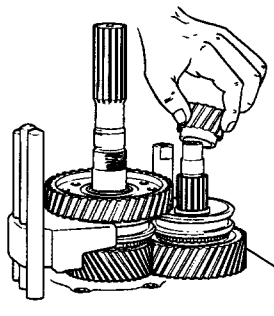
23. Remove the synchronizer and the 5th speed gear.



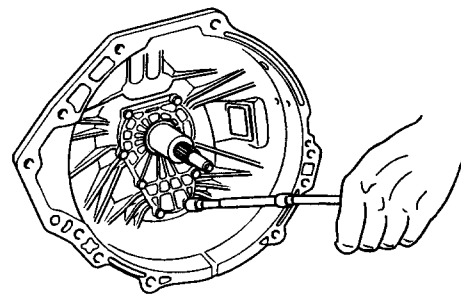
KMMB054A

19. Remove the counter shaft reverse gear.

24. Remove the front retainer.



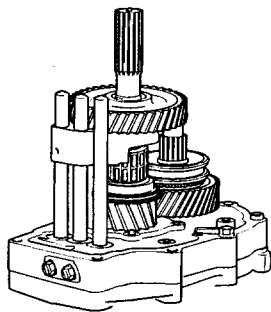
KMMB052B



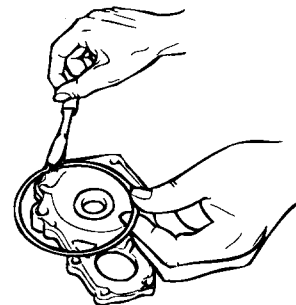
KMMB055A

20. Remove the reverse gear and the shift fork.

25. Make sure the damage of the front retainer snap ring and the oil seal.

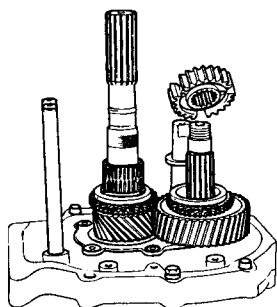


KMMB053A



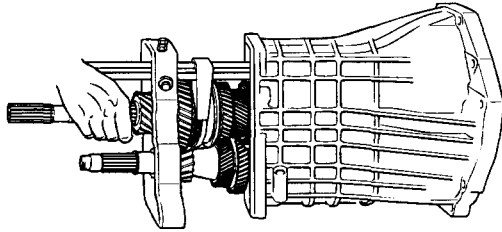
KMMB056A

21. Remove the hub and the sleeve (5&R).



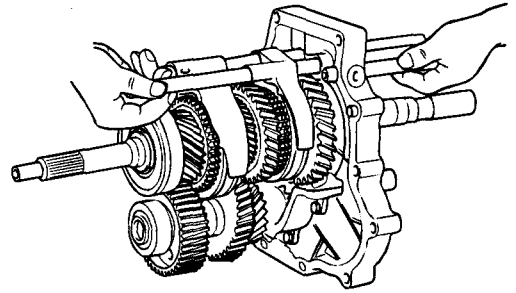
KMMB053B

26. Separate the main shaft, the shift rail, the counter shaft and the intermediate housing from the transmission case.



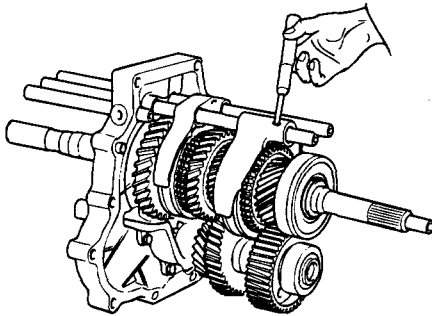
KMMB057A

30. Remove the shift rail.



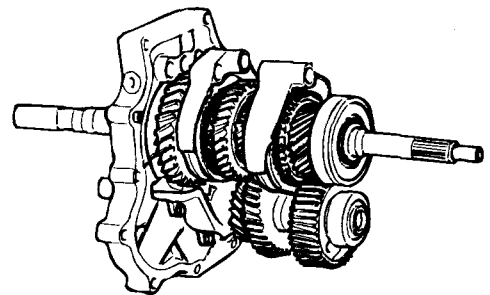
KMMB060A

27. Remove the shift fork pin (3&4).



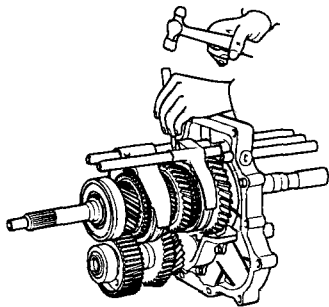
KMMB058A

31. Remove the shift fork.



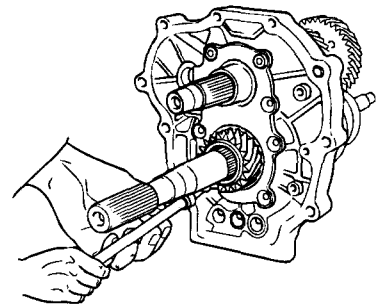
KMMB060B

28. Remove the shift fork pin (1&2).



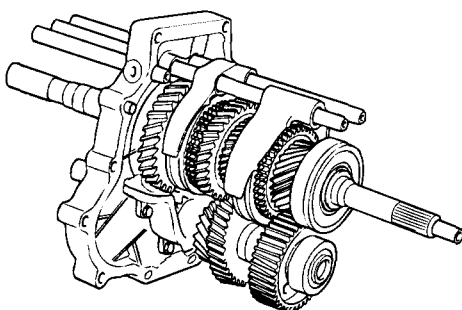
KMMB058B

32. Remove the oil guide.



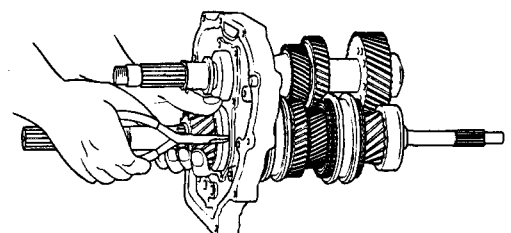
KMMB061B

29. Remove the poppet ball.



KMMB059A

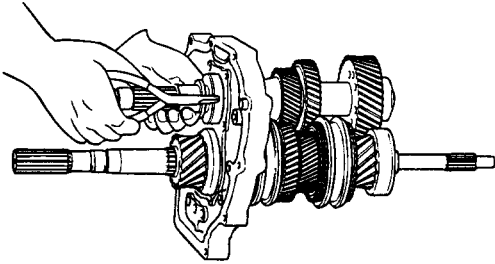
33. Remove the rear bearing retainer.



KMMB061C

34. Remove the main shaft side snap ring.

35. Remove the counter shaft side snap ring.

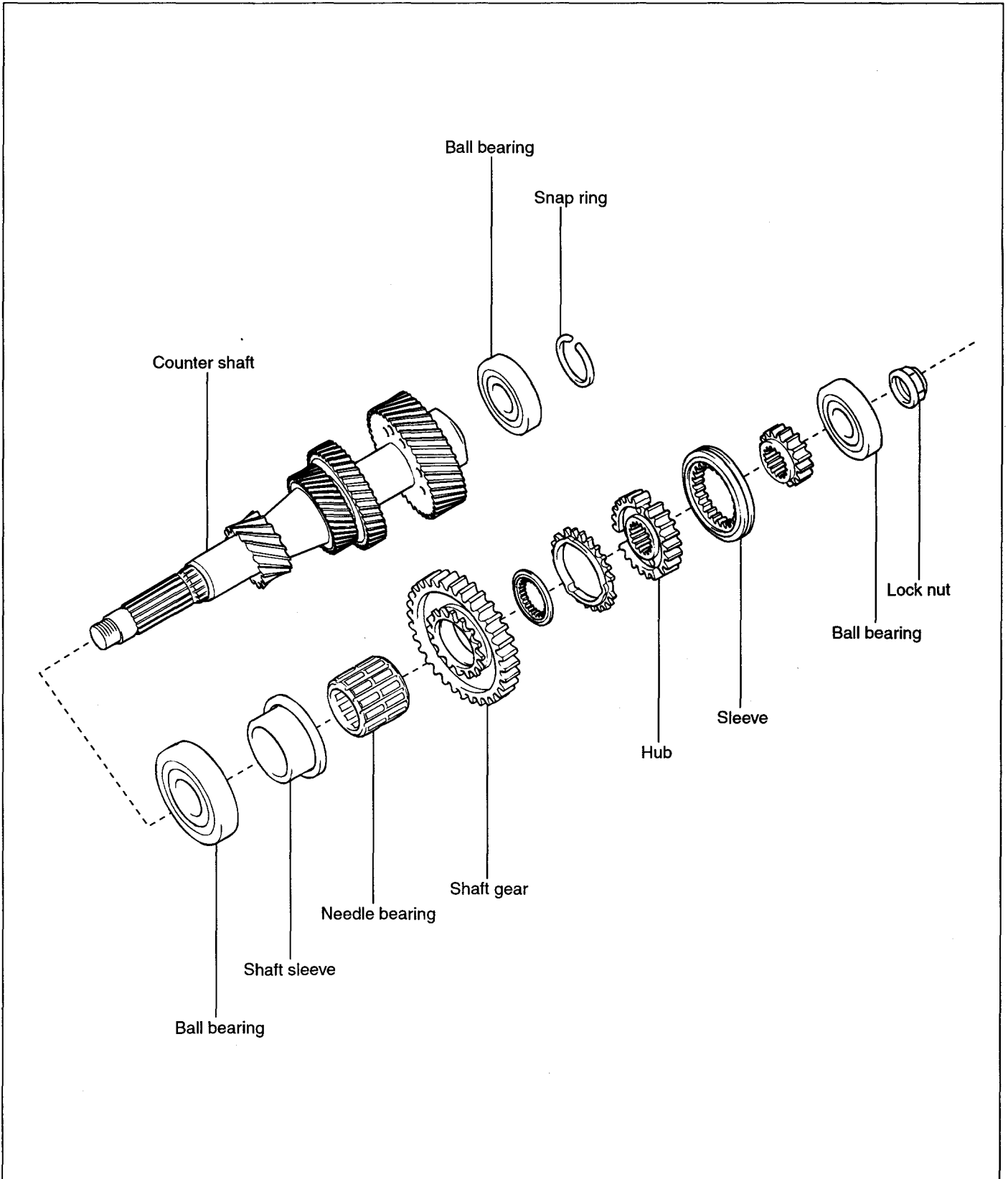


KMMB061D

36. Separate the main shaft assembly and the counter shaft assembly from the intermediate housing.

COUNTER SHAFT EMMB0210

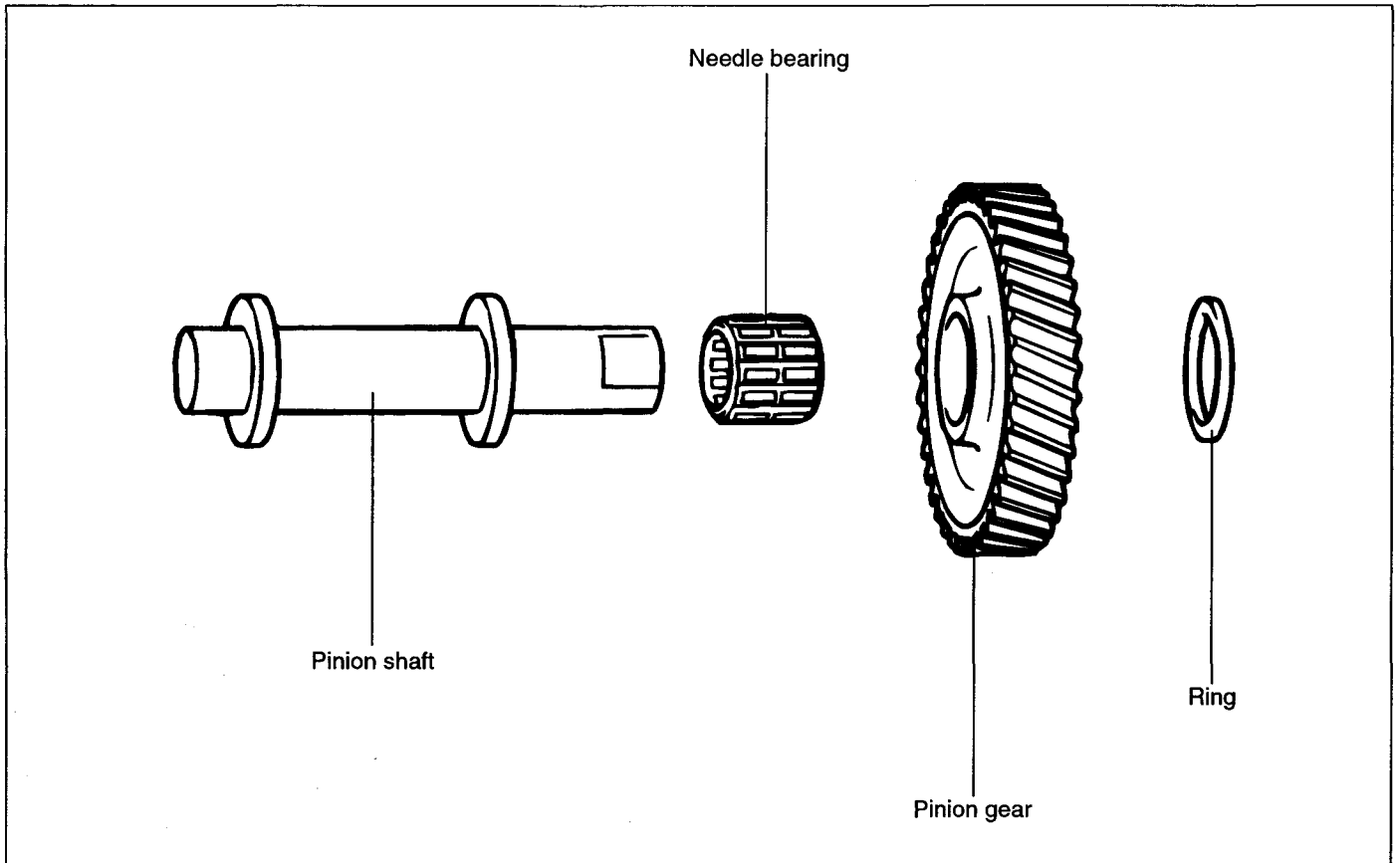
COMPONENTS



# MAIN DRIVE PINION GEAR

KMMB0260

## COMPONENTS

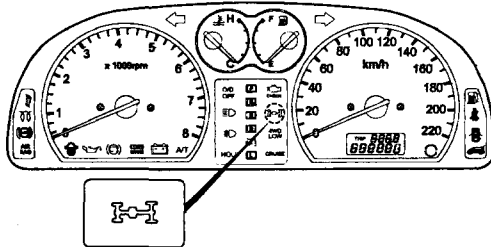


EMMB026A

# TRANSFER CASE ASSEMBLY

## ELECTRIC SHIFT TRANSFER EMMB0330

1. If a malfunction occurs, the 4WD indicator lamp will blink to warn the driver.



KMMB033A

2. Following items will be indicated
  - 1) TCCM
  - 2) Shift motor
  - 3) Magnetic synchronizer clutch
  - 4) Speed sensor
  - 5) Hub solenoid
  - 6) Selector switch
  - 7) Motor position sensor
3. Diagnosis memory is erased by grounding the TCCM NO.22 pin or DLC NO.12 pin.
4. DTC Table

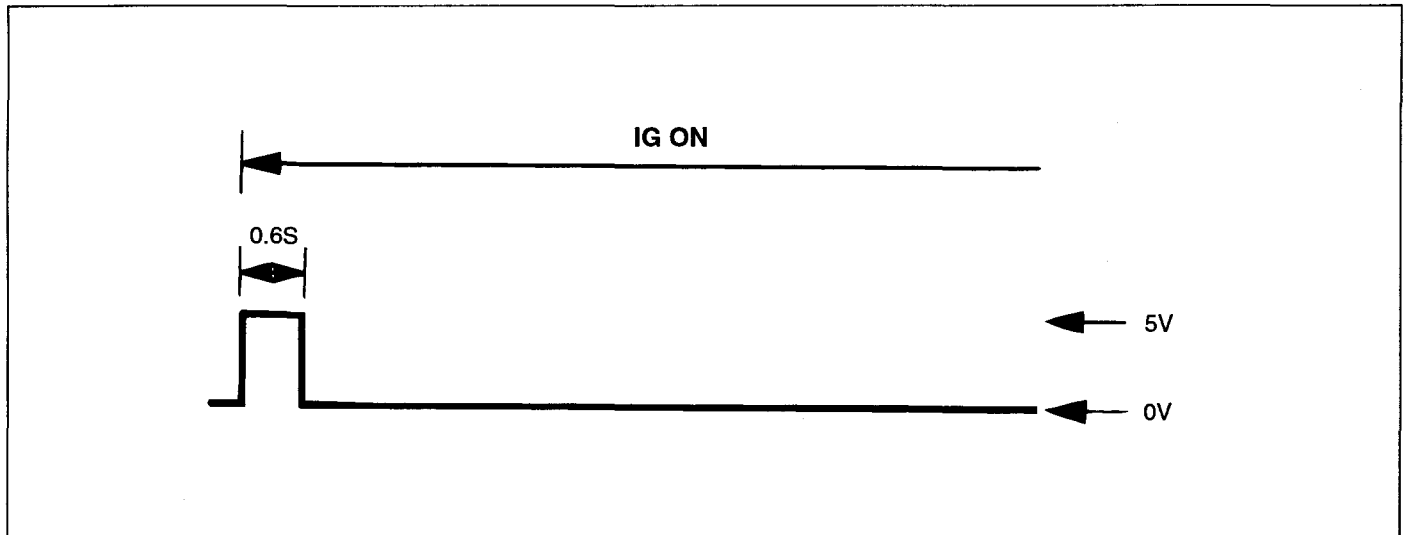
Code	Item
001	TCCM
010	Shift motor
011	Synchronizer clutch
100	Speed sensor
101	Hub solenoid
110	Selector switch
111	Motor position sensor

5. DTC Indication
  - 1) Indicator lamp check (0.6S)
  - 2) Lamp OFF (3S)
  - 3) DTC Indication

- 4) OFF (3S)
- 5) Repeat steps 3), 4)
- 6) Repeat steps 3), 4), 5) for additional faults.
6. Meaning of code
  - 0 : Lamp ON for 0.5 second
  - 1 : Lamp ON for 1 second
7. EX) TCCM Fault (DTC : 001)
  - 1) Indicator lamp check (0.6S)
  - 2) Lamp OFF (3S)
  - 3) Lamp ON (0.5S)
  - 4) Lamp OFF (0.5S)
  - 5) Lamp ON (0.5S)
  - 6) Lamp OFF (0.5S)
  - 7) Lamp ON (1S)
  - 8) Lamp OFF (3S)
  - 9) Repeat steps 3) ~ 8).

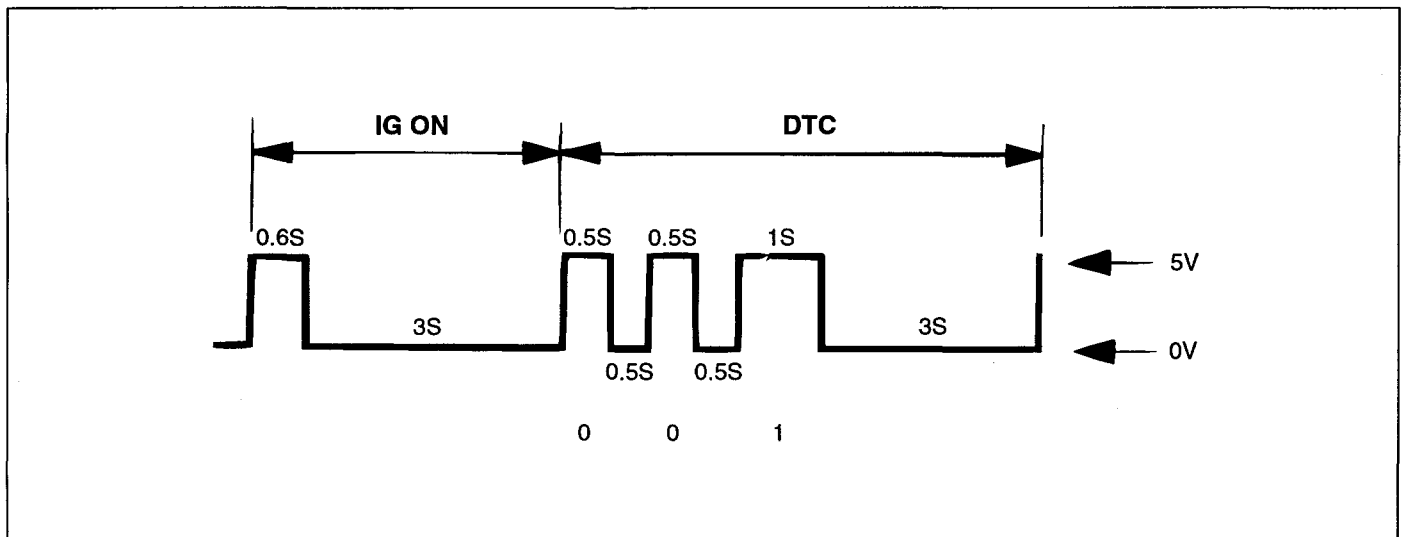
READING METHOD

NORMAL



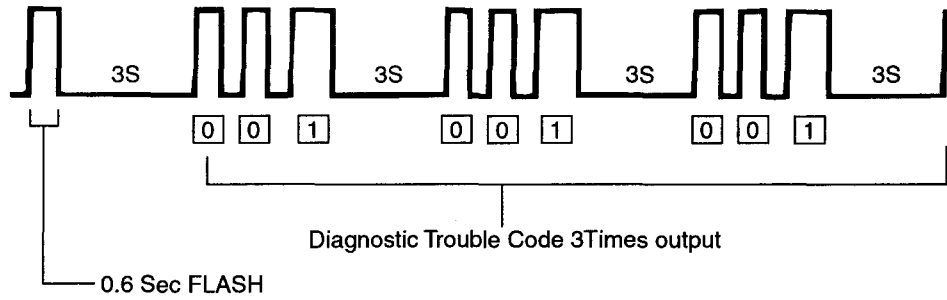
KMMB033B

FAULT



KMMB033C

[Example]

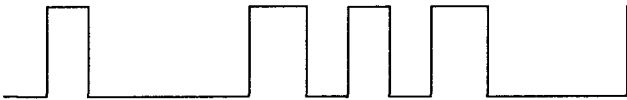
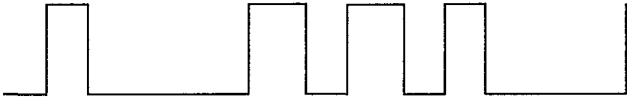
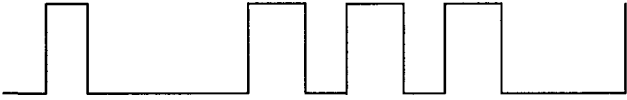


EMMB033A

**DTC PATTERN**

Code	Output pattern	Item
001	<p>KMMB033E</p>	TCCM
010	<p>KMMB033F</p>	Shift motor
011	<p>KMMB033G</p>	Magnetic synchronizer clutch
100	<p>KMMB033H</p>	Speed sensor



Code	Output pattern	Item
101	 <p style="text-align: right; font-size: small;">KMMB033I</p>	Hub solenoid valve
110	 <p style="text-align: right; font-size: small;">KMMB033J</p>	Select switch
111	 <p style="text-align: right; font-size: small;">KMMB033K</p>	Motor position sensor

**ACTIVE TORQUE TRANSFER** EMMB0340

DTC	내 용
P1725	TOD CONTROL MODULE(CHECKSUM) ERROR
P1726	THROTTLE POSITION INPUT - LOSS OF SIGNAL
P1727	THROTTLE POSITION INPUT - OUT OF RANGE
P1728	EMC - OPEN/SHORT TO BATTERY
P1729	EMC - SHORT TO GROUND
P1730	FRONT SPEED SENSOR - LOW INPUT
P1731	FRONT SPEED SENSOR - HIGH INPUT
P1732	REAR SPEED SPEED SENSOR - LOW INPUT
P1733	REAR SPEED SPEED SENSOR - HIGH INPUT
P1734	SPEED SENSOR REFERENCE - LOW INPUT
P1735	SPEED SENSOR REFERENCE - HIGH INPUT
P1736	SHIFT MOTOR - OPEN
P1737	SHIFT MOTOR - OPEN/SHORT TO GROUND
P1738	SHIFT SYSTEM TIMEOUT
P1739	GENERAL POSITION ENCODER FAULT
P1740	POSITION 1 - SHORT TO GROUND
P1741	POSITION 2 - SHORT TO GROUND
P1742	POSITION 3 - SHORT TO GROUND
P1743	POSITION 4 - SHORT TO GROUND

**DTC Memory Erase**

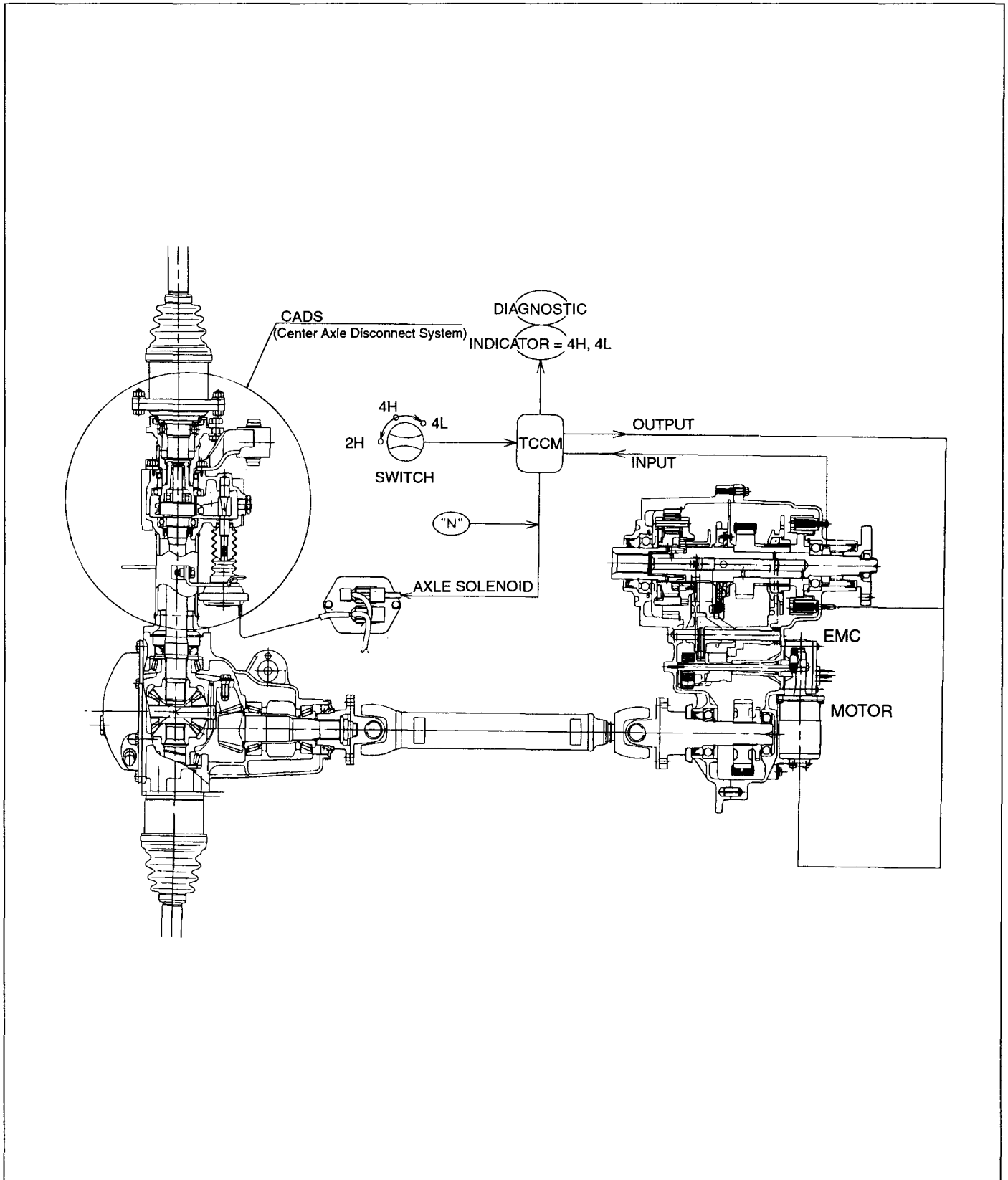
DTC memory in case of the Active Torque Transfer type is erased by the Hi-Scan.

## TRANSFER CASE

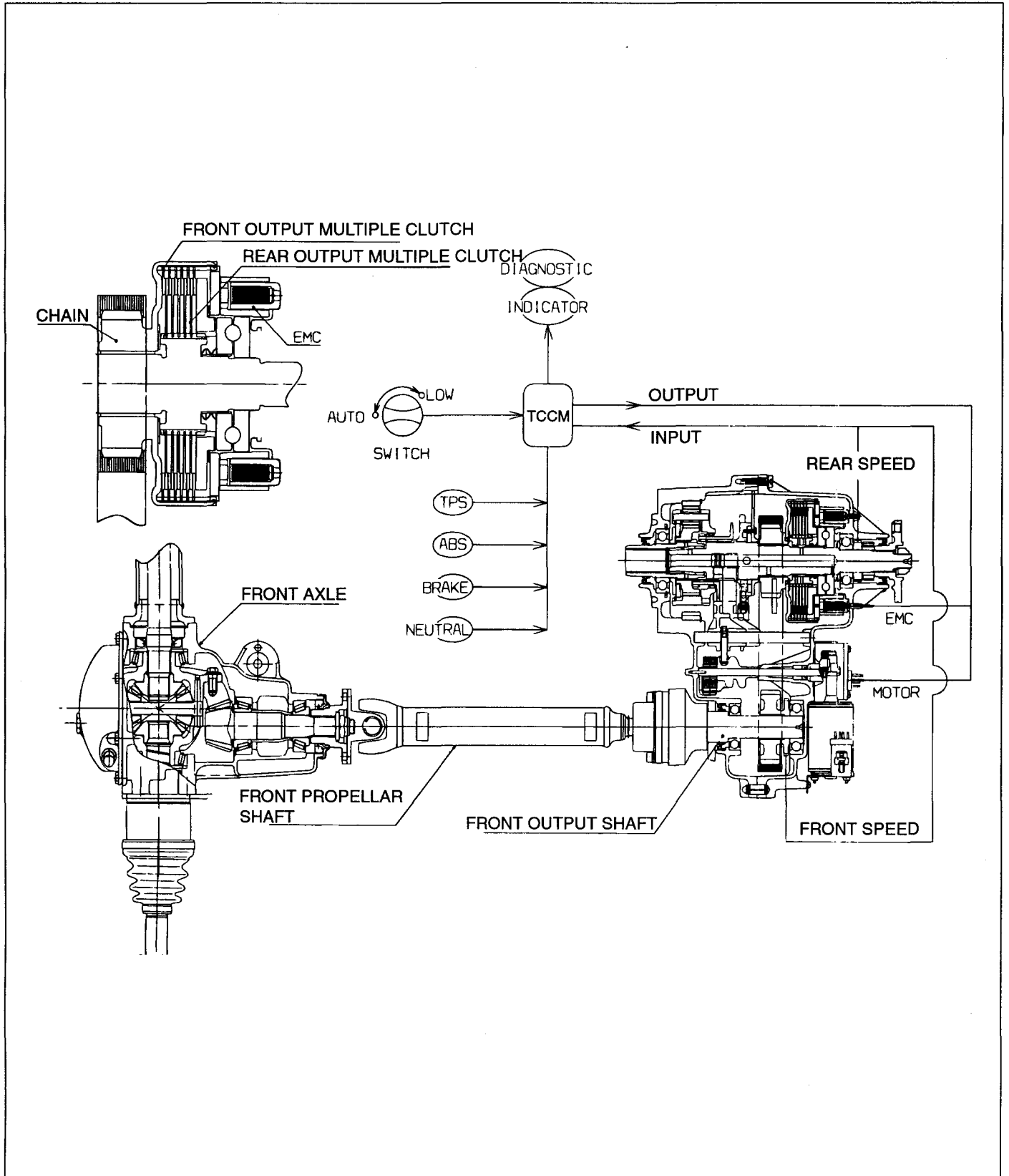
## 4WD SYSTEM DESCRIPTION EMMB0280

Drive type	Drive item	Drive mode	Drive status	Useful condition
Electroc Shift Transfer (EST type)	Drive mode	2H	2WD, Rear wheel drive	Use on the roadway.
		4H	4WD HIGH	<ul style="list-style-type: none"> <li>Use on the off-road or snowy and rainy road having slippery road surface.</li> <li>Impossible to drive on the roadway due to free of CENTER DIFF (absorbing revolution difference between front and rear wheels). When turning on the roadway at low speed, vibration and noise happens by tight corner braking.</li> </ul>
		4L	4WD LOW	Use in the condition which driving force is required like escaping from rough way and towing.
	Transfer	2H ⇔ 4H	2WD ⇔ 4WD	Possible to transfer 2WD into 4WD and vice versa at 80kph or below during driving.
		4H ⇔ 4WD(L)	4WD(H) ⇔ 4WD(L)	<ul style="list-style-type: none"> <li>Necessary to stop the vehicle for transfer <ul style="list-style-type: none"> <li>M/T vehicle : Transfer the switch after pressing the clutch pedal.</li> <li>A/T vehicle : Transfer the switch after positioning the A/T lever to "N".</li> </ul> </li> <li>All vehicles with 4L mode should stop the vehicle for transfer.</li> </ul>
Active Torque Transfer (ATT type)	Drive mode	AUTO	2WD ⇔ 4WD	<ul style="list-style-type: none"> <li>Use on the various road surfaces including roadway, off-roda, or snowy and rainy road haring slippery road surface.</li> <li>Using multiple clutch, control the revolution difference between front and rear wheels electronically. So this mode can conespond to the various road surfaces by controlling the CENTER DIFF. FREE and LOCKING automatically.</li> </ul>
		LOW	4WD LOW	Refer to 4L of part time.
	Transfer	AUTO ⇔ LOW	4WD(H) ⇔ 4WD(L)	<ul style="list-style-type: none"> <li>Necessary to stop the vehicle for transfer <ul style="list-style-type: none"> <li>M/T vehicle : Transfer the switch after pressing the clutch pedal.</li> <li>A/T vehicle : Transfer the switch after positioning the A/T lever to "N".</li> </ul> </li> <li>All vehicles with 4L mode should stop the vehicle for transfer.</li> </ul>

ELECTRIC SHIFT TRANSFER EMMB0290

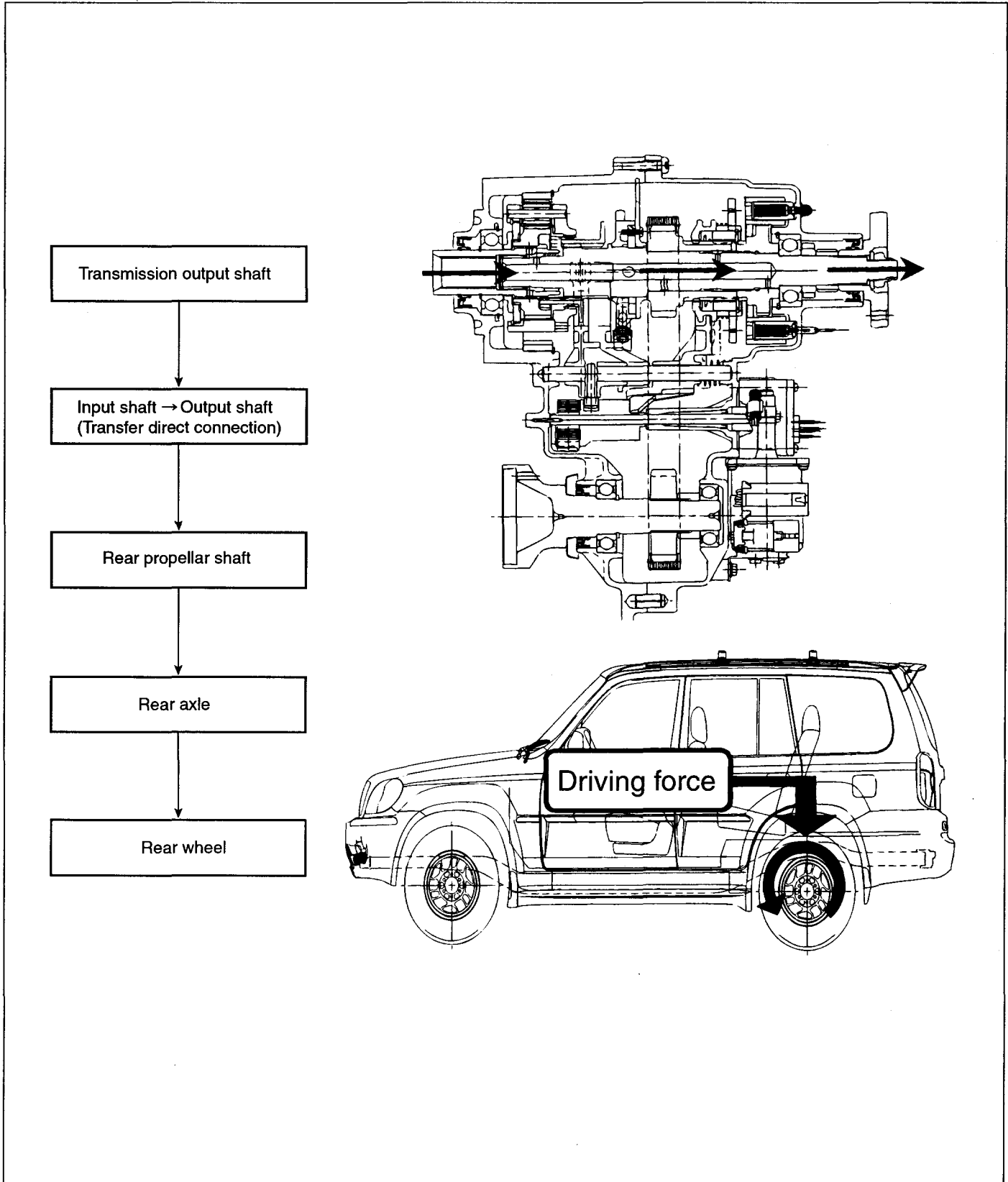


ACTIVE TORQUE TRANSFER EMMB0300

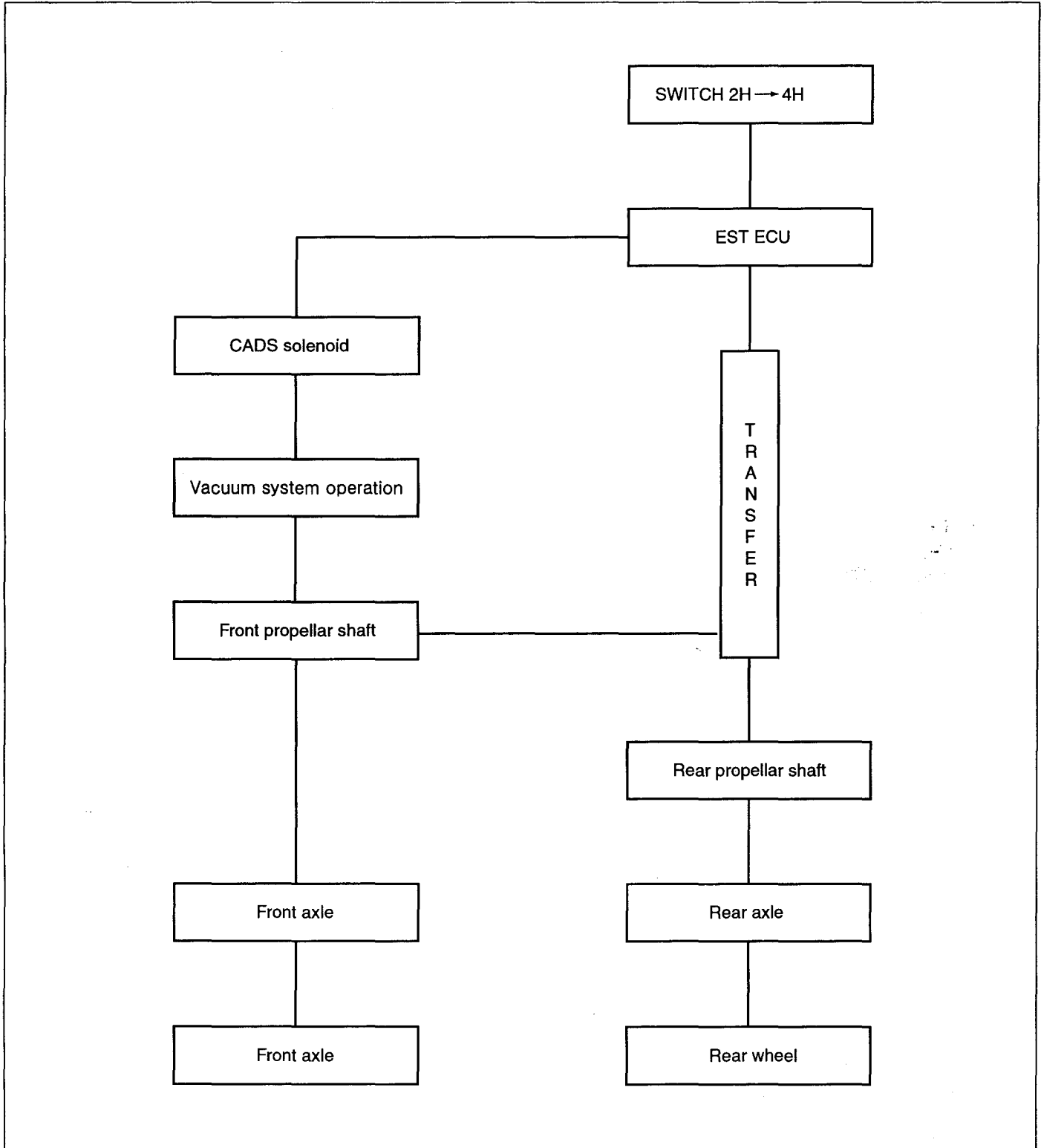


EST POWER FLOW EMMB0310

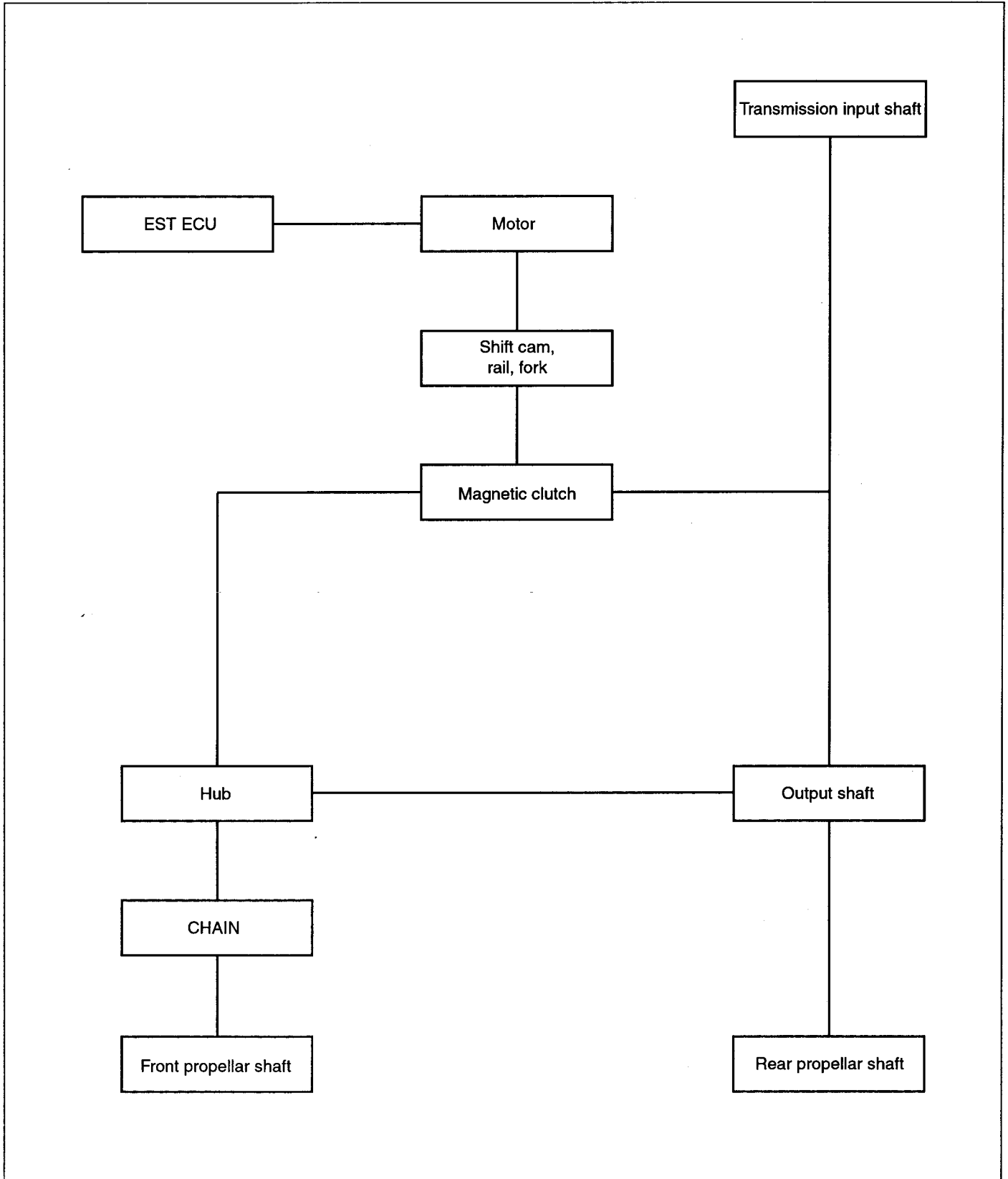
1. 2H Mode (Rear Wheel Drive)



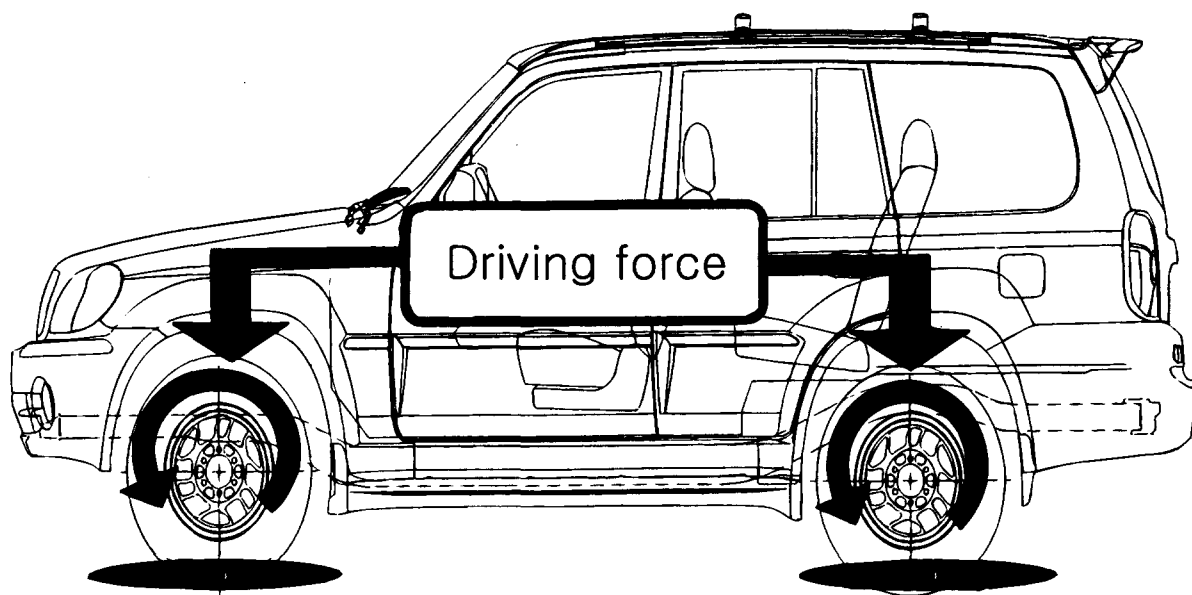
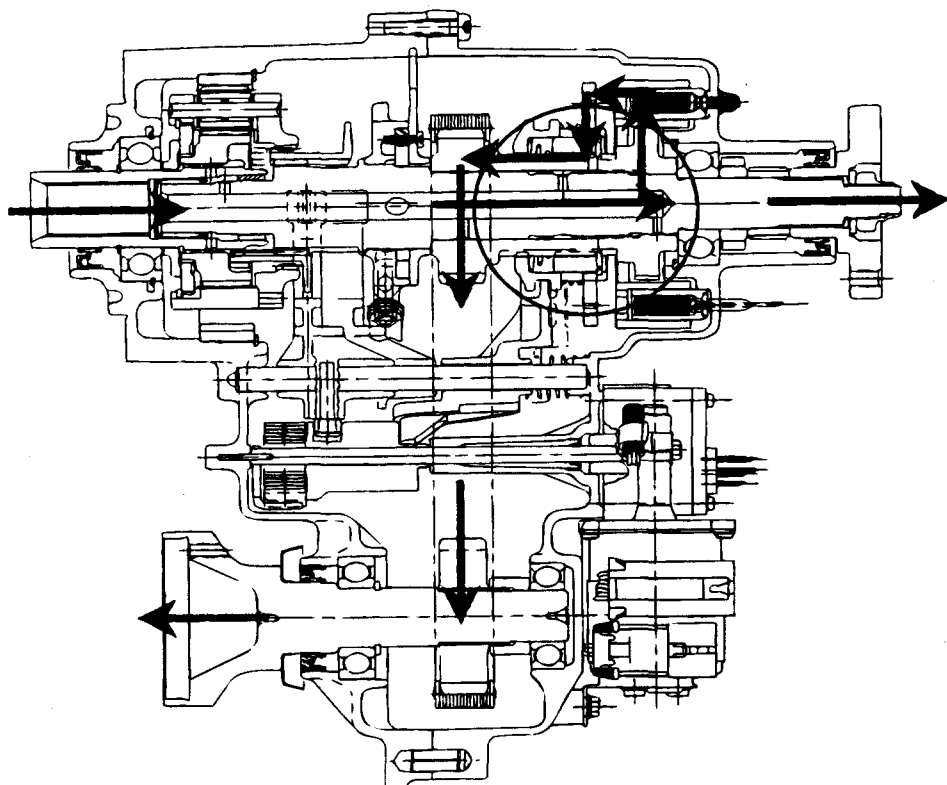
2. 4H Mode (Driving Force Transfer)



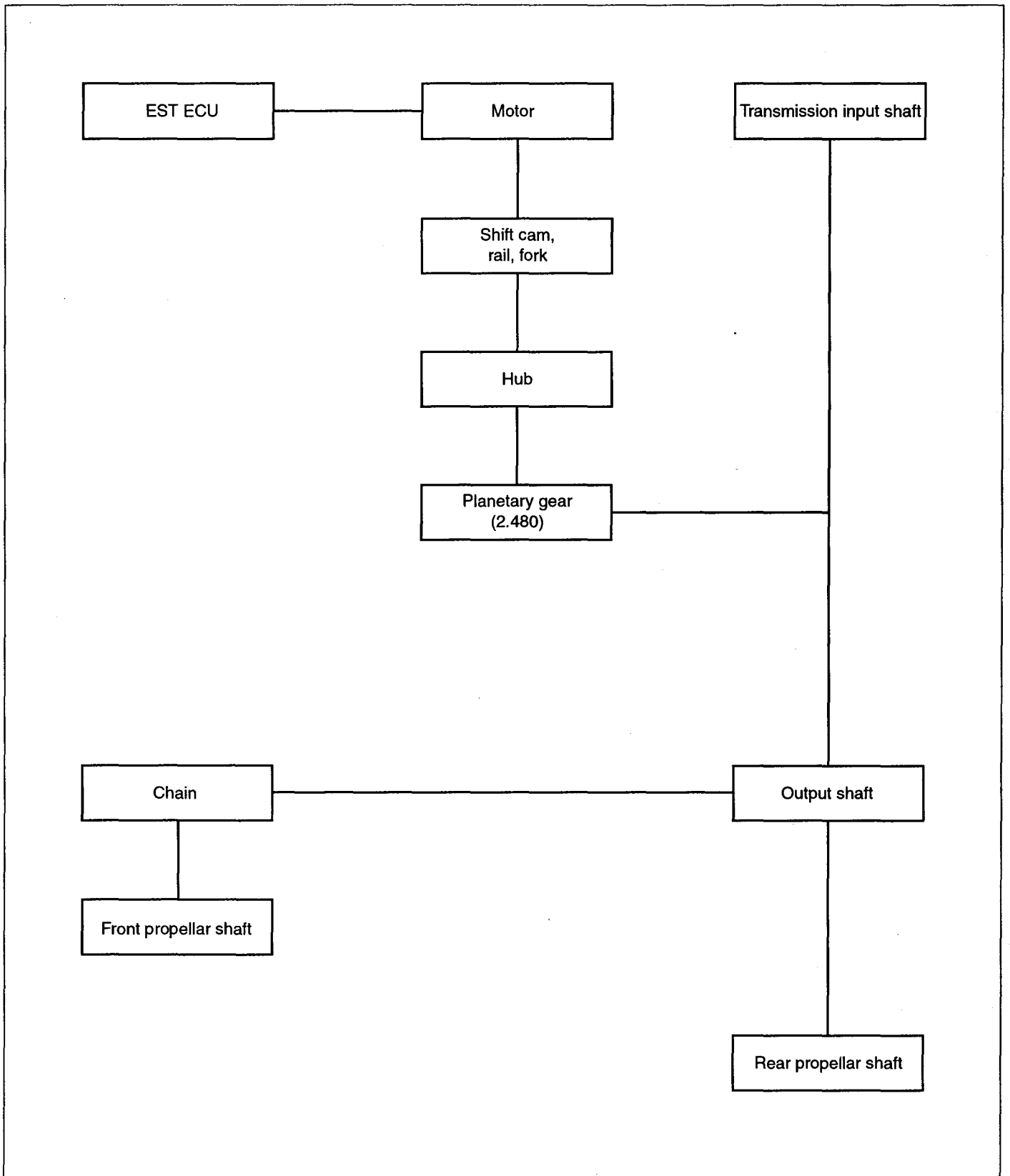
3. 4H Mode (transfer operation)

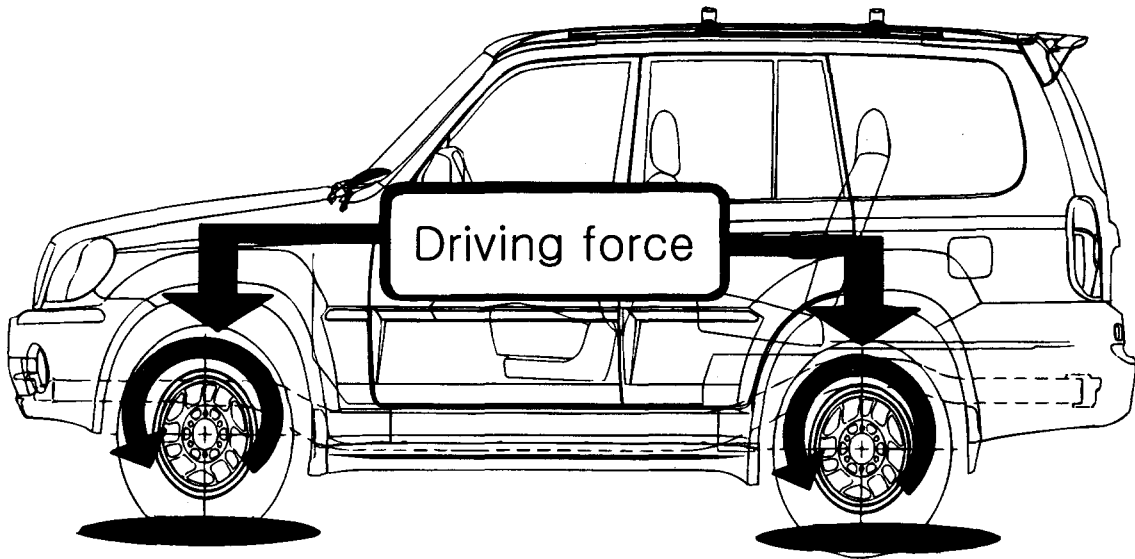
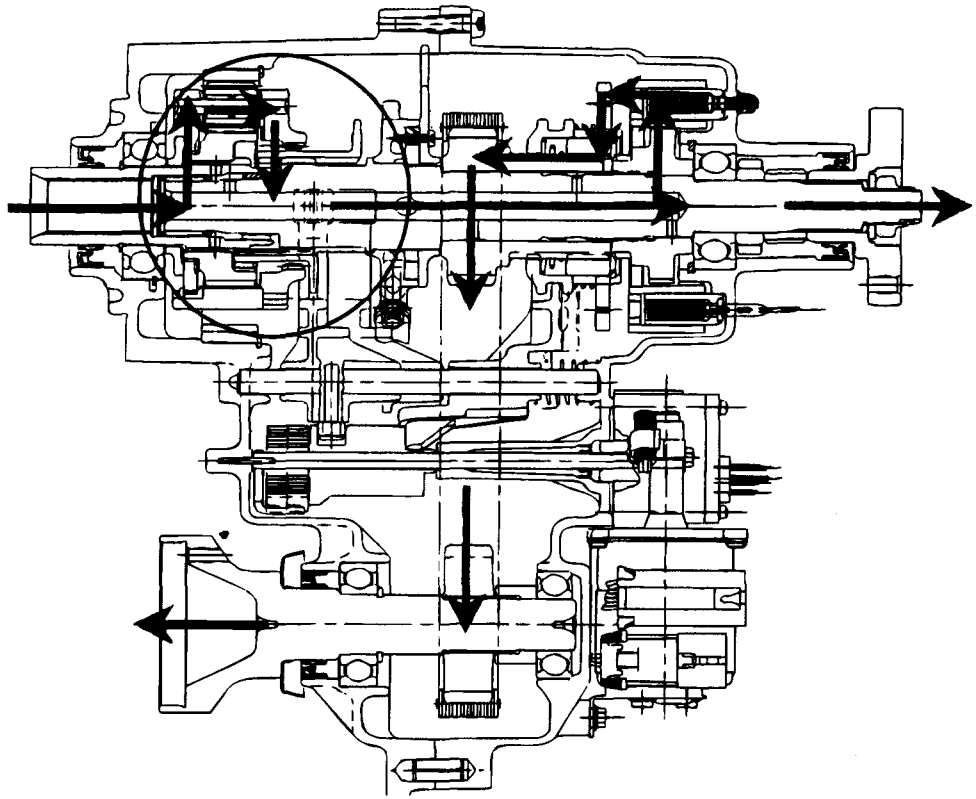






4. 4L Mode

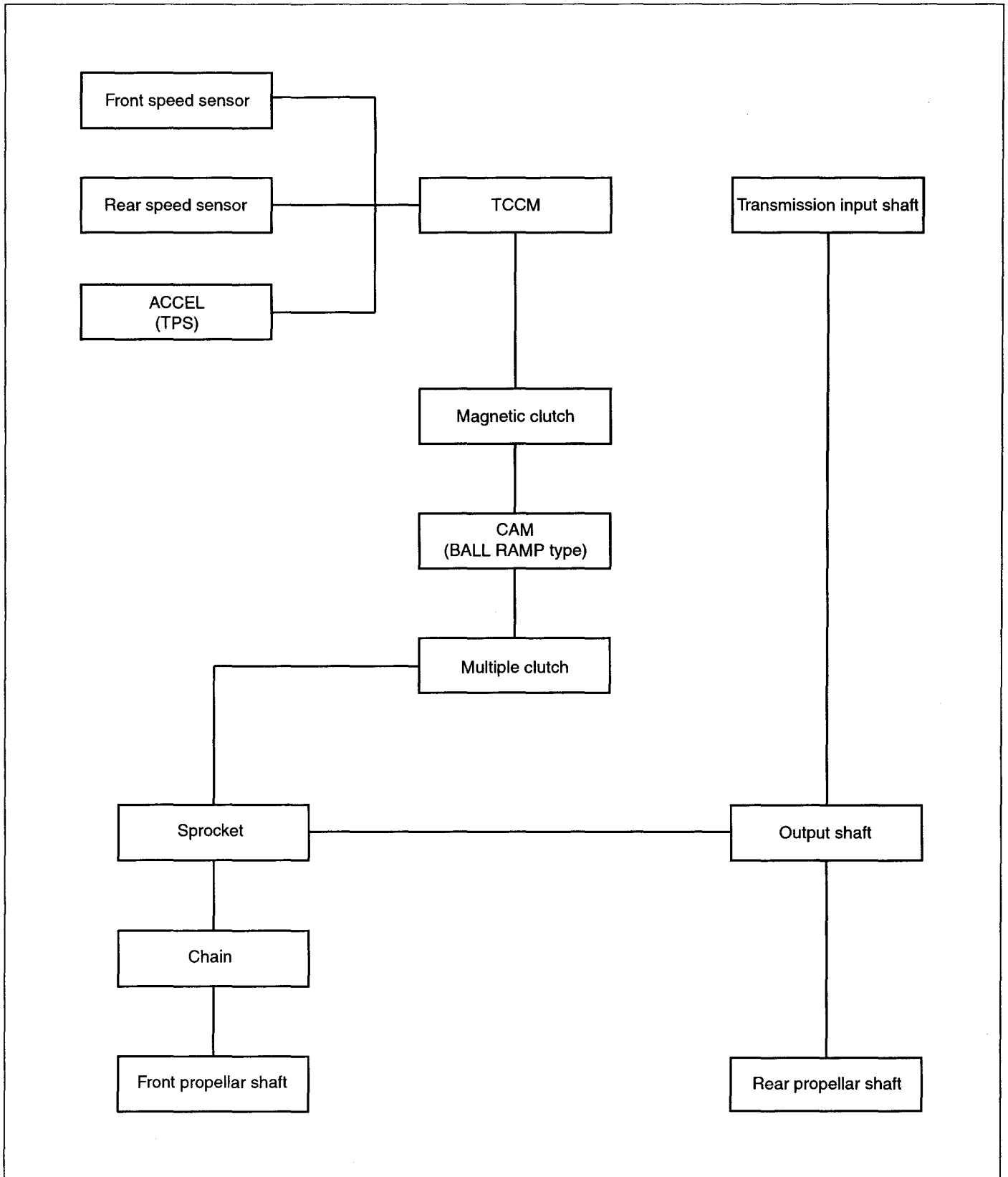


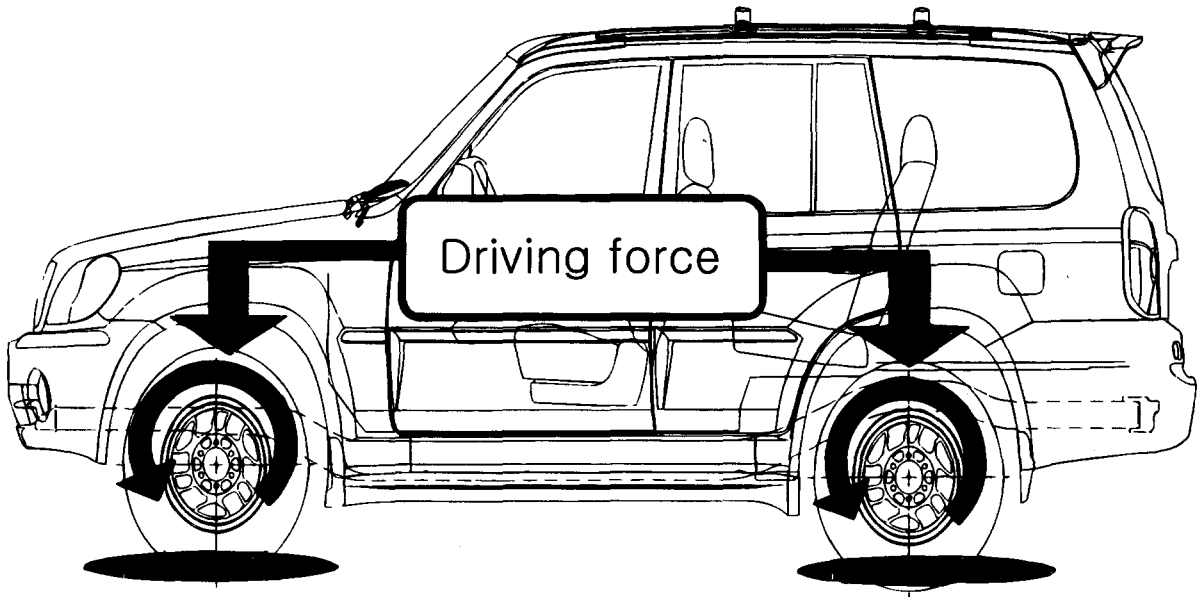
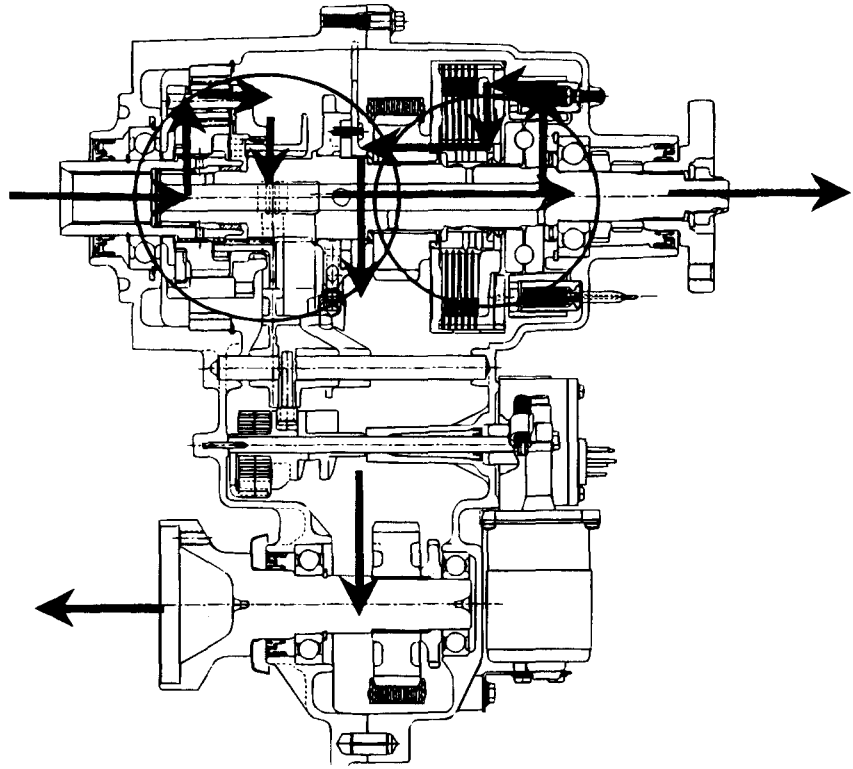


ATT(ACTIVE TORQUE TRANSFER)

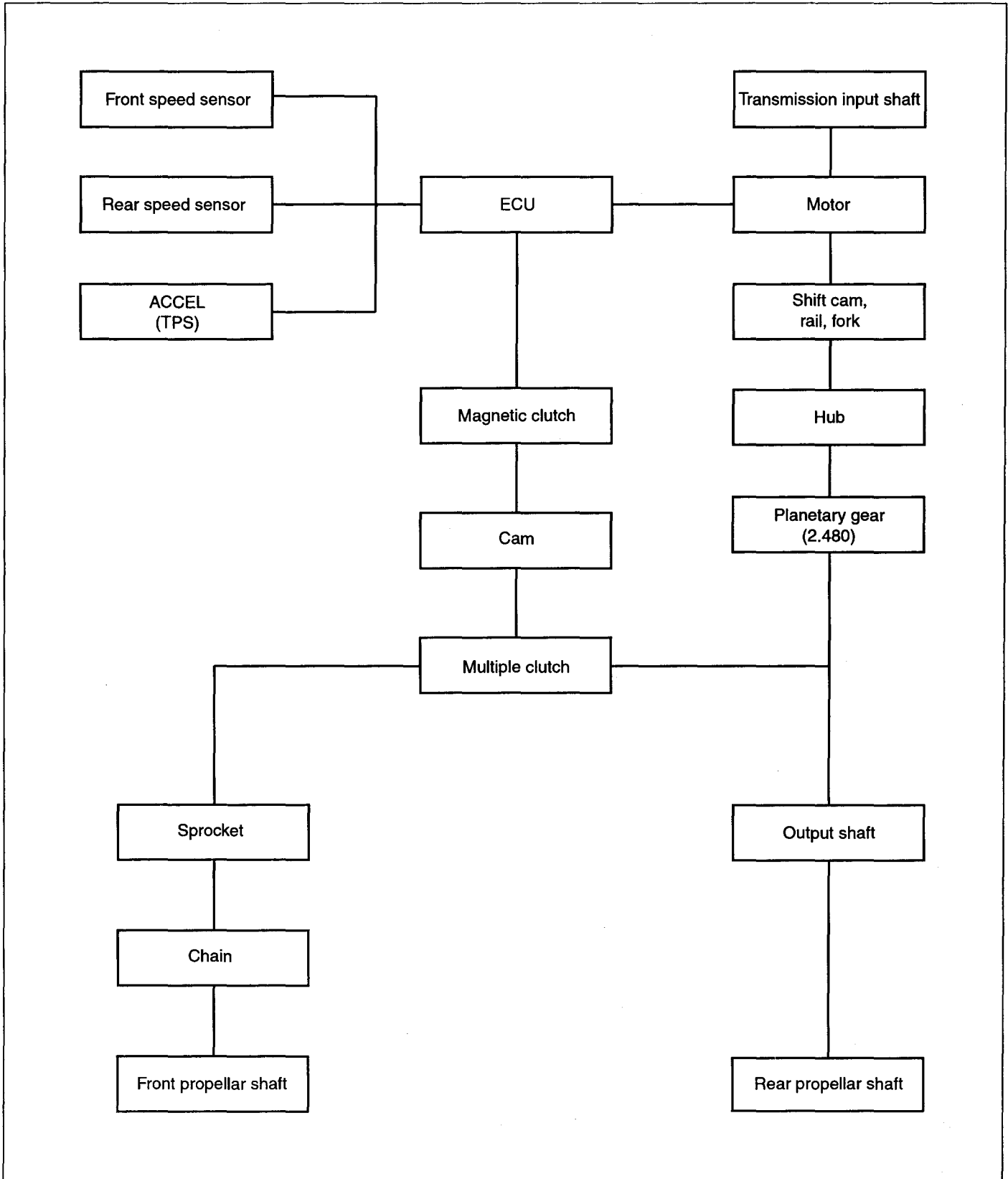
POWER FLOW EMMB0320

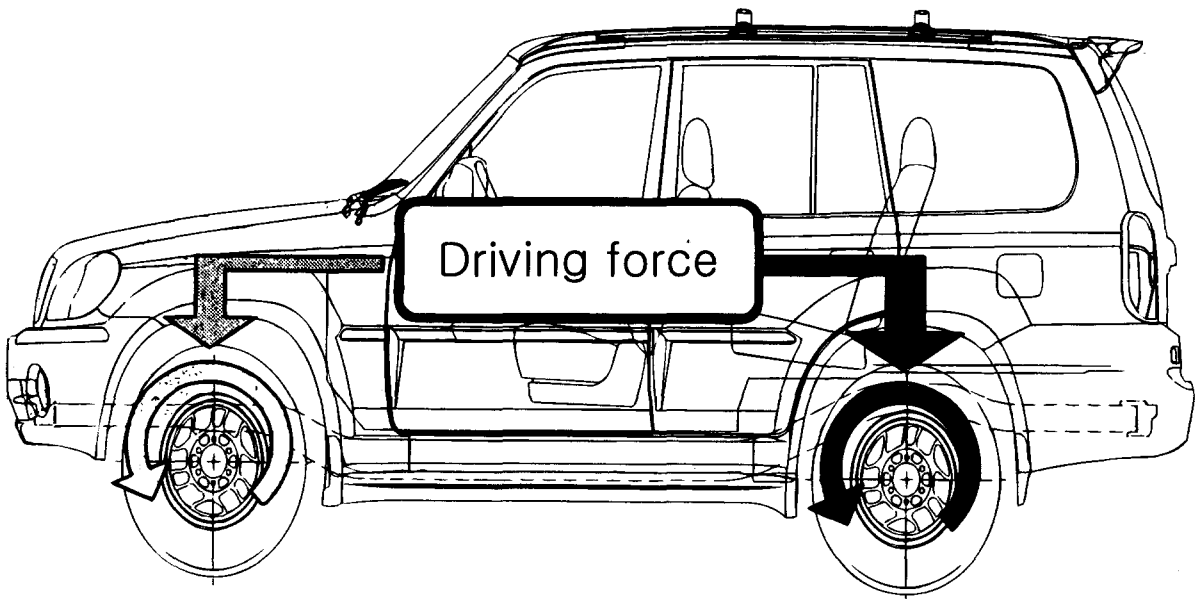
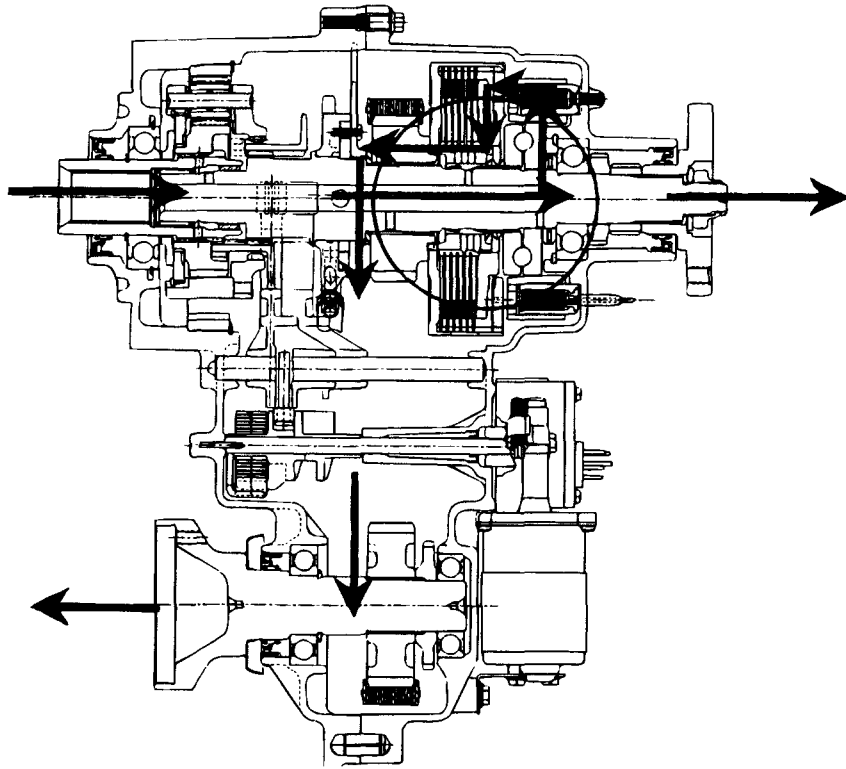
1. AUTO Mode





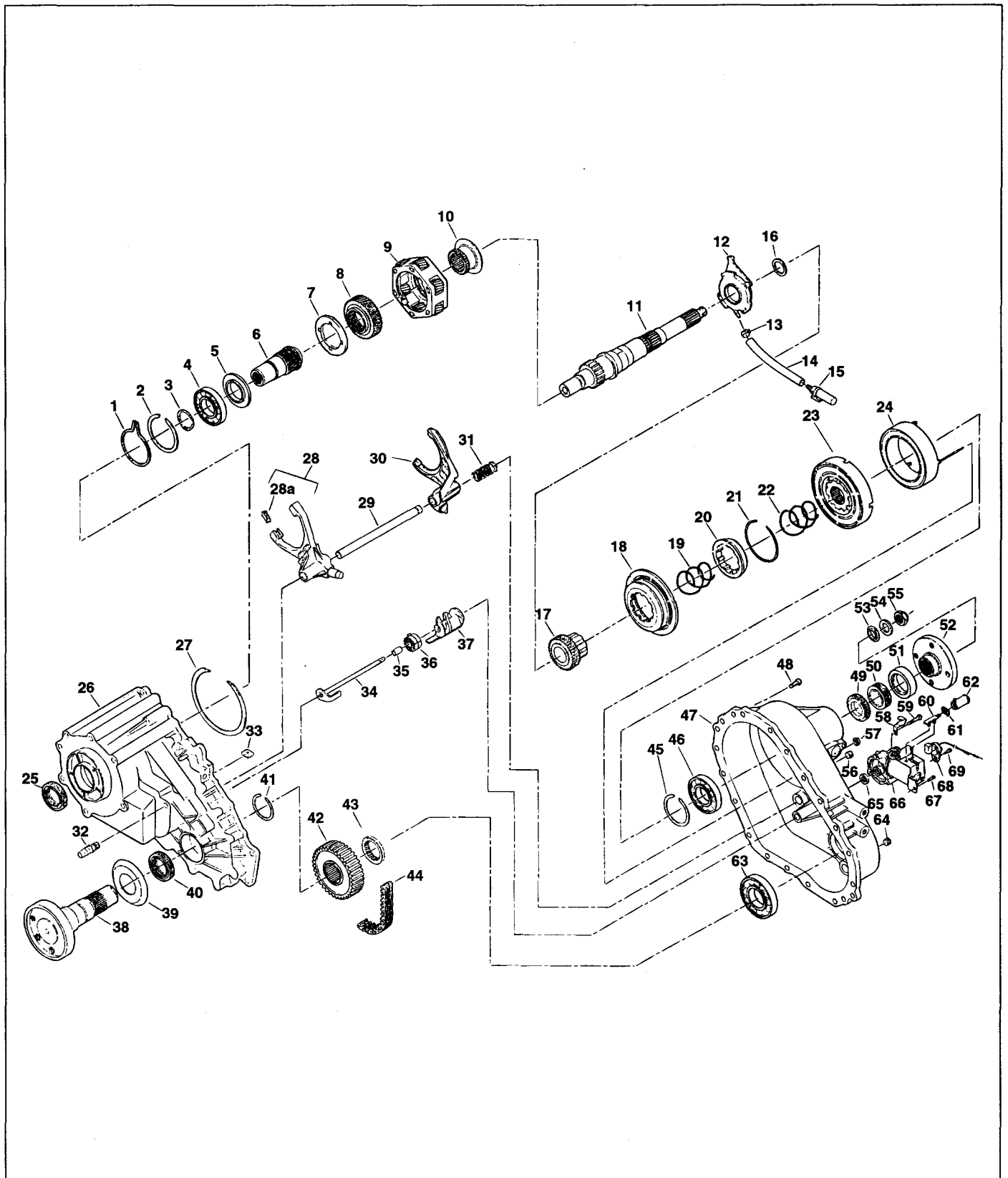
2. LOW Mode





EST EMMB0360

COMPONENTS (1)





## COMPONENTS (2)

1. Snap ring
2. Snap ring
3. Snap ring
4. Bearing
5. Hub
6. Input shaft
7. Thrust plate
8. Sun gear
9. Carrier
10. Reduction hub
11. Main shaft
12. Rotor pump
13. Hose clamp
14. Hose
15. Filter
16. Thrust washer
17. Upper socket
18. Lock-up collar
19. Sleeve return spring
20. Lock-up hub
21. Snap ring
22. Spring
23. Clutch housing
24. Electric coil
25. Oil seal
26. Transfer case
27. Retaining ring
28. Shift fork
- 28a. Shift fork pad
29. Shift rail
30. Lock-up fork
31. Return spring
32. Breather
33. Magnet
34. Shift shaft
35. Spacer
36. Torsion spring
37. Shift cam
38. Output shaft
39. Dust deflector
40. Oil seal
41. Snap ring
42. Lower sprocket
43. Spacer
44. Chain
45. Retaining ring
46. Bearing
47. Cover
48. Nut
49. Tone wheel
50. Speedo gear
51. Oil seal
52. Companion flange
53. Oil seal
54. Washer
55. Nut
56. Pipe plug
57. Nut
58. 'J' clip
59. Bolt
60. Clip
61. Connector lock
62. Connector
63. Bearing
64. Plug
65. Oil seal
66. Electric motor
67. Bolt
68. Speed sensor
69. Bolt

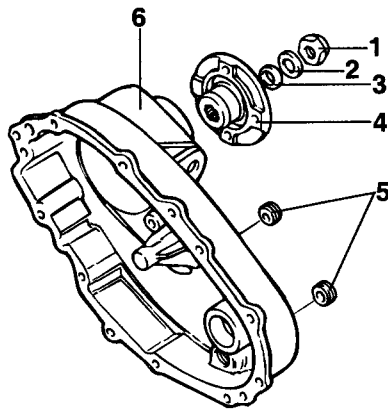
**DISASSEMBLY** EMMB0370

**COMPANION FLANGE**

**NOTE**

Position transfer case on work bench with rear or cover side up.  
Use wooden blocks under front to keep assembly level.

1. Remove nut and washer.
2. Pull companion flange.
3. Remove oil seal.
4. If installed, remove two plugs from cover.

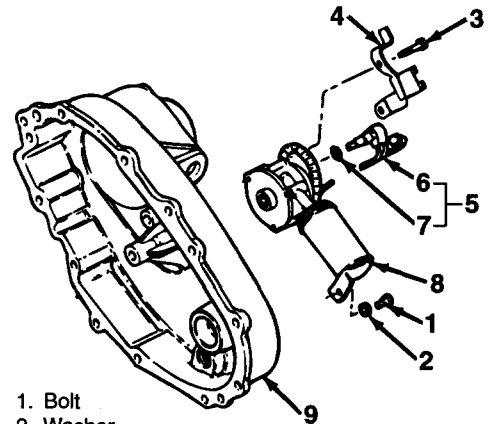


1. Nut
2. Washer
3. Oil seal
4. Companion flange
5. Plug
6. Cover

**EXTERNAL ELECTRIC SHIFT**

On electric shift units, remove components as follows.

1. Remove bolt (1).
2. Remove three bolts (3).
3. Remove sensor and harness bracket.
4. Remove speed sensor assembly.
5. Remove motor assembly.

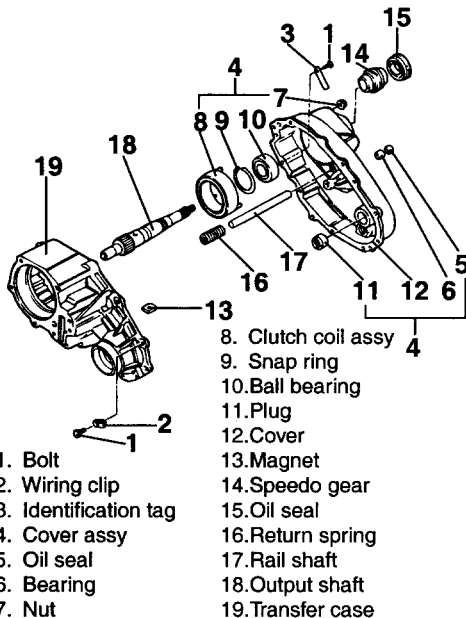


1. Bolt
2. Washer
3. Bolt
4. Harness bracket & sensor
5. Sensor assembly
6. Speed sensor
7. O-ring
8. Motor assembly
9. Cover

EMMB037A

**COVER ASSEMBLY**

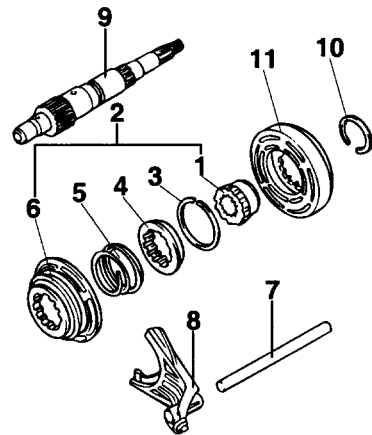
1. Remove nine bolts (1). This will free wiring harness clip and identification tag. Use care not to lose identification tag.  
It contains information required for ordering replacement parts.
2. Pry at the bosses provided on the cover and transfer case to break the sealant bond loose. Then, lift cover assembly straight up to remove.
3. On electric shift units, remove oil seal (5), bearing, three nuts and clutch coil assembly.
4. Remove snap ring and pull ball bearing from cover. This will free speedo gear.
5. Pull needle bearing from cover.
6. Pull oil seal (15) from cover.
7. Remove magnet from slot in case.
8. Remove return spring from rail shaft.
9. Scrap and clean sealant from mating faces of cover and transfer case. Use care not to damage metal faces or allow scrapings to fall into transfer case.



- |                       |                     |
|-----------------------|---------------------|
| 1. Bolt               | 8. Clutch coil assy |
| 2. Wiring clip        | 9. Snap ring        |
| 3. Identification tag | 10. Ball bearing    |
| 4. Cover assy         | 11. Plug            |
| 5. Oil seal           | 12. Cover           |
| 6. Bearing            | 13. Magnet          |
| 7. Nut                | 14. Speedo gear     |
|                       | 15. Oil seal        |
|                       | 16. Return spring   |
|                       | 17. Rail shaft      |
|                       | 18. Output shaft    |
|                       | 19. Transfer case   |

**LOCK SHIFT**

1. From electric shift only, remove retaining ring and slide clutch housing from shift collar hub.
2. Remove shift collar hub from output shaft.
3. Together, slide 2W-4W lockup assembly and lockup fork from output shaft and rail shaft. Separate assemblies and remove rail shaft.
4. To disassemble 2W-4W lockup assembly, remove snap ring, lockup hub and return spring from lockup collar.
5. One-piece, plastic lockup fork replaces earlier fork assembly with metal fork and separate roller parts.



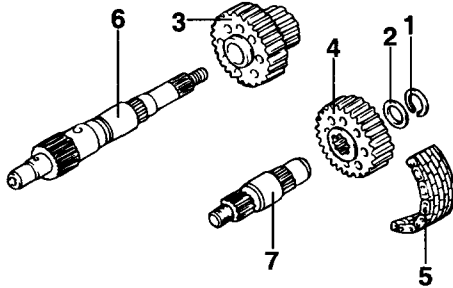
- |                      |                    |
|----------------------|--------------------|
| 1. Shift collar hub  | 7. Rail shaft      |
| 2. 2W-4W Lockup assy | 8. Lockup fork     |
| 3. Snap ring         | 9. Output shaft    |
| 4. Lockup hub        | 10. Retaining ring |
| 5. Return spring     | 11. Clutch housing |
| 6. Lockup collar     |                    |

H7MT1130

H7MT1120

**CHAIN DRIVE**

1. Remove snap ring and spacer from output shaft (front).
2. Together, slide drive sprocket, driver sprocket and drive chain from output shafts (rear and front). Separate sprockets and chain when out of assembly.

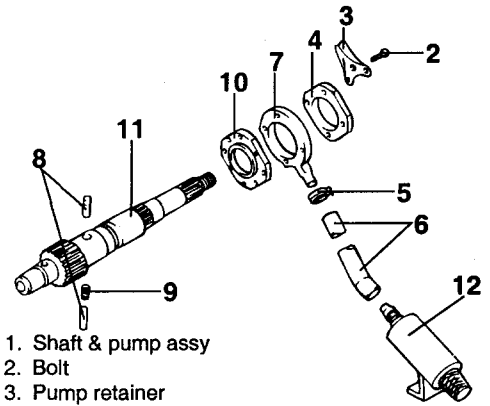


1. Snap ring
2. Spacer
3. Drive sprocket
4. Driven sprocket
5. Drive chain
6. Output shaft (rear)
7. Lockup collar

H7MT1150

**OIL PUMP**

1. Remove four bolts (2) and retainer. Slide rear pump cover off output shaft.
2. Loosen hose clamp and separate hose coupling from pump housing. Slide pump housing off output shaft.
3. Remove hose clamp, hose coupling and strainer.
4. Remove two pump pins and spring from output shaft.
5. Slide front pump cover off output shaft and remove output shaft.

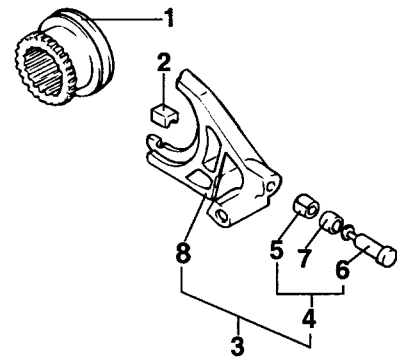


1. Shaft & pump assy
2. Bolt
3. Pump retainer cover
4. Rear pump cover
5. Hose clamp
6. Hose coupling
7. Pump housing
8. Pump pin
9. Spring
10. Front pump cover
11. Output shaft
12. Strainer

H7MT1160

**REDUCTION SHIFT**

1. Remove reduction hub and reduction shift fork assembly from transfer case.
2. Remove two facings from shift fork assembly.
3. Disassemble fork assembly only if parts replacement is required. Cut plastic retainer to remove, freeing pin and cam roller.

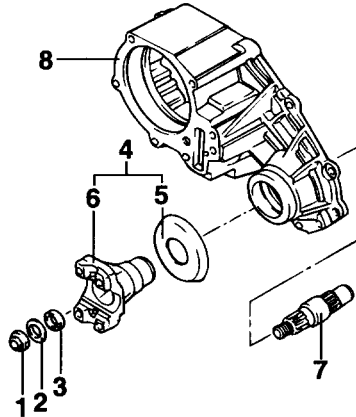


1. Reduction hub
2. Shift fork facing
3. Reduction shift fork assy
4. Pin, roller and retainer assy
5. Retainer
6. Pin
7. Cam roller
8. Reduction shift fork

H7MT1170

**FRONT OUTPUT SHAFT**

1. Hold yoke and remove nut and washer. Pull yoke assembly and oil seal.
2. Press deflector from yoke only if replacement is required.
3. Remove output shaft.



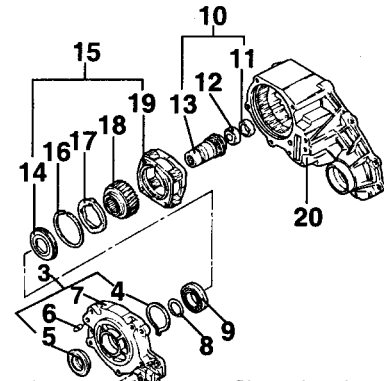
1. Nut
2. Washer
3. Oil seal
4. Yoke assy
5. Deflector
6. Yoke
7. Output shaft(front)
8. Transfer case

H7MT1180

**ADAPTER, INPUT SHAFT AND GEAR CARRIER**

1. Remove breather.
2. Remove six bolts (2). Carefully pry front adapter up to break sealant band with transfer case. Use care not to damage adapter or case.
3. Remove adapter assembly, input shaft assembly and gear carrier assembly as an assembled group.
4. Holding end of input shaft on workbench, press down on adapter while expanding long ends of snap ring.
5. Remove snap ring and pump oil seal from front adapter. Remove pin only if replacement is required.
6. Remove retaining ring (8). Pull bearing and thrust washer from end of input shaft assembly. Remove input shaft assembly from gear carrier assembly.
7. To disassemble input shaft assembly, pull sleeve bearing and needle bearing from input shaft.

8. Remove retaining ring (16), thrust plate end sun gear from planet carrier assembly.

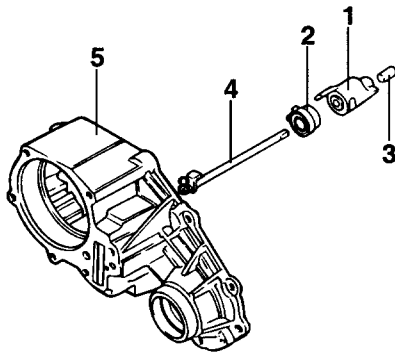


- |                      |                         |
|----------------------|-------------------------|
| 1. Breather          | 11. Sleeve bearing      |
| 2. Bolt              | 12. Needle bearing      |
| 3. Adapter assy      | 13. Input shaft         |
| 4. Snap ring         | 14. Thrust washer       |
| 5. Oil seal          | 15. Gear carrier assy   |
| 6. Spiral pin        | 16. Retaining ring      |
| 7. Front adapter     | 17. Thrust plate        |
| 8. Retaining ring    | 18. Sun gear            |
| 9. Bearing           | 19. Planet carrier assy |
| 10. Input shaft assy | 20. Transfer case       |

H7MT1190

**SHIFT CAM (ELECTRIC PARTS)**

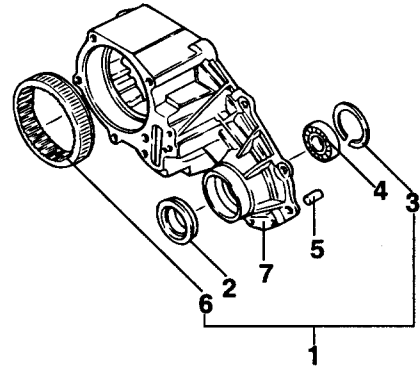
1. Remove electric shift cam group (1 through 4) from transfer case as an assembly.
2. Slide electric shift cam off shift shaft.
3. Clamp retainer end of shift shaft.  
Keeping fingers away from spring ends, pry torsion spring out of engagement with shaft drive tang using a screwdriver.
4. Remove torsion spring and spacer from shift shaft.



1. Electric shift cam
2. Torsion spring
3. Spacer
4. Shift shaft
5. Transfer case

**CASE ASSEMBLY**

1. Pull oil seal.
2. Remove retaining ring and pull ball bearing.
3. Remove dowel pins from transfer case only if they are loose or damaged.
4. Press ring gear out of transfer case only if ring gear must be replaced.



1. Transfer case assembly
2. Oil seal
3. Retaining ring
4. Ball bearing
5. Dowel pin
6. Ring gear
7. Transfer case

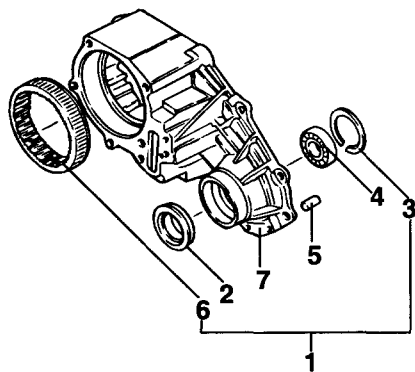
H7MT1210

H7MT1220

**REASSEMBLY** EMMB0380

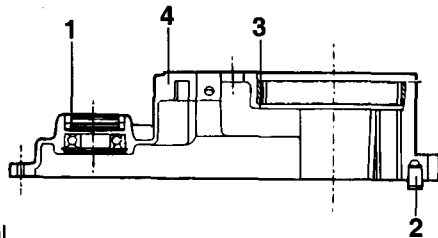
**CASE ASSEMBLY**

1. If ring gear was removed for replacement, align serrations on OD of new ring gear with those in transfer case. Press in ring gear, chamfered end first. Make sure gear is not cocked and is firmly seated in case.
2. If removed, press two new dowel pins into case.
3. Press in ball bearing to bottom in transfer case and install retaining ring.
4. Position new oil seal and press in to seat seal flange against transfer case.



1. Transfer case assembly
2. Oil seal
3. Retaining ring
4. Ball bearing
5. Dowel pin
6. Ring gear
7. Transfer case

H7MT1220

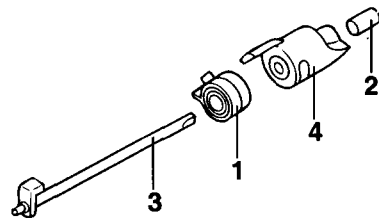


1. Oil seal
2. Dowel pin
3. Ring gear
4. Transfer case

H7MT1230

**SHIFT CAM (ELECTRIC PARTS)**

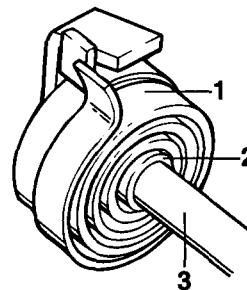
1. Insert spacer in torsion spring and install over free end of shift shaft.



1. Torsion spring
2. Spacer
3. Shift shaft
4. Electric shift cam

H7MT1240

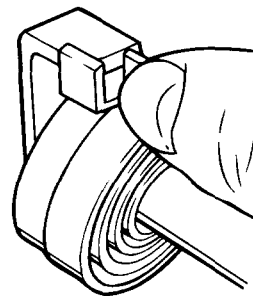
2. Slide torsion spring and spacer on shift shaft up to drive tang and position first spring end to left (Viewed from free end of shaft) of drive tang.



1. Torsion spring
2. Spacer
3. Shift shaft

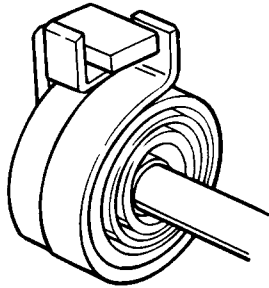
H7MT1250

3. Twist second spring end to right of drive tang on shift shaft.



H7MT1260

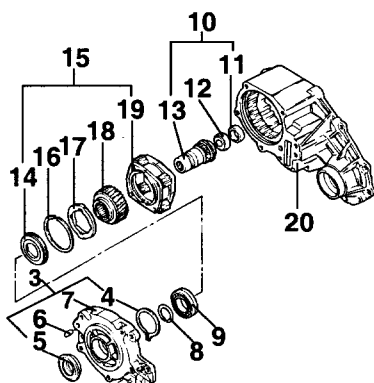
4. Push torsion spring and spacer together back as far as they will go.
5. Slide electric shift cam onto shift shaft, drive tang on cam first.  
Position drive tang on cam so that it will go under drive tang on shift shaft and between spring ends and slide cam as far as it will go.



H7MT1270

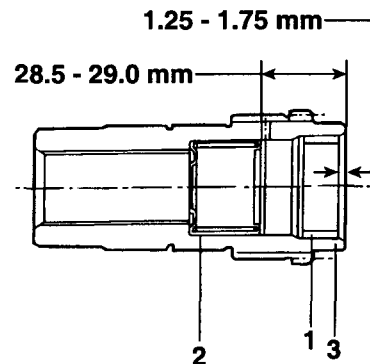
**ADAPTER, INPUT SHAFT AND CARRIER**

1. Lay planet carrier assembly on work bench with end having groove for retaining ring up.
2. Install sun gear with hub end up. Rotate gear of planet carrier assembly as required until sun gear is fully meshed.
3. Align tabs and install thrust plate into planet carrier assembly.
4. Install retaining ring (16) to complete gear carrier assembly.



- |                      |                         |
|----------------------|-------------------------|
| 1. Breather          | 11. Sleeve bearing      |
| 2. Bolt              | 12. Needle bearing      |
| 3. Adapter assy      | 13. Input shaft         |
| 4. Snap ring         | 14. Thrust washer       |
| 5. Oil seal          | 15. Gear carrier assy   |
| 6. Spiral pin        | 16. Retaining ring      |
| 7. Front adapter     | 17. Thrust plate        |
| 8. Retaining ring    | 18. Sun gear            |
| 9. Bearing           | 19. Planet carrier assy |
| 10. Input shaft assy | 20. Transfer case       |

5. If removed, position needle bearing and press into input shaft to dimension shown. Press in new sleeve bearing to complete input shaft assembly.
6. Lift up gear carrier assembly and install input shaft assembly up through gear carrier assembly. Install thrust washer and press bearing over end of input shaft assembly. Retain bearing on input shaft with retaining ring in shaft groove.
7. If removed, press new pin into front adapter.
8. Position oil seal and press into front adapter to dimension shown.
9. Install snap ring in groove in front adapter with long ends of snap ring in adapter groove to complete front adapter assembly.
10. Position front adapter assembly with face that mates with transfer case up. Support on wood blocks to provide clearance for input shaft assembly. Position assembled input shaft and carrier group over front adapter with input shaft down. Lower shaft and carrier group while expanding long ends of snap ring until snap ring engages groove in outside diameter of bearing.



1. Sleeve bearing
2. Needle bearing
3. Input shaft

H7MT1280

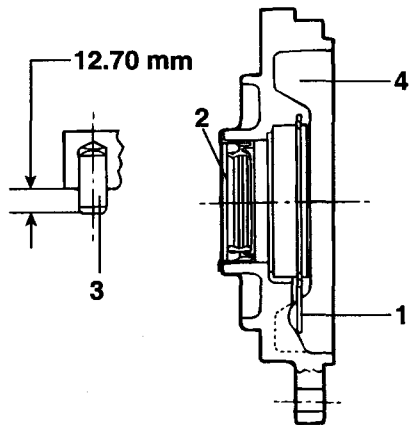
11. Apply continuous 1/16 in. (1.6 mm) bead of sealant (Neutral Cure RTV, Loctite 598) all around transfer case mounting face for front, adapter. Center sealant bead between edges of face. Circle bolt holes.

H7MT1190



12. Install assembled adapter, input shaft and carrier group on transfer case and attach with six bolts. Torque bolts to 20 - 34 lb.ft (27 - 46 Nm)

13. Install breather bard and torque to 6 - 14 lb.ft (8 - 19 Nm).

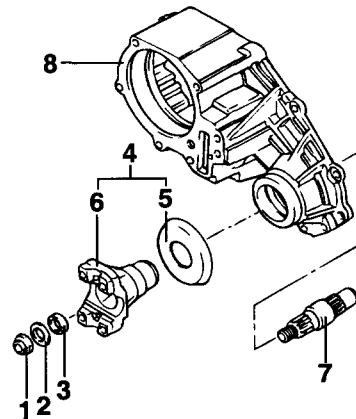


1. Snap ring
2. Oil seal
3. Spiral pin
4. Front adapter

H7MT1290

### FRONT OUTPUT SHAFT

1. If removed, press deflector onto yoke.
2. Position output shaft in transfer case and install yoke assembly, oil seal, washer and nut.
3. Hold yoke and torque nut to 150 - 180 lb-ft (203 - 244 Nm).

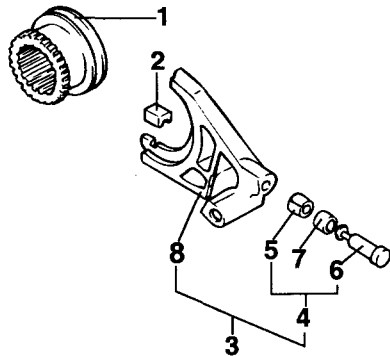


1. Nut
2. Washer
3. Oil seal
4. Yoke assy
5. Deflector
6. Yoke
7. Output shaft(front)
8. Transfer case

H7MT1180

**REDUCTION SHIFT**

1. If disassembled for parts replacement, assemble reduction shift fork assembly using new pin, roller and retainer assembly.  
Press pin, roller and retainer assembly into bore in reduction shift fork until retainer passes completely through and snaps in place. Make sure that cam roller turns freely.
2. Install two fork facings on reduction shift fork assembly.
3. Engage reduction shift fork assembly with reduction hub and position in transfer case, reduction hub in gear carrier assembly previously installed.
4. Install output shaft, engaging output shaft end with input shaft bearings and output shaft spline with reduction hub.



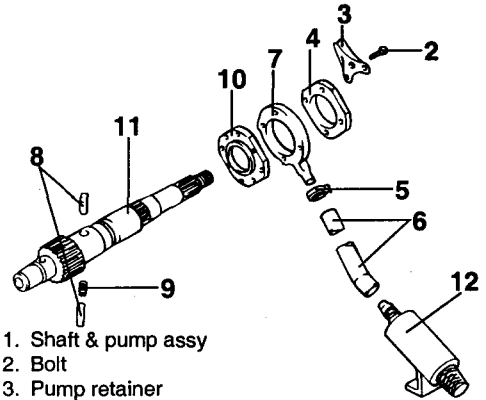
1. Reduction hub
2. Shift fork facing
3. Reduction shift fork assy
4. Pin, roller and retainer assy
5. Retainer
6. Pin
7. Cam roller
8. Reduction shift fork

H7MT1170

**OIL PUMP**

1. Locate pump front cover. Front pump cover has tapped holes.  
Position front cover so that word TOP faces down and turned so that it will be at top of transfer case when installed in vehicle.  
Install front pump cover over output shaft in this position.
2. Install two pump pins with spring between them in output shaft.  
Flat surface on both pins must point out and face up.  
Center pins and spring in output shaft.

3. Push hose coupling onto barb on strainer and install L shaped foot on filter in slot in transfer case. Hose coupling must point in direction of pump assembly.
4. Install pump housing so that word REAR marked on it is up and hose bard points toward hose coupling and strainer. Lower pump housing over upper output shaft, moving pump pins inward and compressing spring so that both pins are contained inside pump housing.
5. Slip hose clamp over free end of hose coupling and push onto hose bard on pump housing. Secure hose clamp over hose coupling on hose barb.
6. Position pump rear cover over assembly with words TOP REAR facing up and located to be at top of transfer case when installed.  
Position pump retainer on cover so that tab on retainer is in notch in transfer case. Clean threads on four bolts and apply Loctite 222. Align pump holes and install bolts. Torque bolts to 2.9 - 6.3 lb-ft (4.0 - 8.5 Nm) while turning output shaft by hand to insure that pump pins move freely.

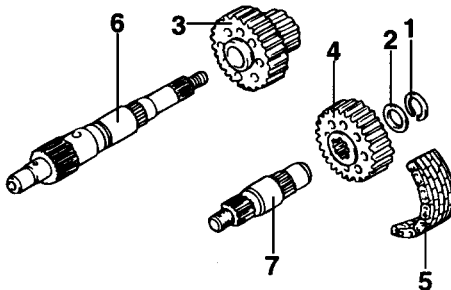


1. Shaft & pump assy
2. Bolt
3. Pump retainer
4. Rear pump cover
5. Hose clamp
6. Hose coupling
7. Pump housing
8. Pump pin
9. Spring
10. Front pump cover
11. Output shaft
12. Strainer

H7MT1160

**CHAIN DRIVE**

1. On work bench, next to transfer case assembly, position driven sprocket (with internal spline) at front output shaft end of case and drive sprocket (with smooth bore) at output shaft end.
2. Assemble drive chain around sprockets.
3. Grasp each sprocket, hold drive chain tight and parallel with transfer case, and install chain drive assembly over output shaft. It may be necessary to rotate driven sprocket slightly to engage splines on front output shaft.
4. Install spacer on front output shaft. Install snap ring in shaft groove over spacer.



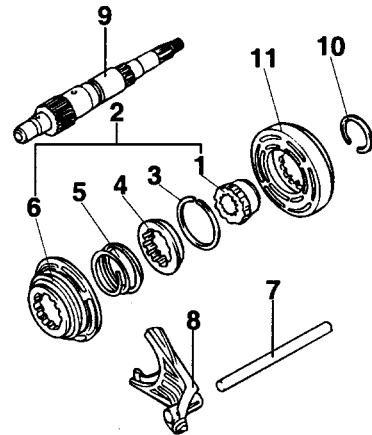
1. Snap ring
2. Spacer
3. Drive sprocket
4. Driven sprocket
5. Drive chain
6. Output shaft (rear)
7. Lockup collar

H7MT1150

**LOCKUP SHIFT**

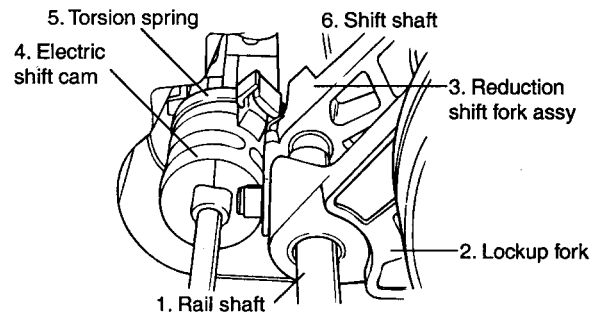
1. Assemble return spring and lockup hub in lockup collar and retain with snap ring, completing 2W-4W lockup assembly.
2. Install rail shaft in transfer case, through reduction shift fork assembly previously installed and into blind hole in case.
3. Engage lockup fork in groove in 2W-4W lockup assembly and slide this group down over output shaft and rail shaft.
4. Install shift collar hub, engaging splines on output shaft and in 2W-4W lockup assembly.

5. On electric shift units only, install electric shift cam group previously assembled and clutch housing as follow :
  - 1) Position electric shift cam group rotated so that end of torsion spring will contact side of reduction shift fork assembly that faces up, toward top of case.
  - 2) Holding rail shaft down, raise up fork assemblies slightly. Rotate electric shift cam group into position so that roller on reduction shift fork assembly is in groove in shift cam and button on lockup fork is on cam end. Then lower this group of parts into the transfer case engaging shift shaft on pin in transfer case.
  - 3) Position clutch housing in transfer case over shift collar hub. Attach with retaining ring in clutch collar hub groove.



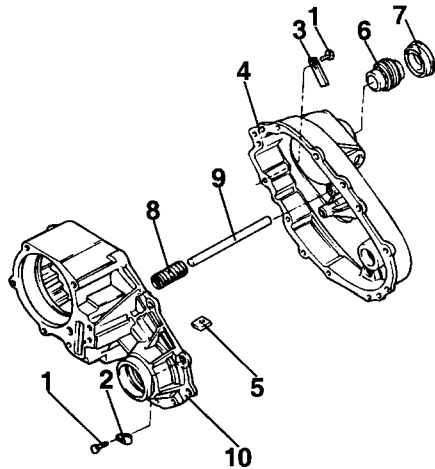
1. Shift collar hub
2. 2W-4W Lockup assy
3. Snap ring
4. Lockup hub
5. Return spring
6. Lockup collar
7. Rail shaft
8. Lockup fork
9. Output shaft
10. Retaining ring
11. Clutch housing

H7MT1130



H7MT1300

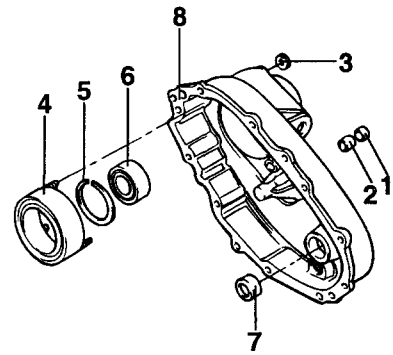
CASE COVER



- |                       |                   |
|-----------------------|-------------------|
| 1. Bolt               | 6. Speedo gear    |
| 2. Wiring clip        | 7. Oil seal       |
| 3. Identification tag | 8. Return spring  |
| 4. Cover assy         | 9. Rail shaft     |
| 5. Magnet             | 10. Transfer case |

H7MT1310

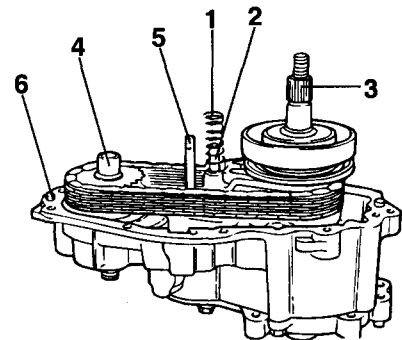
1. Position cover on bed of suitable press so that open face of cover is up and parallel with press bed.
2. Position end of needle bearing with identification marking up and press into cover until upper end of bearing is 1.593 - 1.603 in. (40.47 - 40.97 mm) below face of cover that mates with transfer case.
3. Press in ball bearing to bottom in cover and install snap ring.
4. On electric shift units only, install parts as follow :
  - 1) Verify that four O-rings (one on wire and one each on three studs) are in place on clutch coil assembly. Install clutch coil assembly in inside of cover, with electrical wire and studs extending through cover, with electrical wire and studs extending through cover. Use care not to kink or trap electrical wire under clutch coil assembly. Attach with three nuts and torque to 6 - 8 lb-ft (8 - 11 Nm).
  - 2) Install motor bearing and oil seal in cover.



- |                     |
|---------------------|
| 1. Oil seal         |
| 2. Bearing          |
| 3. Nut              |
| 4. Clutch coil assy |
| 5. Snap ring        |
| 6. Ball bearing     |
| 7. Needle bearing   |
| 8. Case cover       |

H7MT1320

5. Install return spring over rail shaft in transfer case to rest on shift fork.
6. Install magnet in slot in transfer case.
7. Apply continuous 1/16 in. (1.6 mm) bead of sealant (Neutral Cure RTV, Loctite 598) all around transfer case mounting face for cover assembly. Center sealant bead between edges of face. Circle bolt holes. Remove excess if sealant bead is larger than 1/16 in. (1.6 mm).



- |                       |
|-----------------------|
| 1. Return spring      |
| 2. Rail shaft         |
| 3. Output shaft       |
| 4. Front output shaft |
| 5. Shift shaft        |
| 6. Dowel pin          |

H7MT1330

8. Install cover assembly on transfer case. All of the following alignment conditions must be met for the cover assembly to seat on transfer case properly.

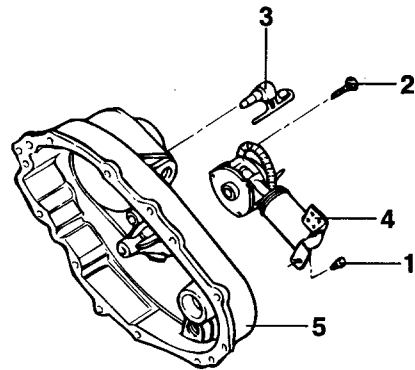
- 1) Cover holes with transfer case dowel pins.
- 2) Cover bearings with output shafts.
- 3) Blind hole in cover with rail shaft. Make sure spring is not cocked. On electric shift, check with pen light through cover hole for speed sensor.
- 4) On electric shift units, cover bearing with shift shaft.

9. Install nine bolts positioning identification tag and wiring clip under bolt heads at locations. Torque bolts to 20 - 34 lb-ft (27 - 46 Nm).

10. Install speedo gear over spline of output shaft into cover assembly.

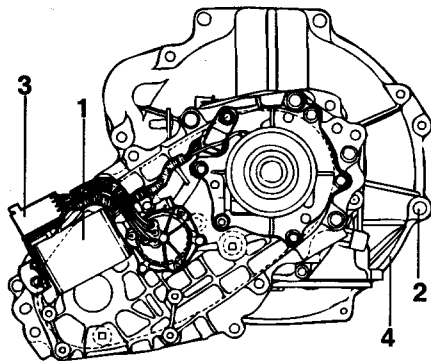
11. Press new oil seal into cover assembly.

3. Install bolt and washer at bracket end of motor assembly and torque to 6 - 8 lb-ft (8 - 11 Nm).



1. Bolt
2. Bolt
3. Speed sensor
4. Motor assembly
5. Cover

H7MT1110



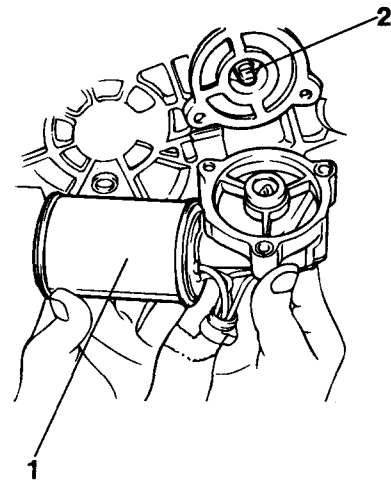
1. Motor assembly
2. Bolt
3. Wiring clip
4. Identification tag

H7MT1000

## EXTERNAL ELECTRIC SHIFT

1. Position motor assembly so that triangular slot in motor will align with shift shaft. Move motor in to engage shift shaft and contact cover. Then rotate motor in clockwise direction until motor is in correct position and mounting holes are aligned.

2. Fit O-ring on speed sensor and install speed sensor assembly in cover. Install bracket so that it is over speed sensor and install three bolts. Torque bolts to 6 - 8 lb-ft (8 - 11 Nm).



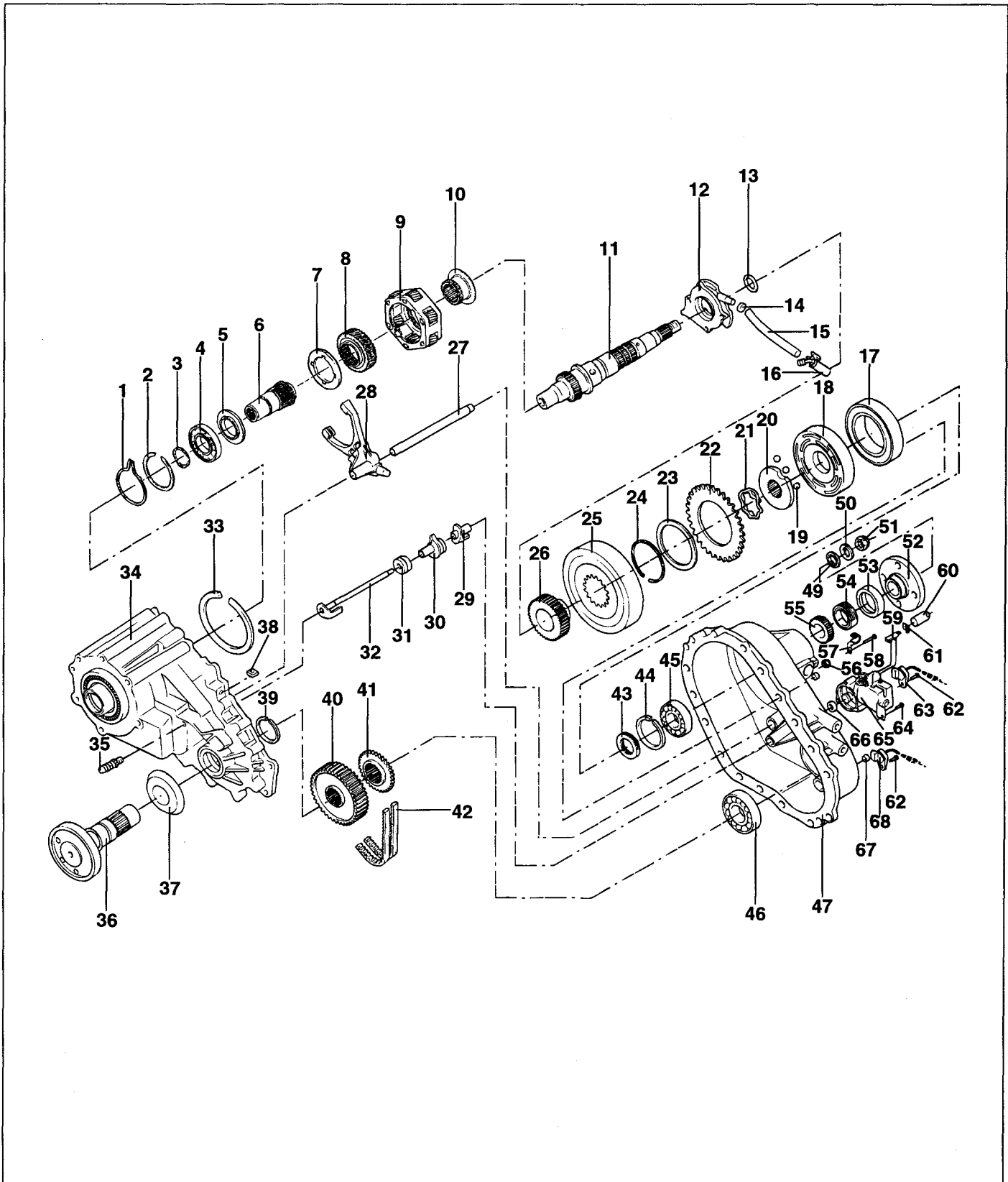
1. Motor assy
2. Shift shaft

H7MT1340

ATT (ACTIVE TORQUE TRANSFER)

EMMB0410

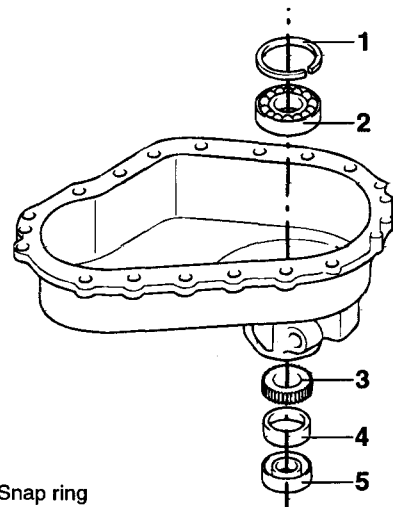
COMPONENTS



1. Snap ring
2. Snap ring
3. Snap ring
4. Bearing
5. Circula hub
6. Input shaft
7. Thrust plate
8. Sun gear
9. Carrier
10. Reduction hub
11. Main shaft
12. Pump
13. Thrust washer
14. Hose clamp
15. Hose
16. Filter
17. Electric coil
18. Cam coil housing
19. Ball
20. Cam apply
21. Wave spring
22. Amateur
23. Insulator washer
24. Retaining ring
25. Clutch pack
26. Drive sprocket
27. Shift rail
28. Shift fork
29. Electric shift cam
30. Electric shift cam
31. Torsion spring
32. Shift shaft
33. Retaining ring
34. Transfer case
35. Breather
36. Output shaft
37. Dust deflector
38. Magnet
39. Snap ring
40. Lower socket
41. Lower tone wheel
42. Chain
43. Bearing thrust
44. Retaining ring
45. Bearing
46. Bearing
47. Cover
48. Metric bolt
49. Oil seal
50. Washer
51. Metric nut
52. Companion flange
53. Oil seal
54. Speedo gear
55. Upper tone wheel
56. Metric nut
57. J-clip
58. Hex head bolt
59. Clip
60. Connector
61. Connector lock
62. Hex head bolt
63. Upper speed sensor
64. Hex head cap screw
65. Electric motor
66. Oil seal
67. Pipe plug
68. Lower speed sensor

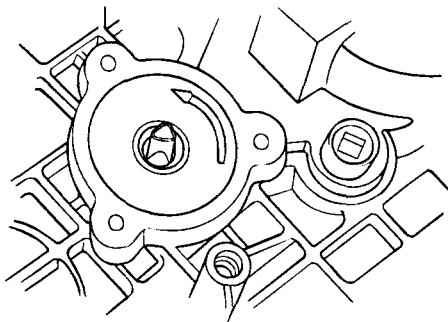
**DISASSEMBLY** EMMB0420

1. Remove the transfer case from the vehicle.
2. Remove the flange washer and nut.
3. Disconnect the shift motor/clutch coil connector and the speed sensor connector.
4. Remove the outer tube of the speed sensor connector wire.
5. Remove the wire fixing cap in the rear of the speed sensor connector.
6. Disconnect the speed sensor connector.
7. Remove the shift motor.



1. Snap ring
2. Bearing
3. Upper tone wheel
4. Speedometer drive gear
5. Flange seal yoke

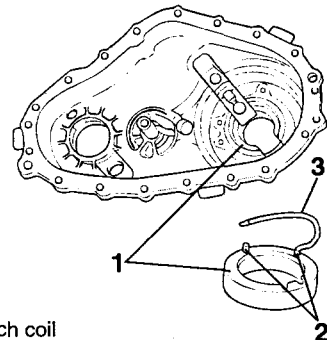
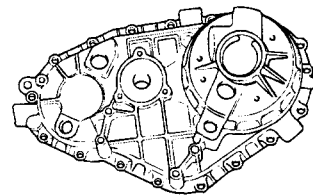
EMMB042A



KMMB042B

8. If necessary, remove the front and rear speed sensor.
9. Remove the mounting bolts for the rear and front case.
10. Make sure that the front case is facing downward so that the rear cover is facing upwards.
11. Separate the front case from the rear case.
12. Remove all traces of gasket sealant from the mating surfaces of the front case and rear case.
13. If the speedometer drive gear is to be replaced, first remove the flange seal or use the Impact Slide Hammer to pop off the flange seal.

14. Remove the speedometer drive gear and upper tone wheel.
15. If the rear output shaft bearing requires replacing, remove the internal snap ring that retains the bearing in the bore.
16. From the outside of the case, drive out the bearing.
17. Remove the three nuts and washers retaining the clutch coil assembly to the rear case.
18. Pull the coil assembly, along with the O-rings and wire, from the case.



1. Clutch coil
2. Clutch coil retaining nut
3. Wire

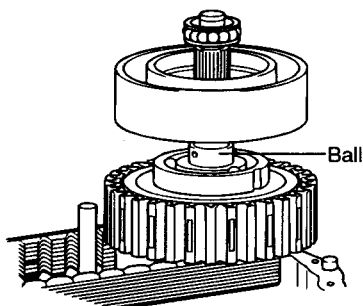
**CAUTION**

*Do not damage the bearing and the bearing case.*

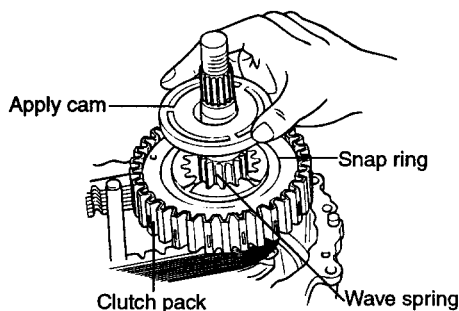
EMMB042B



19. Remove the bearing assembly from the output shaft.
20. Remove the clutch housing from the output shaft.
21. Remove the balls and the apply cam and the waver washer from the output shaft.
22. Remove the snap ring from the output shaft.
23. Remove the clutch pack and lower tone wheel from output shaft.

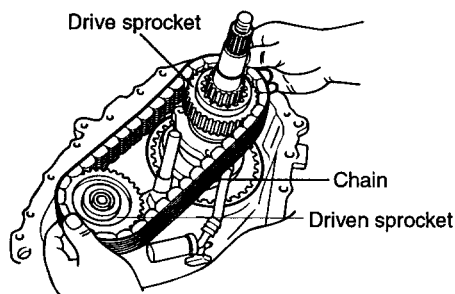


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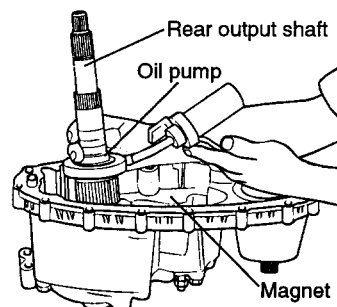
24. Remove the chain, the driven sprocket and the drive sprocket as an assembly.



EMMB042E

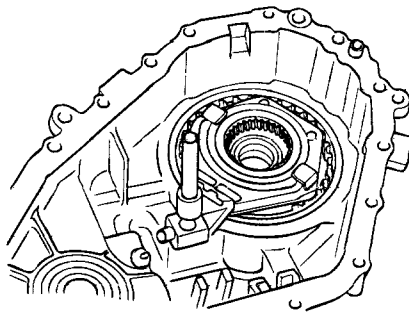
25. Remove the thrust washer from the output shaft.
26. Remove the oil pan magnet from the slot in the front of the case bottom.
27. Remove the output shaft and oil pump as an assembly.

28. If required, to remove the pump from the output shaft, rotate the pump to align.
29. Pull out the shift rail.
30. Remove the helical cam from the front case.
31. If required, remove the helical cam, torsion spring and sleeve from the shaft.



EMMB042F

32. Remove the high-low range shift fork and collar as an assembly.
33. Expand the tangs of the large snap ring in the case using the Ring Plier or equivalent.
34. With the input shaft against a bench, push the case down and slide the main drive gear bearing retainer off the bearing.
35. Lift the input shaft and front planet from the case.
36. If required, remove the oil seal from the case by prying and pulling on the curved-up lip of the oil seal or use the Slide Hammer to pop off the oil seal.
37. Remove the internal snap ring from the planetary carrier.
38. Separate the front planet from the input shaft.
39. Remove the external snap ring from the input shaft.
40. Place the input shaft in a vise and remove the bearing.
41. Remove the thrust washer, thrust plate and the sun gear off the input shaft.



KMMB042I

42. Inspect the bushing and needle bearing in the end of the input shaft for wear or damage.

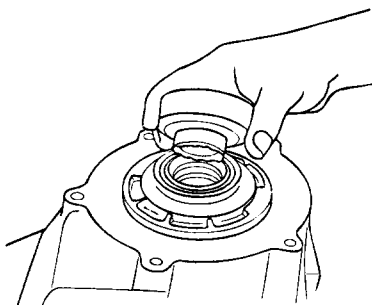
**CAUTION**

*Under normal use, the needle bearing and bushing should not require replacement. If replacement is required, the bushing and needle bearing must be replaced as a set.*

43. If required, remove the front yoke to flange seal by prying and pulling on the curved-up lip of the yoke to flange seal.
44. If required, remove the internal snap ring retaining the front output shaft ball bearing and remove the bearing.

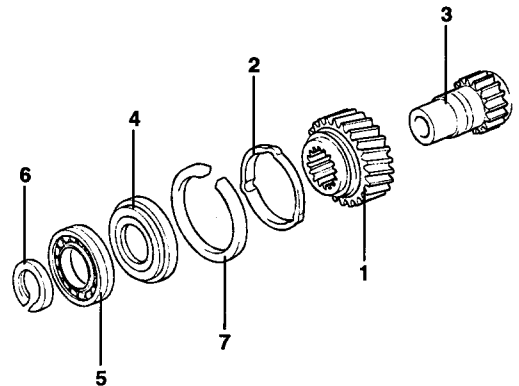
**REASSEMBLY** EMMB043O

- Before assembly, lubricate all parts with the specified grease oil.
- If removed, drive the bearing into the front output case bore.
- Install the internal snap ring that retains the bearing to the front case.
- If removed, install the front yoke to flange seal in the front case bore.
- If removed, install the yoke to flange seal into the mounting adapter bore.



KMMB043Q

- If the input shaft needle bearing and bushing were removed, install a new bearing and bushing.
- The recessed face of the sun gear and the snap ring groove on the bearing outer race should be toward the rear of the transfer case.
- The stepped face of the thrust washer should face toward the bearing.
- Slide the sun gear, thrust plate and thrust washer into position on the input shaft.
- Press the bearing over the input shaft.
- Install the external snap ring to the input shaft.
- Install the front planet to the sun gear and input shaft.
- Install the internal snap ring to the planetary carrier.

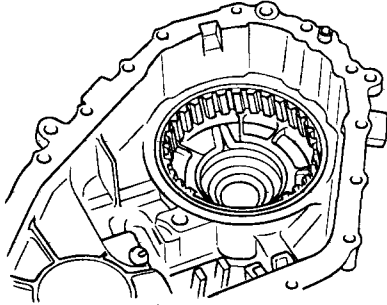


- Sun gear
- Thrust plate
- Input shaft
- Thrust washer

- Bearing
- Outer snap ring
- Inner snap ring

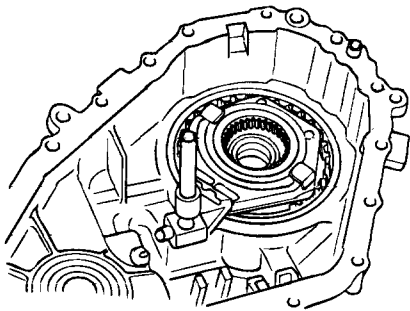
EMMB043A

14. Place the tanged snap ring in the case.  
Expand the snap ring with the snap ring pliers and install the planetary carrier assembly.  
Check the installation by holding the case and carefully tapping the face of the input shaft against a wooden block to make sure the snap ring is installed.
15. Remove all traces of gasket sealant from the front case and mounting adapter mating surfaces.



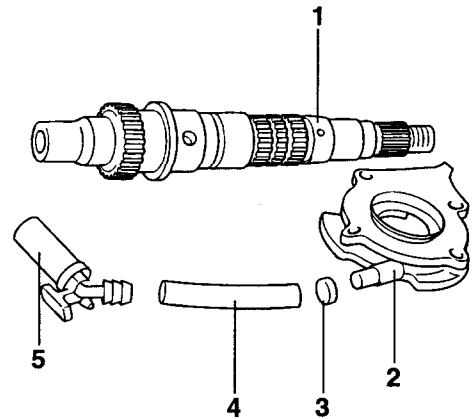
KMMB043C

16. Install the high-low shift fork and high-low collar as an assembly into the front planet.



KMMB043D

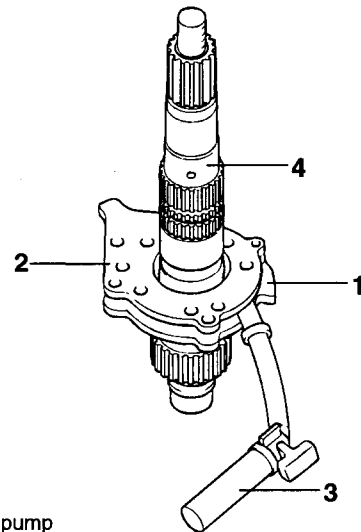
17. Check the pump to make sure the pump rotates freely.
18. Inspect the outside surfaces and bore of the oil pump.



1. Rear output shaft  
2. Pump body  
3. Clamp  
4. Hose  
5. Filter

EMMB043B

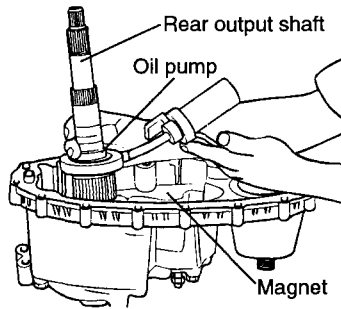
19. Install the output shaft and oil pump in the input shaft. Make sure that the internal splines of the output shaft engage the internal splines of the high-low shift collar. Make sure that the oil pump retainer arm and oil filter leg are in the groove and slot of the front case.



1. Oil pump  
2. Pump retainer  
3. Oil pump filter  
4. Output shaft

EMMB043C

20. Install the oil pan magnet in the slot in the front case just above the oil filter leg.
21. Install the front output shaft in the front case.

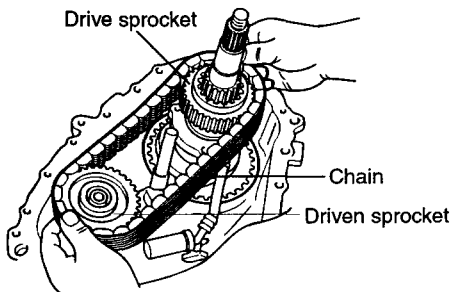


EMMB042F

22. Install the thrust washer on the rear output shaft.
23. Install the chain, drive sprocket and driven sprocket as an assembly over the output shaft.

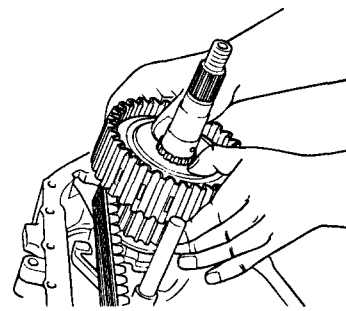
**CAUTION**

*The driven sprocket (on the front output shaft) must be installed with the marking REAR facing toward the rear case, if so marked.*



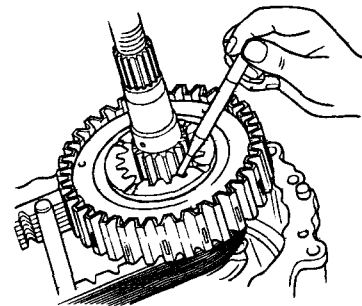
EMMB042E

24. Install tone wheel onto the front output shaft. Make sure the spline on the tone wheel engages the spline on the front output shaft.
25. Install clutch pack assembly onto the rear output shaft. Make sure that the spline on the clutch pack engages to the spline of the sprocket.



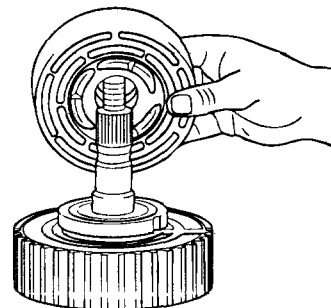
KMMB043G

26. Install snap ring onto the rear output shaft. Start the snap ring over the spline and use the wave spring to seat the snap ring in the snap ring groove. If the snap ring will not install, the thrust washer inside the clutch pack may not be seated properly.



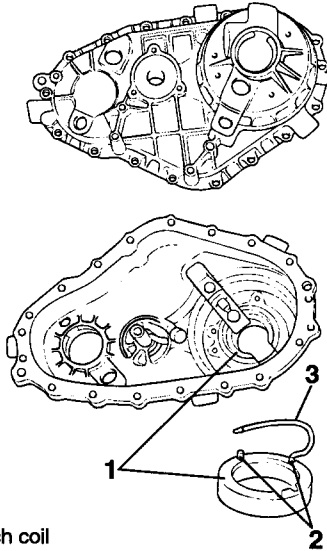
KMMB043H

27. Three slots on the thrust washer must be aligned with the three tabs on the clutch pack housing.
28. Install the apply cam onto the rear output shaft.
29. Install three balls into the apply cam.
30. Install cam and coil housing assembly onto rear output shaft.
31. Install thrust bearing assembly onto output shaft.



KMMB043I

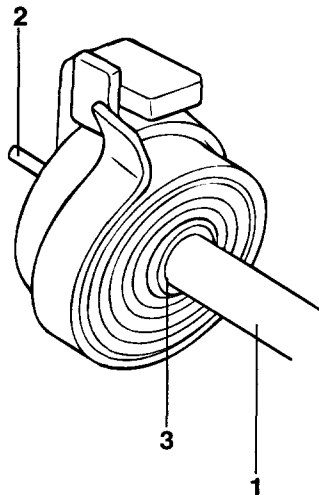
32. Install the clutch coil from inside the rear case until the wire and studs extend through the cover.
33. Install the washers and nuts and tighten to 8 - 11Nm



1. Clutch coil
2. Clutch coil retaining nut
3. Wire

EMMB042B

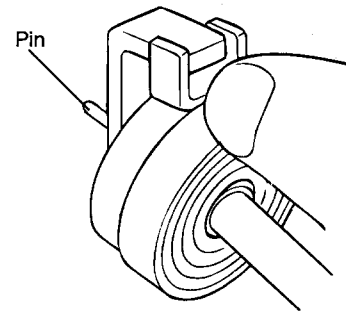
34. Slide the spring spacer on the cam shaft and position it beneath the drive tang.
35. Place the torsion spring on the cam shaft. Position the first spring tang to the left of the cam shaft drive tang.



1. Cam shaft
2. Pin
3. Spring spacer

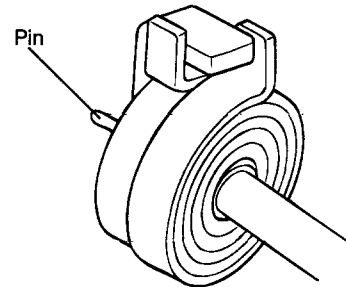
EMMB043D

36. Wind the second spring tang clockwise past the drive tang.



EMMB043E

37. Push the torsion spring and sleeve in as far as it will go.
38. Install the helical cam and slide the drive tang between the torsion spring tangs as far as it will go.



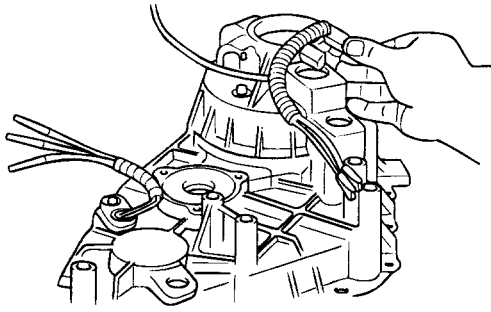
EKKB043F

39. Install the pin on the tang end of the helical cam into the hole in the front case. Position the torsion spring tangs so that they are pointing toward the top side of the transfer case and just touching the high-low shift fork.

**⚠ CAUTION**

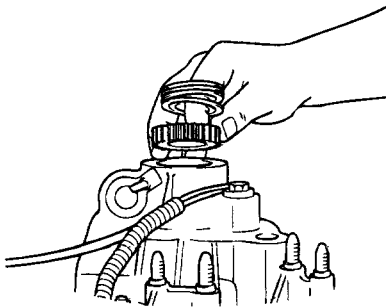
**Do not bend the helical cam during installation to the front case because of possible damage to the pin at the tang end of the motor shaft.**

40. Install the shift rail through the high-low shift fork and make sure that the reverse gear shift rail is seated in the front case bore.
41. Install upper and lower speed sensors into the cover. Feed the coil wire through the upper speed sensor wire shield.



KMMB043M

42. Install upper tone wheel, speedometer gear and rear output seal.

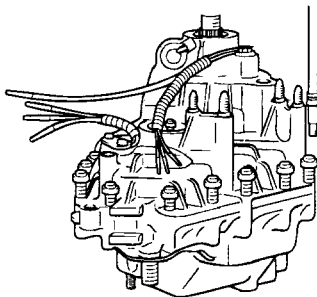


KMMB043N

43. Coat the mating surface of the front case with sealant.
44. The following procedure must be followed prior to installing the rear case onto the front case half :

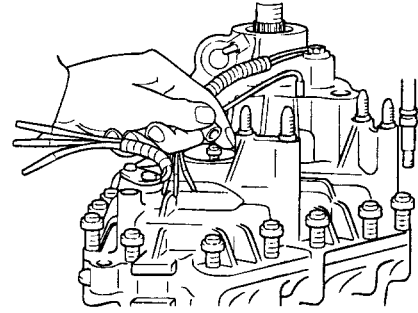
- 1) Align the output shaft with the rear case output shaft bore.
- 2) Align the helical cam with the rear case motor bore.  
If difficulty is encountered with seating the rear case, tap the rear output shaft with a sharp blow using a rubber mallet in a direction away from the triangular shaft while pushing down on the rear case.

45. Install the bolts retaining the case halves and tighten to 25 - 37 N·m (250 - 370 kg·cm, 19 - 25 lb·ft).



KMMB043O

46. Install shift shaft oil seal if it is not installed.



KMMB043P

47. Using pliers equipped with soft jaws, rotate the triangular shaft so it is aligned with the triangular slot in the transfer case shift motor. If triangular shaft will not rotate, rotate the rear output shaft.
48. Slightly loosen the two nuts that attach the slotted support bracket to the end of the motor house.
49. Apply the sealant to motor housing base and install on transfer case.
50. Install the transfer case shift motor.
51. Holding the slotted support bracket tight against the motor housing end secure the bracket to the transfer case, tightening the bolt with lockwasher to 8 - 11 N·m (80 - 110 kg·cm, 6 - 8 lb·ft)
52. Retighten the two nuts that attach the slotted support bracket to the end of the motor to 3 - 4 N·m (30 - 40 kg·cm, 2 - 3 lb·ft)

## SERVICE ADJUSTMENT PROCEDURES

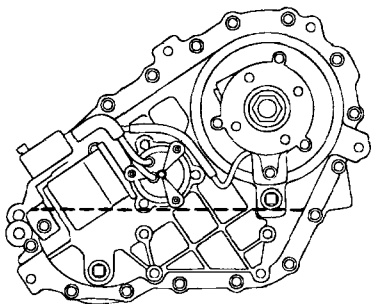
EMMB0450

### FLUID LEVEL INSPECTION

1. Wipe fluid level plug and surrounding area clean.
2. Remove fluid level plug.
3. When transfer case is full, lubricant will just drip out fluid level plug opening.
4. Add approved lubricant if required.
5. Install fluid level plug and torque to 20 - 30 N·m (14 - 22 lb·ft).

#### NOTE

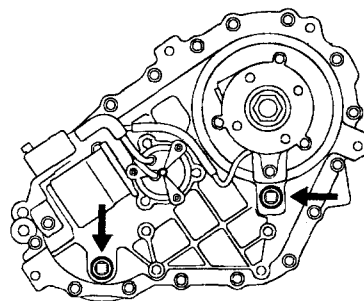
- To check or drain the lubricant, the transfer case should be warm.  
*This is best done shortly after shutdown.*
- Do not use an impact wrench to remove or install the fill or drain plugs since this will damage female threads in transfer case cover.



KMMB045B

### FLUID REPLACEMENT

1. Wipe fluid level and drain plug and surrounding areas clean.
2. Place suitable container under transfer case.
3. Remove drain plug.
4. Remove fluid level plug.
5. Allow all lubricant to drain.
6. Install drain plug and torque to 20 - 30 N·m (14 - 22 lb·ft).
7. Add approved lubricant through fluid level plug opening until lubricant just begins to drip back out of opening.
8. Install fluid level plug and torque to 20 - 30 N·m (14 - 22 lb·ft).

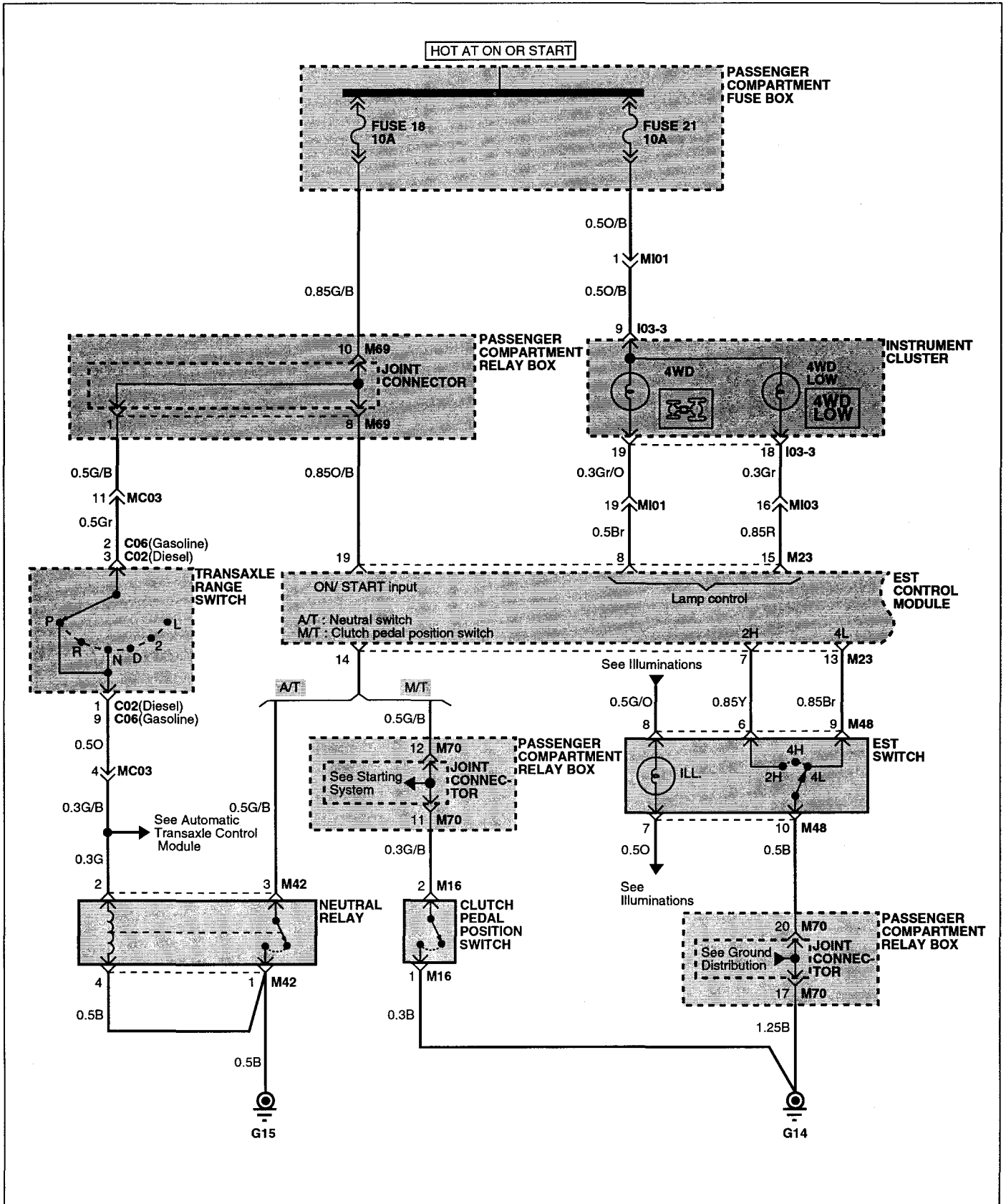


KMMB045C

TCCM

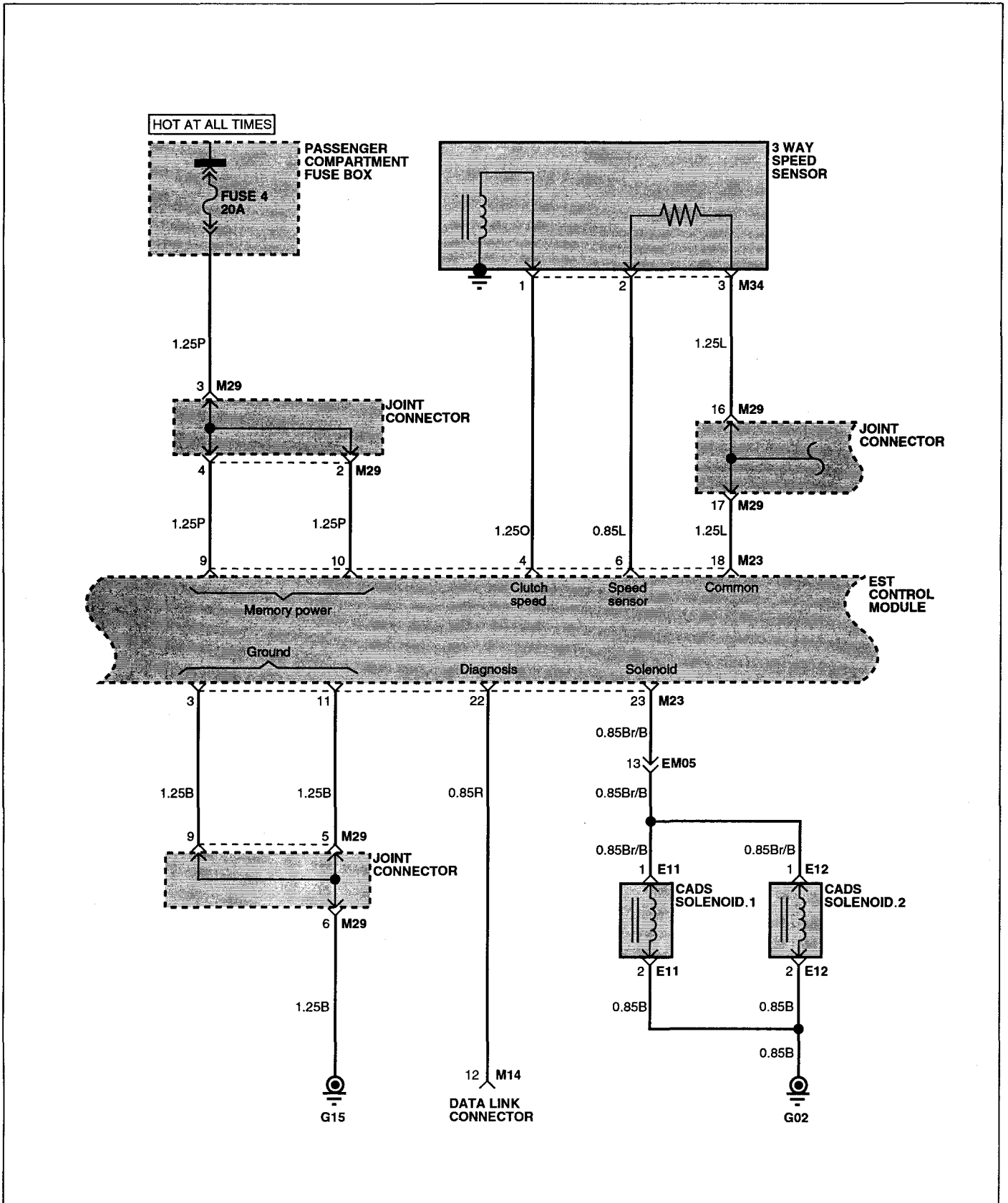
EMMA0500

EST CIRCUIT DIAGRAM (1)

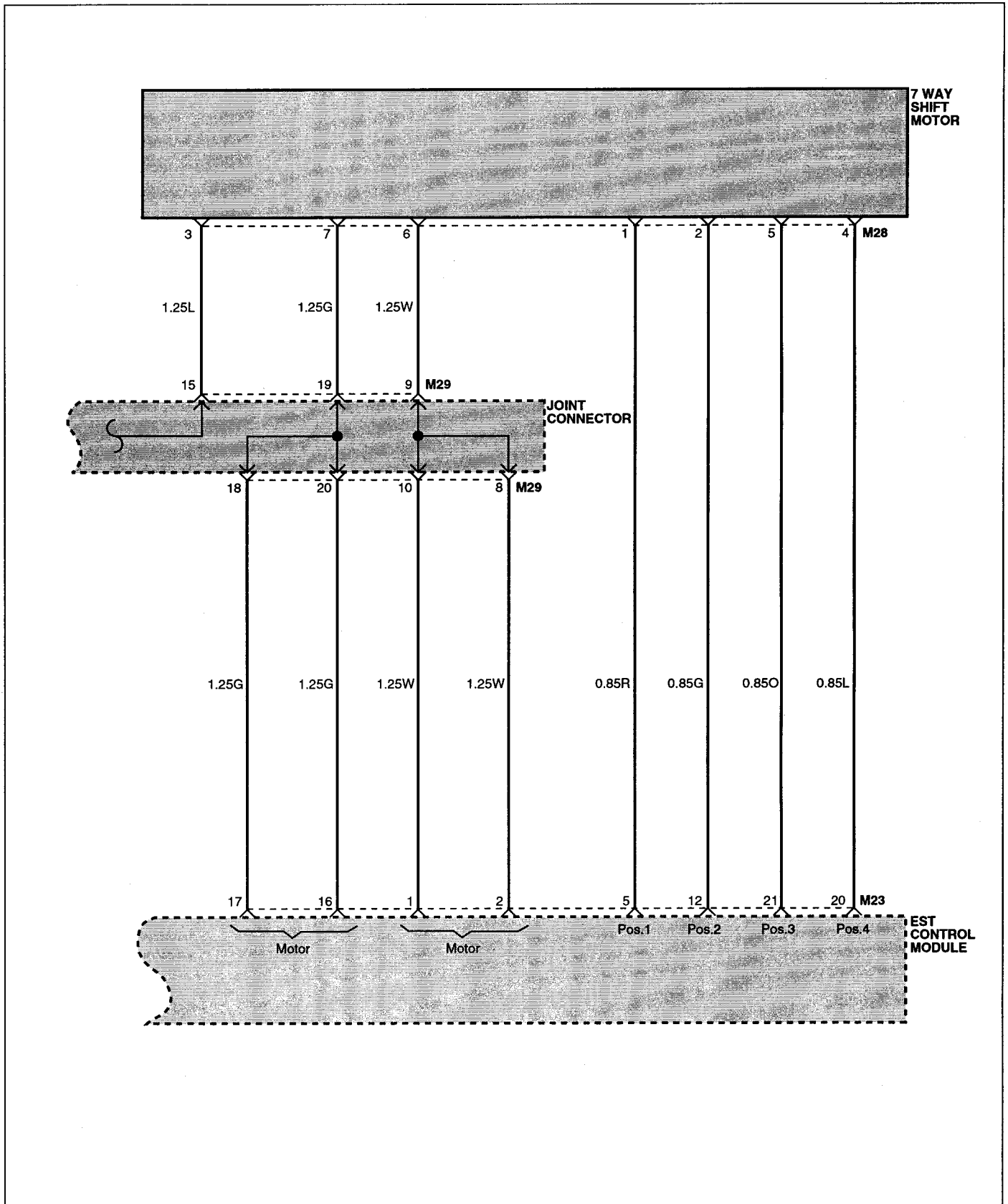




EST CIRCUIT DIAGRAM (2)

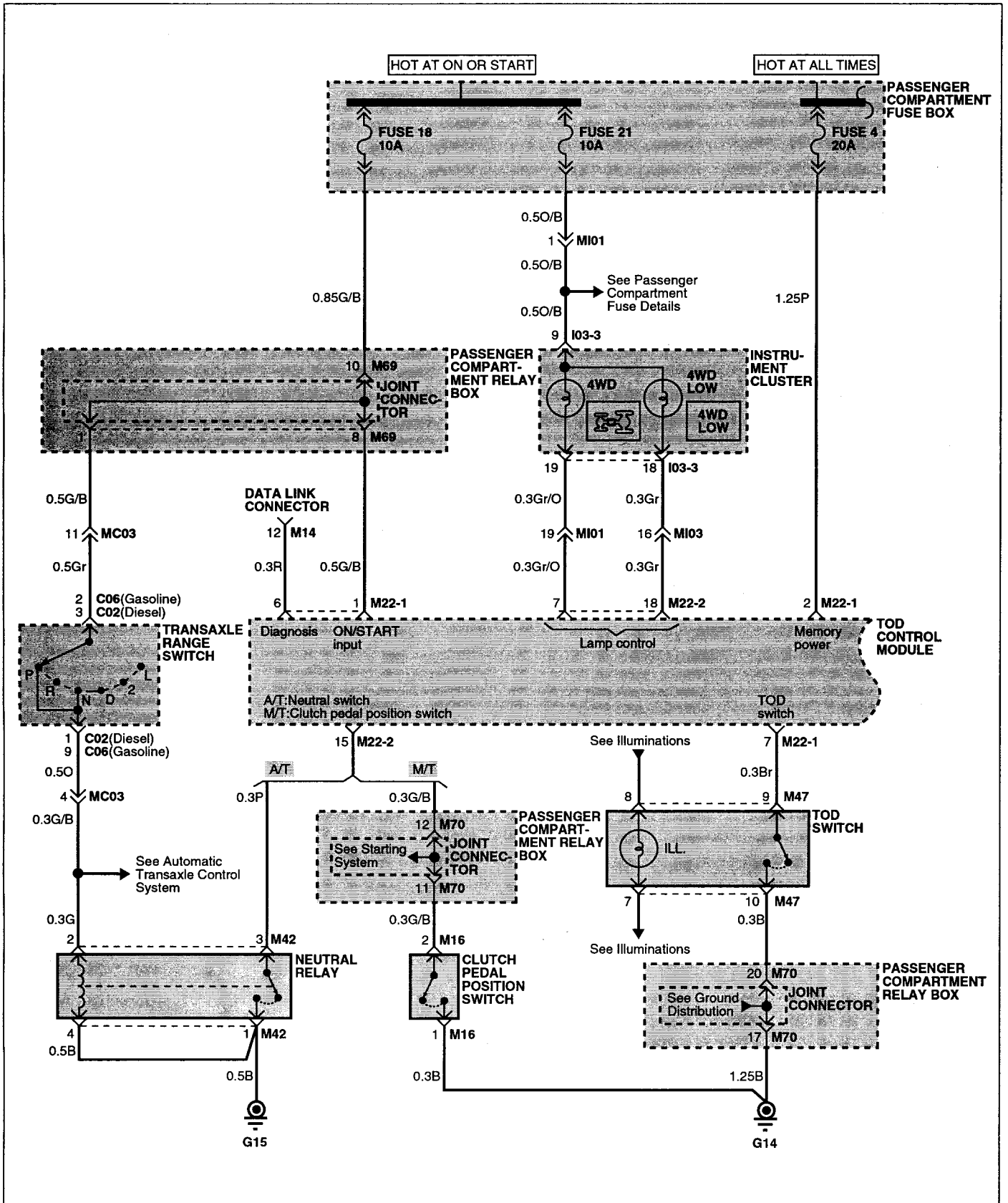


EST CIRCUIT DIAGRAM (3)

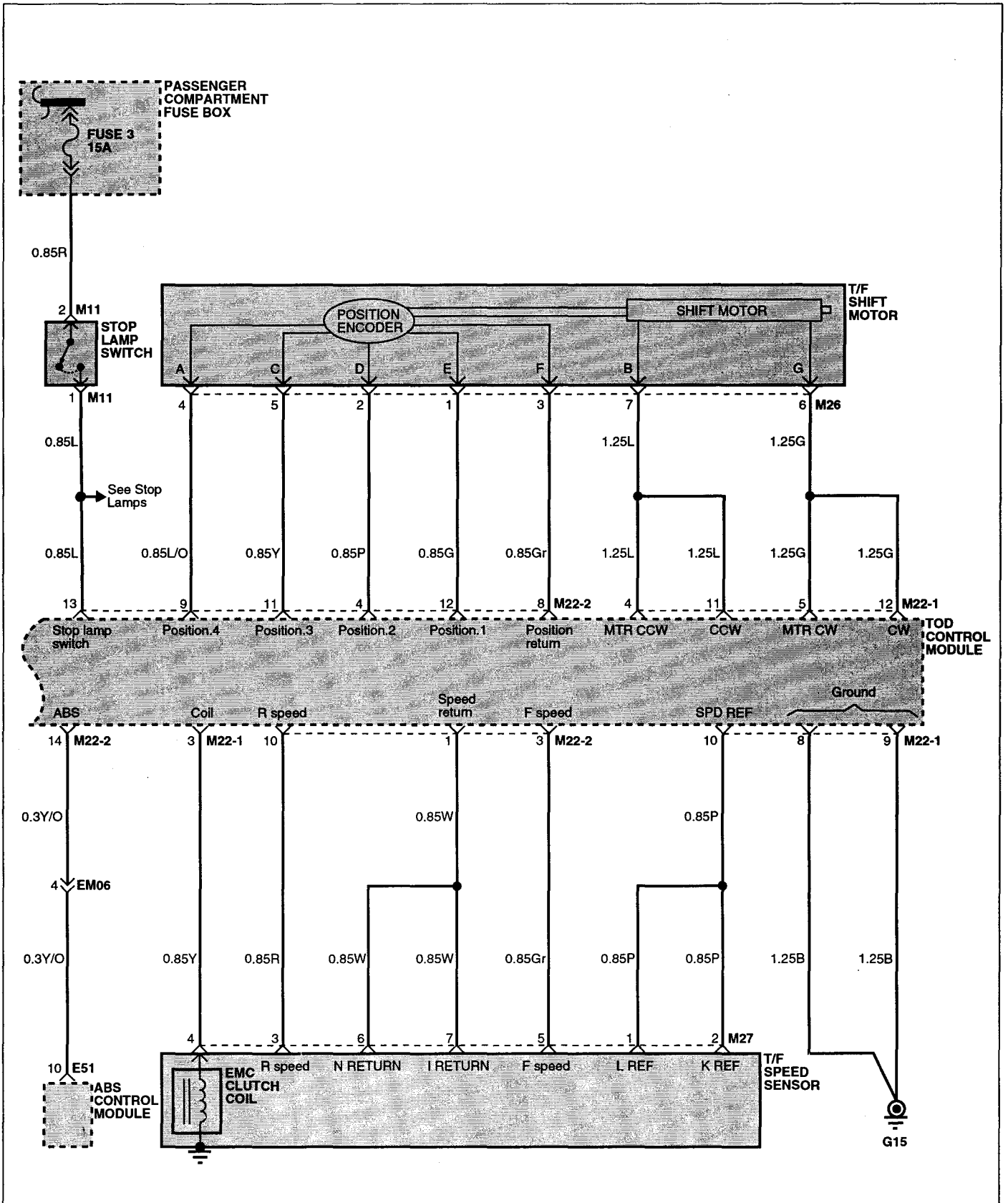


EMMB0510

ATT(OR TOD) CIRCUIT DIAGRAM (1)



ATT(OR TOD) CIRCUIT DIAGRAM (2)



# Steering System

GENERAL ..... ST -2

POWER STEERING SYSTEM ..... ST -13



# GENERAL

## SPECIFICATIONS EPMB0100

Items	Specifications
Steering wheel diameter (Outer)	386
Power steering gear box Steering gear type Steering gear ratio	Ball and nut, torsion (Integral type) 16.4-18.0
Oil pump Oil pump type	Vane type
Displacement	9.6 cc/rev

## SERVICE SPECIFICATIONS

Items	Specifications
Steering wheel free play Steering gear angle Inner wheel (Tier size)  Outer wheel (Tier size)	mm 30 34° (P235/75 R15) 33° (P255/65 R16) 31.50° (P235/75 R15) 30.50° (P255/65 R16)
Stationary steering effort	kg (lbs) 3.3 (7.3)
Drive belt tension 3.5 Gasoline 2.5 Diesel	mm 8-11 8-11
Oil pump pressure Gauge hose valve closed Gauge hose valve opened	kg/cm <sup>2</sup> (psi) 75-82 (1,067-1.166) 10 (142) or less
Cross-shaft axial play Power steering	0.05
Main shaft total starting torque Power steering	kg-cm (in-lbs) 4.5-12.5 (4-8)
Backlash between ball groove of rack piston and balls Ball joint starting torque Idler arm turning torque Spring balance reading	mm 0.05-0.10 kg-cm (in-lbs) 10-30 (8.9-26) kg-cm (in-lbs) 30-90 (26-78) kg (lbs) 2.5-7.5 (5.5-16.5)

Items		Specifications
Limit		
Steering wheel free play	mm	
Power steering		50
Steering gear backlash	mm	0.5
Ball joint axial play	mm	1.5
Oil pump pressure	kg/cm <sup>2</sup> (psi)	
Gauge hose valve closed		15 (218)
Backlash between ball groove of rack piston and balls	mm	0.2
Gap between vane and rotor groove	mm	0.06
Clearance between oil pump drive shaft and pump body	mm	0.1

### TORQUE SPECIFICATIONS EPMB0200

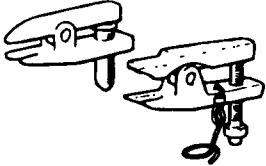

Items	kgf-m	ft-lbs
Steering column and shaft		
Steering wheel to steering shaft	4.0-5.0	29-36
Steering shaft B to joint assembly	1.3-1.8	9.4-13
Joint assembly to steering gear box	2.2-2.7	13-20
Power steering gear box		
Gear box to frame	5.5-6.5	40-47
Gear box to joint assembly	2.2-2.7	13-20
pitman arm to relay rod	4.5	33
Gear box to pressure hose	1.2-1.8	9-13
Gear box to pressure hose	1.2-1.8	9-13
Side cover to gear box housing	3.0-4.5	22-33
Adjusting bolt lock nut	3.0-4.5	22-33
Breather plug to side cover	0.5-0.8	4-6
pitman arm to cross-shaft	15-17	108-122
Valve housing to gear box housing	4.5-5.5	33-40
Valve housing lock nut	18-23	130-166
Oil pump		
<3.5 Gasoline>		
Oil pump bracket to engine	3.5-4.5	25-33
Oil pump to oil pump bracket	3.5-4.5	25-33
Oil pump to pressure hose	5.5-6.5	40-47
Oil pump to pressure switch	1.7-2.3	12.2-16.6
Oil pump		
<2.5 Gasoline>		
Oil pump bracket to engine	1.7-2.6	12.2-18
Oil pump to pressure hose	5.5-6.5	40-47
Oil pump to oil pump bracket	2.5-3.3	18-24
Steering hoses		
Pressure hose to oil pump	5.5-6.5	40-47
Pressure hose to gear box	1.2-1.8	9-13
Return hose (or return tube) to gear box	1.2-1.8	9-13
Pressure hose to clip to bracket	0.8-1.2	6-9
Return hose clip to radiator	0.8-1.2	6-9

Items	kgf-m	ft-lbs
Steering linkage		
Tie rod end to knuckle	4.5	33
Tie rod end to relay rod	4.5	33
Tie rod end to pipe	6.5-8.0	47-58
Relay rod to pitman arm	4.5	33
Relay rod to idler arm	4.5	33
Idler arm to idler arm support	4.0-6.0	29-43
Idler arm support frame	5.5-6.5	40-47

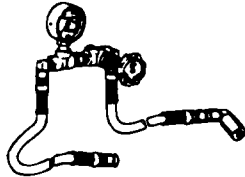
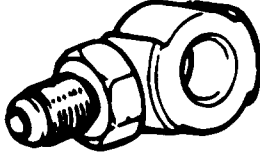
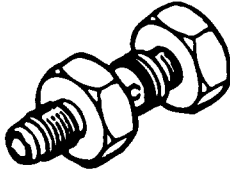
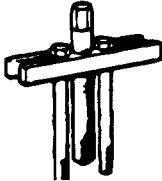
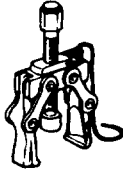
**LUBRICANTS** EPMB0300

Items	Specified Lubricant	Quantity
Power steering gear box		
Bearing	PSF-3	As required
O-ring	PSF-3	As required
Oil seal	PSF-3	As required
Oil pump		
Power steering fluid	PSF-3	1.06 lit
Flow control valve		
Friction surface of rotor, vane, cam ring and pump cover	PSF-3	As required
O-ring	PSF-3	As required

**LUBRICANTS** EPMB0400

Tool (Number and name)	Illustration	Use
Steering linkage puller (09568-34000)	 KPMB040A	Disconnection of the steering linkage
Steering linkage joint gauge (HSG3043)	 KPMB040B	Measurement of the ball joint axial play



Tool (Number and name)	Illustration	Use
Oil pressure gauge (09572-21000)	 <p style="text-align: right;">KPMB040C</p>	Measurement of the oil pump pressure
Power steering oil pressure gauge adapter (Pump side) (09572-33100)	 <p style="text-align: right;">KPMB040D</p>	
Power steering oil pressure gauge adapter (Hose side) (09572-21200)	 <p style="text-align: right;">KPMB040E</p>	
Steering wheel puller (09561-11002)	 <p style="text-align: right;">KPMB040F</p>	Removal of the steering wheel
Pittman arm puller (HSG3046)	 <p style="text-align: right;">KPMB040H</p>	Removal of the Pittman arm

## SERVICE ADJUSTMENT PROCEDURES

EPMB0500

### STEERING WHEEL FREE PLAY CHECK

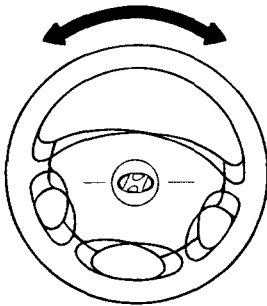
1. With the engine stationary and the steering wheel in the straight-ahead position, apply a force of 0.5 kg (1.1 lbs.) to the steering wheel in the peripheral direction.

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 Standard value : 25 mm or less

 Limit : 50 mm
 

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KPMB050A

2. If the measured value exceeds the repair limit, check the steering gear backlash and ball joint axial play.

### STEERING GEAR BACKLASH CHECK

1. Jack up to the vehicle front and hold the steering wheel in the straight ahead position.
2. Apart the pitman arm and the relay rod.

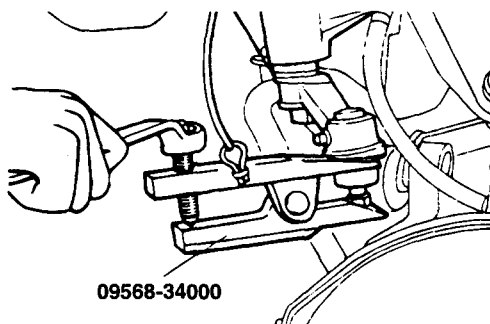
#### ! CAUTION

- Use cord to bind the special tool closely so it will not become separated.
- The nut should be loosened only, not removed.

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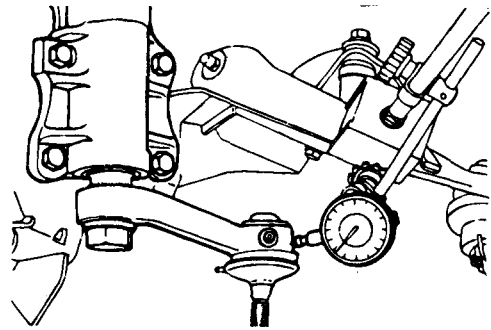
 Limit : 0.5 mm
 

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09568-34000

KPMB050B

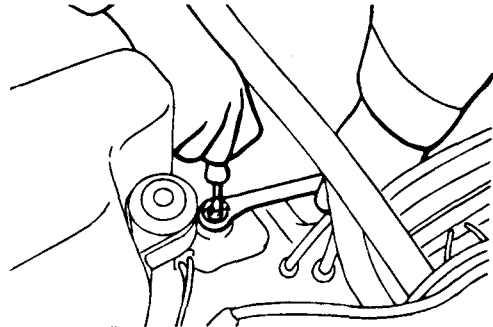


KPMB050C

3. If the measured value exceeds the limit, screw in the steering gear box adjusting bolt until steering wheel free play is within the range of standard value.

#### ! CAUTION

- Be sure to make the adjustment with the steering wheel in the straight-ahead position.
- If the adjusting bolt is over tightened, more steering effort will be required, and return of the wheel will be adversely affected.



KPMB050D

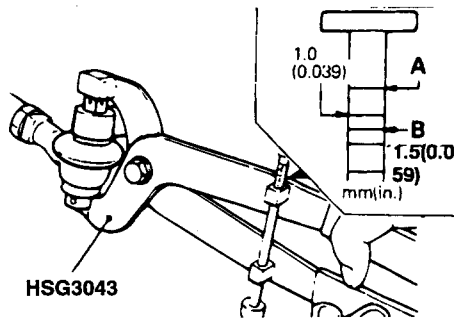
### BALL JOINT AXIAL PLAY CHECK

1. Hold the ball joint by using the special tool.
2. Set the scale of special tool to the upper limit (A), compress the ball stud, and measure the axial play. The measured displacement should be between the upper limit (A) and the Centre graduation (B).

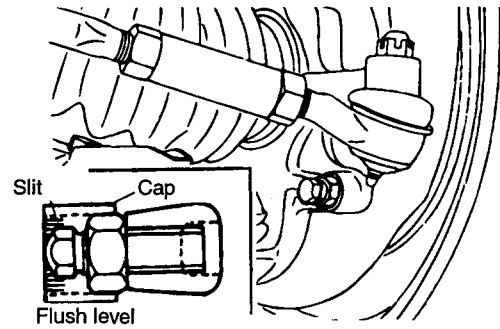
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 Limit : 1.5 mm
 

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EPMB050E



EPMB050G

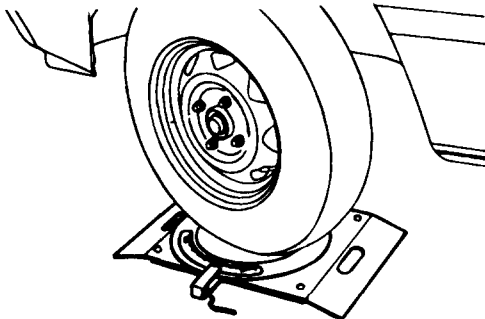
- If the measured displacement exceeds the Centre graduations (B), replace the ball joint.

**STEERING ANGLE CHECK**

- Place the front wheel on a turning radius gauge and measure the steering angle.

**STANDARD VALUE**

Inner wheel	P235/75 R15	34°
	P255/65 R16	33°
Outer wheel	P235/75 R15	31.50°
	P255/65 R16	30.50°



KPMB050F

- Adjust the steering angle of each wheel by turning the stop bolt of the knuckle arm.

**NOTE**

After adjusting the steering angle, mount the cap onto the jam bolt so that the edge of the slit side of the cap and the head of the stop bolt are flush and face in the same direction, and then pack the head of the stop bolt with multipurpose grease.

**CAUTION**

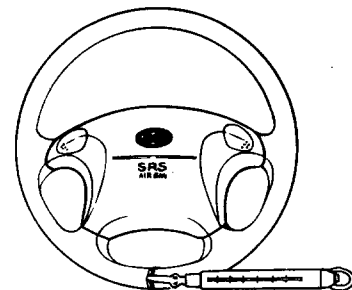
Be sure that the toe-in is properly adjusted before adjusting the steering angle.

**STATIONARY STEERING EFFORT CHECK (POWER STEERING)**

- Place the vehicle on a level surface and place the steering wheel in the straight-ahead position.
- Set the engine speed to 1,000 r/min.
- Measure the tangential force with a spring balance by turning the steering wheel clockwise and counter-clockwise one and a half turns.

Standard value : 3.7 kg (8.21 lbs) or less

- If the stationary steering effort exceeds the standard value, check for belt slackness, damage, insufficient oil, air mixed into oil, collapsed or twisted hoses, etc., and repair if found.



KPMB050H

**CHECKING OF THE STEERING WHEEL RETURN TO CENTRE (POWER STEERING)**

To check for the return of steering wheel to Centre, carry out drive test and check the following points.

- Make gentle and sharp turns and check to get a feel for that there is no appreciable difference in steering effort and return to Centre between right and left turns.

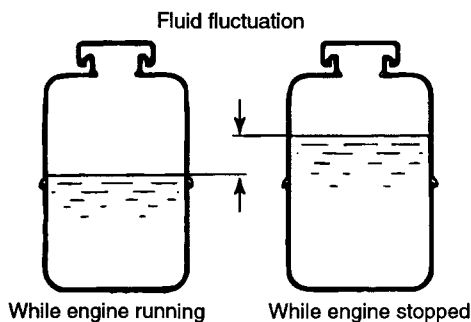
2. Drive at a speed of about 35 km/h turn the steering wheel 90 clockwise or counterclockwise, and release the wheel a second or two later, if the wheel returns more than 70 , the return may be considered good.

### NOTE

When the steering wheel is turned abruptly, momentary hard steering might result, but this does not mean any problem. It is caused by low oil pump delivery during idling.

### FLUID LEVEL CHECK (POWER STEERING)

1. Park the vehicle on a flat, level surface, start the engine, and then turn the steering wheel several times to raise the temperature of the fluid to approximately 50° - 60° C.
2. With the engine running, turn the wheel all the way to the left and right several times.
3. Check the fluid in the oil reservoir for foaming or milkiness.
4. Check the difference of the fluid level when the engine is stopped, and while it is running. If the fluid level changes considerably, air bleeding should be done.



EPMB0501

### FLUID REPLACEMENT (POWER STEERING)

1. Raise the front wheels on a jack, and then support them with rigid racks.
2. Disconnect the return hose connection.
3. Connect a vinyl hose to the return hose, and drain the oil into a container.
4. On vehicles with a petrol engine, disconnect the high tension cable. On vehicles with a diesel engine, remove the fuel cut valve connector attached to the injection pump.  
While operating the starting wheel all the way to tently, turn the steering wheel all the way to the left and right several times to drain all of the fluid.

5. Connect the return hoses securely, and then secure it with the clip.
6. Fill the oil reservoir with the specified fluid up to the lower position of the filter, and then bleed the air.

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Specified fluid : PSF-3

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### BLEEDING EPMB0600

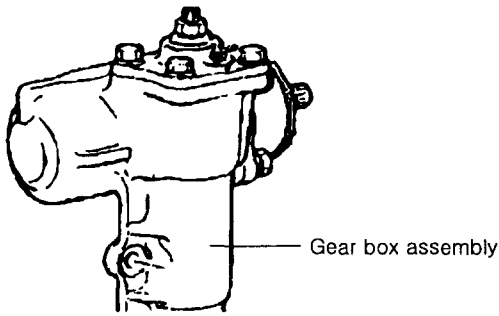
1. Jack up the front wheels and support them by using a rigid rack.
2. Manually turn the oil pump pulley a few times.
3. Turn the steering wheel all the way to the left and to the right five or six times.
4. On vehicles with a petrol engine, disconnect the high tension cable. On vehicles with a diesel engine, remove the fuel cut valve connector attached to the injection pump.  
While operating the starting motor intermittently, turn the steering wheel all the way to the left and right five or six times (for 15 to 20 seconds).

### CAUTION

- During air bleeding, replenish the fluid supply so that the level never falls below the lower position of the filter.
  - If air bleeding is done while engine is running, the air will be broken up and absorbed into the fluid; be sure to do the bleeding only while cranking.
5. On vehicles with a petrol engine, connect the ignition cable. On vehicles with a diesel engine, connect the fuel cut valve connector attached to the injection pump. Start the engine (idling).
  6. Turn the steering wheel to the right and test a air bleeding with air bleeder of the steering gear box loosened, then turn it to the left and test. The same work is repeated 3-4 times.

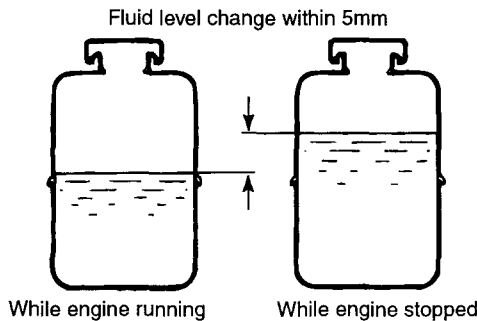
### CAUTION

- During air bleeding, replenish the fluid supply so that the level never falls below the lower position of the filter.
- After air bleeding, clean the position which is polluted with power steering oil with water.



EPMB060B

7. Turn the steering wheel to the left and right until there are no air bubbles in the oil reservoir.
8. Confirm that the fluid is not milky, and that the level is up to the specified position on the level gauge.
9. Confirm that there is very little change in the fluid level when the steering wheel is turned left and right.
10. Check whether or not the change in the fluid level is within 5 mm (0.20 in.) when the engine is stopped and when it is running.



EPMB060A

**! CAUTION**

- If the change of the fluid level is 5 mm (0.20 in.) or more, the air has not been completely bled from the system, and thus must be bled completely.
- If the fluid level rises suddenly after the engine is stopped, the air has not been completely bled.
- If air bleeding is not complete, there will be abnormal noises from the pump and the flow-control valve, and this condition could cause a lessening of the life of the pump, etc.

**OIL PUMP PRESSURE TEST CHECKING**

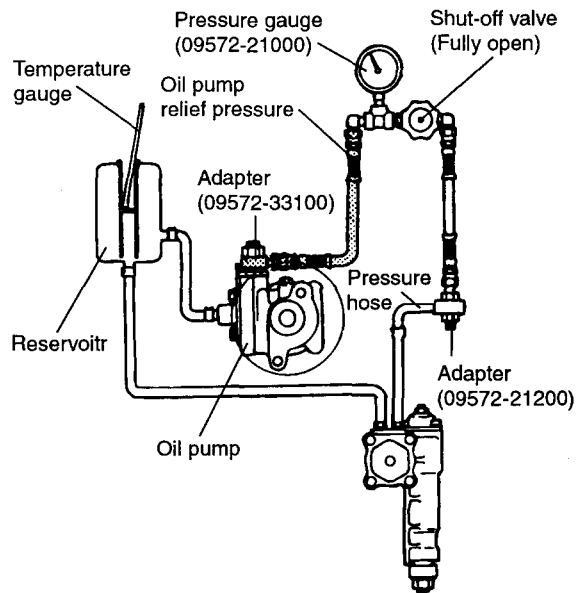
**THE OIL PUMP RELIEF PRESSURE**

EPMB0700

1. Disconnect the pressure hose from the oil pump, and then connect the special tools.

2. Bleed the air, and then turn the steering wheel several times while the vehicle is not moving so that the temperature of the fluid rises to approximately 50-60° C (122-140° F).
3. Start the engine and idle it at 1,000 ± 100 rpm.
4. Fully close the shut-off valve of the pressure gauge and measure the oil pump relief pressure to confirm that it is within the standard value range.

Standard value : 75-82 kg/cm<sup>2</sup> (1,067-1, 166 psi)



EPMB070A

**! CAUTION**

**Pressure gauge shut off valve must not remain closed for more than 10 seconds.**

5. If it is not within the standard value, overhaul the oil pump.
6. Remove the special tools, and then tighten the pressure hose to the specified torque.
7. Bleed the system.

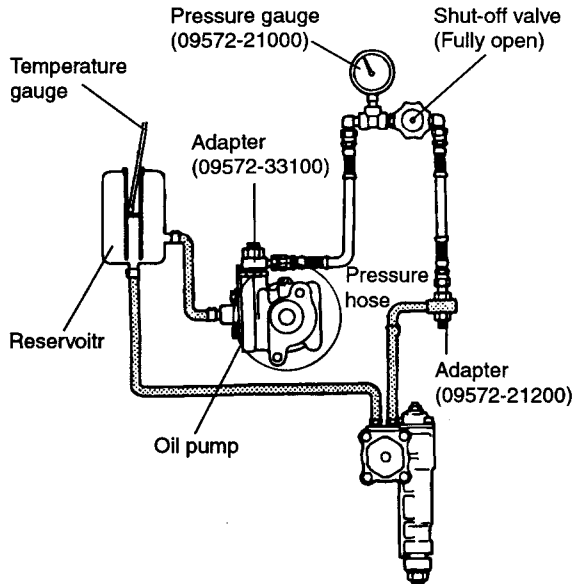
**CHECKING THE PRESSURE UNDER NO-LOAD CONDITIONS**

1. Disconnect the pressure hose from the oil pump, and then connect the special tools.
2. Bleed the air, and then turn the steering wheel several times while the vehicle is not moving so that the temperature of the fluid raise to approximately 50-60° C (122-140° F).

3. Start the engine and idle it at  $1,000 \pm 100$  rpm.
4. Check whether or not the hydraulic pressure is the standard value when no-load conditions are created by fully opening the shut-off valve of the pressure gauge.

Standard value : 8-10 kg/cm<sup>2</sup> (114-142 psi)

Limit : 15 kg/cm<sup>2</sup> (213 psi)



EPMB070B

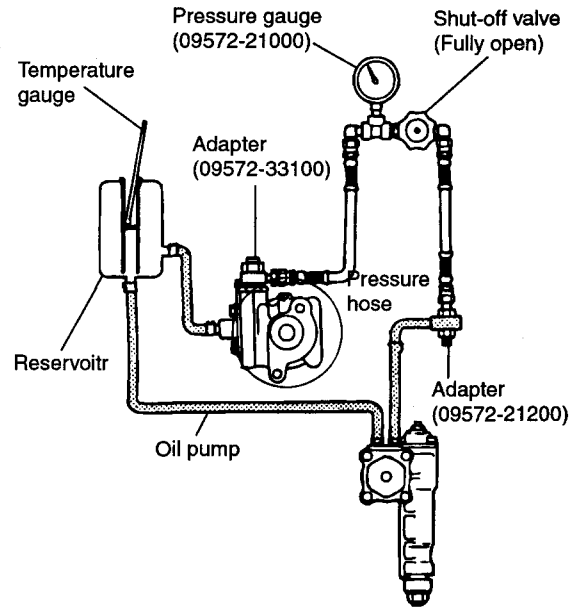
5. If it is not within the standard value, the probable cause is a malfunction of the oil line or steering gear box, so check these parts and repair as necessary.
6. Remove the special tools, and then tighten the pressure hose to the specified torque.
7. Bleed the system.

### CHECKING THE STEERING GEAR RETENTION HYDRAULIC PRESSURE

1. Disconnect the pressure hose from the oil pump, and then connect the special tools.
2. Bleed the air and then turn the steering wheel several times while the vehicle is not moving so that the temperature of the fluid rises to approximately 50-60° C.
3. Start the engine and idle it at  $1,000 \pm 100$  rpm.
4. Fully close and fully open the shut-off valve of the pressure gauge.

5. Turn the steering wheel all the way to the left or right; then check whether or not the retention hydraulic pressure is the standard value.

Standard value : 75-82 kg/cm<sup>2</sup> (1,067-1,166 psi)



EPMB070C

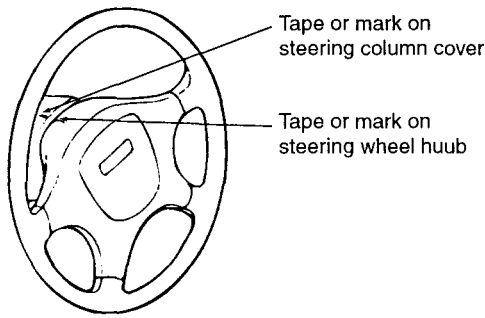
6. When not within the standard value, overhaul the steering gear box.
7. Remove the special tools, and then tighten the pressure hose to the specified torque.
8. Bleed the system.

### STEERING WHEEL CENTERING SIMPLIFIED STEERING WHEEL CENTERING

EPMB0800

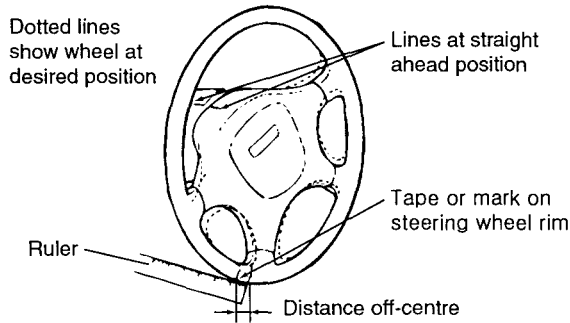
#### DETERMINING STEERING WHEEL'S OFF CENTRE

1. For the road test, take along chalk or tape and a ruler.
2. Drive straight ahead on an uncambered level surface.
3. When the vehicle's wheels are pointing straight ahead, mark the steering wheel hub and column cover with a chalk or tape line.



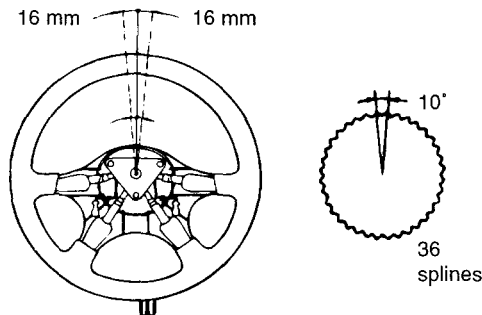
EPMB080A

4. Stop the vehicle and line up the marks on the hub and column cover.
5. Place a tape strip or mark on the steering wheel rim.
6. Hold a ruler next to the rim as shown in the illustration, and then steer the steering wheel until it is in the desired centered position.



EPMB080B

7. Record the distance the strip or mark on the rim has moved. This is how far the steering wheel is off Centre. If it is more than 16 mm (0.63 in.) off Centre, it can be centered by indexing it ten degrees towards the Centre.



EPMB080C

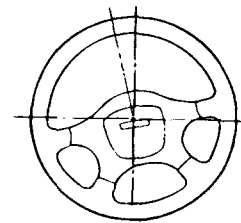
**INDEXING STEERING WHEEL TO CENTRE IT**

The steering wheel shaft has 36 splines, allowing the steering wheel to be indexed in ten-degree increments.

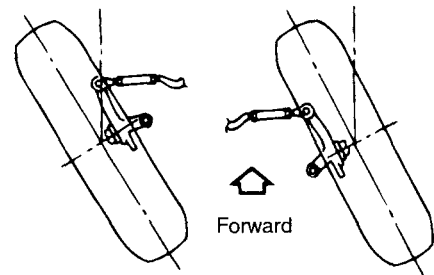
1. Remove the steering wheel.
2. Without disturbing the position of the steering wheel shaft, re-install the wheel as near on-Centre as possible.

**PRECISION STEERING WHEEL CENTERING**

In general, the tie rods are adjusted to steer the front wheels in the same direction that the steering wheel is off Centre. If the steering wheel is off Centre to the left, Centre it by adjusting the tie rods to make the front wheels steer toward the left, and vice versa.



Steering wheel off-centre left



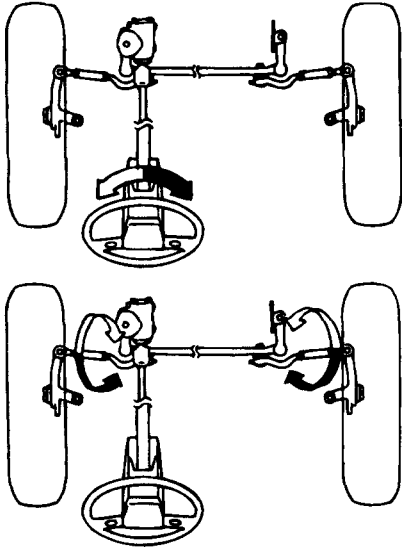
Adjust tie to steer left

EPMB080D

1. Hold the tie rods with a wrench while loosening the locking nuts at lest 1/4 turn.
2. Hold the tie rod end with a wrench and turn the tie rod the desired number of turns. Adjust both tie rods equally in same direction to Centre the steering wheel.

**NOTE**

By turning the tie rods 1/6 of a turn, an adjustment of 2 (at the steering wheel Centre) or 6 mm (0.24 in.) (at the steering wheel rim) can be made.



- ◊ Off-centre to left
- ◆ Off-centre to right

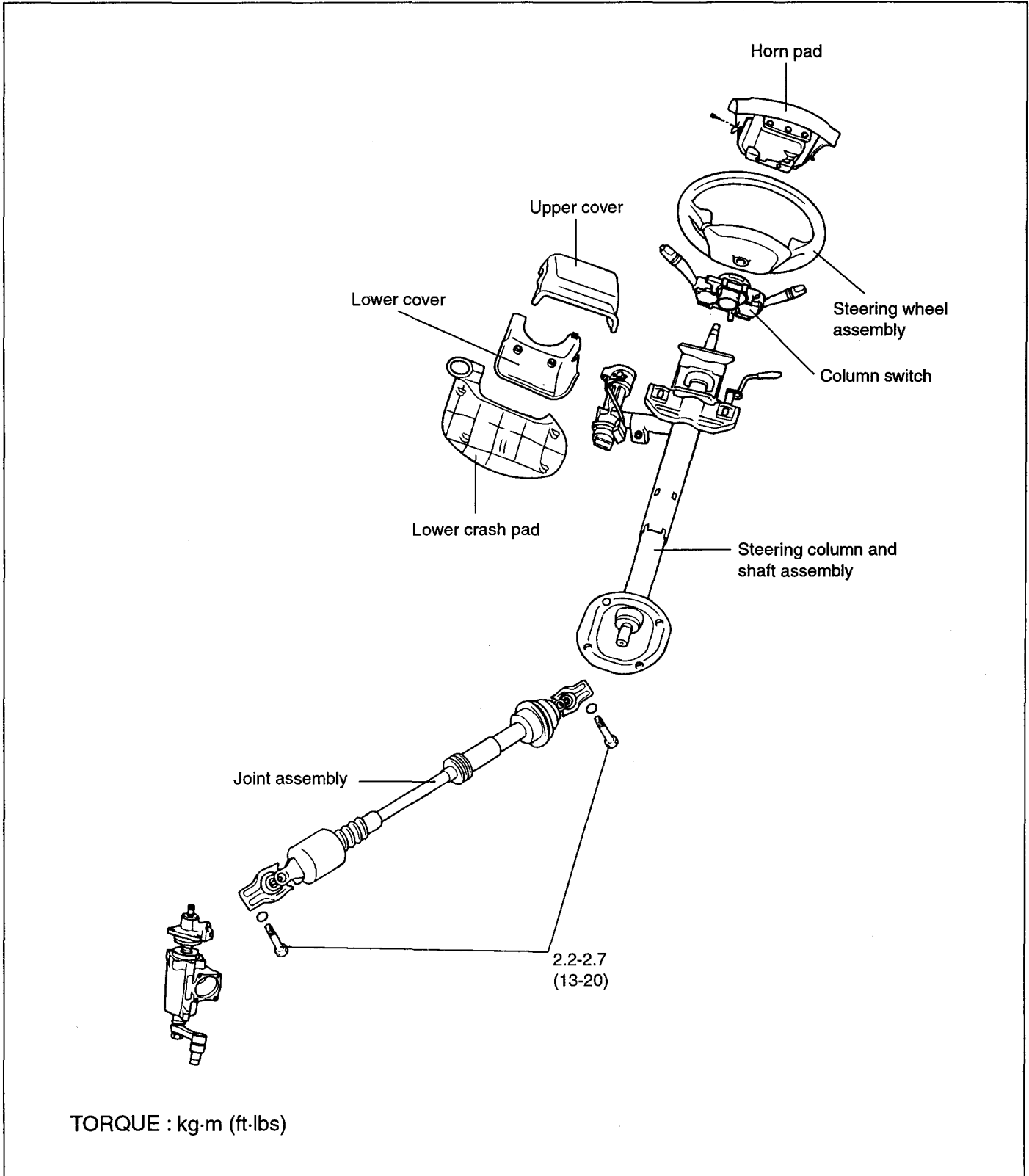
EPMB080E



# POWER STEERING SYSTEM

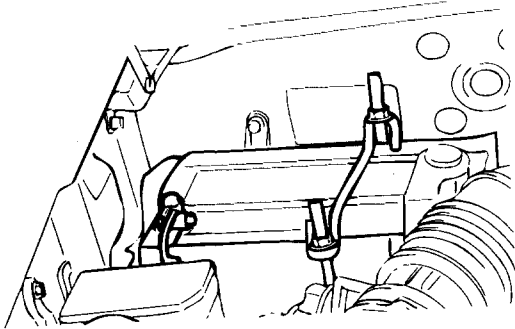
## STEERING COLUMN/SHAFT

### COMPONENTS EPMB0900



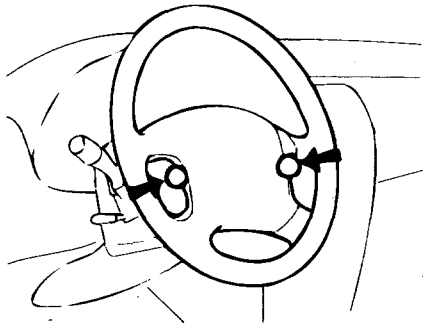
**REMOVAL** EPMB1000

1. Disconnect the negative (-) terminal from the battery.



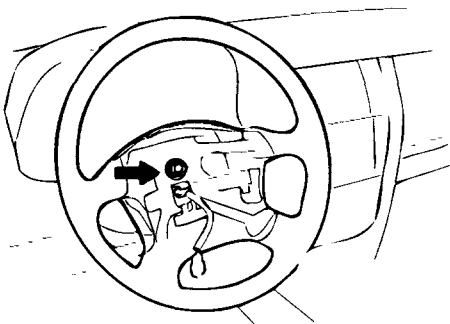
KPMB100A

2. After removing the two screws in the illustration, remove the driver's airbag module.



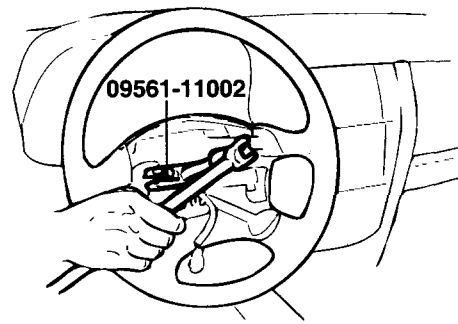
KPMB100B

3. Remove the steering wheel lock nut.



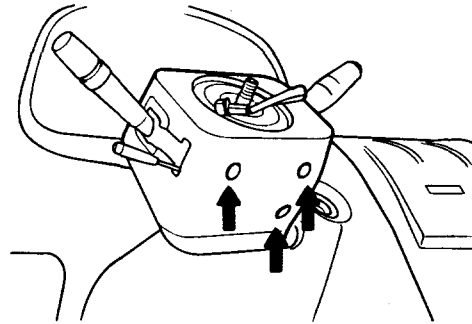
KPMB100C

4. After aligning the marks on the steering shaft and wheel, remove the steering wheel using the special tool (09561-11002).



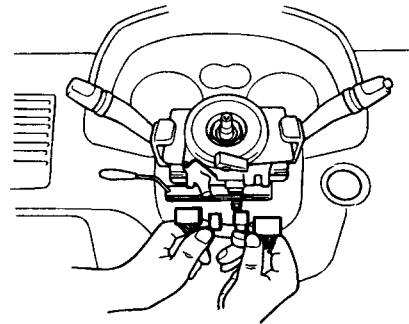
KPMB100D

5. After removing the three screws in the illustration, remove the steering column upper and lower shrouds.



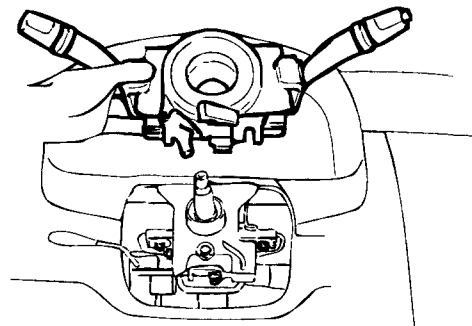
KPMB100E

6. Remove the connectors from the multifunction switch.



KPMB100F

7. After removing the three bolts in the illustration, remove the multifunction switch assembly.

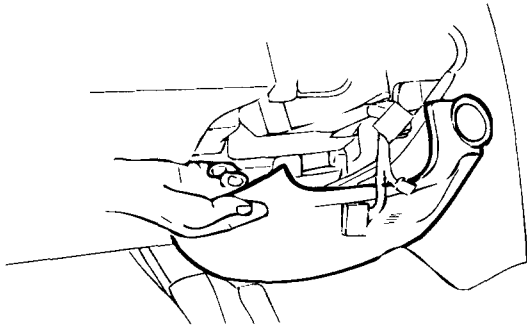


KPMB100G

**⚠ CAUTION**

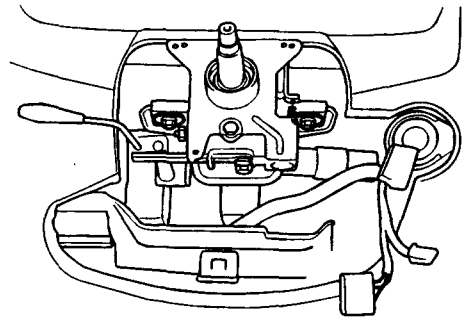
**Do not hammer on the steering wheel to remove it; it may damage the steering column.**

8. Remove the lower crash pad.



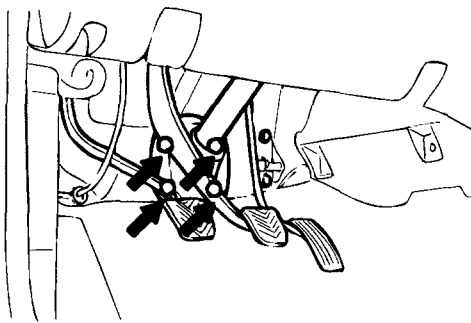
KPMB100H

11. After removing the two mounting bolts, remove the steering column shaft assembly.



KPMB100K

9. Remove the four mounting bolts in the dust cover assembly.



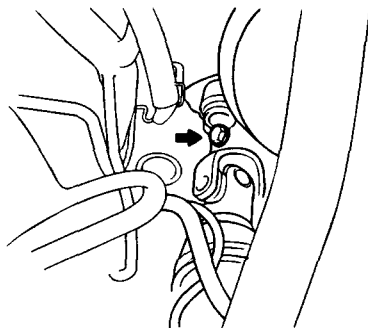
KPMB100I

12. After removing the bolt connecting the steering gear box with the universal joint, separate the universal joint from the gear box.



KPMB100L

10. Remove the bolt connecting the steering column shaft assembly with the universal joint assembly, and then separate them apart.



KPMB100J

**INSPECTION**

EPMB1100

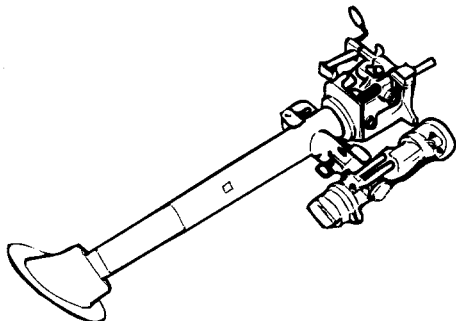
1. Check the steering column shaft for damage and deformation.
2. Check the connections for play, damage and smooth operation.
3. Check the ball joint bearing for wear and damage.

**ASSEMBLY** EPMB1200

Assembly is the reverse of removal.

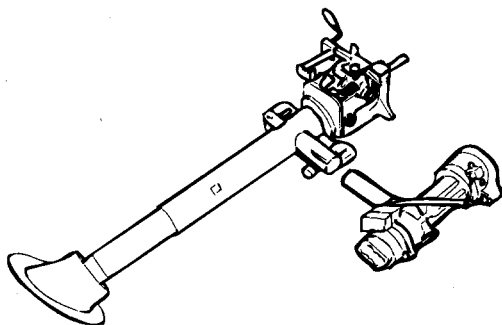
**DISASSEMBLY AND REASSEMBLY**

1. If it is necessary to remove the key lock assembly, use a pinch to make a groove on the head of the special bolt, and then use a screwdriver to remove the key lock assembly mounting bracket.



KPMB120A

2. Disassemble the key lock assembly from the steering column shaft.

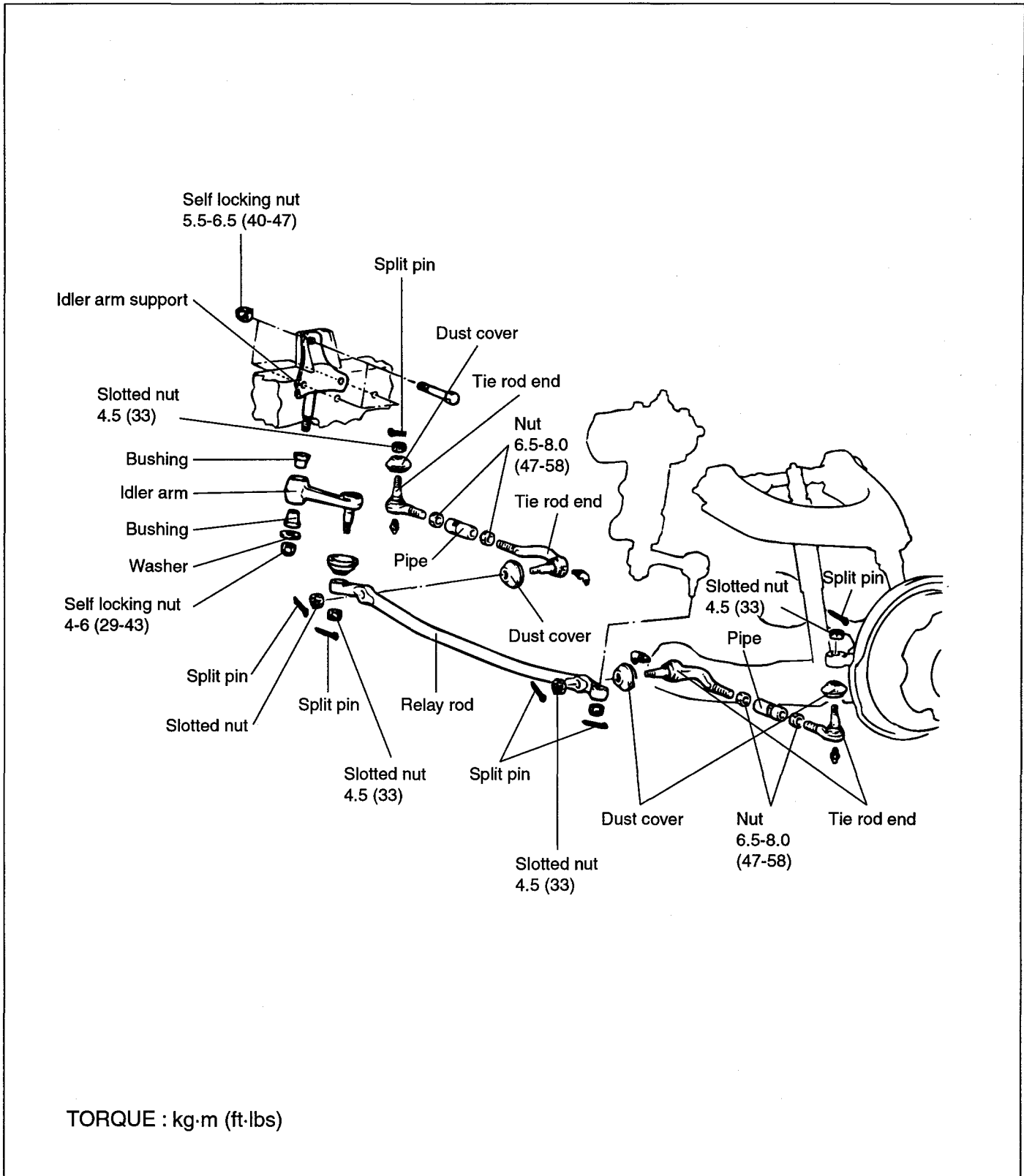


KPMB120B

3. Reassembly is the reverse of disassembly.

STEERING LINKAGE

COMPONENT KPMB2900



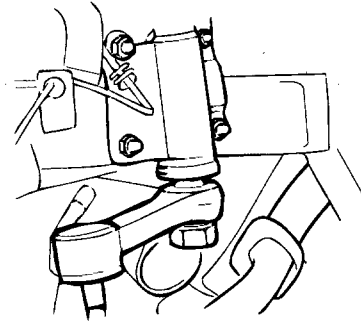
TORQUE : kg·m (ft·lbs)

**REMOVAL** EPMB3000

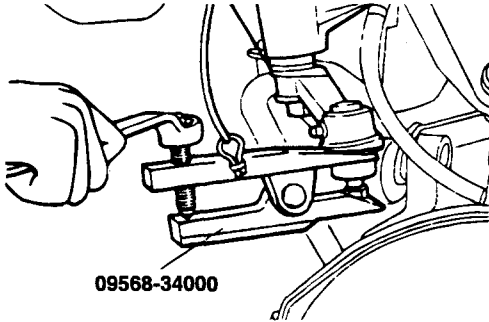
1. Remove the tie rod ends from the left and right knuckles.

**NOTE**

- When removing the tie rod ends, be sure to tighten the special tool not to be separated.
- Only loosen the nut, do not remove it.



KPMB290A



09568-34000

KPMB050B

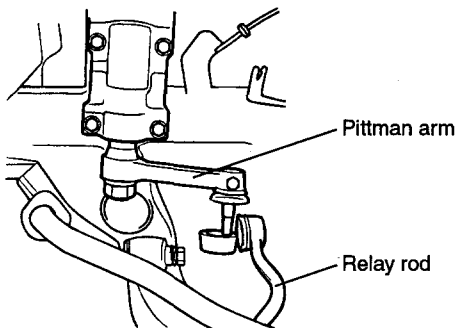
**INSTALLATION** EPMB3100

Installation is the reverse of removal.

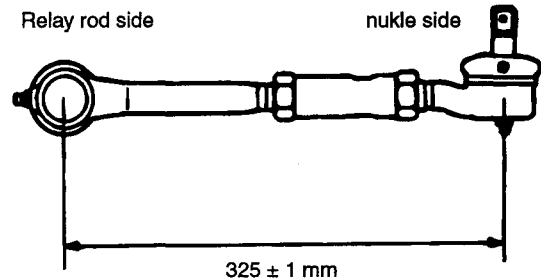
**CAUTION**

- Apply the specified anti-corrosion agent to the threaded portion of the tie rod end.
- Tighten the tie rod so that the distance between tie rods becomes the value shown in the illustration.
- At this time, tie rod end tightness of left and right is uniformed.

2. Remove the relay rod from the pitman arm.



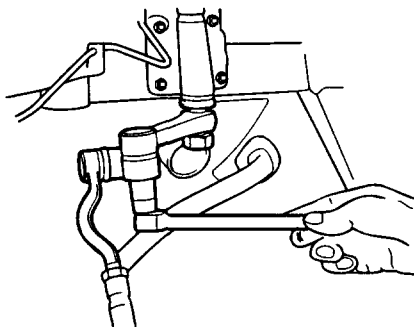
EPMB140B



325 ± 1 mm

3. Remove the relay rod from the idler arm.

EPMB310A

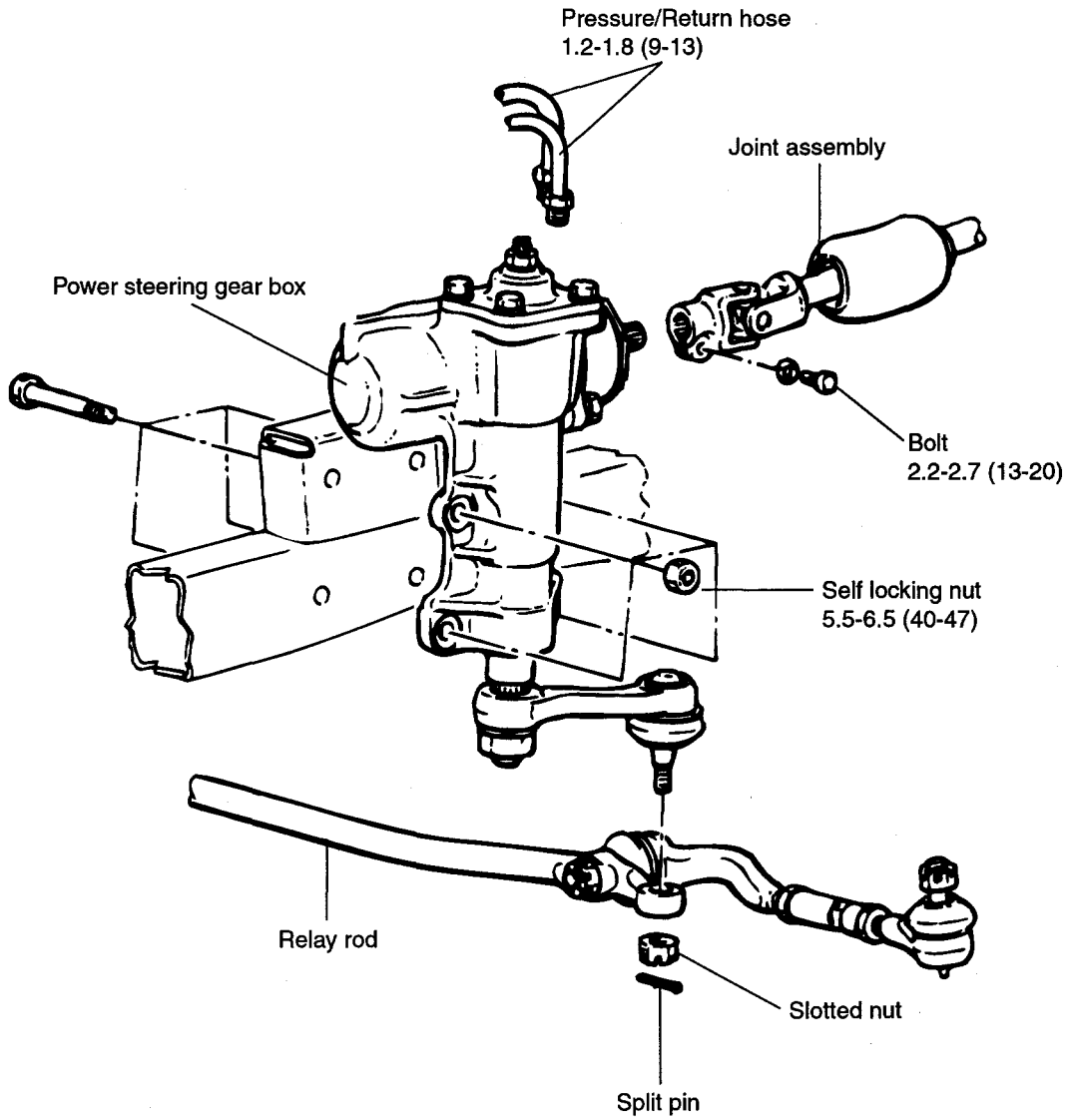


KPMB300A

4. Remove the idler arm from the idler arm support.

# POWER STEERING GEAR BOX

## COMPONENTS EPMB1300



TORQUE : kg·m (ft·lbs)

**REMOVAL** EPMB1400**INSPECTION AND ADJUSTMENT BEFORE DISASSEMBLY**

- Before disassembly of steering gear box, clean the steering gear box surface and dry it out. Then check the fluid leakage by turning the steering wheel left and right.
  - Check the input shaft oil seal part for leakage.
  - Check the gear box and valve housing assembly for leakage.
  - Check the gear box and side cover assembly for leakage.
  - Check the ball coking part of gear box for leakage.
  - Check the pressure/return hose assembly for leakage.
  - Check the other part for abnormality.
- Before removal of steering gear box, check the tire pressure, wheel balance, etc. Turn the steering wheel smoothly to the left and right to check the turning for abnormality and unbalance at the steering pump operation and non-operation conditions. If it is an abnormal, re-check the vehicle after lifting it.
- After inspection and adjustment of above 1.2, if abnormality is found, replace the parts according to the removal and disassembly procedures.

1. Drain the power steering fluid.

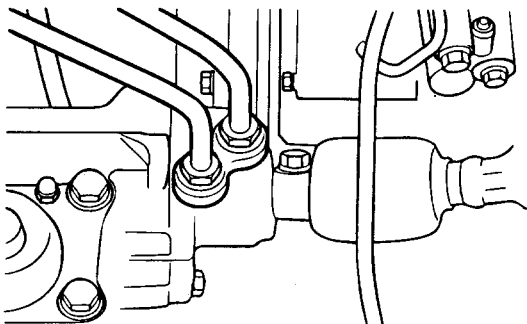
**NOTE**

Drain the power steering fluid through the return hose side. With the vehicle kept stationary, turn the steering wheel fully clockwise and counterclockwise several times during the drain.

2. Remove the power steering pressure/return hoses.

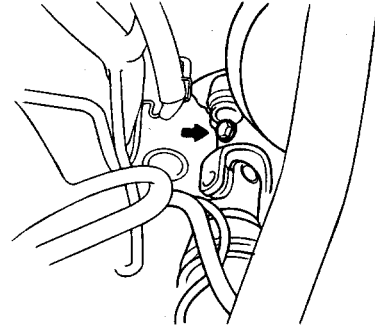
**NOTE**

Clog the each hose ends with waste cloth to prevent the oil leakage or the entry of foreign material.



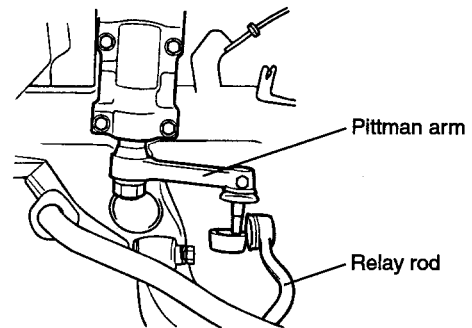
KPMB140A

3. Remove the universal joint assembly from the steering gear box.



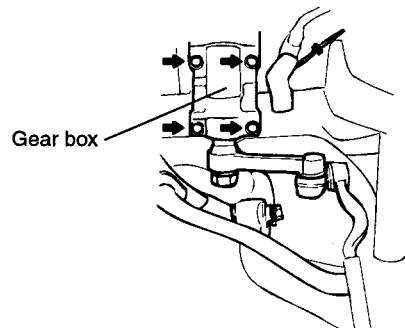
KPMB100J

4. Remove the pitman arm from the relay rod.



EPMB140B

5. After removing the 4 mounting bolts, remove the power steering gear box.



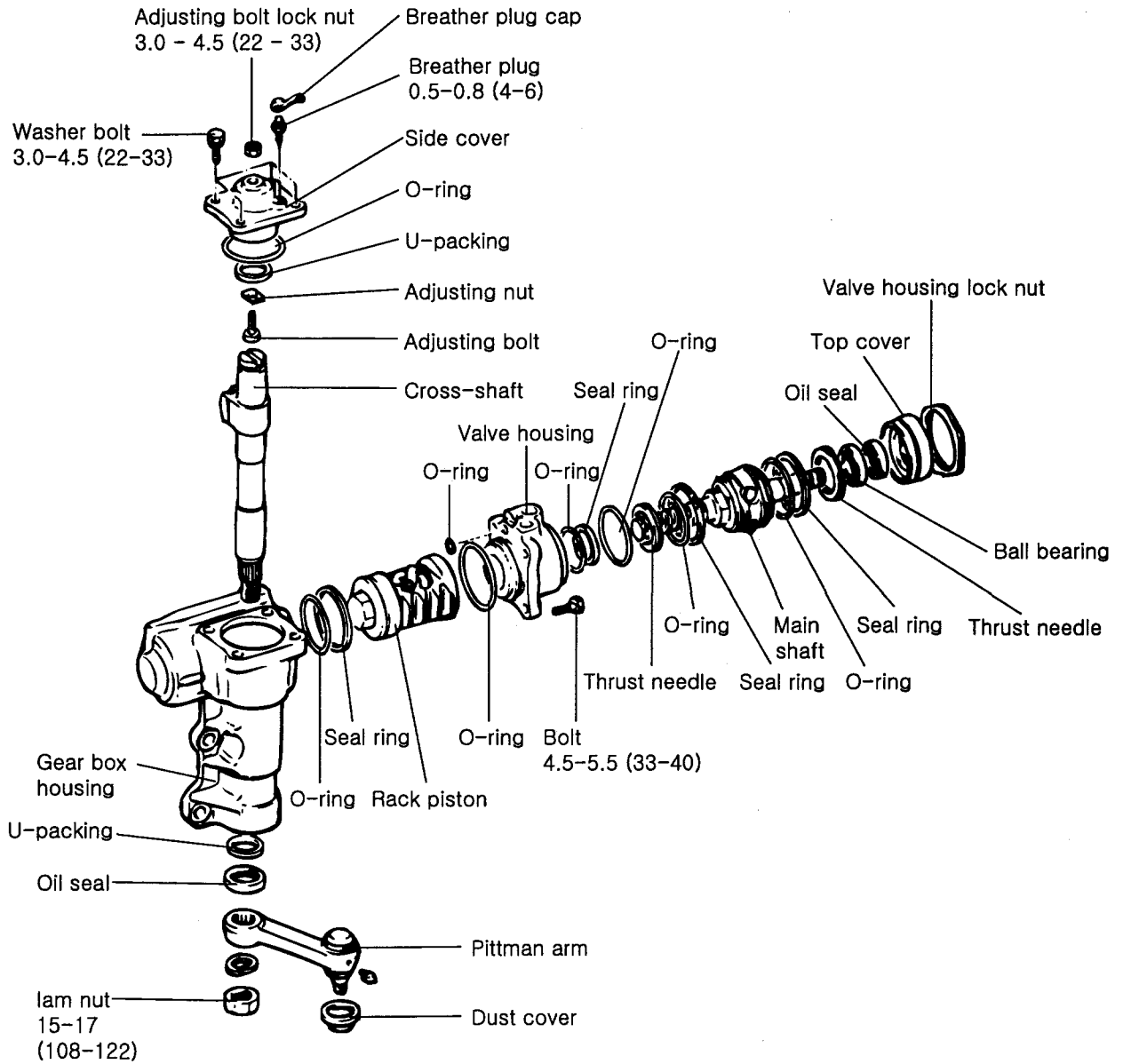
EPMB140C

**INSTALLATION** EPMB1500

Installation is the reverse of removal.



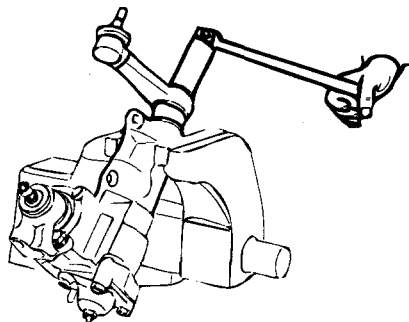
DISASSEMBLY AND ASSEMBLY EPMB1600



TORQUE : kg·m (ft·lbs)

**DISASSEMBLY** EPMB1700

1. After mounting the steering gear box in a vise remove the nut (32 mm) and the spring washer.

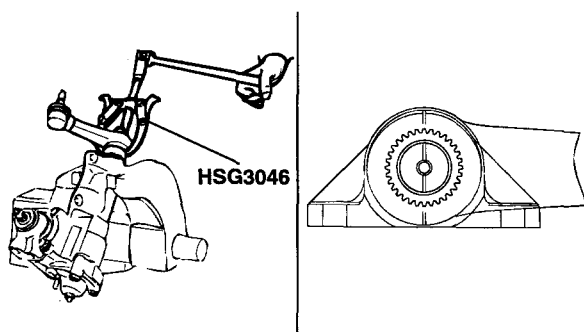


KPMB170A

2. Remove the pitman arm using the special tool (HSG3046).

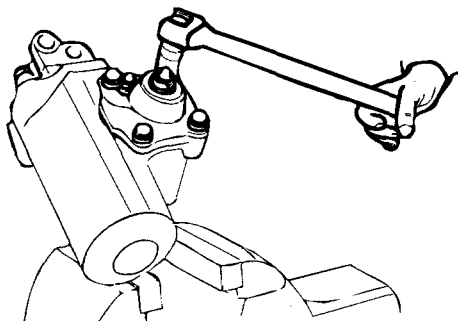
**⚠ CAUTION**

- Be careful not to damage the pitman arm and nut connections.
- When removing the pitman arm, make identification marks to avoid making any mistake when install it again as below.



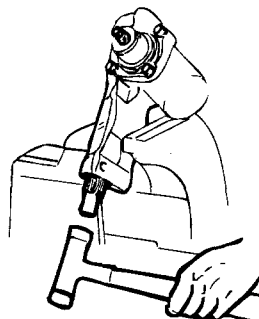
KPMB180D

3. Remove the four side cover mounting washer bolts (14 mm).



KPMB170D

4. After checking the gear box at neutral position, tap the sector shaft end lightly with a plastic hammer, and remove the gear box together with the side cover.

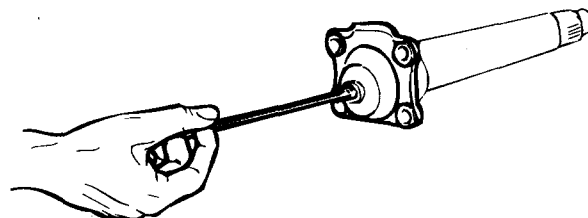


KPMB170E

5. Remove the nut (17 mm) from the side cover and separate side cover from the sector shaft by turning the adjusting screw (-) to the right.

**⚠ CAUTION**

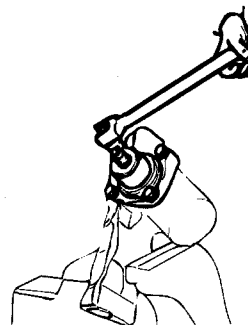
*Do not disassemble the side cover if leakage is not found in the nut part.*



KPMB170F

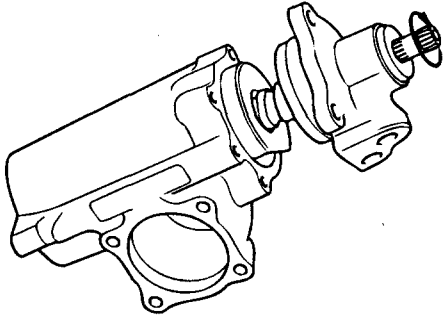
6. Remove the ball screw unit.

- 1) Remove the four mounting bolts (14mm).



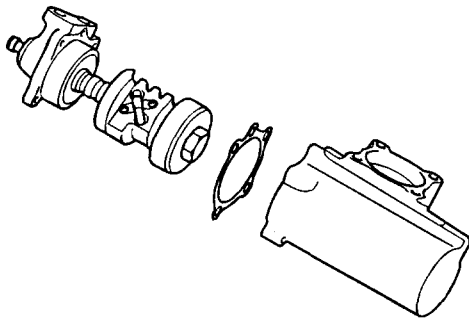
KPMB170G

- 2) Rotate the input shaft clockwise so as to move the ball screw unit forward.



KPMB170H

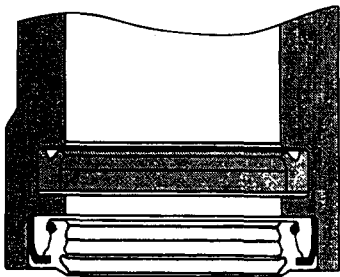
- 3) Holding the valve housing, remove the ball screw unit by pulling it.



KPMB170I

- 4) Hold the rack piston and the input shaft with each hand, and then turn them left and right to check for abnormality.

7. Remove the gear box oil seal and packing.



KPMB170J

**REASSEMBLY** EPMB1800

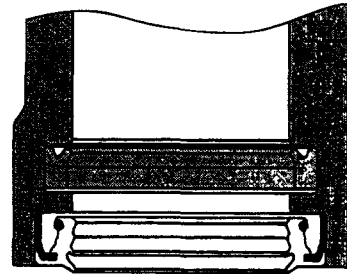
- Clean away foreign material, dirt, etc. from all parts for reassembly.
- Tighten bolts and nuts to the specified torque and Install O-ring while rechecking for mission, distortion, and damage.

1. Reassembly of gear box packing and oil seal.

- 1) Clean the gear box mounting part, packing and seal.
- 2) Apply oil to the packing and then install it in the direction shown in the illustration.
- 3) After installation, be sure to be installed properly.
- 4) Install the dust seal properly.

**CAUTION**

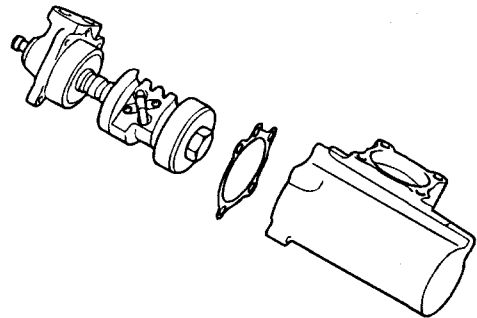
*Be sure to press-fit the packing and oil seal in the proper direction.*



KPMB170J

2. Ball screw unit reassembly.

- 1) Install the piston ring checking for damage.



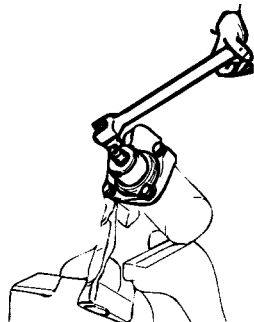
KPMB170I

- 2) Insert the ball screw into the gear box slowly.

**CAUTION**

*Be careful not to damage the piston ring by slanting partion of gear box.*

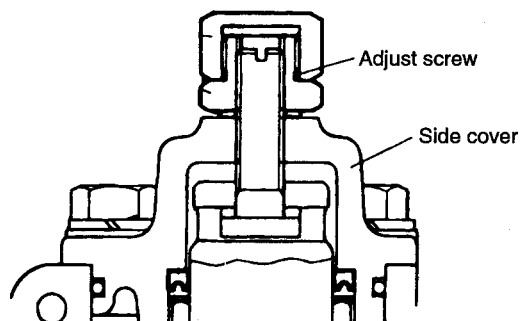
- 3) Tighten the four bolts to the specified torque.



KPMB170G

3. Side cover reassembly.

- 1) Install the packing in the proper direction.
- 2) Apply grease to the adjusting plate and the adjusting screw and then install them to the sector shaft.
- 3) Install the side cover by turning the adjusting screw counter-clockwise.



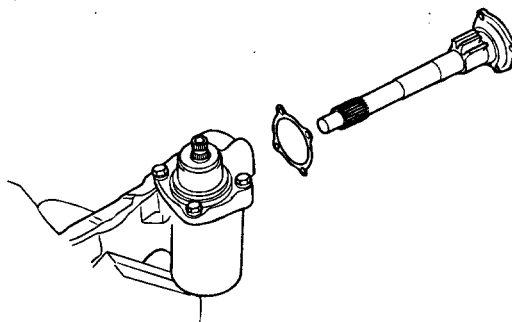
EPMB180B

4. Insertion of sector shaft.

- 1) Install the rack piston to the gear box body.
- 2) Install the sector shaft aligning the central tooth of sector shaft with the central groove of rack piston.

**CAUTION**

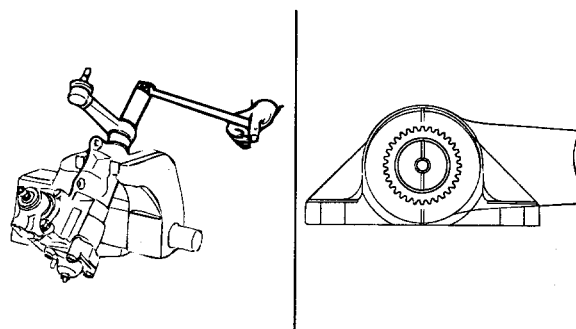
**Check the tooth of sector shaft is properly seated in the correct position.**



KPMB180C

5. Reassembly of pitman arm assembly.

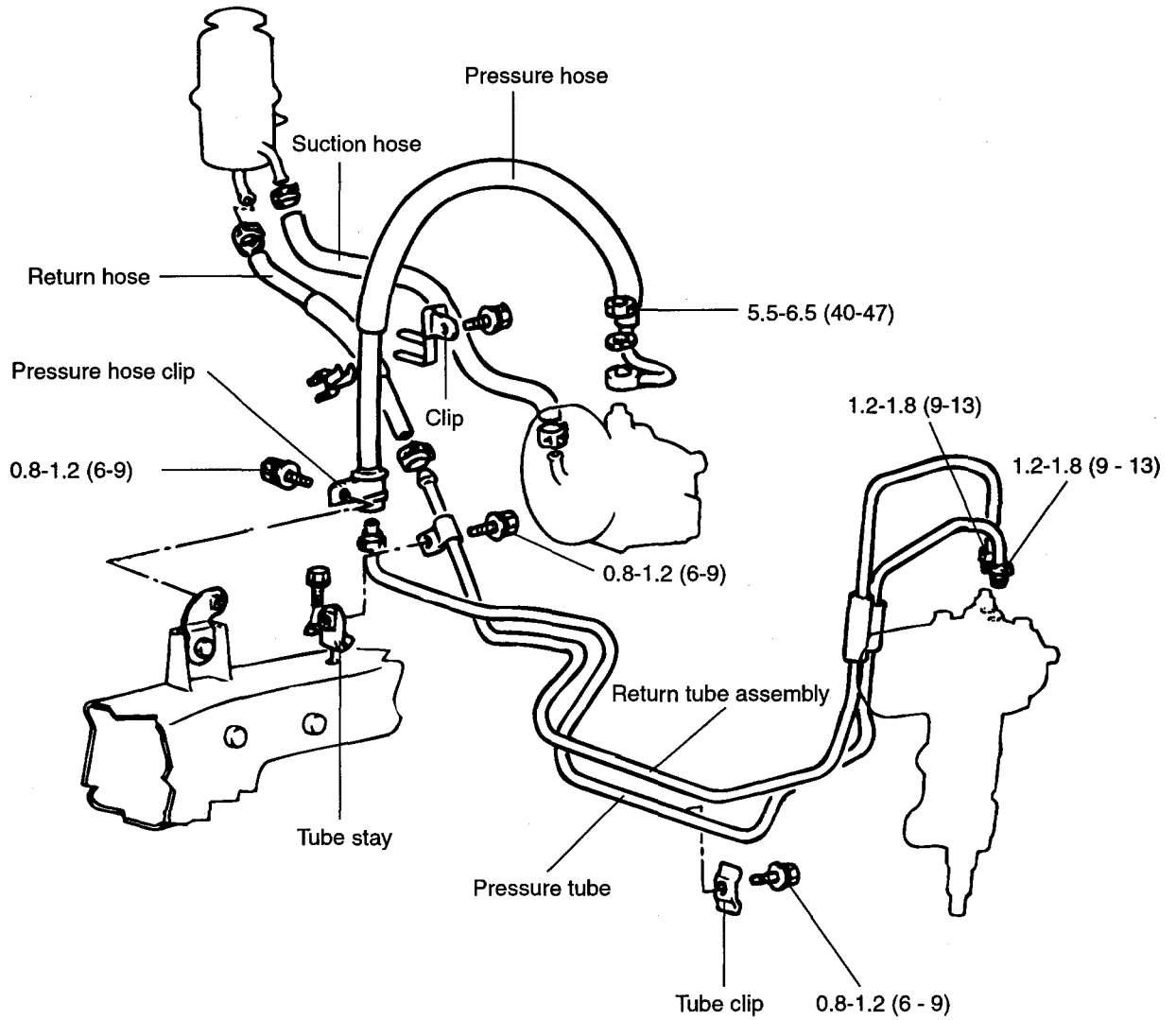
After installation of the rubber packing and the pitman arm to the identification marks on the sector shaft, install the spring washer and nuts to the specified torque.



KPMB180E

POWER STEERING HOSES

COMPONENT KPMB2500

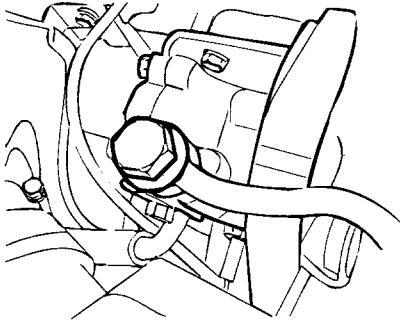


TORQUE : kg·m (ft·lbs)

**REMOVAL** EPMB2600

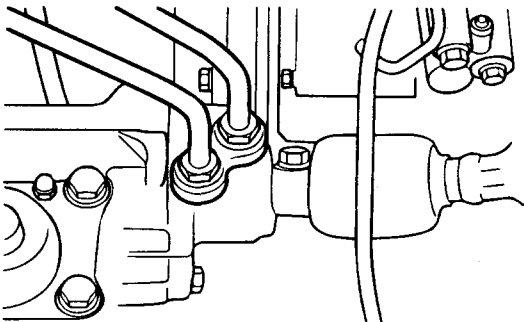
Before removal of steering hose, drain the power steering oil.

1. Removal of pressure hose and tube.
  - 1) Disconnect the pressure hose from the steering oil pump.



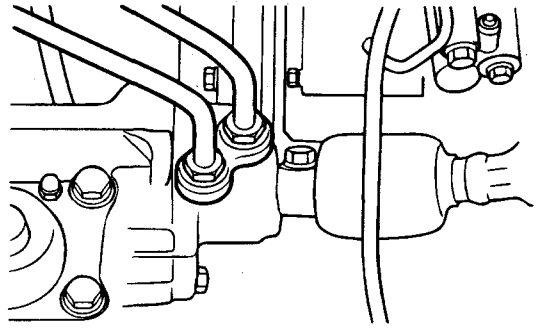
KPMB200A

- 2) Loosen the bolt of pressure hose mounting clamp.
- 3) Remove the pressure/return tube clip mounting bolt.
- 4) Disconnect the pressure tube from the steering gear box, and then disconnect the pressure hose and the tube.



KPMB140A

2. Removal of RETURN HOSE AND TUBE.
  - 1) Disconnect the return hose from the oil reservoir.
  - 2) Loosen the return tube clip mounting bolt.
  - 3) Remove the return/pressure tube clip mounting bolt.
  - 4) Disconnect the return tube from the steering gear box, and then disconnect the return hose and the tube.



KPMB140A

3. Removal of suction hose.
  - 1) Disconnect the suction hose from the steering oil reservoir.
  - 2) Loosen the two bolts of steering oil pump and disconnect the suction hose.

**INSTALLATION** EPMB2700

Installation is the reverse of removal

**CAUTION**

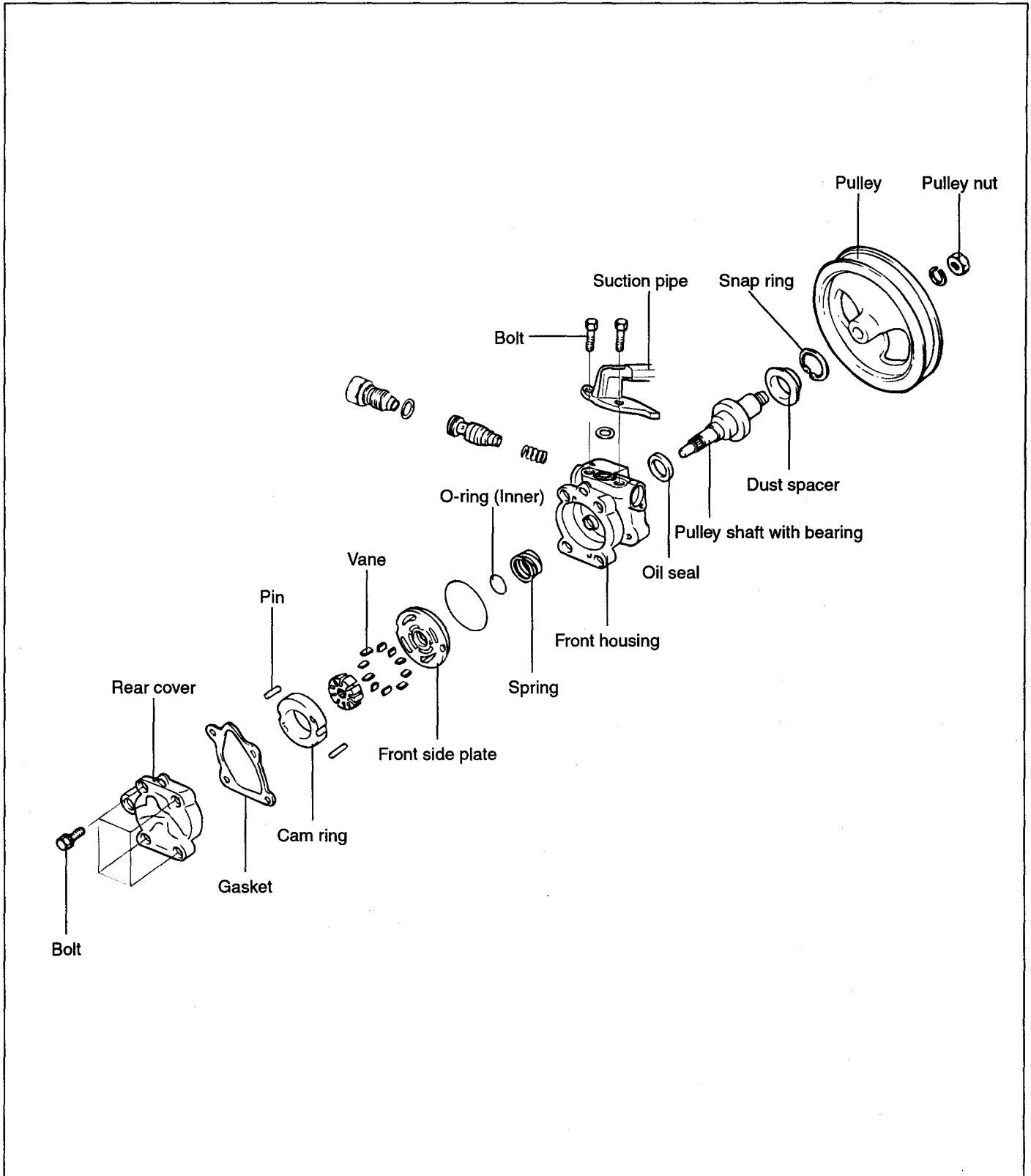
- **Install the hose lest they should be twisted and come in contact with any other parts.**
- **After installation, bleed the air.**

**INSPECTION** EPMB2800

1. Inspect the hose for cracks by twisting it by hand.
2. Check for interference between hose and the other parts.

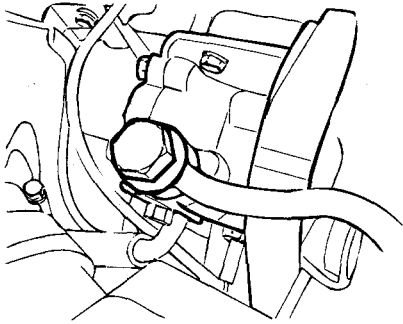
POWER STEERING OIL PUMP

COMPONENTS EPMB1900



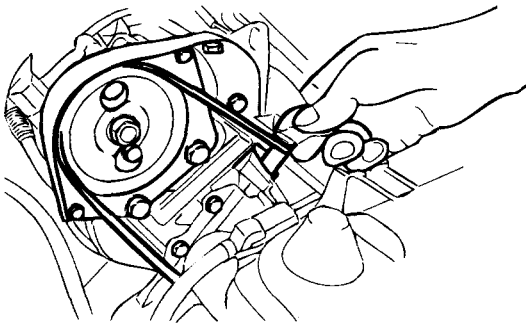
**REMOVAL** EPMB2000

1. Disconnect the pressure hose from the oil pump, disconnect the suction hose from the suction pipe, and drain the oil.



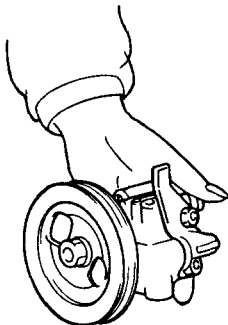
KPMB200A

2. Loosen the power steering tension adjusting bolt.
3. Separate the "V" belt from the power steering oil pump pulley.



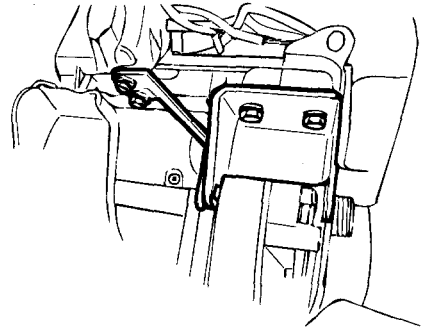
KPMB200B

4. Loosen the power steering oil pump mounting bolt, and then remove the power steering oil pump assembly.



KPKA048A

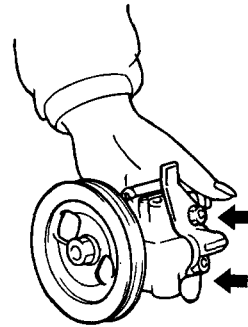
5. Remove the power steering oil pump mounting bracket.



KPMB200C

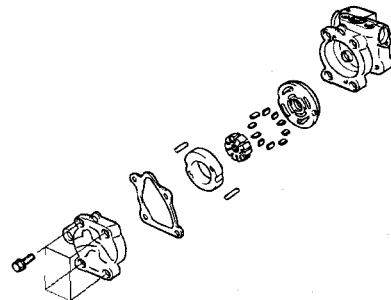
**DISASSEMBLY** EPMB2100

1. Remove the two bolts (12 mm) from oil pump body, and then remove the suction pipe and O-ring.



KPKA050A

2. Remove the four bolts (14 mm), and then remove the oil pump cover assembly.
3. Remove the cap ring.
4. Remove the rotor and the vane.
5. Remove the oil pump side plate.



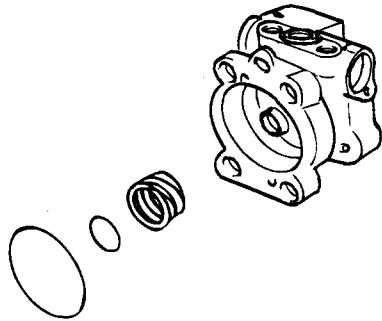
KPKA046A

6. Remove the inner and outer O-ring.
7. Remove the side plate spring.



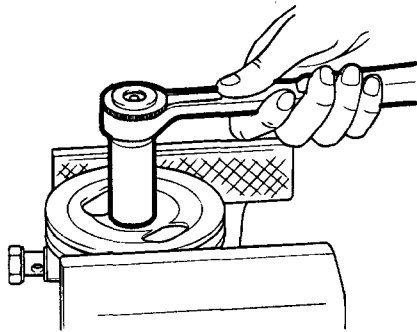
 **NOTE**

When assembling, use a new gasket and O-ring.



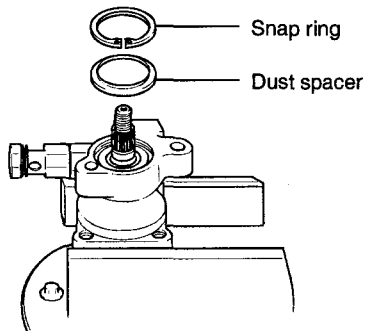
KPKA055A

8. Mount the pulley in a vise and remove the pulley nut and the spring washer.



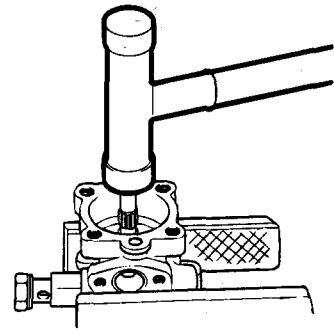
KPKA056A

9. Pull the pulley out.
10. After removing the snap ring of the shaft with snap ring pliers, remove the dust spacer.



KPKA057A

11. Tap the rotor side of the shaft slightly with a plastic hammer to remove the shaft.

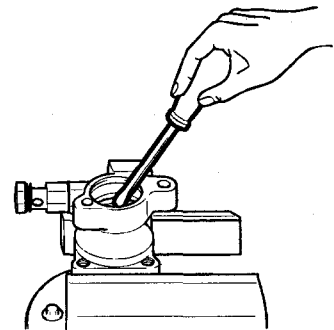


KPKA058A

12. Remove the oil seal from the oil pump body.

 **NOTE**

When assembling, use a new oil seal.

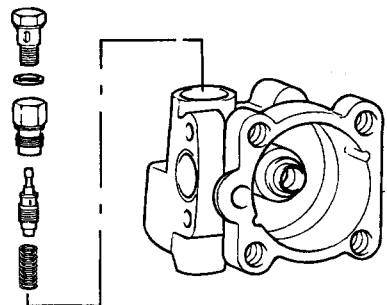


KPKA059A

13. Remove the connector from the oil pump body, and take out the flow control valve and the flow control spring.
14. Remove the O-ring from the connector.

 **CAUTION**

Do not disassemble the flow control valve.



KPKA060A

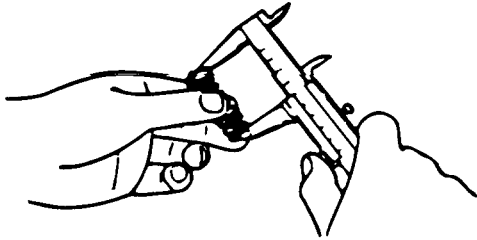
**INSPECTION** EPMB2200

1. Check the free length of the flow control spring.

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Free length of the flow control spring : 36.5 mm

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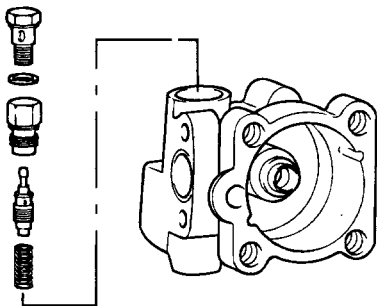


KPKA068A

2. Check that the flow control valve is not bent.
3. Check the shaft for wear and damage.
4. Check the V-belt for wear and deterioration.
5. Check the grooves of the rotor and vanes for stratified abrasion.
6. Check the contact surface of the cam ring and vanes for stratified abrasion.
7. Check vanes for damage.
8. Check that there is no striped wear in the side plate or contacting part between the shaft and the pump cover surface.

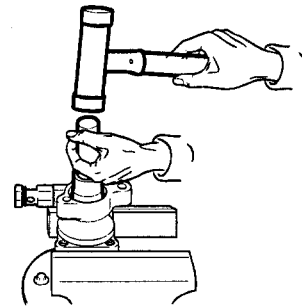
**REASSEMBLY** EPMB2300

1. Install the flow control spring the flow control valve and the connector in to the pump body.



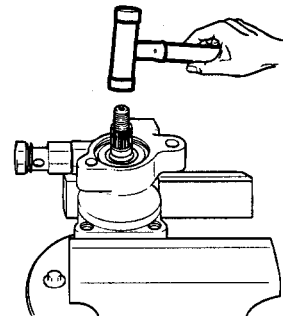
KPKA060A

2. Install the oil seal in the pump body by using the special tool.

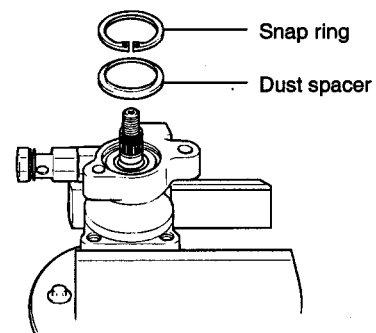


KPKA061A

3. After inserting the shaft assembly into the pump body, install the dust spacer and snap ring.

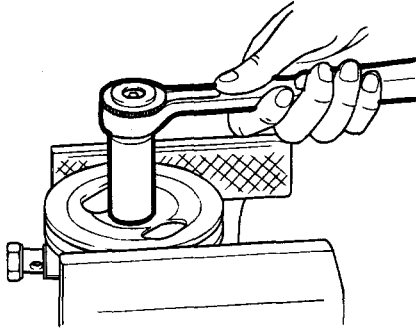


KPKA062A



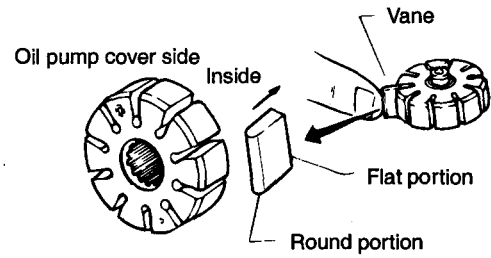
KPKA057A

4. Install the pump pulley.



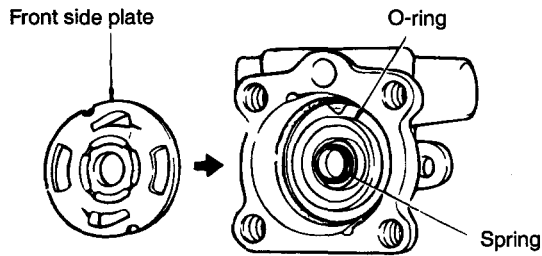
KPKA056A

9. Install vanes so that the rounded edges face outward.



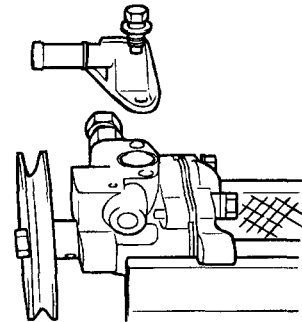
EPKB300C

5. Install the spring and inner O-ring.
6. Insert the outer O-ring in the oil pump side plate then install it in the pump body.



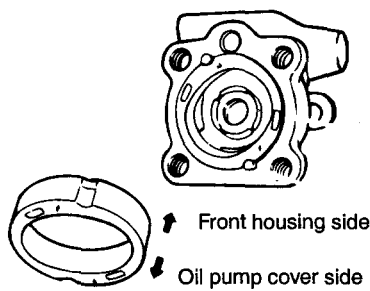
EPKB300A

10. Install the gasket and oil pump cover assembly.
11. Install the suction pipe and O-ring.



KPKA063A

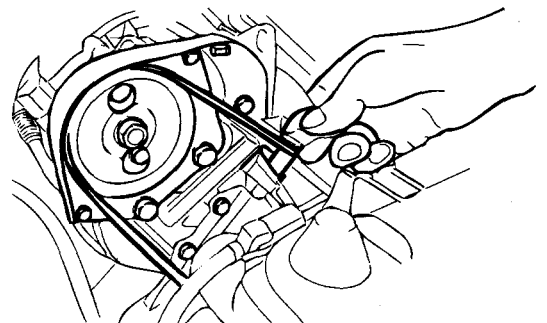
7. After inserting the lock pin into the groove of the front housing, install the cam ring attending to the direction.



EPKB300B

**INSTALLATION** EPMB2400

1. After installing the oil pump to the oil pump bracket, install the "V" belt and tighten the bolt adjusting tension to the specified torque.



KPMB200B

8. Install the rotor.

2. Install the suction hose.

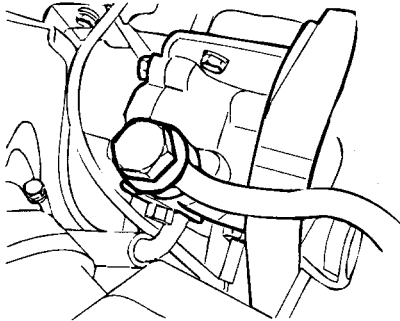
**CAUTION**

*Install the pressure hose to the oil pump.*

3. Install the pressure hose to the oil pump.

 **NOTE**

*Install the pressure hose being careful so that it does not twist and come in contact with other components.*



KPMB200A

4. Add power steering fluid (PSF-3).
5. Air bleed the system.
6. Check the oil pump pressure.

# Suspension System

<b>GENERAL .....</b>	<b>SS -2</b>
<b>FRONT SUSPENSION SYSTEM .....</b>	<b>SS -9</b>
<b>REAR SUSPENSION SYSTEM .....</b>	<b>SS -22</b>
<b>TIRES/WHEELS .....</b>	<b>SS -28</b>

## GENERAL

## SPECIFICATIONS EHMB0100

Front suspension system

Double wishbone torsion bar type

## Shock absorber

Items		Specifications
Type		Gas pressurized type
Stroke (mm)	mm (in.)	115 (4.53)
Damping force (0.3 m/sec)		
Expansion	N (kg)	1650 (165)
Compression	N (kg)	520 (52)
I-D color		White

## Torsion bar

Items		2.5L Diesel	3.5L Gasoline
Length X Outer dia.	mm (in.)	1273 X 27.3 (50.1 X 1.1)	1273 X 27.7 (50.1 X 1.1)
Torsional spring constant (kg-cm/deg)		598 ± 3%	631 ± 3%
I-D color		Left (LH) : Yellow 1 line Right (RH) : White 1 line	Left (LH) : Yellow 2 lines Right (RH) : White 2 lines

Rear suspension system

5 link rigid axle (coil spring) type

Items		Specifications
Coil spring free height and identification color		
Free height	mm (in.)	395.7 (15.6)
I-D color		Gray 2 lines
Shock absorber		
Type		Gas pressurized type
Stroke (mm)	mm(in.)	198 (8)
Damping force (0.3 m/sec)		
Expansion	N (kg)	1640 (164)
Compression	N (kg)	470 (47)
I-D color		White

## SERVICE STANDARD

EHMB0200

Front wheel alignment			
Items		Standard values	Specifications
Toe-in	Front	3.5 ± 3.5 mm (0.138 ± 0.138 in.)	Individual toe is within 0-3.5 mm (0-0.138 in.) Do not adjust
	Rear	0	
Camber	Front	0° ± 30'	Difference between LH and RH : max. 30' Do not adjust
	Rear	0	
Caster		3° 5' ± 30'	Difference between LH and RH : max. 30'
King pin angle		13°	

Wheel size : 6J X 15 (Aluminum), 7J X 16 (Aluminum), 6J X 15 (steel)  
Tire size : 235/75 R15, 255/65 R16  
Tire inflation pressure KPa (psi) : 196 (29)

EHMB020A

## TIGHTENING TORQUE

EHMB0300

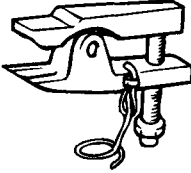
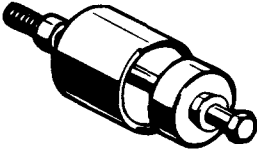
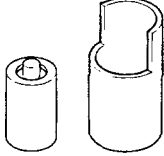

Items	Nm	kg-cm	lb-ft
Wheel nut	100-120	1000-1200	73-88
Shock absorber upper mounting nut	12-18	120-180	9-13
Shock absorber lower mounting nut	70-95	700-950	51-70
Knuckle to upper arm ball joint tightening nut	60-90	600-900	44-66
Upper arm shaft to upper arm mounting	122-145	1220-1450	89-106
Upper arm shaft to body mounting bolt	100-120	1000-1200	73-88
Upper arm ball joint mounting nut	17-26	170-260	13-19
Rebound stopper mounting nut	8-12	80-120	6-9
Lower arm ball joint to knuckle mounting locking nut	120-180	1200-1800	88-131
Lower arm to body mounting bolt	140-160	1400-1600	103-117
Lower arm ball joint mounting nut	54-75	540-750	40-55
Anchor arm mounting nut	95-120	950-1200	70-88
Stabilizer bar link ball joint nut	100-120	1000-1200	73-88
Stabilizer bar mounting bracket	35-55	350-550	26-40
Tie rod end to knuckle mounting nut	40-50	400-500	29-37
Toe-in adjusting nut	65-80	650-800	48-58
Rear shock absorber lower mounting nut	90-120	900-1200	66-88
Rear upper link mounting nut	150-180	1500-1800	110-131
Rear lower link mounting nut	150-180	1500-1800	110-131

Items	Nm	kg·cm	lb·ft
Lateral rod mounting nut (Frame side)	150-180	1500-1800	110-131
Lateral rod mounting nut (Axle side)	180-240	1800-2400	132-175
Rear stabilizer bar link bushing mounting nut	19-28	190-280	14-21
Rear stabilizer bar bracket mounting bolt	30-40	300-400	22-29

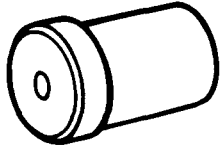
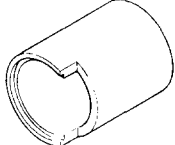

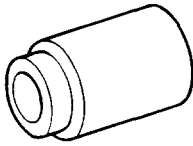
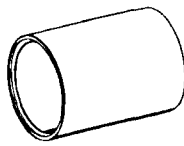
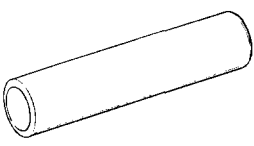
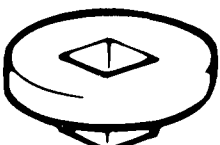
 **CAUTION**

*Replace the self-locking nuts with new ones after removal.*

**SPECIAL TOOLS** EHMBO400

Tool (Number and Name)	Illustration	Usage
09568-34000 Ball joint puller	 KHMB040A	Removal of upper ball joint Removal of tie rod end ball joint
09624-34000 Trailing bushing remover/installer	 KHMB040B	Replacement of front lower arm bushing
09545-25000 Lower arm bushing remover/installer	 KHMB040C	Replacement of front lower arm bushing (Use with 09624-34000)
09517-43001 Bearing puller	 KHMB040D	Removal of lower arm ball joint



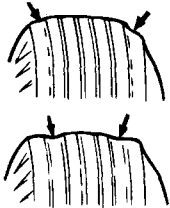
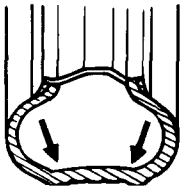
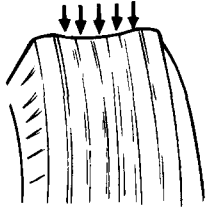
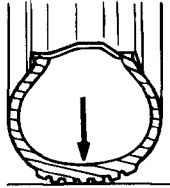

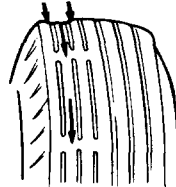
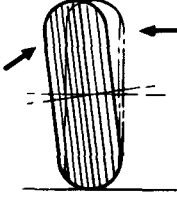
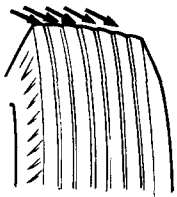
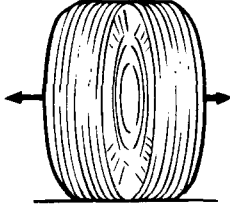
Tool (Number and Name)	Illustration	Usage
09495-33100 Center bearing remover/install	 KHMB040E	Replacement of lateral rod bushing (Use with 09545-24100)
09545-24100 Lower arm bushing remover/installer	 KHMB040F	Replacement of lateral rod bushing (Use with 09495-33100)
09455-21100 Bearing installer	 KHMB040G	Replacement of lateral rod bushing (Use with 09517-21200)
09517-21200 Front axle base	 KHMB040H	Replacement of lateral rod bushing (Use with 09455-21100) Replacement of upper arm bushing (Use with 09455-33200)
09216-21300 Hub bearing installer	 KHMB040I	Replacement of rear lower arm bushing (Use with 09455-33200)
09455-33200 Bearing installer	 KHMB040J	Replacement of rear lower arm bushing (Use with 09216-21300)
09532-11600 Preload socket	 KHMB040K	Measurement of stabilizer link ball joint starting torque (Use with torque wrench)

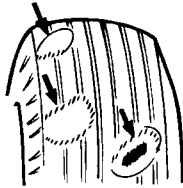
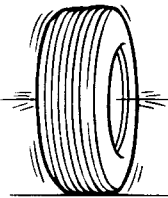

## TROUBLESHOOTING

EHMB0500

Symptoms	Possible causes	Remedy
Excessive vehicle rolling	Broken or deteriorated stabilizer	Replace
	Damaged shock absorber	Replace
Abnormal noise	Loose mounting parts	Retighten
	Broken or worn wheel bearing	Replace
	Shock absorber malfunction	Replace
	Damaged tire	Replace
Poor riding	Excessive tire inflation pressure	Adjust the tire inflation the pressure
	Shock absorber malfunction	Replace
	Loose wheel nut	Tighten to the specified torque
	Distorted or broken coil spring	Replace
	Damaged tire	Replace
	Worn bushing	Replace
Vehicle leans to one side	Deformed arm assembly	Replace
	Worn bushing	Replace
	Distorted or broken coil spring	Replace
	Improper torsion bar anchor bolt height adjustment	Adjust
Hard steering	Improper front wheel alignment	Repair
	Excessive turning resistance of lower arm ball joint	Replace
	Lack of tire inflation pressure	Adjust
	Power steering malfunction	Repair or Replace
Wandering	Improper front wheel alignment	Repair
	Worn or loose lower arm bushing	Retighten or Replace
Bottoming	Broken or worn coil spring	Replace

WHEEL AND TIRE DIAGNOSIS

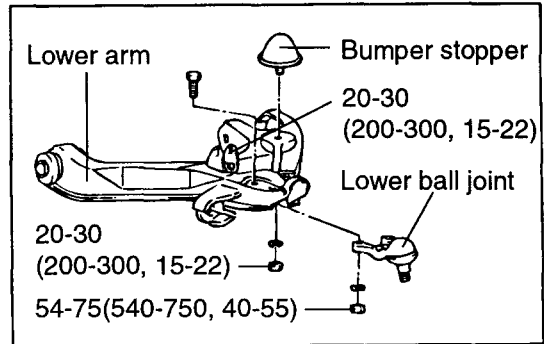
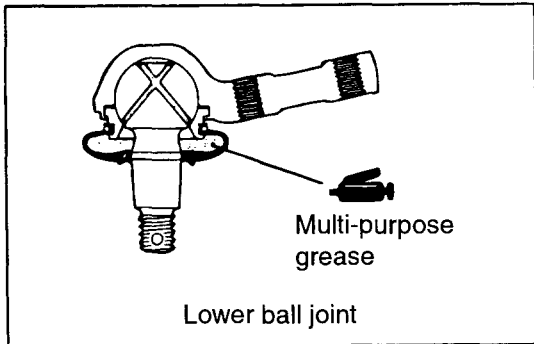
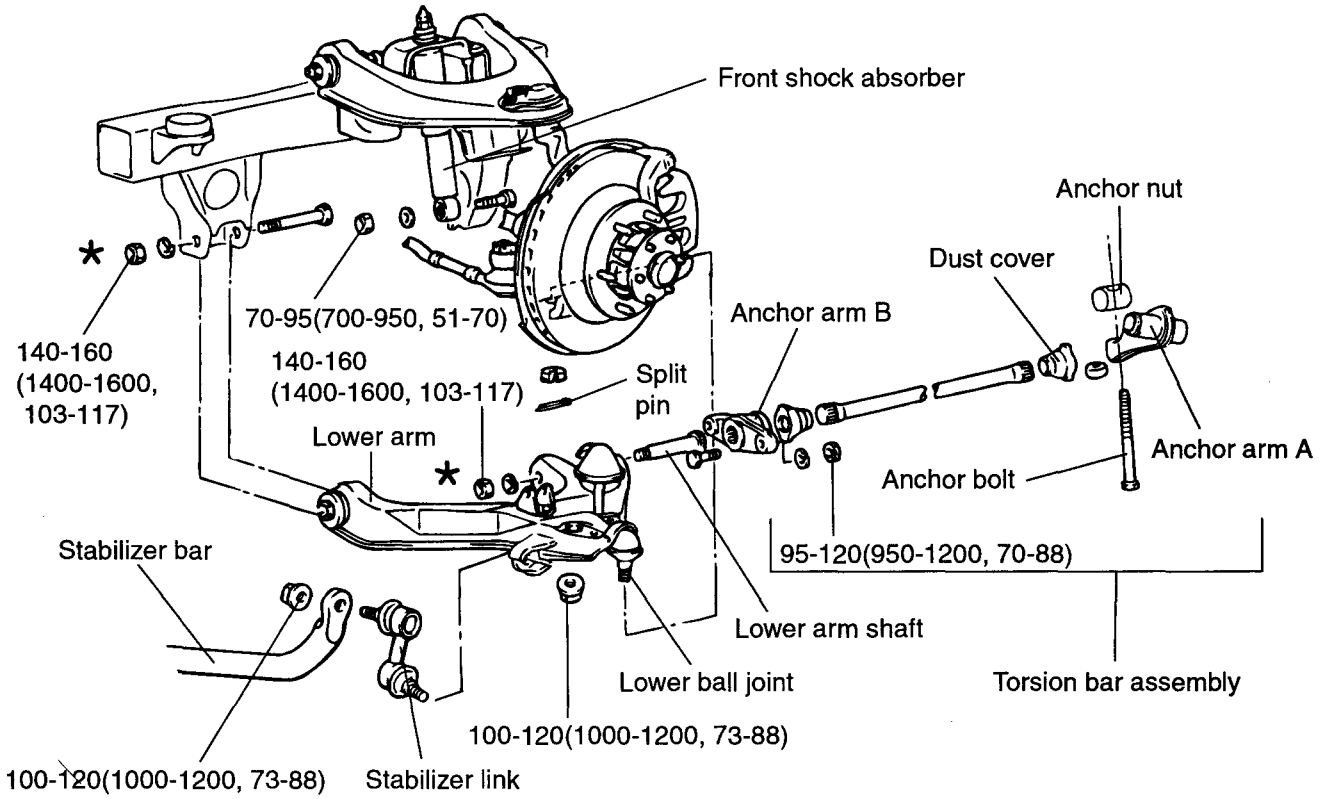
Symptoms	Possible causes	Remedy
<p>Rapid wear at shoulders</p>  <p>EHPSS01A</p>	<p>Under-inflation or lack of rotation</p>  <p>EHPSS02A</p>	<p>Adjust the tire inflation pressure</p>
<p>Rapid wear at center</p>  <p>EHPSS04A</p>	<p>Over-inflation or lack of rotation</p>  <p>EHPSS03A</p>	
<p>Cracked treads</p>  <p>EHPSS20A</p>	<p>Under-inflation</p>	
<p>Wear on one side</p>  <p>EHPSS05A</p>	<p>Excessive camber</p>  <p>EHPSS06A</p>	<p>Inspect the camber</p>
<p>Feathered edge</p>  <p>EHPSS07A</p>	<p>Incorrect toe-in</p>  <p>EHPSS08A</p>	<p>Adjust the toe-in</p>

Symptoms	Possible causes	Remedy
<p>Bald spots</p>  <p>EHPSS09A</p>	<p>Unbalanced wheel</p>  <p>EHPSS10A</p>	<p>Adjust the unbalanced wheels</p>
<p>Scalloped wear</p>  <p>EHPSS11A</p>	<p>Unbalanced wheel</p>	<p>Adjust</p>
	<p>Wheel bearing end play</p>	<p>Inspect end play Adjust preload</p>
	<p>Ball joint end play</p>	<p>Inspect</p>
	<p>Shock absorber malfunction</p>	<p>Inspect</p>

# FRONT SUSPENSION SYSTEM

## LOWER ARM

### COMPONENTS EHMB0600



**CAUTION**

\* Parts should be temporarily tightened, and then tightened to the specified torque with the vehicle on the ground in the unladen condition.

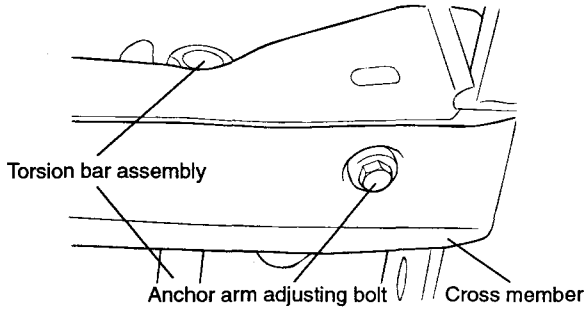
TORQUE : Nm (kg·cm, ft·lb)

**REMOVAL** EHMB0700

1. Loosen the anchor arm assembly adjusting bolt of torsion bar.

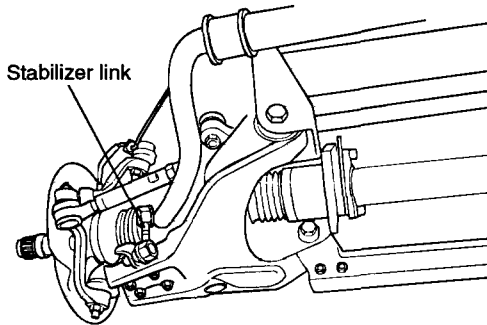
**NOTE**

Support the lower arm with a jack to easily loosen the anchor arm assembly adjusting bolt.



EHPSS77A

2. Disconnect the ABS speed sensor (Vehicle with ABS only).
3. Disconnect the stabilizer bar link.



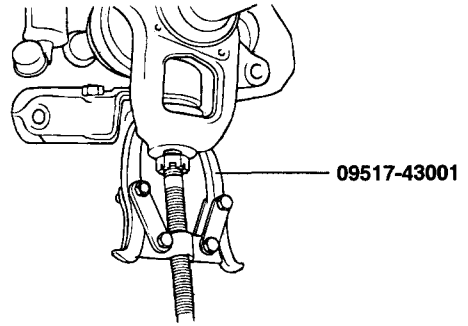
EHPSS13A

4. Remove the shock absorber lower mounting bolt/nut.
5. Remove the torsion bar anchor arm B and lower arm mounting bolt/nut.

**NOTE**

Press down the lower arm fully so as to remove bolt and nut easily.

6. Disconnect the knuckle from the lower arm ball joint using the special tool (09517-43001).



KHPSS14A

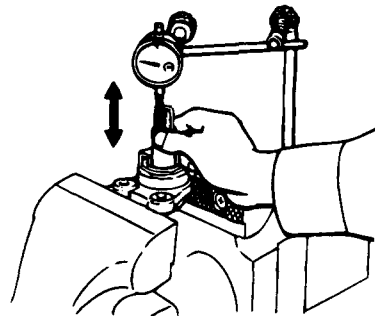
7. Remove the lower arm mounting bolt of the frame side.

**INSPECTION** EHMB0800

**LOWER ARM BALL JOINT END PLAY MEASUREMENT**

1. Using a dial gauge, measure the lower arm ball joint end play.

Limit value : 0.03 mm (0.0012 in.) or less



KHPS055A

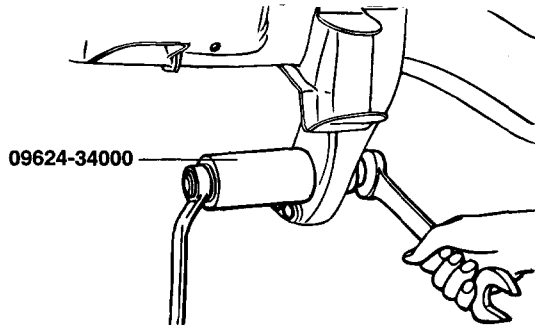
2. When the lower arm ball joint end play is above the limit value, replace the lower arm ball joint.

**LOWER ARM BUSHING (A) REPLACEMENT**

- 1. Use the special tool (09624-34000) to replace the bushing (A).

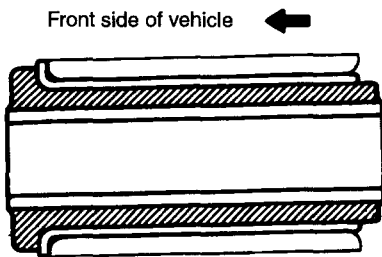
**NOTE**

When removing the left side bushing (A), remove the differential carrier.



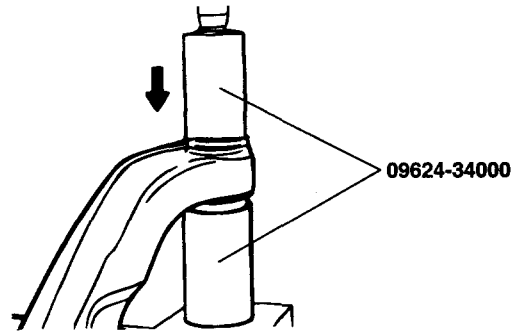
KHPSS15A

- 2. Install the bushing to the direction shown in the illustration.



EHPSS16A

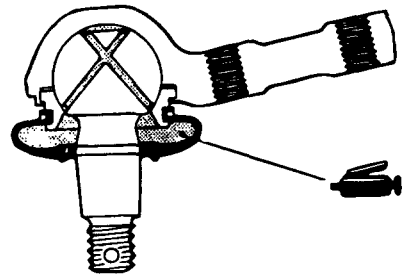
- 2. Use the special tool (09624-34000) to install the bushing (B).



KHPSS18A

**LOWER ARM BALL JOINT DUST COVER REPLACEMENT**

- 1. Remove the lower arm dust cover.
- 2. Apply multi-purpose grease to the inside of the lower arm dust cover and the lower ball joint.



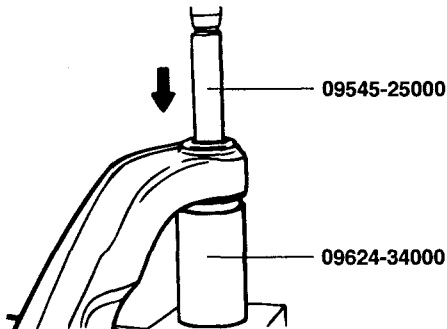
KHPSS19A

- 3. Install the dust cover to the ball joint.

**LOWER ARM BUSHING (B) REPLACEMENT**

EHMB0900

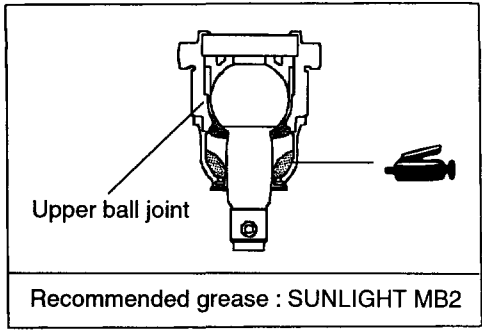
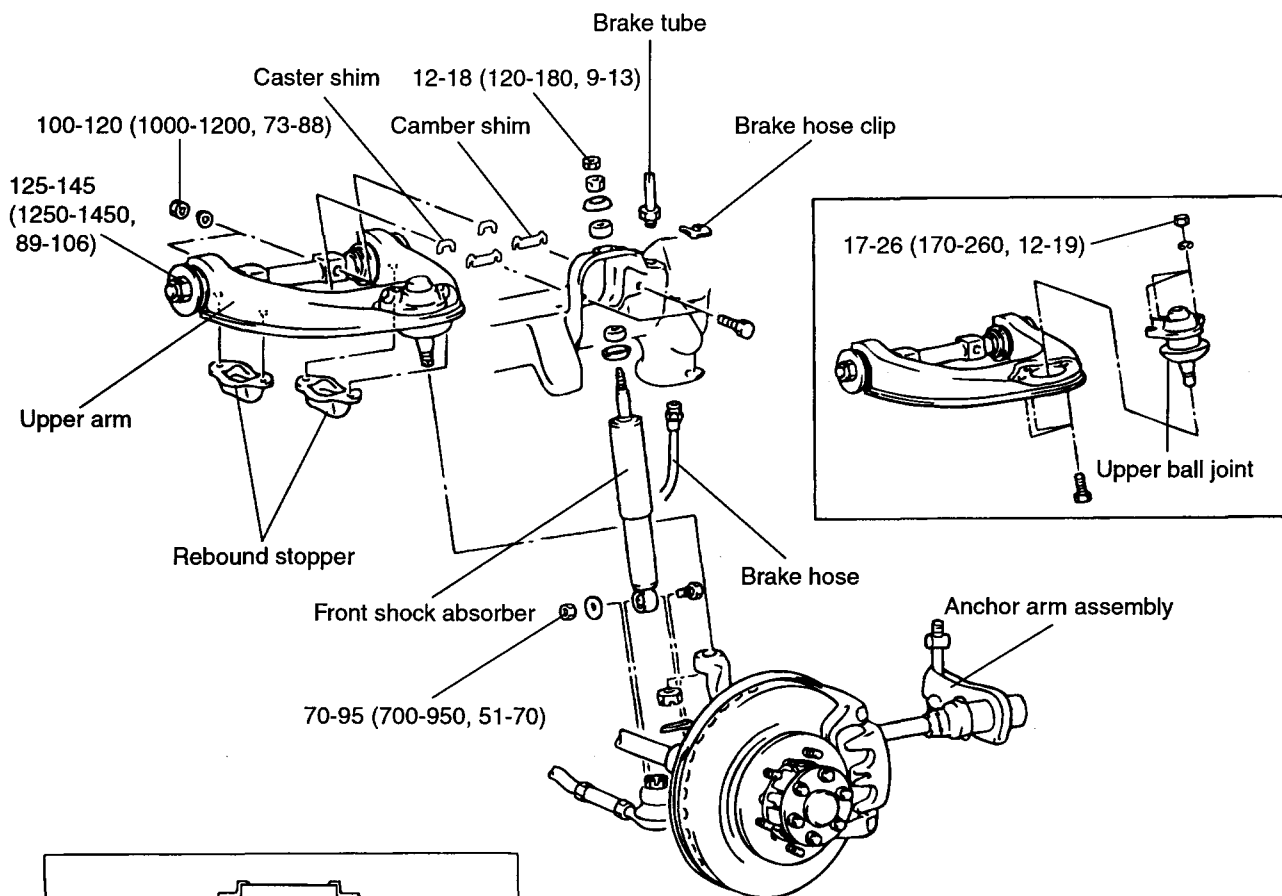
- 1. Use the special tool (09624-34000, 09545-25000) to remove the bushing (B).



KHPSS17A

# UPPER ARM

## COMPONENTS EHMB1000



TORQUR : Nm (kg-cm, lb-ft)

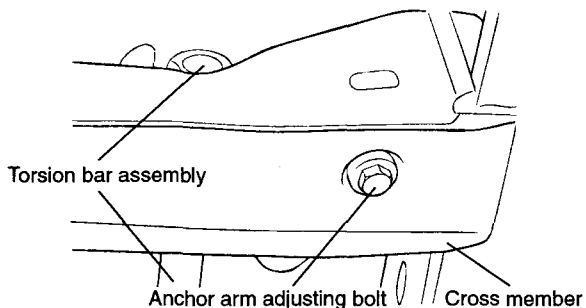


**REMOVAL** EHMB1100

1. Loosen the anchor arm assembly adjusting bolt of torsion bar.

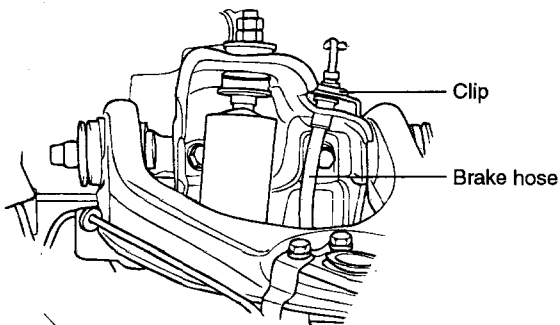
**NOTE**

Support the lower arm with a jack to easily loosen the anchor arm assembly adjusting bolt.



EHPSS77A

2. Remove the brake hose clip and disconnect the brake hose connecting part.

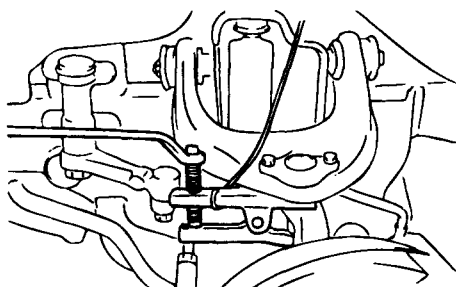


EHMB110A

3. Use the special tool (09568-34000) to disconnect the upper ball joint.

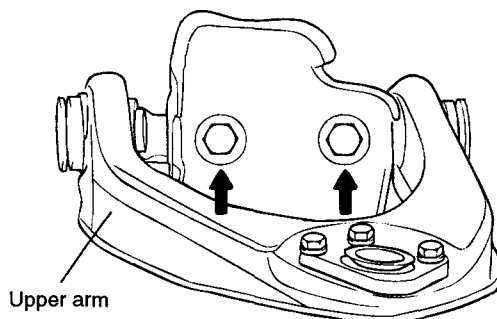
**NOTE**

- Only loosen the nut, do not remove it.
- Support the special tool with a cord not to be separated.



KHPSS08A

4. Remove the shock absorber.
5. After loosening the upper arm shaft mounting bolt, remove the camber and cast adjusting shim.

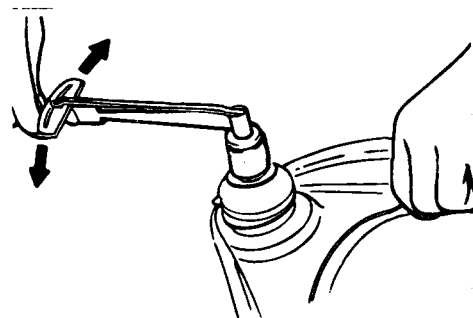


EHMB110B

**INSPECTION** EHMB1200

1. Check the upper arm for crack and deformation.
2. Check the upper arm shaft for crack and distortion.
3. Measure the upper ball joint starting torque.
  - 1) After shaking the ball joint stud several times, measure the starting torque using the special tool (09532-11600).

Standard Value : 0.8-3.5 Nm (8-35 kg·cm, 0.59-2.59 lb·ft)



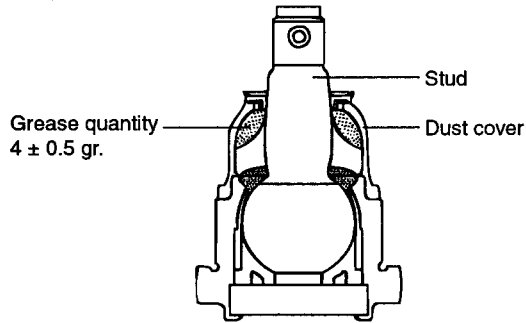
KHPS409A

- 2) If the upper ball joint starting torque exceeds the standard value, replace the upper ball joint.

**BALL JOINT DUST COVER REPLACEMENT** EHMB1300

1. Remove the dust cover.
2. Apply multi-purpose grease to the inside of the dust cover and the upper ball joint.

Recommended grease : SUNLIGHT MB2  
Quantity :  $4 \pm 0.5$  gr.

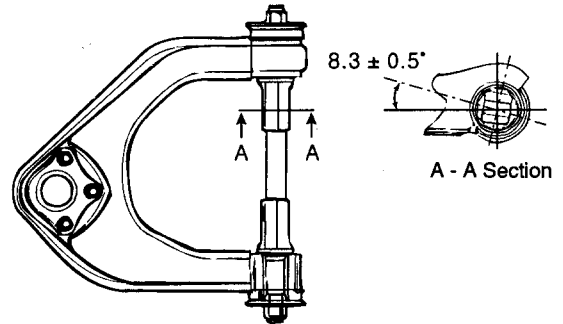


EHMB130A

3. Install the dust cover to the ball joint.

**INSTALLATION** EHMB1400

1. Install the upper arm shaft at the specified value  $8.3 \pm 0.5^\circ$  shown in the illustration.



EHMB140A

2. Tighten the following parts to the specified torque.

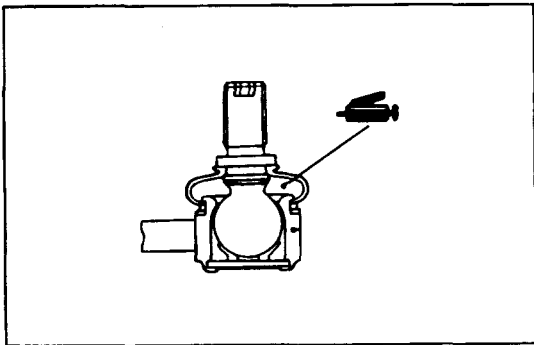
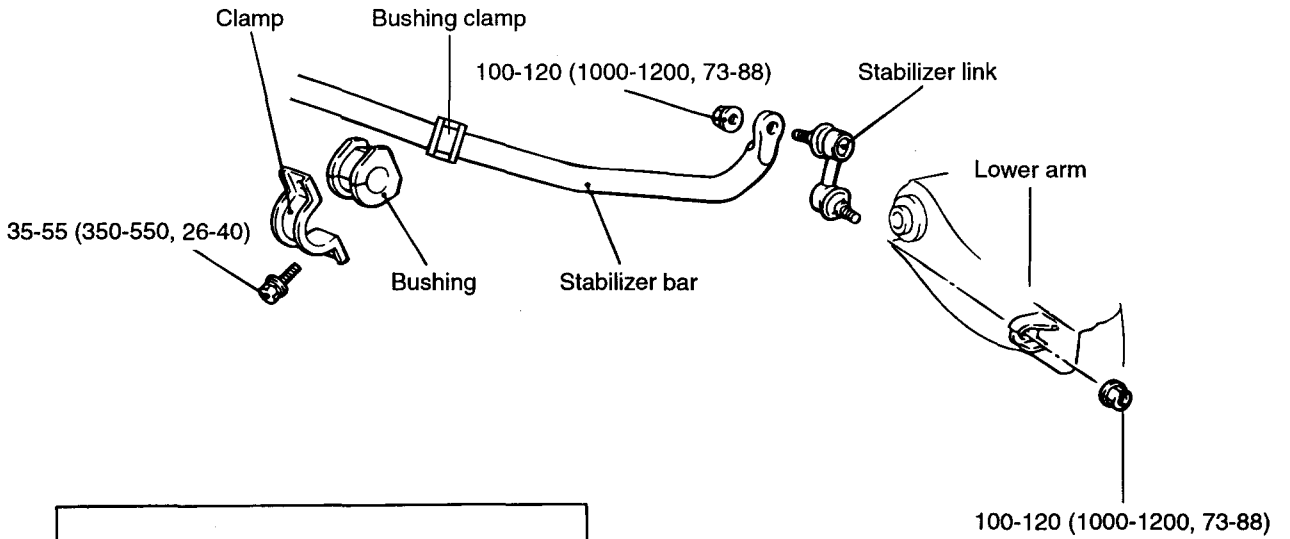
Items	Nm	kg-cm	ft-lb
Upper arm shaft to upper arm mounting self-locking flange nut	122-145	1220-1450	89-106
Rebound stopper mounting bolt	8-12	80-120	6-9
Upper ball joint to upper arm mounting nut	17-26	170-260	13-19
Upper arm to body mounting bolt	100-120	1000-1200	73-88
Shock absorber upper mounting nut	12-18	120-180	9-13
Shock absorber lower mounting	70-95	700-950	51-70

**CAUTION**

*Replace the self-locking nuts with new ones after removal.*

# FRONT STABILIZER BAR

## COMPONENTS EHMB1500



TORQUR : Nm (kg-cm, lb-ft)

**REMOVAL** EHMB1600

1. Disconnect the stabilizer bar link from the lower arm.
2. Remove the stabilizer bar bushing bracket.

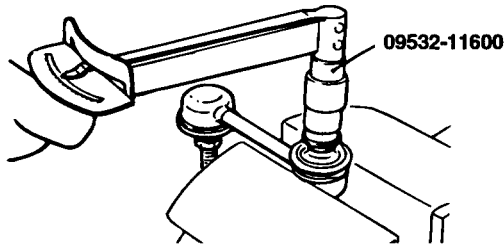
**INSPECTION** EHMB1700

1. Check the bushing for deformation and wear.
2. Check the stabilizer bar for deformation and damage.
3. Check the stabilizer link ball joint dust cover for cracks.
4. Inspect the stabilizer link ball joint rotating torque.

**CAUTION**

**After shaking the stabilizer link ball joint stud several times, measure the starting torque.**

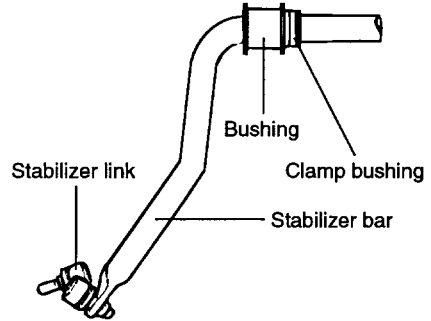
Specified value : 0.7-2 Nm (7-20 kg·cm, 0.51-1.5 lb·ft)



H7FS0330

**INSTALLATION** EHMB1800

1. Installation is the reverse of removal.
2. While installing, place the yellow mark on the stabilizer link to the right side.
3. Press-fit the clamp bushing to the inside of the stabilizer bushing.



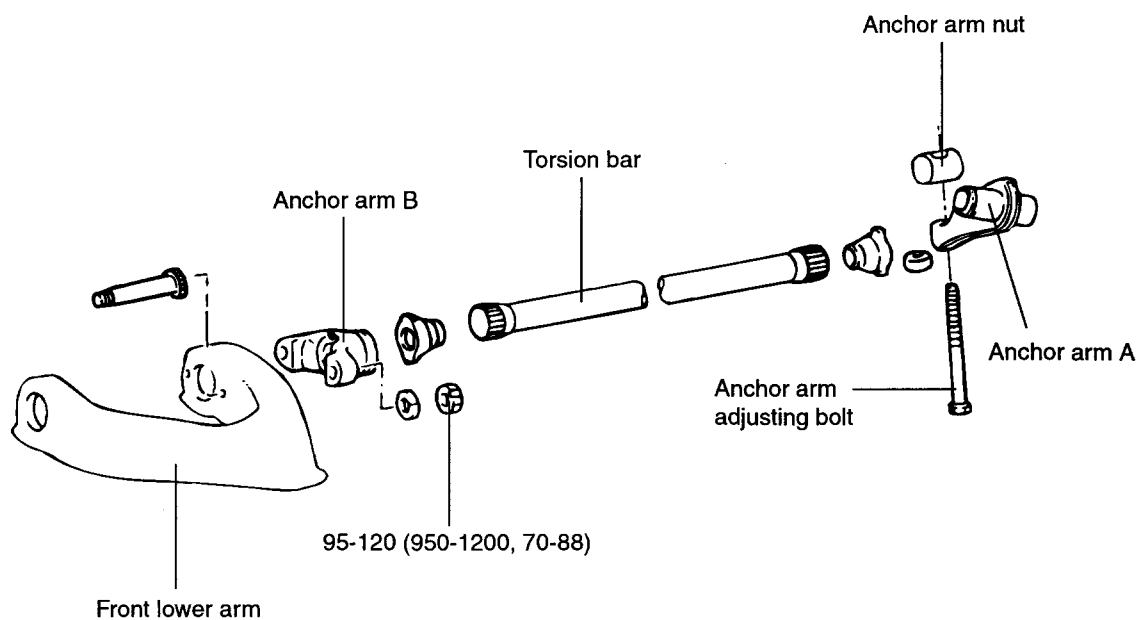
EHPSS21A

4. Install the stabilizer bar to the specified torque as follows.

Items	Spified torque Nm (kg·cm, lb·ft)
Stabilizer bushing bracket mounting	35-55 (350-550, 26-40)
Stabilizer link self-locking nut	100-120 (1000-1200, 73-88)

# TORSION BAR

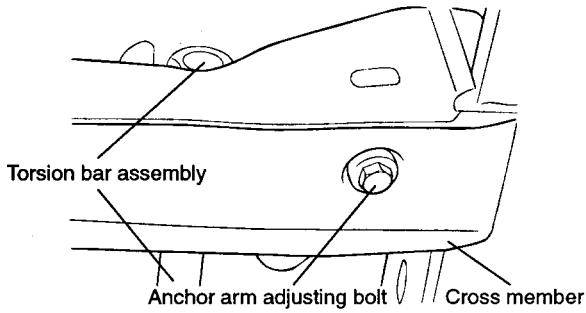
## COMPONENTS EHMB1900



TORQUE : Nm (kg-cm, lb-ft)

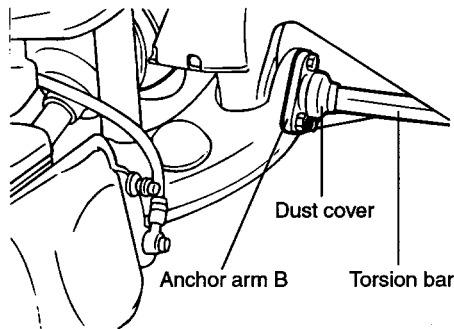
**REMOVAL** EHMB2000

1. Remove the anchor arm adjusting bolt.



EHPSS77A

2. Remove the torsion bar from the anchor arm B located in the lower arm. At this time place the dust cover to the torsion bar side.



EHPSS23A

**INSPECTION** EHMB2300

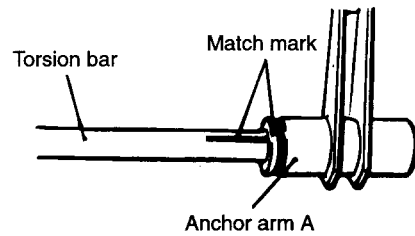
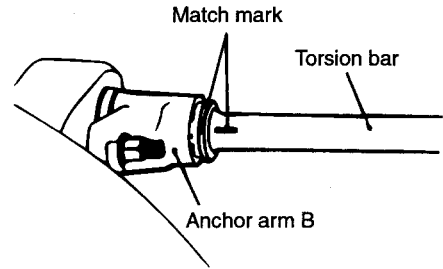
1. Check the torsion for deformation and the dust cover for tear and damage and then replace them if necessary.
2. Check the anchor bolt and adjusting nut for wear.

**INSTALLATION** EHMB2200

1. Installation is the reverse of removal.
2. Make sure of the identification color on the torsion bar.

2.5 Diesel	3.5 Gasoline
Left (LH) : Yellow 1 line	Left (LH) : Yellow 2 line
Right (RH) : White 1 line	Right (RH) : White 2 line

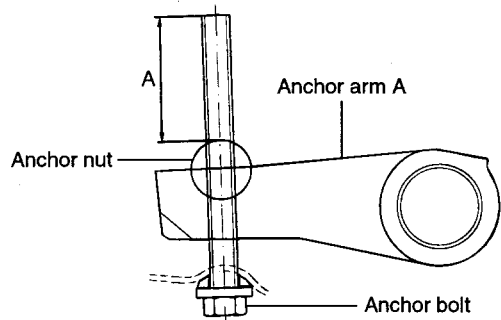
3. While installing, align the match marks on the anchor arm (A/B) with torsion bar.



EHPSS88A

4. Tighten the adjusting nut until the protruding length of the anchor bolt becomes as below.

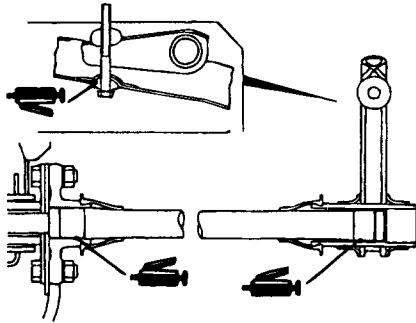
Protruding length (A)	Left (LH)	Left (RH)
2.5 Diesel	48 mm (1.89 in.)	46 mm (1.81 in.)
3.5 Gasoline	51 mm (2.01 in.)	47 mm (1.85 in.)



EHPSS83A

**⚠ CAUTION**

*When tightening the anchor bolt, apply grease to the threaded.*



KHPSS24A

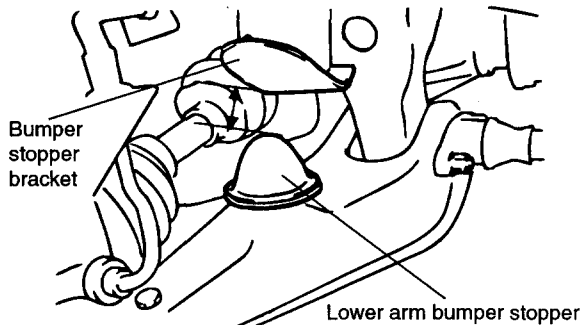
5. With the vehicle in an unladen condition, measure the distance from the lower arm bumper stopper to the bumper stopper bracket.

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Standard value : 20 mm (0.79 in.)

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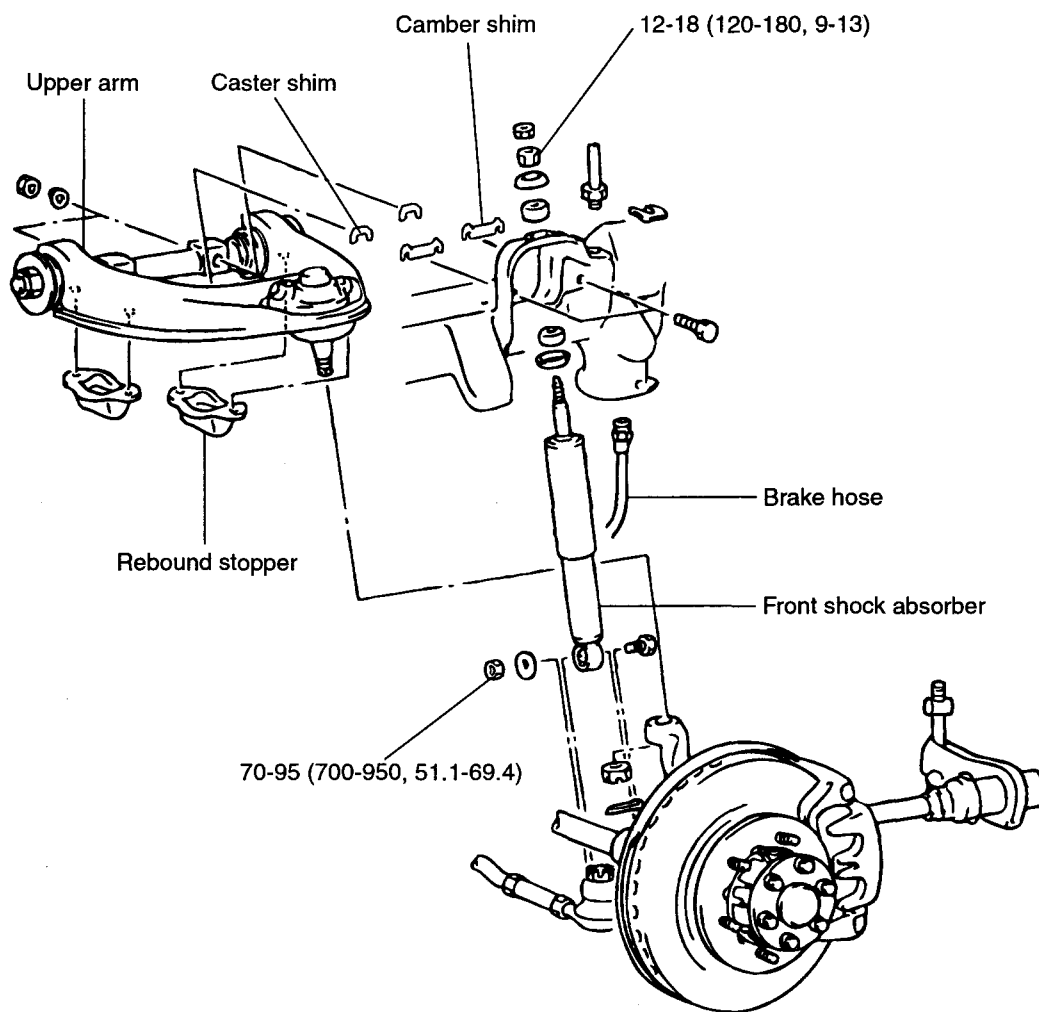
If the distance is out of the standard value, adjust the anchor bolt for proper distance.



EHPSS50A

# FRONT SHOCK ABSORBER

## COMPONENTS EHMB2300

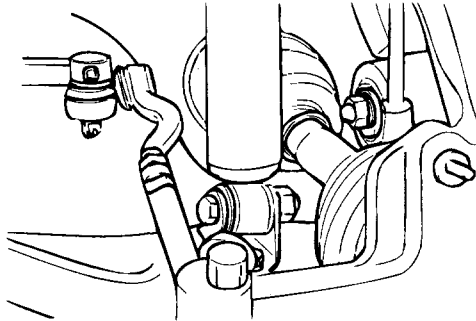


TORQUE : Nm (kg-cm, lb-ft)



**REMOVAL** EHMB2400

1. Remove the wheel and tire.
2. Remove the shock absorber mounting nut.



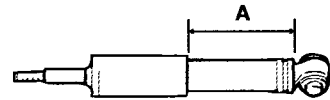
KHPSS51A

**DISPOSAL** EHMB2600

1. Fully extend the shock absorber.
2. Drill a hole on the section A to drain gas from the cylinder.

**CAUTION**

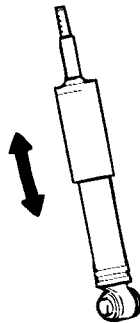
The gas coming out is harmless, but be careful of chips that may fly up during drilling.



**INSPECTION** EHMB2500

1. Check the rubber parts for deterioration and damage.
2. Check the shock absorber for damage or oil leakage.
3. Inspect the shock absorber for abnormal resistance and noise.

KHMB090A



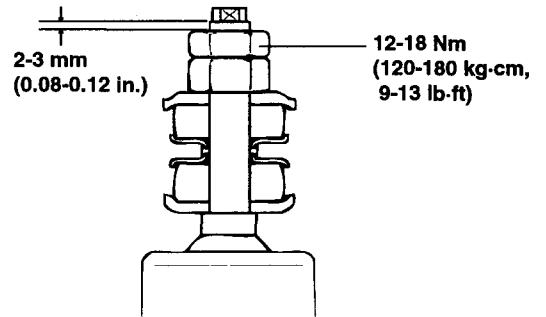
KHPSS03A

**INSTALLATION** EHMB2700

1. Tighten the below parts to the specified torque.

Items	Specified torque Nm (kg-cm, lb-ft)
Shock absorber upper mounting nut	12-18 (120-180, 9-13)
Shock absorber lower mounting nut	70-95 (700-9500, 51-70)

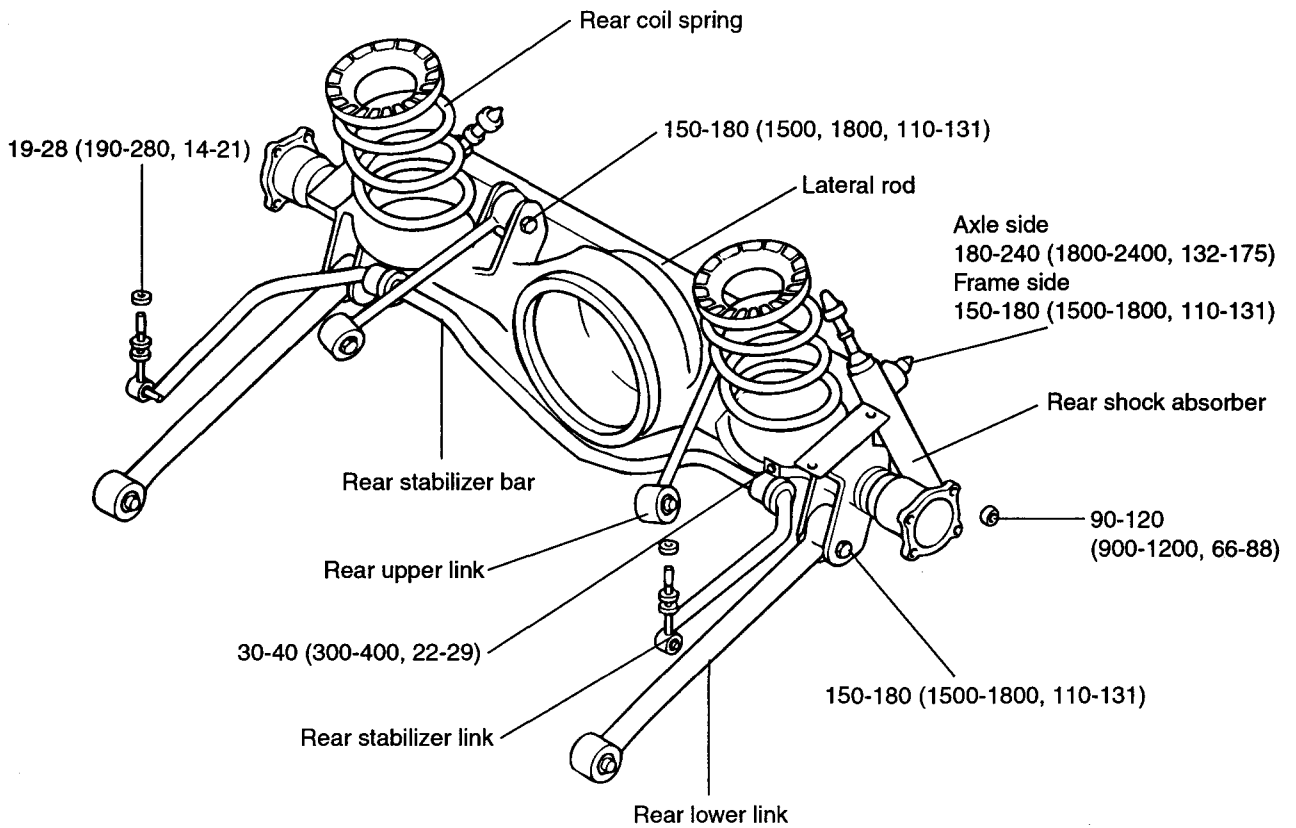
2. When installing the shock absorber upper mounting nut, tighten the mounting nut as shown in the illustration.



EHMB270A

# REAR SUSPENSION SYSTEM

## COMPONENTS EHMB2800



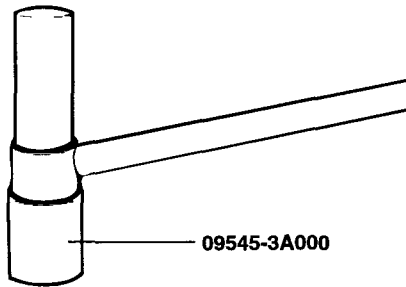
TORQUE : Nm (kg·cm, lb·ft)

# UPPER ARM, LOWER ARM AND ASSIST LINK

## REAR LOWER LINK REPLACEMENT

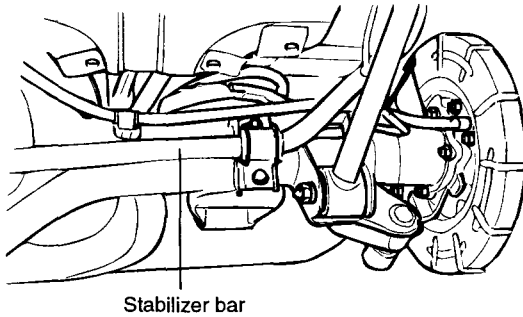
EHMB2900

1. Support the bottom of the rear differential carrier with a jack and remove the lower link.
2. Use the special (09545-3A000) to replace the bushing.



KHPSS30B

3. Install the rear lower link.



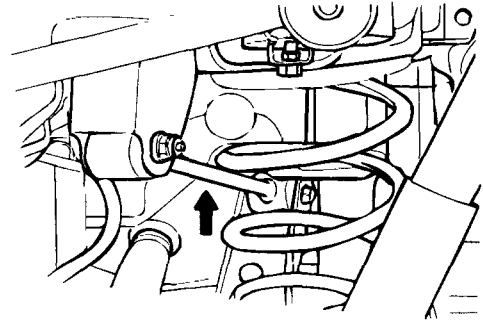
Stabilizer bar

EHPSS31A

## REAR UPPER LINK REPLACEMENT

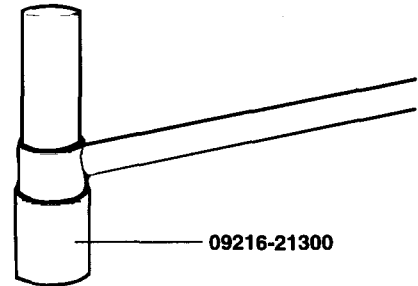
EHMB3000

1. Support the bottom of the rear differential carrier with jack and remove the rear upper link.



KHPSS32A

2. Use the special (09216-21300) to replace the bushing.



KHPSS30C

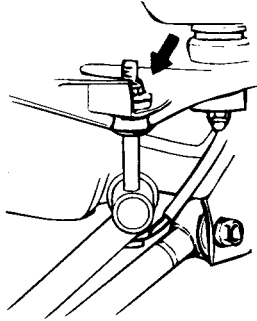
3. Install the upper link.

## REAR STABILIZER BAR

### REAR STABILIZER BAR REPLACEMENT

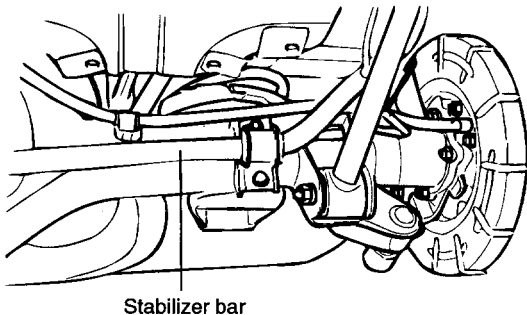
EHMB3100

1. Support the bottom of the rear differential carrier with a jack.
2. Remove the stabilizer link mounting nut.



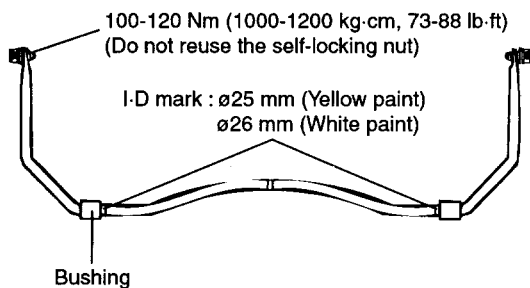
EHPSS36A

3. Remove the stabilizer bar bushing bracket.



EHPSS31A

4. Align the identification mark white paint on stabilizer bar with bushing and install the stabilizer bar bushing bracket.

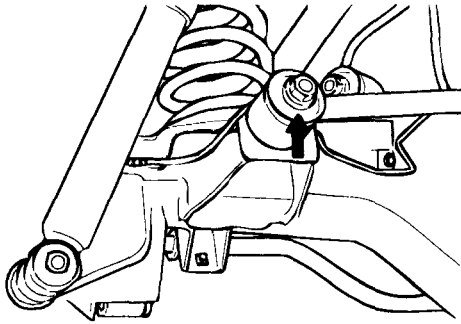


EHPSS38A

## LATERAL ROAD

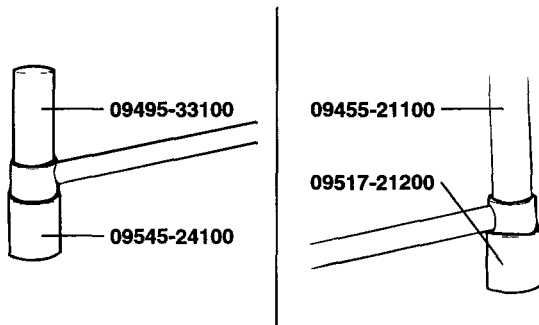
### LATERAL ROD REPLACEMENT EHMB3200

1. Support the bottom of the rear differential carrier with a jack and remove the lateral rod.



KHPSS28A

2. Use the special tools to replace the bushing.



KHPSS29A

3. Install the lateral rod.

---

**Tightening torque :**

Axle side :

180-240 Nm (1800-2400 kg-cm, 132-175 lb-ft)

Frame side :

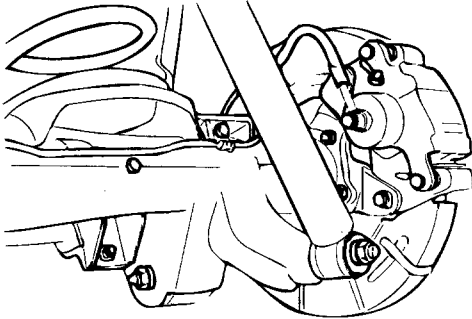
150-180 Nm (1500-1800 kg-cm, 110-131 lb-ft)

---

## REAR SHOCK ABSORBER

### REMOVAL EHMB3300

1. Remove the rear shock absorber.



KHPSS26A

2. After holding the upper mounting nut, remove the shock absorber turning by hand.

**⚠ CAUTION**

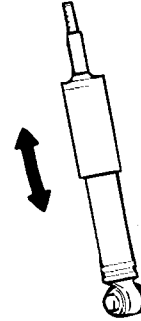
*If the shock absorber is not removed by hand, try again after fixing it with chain or rubber.*



KHPSS27A

### INSPECTION EHMB3400

1. Check the shock absorber for damage and oil leakage.
2. Check the shock absorber for irregular noise or abnormal operation.



KHPSS03A

### INSPECTION EHMB3500

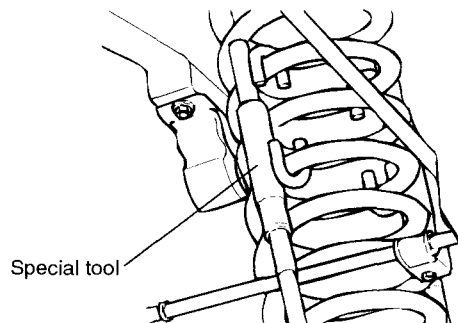
Installation is the reverse of removal.

## COIL SPRING

### REAR COIL SPRING

#### REPLACEMENT EHMB3600

1. Use a suitable special tool to compress the coil spring.



EHPSS34A

2. Remove the coil spring.

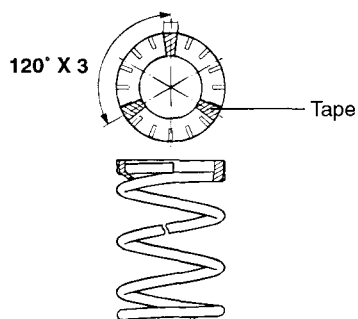
 **NOTE**

*When removing the coil spring, remove the left side (LH) at the vehicle's rear side and the right side (RH) at the vehicle's front side.*

3. Install the coil spring in the compressed condition using the special tool.

 **CAUTION**

***Align the spring end with the groove of the spring pad and fix the spring and the spring pad by adhering the 3 parts with tape.***



EHPSS35A

# TIRES/WHEELS

## TIRE

### FRONT WHEEL ALIGNMENT EHMB3700

1. Measure the wheel alignment always positioning the car on a level surface with the front wheels facing straight ahead.
2. Before measurement, make sure that the front suspension, steering system, wheels and tires are in normal operating conditions.

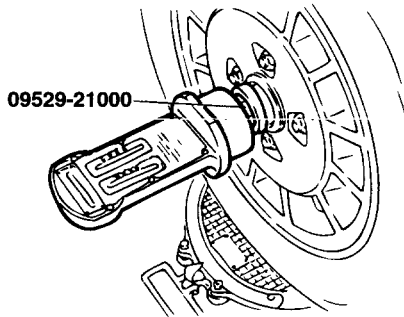
### TOE-IN

1. Measure the toe-in.

---

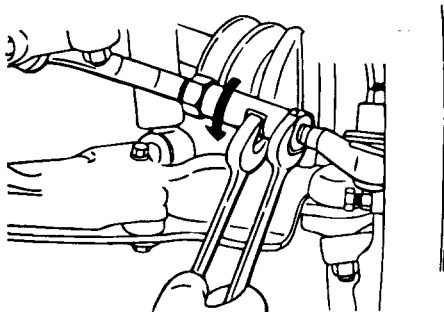
Standard value :  $3.5 \pm 3.5$  mm ( $0.138 \pm 0.138$  in.)

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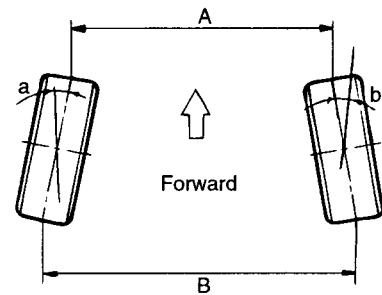
E4ZR0030

2. Toe-in is adjusted by rotating the tie rod turnbuckles. Left front wheel toe-in is reduced by rotating the tie rod toward the rear of the vehicle. Adjust toe-in in the same amount by turning the left and right wheel tie rod.



KHPSS39A

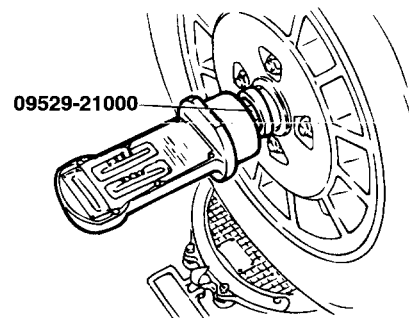
3. Calculate the toe-in value (B-A).



E4ZR0010

### CAMBER

1. Measure the camber using a camber/caster/king pin gauge.



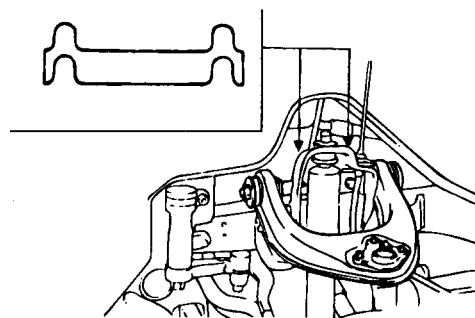
E4ZR0030

2. Adjust the camber by varying the thickness of the adjusting shim between upper arm shaft and crossmember.

---

Standard value :  $0^\circ \pm 30'$

---



KHPSS40A

### NOTE

- Thickness of the adjusting should be 4 mm (0.157 in.) or less.
- Never use the adjusting shim more than 3 pieces.



**CAMBER ADJUSTING SHIM THICKNESS**

Parts number	Shim thickness
MB176288A	1.0 mm (0.039 in.)
MB176289A	2.0 mm (0.079 in.)

**CASTER**

1. Measure the caster using a camber/caster/king pin gauge and a turning radius gauge.

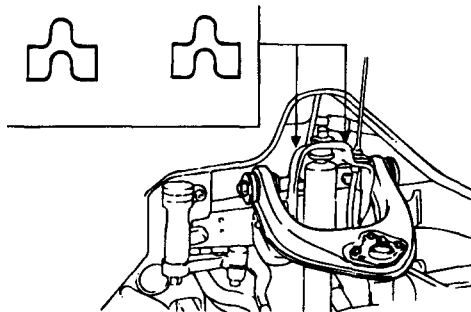
Standard value : 3° 5 ± 30'

**NOTE**

Available range of caster adjustment between left and right: within 30 or less.

2. If the caster is not within the standard value, adjust the caster by inserting or removing the caster adjusting shim between upper arm shaft and crossmember.

Shim thickness	Inserting a piece (Front)	Removing a piece (Rear)
1 mm (0.039 in.)	Gains 28'	Loses 28'
2 mm (0.079 in.)	Gains 56'	Loses 56'



KHPSS41A

**NOTE**

- According to the differences of the caster adjusting shim thickness, camber's angle is changed as follows.

Shim thickness	Inserting a piece (Front)	Removing a piece (Rear)
1 mm (0.039 in.)	Loses 10'	Loses 3'
2 mm (0.079 in.)	Loses 20'	Loses 6'

- Thickness of the adjusting shim should be 2 mm or less.
- Never use the adjusting shim more than 1 piece.

**TIRE WEAR**

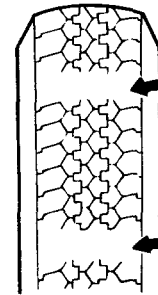
1. Measure the tread depth of the tire.

Tread depth of tire (Limit) : 1.6 mm (0.0630 in.)

2. If the tread depth is less than the limit, replace the tire.

**NOTE**

When the tread depth of the tire is reduced to 1.6 mm (0.0630 in.) or less, the wear indicators will appear.



E4ZR0050

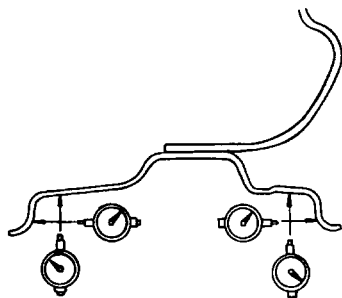
## WHEEL

### WHEEL RUNOUT EHMB3800

1. Jack up the vehicle and support it with jack stands.
2. Measure wheel runout with a dial indicator.
3. Replace the wheel if wheel runout exceeds the limit.

### WHEEL RUNOUT [LIMIT]

	Aluminum wheel	Steel wheel
Radial	0.3 mm (0.012 in.)	1.0 mm (0.039 in.)
Axial	0.3 mm (0.012 in.)	1.2 mm (0.222 in.)



KHMB350A

### WHEEL NUT TIGHTENING

1. Tightening torque.

---

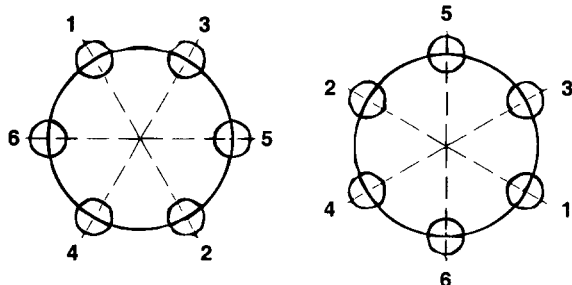
Specified torque : 100-120 (1000-1200, 73-88)

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#### CAUTION

**When using an impact-wrench, adjust the tightening torque completely.**

2. Tighten all the wheel nut according to the order shown in the illustration until they are all tight.



KHPSS42A

# Restraints

<b>GENERAL .....</b>	<b>RT-2</b>
<b>SRSCM (SUPPLEMENTAL RESTRAINTS SYSTEM</b>	
<b>CONTROL MODULE) .....</b>	<b>RT-6</b>
<b>AIR BAG MODULE (DRIVE SIDE) AND CLOCK SPRING .....</b>	<b>RT-13</b>
<b>AIR BAG MODULE (PASSENGER SIDE) .....</b>	<b>RT-16</b>
<b>AIR BAG CONNECTORS .....</b>	<b>RT-21</b>
<b>TROUBLESHOOTING .....</b>	<b>RT-22</b>
<b>AIRBAG MODULE DISPOSAL .....</b>	<b>RT-48</b>

# GENERAL

## GENERAL ERMB0010

The supplemental restraint system (SRS AIRBAG) is designed to supplement the seat belt to help reduce the risk and/or severity of injury to the driver and passenger by activating and deploying the driver, and passenger in certain frontal collisions.

The SRS AIRBAG consists of : a driver side airbag module located in the center of the steering wheel, which contains a folded cushion and an inflator unit ; a passenger side airbag module located in the passenger side crash pad which contains a folded cushion assembled with an inflator unit ; driver and passenger belt pretensioner : SRSCM located on the floor under the audio which monitors the system: a spring interconnection (clock spring) located within the steering column ; system wiring and wiring connector. The impact sensing function of the SRSCM is carried out by an electronic accelerometer that continuously measures the vehicle's acceleration and delivers a corresponding signal through an amplifying and filtering circuitry to the microprocessor.

Only authorized service personnel should work on or around the SRS components. Those service personnel should read this manual carefully before doing any such work. Extreme caution must be used when servicing the SRS to avoid injury to the service personnel (by inadvertent deployment of the air bag) or the driver (by render the SRS inoperative).

## CUSTOMER CAUTIONS ERHA0050

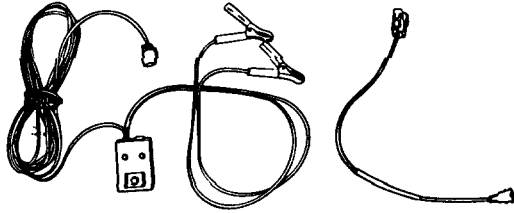

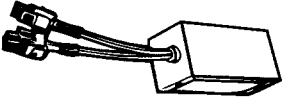
Failure to carry out service procedure in the correct sequence could cause the airbag system to unexpectedly deploy during service, possibly leading to serious injury.

Further more, if a mistake is made in servicing the airbag system, it is possible that the airbag may fail to operate when required.

Before performing service (including removal or installation of parts, inspection or replacement), be sure to read the following items carefully.

1. Be sure to proceed with airbag related service only after approx. 30 seconds or more from the time the ignition switch is turned to the LOCK position and the negative (-) battery terminal cable is disconnected from the battery. The airbag system is equipped with a back-up power source to assure the deployment of the airbag if the battery cable is disconnected due to an accident. The back-up power is available for approx. 150 ms.
2. When the negative (-) terminal cable is disconnected from the battery, the memory of the clock and audio systems will be canceled. So before starting work, record the contents in the memory of these systems. When the work is finished, reset the audio system and adjust the clock.
3. Malfunction symptoms of the airbag system are difficult to confirm, so the diagnostic trouble codes become the most important source of information when troubleshooting.
4. When troubleshooting the airbag system, always inspect the diagnostic trouble codes before disconnecting the battery.
5. Never use airbag component from another vehicle. When replacing parts, replace them with new parts.
6. Never attempt to disassemble and repair the airbag modules (DAB,PAB, BPT), clock spring and wiring in order to reuse them.
7. If any components of the SRS have been dropped, or if there are cracks, dents or other defects in the case, bracket or connector, replace them with new ones.
8. After work on the airbag system is completed, perform the SRS SRI check. The airbag indicator lamp can be interrupted by other circuit faults in some cases. Therefore, if the airbag indicator lamp is turned on, be sure to erase the DTC codes using the Hi-Scan just after repairing or replacing components, including the fuse.
9. Especially when welding the body, never fail to disconnect the negative (-) battery terminal.

## SPECIAL SERVICE TOOL ERMB0050

Tool (Number and name)	Illustration	Use
DAB, PAB : 0957A-38100 BPT : 0957A-34200 Deployment adaptor	 <p style="text-align: right;">ERHA010A</p>	Deployment inside the vehicle (when vehicle will no longer be driven)
0957A-38000 Diagnosis checker	 <p style="text-align: right;">ERHA010B</p>	Wring harness checker of each module
0957A-38200 Dummy	 <p style="text-align: right;">ERHA010C</p>	Simulator to check the resistance of each wiring harness

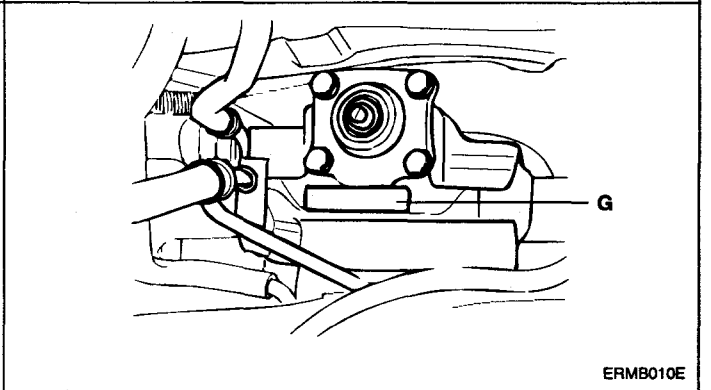
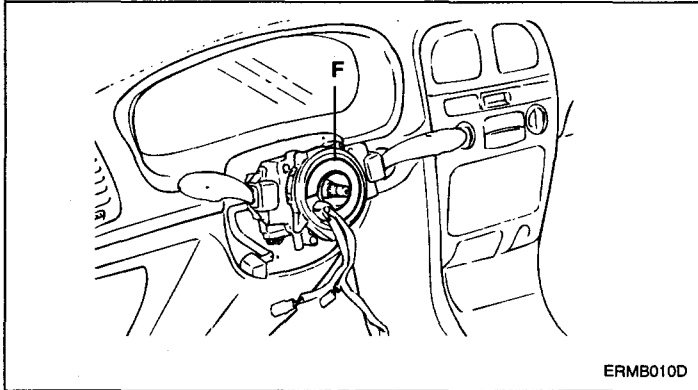
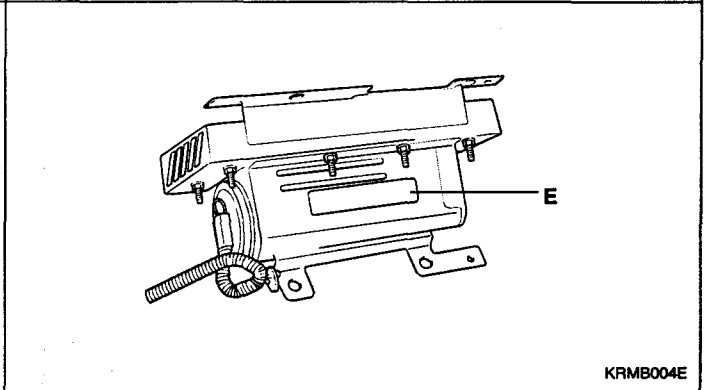
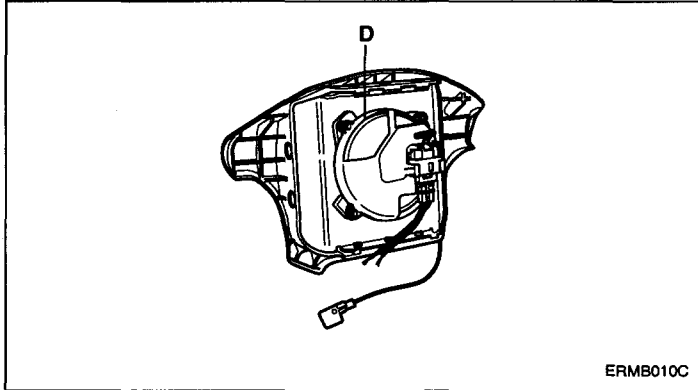
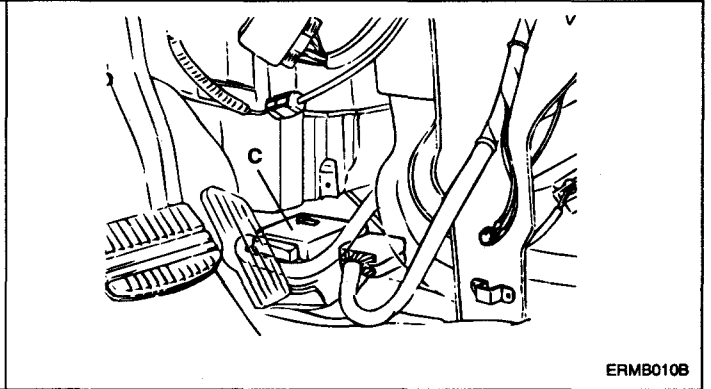
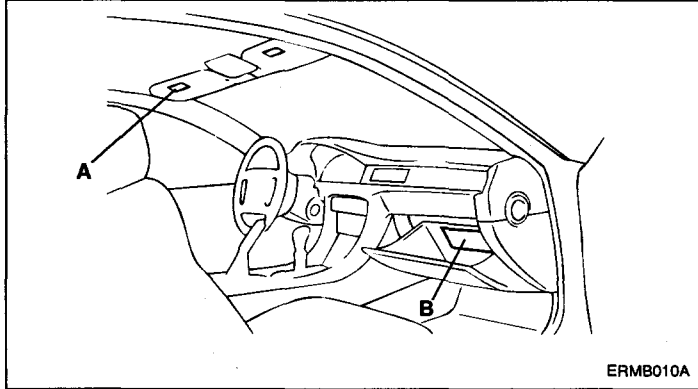
- \* DAB : Driver side air bag
- \* PAB : Passenger side air bag
- \* BPT : Belt Pretensioner

**WARNING/CAUTION LABELS**

ERMB0100

A number of caution labels relating to the SRS are found in the vehicle, as shown in the following illustration. Follow label instructions when servicing the SRS.

If labels are dirty or damaged, replace them with new ones.



ERMB0150

<p><b>A. AIRBAG WARNING</b>  <b>TO AVOID SERIOUS INJURY :</b></p> <ul style="list-style-type: none"> <li>• Never put a rear-facing child seats in front.</li> <li>• Unbelted children can be killed by the air bag.</li> <li>• Do not sit close to the airbag.</li> <li>• Always use seat belts.</li> <li>• Do not place any objects over the airbag or between the airbag and yourself.</li> <li>• See the owner's manual for further information and explanation.</li> </ul>	<p><b>B. SUPPLEMENTAL RESTRAINT SYSTEM (AIRBAG) INFORMATION</b>  The airbag is a supplemental restraint system (SRS). You must always wear the seat belts. The airbag system condition is normal when "SRS" lamp in cluster flashes approximately 6 times after the ignition key is turned on and then goes off.</p> <p>If any of the following conditions occur, the system must be serviced.</p> <ol style="list-style-type: none"> <li>1. "SRS" lamp does not light up when key is turned on.</li> <li>2. "SRS" lamp stays lit or flashes continuously.</li> <li>3. The airbag has inflated.</li> </ol> <p>The airbag system must be inspected by an authorized dealer ten years after vehicle manufacture date shown on certification label, located on left front door opening area.</p> <p><b>⊗ WARNING</b>  <b>Failure to follow above instructions may result in injury to you or other occupants in the vehicle. See "SRS" section in Owner's Manual for more information about airbag.</b></p>
<p><b>C. CAUTION : AIRBAG ESPS UNIT</b>  Detach connector before unmounting. Assemble strictly according to manual instructions.</p>	<p><b>D. WARNING</b>  This item contains an explosive igniter, to help avoid personal injury due to unwanted inflation do not service or dispose of this unit without following instructions in the service manual.</p> <p>Failure to do so may render the SRS system inoperative, risking serious driver injury.</p>
<p><b>E. CAUTION : SUPPLEMENTAL RESTRAINT SYSTEM MODULE</b>  This item contains an explosive igniter, to help avoid personal injury due to unwanted inflation do not service or dispose of this unit without following instructions in the service manual.</p> <p>Failure to do so may render the SRS system inoperative, risking serious driver injury.</p>	<p><b>F. CAUTION : SRS clock spring</b>  This is not a repairable part. Do not disassemble or tamper. If defective, replace entire unit as per service manual instructions.</p> <p>To re-center, rotate clockwise until tight. Then rotate in opposite direction approximately 3 turns and align the &gt;&lt; mark.</p> <p>Failure to follow these instructions may render SRS system inoperative, risking serious driver injury.</p>
<p><b>G. CAUTION : SRS</b>  Before removal of steering gearbox, read service manual, center the front wheels and remove the ignition key. Failure to do so may damage SRS clock spring and render the SRS system inoperative, risking serious driver injury.</p>	

# SRSCM (SUPPLEMENTAL RESTRAINTS SYSTEM CONTROL MODULE)

## ELECTRICAL SYSTEM ERHA0250

The SRS airbag system has sophisticated electrical and electronic components. Therefore the airbag operating components should be handled very carefully.

### SRSCM (Supplement Restraint System Control Module)

The SRSCM will deploy the airbag modules by sensing the frontal impact sensed by the sensor built in to the SRSCM.

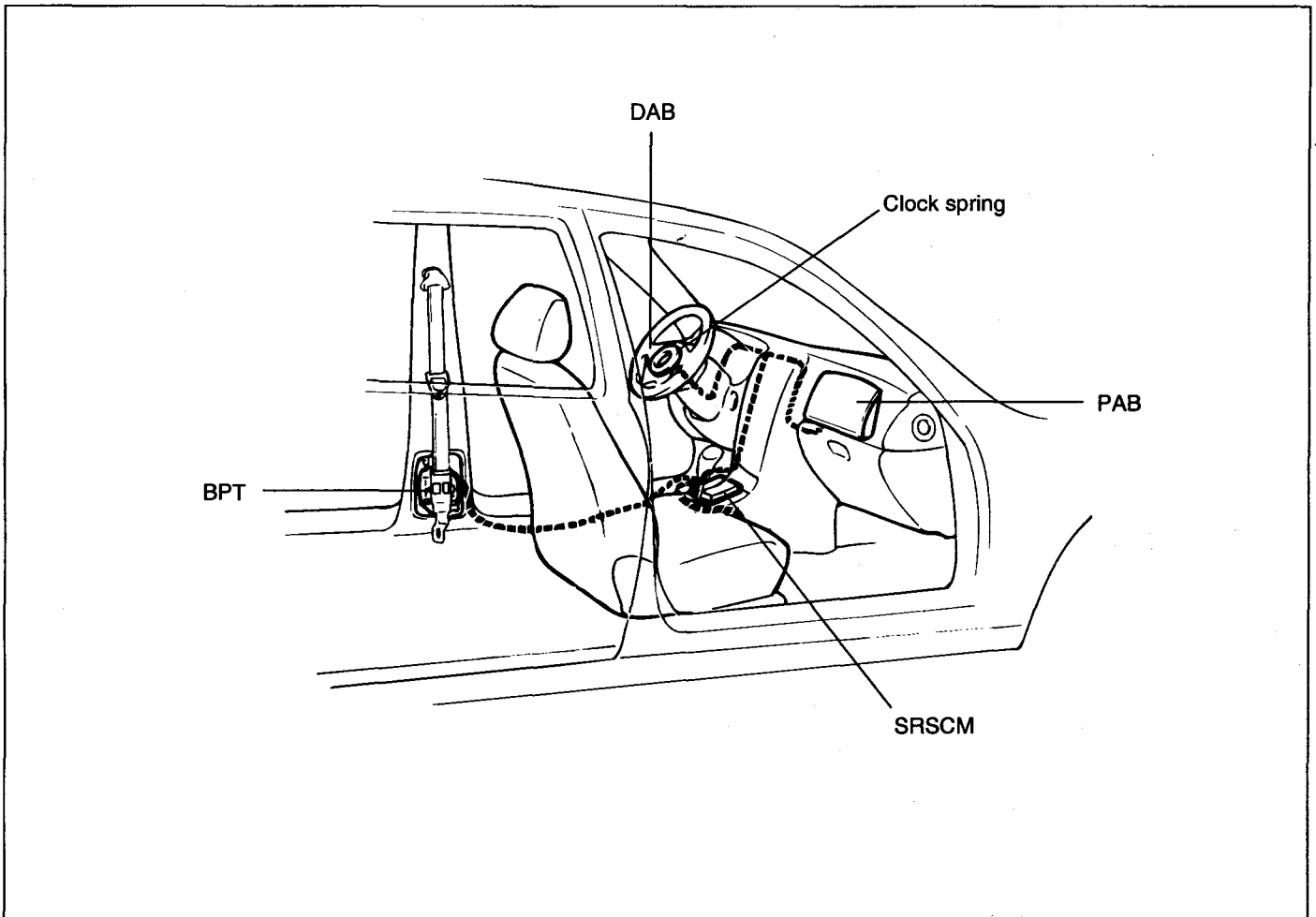
1. **DC/DC convertor :** The DC/DC converter in the power supply includes a step-up and a step-down converter, which provides the firing voltage for four firing circuits and the internal operating voltage. If the internal operating voltage falls below a defined threshold, a reset is executed.
2. **Arming sensor/safing sensor :** The arming/safing sensor built in to the airbag firing circuit has the function of arming the airbag circuit under all required deployment conditions and maintaining the airbag firing circuits unarmed under normal driving conditions. The safing sensor is a dual-contact electromechanical switch that closes if it experiences a deceleration exceeding a specified threshold.
3. **Back-up power :** The SRSCM reserves an energy reserve to provide deployment energy for a short period when the vehicle voltage is low or if lost in a vehicle frontal crash.
4. **Malfunction detection :** The SRSCM continuously monitors SRS operating status while the ignition key is turned on and detects possible malfunctions in the system. The malfunction can be displayed in the form of a diagnostic trouble codes using the Hi-Scan Pro.
5. **MIL (Malfunction Indication Lamp) notification :** If any fault is detected, the SRSCM sends a signal to the indicator lamp on the instrument cluster to warn the vehicle driver.  
The MIL indicator is the key item in notifying the driver of SRS faults. It verifies lamp and SRSCM operation by flashing 6 times when the ignition switch is first turned on.
6. **Malfunction recording :** Once a fault occurs in the system, the SRSCM records the fault in memory in the form of a DTC, which can only be erased by the Hi-Scan Pro.
7. **Data link connector :** SRSCM memory stored is linked through this connector located underneath the driver side crash pad to an external output device such as the Hi-Scan Pro.
8. **After firing the airbags once, the SRSCM cannot be used again and must be replaced.**
9. **Crash output**  
The crash output is used to unlock the doors in case of a crash. The crash output is : 0-200  $\mu$ A in OFF mode and 200mA in ON mode. During the unlock command, the switch is closed for 200 mS.



**INFLATOR MODULE (DAB, PAB)** ERMB0250

The DAB (Driver airbag), PAB (Passenger airbag) module and BPT (Belt pretensioner) are comprised of an inflator

and cushion. The initiator (A gas generator igniting device) is positioned in the inflator. When the vehicle crashes from the front with sufficient force, closing the sensor of the SRSCM, current develops through the deployment loop. Current passing through the initiator ignites the material in the DAB and PAB module and inflates the airbag.



ERMB025A

1. When removing the air-bag module or handling a new airbag module, it should be placed with the pad top surface facing up. This way the twin-lock type connector lock lever should be in a locked state and care should be taken to place it so that the connector will not be damaged. Do not store a steering wheel pad on top of another one. (Storing the pad with its metallic surface facing up may lead to a serious accident if the airbag should inflate.)
2. Never measure the resistance of the airbag squib. (This may cause the airbag to deploy.)
3. Store the airbag module where the ambient temperature remains below 93°C (200°F), without high humidity and away from electrical noise.
4. When using electric welding, disconnect the battery(-) terminal before starting work.

**SRS HARNESS** ERMB0260

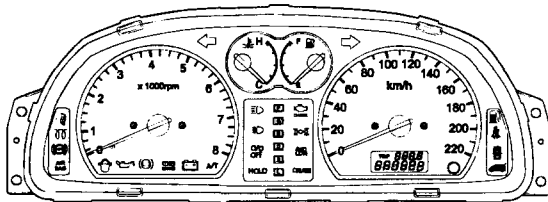
The SRS harness is wrapped in a yellow tube to enable it to be discriminated from other system harnesses. And the shorting bar is contained inside the wiring connectors of the DAB, PAB and BPT inflator side. The shorting bar shorts the current flow of the DAB, PAB and BPT module circuits when the connectors are disconnected. The circuits to the inflator module are shorted in this way to help prevent unwanted deployment of the airbag when serving the airbag module.

**SRSCM INDEPENDENT LAMP ACTIVATION**

The SRS malfunction indicator lamp (MIL) is located on the cluster giving information about SRS operating conditions by the control signals from SRSCM.

There are certain faulty conditions in which the SRSCM (SRS Control Module) cannot function and thus cannot control the operation of the lamp. In these cases, the lamp is directly activated by appropriate circuitry that operates independently of the SRSCM, as follow :

1. Loss of ignition voltage supply to the SRSCM : lamp turned on continuously.
2. Loss of internal operating voltage to the SRSCM : lamp turned on continuously.
3. SRSCM faults : lamp turned on continuously
4. SRSCM not connected : lamp turned on through shorting bar in wiring harness connector.



KTMB002C

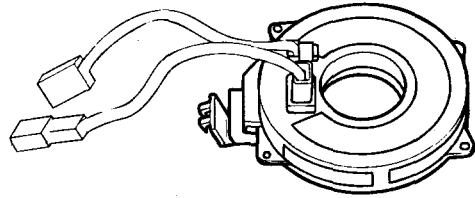
**MIL OPERATING METHOD** ERHA0400

	Operating situation	Operating method
R U N N I N G	o Return to normal from temporary fault	 ON → OFF
	o $\sum$ Faults frequency $\geq 5$ o Active fault	 Turn it on continuously
S T A R T I N G	o Normal	 Blink 6 times
	o $\sum$ Faults frequency $\leq 4$	 On to off after 6 seconds
	o $\sum$ Faults frequency $\geq 5$ o Active fault	 Turn it on continuously

ERDA009A

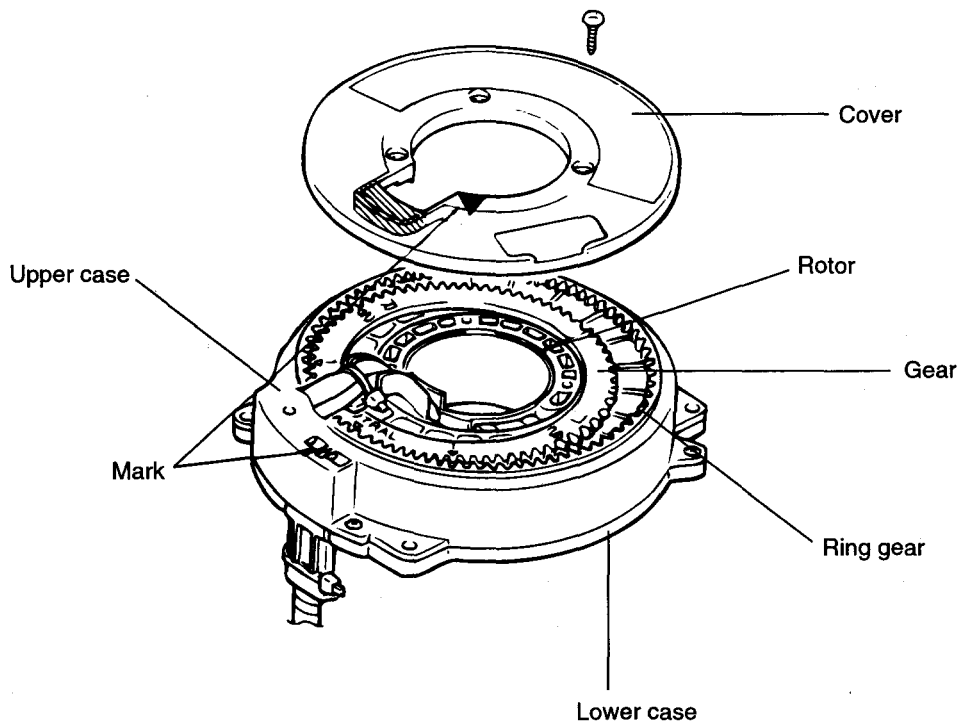
**CLOCK SPRING** ERM0300

The clock spring (coil spring) consists of two current carrying coils. It is attached between the steering column and the steering wheel. It allows rotation of the steering wheel while maintaining continuous contact with the deployment loop through the inflator module.



The steering wheel must be fitted correctly to the steering column with the clock spring at the neutral position, otherwise cable disconnection and other troubles may result.

ERHA003B

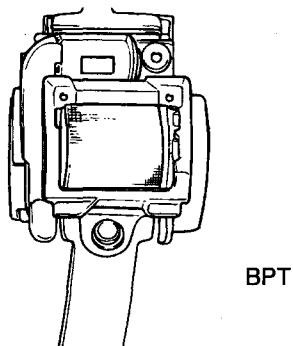
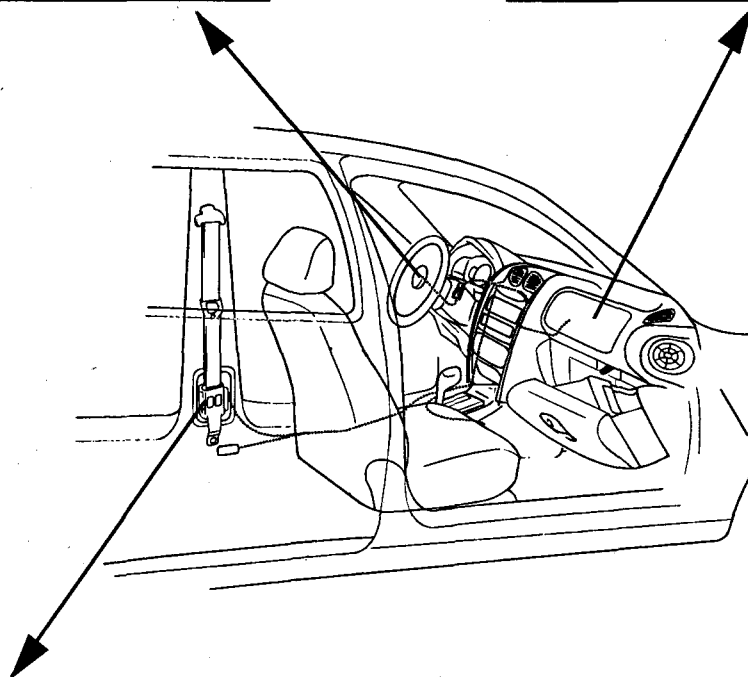
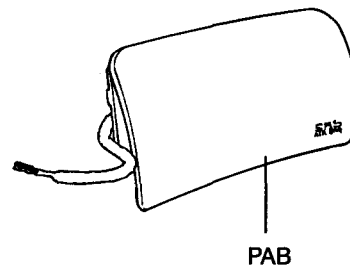
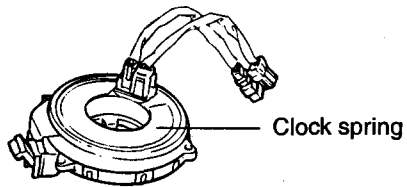


When the rotor is rotated clockwise

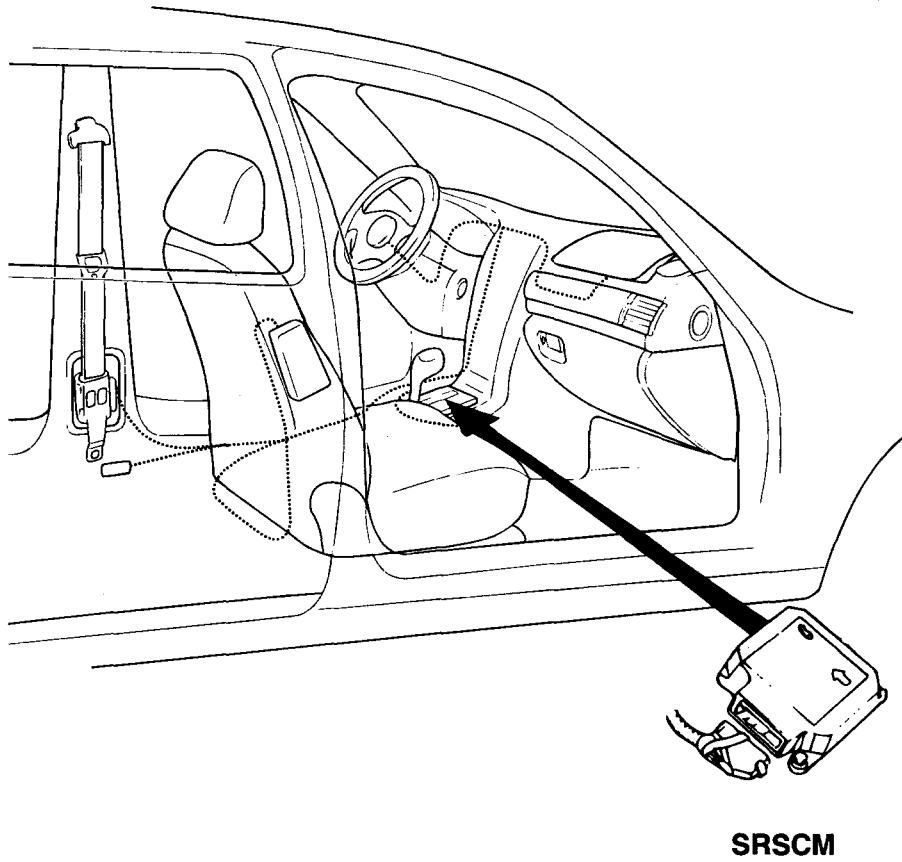
ERLB002C

**SYSTEM COMPONENT AND LAYOUT**

ERMB0350

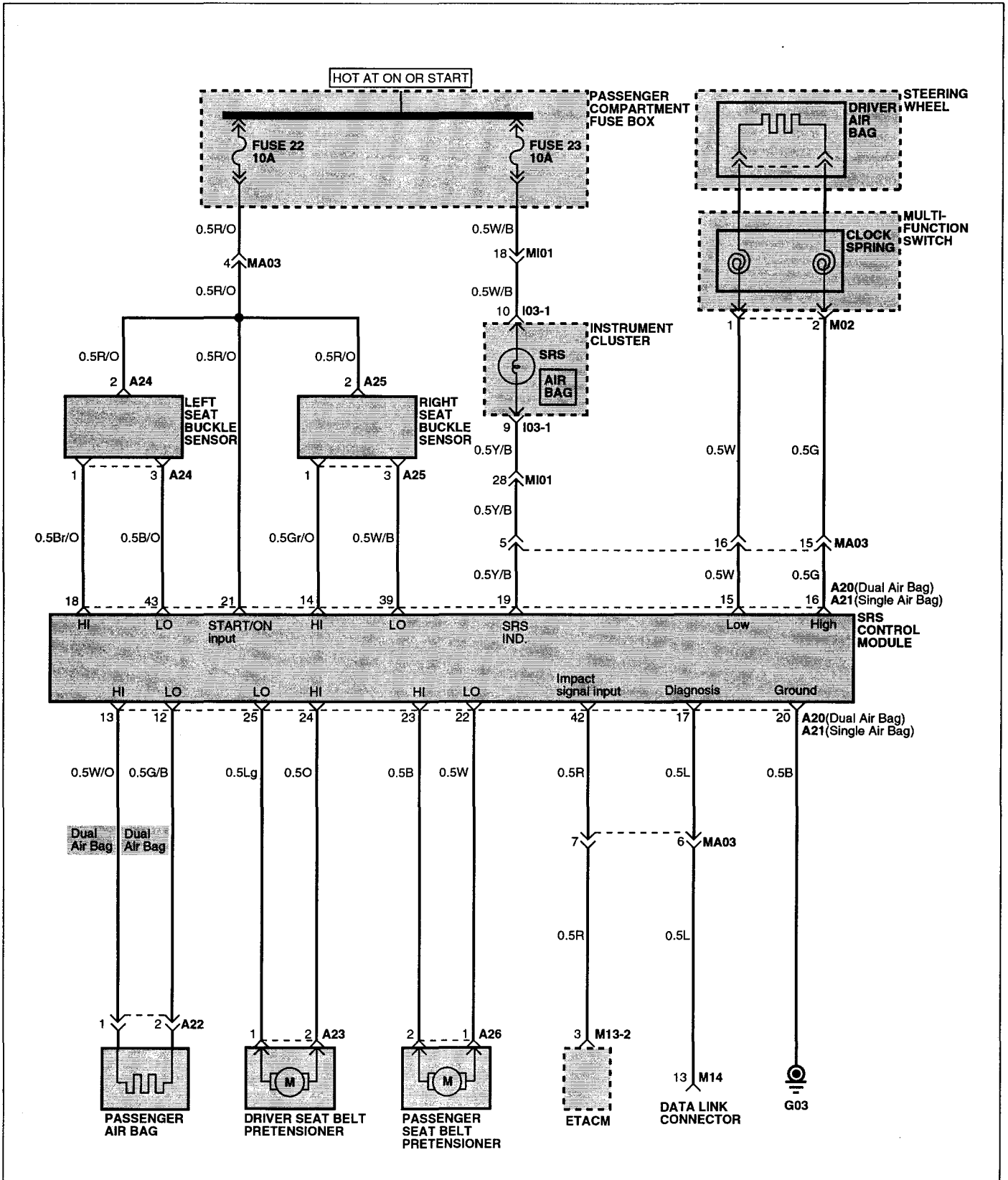


SRSCM (SRS CONTROL MODULE) ERJB0130



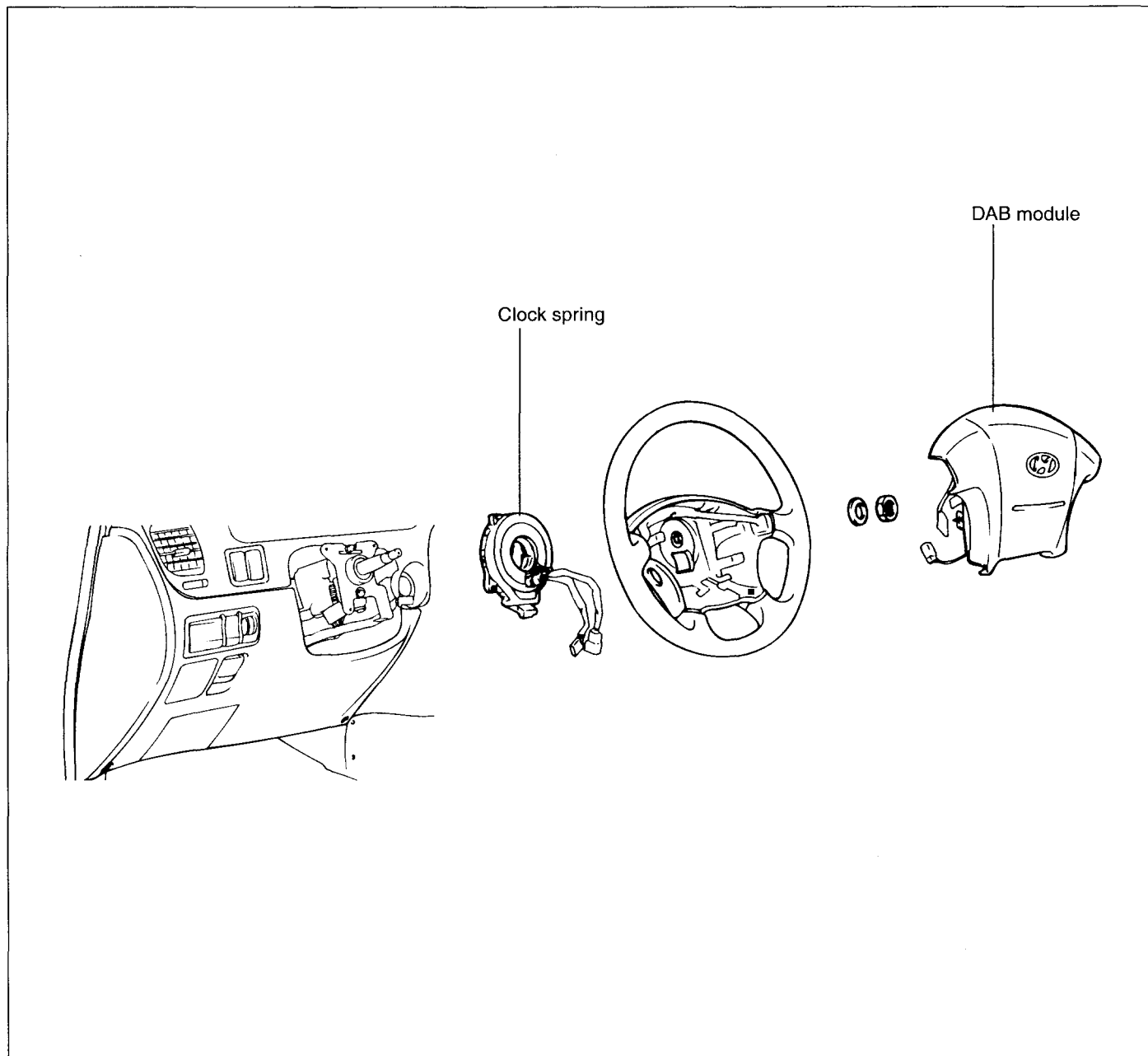
AIRBAG

ERMB0430



# AIR BAG MODULE (DRIVE SIDE) AND CLOCK SPRING

COMPONENTS ERHA0700

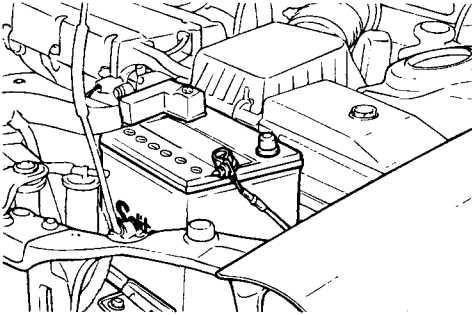


**REMOVAL** ERMB0480

1. Disconnect the negative battery cable and keep it secure away from battery.

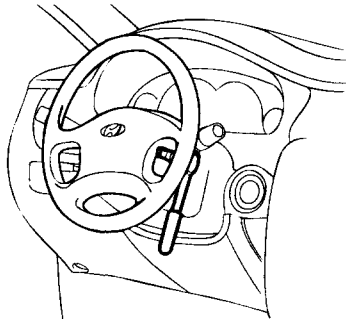
**⚠ CAUTION**

**Wait for 30 seconds after disconnecting the battery cable before doing any further work.**



ERA9007A

2. Remove the side protect cover of the steering wheel and the airbag module mounting bolts using a hexagonal wrench.

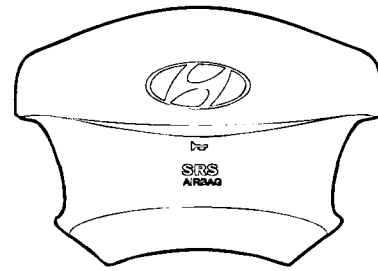


EPA002A

3. When disconnecting the connector of the clock spring from the airbag module, pull the airbag's lock toward the outer side to spread it open.
4. Remove the driver's airbag module.

**⚠ CAUTION**

1. **When disconnecting the airbag module-clock spring connector, take care not to apply excessive force to it.**
2. **The removed airbag module should be stored in a clean, dry place with the pad cover facing up.**

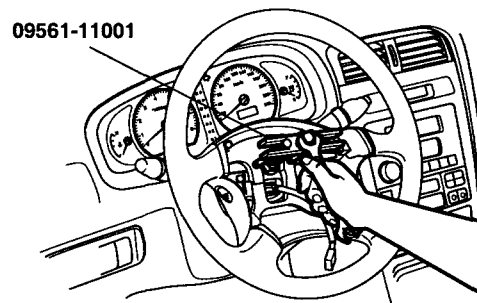


ERHA005A

5. Remove the steering wheel using the SST (09561-11002).

**⚠ CAUTION**

**Do not hammer on the steering wheel. Doing so may damage the collapsible column mechanism.**



KFWC003A



**INSPECTION** ERMB0490**AIRBAG MODULE**

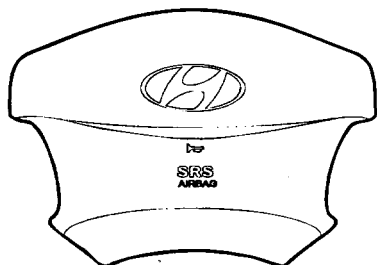
If any damaged or worn parts are found during the following inspection, replace the airbag module with a new one.

Dispose the old one according to the specified procedure.

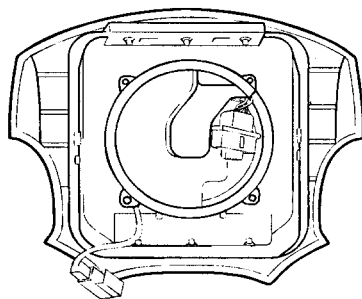
**⚠ CAUTION**

*Never attempt to measure the circuit resistance of the airbag module (squib) even if you are using the specified tester. If the circuit resistance is measured with a tester, accidental airbag deployment could result in serious personal injury.*

1. Check the pad cover for dents, cracks or deformities.
2. Check the airbag module for denting, cracking or deformation.
3. Check hooks and connectors for damage, terminals for deformities, and harnesses for binds.
4. Check the airbag inflator case for dents, cracks or deformities.

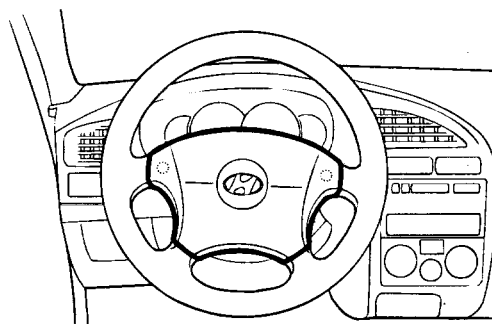


ERHA005A



ERHA004A

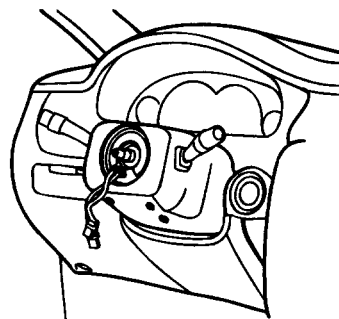
5. Install the airbag module to the steering wheel to check the fit and alignment with the wheel.



KPKA012A

**CLOCK SPRING**

1. If, as a result of the following checks, even one abnormal point is discovered, replace the clock spring with a new one.
2. Check the connectors and protective tube for damage, and terminals for deformities.



ERHA004C

# AIR BAG MODULE (PASSENGER SIDE)

## AIR BAG MODULE (PASSENGER)

### REMOVAL ERMB0500

#### CAUTION

1. *Never attempt to disassemble or repair the airbag module.*
2. *Do not drop the airbag module or allow contact with water, grease or oil. Replace it if a dent, crack, deformation or rust are detected.*
3. *The airbag module should be stored on a flat surface and placed so that the pad surface is facing upward. Do not place anything on top of it.*
4. *An undeployed airbag module should only be disposed of in accordance with the procedures.*
5. *Never attempt to measure the circuit resistance of the airbag module (squib) even if you are using the specified tester. If the circuit resistance is measured with a tester, accidental airbag deployment could result in serious personal injury.*
6. *Whenever the PAB is deployed it should be replaced with a new one assembled with an extension wire, because the squib is a melt down if the PAB is deployed making the extension wire useless.*

1. Disconnect the battery negative (-) terminal cable.

#### CAUTION

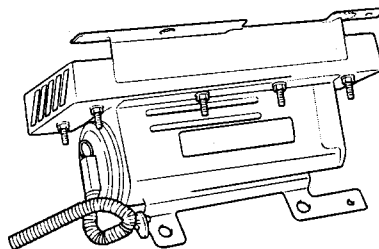
**Wait at least 30 seconds.**



ERA9007A

2. Remove the glove box.
3. Disconnect the PAB module connector.

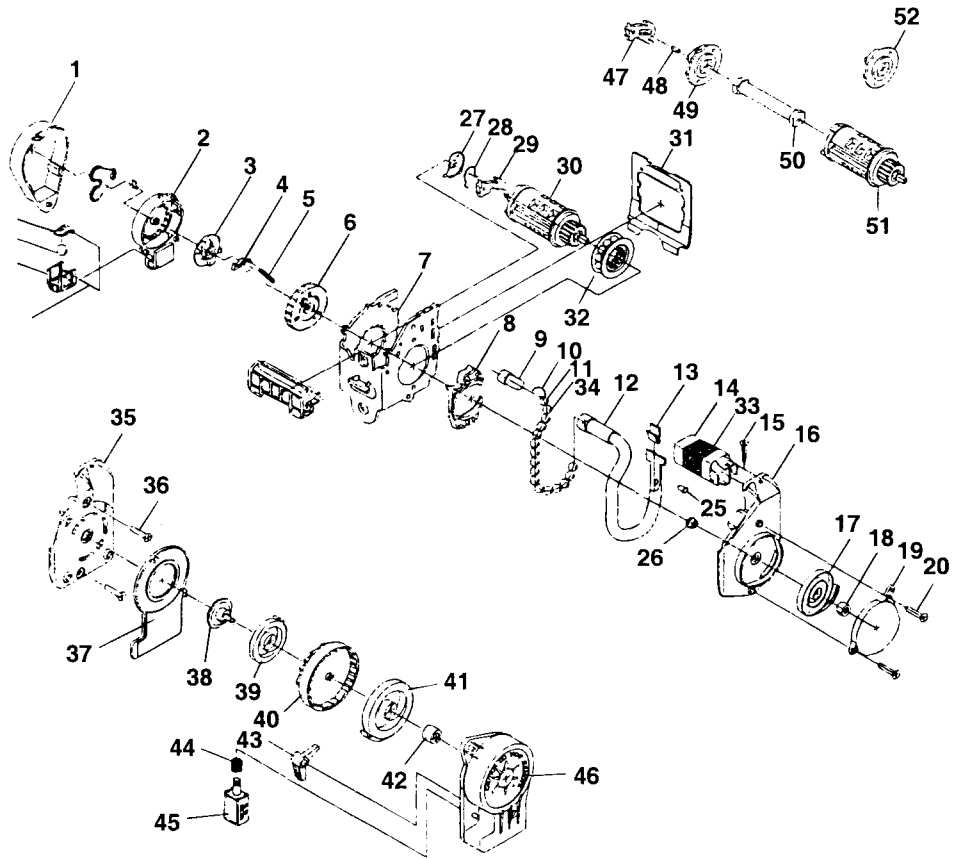
4. Remove the crash pad assembly and then undo the PAB module. (Refer to the BD section)



KRMB001A

PRETENSIONER SEAT BELT

COMPONENTS ERJB0260



- |                       |                           |                          |                                  |
|-----------------------|---------------------------|--------------------------|----------------------------------|
| 1. COVER-L/RH         | 13. BALL STOPPING SPRING  | 31. DISTANCE SHEET       | 43. SOLENOID ASSY                |
| 2. BEARING PLATE-L/RH | 14. BALL TRAP-L/RH        | 32. PINION GEAR          | 44. RETURN SPRING                |
| 3. INERTIA MASS       | 15. SCREW                 | 33. LABEL                | 45. SOLENOID LEVER-L/RH          |
| 4. WEB SENSOR PAWL    | 16. TUBE COVER-L/RH       | 34. BALL ALUMINUM        | 46. T/R COVER-L/RH               |
| 5. WEB SENSOR SPRING  | 17. REWINDING SPRING      | 35. TUB COVER (T/R)-L/RH | 47. LOCK G ELEMENT (L/L)-L/RH    |
| 6. STEERING DISC-L/RH | 18. SPRING CORE-L/RH      | 36. RIVET (T/R)          | 48. NECK                         |
| 7. BASE L/RH          | 19. SPRING COVER-L/RH     | 37. RETAINER-L/RH        | 49. TREAD HEAD (W/STOP)-L/RH     |
| 8. BALL L/RH          | 20. RIVET                 | 38. BUSH SHAFT           | 50. TORSION BAR-5.5kN            |
| 9. GAS GENERATOR      | 27. RETAINING WASHER-L/RH | 39. REDUCE SPRING        | 51. SPINDLE (L/L)-L/RH           |
| 10. TUBE SPRING       | 28. LOCK DISC SPRING      | 40. HOLDER-L/RH          | 52. TREAD HEAD (W/OUT STOP)-L/RH |
| 11. PISTON            | 29. LOCKING ELEMENT-L/RH  | 41. NORMAL SPRING        |                                  |
| 12. TUBE-L/RH         | 30. SPINDLE-L/RH          | 42. STAY SHAFT           |                                  |

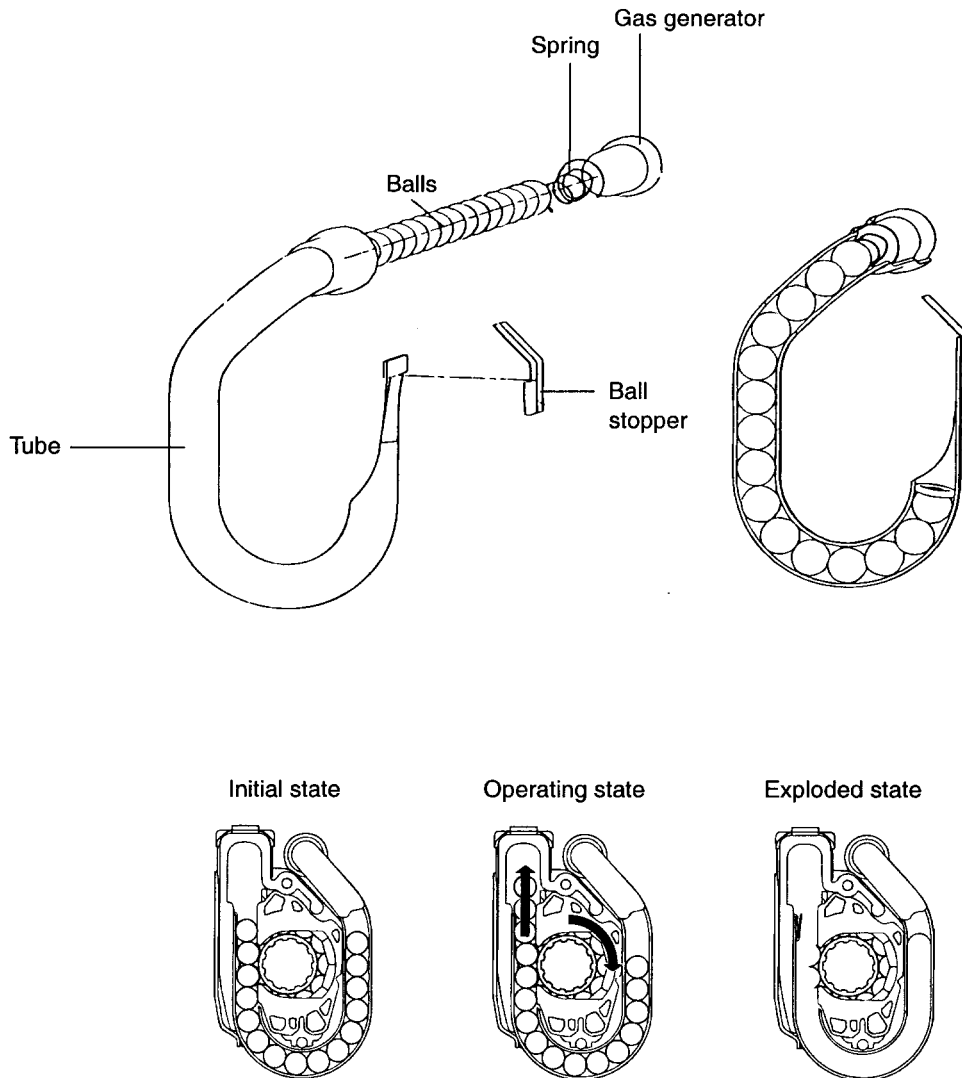
**FUNCTION OF PRETENSIONER** ERHA0900

When a vehicle crashes with a certain degree of frontal impact, the gas generator will ignited an electrical firing signal from the SRSCM (Supplemental Restraint System Control Module).

Gas from the gas generator causes movement of the piston in the manifold case (cylinder), which operates the rack gear.

The rack gear, rotates a piston gear and a pinion rotates the planet gears.

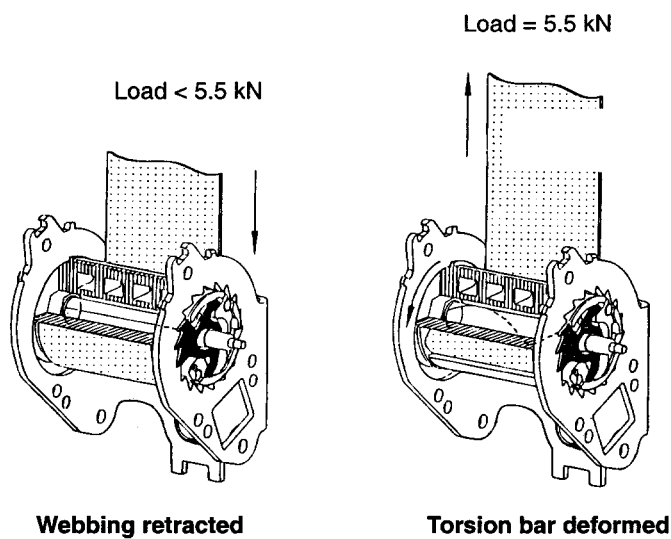
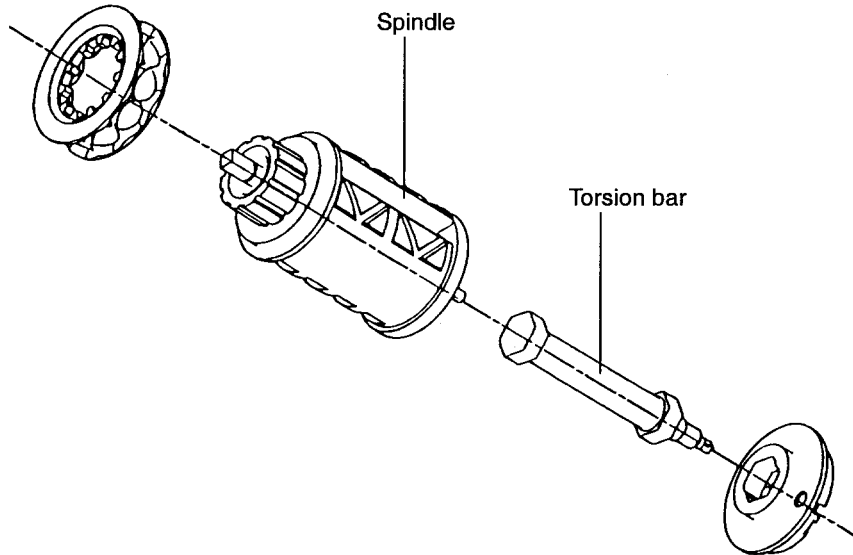
Finally, the webbing is retracted by the rotation of the spool. Therefore, the pretensioner seat belt helps to reduce the severity of injury to the front seat occupant by retracting the seat belt webbing. This prevents the occupant from thrusting forward and hitting the steering wheel or the instrument panel when the vehicle crashes.



**LOAD LIMITER**

The load limiter is designed to relieve the impact force to an occupant chest's of the seat belt webbing when the occupant is restrained by the seat belt during a crash. If

the crash force reaches a certain value, the torsion bar in the pretensioned seat belt will deform and cause the webbing to be extracted from the seat belt, thus, relieving the impact force.



**REMOVAL** ERM80570

1. Disconnect the battery negative (-) terminal.

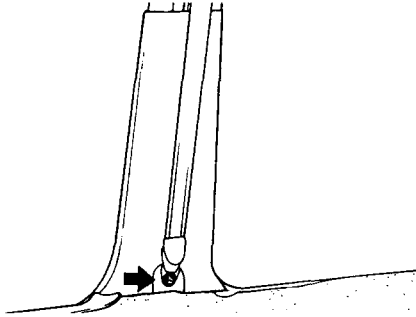
**⚠ CAUTION**

**Wait at least 30 seconds.**



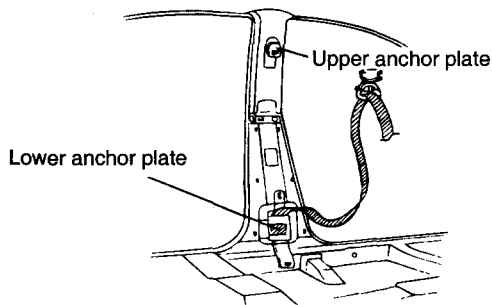
ERA9007A

2. Remove the door scuff trim.
3. Remove the center pillar lower trim after removing seat belt lower anchor bolt.



ESHA040I

4. Remove the upper anchor plate cover and upper anchor plate.
5. Remove the lower anchor plate and front seat belt.



HEW6015A

**⚠ CAUTION**

1. **Never attempt to disassemble or repair the BPT.**

2. **Do not drop the BPT or allow contact with water, grease, oil. Replace it if a dent, crack, deformation or rust are detected.**
3. **Do not place anything on the BPT.**
4. **Do not expose the BPT to temperature over 93° C (200° F).**
5. **BPT functions one time only. Be sure to replace the BPT after it is deployed.**
6. **Be sure to wear gloves and safety goggles when handling the deployed BPT.**

# AIR BAG CONNECTORS

## SRSCM CONNECTOR

(DAB+PAB+BPT) ERMBO450

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
											●	●	●	●	●	●	●	●	●	●	●	●	●	●
26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
						○	○				○	●		○		●	●	○			○		○	

○ Shorting bar

ERMB005A

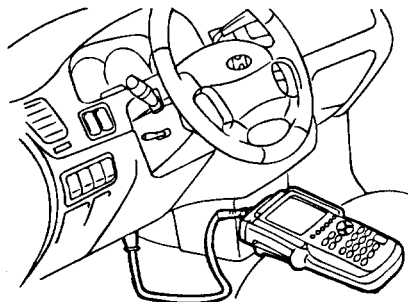
PIN NO	Description	Input/output
1-11	-	-
12	Passenger airbag, Low	Output
13	Passenger airbag, High	Output
14	Passenger seat belt buckle switch, High	Output
15	Driver airbag, Lows	Output
16	Driver airbag, High	Output
17	Diagnosis	Input/output
18	Driver seat belt buckle switch, High	Output
19	Warning lamp	Output
20	Ground	Input
21	Battery supply	Input
22	Passenger seat belt pretensioner, Low	Output
23	Passenger seat belt pretensioner, High	Output
24	Driver seat belt pretensioner, High	Output
25	Driver seat belt pretensioner, Low	Output
26-31	-	-
32-35	Shorting bar	-
36	-	-
37-38	Shorting bar	-
39	Passenger seat belt buckle switch, Low	Output
40-41	Shorting bar	-
42	Crash output	Output
43	Driver seat belt buckle switch, Low	Output
44-45	Shorting bar	-
46	-	-
47-50	Shorting bar	-

# TROUBLESHOOTING

## DIAGNOSIS WITH SCAN TOOL ERHA1000

### CHECK PROCEDURES

1. Turn the ignition key to "OFF" position.
2. Connect the Scan tool DLC to the vehicle data link connector in the lower dash panel.
3. Turn the ignition key to "ON" position and turn on Scan tool.
4. Perform the SRS diagnosis according to the vehicle's model configuration.
5. If a fault code is shown, replace the component. Never attempt to repair the component.
6. If the Scan tool finds that a component in the system is faulty, there is a possibility that the fault is not in the components but in the SRS wiring or connector.

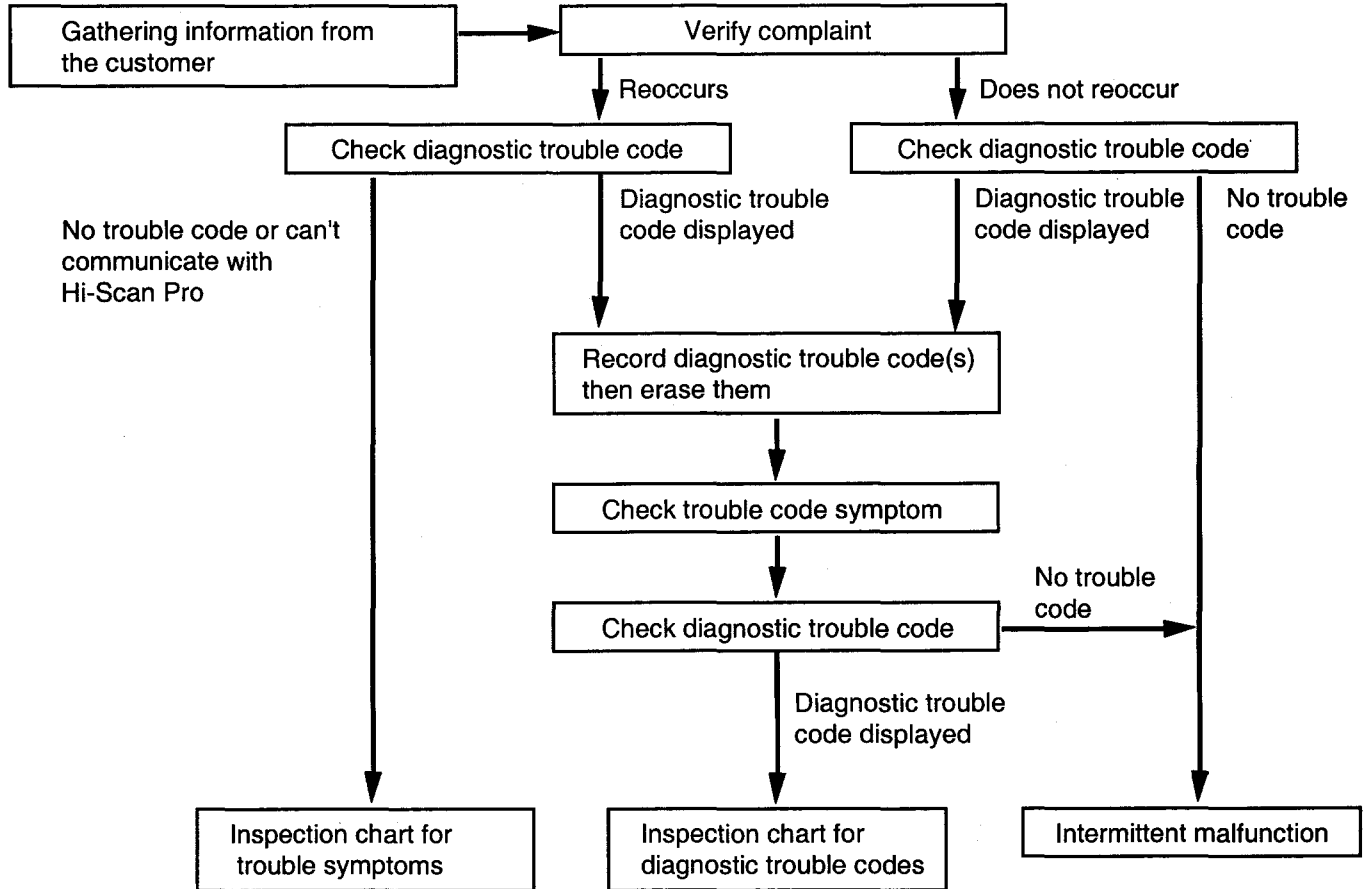


ERHA006A



DIAGNOSTIC TROUBLESHOOTING

FLOW ERMB0650



ERA9035A

SPECIFICATION

	DAB	PAB	BPT
Resistance	2 ± 0.2Ω	2 ± 0.4Ω	2.15 ± 0.35Ω
All-fire current	0.4A(Min), 10sec	0.25A(Min), 10sec	200mA, 10sec
No-fire current	1.2A(Max), 2mS	1.2A, 2mS	800mA, 2mS
Monitor current	50mA	100mA	40mA

ERMB0700

**INSPECTION CHART FOR DIAGNOSTIC TROUBLE CODE  
OPTIONS : DAB + PAB + BPT**

<b>DTC No.</b>	<b>Fault description</b>	<b>Remedy</b>
B1111	Battery voltage too high	Erasible
B1112	Battery voltage too low	Erasible
B1346	Driver airbag (DAB), Resistance too high	Erasible
B1347	Driver airbag (DAB), Resistance too low	Erasible
B1348	Driver airbag (DAB), Short to GND	Erasible
B1349	Driver airbag (DAB), Short to Battery	Erasible
B1352	Passenger airbag (PAB), Resistance too high	Erasible
B1353	Passenger airbag (PAB), Resistance too low	Erasible
B1354	Passenger airbag (PAB), Short to GND	Erasible
B1355	Passenger airbag (PAB), Short to Battery	Erasible
B1361	Driver seat belt pretensioner (DBPT), Resistance too high	Erasible
B1362	Driver seat belt pretensioner (DBPT), Resistance too low	Erasible
B1363	Driver seat belt pretensioner (DBPT), Short to GND	Erasible
B1364	Driver seat belt pretensioner (DBPT), Short to Battery	Erasible
B1367	Passenger seat belt pretensioner (PBPT), Resistance too high	Erasible
B1368	Passenger seat belt pretensioner (PBPT), Resistance too low	Erasible
B1369	Passenger seat belt pretensioner (PBPT), Short to GND	Erasible
B1370	Passenger seat belt pretensioner (PBPT), Short to Battery	Erasible
B1511	Driver seat buckle switch, short to battery	Erasible
B1512	Driver seat buckle switch, short to ground	Erasible
B1513	Passenger seat buckle switch, short to battery	Erasible
B1514	Passenger seat buckle switch, short to ground	Erasible
B1620	Internal fault	Replace SRSCM
B1650	Crash recorded	Replace SRSCM
B1661	ECU mismatching	Erasible
B2500	Warning lamp failure	Erasible

 **NOTE**

- The DAB is located in the steering wheel.
- The PAB is located in the crash pad.

ERMB0750

CIRCUIT INSPECTION

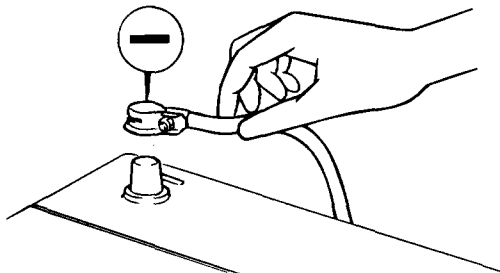
<b>DTC</b>	<b>B1111 B1112</b>	<b>Battery voltage too high Battery voltage too low</b>
------------	------------------------	---

CIRCUIT DESCRIPTION

The SRS is equipped with a voltage-increase or decrease circuit (DC-DC converter) in the SRSCM in case the source voltage goes down or up. When the battery voltage is down or up the voltage-increase or decrease circuit (DC-DC converter) function will increase or decrease the voltage of the SRS to normal voltage. The diagnosis system malfunction display for this circuit is different to other circuits. When the SRS warning lamp remains lit up and the DTC is a B1111 or B1112 code, battery voltage too high or low is indicated. When voltage returns to normal, the SRS warning light automatically goes off and a malfunction is no longer indicated.

INSPECTION PROCEDURE

1. Preparation.
  - 1) Disconnect the negative (-) terminal cable from the battery, and wait at least 30 seconds.
  - 2) Remove the DAB module.
  - 3) Disconnect the connectors of the PAB and belt pretensioners.
  - 4) Disconnect the SRSCM connector.



EADA011A

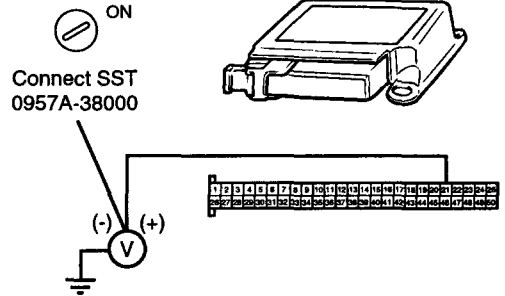
**CAUTION**

*Place the DAB with the front surface facing upward.*

2. Check source voltage.

- 1) Connect the negative (-) terminal cable to the battery.

2) Turn the ignition switch ON.



ERMB075A

[CHECK]

Measure voltage between the battery supply terminal 21 of the SRS connector and body ground.

**LIMIT : 9 - 16V**

**NG** → Check the harness between the battery and the SRSCM. Check the battery and charging system

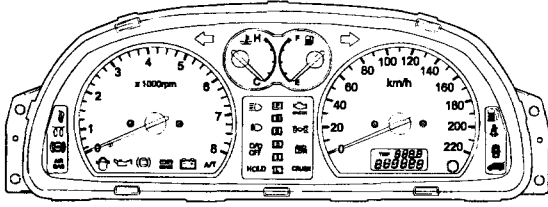
**OK**  
↓

ERJB040A

3. Does the SRS warning light turn off ?

[PREPARATION]

- 1) Turn the ignition switch to LOCK.
- 2) Connect the DAB module.
- 3) Connect the PAB connector, left and right side airbag, belt pretensioner and satellite connectors.
- 4) Connect the SRSCM connector.
- 5) Turn the ignition switch ON.



KTMB002C

**[CHECK]**

Check that the SRS warning light goes off.

**NG** → Check for DTCs. If a DTC is output, perform troubleshooting for the DTC.  
If B1111 or B1112 is output, replace the SRSCM.

**OK**



From the results of the above inspection, the malfunctioning part can now be considered normal.

ERJB040B

ERHA1100

CIRCUIT INSPECTION

<b>DTC</b>	<b>B1348</b> <b>B1354</b> <b>B1363</b> <b>B1369</b>	<b>DAB Short to ground</b> <b>PAB Short to ground</b> <b>Driver BPT Short to ground</b> <b>Passenger BPT Short to ground</b>
------------	--	---

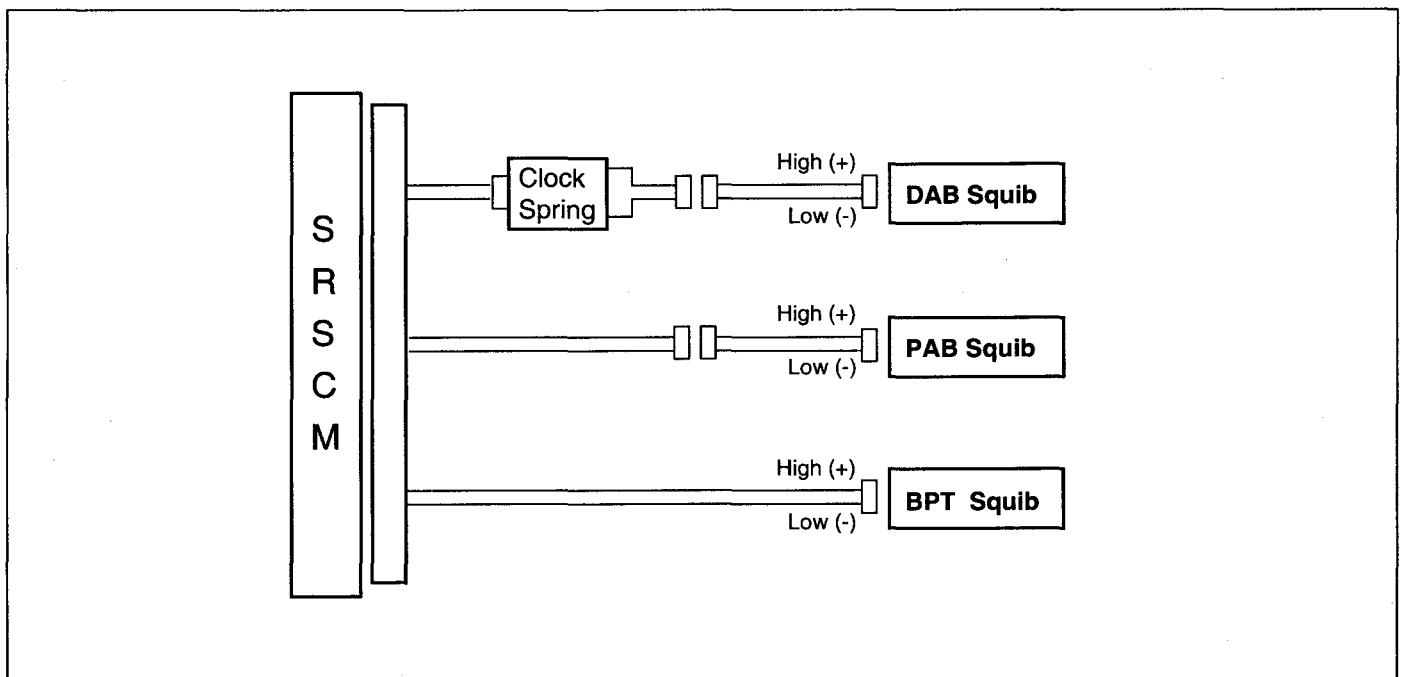
CIRCUIT DESCRIPTION

DTCs are recorded when short to ground is detected in the squib circuit.

The squib circuit consists of the SRSCM, clock spring, DAB, PAB and BPT. It causes the SRS to deploy when the SRS deployment conditions are satisfied. The above

DTC Detecting Condition	Trouble Area
<ul style="list-style-type: none"> <li>• Short circuit in squib wire harness (to ground)</li> <li>• Squib malfunction</li> <li>• Clock spring malfunction</li> <li>• SRSCM malfunction</li> </ul>	<ul style="list-style-type: none"> <li>• DAB squib</li> <li>• PAB squib</li> <li>• BPT squib</li> <li>• Clock spring</li> <li>• SRSCM</li> <li>• Wire harness</li> </ul>

WIRING DIAGRAM



**INSPECTION PROCEDURE**

1. Preparation

- 1) Disconnect the battery negative terminal and wait for 30 seconds.
- 2) Disconnect the DAB module connector.
- 3) Disconnect the PAB and BPT connectors.
- 4) Disconnect the SRSCM connector.

**NOTE**

Place the DAB module facing upward.

2. Check DAB squib circuit.

**[CHECK]**

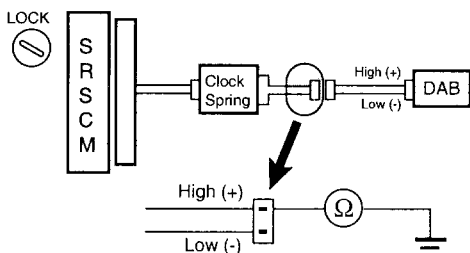
For the connector (on the clock spring side) between clock spring and DAB, measure the resistance between DAB high and body ground.

Resistance : ∞

**NG** → Go to step "9".

**OK**  
↓  
Go to step "6".

ERDA027F



ERDA027J

3. Check PAB squib circuit.

**[CHECK]**

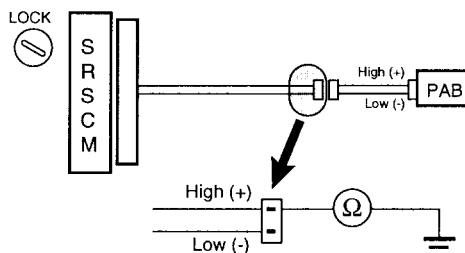
For the connector (on the SRSCM side) between SRSCM and PAB, measure the resistance between PAB high and body ground.

Resistance : ∞

**NG** → Repair or replace harness or connector between SRSCM and PAB.

**OK**  
↓  
Go to step "7".

ERDA027G



ERDA027K

4. Check BPT squib circuit.

**[CHECK]**

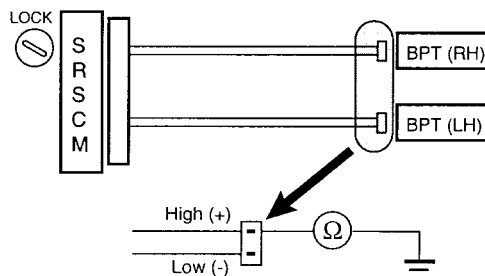
For the connector (on the SRSCM side) between SRSCM and BPT, measure the resistance between BPT high and body ground.

Resistance : ∞

**NG** → Repair or replace harness between SRSCM and BPT.

**OK**  
↓  
Go to step "8".

ERDA027H



ERDA027L

5. Check SRSCM.

**[PREPARATION]**

1. Connector to SRSCM.
2. Using a service wire, connect DAB high and DAB low on the clock spring side of connector between clock spring and DAB.
3. Using a service wire, connect PAB high and low on SRSCM side of connector between SRSCM and PAB.
4. Connect BPT using the same method.
5. Connect negative (-) terminal cable to battery, and wait for 30 seconds.

**[CHECK]**

1. Turn ignition switch to "ON", and wait for at least 30 seconds.
2. Clear the malfunction code stored in the memory with Scan tool.
3. Turn the ignition switch to "LOCK", and wait for 30 seconds.
4. Turn the ignition switch to "ON", and wait for 30 seconds.
5. Using the Scan tool, check the DTC.

**DTC has no output.**

**[HINT]**

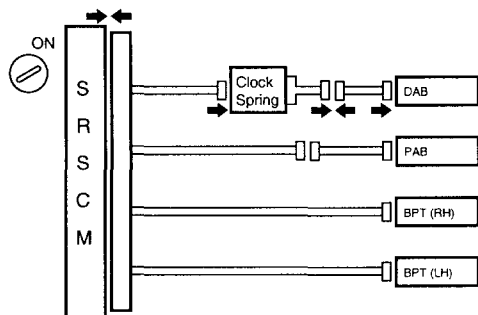
Codes other than these ones may be output at this time, but they are not relevant to this checking procedure.

**NG** → Replace SRSCM.

**OK**



From the results of the above inspection, the part can now be considered to be normal.



ERDA027M

ERDA027C

6. Check DAB squib.

**[PREPARATION]**

1. Turn ignition switch to "LOCK".
2. Disconnect the negative (-) terminal cable from the battery, and wait for 30 seconds.
3. Connect the DAB connector.
4. Connect the negative (-) terminal cable to the battery, and wait for 30 seconds.

**[CHECK]**

1. Turn the ignition switch "ON", and wait for at least 30 seconds.
2. Clear malfunction code stored in the memory of the Scan tool.
3. Turn the ignition switch to "LOCK", and wait for 30 seconds.
4. Turn the ignition switch "ON", and wait for 30 seconds.
5. Using the Scan tool, check the DTC.

**DTC has not output.**

**[HINT]**

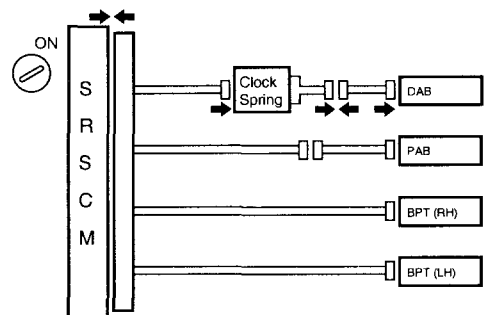
Codes other than these ones may be output at this time, but they are not relevant to this checking procedure.

**NG** → Replace DAB.

**OK**



From the results of the above inspection, the part can now be considered to be normal.



ERDA027N

ERDA027C

7. Check PAB squib.

**[PREPARATION]**

1. Turn the ignition switch to "LOCK".
2. Disconnect the negative (-) terminal cable from the battery, and wait for 30 seconds.
3. Connect the PAB connector.
4. Connect the negative (-) terminal cable from the battery, and wait for 30 seconds.

**[CHECK]**

1. Turn the ignition switch to "ON", and wait for at least 30 seconds.
2. Clear the malfunction code stored in the memory with Scan tool.
3. Turn the ignition switch to "LOCK", and wait for 30 seconds.
4. Turn the ignition switch "ON", and wait for 30 seconds.
5. Using the Scan tool, check the DTC.

**DTC has no output.**

**[HINT]**

Codes other than these ones may be output at this time, but they are not relevant to this checking procedure.

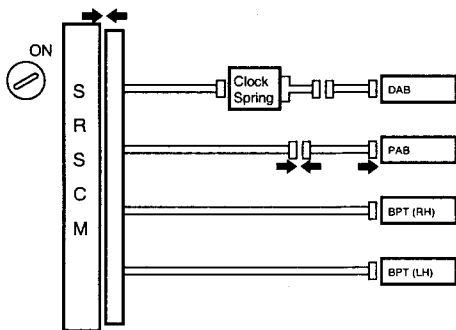
**NG** → Replace PAB.

**OK**



From the results of the above inspection, the part can now be considered to be normal.

ERDA027O



ERDA027D

8. Check BPT squib.

**[PREPARATION]**

1. Turn the ignition switch to "LOCK".
2. Disconnect the negative (-) terminal cable from the battery, and wait for 30 seconds.
3. Connect the BPT connector.
4. Connect the negative (-) terminal cable from the battery, and wait for 30 seconds.

**[CHECK]**

1. Turn the ignition switch to "ON", and wait for 30 seconds.
2. Clear the malfunction code stored in the memory with the Scan tool.
3. Turn the ignition switch to "LOCK", and wait for 30 seconds.
4. Turn the ignition switch to "ON", and wait for 30 seconds.
5. Using the Scan tool, check the DTC.

**DTC is not the output.**

**[HINT]**

Codes other than these ones may be output at this time, but they are not relevant to this checking procedure.

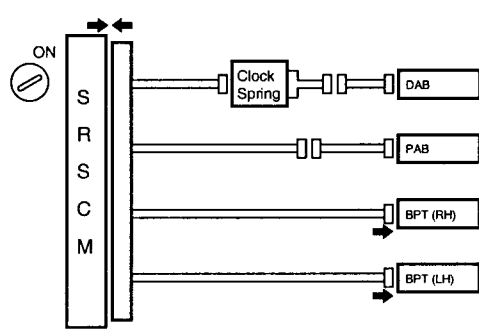
**NG** → Replace BPT.

**OK**



From the results of the above inspection, the part can now be considered to be normal.

ERDA027P



ERDA027E



9. Check clock spring circuit.

**[PREPARATION]**

Disconnect the connector between the SRSCM and clock spring.

**[CHECK]**

Measure the resistance between the DAB high on clock spring side of the connector between the clock spring and DAB and body ground.

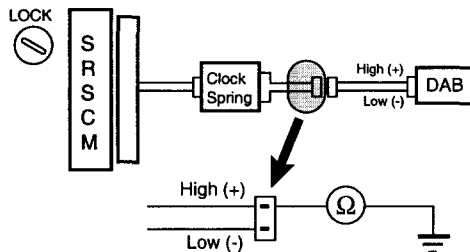
**Resistance :  $\infty$**

**NG** → Replace the clock spring.

**OK**

↓  
Repair or replace the harness or the connector between the SRSCM and the clock spring.

ERDA027R



ERDA027Q

ERHA1150

**CIRCUIT INSPECTION**

<b>DTC</b>	<b>B1349</b> <b>DAB Short to battery</b> <b>B1355</b> <b>PAB Short to battery</b> <b>B1364</b> <b>BPT (Driver) Short to battery</b> <b>B1370</b> <b>BPT (Passenger) Short to battery</b>
------------	---

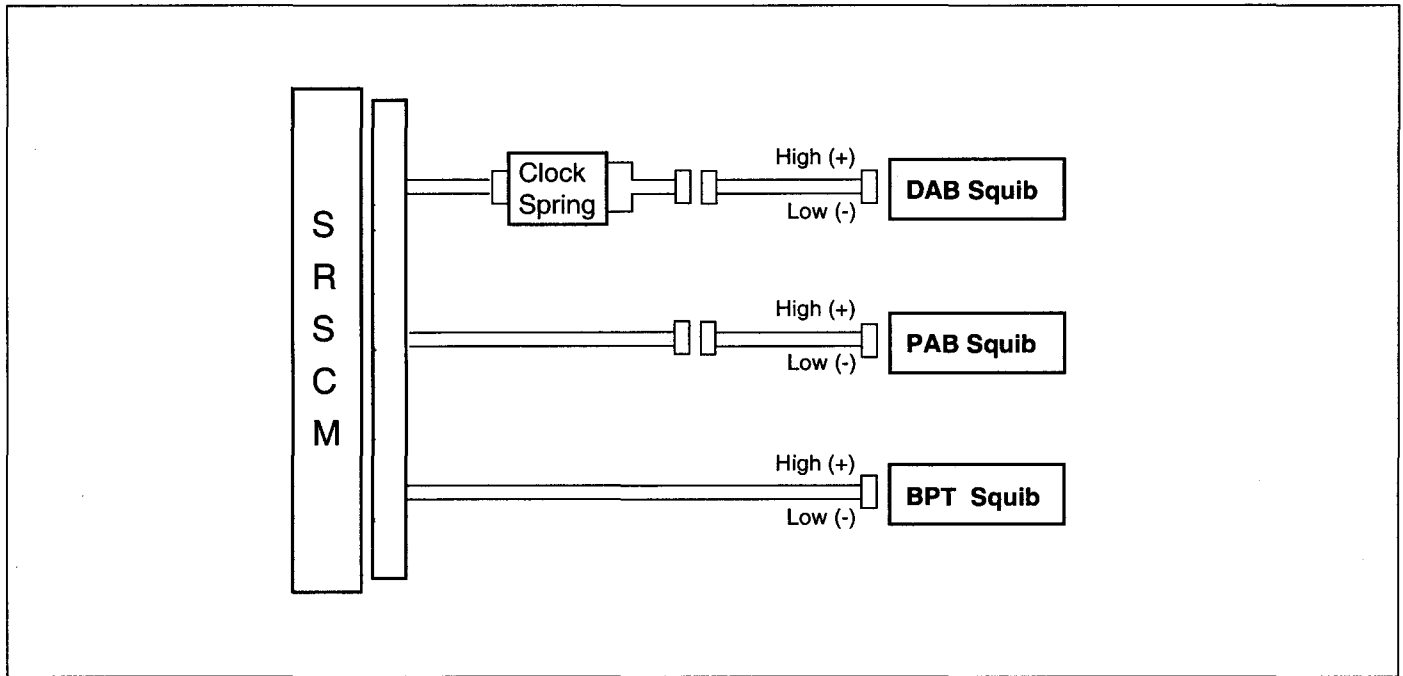
**CIRCUIT DESCRIPTION**

DTCs are recorded when a B+ short is detected in the squib circuit.

The squib circuit consists of the SRSCM, clock spring, DAB, PAB, and BPT. It causes the SRS to deploy when the SRS deployment conditions are satisfied. The above

DTC Detecting Condition	Trouble Area
<ul style="list-style-type: none"> <li>• Short circuit in squib wire harness (to B+)</li> <li>• Squib malfunction</li> <li>• Spiral cable malfunction</li> <li>• SRSCM malfunction</li> </ul>	<ul style="list-style-type: none"> <li>• DAB squib</li> <li>• PAB squib</li> <li>• BPT squib</li> <li>• Wire harness</li> </ul>

**WIRING DIAGRAM**



**INSPECTION PROCEDURE**

**1. Preparation.**

- 1) Disconnect the battery negative terminal and wait for 30 seconds.
- 2) Disconnect the DAB module connector.
- 3) Disconnect the PAB and BPT connectors.
- 4) Disconnect the SRSCM connector.

**NOTE**

Place the DAB module facing upward.

**2. Check the DAB squib circuit.**

**[CHECK]**

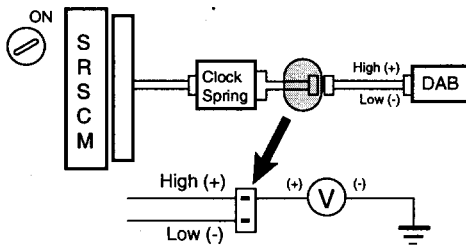
For the connector (on the clock spring side) between clock spring and DAB, measure the voltage between DAB high and body ground.

**Voltage : 0 V**

**NG** → Go to step "9".

**OK**

Go to step "6".



ERDA027F

**3. Check PAB squib circuit.**

**[CHECK]**

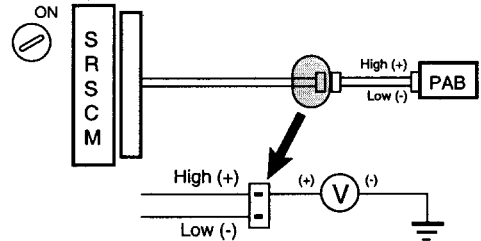
For the connector (on the SRSCM side) between SRSCM and PAB, measure the voltage between PAB high and body ground.

**Voltage : 0 V**

**NG** → Repair or replace harness or connector between SRSCM and PAB.

**OK**

Go to step "7".



ERDA027G

**4. Check BPT squib circuit.**

**[CHECK]**

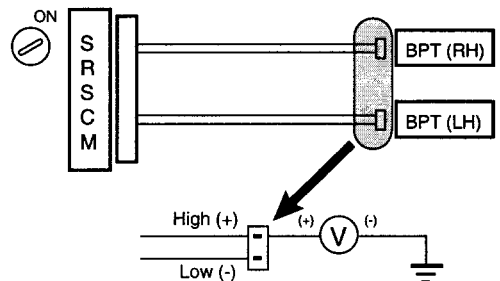
For the connector (on the SRSCM side) between SRSCM and BPT, measure the voltage between BPT high and body ground.

**Voltage : 0 V**

**NG** → Repair or replace harness between SRSCM and BPT.

**OK**

Go to step "8".



ERDA027H

ERDA028B

ERDA028D

5. Check SRSCM.

**[PREPARATION]**

1. Connect the connector to the SRSCM.
2. Using a service wire, connect DAB high and low on the clock spring side of the connector between the clock spring and DAB.
3. Using a service wire, connect PAB high and low on the SRSCM side of the connector between the SRSCM and PAB.
4. Using a service wire, connect BPT high and low on the SRSCM side of the connector between SRSCM and BPT.
5. Connect the negative (-) terminal cable to battery, and wait for 30 seconds.

**[CHECK]**

1. Turn the ignition switch "ON", and wait for at least 30 seconds.
2. Clear the malfunction code stored in the memory with Scan tool.
3. Turn the ignition switch to "LOCK", and wait for 30 seconds.
4. Turn the ignition switch to "ON", and wait for at least 30 seconds.
5. Using the Scan tool, check the DTC.

**DTC is no output.**

**[HINT]**

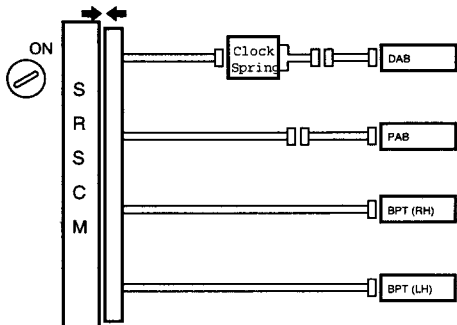
Codes other than these ones may be output at this time, but they are not relevant to this checking procedure.

**NG** → Replace SRSCM.

**OK**



From the results of the above inspection, the part can now be considered to be normal.



ERDA027M

ERFA028A

6. Check DAB squib.

**[PREPARATION]**

1. Turn the ignition switch to "LOCK".
2. Disconnect the negative (-) terminal cable from the battery, and wait for 30 seconds.
3. Connect the DAB connector.
4. Connect the negative (-) terminal cable to the battery, and wait for 30 seconds.

**[CHECK]**

1. Turn the ignition switch to "ON", and wait for 30 seconds.
2. Clear the malfunction code stored in the memory with Scan tool.
3. Turn the ignition switch to "LOCK", and wait for 30 seconds.
4. Turn the ignition switch to "ON", and wait for 30 seconds.
5. Using the Scan tool, check the DTC.

**DTC is no output.**

**[HINT]**

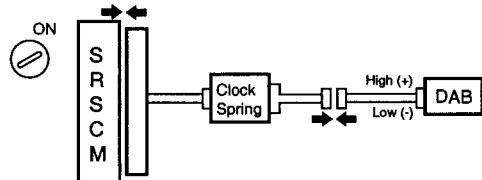
Codes other than these ones may be output at this time, but they are not relevant to this checking procedure.

**NG** → Replace DAB.

**OK**



From the results of the above inspection, the part can now be considered to be normal.



ERDA027N

ERDA028E

## 7. Check PAB squib.

**[PREPARATION]**

1. Turn the ignition switch to "LOCK".
2. Disconnect the negative (-) terminal cable from the battery, and wait for at least 30 seconds.
3. Connect the PAB connector.
4. Connect the negative (-) terminal cable to the battery, and wait for 30 seconds.

**[CHECK]**

1. Turn the ignition switch to "ON", and wait for 30 seconds.
2. Clear the malfunction code stored in the memory with Scan tool.
3. Turn the ignition switch to "LOCK", and wait for 30 seconds.
4. Turn the ignition switch to "ON", and wait 30 seconds.
5. Using the Scan tool, check the DTC.

**DTC is no output.**

**[HINT]**

Codes other than these ones may be output at this time, but they are not relevant to this checking procedure.

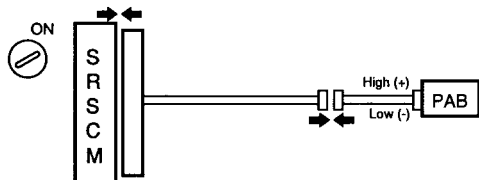
**NG** → Replace PAB.

**OK**



From the results of the above inspection, the part can now be considered to be normal.

ERDA0270



ERDA028F

## 8. Check BPT squib.

**[PREPARATION]**

1. Turn the ignition switch to "LOCK".
2. Disconnect the negative (-) terminal cable from the battery, and wait for 30 seconds.
3. Connect the BPT connector.
4. Connect the negative (-) terminal cable from the battery, and wait for 30 seconds.

**[CHECK]**

1. Turn the ignition switch to "ON", and wait for at least 30 seconds.
2. Clear the malfunction code stored in the memory with Scan tool.
3. Turn the ignition switch to "LOCK", and wait for 30 seconds.
4. Turn the ignition switch to "ON", and wait for 30 seconds.
5. Using the Scan tool, check the DTC.

**DTC is no output.**

**[HINT]**

Codes other than these ones may be the output at this time, but they are not relevant to this checking procedure.

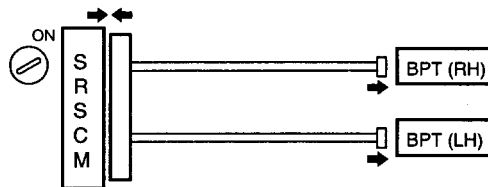
**NG** → Replace BPT.

**OK**



From the results of the above inspection, the part can now be considered to be normal.

ERDA027P



ERDA028G

## 9. Check Clock spring.

**[PREPARATION]**

1. Turn the ignition switch to "LOCK".
2. Disconnect the connector between the SRSCM and clock spring.

**[CHECK]**

Turn the ignition switch to "ON", and measure voltage between DAB high on the side and body ground.

**Voltage : 0 V**

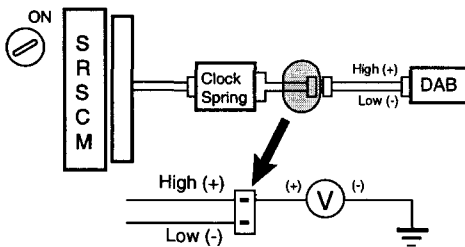
**NG** → Replace the clock spring.

**OK**



Repair or replace the harness or the connector between the SRSCM and the clock spring.

ERDA027R



ERDA028B

ERHA1200

**CIRCUIT INSPECTION**

<b>DTC</b>	<b>B1346</b> <b>B1347</b>	<b>DAB resistance too high (<math>R \geq 6.7 \Omega</math>)</b> <b>DAB resistance too low (<math>R \leq 1.06 \Omega</math>)</b>
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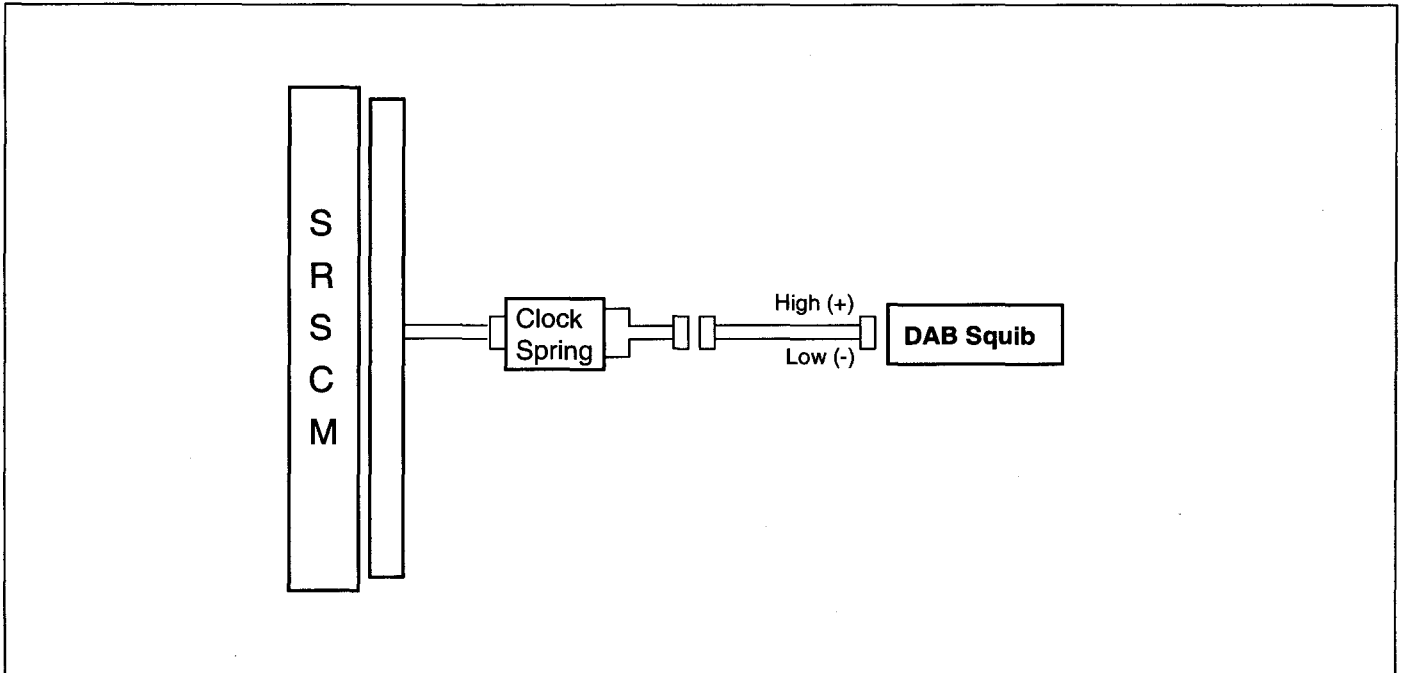
**CIRCUIT DESCRIPTION**

recorded when DAB resistance too high or low is detected in the DAB squib circuit.

The DAB squib circuit consists of the SRSCM, clock spring and DAB. It causes the airbag to deploy when the airbag deployment conditions are satisfied. The above DTCs are

DTC Detecting Condition	Trouble Area
<ul style="list-style-type: none"> <li>• Too high or low resistance between DAB high (+) wiring harness and DAB low (-) wiring harness of squib.</li> <li>• DAB malfunction</li> <li>• Clock spring malfunction</li> <li>• SRSCM malfunction</li> </ul>	<ul style="list-style-type: none"> <li>• DAB squib</li> <li>• Clock spring</li> <li>• SRSCM</li> <li>• Wire harness</li> </ul>

**WIRING DIAGRAM**



## INSPECTION PROCEDURE

## 1. Preparation.

- 1) Disconnect the battery negative terminal and wait for 30 seconds.
- 2) Disconnect the DAB module connector.
- 3) Disconnect the PAB and BPT connectors.
- 4) Disconnect the SRSCM connector.

 **NOTE**

Place the DAB module facing upward.

## 2. Check the DAB resistance.

**[PREPARATION]**

Release the airbag activation prevention mechanism on the SRSCM side of airbag squib. Connect the dummy (0957A-38200) to the clock spring side connector.

**[CHECK]**

Measure the resistance between DAB high (+) and low (-).

$$1.8 \Omega < R < 3.4 \Omega$$

**NG** → Go to step "4".

**OK**



## 3. Check DAB squib.

**[PREPARATION]**

1. Turn the ignition switch to "LOCK".
2. Disconnect the negative (-) terminal cable from the battery, and wait for 30 seconds.
3. Connect the DAB connector.
4. Connect the negative (-) terminal cable to the battery, and wait for 30 seconds.

**[CHECK]**

1. Turn the ignition switch to "ON", and wait for 30 seconds.
2. Clear the malfunction code stored in the memory with Scan tool.
3. Turn the ignition switch to "LOCK", and wait for 30 seconds.
4. Turn the ignition switch "ON", and wait for 30 seconds.
5. Using the Scan tool, check the DTC.

**DTC is no output.**

**[HINT]**

Codes other than these ones may be output at this time, but they are not relevant to this checking procedure.

**NG** → Replace DAB.

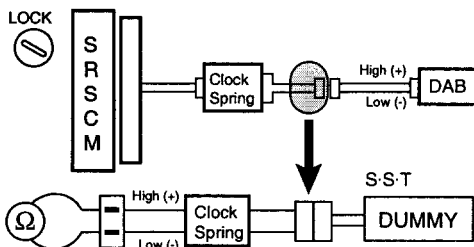
**OK**



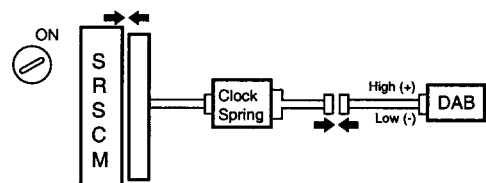
From the results of the above inspection, the part can now be considered to be normal.

ERDA029C

ERDA027N



ERDA029B



ERDA028E



4. Check Clock spring.

**[PREPARATION]**

Disconnect the connector between the SRSCM clock spring, and connect the dummy connector (0957A-38200) to the clock spring side of the connector as illustrated.

**[CHECK]**

Measure the resistance between DAB high (+) and low (-).

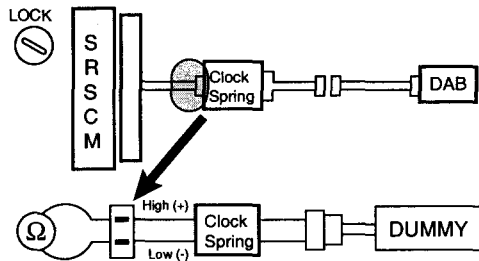
$$1.8 \Omega < R < 3.4 \Omega$$

**NG** → Replace the clock spring.

**OK**

↓  
Repair or replace the harness or the connector between the SRSCM and the clock spring.

ERDA027R



ERDA029D

ERHA1250

**CIRCUIT INSPECTION**

<b>DTC</b>	<b>B1352</b> <b>B1353</b>	<b>PAB resistance too high (<math>R \geq 5.4 \Omega</math>)</b> <b>PAB resistance too low (<math>R \leq 0.4 \Omega</math>)</b>
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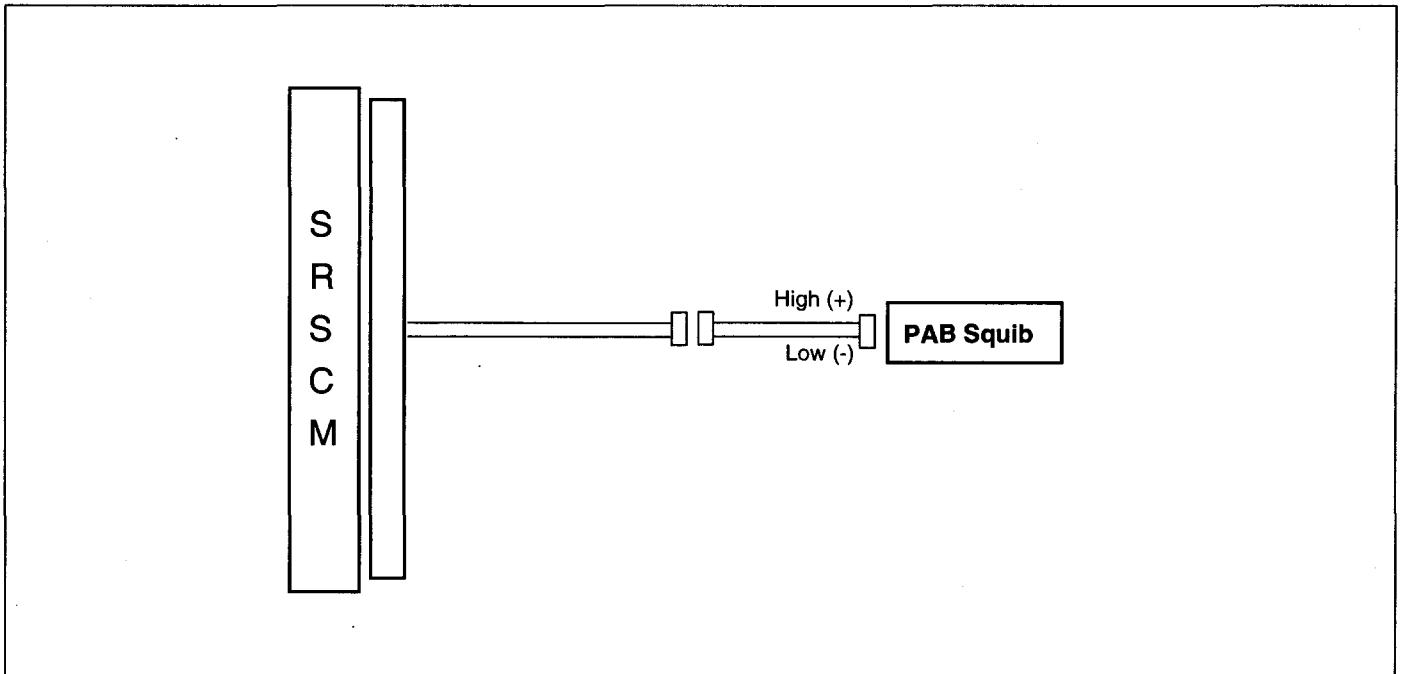
**CIRCUIT DESCRIPTION**

when PAB resistance too high or low is detected in the PAB squib circuit.

The PAB squib circuit consists of the SRSCM and PAB. It causes the airbag to deploy when the airbag deployment conditions are satisfied. The above DTCs are recorded

DTC Detecting Condition	Trouble Area
<ul style="list-style-type: none"> <li>• Too high or low resistance between PAB high (+) wiring harness and PAB low (-) wiring harness of squib.</li> <li>• PAB malfunction</li> <li>• SRSCM malfunction</li> </ul>	<ul style="list-style-type: none"> <li>• PAB squib</li> <li>• SRSCM</li> <li>• Wire harness</li> </ul>

**WIRING DIAGRAM**



## INSPECTION PROCEDURE

## 1. Preparation.

- 1) Disconnect the battery negative terminal and wait for 30 seconds.
- 2) Disconnect the DAB module connector.
- 3) Disconnect the PAB and BPT connectors.
- 4) Disconnect the SRSCM connector.

**NOTE**

Place the DAB module facing upward.

## 2. Check the PAB resistance.

**[PREPARATION]**

Release the airbag activation prevention mechanism on the SRSCM side of the airbag squib. Connect the dummy connector (0957A-38200) to the PAB connector of the SRSCM connector side.

**[CHECK]**

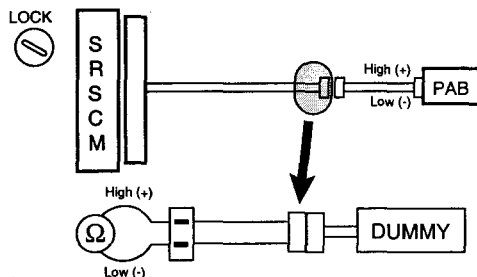
Measure the resistance between PAB high (+) and PAB low (-).

$$1.6 \Omega < R < 2.8 \Omega$$

**NG** → Repair or replace harness or connector between the SRSCM and PAB.

**OK**

↓  
Go to step "3".



ERHA125A

ERDA030B

## 3. Check PAB squib.

**[PREPARATION]**

1. Turn the ignition switch to "LOCK".
2. Disconnect the negative (-) terminal cable from the battery, and wait for at least 30 seconds.
3. Connect the PAB connector.
4. Connect the negative (-) terminal cable to the battery, and wait for 30 seconds.

**[CHECK]**

1. Turn the ignition switch to "ON", and wait for 30 seconds.
2. Clear the malfunction code stored in the memory with Scan tool.
3. Turn the ignition switch to "LOCK", and wait for 30 seconds.
4. Turn the ignition switch to "ON", and wait for 30 seconds.
5. Using the Scan tool, check the DTC.

**DTC is no output.**

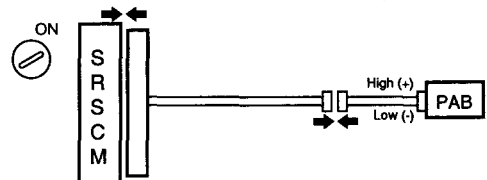
**[HINT]**

Codes other than these ones may be output at this time, but they are not relevant to this checking procedure.

**NG** → Replace PAB.

**OK**

↓  
From the results of the above inspection, the part can now be considered to be normal.



ERDA0270

ERDA028F

ERHA1260

**CIRCUIT INSPECTION**

<b>DTC</b>	<b>B1361</b> Driver seat belt pretensioner, resistance too high ( $R \geq 5.4\Omega$ ) <b>B1362</b> Driver seat belt pretensioner, resistance too low ( $R \leq 0.4\Omega$ ) <b>B1367</b> Passenger seat belt pretensioner, resistance too high ( $R \geq 5.4\Omega$ ) <b>B1368</b> Passenger seat belt pretensioner, resistance too low ( $R \leq 0.4\Omega$ )
------------	--

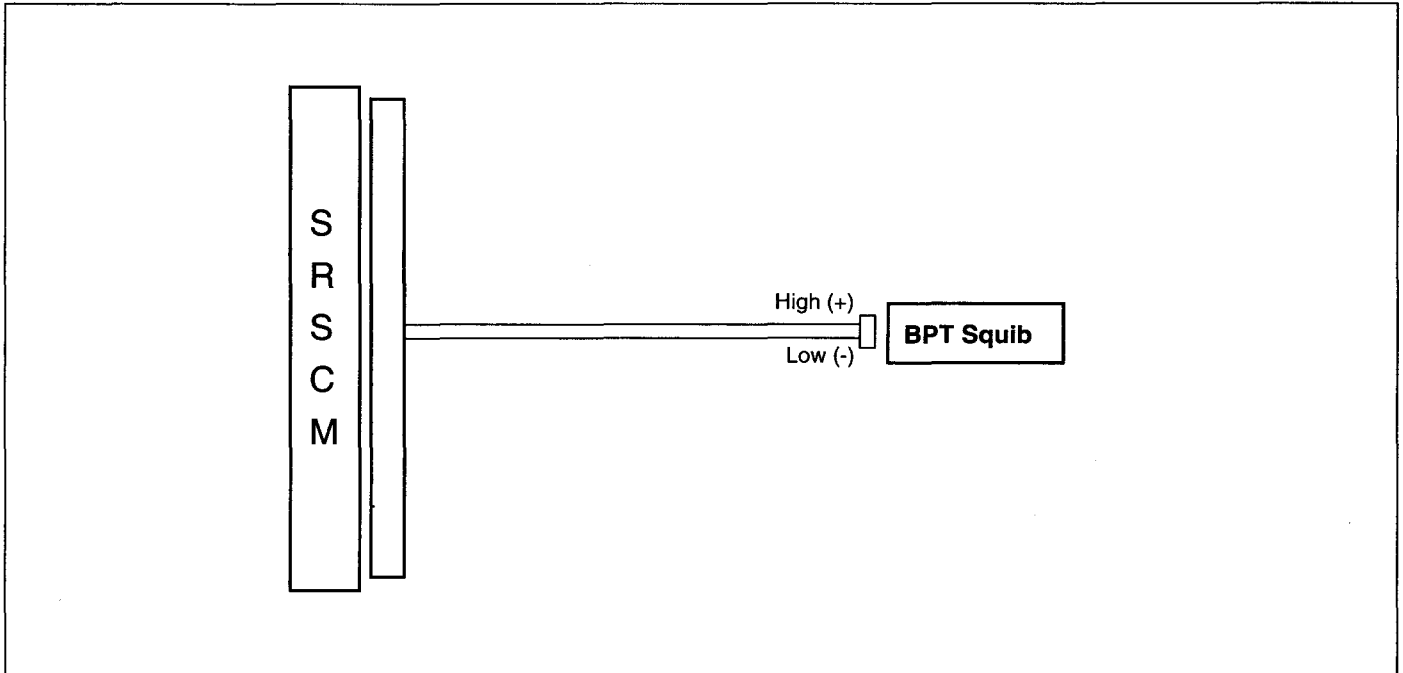
**CIRCUIT DESCRIPTION**

The BPT squib circuit consists of the SRSCM and BPT. It causes the airbag to deploy when the airbag deployment conditions are satisfied. The above DTCs are recorded

when BPT resistance too high or low is detected in the BPT squib circuit.

DTC Detecting Condition	Trouble Area
<ul style="list-style-type: none"> <li>• Too high or low resistance between BPT high(+) and BPT low(-) wiring harness of squib</li> <li>• SRSCM malfunction</li> <li>• BPT malfunction</li> </ul>	<ul style="list-style-type: none"> <li>• BPT squib</li> <li>• SRSCM</li> <li>• Wire harness</li> </ul>

**WIRING DIAGRAM**



## INSPECTION PROCEDURE

## 1. Preparation.

- 1) Disconnect the negative(-) terminal cable from the battery, and wait for 30 seconds.
- 2) Disconnect the BPT connector.
- 3) Disconnect the SRSCM connector.

## 2. Check DAB squib circuit.

## [PREPARATION]

Release the airbag activation prevention mechanism on the SRSCM side of the airbag squib side. Connect the dummy connector(0957A-38200) to the BPT connector of the SRSCM connector side.

## [NOTE]

Before checking the resistance, you have to insert the shorting bar with the insert plastic attached diagnosis checker into the SRSCM connector.

## [CHECK]

Measure the resistance between BPT high(+) and BPT low(-).

$$1.8\Omega < R < 2.5\Omega$$

**NG** → Repair or replace harness or connector between the SRSCM and BPT.

**OK**  
↓  
Go to step "3"

## 3. Check BPT squib.

## [PREPARATION]

1. Turn the ignition switch to "LOCK".
2. Disconnect the negative(-) terminal cable from the battery, and wait for 30 seconds.
3. Connect the BPT connector.
4. Connect the negative(-) terminal cable to the battery, and wait for 30 seconds.

## [CHECK]

1. Turn the ignition switch to "ON", and wait for 30 seconds.
2. Clear the malfunction code stored in the memory with Scan tool.
3. Turn the ignition switch to "LOCK", and wait for 30 seconds.
4. Turn the ignition switch to "ON", and wait for 30 seconds.
5. Using the Scan tool, check the DTC.

**DTC is not output.**

## [HINT]

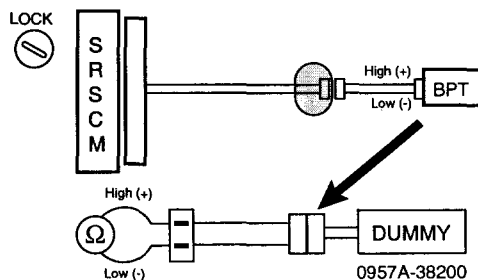
Codes other than these ones may be output at this time, but they are not relevant to this checking procedure.

**NG** → Replace BPT

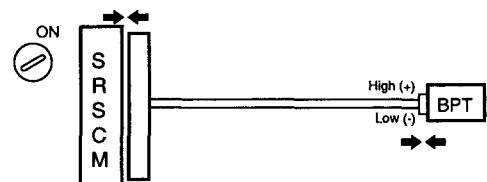
**OK**  
↓  
From the results of the above inspection, the part can now be considered to be normal.

ERHA126B

ERHA126D



ERHA126C



ERHA126E

ERMB1500

CIRCUIT INSPECTION

DTC	<p><b>B1511</b> Driver seat belt switch open/short to Battery</p> <p><b>B1512</b> Driver seat belt switch short to GND</p> <p><b>B1513</b> Passenger seat belt switch open/short to Battery</p> <p><b>B1514</b> Passenger seat belt switch short to GND</p>
-----	---

CIRCUIT DESCRIPTION

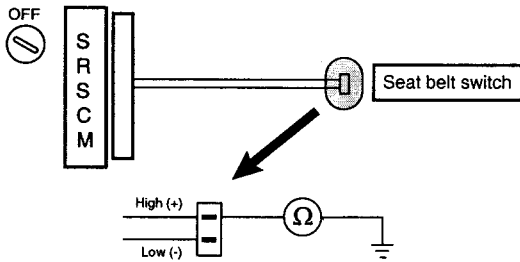
This system decides whether the seat belt of the driver or passenger are locked and then prevent the belt pretensioner from deploying on crash.

INSPECTION PROCEDURE

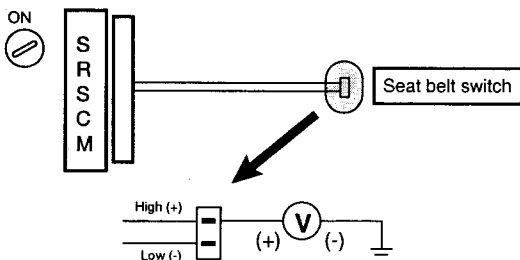
1. Preparation.

- 1) Disconnect the negative (-) terminal cable from the battery, and wait for 30 seconds.
- 2) Remove the DAB module.
- 3) Disconnect the connectors of the PAB and BPT.
- 4) Disconnect the SRSCM connector.

2. Check buckle switch sensor circuit (Short to GND/Battery).



ERKB030B



ERKB030C

[CHECK]

Measure the voltage and resistance of the seat belt switch high and body ground between the SRSCM connector and the seat belt switch connector.

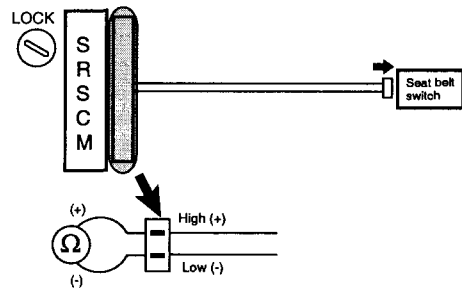
Resistance : ∞  
Voltage : 0V

**NG** → Repair or replace the harness between the SRSCM and the seat belt switch.

**OK**  
↓

ERKB049B

3. Check the seat belt switch



ERKB030D

[CHECK]

Check the resistance with the switch on and off.

**SWITCH OPEN : R = 4KΩ ± 10% (Belted)**  
**SWITCH OPEN : R = 1KΩ ± 10% (Unbelted)**

**NG** → Replace the seat belt switch

**OK**



From the results of the above inspection the malfunctioning part can now be considered normal.

ERKB049C

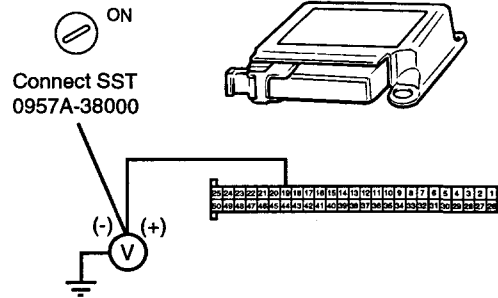
ERMB1700

**CIRCUIT INSPECTION**

<b>DTC</b>	<b>B2500</b>	<b>Warning lamp failure</b>
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**CIRCUIT DESCRIPTION**

The SRS warning lamp is located on the cluster. When the airbag system is normal, the SRI flashes for approx. 6 seconds after the ignition switch is turned "ON", and then turns off automatically. If there is a malfunction in the airbag system, the SRI stays on to inform the driver of the abnormality. The SRSCM measures the voltage at the airbag SRI (Service Reminder Indicator) output pin, both when the lamp is on and when the lamp is off, to detect whether the requested state matches the actual state.



ERMB170A

**INSPECTION PROCEDURE**

1. Check the fuse.  
**[PREPARATION]**
  1. Remove fuse No. 22 and 23 from the junction block.
  2. Inspect the state of the fuses.
  3. Replace if necessary.

**NG** → If no fault is found in wiring or connector, replace the SRSCM.

2. Check SRS warning lamp circuit.  
**[PREPARATION]**
  1. Connect the negative (-) terminal cable to the battery.
  2. Turn the ignition switch to "ON".

**OK**  
 ↓  
 From the results of the above inspection, the part can now be considered to be normal.

ERDA032B

- [CHECK]**
1. Measure voltage of the harness side connector of the SRSCM.  
**Voltage : 9 - 16V**

**NG** → Check the SRS warning light bulb/repair the SRS warning light circuit.

**OK**  
 ↓

ERDA032A

2. Check the SRS SRI (Service Reminder Indicator).  
**OK : SRS SRI ON**



ERHA1350

**CIRCUIT INSPECTION**

<b>DTC</b>	<b>B1620</b> <b>B1650</b> <b>B1661</b>	<b>Internal fault</b> <b>Crash recorded</b> <b>ECU mismatching</b>
------------	--	--

**CIRCUIT DESCRIPTION****SRSCM MALFUNCTION**

The SRSCM shall also cyclically monitor the following :

1. Functional readiness of the firing circuit activation transistors.
2. Adequacy of deployment energy reserves.
3. Safety sensor integrity : detection of faulty closure.
4. Plausibility of accelerometer signal.
5. Operation of SRSCM components.

The timely completion of all tests is monitored by a separate hardware watchdog. During normal operation, the watchdog is triggered periodically by the SRSCM ; If the SRSCM fails to trigger the watchdog, the watchdog will reset the SRSCM and activate the SRI (Service Reminder Indicator). The SRSCM must be replaced, once the fault codes mentioned above are confirmed.

# AIRBAG MODULE DISPOSAL

*always wear gloves to avoid direct contact with by-product material.*

## AIRBAG MODULE DISPOSAL PROCEDURES

### FIELD DEPLOYMENT PROCEDURES

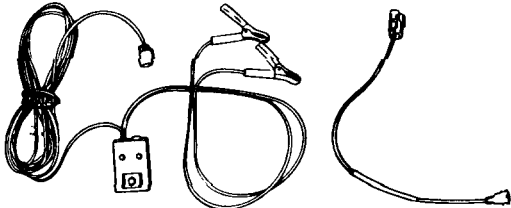
ERMB2000

Before either disposing of a vehicle equipped with an airbag, or prior to disposing of the airbag module, be sure to first follow the procedures described below to deploy the airbag.

**CAUTION**

*When handling the deployed airbag, be careful not to allow by-product dust to enter the eyes and*

### AIRBAG REMOTE DEPLOYMENT DEVICES

Tool, Number, Name	Use
Deployment tool (0957A-34100-A) SRS DEPLOYMENT ADAPTER HARNESS DAB : 0957A-38000 PAB : 0957A-34200  	Deployment inside the vehicle (when vehicle will no longer be driven)

ERDA034A

### DISPOSAL PLAN

When the problem occurs, take the following disposal steps.

CASE		DISPOSAL PLAN
Car scrapping	DAB, PAB, BPT	Deploy the airbag module in the scrapper yard with SST
Crash (Deployed)		Service station disposes of the airbag module

ERMB2100

## UNDEPLOYED AIRBAG MODULE DISPOSAL

**CAUTION**

1. If the vehicle is to be scrapped, junked, or otherwise disposed of, deploy the airbag inside the vehicle.
2. Since there is a loud noise when the airbag is deployed, avoid residential areas whenever possible. If anyone is nearby, give out a warning.
3. Since a large amount of smoke is produced when the airbag is deployed, select a well-ventilated site. Moreover, never attempt the test near a fire or smoke sensor.

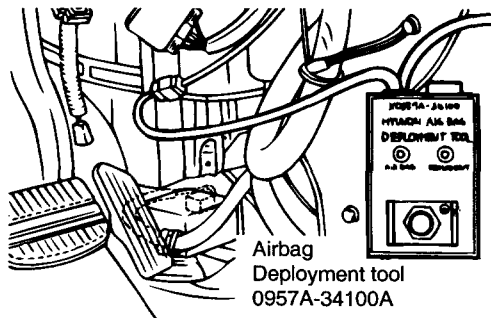
## DEPLOYMENT INSIDE THE VEHICLE

## WHEN VEHICLE WILL NO LONGER BE DRIVEN

1. Open all windows and doors of the vehicle. Move the vehicle to an isolated spot.
2. Disconnect the negative (-) and positive (+) battery cables from the battery terminals, and then remove the battery from the vehicle.

**CAUTION**

Wait for at least 30 seconds after disconnecting the battery cable before doing any further work.



ERDA034B

3. Remove the airbag SRSCM connector.
4. Connect the deployment tool to the connector of each module.
5. As far away from the vehicle as possible, press the push button (removed from the vehicle) to deploy the airbag.

**CAUTION**

1. Before deploying the airbag in this manner, first check to be sure that there is no one in or near the vehicle. Wear safety glasses.

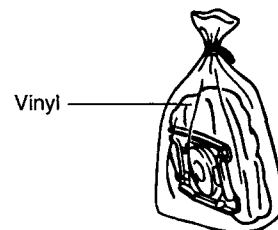
2. The inflator will be quite hot immediately following the deployment, so wait for 30 minutes to allow it to cool before attempting to handle it. Although not poisonous, do not inhale gas from the airbag deployment. See the Deployed Airbag Module Disposal Procedures for the post-deployment handling instructions.
3. If the airbag fails to deploy when the procedures above are followed, do not go near the module. Contact your local distributor.

ERMB2200

## DEPLOYED AIRBAG MODULE DISPOSAL PROCEDURES

After deployment, the airbag module should be disposed of in the same manner as any other scrap parts, except that the following points should be carefully noted during disposal.

1. The inflator will be quite hot immediately following deployment, so wait for 30 minutes to allow it to cool before attempting to handle it.
2. Do not put water or oil on the airbag after deployment.
3. There may be, adhered to the deployed airbag module, material that could irritate the eyes and/or skin, so wear gloves and safety glasses when handling a deployed airbag module. IF, DESPITE THESE PRECAUTIONS, THE MATERIAL DOES GET INTO THE EYES OR ON THE SKIN, IMMEDIATELY RINSE THE AFFECTED AREA WITH A LARGE AMOUNT OF CLEAN WATER. IF ANY IRRITATION DEVELOPS, SEEK MEDICAL ATTENTION.
4. Tightly seal the airbag module in a strong vinyl bag for disposal.
5. Be sure to always wash your hands after completing this operation.



ERDA034D

# Fuel System

## (J3 TCI - DSL2.9)

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REMOVAL .....	FLB-154
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## GENERAL

## SPECIFICATION EB2FEC9C

Items		Specification		
Fuel Tank		Capacity	75l	
Fuel Pump		Type	High pressure pump (Gear driven type)	
Fuel Filter		Type	High pressure type	
Fuel Pressure (at common rail)		Pressure	1,600 bar (1,631.5kgf/cm <sup>2</sup> )	
SEN- SORS	Mass Air Flow Sensor (MAFS)	Type	HOT FILM type	
	Intake Air Temperature Sensor (IATS)	Type	Thermister type	
		Specification	-40°C (-40°F)	39.3kΩ
			-20°C(-4°F)	13.9kΩ
			0°C(32°F)	5.5kΩ
			20°C(68°F)	2.4kΩ
			40°C(104°F)	1.2kΩ
			60°C(140°F)	0.6kΩ
	80°C(176°F)		0.3kΩ	
	Accelerator Position Sensor (APS)	Type	Thermister type	
	Camshaft Position Sensor (CMPS)	Type	Hall sensor type	
	Crankshaft Position Sensor (CKPS)	Type	Magnetic type	
	Rail Pressure Sensor (RPS)	Type	Piezo electricity type	
	Fuel Temperature Sensor (FTS)	Type	Thermister type	
		Specification	-30°C(-22°F)	22.2 ~ 31.8kΩ
			-20°C(-4°F)	13.2 ~ 18.1kΩ
			0°C(32°F)	5.2 ~ 6.6kΩ
			20°C(68°F)	2.3 ~ 2.7kΩ
			40°C(104°F)	1.1 ~ 1.3kΩ
			60°C(140°F)	0.54 ~ 0.65kΩ
80°C(176°F)	0.30 ~ 0.32kΩ			
Engine Coolant Temperature Sensor (ECTS)	Type	Thermister type		
	Specification	-40°C (-40°F)	44.4kΩ	
		-20°C(-4°F)	13.4 ~ 16.8kΩ	
		0°C(32°F)	5.74kΩ	
		20°C(68°F)	2.3 ~ 2.6kΩ	
		40°C(104°F)	1.15kΩ	
		60°C(140°F)	0.58kΩ	
80°C(176°F)		0.32kΩ		

Items		Specification	
ACTUATORS	Injector	Type	Solenoid type
		Number	4
	Inlet Metering Valve (IMV)	Resistance	5.5Ω at 20°C(68°F)
	EGR Solenoid Valve	Resistance	15.0 ~ 16.0Ω at 20°C(68°F)

**SEALANT** EE554B8A

Engine Coolant Temperature Sensor (ECTS)	LOCTITE 962T
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**SERVICE STANDARD**


Idle Speed	800±100 rpm
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**TIGHTENING TORQUES**

Items		Kgf·m	N·m	lbf·ft
ENGINE CONTROL SYSTEM	Engine Coolant Temperature Sensor (ECTS)	2.00	19.61	14.47
	Knock Sensor (KS)	1.50 ~ 2.50	14.71 ~ 24.52	10.85 ~ 18.08
	Crankshaft Position Sensor (CKPS)	0.90 ~ 1.00	8.83 ~ 9.81	6.51 ~ 7.23
	EGR Solenoid Valve	0.80 ~ 1.10	7.85 ~ 10.79	5.79 ~ 7.96
FUEL DELIVERY SYSTEM	High pressure pump mounting bolts (on timing case)	2.20 ~ 2.60	21.57 ~ 25.50	15.91 ~ 18.81
	High pressure pump mounting bolts (on bracket)	2.20 ~ 2.60	21.57 ~ 25.50	15.91 ~ 18.81
	High Pressure Pipe connecting between high pressure pump and common rail	3.65 ~ 4.35	35.79 ~ 42.66	26.40 ~ 31.46
	High Pressure Pipe connecting between common rail and injectors	3.65 ~ 4.35	35.79 ~ 42.66	26.40 ~ 31.46
	Common rail mounting bolts	1.90 ~ 2.30	18.63 ~ 22.56	13.74 ~ 16.64
	Injector clamp bolt	2.00 ~ 2.20	19.61 ~ 21.57	14.47 ~ 15.91

**BASIC TROUBLESHOOTING** E40A46A4

**BASIC TROUBLESHOOTING GUIDE**

1	Bring Vehicle to Workshop
2	Analyze Customer's Problem <ul style="list-style-type: none"> <li>• Ask the customer about the conditions and environment relative to the issue (Use CUSTOMER PROBLEM ANALYSIS SHEET).</li> </ul>
3	Verify Symptom, and then Check DTC and Freeze Frame Data <ul style="list-style-type: none"> <li>• Connect Hi-Scan (Pro) to Diagnostic Link Connector (DLC).</li> <li>• Record the DTC and freeze frame data.</li> </ul> <p> <b>NOTE</b> To erase DTC and freeze frame data, Refer to Step 5.</p>
4	Confirm the Inspection Procedure for the System or Part <ul style="list-style-type: none"> <li>• Using the SYMPTOM TROUBLESHOOTING GUIDE CHART, choose the correct inspection procedure for the system or part to be checked.</li> </ul>
5	Erase the DTC and Freeze Frame data  (WARNING) NEVER erase DTC and freeze frame data before completing Step 2 MIL/DTC in "CUSTOMER PROBLEM ANALYSIS SHEET".
6	Inspect Vehicle Visually <ul style="list-style-type: none"> <li>• Go to Step 11, if you recognize the problem.</li> </ul>
7	Recreate (Simulate) Symptoms the DTC <ul style="list-style-type: none"> <li>• Try to recreate or simulate the symptoms and conditions of the malfunction as described by customer.</li> <li>• If DTC(s) is/are displayed, simulate the condition according to troubleshooting procedure for the DTC.</li> </ul>
8	Confirm Symptoms of Problem <ul style="list-style-type: none"> <li>• If DTC(s) is/are not displayed, go to Step 9.</li> <li>• If DTC(s) is/are displayed, go to Step 11.</li> </ul>
9	Recreate (Simulate) Symptom <ul style="list-style-type: none"> <li>• Try to recreate or simulate the condition of the malfunction as described by the customer.</li> </ul>
10	Check the DTC <ul style="list-style-type: none"> <li>• If DTC(s) does(do) not occur, refer to BASIC INSPECTION in INTERMITTENT PROBLEM PROCEDURE.</li> <li>• If DTC(s) occur(s), go to Step 11.</li> </ul>
11	Perform troubleshooting procedure for DTC
12	Adjust or repair the vehicle

13	Confirmation test
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14	END
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**CUSTOMER PROBLEM ANALYSIS SHEET**

1. VEHICLE INFORMATION

(I) VIN:
(II) Production Date:
(III) Odometer Reading: (miles/km)

2. SYMPTOMS

<input type="checkbox"/> Unable to start	<input type="checkbox"/> Engine does not turn over <input type="checkbox"/> Incomplete combustion <input type="checkbox"/> Initial combustion does not occur
<input type="checkbox"/> Difficult to start	<input type="checkbox"/> Engine turns over slowly <input type="checkbox"/> Other _____
<input type="checkbox"/> Poor idling	<input type="checkbox"/> Rough idling <input type="checkbox"/> Incorrect idling <input type="checkbox"/> Unstable idling (High: _____ rpm, Low: _____ rpm) <input type="checkbox"/> Other _____
<input type="checkbox"/> Engine stall	<input type="checkbox"/> Soon after starting <input type="checkbox"/> After accelerator pedal depressed <input type="checkbox"/> After accelerator pedal released <input type="checkbox"/> During A/C ON <input type="checkbox"/> Shifting from N to D-range <input type="checkbox"/> Other _____
<input type="checkbox"/> Others	<input type="checkbox"/> Poor driving (Surge) <input type="checkbox"/> Knocking <input type="checkbox"/> Poor fuel economy <input type="checkbox"/> Back fire <input type="checkbox"/> After fire <input type="checkbox"/> Other _____

3. ENVIRONMENT

Problem frequency	<input type="checkbox"/> Constant <input type="checkbox"/> Sometimes (_____) <input type="checkbox"/> Once only <input type="checkbox"/> Other _____
Weather	<input type="checkbox"/> Fine <input type="checkbox"/> Cloudy <input type="checkbox"/> Rainy <input type="checkbox"/> Snowy <input type="checkbox"/> Other _____
Outdoor temperature	Approx. _____ °C/°F
Place	<input type="checkbox"/> Highway <input type="checkbox"/> Suburbs <input type="checkbox"/> Inner City <input type="checkbox"/> Uphill <input type="checkbox"/> Downhill <input type="checkbox"/> Rough road <input type="checkbox"/> Other _____
Engine temperature	<input type="checkbox"/> Cold <input type="checkbox"/> Warming up <input type="checkbox"/> After warming up <input type="checkbox"/> Any temperature
Engine operation	<input type="checkbox"/> Starting <input type="checkbox"/> Just after starting (____ min) <input type="checkbox"/> Idling <input type="checkbox"/> Racing <input type="checkbox"/> Driving <input type="checkbox"/> Constant speed <input type="checkbox"/> Acceleration <input type="checkbox"/> Deceleration <input type="checkbox"/> A/C switch ON/OFF <input type="checkbox"/> Other _____

4. MIL/DTC

MIL (Malfunction Indicator Lamp)	<input type="checkbox"/> Remains ON <input type="checkbox"/> Sometimes lights up <input type="checkbox"/> Does not light
DTC	<input type="checkbox"/> Normal <input type="checkbox"/> DTC (_____) <input type="checkbox"/> Freeze Frame data

## BASIC INSPECTION PROCEDURE

## MEASURING CONDITION OF ELECTRONIC PARTS' RESISTANCE

The measured resistance at high temperature after vehicle running may be high or low. So all resistance must be measured at ambient temperature (20°C, 68°F), unless there is any notice.

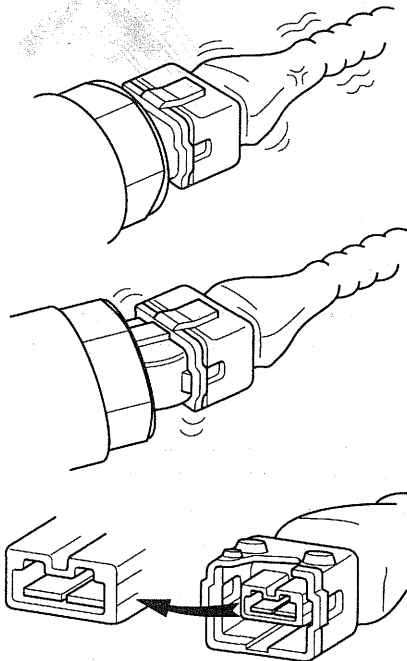
 **NOTE**

*The measured resistance in except for ambient temperature (20°C, 68°F) is reference value.*

## INTERMITTENT PROBLEM INSPECTION PROCEDURE

Sometimes the most difficult case in troubleshooting is when a problem symptom occurs but does not occur again during testing. An example would be if a problem appears only when the vehicle is cold but has not appeared when warm. In this case, technician should thoroughly make out a "CUSTOMER PROBLEM ANALYSIS SHEET" and recreate (simulate) the environment and condition which occurred when the vehicle was having the issue.

1. Clear Diagnostic Trouble Code (DTC).
2. Inspect connector connection, and check terminal for poor connections, loose wires, bent, broken or corroded pins, and then verify that the connectors are always securely fastened.



BFG321A

3. Slightly shake the connector and wiring harness vertically and horizontally.
4. Repair or replace the component that has a problem.
5. Verify that the problem has disappeared with the road test.

 **SIMULATING VIBRATION**

- a. Sensors and Actuators  
: Slightly vibrate sensors, actuators or relays with finger.

 **WARNING**

**Strong vibration may break sensors, actuators or relays**

- b. Connectors and Harness  
: Lightly shake the connector and wiring harness vertically and then horizontally.

 **SIMULATING HEAT**

- a. Heat components suspected of causing the malfunction with a hair dryer or other heat source.

 **WARNING**

- **DO NOT heat components to the point where they may be damaged.**
- **DO NOT heat the ECM directly.**

 **SIMULATING WATER SPRINKLING**

- a. Sprinkle water onto vehicle to simulate a rainy day or a high humidity condition.

 **WARNING**

**DO NOT sprinkle water directly into the engine compartment or electronic components.**

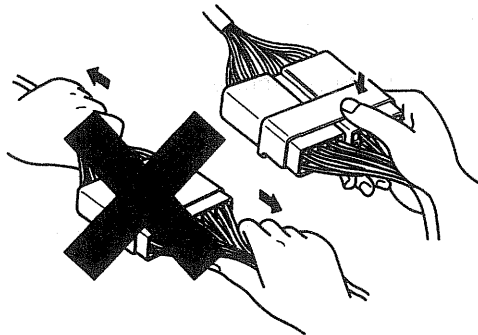
 **SIMULATING ELECTRICAL LOAD**

- a. Turn on all electrical systems to simulate excessive electrical loads (Radios, fans, lights, etc.).

**CONNECTOR INSPECTION PROCEDURE**

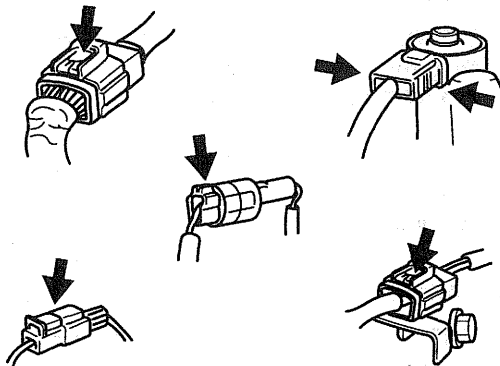
1. Handling of Connector

- a. Never pull on the wiring harness when disconnecting connectors.



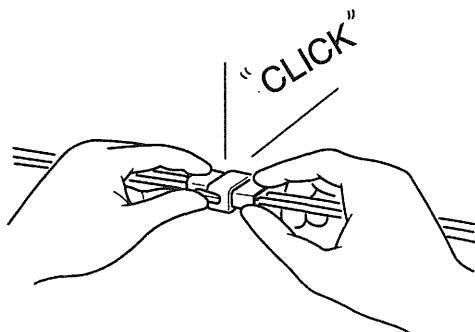
BFG015F

- b. When removing the connector with a lock, press or pull locking lever.



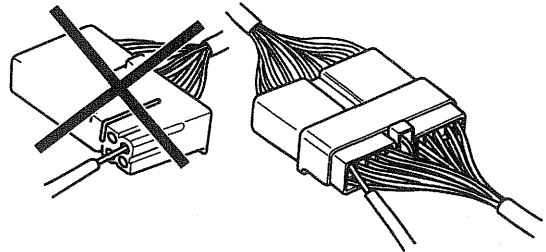
BFG015G

- c. Listen for a click when locking connectors. This sound indicates that they are securely locked.



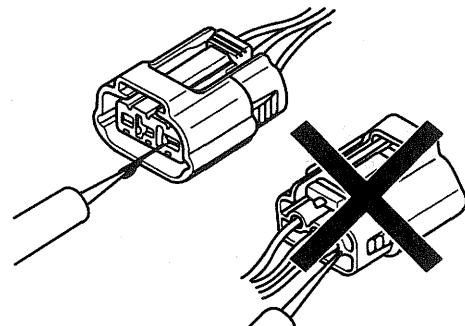
BFG015H

- d. When a tester is used to check for continuity, or to measure voltage, always insert tester probe from wire harness side.



BFG015I

- e. Check waterproof connector terminals from the connector side. Waterproof connectors cannot be accessed from harness side.



BFG015J

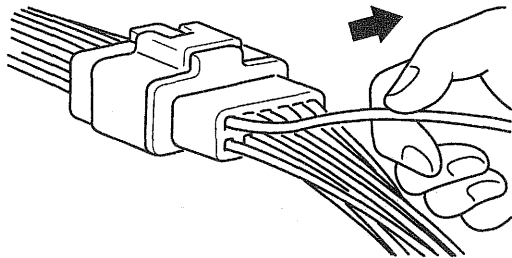
**NOTE**

- Use a fine wire to prevent damage to the terminal.
- Do not damage the terminal when inserting the tester lead.

2. Checking Point for Connector

- a. While the connector is connected: Hold the connector, check connecting condition and locking efficiency.
- b. When the connector is disconnected: Check missed terminal, crimped terminal or broken core wire by slightly pulling the wire harness. Visually check for rust, contamination, deformation and bend.
- c. Check terminal tightening condition: Insert a spare male terminal into a female terminal, and then check terminal tightening conditions.

- d. Pull lightly on individual wires to ensure that each wire is secured in the terminal.



BFGE015K

3. Repair Method of Connector Terminal

- a. Clean the contact points using air gun and/or shop rag.

**NOTE**

Never use sand paper when polishing the contact points, otherwise the contact point may be damaged.

- b. In case of abnormal contact pressure, replace the female terminal.

**WIRE HARNESS INSPECTION PROCEDURE**

1. Before removing the wire harness, check the wire harness position and crimping in order to restore it correctly.
2. Check whether the wire harness is twisted, pulled or loosened.
3. Check whether the temperature of the wire harness is abnormally high.
4. Check whether the wire harness is rotating, moving or vibrating against the sharp edge of a part.
5. Check the connection between the the wire harness and any installed part.
6. If the covering of wire harness is damaged; secure, repair or replace the harness.

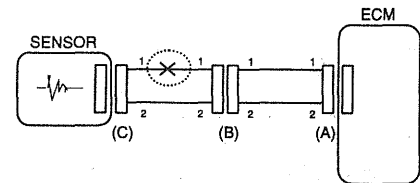
**ELECTRICAL CIRCUIT INSPECTION PROCEDURE**

● CHECK OPEN CIRCUIT

1. Procedures for Open Circuit
  - Continuity Check
  - Voltage Check

If an open circuit occurs (as seen in [FIG. 1]), it can be found by performing Step 2 (Continuity Check Method) or Step 3 (Voltage Check Method) as shown below.

FIG. 1



BFGE501A

2. Continuity Check Method

**NOTE**

When measuring for resistance, lightly shake the wire harness above and below or from side to side.

Specification (Resistance)

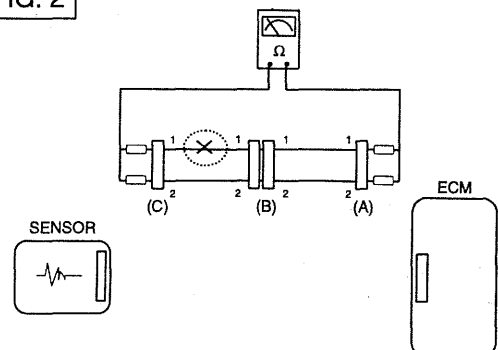
1Ω or less → Normal Circuit

1MΩ or Higher → Open Circuit

- a. Disconnect connectors (A), (C) and measure resistance between connector (A) and (C) as shown in [FIG. 2].

In [FIG.2.] the measured resistance of line 1 and 2 is higher than 1MΩ and below 1Ω respectively. Specifically the open circuit is line 1 (Line 2 is normal). To find exact break point, check sub line of line 1 as described in next step.

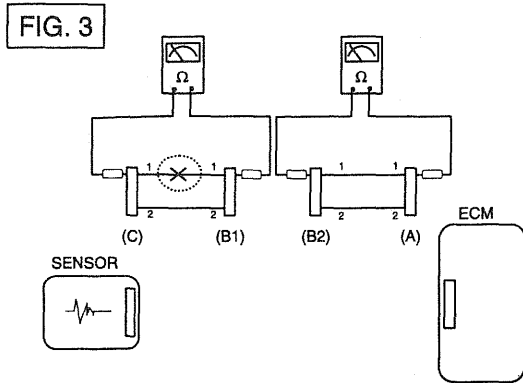
FIG. 2



BFGE501B

- b. Disconnect connector (B), and measure for resistance between connector (C) and (B1) and between (B2) and (A) as shown in [FIG. 3].

In this case the measured resistance between connector (C) and (B1) is higher than  $1M\Omega$  and the open circuit is between terminal 1 of connector (C) and terminal 1 of connector (B1).

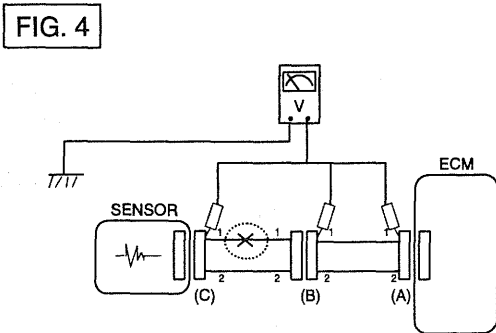


BFG501C

3. Voltage Check Method

- a. With each connector still connected, measure the voltage between the chassis ground and terminal 1 of each connectors (A), (B) and (C) as shown in [FIG. 4].

The measured voltage of each connector is 5V, 5V and 0V respectively. So the open circuit is between connector (C) and (B).



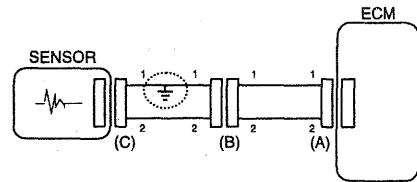
BFG501D

● CHECK SHORT CIRCUIT

- 1. Test Method for Short to Ground Circuit
  - Continuity Check with Chassis Ground

If short to ground circuit occurs as shown in [FIG. 5], the broken point can be found by performing below Step 2 (Continuity Check Method with Chassis Ground) as shown below.

FIG. 5



BFG501E

2. Continuity Check Method (with Chassis Ground)

**NOTE**

*Lightly shake the wire harness above and below, or from side to side when measuring the resistance.*

Specification (Resistance)

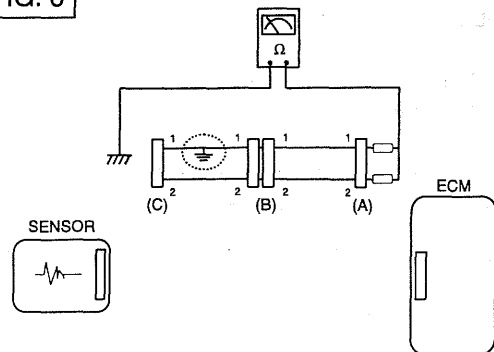
$1\Omega$  or less → Short to Ground Circuit

$1M\Omega$  or Higher → Normal Circuit

- a. Disconnect connectors (A), (C) and measure for resistance between connector (A) and Chassis Ground as shown in [FIG. 6].

The measured resistance of line 1 and 2 in this example is below  $1\Omega$  and higher than  $1M\Omega$  respectively. Specifically the short to ground circuit is line 1 (Line 2 is normal). To find exact broken point, check the sub line of line 1 as described in the following step.

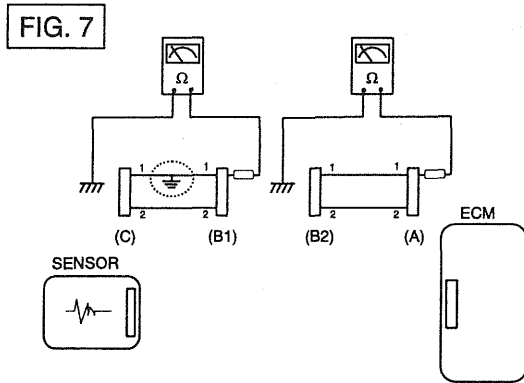
FIG. 6



BFG501F

- b. Disconnect connector (B), and measure the resistance between connector (A) and chassis ground, and between (B1) and chassis ground as shown in [FIG. 7].

The measured resistance between connector (B1) and chassis ground is  $1\Omega$  or less. The short to ground circuit is between terminal 1 of connector (C) and terminal 1 of connector (B1).



BFG501G

### ECM PROBLEM INSPECTION PROCEDURE

1. **TEST ECM GROUND CIRCUIT:** Measure resistance between ECM and chassis ground using the backside of ECM harness connector as ECM side check point. If the problem is found, repair it.

---

Specification (Resistance):  $1\Omega$  or less

---

2. **TEST ECM CONNECTOR:** Disconnect the ECM connector and visually check the ground terminals on ECM side and harness side for bent pins or poor contact pressure. If the problem is found, repair it.
3. If problem is not found in Step 1 and 2, the ECM could be faulty. If so, replace the ECM with a new one, and then check the vehicle again. If the vehicle operates normally then the problem was likely with the ECM.
4. **RE-TEST THE ORIGINAL ECM :** Install the original ECM (may be broken) into a known-good vehicle and check the vehicle. If the problem occurs again, replace the original ECM with a new one. If problem does not occur, this is intermittent problem (Refer to INTERMITTENT PROBLEM PROCEDURE in BASIC INSPECTION PROCEDURE).

## SYMPTOM TROUBLESHOOTING GUIDE CHART

Problem	Possible cause
Engine does not start	Run out of petrol
	Starter out of order
	Pump hose supply cut
	High pressure leakage
	Fuse out of order
	The compensation of individual injector not adapted
	Drift of the engine coolant temperature sensor not detected
	Drift of the rail pressure sensor not detected
	Cam and Crank signals missing simultaneously
	Battery voltage too low
	Faulty antitheft
	EGR valve blocked open (engine doesn't start)
	IMV contaminated, stuck, jammed
	Fuel quality / presence of water
	Inversion of low pressure fuel connections
	Fuel filter not adapted
	Low pressure fuel circuit sealed
	Sealed fuel filter
	Intermittent fault connection
	Air ingress in the low pressure fuel circuit
	Fuel return circuit of the pump sealed
	Air heaters out of order
	Engine compression too low
	Leakage at the injector valve
	Transfer pump out of order
	High pressure pump out of order
	Injector jammed open
	Bug soft or hardware fault not detected

Problem	Possible cause
Engine starts with difficulty or starts and stalls	Run out of petrol
	Fuel return hose of nozzle holder cut
	High pressure leakage
	Fuse out of order
	Air filter sealed
	Alternator or voltage regulator out of order
	The compensation of individual injector not adapted
	Drift of the engine coolant temperature sensor not detected
	Drift of the rail pressure sensor not detected
	Battery voltage too low
	EGR valve blocked open (engine doesn't start)
	IMV contaminated, stuck, jammed
	Fuel quality / presence of water
	Inversion of low pressure fuel connections
	Fuel filter not adapted
	Low pressure fuel circuit sealed
	Sealed fuel filter
	Oil level too high/too low
	Catalytic converter sealed or damaged
	Intermittent fault connection
	Air ingress in the low pressure fuel circuit
	Fuel return circuit of the pump sealed
	Air heaters out of order
	Engine compression too low
	Fuel return hose of nozzle holder sealed
	Carbon deposit on the injector (sealed holes)
	Needle stuck (injection possible over a certain pressure)
	Petrol in fuel
Bug soft or hardware fault not detected	



Problem	Possible cause
Poor starting when hot	The compensation of individual injector not adapted
	Drift of the rail pressure sensor not detected
	Drift of the engine coolant temperature sensor not detected
	EGR valve blocked open (engine doesn't start)
	IMV contaminated, stuck, jammed
	Air filter sealed
	Fuel filter not adapted
	Air ingress in the low pressure fuel circuit
	Fuel quality / presence of water
	Fuel return circuit of the pump sealed
	Sealed fuel filter
	Engine compression too low
	Intermittent fault connection
	Carbon deposit on the injector (sealed holes)
	Needle stuck (injection possible over a certain pressure)
	Petrol in fuel
Bug soft or hardware fault not detected	
Unstable idling	Fuel return hose of nozzle holder cut
	The compensation of individual injector not adapted
	Drift of the rail pressure sensor not detected
	Drift of the sensors used to evaluate the air flow not detected
	Harness resistance increased
	Fuel filter not adapted
	Air ingress in the low pressure fuel circuit
	Fuel quality / presence of water
	Sealed fuel filter
	Air filter sealed
	Fuel return hose of nozzle holder sealed
	High pressure leakage
	Air heaters out of order
	Engine compression too low
	Bad flanging of the injector
	High pressure pump out of order
	Injector not adapted
	Carbon deposit on the injector (sealed holes)
Needle stuck (injection possible over a certain pressure)	
Injector jammed open	

Problem	Possible cause
Idle speed too high/too low	Drift of the engine coolant temperature sensor not detected
	Incorrect state of the electrical pack devices
	Alternator or voltage regulator out of order
	Clutch not well set
	Bug soft or hardware fault not detected
Blue, white, black smokes	The compensation of individual injector not adapted
	Drift of the sensors used to evaluate the air flow not detected
	Drift of the engine coolant temperature sensor not detected
	Drift of the rail pressure sensor not detected
	EGR valve blocked open (engine doesn't start)
	IMV contaminated, stuck, jammed
	Oil level too high/too low
	Fuel quality / presence of water
	Catalytic converter sealed or damaged
	Air filter sealed
	Oil suction (engine racing)
	Air heaters out of order
	Engine compression too low
	Bad flanging of the injector
	Injector washer not adapted, forgotten, doubled
	Injector not adapted
	Carbon deposit on the injector (sealed holes)
	Injector jammed open
Petrol in fuel	
Engine rattling, noisy engine	The compensation of individual injector not adapted
	EGR valve blocked closed (noisy engine)
	EGR valve blocked open (engine doesn't start)
	Drift of the engine coolant temperature sensor not detected
	Drift of the sensors used to evaluate the air flow not detected
	Air heaters out of order
	Engine compression too low
	Fuel return hose of nozzle holder sealed
	Drift of the rail pressure sensor not detected
	Injector washer not adapted, forgotten, doubled
	Injector not adapted
	Carbon deposit on the injector (sealed holes)
	Needle stuck (injection possible over a certain pressure)
	Injector jammed open

Problem	Possible cause
Burst noise	The compensation of individual injector not adapted
	Intermittent fault connection
	Drift of the rail pressure sensor not detected
	IMV contaminated, stuck, jammed
	Bug soft or hardware fault not detected
Untimely acceleration/deceleration and engine racing	Pedal sensor blocked (cable jammed)
	EGR valve blocked open (engine doesn't start)
	Intermittent fault connection
	Oil suction (engine racing)
	Drift of the rail pressure sensor not detected
	Bug soft or hardware fault not detected
Gap when accelerating and at re-coupling (response time)	Air inlet circuit open
	Incorrect state of the electrical pack devices
	Pedal sensor blocked (cable jammed)
	EGR valve blocked open (engine doesn't start)
	Turbo charger damaged
	Fuel filter not adapted
	Sealed fuel filter
	Engine compression too low
	High pressure leakage
	IMV contaminated, stuck, jammed
	Needle stuck (injection possible over a certain pressure)
	Bug soft or hardware fault not detected

Problem	Possible cause
Engine stop/ stalling	Run out of petrol
	Pump hose supply cut
	High pressure leakage
	Fuse out of order
	Fuel quality / presence of water
	Low pressure fuel circuit sealed
	Sealed fuel filter
	Cam and Crank signals missing simultaneously
	EGR valve blocked open (engine doesn't start)
	IMV contaminated, stuck, jammed
	Alternator or voltage regulator out of order
	Intermittent fault connection
	Catalytic converter sealed or damaged
	Oil suction (engine racing)
	Transfer pump out of order
	High pressure pump out of order
	Faulty ignition key
	Petrol in fuel
Bug soft or hardware fault not detected	

Problem	Possible cause
Engine judder	Run out of petrol
	Fuel return hose of nozzle holder cut
	Incorrect state of the electrical pack devices
	The compensation of individual injector not adapted
	Drift of the sensors used to evaluate the air flow not detected
	EGR valve blocked open (engine doesn't start)
	Fuel filter not adapted
	Air ingress in the low pressure fuel circuit
	Fuel quality / presence of water
	Sealed fuel filter
	Intermittent fault connection
	Harness resistance increased
	Air heaters out of order
	Engine compression too low
	Fuel return hose of nozzle holder sealed
	Valve clearance
	Transfer pump out of order
	Injector washer not adapted, forgotten, doubled
	Carbon deposit on the injector (sealed holes)
	Needle stuck (injection possible over a certain pressure)
	Injector jammed open
Petrol in fuel	
Bug soft or hardware fault not detected	

Problem	Possible cause
Lack of power	The compensation of individual injector not adapted
	Pedal sensor blocked (cable jammed)
	Incorrect state of the electrical pack devices
	Drift of the sensors used to evaluate the air flow not detected
	EGR valve blocked open (engine doesn't start)
	Air inlet circuit open
	Air filter sealed
	Oil level too high/too low
	Catalytic converter sealed or damaged
	Turbo charger damaged
	Fuel filter not adapted
	Sealed fuel filter
	Leakage at the injector valve
	Fuel return circuit of the pump sealed
	Fuel return hose of nozzle holder sealed
	Engine compression too low
	Injector not adapted
Carbon deposit on the injector (sealed holes)	
Valve clearance	
Too much power	EGR valve blocked closed (noisy engine)
	The compensation of individual injector not adapted
	Oil suction (engine racing)
	Injector not adapted
	Bug soft or hardware fault not detected

Problem	Possible cause
Excessive fuel consumption	Fuel return hose of nozzle holder cut
	Leakage at the IMV
	Leakage at fuel temperature sensor
	Leakage at the spacers
	High pressure leakage
	Air inlet circuit open
	Air filter sealed
	The compensation of individual injector not adapted
	EGR valve blocked open (engine doesn't start)
	Incorrect state of the electrical pack devices
	Oil level too high/too low
	Fuel quality / presence of water
	Catalytic converter sealed or damaged
	Turbo charger damaged
	Engine compression too low
	Injector not adapted
Bug soft or hardware fault not detected	
Over speed engine when changing the gear box ratio	Pedal sensor blocked (cable jammed)
	The compensation of individual injector not adapted
	Intermittent fault connection
	Clutch not well set
	Oil suction (engine racing)
	Turbo charger damaged
	Injector not adapted
	Bug soft or hardware fault not detected
Exhaust smells	EGR valve blocked open (engine doesn't start)
	Oil suction (engine racing)
	Turbo charger damaged
	Oil level too high/too low
	The compensation of individual injector not adapted
	Catalytic converter sealed or damaged
	Bad flanging of the injector
	Injector washer not adapted, forgotten, doubled
	Injector not adapted
	Carbon deposit on the injector (sealed holes)
	Needle stuck (injection possible over a certain pressure)
	Injector jammed open
	Bug soft or hardware fault not detected

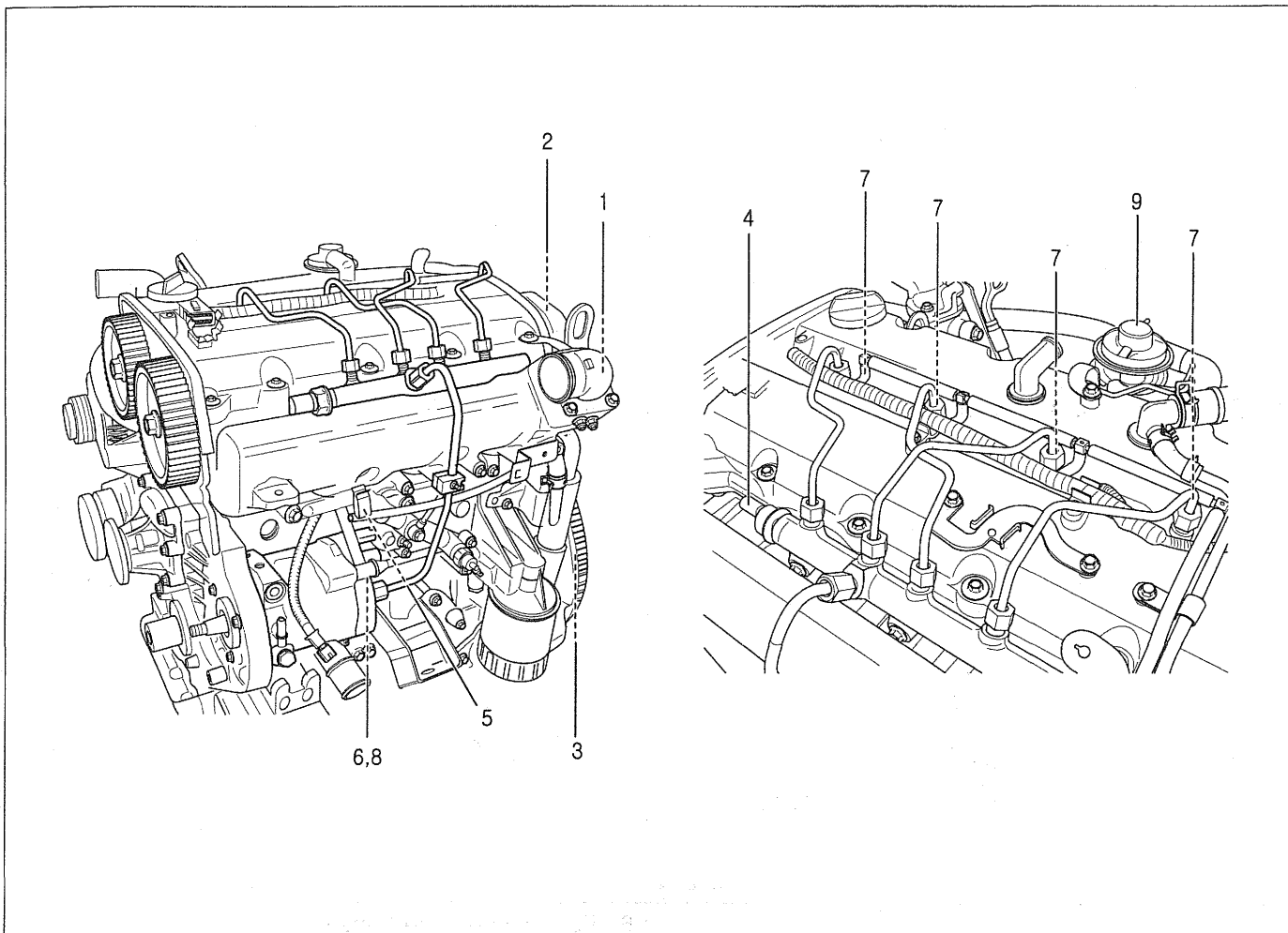
Problem	Possible cause
Smokes (black, white, blue) when accelerating	The compensation of individual injector not adapted
	EGR valve blocked open (engine doesn't start)
	Drift of the sensors used to evaluate the air flow not detected
	Air filter sealed
	Fuel quality / presence of water
	Oil level too high/too low
	Turbo charger damaged
	Catalytic converter sealed or damaged
	Oil suction (engine racing)
	Air heaters out of order
	Engine compression too low
	High pressure leakage
	Intermittent fault connection
	Bad flanging of the injector
	Injector washer not adapted, forgotten, doubled
	Injector not adapted
	Carbon deposit on the injector (sealed holes)
	Needle stuck (injection possible over a certain pressure)
	Injector jammed open
	Petrol in fuel
Bug soft or hardware fault not detected	
Fuel smells	Pump hose supply cut
	Fuel return hose of nozzle holder cut
	Leakage at the IMV
	Leakage at fuel temperature sensor
	Leakage at the spacers
	High pressure leakage



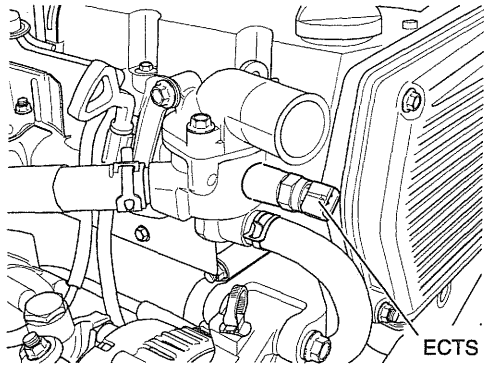
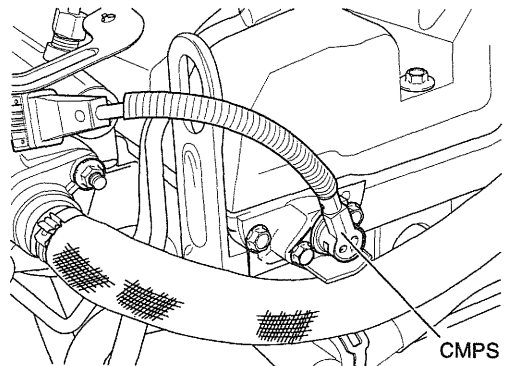
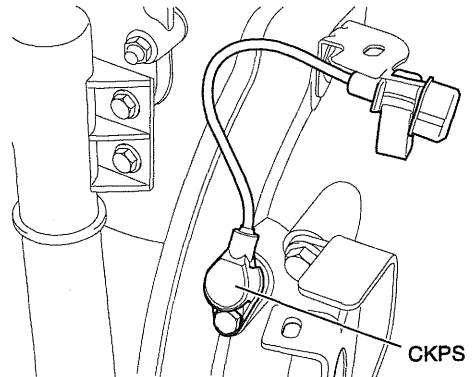
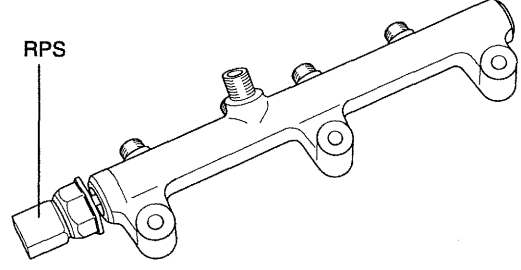
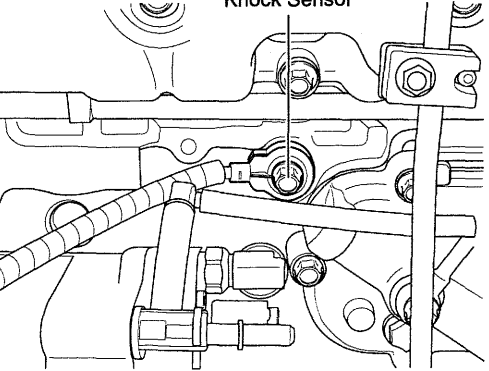
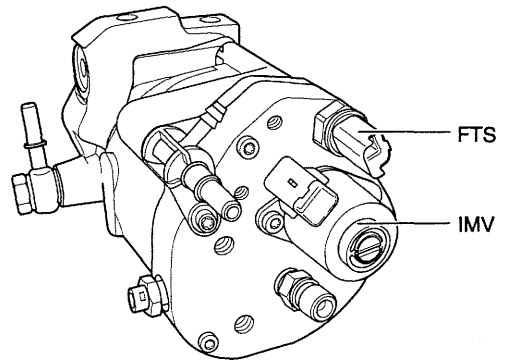
Problem	Possible cause
The engine collapses at take off	Pedal sensor blocked (cable jammed)
	Incorrect state of the electrical pack devices
	Air filter sealed
	Inversion of low pressure fuel connections
	Fuel filter not adapted
	Fuel quality/presence of water
	Air ingress in the low pressure fuel circuit
	Sealed fuel filter
	Catalytic converter sealed or damaged
	Clutch not well set
	Intermittent fault connection
	Drift of the rail pressure sensor not detected
	IMV contaminated, stuck, jammed
	Petrol in fuel
Bug soft or hardware fault not detected	
The engine does not stop	Faulty ignition key
	Oil suction (engine racing)
	Bug soft or hardware fault not detected
Different mechanical noises	Buzzer noise (discharge by the injectors)
	Clip broken (vibrations, resonance, noises)
	Incorrect state of the electrical pack devices
	Catalytic converter sealed or damaged
	Air inlet circuit open
	Bad flanging of the injector
	Clutch not well set
	Turbo charger damaged
Valve clearance	

# DIESEL CONTROL SYSTEM

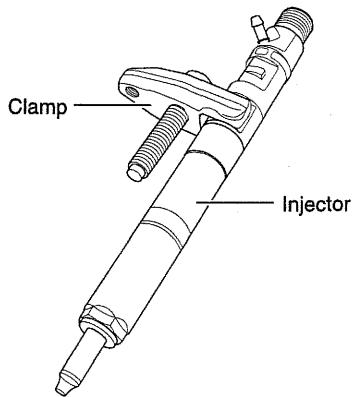
## COMPONENTS EE257321



- |   |  |
|---|--|
| 1. Engine Coolant Temperature Sensor (ECTS) | 8. Inlet Metering Valve (IMV)            |
| 2. Camshaft Position Sensor (CMPS)          | 9. EGR Valve                             |
| 3. Crankshaft Position Sensor (CKPS)        | 10. EGR Solenoid Valve                   |
| 4. Rail Pressure Sensor (RPS)               | 11. Accelerator Position Sensor (APS)    |
| 5. Knock Sensor (KS)                        | 12. Mass Air Flow Sensor (MAFS)          |
| 6. Fuel Temperature Sensor (FTS)            | 13. Intake Air Temperature Sensor (IATS) |
| 7. Injector                                 |  |

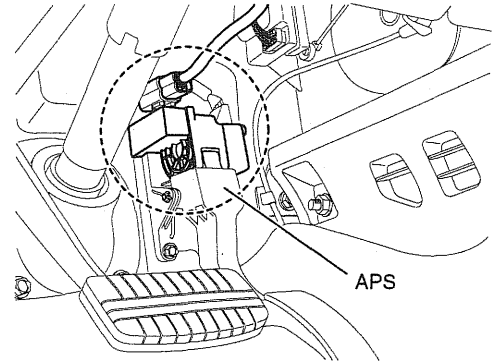
<p>1. Engine Coolant Temperature Sensor (ECTS)</p>  <p>ECTS</p> <p>AFBE100G</p>	<p>2. Camshaft Position Sensor (CMPS)</p>  <p>CMPS</p> <p>AFBE100H</p>
<p>3. Crankshaft Position Sensor (CKPS)</p>  <p>CKPS</p> <p>AFBE100I</p>	<p>4. Rail Pressure Sensor (RPS)</p>  <p>RPS</p> <p>AFBE100J</p>
<p>5. Knock Sensor (KS)</p>  <p>Knock Sensor</p> <p>EWMF100K</p>	<p>6. Fuel Temperature Sensor (FTS) 8. Inlet Metering Valve (IMV)</p>  <p>FTS</p> <p>IMV</p> <p>AFBE100L</p>

**7. Injector**



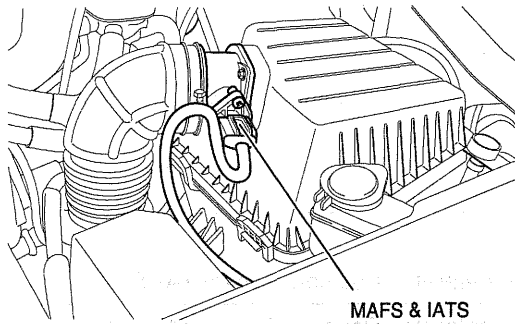
EWMF100M

**9. Accelerator Position Sensor (APS)**



KFME100P

**10. Mass Air Flow Sensor (MAFS)  
11. Intake Air Temperature Sensor (IATS)**



KFME100Q

## ECM CONNECTOR E0AE603B

## ECM Harness Connector

1	5	9	13	17	21	25	29
2	6	10	14	18	22	26	30
3	7	11	15	19	23	27	31
4	8	12	16	20	24	28	32

E03-1

33	37	41	45	49	53	57	61	65	69	73	77
34	38	42	46	50	54	58	62	66	70	74	78
35	39	43	47	51	55	59	63	67	71	75	79
36	40	44	48	52	56	60	64	68	72	76	80

E03-2

81	85	89	93	97	101	105	109
82	86	90	94	98	102	106	110
83	87	91	95	99	103	107	111
84	88	92	96	100	104	108	112

E03-3

EWMF100A

## CONNECTOR [E03-1]

Pin	Function	Connected to
1	-	
2	Accelerator position sensor signal input 1	Accelerator Position Sensor (APS) 1
3	Sensor ground	Accelerator Position Sensor (APS) 1
4	Power ground	Chassis Ground
5	Power supply (Battery voltage)	Main Relay
6	Sensor power supply	Accelerator Position Sensor (APS) 1
7	-	
8	Power ground	Chassis Ground
9	Malfunction indicator lamp control output	Cluster
10	Sensor power supply	Accelerator Position Sensor (APS) 2
11	Accelerator position sensor signal input 2	Accelerator Position Sensor (APS) 2
12	Sensor ground	Accelerator Position Sensor (APS) 2
13	-	
14	Immobilizer lamp control output	Cluster
15		
16	Brake switch 1 signal input	Brake Switch
17	Ignition switch sense	Ignition Switch
18	-	
19	-	
20	-	
21	Auto cruise indicator lamp control output	Auto Cruise Indicator Lamp
22	-	
23	-	
24	Clutch switch (M/T only)	Clutch Switch
25	-	
26	Engine speed signal output	Cluster
27	Immobilizer diagnosis line	Immobilizer

Pin	Function	Connected to
28	Diagnosis line (K-LINE)	Data Link Connector (DLC)
29	Glow indicator lamp control output	Cluster
30	A/T: P/N switch signal input	Inhibitor switch
	M/T: 1st gear switch signal input	1st Gear Switch
31	CAN - LOW	TCM
32	CAN - HIGH	TCM

## CONNECTOR [E03-2]

Pin	Function	Connected to
33	Sensor shield	Knock Sensor (KS)
34	-	
35	Intake throttle solenoid valve control output	Intake Throttle Solenoid Valve
36	Inlet metering valve control output	Inlet Metering Valve (IMV)
37	Sensor shield	Crankshaft Position Sensor (CKPS)
38	Water indicator lamp control output	Cluster
39	EGR solenoid valve control output	EGR Solenoid Valve
40	-	
41	-	
42	Intake air temperature sensor signal input	Intake Air Temperature Sensor (IATS)
43	-	
44	-	
45	-	
46	Glow relay 2 diagnosis line	Glow Relay 2
47	-	
48	-	
49	-	
50	Engine coolant temperature sensor signal input	Engine Coolant Temperature Sensor (ECTS)
51	Sensor ground	Engine Coolant Temperature Sensor (ECTS)
52	Injector (Cylinder #4) Low	Injector (Cylinder #4)
53	Knock sensor signal input	Knock Sensor (KS)
54	Fuel temperature sensor signal input	Fuel Temperature Sensor (FTS)
55	Sensor ground	Fuel Temperature Sensor (FTS)
56	Injector (Cylinder #4) High	Injector (Cylinder #4)
57	Sensor ground	Knock Sensor (KS)
58	Crankshaft position sensor [+] signal input	Crankshaft Position Sensor (CKPS)
59	Crankshaft position sensor [-] signal input	Crankshaft Position Sensor (CKPS)
60	Injector (Cylinder #3) Low	Injector (Cylinder #3)
61	Sensor power supply	Camshaft Position Sensor (CMPS)
62	Camshaft position sensor signal input	Camshaft Position Sensor (CMPS)

Pin	Function	Connected to
63	Sensor ground	Camshaft Position Sensor (CMPS)
64	Injector (Cylinder #3) High	Injector (Cylinder #3)
65	Sensor power supply	Rail Pressure Sensor (RPS)
66	Rail pressure sensor signal input	Rail Pressure Sensor (RPS)
67	Sensor ground	Rail Pressure Sensor (RPS)
68	Injector (Cylinder #2) Low	Injector (Cylinder #2)
69	-	
70	-	
71	-	
72	Injector (Cylinder #2) High	Injector (Cylinder #2)
73	-	
74	-	
75	-	
76	Injector (Cylinder #1) Low	Injector (Cylinder #1)
77	Sensor power supply	Mass Air Flow Sensor (MAFS)
78	Mass air flow sensor signal input	Mass Air Flow Sensor (MAFS)
79	Sensor ground	Mass Air Flow Sensor (MAFS)
		Intake Air Temperature Sensor (IATS)
80	Injector (Cylinder #1) High	Injector (Cylinder #1)

## CONNECTOR [E03-3]

Pin	Function	Connected to
81	-	
82	-	
83	-	
84	Compressor fan relay control output	Compressor Fan Relay
85	-	
86	Brake switch 2 signal input	Brake Switch
87	-	
88	-	
89	Auto cruise switch signal input	Auto Cruise Switch
90	-	
91	Glow relay 1 control output	Glow Relay 1
92	-	
93	Blower switch signal input	Blower switch
94	Glow relay 1 diagnosis line	Glow Relay 1
95	Glow relay 2 control output	Glow Relay 2
96	-	
97	MT/AT switch signal input	A/T: Chassis Ground, M/T: not used
98	Torque reduction signal input	TCM
99	A/C switch signal input	A/C Switch
100	Vehicle speed sensor signal input	Vehicle Speed Sensor (VSS)
101	-	
102	Water sensor signal input	Water Sensor in Fuel Filter
103	Accelerator position signal input (4WD only)	4WD: TOD (Torque On Demand), A/T: TCM
104	Main relay control output	Main Relay
105	A/C relay control output	A/C Relay
106	-	
107	Power supply (Battery voltage)	Main Relay
108	Power ground	Chassis Ground
109	-	
110	-	
111	Power supply (Battery voltage)	Main Relay
112	Power ground	Chassis Ground



# DTC TROUBLESHOOTING PROCEDURES

## INSPECTION CHART FOR DIAGNOSTIC TROUBLE CODES (DTC) E6EB026F

DTC	CC - CODE	Description	MIL
P0100		<b>EGR Control Malfunction</b>	△
	04	Parameter at minimum limit	
	05	Parameter at maximum limit	
P0101		<b>Mass Air Flow Sensor (MAFS) Circuit Malfunction</b>	△
	0a	Signal low (Open circuit or short circuit to ground)	
	0b	Signal high (Short circuit to battery line)	
P0102		<b>Mass Air Flow Sensor (MAFS) Range/Performance Problem</b>	△
	04	Signal lower than lower limit	
	05	Signal higher than upper limit	
P0115		<b>Engine Coolant Temperature Sensor (ECTS) Circuit Malfunction</b>	△
	0b	Signal low (Open circuit or short circuit to battery line)	
	02	Signal high (Short circuit to ground)	
P0120		<b>Accelerator Position Sensor (APS) 1 Circuit Malfunction</b>	△
	0a	Signal low (Open circuit or short circuit to ground)	
	0b	Signal high (Short circuit to battery line)	
	06	Value incoherent	
P0180		<b>Fuel Temperature Sensor (FTS) Circuit Malfunction</b>	△
	0b	Signal low (Open circuit or short circuit to battery line)	
	02	Signal high (Short circuit to ground)	
P0190		<b>Rail Pressure Sensor (RPS) Range/Performance Problem</b>	△
	0a	Signal low (Short circuit to ground)	
	0b	Signal high (Open circuit or short circuit to battery line)	
	06	Rail pressure incoherent	
	08	Signal low	
	09	Signal high	
	05	Parameter at maximum limit	
	8d	Above the average threshold	

DTC	CC - CODE	Description	MIL
P0201		<b>Inector #1 (Cylinder #1) Circuit Malfunction</b>	△
	04	Signal low	
	91	Injector stuck (Open)	
	86	Injector stuck (Close)	
	01	Open Circuit	
	0c	Short Circuit	
P0202		<b>Inector #2 (Cylinder #3) Circuit Malfunction</b>	△
	04	Signal low	
	91	Injector stuck (Open)	
	86	Injector stuck (Close)	
	01	Open Circuit	
	0c	Short Circuit	
P0203		<b>Inector #3 (Cylinder #4) Circuit Malfunction</b>	△
	04	Signal low	
	91	Injector stuck (Open)	
	86	Injector stuck (Close)	
	01	Open Circuit	
	0c	Short Circuit	
P0204		<b>Inector #4 (Cylinder #2) Circuit Malfunction</b>	△
	04	Signal low	
	91	Injector stuck (Open)	
	86	Injector stuck (Close)	
	01	Open Circuit	
	0c	Short Circuit	
P0220		<b>Accelerator Position Sensor (APS) 2 Circuit Malfunction</b>	△
	0a	Signal low (Open circuit or short circuit to ground)	
	0b	Signal high (Short circuit to battery line)	
	02	Signal low	
	03	Signal high	
P0226		<b>Accelerator Position Sensor (APS) 2 Range/Performance Problem</b>	△
	06	APS 1/2 signal incoherent	
	0b	Abnormal signal	
P0325		<b>Knock Sensor Circuit Malfunction</b>	△
	09	Signal high	
	07	No signal	

DTC	CC - CODE	Description	MIL
P0335		<b>Crankshaft Position Sensor (CKPS) Circuit Malfunction</b>	△
	93	Too many extra teeth detected	
	95	Extra teeth detected	
	07	No signal	
	94	Missing teeth detected	
	06	Abnormal airgap	
	92	Too many missing teeth detected	
P0340		<b>Camshaft Position Sensor (CMPS) Circuit Malfunction</b>	△
	07	No signal	
	06	CMPS/CKPS signal incoherent	
P0380		<b>Glow Relay 1 Circuit Malfunction</b>	△
	0a	Signal low (Open circuit or short circuit to ground)	
	03	Signal high (Short circuit to battery line)	
	0a	Open circuit or short circuit to ground	
	03	Short circuit to battery line	
P0381		<b>Glow Indicator Lamp Circuit Malfunction</b>	△
	0a	Open circuit or short circuit to ground	
	03	Short circuit to battery line	
P0382		<b>Glow Relay 2 Circuit Malfunction</b>	△
	0a	Signal low (Open circuit or short circuit to ground)	
	03	Signal high (Short circuit to battery line)	
	0a	Open circuit or short circuit to ground	
	03	Short circuit to battery line	
P0400		<b>EGR Solenoid Valve Circuit Malfunction</b>	△
	0a	Open circuit or short circuit to ground	
	03	Short circuit to battery line	
P0560		<b>Battery Voltage Malfunction</b>	△
	08	Battery voltage too low	
	09	Battery voltage too high	
P0600		<b>CAN Communication Error</b>	△
	07	No signal	
	06	No signal or TCM error	
	0a	No signal or TCS(or ESP) error	
P0650		<b>Malfunction Indicator Lamp Circuit Malfunction</b>	△
	0a	Open circuit or short circuit to ground	
	03	Short circuit to battery line	

DTC	CC - CODE	Description	MIL
P1119		<b>Inlet Metering Valve (IMV) Control Malfunction</b>	△
	96	Fuel leakage	
	97	Fuel leakage	
	98	Fuel leakage	
	99	Fuel leakage	
P1120		<b>Inlet Metering Valve (IMV) Circuit Malfunction</b>	△
	0a	Open circuit or short circuit to ground	
	03	Short circuit to battery line	
	05	Fuel leakage	
	04	Fuel leakage	
	08	Fuel leakage	
P1140		<b>Intake Air Temperature Sensor (IATS) Circuit Malfunction</b>	△
	0b	Signal low (Open circuit or short circuit to battery line)	
	02	Signal high (Short circuit to ground)	
P1150		<b>Atmospheric Pressure Sensor Fault</b>	△
	0a	Signal low (Open circuit or short circuit to ground)	
	03	Signal high (Short circuit to battery line)	
P1190		<b>Throttle Drive Fault</b>	△
	0a	Signal low (Open circuit or short circuit to ground)	
	03	Signal high (Short circuit to battery line)	
P1300		<b>Injector Specific Data Fault</b>	△
	04	Injector parameters incorrect	
P1310		<b>Injector Control Circuit Fault</b>	△
	03	Short circuit to battery line	
	02	Short circuit to ground	
P1458		<b>A/C Switch Fault</b>	△
	06	Value incoherent	
P1500		<b>Vehicle Speed Sensor (VSS) Circuit Malfunction</b>	△
	06	Abnormal signal after running	
	06	Abnormal signal after running	
	06	Abnormal signal after running	
	07	No signal before running	
P1543		<b>Brake Switch Signal Fault</b>	△
	03	Short to battery line in brake switch 1 circuit	
	02	Short to ground in brake switch 1 circuit	
	0b	Short to battery line in brake switch 2 circuit	
	0a	Short to ground in brake switch 2 circuit	
	0c	Brake 1/2 signal incoherent	

DTC	CC - CODE	Description	MIL
P1603		<b>CAN BUS OFF</b>	△
	07	CAN BUS OFF Fault	
P1608		<b>ECM Fault</b>	△
	81	ECM internal fault	
	82	ECM internal fault	
	82	ECM internal fault	
	82	ECM internal fault	
P1610		<b>Sensor External Voltage Fault</b>	△
	08	Sensor supply voltage too low	
	09	Sensor supply voltage too high	
P1614		<b>ECM Programming Error</b>	△
	85	ECM internal fault	
	83	ECM internal fault	
	8b	ECM internal fault	
	88	ECM internal fault	
	87	ECM internal fault	
	8a	ECM internal fault	
	8c	ECM internal fault	
	8a	ECM internal fault	
P1620		<b>A/C Relay Circuit Malfunction</b>	△
	0a	Open circuit or short circuit to ground	
	03	Short circuit to battery line	
P1640		<b>Main Relay Circuit Malfunction</b>	●
	0a	Open circuit or short circuit to ground	
P1674		<b>A/C Fan Relay Circuit Malfunction</b>	●
	0a	Open circuit or short circuit to ground	
P1780		<b>Torque Reduction Signal Fault</b>	△
	06	Abnormal signal	
	09	Abnormal signal	
	0a	Signal low (Open circuit or short circuit to ground)	
	0b	Signal high (Short circuit to battery line)	
P1786		<b>Tachometer Output Fault</b>	△
	0a	Signal low (Short circuit to ground)	
P2264		<b>Water Sensor Circuit Malfunction</b>	△
	0b	Permanent low level	

DTC	CC - CODE	Description	MIL
P2269		<b>Water in Fuel Filter Indicator Lamp Circuit Malfunction</b>	△
	0a	Signal low (Open circuit or short circuit to ground)	
	03	Signal high (Short circuit to battery line)	

 **NOTE**

- : MIL ON & FAULT CODE MEMORY
- △ : MIL OFF & FAULT CODE MEMORY

 **NOTE**

- Refer to the Group "BE" for the troubleshooting procedures of DTC P1611, P1612, P1613 and P1626.
- Refer to the Group "EE" for the troubleshooting procedures of DTC P1660 and P1661.

**TROUBLESHOOTING FOR DTC** E4392AED

DTC	P0100	EGR Control Malfunction
CC-CODE	04	Parameter at minimum limit
	05	Parameter at maximum limit

**DTC DETECTING CONDITION**

CC-CODE	Detecting Condition	Suspect Area
04	<ul style="list-style-type: none"> <li>• (Target intake air mass - Actual intake air mass) &lt; 200 mg/stroke</li> </ul>	<ul style="list-style-type: none"> <li>• EGR valve</li> <li>• EGR solenoid valve</li> <li>• Pipe connecting EGR valve and exhaust manifold</li> <li>• ECM</li> </ul>
05	<ul style="list-style-type: none"> <li>• (Target intake air mass - Actual intake air mass) &gt; 900 mg/stroke</li> </ul>	

**INSPECTION PROCEDURE**

**1. CHECK DTC**

1. Connect the Hi-Scan (Pro) to the Data Link Connector (DLC).
2. Turn ignition switch to ON and check that any other DTC(s) is (are) detected.

**Is P0400 also set?**

**No**

Yes	Do all repairs associated with those codes before proceeding with this procedure.
-----	---

**2. EGR VALVE INSPECTION**

1. Inspect below items.
  - **EGR valve**
  - **Pipe connecting EGR valve and exhaust manifold**

**Are all items have normal condition?**

**Yes**

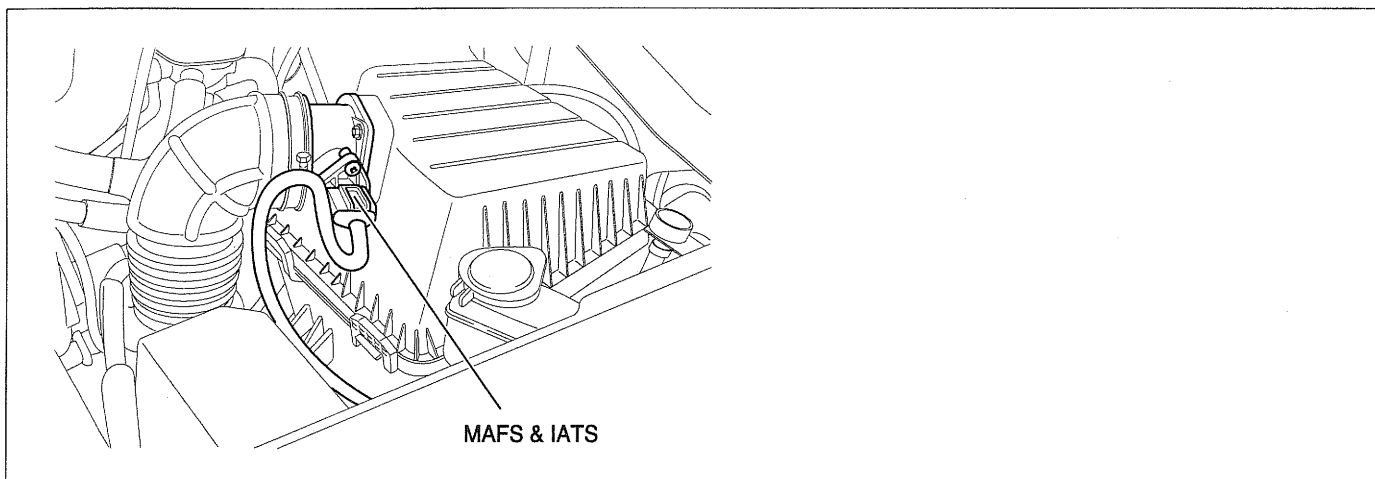
No	Repair or replace it.
----	-----------------------

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

**TROUBLESHOOTING FOR DTC** EFED28F4

<b>DTC</b>	<b>P0101</b>	<b>Mass Air Flow Sensor (MAFS) Circuit Malfunction</b>
CC-CODE	0a	Signal low (Open circuit or short circuit to ground)
	0b	Signal high (Short circuit to battery line)

<b>DTC</b>	<b>P0102</b>	<b>Mass Air Flow Sensor (MAFS) Range/Performance Problem</b>
CC-CODE	04	Signal lower than lower limit
	05	Signal higher than upper limit



KFME200N

**DESCRIPTION**

The mass air flow sensor (MAFS) has an intake air temperature sensor built-in and is located between the air cleaner assembly and the throttle device. The MAFS uses a hot film type sensing-element to measure the mass of intake air entering the engine. Mass air flow rate is measured by detection of heat transfer from a hot film probe. The change in air flow rate causes change in the amount of heat being transferred from the hot film probe surface to

the air flow. A large amount of intake air represents acceleration or high load conditions while a small amount of intake air represents deceleration or idle. The ECM uses this information to control the EGR solenoid valve and correct the fuel amount.

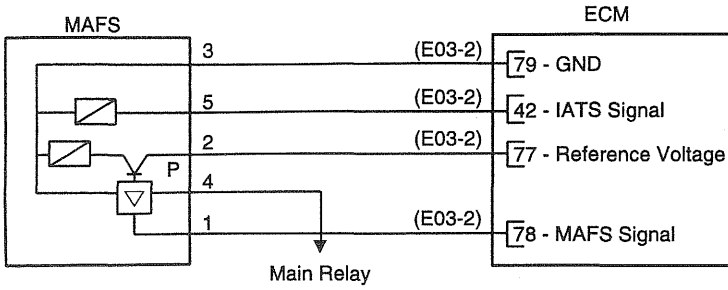
**DTC DETECTING CONDITION**

CC-CODE	Detecting Condition	Suspect Area
0a	• Mass air flow < 50 mg/stroke	<ul style="list-style-type: none"> <li>• Open or short in MAFS circuit</li> <li>• MAFS</li> <li>• ECM</li> </ul>
0b	• Mass air flow > 1,000 mg/stroke	
04	• Mass air flow sensor fault	
05		



[SCHEMATIC DIAGRAM]

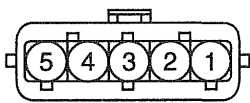
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM E03-2 (78)	MAFS Signal
2	ECM E03-2 (77)	Reference Voltage
3	ECM E03-2 (79)	Sensor Ground
4	Main Relay	Battery Voltage
5	ECM E03-2 (42)	IATS Signal

[HARNESS CONNECTORS]



**E17**  
MAFS & IATS

33	37	41	45	49	53	57	61	65	69	73	●
34	38	●	46	50	54	58	62	66	70	74	●
35	39										
		43	47	51	55	59	63	67	71	75	●
36	40	44	48	52	56	60	64	68	72	76	80

**E03-2**  
ECM

INSPECTION PROCEDURE

**1. CHECK MAFS AND ECM CONNECTORS**

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
  - Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

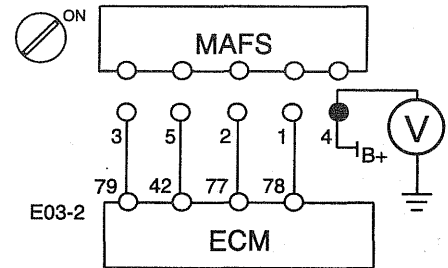
Are all connectors good?

Yes

No	Repair or replace it
----	----------------------

**2. CHECK POWER TO MAFS**

1. Turn ignition switch to OFF and disconnect MAFS connector.
2. Turn ignition switch to ON.
3. Measure voltage in harness between terminal 4 of MAFS harness connector and chassis ground.
  - **Specification: approximately B+**



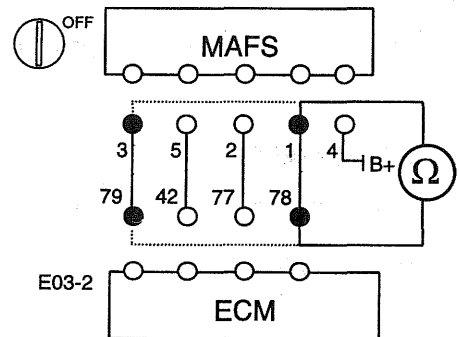
Is(Are) voltage(s) within specification?

Yes

No	Repair open or short circuit in harness.
----	--

**3. CHECK FOR OPEN IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and MAFS connector.
2. Measure resistance between terminal 1 of MAFS harness connector and terminal E03-2(78) of ECM harness connector.
3. Measure resistance between terminal 3 of MAFS harness connector and terminal E03-2(79) of ECM harness connector.
  - **Specification: below 1Ω**



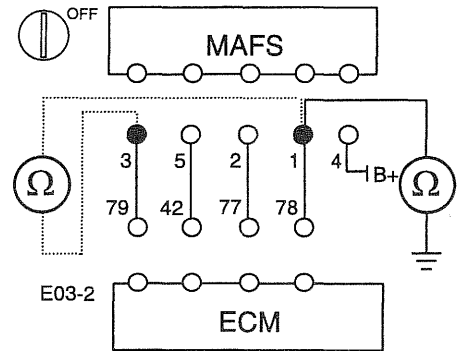
Is(Are) resistance(s) within specification?

Yes

No	Repair open circuit in harness.
----	---------------------------------

**4. CHECK FOR SHORT TO GROUND IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and MAFS connector.
2. Measure resistance between terminal 1 of MAFS harness connector and chassis ground.
3. Measure resistance between terminal 1 and 3 of MAFS harness connector.
  - **Specification: infinite**



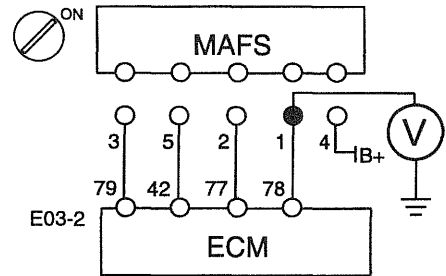
Is(Are) resistance(s) within specification?

Yes

No	Repair short or short to chassis ground in harness.
----	---

**5. CHECK FOR SHORT TO POWER IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and MAFS connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 1 of MAFS harness connector and chassis ground.
  - **Specification: below 0.5V**



Is(Are) voltage(s) within specification?

Yes

No	Repair short to power in harness.
----	-----------------------------------

**6. CHECK MAFS**

1. Replace the MAFS with a new one, and then monitor the vehicle again using a Hi-Scan (Pro).

Are these problem fixed?

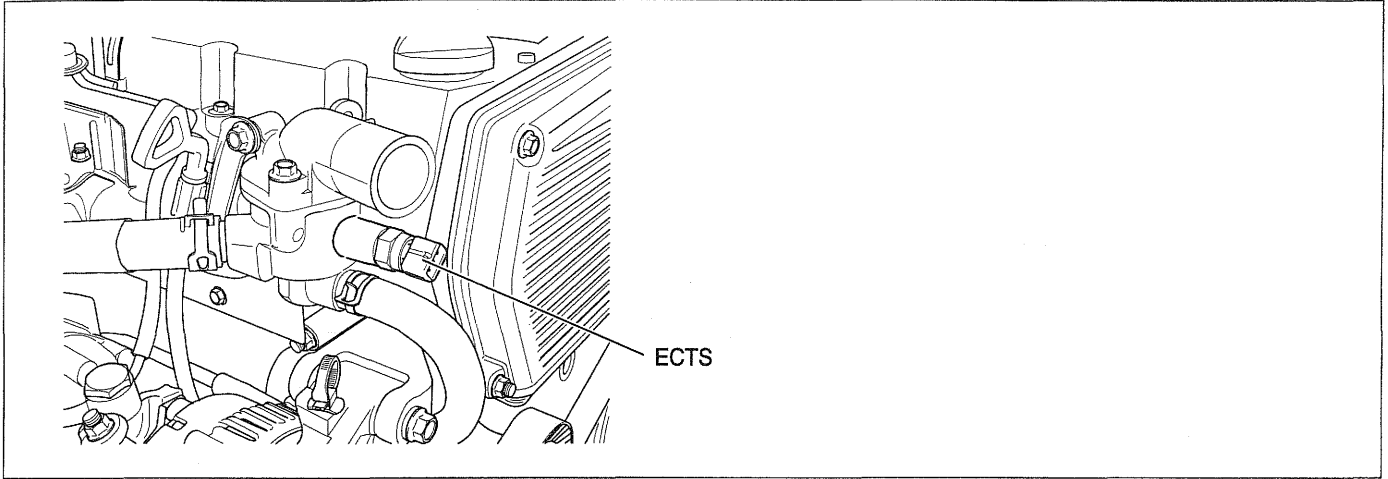
Yes

No	Replace the MAFS.
----	-------------------

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

TROUBLESHOOTING FOR DTC E91DF16A

DTC	P0115	Engine Coolant Temperature Sensor (ECTS) Circuit Malfunction
CC-CODE	0b	Signal low (Open circuit or short circuit to battery line)
	02	Signal high (Short circuit to ground)



AFBE2000

**DESCRIPTION**

The engine coolant temperature sensor (ECTS) is located in the engine coolant passage of the cylinder head for detecting the engine coolant temperature. The ECTS uses a thermistor whose resistance changes with the temperature. The electrical resistance of the ECTS decreases as the engine coolant temperature increases, and increases as the engine coolant temperature decreases. The 5 V power source in the ECM is supplied to the ECTS via a resistor in the ECM. That is, the resistor in the ECM and

the thermistor in the ECTS are connected in series. When the resistance value of the thermistor in ECTS changes according to the engine coolant temperature, the signal voltage also changes. This information of engine coolant temperature is used in determination of basic fuel quantity and cooling fan control.

**DTC DETECTING CONDITION**

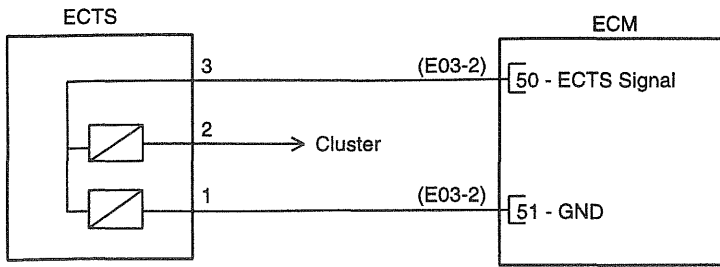
CC-CODE	Detecting Condition	Suspect Area
0b	• Engine coolant temperature < -49°C(-56.2°F)	• Open or short in ECTS circuit • ECTS • ECM
02	• Engine coolant temperature > 139°C(282.2°F)	

**SPECIFICATION**

Temperature [°C (°F)]	-40(-40)	-20(-4)	0(32)	20(68)	40(104)	60(140)	80(176)
Resistance (kΩ)	44.4	13.4 ~ 16.8	5.74	2.3 ~ 2.6	1.15	0.58	0.32

[SCHEMATIC DIAGRAM]

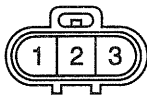
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM E03-2 (51)	Sensor Ground
2	Cluster	-
3	ECM E03-2 (50)	ECTS Signal

[HARNES CONNECTORS]



E43

ECTS

33	37	41	45	49	53	57	61	65	69	73	77
34	38	42	46	50	54	58	62	66	70	74	78
35	39	43	47	51	55	59	63	67	71	75	79
36	40	44	48	52	56	60	64	68	72	76	80

E03-2

ECM

INSPECTION PROCEDURE

**1. CHECK ECTS AND ECM CONNECTORS**

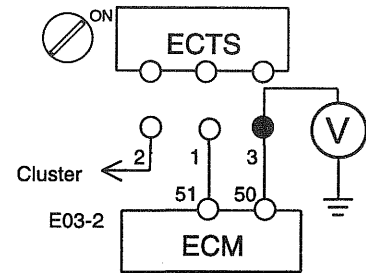
1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
  - Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

Are all connectors good?

<b>Yes</b>		
<b>No</b>		Repair or replace it.

**2. CHECK REFERENCE VOLTAGE TO ECTS**

1. Turn ignition switch to OFF and disconnect ECTS connector.
2. Turn ignition switch to ON.
3. Measure voltage in harness between terminal 3 of ECTS harness connector and chassis ground.
  - **Specification: approximately 5V**

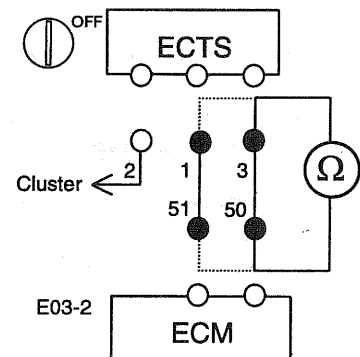


Is(Are) voltage(s) within specification?

<b>Yes</b>		
<b>No</b>		Repair open or short circuit in harness.

**3. CHECK FOR OPEN IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and ECTS connector.
2. Measure resistance between terminal 3 of ECTS harness connector and terminal E03-2(50) of ECM harness connector.
3. Measure resistance between terminal 1 of ECTS harness connector and terminal E03-2(51) of ECM harness connector.
  - **Specification: below 1Ω**

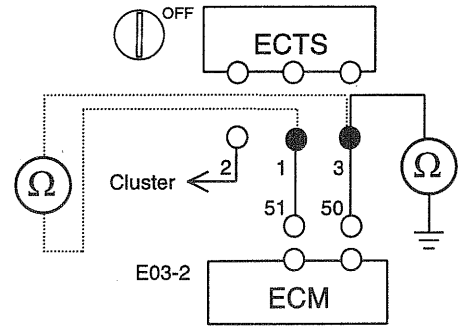


Is(Are) resistance(s) within specification?

<b>Yes</b>		
<b>No</b>		Repair open circuit in harness.

**4. CHECK FOR SHORT TO GROUND IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and ECTS connector.
2. Measure resistance between terminal 3 of ECTS harness connector and chassis ground.
3. Measure resistance between terminal 3 and 1 of ECTS harness connector.
  - **Specification: infinite**

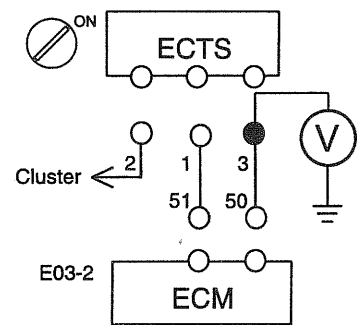


Is(Are) resistance(s) within specification?

<b>Yes</b>		
	No	Repair short or short to chassis ground in harness.

**5. CHECK FOR SHORT TO POWER IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and ECTS connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 3 of ECTS harness connector and chassis ground.
  - **Specification: below 0.5V**

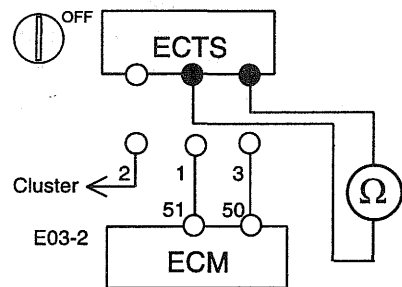


Is(Are) voltage(s) within specification?

<b>Yes</b>		
	No	Repair short to power in harness.

**6. CHECK ECTS RESISTANCE**

1. Turn ignition switch to OFF and disconnect ECTS connector.
2. Measure resistance between terminal 3 and 1 of ECTS connector.
  - **Refer to "SPECIFICATION" for more information.**



Is(Are) resistance(s) within specification?

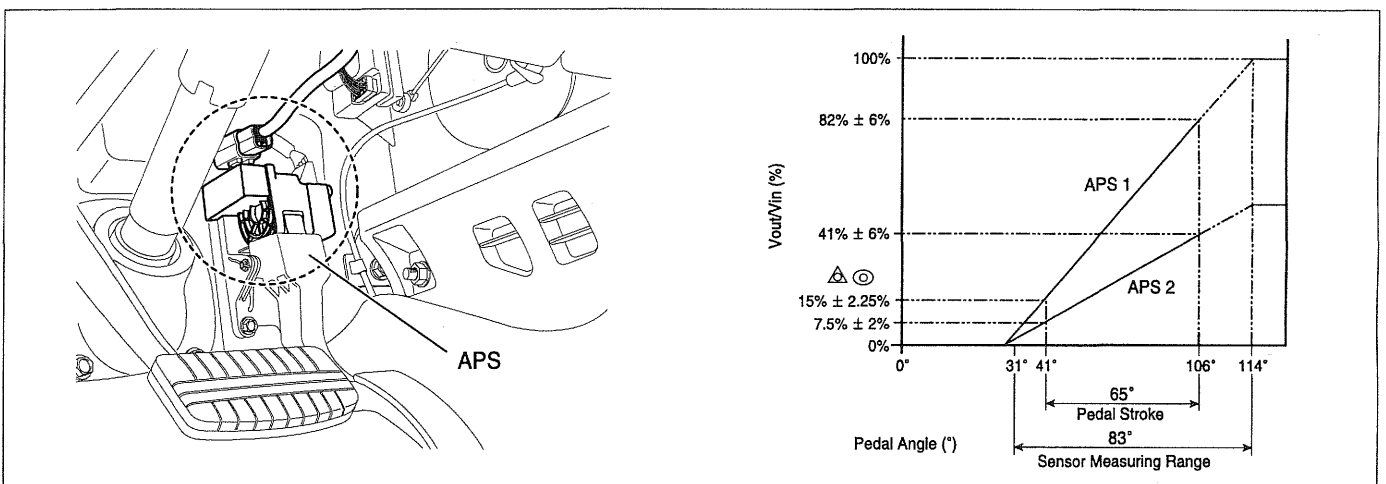
<b>Yes</b>		
	No	Replace the ECTS.

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

TROUBLESHOOTING FOR DTC ECAFD836

DTC	P0120	Accelerator Position Sensor (APS) 1 Circuit Malfunction
CC-CODE	0a	Signal low (Open circuit or short circuit to ground)
	0b	Signal high (Short circuit to battery line)
	06	Value incoherent

DTC	P0220	Accelerator Position Sensor (APS) 2 Circuit Malfunction
CC-CODE	0a	Signal low (Open circuit or short circuit to ground)
	0b	Signal high (Short circuit to battery line)
	02	Signal low
	03	Signal high



EWMF200P

**DESCRIPTION**

On electronic injection systems, there is no longer a load lever that mechanically controls the fuelling. The flow is calculated by the ECM depending on a number of parameters, including pedal position, which is measured using a potentiometer. The absence of a mechanical link between the accelerator pedal and the injection system presents a risk of loss of control of the engine in the event of a failure of the component in charge of providing the driver's request information to the injection system. The pedal sensor therefore has two potentiometers whose slides are mechanically solid. The two potentiometers are supplied from

distinct and different power sources so there is built in redundancy of information giving reliable driver's request information.

A voltage is generated across the potentiometer in the acceleration position sensor as a function of the accelerator-pedal setting. Using a programmed characteristic curve, the pedal's position is then calculated from this voltage.

**DTC DETECTING CONDITION**

**(P0120)**

CC-CODE	Detecting Condition	Suspect Area
0a	• Accelerator pedal angle (APS 1) < 4%	<ul style="list-style-type: none"> <li>• Open or short in APS circuit</li> <li>• APS</li> <li>• ECM</li> </ul>
0b	• Accelerator pedal angle (APS 1) > 95%	
06	•  Accelerator pedal angle (APS 1) - Accelerator pedal angle (APS 2)  > 8%	



(P0220)

CC-CODE	Detecting Condition	Suspect Area
0a	• Accelerator pedal angle (APS 2) < 2%	<ul style="list-style-type: none"> <li>• Open or short in APS circuit</li> <li>• APS</li> <li>• ECM</li> </ul>
0b	• Accelerator pedal angle (APS 2) > 49.5%	
02	• Sensor supply voltage < 3.17V	
03	• Sensor supply voltage > 4.63V	

**SPECIFICATION**

Condition	C.T	W.O.T
Pedal Angle	41°	106°
Vout/Vin (%)	APS 1	14.66 ~ 15.34%
	APS 2	7.35 ~ 7.65%
		77.08 ~ 86.92%
		38.5 ~ 43.5%

**[SCHEMATIC DIAGRAM ]**

**[CIRCUIT DIAGRAM]**

**[CONNECTION INFORMATION]**

Terminal	Connected to	Function
1	ECM E03-1 (11)	APS 2 Signal
2	ECM E03-1 (2)	APS 1 Signal
3	ECM E03-1 (10)	Reference Voltage
4	ECM E03-1 (12)	Sensor Ground
5	ECM E03-1 (3)	Sensor Ground
6	ECM E03-1 (6)	Reference Voltage

**[HARNESS CONNECTORS]**

**M07**  
ECTS

1	5	9	13	17	21	25	29
●	●	●	14	18	22	26	30
●	7	●	15	19	23	27	31
4	8	●	16	20	24	28	32

**E03-1**  
ECM

INSPECTION PROCEDURE

**1. CHECK APS AND ECM CONNECTORS**

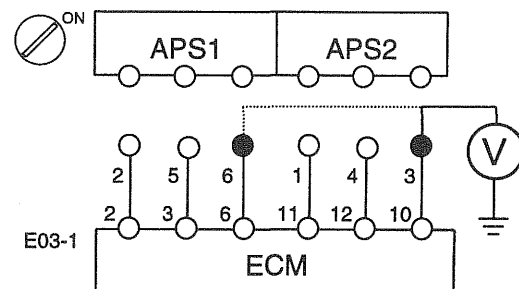
1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
  - Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

Are all connectors good?

Yes	No	Repair or replace it.
-----	----	-----------------------

**2. CHECK REFERENCE VOLTAGE TO APS**

1. Turn ignition switch to OFF and disconnect APS connector.
2. Turn ignition switch to ON.
3. Measure voltage in harness between terminal 6 of APS harness connector and chassis ground [APS 1].
4. Measure voltage in harness between terminal 2 of APS harness connector and chassis ground [APS 2].
  - Specification: approximately 5V

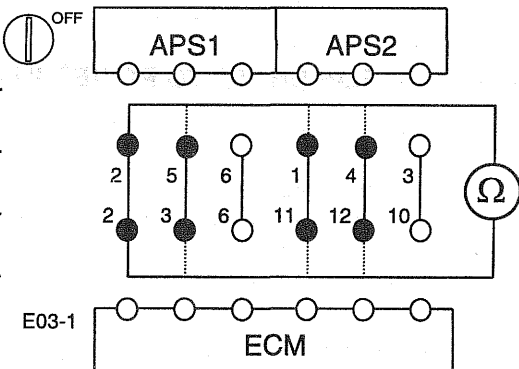


Is(Are) voltage(s) within specification?

Yes	No	Repair open or short circuit in harness.
-----	----	--

**3. CHECK FOR OPEN IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and APS connector.
2. Measure resistance between terminal 2 of APS harness connector and terminal E03-1(2) of ECM harness connector [APS 1].
3. Measure resistance between terminal 5 of APS harness connector and terminal E03-1(3) of ECM harness connector [APS 1].
4. Measure resistance between terminal 1 of APS harness connector and terminal E03-1(11) of ECM harness connector [APS 2].
5. Measure resistance between terminal 4 of APS harness connector and terminal E03-1(12) of ECM harness connector [APS 2].
  - Specification: below 1Ω

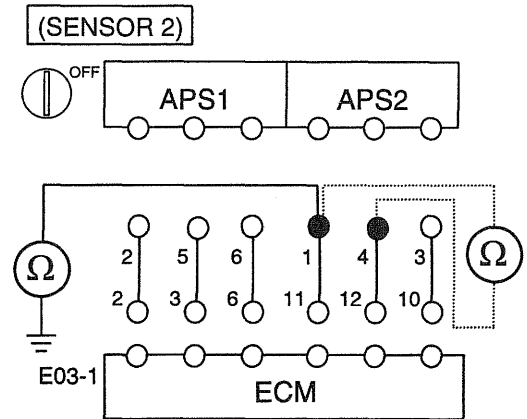
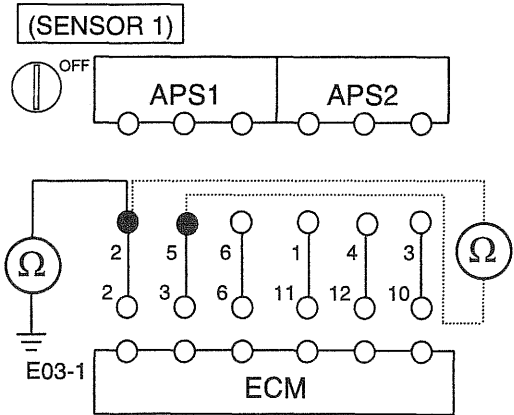


Is(Are) resistance(s) within specification?

Yes	No	Repair open circuit in harness.
-----	----	---------------------------------

**4. CHECK FOR SHORT TO GROUND IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and APS connector.
  2. Measure resistance between terminal 2 of APS harness connector and chassis ground [APS 1].
  3. Measure resistance between terminal 2 and 5 of APS harness connector [APS 1].
  4. Measure resistance between terminal 1 of APS harness connector and chassis ground [APS 2].
  5. Measure resistance between terminal 1 and 4 of APS harness connector [APS 2].
- **Specification: infinite**



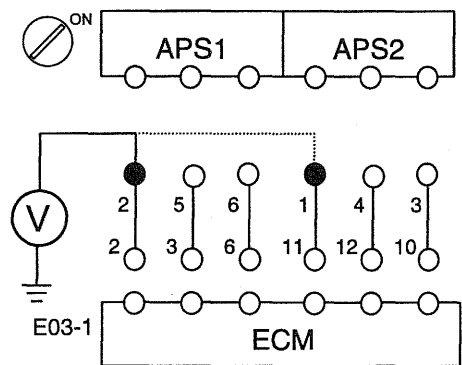
Is(Are) resistance(s) within specification?

Yes

No	Repair short or short to chassis ground in harness.
----	---

**5. CHECK FOR SHORT TO POWER IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and APS connector.
  2. Turn ignition switch to ON.
  3. Measure voltage between terminal 2 of APS harness connector and chassis ground [APS 1].
  4. Measure voltage between terminal 1 of APS harness connector and chassis ground [APS 2].
- **Specification: below 0.5V**



Is(Are) voltage(s) within specification?

Yes

No	Repair short to power in harness.
----	-----------------------------------

**6. CHECK APS SIGNAL**

1. Turn ignition switch to OFF and connect APS connector.
2. connect Hi-Scan (Pro) to APS.
3. Turn ignition switch to ON.
4. Using Hi-Scan (Pro), monitor APS signal while slowly stepping the accelerator position.
  - Refer to "SPECIFICATION" for more information.

**Is signal within specification and consistent with the normal curve?**

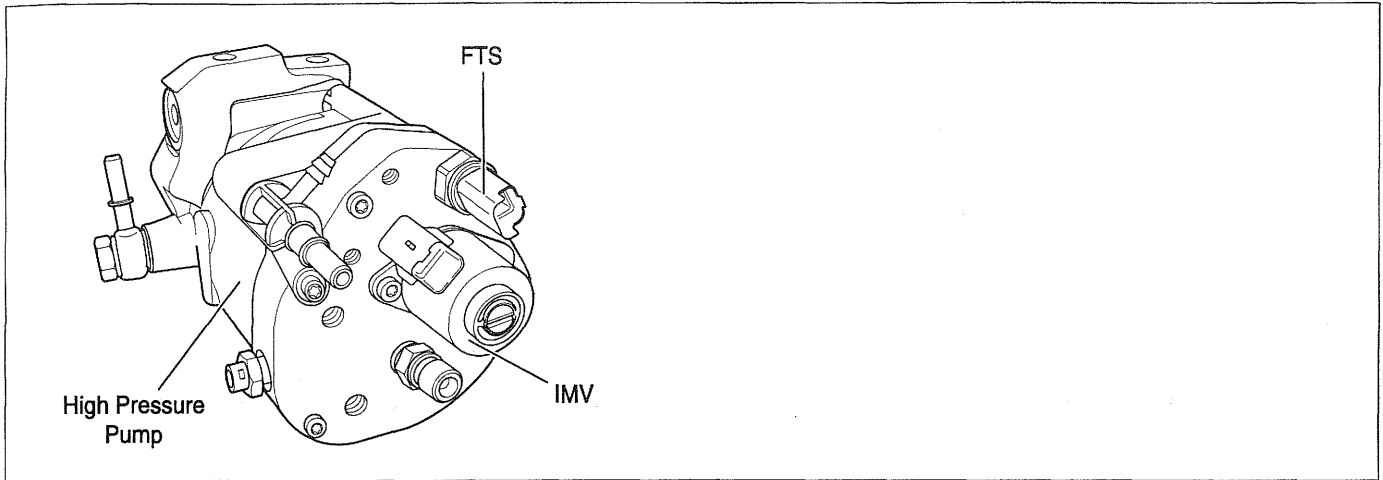
Yes

No	Replace the APS.
----	------------------

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

**TROUBLESHOOTING FOR DTC** ED8D1F3D

DTC	P0180	Fuel Temperature Sensor (FTS) Circuit Malfunction
CC-CODE	0b	Signal low (Open circuit or short circuit to battery line)
	02	Signal high (Short circuit to ground)



EWMF200Q

**DESCRIPTION**

The fuel temperature sensor (FTS) is located in the high-pressure pump assembly to measure the fuel temperature. The FTS uses a thermistor whose resistance changes with the temperature. The electrical resistance of the FTS decreases as the fuel temperature increases, and increases as the fuel temperature decreases. The 5 V power source in the ECM is supplied to the FTS via a resistor in the ECM.

That is, the resistor in the ECM and the thermistor in the FTS are connected in series. When the resistance value of the thermistor in FTS changes according to the fuel temperature, the signal voltage also changes. This information of fuel temperature is used in correcting fuel quantity.

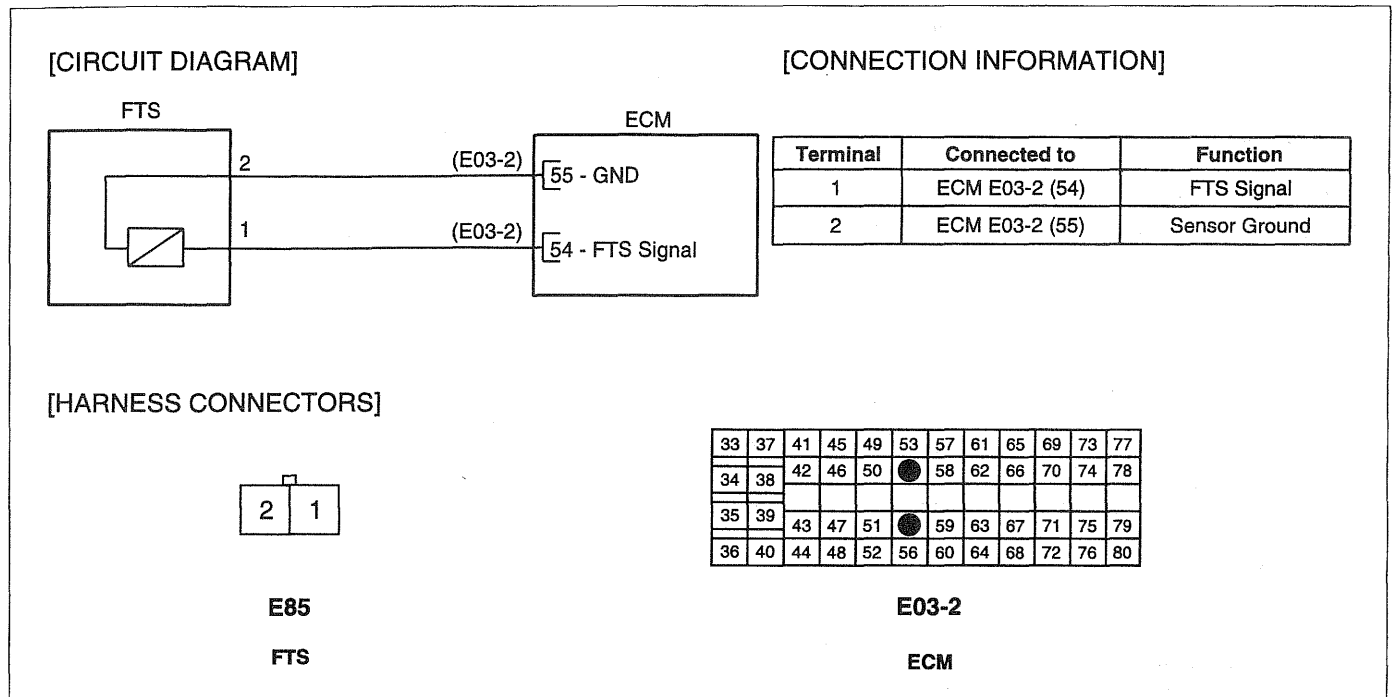
**DTC DETECTING CONDITION**

CC-CODE	Detecting Condition	Suspect Area
0b	• Fuel temperature < -40°C(-40°F)	<ul style="list-style-type: none"> <li>• Open or short in FTS circuit</li> <li>• FTS</li> <li>• ECM</li> </ul>
02	• Fuel temperature > 140°C(284°F)	

**SPECIFICATION**

Temperature [°C (°F)]	-30(-22)	-20(-4)	0(32)	20(68)	40(104)	60(140)	80(176)
Resistance (kΩ)	22.2 ~ 31.8	13.2 ~ 18.1	5.2 ~ 6.6	2.3 ~ 2.7	1.1 ~ 1.3	0.54 ~ 0.65	0.30 ~ 0.32

[SCHEMATIC DIAGRAM]



INSPECTION PROCEDURE

**1. CHECK FTS AND ECM CONNECTORS**

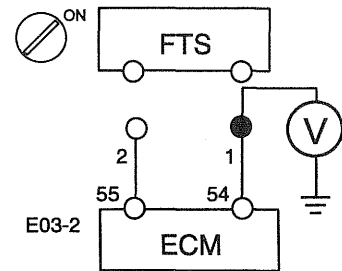
1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
  - Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

Are all connectors good?

<b>Yes</b>	No	Repair or replace it.
------------	----	-----------------------

**2. CHECK REFERENCE VOLTAGE TO FTS**

1. Turn ignition switch to OFF and disconnect FTS connector.
2. Turn ignition switch to ON.
3. Measure voltage in harness between terminal 1 of FTS harness connector and chassis ground.
  - **Specification: approximately 5V**

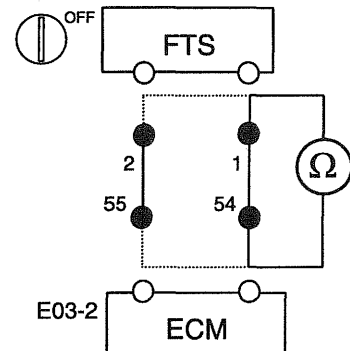


Is(Are) voltage(s) within specification?

<b>Yes</b>	No	Repair open or short circuit in harness.
------------	----	--

**3. CHECK FOR OPEN IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and FTS connector.
2. Measure resistance between terminal 1 of FTS harness connector and terminal E03-2(54) of ECM harness connector.
3. Measure resistance between terminal 2 of FTS harness connector and terminal E03-2(55) of ECM harness connector.
  - **Specification: below 1Ω**

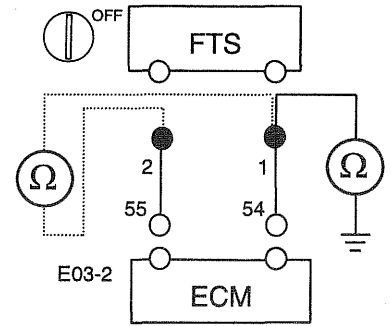


Is(Are) resistance(s) within specification?

<b>Yes</b>	No	Repair open circuit in harness.
------------	----	---------------------------------

**4. CHECK FOR SHORT TO GROUND IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and FTS connector.
2. Measure resistance between terminal 1 of FTS harness connector and chassis ground.
3. Measure resistance between terminal 1 and 2 of FTS harness connector.
  - **Specification: infinite**



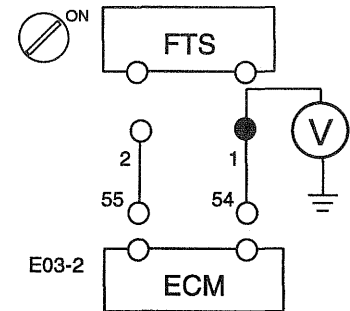
Is(Are) resistance(s) within specification?

Yes

No	Repair short or short to chassis ground in harness.
----	---

**5. CHECK FOR SHORT TO POWER IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and FTS connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 1 of FTS harness connector and chassis ground.
  - **Specification: below 0.5V**



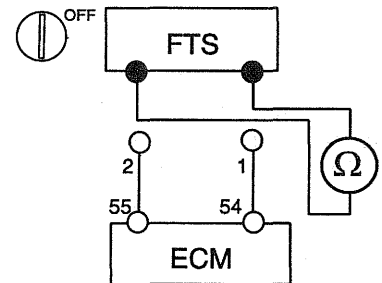
Is(Are) voltage(s) within specification?

Yes

No	Repair short to power in harness.
----	-----------------------------------

**6. CHECK FTS RESISTANCE**

1. Turn ignition switch to OFF and disconnect FTS connector.
2. Measure resistance between terminal 1 and 2 of FTS connector.
  - **Refer to "SPECIFICATION" for more information.**



Is(Are) resistance(s) within specification?

Yes

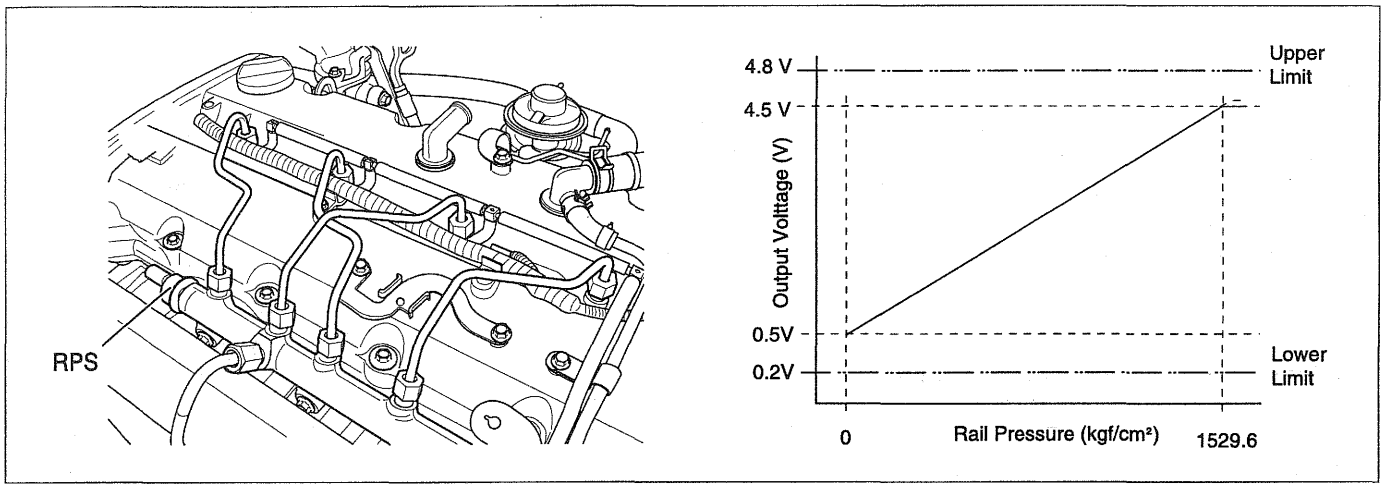
No	Replace the FTS.
----	------------------

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.



TROUBLESHOOTING FOR DTC E6FE4E7A

DTC	P0190	Rail Pressure Sensor (RPS) Range/Performance Problem
CC-CODE	0a	Signal low (Short circuit to ground)
	0b	Signal high (Open circuit or short circuit to battery line)
	06	Rail pressure incoherent
	08	Signal low
	09	Signal high
	05	Parameter at maximum limit
	8d	Above the average threshold



EWMF200R

**DESCRIPTION**

The aim of the Rail Pressure Sensor (RPS) is to provide to the ECM the voltage signal corresponding to fuel pressure in the rail. This information is used for fueling and timing calculation. The sensor element (semiconductor device) for converting the pressure to an electric signal is mounted on the diaphragm. The sensor operates as an

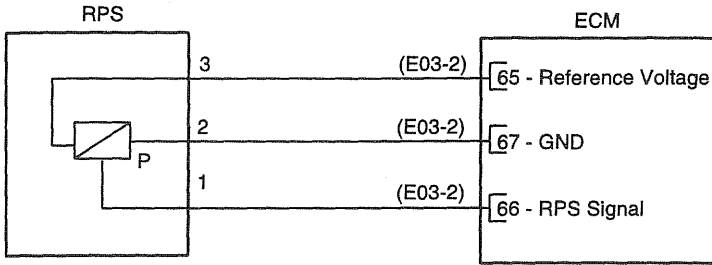
analog resistor. The change in resistance is proportional to the rail pressure acting upon this diaphragm. A rail pressure change lead to a geometry change. This movement changes the electrical resistance. A bridge circuit on the diaphragm supplies a voltage that is amplified to a range from 0.5 V to 4.5 V (respectively 0 and 1,800 kgf/cm²).

**DTC DETECTING CONDITION**

CC-CODE	Detecting Condition	Suspect Area
0a	• Rail pressure < -114.7 kgf/cm²	<ul style="list-style-type: none"> <li>• Open or short in RPS circuit</li> <li>• RPS</li> <li>• ECM</li> </ul>
0b	• Rail pressure > 1,950.2 kgf/cm²	
06	• Pressure variation greater than 255 kgf/cm² between two successive measurements.	
08	• Rail pressure < -91.8 kgf/cm² when IG ON	
09	• Rail pressure when IG ON is more than 255 kgf/cm² higher than the rail pressure at the previous IG OFF (upwards sensor drift).	
05	• Rail pressure > 1,753.9 kgf/cm²	
8d	• The rail pressure is > 91.8 kgf/cm² for 20 consecutive IG ON (upwards sensor drift).	

[SCHEMATIC DIAGRAM]

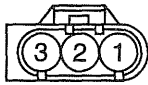
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM E03-2 (66)	RPS Signal
2	ECM E03-2 (67)	Sensor Ground
3	ECM E03-2 (65)	Reference Voltage

[HARNESS CONNECTORS]



E88

RPS

33	37	41	45	49	53	57	61	65	69	73	77
34	38	42	46	50	54	58	62	66	70	74	78
35	39	43	47	51	55	59	63	67	71	75	79
36	40	44	48	52	56	60	64	68	72	76	80

E03-2

ECM

INSPECTION PROCEDURE

**1. CHECK DTC**

1. Connect the Hi-Scan (Pro) to the Data Link Connector (DLC).
2. Turn ignition switch to ON and check that any other DTC(s) is (are) detected.

Are the DTCs related to IMV (P1119 or P11200) also set?

Yes

No	Do all repairs associated with those codes before proceeding with this procedure.
----	---

**2. CHECK RPS AND ECM CONNECTORS**

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
  - Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

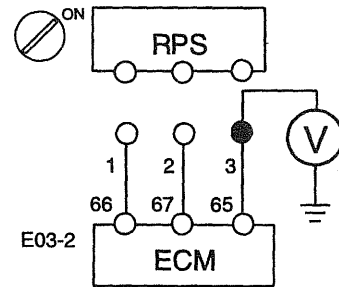
Are all connectors good?

Yes

No	Repair or replace it.
----	-----------------------

**3. CHECK REFERENCE VOLTAGE TO RPS**

1. Turn ignition switch to OFF and disconnect RPS connector.
2. Turn ignition switch to ON.
3. Measure voltage in harness between terminal 3 of RPS harness connector and chassis ground.
  - Specification: approximately 5V



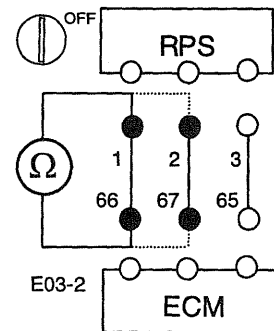
Is(Are) voltage(s) within specification?

Yes

No	Repair open or short circuit in harness.
----	--

**4. CHECK FOR OPEN IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and RPS connector.
2. Measure resistance between terminal 1 of RPS harness connector and terminal E03-2(66) of ECM harness connector.
3. Measure resistance between terminal 2 of RPS harness connector and terminal E03-2(67) of ECM harness connector.
  - Specification: below 1Ω



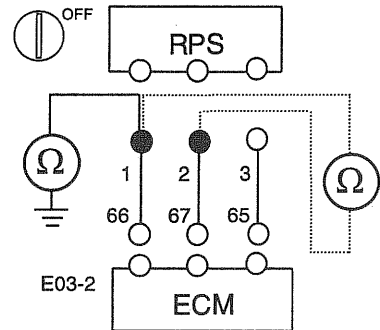
Is(Are) resistance(s) within specification?

Yes

No	Repair open circuit in harness.
----	---------------------------------

**5. CHECK FOR SHORT TO GROUND IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and RPS connector.
2. Measure resistance between terminal 1 of RPS harness connector and chassis ground.
3. Measure resistance between terminal 1 and 2 of RPS harness connector.
  - **Specification: infinite**



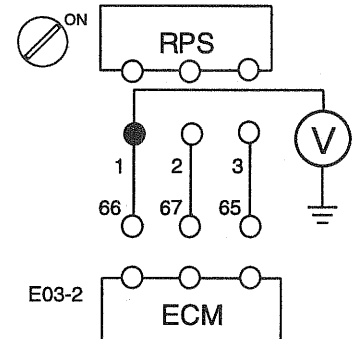
Is(Are) resistance(s) within specification?

Yes

No	Repair short or short to chassis ground in harness.
----	---

**6. CHECK FOR SHORT TO POWER IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and RPS connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 1 of RPS harness connector and chassis ground.
  - **Specification: below 0.5V**



Is(Are) voltage(s) within specification?

Yes

No	Repair short to power in harness.
----	-----------------------------------

**7. CHECK RPS**

1. Replace the RPS with a new one, and then monitor the vehicle again using a Hi-Scan (Pro).

Is this problem fixed?

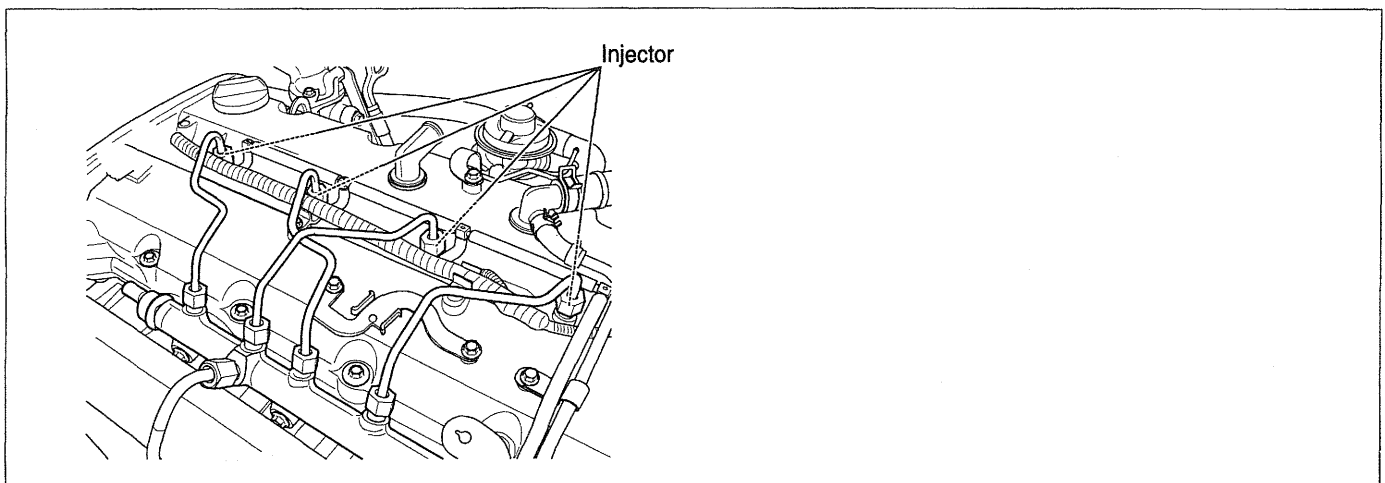
Yes

No	Replace the RPS.
----	------------------

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

**TROUBLESHOOTING FOR DTC** E35C1F2A

DTC	P0201	Inector #1 (Cylinder #1) Circuit Malfunction
DTC	P0202	Inector #2 (Cylinder #3) Circuit Malfunction
DTC	P0203	Inector #3 (Cylinder #4) Circuit Malfunction
DTC	P0204	Inector #4 (Cylinder #2) Circuit Malfunction
CC-CODE	04	Signal low
	91	Injector stuck (Open)
	86	Injector stuck (Close)
	01	Open Circuit
	0c	Short Circuit



EWMF202M

**DESCRIPTION**

The injector of the Common Rail System is electronically controlled. It has been designed to allow multiple injection with short intervals, to be fully electronically controlled, and to release a small amount of heat. The nozzle of injector opens when the solenoid valve is triggered and permits the flow of fuel. They inject the fuel directly into the engine's combustion chamber. The fuel is stored in the Rail ready for injection and the injected fuel quantity is defined by the injector opening time and the rail pressure.

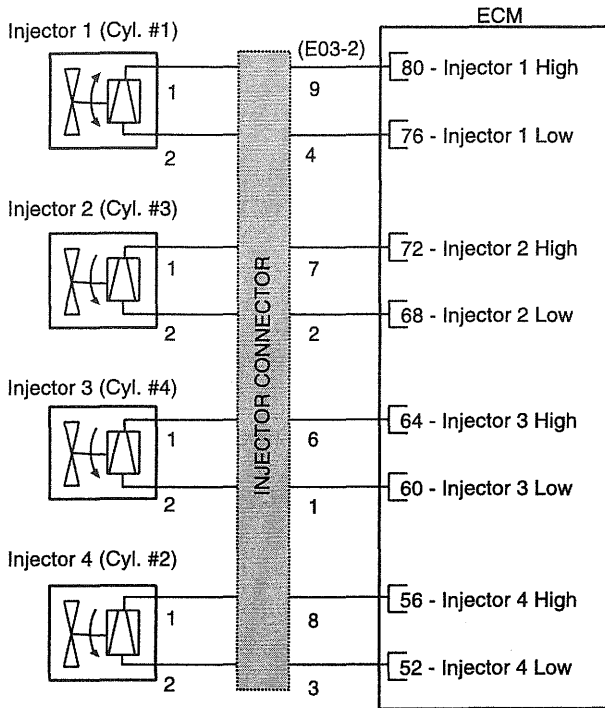
The excess fuel, which was needed for opening the nozzle of injector, flows back to the tank through a collector line. The return fuel from the pressure-control valve and from the low-pressure stage is also led into this collector line together with the fuel used to lubricate the high-pressure pump.

**DTC DETECTING CONDITION**

CC-CODE	Detecting Condition	Suspect Area
04	<ul style="list-style-type: none"> <li>MDP (Minimum Drive Pulse) correction determined by the knock sensor strategy exceeds a calibrated value.</li> </ul>	<ul style="list-style-type: none"> <li>Open or short circuit in injector</li> <li>Injector</li> <li>Compression pressure</li> <li>Fuel line</li> <li>ECM</li> </ul>
91	<ul style="list-style-type: none"> <li>Injector stuck (Open)</li> </ul>	
86	<ul style="list-style-type: none"> <li>Injector stuck (Close)</li> </ul>	
01	<ul style="list-style-type: none"> <li>Open circuit</li> </ul>	
0c	<ul style="list-style-type: none"> <li>Short circuit</li> </ul>	

[SCHEMATIC DIAGRAM]

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Injector #1 (Cylinder #1)

Terminal	Injector Connector	Connected to	Function
1	7	ECM E03-2 (80)	Injector1 (Cyl. #1) High
2	2	ECM E03-2 (76)	Injector1 (Cyl. #1) Low

Injector #2 (Cylinder #3)

Terminal	Injector Connector	Connected to	Function
1	9	ECM E03-2 (72)	Injector2 (Cyl. #3) High
2	4	ECM E03-2 (68)	Injector2 (Cyl. #3) Low

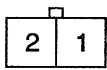
Injector #3 (Cylinder #4)

Terminal	Injector Connector	Connected to	Function
1	10	ECM E03-2 (64)	Injector3 (Cyl. #4) High
2	5	ECM E03-2 (60)	Injector3 (Cyl. #4) Low

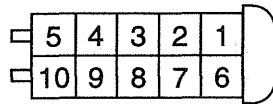
Injector #4 (Cylinder #2)

Terminal	Injector Connector	Connected to	Function
1	8	ECM E03-2 (56)	Injector4 (Cyl. #2) High
2	3	ECM E03-2 (52)	Injector4 (Cyl. #2) Low

[HARNES CONNECTORS]



**E157**  
**INJECTOR**



**INJECTOR CONNECTOR**

33	37	41	45	49	53	57	61	65	69	73	77
34	38	42	46	50	54	58	62	66	70	74	78
35	39	43	47	51	55	59	63	67	71	75	79
36	40	44	48	●	●	●	●	●	●	●	●

**E03-2**  
**ECM**

INSPECTION PROCEDURE

**1. CHECK DTC**

1. Connect the Hi-Scan (Pro) to the Data Link Connector (DLC).
2. Turn ignition switch to ON and check that any other DTC(s) is (are) detected.

Are the CC-codes 86, 91, or 04 also set?

Yes

No	<ul style="list-style-type: none"> <li>• CC-CODE 86 or 91                             <ul style="list-style-type: none"> <li>- Inspect the cylinder compression pressure (refer to group "EM" in this Shop Manual)</li> <li>- Inspect the fuel delivery line (refer to "FUEL DELIVERY SYSTEM-DIESEL")</li> </ul> </li> <li>• CC-CODE 04                             <ul style="list-style-type: none"> <li>- Replace the injector</li> </ul> </li> </ul>
----	--

**2. CHECK INJECTOR AND ECM CONNECTORS**

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
  - Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

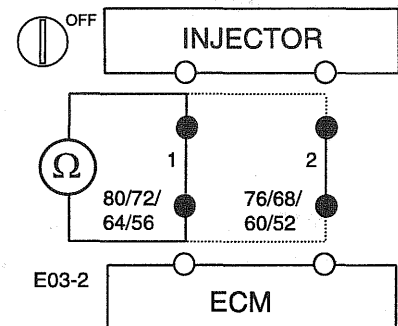
Are all connectors good?

Yes

No	Repair or replace it.
----	-----------------------

**3. CHECK FOR OPEN IN HARNESS**

1. Turn ignition switch to OFF and wait for about 10 seconds.
2. Disconnect ECM and injector connector.
3. Measure resistance between terminal 1 of injector harness connector and terminal E03-2(80/72/64/56) of ECM harness connector (respectively injector #1/2/3/4).
4. Measure resistance between terminal 2 of injector harness connector and terminal E03-2(76/68/60/52) of ECM harness connector (respectively injector #1/2/3/4).
  - Specification: below 1Ω



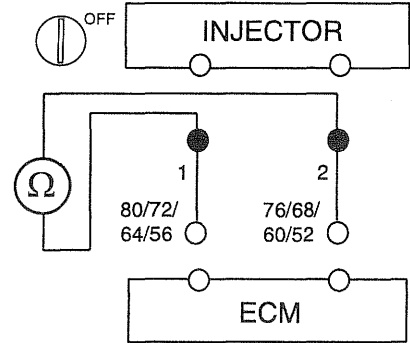
Is(Are) resistance(s) within specification?

Yes

No	Repair open circuit in harness.
----	---------------------------------

**4. CHECK FOR SHORT IN HARNESS**

1. Turn ignition switch to OFF and wait for about 10 seconds.
2. Disconnect ECM and injector connector.
3. Measure resistance between terminal 1 and 2 of injector harness connector.
  - **Specification: infinite**



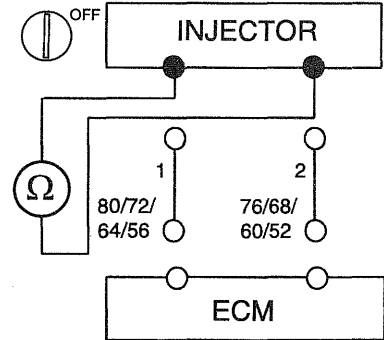
Is(Are) resistance(s) within specification?

**Yes**

No	Repair short or short to chassis ground in harness.
----	---

**5. CHECK INJECTOR**

1. Turn ignition switch to OFF and wait for about 10 seconds.
2. Disconnect injector connector.
3. Measure resistance between terminal 1 and 2 of injector connector.
  - **Specification: below 1Ω**



Is(Are) resistance(s) within specification?

**Yes**

No	Replace the injector.
----	-----------------------

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.



TROUBLESHOOTING FOR DTC E133D74F

DTC	P0226	Accelerator Position Sensor (APS) 2 Range/Performance Problem
CC-CODE	06	APS 1/2 signal incoherent
	0b	Abnormal signal

## DTC DETECTING CONDITION

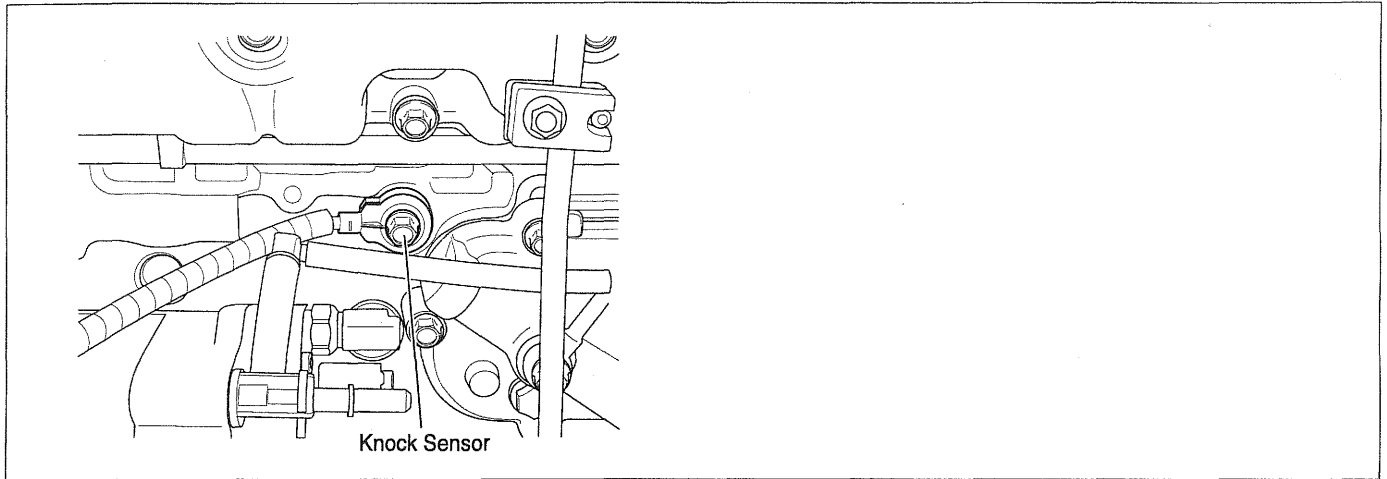
CC-CODE	Detecting Condition	Suspect Area
06	<ul style="list-style-type: none"> <li>• APS 1/2 circuit malfunction</li> </ul>	<ul style="list-style-type: none"> <li>• Refer to P0120, P0220</li> </ul>
0b	<ul style="list-style-type: none"> <li>• Accelerator pedal fault</li> <li>• Brake switch circuit malfunction</li> </ul>	<ul style="list-style-type: none"> <li>• Accelerator pedal</li> <li>• Open or short in brake switch circuit</li> <li>• Brake switch</li> <li>• ECM</li> </ul>

## INSPECTION PROCEDURE

- CC-CODE 06: Refer to troubleshooting procedure for DTC P0120, P0220
- CC-CODE 06
  - Inspect accelerator pedal
  - Inspect brake switch circuit (Refer to troubleshooting procedure for DTC P1543)

TROUBLESHOOTING FOR DTC EA19DE6F

DTC	P0325	Knock Sensor Circuit Malfunction
CC-CODE	09	Signal High
	07	No Signal



EWMF200V

**DESCRIPTION**

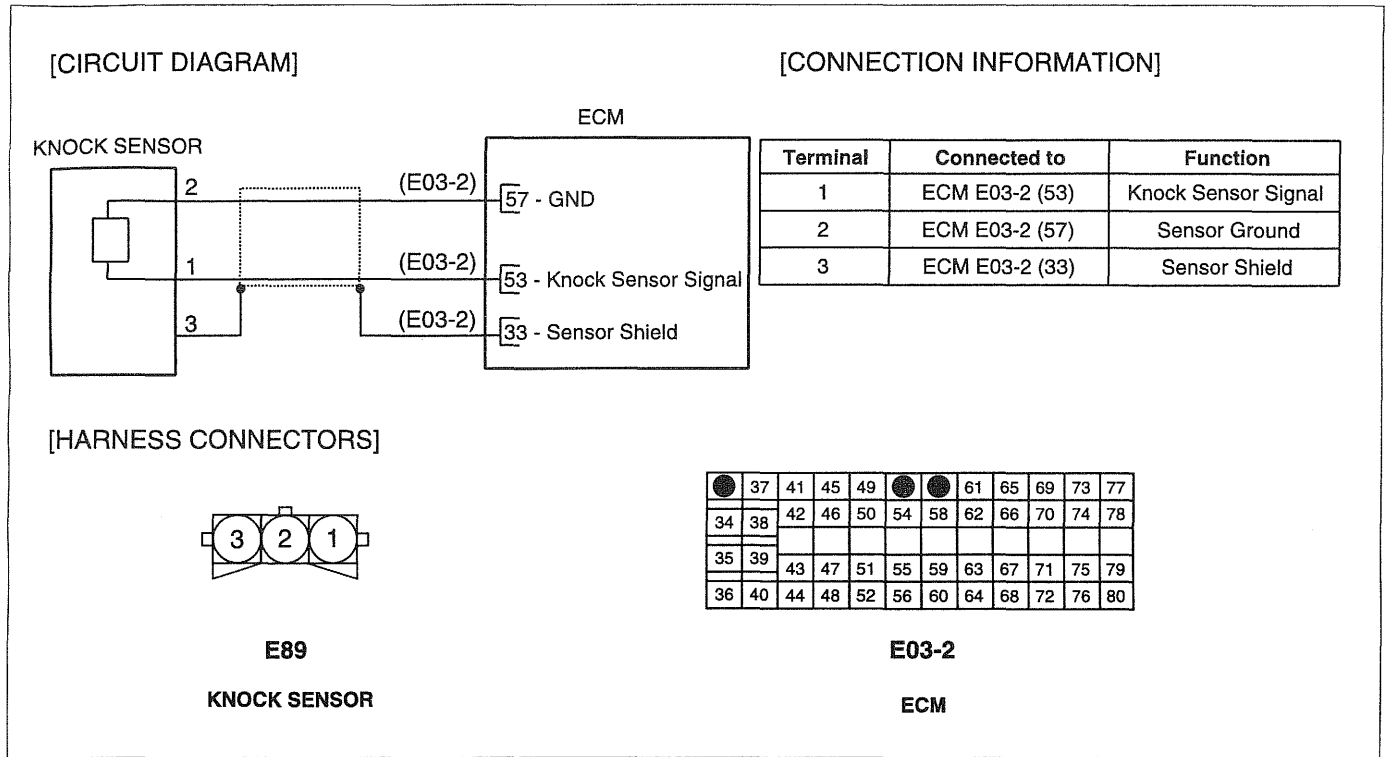
A knock sensor with piezoelectric element (ceramic) is attached to the center of cylinder block to sense the engine knocking condition (Check for knocking for each cylinder). The piezoelectric device output (V) = Q/C = 2dF/C (d = piezoelectric integer, C = Electrostatic capacity). The ECM

performs the knocking control to make the engine to operate in optimum condition before the knocking limit.

**DTC DETECTING CONDITION**

CC-CODE	Detecting Condition	Suspect Area
09	<ul style="list-style-type: none"> <li>Abnormal signal</li> </ul>	<ul style="list-style-type: none"> <li>Open or short in Knock Sensor circuit</li> <li>Knock Sensor</li> <li>ECM</li> </ul>
07		

[SCHEMATIC DIAGRAM]



INSPECTION PROCEDURE

**1. CHECK DTC**

1. Connect the Hi-Scan (Pro) to the Data Link Connector (DLC).
2. Turn ignition switch to ON and check that any other DTC(s) is (are) detected.

Are the DTC related to ECTS, MAFS, IATS, or Atmospheric Pressure Sensor also set?

Yes

No

Do all repairs associated with those codes before proceeding with this procedure

**2. CHECK KNOCK SENSOR AND ECM CONNECTORS**

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
  - Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

Are all connectors good?

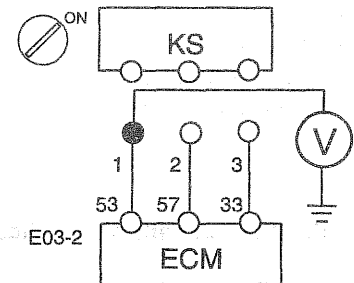
Yes

No

Repair or replace it.

**3. CHECK REFERENCE VOLTAGE TO KNOCK SENSOR**

1. Turn ignition switch to OFF and disconnect knock sensor connector.
2. Turn ignition switch to ON.
3. Measure voltage in harness between terminal 1 of knock sensor harness connector and chassis ground.
  - Specification: approximately 5V



Is(Are) voltage(s) within specification?

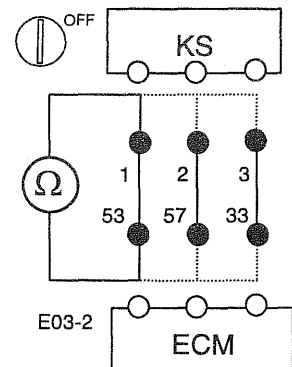
Yes

No

Repair open or short circuit in harness.

**4. CHECK FOR OPEN IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and knock sensor connector.
2. Measure resistance between terminal 1 of knock sensor harness connector and terminal E03-2(53) of ECM harness connector.
3. Measure resistance between terminal 2 of knock sensor harness connector and terminal E03-2(57) of ECM harness connector.
4. Measure resistance between terminal 3 of knock sensor harness connector and terminal E03-2(33) of ECM harness connector.
  - Specification: below 1Ω



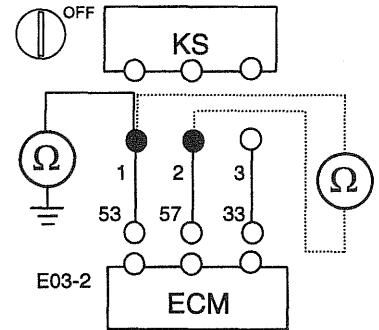
Is(Are) resistance(s) within specification?

Yes

No Repair open circuit in harness.

**5. CHECK FOR SHORT TO GROUND IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and knock sensor connector.
2. Measure resistance between terminal 1 of knock sensor harness connector and chassis ground.
3. Measure resistance between terminal 1 and 2 of knock sensor harness connector.
  - **Specification: infinite**



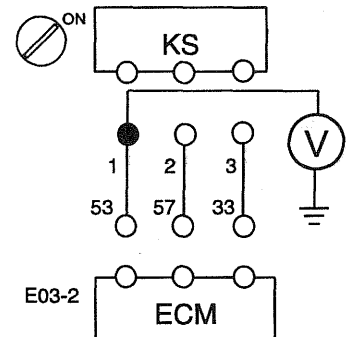
Is(Are) resistance(s) within specification?

Yes

No Repair short or short to chassis ground in harness.

**6. CHECK FOR SHORT TO POWER IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and knock sensor connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 1 of knock sensor harness connector and chassis ground.
  - **Specification: below 0.5V**



Is(Are) voltage(s) within specification?

Yes

No Repair short to power in harness.

**7. CHECK KNOCK SENSOR**

1. Replace the knock sensor with a new one, and then monitor the vehicle again using a Hi-Scan (Pro).

Is this problem fixed?

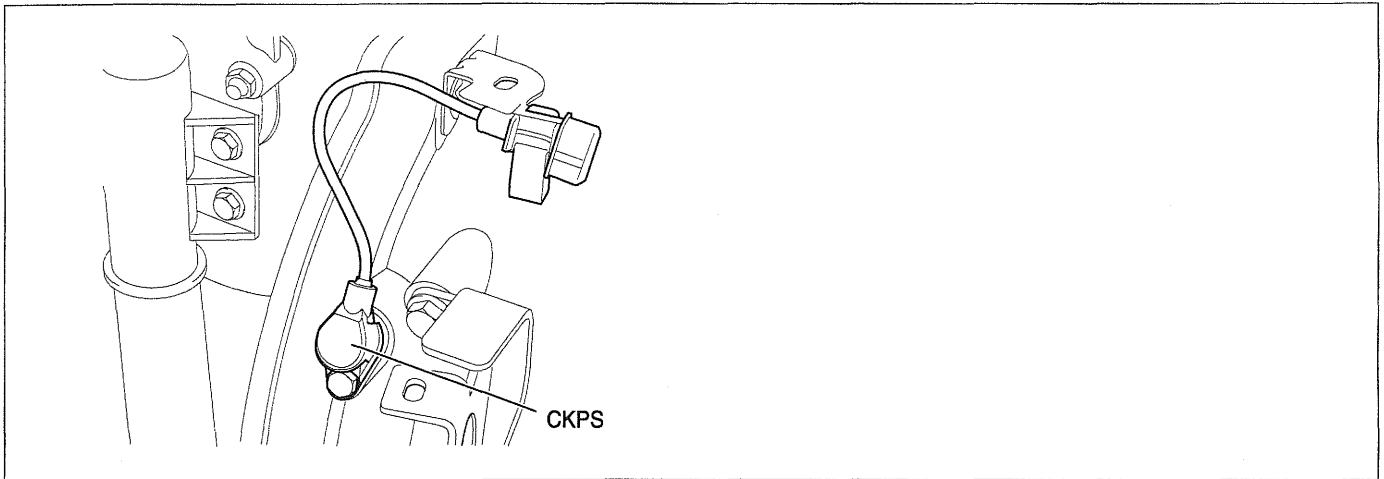
Yes

No Replace the knock sensor.

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

**TROUBLESHOOTING FOR DTC** E73A1AE4

DTC	P0335	Crankshaft Position Sensor (CKPS) Circuit Malfunction
CC-CODE	06	Abnormal airgap
	07	No signal
	92	Too many missing teeth detected
	93	Too many extra teeth detected
	94	Missing teeth detected
	95	Extra teeth detected



AFBE200Z

**DESCRIPTION**

Piston position on combustion chamber is the substantial to define the starting of injection timing. All engine pistons are connected to crankshaft by connecting rod. Crankshaft position sensor (CKPS) senses the information concerning all piston positions and uses this signal to calculate the injection timing and engine speed. Camshaft position sensor (CMPS) senses the position of camshaft in reference to the upper dead point of compression of cylinder and sends this signal, based on which the ECM determines the injection sequence of each cylinder and the fuel injection timing.

DTC DETECTING CONDITION

CC-CODE	Detecting Condition	Suspect Area
06	• No gap detection on the engine flywheel, but no extra or mission teeth detected	<ul style="list-style-type: none"> <li>• Open or short in CKPS</li> <li>• CKPS</li> <li>• ECM</li> </ul>
07	• Loss of engine speed sensor signal	
92	• More than 4 missing teeth detected on an engine flywheel rotation	
93	• More than 2 extra teeth detected on an engine flywheel rotation	
94	• 4 missing teeth detected on an engine flywheel rotation	
95	• 2 extra teeth detected on an engine flywheel rotation	

SPECIFICATION

Air gab between target wheel and CKPS	0.5 ~ 1.5 mm
---------------------------------------	--------------

[SCHEMATIC DIAGRAM]

[CIRCUIT DIAGRAM]

[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM E03-2 (58)	CKPS [+] Signal
2	ECM E03-2 (59)	CKPS [-] Signal
3	ECM E03-2 (37)	Sensor Shield

[HARNESS CONNECTORS]

**C04**  
CKPS

33	41	45	49	53	57	61	65	69	73	77	
34	38	42	46	50	54	62	66	70	74	78	
35	39	43	47	51	55	63	67	71	75	79	
36	40	44	48	52	56	60	64	68	72	76	80

**E03-2**  
ECM

INSPECTION PROCEDURE

**1. CHECK CKPS AND ECM CONNECTORS**

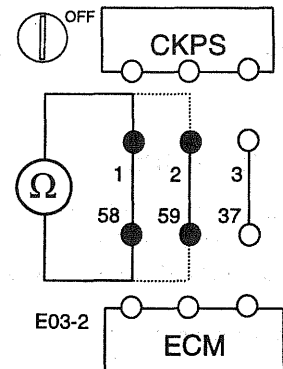
1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
  - Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

Are all connectors good?

<b>Yes</b>		
	No	Repair or replace it.

**2. CHECK FOR OPEN IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and CKPS connector.
2. Measure resistance between terminal 1 of CKPS harness connector and terminal E03-2(58) of ECM harness connector.
3. Measure resistance between terminal 2 of CKPS harness connector and terminal E03-2(59) of ECM harness connector.
  - **Specification: below 1Ω**

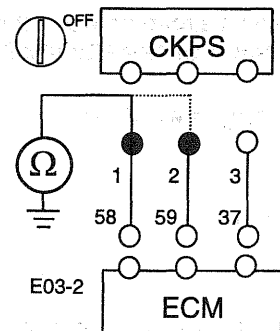


Is(Are) resistance(s) within specification?

<b>Yes</b>		
	No	Repair open circuit in harness.

**3. CHECK FOR SHORT TO GROUND IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and CKPS connector.
2. Measure resistance between terminal 1 of CKPS harness connector and chassis ground.
3. Measure resistance between terminal 2 of CKPS harness connector and chassis ground.
  - **Specification: infinite**



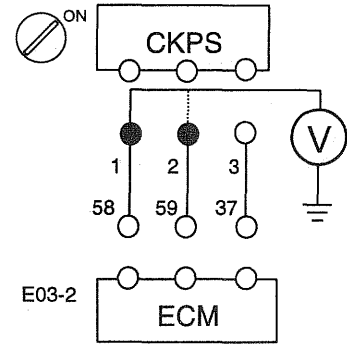
Is(Are) resistance(s) within specification?

<b>Yes</b>		
	No	Repair short or short to chassis ground in harness.



**4. CHECK FOR SHORT TO POWER IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and CKPS connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 1 of CKPS harness connector and chassis ground.
4. Measure voltage between terminal 2 of CKPS harness connector and chassis ground.
  - **Specification: below 0.5V**



Is(Are) voltage(s) within specification?

<b>Yes</b>	No	Repair short to power in harness.
------------	----	-----------------------------------

**5. CHECK CKPS**

1. Replace the CKPS with a new one, and then monitor the vehicle again using a Hi-Scan (Pro).
  - **Specification: below 0.5V**

Is this problem fixed?

<b>Yes</b>	No	Replace the knock sensor.
------------	----	---------------------------

**6. CHECK CKPS AIRGAP**

1. Inspect airgap between the target-wheel and CKPS.
  - **Refer to "SPECIFICATION" for more information.**

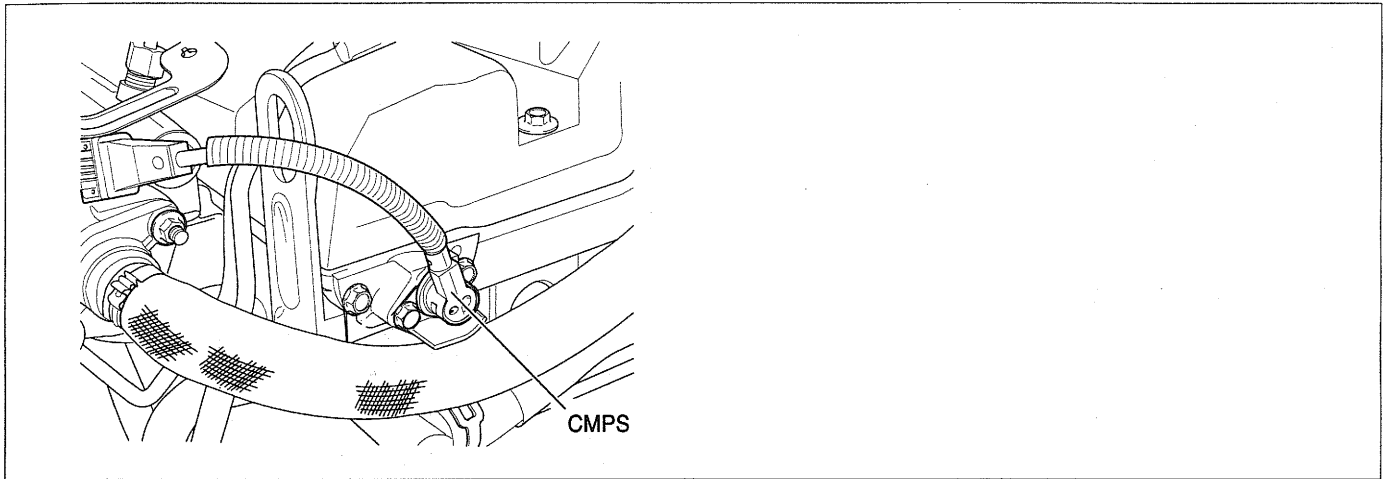
Is the airgap within specification?

<b>Yes</b>	No	Adjust airgap between target-wheel and CKPS.
------------	----	--

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

**TROUBLESHOOTING FOR DTC** E37B3222

<b>DTC</b>	<b>P0340</b>	<b>Camshaft Position Sensor (CMPS) Circuit Malfunction</b>
<b>CC-CODE</b>	07	No signal
	06	CMPS/CKPS signal incoherent



AFBE204D

**DESCRIPTION**

Piston position on combustion chamber is the substantial to define the starting of injection timing. All engine pistons are connected to crankshaft by connecting rod. Crankshaft position sensor (CKPS) senses the information concerning all piston positions and uses this signal to calculate the injection timing and engine speed. Camshaft position sensor (CMPS) senses the position of camshaft in

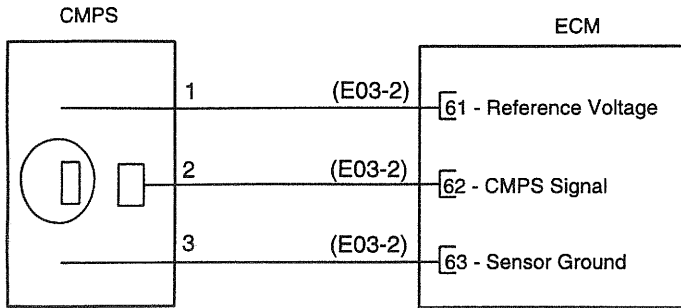
reference to the upper dead point of compression of cylinder and sends this signal, based on which the ECM determines the injection sequence of each cylinder and the fuel injection timing.

**DTC DETECTING CONDITION**

<b>CC-CODE</b>	<b>Detecting Condition</b>	<b>Suspect Area</b>
07	<ul style="list-style-type: none"> <li>No signal</li> </ul>	<ul style="list-style-type: none"> <li>Open or short in CMPS circuit</li> <li>CMPS</li> <li>ECM</li> </ul>
06	<ul style="list-style-type: none"> <li>CMPS/CKPS incoherent</li> </ul>	

[SCHEMATIC DIAGRAM]

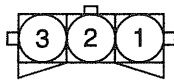
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM E03-2 (61)	Reference Voltage
2	ECM E03-2 (62)	CMPS Signal
3	ECM E03-2 (63)	Sensor Ground

[HARNES CONNECTORS]



E90  
CMPS

33	37	41	45	49	53	57	65	69	73	77	
34	38	42	46	50	54	58	66	70	74	78	
35	39	43	47	51	55	59	67	71	75	79	
36	40	44	48	52	56	60	64	68	72	76	80

E03-2  
ECM

INSPECTION PROCEDURE

**1. CHECK CMPS AND ECM CONNECTORS**

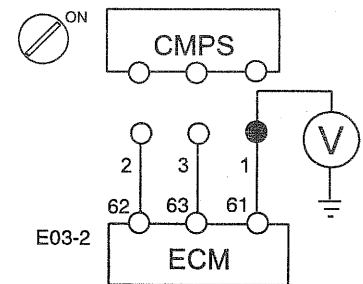
1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
  - Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

Are all connectors good?

Yes		No	Repair or replace it.
-----	--	----	-----------------------

**2. CHECK REFERENCE VOLTAGE TO CMPS**

1. Turn ignition switch to OFF and disconnect CMPS connector.
2. Turn ignition switch to ON.
3. Measure voltage in harness between terminal 1 of CMPS harness connector and chassis ground.
  - Specification: approximately 5V

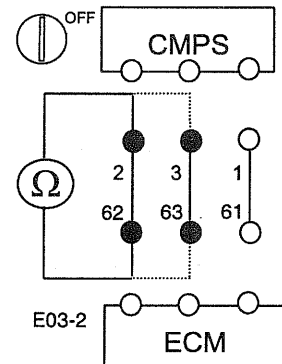


Is(Are) voltage(s) within specification?

Yes		No	Repair open or short circuit in harness.
-----	--	----	--

**3. CHECK FOR OPEN IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and CMPS connector.
2. Measure resistance between terminal 2 of CMPS harness connector and terminal E03-2(62) of ECM harness connector.
3. Measure resistance between terminal 3 of CMPS harness connector and terminal E03-2(63) of ECM harness connector.
  - Specification: below 1Ω

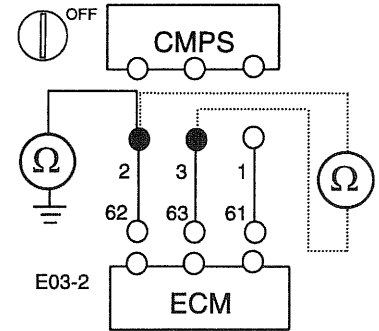


Is(Are) resistance(s) within specification?

Yes		No	Repair open circuit in harness.
-----	--	----	---------------------------------

**4. CHECK FOR SHORT TO GROUND IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and CMPS connector.
2. Measure resistance between terminal 2 of CMPS harness connector and chassis ground.
3. Measure resistance between terminal 2 and 3 of CMPS harness connector.
  - **Specification: infinite**



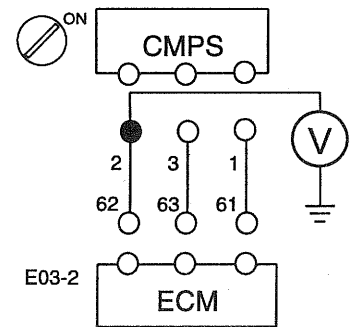
Is(Are) resistance(s) within specification?

Yes

No	Repair short or short to chassis ground in harness.
----	---

**5. CHECK FOR SHORT TO POWER IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and CMPS connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 2 of CMPS harness connector and chassis ground.
  - **Specification: below 0.5V**



Is(Are) voltage(s) within specification?

Yes

No	Repair short to power in harness.
----	-----------------------------------

**6. CHECK TIMING BELT**

1. Inspect the timing belt installation condition (Refer to the group "EM" in this Shop Manual).

Is the timing belt installed correctly?

Yes

No	Adjust or replace the timing belt.
----	------------------------------------

**7. CHECK CKPS**

1. Replace the CKPS with a new one, and then monitor the vehicle again using a Hi-Scan (Pro).

Is this problem fixed?

No

Yes	Replace the CMPS.
-----	-------------------

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

**TROUBLESHOOTING FOR DTC** E0430229

DTC	P0380	Glow Relay 1 Circuit Malfunction
CC-CODE	0a	Signal low (Open circuit or short circuit to ground)
	03	Signal high (Short circuit to battery line)
	0a	Open circuit or short circuit to ground
	03	Short circuit to battery line

DTC	P0382	Glow Relay 2 Circuit Malfunction
CC-CODE	0a	Signal low (Open circuit or short circuit to ground)
	03	Signal high (Short circuit to battery line)
	0a	Open circuit or short circuit to ground
	03	Short circuit to battery line

**DESCRIPTION**

Glow plug plays an efficient role at cold start. It also shortens the warm-up period, a fact that is highly relevant for exhaust emissions. The time of preheating is determined by a number of parameters that include the engine speed

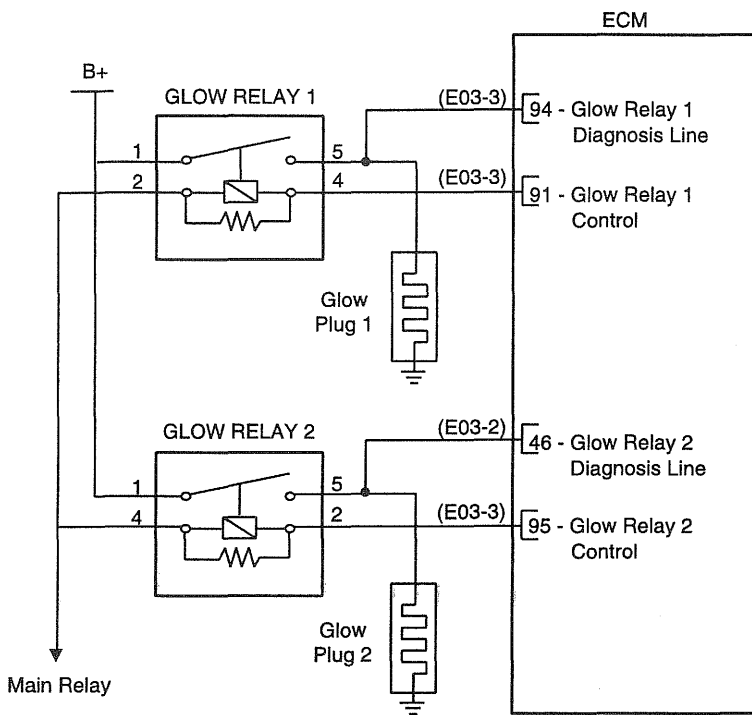
and the coolant temperature. The ECM controls the glow plug via glow plug relay.

**DTC DETECTING CONDITION**

CC-CODE	Detecting Condition	Suspect Area
0a	• Open or short to ground in glow relay circuit	<ul style="list-style-type: none"> <li>• Open or short in Glow Relay circuit</li> <li>• Glow Relay</li> <li>• ECM</li> </ul>
03	• Short to battery line in glow relay circuit	

[SCHEMATIC DIAGRAM]

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

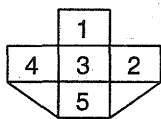
Glow Relay 1

Terminal	Connected to	Function
1	Battery	Battery Voltage
2	Main Relay	Battery Voltage
3	-	-
4	ECM E03-3 (91)	Diagnosis
5	ECM E03-3 (94)	Glow Relay 1 Control
	Glow Plug 1	Glow Plug 1 Control

Glow Relay 2

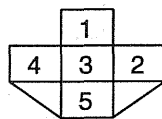
Terminal	Connected to	Function
1	Battery	Battery Voltage
2	ECM E03-2 (95)	Diagnosis
3	-	-
4	Main Relay	Battery Voltage
5	ECM E03-2 (46)	Glow Relay 2 Control
	Glow Plug 2	Glow Plug 2 Control

[HARNESS CONNECTORS]



E140

Glow Relay 1



E52

Glow Relay 2

33	37	41	45	49	53	57	61	65	69	73	77
34	38	42	46	50	54	58	62	66	70	74	78
35	39	43	47	51	55	59	63	67	71	75	79
36	40	44	48	52	56	60	64	68	72	76	80

E03-2

ECM

81	85	89	93	97	101	105	109
82	86	90	94	98	102	106	110
83	87	91	95	99	103	107	111
84	88	92	96	100	104	108	112

E03-3



INSPECTION PROCEDURE

**1. CHECK GLOW RELAY AND ECM CONNECTORS**

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
  - Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

Are all connectors good?

Yes	No	Repair or replace it.
-----	----	-----------------------

**2. CHECK GLOW RELAY**

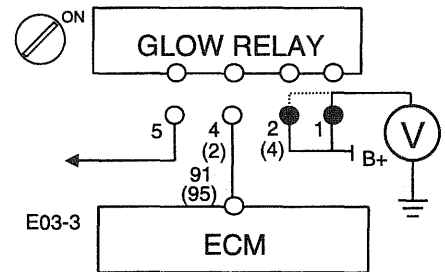
1. Turn ignition switch to OFF and remove the glow relay.
2. Apply power to the terminal 2(4) and ground terminal 4(2) of glow relay 1(2).
3. Check if glow relay works well. (If glow relay works normally, a "click" sound can be heard).

Does the glow relay operate normally?

Yes	No	Replace the glow plug relay
-----	----	-----------------------------

**3. CHECK REFERENCE VOLTAGE TO GLOW RELAY**

1. Turn ignition switch to OFF and disconnect glow relay connector.
2. Turn ignition switch to ON.
3. Measure voltage in harness between terminal 1 of glow relay harness connector and chassis ground.
4. Measure voltage in harness between terminal 2(4) of glow relay harness connector and chassis ground.
  - **Specification: approximately B+**



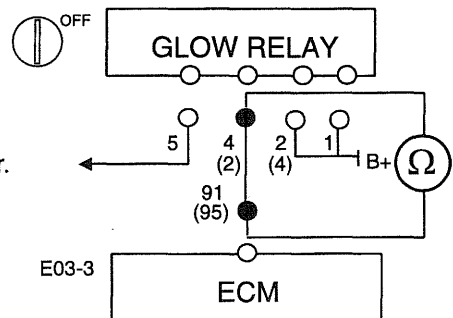
( ): Glow Relay #2

Is(Are) voltage(s) within specification?

Yes	No	Repair open or short circuit in harness.
-----	----	--

**4. CHECK FOR OPEN IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and glow relay connector.
2. Measure resistance between terminal 4(2) of glow relay 1(2)harness connector and terminal E03-3(91)(E03-3(95)) of ECM harness connector.
  - **Specification: below 1Ω**



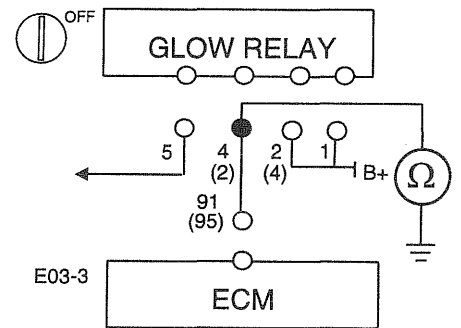
( ): Glow Relay #2

Is(Are) resistance(s) within specification?

<b>Yes</b>		No Repair open circuit in harness.
------------	--	------------------------------------

**5. CHECK FOR SHORT TO GROUND IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and glow relay connector.
2. Measure resistance between terminal 4(2) of glow relay 1(2) harness connector and chassis ground.
3. Measure resistance between terminal 2 and 3 of glow relay harness connector.
  - **Specification: infinite**



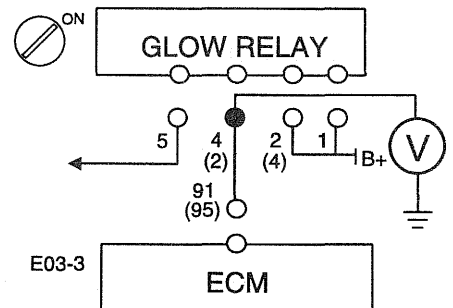
Is(Are) resistance(s) within specification?

( ): Glow Relay #2

<b>Yes</b>		No Repair short or short to chassis ground in harness.
------------	--	--

**6. CHECK FOR SHORT TO POWER IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and glow relay connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 4(2) of glow relay 1(2) harness connector and chassis ground.
  - **Specification: below 0.5V**



Is(Are) voltage(s) within specification?

( ): Glow Relay #2

<b>Yes</b>		No Repair short to power in harness.
------------	--	--------------------------------------

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

**TROUBLESHOOTING FOR DTC** E00C6DA7

DTC	P0381	Glow Indicator Lamp Circuit Malfunction
CC-CODE	0a	Open circuit or short circuit to ground
	03	Short circuit to battery line

**DESCRIPTION**

Glow plugs in the diesel engine are small 12 V heating elements with the tip exposed to a small chamber where the volume of air can readily be heated. When the diesel engine is started up, the glow plug preheating current is controlled, taking into account factors such as coolant temperature.

In addition to shortening preheating time, the surface temperature of the glow plug is maintained at a fixed temperature after the engine has been started. This has the effect of stabilizing engine speed and reducing the amount of smoke. The preheating warning light (Glow Indicator Lamp), which is located on the cluster, notifies the driver that the ECM is preheating it to improve the driving performance.

**DTC DETECTING CONDITION**

CC-CODE	Detecting Condition	Suspect Area
0a	<ul style="list-style-type: none"> <li>Open or short to ground in glow indicator lamp circuit</li> </ul>	<ul style="list-style-type: none"> <li>Open or short in Glow Indicator Lamp circuit</li> <li>Glow Indicator Lamp</li> <li>ECM</li> </ul>
03	<ul style="list-style-type: none"> <li>Short to battery line in glow indicator lamp circuit</li> </ul>	

**[SCHEMATIC DIAGRAM]**

**[CIRCUIT DIAGRAM]**

The diagram shows a glow lamp with two terminals. Terminal 12 is connected to the ECM at terminal 29, labeled 'Glow Lamp Control'. Terminal 14 is connected to the 'IG ON' line.

**[CONNECTION INFORMATION]**

Terminal	Connected to	Function
12	ECM E03-1 (29)	Glow Lamp Control
14	IG	Battery Voltage

**[HARNESS CONNECTORS]**

**I03-1**  
CLUSTER

1	5	9	13	17	21	25	●
2	6	10	14	18	22	26	30
3	7	11	15	19	23	27	31
4	8	12	16	20	24	28	32

**E03-1**  
ECM

INSPECTION PROCEDURE

**1. CHECK GLOW INDICATOR LAMP (CLUSTER) AND ECM CONNECTORS**

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
  - Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

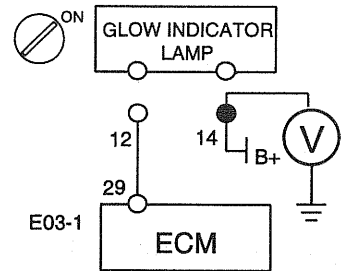
Are all connectors good?

Yes

No	Repair or replace it.
----	-----------------------

**2. CHECK REFERENCE VOLTAGE TO GLOW INDICATOR LAMP**

1. Turn ignition switch to OFF and disconnect glow indicator lamp (cluster) connector.
2. Turn ignition switch to ON.
3. Measure voltage in harness between terminal 14 of glow indicator lamp (cluster) harness connector and chassis ground.
  - **Specification: approximately B+**



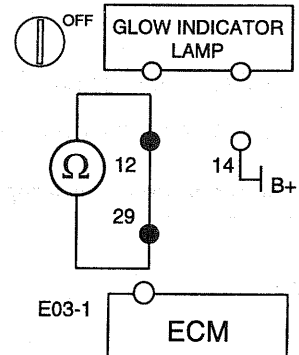
Is(Are) voltage(s) within specification?

Yes

No	Repair open or short circuit in harness.
----	--

**3. CHECK FOR OPEN IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and glow indicator lamp (cluster) connector.
2. Measure resistance between terminal 12 of glow indicator lamp (cluster) harness connector and terminal E03-1(29) of ECM harness connector.
  - **Specification: below 1Ω**



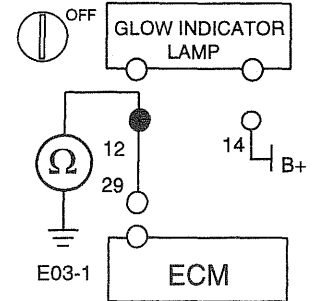
Is(Are) resistance(s) within specification?

Yes

No	Repair open circuit in harness.
----	---------------------------------

**4. CHECK FOR SHORT TO GROUND IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and glow indicator lamp (cluster) connector.
2. Measure resistance between terminal 12 of glow indicator lamp (cluster) harness connector and chassis ground.
  - **Specification: infinite**



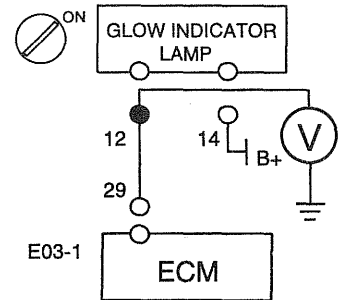
Is(Are) resistance(s) within specification?

**Yes**

No	Repair short or short to chassis ground in harness.
----	---

**5. CHECK FOR SHORT TO POWER IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and glow indicator lamp (cluster) connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 12 of glow indicator lamp (cluster) harness connector and chassis ground.
  - **Specification: below 0.5V**



Is(Are) voltage(s) within specification?

**Yes**

No	Repair short to power in harness.
----	-----------------------------------

**6. CHECK GLOW INDICATOR LAMP**

1. Inspect the glow indicator lamp installed on the cluster.

Does the glow indicator lamp have normal condition?

**Yes**

No	Replace the glow indicator lamp
----	---------------------------------

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

**TROUBLESHOOTING FOR DTC** E5DD1E09

<b>DTC</b>	<b>P0400</b>	<b>EGR Solenoid Valve Circuit Malfucntion</b>
CC-CODE	0a	Open circuit or short circuit to ground
	03	Short circuit to battery line

**DESCRIPTION**

The exhaust-gas recirculation (EGR) system is designed to introduce exhaust gas into the engine's intake manifold. Up to a certain degree, this system enables to reduce the formation of oxides of nitrogen (NOx) by cooling the combustion process. EGR solenoid valve will not open under all driving conditions. For it to cycle, the engine must be at normal operating temperature and not under heavy load. The amount and timing of exhaust gas introduced into the combustion cycle varies by such factors as engine

vacuum, exhaust system back pressure, coolant temperature and accel position. Depending upon the engine's operating point, the air/gas mass drawn into the cylinders can be composed of up to 40%exhaust gas. Using the signal generated by the ECM control circuit, the EGR valve opens so that exhaust gas can flow into the intake manifold. If the EGR valve begins to clog or only partially opens, its flow will be reduced and emissions will increase.

**DTC DETECTING CONDITION**

CC-CODE	Detecting Condition	Suspect Area
0a	<ul style="list-style-type: none"> <li>EGR solenoid valve duty &gt; 95%</li> </ul>	<ul style="list-style-type: none"> <li>Open or short in EGR Solenoid Valve circuit</li> <li>EGR Solenoid Valve</li> <li>ECM</li> </ul>
03	<ul style="list-style-type: none"> <li>EGR solenoid valve duty &lt; 5%</li> </ul>	

**SPECIFICATION**

EGR Solenoid Valve Resistance (Ω)	15.0 ~ 16.0Ω at 20°C (68°F)
-----------------------------------	-----------------------------

**[SCHEMATIC DIAGRAM]**

**[CIRCUIT DIAGRAM]**

**[CONNECTION INFORMATION]**

Terminal	Connected to	Function
1	ECM E03-2 (39)	EGR Solenoid Valve Control
2	Main Relay	Battery Voltage

**[HARNESS CONNECTORS]**

**E34**  
EGR Solenoid Valve Control

33	37	41	45	49	53	57	61	65	69	73	77
34	38	42	46	50	54	58	62	66	70	74	78
35	●	43	47	51	55	59	63	67	71	75	79
36	40	44	48	52	56	60	64	68	72	76	80

**E03-2**  
ECM

INSPECTION PROCEDURE

**1. CHECK EGR SOLENOID VALVE AND ECM CONNECTORS**

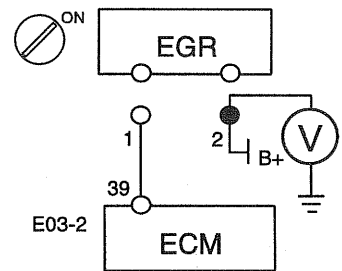
1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
  - Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

Are all connectors good?

Yes		
No		Repair or replace it.

**2. CHECK REFERENCE VOLTAGE TO EGR SOLENOID VALVE**

1. Turn ignition switch to OFF and disconnect EGR solenoid valve connector.
2. Turn ignition switch to ON.
3. Measure voltage in harness between terminal 2 of EGR solenoid valve harness connector and chassis ground.
  - Specification: approximately B+

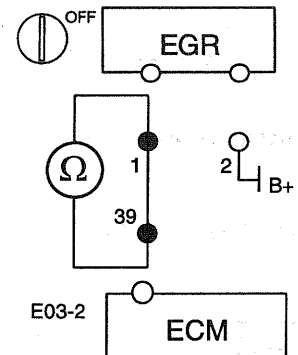


Is(Are) voltage(s) within specification?

Yes		
No		Repair open or short circuit in harness.

**3. CHECK FOR OPEN IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and EGR solenoid valve connector.
2. Measure resistance between terminal 1 of EGR solenoid valve harness connector and terminal E03-2(39) of ECM harness connector.
  - Specification: below 1Ω

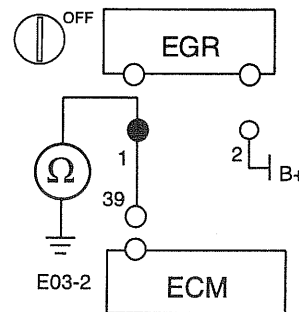


Is(Are) resistance(s) within specification?

Yes		
No		Repair open circuit in harness

**4. CHECK FOR SHORT TO GROUND IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and EGR solenoid valve connector.
2. Measure resistance between terminal 1 of EGR solenoid valve harness connector and chassis ground.
  - **Specification: infinite**



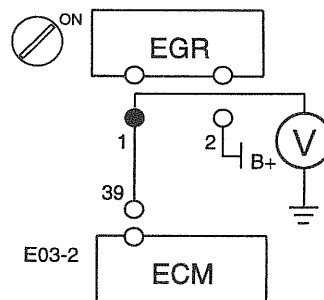
Is(Are) resistance(s) within specification?

Yes

No	Repair short or short to chassis ground in harness.
----	---

**5. CHECK FOR SHORT TO POWER IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and EGR solenoid valve connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 1 of EGR solenoid valve harness connector and chassis ground.
  - **Specification: below 0.5V**



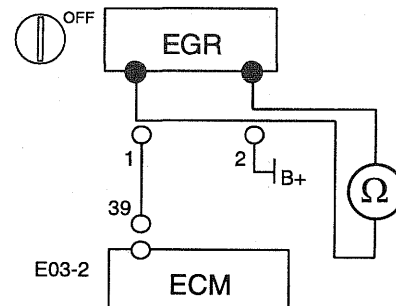
Is(Are) voltage(s) within specification?

Yes

No	Repair short to power in harness.
----	-----------------------------------

**6. CHECK EGR SOLENOID VALVE**

1. Turn ignition switch to OFF and disconnect EGR solenoid valve connector.
2. Measure resistance between terminal 1 and 2 of EGR solenoid valve connector.
  - **Refer to "SPECIFICATION" for more information.**



Is(Are) resistance(s) within specification?

Yes

No	Replace the EGR solenoid valve
----	--------------------------------

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.



**TROUBLESHOOTING FOR DTC** E5DF4755

DTC	P0560	Battery Voltage Malfunction
CC-CODE	08	Battery voltage too low
	09	Battery voltage too high

**DESCRIPTION**

The charging system includes a battery, generator with a built in regulator, the charging indicator light, and connecting wiring. The generator uses diodes to rectify alternating current (AC) to direct current (DC). The ECM provides ground to one side of coil of main relay and the other side

is connected to battery. The ECM monitors battery voltage and the voltage after main relay.

**DTC DETECTING CONDITION**

CC-CODE	Detecting Condition	Suspect Area
08	• Battery voltage < 6V at engine speed = 700 rpm	<ul style="list-style-type: none"> <li>• Open or short in Main Relay circuit</li> <li>• Main Relay</li> <li>• Battery</li> <li>• Alternator</li> <li>• ECM</li> </ul>
09	• Battery voltage > 18V at engine speed = 700 rpm	

**[SCHEMATIC DIAGRAM]**

**[CIRCUIT DIAGRAM]**

**[CONNECTION INFORMATION]**

Terminal	Connected to	Function
1	Battery	Battery Voltage
2	ECM E03-3 (104)	Main Relay Control
3	-	-
4	Battery	Battery Voltage
5	-	-

**[HARNESS CONNECTORS]**

**E113**  
**MAIN RELAY**

81	85	89	93	97	101	105	109
82	86	90	94	98	102	106	110
						107	111
83	87	91	95	99	103		
84	88	92	96	100	104	108	112

**E03-3**  
**ECM**

INSPECTION PROCEDURE

**1. CHECK MAIN RELAY, BATTERY CABLE AND ECM CONNECTORS**

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
  - Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

Are all connectors good?

Yes		No Repair or replace it.
-----	--	--------------------------

**2. CHECK MAIN RELAY**

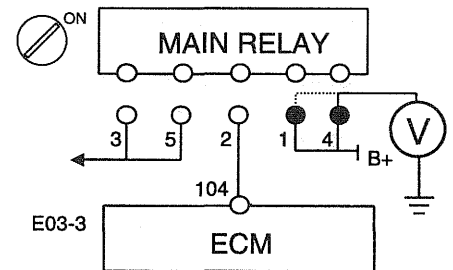
1. Turn ignition switch to OFF and remove the main relay.
2. Apply power to the terminal 4 and ground terminal 2 of main relay.
3. Check if main relay works well.
  - (If main relay works normally, a "click" sound can be heard).

Does the main relay operate normally?

Yes		No Replace the glow plug relay
-----	--	--------------------------------

**3. CHECK POWER TO MAIN RELAY**

1. Turn ignition switch to OFF and disconnect main relay connector.
2. Turn ignition switch to ON.
3. Measure voltage in harness between terminal 4 of main relay harness connector and chassis ground.
4. Measure voltage in harness between terminal 1 of main relay harness connector and chassis ground.
  - Specification: approximately B+

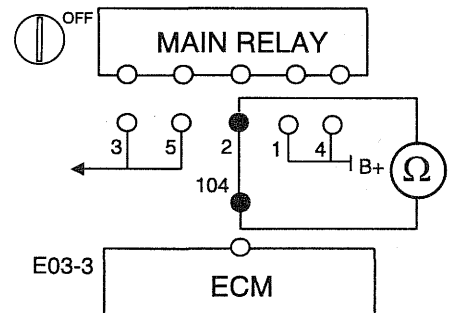


Is(Are) voltage(s) within specification?

Yes		No Repair open or short circuit in harness.
-----	--	---

**4. CHECK FOR OPEN IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and main relay connector.
2. Measure resistance between terminal 2 of main relay harness connector and terminal E03-3(104) of ECM harness connector.
  - Specification: below 1Ω



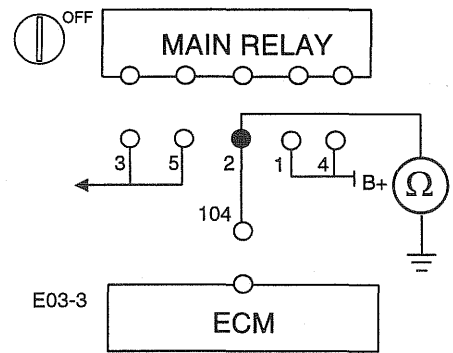
Is(Are) resistance(s) within specification?

Yes

No	Repair open circuit in harness.
----	---------------------------------

**5. CHECK FOR SHORT TO GROUND IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and main relay connector.
2. Measure resistance between terminal 2 of main relay harness connector and chassis ground.
  - **Specification: infinite**



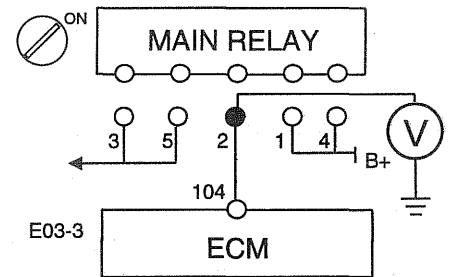
Is(Are) resistance(s) within specification?

Yes

No	Repair short or short to chassis ground in harness.
----	---

**6. CHECK FOR SHORT TO POWER IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and main relay connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 2 of main relay harness connector and chassis ground.
  - **Specification: below 0.5V**



Is(Are) voltage(s) within specification?

Yes

No	Repair short to power in harness.
----	-----------------------------------

**7. CHECK BATTERY**

1. Check battery.
  - **Refer to the group "EE" in this Shop Manual.**

Is battery okay?

Yes

No	Repair or replace it.
----	-----------------------

**8. CHECK ALTERNATOR**

- 1. Check alternator.
  - Refer to the group "EE" in this Shop Manual.

**Is alternator okay?**



No	Repair or replace it.
----	-----------------------

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

**TROUBLESHOOTING FOR DTC** EC60D8FC

DTC	P0650	Malfunction Indicator Lamp Circuit Malfunction
CC-CODE	0a	Open circuit or short circuit to ground
	03	Short circuit to battery line

**DESCRIPTION**

The Malfunction Indicator Lamp (MIL), which is located in the instrument cluster, comes on to notify the driver that there may be a problem with the vehicle and that service is needed. Immediately after the ignition switch turns on, the

malfunction indicator lamp is lit for 5 seconds to indicate that the MIL operates normally.

**DTC DETECTING CONDITION**

CC-CODE	Detecting Condition	Suspect Area
0a	• Open or short to ground in MIL circuit	• Open or short in MIL circuit • MIL • ECM
03	• Short to battery line in MIL circuit	

**[SCHEMATIC DIAGRAM]**

**[CIRCUIT DIAGRAM]**

The diagram shows a box labeled 'MIL' containing a lamp symbol. A line labeled '20' connects the lamp to a box labeled 'ECM'. Inside the ECM box, terminal '9 - MIL Control' is connected to the '20' line. Another line labeled '9' connects terminal '9' of the ECM to 'IG ON'.

**[CONNECTION INFORMATION]**

Terminal	Connected to	Function
20	ECM E03-1 (9)	MIL Control
9	IG	Battery Voltage

**[HARNESS CONNECTORS]**

10	9	8	7	6	5	4	3	2	1
20	19	18	17	16	15	14	13	12	11

**I03-3**  
CLUSTER

1	5	●	13	17	21	25	29
2	6		10	14	18	22	30
3	7		11	15	19	23	27
4	8		12	16	20	24	28

**E03-1**  
ECM

INSPECTION PROCEDURE

**1. CHECK MIL(CLUSTER) AND ECM CONNECTORS**

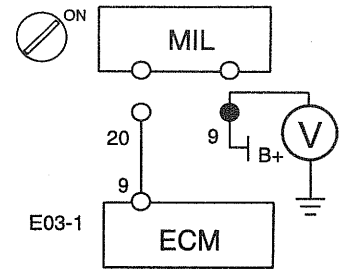
1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
  - Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

Are all connectors good?

Yes		No	Repair or replace it.
-----	--	----	-----------------------

**2. CHECK POWER TO MIL**

1. Turn ignition switch to OFF and disconnect MIL(Cluster) connector.
2. Turn ignition switch to ON.
3. Measure voltage in harness between terminal 9 of MIL(Cluster) harness connector and chassis ground.
  - Specification: approximately B+

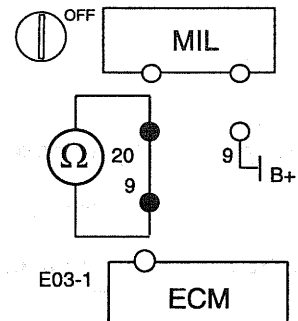


Is(Are) voltage(s) within specification?

Yes		No	Repair open or short circuit in harness.
-----	--	----	--

**3. CHECK FOR OPEN IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and MIL(Cluster) connector.
2. Measure resistance between terminal 20 of MIL(Cluster) harness connector and terminal E03-1(9) of ECM harness connector.
  - Specification: below 1Ω

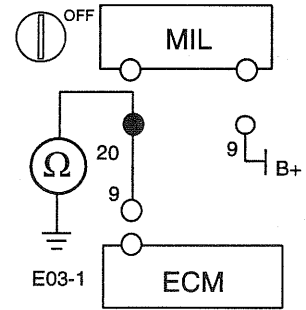


Is(Are) resistance(s) within specification?

Yes		No	Repair open circuit in harness.
-----	--	----	---------------------------------

**4. CHECK FOR SHORT TO GROUND IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and MIL(Cluster) connector.
2. Measure resistance between terminal 20 of MIL(Cluster) harness connector and chassis ground.
  - **Specification: infinite**

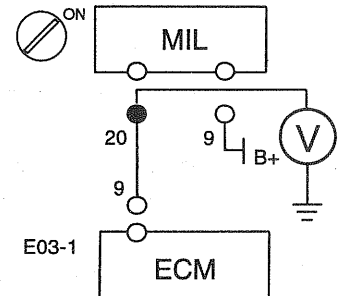


Is(Are) resistance(s) within specification?

<b>Yes</b>	No	Repair short or short to chassis ground in harness.
------------	----	---

**5. CHECK FOR SHORT TO POWER IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and MIL(Cluster) connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 20 of MIL(Cluster) harness connector and chassis ground.
  - **Specification: below 0.5V**



Is(Are) voltage(s) within specification?

<b>Yes</b>	No	Repair short to power in harness.
------------	----	-----------------------------------

**6. CHECK MIL(CLUSTER)**

1. Inspect the MIL installed on the cluster.

Does the MIL have normal condition?

<b>Yes</b>	No	Replace the MIL.
------------	----	------------------

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

## TROUBLESHOOTING FOR DTC EDE9BA65

DTC	P1119	Inlet Metering Valve (IMV) Control Malfunction
CC-CODE	96	Fuel leakage
	97	Fuel leakage
	98	Fuel leakage)
	99	Fuel leakage

DTC	P1120	Inlet Metering Valve (IMV) Circuit Malfunction
CC-CODE	0a	Open circuit or short circuit to ground
	03	Short circuit to battery line
	05	Fuel leakage
	04	Fuel leakage
	08	Fuel leakage

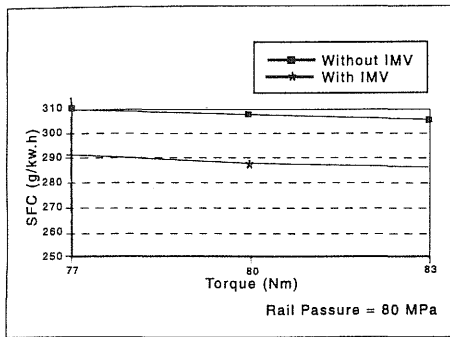
**DESCRIPTION**

The Inlet Metering Valve (IMV) is used to control the rail pressure by regulating the amount of fuel which is sent to the pumping element of the HP pump. This IMV has two purposes:

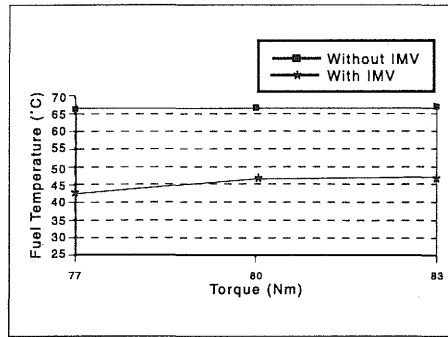
1. Firstly, it allows the efficiency of the injection system to be improved, since the HP pump only compresses the amount of fuel necessary to maintain in the rail the level of pressure required by the system as a function of the engine operating conditions.
2. Secondly, it allows the temperature to be reduced in the fuel tank. When the excess fuel is discharged into the back leak circuit, the pressure reduction in the fluid (from rail pressure down to atmospheric pressure) gives off a large amount of heat. This leads to a temperature rise in the fuel entering the tank. In order to prevent too high a temperature being reached, it is necessary to limit the amount of heat generated by the fuel pressure reduction, by reducing the back leak flow. To reduce the back leak flow, it is sufficient to adapt the flow of the HP pump to the engine requirements throughout its operating range.



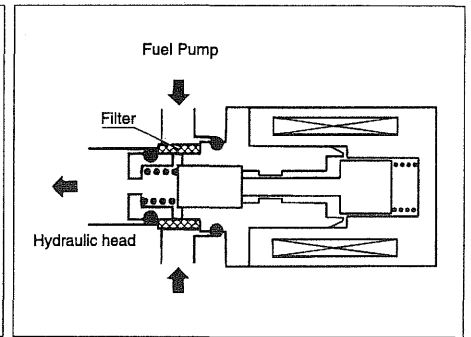
[FIG 1] Inlet Metering Valve Effect



[FIG 2] Fuel Temperature at System Backleak



[FIG 3] Operation Principle



EWMF203R

**DTC DETECTING CONDITION**

**(P1119)**

CC-CODE	Detecting Condition	Suspect Area
96	<ul style="list-style-type: none"> <li>The rail pressure is slightly lower than the demand.</li> </ul>	<ul style="list-style-type: none"> <li>Open or short in IMV circuit</li> <li>IMV</li> <li>High pressure fuel circuit</li> <li>Low pressure fuel circuit</li> <li>Injector</li> <li>High pressure pump</li> <li>ECM</li> </ul>
97		
98		
99	<ul style="list-style-type: none"> <li>The rail pressure is slightly higher than the demand.</li> </ul>	

**(P1120)**

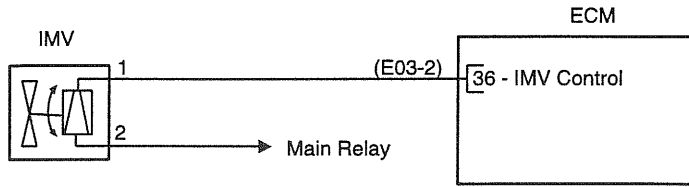
CC-CODE	Detecting Condition	Suspect Area
0a	<ul style="list-style-type: none"> <li>Open or short to ground in IMV circuit</li> </ul>	<ul style="list-style-type: none"> <li>Open or short in IMV circuit</li> <li>IMV</li> <li>High pressure fuel circuit</li> <li>Low pressure fuel circuit</li> <li>Injector</li> <li>High pressure pump</li> <li>ECM</li> </ul>
03	<ul style="list-style-type: none"> <li>Short to battery line in IMV circuit</li> </ul>	
05	<ul style="list-style-type: none"> <li>The rail pressure remains 101.9 kgf/cm<sup>2</sup> above the demand for a variable time depending on the difference.</li> </ul>	
04	<ul style="list-style-type: none"> <li>The rail pressure remains 101.9 kgf/cm<sup>2</sup> below the demand for a variable time depending on the difference.</li> </ul>	
08	<ul style="list-style-type: none"> <li>The pressure rise on starting is too slow.</li> </ul>	

**SPECIFICATION**

Inlet Metering Valve Resistance (Ω)	5.5Ω at 20°C (68°F)
-------------------------------------	---------------------

[SCHEMATIC DIAGRAM]

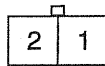
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM E03-2 (36)	IMV Control
2	Main Relay	Battery Voltage

[HARNESS CONNECTORS]



**E86**  
**IMV**

33	37	41	45	49	53	57	61	65	69	73	77
34	38	42	46	50	54	58	62	66	70	74	78
35	39	43	47	51	55	59	63	67	71	75	79
●	40	44	48	52	56	60	64	68	72	76	80

**E03-2**  
**ECM**

INSPECTION PROCEDURE

**1. CHECK DTC**

1. Connect the Hi-Scan (Pro) to the Data Link Connector (DLC).
2. Turn ignition switch to ON and check that any other DTC(s) is (are) detected.

Is P0190 also set?

Yes

No Do all repairs associated with those codes before proceeding with this procedure.

**2. CHECK IMV AND ECM CONNECTORS**

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
  - Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

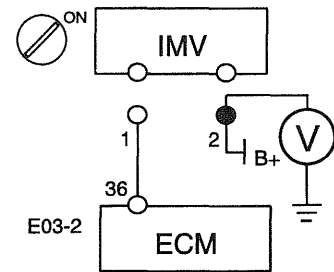
Are all connectors good?

Yes

No Repair or replace it.

**3. CHECK POWER TO IMV**

1. Turn ignition switch to OFF and disconnect IMV connector.
2. Turn ignition switch to ON.
3. Measure voltage in harness between terminal 2 of IMV harness connector and chassis ground.
  - Specification: approximately B+



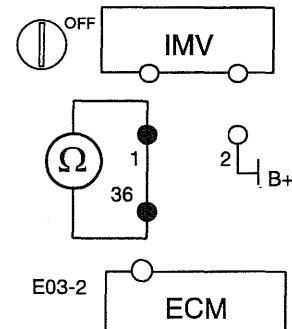
Is(Are) voltage(s) within specification?

Yes

No Repair open or short circuit in harness.

**4. CHECK FOR OPEN IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and IMV connector.
2. Measure resistance between terminal 1 of IMV harness connector and terminal E03-2(36) of ECM harness connector.
  - Specification: below 1Ω



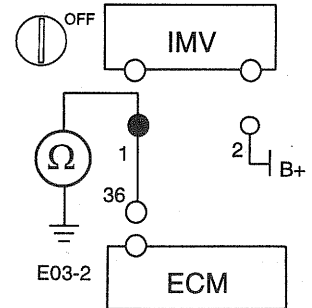
Is(Are) resistance(s) within specification?

Yes

No	Repair open circuit in harness.
----	---------------------------------

**5. CHECK FOR SHORT TO GROUND IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and IMV connector.
2. Measure resistance between terminal 1 of IMV harness connector and chassis ground.
  - **Specification: infinite**



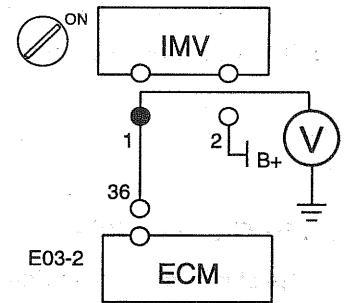
Is(Are) resistance(s) within specification?

Yes

No	Repair short or short to chassis ground in harness.
----	---

**6. CHECK FOR SHORT TO POWER IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and IMV connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 1 of IMV harness connector and chassis ground.
  - **Specification: below 0.5V**



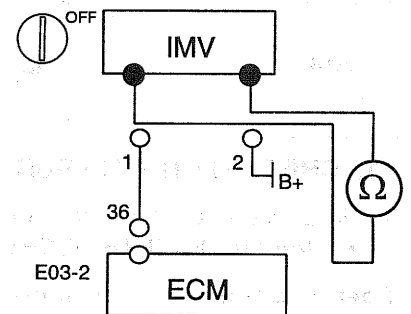
Is(Are) voltage(s) within specification?

Yes

No	Repair short to power in harness.
----	-----------------------------------

**7. CHECK IMV**

1. Turn ignition switch to OFF and disconnect IMV connector.
2. Measure resistance between terminal 1 and 2 of IMV connector.
  - **Refer to "SPECIFICATION" for more information.**



Is(Are) resistance(s) within specification?

Yes

No

Replace the IMV

**8. CHECK LOW PRESSURE FUEL CIRCUIT**

1. Inspect following items:

- The presence of fuel in fuel tank
- Leakage and connection condition of fuel line from fuel tank to high pressure pump
- Leakage and connection condition of fuel line from fuel tank to injector via high pressure pump
- The absence of air in the low pressure circuit (If air exists, place a receptacle under the venturi, and then disconnect the pump return hose at the venturi and prime the fuel circuit with the hand-priming pump).

Are all system above normal?

Yes

No

Repair or replace it.

**9. CHECK HIGH PRESSURE FUEL CIRCUIT**

1. Inspect high pressure fuel circuit.

- Refer to "FUEL DELIVERY SYSTEM-DIESEL".

Does it have normal condition?

Yes

No

Repair or replace it.

**10. CHECK INJECTOR**

1. Inspect injector as following.

- Operation condition of injector
- Leakage on injector
- Fuel amount of injector return line
- Installation condition of injector (including the injector gasket and the tightening torques of clamp)
- Refer to "FUEL DELIVERY SYSTEM-DIESEL".

Are all system above normal?

Yes

No

Repair or replace it.

**11. CHECK HIGH PRESSURE PUMP**

1. Inspect operation condition of high pressure pump.

- Refer to "FUEL DELIVERY SYSTEM-DIESEL".

Does it have normal condition?

Yes

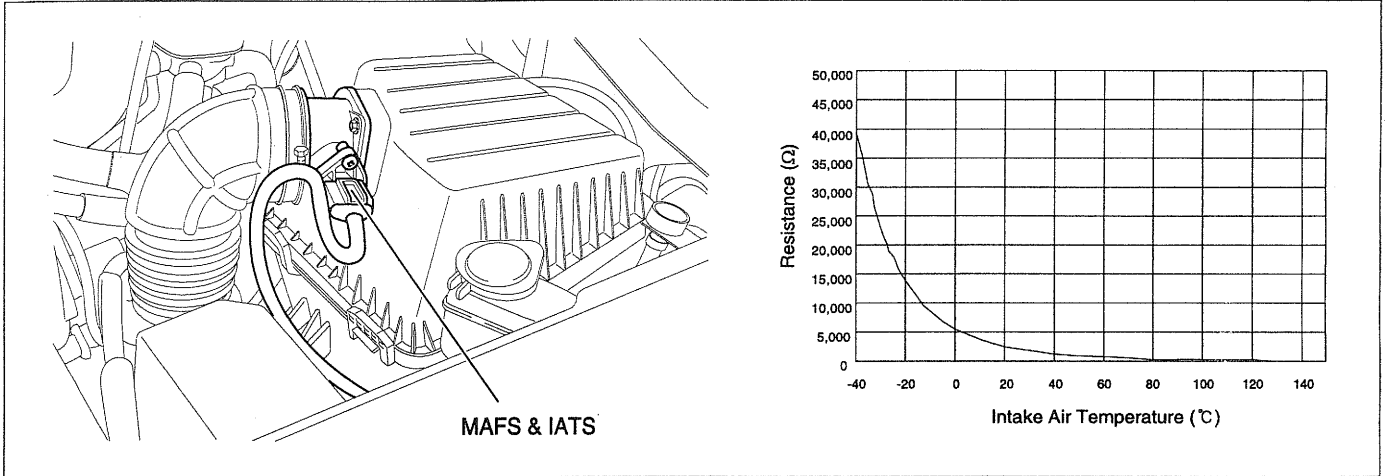
No

Repair or replace it.

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

TROUBLESHOOTING FOR DTC E771E34A

DTC	P1140	Intake Air Temperature Sensor (IATS) Circuit Malfunction
CC-CODE	0b	Signal low (Open circuit or short circuit to battery line)
	02	Signal high (Short circuit to ground)



EWMF201Z

DESCRIPTION

The intake air temperature sensor (IATS) is built in the mass air flowmeter sensor (MAFS). It is located between the air cleaner assembly and the throttle device. The IATS uses a thermistor whose resistance changes with the temperature to check the mass of intake air entering the engine.

The electrical resistance of the IATS decreases as the temperature increases, and increases as the temperature decreases. The 5 V power source in the ECM is supplied

to the IATS via a resistor in the ECM. That is, the resistor in the ECM and the thermistor in the IATS are connected in series. When the resistance value of the thermistor in IATS changes according to the intake air temperature, the signal voltage also changes. Using this signal, the information of the intake air temperature, the ECM corrects fuel flow, injection timing.

DTC DETECTING CONDITION

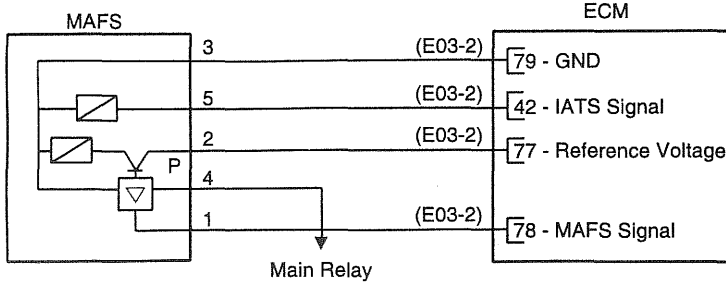
CC-CODE	Detecting Condition	Suspect Area
0b	• Intake air temperature < -49°C(-56.2°F)	• Open or short in IATS circuit • IATS • ECM
02	• Intake air temperature > 130°C(266°F)	

SPECIFICATION

Temperature [°C (°F)]	-40(-40)	-20(-4)	0(32)	20(68)	40(104)	60(140)	80(176)
Resistance (kΩ)	39.3	13.9	5.5	2.4	1.2	0.6	0.3

[SCHEMATIC DIAGRAM]

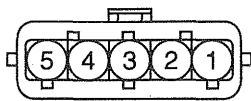
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM E03-2 (78)	MAFS Signal
2	ECM E03-2 (77)	Reference Voltage
3	ECM E03-2 (79)	Sensor Ground
4	Main Relay	Battery Voltage
5	ECM E03-2 (42)	IATS Signal

[HARNESS CONNECTORS]



**E17**  
MAFS & IATS

33	37	41	45	49	53	57	61	65	69	73	●
34	38	●	46	50	54	58	62	66	70	74	●
35	39										
36	40	44	48	52	56	60	64	68	72	76	80

**E03-2**  
ECM

INSPECTION PROCEDURE

**1. CHECK IATS AND ECM CONNECTORS**

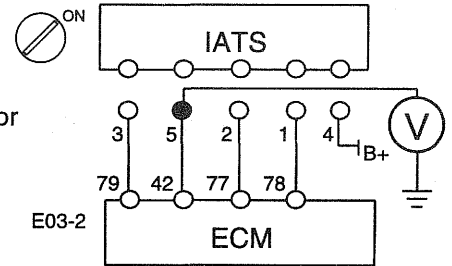
1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
  - Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

Are all connectors good?

<b>Yes</b>		
	No	Repair or replace it.

**2. CHECK REFERENCE VOLTAGE TO IATS**

1. Turn ignition switch to OFF and disconnect IATS connector.
2. Turn ignition switch to ON.
3. Measure voltage in harness between terminal 5 of IATS harness connector and chassis ground.
  - **Specification: approximately 5V**

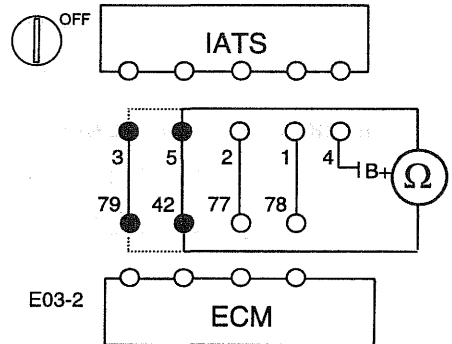


Is(Are) voltage(s) within specification?

<b>Yes</b>		
	No	Repair open or short circuit in harness.

**3. CHECK FOR OPEN IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and IATS connector.
2. Measure resistance between terminal 5 of IATS harness connector and terminal E03-2(42) of ECM harness connector.
3. Measure resistance between terminal 3 of IATS harness connector and terminal E03-2(79) of ECM harness connector.
  - **Specification: below 1Ω**



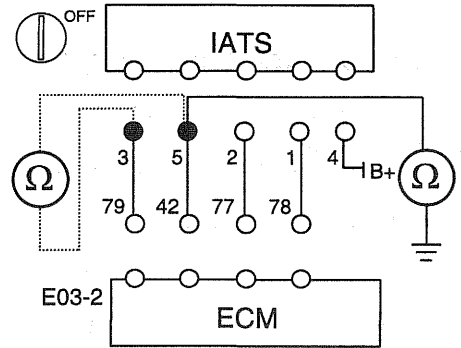
Is(Are) resistance(s) within specification?

<b>Yes</b>		
	No	Repair open circuit in harness.



**4. CHECK FOR SHORT TO GROUND IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and IATS connector.
2. Measure resistance between terminal 5 of IATS harness connector and chassis ground.
3. Measure resistance between terminal 5 and 3 of IATS harness connector.
  - **Specification: infinite**



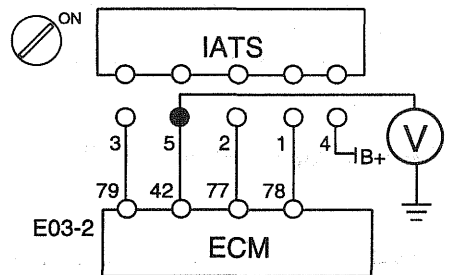
Is(Are) resistance(s) within specification?

Yes

No	Repair short or short to chassis ground in harness.
----	---

**5. CHECK FOR SHORT TO POWER IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and IATS connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 5 of IATS harness connector and chassis ground.
  - **Specification: below 0.5V**



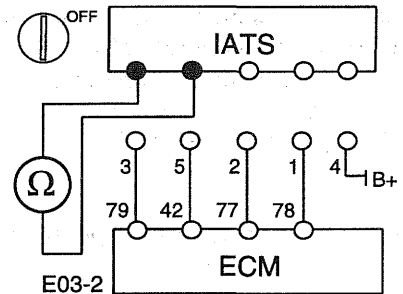
Is(Are) voltage(s) within specification?

Yes

No	Repair short to power in harness.
----	-----------------------------------

**6. CHECK IATS RESISTANCE**

1. Turn ignition switch to OFF and disconnect IATS connector.
2. Measure resistance between terminal 5 and 3 of IATS connector.
  - **Refer to "SPECIFICATION" for more information.**



Is(Are) resistance(s) within specification?

Yes

No	Replace the IATS.
----	-------------------

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

**TROUBLESHOOTING FOR DTC** E32031F0

DTC	P1150	Atmospheric Pressure Sensor Fault
CC-CODE	0a	Signal low (Open circuit or short circuit to ground)
	03	Signal high (Short circuit to battery line)

**DTC DETECTING CONDITION**

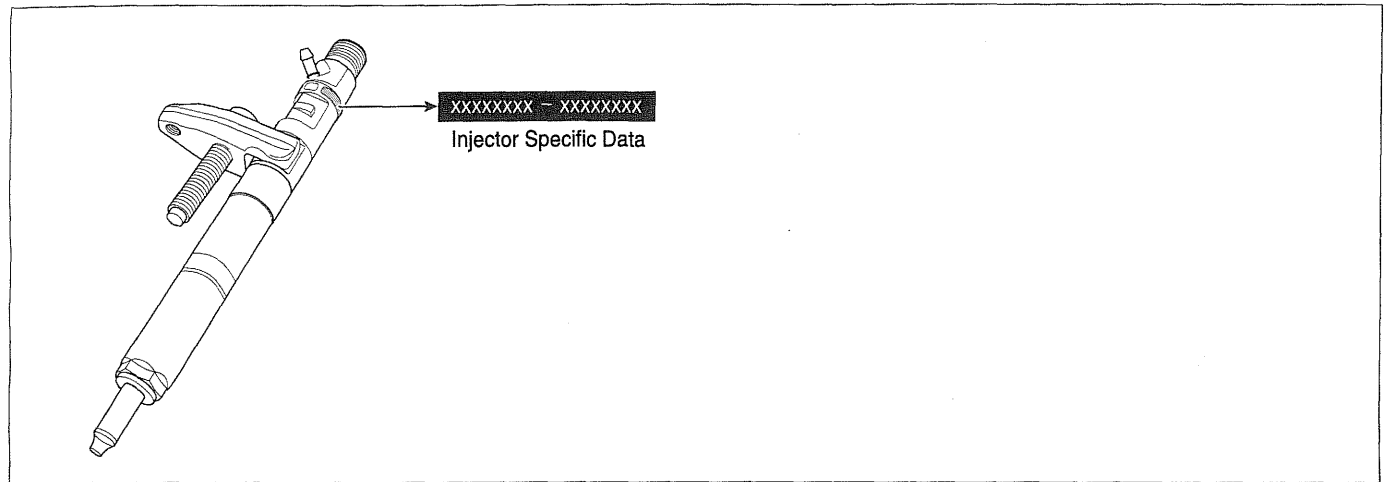
CC-CODE	Detecting Condition	Suspect Area
0a	<ul style="list-style-type: none"> <li>Atmospheric pressure &lt; 0.43 kgf/cm<sup>2</sup></li> </ul>	<ul style="list-style-type: none"> <li>Open or short in ECM internal circuit</li> </ul>
03	<ul style="list-style-type: none"> <li>Atmospheric pressure &gt; 1.08 kgf/cm<sup>2</sup></li> </ul>	

**INSPECTION PROCEDURE**

Replace the ECM
-----------------

**TROUBLESHOOTING FOR DTC** ED6BC73B

<b>DTC</b>	<b>P1300</b>	<b>Injector Specific Data Fault</b>
CC-CODE	04	Injector parameters incorrect



EWMF201X

**DTC DETECTING CONDITION**

CC-CODE	Detecting Condition	Suspect Area
04	<ul style="list-style-type: none"> <li>• Incorrect injector specific data</li> </ul>	<ul style="list-style-type: none"> <li>• ECM</li> </ul>

**INSPECTION PROCEDURE**

**1. VERIFICATION OF INJECTOR SPECIFIC DATA**

1. Connect the Hi-Scan (Pro) to the Data Link Connector (DLC).
2. Compare the injector specific data memorized in ECM memory with the one written on injector.

**Are the two data same?**



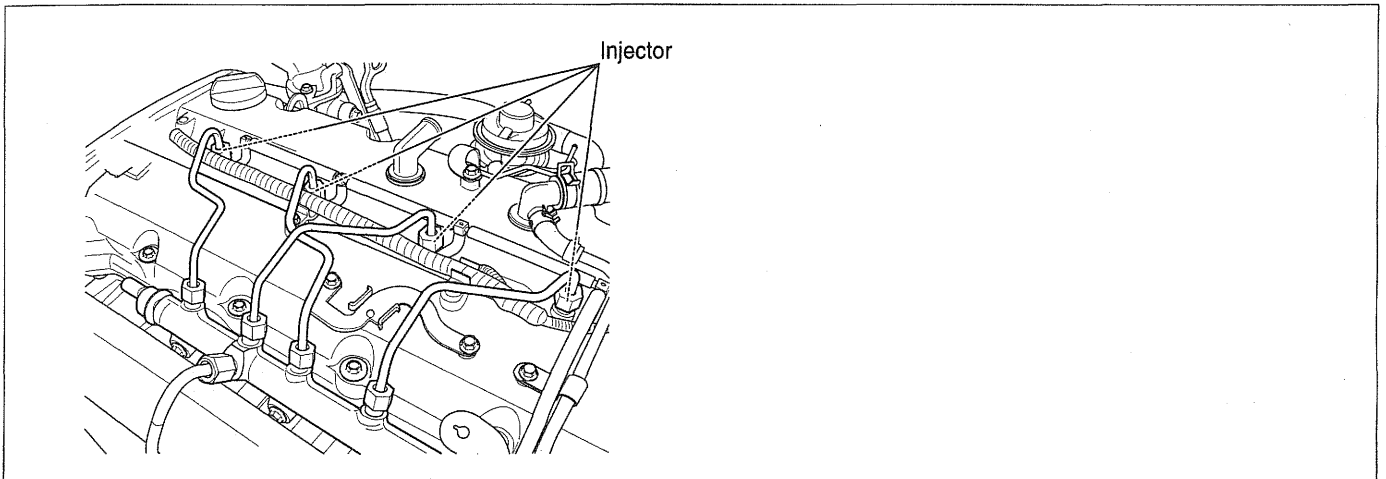
No	Input the injector specific data using Hi-Scan (Pro).
----	---

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EWMF201Y

**TROUBLESHOOTING FOR DTC** E4BCBBF5

DTC	P1310	Injector Control Circuit Fault
CC-CODE	03	Short circuit to battery line
	02	Short circuit to ground



EWMF202M

**DESCRIPTION**

The injector of the Common Rail System is electronically controlled. It has been designed to allow multiple injection with short intervals, to be fully electronically controlled, and to release a small amount of heat. The nozzle of injector opens when the solenoid valve is triggered and permits the flow of fuel. They inject the fuel directly into the engine's combustion chamber. The fuel is stored in the Rail ready for injection and the injected fuel quantity is defined by the injector opening time and the rail pressure.

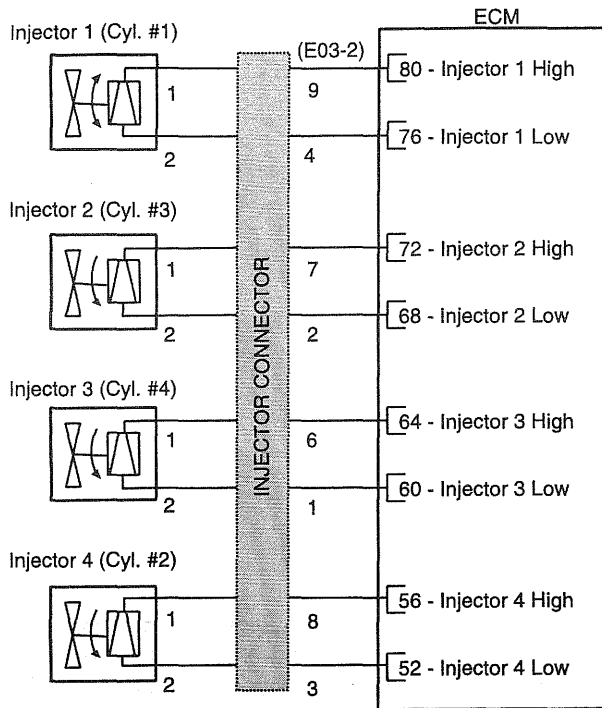
The excess fuel, which was needed for opening the nozzle of injector, flows back to the tank through a collector line. The return fuel from the pressure-control valve and from the low-pressure stage is also led into this collector line together with the fuel used to lubricate the high-pressure pump.

**DTC DETECTING CONDITION**

CC-CODE	Detecting Condition	Suspect Area
03	<ul style="list-style-type: none"> <li>• Short to battery line in injector circuit</li> </ul>	<ul style="list-style-type: none"> <li>• Open or short in injector</li> <li>• Injector</li> <li>• ECM</li> </ul>
02	<ul style="list-style-type: none"> <li>• Short to ground in injector circuit</li> </ul>	

[SCHEMATIC DIAGRAM]

[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Injector #1 (Cylinder #1)

Terminal	Injector Connector	Connected to	Function
1	7	ECM E03-2 (80)	Injector1 (Cyl. #1) High
2	2	ECM E03-2 (76)	Injector1 (Cyl. #1) Low

Injector #2 (Cylinder #3)

Terminal	Injector Connector	Connected to	Function
1	9	ECM E03-2 (72)	Injector2 (Cyl. #3) High
2	4	ECM E03-2 (68)	Injector2 (Cyl. #3) Low

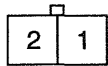
Injector #3 (Cylinder #4)

Terminal	Injector Connector	Connected to	Function
1	10	ECM E03-2 (64)	Injector3 (Cyl. #4) High
2	5	ECM E03-2 (60)	Injector3 (Cyl. #4) Low

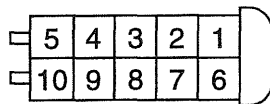
Injector #4 (Cylinder #2)

Terminal	Injector Connector	Connected to	Function
1	8	ECM E03-2 (56)	Injector4 (Cyl. #2) High
2	3	ECM E03-2 (52)	Injector4 (Cyl. #2) Low

[HARNESS CONNECTORS]



**E157**  
INJECTOR



INJECTOR CONNECTOR

33	37	41	45	49	53	57	61	65	69	73	77
34	38	42	46	50	54	58	62	66	70	74	78
35	39										
36	40	44	48	51	55	59	63	67	71	75	79

**E03-2**  
ECM

INSPECTION PROCEDURE

**1. CHECK INJECTOR AND ECM CONNECTORS**

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
  - Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

Are all connectors good?

Yes		
No		Repair or replace it.

**2. CHECK INJECTOR**

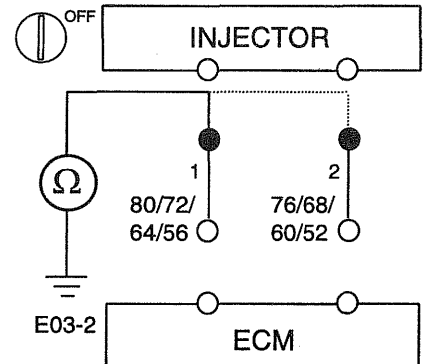
1. Connect the Hi-Scan (Pro) to the Data Link Connector (DLC).
2. Turn ignition switch to ON and check that any other DTC(s) is (are) detected.

Is this problem fixed?

No		
Yes		<ol style="list-style-type: none"> <li>1. Delete the DTC P1310, and then turn ignition switch to OFF and connect the injector connector again.</li> <li>2. Connect the Hi-Scan (Pro) to the Data Link Connector (DLC).</li> <li>3. Turn ignition switch to ON and check again that any other DTC(s) is (are) detected.                             <ul style="list-style-type: none"> <li>• If the DTC P1310 occurs again, replace the injector (injector fault).</li> </ul> </li> </ol>

**3. CHECK FOR SHORT TO GROUND IN HARNESS**

1. Turn ignition switch to OFF and wait for about 10 seconds.
2. Disconnect ECM and injector connector.
3. Measure resistance between terminal 1 of injector harness connector and chassis ground.
4. Measure resistance between terminal 2 of injector harness connector and chassis ground.
  - **Specification: infinite**

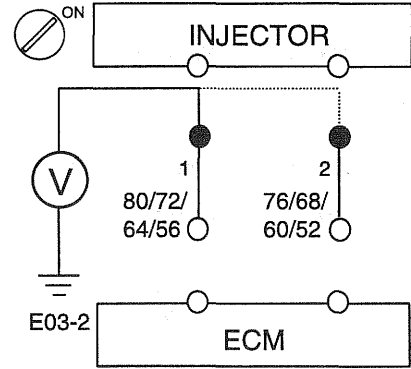


Is(Are) resistance(s) within specification?

Yes		
No		Repair short or short to chassis ground in harness.

**4. CHECK FOR SHORT TO POWER IN HARNESS**

1. Turn ignition switch to OFF and wait for about 10 seconds.
2. Disconnect ECM and injector connector.
3. Turn ignition switch to ON.
4. Measure voltage between terminal 1 of injector harness connector and chassis ground.
5. Measure voltage between terminal 2 of injector harness connector and chassis ground.
  - **Specification: below 0.5V**



Is(Are) voltage(s) within specification?

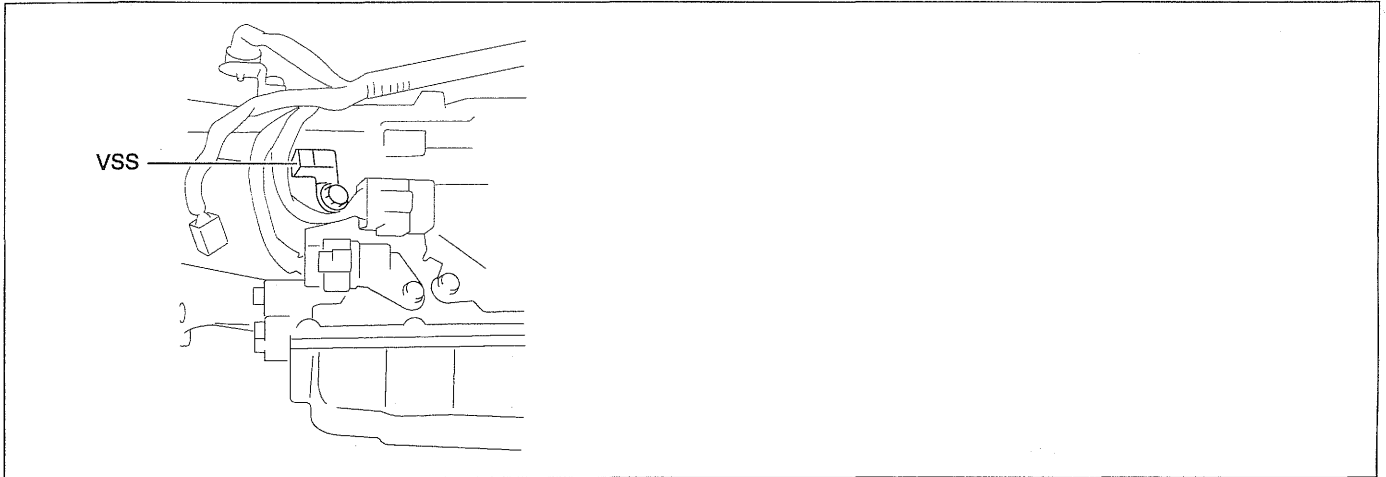
Yes

No	Repair short to power in harness.
----	-----------------------------------

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

**TROUBLESHOOTING FOR DTC** EC685BE5

DTC	P1500	Vehicle Speed Sensor (VSS) Circuit Malfunction
CC-CODE	06	Abnormal signal after running
	06	Abnormal signal after running
	06	Abnormal signal after running
	07	No signal before running



EWMF203Z

**DESCRIPTION**

The function of vehicle speed sensor (VSS) is to sense the tooth signal in T/M housing (4 pulses signal for every revolution of the rotor shaft) and send relevant signal to the Engine control module(ECM). The signal is used for

computing the vehicle speed and the speed display on the tachometer as well.

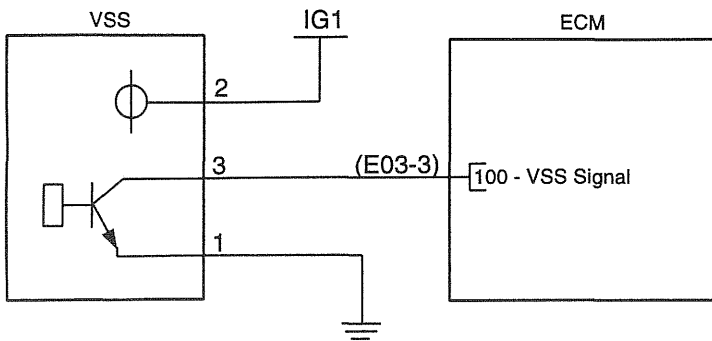
**DTC DETECTING CONDITION**

CC-CODE	Detecting Condition	Suspect Area
06	<ul style="list-style-type: none"> <li>• Open or short in VSS circuit</li> <li>• VSS fault</li> </ul>	<ul style="list-style-type: none"> <li>• Open or short in VSS circuit</li> <li>• VSS</li> <li>• ECM</li> </ul>
07		



[SCHEMATIC DIAGRAM]

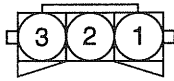
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	Chassis Ground	Sensor Ground
2	IG	Battery Voltage
3	ECM E03-3 (100)	VSS Signal

[HARNESS CONNECTORS]



C01

VSS

81	85	89	93	97	101	105	109
82	86	90	94	98	102	106	110
						107	111
83	87	91	95	99	103		
84	88	92	96	100	104	108	112

E03-3

ECM

INSPECTION PROCEDURE

**1. CHECK VSS AND ECM CONNECTORS**

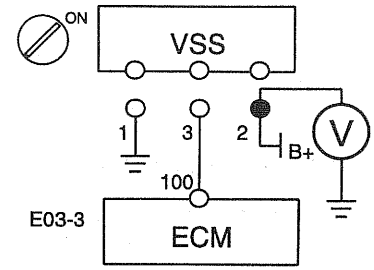
1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
  - Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

Are all connectors good?

<b>Yes</b>	No	Repair or replace it.
------------	----	-----------------------

**2. CHECK POWER TO VSS**

1. Turn ignition switch to OFF and disconnect VSS connector.
2. Turn ignition switch to ON.
3. Measure voltage in harness between terminal 2 of VSS harness connector and chassis ground.
  - **Specification: approximately B+**

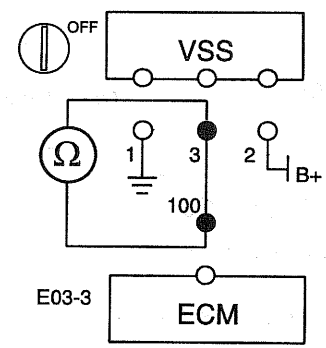


Is(Are) voltage(s) within specification?

<b>Yes</b>	No	Repair open or short circuit in harness.
------------	----	--

**3. CHECK FOR OPEN IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and VSS connector.
2. Measure resistance between terminal 3 of VSS harness connector and terminal E03-3(100) of ECM harness connector.
  - **Specification: below 1Ω**

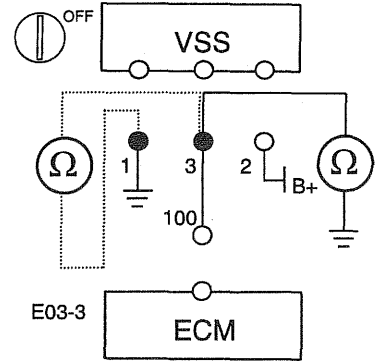


Is(Are) resistance(s) within specification?

<b>Yes</b>	No	Repair open circuit in harness.
------------	----	---------------------------------

**4. CHECK FOR SHORT TO GROUND IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and VSS connector.
2. Measure resistance between terminal 3 of VSS harness connector and chassis ground.
3. Measure resistance between terminal 3 and 1 of VSS harness connector.
  - **Specification: below 1Ω**



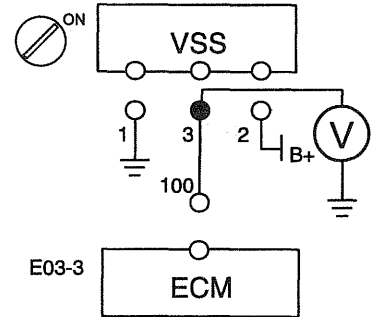
Is(Are) resistance(s) within specification?

Yes

No	Repair short or short to chassis ground in harness.
----	---

**5. CHECK FOR SHORT TO POWER IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and VSS connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 3 of VSS harness connector and chassis ground.
  - **Specification: below 0.5V**



Is(Are) voltage(s) within specification?

Yes

No	Repair short to power in harness.
----	-----------------------------------

**6. CHECK VSS**

1. Replace the VSS with a new one, and then monitor the vehicle again using a Hi-Scan (Pro).

Is this problem fixed?

Yes

No	Replace the VSS.
----	------------------

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

DTC DETECTING CONDITION ECD3F5BE

DTC	P1543	Brake Switch Signal Fault
CC-CODE	03	Short to battery line in brake switch 1 circuit
	02	Short to ground in brake switch 1 circuit
	0a	Short to battery line in brake switch 2 circuit
	0b	Short to ground in brake switch 2 circuit
	0c	Barke 1/2 signal incoherent

DESCRIPTION

Brake has an energy-absorbing mechanism that converts vehicle movement into heat to stop rotating wheels. Braking system is designed to reduce the speed and stop moving vehicle. The driver exerts a force on a brake pedal and

the force on the brake pedal pressurizes brake fluid in a master cylinder. This hydraulic force is transferred through steel lines to a wheel cylinder at each wheel. Hydraulic pressure to each wheel cylinder is used to force friction materials against the brake drum. The ECM senses the state of brake operating through brake switch.

DTC DETECTING CONDITION

CC-CODE	Detecting Condition	Suspect Area
02	• Short to battery line in brake switch 1 circuit	<ul style="list-style-type: none"> <li>• Open or short in Brake Switch circuit</li> <li>• Brake Switch</li> <li>• Brake Pedal</li> <li>• ECM</li> </ul>
03	• Short to ground in brake switch 1 circuit	
0a	• Short to battery line in brake switch 2 circuit	
0b	• Short to ground in brake switch 2 circuit	
0c	• Incoherent brake switch 1/2 signal	

[SCHEMATIC DIAGRAM ]

[CIRCUIT DIAGRAM]

[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM E03-1 (16)	Brake Switch 1
	STOP Light	-
2	Battery	Battery Voltage
3	ECM E03-3 (86)	Brake Switch 2
4	Chassis Ground	Ground

[HARNESS CONNECTORS]

2	1
4	3

M11  
BRAKE SWITCH

1	5	9	13	17	21	25	29
2	6	10	14	18	22	26	30
3	7	11	15	19	23	27	31
4	8	12	20	24	28	32	

E03-1

81	85	89	93	97	101	105	109
82	90	94	98	102	106	110	
83	87	91	95	99	103	107	111
84	88	92	96	100	104	108	112

E03-3

ECM

INSPECTION PROCEDURE

**1. CHECK BRAKE SWITCH AND ECM CONNECTORS**

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
  - Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

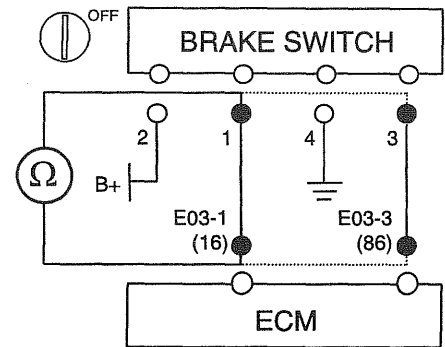
Are all connectors good?

Yes

No	Repair or replace it.
----	-----------------------

**2. CHECK FOR OPEN IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and brake switch connector.
2. Measure resistance between terminal 1 of brake switch harness connector and terminal E03-1(16) of ECM harness connector.
3. Measure resistance between terminal 3 of brake switch harness connector and terminal E03-3(86) of ECM harness connector.
  - **Specification: below 1Ω**



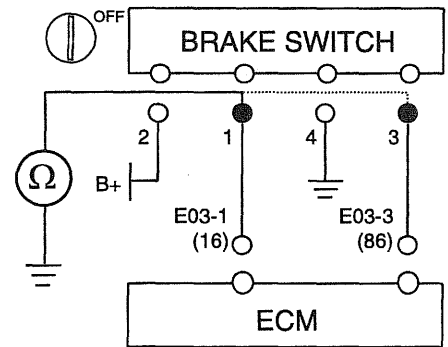
Is(Are) resistance(s) within specification?

Yes

No	Repair open circuit in harness.
----	---------------------------------

**3. CHECK FOR SHORT TO GROUND IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and brake switch connector.
2. Measure resistance between terminal 1 of brake switch harness connector and chassis ground.
3. Measure resistance between terminal 3 of brake switch harness connector and chassis ground.
  - **Specification: infinite**



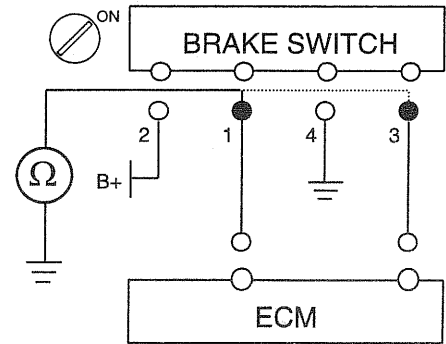
Is(Are) resistance(s) within specification?

Yes

No	Repair short or short to chassis ground in harness.
----	---

**4. CHECK FOR SHORT TO POWER IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and brake switch connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 1 of brake switch harness connector and chassis ground.
4. Measure voltage between terminal 3 of brake switch harness connector and chassis ground.
  - **Specification: below 0.5V**



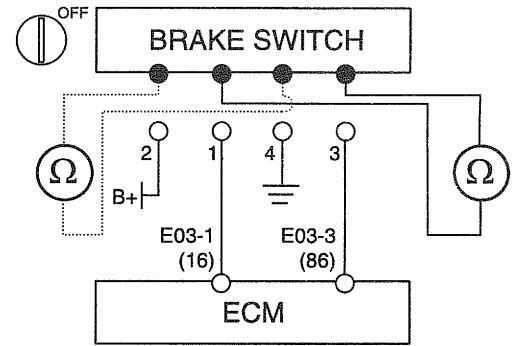
Is(Are) voltage(s) within specification?

Yes

No	Repair short to power in harness.
----	-----------------------------------

**5. CHECK BRAKE SWITCH**

1. Turn ignition switch OFF and check resistance of brake switch.
  - **In case the brake pedal is released**
    - Between the terminals 1 and 2 of brake S/W connector : infinite
    - Between the terminals 3 and 4 of brake S/W connector : below 1Ω
  - **In case the brake pedal is depressed**
    - Between the terminals 1 and 2 of brake S/W connector : below 1Ω
    - Between the terminals 3 and 4 of brake S/W connector : infinite



Is resistance within specification?

Yes

No	Replace the brake switch.
----	---------------------------

**6. CHECK BRAKE PEDAL**

1. Inspect operation condition and free-play of brake pedal.
  - **Refer to the group "BR" in this Shop Manual.**

Does the brake pedal have normal condition?

Yes

No	Replace the brake pedal.
----	--------------------------

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

TROUBLESHOOTING FOR DTC E59F60B6

DTC	P1608	ECM Fault
CC-CODE	81	ECM internal fault
	82	ECM internal fault
	82	ECM internal fault
	82	ECM internal fault

DTC DETECTING CONDITION

CC-CODE	Detecting Condition	Suspect Area
81	<ul style="list-style-type: none"> <li>Digital/Analog converter fault</li> </ul>	<ul style="list-style-type: none"> <li>ECM</li> </ul>
82		

INSPECTION PROCEDURE

<ul style="list-style-type: none"> <li>Relace the ECM</li> </ul>
--

TROUBLESHOOTING FOR DTC E5EF0BC6

DTC	P1610	Sensor External Voltage Fault
CC-CODE	08	Sensor supply voltage too low
	09	Sensor supply voltage too high

DTC DETECTING CONDITION

CC-CODE	Detecting Condition	Suspect Area
08	• Sensor reference voltage < 4.8V	• Short to battery line or ground in MAFS/APS1/RPS/CMPS supply line
09	• Sensor reference voltage > 5.2V	

[SCHEMATIC DIAGRAM] <1> MASS AIR FLOW SENSOR (MAFS)

[CIRCUIT DIAGRAM]

[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM E03-2 (78)	MAFS Signal
2	ECM E03-2 (77)	Reference Voltage
3	ECM E03-2 (79)	Sensor Ground
4	Main Relay	Battery Voltage
5	ECM E03-2 (42)	IATS Signal

[HARNESS CONNECTORS]

**E17**  
MAFS & IATS

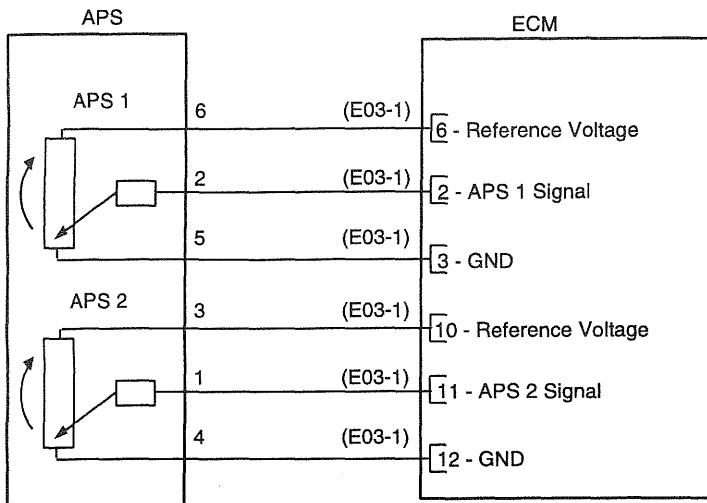
33	37	41	45	49	53	57	61	65	69	73	●
34	38	●	46	50	54	58	62	66	70	74	●
35	39	43	47	51	55	59	63	67	71	75	●
36	40	44	48	52	56	60	64	68	72	76	80

**E03-2**  
ECM



[SCHEMATIC DIAGRAM] <2> ACCELERATOR POSITION SENSOR (APS) 1

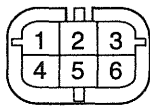
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM E03-1 (11)	APS 2 Signal
2	ECM E03-1 (2)	APS 1 Signal
3	ECM E03-1 (10)	Reference Voltage
4	ECM E03-1 (12)	Sensor Ground
5	ECM E03-1 (3)	Sensor Ground
6	ECM E03-1 (6)	Reference Voltage

[HARNESS CONNECTORS]



**M07**

**ECTS**

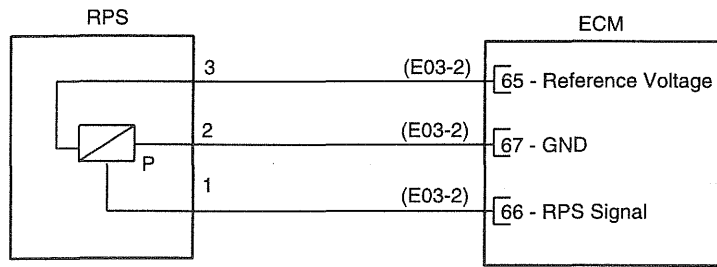
1	5	9	13	17	21	25	29
●	●	●	14	18	22	26	30
●	7	●	15	19	23	27	31
4	8	●	16	20	24	28	32

**E03-1**

**ECM**

[SCHEMATIC DIAGRAM] <3> RAIL PRESSURE SENSOR (RPS)

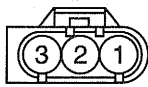
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM E03-2 (66)	RPS Signal
2	ECM E03-2 (67)	Sensor Ground
3	ECM E03-2 (65)	Reference Voltage

[HARNESS CONNECTORS]



E88  
RPS

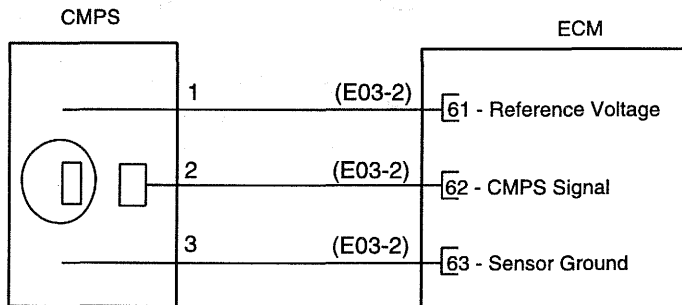
33	37	41	45	49	53	57	61	65	69	73	77
34	38	42	46	50	54	58	62	66	70	74	78
35	39	43	47	51	55	59	63	67	71	75	79
36	40	44	48	52	56	60	64	68	72	76	80

E03-2  
ECM

EWMF200S

[SCHEMATIC DIAGRAM] <4> CAMSHAFT POSITION SENSOR (CMPS)

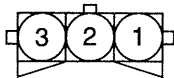
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	ECM E03-2 (61)	Reference Voltage
2	ECM E03-2 (62)	CMPS Signal
3	ECM E03-2 (63)	Sensor Ground

[HARNESS CONNECTORS]



E90  
CMPS

33	37	41	45	49	53	57	61	65	69	73	77
34	38	42	46	50	54	58	62	66	70	74	78
35	39	43	47	51	55	59	63	67	71	75	79
36	40	44	48	52	56	60	64	68	72	76	80

E03-2  
ECM

EWMF201D

INSPECTION PROCEDURE

**1. CHECK DTC**

1. Connect the Hi-Scan (Pro) to the Data Link Connector (DLC).
2. Turn ignition switch to ON and check that any other DTC(s) is (are) detected.

Is(Are) any DTC(s) related to MAFS, APS 1, RPS or CMPS also set?

**NO**

YES	Do all repairs associated with those codes before proceeding with this procedure.
-----	---

**2. CHECK MAFS, APS 1, RPS, CMPS AND ECM CONNECTORS**

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
  - Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

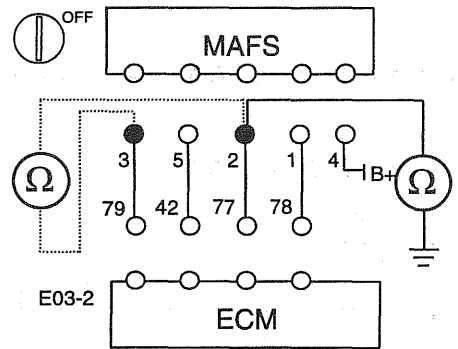
Are all connectors good?

**Yes**

No	Repair or replace it.
----	-----------------------

**3-1. CHECK FOR SHORT TO GROUND IN HARNESS (MAFS)**

1. Turn ignition switch to OFF, and then disconnect ECM and MAFS connector.
2. Measure resistance between terminal 2 of MAFS harness connector and chassis ground.
3. Measure resistance between terminal 2 and 3 of MAFS harness connector.
  - **Specification: infinite**



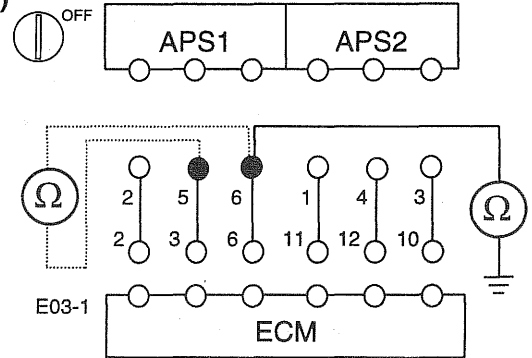
Is(Are) resistance(s) within specification?

**Yes**

No	Repair short or short to chassis ground in harness.
----	---

**3-2. CHECK FOR SHORT TO GROUND IN HARNESS (APS 1)**

1. Turn ignition switch to OFF, and then disconnect ECM and APS connector.
2. Measure resistance between terminal 6 of APS harness connector and chassis ground.
3. Measure resistance between terminal 6 and 5 of APS harness connector.
  - **Specification: infinite**



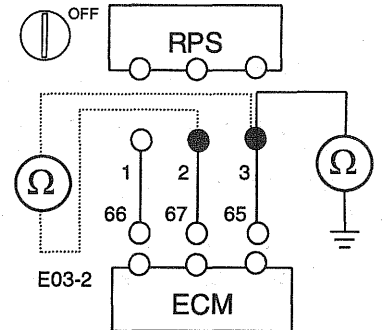
Is(Are) resistance(s) within specification?

Yes

No Repair short or short to chassis ground in harness.

**3-3. CHECK FOR SHORT TO GROUND IN HARNESS (RPS)**

1. Turn ignition switch to OFF, and then disconnect ECM and RPS connector.
2. Measure resistance between terminal 3 of RPS harness connector and chassis ground.
3. Measure resistance between terminal 3 and 2 of RPS harness connector.
  - **Specification: infinite**



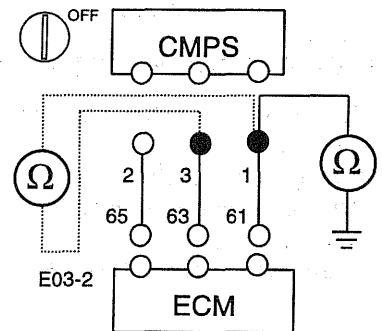
Is(Are) resistance(s) within specification?

Yes

No Repair short or short to chassis ground in harness.

**3-4. CHECK FOR SHORT TO GROUND IN HARNESS (CMPS)**

1. Turn ignition switch to OFF, and then disconnect ECM and CMPS connector.
2. Measure resistance between terminal 1 of CMPS harness connector and chassis ground.
3. Measure resistance between terminal 1 and 3 of CMPS harness connector.
  - **Specification: infinite**



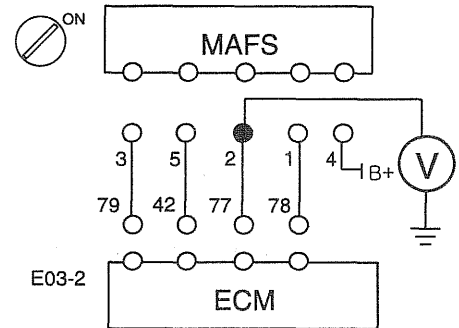
Is(Are) resistance(s) within specification?

Yes

No Repair short or short to chassis ground in harness.

**4-1. CHECK FOR SHORT TO POWER IN HARNESS (MAFS)**

1. Turn ignition switch to OFF, and then disconnect ECM and MAFS connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 2 of MAFS harness connector and chassis ground.
  - **Specification: below 0.5V**



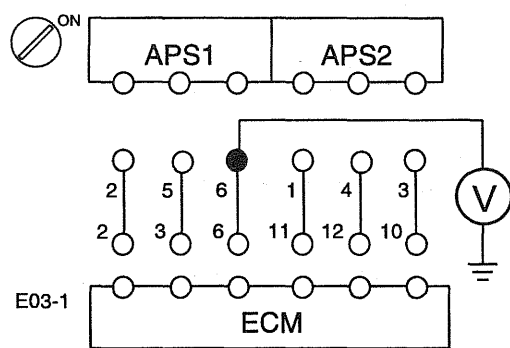
Is(Are) voltage(s) within specification?

Yes

No Repair short to power in harness.

**4-2. CHECK FOR SHORT TO POWER IN HARNESS (APS 1)**

1. Turn ignition switch to OFF, and then disconnect ECM and APS connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 6 of APS harness connector and chassis ground.
  - **Specification: below 0.5V**



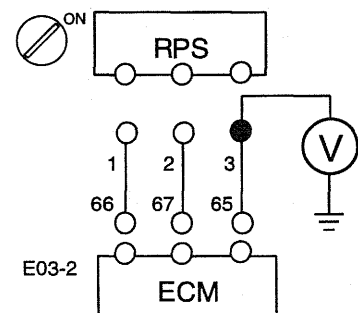
Is(Are) voltage(s) within specification?

Yes

No Repair short to power in harness.

**4-3. CHECK FOR SHORT TO POWER IN HARNESS (RPS)**

1. Turn ignition switch to OFF, and then disconnect ECM and RPS connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 3 of RPS harness connector and chassis ground.
  - **Specification: below 0.5V**



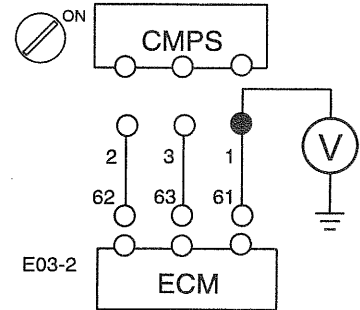
Is(Are) voltage(s) within specification?

Yes

No	Repair open circuit in harness.
----	---------------------------------

**4-4. CHECK FOR SHORT TO POWER IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and CMPS connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 1 of CMPS harness connector and chassis ground.
  - **Specification: below 0.5V**



Is(Are) voltage(s) within specification?"

Yes

No	Repair short to power in harness.
----	-----------------------------------

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

**TROUBLESHOOTING FOR DTC** EF5AE540

DTC	P1614	ECM Programming Error
CC-CODE	85	ECM internal fault
	83	ECM internal fault
	8b	ECM internal fault
	88	ECM internal fault
	87	ECM internal fault
	8a	ECM internal fault
	8c	ECM internal fault
	8a	ECM internal fault

**DTC DETECTING CONDITION**

CC-CODE	Detecting Condition	Suspect Area
85	<ul style="list-style-type: none"> <li>• Impossibility of reading on the EEPROM</li> </ul>	<ul style="list-style-type: none"> <li>• Injector control line</li> <li>• ECM</li> </ul>
83	<ul style="list-style-type: none"> <li>• Impossibility of writing on the EEPROM</li> </ul>	
8b	<ul style="list-style-type: none"> <li>• Electrical interference on the injector control line</li> </ul>	
88	<ul style="list-style-type: none"> <li>• Fault in the calibration file or in the software.</li> </ul>	
87	<ul style="list-style-type: none"> <li>• One or more cells are found to be defective during the testing of the cells of the entire RAM used by the ECM</li> <li>• Incorrect injector specific data</li> </ul>	
8a	<ul style="list-style-type: none"> <li>• Watchdog operation fault</li> </ul>	
8c		
8a		

INSPECTION PROCEDURE

[CASE 1] CC-CODE 8a, 8c, 83, 85, 87, 88

- Relace the ECM

EWMF213D

[CASE 2] CC-CODE 8b

**1. VERIFICATION OF INJECTOR SPECIFIC DATA**

1. Connect the Hi-Scan (Pro) to the Data Link Connector (DLC).
2. Compare the injector specific data memorized in ECM memory with the one written on injector.

Are the two data same?

NO

YES	Input the injector specific data using Hi-Scan (Pro).
-----	---

**2. CHECK INJECTOR CONTROL LINE**

1. Inspect the wiring harness between the injector and ECM.

Does this wiring harness have normal condition?"

Yes

No	Repair or replace the wiring harness.
----	---------------------------------------

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

EWMF203I



**TROUBLESHOOTING FOR DTC** E6981CE4

<b>DTC</b>	<b>P1620</b>	<b>A/C Relay Circuit Malfunction</b>
<b>CC-CODE</b>	0a	Open circuit or short circuit to ground
	03	Short circuit to battery line

**DTC DETECTING CONDITION**

<b>CC-CODE</b>	<b>Detecting Condition</b>	<b>Suspect Area</b>
0a	<ul style="list-style-type: none"> <li>Open or short to ground in A/C relay circuit</li> </ul>	<ul style="list-style-type: none"> <li>Open or short in A/C Relay circuit</li> <li>A/C Relay</li> <li>ECM</li> </ul>
03	<ul style="list-style-type: none"> <li>Short to battery line in A/C relay circuit</li> </ul>	

**[SCHEMATIC DIAGRAM]**

**[CIRCUIT DIAGRAM]**

**[CONNECTION INFORMATION]**

Terminal	Connected to	Function
1	Battery	Battery Voltage
2	Compressor	Compressor Power Supply
3	ECM E03-3 (105)	A/C Relay Control
4	-	-
5	Main Relay	Battery Voltage

**[HARNESS CONNECTORS]**

1
2
5 * 3

**E121**

**A/C RELAY**

81	85	89	93	97	101	109
82	86	90	94	98	102	106 110
						107 111
83	87	91	95	99	103	
84	88	92	96	100	104	108 112

**E03-3**

**ECM**

INSPECTION PROCEDURE

**1. CHECK A/C RELAY AND ECM CONNECTORS**

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
  - Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

Are all connectors good?

<b>NO</b>	YES	Repair or replace it.
-----------	-----	-----------------------

**2. CHECK A/C RELAY**

1. Turn ignition switch to OFF and remove the A/C relay.
2. Apply power to the terminal 5 and ground terminal 3 of A/C relay.
3. Check if A/C relay works well.
 

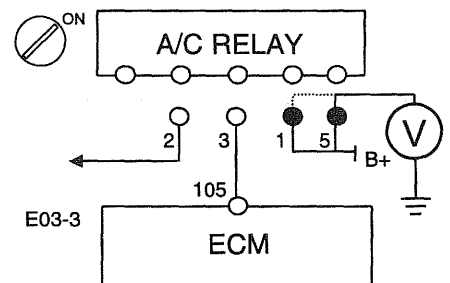
(If A/C relay works normally, a "click" sound can be heard).

Does the A/C relay operate normally?

<b>Yes</b>	No	Replace the glow plug relay
------------	----	-----------------------------

**3. CHECK POWER TO A/C RELAY**

1. Turn ignition switch to OFF and disconnect A/C relay connector.
2. Turn ignition switch to ON
3. Measure voltage in harness between terminal 1 of A/C relay harness connector and chassis ground.
4. Measure voltage in harness between terminal 5 of A/C relay harness connector and chassis ground.
  - **Specification: approximately B+**

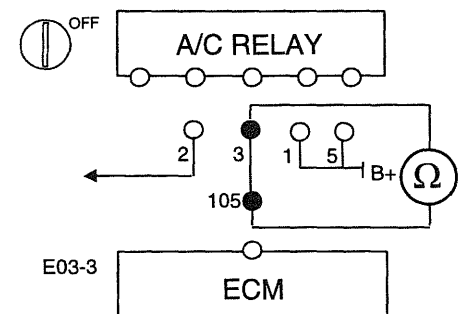


Is(Are) voltage(s) within specification?

<b>Yes</b>	No	Repair open or short circuit in harness.
------------	----	--

**4. CHECK FOR OPEN IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and A/C relay connector.
2. Measure resistance between terminal 3 of A/C relay harness connector and terminal E03-3(105) of ECM harness connector.
  - **Specification: below 1Ω**



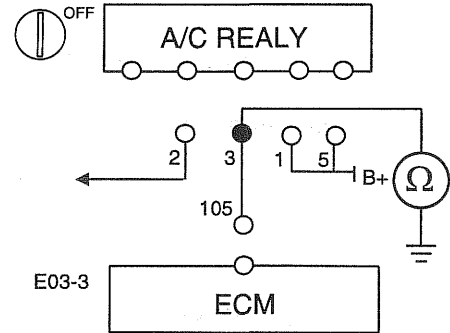
Is(Are) resistance(s) within specification?

Yes

No Repair open circuit in harness.

**5. CHECK FOR SHORT TO GROUND IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and A/C relay connector.
2. Measure resistance between terminal 3 of A/C relay harness connector and chassis ground.
  - **Specification: infinite**



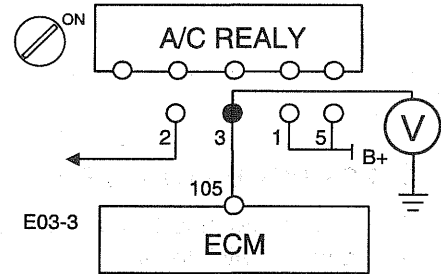
Is(Are) resistance(s) within specification?

Yes

No Repair short or short to chassis ground in harness.

**6. CHECK FOR SHORT TO POWER IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and A/C relay connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 3 of A/C relay harness connector and chassis ground.
  - **Specification: below 0.5V**



Is(Are) voltage(s) within specification?

Yes

No Repair short to power in harness.

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

TRUBLESHOOTING FOR DTC EEC4BFF4

DTC	P1640	Main Relay Circuit Malfunction
CC-CODE	0a	Open circuit or short circuit to ground
	0b	Short circuit to battery line

DESCRIPTION

The charging system includes a battery, generator with a built in regulator, the charging indicator light, and connecting wiring. The generator uses diodes to rectify alternating current (AC) to direct current (DC). The ECM provides ground to one side of coil of main relay and the other side

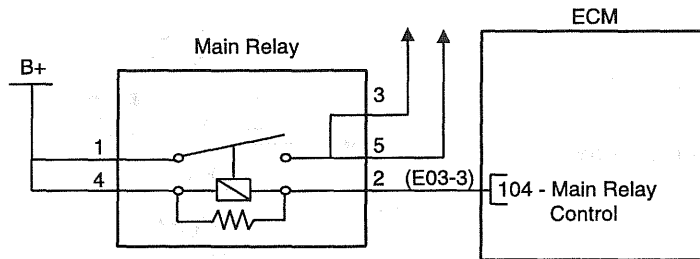
is connected to battery. The ECM monitors battery voltage and the voltage after main relay.

DTC DETECTING CONDITION

CC-CODE	Detecting Condition	Suspect Area
0a	• Open or short to ground in main relay circuit	<ul style="list-style-type: none"> <li>• Open or short in Main Relay circuit</li> <li>• Main Relay</li> <li>• ECM</li> </ul>
0b	• Short to battery line in main relay circuit	

[SCHEMATIC DIAGRAM]

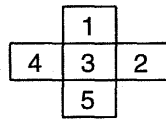
[CIRCUIT DIAGRAM]



[CONNECTION INFORMATION]

Terminal	Connected to	Function
1	Battery	Battery Voltage
2	ECM E03-3 (104)	Main Relay Control
3	-	-
4	Battery	Battery Voltage
5	-	-

[HARNESS CONNECTORS]



E113

MAIN RELAY

81	85	89	93	97	101	105	109
82	86	90	94	98	102	106	110
						107	111
83	87	91	95	99	103		
84	88	92	96	100	104	108	112

E03-3

ECM

INSPECTION PROCEDURE

**1. CHECK MAIN RELAY AND ECM CONNECTORS**

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
  - Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

Are all connectors good?

<b>YES</b>	NO	Repair or replace it.
------------	----	-----------------------

**2. CHECK MAIN RELAY**

1. Turn ignition switch to OFF and remove the main relay.
2. Apply power to the terminal 4 and ground terminal 2 of main relay.
3. Check if main relay works well.
  - (If main relay works normally, a "click" sound can be heard).
  - Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

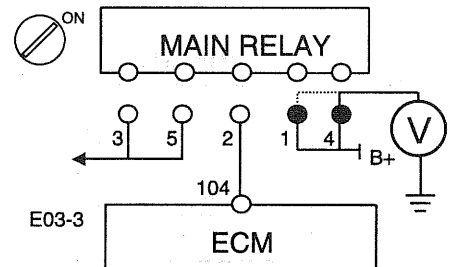
Does the main relay operate normally?

<b>Yes</b>	No	Replace the glow plug relay
------------	----	-----------------------------

**3. CHECK POWER TO MAIN RELAY**

1. Turn ignition switch to OFF and disconnect main relay connector.
2. Turn ignition switch to ON.
3. Measure voltage in harness between terminal 4 of main relay harness connector and chassis ground.
4. Measure voltage in harness between terminal 1 of main relay harness connector and chassis ground.
  - **Specification: approximately B+**

Is(Are) voltage(s) within specification?

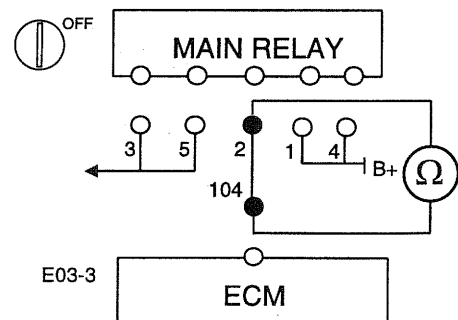


<b>Yes</b>	No	Replace the glow plug relay
------------	----	-----------------------------

**4. CHECK FOR OPEN IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and main relay connector.
2. Measure resistance between terminal 2 of main relay harness connector and terminal E03-3(104) of ECM harness connector.
  - **Specification: below 1Ω**

Is(Are) resistance(s) within specification?

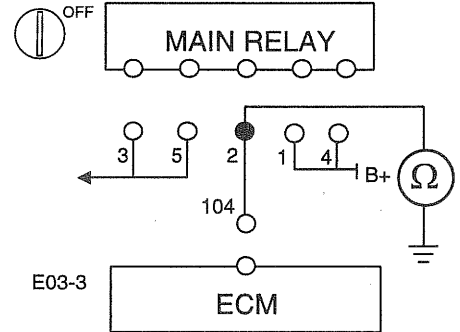


Yes

No Repair open or short circuit in harness.

**5. CHECK FOR SHORT TO GROUND IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and main relay connector.
2. Measure resistance between terminal 2 of main relay harness connector and chassis ground.
  - **Specification: infinite**



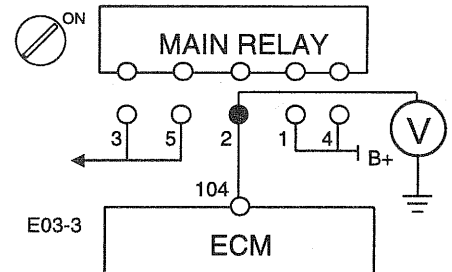
Is(Are) resistance(s) within specification?

Yes

No Repair open circuit in harness.

**6. CHECK FOR SHORT TO POWER IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and main relay connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 1 of main relay harness connector and chassis ground.
  - **Specification: below 0.5V**



Is(Are) voltage(s) within specification?

Yes

No Repair short to power in harness.

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

TROUBLESHOOTING FOR DTC E0FE59FA

DTC	P1674	A/C Fan Relay Circuit Malfunction
CC-CODE	0a	Open circuit or short circuit to ground
	03	Short circuit to battery line

DTC DETECTING CONDITION

CC-CODE	Detecting Condition	Suspect Area
0a	<ul style="list-style-type: none"> <li>Open or short to ground in A/C fan relay circuit</li> </ul>	<ul style="list-style-type: none"> <li>Open or short in A/C Fan Relay circuit</li> <li>A/C Fan Relay</li> <li>ECM</li> </ul>
03	<ul style="list-style-type: none"> <li>Short to battery line in A/C fan relay circuit</li> </ul>	

[SCHEMATIC DIAGRAM]

**[CIRCUIT DIAGRAM]**

The circuit diagram shows two A/C fan relays. A/C Fan Relay #2 is controlled by the A/C Control Module (Auto A/C) and a Thermostatic Switch (Manual A/C). Its terminals are: 1 (B+), 2 (Chassis Ground), 4 (Control), and 5 (Radiator Fan Motor). A/C Fan Relay #1 is controlled by the ECM (E03-3) at terminal 84. Its terminals are: 1 (B+), 4 (Main Relay), 2 (ECM E03-3), and 5 (Condenser Fan Motor). Both relays have a coil and a contact. The Main Relay is also shown connected to the B+ line.

**[CONNECTION INFORMATION]**

Terminal	Connected to	Function
1	Battery	Battery Voltage
2	Chassis Ground	Ground
3	-	-
4	(Auto A/C) A/C Control Module (Manual A/C) Thermostatic Switch	A/C Fan Relay #2 Control
5	Radiator Fan Motor	Motor Power Supply

Terminal	Connected to	Function
1	Battery	Battery Voltage
2	ECM E03-3 (84)	A/C Fan Relay #1 Control
3	-	-
4	Main Relay	Battery Voltage
5	Condenser Fan Motor	Motor Power Supply

**[HARNES CONNECTORS]**

**E110**  
A/C FAN RELAY #1

**E111**  
A/C FAN RELAY #2

81	85	89	93	97	101	105	109
82	86	90	94	98	102	106	110
						107	111
83	87	91	95	99	103		
● 88	92	96	100	104	108	112	

**E03-3**  
ECM

INSPECTION PROCEDURE

**1. CHECK A/C FAN RELAY #1 AND ECM CONNECTORS**

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
  - Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

Are all connectors good?

<b>Yes</b>	No	Repair or replace it.
------------	----	-----------------------

**2. CHECK A/C FAN RELAY #1**

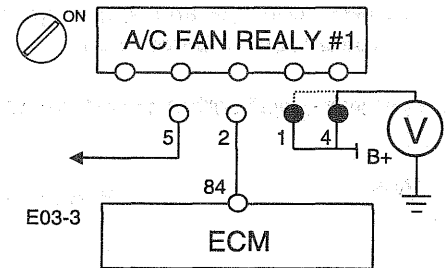
1. Turn ignition switch to OFF and remove the A/C fan relay #1.
2. Apply power to the terminal 3 and ground terminal 5 of A/C fan relay #1.
3. Check if A/C fan relay #1 works well.
  - (If A/C fan relay #1 works normally, a "click" sound can be heard).

Does the A/C fan relay #1 operate normally?

<b>Yes</b>	No	Replace the glow plug relay
------------	----	-----------------------------

**3. CHECK POWER TO A/C FAN RELAY #1**

1. Turn ignition switch to OFF and disconnect A/C fan relay #1 connector.
2. Turn ignition switch to ON.
3. Measure voltage in harness between terminal 1 of A/C fan relay #1 harness connector and chassis ground.
4. Measure voltage in harness between terminal 4 of A/C fan relay #1 harness connector and chassis ground.
  - **Specification: approximately B+**

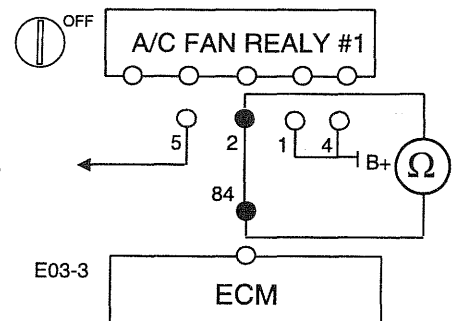


Is(Are) voltage(s) within specification?

<b>Yes</b>	No	Repair open or short circuit in harness.
------------	----	--

**4. CHECK FOR OPEN IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and A/C fan relay #1 connector.
2. Measure resistance between terminal 2 of A/C fan relay #1 harness connector and terminal E03-3(84) of ECM harness connector.
  - **Specification: below 1Ω**



Is(Are) resistance(s) within specification?

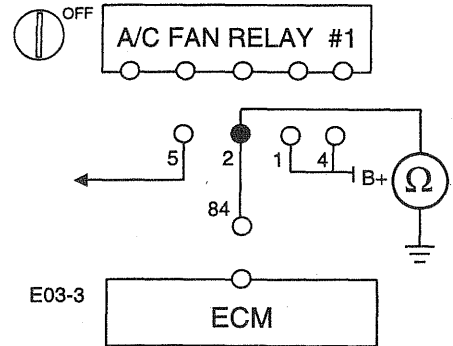


Yes

No Repair open circuit in harness.

**5. CHECK FOR SHORT TO GROUND IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and A/C fan relay #1 connector.
2. Measure resistance between terminal 2 of A/C fan relay #1 harness connector and chassis ground.
  - **Specification: infinite**



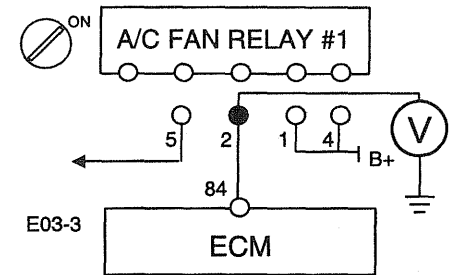
Is(Are) resistance(s) within specification?

Yes

No Repair short or short to chassis ground in harness.

**6. CHECK FOR SHORT TO POWER IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and A/C fan relay #1 connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 2 of A/C fan relay #1 harness connector and chassis ground.
  - **Specification: below 0.5V**



Is(Are) voltage(s) within specification?

Yes

No Repair short to power in harness.

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

TROUBLESHOOTING FOR DTC ED5C53BD

DTC	P1786	Tachometer Output Fault
CC-CODE	0a	Signal low (Short circuit to ground)
	03	Signal high (Short circuit to battery line)

DTC DETECTING CONDITION

CC-CODE	Detecting Condition	Suspect Area
0a	<ul style="list-style-type: none"> <li>Open or short to ground in tachometer output circuit</li> </ul>	<ul style="list-style-type: none"> <li>Open or short in Tachometer Output circuit</li> <li>ECM</li> </ul>
03	<ul style="list-style-type: none"> <li>Short to battery line in tachometer output circuit</li> </ul>	

[SCHEMATIC DIAGRAM]

[CIRCUIT DIAGRAM]

[CONNECTION INFORMATION]

Terminal	Connected to	Function
8	ECM E03-1 (26)	Engine Speed Output

[HARNESS CONNECTORS]

**I03-1**  
CLUSTER

1	5	9	13	17	21	25	29
2	6	10	14	18	22	26	30
3	7	11	15	19	23	27	31
4	8	12	16	20	24	28	32

**E03-1**  
ECM

INSPECTION PROCEDURE

**1. CHECK CLUSTER AND ECM CONNECTORS**

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
  - Refer to ""CONNECTOR INSPECTION PROCEDURE"" in BASIC INSPECTION PROCEDURE.

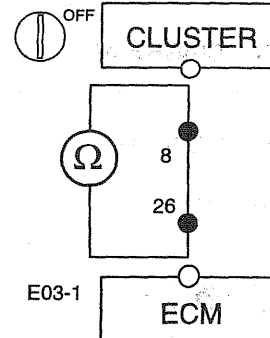
Are all connectors good?

Yes

No Repair or replace it.

**2. CHECK FOR OPEN IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and cluster connector.
2. Measure resistance between terminal I03-1(8) of cluster harness connector and terminal E03-1(26) of ECM harness connector.
  - **Specification: below 1Ω**



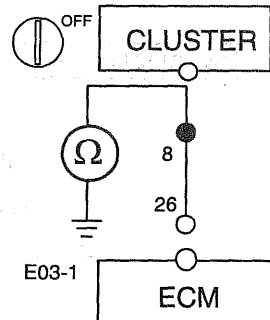
Is(Are) resistance(s) within specification?

Yes

No Repair open circuit in harness.

**3. CHECK FOR SHORT TO GROUND IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and cluster connector.
2. Measure resistance between terminal I03-1(8) of cluster harness connector and chassis ground.
  - **Specification: infinite**



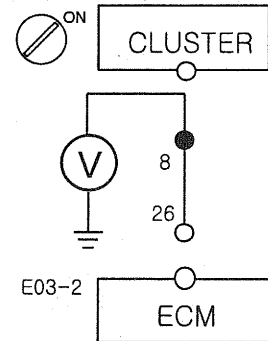
Is(Are) resistance(s) within specification?

Yes

No Repair short or short to chassis ground in harness.

**4 . CHECK FOR SHORT TO POWER IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and cluster connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal I03-1(8) of cluster harness connector and chassis ground.
  - **Specification: below 0.5V**



**Is(Are) voltage(s) within specification?**

**Yes**

No	Repair short to power in harness.
----	-----------------------------------

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

**TROUBLESHOOTING FOR DTC** E61190DB

<b>DTC</b>	<b>P2264</b>	<b>Water Sensor Circuit Malfunction</b>
CC-CODE	0b	Permanent low level

**DESCRIPTION**

Water Sensor is located in the fuel filter assembly and senses water in fuel. When water is detected, the ECM turns the Indicator Lamp in cluster on.

**DTC DETECTING CONDITION**

CC-CODE	Detecting Condition	Suspect Area
0b	<ul style="list-style-type: none"> <li>Open or short to ground in water sensor circuit</li> </ul>	<ul style="list-style-type: none"> <li>Open or short in Water Sensor circuit</li> <li>Water Sensor</li> <li>ECM</li> </ul>

**[SCHEMATIC DIAGRAM]**

**[CIRCUIT DIAGRAM]**

WATER SENSOR (IN FUEL FILTER)

IG1

ECM

15 - Water Sensor Signal

(E03-1)

**[CONNECTION INFORMATION]**

Terminal	Connected to	Function
1	IG1	Battery Voltage
2	ECM E03-1 (15)	Water Sensor Signal
3	Chassis Ground	Sensor Ground

**[HARNESS CONNECTORS]**

WATER SENSOR (IN FUEL FILTER)

1	5	9	13	17	21	25	29
2	6	10	14	18	22	26	30
3	7	11	15	19	23	27	31
4	8	12	16	20	24	28	32

**E03-1**

**ECM**

INSPECTION PROCEDURE

**1. CHECK WATER SENSOR AND ECM CONNECTORS**

1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
  - Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

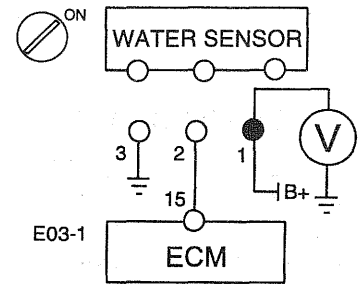
Are all connectors good?

Yes

No	Repair or replace it.
----	-----------------------

**2. CHECK POWER TO WATER SENSOR**

1. Turn ignition switch to OFF and disconnect water sensor connector.
2. Turn ignition switch to ON.
3. Measure voltage in harness between terminal 1 of water sensor harness connector and chassis ground.
  - Specification: approximately B+



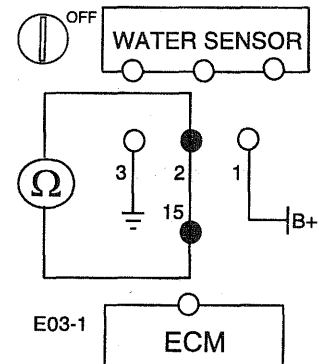
Is(Are) voltage(s) within specification?

Yes

No	Repair open or short circuit in harness.
----	--

**3. CHECK FOR OPEN IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and water sensor connector.
2. Measure resistance between terminal 2 of water sensor harness connector and terminal E03-1(15) of ECM harness connector.
  - Specification: below 1Ω



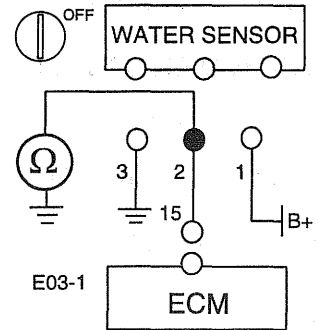
Is(Are) resistance(s) within specification?

Yes

No	Repair open circuit in harness.
----	---------------------------------

**4 . CHECK FOR SHORT TO GROUND IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and water sensor connector.
2. Measure resistance between terminal 2 of water sensor harness connector and chassis ground.
  - **Specification: infinite**

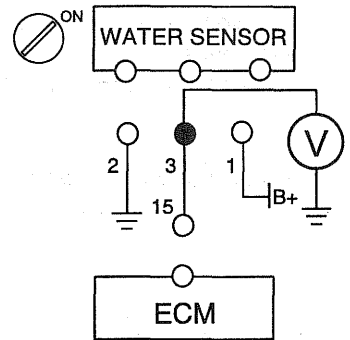


Is(Are) resistance(s) within specification?

<b>Yes</b>	No	Repair short or short to chassis ground in harness.
------------	----	---

**5 . CHECK FOR SHORT TO POWER IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and water sensor connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal 2 of water sensor harness connector and chassis ground.
  - **Specification: below 0.5V**



Is(Are) voltage(s) within specification?

<b>Yes</b>	No	Repair short to power in harness.
------------	----	-----------------------------------

**6 . CHECK WATER SENSOR**

1. Replace the water sensor with a new one, and then monitor the vehicle again using a Hi-Scan (Pro).

Is this problem fixed?

<b>Yes</b>	No	Replace the water sensor.
------------	----	---------------------------

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

**TROUBLESHOOTING FOR DTC** EEC2D86D

<b>DTC</b>	<b>P2269</b>	<b>Water in Fuel Filter Indicator Lamp Circuit Malfunction</b>
CC-CODE	0a	Signal low (Open circuit or short circuit to ground)
	03	Signal high (Short circuit to battery line)

**DESCRIPTION**

Water Sensor is located in the fuel filter assembly and senses water in fuel. When water is detected, the ECM turns the Indicator Lamp in cluster on.

**DTC DETECTING CONDITION**

CC-CODE	Detecting Condition	Suspect Area
0a	<ul style="list-style-type: none"> <li>Open or short to ground in Water Indicator Lamp circuit</li> </ul>	<ul style="list-style-type: none"> <li>Open or short in Water Indicator Lamp circuit</li> <li>Water Indicator Lamp</li> <li>ECM</li> </ul>
03	<ul style="list-style-type: none"> <li>Short to battery line in Water Indicator Lamp circuit</li> </ul>	

**[SCHEMATIC DIAGRAM]**

**[CIRCUIT DIAGRAM]**

**[CONNECTION INFORMATION]**

Terminal	Connected to	Function
A	ECM E03-2 (38)	Water Indicator Lamp Control
B	IG	Battery Voltage

**NOTE**  
Refer to "ELECTRICAL TROUBLESHOOTING MANUAL" for the terminals A and B.

**[HARNES CONNECTORS]**

33	37	41	45	49	53	57	61	65	69	73	77
34		42	46	50	54	58	62	66	70	74	78
35	39										
		43	47	51	55	59	63	67	71	75	79
36	40	44	48	52	56	60	64	68	72	76	80

**E03-2**  
**ECM**



INSPECTION PROCEDURE

**1. CHECK WATER INDICATOR LAMP (CLUSTER) AND ECM CONNECTORS**

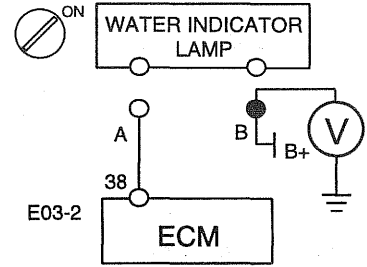
1. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
  - Refer to "CONNECTOR INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

Are all connectors good?

Yes		
No		Repair or replace it.

**2. CHECK POWER TO WATER INDICATOR LAMP (CLUSTER)**

1. Turn ignition switch to OFF and disconnect water indicator lamp(Cluster) connector.
2. Turn ignition switch to ON.
3. Measure voltage in harness between terminal B of water indicator lamp(Cluster) harness connector and chassis ground.
  - **Specification: approximately B+**

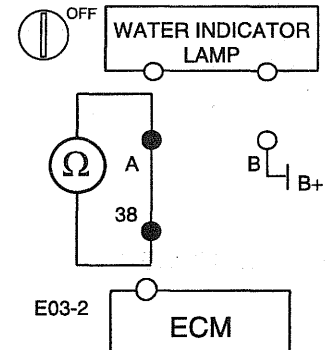


Is(Are) voltage(s) within specification?

Yes		
No		Repair open or short circuit in harness.

**3. CHECK FOR OPEN IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and water indicator lamp(Cluster) connector.
2. Measure resistance between terminal A of water indicator lamp(Cluster) harness connector and terminal E03-2(38) of ECM harness connector.
  - **Specification: below 1Ω**

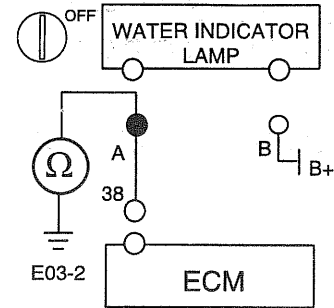


Is(Are) resistance(s) within specification?

Yes		
No		Repair open circuit in harness.

**4 . CHECK FOR SHORT TO GROUND IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and MIL(Cluster) connector.
2. Measure resistance between terminal A of MIL(Cluster) harness connector and chassis ground.
  - **Specification: infinite**



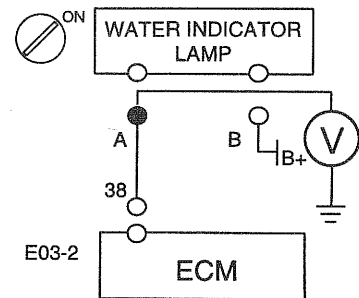
Is(Are) resistance(s) within specification?

Yes

No	Repair short or short to chassis ground in harness.
----	---

**5 . CHECK FOR SHORT TO POWER IN HARNESS**

1. Turn ignition switch to OFF, and then disconnect ECM and MIL(Cluster) connector.
2. Turn ignition switch to ON.
3. Measure voltage between terminal A of MIL(Cluster) harness connector and chassis ground.
  - **Specification: below 0.5V**



Is(Are) voltage(s) within specification?

Yes

No	Repair short to power in harness.
----	-----------------------------------

**6 . CHECK MIL(CLUSTER)**

1. Inspect the MIL installed on the cluster.

Does the MIL have normal condition?

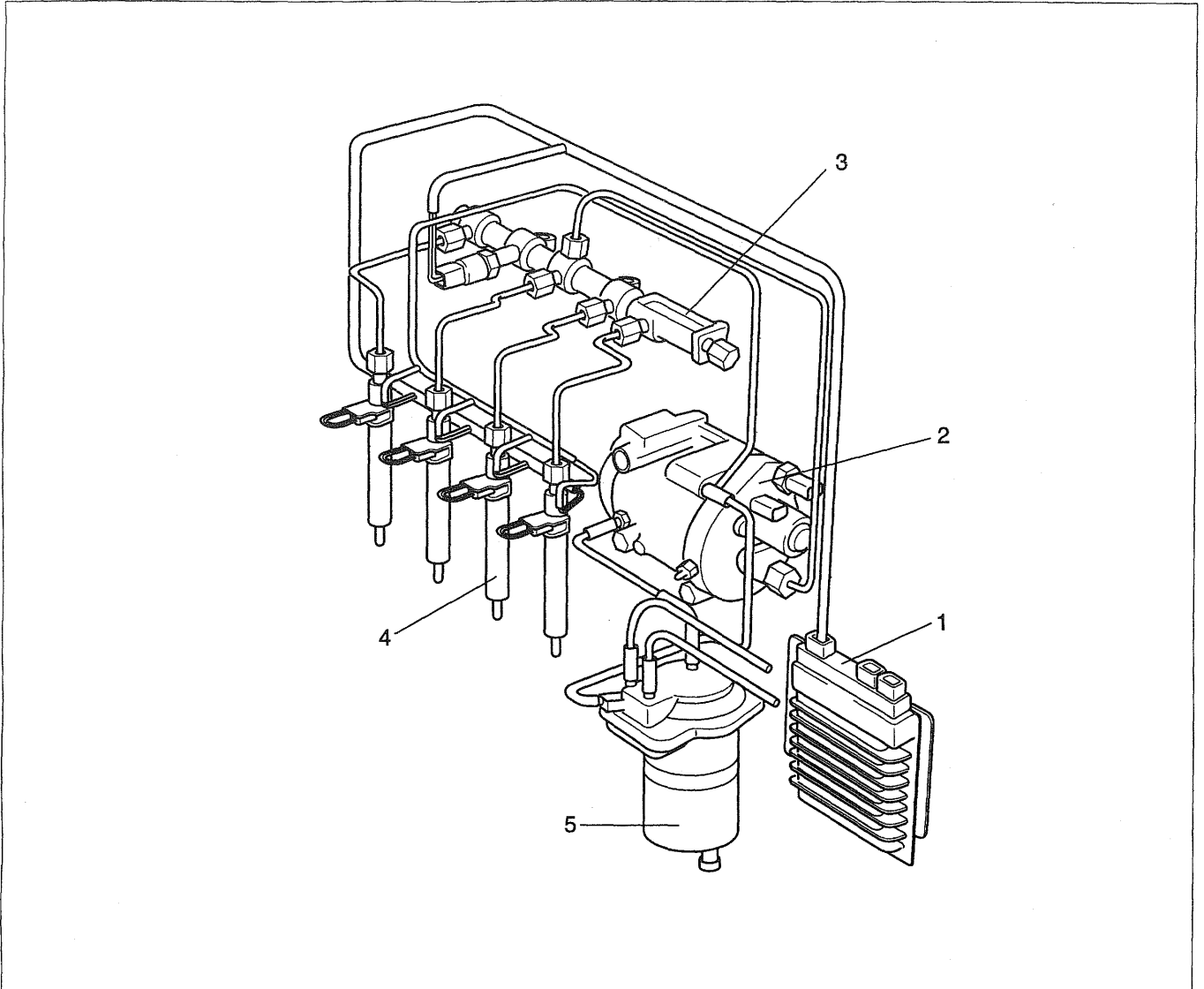
Yes

No	Replace the MIL.
----	------------------

Proceed with "ECM PROBLEM INSPECTION PROCEDURE" in BASIC INSPECTION PROCEDURE.

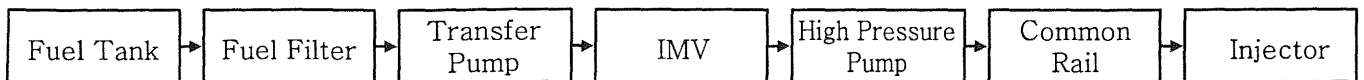
# FUEL DELIVERY SYSTEM-DIESEL

## COMMON RAIL FUEL INJECTION SYSTEM EBFF6ADE



- 1. ECM
- 2. High Pressure Pump (Transfer Pump Integrated)
- 3. Common Rail
- 4. Injector
- 5. Fuel Filter

EWMF125A



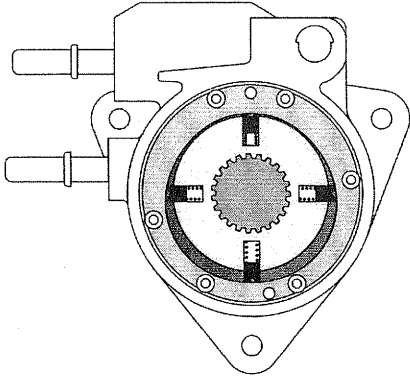
EWMF101H

**⊗ WARNING**

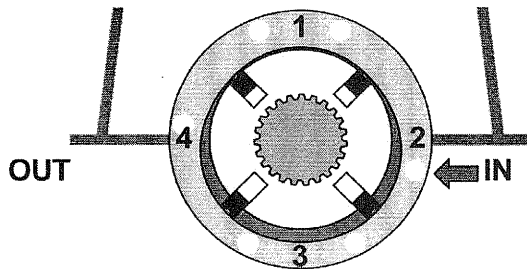
- Common Rail Fuel Injection System is subject to extremely high pressure (Approximately 1,600 bar)
- Never perform any work on injection system with engine running or within 30 seconds after the engine stops.
- Always pay attention to safety precaution.
- Ensure the absolute cleanliness.
- It is not recommended to remove the injectors without any notice.

**LOW PRESSURE LINE****1. FUEL TANK****2. TRANSFER PUMP**

The transfer pump is included in the housing of the HP pump. The transfer pump is of the volumetric blade type pump. The pump draws the fuel from the fuel tank and continually delivers the required quantity of fuel in the direction of the high-pressure pump.



AFBE145A



AFBE145B

**3. FUEL FILTER**

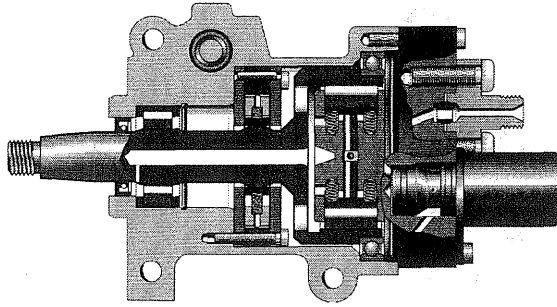
Inadequate filtering can lead to damage at the pump components, delivery valves, and injector nozzles. The fuel filter cleans the fuel before it reaches the lift pump, and thereby prevents premature wear at the pump's sensitive components.

**4. HAND PRIME PUMP**

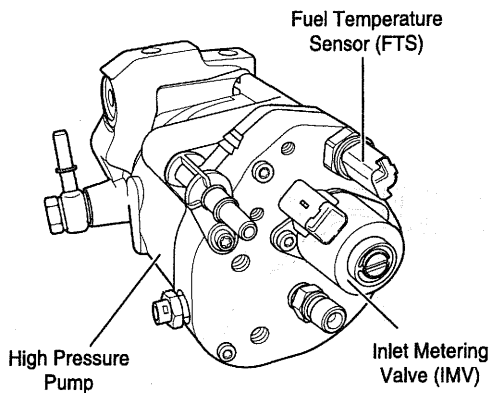
**HIGH PRESSURE CIRCUIT**

**1. HIGH PRESSURE PUMP**

The high pressure pump pressurises the fuel to a system pressure of up to 1,600bar. This pressurized fuel then passes through a high-pressure line and into the tubular high-pressure common rail.



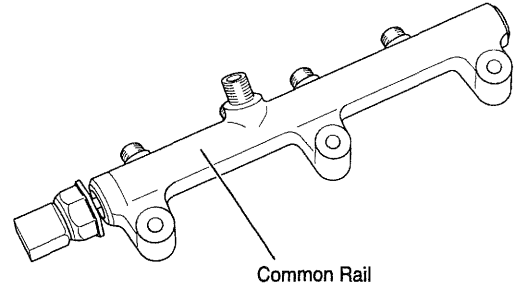
AFBE145F



EWMF101K

**2. COMMON RAIL**

Even after an injector has taken fuel from the rail in order to inject it, the fuel pressure inside the common rail remains practically constant. This is due to the common rail effect arising from the fuel's inherent elasticity. Fuel pressure is measured by the rail pressure sensor and maintained at the desired level by the pressure control valve. It is the job of the inlet metering valve to limit the fuel pressure in the common rail to maximum 160 MPa (23,206 psi) The highly pressurized fuel is directed from the rail to the injectors by a flow limiter, which prevents excess fuel reaching the combustion chamber.



EWMF101L

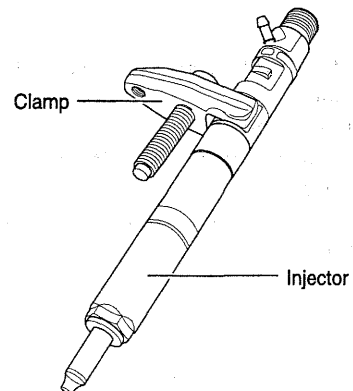
**3. HIGH PRESSURE PIPE**

These fuel lines carry the high-pressure fuel. They must therefore be able to permanently withstand the maximum system pressure and, during the pauses in injection, the sometimes high frequency pressure fluctuations which occur. They are therefore manufactured from steel tubing. Normally, they have an outside diameter of 6 mm and an internal diameter of 2.4 mm.

The injection lines between the common rail and the injectors must all be of the same length. The differences in length between the common rail and the individual injectors are compensated for by using slight or pronounced bends in the individual lengths of tubing. Nevertheless, the injection lines should be kept as short as possible.

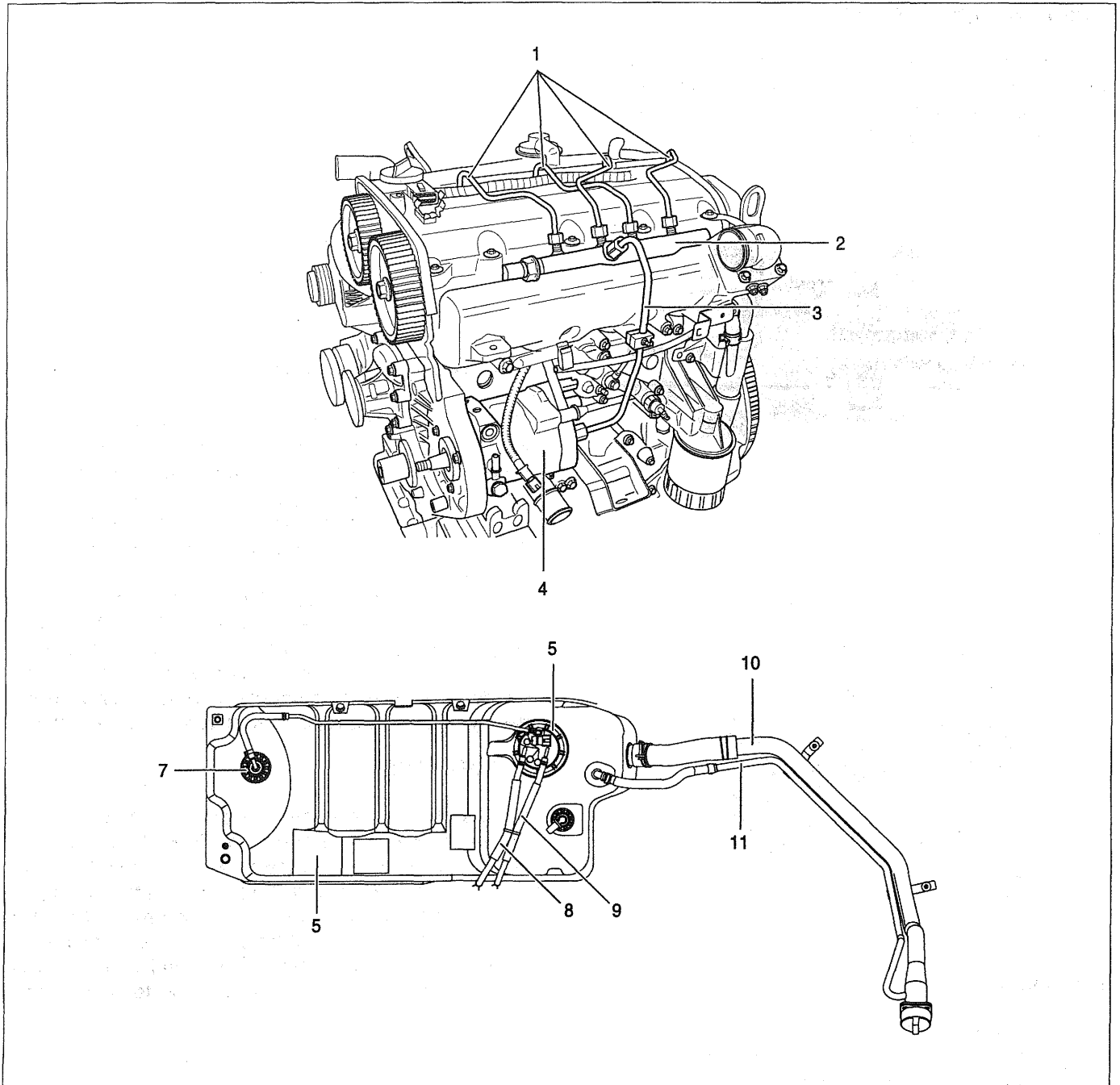
**4. INJECTORS**

The nozzles of these injectors open when the solenoid valve is triggered and permit the flow of fuel. They inject the fuel directly into the engine's combustion chamber. The excess fuel which was needed for opening the injector nozzles flowsback to the tank through a collector line. The return fuel from the pressure control valve and from the low-pressure stage is also led into this collector line together with the fuel used to lubricate the high-pressure pump.



EWMF101M

COMPONENTS ECCC9D93



- 1. High Pressure Pipe (Common Rail ↔ Injector)
- 2. Common Rail
- 3. High Pressure Pipe  
(High Pressure Pump ↔ Common Rail)
- 4. High Pressure Pump  
(FTS, IMV and Transfer Pump integrated)
- 5. Fuel Sender

- 6. Fuel Tank
- 7. Fuel Sender (Sub)
- 8. Return Hose
- 9. Fuel Feed Hose
- 10. Fuel Filler Hose
- 11. Breather Hose

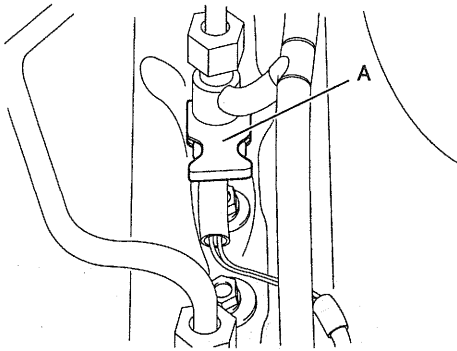
INJECTOR

REMOVAL E0A9B2A1

**⊗ WARNING**

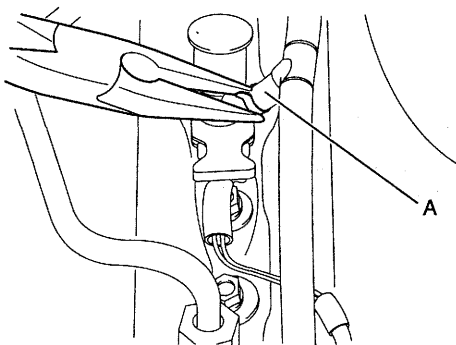
- Common Rail Fuel Injection System is subject to extremely high pressure (Approximately 1,600 bar)
- Never perform any work on injection system with engine running or within 30 seconds after the engine stops.
- Always pay attention to safety precaution.
- Ensure the absolute cleanliness.
- It is not recommended to remove the injectors without any notice.

1. Disconnect the injector connector (A).



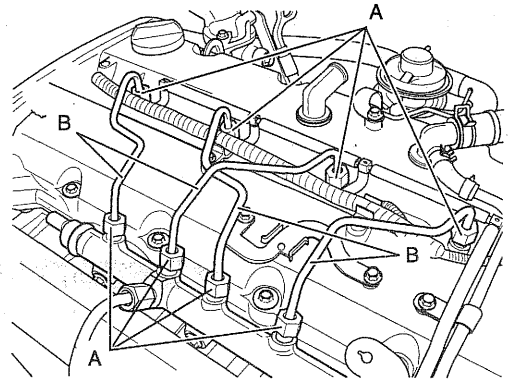
AFBE100T

2. Disconnect the injector return hose (A).



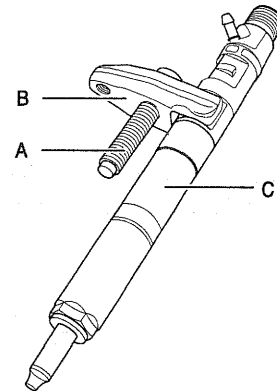
AFBE100U

3. Remove the high pressure pipe mounting nut (A) on the common rail and injector, and then remove the high pressure pipe(B).



AFBE102L

4. Remove the injector clamp bolt (A) using a hexagonal-wrench and remove the clamp(B) and injector(C).



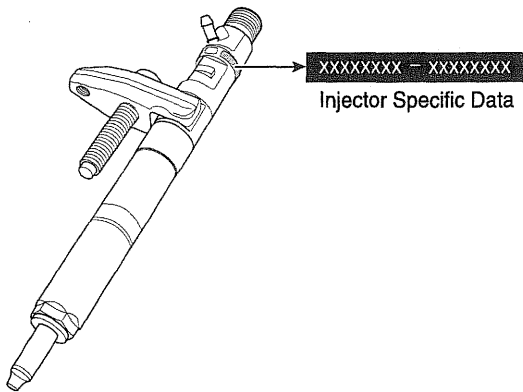
AFBE102M



**INSTALLATION** E56B54E3

**NOTE**

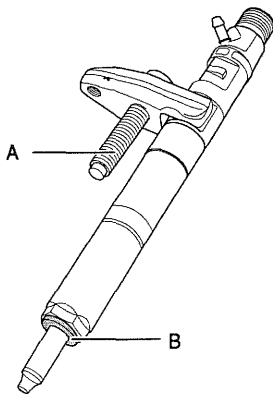
The new injector possesses different characteristics from the one which was originally fitted to the engine. These characteristics are summarized in the 16-character code shown on the label stuck to the top of the injector holder. This code must be entered into the ECM memory with the Hi-Scan (Pro).



EWMF1020

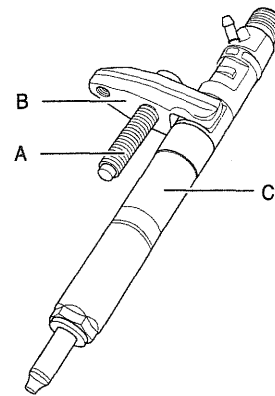
**CAUTION**

When installing a new injector, **MUST** replace the injector clamp bolt(A) and gasket(B) with a new one.



AFBE102N

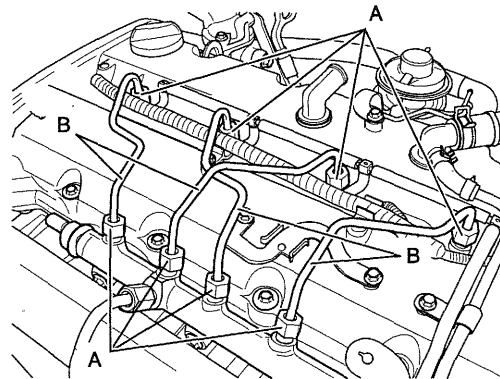
1. Place the injector(C) and clamp(B) on the engine block and install the injector clamp bolt(A).



AFBE102M

2. Install the high pressure pipe(B) in between the common rail and injector with installing the nut (A).

Tightening Torques: 3.65 ~ 4.35 Kgf-m (35.79 ~ 42.66 N·m, 26.40 ~ 31.46 lbf-ft)

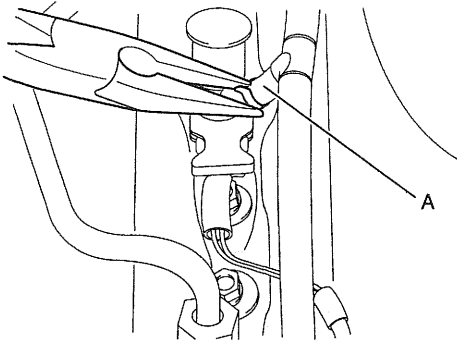


AFBE102L

**CAUTION**

When installing the high pressure pipe, spread specified lubricating oil on the nut.

3. Connect the injector return hose (A).

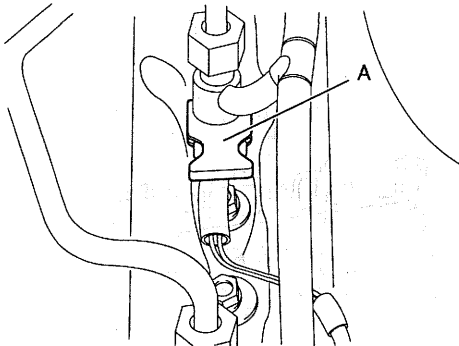


AFBE100U

**⚠ CAUTION**

***When installing a new injector, MUST replace the injector return hose clamp with a new one.***

4. Connect the injector connector(A).



AFBE100T

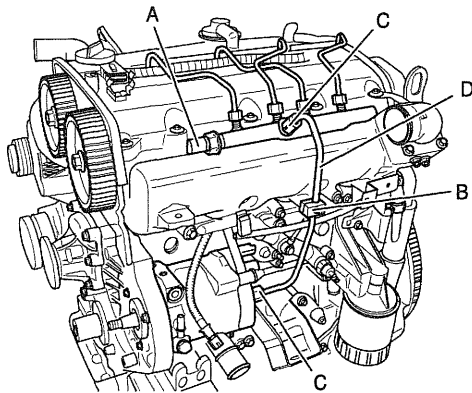
## ACCUMULATOR

### REMOVAL ED9CD89F

#### ⊗ WARNING

- Common Rail Fuel Injection System is subject to extremely high pressure (Approximately 1,600 bar)
- Never perform any work on injection system with engine running or within 30 seconds after the engine stops.
- Always pay attention to safety precaution.
- Ensure the absolute cleanliness.
- It is not recommended to remove the injectors without any notice.

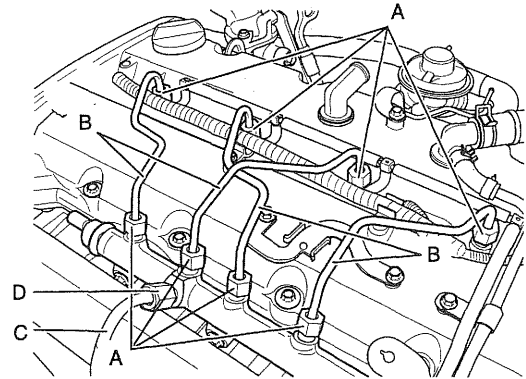
1. Disconnect the rail pressure sensor connector (A).



AFBE102Q

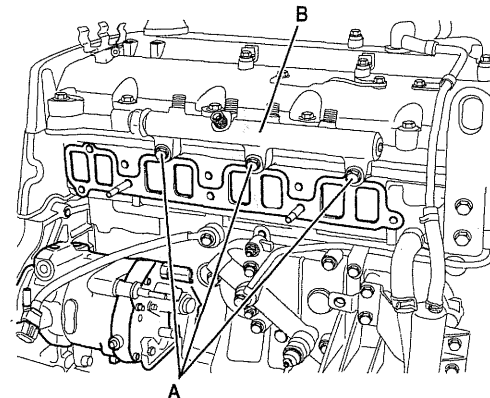
2. Remove the high pressure pipe fixing clip(B).
3. Remove the high pressure pipe (D) with unscrewing the mounting nut (C).
4. Remove the intake manifold (Refer to the group "EM" in this Shop Manual).

5. Remove the high pressure pipe mounting nut (A) on the common rail and injector, and then remove the high pressure pipe(B).



AFBE112L

6. Remove the high pressure pipe mounting nut (D) on the common rail and high pressure pump, and then remove the high pressure pipe(C).
7. Remove the common rail mounting bolts (A).



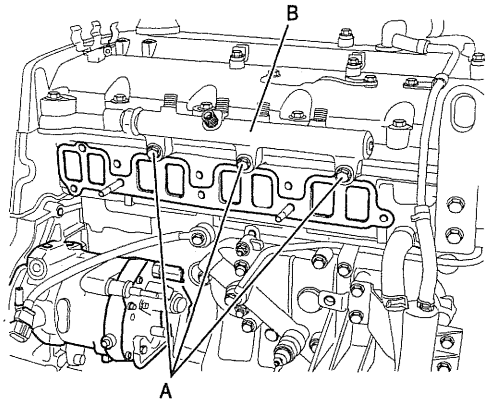
AFBE102P

8. Remove the common rail (B).

**INSTALLATION** E3C81425

1. Place the common rail (B) on the engine block and screw the mounting bolts (A).

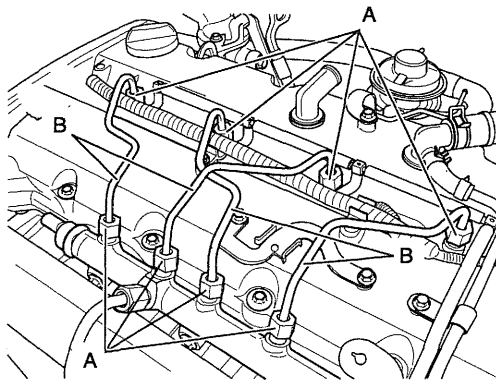
Tightening Torques: 1.90 ~ 2.30 Kgf·m (18.63 ~ 22.56 N·m, 13.74 ~ 16.64 lbf·ft)



AFBE102P

2. Install the high pressure pipe (B) in between injector and common rail with screwing the mounting nut (A).

Tightening Torques: 3.65 ~ 4.35 Kgf·m (35.79 ~ 42.66 N·m, 26.40 ~ 31.46 lbf·ft)



AFBE102L

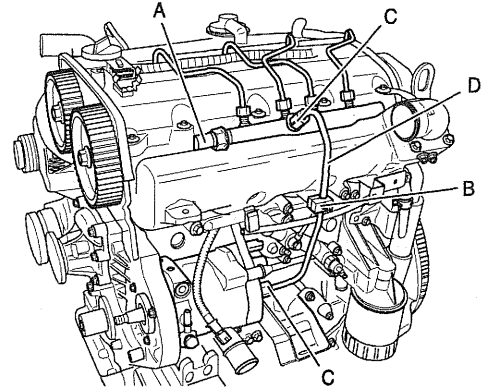
**CAUTION**

*When installing the high pressure pipe, spread specified lubricating oil on the nut.*

3. Install the intake manifold (Refer to the group "EM" in this Shop Manual).

4. Install the high pressure pipe (D) in between high pressure pump and the common rail with screwing the mounting nut (C).

Tightening Torques: 3.65 ~ 4.35 Kgf·m (35.79 ~ 42.66 N·m, 26.40 ~ 31.46 lbf·ft)



AFBE102Q

**CAUTION**

*When installing the high pressure pipe, spread specified lubricating oil on the nut.*

5. Install the fixing clip (B) on the intake manifold.
6. Connect the rail pressure sensor connector (A).

## FUEL LINE

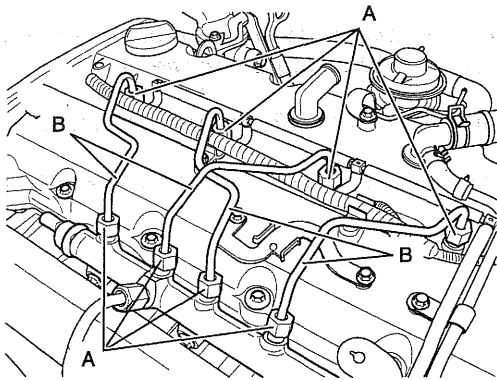
### REMOVAL E2DB4DCB

#### ⊗ WARNING

- Common Rail Fuel Injection System is subject to extremely high pressure (Approximately 1,600 bar)
- Never perform any work on injection system with engine running or within 30 seconds after the engine stops.
- Always pay attention to safety precaution.
- Ensure the absolute cleanliness.
- It is not recommended to remove the injectors without any notice.

### HIGH PRESSURE PIPE (INJECTOR ↔ COMMON RAIL)

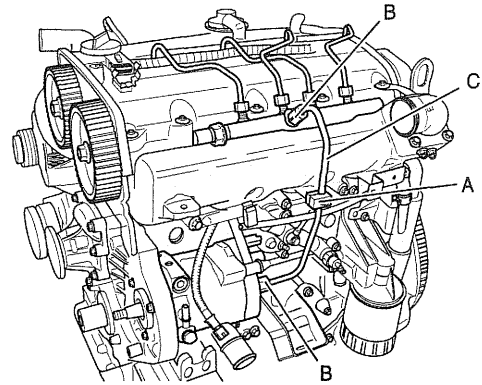
1. Remove the high pressure pipe mounting nut (A) on the common rail and injector, and then remove the high pressure pipe(B).



AFBE102L

### HIGH PRESSURE PIPE (COMMON RAIL ↔ HIGH PRESSURE PIPE)

1. Remove the high pressure pipe fixing clip(A).
2. Remove the high pressure pipe mounting nut (B) on the common rail and high pressure pump, and then remove the high pressure pipe(C).

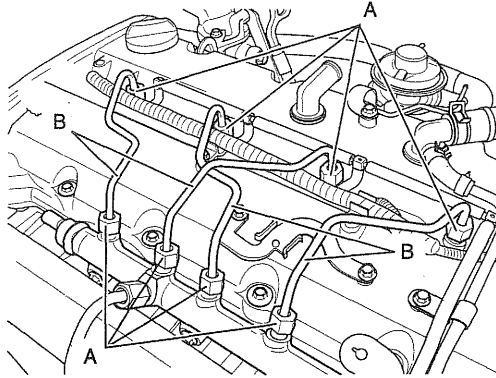


AFBE101O

**INSTALLATION** E1E0265D

**HIGH PRESSURE PIPE (INJECTOR ↔ COMMON RAIL)**

1. Install the high pressure pipe (B) in between injector and common rail with screwing the mounting nut (A).



AFBE102L

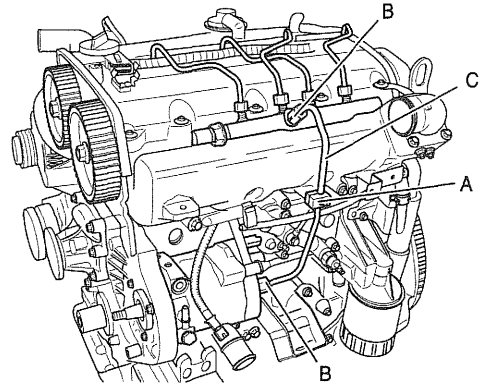
Tightening Torques: 3.65 ~ 4.35 Kgf·m (35.79 ~ 42.66 N·m, 26.40 ~ 31.46 lbf·ft)

**⚠ CAUTION**

*When installing the high pressure pipe, spread specified lubricating oil on the nut.*

**HIGH PRESSURE PIPE (COMMON RAIL ↔ HIGH PRESSURE PIPE)**

1. Install the high pressure pipe (C) in between injector and common rail with screwing the mounting nut (B).



AFBE101O

Tightening Torques: 3.65 ~ 4.35 Kgf·m (35.79 ~ 42.66 N·m, 26.40 ~ 31.46 lbf·ft)

**⚠ CAUTION**

*When installing the high pressure pipe, spread specified lubricating oil on the nut.*

2. Install the fixing clip (A) on the intake manifold.

# Heating, Ventilation & Air Conditioning

<b>GENERAL .....</b>	<b>HA -2</b>
<b>AIR CONDITIONING SYSTEM .....</b>	<b>HA -4</b>
<b>MANUAL A/C COMPRESSOR CONTROLS .....</b>	<b>HA -21</b>
<b>HEATER .....</b>	<b>HA -30</b>
<b>BLOWER CONTROLS .....</b>	<b>HA -34</b>
<b>BLOWER AND A/C CONTROLS (MANUAL) .....</b>	<b>HA -42</b>
<b>BLOWER AND A/C CONTROLS (AUTOMATIC) .....</b>	<b>HA -50</b>

# GENERAL

## SPECIFICATIONS EQMB0010

### A/CON

ITEM		DIESEL		GASOLINE	Remark
		2.5D	2.9D	3.5G	
COMPRESSOR	TYPE	HS-18	←	←	
	Capacity	FD46XG 180cc	←	←	
COMP.PULLEY	TYPE	1PK-TYPE	5PK-TYPE	4PK-TYPE	
	PULLEY Dia.	ø135	ø140	ø120	
CONDENSER	TYPE	P-F	←	←	
TRIPLE S/W	High (Kg/cm <sup>2</sup> G)	32.0 ± 2.0	←	←	
	Medium (Kg/cm <sup>2</sup> G)	18.0 ± 0.8	←	←	
	Low (Kg/cm <sup>2</sup> G)	2.0 ± 0.2	←	←	
EXPANSION V/V	TYPE	BLOCK	←	←	
SOLENOID V/V		DUAL ONLY	←	←	
Refrigerant	Type	R-134a	←	←	
	Capacity (g)	850 ± 25	←	←	

### BLOWER AND EVAPORATOR

ITEM		MANUAL	AUTO
Fresh and Recirculation	Operating method	ACTUATOR	←
BLOWER	Rotating direction	Clockwise	←
	SPEED step	1 - 4 Speed	AUTO + 7 Speed
	SPEED control	RESISTOR	POWER TR & HI-RELAY
EVAPORATOR	TYPE	DRAWN CUP	←
	Temp. control type	THERMISTER	FIN-SENSOR
	A/C ON/OFF	OFF : 0.5°C, ON : 3.0°C	←
AIR FILTER	TYPE	PARTICLE	←



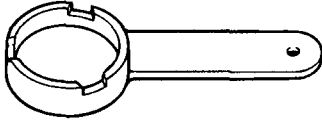
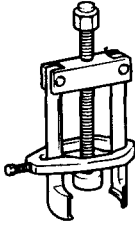
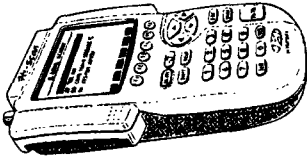
HEATER UNIT

ITEM		MANUAL	AUTO
HEATER MODE Selection	TYPE	DIMPLED	←
	HEATING efficient area	336.5cm <sup>2</sup>	←
	Operating method	ACTUATOR	←
TEMP selection	Operating method	ACTUATOR	←

CONTROL UNIT

ITEM	MANUAL	AUTO (without AQS)	AUTO (with AQS)
AQS (AIR QUALITY SYSTEM)	X	X	O
INCAR SENSOR	X	O	↑
AMBIENT SENSOR	X	O	↑
PHOTO SENSOR	X	O	↑

SPECIAL TOOLS EQMB0020

Tool (Number and name)	Illustration	Use
09977-29000 Pressure plate bolt remover	 <p style="text-align: right;">17729000</p>	Removal and installation of pressure plate
09455-34000 Bearing and gear puller	 <p style="text-align: right;">D5534000</p>	Removal of field coil
09900-11000 Hi-scan	 <p style="text-align: right;">10011000</p>	Diagnosis of the A/con system

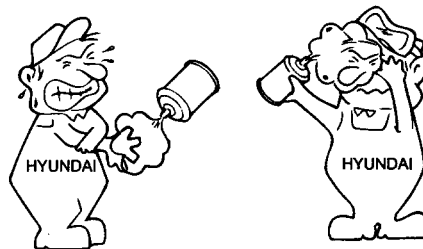
# AIR CONDITIONING SYSTEM

## INSTRUCTIONS EQMB0030

### WHEN HANDLING REFRIGERANT

1. R-134a liquid refrigerant is highly volatile. A drop on the skin of your hand could result in localized frostbite. When handling the refrigerant, be sure to wear gloves.
2. It is standard practice to wear goggles or glasses to protect your eyes, and gloves to protect your hands. If the refrigerant splashes into your eyes, wash them with clean water immediately.
3. The R-134a container is highly pressurized. Never leave it in a hot place, and check that the storage temperature is below 52°C (126°F).
4. A electronic leak detector should be used to check the system for refrigerant leakage. Bear in mind that the R-134a, upon coming into contact with flame, produces phosgene, a highly toxic gas.
5. Use only recommended the lubricant for R-134a systems. If lubricants other than the recommended one used, system failure may occur.
6. PAG lubricant absorbs moisture from the atmosphere at a rapid rate, therefore the following precautions must be observed:
  - When removing refrigerant components from a vehicle, cap immediately the components to prevent from the entry of moisture.
  - When installing refrigerant components to a vehicle, do not remove the cap until just before connecting the components.
  - Complete the connection of all refrigerant tubes and hoses without delay to prevent the A/C system from taking on moisture.
  - Use the recommended lubricant from a sealed container only.

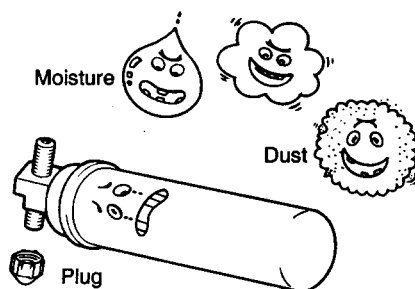
7. If an accidental discharge in the system occurs, ventilate the work area before resuming service.



EQDA010A

### WHEN REPLACING PARTS ON A/C SYSTEM

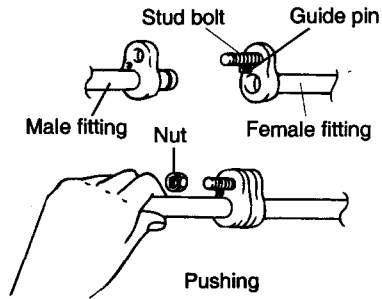
1. Never open or loosen a connection before discharging the system.
2. Seal the open fittings of components with a cap or plug immediately to prevent intrusion of moisture or dust.
3. Do not remove the sealing caps from a replacement component until it is ready to be installed.
4. Before connecting an open fitting, always install a new sealing ring. Coat the fitting and seal with refrigerant oil before making the connection.



EQDA010B

**WHEN INSTALLING CONNECTING PARTS****FLANGE WITH GUIDE PIN**

Check the new O-ring for damage (use only the specified) and lubricate it using compressor oil. Tighten the nut to specified torque.



EQDA010C

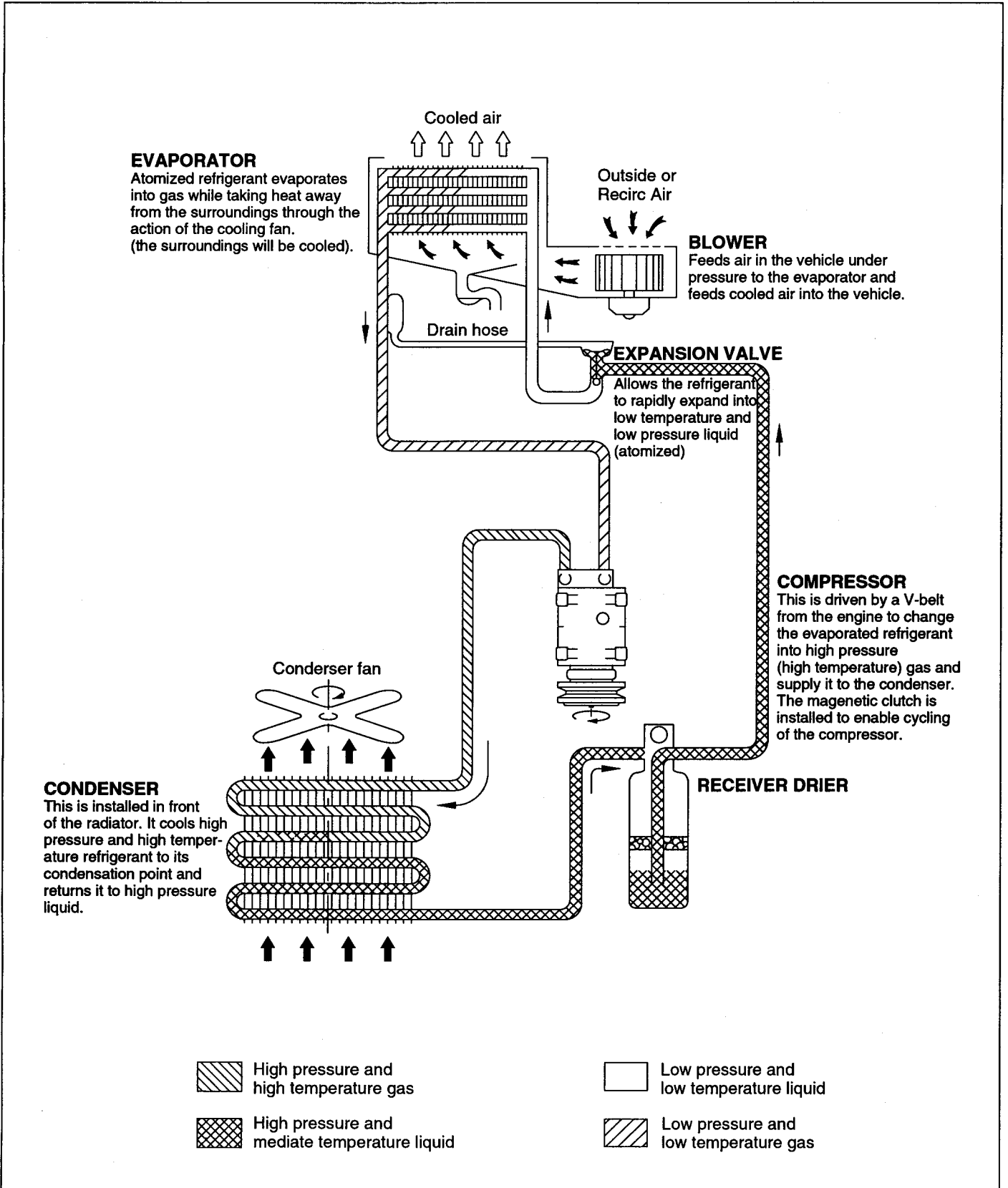
**HANDLING TUBING AND FITTINGS**

The internal parts of the refrigeration system will remain in a state of chemical stability as long as pure moisture-free refrigerant and refrigerant oil are used. Abnormal amounts of dirt, moisture or air can upset the chemical stability and cause problems or serious damage.

**THE FOLLOWING PRECAUTIONS MUST BE OBSERVED**

1. When it is necessary to open the refrigeration system, have everything you will need to service the system ready so the system will not be left open any longer than necessary.
2. Cap or plug all lines and fittings as soon as they are opened to prevent the entrance of dirt and moisture.
3. All lines and components in parts stock should be capped or sealed until they are ready to be used.
4. Never attempt to rebend formed lines to fit. Use the correct line for the installation you are servicing.
5. All tools, including the refrigerant dispensing manifold, the gauge set manifold and test hoses, should be kept clean and dry.

REFRIGERATION CYCLE EQHA0200



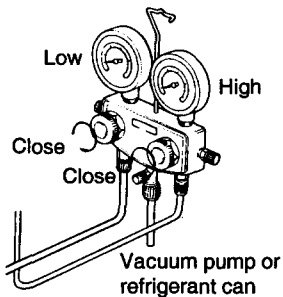
## INSTALLATION OF MANIFOLD GAUGE SET

SET EQMB0090

### CAUTION

**When connecting the manifold gauge set test hoses, be sure to observe all safety precautions.**

1. Close both valves of the manifold gauge set.
2. Install the charging hoses of the gauge set to the fittings. Connect the low-pressure hose to the low-pressure service port, and the high-pressure hose to the high-pressure service port. Tighten the hose nuts by hand.



EQHA030A

## REFRIGERANT DISCHARGING PROCEDURE

EQMB0100

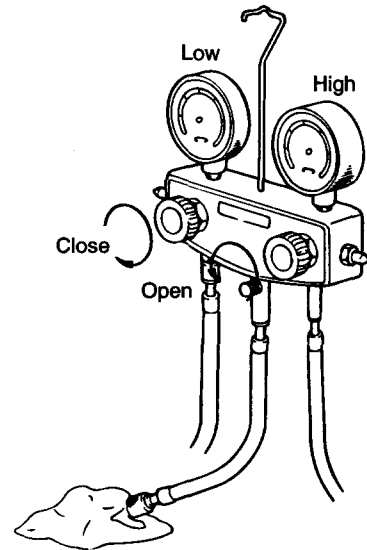
1. Connect the manifold gauge set to the system.
2. Put a towel under the open end of the center hose.
3. Open the high pressure valve slowly to discharge the refrigerant.

### CAUTION

**If discharging the refrigerant too fast, compressor oil may drain from the system.**

4. Check if the towel is stained with oil. If so, gently close the valve.
5. If the manifold gauge reading drops below 3.5kg/cm<sup>2</sup>, open the low pressure valve slowly.

6. Open the high and low pressure valves slowly in order to drop the system pressure until the gauge indicates 0kg/cm<sup>2</sup>.



EQHA035A

## EVACUATING REFRIGERANT SYSTEM

EQMB0110

### NOTE

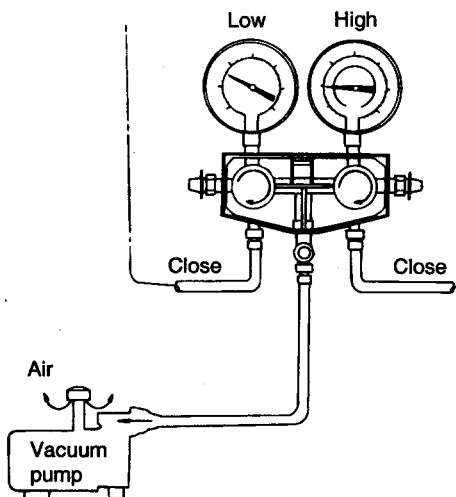
*It is necessary to evacuate the air conditioning system any time the system has been opened. Evacuation is necessary to rid the system of all air and moisture that may have been allowed to enter the unit. After installation of a component, the system should be evacuated for approximately 15 minutes. A component in service that has been opened for repair should be evacuated for 30 minutes.*

1. Engine should be off.
2. Connect a manifold gauge set to the compressor gauge fittings. Close both high and low pressure valves.
3. Make sure the refrigerant has been discharged from the system.
4. Connect the center hose of the gauge set to the vacuum pump inlet.
5. Start the vacuum pump and then open the high and low manifold pressure valves.

6. After about ten minutes, check that the low pressure gauge reads more than  $-94.39 \text{ kPa}$  ( $-0.96 \text{ kg/cm}^2$ ,  $-13.7 \text{ psi}$ ) vacuum. If negative pressure can not be obtained, there is a leak in the system. In this case, repair the leak as following:

- Close both the manifold valves and stop the vacuum pump.
- Charge system with a can or refrigerant [about  $0.4 \text{ kg}$  ( $0.9 \text{ lb}$ )]. Refer to Charging Refrigerant.
- Check for refrigerant leakage with a leak detector. Repair any leakage found.
- Discharge refrigerant again, and then evacuate the system. If no leaks are found, continue evacuating the system.

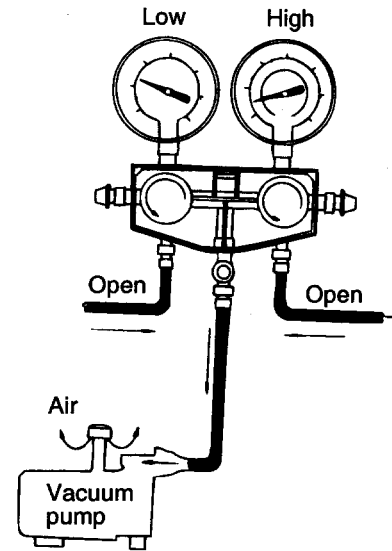
7. Start the vacuum pump.



EQA9007A

- Open both manifold valves to obtain  $-94.39 \text{ kPa}$  ( $-0.96 \text{ kg/cm}^2$ ,  $-13.7 \text{ psi}$ ) of vacuum.
- After the low pressure manifold gauge indicates close to  $-94.39 \text{ kPa}$  ( $-0.96 \text{ kg/cm}^2$ ,  $-13.7 \text{ psi}$ ), continue evacuating for 15 minutes.

10. After evacuating for 15 minutes, close both manifold valves and stop the vacuum pump. Disconnect the hose from the vacuum pump. The system is now ready for charging.



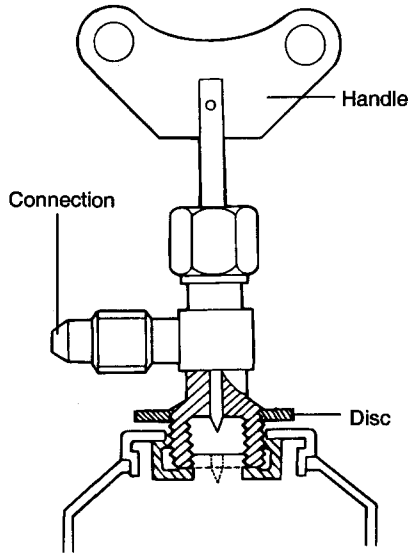
EQA9007B

### HANDLING REFRIGERANT SERVICE TAP VALVE

EQMB0120

- Before connecting the valve to the refrigerant container, turn the handle fully counterclockwise.
- Turn the disc counterclockwise until it reaches its highest position.
- Connect the center hose to the valve fitting. Turn the disc fully clockwise by hand.
- Turn the handle clockwise to make a hole in the sealed top.
- Turn the handle fully counterclockwise to fill the center hose with air. Do not open the high and low-pressure hand valves.
- Loosen the center hose nut connected to the center fitting of the manifold gauge.

- Allow air to escape for a few seconds, and then tighten the nut.

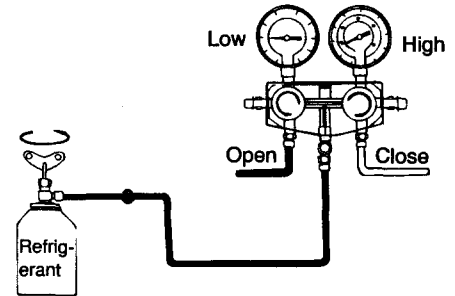


EQA9008A

- Run the engine at fast idle and operate the air conditioning.

**NOTE**

Be sure to keep the container upright to prevent liquid refrigerant from being charged into the system through the suction side, resulting in possible damage to the compressor.



EQA9009B

- Charge the system to the specified amount. Then close the low pressure valve.

Specified amount :  $850 \pm 25g$

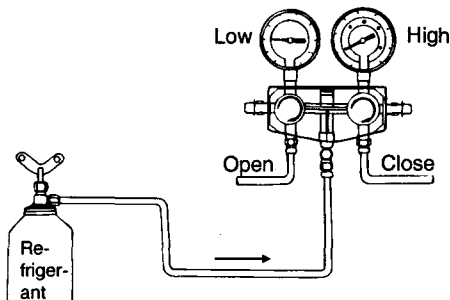
**CHARGING REFRIGERANT SYSTEM (VAPOR)**

EQMB0130

**NOTE**

This step is to charge the system through the low pressure side with refrigerant in a vapor state. When the refrigerant container is placed right side up, refrigerant will enter the system as a vapor.

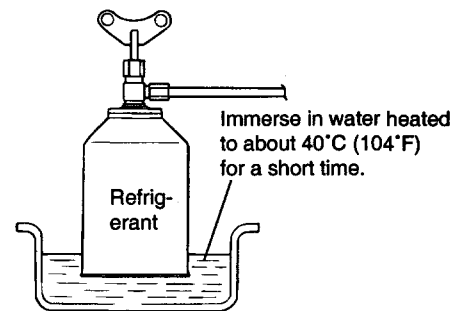
- Open the low pressure valve. Adjust the valve so that the low pressure gauge does not read over 412 kPa (4.2 kg/cm<sup>2</sup>, 60 psi).



EQA9009A

**WARNING**

- Under any circumstances the refrigerant must not be warmed in water heated to a temperature of over 52°C (126°F).
- A blow torch or stove must never be used to warm up the can.



EQA9009C

- Put the refrigerant in a pan of warm water (maximum temperature 40°C or 104°F) to keep vapor pressure in the container slightly higher than vapor pressure in the system.

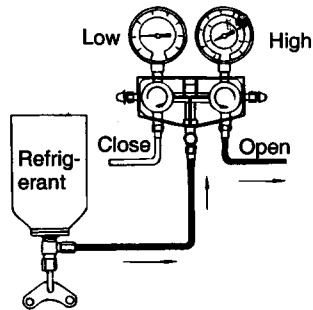
## CHARGING REFRIGERANT SYSTEM (LIQUID)

 **NOTE**

This step is to charge an empty system through the high pressure side with refrigerant in a liquid state. When the refrigerant container is held upside down, refrigerant will enter the system as a liquid.

 **CAUTION**

Never run the engine when charging the system through the high pressure side. Do not open the low pressure valve when the system is being charged with liquid refrigerant.



EQA9010A

1. Close both high and low pressure valves completely after the system is evacuated.
2. Install the refrigerant can tap valve as described in "Handling Refrigerant Service Tap Valve" section.
3. Open the high pressure valve fully and keep the container upside down.
4. Charge the system to the specified amount by weighing the refrigerant with a scale. Overcharging will cause the discharge pressure (high side) to rise. Then, close the high pressure valve.

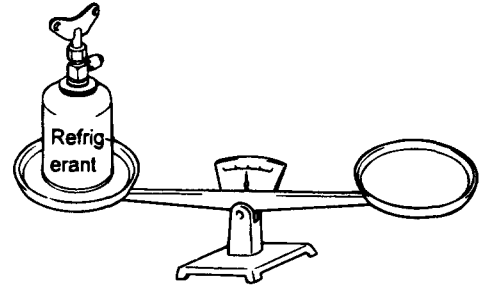
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Specified amount : 850 ± 25g

---

 **NOTE**

If the low pressure gauge does not show a reading, the system is restricted and must be repaired.



EQA9010B

5. After the specified amount of refrigerant has been charged into system, close the manifold valve.
6. Confirm that there are no leaks in the system by checking with a leak detector. Refer to Checking Refrigerant Leak.

 **NOTE**

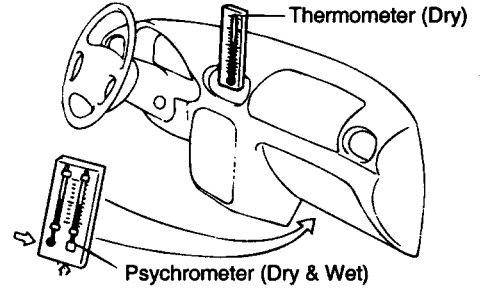
Conducting a performance test prior to removing the manifold gauge is good service operation.



**PERFORMANCE TEST** EQMB0150

1. Install the manifold gauge set.
2. Run the engine at 2,000 rpm and set the controls for maximum cooling and high blower speed.
3. Keep all windows and doors open.
4. Place a dry-bulb thermometer in the cool air outlet.
5. Place a wet—dry thermometer close to the inlet of the cooling unit.
6. Check that the reading on the high pressure gauge is 1,373-1,575 kPa (14-16 kg/cm<sup>2</sup>, 199-228 psi). If the reading is too high, pour water on the condenser. If the reading is too low, cover the front of the condenser.

7. Check that the reading on the dry-bulb thermometer at the air inlet at 25-35°C (77-95°F).
8. Calculate the relative humidity from the psychrometric graph by comparing the wet-and dry-bulb reading at the air inlet.



EQA9019A

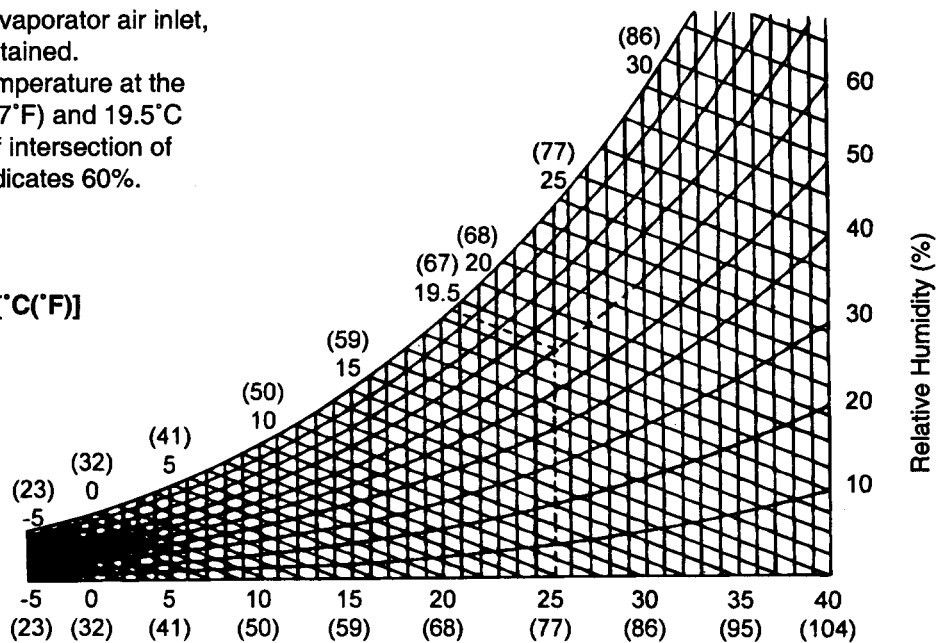
**HOW TO READ THE GRAPH :**

After measuring the temperatures of the wet and dry-bulb thermometers at the evaporator air inlet, relative humidity (%) can be obtained.

Example : Dry-and wet-bulb temperature at the evaporator air inlet are 25°C (77°F) and 19.5°C (67°F) respectively, the point of intersection of the dotted lines in the graph indicates 60%.

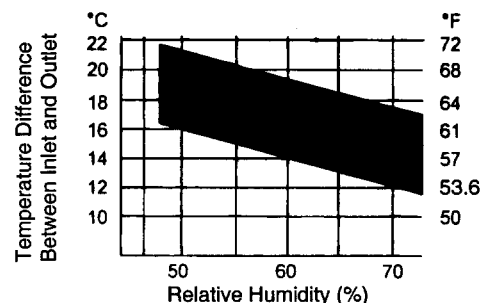
**WET-BULB TEMPERATURE [°C(°F)]**

100	(212)
90	(194)
80	(176)
70	(158)
60	(140)
50	(122)
40	(104)
30	(86)
20	(68)
10	(50)



EQA9019B

9. Measure the dry-bulb temperature at the cool air outlet, and calculate the difference between the inlet dry-bulb and outlet dry-bulb temperatures.
10. Check that the intersection of the relative humidity and temperature difference falls within the block below. If the intersection is within the block, cooling performance is satisfactory.



EQA9019C

**COMPRESSOR OIL** EQMB0160

Oil lubricates the compressor and circulates in the system while the compressor is operating. Whenever replacing any component of the system, or when a large amount of gas leakage occurs, add oil to maintain the original total amount of oil.

**HANDLING OF OIL**

1. The oil should be free from moisture, dust, metal filings, etc.
2. Do not mix oils.
3. The moisture content in the oil increases when exposed to the air for prolonged periods. After use, seal the container immediately.

**OIL RETURN OPERATION**

To check the oil level or add the oil, idle the engine for 20–30 minutes with the controls set to maximum cooling and blower level, to return the lubricant to compressor.

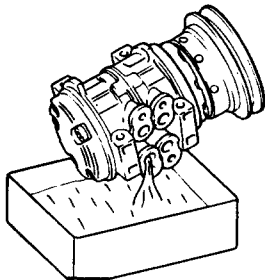
**CHECKING AND ADDING OF COMPRESSOR OIL LEVEL**

In order to add oil to an operating compressor, check the compressor oil using the following procedure:

1. Stop the engine, discharge the refrigerant, and dismantle the compressor from the vehicle.
2. Pour oil from the system line outlet.

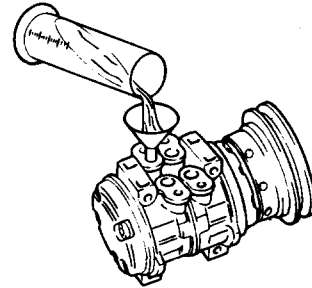
**NOTE**

*If the compressor is cold, sometimes it can be hard to drain the oil. Warm the compressor (approx. 40–50°C) to drain the oil.*



EQHA060A

3. Check the volume of the discharged oil. If it is less than 70cc, it means there is little leak. Perform the leakage test on each system connection, and repair or replace faulty parts if necessary.
4. Check the oil for contamination and replenish the oil level in the following procedure:



EQHA060B

- a. When oil is clean

Discharge	Setting
Above 70cc	Oil level is normal. Add an equal amount of discharged oil.
Below 70cc	Oil level is low. Add 70cc of oil.

- b. If the oil is contaminated with metal fragments or other material, clean the receiver drier after charging the refrigerant.

**CHECKING FOR REFRIGERANT****LEAKS** EQMB0170

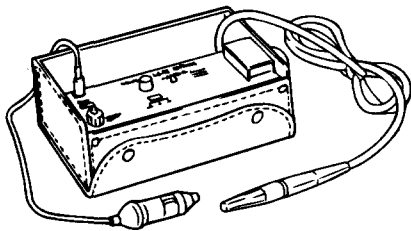
Always conduct a leak test with an electronic leak detector whenever leakage or refrigerant is suspected and when conducting service operations which are accompanied by disassembly or loosening or connection fittings.

 **NOTE**

*In order to use the leak detector properly, read the manual supplied by the manufacturer.*

If a gas leak is detected, proceed as follows:

1. Check the torque on the connection fittings and, if too loose, tighten to the proper torque. Check for gas leakage with a leak detector.
2. If leakage continues even after the fitting has been tightened, discharge the refrigerant from the system, disconnect the fittings, and check their seating faces for damage. Always replace, even if the damage is slight.
3. Check the compressor oil and add oil if required.
4. Charge the system and recheck for gas leaks. If no leaks are found, evacuate and charge the system again.



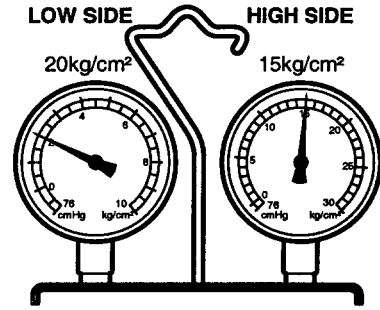
EQHA065A

**PERFORMANCE TEST DIAGNOSIS USING MANIFOLD GAUGE**

EQMB0180

**STANDARD VALUE**

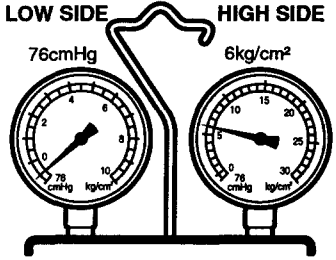
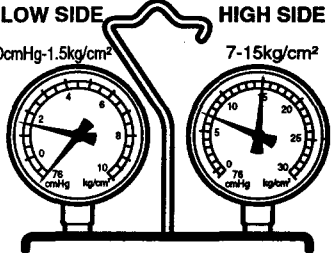
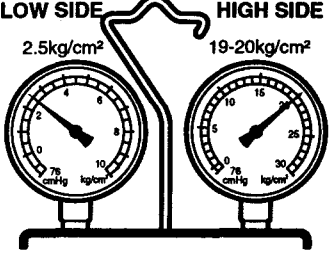
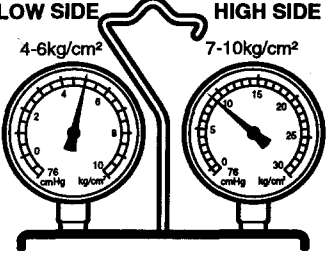
If cooling cycle is operating normally, the manifold gauge reading will be approx. 1.5–2.0kg/cm<sup>2</sup> for the low pressure side and approx. 14.5–15kg/cm<sup>2</sup> for the high pressure side. Inlet temperature should be 30–35°C, with the engine at 2,000 rpm, maximum cooling selected, and the blower on highest level.



KFWD001A

**DIAGNOSIS**

SYMPTOMS	PROBABLE CAUSES	REMEDY	MANIFOLD GAUGE READINGS
<ol style="list-style-type: none"> <li>Low pressure and high pressure are low.</li> <li>Cooler outlet air is a little cooler.</li> </ol>	<ul style="list-style-type: none"> <li>Gas leak.</li> </ul>	<ul style="list-style-type: none"> <li>Check and repair.</li> <li>Add refrigerant.</li> </ul>	<p>KFWD002A</p>
<ol style="list-style-type: none"> <li>Low pressure and high pressure are high.</li> </ol>	<ul style="list-style-type: none"> <li>Faulty cooling or condenser freezing.</li> <li>Belt slip.</li> </ul>	<ul style="list-style-type: none"> <li>Maintain the proper level of refrigerant. Clean the condenser.</li> <li>Adjust the belt.</li> </ul>	<p>KFWD003A</p>
<ol style="list-style-type: none"> <li>Low pressure and high pressure are high.</li> <li>Low pressure pipe is not cold.</li> </ol>	<ul style="list-style-type: none"> <li>Air in the system.</li> </ul>	<ul style="list-style-type: none"> <li>Clean or repair the receiver drier.</li> <li>Check for oil contamination.</li> </ul>	<p>KFWD004A</p>

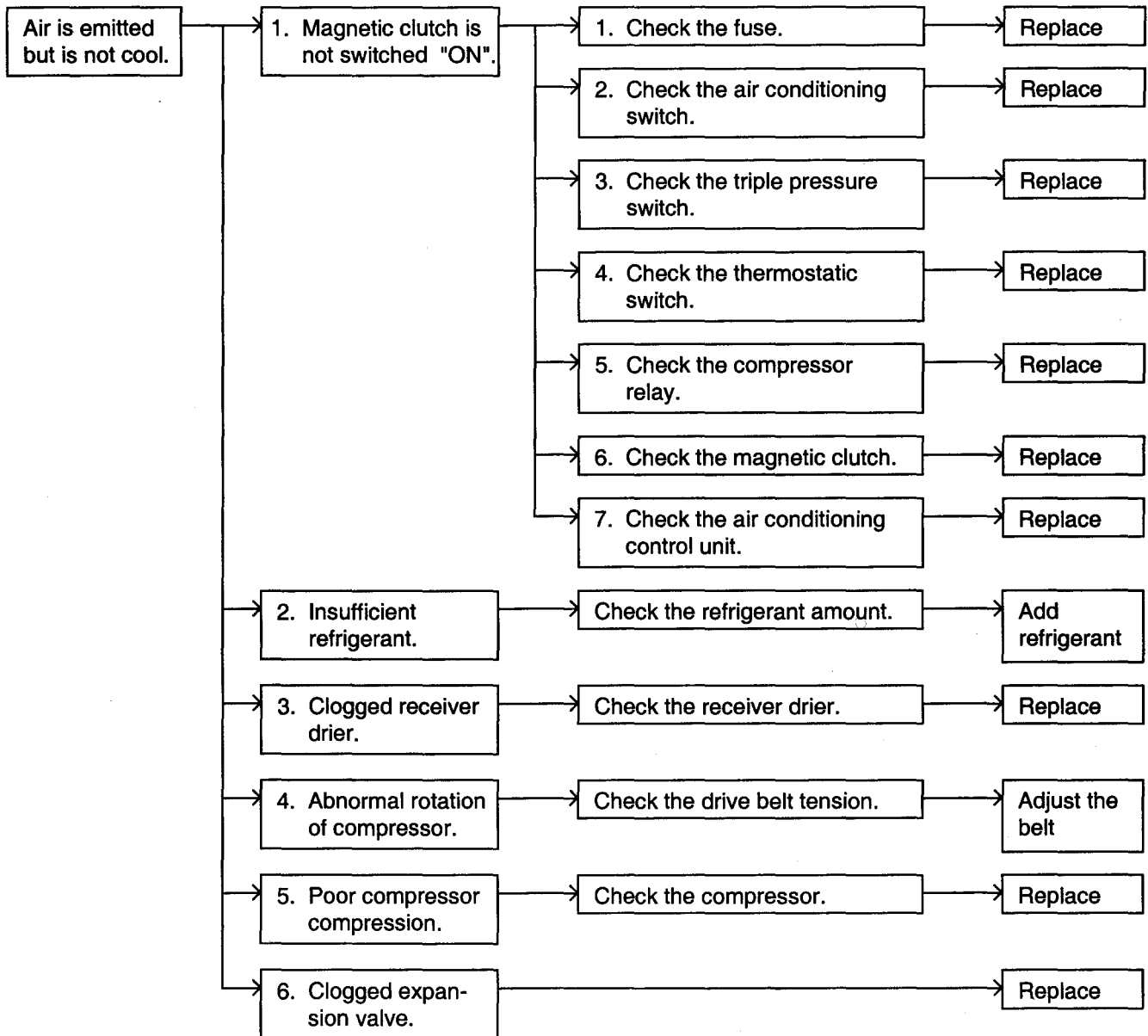
SYMPTOMS	PROBABLE CAUSES	REMEDY	MANIFOLD GAUGE READINGS
<ol style="list-style-type: none"> <li>Low pressure side indicates negative pressure and high pressure side indicates low pressure.</li> <li>Front or dew on pipes connected with receiver or expansion valve.</li> </ol>	<ul style="list-style-type: none"> <li>Dust or moisture frozen at expansion valve.</li> <li>Gas leak.</li> </ul>	<ul style="list-style-type: none"> <li>Repair the receiver drier and replace the expansion valve.</li> <li>Replace the expansion valve if the receiver-drier is faulty.</li> </ul>	<p><b>LOW SIDE</b>      <b>HIGH SIDE</b></p> <p>76cmHg      6kg/cm<sup>2</sup></p>  <p style="text-align: right;">KFW005A</p>
<ol style="list-style-type: none"> <li>Low pressure side pressure sometimes goes to negative pressure or normal.</li> </ol>	<ul style="list-style-type: none"> <li>Intaken moisture is frozen at expansion valve hole.</li> </ul>	<ul style="list-style-type: none"> <li>Repair and bleed receiver drier</li> </ul>	<p><b>LOW SIDE</b>      <b>HIGH SIDE</b></p> <p>50cmHg-1.5kg/cm<sup>2</sup>      7-15kg/cm<sup>2</sup></p>  <p style="text-align: right;">KFW006A</p>
<ol style="list-style-type: none"> <li>Low pressure and high pressure are high.</li> <li>Much frost or dew on the low pressure side piping.</li> </ol>	<ul style="list-style-type: none"> <li>Expansion valve failure. Receiver-drier faulty.</li> <li>Flow control faulty.</li> </ul>	<ul style="list-style-type: none"> <li>Repair receiver drier.</li> <li>Check oil contamination.</li> </ul>	<p><b>LOW SIDE</b>      <b>HIGH SIDE</b></p> <p>2.5kg/cm<sup>2</sup>      19-20kg/cm<sup>2</sup></p>  <p style="text-align: right;">KFW007A</p>
<ol style="list-style-type: none"> <li>Low pressure side pressure is high and pressure side pressure is low.</li> </ol>	<ul style="list-style-type: none"> <li>Leak inside compressor.</li> </ul>	<ul style="list-style-type: none"> <li>Replace compressor.</li> </ul>	<p><b>LOW SIDE</b>      <b>HIGH SIDE</b></p> <p>4-6kg/cm<sup>2</sup>      7-10kg/cm<sup>2</sup></p>  <p style="text-align: right;">KFW008A</p>

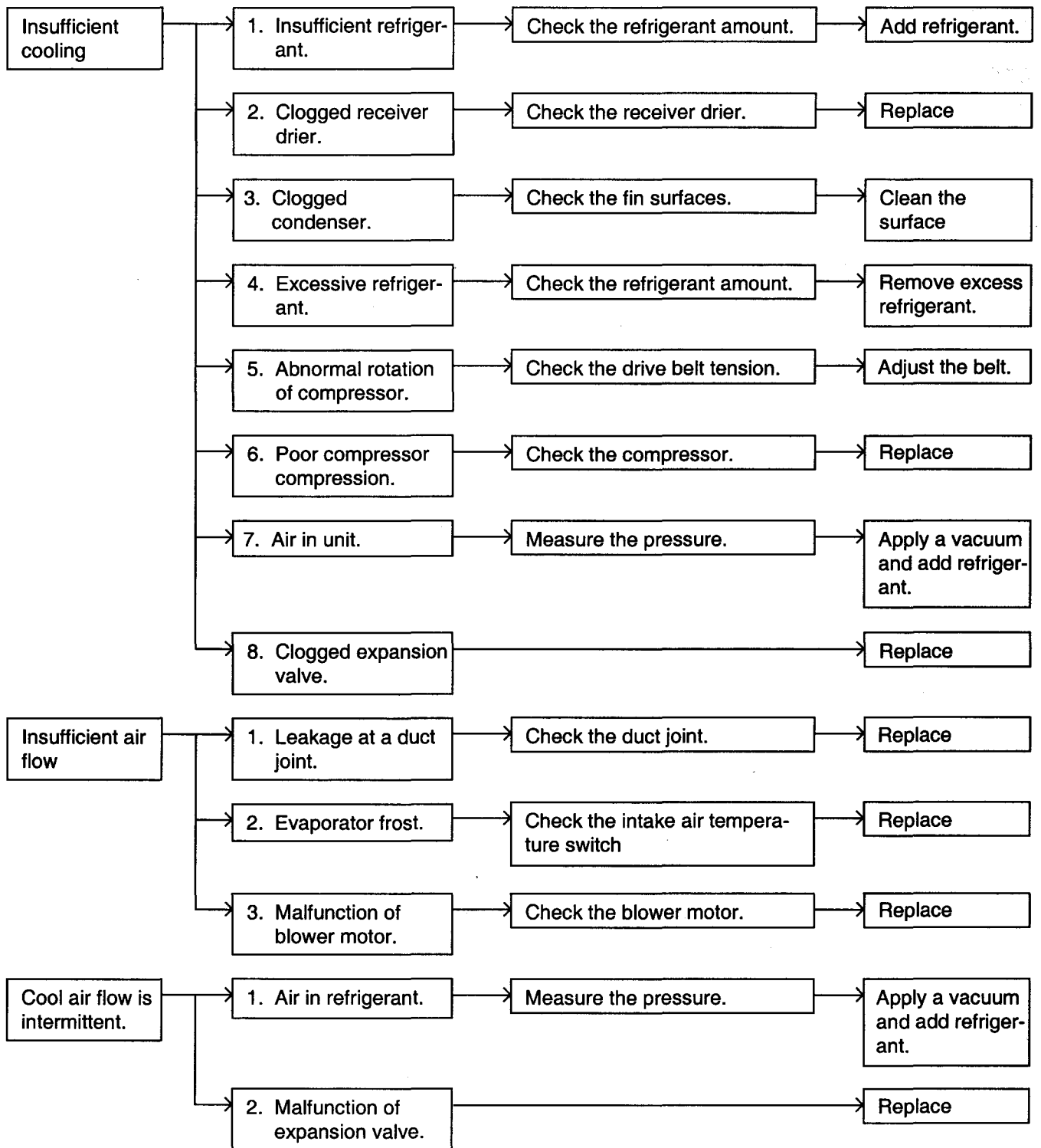
**TROUBLESHOOTING** EQHA0100

Before replacing or repairing air conditioning components, first determine if the malfunction is due to the refrigerant charge, air flow or compressor. The following diagnostic charts have been developed as a quick reference for determining the cause of the malfunction. If these charts do

not satisfactorily describe the problem, refer to the appropriate section for a more detailed explanation. After correcting the malfunction, check the complete system to ensure that performance is satisfactory.

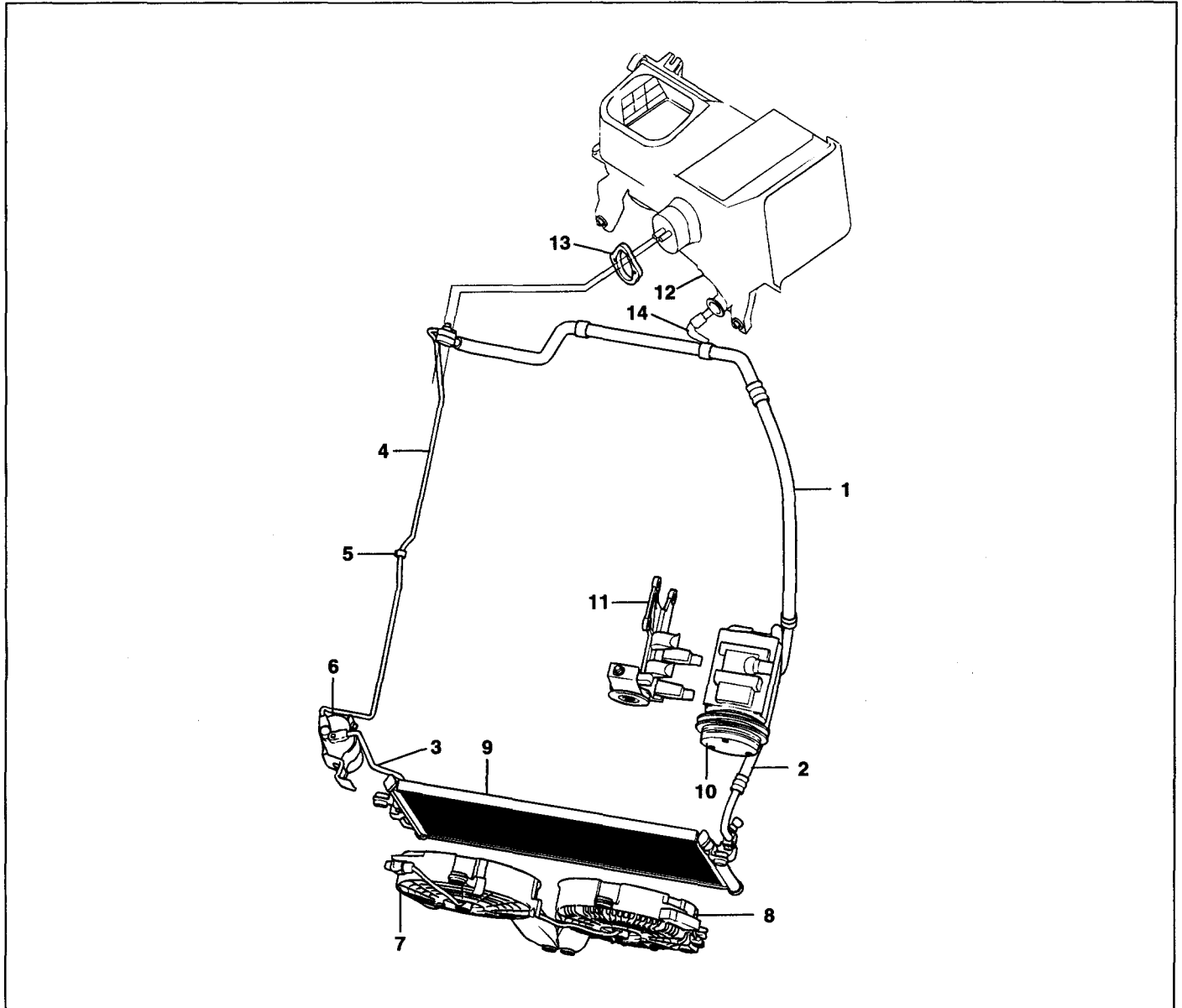
**MALFUNCTION CAUSES AND REMEDIES (NUMBERS INDICATE CHECKING/INSPECTION ORDER.)**





REFRIGERANT LINE

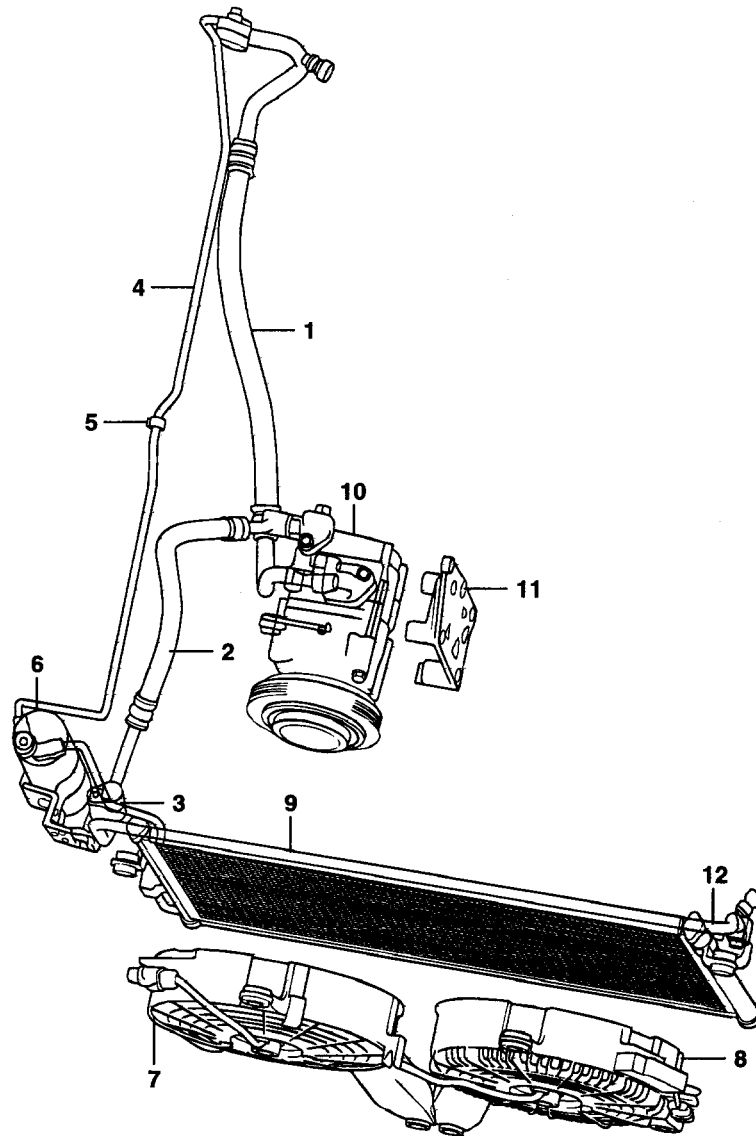
REFRIGERATION LINE (2.5 TCI) EQMB0060



NO	NAME	NO	NAME
1	Suction hose	8	Condenser fan (left side)
2	Discharge hose	9	Condenser
3	Liquid pipe, A	10	Compressor
4	Liquid pipe, B	11	Compressor mounting bracket
5	Liquid pipe clamp	12	Blower & Evaporator
6	Receiver drier	13	Evaporator pipe seal
7	Condensen fan (right side)	14	Drain hose

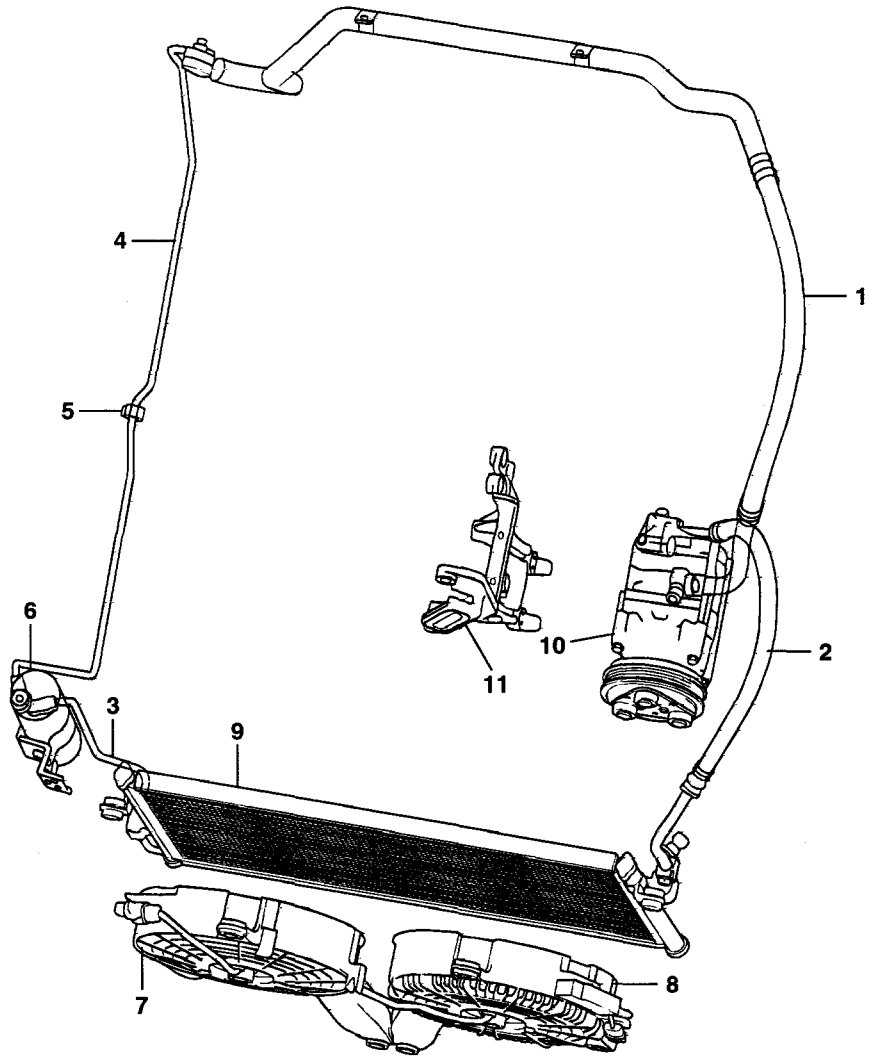


REFRIGERATION LINE (2.9 TCI) EQMB0070



NO	NAME	NO	NAME
1	Suction hose	7	Condenser fan (right side)
2	Discharge hose, A	8	Condenser fan (left side)
3	Liquid pipe, A	9	Condenser
4	Liquid pipe, B	10	Compressor
5	Liquid pipe clamp	11	Compressor mounting bracket
6	Receiver drier	12	Discharge hose, B

REFRIGERATION LINE (3.5 V6) EQMB0080



NO	NAME	NO	NAME
1	Suction hose	7	Condenser fan (right side)
2	Discharge hose	8	Condenser fan (left side)
3	Liquid pipe, A	9	Condenser
4	Liquid pipe, B	10	Compressor
5	Liquid pipe clamp	11	Compressor mounting bracket
6	Receiver drier		

# MANUAL A/C COMPRESSOR CONTROLS

## MAGNETIC CLUTCH

### CHECKING THE CLUTCH AIR GAP EQMB0430

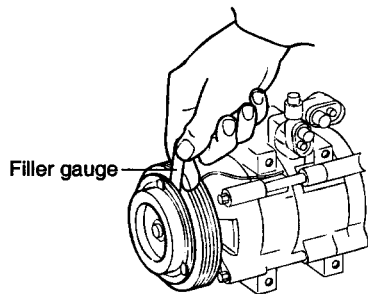
1. Check the air gap between the clutch hub and pulley contact surface using a feeler gauge.

---

Clutch air gap : 0.35 - 0.65mm

---

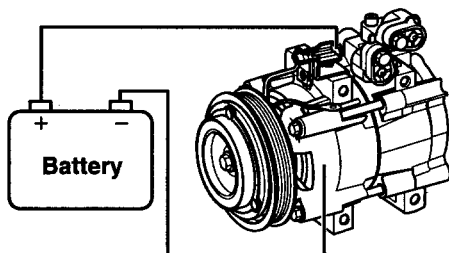
2. Check the gap around the pulley at 3 points.
3. If the clutch air gap is outside the normal range, correct it using a shim of proper size.



KFWD052A

### MAGNETIC CLUTCH OPERATION EQMB0440

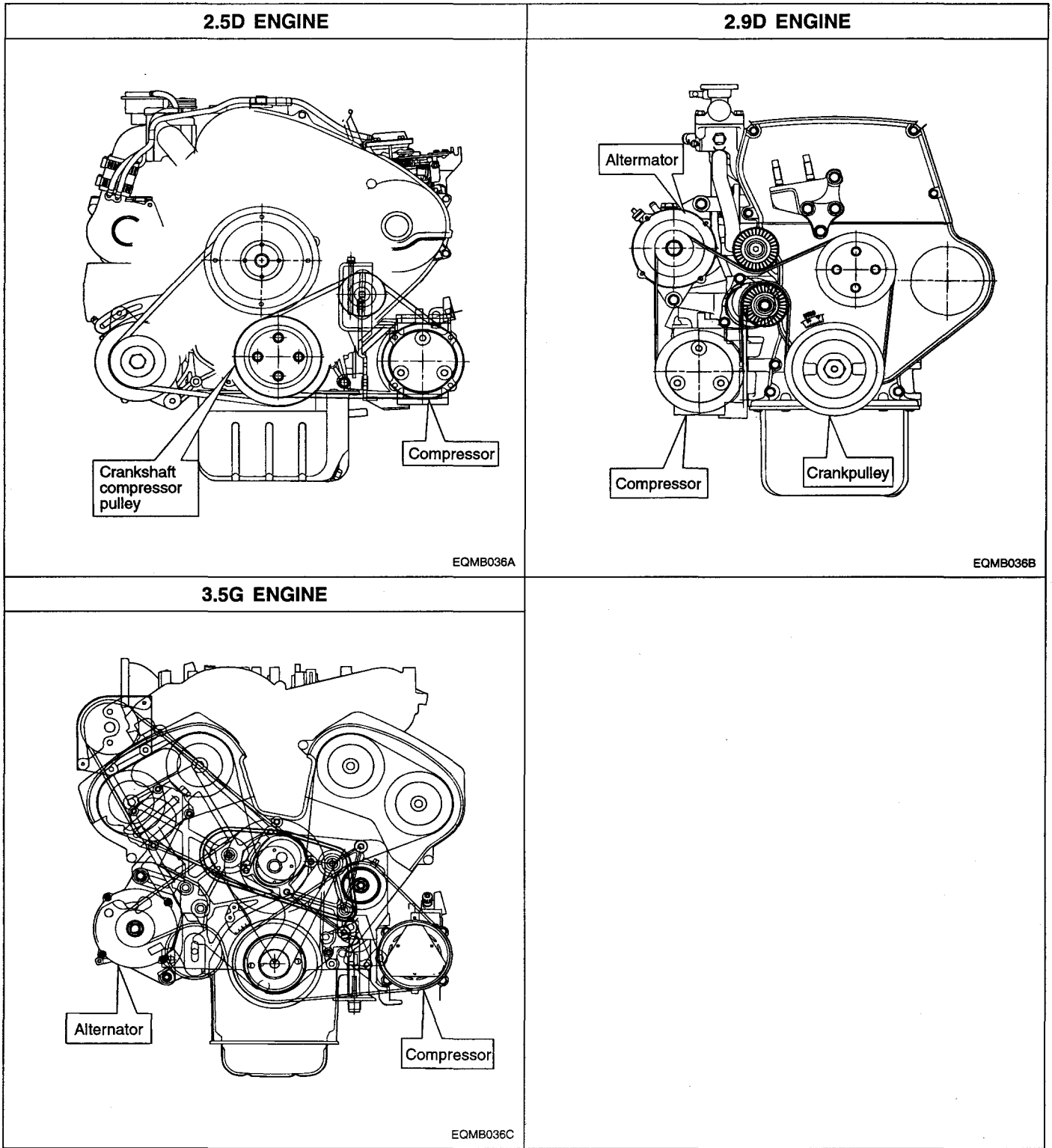
Connect the compressor terminal to battery(+) and the battery(-) terminal to the compressor body. Verify magnetic clutch operation by a clicking noise.



KFWD053A

# COMPRESSOR

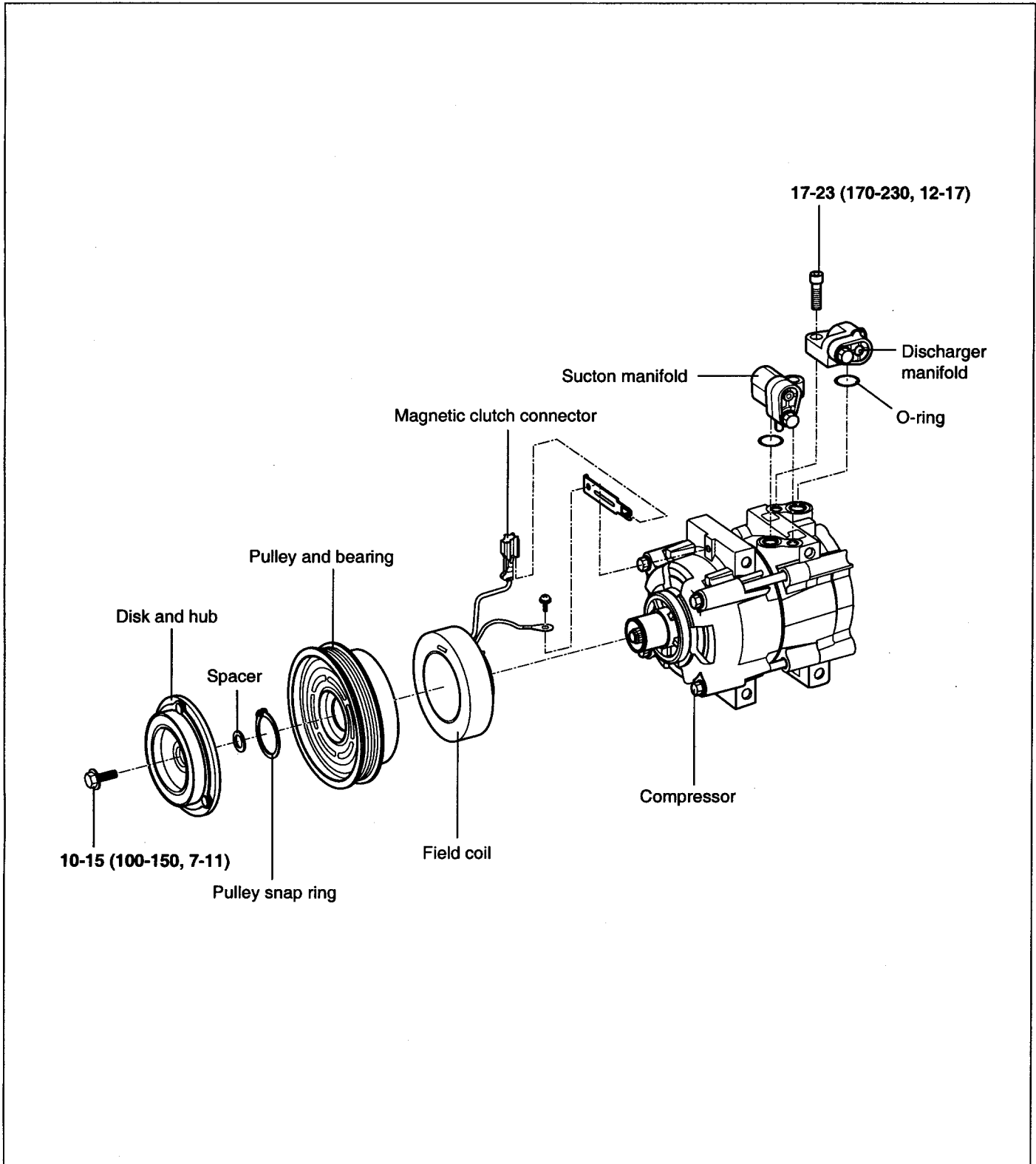
## COMPONENTS EQMB0360



**REMOVAL AND INSTALLATION** EQHA1200

1. Remove the drive belt after loosening the tension pulley.
2. Discharge the refrigerant.
3. Remove the discharge and suction hoses.
4. Remove the compressor.
5. Installation is the reverse of removal.

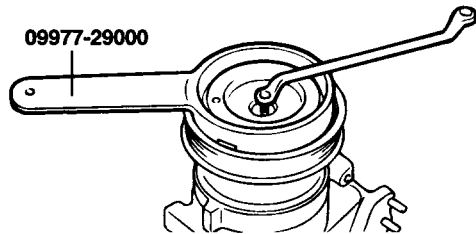
COMPONENTS EQJA1250



# CLUTCH HUB AND PULLEY

## DISASSEMBLY EQMB0390

1. Remove the clutch hub supporting bolt using the Special Tool.

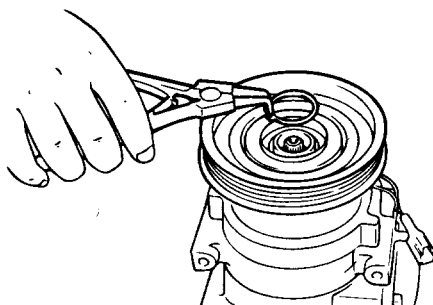


EQA9014A

2. Pull out the clutch hub and shim from the compressor shaft. If it is hard to pull out the hub from compressor, insert an 8mm bolt into the shaft hole to remove the hub from the shaft.
3. Remove the pulley supporting the snap ring.
4. Remove the pulley and bearing assembly from the compressor.

## ASSEMBLY EQMB0400

1. Clean the pulley bearing surface of the compressor head and remove dirt and rust.
2. Install the pulley and bearing on the compressor.
3. Install the snap ring with its bevelled side facing out.
4. Place one space shim of specified size over the hub spline and slide the hub onto the compressor shaft end.



EQA9014B

5. Install a new hub supporting bolt at the compressor shaft end. Tighten the bolt with tightening torque.

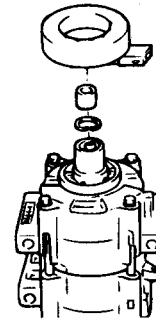
Tightening torque : 102 - 153kg.cm



**Do not use air tools.**

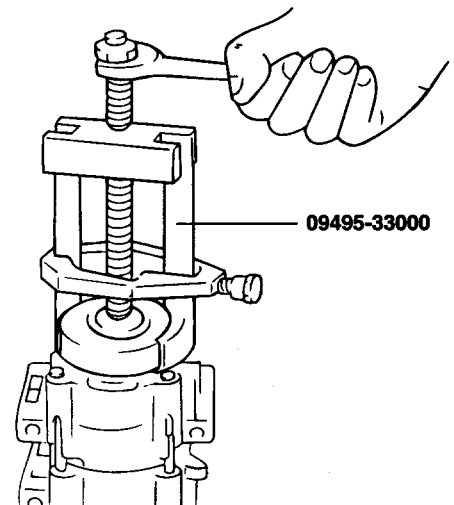
## DISASSEMBLY EQMB0410

1. Remove the clutch hub and pulley.



EQHA130A

2. Install a shaft protection tool at the compressor opening.
3. Install the pulley on the compressor. Place the puller screw end on the shaft arms center concave and the puller projection around the rear side of the field coil.



EQHA130B

4. Turn the puller screw using a wrench and remove the coil.

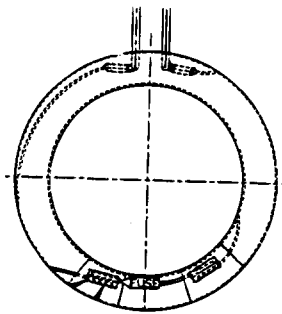


**Do not use air tools.**

## CLUTCH FIELD COIL

### THERMAL FUSE EQMB0420

1. A thermal fuse is located on the compressor clutch coil.
2. The thermal fuse will detect clutch slip heat (184°C off) generated by faulty compressor operation, then interrupt the coil's power supply. Therefore, the clutch bearing and the pulley bearing will not be damaged, also protecting the belt and engine. Once the thermal fuse blows the compressor will not operate. Check the clutch oil resistance (3.0–3.2Ω) to determine the thermal fuse condition, and replace the clutch coil if required.

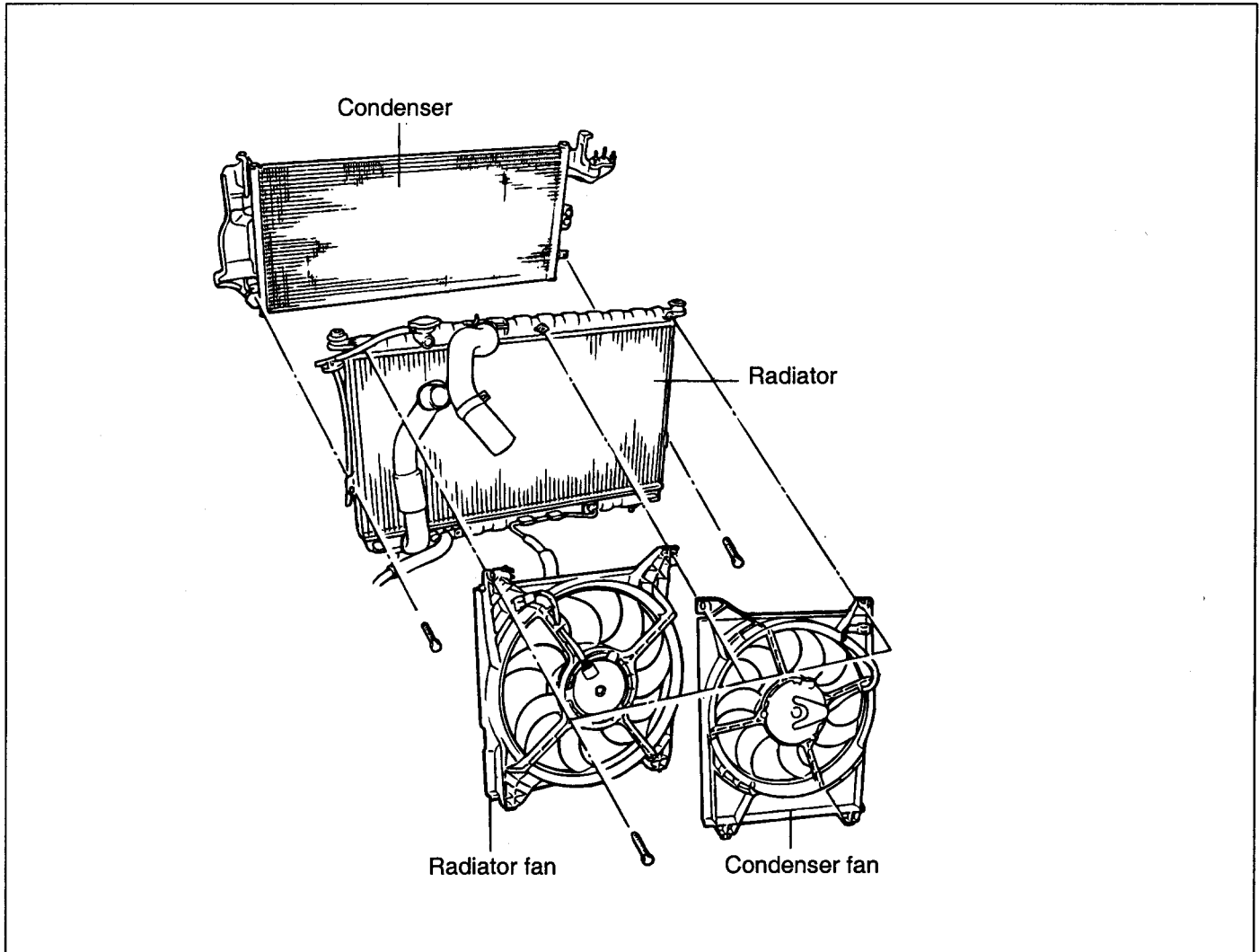


HEW97018



# CONDENSER FAN AND RELAY

## COMPONENTS EQMB0450



HEW97019

## CHECKING EQJA1400

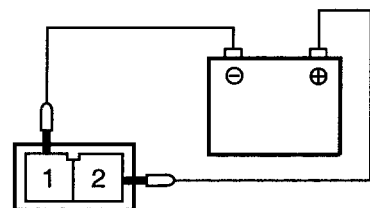
### CONDENSER

1. Check the condenser fins for clogging and damage. If clogged, clean them with water, and blow them with compressed air. If bent, gently bend them using a screwdriver or a pliers.
2. Check the condenser connections for leakage, and repair or replace it, if required.

### CONDENSER FAN

1. Check the condenser fan for proper operation.
2. Check the harness connector.

3. Check the condenser fan motor using battery voltage as shown below.

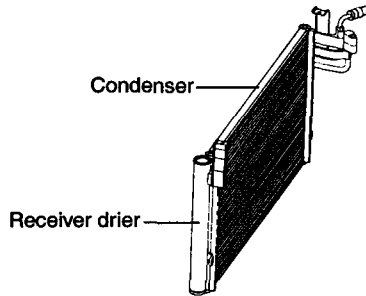


EQJA013C

## RECEIVER/DRIER

### RECEIVER/DRIER EQHA1450

1. Check the fusible plug and the fittings for leakage, using a leak detector.
2. Run the engine at fast idle with the air conditioning "ON", and check both the inlet and outlet temperatures. If the difference in temperatures between the inlet and outlet is large, replace the receiver-drier.



EQHA201A

#### NOTE

1. Plug the all open fittings immediately to keep moisture out of the system.
2. Do not remove plugs until ready for connection.
3. If the receiver-drier is replaced with a new unit, add 40cc of compressor oil to the compressor.
4. Evacuate, charge and test the refrigeration system.

# TRIPLE PRESSURE SWITCH

## TRIPLE SWITCH EQJA1500

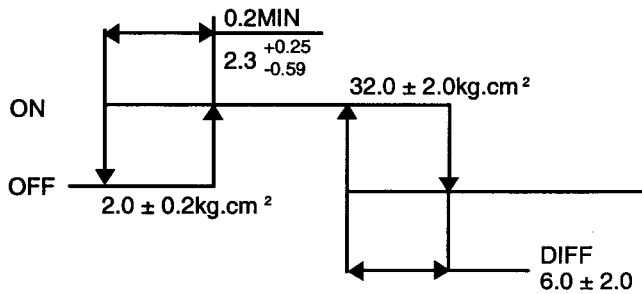
The triple switch is a combination of a medium switch as well as conventional low pressure and high pressure switches. The low pressure switch will be turned off to stop compressor operation if refrigerant pressure is low. The high pressure switch will be turned off to stop compressor operation if refrigerant pressure is too high. The medium switch will be turned on at medium level pressure to cool the A/C system operating radiator fan and condenser fan at high speed.

### OPERATING CHARACTERISTIC

Pressure	kg·cm <sup>2</sup>	
	ON	OFF
High	32.0 ± 2.0	26.0 ± 2.0
Low	2.3 ± 0.25	2.0 ± 0.2
Medium	15.5 ± 0.8	11.5 ± 1.2

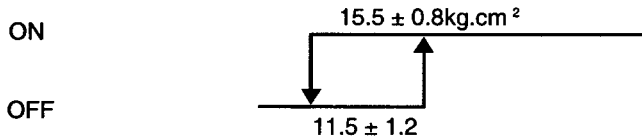
EQJA150B

### LOW & HIGH



EQHA150A

### MEDIUM



EQHA150C

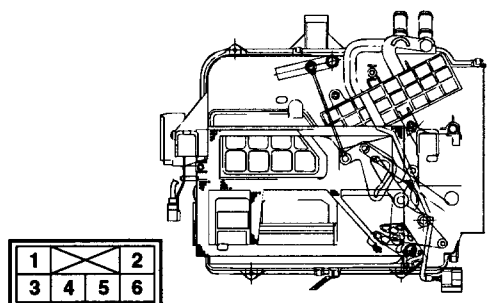
# HEATER

## TEMP. ACTUATOR POTENTIOMETER

### TEMPERATURE CONTROL

#### ACTUATOR EQJA1700

1. Temperature control actuators are installed in the heater unit case. The control switches and the vent ductswitch will operate actuators to regulate the temperature and discharge air.



EQJA020C

2. Temp. switch terminal voltage check.

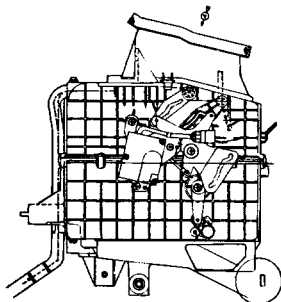
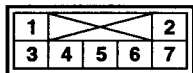
Terminal	Voltage	Remark
1	12V (+,-)	Change Polarity
3	12V (+,-)	Change Polarity
4	5V	Sensor Voltage
5	Change with resistance	Variable Resistance
6	Ground	Ground

## VENTS/AIR DISTRIBUTION

### MODE CONTROL ACTUATOR EQMB0520

- Pressing the mode select switch with the ignition on will shift the driver side and passenger side mode door actuators as follows :  
 VENT ⇒ BI/LEVEL ⇒ FLOOR ⇒ MIX
- Mode actuator circuit diagram and voltage

Terminal	Description	Voltage
1	IG	12V
2	Ground	-
3	Vent	0V
4	Bi-level	12V
5	Floor	12V
6	Mix	12V
7	Defroster	12V



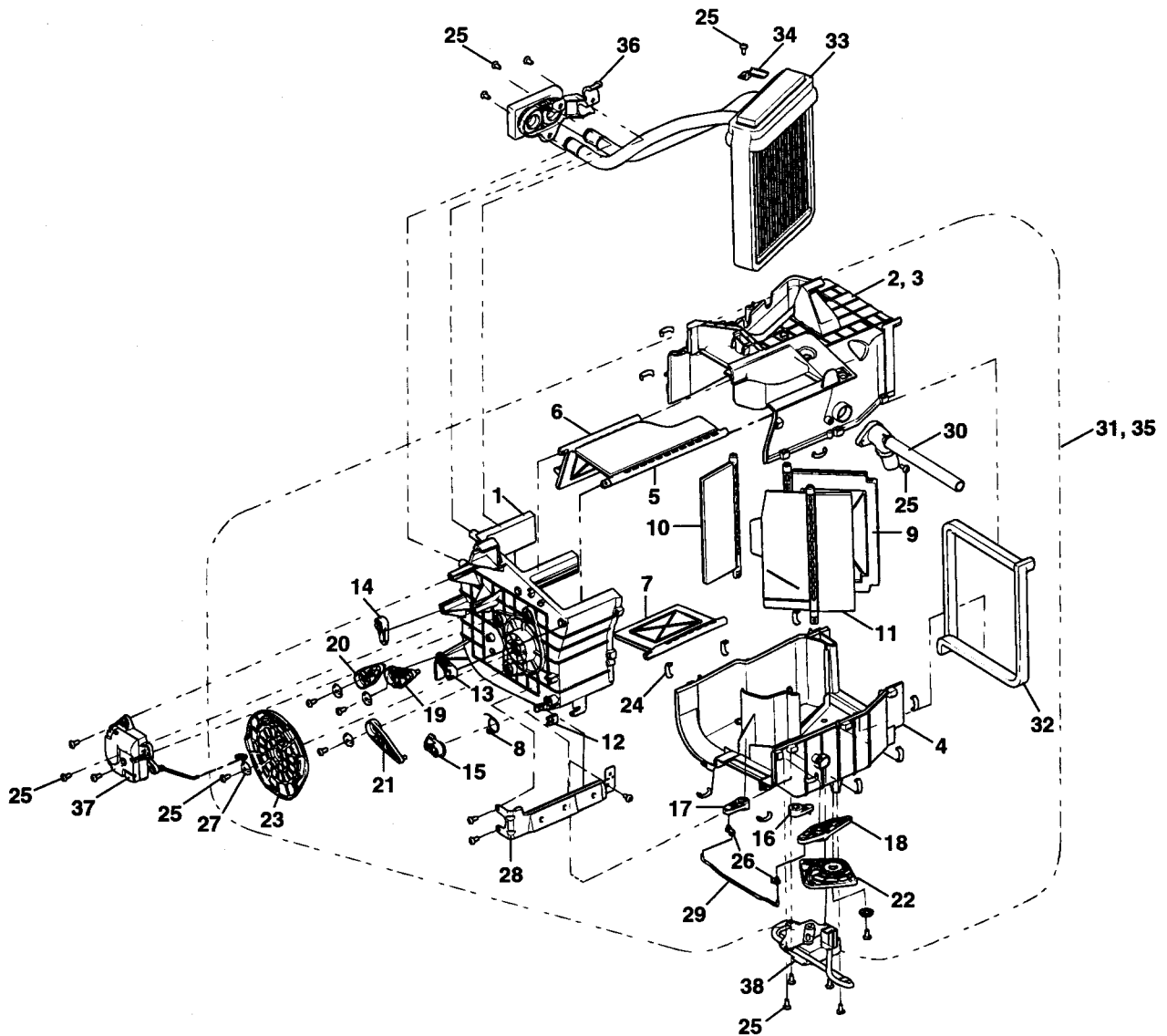
EQJA020D

### HEATER

Mode Position	Recirculation	Fresh			
	COOL	1/2 COOL	WARM		
	Vent	Bi level	Floor	Mix	Defroster
Vent	100	60	-	-	-
Floor	-	40	73	55	-
Defroster	-	-	27	45	100

# HEATER UNIT

## COMPONENTS EQMB0490



- |                               |                         |                                  |
|-------------------------------|-------------------------|----------------------------------|
| 1. Heater case (left)         | 14. Defrost door arm    | 27. Spring washer                |
| 2. Upper heater case (Manual) | 15. Floor door arm      | 28. Power relay mounting bracket |
| 3. Upper heater case (Auto)   | 16. Temp. door arm      | 29. Temp. door link              |
| 4. Lower heater case          | 17. Temp. (A) door arm  | 30. Aspirator                    |
| 5. Vent door & seal           | 18. Air bypass door arm | 31. Case & door (Manual)         |
| 6. Defrost door & seal        | 19. Vent lever          | 32. Seal (Heater core and seal)  |
| 7. Floor door & seal          | 20. Defrost lever       | 33. Heater core & seal           |
| 8. Tension spring             | 21. Floor lever         | 34. Heater core & bracket (A)    |
| 9. Temp. door & seal          | 22. Temp. lever         | 35. Case & door (FATC)           |
| 10. Temp.(A) door & seal      | 23. Mode lever          | 36. Heater tube bracket          |
| 11. Bypass door & seal        | 24. Clip                | 37. Mode actuator motor          |
| 12. Spring nut                | 25. Tap screw           | 38. Temp. actuator motor         |
| 13. Vent door arm             | 26. Rod link holder     |                                  |

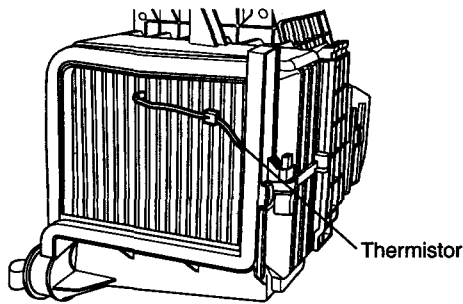
# BLOWER CONTROLS

## THERMOSTATIC SWITCH (THERMISTOR)

### SENSOR CHECKING EQMB0610

#### THERMISTOR

The thermistor will detect the core temperature and interrupt compressor relay power, in order to prevent evaporator freezing by excessive cooling. The thermistor is an NTC device.

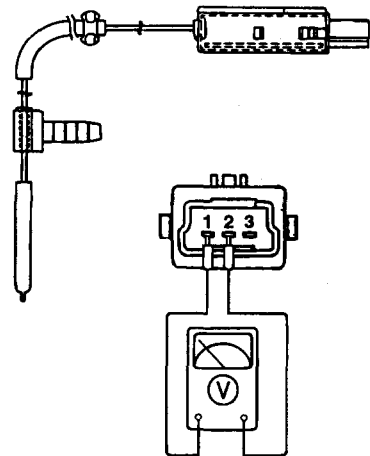


KFWD049A

#### THERMISTOR CHECK

1. Remove the glove box.
2. Start the engine.
3. Turn on the air conditioner.
4. Using the multi-tester, check the output voltage between terminals 2 and 3 in the thermistor.

Thermistor	Operating temperature	Output voltage
ON	3 - 6°C	12V
OFF	0.5 ± 0.5°C	0V



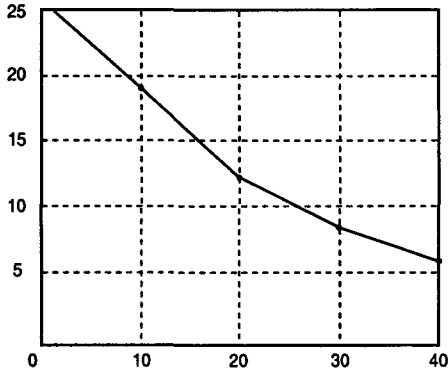
KQMB061B

## IN CAR SENSOR

### IN-CAR AIR TEMPERATURE SENSOR

EQHA2200

It will detect interior temperature, which will be used for discharge temperature control, sensor failsafe, temperature door control, blower motor level control, A/C auto control.



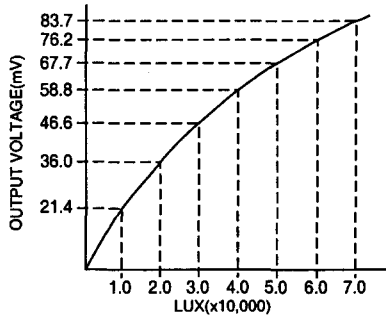
KFWD034A



PHOTO SENSOR

PHOTO SENSOR EQJA2050

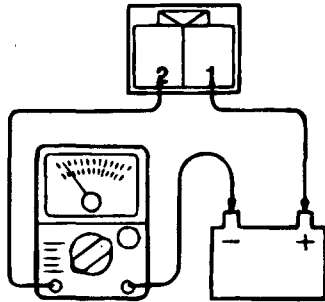
The photo sensor is located by the driver side defrost nozzle. In response to photo intensity level in vehicle, the sensor will send signal to control module to control the blower level and discharge temperature.



KFWD028A

**NOTE**

Emit intensive light toward driver side and passenger side using a lamp, and check the current change between terminals 1 & 2.

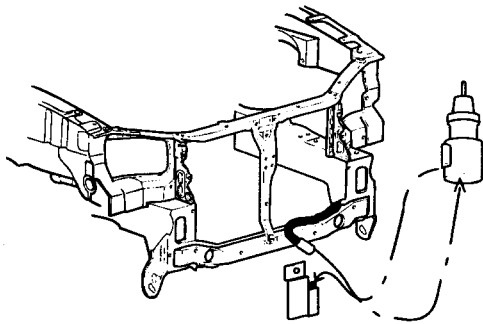


S6HA030C

# AMBIENT TEMPERATURE SENSOR

## AMBIENT AIR TEMPERATURE SENSOR EQJA2150

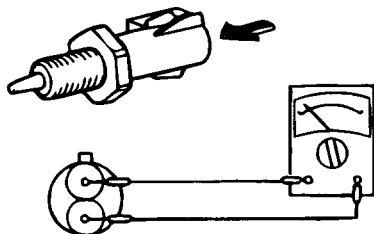
1. The air temperature sensor, located at the front of the engine radiator, and detect ambient air temperature. It is a negative type thermistor; resistance will increase with lower temperature, and decrease with higher temperatures.
2. The sensor output will be used for discharge temperature sensor, sensor fail-safe, temperature regulation door control, blower motor level control, mix mode control and in-car humidity control.



EQJA025D

### CHECK

Temperature (°C)	Min. Resistance (Ω)	Max. Resistance (Ω)
-40	787.25	982.15
-20	254.8	287.5
0	89.2	109.6
20	35.0	39.5
40	15.1	17.1
60	7.1	8.0



HEW97038

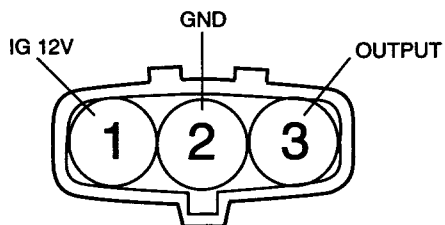
## A.Q.S (AIR QUALITY SENSOR)

### A.Q.S. SENSOR EQJA2100

1. The A.Q.S. sensor, located at the center support in front of the center member, detects hazardous elements in ambient air, and provides output signals to the control module.
2. It will detect sulfurous acid gas, carbon dioxide, carbon monoxide, hydrocarbon and allergen.

### SENSOR OUTPUT

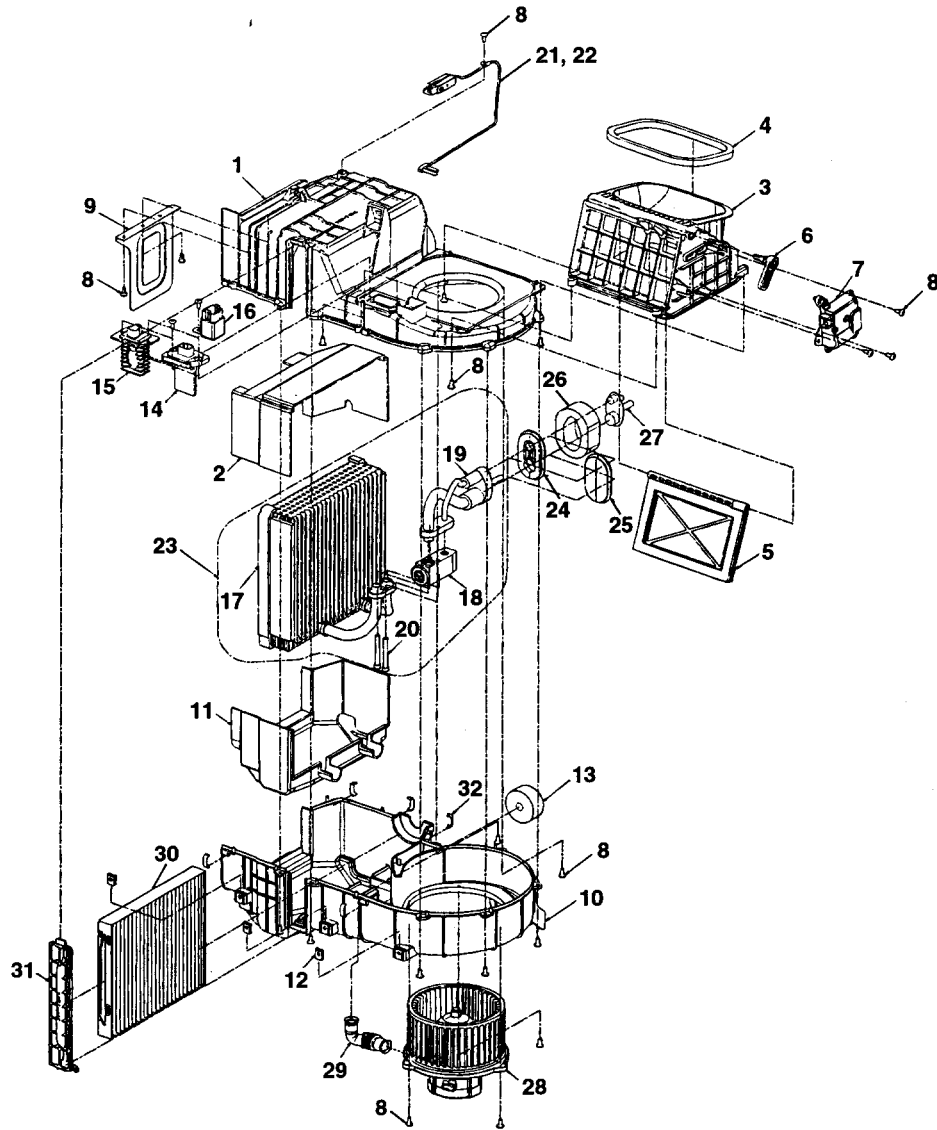
Condition	Resistance
Normal condition	5V
Hazardous gas detection	0V



KFWD030A

## BLOWER UNIT

## COMPONENTS EQMB0530



- |                                      |                                       |                                   |
|--------------------------------------|---------------------------------------|-----------------------------------|
| 1. Evaporator upper case             | 11. Evaporator blower lower insulator | 22. Evaporator core sensor (Auto) |
| 2. Evaporator blower upper insulator | 12. Spring nut                        | 23. Evaporator core               |
| 3. Air in-let duct case              | 13. Evaporator drain seal             | 24. Evaporator core tube bracket  |
| 4. Air in-let duct seal              | 14. Blower speed register             | 25. Evaporator tube grommet       |
| 5. Air vent door                     | 15. Power TR                          | 26. Seal                          |
| 6. Air in-let door arm               | 16. Power relay                       | 27. Joint flange cap              |
| 7. Air in-let door actuator motor    | 17. Evaporator core                   | 28. Motor & wheel                 |
| 8. Tap screw                         | 18. Block expansion valve             | 29. Blower motor cooling tube     |
| 9. Air screen baffle                 | 19. Dash panel side tube              | 30. Air filter                    |
| 10. Evaporator lower case            | 20. Expansion valve mounting bolt     | 31. Air filter cover              |
|                                      | 21. Evaporator core sensor (Manual)   | 32. Clip                          |

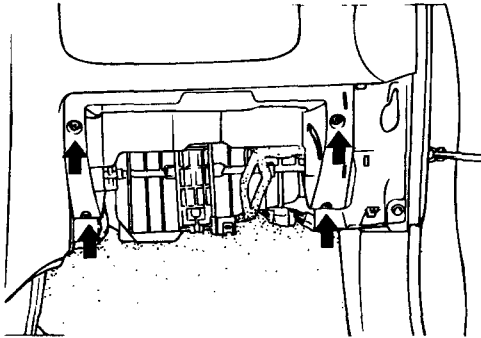
## BLOWER MOTOR

### AIR FILTER EQMB0550

The combination filter eliminates foreign materials and odor. The combination filter includes an odor filter as well as conventional dust filter to ensure comfortable interior environment.

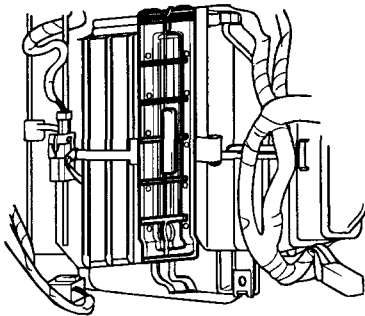
#### REMOVAL

1. Remove the glove under cover.
2. Remove the glove box housing.
3. Remove the upper cover of the glove box.



ESJA035L

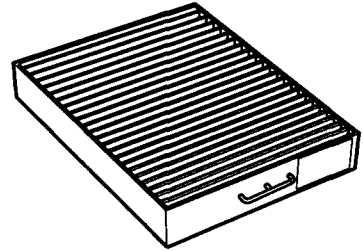
4. Remove the glove box housing bracket.
5. Remove the air filter cover and the air filter.



EQJA005A

#### CAUTION

*When driving in an air-polluted area or rugged terrain, check and replace the air filter as frequently as possible.*



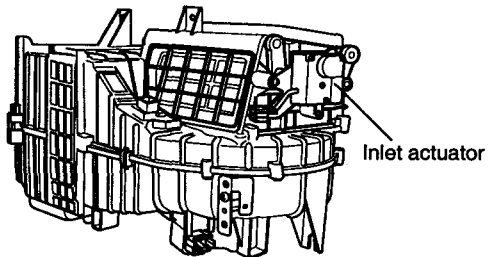
KFWD051A

## POWER TRANSISTOR

### FRESH AIR RECIRCULATION SWITCHING

#### ACTUATOR EQMB0600

The intake selection switch is located on the control panel. Pressing the switch will shift between recirculation and fresh air modes.



KFWD046A

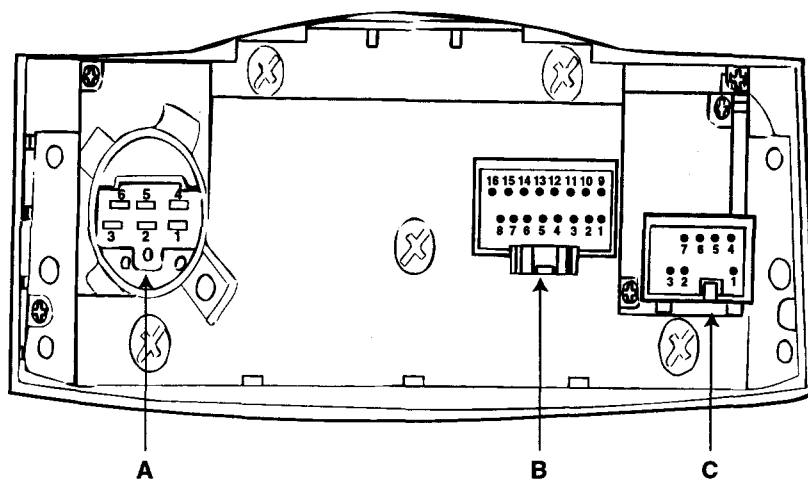
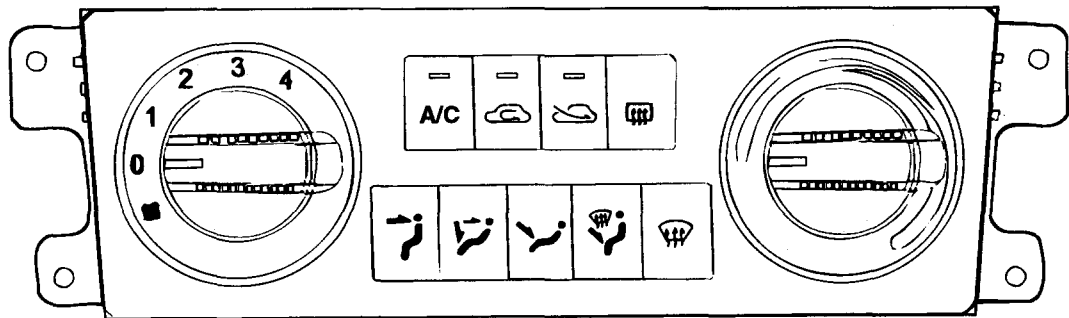
#### CHECK

Input		Output
1	2	Fresh/recirculation shifting
+	-	Recirculation
-	+	Fresh

# BLOWER AND A/C CONTROLS (MANUAL)

## AIR CONDITIONING SWITCH

CONTROL PANEL EQMB0200



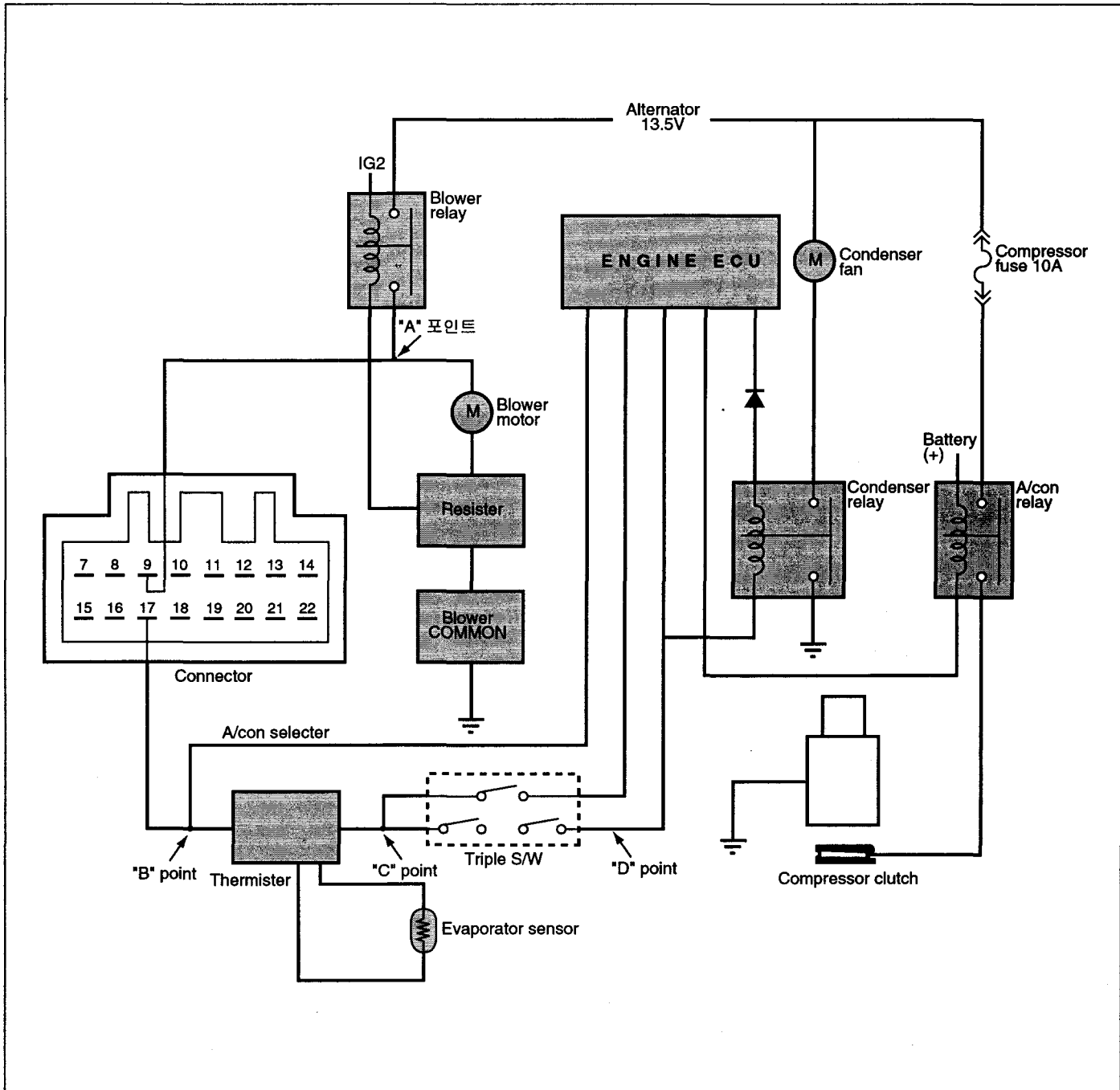
CONNECTOR PIN DESCRIPTION

Item	PIN NO.	PIN Name	Item	PIN NO.	PIN Name
MAIN CONNECTOR (B)	1	IGNITION	BLOWER S/W (A)	6	LOW
	2	ILLUMINATION(+)		5	MIDDLE LOW
	3	B+		4	HIGH
	4	REAR DEFOGER S/W		3	EARTH
	5	FRE		2	COMMON
	6	VENT		1	MIDDLE HIGH
	7	BI-LEVEL	TEMP. S/W (C)	1	IGNITION
	8	FLOOR		2	GROUND
	9	GROUND		3	WARM
	10	ILLUMINATION (-)		4	COOL
	11	THERMISTOR		5	VCC
	12	REAR DEFOG INDICATOR		6	PBR
	13	REC		7	SENSOR GROUND
	14	MIX			
	15	DEF			
	16	-			



CHECKPOINT BY TYPE EQMB0220

A/CON CHECK

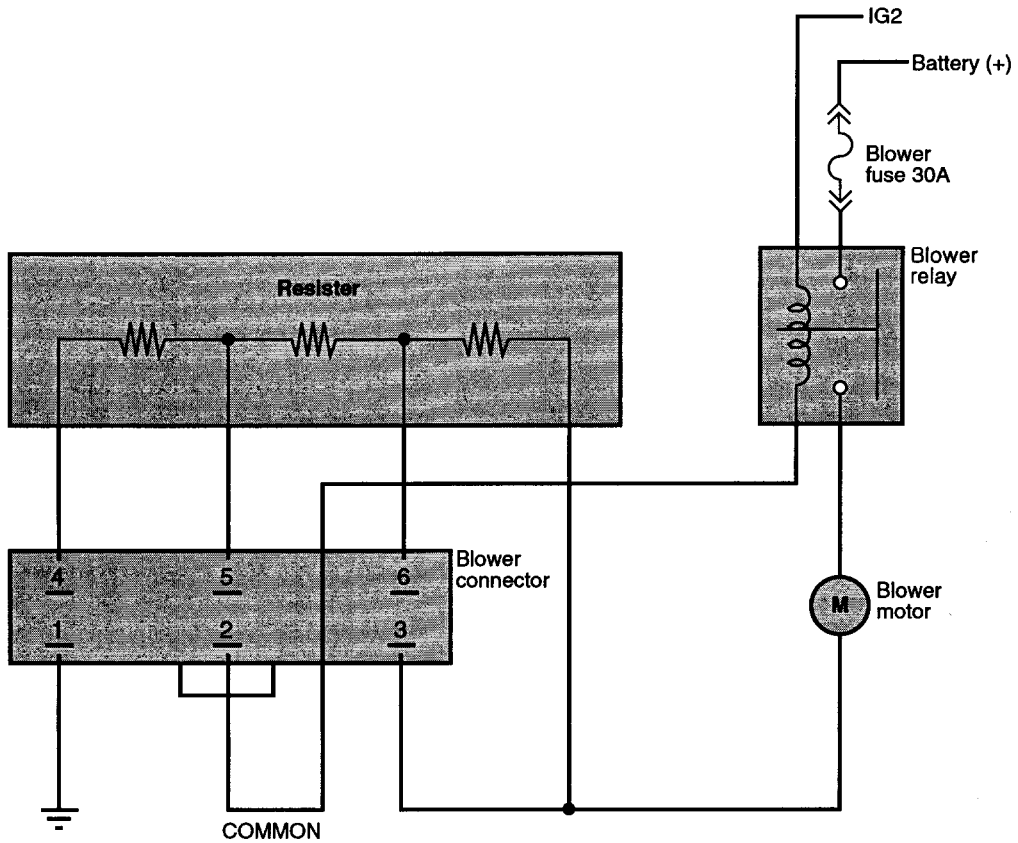


EQMB022A

1. For A/CON output, blower must be basically operated.
2. When blower 1-speed is selected, blower relay becomes turned on, and voltage is supplied to point "A".
3. When the supplied voltage at point "A" is entered into control connector 3 and at this moment when A/CON switch is turned on, voltage is supplied to connector pin 11 at 9V or more.
4. The state of ON/OFF of triple switch determines whether the input power at point "C" is supplied to point "D" or not. Finally when the voltage is supplied to point "D", Engine ECU determines whether A/CON and Condenser are turned ON/OFF.

EQMB0230

**BLOWER MOTOR CHECK**

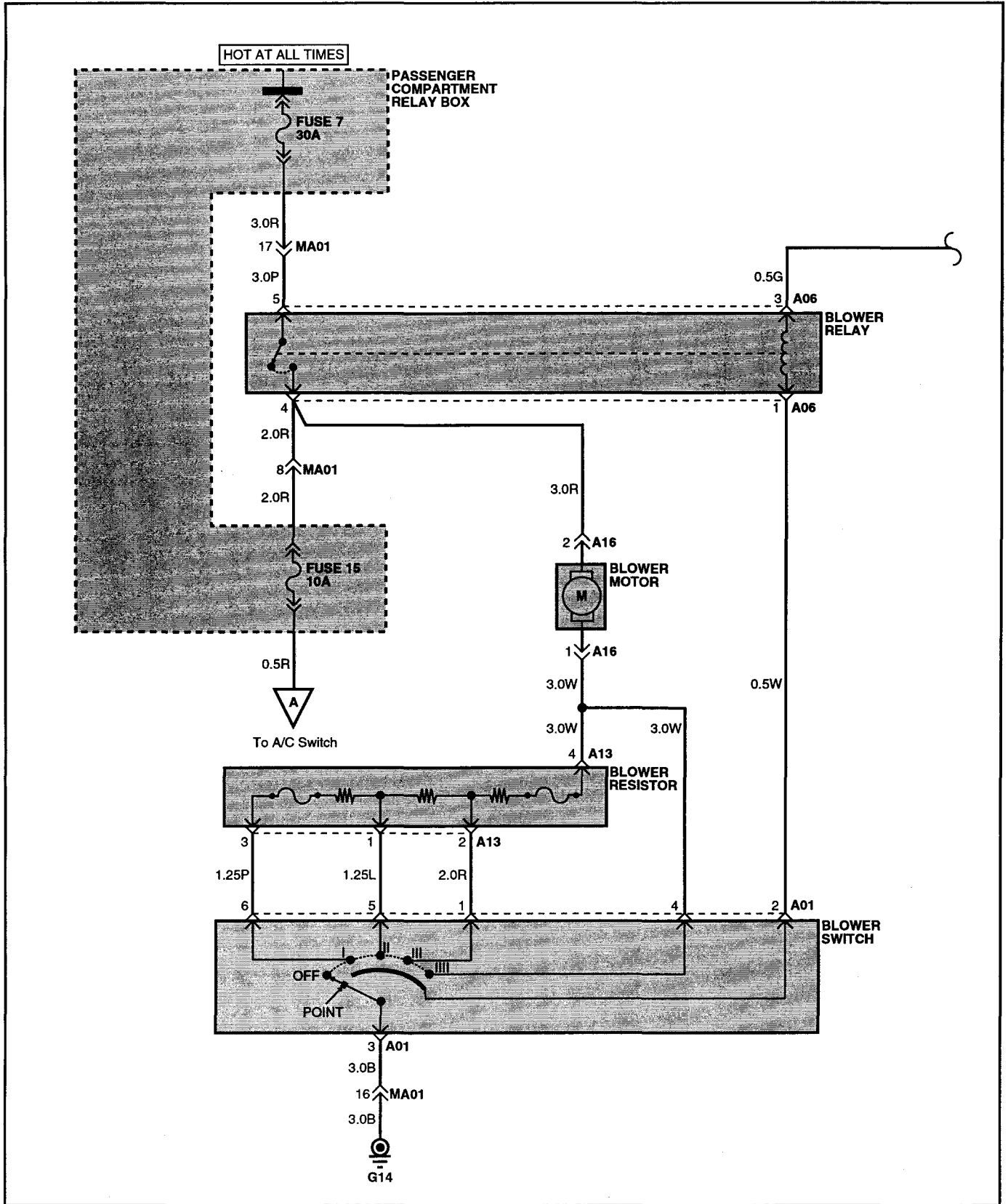


EQMB023A

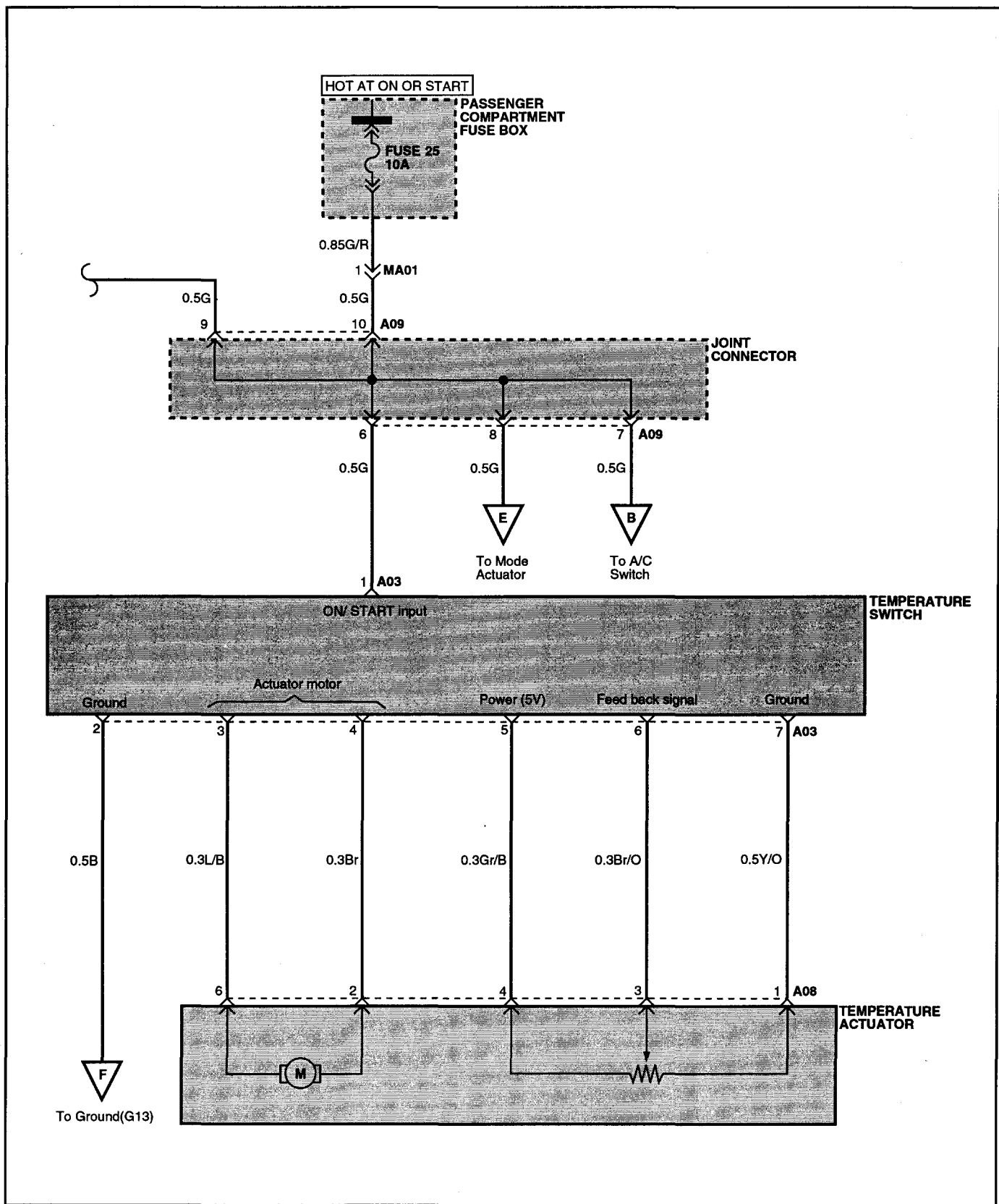
When blower is turned on, blower relay becomes turned on and voltage is supplied to blower motor. Current determined by register runs through the selected blower register and blower motor.

SCHEMATIC DIAGRAM (MANUAL) EQMB0700

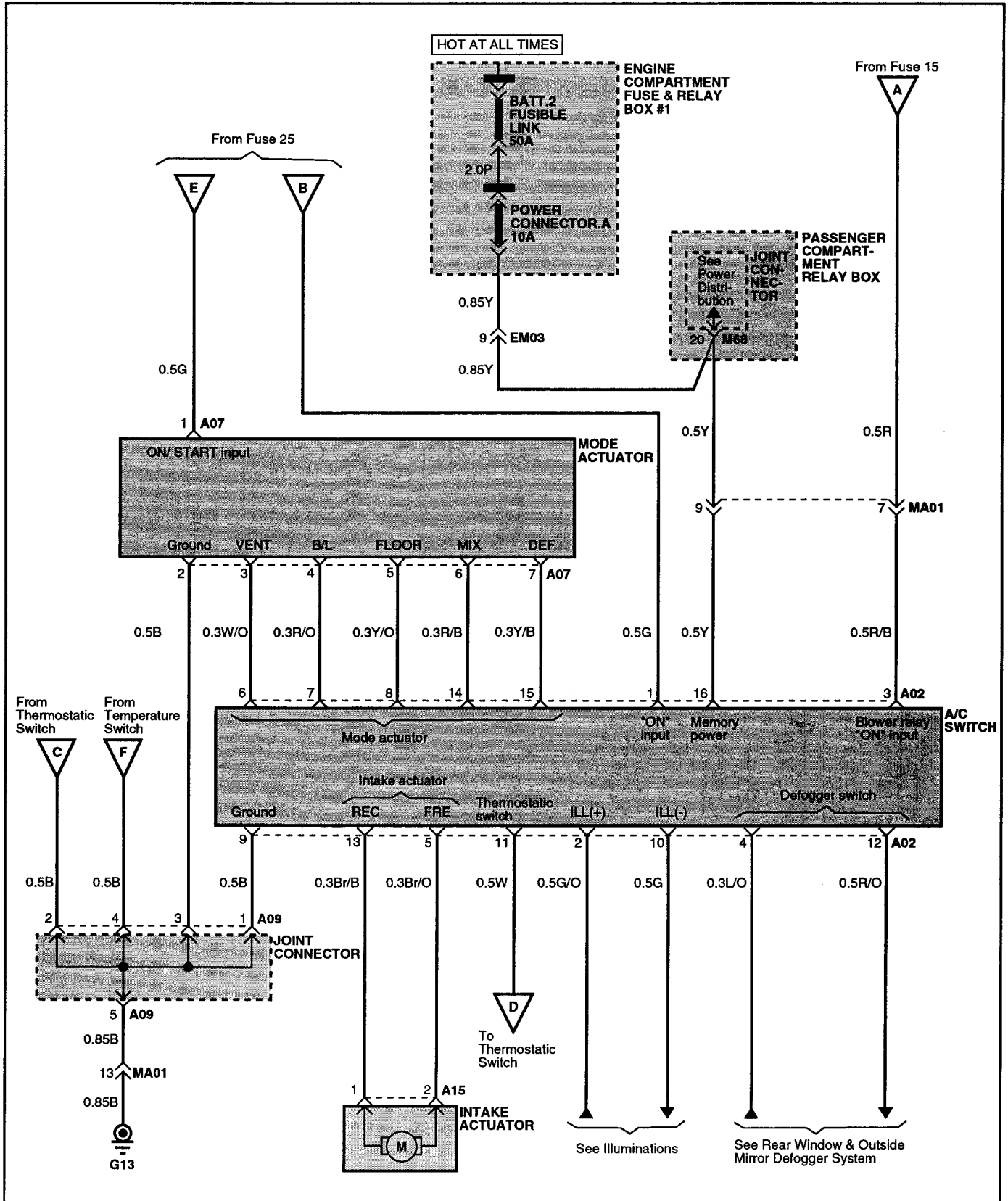
BLOWER AND A/C CONTROLS (MANUAL) (1)



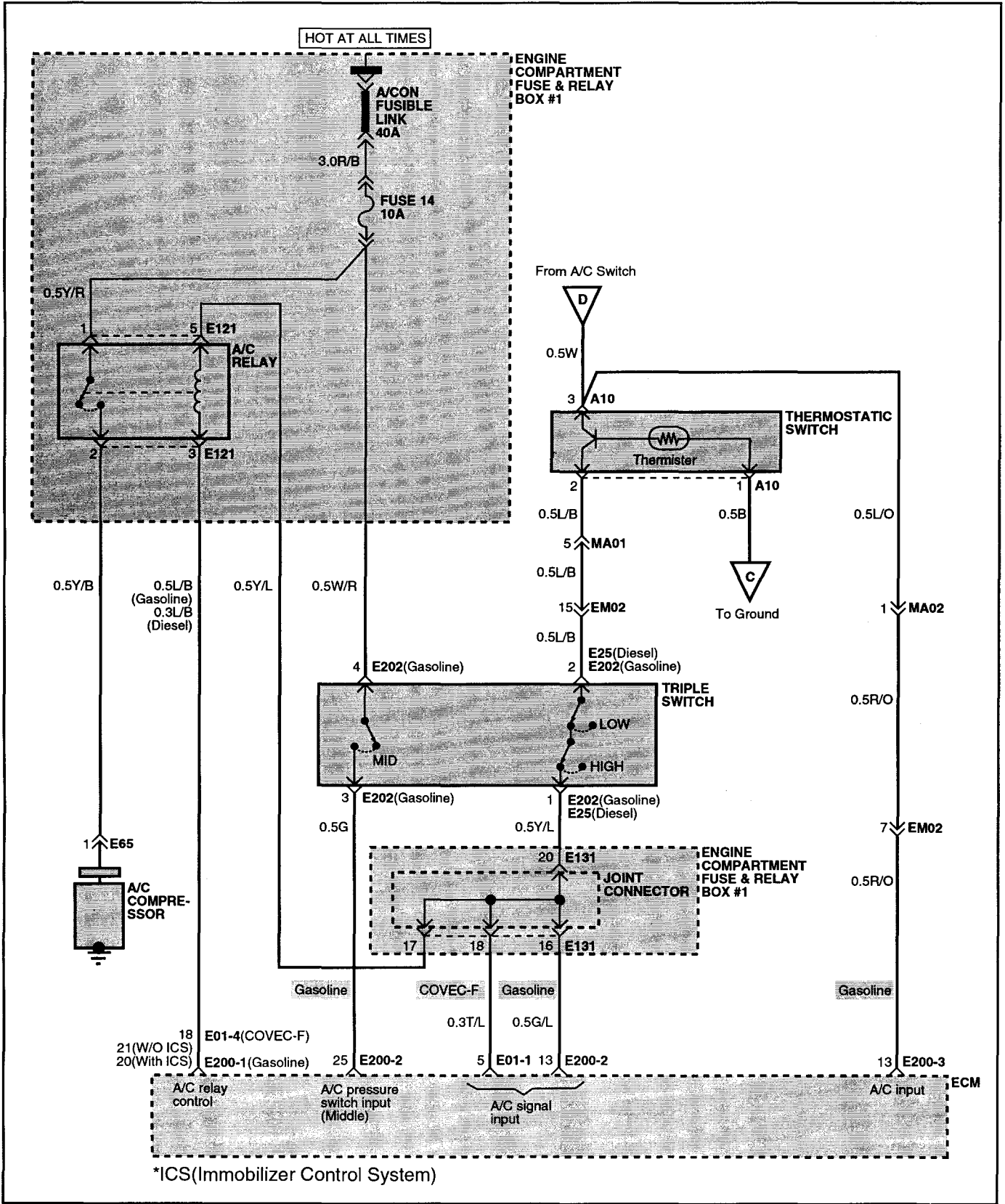
BLOWER AND A/C CONTROLS (MANUAL) (2)



BLOWER AND A/C CONTROLS (MANUAL) (3)



BLOWER AND A/C CONTROLS (MANUAL) (4)

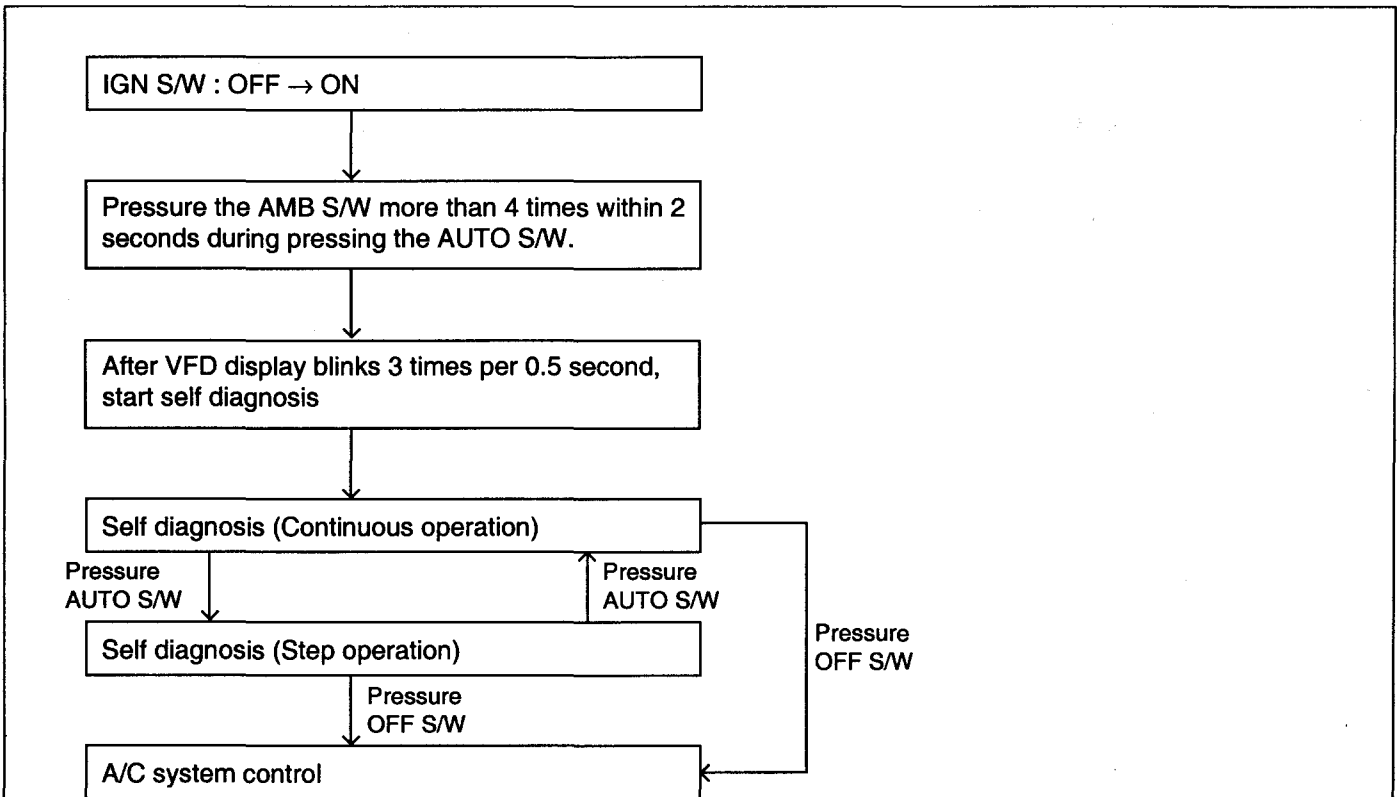


# BLOWER AND A/C CONTROLS (AUTOMATIC)

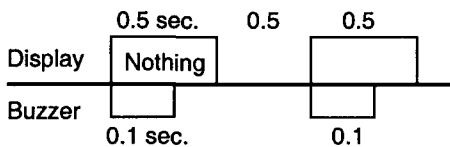
## DIAGNOSIS SYSTEM EQMB0260

### OPERATION METHOD (SELF-DIAGNOSIS)

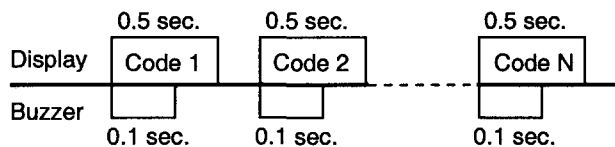
The F.A.T.C. module self test feature will detect electrical malfunction and provide error codes for system components with suspected failures.



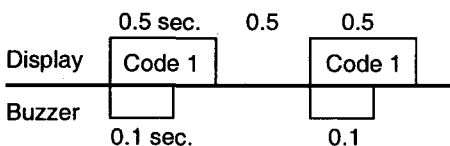
1. Normal



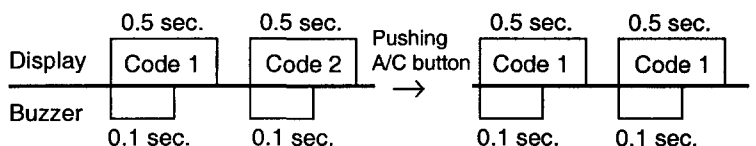
3. More error codes than two



2. One error code



4. Checking each error code



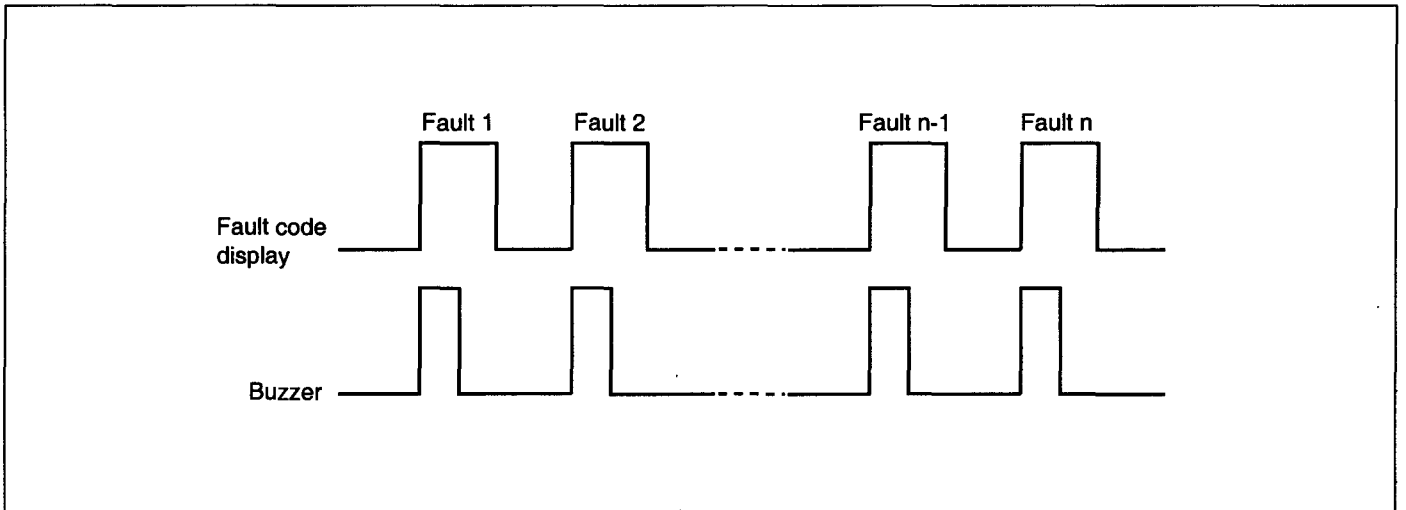
**FAIL SAFE FUNCTION**

No.	Item	Failure	FAIL SAFE Function
1	In-car temperature sensor	Open/Short	25°C alternate value control
2	Ambient temperature sensor	Open/Short	20°C alternate value control
3	Pin thermo sensor	Open/Short	-2°C alternate value control
4	Temperature door potentiometer	Open/Short setup temperature	For 17°C to 24.5°C, Set to maximum cooling position. For 25°C to 32°C, Set to maximum heating position.
5	AQS	Open	Does not AQS function. AQS indicator : off

**HOW TO READ SELF-DIAGNOSTIC CODE**

1. After the display panel flickers three times every 0.5 second, the corresponding error code flickers on the setup temperature display panel every 0.5 second and will show two figures.
2. If error code is more than two, each code flickers 2 times in sequence.

**FAULT CODE DISPLAY**



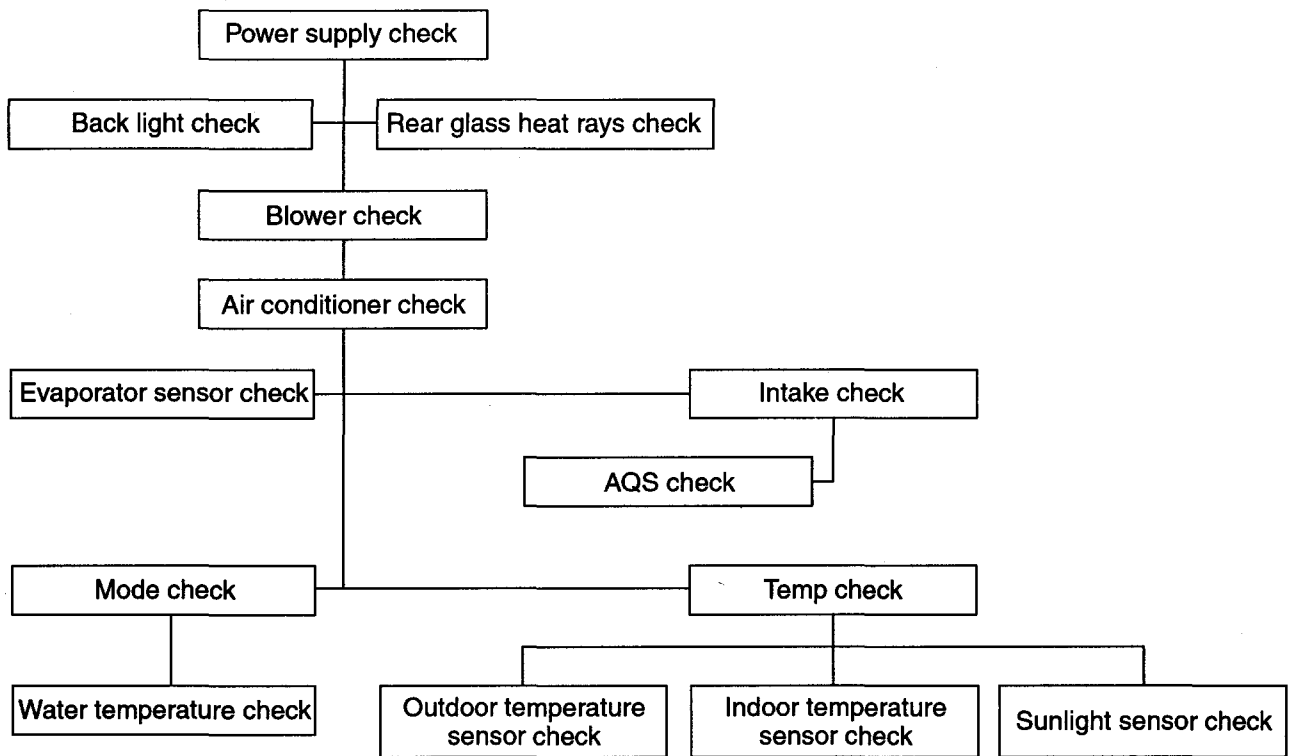


**DTC CHART**

If a malfunction code is displayed during the DTC check, check the circuit listed for that code in the table below.

<b>DTC code</b>	<b>Detection item</b>	<b>Trouble area</b>
00	Normal	-
11	Open INCAR Sensor circuit	<ul style="list-style-type: none"> <li>• Incar sensor</li> <li>• Harness or connector between incar sensor and A/C control assembly</li> <li>• A/C control assembly</li> </ul>
12	Shorted INCAR Sensor circuit	
13	Open Ambient sensor circuit	<ul style="list-style-type: none"> <li>• Ambient sensor</li> <li>• Harness or connector between ambient sensor and A/C control assembly.</li> <li>• A/C control assembly.</li> </ul>
14	Shorted Ambient sensor circuit	
15	Open pin thermo sensor	<ul style="list-style-type: none"> <li>• Pin thermo sensor</li> <li>• Harness or connector between evap. sensor and A/C control assembly</li> <li>• A/C control assembly</li> </ul>
16	Shorted pin thermo sensor	
17	Open or shorted temp. door potentiometer	<ul style="list-style-type: none"> <li>• Harness or connector between temp. door potentiometer and A/C control assembly</li> </ul>
18	Defective temp. door potentiometer	<ul style="list-style-type: none"> <li>• Temp. door potentiometer</li> </ul>

## CHECKPOINT BY TYPE EQMB0270



EQMB027A

Since FATC controller is complicated in functions as shown in the above chart, it is impossible to conclude its reason at the occurrence of failure. All possibilities of failure shall be considered for the purpose of efficient How to check.

1. Power supply check
2. Back light and Rear glass heat rays check
3. Blower check
4. Air conditioner check
5. Intake check and AQS check
6. Mode check
7. Temp check
8. Each sensor check

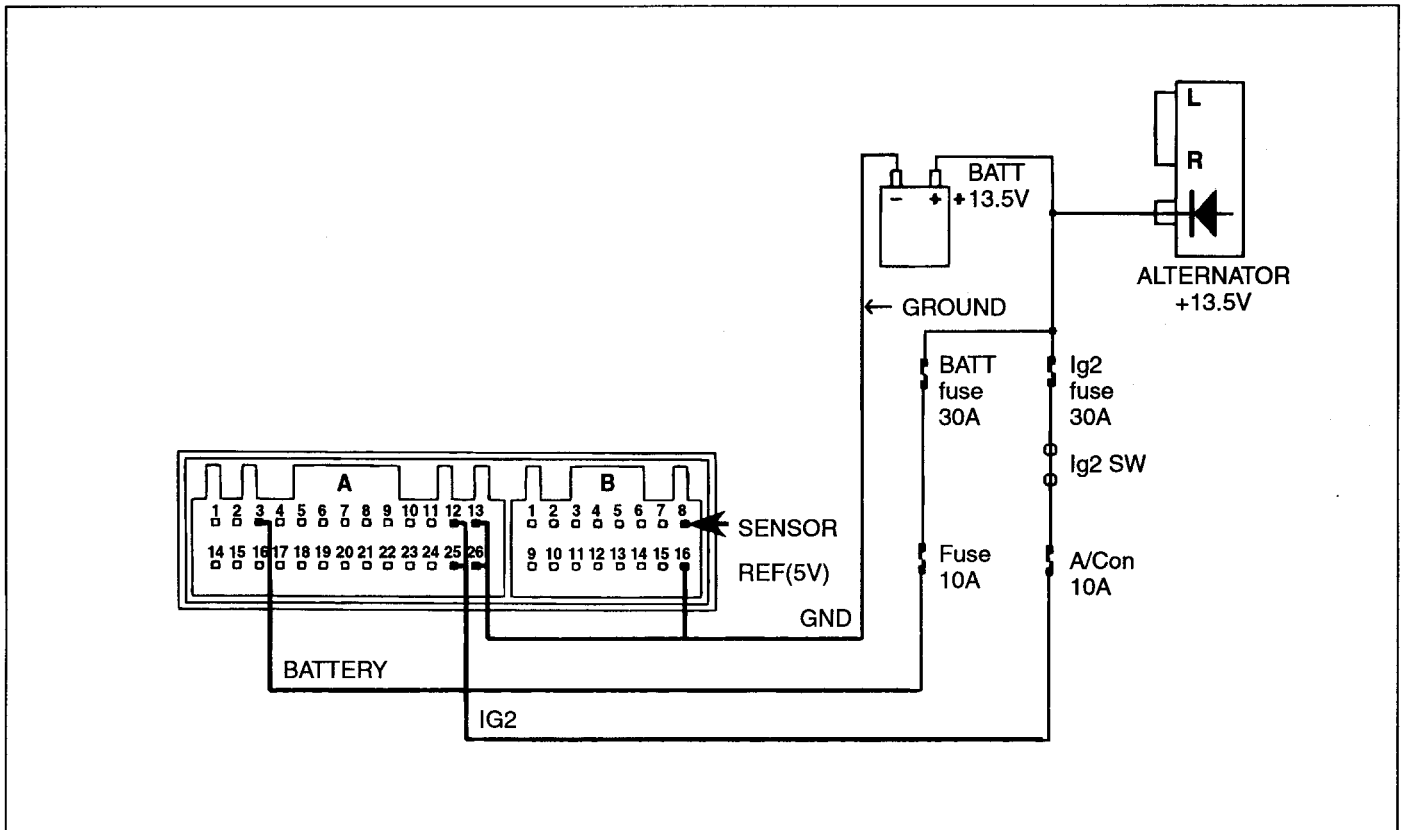
**POWER SUPPLY CHECK** EQMB0280

In turning off IGN, battery supplies power for ordinary power, FATC connector A-3 through battery fuse. FATC performs memory function by means of battery power supplied as described above. In turning on IGN, alternator

is driven. At this time, IG2 power generated in alternator FATC connector A-12 and A-25 terminal through IG1 fuse and air conditioner fuse (10A). FAT carried out actual system operation by means of IG2 power supplied as described above.

**ERROR DIAGNOSTICS**

Symptoms	Causes	How to check
When IF is ON, memory function error occurs	Battery power supply error	Check voltage of battery after turning off IG. If 10V and more, check FATC connector and if no problem, check the inside of controller. If 10V and less, check fuse or wiring state of battery power source.
When IG is ON, system running error occurs.	IG2 power supply error	Check voltage of IG2 after turning on IG. If 10V and more, check FATC connector and if no problem, check the inside of controller. If 10V and less, check fuse or wiring state of IG2 power source.



**BACK LIGHT AND REAR GLASS HEAT**

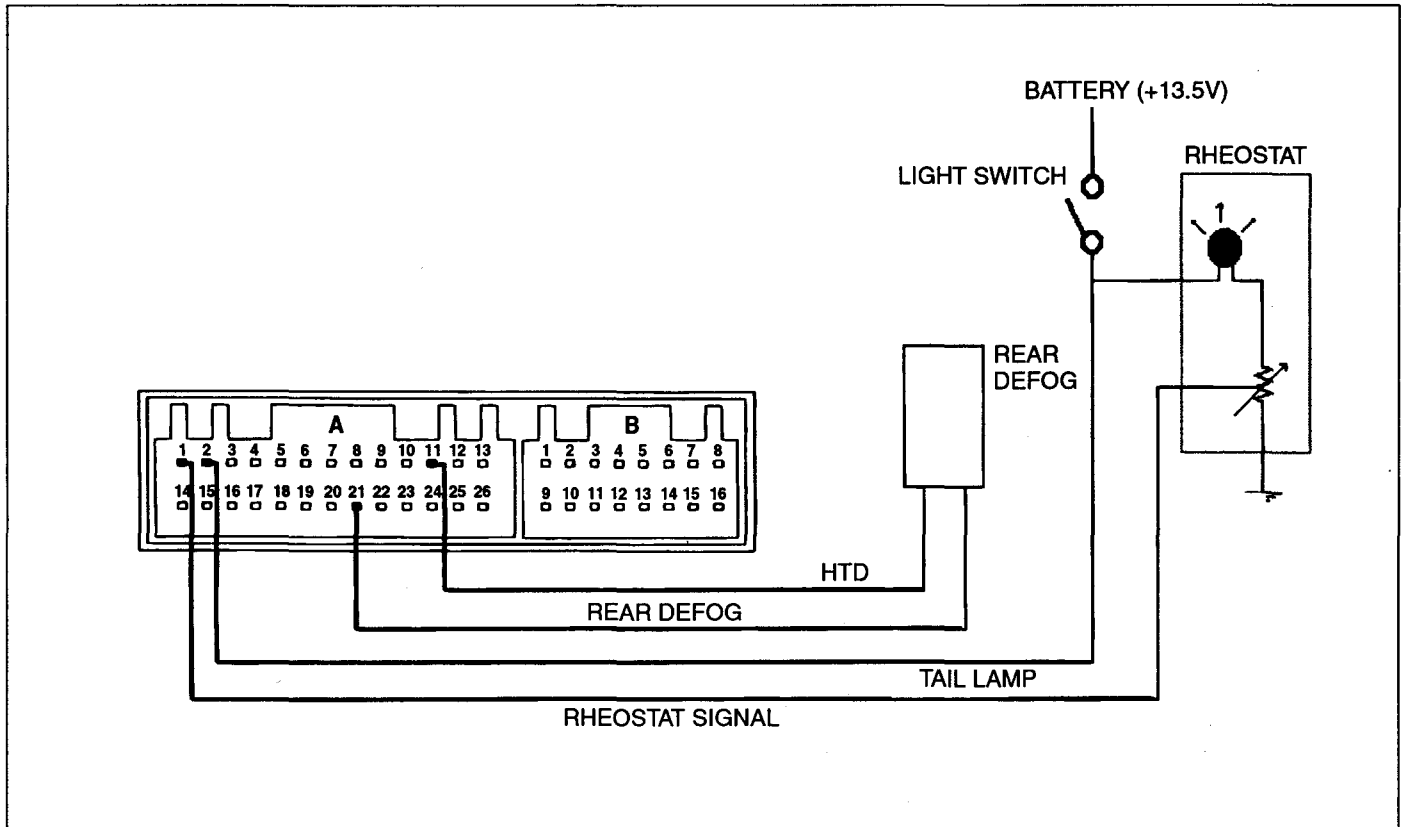
**RAYS CHECK** EQMB0290

In turning on IG and then light switch, battery power is supplied for FATC connector A-2 terminal through wiring. The

supplied power passes connector A-1 terminal through light bulb in FATC and flows into reostart as shown in the above figure. The brightness is adjusted according to resistance value of reostart.

**ERROR DIAGNOSTICS**

Symptoms	Causes	How to check
When light switch is ON, partial error occurs in back light.	Light bulb lighting error in FATC	
When light switch is ON, entire error occurs in back light.	Light power supply error	Measure voltage of tail light shown in the above figure after switching on light. If 10V and more, check FATC connector and if no problem, measure signal voltage of reostart shown in the above figure. If 8V and more, check reostart wiring and reostart. If tail light is below 1V, check tail light wiring.



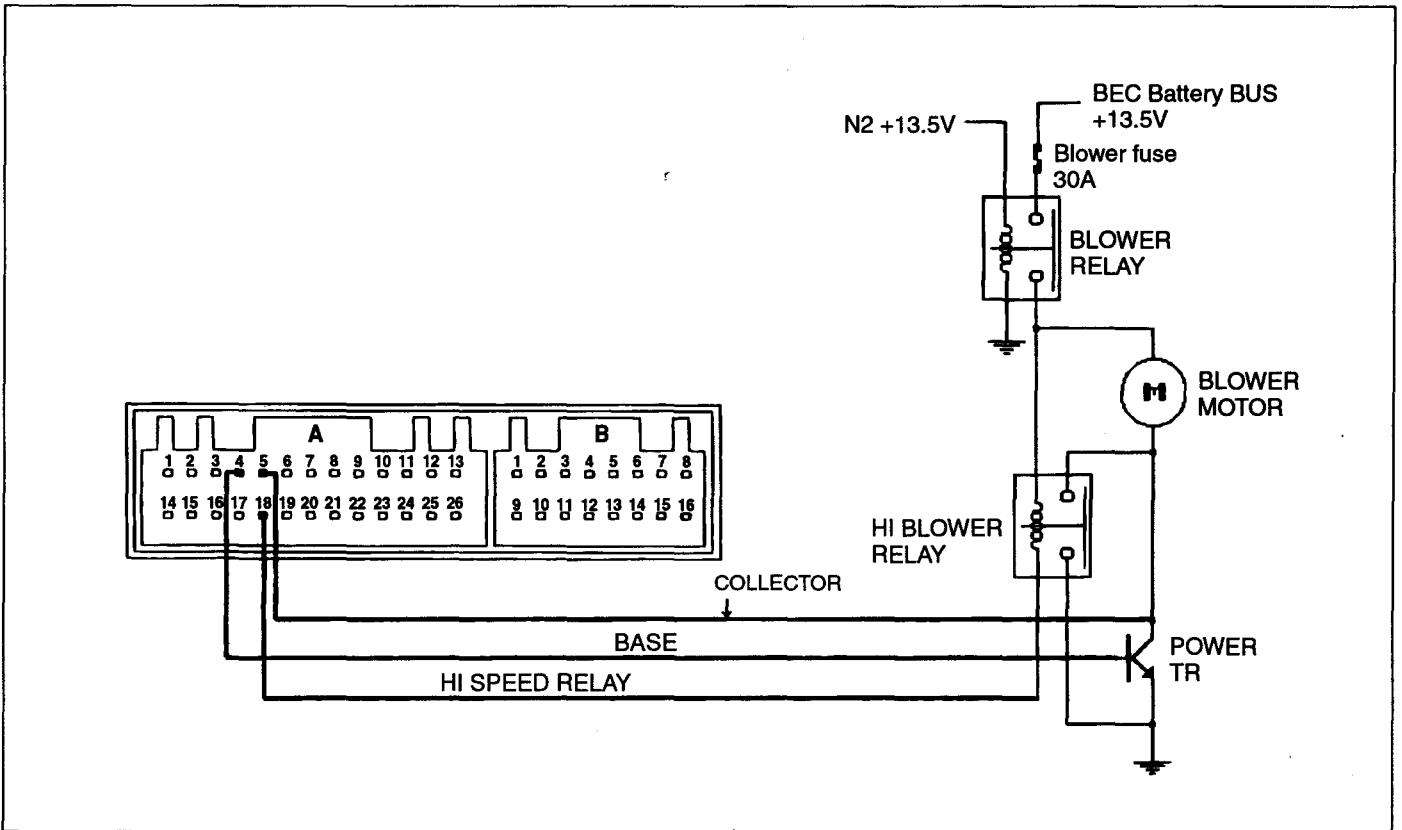
**BLOWER CHECK** EQMB0300

Perform the blower check in manual blower running state because it is difficult to check blower at automatic control. Blower is controlled from level 1 to level 7 equally as in button operation and running logic. In turning on IG, blower relay is ON and voltage of 0.1 to 1.4V is transferred from

FATC connector A-4 terminal to base source of power TR according to FATC control (selectable from level 1 to level 7). At this time, voltage of blower motor's both ends is determined according to collector voltage of FATC connector A-5 terminal. If FATC is controlled in level 7, GND(0V) is supplied for FATC connector A-18 terminal and high blower relay is driven.

**ERROR DIAGNOSTICS**

Symptoms	Causes	How to check
Amount of wind is wrong at manual selection of blower.	Power TR error	Check voltage of blower motor's both ends. (Level 1 : 3.8V, Level 2 : 5.3V, Level 3 : 6.7V, Level 4 : 8.1, Level 5 : 9.5V, Level 6 : 0.6V, Level 7 :13.5V [high-relay operation]) Measure voltage of each terminal and if there is difference more than ±0.6V, check power TR.
Blower wind is discharged despite pressing OFF switch.	Power TR error	Power TR change



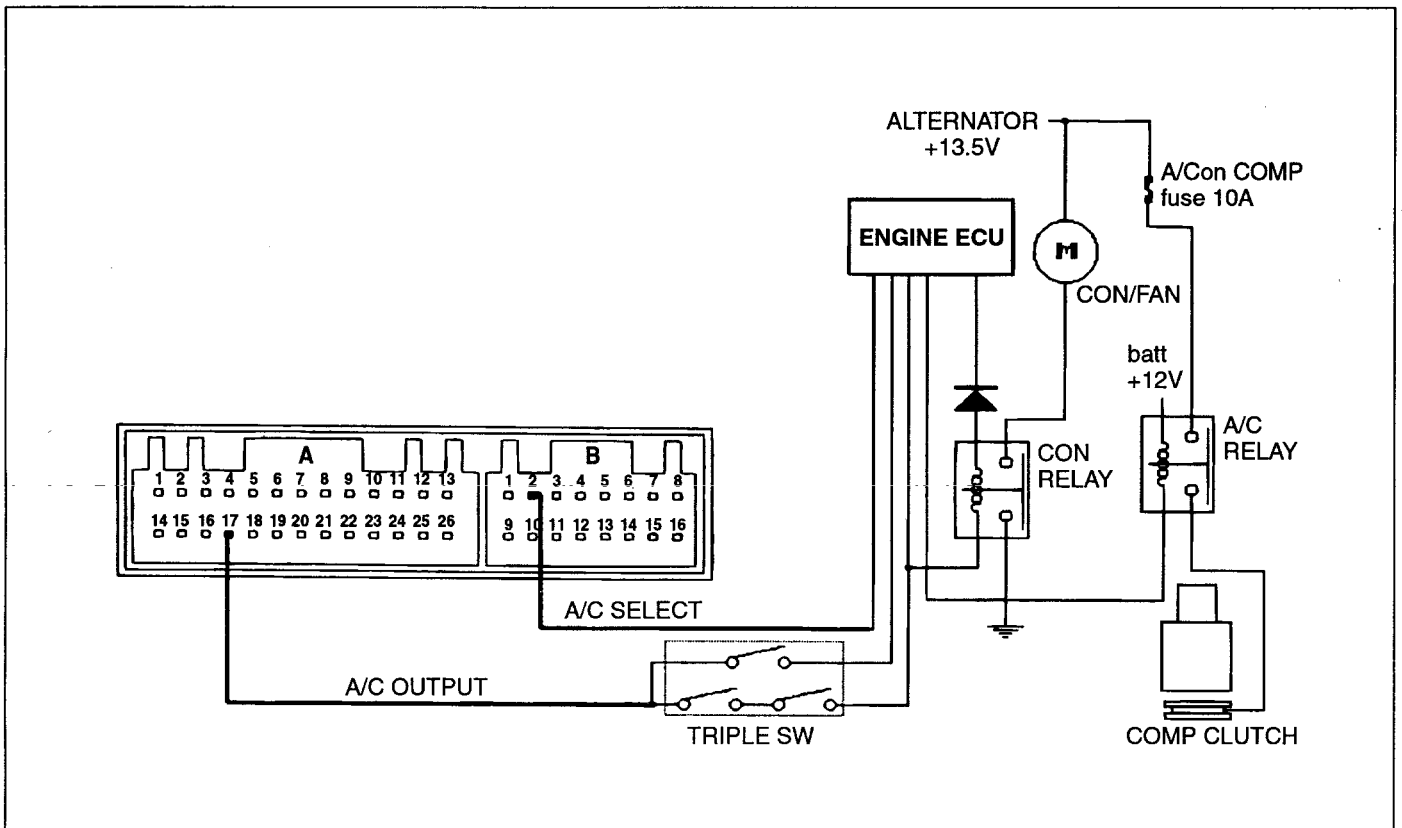
**AIR CONDITIONER CHECK** EQMB0310

11V is outputted from connector A-17 terminal in turning on INSULATING and pressing air conditioner switch. However, although 11V is outputted from FATC connector A-17 terminal, compressor clutch isn't driven. Wind of air conditioner is discharged if only compressor clutch works. Output signal from air conditioner is inputted in engine computer through triple switch. Then, the engine computer considers several conditions and when output of air conditioner is judged to be practical, it gives GND to signal

terminal of air conditioner relay. Accordingly, relay of air conditioner is ON and compressor clutch works. Triple switch checks pressure of refrigerant flowing through pipe and turns on/off switches in it according to standard. So, it controls that output signal of air conditioner outputted from FATC is inputted into engine computer, and also speed of condenser fan according to pressure level. (For high pressure, high-speed and for low pressure, low-speed)

**ERROR DIAGNOSTICS**

Symptoms	Causes	How to check
Wind of air conditioner isn't discharged into vehicle despite switching on air conditioner.	Signal output error of air conditioner	Switch on air conditioner and measure voltage of FATC connector A-17 terminal as shown in the above figure. If 9V and more, check triple switch, air conditioner relay and ECM.  Switch on air conditioner and measure voltage of FATC connector A-17 terminal as shown in the above figure. If 1V and less, check input value of evaporator sensor.
	Input error of evaporator sensor	If evaporator sensor is disconnected or short or voltage of its input source is more than 3.0V (below 0.5°C), output of air conditioner isn't made.



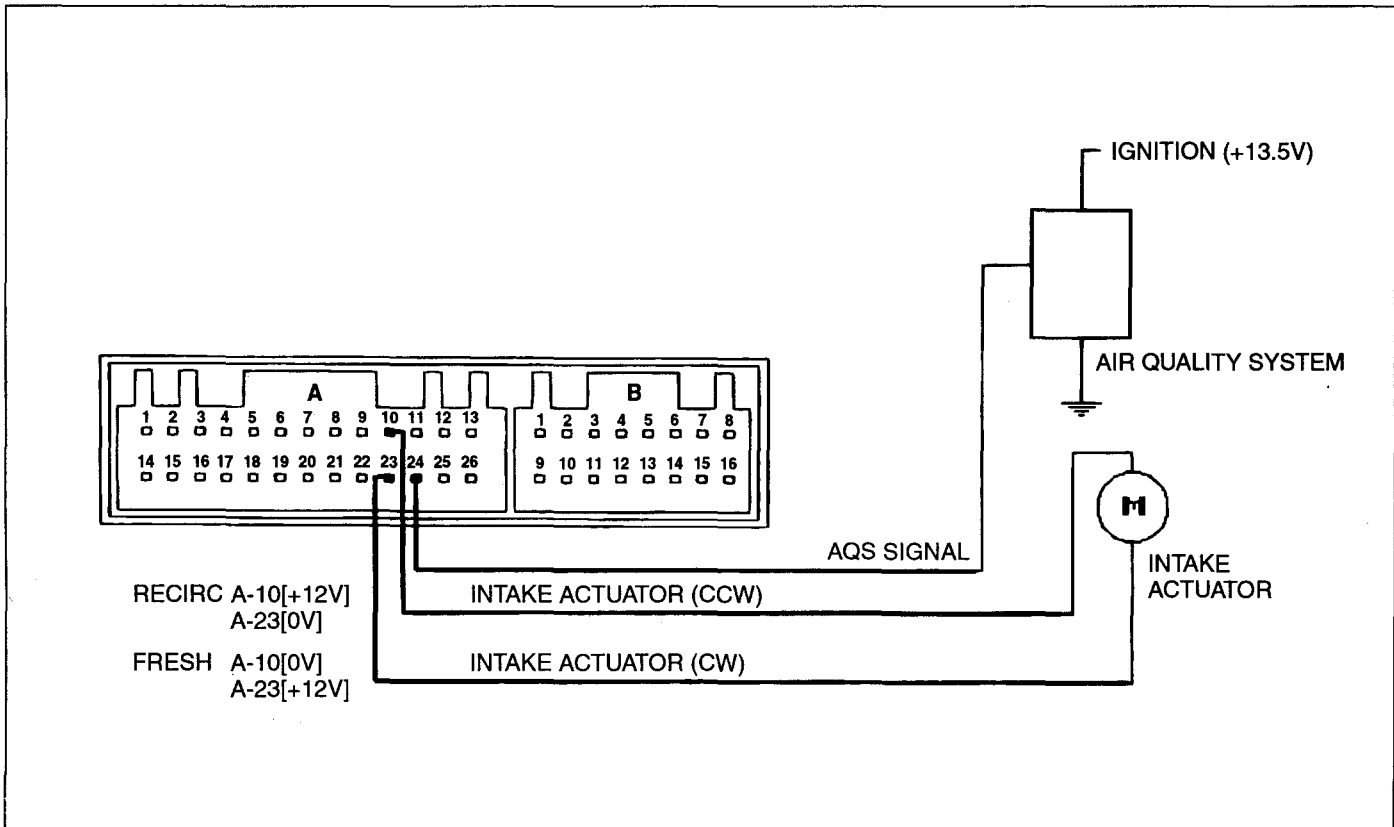
**INTAKE AND AQS CHECK** EQMB0320

In turning on IG and selecting outdoor mode with indoor switch, 12V is outputted from FATC connector A-23 terminal, 0V is supplied for A-10 terminal and motor works in direction of outdoor.

In selecting indoor mode with indoor switch, 12V is outputted from FATC connector A-10 terminal, 0V is supplied for A-23 terminal and motor works in direction of indoor.

**ERROR DIAGNOSTICS**

Symptoms	Causes	How to check
Outdoor mode running error	Power supply error in actuator	Separate connector linked with actuator, select outdoor mode with indoor switch and measure voltage of FATC connector A-23 terminal. If 8V and more, check actuator or wiring state and if 9V and less, check the inside of controller.
Indoor mode running error	Power supply error in actuator	Select indoor mode in the above method and measure voltage of FATC connector A-10 terminal. If 8V and more, check actuator or wiring state and if 9V and less, check the inside of controller.
Fixed in outdoor or indoor mode at AQS selection.	AQS signal terminal output error	Select AQS switch and measure AQS signal terminal as shown in the above figure. If there is no change of voltage over 10 min, check AQS.



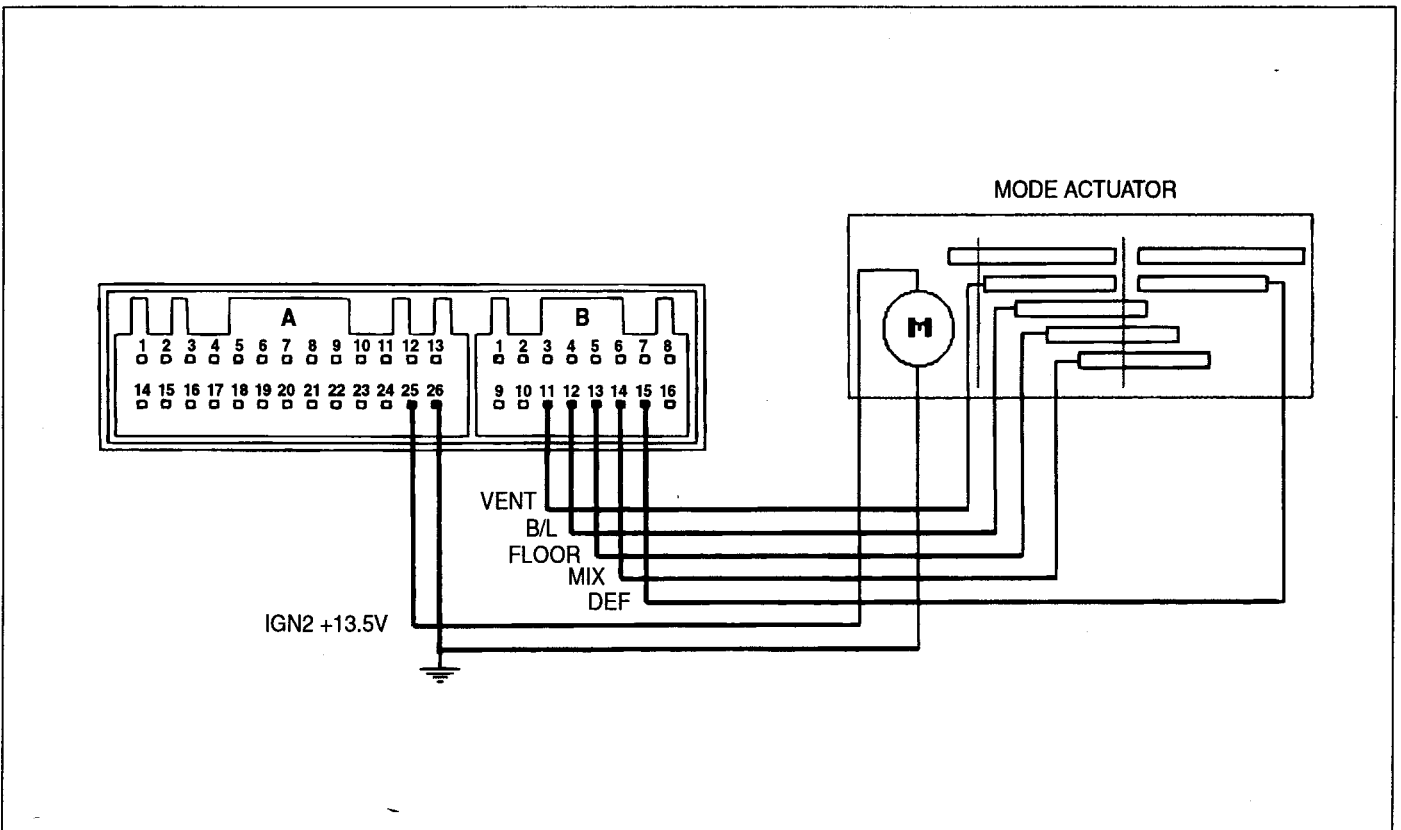
**MODE CHECK** EQMB0330

In turning on IG and selecting mode switch, sequential operation begins in order of Vent→Bi-level→Blower→Mix. DIP mode works regardless of order at selecting it. In selecting Vent mode as mode switch, GND(0V) is supplied

for FATC connector B-11(Vent) terminal. Voltage of 9V and more is set in the rest terminals B-12, B-13, B-14, B-15 and motor drive IC in mode actuator which receives the signal, works in direction of vent mode setup. Vent, Built-in-level, Blower, Mix and Defrost mode can be selected in the method described above.

**ERROR DIAGNOSTICS**

Symptoms	Causes	How to check
Specific mode isn't selected.	Signal transmission error of selected mode	Measure voltage of selected mode wiring without separating connector linked with actuator. If 8V and more, check the inside of controller.
	Mode actuator running error	If 1V and less at measuring in the above method, check mode actuator and wiring state.
Mode selection is impossible	Internal error of mode actuator	If motor driver IC built in mode actuator is bad, mode selection is impossible. When mode isn't selected though GND(0V) is supplied for selected mode wiring after selecting mode in controller, its cause is internal failure of mode actuator.





**TEMP CHECK** EQMB0340

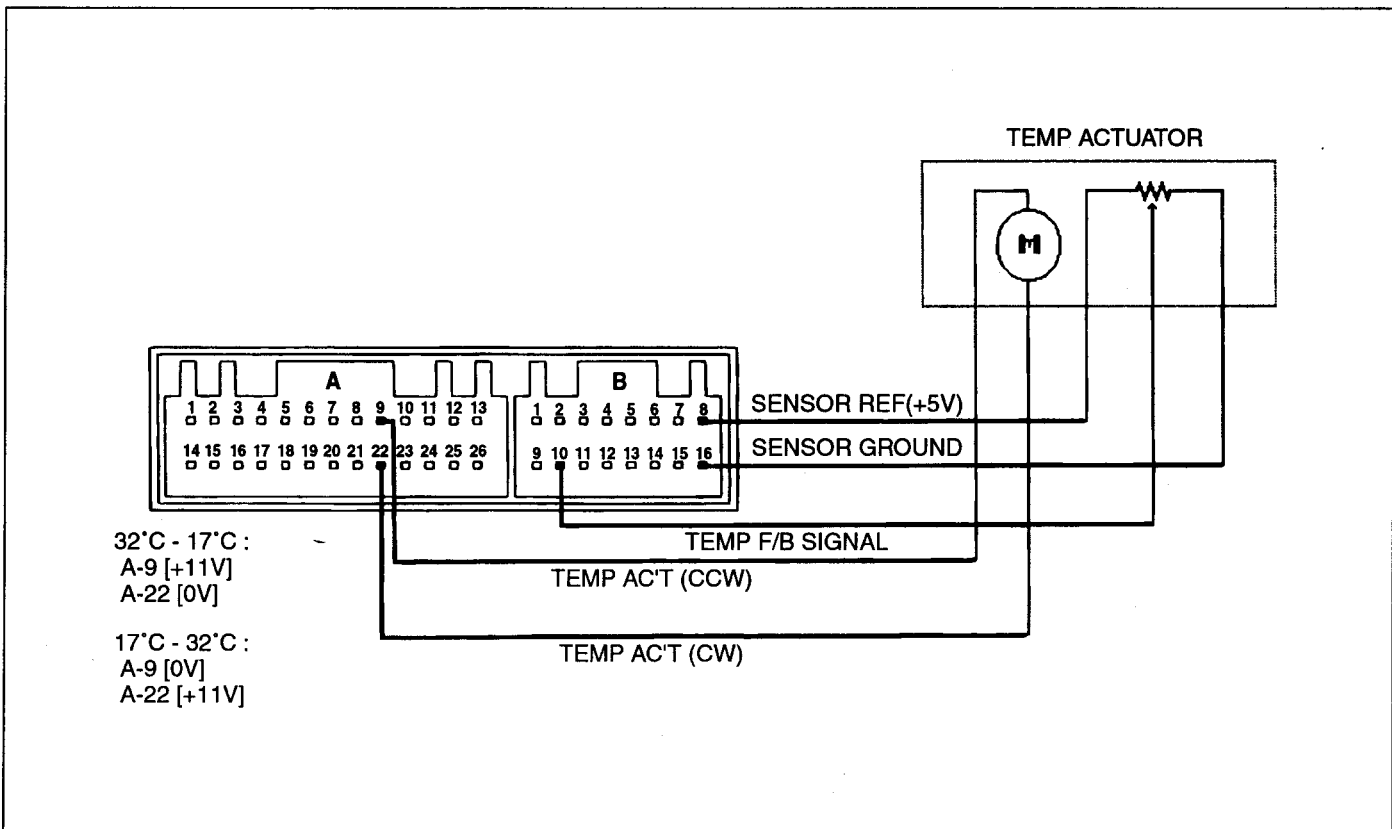
In adjusting temp switch from 32°C to 17°C, 11V is outputted from FATC connector A-9 terminal, 0V is supplied for A-22 terminal and temp motor works in direction of COOL. In adjusting temp switch from 17°C to 32°C, 11V is outputted from FATC connector A-22 terminal, 0V is supplied for A-9 terminal and temp motor works in direction of WARM. When temp actuator has to move to a certain location for its automatic control, temp feedback signal terminal moves equally in temp actuator and informs controller of location of temp actuator through FATC connector B-10 terminal. Comparing original value with inputted value, it

works until they are same. If 4.9V and more is inputted in B-10 terminal, it is regarded as disconnection. If 0.1V and less is inputted in B-10 terminal, it is regarded as short-circuit. In the case of disconnection or short-circuit as a result of self-diagnostic, substitute control is carried out as follows.

- If setup temperature is 17°C to 24.5°C, set to MAX COOL.
- If setup temperature is 25°C to 32.0°C, set to MAX WAR.

**ERROR DIAGNOSTICS**

Symptoms	Causes	How to check
Temp actuator running error	Power supply error in temp actuator	After altering 17°C to 32°C and adversely, measure voltage of A-22 terminal. If Both of them are 9V and more, check temp actuator and peripheral wiring state and if one or both of them are 5V and less, its cause is internal failure of FATC.
	Sensor (+5) power supply error	If automatic control isn't operated smoothly, measure voltage of FATC connector B- 8 terminal. If under 4.8V or over 5.2V, its cause is internal failure of FATC.
	Driver error of temp actuator	If No. 20 is outputted as a result of self-diagnostic, check temp actuator driver.

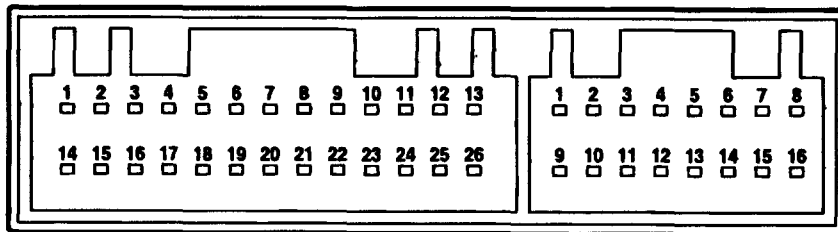
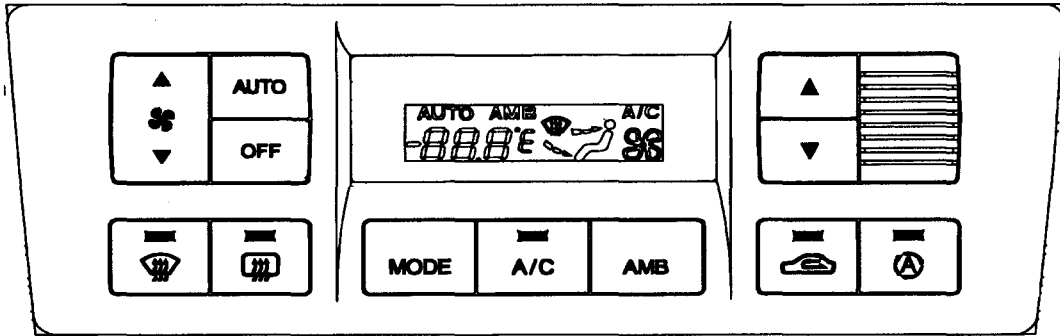


# AIR CONDITIONING SWITCH

## FULL AUTOMATIC AIR CONDITIONER

(FATC) EQMB0240

### CONTROL PANEL



**SWITCH OPERATION AND FEATURES** EQMB0250

1. Full auto air conditioning system: One-touch button type.
2. Manual air conditioning system: Combination of dial switch and one-touch button.

**CONTROL PANEL SWITCHES WILL GENERATE BUZZER SOUND ON OPERATION**

Button	Function	Display	System operation	Replusing switch and system operation
TEMP	Setting temp.	<ul style="list-style-type: none"> <li>• Seting temperature indication (17°C → 32°C Scale: 0.5°C)</li> <li>• User may chose the temperature indication between °C/°F.</li> <li>• 17°C=62°F</li> <li>• 32°C=90°F</li> <li>• 25°C=77°F</li> </ul>	<ol style="list-style-type: none"> <li>1. The switch will operate temperature door to regulate cool/warm air ratio and resultingly control discharge air control.</li> <li>2. The switch will raise up or lower down the temperature by unit of 0.5.</li> <li>3. Setting at 17°C (62°F) will provide max. cooling, and setting at 32°C (90°F) will provide max. heating.</li> <li>4. Switching off→on, it will be displayed the temperature setting just before the previous switching-off.</li> <li>5. In shifting 17.5°C→17°C or 31.5°C→32°C, raising temperature setting will generate buzzer sound 5 times at interval of 0.15 seconds.</li> <li>6. Lowering temperature setting at 17°C or raising temperature setting at 32°C, it will generate buzzer sound 5 times at interval of 0.15 sec.</li> <li>7. Pressing repeatly on: Shift one unit every 0.7 second. Holding down: First shift in 0.7 seconds and than shift every 0.3 seconds (buzzer sound for 0.1 second upon each shift)</li> </ol>	<ul style="list-style-type: none"> <li>• When the switch is off, the system will be off.</li> <li>• When the temp. s/w is on, the setting temperature will be up/down.</li> </ul>

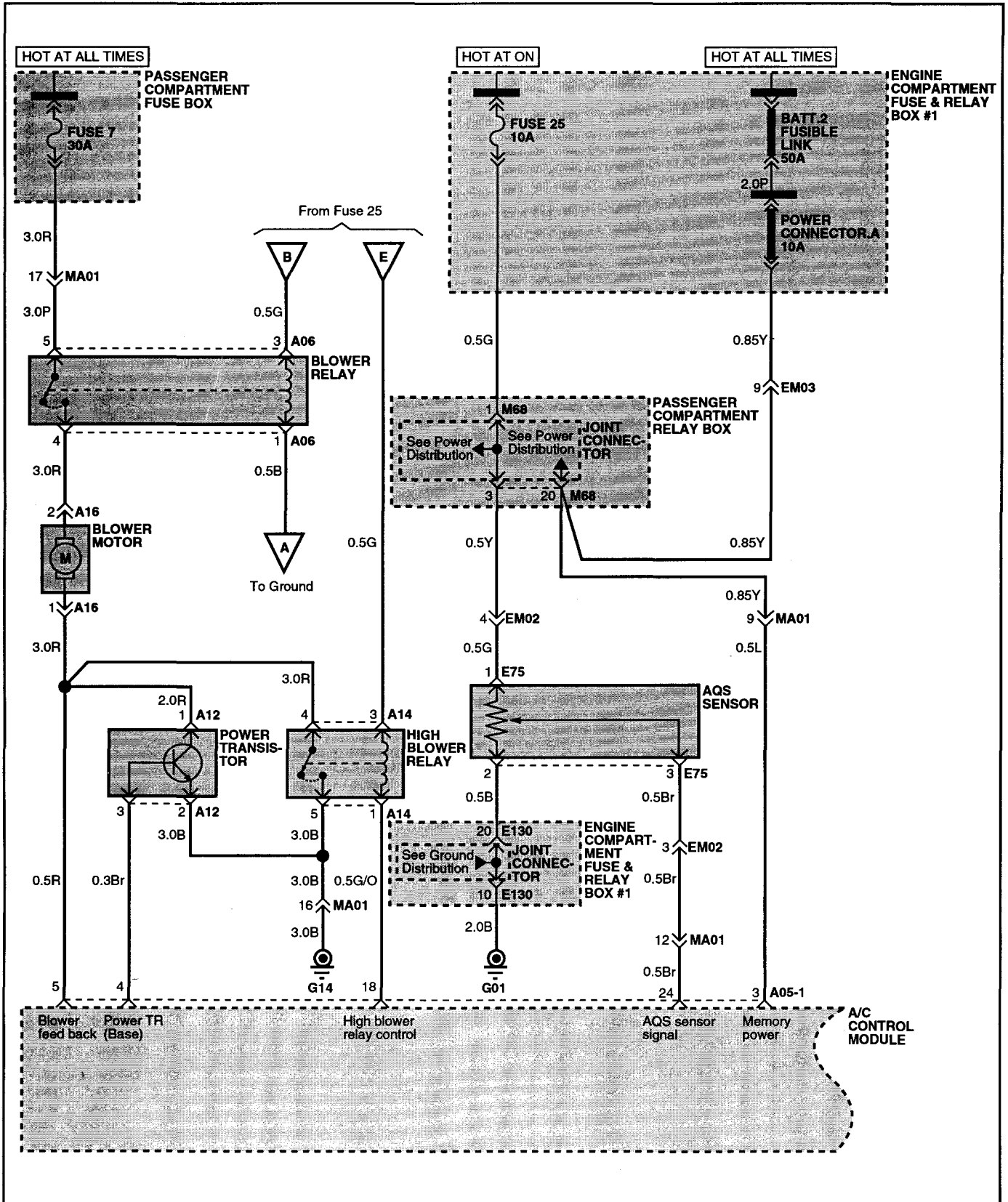
Button	Function	Display	System operation	Replusing switch and system operation
AUTO (Auto control)	Auto control of air conditioning system	"AUTO" will be displayed on control panel.	<ol style="list-style-type: none"> <li>The system will provide auto control of the below features on the basis of temperature setting: <ul style="list-style-type: none"> <li>Temperature door</li> <li>Mode door</li> <li>Intake door(Shift between fresh air/recirculation)</li> <li>Blower speed</li> <li>Compressor.</li> </ul> </li> <li>"AUTO" will be disappeared upon releasing AUTO switch.</li> <li>Features except manually selected switches will be controlled automatically upon releasing auto switch.</li> </ol>	<ul style="list-style-type: none"> <li>Off→System Off</li> <li>Blower switch : Manually control blower</li> <li>MODE : Manually control discharge mode</li> <li>A/C : Manually control compressor on/off.</li> <li>Fresh air : Manually control fresh air</li> <li>Recirculation : Manually control recirculation</li> <li>Defroster : Manually control defroster (when air conditioning system is on and recirculation selected)</li> </ul>
AMB	Indicate ambient air temperature	<ul style="list-style-type: none"> <li>'AMB' lamp will be indicated.</li> <li>Ambient air temperature indication.</li> <li>Other lamps will go out</li> </ul>	<ol style="list-style-type: none"> <li>Pressing AMB switch, any previous indication will go out and 'AMB' lamp and ambient air temperature will come on 5 seconds, and then it will return to the previous indication just before pressing AMB switch.</li> </ol>	<ul style="list-style-type: none"> <li>AMB: Pressing the AMB switch when ambient air temperature is indicated, ambient air temperature indication will be extinguished.</li> <li>Other switches: Pressing another switch when the ambient air temperature is indicated, ambient air temperature indication will be extinguished and selected.</li> </ul>
INTAKE	Recirculation	<ul style="list-style-type: none"> <li>Recirculation lamp will come on.</li> <li>"AUTO" lamp will go out.</li> </ul>	Fix intake door at the circulation position.	<ul style="list-style-type: none"> <li>INTAKE : REC. Control</li> <li>OFF S/W : REC. Fix</li> <li>AUTO : Auto Control</li> </ul>
	Fresh air	<ul style="list-style-type: none"> <li>Fresh air lamp will come on.</li> <li>"AUTO" lamp will go out.</li> </ul>	Fix intake door at the fresh air position.	

Button	Function	Display	System operation	Replusing switch and system operation
Blower fan speed UP/DOWN	Blower fan speed, UP/DOWN control	Fan indication : on/off	<ol style="list-style-type: none"> <li>1. The speed will shift up/down based on the current fan level.</li> <li>2. Switching on a switch except fan switch at 'off' condition, the speed will rise steadily from LOW to the target speed. (Require 6 seconds from LOW to HI).</li> <li>3. Shifting a step will take 0.7 seconds when pressing the switch once. Holding on the switch, a shift will occur every 0.3 seconds and buzzer sounds for 0.1 second.</li> <li>4. Pressing UP switch at HI position or DOWN switch at LOW position, buzzer sound will occur 5 times at 0.15 second interval.</li> </ol>	<ul style="list-style-type: none"> <li>• AUTO: Auto control</li> <li>• OFF : System off</li> <li>• Fan speed control: Manually control blower fan speed.</li> </ul>
	Output increment step by step			
	Fan speed levels and voltages <ul style="list-style-type: none"> <li>- Auto cooling : No level(4.5V~B+)</li> <li>- Auto heating: No level(4.5V~B+)</li> <li>- Manual control: 7 levels (3.8V~B+)</li> </ul>			
A/C Air conditioning switch	Compressor on/off control	<ul style="list-style-type: none"> <li>• A/C lamp (on/off)</li> <li>• AUTO lamp off</li> </ul>	Airconditioning on/off	<ul style="list-style-type: none"> <li>• A/C: A/C on/off, manual control.</li> <li>• OFF: System off.</li> <li>• AUTO: Auto control.</li> <li>• DEF: Defroster, manual control.</li> </ul>
MODE (Discharge mode)	Mode door control VENT, FLOOR, B/L, MIX	MODE indication (on/off) AUTO lamp off	<ol style="list-style-type: none"> <li>1. Fix mode door at B/L or MIX</li> <li>2. Manual operating mode switch, the switch will shift in the order of VENT-B/L-FLOOR-MIX</li> </ol>	<ul style="list-style-type: none"> <li>• MODE: Shift control in order of Vent-B/L-Floor-Mix-Vent.</li> <li>• DEF: Defroster, manual control.</li> <li>• AUTO: Auto control</li> </ul>
DEF (Defroster) <ul style="list-style-type: none"> <li>• Remove moisture/frost on windshield.</li> </ul>	DEF control	<ul style="list-style-type: none"> <li>• DEF indicator lamp on</li> <li>• DEF indication on</li> <li>• A/C lamp on</li> <li>• INTAKE indicator lamp off</li> <li>• AUTO indicator lamp off</li> </ul>	<ol style="list-style-type: none"> <li>1. Mode door: Fixed at defroster.</li> <li>2. Intake door: Fresh air control (Selecting recirculation is enabled).</li> <li>3. A/C: on (Compressor will be controlled on/off based on detected temperature by fin sensor).</li> <li>4. Prevails over max. cooling and max. heating.</li> <li>5. Prevails over mix mode control</li> </ol>	<ul style="list-style-type: none"> <li>• AUTO: System auto control.</li> <li>• MODE: Discharge mode, manual control (release the defroster control).</li> <li>• A/C: A/C on/off, manual control</li> <li>• DEF: Return to the previous condition before selecting DEF switch.</li> </ul>

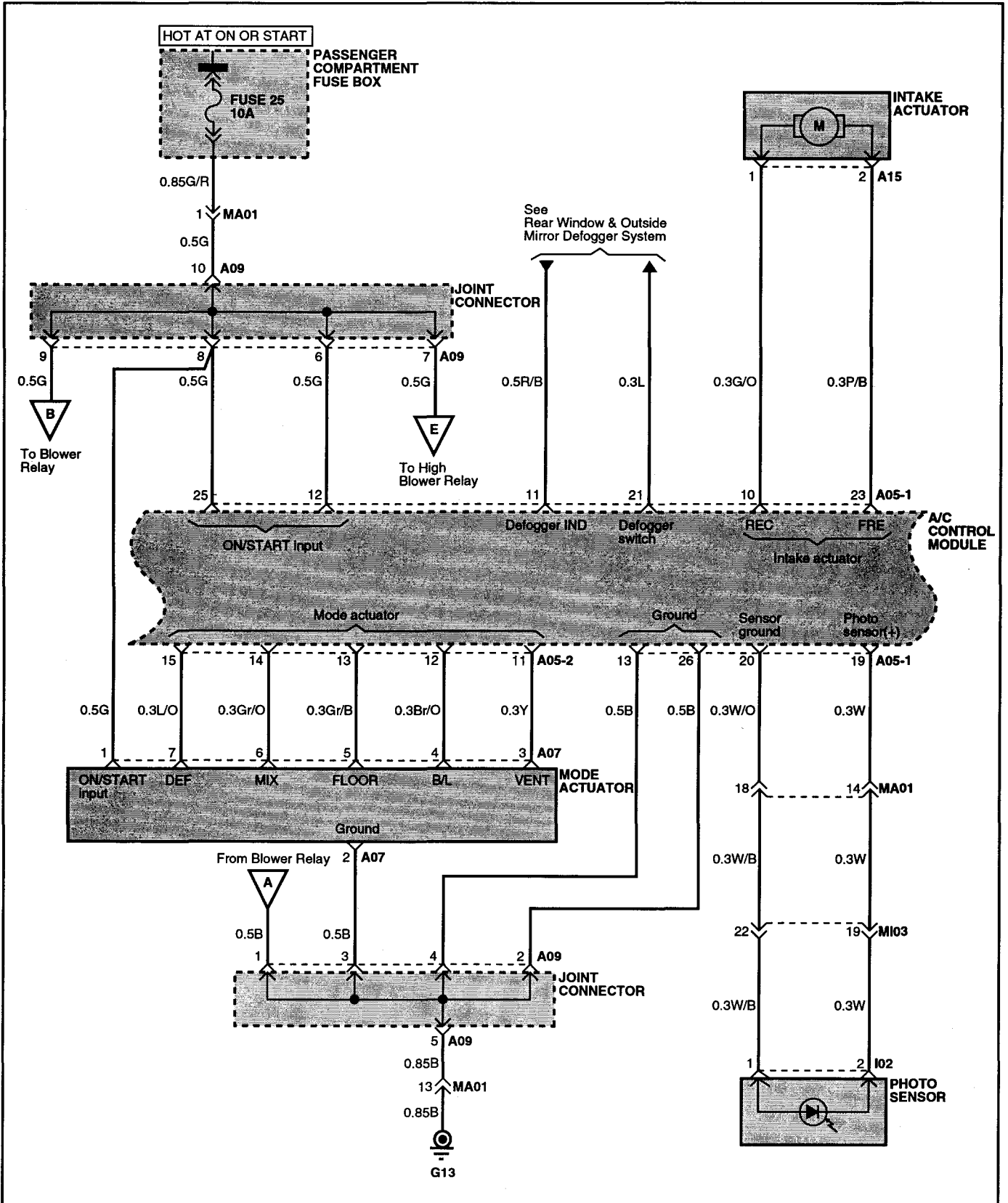
Button	Function	Display	System operation	Replensing switch and system operation
OFF	System off	<ul style="list-style-type: none"> <li>• LCD off</li> <li>• Indicator lamps on</li> </ul>	<ol style="list-style-type: none"> <li>1. Blower fan speed off.</li> <li>2. Compressor off.</li> <li>3. Intake door: Fixed at the location prior to system off.</li> <li>4. Temperature door: Auto control.</li> <li>5. Mode door: Fixed at the condition prior to system off.</li> <li>6. AMB : Pressing AMB switch after system off, 'AMB' lamp/ambient air temperature will come on for 5 seconds and then go out.</li> </ol>	<ul style="list-style-type: none"> <li>• AUTO: Auto control.</li> <li>• Blower speed: Return to MANUAL LOW.</li> <li>• Others: Return to the previous condition before system off</li> </ul>
		<ul style="list-style-type: none"> <li>• INTAKE(recirc/fresh air) control at the system off condition                             <ol style="list-style-type: none"> <li>1) Selecting the fresh air switch at the recirculation position after system off: It will shift to the fresh air position and extinguish the recirculation indicator lamp. The LCD will be held off.</li> <li>2) Selecting the recirculation switch at the fresh air position after system off: It will shift to the recirculation position and extinguish the recirculation indicator lamp. The LCD will be held off.</li> <li>3) Other switches will be held off at the above condition.</li> </ol> </li> </ul>	<ul style="list-style-type: none"> <li>• A/C: Airconditioning on.</li> <li>• Others: Return to the previous condition before system off (Blower speed: Return to MANUAL LOW)</li> <li>• MODE: Hold at the previous condition before system off. (Auto control is released).</li> <li>• Others: Return to the previous condition before system off (Blower speed: Return to MANUAL LOW)</li> <li>• DEF: Shift to defroster mode</li> <li>• A/C : Air conditioning on</li> <li>• Intake : fresh air</li> <li>• Others: Return to the previous condition before system off</li> <li>• TEMP: Auto control.</li> <li>• Others: Return to the previous condition before system off.</li> </ul>	

**SCHEMATIC DIAGRAM (FULL AUTO)**  
EQMB0620

**BLOWER AND A/C CONTROLS (FULL AUTO) (1)**

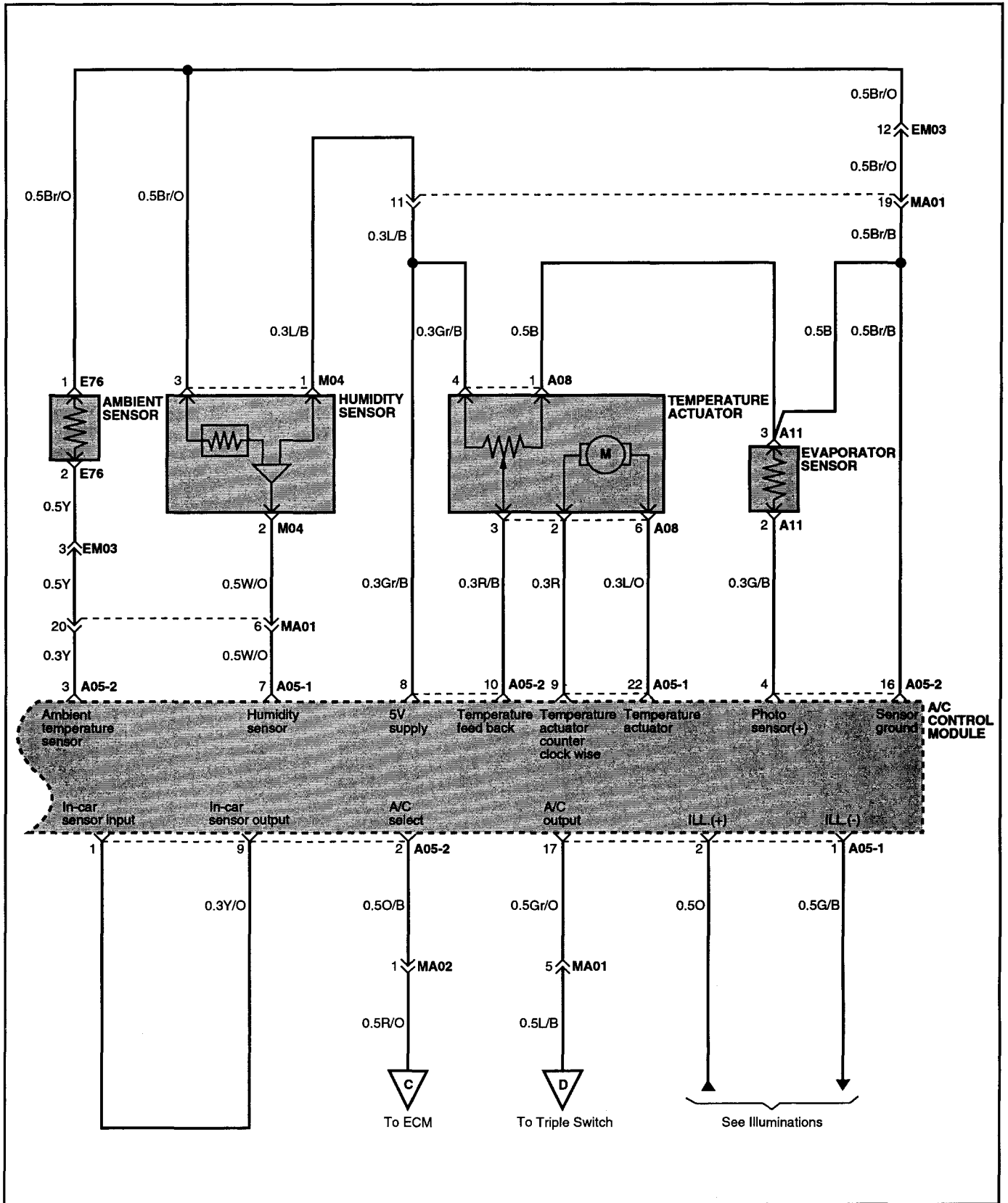


BLOWER AND A/C CONTROLS (FULL AUTO) (2)

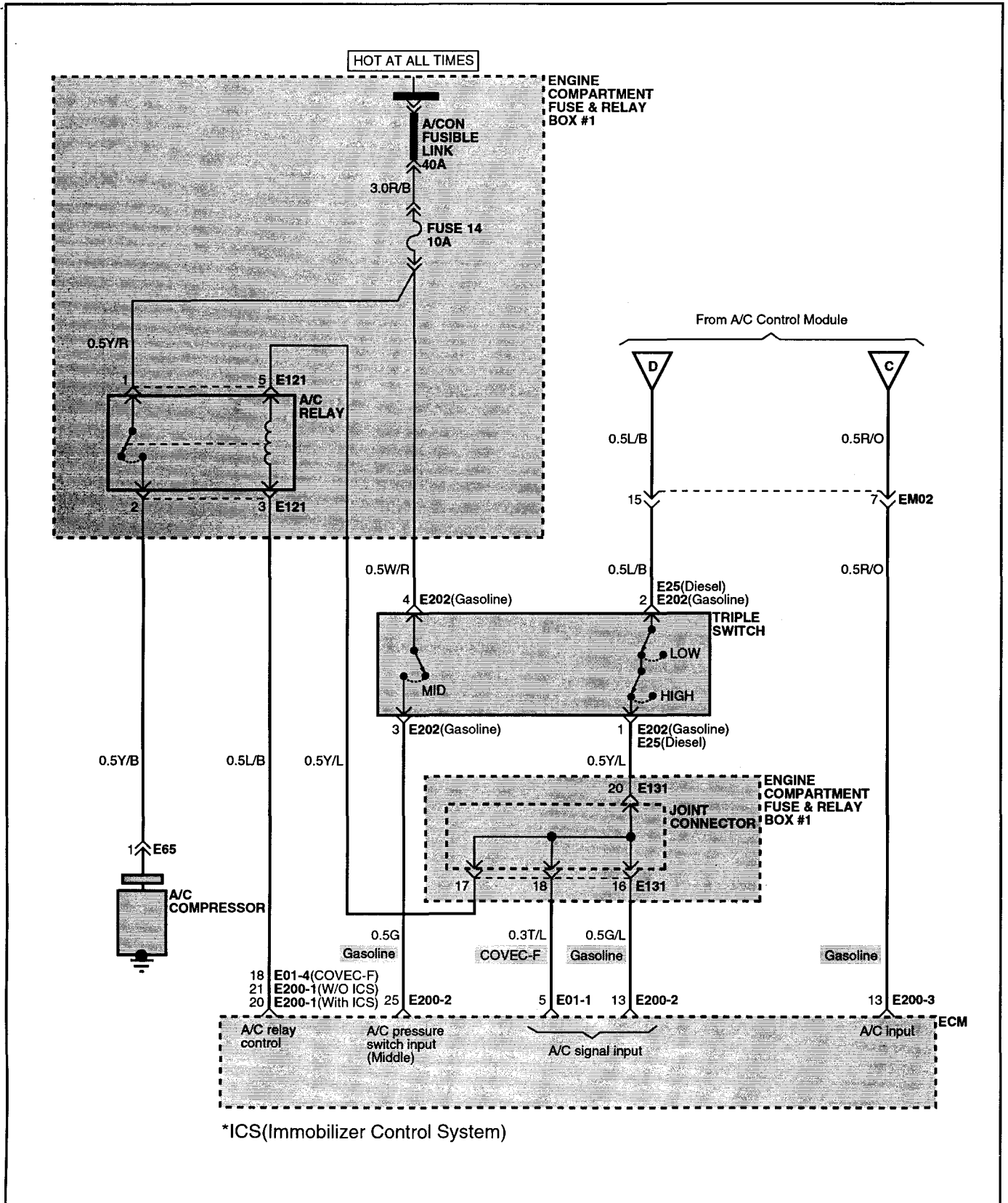




BLOWER AND A/C CONTROLS (FULL AUTO) (3)



BLOWER AND A/C CONTROLS (FULL AUTO) (4)



\*ICS(Immobilizer Control System)

# General Information

<b>GENERAL INFORMATION .....</b>	<b>GI - 2</b>
<b>RECOMMENDED LUBRICANTS AND CAPACITIES .....</b>	<b>GI -12</b>
<b>MAINTENANCE INFORMATION .....</b>	<b>GI -13</b>

# GENERAL INFORMATION

## HOW TO USE THIS MANUAL EAMB1000

This manual is divided into 21 sections. The first page of each section is marked with a black tab at the edge of the page. You can quickly find the first page of each section without looking through the whole table of contents.

Each section includes the essential removal, installation, adjustment and maintenance procedures for servicing all body styles. This information is correct at the time of publication.

An **INDEX** is provided on the first page of each section to guide you to the appropriate item.

**TROUBLESHOOTING** tables are included for each system to help you diagnose the problem and find the cause. The repair for each possible cause is referred to in the remedy column to lead you to the solution quickly.

## DEFINITION OF TERMS

### STANDARD VALUE (SERVICE STANDARD)

Indicates the value used when a part or assembled item should be inspected or the value to which a part or assembled item should be adjusted after reinstallation. It is given as a tolerance.

### SERVICE LIMIT

Indicates the maximum or minimum value that a part or assembled item must meet when inspected. It is a value established beyond the standard value.

### NOTE, WARNING, CAUTION, ABBREVIATION

#### **NOTE**

*Information needed in reference to a repair service.*

#### **CAUTION**

*Information about an activity that could cause damage to the vehicle.*

#### **WARNING**

*Information about an activity that could cause injury or damage to the driver, occupants or repairman.*

## ABBREVIATIONS

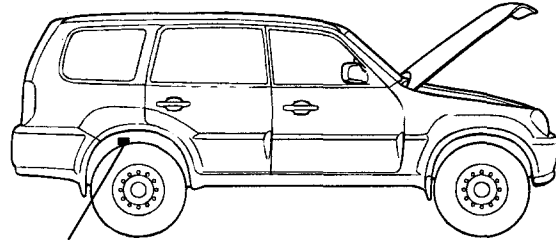
**DOHC** : Double Over Head Camshaft

**V6** : V-type 6 Cylinder

**I4** : Inline 4 Cylinder

## VEHICLE IDENTIFICATION NUMBER LOCATION

The vehicle identification number (VIN) is located on the right side of rear frame and on the driver's side of the dash cover.



VIN. NO.

KAMB100A

## VEHICLE IDENTIFICATION NUMBER

The Vehicle identification number consists of 17 digits.

K	M	H	N	M	8	3	C	P	Y	U	0	0	0	0	0	1
1			2	3	4	5	6	7	8	9	10					

EAMB100A

1. W.I.C. (World manufacturer's Identification Code)  
KMH - Hyundai Motor Company, Korea
2. Vehicle Line  
N : TERRACAN
3. Model & Series  
L : Standard(L)  
M : Deluxe (GL)  
N : Super deluxe (GLS)
4. Body Type  
8 : Wagon
5. Restraint system or brake system  
1 - A / Belt (Driver side + Passenger side)  
2 - P / Belt (Driver side + Passenger side)  
3 - Driver side : A / Belt + A / Bag, Passenger side :  
A / Belt or P / Belt  
4 - A / Belt + A / Bag (Driver side + Passenger side)

#### **NOTE**

A / Belt : Active belt

P / Belt : Passive belt

A / Bag : Air bag

6. Engine type  
C : G 3.5 V6  
W : D 2.5 I4  
X : D 2.9 I4
7. Driver side  
P : LHD (Left hand driver)

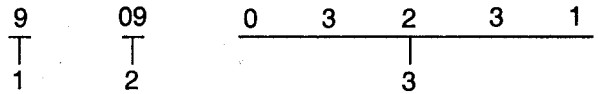
R : RHD (Reft hand driver)

- 8. Production year  
Y - 2000 Model Year, 2 - 2002 Model year  
1 - 2001 Model Year, 3 - 2003 Model year
- 9. Production plant  
U - Ulsan (Korea)
- 10. Vehicle production sequence number  
000001 - 999999

000001 - 999999

**TRANSAXLE IDENTIFICATION NUMBER LOCATION**

**DESCRIPTION (MANUAL TRANSAXLE)**

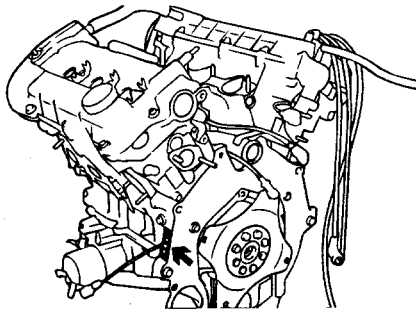


**ENGINE IDENTIFICATION NUMBER LOCATION**

The engine identification number is stamped on the right front side of the top edge of the cylinder block.

EAJB001X

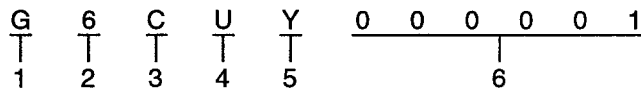
V6



EAA9004A

**DESCRIPTION OF ENGINE IDENTIFICATION NUMBER**

The engine identification number consists of 11 digits.

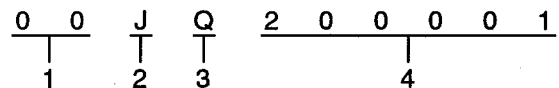


EAMB100B

- 1. Engine fuel  
G - Gasoline  
D - Diesel
- 2. Engine range  
4 - In line 4 cycle 4 cylinder  
6 - V type 4 cycle 6 cylinder
- 3. Engine development order  
C - V6 sigma Engine  
B - 4D56 Engine
- 4. Engine capacity  
V - 3496cc  
H - 2467cc
- 5. Production year  
Y - 2000  
1 - 2001  
2 - 2002  
3 - 2003
- 6. Engine production sequence number

- 1. Production year  
9 : 1999  
0 : 2000  
1 : 2001
- 2. Production month  
09-9 (September)  
12-12 (December)
- 3. Transmission production sequence number  
000001 ~ 999999

**DESCRIPTION (AUTOMATIC TRANSAXLE)**



EAMB100C

- 1. Production year  
00 - 2000  
01 - 2001
- 2. Production month  
J - 9
- 3. Model  
Q - 03 - 7ILE
- 4. Production sequence number

**PROTECTION OF THE VEHICLE**

Always be sure to cover fenders, seats, and floor areas before starting work.

**CAUTION**

*The support rod must be inserted into the hole near the edge of the hood whenever you inspect the engine compartment to prevent the hood from falling and causing possibly injury. Make sure that the support rod has been released prior to closing the hood. Always check to be sure the hood is firmly latched before driving the vehicle.*

## A WORD ABOUT SAFETY

The following precautions must be followed when jacking up the vehicle.

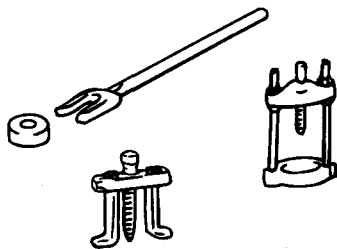
1. Block the wheels.
2. Place a jack under the specified jacking point.
3. Support the vehicle with safety stands (jack stands) Refer to page GI-10.
4. Start the engine when engine compartment is clean.

## PREPARATION OF TOOLS AND MEASURING EQUIPMENT

Be sure that all necessary tools and measuring equipments are available before starting work.

## SPECIAL TOOLS

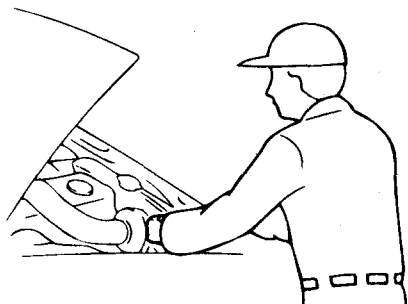
Use special tools when required.



EAA9006A

## REMOVAL OF PARTS

First find the cause of the trouble and then make sure whether removal or disassembly is required before starting the job.



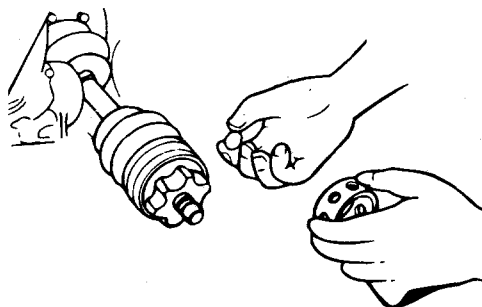
EADA010I

## DISASSEMBLY

If the disassembly procedure is complex and requires many parts to be disassembled, all parts should be disassembled in a way that will not affect their performance or external appearance.

### 1. Inspection of parts

Each part, when removed, should be carefully inspected for malfunction, deformation, damage, and other problems.

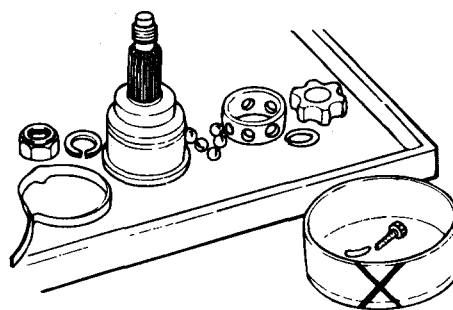


EADA010J

### 2. Arrangement of parts

All disassembled parts should be carefully arranged for effective reassembly.

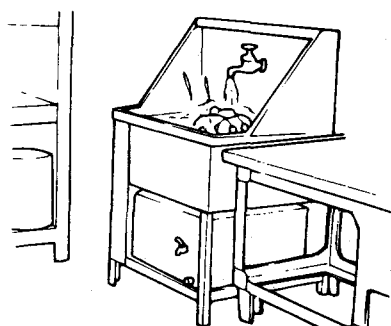
Be sure to separate and correctly identify the parts to be replaced from those that will be used again.



EAA9008B

### 3. Cleaning parts for reuse

All parts to be used again should be carefully and thoroughly cleaned by the appropriate method.



EADA010K

**PARTS**

When replacing parts, use HYUNDAI genuine parts.

**HYUNDAI**  
Genuine  
Parts



Made in Korea

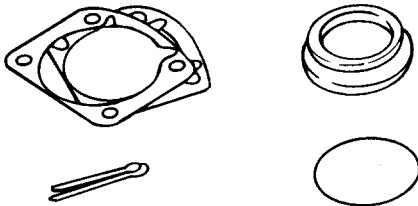
EADA010M

**REPLACEMENT**

Standard values, such as torques and certain adjustments, must be strictly observed in the reassembly of all parts.

If removed, the following parts should be always replaced with new ones.

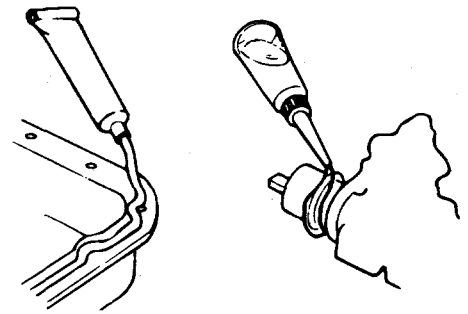
1. Oil seals
2. Gaskets
3. O-rings
4. Lock washers
5. Cotter pins (split pins)
6. Plastic nuts



EADA010N

Depending on their location.

1. Sealant should be applied to gaskets.
2. Oil should be applied to the moving components of parts.
3. Specified oil or grease should be applied to the prescribed locations (oil seals, etc.) before assembly.



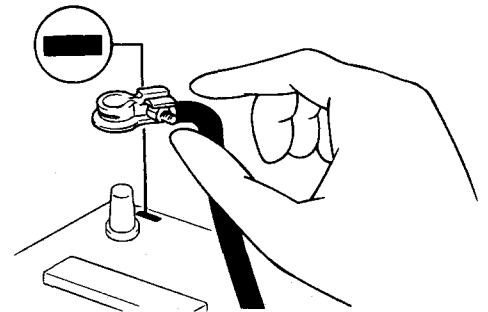
EADA010O

**ADJUSTMENT**

Use gauges and testers to adjust correctly the parts to standard values correctly.

**ELECTRICAL SYSTEM**

1. Be sure to disconnect the battery cable from the negative (-) terminal of the battery.
2. Never pull on the wires when disconnecting connectors.
3. Locking connectors will click when the connector is secure.
4. Handle sensors and relays carefully. Be careful not to drop them or hit them against other parts.



EAA9011A

**RUBBER PARTS AND TUBES**

Always prevent gasoline or oil from touching rubber parts or tubing.



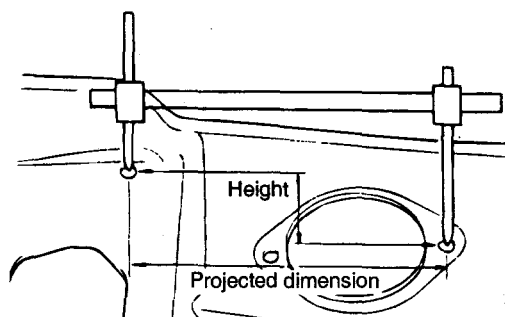
EADA010Q

## MEASURING BODY DIMENSIONS

1. Basically, all measurements in this manual are taken with a tracking gauge.
2. When a measuring tape is used, check to be sure there is no elongation, twisting or bending.
3. For measuring dimensions, both projected dimensions and actual-measurement dimensions are used in this manual.

## DIMENSIONS PROJECTED

1. These are the dimensions measured when the measurement points are projected from the vehicle's surface, and are the reference dimensions used for body alterations.
2. If the length of the tracking gauge probes is adjustable, measure it by lengthening one of the two probes as long as the height of the two surfaces are different.



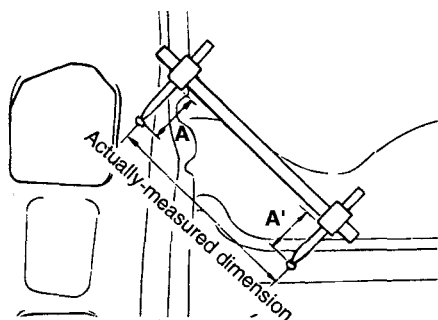
EADA011M

## MEASURING ACTUAL DIMENSIONS

1. These dimensions indicate the actual linear distance between measurement points, and are used as the reference dimensions when a tracking gauge is used for measurement.
2. First adjust both probes to the same length ( $A=A'$ ) before measurement.

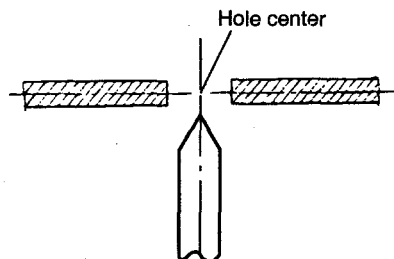
### NOTE

Check the probes and gauge itself to make sure there is no free play.



## MEASUREMENT POINT

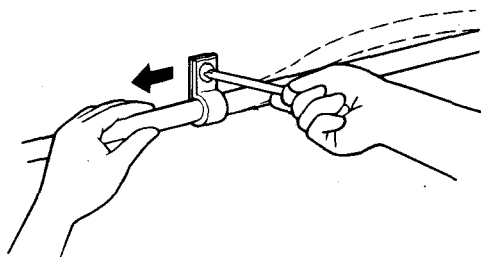
Measurement should be taken at the center of the hole.



EADA011O

## CHECKING CABLES AND WIRES

1. Check the terminal for tightness.
2. Check terminals and wires for corrosion from battery electrolyte, etc.
3. Check terminals and wires for open circuits.
4. Check wire insulation and coating for damage, cracks and degrading.
5. Check the conductive parts of terminals for contact with other metallic parts (vehicle body and other parts).
6. Check grounded parts to verify that there is complete continuity between their attaching bolt(s) and the vehicle's body.
7. Check for incorrect wiring.
8. Check that the wiring is clamped firmly to prevent contact with sharp corners of the vehicle body, etc. or hot parts (exhaust manifold, etc.)
9. Check that the wiring is clamped firmly to provide enough clearance from the fan pulley, fan belt and other rotating or moving parts.
10. Check that the wiring has a little space so that it can vibrate between the fixed and moving parts such as the vehicle body and the engine.

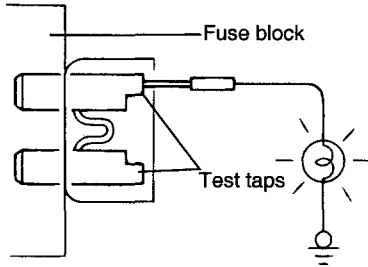


EADA011B



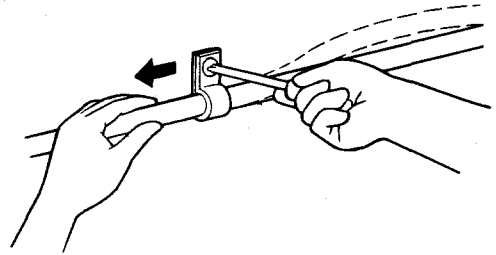
**CHECKING FUSES**

A blade type fuse has test taps provided to allow checking the fuse itself without removing it from the fuse block. The fuse is good if the test lamp lights up when its one lead is connected to the test taps (one at a time) and the other lead is grounded. (Turn the ignition switch so that the fuse circuit becomes operative.)



EAA9014B

2. Attach the wiring harnesses with clamps so that there is no slack. However, for any harness which passes the engine or other vibrating parts of the vehicle, allow some slack within a range that does not allow the engine vibrations to cause the harness to come into contact with any of the surrounding parts, and then secure the harness by using a clamp.



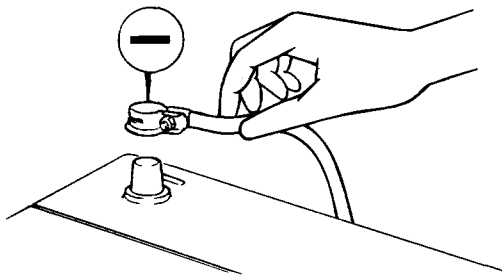
EADA011B

**SERVICING THE ELECTRICAL SYSTEM**

1. Prior to servicing the electrical system, be sure to turn off the ignition switch and disconnect the battery ground cable.

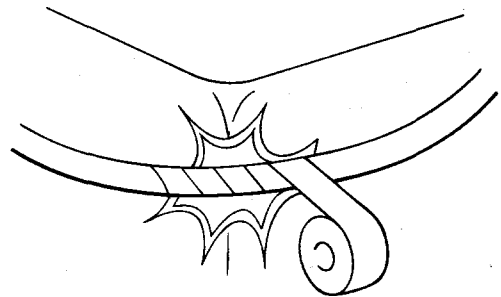
**NOTE**

*In the course of MFI or ELC system diagnosis, when the battery cable is removed, any diagnostic trouble code retained by the computer will be cleared. Therefore, if necessary, read the diagnostic codes before removing the battery cable.*



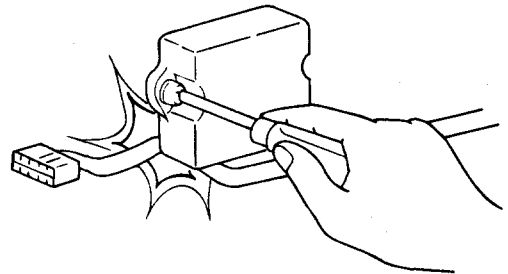
EADA011A

3. If any section of a wiring harness interferes with the edge of a part, or a corner, wrap the section of the harness with tape or something similar in order to protect it from damage.



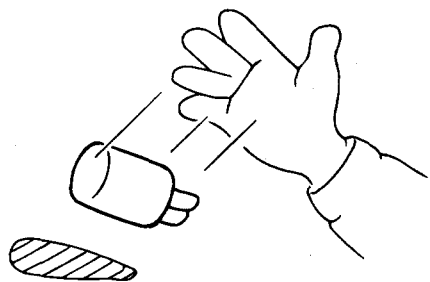
EADA011C

4. When installing any parts, be careful not to pinch or damage any of the wiring harnesses.



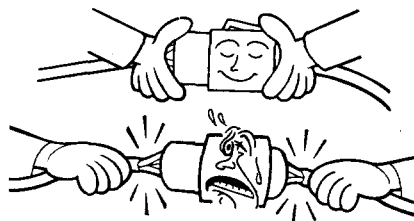
EADA011D

5. Never throw relays, sensors or electrical parts, or expose them to strong shock.



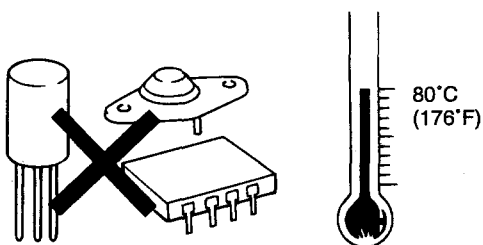
EADA011E

8. When disconnecting a connector, be sure to grip only the connector, not the wires.



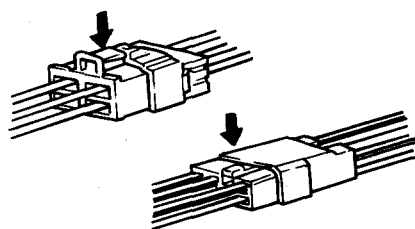
EADA011H

6. The electronic parts used in the computer, relays, etc. are readily damaged by heat. If there is a need for service operations that may cause the temperature to exceed 80°C (176°F), remove the electronic parts beforehand.



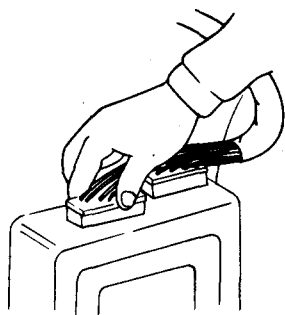
EADA011F

9. Disconnect connectors which have catches by pressing in the direction of the arrows shown the illustration.



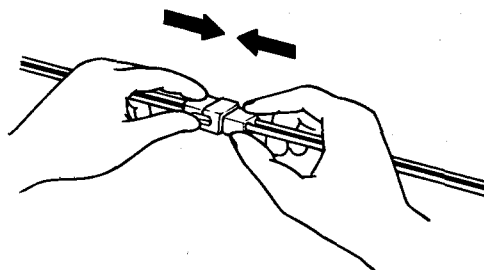
EADA011I

7. Loose connectors cause problems. Make sure that the connectors are always securely fastened.



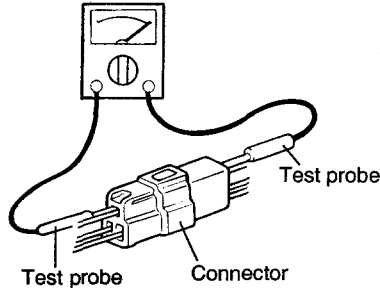
EADA011G

10. Connect connectors which have catches by inserting the connectors until they make a clicking sound.



EADA011J

- When, using a circuit tester, to check continuity or voltage on connector terminals, insert the test probe into the harness side. If the connector is a sealed connector, insert the test probe through the hole in the rubber cap until it contacts the terminal, being careful not to damage the insulation of the wires.



EADA011K

- To avoid overloading the wiring, take the electrical current load of the optional equipment into consideration, and determine the appropriate wire size.

Nominal size	SAE gauge No.	Permissible current	
		In engine compartment	Other areas
0.3 mm <sup>2</sup>	AWG 22	-	5A
0.5 mm <sup>2</sup>	AWG20	7A	13A
0.85 mm <sup>2</sup>	AWG18	9A	17A
1.25 mm <sup>2</sup>	AWG16	12A	22A
2.0 mm <sup>2</sup>	AWG14	16A	30A
3.0 mm <sup>2</sup>	AWG12	21A	40A
5.0 mm <sup>2</sup>	AWG10	31A	54A

**PRECAUTIONS FOR CATALYTIC CONVERTER**

**CAUTION**

*If a large amount of unburned gasoline flows into the converter, it may overheat and create a fire hazard. To prevent this, observe the following precautions and explain them to your customer.*

- Use only unleaded gasoline.
- Do not run the engine while the car is at rest for a long time. Avoid running the engine at fast idle speed for more than 10 minutes and at idle speed for more than 20 minutes.
- Avoid spark- jump tests. Do spark- jumps only when absolutely necessary. Perform this test as rapidly as possible and, while testing, never race the engine.

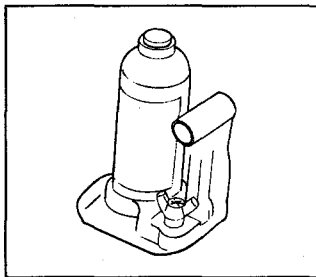
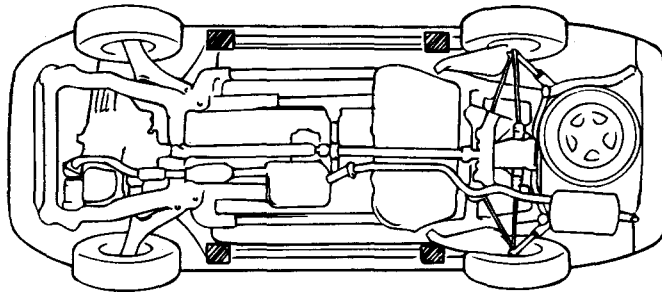
- Do not measure engine compression for an extended time. Engine compression tests must be made as rapidly as possible.
- Do not run the engine when the fuel tank is nearly empty. This may cause the engine to misfire and create an extra load on the converter.
- Avoid coasting with the ignition turned off and during prolonged braking.
- Do not dispose of a used catalytic converter together with parts contaminated with gasoline or oil.

**SRS SYSTEM COMPONENTS INFORMATION**

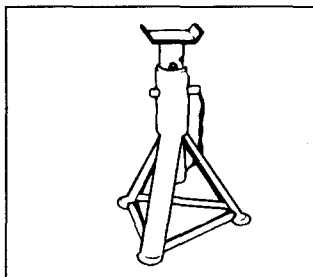
**CUSTOMER CAUTIONS**

Failure to carry out service operations in the correct sequence could cause the airbag system to be deployed unexpectedly during servicing, and a serious accident to occur. Further, if there is a mistake in servicing the airbag system, it is possible the airbag may fail to operate when required. Before performing servc (including removal or installation of parts, inspection or replacement), be sure to read the following items carefully, then follow the correct procedures described in the repair manual.

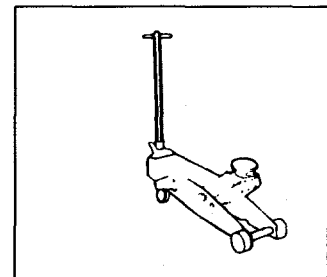
- Work must be started approx. 30 seconds or longer after the ignition switch is turned to the LOCK position and the negative (-) battery cable is disconnected. (The airbag system is equipped with a back-up power source. If work is started within 30 seconds after disconnecting the negative (-) terminal cable of the battery, the airbag may be operative.) When the negative (-) terminal cable is disconnected from the battery, the clock and audio systems memories will be erased. Before starting work, record the setting of the audio memory system. When work is finished, reset the audio system as before and adjust the clock.
- Malfunction symptoms of the airbag system are difficult to confirm, so diagnostic codes become the most important source of information when troubleshooting. When troubleshooting the airbag system, always read the diagnostic codes before disconnecting the battery.
- Never use airbag parts from another vehicle. When replacing parts, replace them with new parts.
- Never attempt to disassemble and repair the airbag modules, SRSCM, clock spring and airbag wiring harness in order to reuse it.
- If the SRSCM or airbag module has been dropped, or if there are cracks, dents or other defects in the case, bracket or connector, replace them with new ones.
- After work on the airbag system is completed, re-set the SRS SRI.



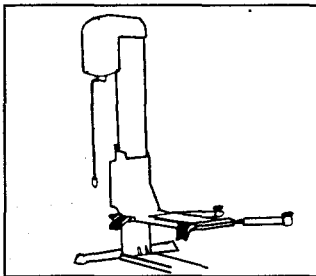
The jack provided with the vehicle (for reference)



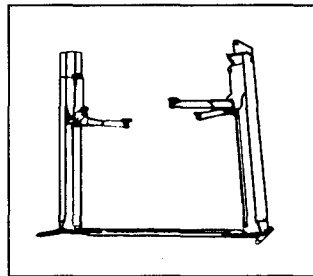
Rigid rack (Safety stand)



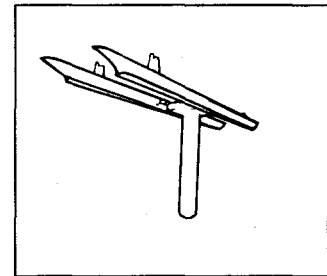
Garage jack (floor Jack)



Single post lift



Double post lift



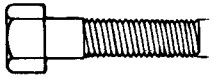

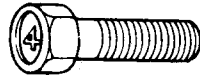
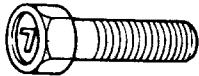
Free wheel type of auto lift (H bar lift)

EAMB100D

**⚠ CAUTION**

1. Never use a jack beneath the lateral rod or rear suspension assembly.
2. In order to prevent scratching the sub frame, place a piece of cloth on the jack's contact surface (to prevent corrosion caused by damage to the coating).
3. Never support vehicle with only a jack. Always use safety stands.
4. Do not attempt to raise one entire side of the vehicle by placing a jack midway between the front and rear wheels. To do so could result in permanent damage to the body.

## TIGHTENING TORQUE TABLE OF STANDARD PARTS

Bolt nominal diameter (mm)	Pitch (mm)	Torque Nm (kg.cm, lb.ft)	
		Head Mark 4	Head Mark 7
 EADA010R	 EADA010S	 EADA010T	 EADA010U
M5	0.8	3-4 (30-40, 2.2-2.9)	5-6 (50-60, 3.6-4.3)
M6	1.0	5-6 (50-60, 3.6-4.3)	9-11 (90-110, 6.5-8.0)
M8	1.25	12-15 (120-150, 9-11)	20-25 (200-250, 14.5-18.0)
M10	1.25	25-30 (250-300, 18-22)	30-50 (300-500, 22-36)
M12	1.25	35-45 (350-450, 25-33)	60-80 (600-800, 43-58)
M14	1.5	75-85(750-850,54-61)	120-140(1,200-1,400,85-100)
M16	1.5	110-130(1,100-1,300,80-94)	180-210(1,800-2,100, 130-150)
M18	1.5	160-180(1,600-1,800, 116-130)	260-300(2,600-3,000, 190-215)
M20	1.5	220-250 (2,200-2,500, 160-180)	360-420 (3,600-4,200,260-300)
M22	1.5	290-330 (2,900-3,300, 210-240)	480-550 (4,800-5,500,350-400)
M24	1.5	360-420 (3,600-4,200, 260-300)	610-700 (6,100-7,000, 440-505)

 NOTE

- The torques shown in the table are standard values under the following conditions:
  - Nuts and bolts are made of steel bar, and galvanized.
  - Galvanized plain steel washers are inserted.
  - All nuts, bolts, and plain washers are dry.
- The torques shown in the table are not applicable:
  - When Spring washers, toothed washers and the like are inserted.
  - If plastic parts are fastened.
  - If self-tapping screws or self-locking nuts are used.
  - If threads and surface are coated with oil.
- If you reduce the torques in the table to the percentage indicated below, under the following conditions, it will be the standard value.
  - If spring washers are used. : 85%
  - If threads and bearing surfaces are stained with oil. : 85%

# RECOMMENDED LUBRICANTS AND CAPACITIES

## RECOMMENDED LUBRICANTS EAMB2000

Parts	Specifications	Remarks
Engine oil	API Classification SG Above	For further details, refer to SAE viscosity number
Manual transaxle	API classification GL-4	SAE grade number: SAE 75W/90
Automatic transaxle	GENUINE HYUNDAI transaxle oil, GENUINE DIAMOND ATF SP-II M	
Brake	DOT 3 or DOT 4	
Cooling system	High quality ethylene glycol	Concentration level 50% (normal) Concentration level 40% (tropical)
Power steering	PSF-3	
Transaxle linkage, parking brake cable mechanism, hood lock and hook, door latch, seat adjuster, trunk latch, door hinges, trunk hinges	Multipurpose grease NLGI grade #2	

M/EAST : Middle East, GEN.: General Areas  
 AUST.: Australia, EC : European Community

## LUBRICANTS CAPACITIES

Description		Capacities	
		2.5 I4	3.5 V6
Engine oil	Oil pan	5.8 (6.6, 5.5)	4.1 (4.66, 3.88)
	Oil filter	0.7 (0.8, 0.66)	0.3 (0.32, 0.26)
	Total	6.5 (7.4, 6.15)	4.4 (5, 4.2)
Cooling system		8 (9, 7.6)	11 (12.5, 10.4)
Manual transaxle		2.5 (2.64, 2.2)	2.5 (2.64, 2.2)
Automatic transaxle		8.2 (8.66, 7.21)	10.46 (11.0, 9.2)
Power steering		1.0 (1.05, 0.88)	1.0 (1.05, 0.88)

liter (U.S. qts., Imp. qts.)

# MAINTENANCE INFORMATION

## CHANGING ENGINE OIL EAMB3000

1. If the engine is cold, run the engine until it reaches normal operating temperature.
2. Turn off the engine.
3. Remove the oil filler cap and drain plug. Drain the engine oil.
4. Tighten the drain plug to the specified torque.

### Tightening torque

Oil pan drain plug :

35-45 N.m (350-450 kg.cm, 25-33 lb.ft)

### NOTE

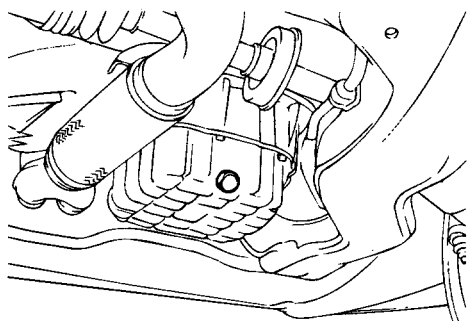
Whenever tightening the oil drain plug, use a new drain plug gasket.

5. Fill new engine oil through the oil filler cap opening.

### NOTE

Do not overfill, this will cause oil aeration and loss of oil pressure.

6. Install the oil filler cap.
7. Start and run the engine.
8. Turn off the engine and then check the oil level. Add oil if necessary.



ECA9081A

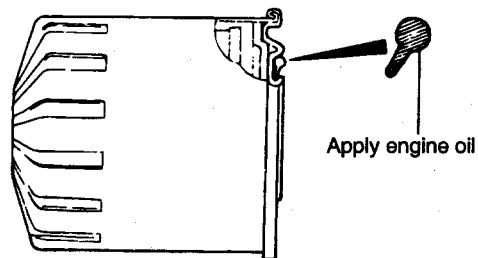
## REPLACING THE ENGINE OIL FILTER

1. Use a filter wrench to remove the oil filter.
2. Before installing a new oil filter on the engine, apply clean engine oil to the surface of the rubber gasket.
3. Tighten the oil filter to the specified torque.

### Tightening torque

Oil filter : 12 -16 N.m (120-160 kg.cm, 9-12 lb.ft)

4. Start and run the engine and check for engine oil leaks.
5. After turning off the engine, check the oil level and add oil as necessary.



ECA9970B

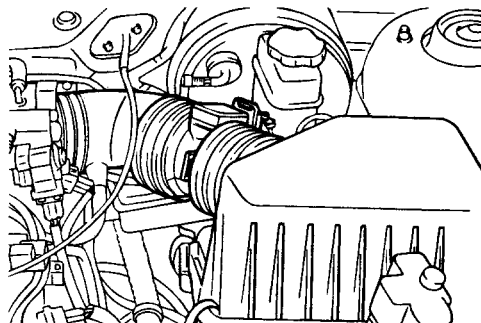
## REPLACING THE AIR CLEANER FILTER

The air cleaner filter will become dirty during use and the filtering efficiency will be substantially reduced. Replace with a new one as needed.

1. Disconnect the clip holding air cleaner filter cover.
2. Remove the air filter cover.

### CAUTION

The air filter cover should be removed carefully because intake hose includes the air-flow sensor.

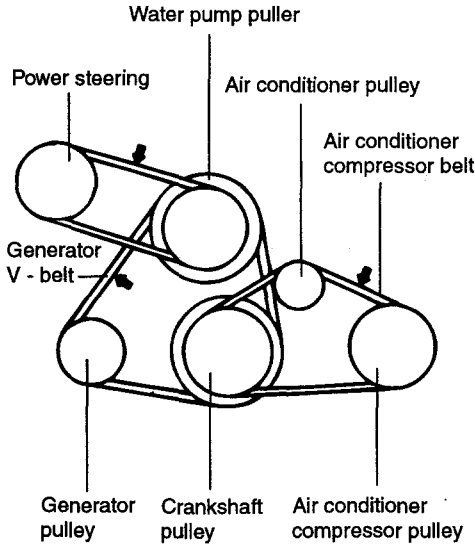


EDJAB60A

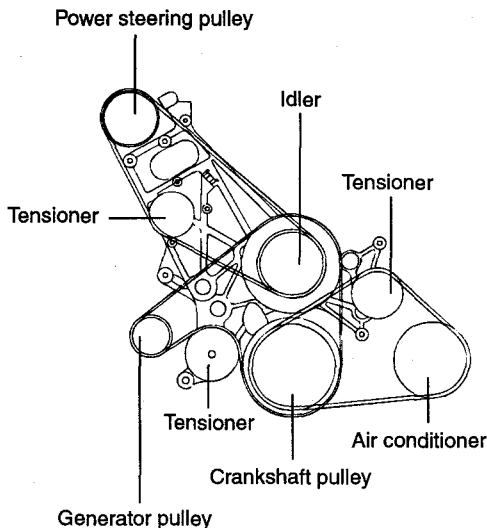
3. Remove the air cleaner filter.
4. Install a new air cleaner filter and replace the air cleaner filter cover.

**CHECKING AND ADJUSTING BELT TENSION**

Refer to the EM and EMA-Sections.



ECLA003A



EDMB007B

**COOLING SYSTEM**

Check the cooling system for damaged hoses, loose or leaking connections, or other possible causes of coolant leaks.

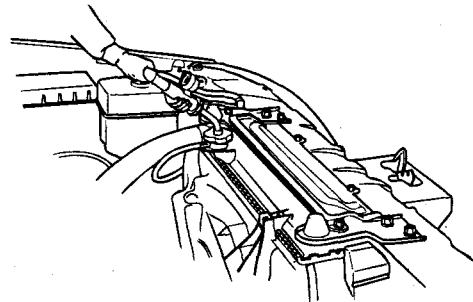
**ANTIFREEZE**

The engine cooling system is provided with a mixture of 50% ethylene glycol anti-freeze and 50% water (For the vehicles of tropical area, the engine cooling system is provided with a mixture of 40% ethylene glycol anti-freeze and 60% water at the time of manufacture.)

Since the cylinder head and water pump body are made of aluminum alloy casting, be sure to use a 30 to 60% ethylene glycol antifreeze coolant to assure corrosion protection and freezing prevention.

**CAUTION**

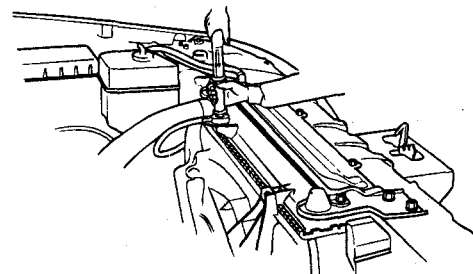
*If the concentration of the antifreeze is below 30%, the anticorrosion property will be adversely affected. In addition, if the concentration is above 60%, both the antifreeze and engine cooling properties will decrease, adversely affecting the engine. For these reasons, be sure to maintain the concentration level within the specified range.*



KDMB002A

**MEASURING OF ANTIFREEZE CONCENTRATION**

Run the engine until the coolant is fully mixed. Drain some coolant (antifreeze), and then measure the temperature and specific gravity of the coolant. Determine its concentration and safe working temperature. If the coolant is short of antifreeze, add antifreeze to a concentration of 50%. (Tropical Areas : 40%)



KDMB002B

**REPLACING OF THE COOLANT**

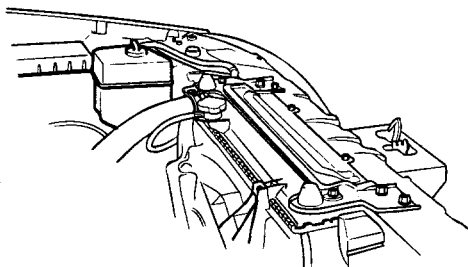
1. Set the temperature control lever to the hot position.



- Remove the radiator cap.

**CAUTION**

*Remove the cap slowly. The system is pressurized and the coolant may be hot. Do not open the cap when the engine is hot.*



KDMB002E

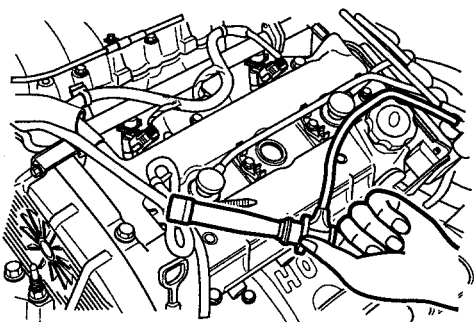
- Loosen the drain plug to drain the coolant.
- Drain the coolant from the reserve tank.
- After draining the coolant, tighten the drain plug securely.
- Fill the radiator with the coolant up to its filler neck.
- Fill the reserve tank with the coolant.
- Warm up the engine until the thermostat opens, remove the radiator cap and check the coolant level.
- When the radiator is filled up to its filler neck, install the radiator cap securely.
- Fill the reserve tank with coolant up to the "FULL" line.

**REPLACING IGNITION CABLES**

The ignition cables should be replaced periodically with new ones. After replacing, make sure that the ignition cables and terminals are properly connected and positioned correctly.

**NOTE**

*When disconnecting an ignition cable, be sure to hold the cable cap. If the cable is disconnected by pulling on the cable alone, an open circuit might result.*



KFW2005A

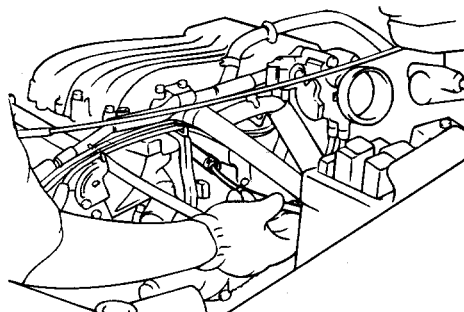
**REPLACING OXYGEN SENSOR**

The oxygen sensor is a device which helps control the fuel mixture. If the oxygen sensor is damaged, the exhaust-gas cleaning efficiency as well as driveability deteriorates. Therefore, it should be replaced periodically with a new one.

**FUEL SYSTEM**

**Tank, Lines And Connections**

- Check for damage or leakage in the fuel lines and connections.
- Inspect the surface of fuel hoses for heat and mechanical damage. Hard and brittle rubber, cracking, tears, cuts, abrasions and excessive swelling indicate deterioration of the rubber.
- If the fabric casing of the rubber hose is damaged by cracks and abrasions in the fuel system, the hoses should be changed.

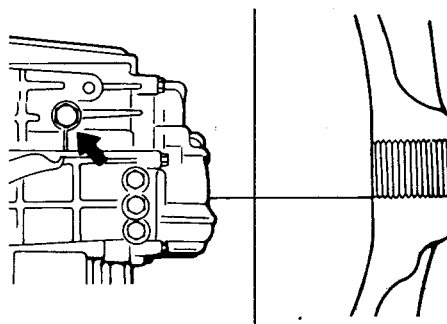


ECHA060A

**MANUAL TRANSAXLE (INSPECT OIL LEVEL)**

Inspect for leakage in each component and check the oil level by removing the filler plug. If the oil is contaminated, replace it with new oil.

- With the vehicle parked at a level place, remove the filler plug and make sure that the oil level is the same level as the plug hole.
- Check that the transaxle oil is not dirty.



EAA9029A

**TRANSAXLE OIL (REPLACE)**

1. With the vehicle parked at a level place, remove the magnetic plug and drain transaxle oil.
2. Replace the washer with a new one and reinstall the plug.
3. Fill with transaxle oil (through the filler plug part) until the oil level is the same level as the plug hole.

**INSPECTING STEERING LINKAGE**

1. Check the steering wheel freeplay.

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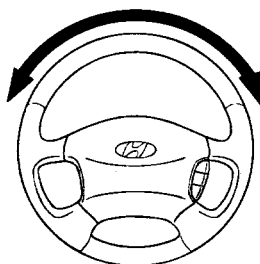
Maximum steering wheel freeplay : 30 mm (1.181 in.)

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2. Check the steering linkage for looseness and damage.
  - a) Tie rod ends must not have excessive play.
  - b) Dust seals and boots must not be damaged.
  - c) Boot clamps must not be loose.

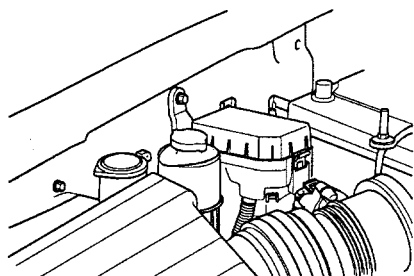
**POWER STEERING FLUID LEVEL (INSPECT FLUID LEVEL)**

1. Park the vehicle on a level surface, start the engine, and then turn the steering wheel several times to raise the temperature of the fluid to approximately 50°C (122°F).



ECHA062A

2. With the engine idling, turn the wheel all the way to the left and right several times. Check the fluid in the oil reservoir for foaming, and its level. Replenish the fluid in the oil reservoir through the oil filter if necessary.



KDMB002D

**POWER STEERING HOSES (CHECK FOR DETERIORATION OR LEAKS)**

1. Check the hose connections for fluid leaks.
2. The power steering hoses should be replaced if there is severe surface cracking, pulling, scuffing or worn steps. Deterioration of the hoses could cause premature failure.

**BALL JOINT AND STEERING LINKAGE SEALS, STEERING AND DRIVE SHAFT BOOTS**

1. These components, which are permanently lubricated at the factory, do not require lubrication. Damaged seals and boots should be replaced to prevent leakage or contamination of the grease.
2. Inspect the dust covers and boots for proper sealing, leakage and damage. Replace them if defective.

**INSPECTING BRAKE LINES**

1. Check all brake lines and hoses for damage, wear, cracks, corrosion, leaks, bends and twists.
2. Check all clamps for tightness.
3. Check that the lines are clear of sharp edges, moving parts and the exhaust system.



EAA9033A

**FRONT DISC BRAKE PADS**

Check for fluid contamination and wear. Always replace brake pads in complete sets.

**NOTE**

*If a squealing or scraping noise occurs from the brake during driving, check if the pad wear indicator is contacting the disc. If it is, the brake pads should be replaced.*

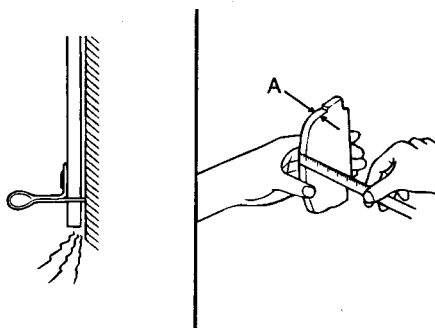
**CAUTION**

*The pads for the right and left wheels should be replaced at the same time. Never split or intermix brake pad sets. All pads must be replaced as a complete set.*

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Thickness of pad lining [Limit] : 2.0 mm (0.079 in.)

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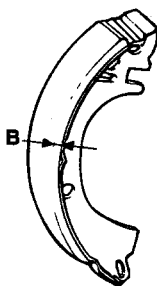
EAA9034A

**REAR DRUM BRAKE LININGS AND REAR WHEEL CYLINDERS**

1. Remove the brake drum and check the thickness of the brake shoe lining for wear. Check the automatic brake adjusting system by hand to see that it operates smoothly, and gears are in proper mesh with each other. To assure smooth function, apply a very thin coat of grease to the friction surface of the adjuster and link shaft.
2. Inspect the wheel cylinder boots for fluid leaks. Visually check the boots for cuts, tears or heat cracks. (A small amount of fluid on the boot may not be a leak but preservative fluid used at assembly.)

Checking the brake shoes for wear.

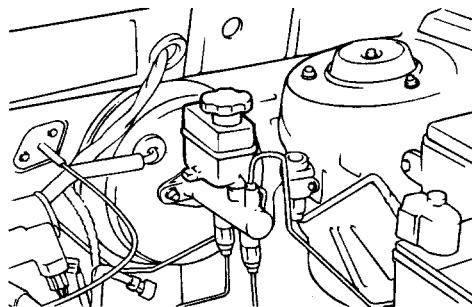
Thickness of lining [Limit] : 0.8 mm (0.031 in.)



EAA9035A

**CHECKING THE BRAKE FLUID LEVEL**

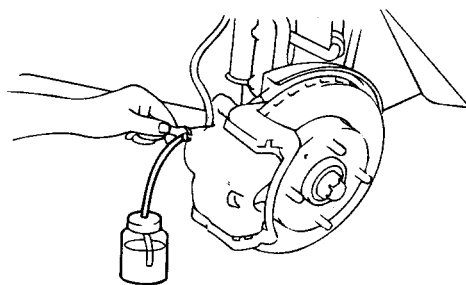
1. Check the level of the brake fluid in the reserve tank of the master cylinder.
2. The level should be between the "MAX" and "MIN" mark.
3. If the level is lower than the "MIN" mark, add new brake fluid up to the "MAX" mark.



ECJA230A

**CHANGING BRAKE FLUID**

1. Refer to BR-Section for air-bleeding procedures.
2. With a vehicle equipped with ABS(Anti-lock Brake System), refer to BR-section.
3. Connect a vinyl tube to the bleeder screw of each wheel cylinder. Put the other end of the vinyl tube in a vessel to receive the brake fluid.



EAA9037A

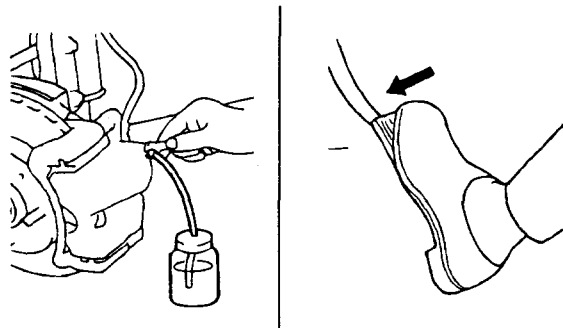
4. Depress the brake pedal a few times. Then loosen the bleeder screw(with the brake pedal still depressed), and tighten it after the brake fluid stops flowing.

5. Repeat the above operation until there are no air bubbles in the brake fluid.
6. Repeat these steps for the other cylinders.
7. Add new brake fluid up to the "MAX" level in the reserve tank.

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Brake fluid : DOT 3 or DOT4

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EAHA014B

### CHECKING TIRE INFLATION PRESSURE

Check the tire inflation pressures as follows.

#### TIRE INFLATION PRESSURE (CHECK WITH TIRES COOL)

	Tire size	Front	Rear
4WD	225/70 R15	30 psi	30 psi

### ROAD TEST

Drive the vehicle and check for abnormal conditions.

1. Check oil, fluid, fuel, water and exhaust gas leaks.
2. Check free play of clutch pedal and brake pedal.
3. Check operation of brake booster.
4. Check the operation of service brake and parking brake systems.
5. Check the stroke of parking brake lever.
6. Check the driveability of engine.
7. Check the condition of instruments, gauges, indicators, exterior lamps, heater and ventilators.
8. Check the abnormal noises from each part.

### STEERING AND DRIVE SHAFT BOOTS

1. Aluminum wheels require special attention. If salt or chemicals adhere to the wheels, they need to be rinsed off as soon as possible. After cleaning the wheels, apply a coating of wax to them to prevent corrosion.
2. When cleaning the vehicle with steam, do not direct steam onto the aluminum wheels.
  - Clean the hub surface.
  - After tightening the wheel nuts by hand, tighten them according to specifications.
  - Do not use an impact wrench or stand on the wrench with your foot to tighten the wheel nuts.
  - Do not apply oil to the threaded portions.

### TIRE CHAINS AND SNOW TIRES

- Use tire chains only on the rear wheels.
- When using snow tires, use them on all four wheels for added maneuverability and safety.

# Fuel System [Diesel 2.5]

GENERAL .....	FLB -2
INJECTION PUMP-MECHANICAL .....	FLB -11
FUEL DELIVERY SYSTEM-DIESEL .....	FLB -22

# GENERAL

## SPECIFICATIONS EFMB3010

Fuel injection pump Injection pump Type Turning direction Injection sequence Governor type Timer type Feed pump type Control equipment Fast idle mechanism  Injection nozzle and holder Type Nozzle Type  Engine control system   Fuel tank Capacity lit. (U.S. gals., Imp.gals.)	Distribution type Clockwise as viewed from drive side 1 - 3 - 4 - 2 Centrifugal type Hydraulic Vane type  Manual type   Screw-on type   Throttle type  Pedal-operated cable type, incorporating electric engine stop mechanism interlocked with starter switch Throttle button type   75 (19.8, 16.6)
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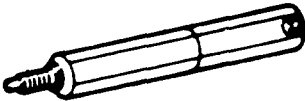
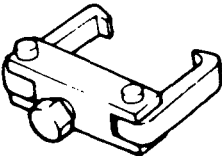
## SERVICE SPECIFICATIONS EFMB3030

	Standard	Limit
Fuel injection pump Injection timing (when plunger lift 1 mm) Cam lift mm Plunger diameter mm Delivery valve opening pressure (bar) Fuel cut solenoid  Injection nozzle Injection orifice (Number-diameter) mm Breaking pressure (bar) Idle speed rpm  Engine control system Cable length Accelerator control cable mm  Throttle cable mm  Throttle knob stroke mm	9° ATDC 2.2 10 25.8 bar Rated voltage : 12V; Resistance : 8Ω  1-1.02 150 bar 750 ± 30  L : 2725-2735 A + B : 125-129 L : 642-648 C : 60-62 25 or more	132 bar

**TORQUE SPECIFICATIONS** EFLB0050

	Nm	Kg·m	lb·ft
Injection pipe clamp bolts	4 - 6	0.4 - 0.6	3 - 4
Injection pipe union nuts	23 - 37	2.3 - 3.7	17 - 27
Pump bracket-to-cylinder block bolts	18 - 25	1.8 - 2.5	13 - 18
Injection pump-to-pump bracket bolts	20 - 27	2.0 - 2.7	14 - 19
Injection pump mounting nuts	15 - 22	1.5 - 2.2	11 - 16
Fuel return pipe nuts	30 - 40	3.0 - 4.0	22 - 29
Injection nozzle	50 - 60	5.0 - 6.0	36 - 43
Retaining nut-to-nozzle body	35 - 40	3.5 - 4.0	25 - 29
Pump sprocket nut	80 - 90	8.0 - 9.0	58 - 65
Fuel tank mounting bolts	15 - 22	1.5 - 2.2	11 - 16

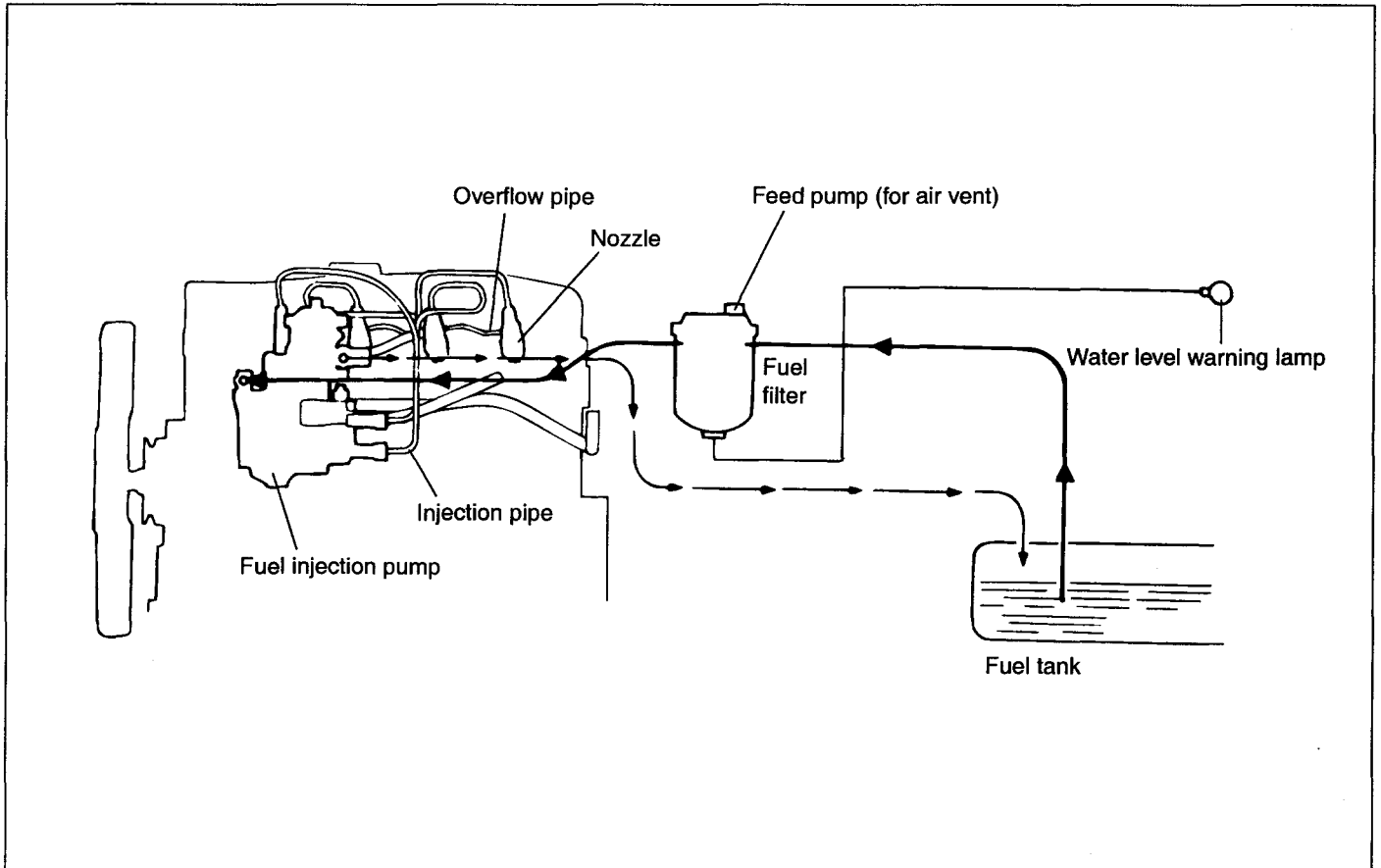
**SPECIAL TOOLS** EFLB0070

Tool (Number and name)	Illustration	Use
09310-43000 Prestroke measuring adapter	 <p style="text-align: right;">C1043000</p>	Injection timing adjustment
09314-43000 Injection pump sprocket puller	 <p style="text-align: right;">C1443000</p>	Removal of injection pump sprocket

## GENERAL INFORMATION EFLB0080

A distribution-type fuel injection pump is installed in the front upper case and is driven by the timing belt. The fuel is drawn from the fuel tank by a pump inside the fuel injection pump and sent to the injection pump through a filter which contains a water separator. The fuel under pressure enters the pump chamber, where the fuel pressure is regulated by a regulating valve. From the pump chamber, the fuel is sent through the distributor head passage and then the inlet port in the barrel to the high pressure chamber above the plunger. The plunger pumps the fuel

and the highly pressurized fuel is injected from the nozzle in accordance with the injection sequence. The excess fuel in the pump housing chamber is returned through the overflow valve and the overflow pipe to the fuel tank. The injection pump is cooled and lubricated by means of fuel circulation. The excess fuel at the nozzle holder is also returned through the overflow pipe with unions on the injection pump to the fuel tank. Since the injection pump is lubricated by fuel, water in the fuel will shorten the pump life to a great degree. Therefore, special care must be taken to prevent the entry of water, dust, etc. into the system.





## TROUBLESHOOTING EFLB0090

## FUEL INJECTION SYSTEM

Symptom	Probable cause	Remedy
Engine does not start	Cranking speed too low	Repair starting system or charge or replace battery so that engine cranks at a minimum of 150 rpm.
	No voltage at fuel cut-off solenoid on injection pump	Check for voltage with test light. If necessary, replace fuse or faulty wires.
	Fuel cut-off solenoid on injection pump loose or faulty	Tighten solenoid. Check that solenoid clicks when key is turned off and on. Replace faulty solenoid.
	No voltage at glow plug bus	If test light shows no voltage at bus with key at "ON" position, test relay and wiring.
	Glow plug faulty	Test and, if necessary, replace glow plug.
	Air in fuel system	Bleed fuel system.
	Injection pump not delivering fuel	If no fuel emerges from a looseness injection pipe during cranking, check timing belt and fuel supply from filter.
	Injection pipes misconnected	Connect pipes in correct location
	Injection timing incorrect	Adjust injection timing.
	Faulty injection nozzles	Check and, if necessary, repair or replace nozzles.
	Engine mechanical faults, as described earlier under this heading	Test compression and, if necessary, repair engine.
	Faulty injection pump	Try to start engine with new pump installed. If necessary, replace pump permanently.
Idle speed incorrect or idle rough irregular	Idle speed incorrectly adjusted	Check and, if necessary, adjust the idle speed.
	Accelerator control binding	Check that accelerator lever on pump is not loose, then adjust accelerator cable.
	Loose fuel hose between filter and injection pump	Replace hose or secure with clamps, bleed air from system.
	Air in fuel system	Bleed fuel system.
	Inadequate fuel supply owing to clogged fuel filter, or fuel return line and injection pipes leaking, dirty, kinked, or squeezed at connections	Inspect and, if necessary, replace lines and hoses or replace fuel filter.
	Faulty injection nozzles	Check and, if necessary, repair or replace injection nozzles.
	Injection timing incorrect	Adjust injection timing.
	Engine mechanical faults, as described earlier under this heading	Test compression and, if necessary, repair engine.
	Faulty injection pump	Try engine at idle with new pump installed. If necessary, replace pump permanently.
Engine lugging in too high a gear	Observe correct shift speeds.	

Symptom	Probable cause	Remedy
Smoky exhaust (black, blue or white)	Engine not reaching correct operating temperature	Check and, if necessary, replace cooling system thermostat.
	Maximum rpm incorrect	Check and if necessary, replace injection pump.
	Faulty injection nozzles	Check and, if necessary, repair or replace injection nozzles.
	Injection timing incorrect	Adjust injection timing.
	Restricted exhaust system	Check exhaust system for dents and obstructions.
	Engine mechanical faulty, as described earlier under this heading	Test compression and, if necessary, repair engine.
	Faulty injection pump	Observe exhaust with new pump installed if necessary, replace pump permanently.
Poor power output, slow acceleration (speedometer accurate, clutch not slipping)	Injection pump accelerator lever loose or not reaching maximum rpm adjusting screw	Tighten lever, check that accelerator pedal travel is not restricted, then adjust accelerator cable.
	Maximum rpm incorrect	Check and, if necessary, replace injection pump.
	Air cleaner filter dirty	Clean or replace air cleaner filter.
	Inadequate fuel supply owing to clogged fuel filter, or fuel return line and injection pipes leaking, dirty, kinked, or squeezed at connections	Inspect and, if necessary, replace lines and hoses, replaced fuel filter.
	Air in fuel system	Bleed fuel system.
	Ice or solidified wax in fuel lines. (winter time only)	Move car to a warm garage until ice or wax has become liquid, then bleed fuel system.
	Faulty injection nozzles	Check and, if necessary, repair or replace injection nozzles.
	Injection timing incorrect	Adjust injection timing.
	Engine mechanical faults, as described earlier under this heading	Test compression and, if necessary, repair engine.
Faulty injection pump	Check acceleration and speed with new pump installed. If necessary, replace pump permanently.	

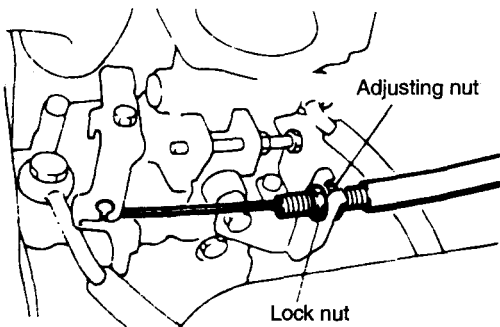
Symptom	Probable cause	Remedy
Excessive fuel consumption	Air cleaner filter dirty	Clean or replace air cleaner filter.
	Fuel leaks	Check and, if necessary, replace or tighten all pipes, hoses and connections.
	Return pipe and hose blocked	Check return line for kinks and dents. Replace faulty lines. If line is clogged, blow it out with compressed air, then bleed fuel system.
	Idle speed too fast or maximum rpm too high	Check and, if necessary, adjust idle speed or replace injection pump.
	Faulty injection nozzles	Check and, if necessary, repair or replace injection nozzles.
	Injection timing incorrect	Adjust injection timing.
	Engine mechanical fault, as described earlier under this heading	Test compression and, if necessary, repair engine.
	Faulty injection pump	Check fuel consumption with new pump installed, if unnecessary, replace pump permanently.
Excessive accelerator pedal effort required (Incomplete pedal return included)	Rusty pedal arm	Clean and lubricate.
	Incorrect routing	Ensure bending radius of 150 mm or more and correct excessively bent portion.
	Rusty cable	Replace
	Shift throttle cable	Lubricate link and shaft.
Broken accelerator control cable	Binding cable end	Remove rust and burrs from cable end.
	Incorrect perpendicularity of cable end mounting point	Correct ends on the lever side.
	Incorrect perpendicularity between cable end and cable	Correct or replace parts.
Engine does not stop	Faulty starting switch operation	Correct or replace part.
	Broken harness between starting switch and fuel cut solenoid	Replace harness

**INSPECTION AND ADJUSTMENT**

EFLB0150

**ACCELERATOR CABLE**

1. Warm engine until stabilized at idle.
2. Confirm idle rpm is at prescribed rpm.
3. Stop engine.
4. Confirm there are no sharp bends in accelerator cable.
5. Check inner cable for correct slack.



AU003

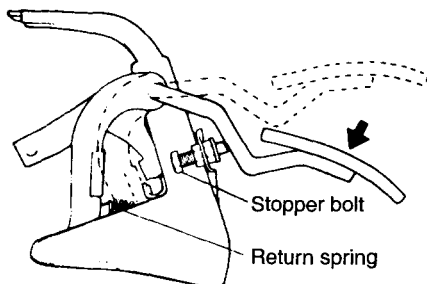
6. If there is too much slack, adjust slack by the following procedures.
  - 1) Loosen adjusting nut. Fully close throttle lever.
  - 2) Tighten adjusting nut until throttle lever just starts moving. Return 1 turn and lock with lock nut. This adjusts accelerator cable play to standard value.

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Standard value : approx. 1 mm (0.04 in.)

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- 3) Adjust so that accelerator pedal stopper touches pedal arm when throttle lever is fully opened.
- 4) After adjusting, confirm that throttle level fully opens and closes by operating pedal.



AU004

**ADJUSTMENT**

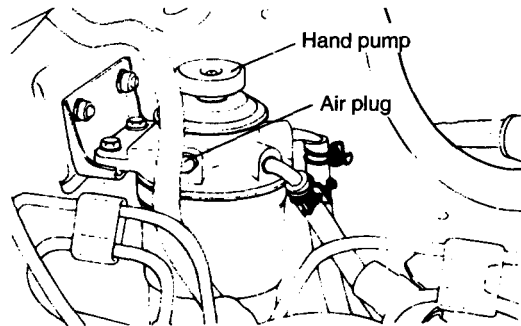
EFLB0160

**EVACUATION OF AIR FROM FUEL LINE**

Evacuate air after following services.

- When fuel is drained and re-filled for service.
- When fuel filter is replaced.
- When main fuel line is removed.

1. Loosen fuel filter air plug.
2. Place rags around air plug hole. Operate hand pump repeatedly until no bubbles come from plug hole. Tighten air plug.
3. Repeat until hand pump operation becomes stiff.



AU005

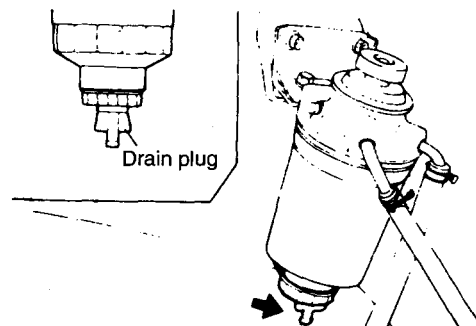
**ADJUSTMENT**

EFLB0170

**EVACUATION OF WATER FROM FUEL FILTER**

Water is in the filter when fuel filter indicator lights. Evacuate water by the following procedures.

1. Loosen drain plug.
2. Drain water with hand pump. Finger-tighten drain plug.



AU006

**INSPECTION AND ADJUSTMENT** EFMB3180

**INJECTION NOZZLE**

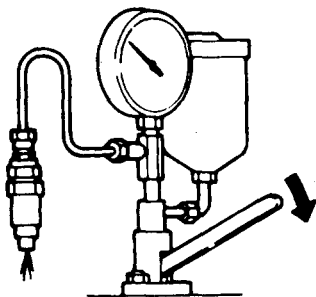
**INJECTION START PRESSURE**

1. Set injection nozzle in nozzle tester and check the following.
2. Move nozzle tester handle at about one stroke per second.
3. The pressure gauge pointer rises slowly and swings when injection is made. Read the position at which the pointer started to swing. Check the injection start pressure is the standard value.

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**Standard value** : 150 bar  
**Limit** : 132 bar or less

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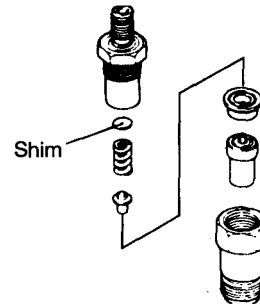
AU007

4. If the nozzle is faulty, disassemble and adjust injection start pressure to the standard value by changing the shim thickness. Injection pressure increases by approx. 12 bar as shim thickness is increased by 0.1 mm (0.0039 in.).

**CAUTION**

*When disassembling nozzle holder, be careful not to allow entry of dirt or water.*

5. If the injection start pressure can not be adjusted by changing the shim thickness, replace nozzle assembly.



EFLB018B

**INJECTION STATUS**

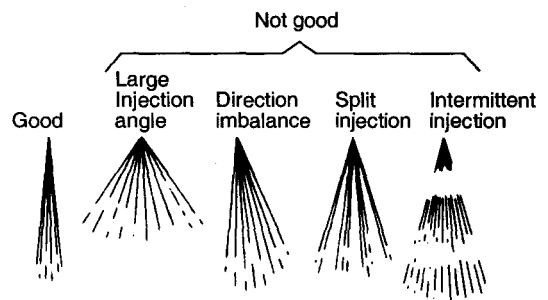
1. Move nozzle tester handle at about 1 stroke per second.

**[NEEDLE VALVE VIBRATION]**

Inject on is normal if the characteristic intermittent sound is heard as the handle is operated, and vibration of the needle valve is felt at the handle.

**[SPRAY]**

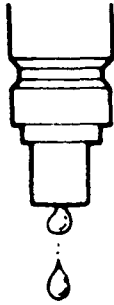
Check that the spray is good, as illustrated in the figure, in the test, the spray may be bolt shaped with a course mist and fuel may remain. This is phenomenon common in this type of inspection, and the nozzle function is normal.



EFLB018C

2. Move nozzle tester handle at 4 to 6 strokes per second.
3. Confirm the spray is cone shaped with an angle of about 15°. This indicates a good condition.
4. If the injection is not good, disassemble nozzle and replace nozzle tip or entire assembly.
5. Confirm fuel does not drip after injection.

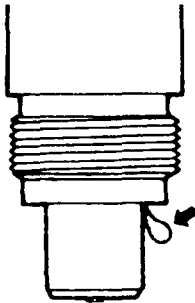
6. If dripping, disassemble injection nozzle and replace nozzle tip or entire assembly.



EFLB018D

### NOZZLE OIL-SEAL

1. Maintain internal nozzle pressure (pressure gauge indication value) with the nozzle tester at 120 - 132 bar. Check for fuel leaking from nozzle tip in this condition.
2. If there is leakage, disassemble injection nozzle and replace nozzle tip or entire assembly.



EFLB018E

# INJECTION PUMP-MECHANICAL

## INSPECTION EFLB1010

### FUEL INJECTION PUMP AND INJECTION NOZZLE ON VEHICLE

If found defective, replace the injection pump as assembly.

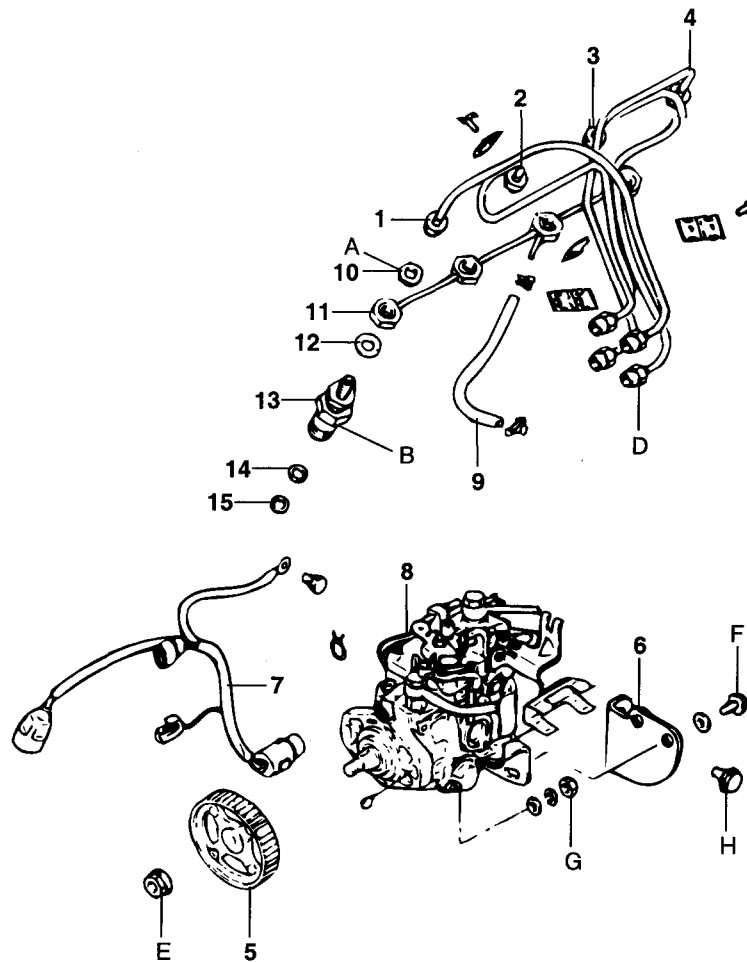
 **NOTE**

*Limit the injection pump adjustment to the idle adjustment.*

Description	Check procedure	Criteria
Idling run	Measure rpm	702-780 rpm
Color of exhaust gas	Give fast acceleration under no load and check color of exhaust gas. (Measure smoke value).	Voluminous black smoke is unacceptable. (Smoke ref. value : within 50%)
Timer	Operate accelerator lever to maintain an engine speed of approx. 1,500 rpm. In this condition, manually operate accelerator switch knob to see how engine speed changes.	Engine noise changes.
Fuel cut solenoid	Turn on and off ignition switch	Actuating sound (click) is heard.

COMPONENTS

EFLB1030



- 1. Injection pipe No.1
- 2. Injection pipe No.2
- 3. Injection pipe No.3
- 4. Injection pipe No.4
- 5. Injection pump sprocket
- 6. Injection pump bracket
- 7. Injection pump harness assembly
- 8. Fuel injection pump
- 9. Fuel hose
- 10. Fuel return pipe nut
- 11. Fuel return pipe
- 12. Gasket
- 13. Injection nozzle
- 14. Holder gasket
- 15. Nozzle gasket

**NOTE**

Reverse the removal procedures to reinstall

	Nm	kg·m	lb·ft
A	30-40	3.0-4.0	21-29
B	50-60	5.0-6.0	36-43
C	4-6	0.4-0.6	3-4
D	23-37	2.3-3.7	16-27
E	80-90	8.0-9.0	58-65
F	20-27	2.0-2.7	14-19
G	15-22	1.5-2.2	10-16
H	18-25	1.8-2.5	13-18



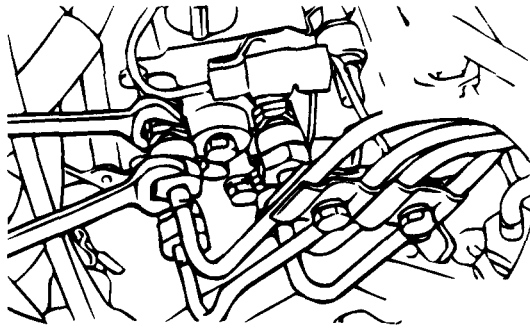
**REMOVAL** EFLB1050

**INJECTION PIPE**

When loosening the union nuts, hold delivery valve holder on fuel injection pump head or hexagon nut of fuel return pipe with a wrench to prevent it from rotating along with the union nut.

**CAUTION**

*Because VE type injection pipe is different from DPC type injection pipe, be careful when you install. (VE type injection pipe is coated yellow)*



EFLB105A

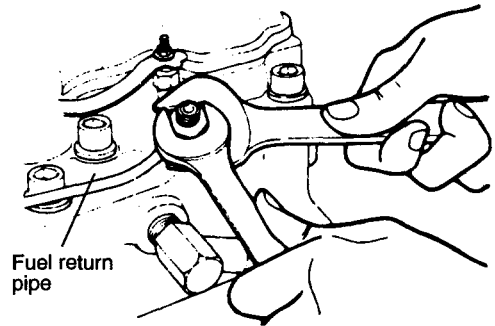
*So you must remove the hexagon nut with holding return pipe.*

**FUEL RETURN PIPE NUT**

When removing the fuel return pipe nut, hold the fuel return pipe by the hexagon nut with a wrench.

**CAUTION**

*If you remove the hexagon nut without holding the fuel return pipe nut, the pipe might be damaged. So you must remove the hexagon nut with holding return pipe.*



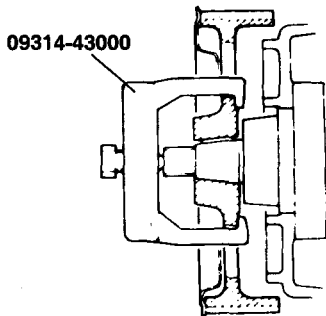
EFLB105C

**INJECTION PUMP SPROCKET**

Use the special tool to remove the injection pump sprocket.

**CAUTION**

*Jarring the sprocket may cause injection pump malfunction.*



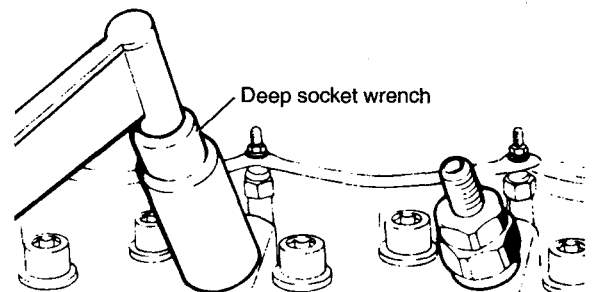
EFLB105B

**INJECTION NOZZLE**

Using a deep socket wrench, loosen the injection nozzle and remove.

**CAUTION**

*Write the number of the cylinder on the injection nozzle that has been removed. Cover the opening with an appropriate cap to prevent entry of dust, water and foreign material into the fuel passage and combustion chamber.*



EFLB105D

**FUEL INJECTION PUMP**

When removing the fuel return pipe nut, hold the fuel return pipe by the hexagon nut with a wrench.

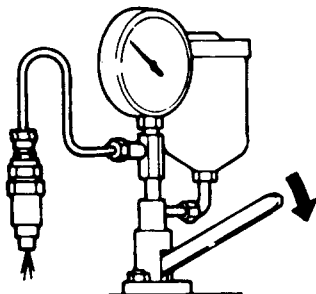
**CAUTION**

*If you remove the hexagon nut without holding the fuel return pipe nut, the pipe might be damaged.*

**INSPECTION** EFMB3070

**INJECTION NOZZLE**

Make the following checks and, if defects are found, correct or replace.



AU007

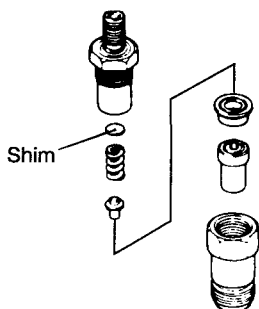
**CHECKING OF INJECTION PRESSURE**

1. Mount nozzle on nozzle tester and operate tester handle to bleed the nozzle.
2. Operate tester handle at a rate of approximately one stroke/sec and read the pressure gauge.  
If the pressure reading is below the service limit, disassemble nozzle and adjust it by replacing the interior shim so that the pressure reading will be within the standard value range.

Standard value :	150 bar
Service limit :	132 bar

**NOTE**

1. Increase of 0.1 mm shim thickness will result in increase of pressure to 12 bar.
2. 20 different shims available ranging in thickness from 1.00-1.95 mm.



EFLB018B

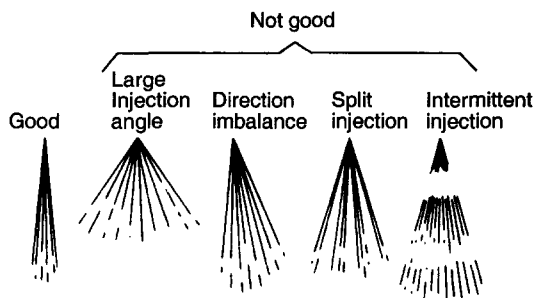
**CHECKING OF SPRAY CHARACTERISTICS**

1. Operate tester handle at a rate of approximately one stroke/sec. When the tester handle is moved, the nozzle should inject fuel producing a characteristic intermittent noise, and vibration of needle valve should be palpable at the tester handle.

**NOTE**

Fuel may remain at the nozzle tip after injection. This sometimes occurs when checking the nozzle but it does not mean that the nozzle is malfunctioning.

2. Spray condition  
Only one shows the good spray condition, others being poor. Spray may be shaped like a rod with coarse fuel particles and the gas oil may be present at the orifice after injection. This is a symptom that occurs uniquely during this inspection and does not represent any abnormal condition of the nozzle.
3. Operate the tester handle 4 to 6 strokes per second. The shape of spray is conical with an angle of about 30 degree.



EFLB018C

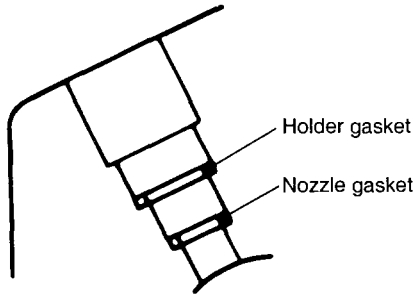
**NOZZLE OIL TIGHTNESS**

Operate the nozzle tester so that the interior pressure of the nozzle is maintained at a pressure gauge reading of 120 - 132 bar and check nozzle tip for fuel leakage.

**INSTALLATION** EFLB1090

**NOZZLE GASKET AND HOLDER GASKET**

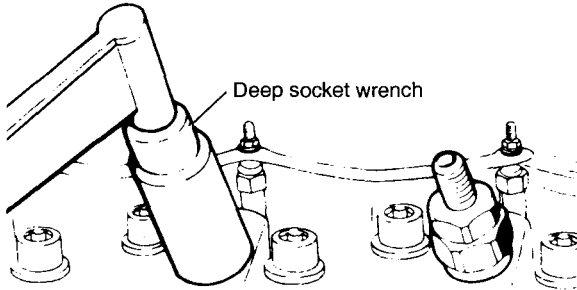
1. Clean nozzle holder installation area of the cylinder head.
2. Fit a new nozzle gasket and holder gasket into the nozzle holder hole in the cylinder head.



EFLB109A

**INJECTION NOZZLE**

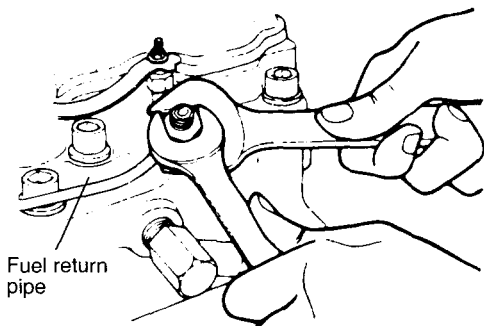
Install the injection nozzle in the cylinder head and tighten to the specified torque, using a deep socket wrench.



EFLB105D

**FUEL RETURN PIPE NUT**

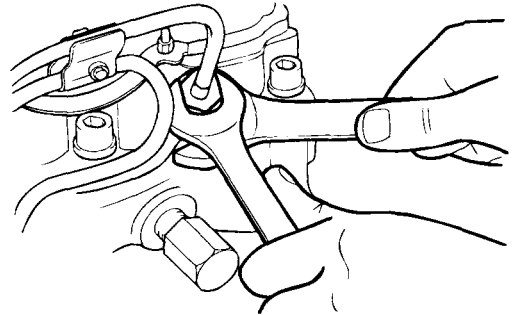
While holding the fuel return pipe by the hexagon nut with a wrench, tighten the fuel return pipe nut to the specified torque.



EFLB105C

**INJECTION PIPE**

When tightening the injection pipe nuts, hold the delivery valve holder or the fuel return pipe by the hexagon nut with a wrench in order to prevent it from rotating along with the nut.



EFLB109B

**ADJUSTMENT** EFLB1110

1. Loosen (but do not remove) two nuts and two bolts holding the injection pump.
2. Loosen (but do not remove) the 4 nuts on the injection pump side which hold the injection pipes.

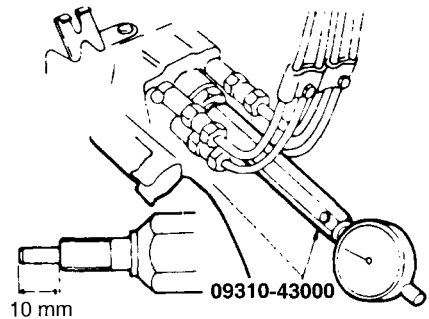
**CAUTION**

*When loosening the nuts, hold the delivery valve holder with a wrench to prevent it from turning along with the nut.*

3. Remove the plug from the rear of injection pump, and attach the special tool and dial indicator.

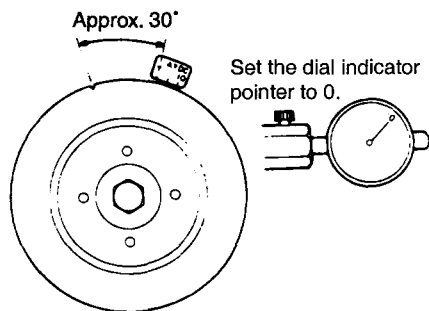
**CAUTION**

*Before installing the adapter, make sure that the push rod projects 10mm. Push rod projection can be adjusted by means of the interior nut.*



EFLB111A

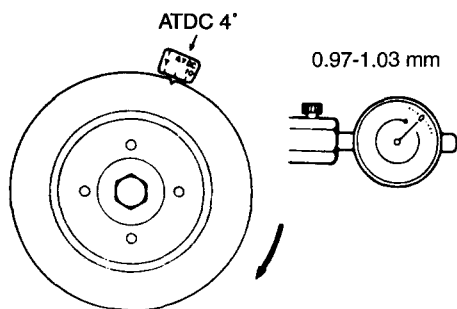
- Set the notch on the crank pulley at approximately 30° BTDC of the compression stroke of the No.1 cylinder. With the notch in this position, set the dial indicator at zero. Turn the crank pulley slightly in both directions to make sure that the dial indicator pointer does not deviate from the zero position. If the pointer deviates, the notch position is not correct. Readjust it to 30° BTDC.



EFLB111B

- Turn the crankshaft clockwise to bring the notch on the pulley to 4° ATDC, and check to be sure that the dial indicator reading is within the standard value range.

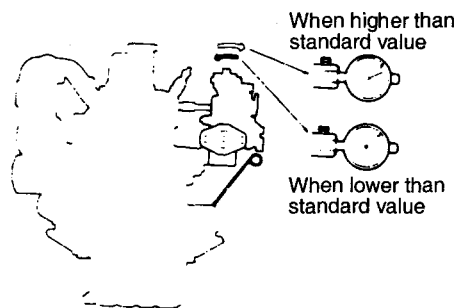
**Standard value : 0.97-1.03 mm**



EFLB111C

- If dial indicator reading is not within the standard value range, tilt the injection pump body to the right or left until the reading is within the standard value range. Then, temporarily tighten the injection pump nuts and bolts.
- Repeat Steps 4 and 6 to make sure that the adjustment has been correctly performed.
- Remove the dial indicator and the special tool.

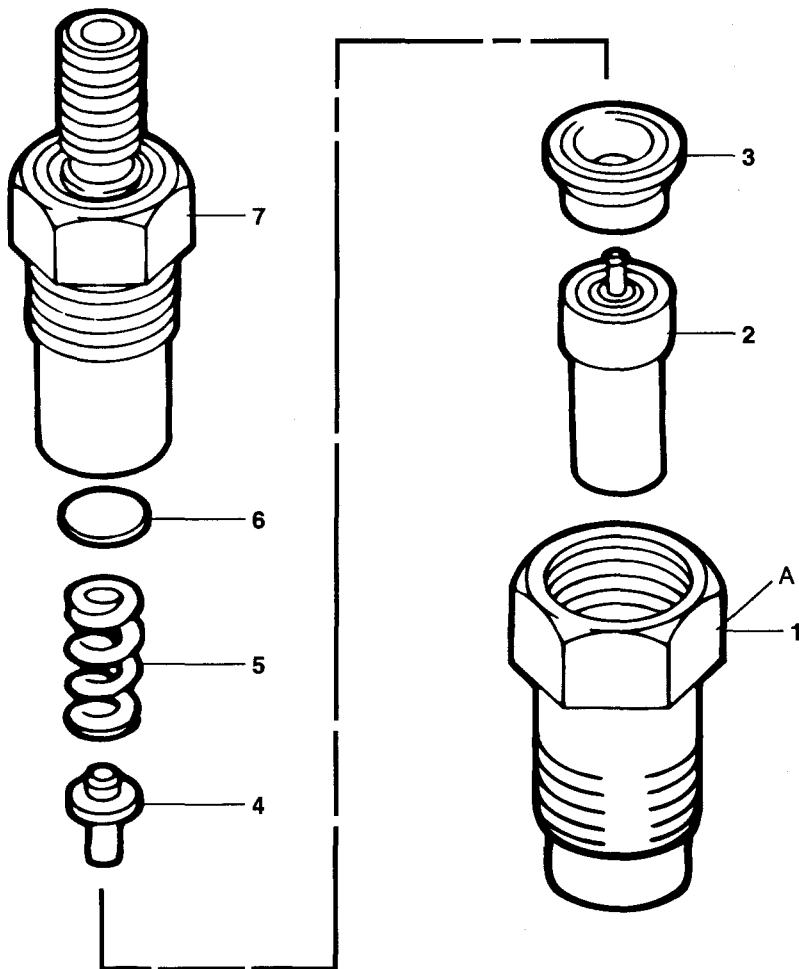
- Tighten the bolts and nuts to the specified torque.



EFLB111D

INJECTION NOZZLE HOLDER EFLB1130

COMPONENTS



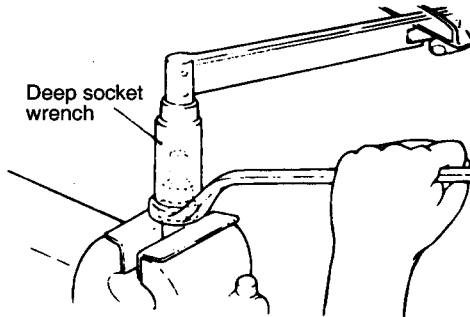
- 1. Retaining nut
- 2. Nozzle tip
- 3. Spacer
- 4. Retaining pin
- 5. Pressure spring
- 6. Shim
- 7. Nozzle holder body

**NOTE**  
Reverse the disassembly procedures to reassembly.

	Nm	kg-m	lb-ft
A	35-40	3.5-4.0	25-29

**DISASSEMBLY** EFLB1150**RETAINING NUT**

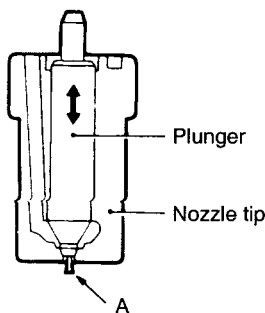
1. Lightly clamp the retaining nut with a cushion bracket
2. Hold the retaining nut with a box wrench, and loosen the nozzle holder body using a deep socket wrench.



EFLB115A

**INSPECTION** EFLB1170**NOZZLE TIP**

1. Check the nozzle tip for carbon deposits: Scrape off carbon deposits with a piece of wood and clean each part with petrol. After cleaning, keep parts submerged in diesel fuel. Take particular care to protect the nozzle tip needle valve from damage.
2. While the nozzle tip is submerged in diesel fuel, check that the needle valve slides smoothly. If the needle valve does not slide smoothly, replace the nozzle tip. When replacing the nozzle tip, completely wash off the anticorrosive oil from the new nozzle tip with clean diesel fuel before using it.
3. Check plunger tip "A" for deformation and breakage. If "A" is damaged or broken replace it.



EFLB117A

**DISTANCE PIECE**

Check the surface in contact with the nozzle holder body by using minimum.

**PRESSURE SPRING**

Check spring for weakness and breakage.

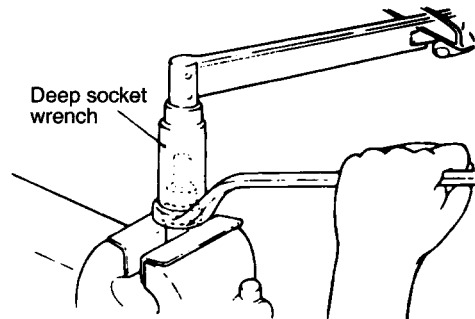
**REASSEMBLY** EFLB1190**RETAINING NUT**

1. Finger-tighten the nozzle holder body.
2. Lightly clamp the retaining nut in a vise with cushion plates.
3. While holding the retaining nut with a box wrench, tighten the nozzle holder body to the specified torque with a deep socket wrench.

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**Tightening torque : 35-40 Nm (3.5-4.0 kgm)**

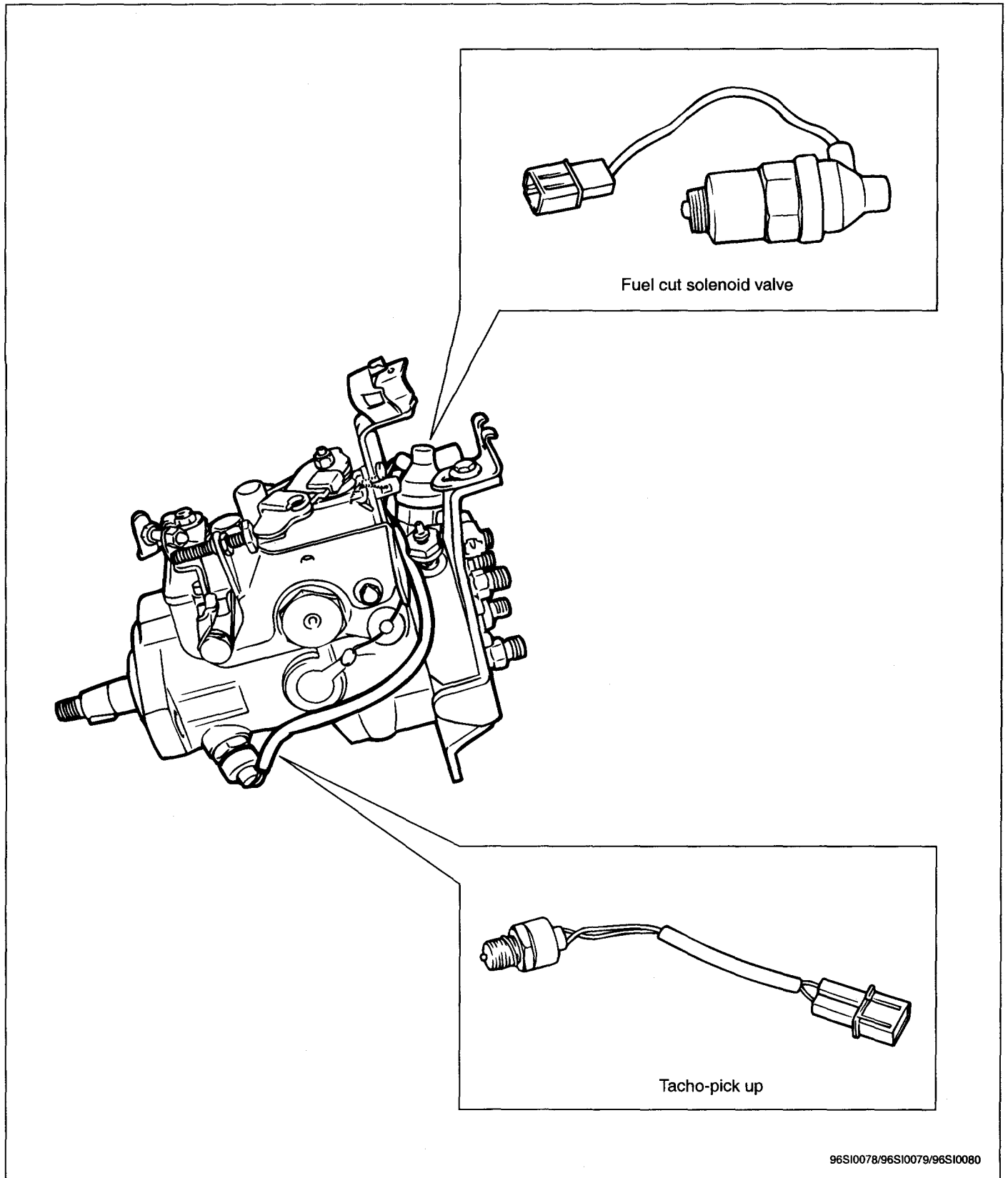
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EFLB115A

LUCAS INJECTION PUMP EFLB1210

COMPONENTS



## INSPECTION AND ADJUSTMENT

EFLB1230

## INJECTION TIMING

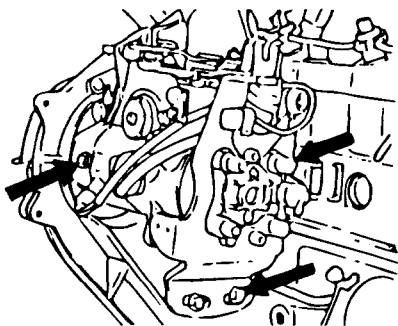
## • Preparation

- Turn off the engine.
- Set the timing belt in normal mounting condition.
- Set the transmission in neutral position

1. Untighten the upper installation nut and bolt of injection pump and also untighten the injection pump and also untighten the injection pipe halfway.

**⚠ CAUTION**

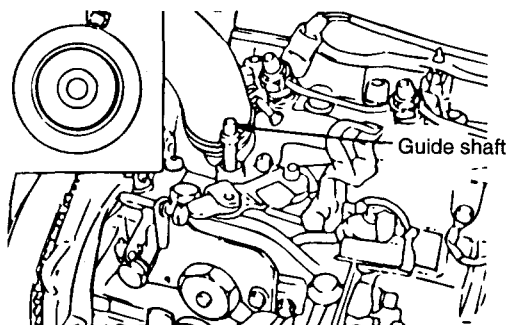
**When untightening injection pipe nut, hold the valve holder with spanner so that the delivery valve holder shall not be turned together.**



EFLB123A

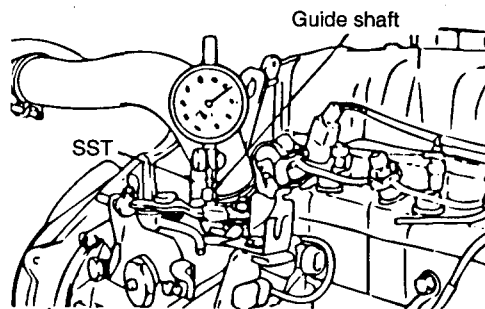
2. Using box wrench, turn the crankshaft pulley to mate the V-groove at ATDC 4°.

Disconnect the timing check plug of injection pump, then insert the SST (Timing Measurement Guide Shaft).



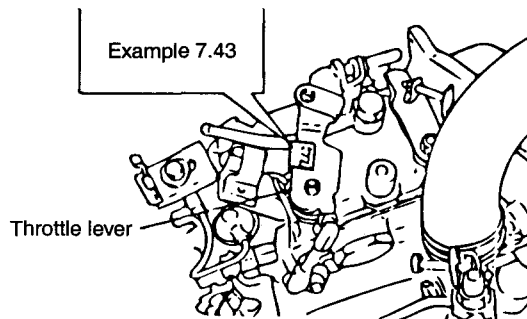
EFLB123B

3. Set the dial gauge to zero (0) after dial gauge installation special tool and dial gauge are installed to timing check guide shaft.



EFLB123C

4. With the V-groove of crankshaft pulley being positioned at ATDC 4° by turning the crankshaft clockwise of 1 rotation, check to sure that the dial indicator reading is within the value indicated on throttle lever.
  - If dial indicator reading is not within the standard value range, tilt the injection pump body to the right or left until the reading is within the standard value range.



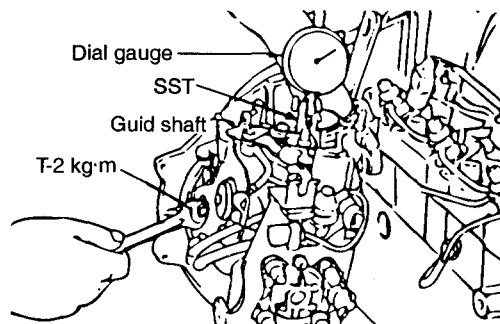
EFLB123D

5. Tighten the injection pump nut and bolt and injection pipe nut. Turn the crankshaft pulley counterclockwise more than 90° and then match to ATDC 4° by turning the crankshaft clockwise. And, check the dial gauge indicating value and adjusting value.

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Limited Value :  $\pm 0.05$  mm

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EFLB123E

6. Remove the timing adjusting data and SST and Guide Shaft, then assemble the check plug using hexagon wrench.

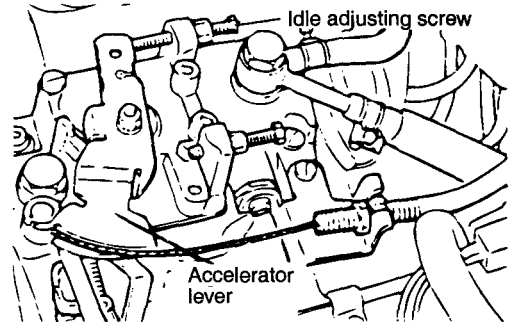


**INSPECTION AND ADJUSTMENT** EFLB1240

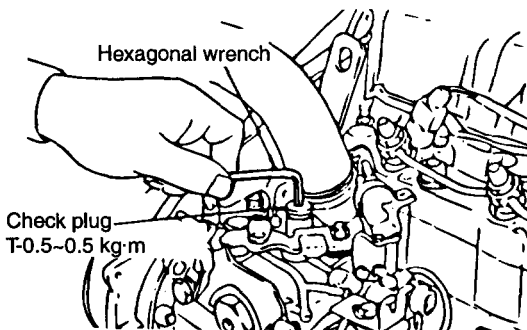
**IDLE RPM**

1. Set the vehicle in the following conditions before inspection and adjustment.
  - Engine coolant temperature : 80-90
  - Lights, accessories : OFF
  - Transmission position : Neutral
2. Check that the valve clearance is within standard value.
3. Check that the injection timing within standard value

7. After adjustment, completely tighten the lock nut.



EFLB123H

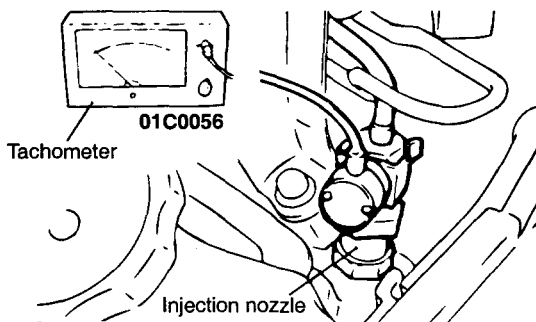


EFLB123F

4. Set the tachometer to injection nozzle or injection pipe.

**NOTE**

When setting tachometer to injection pipe, fully loosen the assembly clamp of pipe prior to set.



EFLB123G

5. Check that the idle rpm is with standard value.

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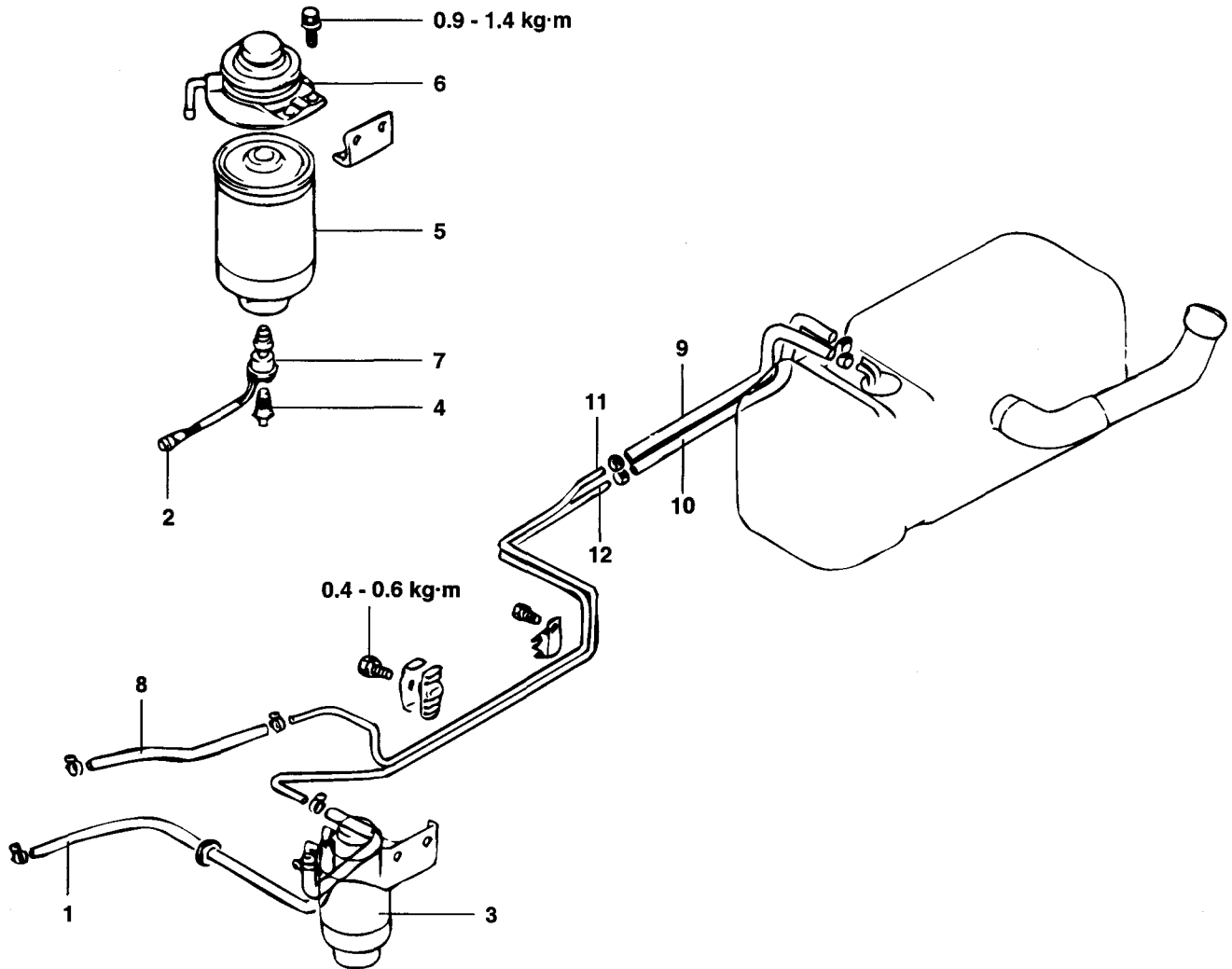
Standard Value : 750 ± 50 rpm

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6. If the idle rpm is over the standard value, loosen the lock nut of idle adjusting screw to the standard value.

# FUEL DELIVERY SYSTEM-DIESEL

## COMPONENTS EFLB2010

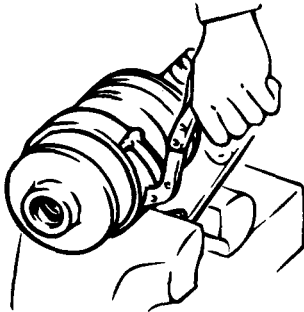


1. Fuel hose (main)
2. Water level sensor connector
3. Fuel filter
4. Drain plug
5. Fuel filter cartridge
6. Fuel filter pump

7. Water level sensor
8. Fuel return hose (main)
9. Fuel hose (connection)
10. Fuel return hose (connection)
11. Fuel main pipe
12. Fuel return pipe

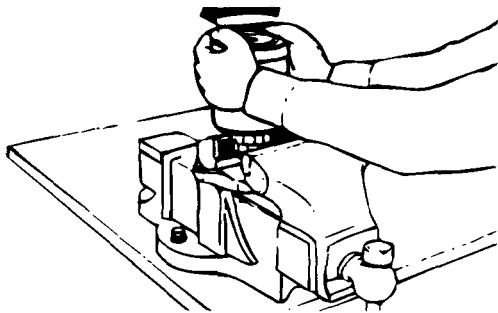
**REMOVAL** EFLB2030

1. Fuel filter cartridge  
With holding fuel filter pump in vice, remove the fuel filter cartridge using fuel filter wrench.



EFLB203A

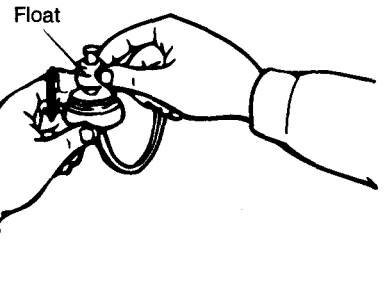
2. Water level sensor  
With holding water level sensor in vice, turn and remove the fuel filter cartridge with both hands.



EFLB203B

**INSPECTION** EFLB2050

1. Normal inspection
  - 1) Check hose and pipe for crack, cooking, blaze and clog.
  - 2) Check fuel filter for clog and damage.
2. Operation of water level sensor  
Connect circuit tester to water level sensor connector. If the circuit is discontinuity or continuity when the float is moved up or down, the water level sensor is good.

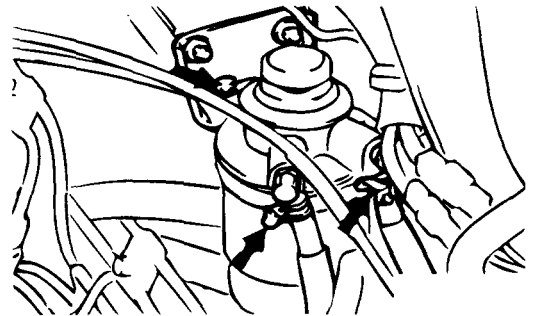


EFLB205A

**REPLACEMENT** EFLB2070

Fuel filter

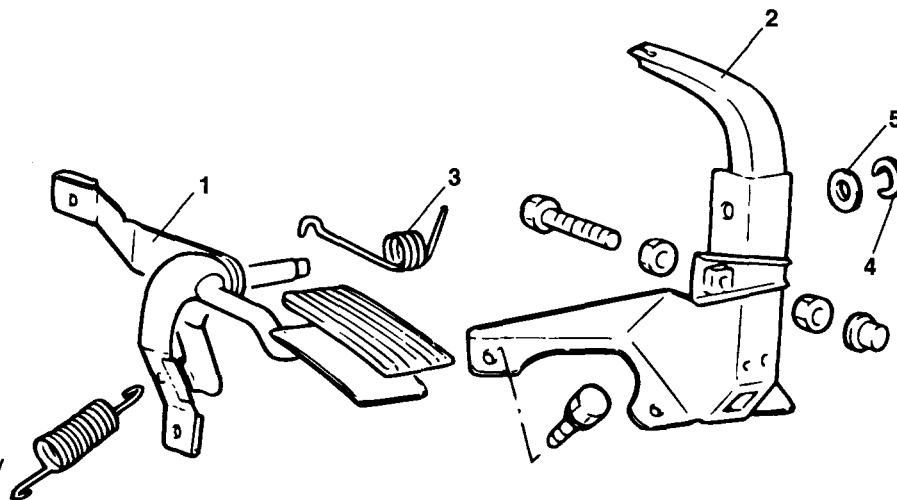
1. Lower the fuel tank pressure by removing fuel filler cap.
2. Disconnect the connector of water level sensor.
3. Remove fuel filter cartridge from fuel filter pump body with hand.
4. Disconnect fuel lose(main) from fuel filter pump.
5. Remove fuel filter pump.
6. Replace fuel filter.



EFLB207A

ENGINE CONTROL EFLB2090

ACCELERATOR PEDAL



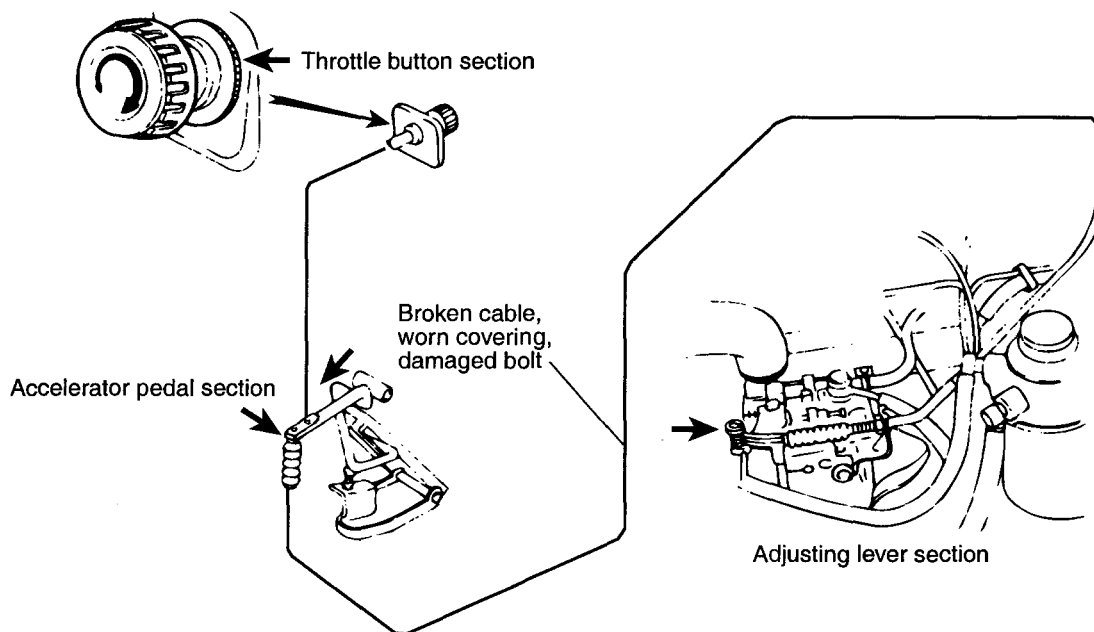
- 1. Accelerator pedal assembly
- 2. Bracket assembly
- 3. Return spring
- 4. Snap ring
- 5. Plain washer

**NOTE**

Reverse the disassembly procedures to reassemble.

EFLB209A

THROTTLE CONTROL EFLB2110



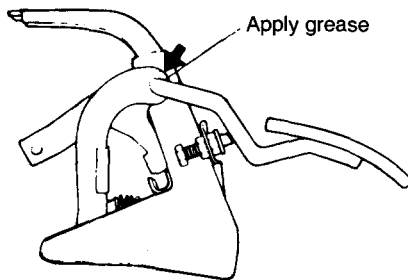
EFLB211A

**REASSEMBLY** EFLB2130**ACCELERATOR PEDAL**

Apply grease to accelerator pedal slide-contacting surface.

**RETURN SPRING**

Apply grease to inner surface.



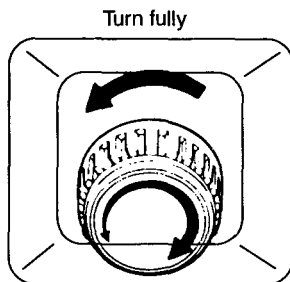
EFLB213A

**CABLE INSTALLATION AND ADJUSTMENT** EFLB2150**THROTTLE CABLE**

Turn the throttle button fully in the opposite direction to that of arrow indicated on the button. With the inner cable most protruded, install the accelerator pedal arm or accelerator lever. At that time, make sure that when the engine speed reaches the lowest speed, the inner cable is in the most protruded state.

**NOTE**

1. *Make this adjustment with the cab tilt and tilt handle down.*
2. *Route each cable so that it may not come in contact with the edge of sheet metal.*
3. *The routing radius of each cable shall 150 mm or more.*



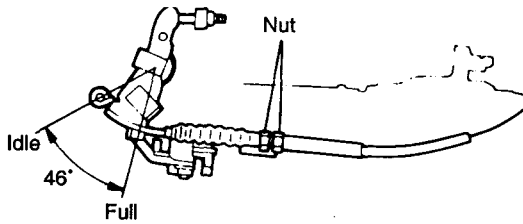
EFLB215A

## ACCELERATOR CONTROL CABLE

Turn the throttle button in the opposite direction to that of arrow indicated on the button and make sure that the accelerator pedal does not move. Install the accelerator control cable to the adjusting lever and secure the engine side of the cable by tightening the nut.

### NOTE

*Do not move the engine side adjusting lever when the accelerator control cable is installed.*



EFLB215B

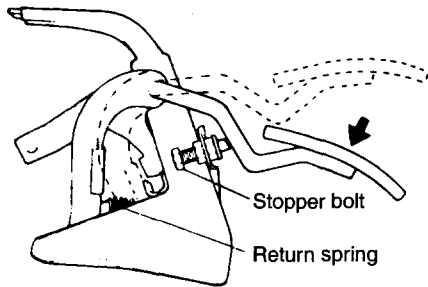
## ACCELERATOR PEDAL STOPPER

Make adjustment so that when the engine side adjusting lever is in contact with the fuel stopper, clearance between accelerator pedal and adjusting bolt is equal to dimension A.

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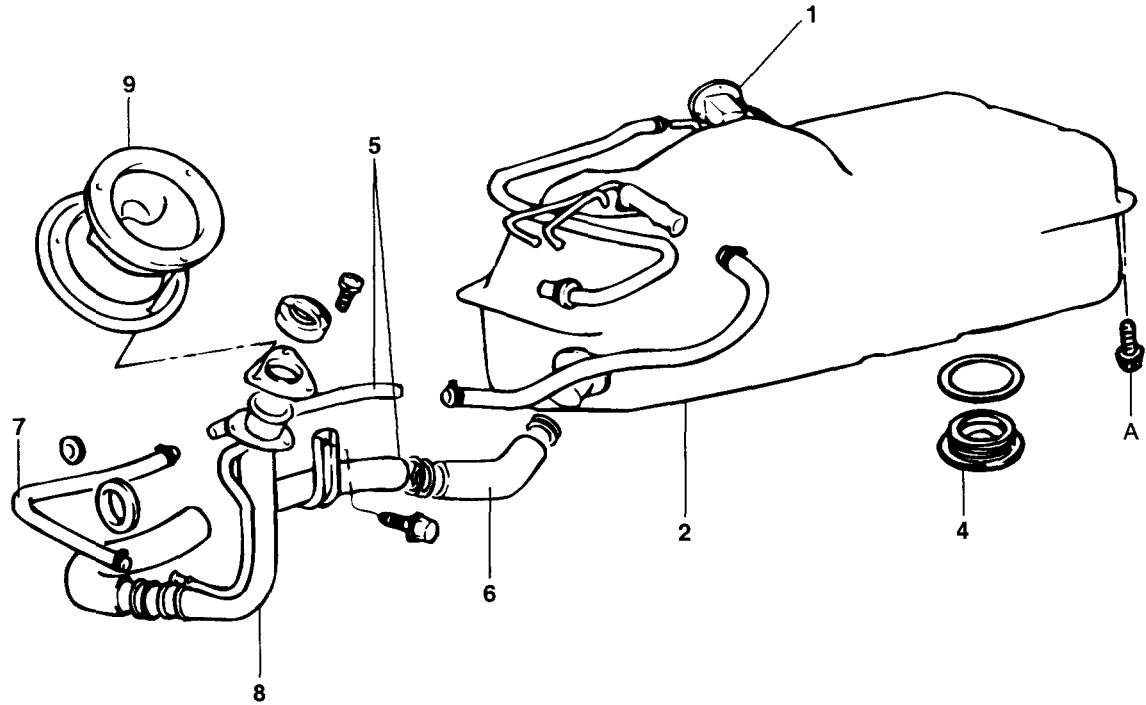
Dimension A : 0 - 5 mm

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AU004

COMPONENTS EFLB2170

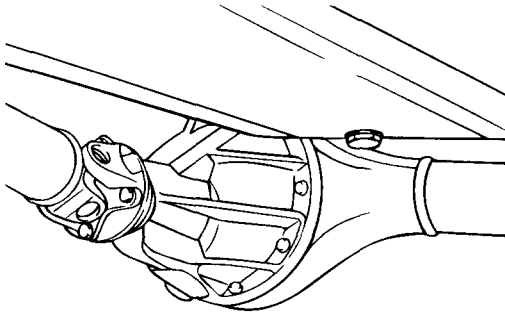


1. Fuel gauge unit
2. Breather hose
3. Fuel tank
4. Drain plug
5. Filler and breather pipe assembly
6. Filler hose
7. Breather hose
8. Filler neck
9. Filler neck cover

	Nm	kg·m	lb·ft
A	15-22	1.5-2.2	11-16

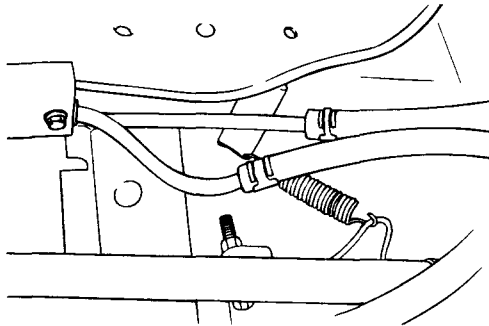
**REMOVAL** EFLB2190

1. Discharge fuel with the drain plug removed.



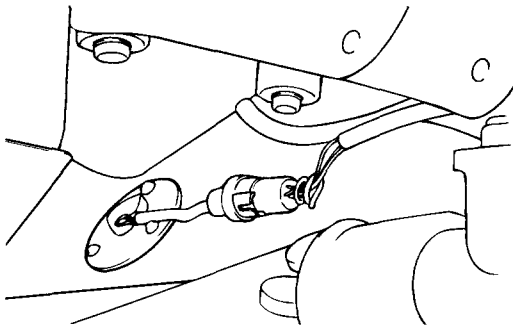
EFLB219A

2. Disconnect the fuel feed hose and return hose.



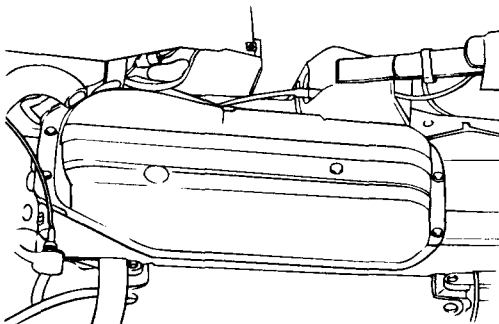
EFLB219B

3. Disconnect the fuel gauge unit connector.



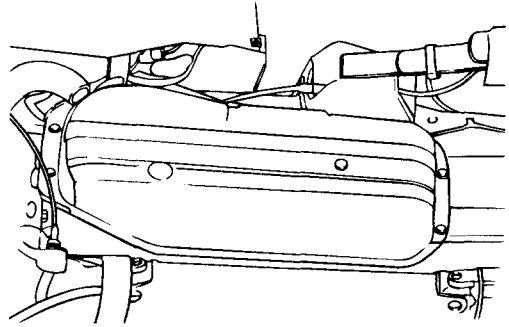
EFLB219C

4. Disconnect the breather hose and filler hose.



EFLB219D

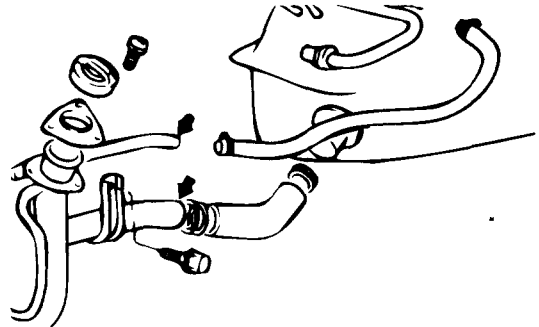
5. Remove the fuel tank.  
Remove the fuel gauge unit if necessary.



EFLB219D

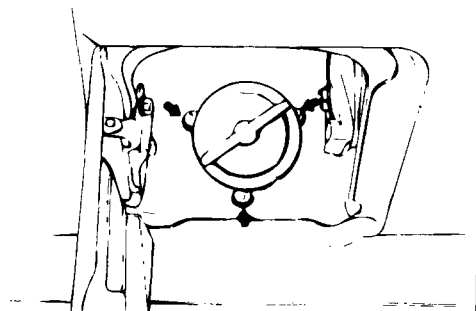
6. Remove the filler neck and filler pipe by the following procedure.

- 1) Disconnect the filler and breather hose from filler and breather pipes.



EFLB219E

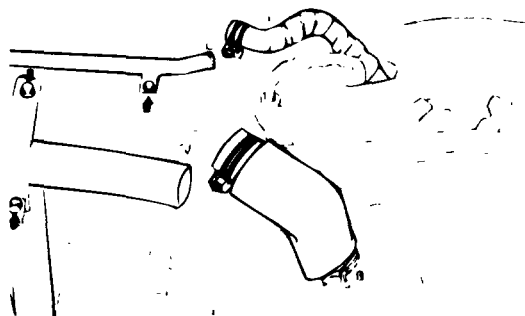
- 2) Pull out the filler neck cover and then remove the filler neck.



EFLB219F



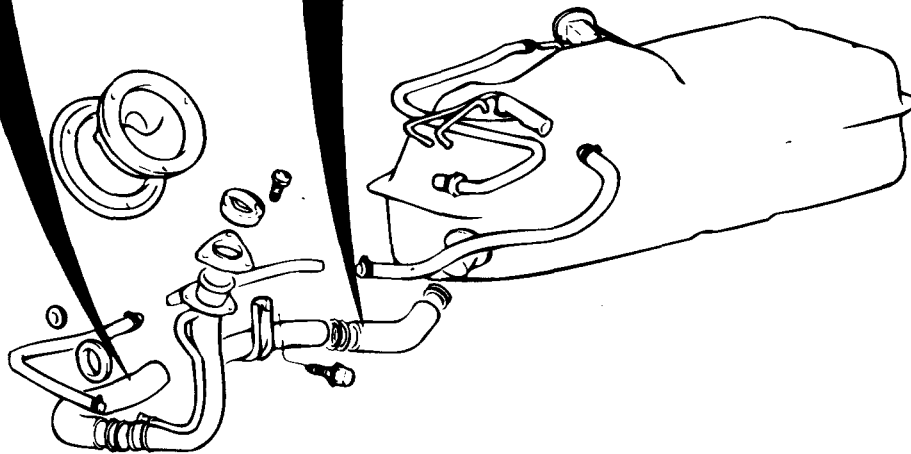
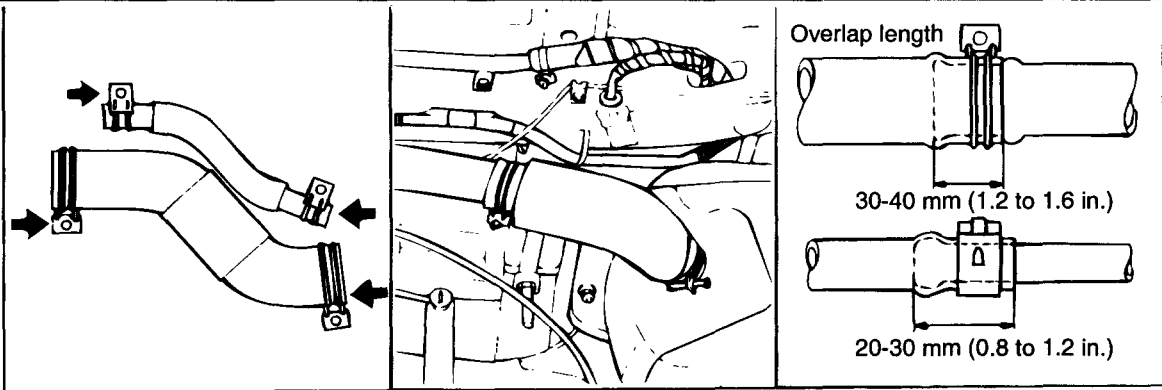
- 3) Remove the filler and breather pipe assembly.



EFLB219G

**INSTALLATION** EFLB2210

When hose are connected to pipes, make that specified overlap length are observed. Tighten hose clamps as position shown in the illustration to prevent the hoses from interfering with other parts.



# Fuel System [Covec-F 2.5]

GENERAL ..... FLA -2

DIAGNOSIS ..... FLA -15



# GENERAL

## DESCRIPTION EFMB6010

This Supplement shop manual consists of two parts, service manual for construction & operation and self-diagnosis system. The first part, service manual for construction & operation, describes construction and operation of the micro-computer controlled fuel injection quantity and injection timing control system COVEC-F (Computed VE pump Control system Full). And the second part, service manual for self-diagnosis system, describes the self-diagnosis system of the microcomputer controlled fuel injection quantity and injection timing control system COVEC-F

## SPECIFICATIONS

Item	Specification
No of cylinders	4, 6
Direction of rotation	Clockwise and counter clockwise
Maximum speed	Approx 3,000 r/min
Plunger diameters	8, 9, 10, 11, 12mm
Injection timing adjustment	TCV duty ratio control
Injection quantity control	Electronic control of control sleeve position
Weight	Approx 6.5kg
Prevention of reverse rotation	Constructed so that fuel injection is not performed at reverse rotation
Additional devices	Not necessary

(Computed VE pump Control system-Full). This supplement is intended for use by vehicle maintenance technicians or persons with an adequate knowledge of injection pumps.

## CONSTRUCTION & OPERATION

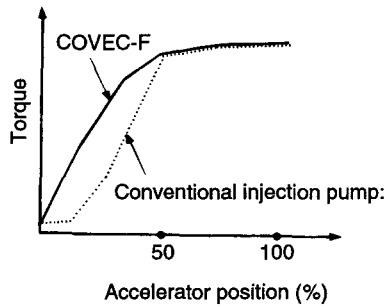
### OUTLINE

The COVEC-F fuel injection system (Computed VE pump Control system-Full) is a distributor type fuel injection system that uses a micro-computer to control fuel injection quantity and injection timing. COVEC-F was developed to improve the power performance of small diesel engines, to improve driving comfort, as well as to decrease pollution.

**FEATURES** EFMB6030

**IMPROVED POWER PERFORMANCE**

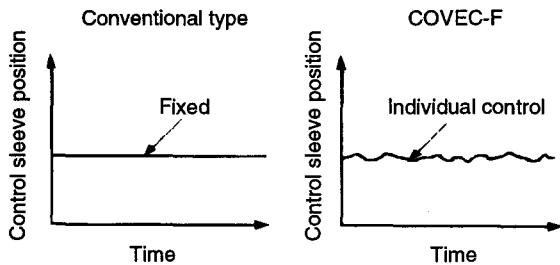
The left hand figure shows the relationship between accelerator position and output torque. Compared to conventional injection pumps, COVEC-F provides the most suitable injection quantity corresponding to accelerator position. This enables increased torque at a lower accelerator position, which improves power performance.



EFMB603A

**INCREASED COMFORT**

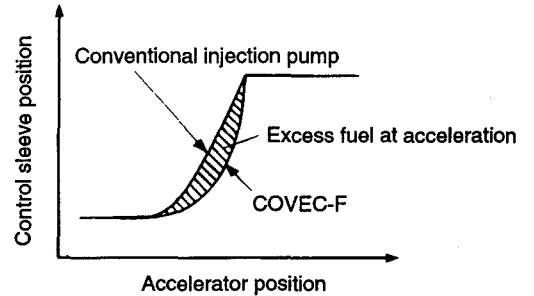
On conventional injection pumps, minute variations of control sleeve position are not performed. COVEC-F, however, detects variations in speed at each engine combustion at idling, and in response to this controls the control sleeve position to increase or decrease the fuel injection quantity. In this way, each cylinder's injection quantity is controlled for each injection to decrease engine vibration and improve comfort.



EFMB603B

**DECREASED SMOKE AT ACCELERATION**

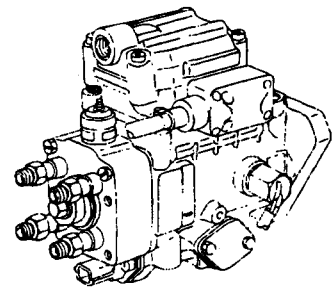
Injection quantity is increased at acceleration to increase engine output. With conventional injection pumps, this excess fuel results in the generation of smoke. With COVEC-F, however, fuel injection quantity is precisely controlled, even at acceleration, to prevent the generation of smoke without adversely affecting engine response.



EFMB603C

**ADDITIONAL DEVICES UNNECESSARY**

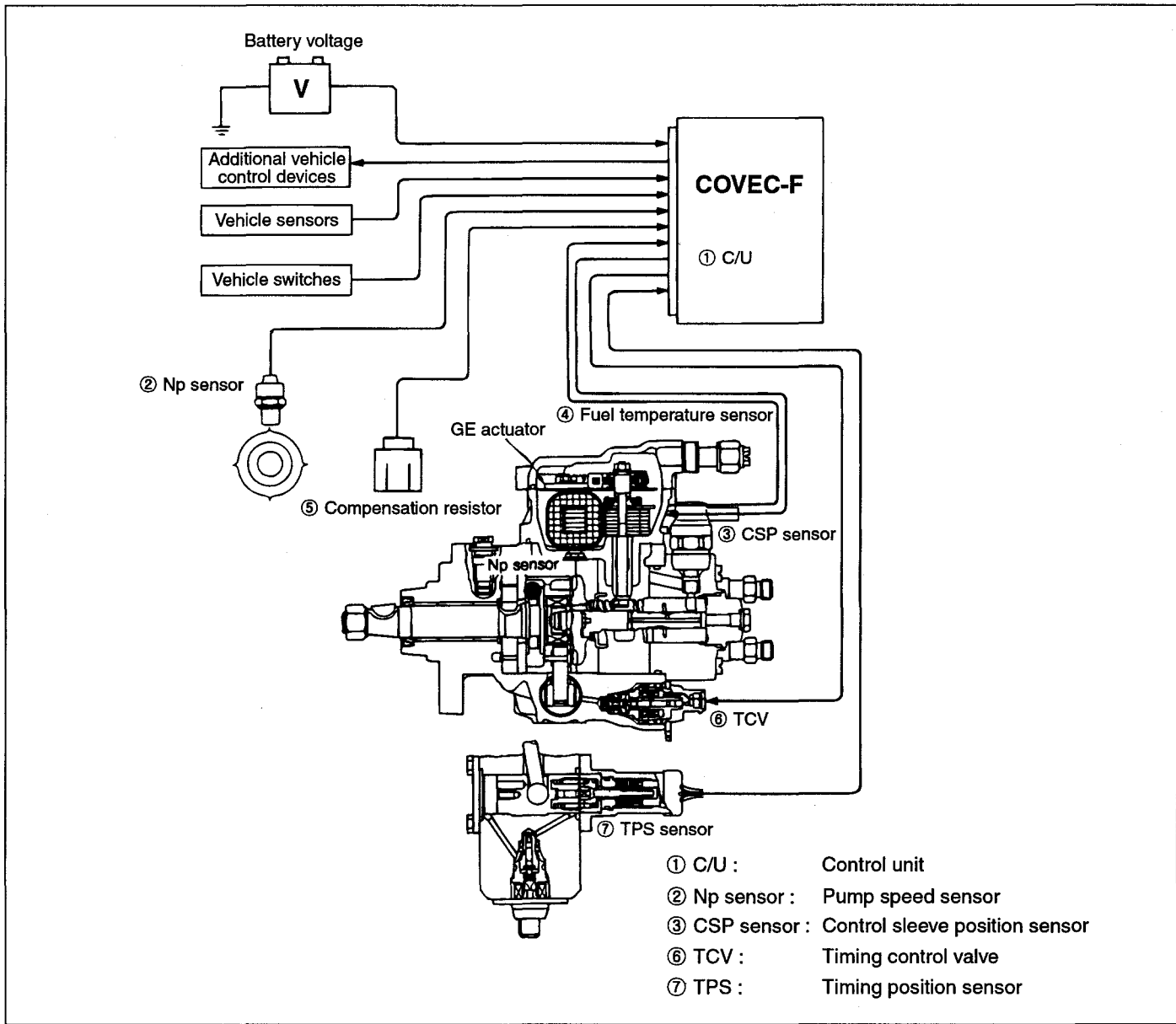
Additional devices such as a boost compensator, aneroid compensator, or injection timing compensation devices are unnecessary as compensation is performed electronically in response to signals from the various sensors. Because of this, the exterior of the injection pump is greatly simplified, enabling better utilization of space around the injection pump.



KFMB503D

**SYSTEM OUTLINE** EFMB6060

The figure below shows an outline of the COVEC-F-II system.

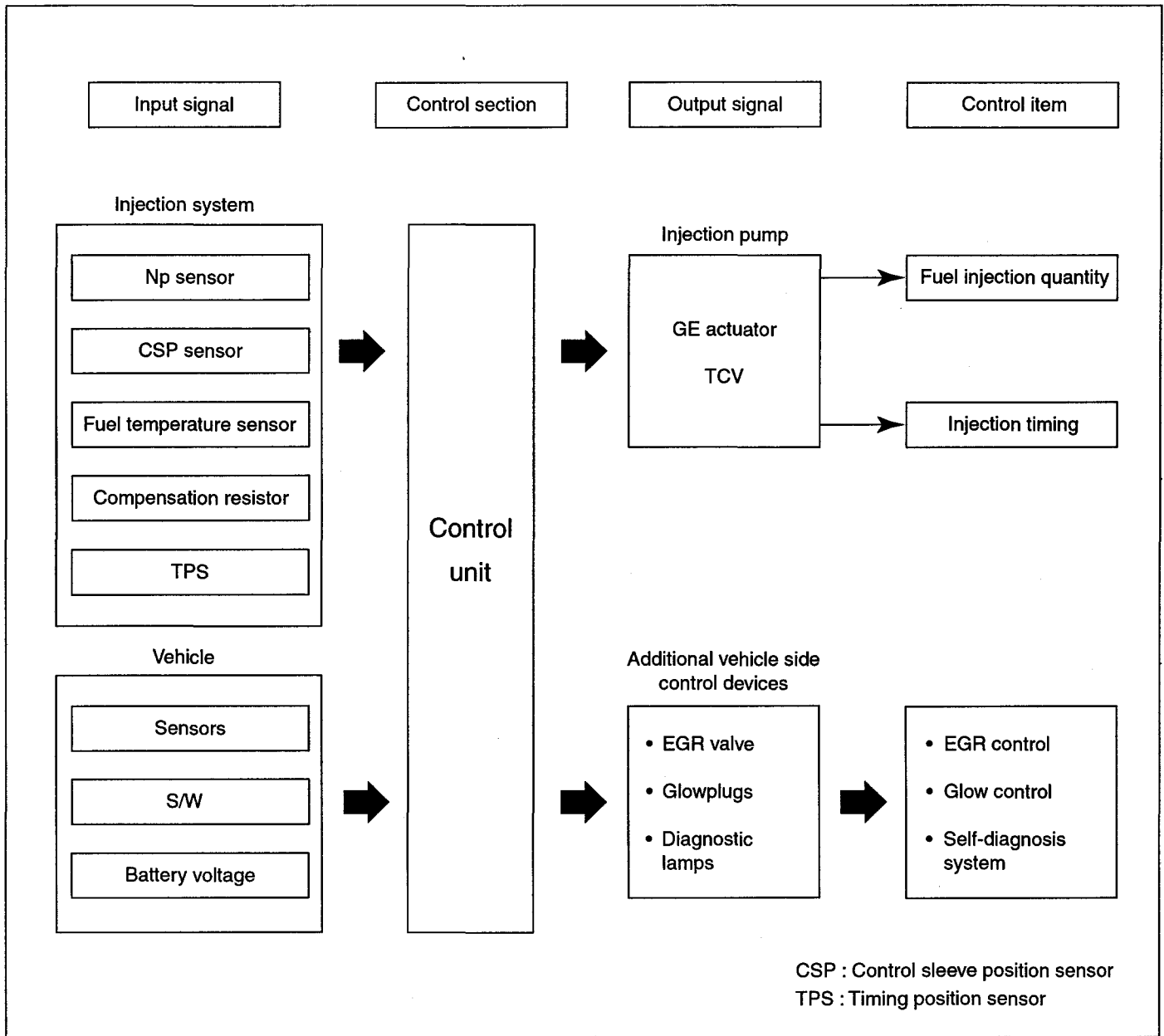


EFMB606A

No	Part name	Function
1	Control unit	Running condition comparison, processing
2	Np sensor	Detects pump speed
3	CSP sensor	Detects control sleeve position
4	Fuel temperature sensor	Detects fuel temperature
5	Compensation resistor	Compensation
6	TCV	Adjusts injection timing
7	TPS	Detects timer piston position

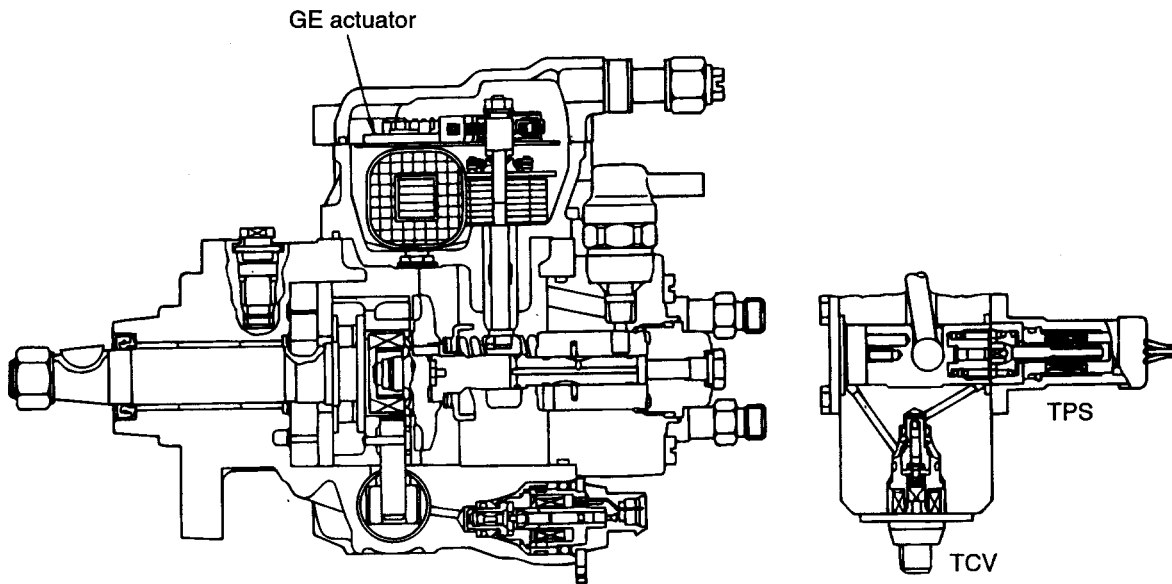
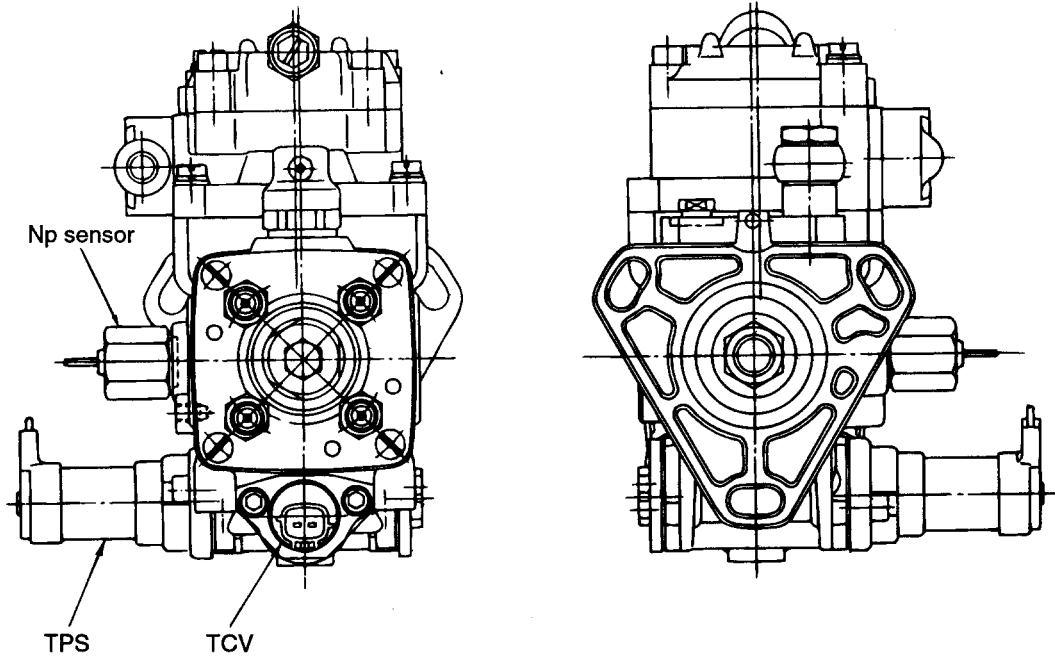
**SYSTEM CONTROL** EFMB6090

COVEC-F detects physical signals as electrical signals from each sensor and switch. The control unit processes this information to electronically control injection timing and injection quantity.



CONSTRUCTION EFMB6120

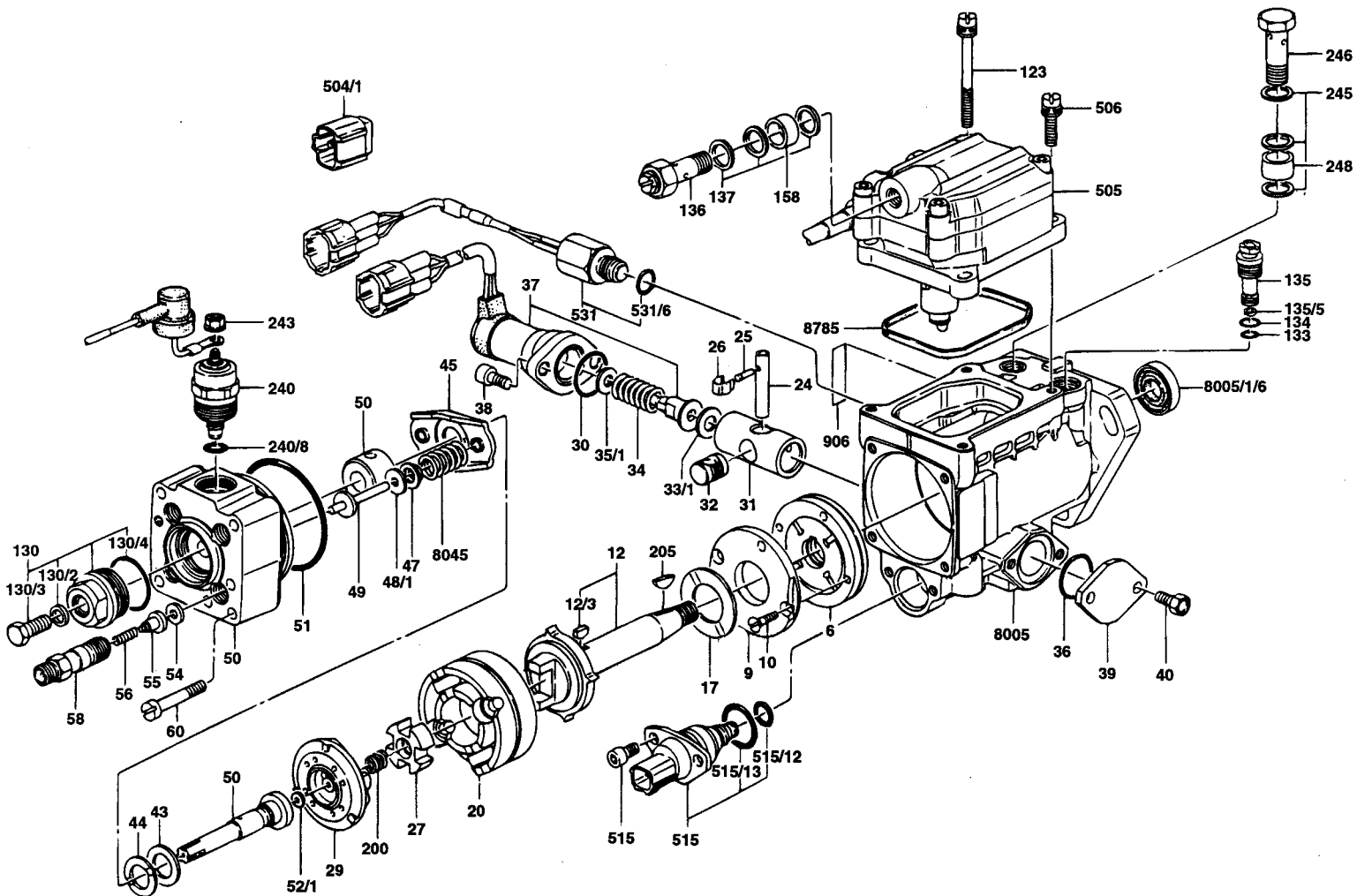
EXTERIOR AND CROSS-SECTIONAL VIEWS





EFMB6140

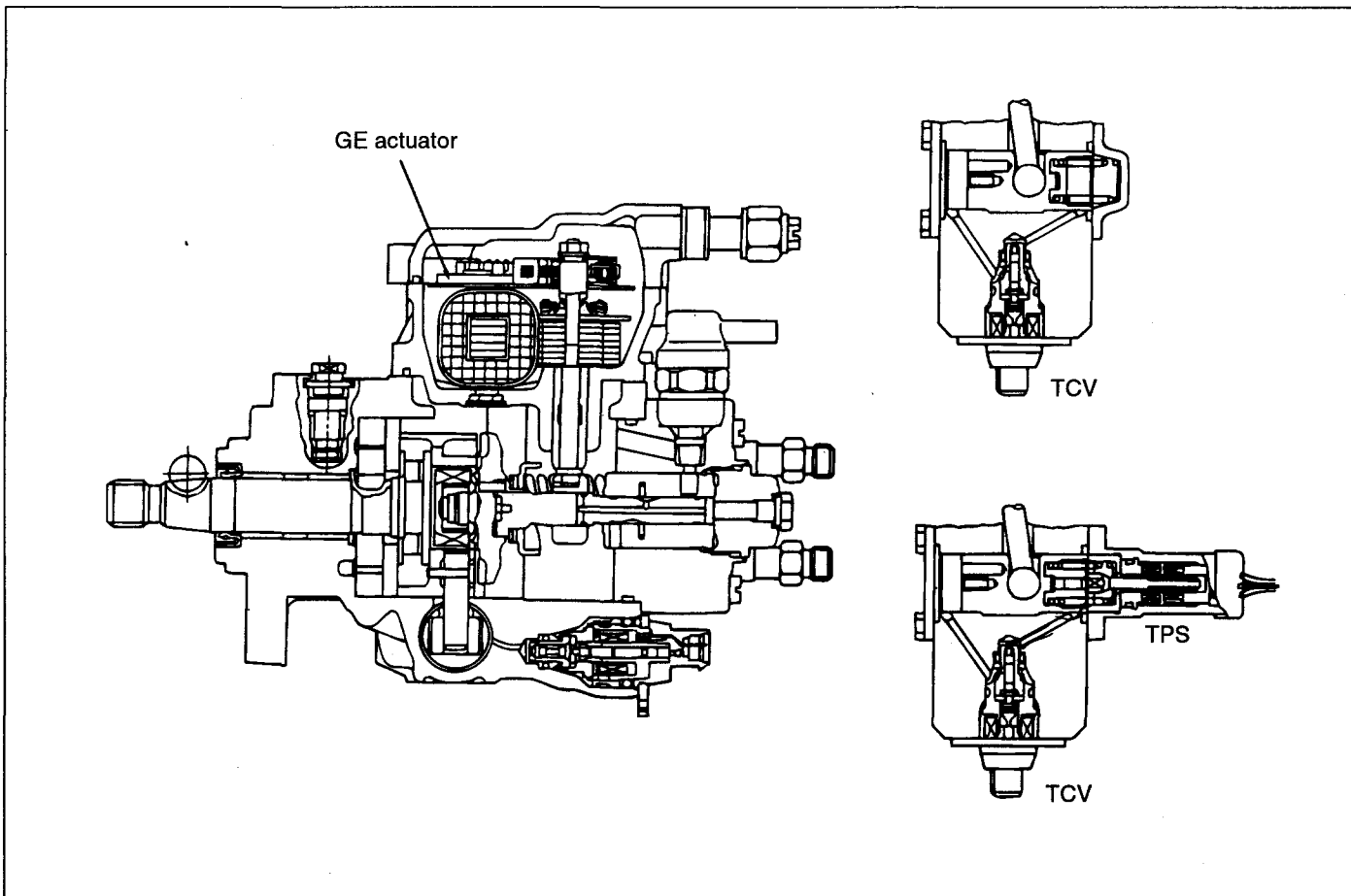
EXPLODED VIEW



EFMB614A

## CONSTRUCTION EFMB6160

### COVEC-F BODY



EFMB616A

Refer to the VE type injection pump service manual for conventional injection pump construction and parts with common construction.

Fuel intake and pressure delivery by COVEC-F is identical to that of the conventional injection pump. The inside of the pump is separated into a governor chamber, where fuel injection quantity control is performed, and a pump chamber, where fuel intake and delivery are performed.

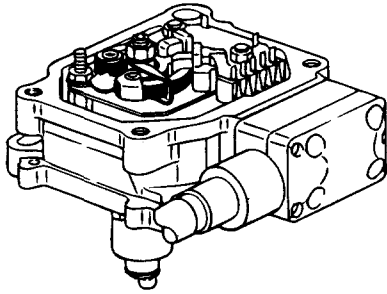
The conventional injection pump is controlled by a centrifugal governor. COVEC-F, however, utilizes a GE actuator (ie, an electronic governor). Flyweights are not utilized. Therefore, there is no control lever at the upper cover. Instead, the control unit cable is connected to the upper part of the injection pump. Also, the conventional injection pump utilizes a flyweight holder gear (with 23 teeth) to detect pump speed. COVEC-F, however, utilizes a sensing gear plate provided on the drive shaft to detect pump speed. The number of projections on the gear plate corresponds to the number of engine cylinders.

A TCV (timing control valve) is provided at the lower part of the pump body between the timer's high pressure and low pressure chambers to adjust pressure to that necessary for advance timing. The conventional injection pump

is sometimes equipped with a check valve inside the overflow valve. With COVEC-F, however, the overflow valve is always equipped with a check valve to prevent overflow until a fixed pressure is reached. COVEC-F-II is provided with a TPS (timing position sensor) at the lower part of the injection pump to detect timer piston position.

**GE ACTUATOR (ELECTRONIC GOVERNOR)**

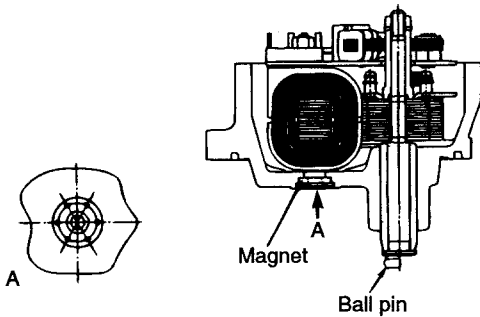
The GE actuator is attached to the governor chamber at the upper part of the injection pump.



EFMB616B

The governor chamber and the pump chamber are connected through a magnet filter, and the fuel oil flowing into the governor chamber cools the coil.

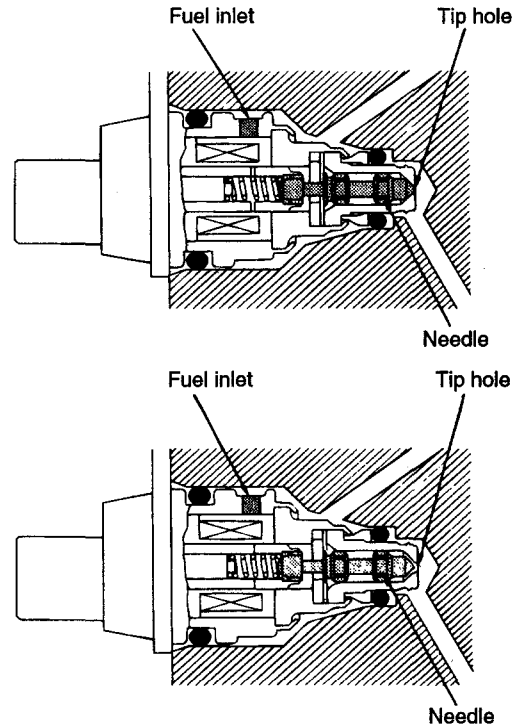
The magnet filter also prevents iron filings from entering the inside of the GE actuator. The tip of the shaft pressfitted to the rotor is equipped with a ball pin which is eccentric to the shaft. This ball pin is inserted into a hole in the control sleeve.



EFMB616C

**DECREASED SMOKE AT ACCELERATION**

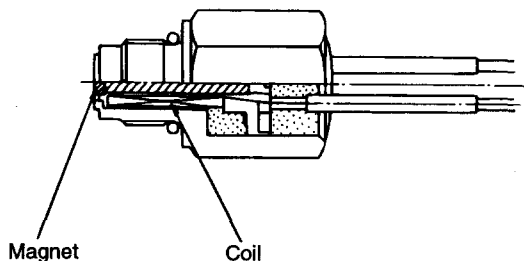
The TCV has a fuel inlet located in the center of the side of the TCV body. The fuel inlet is equipped with a filter. This inlet connects through the inside of the TCV to a hole in the end of the TCV body. A needle valve inside the TCV seats inside this end hole. When current is applied to the TCV, the needle valve is pulled to the left (see right hand figure) by a magnet to open the end seat. Injection timing is varied by timer piston movement transferred to the roller holder, as with conventional injection pumps. Previously, though, the pressure inside the timer's high pressure chamber controlling the timer piston varied in accordance with pump speed. With COVEC-F, however, the TCV controls pressure inside the high pressure chamber.



EFMB616D

**NP SENSOR (PUMP SPEED SENSOR)**

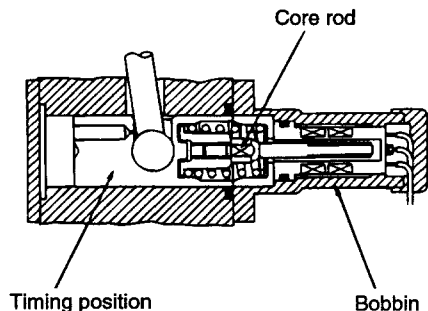
The Np sensor detects pump speed necessary for the various controls, and outputs signals to the control unit. The Np sensor is constructed of a permanent magnet and an iron pole, and a coil. The magnetic field is varied by sensing gear movement, and the voltage generated is detected as a speed signal.



EFMB616E

**TPS SENSOR (TIMING POSITION SENSOR)**

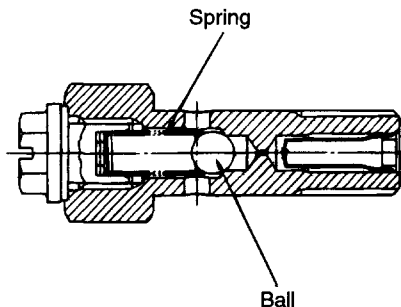
The TPS is installed on the timer's low pressure side. The TPS is constructed of a core rod and a bobbin, and detects timer piston position electrically.



EFMB616F

**OVERFLOW VALVE (WITH CHECK VALVE)**

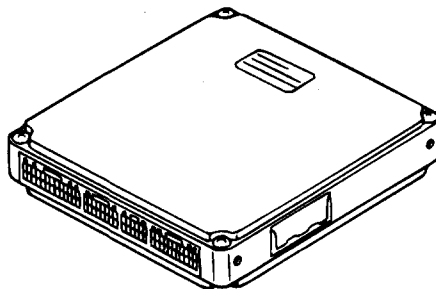
The overflow valve is installed on the end face of the GE actuator cover (ie, on the distributor head side). The check valve is constructed with a ball and spring to prevent overflow until the pump chamber pressure reaches a specified value.



EFMB616G

**CONTROL UNIT**

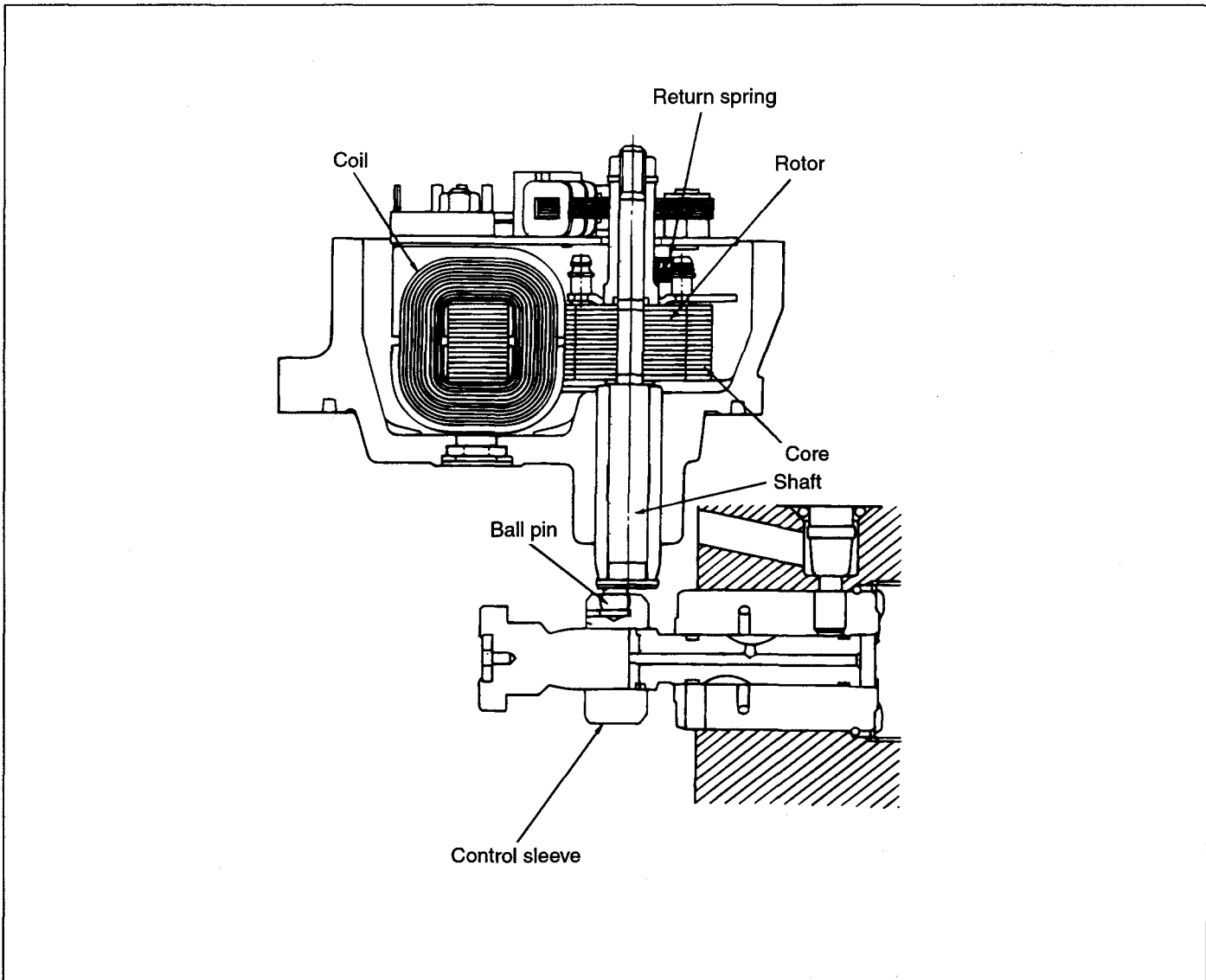
The control unit is installed on the vehicle. The control unit receives information signals detected by each sensor. Based on this information, the control unit then performs comparative calculations using programmed set values, and then instantaneously outputs optimum control signals to each control section. The control unit also includes a fault diagnosis system.



EFMB616H

OPERATION EFMB6180

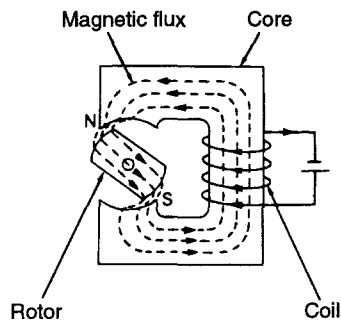
GE ACTUATOR (ELECTRONIC GOVERNOR)



EFMB618A

Unlike the conventional injection pump, COVEC-F adjusts fuel injection quantity electromagnetically. Control sleeve position is detected by the control sleeve position sensor and fed back to the control unit.

When the coil is energized, the core generates magnetic flux to rotate the rotor within a specific range. The intensity of the magnetic flux generated by the coil is determined by the input current. The rotor is rotated until the intensity of the core's magnetic flux equals the force of the rotor's return spring.

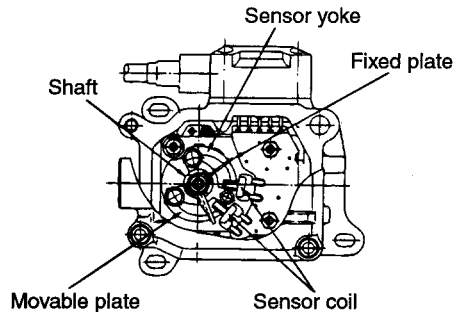


EFMB618B

The control sleeve position sensor detects rotational angle. It is installed at the top of the GE actuator to detect whether the control sleeve position (ie, the rotor's angle of rotation) specified by the current is in fact the correct

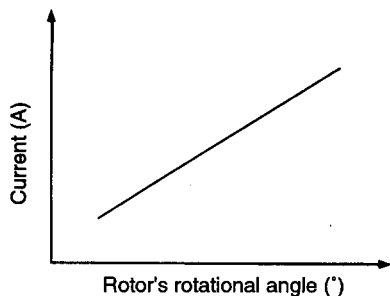
position. The control sleeve position sensor consists of a sensor yoke, a sensor coil, a movable plate and a fixed plate. The movable plate is connected directly to and rotates with the shaft.

The fixed plate compensates for temperature induced inductance variations.



EFMB618C

The control sleeve position sensor converts differences in the inductances of the upper and lower coils into angles, and feeds this back to the control unit. The control unit compares the target angle with the actual angle measured, and compensates the current so that the angle corresponds to the target angle.



EFMB618D

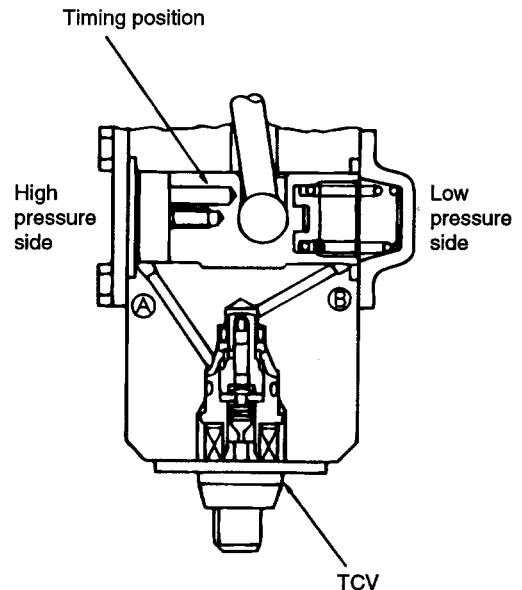
**TCV (TIMING CONTROL VALVE)**

The TCV is located at the lower part of the injection pump. Two holes (A and B) in the pump housing connect to the TCV. Hole A connects the timer piston's high pressure chamber to the fuel inlet side of the TCV. A filter is installed at this inlet to exclude foreign matter.

Hole B connects the timer piston's low pressure chamber to the fuel outlet at the tip of the TCV. Installed between the timer piston's high and low pressure chambers, the TCV adjusts high pressure chamber pressure by opening and closing the needle.

When current is not flowing to the TCV, the tip of the needle completely separates the high and low pressure chambers. When current is applied, the needle tip seat is opened, the high and low pressure chambers are connected, and the high pressure chamber pressure decreases. The timer piston is then moved by the timer spring to a position that balances the high pressure chamber pressure.

Accompanying this, the roller holder rotates to vary the injection timing. Injection timing can therefore be varied by utilizing the ON-OFF duty ratio of the current flowing to the TCV. Injection timing is controlled by duty. All characteristics and control signals are processed with TCV drive signal duty ratios. Also, the frequency of the TCV drive signal can be varied to correspond to the frequency of injection pump speed.



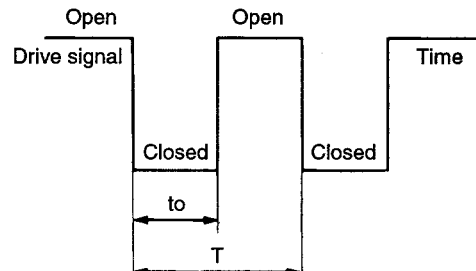
EFMB618E

Duty ratio is the ratio of the time that the timing control valve is closed per unit of time (ie, per cycle).

$$\text{Duty ratio} = \frac{t_o}{T} \times 100(\%)$$

**NOTE**

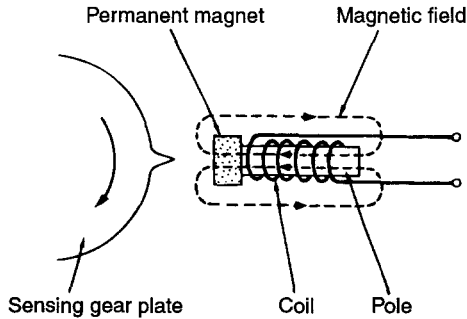
*Injection timing is retarded when the duty ratio decreases from 100%.*



EFMB618F

**NP SENSOR (PUMP SPEED SENSOR)**

When the drive shaft rotates, the sensing gear plate projections pass through the pump speed sensor's magnetic field to generate AC voltage at the coil. This voltage is input to the control unit, converted to a pulse signal, and used as a pump speed signal.



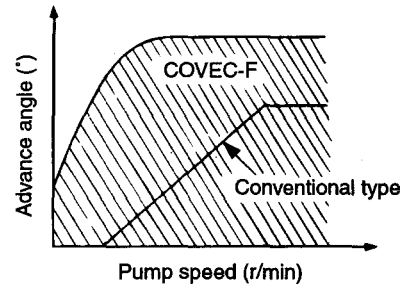
EFMB618G

**CHECK VALVE**

The right hand figure shows the advance characteristics of the conventional injection pump and the possible range of advance control of COVEC-F.

With the conventional VE type injection pump, fuel pressure is increased in accordance with increases in speed to obtain advance characteristics.

With COVEC-F, the overflow valve is equipped with a check valve so that even at starting rotation, there is sufficient pressure to control advance. Therefore, as shown at left, the possible control range is much wider.



EFMB618J

**TPS (TIMING POSITION SENSOR)**

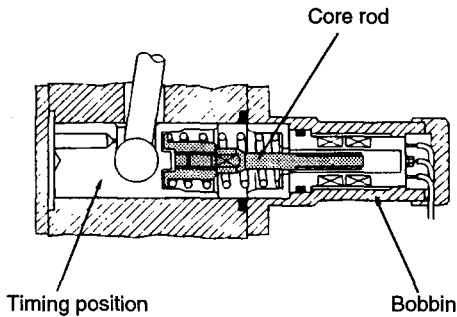
The TPS detects variations in the core rod inductance to measure timer piston position.

- Reference (standard point)

---

$T_A = 0\text{mm}$

---



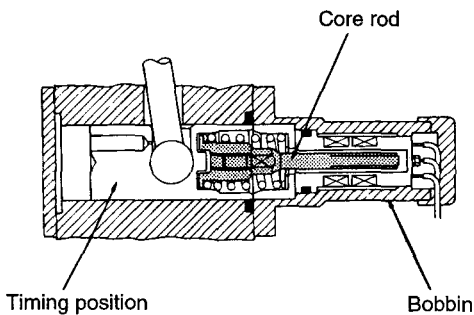
EFMB618H

- Reference (Operation)

---

$T_A = \text{advance angle direction}$

---



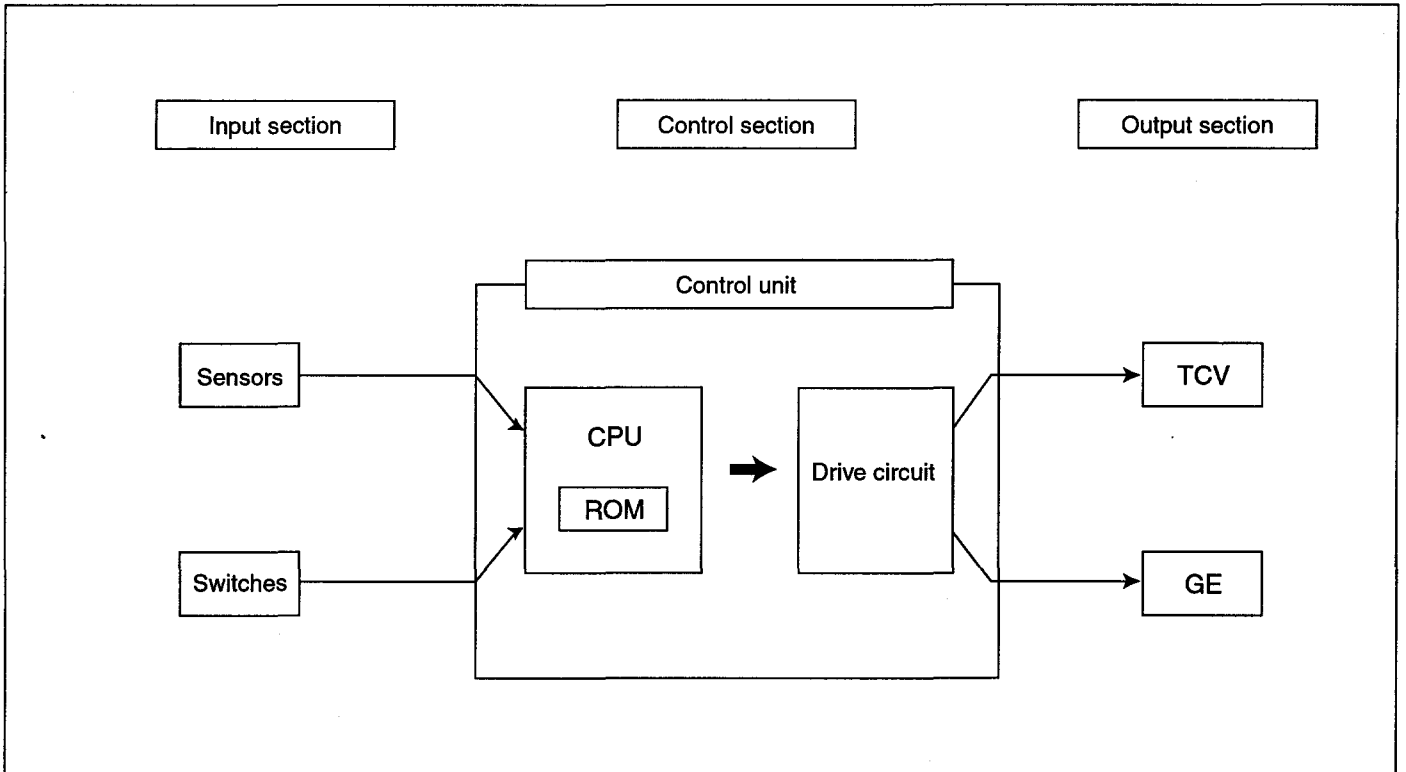
EFMB618I

**CONTROL UNIT**

Information signals detected by each sensor and switch are input to the control unit's micro-computer. Based on these information signals, characteristic data as well as compensation data recorded in the ROM (read only memory) are read into the CPU (central processing unit). Comparative calculations are then performed utilizing this data and information signals are output.

The control signals output by the micr-computer are then converted to drive signals. These are then input to the GE actuator and the TCV to control fuel injection quantity and injection timing.

In addition to this, COVEC-F also has a function that continually compensates real values to target values (feedback control) to perform optimum control of the diesel engine and ensure precision and endurance.





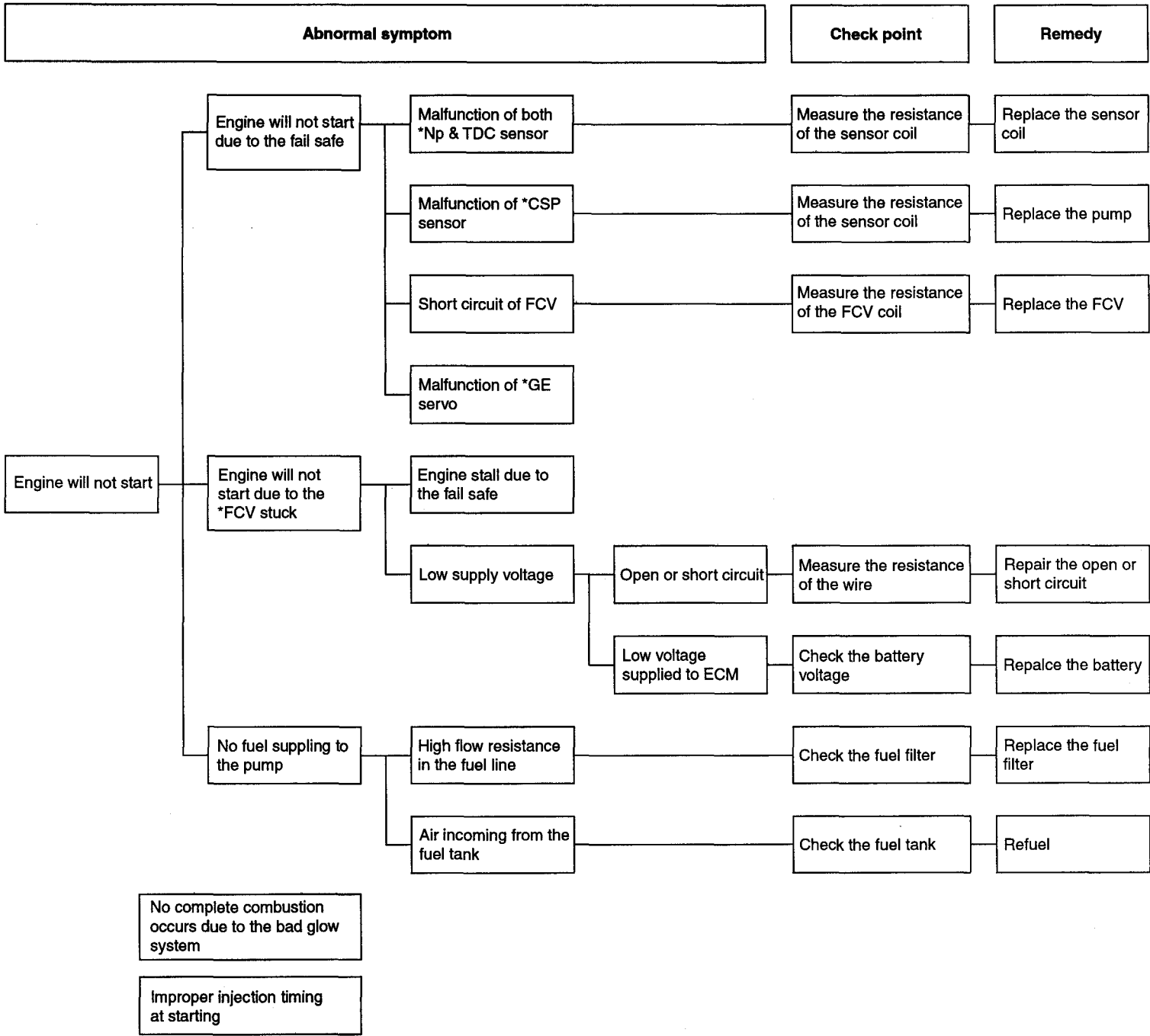
# DIAGNOSIS

## TROUBLESHOOTING FOR ENGINE WITH

ZEXEL COVEC-F

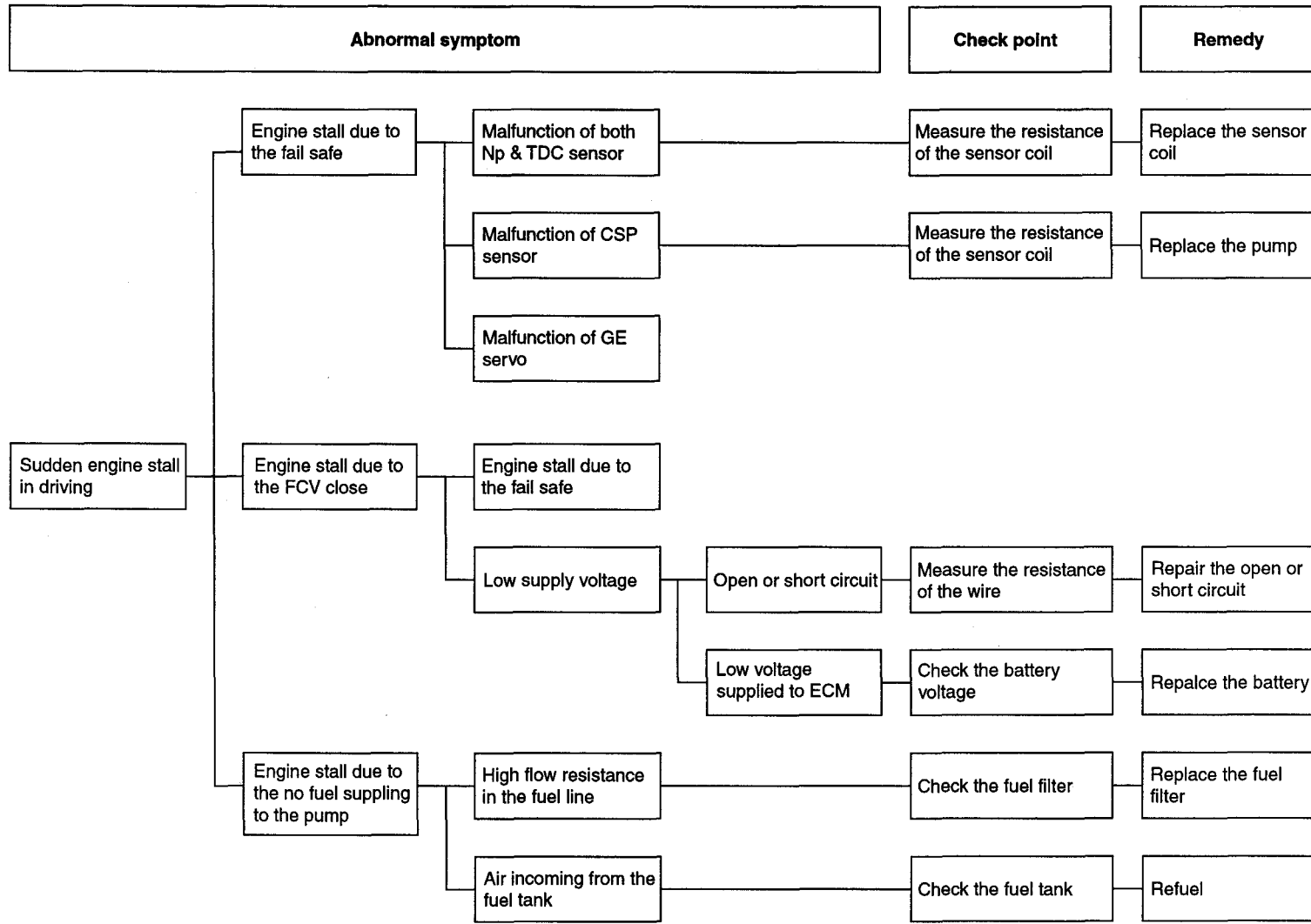
EFMB6810

### ENGINE WILL NOT START



EFMB6811

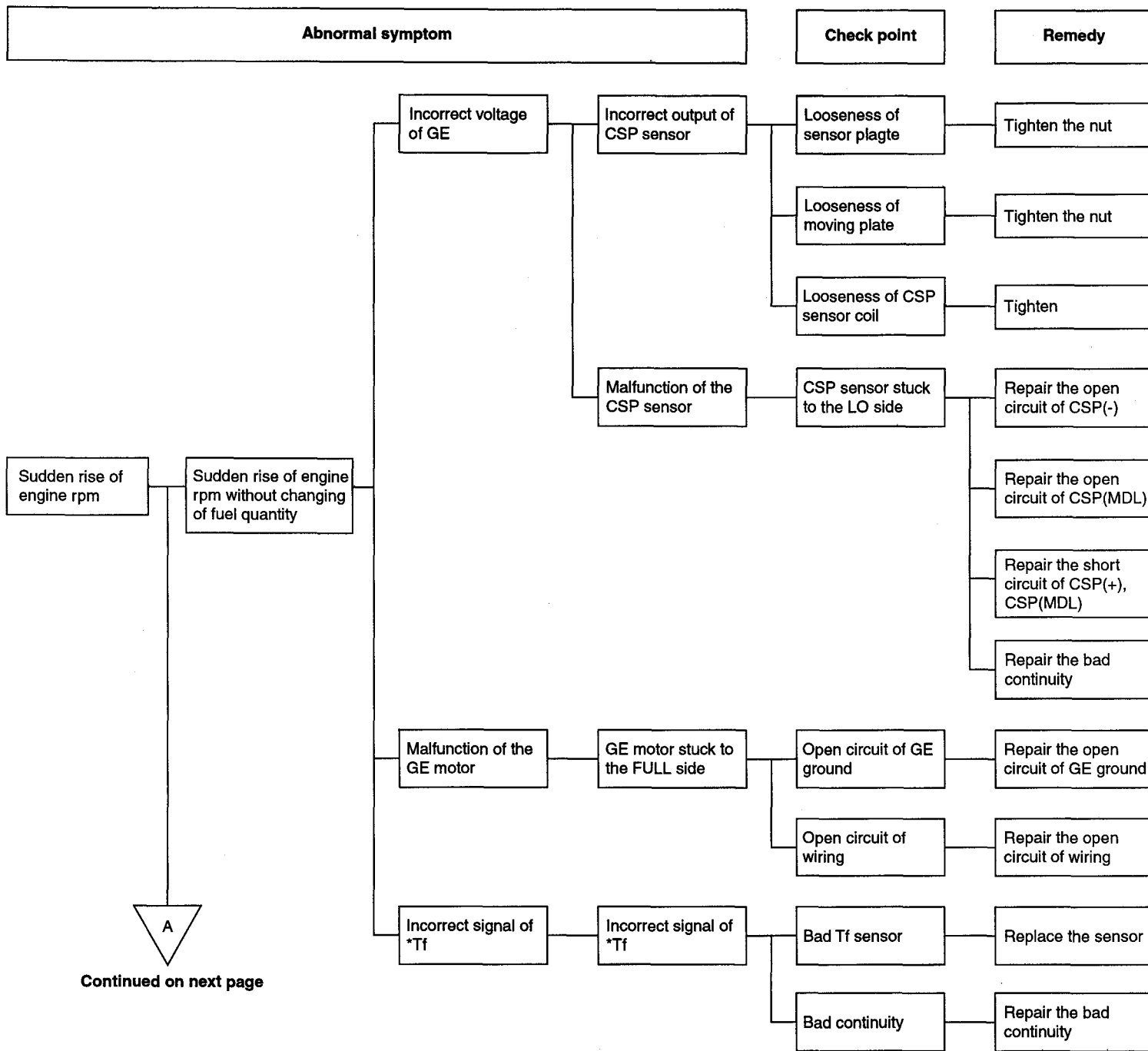
ENGINE STALL

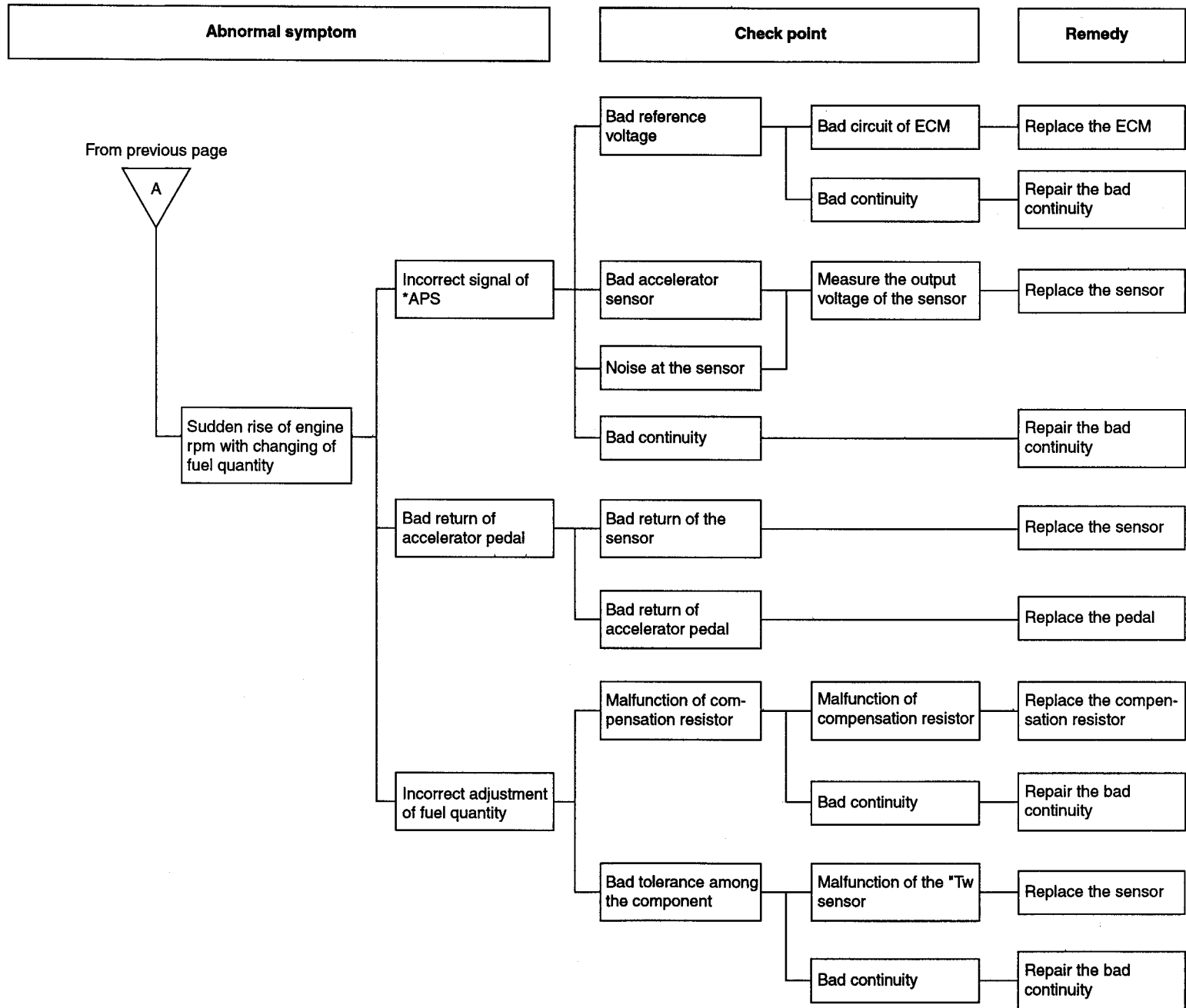


EFMB681B

EFMB6812

SUDDEN RISE OF ENGINE RPM





○ : Effect much  
△ : Effect little

ITEM	Symptom	Hard to start	Rough idling	Lack of power/ poor acceleration	Bad return of overrun rpm	Engine stop	Much black smoke	Much white smoke	Knocking and vibration	Poor fuel economy	Impossible to stop the engine	Sudden rise of engine rpm	Check point
	Main cause												
Fuel cut solenoid valve	Poor connection or looseness of terminal	○				○			△				Tightening torque : 2.0-2.5kg·m
	Valve fail (Open or being stuck)	○				○					○		Check the resistance or output signal Inspect the part after removal
TCV	Poor connection or looseness of connector	○	○	○	△	△	○	○	○	○			Check the installation condition
	Malfunction of TCV (Open or being stuck)	○	○	○	△	△	○	○	○	○			Check the resistance or output signal
	TCV filter clogged (O-ring torn)	○	○	○	△	△	○	○	○	○			
CSP sensor	Bad output of CSP sensor	○	○	○	○	○	○	○	○	○		○	Check the resistance or output signal
	Malfunction of CSP sensor(open or short)	○	○	○	○	○	○	○	○	○			
GE actuator	Bad output of GE coil	○	○	○	○	○	○	○	○	○	△	△	Check the resistance or output signal
	Malfunction of GE coil (open or short)	○	○	○	○	○	○	○	○	○	△		
Fuel temp. sensor	Malfunction of fuel temp. sensor	○	○				○	○		○			Check the resistance or output signal
	Bad output of sensor	○	○		△		○	○		○			Check the characteristic of resistance for temp. range
Compensation resistor	Compensation resistor poor connection	○	○	○	△	△	○	○	△	○			Check the open or short
	Wrong resistor	○	○	○	△	△	○	○	△	○			Check the compensation resistor
Np sensor (TDC sensor is good)	Bad installation noise				○								Tightening torque : 2.0-2.5kg·m Compensation resistor

ITEM	Symptom	Hard to start	Rough idling	Lack of power/ poor acceleration	Bad return of overrun rpm	Engine stop	Much black smoke	Much white smoke	Knocking and vibration	Poor fuel economy	Impossible to stop the engine	Sudden rise of engine rpm	Check point
	Main cause												
Np sensor (TDC sensor is good)	Malfunction of sensor (open or short)				○				△				Check the resistance and output signal
Np sensor (with faulty TDC sensor)	Bad installation, noise		○			○							Tightening torque:2.0-2.5kg·m Check the output signal
	Malfunction of sensor (open or short)					○							Check the resistance and output signal
TPS	Bad installation and output signal	○	○	○	△	△	○	○	○	○			Tightening torque:0.7-0.9kg·m Check the output signal
	Malfunction of sensor (open or short)	○	○	○	△	△	○	○	○	○			Check the resistance
Boost sensor	Bad installation and output signal			○			△	△		△			Inspect the installation condition
	Malfunction of sensor (open or short)			○			△	△		△			Check the output signal's characteristic
TDC sensor (with good Np sensor)	Bad installation, noise Malfunction of sensor (open or short)		○	○			○	○	○	○		○	Inspect the installation condition and fly wheel Check the output signal's characteristic
TDC sensor (with faulty Np sensor)	Bad installation, noise Malfunction of sensor (open or short)		○	○	○	○	○	○	○	○			
*ECT sensor	Bad installation and output signal	○	○	△			○	○	△	○		△	Inspect the installation condition
	Malfunction of sensor (open or short)	△	○	△			○	○	△	○		△	Check the output signal's characteristic
VSP	Bad installation and output signal			○					○				Check the output signal's characteristic
	Malfunction of sensor (open or short)			○					○				Check the wiring harness
APS sensor	Malfunction of sensor (open or short)	△	○	○	○		○	○		○		○	Check the output signal's characteristic

ITEM	Symptom	Hard to start	Rough idling	Lack of power/ poor acceleration	Bad return of overrun rpm	Engine stop	Much black smoke	Much white smoke	Knocking and vibration	Poor fuel economy	Impossible to stop the engine	Sudden rise of engine rpm	Check point
	Main cause												
IDLE switch	Open or short		○		○					△		○	Check the resistance and output signal
Neutral switch	Bad installation and output signal (open and short)					△							Tightening torque:2.0-2.5kg·m Check the output signal
ECU	Power system (open or short)	○											Check the resistance and output signal
	Bad output signal of PWM signal for TCM (open or short)			○					○				Tightening torque:0.7-0.9kg·m Check the output signal
ECU	Bad output signal of barometric pressure sensor			○			○	○		○			Check the resistance
	Bad communication for IMMOB (open or short)	○				○							Inspect the installation condition
T/C waste gate (boost hose)	Malfunction (stuck)			○			○			○			Check the output signal's characteristic
Glow relay	Open or short	○	○					○					Inspect the installation condition and fly wheel Check the output signal's characteristic
EGR solenoid valve	Being stuck, bad operation			○			○			○			Check the output signal's characteristic

**NOTE**

Abbreviation marked \* are listed below.

- Np : Injection pump speed sensor
- CSP : Control sleeve position
- FCV : Fuel cut valve
- GE : Electronic governor
- Tf : Fuel temperature sensor
- APS : Acceleration position sensor
- Tw : Water temperature sensor
- TCV : Timing control valve
- ECT : Engine coolant temperature
- IMMOBI : Immobilizer

**SELF-DIAGNOSIS PRECAUTIONS**

EFMB6815

**⊗ WARNING**

The following definitions and warning signs are used in this service manual. These are extremely important to safe operation. Important points are described to prevent bodily injury and property damage. They must be fully understood before beginning COVEC-F self diagnosis system operation.

**⚠ CAUTION**

*Improper maintenance can result in injury or property damage.*

**MEANINGS OF MARKS**

The following marks are used in this service manual to facilitate correct COVEC-F self diagnosis system operation.

**ADVICE**

Procedures that must be performed to enable the best possible COVEC-F self diagnosis system operation.

**📖 NOTE**

*Information assisting in the best possible COVEC-F self diagnosis system operation.*

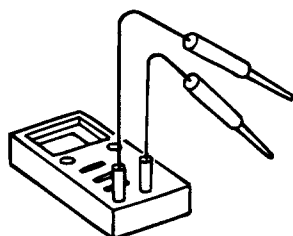
**PREPARATION**

Prepare the following.

- Circuit tester

**📖 NOTE**

*The circuit tester is used during inspection procedures to check the continuity and resistances of each electrical component.*



Circuit tester

PCOVT001

**CIRCUIT TESTER USE**

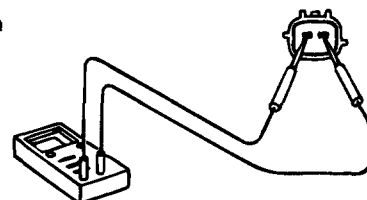
- Turn the engine's key switch OFF when checking continuity or resistance.

**⚠ CAUTION**

*If the key switch is on when checking continuity or resistance, electrical components may be damaged.*



Key switch

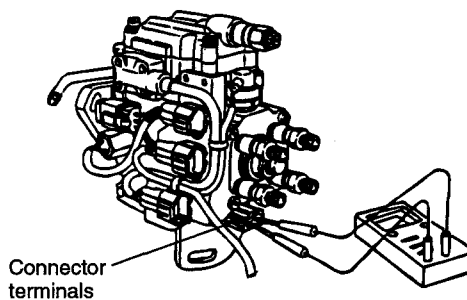


PCOVT002

- Do not damage connector terminals when checking continuity or resistance. Do not push the tester pins into the female terminals.

**⚠ CAUTION**

*New faults may arise if the connector terminals are damaged.*



Connector terminals

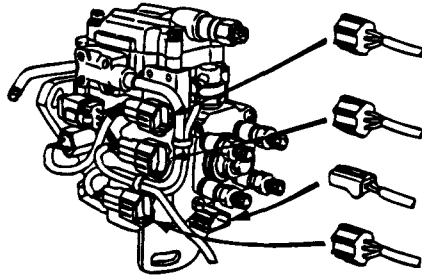
PCOVT003

- Always reconnect connectors in their original positions after checking continuity or resistance.



**⚠ CAUTION**

***New faults or improper operation may arise if connectors are not remstalled in their original positions.***



PCOVT004

**SELF-DIAGNOSIS FROM FAILURE****MODE** EFMB6820

The COVEC-F system includes a self-diagnosis system which alerts the operator to system malfunctions. The control unit continually monitors the signals input from each sensor and the GE actuator for abnormal values.

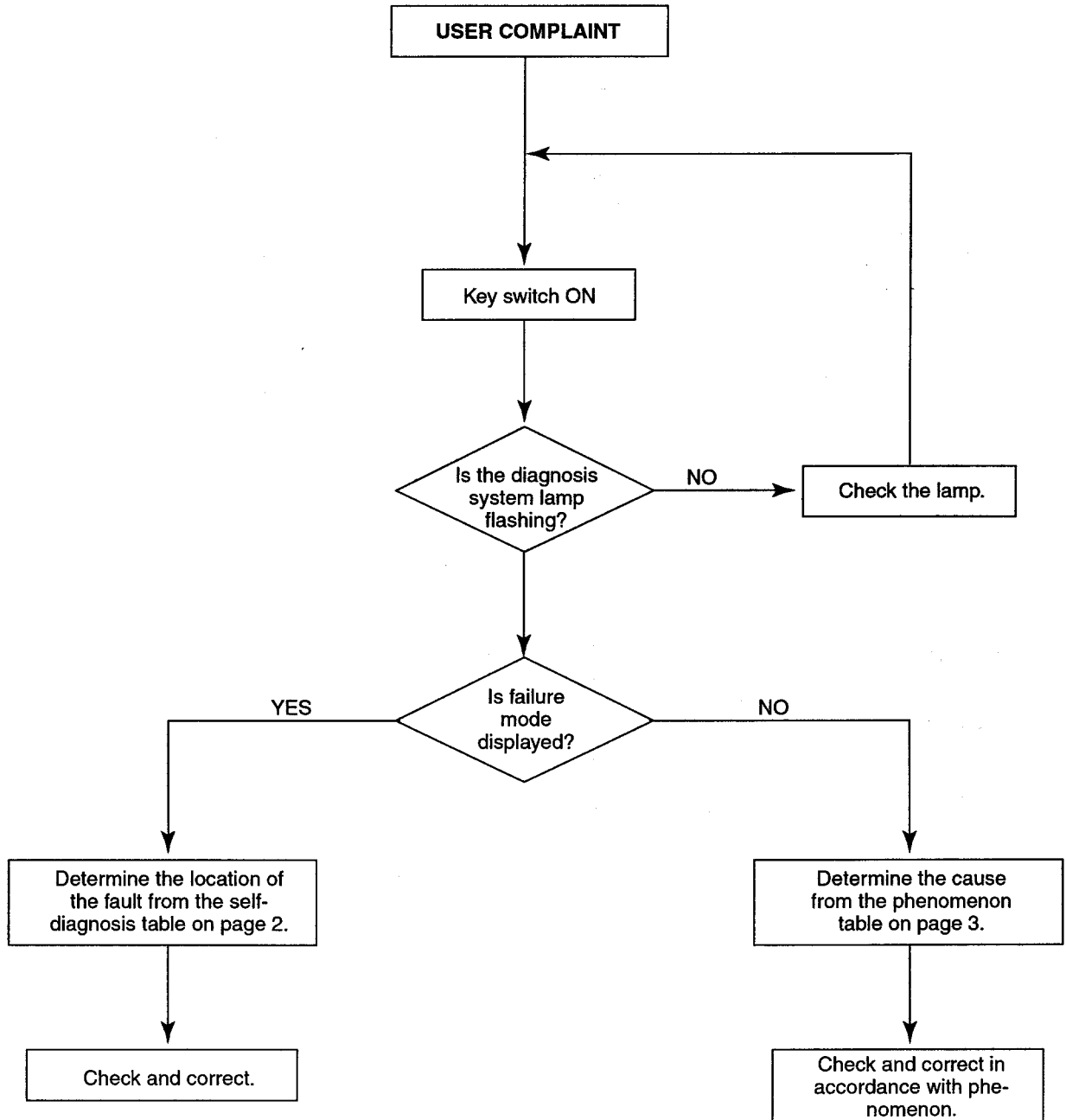
**FAILURE MODE TABLE**

No.	DTC No.	CONTENTS	MIL
1	P0105	BAROMETRIC SENSOR-MAL.	X
2	P0110	INT. AIR TEMP. CIRCUIT-MAL.	X
3	P0115	ENG. COOLANT TEMP-MAL.	O
4	P0120	ACCEL P. SNSR-MAL.	X
5	P0121	APS. RANGE/PERFORMANCE-MAL.	O
6	P0180	FUEL TEMP. SNSR. CIRCUIT-MAL.	X
7	P0320	ENGINE SPEED INPUT CIRCUIT-MAL.	X
8	P0335	CRANKSHAFT P. SNSR-MAL.	X
9	P0500	VEHICLE SPEED SNSR-MAL.	X
10	P0600	IMMOBILIZER COMMUNICATION-MAL.	O
11	P0605	CONTROL MODULE(EEPROM) ROM-MAL.	X
12	P0613	ECU-MALFUNCTION	X
13	P1116	BOOST PRESSURE SENSOR-MAL.	O
14	P1120	ELECTRIC GOVERNOR-MAL.	O
15	P1122	BOOST PRESSURE CONTROL VALVE-MAL.	O
16	P1123	TIMER POSITION SENSOR-MAL.	X
17	P1127	CONTROL SLEEVE POSITION SNSR.-MAL.	O
18	P1131	INJECTION QUANTITY ADJUST-MAL.	X
19	P1135	INJECTION TIMING SERVO-MAL.	X
20	P1324	GLOW RELAY-MALFUNCTION	O
21	P1522	BATTERY VOLTAGE ERROR	O
22	P1525	5V SOURCE VOLTAGE	X
23	P1621	FUEL CUT VALVE-MAL.	O

Use the following chart to check the system when malfunctions occur.

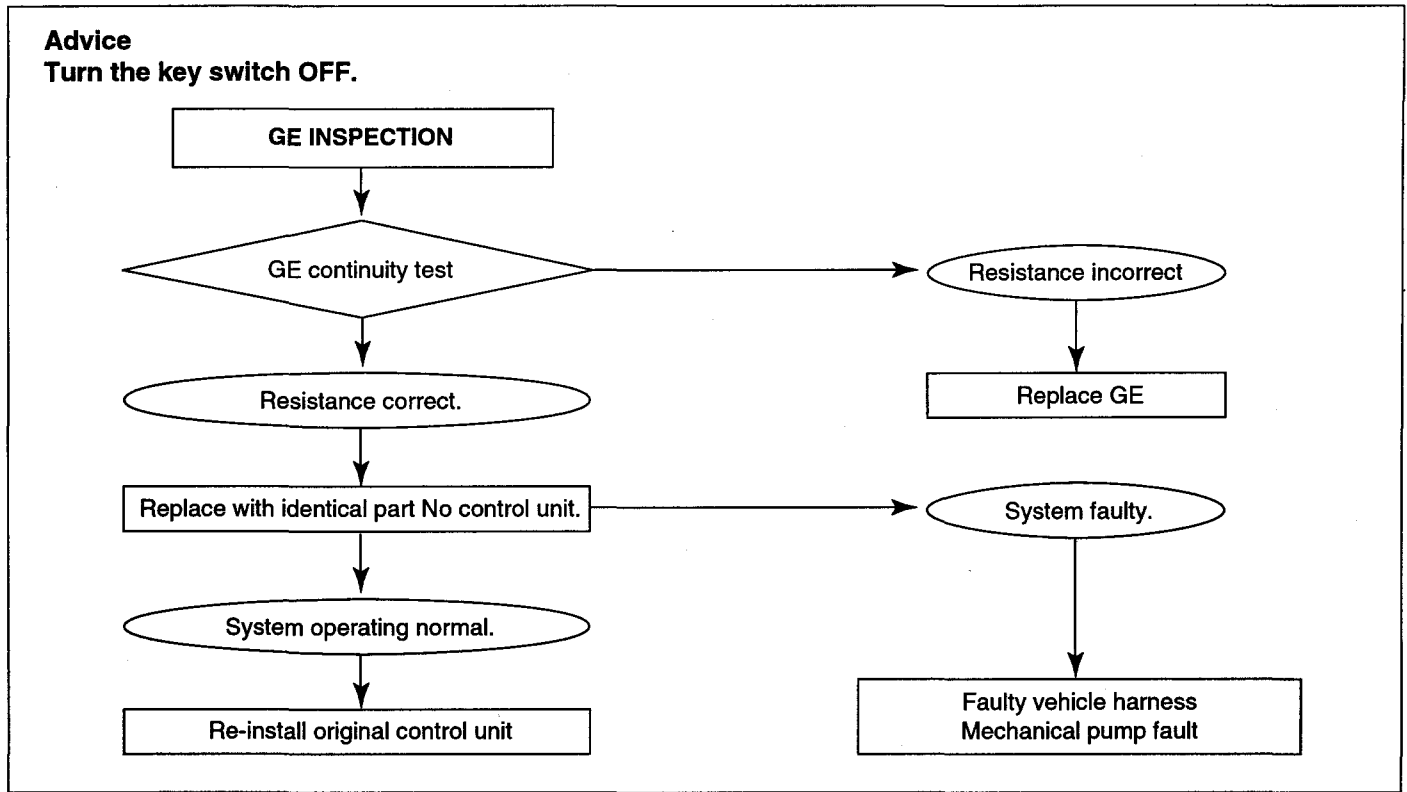
**Advice**

When the key switch in ON, leave each electrical component's connector connected.



**INSPECTION OF PARTS** EFMB6860

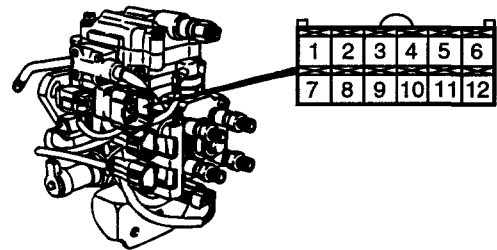
**GE ACTUATOR**



EFMB686A

1. GE actuator terminals

Terminal	Component	Remarks
1	GE (-)	GE (-)
2	TCV (+)	Timing control valve (+)
3	CSP (+)	Oscillate (+)
4	Adj (+)	Adjustment resistor (+)
5	Adj (-)	Adjustment resistor (-)
6	FCV	Fuel Cut Valve
7	CSP (-)	Oscillate (-)
8	TF (-)	Fuel Temperature (-)
9	GE (+)	GE (+)
10	TCV (-)	Timing control valve (-)
11	CSP	Neutral
12	TF (+)	Fuel temperature (+)

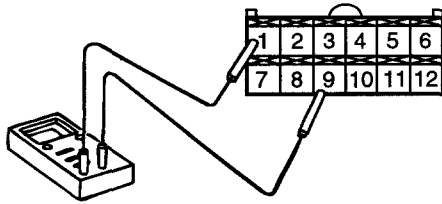


EFMB686B

2. Check the GE actuator resistances.

- Reference values

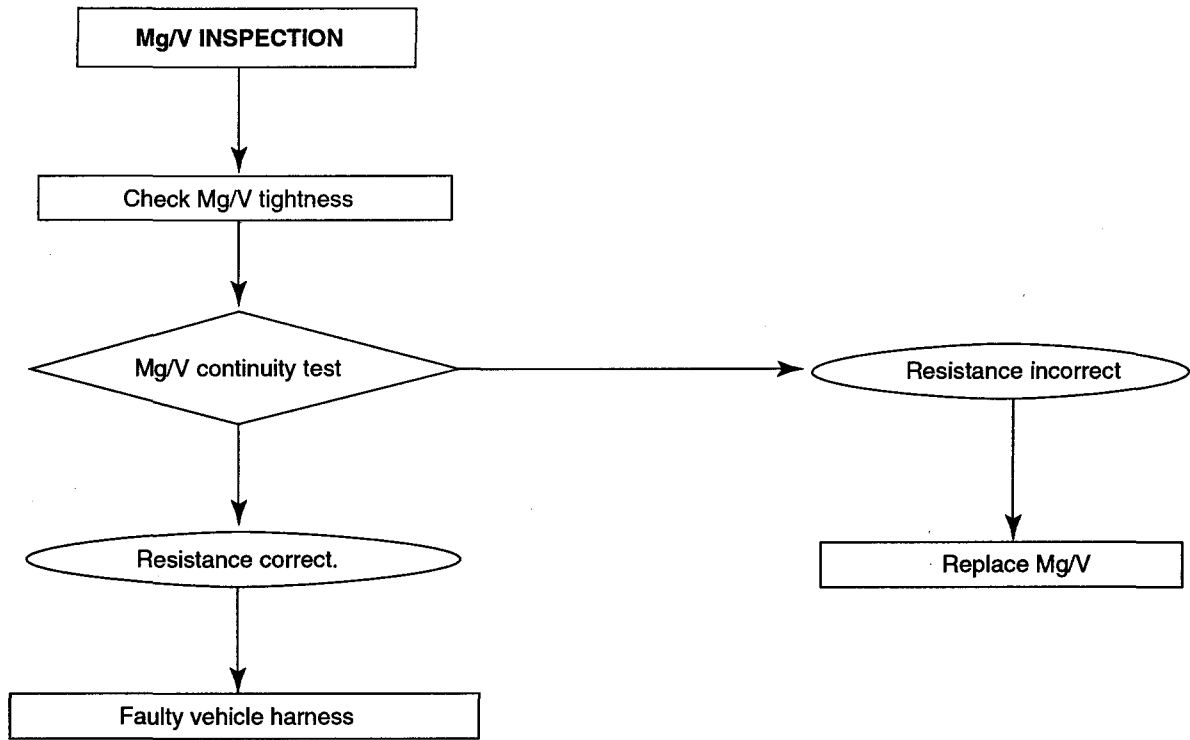
Terminal	Resistance	Temperature (°C)
1 - 9	$0.71 \pm 0.13\Omega$	23
3 - 7	$11.8 \pm 0.6\Omega$	23
3 - 11	$5.9 \pm 0.3\Omega$	23
7 - 11	$5.9 \pm 0.3\Omega$	23



EFMB686C

EFMB6880

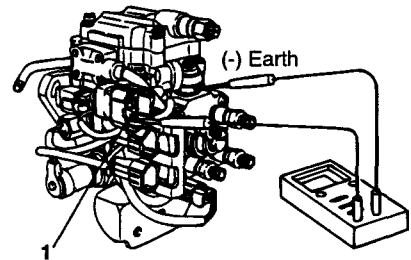
**Advice**  
Turn the key switch OFF.



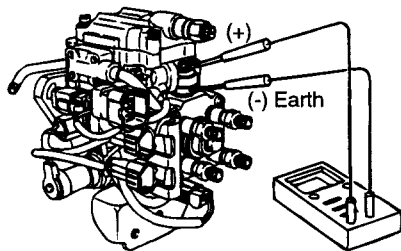
EFMB688A

1. Check Mg/V resistance.
- Reference Values

Resistance ( $\Omega$ )	Temperature ( $^{\circ}\text{C}$ )	Remarks
$8.6 \pm 1.1$	$23 \pm 10$	



EFMB688C



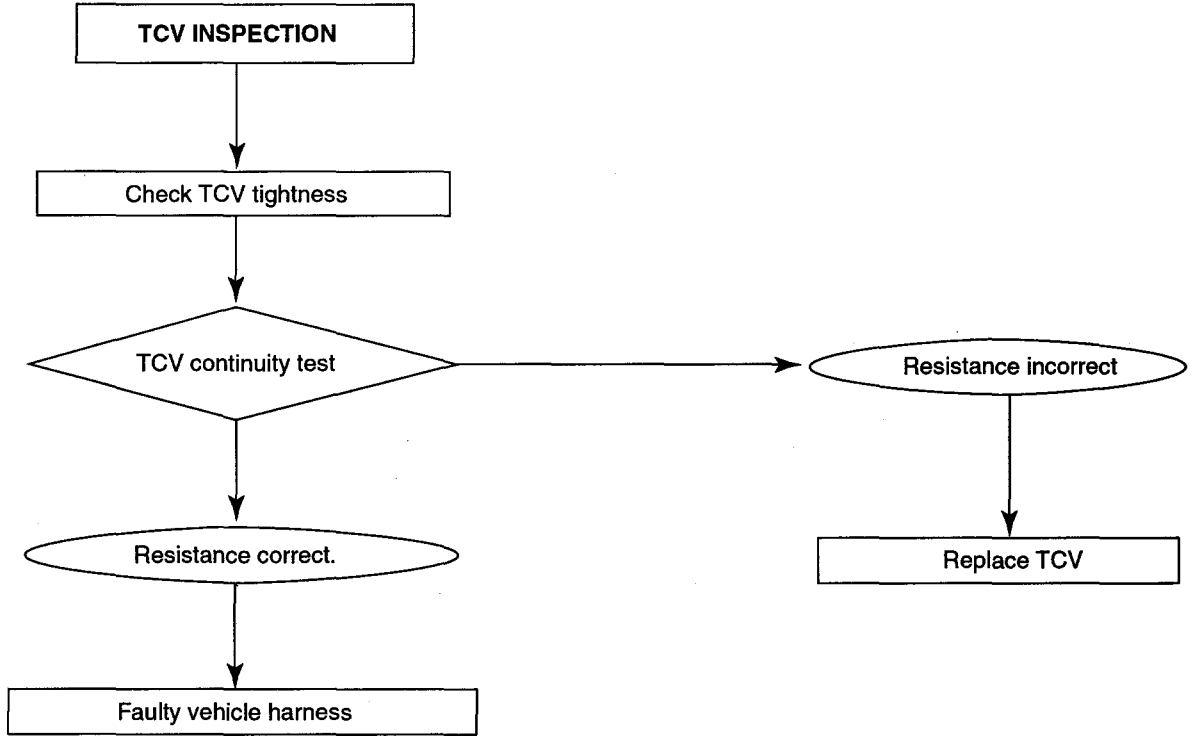
EFMB688B

2. Confirm that there is continuity between the Mg/V body's earth (-) and the GE actuator connector terminal no 6.

EFMB6900

TCV (TIMING CONTROL VALVE)

**Advice**  
Turn the key switch OFF.

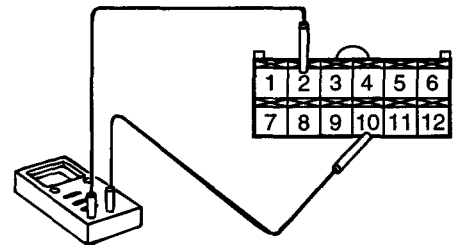
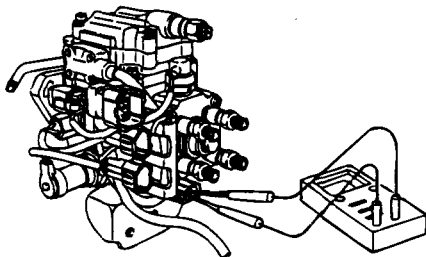


EFMB690A

1. Check Mg/V resistance.
  2. Check TCV resistance.
- Reference Values

3. Confirm that there is continuity between the GE actuator connector terminal no 2 and no 10.

Resistance ( $\Omega$ )	Temperature ( $^{\circ}\text{C}$ )	Remarks
11.0 $\pm$ 0.7	20 $\pm$ 10	



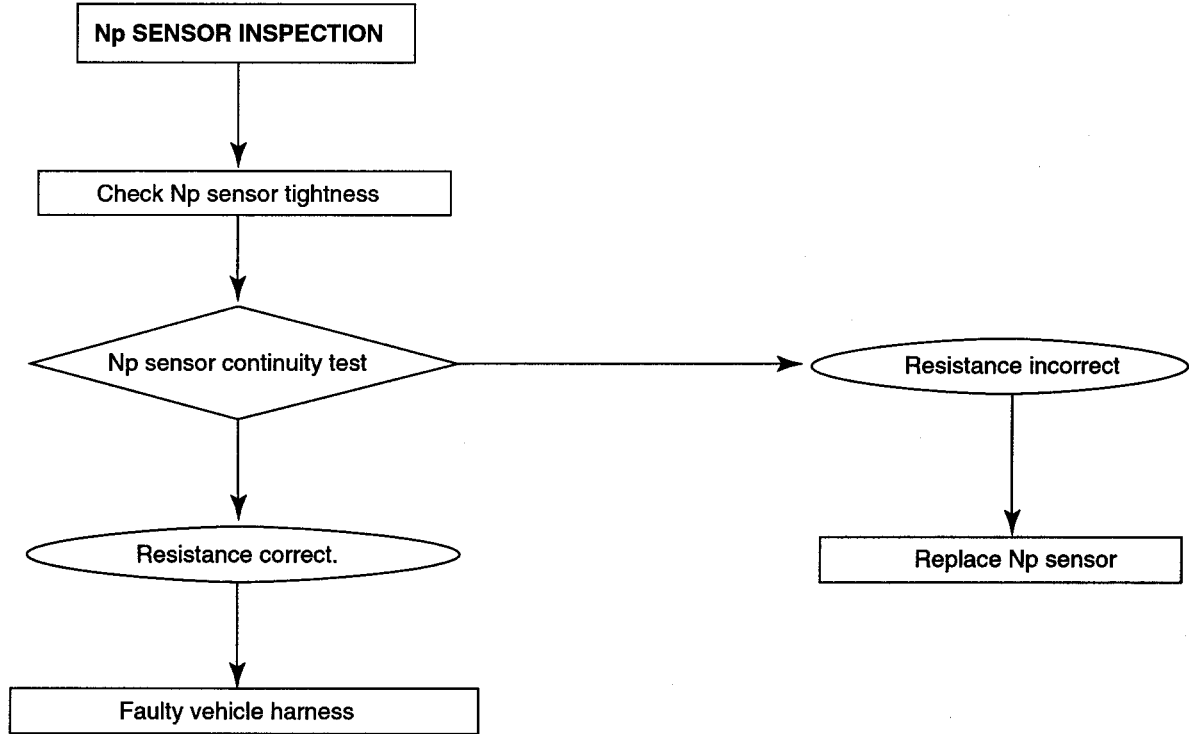
EFMB690C

EFMB690B

EFMB6920

**NP SENSOR**

**Advice**  
Turn the key switch OFF.



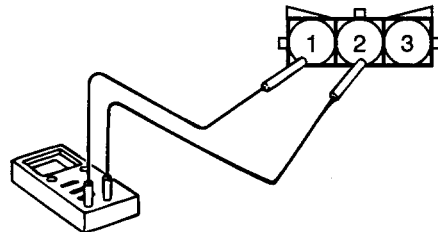
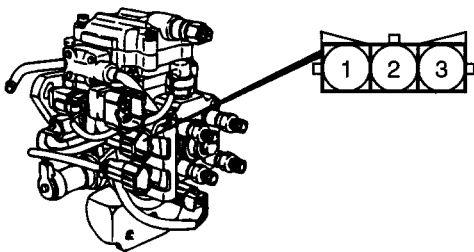
EFMB692A

1. Np sensor terminals.

Terminal No	Component wiring	Remarks
1	SIGNAL	Output
2	GND	
3	Blind plug	2.6V

• Reference Values

Terminal No	Resistance (kΩ)	Temperature (°C)
1 - - 2	1.65 ± 0.15	25 ± 5



EFMB692C

EFMB692B

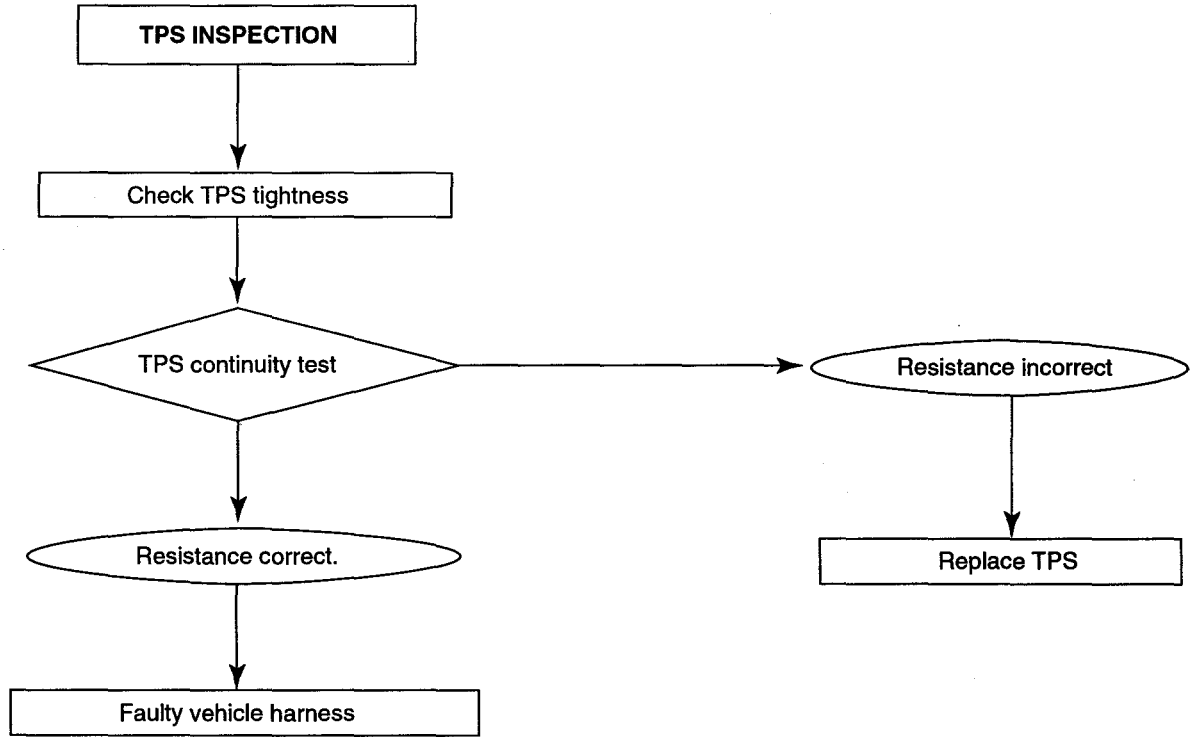
2. Check Np sensor resistance.



EFMB6940

TPS (TIMING POSITION SENSOR)

**Advice**  
Turn the key switch OFF.



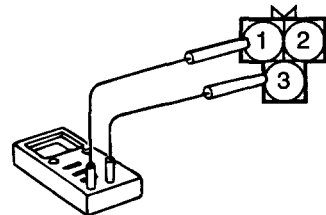
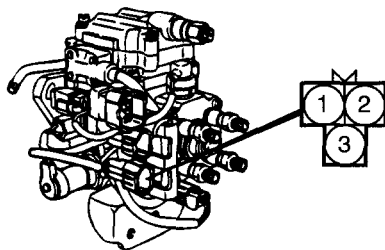
EFMB694A

1. TPS terminals.

Terminal No	Component wiring	Remarks
1	OSC (+)	Oscillate (+)
2	OSC (-)	Oscillate (-)
3	MDL	

• Reference Values

Terminal No	Resistance (kΩ)	Temperature (°C)
1 - - 3	82 ± 5.7	25 ± 10
2 - - 3	82 ± 5.7	25 ± 10



EFMB694C

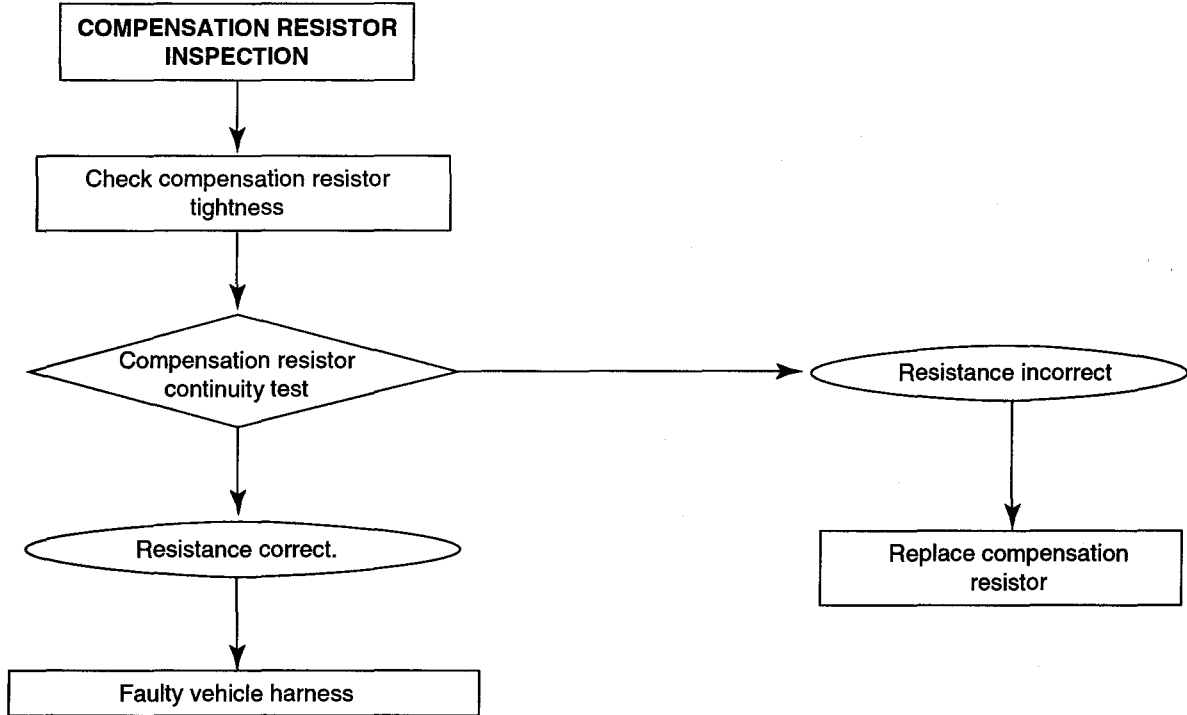
EFMB694B

2. Check TPS resistance.

EFMB6960

**COMPENSATION RESISTOR**

**Advice**  
Turn the key switch OFF.

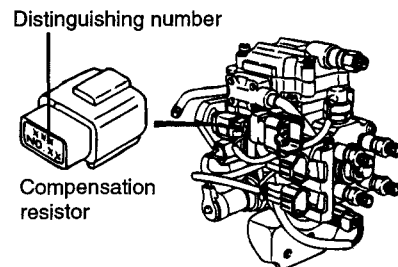


EFMB696A

1. GE actuator terminals

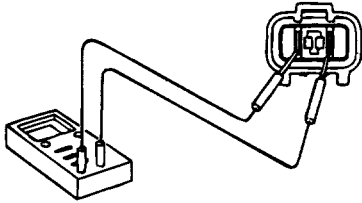
Compensation resistor (No, kΩ)	Distinguishing No.	Part No.
No1, 0.18	945	146649-4500
No2, 0.30	946	146649-4600
No3, 0.43	947	146649-4700
No4, 0.62	948	146649-4800
No5, 0.82	949	146649-4900
No6, 1.10	950	146649-5000
No7, 1.50	951	146649-5100
No8, 2.00	952	146649-5200
No9, 2.70	953	146649-5300
No10, 3.90	954	146649-5400
No11, 5.60	955	146649-5500

Compensation resistor (No, kΩ)	Distinguishing No.	Part No.
No12, 8.20	956	146649-5600
No13, 15.0	957	146649-5700



EFMB696B

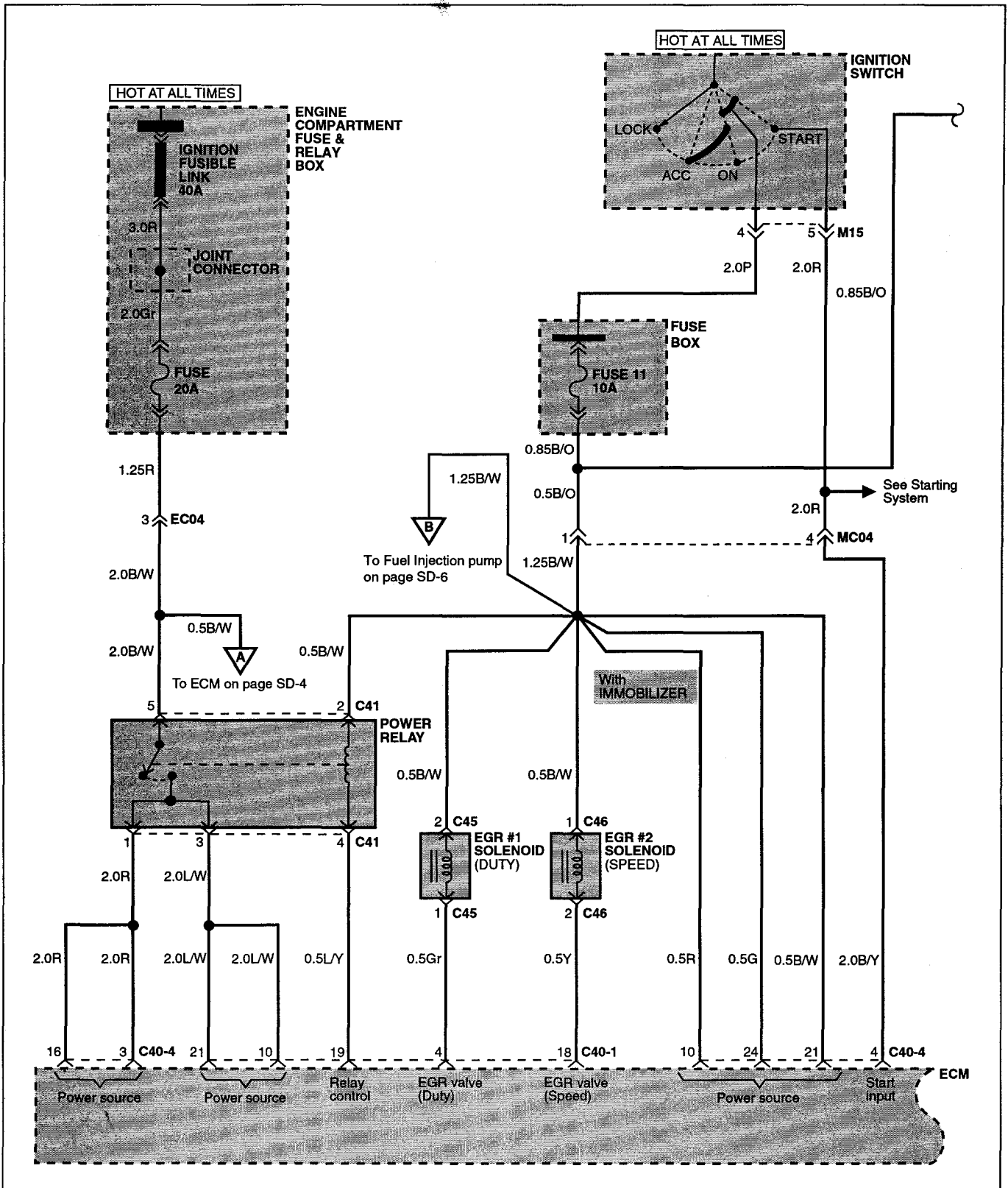
2. Measure the compensation resistance, referring to the above table.  
Resistance tolerance :  $\pm 5\%$



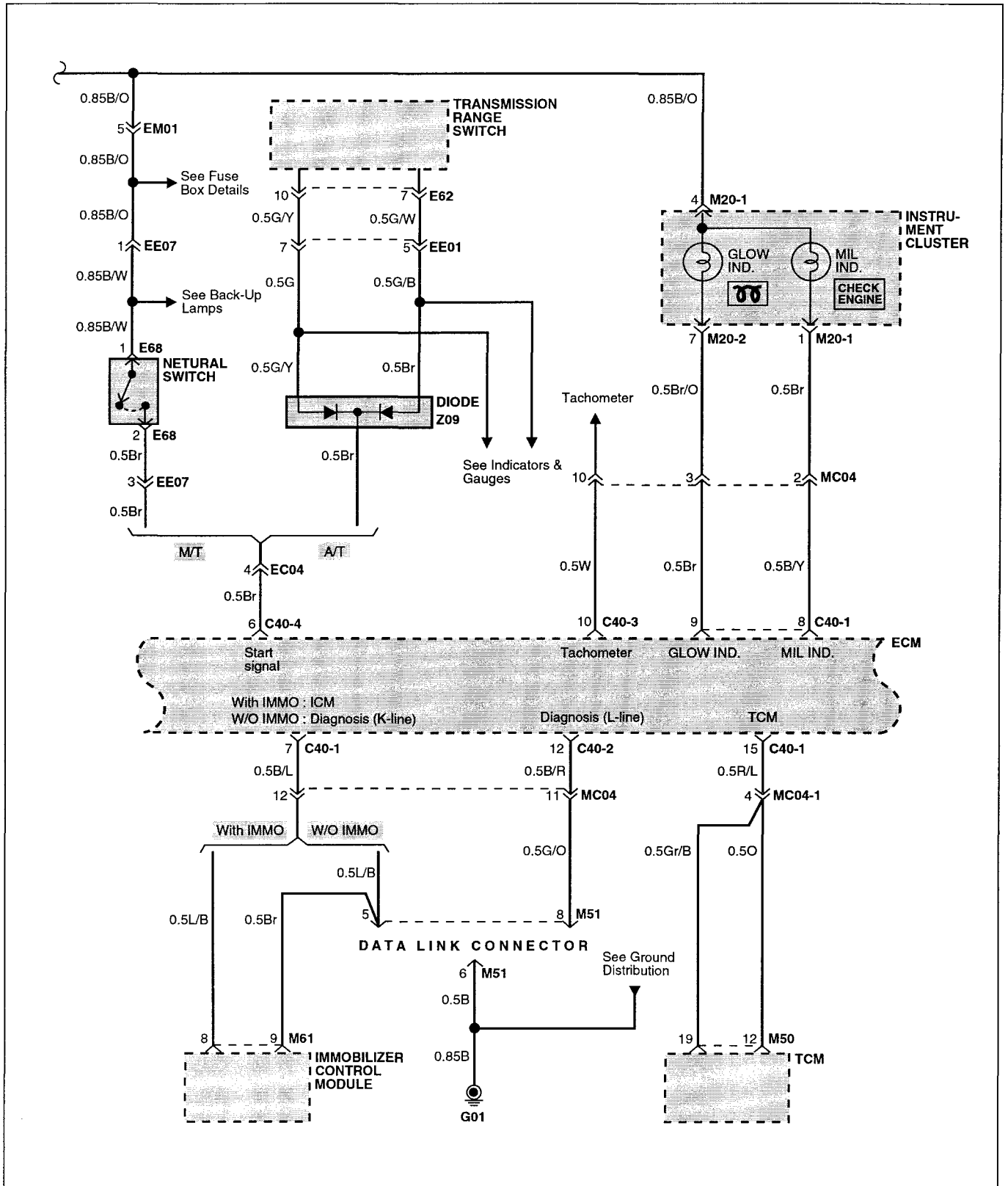
EFMB696C

**SCHEMATIC DIAGRAM** EFM6970

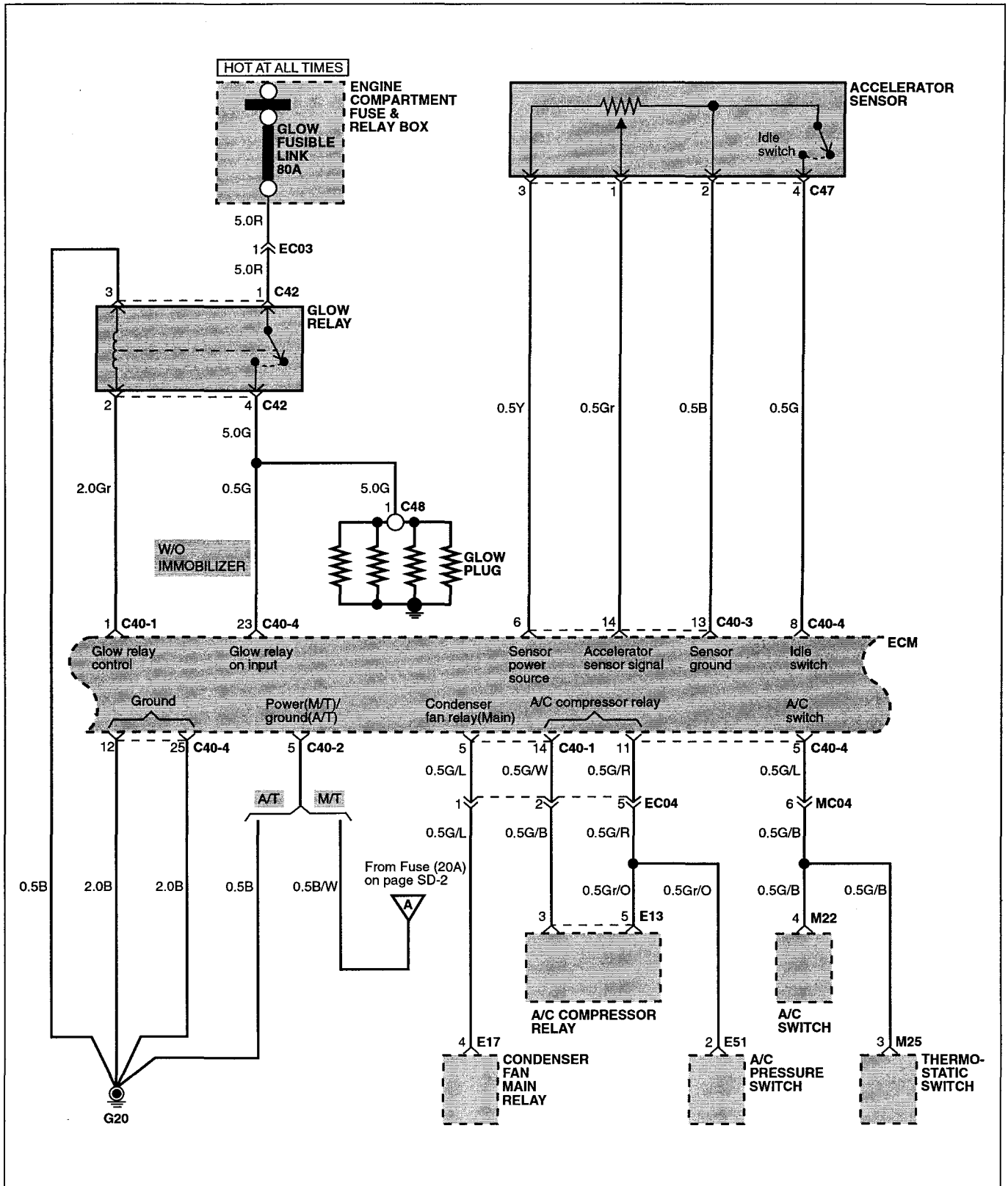
**ENGINE CONTROL SYSTEM (1)**



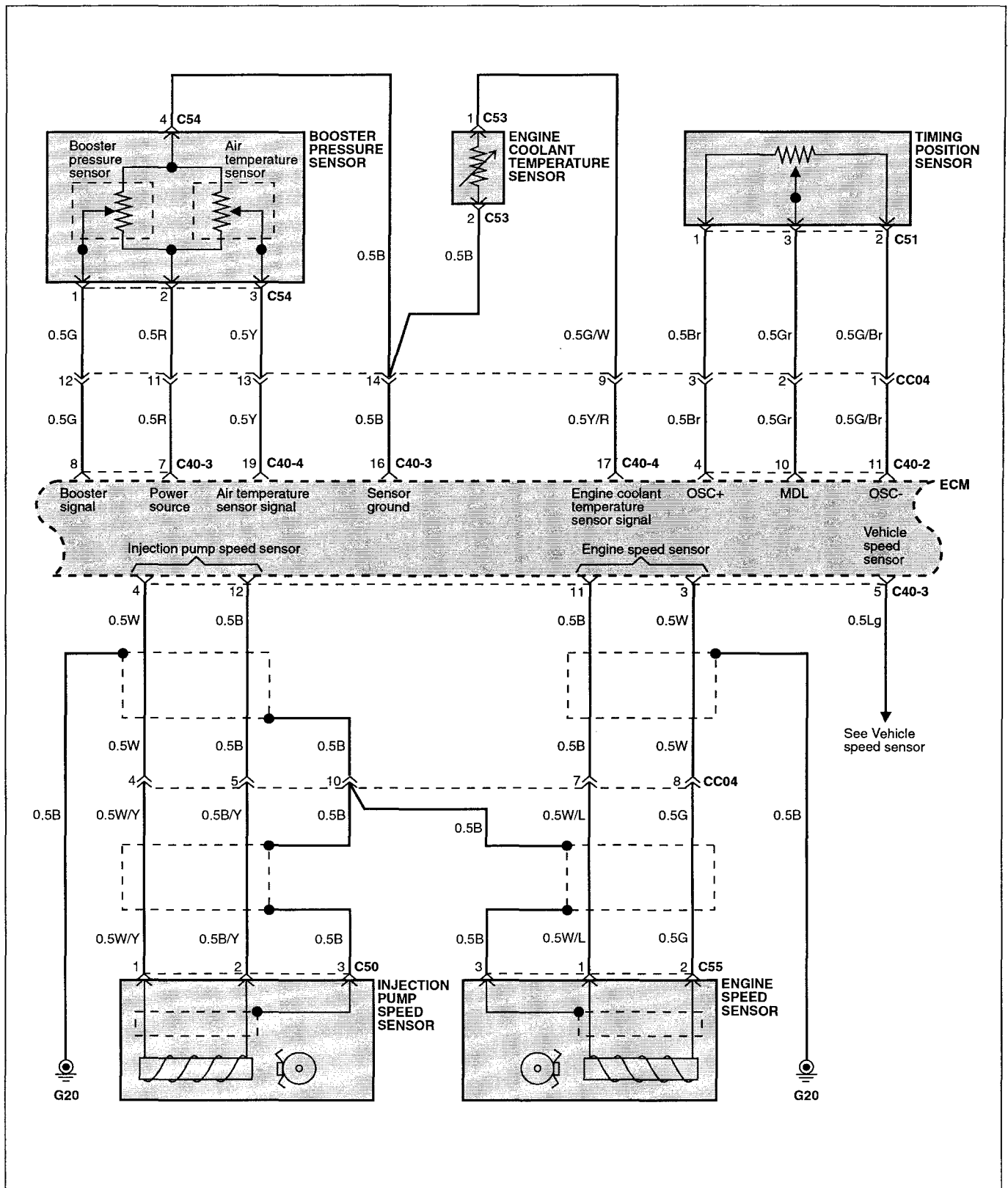
ENGINE CONTROL SYSTEM (2)



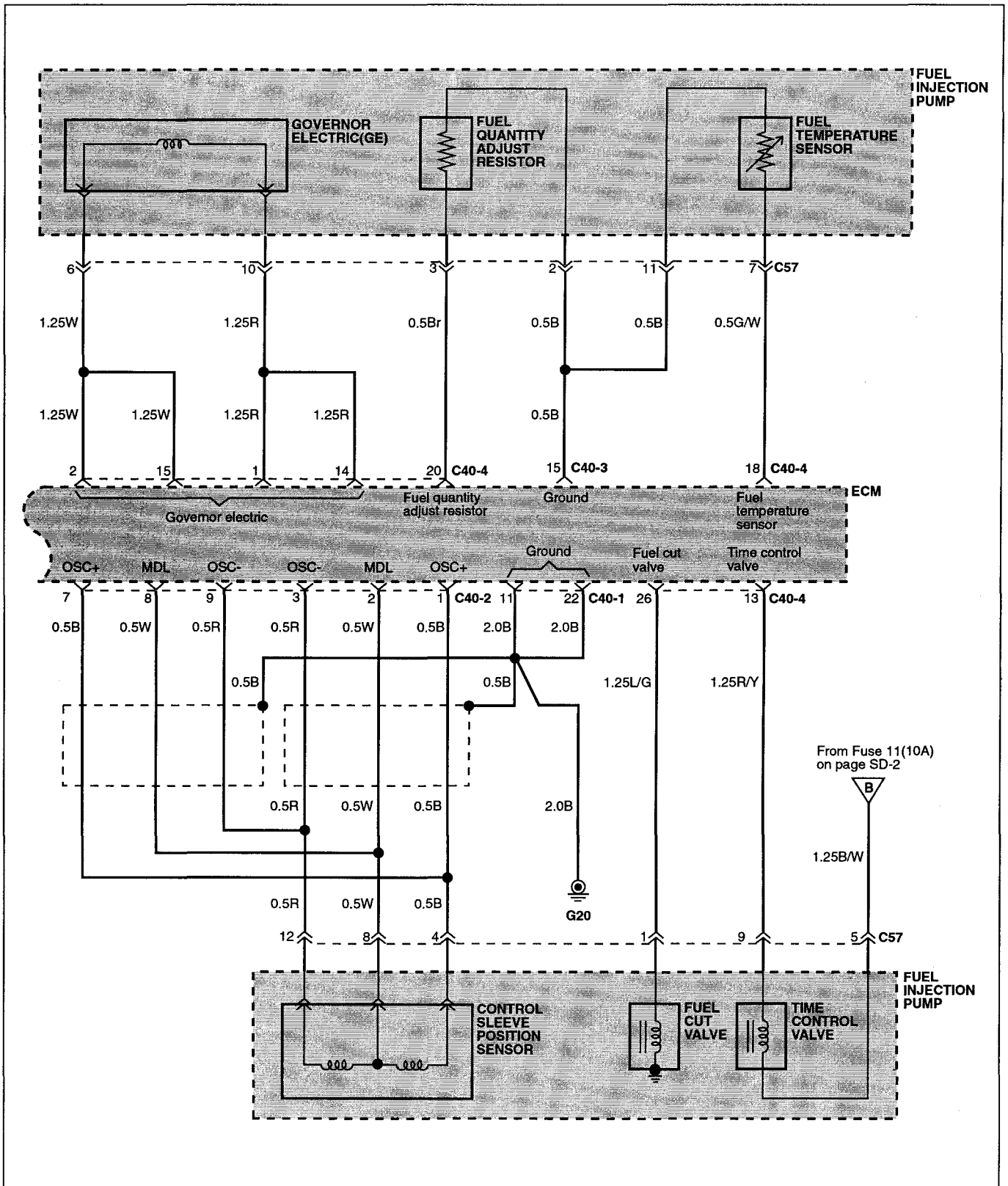
ENGINE CONTROL SYSTEM (3)



ENGINE CONTROL SYSTEM (4)

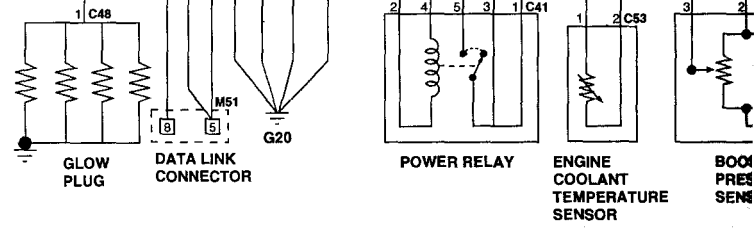
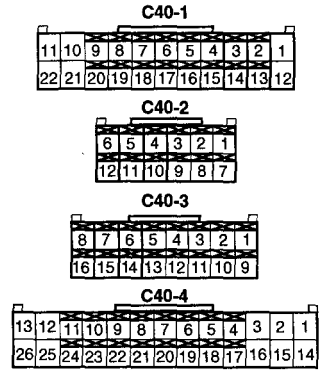
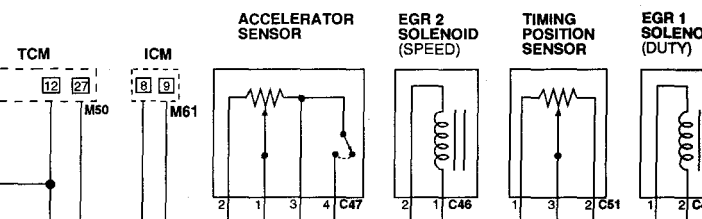
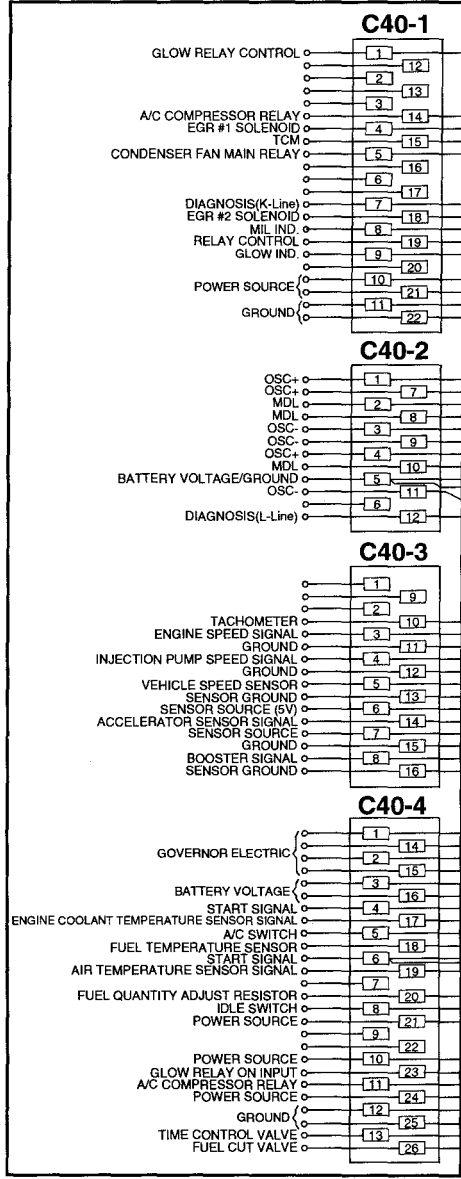


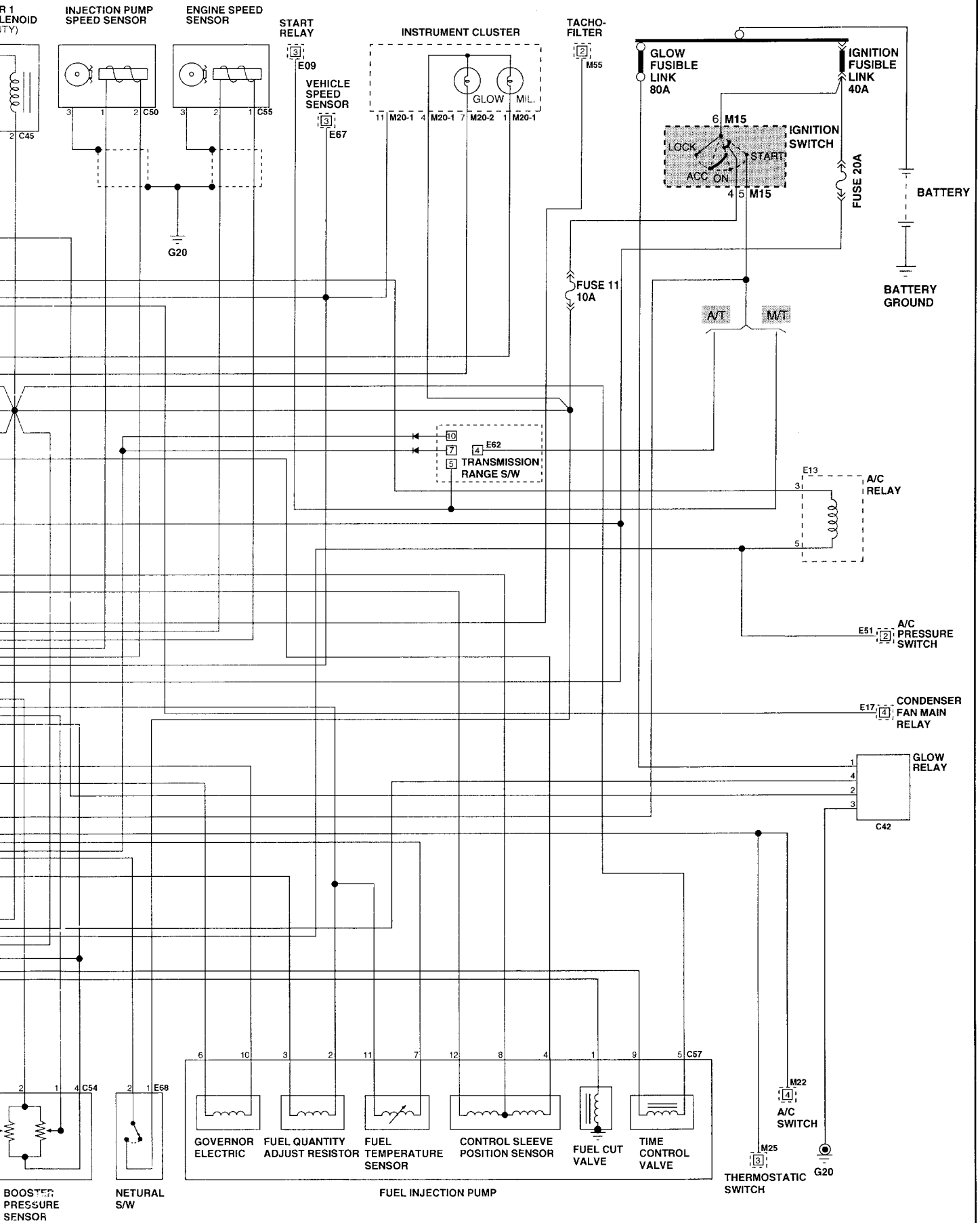
ENGINE CONTROL SYSTEM (5)





# ENGINE CONTROL SYSTEM (COVEC-F)





# Fuel System

## [Gasoline 3.5]

GENERAL .....	FL - 2
MFI CONTROL SYSTEM .....	FL -20
FUEL DELIVERY SYSTEM .....	FL -78
TROUBLESHOOTING FOR DTC .....	FL -88

# GENERAL

## SPECIFICATION EFMB0010

<b>Fuel tank</b> Capacity	75 lit.
<b>Fuel filter</b> Type	High pressure type
<b>Fuel pump</b> Type Driven by	Electrical, in-tank type Electric motor
<b>Throttle body</b> Throttle position sensor (TP Sensor) Type Output voltage at curb idle  Output voltage at WOT  Idle speed control (ISC) motor Type Resistance Idle position switch Type	Variable resistor type 0.3 - 0.9V  4.5 - 5.0V  Step motor type 28 - 32 $\Omega$ at 20°C (68°F)  Contact type (Built in TPS)
<b>Input sensor</b> Mass air flow sensor Type Intake air temperature (IAT) sensor Type Resistance  Engine coolant temperature (ECT) sensor Type Resistance  Heated oxygen sensor (HO2S) Type Vehicle speed sensor Type Camshaft position (CMP) sensor Type Crankshaft position (CKP) sensor Type	Hot film type  Thermistor type 2.33 - 2.97k $\Omega$ or 2.5 - 2.7V at 20°C (68°F) 0.31 - 0.43k $\Omega$ or 0.6 - 0.8V at 80°C (176°F)  Thermistor type 2.4k $\Omega$ or 2.5 - 2.7V at 20°C (68°F) 0.3k $\Omega$ or 0.5 - 0.7V at 80°C (176°F)  Zirconia sensor  Hall IC type  Hall effect sensor  Hall effect sensor
<b>Output actuator</b> Injector Type Number Coil resistance	Electromagnetic type 6 13 - 16 $\Omega$ at 20°C (68°F)
<b>Fuel pressure regulator</b> Fuel pressure	320 - 340kPa (3.26 - 3.47kg/cm <sup>2</sup> , 46 - 49 psi)

**SEALANT** EFBB0020

Engine coolant temperature sensor	LOCTITE 962T or equivalent
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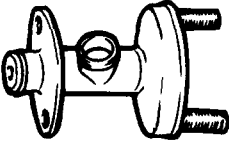
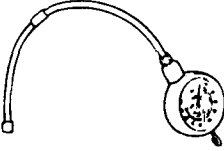
**SERVICE STANDARD** EFMB0030

Actual ignition timing			BTDC 5° ± 2°
Curb idle speed	N-range	A/CON : OFF	800 ± 100
		A/CON : ON	800 ± 100
	D-range	A/CON : OFF	800 ± 100
		A/CON : ON	800 ± 100

**TIGHTENING TORQUE** EFBB0040

Item	Nm	Kg.cm	lb.ft
Delivery pipe installation bolt	10 - 13	100 - 130	7 - 9
Engine coolant temperature sensor	20 - 40	200 - 400	14 - 29
Heated oxygen sensor	40 - 50	400 - 500	29 - 36
Heated oxygen sensor connector bracket bolt	8 - 12	80 - 120	5.8 - 8.7
Fuel pressure regulator installation bolt	7 - 11	70 - 110	5 - 8
High pressure hose and fuel main pipe	30 - 40	300 - 400	22 - 29
High pressure hose and fuel filter	25 - 35	250 - 350	18 - 25
High pressure hose to delivery pipe	3 - 4	30 - 40	2.2 - 3
Fuel pump assembly to fuel tank	2 - 3	20 - 30	1.4 - 2.2
High pressure hose at fuel tank	30 - 40	300 - 400	22 - 29
Throttle body to surge tank	10 - 13	100 - 130	7.2 - 9
Fuel tank drain plug	15 - 25	150 - 250	11 - 18
Fuel filter mounting bolts	9 - 14	90 - 140	6.5 - 10
Accelerator arm bracket bolts	8 - 12	80 - 120	5.8 - 8.7
ISC motor (stepper motor)	2.5 - 4.5	25 - 45	1.8 - 3.3
Fuel sender to fuel tank	2 - 3	20 - 30	1.4 - 2.2

**SPECIAL TOOLS** EFA90050

Tool (Number and name)	Illustration	Use
<p>09353-38000 Fuel pressure gauge adapter</p>	 <p style="text-align: right;">EFA9005A</p>	<p>Connection of fuel pressure gauge to delivery pipe for measurement of fuel pressure.</p>
<p>09353-24100 Fuel pressure gauge &amp; hose</p>	 <p style="text-align: right;">EFA9005B</p>	

**TROUBLESHOOTING** EFA90060

When checking engine trouble, it is important to start with an inspection of the basic systems. If one of the following conditions exists, (A) engine start failure, (B) unstable idling or (C) poor acceleration, begin by checking the following basic systems.

1. Power supply
  - Battery
  - Fusible link
  - Fuse
2. Body ground
3. Fuel supply
  - Fuel line
  - Fuel filter
  - Fuel pump
4. Ignition system
  - Spark plug
  - High-tension cable
  - Ignition coil
5. Emission control system
  - PCV system
  - Vacuum leak
6. Others
  - Ignition timing
  - Idle speed

Trouble with the MFI system is often caused by poor contact of the harness connectors. It is important to check all harness connectors and verify that they are securely connected.

TROUBLESHOOTING GUIDE CHART EFDA0070

Main Symptoms  Sub-Symptoms  Check points	STARTING							Poor Idling					Poor Driving	
	Unable to start			Difficult to start				Incorrect fast idle	High idle speed	Low idle speed	Rough idling	Engine hesitates or accelerates poorly	Surging	Knocking
	Engine does not turn over	Starter runs but engine does not turn over	Incomplete combustion	Engine turns over	Always	When the engine is cold	When the engine is hot							
Starter relay	1													
Starter	2	2		1										
Park/Neutral SW [A/T] or Clutch start SW [M/T]	3													
Flywheel [M/T] or Drive plate [A/T]		4												
Mass air flow sensor circuit			3						3	10	7			
Idle speed control actuator			4		3	3	3	3	2	7			2	
Fuel pressure regulator			5		5	5	5			4	11	1		
ECT sensor circuit			6		4	1	1	2	2	1	2	8	6	
Compression			7		8						8	5		
Piston rings			8		9						9			
Ignition timing					10						11	14		
Timing mark			9								12			
Injectors			10		13	8	8		7	4	13	15	4	
PCM			11		14	9	9	4	8	5	14	16	5	
A/C circuit				2					6					
Connecting rod bearing				3										
Crankshaft bearing				4										
Fuel quality					1	2	2				1	3	3	
Spark plugs					2						3	4	2	
Fuel pump					6	6	6				5	12		
Fuel lines					7	7	7				6	13		
Ignition circuit			2		11								3	
Intake air temp. sensor circuit					12	4	4		4			9	1	
Accelerator pedal link								1	1					
TP Sensor circuit									5			6		
Cylinder head											15			
Clutch [M/T]												1		
Brakes not releasing properly												2		
Oxygen sensor circuit												10		
Crankshaft position sensor		3												
Battery voltage		1	1											



Main Symptoms Sub-Symptoms Check points	Engine Stalls				Others			Refueling
	Soon after starting	After accelerator pedal is depressed	After accelerator pedal is released	During A/C ON	Excessive fuel consumption	Engine overheats	Engine too cool	Hard to refuel Overflowing spit-Back
Fuel quality	1							
Fuel pressure regulator	2	4			2			
Fuel pump	3							
Fuel lines	4	5						
ISC actuator	5		1	2				
MAF sensor circuit	6	1	2		13			
ECT sensor circuit	7				11			
Injectors	8	6			10			
ECM	9	7	3	3	17			
TP Sensor circuit		2			12			
Spark plug		3			6	8		
A/C circuit				1	14			
Fuel leakage					1			
Accelerator pedal link					3			
Clutch [M/T]					4			
Brakes drag when pedal released					5			
Compression					7			
Piston ring					8			
Ignition timing					9			
Oxygen sensor circuit					15			
Intake air temp. sensor circuit					16			
Coolant leakage						1		
Cooling fan						2	1	
Thermo switch						3		
Radiator and radiator cap						4	2	
Thermostat						5		
Timing belt						6		
Engine coolant pump						7		
Oil pump						9		
Cylinder head						10		
Cylinder block						11		
ECT sender						12	3	
Crankshaft position sensor	11	8	4	4				
Fill vent valve hose-clogging								1
Canister fillter-Contamination								2
Fuel shut off valve-operation								3

EFDA007B

 **NOTE**

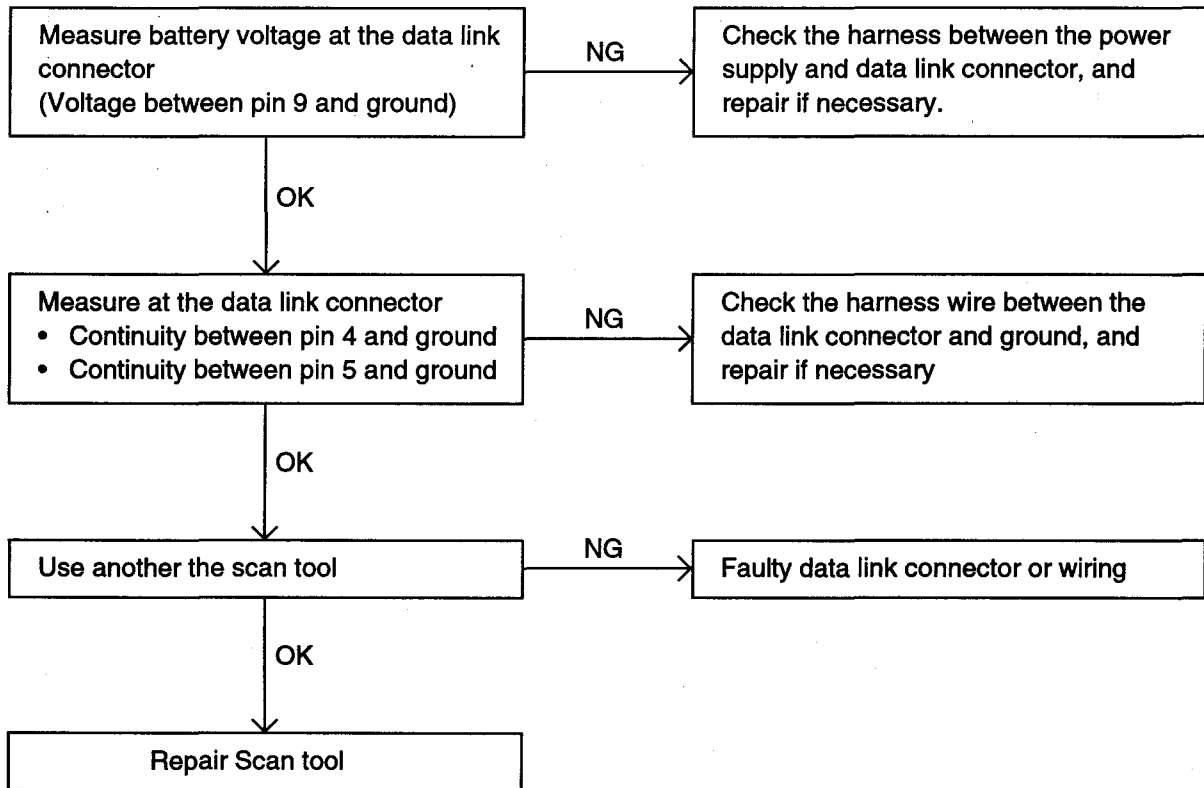
The number herein means the check order.

## MFI TROUBLESHOOTING PROCEDURES

EFA90080

### PROBLEM

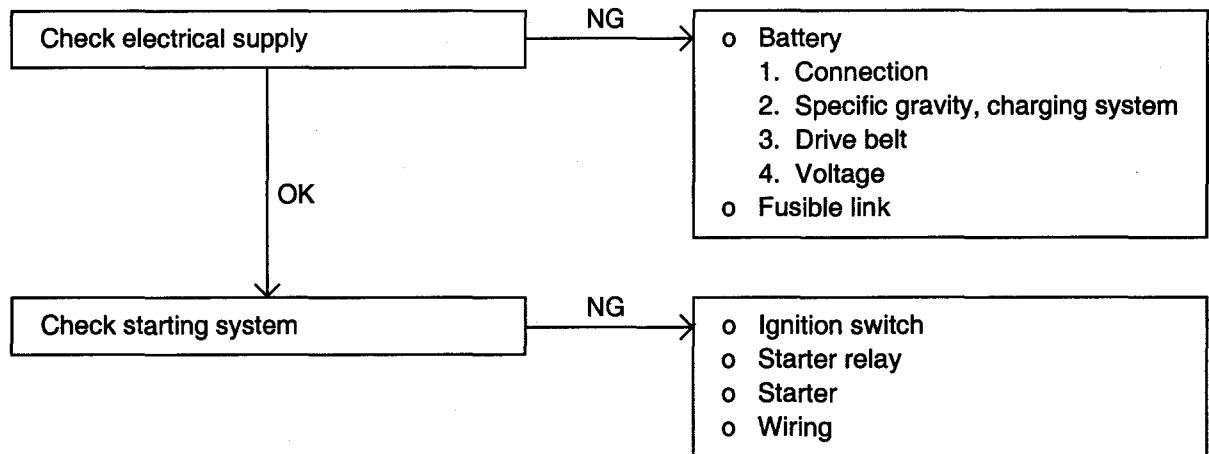
Communication with scan tool is not possible.  
(Cannot communicate with any system)



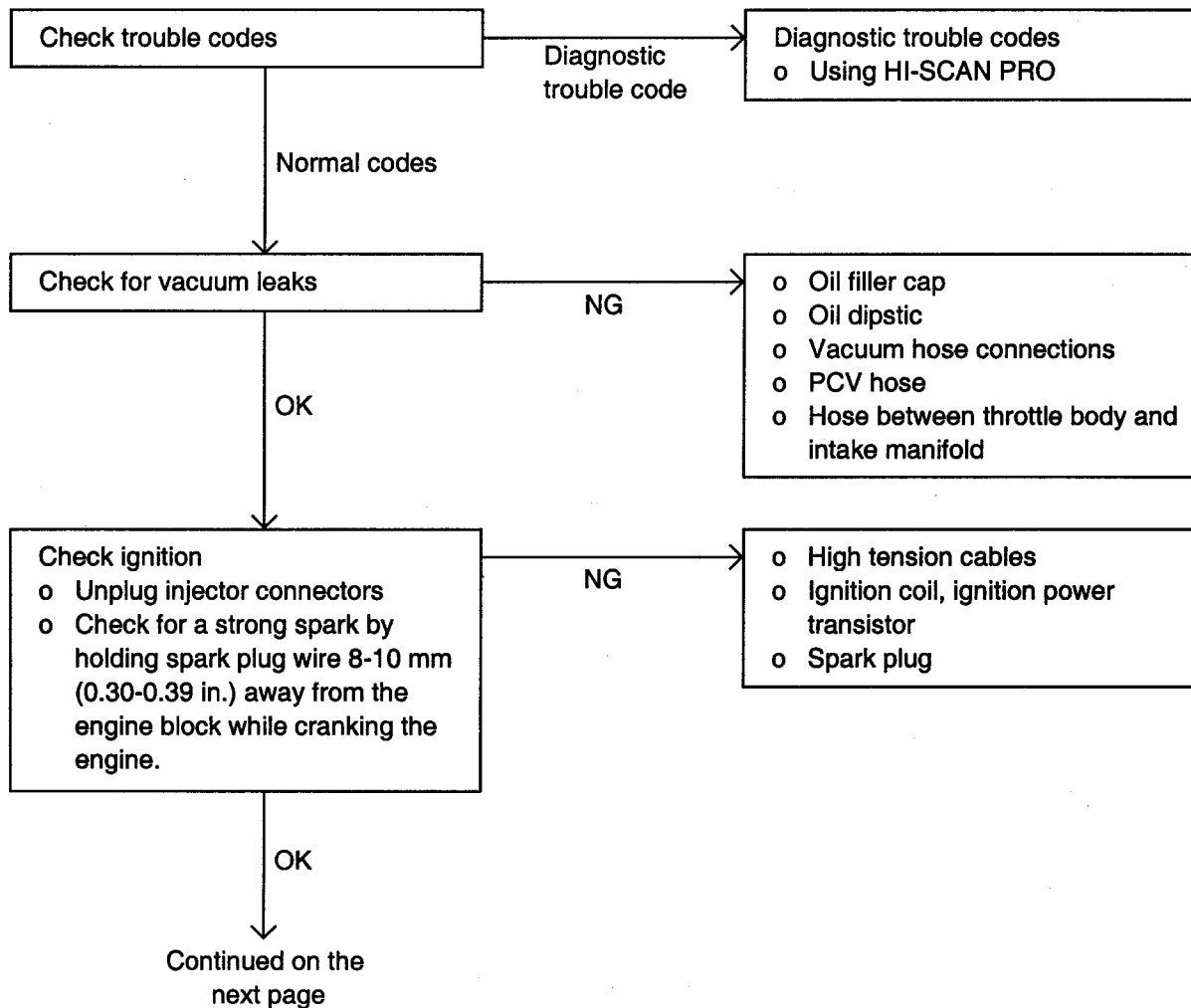
**SCAN TOOL COMMUNICATION WITH PCM  
IS NOT POSSIBLE** EFA90090

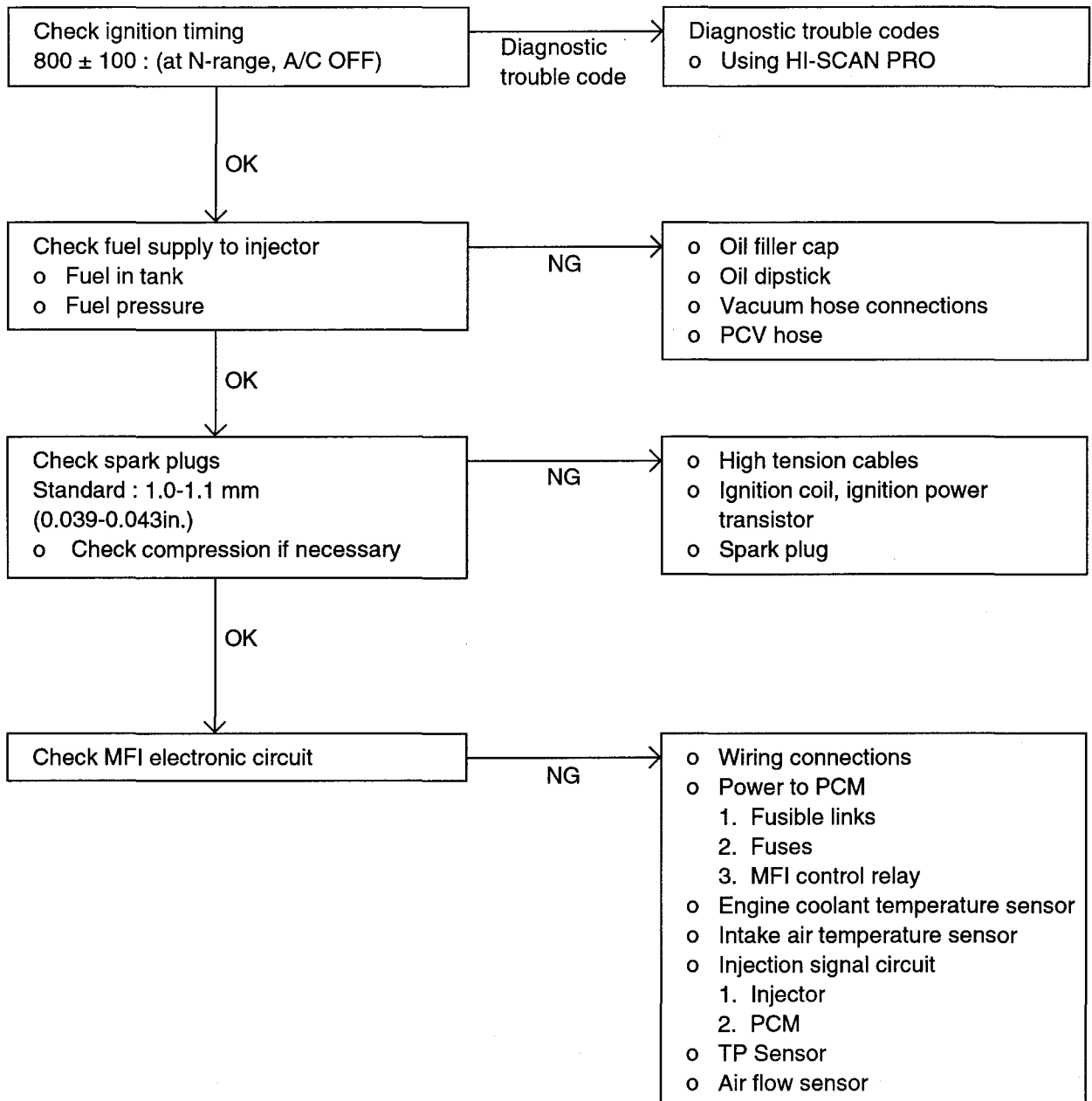
Comment	Probable cause
One of the following causes may be suspected <ul style="list-style-type: none"> <li>• No power supply to PCM</li> <li>• Defective ground circuit of PCM</li> <li>• Defective PCM</li> <li>• Improper communication line between PCM and scan tool</li> </ul>	<ul style="list-style-type: none"> <li>• Malfunction of PCM power supply circuit.</li> <li>• Malfunction of the PCM.</li> <li>• Open circuit between PCM and DLC.</li> </ul>

**ENGINE WILL NOT START** EFA90100

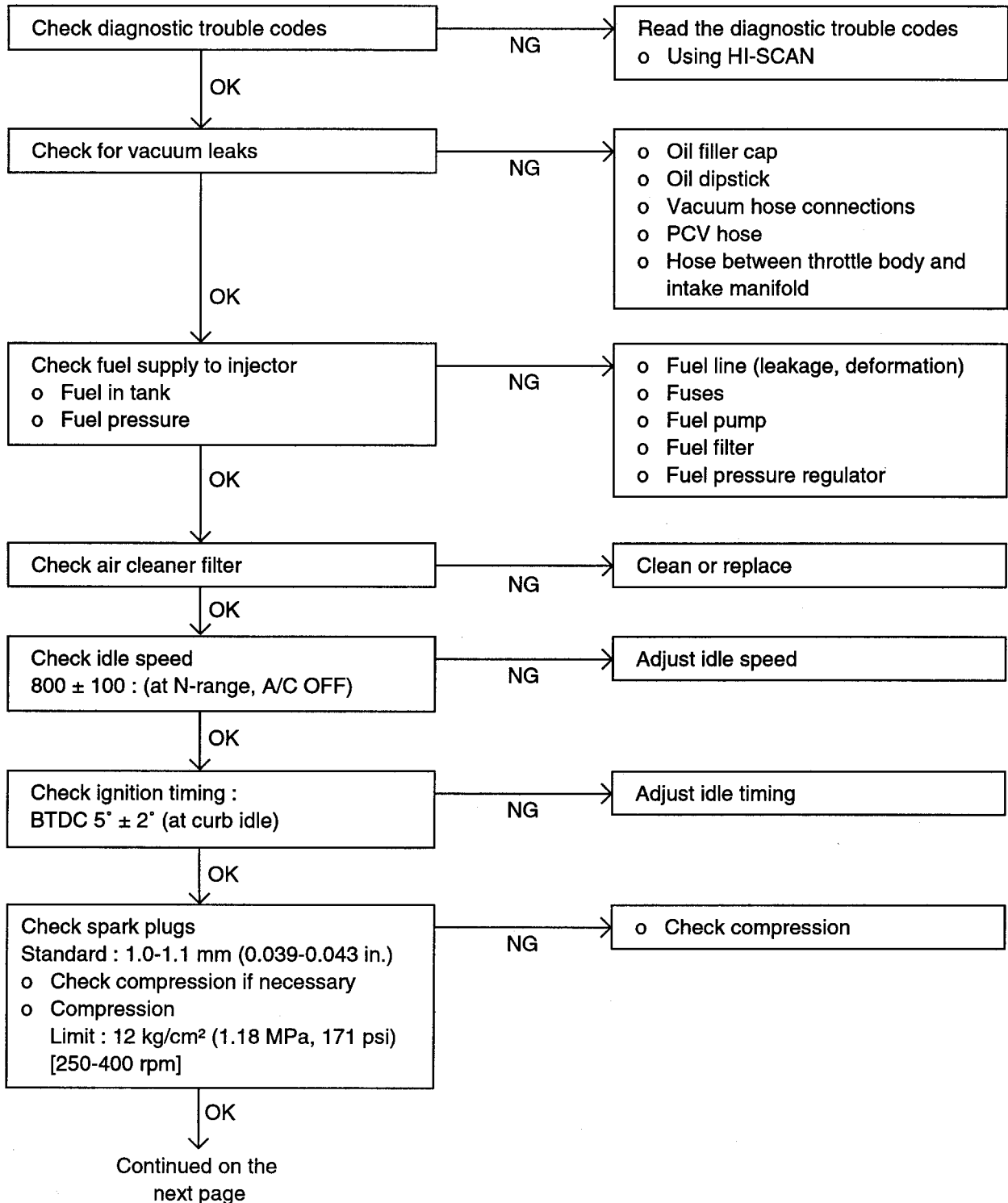


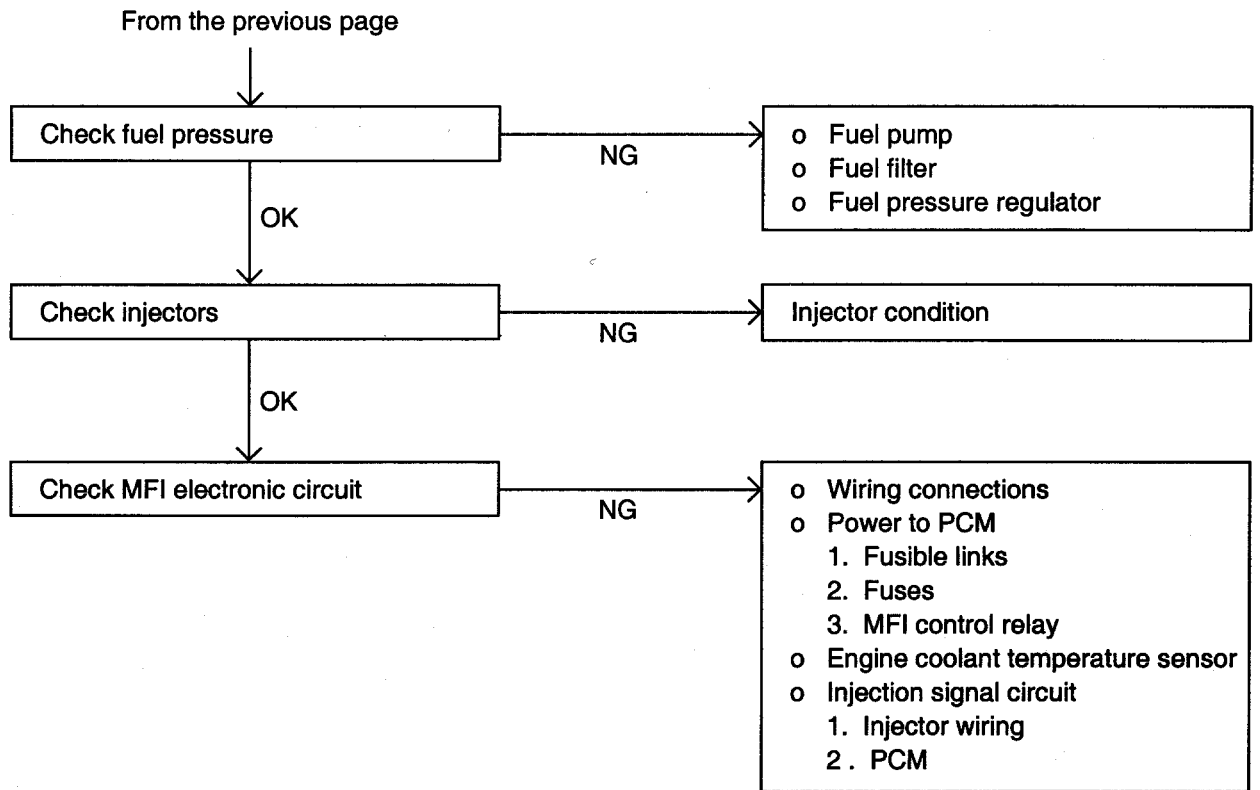
**DIFFICULT TO START (ENGINE  
CRANKS)** EFMB0110





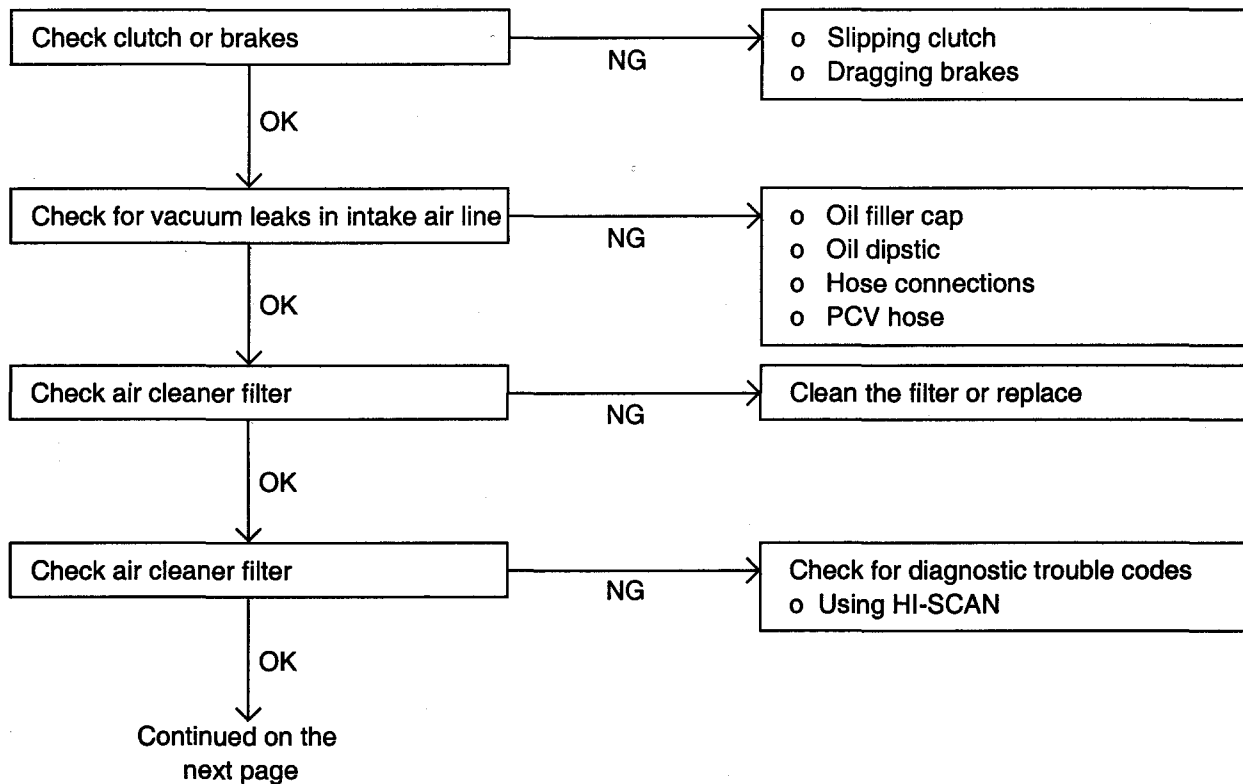
**ROUGH IDLE OR ENGINE STALLS** EFMB0120



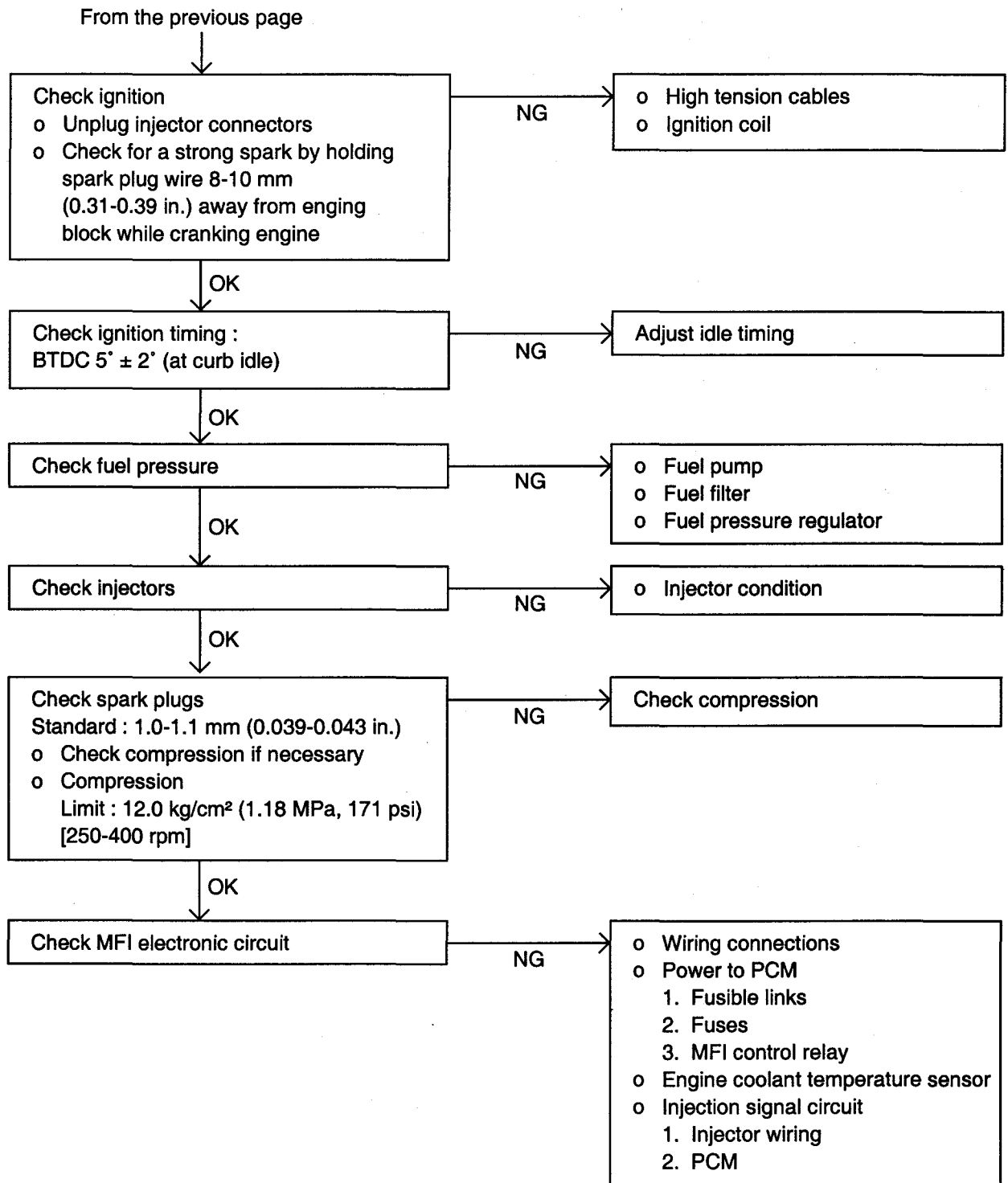


**ENGINE HESITATES OR ACCELERATES**

**POORLY** EFBB0130







**TROUBLESHOOTING** EFA90140

Trouble symptom	Probable cause	Remedy
Engine will not crank.	Battery charge low	Charge or replace battery
	Battery cables loose, corroded or worn	Repair or replace cables
	Transaxle range switch faulty (Vehicle with automatic transaxle only)	Adjust or replace switch
	Fusible link blown	Replace fusible link
	Starter motor faulty	Repair starter motor
	Ignition switch faulty	Replace ignition switch
Engine cranks slowly	Battery charge low	Charge or replace battery
	Battery cables loose, corroded or worn	Repair or replace cables
	Starter motor faulty	Repair starter motor
Starter keeps running	Starter motor faulty	Repair starter motor
	Ignition switch faulty	Replace ignition switch
Starter spins but engine will not crank	Pinion gear teeth broken or starter motor faulty	Repair starter motor
	Ring gear teeth broken	Replace flywheel ring gear or torque converter

**FUEL TANK AND FUEL LINE** EFA90150

Trouble symptom	Probable cause	Remedy
Engine malfunctions due to insufficient fuel supply	Bent or kinked fuel pipe or hose	Repair or replace
	Clogged fuel pipe or hose	Clean or replace.
	Clogged fuel filter or in-tank fuel filter	Replace
	Water in fuel filter	Replace the fuel filter or clean the fuel tank and fuel lines
	Dirty or rusted fuel tank interior	Clean or replace
	Malfunctioning fuel pump (clogged filter in the pump)	Replace
Evaporative emission system malfunction (when fuel filler cap is removed, pressure is released)	Incorrect routing of a vapor line	Correct
	Disconnected vapor line	Correct
	Folded, bent, cracked or clogged vapor line	Replace
	Faulty fuel tank cap	Replace
	Malfunctioning overfill limiter (two-way valve)	Replace

## MULTIPOINT FUEL INJECTION (MFI) EFBB0160

### GENERAL INFORMATION

The Multiport Fuel Injection System consists of sensors which detect the engine conditions, the POWERTRAIN CONTROL MODULE (PCM) which controls the system based on signals from these sensors, and actuators which operate under the control of the PCM. The PCM carries out activities such as fuel injection control, idle air control and ignition timing control. In addition, the PCM is equipped with several diagnostic test modes which simplify troubleshooting when a problem occurs.

### FUEL INJECTION CONTROL

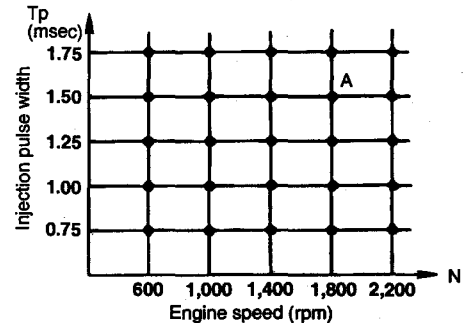
The injector drive times and injector timing are controlled so that the optimum air/fuel mixture is supplied to the engine to correspond to the continually-changing engine operation conditions. A single injector is mounted at the intake port of each cylinder. Fuel is sent under pressure from the fuel tank by the fuel pump, with the pressure being regulated by the fuel pressure regulator. The fuel thus regulated is distributed to each of the injectors. This is called multiport. Fuel injection is normally carried out once for each cylinder for every two rotations of the crankshaft. The PCM provides a richer air/fuel mixture by carrying out "open-loop" control when the engine is cold or operating under high load conditions in order to maintain engine performance. In addition, when the engine is warm or operating under normal conditions, the PCM controls the air/fuel mixture by using the heated oxygen sensor signal to carry out "closed-loop" control in order to obtain the theoretical air/fuel mixture ratio that provides the maximum cleaning performance from the three way catalyst.

### IDLE SPEED CONTROL

The idle speed is kept at the optimum speed by controlling the amount of air that bypasses the throttle valve in accordance with changes in idling conditions and engine load during idling. The PCM drives the idle speed control (ISC) motor to keep the engine running at the pre-set idle target speed in accordance with the engine coolant temperature and air conditioning load. In addition, when the air conditioning switch is turned off and on while the engine is idling, the ISC motor operates to adjust the throttle valve bypass air amount in accordance with the engine load conditions in order to avoid fluctuations in the engine speed.

## IGNITION TIMING CONTROL

The ignition power transistor located in the ignition primary circuit turns ON and OFF to control the primary current flow to the ignition coil. This controls the ignition timing in order to provide the optimum ignition timing with respect to the engine operating conditions. The ignition timing is determined by the PCM from the engine speed, intake air volume, engine coolant temperature and atmospheric pressure.



EFJB016C

## OTHER CONTROL FUNCTIONS EFA90170

- Fuel Pump Control :**  
Turns the fuel pump relay ON so that current is supplied to the fuel pump while the engine is cranking or running.
- A/C Compressor Clutch Relay Control :**  
Turns the compressor clutch of the A/C ON and OFF.
- Fan Relay Control :**  
The radiator fan and condenser fan speeds are controlled in response to the engine coolant temperature and vehicle speed.
- Evaporative Emission Purge Control (Refer to GROUP EC).**

## DIAGNOSTIC TEST MODE EFA90180

- When an abnormality is detected in one of the sensors or actuators related to emission control, the CHECK ENGINE/MALFUNCTION INDICATOR LAMP illuminates as a warning to the driver.
- When an abnormality is detected in one of the sensors or actuators, a diagnostic trouble code corresponding to the abnormality is output.
- The RAM data inside the ECM that is related to the sensors and actuators can be read by means of the scan tool. In addition, the actuators can be controlled under certain circumstances.

## HOW TO COPE WITH INTERMITTENT MALFUNCTIONS

EFA90190

Most intermittent malfunctions occur under certain conditions. If those conditions can be identified, the cause will be easier to find.

### TO COPE WITH INTERMITTENT MALFUNCTION:

1. Ask the customer about the malfunction. Ask what it feels like, what it sounds like, etc. Then ask about driving conditions, weather, frequency of occurrence, and so on.
2. Determine the conditions from the customer's responses. Typically, almost all intermittent malfunctions occur from conditions like vibration, temperature and/or moisture change, poor connections. From the customer's replies, it should be deduced which condition exists.
3. Use the simulation test  
In the cases of vibration or poor connections, use the simulation tests below to attempt to duplicate the customer's complaint. Determine the most likely circuit(s) and perform the simulation tests on the connectors and parts of that circuit(s). Be sure to use the inspection procedures provided for diagnostic trouble codes and trouble symptoms. For temperature and/or moisture conditions related intermittent malfunctions, using common sense, try to change the conditions of the suspected circuit components, then use the simulation tests below.
4. Verify that the intermittent malfunction is eliminated. Repair the malfunctioning part and try to duplicate the condition(s) again to verify that the intermittent malfunction has been eliminated.

### SIMULATION TESTS

For these simulation tests, shake, then gently bend, pull and twist the wiring of each of these examples to duplicate the intermittent malfunction.

- Shake the connector up-and-down, right-and-left.
- Shake the wiring harness up-and-down, right-and-left.
- Vibrate the part or sensor.

## SERVICE POINTS IN INSPECTING A BLOWN FUSE

EFAA0200

Remove the fuse and measure the resistance between the load side of the fuse and ground. Set the switches of all circuits which are connected to this fuse to a condition of continuity. If the resistance is almost  $0\Omega$  at this time, there is a short somewhere between these switches and the load. If the resistance is not  $0\Omega$ , there is no short at

the present time, but a momentary shortage has probably caused the fuse to blow.

The main causes of a short circuit are the following.

- Harness being crushed by the vehicle body.
- Damage to the outer casing of the harness due to wear or heat.
- Water getting into the connector or circuitry.
- Human error (mistakenly shorting a circuit, etc.).

## INSPECTING THE MFI SYSTEM

EFBB0210

If the MFI system components (sensors, PCM, injector, etc.) fail, the interruption or failure to supply the proper amount of fuel for various engine operating conditions will result. The following situations may be encountered:

1. Engine is hard to start or does not start at all
2. Unstable idle
3. Poor driveability

If any of the above conditions is noted, first check for trouble codes and make basic engine checks (ignition system malfunction, incorrect engine adjustment, etc.). Then, inspect the MFI system components.

### ON-BOARD DIAGNOSTICS

- Diagnostic trouble codes are set as follows:  
After the PCM first detects a malfunction, a diagnostic trouble code is recorded when the engine is restarted and the same malfunction is re-detected. (The malfunction is detected in driving cycle). However, for fuel system rich/lean misfiring, a diagnostic trouble code is recorded on the first detection of the malfunction.
- Erasing diagnostic trouble codes:  
After recording the diagnostic trouble code, if the PCM does not re-detect the malfunction for 40 driving cycles, the diagnostic trouble code will be erased from the PCM memory. However, for fuel system rich/lean or misfiring, the diagnostic trouble code will be erased if both of the following conditions are met:
  - When driving conditions (engine speed, engine coolant temperature, etc.) are identical to those when the malfunction was first recorded.
  - When the PCM does not re-detect the malfunction for 80 driving cycles.

### NOTE

A "driving cycle" is complete as soon as the vehicle goes into closed-loop operation.

### MALFUNCTION INDICATOR LIGHT (MIL)

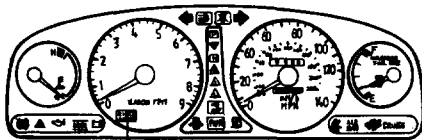
The MIL lights up to notify the driver that there is a problem with the vehicle.

However the MIL will go off automatically after 3 subsequent sequential driving cycles that do not re-detected the same malfunctions.

Immediately after the ignition switch is turned on, the MIL is lit for 5 seconds to indicate that the light operates normally.

The following items can be indicated by the MIL:

- Catalyst
- Fuel system
- Air flow sensor (MAF sensor)
- Intake Air Temperature Sensor (IAT sensor)
- Engine Coolant Temperature Sensor (ECT sensor)
- Throttle Position Sensor (TPS)
- Front Oxygen Sensor
- Rear Oxygen Sensor Heater
- Rear Oxygen Sensor
- Front Oxygen Sensor Heater
- Injector
- Misfire
- Crankshaft Position Sensor (CKP sensor)
- Camshaft Position Sensor (CMP sensor)
- Evaporative Emission Control System
- Vehicle Speed Sensor (VSS)
- Idle Speed Control
- PCM
- Manifold Absolute Pressure (MAP) Sensor
- Idle Switch
- EGR System



Malfunction indicator light

EFA9021A

**INSPECTING THE MALFUNCTION INDICATOR LAMP (MIL)**

1. After turning the ignition key on, check that the light illuminates for 5 seconds without the engine running.
2. If the light does not illuminate, check for an open circuit in the harness, blown fuse and blown bulb.

**SELF-DIAGNOSIS**

The PCM monitors the input/output signals (some signals at all times and others under specified conditions). When the PCM detects an irregularity, it memorizes the diagnostic trouble code, and outputs the signal to the self-diagnosis output terminal. The diagnosis results can be read by a Generic Scan Tool (GST) or Hi-Scan Pro. A diagnostic trouble code (DTC) will remain in the PCM as long as battery power is maintained. The diagnostic trouble code will however be erased when the battery terminal or the powertrain control module (PCM) connector is disconnected or erased using the Generic Scan Tool.

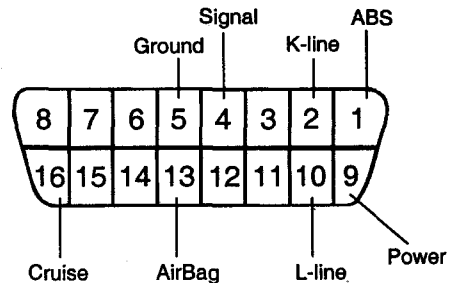
**CHECKING PROCEDURE (SELF-DIAGNOSIS)**

**NOTE**

1. When battery voltage is excessively low, diagnostic trouble codes can not be read. Be sure to check the battery for voltage and the charging system before starting the test.
2. Codes are erased if the battery or the PCM connector is disconnected. Do not disconnect the battery before the diagnostic trouble codes are completely read and recorded.

**Inspection Procedure (Using Generic Scan Tool)**

1. Turn OFF the ignition switch.
2. Connect the scan tool to the data link connector on the lower crash pad.
3. Turn ON the ignition switch.
4. Use the Hi-Scan Pro to check the diagnostic trouble code.
5. Repair the faulty part from the diagnosis chart.
6. Erase the diagnostic trouble code.
7. Disconnect the Hi-Scan Pro.

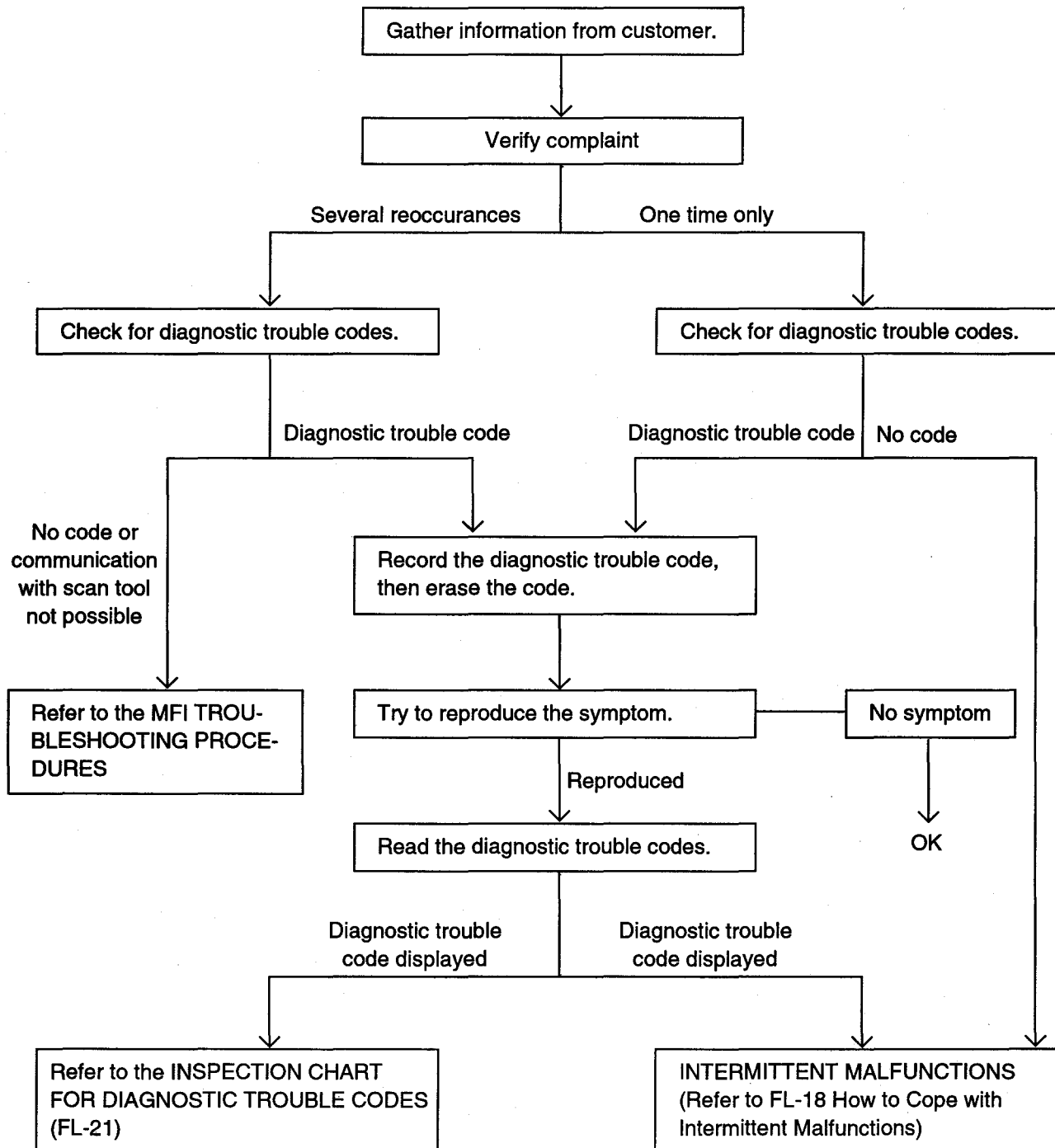


EFHA021B

# MFI CONTROL SYSTEM

## TROUBLESHOOTING EFMB0220

### DIAGNOSTIC TROUBLESHOOTING FLOW



**INSPECTION CHART FOR DIAGNOSTIC  
TROUBLE CODES**

EFMB0240

DTC NO.	CONTENT	EOBD	NON-EOBD
P0101	Mass or Volume Air Flow Circuit Range/Performance Problem	O	-
P0100	Mass or Volume Air Flow Sensor Malfunction	-	O
P0102	Mass or Volume Air Flow Circuit Low Voltage	O	-
P0103	Mass or Volume Air Flow Circuit High Voltage	O	-
P0110	Intake Air Temp. Sensor Malfunction	-	Δ
P0112	Intake Air Temp. Circuit Low Voltage	O	-
P0113	Intake Air Temp. Circuit High Voltage	O	-
P0115	Engine Coolant Temp. Circuit Malfunction (open/short)	O	O
P0116	Engine Coolant Temp. Circuit Drift	O	-
P0120	Throttle Position Sensor Malfunction	-	Δ
P0122	Throttle Position Sensor Circuit Low Voltage	O	-
P0123	Throttle Position Sensor Circuit High Voltage	O	-
P0125	Excessive Time to Enter Closed Loop Control (ECT sensor)	O	-
P0130	Oxygen Sensor Malfunction (Bank 1)	-	O
P0132	Oxygen Sensor Circuit Malfunction - Open (Bank 1, Sensor 1)	O	-
P0133	Oxygen Sensor Circuit Malfunction - Response rate (Bank 1, Sensor 1)	O	-
P0134	Oxygen Sensor Circuit Malfunction - No Activity (Bank 1, Sensor 1)	O	-
P0135	Oxygen Sensor Heater Circuit Malfunction (Bank 1, Sensor 1)	O	-
P0136	Oxygen Sensor Circuit Malfunction - Open (Bank 1, Sensor 2)	O	-
P0140	Oxygen Sensor Circuit Malfunction - Short (Bank 1, Sensor 2)	O	-
P0141	Oxygen Sensor Heater Circuit Malfunction (Bank 1, Sensor 2)	O	-
P0150	Oxygen Sensor Circuit Malfunction - Response rate (Bank 2, Sensor 1)	O	O
P0152	Oxygen Sensor Circuit Malfunction - Open (Bank 2, Sensor 1)	O	-
P0154	Oxygen Sensor Circuit Malfunction - No Activity (Bank 2, Sensor 1)	O	-
P0155	Oxygen Sensor Circuit Malfunction - Heater open/short (Bank 2, Sensor 1)	O	-
P0156	Oxygen Sensor Circuit Malfunction - Open (Bank 2, Sensor 2)	O	-
P0160	Oxygen Sensor Circuit Malfunction - Short (Bank 2, Sensor 2)	O	-
P0161	Oxygen Sensor Circuit Malfunction - Heater open/short (Bank 2, Sensor 2)	O	-
P0171	Fuel System Too Lean - (Bank 1)	O	-
P0172	Fuel System Too Rich - (Bank 1)	O	-
P0174	Fuel System Too Lean - (Bank 2)	O	-
P0175	Fuel System Too Rich - (Bank 2)	O	-
P0201	Injector Circuit Malfunction (Injector -1)	O	Δ

DTC NO.	CONTENT	EOBD	NON-EOBD
P0202	Injector Circuit Malfunction (Injector -2)	O	Δ
P0203	Injector Circuit Malfunction (Injector -3)	O	Δ
P0204	Injector Circuit Malfunction (Injector -4)	O	Δ
P0205	Injector Circuit Malfunction (Injector -5)	O	Δ
P0206	Injector Circuit Malfunction (Injector -6)	O	Δ
P0300	Random Misfire Detected	O	-
P0301	Misfire Detected (Cylinder -1)	O	-
P0302	Misfire Detected (Cylinder -2)	O	-
P0303	Misfire Detected (Cylinder -3)	O	-
P0304	Misfire Detected (Cylinder -4)	O	-
P0305	Misfire Detected (Cylinder -5)	O	-
P0306	Misfire Detected (Cylinder -6)	O	-
P0325	Knock Sensor Circuit Malfunction	Δ	Δ
P0335	Crankshaft Position Sensor Circuit Malfunction	O	Δ
P0340	Camshaft Position Sensor Circuit Malfunction	O	Δ
P0350	Ignition Coil Malfunction	O	Δ
P0320	Ignition Failure Sensor Malfunction	Δ	-
P0421	Warm-up Catalyst Efficiency Below Threshold - (Bank 1)	O	-
P0431	Warm-up Catalyst Efficiency Below Threshold - (Bank 2)	O	O
P0443	Purge Control Solenoid Valve Malfunction	O	O
P0500	Vehicle Speed Sensor Malfunction	O	Δ
P0506	Idle Speed Control RPM Lower Than Expected	O	-
P0507	Idle Speed Control RPM Higher Than Expected	O	-
P0510	Idle Switch Malfunction	O	-
P1330	Spark Timing Adjust Malfunction	O	Δ

 **NOTE**

"O" means DTC and MIL-ON.

"Δ" means only DTC-ON.

"-" means not applicable.



## TROUBLE AREA RELATED TO DTC EFMB0250

 NOTE

Check items for each diagnostic items do not list all possible causes.

DTC No.	Diagnostic items	Check items (Remedy)	Memory	MIL*
P0100	Mass Air Flow Circuit Malfunction	<ul style="list-style-type: none"> <li>• Open or short in mass air flow sensor circuit</li> <li>• Mass air flow sensor</li> <li>• PCM</li> </ul>	○	○
P0110	Intake Air Temperature Circuit Malfunction	<ul style="list-style-type: none"> <li>• Harness and connector</li> <li>• Intake air temperature sensor</li> <li>• Open or short in intake air temp. sensor circuit</li> <li>• Intake air temp. sensor</li> <li>• PCM</li> </ul>	○	-
P0115	Engine Coolant Temperature Circuit Malfunction	<ul style="list-style-type: none"> <li>• Harness and connector</li> <li>• Engine coolant temperature sensor</li> <li>• Open or short in engine coolant temp. sensor circuit</li> <li>• PCM</li> </ul>	○	○
P0120	Throttle Position Circuit Malfunction	<ul style="list-style-type: none"> <li>• Harness and connector</li> <li>• Throttle position sensor</li> <li>• Idle switch</li> <li>• Open or short in throttle position sensor circuit</li> <li>• PCM</li> </ul>	○	-
P0130	Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 1)	<ul style="list-style-type: none"> <li>• Harness and connector</li> <li>• Oxygen sensor</li> </ul>	○	○
P0136	Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 2)	<ul style="list-style-type: none"> <li>• Harness and connector</li> <li>• Oxygen sensor (rear)</li> </ul>	○	○
P0201	Injector Circuit Malfunction - Cylinder 1	<ul style="list-style-type: none"> <li>• Harness and connector</li> <li>• Injector</li> </ul>	○	○
P0202	Injector Circuit Malfunction - Cylinder 2		○	○
P0203	Injector Circuit Malfunction - Cylinder 3		○	○
P0204	Injector Circuit Malfunction - Cylinder 4		○	○
P0205	Injector Circuit Malfunction - Cylinder 5		○	○
P0206	Injector Circuit Malfunction - Cylinder 6		○	○
P0220	TPS 2 (Sub) for ETS Malfunction	<ul style="list-style-type: none"> <li>• Harness and connector</li> <li>• Throttle position sensor</li> <li>• Open or short in TPS circuit</li> <li>• PCM</li> </ul>	○	○
P0325	Knock Sensor 1 Circuit Malfunction	<ul style="list-style-type: none"> <li>• Open or short between knock sensor and PCM</li> <li>• Harness and connector</li> <li>• Knock sensor</li> </ul>	○	○

DTC No.	Diagnostic items	Check items (Remedy)	Memory	MIL*
P0335	Crankshaft Position Sensor Circuit Malfunction	<ul style="list-style-type: none"> <li>• Harness and connector</li> <li>• Open or short in crankshaft position sensor</li> <li>• Crankshaft position sensor</li> <li>• PCM</li> </ul>	○	○
P0340	Camshaft Position Sensor Circuit Malfunction	<ul style="list-style-type: none"> <li>• Harness and connector (If harness and connector are normal replace camshaft position sensor)</li> </ul>	○	○
P0350	Ignition Primary/Secondary Circuit Malfunction	<ul style="list-style-type: none"> <li>• Harness and connector</li> <li>• Bad connection between PCM and spark plugs</li> <li>• Bad ignition system</li> </ul>	○	○
P0500	Vehicle Speed Sensor Malfunction	<ul style="list-style-type: none"> <li>• Harness and connector</li> <li>• Vehicle speed sensor</li> </ul>	○	○
P1330	Spark Timing Adjust Signal	<ul style="list-style-type: none"> <li>• PCM malfunction</li> <li>• Harness and connector</li> </ul>	○	○

 **NOTE**

\* O : MIL(Malfunction Indication Lamp) lights up.

Inspection Item	Inspection contents		Normal condition	Inspection procedure	Reference page
Heated oxygen sensor (front)	Engine: Warm (Air/fuel mixture is made leaner when decelerating, and is made richer when racing.)	When at 4,000 r/min, engine is suddenly decelerated	200mV or less	P0130	-
		When engine is suddenly raced	600-1,000mV		
	Engine: Warm (The heated oxygen sensor signal is used to check the air/fuel mixture ratio, and control condition is also checked by the PCM.)	Engine is idling 2,500 r/min	400mV or less ⇔ 600-1,000mV (Changes)		
Mass air flow sensor *1	<ul style="list-style-type: none"> <li>• Engine coolant temperature: 80-90°C (176-203°F)</li> <li>• Lights, electric cooling fan and all accessories: OFF</li> <li>• Transaxle: Neutral (A/T: P range)</li> </ul>	Engine is idling	0-2V	-	-
		3,000 r/min	2-4V		
		Engine is idling	Voltage increases in responses to racing		

Inspection item	Inspection contents		Normal condition	Inspection procedure	Reference page
Intake air temperature sensor	Ignition switch: ON or with engine running	When intake air temperature is -20°C (-4°F)	-20°C (-4°F)	P0110	-
		When intake air temperature is 0°C (32°F)	0°C (32°F) 3.4-3.6V		
		When intake air temperature is 20°C (68°F)	20°C (68°F) 2.5-2.7V		
		When intake air temperature is 40°C (104°F)	40°C (104°F) 1.7-1.9V		
		When intake air temperature is 80°C (176°F)	80°C (176°F) 0.6-0.8V		
Throttle position sensor	Ignition switch: ON	Set to idle position	300-900mV (6-20%)	P0120	-
		Gradually open	Increases in proportion to throttle opening angle		
		Open fully	4500-5000mV (80-100%)		
Power supply voltage	Ignition switch: ON		Battery positive voltage	-	-
Cranking signal (Ignition switch-ST)	Ignition switch: ON	Engine: Stopped	OFF	-	-
		Engine: Cranking	ON		
Engine coolant temperature sensor	Ignition switch: ON or with engine running	When engine coolant temperature is -20°C (-4°F)	-20°C (-4°F)	P0115	-
		When engine coolant temperature is 0°C (32°F)	0°C (32°F) 3.4-3.6V		
		When engine coolant temperature is 20°C (68°F)	20°C (68°F) 2.5-2.7V		
		When engine coolant temperature is 40°C (104°F)	40°C (104°F) 1.5-1.7V		
		When engine coolant temperature is 80°C (176°F)	80°C (176°F) 30.5-0.7V		

Inspection item	Inspection contents		Normal condition	Inspection procedure	Reference page
Crankshaft position sensor	<ul style="list-style-type: none"> <li>Engine: Cranking</li> <li>Tachometer: Connected</li> </ul>	Compare the rpm of the tachometer with the one of the scan tool.	Identical	P0335	-
	<ul style="list-style-type: none"> <li>Engine: Idling</li> <li>Idle position switch: ON</li> </ul>	When engine coolant temperature is -20°C (-4°F)	1300-1500r/min		
		When engine coolant temperature is 0°C (32°F)	1300-1500r/min		
		When engine coolant temperature is 20°C (68°F)	1150-1350r/min		
		When engine coolant temperature is 40°C (104°F)	950-1150r/min		
		When engine coolant temperature is 80°C (176°F)	650-850r/min		
Vehicle speed sensor	Drive at 40 km/h (25 miles/h)		Approx. 40 km/h	P050	-
Idle position switch	Ignition switch: ON Check by operating accelerator pedal repeatedly	Throttle valve: Set to idle position	ON	P0510	-
		Throttle valve: Slightly open	OFF *4		
A/C switch	Engine: Idling (When A/C switch is ON, A/C compressor should be operating.)	A/C switch: OFF	OFF	-	-
		A/C switch: ON	ON		
Park/Neutral position switch <AT>	Ignition switch: ON	P or N	P or N	-	-
		D, 2, L or R	D, 2, L or R		
Injectors *2	Engine: Cranking	When engine coolant temperature is 0°C (32°F) (Injection is carried out for all cylinders simultaneously)	13.8-20.6ms	-	-
		When engine coolant temperature is 20°C (68°F)	34-51ms		
		When engine coolant temperature is 80°C (176°F)	8.8-13.2ms		

Inspection item	Inspection contents	Normal condition	Inspection procedure	Reference page
Injectors *3	<ul style="list-style-type: none"> <li>Engine coolant temperature: 80-95°C (176-203°F)</li> <li>Lights, electric cooling fan and all accessories: OFF</li> <li>Transaxle: Neutral (A/T : P range)</li> </ul>	Engine is idling	2.6-3.8ms	
		2,500 r/min	2.3-3.5ms	
		When engine is suddenly raced	Increases	
Ignition coils and ignition power transistors	<ul style="list-style-type: none"> <li>Engine: After having warmed up</li> <li>Timing light is set. (The timing light is set in order to check actual ignition timing.)</li> </ul>	Engine is idling	7-23° BTDC	-
		2,500 r/min	27-47° BTDC	
A/C compressor clutch relay	Engine: After having warmed up/Engine is idling	A/C switch: OFF	OFF (Compressor clutch is not operating)	-
		A/C switch: ON	ON (Compressor clutch is operating)	
Heated oxygen sensor (rear)	<ul style="list-style-type: none"> <li>Transaxle: 2nd gear &lt;M/T&gt; L range &lt;A/T&gt;</li> <li>Drive with wide open throttle</li> </ul>	3,500 r/min	600-1,000mV	P0136

 **NOTE**

1. In a new vehicle [driven approximately 500km (300mile) or less], the mass air flow sensor output voltage is sometimes 10% higher than the standard voltage.
2. The injector drive time represents the time when the cranking speed is at 250 r/min or below when the power supply voltage is 11V.
3. In a new vehicle [driven approximately 500km (300mile) or less], the injector drive time is sometimes 10% longer than the standard time.
4. The idle position switch normally turns off when the voltage of the throttle position sensor is 50-100mV higher than the voltage at the idle position. If the idle position switch turns back on after the throttle position sensor voltage has risen by 100mV and the throttle valve has opened, the idle position switch and the throttle position sensor need to be adjusted.

## ACTUATOR TEST REFERENCE

TABLE EFBB0260

Drive contents	Inspection item	Inspection contents		Normal condition	Inspection procedure	Reference page
Injectors	Cut fuel to No.1 injector	Engine: Warm, idle (Cut the fuel supply to each injector in turn and check cylinders which don't affect idling.)		Idle speed drops equally for each injector	Code No. P0201, P0202, P0203, P0204, P0205, P0206,	-
	Cut fuel to No.2 injector					
	Cut fuel to No.3 injector					
	Cut fuel to No.4 injector					
	Cut fuel to No.5 injector					
	Cut fuel to No.6 injector					
Fuel pump	Fuel pump operates and fuel is recirculated.	<ul style="list-style-type: none"> <li>• Engine: Cranking</li> <li>• Fuel pump: Activated</li> </ul>	Pinch the return hose with fingers to feel the pulse of the fuel being recirculated.	Pulse is felt.	-	-
		Inspect according to both the above conditions	Listen near the fuel tank for the sound of fuel pump operation.	Sound of operation is heard		
Evaporative emission purge solenoid	Solenoid valve turns from OFF to ON.	Ignition switch: ON		Clicks when solenoid valve is driven.	P0443	-
Radiator fan (Hi) Condenser fan (Hi)	Drive the fan motors (radiator and condenser).	Ignition switch: ON A/C switch: ON		Fan motor operates at high speed.	-	-
Radiator fan (Hi) Condenser fan (Low)	Drive the fan motors (radiator and condenser).	Ignition switch: ON A/C switch: ON		Fan motor operates at low speed.	-	-

**CHECK AT THE POWER-TRAIN CONTROL MODULE (PCM)** EFMB0270

- Checks don't have to be carried out in the order given in the chart.

**TERMINAL VOLTAGE CHECK CHART**

1. Connect a needle-nosed wire probe (paper clip etc.) to a voltmeter probe.
2. Insert the needle-nosed wire probe into each of the PCM connector terminals from the wire side, and measure the voltage while referring to the check chart.

**NOTE**

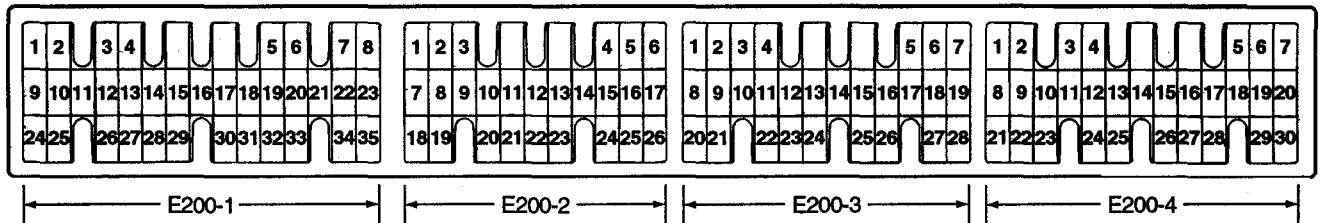
- Measure voltage with the PCM connectors connected.
- You may find it convenient to pull out the PCM to make it easier to reach the connector terminals.

**CAUTION**

**Short-circuiting the positive(+) probe between a connector terminal and ground could damage the vehicle wiring, the sensor, PCM, or all three. Use care to prevent this!**

4. If voltmeter shows any deviation from standard value, check the corresponding sensor, actuator and related electrical wiring, then repair or replace.
5. After repair or replacement, recheck with the voltmeter to confirm that the repair has corrected the problem.

**POWER-TRAIN CONTROL MODULE (PCM) CONNECTOR TERMINAL ARRANGEMENT**



EFMB027A

Terminal No.	Check item	Check condition (Engine condition)	Normal condition
E200-1 (1)	No. 1 injector	<ul style="list-style-type: none"> <li>• Engine: Warm, idle</li> <li>• Suddenly depress the accelerator pedal</li> </ul>	From 11-14V, momentarily drops slightly
E200-1 (9)	No. 2 injector		
E200-1 (24)	No. 3 injector		
E200-1 (2)	No. 4 injector		
E200-1 (10)	No. 5 injector		
E200-1 (25)	No. 6 injector		
E200-1 (6)	EGR solenoid	Ignition switch: ON	B+
		<ul style="list-style-type: none"> <li>• Engine: Idle</li> <li>• Suddenly depress the accelerator pedal.</li> </ul>	From B+, momentarily drops
E200-1 (20)	Fuel pump relay	Ignition switch: ON	B+
		Engine: Idle	0-0.5V
E200-1 (34)	Evaporative emission purge solenoid	Engine: Warm, 3000 r/min	Low: 0-1V High: B+

Terminal No.	Check item	Check condition (Engine condition)		Normal condition
E200-1 (11)	IG COIL 1/4	Engine: 3000 r/min		Low: 0-0.1V High: 0.5-3V
E200-1 (12)	IG COIL 2/5			
E200-1 (13)	IG COIL 3/6			
E200-2 (1)	Power supply	Ignition switch: ON		B+
E200-2 (7)				
E200-1 (17)	Fan motor relay (High)	Radiator fan is not operating [Engine coolant temperature is 90°C (194°F) or less]		B+
		Radiator fan is not operating at high speed [Engine coolant temperature is 105°C (221°F) or more]		0-1V
E200-1 (18)	Fan motor relay (Low)	Radiator fan is not operating [Engine coolant temperature is 90°C (194°F) or less]		B+
		Radiator fan is not operating at low speed [Engine coolant temperature is 90-105°C (194-221°F) or more]		0-1V
E200-1 (21)	A/C compressor clutch relay	<ul style="list-style-type: none"> <li>• Engine: Idle</li> <li>• A/C switch: OFF → ON (A/C compressor is operating)</li> </ul>		B+ or momentarily 6V or more → 0-3V as A/C clutch cycles
E200-2 (3)	Engine ignition detect signal	Engine: Idle		Low: 0-0.5V High: 4.5-5V
E200-1 (8)	Generator G terminal	<ul style="list-style-type: none"> <li>• Engine: Warm, idle (radiator fan: OFF)</li> <li>• Headlight: OFF → ON</li> <li>• Rear defogger switch: OFF → ON</li> <li>• Stop light: OFF → ON</li> </ul>		Low: 0-1V High: 2-3V
E200-2 (14)	Generator FR terminal	<ul style="list-style-type: none"> <li>• Engine: Warm, idle (radiator fan: OFF)</li> <li>• Headlight: OFF → ON</li> <li>• Rear defogger switch: OFF → ON</li> <li>• Stop light: OFF → ON</li> </ul>		Voltage falls by 0.2-3.5V
E200-1 (22)	Check engine/ Malfunction indicator lamp	Ignition switch: OFF → ON		0-3V → 9-13V (After several seconds have elapsed)
E200-2 (12)	Power steering pressure switch	Engine: Warm, idle	When steering wheel is stationary	B+
			When steering wheel is turned	0-3V
E200-2 (9)	MFI relay (Power supply)	Ignition switch: OFF		B+
		Ignition switch: ON		0-3V
E200-2 (22)	A/C pressure switch	Engine: Idle	Turn the A/C switch OFF	0-3V
			Turn the A/C switch ON (A/C compressor is operating)	B+
E200-2 (18)	Ignition switch-ST	Engine: Cranking		8V or more



Terminal No.	Check item	Check condition (Engine condition)		Normal condition
E200-2 (24)	Intake air temperature sensor	Ignition switch: ON	When intake air temperature is 0°C (32°F)	3.4-3.6V
			When intake air temperature is 20°C (68°F)	2.5-2.7V
			When intake air temperature is 40°C (104°F)	1.7-1.9V
			When intake air temperature is 80°C (176°F)	0.6-0.8V
E200-3 (3)	Heated oxygen sensor (Rear, Left)	<ul style="list-style-type: none"> <li>• Transaxle: 2nd &lt;M/T&gt;, L range &lt;A/T&gt;</li> <li>• Driving with the throttle widely open</li> <li>• Engine: 3500 r/min or more</li> </ul>		0.6-1.0V
E200-3 (4)	Heated oxygen sensor (Rear, Right)			
E200-3 (1)	Heated oxygen sensor (Front, Left)	Engine: Warm, 2500 r/min (Check using a digital type voltmeter)		0 ⇔ 0.8V (Change repeatedly)
E200-3 (2)	Heated oxygen sensor (Front, Right)			
E200-2 (26)	Backup power supply	Ignition switch: OFF		B+
E200-2 (4)	Engine coolant temperature sensor	Ignition switch: ON	When engine coolant temperature is 0°C (32°F)	3.4-3.6V
			When engine coolant temperature is 20°C (68°F)	2.5-2.7V
			When engine coolant temperature is 40°C (104°F)	1.5-1.7V
			When engine coolant temperature is 80°C (176°F)	0.5-0.7V
E200-3 (8)	Throttle position sensor	Ignition switch: ON (Check for smooth voltage increase as throttle is moved from idle position to wide open throttle)	Idle	0.3-0.9V
			Wide open throttle valve	4.5-5.0V
E200-3 (10)	Vehicle speed sensor	<ul style="list-style-type: none"> <li>• Ignition switch: ON</li> <li>• Move the vehicle slowly forward</li> </ul>		0 ⇔ 5V (Change repeatedly)
E200-3 (9)	Closed throttle position switch	Ignition switch: ON	Set throttle valve to idle position	0-1V
			Slightly open throttle valve	4V or more
E200-2 (16)	Camshaft position sensor	Engine: Cranking		0.4-3.0V
		Engine: Idle		0.5-2.0V

Terminal No.	Check Item	Check condition (Engine condition)		Normal condition
E200-2 (5)	Crankshaft position sensor	Engine: Cranking		0.4-4.0V
		Engine: Idle		1.5-2.5V
E200-2 (15)	Mass air flow sensor	Engine: Idle		0-2V
		Engine: 3000 r/min		2-4V
E200-4 (21)	Park/Neutral position switch <A/T>	Ignition switch: ON	Set selector lever to P or N	0-3V
			Set selector lever to D,2,L or R	8-14V
E200-1 (26)	Heated oxygen sensor heater (Rear, Left)	Engine: Warm, idle		0-3V
		Engine: 5000 r/min		B+
E200-1 (27)	Heated oxygen sensor heater (Rear, Right)	Engine: Warm, idle		0-3V
		Engine: 5000 r/min		B+
E200-1 (3)	Heated oxygen sensor heater (Front, Left)	Engine: Warm, idle		0-3V
		Engine: 5000 r/min		B+
E200-1 (4)	Heated oxygen sensor heater (Front, Right)	Engine: Warm, idle		0-3V
		Engine: 5000 r/min		B+

**TERMINAL RESISTANCE AND CONTINUITY CHECK** EFMB0280

1. Turn the ignition switch to OFF.
2. Disconnect the PCM connector.
3. Measure the resistance and check for continuity between the terminals of the PCM harness-side connector while referring to the check chart.

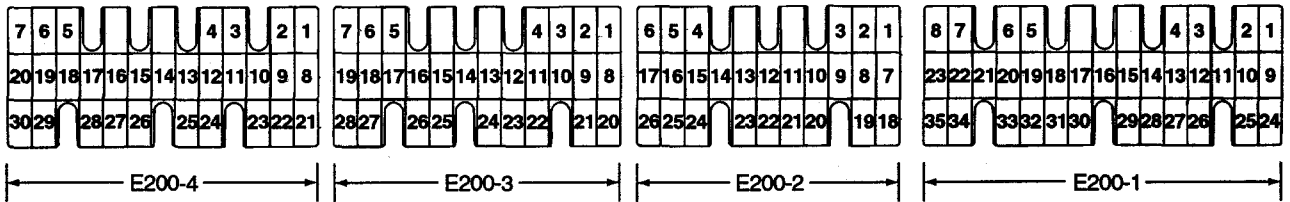
**NOTE**

- When measuring resistance and checking continuity, a harness for checking connect pin pressure should be used instead of inserting a test probe.
- Checks do not have to be carried out in the order given in this chart.

**CAUTION**

If resistance or continuity checks are performed on the wrong terminals, damage to the vehicle wiring, sensors, PCM, and/or ohmmeter may occur. Use care to prevent this!

3. If the ohmmeter shows any deviation from the normal condition, check the corresponding sensor, actuator and related electrical wiring, and then repair or replace.
4. After repair or replacement, recheck with the ohmmeter to confirm that the repair or replacement has corrected the problem.



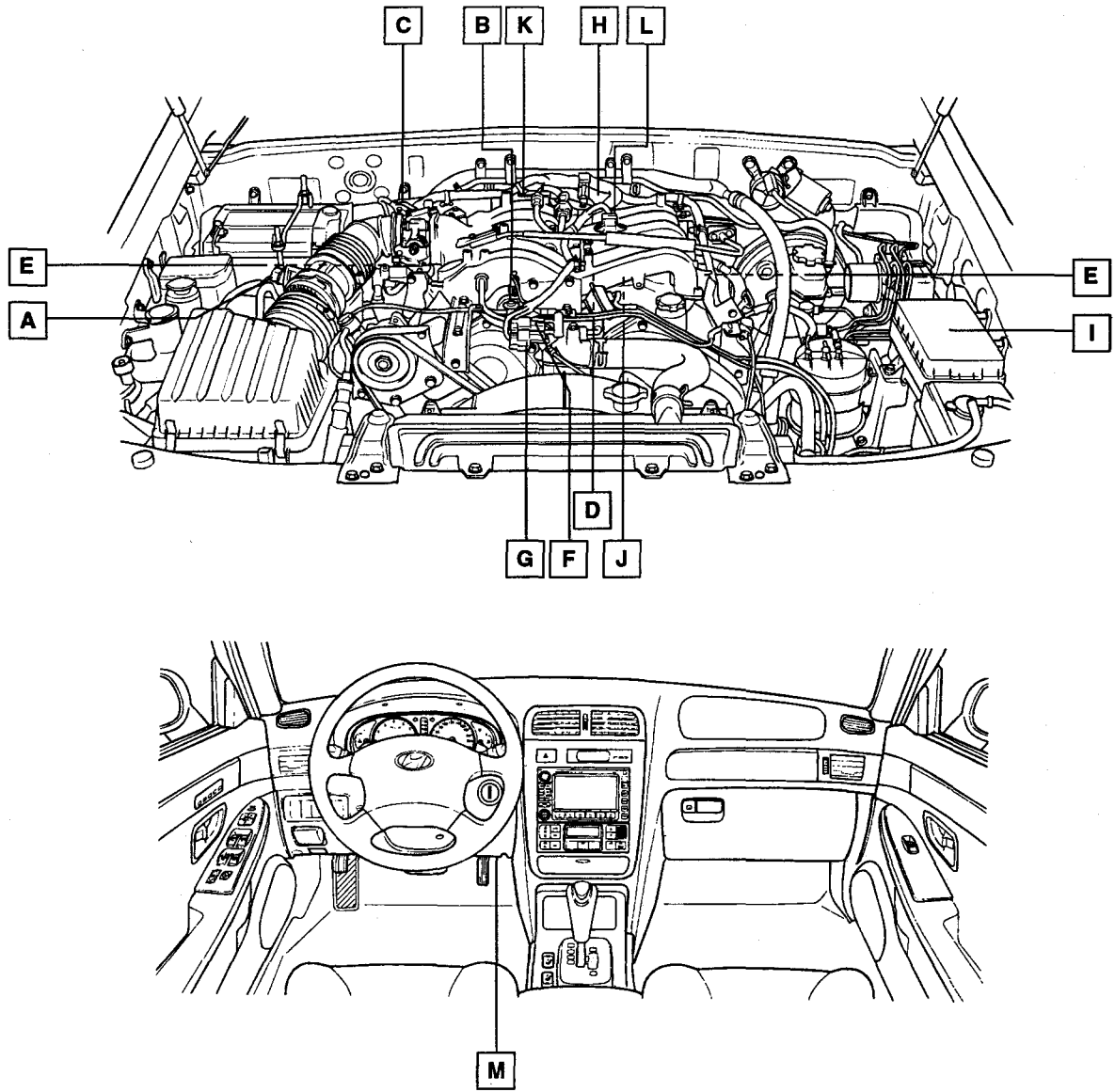
EFMB028A

Terminal No.	Inspection item	Normal condition (Check condition)
E200-1 (1) - E200-2 (1)	No.1 injector	13-16Ω [At 20°C (68°F)]
E200-1 (9) - E200-2 (1)	No.2 injector	
E200-1 (24) - E200-2 (1)	No.3 injector	
E200-1 (2) - E200-2 (1)	No.4 injector	
E200-1 (10) - E200-2 (1)	No.5 injector	
E200-1 (25) - E200-2 (1)	No.6 injector	
E200-1 (6) - E200-2 (1)	EGR solenoid	62-74Ω [At 20°C (68°F)]
E200-1 (34) - E200-2 (1)	Evaporative emission purge solenoid	24.5-27.5Ω [At 20°C (68°F)]
E200-2 (2) - Body ground	PCM ground	Continuity (0Ω)
E200-1 (3) - E200-2 (1)	Heated oxygen sensor heater (Front, Left)	7-40Ω [At 20°C (68°F)]
E200-1 (4) - E200-2 (1)	Heated oxygen sensor heater (Front, Right)	
E200-1 (26) - E200-2 (1)	Heated oxygen sensor (Rear, Left)	7-40Ω [At 20°C (68°F)]
E200-1 (27) - E200-2 (1)	Heated oxygen sensor (Rear, Right)	

Terminal No.	Inspection item	Normal condition (Check condition)
E200-2 (24) - E200-2 (17)	Intake air temperature sensor	5.3-6.7Ω [When intake air temperature is 0°C (32°F)]
		2.3-3.0Ω [When intake air temperature is 20°C (68°F)]
		1.0-1.5Ω [When intake air temperature is 40°C (104°F)]
		0.30-0.42Ω [When intake air temperature is 80°C (176°F)]
E200-2 (4) - E200-2 (17)	Engine coolant temperature sensor	5.1-6.5Ω [When coolant temperature is 0°C (32°F)]
		2.1-2.7Ω [When coolant temperature is 20°C (68°F)]
		0.9-1.3Ω [When coolant temperature is 40°C (104°F)]
		0.26-0.36Ω [When coolant temperature is 80°C (176°F)]
E200-3 (9) - E200-2 (17)	Closed throttle position switch	Continuity (When throttle valve is at idle position)
		No continuity (When throttle valve is slightly open)
E200-4 (21) - Body ground	Park/Neutral position switch <A/T>	Continuity (When select lever is at P or N)
		No continuity (When select lever is at D,2,L or R)

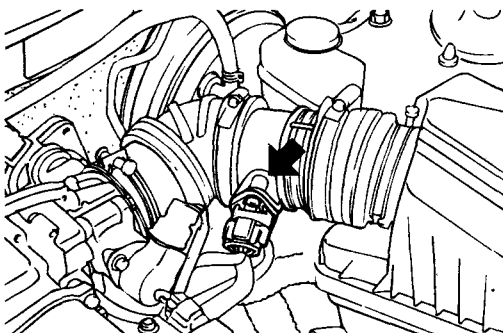
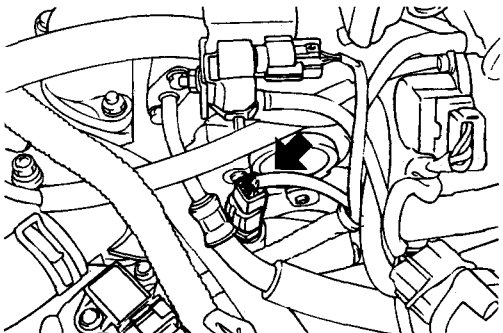
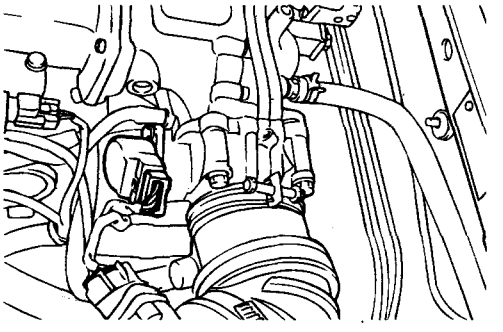
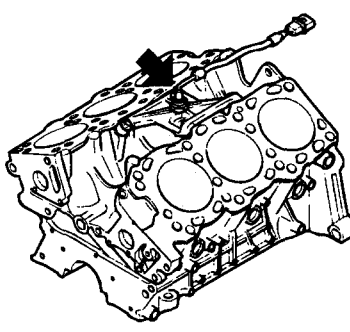
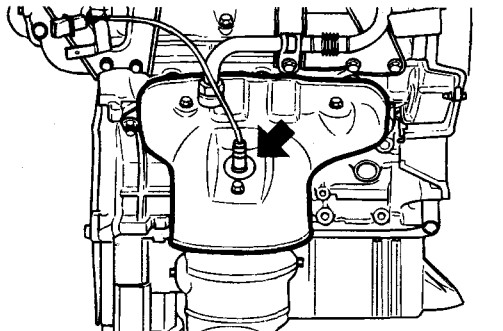
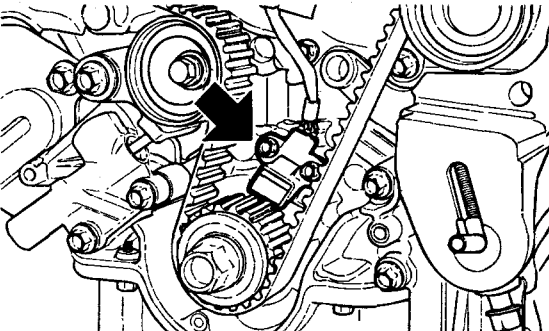
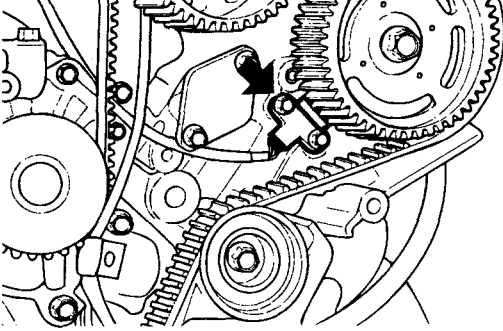
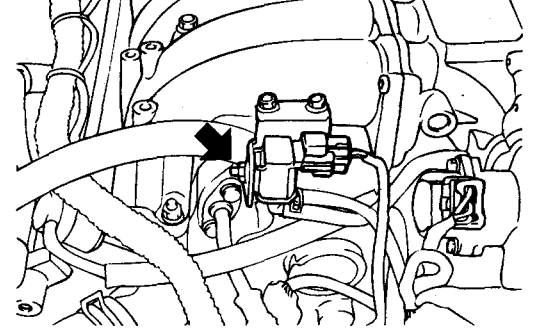
COMPONENT INSPECTION EFMB0290

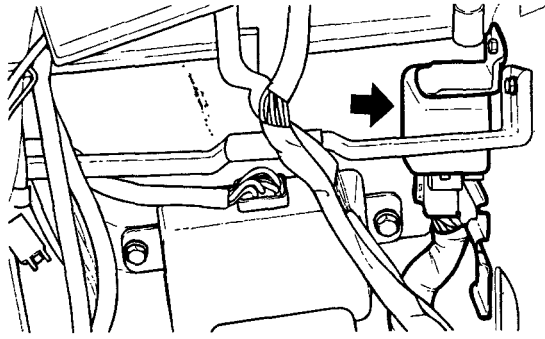
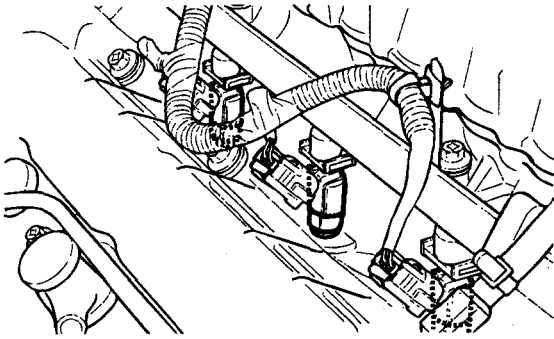
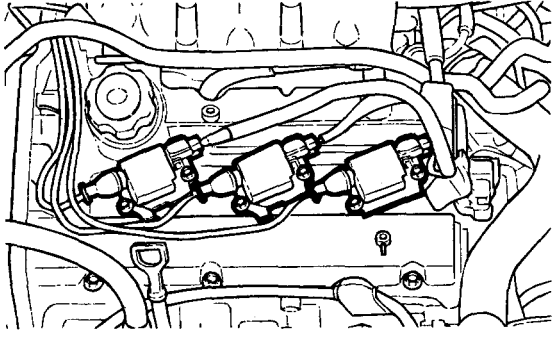
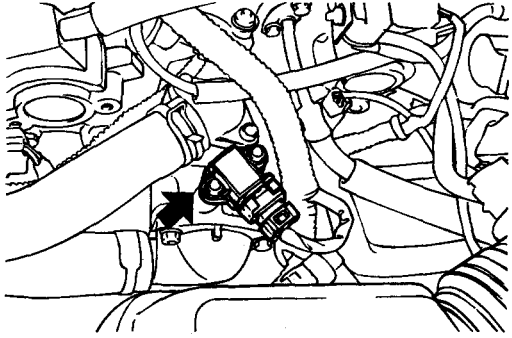
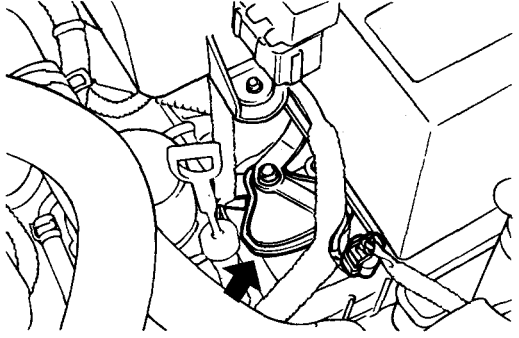
LOCATION OF MFI COMPONENTS



- A** AFS & IAT-sensor
- B** Engine coolant temperature sensor
- C** TPS (including idle switch)
- D** Knock sensor
- E** O2 sensor
- F** Crankshaft position sensor
- G** Camshaft position sensor

- H** PCSV
- I** Control relay
- J** Injector
- K** Ignition coil
- L** Ignition failure sensor
- M** DLC connector

<p>A</p> <p>AFS &amp; IAT-sensor</p>  <p>EFB9009A</p>	<p>B</p> <p>Engine Coolant temp. sensor</p>  <p>EFB9010A</p>
<p>C</p> <p>TPS (Including idle switch) &amp; ETS</p>  <p>EFMB005A</p>	<p>D</p> <p>Knock sensor</p>  <p>KFW5014A</p>
<p>E</p> <p>O2 sensor</p>  <p>KFW3244A</p>	<p>F</p> <p>Crankshaft Position Sensor</p>  <p>KFW5202A</p>
<p>G</p> <p>Camshaft Position Sensor</p>  <p>KFW5203A</p>	<p>H</p> <p>PCSV</p>  <p>EFB9007A</p>

I	Control relay	 <p>A technical line drawing showing the engine compartment. A black arrow points to a rectangular control relay mounted on a bracket. The relay is connected to various wires. The engine block and other components are visible in the background.</p>	J	Injector	 <p>A technical line drawing showing the fuel injection system. It depicts several injectors mounted on a rail, with fuel lines and electrical wiring connected to them. The engine block is visible in the background.</p>
K	Ignition coil	 <p>A technical line drawing showing the ignition system. It features two ignition coils mounted on a distributor. Wires connect the coils to the spark plugs. The engine block and other components are visible in the background.</p>	L	Igniting failure sensor	 <p>A technical line drawing showing the igniting failure sensor. The sensor is mounted on the engine block. A black arrow points to the sensor. The engine block and other components are visible in the background.</p>
M	Inhibitor switch	 <p>A technical line drawing showing the inhibitor switch. The switch is mounted on the engine block. A black arrow points to the switch. The engine block and other components are visible in the background.</p>			

KFW5221A

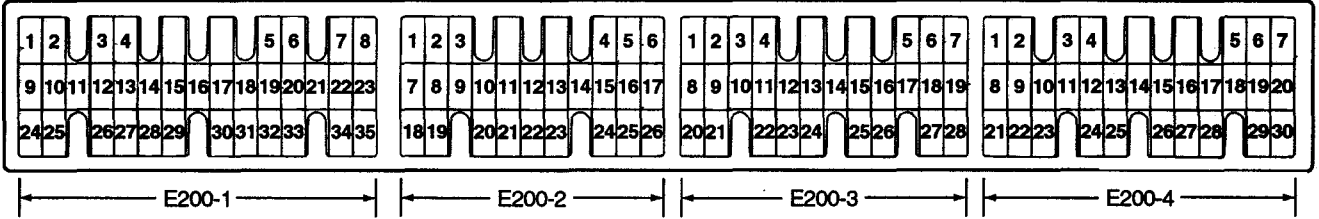
KFW5018A

KFW5222A

EFB9006A

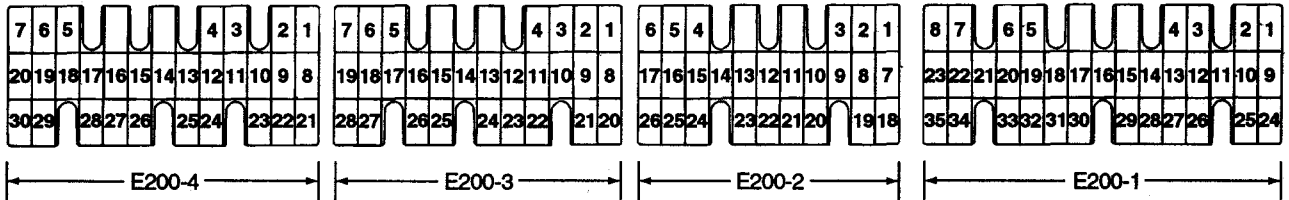
EFB9008A

PCM CONFIGURATION



EFMB029C

PCM HARNESS CONFIGURATION



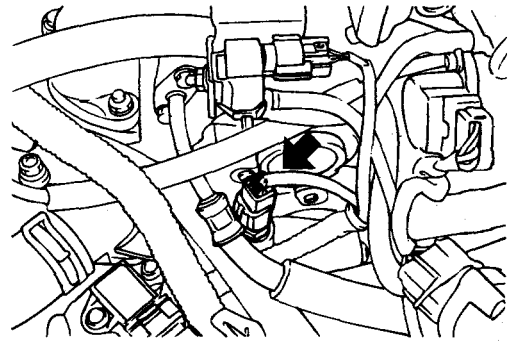
EFMB029D



**ENGINE COOLANT TEMPERATURE (ECT)**

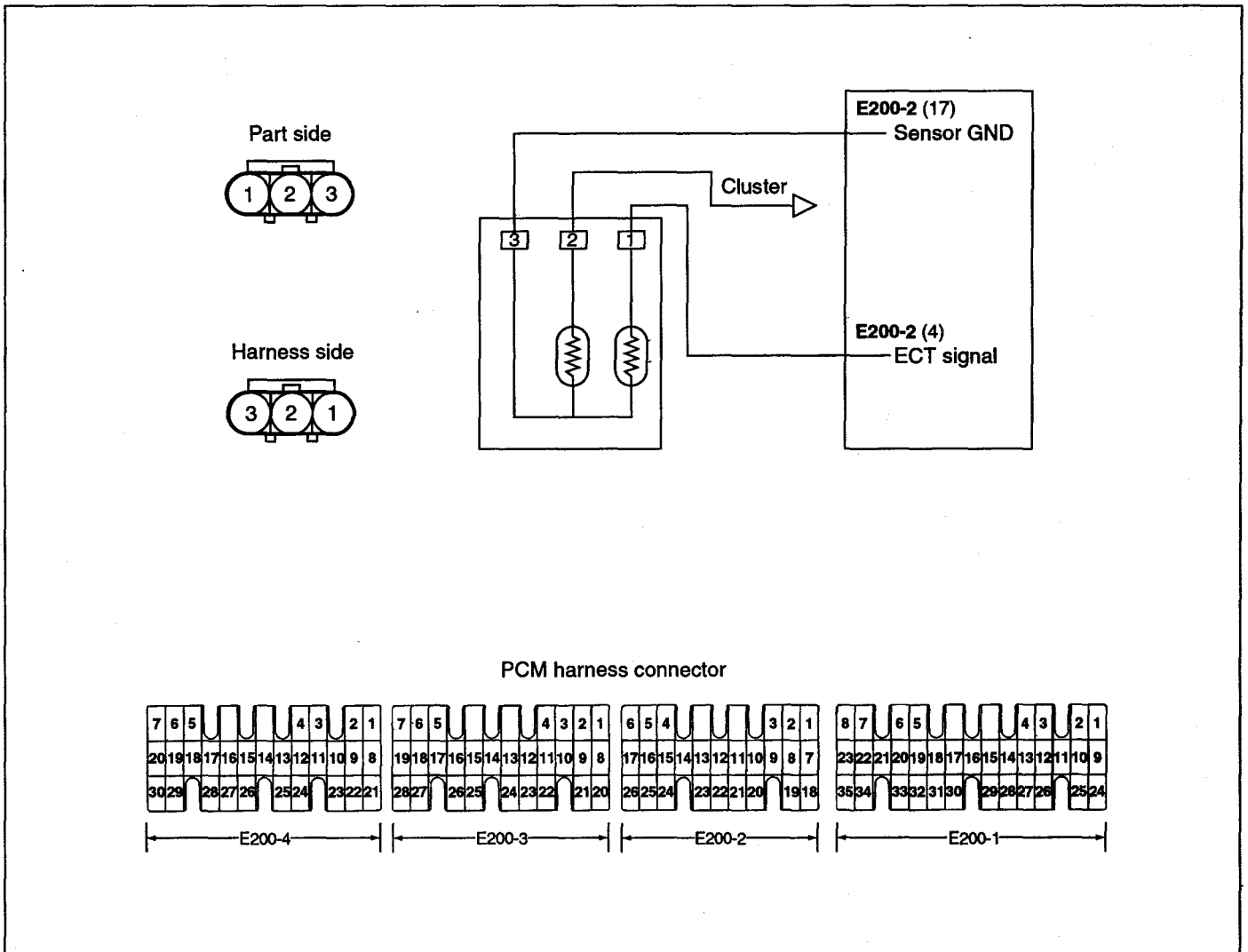
**SENSOR** EFMB1010

The engine coolant temperature sensor installed in the engine coolant passage of the cylinder head detects the engine coolant temperature and emits signals to the PCM. This part employs a thermistor which is sensitive to changes in temperature. The electric resistance of the thermistor decreases in response to a temperature rise (NTC). The PCM determines engine coolant temperature by the sensor output voltage and provides optimum fuel enrichment when the engine is cold.



EFB9010A

**CIRCUIT DIAGRAM**



EFMB101A

**SENSOR CHECKING**

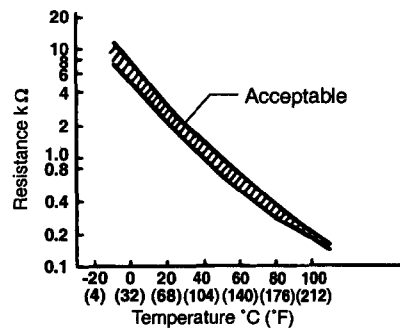
**USING HI-SCAN (PRO)**

Check item	Data display	Check conditions	Intake air temperature	Test specification
Engine coolant temperature sensor	Sensor temperature	Ignition switch : ON or engine running	When -20°C (-4°F)	-20°C
			When 0°C (32°F)	0°C
			When 20°C (68°F)	20°C
			When 40°C (104°F)	40°C
			When 80°C (176°F)	80°C

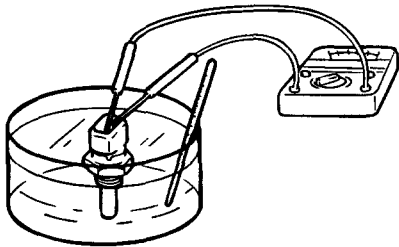
**USING MULTI-METER**

1. Remove the engine coolant temperature sensor from the intake manifold.
2. With the temperature sensing portion of the engine coolant temperature sensor immersed in hot engine coolant, check the resistance.

Temperature [°C (°F)]	Resistance (kΩ)
0 (32)	5.9
20 (68)	2.5
40 (104)	1.1
80 (176)	0.3



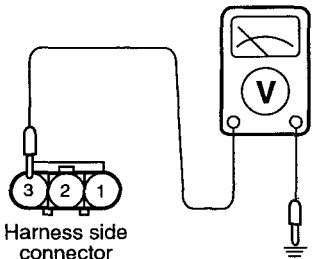
EFJB703D



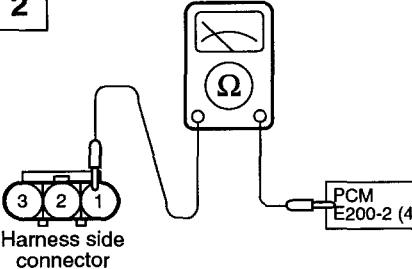
EFA9028A

3. If the resistance deviates from the standard value greatly, replace the sensor.

HARNESS INSPECTION PROCEDURES

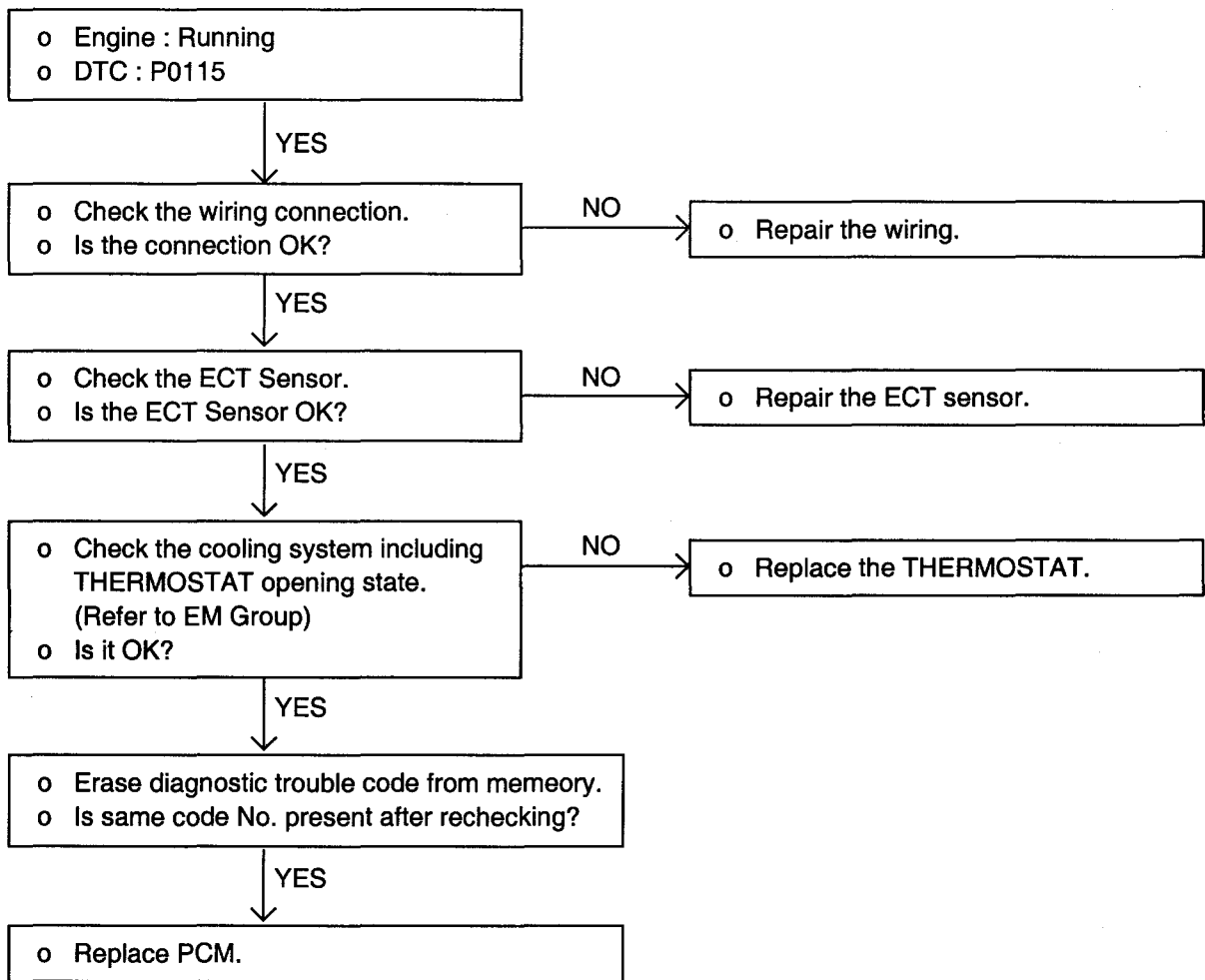
<p><b>1</b></p>  <p>Harness side connector</p>	<p>Check for continuity of the ground circuit.</p> <ul style="list-style-type: none"> <li>o Connector: Disconnected</li> </ul>	<p><b>OK</b> → <b>2</b></p> <p><b>NG</b> → Repair the harness.</p>
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EFMB101B

<p><b>2</b></p>  <p>Harness side connector</p> <p>PCM E200-2 (4)</p>	<p>Measure the power supply voltage.</p> <ul style="list-style-type: none"> <li>o Connector: Disconnected</li> <li>o Ignition switch: ON</li> <li>o Voltage (V): 4.5-4.9V</li> </ul>	<p><b>OK</b> → <b>END !</b></p> <p><b>NG</b> → Repair the harness.</p>
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EFMB101C

TROUBLESHOOTING PROCEDURES



DTC : Diagnosis Trouble Code  
 PCM : Powertrain Control Module  
 ECT : Engine coolant Temperature

## USING VOLTMETER

Check item	Coolant temperature	Test specification
Engine coolant temperature sensor output voltage	When 0°C	4.05V
	When 20°C	3.44V
	When 40°C	2.72V
	When 80°C	1.25V

## TROUBLESHOOTING HINTS

If the fast idle speed is not adequate or the engine gives off dark smoke during warm-up, the engine coolant temperature sensor might be the cause.

## INSTALLATION

1. Apply sealant LOCTITE 962T or the equivalent to the threaded portion.
2. Install the engine coolant temperature sensor and tighten it to the specified torque.

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**Tightening torque**

Engine coolant temperature sensor :

20-40 Nm (200-400 kg·cm, 14-29 lb·ft)

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3. Securely connect the harness connector.

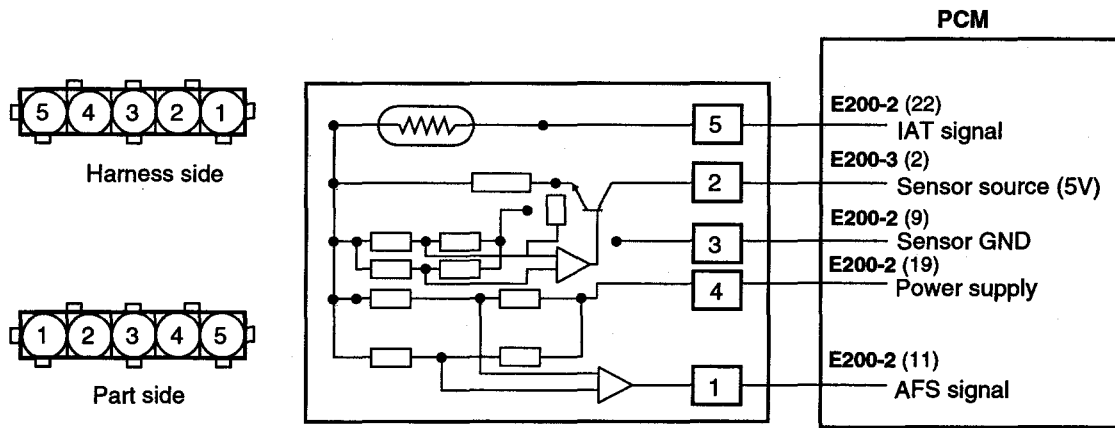
**MASS AIR FLOW(MAF) SENSOR & INTAKE AIR TEMP.(IAT) SENSOR** EFMB1030

This hot film type air flow sensor is composed of a hot film sensor, housing and metering duct (hybrid sensor element). Mass air flow rate is measured because the change of the mass air flow rate causes a change in the amount of heat being transferred from the hot film probe surface

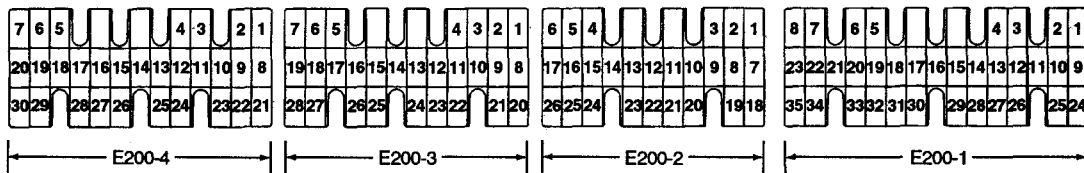
to the air flow. The air flow sensor generates a pulse so it repeatedly opens and closes between the 5V voltage supplied from the powertrain control module.

The intake air temperature sensor (IAT Sensor), located in the intake air hose, is a resistor-based sensor for detecting the intake air temperature. The intake air temperature information from the sensor helps the PCM provide the necessary fuel injection.

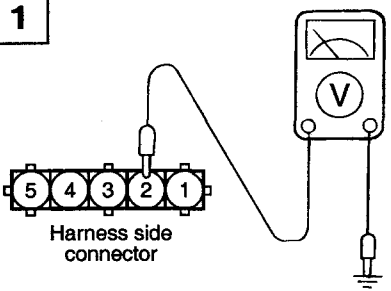
**CIRCUIT DIAGRAM**



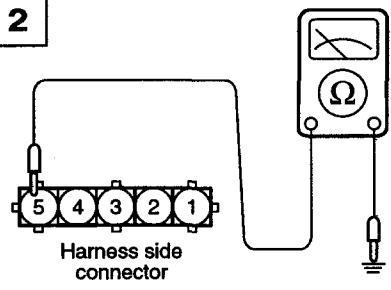
PCM harness connector



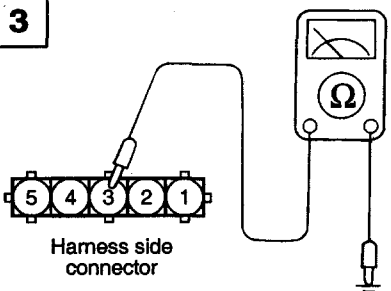
HARNESS INSPECTION PROCEDURES

<div style="border: 1px solid black; padding: 2px; width: 30px; margin: 0 auto;">1</div>  <p style="text-align: center;">Harness side connector</p>	<p>Measure the power supply voltage for the IAT sensor.</p> <ul style="list-style-type: none"> <li>o Connector: Disconnected.</li> <li>o Ignition switch : ON.</li> <li>o Voltage (V) : 4.8-5.2 V.</li> </ul>	<p><b>OK</b> → <div style="border: 1px solid black; padding: 2px; width: 30px; margin: 0 auto;">2</div></p> <p><b>NG</b> → Repair the harness.</p>
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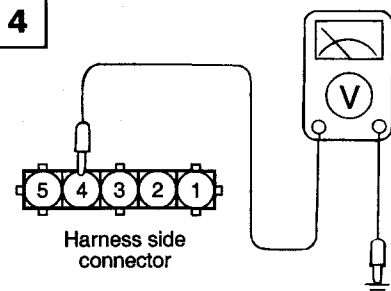
EFJB705B

<div style="border: 1px solid black; padding: 2px; width: 30px; margin: 0 auto;">2</div>  <p style="text-align: center;">Harness side connector</p>	<p>Check for an open circuit, or a short circuit to ground between the powertrain control module and the IAT sensor.</p> <ul style="list-style-type: none"> <li>o Connector : Disconnected</li> <li>o PCM connector : Disconnected</li> </ul>	<p><b>OK</b> → <div style="border: 1px solid black; padding: 2px; width: 30px; margin: 0 auto;">3</div></p> <p><b>NG</b> → Repair the harness.</p>
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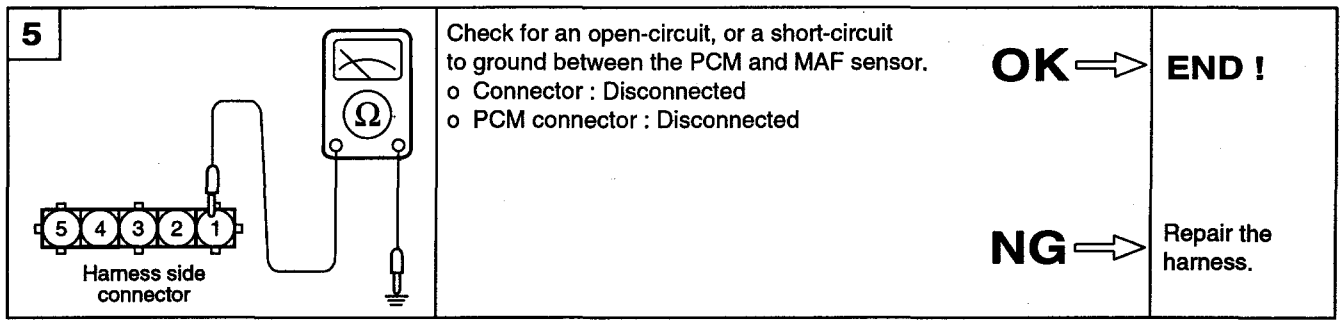
EFMB705C

<div style="border: 1px solid black; padding: 2px; width: 30px; margin: 0 auto;">3</div>  <p style="text-align: center;">Harness side connector</p>	<p>Check for continuity of the ground circuit.</p> <ul style="list-style-type: none"> <li>o Connector : Disconnected.</li> </ul>	<p><b>OK</b> → <div style="border: 1px solid black; padding: 2px; width: 30px; margin: 0 auto;">4</div></p> <p><b>NG</b> → Repair the harness.</p>
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EFJB705D

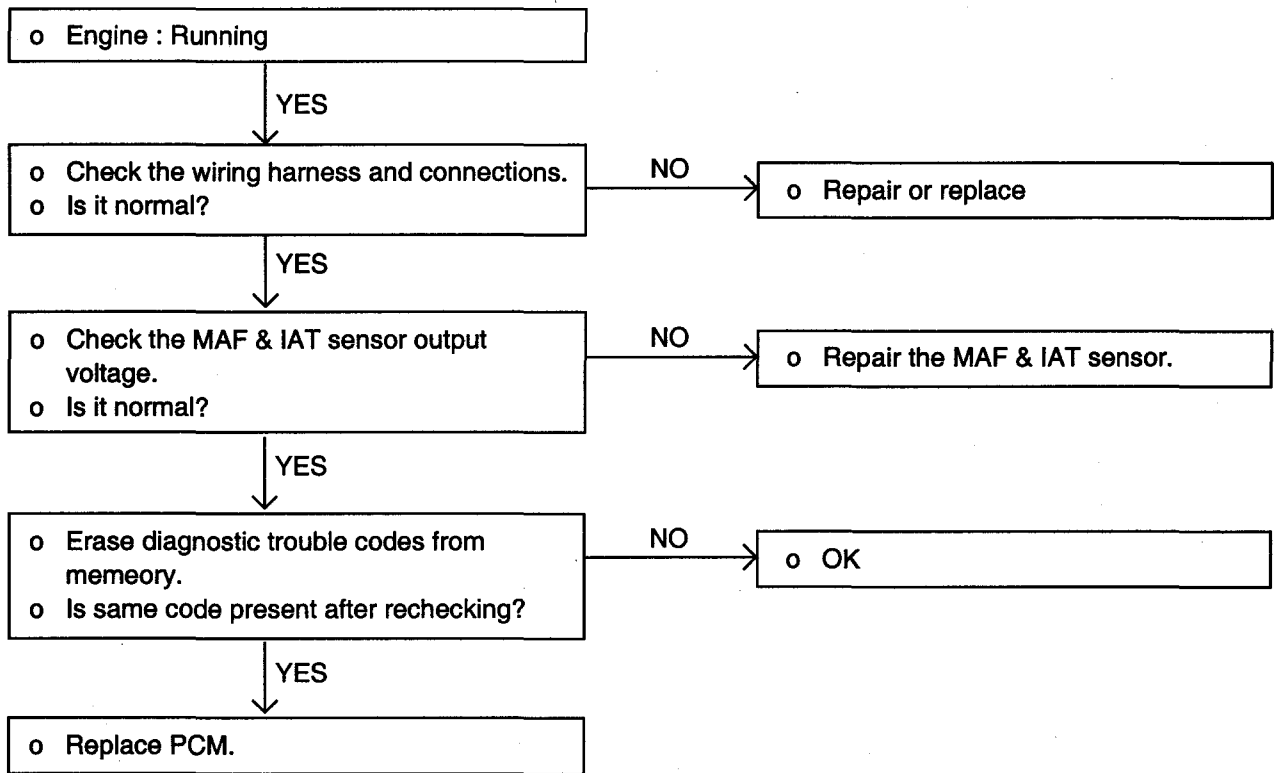
<div style="border: 1px solid black; padding: 2px; width: 30px; margin: 0 auto;">4</div>  <p style="text-align: center;">Harness side connector</p>	<p>Check the power supply(Bat) voltage for MAF sensor.</p> <ul style="list-style-type: none"> <li>o Connector : Disconnected</li> <li>o PCM connector : Connected</li> <li>o Voltage : Battery voltage</li> </ul>	<p><b>OK</b> → <div style="border: 1px solid black; padding: 2px; width: 30px; margin: 0 auto;">5</div></p> <p><b>NG</b> → Repair the harness.</p>
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EFJB705E



EFMB705F

**TROUBLESHOOTING PROCEDURES**



DTC : Diagnosis Trouble Code  
 PCM : Powertrain Control Module

EFJB705G



## TROUBLESHOOTING HINTS

1. If the engine stalls occasionally, start the engine and shake the MAF sensor harness. If the engine stalls, check for poor contact at the MAF sensor connector.
2. If the MAF sensor output voltage is other than 0 when the ignition switch is turned on (do not start the engine), check for a faulty MAF sensor or PCM.
3. If the engine can idle even if the MAF sensor output voltage is out of specification, check for the following conditions;
  - Disturbed air flow in the MAF sensor, disconnected air duct, and clogged air cleaner filter.
  - Poor combustion in the cylinder, faulty ignition plug, ignition coil, injector, and incorrect comparison.
4. Even if no AFS malfunction occurs, check the mounting direction of the AFS.

Check item	Check condition	Test specification
Mass air flow sensor output voltage	Idle rpm	0.5V
	2000 rpm	1.0V

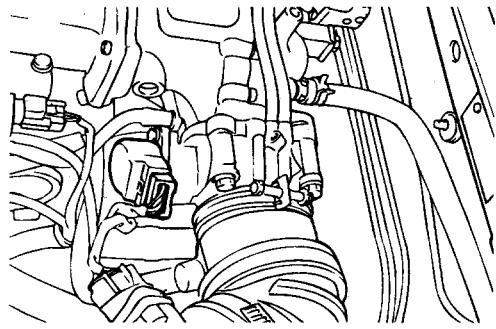
 **NOTE**

- *When the vehicle is new [within initial operation of about 500 km (300 miles)], the mass air flow sensor air quantity will be about 10% higher.*
- *Use an accurate digital voltmeter.*
- *Before checking, warm up the engine until the engine coolant temperature reaches 80 to 90°C (176 to 198°F).*

### THROTTLE POSITION SENSOR

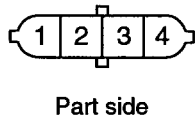
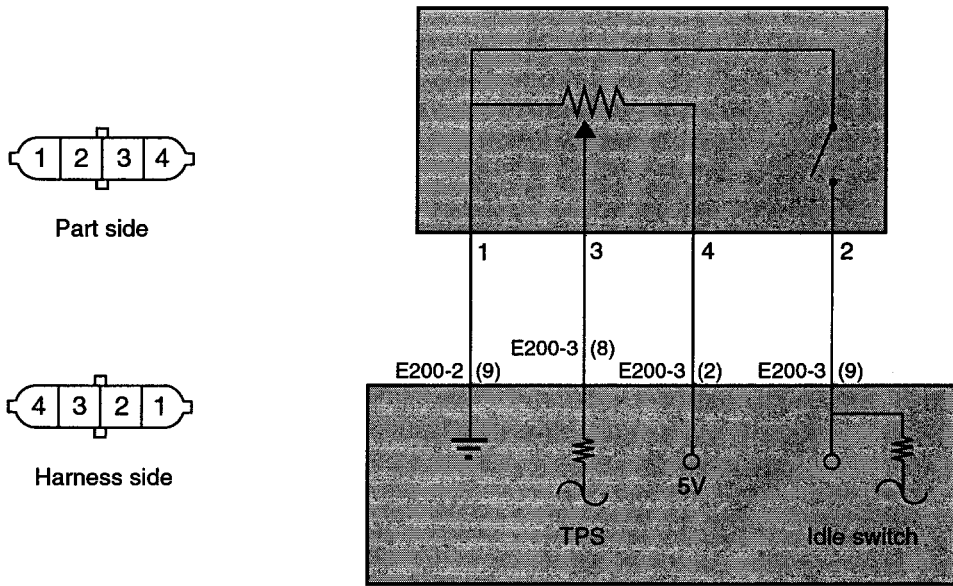
(TPS) EFMB1050

The TPS is a variable resistor type that rotates with the throttle shaft to sense the throttle valve angle. As the throttle shaft rotates, the output voltage of the TPS changes. The PCM detects the throttle valve opening based on this voltage change.

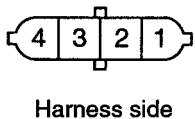


EFMB005A

### CIRCUIT DIAGRAM

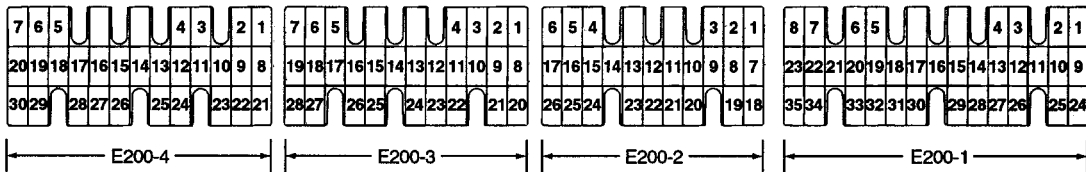


Part side



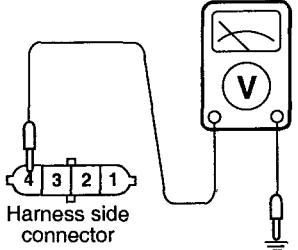
Harness side

PCM harness connector

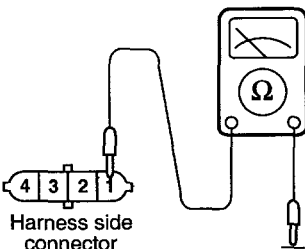


EFMB105A

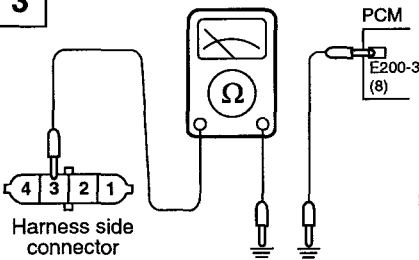
HARNESS INSPECTION PROCEDURES

<b>1</b>	 <p>Harness side connector</p>	<p>Measure the power supply voltage of the throttle position sensor.</p> <ul style="list-style-type: none"> <li>o Connector : Disconnected</li> <li>o Ignition switch : ON</li> <li>o Voltage (V) : 4.25 - 4.7</li> </ul>	<p><b>OK</b> → <b>2</b></p> <p><b>NG</b> → Repair the harness.</p>
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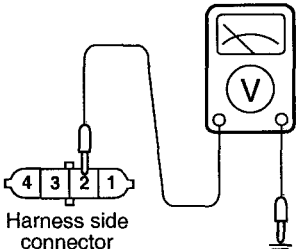
EFBB105B

<b>2</b>	 <p>Harness side connector</p>	<p>Check for continuity of the ground circuit.</p> <ul style="list-style-type: none"> <li>o Connector : Disconnected</li> </ul>	<p><b>OK</b> → <b>3</b></p> <p><b>NG</b> → Repair the harness.</p>
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EFBB105C

<b>3</b>	 <p>Harness side connector</p> <p>PCM E200-3 (8)</p>	<p>Check for an open-circuit, or a short-circuit to ground between the powertrain control module and the throttle position sensor.</p> <ul style="list-style-type: none"> <li>o Throttle position sensor connector : Disconnected</li> <li>o Powertrain Control Module connector : Disconnected</li> </ul>	<p><b>OK</b> → <b>4</b></p> <p><b>NG</b> → Repair the harness.</p>
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EFMB105D

<b>4</b>	 <p>Harness side connector</p>	<p>Measure the power supply voltage of the TPS.</p> <ul style="list-style-type: none"> <li>o Connector: Disconnected</li> <li>o Ignition switch: ON</li> <li>o Voltage (V): 4V or more</li> </ul>	<p><b>OK</b> → <b>END !</b></p> <p><b>NG</b> → Repair the harness.</p>
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EFBB105E

TROUBLESHOOTING HINTS

The TPS signal is important in the control of the automatic transaxle. Shift shock and other trouble will occur if the sensor is faulty.

**SENSOR CHECKING**

**USING HI-SCAN (PRO)**

Check item	Data display	Check conditions	Throttle valve	Test specification
Crankshaft position sensor	Sensor voltage	Ignition switch : ON	At idle position	300-900 mV
			Open slowly	Increases with valve opening
			Open wide	4,250-4,700 mV

**Using voltmeter**

1. Disconnect the throttle position sensor connector.
2. Measure resistance between terminal 1 (sensor ground) and terminal 4 (sensor power).

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Standard value : 3.5 - 6.5 kΩ

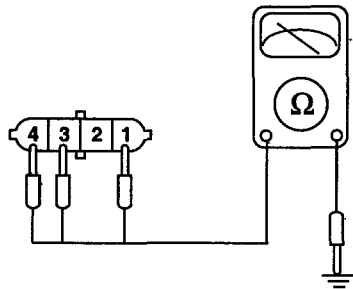
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3. Connect a pointer type ohmmeter between terminal 1 (sensor ground) and terminal 3 (sensor output).
4. Operate the throttle valve slowly from the idle position to the full open position and check that the resistance changes smoothly in proportion with the throttle valve opening angle.
5. If the resistance is out of specification, or fails to change smoothly, replace the throttle position sensor.

**Tightening torque**

TP Sensor : 1.5-2.5 Nm (15-25 kg·cm, 1.1-1.8 lb·ft)

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## SENSOR CHECKING (IDLE SWITCH)

## USING HI-SCAN (PRO)

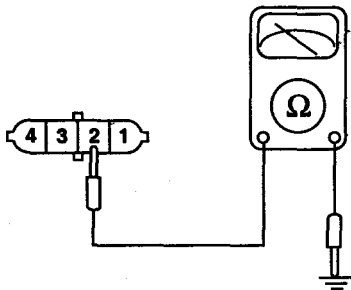
Check item	Data display	Check conditions	Throttle valve	Normal indication
Idle position switch • Service data item	Switch state	Ignition switch : ON (check by operating accelerator pedal repeatedly)	At idle position	ON
			Open a little	OFF

## Using voltmeter

1. Disconnect the throttle position sensor connector.
2. Check the continuity between terminal 3 and sensor ground.

TPS voltage	Continuity
Higher than 300-900mV	Non-conductive ( $\infty\Omega$ )
300-900mV	Conductive ( $0\Omega$ )

3. If out of specification, replace the throttle position sensor.



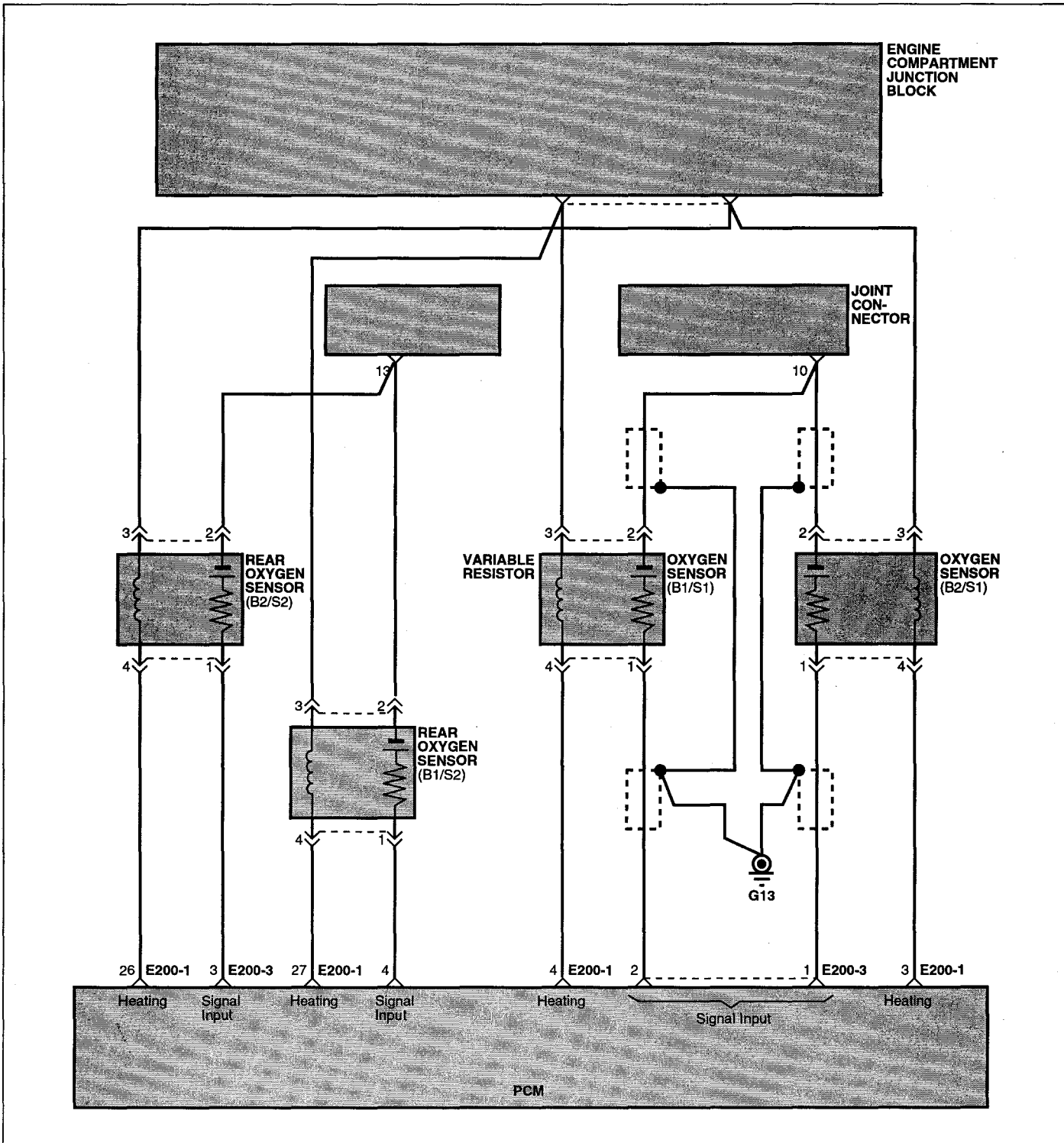
EFBB105G

**HEATED OXYGEN SENSOR (HO2S)** EFM B1090

The heated oxygen sensor senses the oxygen concentration in exhaust gas and converts it into a voltage which is sent to the PCM. For Zirconium type sensors, the oxygen sensor outputs about 1V when the air fuel ratio is richer

than the theoretical ratio, and outputs about 0V when the ratio is leaner (higher oxygen concentration in exhaust gas.). The PCM controls the fuel injection ratio based on this signal so that the air fuel ratio is maintained at the stoichiometric ratio. The oxygen sensor has a heating element which ensures sensor performance during all driving conditions.

**CIRCUIT DIAGRAM**



1. If the HO2S is defective, abnormally high emissions may occur.
2. If the HO2S check results are normal, but the sensor output voltage is out of specification, check for the following items (related to air fuel ratio control system):
  - Defective injector
  - Air leaks in the intake manifold
  - Defective volume air flow sensor, intake air temperature sensor, barometric pressure sensor and engine coolant temperature sensor.

Check item	Check conditions	Engine state	Test specification (I4)
Oxygen sensor	Engine: Warm-up (make the mixture lean by engine speed reduction, and rich by racing)	When sudden deceleration from 4,000 rpm	200mV or lower
		When engine is suddenly raced	600-1,000 mV
	Engine: Warm-up (using the heated oxygen sensor signal, check the air/fuel mixture ratio, and also check the condition of control by the PCM)	Idle	400 mV or lower - (oscilate)
		2,000 rpm	600-1,000 mV

**INSPECTION**

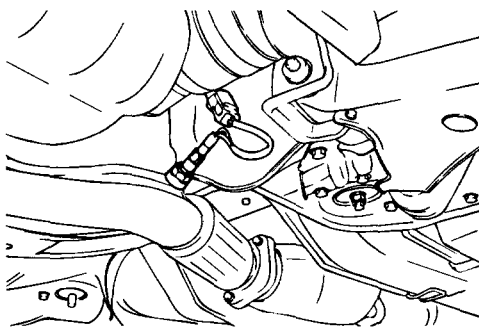
**NOTE**

- Before checking, warm up the engine until the engine coolant temperature reaches 80 to 95°C (176 to 205°F).
- Use an accurate digital voltmeter.

1. Disconnect the oxygen sensor connector, and measure the resistance between terminal 3 and terminal 4.

**Standard value**

Temperature °C (°F)	Resistance (Ω)
400 (752)	30 or more



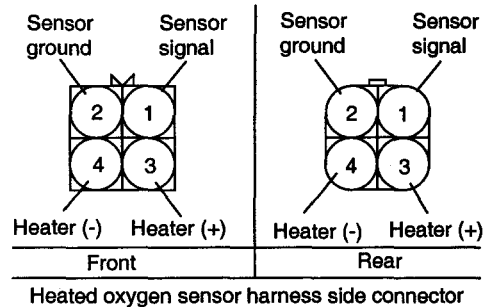
EFAA719E

2. Replace the oxygen sensor if there is a malfunction.
3. Apply battery voltage directly between terminal 3 and terminal 4.

**NOTE**

Be careful when applying the voltage. Damage will result if terminals 1 and 2 are connected to any voltage.

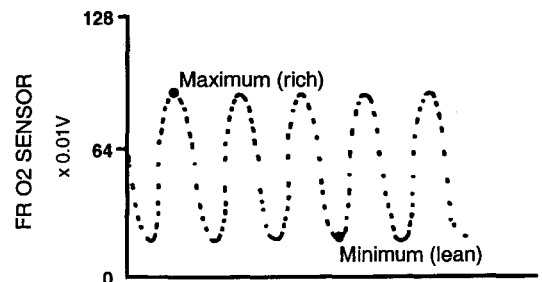
4. Connect a high-impedance digital-type voltmeter between terminal 1 and terminal 2.



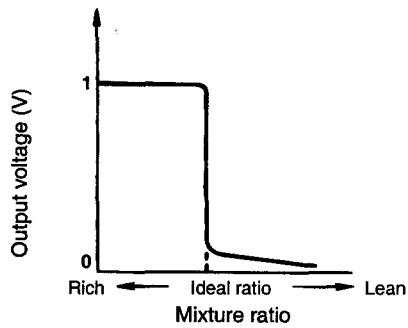
EFAA719F

5. While repeatedly racing the engine, measure the oxygen sensor output voltage.

Engine	Oxygen sensor output voltage	Resistance (Ω)
Race	Min. 0.6V	30 or more



EFJB719H

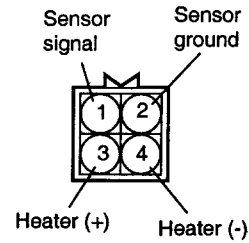


EFJB719I

**Tightening torque**

Heated oxygen sensor :

40-50 Nm (400-500 kg·cm, 29-36 lb·ft)



Heated oxygen sensor side connector (FRONT, REAR)

6. If there is a problem, there may be an oxygen sensor malfunction.

EFAA719G

**HARNES INSPECTION PROCEDURES**

<b>1</b>	<p>Harness side connector</p>	<p>Measure the power supply voltage of the heated oxygen sensor.</p> <ul style="list-style-type: none"> <li>o Connector: Disconnected</li> <li>o Ignition switch: ON</li> <li>o Voltage (V): Battery voltage</li> </ul>	<p><b>OK</b> → <b>2</b></p> <p><b>NG</b> → Repair the harness.</p>
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EFHA719B

<b>2</b>	<p>Harness side connector</p>	<p>Check for open circuit, or a short circuit to ground between the PCM and the oxygen sensor.</p> <ul style="list-style-type: none"> <li>o Oxygen sensor connector : Disconnected</li> <li>o PCM connector : Disconnected</li> </ul>	<p><b>OK</b> → <b>3</b></p> <p><b>NG</b> → Repair the harness.</p>
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EFHA719C

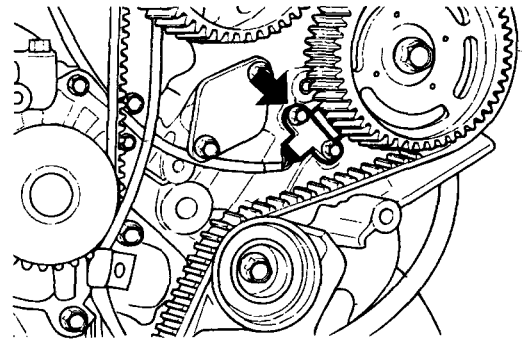
<b>3</b>	<p>Harness side connector</p>	<p>Check for continuity of the ground circuit.</p> <ul style="list-style-type: none"> <li>o Connector : Disconnected</li> </ul>	<p><b>OK</b> → <b>END !</b></p> <p><b>NG</b> → Repair the harness.</p>
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EFHA719D



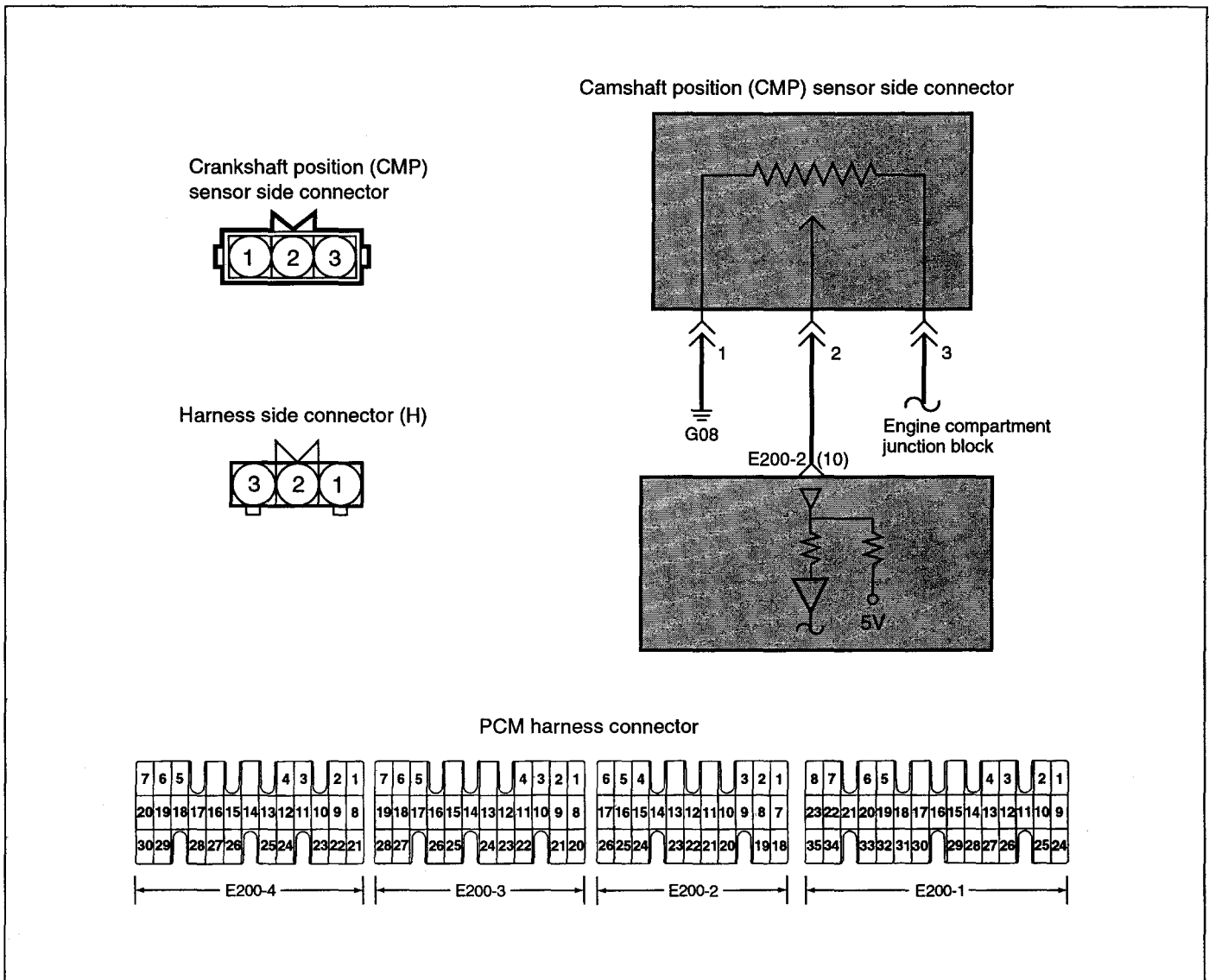
**CAMSHAFT POSITION SENSOR** EFMB1110

The CMP is a Hall-effect sensor that detects the camshaft position on the compression stroke of the No.1 cylinders, converts it into a pulse signal, and inputs it to the PCM. The PCM then computes the fuel injection sequence, etc. based on the input signal.



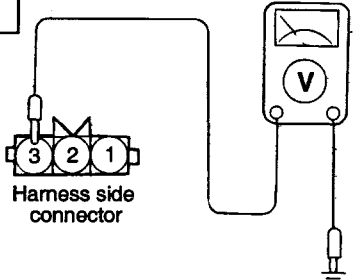
KFW5203A

**CIRCUIT DIAGRAM**

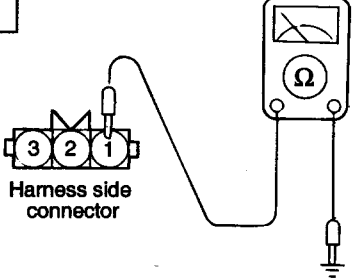


EFMB111A

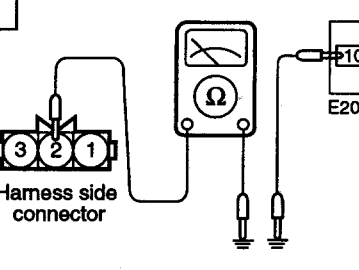
**HARNESS INSPECTION PROCEDURES**

<p><b>1</b></p>  <p>Harness side connector</p>	<p>Measure the power supply voltage.</p> <ul style="list-style-type: none"> <li>o Connector: Disconnected</li> <li>o Ignition switch: ON</li> <li>o Voltage (V): Battery voltage</li> </ul>	<p><b>OK</b> → <b>2</b></p> <p><b>NG</b> → Repair the harness.</p>
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EFHA723B

<p><b>2</b></p>  <p>Harness side connector</p>	<p>Check for continuity of the ground circuit.</p> <ul style="list-style-type: none"> <li>o Connector : Disconnected</li> </ul>	<p><b>OK</b> → <b>3</b></p> <p><b>NG</b> → Repair the harness.</p>
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EFHA723C

<p><b>3</b></p>  <p>Harness side connector</p>	<p>Check the signal voltage.</p> <ul style="list-style-type: none"> <li>o Connector: Disconnected</li> <li>o Ignition switch : ON</li> <li>o Voltage : 4.8-5.2 V</li> </ul>	<p><b>OK</b> → <b>END !</b></p> <p><b>NG</b> → Repair the harness.</p>
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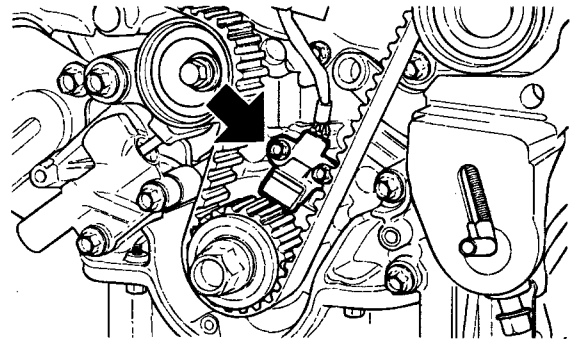
EFMB111D

**TROUBLESHOOTING HINTS**

If the CMP Sensor does not operate correctly, sequential injection is may not occur and the engine may stall or run irregularly at idle or fail to accelerate normally.

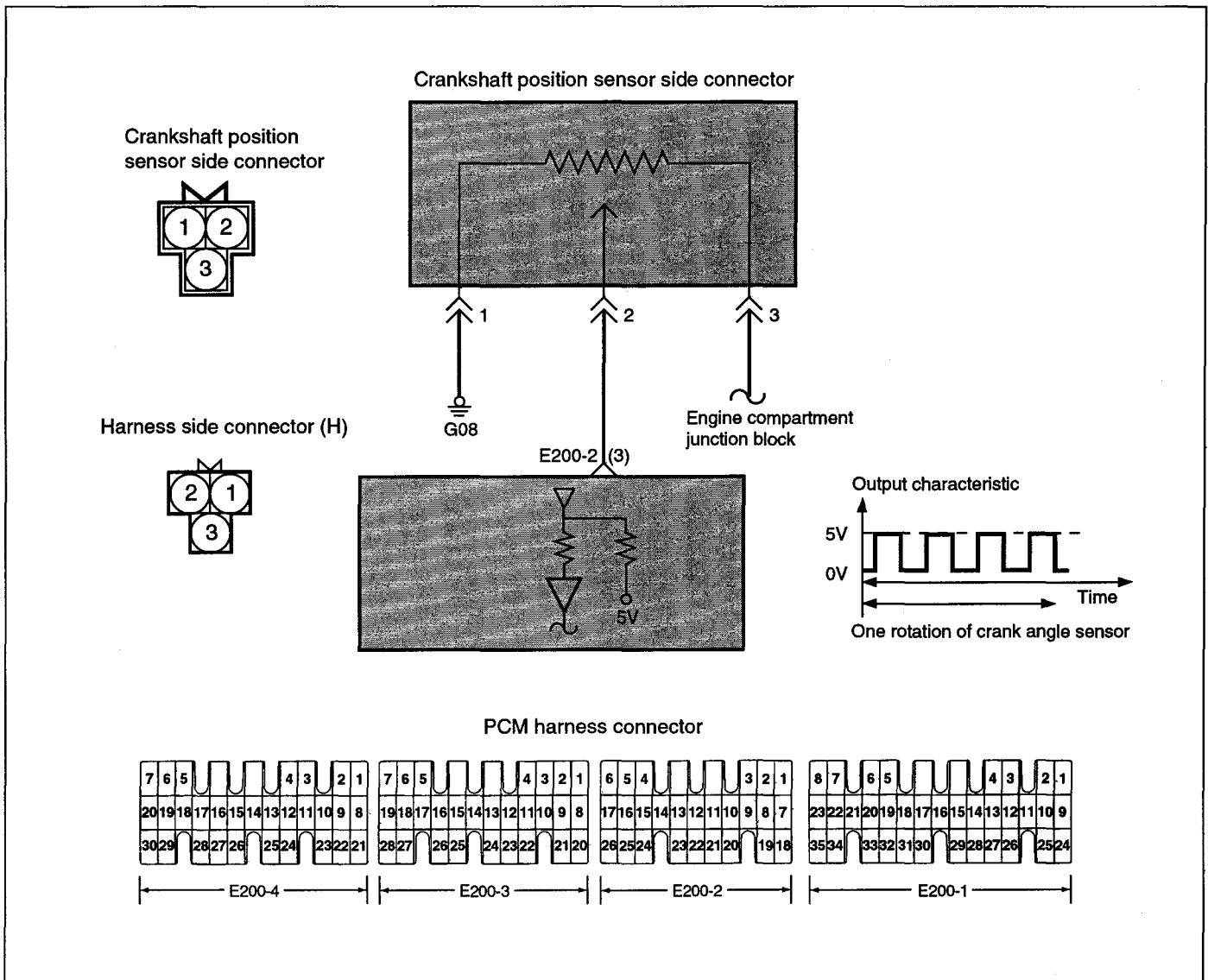
**CRANKSHAFT POSITION SENSOR** EFMB1130

The crankshaft position sensor is a Hall-effect sensor that senses the crank angle (piston position) of each cylinder and converts it into a pulse signal. Based on the input signal, the PCM computes the engine speed and controls the fuel injection timing and ignition timing.



KFW5202A

**CIRCUIT DIAGRAM**



EFMB113A

**TROUBLESHOOTING HINTS**

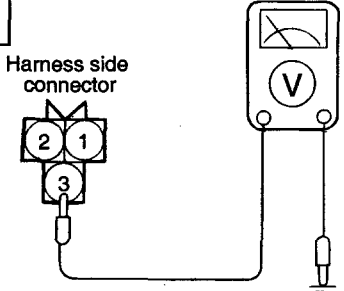
1. If unexpected shocks are felt during driving or the engine stalls suddenly, shake the crankshaft position sensor harness. If this causes the engine to stall, check for poor sensor connector contact.
2. If the tachometer reads 0 rpm when the engine is cranked, check for faulty crank angle sensor, broken timing belt or ignition system problems.
3. If the engine can be run at idle even if the crank angle sensor reading is out of specification, check the following:
  - Faulty engine coolant temperature sensor
  - Faulty idle speed control motor
  - Poorly adjusted reference idle speed
4. The engine will run without a crank angle sensor signal, but will not start. Once the sensor detects TDC, the data is stored until the next re-start.

**USING HI-SCAN (PRO)**

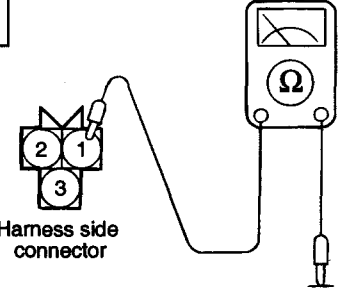
Check Item	Check conditions	Check content	Normal state
Crankshaft position sensor	<ul style="list-style-type: none"> <li>• Engine cranking</li> <li>• Tachometer connected (check on and off ignition coil by tachometer)</li> </ul>	Compare cranking speed and multi-tester reading	Indicated speed agrees

Check Item	Check conditions	Coolant temperature	Test specification
Crankshaft position sensor	<ul style="list-style-type: none"> <li>• Engine: Running at idle</li> <li>• Idle position switch: ON</li> </ul>	When -20°C (-4°F)	1,500-1,700 rpm
		When 0°C (-32°F)	1,350-1,550 rpm
		When 20°C (-68°F)	1,200-1,400 rpm
		When 40°C (-104°F)	1,000-1,200 rpm
		When 80°C (-176°F)	Idle rpm

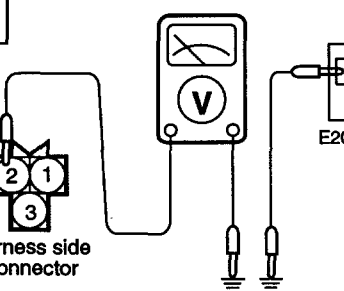
HARNESS INSPECTION PROCEDURES

<p><b>1</b></p>	 <p>Harness side connector</p>	<p>Measure the power supply voltage.</p> <ul style="list-style-type: none"> <li>o Connector: Disconnected</li> <li>o Ignition switch: ON</li> <li>o Voltage (V): Battery voltage</li> </ul>	<p><b>OK</b> → <b>2</b></p> <p><b>NG</b> → Repair the harness.</p>
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EFAA725C

<p><b>2</b></p>	 <p>Harness side connector</p>	<p>Check for continuity of the ground circuit.</p> <ul style="list-style-type: none"> <li>o Connector : Disconnected</li> </ul>	<p><b>OK</b> → <b>3</b></p> <p><b>NG</b> → Repair the harness.</p>
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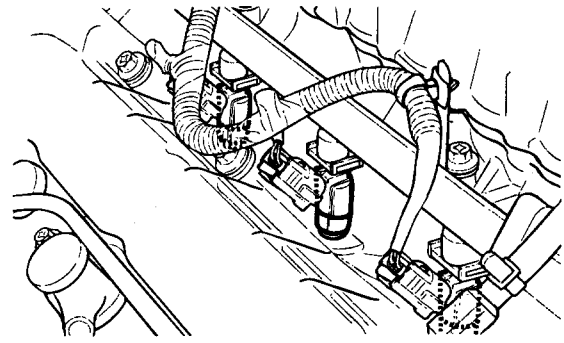
EFAA725D

<p><b>3</b></p>	 <p>Harness side connector</p>	<p>Check for continuity of the ground circuit.</p> <ul style="list-style-type: none"> <li>o Connector : Disconnected</li> <li>o Ignition switch : ON</li> <li>o Voltage : 4.8-5.2 V</li> </ul>	<p><b>OK</b> → <b>END !</b></p> <p><b>NG</b> → Repair the harness.</p>
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EFMB113E

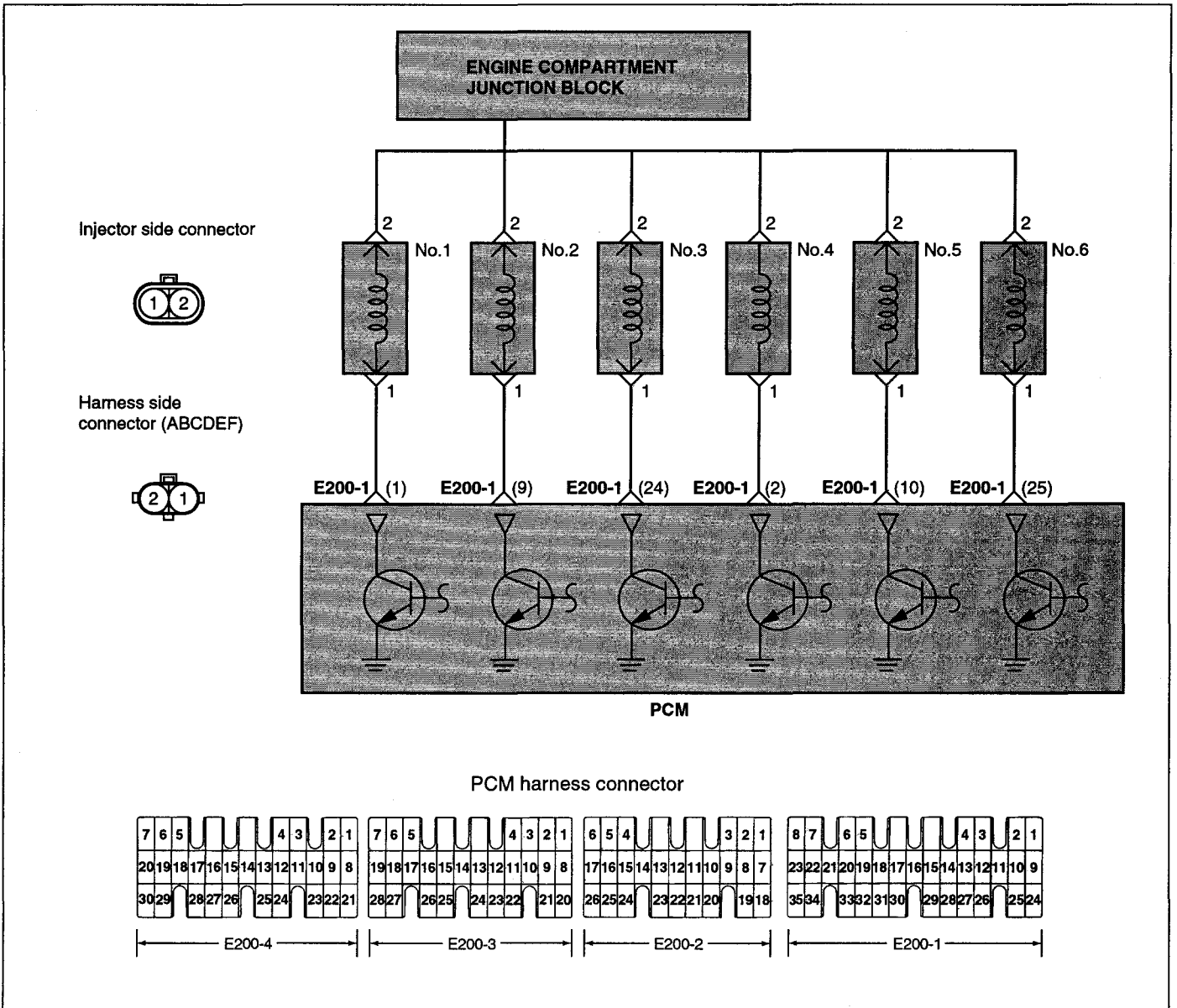
**FUEL INJECTOR** EFMB1150

The injectors inject fuel according to a signal coming from the PCM. The amount of fuel injected by the injectors is determined by the time during which the solenoid valve is energized. The amount of time the solenoid valve is energized is determined by the pulse width of the signal from the PCM.



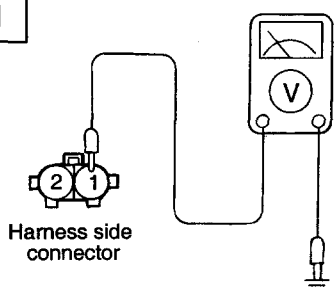
KFW5018A

**CIRCUIT DIAGRAM**

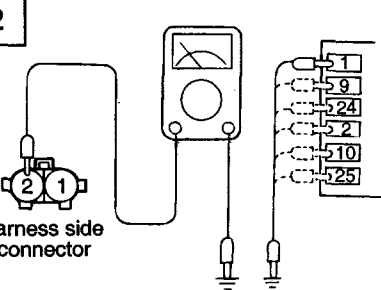


EFMB115A

HARNESS INSPECTION PROCEDURES

<div style="border: 1px solid black; padding: 2px; width: 20px; margin: 0 auto;">1</div>  <p style="text-align: center;">Harness side connector</p>	<p>Measure the power supply voltage.</p> <ul style="list-style-type: none"> <li>o Connector: Disconnected</li> <li>o Ignition switch: ON</li> <li>o Voltage (V): Battery voltage</li> </ul>	<p><b>OK</b> → <div style="border: 1px solid black; padding: 2px; width: 20px; margin: 0 auto;">2</div></p> <p><b>NG</b> → Repair the harness.</p>
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EFHA729B

<div style="border: 1px solid black; padding: 2px; width: 20px; margin: 0 auto;">2</div>  <p style="text-align: center;">Harness side connector</p>	<p>Check for an open circuit, or a short circuit to ground between the powertrain control module and the injector.</p> <ul style="list-style-type: none"> <li>o PCM connector : Disconnected</li> <li>o Injector connector : Disconnected</li> </ul>	<p><b>OK</b> → <b>END !</b></p> <p><b>NG</b> → Repair the harness.</p>
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EFBB115C

INJECTOR CHECKING

USING HI-SCAN

Check Item	Data display	Check conditions	Check content	Test specification
Injector	Drive time	Engine: Cranking	0°C (32°F)	Approx. 17 ms
			20°C (68°F)	Approx. 35 ms
			80°C (176°F)	Approx. 8.5 ms

Check Item	Data display	Check conditions	Engine state	Test specification
Injector	Drive time	<ul style="list-style-type: none"> <li>Engine coolant temperature: 80 to 95°C (176 to 205°F)</li> <li>Lamps, electric cooling fan, accessory modules: All OFF</li> <li>Transaxle: Neutral (P range for vehicle with A/T)</li> <li>Steering wheel: Neutral</li> </ul>	Idle rpm	2.2-2.9 ms
			2,000 rpm	1.8-2.6 ms
			Rapid racing	To increase

**NOTE**

- The injector drive time is when the supply voltage is 11V and the cranking speed is less than 250 rpm.
- When engine coolant temperature is lower than 0°C (32°F), the PCM fires all four cylinders simultaneously.

- When the vehicle is new (within initial operation of about 500 km [300 miles]), the injector drive time may be about 10% longer.

Check Item	Item No.	Drive content	Check condition	Normal state
Injector • Actuator test	01	No. 1 injector shut off	Engine: Idling after warm-up (Shut off the injectors in sequence during and after engine warm-up; check the idle condition)	Idle should become unstable as injector shuts off.
	02	No. 2 injector shut off		
	03	No. 3 injector shut off		
	04	No. 4 injector shut off		
	05	No. 5 injector shut off		
	06	No. 6 injector shut off		

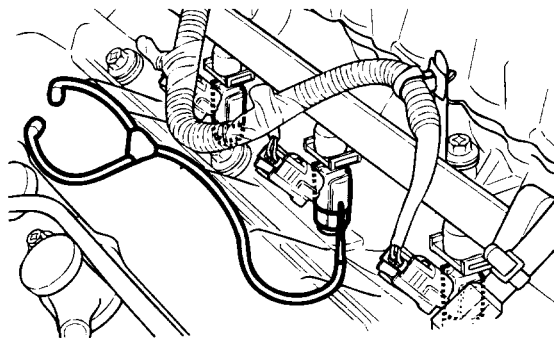
**USING STETHOSCOPE AND VOLTMETER**

Operation Sound Check

- Using a stethoscope, check the injectors for a clicking sound at idle. Check that the sound is produced at shorter intervals as the engine speed increases.

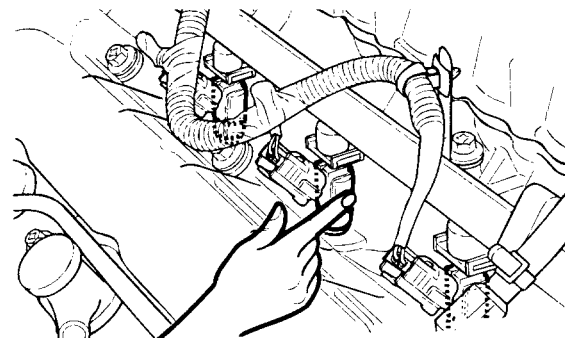
**NOTE**

Ensure that the sound from an adjacent injector is not being transmitted along the delivery pipe to an inoperative injector.



KFW5019A

- If a stethoscope is not available, check the injector operation with your finger. If no vibration is felt, check the wiring connector, injector or injection signal from the PCM.



KFW5020A

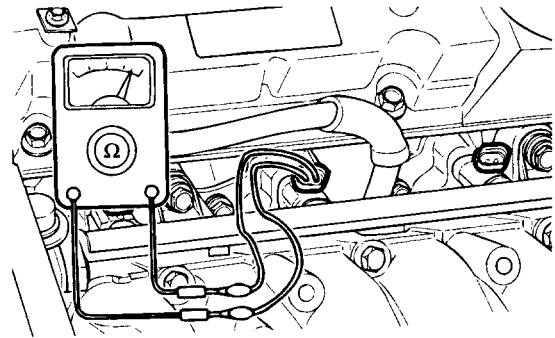
Resistance Measurement Between Terminals

- Disconnect the connector at the injector.

- Measure the resistance between terminals.

Standard value : 13-16Ω [at20°C (68°F)]

- Re-connect the connector to the injector.



KFW5021A

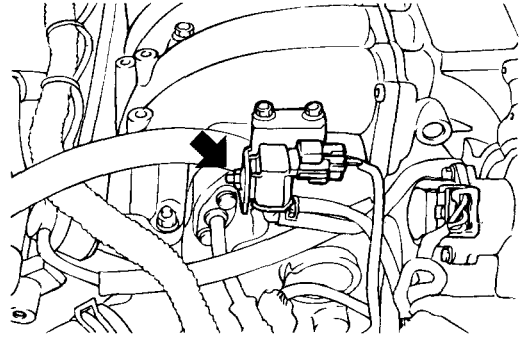
**TROUBLESHOOTING HINTS**

- If the engine is hard to start when hot, check for fuel pressure and injector leaks.
- If the injectors do not operate when the engine is cranked, then check the followings:
  - Defective power supply circuit to the PCM, faulty ground circuit
  - Defective control relay
  - Defective crankshaft position (CKP) sensor or camshaft position (CMP) sensor
- If there is any cylinder whose idle state remains unchanged when the fuel injectors are cut one after another during idling, check for the following items about that a cylinder.
  - Injector and harness
  - Ignition plug and high tension cable
  - Compression pressure
- If the injection system is OK but the injector drive time is out of specification, check for the following items.
  - Poor combustion in the cylinder (faulty ignition plug, ignition coil, compression pressure, etc.)
  - Loose EGR valve seating



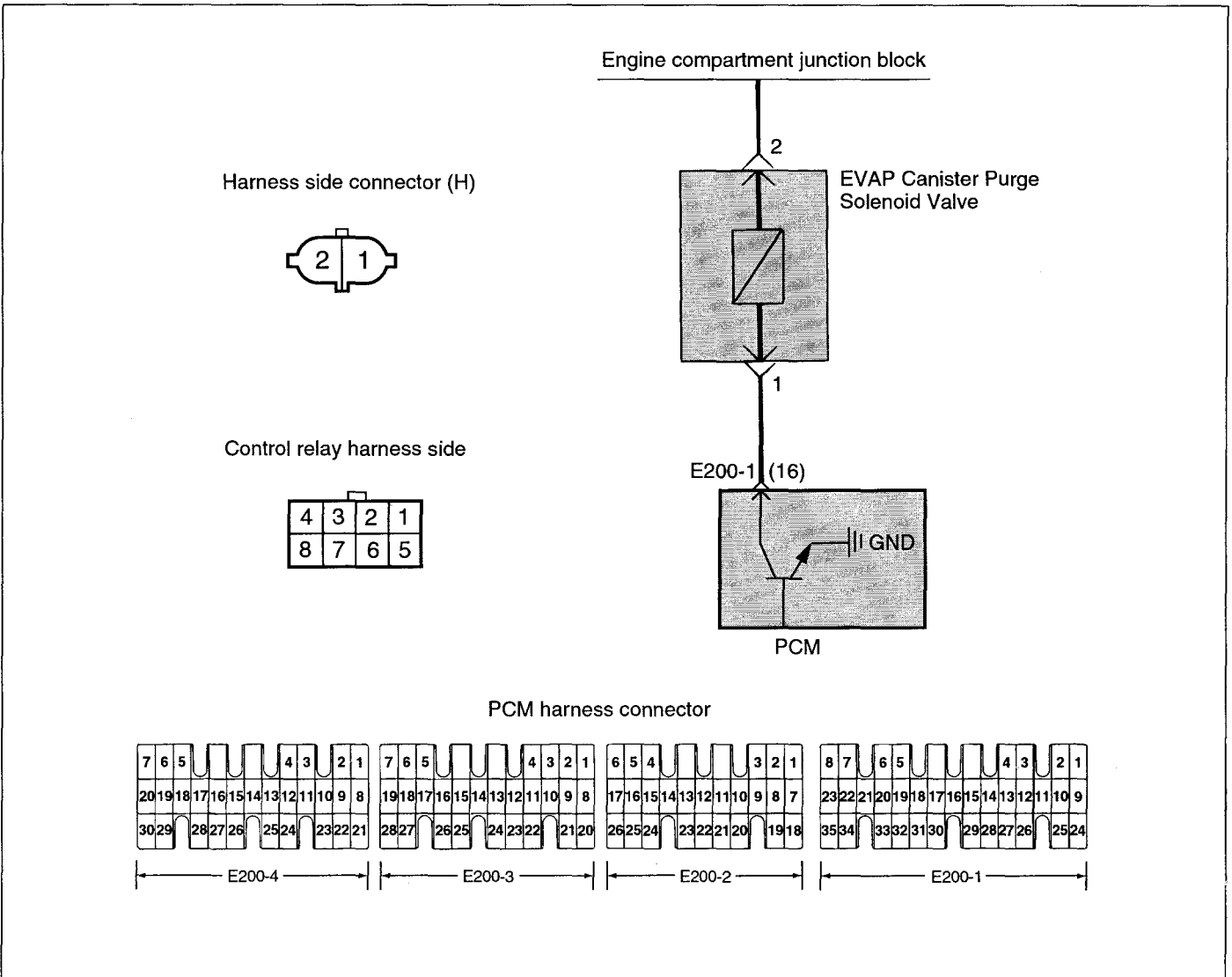
**EVAPORATIVE EMISSION CANISTER  
PURGE CONTROL SOLENOID  
VALVE** EFMB1170

The evaporative emission canister purge control solenoid valve is a duty control type, which controls purge air from the evaporative emission canister.



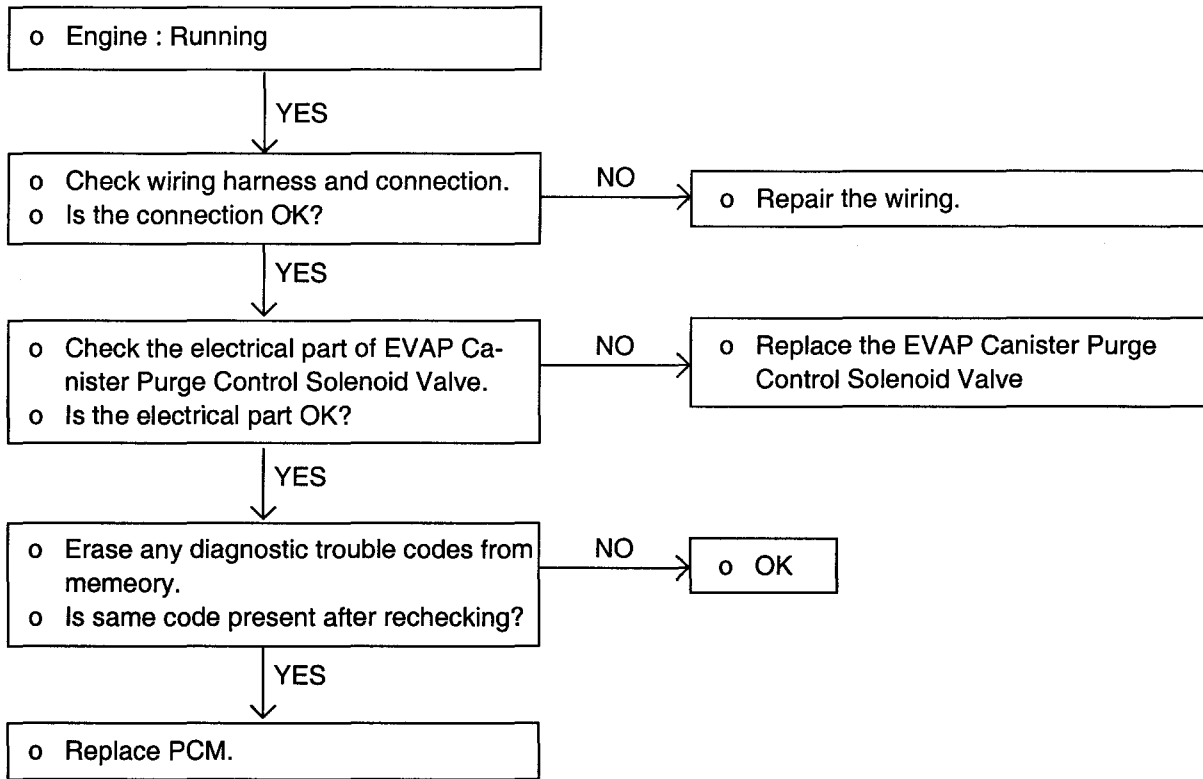
EFB9007A

**CIRCUIT DIAGRAM**



EFMB117A

**TROUBLESHOOTING PROCEDURES**

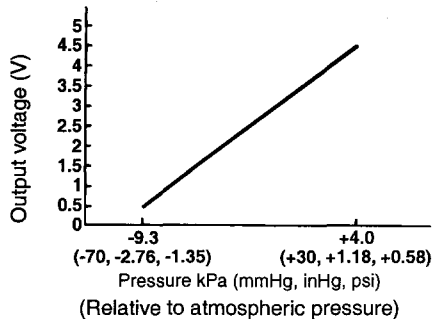


DTC : Diagnosis Trouble Code  
PCM : Powertrain Control Module

EFAA731B

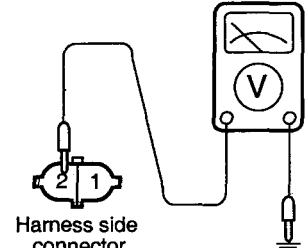
**USING HI-SCAN (PRO)**

Check Item	Check conditions	HI-SCAN display	Type
Evaporative emission canister purge solenoid valve • Actuator test	IG. S/W ON (Do not start)	PCSV	Activate

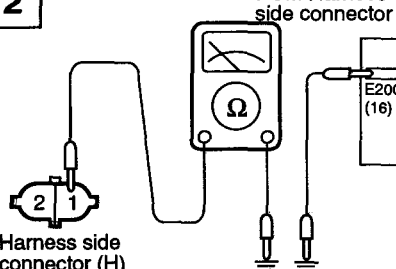


EFJB731E

HARNESS INSPECTION PROCEDURES

<p><b>1</b></p>  <p>Harness side connector</p>	<p>Measure the power supply voltage.</p> <ul style="list-style-type: none"> <li>o Connector: Disconnected</li> <li>o Ignition switch: ON</li> <li>o Voltage (V): Battery voltage</li> </ul>	<p><b>OK</b> → <b>2</b></p> <p><b>NG</b> → Repair the harness.</p>
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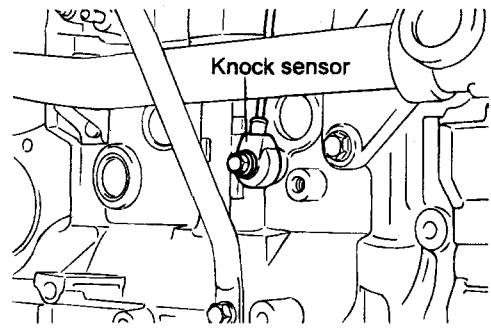
EFBB117B

<p><b>2</b></p>  <p>Harness side connector (H)</p> <p>PCM Harness side connector</p> <p>E200-1 (16)</p>	<p>Check for an open circuit, or a short circuit to ground between the evaporative emission canister purge solenoid valve and the powertrain control module.</p> <ul style="list-style-type: none"> <li>o PCM connector : Disconnected</li> <li>o Evaporative emission canister purge solenoid valve connector : Disconnected</li> </ul>	<p><b>OK</b> → <b>END !</b></p> <p><b>NG</b> → Repair the harness.</p>
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EFMB117C

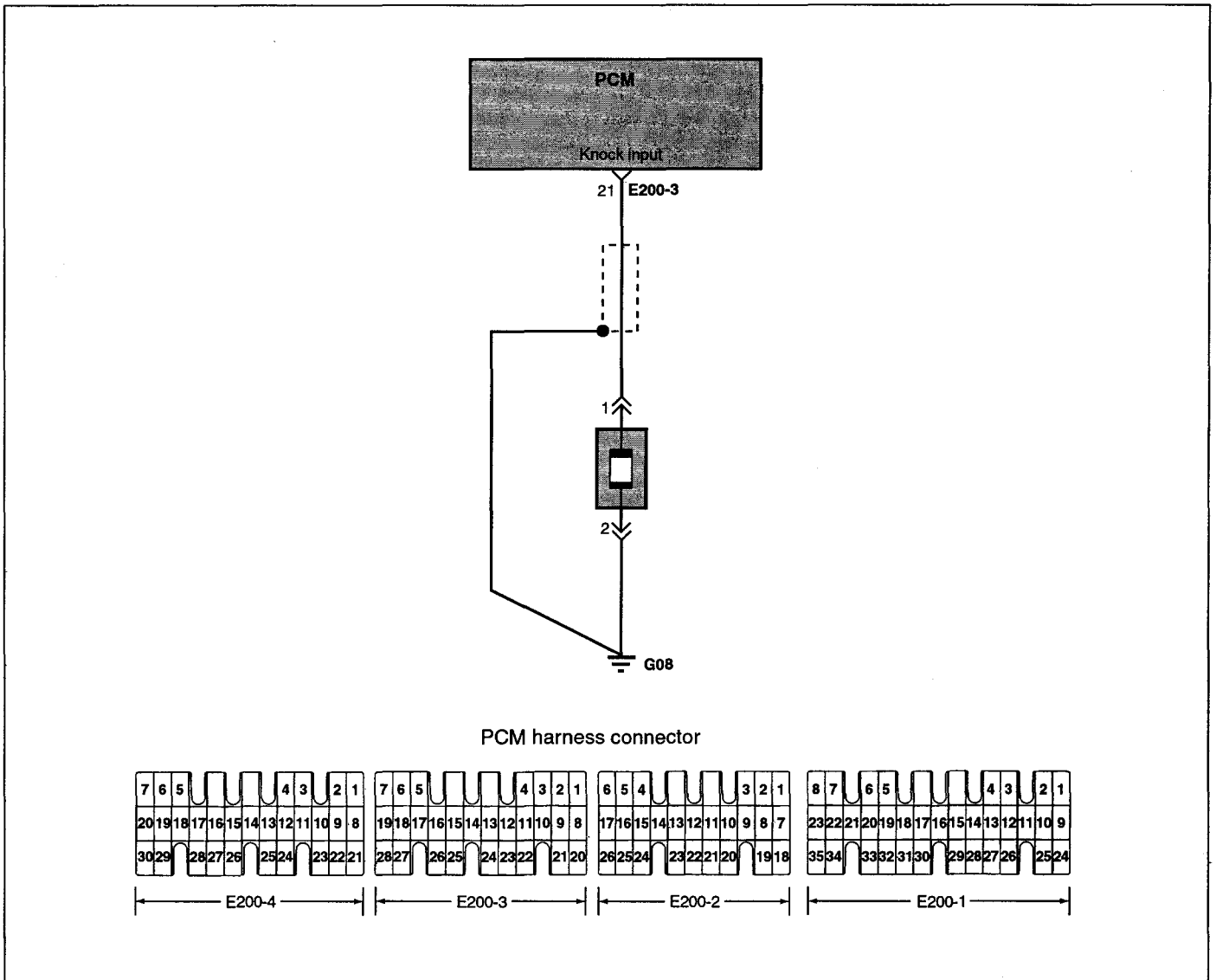
**KNOCK SENSOR** EFMB1190

The knock sensor is a piezoelectric device attached to the cylinder block that senses pressure from engine knocking conditions. This vibrational pressure is then converted into a voltage signal which is delivered as output. If engine knock occurs, ignition timing is retarded to suppress it.



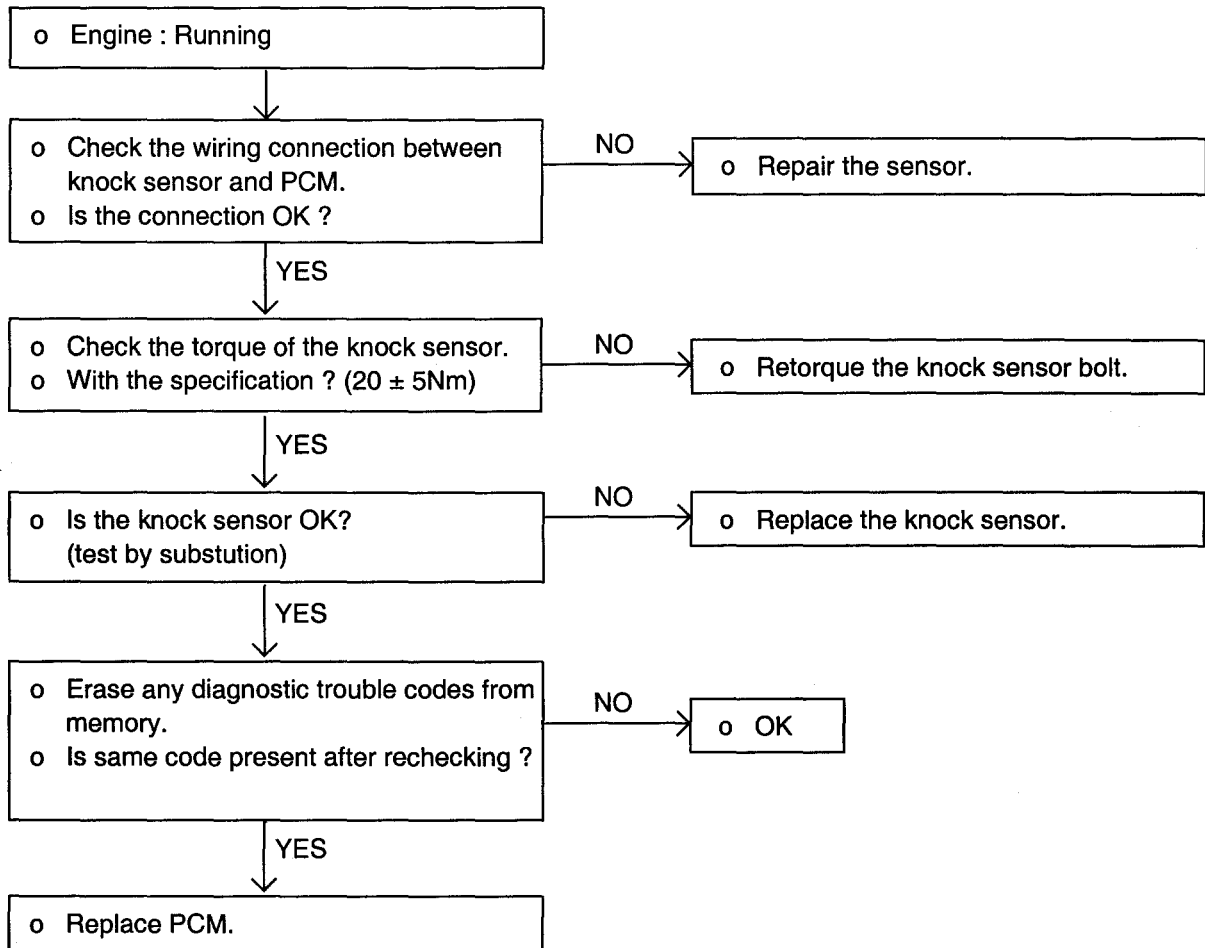
EFA9094A

**CIRCUIT DIAGRAM**



EFMB119A

## TROUBLESHOOTING PROCEDURES



DTC : Diagnosis Trouble Code  
PCM : Powertrain Control Module

EFAA733B

## TROUBLESHOOTING HINTS

1. The MIL is ON or the DTC is displayed on the HI-SCAN PRO under the following condition:
  - When the knock sensor signal is not detected, even though the engine is in an overload condition.
  - When the knock sensor signal is abnormally low.

**HARNESS INSPECTION PROCEDURES**

<b>1</b>	<p>Harness side connector (A)</p>	<p>Check for an open circuit, or a short circuit to ground between the PCM and the knock sensor</p> <ul style="list-style-type: none"> <li>o PCM connector : Disconnected</li> <li>o Knock sensor connector : Disconnected</li> </ul>	<p><b>OK</b> → <b>2</b></p> <p><b>NG</b> → Repair the harness. A1 - E200-3 : 21</p>
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EFMB119C

<b>2</b>	<p>Harness side connector</p>	<p>Check for continuity of the ground circuit</p> <ul style="list-style-type: none"> <li>o Continuity</li> </ul>	<p><b>OK</b> → <b>END !</b></p> <p><b>NG</b> → Repair the harness.</p>
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EFBB119D

**SENSOR INSPECTION**

1. Disconnect the knock sensor connector.
2. Measure the resistance between terminals 2 and 3.

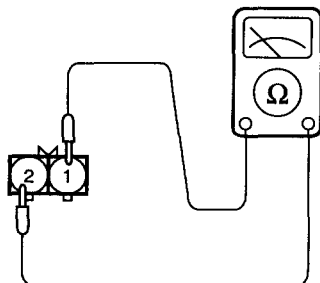
Standard value : about  $5M\Omega$  [at  $20^{\circ}C$  ( $68^{\circ}F$ )]

3. If the resistance is zero, replace the knock sensor.

Knock sensor :  
16-28Nm (160-250 kg·cm, 11.8-18.4 lb·ft)

4. Measure the capacitance between the terminal 2 and 3.

Standard value : 800-1600 pF

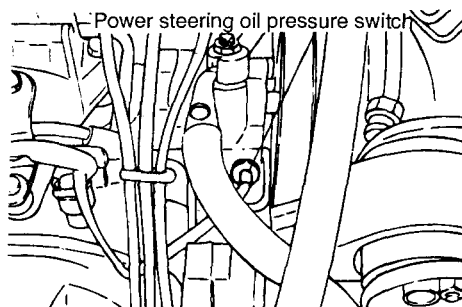


EFBB119E

### POWER STEERING PRESSURE SWITCH

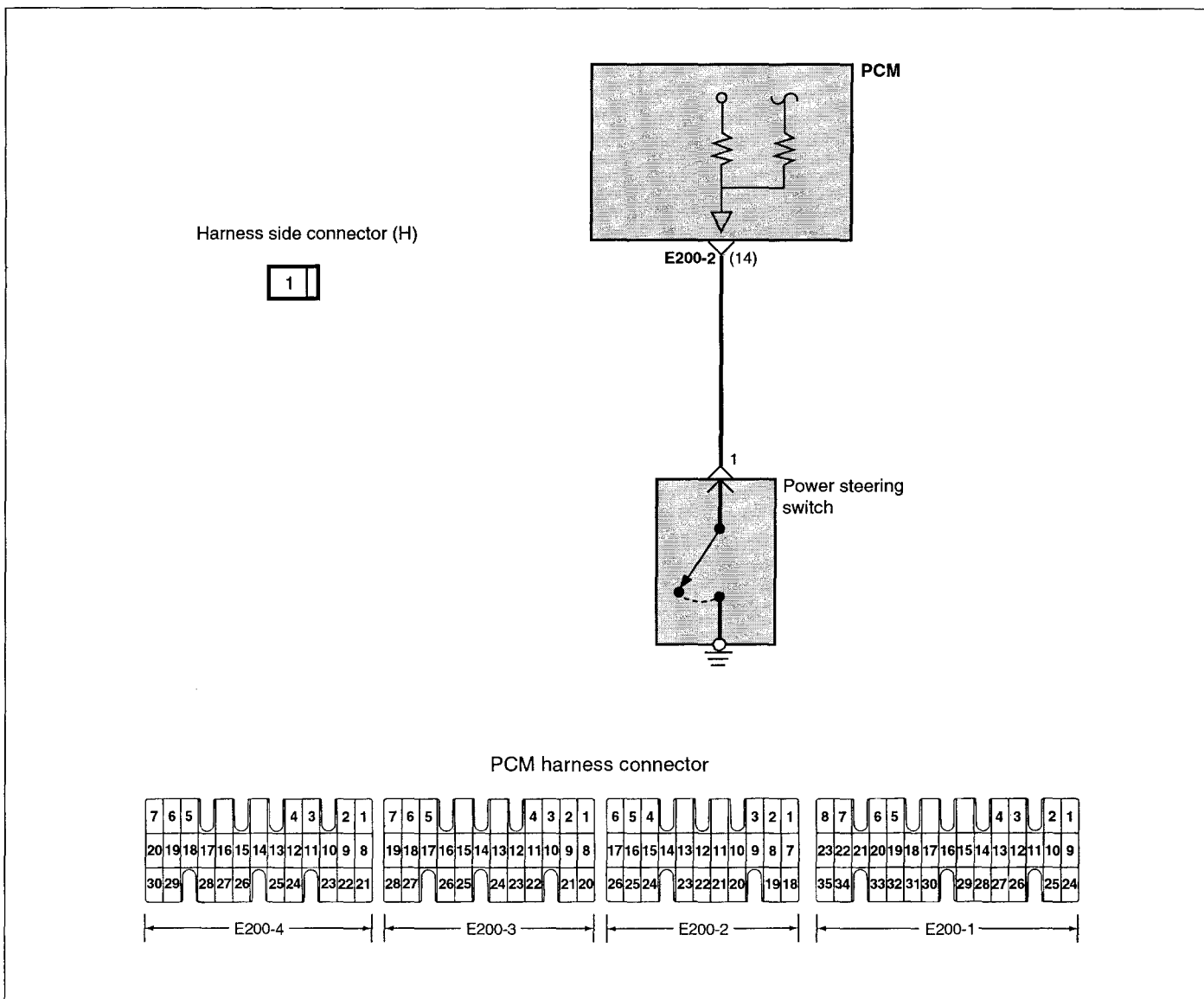
EFMB1210

The power steering oil pressure switch senses the power steering load and inputs it to PCM, which then adjusts the idle speed control motor to maintain idle speed when the power steering pump puts a load on the engine.



EFA9103A

### CIRCUIT DIAGRAM

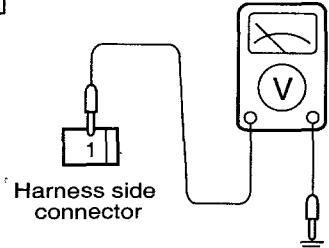


EFMB121A

USING HI-SCAN (PRO)

Check item	Data display	Check conditions	Steering wheel	Normal indication
Power steering oil pressure switch	Switch state	Engine : Idling	Steering wheel neutral position (wheels straightahead direction)	OFF
			Steering wheel half turn	ON

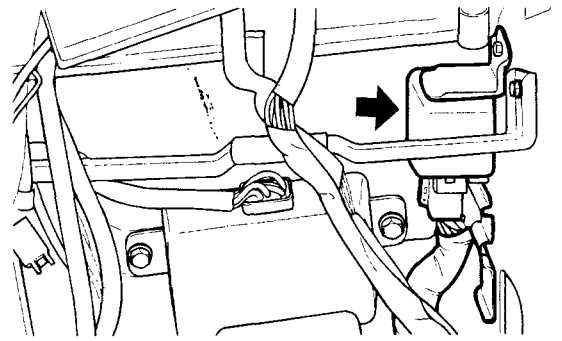
HARNES INSPECTION PROCEDURES

<div data-bbox="83 482 128 524" style="border: 1px solid black; padding: 2px; width: 20px; height: 20px; display: inline-block;">1</div>  <p style="margin-left: 20px;">Harness side connector</p>	<p>Measure the power supply voltage.</p> <ul style="list-style-type: none"> <li>o Connector: Disconnect</li> <li>o Ignition switch: ON</li> <li>o Voltage (V): Battery voltage</li> </ul>	<p><b>OK</b> ⇒</p> <p><b>NG</b> ⇒</p>	<p><b>END !</b></p> <p>Repair the harness.</p>
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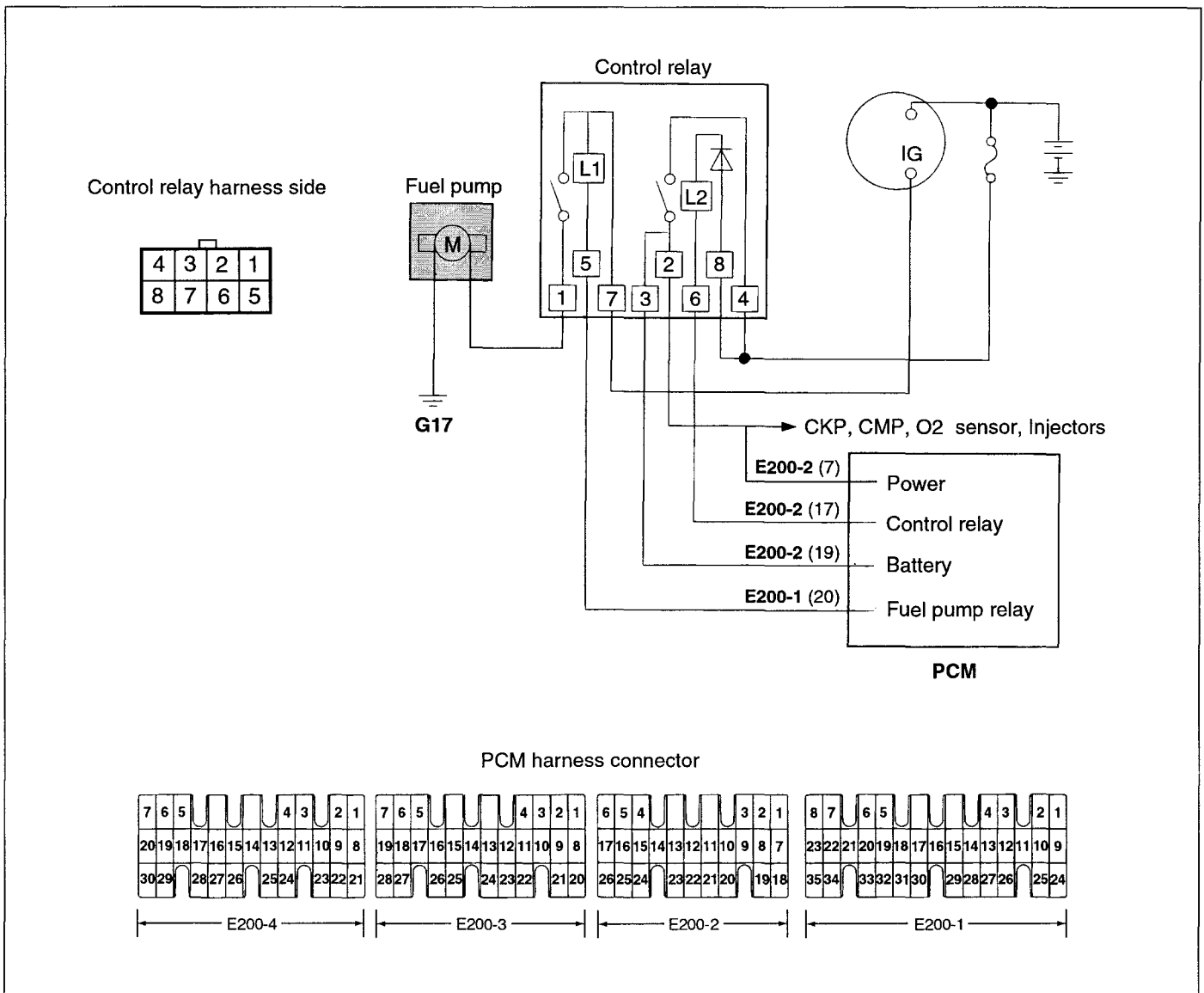
**CONTROL RELAY** EFMB1230

When the ignition switch is turned on, battery voltage is applied from the ignition switch to the PCM, turning ON the ignition power transistor and energizing the MFI control relay coil. This turns ON the MFI control relay switch, and supplies power from the battery to the PCM through the MFI control relay switch.



KFW5221A

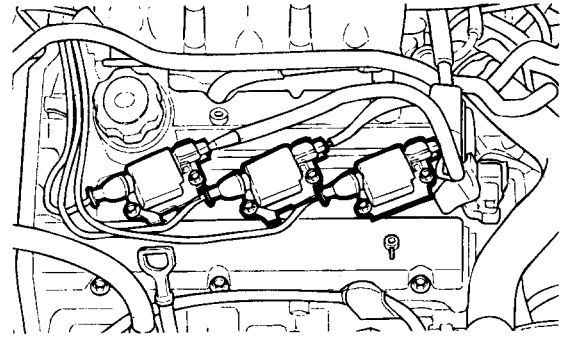
**CIRCUIT DIAGRAM**



EFMB123A

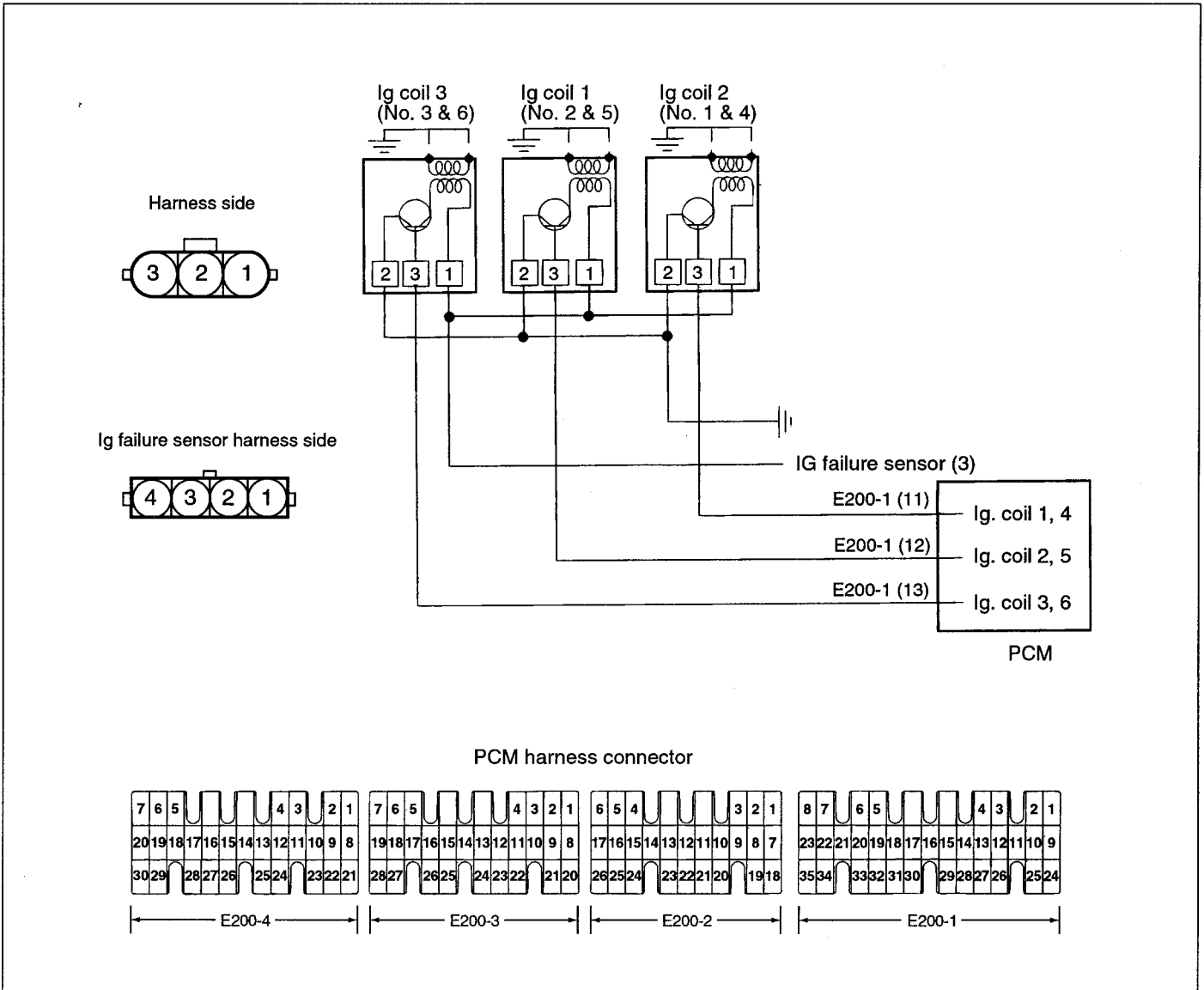
**IGNITION COIL** EFMB1250

The ignition power transistor functions to control the ignition timing by controlling the ignition coil primary current through signals from the PCM.



KFW5222A

**CIRCUIT DIAGRAM**



EFMB125A

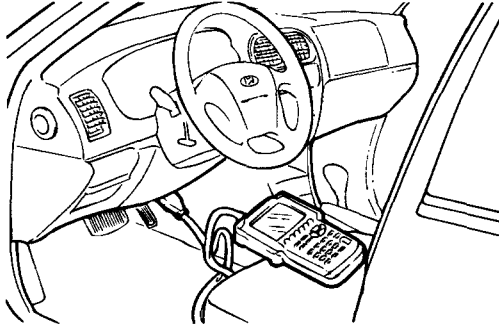
## THROTTLE POSITION SENSOR(TPS)

### INSPECTION EFMB2060

1. Connect a HI-SCAN (PRO) to the data link connector.

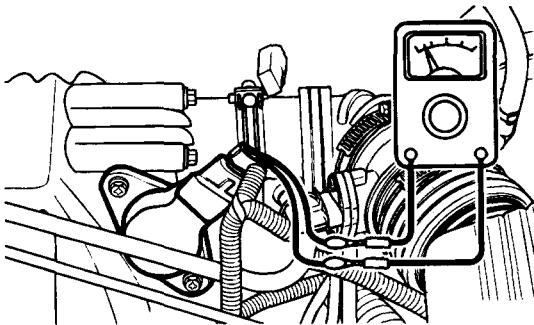
#### NOTE

Before inspecting the TPS, verify the basic idle speed is as specified.



EFA9100A

2. If a HI-SCAN (PRO) is not used, connect a digital type voltmeter between ground and TPS output terminal.



EFMB206A

3. Turn the ignition switch to the ON position (do not start engine) and check that TPS output voltage is as specified. If a HI-SCAN (PRO) is used, read the TPS voltage.

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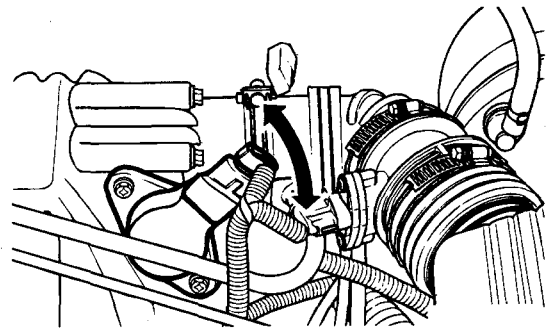
Standard value (ETS vehicle) : 300-900mV

---

4. If it is out of specification, loosen TPS mounting screws and adjust by turning the TPS.

#### NOTE

- Turning the TP Sensor clockwise increases the output voltage.
- Tighten the screws securely after adjustment.



EFMB206B

5. Turn the ignition switch to the OFF position.

### THROTTLE BODY CLEANING EFBB2120

#### NOTE

Disconnect the intake air hose from the throttle body, and check the throttle valve surface for dirt. Spray cleaning solvent on the face of the valve to remove dirt.

1. Warm up the engine, then stop it.
2. Remove the intake air hose from the throttle body.
3. Plug the bypass passage inlet of the throttle body.

#### NOTE

Make sure the solvent does not enter the by-pass passage.

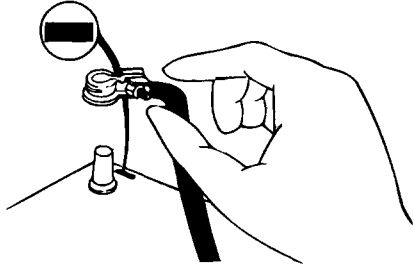
4. Spray cleaning solvent into the valve through the throttle body intake port and let it soak for about 5 minutes. After 5 minutes open the valve and wipe it clean with a soft rag.

#### CAUTION

Keep the throttle valve closed while spraying to avoid charging the intake path with solvent.

5. Start the engine, race it several times and allow the engine to run near idle for 1 minute.
6. Repeat Steps 4 and 5.
7. Unplug the bypass passage inlet.
8. Attach the intake air hose.

- Disconnect the battery ground cable for more than 10 seconds.



EFA9112B

**FUEL FILTER REPLACEMENT**

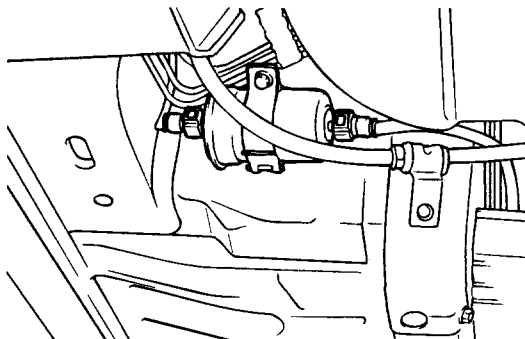
EFBB2070

- Lift up the vehicle.
- Reduce the internal pressure of the fuel lines and hoses and make the following operations.
  - Disconnect the fuel pump harness connector at the fuel tank rear side.
  - Start the engine and after it stops, turn the ignition switch to OFF.
  - Disconnect the battery negative (-) terminal.
  - Connect the fuel pump harness connector.
- Remove the two fitting nuts while holding the fuel filter nuts securely.
- Remove the fuel filter mounting bolts, and then remove the fuel filter from the fuel filter clamp.

**Tightening torque**

Fuel filter fitting nut :

30-40 Nm (300-400 kg-ch, 22.1-29.5 lb-ft)

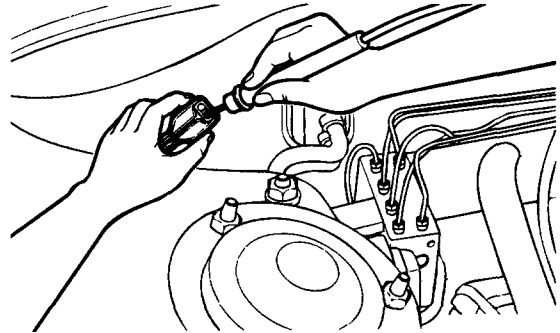


EFA9157A

**FUEL PUMP OPERATION CHECK**

EFBB2080

- Turn the ignition switch to the OFF position.
- Apply battery voltage to the fuel pump drive connector to check that the pump operates.

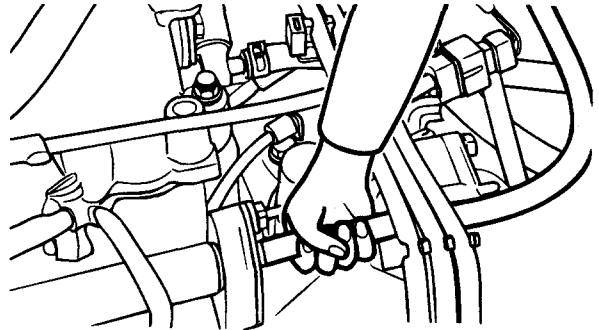


KFW5022A

**NOTE**

The fuel pump is an in-tank type and its operating sound is hard to hear without removing the fuel tank cap.

- Pinch the hose to check that fuel pressure is felt.



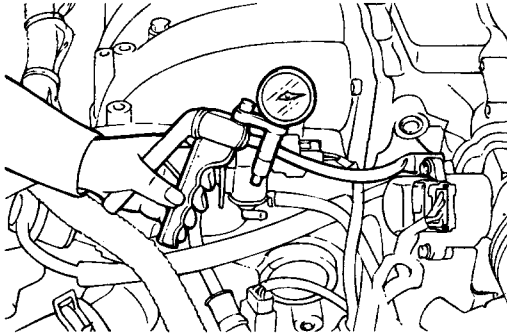
HEW31006

**EVAP CANISTER PURGE PORT VACUUM CHECK** EFBB2090

**CHECKING CONDITION**

Engine coolant temperature : 80-95°C (176-205°F)

1. Disconnect the vacuum hose from the throttle body EVAP Canister purge hose fitting and connect a vacuum pump.

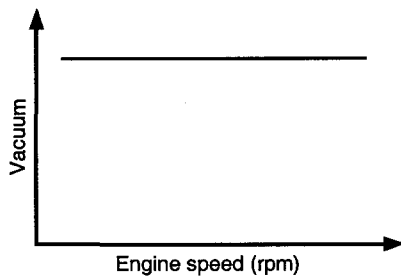


EEB9015A

2. Start the engine and check to see that, after increasing the engine speed, vacuum rises fairly constantly.

**NOTE**

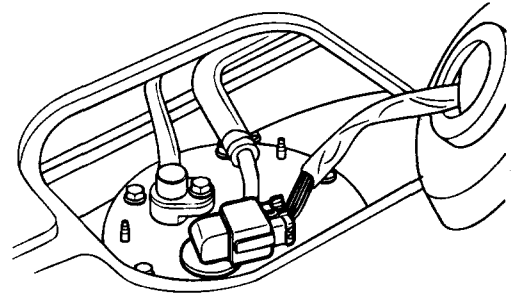
If there is no vacuum, it is possible that the throttle body port may be restricted and may require cleaning.



EFA9109B

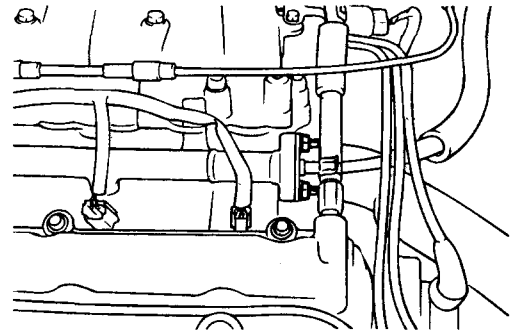
**FUEL PRESSURE TEST** EFBB2100

1. Reduce the internal pressure of the fuel lines and hoses:
  - Disconnect the fuel pump harness connector
  - Start the engine and after it stalls, turn the ignition switch to the OFF position
  - Disconnect the battery negative (-) terminal
  - Connect the fuel pump harness connector



KFW5023A

2. Remove the bolt connecting the fuel line to the fuel delivery pipe.



EFA9141A

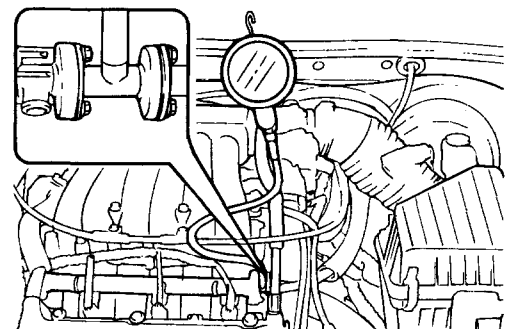
**CAUTION**

Cover the hose connection with a shop towel to prevent splashing of fuel caused by residual pressure in the fuel line.

3. Using the fuel pressure gauge adapter, install the fuel pressure gauge to the fuel pressure gauge adaptor. Tighten the bolt to the specified torque.

Fuel pressure gauge to fuel delivery pipe :

25-35 Nm (250-350 kg-cm, 18-26 lb-ft)



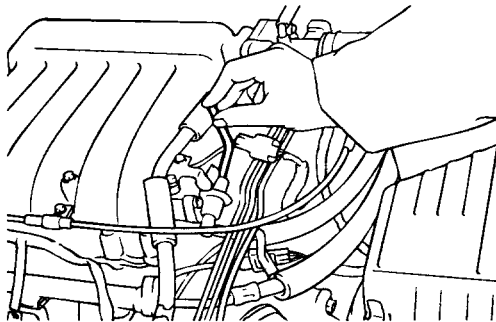
EFA9141B

4. Connect the battery's negative (-) terminal.

5. Apply battery voltage to the terminal for the pump drive and activate the fuel pump. With fuel pressure applied, check that there is no fuel leakage from the pressure gauge or connection part.
6. Start and run the engine at curb idle speed.
7. Disconnect the vacuum hose from the pressure regulator, and plug the hose end. Measure the fuel pressure at idle.

Standard value :

320-340 kPa (3.26-3.47 kg/cm<sup>2</sup>, 46-49 psi)



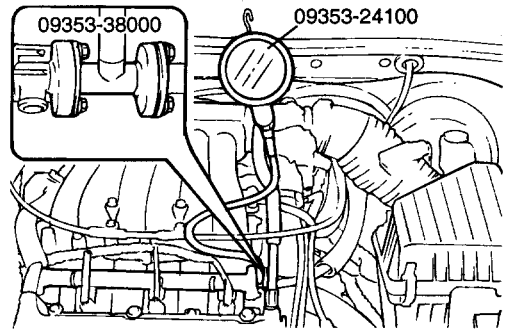
EFBB210C

8. Measure the fuel pressure when the vacuum hose is connected to the pressure regulator.

Standard value :

Approx.255 kPa (2.57 kg/cm<sup>2</sup>, 37 psi)

9. If the results of the measurements made in steps (7) and (8) are not within the standard value, use the table below to determine the probable cause, and make the necessary repairs.



EFBB210A

Condition	Probable cause	Remedy
Fuel pressure is too low	<ul style="list-style-type: none"> <li>• Clogged fuel filter</li> <li>• Fuel leakage to the return side, caused by poor seating of the fuel-pressure regulator</li> </ul>	<ul style="list-style-type: none"> <li>• Replace fuel filter</li> <li>• Replace fuel pressure regulator</li> </ul>
	<ul style="list-style-type: none"> <li>• Low discharge pressure of the fuel pump</li> </ul>	<ul style="list-style-type: none"> <li>• Check the in-tank fuel hose for large or replace the fuel pump</li> </ul>
Fuel pressure is too high	<ul style="list-style-type: none"> <li>• Sticking fuel pressure regulator</li> <li>• Clogged or bent fuel return hose or pipe</li> </ul>	<ul style="list-style-type: none"> <li>• Replace fuel pressure regulator</li> <li>• Repair or replace hose or pipe</li> </ul>
There is no difference in fuel pressure when the vacuum hose is connected and when it is not.	<ul style="list-style-type: none"> <li>• Clogged, or damaged vacuum hose or nipple</li> <li>• Sticking or poor seating of the fuel pressure regulator</li> </ul>	<ul style="list-style-type: none"> <li>• Repair or replace the vacuum hose or the nipple</li> <li>• Repair or replace hose or pipe</li> </ul>

10. Stop the engine and check for a change in the fuel pressure gauge reading, which should hold for approximately 5 minutes. If the gauge indication drops, observe the rate at which it drops. Determine and remove the causes according to the following table.

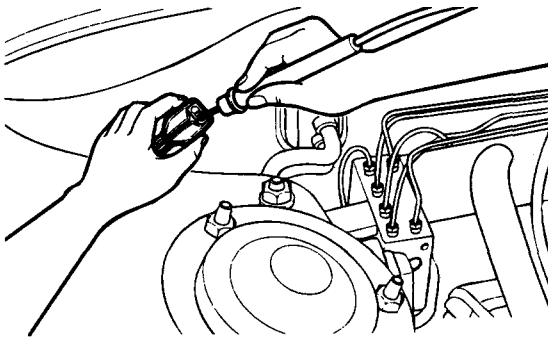
Condition	Probable cause	Remedy
Fuel pressure drops slowly after engine is stopped	<ul style="list-style-type: none"> <li>• Injector leakage</li> </ul>	<ul style="list-style-type: none"> <li>• Replace injector</li> </ul>
Fuel pressure drops immediately after engine is stopped	<ul style="list-style-type: none"> <li>• The check valve within the fuel pump is open</li> </ul>	<ul style="list-style-type: none"> <li>• Replace fuel pump</li> </ul>

11. Reduce the pressure in the fuel line.
12. Disconnect the hose and the gauge.

 **CAUTION**

***Cover the hose connection with a shop towel to prevent splashing of fuel caused by fuel residual pressure in the fuel line.***

13. Replace the O-ring at the end of the hose.
14. Connect the fuel hose to the delivery pipe and tighten to the specified torque.
15. Check for fuel leakage.
  - Apply battery voltage to the fuel pump drive terminal to operate the fuel pump.
  - With pressure, check the fuel line for leaks.

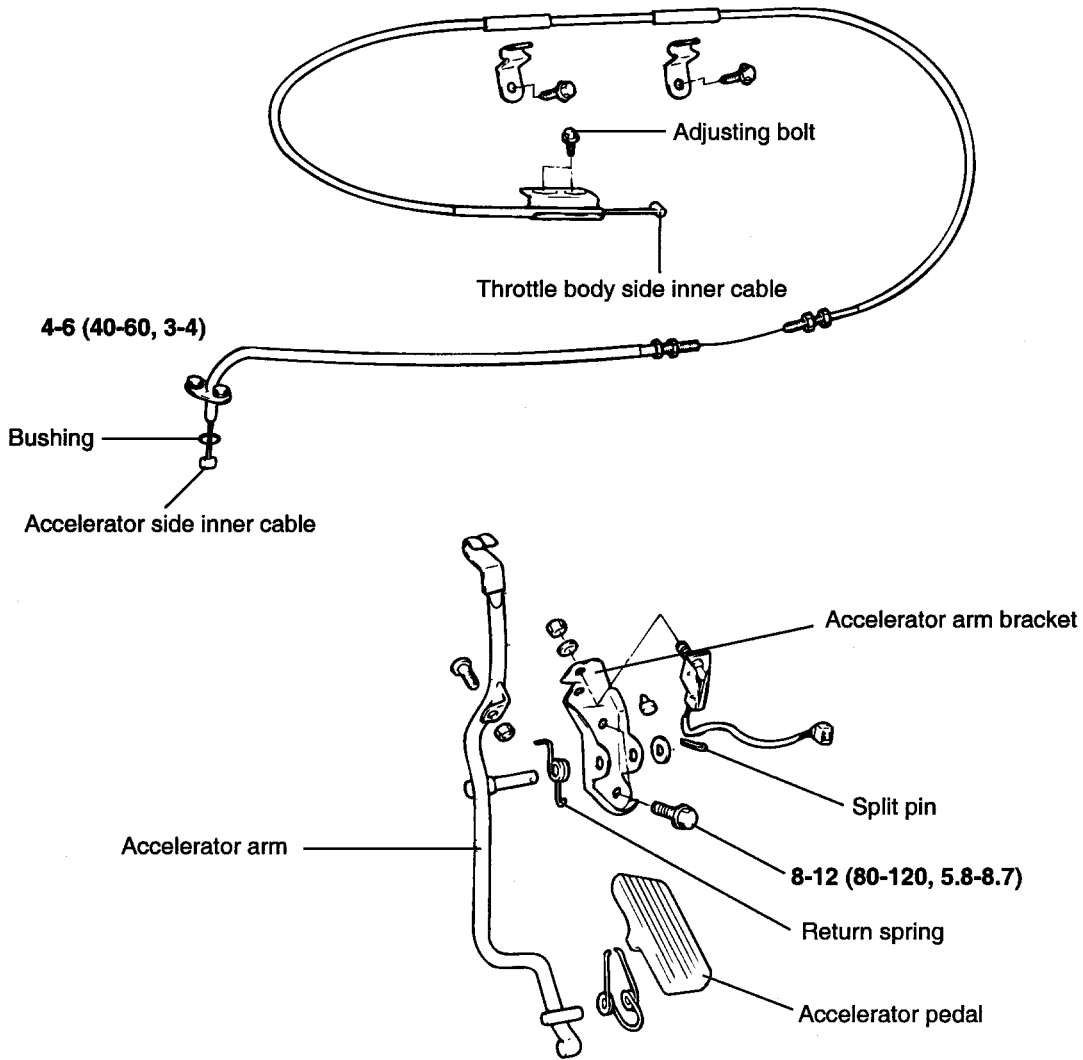


KFW5022A

# FUEL DELIVERY SYSTEM

## ACCELERATOR PEDAL EFBB2190

### COMPONENTS

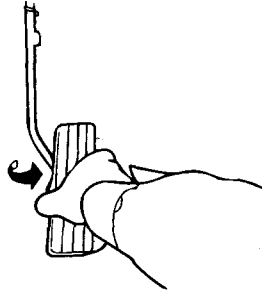


**TORQUE : Nm (Kg-cm, lb-ft)**



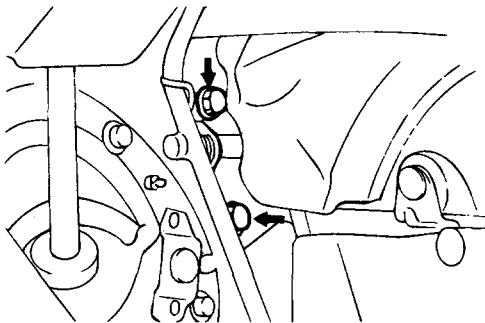
**REMOVAL** EFA91220

1. Remove the bushing and inner cable of the accelerator arm.
2. Pull the left side of the accelerator pedal toward you, and then remove the accelerator pedal from the accelerator arm.



EFA9122A

3. Loosen the bolts of the accelerator arm bracket and remove.



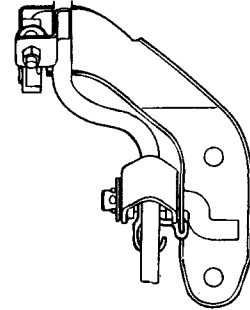
EFA9122B

**INSPECTION** EFA91230

1. Check the inner and outer cable for damage.
2. Check the cable for smooth movement.
3. Check the accelerator arm for deformation.
4. Check the return spring for deterioration.
5. Check the connection of the bushing to the inner cable.
6. Check the accelerator for proper operation.

**INSTALLATION** EFA91240

1. When installing the return spring and accelerator arm, apply multi-purpose grease around each moving point of the accelerator arm.



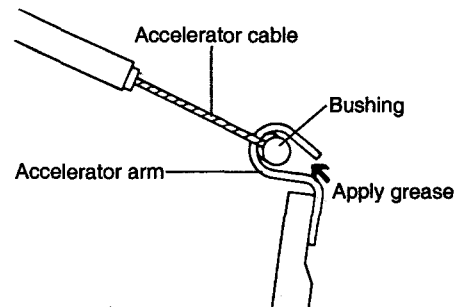
EFA9124A

2. Apply sealant to the bolt mounting hole and tighten the accelerator arm bracket.

**Tightening torque**

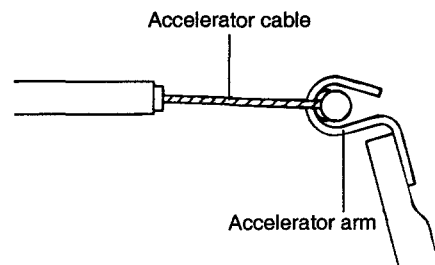
Accelerator arm bracket bolts :

8-12 Nm(80-120 kg-cm, 6-7 lb-ft)



EFA9124B

3. Securely install the resin bushing of the accelerator cable on the end of the accelerator arm.



EFA9124C

**FUEL INJECTOR** EFA91260**INSPECTION**

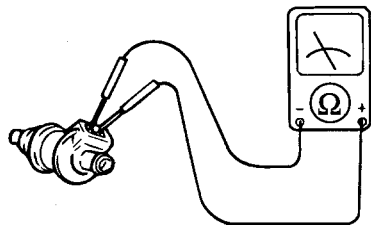
1. Measure the resistance of the injectors between the terminals using an ohmmeter.

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Resistance : 13-16 $\Omega$ [at 20°C (68°F)]

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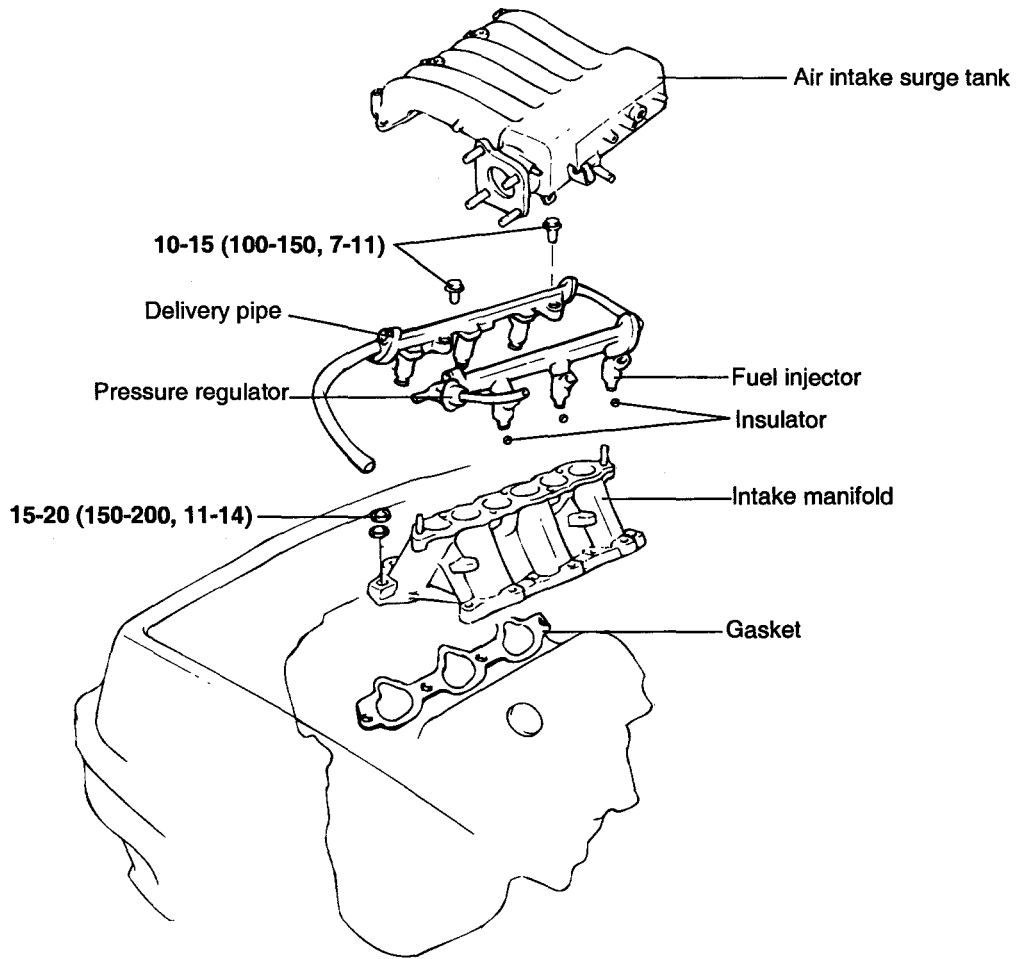
2. If the resistance is not within specification, replace the injector.



EFA9126A

FUEL LINE EFB2280

COMPONENTS



TORQUE : Nm (kg-cm, lb-ft)

**REMOVAL** EFA91290

1. Release residual pressure from the fuel line to prevent fuel from spilling.

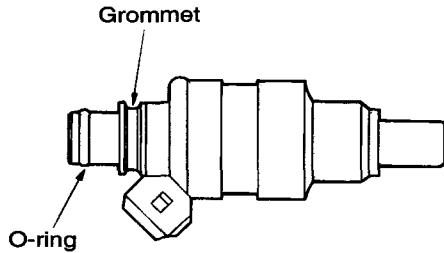
**CAUTION**

*Cover the hose connection with rags to prevent splashing of fuel from residual pressure in the fuel line.*

2. Remove the delivery pipe with the fuel injector and pressure regulator.

**INSTALLATION** EFA91300

1. Install a new grommet and O-ring to the injector.
2. Apply a coating of solvent, spindle oil or gasoline to the injector O-ring.

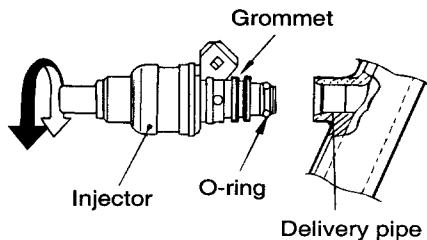


EFA9130A

3. While turning the injector left and right, install it onto the delivery pipe.
4. Be sure the injector turns smoothly.

**NOTE**

*If injector does not turn smoothly, the O-ring may be jammed. Remove the injector and re-insert it into the delivery pipe and re-check.*



EFA9130B

**FUEL LINE AND VAPOR LINE** EFB82320

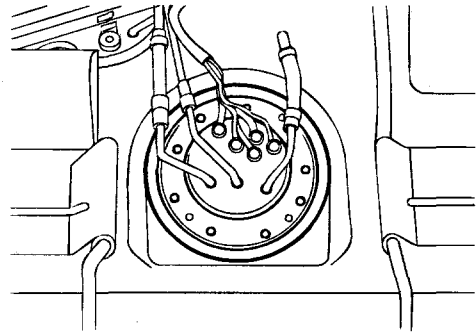
**REMOVAL**

1. Remove the fuel tank cap to lower the fuel tank's internal pressure. Raise the vehicle and disconnect the fuel pump connector.

**CAUTION**

- Reduce the fuel pressure before disconnecting the fuel line and hose, or fuel will spill out.
- Cover the pipe connection with a shop towel to prevent splashing of fuel from residual pressure in the fuel line.

2. Remove the fuel pump installation screws, then remove the fuel pump assembly from the fuel tank



EFHA006A

3. Remove the fuel return hose and line.
4. Remove the fuel vapor hose and line

**INSPECTION** EFJB1330

1. Check the hoses and pipes for cracking, bending, deformation or restrictions.
2. Check the EVAP Canister for restrictions.
3. Check the fuel pump assembly for restrictions and damage.

**INSTALLATION** EFBB2340

1. Install the fuel vapor hose and return hoses.
  - If the fuel line has a stepped section, connect the fuel hose to the line securely, as shown in the illustration.
  - If the fuel line does not have a stepped section, connect the fuel hose to the line securely.



EFA9134A

2. Install the fuel filter and tighten the fuel filter bracket.
3. Tighten the two fitting nuts while holding the fuel filter nuts.

---

**Tightening torque**

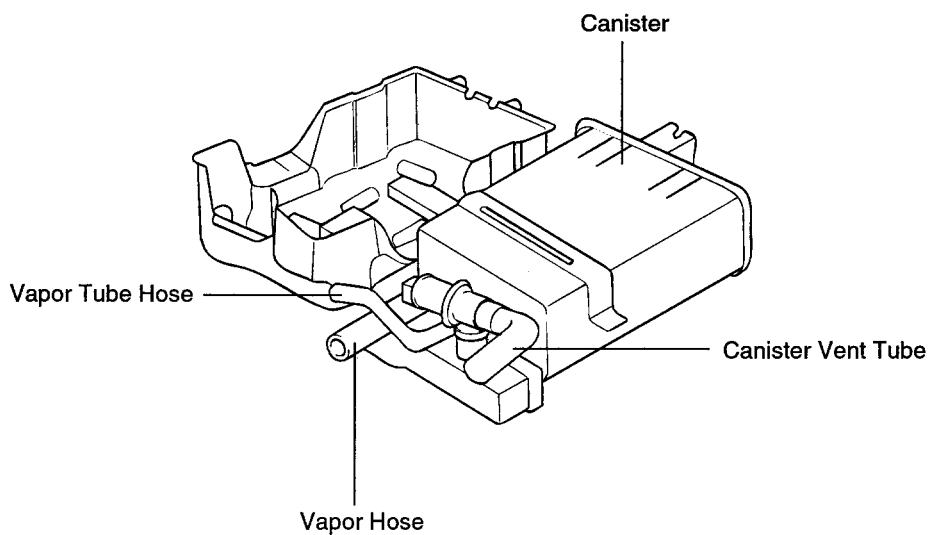
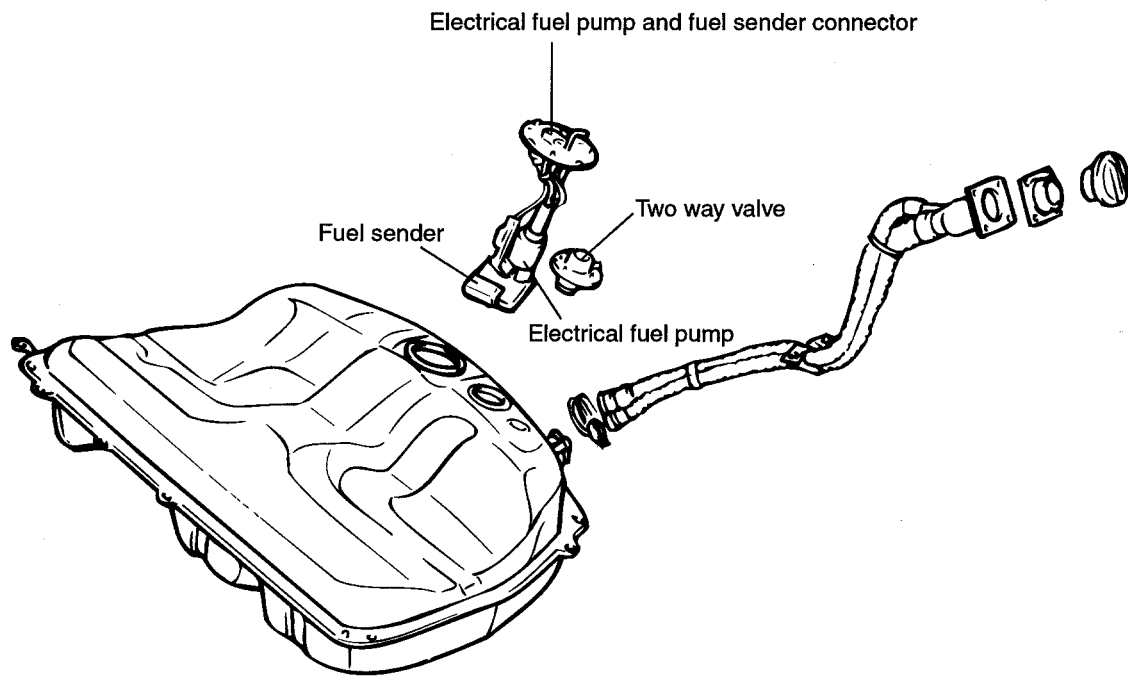
Fuel filter fitting nuts :

20-40 Nm (300-400 kg·cm, 22.1-29.5 lb-ft)

- 
4. Install the clips and make sure that they do not interfere with other components.

FUEL TANK EFMB2350

COMPONENTS



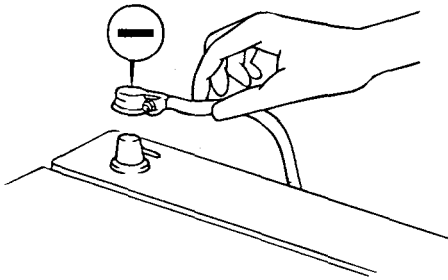
**REMOVAL** EFJB1360

1. To reduce the internal pressure of the fuel main pipes and hose, first start the engine and then disconnect the electrical fuel pump connector located near the fuel tank.

**CAUTION**

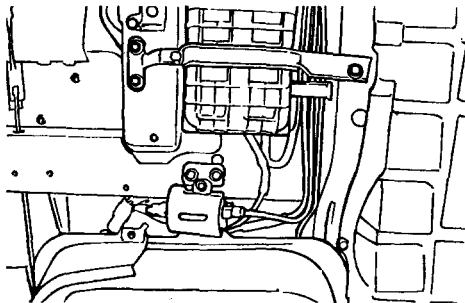
*Be sure to reduce the fuel pressure before disconnecting the fuel main pipe and hose, otherwise fuel will spill out.*

2. Disconnect the battery cable from the negative terminal of the battery.



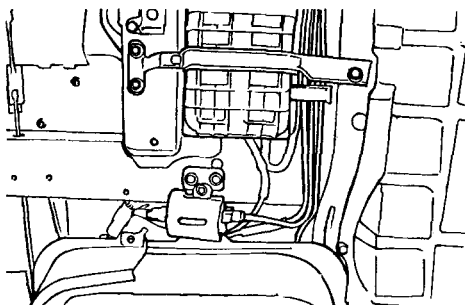
EFA9136A

3. Remove the fuel tank cap.
4. Disconnect the return hose and vapor hose.



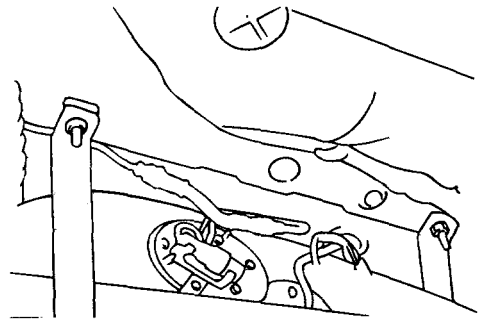
EFHA136C

5. Disconnect the fuel pump connector.
6. Disconnect the high pressure hose from the fuel tank.



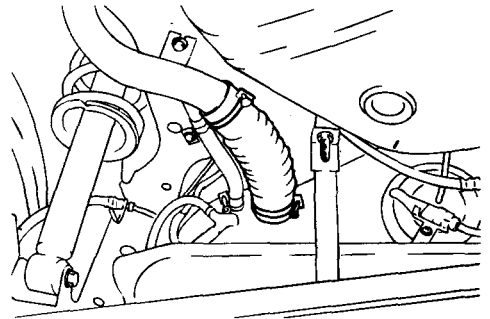
EFHA136C

7. Loosen the two self-locking nuts that hold the tank in position and remove the two tank bands.



EFA9136D

8. Detach the fuel filler hose and leveling hose.
9. Remove the fuel vapor hose and the fuel tank.

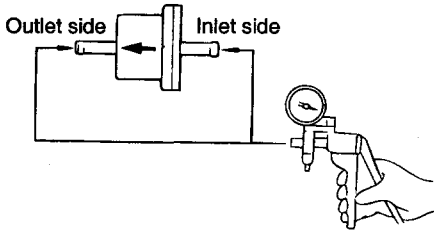


EFA9136E

**INSPECTION** EFA91370

1. Check the hoses and the pipes for cracks or damage.
2. Check the fuel tank cap for proper operation.
3. Check the fuel tank for deformation, corrosion or cracking.
4. Check the fuel tank inside for dirt or contamination.
5. Check the in-tank fuel filter for damage or restriction.
6. Test the two-way valve for proper operation.
7. Using a vacuum hand pump, check the operation of the two-way valve.

Valve pump	Guide lines for acceptance or rejection
When connected to inlet side	Negative pressure generated and vacuum maintained
When connected to outlet side	No negative pressure generated

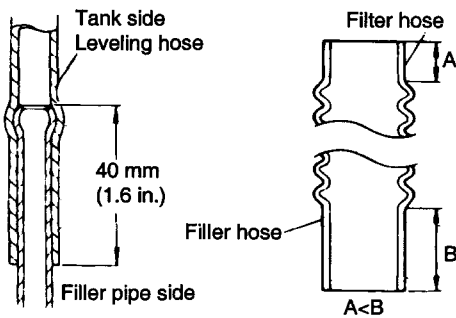


EFA9137A

**INSTALLATION**

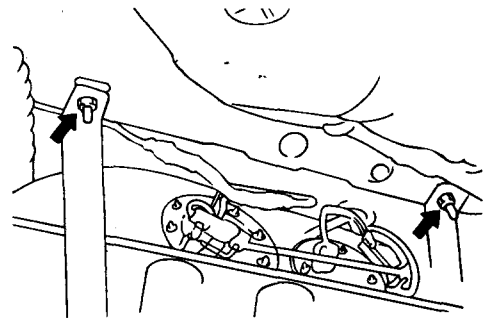
EFJB1380

1. Connect the leveling hose to the tank at approximately 40 mm (1.6 in.) of the filler neck.
2. When connecting the filler hose, connect the end with the shorter straight pipe to the tank side.



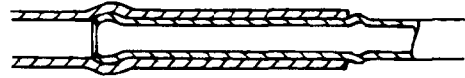
EFA9138A

3. Confirm that the pad is fully bonded to the fuel tank. Install the fuel tank by tightening the self-locking nuts to the tank bands until the rear end of the tank band contacts the body.



EFA9138B

4. Connect the vapor hose and return hose. Attach the fuel hose to the line as shown in the illustration.



EFA9138C

5. To connect the high pressure hose to the fuel pump, temporarily tighten the flare nut by hand, and then tighten it to the specified torque. Be careful that the fuel hose does not twist.

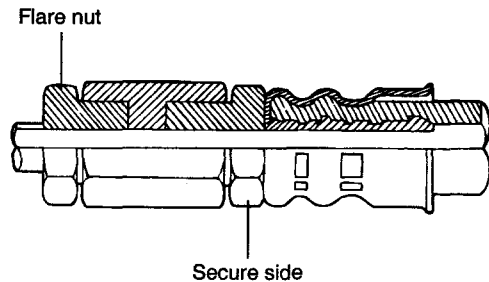
**Tightening torque**

High pressure hose flare nut :

30-40 Nm(300-400 kg·cm, 22-29 lb·ft)

**NOTE**

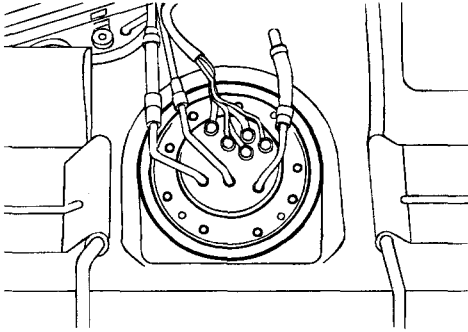
When tightening the flare nut, be careful not to bend or twist the line to prevent damage to the fuel pump connection.



EFA9138D



6. Connect the electrical fuel pump assembly connector.



EFHA006A

# TROUBLESHOOTING FOR DTC

**DIAGNOSTIC ITEM** EFM85000

DTC	Diagnostic item
P0100	Mass Air Flow Sensor Malfunction
P0101	Mass Air Flow Circuit Rang/Performance Problem
P0102	Mass Air Flow Circuit Low Voltage
P0103	Mass Air Flow Circuit High Voltage

**DESCRIPTION**

The Mass Air Flow (MAF) sensor is located near the air cleaner.

The sensor measures the mass of air passing through the air intake and generates a voltage signal. The Powertrain Control Module(PCM) receives the voltage generated by

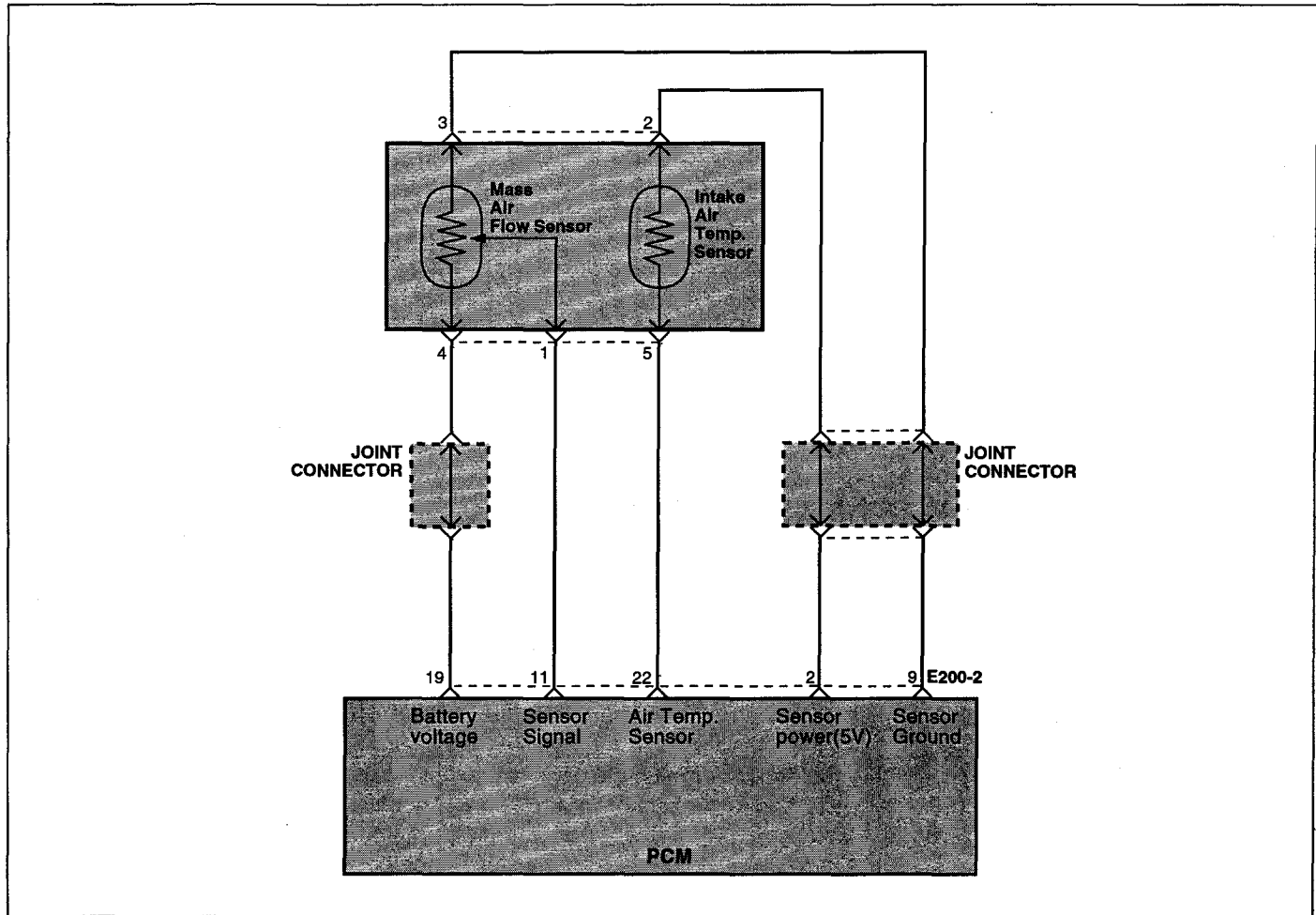
the sensor and uses the signal to set fuel injector base pulse width and ignition timing.

The resistance of the sensor decreases as mass air flow increases. Voltage and current flow is increased to maintain the film's temperature and resistivity.

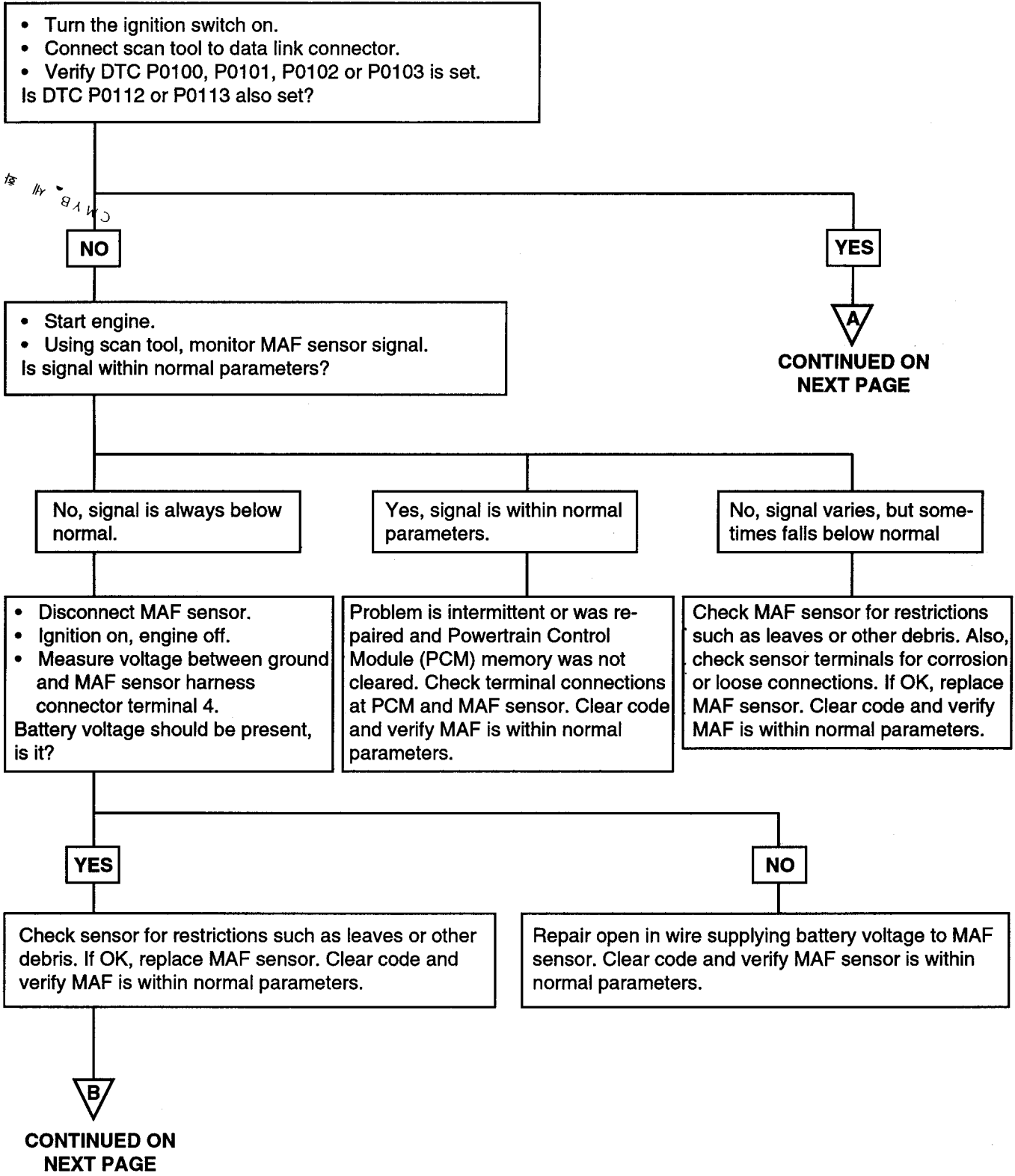
**TROUBLESHOOTING GUIDE**

DTC detection condition	Probable cause
<p><b>Background</b></p> <ul style="list-style-type: none"> <li>While the engine is running, the mass air flow sensor outputs a voltage signal which corresponds to the mass of air flow.</li> <li>The Powertrain Control Module checks whether the voltage of this signal is at or above the set value.</li> </ul> <p><b>Check Area</b></p> <ul style="list-style-type: none"> <li>At idle rpm</li> <li>Or engine speed is 3000 r/min or more</li> </ul> <p><b>Judgment Criteria</b></p> <ul style="list-style-type: none"> <li>Sensor output voltage has continued to be 0.5V or lower for 4 sec.</li> </ul> <p><b>Check Area</b></p> <ul style="list-style-type: none"> <li>Throttle position sensor voltage is 12V or lower.</li> <li>Engine speed is 2000 rpm or less.</li> </ul> <p><b>Judgment Criteria</b></p> <ul style="list-style-type: none"> <li>Sensor output voltage has continued to be 4.5V or higher for 4 seconds.</li> </ul>	<ul style="list-style-type: none"> <li>Mass air flow sensor failed</li> <li>Open or shorted mass air flow sensor circuit, or loose connector</li> <li>Powertrain control module failed</li> </ul>

CIRCUIT DIAGRAM



TEST PROCEDURE



CONTINUED FROM  
PREVIOUS PAGE

A

- Turn the ignition off.
- Disconnect MAF sensor.
- Measure resistance between ECM connector E200-2 terminal 22 and MAF sensor harness connector terminal 5. Resistance should be approximately 1 ohm or less, is it?

YES

Replace MAF sensor. Clear code and verify MAF is within normal parameters.

NO

Repair open in wire between MAF sensor harness connector terminal 5 and ECM connector E200-2 terminal 22. Clear code and verify MAF is within normal parameters.

CONTINUED FROM  
PREVIOUS PAGE

B

YES

- Ignition off, PCM and MAF sensor still disconnected.
- Ground MAF sensor harness connector terminal 3.
- Measure resistance between ground and ECM connector E200-2 terminal 9. Resistance should be approximately 1 ohm or less, is it?

YES

Verify PCM connectors are secure. If OK, replace MAF sensor with a known good component. Clear code and verify MAF sensor is within normal parameters. If problem persists, replace ECM.

NO

Repair open in wire between MAF sensor harness connector terminal 3 and PCM. Clear code and verify MAF is within normal parameters.

EFMB5020

DTC	Diagnostic item
P0110	Intake Air Temperature Sensor Malfunction
P0112	Intake Air Temperature Circuit Low Voltage
P0113	Intake Air Temperature Circuit High Voltage

**DESCRIPTION**

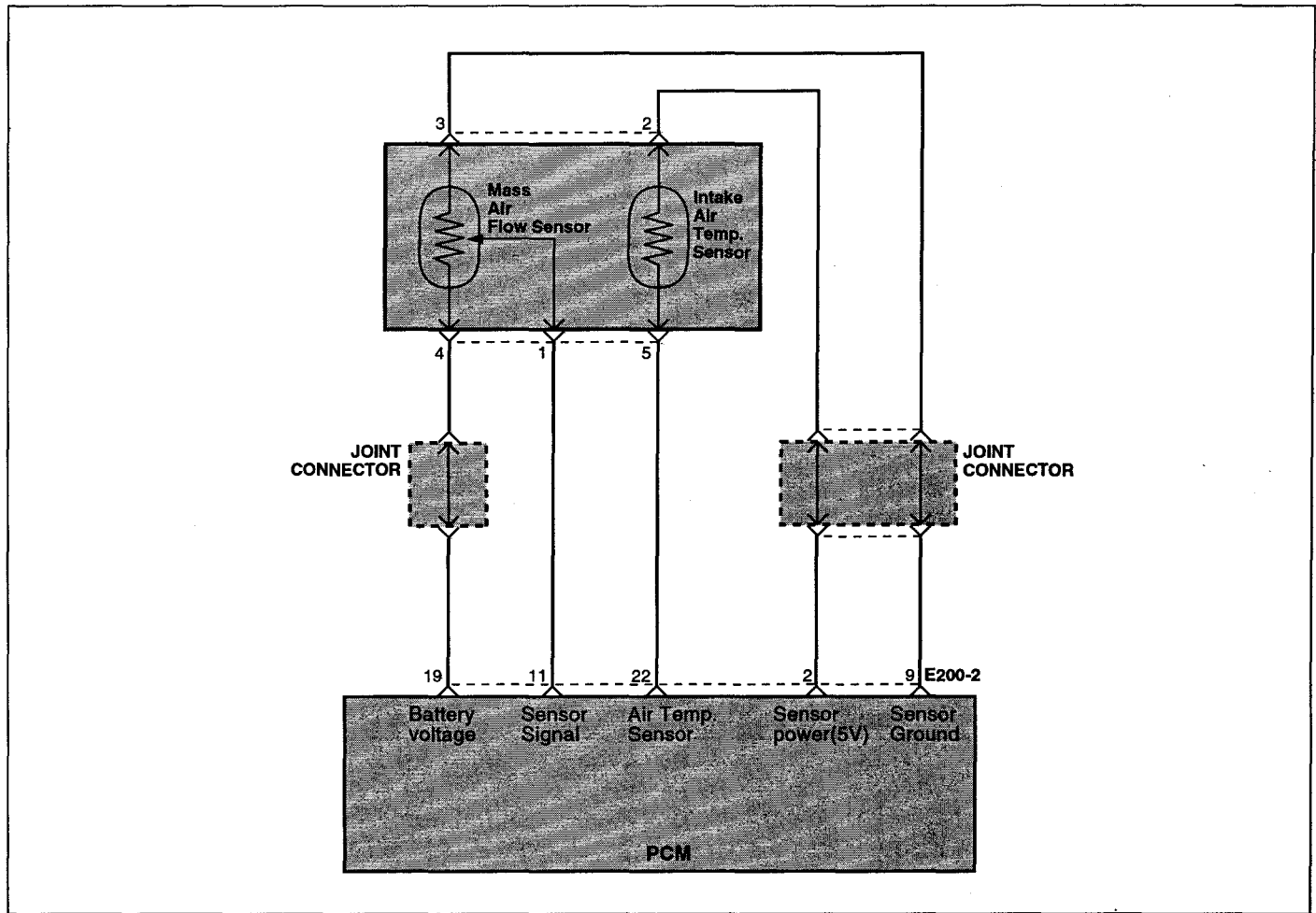
The Intake Air Temperature (IAT) sensor is in the MAF sensor. The IAT sensor is a variable resistor whose resistance changes as the temperature of the air flowing through the air intake changes. The Powertrain Control Module (PCM) uses the IAT sensor input to adjust fuel injector pulse width.

When the temperature sensed is cold, the PCM enriches fuel mixture by increasing injector pulse width; as the air warms, the injector pulse width time is shortened.

**TROUBLESHOOTING GUIDE**

DTC detection condition	Probable cause
<p><b>Background</b></p> <ul style="list-style-type: none"> <li>The intake air temperature sensor converts the intake air temperature to a voltage and outputs it.</li> <li>The powertrain control module checks whether the voltage is within a specified range.</li> </ul> <p><b>Check Area</b></p> <ul style="list-style-type: none"> <li>Sixty seconds or more have passed since the engine was started.</li> </ul> <p><b>Judgment Criteria</b></p> <ul style="list-style-type: none"> <li>Sensor output voltage has continued to be 4.6V or higher [corresponding to an intake air temperature of -45°C (-49°F) or lower] for 4 sec.</li> <li>Sensor output voltage has continued to be 0.2V or lower [corresponding to an intake air temperature of 125°C (257°F) or higher] for 4 sec.</li> </ul>	<ul style="list-style-type: none"> <li>IAT sensor failed</li> <li>Open or shorted mass air flow sensor circuit, or loose connector</li> <li>powertrain control module failed</li> </ul>

CIRCUIT DIAGRAM



TEST PROCEDURE

- Turn the ignition switch on.
- Connect scan tool to data link connector.
- Verify DTC P0110, P0112 or P0113 is set.

Is other DTC also set?

NO

YES

- Engine at ambient temperature (overnight cool down in shop recommended).
- Measure air temperature of shop.
- Turn the ignition on.
- Connect scan tool and observe intake air temperature (IAT) sensor reading.

Scanned temperature should be very close to shop air temperature, is it?



CONTINUED ON NEXT PAGE

No, scanned temperature is above air temperature of shop.

No, scanned temperature is below air temperature of shop.

Yes, scanned temperature is very close to measured air temperature of shop.

- Turn the ignition off.
- Disconnect MAF & IAT sensor.
- Turn the ignition on.
- Observe IAT sensor reading on scan tool.

Scanned temperature should now be -40°F (-4.4°C), is it?

- Turn the ignition off.
- Disconnect MAF & IAT sensor.
- Turn the ignition on.
- Measure voltage between ground and MAF & IAT harness connector terminal 2.

Voltage measured should be 4.5 to 5.0 volts, is it?

No problem found at this time. Fault is intermittent or was repaired and PCM memory was not cleared. Clear code and verify IAT sensor is within normal parameters.

NO

YES

Yes, 4.5 to 5.0 volts is present.

No, 0 volts is present.

No, 12 volts is present.

Replace MAF & IAT sensors. Clear code and verify IAT sensor is within normal parameters.

Repair short to battery voltage in wire between MAF & IAT sensor and PCM. Clear code and verify IAT sensor is within normal parameters.



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• Turn the ignition off.  
 • Disconnect MAF & IAT sensor.  
 • Measure resistance between ground and MAF & IAT sensor harness connector terminal 3.  
 Resistance should be approximately 1 ohm or less, is it?

YES

Replace MAF & IAT sensor.  
 Clear codes and verify IAT sensor is within normal parameters.

NO

Repair open in wire between MAF & IAT sensor harness connector terminal 3 and PCM. Clear codes and verify IAT sensor is within normal parameters.

CONTINUED FROM PREVIOUS PAGE



• MAF & IAT sensor disconnected.  
 • Turn the ignition off.  
 • Disconnect PCM connector.  
 • Measure resistance between ground and MAF & IAT sensor harness connector terminal 5.  
 Resistance should indicate an open circuit, does it?

NO

Repair short to ground in wire between MAF & IAT sensor harness connector terminal 5 and PCM. Clear code and verify IAT sensor is within normal parameters.

YES

Verify PCM connectors are secure  
 If OK, replace MAF & IAT sensor.  
 Clear code and verify IAT sensor is within normal parameters.  
 If problem persists, replace ECM.

CONTINUED FROM PREVIOUS PAGE



• MAF & IAT sensor disconnected.  
 • Turn the ignition off.  
 • Disconnect PCM connector C44-2.  
 • Ground MAF & IAT sensor harness connector terminal 1.  
 • Measure resistance between ground and PCM connector C44-2 terminal 9.  
 Resistance should be approximately 1 ohm or less, is it?

YES

Repair open in wire between MAF & IAT sensor harness connector terminal 5 and PCM. Clear code and verify IAT sensor is within normal parameters.

NO

EFMB5030

DTC	Diagnostic item
P0115	Engine Coolant Temperature Circuit Malfunction (Open/Short)
P0116	Engine Coolant Temperature Circuit Drift
P0125	Insufficient Coolant Temperature For Feed-Back Control

**DESCRIPTION**

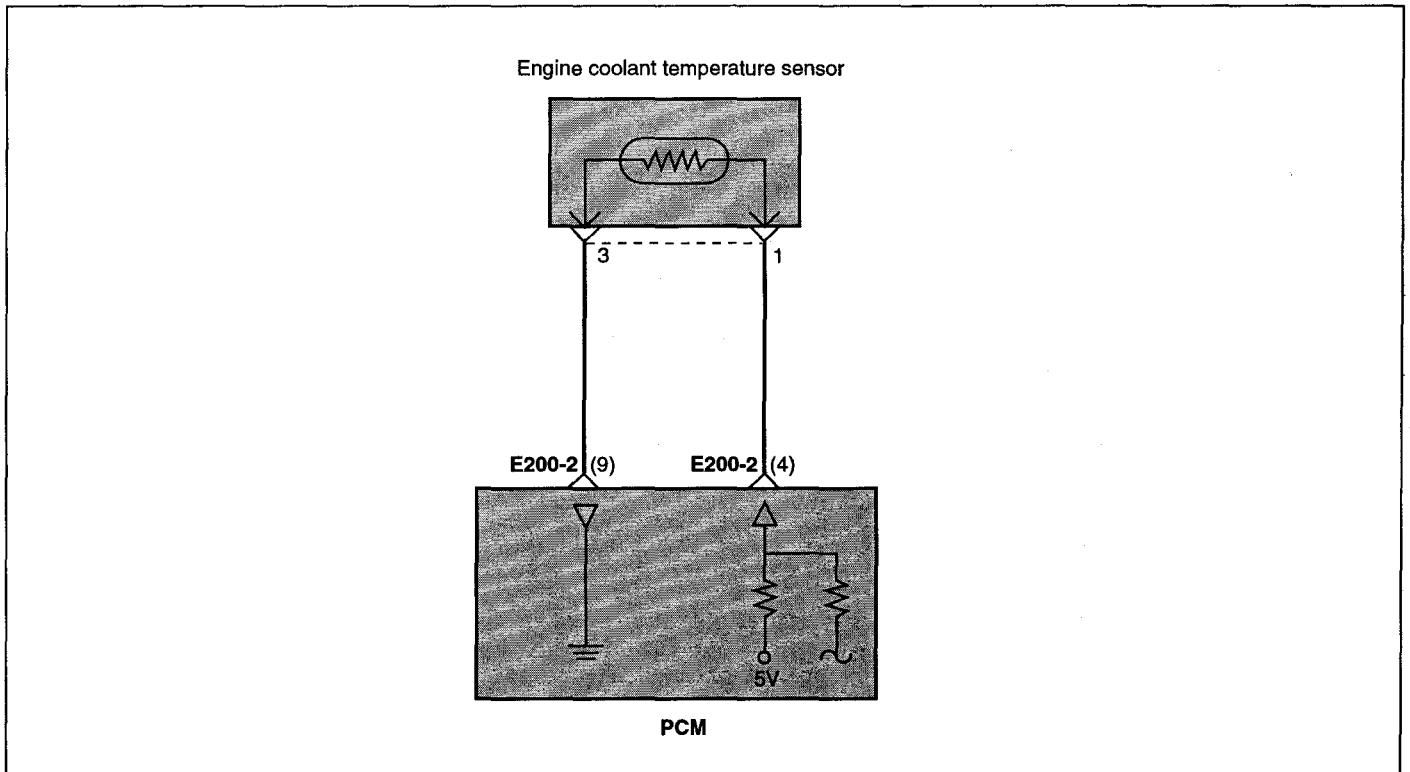
The Engine Coolant Temperature (ECT) sensor is located in a coolant passage of the cylinder head. The ECT sensor is a variable resistor whose resistance changes as the temperature of the engine coolant flowing past the sensor changes. When the coolant temperature is low, the sensor resistance is high; when the coolant temperature is high,

the sensor resistance is low. The Powertrain Control Module (PCM) checks ECT voltage fifty times per second and uses the information to help adjust the fuel injector pulse width and ignition timing. When the temperature sensed is very cold, the PCM enriches the fuel mixture.

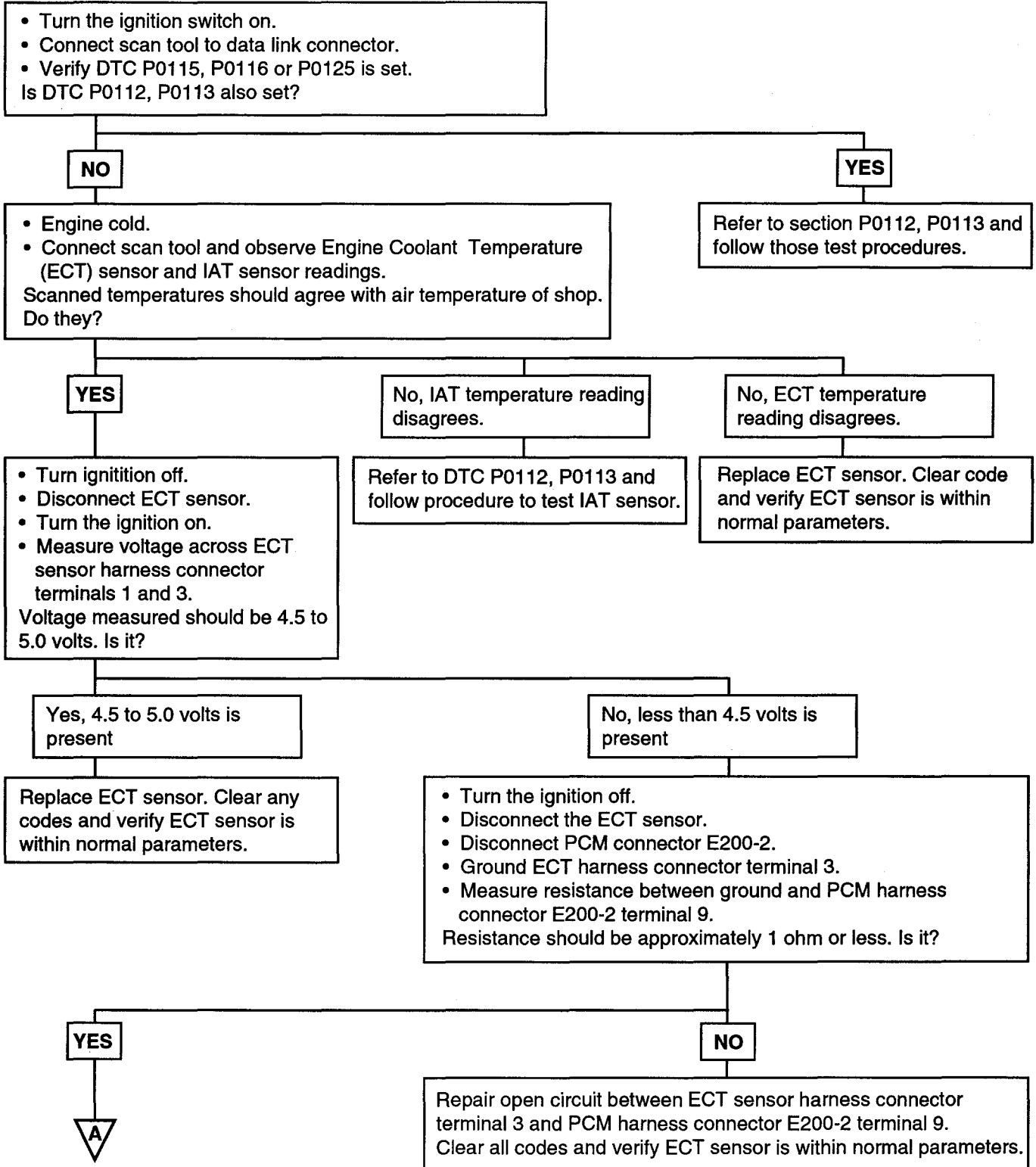
**TROUBLESHOOTING GUIDE**

DTC detection condition	Probable cause
<p><b>Background</b></p> <ul style="list-style-type: none"> <li>The engine coolant temperature sensor converts the engine coolant temperature to a voltage and outputs it.</li> <li>The Powertrain Control Module checks whether the voltage is within a specified range. In addition, it checks that the engine coolant temperature (signal) does not drop while the engine is warming up.</li> </ul> <p><b>Malfunction; out-of-range</b></p> <ul style="list-style-type: none"> <li>Sensor output voltage has continued to be 4.6V or higher [corresponding to a coolant temperature of -45°C (-49°F) or lower] for 4 sec.</li> <li>Sensor output voltage has continued to be 0.1V or lower [corresponding to a coolant temperature of 140°C (284°F) or higher] for 4 sec.</li> </ul> <p><b>Malfunction; out-of-range</b></p> <ul style="list-style-type: none"> <li>Sensor output voltage increased from a value lower than 1.6V to a value higher than 1.6V [Coolant temperature decreases from higher than 40°C (104°F) temperature to lower than 40°C (104°F) temperature.].</li> <li>Sensor output voltage has continued to be 1.6V or higher for 5 min.</li> </ul> <p><b>Judgment Criteria, Proper Performance</b></p> <ul style="list-style-type: none"> <li>The Engine Coolant Temperature is approx. 40°C (104°F) or less after starting sequence is completed.</li> <li>Approx. 60 - 300 seconds have passed for the engine coolant temperature to rise to about 40°C (104°F) after starting sequence was completed.</li> </ul>	<ul style="list-style-type: none"> <li>Engine Coolant Temperature sensor failed.</li> <li>Open or shorted Engine Coolant Temperature sensor circuit, or loose connector.</li> <li>Powertrain Control Module failed.</li> </ul>

CIRCUIT DIAGRAM



TEST PROCEDURE



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PREVIOUS PAGE

A

- Turn the ignition off.
  - Disconnect the ECT sensor.
  - Disconnect PCM connector E200-2.
  - Measure resistance between ground and PCM harness connector E200-2 terminal 9.
- Resistance should indicate an open circuit. Does it?

YES

NO

Repair short to ground between ECT sensor harness connector terminal 3 and PCM harness connector E200-2 terminal 9. Clear all codes and verify ECT sensor is within normal parameters.

- Turn the ignition off.
  - Disconnect the ECT sensor.
  - Disconnect PCM connector E200-2.
- Measure resistance between ground and ECT sensor harness connector terminal 1.  
Resistance should indicate an open circuit. Does it?

YES

NO

Verify PCM connector is secure. Replace ECT sensor with a known good component. If problem persists, replace PCM. Clear code and verify ECT sensor is within normal parameters.

Repair open circuit between ECT sensor harness connector terminal 1 and PCM harness connector E200-2 terminal 4. Clear any codes and verify ECT sensor is within normal parameters.

EFMB5040

DTC	Diagnostic item
P0120	Throttle Position Circuit Malfunction
P0122	Throttle Position Circuit Low Voltage
P0123	Throttle Position Circuit High Voltage

**DESCRIPTION**

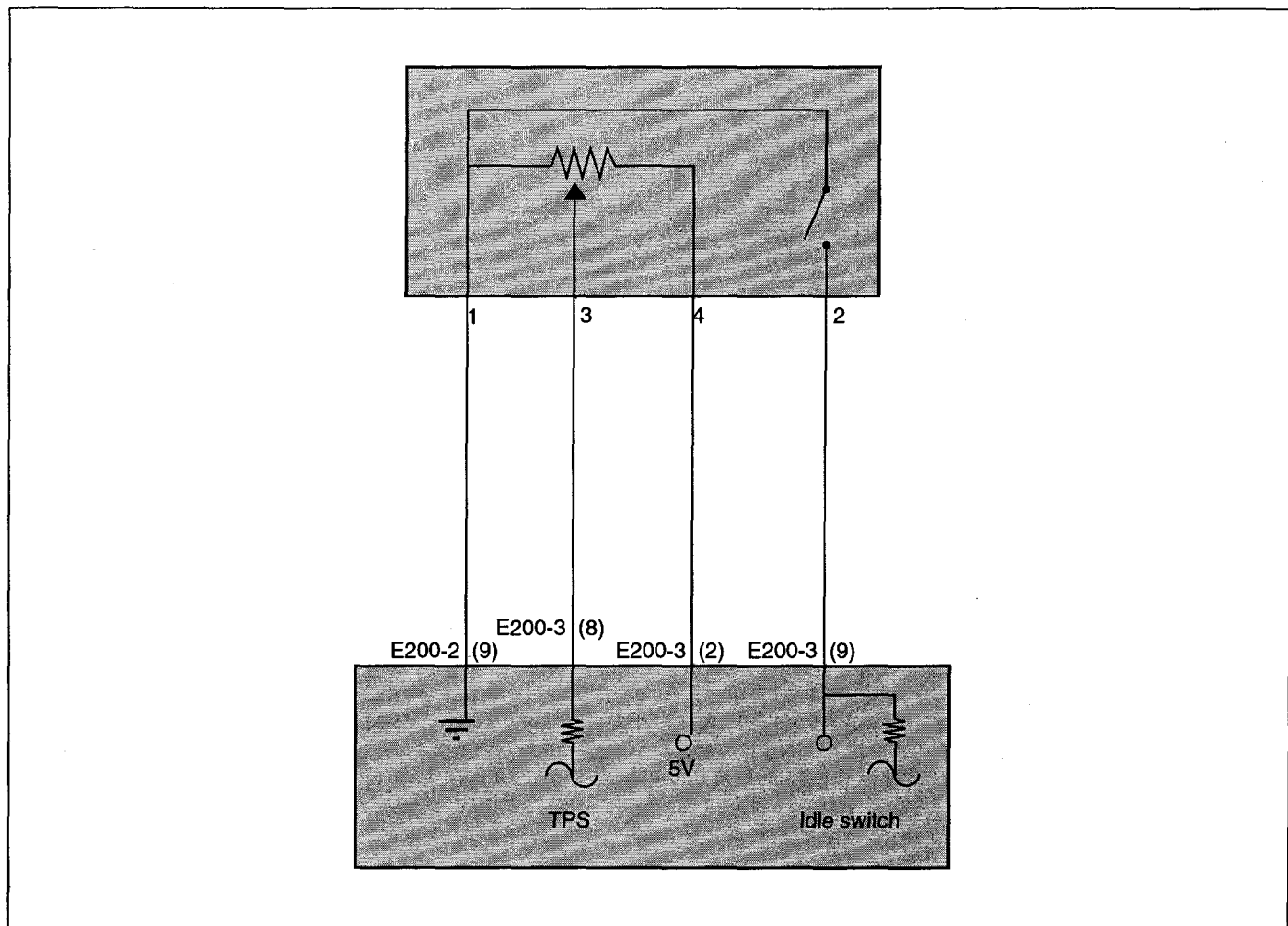
The throttle position sensor (TPS) mounts on the side of the throttle body and is connected to the throttle blade shaft. The TPS is a variable resistor (potentiometer) whose resistance changes according to the throttle blade shaft position. During acceleration, the TPS resistance decreases; during deceleration, the TPS resistance increases. The TPS also includes an idle position switch. The switch is closed in the idle position. The Powertrain

Control Module (PCM) applies a reference voltage to the TPS and then measures the voltage that is present on the TPS signal circuit. The PCM uses the TPS signal to adjust the timing and injector pulse width. The TPS signal along with the MAP sensor signal is used by the PCM to calculate the engine load.

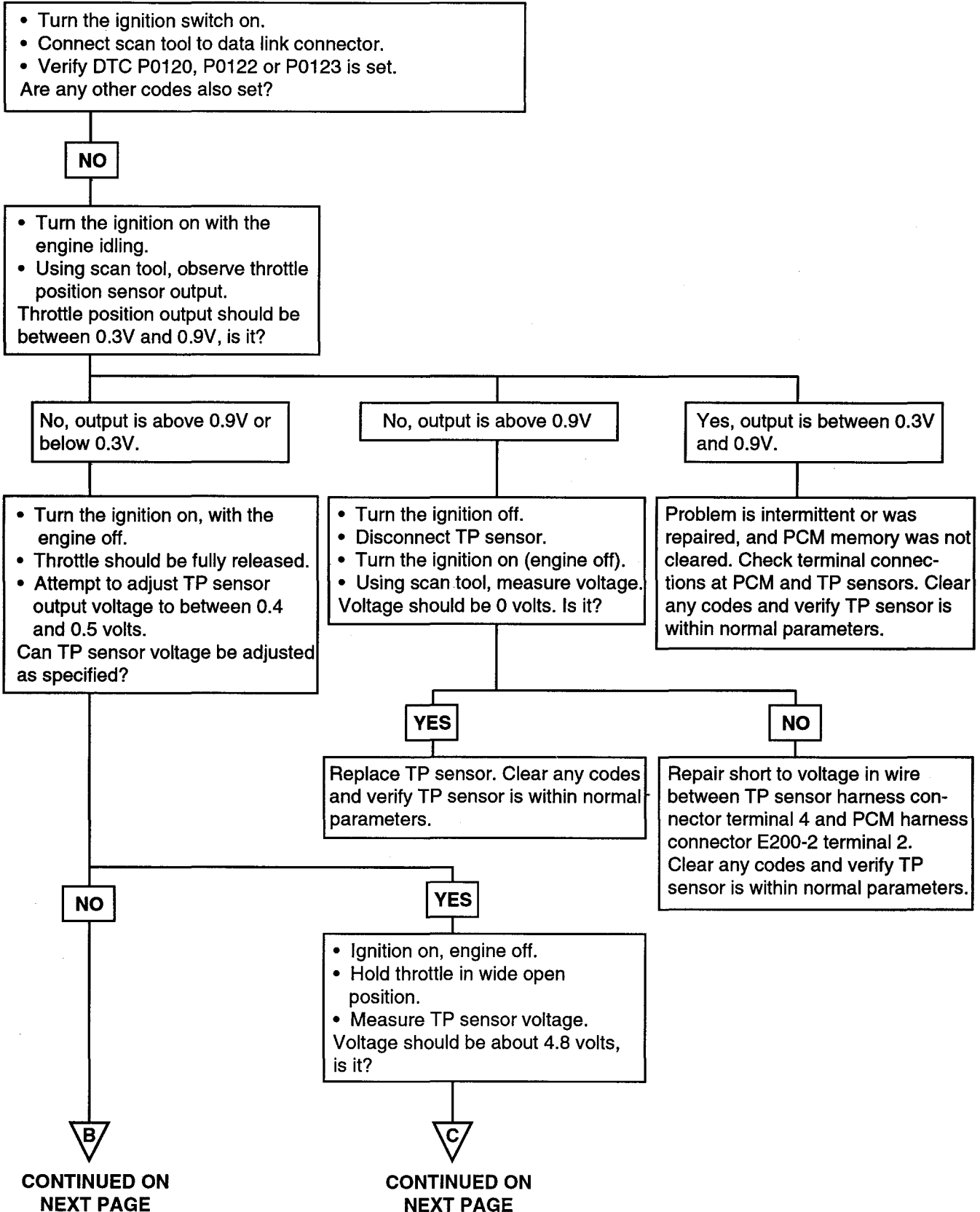
**TROUBLESHOOTING GUIDE**

DTC detection condition	Probable cause
<p><b>Background</b></p> <ul style="list-style-type: none"> <li>• The Throttle Position sensor outputs a voltage which is proportional to the throttle valve opening angle.</li> <li>• The Powertrain Control Module checks whether the voltage output by the throttle position sensor is within a specified range. In addition, it checks that the voltage output does not become too large while the engine is idling.</li> </ul> <p><b>Malfunction; out-of-range</b></p> <ul style="list-style-type: none"> <li>• With the close Throttle Position switch set to ON, the sensor output voltage has continued to be 2V or higher for 4 sec.</li> <li>• Sensor output voltage has continued to be 0.2V or lower for 4 sec.</li> </ul> <p><b>Operating parameters</b></p> <ul style="list-style-type: none"> <li>• Engine speed is between 500 and 3,000 rpm.</li> <li>• Engine load is lower than 30%.</li> </ul> <p><b>Proper Performance</b></p> <ul style="list-style-type: none"> <li>• Sensor output voltage has continued to be 4.6V or higher for 4 sec.</li> </ul>	<ul style="list-style-type: none"> <li>• Throttle Position sensor failed or maladjusted.</li> <li>• Open or shorted Throttle Position sensor circuit, or loose connector.</li> <li>• Closed Throttle Position switch ON malfunction.</li> <li>• Closed Throttle Position switch signal wire shorted.</li> <li>• Powertrain control module failed.</li> </ul>

CIRCUIT DIAGRAM



TEST PROCEDURE





CONTINUED FROM  
PREVIOUS PAGE

**B**

- Turn the ignition off.
- Disconnect TP sensor.
- Turn the ignition on.
- Using a voltmeter, measure voltage between ground and TP sensor harness connector terminal 4.

5 volts should be present. Is it?

**YES**

- Turn the ignition on with the engine off.
- Disconnect the TP sensor.
- Measure resistance between ground and TP sensor harness connector terminal 1.

Resistance should be approximately 1 ohm or less. Is it?

**YES**

- Connect a fused jumper across TP sensor harness connector terminal 1 and terminals 4.
- Using scan tool, observe TP sensor's output voltage.

Voltage should be above 4.8 volts. Is it?

**NO**

- Turn the ignition off.
- Fused jumper in place.
- Measure voltage (backprobe) between PCM connector E200-3 terminal 2 and ETS connector E200-2 terminal 4.

5 volts should be present. Is it?

**D**

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NEXT PAGE

**NO**

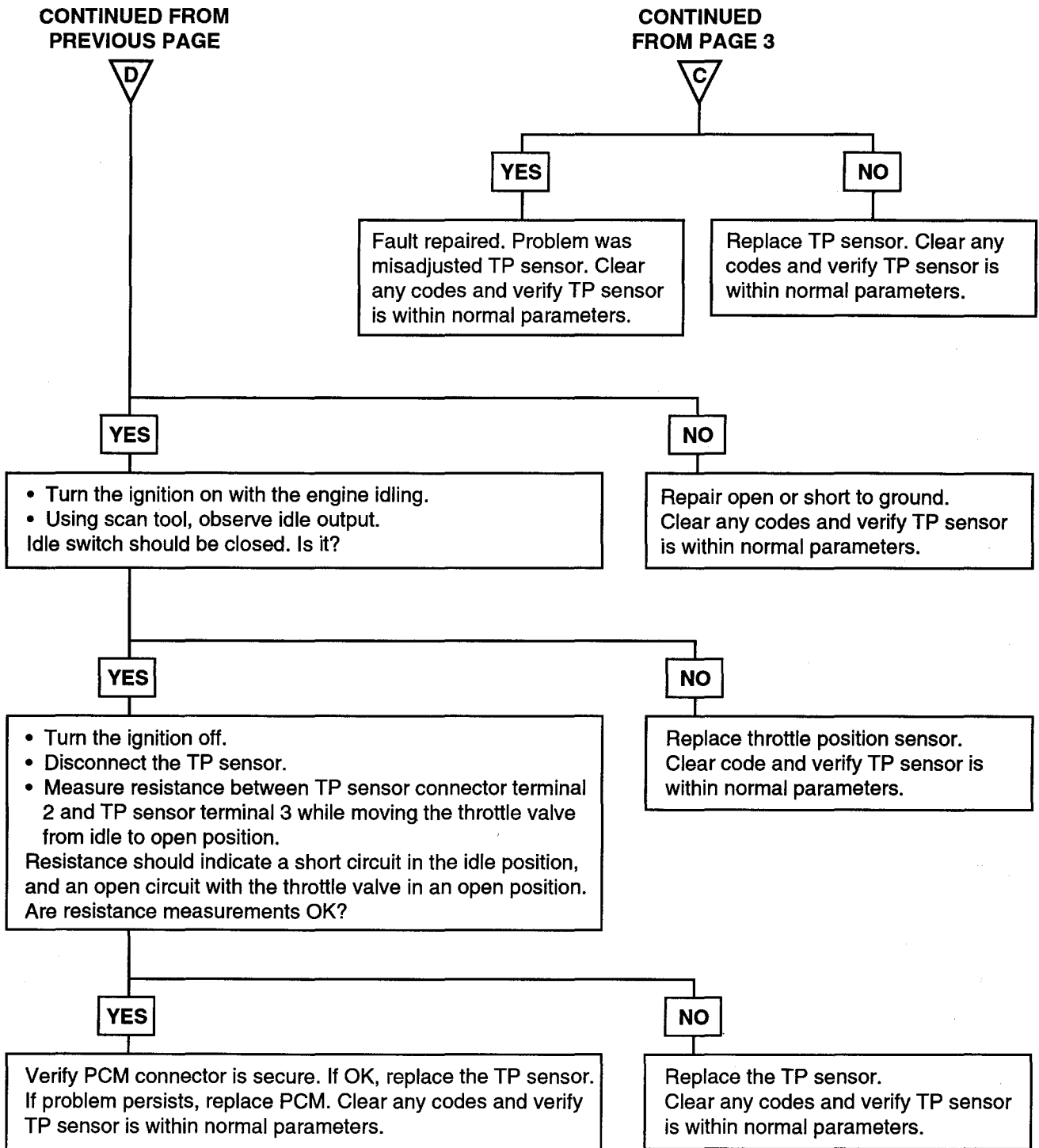
Repair open in wire between TP sensor harness connector terminal 4 and PCM harness connector E200- terminal 2.  
Clear any codes and verify TP sensor is within normal parameters.

**NO**

Repair poor ground or open in wire between TP sensor harness connector terminal 1 and PCM harness connector E200-2 terminal 2.  
Clear code and verify TP sensor is within normal parameters.

**YES**

Replace TP sensor.  
Clear code and verify TP sensor is within normal parameters.



EFMB5060

DTC	Diagnostic item
P0132	Oxygen Sensor Circuit Malfunction -Open (Bank 1, Sensor 1)
P0133	Oxygen Sensor Circuit Malfunction (Bank 1, Sensor 1)
P0150	Oxygen Sensor Circuit Malfunction (Bank 2, Sensor 1)
P0152	Oxygen Sensor Circuit Malfunction Open (Bank 2, Sensor 1)

## DESCRIPTION

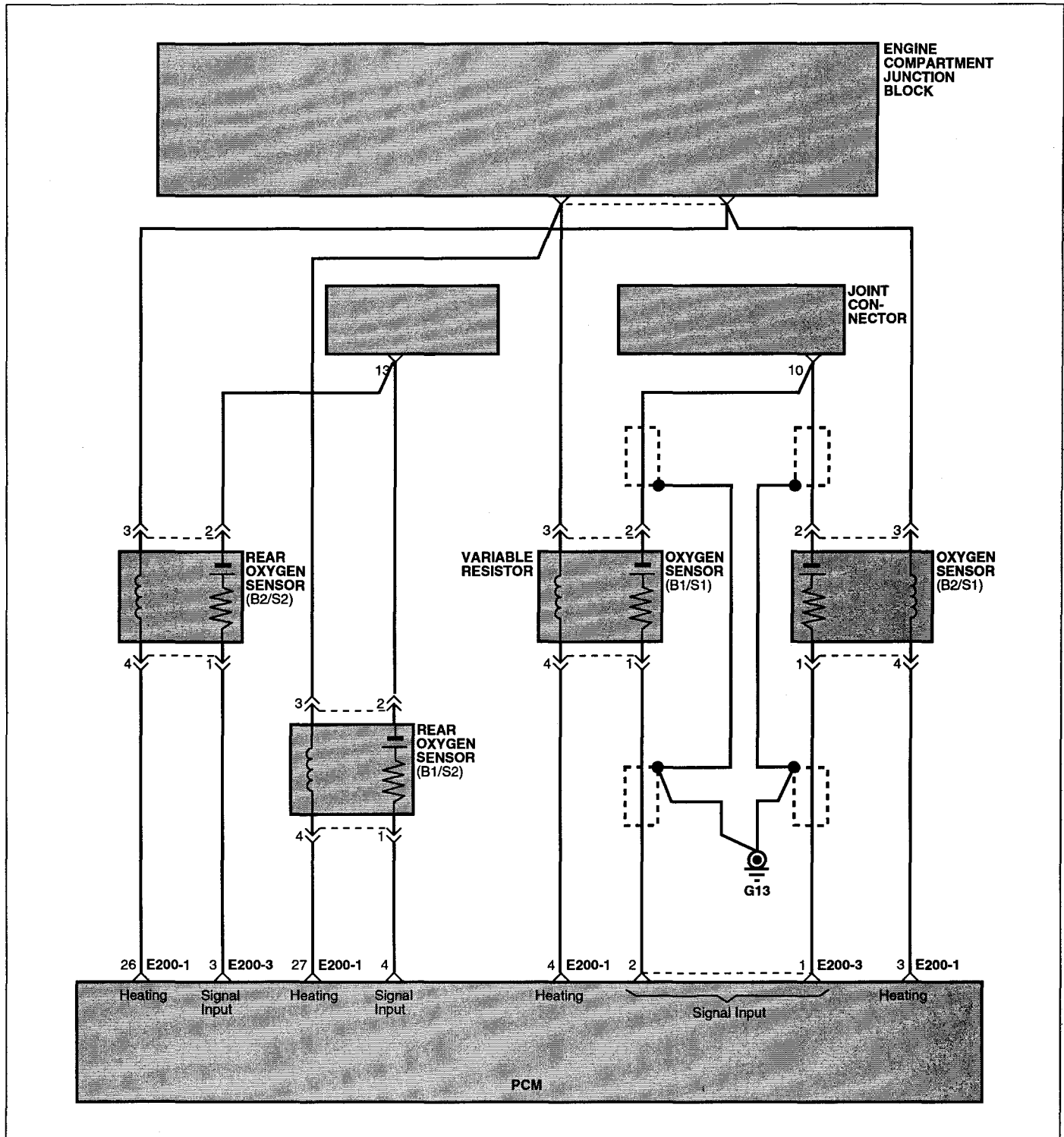
To obtain a high purification rate for the CO, HC and NO<sub>x</sub> components of the exhaust gas, a three way catalytic converter is used, but for the most efficient use of the three-way catalytic converter, the ratio of the air must be precisely controlled so that it is always close to the stoichiometric air-fuel ratio. The oxygen sensor has the characteristic whereby its output voltage changes suddenly in the vicinity of the stoichiometric air-fuel ratio. This characteristic is used to detect the oxygen concentration in the exhaust gas and provide feedback to the computer for control of the air-fuel ratio. When the air-fuel ratio becomes LEAN, the oxygen concentration in the exhaust increases and the oxygen sensor informs the PCM of the LEAN condition. When the air-fuel ratio is RICHER than the stoichiometric air-fuel ratio the oxygen concentration in the exhaust gas is reduced and the oxygen sensor informs the PCM of the RICH condition.

The PCM determines by the electromotive force from the oxygen sensor whether the air-fuel ratio is RICH or LEAN and controls the injection time accordingly. However, if malfunction of the oxygen sensor causes output of abnormal electromotive force, the PCM is unable to perform an accurate air-fuel ratio control. The heated oxygen sensors include a heater which heats the sensing element. The heater is controlled by the PCM. When the intake air volume is low (the temperature of the exhaust gas is low), current flows to the heater to heat the sensor for accurate oxygen concentration detection.

## TROUBLESHOOTING GUIDE

DTC detection condition	Probable cause
<p><b>Background</b></p> <ul style="list-style-type: none"> <li>• When the heated oxygen sensor begins to deteriorate, the oxygen sensor signal response becomes poor.</li> <li>• The Powertrain Control Module forcibly varies the air/fuel mixture to make it leaner and richer and checks the response speed of the heated oxygen sensor.</li> </ul> <p>In addition, the Powertrain Control Module also checks for an open circuit in the heated oxygen sensor output line.</p> <p><b>Malfunction; out-of-range</b></p> <ul style="list-style-type: none"> <li>• Coolant temperature sensor: Normal.</li> <li>• Heated oxygen sensor signal voltage has continued to be 0.1V or lower for 3 min. or more after the starting sequence was completed.</li> <li>• Engine Coolant Temperature is higher than 80°C (176°F).</li> <li>• Engine speed is higher than 1,200 r/min.</li> <li>• Engine load is 25% or more. Judgment Criteria</li> <li>• Input voltage supplied to the Powertrain Control Module interface circuit is 4.5V or more when 5V is applied to the heated oxygen sensor output line via a resistor.</li> </ul> <p><b>Proper Operation</b></p> <ul style="list-style-type: none"> <li>• Coolant temperature sensor: Normal.</li> <li>• Engine Coolant Temperature is 50°C (122°F) or more.</li> <li>• Engine speed is between 1,500 and 3,000 r/min or 1,100 and 3,000 r/min.</li> <li>• Engine load is 25 - 60%.</li> <li>• Intake air temperature is -10°C (14°F) or more.</li> <li>• Under the closed loop air-fuel control.</li> <li>• Monitoring Time: 8sec.</li> </ul> <p><b>Failure Criteria</b></p> <ul style="list-style-type: none"> <li>• When the air-fuel ratio is forcibly changed (lean to rich and rich to lean), the heated oxygen sensor signal doesn't provide response within 1.28 sec.</li> <li>• Monitored only once per trip.</li> </ul>	<ul style="list-style-type: none"> <li>• Heated oxygen sensor deteriorated</li> <li>• Open circuit in heated oxygen sensor output line</li> <li>• Powertrain control module failed</li> </ul>

CIRCUIT DIAGRAM



TEST PROCEDURE

• Turn the ignition switch on.  
• Connect scan tool to data link connector.  
• Verify DTC P0132, P0133, P0150 or P0152 is set.  
Are other DTCs also set?

NO

YES

• Start engine and warm it to normal operating temperature.  
• Turn on air conditioning (if equipped).  
• Increase engine speed to 4000 RPM and, using scan tool, monitor oxygen sensor voltage.  
Voltage should vary between 0 and 900mV. Does it?

First, repair conditions that caused other DTCs to be set. Refer to DTC test procedures.

No, voltage is constant and the reading is between 19 and 58mV.

No, voltage is constant and approximately 5 or 12 volts.

No, 0 volts present.

No, voltage varies but stays below 500mV (lean).

No, voltage varies but stays above 500mV (rich).

Yes, voltage varies between 100 and 900mV.

Repair short to voltage in wiring harness. Clear code and verify oxygen sensor is within normal parameters.



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• While running the engine, measure voltage (backprobe) between front oxygen sensor connector terminals 1 and 2.  
Does voltage read above and below 500mV?

• Disconnect oxygen sensor connector.  
Does voltage now read between 19 and 58mV on scan tool?



CONTINUED ON NEXT PAGE

NO

YES

Repair short to ground in wire between oxygen sensor harness connector terminal 1 and ground. Clear code and verify oxygen sensor is within normal parameters.

Replace oxygen sensor. Clear code and verify oxygen sensor is within normal parameters.

CONTINUED FROM PREVIOUS PAGE

A

YES

- Turn the ignition off.
- Disconnect front oxygen sensor.
- Disconnect PCM connector.
- Ground front oxygen sensor harness connector terminal 1.
- Measure resistance between ground and the related PCM harness connector E200-3 terminal.

Resistance measured should be approximately 1 ohm or less. Is it?

NO

Replace oxygen sensor. Clear code and verify oxygen sensor is within normal parameters.

YES

Verify PCM connectors are secure. If OK, replace Front Oxygen sensor with a known component of good quality. Clear code and verify oxygen sensor is within normal parameters. If problem persists, replace PCM.

NO

Repair open wire or cause of high resistance. Clear code and verify oxygen sensor is within normal parameters.

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B

Voltage varies but stays below 500mV (lean).

- Inspect air inlet downstream of air flow sensor for leaks or damage.
- Inspect exhaust manifold for cracks.

Are any leaks or damage found?

YES

Repair leaks or replace exhaust manifold. Clear code and verify oxygen sensor is within normal parameters.

NO

- Perform a fuel pressure test

Is fuel pressure within specification and no pressure leak down is observed?

E

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C

Voltage varies but stays above 500mV (rich).

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Voltage varies between 0 and 900mV.

YES

- Turn the ignition off.
- Disconnect the connector at the ignition coil.
- Measure voltage drop across negative battery cable by connecting voltmeter between negative battery post and cable attachment point on engine while cranking the engine. Measured voltage drop should be less than 0.5 volts, is it?

YES

- Disconnect negative battery terminal.
- Measure resistance between generator case and an engine ground point. Resistance measured should be approximately 1 ohm or less. Is it?

YES

- If Malfunction Indicator Lamp (MIL) is turned on intermittently and DTC P0133 is set, the problem is most likely a poor ground circuit. Clean negative battery terminal and engine ground. Also clean mating surfaces of generator housing and engine block.
- If Malfunction Indicator Lamp (MIL) was on and DTC P0133 is set, replace oxygen sensor.
- Clear code and verify oxygen sensor is within normal parameters.

CONTINUED FROM PREVIOUS PAGE



NO

Follow diagnostic procedures. Clear code and verify oxygen sensor is within normal parameters.

NO

Replace negative battery cable. Clear code and verify oxygen sensor is within normal parameters.

NO

Clean mating surfaces of generator housing and engine block. Clear code and verify oxygen sensor is within normal parameters.



EFMB5070

DTC	Diagnostic item
P0135 P0155	Oxygen Sensor Heater Circuit Malfunction (Bank 1, Sensor 1) Oxygen Sensor Heater Circuit Malfunction (Bank 2, Sensor 1)

**DESCRIPTION**

To obtain a high purification rate for the CO, HC and NOx components of the exhaust gas, a three way catalytic converter is used, but for the most efficient use of the three-way catalytic converter, the ratio of the air must be precisely controlled so that it is always close to the stoichiometric air-fuel ratio. The oxygen sensor has the characteristic whereby its output voltage changes suddenly in the vicinity of the stoichiometric air-fuel ratio. This characteristic is used to detect the oxygen concentration in the exhaust gas and provide feedback to the computer for control of the air-fuel ratio. When the air-fuel ratio becomes LEAN, the oxygen concentration in the exhaust increases and the oxygen sensor informs the PCM of the LEAN condition. When the air-fuel ratio is RICHER than the stoichiometric air-fuel ratio the oxygen concentration

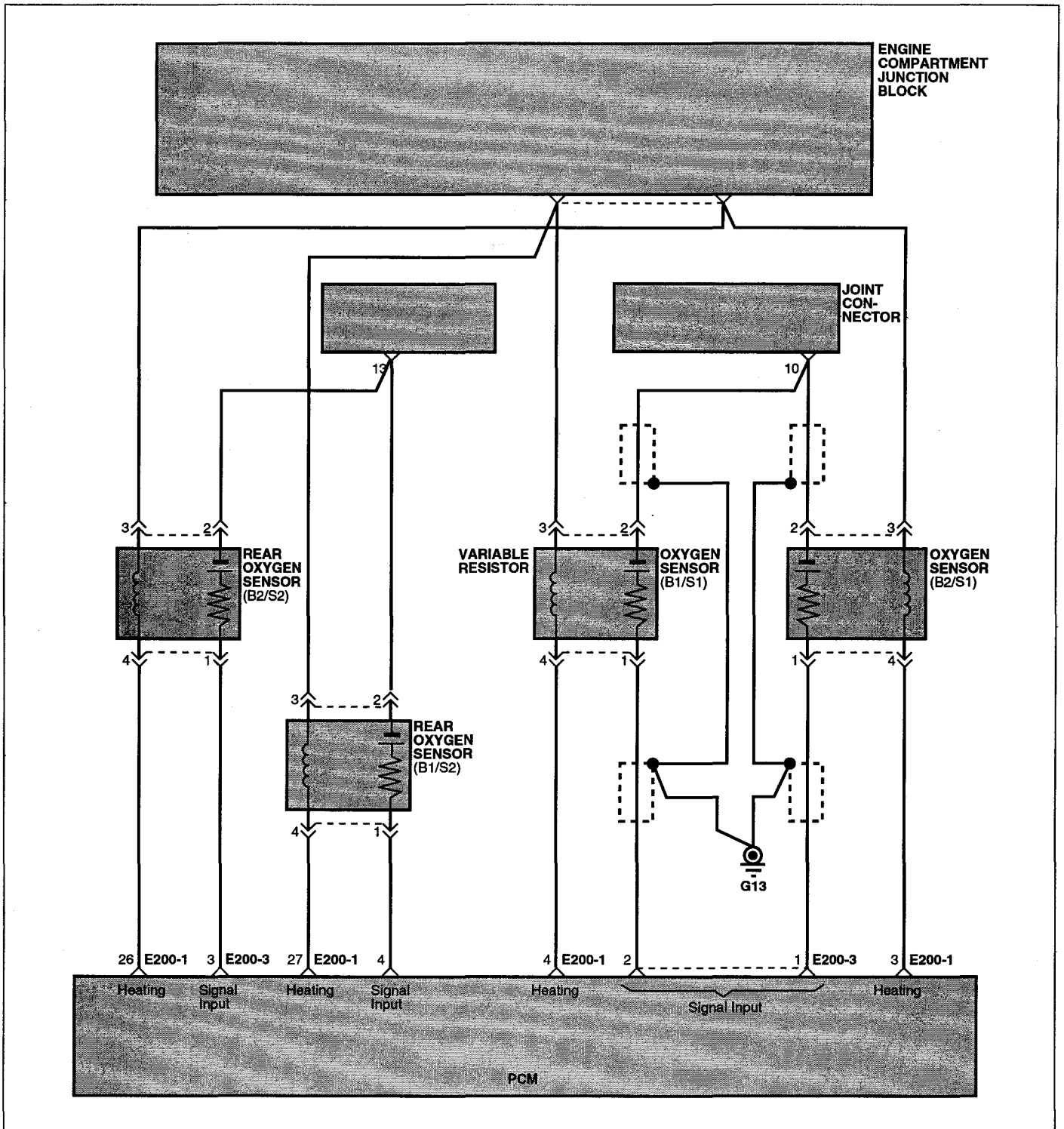
in the exhaust gas is reduced and the oxygen sensor informs the PCM of the RICH condition.

The PCM determines by the electromotive force from the oxygen sensor whether the air-fuel ratio is RICH or LEAN and controls the injection time accordingly. However, if malfunction of the oxygen sensor causes output of abnormal electromotive force, the PCM is unable to perform an accurate air-fuel ratio control. The heated oxygen sensors include a heater which heats the sensing element. The heater is controlled by the PCM. When the intake air volume is low (the temperature of the exhaust gas is low), current flows to the heater to heat the sensor for accurate oxygen concentration detection.

**TROUBLESHOOTING GUIDE**

DTC detection condition	Probable cause
<p><b>Background</b></p> <ul style="list-style-type: none"> <li>The Powertrain Control Module checks whether the heater current is within a specified range when the heater is energized.</li> </ul> <p><b>Check Area</b></p> <ul style="list-style-type: none"> <li>Battery voltage is between 12 and 16V.</li> </ul> <p><b>Judgment Criteria</b></p> <ul style="list-style-type: none"> <li>The heater current of the front heated oxygen sensor heater (Bank 1 Sensor 1 and Bank 2 Sensor 1) has continued to be 0.2 A or less, or 3.5 A or higher for 6 sec.</li> <li>Monitored only once per trip.</li> </ul>	<ul style="list-style-type: none"> <li>Open or shorted oxygen sensor heater circuit</li> <li>Open circuit in oxygen sensor heater</li> <li>Powertrain control module failed</li> </ul>

CIRCUIT DIAGRAM



## TEST PROCEDURE

- Turn the ignition switch on.
- Connect scan tool to data link connector.
- Verify DTC P0135 or P0155 is set.

- Disconnect front oxygen sensor.
- Start engine.
- Measure voltage between oxygen sensor harness connector terminal 3 and ground. Voltage should be between 12 and 16 volts. Is it?

YES

NO

- Turn the ignition switch off.
- Disconnect the front oxygen sensor.
- Disconnect the related PCM connector.
- Ground front oxygen sensor harness terminal 4.
- Measure resistance between ground and PCM harness connector E200-1 terminal 4 or E200-3 terminal 1. Resistance should be 1 ohm or less. Is it?

Repair open or short to ground in wire between engine compartment junction block terminal and oxygen sensor harness connector terminal 3. Clear code and verify oxygen sensor is within normal parameters.

YES

NO

- Turn the ignition switch off.
- Disconnect the front oxygen sensor.
- Disconnect the related PCM connector.
- Measure resistance between ground and oxygen sensor harness connector terminal 4. Resistance should indicate an open circuit. Does it?

Repair open in wire between oxygen sensor harness connector terminal 4 and the related PCM harness connector terminal. Clear code and verify oxygen sensor is within normal parameters.



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YES

NO

• Turn the ignition switch off.  
• Disconnect the front oxygen sensor.  
• Measure resistance between terminals 3 and 4 of oxygen sensor connector.  
Is resistance within normal parameters (11 - 14 ohms)?

Repair short to ground or another circuit in wire between oxygen sensor harness connector terminal 4 and the related PCM harness connector terminal.  
Clear code and verify oxygen sensor is within normal parameters.

YES

NO

Verify PCM connector is secure. If OK, replace Front Oxygen Sensor with a known good component. Clear code and verify oxygen sensor is within normal parameters. If problem persists, replace PCM.

Replace oxygen sensor. Clear code and verify oxygen sensor is within normal parameters.

EFMB5080

DTC	Diagnostic item
P0136	Oxygen Sensor Circuit Malfunction - Open (Bank 1, Sensor 2)
P0156	Oxygen Sensor Circuit Malfunction - Open (Bank 2, Sensor 2)
P0140	Oxygen Sensor Circuit Malfunction - Short (Bank 1, Sensor 2)
P0160	Oxygen Sensor Circuit Malfunction - Short (Bank 2, Sensor 2)

## DESCRIPTION

To obtain a high purification rate for the CO, HC and NO<sub>x</sub> components of the exhaust gas, a three way catalytic converter is used, but for the most efficient use of the three-way catalytic converter, the ratio of the air must be precisely controlled so that it is always close to the stoichiometric air-fuel ratio. The oxygen sensor has the characteristic whereby its output voltage changes suddenly in the vicinity of the stoichiometric air-fuel ratio. This characteristic is used to detect the oxygen concentration in the exhaust gas and provide feedback to the computer for control of the air-fuel ratio. When the air-fuel ratio becomes LEAN, the oxygen concentration in the exhaust increases and the oxygen sensor informs the PCM of the LEAN condition. When the air-fuel ratio is RICHER than the stoichiometric air-fuel ratio the oxygen concentration

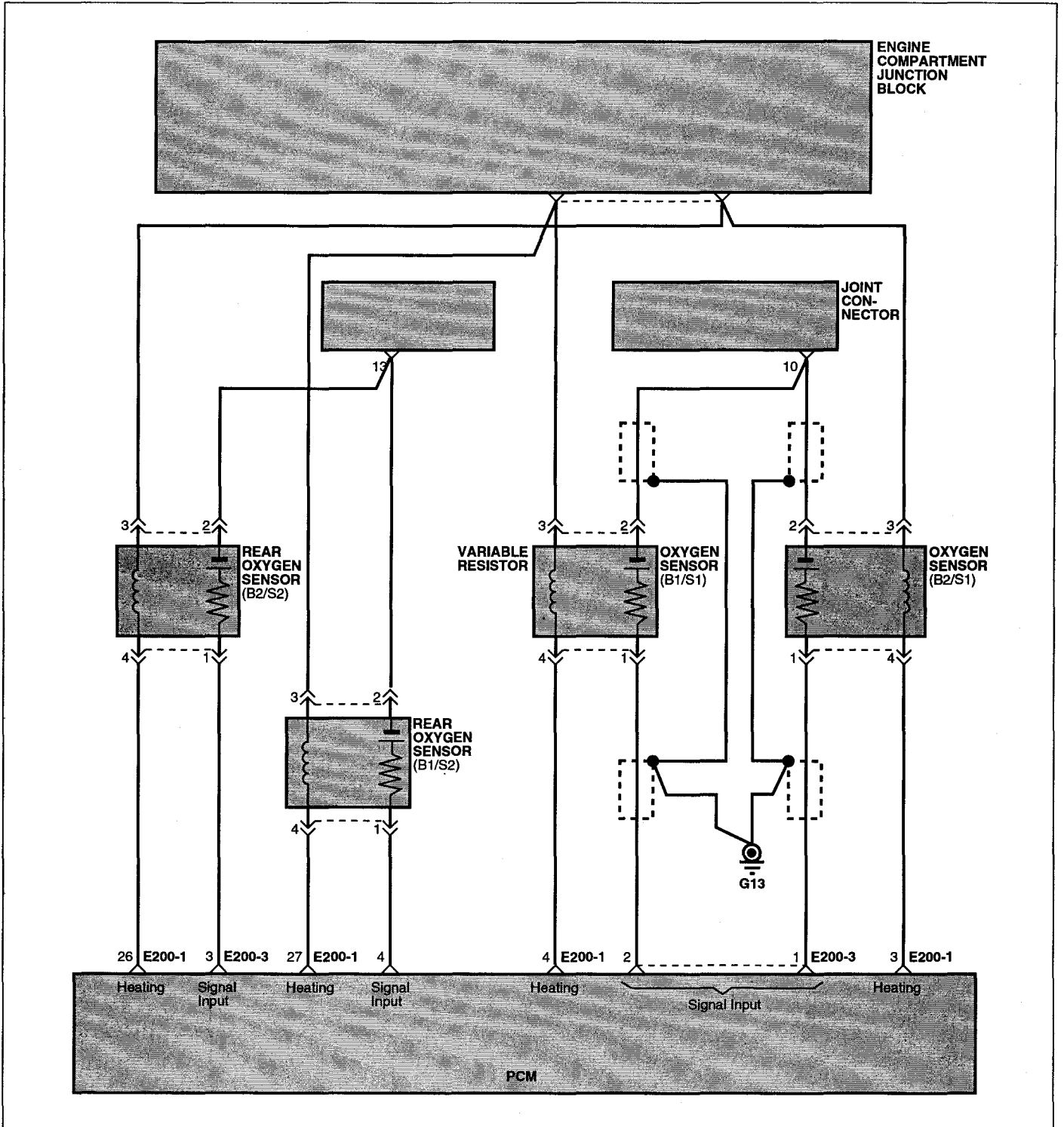
in the exhaust gas is reduced and the oxygen sensor informs the PCM of the RICH condition.

The PCM determines by the electromotive force from the oxygen sensor whether the air-fuel ratio is RICH or LEAN and controls the injection time accordingly. However, if malfunction of the oxygen sensor causes output of abnormal electromotive force, the PCM is unable to perform an accurate air-fuel ratio control. The heated oxygen sensors include a heater which heats the sensing element. The heater is controlled by the PCM. When the intake air volume is low (the temperature of the exhaust gas is low), current flows to the heater to heat the sensor for accurate oxygen concentration detection.

## TROUBLESHOOTING GUIDE

DTC detection condition	Probable cause
<p><b>Background</b></p> <ul style="list-style-type: none"> <li>The Powertrain Control Module checks for an open circuit in the heated oxygen sensor output line.</li> </ul> <p><b>Normal values</b></p> <ul style="list-style-type: none"> <li>Coolant temperature sensor: Normal.</li> <li>Heated oxygen sensor signal voltage has continued to be 0.1V or lower for 3 min. or more after the starting sequence was completed.</li> <li>Engine coolant temperature is 80°C (176°F) or more.</li> <li>Engine speed is higher than 1,200 r/min.</li> <li>Engine load is 25% or more.</li> <li>Monitoring Time: 7 - 10 sec.</li> </ul> <p><b>Items to Check</b></p> <ul style="list-style-type: none"> <li>Input voltage supplied to the Powertrain Control Module interface circuit is 4.5V or more when 5V is applied to the heated oxygen sensor output line via a resistor.</li> <li>Making the air-fuel ratio 15% richer doesn't result in raising the heated oxygen sensor output voltage beyond 0.1V.</li> </ul>	<ul style="list-style-type: none"> <li>Heated oxygen sensor failed</li> <li>Open circuit in heated oxygen sensor output line</li> <li>Powertrain control module failed</li> </ul>

CIRCUIT DIAGRAM



TEST PROCEDURE

- Turn the ignition switch on.
- Connect scan tool to data link connector.
- Verify DTC P0136, P0156, P0140 or P0160 is set. Are other DTCs also set?

NO

YES

- Start engine and warm it to normal operating temperature.
- Turn on air conditioning (if equipped).
- Increase engine speed to 4000 RPM and, using scan tool, monitor oxygen sensor is voltage. Voltage should vary between 0 and 900mV. Does it?

Repair conditions that caused other DTCs to set. Refer to the appropriate DTC test procedures.

No, voltage is constant between 19 and 58mV.

No, voltage is approximately 5 or 12 volts and constant.

No, 0 volts present.

No, voltage varies but stays below 500mV (lean).

No, voltage varies but stays above 500mV (rich).

Yes, voltage varies between 100 and 900mV.

Repair short to voltage in wiring harness. Clear code and verify oxygen sensor is within normal parameters.



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- While running the engine, measure voltage (backprobe) between rear oxygen sensor connector terminals 1 and 2. Does voltage vary above and below 500mV?

- Disconnect oxygen sensor connector. Does voltage now read between 19 and 58mV on scan tool?



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NO

YES

Repair short to ground in wire between oxygen sensor harness connector terminal 1 and ground. Clear code and verify oxygen sensor is within normal parameters.

Replace oxygen sensor. Clear code and verify oxygen sensor is within normal parameters.

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A

YES

NO

- Turn the ignition off.
- Disconnect the related PCM connector.
- Disconnect rear oxygen sensor.
- Ground rear oxygen sensor harness connector terminal 1.
- Measure resistance of wire between oxygen sensor harness connector terminal 1 and the related PCM connector terminal. Resistance measured should be approximately 1 ohm or less. Is it?

Replace oxygen sensor. Clear code and verify oxygen sensor is within normal parameters.

YES

NO

Verify PCM connectors are secure. If OK, replace Rear Oxygen sensor. Clear code and verify oxygen sensor is within normal parameters. If problem persists, replace PCM.

Repair open wire or cause of high resistance. Clear code and verify oxygen sensor is within normal parameters.

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B

Voltage varies but stays below 500mV (lean).

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C

Voltage varies but stays above 500mV (rich).

- Inspect air inlet downstream of air flow sensor for leaks or damage.
- Inspect exhaust manifold for cracks.

Are any leaks or damage found?

YES

NO

Repair leaks or replace exhaust manifold. Clear code and verify oxygen sensor is within normal parameters.

- Perform a fuel pressure test. Is fuel pressure within specification and no pressure leak is observed?

E

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D

Voltage varies between 0 and  
900mV.CONTINUED FROM  
PREVIOUS PAGE

E

YES

NO

- Turn the ignition off.
- Disconnect ignition coil connector.
- Measure voltage drop across negative battery cable by connecting voltmeter between negative battery post and cable attachment point on engine while cranking the engine. Voltage drop measured should be less than 0.5 volts, is it?

Follow diagnostic procedures outlined in shop manual. Clear code and verify oxygen sensor is within normal parameters.

YES

NO

- Disconnect negative battery terminal.
- Measure resistance between generator case and engine ground point. Resistance measured should be approximately 1 ohm or less, is it?

Replace negative battery cable. Clear code and verify oxygen sensor is within normal parameters.

YES

NO

- If Malfunction Indicator Lamp (MIL) is turning on intermittently and DTC P0136 is set, problem is most likely a poor ground circuit. Clean negative battery terminal and engine ground. Also clean mating surfaces of generator housing and engine block.
- If Malfunction Indicator Lamp (MIL) was on and DTC P0139 is set, replace oxygen sensor.
- Clear code and verify oxygen sensor is within normal parameters.

Clean mating surfaces of generator housing and engine block. Clear code and verify oxygen sensor is within normal parameters.

EFMB5090

DTC	Diagnostic item
P0141	Oxygen Sensor Heater Circuit Malfunction (Bank 1, Sensor 2)
P0161	Oxygen Sensor Heater Circuit Malfunction (Bank 2, Sensor 2)

**DESCRIPTION**

To obtain a high purification rate for the CO, HC and NO<sub>x</sub> components of the exhaust gas, a three way catalytic converter is used, but for the most efficient use of the three-way catalytic converter, the ratio of the air must be precisely controlled so that it is always close to the stoichiometric air-fuel ratio. The oxygen sensor has the characteristic whereby its output voltage changes suddenly in the vicinity of the stoichiometric air-fuel ratio. This characteristic is used to detect the oxygen concentration in the exhaust gas and provide feedback to the computer for control of the air-fuel ratio. When the air-fuel ratio becomes LEAN, the oxygen concentration in the exhaust increases and the oxygen sensor informs the PCM of the LEAN condition. When the air-fuel ratio is RICHER than the stoichiometric air-fuel ratio the oxygen concentration

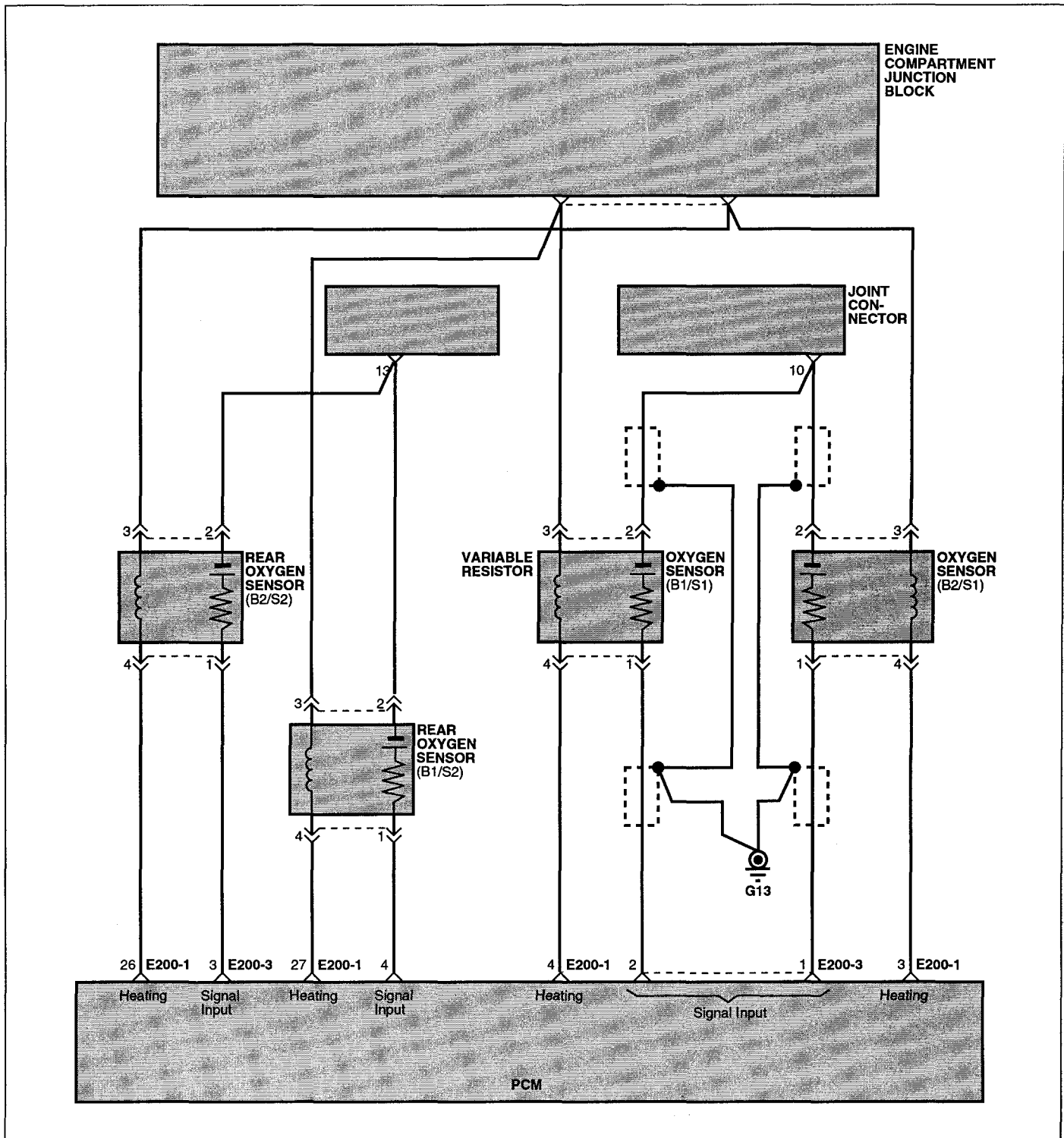
in the exhaust gas is reduced and the oxygen sensor informs the PCM of the RICH condition.

The PCM determines by the electromotive force from the oxygen sensor whether the air-fuel ratio is RICH or LEAN and controls the injection time accordingly. However, if malfunction of the oxygen sensor causes output of abnormal electromotive force, the PCM is unable to perform an accurate air-fuel ratio control. The heated oxygen sensors include a heater which heats the sensing element. The heater is controlled by the PCM. When the intake air volume is low (the temperature of the exhaust gas is low), current flows to the heater to heat the sensor for accurate oxygen concentration detection.

**TROUBLESHOOTING GUIDE**

DTC detection condition	Probable cause
<p><b>Background</b></p> <ul style="list-style-type: none"> <li>The Powertrain Control Module checks whether the heater current is within a specified range when the heater is energized.</li> </ul> <p><b>Check Area</b></p> <ul style="list-style-type: none"> <li>Battery voltage is between 12 and 16V.</li> </ul> <p><b>Judgment Criteria</b></p> <ul style="list-style-type: none"> <li>The heater current of the front heated oxygen sensor heater (Bank 1 Sensor 1 and Bank 2 Sensor 1) has continued to be 0.2 A or less, or 3.5 A or higher for 6 sec.</li> <li>Monitored only once per trip.</li> </ul>	<ul style="list-style-type: none"> <li>Open or shorted oxygen sensor heater circuit</li> <li>Open circuit in oxygen sensor heater</li> <li>Powertrain control module failed</li> </ul>

CIRCUIT DIAGRAM



TEST PROCEDURE

- Turn the ignition switch on.
- Connect scan tool to data link connector.
- Verify DTC P0141 or P0161 is set.

- Disconnect rear oxygen sensor.
- Start engine.
- Measure voltage between oxygen sensor harness connector terminal 3 and ground.

Voltage should be between 12 and 16 volts. Is it?

YES

NO

- Turn the ignition switch off.
- Disconnect the rear oxygen sensor disconnected.
- Disconnect the related PCM connector. Ground rear oxygen sensor harness connector terminal 4.
- Measure resistance between ground and the related PCM connector terminal.

Resistance measured should be approximately 1 ohm or less. Is it?

Repair open in wire between engine compartment junction block terminal and oxygen sensor harness connector terminal 3. Clear code and verify oxygen sensor is within normal parameters.

YES

NO

- Turn the ignition switch off.
- Disconnect the rear oxygen sensor disconnected.
- Disconnect PCM connector C44-1. Measure resistance between ground and oxygen sensor harness connector terminal 4.

Resistance should indicate an open circuit. Does it?

Repair open in wire between the related PCM harness connector terminal and oxygen sensor harness connector terminal 4. Clear code and verify oxygen sensor is within normal parameters.

YES

NO

- Ignition switch off.
- Rear oxygen sensor disconnected.
- Measure resistance between terminals 3 and 4 of oxygen sensor connector.

Is resistance within normal parameters (7-9 ohms)?

Repair short to ground or another circuit in wire between the related PCM harness connector terminal and oxygen sensor harness connector terminal 4. Clear code and verify oxygen sensor is within normal parameters.

YES

NO

Verify PCM connector is secure. If OK, replace Rear Oxygen sensor. Clear code and verify oxygen sensor is within normal parameters. If problem persists, replace PCM.

Replace oxygen sensor. Clear code and verify oxygen sensor is within normal parameters.

EFMB5100

DTC	Diagnostic item
P0201, P0202 P0203, P0204 P0205, P0206	Injector Circuit Malfunction (Cylinder-1, Cylinder-2, Cylinder-3, Cylinder-4, Cylinder-5, Cylinder-6)

**DESCRIPTION**

The fuel injectors are solenoid operated valves that are normally closed. When a fuel injector solenoid is energized (pulsed) the injector needle valve moves, allowing pressurized fuel to pass through the injector and mix with the air entering the engine. Each fuel injector (there is one for each engine cylinder) is mounted in the intake manifold and is positioned to spray fuel into a cylinder head intake port.

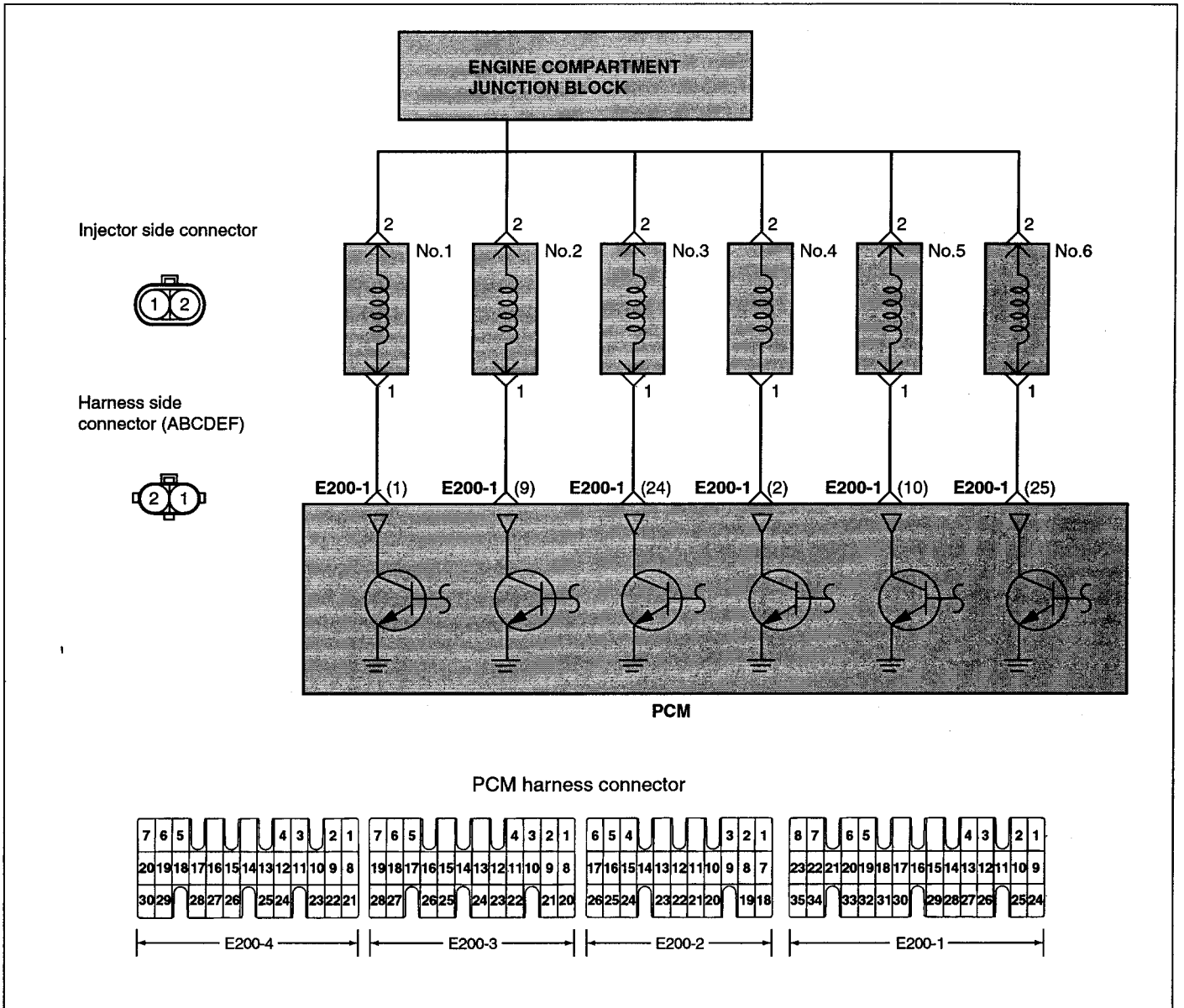
The Powertrain Control Module (PCM) controls injector timing and pulse width (how long the fuel injectors are turned on). The PCM pulses the fuel injectors based on information provided by its network of engine sensors. The PCM uses the crankshaft position sensor to determine

when to pulse the injectors. Engine coolant temperature, intake air temperature, air flow and throttle position data are all used by the PCM to calculate injector pulse width. The PCM also uses its network of sensors to determine whether all injectors should be pulsed at the same time (simultaneous injection) or each injector should be pulsed individually (sequential injection). Sequential injection is almost always used during normal engine operation and simultaneous injection may be used when the engine is being cranked.

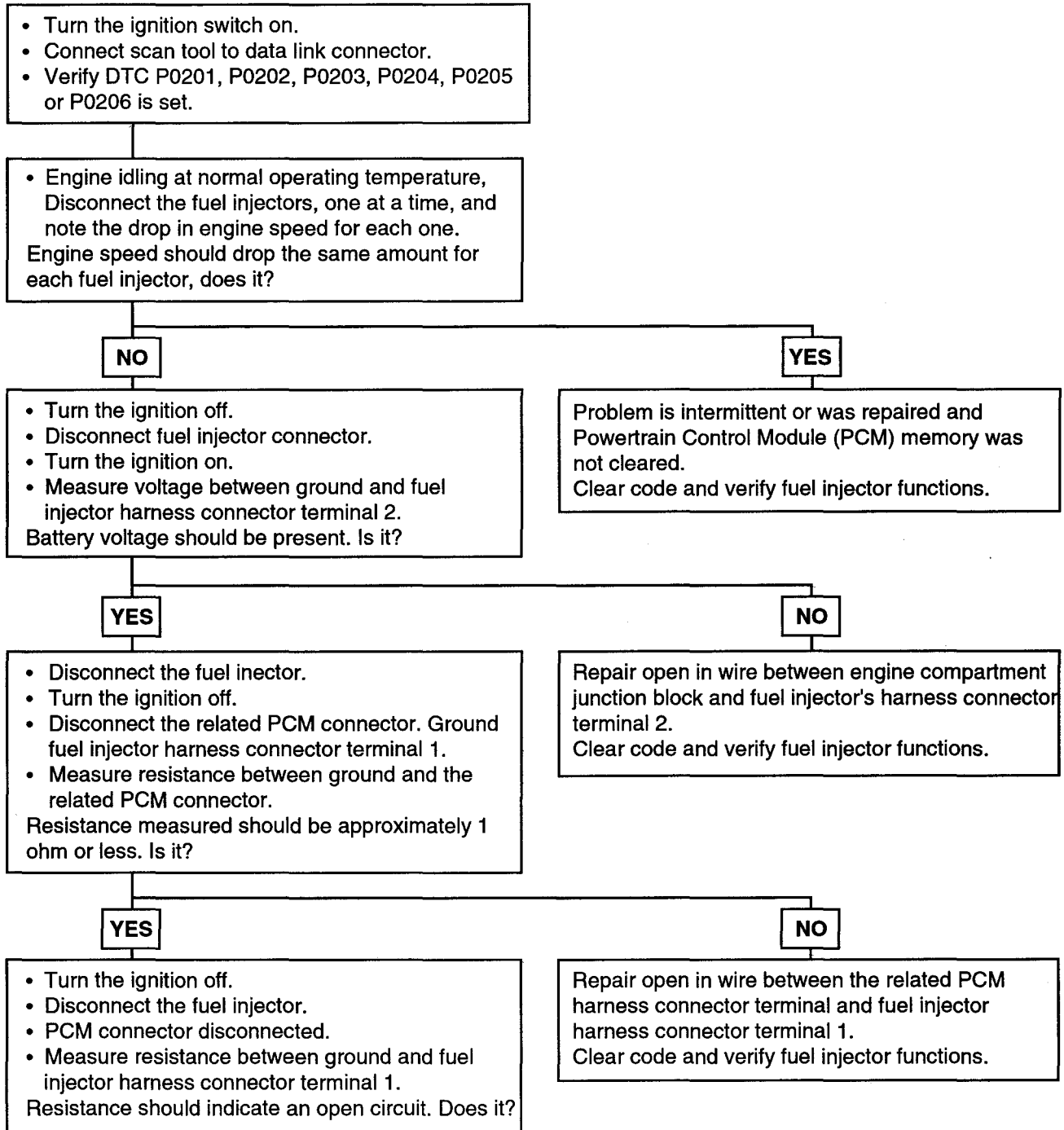
**TROUBLESHOOTING GUIDE**

DTC detection condition	Probable cause
<p><b>Background</b></p> <ul style="list-style-type: none"> <li>• A surge voltage is generated when the injectors are driven and the current flowing to the injector coil is shut off.</li> <li>• The Powertrain Control Module checks this surge voltage.</li> </ul> <p><b>Normal Operation</b></p> <ul style="list-style-type: none"> <li>• The engine speed is between 50 and 1,000 r/min</li> <li>• Throttle position sensor output voltage is 1.16V or less.</li> <li>• Monitoring Time: 4 sec.</li> </ul> <p><b>Malfunction</b></p> <ul style="list-style-type: none"> <li>• Injector coil surge voltage (system voltage +2V) has not been detected for 4 sec.</li> </ul>	<ul style="list-style-type: none"> <li>• Failed injector</li> <li>• Open or shorted injector circuit, or loose connector</li> <li>• Failed powertrain control module</li> </ul>

CIRCUIT DIAGRAM



TEST PROCEDURE



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YES

NO

- Turn the ignition off.
- Disconnect the fuel injector.
- Measure resistance between fuel injector connector terminals 1 and 2.

Resistance should be approximately 14.5 ohms at 68°F (20°C). Is it?

Repair short to ground or another circuit in wire between the related PCM harness connector terminal and fuel injector harness connector terminal 1.  
Clear code and verify fuel injector functions.

YES

NO

Verify PCM connector is secure. If OK, replace fuel injector with a known good component. Clear code and verify fuel injector operates. If problem persists, replace PCM.

Replace fuel injector.  
Clear code and verify fuel injector operates.



EFMB5110

DTC	Diagnostic item
P0300	Random Misfire Detected

**DESCRIPTION**

With the ignition switch ON or START, voltage is applied to the ignition coil. High tension leads go to each cylinder from the ignition coil. The ignition coil fires two spark plugs every power stroke (the cylinder under compression and the cylinder on the exhaust stroke). Coil number one fires cylinders 1 and 4. Coil number two fires cylinders 2 and 5. And coil number three fires cylinders 3 and 6.

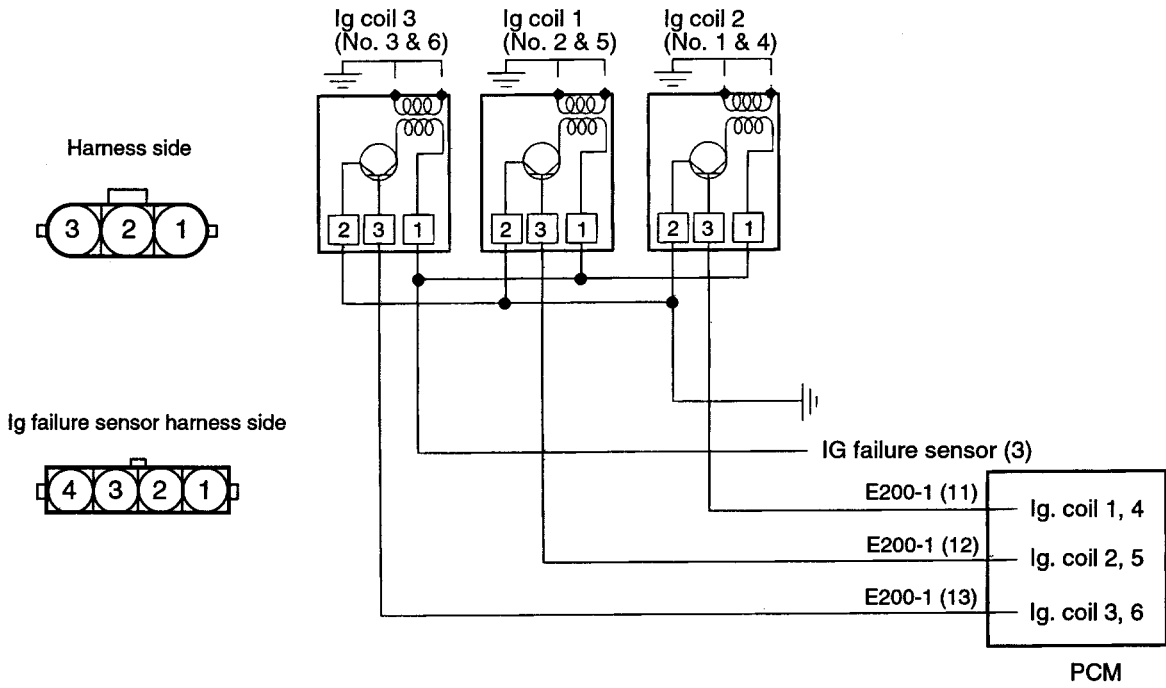
The ignition power transistor, controlled by the Powertrain Control Module (PCM), provides a switching circuit to

ground for energizing the primary ignition coils. When a primary ignition coil is energized and deenergized, the secondary coil produces a high voltage spike across the attached spark plugs. At the same time, the tachometer interface (part of the ignition power transistor) provides the PCM and Transaxle Control Module (TCM) with an RPM signal.

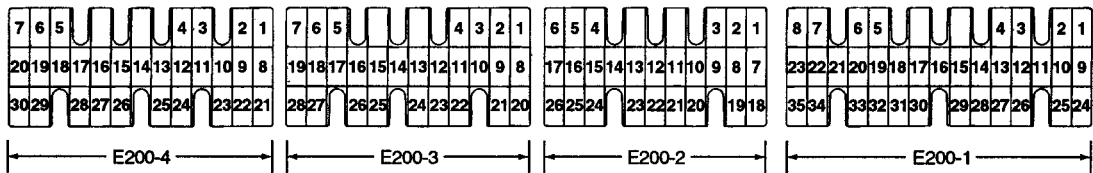
**TROUBLESHOOTING GUIDE**

DTC detection condition	Probable cause
<p><b>Background</b></p> <ul style="list-style-type: none"> <li>• If a misfire occurs while the engine is running, the engine speed suddenly changes.</li> <li>• The Powertrain Control Module checks for changes in the engine speed by monitoring the CKP signal.</li> </ul> <p><b>Normal Operation</b></p> <ul style="list-style-type: none"> <li>• Five seconds or more have passed after the engine has started.</li> <li>• The engine speed is between 500 and 6,000 r/min.</li> <li>• The engine Coolant Temperature is higher than -10°C (14°F).</li> <li>• The intake air temperature is higher than -10°C (14°F).</li> <li>• There is no sudden acceleration/deceleration such as during a shift change.</li> </ul> <p><b>Abnormal Operation (a change in the rate of angular acceleration by the crankshaft is monitored for misfire detection.)</b></p> <ul style="list-style-type: none"> <li>• A misfire has occurred more frequently than allowed during the last 200 revolutions [when the catalyst temperature is higher than 950°C (1,742°F)].</li> <li>• A misfire has occurred more frequently than the allowed number of times (2%) during 1,000 motor revolutions.</li> </ul>	<ul style="list-style-type: none"> <li>• Failed ignition system part(s)</li> <li>• Poor crankshaft position sensor signal</li> <li>• Incorrect air/fuel ratio</li> <li>• Low compression</li> <li>• Failed engine coolant temperature sensor</li> <li>• Timing belt missing teeth</li> <li>• Failed injector</li> <li>• Failed powertrain control module</li> </ul>

CIRCUIT DIAGRAM



PCM harness connector



TEST PROCEDURE

- Check the fuel quality.
- Turn ignition switch on.
- Connect scan tool to data link connector.
- Verify DTC P0300 is set.

Is DTC P0300 the only code set and fuel at least 87 octane?

YES

NO

- Ignition on.
- Disconnect ignition coil connector. Measure voltage between ground and ignition coil connector terminal 1.

Battery voltage should be present, is it?

Refer to the appropriate section and follow test procedures for the other set codes. Refuel vehicle with 87 or higher octane fuel. Clear codes and verify DTC P0300 is no longer set.

YES

NO

- Turn ignition off.
- Disconnect ECM connector.
- Ground ignition coil harness connector terminals 2. Measure resistance between ground and PCM connector E200-1 terminals 11, 12 and 13.

Resistance measured should be approximately 1 ohm or less, is it?

Repair wire between engine compartment junction block and ignition coil connector terminal 1. Clear code and verify code does not reappear.

YES

NO

- Ignition off.
- Measure resistance of wire between ignition failure sensor harness connector terminal 3 and ignition coil harness connector terminal 1.

Resistance measured should be approximately 1 ohm or less, is it?

Repair open in wire(s) between ignition coil connector terminal 2 and ECM connector E200-1 terminal 11, 12 and 13. Clear code and verify code does not reappear.



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YES

NO

- Turn the ignition off.
- Measure resistance between ground and ignition failure sensor harness connector terminal 3. Resistance measured should be approximately 1 ohm or less. Is it?

Repair open in wire(s) between ignition failure sensor harness connector terminal 3 and ignition coil connector terminal 1. Clear code and verify code does not reappear.

YES

NO

- Disconnect the ignition coil.
- Reconnect PCM connectors.
- Put the ignition switch in the start position.
- Measure voltage between ground and ignition coil harness connector terminal 3. Voltage should vary between 5 and 4 volts. Does it?

Repair open in wire between engine compartment junction block and ignition coil connector terminal 3. Clear code and verify code does not reappear.

NO

YES

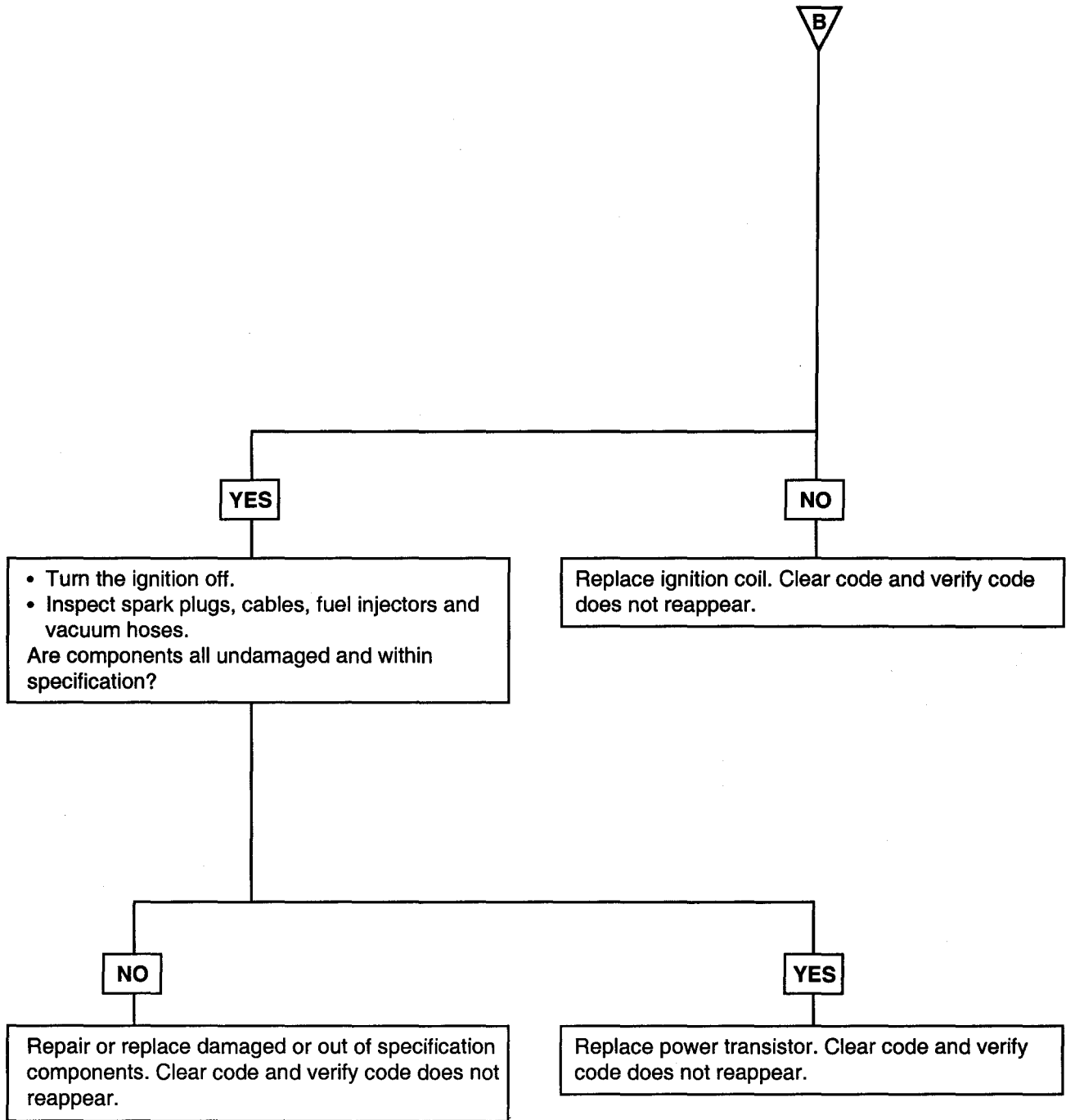
Verify PCM connector is secure. If OK, replace power transistor with a known good component. Clear code and verify code does not reappear. If problem persists, replace PCM.

- Turn the ignition off.
- Disconnect the ignition coil.
- Measure resistance across ignition coil connector terminals 1 and 2. Note results for primary coil resistance.
- Measure resistance across ignition coil spark plug wire terminals 1 and 4. Measure resistance across ignition coil spark plug wire terminals 2 and 5. And measure resistance across ignition coil spark plug wire terminal 3 and 6. Note results for secondary coil resistance. Primary coil resistance should be approximately 1.3 ohms. Secondary coil resistance should be between 10.3K ohms and 13.9K ohms. Are resistances within specification?



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EFMB5120

DTC	Diagnostic item
P0301, P0302, P0303, P0304, P0305, P0306	Misfire detected (Cylinder-1, Cylinder-2, Cylinder-3, Cylinder-4, Cylinder-5, Cylinder-6)

**DESCRIPTION**

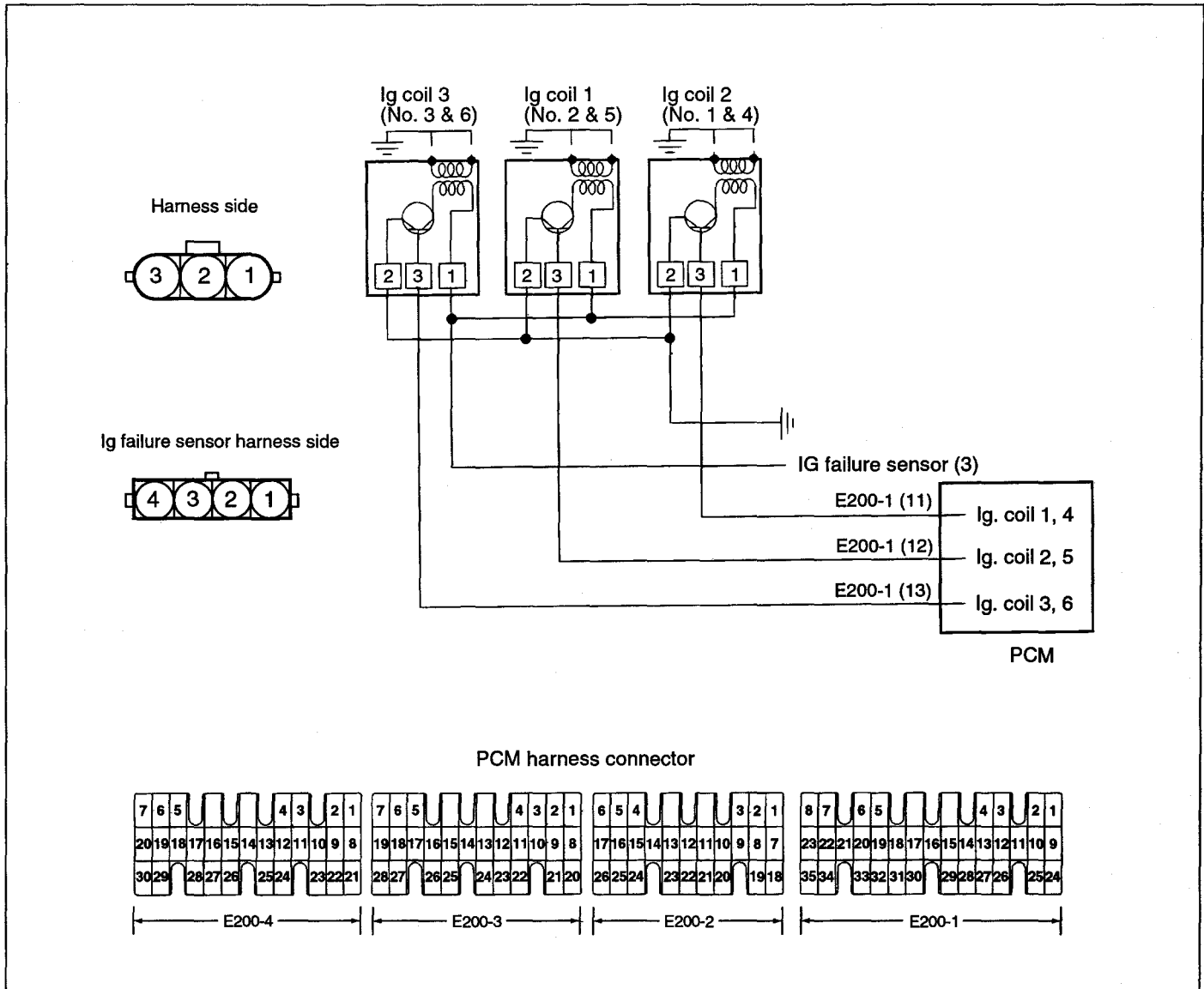
With the ignition switch ON or START, voltage is applied to the ignition coil. High tension leads go to each cylinder from the ignition coil. The ignition coil fires two spark plugs every power stroke (the cylinder under compression and the cylinder on the exhaust stroke). Coil number one fires cylinders 1 and 4. Coil number two fires cylinders 2 and 5. And coil number three fires cylinders 3 and 6. The ignition power transistor, controlled by the Powertrain Control Module (PCM), provides a switching circuit to

ground for energizing the primary ignition coils. When a primary ignition coil is energized and deenergized, the secondary coil produces a high voltage spike across the attached spark plugs. At the same time, the tachometer interface (part of the ignition power transistor) provides the PCM and Transaxle Control Module (TCM) with an RPM signal.

**TROUBLESHOOTING GUIDE**

DTC detection condition	Probable cause
<p><b>Background</b></p> <ul style="list-style-type: none"> <li>• If a misfire occurs while the engine is running, the engine speed suddenly changes.</li> <li>• The Powertrain Control Module checks for changes in the engine speed.</li> </ul> <p><b>Normal Operation</b></p> <ul style="list-style-type: none"> <li>• Five seconds or more have passed after the engine was started.</li> <li>• The engine speed is between 500 and 6,000 rpm.</li> <li>• The engine Coolant Temperature is higher than -10°C (14°F).</li> <li>• The intake air temperature is higher than -10°C (14°F).</li> <li>• The engine is not making sudden acceleration/deceleration such as during a shift.</li> </ul> <p><b>Malfunction Criteria (a change in the angular acceleration of the crankshaft is used for misfire detection.)</b></p> <ul style="list-style-type: none"> <li>• A misfire has occurred more frequently than allowed for during the last 200 revolutions [when the catalyst temperature is higher than 950°C (1,742°F)].</li> <li>• A misfire has occurred more frequently than the allowed number of times (2%) during 1,000 motor revolutions.</li> </ul>	<ul style="list-style-type: none"> <li>• Failed ignition system related part(s)</li> <li>• Poor crankshaft position sensor signal</li> <li>• Incorrect air/fuel ratio</li> <li>• Low compression</li> <li>• Failed engine coolant temperature sensor</li> <li>• Timing belt missing teeth</li> <li>• Failed injector</li> <li>• Failed EGR valve</li> <li>• Failed powertrain control module</li> </ul>

CIRCUIT DIAGRAM



TEST PROCEDURE

- Verify vehicle fuel is 87 octane or higher.
- Turn ignition switch on.
- Connect scan tool to data link connector.
- Verify DTC P0301, P0302, P0303, P0304, P0305 or P0306.

Is DTC P0201, P0202, P0203, P0204, P0205 or P0206 also set or is fuel less than 87 octane?

NO

YES

- Turn the ignition off.
- Disconnect the ignition coil.
- Measure resistance across ignition coil connector terminals 1 and 2. Note results for primary coil resistance.
- Measure resistance across ignition coil spark plug wire terminals 1 and 4. Measure resistance across ignition coil spark plug wire terminals 2 and 5. And measure resistance across ignition coil spark plug wire terminal 3 and 6. Note results for secondary coil resistance.

Primary coil resistance should be approximately 1.3 ohms. Secondary coil resistance should be between 10.3 Kohms ohms and 13.9 Kohms ohms. Are resistances within specification?

Perform related test procedures. If needed, refuel with 87 octane or higher, clear code and verify code does not reappear.

YES

NO

- Turn the ignition off.
- Inspect spark plugs, cables, vacuum hoses and connections.

Are components undamaged?

Replace ignition coil. Clear code and verify code does not reappear.

YES

NO

- Turn the ignition off.
- Check fuel injector for clogging.

Is fuel injector OK?

Repair or replace parts. Clear code and verify code does not reappear.

YES

NO

Verify PCM connector is secure. If OK, replace PCM. Clear code and verify code does not reappear.

Clean or replace fuel injector. Clear code and verify code does not reappear.



EFMB5130

DTC	Diagnostic item
P0335	Crankshaft Position Sensor Circuit Malfunction

**DESCRIPTION**

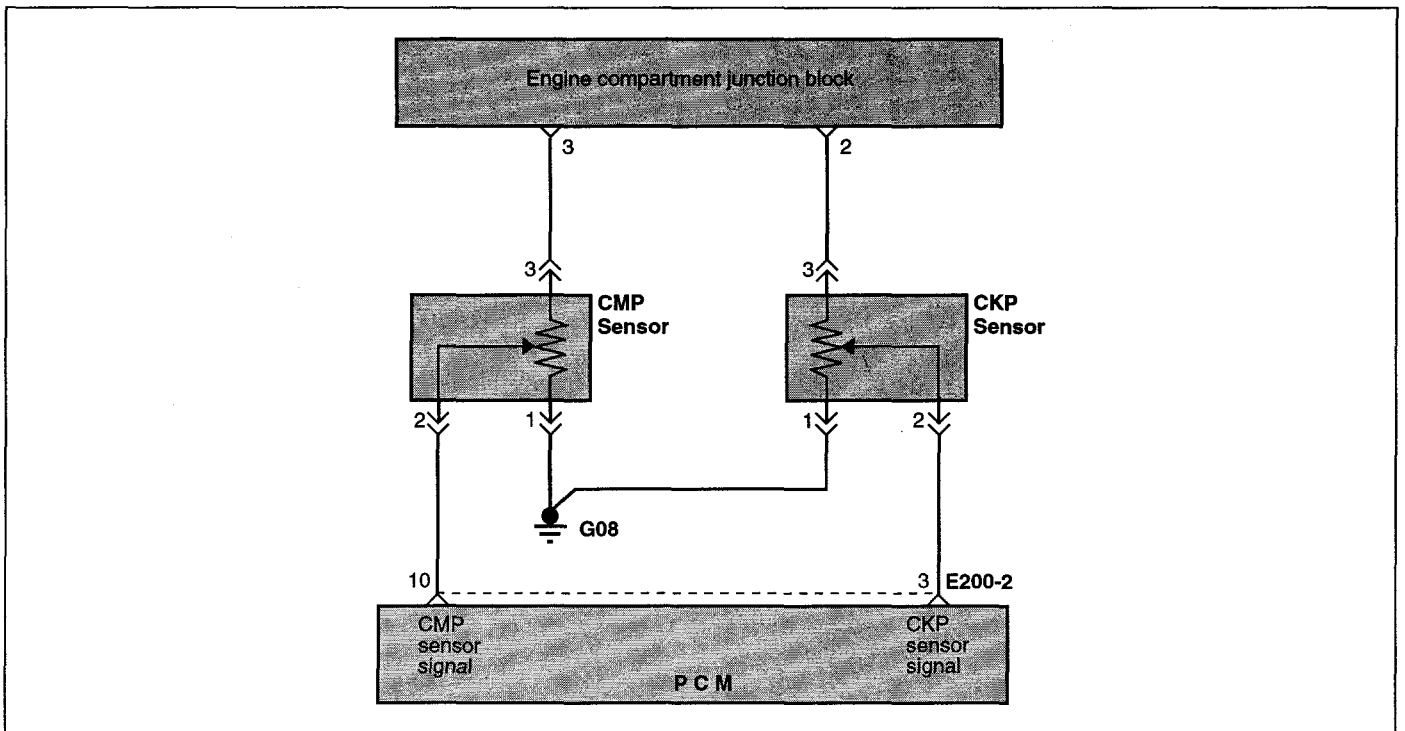
The Hall-effect Crankshaft Position (CKP) sensor consists of a magnet and coil located next to the flywheel. The

voltage signal from the CKP sensor allows the Powertrain Control Module (PCM) to determine the engine of the RPM and Crankshaft Position.

**TROUBLESHOOTING GUIDE**

DTC detection condition	Probable cause
<p><b>Background</b></p> <ul style="list-style-type: none"> <li>When the engine is running, the Crankshaft Position sensor outputs a pulse signal.</li> <li>The Powertrain Control Module checks whether the pulse signal is input while the engine is cranking.</li> </ul> <p><b>Normal Operating condition</b></p> <ul style="list-style-type: none"> <li>Engine is being cranked.</li> </ul> <p><b>Normal Operation</b></p> <ul style="list-style-type: none"> <li>Sensor output voltage has not changed (no pulse signal is input) for 4 sec.</li> </ul> <p><b>Malfunction</b></p> <ul style="list-style-type: none"> <li>Normal signal pattern has not been input for cylinder identification from the crankshaft position sensor signal and camshaft position sensor signal for 4 sec.</li> </ul>	<ul style="list-style-type: none"> <li>Failed crankshaft position sensor</li> <li>Open or shorted crankshaft position sensor circuit</li> <li>Failed powertrain control module</li> </ul>

**CIRCUIT DIAGRAM**



TEST PROCEDURE

- Turn the ignition switch on.
- Connect scan tool to data link connector.
- Verify DTC P0335 is set.

- Turn the ignition on.
- Disconnect Crankshaft Position (CKP) sensor.
- Measure voltage between ground and CKP sensor harness connector terminal 3. Battery voltage should be present. Is it?

YES

NO

- Turn the ignition off.
- Disconnect the CKP sensor.
- Disconnect PCM connector E200-2.
- Ground CKP sensor harness connector terminal 2. Measure resistance between ground and PCM harness connector E200-2 terminal 3. Resistance measured should be approximately 1 ohm or less. Is it?

Repair open in wire between CKP sensor harness connector terminal 3 and Joint connector terminal. Clear code and verify CKP sensor is within normal parameters.

YES

NO

- Turn the ignition off.
- Disconnect the CKP sensor.
- Disconnect PCM connector E200-2. Measure resistance between ground and CKP sensor harness connector terminal 2. Resistance should indicate an open circuit. Does it?

Repair open in wire between CKP sensor harness connector terminal 2 and PCM harness connector E200-2 terminal 3. Clear code and verify CKP sensor is within normal parameters.

YES

NO

Repair short to ground or another circuit in wire between CKP sensor harness connector terminal 2 and PCM harness connector E200-2 terminal 3. Clear code and verify CKP sensor is within normal parameters.



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• Turn the ignition off.  
• Disconnect the CKP sensor.  
• Measure resistance between ground and CKP sensor harness connector terminal 1.  
Resistance measured should be approximately 1 ohm or less. Is it?

YES

• Inspect CKP sensor for damage or debris.  
Is CKP sensor OK?

YES

• Turn the ignition on.  
• Disconnect the CKP sensor.  
• PCM connector connected.  
• Measure voltage between ground and CKP Sensor harness connector terminal 3.  
Voltage should be approximately 5 volts. Is it?

NO

Verify PCM connector is secure. If OK, replace CKP sensor with a known good component. Clear code and verify CKP sensor is within normal parameters. If problem persists, replace PCM.

NO

Repair open or poor ground connection in ground wire. Clear code and verify CKP sensor is within normal parameters.

NO

Repair or replace CKP sensor. Clear code and verify CKP sensor is within normal parameters.

YES

Repair or replace CKP sensor. Clear code and verify CKP sensor is within normal parameters.

EFMB5140

DTC	Diagnostic item
P0340	Camshaft Position Sensor Circuit Malfunction

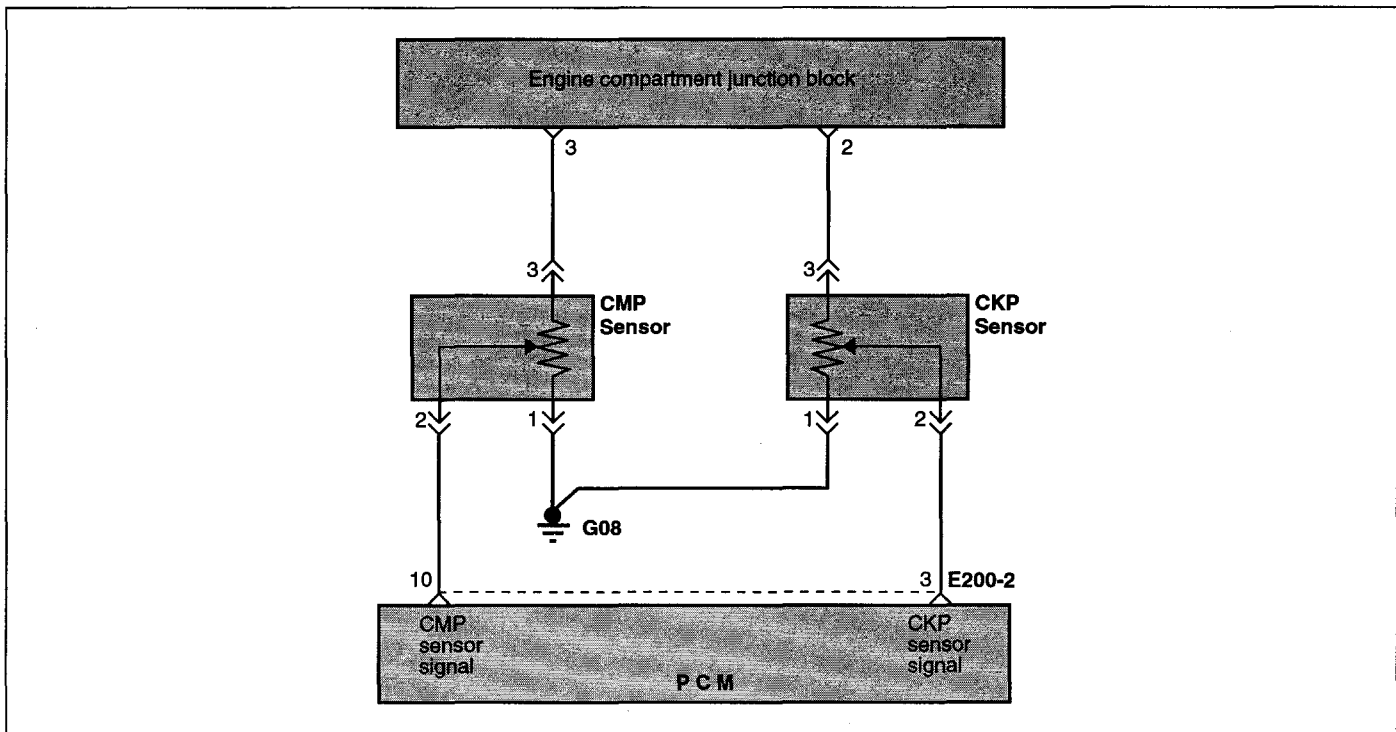
**DESCRIPTION**

The Camshaft Position (CMP) sensor senses the Top Dead Center (TDC) point of the #1 cylinder in the compression stroke. The CMP sensor signal allows the PCM to determine when to operate the fuel injectors.

**TROUBLESHOOTING GUIDE**

DTC detection condition	Probable cause
<p><b>Normal Operation</b></p> <ul style="list-style-type: none"> <li>When the engine is running, the Camshaft Position sensor outputs a pulse signal.</li> <li>The Powertrain Control Module checks whether the pulse signal is input.</li> </ul> <p><b>Malfunction</b></p> <ul style="list-style-type: none"> <li>Normal signal pattern has not been input for cylinder identification from the camshaft position sensor signal for 4 sec.</li> </ul>	<ul style="list-style-type: none"> <li>Camshaft Position sensor malfunction</li> <li>Open or shorted camshaft position sensor circuit or loose connector</li> <li>Powertrain control module failed</li> </ul>

**CIRCUIT DIAGRAM**



## TEST PROCEDURE

- Turn the ignition switch on.
- Connect scan tool to data link connector.
- Verify DTC P0340 is set.

- Turn the ignition on.
- Disconnect Camshaft Position (CMP) sensor.
- Measure voltage between ground and CMP sensor harness connector terminal 3. Battery voltage should be present. Is it?

YES

NO

- Turn the ignition off.
- Disconnect the CMP sensor.
- Disconnect PCM connector E200-2.
- Ground CMP sensor harness connector terminal 2.
- Measure resistance between ground and PCM harness connector E200-2 terminal 10. Resistance measured should be approximately 1 ohm or less. Is it?

Repair open in wire between CMP sensor harness connector terminal 3 and Engine compartment junction block. Clear code and verify CMP sensor signal is within normal parameters.

YES

NO

- Turn the ignition off.
- Disconnect the CMP sensor.
- Disconnect PCM connector E200-2.
- Measure resistance between ground and CMP sensor harness connector terminal 2. Resistance should indicate an open circuit. Does it?

Repair open in wire between CMP sensor harness connector terminal 2 and PCM harness connector terminal. Clear code and verify CMP sensor signal is within normal parameters.

YES

NO

- Turn the ignition off.
- Disconnect the CMP sensor.
- Measure resistance between ground and CMP sensor harness connector terminal 1. Resistance measured should be approximately 1 ohm or less. Is it?

Repair short to ground in wire between CMP sensor harness connector terminal 2 and PCM harness connector terminal. Clear code and verify CMP sensor signal is within normal parameters.

YES

NO

- Inspect CMP sensor for debris or misadjustment. Also verify timing is adjusted properly. Is CMP sensor and timing OK?

Repair open in wire between CMP sensor harness connector terminal 1 and ground. Clear code and verify CMP sensor signal is within normal parameters.

YES

NO

- Verify PCM connector is secure. If OK, replace PCM. Clear code and verify CMP sensor signal is within normal parameters.

Repair or replace CMP sensor as needed. Clear code and verify CMP sensor signal is within normal parameters.

EFBB5170

DTC	Diagnostic item
P0421	Warm Up Catalyst Efficiency Below Threshold (Bank 1)
P0431	Warm Up Catalyst Efficiency Below Threshold (Bank 2)

**DESCRIPTION**

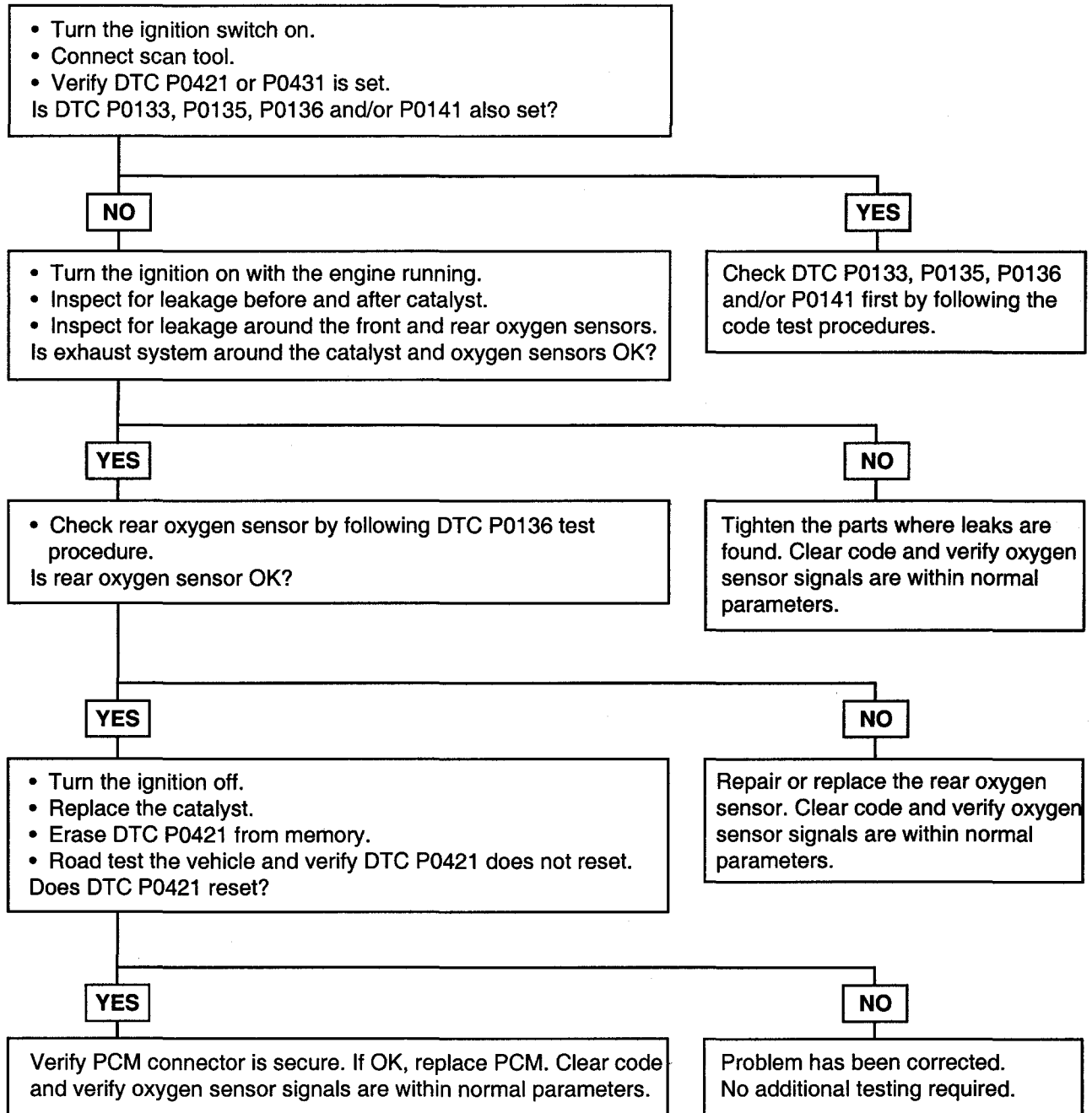
The PCM compares the waveform of the front oxygen sensor with the waveform of the rear oxygen sensor to determine whether or not catalyst performance has deteriorated. Air-fuel ratio feedback compensation keeps the waveform of the front oxygen sensor repeatedly changing back and forth from rich to lean.

If the catalyst is functioning normally, the waveform of the rear oxygen sensor switches back and forth between rich and lean much more slowly than the waveform of the front oxygen sensor. When both waveforms change at a similar rate, catalyst performance has deteriorated.

**TROUBLESHOOTING GUIDE**

DTC detection condition	Probable cause
<p>Normal Operation</p> <ul style="list-style-type: none"> <li>• The signal from the rear Oxygen sensor differs from the front Oxygen sensor. This is because the catalytic converter purifies, the exhaust gas. When the catalytic converter has deteriorated, the signal from the rear becomes similar to that of the front.</li> <li>• The Powertrain Control Module checks the outputs of both oxygen sensor signals.</li> </ul> <p>Normal Operation</p> <ul style="list-style-type: none"> <li>• Engine speed is 3,000 rpm or higher.</li> <li>• Closed throttle position switch: OFF</li> <li>• Closed loop operation</li> <li>• Monitoring Time: 140 sec.</li> </ul> <p>Malfunction</p> <ul style="list-style-type: none"> <li>• The front and rear Oxygen sensor signals are similar.</li> </ul>	<ul style="list-style-type: none"> <li>• Catalytic converter deteriorated</li> <li>• Heated oxygen sensor failed</li> <li>• Powertrain control module failed</li> </ul>

## TEST PROCEDURE



EFMB5190

DTC	Diagnostic item
P0443	Purge Control Solenoid Valve Malfunction

**DESCRIPTION**

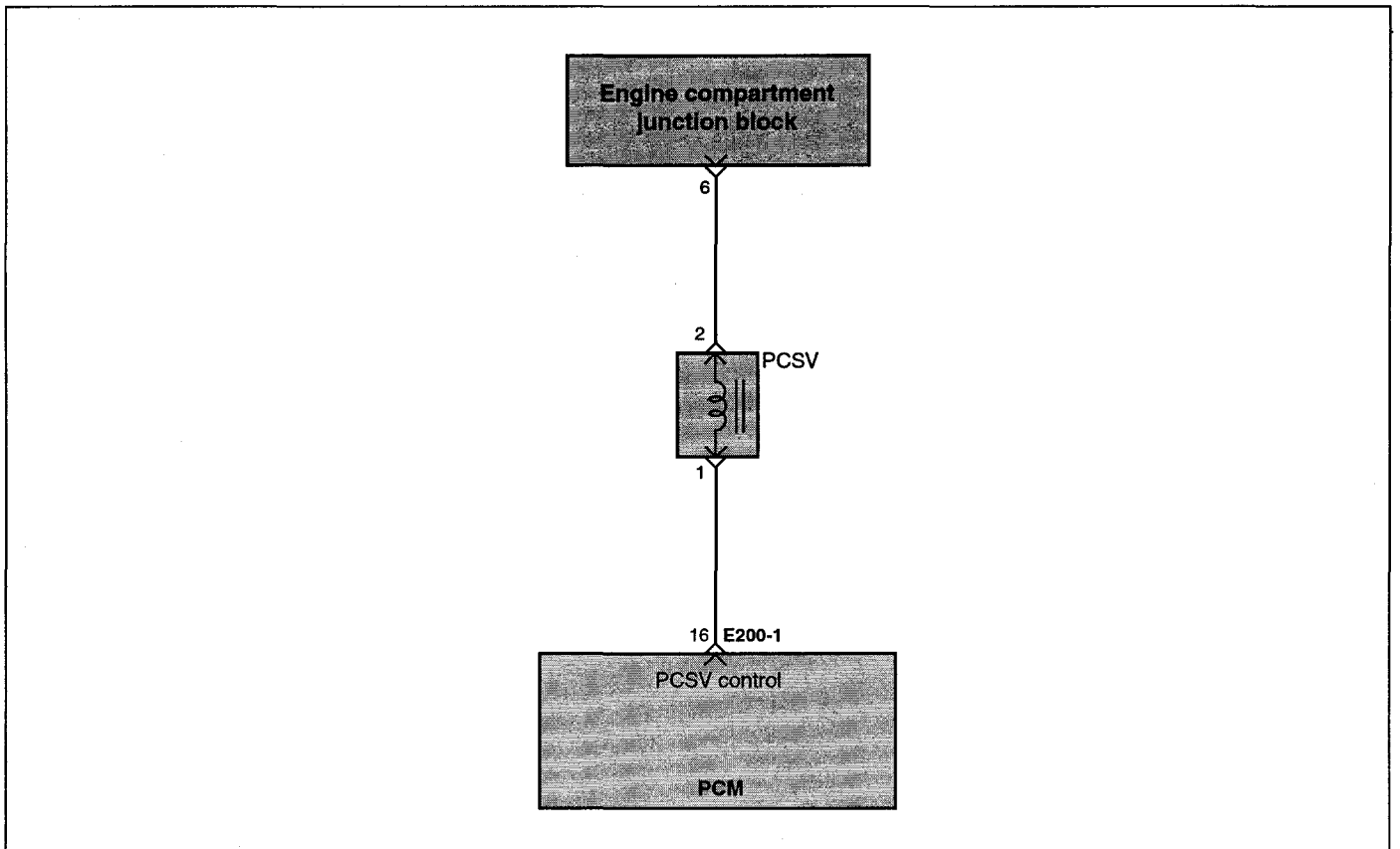
a charcoal canister until it can be flushed into the intake manifold.

The evaporative system reduces hydrocarbon emission by trapping fuel tank vapors until they can be burned as part of the incoming fuel charge. Evaporating fuel is stored in

**TROUBLESHOOTING GUIDE**

DTC detection condition	Probable cause
<p>Normal Operation</p> <ul style="list-style-type: none"> <li>The Powertrain Control Module checks current flows in the evaporative emission purge solenoid drive circuit when the solenoid is ON and OFF.</li> </ul> <p>Normal Operation</p> <ul style="list-style-type: none"> <li>Battery voltage is 10V or higher.</li> </ul> <p>Malfunction</p> <ul style="list-style-type: none"> <li>The solenoid coil surge voltage (system voltage +2V) is not detected when the EVAP emission vent solenoid is turned on/off.</li> </ul>	<ul style="list-style-type: none"> <li>Evaporative emission purge control solenoid valve failed</li> <li>Open or shorted evaporative emission purge solenoid circuit, or loose connector</li> <li>Powertrain control module failed</li> </ul>

**CIRCUIT DIAGRAM**





TEST PROCEDURE

- Turn the ignition switch on.
- Connect scan tool to data link connector.
- Verify DTC P0443 is set.

- Turn the ignition off
  - Disconnect PCSV(Purge Control Solenoid Valve) connector.
  - Turn the ignition on.
  - Measure voltage between ground and PCSV harness connector terminal 2.
- Battery voltage should be present. is it?

YES

NO

- Turn the ignition off.
  - Disconnect the PCSV.
  - Disconnect PCM connector E200-1. Ground PCSV harness connector terminal 1.
  - Measure resistance between ground and PCM harness connector E200-1 terminal 16.
- Resistance measured should be approximately 1 ohm or less. is it?

Repair open or short to ground in wire between Engine compartment junction block terminal and PCSV connector terminal 2.  
Clear codes and verify PCSV is within normal parameters.

YES

NO

- Turn the ignition off.
  - Disconnect the PCM.
  - Disconnect the PCSV solenoid valve.
  - Measure resistance between ground and purge control solenoid valve harness connector terminal 1.
- Resistance should indicate an open circuit. Does it?

Repair open in wire between PCM connector E200-1 terminal 16 and PCSV harness connector terminal 1.  
Clear code and verify PCSV is within normal parameters.



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YES

NO

• Turn the ignition off.  
• Disconnect the PCSV.  
• Measure resistance between the purge control solenoid valve connector terminals 1 and 2. Resistance should be approximately 27 ohms. Is it?

Repair short to ground or another circuit in wire between PCM connector terminal 16 and purge control solenoid valve connector terminal 1.

YES

NO

Verify PCM connector is secure. If OK, replace purge control solenoid valve with a known good component. Clear code and verify purge control solenoid valve is within normal parameters. If problem persists, replace PCM.

Replace purge control solenoid valve. Clear code and verify purge control solenoid valve is within normal parameters.

EFMB5220

DTC	Diagnostic item
P0500	Vehicle Speed Sensor Malfunction

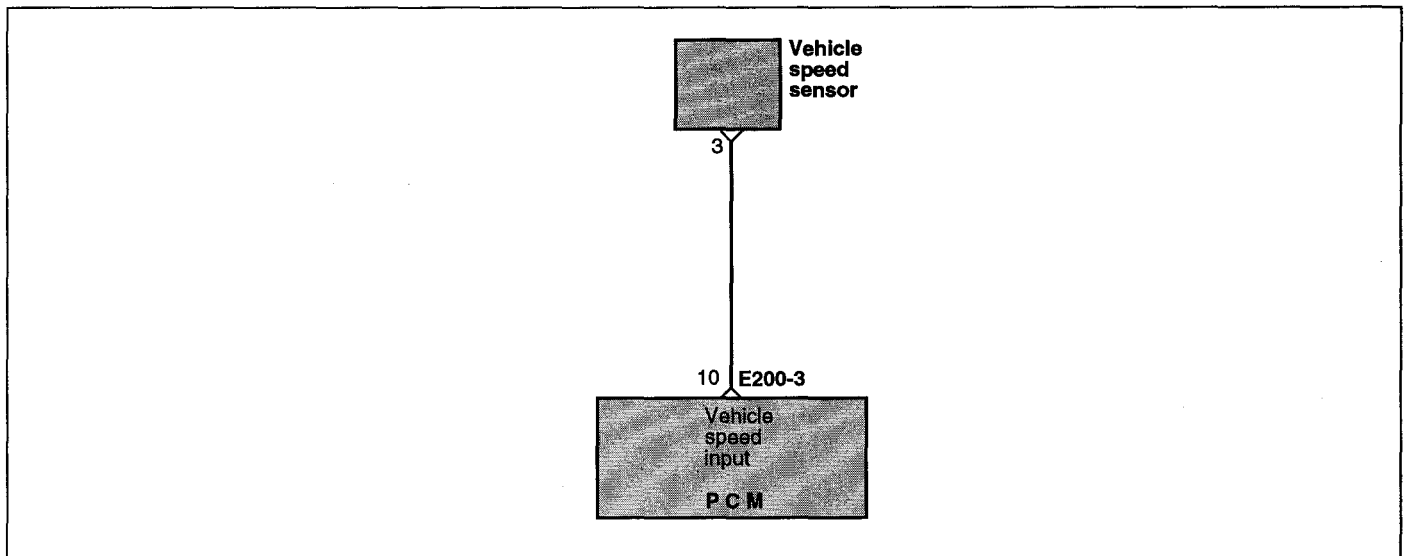
**DESCRIPTION**

The vehicle speed sensor outputs a pulse signal while the vehicle is driven.  
 The powertrain control module checks whether the pulse signal is present.

**TROUBLESHOOTING GUIDE**

DTC detection condition	Probable cause
<p><b>Normal Operation</b></p> <ul style="list-style-type: none"> <li>• The vehicle speed sensor outputs a pulse signal while the vehicle is driven.</li> <li>• The Powertrain Control Module checks whether the pulse signal is present.</li> </ul> <p><b>Normal Operation</b></p> <ul style="list-style-type: none"> <li>• Closed throttle position switch: OFF</li> <li>• Engine speed is 3,000 rpm or more.</li> <li>• Engine load is 70% or more.</li> </ul> <p><b>Malfunction</b></p> <ul style="list-style-type: none"> <li>• Sensor output voltage has not changed (no pulse signal is input) for 4 sec.</li> </ul>	<ul style="list-style-type: none"> <li>• Failed vehicle speed sensor</li> <li>• Open or shorted vehicle-speed sensor circuit, or loose connector</li> <li>• Failed powertrain control module</li> </ul>

**CIRCUIT DIAGRAM**



TEST PROCEDURE

- Turn the ignition switch on.
- Connect scan tool to data link connector.
- Verify DTC P0500 is set.

- Drive vehicle.

Does speedometer operate OK?

YES

- Turn the ignition off.
- Inspect between VSS and transaxle gear.

Is the VSS/transaxle gear interface OK?

YES

- Ignition off.
- Disconnect the VSS.
- Disconnect PCM connector E200-3.
- Ground VSS connector harness terminal 3.
- Measure resistance between ground and PCM harness connector E200-3 terminal 10.

Resistance measure should be approximately 1 ohm or less. Is it ?



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NO

Repair defective speedometer cable and/or drive gear parts. Clear code and verify VSS signal is within normal parameters.

NO

Repair interface between VSS and transaxle gear. Clear code and verify VSS signal is within normal parameters.

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YES

- Turn the ignition off.
- Disconnect the VSS.
- Disconnect the PCM.
- Measure resistance between VSS harness connector terminal 3 and ground. Resistance should indicate an open circuit. Does it?

YES

Verify PCM connector is secure. If OK, replace VSS with a known component of good quality. Clear code and verify VSS signal is within normal parameters. If problem persists, replace PCM.

NO

Repair wire between VSS harness connector terminal 3 and PCM harness connector E200-3 terminal 10. Clear code and verify VSS signal is within normal parameters.

NO

Repair short to ground or another circuit in wire between VSS harness connector terminal 3 and PCM harness connector E200-3 terminal 10. Clear code and verify VSS signal is within normal parameters.

# Engine Mechanical System [3.5 V6]

GENERAL .....	EMA -2
ENGINE BLOCK .....	EMA -19
MAIN MOVING SYSTEM .....	EMA -24
COOLING SYSTEM .....	EMA -38
LUBRICATION SYSTEM .....	EMA -49
INTAKE AND EXHAUST SYSTEM .....	EMA -53
CYLINDER HEAD ASSEMBLY .....	EMA -63
TIMING SYSTEM .....	EMA -69

**GENERAL****SPECIFICATIONS**

EDMB0010

Description	Specification	Limit
<b>General</b> Type Number of Cylinders Bore Stroke Total displacement Compression ratio Firing order Idle R.P.M Ignition timing at idling speed	V-type, DOHC 6 93 mm (3.661 in.) 85.8 mm (3.3779 in.) 3497 cc 10.0 1 - 2 - 3 - 4 - 5 - 6 800 ± 100 BTDC 5° ± 2°	
<b>Valve timing</b> Intake valve Opens (BTDC) Closes (ABDC) Exhaust valve Opens (BBDC) Closes (ATDC)	  11.5° 60.5°  43.5° 20.5°	
<b>Camshaft</b> Drive mechanism Cam height intake Cam height exhaust Journal diameter Bearing oil clearance End play	Cogged type belt 35.098 - 35.298 mm (1.3818 - 1.3897 in.) 34.81 - 35.01 mm (1.3705 - 1.3783 in.) 25.951 - 25.970 mm (1.0220 - 1.0224 in.) 0.05 - 0.09 mm (0.0007 - 0.0024 in.) 0.1 - 0.15 mm (0.0039 - 0.0059 in.)	
<b>Cylinder head</b> Flatness of gasket surface Flatness of maunting Surface Intake Exhaust Valve guide hole diameter 0.05 (0.002) O.S. 0.25 (0.010) O.S. 0.50 (0.20) O.S. Intake valve seat ring hole diameter 0.3 (0.012) O.S. 0.6 (0.024) O.S. Exhaust valve seat ring hole diameter 0.3 (0.012) O.S. 0.6 (0.024) O.S.	Max. 0.03 mm (0.0012 in.)   Max. 0.10 mm (0.0039 in.) Max. 0.15 mm (0.0059 in.)  12.05 - 12.068 mm (0.474 - 0.475 in.) 12.25 - 12.268 mm (0.482 - 0.483 in.) 12.50 - 12.518 mm (0.492 - 0.493 in.)  36.30 - 36.325 mm (1.429 - 1.430 in.) 36.60 - 36.625 mm (1.441 - 1.442 in.)  33.30 - 33.325 mm (1.311 - 1.312 in.) 33.60 - 33.625 mm (1.323 - 1.324 in.)	0.05 mm   0.10 mm 0.15 mm

Description	Specification	Limit
<b>Valve</b> Overall length Intake Exhaust Stem diameter Intake Exhaust Face angle Margin Intake Exhaust Clearance (stem - to - guide) Intake Exhaust	106.28 mm (4.184 in.) 105.4 mm (4.150 in.) 6.565 - 6.580 mm (0.258 - 0.259 in.) 6.530 - 6.550 mm (0.257 - 0.258 in.) 45° - 45.5° 1.0 mm (0.0394 in.) 1.5 mm (0.059 in.) 0.02 - 0.05 mm (0.0009 - 0.0020 in.) 0.05 - 0.085 mm (0.0020 - 0.0033 in.)	
<b>Valve spring</b> Free height Lode Out of squareness	46.4 mm (1.8268 in.) 24.0 kg / 37.9 mm (53 lb / 1.492 in.) Max 2°	41.5 mm (1.6339 in.) 55.8 kg / 28.9 mm (123 lb / 1.378 in.)
<b>Valve guide</b> Length Intake Exhaust Service oversize Valve seat contact width Intake Exhaust Service oversize Seat angle Intake Exhaust	45.5 mm (1.7913 in.) 50.5 mm (1.9882 in.) 0.05, 0.25, 0.50 0.9 - 1.3 mm (0.035 - 0.051 in.) 0.9 - 1.3 mm (0.035 - 0.051 in.) 0.30, 0.60 20° 45°	
<b>Piston</b> Diameter (Standard) Clearance (Piston-to-cylinder) Ring groove width No. 1 No. 2 Oil Piston for service	92.96 - 92.99 mm (3.659 - 3.661 in.) 0.03 - 0.05 mm (0.0012 - 0.0020 in.) 1.503 - 1.505 mm (0.0592 - 0.05925 in.) 1.501 - 1.503 mm (0.0591 - 0.0592 in.) 3.010 - 3.030 mm (0.1185 - 0.1193 in.) 0.25 mm (0.010 in.), 0.50 mm ( 0.020 in.) 0.75 mm (0.030 in.), 1.00 mm ( 0.040 in.) Oversize	



Description	Specification	Limit
<b>Piston ring</b> Number of rings per piston Compression ring type Oil ring Compression ring type No. 1 No. 2 Oil ring type Ring end gap No. 1 No. 2 Oil ring side rail Ring side clearance No. 1 No. 2 Ring for service	3 2 1 Barrel type, steel Taper type, special cast iron 3-piece type 0.30 - 0.45 mm (0.0118 - 0.0177 in.) 0.45 - 0.60 mm (0.0177 - 0.0236 in.) 0.2 - 0.7 mm (0.0079 - 0.0276 in.) 0.04 - 0.08 mm (0.0008 - 0.0031 in.) 0.02 - 0.06 mm (0.0016 - 0.0024 in.) 0.25mm (0.010 in.), 0.50 mm (0.020 in.) 0.75 mm (0.030 in.), 1.00 (0.039 in.), Oversize	
<b>Connecting rod</b> Piston pin press - in load Side clearance (Big end) Bend Twist Bearing Oil clearance Pin diameter	7500 - 17,500 N (750 - 1,750 kg, 1,653 - 3,858 lb) 0.10 - 0.25 mm (0.0039 - 0.0098 in.) 0.05 mm or less/100 mm (0.0020 in. or less/3.937 in.) 0.1 mm or less/100 mm (0.0039 in. or less/3.937 in.) 0.022 - 0.040 mm (0.0009 - 0.0016 in.) 21.974 - 21.985 mm (0.8651 - 0.8655 in.)	0.1 mm (0.004 in.)
<b>Crankshaft</b> Journal O.D. Pin O.D. Out - of - roundness of journal and pin Taper of journal and pin End play Main bearing Oil clearance	63.982 - 64.00 mm (2.519 - 2.5197 in.) 54.982 - 55.00 mm (2.165 - 2.1653 in.) Max. 0.03 mm (0.0012 in.) Max. 0.005 mm (0.0002 in.) 0.05 - 0.25 mm (0.002 - 0.0098 in.) 0.018 - 0.036 mm (0.0007 - 0.0014 in.)	0.3 mm (0.012 in.)
<b>Cylinder block</b> Cylinder bore Flatness of gasket surface Out - of - roundness and taper	93 mm (3.661 in.) Max. 0.05 mm (0.002 in.) Max. 0.02 mm (0.0008 in.)	0.05 mm (0.002 in.)
<b>Oil pump</b> Side clearance Body clearance Side clearance Tip clearance	0.100 - 0.181 mm (0.0039 - 0.0071 in.) 0.040 - 0.095 mm (0.0016 - 0.0037 in.) 0.06 - 0.018 mm (0.0024 - 0.0071 in.)	
<b>Relief spring</b> Free length Load	46.3 mm (1.823 in.) 3.4 kg / 39.1 mm (7.5 lb. / 1.54 in.)	
<b>Oil filter</b> Type	Cartridge, full flow	

Description	Specification	Limit
<b>Engine oil pressure</b>	80 kPa (11.4 psi) or more [Conditions : Oil temperature is 75 to 90°C (167 to 194°F)]	
<b>Cooling method</b>	Engine coolant cooling, forced circulation with electric fan	
<b>Cooling system</b> Quantity	11 lit (11.62 U.S.qts., 9.7 Imp.qts)	
<b>Thermostat</b> Type Normal opening temperature Opening temperature range Wide open temperature	Wax pellet type with jiggle valve 82°C (179.6°F) 80°C - 84°C (176 - 183.2°F) 95°C (203°F)	
<b>Radiator cap</b> Main valve opening pressure Main valve closing pressure Vacuum valve opening pressure	86.1 - 124.5 kPa (0.98 - 1.27 kg/cm <sup>2</sup> , 13.94 - 18.06 psi) 83.4 kPa (0.85 kg/cm <sup>2</sup> , 12.1 psi) - 6.86 kPa (- 0.07 kg/cm <sup>2</sup> , - 1.00 psi)	
<b>Air cleaner</b> Type Element	Dry type Unwoven cloth type	
<b>Exhaust pipe</b> Muffler Suspension system	Expansion resonance type Rubber hangers	

**SERVICE STANDARD****Standard value**

Coolant concentration  
Tropical area : 40%  
Other area : 50%

**LUBRICANT**

Engine coolant : Ethylene glycol base for aluminum radiator

**SEALANT**

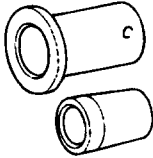
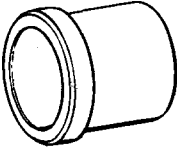
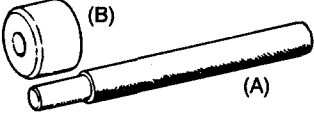
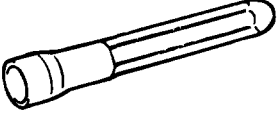
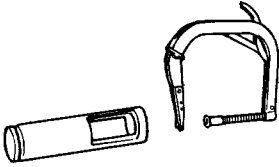
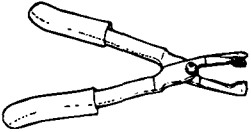
Engine coolant temperature sensor  
Three bond No.2310 or equivalent  
LOCTITE 962T or equivalent

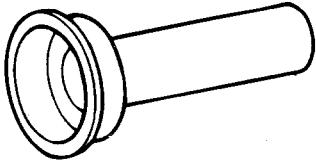
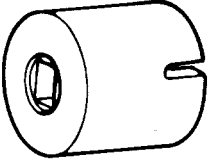
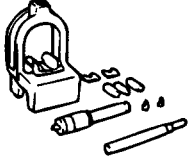
## TIGHTENING TORQUE EDMB0020

	Nm	kg.cm	lb.ft
Crankshaft bolt	180 - 190	1,800 - 1,900	130 - 138
Timing belt tensioner	20 - 27	200 - 1,100	15 - 20
Comshaft sprocket bolt	90 - 110	900 - 1000	65 - 80
Cylinder head cover bolts	5 - 6	50 - 60	4 - 5
Main bearing cap bolts	90 - 100	900 - 1000	65 - 72
Connecting rod nuts	35 + 92°	350 + 92°	26 + 92°
Cylinder head bolts Cold engine	105 - 115	1050 - 1150	75 - 82
Oil pan drain plug	35 - 45	350 - 450	26 - 32
Lower oil pan bolt	10 - 12	100 - 120	7.2 - 9
Upper oil pan bolt			
[10 × 380 mm (0.937 × 1.4961 in.)]	30 - 42	300 - 420	22 - 30
[8 × 22 mm (0.3150 × 0.8661 in.)]	19 - 28	190 - 280	14 - 20
[171.5 mm (6.7519 in.)]	5 - 7	50 - 07	3.7 - 5
[152.5 mm (6.7520 in.)]	5 - 7	50 - 07	3.7 - 5
Oil screen bolt	15 - 22	150 - 220	11 - 15
Oil pump case bolts	12 - 15	120 - 150	9 - 10
Oil relief valve plug	40 - 50	400 - 500	29 - 36
Oil pressure switch	8 - 12	80 - 120	5.8 - 8.7
Oil pump cover screw	8 - 15	80 - 150	5.8 - 11
Oil filter	17 - 25	170 - 250	12 - 18
Drive plate and adaptor plate bolt	73 - 77	730 - 770	53 - 55
Air cleaner body installation bolt	8 - 12	80 - 120	6 - 9
Surge tank stay	15 - 20	150 - 150	11 - 14
Air intake surge tank to intake manifold (bolt)	15 - 20	150 - 200	11 - 14
Air intake surge tank to intake manifold (nut)	15 - 20	150 - 200	11 - 14
Intake manifold to engine	12 - 15	120 - 150	9 - 10
Heat protector to exhaust manifold	12 - 15	120 - 150	14
Exhaust manifold to engine	27 - 33	270 - 330	20 - 40
Oil level gauge guide to engine	12 - 15	120 - 150	9 - 11
Water outlet fitting bolt	17 - 20	170 - 200	12.3 - 14.5
Power steering oil pump bracket to front cylinder head assembly	17 - 26	170 - 260	12 - 19
Power steering oil pump to bracket	17 - 26	170 - 260	12 - 19
Crank position sensor wheel screw	5 - 6	50 - 60	4 - 5
Engine mounting insulator bolt.	30 - 40	300 - 400	22 - 30
Engine mounting bracket bolt and nut.	65 - 85	650 - 850	48 - 63
	33 - 50	330 - 500	24 - 37
Transaxle mounting bracket bolts.	30 - 42	300 - 400	22 - 31
Transaxle mounting insulator bolt.	30 - 42	300 - 420	22 - 31
Starter to engine bolt.	27 - 34	270 - 340	20 - 25
Generator inlet pipe to front cylinder head assembly	12 - 15	120 - 150	9 - 11
Fuel hose clamp to rear cylinder head assembly	12 - 15	120 - 150	9 - 11
Transaxle mounting plate	10 - 12	100 - 120	7 - 9

	Nm	kg.cm	lb.ft
Rear plate	10 - 12	100 - 120	7.3 - 8.6
Oil seal case	10 - 12	100 - 120	7.3 - 8.6
Crankshaft pulley bolt	180 - 190	1,800 - 1,900	130 - 138
Timing belt cover bolt	10 - 12	100 - 120	7 - 9
Engine hanger bracket to engine	20 - 27	200 - 270	14 - 20
Generator mount bracket to engine	20 - 30	200 - 300	14 - 22
Generator mount nut (Engine front case side)	20 - 30	200 - 300	14 - 22
Generator mount bolt (Generator mount bracket side)	20 - 30	200 - 300	14 - 22
Stator to engine (Nut)	20 - 30	200 - 300	14 - 22
Drive belt pulley bolt	35 - 55	350 - 550	26 - 40
Drive belt tensioner bolt	45 - 50	450 - 500	33 - 36
Engine coolant pump to cylinder block bolt head mark "7" bolt	15 - 22	150 - 2200	11 - 15
Engine coolant temperature sensor	20 - 40	200 - 400	14 - 29
Engine coolant inlet fitting attaching bolt	17 - 20	170 - 200	12 - 14
Air cleaner mounting bolts	8 - 12	80 - 120	6 - 9
Intake manifold to cylinder head nuts	12 - 15	120 150	9 - 11
Throttle body to surge tank bolts	10 - 13	100 - 130	7 - 9.5
Exhaust manifold to cylinder head nuts	25 - 30	250 - 300	18 - 22
Exhaust manifold heat protector to exhaust manifold bolts	12 - 15	120 - 150	9 - 11
Oxygen sensor to exhaust manifold	40 - 50	400 - 500	29 - 36
Front exhaust pipe to exhaust manifold nuts	30 - 40	300 - 400	22 - 29
Front exhaust pipe to catalytic converter bolts	40 - 60	400 - 600	29 - 43
Catalytic converter to center exhaust pipe nuts	30 - 40	300 - 400	22 - 29
Center exhaust pipe to main muffler nuts	30 - 40	300 - 400	22 - 29
Main muffler hanger support bracket bolts	10 - 15	100 - 150	7 - 11
Delivery pipe installation bolts	10 - 15	100 - 150	7 - 11
Timing belt tensioner pulley bolt	43 - 55	430 - 550	31 - 40
Timing belt idler pulley bolt	50 - 60	500 600	36 - 43
Timing belt tensioner arm FIXED BOLT	35 - 55	350 550	26 - 40
Auto tensioner fixed bolt	20 - 27	200 - 270	14 - 20
Stator to engine (Bolt)	27 - 34	270 - 340	20 - 25
Camshaft bearing cap			
Outer	19 - 21	190 - 210	14 - 15
Inner	10 - 12	110 - 120	7 - 9

**SPECIAL TOOLS** ECBB0300

Tool (Number and name)	Illustration	Use
Crankshaft front oil seal installer (09214-33000)	 <p style="text-align: right;">HFR20A01</p>	Installation of the crankshaft front oil seal
Camshaft oil seal installer (09221-21000)	 <p style="text-align: right;">HFR20A02</p>	Installation of the camshaft oil seal
Valve guide installer (09222-22000 (B)) (09221-29000 (A))	 <p style="text-align: right;">KFW3003A</p>	Removal and installation of the valve guide
Valve stem oil seal installer (09222-22001)	 <p style="text-align: right;">KFW3002A</p>	Installation of the valve stem oil seal
Valve spring compressor (09222-28000)	 <p style="text-align: right;">J20008F</p>	Removal and installation of the intake or exhaust valve
Valve stem oil seal remover (09222-29000)	 <p style="text-align: right;">KFW3009A</p>	Removal of the valve stem oil seal

Tool (Number and name)	Illustration	Use
Crankshaft rear oil seal installer (09231-33000)	 <p style="text-align: right;">KFW3004A</p>	Installation of the crankshaft rear oil seal
Crankshaft wrench (09231-33100)	 <p style="text-align: right;">KFW3008A</p>	Used if the crankshaft needs to be rotated to attach the timing belt, etc.
Piston pin remover and installer (09234-33001) Fork insert (09234-33003)	 <p style="text-align: right;">HFR20A10</p>	Removal and installation of the piston pin

## TROUBLESHOOTING

ECBB0400

Symptom	Probable cause	Remedy
Knocking of crankshaft and bearing	Worn main bearing Seized bearing Bent crankshaft Excessive crankshaft end play	Replace Replace Replace Replace thrust bearing
Piston and connecting rod knock	Worn bearing Seized bearing Worn piston pin  Worn piston in cylinder Broken piston ring Improper connecting rod alignment	Replace Replace Replace piston and pin or connecting rod Recondition cylinder Repair or replace Replace
Noisy valves	Faulty auto-lash adjuster Thin or diluted engine oil (low oil pressure) Worn or damaged valve stem or valve guide	Replace Change Replace
Excessively worn cylinder and piston	Shortage of engine oil  Dirty engine oil Poor quality of engine oil Improperly assembled piston and connecting rod Improper piston ring end clearance Dirty air cleaner	Add or replace Check oil level on daily basis Replace Use proper oil Repair or replace Replace Clean air cleaner assembly and replace the air filter
Connecting rod and main bearing noise	Insufficient oil supply Thin or diluted engine oil Excessive bearing clearance	Check engine oil level Change and determine cause Replace
Damaged crankshaft bearing	Shortage of engine oil  Low oil pressure Poor quality of engine oil Worn or out-of-round of crankshaft journal Restricted oil passage in crankshaft Worn bearing  Bearing improperly installed Non-concentric crankshaft or bearing	Add or replace Check oil level on daily basis Adjust or repair Use proper engine oil Replace Clean Replace bearing and check engine oil and lubrication system Replace Replace
Timing belt noise	Incorrect belt tension	Replace
Low compression	Blown cylinder head gasket Worn or damaged piston rings Worn piston or cylinder  Worn or damaged valve seat	Replace gasket Replace rings Repair or replace piston and/or cylinder block Repair or replace valve and/or seat ring
Oil pressure drop	Low engine oil level Faulty oil pressure switch Clogged oil filter Worn oil pump gears or cover Thin or diluted engine oil Oil relief valve stuck (open) Excessive bearing clearance	Check engine oil level Replace Replace Replace Change and determine cause Repair Replace

Symptom	Probable cause	Remedy
High oil pressure	Oil relief valve stuck (closed)	Repair
Excessive engine rolling and vibration	Loose engine roll stopper (front, rear) Loose transaxle mount bracket Loose engine mount bracket Loose center member Broken transaxle mount insulator Broken engine mount insulator Broken engine roll stopper insulator	Re-tighten Re-tighten Re-tighten Re-tighten Replace Replace Replace
Low coolant level	Leakage of coolant Damaged radiator core joint Corroded or cracked hoses (Radiator hose, heater hose, etc) Faulty radiator cap valve or setting of spring Faulty thermostat Faulty engine coolant pump	Replace Replace  Replace Replace Replace
Clogged radiator	Foreign material in coolant	Replace
Abnormally high coolant temperature	Faulty thermostat Faulty radiator cap Restriction of flow in cooling system Loose or missing drive belt Faulty engine coolant pump Faulty temperature gauge or wiring Faulty electric fan Faulty thermo-sensor on radiator Insufficient coolant	Replace parts Replace Replace Adjust or replace Replace Repair or replace Repair or replace Replace Refill coolant
Abnormally low coolant temperature	Faulty thermostat Faulty temperature gauge or wiring	Replace Repair or replace
Leakage from oil cooling system	Loose hose and pipe connection Blocked or collapsed hose and pipe	Replace Repair or replace
Inoperative electrical cooling fan	Damaged	Replace or repair
Exhaust gas leakage	Loose connections Broken pipe or muffler	Re-tighten Repair or replace
Abnormal noise	Detached baffle plate in muffler Broken rubber hanger Pipe or muffler contacting vehicle body Broken pipe or muffler	Replace Replace Correct Repair or replace



**CHECKING ENGINE OIL** EDHA0500

1. Position a vehicle on a level surface.
2. Turn off the engine.

** NOTE**

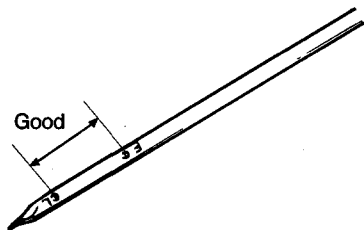
*In the case of a vehicle that has not been used for a prolonged period, run the engine for several minutes. Turn off the engine and wait for 5 minutes at least, then check the oil level.*

3. Check that the engine oil level is within the level range indicated on the oil dipstick. If the oil level is found to have fallen to the lower limit (the "L" mark), refill to the "F" mark.

** NOTE**

*When refilling, use the proper grade of engine oil.*

4. Check that the oil is not dirty or mixed with coolant or gasoline, and that it has the proper viscosity.

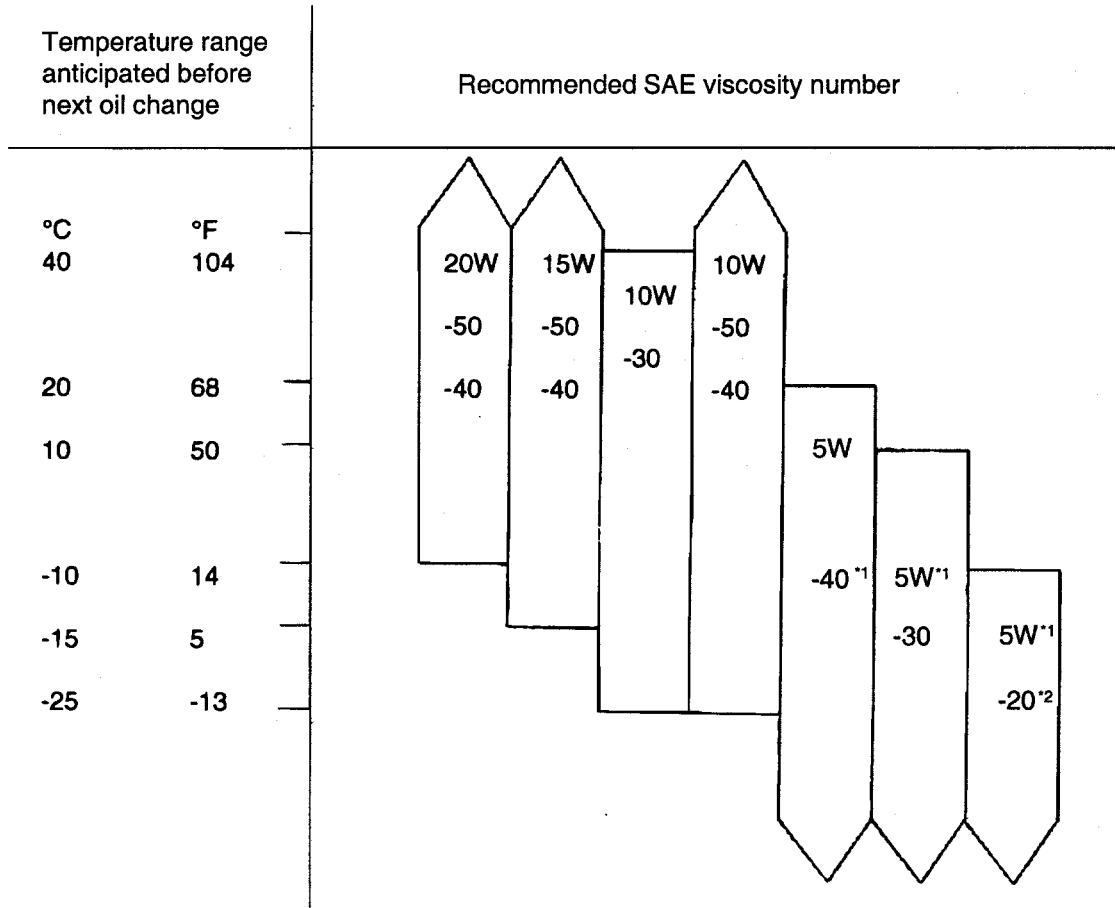


EDA9000A

**SELECTION OF ENGINE OIL** ECBB0600

**Recommended API classification: SD OR ABOVE SE OR ABOVE [For EC.]**

**Recommended SAE viscosity grades:**



\*1 Restricted by driving condition and environment.

\*2 Not recommended for sustained high speed vehicle operation

EDA9990B

**NOTE**

For best performance and maximum protection of all types of operation, select only those lubricants which:

1. Satisfy the requirements of the API classification.
2. Have the proper SAE grade number for expected ambient temperature range.

Lubricants which do not have both an SAE grade number and an API service classification on the container should not be used.

**CHANGE ENGINE OIL** EDMB0030

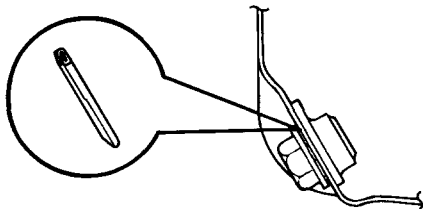
1. Run the engine until it reaches normal operating temperature.
2. Turn off the engine.
3. Remove the oil filler cap and oil filter and then drain plug.  
Drain the engine oil.
4. Tighten the drain plug to the specified torque.

**Tightening torque**

Oil pan drain plug : 35-45 Nm (350-450 kg.cm, 25-33 lb.ft)

**NOTE**

Whenever tightening the oil drain plug, use a new drain plug gasket.



EDB9001A

5. Fill the new engine oil through the oil filler cap.

**Drain and Refill**

Oil quantity : 4.4 lit (5 U.S. qts., 4.2 Imp. qts.)

**NOTE**

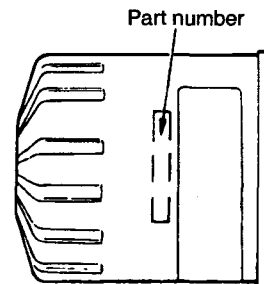
Do not over fill. This will cause oil aeration and loss of oil pressure.

6. Install the oil filler cap.
7. Start and run the engine.
8. Turn off the engine and then check the oil level. Add oil if necessary.

**REPLACEMENT OIL FILTER** ECBB0800**FILTER SELECTION**

All Hyundai Motor Company engines are equipped with a high quality, disposable oil filter. This filter is recommended as a replacement filter for all vehicles. The quality of after market replacement filters is various considerably.

High quality of replacement filters should be used to assure the most efficient service. Make sure that the rubber gasket from the old oil filter is completely removed from the contact surface on the engine block before installing a new filter.



ECA9970A

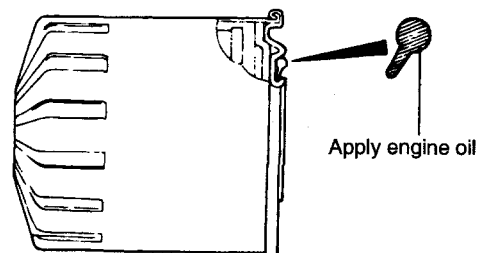
**PROCEDURE FOR REPLACING OIL FILTER**

1. Use a filter wrench to remove the oil filter.
2. Before installing a new oil filter on the engine, apply clean engine oil to the surface of the rubber gasket.
3. Tighten the oil filter of the specified torque.

**Tightening torque**

Oil filter : 17 - 25 Nm (170 - 250 kg.cm, 12 - 18 lb.ft)

4. Start and run the engine and check engine oil leaks.
5. After stopping the engine, check the oil level and add oil as necessary.



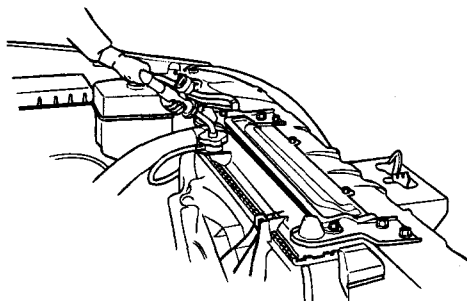
ECA9970B

**CHECKING COOLANT LEAK****CHECK** EDMB0040

1. Loosen the radiator cap.
2. Confirm that the coolant level is up to the filler neck.
3. Install a radiator cap tester to the radiator filler neck and apply 150 KPa (21psi, 1.53 kg/cm<sup>2</sup>) pressure. Hold for two minutes, then check for leakage from the radiator, hoses or connections.

 **CAUTION**

1. **Radiator coolant may be extremely hot. Do not open the system while hot, or scalding engine coolant could gush out, causing personal injury. Allow the vehicle to cool before servicing this system.**
  2. **When the tester is removed, be careful not to spill any coolant from it.**
  3. **Be sure to clean away completely any coolant from the area.**
  4. **Be careful, when installing and removing the tester and when testing, not to deform the filler neck of the radiator.**
4. If there is leakage, repair or replace with the appropriate part.



KDMB002A

**RADIATOR CAP PRESSURE TEST** EDHA1000

1. Use an adapter to attach the cap to the tester.
2. Increase the pressure until the indicator of the gauge stops moving.

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 Main valve opening pressure :

 107.9 ± 14.7 kPa (1.1 ± 0.15 kg/cm<sup>2</sup>, 15.64 ± 2.13 psi)

Main valve closing pressure :

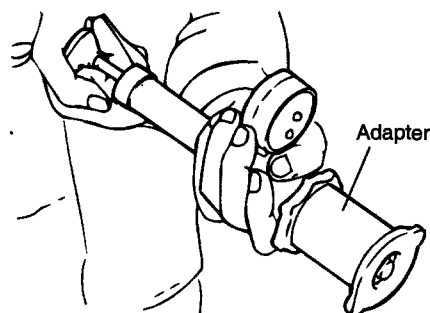
 83.4 kPa (0.85 kg/cm<sup>2</sup>, 12.1 psi)
 

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3. Check that the pressure level is maintained at or above the limit.
4. Replace the radiator cap if the reading does not remain at or above the limit.

 **NOTE**

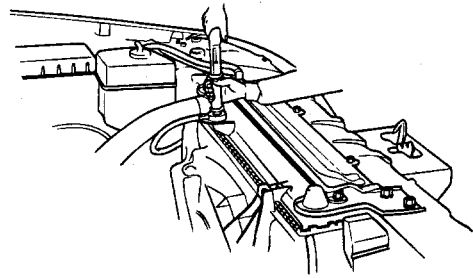
*Be sure that the cap is clean before testing, since rust or other foreign material on the cap seal will cause an incorrect reading.*



ECA9090A

**SPECIFIC GRAVITY TEST** EDMB0050

1. Measure the specific gravity of the coolant with a hydrometer.
2. Measure the coolant temperature and calculate the concentration from the relation between the specific gravity and temperature. Use the following table for reference.



KDMB002B

**RELATION BETWEEN COOLANT CONCENTRATION AND SPECIFIC GRAVITY**

Coolant temperature °C (°F) and specific gravity					Freezing temperature °C (°F)	Safe operating temperature °C (°F)	Coolant concentration (Specific volume)
10 (50)	20 (68)	30 (86)	40 (104)	50 (122)			
1.054	1.050	1.046	1.042	1.036	-16 (3.2)	-11 (12.2)	30%
1.063	1.058	1.054	1.049	1.044	-20 (-4)	-15(5)	35%
1.071	1.067	1.062	1.057	1.052	-25 (-13)	-20 (-4)	40%
1.079	1.074	1.069	1.064	1.058	-30 (-22)	-25 (-13)	45%
1.087	1.082	1.076	1.070	1.064	-36 (-32.8)	-31 (-23.8)	50%
1.095	1.090	1.084	1.077	1.070	-42 (-44)	-37 (-35)	55%
1.103	1.098	1.092	1.084	1.076	-50 (-58)	-45 (-49)	60%

**Example**

The safe operating temperature is -15°C (5°F) when the measured specific gravity is 1.058 at coolant temperature of 20°C (68°F)

- ***If the concentration is above 60%, the engine cooling property will decrease, affecting the engine adversely. For these reasons, be sure to maintain the concentration level within the specified range.***
- ***Do not mix types of anti - freeze.***

**⚠ CAUTION**

- ***If the concentration of the coolant is below 30%, its anti-corrosion property will be adversely affected.***

**RECOMMENDED COOLANT**

Antifreeze

Mixture ratio of antifreeze in coolant

ETHYLENE GLYCOL BASE FOR ALUMINUM

50% [Except tropical areas]

40% [Tropical areas]

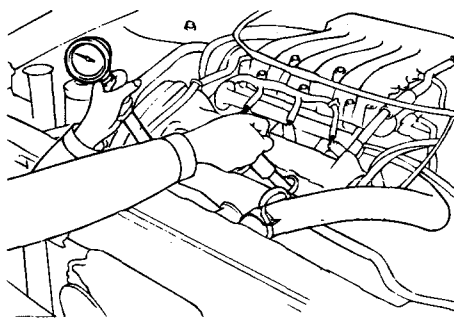
**CHECKING COMPRESSION**

**PRESSURE** EDHA1200

1. Before checking the engine compression, check the engine oil level. Also check that the starter motor and battery are all in normal operating condition.
2. Start the engine and wait until the engine coolant temperature reaches 80 - 95°C (176 - 205°F).
3. Stop the engine and disconnect the spark plug cables.
4. Remove the spark plugs.
5. Crank the engine to remove any foreign material in the cylinders.
6. Insert the compression gauge into the spark plug hole.
7. Depress the accelerator pedal to open the throttle fully.
8. Crank the engine and read the gauge.

Standard value : 1,200kpa(12.2 kg/cm<sup>2</sup> , 170psi)

Limit : 1,050kpa(10.7kg/cm<sup>2</sup> , 149psi)



EDHA015A

- 2) If the compression remains the same, valve seizure, poor valve seating or a compression leak in the cylinder head gasket are all possible causes.

**Tightening torque**

Spark plug : 20-30 Nm (200-300 kg.cm, 14-22 lb.ft)

**TIGHTENING CYLINDER HEAD**

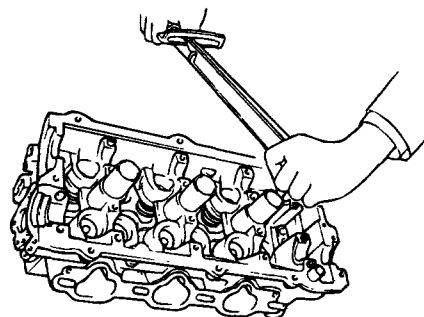
**BOLTS** ECBB1300

1. First loosen slightly and then tighten to the specified torque.

**Tightening torque**

Cylinder head bolts cold [Engine temperature approximately 20°C (68°F)] :

105 - 115 Nm (1050 - 1150 kg.cm, 75 - 82 lb ft.)



EDA9010A

2. Be sure to follow the specific torque sequence as shown in the illustration.

**NOTE**

Run the engine to normal operating temperature and let it cool, then re-torque the bolts to specifications.

9. Repeat steps 6 to 8 for all cylinders, making sure that the pressure difference for each of the cylinders is within the specified limit.

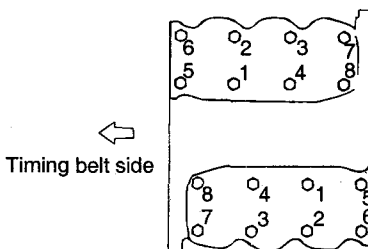
Limit Max. 100kpa (1.0 kg/cm<sup>2</sup> , 14psi)

:

between cylinders

10. If a cylinder's compression or pressure differential is outside the specification, add a small amount of oil through the spark plug hole, and repeat steps 6 to 9.

- 1) If the addition of oil causes the compression to rise, it is possible that the piston ring is be worn.



EDA9060B

**ADJUSTING VALVE CLEARANCE** EDHA1400

As the intake and exhaust valves are equipped with hydraulic lash adjusters, there is no need to adjust the valve clearance. The proper function of the hydraulic lash mechanism may be determined by checking for tappet noise. When there is a tappet noise or any unusual noise, check the hydraulic lash adjuster by removing and bleeding or replacing it.

**ADJUSTING DRIVE BELT AND TENSIONER** EDMB0060

1. Hang the belt on the pulley of the tensioner and install the tensioner.  
(If the tensioner is already installed, loosen its mounting bolts to allow belt installation.)

**Tightening torque**

Tensioner assembly bolt :

45 - 50 Nm (450 - 500 kg.cm, 33 - 36 lb.ft)

3. Adjust the drive belt tension to specification by turning the adjusting bolt clockwise or counterclockwise.

**Standard Value**

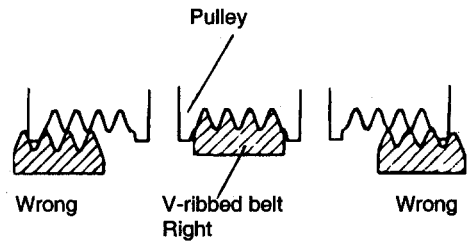
Air - conditioner compressor

: 7 - 10 mm (0.28 - 0.039 in.)

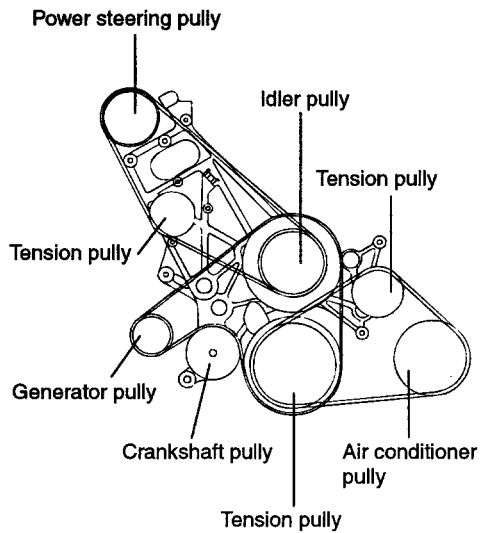
Alternator : 10 - 13 mm (0.39 - 0.51 in.)

Power steering: 8 - 11 mm (0.31 - 0.43 in.)

4. When installing the belt on the pulley, make sure it is centered on the pulley.



EOYR0020



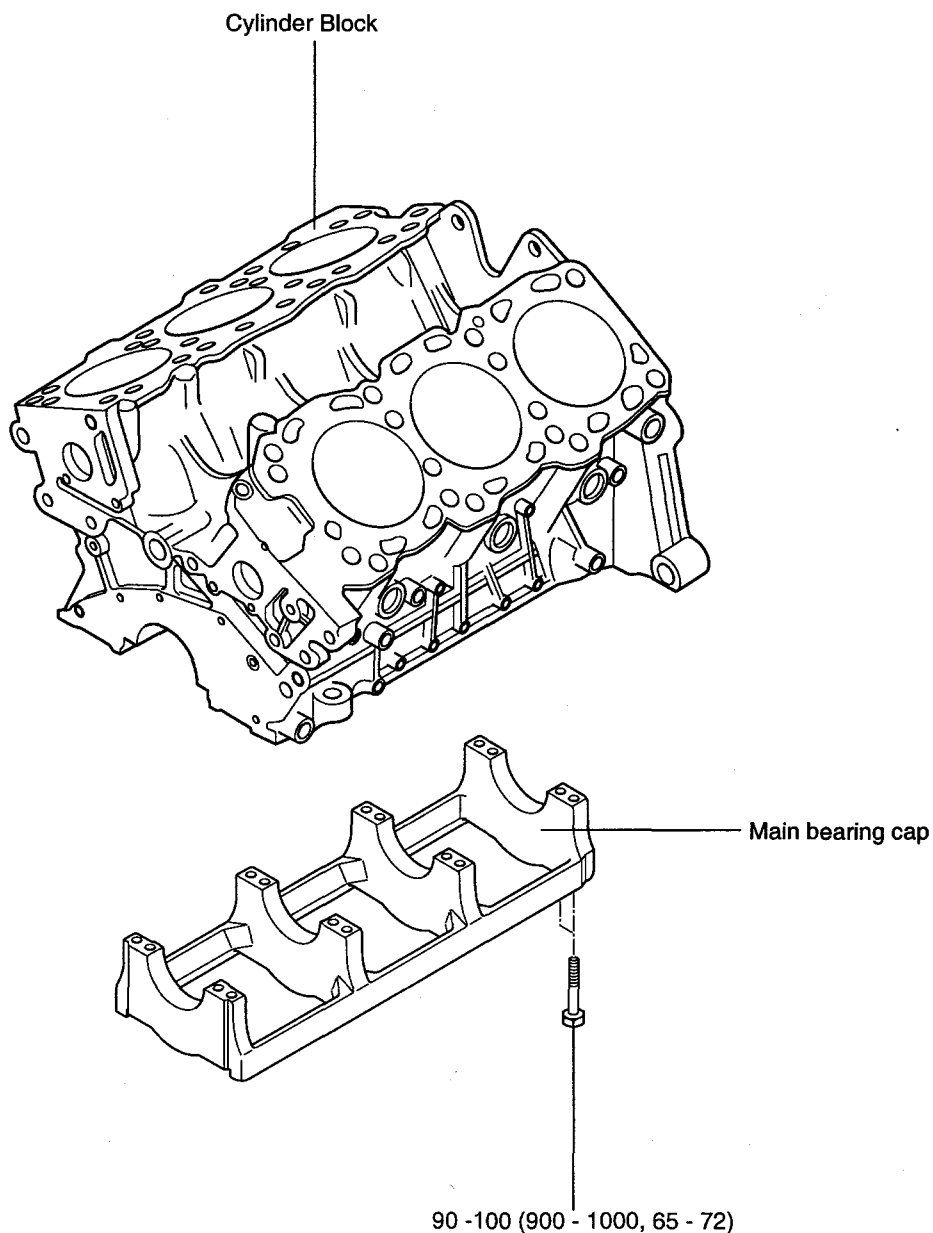
EDMB006A

2. Install drive belt.

# ENGINE BLOCK

## ENGINE BLOCK

### COMPONENTS EDMB0100



**TORQUE : Nm (kg.cm, lb.ft)**



**REMOVAL** EDMB0110

Remove the timing belt, cylinder head assembly, drive plate, transaxle mounting plate, oil pan and oil pump case.

For further details, refer to the appropriate section.

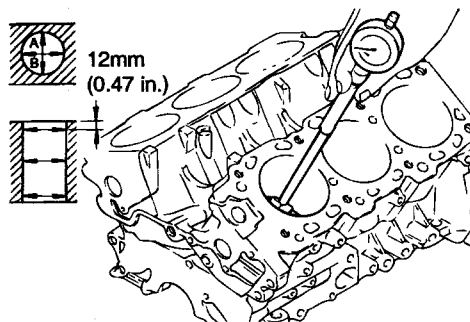
**INSPECTION** EDMB0120**CYLINDER BLOCK**

1. Check the cylinder block for scores, rust and corrosion. Also check for cracks or any other defects. Replace the block if defective.
2. Measure the cylinder bore with a cylinder gauge at the three levels indicated, in the directions A and B.

Level 1 : No.1 piston ring position at TDC

Level 2: Center of cylinder

Level 3 : Bottom of cylinder



EDA9460A

3. If the cylinder bores show more than the specified out-of-round or taper, or if the cylinder walls are badly scuffed or scored, the cylinder block should be re-bored and honed. New oversize pistons and rings should be installed.

**Standard value**

Cylinder bore : 93 - 93.03 mm (3.661 - 3.6625 in.)

Out-of-round and taper of cylinder bore :

Max. 0.02 mm (0.0008 in.)

4. If a ridge exists at the top of the cylinder, cut it off with a ridge reamer.

5. Oversize pistons are available in four sizes.

**Piston service size and mark mm (in.)**

0.25 (0.010) O.S : 0.25

0.50 (0.020) O.S : 0.50

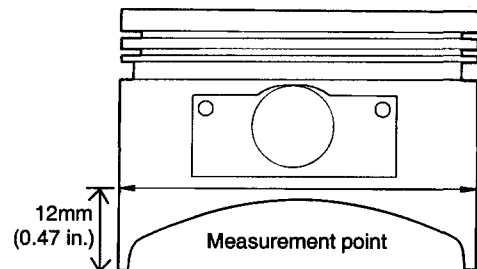
0.75 (0.030) O.S : 0.75

1.00 (0.040) O.S : 1.00

6. To re bore the cylinder bore to the oversize, maintain the specified clearance between the oversize piston and the bore and make sure that all used pistons are the same oversize. The standard measurement of the piston outside diameter is taken at a level of 12mm (0.47 in.) above the bottom of the piston skirt and across the thrust faces.

Piston-to-cylinder clearance :

0.03 - 0.05 mm (0.0012 - 0.0020 in.)



ECBB444A

7. Check for damage or cracks in the cylinders.
8. Check the top surface of the cylinder block for flatness. If the top surface exceeds the limit, grind to the minimum limit or replace.

**Standard value**

Flatness of gasket surface :

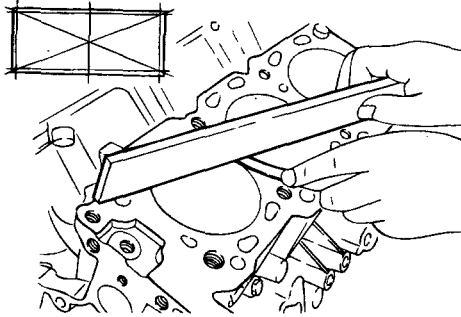
Max. 0.03 mm (0.0012 in.)

**Service limit**

Flatness of gasket surface : 0.05 mm (0.0020 in.)

**⚠ CAUTION**

*When the cylinder head is assembled, grinding less than 0.2mm (0.008in.) is permissible.*



EDA9460B

**BORING CYLINDER** EDMB0130

1. Oversize pistons should be selected according to the largest bore cylinder.

Identification Mark	Size
0.25	0.25 mm (0.010 in.)
0.50	0.50 mm (0.020 in.)
0.75	0.75 mm (0.030 in.)
1.00	1.00 mm (0.040 in.)

**📄 NOTE**

*The size of piston is stamped on top of the piston.*

2. Measure the outside diameter of the piston to be used.
3. According to the measured O.D., calculate the new bore size.  
 $\text{New bore size} = \text{Piston O.D} + 0.03 \text{ to } 0.05 \text{ mm (0.0012 to 0.002 in.) (clearance between piston and cylinder)} - 0.01 \text{ mm (0.0004 in.) (honing margin.)}$
4. Bore each of the cylinders to the calculated size.

**⚠ CAUTION**

*To prevent distortion that may result from temperature rise during honing, bore the cylinder holes in the firing order.*

- 5.hone the cylinders, finishing them to the proper dimension (piston outside diameter + gap with cylinder).

6. Check the clearance between the piston and cylinder.

Standard : 0.03 - 0.05 mm (0.0012 - 0.0020 in.)

**📄 NOTE**

*When boring the cylinders, finish all of the cylinders to the same oversize. Do not bore only one cylinder to the oversize.*

**REASSEMBLY** EDHA2500

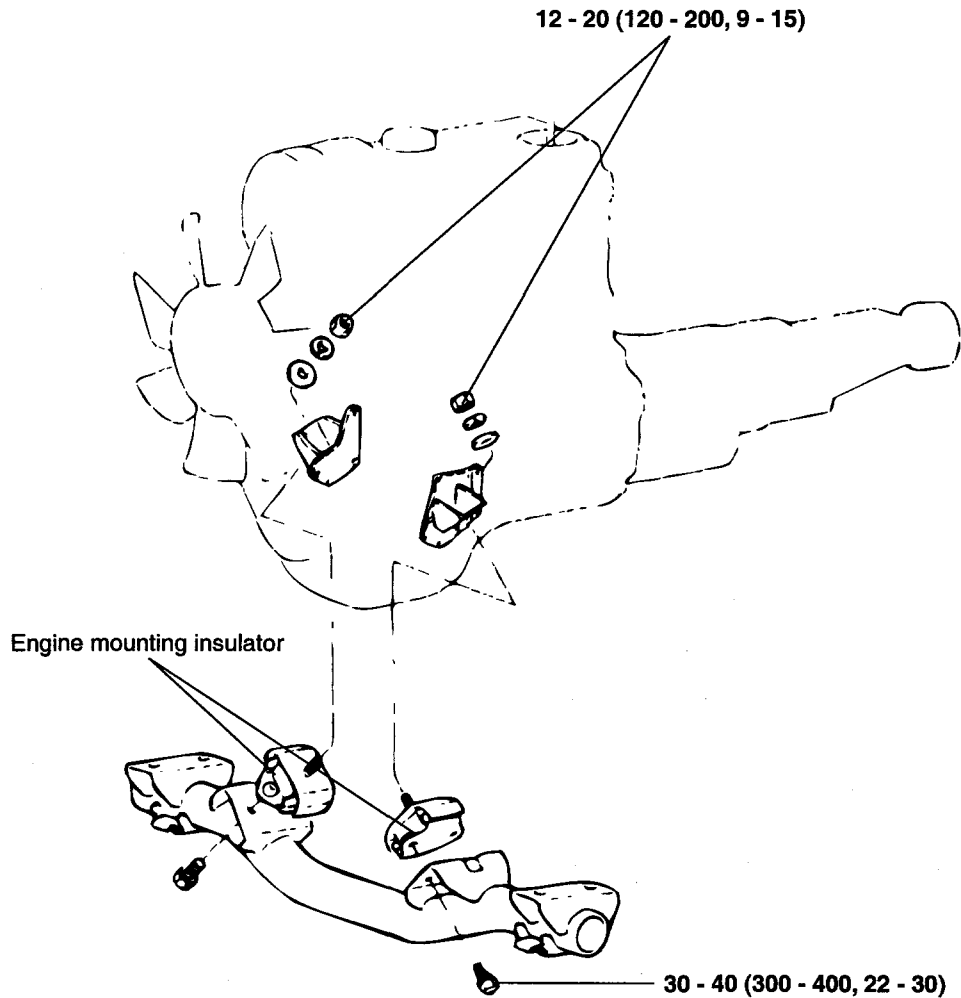
Install the following parts by referring to their respective sections.

1. Crankshaft
2. Drive plate
3. Piston
4. Cylinder head
5. Timing belt
6. Oil pump case

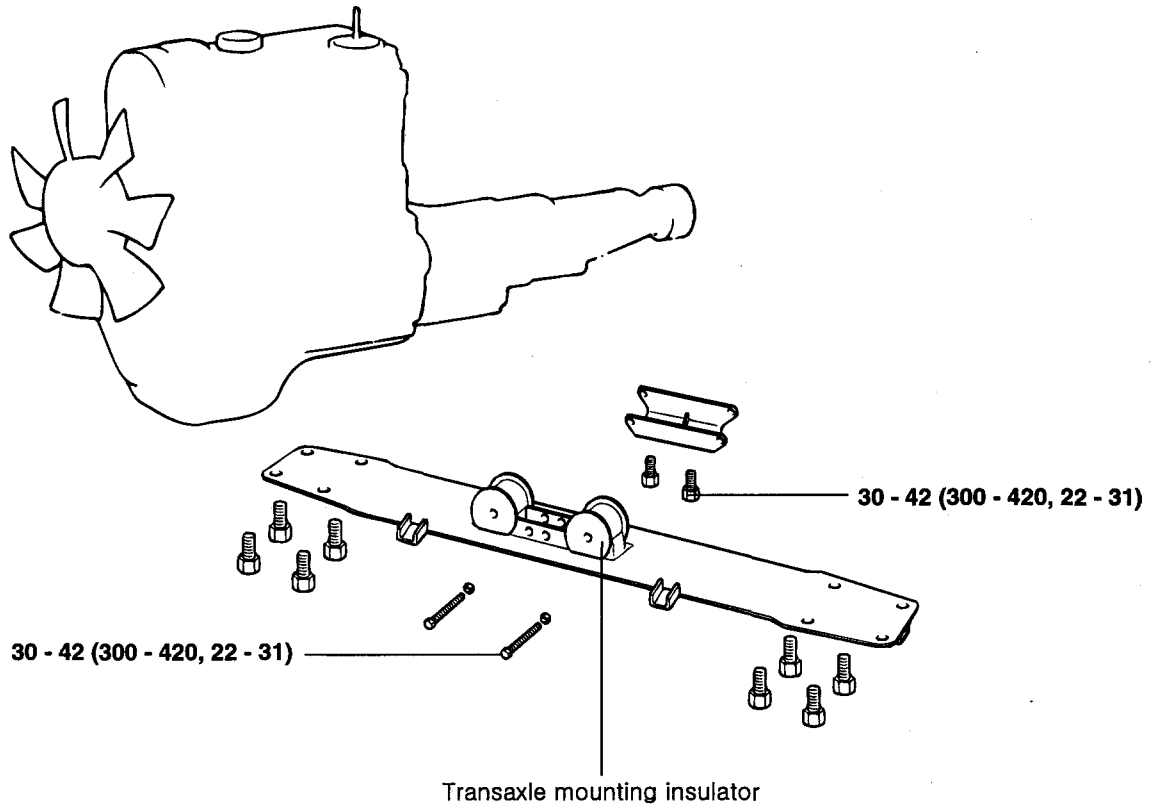
# ENGINE MOUNTS

## COMPONENTS EDMB0150

### FRONT ENGINE MOUNTING



**TORQUE : Nm (kg.cm, lb/.ft)**

T/M MOUNTING EDMB0160

**TORQUE : Nm (kg.cm, lb.ft)**

EDMB016A

**INSPECTION** EDMB0170

1. Check the insulator for damage, crack and deformation.
2. Check the insulator stopper plate for damage, crack and deformation.

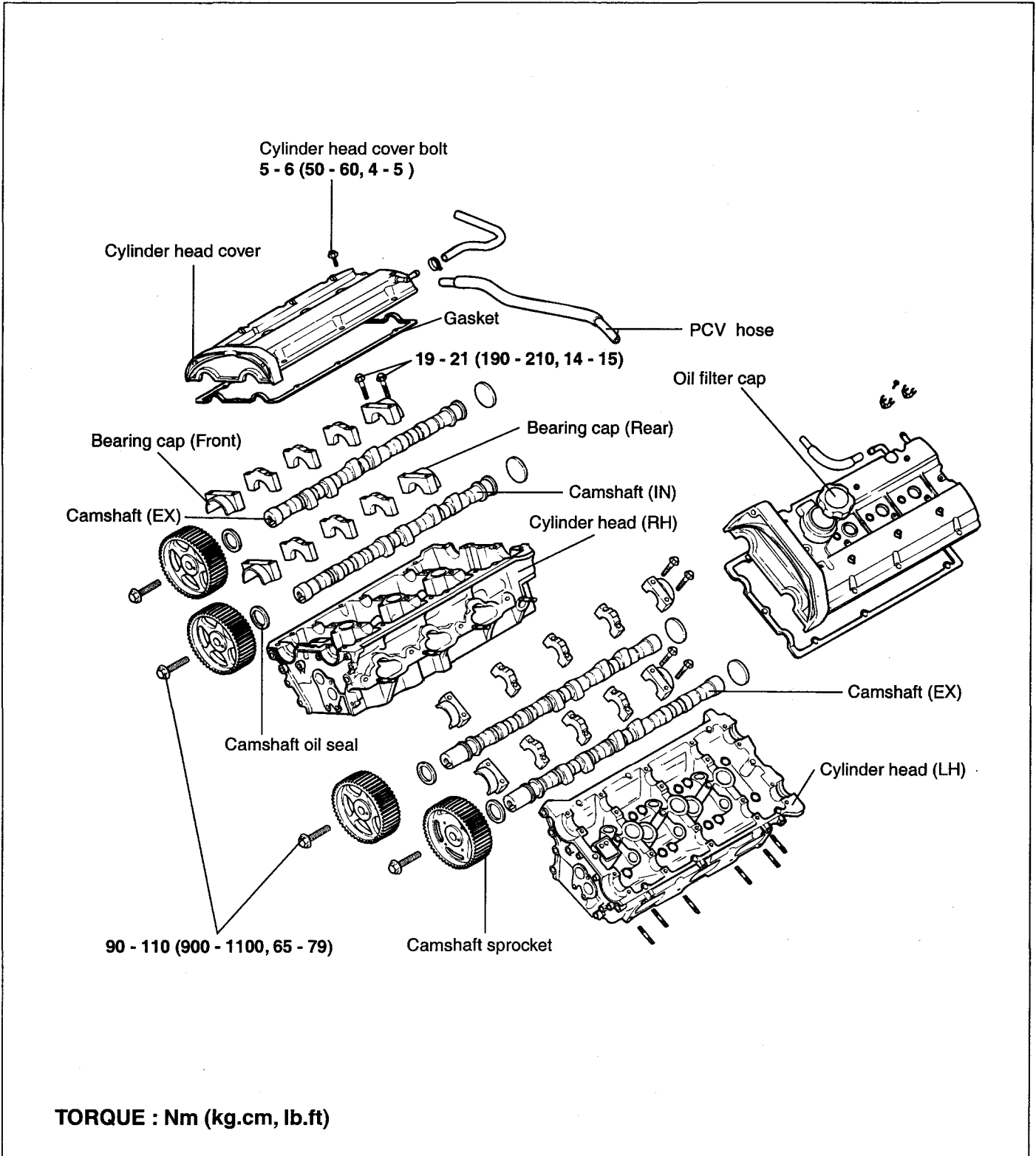
 **NOTE**

*Be careful not to apply oil to the insulator.*

# MAIN MOVING SYSTEM

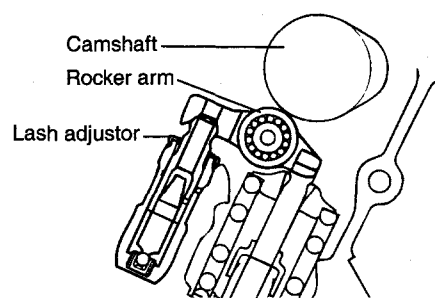
## CAM SHAFT

### COMPONENTS ECBB3000



**DISASSEMBLY** EDMB0200

1. Remove intake manifold.
2. Disconnect the breather hose and the engine harness.
3. Remove the power steering pulley, air conditioner pulley, crankshaft pulley, idler pulley and tensioner pulley.
4. Remove the timing belt cover.
5. Loosen the auto tensioner.
6. Remove the timing belt from the camshaft sprocket.
7. Remove the spark plug cables.
8. Loosen the cylinder head cover bolts and then remove it.



EDB9030C

**INSPECTION** EDMB0210

**CAMSHAFTS**

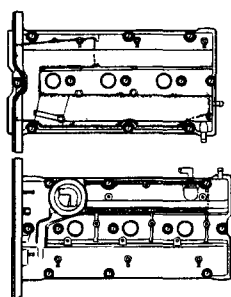
1. Check the camshaft journals for wear. If the journals are badly worn out, replace the camshaft.
2. Check the cam lobes for damage. If the lobe is damaged or excessively worn out, replace the camshaft.

**Cam height**

[Standard]

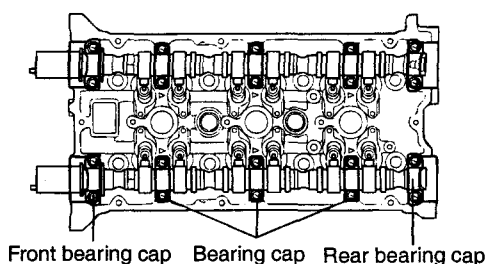
Intake : 35.098 - 35.298 mm (1.3818 - 1.3897 in.)

Exhaust : 34.81 - 35.01 mm (1.3705 - 1.3783 in.)



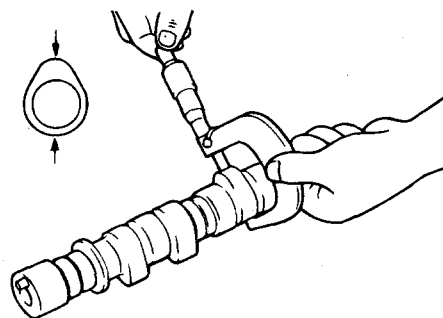
EDB9030A

9. Remove the camshaft sprockets.
10. Remove the camshaft bearing caps.



EDB9030B

11. Remove the camshafts.



EDA9260A

3. Check the cam surface for abnormal wear or damage, and replace if necessary.
4. Check each bearing for damage. If the bearing surface is excessively damaged, replace the cylinder head assembly or camshaft bearing cap, as necessary.

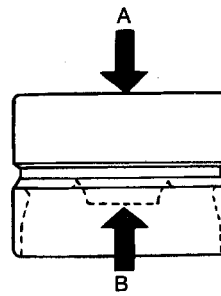
Camshaft end play : 0.1-0.15mm(0.0039-0.0059 in.)

**OIL SEAL (CAMSHAFT FRONT)**

1. Check the lips for wear. If lip threads are worn out, replace the oil seal with new one.
2. Check a contact surface of oil seal lip on camshaft. If there stratified wear, replace the camshaft.

**HLA (HYDRAULIC LASH ADJUSTER)**

With the HLA filled with engine oil, hold A and press B by hand. If B moves, replace the HLA.



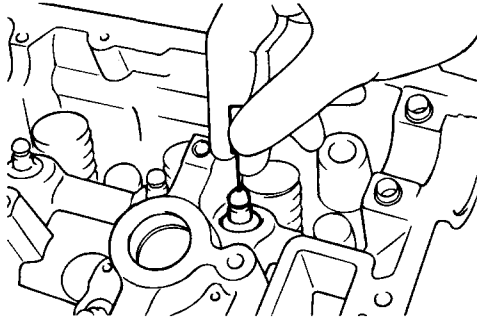
EDA9260B

Problem	Possible cause	Action
1. Temporary noise when starting a cold engine	Normal	This noise will disappear after the oil in the engine reaches the normal pressure.
2. Continuous noise when the engine is started after parking more than 48 hours.	Oil leakage of the high pressure chamber on the HLA, allowing air to get in.	Noise will disappear within 15 minutes when engine runs at 2000-3000 rpm. If it doesn't disappear, refer to step 7 below.
3. Continuous noise when the engine is first started after rebuilding cylinder head.	Insufficient oil in cylinder head oil gallery.	
4. Continuous noise when the engine is started after excessively cranking the engine by the starter motor or band.	Oil leakage of the high-pressure chamber in the HLA, allowing air to get in. Insufficient oil in the HLA.	
5. Continuous noise when the engine is running after changing the HLA.		
6. Continuous noise during idle after high engine speed.	Engine oil level too high or too low.	Check oil level. Drain or add oil as necessary.
	Excessive amount of air in the oil at high engine speed.	Check oil supply system.
	Deteriorated oil.	Check oil quality. If deteriorated, replace with specified type.
7. Noise continues for more than 15 minutes.	Low oil pressure.	Check oil pressure and oil supply system of each part of engine.
	Faulty HLA.	Remove the cylinder head cover and press HLA down by hand. If it moves, replace the HLA.  <b>⊗ WARNING</b> Be careful with the hot HLAS.

**⚠ CAUTION**  
*Do not run engine at a speed higher than 3000 rpm, as this may damage the HLA.*

**AUTO LASH ADJUSTER**

1. Check auto - lash adjusters for free play by inserting a small wire through the air bleed hole in the rocker arm and push the autolash adjuster check ball down very lightly.
2. While lightly holding the check ball down move the rocker arm up and down to check for free play. If there is no play replace the auto - lash adjuster.



EDB9030E

4. The left and right banks of the camshafts are different and you should be careful not to confuse them.

**Identification signal**

Left bank

Intake (IN) : F

Exhaust (Ex) : E

Right bank

Intake (IN) : G

Exhaust (Ex) : H



EDB9034B

**REASSEMBLY** ECBB3250

**CAMSHAFT AND BEARING CAP**

1. Rotate the crankshaft and No. 1 cylinder is in TDC (Compression stroke)
2. Check the position of the rocker arm whether it is exactly installed on the lash adjuster and valve or not.
3. Install the camshaft dowel pin as illustration.

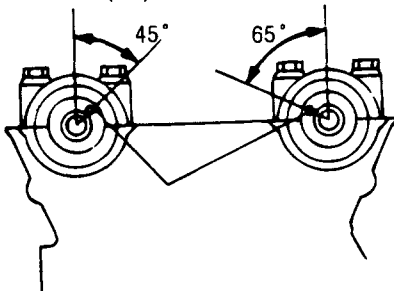
5. Confirm the identification mark and the number. Bearing caps of No.3, No.4, and No.5 have the front mark and arrange the front mark upon the cylinder head while installing the bearing caps.

**Identification mark**

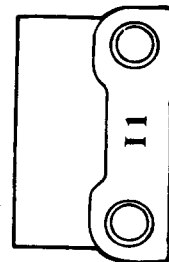
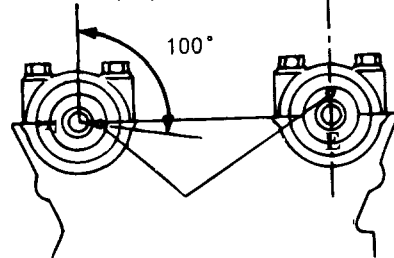
Intake : I

Exhaust : E

Cylinder head (RH)



Cylinder head (RH)



EDB9034C

EDB9034A



6. Tighten the bearing cap by 2 or 3 steps

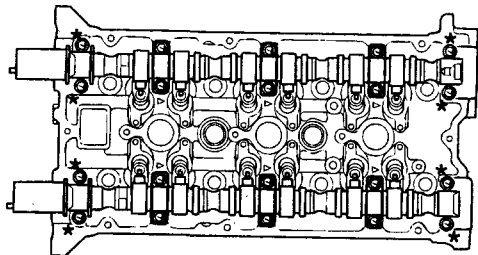
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**Tightening Torque**

Outer (\*) 16 EA : 1.9 - 2.1 kg.m

Inner 24 EA : 1.0 - 1.2 kg.m

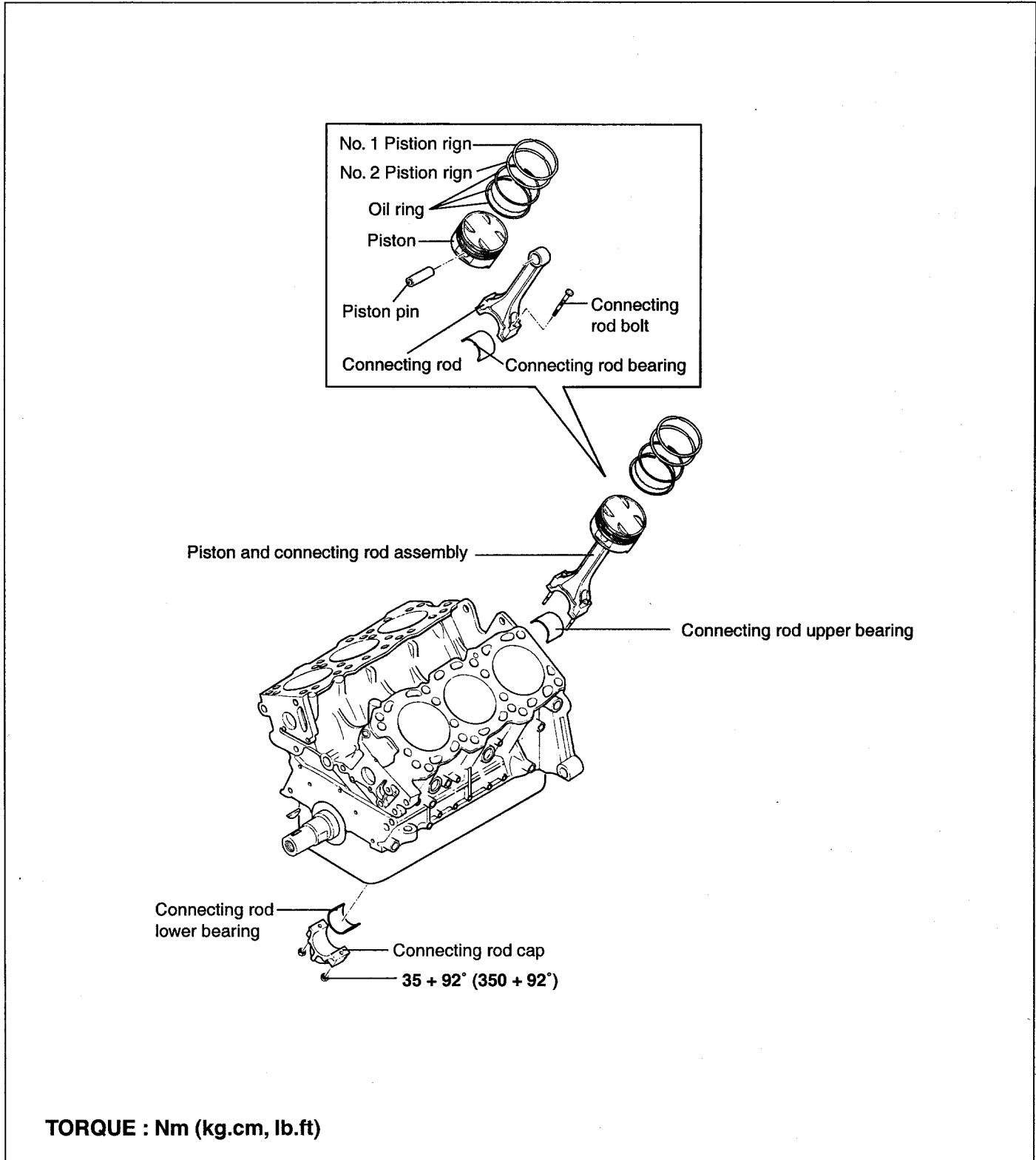
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EDB9034D

# CONNECTING ROD

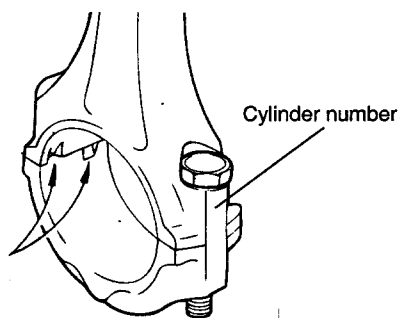
## COMPONENTS EDMB0230



**DISASSEMBLY** ECBB3400**CONNECTING ROD CAP****⚠ CAUTION**

Keep the bearings in order with their corresponding connecting rods (according to cylinder numbers) for proper reassembly.

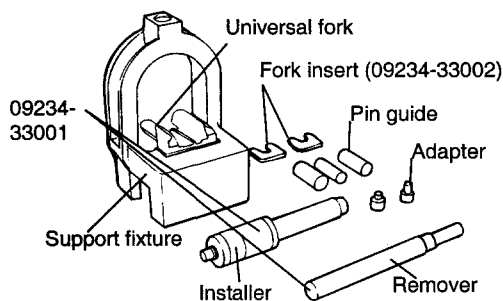
1. Remove the connecting rod cap bolts, then remove the caps and the big end lower bearing mark for re-assembly.
2. Push each piston connecting rod assembly toward the top of the cylinder.



ECBB444D

**DISASSEMBLY AND REASSEMBLY OF THE PISTON PIN**

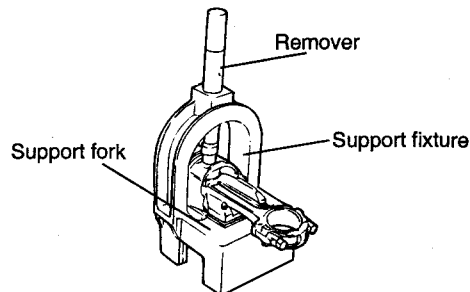
1. Using the special tools 09234 - 33001 and 09234 - 3002, disassemble and reassemble the piston and connecting rod.



ECA9361A

2. The piston pin is a press fit in the rod little end, and the piston floats on the pin.
3. The tool consists of a support fixture with fork inserts, guides, adapters, an installer and a remover. The piston is supported in the support fixture while the pin is being installed or removed. Guides help position the pin as it is installed or removed, while the rod is supported by fork inserts.

4. To remove the pin from the piston, place the piston in the support fixture with the rod resting on the fork inserts. Pass the remover tool through the top of the support fixture and use it to press out the pin.

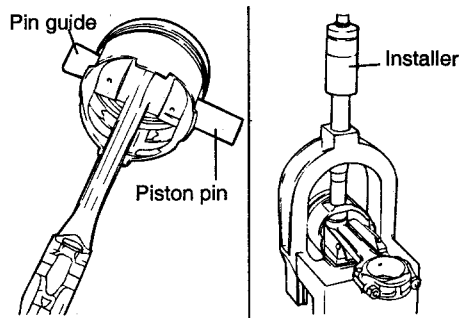


EDA9048A

5. To install a new pin, the proper fork inserts must be in place to support the rod.
6. Position the rod inside the piston. Insert the proper pin guide through one side of the piston and through the rod. Hand tap the pin guide so it is held by the piston. Insert the new pin into the piston from the other side and set the assembly into the support fixture with the pin guide facing down.

**NOTE**

The pin guide should be centered on the connecting rod through the piston. If assembled correctly, the pin guide will sit exactly under the center of the hole in the tool's arch, and rest evenly on the fork inserts. If the wrong size pin guide is used, the piston and pin will not up with the support fixture.



ECA9361C

7. Insert the installer tool through the hole in the arch of the support fixture and use an hydraulic press to force the piston pin through the rod little end. Continue pressing until the pin guide falls free and the installer tool seats against the top of the arch.

**CAUTION**

Do not exceed  $750 \pm 1,750$  kg ( $1,653 \pm 3,858$  lb) of force when the installing tool seats against the top of the arch.

**INSPECTION** ECBB3500

**PISTONS AND PISTON PINS**

1. Check each piston for scuffing, scoring, wear and other defects. Replace any piston that is defective.
2. Check each piston ring for breakage, damage and abnormal wear. Replace the defective rings. When the piston requires replacement, its rings should also be replaced.
3. Check that the piston pin fits in the piston pin hole. Replace any piston and pin assembly that is defective. The piston pin must be pressed smoothly by hand into the pin hole (at room temperature).

**PISTON RINGS**

1. Measure the piston ring side clearance. If the measured value exceeds the service limit, insert a new ring in the ring groove to measure the side clearance. If the clearance still exceeds the service limit, replace the piston and rings together. If it is less than the service limit, replace only the piston rings.

**Piston ring side clearance**

No.1 : 0.04 - 0.08 mm (0.0016 - 0.0031 in.)  
 No.2 : 0.02 - 0.06 mm (0.0008 - 0.0024 in.)

2. To measure the piston ring end gap, insert a piston ring into the cylinder bore. Position the ring at right angles to the cylinder wall by gently pressing it down with a piston. Measure the gap with a feeler gauge. If the gap exceeds the service limit, replace the piston ring.

**Piston ring end gap**

[Standard dimensions]

No.1 : 0.30 - 0.45 mm (0.012 - 0.018 in.)  
 No.2 : 0.45 - 0.60 mm (0.018 - 0.024 in.)  
 Oil ring side rail : 0.2-0.7 mm (0.0079 - 0.0276)

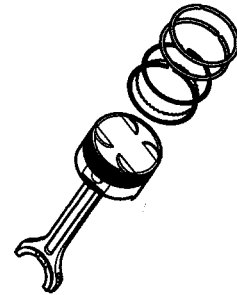
When replacing the ring without correcting the cylinder bore, check the gap with the ring situated at the lower part of cylinder that is less worn out.

**PISTON RING SERVICE SIZE AND MARK**

Standard	None
0.25 mm (0.010 in.) O.S	25
0.50 mm (0.020 in.) O.S	50
0.75 mm (0.030 in.) O.S	75
1.00 mm (0.040 in.) O.S	100

**NOTE**

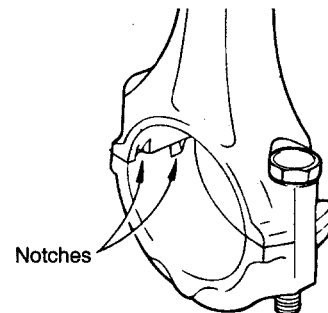
The mark can be found on the upper side of the ring next to the end.



KFW3037C

**CONNECTING RODS**

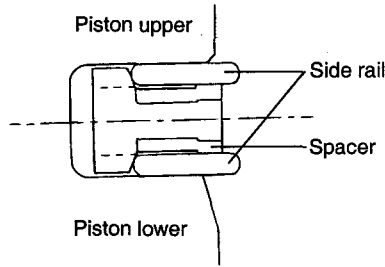
1. When the connecting rod cap is installed, make sure that the cylinder numbers, marked on rod end cap at disassembly, match. When a new connecting rod is installed, make sure that the notches holding the bearing in place are on the same side.
2. Replace the connecting rod if it is damaged at either end of the thrust faces. If it has a stratified wear, or if the surface of the inside diameter of the small end is severely rough, replace the rod.



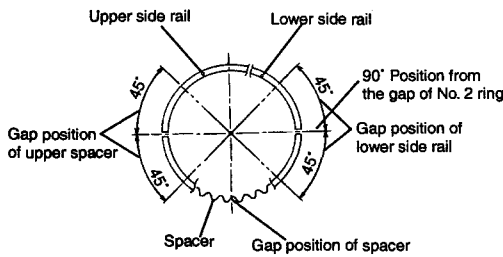
EDA9047A

**REASSEMBLY** ECBB3600

1. Install the spacer.



ECA9082A



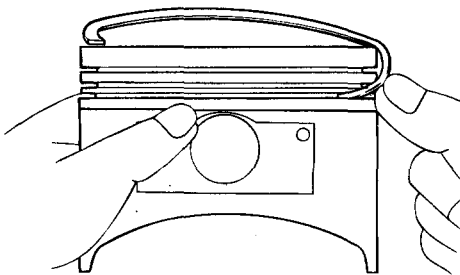
EDJA490A

2. Install the upper side rail. To install the side rail, first put one end of the side rail between the piston ring groove and spacer, hold it firmly, and press down with finger on the portion to be inserted into the groove (as illustrated).

**CAUTION**

**Do not use a piston ring expander when installing the side rail.**

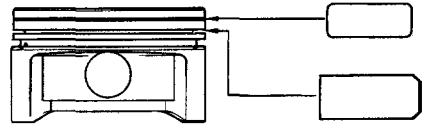
3. Install the lower side rail by the same procedure described in Step 2.



ECA9380B

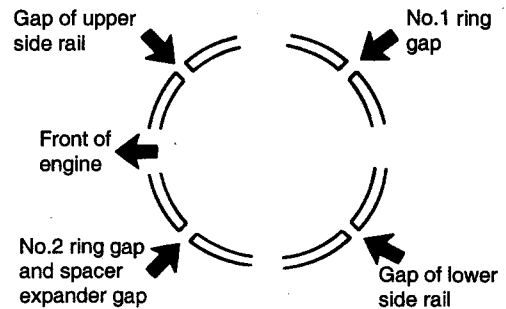
4. Apply engine oil around the piston and piston grooves.
5. Using a piston ring expander, install the No.2 piston ring.

6. Install the No. 1 piston ring.



KFW3055A

7. Position each piston ring end gap as far away from its neighboring gaps as possible. Make sure that the gaps are not positioned in the thrust and pin directions.
8. Hold the piston rings firmly with a piston ring compressor as they are inserted into cylinder.

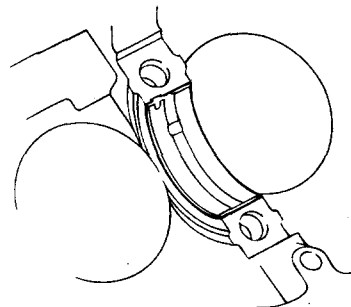


ECA9380D

9. Install the upper main bearings in the cylinder block.
10. Install the lower main bearings in the main bearing caps.

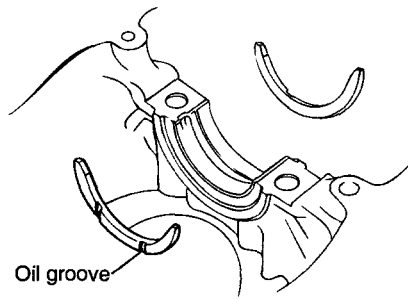
**CAUTION**

**Install the bearing so it matches the oil hole in the block.**



EDA9390E

11. Install the thrust washers in the No. 3 main bearing cap with the oil grooves facing outward.



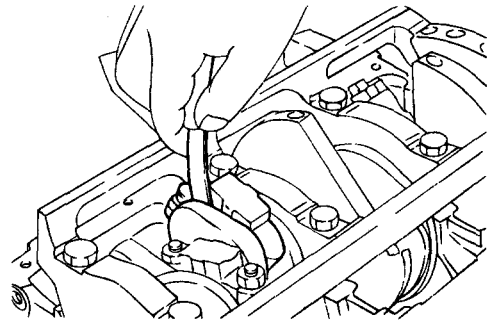
EDA9390F

16. Check the connecting rod side clearance.

**Connecting rod side clearance**

Standard : 0.10-0.25 mm (0.0039-0.0098 in.)

Limit : 0.4 mm (0.0157 in.)



EDA9051A

12. Make sure that the front mark of the piston and the front mark (identification mark) of the connecting rod are directed toward the front of the engine.
13. When the connecting rod cap is installed, make sure that any cylinder numbers placed on the rod and cap at disassembly match.
14. When a new connecting rod is installed, make sure that the notches for holding the bearing in place are on the same side.
15. When assembling, bolts should be fastened using the plastic angle technique as follows.
- 1) Apply oil to the threads and matching areas.
  - 2) Tighten the connecting rod bolt.

**Tightening torque**

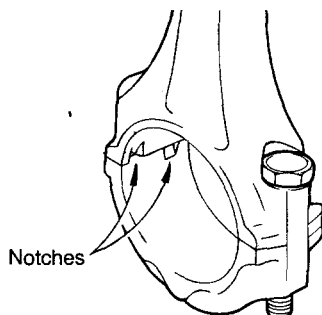
Connecting rod bolt :

50 - 55 Nm (500 - 550 kg.cm, 36 - 37 lb.ft)

**⚠ CAUTION**

**After removing the connecting rod bolt, do not use it again.**

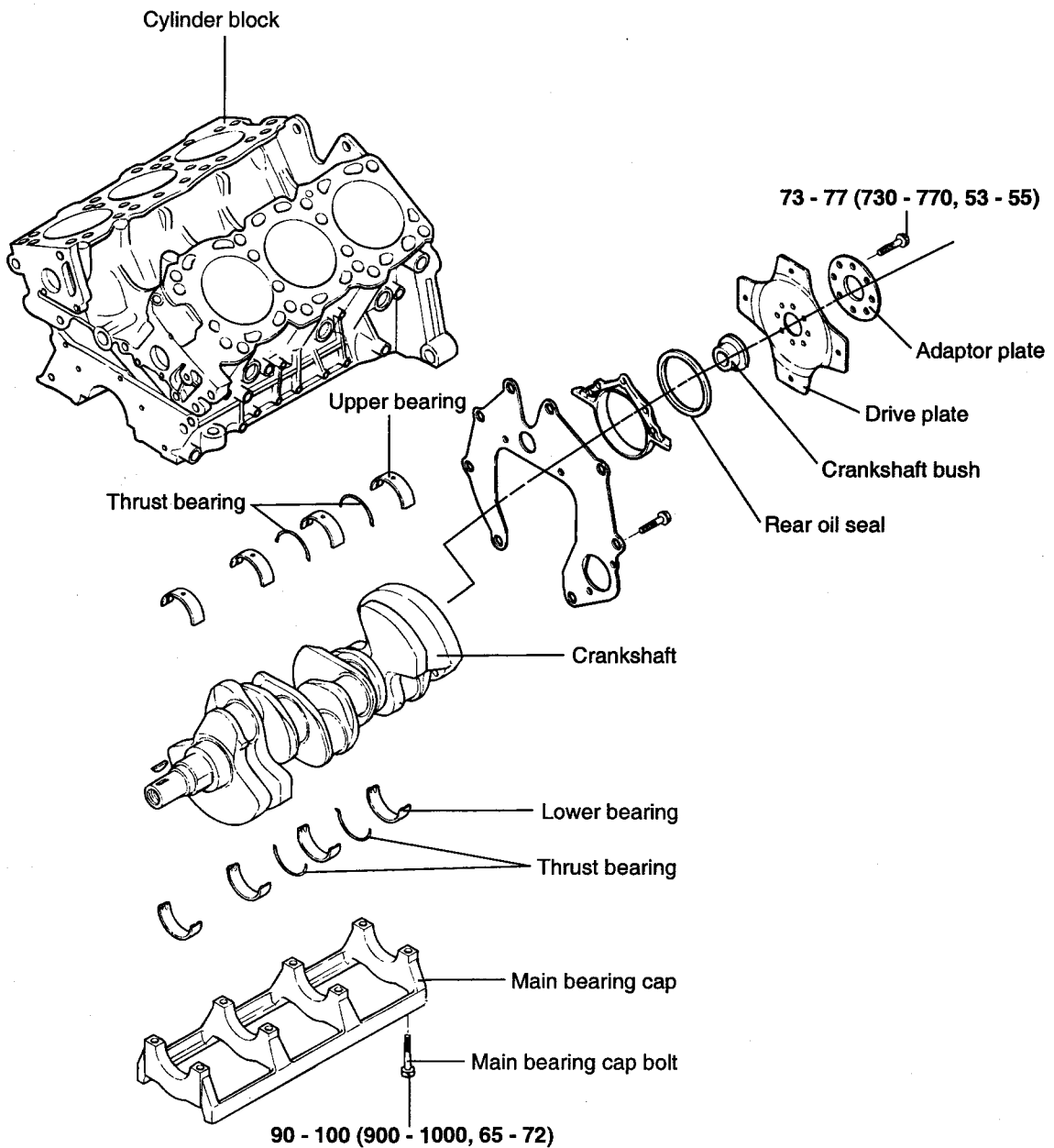
**When using a new bolt, do not tighten the bolt more than 3 times.**



EDA9047A

# CRANK SHAFT

## COMPONENTS ECBB3700



**TORQUE : Nm (kg.cm, lb.ft)**

**DISASSEMBLY** ECBB3800

1. Remove the timing belt train, front case, cylinder head assembly and oil pan. For details, refer to the respective chapters.
2. Remove the rear plate and the rear oil seal.
3. Remove the connecting rod caps.

**NOTE**

Mark the main bearing caps to be able to reassemble in the original position and direction.

4. Remove the main bearing caps and remove the crankshaft. Keep the bearings in order according to the cap number.

**INSPECTION** EDMB0250

**CRANKSHAFT**

1. Check the crankshaft journals and pins for damage, uneven wear and cracks. Also check the oil holes for restrictions. Repair or replace any defective parts.
2. Inspect the crankshaft journal and pin for out-of-round and taper.

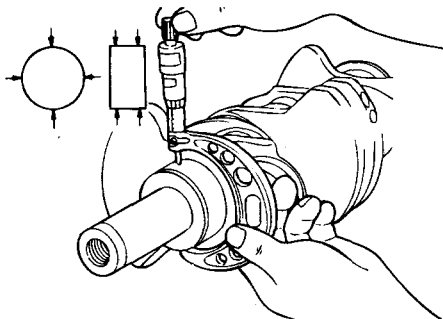
**Standard value**

Crankshaft journal O.D :

63.982 - 64.00 mm (2.519 - 2.5197 in.)

Crankshaft pin O.D :

54.982 - 55.00 mm (2.165 - 2.1653 in.)



ECA9410A

**MAIN BEARINGS AND CONNECTING ROD BEARINGS**

Visually inspect each bearing for peeling, melting, seizure and improper contact. Replace any defective bearings.

**MEASURING OIL CLEARANCE**

Check for oil clearance by measuring the outside diameter of the crankshaft journal and the inside diameter of the bearing. The clearance can be obtained by calculating the difference between the measured outside diameters.

**Standard value**

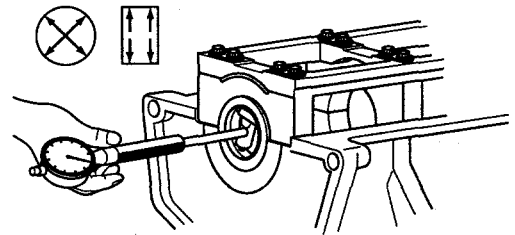
Oil clearance

Crankshaft main bearing :

0.018 - 0.036 mm (0.0007 - 0.0014 in.)

Connecting rod bearing :

0.022 - 0.048 mm (0.0009 - 0.002 in.)



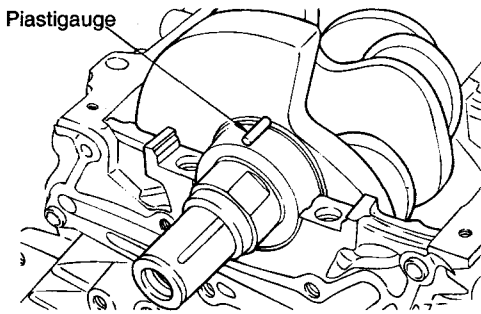
KFW3058A

**PLASTIGAUGE METHOD**

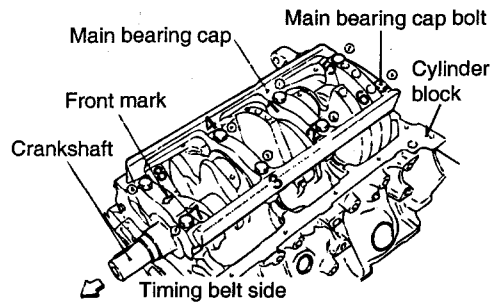
Plastigauge may be used to measure the clearance.

1. Remove oil, grease and any other dirt from the bearings and journals.
2. Cut the plastigauge the same length as the width of the bearing and place it in parallel with the journal, avoiding the oil holes.
3. Install the crankshaft, bearings and caps and tighten them to the specified torques. During this operation, do not turn the crankshaft. Remove the caps. Measure the width of the plastigauge at the widest part by using the scale printed on the gauge package. If the clearance exceeds the service limit, the bearing should be replaced or an undersize bearing should be used. When installing a new crankshaft, be sure to use standard size bearings. If the standard clearance can not be obtained even after replacing the bearing, the journal and pin should be ground to the undersize and a bearing of the corresponding size should be installed.





EDA9420C



BOY183D

**OIL SEAL**

Check the front and rear oil seals for damage or worn surfaces. Replace any seat that is defective.

**DRIVE PLATE (AT)**

Replace distorted, damaged, or cracked drive plates.

**REASSEMBLY**

ECBB4000

**MAIN BEARING**

1. Install a grooved main bearing (upper bearing) on the cylinder block side.
2. Install a grooveless main bearing (lower bearing) on the main bearing cap side.
3. Install the crankshaft. Apply engine oil to journal and pin.
4. Install the bearing caps with the arrow mark directed toward the front of the engine. Cap number must be correct.
5. Tighten the cap bolts to the specified torque.

**Tightening torque**

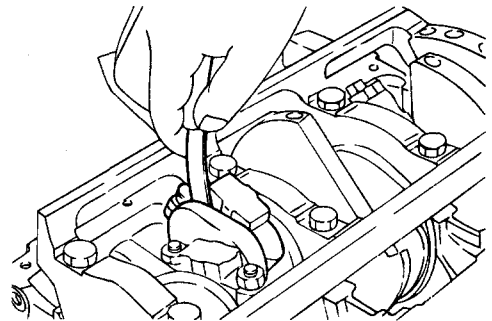
Main bearing cap bolts :  
90 - 100 Nm (900 - 1000 kg.cm, 65 - 72 lb.ft)

6. Cap bolts should be tightened evenly in stages 4 to 5 increments before they are tightened to the specified torque.
7. Make certain that crankshaft turns freely and check the end play of the crankshaft.

**Crankshaft end play**

Standard : 0.070 - 0.250mm (0.0028 - 0.0098 in.)

Limit : 0.35 mm (0.014 in.)



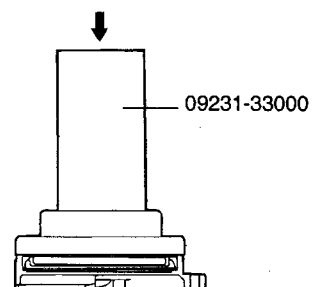
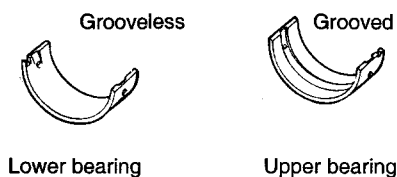
EDA9051A

8. Using special tool(09231-33000), install the rear oil seal in oil seal case.
9. Apply sealant to the area shown in the illustration. Install the oil seal case in the cylinder block.

**Tightening torque**

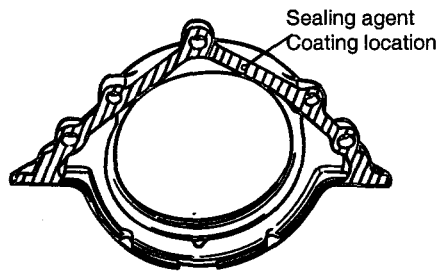
Oil seal case bolt :

10-12Nm (100 - 120 kg.cm, 7 - 9 lb.ft)



EDA9420D

EDA9430C



EDA9430D

10. Tighten the rear plate to the specified torque.

**Tightening torque**

Rear plate : 10 - 12 Nm (100 - 120 kg.cm, 7 - 9 lb.ft)

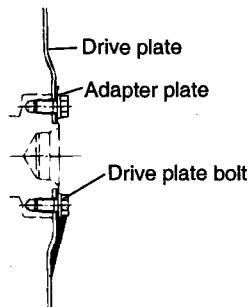
11. Tighten the drive plate and the adapter plate (AT).

**Tightening torque**

Drive plate and adapter plate bolt :

73 - 77 Nm (730 - 770 kg.cm, 53 - 56 lb.ft)

(AT)

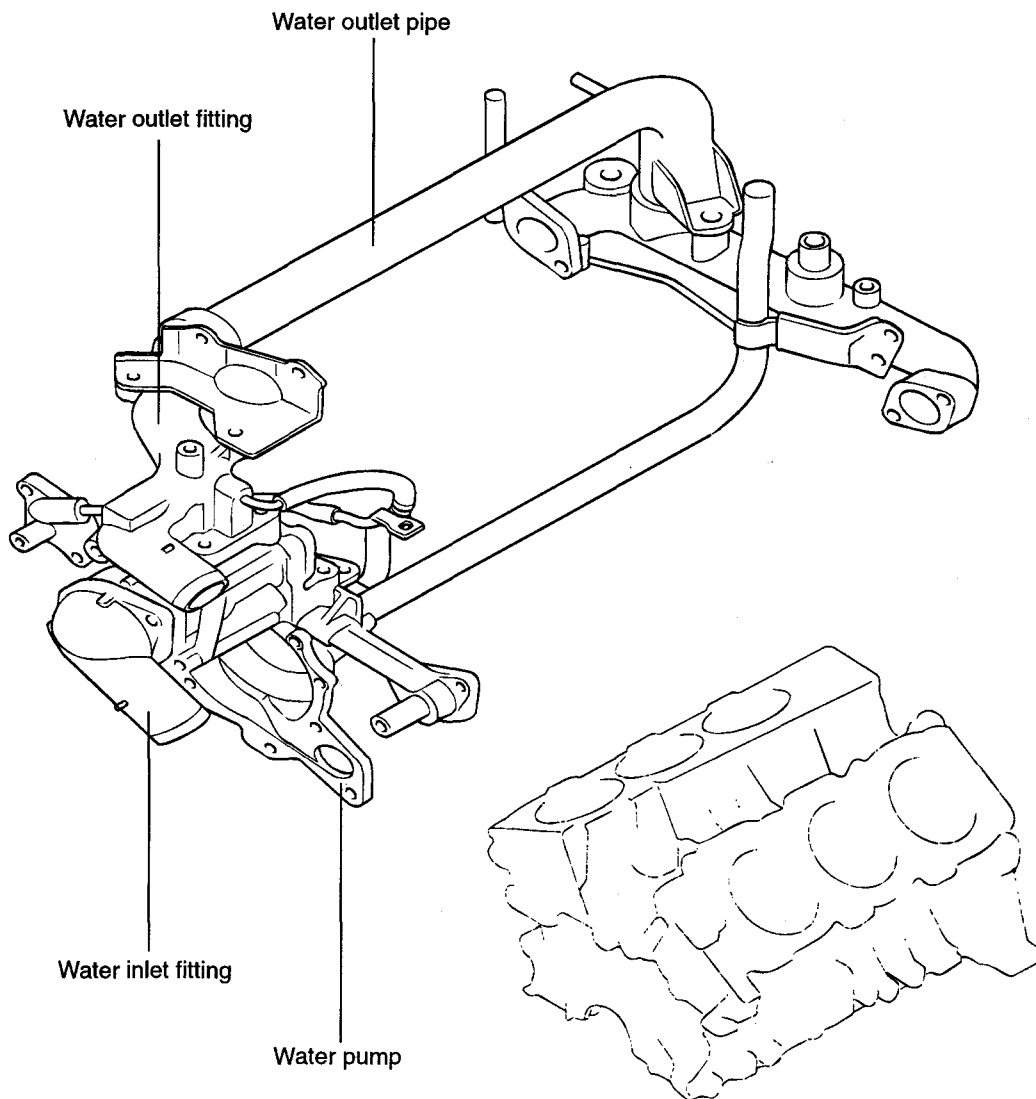


EDJA530A

# COOLING SYSTEM

## ENGINE COOLANT HOSE/PIPES

### COMPONENTS EDMB0270



**INSPECTION** EDHA6100

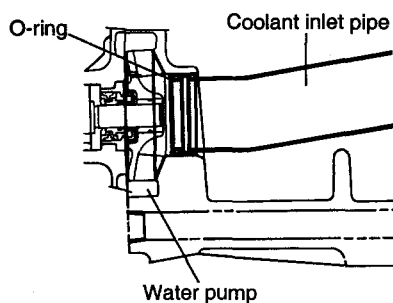
Check the engine coolant pipe and hose for cracks, damage and restrictions. Replace if necessary.

**REASSEMBLY** EDJA4700

Fit the O-ring in the groove of the engine coolant inlet pipe end. Wet the periphery of the O-ring with water and insert the engine coolant inlet pipe.

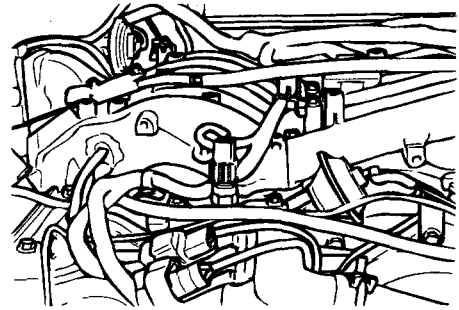
**NOTE**

1. Do not apply oil or grease to the engine coolant pipe O-ring.
2. Keep the engine coolant pipe connections free of sand, dust, etc.
3. Insert the engine coolant pipe into the end of the engine coolant pump inlet.
4. Whenever installing the engine coolant inlet pipe, always replace the O-ring with a new one.



HEW2513B

3. Remove the engine coolant sensor.



KDMB003E

**INSTALLATION** ECBB5400

1. Apply sealant to the sensor's threads. Tighten it to the specified torque.

---

Recommended sealant :

Three bond NO. 2310 or LOCTITE 962T

---

**Tightening torque**

The coolant sensor :

20-40Nm(200-400 kg.cm, 14-29 lb.ft)

---

2. Connect the coolant sensor to the harness.
3. Connect the ground cable of battery.
4. Refill the coolant.

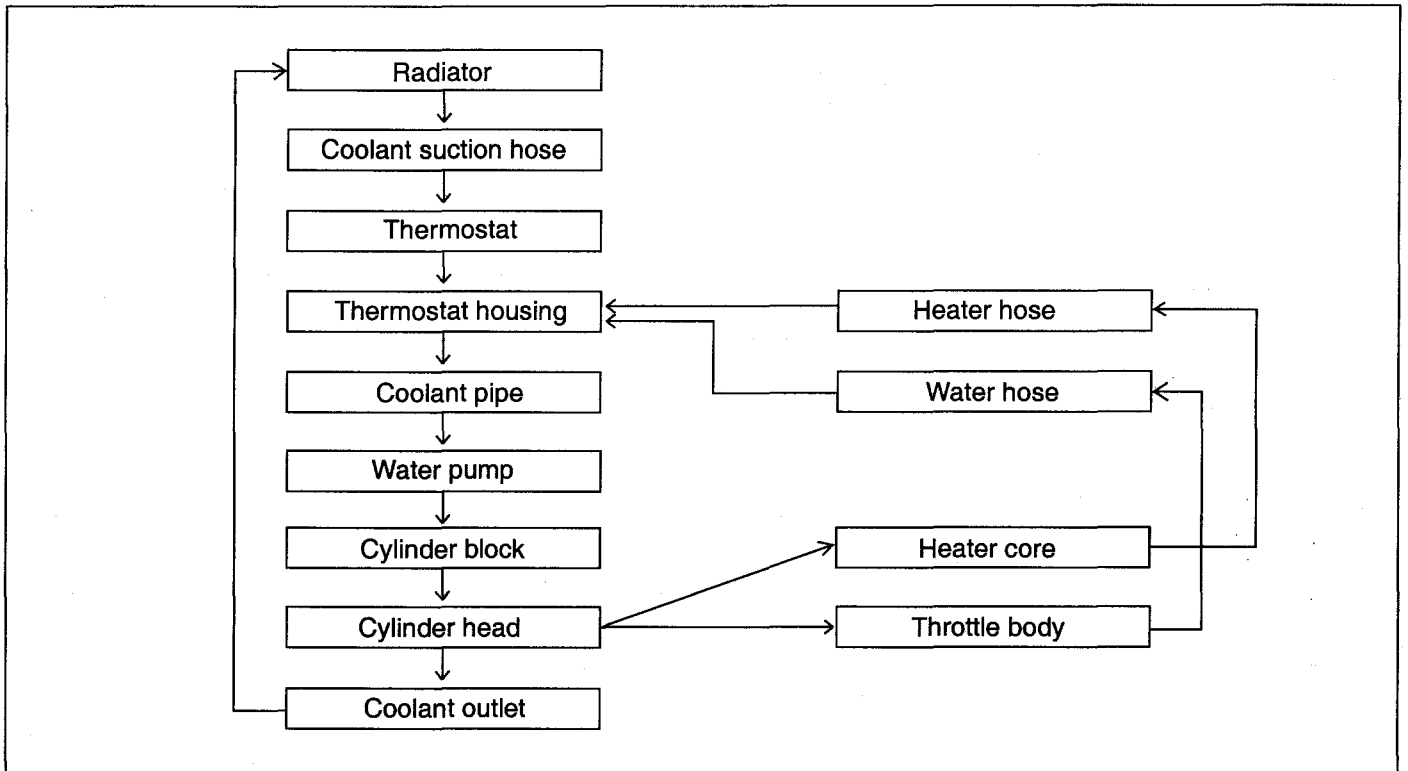
**COOLANT TEMPERATURE SENSOR** EDMB0280**REMOVAL**

1. Drain the engine coolant.
2. Remove the engine harness after disconnecting the ground cable of the battery.

**SCHEMATIC DIAGRAM**

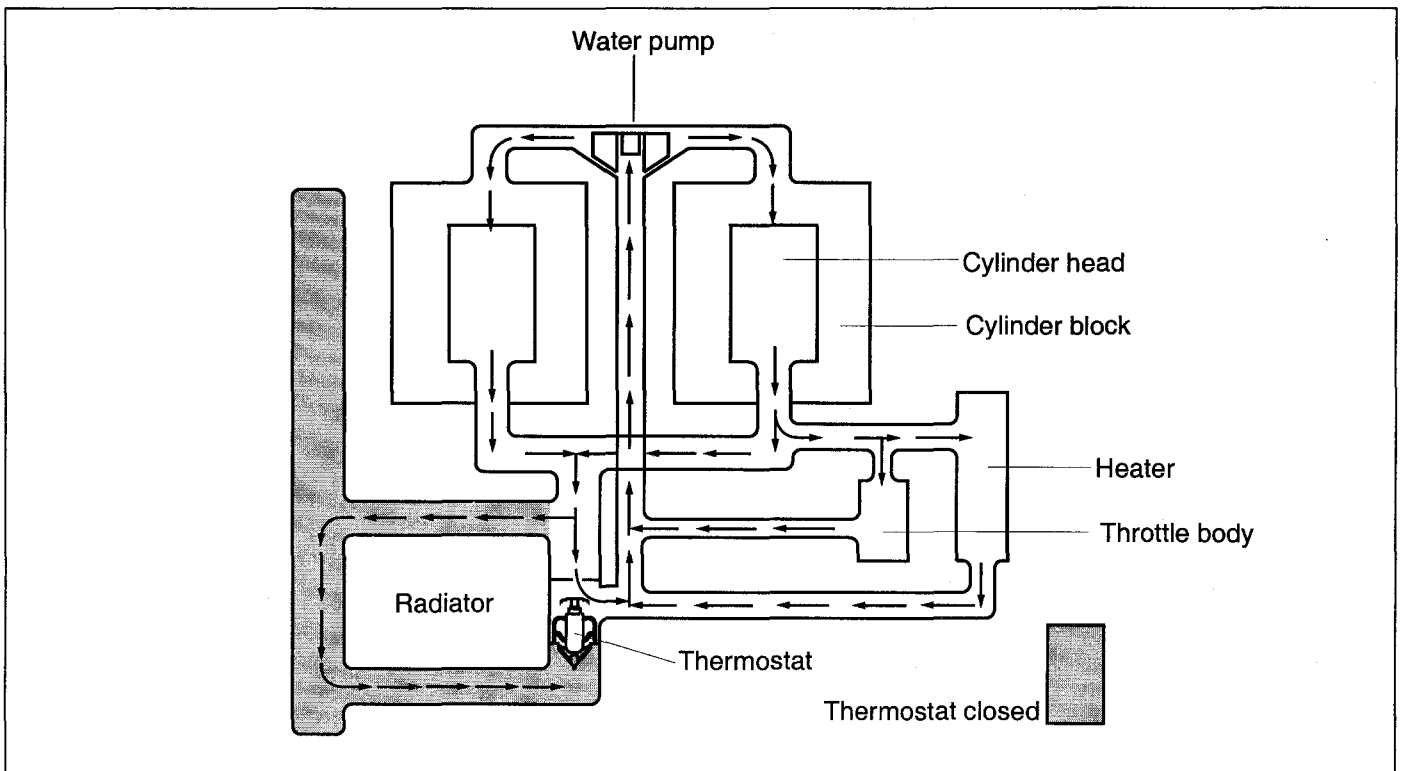
ECBB5500

**INLET CONTROL**



EDHA650A

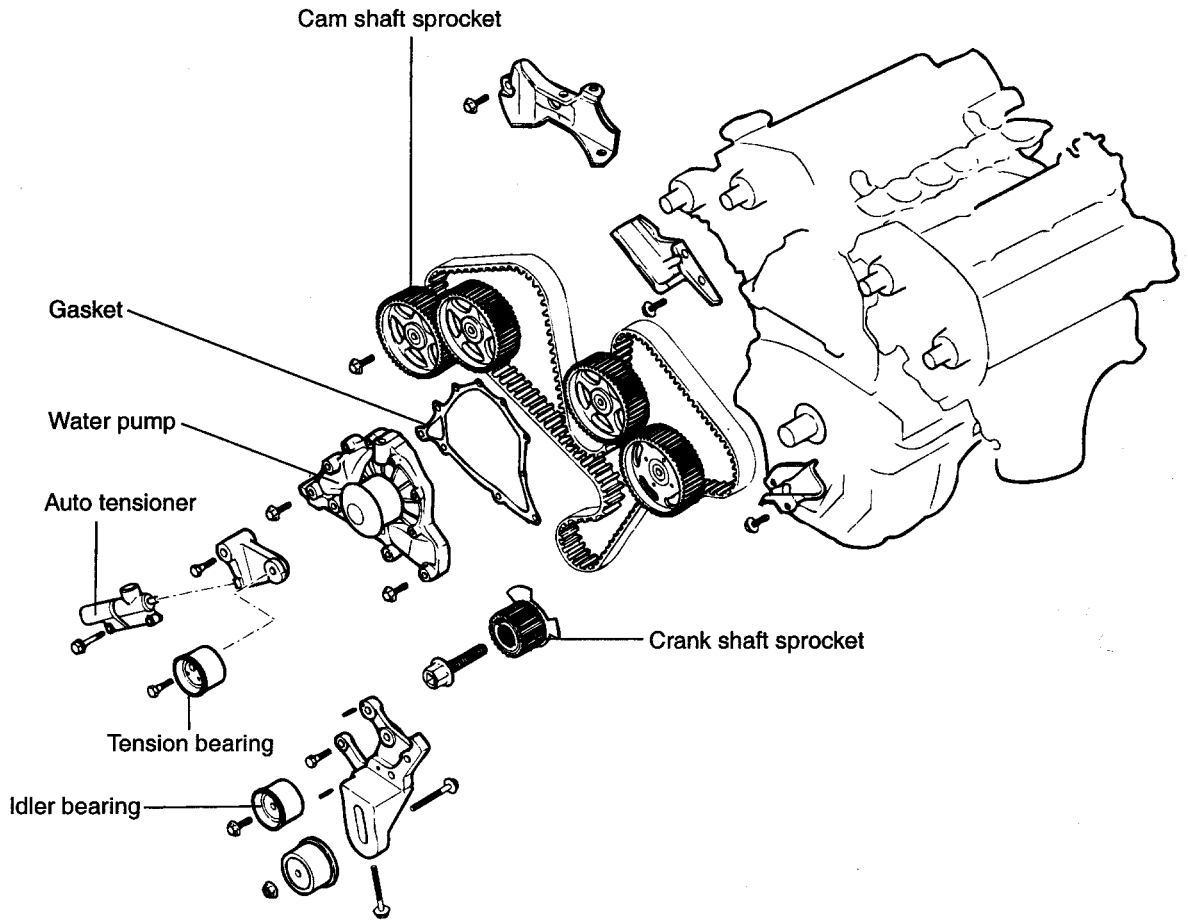
**FLOW CHART**



KFW3201A

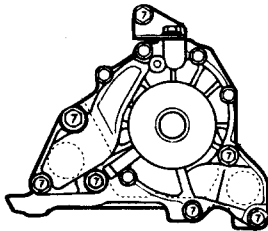
# ENGINE COOLANT PUMP

## COMPONENTS ECBB5600



**REMOVAL** ECBB5700

1. Using the drain plug, drain the coolant.
2. Remove the drive belt and the engine coolant pump pulley.
3. Remove the timing belt cover, the auto tensioner and idler pulley.
4. Remove the engine coolant pump mounting bolts.
5. Remove the engine coolant pump assembly from the cylinder block.



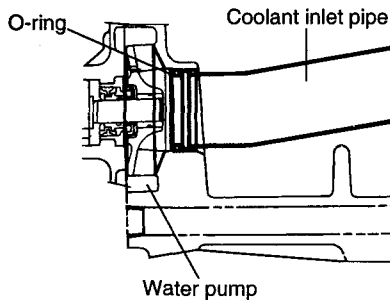
ECB9500L

**INSPECTION** EDHA7300

1. Check the engine coolant pump for cracks, damage or wear, and replace the pump assembly if necessary.
2. Check the bearing for damage, abnormal noise and sluggish rotation and replace the pump assembly if necessary.
3. Check the seal it for leaks and replace the pump assembly if necessary.

**INSTALLATION** ECBB5900

1. Clean the gasket surfaces of the engine coolant pump body and the cylinder block.



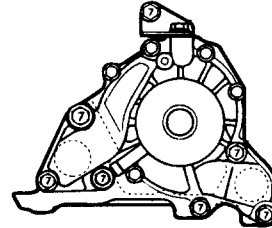
HEW2513B

2. Install the new engine coolant pump gasket and pump assembly. Tighten the bolts to the specified torque.

**Tightening torque**

Engine coolant pump bolt :

Head mark "7" : 15-22 (150-220, 11-16)

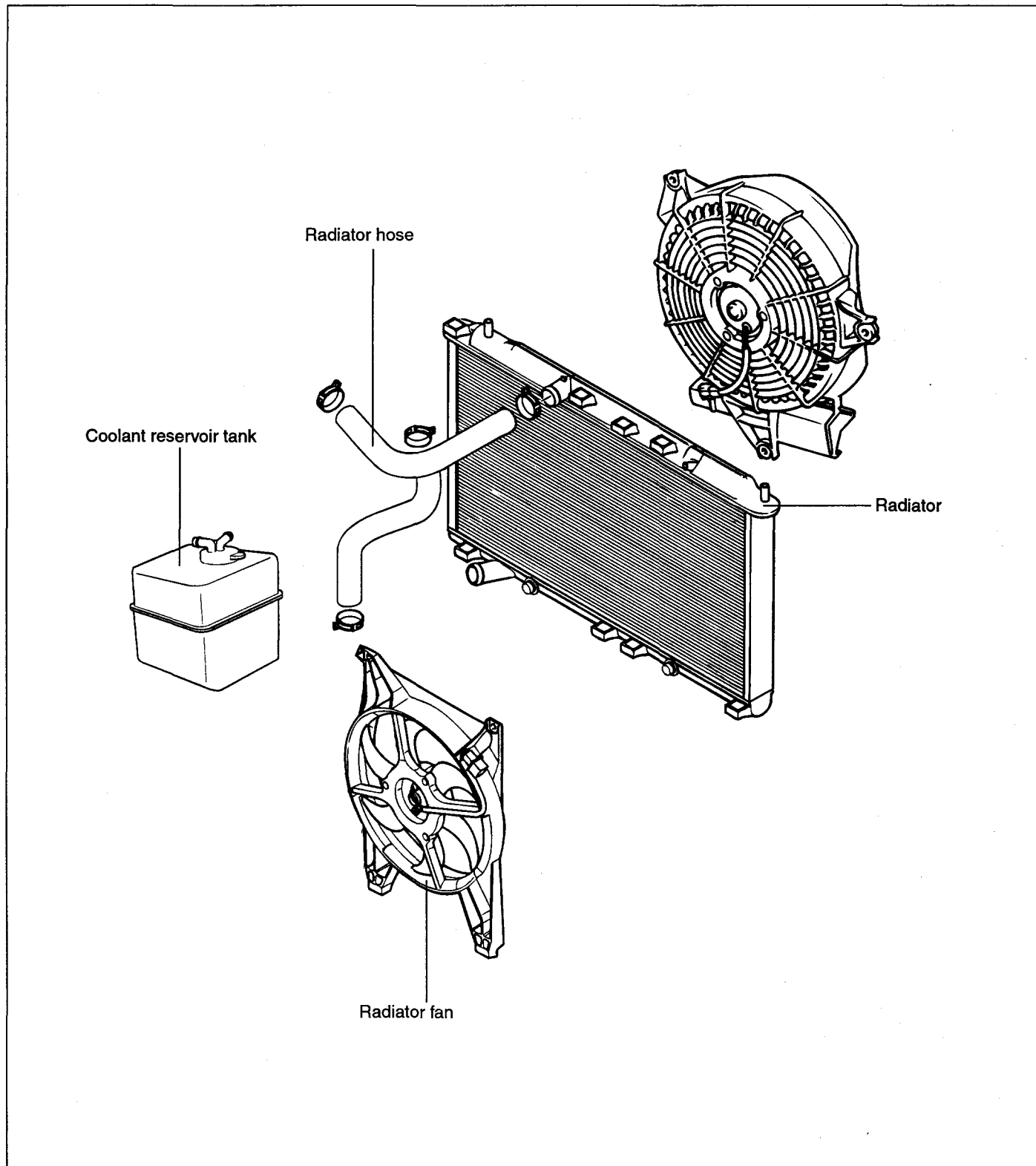


ECB9500L

3. Install the auto tensioner and timing belt. Adjust the timing belt tension, then install the timing belt cover.
4. Install the drive belt, coolant pump pulley and then adjust the auto tensioner.
5. Refill the coolant.
6. Run the engine and check for leaks.

# RADIATOR

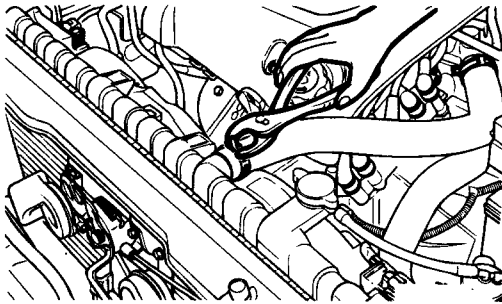
## COMPONENTS EDMB0300





**REMOVAL** ECBB6100

1. Disconnect the ground cable from the battery terminal.
2. Disconnect the fan motor connector.
3. Loosen the radiator drain plug to drain the coolant.
4. Disconnect the upper and lower hoses and overflow tube after marking the radiator hose and the hose clamp the ease reassembly.



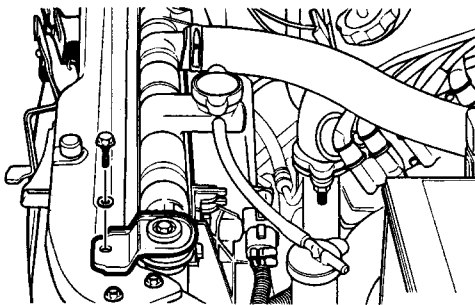
ECB9500B

5. For vehicles with automatic transaxles, disconnect the oil cooler hoses from the automatic transaxle.

 **CAUTION**

**Cover or plug the hose and inlets of the radiator so that dust and other foreign material etc. can not enter after the hose is disconnected from the radiator.**

6. Remove the radiator mounting bolt.



ECB9500C

7. Remove the radiator and the fan motor.
8. Remove the radiator fan motor and condenser fan motor from the radiator.

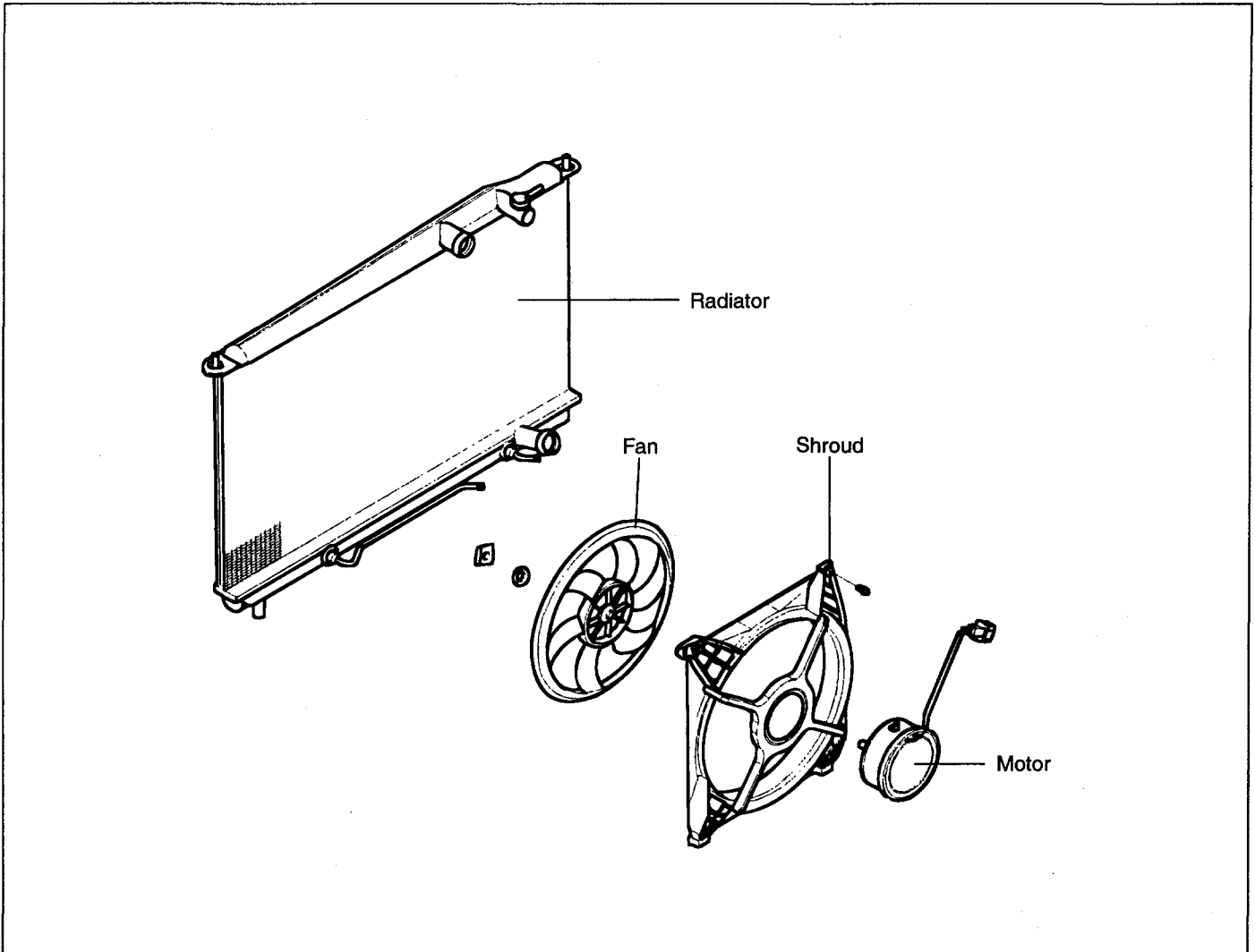
**INSPECTION** EDHA8000

1. Check for foreign material between the radiator fins.
2. Check the radiator fins for damage and straighten if necessary.
3. Check the radiator for corrosion, damage, rust or scale.
4. Check the radiator hoses for cracks, damage or deterioration.
5. Check the reservoir tank for damage.
6. Check the automatic transaxle oil cooler hoses for cracking, damage or deterioration (only A/T).

**INSTALLATION** EDJA6300

1. Fill the radiator and reservoir tank with a clean coolant mixture.
2. Run the engine until the coolant warms up enough so that the thermostat valve opens and then turn off the engine.
3. Remove the radiator cap and pour the coolant up to the filler neck of the radiator. Fill the reservoir tank to the upper level.
4. Check that there are no leaks from the radiator, hoses or connections.

## RADIATOR PAN MOTOR

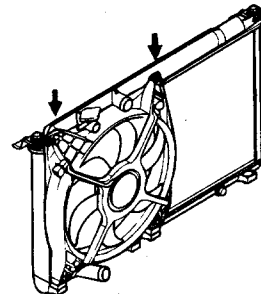
COMPONENTS ECBB6400

ECB9500D

REMOVAL ECBB6500

7. Remove the three screws and detach the fan motor.

1. Disconnect the ground cable from the battery cable.
2. Disconnect the connectors from the fan motor and the harness from the shroud.
3. For vehicles with automatic transaxles, remove the oil cooler hose from the shroud.
4. Remove the four bolts holding the shroud.
5. Remove the shroud with the fan motor.
6. Remove the fan mounting clip and detach the fan from the fan motor.



ECB9500E

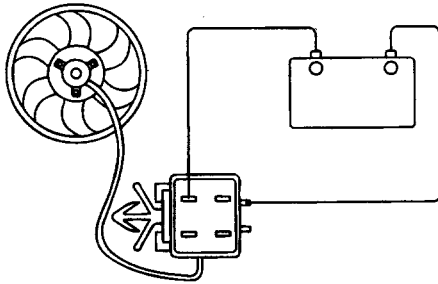
**INSPECTION** ECBB6600

**RADIATOR FAN MOTOR AND CONDENSER FAN MOTOR**

1. Check that the radiator fan rotates when battery voltage is applied between the terminals.
2. Check that there are no abnormal noises while the motor is running.

Terminal Item	1	2	3	4	MOTOR SPEED
RADIATOR FAN MOTOR	⊕		⊖		LOW
	⊕	⊕		⊖	MIDDLE
	⊕	⊕	⊖	⊖	HIGH
CONDENSER FAN MOTOR		⊕	⊖		LOW
	⊕	⊕		⊖	MIDDLE
	⊕	⊕	⊖	⊖	HIGH

ECBB444B



ECB9500F

**INSTALLATION** EDMB0350

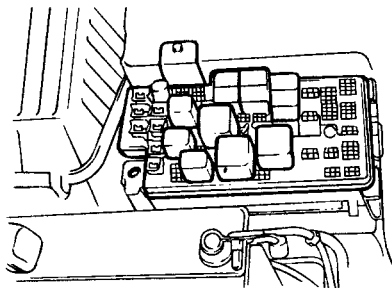
Installation is the reverse of removal.

**NOTE**

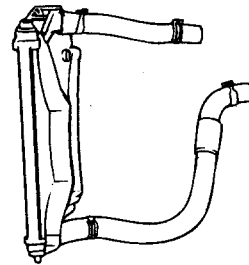
1. Make sure the cooling fan does not come into contact with the shroud when installed.
2. After installation, make sure there is no unusual noise or vibration when the fan is rotating.

**RADIATOR FAN MOTOR RELAY**

1. Remove the radiator fan motor relay (High and Low) from the relay box in the engine room.

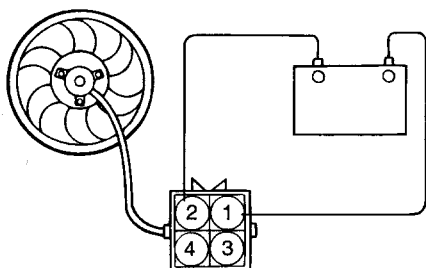


EDA9094A



ECA9061A

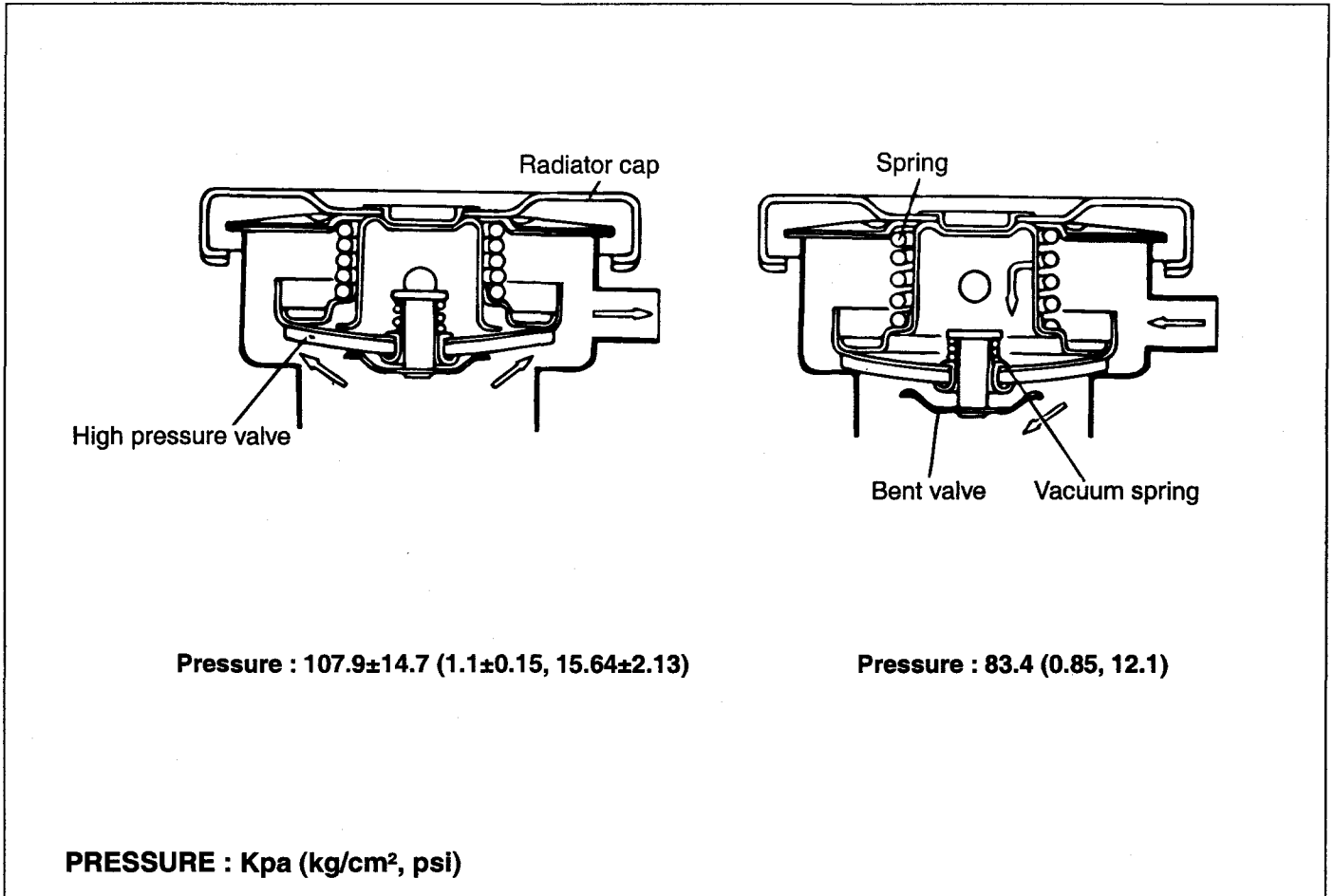
2. Check to be sure that the radiator fan rotates when battery voltage is applied between the terminals (as shown table below).
3. Check to see that abnormal noises are not produced while the motor is turning.



EDA9097A

# RADIATOR CAP

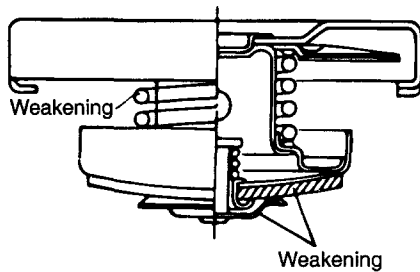
## COMPONENTS ECBB6800



HCT25012

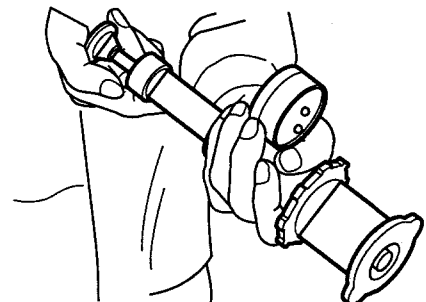
## INSPECTION EDHA8300

1. Check the radiator cap for damage, cracks or weakening.



HCT25013

3. Increase the pressure until the indicator of the gauge stops moving.
4. Replace the radiator cap if the reading does not hold steady for about 10 seconds.



KFW3203A

2. Connect the tester to the radiator cap.

## THERMOSTAT

### REMOVAL EDHA9100

1. Drain the coolant to thermostat level or below.
2. Remove the inlet fitting and gasket.
3. Remove the thermostat.

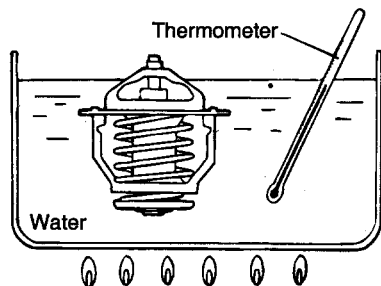
### INSPECTION EDHA9200

1. Heat the thermostat as shown in the illustration.
2. Check that the valve operates properly.
3. Verify the temperature at which the valve begins to open.

---

Valve opening temperature : 80 - 84°C (176 - 183.2°F)  
 Full opening temperature : 95°C (203°C)

---



ECA9600A

### INSTALLATION ECBB7300

1. Check that the flange of the thermostat is correctly placed in the socket of the thermostat housing.
2. Install the inlet fitting.

---

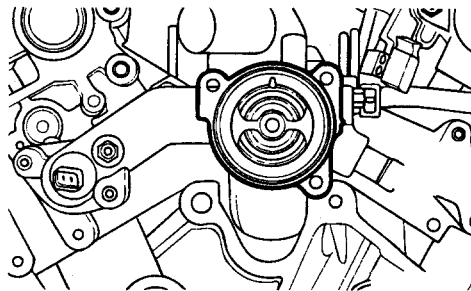
#### Tightening torque

Engine coolant inlet fitting bolt :

17-20 Nm (170-200 kg.cm, 12-14 lb.ft)

---

3. Refill the coolant.

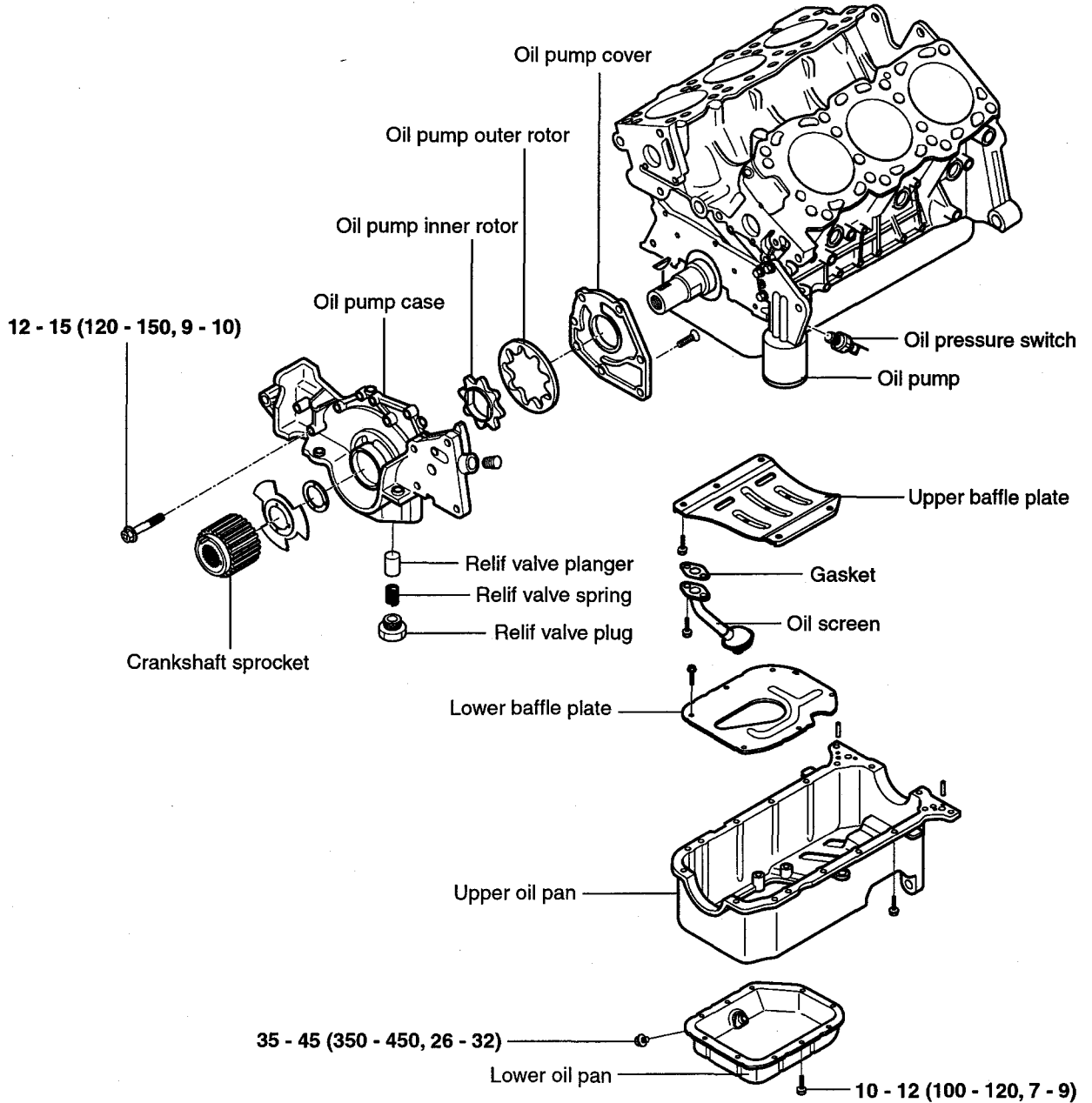


ECB95000

# LUBRICATION SYSTEM

## OIL PUMP

### COMPONENTS EDMB0400



**TORQUE : Nm (kg-cm, lb.ft)**

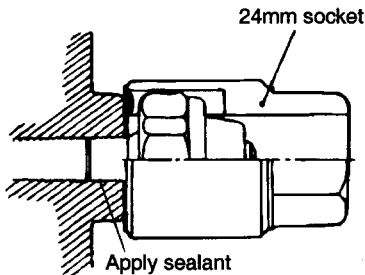
**DISASSEMBLY** EDHA9500

1. Remove the oil pressure switch, using 24 mm deep socket.

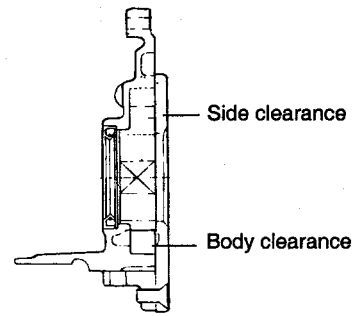
**NOTE**

Since a sealant is used on the threaded area, be careful not to damage the oil pressure switch.

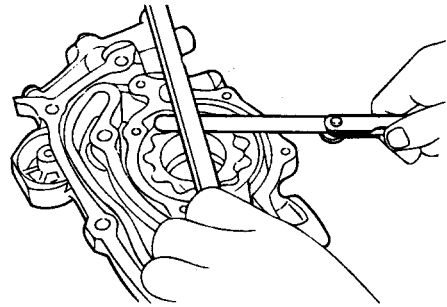
2. Remove the oil filter and the oil pan.
3. Remove the oil screen and gasket.
4. Remove the three bracket securing bolts and remove the oil filter bracket and gasket.
5. Remove the oil relief valve plug from the oil pump case.
6. Remove the oil pump case.



HFR20A33



EDA9041A



EDA9340B

**INSPECTION** ECBB8200

**OIL PUMP**

1. Visually check the parts of the oil pump case for cracks and damage.
2. Assemble the rotor on the oil pump and then check the clearance with a thickness gauge.

**Oil pump side clearance**

Standard value

Body clearance: 0.100-0.181mm (0.0039-0.0071 in.)

Side clearance: 0.040-0.095mm (0.0016-0.0037 in.)

**Oil pump Tip clearance :**

0.06 - 0.18 mm (0.0024 - 0.0071 in.)

**RELIEF PLUNGER AND SPRING**

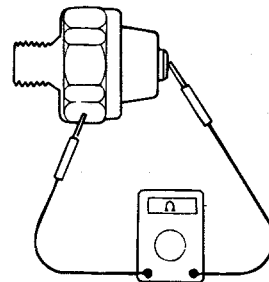
1. Check the relief plunger for smooth operation.
2. Check the relief spring for deformation or breaks.

**OIL FILTER BRACKET**

1. Make sure that there is no damage on the surface that mates with the oil filter.
2. Check the oil filter bracket for oil leaks or cracks.

**OIL PRESSURE SWITCH**

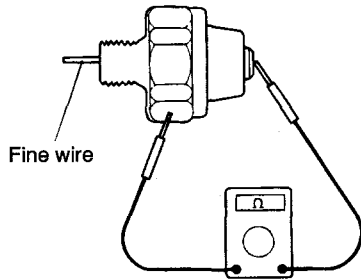
1. Check the continuity between the terminal and the body with an ohmmeter. If there is no continuity, replace the oil pressure switch.



ECA9320D

2. Check the continuity between the terminal and the body when the fine wire is pushed. If there is continuity even when the fine wire is pushed, replace the switch.

- If there is no continuity when a 50 kpa (7 psi) vacuum is applied through the oil hole, the switch is operating properly. Check for air leakage. If air leaks, the diaphragm is broken. Replace it.

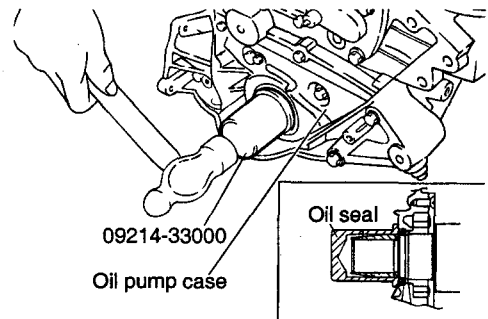


ECA9320E

**Operation Pressure**

Oil pressure switch :  
80 kpa (0.8 kg/cm<sup>2</sup>, 11.4 psi) or more

- Install the oil seal into the oil pump case as tightly as possible, using the special tool (09214-33000).



EDA9350B

- Install the relief plunger and spring, and tighten the oil relief valve plug to the specified torque.

**Tightening torque**

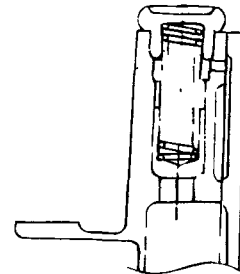
Oil relief valve plug :  
40-50 Nm (400-500 kg.cm, 29-36 lb.ft)

**REASSEMBLY** ECBB8300

- Install the oil pump case with the gasket.

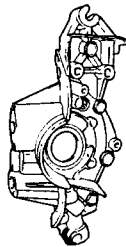
**Tightening torque**

Oil pump case bolt :  
12-15 Nm (120-150 kg.cm, 9-11 lb.ft)  
Oil pump cover screw :  
8-12 Nm (80-120 kg.cm, 6-9 lb.ft)

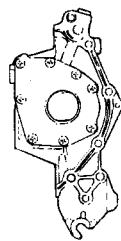


EDA9044A

<Front view>



<Rear view>



EDA9042A

- Install the oil screen and a new gasket.

**Tightening torque**

Oil screen bolt :  
15-22 Nm (150-220 kg.cm, 11-15 lb.ft)

- Clean the gasket surfaces of the cylinder block and the oil pan.
- Apply sealant to the groove of the oil pan flange.

**NOTE**

- Make the first cut approx. 4 mm from the end of the nozzle furnished with the sealant. After application of the sealant, do not exceed 15 minutes before installing the oil pan.
- Make sure that the sealant doesn't enter the inside of the oil pan.



7. Install the oil pan and tighten the bolts to the specified torque.

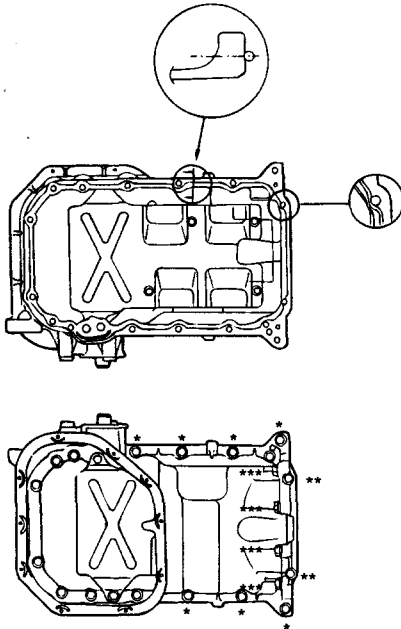
**Tightening torque**

Oil pan bolt :

\* : 19-28 Nm (190-280 kg.cm, 14-20 lb.ft)

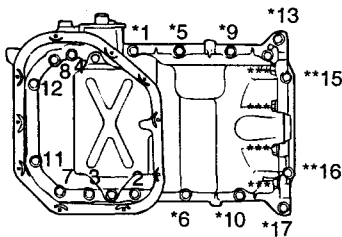
\*\* : 5-7 Nm (50-70 kg.cm, 4-5 lb.ft)

\*\*\* : 30-42 Nm (300-420 kg.cm, 22-30 lb.ft)



EDA9045A

8. Tighten the oil pan bolts as shown in the illustration.



EDA9045B

9. Using a 24 mm deep socket, install the oil pressure switch after applying sealant to the threaded area.

Sealant : Three bond No.1104E or equivalent

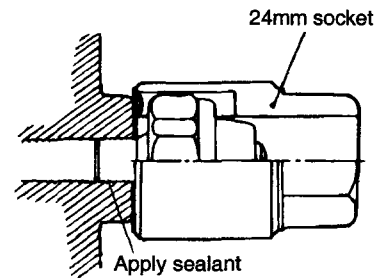
**NOTE**

*Do not torque the oil pressure switch too much.*

**Tightening torque**

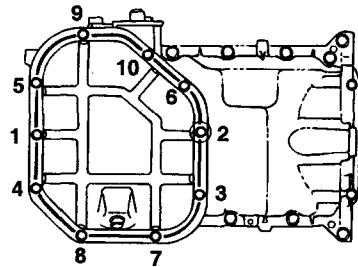
Oil pressure switch :

8 - 12 Nm (80 - 120 kg.cm, 6 - 9 lb.ft)



HFR20A33

10. Tighten the lower oil pan bolts as shown in figure.

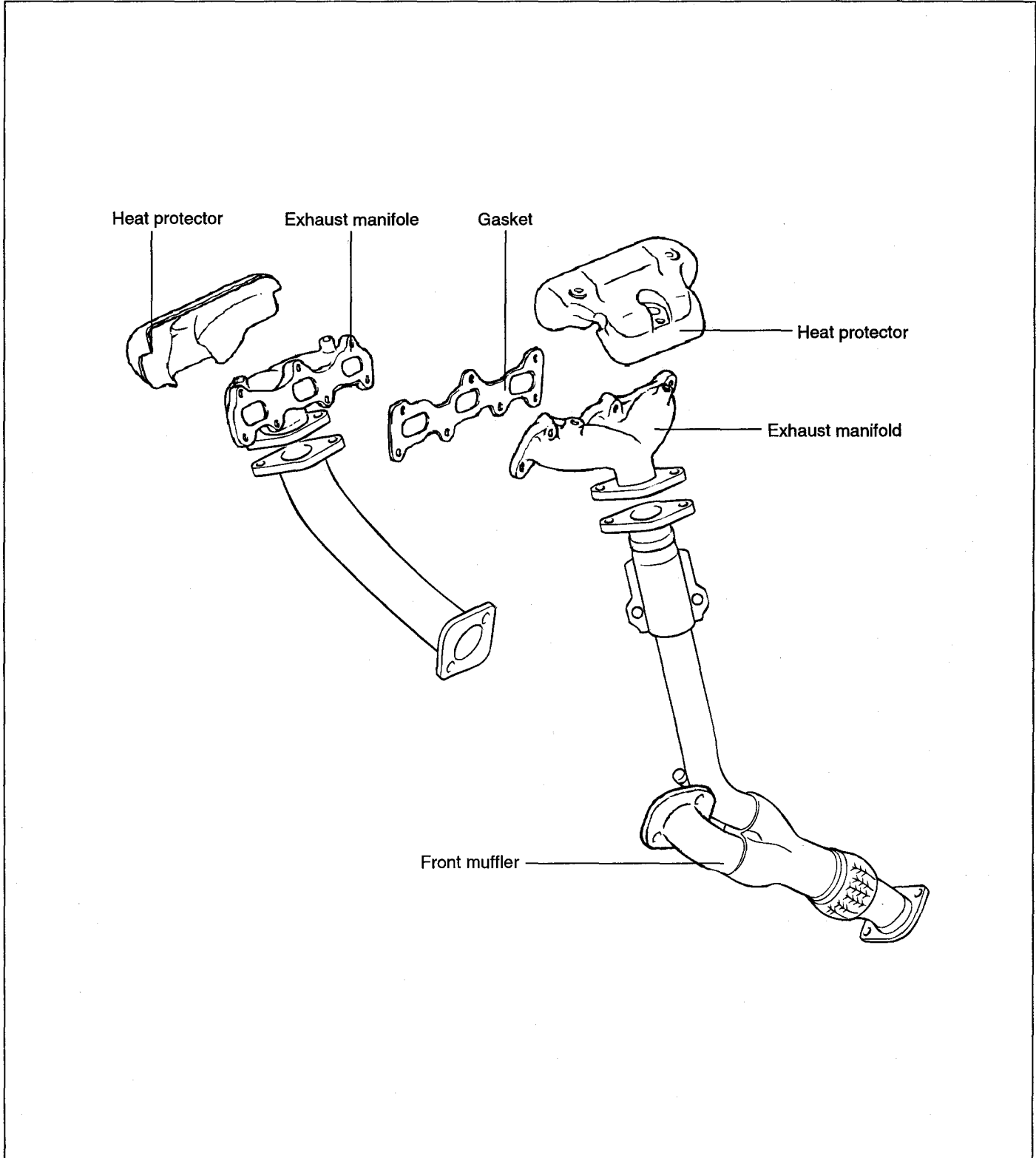


EDJA970A

# INTAKE AND EXHAUST SYSTEM

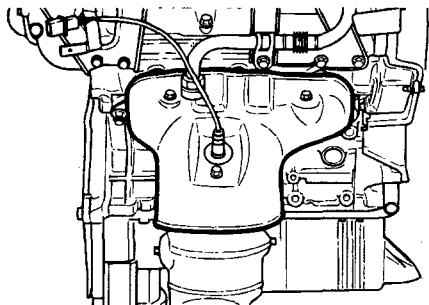
## EXHAUST MANIFOLD

### COMPONENTS EDMB0450



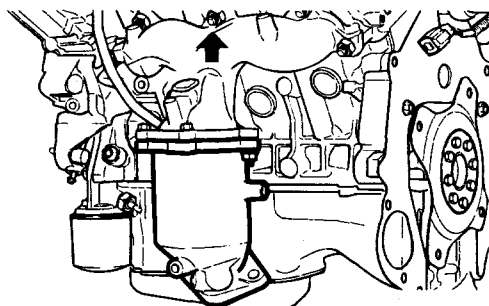
**REMOVAL** ECBB9100

1. Remove the heat protector.



ECB9510B

2. Remove the exhaust manifold.



ECB9510C

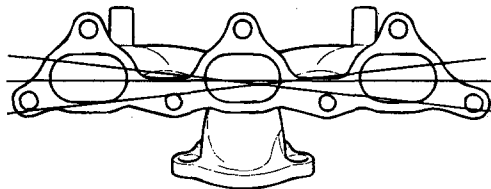
3. Remove the exhaust manifold gasket.

**INSPECTION** ECBB9200

1. Check for damage or cracks.
2. Using a straight edge and feeler gauge, check for distortion on the cylinder head matching surface.

Standard value : 0.15 mm (0.006 in.) or less

Service limit : 0.3 mm (0.012 in.) or less



ECB9510D

3. Check the exhaust manifold for damage and cracks.

**INSTALLATION** ECBB9300

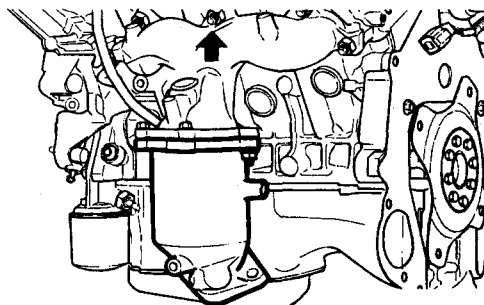
1. Install the exhaust manifold with gasket.

**Tightening torque**

Exhaust manifold : 25-30N.m (250-300 kg.cm, 18-22 lb.ft)

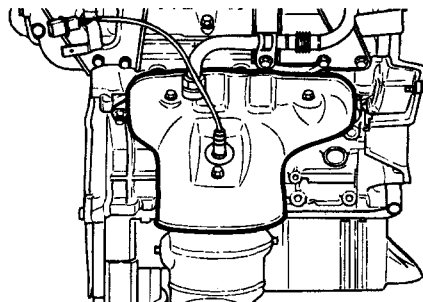
**NOTE**

Do not re - use an exhaust manifold gasket.



ECB9510C

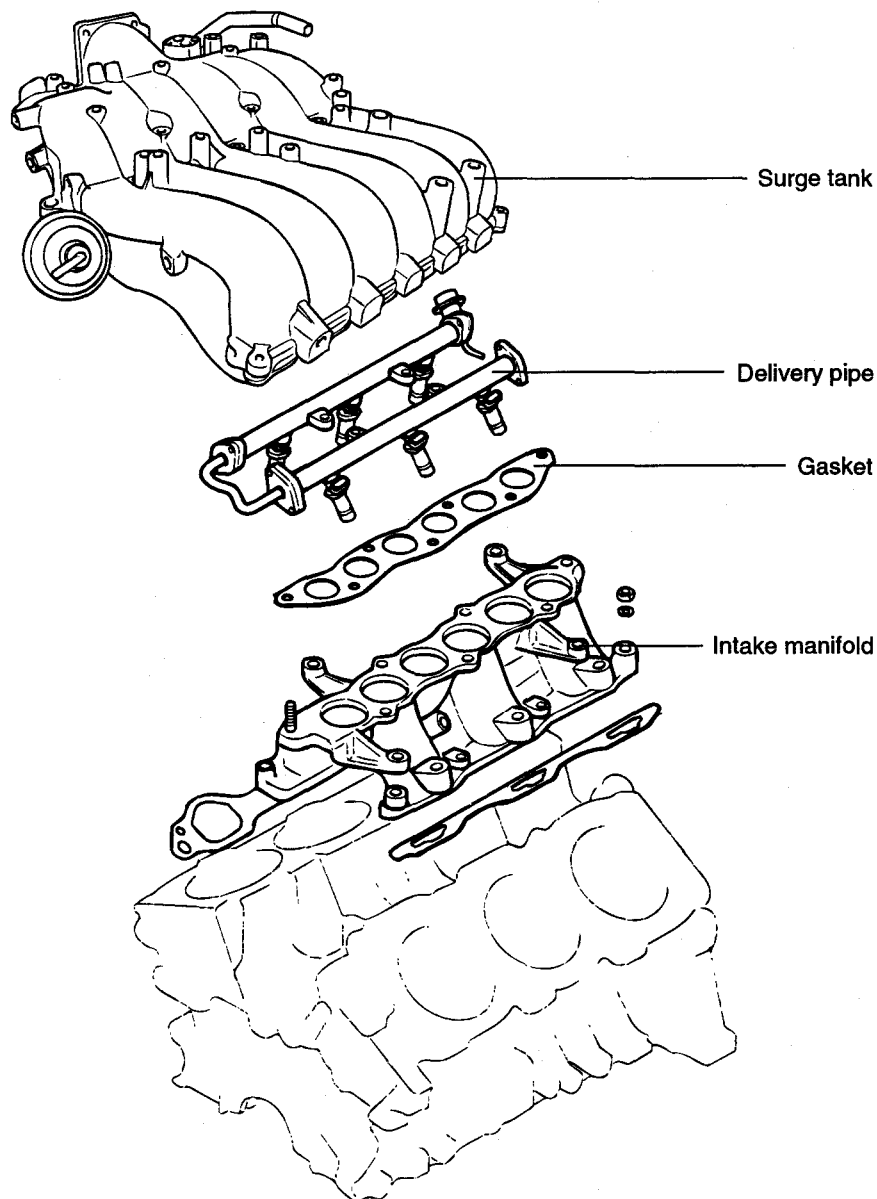
2. Install the heat protector.



ECB9510B

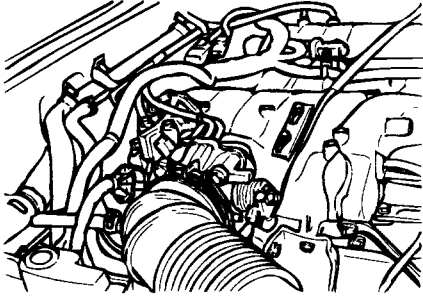
# INTAKE MANIFOLD

## COMPONENTS EDMB0500



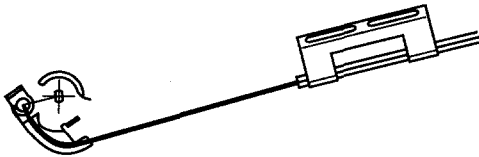
**REMOVAL** EDMB0510

1. Remove the air intake hose connected to the throttle body.



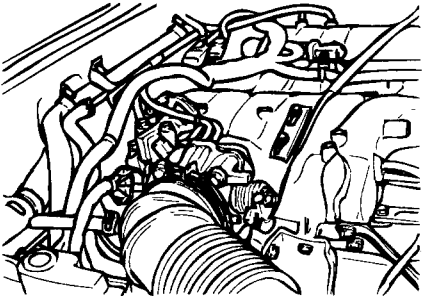
KDMB003B

2. Remove the accelerator and cruise control cables.
3. Remove the engine coolant hose and throttle body.



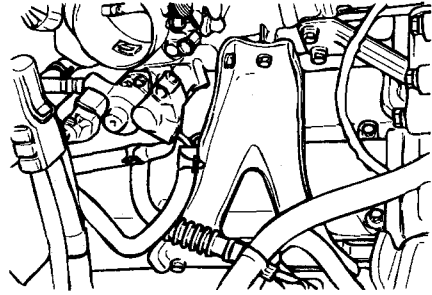
KFW3231A

4. Remove the P.C.V. hose and brake booster vacuum hoses.
5. Disconnect the vacuum hose connections.

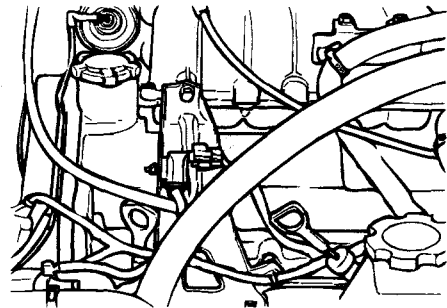


KDMB003B

6. Remove the surge tank stay.

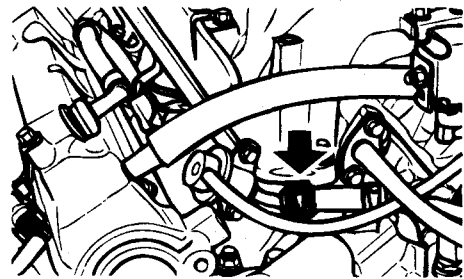


KDMB003C



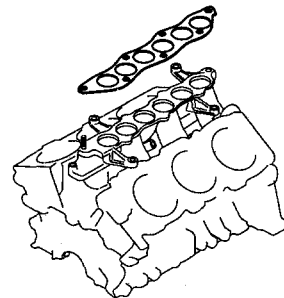
KDMB003D

7. Bleed off the pressure in the fuel pipe line to prevent the fuel from spilling.
8. Disconnect the connector from high pressure hose.



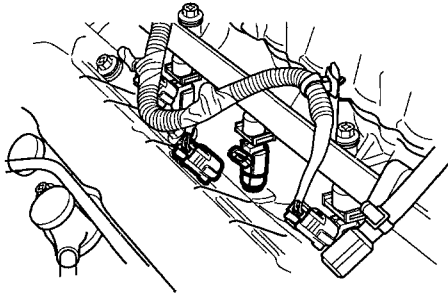
ECBB444F

9. Remove the surge tank and gasket.



KFW3236A

10. Disconnect the fuel injector harness connector.

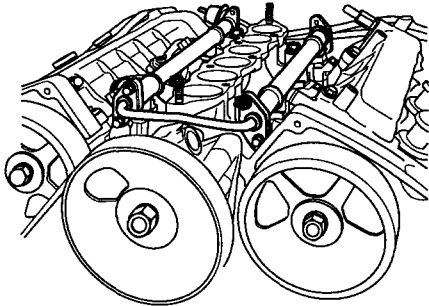


KFW3237A

11. Remove the delivery pipe with the fuel injector and the pressure regulator.

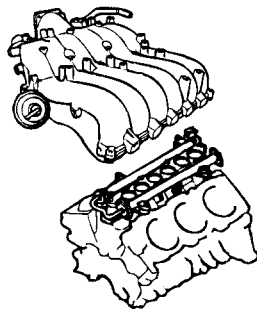
**NOTE**

When the delivery pipe is removed, be careful not to drop an injector.



KFW3238A

12. Disconnect the wiring harness of the coolant sensor assembly.
13. Remove the surge tank.



KDMB009B

**INSPECTION** EDMB0520

**SURGE TANK AND INTAKE MANIFOLD**

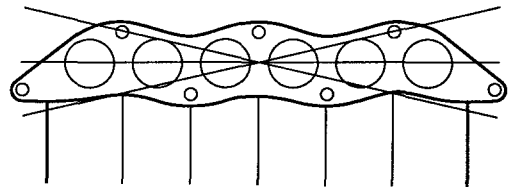
1. Check the surge tank and intake manifold for damage, cracking or restriction of the vacuum outlet port, water or gas passages.
2. Check for distortion on the surface using a straight edge and feeler gauge.

---

Standard value : 0.15 mm (0.006 in.) or less

Service limit : 0.2 mm (0.0078 in.)

---



KDMB087A

**INSTALLATION**

EDMB0530

1. Install the intake manifold and delivery pipe reversing the order of the removal procedure.

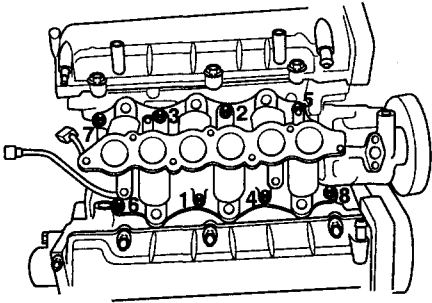
**Tightening torque**

Intake manifold :

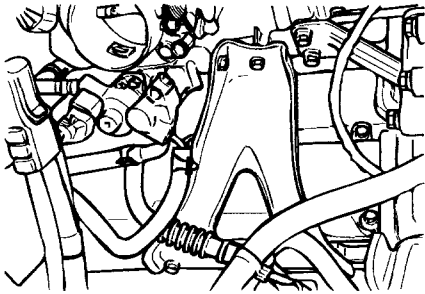
12 - 15 N.m (120 - 150 kg.cm, 9 - 11 lb.ft)

Surge tankstay :

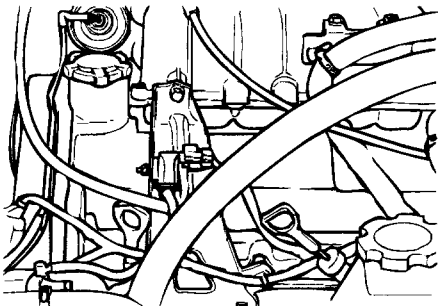
15-20 N.m (150-200 kg.cm, 11-14lb.ft)



KFW3241A



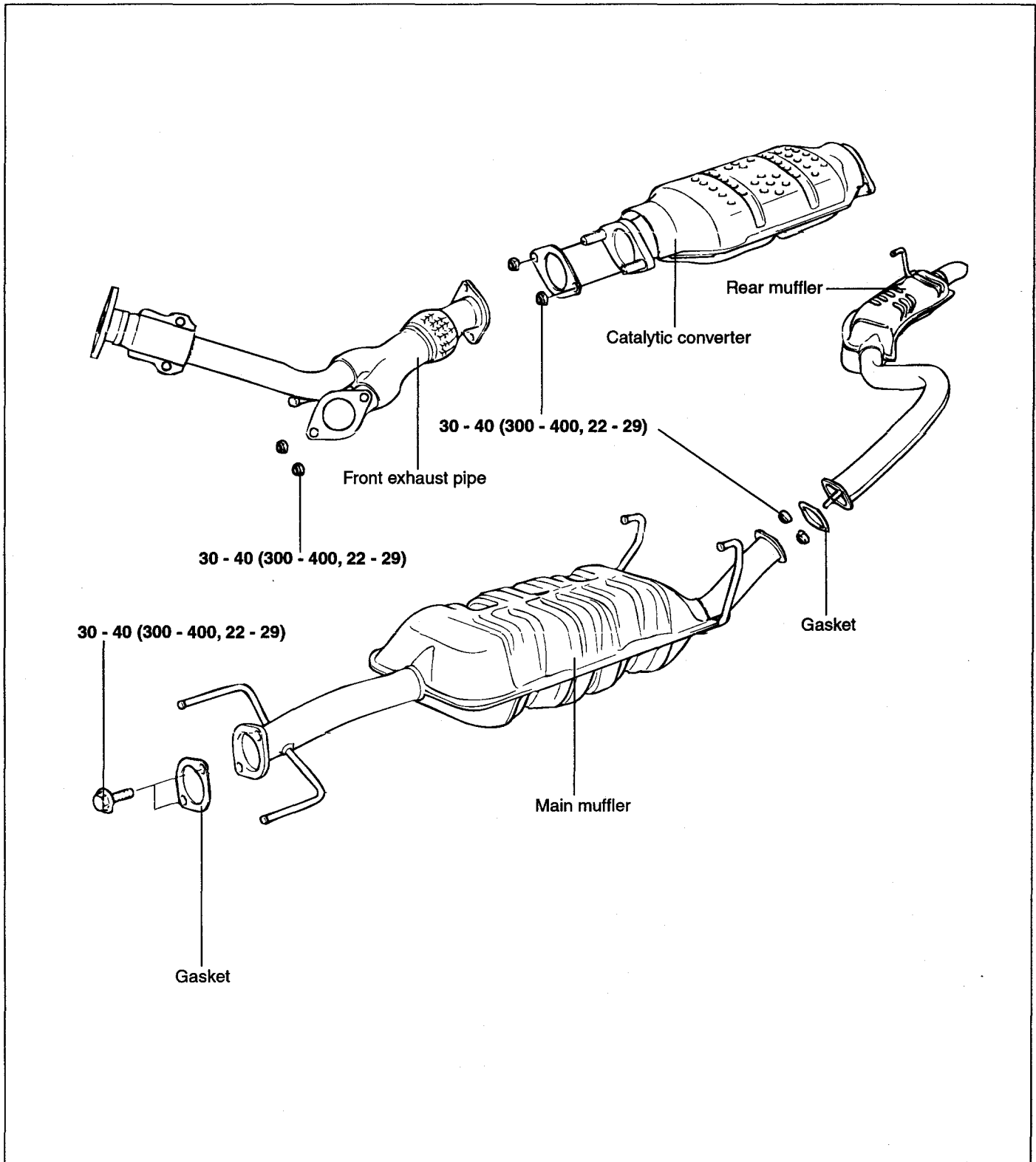
KDMB003C



KDMB003D

# MUFFLER

## COMPONENTS EDMB0600

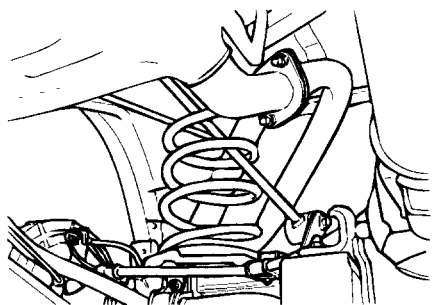




**REMOVAL** EDMB0610**REAR MUFFLER****! CAUTION**

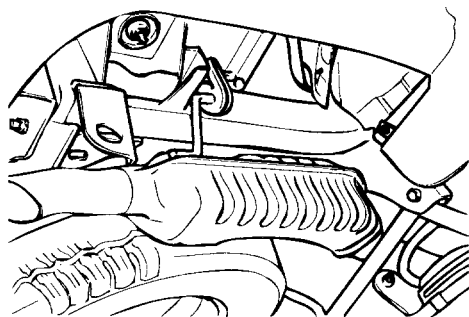
*Before removing or inspecting the exhaust system, ensure that the exhaust system is cool.*

1. Disconnect the rear muffler from the center exhaust pipe.



KDMB001B

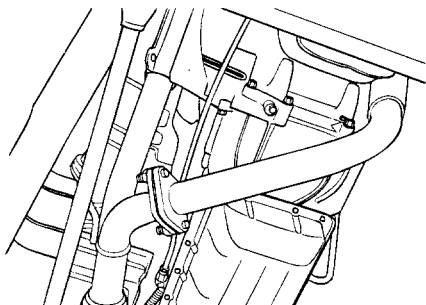
2. Remove the rubber hangers and the rear muffler.



KDMB001C

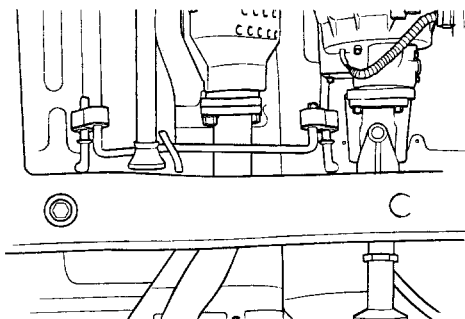
**FRONT EXHAUST PIPE (INCLUDING CATALYTIC CONVERTER)**

1. Remove the front exhaust pipe from the center exhaust pipe.
2. Remove the front exhaust pipe bolt and the exhaust manifold pipe mounting nuts.

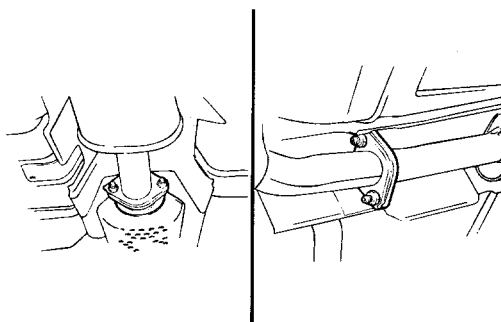


KDMB001D

3. Remove the front exhaust pipe from the rubber hanger.



KDMB001E



ECA9078A

**INSPECTION** EDHAB200

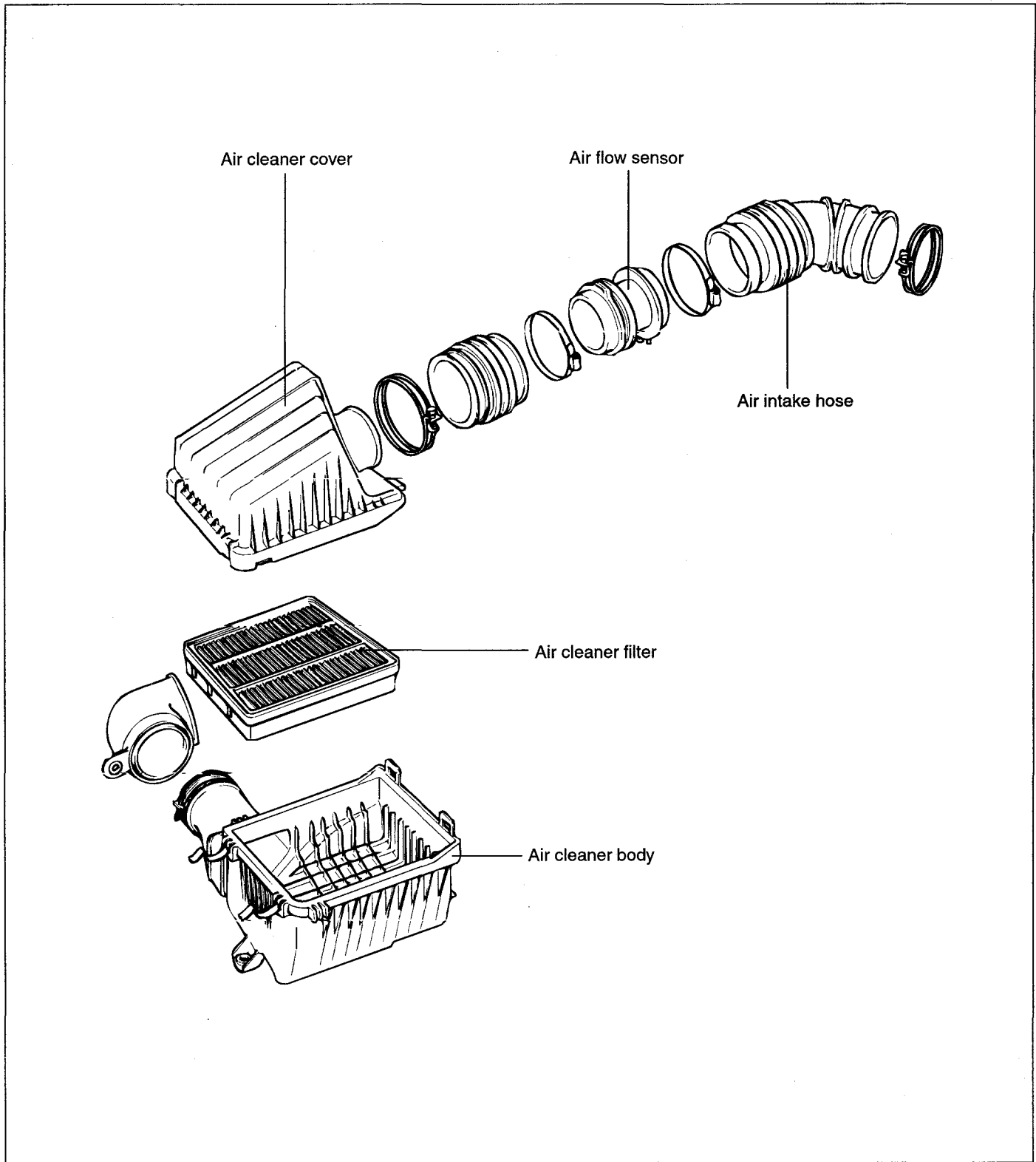
1. Check the mufflers and pipes for leaks, corrosion and damage.
2. Check the rubber hangers for deterioration and cracks.

**INSTALLATION** EDHAB300

1. Temporarily install the front exhaust pipe, the catalytic converter assembly, the center exhaust pipe and the main muffler, in this order.
2. Install the rubber hangers so that they hang equally left and right.
3. Tighten the parts securely and then confirm that there is no interference with any components.

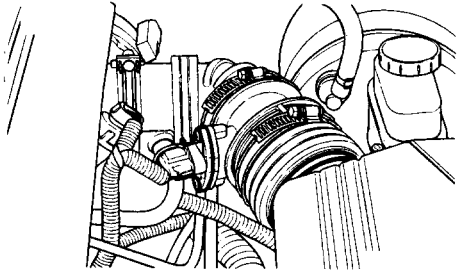
# AIR CLEANER (ACL)

## COMPONENTS EDMB0650



**REMOVAL** ECBBA300

1. Disconnect the air flow sensor connector.
2. Remove the air intake hose and air duct connected to the air cleaner.
3. Remove the three bolts attaching the air cleaner mounting brackets.
4. Detach the air cleaner.



ECB9505C

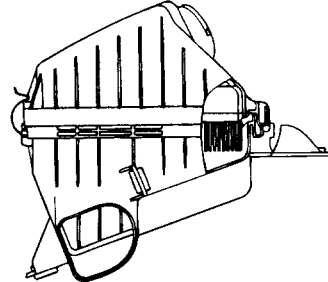
5. Remove the air flow sensor from the air intake hose.

**!** **CAUTION**

**Do not pull on the air flow sensor wires.**

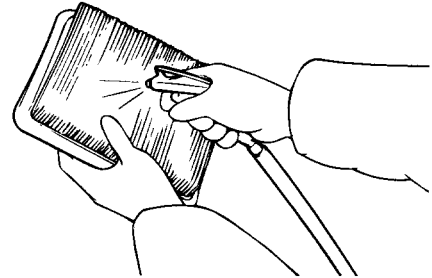
**INSPECTION** ECBBA400

1. Check the air intake hose, air cleaner cover for damage.
2. Check the air duct for damage.



ECB9505D

3. Check the air cleaner element for restriction, contamination or damage.  
If the element is slightly restricted, remove dust and debris by blowing compressed air from the inside of the element. Replace the element if it cannot be cleaned.



ECA9066A

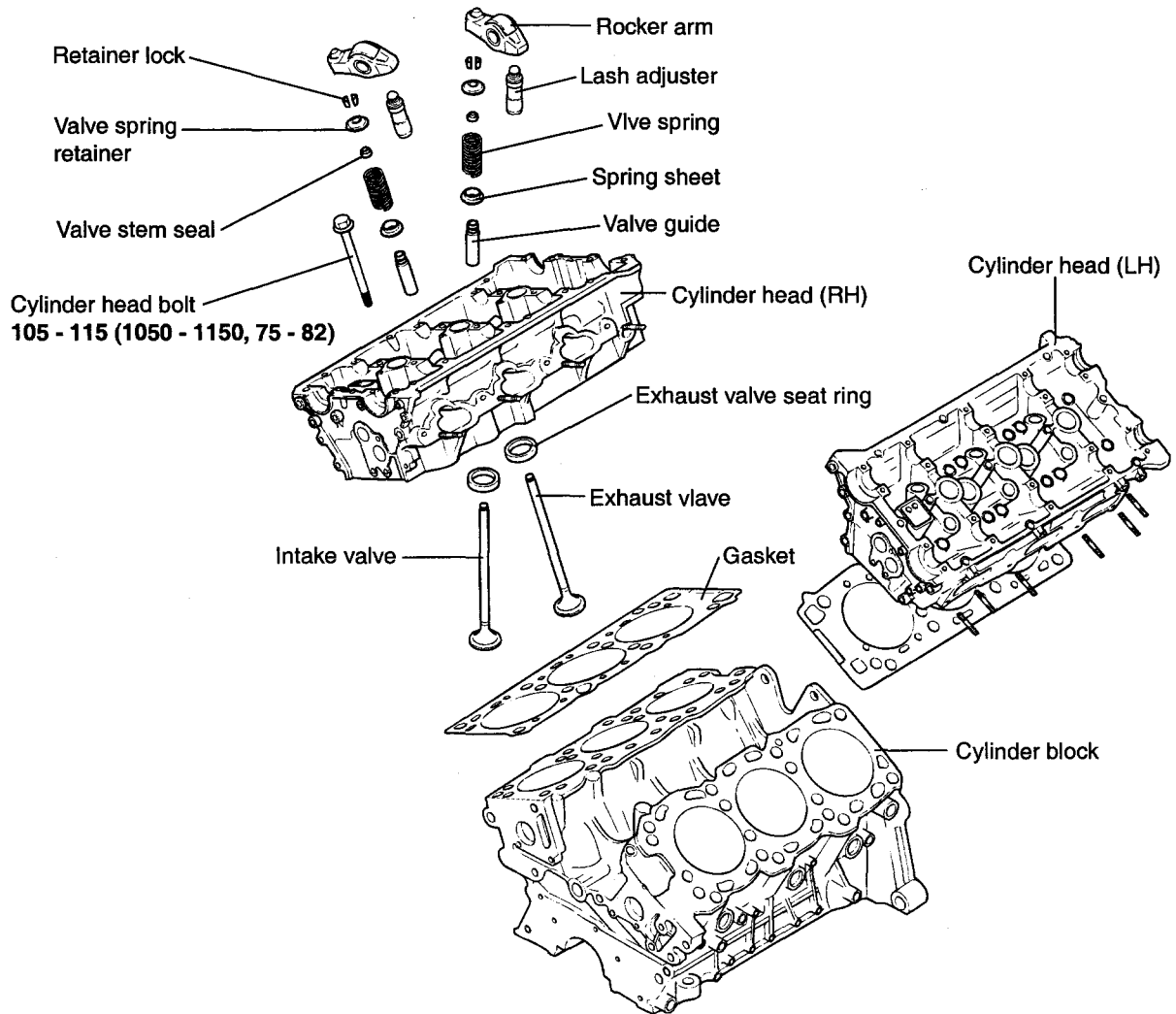
**INSTALLATION** EDHAB800

1. Install the air cleaner assembly following the reverse order of removal.

# CYLINDER HEAD ASSEMBLY

## CYLINDER HEAD

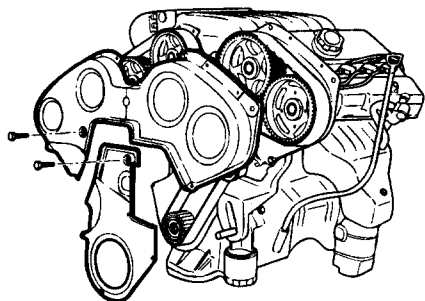
### COMPONENTS ECBBB000



**TORQUE : Nm (kg.cm, lb.ft)**

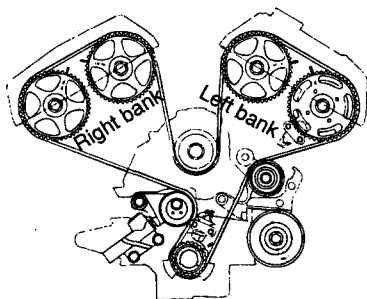
**DISASSEMBLY** ECBBB100

1. Drain the coolant and disconnect the upper radiator hose.
2. Remove the breather hose and air-intake hose.
3. Remove the vacuum hose, fuel hose and coolant hose.
4. Remove the intake manifold.
5. Remove the cables from the spark plugs. The cables should be removed by holding the boot portion.
6. Remove the ignition coil.
7. Remove the upper and lower timing belt cover.



EDB9025C

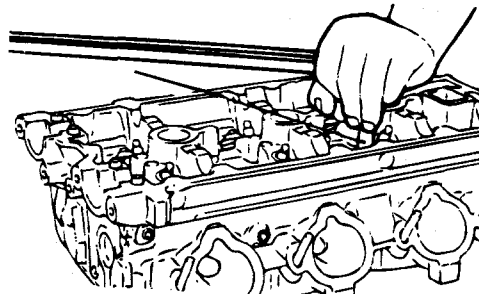
8. Remove the timing belt and camshaft sprockets.



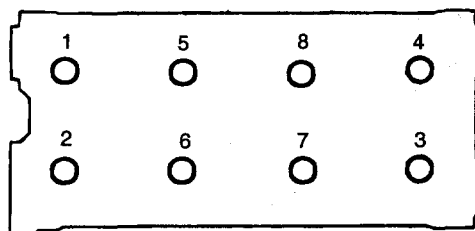
EDB9027G

9. Remove the heat protector and exhaust manifold assembly.
10. Remove the coolant pump pulley and head cover.
11. Remove the intake and exhaust camshaft.

12. Remove the cylinder head assembly. The cylinder head bolts should be removed using the 12 mm socket, in two or three steps.



EDB9032C



EDB9035B

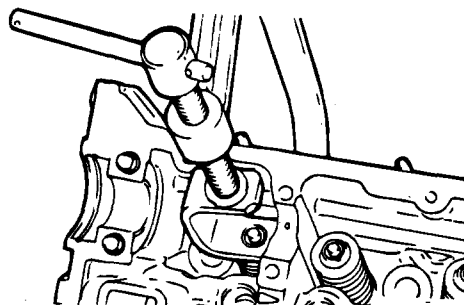
13. Clean the gasket pieces from the cylinder block top surface and cylinder head bottom surface.

**NOTE**

*Make sure that fragments from the gasket do not fall in the engine.*

**RETAINER LOCK**

1. Compress the valve spring using special tool. (09222 - 28000, 09222 - 28100)
2. Remove the retainer lock.



EDB9032D

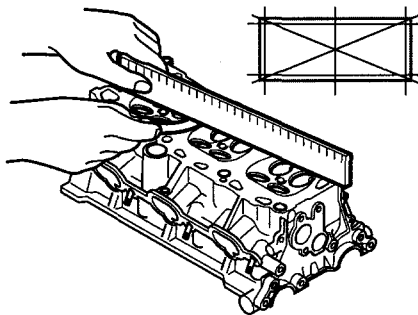
**INSPECTION** EDMB0700

**CYLINDER HEAD**

1. Remove scale, sealing compound and carbon deposits. After cleaning oil passages, apply compressed air to make certain that the passages are not clogged.
2. Visually check the cylinder head for cracks, damage or water leakage.
3. Check the cylinder head surface for flatness with a straight edge and feeler gauge as shown in the illustration.

**Cylinder head flatness:**

Standard dimensions : Max. 0.03mm(0.0059 in.)  
 Service limit : 0.05mm(0.0020 in.)



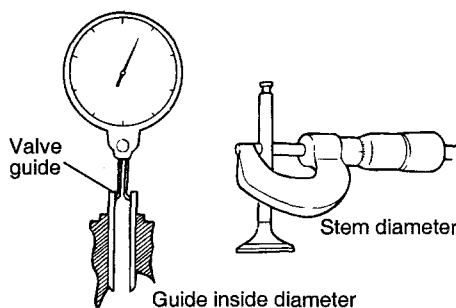
KFW3047A

**VALVE GUIDES**

Check the valve stem-to-guide clearance. If the clearance exceeds the service limit, replace the valve guide with a new oversize guide.

**Valve stem-to-guide clearance**

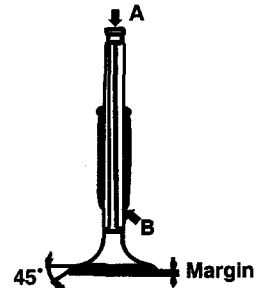
Standard value  
 Intake : 0.02 - 0.05 mm (0.0009 - 0.0020 in.)  
 Exhaust : 0.050 - 0.085 mm (0.0020 - 0.0033 in.)



ECA9281D

**VALVE**

1. Replace the valve if its stem is bent, worn or damaged. Also replace it if the stem end (the surface contacting the hydraulic-lash adjuster) is hollowed out.
2. Check the valve face contact area, and recondition or replace as necessary.

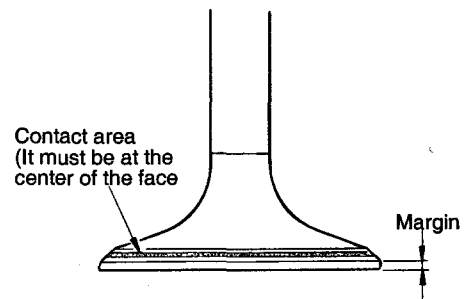


ECA9281B

3. Replace the valve if the width of the margin (thickness of the valve head) is less than the minimum specified.

**Valve margin**

Standard value  
 Intake : 1.0mm (0.0394 in.)  
 Exhaust : 1.3mm (0.0512 in.)



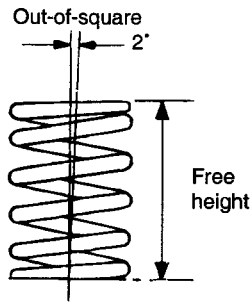
EDA9300D

**VALVE SPRING**

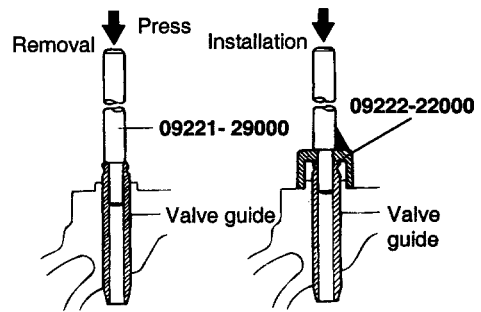
1. Check the free height of each valve spring and replace if necessary.
2. Using a square, test the squareness of each valve spring. If the spring is excessively out-of-square, replace it.

**Valve spring**

Standard value  
 Free height : 46.4 mm (1.8268 in.)  
 Load : 24 kg / 37.9 mm (53 lb / 1.492 in.)  
 Out - of - square : Max. 2°  
 Service limit  
 Free height : .41.5 mm (1.6339 in.)  
 Load : 55.8 kg / 28.9 mm (123 lb / 1.1378 in.)



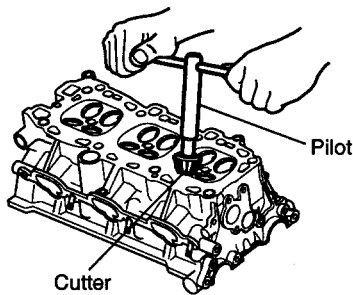
ECA9281C



EDA9300G

**RECONDITIONING VALVE SEAT**

1. Before reconditioning, check the valve guide for wear. Replace worn guides if necessary and then recondition the valve seats.
2. Recondition the valve seat using the Valve Seat Cutter and Pilot.
3. After reconditioning, the valve and valve seat should be lapped lightly with a lapping compound.

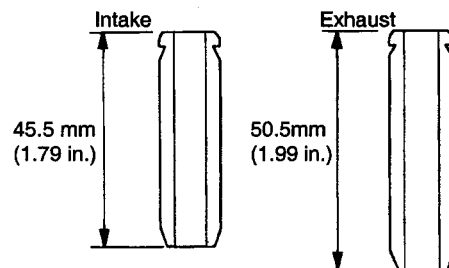


KFW3048A

3. Using the special tool (09221-29000, 09222-22000) press-fit the valve guide. The valve guide must be press-fitted from the upper side of the cylinder head. Keep in mind that the intake and exhaust valve guides are different in length.
4. After the valve guide is press-fitted, insert a new valve and check for proper clearance.
5. After the valve guide is replaced, check that the valve is fully seated. Recondition the valve seats as necessary.

**NOTE**

Do not install a valve guide unless it is oversize.



EOY168A

**REPLACING VALVE GUIDE**

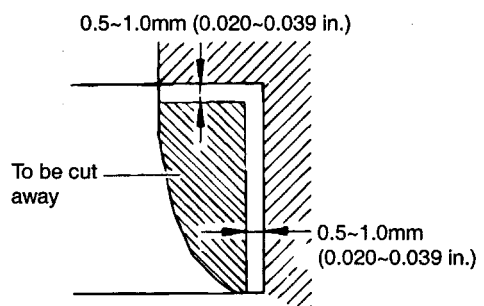
1. Using the special tool (09222 - 22000 B), withdraw the old valve guide out the bottom of the cylinder head.
2. Recondition the valve guide hole so that it can receive the newly press-fitted oversize valve guide.

**VALVE GUIDE OVERSIZES**

Size mm (in.)	Size Mark	Oversize valve guide hole size mm (in.)
0.05 (0.002) O.S.	5	12.05 - 12.068 (0.474 - 0.475)
0.25 (0.010) O.S.	25	12.25 - 12.268 (0.482 - 0.483)
0.50 (0.020) O.S.	50	12.50 - 12.518 (0.492 - 0.493)

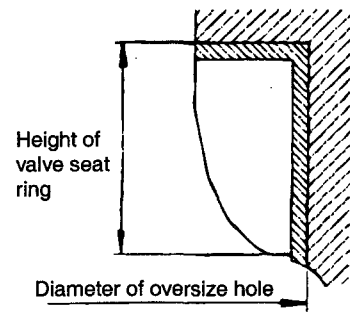
**REPLACING VALVE SEAT RING**

1. Cut away the inner face of the valve seat to reduce the wall thickness.



EOYR3940

2. Enlarge the diameter of the valve seat so that it matches the specified hole diameter of the new valve seat ring.



EOY167A

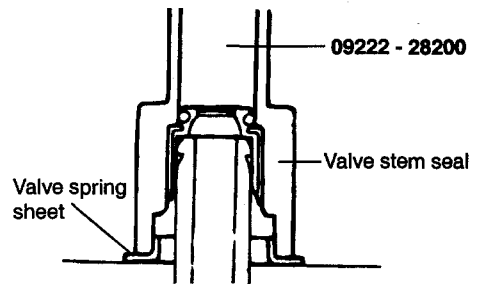
**VALVE SEAT RING OVERSIZES**

Description	Size mm (in.)	Size Mark	Seat ring height H mm (in.)	Oversize hole diameter I.D. mm (in.)
Intake valve seat ring	0.3 (0.012) O.S.	30	7.9 - 8.1 (0.311 - 0.319)	36.300 - 36.325 (1.429 - 1.430)
	0.6 (0.024) O.S.	60	8.2 - 8.4 (0.323 - 0.331)	36.600 - 36.625 (1.441 - 1.442)
Exhaust valve seat ring	0.3 (0.012) O.S.	30	7.9 - 8.1 (0.311 - 0.319)	33.30 - 33.325 (1.311 - 1.312)
	0.6 (0.024) O.S.	60	8.2 - 8.4 (0.323 - 0.331)	33.600 - 33.625 (1.323 - 1.324)

3. Heat the cylinder head to about 250°C (480°F) and press-fit an oversize seat ring for the bore in the cylinder head.
4. Using lapping compound, lap the valve to the new seat.

**Valve seat contact width**

Intake : 0.9 - 1.3 mm (0.035 - 0.051 in.)  
 Exhaust : 0.9 - 1.3 mm (0.035 - 0.051 in.)



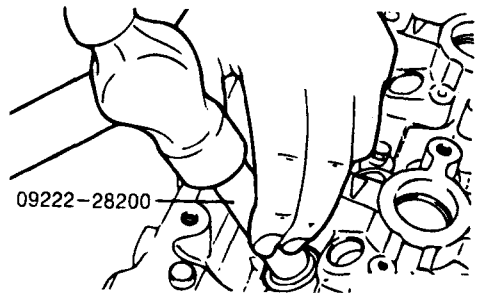
EDB9037A

**REASSEMBLY** ECBBB300

1. Install the spring seats.
2. Using special tool (09222 - 28200), lightly tap the seal in position.

**NOTE**

- Do not reuse old valve stem seals.
- Incorrect installation of the seal could result in oil leakage of from the valve guides.

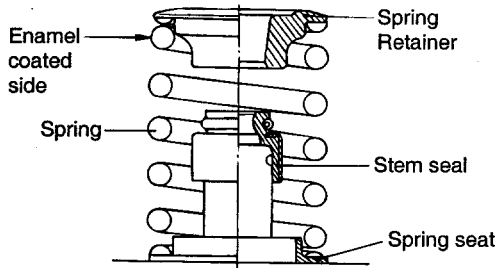


EDB9037B

3. Apply engine oil to each valve. Insert the valve into their guides. Avoid pushing the valve into the seal by force. After installing the valve, check that it moves smoothly.



- Place valve springs so that the side coated with enamel faces toward the valve spring retainer.

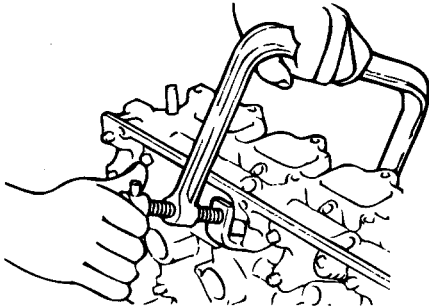


ECA9290B

- Using the special tool (09222 - 28000, 09222 - 28100), compress the spring and install the retainer locks. After installing the valves, ensure that the retainer locks are correctly in place before releasing the valve spring compressor.

**NOTE**

When the spring is compressed, check that the valve stem seal is not pressed against the bottom of the retainer.



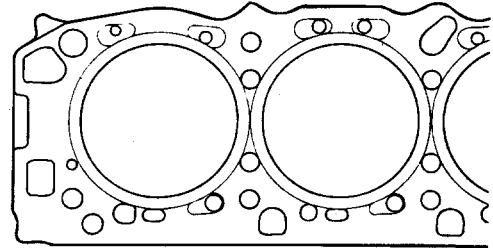
EDAA040B

- Clean both gasket surfaces of the cylinder head and cylinder block.
- Verify the identification marks on the cylinder head gasket.

- Install the gasket so that the surface with the identification mark faces toward the cylinder head.

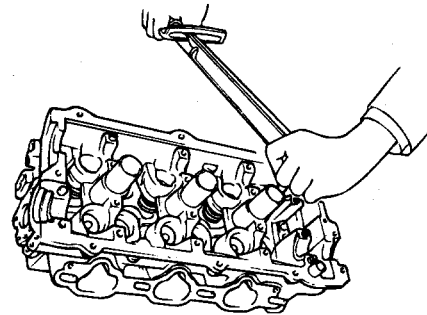
**NOTE**

Do not apply sealant to these surfaces.



EDB9032B

- Tighten the cylinder head bolts in the sequence shown in the illustration with a torque wrench.



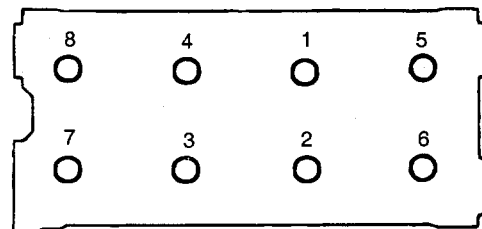
EDA9010A

- Tighten the cylinder head bolts using the torque - angle method. Starting at top center, tighten all cylinder head bolts in sequence as shown in the illustration, using the 12 mm socket.

**Tightening procedure**

Cylinder head bolt :

105 - 115 Nm (1050 - 1150 kg.cm, 75 - 82 lb.ft)

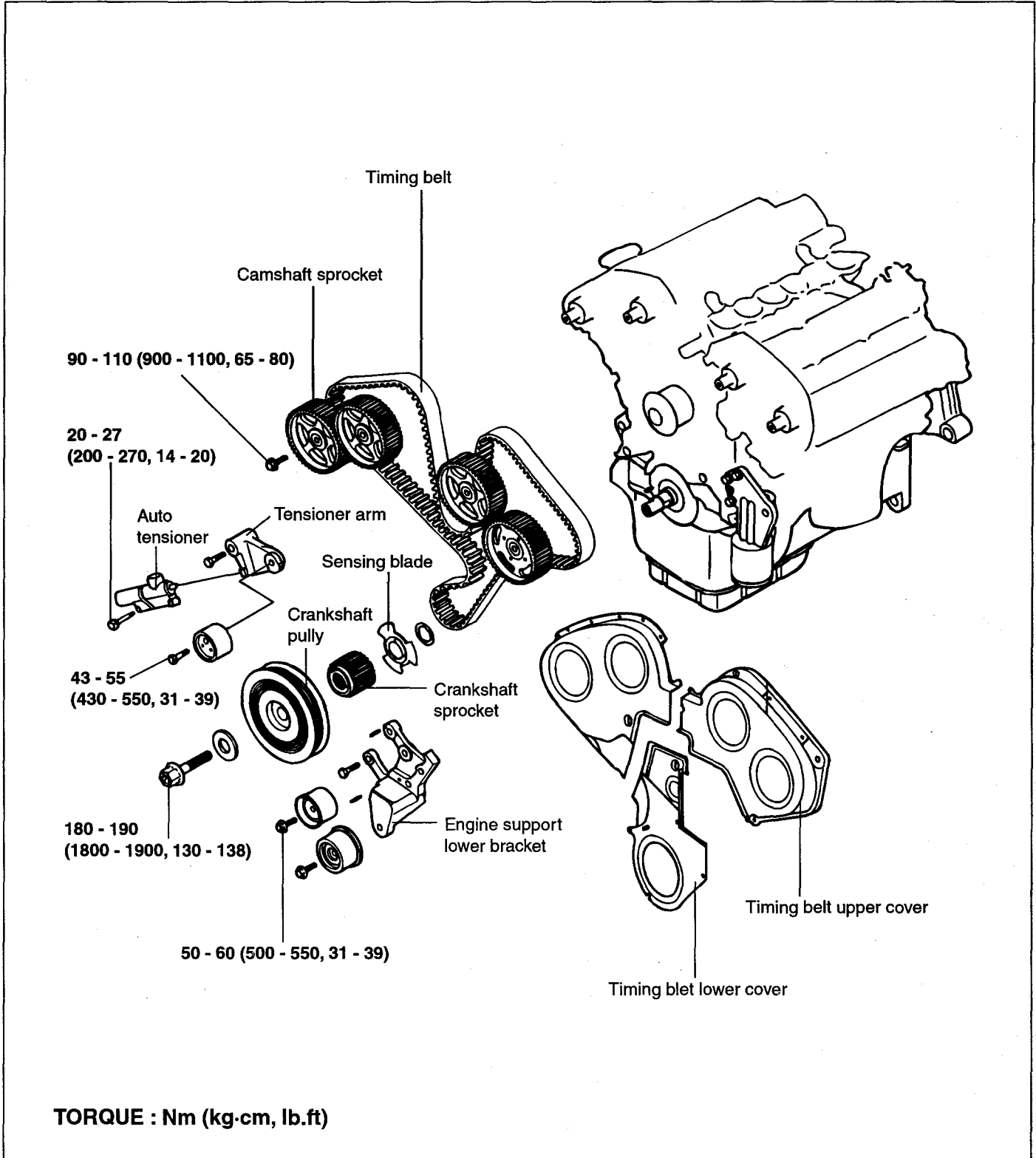


ECBB003A

# TIMING SYSTEM

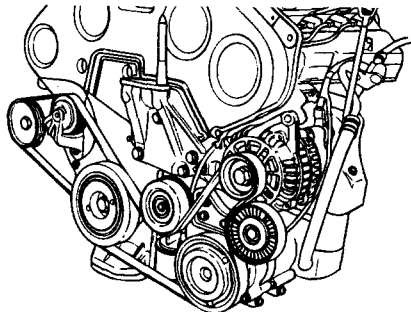
## TIMING BELT

### COMPONENTS EDMB0800



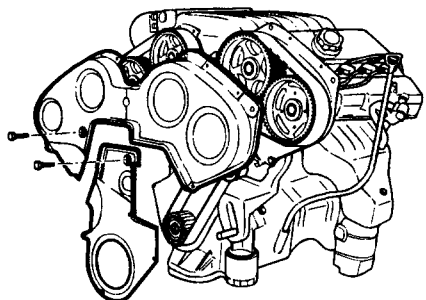
**REMOVAL** EDMB0810

- Using a [16 mm], rotate the tensioner arm clockwise (about 14°) and remove the belt from the pulley.
- Remove the power steering pump pulley, idler pulley, tensioner pulley and crankshaft pulley.



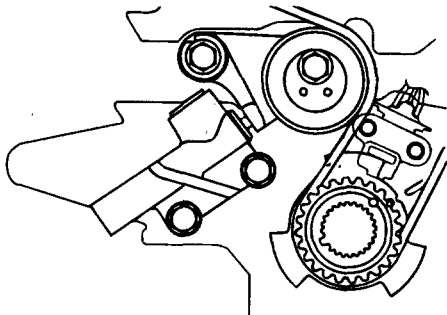
EDB9025B

- Remove the upper and lower timing belt covers.



EDB9025C

- Remove the auto tensioner.

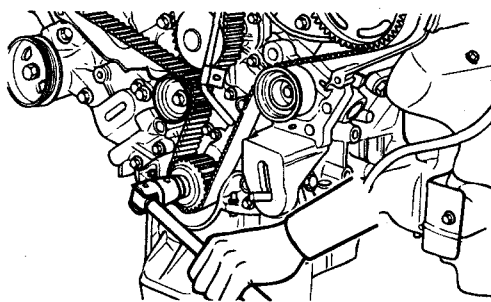


EDB9025D

**NOTE**

Rotate the crankshaft clockwise and align the timing mark to set the No.1 cylinder's piston to TDC (compression stroke).

At this time, the timing marks of the camshaft sprocket and cylinder head cover should coincide with each other.



EDB9025E

- Unbolt the tensioner to remove the timing belt.

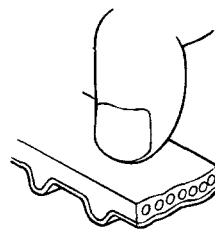
**NOTE**

If you plan to use the timing belt again, mark the rotation direction on the belt so you reinstall it correctly.

**INSPECTION** EDHAD200

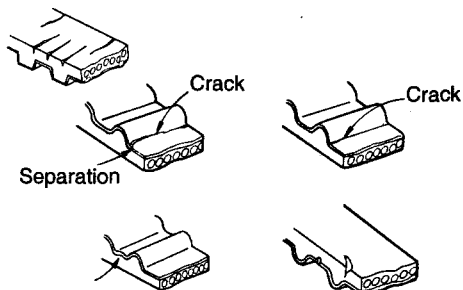
- Inspect the belt closely. If the following problems are evident, replace the belt with a new one.

- 1) Hardened back surface of rubber  
Back surface is glossy, non-elastic and so hard that when the nail of your finger is pressed into it, no mark is produced.



ECA9200B

- 2) Cracked back surface of rubber.

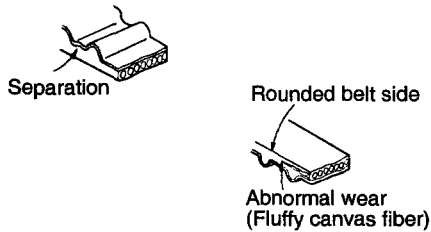


EDA9220B

3) Side of belt is badly worn.

**NOTE**

*A belt in good condition should have clear-cut sides as if it were cut with a sharp knife.*



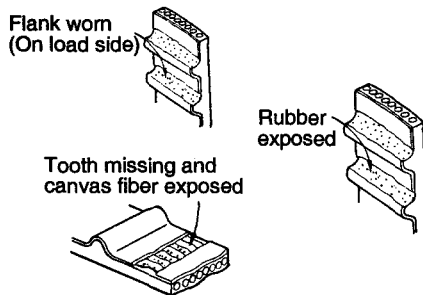
EDA9220C

4) Teeth are badly worn out.

Initial stage : Canvas on load side of the tooth flank worn (fluffy canvas fibers, rubber gone, color changed to white, and unclear canvas texture)

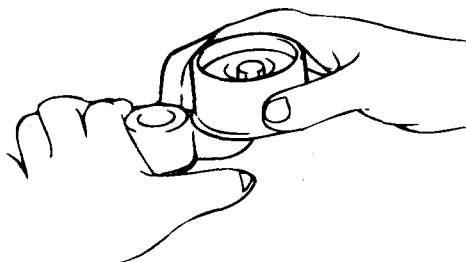
Last stage : Canvas on the load side of the tooth flank worn down and rubber exposed (tooth width reduced).

5) Missing tooth



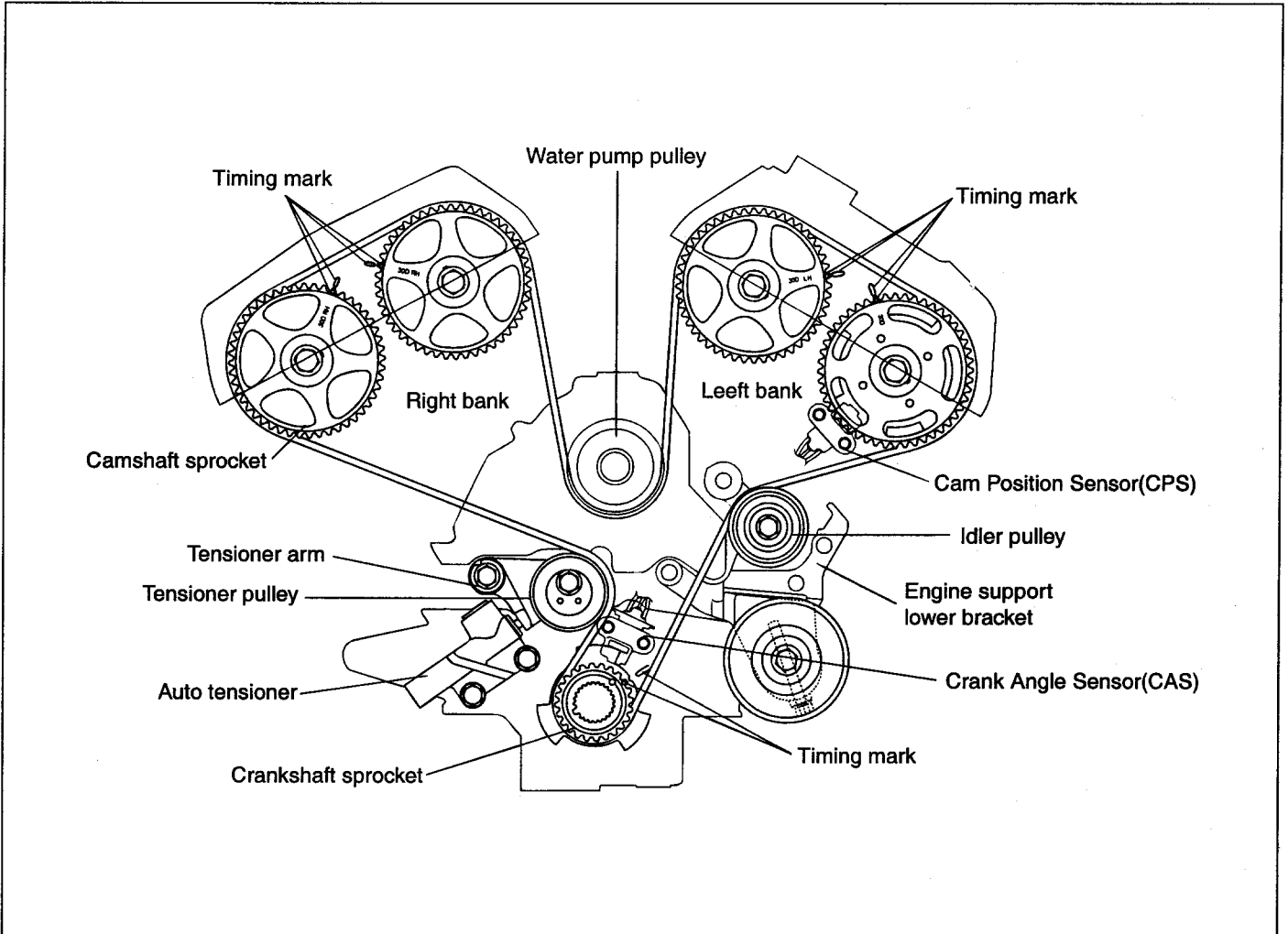
EDA9220D

2. If backlash or an irregular noise is observed when rotating the pulley, replace the timing belt tensioner and idler pulley.



EDA9025A

**TIMING BELT** ECBBC300

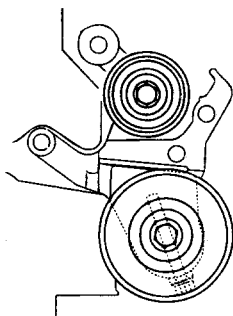


EDB9026A

**INSTALLATION** EDMB0820

The method of installing timing belt and auto tensioner.

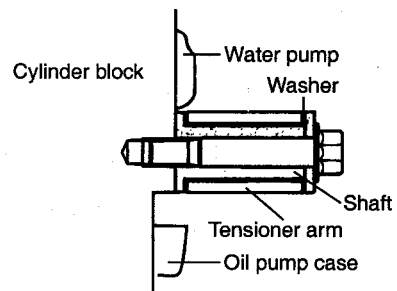
1. Install idler pulley to engine support lower bracket.



EDB9027A

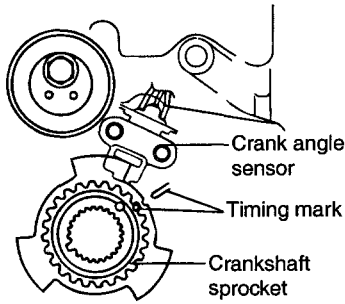
2. Install tensioner arm, shaft and plane washer to cylinder block.

**Tightening torque : 35 - 55 Nm (350 - 550 kg.cm)**



EDB9027B

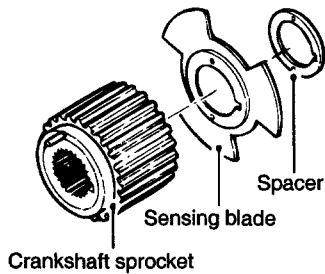
3. Install crankshaft sprocket and align the timing mark.



EDB9027C

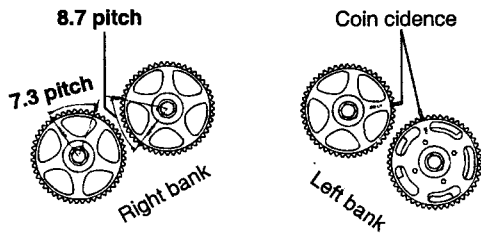
**CAUTION**

*Be careful not to bend crankshaft sensing blade.*



EDB9027D

4. Install camshaft sprocket and adjust initial installation state as illustration.

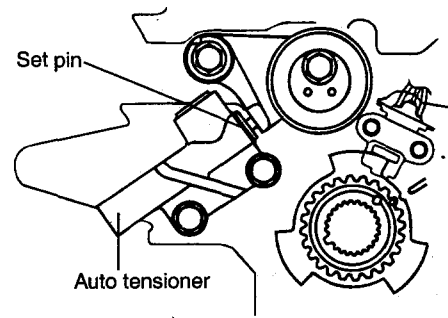


EDB9027E

5. Install auto tensioner to oil pump case.

**NOTE**

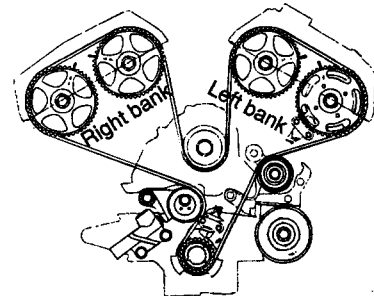
*At this time auto tensioner's set pin should be assembled completely.*



EDB9027F

6. Align the timing marks of each sprocket and install the timing belt in this order.

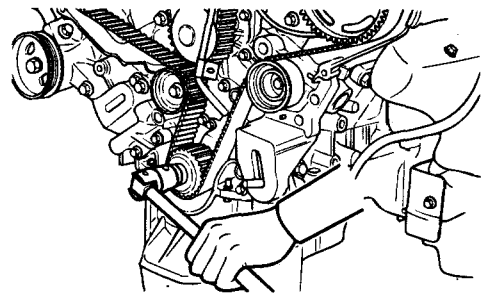
Crankshaft sprocket → Idler pulley → Exhaust camshaft sprocket (LH) → Intake camshaft sprocket (LH) → Water pump pulley → Intake camshaft sprocket (RH) → Exhaust camshaft sprocket (RH) → Tensioner pulley



EDB9027G

**NOTE**

- In this step, No. 1 is in TDC (Compression stroke)
- Do not insert fingers.



EDB9027H

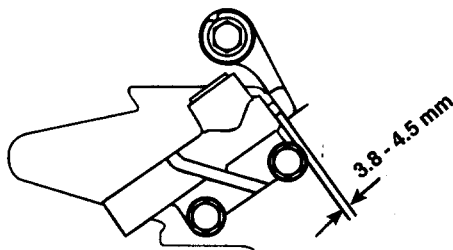
7. After installing the timing belt, reconfirm the timing mark.
8. Install the tensioner pulley.
9. Pull out the set pin of auto tensioner.

**THE METHOD TO ADJUST THE TENJSION OF  
TIMING BELT.**

1. Rotate the crankshaft 2 rotation clockwise and measure the projected load of auto tensioner in the TDC (# 1 Compression stroke) after 5 minutes.
2. Check the projectde length is 3.8 - 4.5 mm.
3. Check again if the timing marks of each sprocket is with in specified position.

** NOTE**

*If not within specified position, do again from procedure 6 in the method of installing timing belt and auto tensioner.*



EDB9028A

# Engine Mechanical System [2.5 TCI]

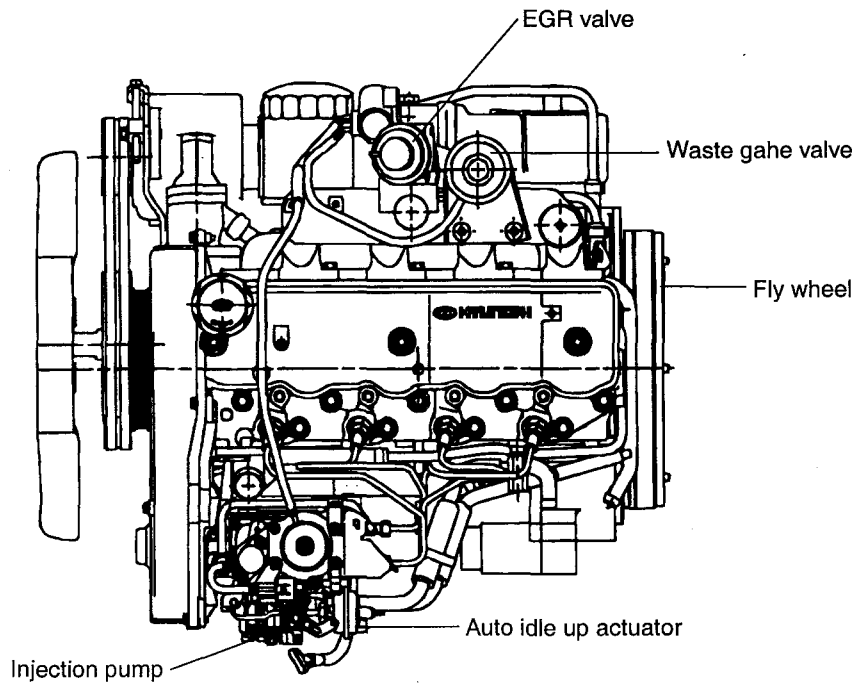
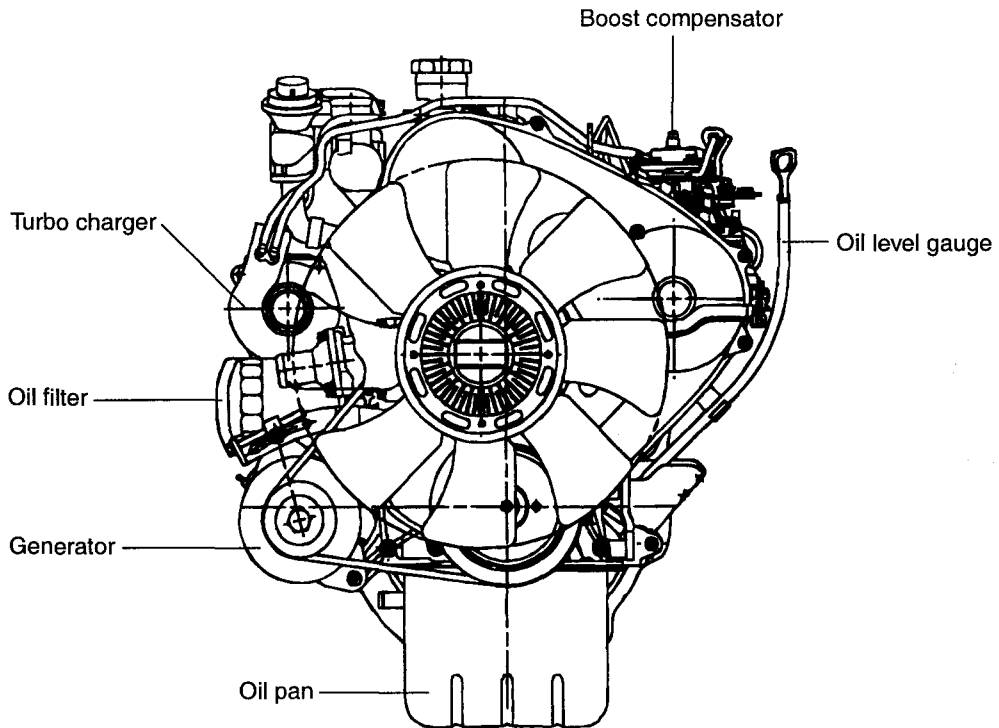
GENERAL .....	EM - 2
ENGINE BLOCK .....	EM -24
MAIN MOVING SYSTEM .....	EM -35
COOLING SYSTEM .....	EM -42
LUBRICATION SYSTEM .....	EM -51
INTAKE AND EXHAUST SYSTEM .....	EM -56
CYLINDER HEAD ASSEMBLY .....	EM -70
TIMING SYSTEM .....	EM -78



# GENERAL

GENERAL ELCB0010

[2.5 TCI]



## SPECIFICATIONS

ELCB0020

	Standard	Limit
<b>Engine model</b> Type No. of cylinders Valve mechanism Total displacement Bor x stroke Compression ratio	D4BH (2.5 TCI) Diesel engine 4 in - line OHC 2,467 cc 91.1 x 95 mm 21	
<b>Valve timing</b> Intake valve Opens (BTDC) Closes (ABDC) Exhaust valve Opens (BBDC) Closes (ATDC)	 20° 48°  54° 22°	
<b>Firing order</b>	1 - 3 - 4 - 2	
<b>Cylinder head</b> Flatness of gasket surface Flatness of maunting mounting surface Overall height Oversize rework dimensions of valve guide hole (both intake and exhaust) 0.05 0.25 0.50 Oversize rework dimensions of intake valve seat ring hole 0.30 0.60 Oversize rework dimensions of intake valve seat ring hole 0.30 0.60	0.05 mm (0.002 in.) 0.15 mm (0.006 in.) 94.0 - 94.1 mm (3.701 - 3.705in.)  13.050 - 13.068 mm (0.5138 - 0.5145) 13.250 - 13.268 mm (0.5127 - 0.5224) 13.500 - 13.518 mm (0.5315 - 0.5322)  43.300 - 43.325 mm (1.7047 - 1.7057 in.) 43.600 - 43.625 mm (1.7165 - 1.7175 in.)  37.300 - 37.325 mm (1.4685 - 1.4695 in.) 37.600 - 37.625 mm (1.4803 - 1.4813 in.)	0.2 mm (0.0079 in.) 0.3 mm (0.0118 in.)
<b>Camshaft</b> Cam height Intake and Exhaust Journal diameter Oil clearance End play	37.05 mm (1.4587 in.) 29.94 - 29.95 mm (1.1787 - 1.1791in.) 0.05 - 0.08 mm (0.002 - 0.0031in.) 0.1 - 0.2 mm (0.0039 - 0.0079 in.)	36.55 mm (1.4389)  0.13 mm (0.005 in.) 0.4 mm (0.0157 in.)
<b>Rocker arm</b> I.D. Rocker arm - to - shaft clearance	18.910 - 18.928 mm (0.7445 - 0.7452 in.) 0.012 - 0.050 mm (0.0005 - 0.0020 in.)	0.08 mm (0.0031 in.)
<b>Rocker shaft</b> O.D.	18.878 - 18.898 mm (0.7432 - 0.7440 in.)	

	Standard	Limit
<b>Valve</b>		
Overall length		
Intake and Exhaust	136.5 mm (5.3740 in.)	
Stem diameter		
Intake	7.96 - 7.975 mm (0.3133 - 0.3140 in.)	
Exhaust	7.93 - 7.950 mm (0.3122 - 0.3130 in.)	
Face angle	45° - 45°30'	
Thickness of valve head (margin)		
Intake and Exhaust	2.0 mm (0.0787 in.)	1.0 mm (0.0394 in.)
Stem-to - guide clearance		
Intake	0.03 - 0.06 mm (0.0012 - 0.0024 in.)	0.10 mm (0.0039 in.)
Exhaust	0.05 - 0.09 mm (0.0020 - 0.0035 in.)	0.15 mm (0.0059 in.)
<b>Valve spring</b>		
Free height	49.1 mm (1.9331 in.)	48.1 mm (1.8937 in.)
Lode / Installed height	276 N (27.6 kg) / 40.4	
Out - of squareness	Max 2°	4°
<b>Valve guide</b>		
Overall length		
Intake	71 mm (2.7953 in.)	
Exhaust	74 mm (2.9134 in.)	
I.D.	8.0 - 8.02 mm (0.3150 - 0.3157 in.)	
O.D.	13.06 - 13.07 mm (0.5142 - 0.5146 in.)	
<b>Valve stat</b>		
Seat angle	45°	
Valve contact width	0.9 - 1.3 mm (0.0354 - 0.0512 in.)	
Sinkage		0.2 mm (0.0079 in.)
<b>Silent shaft</b>		
Journal diameter		
Right		
(front)	18.300 - 18.467 mm (0.7205 - 0.7270 in.)	
(rear)	42.975 - 42.991 mm (1.6920 - 1.6926 in.)	
Left		
(front)	18.959 - 18.980 mm (0.7464 - 0.7472 in.)	
(rear)	42.975 - 42.991 mm (1.6919 - 1.6926 in.)	
Oil clearance		
Front	0.02 - 0.06 mm (0.0008 - 0.0024 in.)	
Rear	0.05 - 0.09 mm (0.0020 - 0.0035 in.)	
<b>Piston</b>		
O.D.	79.0 - 79.2 mm (3.1102 - 3.1181 in.)	
Piston - to cylinder clearance	0.04 - 0.08 mm (0.0016 - 0.0031 in.)	
<b>Ring groove width</b>		
No. 1 ring	2.601 - 2.603 mm (0.1024 - 0.1025 in.)	
No. 2 ring	2.100 - 2.102 mm (0.0827 - 0.0828 in.)	
Oil ring	4.010 - 4.035 mm (0.1579 - 0.1589 in.)	
Service size	0.25, 0.50, 0.75, 1.00 oversize	

	Standard	Limit
<b>Piston ring</b>		
End gap		
No. 1 ring	0.35 - 0.50 mm (0.0138 - 0.0197 in.)	0.8 mm (0.0315 in.)
No. 2 ring	0.25 - 0.40 mm (0.0098 - 0.0157 in.)	0.8 mm (0.0315 in.)
Oil ring	0.25 - 0.45 mm (0.0098 - 0.0177 in.)	0.8 mm (0.0315 in.)
Ring - to - ring groove clearance		
No. 1 ring	0.056 - 0.076 mm (0.0022 - 0.0030 in.)	0.15 mm (0.0059)
No. 2 ring	0.046 - 0.066 mm (0.0018 - 0.0026 in.)	0.15 mm (0.0059)
Oil ring	0.02 - 0.065 mm (0.0008 - 0.0026 in.)	0.1 mm (0.0039)
Service size	0.25, 0.05, 0.75, 1.00	
<b>Piston pin</b>		
O.D.	28.994 - 29.0 mm (1.1415 - 1.1417 in.)	
<b>Coonecting rod</b>		
Big end center - to - small end center lenght	157.95 - 158.05 mm (6.2185 - 6.2224 in.)	
Bend	Max. 0.05 (0.0020)	
Twist	Max. 0.1 (0.0039)	
Big end side clearance	0.10 - 0.25 mm (0.0039 - 0.0098 in.)	
<b>Crankshaft</b>		
End play	0.05 - 0.18 mm (0.0020 - 0.0071 in.)	0.25 mm (0.0098 in.)
Journal O.D.	66 mm (2.5984 in.)	
Pin O.D.	53 mm (2.0866 in.)	
Out - of roundness and taper of journal and pin	0.05 mm (0.0020 in.)	
Oil clearance of journal	0.02 - 0.05 mm (0.0008 - 0.0020 in.)	
Oil clearance of pin	0.02 - 0.05 mm (0.0008 - 0.0020 in.)	0.1 mm (0.0039 in.)
Journal		0.1 mm (0.0039 in.)
0.25 U.S.	65.735 - 65.750 mm (2.5879 - 2.5886 in.)	
0.50 U.S.	65.485 - 65.500 mm (2.5781 - 2.5787 in.)	
0.75 U.S.	65.235 - 65.250 mm (2.5683 - 2.5689 in.)	
Pin		
0.25 U.S.	52.735 - 52.750 mm (2.0716 - 2.0768 in.)	
0.50 U.S.	52.485 - 52.500 mm (2.0663 - 2.0669 in.)	
0.75 U.S.	52.235 - 52.250 mm (2.0565 - 2.0571 in.)	
<b>Cylinder block</b>		
I.D.	91.10 - 91.13 mm (3.5866 - 3.5878 in.)	
Flatness of gasket surface	0.05 mm (0.0020 in.)	0.1 mm (0.0039 in.)
Overall height	318.45 - 318.55 mm (12.537 - 12.541 in.)	
<b>Flywheel</b>		
Flatness	0.13 mm (0.0051 in.)	0.13 mm (0.0051 in.)
<b>Oil pump</b>		
Tip clearance		
Inner gear	0.22 - 0.35 mm (0.0087 - 0.0138 in.)	0.5 mm (0.0197 in.)
Outer gear	0.12 - 0.22 mm (0.0047 - 0.0087 in.)	0.4 mm (0.0157 in.)
Side clearance		
Inner gear, Outer gear	0.04 - 0.10 mm (0.0016 - 0.0039 in.)	0.15 mm (0.0059 in.)
Body clearance		
Outer gear	0.12 - 0.22 mm (0.0047 - 0.0087 in.)	
Inner gear,	0.03 - 0.09 mm (0.0012 - 0.0035 in.)	
Oil pressure at engine idle speed	80 Kpa (0.8 kg/cm <sup>2</sup> ) or more	
<b>Cooling system</b>	Water - cooled forced circulation system	
Drive belt	V - type	
Water pump type	Centrifugal impeller	
Fan clutch type	Thermo type with plate type bimetal	

	Standard	Limit
<b>Thermostat type</b> Type	Wax type with by - pass valve	
<b>Coolant temperature gauge unit</b> Type	Thermister type (2 elements)	
<b>Thermostat</b> Valve opening temperature (°C) Fully opening temperature (°C)	82 95	
<b>Coolant temperature gauge unit</b> Resistance Coolant temperature gauge element ( $\Omega/^\circ\text{C}$ ) Glow control element ( $\Omega/^\circ\text{C}$ )	90.5 - 117.5 / 70, 21.3 - 26.3 / 115 22.3 - 27.3 / -20, 2.92 - 3.58 / 20	
<b>Air cleaner</b>	Paper filter type	
<b>Muffler</b>	Expansion resonance type	

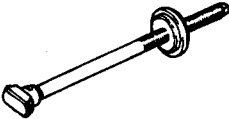
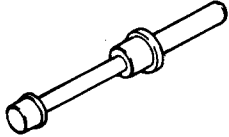



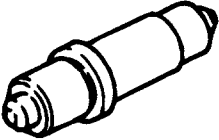

 **NOTE**

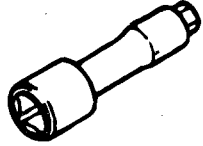
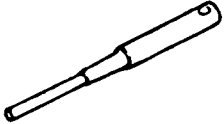



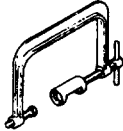
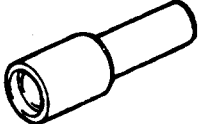
- O.D. : Outer Diameter
- I.D. : Inner Diameter
- U.S. : Undersize Diameter
- O.S. : Oversize Diameter

## TORQUE SPECIFICATIONSSS ELCB0030

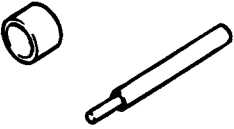
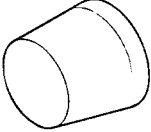
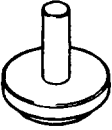

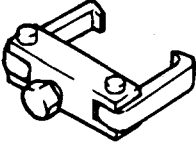
	Nm	kg.cm	lb.ft
Crankshaft pulley bolt	170 - 190	1700 - 1900	125 - 140
Camshaft sprocket bolt	65 - 75	650 - 750	48 - 55
Timing belt tensioner bolt	22 - 30	220 - 300	16 - 22
Injection pump sprocket nut	80 - 90	800 - 900	59 - 66
Silent shaft sprocket nut	34 - 40	340 - 400	25 - 30
Timing belt tensioner "B" nut	22 - 30	220 - 300	16 - 22
Rocker cover bolt	5 - 7	50 - 70	4 - 5
Rocker arm shaft bolt	35 - 40	350 - 400	25 - 29
Camshaft bearing cap bolt	19 - 21	190 - 210	13 - 15
Cylinder head bolt			
Cold engine	105 - 115	1050 - 1150	77 - 85
Hot engine	115 - 125	1150 - 1250	85 - 92
Oil pan bolt	6 - 8	60 - 80	4 - 6
Oil pan drain plug	35 - 45	350 - 450	26 - 33
Front case bolt (upper, lower)	12 - 15	120 - 150	9 - 11
Silent shaft driven gear bolt	34 - 40	340 - 400	25 - 30
Silent shaft plug cap	30 - 45	300 - 450	22 - 33
Silent shaft gear cover bolt	15 - 18	150 - 180	11 - 13
Connecting rod cap nut	45 - 48	450 - 480	33 - 35
Flywheel bolt	130 - 140	1300 - 1400	96 - 103
Crankshaft bearing cap bolt	75 - 85	750 - 850	55 - 63
Oil relief valve plug	30 - 45	300 - 450	22 - 33
Oil pump cover screw	9 - 14	90 - 140	7 - 10
Oil pressure switch	8 - 12	80 - 120	6 - 9
Oil filter bracket	12 - 15	120 - 150	9 - 11
Oil jet check valve	30 - 35	300 - 350	22 - 26
Oil cooler by - pass valve	50 - 60	500 - 600	37 - 44
Cooling fan attaching bolt	10 - 12	100 - 120	7 - 8
Fan clutch attaching bolt	10 - 12	100 - 120	7 - 8
Water outlet fitting attaching bolt	10 - 13	100 - 130	7 - 9
Water pump attaching bolt	12 - 15	120 - 150	8 - 11
Coolant temperature gauge unit	30 - 40	300 - 400	22 - 30
Intake and exhaust manifold nuts and bolts	15 - 20	150 - 200	11 - 15
Heat protector to exhaust manifold	12 - 15	120 - 150	9 - 11
Exhaust pipe to exhaust manifold stud nuts	30 - 40	300 - 400	22 - 30
Exhaust pipe to muffler	30 - 40	300 - 400	22 - 30

**SPECIAL TOOLS** ELCB0040

Tool (Number and name)	Illustration	Use
Silent shaft bearing puller (09212 - 43100)	 ECLA002L	Removal of silent shaft rear bearing
Silent shaft bearing installer (09212 - 43200)	 ECLA002M	Installation of silent shaft rear bearing
Bearing installer stopper (09212 - 43300)	 ECLA002N	Removal of Right silent shaft rear bearing
Crank shaft front oil seal installer (09214 - 32000)	 ECLA002O	Installation of crankshaft front oil seal
Crankshaft front oil seal guide (09214 - 32100)	 ECLA002P	Guide for installation of crank shaft front oil seal
Connecting - rod small - end busing replacement tool (09214 - 43000)	 ECLA002J	Replacement of connecting - rod small - end bushing
Camshaft oil seal installer (09221 - 21000)	 ECLA002I	Installation of the camshaft oil seal

Tool (Number and name)	Illustration	Use
Cylinder head bolt wrench (09221 - 32000)	 <p style="text-align: right;">ECLA002A</p>	Loosening and tightening of cylinder head bolt.
Valve seat cutter pilot (09221 - 43200)	 <p style="text-align: right;">ECLA002B</p>	Correction of valve seat
Valve seat cutter 45° (09221 - 43300)	 <p style="text-align: right;">ECLA002C</p>	Correction of valve seat
Valve seat cutter 65° (09221 - 43400)	 <p style="text-align: right;">ECLA002D</p>	Correction of valve seat
Valve seat cutter 30° (09221 - 43500)	 <p style="text-align: right;">ECLA002E</p>	Correction of valve seat
Valve spring compressor (09222 - 21000)	 <p style="text-align: right;">ECLA002G</p>	Compression of valve spring
Valve stem seal installer (09222 - 32100)	 <p style="text-align: right;">ECLA002H</p>	Installation of valve stem seal



Tool (Number and name)	Illustration	Use
Valve guide installer (09222 - 32200)	 <p style="text-align: right; margin-right: 20px;">ECLA002F</p>	Removal and Installation of valve guide
Silent shaft drive gear oil seal guide (09222 - 43200)	 <p style="text-align: right; margin-right: 20px;">ECLA002K</p>	Installation of silent shaft drive oil seal
Crankshaft rear oil seal installer (09231 - 32000)	 <p style="text-align: right; margin-right: 20px;">ECLA002Q</p>	Installation of crankshaft rear oil seal
Oil pressure switch wrench (09260 - 32000)	 <p style="text-align: right; margin-right: 20px;">ECLA002S</p>	Removal and Installation of oil pressure switch
Injection pump sprocket puller (09314 - 43000)	 <p style="text-align: right; margin-right: 20px;">ECLA002R</p>	Removal of injection pump sprocket

## TROUBLESHOOTING

ELCB0050

Symptom	Probable cause	Remedy
Low compression	Blown cylinder head gasket Worn or broken piston rings  Warped or pitted valves Excessive run - out of valve seats on valve faces  Incorrect valve clearance	Install new head gasket  Hone cylinder bores and install new rings  Install new valve  Reconditioning valve seats and valves  Adjust to specifications
Noisy valves	Worn valve guides  Excessive run - out of valve seats on valve faces  Excessive camshaft end play	Install new valves and / or new valve guides with O.S.  Reconditioning valve seats and valve  Correct end play
Connecting rod noise	Insufficient oil supply Low oil pressure  Thin or diluted oil  Excessive bearing clearance  Connecting rod journals out - of - roundness  Misaligned connecting rods	Check engine oil level  Check engine oil level, inspect oil relief valve and spring  Change oil to correct viscosity  Measure bearings for correct clearance  Replace crankshaft or regrind journals  Replace bent connecting rods
Crankshaft bearing noise	Insufficient oil supply Lower oil pressure  Thin or diluted oil  Excessive bearing clearance  Excessive end play  Crankshaft journal out - of - roundness worn Loose flywheel	Check engine oil level  Check engine oil level. inspect oil relief valve and spring  Change oil to correct viscosity  Measure bearings for correct clearances  Check No. 3 main bearing for wear on flanges Replace crankshaft or regrind journals  Tighten to correct torque  Correct cylinder wear

Symptom	Probable cause	Remedy
Piston noise	Excessive clearance due to cylinder wear Piston or piston pin worn Burnt piston Piston ring damaged	Replace piston Install new piston Install new rings
Oil leak	Oil pan drain plug loose Oil pan mounting bolt loose Oil pan gasket broken Crankshaft front oil seal defective Crankshaft rear oil seal defective Rocker cover gasket broken Oil filter loose Oil filter gasket broken	Tighten to torque Tighten to correct torque Install new gasket Install new oil seal Install new oil seal Install new gasket Tighten to correct torque Install new gasket
Oil consumption	Worn, scuffed, or broken rings  Carbon in oil ring slot Rings fitted too tight in grooves  Worn valve guides  Faulty valve stem seals	Hone cylinder bores and install new rings Install new rings Remove the rings. Check grooves. If groove is not proper width, replace piston Install new valve and / or new valve guides with O.S. Install new valve stem seals
Oil pressure drop	Low oil level Slow idle speed  Faulty oil pressure switch Clogged oil filter Worn parts in oil pump  Thin or diluted oil  Excessive bearing clearance  Oil relief valve stuck  Oil pump cover bent or cracked Oil screen loose or clogged	Check engine oil level Set idle speed to specification Install new switch Install new oil filter Replace worn parts or pump Change oil to correct viscosity Measure bearings for correct clearance Remove valve and inspect, clean and reinstall Install new oil pump Clean or replace screen

Symptom	Probable cause	Remedy
Oil pressure drop	Hole in oil pickup tube Cracked, porous or plugged gallery Gallery plugs missing or misinstalled	Replace or repair tube Repair or replace cylinder block Install plugs or repair
Overheat	Insufficient coolant Antifreeze concentration too great Loose or broken drive belt Inoperative fan clutch Damaged or blocked (insufficiently ventilated) radiator fins Water leaks Damaged radiator core joint Corroded or cracked hoses (Radiator hose, heater hose, etc) Loose bolt or defective gasket in water outlet fitting (thermostat) Faulty radiator cap valve or setting of spring Loose cylinder head bolt Damaged cylinder head gasket Cracked cylinder block Cracked cylinder head Faulty thermostat operation Faulty water pump operation Water passage clogged with slime or rust deposit or foreign substance	Replenish Correct Correct or replace Replace Correct Replace Replace Correct or replace Replace Correct Replace parts Replace Replace Replace Replace Clean
No rise in temperature	Faulty thermostat	Repair
Loss of power	Intake system a. Clogged air cleaner b. Air leaks from intake system connection Exhaust system a. Deformed muffler and exhaust pipe or deposited carbon b. Gas leak from system	a. Clean or replace element b. Repair a. Repair or replace b. Retighten joints Repair or replace broken pipe or muffler

Symptom	Probable cause	Remedy
Unusual noise and vibration	Intake system a. Loose clamping bolts and nuts of the intake system Exhaust system a. Loose clamping bolts and nuts of the exhaust system b. Damaged muffler and exhaust pipe c. Broken rubber hangers d. Interference of pipe or muffler with vehicle body	a. Tighten  a. Tighten b. Replace c. Replace d. Correct

**CHECKING ENGINE OIL** ECJA0500

1. Position a vehicle on a level surface.
2. Turn off the engine.

**NOTE**

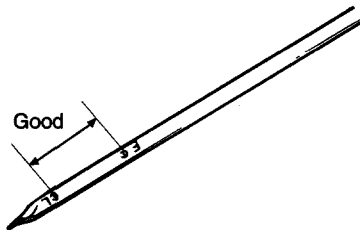
*If a vehicle that has not been used for a prolonged period, run the engine for several minutes. Turn off the engine and wait for 5 minutes at least, and then check the oil level.*

3. Check that the engine oil level is within the level range indicated on the oil dipstick. If the oil level is found to have fallen to the lower limit (the "L" mark), refill to the "F" mark.

**NOTE**

*When refilling, use the proper grade of engine oil.*

4. Check that the oil is not dirty or mixed with coolant or gasoline and it has the proper viscosity.

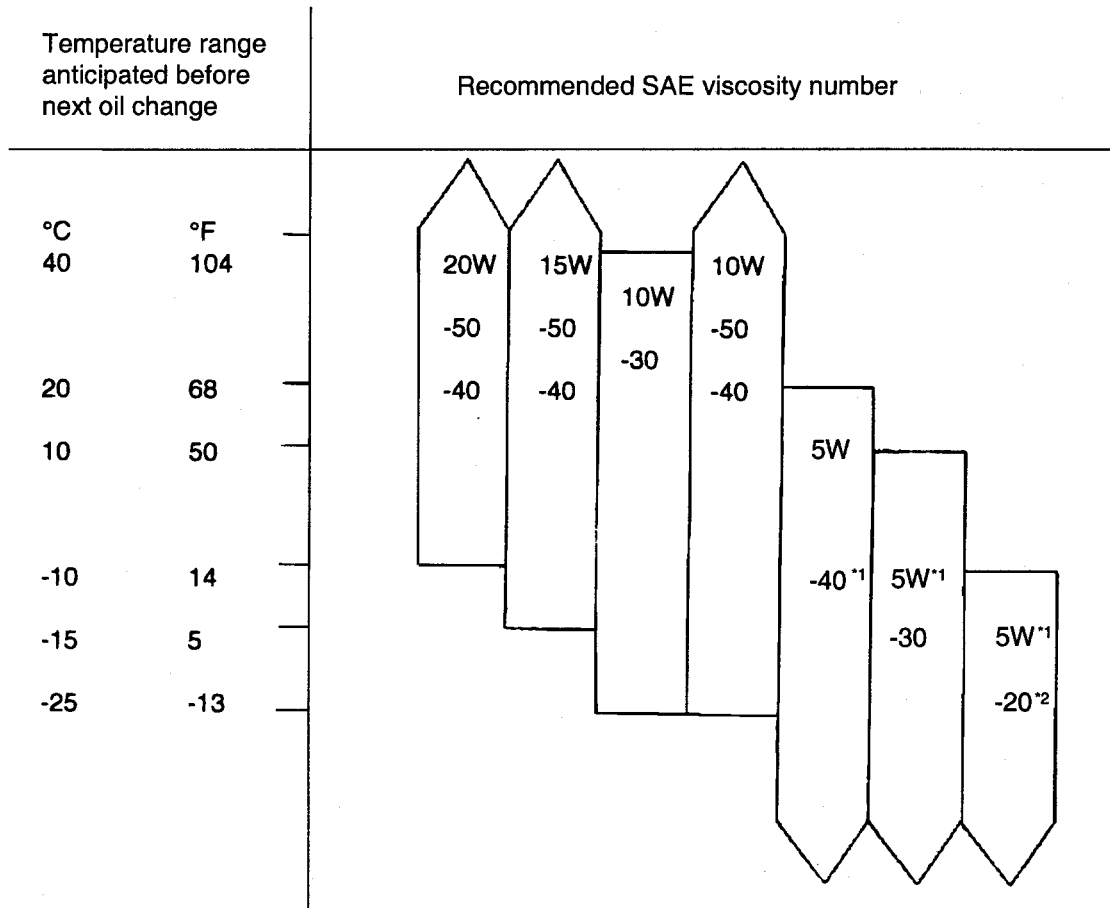


EDA9000A

## SELECTION OF ENGINE OIL ELCB0070

Recommended API classification: ABOVE CD

Recommended SAE viscosity grades:



\*1 Restricted by driving condition and environment.

\*2 Not recommended for sustained high speed vehicle operation

EDA9990B

 **NOTE**

For best performance and maximum protection of all types of operation, select only those lubricants which:

1. Satisfy the requirements of the API classification.
2. Have the proper SAE grade number for expected ambient temperature range.

Lubricants which do not have both an SAE grade number and an API service classification on the container should not be used.

**CHANGING ENGINE OIL** ECMB0100

1. Run the engine until it reaches normal operating temperature.
2. Turn off the engine.
3. Remove the oil filler cap and the drain plug. Drain the engine oil.
4. Tighten the drain plug to the specified torque.

**Tightening torque**

Oil pan drain plug :

35 - 45 Nm (350 - 450 kg.cm, 25 - 33 lb.ft)

**NOTE**

Whenever tightening the oil drain plug, use a new drain plug gasket.

5. Fill new engine oil through the oil filler cap opening.

**Capacity :**

Drain and refill : 6.5 lit (6.87 U.S.qts., 5.72 Imp.qts.)

**NOTE**

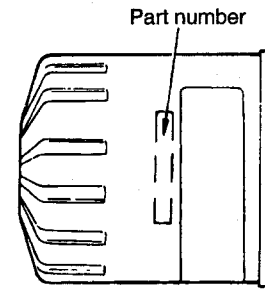
Do not overfill. This will cause oil aeration and loss of oil pressure.

6. Install the oil filler cap.
7. Start and run the engine.
8. Turn off the engine and then check the oil level. Add oil if necessary.

**REPLACING THE OIL FILTER** ECJA0800

All Hyundai Motor Company engines are equipped with a high quality, disposable oil filter. This filter is recommended as a replacement filter for all vehicles. The quality of aftermarket replacement filters is considerably diverse.

High quality replacement filters should be used to assure the most efficient service. Make sure that the rubber gasket from the old oil filter is completely removed from the contact surface on the engine block before installing a new filter.



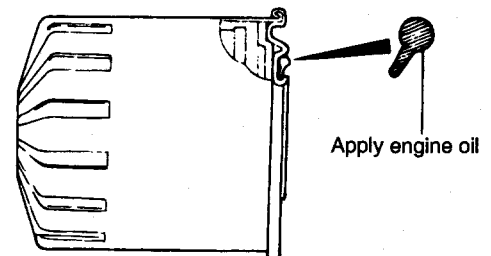
ECA9970A

**PROCEDURE FOR REPLACING THE OIL FILTER**

1. Use a filter wrench to remove the oil filter.
2. Before installing a new oil filter on the engine, apply clean engine oil to the surface of the rubber gasket.
3. Tighten the oil filter to the specified torque.

Oil filter : 12-16 Nm (120-160 kg.cm, 9-12 lb.ft)

4. Start and run the engine and check for engine oil leak.
5. After turning off the engine, check the oil level and add oil as necessary.



ECA9970B



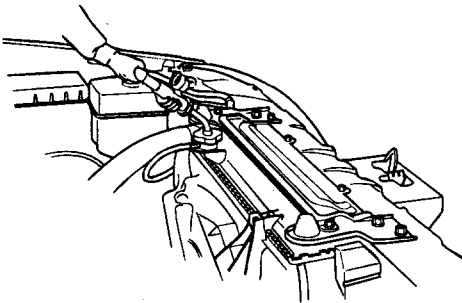
**CHECKING COOLANT LEAK**

ECMB0110

1. Loosen the radiator cap.
2. Confirm that the coolant level is up to the filler neck.
3. Install a radiator cap tester to the radiator filler neck and apply 150 KPa (21psi, 1.53 kg/cm<sup>2</sup>) pressure. Hold it for two minutes in that condition while checking for leakage from the radiator, hoses or connections.

**NOTE**

1. *Radiator coolant may be extremely hot. Do not open the system because hot, or scalding water could gush out causing personal injury. Allow the vehicle to cool before servicing this system.*
  2. *When the tester is removed, be careful not to spill any coolant from it.*
  3. *Be sure to clean away completely any coolant from the area.*
  4. *Be careful when installing and removing the tester and when testing, not to deform the filler neck of the radiator.*
4. If there is leakage, repair or replace with the appropriate part.



KDMB002A

**RADIATOR CAP PRESSURE TEST**

ELCB0110

1. Use an adapter to attach the cap to the tester.
2. Increase the pressure until the gauge stops moving.

Main valve opening pressure :

107.9kPa±14.7kPa (1.1±0.15 kg/cm<sup>2</sup>, 15.64±2.13)

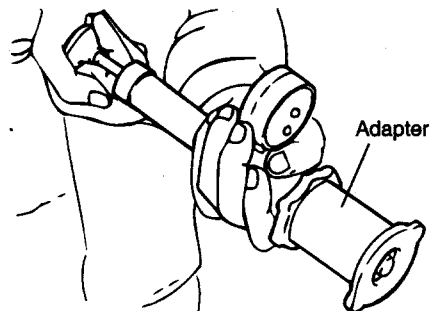
Main valve closing pressure :

83.4 kPa (0.85 kg/cm<sup>2</sup>, 12.1 psi)

3. Check that the pressure level is maintained at or above the limit.
4. Replace the radiator cap if the reading does not remain at or above the limit.

**NOTE**

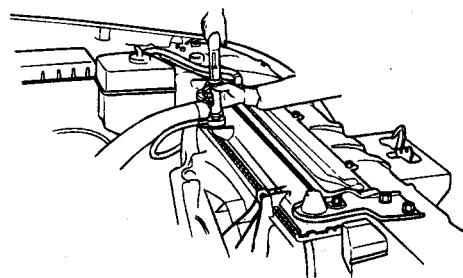
*Be sure that the cap is clean before testing, since rust or other foreign material on the cap seal will cause an incorrect reading.*



ECA9090A

**SPECIFIC GRAVITY TEST** ECMB0120

1. Measure the specific gravity of the coolant with a hydrometer.
2. Measure the coolant temperature and calculate the concentration from the relation between the specific gravity and temperature, using the following table for reference.



KDMB002B

**RELATION BETWEEN COOLANT CONCENTRATION AND SPECIFIC GRAVITY**

Coolant temperature °C (°F) and specific gravity					Freezing temperature °C (°F)	Safe operating temperature °C (°F)	Coolant concentration (Specific volume)
10 (50)	20 (68)	30 (86)	40 (104)	50 (122)			
1.054	1.050	1.046	1.042	1.036	-16 (3.2)	-11 (12.2)	30%
1.063	1.058	1.054	1.049	1.044	-20 (-4)	-15 (5)	35%
1.071	1.067	1.062	1.057	1.052	-25 (-13)	-20 (-4)	40%
1.079	1.074	1.069	1.064	1.058	-30 (-22)	-25 (-13)	45%
1.087	1.082	1.076	1.070	1.064	-36 (-32.8)	-31 (-23.8)	50%
1.095	1.090	1.084	1.077	1.070	-42 (-44)	-37 (-35)	55%
1.103	1.098	1.092	1.084	1.076	-50 (-58)	-45 (-49)	60%

**Example**

The safe operating temperature is -15°C (5°F) when the measured specific gravity is 1.058 at coolant temperature of 20°C (68°F)

- *if the concentration is above 60%, both the anti-freeze and engine cooling property will decrease, affecting the engine adversely. For these reasons, be sure to maintain the concentration level within the specified range.*
- *Do not mix types of anti-freeze.*

**⚠ CAUTION**

- *If the concentration of the coolant is below 30%, its anti-corrosion properties will be adversely affected.*

**RECOMMENDED COOLANT**

Antifreeze	Mixture ratio of anti freeze in coolant
ETHYLENE GLYCOL BASE FOR ALUMINUM	50% [Except tropical areas] 40% [Tropical areas]

**CHECKING ENGINE COMPRESSION****PRESSURE**

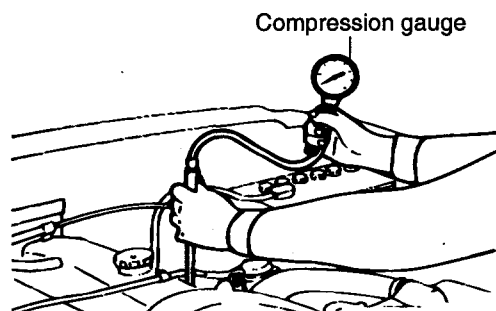
ELCB0130

1. Be sure that the engine oil, starting motor and battery are in the normal condition.
2. Start the engine and allow it to warm up until the temperature of the coolant reaches 80°C to 90°C (176°F to 194°F)
3. Loosen the nuts at the nozzle side of the infection pipes, and disconnect the pipes from the nozzle holders.

**⚠ CAUTION**

**Caps must be used to prevent entry of foreign materials into the nozzles.**

4. Remove the glow plug plate and all 4 glow plugs.
5. Set an engine tachometer in place.
6. Place a compression gauge adaptor and compression gauge in the glow plug hole.



ECLA005A

7. Crank the engine with the throttle valve fully open, and measure the compression at the place where the compression gauge indicator shows a stabilized reading.

Standard value (at engine speed of 250 rpm) :

1920 kPa (19.2 kg/cm<sup>2</sup>, 278 psi)

Difference between each cylinder :

300 kPa (3.0 kg/cm<sup>2</sup>, 43 psi) or less

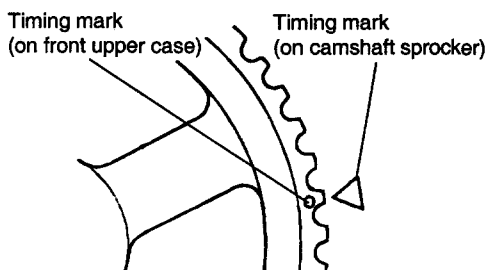
8. If, after the measurement, the compression is below the limit, put a small amount of engine oil through the glow plug hole into the cylinder, then measure the compression once again and determine the cause of the malfunction

9. If, after oil is added, the compression rises, the cause of the malfunction is a worn or damaged piston ring and / or cylinder inner surface. If however, the compression does not rise, the cause is a bad valve or a bad gasket.

**CHECKING AND ADJUSTMENT OF VALVE CLEARANCE**

ELCB0140

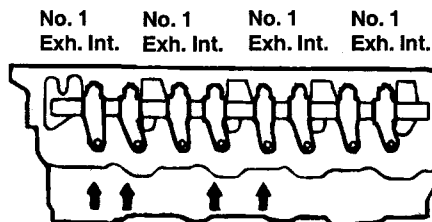
1. Start the engine and allow it to warm up until the temperature of the coolant reaches 80°C to 90°C (176°F to 194°F)
2. Check the infection timing and the idling speed, and adjust if necessary.
3. Remove the upper timing belt cover.
4. Remove the rocker cover.
5. Turn the crankshaft clockwise and align the timing mark on the camshaft sprocket with the timing mark on the top of the front upper case.



ECLA019H

6. Check that valve clearance indicated in the diagram (A) is at the standard value.

[ A ]



ECLA019I

Standard value : Hot engine

Intake : 0.25 mm (0.0098 in.)

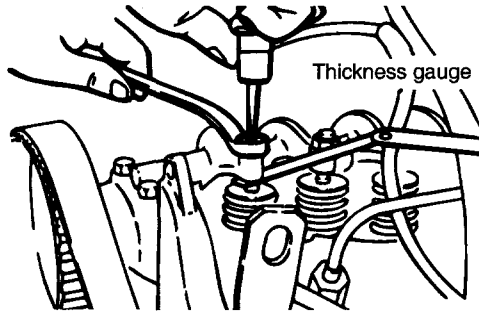
Exhaust : 0.25 mm (0.0098 in.)

Cold engine

Intake : 0.15 mm (0.0059 in.)

Exhaust : 0.15 mm (0.0059 in.)

- If not within the standard value, loosen the adjusting screw locking nut and, while turning the adjusting screw, use a thickness gauge to adjust the valve clearance to the standard value.



ECLA003E

- When installing the rocker cover assembly to the cylinder head, apply a coating of the specified sealant to the semicircular packing and cylinder head top surfaces, and then tighten at the specified torque

**Specified sealant :**

3M ART Part No. 8660 or equivalent

**Tightening torque :**

5 - 7 Nm (50 - 70 kg.cm, 4- 5 lb.ft)

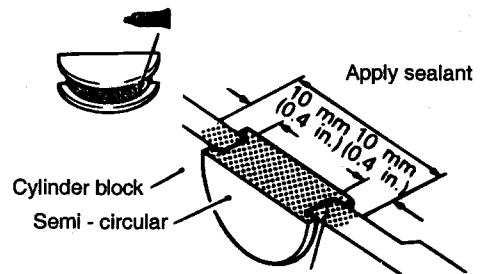
- Block the adjusting screw with a screwdriver, so that it cannot move and tighten the locknut to the specified torque.

**CAUTION**

*If they are overtorqued, a deformed rocker cover or oil leakage could result.*

**Tightening torque :**

12 - 18 Nm (120 - 180 kg.cm, 9 - 13 lb.ft)

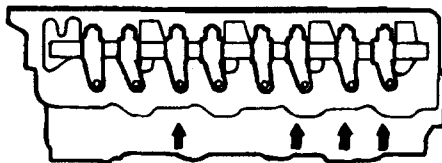


ECLA003F

- Rotate clockwise the crankshaft one complete turn (360 degree).
- Check that valve clearance indicated in the diagram (B) is at the standard value.

[ B ]

No. 1	No. 2	No. 3	No. 4
Exh. Int.	Exh. Int.	Exh. Int.	Exh. Int.



ECLA019K

**ADJUSTMENT OF THE TIMING BELT TENSION**

ELCB0150

- Remove the timing belt upper cover and bring the piston in No. 1 cylinder to top dead center on compression stroke. Check that the timing marks of sprockets are aligned.

**Standard value : Hot engine**

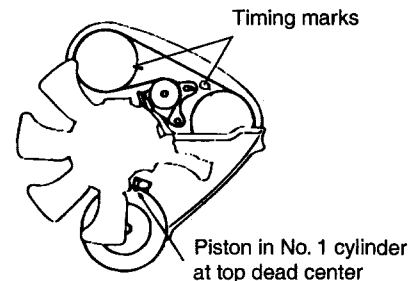
Intake : 0.25 mm (0.0098 in.)

Exhaust : 0.25 mm (0.0098 in.)

**Cold engine**

Intake : 0.15 mm (0.0059 in.)

Exhaust : 0.15 mm (0.0059 in.)



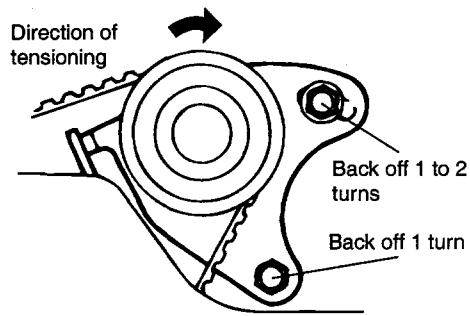
ECLA005B

- If not within the standard value, repeat steps 7 to 8 to adjust the valve clearance of remaining valves.

- Loosen the timing belt tensioner mounting bolts.

**CAUTION**

*Do not loosen the belts more than necessary. They could drop in the lower cover.*

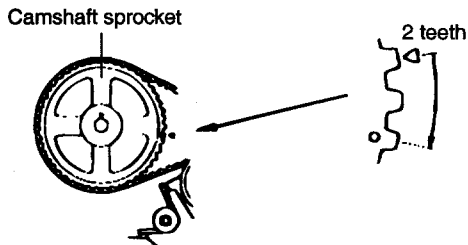


ECLA005C

3. Turn the crankshaft in normal direction (clockwise) through two camshaft sprocket teeth and hold it.
4. Tighten the tensioner mounting bolts.

**NOTE**

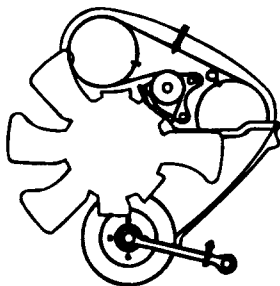
*Tighten the upper bolts first and then the lower ones.*



ECLA005D

5. Reverse the crankshaft to align the timing marks, and push down belt at a point halfway with forefinger to check that tension of belt is up to standard value.

Standard value : 4 - 5 mm (0.16 - 0.20 in.)

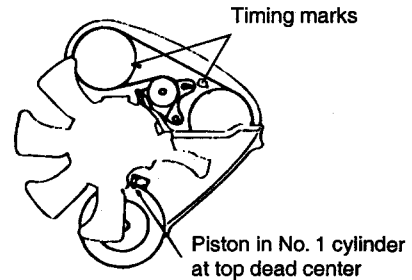


ECLA005E

6. Mount the timing belt upper cover.

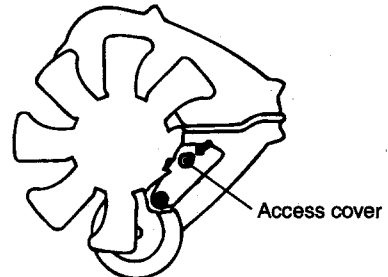
### ADJUSTMENT OF THE TIMING BELT "B" TENSION

1. Remove the timing belt upper cover and bring the piston in No. 1 cylinder to top dead center on compression stroke. Check that the timing marks of sprockets are aligned.



ECLA005B

2. Remove the access cover.



ECLA005F

3. Loosen the timing belt "B" tensioner mounting nut and bolt.

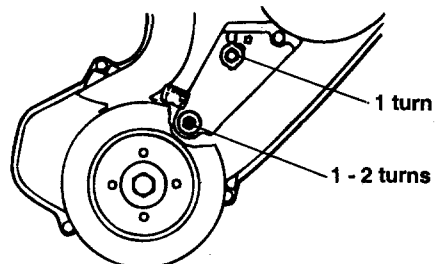
**NOTE**

*Do not loosen the bolts (upper) more than necessary. They could drop in the lower cover.*

4. Tighten the tensioner mounting nut and bolt.

**NOTE**

*Tighten the nut (lower) first and then the bolt (upper).*



ECLA005G

- 5. Mount the access cover.
- 6. Mount the timing belt upper cover.

**INSPECTION AND ADJUSTMENT OF THE BELT FLEX** ECMB0140

- 1. Check the belt for damage or wear. Confirm that the belt is set correctly in pulley groove.

**NOTE**

*If the belt "squeals" or slips, check belt for friction, damage or breaks and check pulley contact surface for damage.*

- 2. Press at 100N (10 kg,22lbs.) center of belt between pulleys as indicated in the diagram. Measure belt flex.

**Standard value**

Air - conditioner compressor :

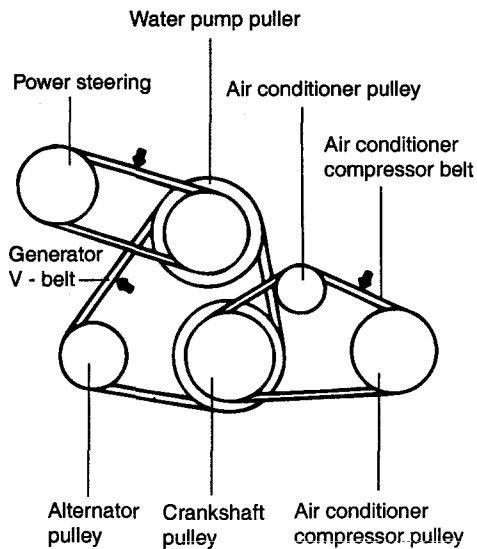
7 - 10 mm (0.28 - 0.39 in.)

Alternator : 10 - 13 mm (0.39 - 0.51 in.)

Power steering : 8 - 11 mm (0.31 - 0.43 in.)

**CAUTION**

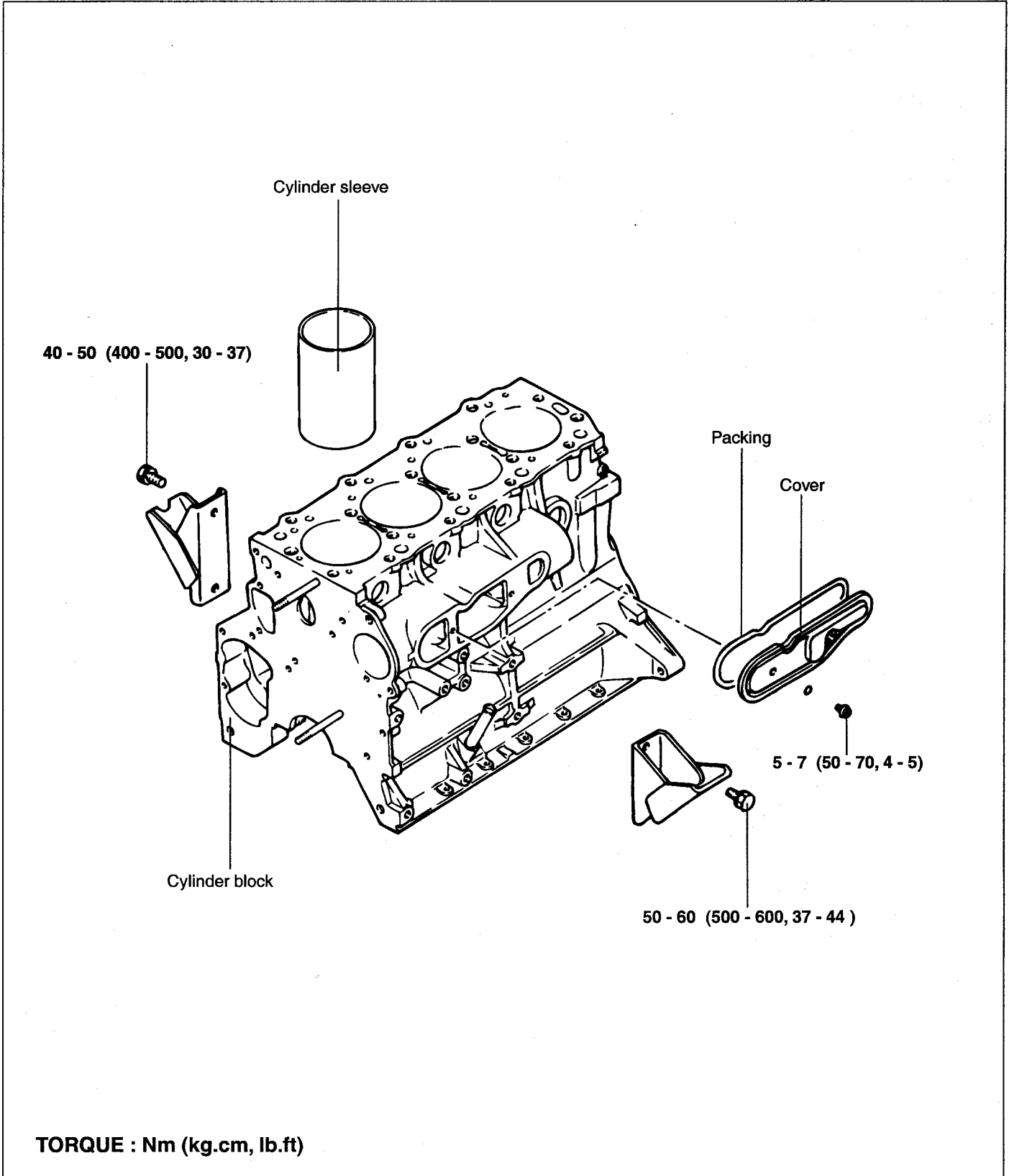
**Measure the belt flex between specified pulleys (→).**



# ENGINE BLOCK

## ENGINE BLOCK

### COMPONENTS ELCB0200



**TORQUE : Nm (kg.cm, lb.ft)**

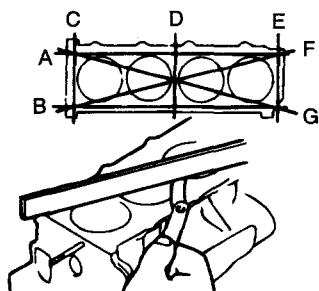
**INSPECTION** ELCB0210

**NOTE**

1. Before inspection and repair, clean parts to remove dirt, oil, carbon, deposits, and scale.
2. Before cleaning the cylinder block, be sure to check for evidences of water leaks and damage.
3. Remove contaminants from oil holes with compressed air and, at the same time, make sure that they are not blocked.

**CYLINDER BLOCK**

1. Check for scratches, rust, and corrosion. Use also a flaw - detecting agent for the check. If defects are evident, correct or replace.
2. Using a straightedge and thickness gauge, check the cylinder block top surface for flatness. Lay the straightedge longways and crossways as indicated by A, B,... in illustration. If flatness is not within the limit, replace the cylinder block. At measurement, ensure that the cylinder block top surface is free from any traces of gasket material.

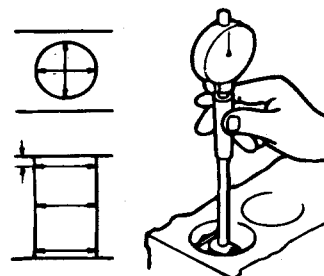


ECLA007B

Standard value : 0.05 mm (0.002 in.)  
 Limit : 0.1 mm (0.004 in.)

3. Check cylinder wall for scratches and seizure. If defects are evident, correct (to oversize) or replace.

4. Using cylinder gauge, measure the cylinder bore. If it wears out excessively, bore the cylinder to oversize and replace the piston and piston rings. Measurement points are as shown.



ECLA007C

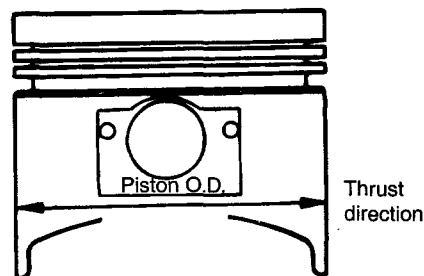
Standard value : 91.1 mm (3.5866 in.)

**BORING OF CYLINDER**

1. Using the maximum cylinder bore as a basis, determine the oversize piston to be used.
2. There are four oversize pistons available : 0.25 mm (0.010 in.), 0.50 mm (0.020 in.), 0.75 mm (0.030 in.), and 1.00 mm (0.039 in.) bore the cylinder to obtain the specified clearance according to the piston O.D.
3. Based on the piston O.D. measured, calculate the boring dimension.

$$\text{Boring dimension} = \text{Piston O.D.} + 0.04 \text{ to } 0.08 \text{ mm} \\
 (0.0016 \text{ to } 0.0031 \text{ in.}) \text{ (piston to cylinder clearance)} \\
 - 0.02 \text{ mm (0.0008 in.) (honing margin).}$$

4. Bore cylinders to obtain the calculated boring dimension.



ECLA007D



 **NOTE**

1. *To prevent thermal distortion due to temperature rise during boring operation, bore cylinders in the sequence of No. 2, 4, 1 and 3.*
2. *The cylinders must be honed to finish dimension.*
3. *Check clearance between piston and cylinder.*

---

Piston to cylinder clearance :

0.04 - 0.08 mm (0.0016 - 0.0031 in.)

---

 **NOTE**

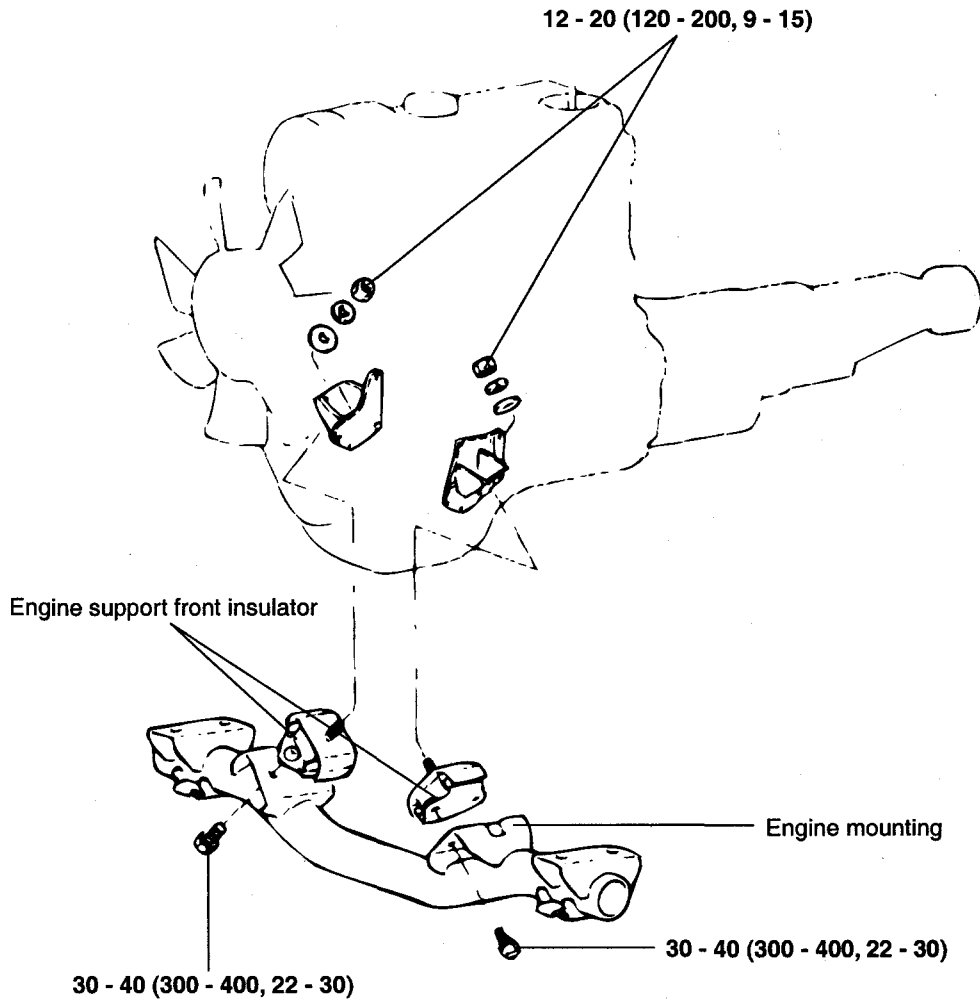
1. *When boring cylinders, finish all of four cylinders to the same oversize.*
2. *Don't bore only one cylinder to oversize.*

# ENGINE MOUNTS

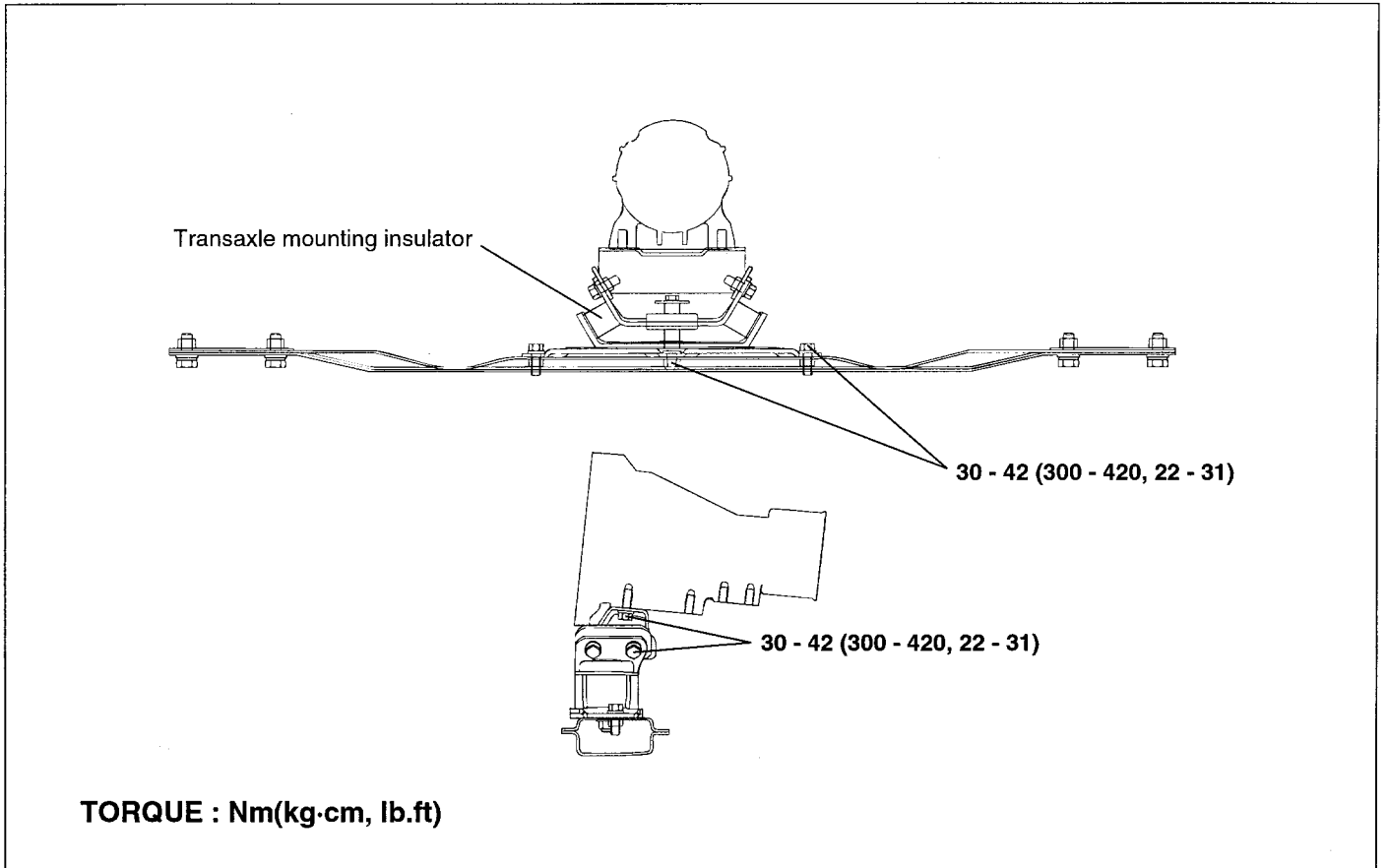
## ENGINE MOUNTING ECMB0150

### COMPONENTS

#### FRONT ENGINE MOUNTING



**TORQUE : Nm (kg.cm, lb/.ft)**

**T/M MOUNTING** ECMB0160

ECMB004A

**INSPECTION** ELCB0240

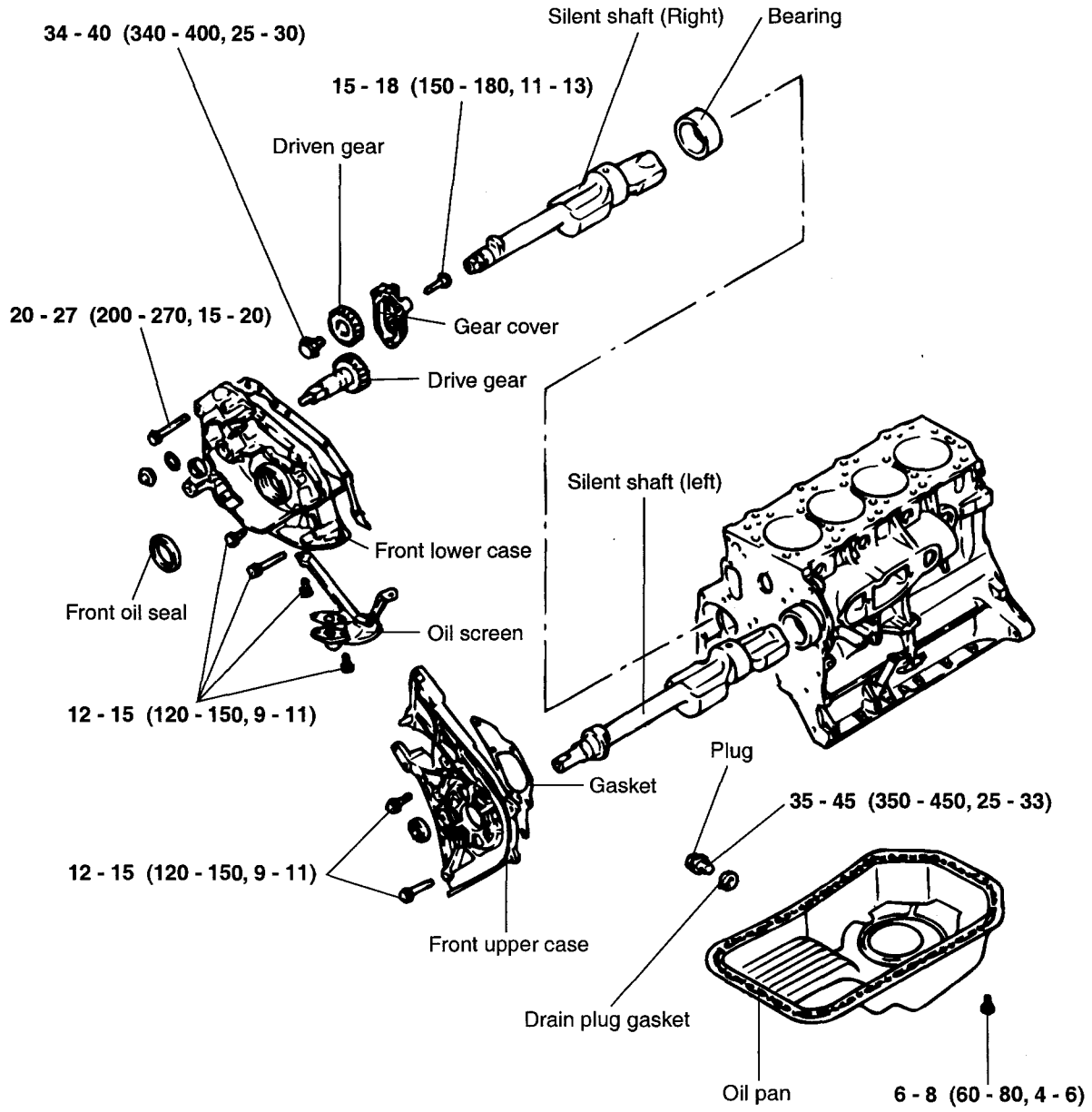
1. Check the insulator for damage, crack and deformation.
2. Check the insulator stopper plate for damage, crack and deformation.

**NOTE**

*Be careful not to apply oil to the insulator.*

FRONT CASE

COMPONENTS ELCB0250

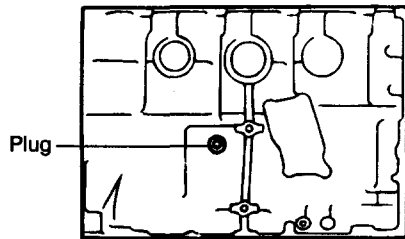


TORQUE : Nm (kg.cm, lb.ft)

**REMOVAL** ELCB0260**SILENT SHAFT**

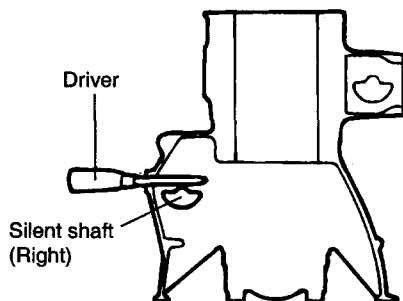
1. Remove the oil pan.
2. Remove the oil screen.
3. Remove the spacer from the forward end of the left silent shaft.
4. Remove the front upper case.
5. Remove the left silent shaft.
6. Remove the plug cap from the top of the right silent shaft drive gear.

Cylinder block (Right)



ECLA007I

7. Slightly loosen the flange bolt at the forward end of the right silent shaft. When loosening the bolt, remove the plug on the right side of the cylinder block and insert a screwdriver to prevent rotation.



ECLA007J

8. Remove the front lower case and the silent shaft as an assembly.
9. Remove the left silent shaft from the front lower case.

**OIL PUMP**

1. Remove the oil pump cover from the front lower case.
2. Remove the oil pump outer gear. Put matching mark on the outer gear to insure correct reassembly.
3. Remove the silent shaft drive gear cover and then remove the drive gear and driven gear.

**CAMSHAFT**

1. Turn the crankshaft to bring the piston in No. 1 cylinder to the top dead center on the compression stroke. (The piston in cylinder is at the top dead center on the compression stroke when the dowel pin is at the top-most.)
2. Remove the timing belt upper cover. With the timing belt as installed, remove the camshaft sprocket, and place on the timing belt lower cover.
3. Remove the rocker shaft assembly.
4. Remove the camshaft bearing cap and take out the camshaft.

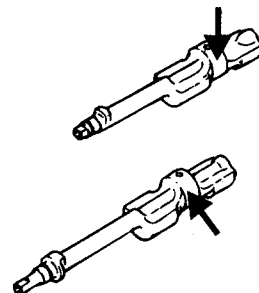
**INSPECTION** ELCB0270**SILENT SHAFT**

1. The oil holes must be free from clogging.
2. Check journal for seizure, damage, and contact with the bearing. If defects are evident, replace the silent shaft, bearing, or front case assembly.
3. Check the silent shaft for oil clearance. If wear is excessive, replace the silent shaft bearing, silent shaft, or front case assembly.

Oil clearance standard value

Front : 0.02 - 0.06 mm (0.0008 - 0.0024 in.)

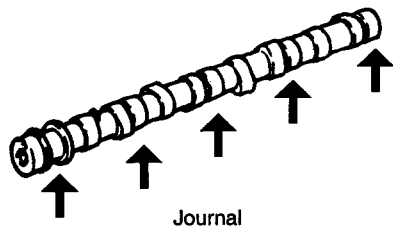
Rear : 0.05 - 0.09 mm (0.0020 - 0.0035 in.)



ECLA007K

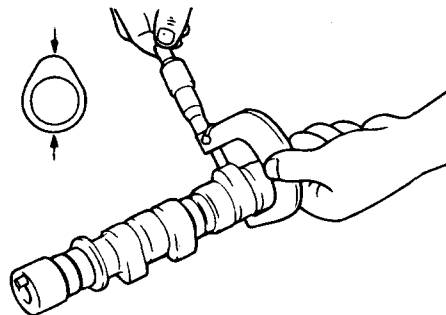
**CAMSHAFT**

1. Check the camshaft journal surfaces and, if damage or seizure is evident, replace the camshaft. If the camshaft journals are seized, check the cylinder head for damage. Check also the cylinder head oil holes for clogging.



ECLA019B

2. Check cam surfaces for abnormal wear and damage. If defects are evident, replace the camshaft, measure the lobe height and, if the limit is exceeded, replace the camshaft.



EDA9260A

**Standard value :**

Intake and exhaust : 37.05 mm (1.4587 in.)

**Limit :**

Intake and exhaust : 36.55 mm (1.4389 in.)

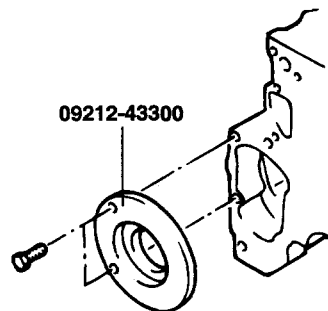
**REPLACEMENT**

ELCB0280

**SILENT SHAFT**

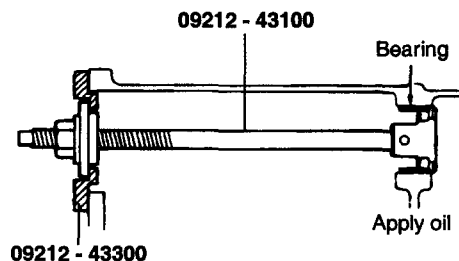
**NOTE**

Use Bearing Installer Stopper (special tool) only for removal and reinstallation of the right bearing.



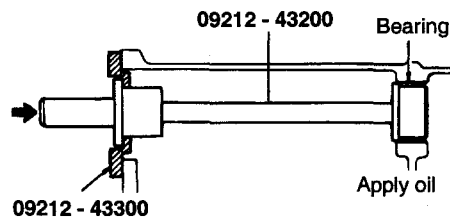
ECLA008A

1. Using Bearing Installer Stopper and Silent Shaft Bearing Puller (09212 - 43300, 09212 - 43100), remove two rear bearings from the cylinder block.



ECLA008B

2. Using Bearing Installer Stopper and Silent Shaft Bearing Installer (09212 - 43300, 09212 - 43200), press-fit bearing into cylinder block.

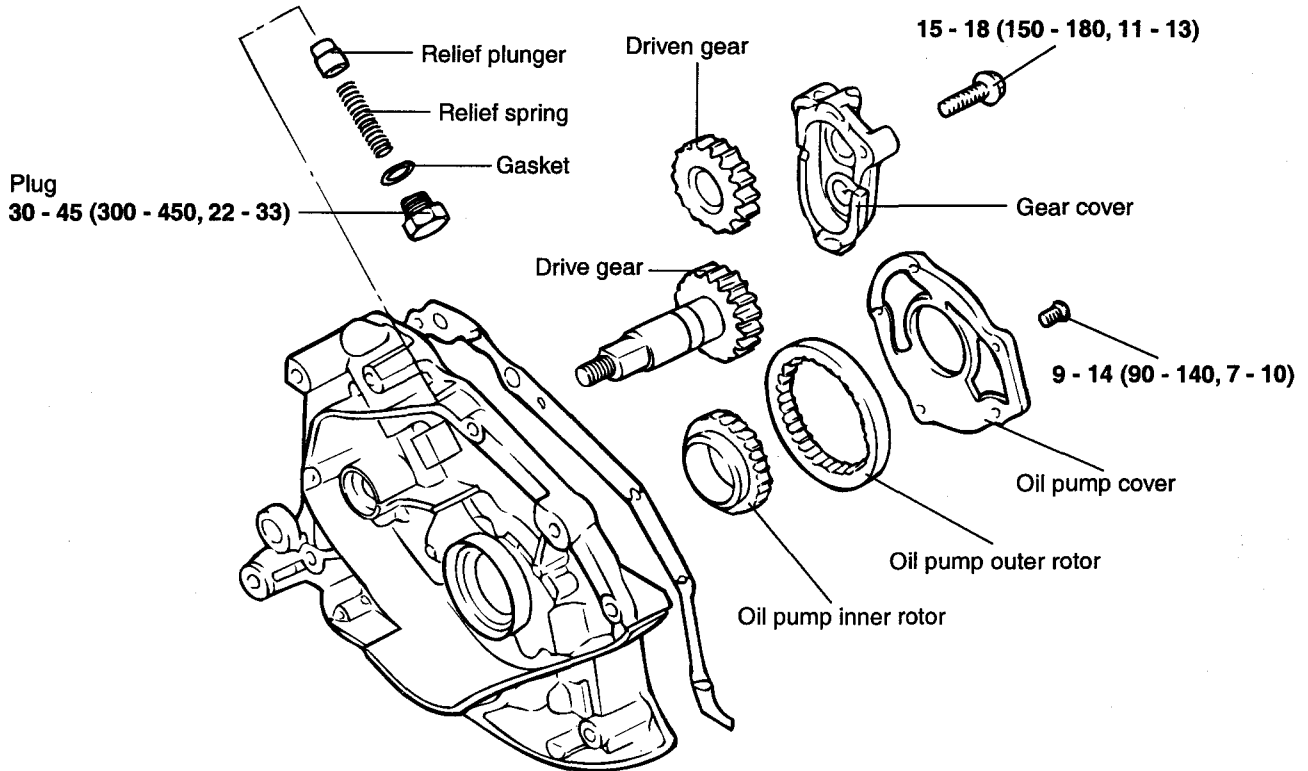
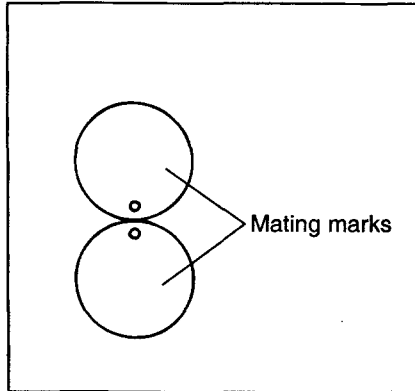


ECLA008C

# INSTALLATION

ELCB0290

Back of silent shaft gear



\* Replace the gasket with new ones after removal.

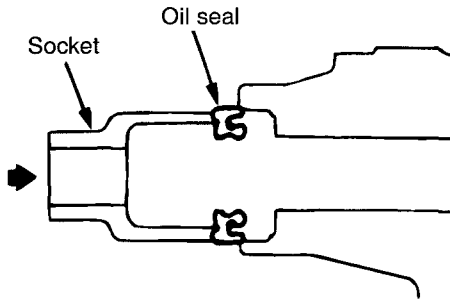
**TORQUE : Nm (kg.cm, lb.ft)**

**OIL SEAL**

When mounting the oil seal from the rear, too, fit the Oil Seal Guide to the drive gear shaft first to prevent the oil seal lips from being caught in steps in shaft during installation.

**NOTE**

Apply oil to outer surfaces of Oil Seal Guide.



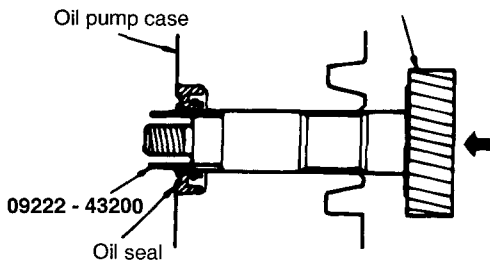
ECLA008E

**SILENT SHAFT DRIVE GEAR**

When mounting the drive gear from the rear because of the drive gear oil seal press-fitted in front lower case, first fit Oil Seal Guide (09222 - 43200) to the drive gear shaft before insertion.

**NOTE**

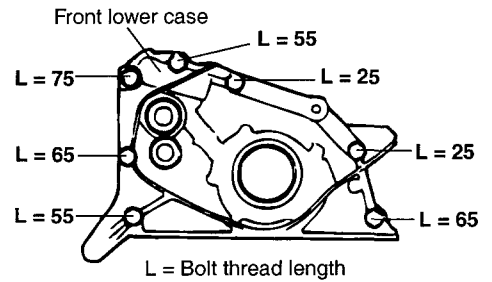
Apply oil to outer surfaces of Oil Seal Guide.



ECLA008G

**FRONT LOWER CASE**

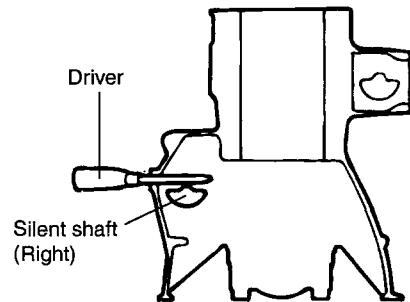
Tighten seven flange bolts to specification.



ECLA008H

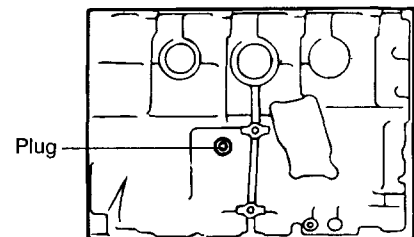
**FLANGE BOLT**

When tightening the bolts, be sure to secure the silent shaft in position.



ECLA007J

**Cylinder block (Right)**



ECLA007I

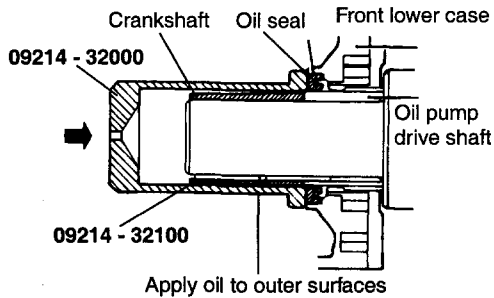


**CRANKSHAFT FRONT OIL SEAL**

Using Oil Seal Installer and Guide (09214 - 32000, 09214 - 32100), install the crankshaft front oil seal.

**NOTE**

The oil pump drive shaft must be installed before installing the front oil seal.



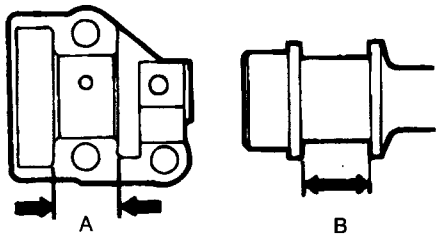
ECLA008I

**CAMSHAFT**

- To obtain the end play, measure A and B. Replace parts if the limit is exceeded.  
End play = B - A

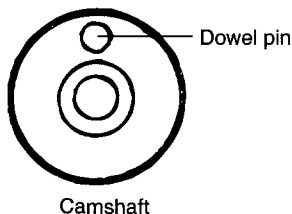
Standard value : 0.1 - 0.2 mm (0.0039 - 0.0079 in.)

Limit : 0.4 mm (0.0157 in.)



ECLA019C

- Install the camshaft to the cylinder head with the dowel pin at the highest position.



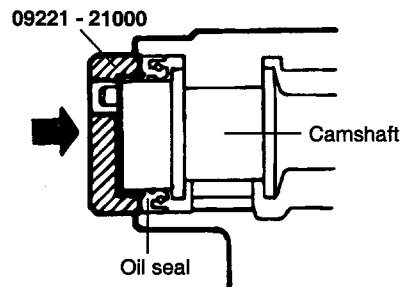
ECLA019D

**CAMSHAFT OIL SEAL**

- Apply oil to the oil seal lips.
- Using Camshaft Oil Seal installer (09221 - 21000), press-fit a new camshaft oil seal into the front bearing cap.

**CAUTION**

Drive in the shaft after the camshaft bearing cap is installed.  
Apply oil to the oil seal lip.

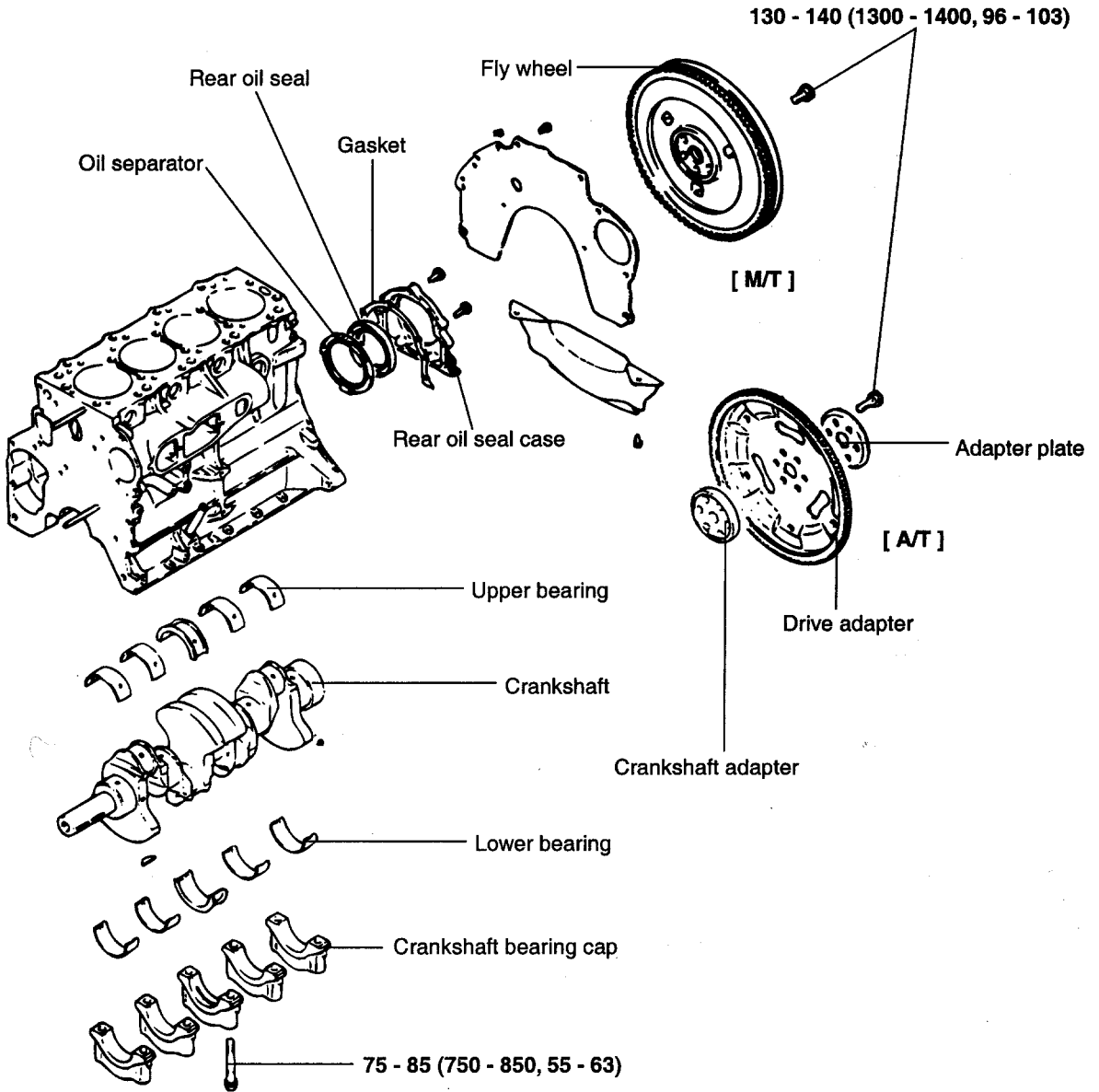


ECLA019E

# MAIN MOVING SYSTEM

## CRANK SHAFT

ELCB0300



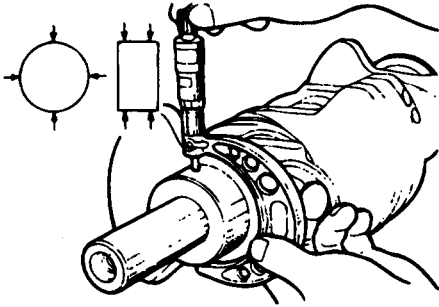
**TORQUE : Nm (kg.cm, lb.ft)**

**INSPECTION**

ELCB0310

**CRANKSHAFT**

1. Measure the journal and pin dimensions in directions A and B at front and rear (1 and 2) positions.
2. If worn excessively, grind to an undersize. If the service limit is exceeded, replace the crankshaft.



ECLA009B

**Standard value**

Journal O.D. : 66 mm (2.598 in.)

Pin O.D. : 53 mm (2.087 in.)

**CRANKSHAFT OIL CLEARANCE**

1. Determine the clearance from the difference between the O.D. of journal as well as pin O.D. and the I.D. of each bearing as assembled to the crankshaft. Measure the bearing I.D. in directions A and B at front and rear (1 and 2) positions.

**Standard value**

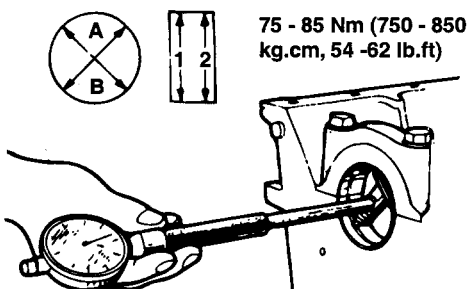
Oil clearance of journal :

0.02 - 0.05 mm (0.0008 - 0.002 in.)

Oil clearance of pin :

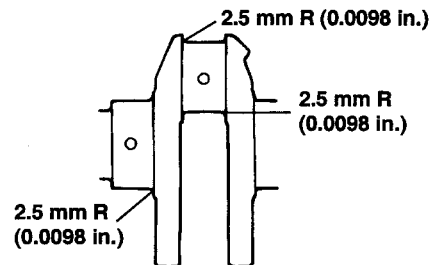
0.02 - 0.05 mm (0.0008 - 0.002 in.)

Limit : 0.1 mm (0.0039 in.)



ECLA009C

2. If the use of a new bearing still results in an oil clearance larger than the standard value, grind the crankshaft to the undersize and use a bearing of corresponding undersize.
3. When grinding the crankshaft to undersize, ensure correct fillet radius dimensions in journals and pins.

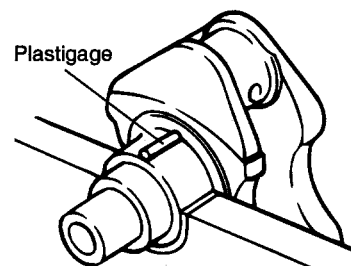


ECLA009D

**CRANKSHAFT OIL CLEARANCE (PLASTIGAGE METHOD)**

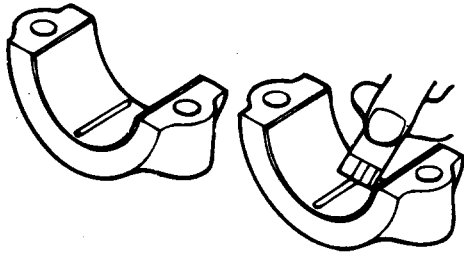
A Plastigage can be used to simplify the measurement of oil clearance. use the following procedure to check the oil clearance with a Plastigage (for journals).

1. Wipe crankshaft O.D. and bearing I.D. clean of oil.
2. Install the crankshaft.
3. Put a strip of Plastigage lengthwise in the center of the journal.



ECLA009E

4. Replace the main bearing cap carefully and tighten bolts to specification.
5. Remove bolts and carefully remove the main bearing cap.
6. Using the scale printed on the bag of plastigage, measure the amount the Plastigage has been flattened (the widest point).



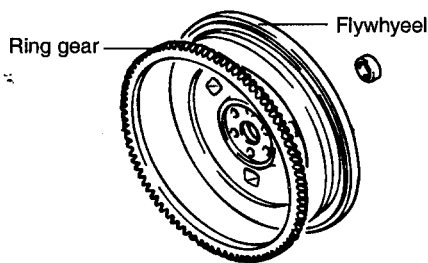
ECLA009F

**CRANKSHAFT FRONT AND REAR OIL SEALS**

1. Wear and damage in oil seal lips.
2. Deteriorated or hardened rubber.
3. Cracks or damage on oil seal case.

**RING GEAR (MANUAL TRANSAXEL)**

1. If the ring gear teeth are worn, damaged, or broken, replace the ring gear. If the teeth are damaged or broken, check the starting motor pinion. To remove the ring gear for replacement, tap its outer rim one place after another. Heating the gear makes it impossible to remove. To install the ring gear onto the flywheel, heat it up to 260-280°C (500-536°C) : it is a shrink fit in the flywheel.
2. Check the ball bearing for rotating condition and unusual noise. Ensure also that the packed grease is not leaking.



ECLA009G

**FLYWHEEL**

1. Check the flywheel clutch disc surface visually.
2. If ridge wear, streak, or seizure is evident, replace.
3. If the clutch disc surface runs out exceeding the limit, replace.

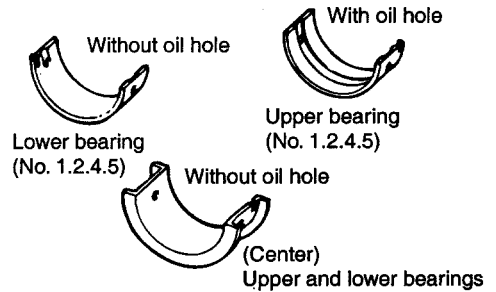
Limit : 0.13 mm (0.0051 in.)

**INSTALLATION**

ELCB0320

**CRANKSHAFT BEARING**

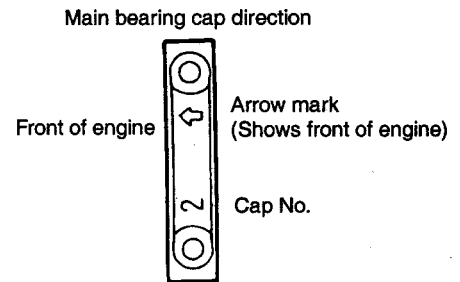
The upper main bearing is provided with an oil hole, whereas the lower bearing has no oil hole, There is no difference in center bearing (with flange) between upper and lower.



ECLA009H

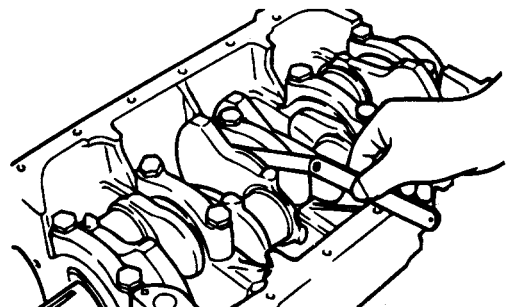
**BEARING CAP**

1. Install the main bearing to the cylinder block. Ensure the correct cap number and arrow mark direction.



ECLA009I

2. Check to ensure that the crankshaft turns smoothly and there is an adequate end play.



ECLA009J

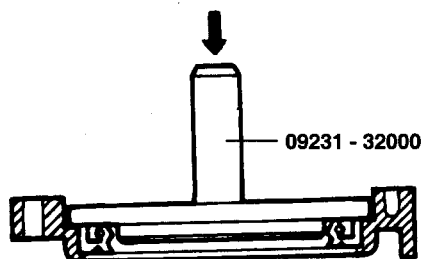
Standard value :

0.05 - 0.18 mm (0.0020 - 0.0071 in.)

Limit : 0.25 mm (0.010 in.)

**OIL SEAL CASE**

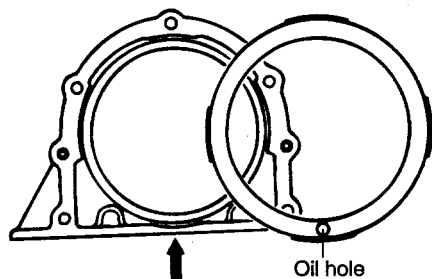
Using special tool, press-fit a new crankshaft rear oil seal into the oil seal case.



ECLA009K

**OIL SEPARATOR**

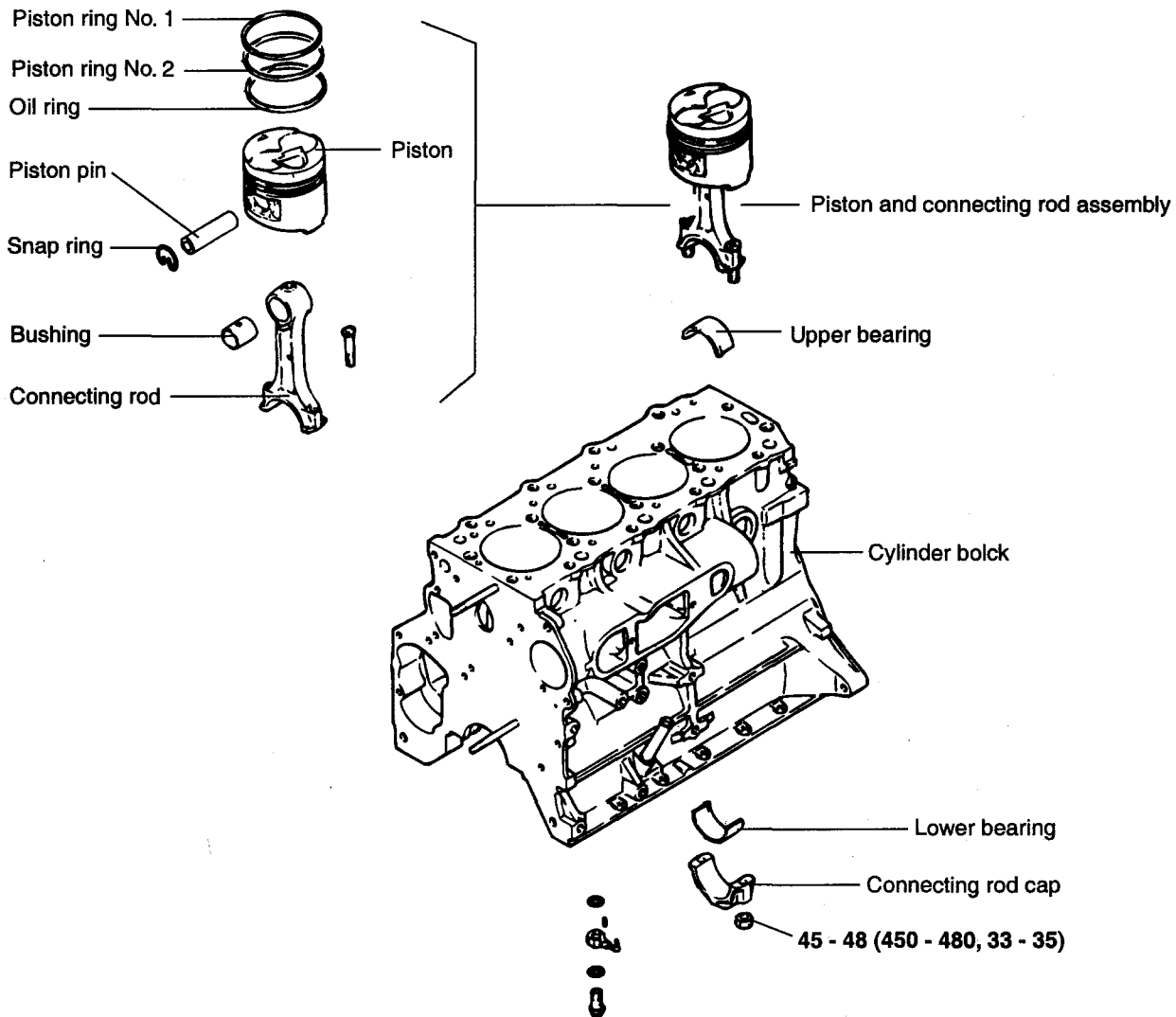
1. Push oil separator into the oil seal case.
2. Make sure that the oil hole in the separator comes at the bottom (indicated by an arrow in illustration.)



ECLA009L

# PISTON

## COMPONENTS ELCB0330



**TORQUE : Nm (kg.cm, lb.ft)**

**INSPECTION**

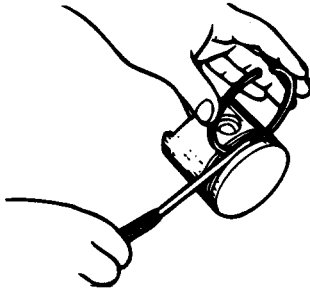
ELCB0340

**PISTON**

1. Check each piston for scuffing, scoring, wear and other defects. Replace any piston that is defective.
2. Check that the piston pin fits in the piston pin hole. Replace any piston and pin assembly that is defective. The piston pin must be smoothly pressed by hand into the pin hole (at room temperature)

**PISTON RING**

1. Check each piston ring for breakage, damage and abnormal wear. Replace the defective rings.
2. When the piston requires replacement, its ring should also be replaced.
3. Measure the clearance between piston ring and ring home.



ECLA010B

**Standard Value : Ring - to - ring groove clearance**

No. 1 : 0.056 - 0.076 mm (0.0022 - 0.0030 in.)

No. 2: 0.046 - 0.066 mm (0.0018 - 0.0026 in.)

Oil ring : 0.02 - 0.065 mm (0.0008 - 0.0026 in.)

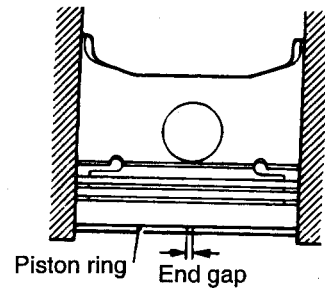
**[Limit]**

No. 1 : 0.15 mm (0.0059 in.)

No. 1 : 0.15 mm (0.0059 in.)

Oil ring : 0.1 mm (0.0039 in.)

4. Place a piston ring in the cylinder bore and set it square by pushing it down with piston.
5. Measure the end clearance using a thickness gauge.



ECLA010D

**Standard Value : End gap**

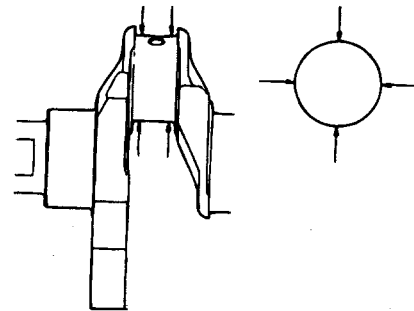
No. 1 : 0.35 - 0.50 mm (0.0138 - 0.0197 in.)

No. 2 : 0.25 - 0.40 mm (0.0098 - 0.0157 in.)

Oil ring : 0.25 - 0.45 mm (0.0098 - 0.0177 in.)

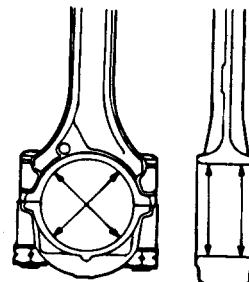
**Limit : 0.8 mm (0.0315 in.)****CONNECTING ROD BEARING**

1. Check the bearing surfaces for uneven contact pattern, streaks, scratches, and seizure. If defects are evident, replace. If the surfaces are seriously nicked and seized, check also the crankshaft. If the crankshaft is also damaged, replace the crankshaft or grind to undersize for reuse.



ECLA010E

2. Measure the connecting rod bearing I.D. and crankshaft pin O.D. If the clearance (oil clearance) exceeds the limit, replace the bearing and, if necessary, the crankshaft. Or, grind the crankshaft to an undersize and, at the same time, replace the bearing with an undersize.



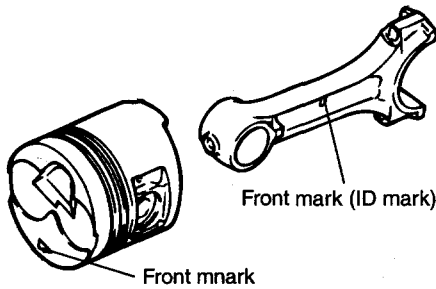
ECLA010F

Standard value : 0.02 - 0.05 mm (0.0008 - 0.0020 in.)  
 Limit : 0.10 mm (0.0039 in.)

**INSTALLATION** ELCB0350

**CONNECTING ROD, PISTON PIN AND PISTON**

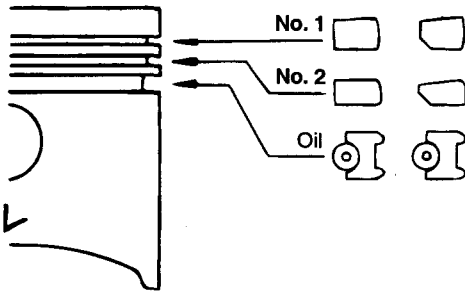
1. Match the piston with the connecting rod.
2. Line up the front marks and insert the piston pin. The piston pin must be smoothly pressed by hand into position. Replace the piston pin if there is excessive play.



ECLA010J

**PISTON RING**

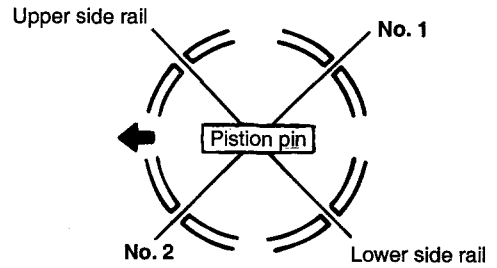
1. Install the oil ring expander and oil ring to the piston.



ECLA010L

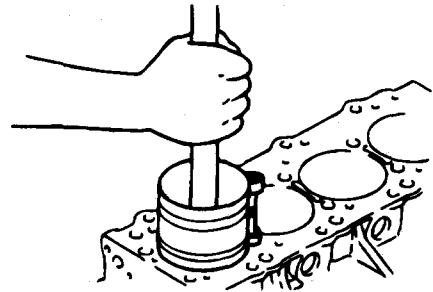
2. Then, install No.2 piston ring and No.1 piston ring, in that order. Make sure that the ring side, on which manufacturer and size marks are stamped, faces to the piston crown.

3. Position ends of piston and oil (side rail, spacer) rings as illustrated.



ECLA010M

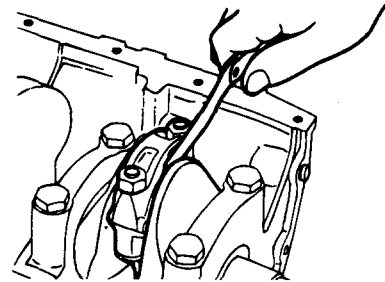
4. Insert the piston and connecting rod assembly from above the top of cylinder. Ensure that the front mark on piston crown and that (ID mark) on the connecting rod face toward the front of engine (to the crank pulley side).
5. Clamp firm the piston rings with the ring band and install the piston assembly into cylinder. Do not strike it hard into the piston, as broken piston ring or damaged crank pin could result.



ECLA010N

6. Make sure the clearance of connecting rod big end side.

Standard Value : 0.10 - 0.25 mm (0.0039 - 0.0098 in.)  
 Limit : 0.4 mm (0.0157 in.)



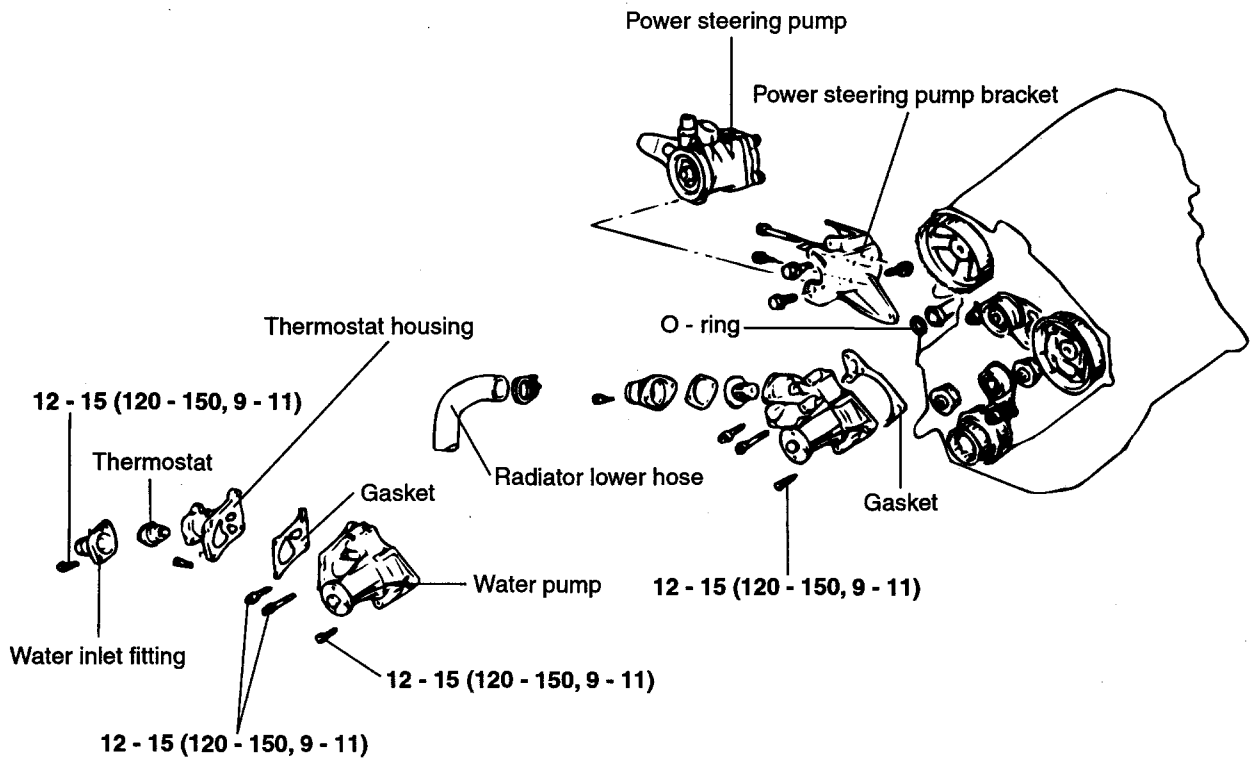
ECLA010O



# COOLING SYSTEM

## ENGINE COOLANT PUMP

### COMPONENTS ELCB0400



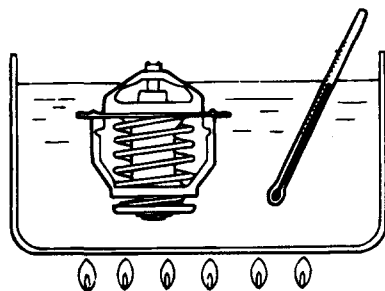
**\* Replace the gasket and O - ring with new ones after removal**

**TORQUE : Nm (kg.cm, lb.ft)**

**INSPECTION** ELCB0410

**THERMOSTAT**

1. Check that valve closes tightly at room temperature.
2. Check for defects or damage.
3. Check for rust on valve. Remove if any.
4. Immerse thermostat in container of water. Stir to raise water temperature and check that thermostat opening valve temperature and the temperature with valve fully open [valve liftover 8.5 mm (0.33 in.)] are at the standard value.



ECLA011C

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Standard value :  
 Opening valve temperature 82° C (180° F)  
 Full - open temperature 95° C (203° F)

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**NOTE**

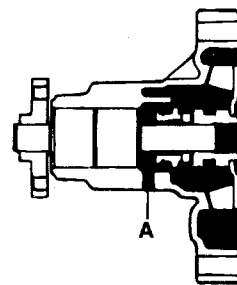
Measure valve height when fully close. Calculate lift by measuring the height when fully open.

**BELT**

1. Check the surface for damage, peeling or cracks.
2. Check the surface for presence of oil or grease.
3. Check the rubber for wear or hardening.

**WATER PUMP**

1. Check each part for cracks, damage or wear, and replace the water pump assembly if necessary.
2. Check the bearing for damage, abnormal noise and sluggish rotation, and replace the water pump assembly if necessary.
3. Check the seal unit for leaks, and replace the water pump assembly if necessary.
4. Check for water leakage. If water leaks from hole "A" seal unit is defective. Replace as an assembly.

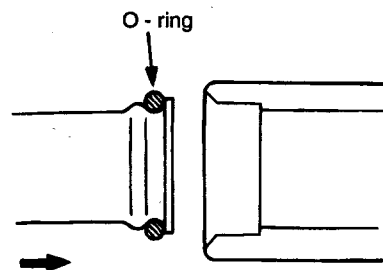


ECLA011B

**INSTALLATION** ELCB0420

**WATER PIPE O - RING**

Fit water pipe O-ring in the groove provided at water pipe end, wet the periphery of water pipe O-ring and insert water pipe.



ECLA011E

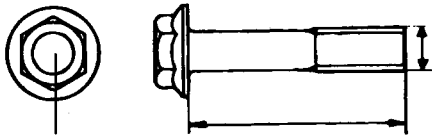
**CAUTION**

1. Do not apply oil and grease to water pipe O-ring.
2. Keep the water pipe connections free of sand, dust, etc.
3. Insert water pipe until its end bottoms.

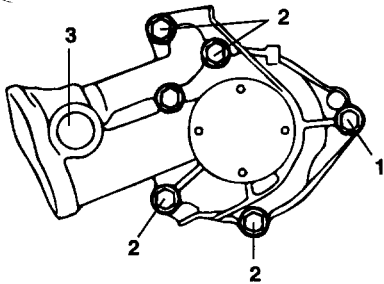
## WATER PUMP

Water pump installation bolt size are different and caution must be paid to ensure that they are properly installed.

No	Hardness category (Head mark)	d x l mm (in.)	Torque Nm (kg.cm, lb.ft)
1	4T	8 x 25 (0.31 x 0.98)	12 - 15 (120 - 150, 9 - 11)
2	4T	8 x 40 (0.31 x 1.57)	
3	7T	8 x 70 (0.31 x 2.76)	20 - 27 (200 - 270, 15 - 20)



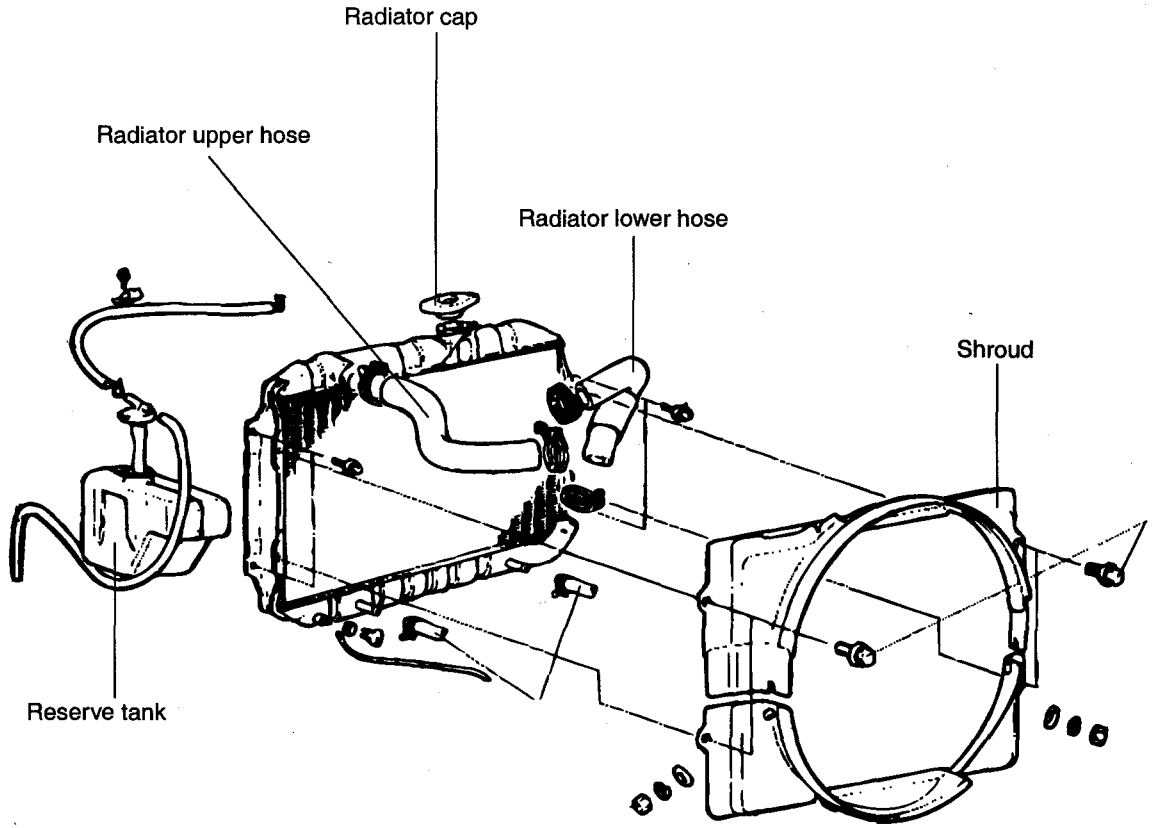
Indication for hardness category



ECLA011D

# RADIATOR

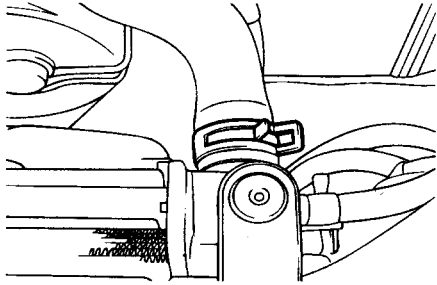
ELCB0430



ECLA012A

**REMOVAL** ELCB0440**RADIATOR**

1. Loosen the radiator drain plug to drain the coolant.
2. Disconnect the radiator hoses from the following parts.  
Upper hose ... from the radiator  
Lower hose ... from the engine.
3. Disconnect the overflow tube from the radiator.

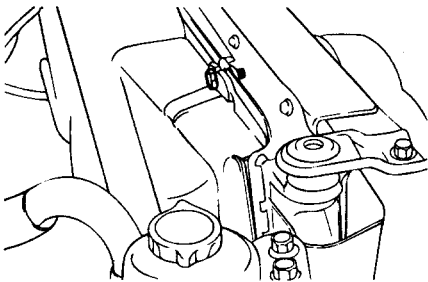


H7EM913A

4. Remove the radiator shroud bolts from the radiator.

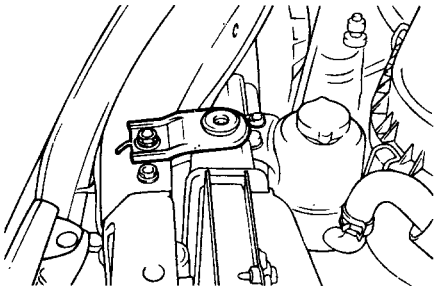
**NOTE**

*Shroud should be hung on the cooling fan, because it cannot be removed unless the radiator is taken out.*



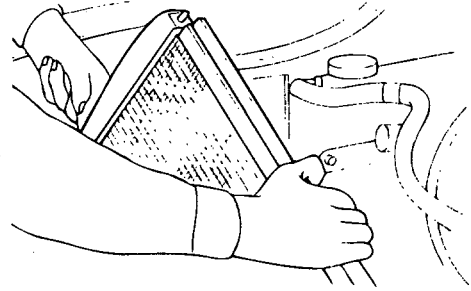
H7EM913B

5. Remove the radiator mounting bolts.



H7EM914A

6. Tilt radiator and take out obliquely upward.



H7EM003A

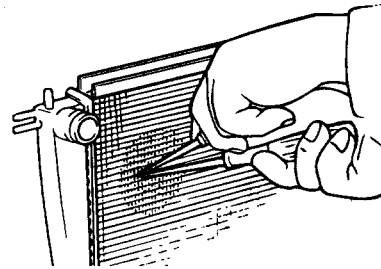
**NOTE**

*When the radiator is removed, make sure that the radiator core is not bent or crushed by other parts.*

7. Remove the radiator shroud.

**CORRECTION OF RADIATOR FIN**

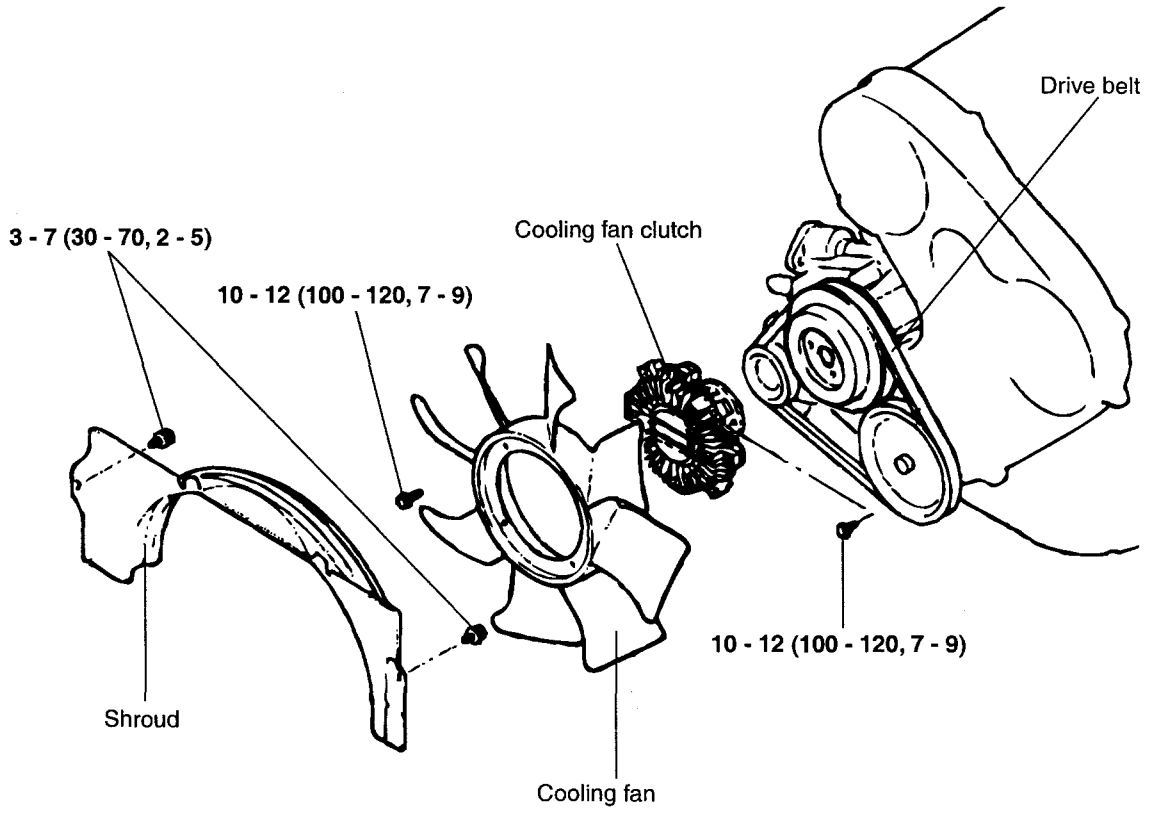
A bent or crushed portion should be corrected as shown.



H7EM003B

# RADIATOR PAN MOTOR

## COMPONENTS ELCB0450



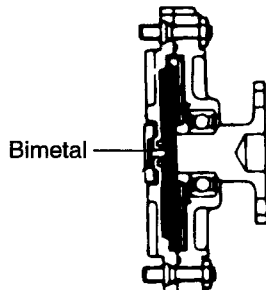
**TORQUE : Nm (kg.cm,lb.ft)**

**INSPECTION** ELCB0460**COOLING FAN**

1. Check the blades for damage and cracks.
2. Check for cracks and damage around bolt holes in fan hub.
3. If any portion of fan is damaged or cracked, replace cooling fan.

**FAN CLUTCH**

1. Check to ensure that fluid in fan clutch is not leaking at case joint and seals. If fluid quantity decreases due to leakage, fan speed will decrease and engine overheating might result.
2. When fan attached to engine is turned by hand, it should give a sense of some resistance. If fan turns lightly, it is defective.
3. In case of thermostatic control type, check for a broken bimetal.



ECLA012C

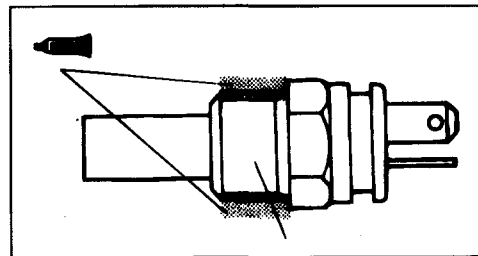
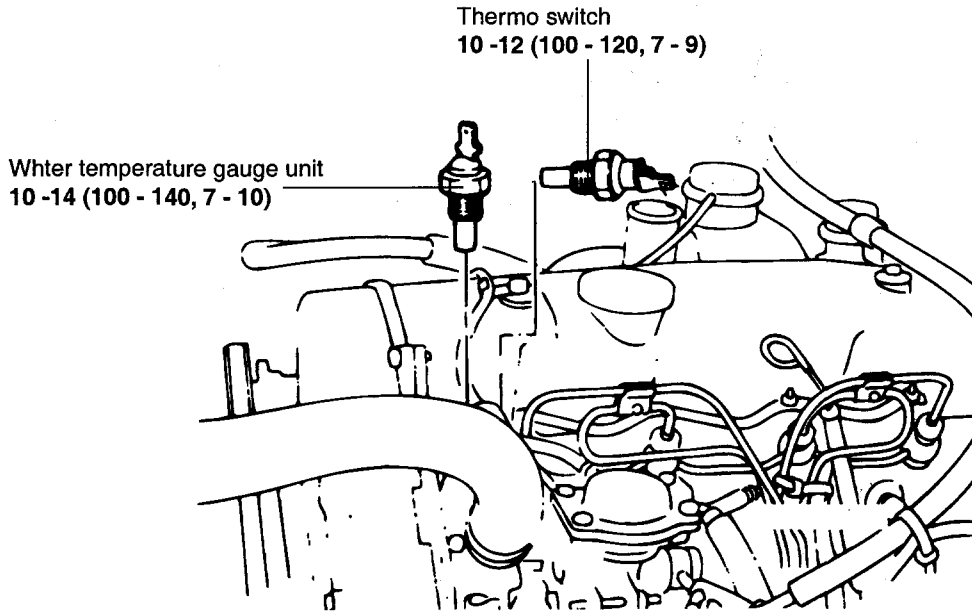
**BELT**

A belt which has following defects should be replaced.

1. Damaged, peeled or cracked surface.
2. Oil or greasy surface.
3. A belt worn to such an extent that it is in contact with bottom of V groove in pulley.
4. Worn or hardened rubber.

**WATER TEMPERATURE GAUGE UNIT,  
THERMO SWITCH**

ELCB0470

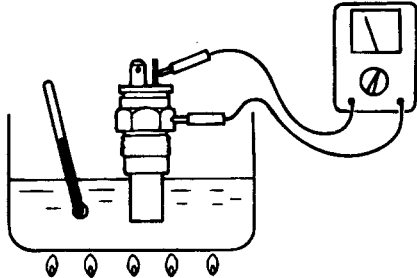


**TORQUE : Nm (kg.cm,lb.ft)**



**INSPECTION** ELCB0480**WATER TEMPERATURE GAUGE UNIT**

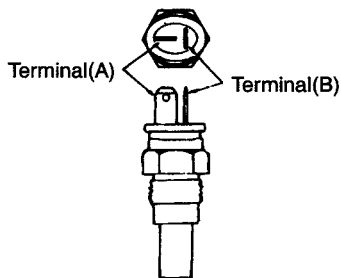
1. Put the sensor in water and increase the water temperature to measure the resistance.



ECLA012E

2. If the measurement radically deviates from specification, replace.
3. Measure the resistance across terminal (A) and body for water temperature gauge element and across terminal (B) and body for glow control element.

Terminal (A)	0.4 $\Omega$ / 70° C
	23.8 $\Omega$ / 115° C
Terminal (B)	24.8 $\Omega$ / - 20° C
	3.25 $\Omega$ / 20° C

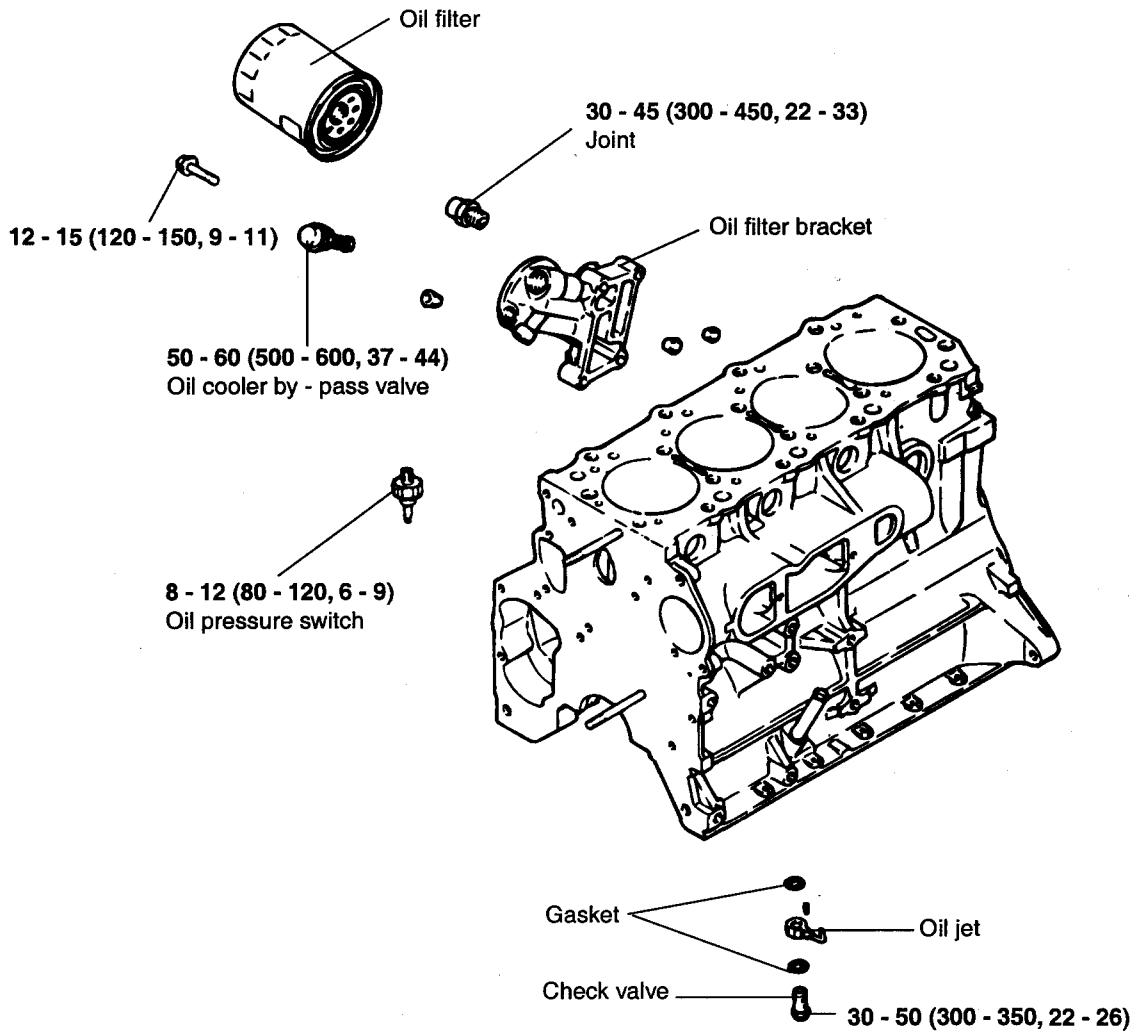


ECLA012F

# LUBRICATION SYSTEM

## OIL FILTER

ELCB0500



\* Replace the gasket with new ones after removal.

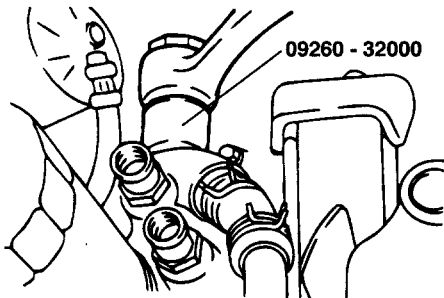
**TORQUE : Nm (kg.cm,lb.ft)**

**REMOVAL** ELCB0510**OIL PRESSURE SWITCH**

To remove the oil pressure switch, use Oil Pressure Switch Wrench (09260 - 32000).

**NOTE**

During removal, use care to prevent damage to the sealant applied to threads.



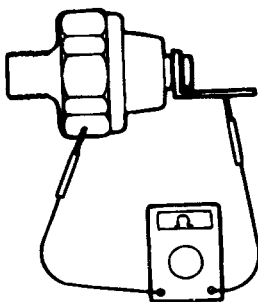
ECLA013B

**INSPECTION** ELCB0520**OIL FILTER BRACKET**

1. The oil filter mounting surface must be free from damage.
2. Check for cracks and oil leaks.
3. Make sure that the relief plunger slides smoothly and the relief spring is not damaged.

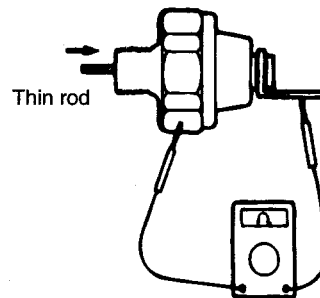
**OIL PRESSURE SWITCH**

1. Connect a tester (ohm range) between the terminal and the body of the switch to check for continuity. The switch is normal if there is continuity. If there is no continuity, replace the switch.



ECLA013C

2. Insert a thin rod in the oil hole of the switch and push it in lightly. The switch is normal if no continuity is detected (infinite resistance on the tester). If there is continuity, replace the switch.

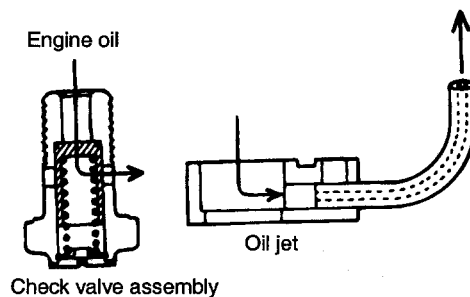


ECLA013D

3. Apply a 0.5 kg/cm<sup>2</sup> pressure to the oil hole. The switch is normal if there is no continuity. Also check for air leaks. If any air leaks are detected, the cause may be a broken diaphragm. Replace the switch if it leaks.

**OIL JET, CHECK VALVE**

1. Check the oil jet and check valve for clogging.
2. Check the oil jet for damage and deformation.



ECLA013E

**OIL COOLER BYPASS VALVE**

1. Make sure that the valve moves smoothly.
2. Ensure that the dimension L measures the standard value under normal temperature and humidity.

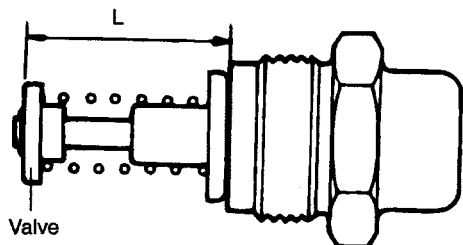
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Dimension L : 34.5 mm (1.36 in.)

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- The dimension must be the standard value when measured after the valve has been dipped in 100° C (212° F) oil.

Dimension L : 40 mm (1.57 in.) or more



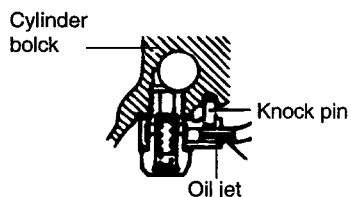
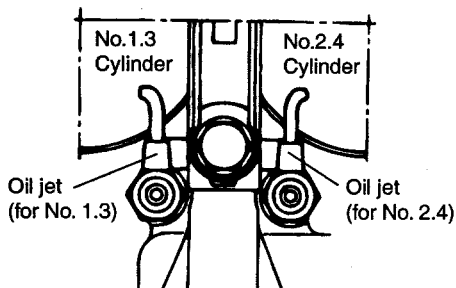
ECLA013F

**INSTALLATION**

ELCB0530

**OIL JET**

There are two types of oil jets installed: one for No. 1 and 3, and the other for No. 2 and 4. Make sure that the correct one is installed with correct direction as shown.



ECLA013G

**OIL PRESSURE SWITCH**

Before installation, apply sealant to the switch threads.

**NOTE**

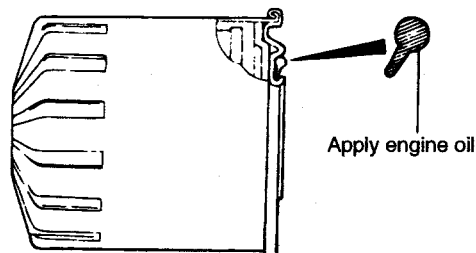
The sealant must not get into the thread top surface. Use care not to torque excessively.

**OIL FILTER**

Wipe clean the mounting surface on the filter bracket. Then, apply a thin coat of engine oil to filter O-ring and tighten oil filter hand-tight.

**CAUTION**

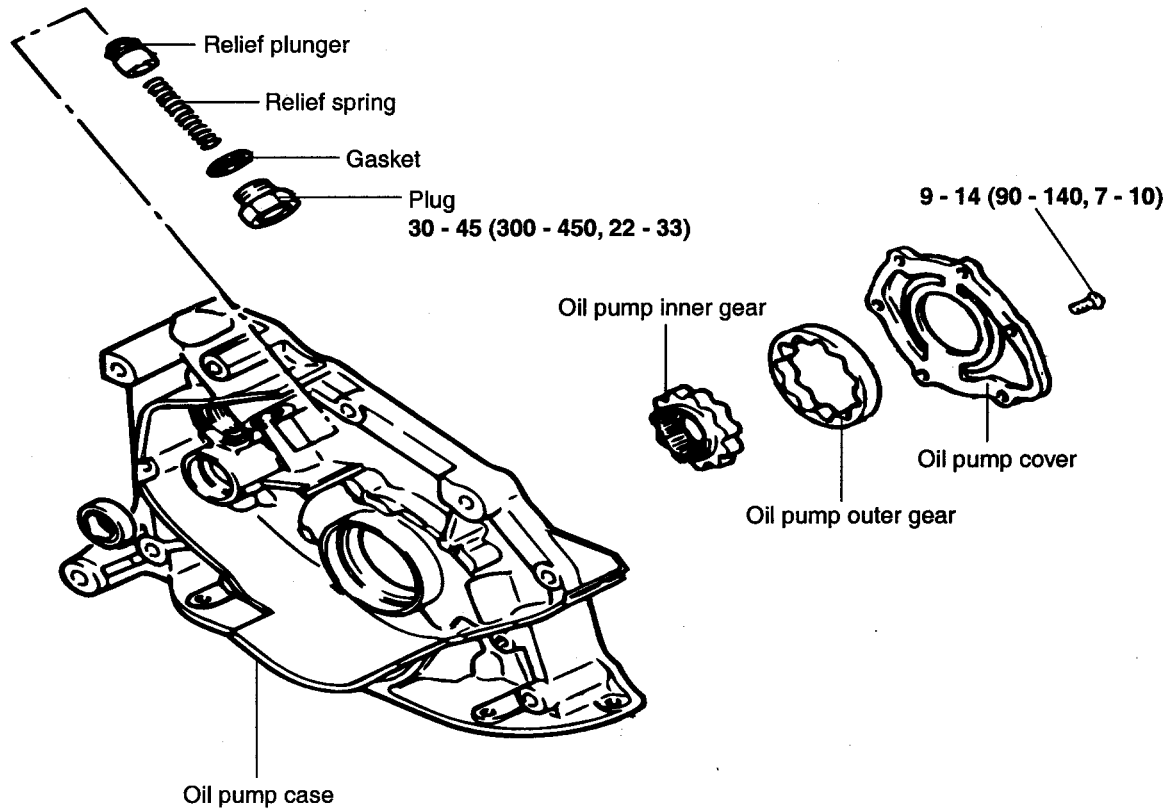
Never use a wrench to tighten the oil filter.



ECA9970B

## OIL PUMP

## COMPONENTS ELCB0540

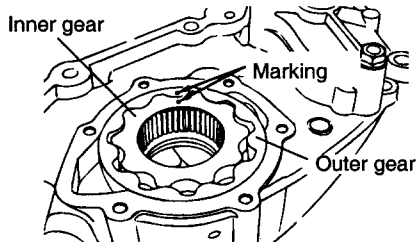


\* Replace the gasket with new ones after removal.

**TORQUE : Nm (kg.cm,lb.ft)**

**DISASSEMBLY** ELCB0550**OIL PUMP**

Before removing the oil pump outer and inner gears, mark the outer gear to make sure that it goes back to the position with correct direction.



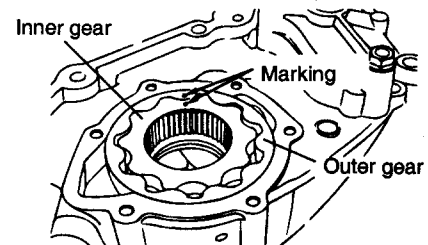
ECLA014B

**INSTALLATION** ELCB0570**OIL PUMP**

Install the outer gear, ensuring it is in position with correct direction according to the alignment mark made during disassembly.

**NOTE**

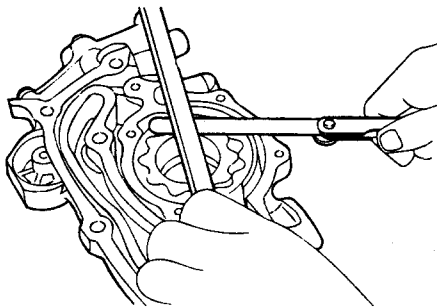
When installing the gears, be sure to apply engine oil to the entire surfaces of the gears.



ECLA014B

**INSPECTION** ELCB0560**OIL PUMP**

1. Install the outer and inner gear into the front case and make sure that they turn smoothly with no excessive play between them.
2. Check the side clearance (the front case and oil pump cover surface)



EDA9340B

Standard : 0.04 - 0.10 mm (0.0016 - 0.0039 in.)  
Limit : 0.15 mm (0.0059 in.)

3. Check the body clearance.

**[Standard]**

Drive gear : 0.03 - 0.09 mm (0.0012 - 0.0035 in.)  
Driven gear : 0.12 - 0.22 mm (0.0047 - 0.0087 in.)

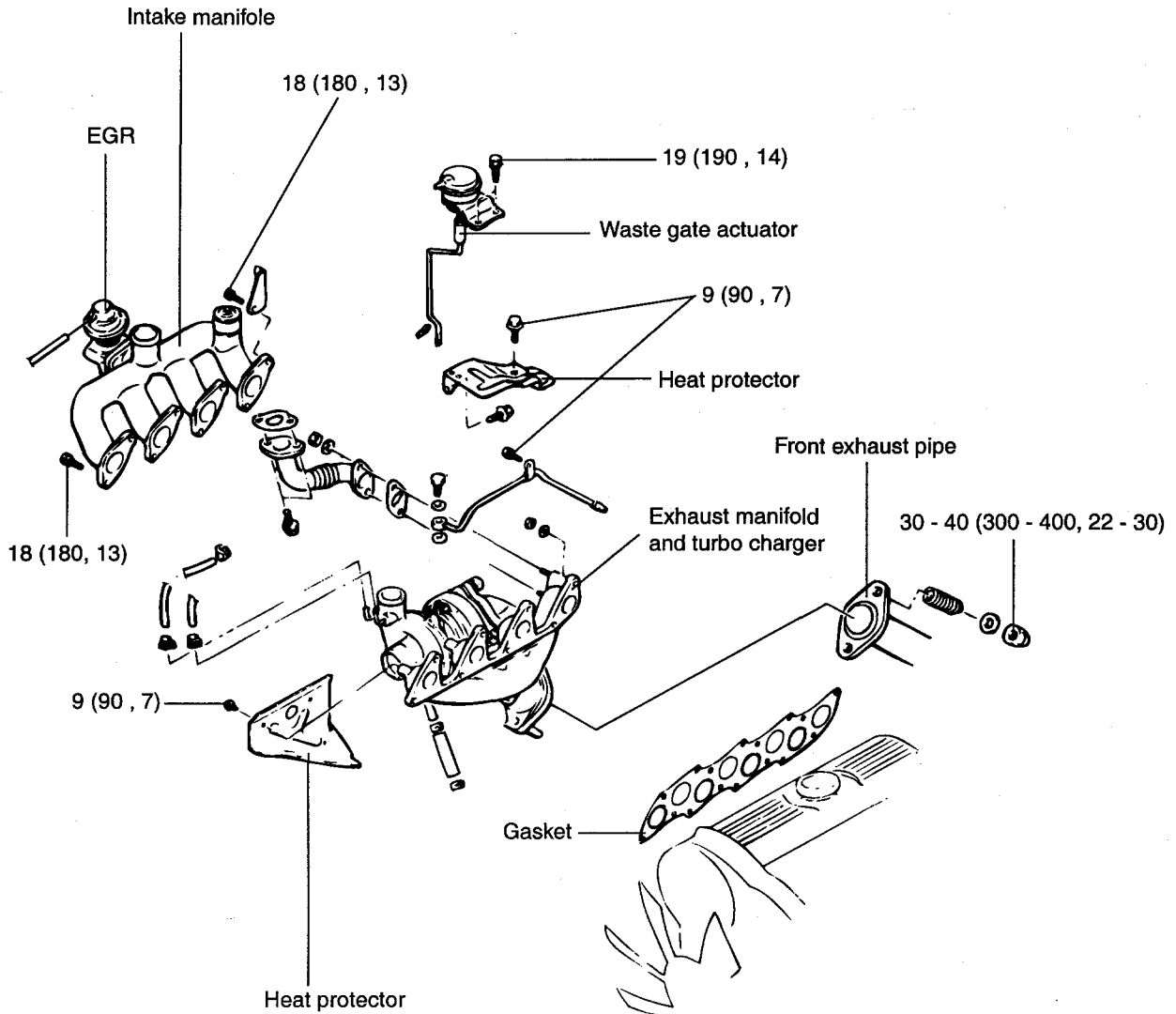
**[Limit]**

Drive gear : 0.5 mm (0.0197 in.)  
Driven gear : 0.4 mm (0.0157 in.)

# INTAKE AND EXHAUST SYSTEM

## EXHAUST MANIFOLD

### COMPONENTS ELCB0600

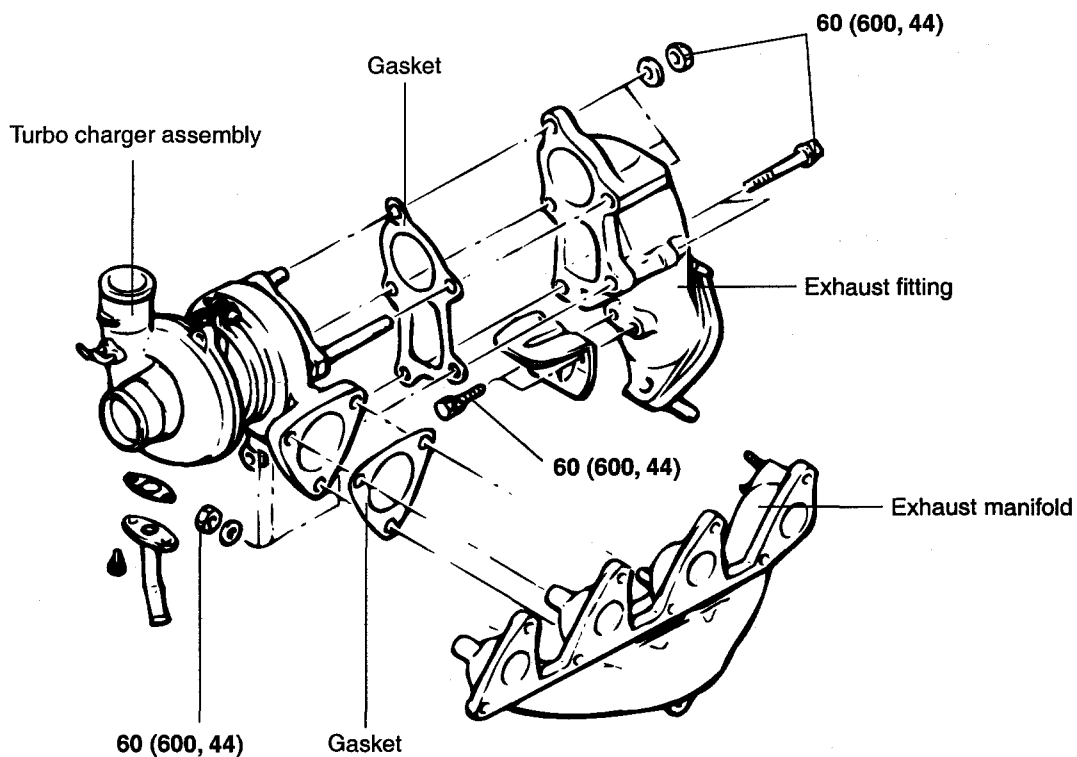


**\*Replace the gasket with new ones after removal.**

**TORQUE : Nm (kg.cm, lb.ft)**

COMPONENTS ELCB0610

[TCI]



\* Replace the gasket with new ones after removal.

TORQUE : Nm (kg.cm,lb.ft)



**INSPECTION** ELCB0620

Check the following and replace if faulty.

**INTAKE AND EXHAUST MANIFOLDS**

1. Check the parts for cracks and damage.
2. Check the vacuum port, water passages and gas passages for clogging.
3. Using a straightedge and a thickness gauge, check distortion of the cylinder head mounting surface.

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Standard value : 0.15 mm max.

Limit : 0.3 mm

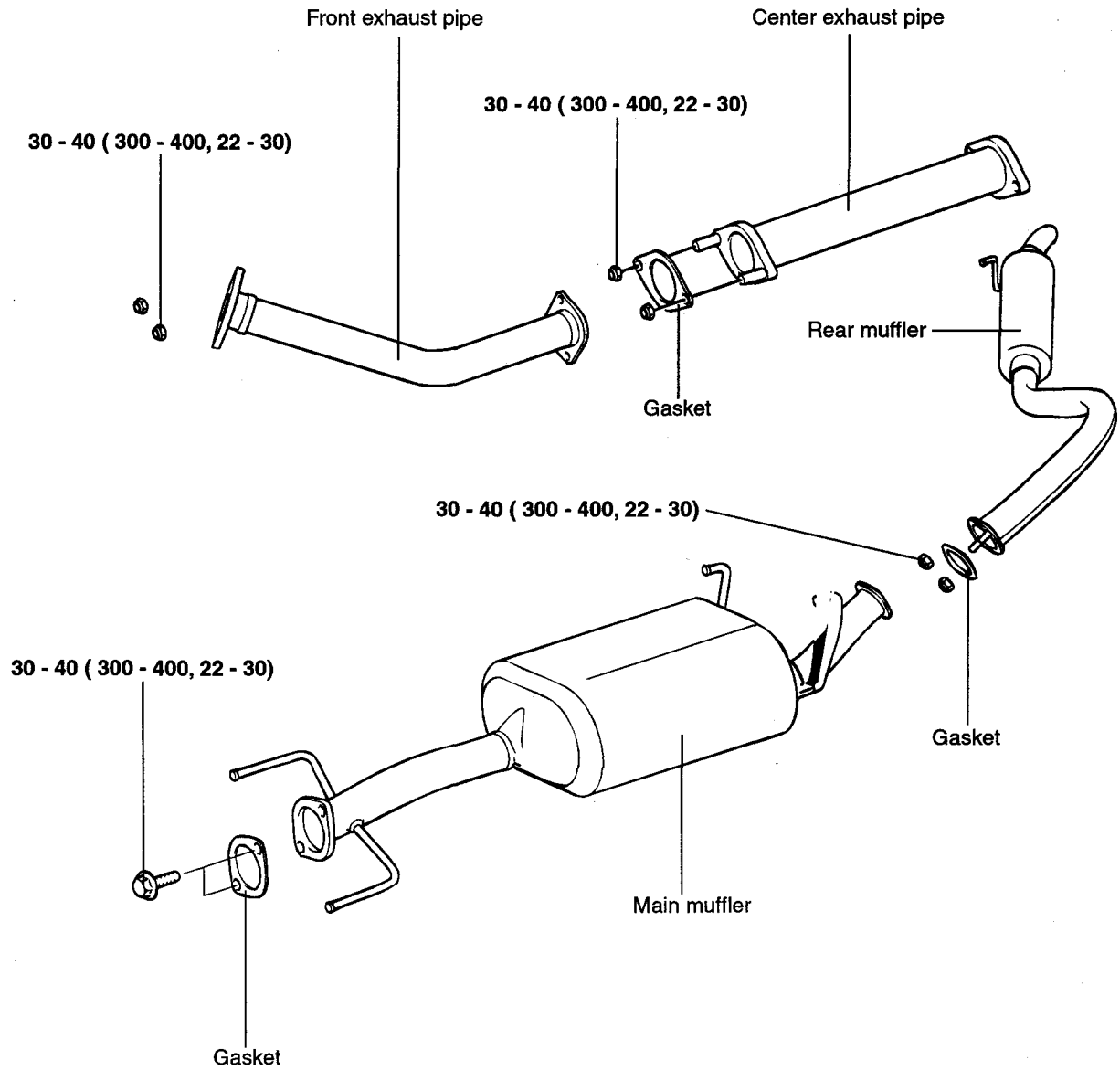
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**EXHAUST MANIFOLD GASKET**

The gasket may be reused if they are free from peeled or damaged surface.

MUFFLER

COMPONENTS ECMB0250



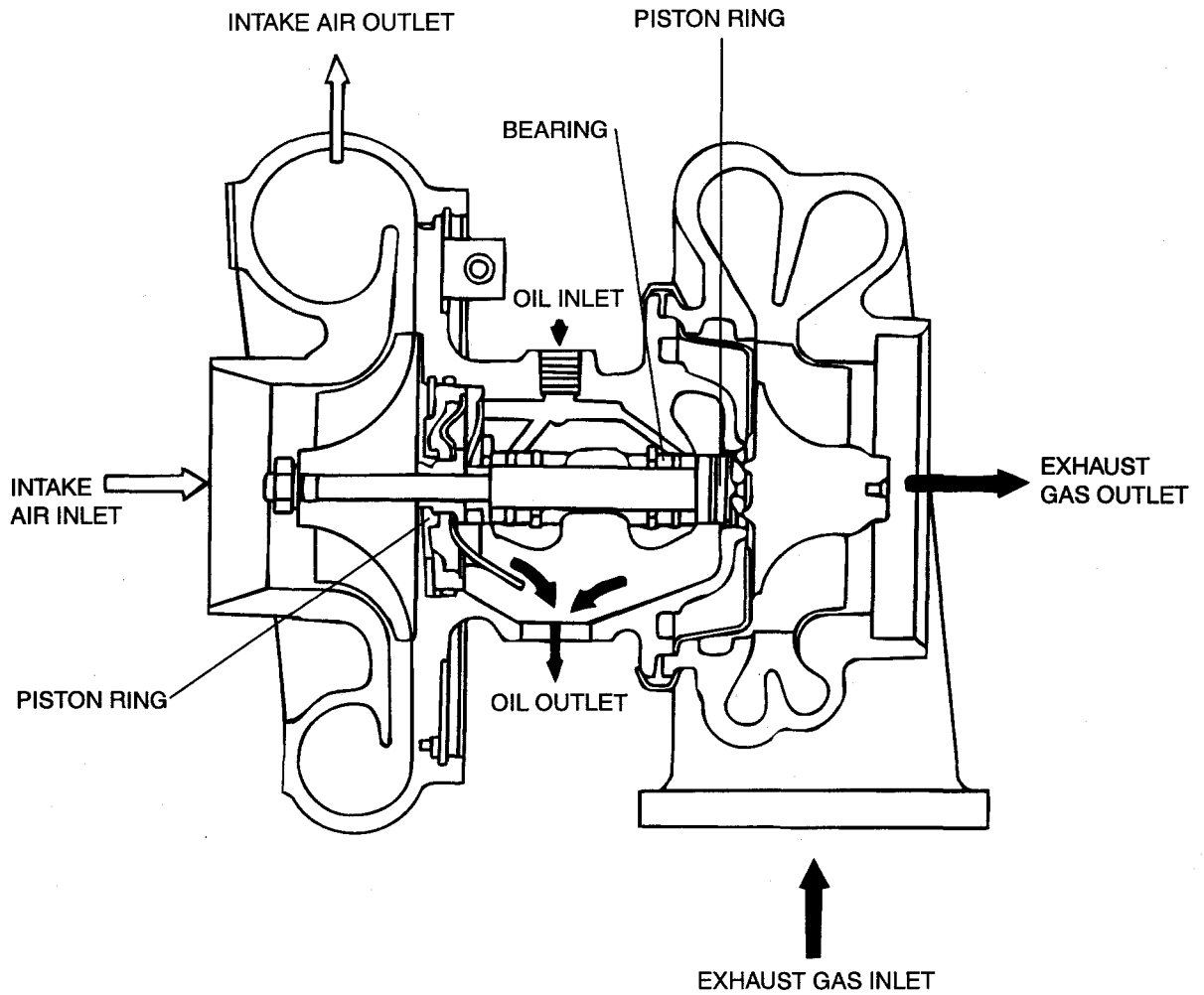
**TORQUE : Nm (kg.cm, lb.ft)**

**INSPECTION** ELCB0640

1. Check the mufflers and pipes for corrosion and damage.
2. Check the rubber hangers for deterioration and cracks.

# TURBO CHARGER (TC)

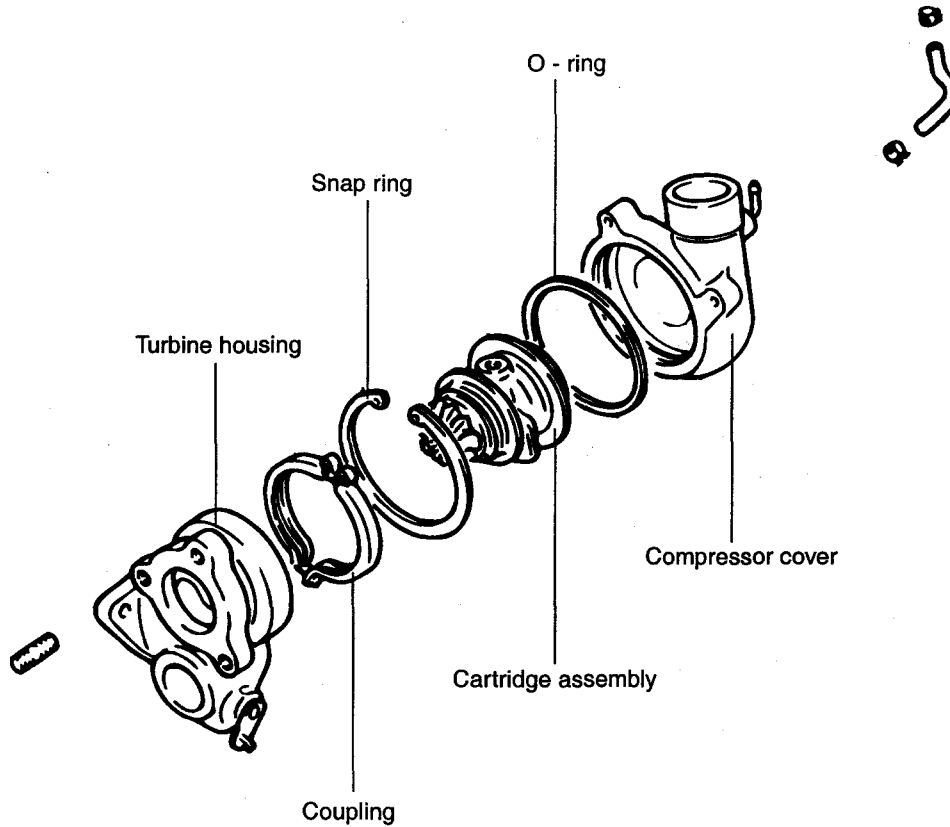
## COMPONENTS ELCB0650



**TORQUE : Nm (kg.cm,lb.ft)**

COMPONENTS

ELCB0660



\* Replace the gasket with new ones after removal.

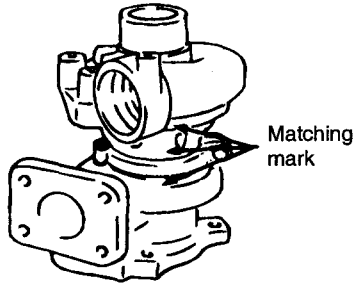
TORQUE : Nm (kg.cm,lb.ft)

**DISASSEMBLY** ELCB0670

1. Before removal, make the matching mark on compressor cover bearing housing and turbine housing.

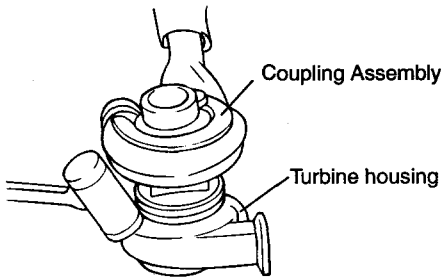
**CAUTION**

*Be sure not to damage the compressor and turbine wheel blade.*



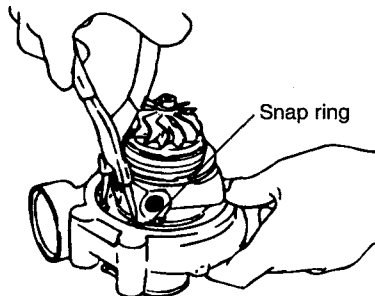
ECLA016B

2. Loosen the assembly and tap the housing by plastic hammer when removing the housing.



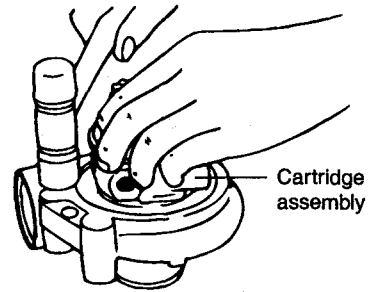
H7ET008B

3. Remove the snap ring using snap ring filler.



ECLA016C

4. Remove by tapping the compressor cover of cartridge assembly with plastic hammer.



ECLA016D

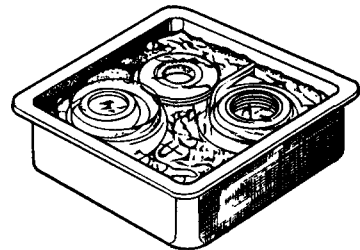
**CLEANING**

1. Use a heavy duty carbon solvent to loosen the carbon from the parts.

**CAUTION**

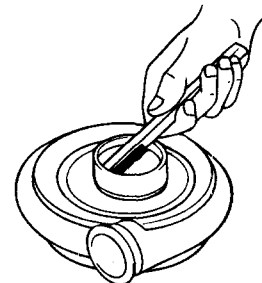
*Do not use caustic solutions, wire brushes, or wire wheels to remove carbon deposits from any turbo charger part.*

2. A small, closed, agitated cleaning tank and solvent will give the best results.



H7ET009A

3. After the carbon is loosened, use a hard, bristle type brush and remove all dirt particles.



H7ET009B

- Clean all drilled passages with air under pressure and put oil on cleaned parts to prevent corrosion.

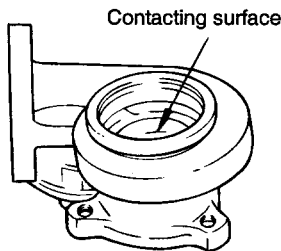


H7ET009C

## INSPECTION

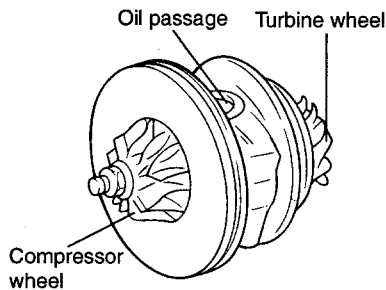
ELCB0680

- Check the inner housing contacting turbine wheel for crack, pitching and other damages caused by over-heat.
- Make sure that the waste gate valve lever operates freely by hands.
- Make sure there are no damages on the inner housing surface contacting compressor wheel.



ECLA016E

- Turbine wheel and shaft assemblies with cracks in the blades or broken blades can not be used again. If the blades are slightly bent, it can be used again but severely bent blades can not be reused.



ECLA016F

- Check if there are foreign materials disturbing the oil flow in the oil passage of cartridge assembly.

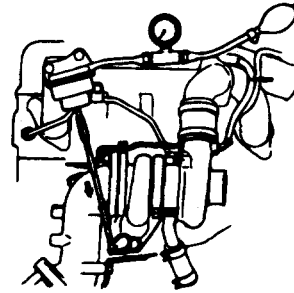
## WASTE GATE INSPECTION

- Check the waste gate rod operation under the pressure below.

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Nominal Value : 77.5 kPa (0.79 kgf / cm<sup>2</sup>)

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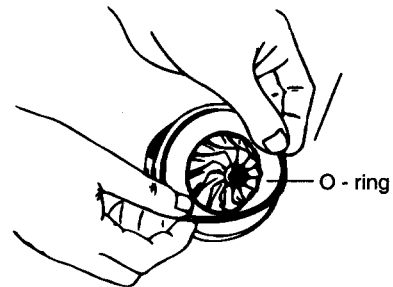


ECLA016J

## REASSEMBLY

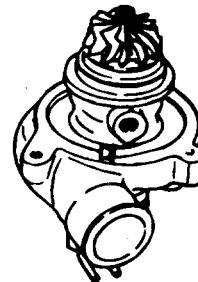
ELCB0690

- Apply engine oil to new O-ring and insert the O-ring to the groove of cartridge assembly.



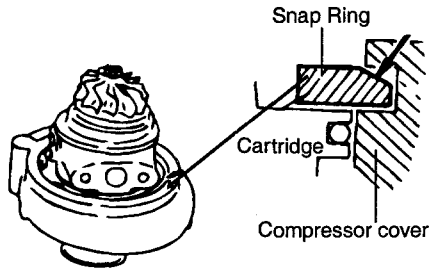
ECLA016G

- Assemble cartridge assembly and compressor cover matching the mark.



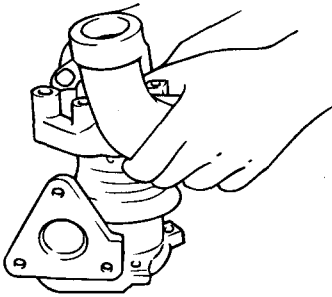
ECLA016H

3. Install the snap ring as shown in the figure.



ECLA016I

4. Before reassembly, make sure that the turbine housing matching mark is matched with compressor cover and cartridge assembly.

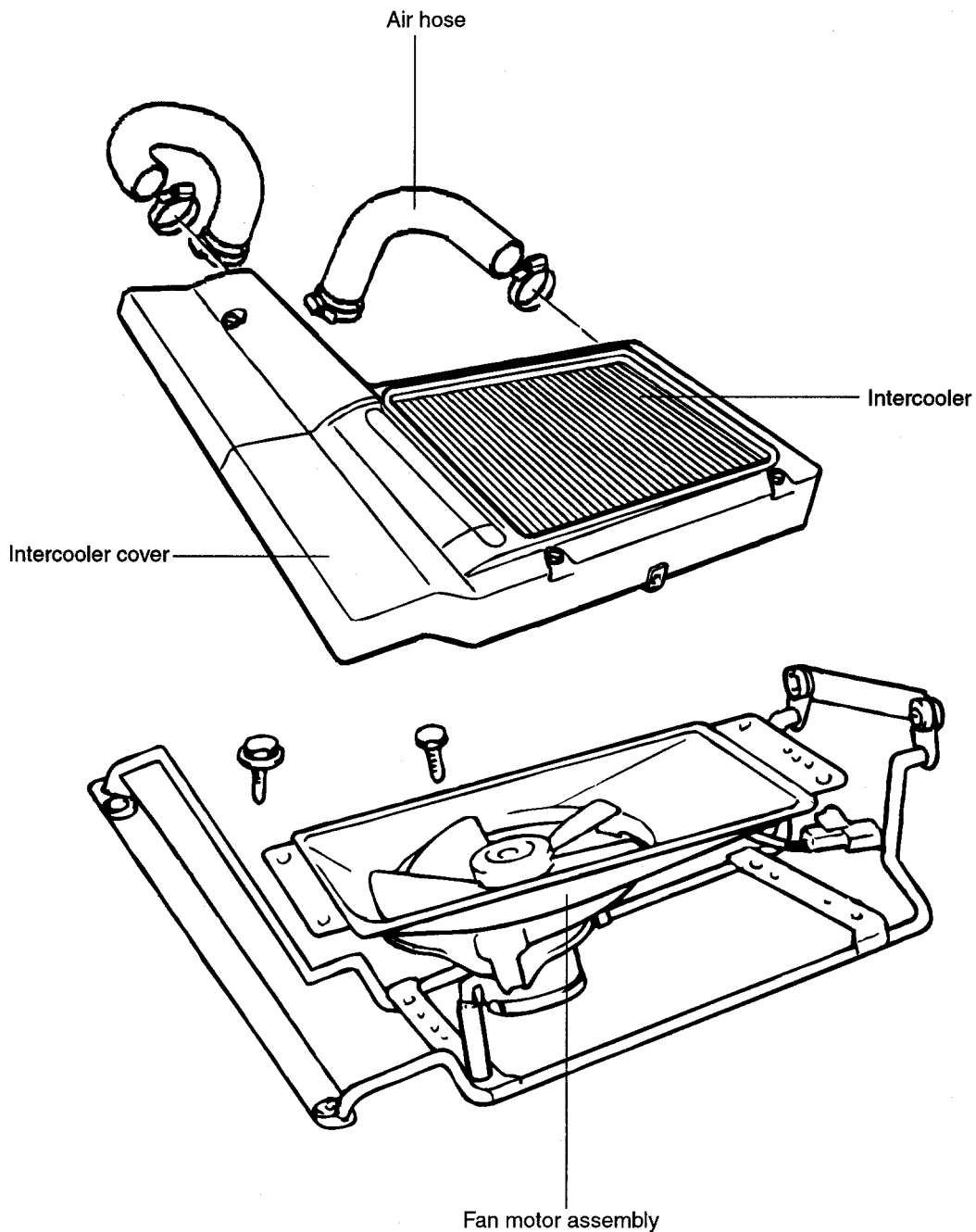


H7ET010D



# INTERCOOLER

## COMPONENTS ELCB0700



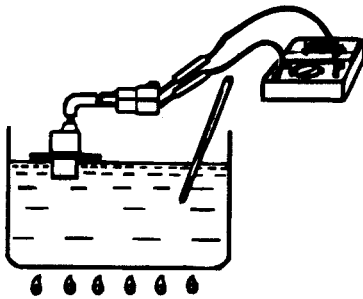
**REMOVAL** ELCB0710

1. Remove the intercooler cover.
2. Disconnect the fan motor and air temperature switch connector.
3. Remove the air hoses.
4. Remove the intercooler assembly.
5. Remove the fan motor assembly.
6. Remove the intercooler bracket.

**INSPECTION** ELCB0720

**AIR TEMPERATURE SWITCH**

1. Place the sensing part of sensor into the water.
2. Check the continuity according as the temperature increase.



ECLA017B

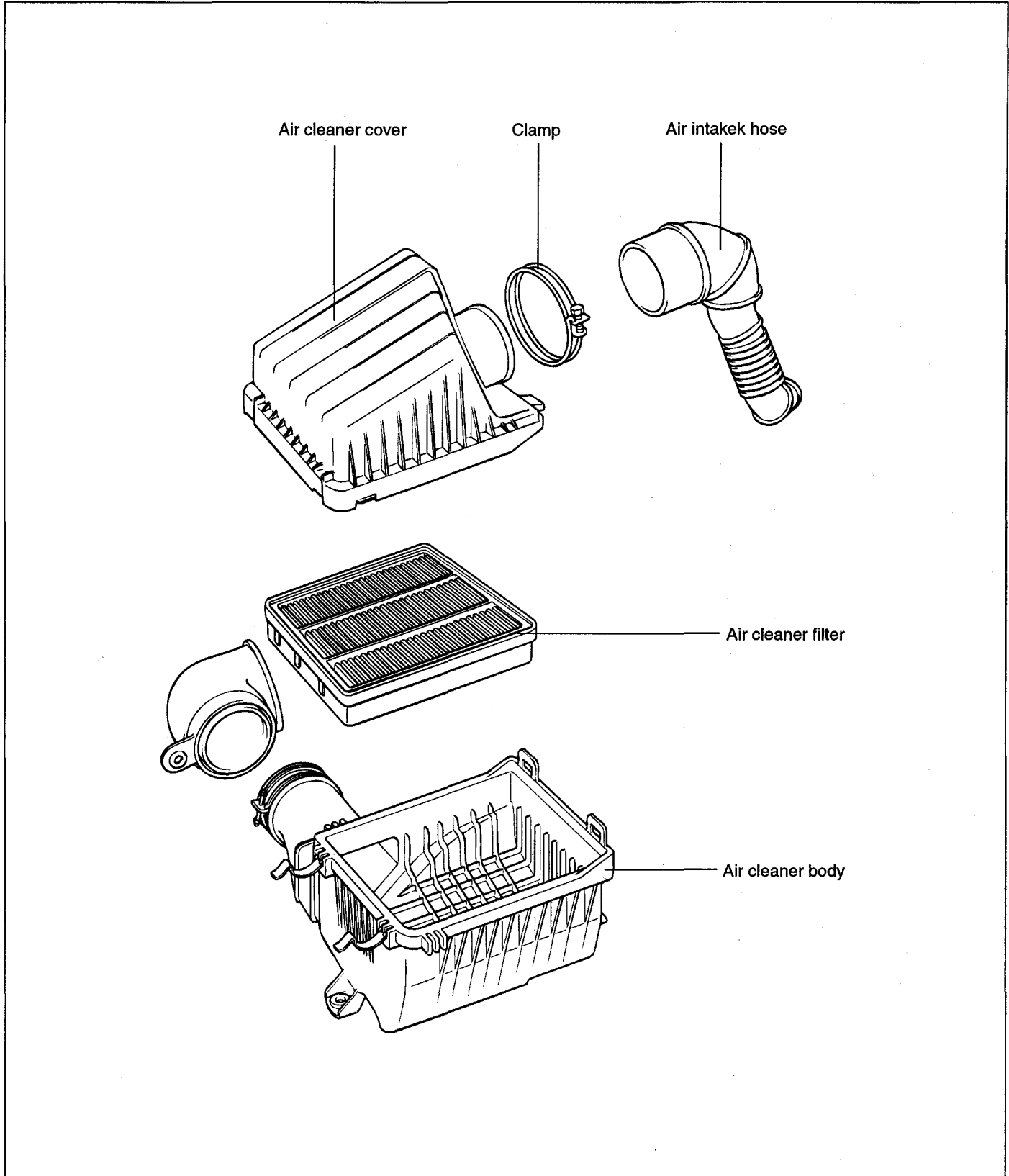
Temperature	Normal Condition
50°C or less	No - Continuity
60°C or more	Continuity

**INTERCOOLER FAN MOTER**

Check the working of fan when the vehicle speed is 60 km/h or less and intake air temperature is 50°C or more.  
(Revolution : 3500 rpm)

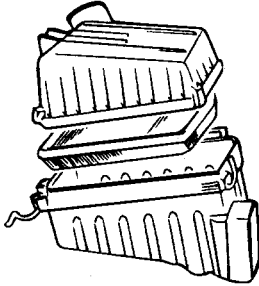
# AIR CLEANER (ACL)

## COMPONENTS ECMB0400



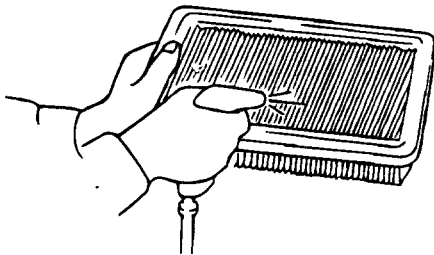
## INSPECTION ECMB0410

1. Check the air cleaner body, cover, or filter for distortion, corrosion or damage.
2. Check the air duct for damage.



ECKA060B

3. Check the air cleaner filter for restriction, contamination or damage. If the filter is slightly restricted, remove the dust and other contaminants by blowing compressed air from the upper side through the filter.



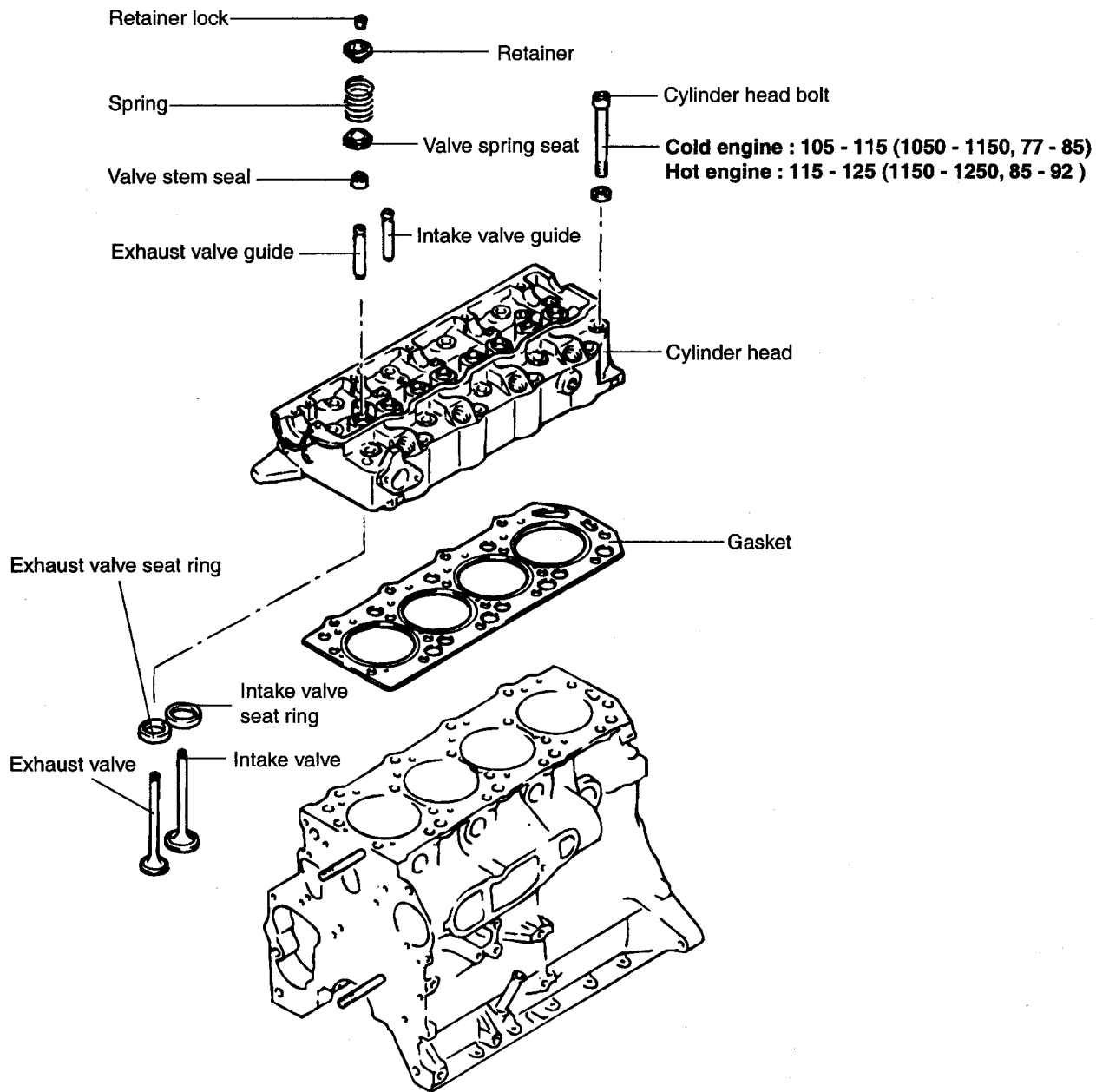
EDDA080B

4. Check the air cleaner housing for restrictions, contamination or damage.

# CYLINDER HEAD ASSEMBLY

## CYLINDER HEAD

### COMPONENTS ELCB0800



**TORQUE : Nm (kg.cm, lb.ft)**

**\* Replace the gasket with new ones after removal**

**DISASSEMBLY** ELCB0810**CYLINDER HEAD**

1. Remove the injection pipe assembly. When loosening the injection pipe nut, hold the nozzle holder and the delivery valve holder with a spanner to prevent them from turning with the nut.

**NOTE**

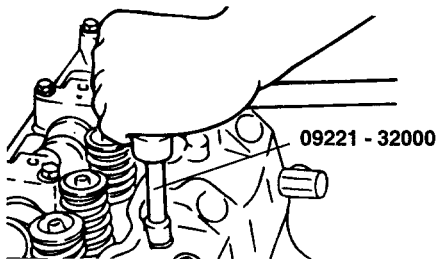
After the injection pipe is removed, put a cap on the nozzle holder and the delivery valve holder to prevent ingress of dust and foreign matter.

2. Remove the timing belt upper cover.
3. Loosen the camshaft sprocket bolt to such an extent that it can be further loosened with fingers.
4. Bring the piston in No.1 cylinder to the top dead center on the compression stroke. Align the timing mark on the camshaft sprocket with that made on the upper case.
5. Manually remove the camshaft sprocket bolt.
6. With the timing belt engaged, remove the sprocket from the camshaft and place the assembly on the timing belt lower cover.

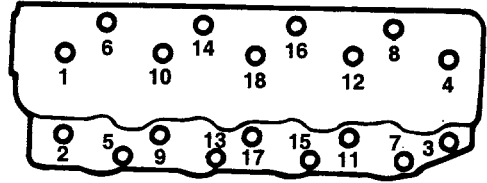
**CAUTION**

Do not turn the crankshaft once the sprocket is removed. Keep the timing belt tense.

7. Remove the rocker cover, rocker arm shaft assembly and camshaft.
8. Using the special tool, Cylinder Head bolt Wrench (09221-32000), loosen 18 Cylinder head bolts and remove them. Loosen the bolts in the sequence shown and in two to three steps.



ECLA018B

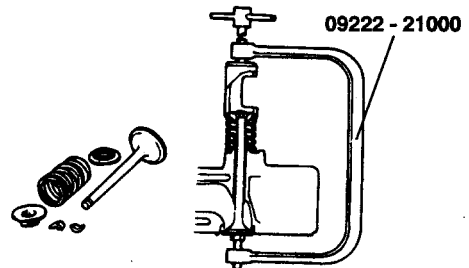


ECLA018C

9. Remove the cylinder head.
10. Remove the cylinder head gasket. Clean the cylinder head and cylinder block gasket surfaces.

**VALVE AND VALVE SPRING**

1. Remove the cylinder head assembly.
2. Remove the parts as illustrated below and store them separately for each cylinder. Using Valve Spring Compressor (09222-21000), remove the valve spring retainer lock. Keep the disassembled parts arranged according to the cylinder number and intake and exhaust.



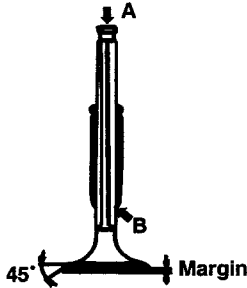
ECLA018D

**INSPECTION**

ELCB0820

**INTAKE VALVE, EXHAUST VALVE**

1. If the valve stem develops wear (taper wear) or damaged, replace. If there is a dent in the stem end face (the surface in contact with the rocker arm adjust screw), replace.



ECA9281B

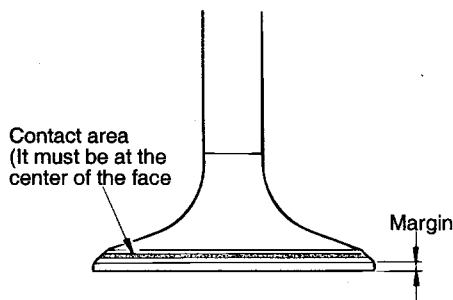
2. Check the valve face for contact. If the contact is not proper, correct with a valve refacer. The contact pattern with the valve seat must be even at the center of valve face.
3. Replace if the margin (valve head thickness) exceeds the limit.

**Standard value**

Intake and exhaust : 2.0 mm (0.0394 in.)

**Limit**

Intake and exhaust : 1.0 mm (0.0394 in.)



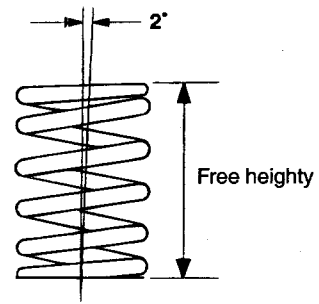
EDA9300D

**VALVE SPRING**

1. Measure the free height of spring and replace if the limit is exceeded.

**Standard value** : 49.1 mm (91.933 in.)**Limit** : 48.1 mm (1.894 in.)

2. Measure the squareness of the spring and, if the limit is exceeded, replace.



BOY041D

**Standard value** : 2° or less**Limit** : 4°**VALVE GUIDE**

Measure the valve guide to stem clearance and, if the measurement exceeds the limit, replace the valve guide or valve, or both.

**Standard value**

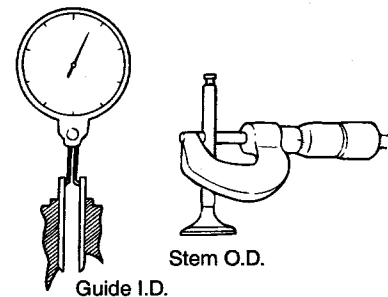
Intake : 0.03-0.06 mm (0.0012-0.0024 in.)

Exhaust : 0.05-0.09 mm (0.0012-0.0024 in.)

**Limit**

Intake : 0.10 mm (0.0394 in.)

Exhaust : 0.15 mm (0.0394 in.)



BOY105D

**CYLINDER HEAD**

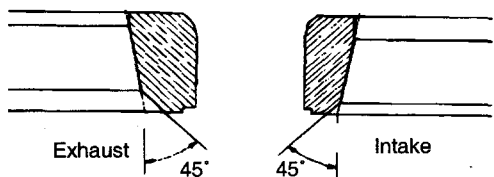
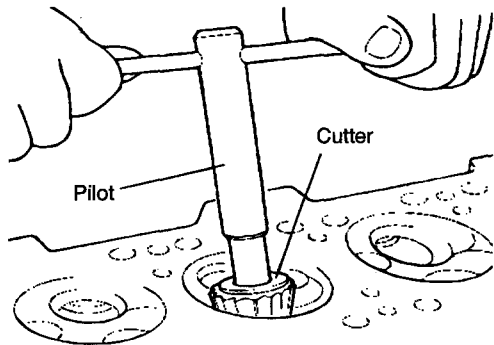
1. Before cleaning the cylinder head, check for water and oil leaks, damage, or cracks.
2. Remove oil, scale, sealant, and carbon deposits completely. After cleaning the oil passages, apply compressed air to ensure that the passages are not clogged.
3. If there is gas leak from the cylinder head gasket surface, measure the surface flatness. If distortion exceeds the limit, replace the cylinder head.

**Standard value** : 0.05 mm (0.002 in.)**Limit** : 0.2 mm (0.008 in.)

4. Visually check the camshaft bearing internal surfaces for damage or seizure. If defects are evident, replace the bearing.

**RECONDITIONING VALVE SEAT**

Check the valve seat for overheating and improper contact with the valve face. Recondition or replace the seat if necessary. Before reconditioning the seat, check the valve guide for wear. If the valve guide is worn, replace it and then recondition the seat. Recondition the valve seat with a valve seat grinder or cutter. The valve seat contact width should be within specifications and centered on the valve face. After reconditioning, the valve and valve seat should be lapped lightly with a lapping compound.

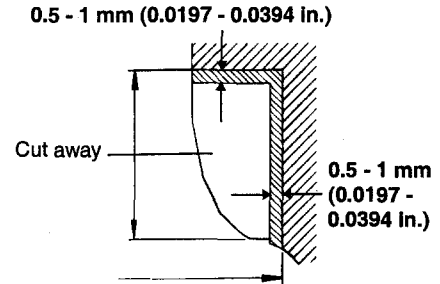


ECHA920B

Angle	No.
45°	09221-43300
65°	09221-43400
30°	09221-43500

**VALVE SEAT REPLACEMENT PROCEDURE**

1. Cut the valve seat to be replaced from the inside to thin the wall thickness. Then, replace the valve seat.



BOYR3940

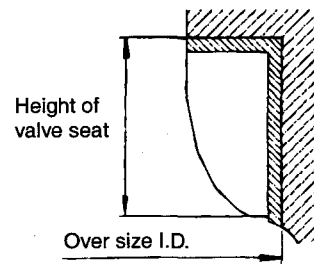
2. Rebore the valve seat hole in cylinder head to the oversize valve seat diameter.

---

Intake valve seat ring hole diameter
0.30 O.S. : 43.300 - 43.325 mm (1.7047 - 1.7057 in.)
0.60 O.S. : 43.600 - 43.625 mm (1.7165 - 1.7175 in.)
Exhaust valve seat ring hole diameter
0.30 O.S. : 37.300 - 37.325 mm (1.4685 - 1.4695 in.)
0.60 O.S. : 37.600 - 37.625 mm (1.4803 - 1.4813 in.)

---

3. Before fitting the valve seat, either heat the cylinder head up to approximately 250°C (482°F) or cool the valve seat in liquid nitrogen to prevent the cylinder head bore from abrasion.
4. After installation, recondition the valve seat.

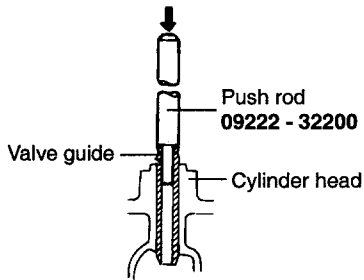


BOYR167A



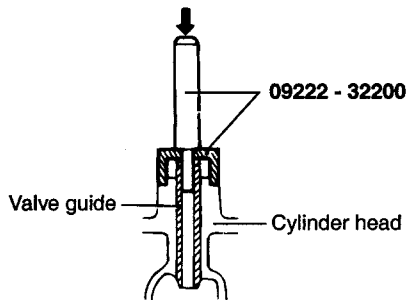
## VALVE GUIDE REPLACEMENT PROCEDURE

- Using the push rod of Valve Guide installer (09222 - 32200) and a press, remove the valve guide forward cylinder block.



ECLA018F

- Rebore valve guide hole to the new oversize valve guide outside diameter.
- Using Valve Guide Installer (09222 - 32200), press-fit the valve guide, working from the the cylinder head top surface.



ECLA018G

### NOTE

When valve guides have been replaced, check for valve contact and correct valve seats as necessary.

- After installing valve guides, insert new valves in them to check for sliding condition.

#### Valve guide hole diameter

0.05 O.S.:	13.050-13.068 mm (0.0012-0.0024 in.)
0.25 O.S.:	13.250-13.268 mm (0.5216-0.5223 in.)
0.50 O.S.:	13.500-13.518 mm (0.5315-0.5322 in.)

## INSTALLATION

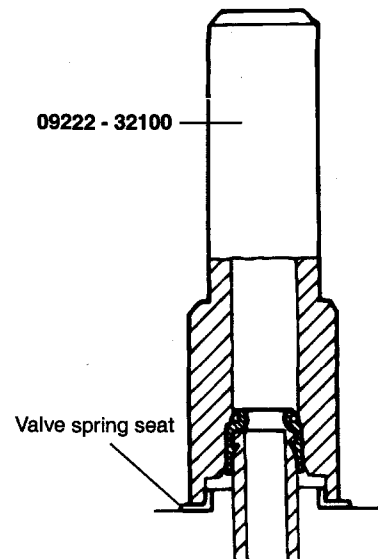
ELCB0830

### VALVE STEM SEAL

- Using Valve Stem Seal Installer (09222 - 32100), install the valve stem seal into the valve guide.

### NOTE

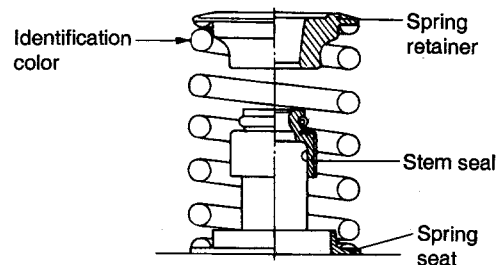
- The valve stem seal must be not reused.
- The special tool must be used for the installation of the valve stem seal. Improper installation could result in oil consumption through valve guide.



ECLA018I

### VALVE SPRING

Direct the valve spring end with identification color to the rocker arm.



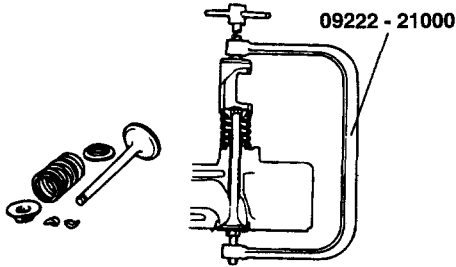
B0Y044B

## VALVE SPRING RETAINER LOCK

Using a valve spring compressor (09222 - 21000), compress the spring and fit the retainer lock in position.

 **NOTE**

*The valve spring, if compressed excessively, causes the bottom end of retainer to be in contact with, and damages, the stem seal.*



ECLA018D

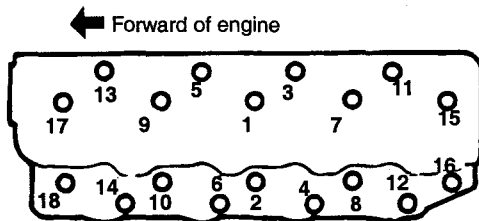
## CYLINDER HEAD

1. Scrape off gasket adhered to cylinder head assembly.

 **CAUTION**

***Be careful that foreign material does not fall into coolant and oil passage ways.***

2. Tighten in the numerical order indicated in the diagram in two or three groups with special tool.



ECLA018J

**Specified torque**

Cold engine :

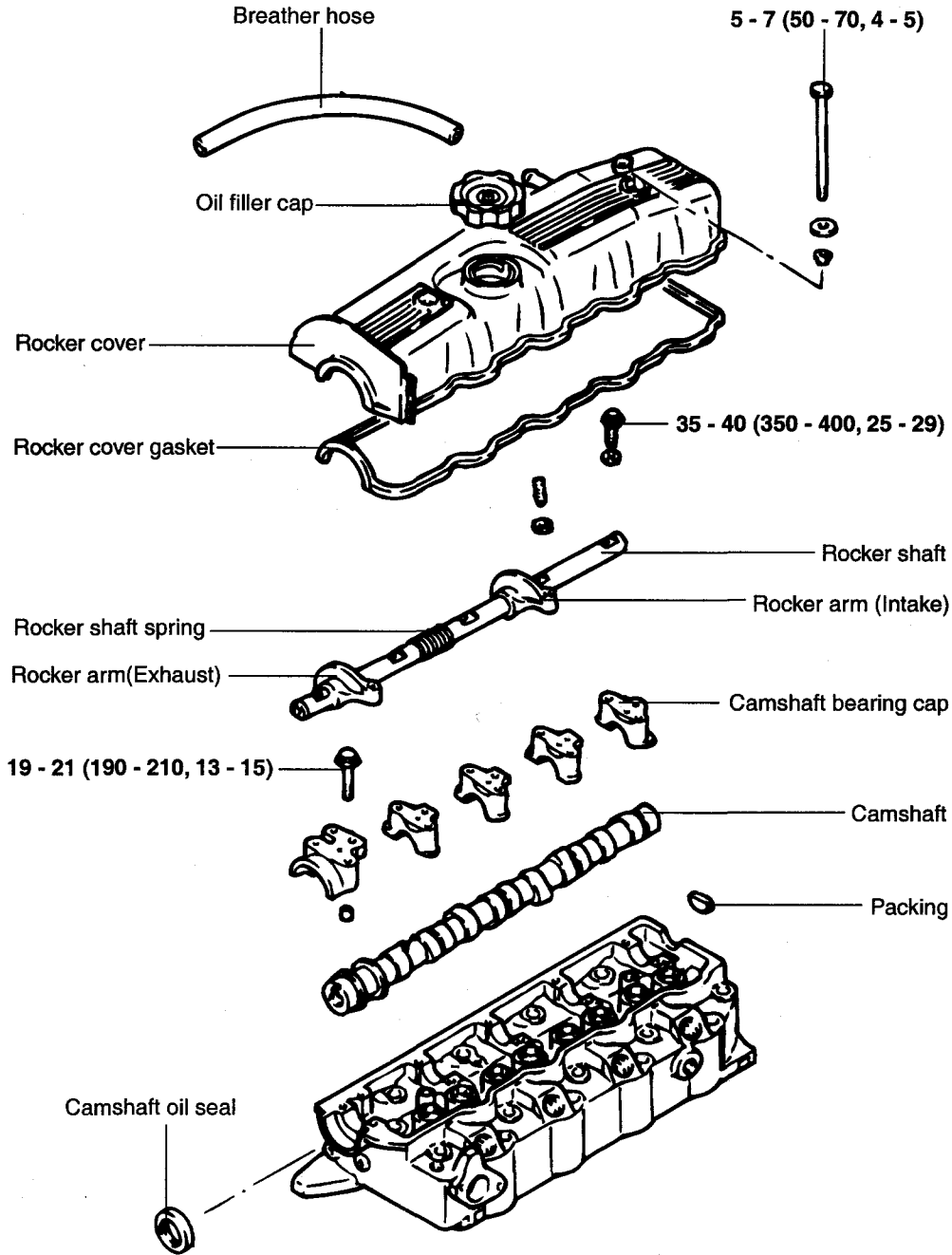
105 - 115 Nm (1050 - 1150 kg.cm, 77 - 85 lb.ft)

Hot engine :

115 - 125 Nm (1150 - 1250 kg.cm, 85 - 92 lb.ft)

# ROCKER ARM

## COMPONENTS ELCB0840

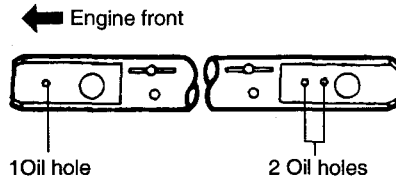


**\*Replace the gasket with new ones after removal.**

**TORQUE : Nm (kg.cm, lb.ft)**

**INSPECTION** ELCB0845**ROCKER SHAFT**

1. Check oil holes for clogging and clean as necessary.
2. Replace the shaft if damage or seizure is evident on the surfaces, to which rocker arms are installed.



ECLA019F

**ROCKER ARM**

1. Check the slipper surface (the surface in contact with the cams). Replace if damage or seizure is evident.
2. Check bore for damage and seizure. Replace if defects are evident.
3. Check the oil clearance

Standard : 0.01 - 0.04 mm (0.0004 - 0.0016 in.)  
 Limit : 0.08 mm (0.0031 in.)

**CHECKING AND ADJUSTMENT OF VALVE CLEARANCE**

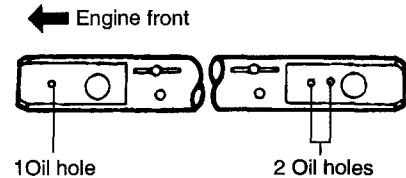
Refer to general part.

**INSTALLATION** ELCB0850**ROCKER ARM AND ROCKER SHAFT**

Turn the crankshaft to bring the piston in No 1. cylinder to the top dead center on the compression stroke. This reduces the cam lift to minimum and facilitates installation.

**ROCKER SHAFT**

1. Keep the oil hole side down.
2. Install the rocker shaft with its side having one oil hole facing to the front.



ECLA019F

**ROCKER ARM (EXHAUST AND INTAKE)**

Install in correct position, confirming the identification marks.

**SEMI - CIRCULAR PACKING**

Apply sealant to the portion indicated in illustration.

Specified sealant : 3M part No 8660 or equivalent

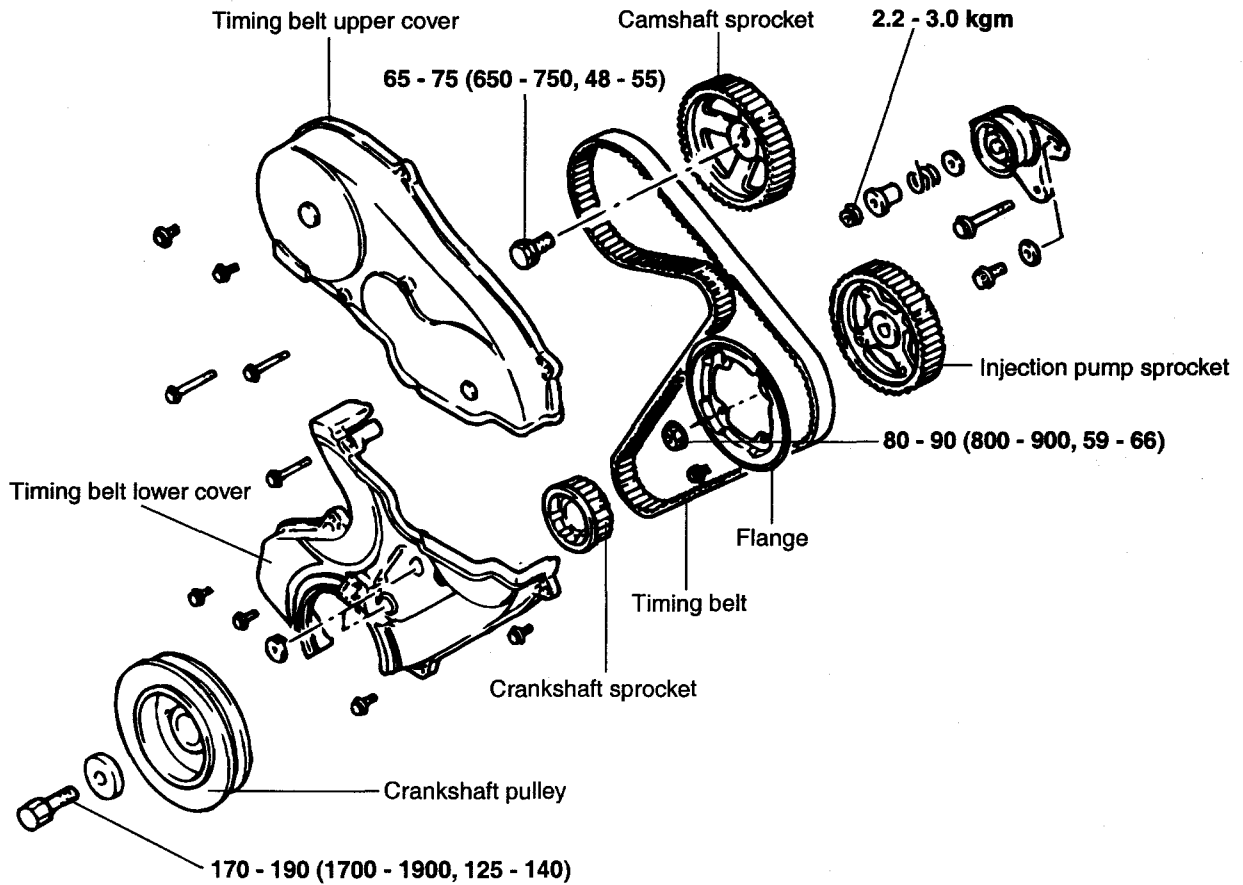


ECLA019G

# TIMING SYSTEM

## TIMING BELT

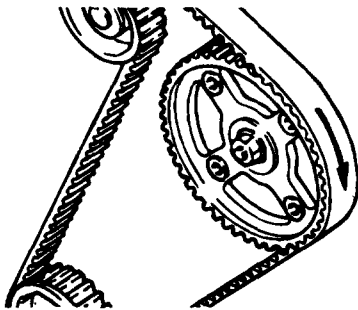
### COMPONENTS ELCB0900



**TORQUE : Nm (kg.cm, lb.ft)**

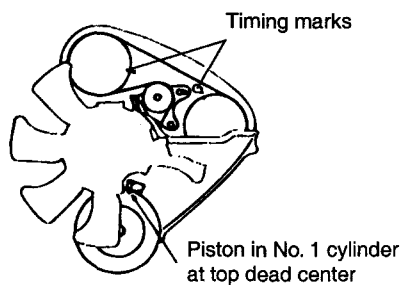
**REMOVAL** ELCB0910**TIMING BELT**

1. Remove the cooling fan, water pump, crankshaft pulley and timing belt cover.
2. Turn the crankshaft to bring the piston in No. 1 cylinder to the top dead center on the compression stroke.
3. Mark an arrow on the back of the timing belt and timing belt B with a chalk to indicate the direction of rotation. This ensures that the belt is installed in the same direction for reuse.



ECLA020B

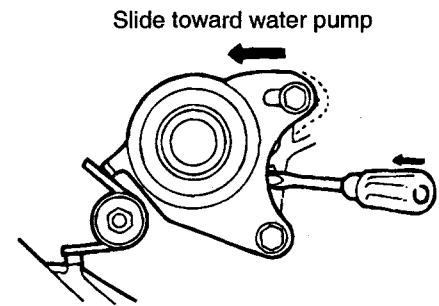
4. The piston in No. 1 cylinder is at the top dead center on the compression stroke when all timing marks at the three places are aligned as shown.



ECLA005B

5. Slightly loosen the two bolts securing the tensioner. Then, slide the tensioner toward the water pump and tighten the bolts temporarily to secure the tensioner in place.

6. Remove the timing belt.



ECLA020C

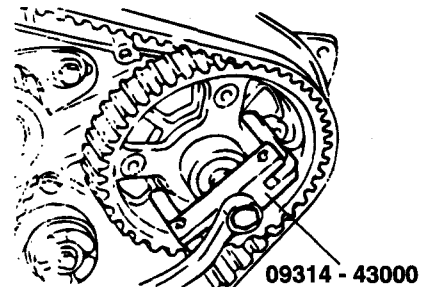
**CAMSHAFT SPROCKET**

1. Loosen the bolt securing the camshaft sprocket and remove the camshaft sprocket.
2. Remove the sprocket nut.

**NOTE**

*Use care not to give shock to the fuel injection pump shaft, as it could result in defective fuel injection pump. Using Injection Pump Sprocket Puller (09314 - 43000) or suitable tool, remove the sprocket from injection pump.*

3. Remove the tensioner and tensioner spring.

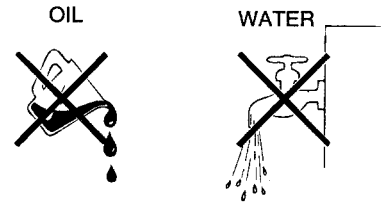


ECLA020D

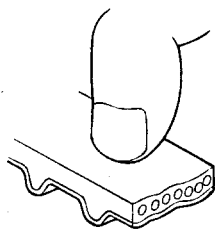
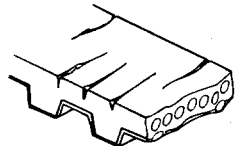
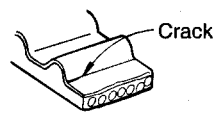
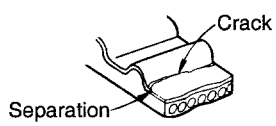
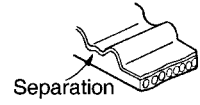
**INSPECTION** ELCB0920

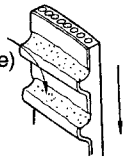
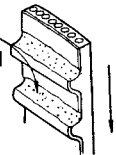
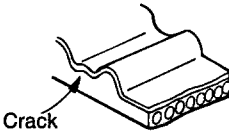
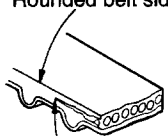
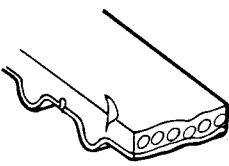
**TIMING BELT**

1. Check the belt for oil or dust deposits. Replace if necessary. Small deposits should be wipe away with a dry cloth or paper. Do not clean with solvent.
2. When the engine is overhauled or belt tension adjusted, check the belt in detail. If the following flaws are evident, replace the belt with a one.



ECA9200A

Description	Flaw conditions
<p>1. Hardened back surface of rubber</p>	<p>Back surface is glossy, Non-elastic and so hard that, when your fingernail is pressed into it, no mark is produced.</p>  <p style="text-align: right;">ECA9200B</p>
<p>2. Cracked back surface of rubber</p>	 <p style="text-align: right;">ECA9200Y</p>
<p>3. Cracked or separating canvas</p>	 <p style="text-align: right;">ECA9200I</p>  <p style="text-align: right;">ECA9200J</p>
<p>4. Badly worn out teeth (initial stage)</p>	 <p style="text-align: right;">ECA9200K</p> <p>Canvas on load side tooth flank worn (Fluffy canvas fibers, rubber gone and color changed to white, and unclear canvas texture)</p>

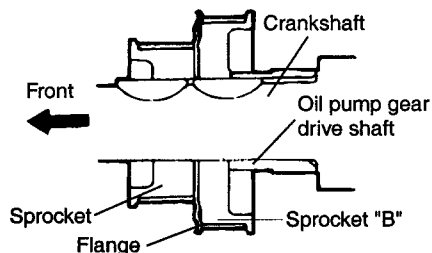
Description	Flaw conditions
5. Badly worn out teeth (last stage)	<p>Flank worn (On load side)</p>  <p>ECA9200C</p> <p>Canvas on load side tooth flank worn down and rubber exposed (tooth width reduced)</p>
6. Cracked tooth bottom	<p>Rubber exposed</p>  <p>ECA9200D</p>
7. Missing tooth	<p>Crack</p>  <p>ECA9200E</p> <p>Tooth missing and canvas fiber exposed</p>
8. Side of belt body worn	<p>Abnormal wear (Fluffy canvas fiber)</p>  <p>ECA9200F</p> <p>Rounded belt side</p>
9. Side of belt cracked	<p>Abnormal wear (Fluffy canvas fiber)</p>  <p>ECA9200G</p> <p><b>NOTE</b> Normal belt should have precisely cut side as if produced by a sharp knife.</p> <p>ECA9200H</p>



## INSTALLATION ELCB0930

### CRANKSHAFT SPROCKET

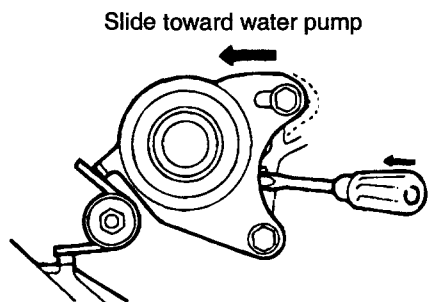
1. Mount the crankshaft sprocket to the crankshaft noting the direction of the sprocket as well as the flange.
2. Mount the camshaft sprocket and tighten the flange bolts to specified torque.



ECLA020E

### TIMING BELT TENSIONER

Install the tensioner, tensioner spring and tensioner spacer and with the tensioner moved all the way to the water pump, temporarily tighten bolt A. Tighten bolt B not fully but finger - tight.



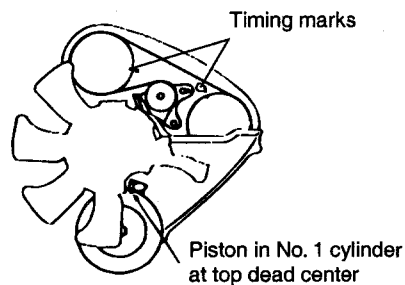
ECLA020C

### TIMING BELT

1. Correctly line up timing marks on three sprockets.
2. While ensuring that the tension side of timing belt is not slack, install belt onto the crankshaft sprocket, injection pump sprocket, tensioner and camshaft sprocket, in that order.

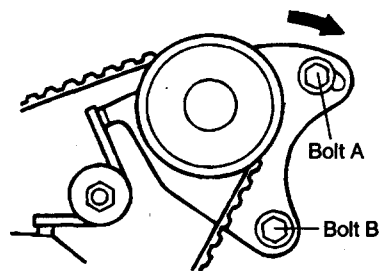
#### NOTE

When installing the belt onto the injection pump sprocket, keep the sprocket in position, as it tends to turn by itself at the timing mark alignment position. If the belt is to be reused, make sure that the arrow mark made during disassembly faces to the correct direction at reassembly.



ECLA005B

3. Check if all timing marks are aligned correctly.
4. Back off tensioner bolt A, that have previously been secured to the water pump side, one to two turns to give tension to the belt using tensioner spring tension.

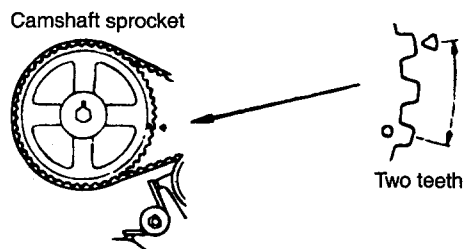


ECLA020F

5. Confirm that the timing belt is correctly engaged with three sprockets.
6. Turn crankshaft clockwise by the two teeth of the camshaft sprocket and keep the position.

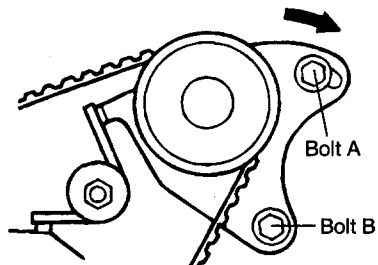
#### CAUTION

**Never turn the crankshaft counterclockwise.**



ECLA020G

7. Tighten the bolt A.
8. Tighten the bolt B.  
If the bolt B is tightened first, the tensioner should be turned together, causing an undue tension to be applied to the timing belt.



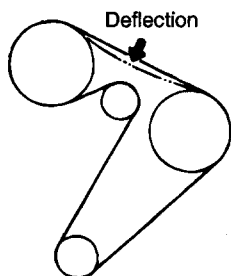
ECLA020F

9. Turn the crankshaft in the direction of backward rotation to line up timing marks. In this condition, ensure that the deflection when the center of belt is pushed by the index finger.

---

Standard : 4 - 5 mm (0.1575 - 0.1969 in.)

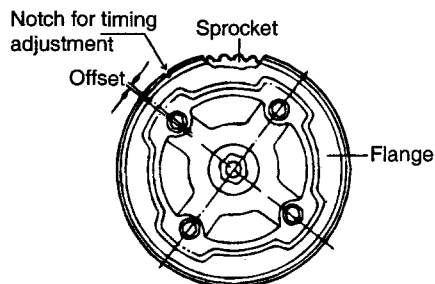
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ECLA020H

## FLANGE

Note that bolt holes in the flange and those in the injection pump sprocket are offset positioned at one place. When assembling, position the flange and sprocket as shown.

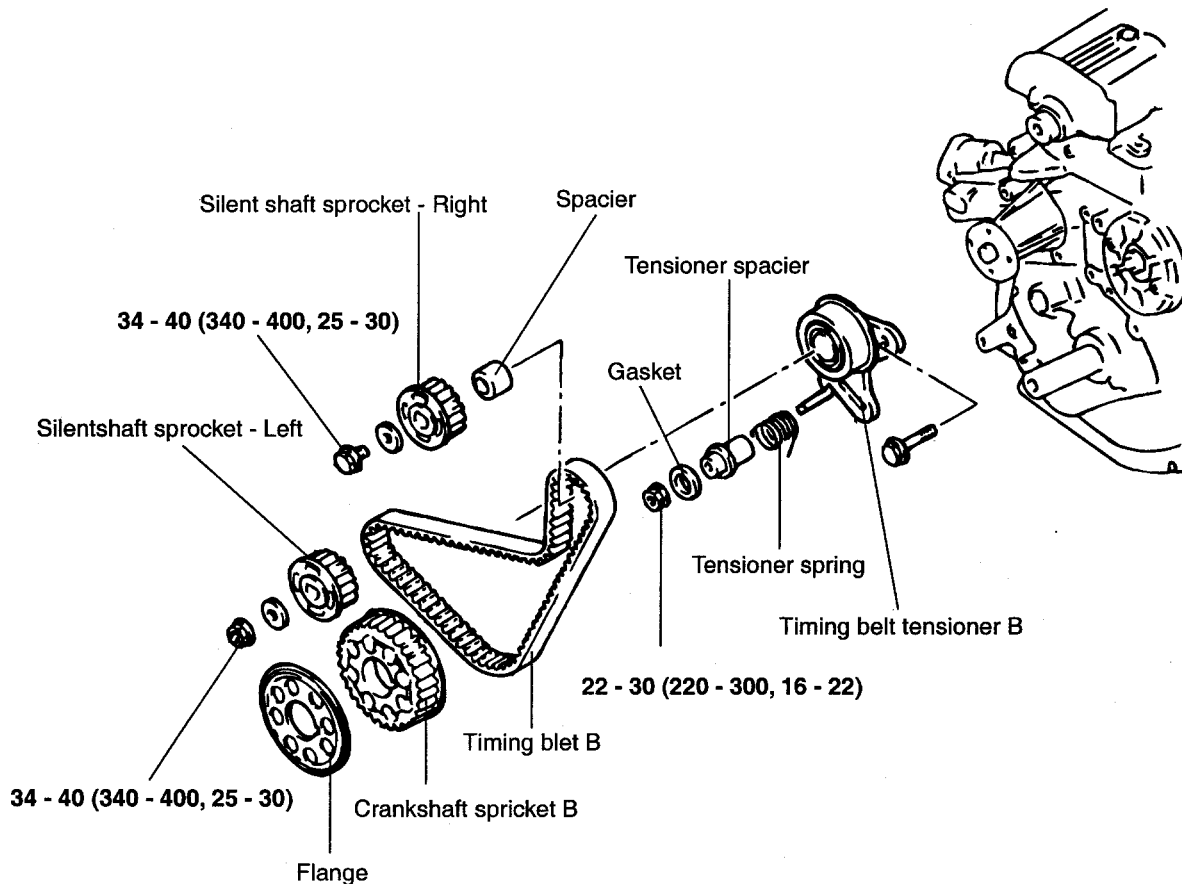


ECLA020I

**TIMING BELT**

ELCB0940

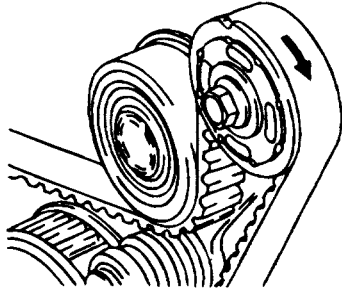
**COMPONENT**



**TORQUE : Nm (kg.cm, lb.ft)**

**REMOVAL** ELCB0950**TIMING BELT "B"**

1. Remove the timing belt.
2. Using chalk or the like, put an arrow on the back of the timing belt "B" to indicate the direction of drive.



ECLA021B

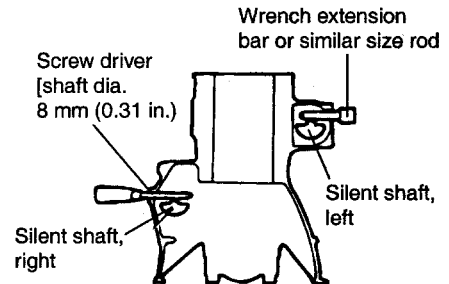
3. Slightly loosen the bolts and nuts securing the tensioner. Then, slide the tensioner toward the water pump and tighten the nuts to secure the tensioner in place temporarily.
4. Remove the timing belt "B"
5. Remove the crankshaft sprocket "B"
6. Remove the two silent shaft sprockets.
7. When loosening the nut and bolt for two silent shaft sprockets, be sure to lock the silent shaft as shown.

**NOTE**

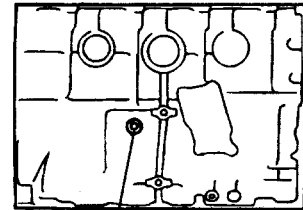
1. Water, oil, or grease on the belt shortens its life drastically. Use special care to ensure that the removed timing belt, sprockets, and tensioner are free from oil and grease.
2. Note also that these parts should not be cleaned. Replace them if seriously contaminated.
3. If there is oil on parks, check for oil leaks from oil seals in from case and camshaft.

**CAUTION**

**Keep the removed parts free from oil and grease. Do not use detergent to clean the timing belt "B", sprocket and tensioner. Wipe clean with rag if found dirty. Replace if excessively contaminated with dirt, grease or oil.**

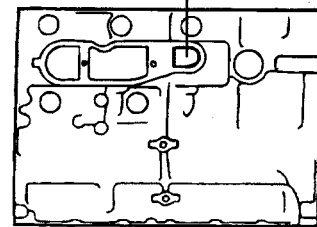


Right side



Remove this plug and insert a screwdriver

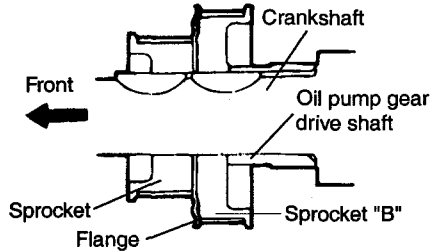
Left side Remove cover and insert bar



ECLA021C

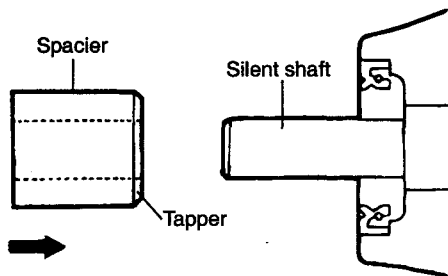
**INSTALLATION** ELCB0960**CRANKSHAFT SPROCKET "B"**

1. Mount the crankshaft sprocket "B" to the crankshaft, noting the direction of the sprocket "B".



ECLA020E

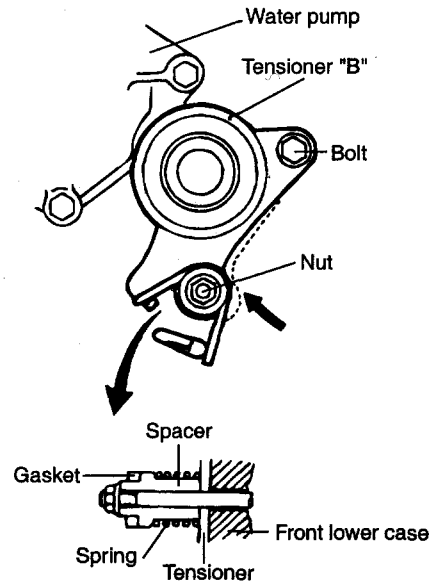
2. The spacer must be installed with its chamfered end facing toward the silent shaft. If the spacer is installed in the wrong direction, damage to oil seal will result.



ECLA021D

**TIMING BELT "B" TENSIONER**

Install the tensioner spring and spacer, with the tensioner moved all the way to the water pump, and tighten the nut. Tighten the bolt not fully put finger - tight.



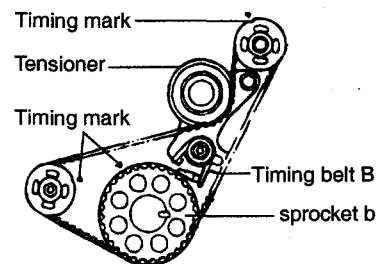
ECLA021E

**TIMING BELT "B"**

1. Line up timing marks on the crankshaft sprocket B, and right and left silent shaft sprockets.
2. With the timing belt B installed, ensure that its tension side is not slack.

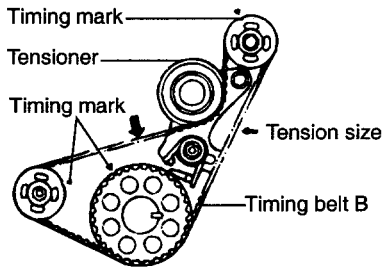
**NOTE**

If the belt is to be reused, make sure that the arrow mark made during disassembly faces to the correct direction at reinstallation.



ECLA021F

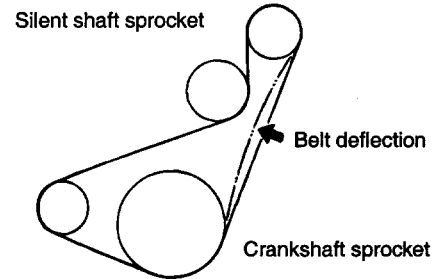
3. With the tension side of timing belt B kept tight by pushing the slack side (indicated by A in illustration) with a finger, make sure that the timing marks are properly aligned with each other.



ECLA021G

7. Ensure that the deflection is 4 to 5 mm (0.0394 to 0.1969 in.) when the belt is pushed by the index finger at the position indicated by and arrow.

Belt deflection : 4 - 5 mm (0.157 - 0.197 in.)

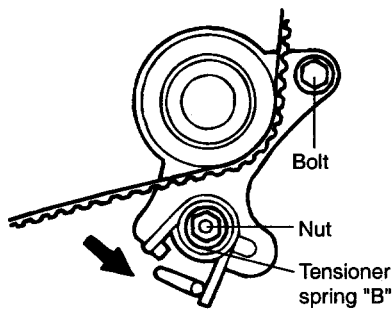


ECLA021I

4. Back off tensioner B nut, that have previously been secured to the water pump side, one to two turns to give tension to the belt using tensioner spring tension.
5. Tighten the tensioner B attaching nut.
6. Tighten the tensioner B attaching bolt.

**NOTE**

*If the bolt is tightened first, the tension B should be turned together, resulting in reduced timing belt B tension.*



ECLA021H

# Engine Electrical System

<b>GENERAL .....</b>	<b>EE - 2</b>
<b>IGNITION SYSTEM .....</b>	<b>EE -10</b>
<b>IGNITION SYSTEM (V6) .....</b>	<b>EE -11</b>
<b>CHARGING SYSTEM .....</b>	<b>EE -14</b>
<b>STARTING SYSTEM .....</b>	<b>EE -34</b>
<b>CRUISE CONTROL SYSTEM .....</b>	<b>EE -45</b>
<b>PREHEATING SYSTEM .....</b>	<b>EE -50</b>

# GENERAL

## SPECIFICATIONS EBMB0010

### IGNITION

	3.5L V6 Engine
Type	
Primary coil resistance	0.74 ± 10% (Ω)
Secondary coil resistance	13.3 ± 15% (KΩ)

### SPARK PLUG

	3.5L V6
Type	
Champion	RC10PYP4
NGK	PFR5N-11
Plug gap	1.0-1.1 mm (0.039-0.043 in.)

### STARTER MOTOR

	3.5L V6	Diesel
Type	Reduction drive (with planetary gear)	Reduction drive (with planetary gear)
Voltage	12V	12V
Output	1.2KW	200KW
No-load characteristics		
Terminal voltage	11V	11V
Amperage	90A or below	90A or below
Speed	2,800 RPM	2,800 RPM
Number of pinion teeth	8	8
Pinion gap	0.5-2.0 mm (0.0197-0.079 in.)	0.5-2.0 mm (0.0197-0.079 in.)

### GENERATOR

	3.5L V6	Diesel
Type	Battery voltage sensing	Battery voltage sensing
Rated output	13.5V / 120A	12V / 75A
Voltage regulator type	Electronic built-in type	Electronic built-in type
Regulator setting voltage	14.4 ± 0.3 V	14.4 ± 0.3 V
Temperature compensated	-10 ± 3 mV / °C	-10 ± 3 mV / °C

### BATTERY

	All Engines
Type	MF 68 AH, MF 90 AH, MF 100 AH
Ampere hours	
5HR	55 AH or more
Cold cranking [at -17.8°C (0°F)]	540 AH or more
Reverse capacity	122 min.
Specific gravity [at 25°C (77°F)]	1.280 ± 0.01



 **NOTE**

*COLD CRANKING AMPERAGE is the amperage a battery can deliver for 30 seconds and maintain a terminal voltage of 7.2 or greater at a specified temperature. REVERSE CAPACITY RATING is the amount of time a battery can deliver 25A and maintain a minimum terminal voltage of 10.5 at 26.7°C (80°F).*

**CRUISE CONTROL SYSTEM**

Speed control module Operating voltage range Operating temperature Voltage drop between unit and actuator Operating speed range	DC 10 - 16V -30 ± 75°C (-22 ± 167°F) 0.4V Low speed limit : 40 ± 3 km/h (25 ± 2 mph) High speed limit : 145 ± 5 km/h (90 ± 3 mph)
Actuator Rated voltage Operating temperature Operating consumption Insulating resistance	DC 12V -30 ± 90°C (-22 ± 194°F) 3A or less (at 12V 20°C) 1MΩ or less (at 500V megger)
Cruise main switch Rated voltage Operating force Voltage drop	DC 12V 0.3 - 1.0 kg 0.15 V or less
Stop lamp switch Rated voltage Rated load Stop lamp Cruise control Insulating resistance	DC 12V 27 x 5W (lamp load) 0.1 - 0.5A (relay load) Min 3 MΩ (by 500V megger)

**TIGHTENING TORQUE**

Items	Nm	Kg·cm	lb·ft
Generator terminal (B+)	5-7	50-70	3.6-5.1
Starter motor terminal (B+)	10-12	100-120	7.3-8.8
Battery terminal	4-6	40-60	2.9-4.3
Spark plug	20-30	200-300	15-22

**TROUBLESHOOTING** EBMB0030**IGNITION SYSTEM**

Trouble symptom	Probable cause	Remedy
Engine will not start or is hard to start (Crank OK)	Ignition lock switch faulty Ignition coil faulty Power transistor faulty Spark plugs faulty Ignition wiring disconnected or broken Spark plugs faulty	Replace ignition lock switch Inspect ignition coil Inspect power transistor Replace plugs Inspect wiring Replace plugs
Rough idle or stalls	Ignition wiring faulty Ignition coil faulty Spark plug cable faulty	Inspect wiring Inspect ignition coil Inspect spark plug cable
Engine hesitates/poor acceleration	Spark plugs faulty Ignition wiring faulty	Replace plugs Inspect ignition coil
Poor mileage	Spark plugs faulty	Replace plugs

**CHARGING SYSTEM**

Trouble symptom	Probable cause	Remedy
Charging warning indicator does not light with ignition switch "ON" and engine off	Fuse blown Light burned out Wiring connection loose Electronic voltage regulator faulty	Check fuses Replace light Tighten loose connections Replace voltage regulator
Charging warning indicator does not go out with engine running (Battery requires frequent recharging)	Drive belt loose or worn Battery cables loose, corroded or worn Fuse blown Fusible link blown Electronic voltage regulator or generator faulty Wiring faulty	Adjust tension or replace drive belt Repair or replace cables Check fuses Replace fusible link Test generator Repair wiring
Engine hesitates/poor acceleration Overcharge	Drive belt loose or worn Wiring connection loose or open circuit  Fusible link blown Poor grounding Electronic voltage regulator or generator faulty  Worn battery Electronic voltage regulator faulty Voltage sensing wire faulty	Adjust tension or replace drive belt Tighten loose connection or repair wiring  Replace fusible link Repair Test generator, if faulty, repair or replace. Replace battery Replace voltage regulator Repair wire

**STARTING SYSTEM**

Trouble symptom	Probable cause	Remedy
Engine will not crank	Battery charge low Battery cables loose, corroded or worn out Transaxle range switch faulty (Vehicle with automatic transaxle only) Fusible link blown Starter motor faulty Ignition switch faulty Ignition lock switch faulty	Charge or replace battery Repair or replace cables Adjust or replace switch Replace fusible link Repair starter motor Replace ignition switch Replace ignition lock switch
Engine cranks slowly	Battery charge low Battery cables loose, corroded or worn out Starter motor faulty	Charge or replace battery Repair or replace cables Repair starter motor
Starter keeps running	Starter motor faulty Ignition switch faulty	Repair starter motor Replace ignition switch
Starter spins but engine will not crank	Short in wiring Pinion gear teeth broken or starter motor faulty Ring gear teeth broken	Repair wiring Repair starter motor Replace flywheel ring gear or torque converter

**GLOW CONTROL SYSTEM (DIESEL)**

Trouble symptom	Probable cause	Remedy
Engine will not start below 50°C	Wiring connection loose or bad wiring ECT sensor malfunction Glow plug malfunction Glow plug control unit failed	Repair or replace wiring Replace ECT sensor Repair or replace glow plug Replace glow control unit
After first combustion, engine stall or rough idle below 50°C	Wiring connection loose or bad wiring Glow plug malfunction Glow plug relay malfunction Glow plug control unit failed	Repair or replace wiring Check the resistance of glow plug and replace, if necessary Check the relay and replace, if necessary Check the control unit and replace, if necessary
Yellow glow lamp will not turn-ON	Open lamp Wiring connection loose or bad wiring Shorted wiring Glow plug control unit failed	Replace lamp Repair or replace wiring Repair or replace wiring Replace control unit, if necessary

## **CRUISE CONTROL SYSTEM PRE-TROUBLESHOOTING**

### **PRE-TROUBLESHOOTING**

Before starting troubleshooting, inspect each of the following sections, and if there is an abnormality, carry out a repair.

1. Check if the installation and connection routes of the cables and vacuum hoses of the cruise vacuum pump assembly, actuator and pulley assembly are all normal.
2. Check if the pulley assembly and the movement of cables are working smoothly.
3. Check if there is no excessive play or tension in each cable.

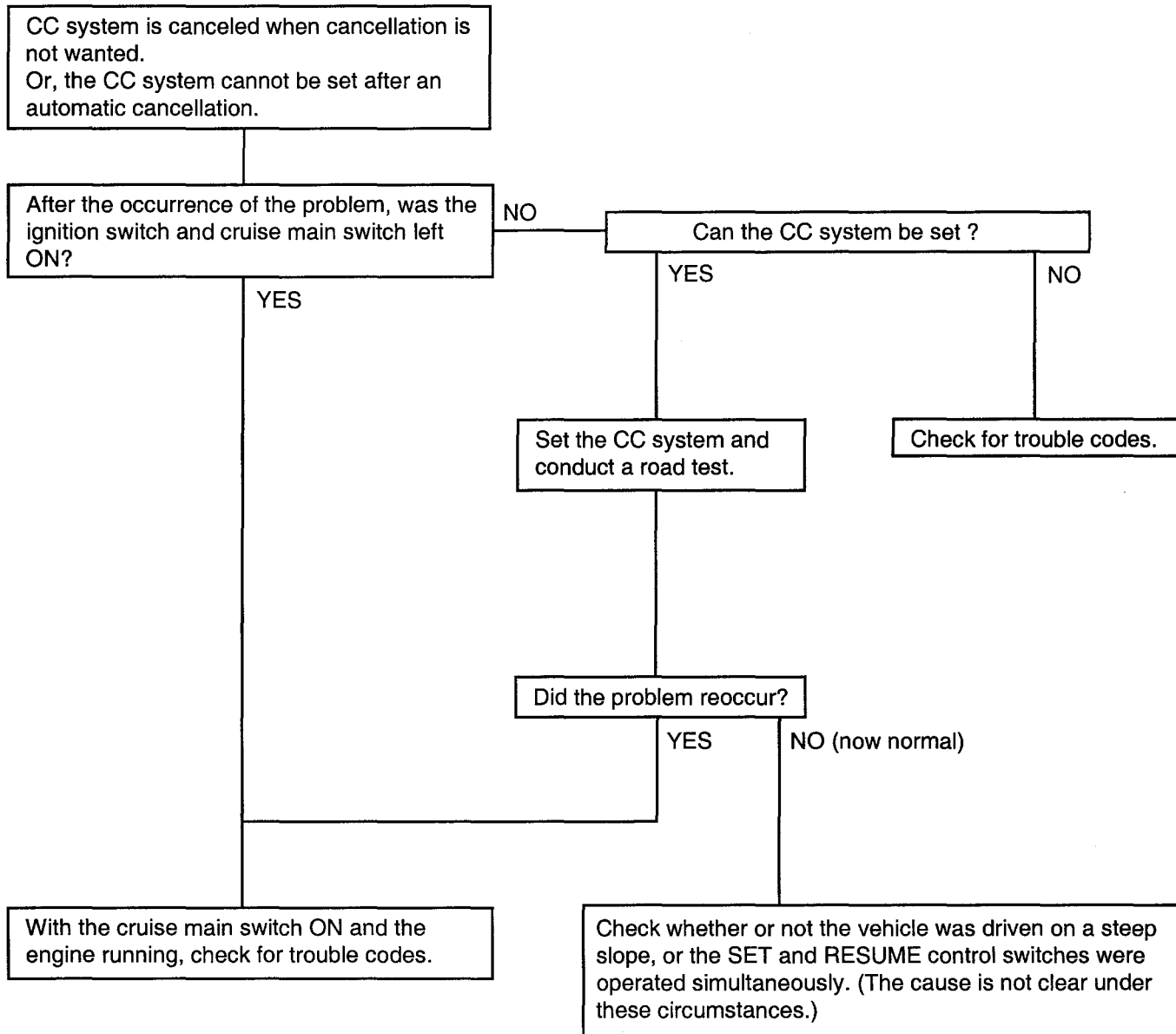
### **TROUBLESHOOTING PROCEDURES**

First, select the applicable malfunction symptom from the "TROUBLE SYMPTOM CHARTS" shown on next pages. Determine the condition of all function circuits.

1. Make the following preliminary inspections.
  - Check that the installation of the actuator, accelerator cable are correct, and that the cables and links are securely connected.
  - Check that the accelerator pedal moves smoothly.
  - Adjust the cable so there is not excessive tension or excessive play on the accelerator cable.
  - Check that the actuator and unit assembly, cruise main, control switch and the connector of each cancel switch are connected securely.
2. Check in the sequence indicated in the "TROUBLE SYMPTOM CHARTS".
3. If a normal condition is indicated, replace the cruise control module.

TROUBLE SYMPTOM CHARTS

TROUBLE SYMPTOM 1



CC : Cruise Control

**TROUBLE SYMPTOM 2**

Trouble symptom	Probable cause	Remedy
The set vehicle speed varies greatly upward or downward "Surging" (repeated alternating acceleration and deceleration) occurs after setting	Malfunction of the vehicle speed sensor circuit	Repair the vehicle speed sensor system, or replace the part
	Malfunction of the speedometer cable or speedometer drive gear	
	Cruise vacuum pump circuit poor contact	Repair the actuator system, or replace the part
	Malfunction of the acutator and unit	Replace the actuator and unit

**TROUBLE SYMPTOM 3**

Trouble symptom	Probable cause	Remedy
The CC system is not canceled when the brake pedal is depressed	Damaged or disconnected wiring of the stop lamp switch	Repair the harness or replace the stop lamp switch
	Cruise vacuum pump drive circuit short-circuit	Repair the harness or replace the vacuum pump
	Malfunction of the actuator and unit	Replace the actuator and unit

**TROUBLE SYMPTOM 4**

Trouble symptom	Probable cause	Remedy
The CC system is not canceled when the shift lever is moved to the "N" position (It is canceled, however, when the brake pedal is depressed)	Damaged or disconnected wiring of inhibitor switch input circuit	Repair the harness or repair or replace the inhibitor switch
	Improper adjustment of inhibitor switch	
	Malfunction of the actuator and unit	Replace the actuator and unit

**TROUBLE SYMPTOM 5**

Trouble symptom	Probable cause	Remedy
Cannot decelerate (coast) by using the SET switch	Temporary damaged or disconnected wiring of SET switch input circuit	Repair the harness or replace the SET switch
	Actuator circuit poor contact	Repair the harness or replace the actuator
	Malfunction of the actuator	
	Malfunction of the actuator and unit	Replace the actuator and unit

**TROUBLE SYMPTOM 6**

Trouble symptom	Probable cause	Remedy
Cannot accelerate or resume speed by using the RESUME switch	Damaged or disconnected wiring, or short circuit, or RESUME switch input circuit	Repair the harness or replace the RESUME switch
	Actuator circuit poor contact	Repair the harness or replace the actuator
	Malfunction of the actuator	
	Malfunction of the actuator and unit	Replace the actuator and unit

**TROUBLE SYMPTOM 7**

Trouble symptom	Probable cause	Remedy
CC system can be set while driving at a vehicle speed of less than 40km/h (25mph), or there is no automatic cancellation at that speed	Malfunction of the vehicle-speed sensor circuit	Repair the vehicle speed sensor system, or replace the part
	Malfunction of the speedometer cable or the speedometer drive gear	
	Malfunction of the actuator and unit	Replace the actuator and unit

**TROUBLE SYMPTOM 8**

Trouble symptom	Probable cause	Remedy
The cruise main switch indicator lamp does not illuminate (But CC system is normal)	Damaged or disconnected bulb of cruise main switch indicator lamp	Repair the harness or replace the part.
	Harness damaged or disconnected	

**TROUBLE SYMPTOM 9**

Trouble symptom	Probable cause	Remedy
Malfunction of control function by ON/OFF switching of idle switch	Malfunction of circuit related to idle switch function	Repair the harness or replace the part
	Malfunction of the actuator and unit	

**TROUBLE SYMPTOM 10**

Trouble symptom	Probable cause	Remedy
Overdrive is not canceled during fixed speed driving	Malfunction of circuit related to overdrive cancelation, or malfunction of actuator and unit	Repair the harness or replace the part
No shift to overdrive during manual driving		

# IGNITION SYSTEM

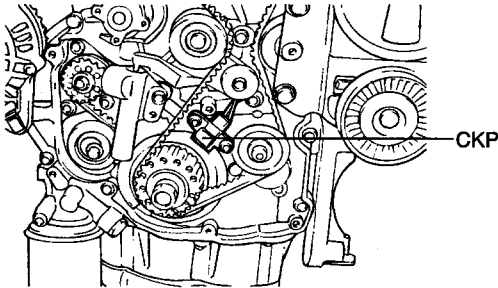
## GENERAL INFORMATION EBB0040

Ignition timing is controlled by the electric control ignition timing system. The ignition timing data for the engine operating conditions are programmed in the memory of the power train control module (PCM).

The engine conditions (speed, load, warm-up condition, etc.) are detected by the various sensors. Based upon these sensor signals and the ignition timing data, signals to interrupt the primary current are sent to the power transistor. The ignition coil is activated and timing is controlled at the optimum point.

\*CKP : Crankshaft Position Sensor

\*CMP : Camshaft Position Sensor



EFA9401D



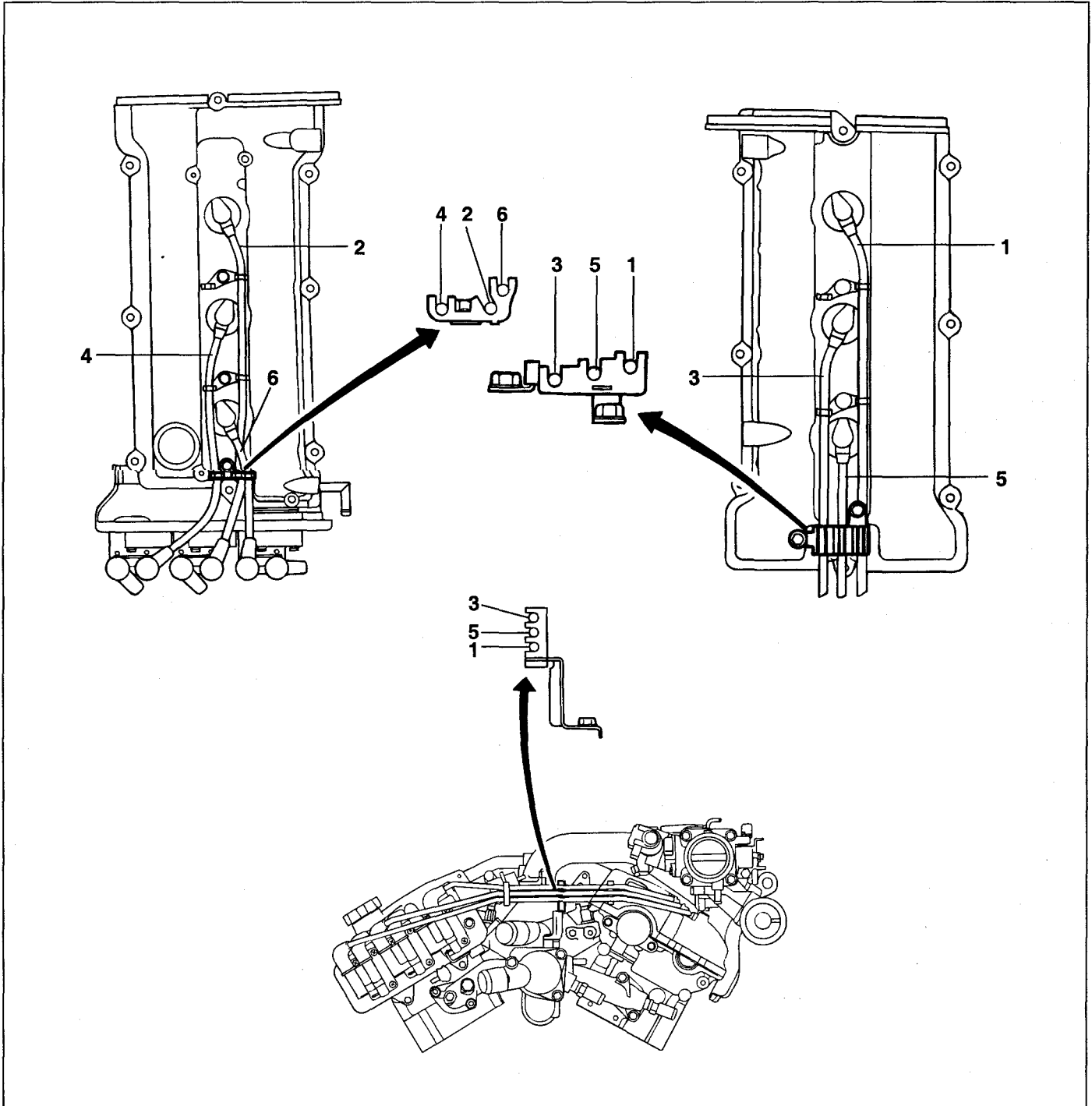
# IGNITION SYSTEM (V6)

Therefore, be careful to arrange the spark plug cables properly as shown in the illustration.

## INSTALLATION OF SPARK PLUG CABLE

EBBB0100

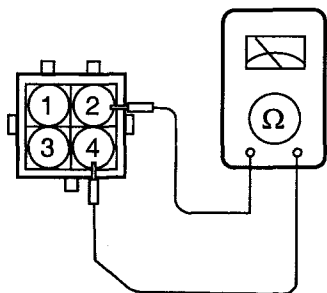
Improper arrangement of spark plug cables will induce flashover between the cables, causing misfiring and surging at acceleration in high-speed operations.



**IGNITION COIL** EBBB0060

- Measurement of the primary coil resistance**  
Measure the resistance between connector terminals 1 and 2 (the coils at the No. 3 and No. 6 cylinder sides) of the ignition coil, and between terminals 2 and 4 (the coils at the No. 1 and No. 4 cylinder sides), and between terminals 2 and 3 (the coils at the No.2 and No.5 cylinder sides).

**Standard value : 0.74 ± 10% (Ω)**



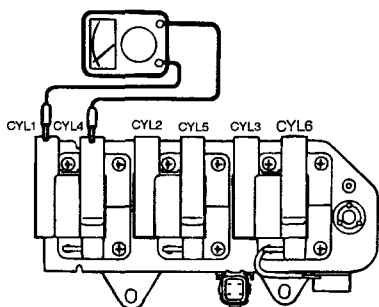
EBHA006A

- Measurement of the secondary coil resistance**  
Measure the resistance between the high-voltage terminal for the No. 3 and No. 6 cylinders, between the high-voltage terminals for the No. 1 and No. 4 cylinders and between the high-voltage terminals for the No.2 and No.5 cylinders.

**Standard value : 13.3 ± 15% (KΩ)**

**CAUTION**

*When measuring the resistance of the secondary coil, be sure to disconnect the connector of the ignition coil.*



EBA9009B

**INSPECTION AND CLEANING** EBHA0110

- Disconnect the spark plug cable from the spark plug.

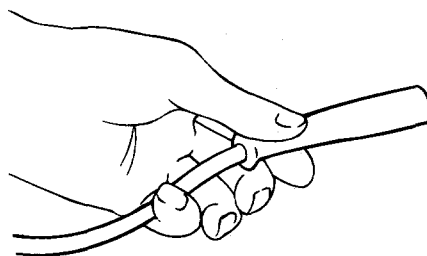
**NOTE**

*Pull on the spark plug cable boot when removing the spark plug cable, not the cable, as it may be damaged.*

- Using the spark plug wrench, remove all of the spark plugs from the cylinder head.

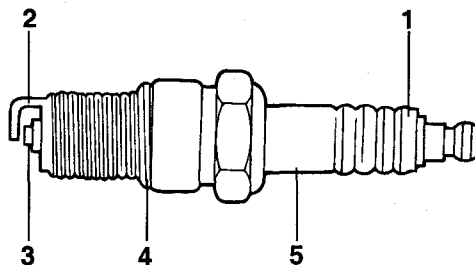
**NOTE**

*Take care not to allow contaminants to enter through the spark plug holes.*



EBA9015A

- Check the spark plugs for the following:
  - Broken insulator
  - Worn electrode
  - Carbon deposits
  - Damaged or broken gasket
  - Condition of the porcelain insulator at the tip of the spark plug (carbon tracking)

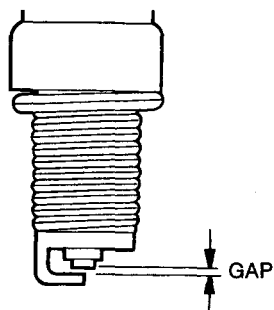


EBA9015B

- Check the spark plug gap using a wire gap gauge, and adjust if necessary.

**Standard value**

Spark plug gap : 1.0-1.1 mm (0.039-0.043 in.)



EBA9015C

5. Re-insert the spark plug and tighten to the specified torque. If it is overtorqued, damage to the threaded portion of cylinder head may result.

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**Tightening torque**

Spark plug : 20-30Nm (200-300kg·cm, 15-22 lb·ft)

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** NOTE**

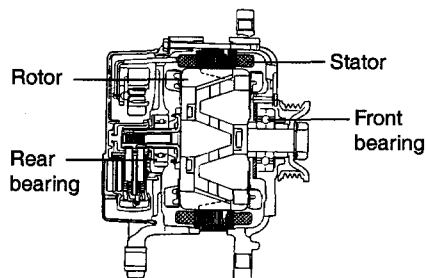
*When replacing the spark plug, use resistance plugs.*

# CHARGING SYSTEM

## GENERAL INFORMATION EBBB0120

The charging system included a battery, an generator with a built-in regulator, and the charging indicator light and wire. The generator has six built-in diodes (three positive and three negative), each rectifying AC current to DC current. Therefore, DC current appears at generator "B" terminal.

In addition, the charging voltage of this generator is regulated by the battery voltage detection system. The generator is regulated by the battery voltage detection system. The main components of the generator are the rotor, stator, rectifier, capacitor brushes, bearings and V-ribbed belt pulley. The brush holder contains a built-in electronic voltage regulator.



EBA9130A

## INSPECTIONA EBBB0130

### VOLTAGE DROP TEST OF GENERATOR OUTPUT WIRE

This test determines whether or not the wiring between the generator "B" terminal and the battery (+) terminal is good by the voltage drop method.

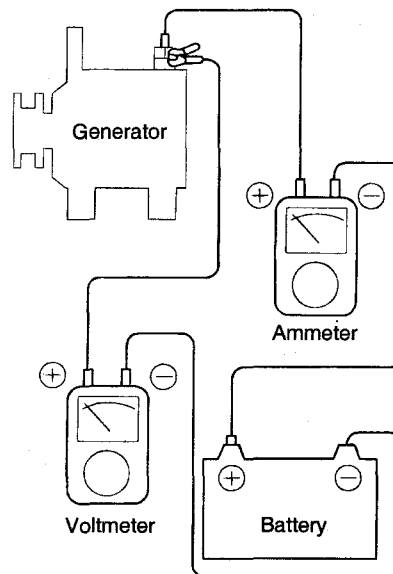
#### PREPARATION

1. Turn the ignition switch to "OFF".

#### NOTE

To find abnormal conditions of the connection, actions should not be taken on the two terminals and each connection during the test.

2. Connect a digital voltmeter between the generator "B" terminal and battery (+) lead wire to the battery (+) terminal. Connect the (+) lead wire of the voltmeter to the "B" terminal and the (-) lead wire to the battery (+) terminal.



EBBB013A

### CONDITIONS FOR THE TEST

1. Start the engine.
2. Switch on the headlamps, blower motor and so on. And then, read the voltmeter under this condition.

### RESULT

1. The voltmeter may indicate the standard value.

Standard value : 0.2V max.

2. If the value of the voltmeter is higher than expected (above 0.2V max.), poor wiring is suspected. In this case check the wiring from the generator "B" terminal to the fusible link to the battery (+) terminal. Check for loose connections, color change due to an overheated harness, etc. Correct them before testing again.
3. Upon completion of the test, set the engine speed at idle. Turn off the head lamps, blower motor and the ignition switch.

### OUTPUT CURRENT TEST

This test determines whether or not the generator gives an output current that is equivalent to the nominal output.

#### PREPARATION

1. Prior to the test, check the following items and correct as necessary.

- 1) Check the battery installed in the vehicle to ensure that it is in good condition. The battery checking method is described in "BATTERY".

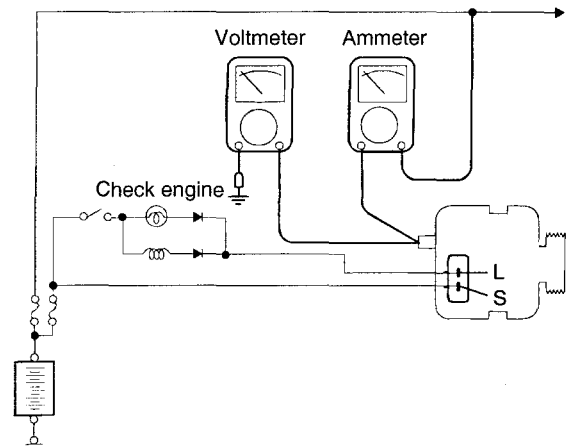
The battery that is used to test the output current should be one that has been partially discharged. With a fully charged battery, the test may not be conducted correctly due to an insufficient load.

- 2) Check the tension of the generator drive belt. The belt tension check method is described in the section "COOLING".
2. Turn off the ignition switch.
3. Disconnect the battery ground cable.
4. Disconnect the generator output wire from the generator "B" terminal.
5. Connect a DC ammeter (0 to 100A) in series between the "B" terminal and the disconnected output wire. Be sure to connect the (-) lead wire of the ammeter to the disconnected output wire.

#### NOTE

*Tighten each connection securely, as a heavy current will flow. Do not rely on clips.*

6. Connect a voltmeter (0 to 20V) between the "B" terminal and ground. Connect the (+) lead wire to the generator "B" terminal and (-) lead wire to a good ground.
7. Attach an engine tachometer and connect the battery ground cable.
8. Leave the engine hood open.



EBBB013B

#### TEST

1. Check to see that the voltmeter reads as the same value as the battery voltage. If the voltmeter reads 0V, and the open circuit in the wire between the generator "B" terminal and battery (-) terminal, a blown fusible link or poor grounding is suspected.
2. Start the engine and turn on the headlights.
3. Set the headlights to high beam and the heater blower switch to HIGH, quickly increase the engine speed to 2,500 rpm and read the maximum output current value indicated by the ammeter.

#### NOTE

*After the engine starts up, the charging current quickly drops. Therefore, the above operation must be done quickly to read the maximum current value correctly.*

#### RESULT

1. The ammeter reading must be higher than the limit value. If it is lower but the generator output wire is in good condition, remove the generator from the vehicle and test it.

---

Limit value (95A generator) : 63A min.

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#### NOTE

- The nominal output current value is shown on the nameplate affixed to the generator body.
- The output current value changes with the electrical load and the temperature of the generator

itself. Therefore, the nominal output current may not be obtained. If such is the case, keep the headlights on the cause discharge of the battery, or use the lights of another vehicle to increase the electrical load.

The nominal output current may not be obtained if the temperature of the generator itself or ambient temperature is too high.

In such a case, reduce the temperature before testing again.

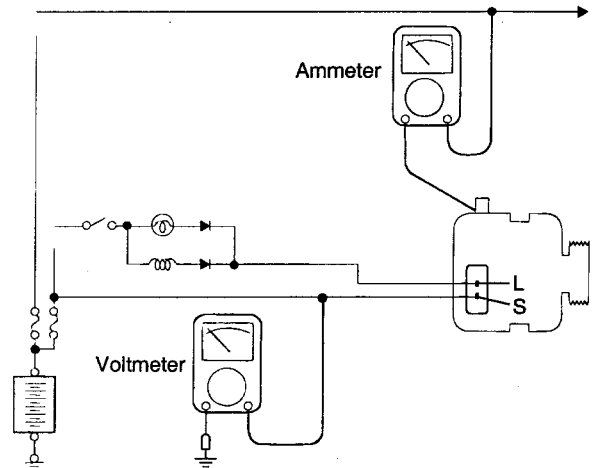
2. Upon completion of the output current test, lower the engine speed to idle and turn off the ignition switch.
3. Disconnect the battery ground cable.
4. Remove the ammeter and voltmeter and the engine tachometer.
5. Connect the generator output wire to the generator "B" terminal.
6. Connect the battery ground cable.

**REGULATED VOLTAGE TEST**

The purpose of this test is to check that the electronic voltage regulator controls voltage correctly.

**PREPARATION**

1. Prior to the test, check the following items and correct if necessary.
  - 1) Check that the battery installed on the vehicle is fully charged. For battery checking method, see "BATTERY."
  - 2) Check the generator drive belt tension. For belt tension check, see "COOLING" section.
2. Turn ignition switch to "OFF."
3. Disconnect the battery ground cable.
4. Connect a digital voltmeter between the "S(L)" terminal of the generator and ground. Connect the (+) lead of the voltmeter to the "S(L)" terminal of the generator. Connect the (-) lead to good ground or the battery (-) terminal.
5. Disconnect the generator output wire from the generator "B" terminal.
6. Connect a DC ammeter (0 to 100A) in series between the "B" terminal and the disconnected output wire. Connect the (-) lead wire of the ammeter to the disconnected output wire.
7. Attach the engine tachometer and connect the battery ground cable.



EBBB013C

**TEST**

1. Turn on the ignition switch and check to see that the voltmeter indicates the following value.

Voltage : Battery voltage

If it reads 0V, there is an open circuit in the wire between the generator "S(L)" terminal and the battery and the battery (+), or the fusible link is blown.

2. Start the engine. Keep all lights and accessories off.
3. Run the engine at a speed of about 2,500 rpm and read the voltmeter when the generator output current drops to 10A or less.

**RESULT**

1. If the voltmeter reading agrees with the value listed in the Regulating Voltage Table below, the voltage regulator is functioning correctly. If the reading is other than the standard value, the voltage regulator or the generator is faulty.

**REGULATING VOLTAGE TABLE**

Voltage regulator ambient temperature °C(°F)	Regulating voltage (V)
-20 (-4)	14.2-15.4
20 (68)	13.9-14.9
60 (140)	13.4-14.6
80 (176)	13.1-14.5

2. Upon completion of the test, reduce the engine speed to idle, and turn off the ignition switch.
3. Disconnect the battery ground cable.
4. Remove the voltmeter and ammeter and the engine tachometer.
5. Connect the generator output wire to the generator "B" terminal.
6. Connect the battery ground cable.

## GENERATOR OUTPUT LINE VOLTAGE

### DROP TEST EBBB0140

This test determines the condition of the wiring from the generator "B" terminal to the battery (+) terminal (including the fusible link).

1. Be sure to check the following before testing:
  - Generator installation and wiring connections
  - Generator drive belt tension
  - Fusible link
  - Abnormal noise from the generator while the engine is running.
2. Turn the ignition switch to the OFF position.
3. Disconnect the negative battery cable.
4. Disconnect the generator output wire from the generator "B" terminal. Connect a DC test ammeter with a range of 0-100A in series between the "B" terminal and the disconnected output wire. (Connect the (+) lead of the ammeter to the "B" terminal. Connect the (-) lead of the ammeter to the disconnected output wire.)

#### NOTE

*An inductive-type ammeter which enables measurements to be taken without disconnecting the generator output wire is recommended. Using this equipment will lessen the possibility of a voltage drop caused by a loose "B" terminal connection.*

5. Connect a digital-type voltmeter between the generator "B" terminal and the battery (+) terminal. (Connect the (+) lead of the voltmeter to the "B" terminal. Connect the (-) lead of the voltmeter to the battery (+) cable.)
6. Reconnect the negative battery cable.
7. Connect a tachometer or the scan tool.
8. Start the engine.

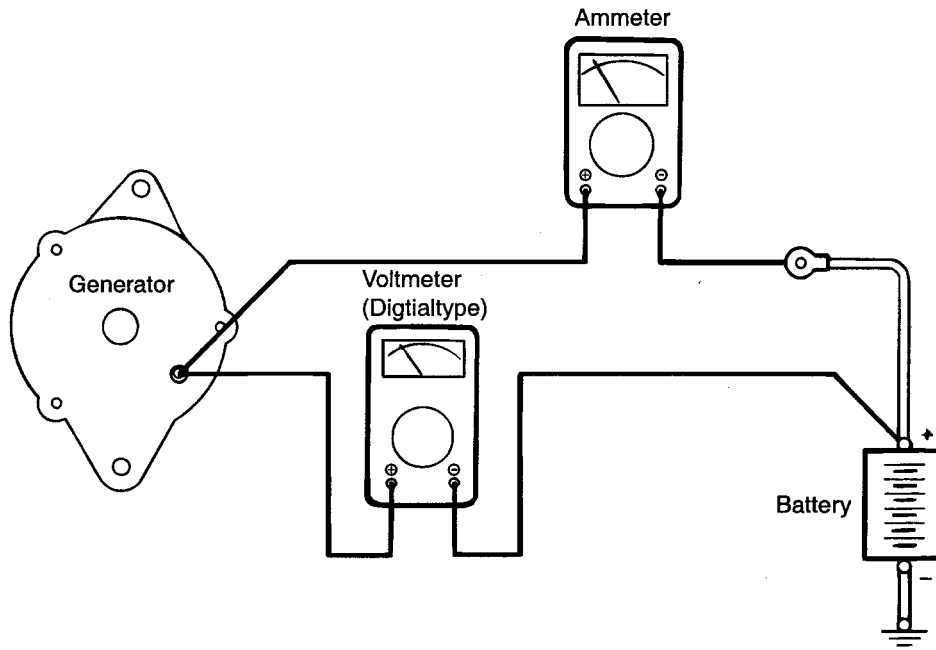
9. With the engine running at approx. 2500 r/min, turn the headlights and other lights on and off to adjust the generator load on the ammeter slightly above 30A.

**Limit: max. 0.3V**

#### NOTE

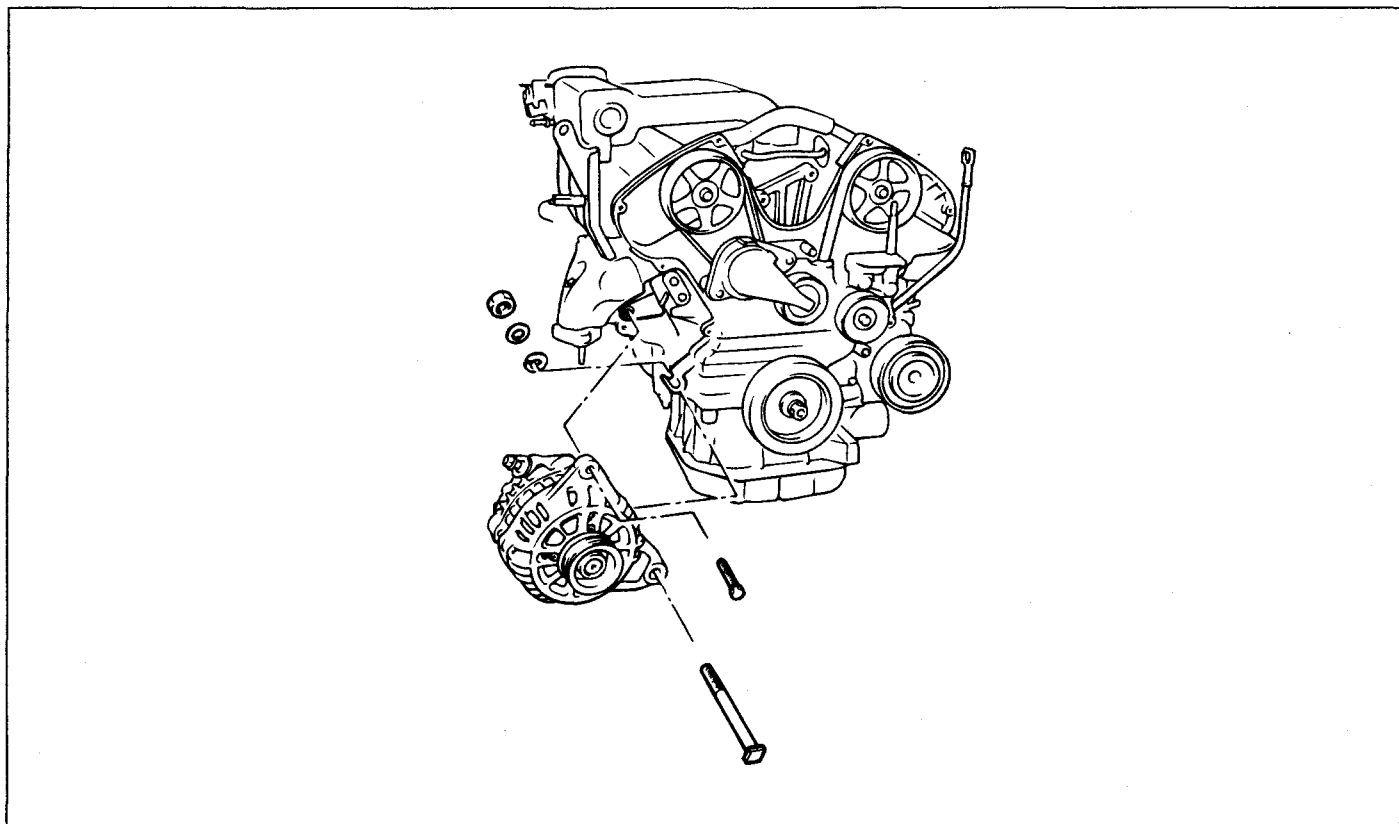
*When the generator output is high and the value displayed on the ammeter does not decrease to 30A, set the value to 40A. Read the value displayed on the voltmeter. In this case the limit becomes max. 0.4V.*

10. If the value displayed on the voltmeter is still above the limit, a malfunction in the generator output wire may exist. Check the wiring between the generator "B" terminal and the battery (+) terminal (including fusible link). If a terminal is not sufficiently tight or if the harness has become discolored due to overheating, repair, the test again.
11. After the test, run the engine at idle.
12. Turn off all lights and turn the ignition switch to the OFF position.
13. Disconnect the tachometer or the scan tool.
14. Disconnect the negative battery cable.
15. Disconnect the ammeter and voltmeter.
16. Connect the generator output wire to the generator "B" terminal.
17. Connect the negative battery cable.

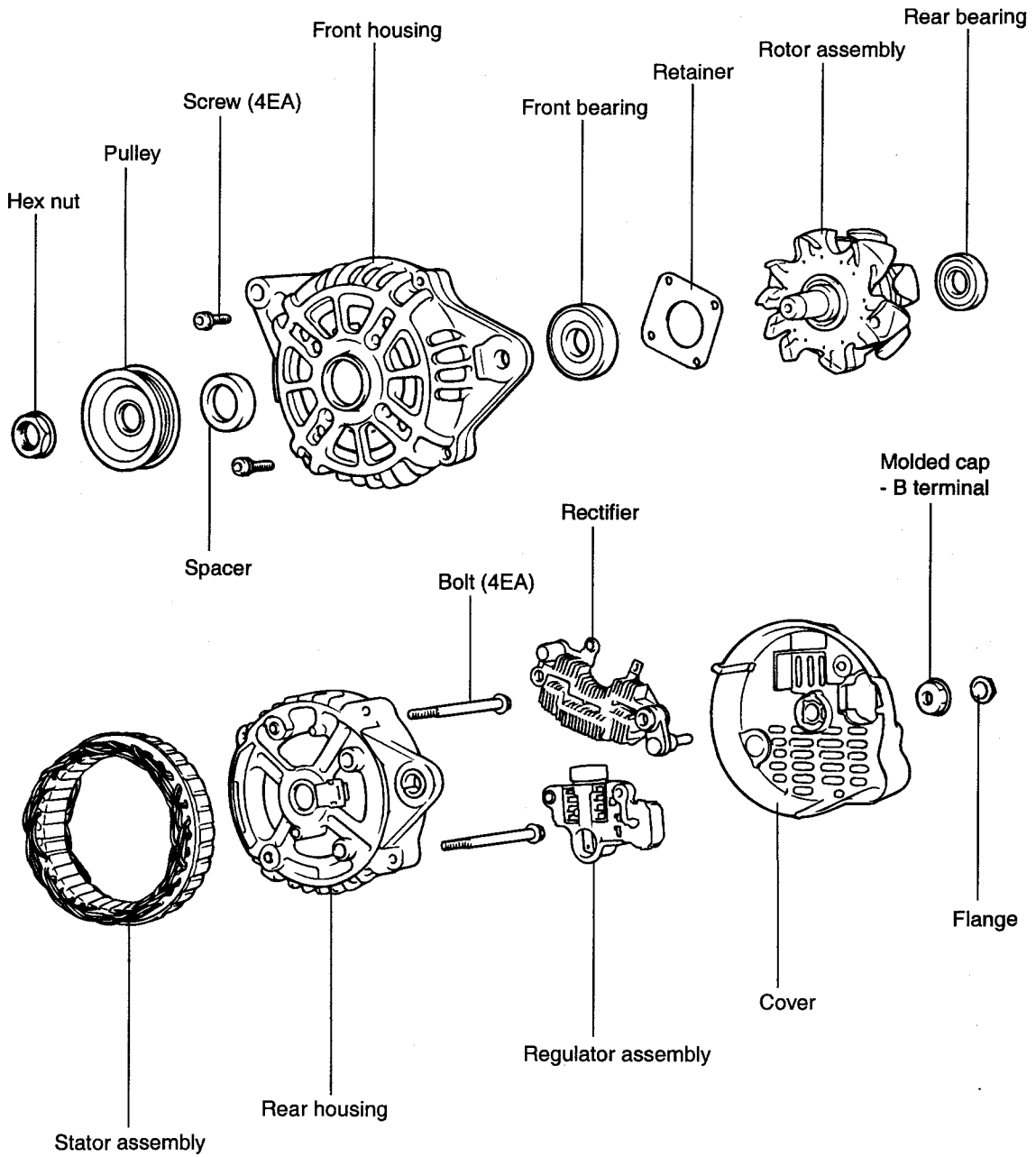




REMOVAL AND INSTALLATION EBBB0150



DISASSEMBLY AND REASSEMBLY EBBB0160

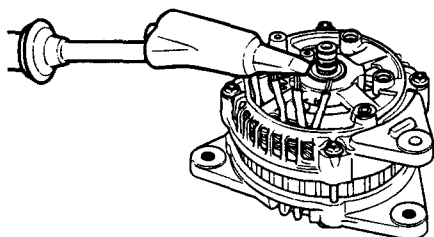


## DISASSEMBLY EBBB0180

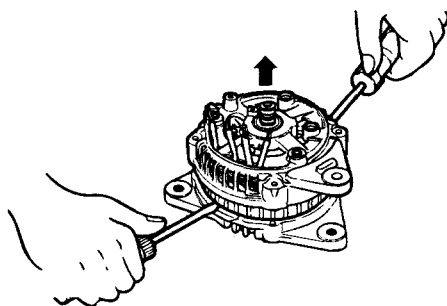
1. Remove the four through bolts.
2. Insert a flat screwdriver between the front bracket and stator core, and pry downward.

**CAUTION**

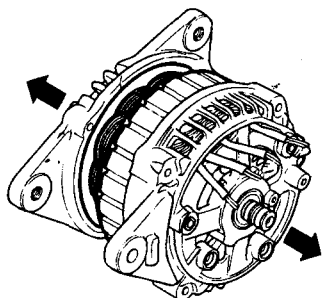
1. **Do not insert the screwdriver too deeply, as there is a danger of damaging the stator coil.**
2. **The rear cover may be hard to remove because a ring is used to lock the outer race of the rear bearing. To facilitate removal of rear cover, heat just the bearing box section with a 200-watt soldering iron. Do not use a heat gun as it may damage the diode assembly.**



KFW2018A



KFW2017A

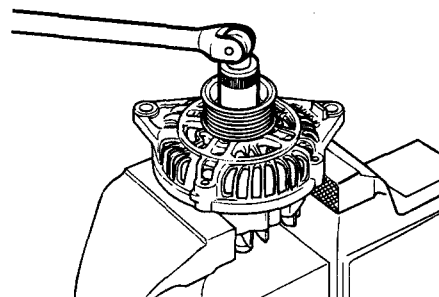


KFW2019A

3. Secure the rotor in a soft-jaw vise with the pulley side up.

**CAUTION**

**Be careful that the vise jaws do not damage the rotor.**



KFW2020A

4. Remove the pulley nut, spring washer, pulley, and spacer.
5. Remove the front bracket and two seals.
6. Remove the rotor from the vise.
7. Remove the brush holder screws, rectifier screws, and nut from the "B" terminal.
8. Remove the stator assembly from the rear bracket.
9. Detach the slinger from the brush holder.
10. If the stator is to be removed, unsolder the three stator leads to the main diodes on the rectifier.

**CAUTION**

1. **When soldering or unsoldering, make sure that heat from soldering iron is not transmitted to the diodes for a long period.**
2. **Do not exert excessive force on the leads of the diodes.**

11. When separating the rectifier from the brush holder, unsolder the two plates soldered to the rectifier.

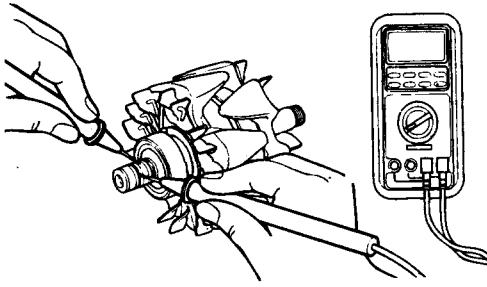
## INSPECTION

## ROTOR

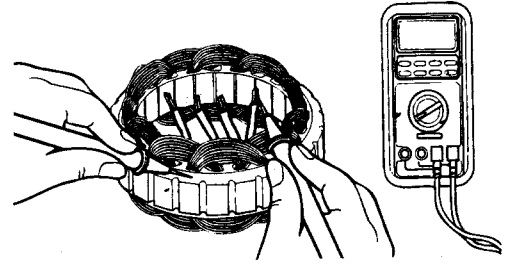
1. Check the rotor coil for continuity. Make sure there is continuity between the slip rings.

If resistance is extremely low, there is a short. If there is no continuity or if there is a short circuit, replace the rotor assembly.

**Resistance value : Approx. 3.1Ω**



KFW2021A



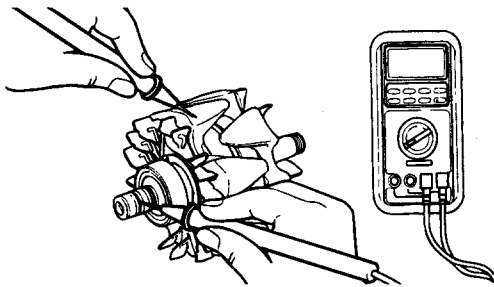
KFW2024A

2. Check the rotor coil for a ground. Check that there is no continuity between the slip ring and the core. If there is continuity, replace the rotor assembly.

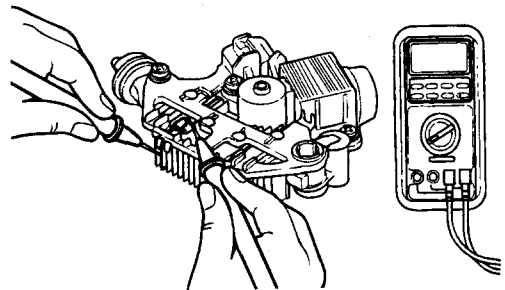
**RECTIFIERS**

**Positive rectifier test**

Check for continuity between the positive rectifier and stator coil lead connection terminal with an ohmmeter. The ohmmeter should read continuity in only one direction. If there is continuity in both directions, a diode is shorted. Replace the rectifier assembly.



KFW2022A



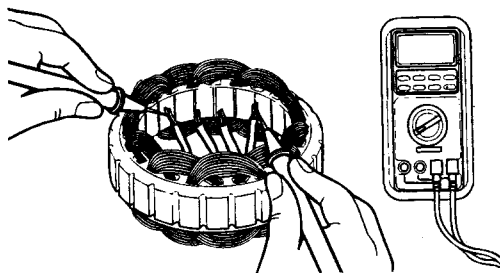
KFW2025A

**STATOR**

1. Make a continuity check on the stator coil. Check that there is continuity between the coil leads. If there is no continuity, replace stator assembly.

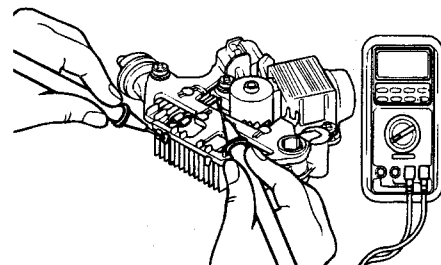
**Negative rectifier test**

Check for continuity between the negative rectifier and the stator coil lead connection terminal. The ohmmeter should read continuity in only one direction. If there is continuity in both directions, the diode is shorted, and the rectifier assembly must be replaced.



KFW2023A

[V6]



KFW2026A

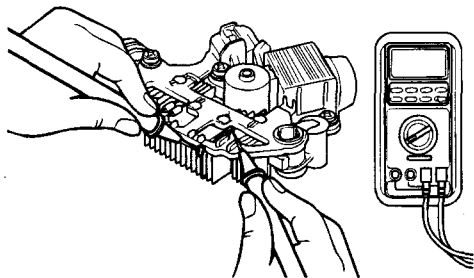
2. Check the coil for grounding. Check that there is no continuity between the coil and the core. If there is continuity, replace the stator assembly.

**Diode trio test**

Check the three diodes for continuity by connecting an ohmmeter to both ends of each diode. Each diode should have continuity in only one direction.

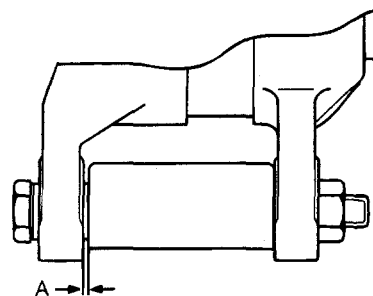
If continuity is present in both directions, the diode is defective and the heatsink assembly must be replaced.

[V6]



KFW2027A

- When installing a new brush, insert the brush into the holder, and then solder the lead wire.



KFW2009A

**REASSEMBLY** EBBB0190

Reassembly is the reverse of disassembly. Pay attention to the following:

Before the rotor is attached to the rear bracket, insert a wire through the small hole in the rear bracket to hold the brush. After the rotor has been installed, the wire can be removed.

**BRUSH REPLACEMENT**

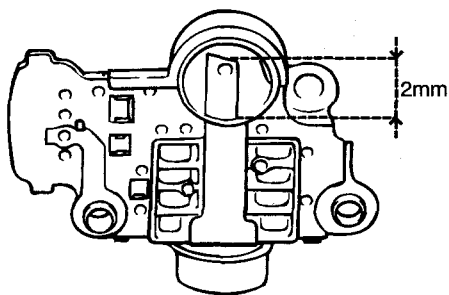
- Measure the length of the brush protrusion shown in the illustration, and replace the brush if the measured value is below the limit value.

---

Limit : 2mm (0.8 in.) or less

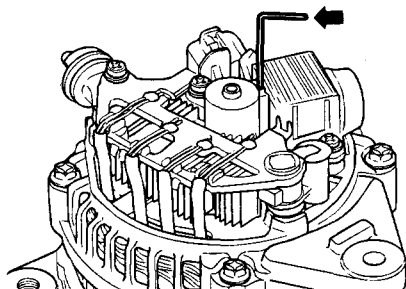
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[V6]



EBA9030E

- The brush can be removed if the solder of the brush lead wire is removed.

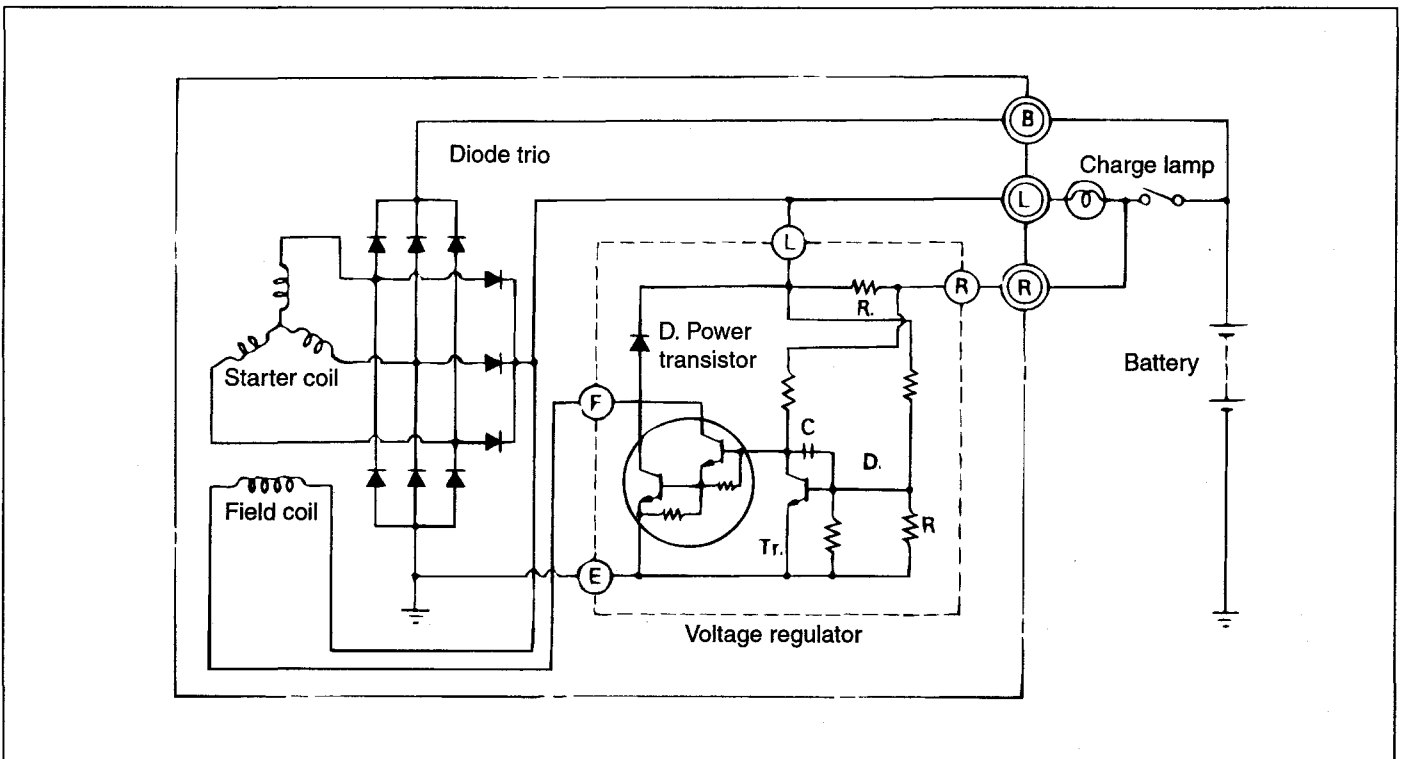


KFW2029A

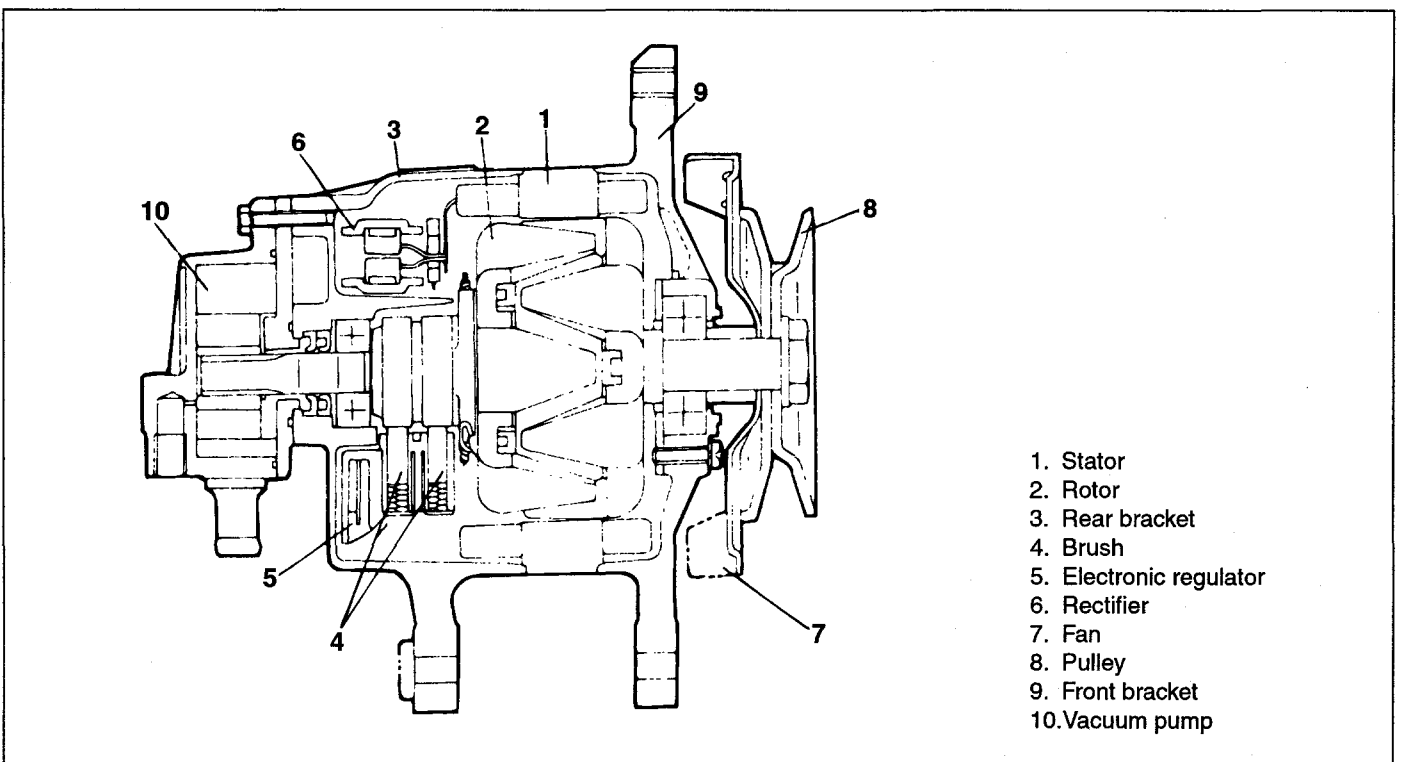
**GENERATOR (DIESEL)** EBMB0200

The conventional internal voltage detection type alternator controls the charging voltage regardless of the battery condition and according to the external load change so

that it sometimes causes battery under or overcharging or causes flickering of meters and lamps due to ripples of generated voltage resulting from load fluctuation. The figure below show the internal circuits of the alternator and voltage regulator.



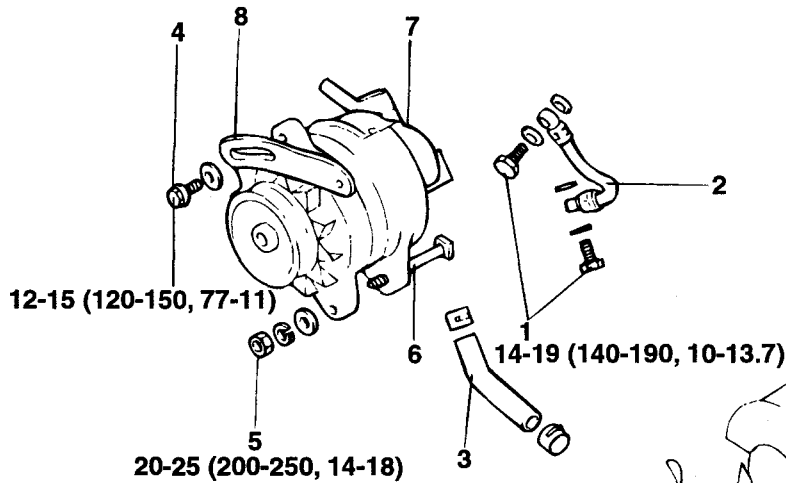
B7AD7415



B7AD7400

## REMOVAL AND INSTALLATION

(DIESEL) EMBB0210

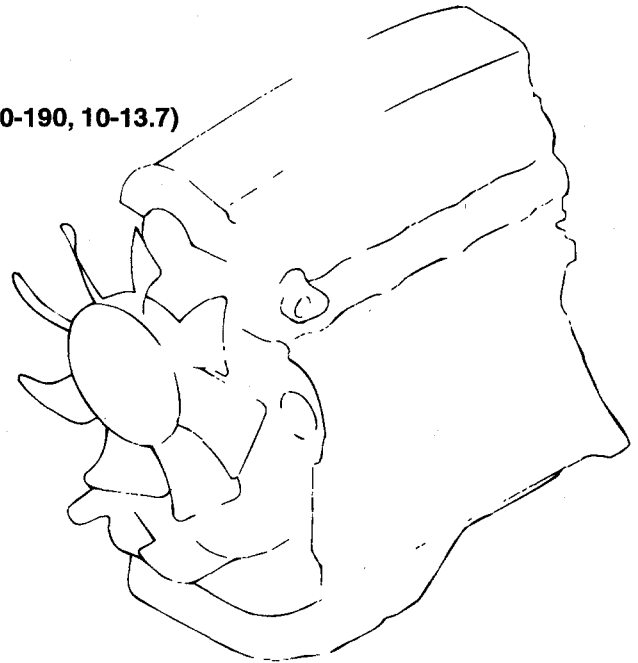


1. Eye bolt
2. Oil tube
3. Oil hose
4. Lock bolt
5. Nut
6. Support bolt
7. Alternator assembly
8. Alternator brace

**NOTE**

Reverse the removal procedures to reinstall.

**TORQUE : Nm (Kg-cm, lb-ft)**



B7AD7395

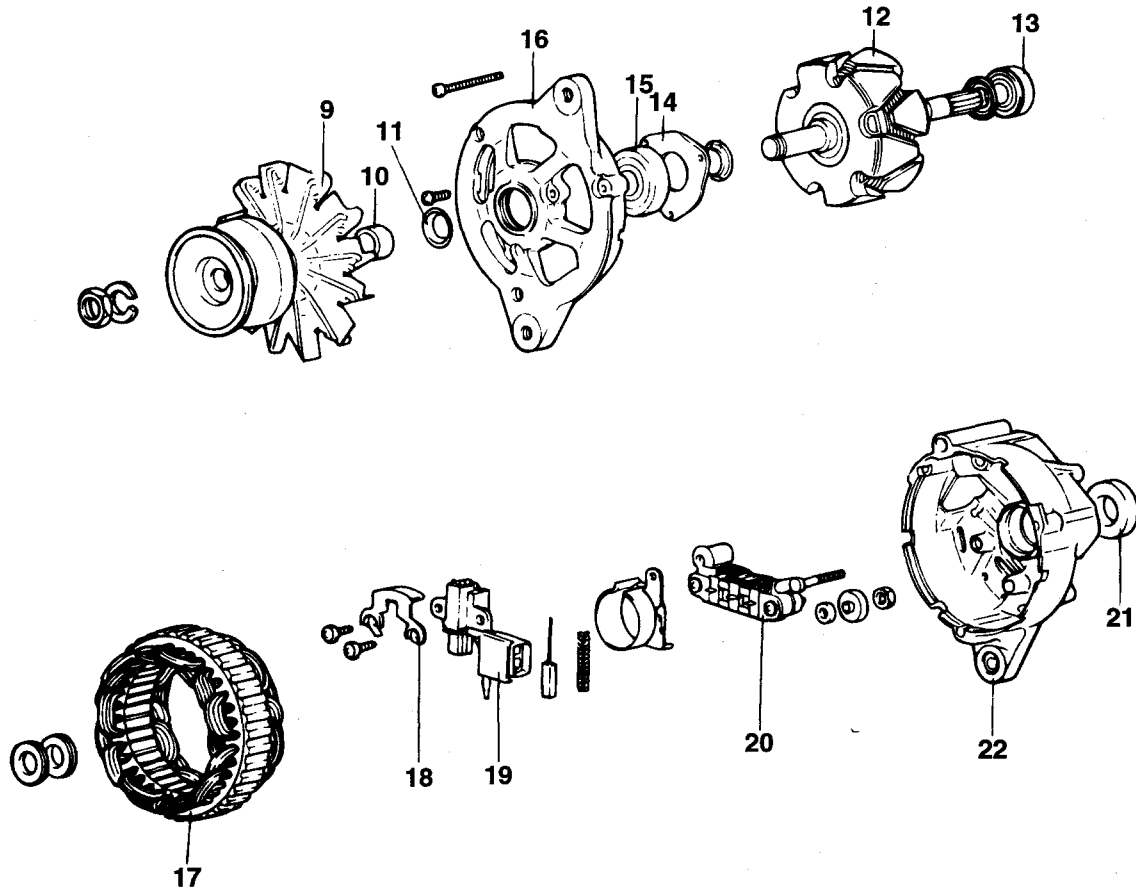
**INSTALLATION** EMBB0220**ALTERNATOR ASSEMBLY**

For belt tension, refer to Group EM Engine-Service adjustment procedures.

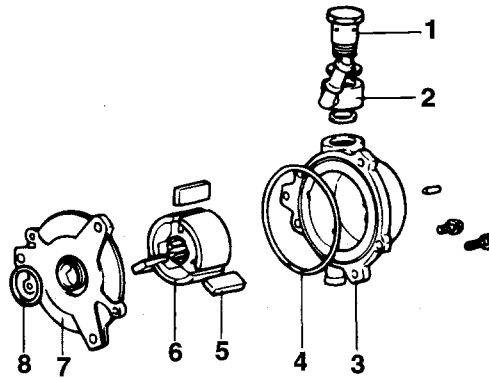
**CAUTION**

- **Install the oil hose to the alternator in advance.**  
When the alternator is installed, connect the oil hose to the nipple on the oil pan side. Clamp the hose clip at the straight portion of the nipple.
- **When the oil tube is installed, do not take a sharp bend nor bring the tube in contact with the cylinder block.**

DISASSEMBLY AND REASSEMBLY EBBM0230



- 1. Check valve
- 2. Nipple
- 3. Vacuum pump housing
- 4. O-ring
- 5. Rotor
- 6. Vane
- 7. Vacuum pump plate
- 8. O-ring
- 9. Pulley fan
- 10. Spacer
- 11. Seal
- 12. Rotor assembly
- 13. Rear bearing
- 14. Bearing retainer
- 15. Front bearing
- 16. Front bracket
- 17. Stator assembly
- 18. Plate
- 19. Regulator & brush holder
- 20. Rectifier Assembly
- 21. Oil seal
- 22. Rear bracket



**NOTE**  
Reverse the disassembly procedures to reassemble.



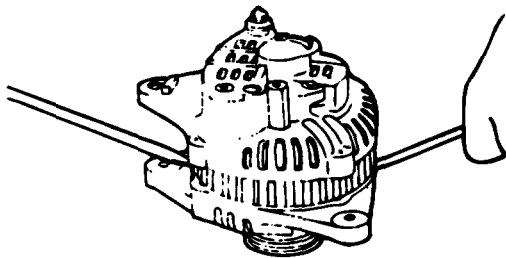
**DISASSEMBLY** EBMB0240

**FRONT BRACKET**

1. With a screwdriver blade inserted between the front bracket and stator core, pry it to separate the stator and the front bracket.
2. If they are hard to separate, lightly strike the bracket with a plastic hammer while prying with the screwdriver.

**CAUTION**

*Do not insert the screwdriver too deep as the stator core could be damaged.*



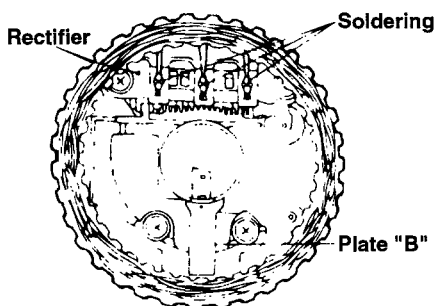
EBMB024A

**STATOR ASSEMBLY, REGULATOR AND BRUSH HOLDER**

**CAUTION**

- *When soldering or unsoldering, use care not to expose the diode to soldering iron heat for extended time.*
- *Complete soldering or unsoldering in as short a time as possible.*
- *Do not overstress the diode leads.*

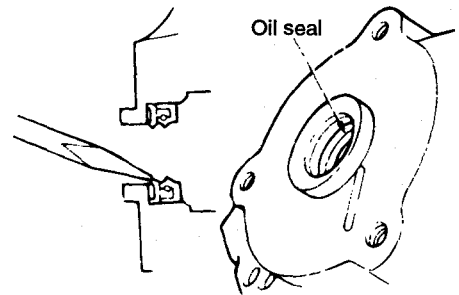
1. When removing the stator, unsolder the three stator leads from the main diodes.
2. When removing the rectifier from the brush holder, unsolder two soldered points.



B7AD7430

**OIL SEAL**

Push out and remove the oil seal using a screwdriver.



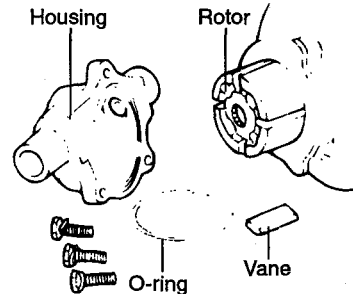
B7AD7435

**INSPECTION** EBMB0250

**VACUUM PUMP**

Check the following and replace if defective.

1. Check the rotor ends for streaks and damage.
2. Check the housing surface in contact with the rotor for streaks and damage.
3. Check the vanes for damage and break.

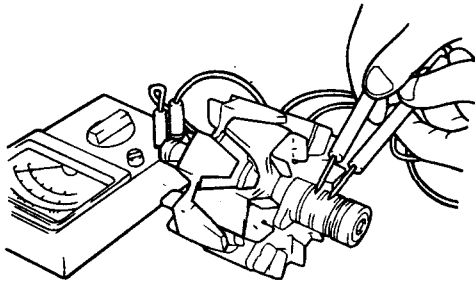


B7AD7440

**ROTOR**

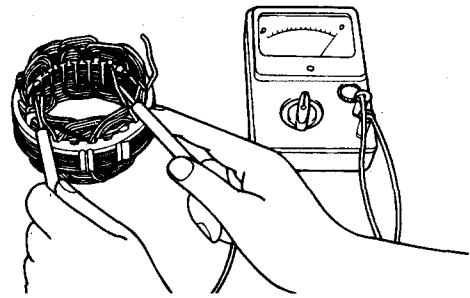
1. Check the rotor coil continuity. Make sure that there is continuity between slip rings. Measure the rotor resistance. If it is excessively small, it indicates a shorted rotor, If without continuity or shorted, replace the rotor assembly.

**Standard value : 3 - 5 ohms**

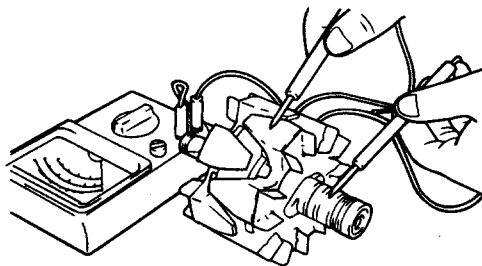


B7ZN0440

2. Check the rotor coil grounding. Make sure that there is no continuity between the slip ring and core. Replace the rotor assembly if there is continuity.



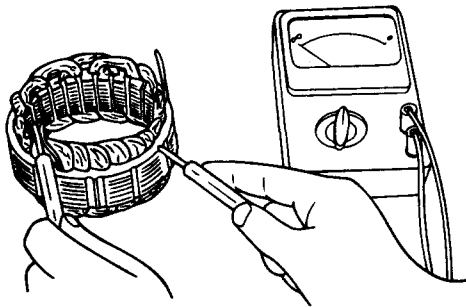
B7ZN0460



B7ZN0450

**STATOR**

1. Check the stator continuity. Make sure that there is continuity between coil leads. Replace the stator assembly if there is no continuity

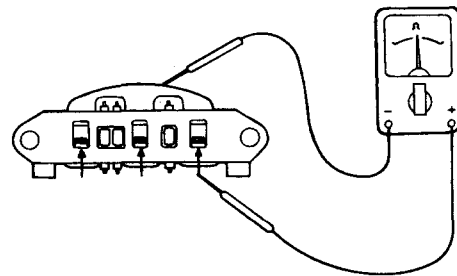


B7ZN0470

2. Check the coil grounding. Make sure that there is no continuity between the coil and core. Replace the stator assembly if there is continuity.

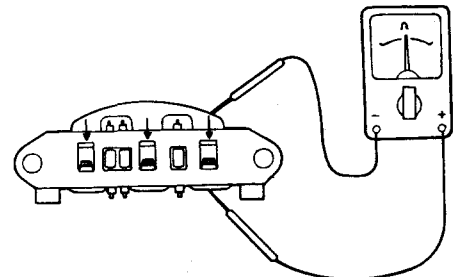
**RECTIFIER**

1. Inspection of (+) Heat Sink Assembly  
Using a circuit tester, check continuity between the (+) heat sink and the stator coil lead connection terminals. If there is continuity in both directions, the diode is shorted. Then, replace the rectifier assembly.



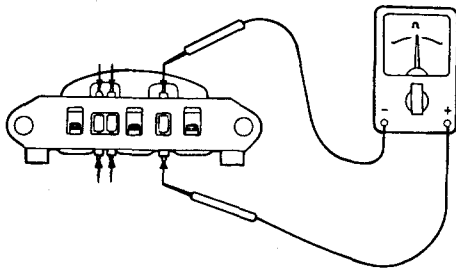
B7ZN0480

2. Inspection of (-) Heat Sink Assembly  
Check continuity between the (-) heat sink and the stator coil lead connection terminals. If there is continuity in both directions the diode is shorted. Then, replace the rectifier assembly.



B7ZN0490

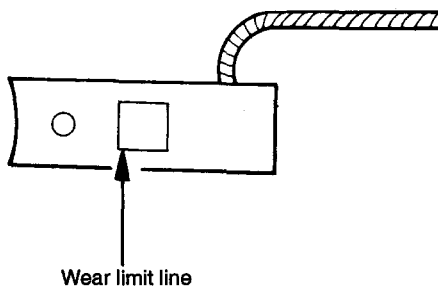
3. Inspection of Diode Trio  
With a circuit tester connected to both ends of each diode, check continuity of the three diodes. If there is continuity or no continuity in both directions, the diode is damaged. Then, replace the rectifier assembly.



B7ZN0500

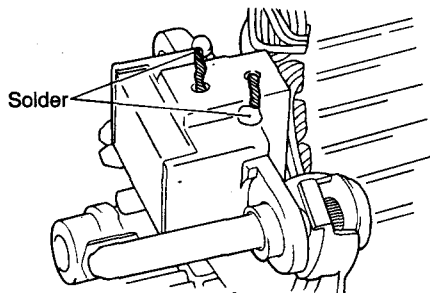
**BRUSH**

1. The brush must be replaced if worn to the wear limit line.



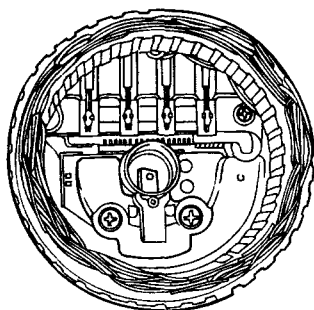
B7ZN0510

2. Unsolder the brush lead wires, and the brush and spring will come out.



B7ZN0520

3. When installing a new brush, push the brush into the holder as illustrated and solder the leads.

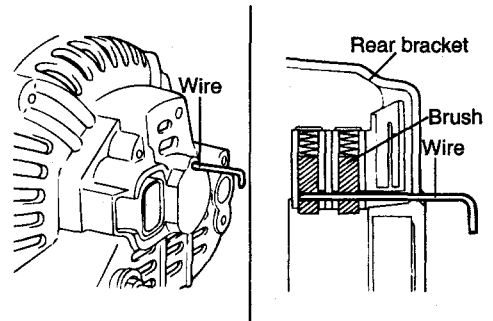


EBMB025A

**REASSEMBLY** EBMB0260

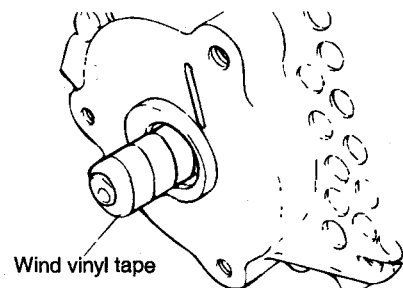
**ROTOR ASSEMBLY**

1. Before installing the rotor on the rear bracket, thread a steel wire through the small hole provided in the rear bracket to lift up the brush. After rotor installation, remove the steel wire.



EBLB022A

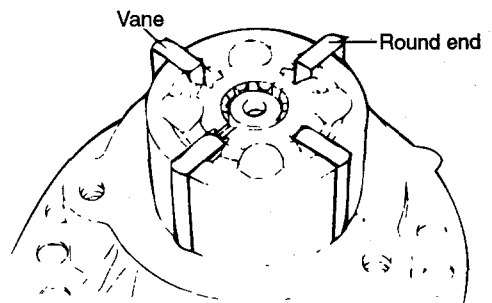
2. When installing the rotor on the alternator rear bracket, wind vinyl tape round the splined shaft to prevent damage to the oil seal



B7AD7500

**ROTOR AND VANES**

1. Check well the housing, rotor, etc. for chips and foreign matter. Then, apply engine oil and install.
2. Install the vanes with round end facing outward.
3. Apply grease to the O-ring and fit in the housing groove when the bolts are tightened.



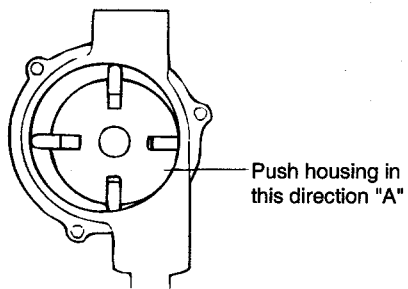
B7AD7505

4. When tightening the housing, lightly push it in the direction of arrow so as to minimize the clearance at "A" and tighten the bolts uniformly.

 **NOTE**

*After the assembly, be sure to conduct the performance test to check to see that the ultimate vacuum is as specified below.*

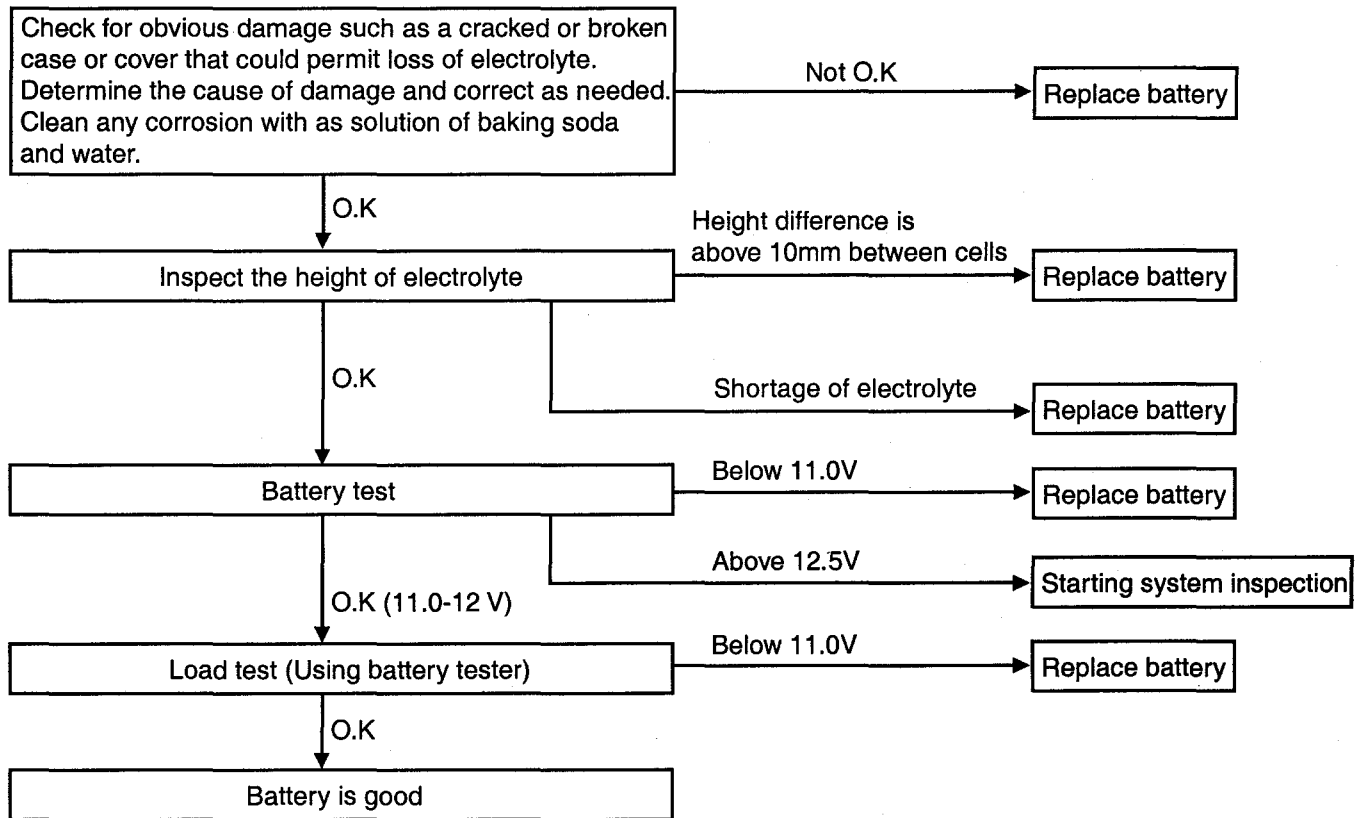
**Standard value of ultimate vacuum :  
600 mmHg or better at 3,000 rpm**



B7AD7510

**BATTERY VISUAL INSPECTION (1)** EBBB0200

**1. CHECKING FLOW**



EBA9018B

**2. CHECKING SHEET**

Item	Trouble	Cause	Remedy	Responsibility	
				User	Manufacturer
1. Visual inspection	* Battery terminal damage	* Carelessness * Over tightening the battery cable	Replace	O	
	Cover Breakage	* Carelessness	Replace	O	
	* Electrolyte leakage				
	- Cover breakage - Cover leakage	* Carelessness * Bad cover seal	Replace Replace	O	O
2. Electrolyte height inspection	* Electrolyte height between cells is over 10mm	* Cell shorted electrically * Vaporization caused by excessive temperature	Replace Replace	O	O
	* Shortage of electrolyte	* Electrolyte loss caused by over-charge	Replace	O	

Item	Trouble	Cause	Remedy	Responsibility	
				User	Manufacturer
3. Voltage inspection	1. Battery voltage >13.2V	1. Over charge	Replace * Check the electric system	○	
	2. 12.5V < Battery voltage < 12.9	2. Normal			
	3. 12.0V < Battery voltage < 12.4V (Simple discharge)	1. Insufficient charge	* Battery Load Test (Refer to Load Test below)	○	
	4. 11.0 V < Battery voltage < 12.0 (Over discharge)	2. Internal failure			
	5. Battery voltage : 11.0V or less	1. Charge condition failure 2. Battery discharged for a long period 3. Internal circuit open	Replace	○	○
		○			

**3. LOAD TEST**

1. When discharging the battery during 15 seconds at half currency of Cold Cranking Power (CCP), the voltage of the battery should be as shown below.

**REGULATING VOLTAGE TABLE**

Ambient Temperature	Voltage
above 20°C	9.6V
~ 18°C	9.5V
~ 10°C	9.4V
~ 4°C	9.3V
~ -1°C	9.1V
~ -7°C	8.9V
~ -12°C	8.7V

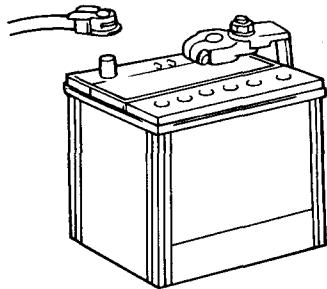
2. When the voltage is not within specification, repeat the load test again, and re-charge.
3. If the battery is left alone for 2 hours after re-charging and its output is over 12.5V, and the voltage after a load test is over the standard value, the battery can be used.

**BATTERY VISUAL INSPECTION (2)** EBBB0210

1. Make sure the ignition switch and all accessories are in the OFF position.
2. Disconnect the battery cables (negative first).
3. Remove the battery from the vehicle.

**⚠ CAUTION**

**Care should be taken in the event the battery case is cracked or leaking, to protect your skin from the electrolyte. Heavy rubber gloves (not the household type) should be worn when removing the battery.**

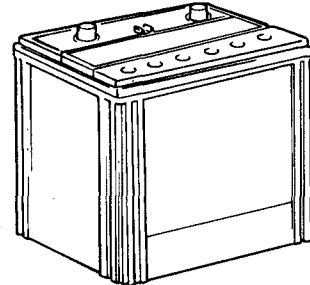


EBA9018C

4. Inspect the battery carrier for damage caused by the loss of electrolyte. If acid damage is present, it will be necessary to clean the area with a solution of clean warm water and baking soda. Scrub the area with a stiff brush and wipe off with a cloth moistened with baking soda and water.
5. Clean the top of the battery with the same solution as described in Step(4).
6. Inspect the battery case and cover for cracks. If cracks are present, the battery must be replaced.
7. Clean the battery posts with a suitable battery post tool.
8. Clean the inside surface of the terminal clamps with a suitable battery cleaning tool. Replace damaged or frayed cables and broken terminal clamps.
9. Install the battery in the vehicle.
10. Connect the cable terminals to the battery post, making sure the tops of the terminals are flush with the tops of the posts.
11. Tighten the terminal nuts securely.
12. Coat all connections with light mineral grease after tightening.

**⚠ CAUTION**

**When batteries are being charged, an explosive gas forms beneath the cover of each cell. Do not smoke near batteries being charged or which have recently been charged. Do not break live circuits at the terminals of batteries being charged. A spark will occur when the circuit is broken. Keep open flames away from the battery.**



EBA9018D

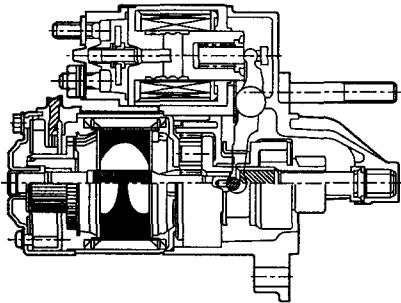
# STARTING SYSTEM

## GENERAL INFORMATION EBBB0290

The starting system includes the battery, starter motor, solenoid switch, ignition switch, inhibitor switch (A/T only), connection wires and the battery cables.

When the ignition key is turned to the start position, current flows and energizes the starter motor's solenoid coil. The solenoid plunger and clutch shift lever are activated, and the clutch pinion engages the ring gear. The contacts close and the starter motor cranks.

In order to prevent damage caused by excessive rotation of the starter armature when the engine starts, the clutch pinion gear overruns.

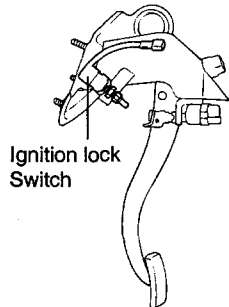


EBBB029A

EBHA0200

## CHECK CLUTCH PEDAL (M/T)

Check that pedal height, pedal freeplay and clutch pedal clevis pin play are correct. (Refer to clutch group)



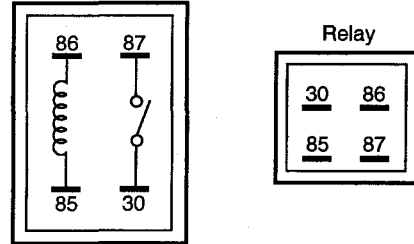
EBA9020D

## CHECK STARTER RELAY

Remove the starter relay and check continuity between the terminals. If the continuity is not as specified, replace the relay.

Terminal No.	85	86	87	30
When de-energized	○	○		
When energized	○	○	○	○

EBA9020E



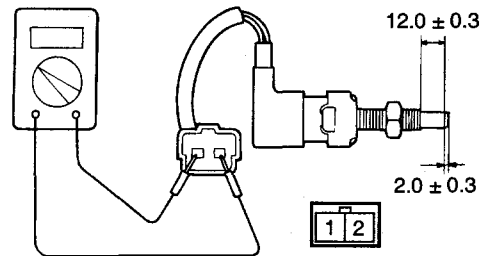
EBA9020F

## CHECK IGNITION LOCK SWITCH

Remove the ignition lock switch and check continuity between the terminals. If the continuity is not as specified, replace the switch.

Terminal	1	2
Pushed	○	○
Free		

EBA9020G

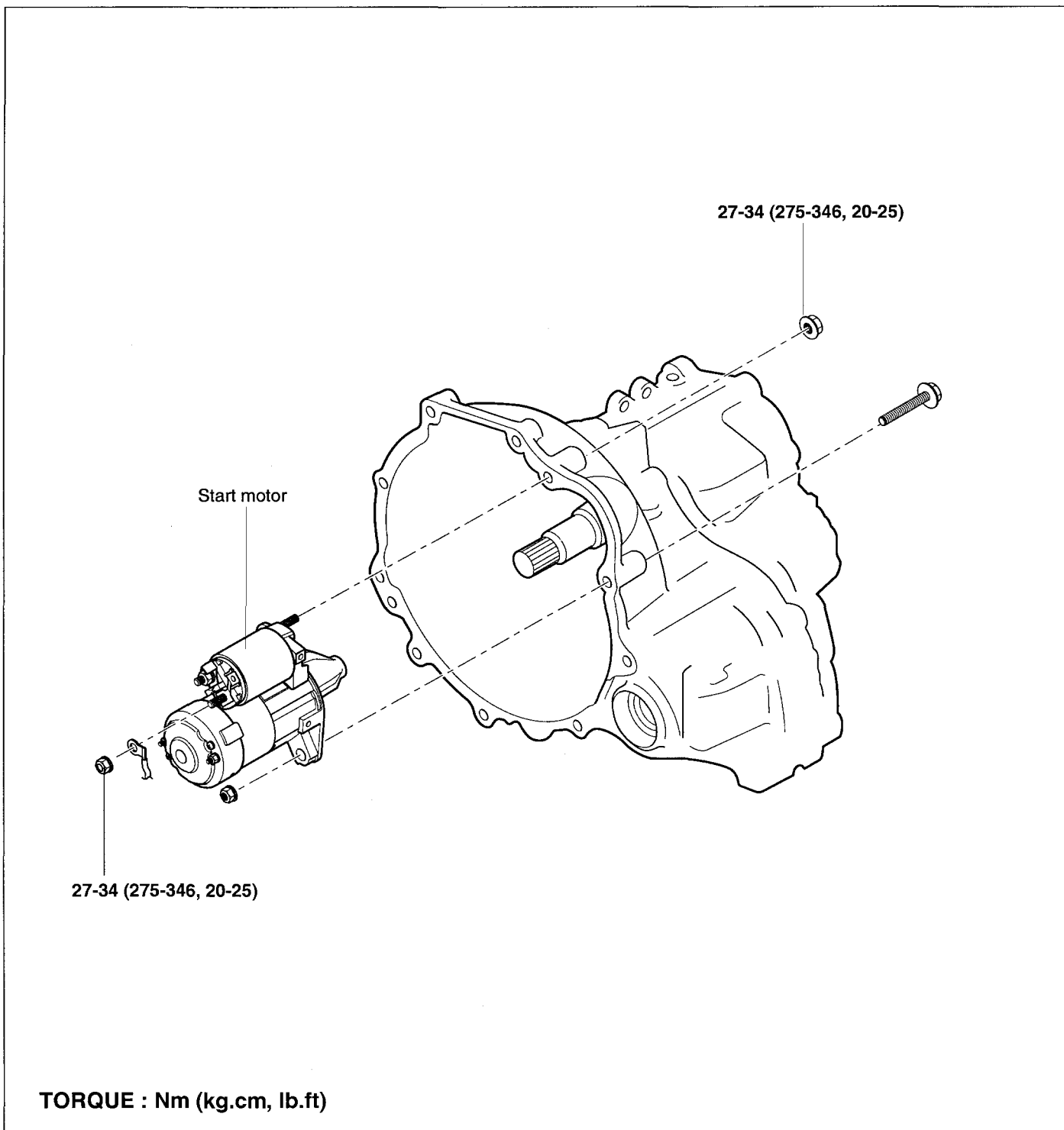


EBHA020A



## REMOVAL AND INSTALLATION

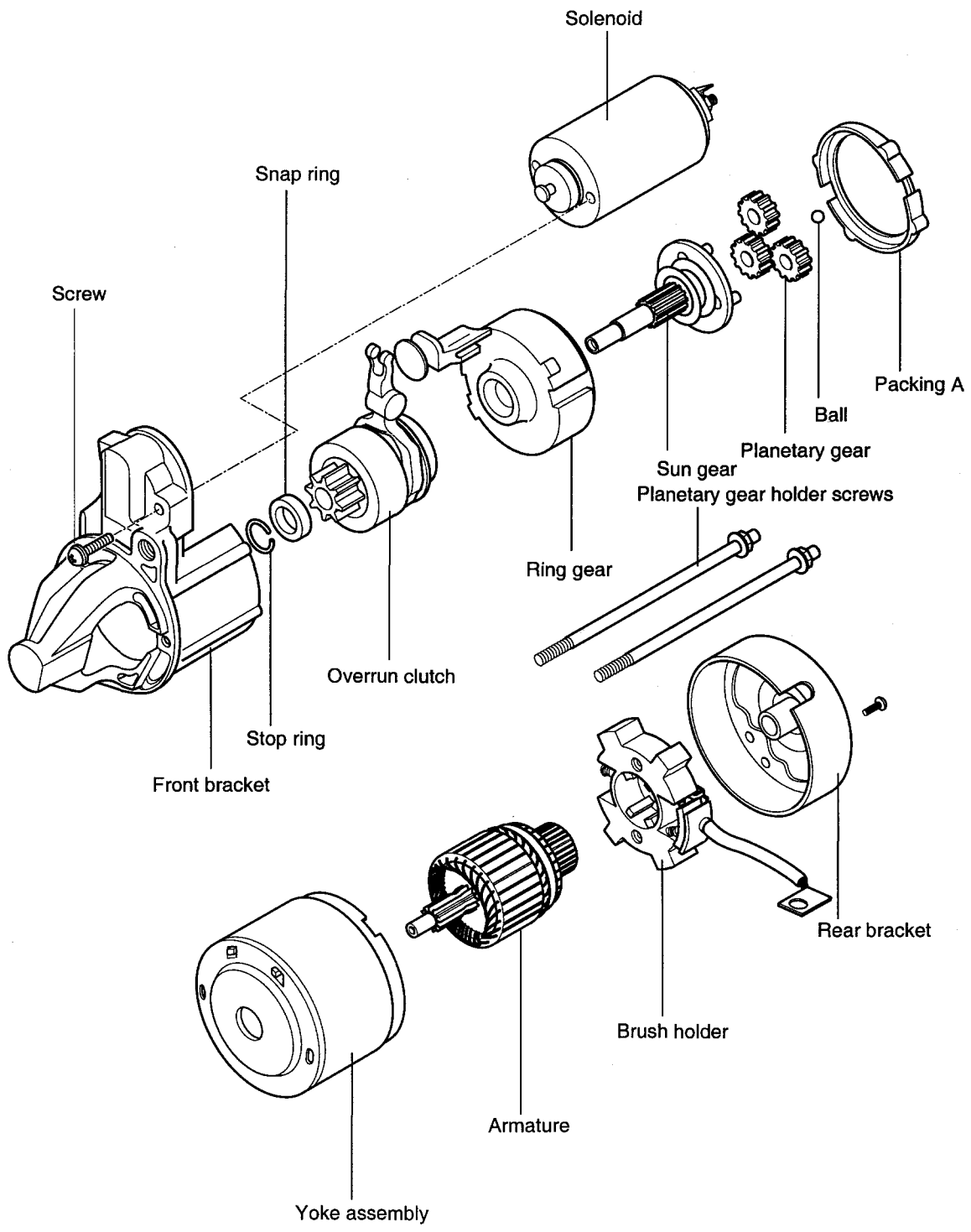
EBHA0210



KFW2011A

1. Disconnect the battery ground cable.
2. Remove the speedometer cable and the shift cable.
3. Disconnect the starter motor connector and terminal.
4. Remove the starter motor assembly.
5. Installation is the reverse of removal.

COMPONENTS EBHA0220



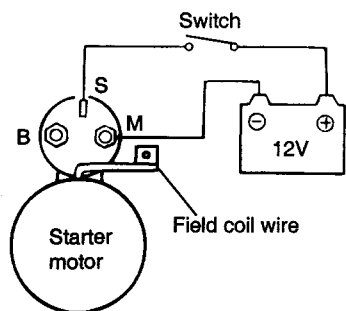
**CHECKING FOR OPERATION** EBHA0230

**SERVICE ADJUSTMENT PROCEDURES FOR PINION GAP ADJUSTMENT**

1. Disconnect the field coil wire from the M-terminal of the solenoid.
2. Connect a 12V battery the S-terminal and the M-terminal.
3. The pinion should move out.

**CAUTION**

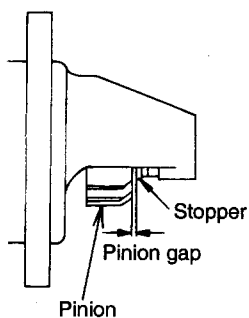
*This test must be performed quickly (in less than 10 seconds) to prevent the coil from overheating.*



EBA9023A

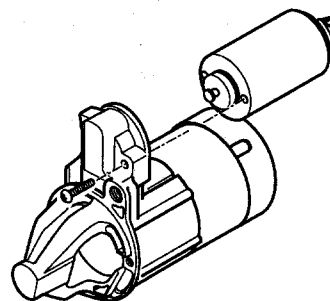
4. Check the pinion for stopper clearance (pinion gap) with a feeler gauge.

**Pinion gap : 0.5-2.0 mm (0.02-0.079 in.)**



EBA9023B

5. If the pinion gap is out of specification, adjust by adding or removing gaskets between the solenoid and the front bracket.



EBHA306D

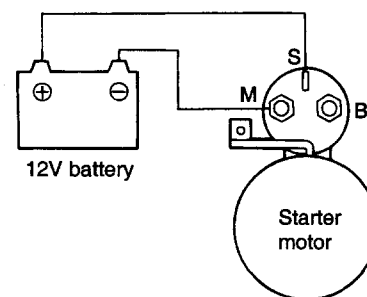
**MAGNETIC SWITCH PULL-IN TEST**

1. Disconnect the field coil wire from the M-terminal of the magnetic switch.
2. Connect a 12V battery between the S-terminal and the M-terminal.

**CAUTION**

*This test must be performed quickly (in less than 10 seconds) to prevent the coil from burning.*

3. If the pinion moves out, then the pull-in coil is good. If it doesn't move out, replace the magnetic switch.



EBA9023D

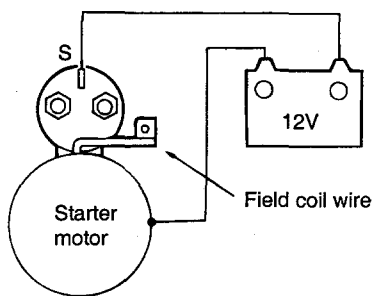
**MAGNETIC SWITCH HOLD-IN TEST**

1. Disconnect the field coil wire from the M-terminal of the magnetic switch.
2. Connect a 12V battery between the S-terminal and the body.

**CAUTION**

*This test must be performed quickly (in less than 10 seconds) to prevent the coil from burning.*

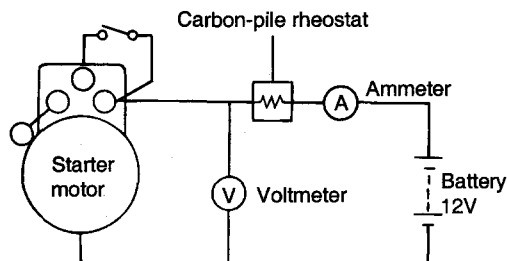
3. If the pinion moves out, everything is in order. If the pinion moves back and forth repeatedly, the hold-in circuit is open. If it is open, replace the magnetic switch.



EBA9023E

**FREE RUNNING TEST**

1. Place the starter motor in a vise equipped with soft jaws and connect a fully-charged 12-volt battery to the starter motor as follows:
2. Connect a test ammeter (100-ampere scale) and carbon pile rheostat as shown in the illustration.



EBA9023F

3. Connect a voltmeter (15-volt scale) across the starter motor.
4. Rotate the carbon pile to the off position.
5. Connect the battery cable from battery's negative post to the starter motor body.
6. Adjust the carbon pile until battery voltage reads 11 volts.
7. Confirm that the maximum amperage is within the specifications and that the starter motor turns smoothly and freely:

**Current : Max. 90 Amps**

**Speed : Min. 3,000 rpm**

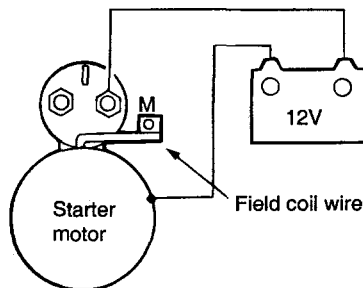
**MAGNETIC SWITCH RETURN TEST**

1. Disconnect field coil wire from the M-terminal of the magnetic switch.
2. Connect a 12V battery between M-terminal and the body.

**NOTE**

*This test must be performed quickly (in less than 10 seconds) to prevent the coil from burning.*

3. Pull the pinion out and release it. If the pinion returns quickly to its original position, everything is in order. If it doesn't, replace the magnetic switch.



EBA9023G

**INSPECTION** EBHA0240

**CHECKING THE COMMUTATOR**

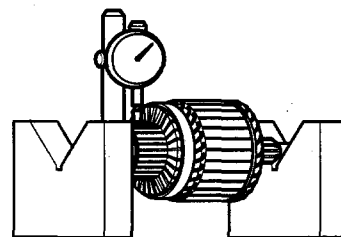
1. Place the armature on a pair of V-blocks, and check the run - out by using a dial gauge.

**Standard value**

Armature run - out : 0.05 mm (0.002 in.)

**Limit**

Armature run - out : 0.1 mm (0.0039 in.)



KFW2033A

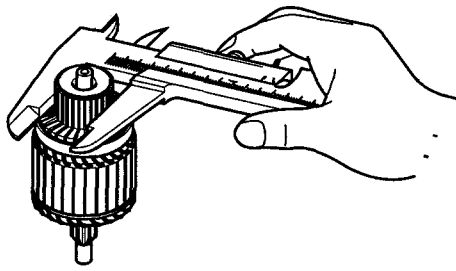
2. Check the outer diameter of the commutator.

**Standard value**

Outer diameter of the commutator : 29.4 mm (1.157 in.)

**Limit**

Outer diameter of the commutator : 28.4 mm (1.118 in.)



KFW2034A

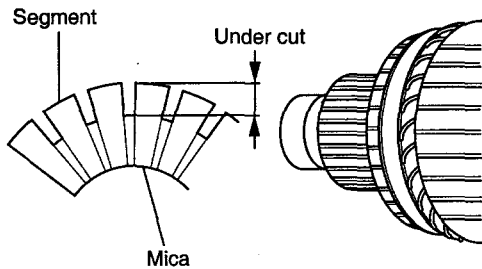
3. Check the depth of the undercut between segments.

**Standard value**

Depth of the undercut between segments : 0.5mm (0.020 in.)

**Limit**

Depth of the undercut between segments : 0.2mm (0.079 in.)

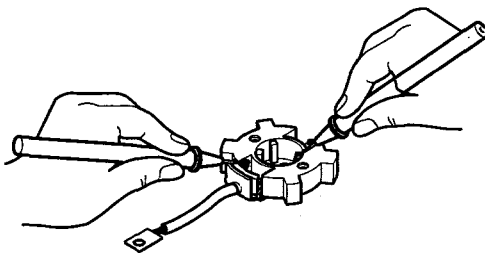


KFW2035A

**BRUSH HOLDER**

Check for continuity between the brush holder plate and the brush holder.

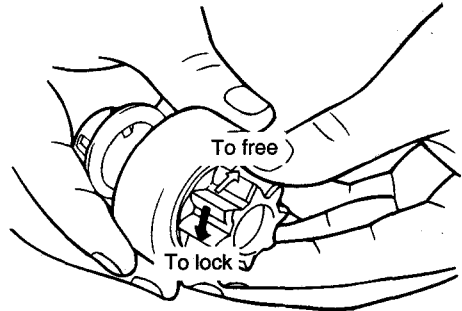
The normal condition is no continuity.



KFW2036A

**OVERRUNNING CLUTCH**

1. While holding the clutch housing, rotate the pinion. The drive pinion should rotate smoothly in one direction, but should not rotate in the opposite direction. If the clutch does not function properly, replace the overrun clutch assembly.
2. Inspect the pinion for wear or burrs. If the pinion is worn or burred, replace the overrun clutch assembly. If the pinion is damaged, also inspect the ring gear for wear or burrs.



EBA9024E

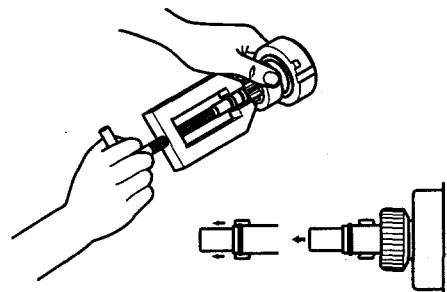
**FRONT AND REAR BRACKET BUSHING**

Inspect the bushing for wear or burrs. If the bushing is worn or burred, replace the front bracket assembly or the rear bracket assembly.

**REASSEMBLY OF THE STOP RING AND SNAP RING**

EBHA0250

Using a suitable pulling tool, pull the overrunning clutch stop ring over the snap ring.



KFW2043A

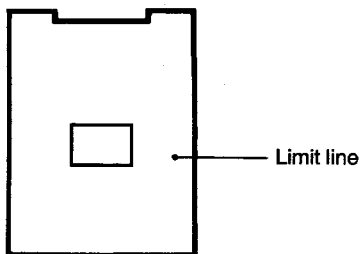
## CLEANING THE STARTER MOTOR

### PARTS EBA90260

1. Do not immerse parts in cleaning solvent. Immersing the yoke and field coil assembly and/or armature will damage the insulation. Wipe these parts with a cloth only.
2. Do not immerse the drive unit in cleaning solvent. The overrun clutch is pre-lubricated at the factory and solvent will wash lubrication from the clutch.
3. The drive unit may be cleaned with a brush moistened with cleaning solvent and wiped dry with a cloth.

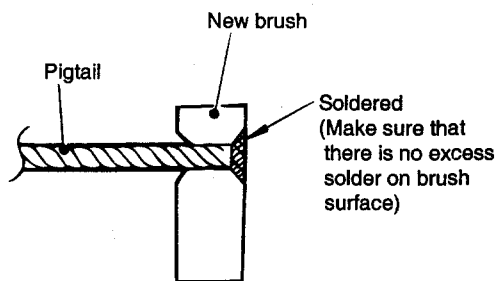
### REPLACEMENT OF BRUSHES AND SPRINGS EBA90270

1. Brushes that are worn out, or oil-soaked, should be replaced.
2. When replacing field coil brushes, crush worn out brushes with pliers, taking care not to damage the pigtail.



EBA9027A

3. Sand the pigtail end with sandpaper to ensure good soldering.
4. Insert the pigtail into the hole provided in the new brush and solder it. Make sure that the pigtail and excess solder do not come out onto the brush surface.
5. When replacing the ground brush, slide the brush from the brush holder by prying the retaining spring back.

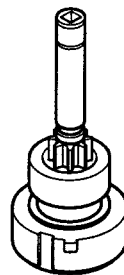


EBA9027B

### DISASSEMBLY EBHA0280

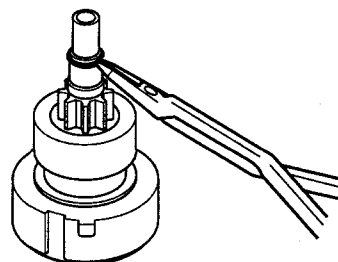
#### REMOVAL OF THE SNAP RING AND STOP RING

1. Press the stop ring using a socket.



KFW2031A

2. After removing the snap ring (using snap-ring pliers), remove the stop ring and the overrunning clutch.

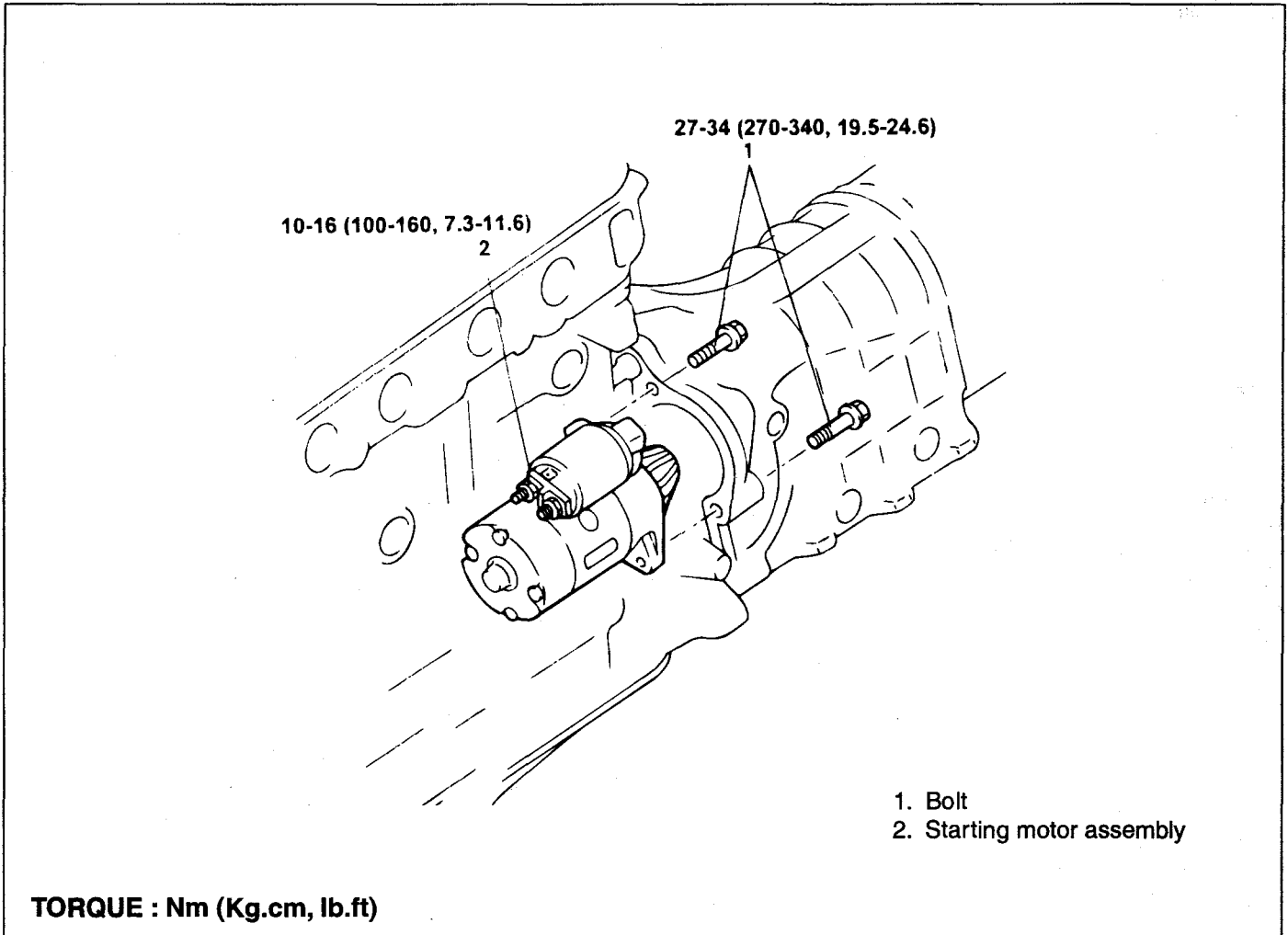


KFW2032A

## REMOVAL AND INSTALLATION

(DIESEL) EMBB0290

## COMPONENTS



B7AD7520

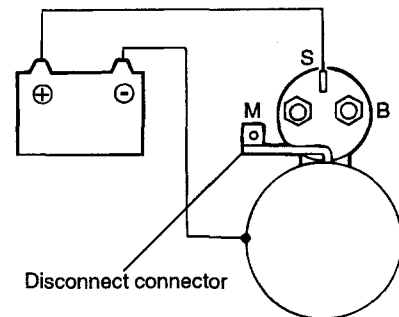
EMBB0300

## PINION GAP ADJUSTMENT

1. Disconnect the field coil wire from the terminal M of the magnetic switch.
2. Connect a battery between the terminal S and starting motor body. (Connect the positive terminal of battery to the terminal S.)

 **NOTE**

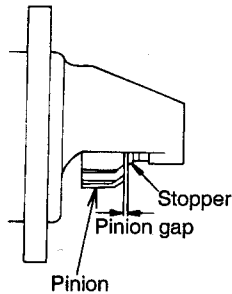
*This test must be performed quickly within 10 seconds to prevent the switch coil from burning.*



EMBB030A

3. When the battery is connected, the pinion moves out. Now, push back the pinion with a finger and measure the pinion stroke (the travel along which the pinion is pushed back). This is the pinion gap.

4. If the pinion gap is not up to specification, adjust by adding or removing fiber washers between the magnetic switch and front bracket. Using more washers makes the gap smaller.



B7ZN0700

EBMB0310

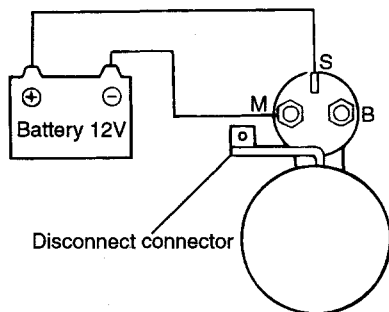
### PULL-IN TEST OF MAGNETIC SWITCH

The pull-in coil is in good condition if the plunger is pulled in to cause the pinion to move out when a battery is connected between the terminals S and M of the magnetic switch. If the pinion does not move out, replace the magnetic switch.

#### **NOTE**

The connector must be disconnected from terminal M for this test.

The test must be finished within 10 seconds.



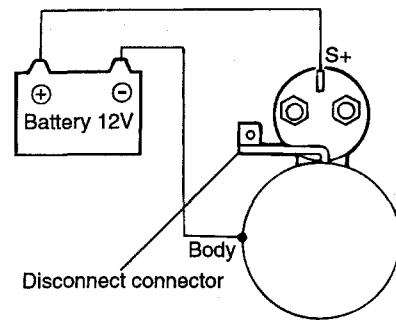
EBMB031A

### HOLD-IN TEST OF MAGNETIC SWITCH

With a battery connected between the terminal S and body of magnetic, manually pull the pinion up to the pinion stopper. The hold-in coil is in good condition if the pinion remains out when releasing it.

#### **NOTE**

This test must be completed with 10 seconds.



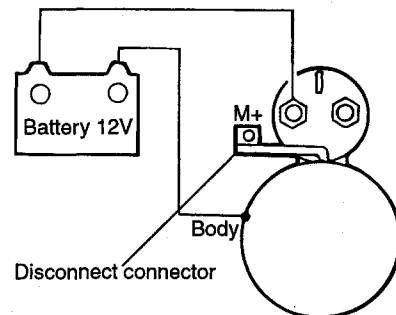
EBMB031B

### RETURN TEST OF MAGNETIC SWITCH

With a battery connected between the terminal M and body of the magnetic switch, manually pull the pinion out to the pinion stopper. Body coils are fully operational if the pinion returns immediately when releasing it.

#### **NOTE**

This test must be completed within 10 seconds.

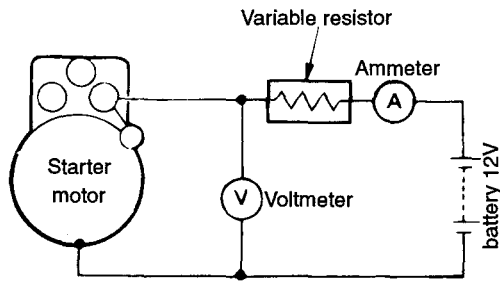


EBMB031C

### NO-LOAD TEST

1. Set up a circuit as shown which connects a starter motor, battery, ammeter, voltmeter, and variable resistance.
2. The starting motor should be in good condition if it turns smoothly and steadily when the switch is turned ON with a maximum variable resistance value. Adjust the variable resistor so that the voltmeter reads 11.5V. If the current and rpm are out of specification after this adjustment, troubleshoot according to the table below and take remedial action as required.



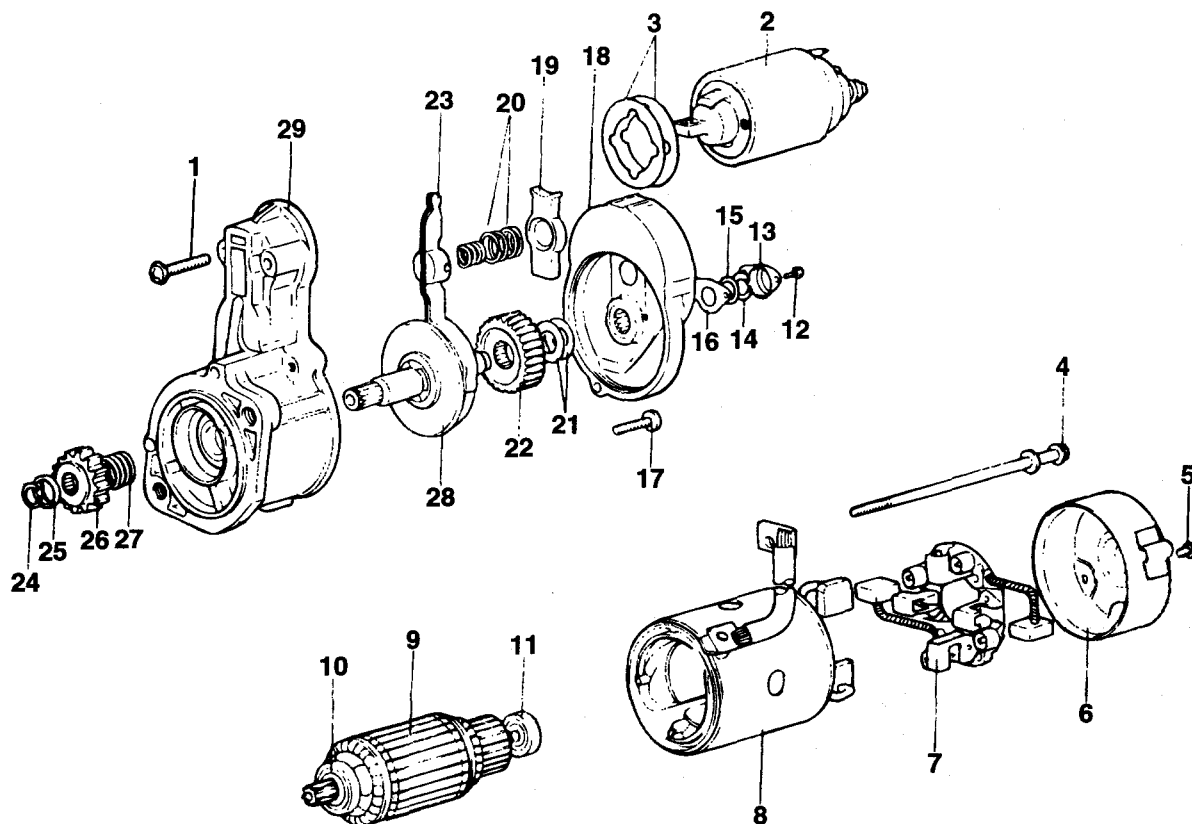


B7AD7550

Symptom	Possible cause
Large current with low rpm (torque also being small)	Contaminated bearing Armature coil rubbing pole piece Armature and field coil grounding Armature coil shorting
Large current with no rotation	Solenoid switch grounding Armature and field coil grounding Seized bearing
No current flowing with no rotation	Broken armature and field coils Broken brush and pigtail Improper contact between brush and commutator
Small current with low rpm (torque also being small)	Improper field coil connection (Note, however, that open or improperly connected shunt coil only will result in high rpm.)
Large current with high rpm (torque being small)	Shorted field coil

## DISASSEMBLY AND REASSEMBLY

EBMB0320



1. Screw
2. Magnetic
3. Fiber
4. Screw
5. Screw
6. Rear bracket
7. Brush holder assembly
8. Yoke assembly
9. Armature
10. Front bearing
11. Rear bearing
12. Screw
13. Cover
14. Snap ring
15. Washer
16. Plate

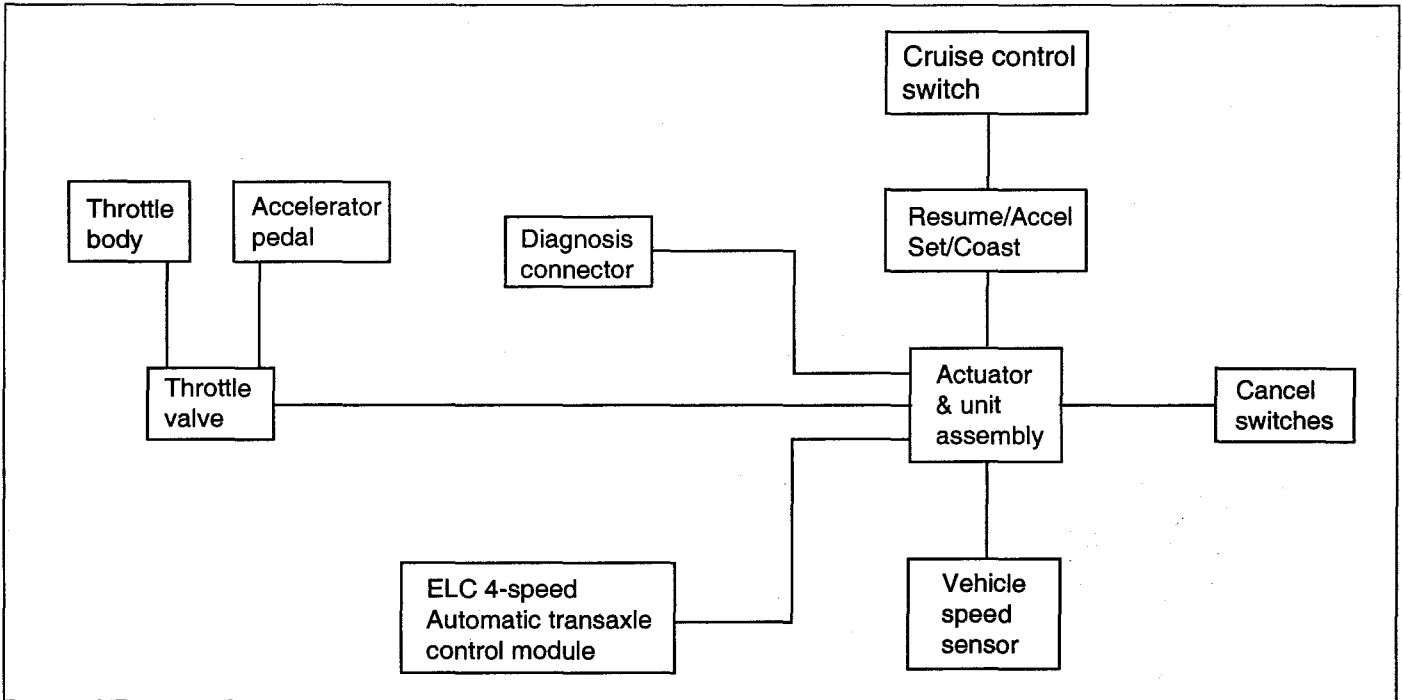
17. Screw
18. Center bracket
19. Packing
20. Lever spring
21. Washer
22. Gear
23. Lever
24. Snap ring
25. Stop ring
26. Pinion gear
27. Spring
28. Pinion shaft assembly
29. Front bracket

**NOTE**

Reverse the disassembly procedures to reassemble

# CRUISE CONTROL SYSTEM

## SYSTEM BLOCK DIAGRAM EBA90290



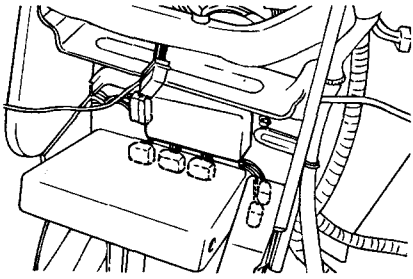
EBA9029A

### COMPONENT PARTS AND FUNCTION OUTLINE

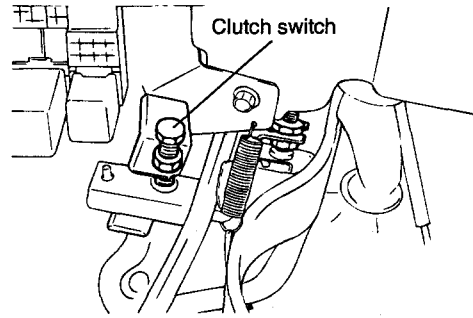
COMPONENT PART	FUNCTION
Vehicle speed sensor	Converts vehicle speed to pulses.
Cruise control module (CCM)	Receives signals from sensor and control switch; CCM controls all automatic speed control function.
Actuator	Regulates the throttle valve to the set opening by signals from the CCM.
Control switch	
CRUISE main switch	Switch for automatic speed control power supply.
SET/RESUME switch	Controls automatic speed control functions by SET (COAST) and RESUME (ACCEL).
CRUISE main switch indicator	Illuminates when CRUISE main switch is ON (Built into cluster).
Cancel switch	Sends cancel signals to the CCM
Stop lamp switch/Clutch switch (M/T)	Cancels cruise
Transaxle range switch	Controls the overdrive ON and OFF, based on signals from the CCM for the CC.
Data link connector	By connecting the voltmeter or scan tool, control module diagnostic codes may be read.

\*CC : Cruise Control

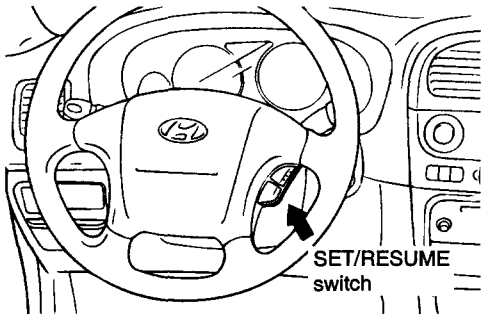
COMPONENTS LOCATION EBBB0310



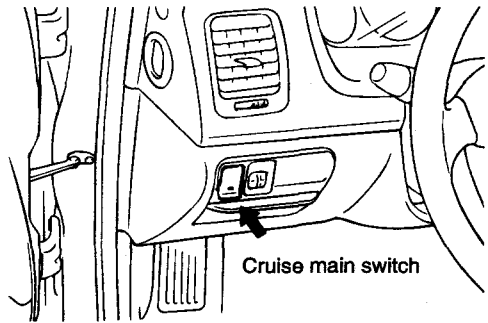
S5EE490E



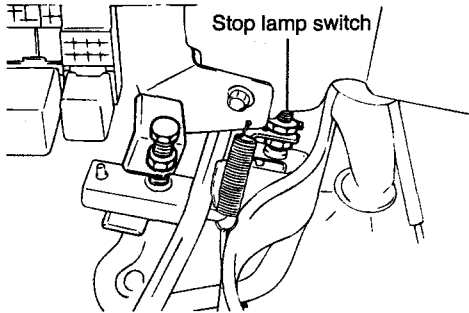
EBBB031A



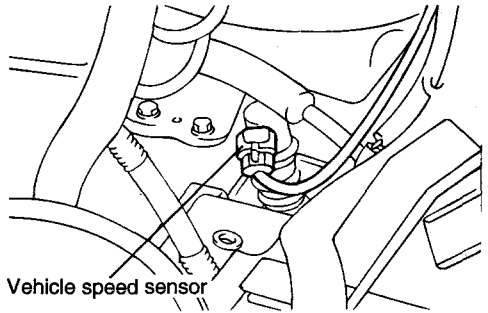
EBAA030B



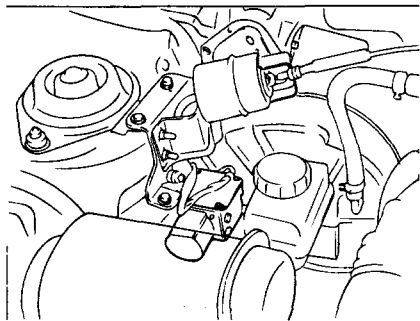
EBAA030C



EBA9030L

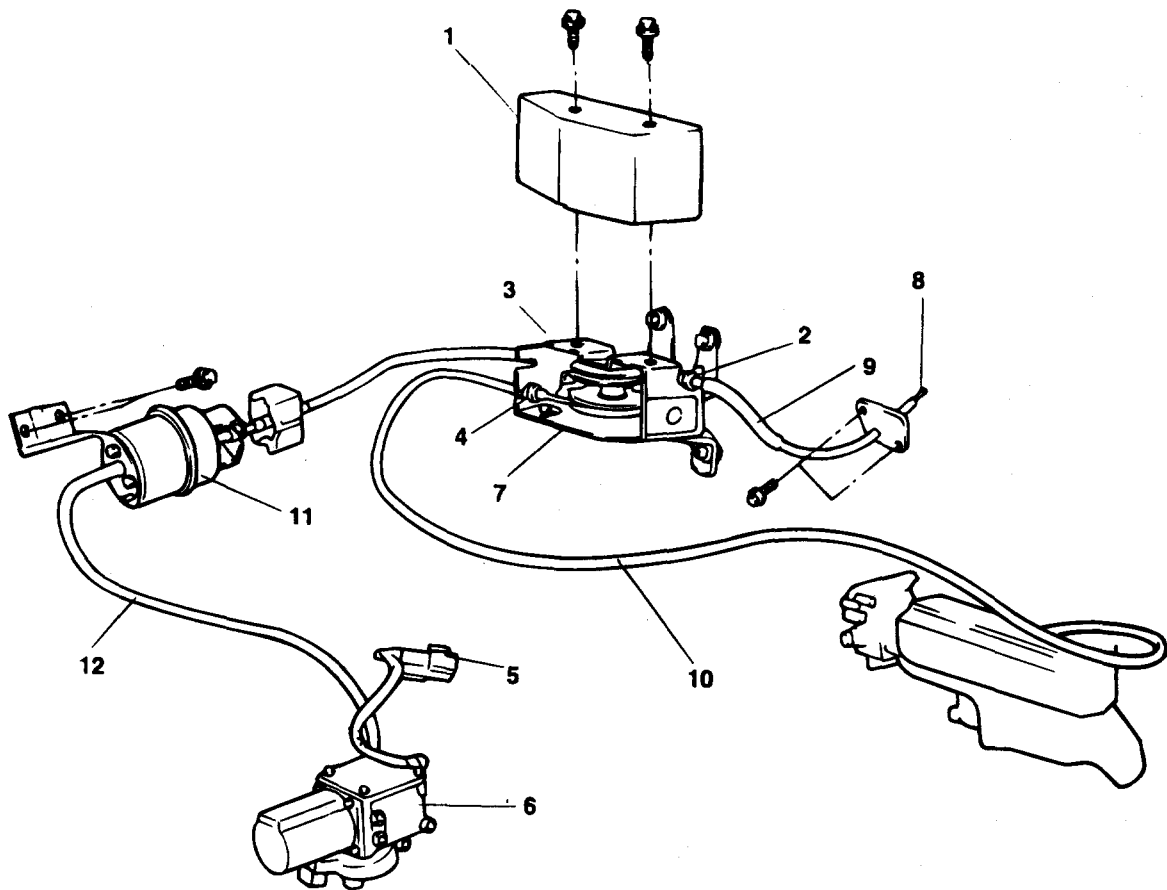


EBA9030N



EBBB031B

## COMPONENTS EBBB0320

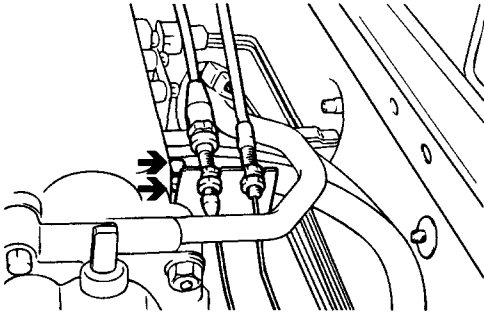


1. Pulley protector
2. Accelerator cable and pulley assembly connection
3. Cruise control cable and pulley assembly connection
4. Throttle cable and pulley assembly connection
5. Vacuum pump connector
6. Pump assembly
7. Pulley assembly
8. Accelerator cable and pedal connection
9. Accelerator cable
10. Throttle cable
11. Actuator
12. Vacuum hose

**REMOVAL AND INSTALLATION**

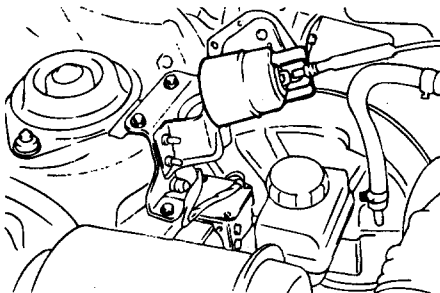
EBBB0330

1. Remove the battery negative terminal.
2. Disconnect the accelerator cable and cruise control cable from throttle assembly by turning throttle lever to full open position.
3. Disconnect the accelerator cable from accelerator pedal connection.
4. Remove the accelerator cable mounting bolts.



EBAA031B

5. Remove the actuator and unit assembly mounting bolt.
6. Installation is the reverse order of removal.



Y27-059C

**PARTS INSPECTION**

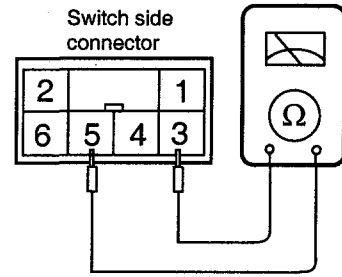
EBAA0320

**CRUISE CONTROL MAIN SWITCH**

1. Operate the switch and check for continuity between the terminals.
2. If continuity is not as specified, replace the switch.

Terminal Position	1	2	3	4	5	6
ON			○	—	○	
OFF	○	—		○		

EBAA032A



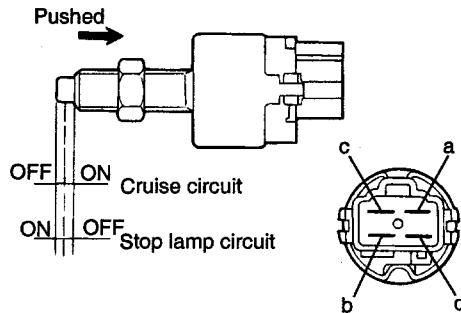
EBAA032B

**STOP LAMP SWITCH**

After operating the stop lamp switch, check for continuity between the terminals.

Terminal Position	1	2	3	4	
Not pushed			○	—	○
Pushed	○	—			○

EBAA032C



EBA9032C

**INSPECTION**

EBAA0330

**CONDITION**

- Turn A/C and all lights OFF. Inspect and adjust at no load.
- Warm the engine until idle is stabilized. Confirm that the idle speed is at the specified RPM.
- Turn the ignition switch OFF.

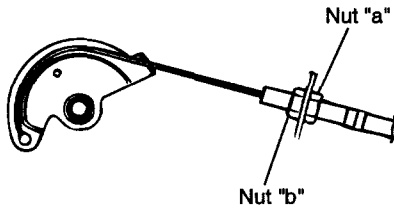
1. Confirm there are no sharp bends in the cables.
2. Depress the accelerator pedal and check if the throttle lever moves smoothly from fully closed to fully open.
3. Check the inner cables for correct slack.
4. If there is too much slack or no slack, adjust the play by the following procedures :

**SERVICE HINT**

1. If the cable is very loose, the loss of speed going uphill will be large.
2. If the cable is too tight, idle RPM will be high.

**CABLE ADJUSTMENT**

1. Assemble the cable to actuator and unit assembly.
2. Tighten nut "b" after pulling the cable tightly.
3. Back nut "b" off one turn.
4. Tighten nut "a".
5. Cable should have approximately 1mm of slack with the actuator and unit against the stop.



EBA033A

# PREHEATING SYSTEM

## GLOW SYSTEM EBMB0330

### SPECIFICATIONS

#### SERVICE SPECIFICATIONS

Items	Auto glow system
Water temperature sensor resistance [at 20°C (68°F)] k	2.92 - 3.58
Glow plug resistance [at 20°C (68°C)] m	250

#### TORQUE SPECIFICATIONS

Items	Nm	kg-cm	lb-ft
Water temperature sensor	8 - 10	80 - 100	6 - 7
Glow plug	15 - 20	150 - 200	11 - 14
Glow plug plate attaching nut	1 - 1.5	10 - 15	0.7 - 1.1

#### SEALANTS AND ADHESIVES

Items	Specified sealant and Adhesive
Water temperature sensor	3M Adhesive Nut Locking 4171 or equivalent

## SERVICE ADJUSTMENT

### PROCEDURES EBMB0340

#### INSPECTION OF GLOW SYSTEM OPERATION

Conditions before inspection :

Battery voltage : 12V

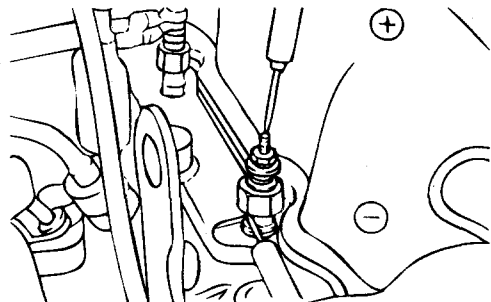
1. Connect voltmeter between glow plug plate and plug body (ground).
2. Check indicated value on voltmeter with ignition switch ON.
3. Check that preheat indication lamp lights for about 6 seconds and indicates battery voltage (about 9V or over) for about 36 seconds immediately after ignition switch is turned on. [At cooling water temperature 20°C (68°F)]

#### NOTE

Continuity time varies depending upon cooling water temperature.

4. After checking 3, set ignition switch at START position.

5. The system is normal if battery voltage (about 9V or over) is generated for about 6 seconds during engine cranking and after start operation. [at cooling water temperature 20°C (68°F)]
6. When the voltage or continuity time is not normal, check the terminal voltage in glow control unit, and single parts.

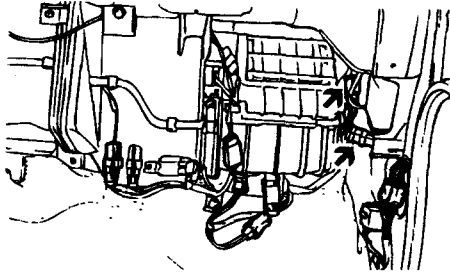


B7AD7645

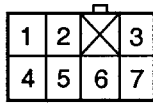


INSPECTION OF GLOW CONTROL UNIT

Check terminal voltage in glow control unit and continuity on harness side.



H7EE020A



C007F001



C002F003

EBLB039A

1. Check with glow control unit connector connected.  
(M14)

Terminal	Connect area or measuring part	Measuring item	Tester connection	Check conditions	Standard value
1	Glow plug relay	Voltage	1 - ground	Ignition switch ON	Indicates battery voltage for about 30 seconds after ON

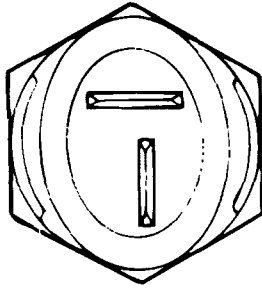
2. Remove glow control unit connector. Check with harness side connector. (M13)

Terminal	Connect area or measuring part	Measuring item	Tester connection	Check conditions	Standard value
1	Ignition switch	Voltage	1 - ground	During engine cranking	Battery voltage
2	Preheat indication lamp	Voltage	2 - ground	Constantly	Battery voltage
3	Ignition switch (IG1 power source)	Voltage	3 - ground	Ignition switch ON	Battery voltage
4	Water temperature sensor	Resistance	4 - ground	-20°C (-4°F) 0°C (30°F) 20°C (68°F) 40°C (104°F)	24.8 ± 2.5 kΩ 8.62 kΩ 3.25 kΩ 1.05 kΩ
5	Vacant terminal	-	-	-	-
6	Control unit earth	Continuity	6 - ground	Constantly	Continuity
7	Generator L terminal	Voltage	7 - ground	Ignition Switch On	1 - 4 V

**INSPECTION OF ENGINE COOLANT TEMPERATURE SENSOR** EBMB0350

1. Remove ECT sensor from intake manifold.
2. Check that ECT sensor resistance is within the standard value.

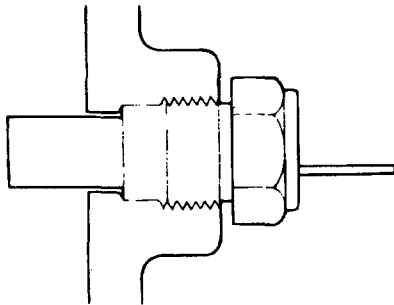
**Standard value : 3.25kΩ [at 20°C (68°F)]**



B7AD7655

3. After checking, apply specified adhesive to coolant temperature sensor screw area to install intake manifold.

**Specified adhesive : 3M Adhesive Nut Locking 4171 or equivalent**

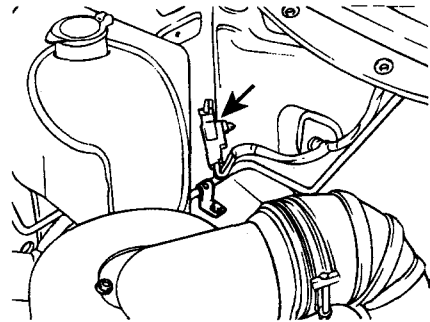


B7AD7660

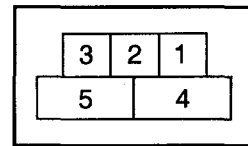
**INSPECTION OF STARTER RELAY** EBMB0360

1. Remove starter relay from relay bracket.
2. Connect battery power source to terminal 1. Check continuity between terminals with terminal 3 grounded.

With power	Between terminals 4 and 5	Continuity
Without power	Between terminals 1 and 3	Continuity
	Between terminals 4 and 5	No Continuity

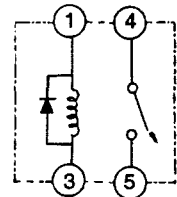


H7EE001A



(M41)

G6CL001T



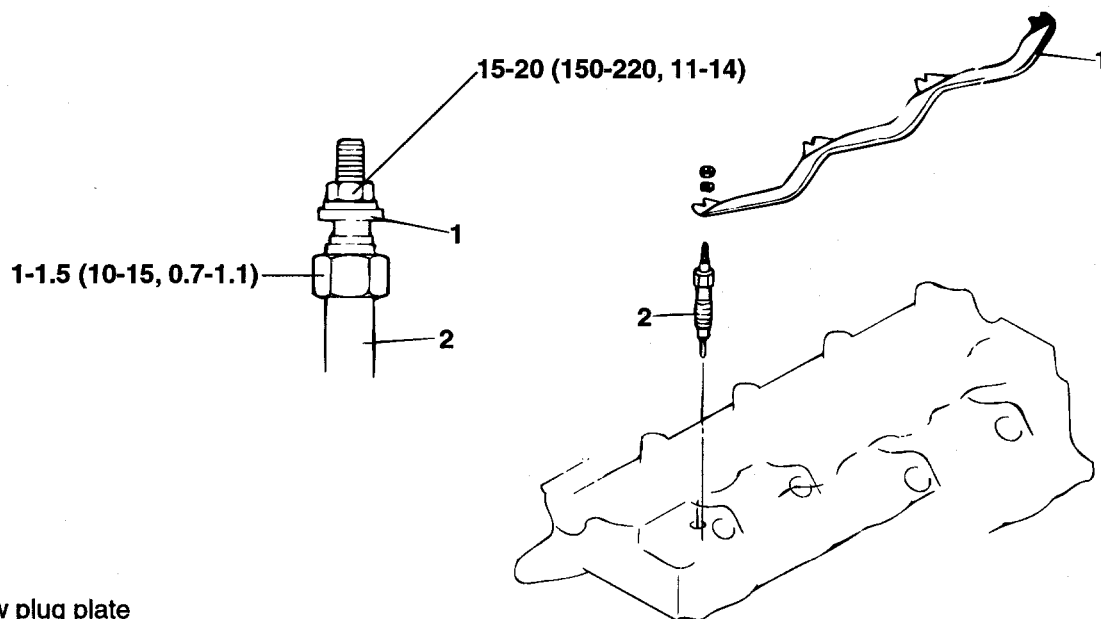
V5BE080A

EBLB041A

## REMOVAL AND INSTALLATION

EBMB0370

## COMPONENTS



1. Glow plug plate
2. Glow plug

**NOTE**

Reverse the removal procedures to reinstall.

**TORQUE : Nm (kg.cm,lb.ft)**

**INSPECTION** EBMB0380**GLOW PLUG**

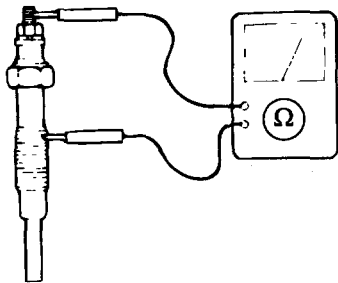
1. Check the continuity between the terminal and body as illustrated. Replace if discontinuity or with large resistance.

**Standard value :  $0.25\Omega$**

**⚠ CAUTION**

***Remove oil from plug before measuring as glow plug resistance is very small.***

2. Check for rust on glow plug plate.
3. Check glow plug for damage.



EBMB038A

# Emissions Control System

GENERAL .....	EC - 2
CRANKCASE EMISSION CONTROL SYSTEM .....	EC - 7
EVAPORATIVE EMISSION CONTROL SYSTEM .....	EC -10
EXHAUST EMISSION CONTROL SYSTEM .....	EC -14

# GENERAL

## SPECIFICATIONS EEMB0010

Components	Function	Remarks
<b>Crankcase Emission System</b> Positive crankcase ventilation (PCV) valve	HC reduction	Variable flow rate type
<b>Evaporative Emission System</b> EVAP Canister EVAP Canister Purge Solenoid Valve	HC reduction	Duty control solenoid valve
<b>Exhaust Emission System</b> MFI system (air-fuel mixture control device) Three-way catalytic converter	CO, HC, NOx reduction CO, HC, NOx reduction	Heated oxygen sensor feedback type Monolithic type

EVAP : Evaporative Emission

## SERVICE STANDARD

<b>EVAP Canister Purge Solenoid Valve</b> Coil current Coil resistance	0.45A or below (at 12V) 24.5 - 27.5 $\Omega$ [at 20°C (68°F)]
<b>EVAP Canister Purge Solenoid Valve</b> Coil resistance	36 - 44 $\Omega$ [at 20°C (68°F)]

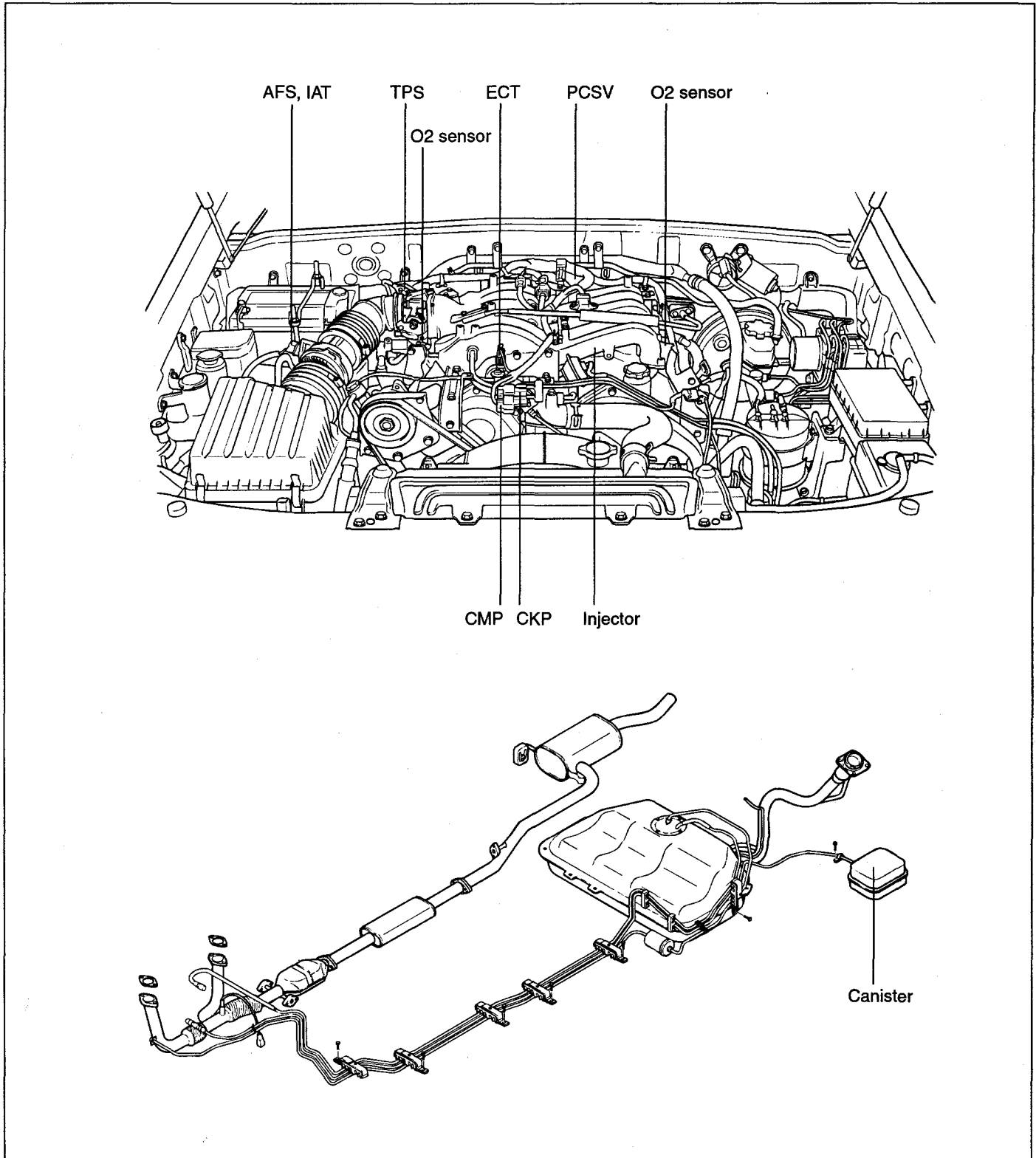
## SEALANT

Engine coolant temperature sensor threaded portion	THREE BOND 2403 or equivalent
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## TROUBLESHOOTING

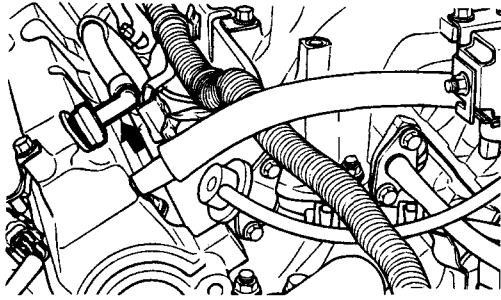
Symptom	Probable cause	Remedy
Engine will not start or hard to start	Vacuum hose disconnected or damaged Malfunction of the EVAP Canister Purge Solenoid Valve	Repair or replace Repair or replace
Rough idle or engine stalls	Vacuum hose disconnected or damaged Malfunction of the PCV valve Malfunction of the EVAP Canister Purge System	Repair or replace Replace Check the system; if there is a problem, check its component parts
Excessive oil consumption	Positive crankcase ventilation line clogged	Check positive crankcase ventilation system

EMISSION CONTROLS LOCATION EEMB0030



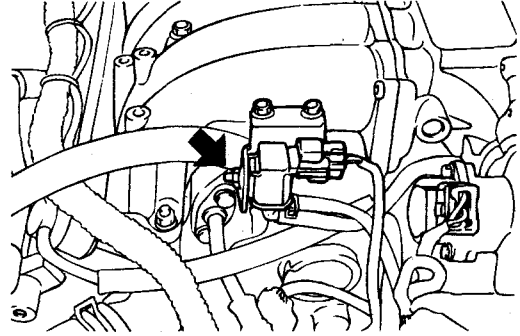


A. PCV valve



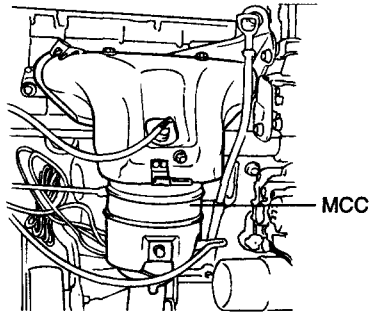
KFW5215A

B. EVAP Canister Purge Solenoid Valve



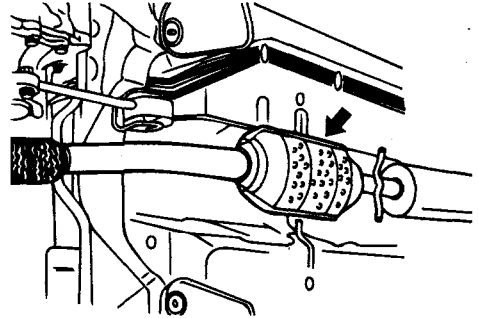
EFB9007A

C. Catalytic Converter (MCC)



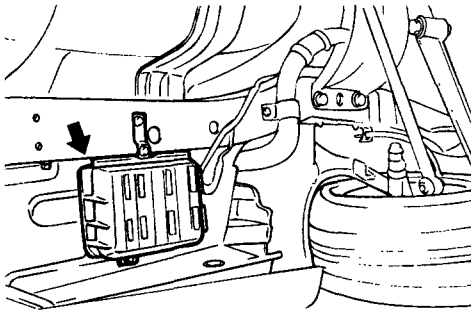
EEA9005G

D. Catalytic Converter (UCC)



EEBB003B

E. EVAP. canister



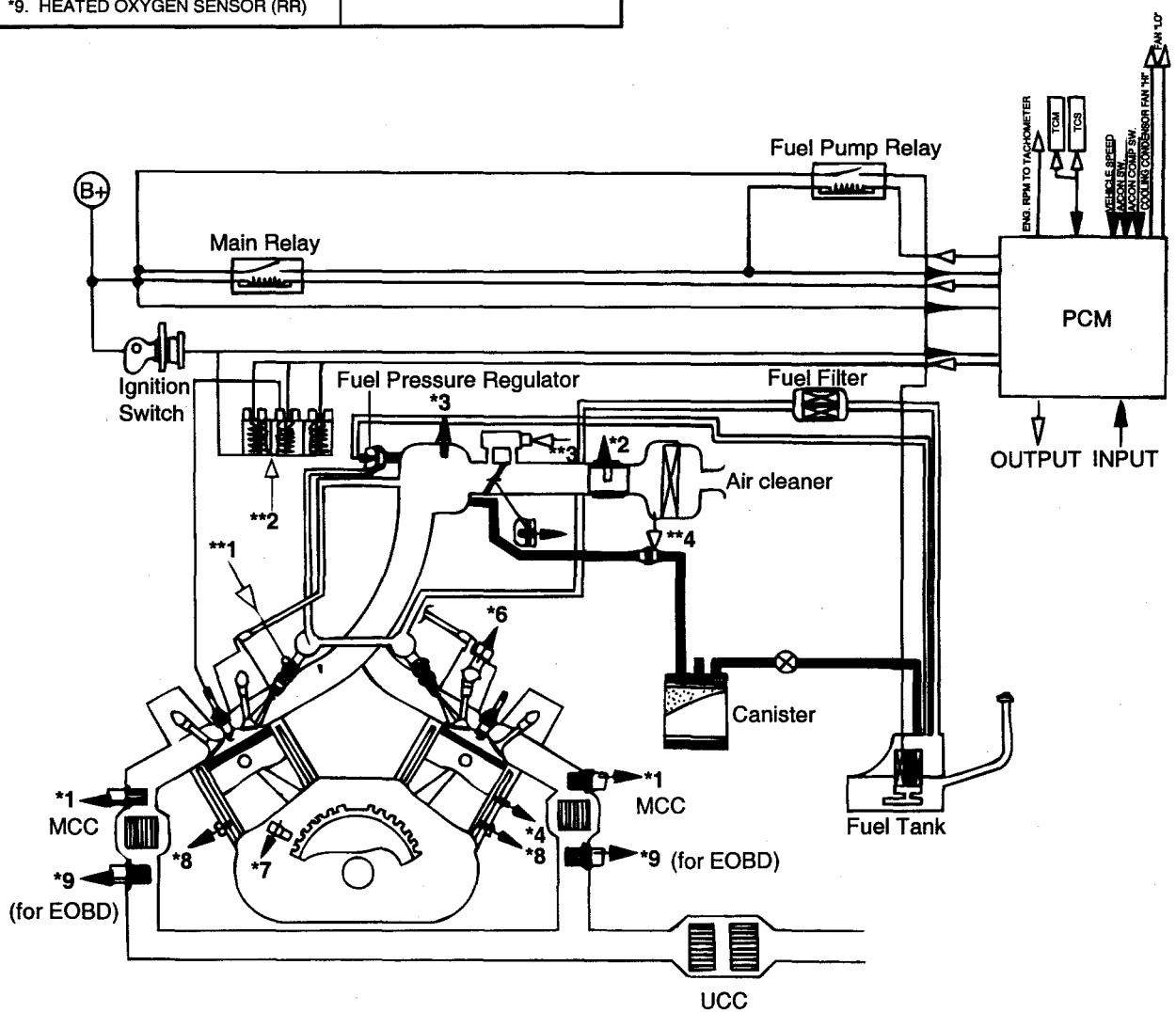
EEA9005E

**SCHEMATIC DRAWING** EEMB0050

- |  |                           |
|--|---------------------------|
| *1. HEATED OXYGEN SENSOR (HO2S)              | o IGNITION SWITCH         |
| *2. HOT FILM SENSOR                          | o BATTERY VOLTAGE         |
| *3. INTAKE AIR TEMP. SENSOR (IAT SENSOR)     | o VEHICLE SPEED SENSOR    |
| *4. ENGINE COOLANT TEMP. SENSOR (ECT SENSOR) | o A/C LOAD SIGNAL         |
| *5. THROTTLE POSITION SENSOR (TP SENSOR)     | o "PNP" SWITCH (A/T ONLY) |
| *6. CAMSHAFT POSITION SENSOR (CMP SENSOR)    | o FUEL PUMP RELAY SIGNAL  |
| *7. CRANKSHAFT POSITION SENSOR (CKP SENSOR)  |                           |
| *8. KNOCK SENSOR                             |                           |
| *9. HEATED OXYGEN SENSOR (RR)                |                           |

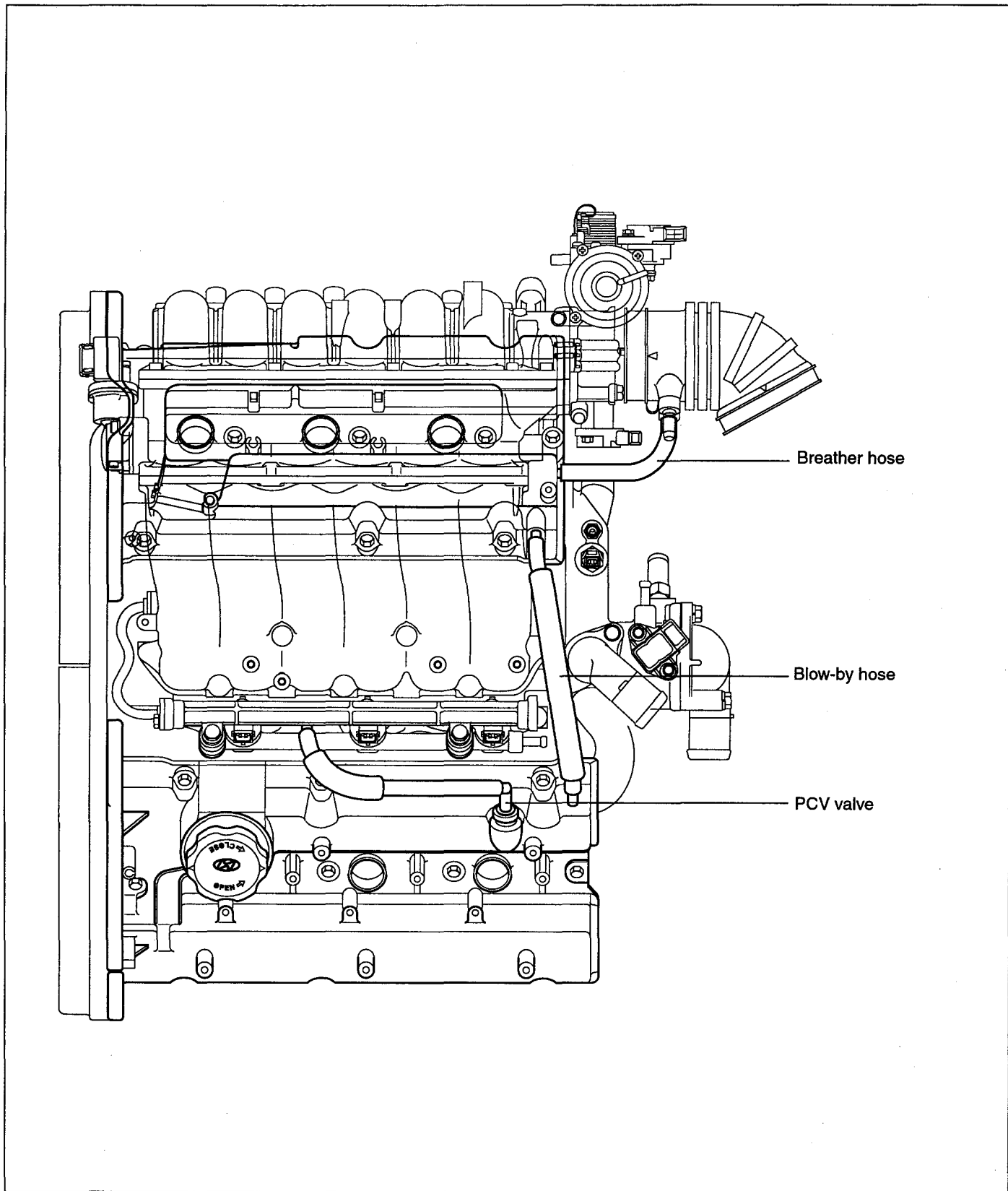


- |   |
|---|
| **1. FUEL INJECTOR                      |
| **2. IGNITION COIL                      |
| **3. ISC MOTOR (Linear Solenoid Type)   |
| **4. EVAP Canister Purge Solenoid Valve |
| o FUEL PUMP CONTROL                     |
| o MFI CONTROL RELAY                     |
| o A/C RELAY                             |
| o IGNITION TIMING CONTROL               |
| o DIAGNOSIS                             |



PCM : Powertrain Control Module  
 EVAP : Evaporative Emission  
 UCC : Underbody Catalytic Converter  
 MCC : Manifold Catalytic Converter

VACUUM HOSES LAYOUT EEMB0110

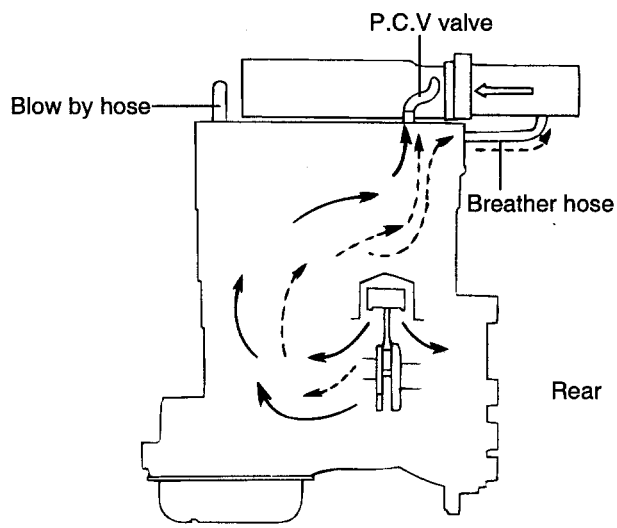
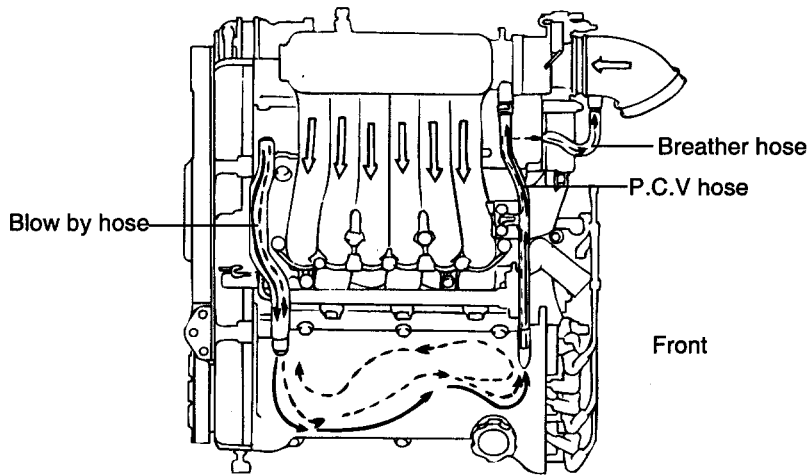


# CRANKCASE EMISSION CONTROL SYSTEM

## POSITIVE CRANKCASE VENTILATION (PCV) VALVE

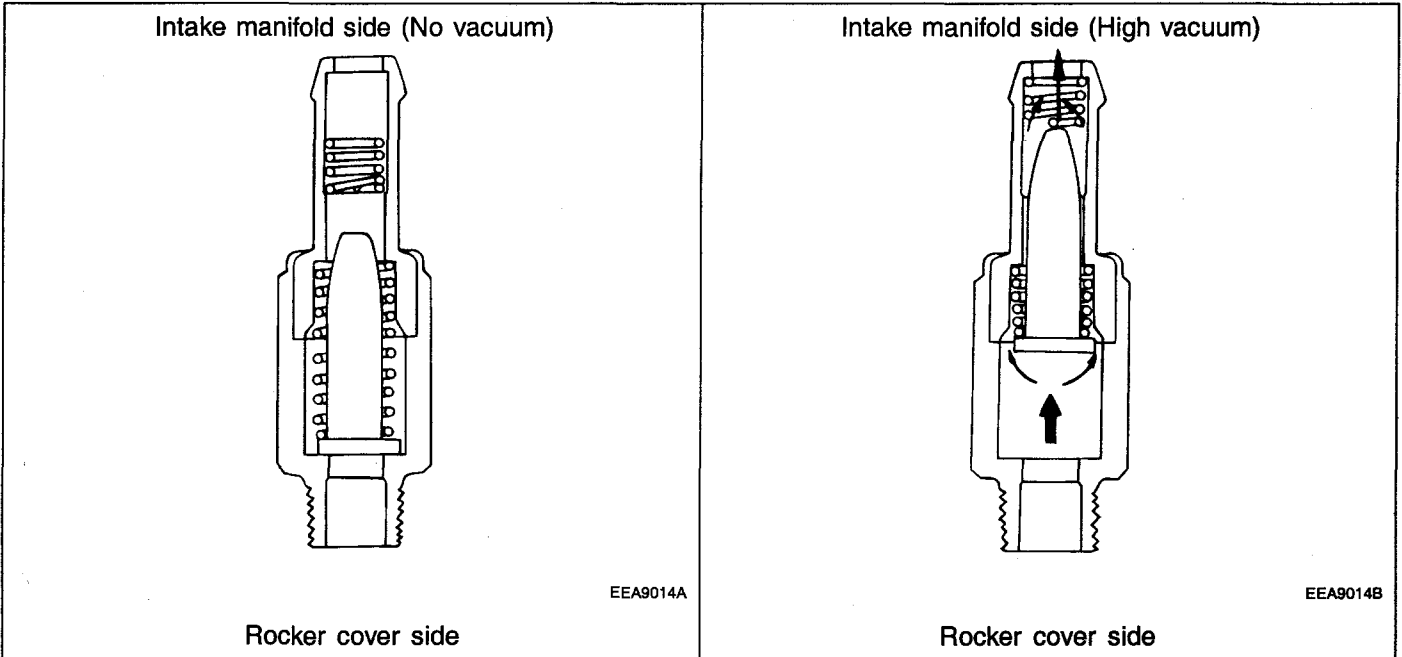
(PCV) VALVE EEBB0070

### COMPONENTS

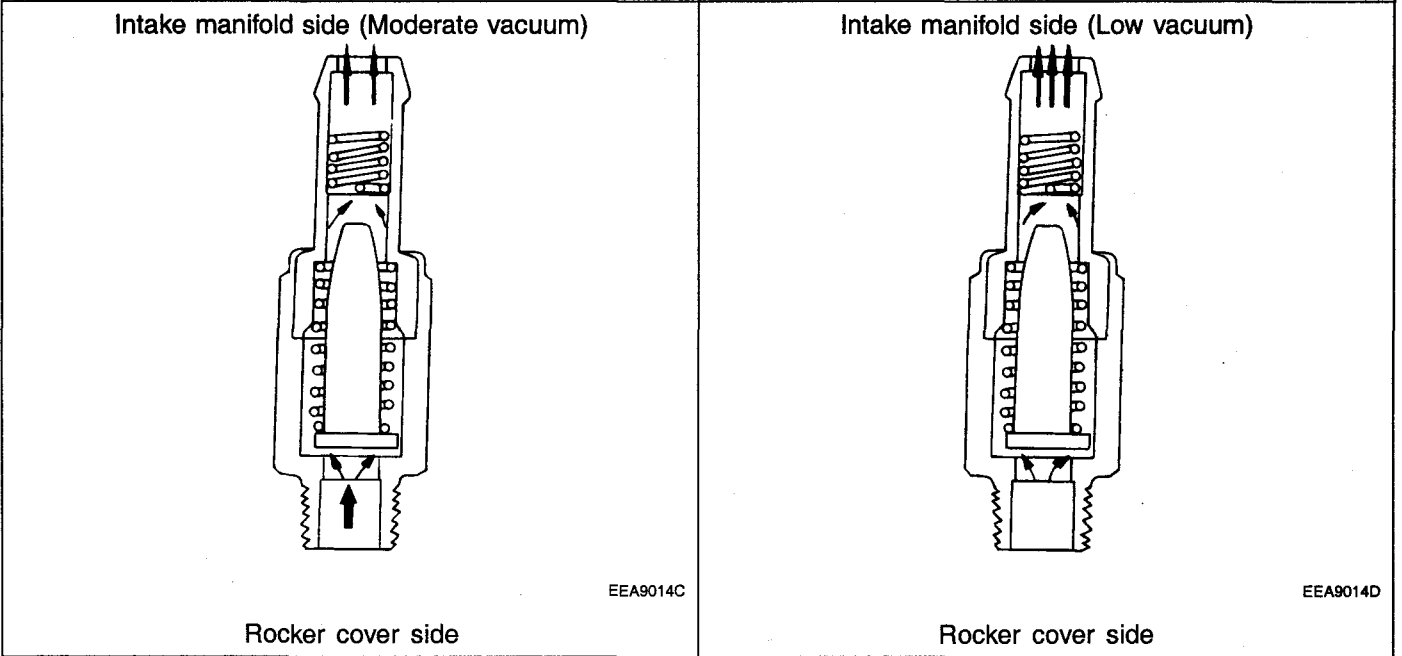


- ← During low load operation
- ← During high load operation
- ← Fresh air

**PCV VALVE OPERATING** EEA90140



Engine condition	Not running	Engine condition	Idling or decelerating
PCV valve	Not operating	PCV valve	Fully operating
Vacuum passage	Restricted	Vacuum passage	Small



Engine condition	Normal operation	Engine condition	Accelerating and high load
PCV valve	Properly operating	PCV valve	Slightly operating
Vacuum passage	Large	Vacuum passage	Much large

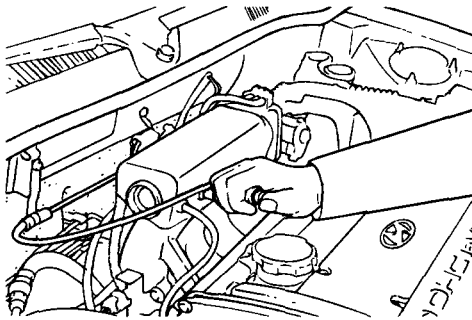
**DISASSEMBLY** EEA90150

1. Disconnect the ventilation hose from the positive crankcase ventilation (PCV) valve. Remove the PCV valve from the rocker cover and reconnect it to the ventilation hose.
2. Run the engine at idle and put a finger on the open end of the PCV valve and make sure that intake manifold vacuum is felt.

**NOTE**

*The plunger inside the PCV valve should move back and forth.*

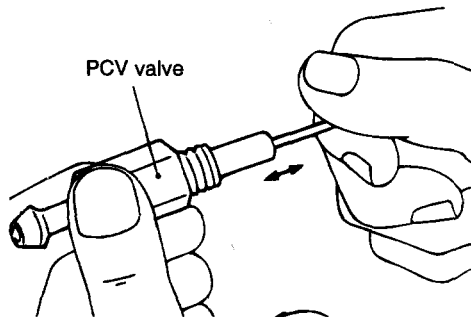
3. If vacuum is not felt, clean the PCV valve and ventilation hose in cleaning solvent, or replace if necessary.



EEA9015A

**INSPECTION**

1. Remove the positive crankcase ventilation valve.
2. Insert a thin stick into the positive crankcase ventilation valve from the threaded side to check that the plunger moves.
3. If the plunger does not move, the positive crankcase ventilation valve is clogged. Clean or replace it.



EEA9015B

**INSTALLATION**

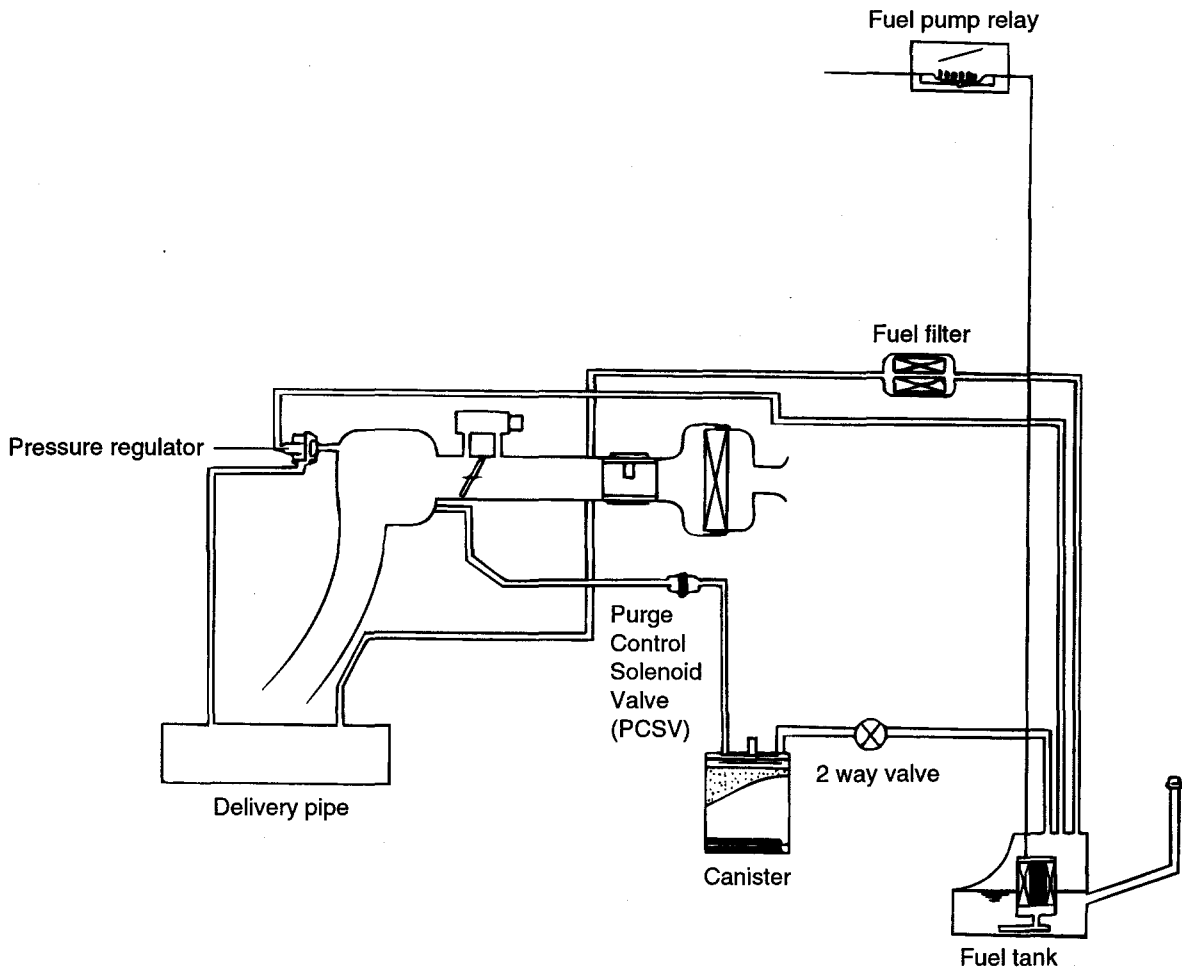
Install the positive crankcase ventilation valve and tighten to the specified torque.

**Tightening torque**

PCV valve : 8-12 Nm (80-120 kg·cm, 6-8 lb·ft)

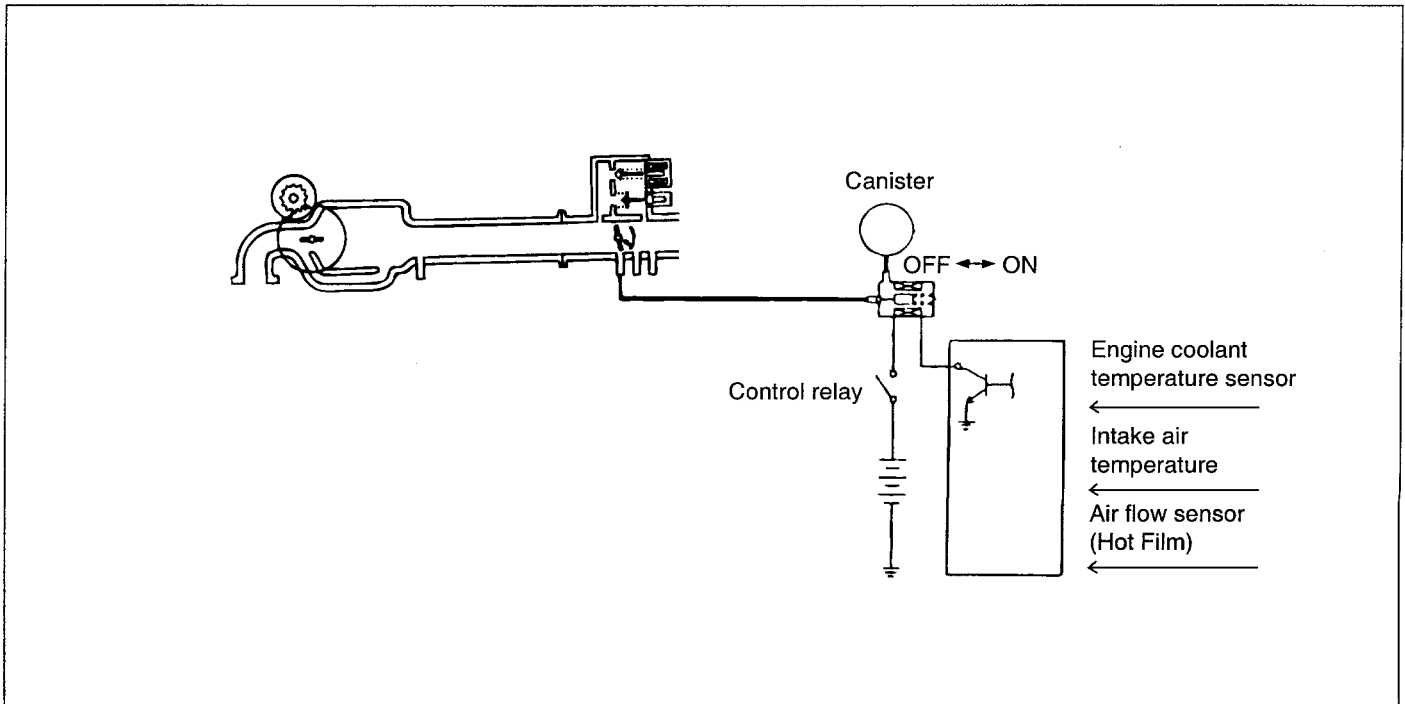
# EVAPORATIVE EMISSION CONTROL SYSTEM

## COMPONENTS EEMB0100



**EVAPORATIVE (EVAP) CANISTER PURGE SOLENOID VALVE**

EEBB0120

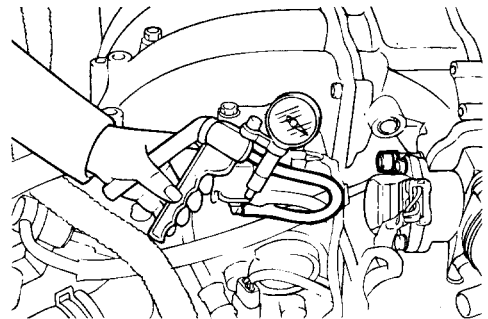


EEBB012A

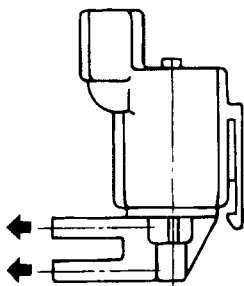
**EVAP CANISTER PURGE SOLENOID VALVE**

**NOTE**

The EVAP Canister Purge Solenoid Valve is controlled by the ECM; when the engine coolant temperature is low, and also during idling, the valve closes so that evaporated fuel is not drawn into the surge tank. After the warm-up of the engine during ordinary driving, valve opens to let the stored vapors flow into the surge tank.



EEB9007A



EEBB012B

1. Disconnect the vacuum hose (black with red stripe) from the solenoid valve.
2. Detach the harness connector.
3. Connect a vacuum pump to the nipple to which the red-striped vacuum hose was connected.
4. Apply vacuum and check when voltage is applied to the EVAP Canister Purge Solenoid Valve and when the voltage is discontinued.

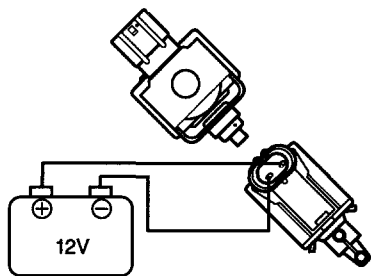
**INSPECTION**

**NOTE**

When disconnecting the vacuum hose, make an identification mark on it so that it can be reconnected to its original position.

Battery voltage	Normal condition
When applied	Vacuum is released
When discontinued	Vacuum is maintained



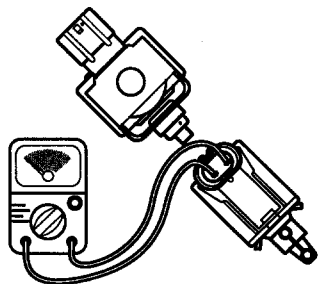


KFW4011A

5. Measure the current between the terminals of the solenoid valve.

**EVAP Canister Purge Solenoid Valve**

Coil at 20°C (68°F) : 0.45A or below (at 12V)  
 Coil resistance : 24.5 - 27.5 Ω [at 20°C (68°F)]

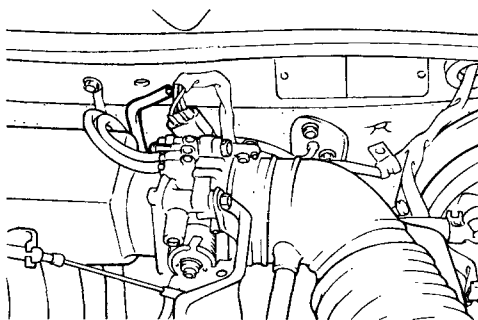


KFW4012A

**VACUUM HOSE**

Engine coolant temperature : 80-95°C (176-205°F)

1. Disconnect the vacuum hose from the intake manifold purge hose nipple and connect a hand vacuum pump to the nipple.

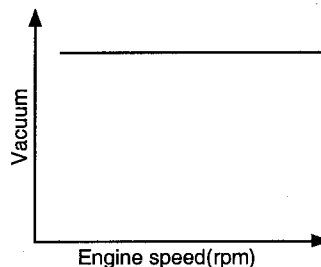


EEA9023A

2. Start the engine and check that, after raising the engine speed by racing the engine, vacuum remains fairly constant.

**NOTE**

If there is no vacuum created, the intake manifold port may be clogged and require cleaning.



EEA9023B

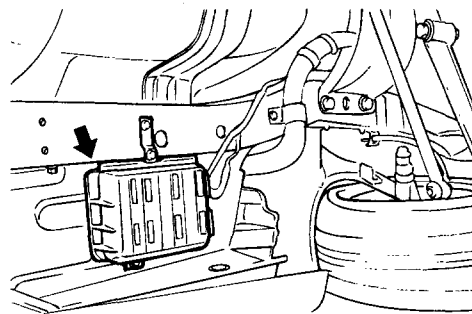
**EVAPORATIVE (EVAP) CANISTER**

EEJB0240

**CANISTER**

Inspect the Canister Close Valve (CCV) and its air filter as shown in the illustration.

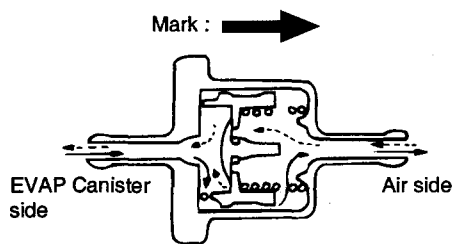
1. Look for loose connections, and sharp bends or damage to the fuel vapor lines.
2. Look for distortion, cracks or fuel leakage.
3. After removing the EVAP Canister, inspect for cracks or damage.



EEA9005E

**TWO-WAY VALVE**

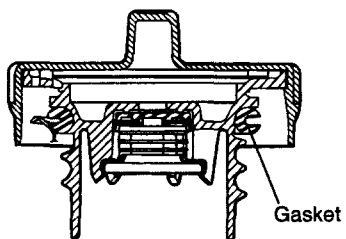
1. Inspect that air flows as shown.
2. Check that the valve is connected correctly noting the arrow mark on the valve.



V5EC201D

**FUEL FILER CAP**      EEAA0260

Check the gasket of the fuel filler cap, and the filler cap itself, for damage or deformation. Replace the cap if necessary.



V5EC205A

# EXHAUST EMISSION CONTROL SYSTEM

## VEHICLES WITH CATALYTIC CONVERTER EEA90270

Exhaust emissions (CO, HC, NO<sub>x</sub>) are controlled by a combination of engine modifications and the addition of special control components in the fuel.

Modifications to the combustion chamber, intake manifold, camshaft and ignition system form the basic control system. Additional control devices include a catalytic converter and the oxygen sensors which monitor mixture richness.

These systems have been integrated into a highly effective system which controls exhaust emissions while maintaining good driveability and fuel economy.

## AIR/FUEL MIXTURE RATIO CONTROL SYSTEM [MULTIPOINT FUEL INJECTION (MFI) SYSTEM] EEA90280

The MFI system employs the signals from the heated oxygen sensor to activate and control the injector installed in the manifold for each cylinder, precisely regulating the air/fuel mixture ratio and reducing emissions.

This allows the engine to produce exhaust gases of the proper composition to permit the use of a three-way catalyst. The three-way catalyst is designed to convert the three pollutants (1) hydrocarbons (HC), (2) carbon monoxide (CO), and (3) oxides of nitrogen (NO<sub>x</sub>) into harmless substances. The two operating modes in the MFI system are as follows:

1. Open loop-air/fuel ratio is controlled by information programmed into the PCM during the manufacturing process.
2. Closed loop-air/fuel ratio varies by the PCM based on information supplied by the heated oxygen sensor.

# Driveshaft and Axle

<b>GENERAL .....</b>	<b>DS - 2</b>
<b>PROPELLER SHAFT ASSEMBLY .....</b>	<b>DS -11</b>
<b>DRIVESHAFT .....</b>	<b>DS -15</b>
<b>FRONT AXLE .....</b>	<b>DS -28</b>
<b>REAR AXLE .....</b>	<b>DS -40</b>
<b>DIFFERENTIAL CARRIER ASSEMBLY .....</b>	<b>DS -48</b>

## GENERAL

## SPECIFICATIONS EIMB0100

## PROPELLER SHAFT

ITEMS	SPECIFICATION	
	2.5 DIESEL	3.5 GASOLINE
Joint type Front Rear	U.J. + U.J. U.J. + U.J.	U.J. + C.V.J. U.J. + U.J.
Length x O.D mm (in.) Front Rear (4WD) Rear (2WD)	749.5 x 50.8 (M/T) 817.5 x 50.8 (A/T) 1089 x 76.2 (M/T) 1022 x 76.2 (A/T) 1497 x 76.2 (M/T) 1420 x 76.2 (A/T)	775.5 x 63.5 (M/T) 753.5 x 63.5 (A/T) 1064 x 76.2 (M/T) 1084 x 76.2 (A/T) ← ←
Runout	0.5mm (0.020 in.) or less	0.5mm (0.020 in.) or less

U.J. : Universal Joint  
C.V.J. : Constant Velocity Joint

2 WD : 2 Wheel Drive  
4 WD : 4 Wheel Drive

M/T : Manual Transmission  
A/T : Automatic Transmission

## FRONT AXLE AND DRIVESHAFT

ITEMS	SPECIFICATION	
	2.5 DIESEL	3.5 GASOLINE
Front axle hub bearing type	Taper roller bearing	←
Driveshaft joint type (4WD) Outer Inner	B.J. D.O.J.	B.J., B.J. T.J., D.O.J.
Differential (4WD) Reduction gear type Reduction ratio	Hypoid gear 4,875 (NO.6) : 2.5 Diesel Engine	Hypoid gear 4,625 (NO.6) : 3.5 Gasoline Engine

B.J. : Birfield Joint

D.O.J. : Double Offset Joint

T.J. : Tripod Joint

## REAR AXLE AND AXLE SHAFT

ITEMS	SPECIFICATION
Axle housing type	Banjo Type
Axle shaft supporting type	Semi-floating type
DIFFERENTIAL Reduction gear type Reduction gear ratio	Hypoid gear 4.875 (NO.7) : 2.5 Diesel Engine 4.625 (NO.7.5) : 3.5 Gasoline Engine

## LUBRICANTS EIMB0200

Items	Specified lubricants	Quantity
<b>B.J. - D.O.J. Driveshaft type (2.5 Diesel, 3.5 Gasoline)</b> B.J. Boot grease  D.O.J. Boot grease	Repair kit grease  Repair kit grease	130(+10/-0) gr. (2.5 Diesel) 145 ± 10 gr. (3.5 Gasoline) 130(+10/-0) gr. (2.5 Diesel) 135 ± 10 gr. (3.5 Gasoline)
<b>B.J. - T.J. Driveshaft type(GKN) (3.5 Gasoline)</b> B.J. Boot grease D.O.J. Boot grease	Repair kit grease Repair kit grease	115 ± 5 gr. 230 ± 10 gr.
<b>Differential</b>  Front  Rear Conventional differential  With LSD (Limited Slip Differential)	Hypoid gear oil GH90W (Warmer than -30°C) GH80W (Colder than -30°C)  GH90W (Warmer than -30°C) GH80W (Colder than -30°C) Multi gear LS90 (MMC CO.LTD), SAE 90 INFILREX33 (MOBIL CO.LTD)	Fill the reservoir to the plug hole 1.8L 1.8L  2.8L (2.5 Diesel) 2.8L (3.5 Gasoline) 2.8L (2.5 Diesel) 2.8L (3.5 Gasoline)

## SEALANTS AND ADHESIVES EIMB0300

Items	Specified sealants and adhesives
Contact surface of the drive flange and front axle hub Threaded holes for mounting of the drive flange and front axle hub Differential cover installation surface (to gear carrier) Contact surface of the rear axle housing and the bearing case	HERM SEAL NO.201 PRETONR #316 or equivalent  THREEBOND #1215 or equivalent THREEBOND #1104 or equivalent

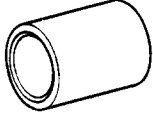

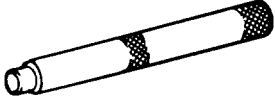
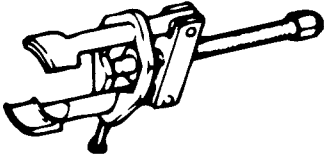
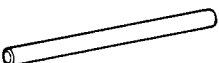

## TORQUE SPECIFICATIONS EIMB0400

Items	Nm	Kg-cm	lb-ft
Propeller shaft			
Yoke flange mounting nut(Front, Rear)	50-60	500-600	37-44
LJ assembly to transfer flange mounting nut	35-40	350-400	26-29
Center bearing mounting self locking flange nut	40-50	400-500	29-37
Center bearing mounting bracket	40-50	400-500	29-37
Self locking nut to center yoke mounting lock nut(2WD)	230-250	2300-2500	168-183
Wheel nut	100-120	1000-1200	73-88
Front hub to brake disc mounting	50-60	500-600	37-44
Upper arm ball joint to knuckle mounting	60-90	600-900	44-66
Lower arm ball joint to knuckle mounting	120-180	1200-1800	88-132
Knuckle to tie rod end mounting	40-50	400-500	26-29
Front hub to drive flange mounting bolt	50-60	500-600	37-44
Driveshaft to inner shaft mounting	50-60	500-600	37-44
Rear axle housing to bearing case	120-140	1200-1400	88.8-103.6
Oil filler plug	40-60	400-600	29-44
Oil drain plug	60-70	600-700	44-51
Differential self-locking nut	160-220	1600-2200	117-161

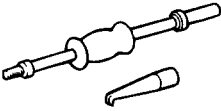

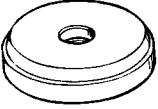
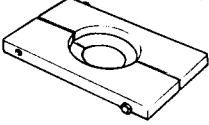

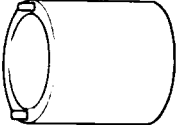

 **CAUTION**


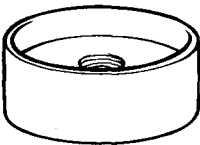
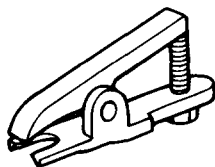


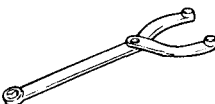
**Replace self-locking nuts with new ones after removal.**

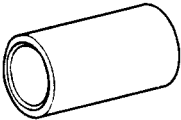
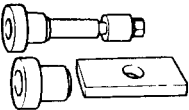
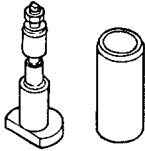
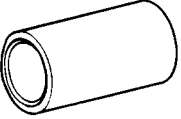
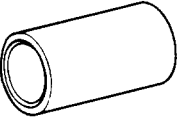
## SPECIAL TOOL EIMB0500

Tool (Number and Name)	Illustration	Use
Bushing remover and installer 09216-21100	 <p style="text-align: right;">B1621100</p>	Press-fitting of the inner shaft housing dust seal
Bearing outer race installer 09432-33700	 <p style="text-align: right;">D3233700</p>	Installation of the front hub bearing (Use with 09500-21000)
Bar 09500-21000	 <p style="text-align: right;">E0021000</p>	Installation of the front hub bearing (Use with 09432-33700)
Bearing and gear puller 09455-21000	 <p style="text-align: right;">HFR49-7</p>	Removal of the inner race from the front hub (Use with 09545-34100)
Draft 09517-21400	 <p style="text-align: right;">E1721400</p>	Removal of the knuckle needle bearing from the knuckle
Universal joint remover 09493-43000	 <p style="text-align: right;">D9343000</p>	Removal and installation of the journal bearing



Tool (Number and Name)	Illustration	Use
Sliding hammer 09526-11100	 <p style="text-align: right;">E2611100</p>	<ul style="list-style-type: none"> <li>• Removal of the front hub and the inner shaft (Use with 09500-11001)</li> <li>• Removal of the rear axle housing oil seal</li> </ul>
Axle puller 09526-11001	 <p style="text-align: right;">E2611001</p>	Removal of the front hub and the inner shaft (Use with 09500-11001)
Oil seal installer 09517-21000	 <p style="text-align: right;">E1721000</p>	Press-fitting of the differential drive pinion oil seal (Use with 09500-21000)
Remove plate 09527-4A000	 <p style="text-align: right;">E274A000</p>	Removal of the differential drive pinion rear bearing
Bearing puller 09517-43001	 <p style="text-align: right;">D9-8</p>	<ul style="list-style-type: none"> <li>• Removal of the front lower arm ball joint</li> <li>• Removal of the differential side bearing</li> </ul>
Lock nut remover 09518-4A000	 <p style="text-align: right;">E184A000</p>	Removal and installation of the front hub lock nut
Preload socket 09532-11600	 <p style="text-align: right;">HFR49-10</p>	Measurement of the drive pinion starting torque (Use with torque wrench)

Tool (Number and Name)	Illustration	Use
Oil seal installer 09532-32000	 <p style="text-align: right;">E3232000</p>	Installation of the differential drive pinion front bearing outer race
Oil seal installer 09542-4A000	 <p style="text-align: right;">E424A000</p>	Press-fitting of the oil seal into knuckle (Use with 09500-11000)
Ball joint puller 09568-34000	 <p style="text-align: right;">HFR49-1</p>	Disconnection of the tie rod ball joint and the upper arm ball joint
Oil seal installer 09532-32100B	 <p style="text-align: right;">E3231200</p>	Installation of the differential drive pinion rear bearing outer race (Use with 09500-11000)
Working base 09517-43401	 <p style="text-align: right;">E1743401</p>	Supporting for the differential carrier
End yoke holder 09517-21700	 <p style="text-align: right;">E1721700</p>	Removal and installation of the differential self-locking nut

Tool (Number and Name)	Illustration	Use
Pinion height gauge base 09500-H1000	 <p style="text-align: right;">E00H1000</p>	Measurement of the front differential drive pinion height (No.6)
Pinion height gauge 09500-43131 (6 $\bar{\text{H}}$ )	 <p style="text-align: right;">E0043131</p>	
Pinion height gauge 09500-4A000	 <p style="text-align: right;">E004A000</p>	Measurement of the rear differential drive pinion height (No.7)
Pinion height gauge tube 09500-4A100	 <p style="text-align: right;">E004A100</p>	
Pinion height gauge base 09500-H1100	 <p style="text-align: right;">E00H1100</p>	

## TROUBLESHOOTING EIMB0600

Symptom		Probable cause	Remedy
Propeller shaft	Noise at start	Worn journal bearing Worn sleeve yoke spline or flange yoke Loose propeller shaft installation	Replace Replace Retighten
	Noise and vibration at high speed	Unbalanced propeller shaft Improper snap ring selection Worn journal bearing	Replace Adjust the clearance Replace
Drive shaft, Inner shaft	Noise during wheel rotation	Housing tube bent Inner shaft bent Inner shaft bearing worn, pounding Drive shaft assembly worn damaged, bent	Replace  Replace Check or replace
	Noise due to excessive play of wheel in turning direction	Inner shaft and side gear serration play Drive shaft and side gear serration play	Replace
Center Axle Disconnect System (CADS)	Does not lock	Negative pressure leakage Vacuum tank damaged Check valve damaged Actuator assembly damaged Shift fork damaged CADS clutch damaged Differential shaft damaged Actuator assembly attaching bolt loose	Correct or replace vacuum hose Replace     Retighten attaching bolts
	Locks but does not become free	Foreign substances on tooth surfaces of differential shaft and clutch sleeve Foreign substances on tooth surfaces of CADS sleeve and CADS clutch	Clean tooth surfaces or replace
Axle shaft, axle housing	Noise while wheels are rotating	Bent axle shaft Worn or scarred axle shaft bearing	Replace Replace
	Grease leakage	Worn or damaged oil seal Malfunction of bearing seal	Replace Replace
Differential	Constant noise	Improper drive gear and drive pinion gear tooth contact Loose, worn or damaged side bearing Loose, worn or damaged drive pinion bearing Worn drive gear, drive pinion Worn side gear thrust washer or pinion shaft Deformed drive gear of differential case Damaged gear Foreign material  Insufficient oil	Correct or replace          Eliminate the foreign (Replace the parts if necessary) Replenish

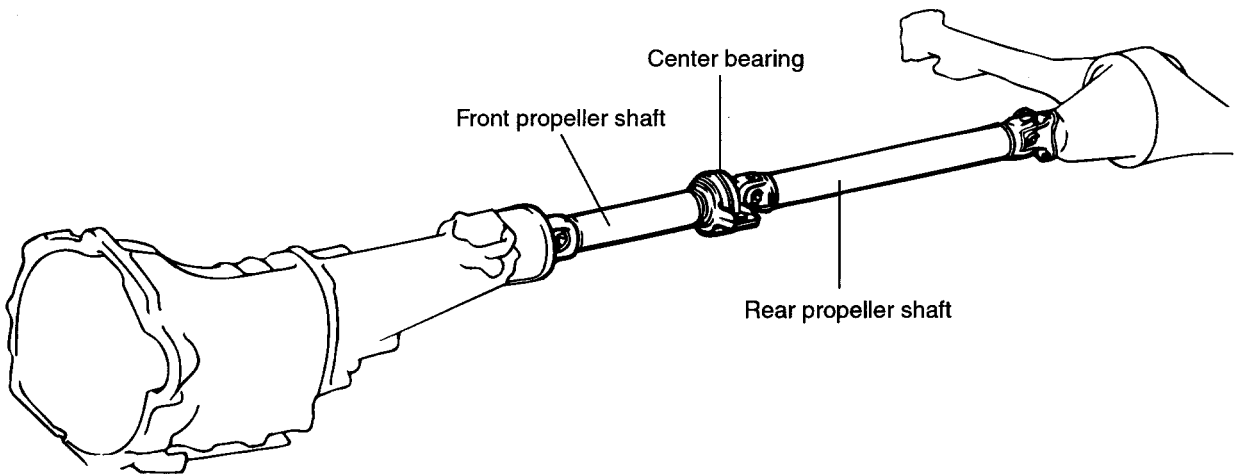
Symptom		Probable cause	Remedy
Differential	Gear noise while driving	Poor gear engagement Improper gear adjustment Improper drive pinion preload adjustment Damaged gear Foreign material  Insufficient oil	Correct or replace  Replace Eliminate the foreign material and check (Replace the parts if necessary) Replenish
	Gear noise while coasting	Improper drive pinion preload adjustment Damaged gear	Correct or replace Replace
	Bearing noise while driving or coasting	Cracked or damaged drive pinion rear bearing	Replace
	Noise while turning	Loose side bearing Damaged side gear, pinion gear or pinion shaft	Replace
	Heat	Improper gear backlash Excessive preload Insufficient oil	Adjust  Replenish
	Oil leakage	Differential carrier not tightened  Seal malfunction Worn or damaged oil seal Excessive oil	Retighten, apply sealant, or replace the gasket  Replace Adjust the oil level

# PROPELLER SHAFT ASSEMBLY

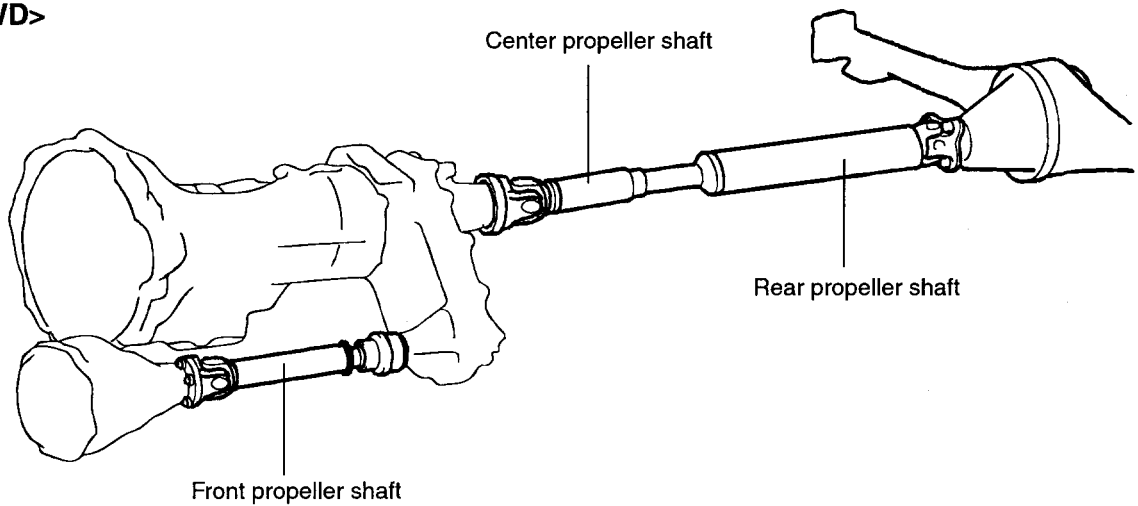
## PROPELLER SHAFT

### COMPONENTS EIMB0700

<2WD>

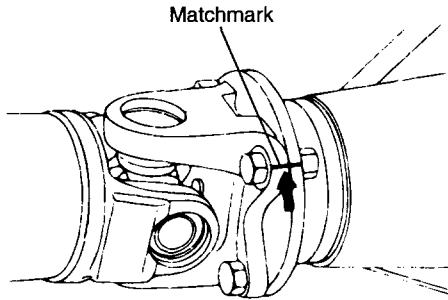


<4WD>



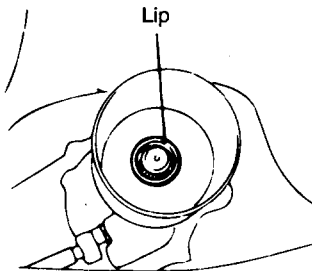
**REMOVAL** EIMB0800

1. Make a matchmark on the flange yoke and the differential companion flange.



KSRPS02A

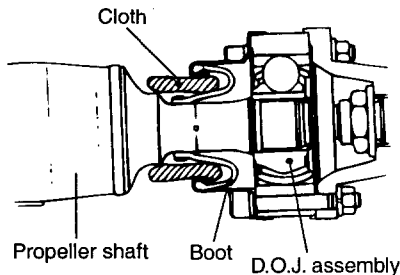
2. Use with the plug as a cover so that no foreign material gets into the transmission(2WD).



AU49-05A

**NOTE**

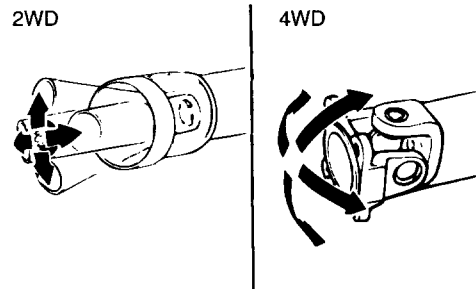
- When removing the propeller shaft, be careful not to damage the boot.
- Insert a piece of cloth into the boot to prevent it from being damaged.



A7PS0280

**INSPECTION** EIMB0900

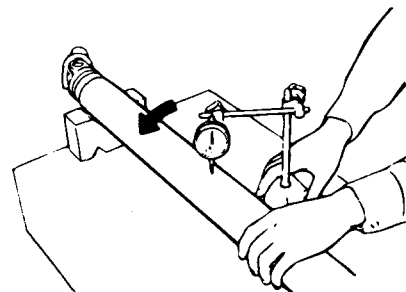
1. Check the sleeve yoke, center yoke and flange yoke for wear, damage or cracks.
2. Check the propeller shaft yokes for wear, damage or cracks.
3. Check the propeller shaft for bends, twisting or damage.
4. Check the universal joints for smooth operation in all directions.



KIMB090A

5. Check the center bearing for smooth movement(2WD).
6. Check the center bearing mounting rubber for damage or deterioration(4WD).
7. Measure the propeller shaft runout with a dial indicator.

Limit	Front	0.5 mm (0.02 in.) or less
	Rear	0.5 mm (0.02 in.) or less



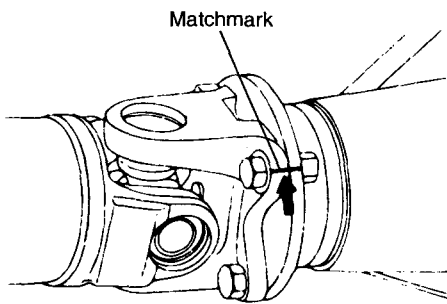
AU49-05C

**INSTALLATION** EIMB1000

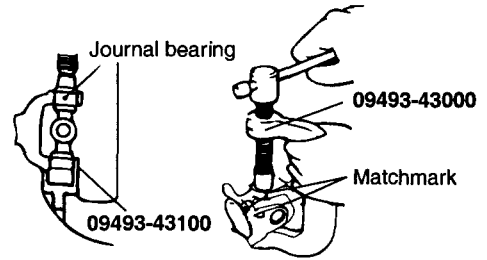
Align the matchmark on the flange yoke and the differential companion flange. Install the propeller shaft.

**CAUTION**

- Clean the thread of the mounting bolts and nuts before tightening these parts. Otherwise, they can become loose.
- Be careful not to damage the lip section of the transmission oil seal when installing the propeller shaft. (2WD)



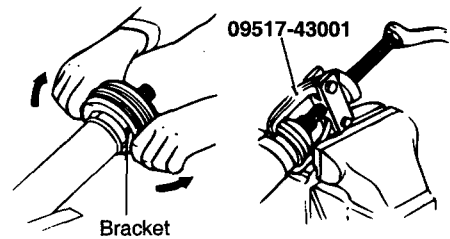
KSRPS02A



TU49-06C

**3. REMOVAL OF CENTER BEARING ASSEMBLY**

- Remove the center bearing bracket.
- Pull out the center bearing with a puller.

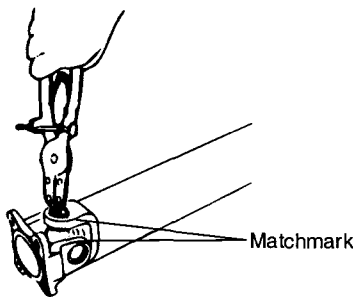


AIJA3190

**DISASSEMBLY** EIMB1100

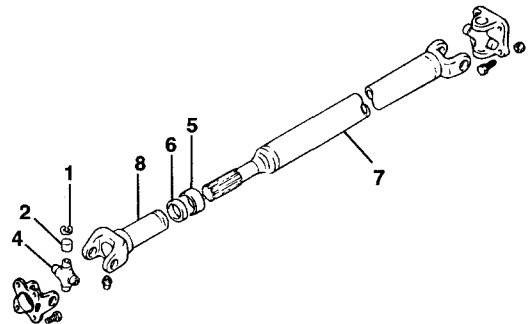
**1. REMOVAL OF SNAP RINGS**

- Make matchmarks on the yoke and universal joint that are to be disassembled.
- Remove the snap ring from the yoke with a snap ring pliers.



A7PS0320

**4. REMOVAL OF REAR PROPELLER SHAFT (4WD)**



**Removal steps**

- Snap ring
- Journal bearing
- Flange yoke
- Universal joint spider
- Packing retainer
- Shield packing
- Rear propeller shaft
- Sleeve yoke

EHPDS02A

**CAUTION**

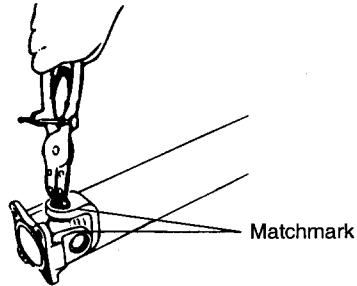
Do not tap the journal bearings to remove them, because this will cause imbalance of the propeller shaft.



**REASSEMBLY** EIMB1200

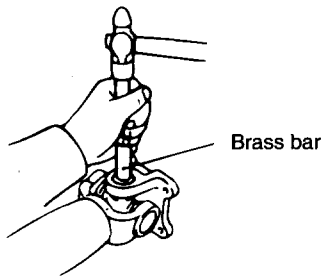
**SNAP RING**

1. Install snap rings of the same thickness onto both sides of each yoke.



ESRPS77A

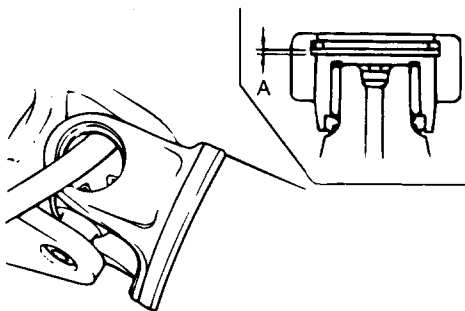
2. Press the bearing and journal into one side using a brass bar.



ESRPS05A

3. Measure the clearance between the snap ring and the groove wall of the yoke with a feeler gauge.

Standard value : 0.03 mm (0.0012 in.) or less

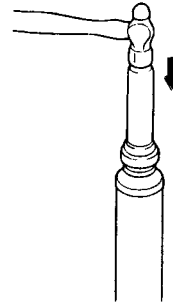


EJA3360

4. If the clearance exceeds the standard value, replace the snap rings.

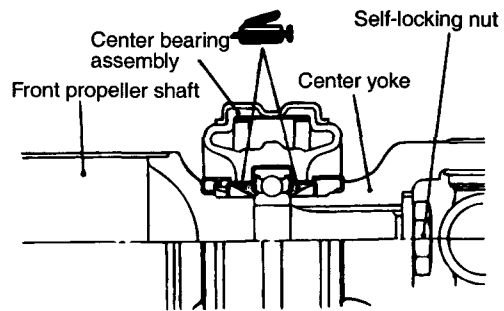
**CENTER BEARING ASSEMBLY/CENTER YOKE**

1. Install the center bearing assembly to the front propeller shaft as shown in the illustration.



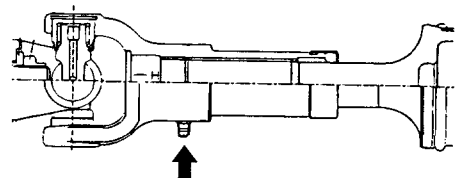
H7PS0260

2. Align the matchmarks on the center yoke and front propeller shaft.
3. Press-fit the center bearing with the center yoke while tightening the self-locking nut.



ESRPS10B

4. Install the propeller shaft so that the flange face of center mounting bracket spacer upward.
5. After installing the propeller shaft, fill the grease into the neeple until it comes out from the sleeve yoke plug hole

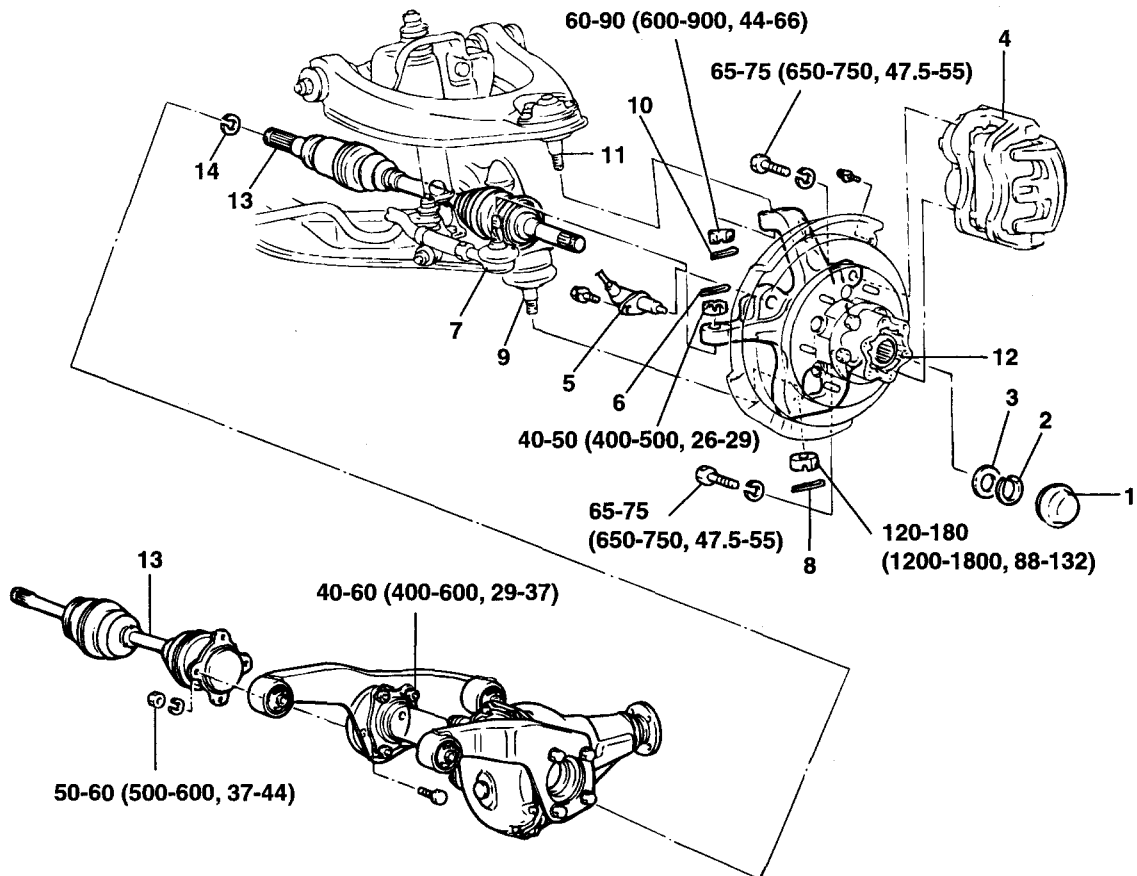


KSRPS03A

## DRIVESHAFT

## FRONT DRIVESHAFT ASSEMBLY

## COMPONENTS EIMB1300



## Removal steps

1. Hub cap
2. Snap ring
3. Shim
4. Front brake assembly
5. Speed sensor (ABS)
6. Split pin
7. Tie rod end
8. Split pin
9. Lower ball joint
10. Split pin
11. Upper ball joint
12. Front hub and knuckle assembly
13. Driveshaft
14. Circlip

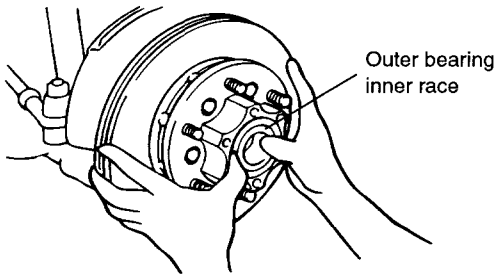
**TORQUE : Nm (kg-cm, ft-lb)**

**REMOVAL** EIMB1400

1. Remove the front hub and knuckle assembly. (Refer to front hub/knuckle for detail)

**CAUTION**

*Do not drop the outer bearing inner race.*

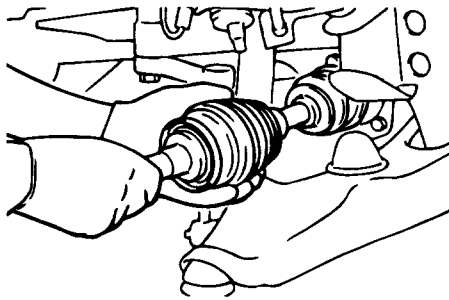


H7FA030A

2. Remove the driveshaft.

**CAUTION**

- *When pulling the driveshaft out from the differential carrier, be careful that the spline part of the driveshaft does not damage the oil seal.*
- *Wrap cloth around the boot of the driveshaft so that the boot is not damaged when it is removed.*



KHPDS13A

**INSPECTION** EIMB1500

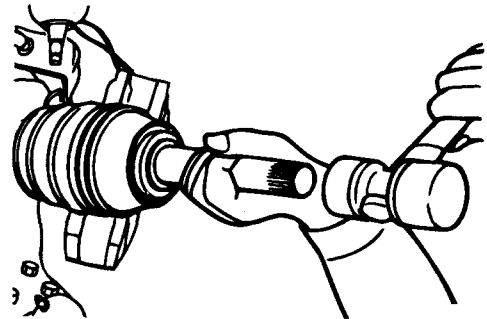
1. Check the boot for damage or deterioration.
2. Check the ball joint for operating condition and excessive looseness.
3. Check the splines for wear or damage.
4. Check the differential carrier oil seal(L.H.) for damaged.



S5DS008A

**INSTALLATION** EIMB1600

1. Installation is the reverse of removal.
2. If the driveshaft is not installed into the differential carrier easily, use a plastic hamer (LH).



KHPDS14A

**CAUTION**

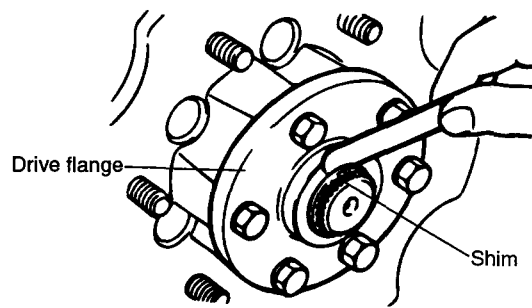
- *Be careful not to damage the lip of the oil seal.*
- *Replace the circlip which is attached to the B.J side spline part with a new one.*

3. Driveshaft end play adjustment.
  - a. Install the shim and snap ring to the driveshaft.
  - b. Push the driveshaft in by hand toward the knuckle until they touch.
  - c. Measure the clearance between the drive flange and the shim with a feeler gage.

---

Standard value : 0.2-0.5mm (0.008-0.2 in.)

---

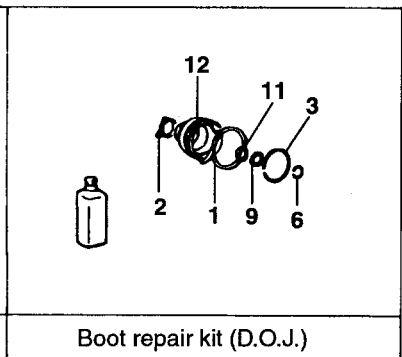
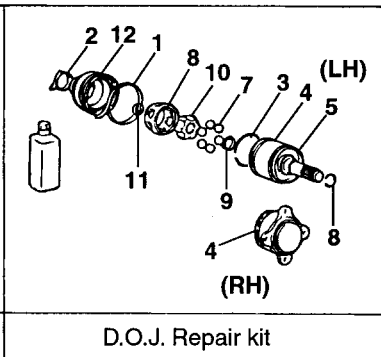
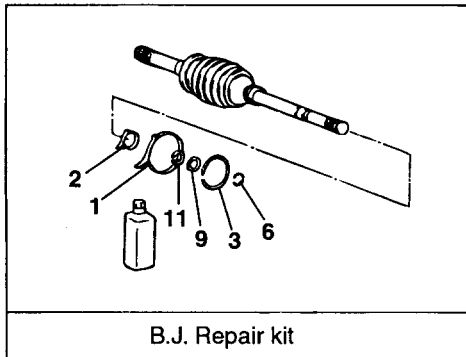
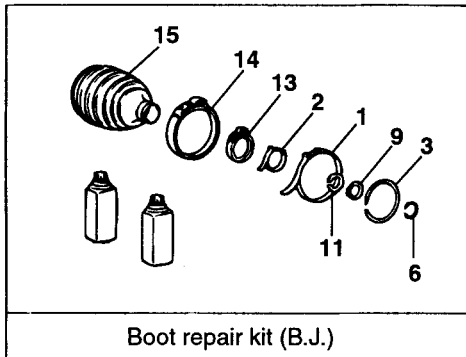
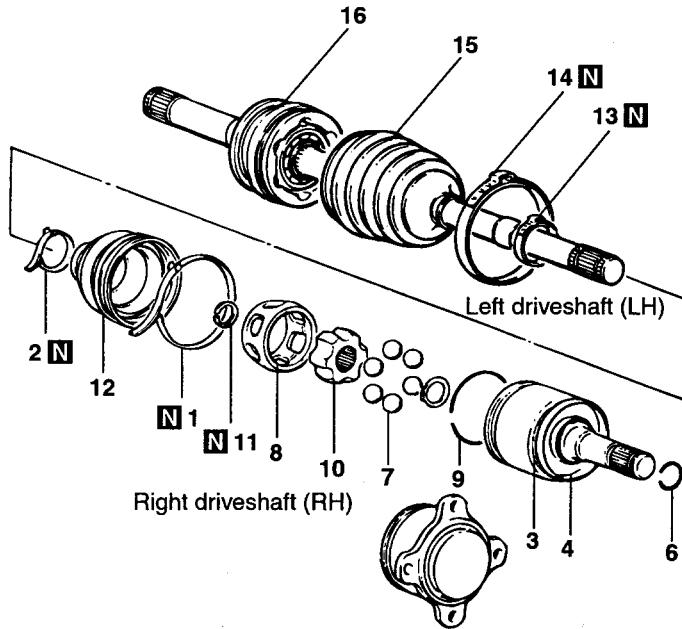


EHPDS11A

- d. If the amount of play is outside the standard value, adjust by selecting a shim that will bring the play to the standard value.

# FRONT DRIVESHAFT (DOJ-BJ TYPE)

## COMPONENTS EIMB1700



- |                      |                            |
|----------------------|----------------------------|
| 1. Boot band A       | 9. Snap ring               |
| 2. Boot band B       | 10. D.O.J. inner race      |
| 3. Circlip           | 11. Circlip                |
| 4. D.O.J. outer race | 12. D.O.J. boot            |
| 5. Dust cover        | 13. B.J. boot band (large) |
| 6. Circlip           | 14. B.J. boot band (small) |
| 7. Ball              | 15. B.J. boot              |
| 8. D.O.J. cage       | 16. B.J. assembly          |

**CAUTION :** N Replace the parts with new one after removal.

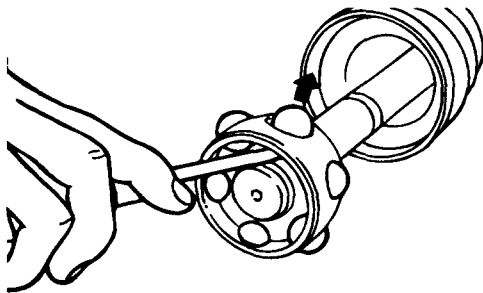
**DISASSEMBLY** EIMB1800

**NOTE**

1. Do not disassemble the B.J. assembly.
2. Special grease must be applied to the driveshaft joint. Do not substitute with another type of grease.
3. The boot band should be replaced with a new one.

**1. REMOVAL OF BALLS**

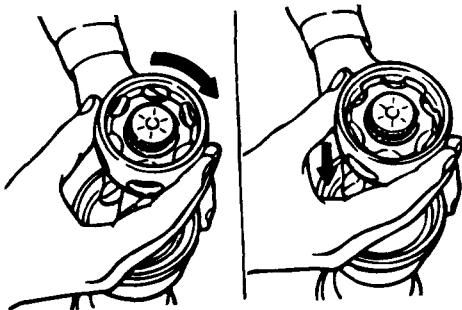
Remove the balls from the D.O.J cage.



KHPDS15A

**2. REMOVAL OF D.O.J CAGE**

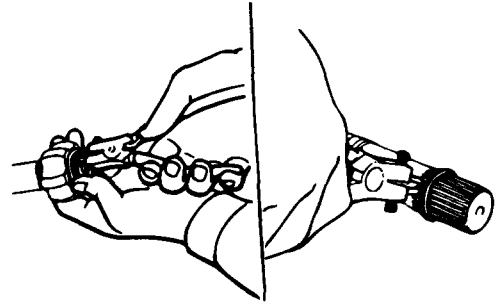
Remove the D.O.J cage from the D.O.J inner race in the direction of the B.J



KHPDS16A

**3. REMOVAL OF SNAP RING/CIRCLIP**

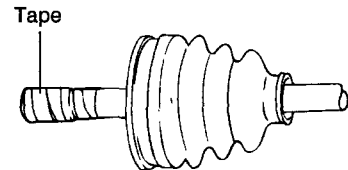
- a. Remove the snap ring from the driveshaft using a snap ring pliers, and then withdraw the D.O.J inner race and D.O.J cage from the driveshaft.
- b. Remove the circlip from the driveshaft using a pliers.



KHPDS17A

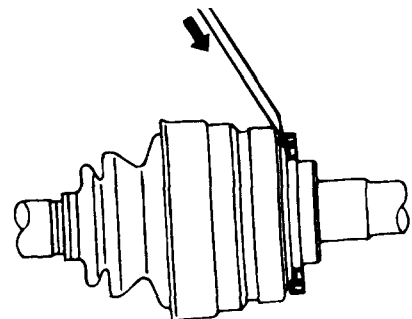
**4. REMOVAL OF D.O.J BOOT**

- a. Wrap vinyl tape around the spline part on the D.O.J side of the driveshaft so that the D.O.J boot is not damaged when they are removed.
- b. Remove the D.O.J boot from the driveshaft.



EIDA251D

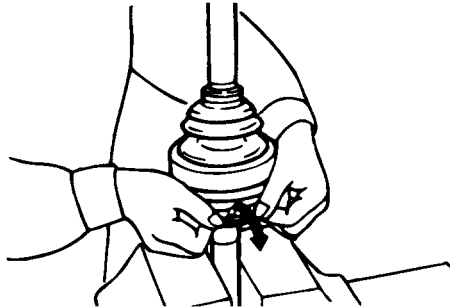
**5. REMOVAL OF DUST COVER**



KHPDS18A

6. REMOVAL OF BOOT PROTECTOR

After extending the folded over part of the boot protector and removing the boot protector band, push the boot protector to the B.J side and then remove it.



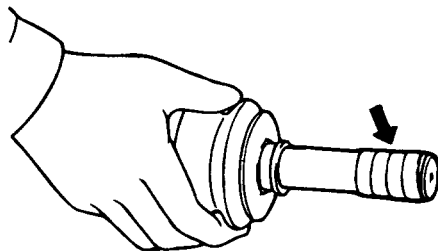
KHPDS19A

7. REMOVAL OF B.J BOOT

- a. Wrap vinyl tape around the spline part on the D.O.J side of the driveshaft so that the D.O.J boot is not damaged when they are removed.
- b. Withdraw the B.J boot from the driveshaft.

**CAUTION**

*Do not disassembly the B.J.*



KHPDS99A

**INSPECTION**

EIMB1900

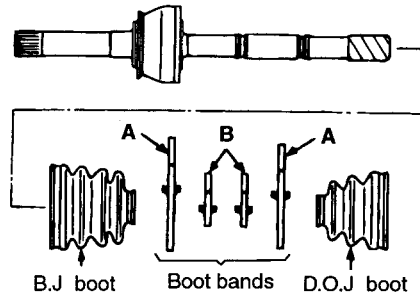
1. Check the driveshaft for bending or wear.
2. Check for water, foreign matter or rust in the boot.
3. Check the ball joint for wear or damage.
4. Check the boot for wear or damage.

**REASSEMBLY**

EIMB2000

1. INSTALLATION OF BOOTS AND BOOT BANDS.

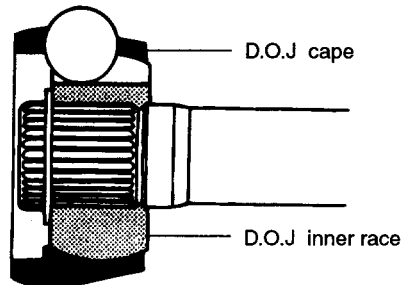
- a. Wrap vinyl tape around the spline part on the D.O.J side of the driveshaft.
- b. Install the B.J boot, boot bands(new ones), and D.O.J boot on the driveshaft.



EHPDS20A

2. INSTALLATION OF D.O.J CAGE/D.O.J INNER RACE

Install the D.O.J cage onto the driveshaft so that the smaller diameter side of the cage is installed first.



EHPDS21A

3. Apply the specified grease to the driveshaft and boot.

Items	Quantity (gr.)	
	2.5 Diesel	3.5 Gasoline
B.J	130 (+10/-0)	145±10
D.O.J	130 (+10/-0)	135±10

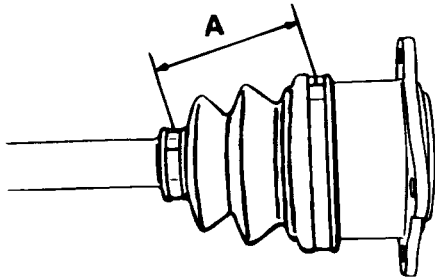
4. INSTALLATION OF D.O.J OUTER RACE

- a. Install the circlip onto the D.O.J outer race. Place the D.O.J boot over the D.O.J outer race, and then use boot band B to secure the boot.

**CAUTION**

*Do not secure the boot band A.*

- b. Secure the driveshaft, and then move the D.O.J outer race until it is at the position where the D.O.J boot assembly dimension is the standard value.



KHPDS22A

- c. Remove a part of the D.O.J boot from the D.O.J outer race and release the air within the boot.
- d. Secure the boot band A on D.O.J boot.

**CAUTION**

*Be sure that the installation direction of the boot bands is correct.*

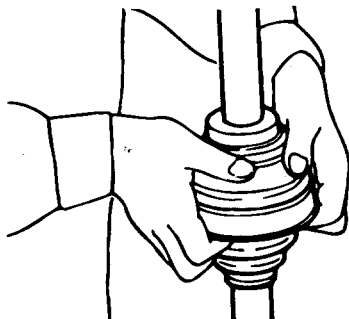
**5. INSTALLATION OF BOOT PROTECTOR/BOOT PROTECTOR BAND**

- a. Push in the boot protector with the hands and tighten it with the boot band.

**CAUTION**

*Be sure that the installation direction of the boot bands is correct.*

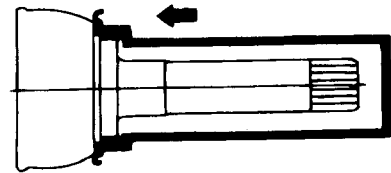
- b. Put the edge of the boot protector back into the original state.



KHPDS23A

**6. INSTALLATION OF DUST COVER**

Using a suitable tool, install the dust cover to B.J assembly.

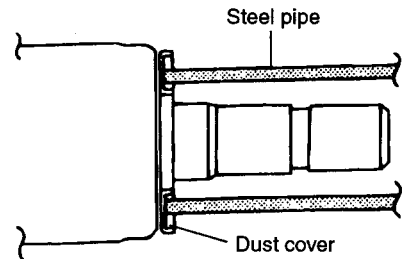


KHPDS24A

**7. INSTALLATION OF DUST COVER**

Using the steel pipe as specified below, force the dust cover to the D.O.J outer race.

Steel pipe	mm (in.)
Outside diameter	77 (3.03)



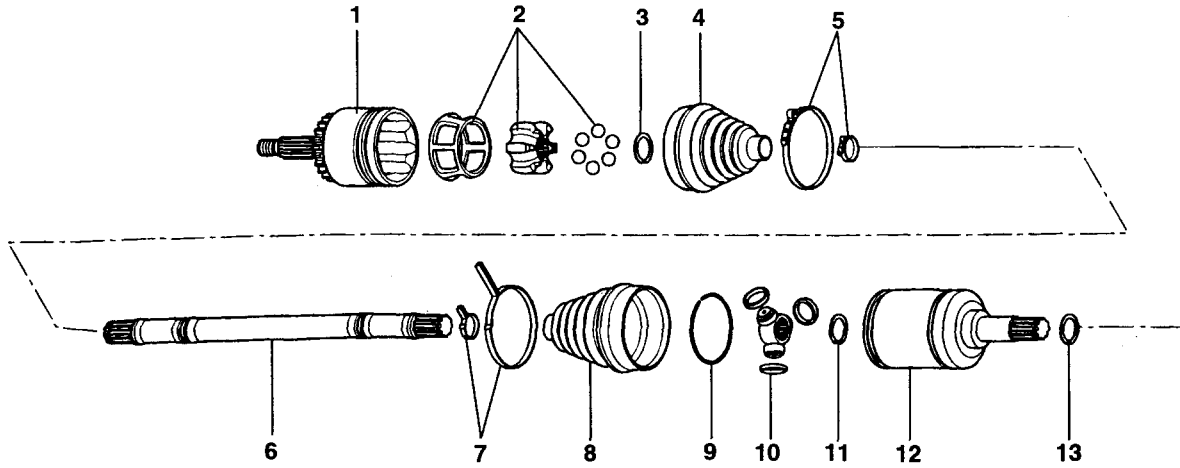
EHPDS25A



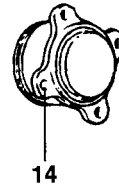
**FRONT DRIVESHAFT (T.J-BJ TYPE)**

**COMPONENTS** EIMB2100

Left driveshaft (LH)

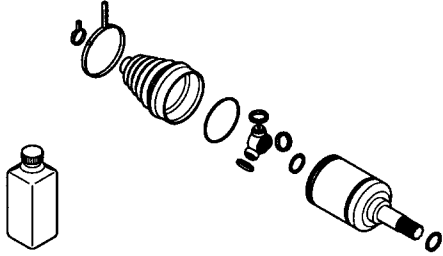
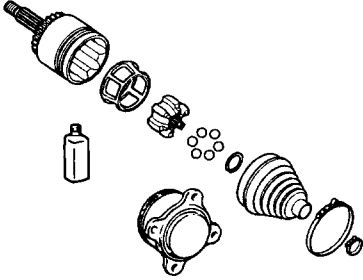


Right driveshaft (RH)



1. B.J assembly
2. B.J inner race and ball
3. Snap ring
4. B.J boot
5. B.J boot band
6. Driveshaft
7. T.J boot band
8. T.J boot
9. Circlip
10. Spider assembly
11. Snap ring
12. T.J assembly
13. Circlip
14. T.J outer race

REPAIR KIT

Kit name	Illustration	Components
T.J boot kit	 <p style="text-align: right;">KIMB290A</p>	<ul style="list-style-type: none"> <li>• T.J boot band</li> <li>• T.J boot</li> <li>• Snap ring</li> <li>• Spider assembly</li> <li>• Snap ring</li> <li>• T.J assembly</li> <li>• Circlip</li> <li>• Grease</li> </ul>
G.J boot kit	 <p style="text-align: right;">KHPDS27A</p>	<ul style="list-style-type: none"> <li>• B.J assembly</li> <li>• B.J inner race and ball</li> <li>• Snap ring</li> <li>• B.J boot</li> <li>• B.J boot band</li> <li>• Grease</li> </ul>

**DISASSEMBLY** EIMB2200

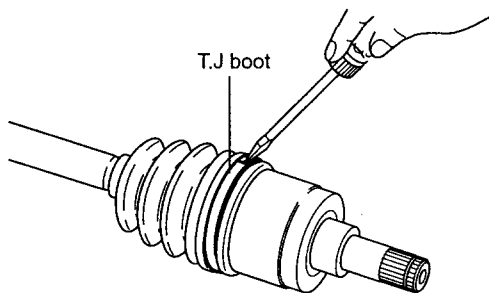
**NOTE**

1. Do not disassemble the B.J assembly.
2. The Driveshaft joint uses special grease. Do not substitute with another type of grease.
3. The Boot band should be replaced with a new one.

1. Remove the T.J boot band and pull the boot from T.J outer race.

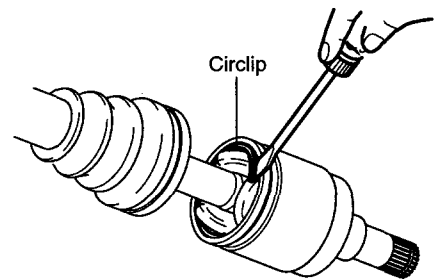
**NOTE**

Be careful not to damage it.



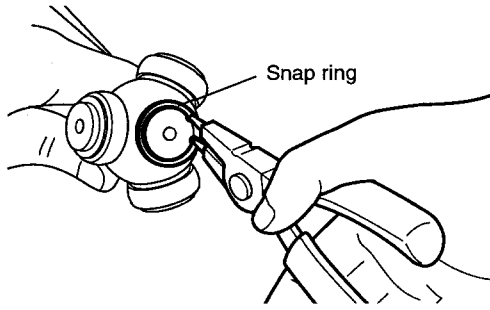
EIMB300A

2. Remove the circlip using a screwdriver.



EIMB300B

3. Remove the driveshaft from the T.J outer race.
4. Remove the snap ring and disassemble the spider assembly from the shaft.
5. Clean the spider assembly.

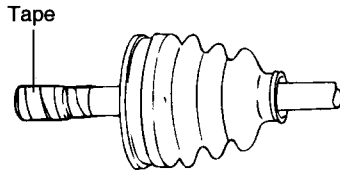


EIMB300C

- Remove the B.J boot band and pull out the T.J boot and the B.J boot.

**CAUTION**

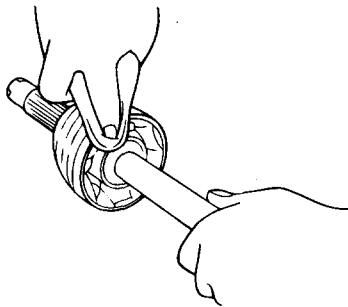
*If the boot is reused, wrap a tape around the drive shaft splines to protect the boot.*



EIDA251D

**INSPECTION** EIMB2300

- Check the driveshaft spline for wear.
- Check for water, foreign matter, or rust in the boot.
- Check the spider ring for revolution and wear.
- Check the T.J case inside for wear and rust.



EIDA252A

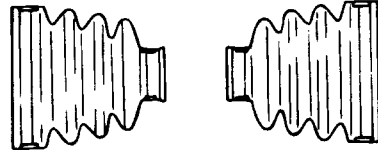
**REASSEMBLY** EIMB2400

- Wrap a tape around the driveshaft spline (T.J side) to avoid boot damage.
- Apply specified grease to the driveshaft and install the boots.

Items	Recommended grease	Quantity (gr.)
B.J	CENTURY	115 ± 5
T.J	ONE LUBER GKN	230 ± 10

T.J boot

B.J boot

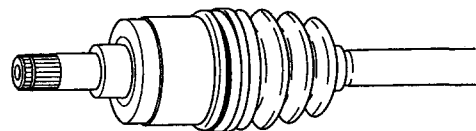


EIMB320A

- Add specified grease as much as was wiped away at the time of inspection.
- Tighten the boot bands.

**CAUTION**

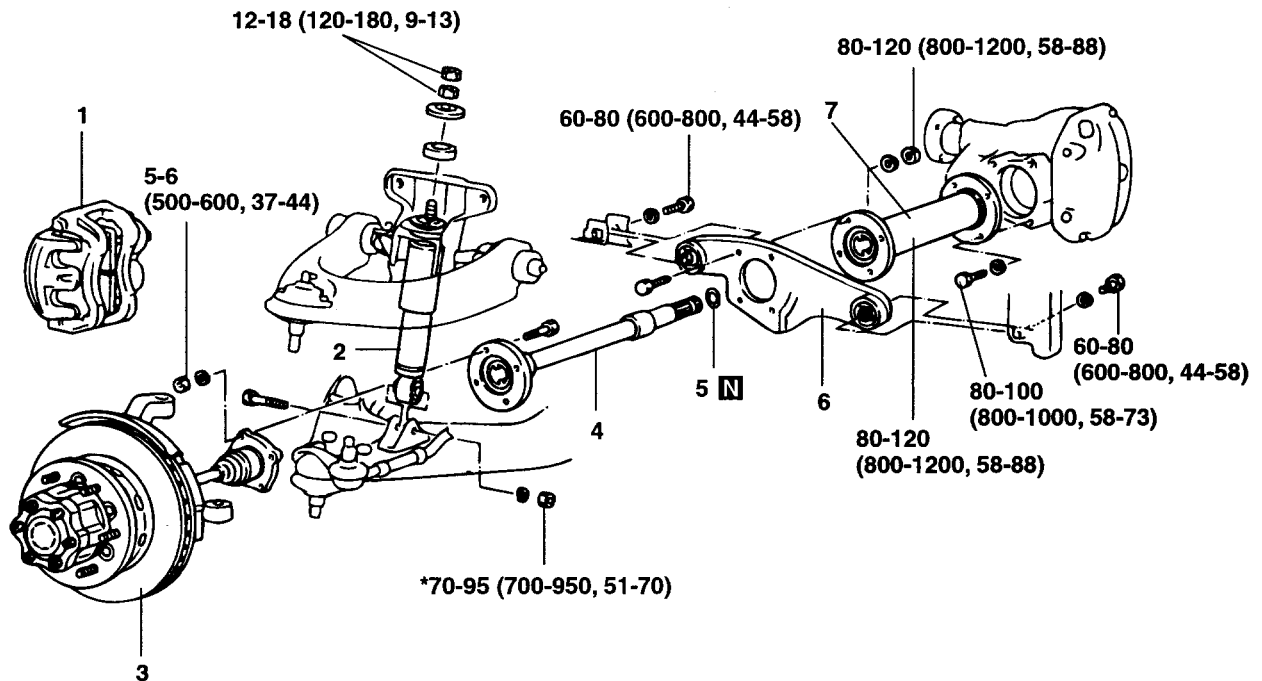
*Keep the specified distance between the boot bands to control the air when they are tightened.*



KGX7012A

# CENTER BEARING AND INNER SHAFT

## COMPONENTS EIMB2500



1. Caliper assembly
2. Shock absorber
3. Hub assembly, knuckle assembly
4. Inner shaft
5. Circle ring
6. Differential mounting bracket (RH)
7. Housing tube assembly

### CAUTION

\* Indicates parts which should be temporarily tightened, and them fully tightened with the vehicles on the ground in the unladen condition.

**N** : Replace the parts with new one after removal.

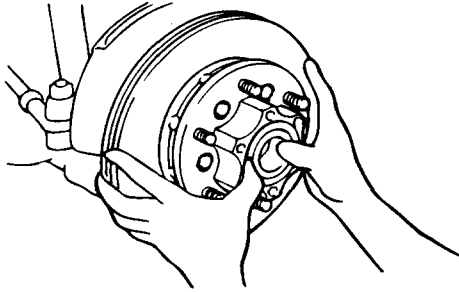
**TORQUE : Nm (kg·m, lb·ft)**

**REMOVAL** EIMB2600

1. Remove the front hub and knuckle.

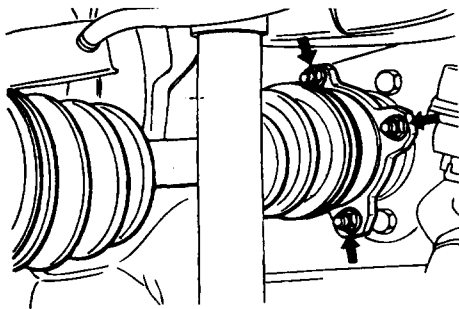
**NOTE**

If the hub assembly is not removed from the knuckle easily, use the special tools(09526-11001, 09526-11100).



H7FA0300

2. Remove the right driveshaft (RH).

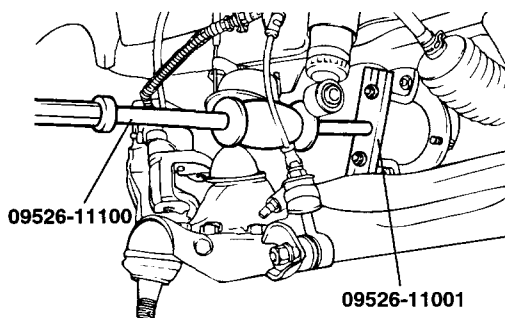


H7FA0250

3. Attach the special tools( 09526-11001, 09526-11100) to the flange of the shaft, and pull the inner shaft out from the front differential carrier.

**CAUTION**

When pulling the inner shaft out from the front differential carrier, be careful that the spline part of the inner shaft does not damage the oil seal.



H7FA1226

**INSPECTION** EIMB2700

1. Check the inner shaft for bends.
2. Check the bearing for wear or damage.
3. Check the housing tube for crack.
4. Check the dust seal for crack or damaged.

**INSTALLATION** EIMB2750

1. Installation is the reverse of removal.
2. Using the special tools(09526-11001, 09526-11100), install the inner shaft to the differential carrier.

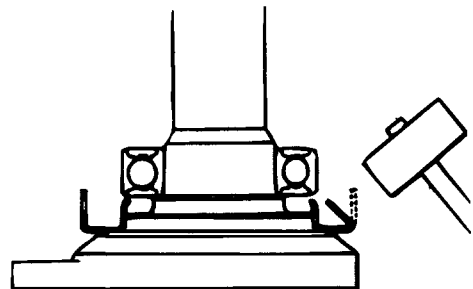
**CAUTION**

Be careful not to damage the lip of the dust seal and oil seal.

**DISASSEMBLY** EIMB2800

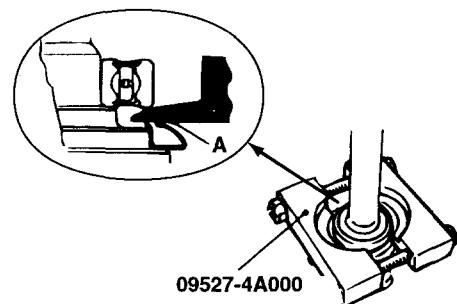
1. REMOVAL OF BEARING

- 1) Bend the outside periphery of dust cover inward with a hammer.



H7FA0610

- 2) After the special tool(09527-4A000) has been installed as shown, tighten the nut of the special tool until the portion "A" of the special tool touches the bearing outer race.

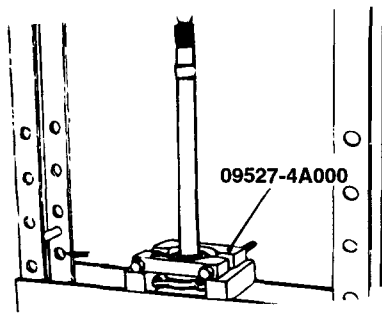


EIMB275A

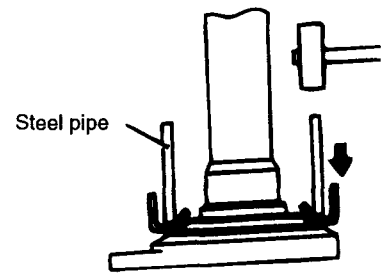
3) Press out the inner shaft from the bearing.

**CAUTION**

*Do not allow the inner shaft to drop.*



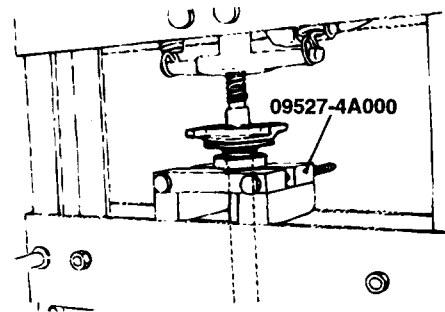
H7FA0630



EIMB290A

**3. BEARING INSTALLATION**

Use the special tool to press-fit the bearing onto the inner shaft.

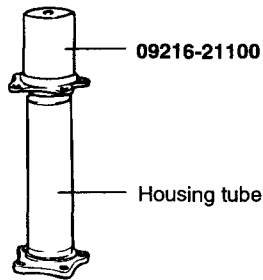


H7FA0660

**REASSEMBLY** EIMB2900

**1. INSTALLATION OF DUST SEAL**

Press-fit the new dust seal into the housing tube using the special tool(09216-21100) until it is flush with the housing tube end face.



EIMB380A

**2. INSTALLATION OF DUST COVER**

Using a steel pipe, force a new dust cover onto the inner shaft.

Steel pipe	mm (in.)
Overall length	50 (1.97)
Outside diameter	75 (2.95)
Wall thickness	4 (0.16)

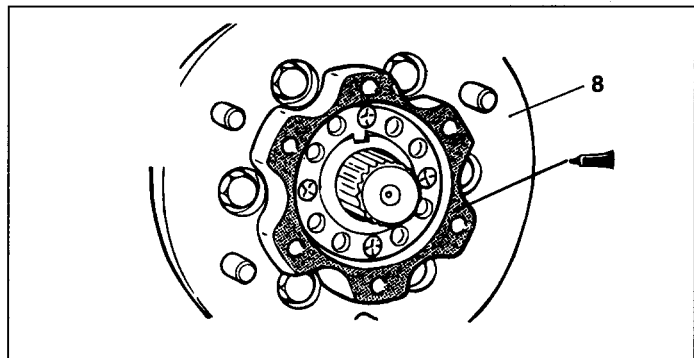
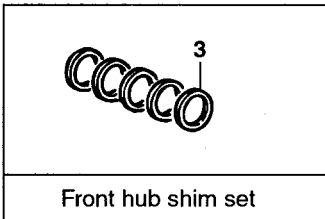
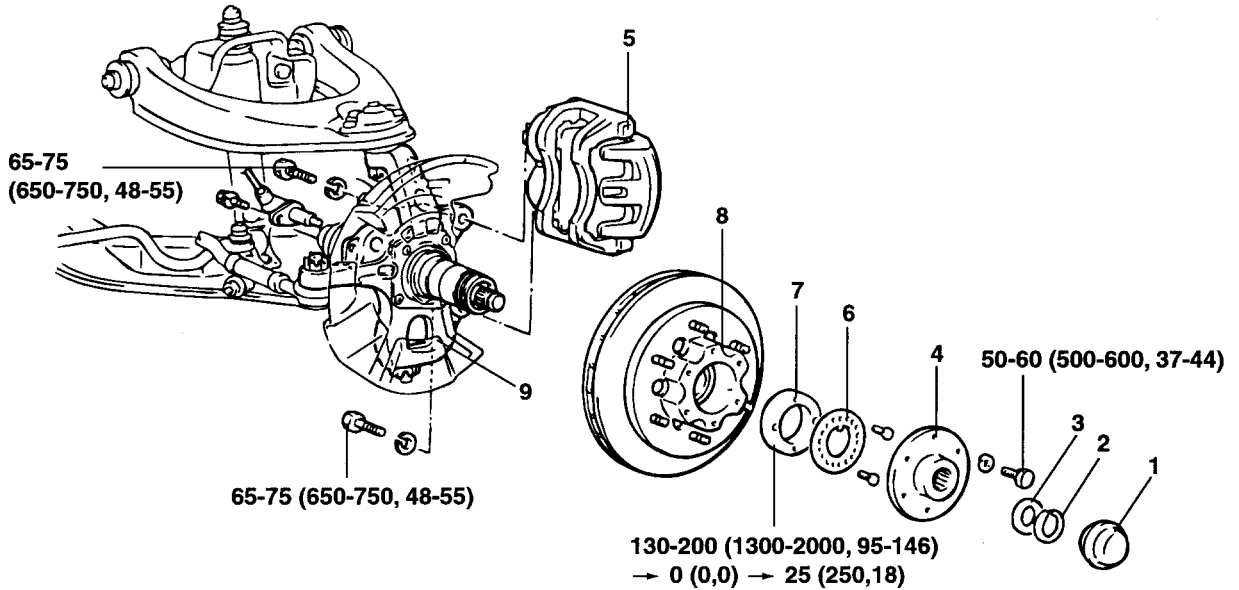
**CAUTION**

*After installing the dust cover, apply 5 gr. more than of the grease (LIG-2) on around rip.*

# FRONT AXLE

## FRONT HUB/KNUCKLE

### COMPONENTS EIMB3000



Sealant : HERM SEAL NO.201 or equivalent

**CAUTION :**

**Make sure that is no excess specified sealant on the hub outside surface.**

**Removal steps**

1. Hub cap
2. Snap ring
3. Shim
4. Drive flange
5. Front brake assembly
6. Lock washer
7. Lock nut
8. Front hub assembly
9. Knuckle

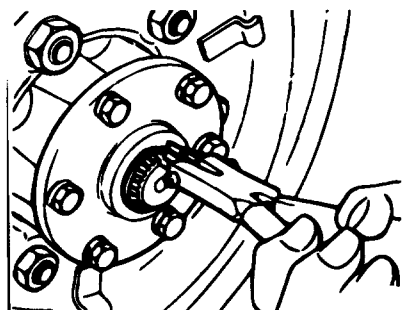
**TORQUE : Nm (kg·m, lb·ft)**

**REMOVAL** EIMB3100

1. Remove the hub cap.
2. Use a snap ring pliers to remove the snap ring from the driveshaft. (4WD)

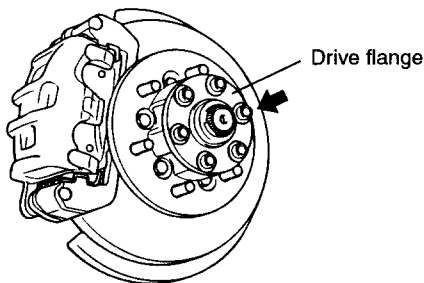
**CAUTION**

*The proper tool for removing and installing the snap ring is a pair of snap ring pliers. Screwdriver or other tool can deform or spread the snap ring beyond its yield point. Be sure to use only snap ring pliers for removing and installing the snap ring.*



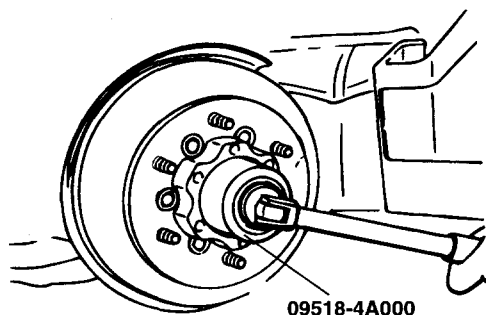
KHPDS04A

3. Remove the drive flange from the hub.



EHPDS05A

4. After removing the lock washer, remove the lock nut with special tool (09518-4A000).



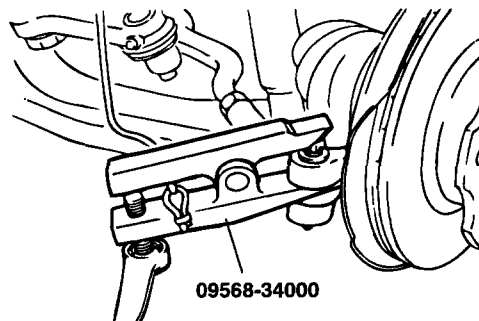
KHPDS06A

5. Remove the front brake assembly.

**CAUTION**

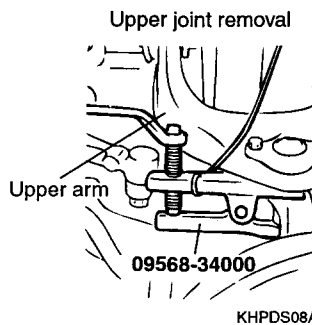
- Use wire to suspend the front brake assembly to the upper arm so that the front brake assembly won't fall.
- Do not twist the brake hose.

6. Using the special tool(09568-34000), disconnect the tie rod from the knuckle.

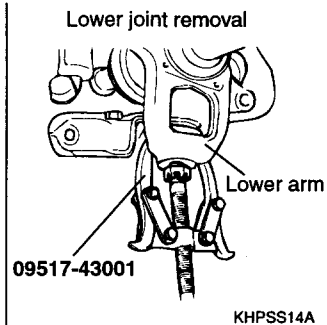


KHPDS07A

7. Using the special tools(09517-43001, 09568-34000), disconnect the upper joint and lower joint from the knuckle.



KHPDS08A



KHPSS14A

EIMB140A

**CAUTION**

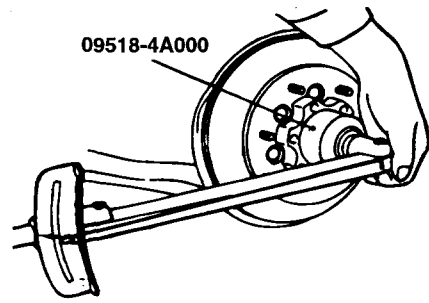
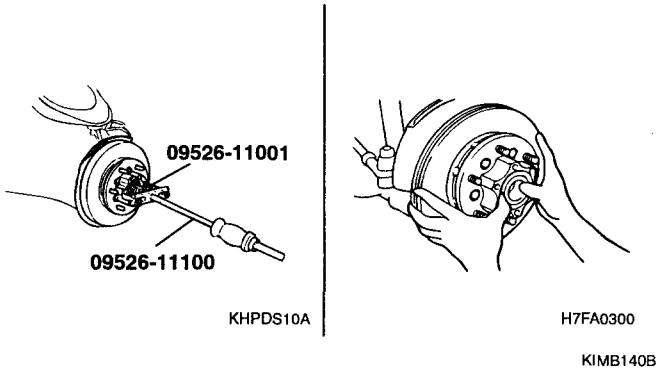
- Use a cord to bind the special tool closely so that it will not become separated.
- The nut should only be loosened, not removed.



8. Remove the hub from the knuckle.

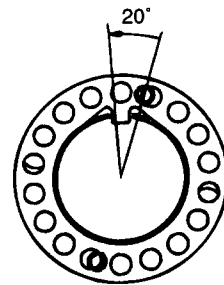
**NOTE**

If the hub assembly is not removed from the knuckle easily, use the special tools(09526-11001, 09526-11100).



H7FA0310

b. Install the lock washer. If the lock washer holes are not aligned with the lock nut holes, move the lock nut within a range of not more than 20° until the holes are aligned.



KHPD673A

c. Loosen the lock nut approximately 30 to 40 degrees to adjust the front hub starting torque and the end play so that they are at the standard values.

**INSPECTION**

EIMB3200

1. Check the oil seal for cracks and damage.
2. Check the bearings for seizure and discoloration.
3. Check the front hub for cracks.
4. Check grease in front hub.

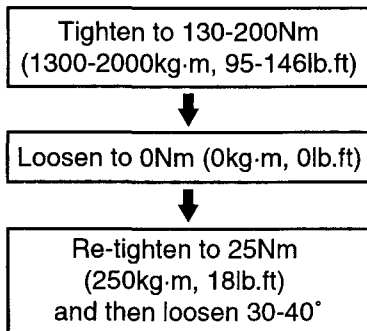
**INSTALLATION**

EIMB3300

1. Installation is the reverse of removal.
2. Wheel bearing preload adjustment.
  - a. Use the special tool(09518-4A000) to tighten the lock nut by the following procedure.

**NOTE**

While the wheel bearing preload adjust, remove the brake assembly.



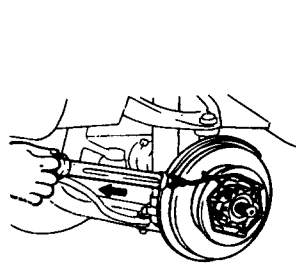
EIMB330A

**Standard value :**

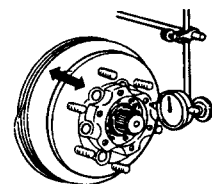
Starting torque : 0.3-13Nm (3-13kg·cm, 0.22-0.95lb·ft)  
 end play : 0.05m (0.0in.) or less

**NOTE**

If adjustment is not possible, the bearing may be incorrectly installed; check and repair if necessary. The lubrication condition should also be checked.



H7FA0330

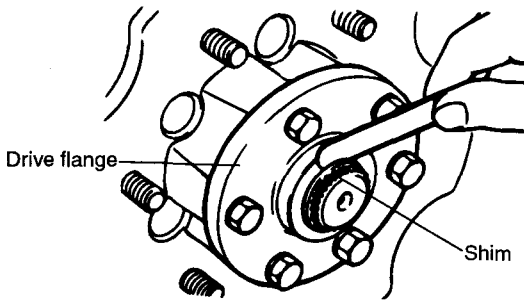


H7FA0340

KIMB150B

- d. Install the lock washer.  
If the lock washer holes are not aligned with the lock nut holes, loosen the lock nut to align them.
3. Driveshaft end play adjustment.
- a. Install the shim and snap ring to the driveshaft.
  - b. Push the driveshaft in by hand toward the knuckle until they touch.
  - c. Measure the clearance between the drive flange and the shim with a feeler gage as shown in the illustration.

Standard value : 0.2-0.5 mm (0.008-0.02 in.)



EHPDS11A

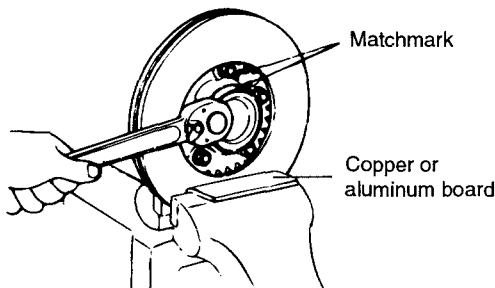
- d. If the amount of play is outside the standard value, adjust by selecting a shim that will bring the play to the standard value.

**DISASSEMBLY FRONT HUB** EIMB3400

- 1. Make the matchmark on the brake disc and front hub, and then separate the front hub and brake disc, if necessary.

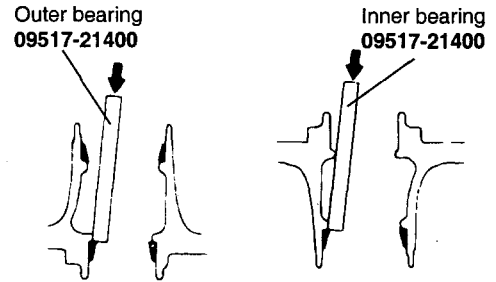
**CAUTION**

*When mounting the disc in vice, fix copper or aluminum board to the jaws of it.*



EIMB160A

- 2. Using the special tool, drive out the inner and outer bearing outer races by tapping them equally.



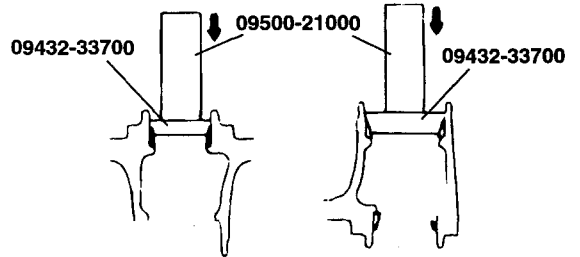
ESRDS71A

**REASSEMBLY FRONT HUB** EIMB3500

- 1. Press-fit the inner bearing outer race and outer bearing outer race.

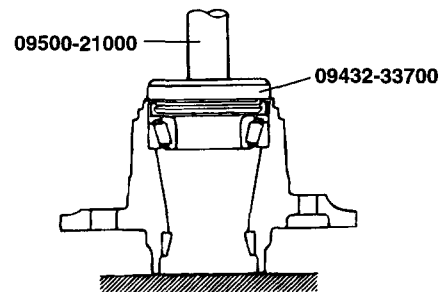
**NOTE**

*The bearing inner race and bearing outer race should be replaced as an assembly.*



KIMB170A

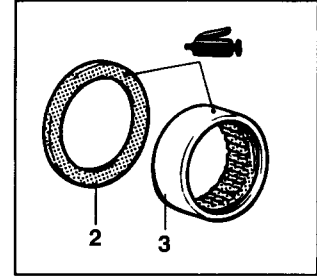
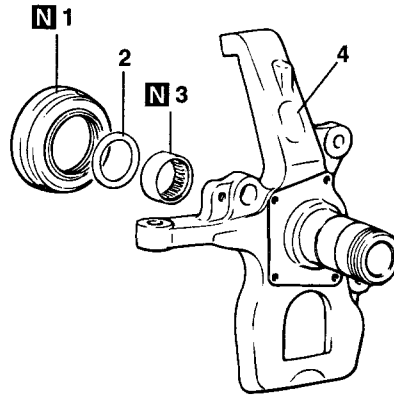
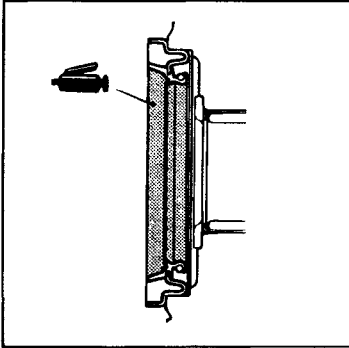
- 2. Using the special tools (09432-33700, 09500-21000), press-fit new oil seal into the front hub.



KHPDS12A

**KNUCKLE (4WD)** EIMB3600

**COMPONENTS**



**Disassembly steps**

1. Oil seal
2. Spacer
3. Needle bearing
4. Knuckle

**N** : Replace the parts with new one after removal.

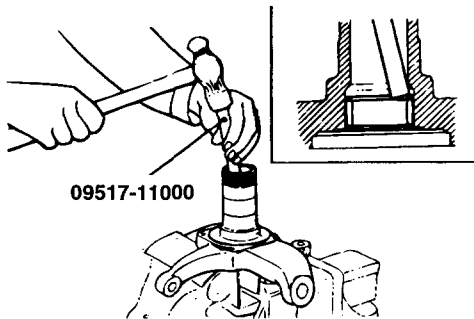
EHPDS12B

**DISASSEMBLY** EIMB3700

1. Remove the oil seal and take out the spacer.
2. Drive out the needle bearing by tapping the needles uniformly.

**!** **CAUTION**

*Once removed, the needle bearing must not be reused.*

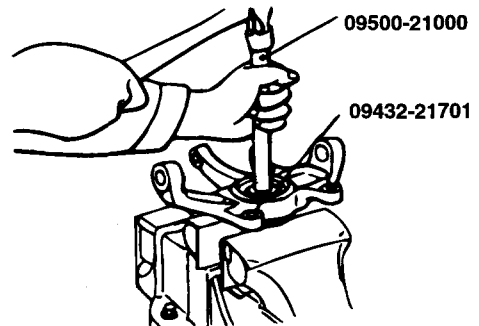


**REASSEMBLY** EIMB3800

1. Use the special tools to press-fit the needle bearing until it is flush with the knuckle end face.

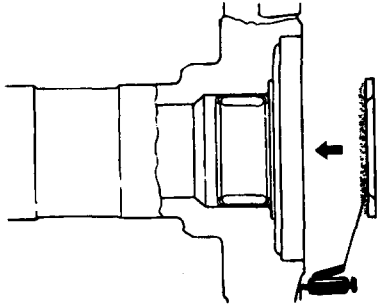
**!** **CAUTION**

*Care to prevent driving the needle bearing too far in.*



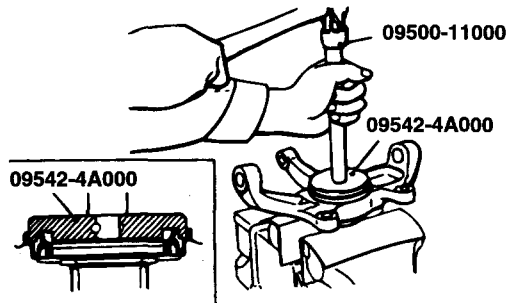
KIMB200A

2. Apply multi-purpose grease(LIG-2 or equivalent) to the contact surface of the spacer and install the spacer to knuckle.



H7FA0480

3. Use the special tools(09500-11000, 09542-4A000) to press-fit the new oil seal until it is flush with the knuckle end face.



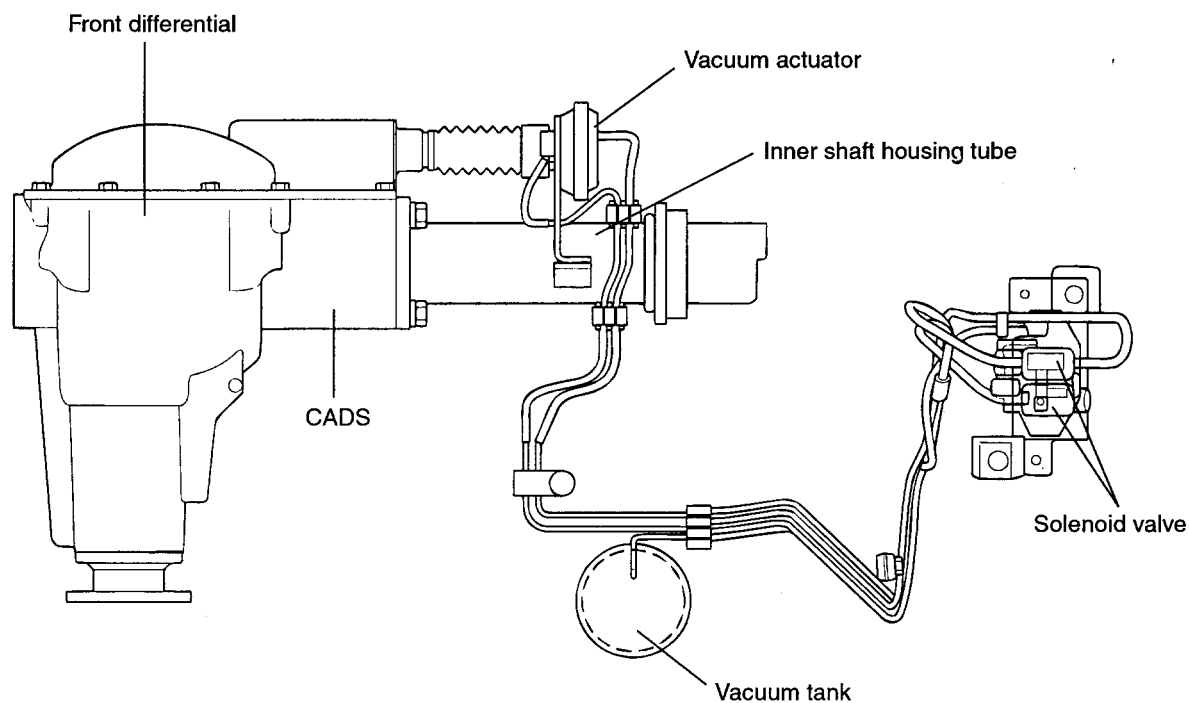
H7FA0490

## CENTER AXLE DISCONNECT SYSTEM

### DESCRIPTION EIMB3900

When transferring 2 wheel drive to 4 wheel drive and vice versa of the vehicle, as final controlling system of driving force, CADS (Center Axle Disconnect System) helps the transfer of 2 wheel or 4 wheel when driving. While 2 wheel driving, front axle is rotating at idle by the speed of vehicle. As a result of this, noise and vibration generated from incomplete driving decreases the optimal driving. To prevent it, this system helps the complete 2 wheel drive by applying CADS to axle.

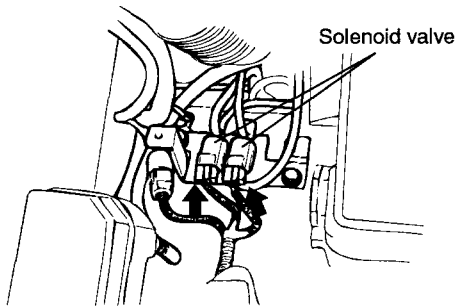
### COMPONENTS EIMB4000



**REMOVAL** EIMB4100

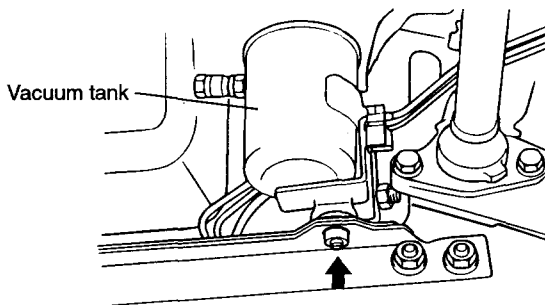
1. Solenoid valve and vacuum hose removal.

- 1) After removing the battery(-) cable, disconnect each harness connector from the solenoid valves.



EHPDS30A

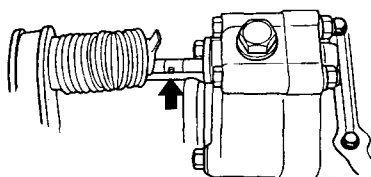
- 2) Disconnect the solenoid valve and the vacuum hose, remove the solenoid valve.
- 3) Remove the vacuum pipe bracket, and disconnect the vacuum pipe and hose.
- 4) Remove the vacuum tank assembly.



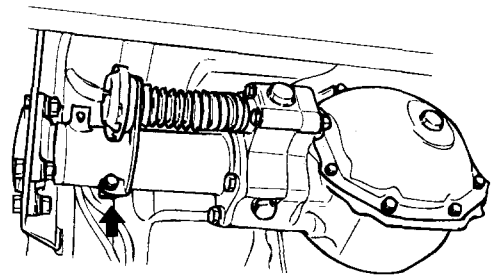
EHPDS31A

2. CADS REMOVAL

- 1) Disconnect the vacuum hose from the actuator.
- 2) Remove the pin from the actuator shift rod.



- 3) Remove the actuator from the inner shaft housing tube.



KHPDS33A

- 4) Remove the inner shaft and housing tube.
- 5) Remove the CADS from the front differential carrier.

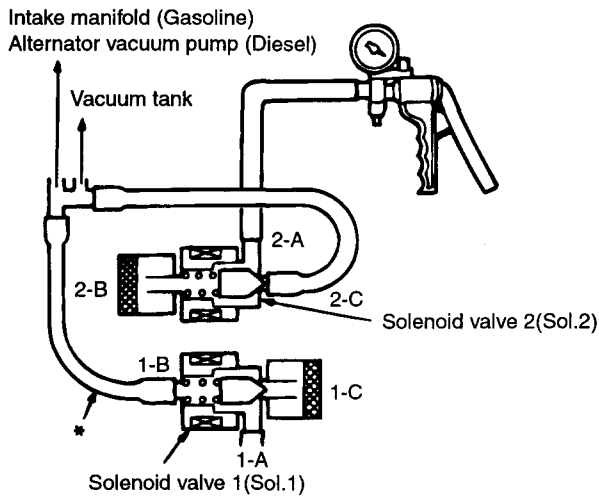
**INSPECTION** EIMB4200

**SOLENOID VALVE AND HOSE CHECK**

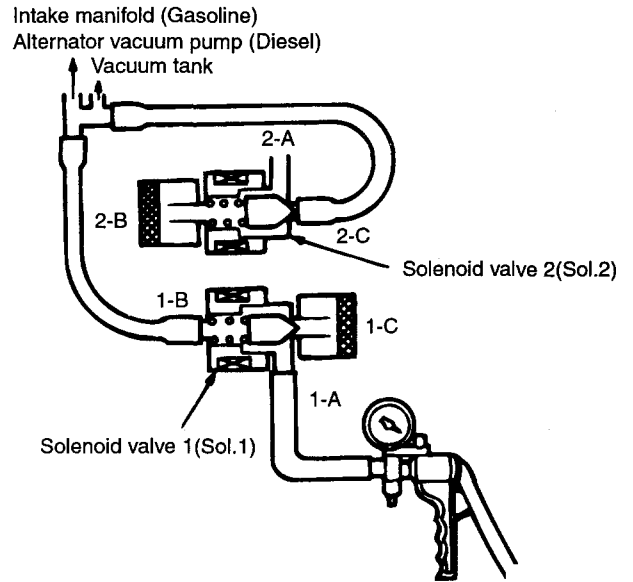
1. Check the vacuum hose and pipe for damage.
2. Check the vacuum tank for damage.

**SOLENOID VALVE OPERATION CHECK**

1. Remove the vacuum hoses from the solenoid valves.
2. Disconnect the harness connectors
3. Connect a hand vacuum pump to solenoid valve 2(Sol.2). Apply negative pressure and carry out the following inspections.
  - 1) Even if the hand pump is operated with no other operation, no negative pressure develops.
  - 2) Even when battery positive voltage is applied to solenoid 2(Sol.2), the condition is the same as in "1)". But when the vacuum hose of solenoid 1(Sol.1) is blocked by bending at the \*mark, negative pressure is maintained.
  - 3) When battery positive voltage is applied to solenoids 2(Sol.2) and 1(Sol.1) negative pressure is maintained.



EHPDS34A



EHPDS35A

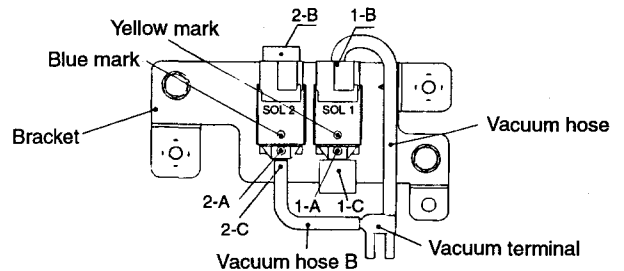
4. Connect the hand vacuum pump to solenoid valve 1(Sol.1).  
Apply negative pressure and carry out the following inspections.

- 1) With no other operation, negative pressure is maintained.
- 2) When battery positive voltage is applied to solenoid 1(Sol.1), the negative pressure equalizes.
- 3) When battery positive voltage is applied to solenoid 2(Sol.2), the negative pressure equalizes.



**NOTE**

**SOLENOID VALVE OPERATING**



EHPD131A

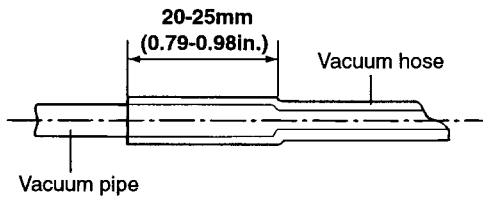
	OFF	ON
SOL VLV 1	1-B ↔ 1-A ↗ 1-C	1-B ↗ 1-A ↔ 1-C
SOL VLV 2	2-B ↔ 2-A ↗ 2-C	2-B ↗ 2-A ↔ 2-C
Actuator operating	2WD (NORMAL)	4WD

↔ : Valve ON  
↗ : Valve OFF

EIMB420A

**INSTALLATION** EIMB4300

1. Installation is the reverse of removal.
2. Connect the vacuum hose and the pipe as follows.  
If the straight line of the hose is short, fully push the hose to install.

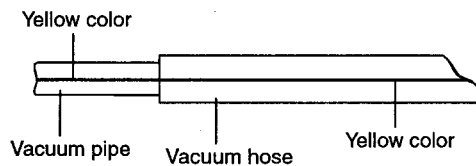


EHPDS36A

3. Install the vacuum hoses and pipes so that the identification colors matched.

**⚠ CAUTION**

***Be careful not to be punched and twisted when installing the vacuum hoses and pipes.***

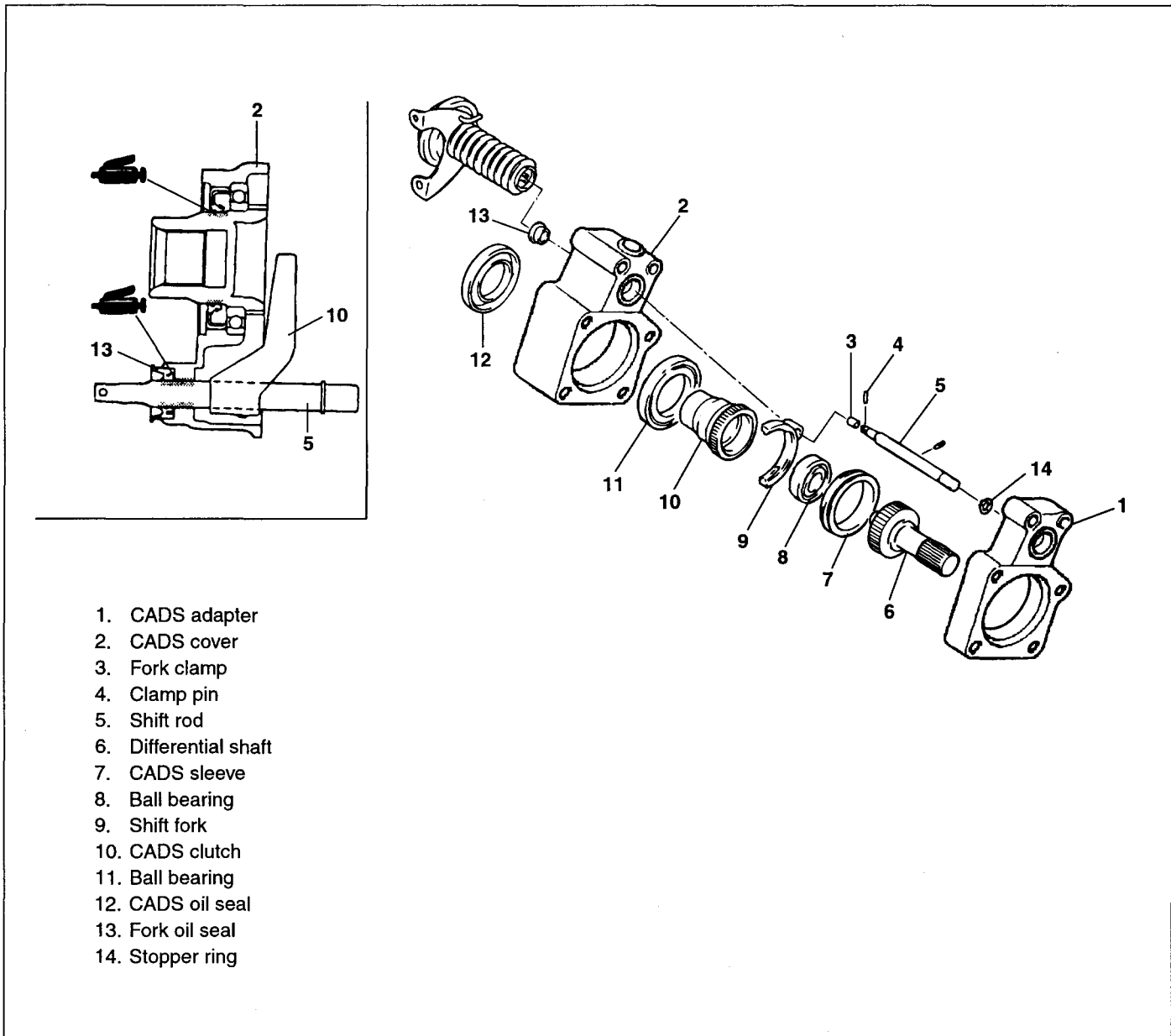


EHPDS37A



DISASSEMBLY EIMB4400

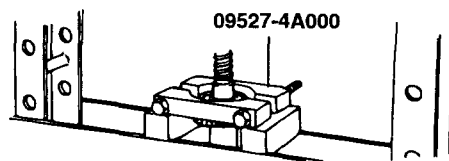
COMPONENTS



- 1. CADs adapter
- 2. CADs cover
- 3. Fork clamp
- 4. Clamp pin
- 5. Shift rod
- 6. Differential shaft
- 7. CADs sleeve
- 8. Ball bearing
- 9. Shift fork
- 10. CADs clutch
- 11. Ball bearing
- 12. CADs oil seal
- 13. Fork oil seal
- 14. Stopper ring

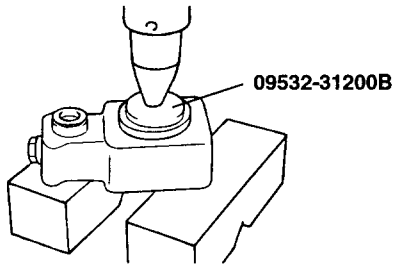
EHPDS32B

1. Using the special tool(09527-4A000), remove the ball bearing from the differential shaft.



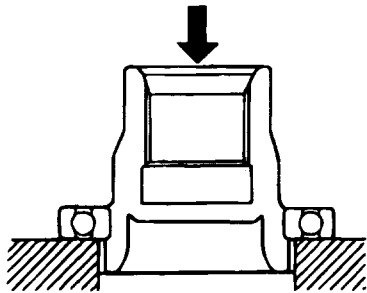
KHPDS38A

- Using the special tool(09532-31200B), remove the clutch and the bearing from the CADS cover.



KHPDS39A

- Separate the bearing from the CADS clutch.



KHPDS40A

## INSPECTION

EIMB4500

- Check the oil seal for damage or wear.
- Check the bearing for wear or discoloration.
- Check the gear and the clutch for wear or damage.
- Check the CADS cover and the adapter for crack.

## REASSEMBLY

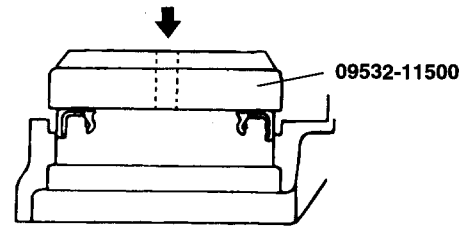
EIMB4600

- Using the special tool(09532-11500), install the oil seal until it is flush with the CADS cover.



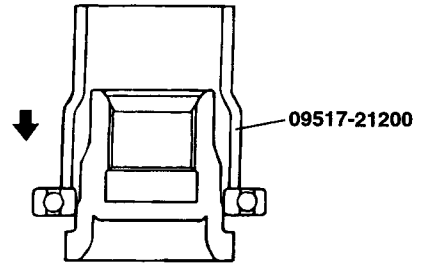
### NOTE

Apply gear oil to the oil seal slightly.



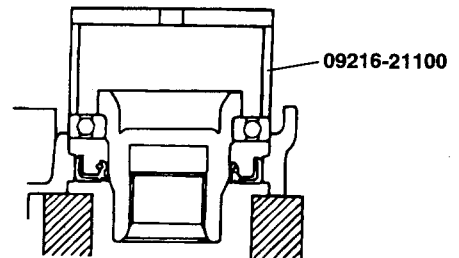
KHPDS41A

- Using the special tool(09517-21200), press-fit the bearing into the CADS clutch.



KHPDS42A

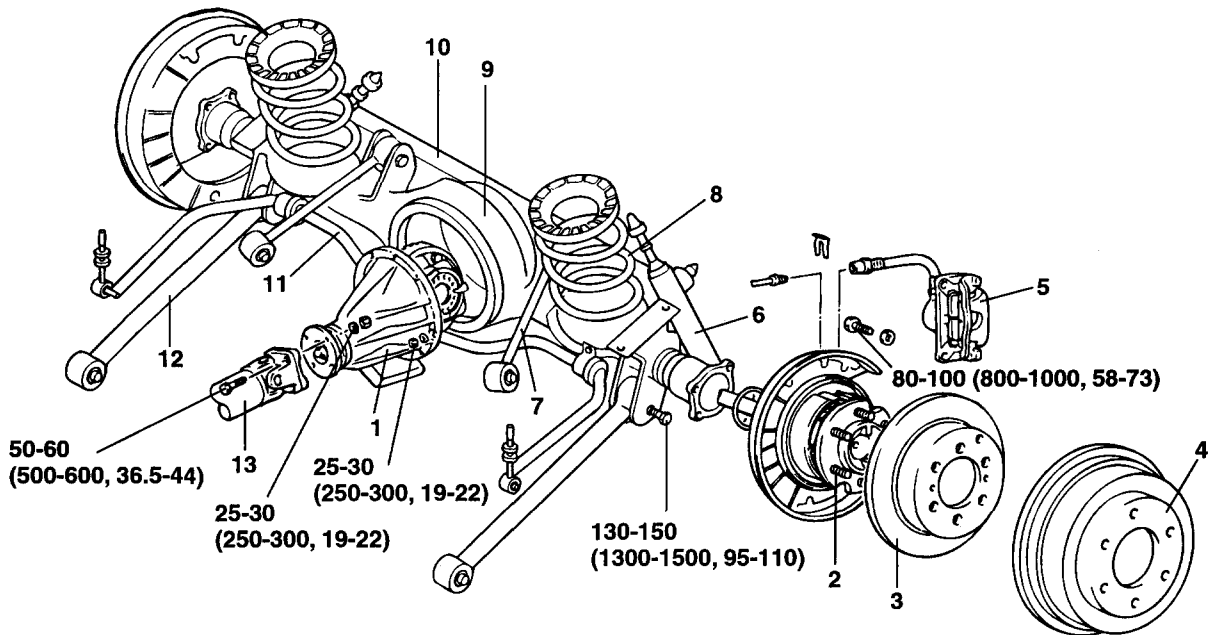
- Using the special tool(09216-21100), press-fit the bearing into the CADS cover.



KHPDS43A

# REAR AXLE

## COMPONENTS EIMB4700



1. Differential carrier
2. Rear axle shaft
3. Brake disc (ABS)
4. Rear drum (CBS)
5. Rear caliper assembly (ABS)
6. Rear shock absorber
7. Upper link
8. Rear coil spring
9. Rear axle housing
10. Lateral rod
11. Stabilizer bar
12. Lower link

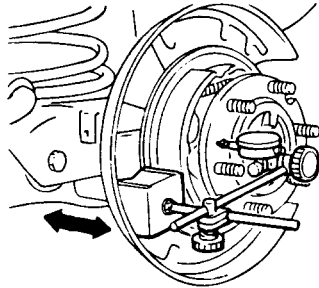
**TORQUE : Nm (kg·m, lb·ft)**

**SERVICE INSPECTION PROCEDURE** EIMB4800

**AXLE SHAFT END PLAY CHECK**

1. Measure the axle shaft end play using a dial indicator.

Standard value : 0-0.25mm (0-0.0098 in.)



KHPDS47A

2. If the axle shaft end play exceeds the standard value, replace the bearing with a new one.

**GEAR OIL LEVEL CHECK**

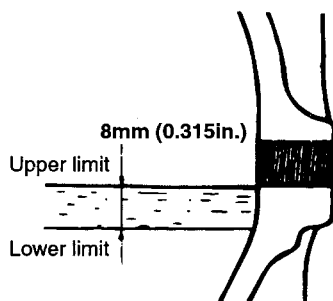
1. Remove the filler plug and check the quantity of oil in the differential carrier.
2. It is enough if oil is applied until the filler plug.

**Specified gear oil :**

- Hipoid gear oil
- Conventional differential
  - GH90W (Warmer than -30°C)
  - GH80W (Colder than -30°C)
- With Limited Slip Differential
  - Multi gear LS90 MMC CO.LTD, SAE 90:2.5 Diesel
  - INFILREX 33 (MOBIL CO.LTD):3.5 Gasolie

**SPECIFIED GEAR OIL QUANTITY**

Items	Oil quantity
No. 7 (2.5 Diesel)	2.8 Liter
No.7.5 (3.5 Gasoline)	2.8 Liter



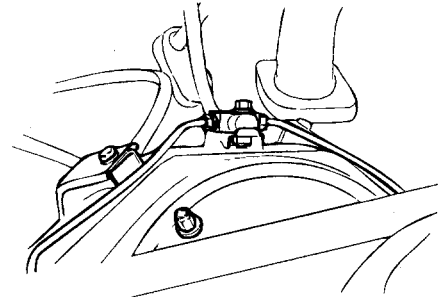
EIMB560A

**REMOVAL** EIMB4900

1. Remove the brake drum.
2. Remove the parking brake cable and speed sensor.
3. Disconnect the brake tube connection.

**NOTE**

Hold the brake hose in a vise or equivalent to prevent overflowing brake fluid.

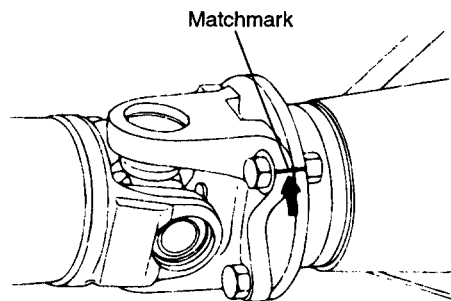


KHPDS50A

4. Make a matchmark on the companion flange and flange yoke, disconnect the propeller shaft from the differential assembly.

**CAUTION**

Suspend the propeller shaft from the body with wire, etc, to prevent it from falling.

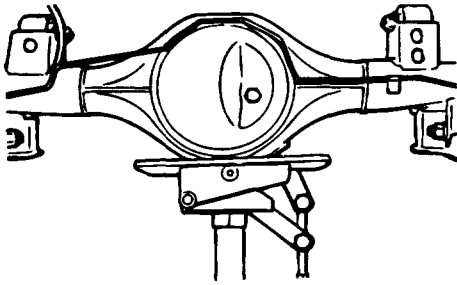


EIMB080A

5. Remove the stabilizer bar.

**CAUTION**

Support the rear axle housing with rigid jack before removing the stabilizer bar.



H7RA0600

6. Remove the lateral rod.
7. Remove the rear shock absorber assembly.
8. Remove the lower link and the upper link.

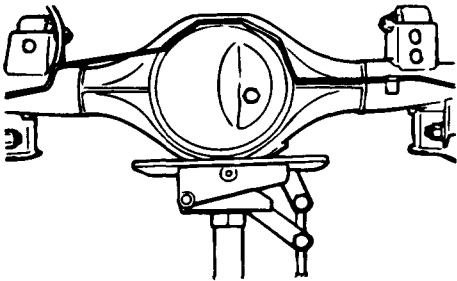
**⚠ CAUTION**

***Be careful not to drop the rear coil spring when removing it.***

9. Remove the rear axle assembly from the vehicle.

**⚠ CAUTION**

***Be careful not to drop the axle assembly.***



H7RA0600

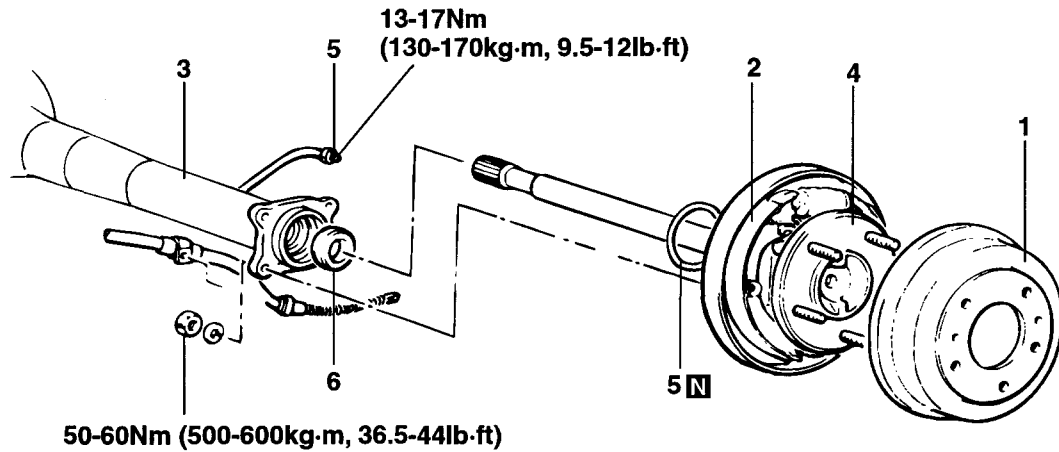
## INSTALLATION EIMB5000

1. Installation is the reverse of removal.
2. Tighten the parts with the specified torque as follows :

Items	Specified torque Nm(kg-cm, lb-ft)
Wheel nut mounting	100-120 (1000-1200, 73-88)
Brake caliper mounting bolt	80-100 (800-1000, 58-73)
Rear shock absorber lower mounting nut	90- 20 (900-1200, 66-88)
Rear upper link mounting	150-180 (1500-1800, 110-131)
Rear lower link mounting	150-180 (1500-1800, 110-131)
Lateral rod mounting nut (Rear axle side)	180-240 (1800-2400, 131-175)
Lateral rod mounting (Frame side)	150-180 (1500-1800, 110-131)
Rear stabilizer link bush mounting nut	19-28 (190-280, 14-20)
Rear stabilizer link bracket mounting	30-40 (300-400, 22-29)

## REAR AXLE SHAFT ASSEMBLY

## COMPONENTS EIMB5100



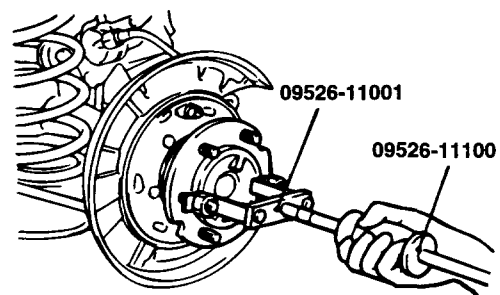
1. Brake drum/Disc
2. Shoe-lining assembly
3. Rear axle housing
4. Axle shaft assembly
5. O-ring
6. Oil seal

**N** : Replace the parts with new one after removal.

EHPDS46A

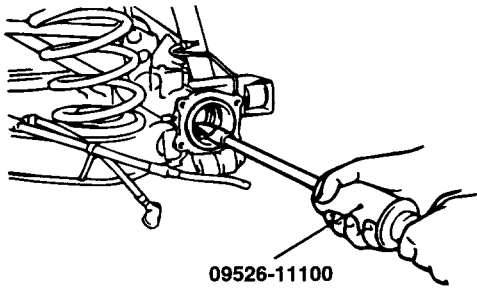
## REMOVAL EIMB5200

1. Remove the brake drum.
2. Remove the shoe-lining assembly.
3. Remove the parking brake cable and speed sensor cable.
4. Disconnect the brake hose and tube connection.
5. Remove the rear axle housing and axle shaft mounting bolt.
6. Using the special tools(09526-11001, 09526-11100), remove the axle shaft from the rear axle housing.



H7RA0540

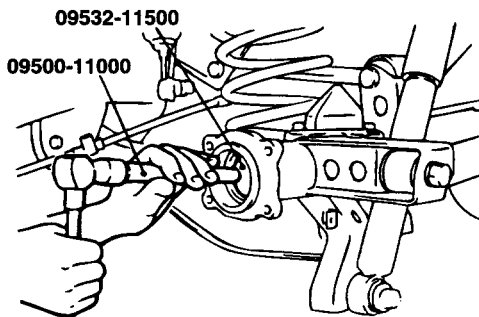
- Using the special tool(09526-11100), remove the oil seal.



H7RA0550

## INSTALLATION EIMB5300

- Installation is the reverse of removal.
- Apply grease to the oil seal lip.
- Using the special tools(09500-11000, 09532-11500), install the oil seal.

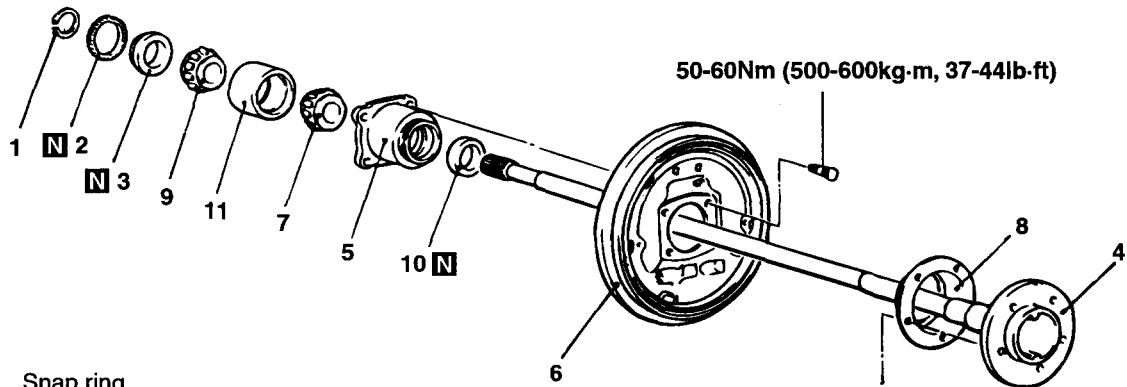


H7RA0560

- After installing the axle shaft, bleed the brake line.
- Adjust the parking brake lever stroke.

DISASSEMBLY AND REASSEMBLY EIMB5400

COMPONENTS



- 1. Snap ring
- 2. Rotor (Vehicles with ABS)
- 3. Retainer
- 4. Axle shaft
- 5. Bearing case
- 6. Backing plate
- 7. Outer bearing inner race
- 8. Dust cover
- 9. Inner bearing inner race
- 10. Oil seal
- 11. Bearing outer race

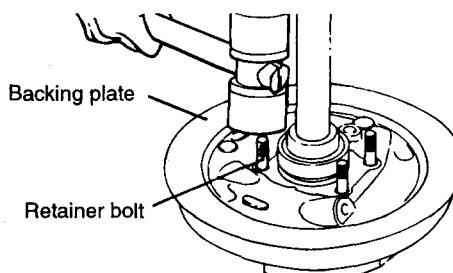
**N** : Replace the parts with new one after removal.

**TORQUE : Nm (kg-m, lb-ft)**

EIMB620A

DISASSEMBLY EIMB5500

1. Remove the snap ring.
2. Remove the retainer bolt from the backing plate.



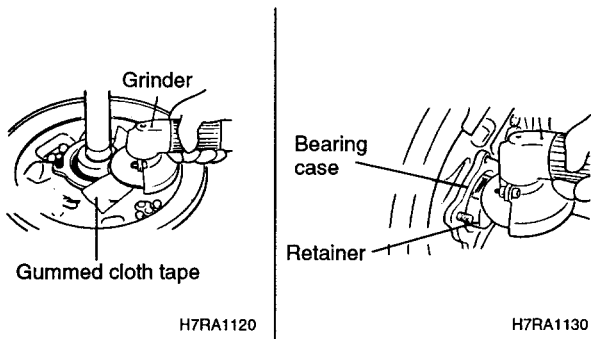
3. Apply gummed cloth tape around the edge of the bearing case for protection.
4. As shown in the figure, fix the axle shaft and shave off with grinder a point of its circumference locally until the wall thickness on the side of axle shaft of retainer becomes approximately 1.0-1.5mm (0.039-0.059in.).

**CAUTION**

*Be careful not to damage the bearing case and the axle shaft.*

EHPDS33B





H7RA1120

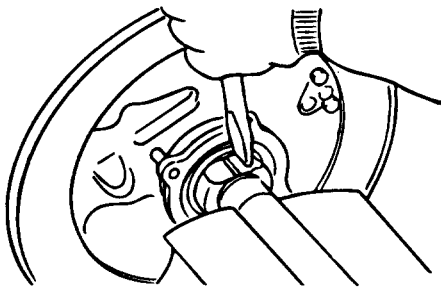
H7RA1130

EIMB630A

5. Cut in with a chisel the place where the retainer ring has been shaven.

**CAUTION**

*Be careful not to damage the axle shaft.*

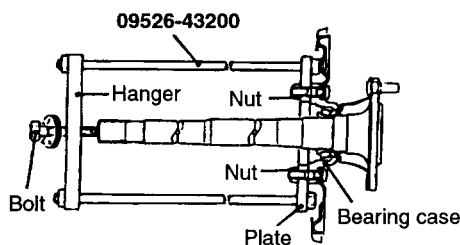


H7RA1140

6. Install the special tool(09526-43200) and then separate the bearing case and backing plate from the axle shaft.

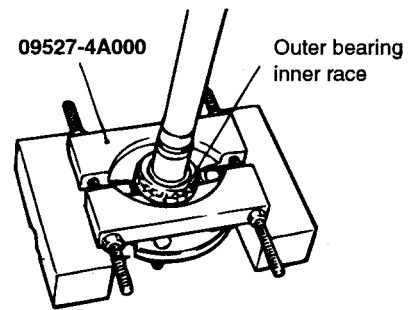
**NOTE**

*Secure the plate of the special tool(09526-43200) and bearing case with the bolts (length : 100mm or longer).*



EIMB550A

7. Using the special tool(09527-4A000), remove the outer bearing inner race from the axle shaft.



EIMB550B

**INSPECTION**

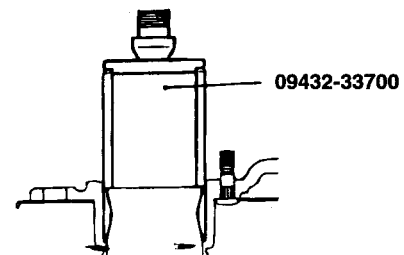
EIMB5600

1. Check the axle shaft spline part for wear or damage.
2. Check the backing plate for deformation and damage.
3. Check the bearing for seizure and discoloration.
4. Check the axle shaft for bend, wear or damage.

**REASSEMBLY**

EIMB5700

1. Press-fit bearing outer race to the bearing case.



H7RA0750

2. Apply multi-purpose grease to the roller surface and ends of the bearing inner race and fit it to the bearing case.

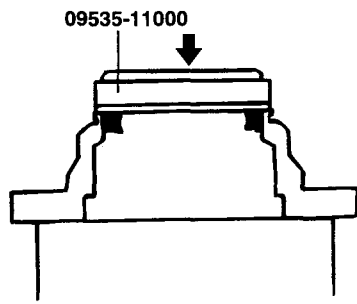
Specified grease : CENTOPLEX 278 (MS511-7)

3. Press-fit the oil seal into the bearing case until it is flush with the face of the bearing case using the special tool(09535-11000).

**NOTE**

*Apply multi-purpose grease to the lip of the oil seal.*

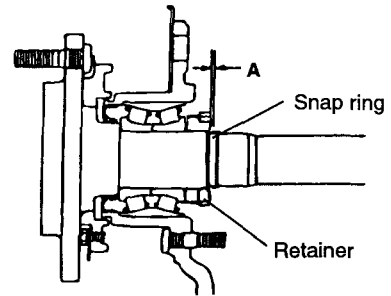
Specified grease : CENTOPLEX 278 (MS511-7)



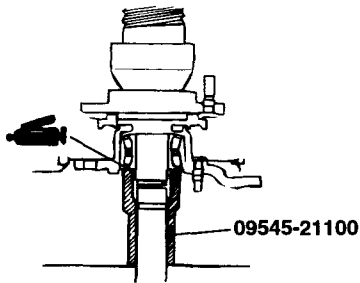
H7RA1260

Thickness of snap ring (mm)	Identification color
2.17	Blue
2.01	Violet
1.85	Red
1.69	Yellow
1.53	-

4. Install the backing plate.
5. Using the special tool(09545-21100), press-fit the bearing case, inner bearing inner race, and outer bearing inner race to the axle shaft.

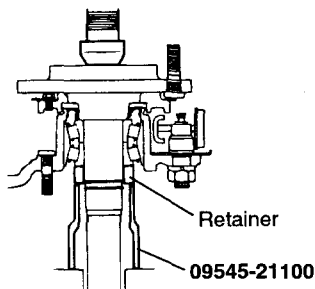


EHPDS48A



H7RA0730

6. Using the special tool(09545-21100), press-fit the retainer at the initial force of 5,000kg or more and at the final force of 10,000-11,000kg.



EHPDS51A

7. After installing the snap ring, measure the clearance(A) between the snap ring and the retainer.

Standard value(A) : 0-0.166mm (0-0.0065in.)

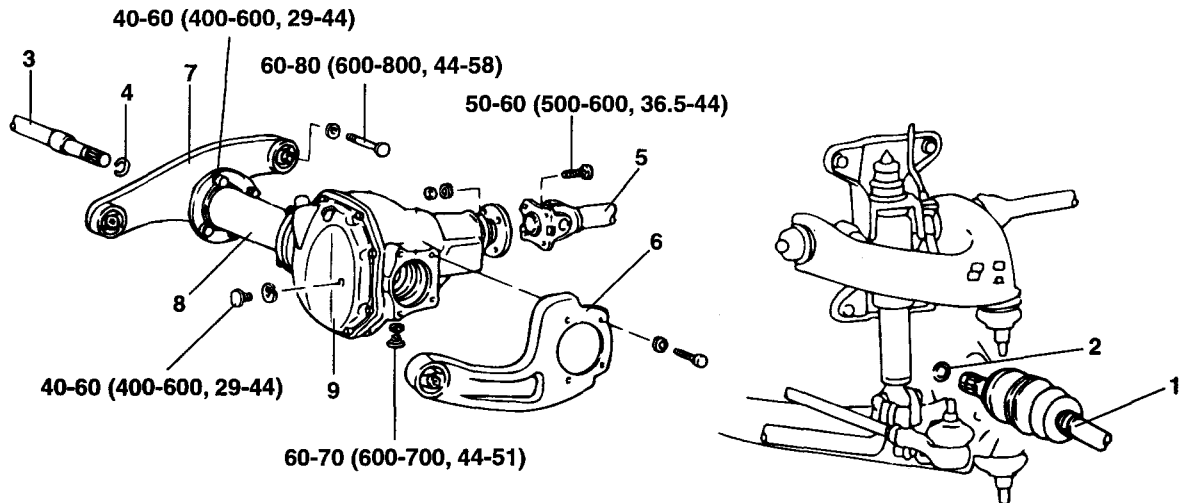
**NOTE**

If the clearance exceeds the standard value, change the snap ring so that the clearance is at the standard value.

# DIFFERENTIAL CARRIER ASSEMBLY

## FRONT DIFFERENTIAL CARRIER

### COMPONENTS EIMB5800



#### Removal steps

1. Driveshaft
2. Circlip
3. Inner shaft
4. Circlip
5. Propeller shaft
6. Differential mounting bracket (LH)
7. Differential mounting bracket (RH)
8. Housing tube
9. Differential carrier assembly

**TORQUE : Nm (kg-m, lb-ft)**

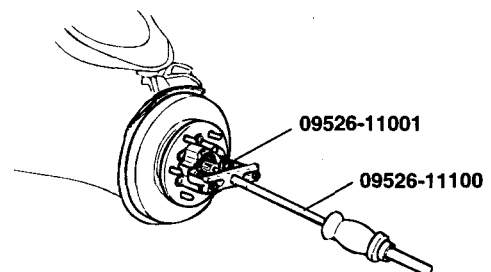
EHPDS44A

### REMOVAL EIMB5900

1. Remove the hub and knuckle (Refer to "Front hub/knuckle" for the detail).

#### NOTE

Use the special tools(09526-11001, 09526-11100) so as to remove the hub remove the hub and knuckle easily.

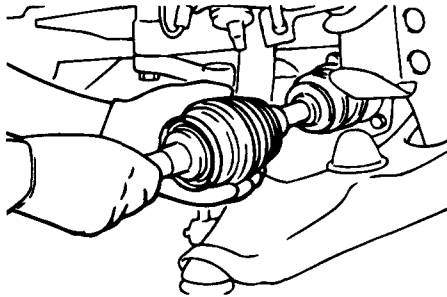


KHPDS10A

2. Remove the driveshaft.

**CAUTION**

When removing the driveshaft, be careful not to damage the differential carrier oil seal by interference of spline part.

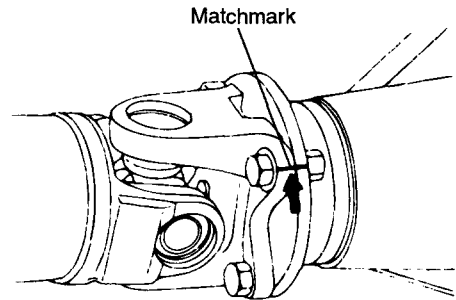


KHPDS13A

6. Remove the front propeller shaft.

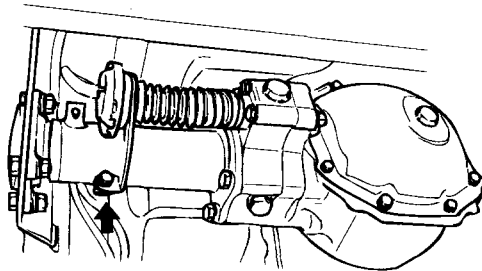
**NOTE**

Make matchmark on the flange yoke and differential companion flange to avoid any mistake when installing them again.



EIMB080A

3. Remove the actuator from the inner shaft housing (Vehicle with CADS)



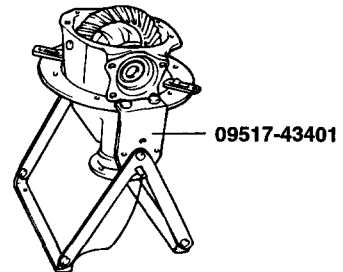
KHPDS33A

7. Remove the differential carrier.

**INSPECTION BEFORE DISASSEMBLY**

EIMB6000

Mount the differential carrier on the special tool(09517-43401).



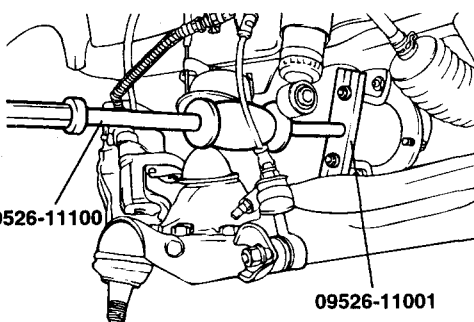
H7FS0600

4. Drain oil.

5. Remove the inner shaft.

**CAUTION**

- Support the differential carrier with a jack to prevent it from falling.
- Use the special tools(09526-11001, 09526-11100) to remove the inner shaft easily.



09526-11100

09526-11001

H7FA1226

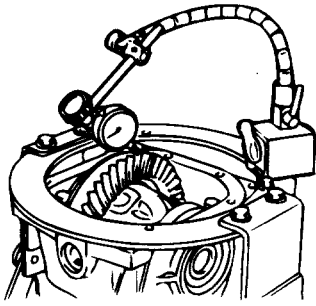
**FINAL DRIVE GEAR BACKLASH**

1. Fix the drive gear so it cannot move and measure the final drive gear backlash with a dial indicator.

**NOTE**

Measure at four points or more on the circumference of the drive gear.

Standard value : 0.11-0.16mm (0.0043-0.0063in.)



H7FA0690

- If the backlash is beyond the standard value, adjust it using the side bearing spacer.

**NOTE**

After adjustment, inspect the contact of the final drive gear.

### DRIVE GEAR RUNOUT

Check the back-face lash as follows:

- Place a dial gauge on the back-face of the drive gear and measure the runout.

---

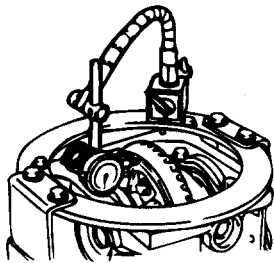
Limit : 0.05 mm (0.0020 in.)

---

- If the runout is beyond the limit, check that there are no foreign substances between the drive gear and differential case and, that the bolts fixing the drive gear are not loose.
- If nothing is wrong in check (2), adjust the drive gear depth and remeasure.

**NOTE**

If these adjustments are impossible, replace the case or install a new drive gear/drive pinion as a set.



H7FA0700

### DIFFERENTIAL GEAR BACKLASH

- Fix the side gear with a wedge so it cannot move and measure the differential gear backlash with a dial indicator on the pinion gear.

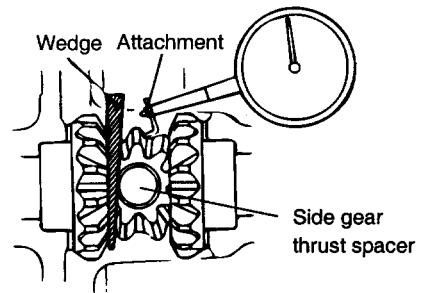
**NOTE**

Take the measurements at two places (4 places for LSD) on the pinion gear.

---

Standard value : 0-0.076 mm (0-0.003 in.)

---



A7FA0710

- If the backlash exceeds the limit, adjust using side bearing spacers.

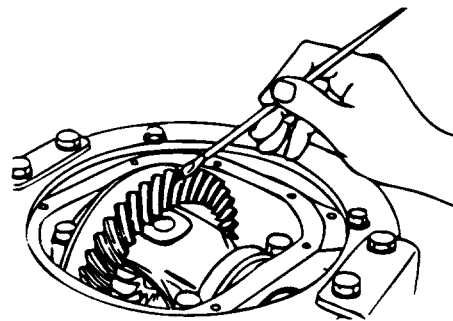
**NOTE**

If adjustment is impossible, replace the side gear and pinion gears as a set.

### FINAL DRIVE GEAR TOOTH CONTACT

Check the final drive gear tooth contact by following the steps below :

- Apply the same amount of machine blue slightly to both surfaces of the drive gear teeth.



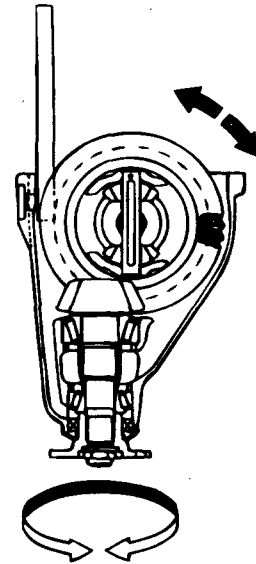
H7FA0720

2. Insert a brass rod between the differential carrier and the differential case, and then rotate the companion flange by hand (once in the normal direction, and then once in the reverse direction) while applying a load to the drive gear so that some torque (approximately 25-30 kg•cm) is applied to the drive pinion.

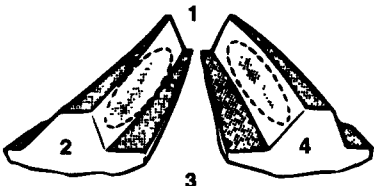
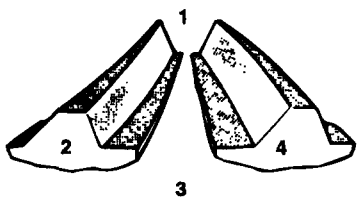
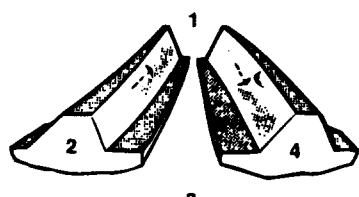
**CAUTION**

*If the drive gear is rotated too much, the tooth contact pattern will become unclear and difficult to check.*

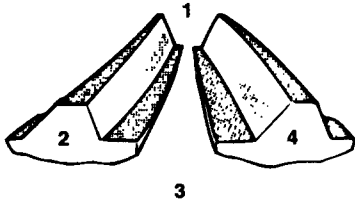
3. Check the tooth contact pattern.



EIJA001B

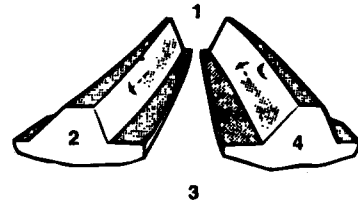
<p><b>Standard tooth contact pattern</b></p> <ol style="list-style-type: none"> <li>1. Narrow tooth side</li> <li>2. Drive-side tooth surface (the side receiving power during acceleration)</li> <li>3. Wide tooth side</li> <li>4. Coast-side tooth surface (the side receiving power during coast-down)</li> </ol>	 <p style="text-align: right;">EIJA0011</p>
<p style="text-align: center;">Problem</p>	<p style="text-align: center;">Solution</p>
<p>Tooth contact pattern resulting from excessive pinion height</p>  <p style="text-align: right;">EIJA0012</p> <p>The drive pinion is positioned too far from the center of the drive gear.</p>	 <p style="text-align: right;">EIJA0013</p> <p>Increase the thickness of the pinion height adjusting shim, and position the drive pinion closer to the center of the drive gear.</p> <p>Also, for backlash adjustment, reposition the drive gear further from the drive pinion.</p>

Tooth contact pattern resulting from insufficient pinion height



EIJ0014

The drive pinion is positioned too close to the center of the drive gear.



EIJ0015

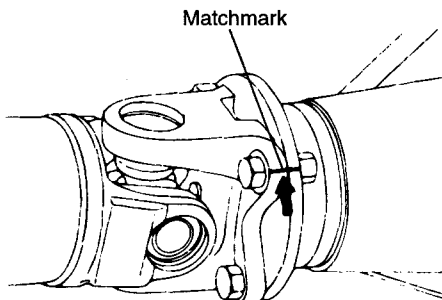
Decrease the thickness of the pinion height adjusting shim, and position the drive pinion further from the center of the drive gear. Also, for backlash adjustment, reposition the drive gear closer to the drive pinion.

### NOTE

- Tooth contact pattern is a method for judging the result of the adjustment of drive pinion height and final drive gear backlash. The adjustment of drive pinion height and final drive gear backlash should be repeated until the tooth contact patterns are similar to the standard tooth contact pattern.
- When you cannot obtain a correct pattern, the drive gear and drive pinion have exceeded their limits. Both gears should be replaced as a set.

## INSTALLATION EIMB6100

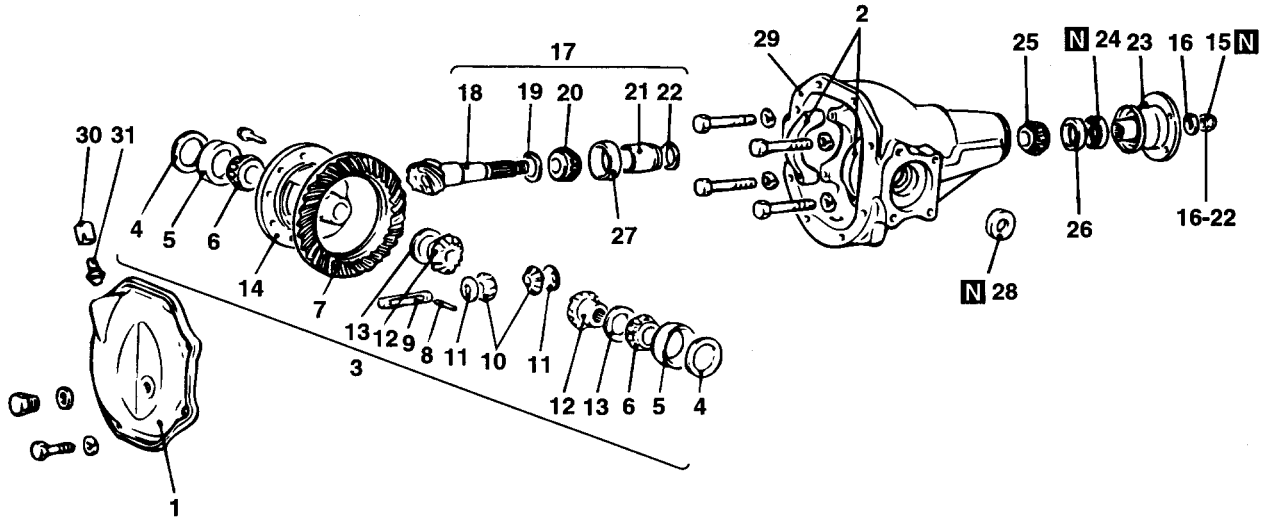
1. Installation is the reverse of removal.
2. Align the matchmark on the flange yoke and the companion flange.  
Tighten the propeller shaft and the front differential carrier.



EIMB080A

**DISASSEMBLY** EIMB6200

**COMPONENTS**



**Disassembly steps**

- |   |   |
|---|---|
| <ol style="list-style-type: none"> <li>1. Cover</li> <li>2. Bearing cap</li> <li>3. Differential case assembly</li> <li>4. Side bearing spacer</li> <li>5. Side bearing outer race</li> <li>6. Side bearing inner race</li> <li>7. Drive gear</li> <li>8. Lock pin</li> <li>9. Pinion shaft</li> <li>10. Pinion gear</li> <li>11. Pinion washer</li> <li>12. Side gear</li> <li>13. Side gear spacer</li> <li>14. Differential case</li> <li>15. Self-locking nut</li> <li>16. Washer</li> <li>17. Drive pinion assembly</li> <li>18. Drive pinion</li> </ol> | <ol style="list-style-type: none"> <li>19. Drive pinion<br/>(for pinion height adjustment)</li> <li>20. Drive pinion front bearing inner race</li> <li>21. Drive pinion spacer</li> <li>22. Drive pinion rear shim<br/>(for turning torque adjustment)</li> <li>23. Companion flange</li> <li>24. Oil seal</li> <li>25. Drive pinion rear bearing inner race</li> <li>26. Drive pinion rear bearing outer race</li> <li>27. Drive pinion front bearing outer race</li> <li>28. Oil seal</li> <li>29. Gear carrier</li> <li>30. Plug cover</li> <li>31. Vent plug</li> </ol> |
|---|---|

**N** : Replace the parts with new one after removal.

**TORQUE : Nm (kg-cm, lb-ft)**

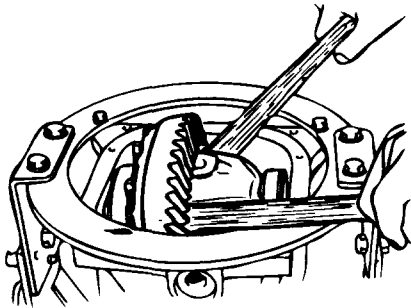


**DISASSEMBLY** EIMB6300**1. REMOVAL OF THE DIFFERENTIAL CASE ASSEMBLY****⚠ CAUTION**

*Remove the differential case assembly slowly and carefully. Be careful so that the side bearing outer race is not dropped.*

**📖 NOTE**

*Keep the right and left side bearings separate so that they are not mixed during reassembly.*

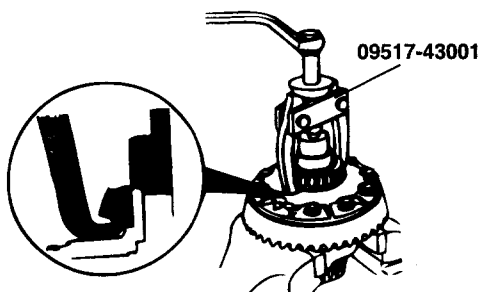


H7FA0740

**2. REMOVAL OF THE SIDE BEARING INNER RACES**  
Fit the nut on top of the differential case, and then use the special tool(09517-43001) to remove the side bearing inner race.

**📖 NOTE**

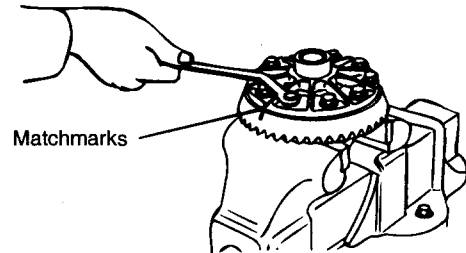
*Attach the prongs of the special tool to the inner race of the side bearing through the notched section in the differential case.*



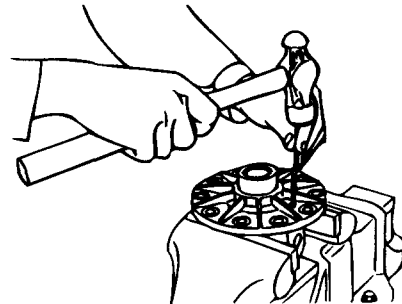
H7FA0750

**3. REMOVAL OF DRIVE GEAR**

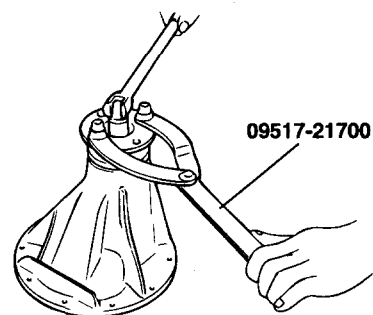
- Make the matchmarks to the differential case and the drive gear.
- Loosen the drive gear attaching bolts in diagonal sequence to remove the drive gear.



A7FA0760

**4. REMOVAL OF LOCK PIN (FOR CONVENTIONAL DIFFERENTIAL)**

H7FA0770

**5. REMOVAL OF SELF-LOCKING NUT**

H7RA1100

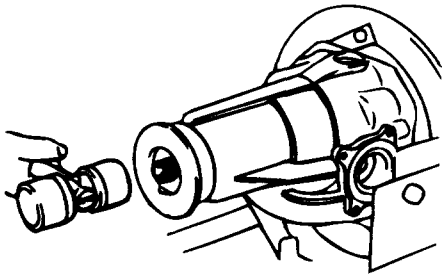
**6. REMOVAL OF DRIVE PINION**

- a. Make the matchmarks to the drive pinion and companion flange.

**CAUTION**

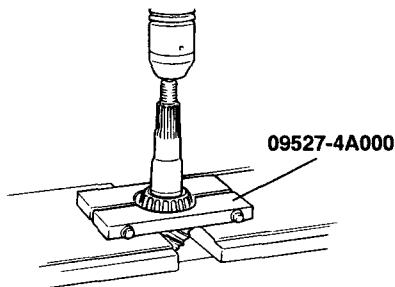
*Matchmarks should not be made to the contact surfaces of the companion flange and the propeller shaft.*

- b. Drive out the drive pinion together with the drive pinion spacer and drive pinion front shims.



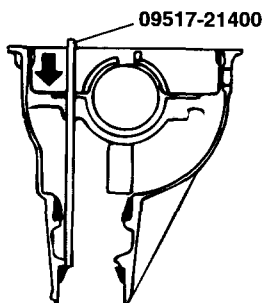
H7FA0790

**7. REMOVAL OF DRIVE PINION REAR BEARING INNER RACE**



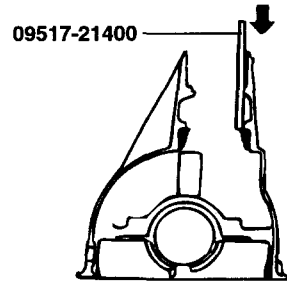
H7RA1090

**8. REMOVAL OF OIL SEAL / DRIVE PINION FRONT BEARING INNER RACE / DRIVE PINION FRONT BEARING OUTER RACE**



KIMB520D

**9. REMOVAL OF DRIVE PINION REAR BEARING OUTER RACE**



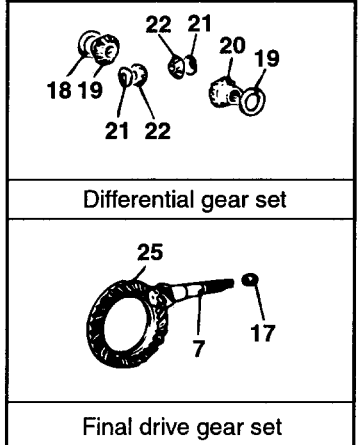
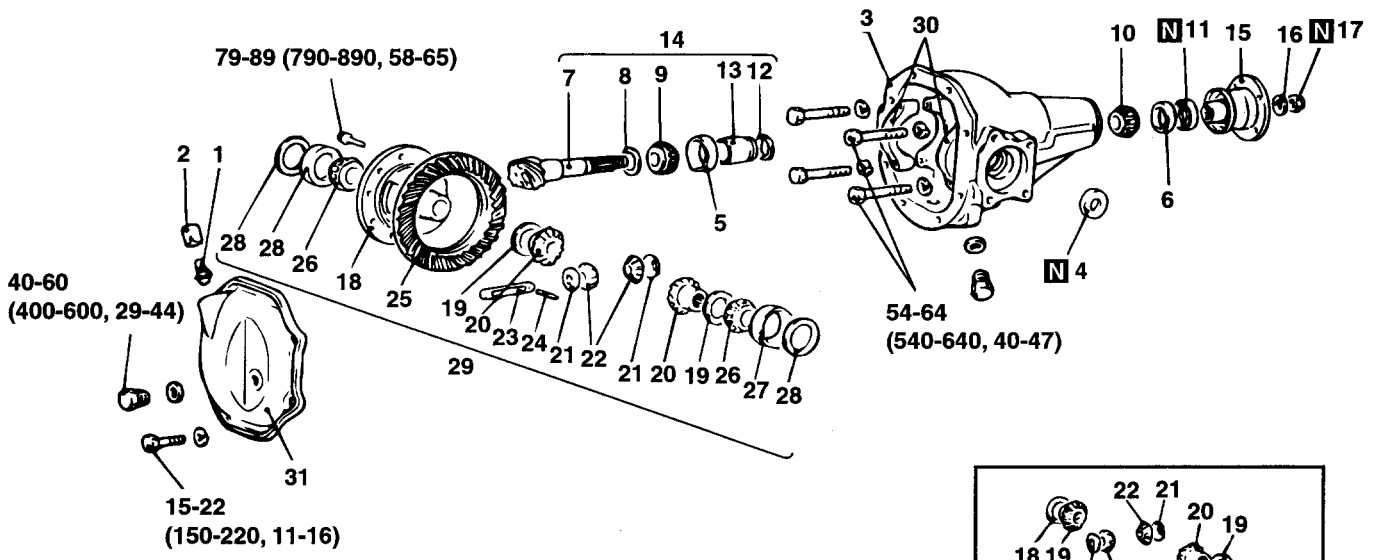
KIMB520E

**INSPECTION** EIJB0490

1. Check the companion flange for wear or damage.
2. Check the bearings for wear or discoloration.
3. Check the gear carrier for cracks.
4. Check the drive pinion and drive gear for wear or cracks.
5. Check the side gears, pinion gears and pinion shaft for wear or damage.
6. Check the side gear spline for wear or damage.

REASSEMBLY EIMB6500

COMPONENTS



Disassembly steps

- |  |   |
|--|---|
| <ol style="list-style-type: none"> <li>1. Vent plug</li> <li>2. Plug cover</li> <li>3. Gear carrier</li> <li>4. Oil seal</li> <li>5. Drive pinion front bearing outer race</li> <li>6. Drive pinion rear bearing outer race</li> <li>• Pinion height adjustment</li> <li>7. Drive pinion</li> <li>8. Drive pinion front shim (for pinion height adjustment)</li> <li>9. Drive pinion front bearing inner race</li> <li>10. Drive pinion rear bearing inner race</li> <li>11. Oil seal</li> <li>12. Drive pinion rear shim (for turning torque adjustment)</li> <li>13. Drive pinion spacer</li> <li>14. Drive pinion assembly</li> <li>15. Companion flange</li> <li>16. Washer</li> <li>17. Self-locking nut</li> </ol> | <ol style="list-style-type: none"> <li>18. Differential case</li> <li>19. Side gear spacer</li> <li>20. Side gear</li> <li>21. Pinion washer</li> <li>22. Pinion gear</li> <li>• Differential gear backlash adjustment</li> <li>23. Pinion shaft</li> <li>24. Lock pin</li> <li>25. Drive gear</li> <li>26. Side bearing inner race</li> <li>27. Side bearing outer race</li> <li>28. Side bearing adjustment spacer</li> <li>• Drive gear backlash adjustment</li> <li>29. Differential case assembly</li> <li>30. Bearing cap</li> <li>31. Cover</li> </ol> |
|--|---|

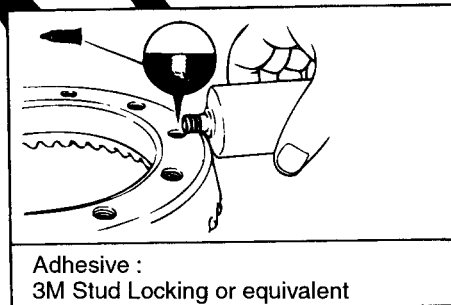
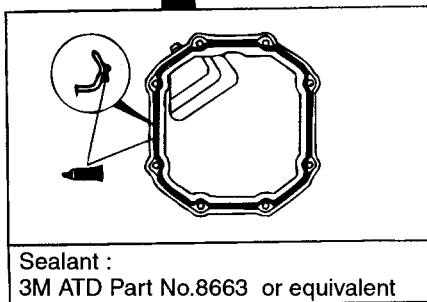
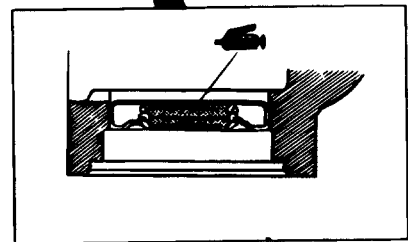
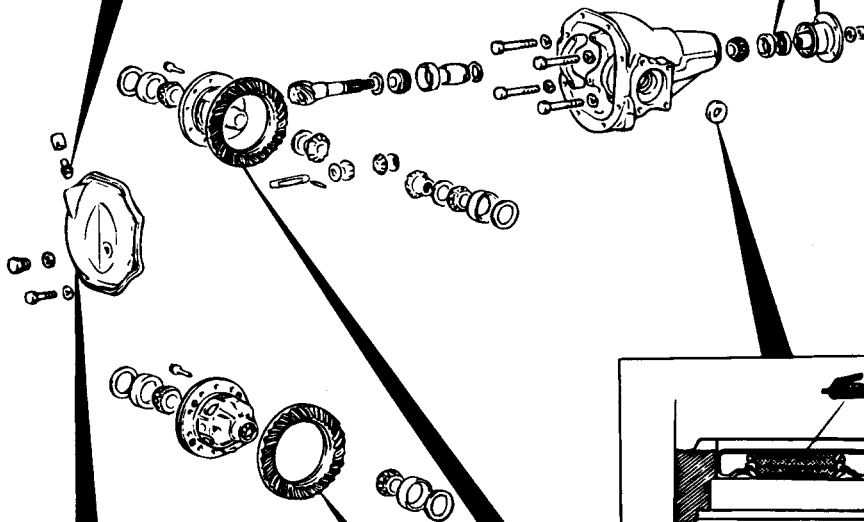
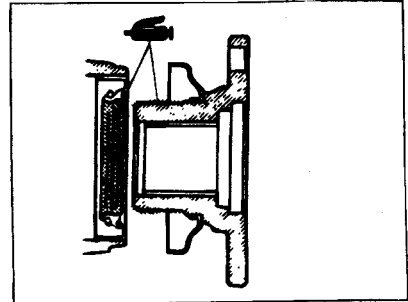
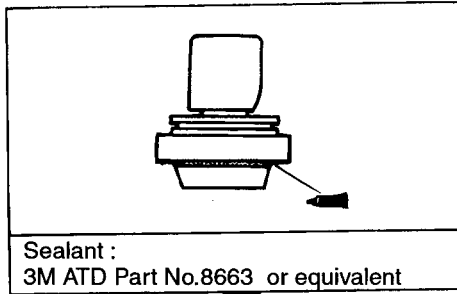
**N** : Replace the parts with new one after removal.

**TORQUE : Nm (kg-cm, lb-ft)**

LUBRICATION, SEALING AND ADHESIVE POINTS

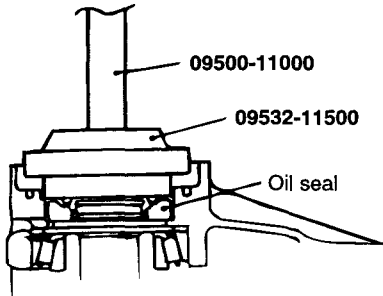
EIMB6600

COMPONENTS



**REASSEMBLY** EIMB6700

1. PRESS-FITTING OF IL SEAL

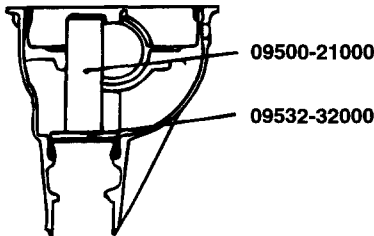


EIMB670A

2. DRIVE PINION FRONT BEARING OUTER RACE INSTALLATION

**CAUTION**

*When press-fitting the outer race, do not incline it.*

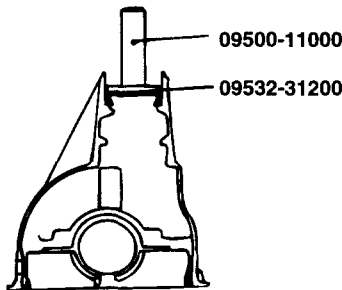


H7FA0860

3. DRIVE PINION REAR BEARING OUTER RACE INSTALLATION

**CAUTION**

*When press-fitting the outer race, do not incline it.*



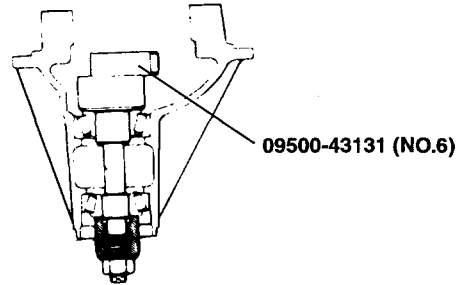
H7FA0870

4. ADJUSTMENT OF PINION HEIGHT  
Adjustment the drive pinion height by the following procedure.

- 1) Install the special tool, drive pinion front and rear bearing inner races to the gear carrier.

**CAUTION**

*Apply multipurpose grease to the washer of the special tool(09500-43131).*



EIMB670B

- 2) Tighten the nut of the special tool(09500-43131) slowly until the standard value of drive pinion turning torque(without oil seal) is obtained.

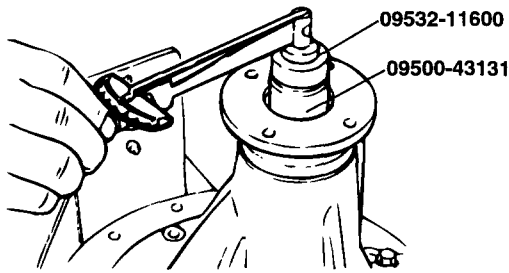


EIMB670C

Bearing division	Bearing lubrication	Rotation torque
New	None (With anti-rust agent)	0.5 - 0.7Nm
New or reusing	Gear oil applied	0.3 - 0.4Nm

**NOTE**

- Gradually tighten the nut of the special tool while checking the drive pinion turning torque.
- Because the special tool cannot be turned one rotation, turn it several times within the range that it can be turned. After obtaining smooth bearing operation, measure the rotation torque.



- 1) Fit the drive pinion front shim(s) between the drive pinion spacer and the drive pinion front bearing inner race.

**NOTE**

*Do not install the oil seal.*

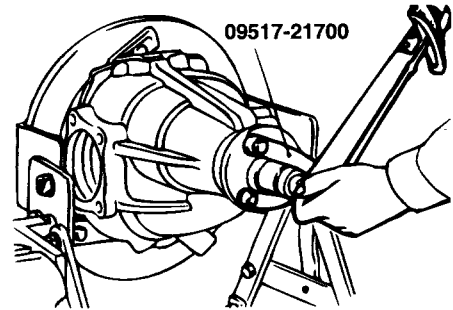
- 2) Tighten the companion flange self-locking nut to the specified torque using the special tool.

KIMB540A

5. Position the special tool in the side bearing seat of the gear carrier and select a drive pinion rear shim of a thickness which corresponds to the gap between the special tools.

**NOTE**

- Clean the side bearing seat thoroughly. When positioning the special tool, confirm that the cut-out sections of the special tool touch the side bearing seat very closely.
- When selecting the drive pinion rear shims, use the fewest number of shims necessary.

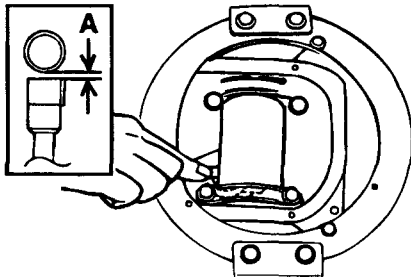


H7FA0930

- 3) Measure the drive pinion turning torque (without the oil seal) using the special tool.

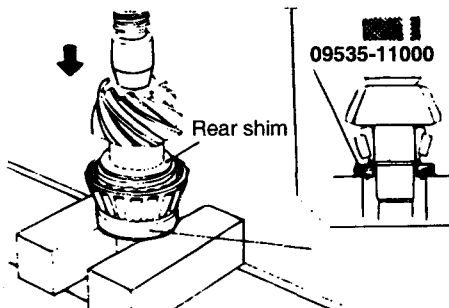
**Standard value :**

0.15-0.25Nm (1.5-2.5kg·cm, 0.12-0.18lb·ft)

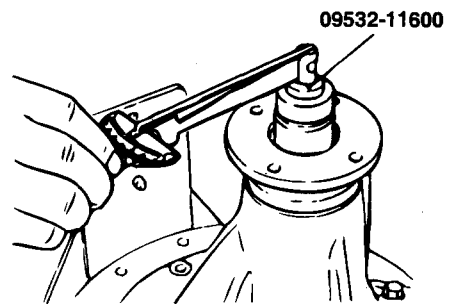


KHPD736A

6. Fit the selected drive pinion rear shim(s) to the drive pinion, and press-fit the drive pinion rear bearing inner race using the special tool(09535-11000).



AIJA030A



H7FA0940

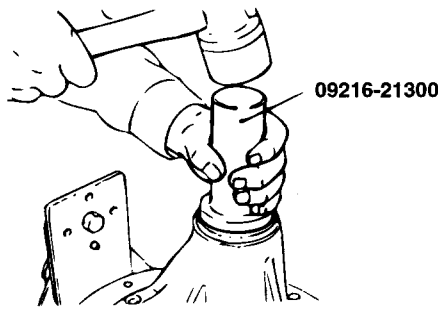
- 4) If the drive pinion turning torque is not within the range of the standard value, adjust the turning torque by replacing the drive pinion front shim(s) or the drive pinion spacer.

**NOTE**

*When selecting the drive pinion front shim pack use the minimum number of shims.*

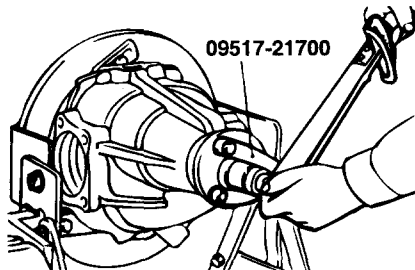
- 5) Remove the companion flange and drive pinion once again. Insert the oil seal into the gear carrier front lip using the special tool(09216-21300). Apply multipurpose grease to the oil seal lip.

7. **ADJUSTMENT OF DRIVE PINION PRELOAD**  
Adjust the drive pinion turning torque according to the following procedures :



H7FA0960

- 6) Install the drive pinion assembly, shim packs and companion flange with matchmarks properly aligned, and tighten the companion flange self-locking nut to the specified torque using the special tool(09517-21700).

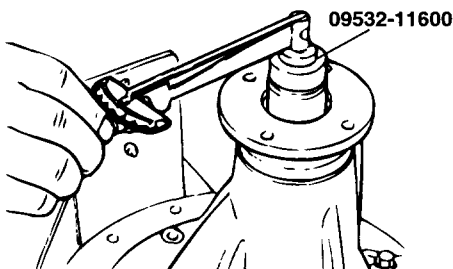


H7FA0970

- 7) Measure the drive pinion turning torque using the special tool(09532-11600).

**Standard value :**

0.35-0.45Nm (3.5-4.5kg·cm, 0.26-0.33lb-ft)



H7FA0980

- 8) If it is beyond the standard value, verify the torque of the companion flange self-locking nut or the fit of the oil seal.

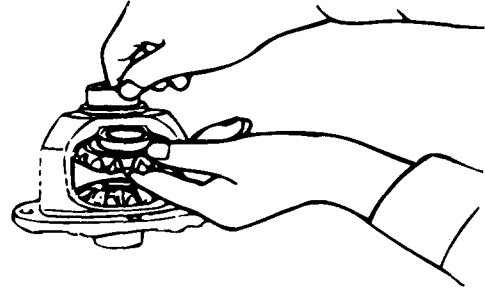
**8. ADJUSTMENT OF DIFFERENTIAL GEAR BACKLASH**

Adjust the differential gear backlash according to the following procedures :

- 1) Assemble the side gears, side gear spacers, pinion gears, and pinion washers into the differential case.
- 2) Temporarily install the pinion shaft.

**NOTE**

*Do not install the lock pin yet.*



H7FA0990

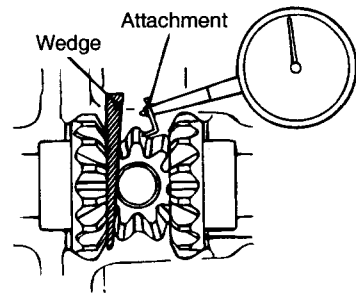
- 3) Insert a wedge in the side gear and measure the differential gear backlash with a dial indicator on the pinion gear.

**NOTE**

*Measure both pinion gears separately.*

Standard value : 0-0.076 mm (0-0.0003 in.)

Limit : 0.2 mm (0.008 in.)



A7FA1000

- 4) If the differential gear backlash exceeds the limit, adjust the backlash by selecting thicker side gear thrust spacers.
- 5) Measure the differential gear backlash once again, and confirm that it is within the limit.

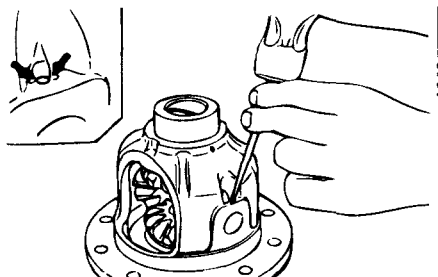
**NOTE**

- After adjustment, check that the backlash is within the limit and the differential gear rotates smoothly.

- When adjustment is impossible, replace the side gear and the pinion gear as a set.

**9. INSTALLATION OF THE LOCK PIN**

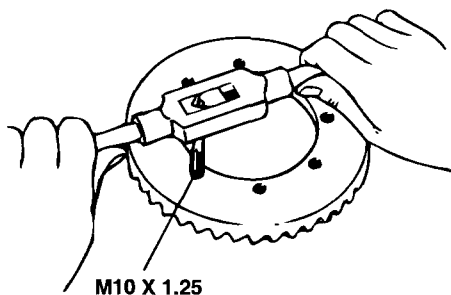
- 1) Align the pinion shaft lock pin hole with the differential case lock pin hole, and drive in the lock pin.
- 2) Fix the lock pin in place by staking two points around the lock pin hole with a punch.



H7FA1010

**10. INSTALLATION OF THE DRIVE GEAR**

- 1) Clean the drive gear attaching bolts.
- 2) Remove the adhesive on the threaded holes of the drive gear use a tap (M10 x 1.25), and then clean the threaded holes with compressed air.

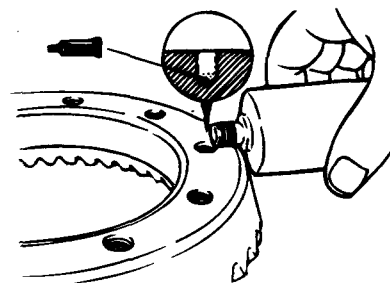


M10 X 1.25

H7FA1020

- 3) Apply the specified adhesive to the threaded holes of the drive gear.

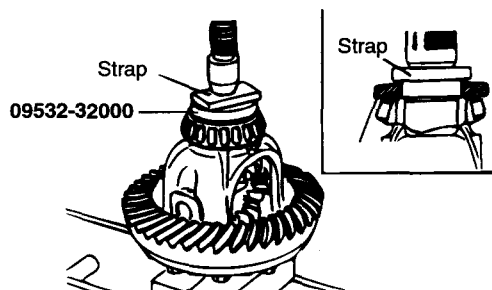
**Specified adhesive : LOCTITE #262 or equivalent**



H7FA1030

- 4) Install the drive gear in the differential case with the matchmarks properly aligned. Tighten the bolts to the specified torque in a diagonal sequence.

**11. PRESS THE SIDE BEARING INNER RACE**



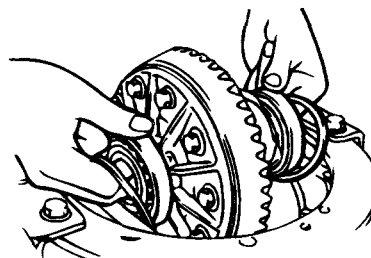
EIMB670D

**12. ADJUSTMENT OF FINAL DRIVE GEAR BACKLASH**  
Adjust the final drive gear backlash according to the following procedures :

- 1) Install side bearing spacers which are thinner than those removed, to the side bearing outer races, and then mount the differential case assembly into the gear carrier.

**NOTE**

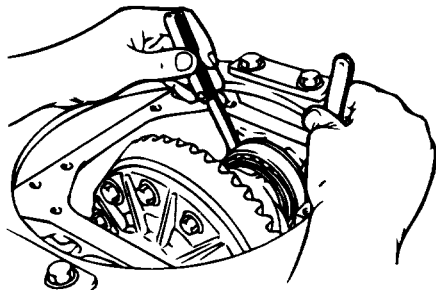
Select side bearing spacers with the same thickness for both the drive pinion side and the drive gear side.



H7FA1050

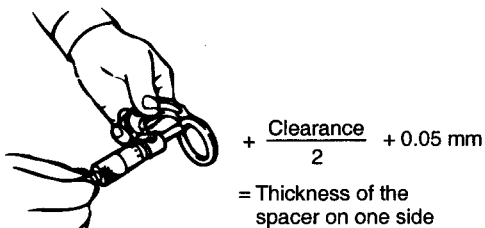


- 2) Push the differential case to one side, and measure the clearance between the gear carrier and the side bearing with a feeler gauge.



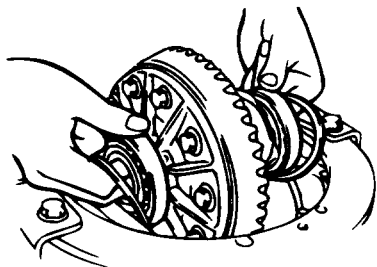
H7FA1060

- 3) Select two pairs of spacers which correspond to the value calculated according to the expression in the illustration. Install one pair each to the drive pinion side and the drive gear side.



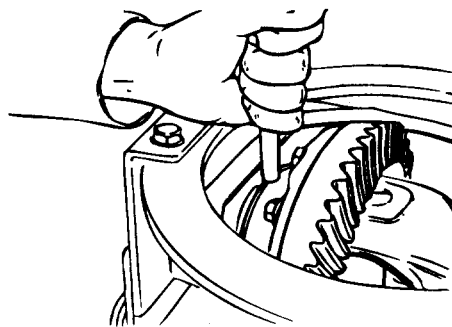
A7FA1070

- 4) Install the side bearing spacers and differential case assembly, as shown in the illustration, to the gear carrier.



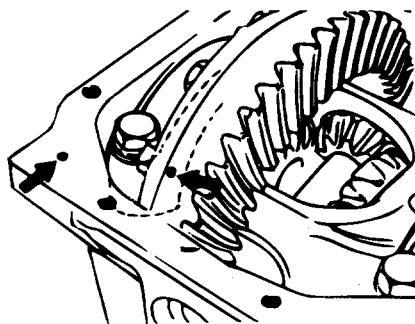
H7FA1080

- 5) Tap the side bearing spacers with a brass bar to fit them to the side bearing outer race.



H7FA1090

- 6) Align the matchmarks on the gear carrier and the bearing cap and tighten the bearing cap.



H7FA1100

- 7) With the drive pinion locked in place, measure the final drive gear backlash with a dial indicator on the drive gear.

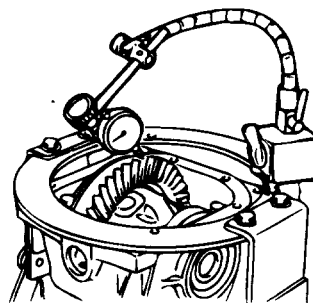
**NOTE**

Measure at four points or more on the circumference of the drive gear.

---

Standard value : 0.11-0.16mm (0.0043-0.0063in.)

---

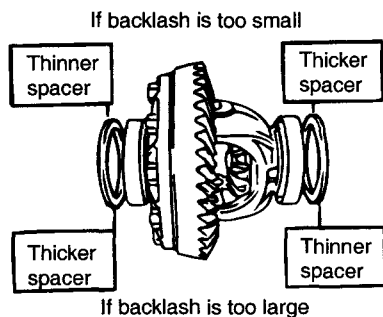


H7FA1110

- 8) Change the side bearing spacers as illustrated and then adjust the final drive gear backlash between the drive gear and the drive pinion.

 **NOTE**

*When increasing the number of side bearing spacers, use the same number for each and as few as possible.*



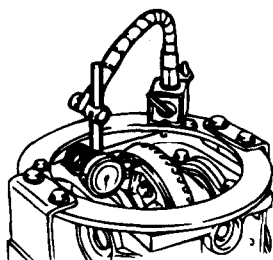
A7FA1120

- 9) Check the drive gear and drive pinion for tooth contact. If poor contact is evident, adjust again.
- 10) Measure the drive gear runout at the shoulder on the reverse side of the drive gear.

---

Limit : 0.05 mm (0.002 in.)

---

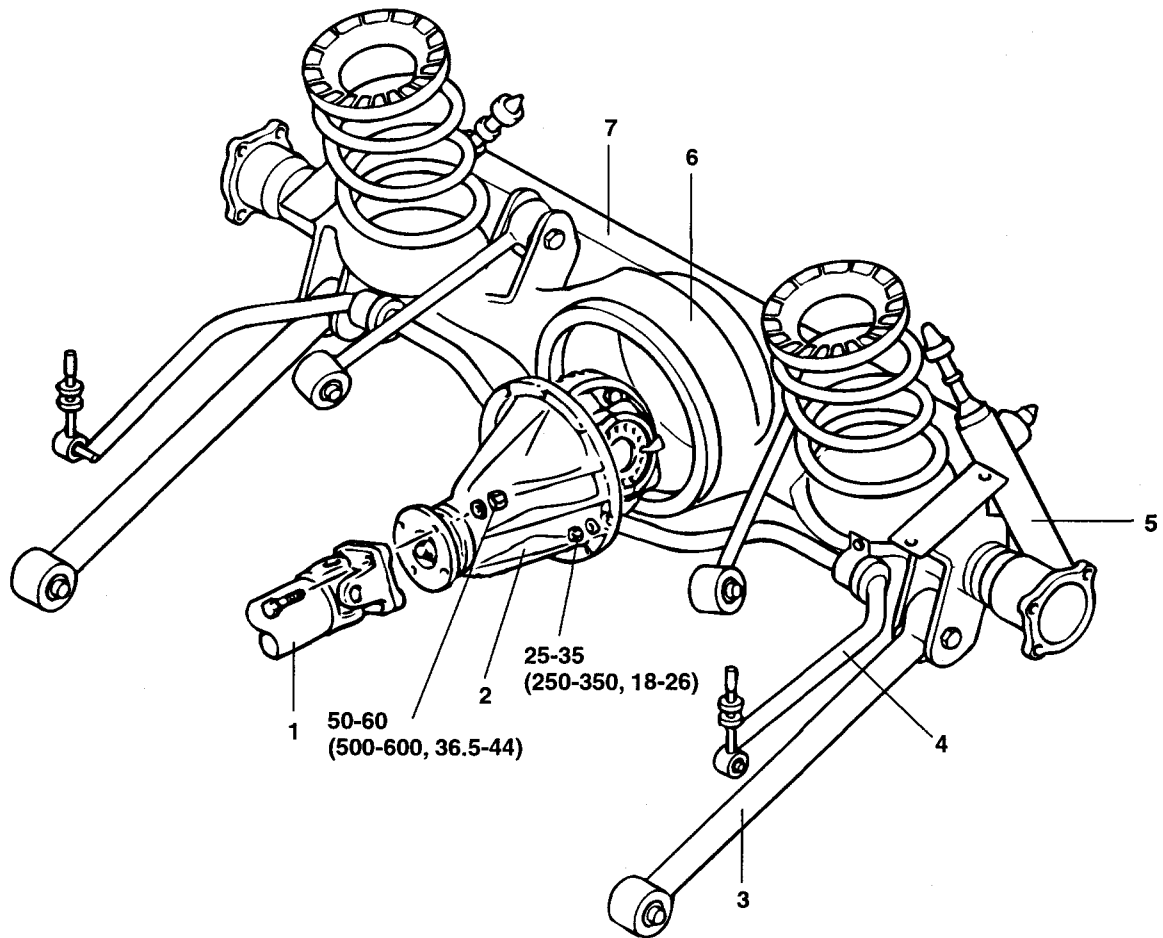


H7FA1130

- 11) If the drive gear runout exceeds the limit, reinstall by changing the position of the drive gear and differential case, and remeasure.

# REAR DIFFERENTIAL CARRIER

## COMPONENTS EIMB6800



1. Rear propeller shaft
2. Differential carrier assembly
3. Lower link
4. Stabilizer bar
5. Rear shock absorber
6. Rear axle housing
7. Lateral rod

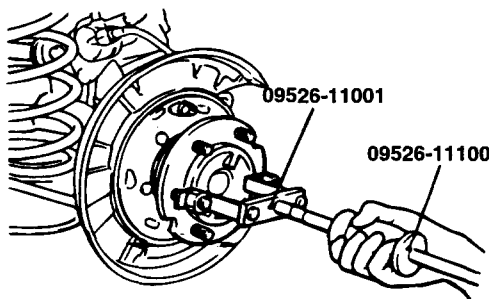
**TORQUE : Nm (kg·cm, lb·ft)**

**REMOVAL** EIMB6900

1. Drain the differential gear oil.
2. Remove the rear brake drum.
3. Remove the parking brake cable attaching bolt.
4. Remove the stabilizer bar.
5. Pull out the right and left axle shaft using the special tools(09526-11001, 09526-11000) after removing the coupling nuts.

**CAUTION**

*Be careful not to damage the oil seal when pulling axle shaft.*

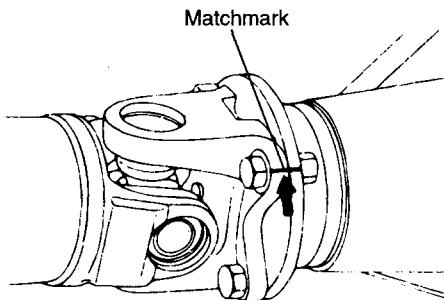


H7RA0870

6. After marking the matchmark on the flange yoke of the rear propeller shaft and the companion flange of the differential case, remove the rear propeller shaft assembly.

**CAUTION**

*Suspend the propeller shaft from the body with wire, etc.*

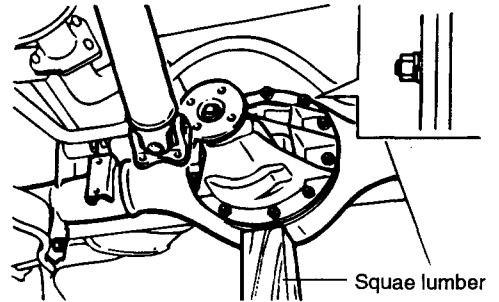


EIMB080A

7. Remove the attaching nuts and strike the lower part of differential carrier assembly with a piece of times several times to loosen, then remove the differential carrier assembly.

**NOTE**

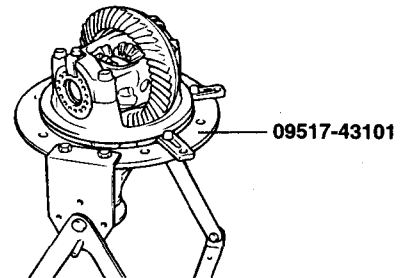
*Use care not to strike the companion flange.*



EIMB660A

**INSPECTION BEFORE DISASSEMBLY** EIMB7000

Secure the special tool(09517-43101) and install the differential carrier assembly with the attachment. Then carry out the following inspection.



H7RA1070

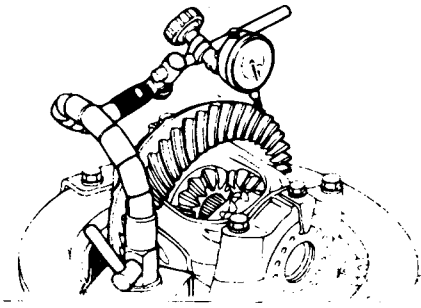
1. **FINAL DRIVE GEAR BACKLASH**  
Check the final drive gear backlash by the following procedure.
  - 1) Place the drive pinion and move the drive gear to check backlash is within the standard range.

**NOTE**

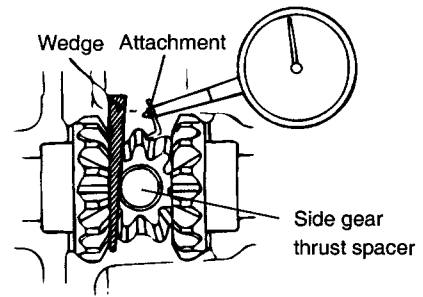
*Measure at 4 points on the gear periphery.*

**Standard value**

0.01-0.16 mm (0.0043-0.0063 in.)



AU52-23B



A7FA0710

- 2) Adjust with the side bearing nuts if backlash values are not within standard range.

**NOTE**

After adjusting, check the state of the final drive gear's tooth contact.

2. DRIVE GEAR RUNOUT

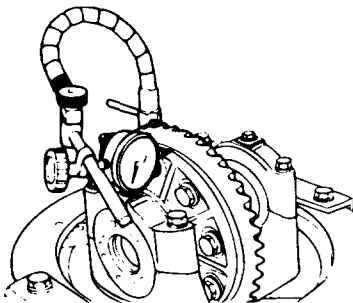
Check the back-face lash as follows:

- 1) Place a dial gauge on the back-face of the drive gear and measure the runout.

---

Limit : 0.05mm (0.0020in.)

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AU52-32A

- 2) If the runout is beyond the limit, check that there are no foreign substances between the drive gear and differential case and, that the bolts fixing the drive gear are not loose.

3. DIFFERENTIAL GEAR BACKLASH

- 1) Fix the side gear with a wedge so it cannot move and measure the differential gear backlash with a dial indicator on the pinion gear.

**NOTE**

Take the measurements at two places on the pinion gear.

---

Standard value : 0.01-0.25mm (0.0004-0.0098in.)

---

- 2) If the backlash exceeds the limit, adjust using side bearing spacers.

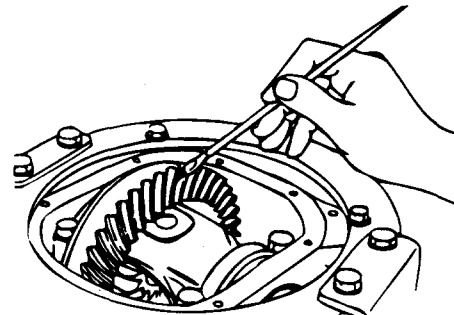
**NOTE**

If adjustment is impossible, replace the side gear and pinion gears as a set.

4. FINAL DRIVE GEAR TOOTH CONTACT

Check the final drive gear tooth contact by following the steps below :

- 1) Apply the same amount of machine blue slightly to both surfaces of the drive gear teeth.



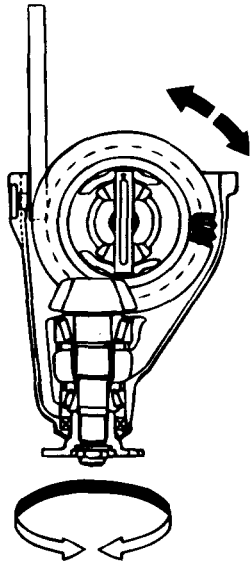
H7FA0720

- 2) Insert a brass rod between the differential carrier and the differential case, and then rotate the companion flange by hand (once in the normal direction, and then once in the reverse direction) while applying a load to the drive gear so that some torque (approximately 25-30kg·cm) is applied to the drive pinion.

**CAUTION**

If the drive gear is rotated too much, the tooth contact pattern will become unclear and difficult to check.

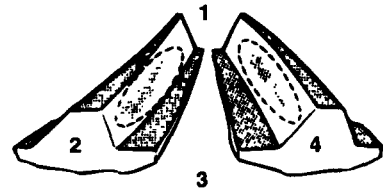
- 3) Check the tooth contact pattern.



EIJA001B

**Standard tooth contact pattern**

- 1. Narrow tooth side
- 2. Drive-side tooth surface (the side receiving power during acceleration)
- 3. Wide tooth side
- 4. Coast-side tooth surface (the side receiving power during coast-down)

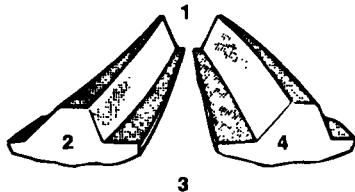


EIJA0011

**Problem**

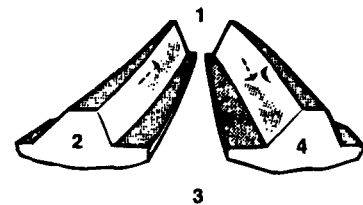
**Solution**

Tooth contact pattern resulting from excessive pinion height



EIJA0012

The drive pinion is positioned too far from the center of the drive gear.

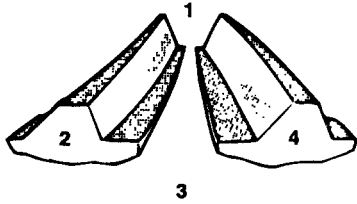


EIJA0013

Increase the thickness of the pinion height adjusting shim, and position the drive pinion closer to the center of the drive gear.

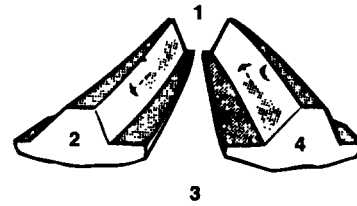
Also, for backlash adjustment, reposition the drive gear further from the drive pinion.

Tooth contact pattern resulting from insufficient pinion height



EIJ A0014

The drive pinion is positioned too close to the center of the drive gear.



EIJ A0015

Decrease the thickness of the pinion height adjusting shim, and position the drive pinion further from the center of the drive gear. Also, for backlash adjustment, reposition the drive gear closer to the drive pinion.

### NOTE

- *Tooth contact pattern is a method for judging the result of the adjustment of drive pinion height and final drive gear backlash. The adjustment of drive pinion height and final drive gear backlash should be repeated until the tooth contact patterns are similar to the standard tooth contact pattern.*
- *When you cannot obtain a correct pattern, the drive gear and drive pinion have exceeded their limits. Both gears should be replaced as a set.*

## INSTALLATION EIMB7100

### 1. DIFFERENTIAL CARRIER ASSEMBLY

Apply specified sealant to axle housing flange surface, and install the differential carrier assembly.

---

Specified sealant : Three bond 1215 or equivalent

---

### 2. PROPELLER SHAFT

Align the matchmarks on the flange yoke and companion flange, and install the propeller shaft.

#### **Tightening torque**

50-60Nm (500-600kg-cm, 37-44lb-ft)

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### 3. AXLE SHAFT ASSEMBLY

- 1) Apply specified sealant to the axle housing and bearing case end faces.

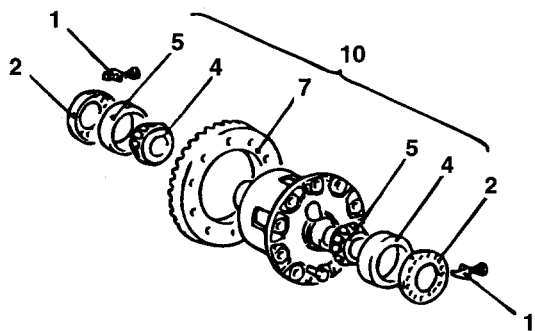
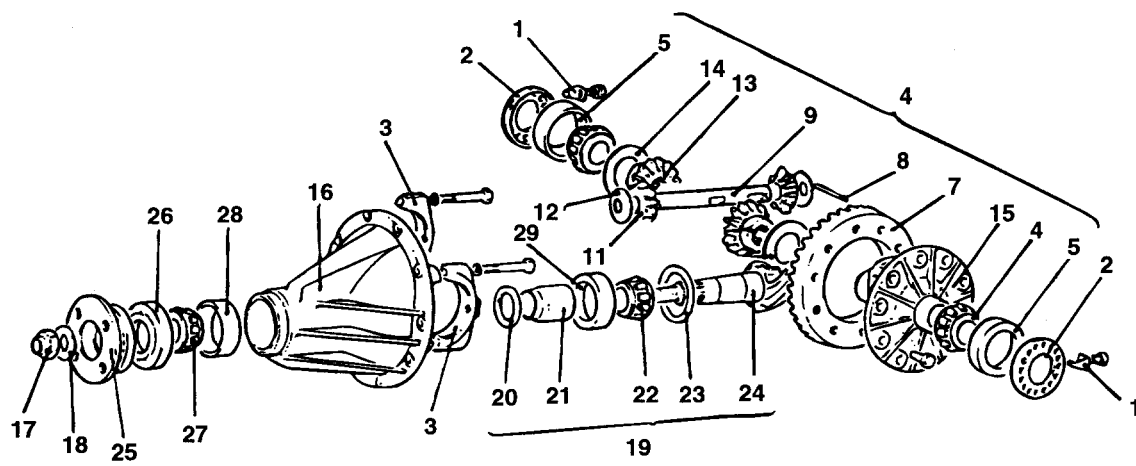
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Specified sealant : Three bond 1104

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- 2) Install the axle shaft assembly after installing new O-ring into the axle shaft.

COMPONENTS EILB0330



**Disassembly steps**

- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li>1. Lock plate</li> <li>2. Side bearing nut</li> <li>3. Bearing cap</li> <li>4. Differential case assembly</li> <li>5. Side bearing inner race</li> <li>7. Drive gear</li> <li>8. Lock pin</li> <li>9. Pinion shaft</li> <li>10. Differential case assembly</li> <li>11. Pinion gear</li> <li>12. Pinion washer</li> <li>13. Side gear</li> <li>14. Side gear thrust spacer</li> <li>15. Differential carrier case</li> <li>16. Differential carrier</li> <li>17. Self-locking nut</li> <li>18. Washer</li> </ul> | <ul style="list-style-type: none"> <li>19. Drive pinion assembly</li> <li>20. Drive pinion front shim<br/>(For preload adjustment)</li> <li>21. Drive pinion spacer</li> <li>22. Drive pinion rear bearing inner race</li> <li>23. Drive pinion rear shim<br/>(For drive pinion height adjustment)</li> <li>24. Drive pinion</li> <li>25. Companion flange</li> <li>27. Drive pinion front bearing inner race</li> <li>28. Drive pinion front bearing outer race</li> <li>29. Drive pinion rear bearing outer race</li> </ul> |
|---|---|

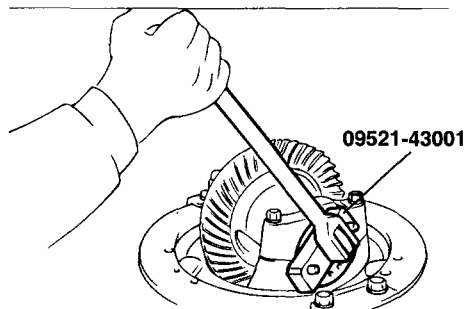


**DISASSEMBLY** EIMB7300**1. SIDE BEARING NUT**

Using the special tool (09521-43001), remove the side bearing nut.

**NOTE**

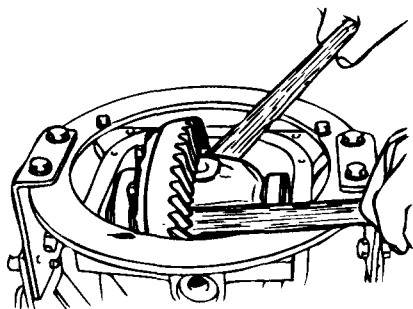
Keep the right and left side bearing nuts separate so that they are not mixed during reassembly.



AU52-25B

**2. REMOVAL OF THE DIFFERENTIAL CASE ASSEMBLY****CAUTION**

- Remove the differential case assembly slowly and carefully.
- Be careful so that the side bearing outer race is not dropped.
- Keep the right and left side bearing outer races separate so that they are not mixed during reassembly.



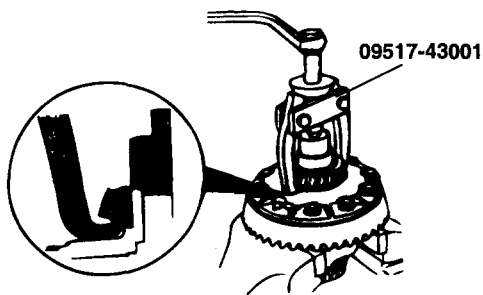
H7FA0740

**3. REMOVAL OF THE SIDE BEARING INNER RACES**

Fit the nut on top of the differential case, and then use the special tool to remove the side bearing inner race.

**NOTE**

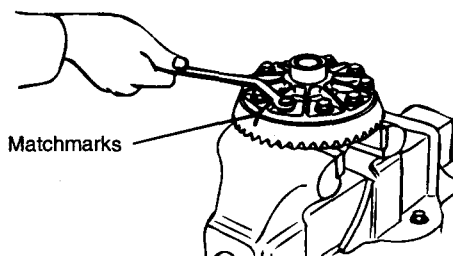
Attach the prongs of the special tool (09517-43001) to the inner race of the side bearing through the notched section in the differential case.



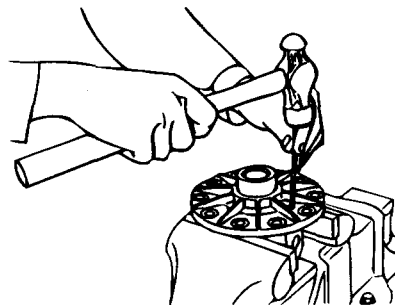
H7FA0750

**4. REMOVAL OF DRIVE GEAR**

- Make the matchmarks to the differential case and the drive gear.
- Loosen the drive gear attaching bolts in diagonal sequence to remove the drive gear.

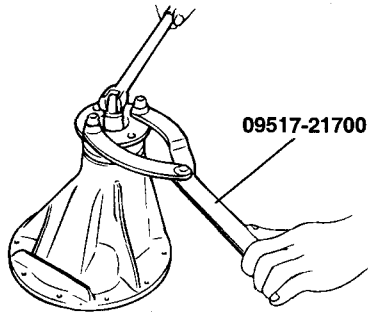


A7FA0760

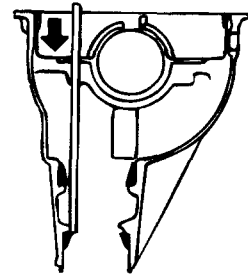
**5. REMOVAL OF LOCK PIN (FOR CONVENTIONAL DIFFERENTIAL)**

H7FA0770

6. REMOVAL OF SELF-LOCKING NUT



H7RA1100



H7FA0810

7. REMOVAL OF DRIVE PINION

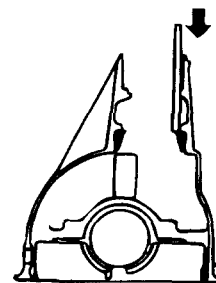
- a. Make the matchmarks on the drive pinion and companion flange.

**CAUTION**

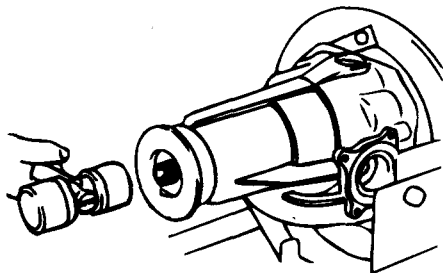
*Matchmarks should not be made on the contact surfaces of the companion flange and the propeller shaft.*

- b. Drive out the drive pinion together with the drive pinion spacer and drive pinion front shims.

10. REMOVAL OF DRIVE PINION REAR BEARING OUTER RACE

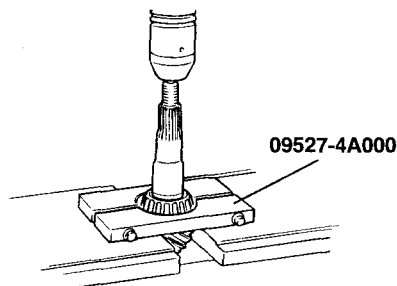


H7FA0820



H7FA0790

8. REMOVAL OF DRIVE PINION REAR BEARING INNER RACE



H7RA1090

9. REMOVAL OF OIL SEAL / DRIVE PINION FRONT BEARING INNER RACE / DRIVE PINION FRONT BEARING OUTER RACE

INSPECTION EIJB0490

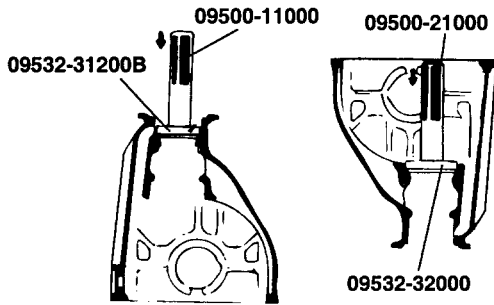
1. Check the companion flange for wear or damage.
2. Check the bearings for wear or discoloration.
3. Check the gear carrier for cracks.
4. Check the drive pinion and drive gear for wear or cracks.
5. Check the side gears, pinion gears and pinion shaft for wear or damage.
6. Check the side gear spline for wear or damage.

REASSEMBLY EIMB7500

Install the drive pinion rear bearing outer race and drive pinion front bearing outer race using the special tools (09500-11000, 09500-21000, 09532-31200B and 09532-32000).

**CAUTION**

*Be careful not to press in the outer race when it is inclined.*



EIJA005C

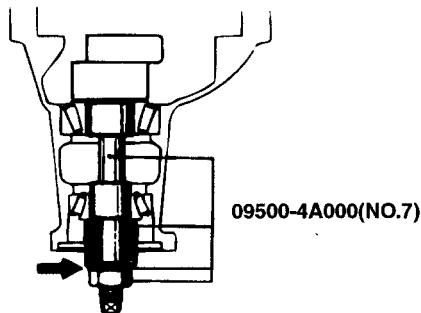
**ADJUSTMENT OF PINION HEIGHT**

Adjust the drive pinion height according to the following procedures:

1. Install the drive pinion inner and outer bearing races to the special tools (09500-43131, 09500-4A000) in sequence shown in the illustration.

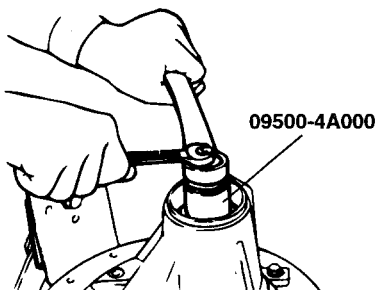
**NOTE**

Apply a thin coat of the multipurpose grease on the mating face of the washer of the special tool.



EIMB750A

2. Tighten the nut of the special tool slowly until the standard value of drive pinion turning torque is obtained.



EIMB750B

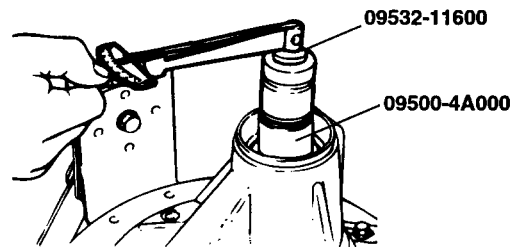
3. Measure the drive pinion turning torque (without the oil seal) using the special tool (09532-11600).

**STANDARD VALUE :**

Bearing division	Bearing lubrication	Rotation torque Nm (kg-cm)
New	None (with anti-rust agent)	0.6-0.9 (6-9)
New or reused	Oil application	0.4-0.9 (4-9)

**NOTE**

- Gradually tighten the nut of the special tool (09500-43131) while checking the drive pinion turning torque.
- Because the special tool cannot be turned one rotation, turn it several times within the range that it can be turned. After obtaining smooth bearing operation, measure the rotation torque.

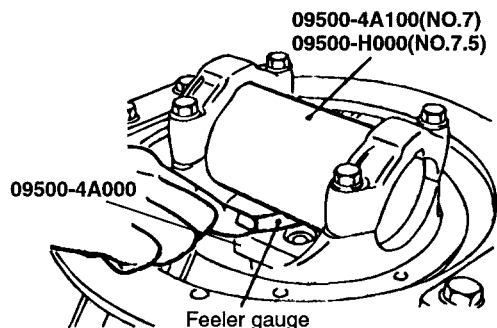


KIMB720C

4. Position the special tool in the side bearing seat of the gear carrier and select a drive pinion rear shim of a thickness which corresponds to the gap between the special tools.

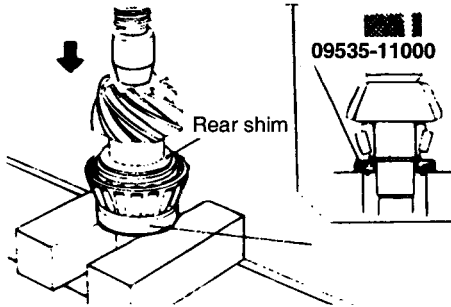
**NOTE**

- Clean the side bearing seat thoroughly. When positioning the special tool, confirm that the cut-out sections of the special tools touch the side bearing seat very closely.
- When selecting the drive pinion rear shims, use the fewest number of shims necessary.



EIMB750C

- Fit the selected drive pinion rear shim(s) to the drive pinion, and press-fit the drive pinion rear bearing inner race using the special tool (09535-11000).



AIJA030A

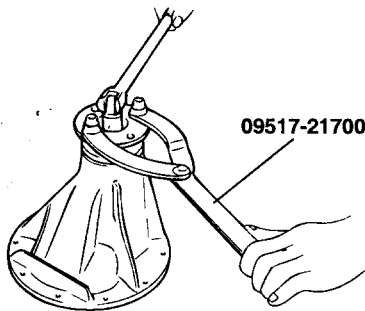
**ADJUSTMENT OF DRIVE PINION PRELOAD**

Adjust the drive pinion turning torque according to the following procedures :

- Fit the drive pinion front shim(s) between the drive pinion spacer and the drive pinion front bearing inner race.
- Tighten the companion flange to the specified torque using the special tool (09517-21700).

**NOTE**

Do not install the oil seal.

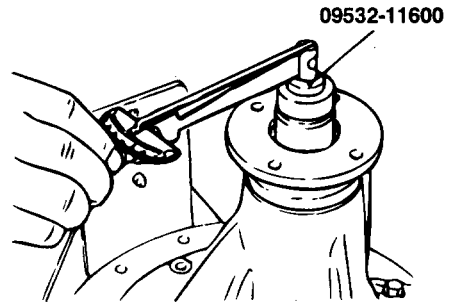


H7RA1100

- Measure the drive pinion turning torque (without the oil seal) using the special tool.

**STANDARD VALUE :**

Bearing use	Bearing lubrication	Rotation torque Nm (kg-cm)
New	None (with anti-rust agent)	0.6-0.9 (6-9)
New or reused	Oil application	0.4-0.9 (4-9)



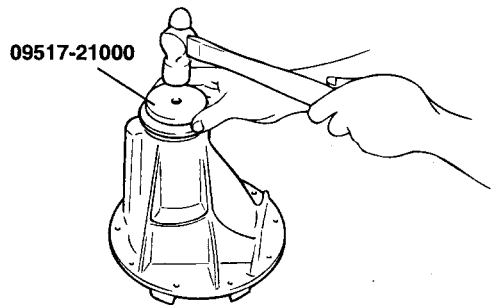
H7FA0940

- If the drive pinion turning torque is not within the range of the standard value, adjust the turning torque by replacing the drive pinion front shim(s) or the drive pinion spacer.

**NOTE**

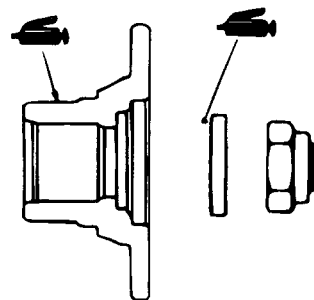
When selecting the drive pinion front shim pack, use the minimum number of shims.

- Remove the companion flange and drive pinion once again. Insert the oil seal into the gear carrier front lip using the special tool (09517-21000). Apply multipurpose grease to the oil seal lip.



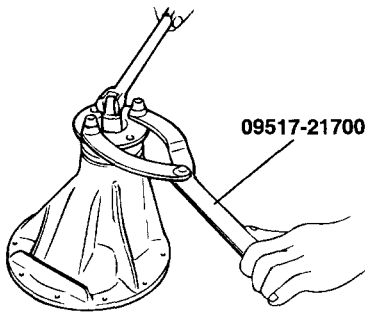
H7RA1080

- Apply a thin coat of multipurpose grease to the contacting surface of the oil seal in the companion flange and contacting surface of the washer of the flange before installing the drive pinion assembly.



EIJA007B

- Install the drive pinion assembly, shim packs and companion flange with matchmarks properly aligned, and tighten the companion flange self-locking nut to the specified torque using the special tool (09517-21700).



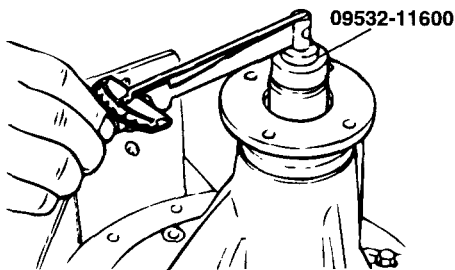
H7RA1100

- Measure the drive pinion turning torque (with oil seal) by using the special tool (09552-11600) to verify that the drive pinion turning torque is within the standard value.

**STANDARD VALUE :**

Bearing use	Bearing lubrication	Rotation torque Nm (kg-cm)
New	None (with anti-rust agent)	0.8-1.15 (8-11.5)
New or reused	Oil application	0.65-0.75 (6.5-7.5)

- If it is beyond the standard value, check the torque of the companion flange self-locking nut, or the assembly condition of the oil seal.



H7FA0980

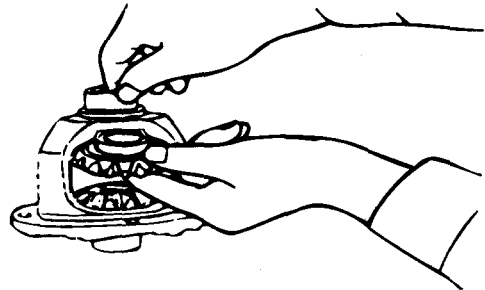
**ADJUSTMENT OF DIFFERENTIAL GEAR BACKLASH**

Adjust the differential gear backlash according to the following procedures :

- Assemble the side gears, side gear spacers, pinion gears, and pinion washers into the differential case.
- Temporarily, install the pinion shaft.

**NOTE**

Do not install the lock pin yet.



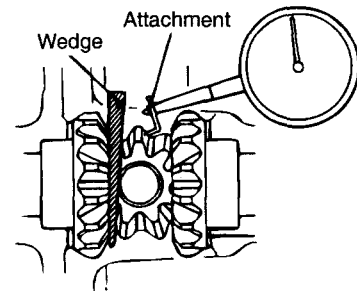
H7FA0990

- Insert a wedge in the side gear and measure the differential gear backlash with a dial indicator on the pinion gear.

**NOTE**

Measure both pinion gears separately.

Standard value : 0-0.076mm (0-0.003in.)  
Limit : 0.2mm (0.008in.)



A7FA1000

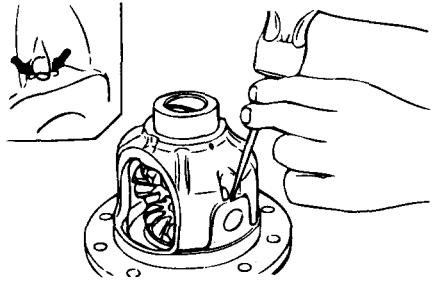
- If the differential gear backlash exceeds the limit, adjust the backlash by installing thicker side gear thrust spacers.
- Measure the differential gear backlash once again, and confirm that it is within the limit.

**NOTE**

- After adjustment, check that the backlash is within the limit and the differential gear rotates smoothly.
- When adjustment is impossible, replace the side gear and the pinion gear as a set.

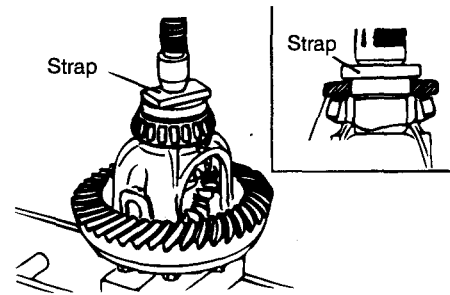
- Installation of the lock pin
  - Align the pinion shaft lock pin hole with the differential case lock pin hole, and drive in the lock pin.

- b. Fix the lock pin in place by staking two points around the lock pin hole with a punch.



H7FA1010

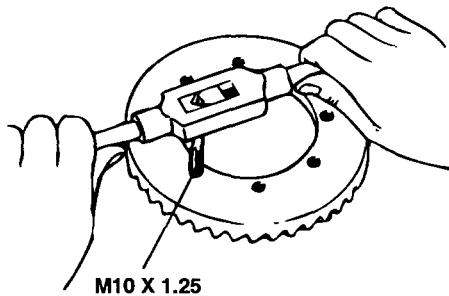
- 8. Press-fit the side bearing inner race



A7FA1040

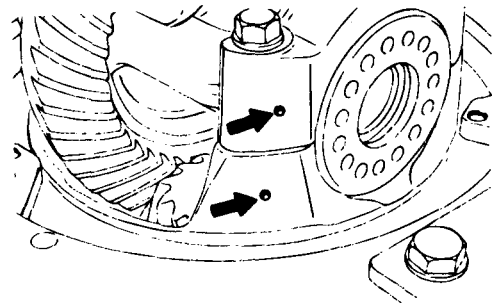
- 7. Installation of the drive gear

- a. Clean the drive gear attaching bolts.
- b. Remove the adhesive on the threaded holes of the drive gear with a tap (M10 x 1.25), and then clean the threaded holes with compressed air.



H7FA1020

- 9. Align the matchmark on the gear carrier and the bearing cap, and then tighten the bearing cap.

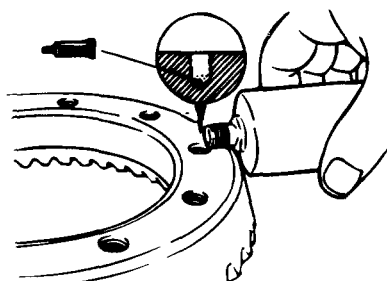


AU52-31D

- c. Apply the specified adhesive to the threaded holes of the drive gear.

Specified adhesive : LOCTITE #262 or equivalent

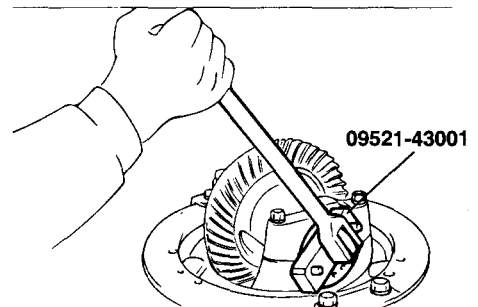
- d. Install the drive gear in the differential case with the matchmarks properly aligned. Tighten the bolts to the specified torque (800-900 kg.cm) in a diagonal sequence.



H7FA1030

- 10. ADJUSTMENT OF FINAL DRIVE GEAR BACKLASH  
Adjust final drive gear backlash as follows :

- 1) Using the special tool(09521-43001), temporarily tighten the side bearing nut until it is in the state just before preloading of the side bearing.



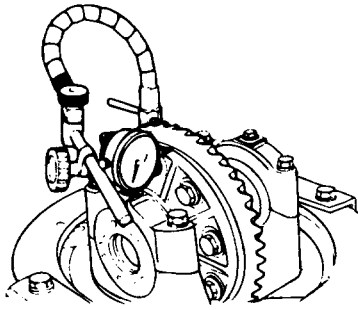
AU52-25B

- 2) Measure the final drive gear backlash.

Standard value : 0.11-0.16mm (0.0043-0.0063in.)

**NOTE**

Measure at least 4 point on the drive gear periphery.

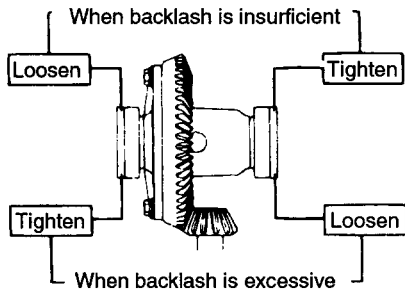


AU52-32A

- 3) Using the special tool(09521-43000), adjust the backlash to standard value by moving the side bearing nut as shown.

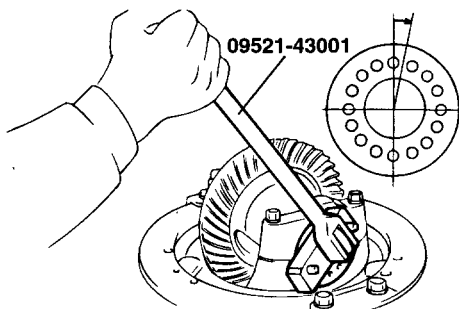
**NOTE**

First turn the side bearing nut for loosening, and then turn (by the same amount) the side bearing nut for tightening.



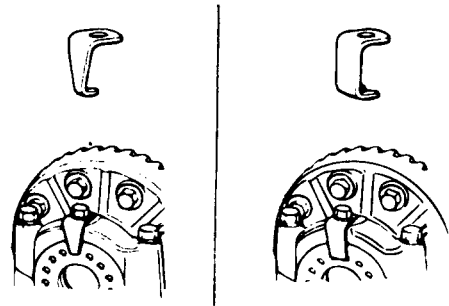
EIMB750D

- 4) Using the special tool(09521-43001) to apply the preload, turn down both right and left side bearing nut on half the distance between centers of two neighboring holes.



AU52-32C

- 5) Choose and install the lock plates two kinds.



AU52-32D

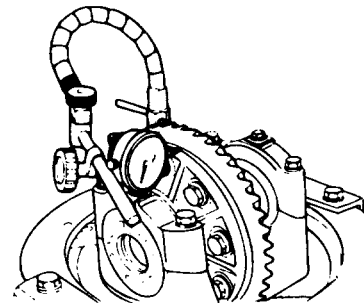
- 6) Check the final drive gear tooth contact. If poor contact is evident, make adjustment.
- 7) Measure the drive gear runout.

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Limit : 0.05mm (0.0020in.)

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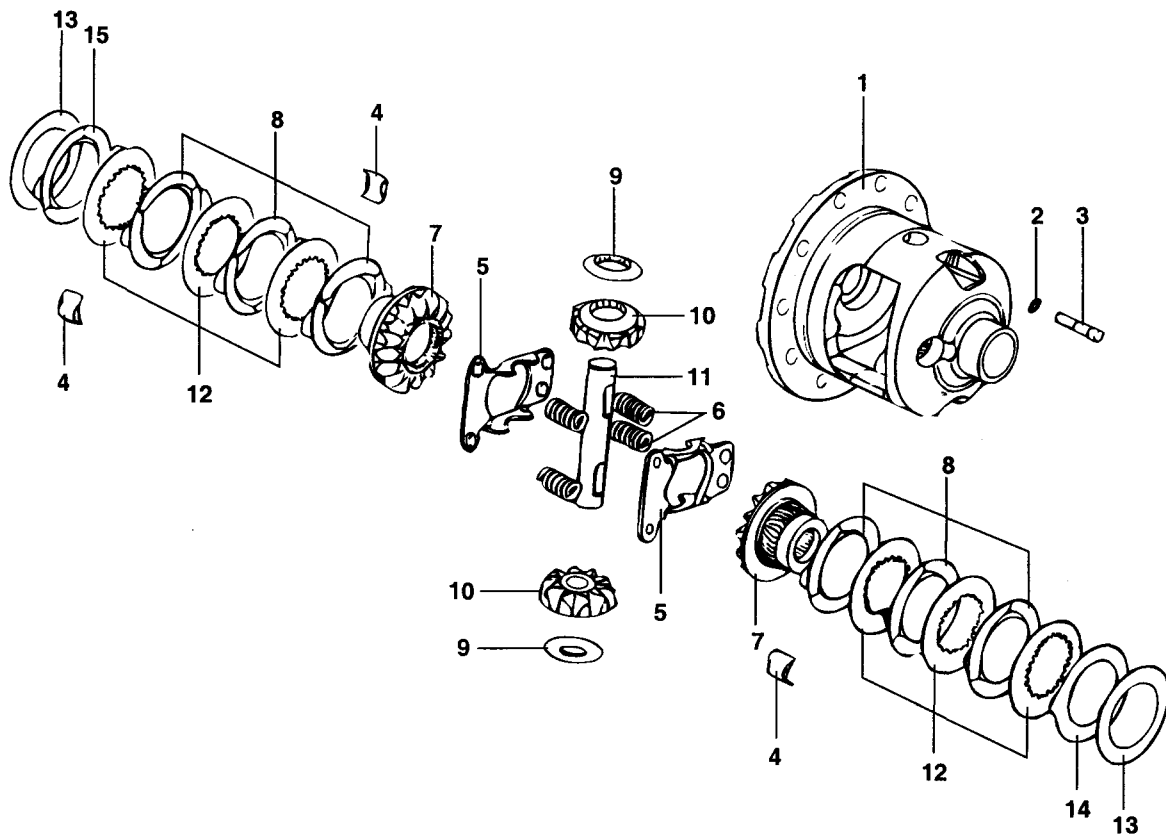
- 8) When drive gear runout exceeds the limit, remove the differential case and then the drive gears, moving them to different positions and reinstalling them.



AU52-32A

**LIMITED SLIP DIFFERENTIAL  
(LSD)**

**COMPONENTS** EIMB7600



- 1. Case
- 2. Washer-lock
- 3. Screw-lock
- 4. Guide-ear
- 5. Plate-preload
- 6. Spring-preload
- 7. Gear-side
- 8. Eared disc S/A (carbon on both sides)
- 9. Thrust washer-pinion
- 10. Pinion gear
- 11. Cross shaft-pinion
- 12. Disc-splined friction
- 13. Shim-side gear
- 14. Eared disc S/A (carbon on one side)

**TORQUE : Nm (kg-cm, lb-ft)**



**DESCRIPTION** EILB0390

This Carbon Disc Limited Slip Differential has a one piece case. Inside the case is a bevel gear set. The gear set has two side gears and two pinion gears. Each pinion gear is held in place by a spherical thrust washer and the cross shaft. The cross shaft fits into the holes in the case. The cross shaft is retained by a threaded lock pin with a lock washer. Behind each side gear is a friction disc pack. Between each disc pack and the internal pockets of the case is a shim. The thickness of these shims is selected to provide the correct backlash between the side gears and pinion gears. Between the side gears are a spring preload assembly and a thrust block. The preload plates are constructed so they straddle the cross shaft, hold the preload springs and position the thrust block.

**DISASSEMBLY** EILB0400

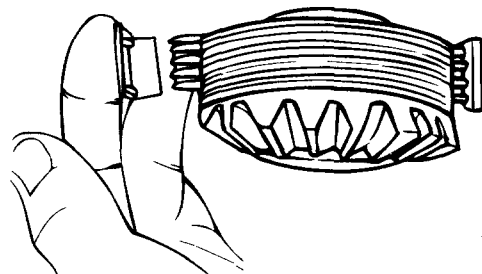
1. Remove the threaded lock screw and the cross shaft.
2. Remove the spring preload assembly. Use a hammer and punch to drive the spring plates out from the large window.
3. Without preload on the side gears, they can be turned by hand. Rotate the side gears until the pinions are in the window area. Remove the pinions and pinion thrust washers.
4. Remove the gear sub-assemblies (side gear, disc pack, ear guides and disc pack shims). Do not mix parts. Identify the parts so they can be reassembled to the original location.

**INSPECTION** EIMB7900

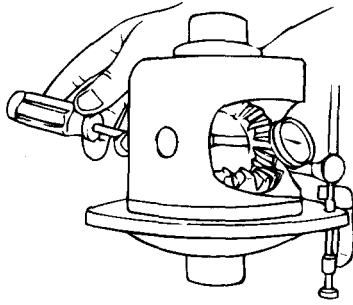
1. Check the side gears, pinions, pinion thrust washers, thrust block and cross shaft for wear or damage. If there is excessive wear, cracks, nicks, grooves or galling, replace the parts.
2. Inspect the carbon surfaces. After cleaning with a solvent, the carbon surface should appear like a coarse weave fabric with flat spots on the peaks of the weave. If the surface is smooth, either from wear or from the weave filled with debris, replace the entire disc pack.
3. Measure the thickness of the carbon friction discs. If any of the double sided discs are less than 2.56mm (0.101in.) or the single sided disc is less than 2.15mm (0.085in.), replace the entire disc pack.
4. Inspect the splined friction discs. If they have grooves or a mirror like finish, replace the entire disc pack. Small scratches on a buff like finish is okay.

**REASSEMBLY AND SHIM****SELECTION** EIMB8000

1. Apply axle lubricant to all sliding surfaces. Be especially careful to coat the mating surfaces of the friction discs.
2. Starting with a double sided eared disc next to the side gear, stack four eared discs and three splined discs on to the spline of the side gear. A splined disc goes in between each eared disc with the last eared disc being single sided and the carbon surface facing the side gear. Use a heavy bearing grease in the ear guides to hold them in place during assembly.
3. Select a shim 0.76mm (0.023in.) thick and place on the hub side of the disc pack subassembly.
4. Lubricate and assemble the other side gears as above.
5. Install the flange end side gear subassembly and shim in the flange end of the differential case.
6. Position pinion gears and thrust washers on the side gears and install the cross shaft through the case and pinions.
7. Install a dial indicator on the case.
8. Compress the clutch pack with a large screw driver or pry bar as shown. Rotate the pinion gear back and forth to obtain backlash. Tooth backlash should be 0 to 0.10mm (0 to 0.004in.). If required, change the .76mm (0.023in.) shim to obtain the proper backlash.

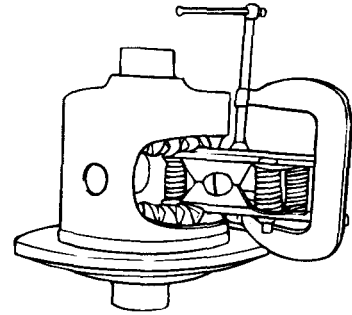


H7RA1240



H7RA1250

13. Position the spring pack between the side gears and remove the "C" clamp.

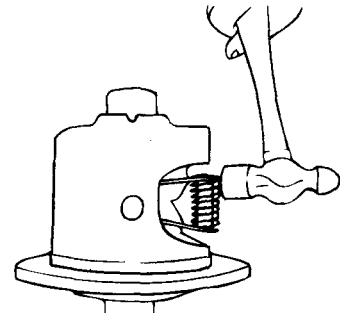


H7RA1190

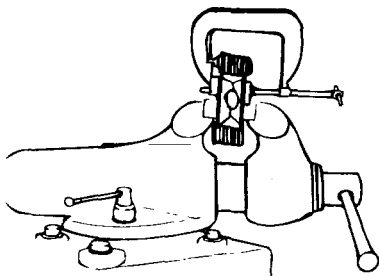
9. Remove the side gear subassembly and repeat the tooth backlash procedure for the other gear pack on the opposite side of the case.
10. Remove the cross shaft, pinions and thrust washers and reinstall the first side gear subassembly and shim in the flange end of the case.
11. Install a pinion and thrust washer through each window so that the gear teeth mesh and so that the pinions are in line with each other. Rotate one side gear so the pinions and thrust washers rotate at a position where they line up with the cross shaft holes in the case.
12. Mount springs and load plates in a vise. With the thrust block between the spring plates, compress the assembly until the load plates touch. Install a "C" clamp on the plates and install 6 mm bolts through each front spring. Retain nuts on the screws as shown in the illustration.

14. Drive the spring pack into the side gears far enough to retain the springs. Then remove the 6 mm bolts and complete the pack installation by driving the spring pack in position so that the cross shaft can slide through the middle as shown. Turn the thrust block so that the hole in the middle lines up with the hole in the case.

15. Install the pinion shaft, lock screw and lock washer. Tighten the lock screw to 30-40Nm (22-29lb·ft) torque.

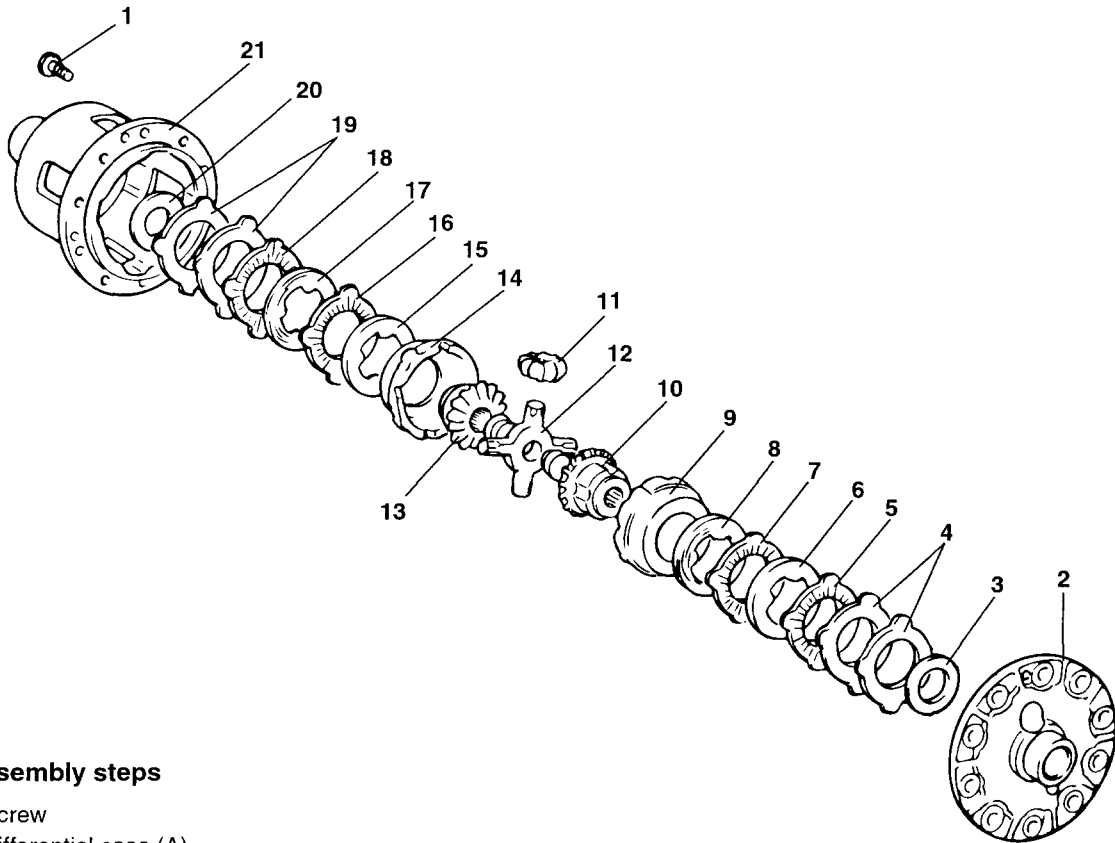


H7RA1170



H7RA1230

## COMPONENTS EIMB8100

**Disassembly steps**

1. Screw
2. Differential case (A)
3. Thrut washer
4. Spring plate
5. Friction plate
6. Friction disc
7. Friction plate
8. Friction disc
9. Pressure ring
10. Side gear
11. Differential pinion gear
12. Differential pinion shaft
13. Side gear
14. Pressure ring
15. Friction disc
16. Friction plate
17. Friction disc
18. Friction plate
19. Spring plate
20. Thrust washer  
(Adjustment of clutch plate friction force)
21. Differential case (B)

**DISASSEMBLY** EIMB8200

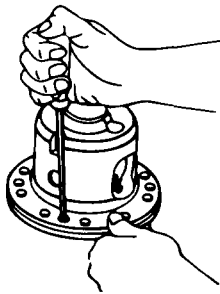
**SERVICE POINTS OF DISASSEMBLY**

**REMOVAL OF SCREW**

1. Loosen screws of the differential cases (A) and (B) uniformly a little at a time.
2. Separate differential cases (A) from differential case (B).

 **NOTE**

Before disassembling the differential cases, confirm that the matchmark (numbers) on case A and case B are the same.



EIJA0301

3. Remove the components from the differential case (B).

 **NOTE**

Keep the right and left thrust washers, spring plates, spring discs, friction plates, and friction discs separate in order to be able to distinguish them for reassembly.

**INSPECTION** EIMB8300

1. Check the side gears, pinion gears and pinion shaft for wear or damage.
2. Check the side gears spline for wear or damage.
3. Inspection of contact and sliding surfaces of parts.

**Inspect the friction plate, friction disc, spring plate, spring disc and pressure ring.**

- A. The friction surfaces of the friction plate, friction disc, spring plate, and spring disc. If there are any signs of seizure, severe friction, or color change from the heat, it will adversely affect the locking performance ; replace the part with a new one.

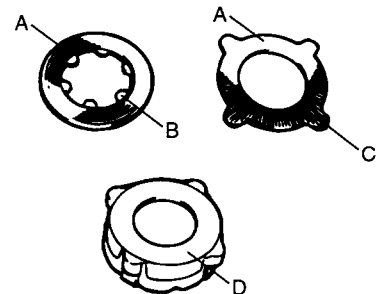
 **NOTE**

The strong contact on the inner circumference of the friction surfaces is because of the spring plate and the spring disc : this wear is not abnormal.

- B. The six projections on the inner circumference of the friction disc.  
If there are nicks and dents, it will cause abnormalities in the clutch pressure.  
Repair the parts using an oil stone ; if the parts cannot be repaired, replace them.
- C. The four projections on the outer circumference of the friction disc.  
If there are nicks and dents, it will cause abnormalities in the clutch pressure.  
Repair the parts using an oil stone ; If the parts cannot be repaired, replace them.
- D. The friction surface of the friction disc of the pressure ring.  
If there are nicks or scratches, repair the part by first grinding with an oil stone and them polishing with rubbing compound on a surface plate.

 **NOTE**

The strong contact on the inner circumference of the friction surface is because of the spring plate and the spring disc ; this wear is not abnormal.

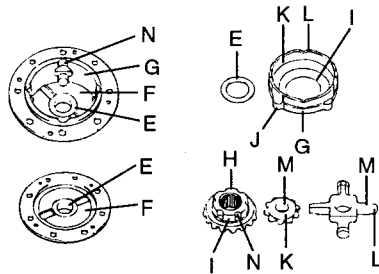


EHP1001A

**Inspect the contact and sliding surfaces listed below, and repair any nicks and burrs using an oil stone.**

- E. The sliding surfaces of the thrust washer and the case.
- F. The spring contacting surface of the differential case.
- G. The contact surfaces of the outer circumference of the pressure ring and the inner circumference of the differential case.
- H. The sliding surface of the thrust washer.
- I. The sliding surfaces of the hole in the pressure ring and the outer circumference of the side gear.

- J. The projection on the outer circumference of the pressure ring.
- K. The spherical surface of the differential pinion gear and the inner diameter of the pressure ring.
- L. The V-shaped groove in the pressure ring, and the V-shaped part in the pinion shaft.
- M. The outer diameter of the pinion shaft and the hole of the differential pinion gear.
- N. The outer circumference groove of the side gear.
- O. The inner circumference groove of the differential case.

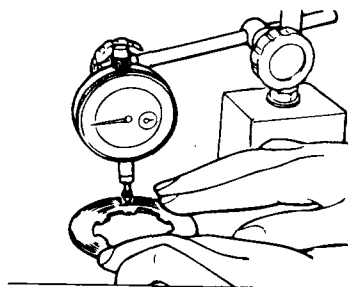


EHPDS63A

4. INSPECTION FOR WARPING OF FRICTION PLATED AND FRICTION DISC

Using a dial indicator, measure the amount of warping(the flatness) of the friction plate and the friction disc on a surface plate by turning the friction plate or disc.

Limit : 0.08mm (0.0031in.)



KHPDS64A

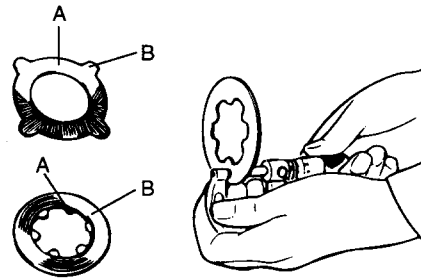
5. INSPECTION FOR WEAR OF FRICTION PLATE AND FRICTION DISC

- 1) In order to measure the wear, measure the thickness of the friction surfaces and projections of the friction disc and plate, and then find the difference.  
(The same procedure is used for the spring discs and the spring plates.)

Limit : 0.1mm (0.0041in.)

**NOTE**

Make the measurement at several different points.



KHPDS65A

- 2) If the parts are worn beyond the limit value, replace them with new parts.

**SERVICE POINT OF REASSEMBLY**

EIMB8400

**ADJUSTMENT OF CLUTCH PLATE FRICTION FORCE**

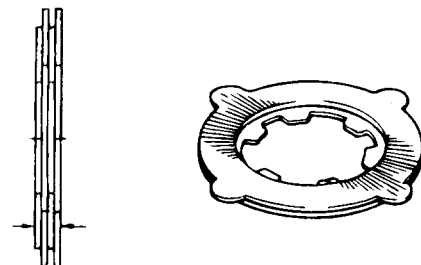
Before assembly, use the following method to adjust the clearance between the spring plates and differential cases (for adjustment of the clutch plate friction force), and to adjust the axial clearance of the side gear when installing the internal components into the differential case.

- 1. Arrange the two(each) friction discs and friction plates for each side, one on top of another, as shown in the figure, combining them so that the difference in thickness between the left and the right is the standard value.

Standard value : 0.05mm (0.002in.) or less

**NOTE**

For new ones, there is one type of friction plate : 1.75mm (0.0689in.) ; there are two types of friction disc : 1.75mm (0.0689in.) and 1.85mm (0.0728in.).

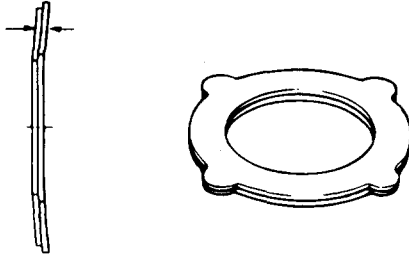


KHPDS66A

2. Arrange one spring disc and one spring plate for each side, one on top of the other, so that the difference between the left and the right thickness is minimized.

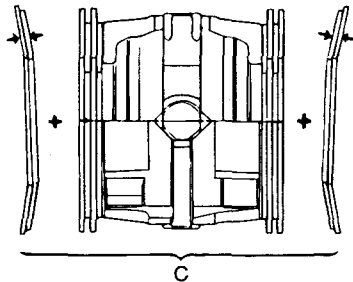
**NOTE**

For new ones, there is one type of spring disc and spring plate : 1.75mm (0.0689in.).



KHPDS67A

3. Assemble the pressure ring's internal components (differential pinion shaft and pressure ring) and the friction discs and friction plates, and then, as shown in the figure, measure the overall width.
4. Calculate the total value (C) of the thickness of the spring discs and spring plates plus the value measured in (3) above.



EHPDS68A

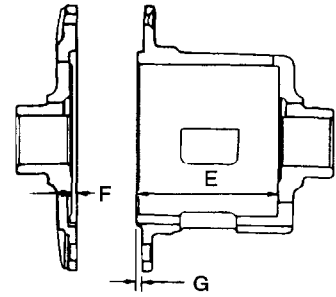
5. Obtain the dimension (D) between the spring plate contact surfaces when differential cases (A) and (B) are combined.

**No 6. Diff :  $D + F - G$**

**No 7. Diff :  $E - F + H - G$**

6. Change the thickness of the friction disc so that the clearance (D - C) between the differential case and the spring plate becomes the standard value.

Standard value : 0.06-0.20mm (0.0024-0.0079in.)



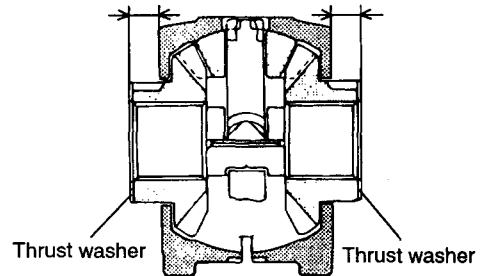
EHPDS69A

7. Remove the spring plates, spring discs, friction plates and friction disc.
8. Install the thrust washer as shown in the figure, and then select a thrust washer so that the difference between the left and right dimensions from the pressure ring rear face to the thrust washer end face is the standard value.

Standard value : 0.05mm (0.0020in.) or less

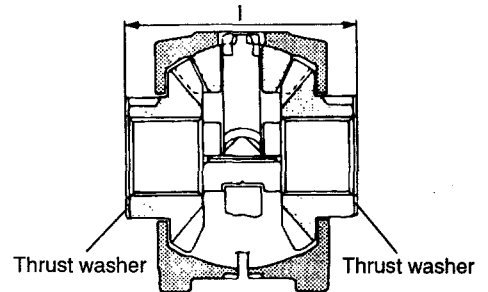
**NOTE**

Measure the distance while squeezing the V-shaped groove manually.



EIMB840A

9. Measure the dimension (I) from the thrust washer end surface to end surface.



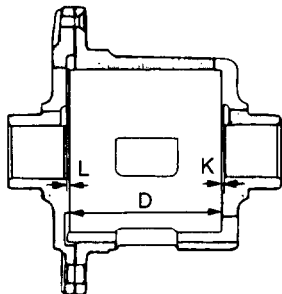
EHPDS70A

10. Obtain the dimension (J) between the thrust washer contact surfaces when differential cases (A) and (B) are combined.

$$J = K + L + D$$

 **NOTE**

Dimension (D) is the distance between the spring plate contact surfaces when differential cases (A) and (B) are combined.



EHPDS71A

11. Change the thickness of the thrust washer so that the clearance (J-I) between the thrust washer and the differential case is the standard value.

Standard value : 0.05-0.20mm (0.0020-0.0079in.)

 **NOTE**

- Select the thrust washer so that the difference between the left and right dimensions from the pressure ring rear face and the thrust washer end surface are the standard value even when the thrust washer is changed.
- There are three sizes of new thrust washers : 1.50mm (0.0591in.), 1.60mm (0.0630in.), and 1.70mm(0.0670in.).

12. Place the each part in the differential case (B) as directions shown in the figure.

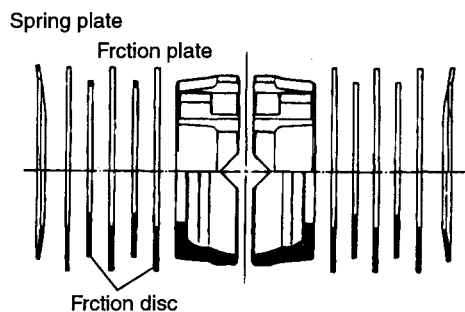
 **NOTE**

- Before assembly, apply the specified gear oil to each component especially careful to coat contact surfaces and sliding surfaces.

Specified gear oil :

MITSUBISHI Genuine gear oil Part No.  
8149630EX or equivalent

- Be careful not to insert the friction plates and friction discs in the incorrect order and to install the spring plates and spring disc in incorrect direction.



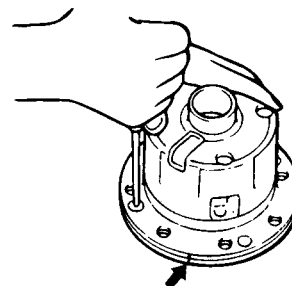
EHPP102A

### INSTALLATION OF SCREW

1. Align the matchmark (the same numeral on each case) of differential case (A) and differential case (B).
2. Turning the screwdriver slowly several times, tighten the screw so that the cases are in close contact.

 **NOTE**

If even though the screw is tightened, the end surfaces of case (A) and case (B) do not come into close contact, probably the thrust washer and spring plate are not fit correctly into the groove, so make the assembly again.



KHPDS73A

3. After assembly, in order to check the frictional force of the clutch plate, use the special tools to measure the turning torque.

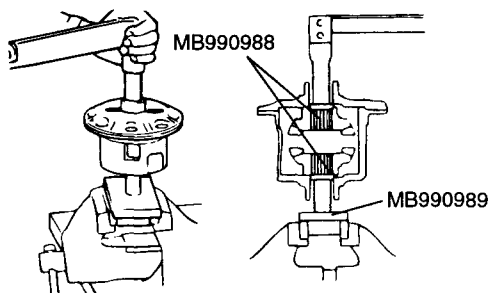
### Standard value :

When a new clutch plate is used  
40-75Nm (400-750kg·cm)

When an old clutch plate is used  
25-75Nm (250-750kg·cm)

 **NOTE**

*Measure the turning torque after rotating slightly.  
When measuring the torque, do so at the beginning  
of movement.*



EHPDS74A



# Clutch System

GENERAL .....	CH - 2
CLUTCH SYSTEM .....	CH - 6

# GENERAL

## SPECIFICATIONS EOMB0010

<b>Clutch operating method</b>	Hydraulic type
Clutch disc	
Type	Single, dry with diaphragm.
Facing diameter (Outside x Inside) mm (in.)	225 x 155 (8.9 x 6.1) : 2.5 TCI 240 x 155 (9.4 x 6.1) : 2.9 TCI 240 x 155 (9.4 x 6.1) : 3.5 V6
Clutch cover assembly	
Type	Diaphragm spring strap
Setting load N (lb)	5500-6100 (1232-1366) : 2.5 TCI More than 7250 (1624) : 2.9 TCI, 3.5 V6
Clutch release cylinder	
I.D.mm (in.)	19.05 (0.74)
Clutch master cylinder	
I.D.mm (in.)	15.87(0.62)

## SERVICE STANDARD EOMB0020

ITEM	Standard value
Clutch disc thickness [When free]	8.3 ± 0.3 mm (0.326 ± 0.0118 in.) : 2.5 TCI 8.0 ± 0.3 mm (0.314 ± 0.0118 in.) : 2.9 TCI, 3.5 V6
Clutch pedal height	202 mm (7.95 in.)
Clutch pedal free play	6-13 mm (0.24-0.51 in.)
Clutch pedal stroke	155 mm (6.10 in.)
<b>Limit</b>	
Clutch disc rivet inset	0.3 mm (0.012 in.)
Diaphragm spring end height difference	0.5 mm (0.02 in.)
Clutch release cylinder clearance to piston	0.15 mm (0.006 in.)
Clutch master cylinder clearance to piston	0.15 mm (0.006 in.)

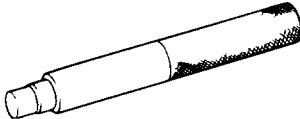
**TIGHTENING TORQUE** EOMB0030

Item	Nm	kg·cm	lb·ft
Clutch pedal bracket	18 - 25	180 - 250	13 - 18
Clutch master cylinder mounting bolt	7 - 9	70 - 90	5 - 6
Clutch tube flare nut	13 - 17	130 - 170	9 - 12
Clutch release cylinder mounting bolt	30 - 42	300 - 420	21 - 30
Clutch release cylinder union bolt	20 - 25	200 - 250	14 - 18
Clutch cover assembly	15 - 22	150 - 220	11 - 16
Clutch master cylinder reservoir	8 - 10	80 - 100	6 - 7
Ignition lock switch	5 - 7	50 - 70	4 - 5
Clutch pedal to pedal bracket	25 - 35	250 - 350	18 - 25

**LUBRICANTS** EOA90040

Items	Specified lubricants	Quantity
Contact surface of release bearing and fulcrum of clutch release fork	CASMOLY L 9508	As required
Inner surface of clutch release bearing	CASMOLY L 9508	As required
Inner surface of clutch release cylinder and outer circumference of piston and cup	Brake fluid DOT3	As required
Inner surface of clutch disc spline	CASMOLY L 9508	As required
Inner surface of clutch master cylinder and outer circumference of piston assembly	Brake fluid DOT 3	As required
Clutch master cylinder push rod, clevis pin and washer	Wheel bearing grease SAE J310, NLGI No.2	As required
Clutch pedal shaft and bushings	Chassis grease SAE J310, NLGI No.1	As required
Contact portion of release fork to release cylinder push rod	CASMOLY L9508	As required
Input shaft spline	CASMOLY L9508	As required

**SPECIAL TOOLS** EOMB0050

Tool (Number and name)	Illustration	Use
09411-43000 Clutch disc guide	 <p style="text-align: right;">D1143000</p>	Installation of the clutch disc

## TROUBLESHOOTING

EOA90060

Trouble symptom		Probable cause	Remedy
Clutch slipping <ul style="list-style-type: none"> <li>• Car will not respond to engine speed during acceleration</li> <li>• Insufficient car speed</li> <li>• Lack of power driving uphill</li> </ul>		Insufficient pedal free play	Adjust
		Clogged hydraulic system	Correct or replace parts
		Excessive wear of clutch disc facing	Replace
		Hardened clutch disc facing, or oil on surface	Replace
		Damaged pressure plate or flywheel	Replace
		Weak or broken pressure spring	Replace
Difficult gear shifting (gear noise during shifting)		Excessive pedal free play	Adjust
		Hydraulic system fluid leaks, air trapped or lines clogged	Repair or replace parts
		Unusual wear or corrosion of the clutch disc spring	Replace
		Excessive vibration (distortion) of the clutch disc	Replace
Clutch noisy	When the clutch is not used	Insufficient play of the clutch pedal	Adjust
		Excessive wear of the clutch disc facing	Replace
	A noise is heard after the clutch is disengaged	Unusual wear and/or damage of the release bearing	Replace
	A noise is heard when the clutch is disengaged	Insufficient grease on the sliding surface of the bearing sleeve	Repair
		Improperly installed the clutch assembly or bearing	Repair
	A noise is heard when the car suddenly jump starts with the clutch partially engaged	Damaged pilot bushing	Replace
Hard pedal effort		Insufficient lubrication of the clutch pedal	Repair
		Insufficient lubrication of the spline part of clutch disc	Repair
		Insufficient lubrication of the clutch release lever shaft	Repair
		Insufficient lubrication of the front bearing retainer	Repair
Hard to shift or will not shift		Excessive clutch pedal free play	Adjust the pedal free play
		Faulty clutch release cylinder	Repair the release cylinder
		Clutch disc out of place, runout is excessive or lining broken	Inspect the clutch disc
		Dirty spline on input shaft or the clutch disc	Repair as necessary
		Faulty clutch pressure plate	Replace the clutch cover
Clutch slips		Insufficient clutch pedal free play	Adjust the pedal free play
		Clogged hydraulic system	Repair or replace parts
		Clutch disc lining oily or worn out	Inspect the clutch disc
		Faulty pressure plate	Replace the clutch cover
		Binding release fork	Inspect the release fork

Trouble symptom	Probable cause	Remedy
Clutch grabs/chatters	Clutch disc lining oily or worn out	Inspect the clutch disc
	Faulty pressure plate	Replace the clutch cover
	Bent clutch diaphragm spring	Replace the clutch cover
	Worn or broken torsion spring	Replace the clutch disc
	Loose engine mounts	Repair as necessary
Noisy clutch	Damaged the clutch pedal bushing	Replace the clutch pedal bushing
	Loose part inside housing	Repair as necessary
	Worn or dirty release bearing	Replace the release bearing
	Sticking release fork or linkage	Repair as necessary

# CLUTCH SYSTEM

## SERVICE ADJUSTMENT PROCEDURE

EOMB0070

### CLUTCH PEDAL INSPECTION AND ADJUSTMENT

1. Measure the clutch pedal height (From the face of the pedal pad to the floorboard) and the clutch pedal free-play (measured at the face of the pedal pad).

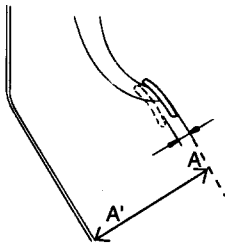
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 Standard value :

(A) 6-13 mm (0.24-0.51 in.)

(A') 202 mm

Clutch pedal free-play (A) and Pedal height (A')



EOMB007A

2. If the clutch pedal free-play is not within the standard value range, adjust as follows :
  - a. Turn and adjust the bolt, then secure it by tightening the lock nut.

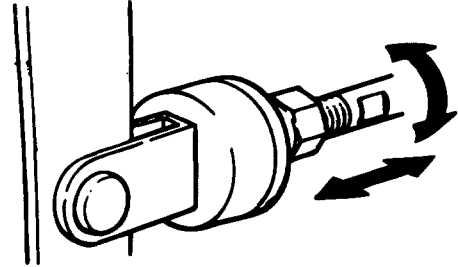
#### NOTE

After the adjustment, tighten the bolt until it reaches the pedal stopper, and then tighten the lock nut.

- b. Turn the push rod to coincide with the standard value and then secure the push rod with the lock nut.

#### CAUTION

When adjusting the clutch pedal height or the clutch pedal clevis pin play, be careful not to push the push rod toward the master cylinder.



KOMB007B

3. After completing the adjustments, check that the clutch pedal free play (measured at the face of the pedal pad) falls within the standard value ranges.

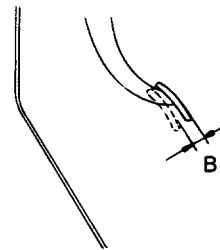
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 Standard value : 6-13 mm (0.2-0.5 in.)
 

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4. If the clutch pedal free play and the distance between the clutch pedal and the floor board when the clutch is disengaged do not meet the standard values, the cause may be either air in the hydraulic system or a faulty master cylinder clutch. Bleed the system or disassemble and inspect the master cylinder or clutch.

Clutch pedal free play



EOA9007C

**BLEEDING** EOMB0080

Bleed the system whenever the clutch tube, the clutch hose, and/or the clutch master cylinder have been removed, or if the clutch pedal is spongy.

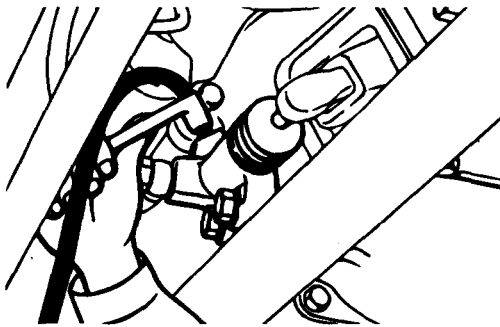
**⚠ CAUTION**

**Use the specified fluid. Avoid mixing different brands of fluid.**

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Specified fluid : SAE J1703 (DOT3 or DOT4)

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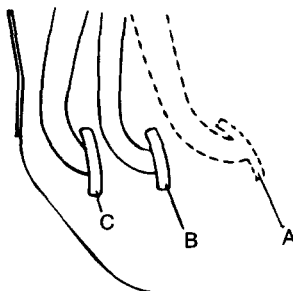


KOMB008A

1. Loosen the bleeder screw on the clutch release cylinder.
2. Pump the clutch pedal slowly until all air is expelled.
3. Hold the clutch pedal down until the bleeder is retightened.
4. Refill the clutch master cylinder with the specified fluid.

**⚠ CAUTION**

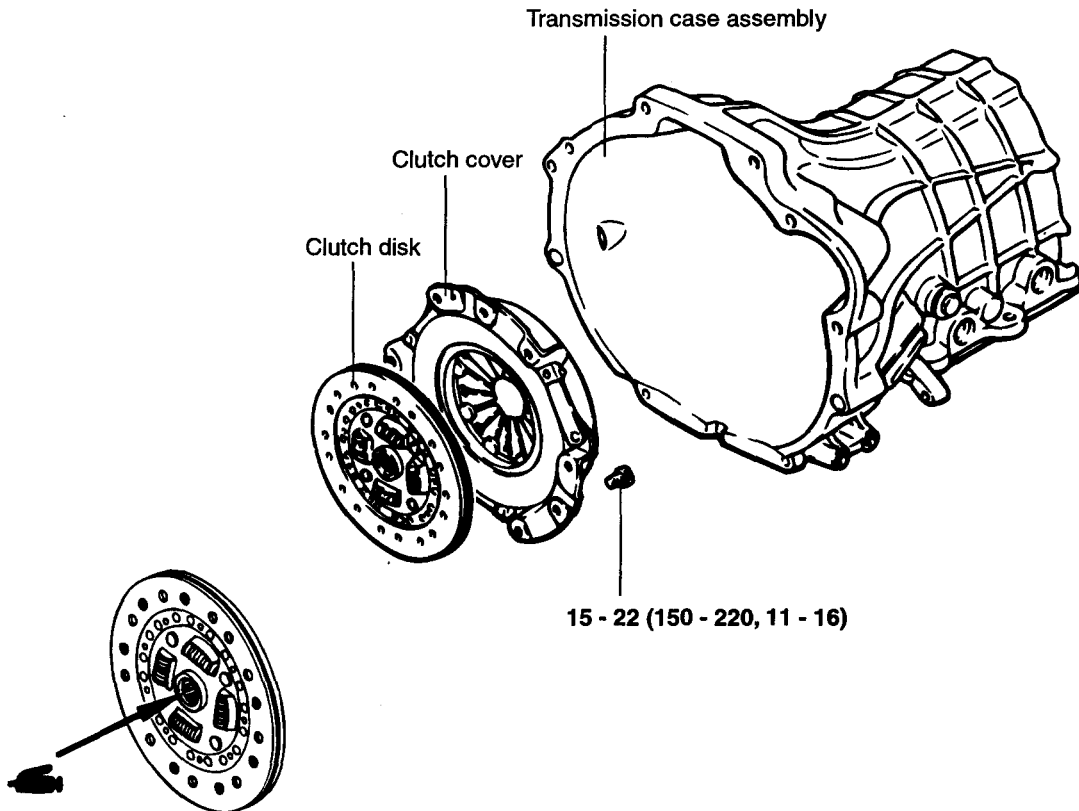
**The rapidly-repeated operation of the clutch pedal in B-C range may disrupt the release cylinder's position. During the bleeding operation, press the clutch pedal to the floor after it returns to the "A" point.**



EOA9008B

# CLUTCH COVER AND DISC

## COMPONENTS EOMB0270



**TORQUE : N·m (kg·cm, lb·ft)**

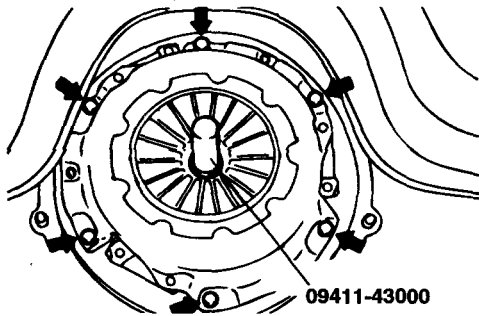


**REMOVAL** EOMB0280

1. Insert the special tool (09411-43000) in the clutch disc to prevent the disc from shifting.
2. Loosen the bolts which attach the clutch cover to the flywheel in a star pattern. Loosen the bolts in succession, one or two turns at a time, to avoid bending the cover.

**NOTE**

Do not clean the clutch disc or the release bearing with cleaning solvent.



KOMB028A

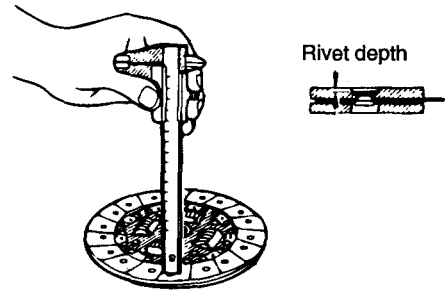
**INSPECTION** EOA90290**CLUTCH COVER ASSEMBLY**

1. Clean the dust from the clutch housing using a vacuum or cloth, Do not use compressed air. Check for oil leakage from the engine rear bearing oil seal and transaxle front oil seal. If leaky, repair them.
2. The friction surface of the pressure plate must be uniform over the entire disc surface. If any part shows excessive wear, the pressure plate is installed badly.
3. Check the friction surface of the flywheel for color change, partial damage, small cracks, and wear.
4. Don't touch the clutch disc with contaminated hands or gloves. Replace the clutch disc if the facing is stained with oil or grease. Measure the rivet depth. Replace the clutch disc if the rivet depth is less than 3 mm.

---

Limit : 0.3 mm (0.012 in.)

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EOA9029B

5. Check the hub spline and torsion spring of the clutch disc for excessive wear.
6. Clean the friction surface of the pressure plate with cleaning solvent.
7. Measure the flatness of the pressure plate with a square. If it exceeds 0.5 mm, replace it. Check the pressure plate surface of wear, cracks, and color change.
8. Check that the three-dowel on the flywheel is installed completely.

**CLUTCH RELEASE BEARING****CAUTION**

*The release bearing is packed with grease. Do not use cleaning solvent or oil on it.*

1. Check the bearing for seizure, damage or abnormal noise. Also check the diaphragm spring contact points for wear.
2. Replace the bearing if the release fork contacting points are worn out.

**CLUTCH RELEASE FORK**

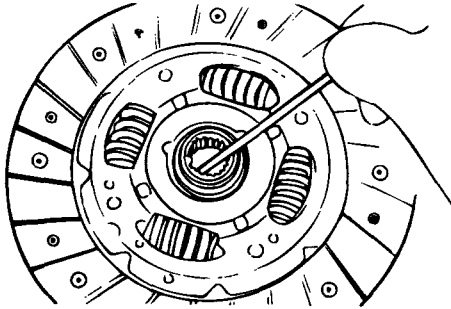
If there is abnormal wear at the point of contact with the bearing, replace the release fork.

**INSTALLATION** EOMB0300

1. Apply multipurpose grease to the spline of the disc.  
Grease : CASMOLY L 9508

**⚠ CAUTION**

*When installing the clutch, apply grease to each part, but be careful not to apply excessive grease. It can cause clutch slippage and judder.*



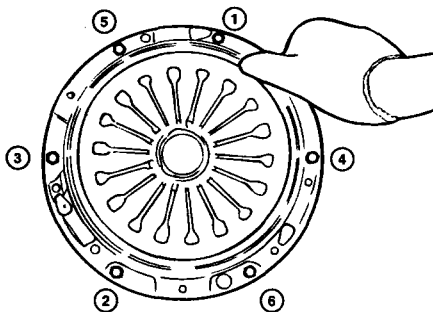
EOA9030F

2. Install the clutch disc assembly to the flywheel using the special tool (09411-43000).
3. Install the clutch cover assembly to the flywheel and temporarily tighten the bolts one or two steps at a time in a star pattern.

**Tightening torque**

Clutch cover bolt :

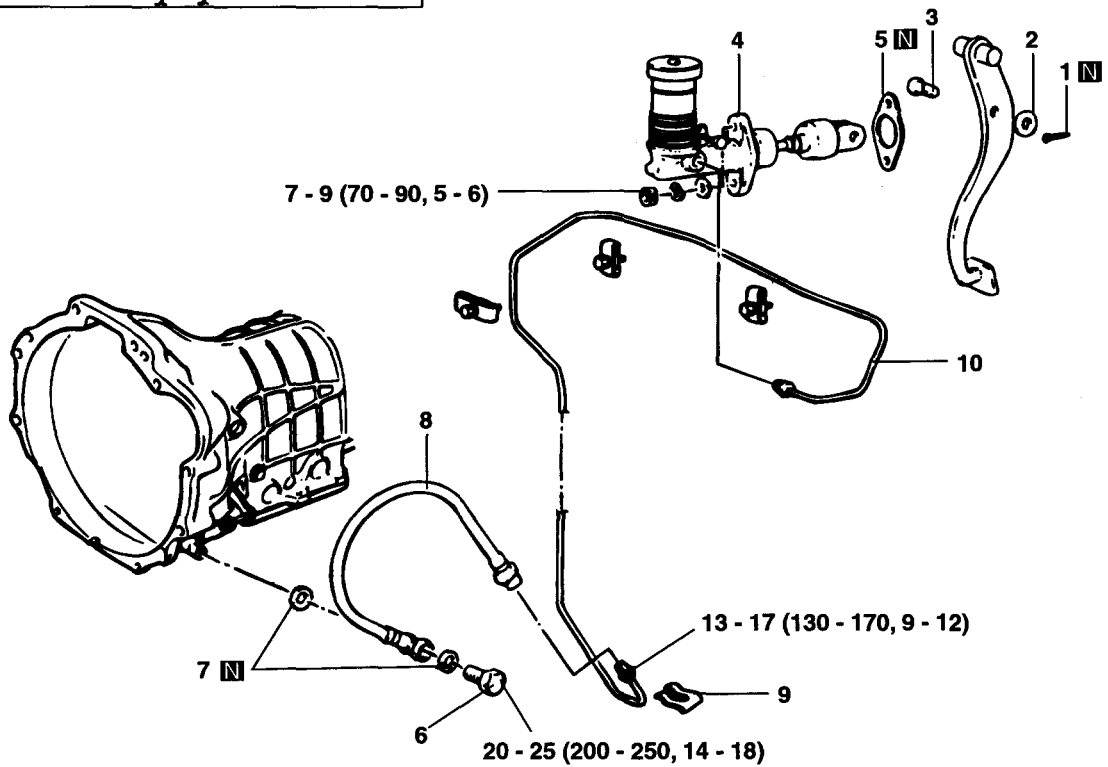
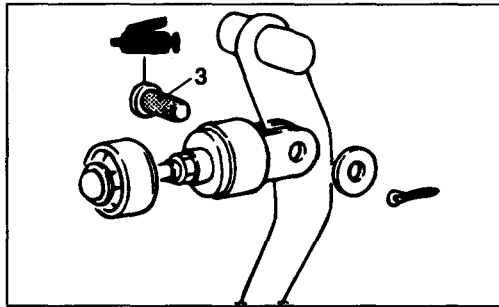
15-22 Nm (150-220 kg-cm, 11-16 lb-ft)



EOA9030B

# CLUTCH MASTER CYLINDER

## COMPONENTS EOMB0130



**[Removal procedure]**

- |                           |                 |
|---------------------------|-----------------|
| 1. Cotter pin             | 6. Eye bolt     |
| 2. Washer                 | 7. Gasket       |
| 3. Clevis pin             | 8. Clutch hose  |
| 4. Clutch master cylinder | 9. Hose clip    |
| 5. Sealer                 | 10. Clutch tube |

**TORQUE : N·m (kg·cm, lb·ft)**

**REMOVAL** EOMB0140

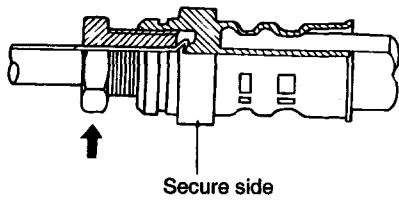
Refer to the removal procedure on the "COMPONENTS".

**INSPECTION** EOA90160

Check the clutch hose or line for cracks or clogging.

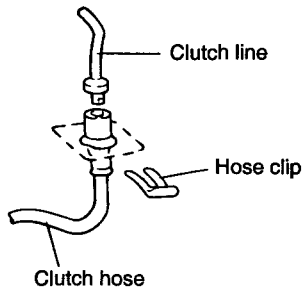
**REASSEMBLY** EOMB0160

1. Connect the clutch tube (clutch hose side).
2. Temporarily tighten the flare nut by hand, then tighten it to the specified torque, being careful that the clutch hose does not become twisted.



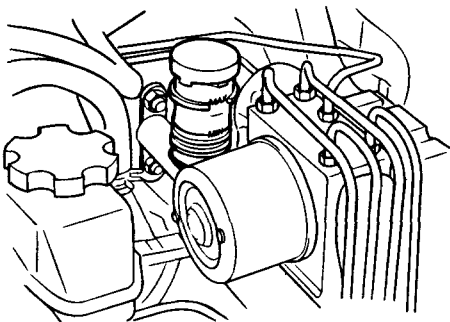
EOA9017A

3. Install the clutch line and clips.



EOA9014C

4. Install the master cylinder.

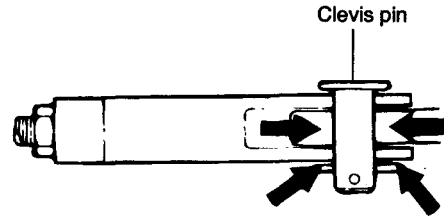


KOMB016D

5. Apply the specified grease to the clevis pin and washer.

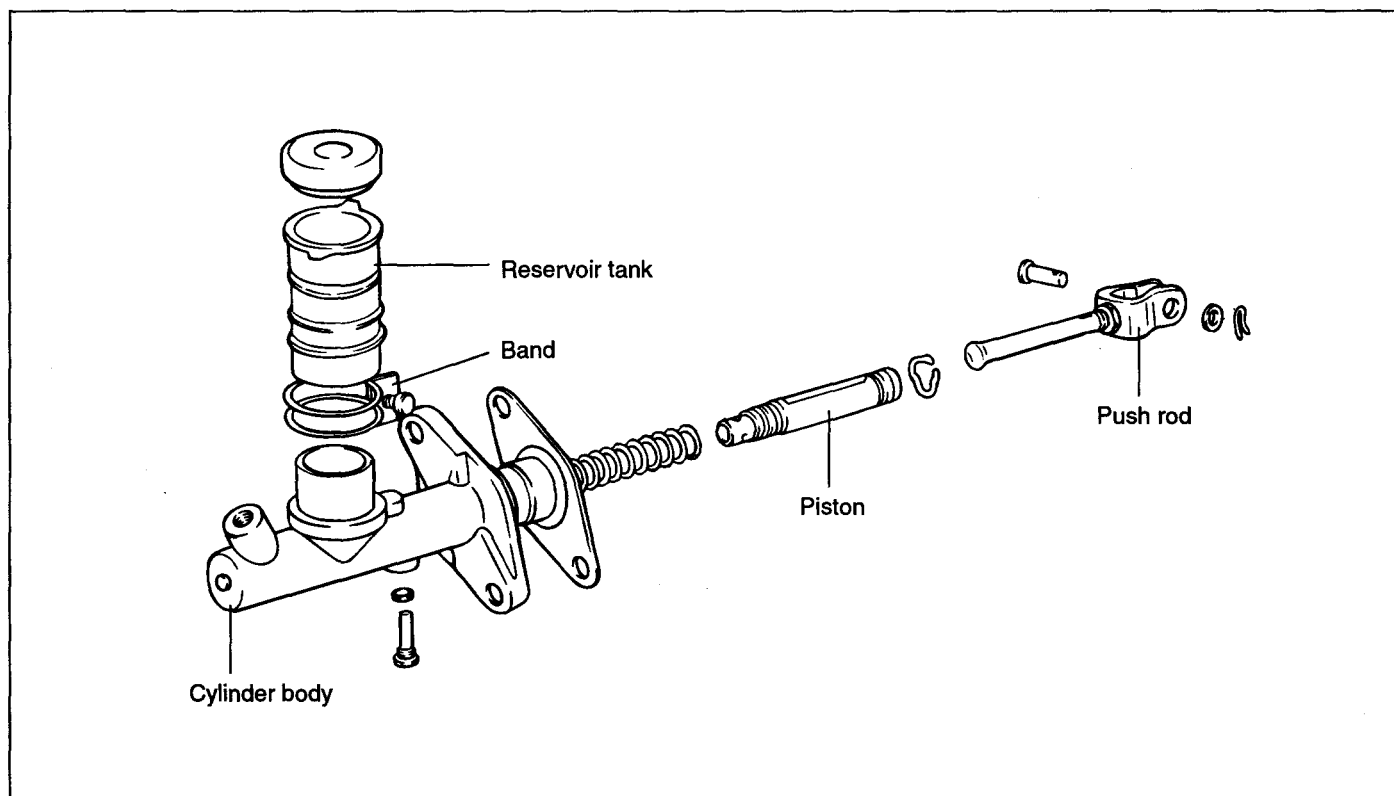
Wheel bearing grease : SAE J310a, NLGI NO.2

6. Install the push rod to the clutch pedal.
7. Pour clutch fluid into the clutch master cylinder.
8. Bleed the clutch system.



EOJA017A

## COMPONENTS EOMB0170



EOMB017A

## DISASSEMBLY EOJA0190

1. Remove the piston stop ring.
2. Pull out the push rod and piston assembly.
3. Remove the reservoir band, reservoir cap, and reservoir.

 **NOTE**

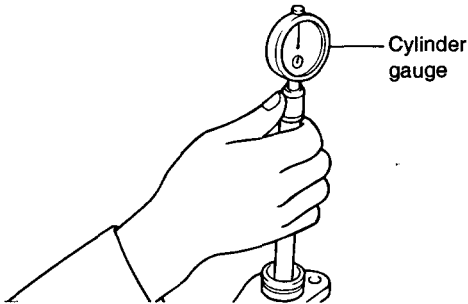
- Use care not to damage the master cylinder body and piston assembly.
- Do not disassemble the piston assembly itself (item 3).

**INSPECTION** EOMB0190

1. Check the inside of the cylinder body for rust, pitting or scoring.
2. Check the piston cup for wear or distortion.
3. Check the piston for rust, pitting or scoring.
4. Check the clutch tube line for clogged.
5. Measure the master cylinder inside diameter and the piston outside diameter with a cylinder gauge micrometer.

**NOTE**

Measure the inside diameter of the master cylinder at three places (bottom, middle, and top) in a perpendicular direction.



EODA014A

6. If the master cylinder-to-piston clearance exceeds the limit, replace the master cylinder and/or piston assembly.

---

Limit : 0.15 mm (0.006 in.)

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**REASSEMBLY** EOMB0200

1. Apply brake fluid to the inner surface of the master cylinder body and to the entire periphery of the piston assembly.
2. Install the piston assembly.

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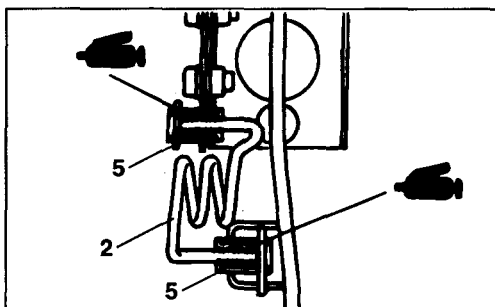
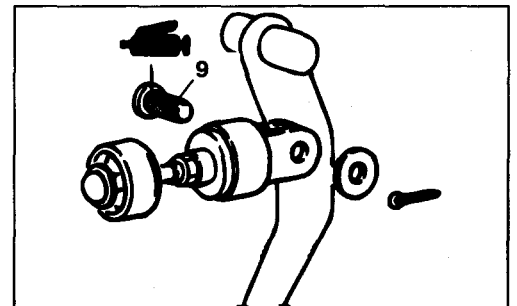
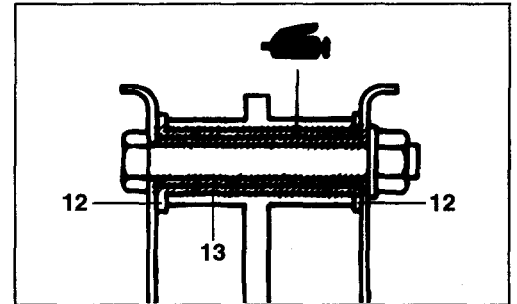
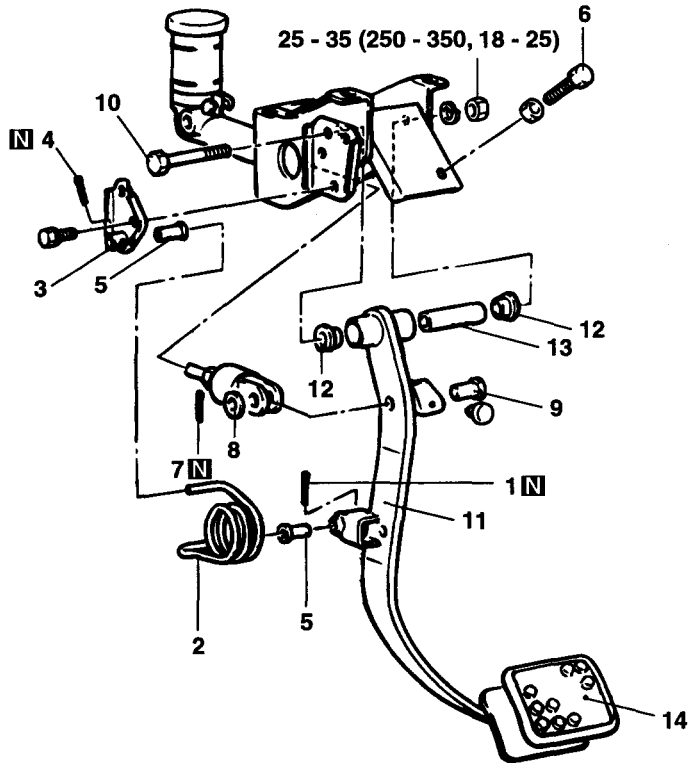
Specified fluid : Brake fluid DOT 3 or DOT 4

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3. Install the push rod.
4. Install the reservoir on the master cylinder body.

CLUTCH PEDAL

COMPONENTS EOMB0090



[Removal procedure]

- |                  |                  |
|------------------|------------------|
| 1. Cotter pin    | 8. Washer        |
| 2. Return spring | 9. Clevis pin    |
| 3. Bracket       | 10. Bolt         |
| 4. Cotter pin    | 11. Clutch pedal |
| 5. Bushing       | 12. Bushing      |
| 6. Stopper bolt  | 13. Spacer       |
| 7. Cotter pin    | 14. Pedal pad    |

NOTE

(1) :  $\square$  Non-reusable parts

TORQUE : N·m (kg·cm, lb·ft)

**REMOVAL** EOMB0100

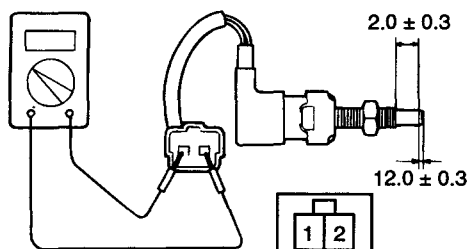
Refer to the removal procedure on the "COMPONENTS".

**INSPECTION** EOMB0110

1. Check the pedal shaft and bushing for wear.
2. Check the clutch pedal for bending or torsion.
3. Check the return spring for damage or deterioration.
4. Check the pedal pad for damage or wear.

**IGNITION LOCK SWITCH INSPECTION**

Remove the ignition lock switch and check for continuity between the terminals. If the continuity is not as specified, replace the switch.



KOMB011A

**INSTALLATION** EOMB0120

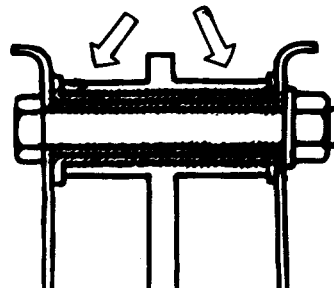
1. Apply the specified grease to the clutch pedal and bushings.

---

Chassis grease : SAE J310a, NLGI No.1

---

2. Install the clutch pedal mounting bolt.



KOMB012A

3. Apply the specified grease to the clevis pin and washer.

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Wheel bearing grease : SAE J310, NLGI No.2

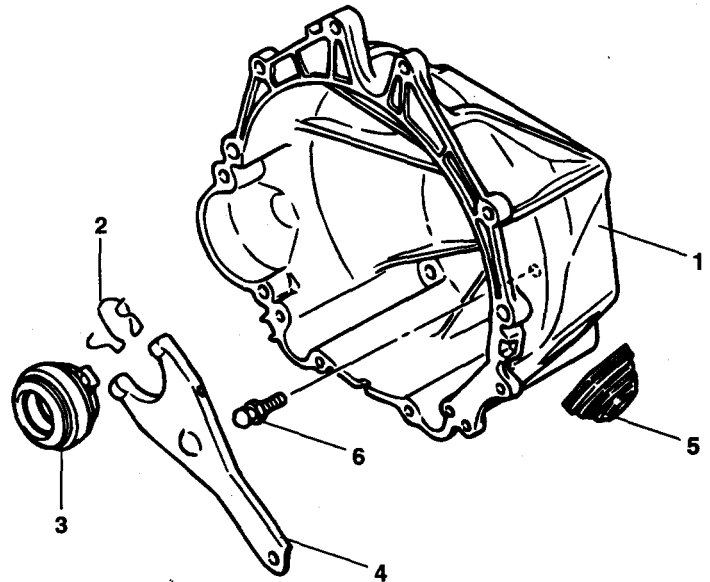
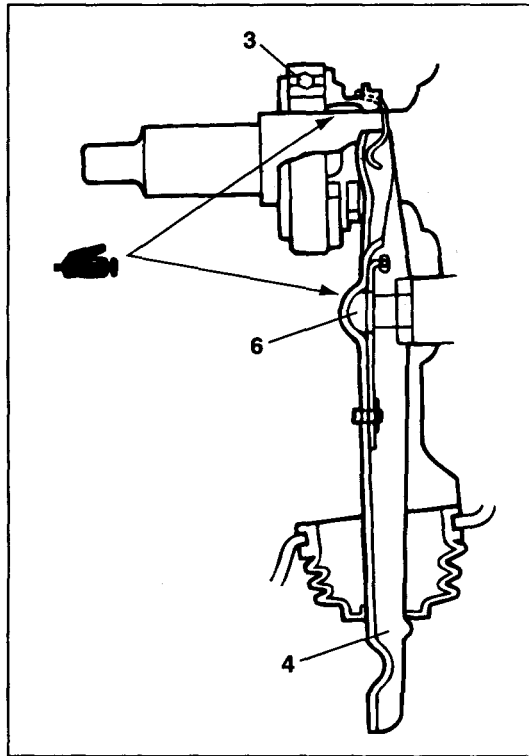
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4. Install the push rod to the clutch pedal.
5. Adjust the clutch pedal clevis pin play.



## CLUTCH RELEASE BEARING

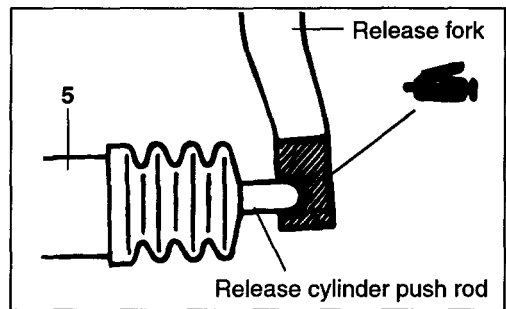
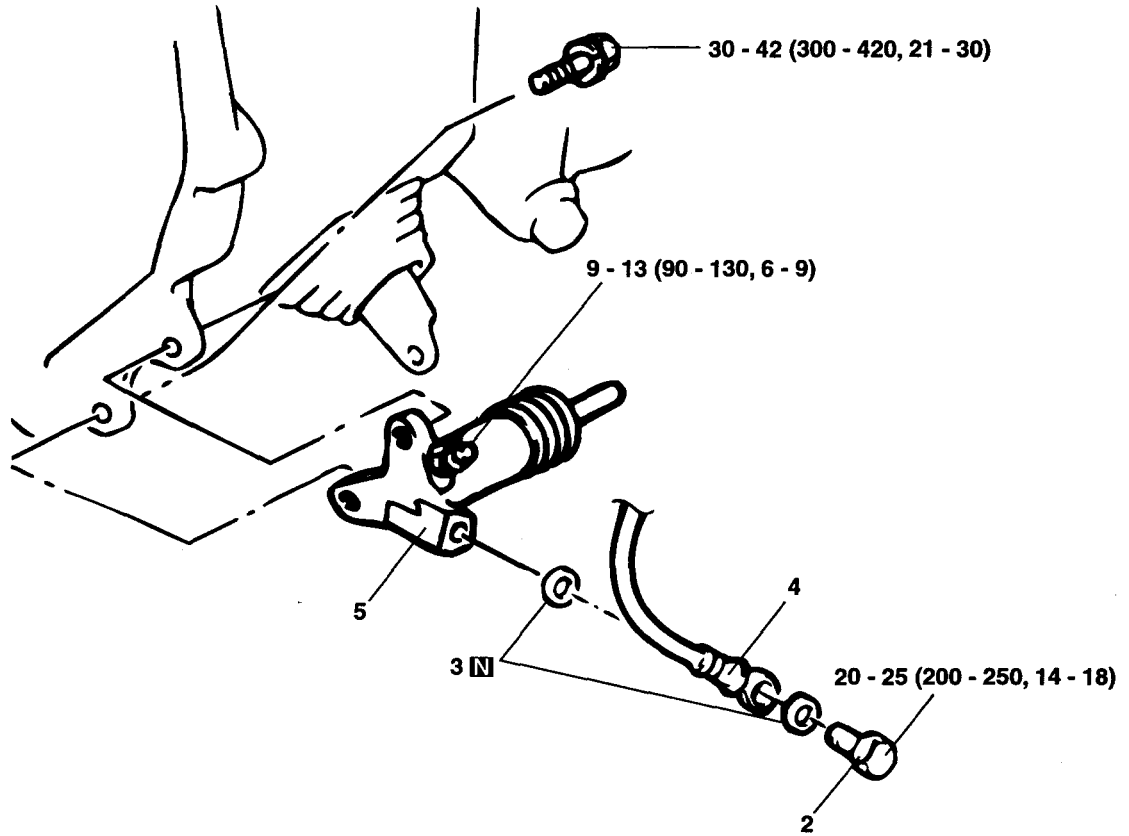
## COMPONENTS EOMB0310

**[Removal procedure]**

1. Transmission case
2. Return spring
3. Clutch release bearing
4. Clutch release fork
5. Clutch release fork boot
6. Fulcrum

# CLUTCH RELEASE CYLINDER

## COMPONENTS EOMB0210



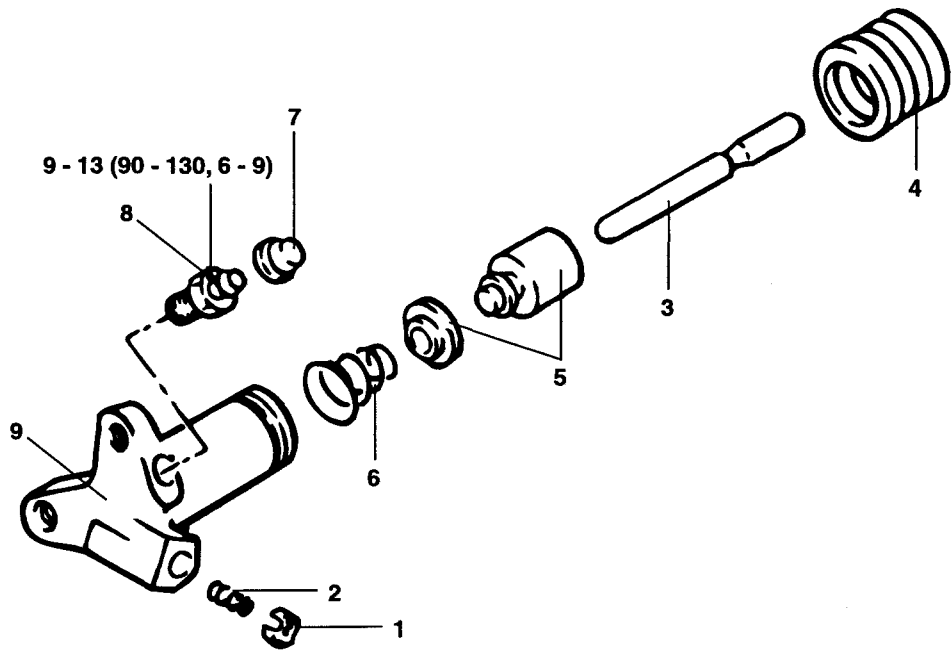
**[Removal procedure]**

1. Bleeder plug
2. Eye bolt
3. Gasket
4. Clutch hose
5. Clutch release cylinder

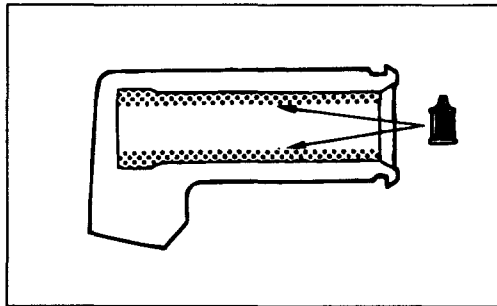
**TORQUE : N·m (kg·cm, lb·ft)**

**NOTE :  $\square$  Non-reusable part**

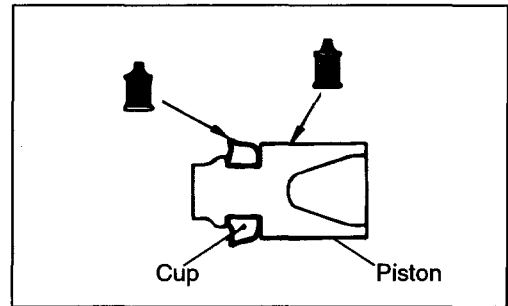
COMPONENTS EOMB0220



Brake Fluid DOT3



Brake Fluid DOT3



[Removal Procedure]

- |                 |                     |
|-----------------|---------------------|
| 1. Valve plate  | 6. Cup              |
| 2. Spring       | 7. Spring           |
| 3. Push rod     | 8. Bleeder plug     |
| 4. Boot         | 9. Release cylinder |
| 5. Piston & Cup |                     |

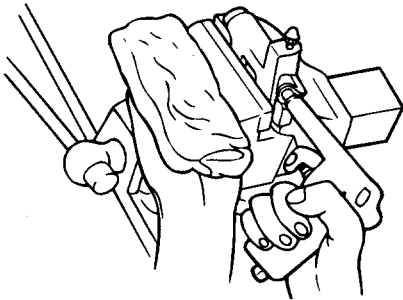
TORQUE : N·m (kg·cm, lb·ft)

**REMOVAL** EOA90230

1. Remove the clutch hose, valve plate, spring, push rod, and boot.
2. Remove any dirt from the piston bore opening of the release cylinder.
3. Remove the piston from the release cylinder using compressed air.

**CAUTION**

- Use rags to prevent the piston from popping out and causing injury.
- Apply compressed air slowly. Keep the fluid from splashing in your eyes or on your skin.

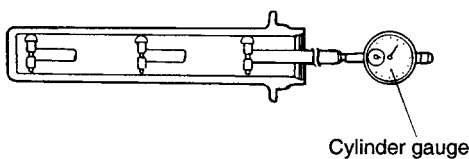


EOA9023A

**INSPECTION** EOA90240

1. Check the clutch release cylinder for fluid leakage.
2. Check the clutch release cylinder boots for damage.
3. Check the release cylinder bore for rust and damage.
4. Measure the release cylinder bore at three locations (bottom, middle, and top) with a cylinder gauge and replace the release cylinder assembly if the bore-to-piston clearance exceeds the limit.

Limit :  
Clearance to piston .. 0.15 mm (0.006 in.)

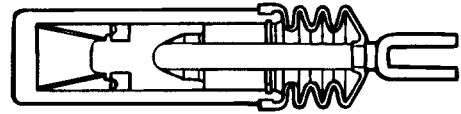


EOA9024A

**REASSEMBLY** EOMB0250

1. Apply specified brake fluid to the release cylinder bore and the outer surface of the piston and piston cup. Push the piston cup assembly in to the cylinder.

Use the specified fluid : Brake fluid DOT3 or DOT4



EOA9025A

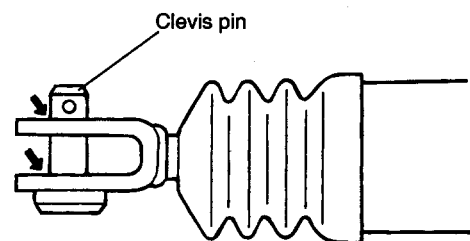
2. Install the clutch hose, valve plate, spring, push rod, and boot.

**INSTALLATION** EOA90260

1. Coat the clevis pin with the specified grease. Align the hose at the end of the release cylinder push rod with that of the clutch release fork shaft, and insert the clevis pin into the holes.

Specified grease : CASMOLY L9508

2. Install the clutch release cylinder and the clutch tube.



EOA9026A

# Brake System

<b>GENERAL .....</b>	<b>BR -2</b>
<b>BRAKE SYSTEM .....</b>	<b>BR -8</b>
<b>PARKING BRAKE SYSTEM .....</b>	<b>BR -37</b>
<b>ABS (ANTI-LOCK BRAKE SYSTEM) .....</b>	<b>BR -39</b>

# GENERAL

## SPECIFICATIONS EJMB0010

ITEMS	SPECIFICATIONS
<b>Master cylinder</b> Type I.D. Fluid level sensor	Tandem type 25.4 mm (1.0 in.) Provided
<b>Brake booster</b> Type Effective dia. Boosting ratio	Vacuum type with tandem booster 7 + 8 in.(Diesel), 8 + 9 in.(Gasoline) 7.0 : 1
<b>Front brake</b> Type Disc O.D. Disc thickness Pad thickness Cylinder type Cylinder I.D.	Floating with ventilated disc 280 mm (11.02 in.) 27 mm (1.06 in.) 10 mm (0.39 in.) Double piston 42.9 mm (1.689 in.) (x2)
<b>Rear disk brake (ABS)</b> Type Disc O.D. Disc thickness Pad thickness Cylinder type Cylinder I.D.	Floating with ventilated disc 315 mm (12.4 in.) 20 mm (0.787 in.) 10 mm (0.39 in.) Single piston 42.9 mm (1.69 in.)
<b>Rear drum brake (CBS)</b> Type Drum I.D. Cylinder I.D. Clearance adjustment Lining thickness	Leading & Trailing type 270 mm (10.63 in.) 23.81 mm (0.94 in.) Automatic 4.7 mm (0.19 in.)
<b>Parking brake</b> Type Brake type	Drum type (CBS), Disc type (ABS) Hand brake lever type

O.D. = Outer diameter

I.D. = Inner diameter

ABS = Anti-lock Brake System

CBS = Conventional Brake System

**SERVICE STANDARD** EJMB0020

ITEMS	SPECIFICATIONS
<b>Standard value</b>	
Brake pedal height	M/T : 188 mm (7.40 in.), A/T : 189 mm (7.44 in.)
Clearance between stop lamp switch outer case and pedal arm	0.5 - 1.0 mm (0.020 - 0.040 in.)
Brake pedal free play	3-8 mm (0.117 - 0.312 in.)
Clearance between brake pedal and floor board	M/T : 54 mm, A/T : 55 mm
Parking brake lever stroke	8 clicks (When lever assembly is pulled with 20kgf)
<b>Service limit</b>	
Front disc brake pad thickness	2.0 mm (0.079 in.)
Front disc thickness (minimum)	25.4 mm (1 in.)
Front disc runout	0.03 mm ( 0.0012 in.)
Front disc thickness variation	0.005 mm (0.0002 in.)
Rear disc brake pad thickness	2.0 mm (0.079 in.)
Rear disc thickness	18.4 mm (0.724 in.)
Rear drum I.D.	272 mm (10.71 in.)
Rear brake lining thickness	1.5 mm (0.059 in.)

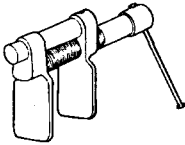
**TIGHTENING TORQUE** EJMB0030

ITEMS	Nm	Kg-cm	lb-ft
Brake support member mounting	18-25	180-250	13-18
Brake pedal stop lamp lock nut/ignition switch	10-15	100-150	0.73-11
Brake booster mounting nut	8-12	80-120	6-9
Brake booster vacuum warning switch	20-25	200-250	15-18
Bleeder screw	7-9	70-90	5-7
Brake tube flare nut, brake hose	13-17	130-170	9.5-13
Caliper guide rod bolt	22-32	220-320	16-23
Caliper assembly to knuckle	65-75	650-750	48-55
Brake hose to front caliper	25-30	250-300	18-22
Wheel cylinder mounting bolt	12-18	120-180	9-13
Parking brake mounting bolt	17-26	170-260	13-19

**LUBRICANTS** EJHA0150

Items	Recommended lubricant	Quantity
Brake fluid	DOT 3 or equivalent	As required
Brake pedal bushing and brake pedal bolt	Chassis grease SAE J310, NLGI No.0	As required
Clevis pin	Wheel bearing grease SAE J310, NLGI No.2	As required
Parking brake shoe and backing plate contact surfaces	Bearing grease, NLGI No.0-1	As required

## SPECIAL TOOLS EJHA0200

Tool (Number and Name)	Illustration	Usage
09581 - 11000 Piston expander	 <p style="text-align: right; font-size: small;">EJDA043A</p>	Pushing back of the front disc and rear disc brake piston

## TROUBLESHOOTING EJMB0040

Trouble symptom	Possible cause	Remedy
Noise or vibration when brakes are applied	Caliper improperly mounted Loose caliper mounting bolts Unevenly worn or cracked brake drum or brake disc Foreign material in brake drum Seized pad or lining contact surface Excessive clearance between pad assembly and caliper Uneven pad contact Lack of lubrication in sliding parts Loose suspension parts Excessive of disc runout Excessive variation of disc thickness	Correct Retighten Replace Clean Replace Correct Correct Lubricate Retighten Correct the runout Replace disc
Vehicle pulls to one side when brakes are applied	Difference in left and right tire inflation pressure Inadequate contact of pad Grease or oil on pad or lining surface Drum warped or uneven wear Incorrect wheel cylinder installation Auto adjuster malfunction	Adjust Correct Replace Replace Correct Repair
Insufficient braking power	Low or deteriorated brake fluid Air in the brake system Brake booster malfunction Inadequate contact of pad Grease or oil on pad surface Auto adjuster malfunction Overheated brake rotor due to dragging of pad Clogged brake line LCR valve malfunction	Refill or change Bleed the system Correct Correct Replace Correct Correct Replace Replace



## SERVICE ADJUSTMENT PROCEDURES

EJMB0050

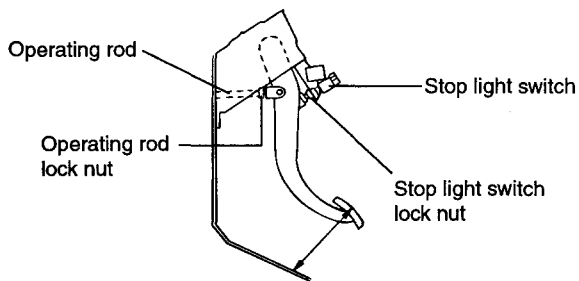
### INSPECTION AND ADJUSTMENT

1. Measure the brake pedal height. If the brake pedal height is not within the standard value, adjust as follows.

#### Standard value

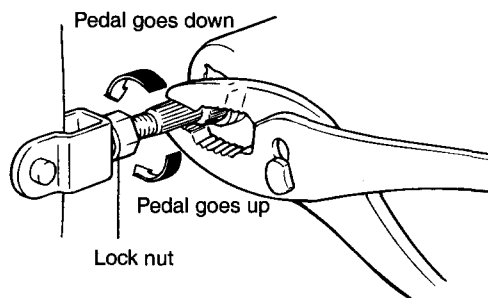
M/T : 188 mm (7.40 in.)

A/T : 189 mm (7.44 in.)



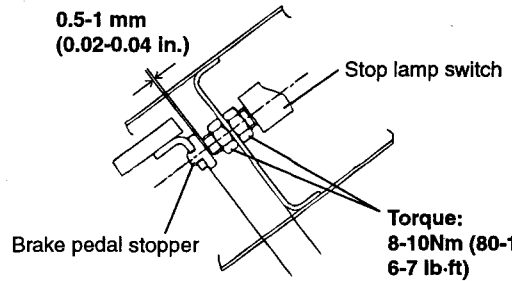
EJMB065A

- 1) Disconnect the stop lamp switch connector, loosen the lock nut, and move the stop lamp switch to a position where it does not contact the brake pedal arm.
- 2) Adjust the brake pedal height by turning the operating rod with pliers (with the operating rod lock nut loosened), until the correct brake pedal height is obtained.



H7BR202A

- 3) After turning the stop lamp switch until it contacts the brake pedal stopper (just before the brake pedal is caused to move), return the stop lamp switch 1/2 to 1 turn and secure by tightening the lock nut.
- 4) Connect the connector of the stop lamp switch.
- 5) Check that the stop lamp is not illuminated with the brake pedal unpressed.



EHPBR01A

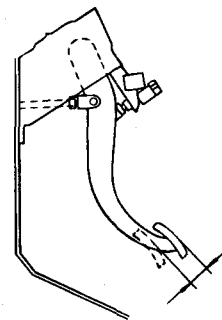
2. With the engine stopped, depress the brake pedal two or three times. After eliminating the vacuum in the power brake booster, press the pedal down by hand, and confirm that the amount of movement before resistance is met (the free play) is within the standard value.

#### Standard value

3 - 8 mm (0.118 - 0.315 in.)

If free play does not reach the standard value, check that clearance between the outer case of stop light switch and brake pedal is within the standard value. If free play exceeds the standard value, it is probably due to excessive clearance between the clevis pin and brake pedal arm.

Check for excessive clearance and replace faulty parts as required.



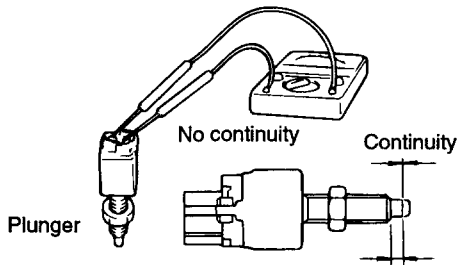
H7BR204A

3. Start the engine, depress the break pedal with approximately 120kgf of force, and check for oil leakage in the master cylinder, brake line and each connecting part. Repair the faulty parts as required.

### STOP LAMP SWITCH INSPECTION

Connect a circuit tester to the connector of stop lamp switch, and check whether or not there is continuity when the plunger of the stop lamp switch is pushed in and when it is released.

The stop lamp switch is in good condition if there is no continuity when the plunger is pushed.



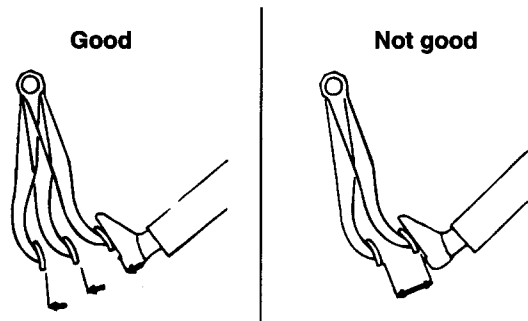
H7BR206A

### BRAKE BOOSTER OPERATING TEST

For simple checking of the brake booster operation, carry out the following tests :

1. Run the engine for one or two minutes, and then stop it.

If the pedal depresses fully the first time but gradually becomes higher when depressed succeeding times, the booster is operating properly, if the pedal height remains unchanged, the booster is defective.

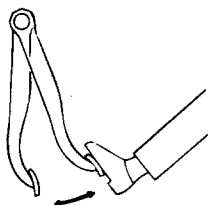


EJA9002A

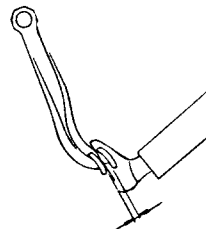
2. With the engine stopped, step on the brake pedal several times.

Then step on the brake pedal and start the engine. If the pedal moves downward slightly, the booster is in good condition. If there is no change, the booster is defective.

When engine is stopped



When engine is started



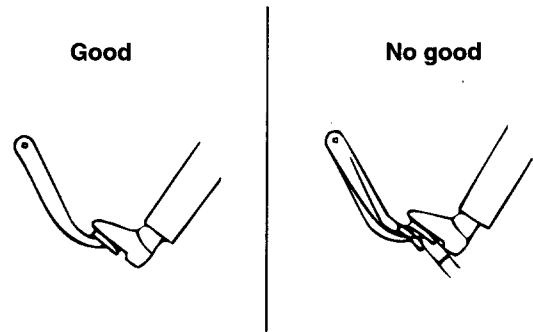
EJA9002B

3. With the engine running, step on the brake pedal and then stop the engine.

Hold the pedal depressed for 30 seconds. If the pedal height does not change, the booster is in good condition, if the pedal rises, the booster is defective.

If the above three tests are okay, the booster performance can be determined as good.

Even if one of the above three tests is not okay, check the check valve, vacuum hose and booster for defect.



H7BR209A

### BLEEDING THE BRAKE SYSTEM

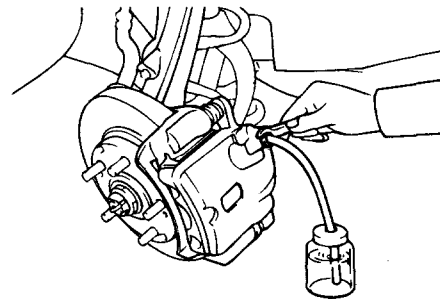
EJMB0060

1. Remove the reservoir cap and fill the brake reservoir with brake fluid.

#### ! CAUTION

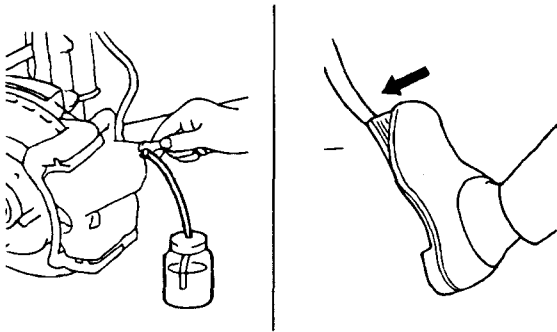
- Do not allow brake fluid to remain on a painted surface. Wash it off immediately.
- Use the specified brake fluid. Avoid using a mixture of the specified brake fluid and other fluid.

2. Connect a vinyl tube to the wheel cylinder bleeder screw and insert the other end of the tube in a container of brake fluid which is half full.



KJMB070A

3. Start the engine.
4. Slowly depress the brake pedal several times.
5. While depressing the brake pedal fully, loosen the bleeder screw until fluid runs out. Then close the bleeder screw and release the brake pedal.



EAHA014B

6. Repeat steps 4 and 5 until there are no more bubbles in the fluid.
7. Tighten the bleeder screw.

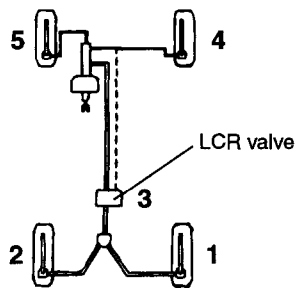
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**Tightening torque**

Bleeder screw : 7 - 9 Nm (70-90kg·cm, 5-6.6 lb·ft)

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8. Repeat the above procedure for each wheel in the sequence shown in the illustration.



EHP1341A

# BRAKE SYSTEM

## L.C.R(LOAD CONSCIOUS REDUCING) VALVE

### L.C.R (LOAD CONSCIOUS REDUCING) VALVE

EJMB0070

L.C.R valve is designed to provide maximum brake ability while controlling the brake according to the vehicle weight.

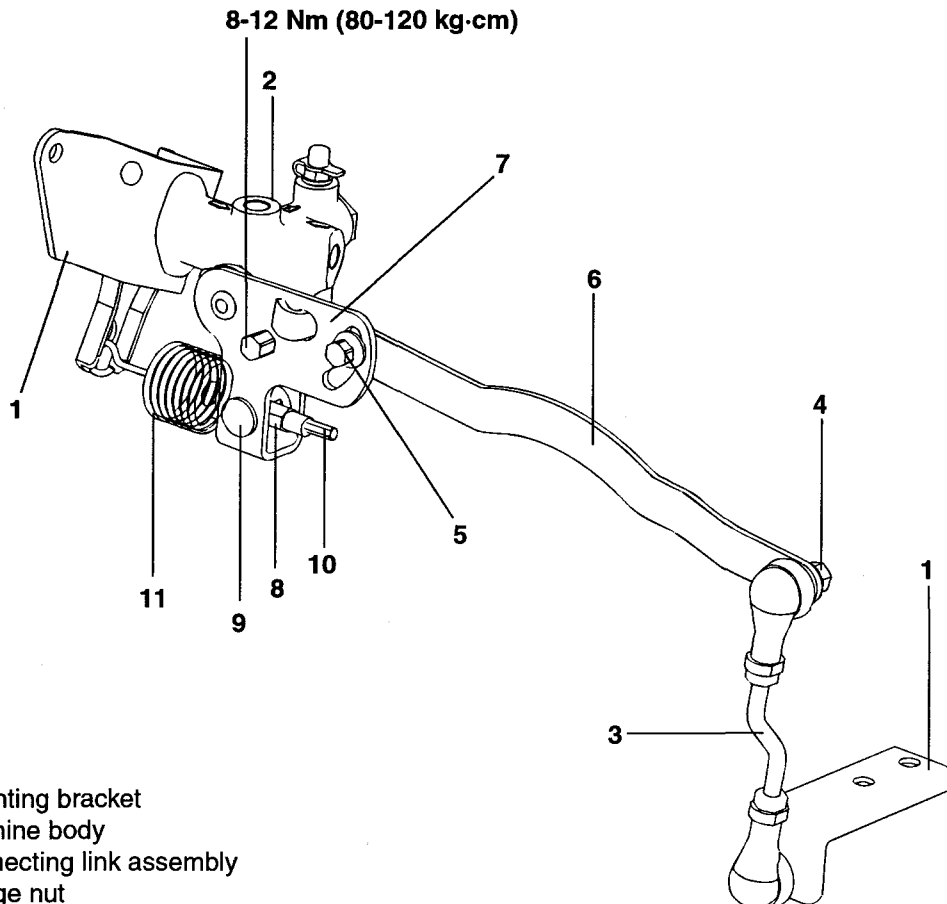
The brake fluid pressure of rear wheel may reduce as the vehicle weight is increased by heavy load or the number of passenger.

The changes of rear wheel suspension by the load of vehicle would affect to the valve body of L.C.R valve causing reducing or increasing the brake fluid into the rear brake system.

It is pre-setting type which does not need the difficult setting procedures.

EJMB0080

### COMPONENTS



1. Mounting bracket
2. Machine body
3. Connecting link assembly
4. Flange nut
5. Flange bolt
6. Operating lever
7. Bell crank assembly
8. Adjuster nut
9. Guide spring
10. Rod
11. Sensing spring assembly

## THE L.C.R VALVE CONSISTS OF EJMB0090

1. Load sensing part : sensing spring, Lever
2. Linkage part : Connecting link, Operating lever, Bell crank
3. Pressure control part : Machine body, Piston, Valve seal
4. By-pass part : By-pass piston, O-ring

## INSTALLATION EJMB0100

When the L.C.R valve is set, the adjustment procedure is unnecessary.

1. When the fuel tank is full, position the vehicle on a level surface. Don't load things or people in the vehicle.
2. Set the valve body to the vehicle with the hole of the mounting bracket.

### Tightening torque

11 - 14 Nm (110 - 140 kg·cm, 8.14 - 10.36 lb·ft)

3. Tighten the bolt of the connecting rod end in the valve mounting bracket.

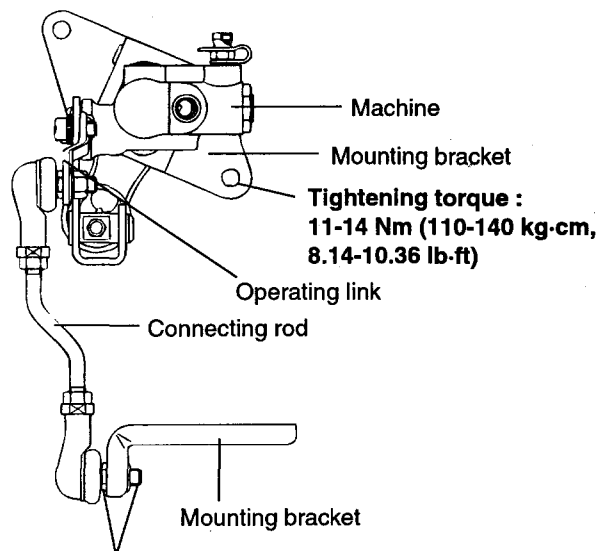
### Tightening torque

11 - 14 Nm (110 - 140 kg·cm, 8.14 - 10.36 lb·ft)

4. When the machine body and the bolt of the connecting rod are fixed, tighten the flange bolt in the bell crank so that the connecting rod and operating lever can't move.

### Tightening torque

19 - 23 Nm (190 - 230 kg·cm, 14.06 - 17.02 lb·ft)



Machine

Mounting bracket

**Tightening torque :**  
11-14 Nm (110-140 kg·cm,  
8.14-10.36 lb·ft)

Operating link

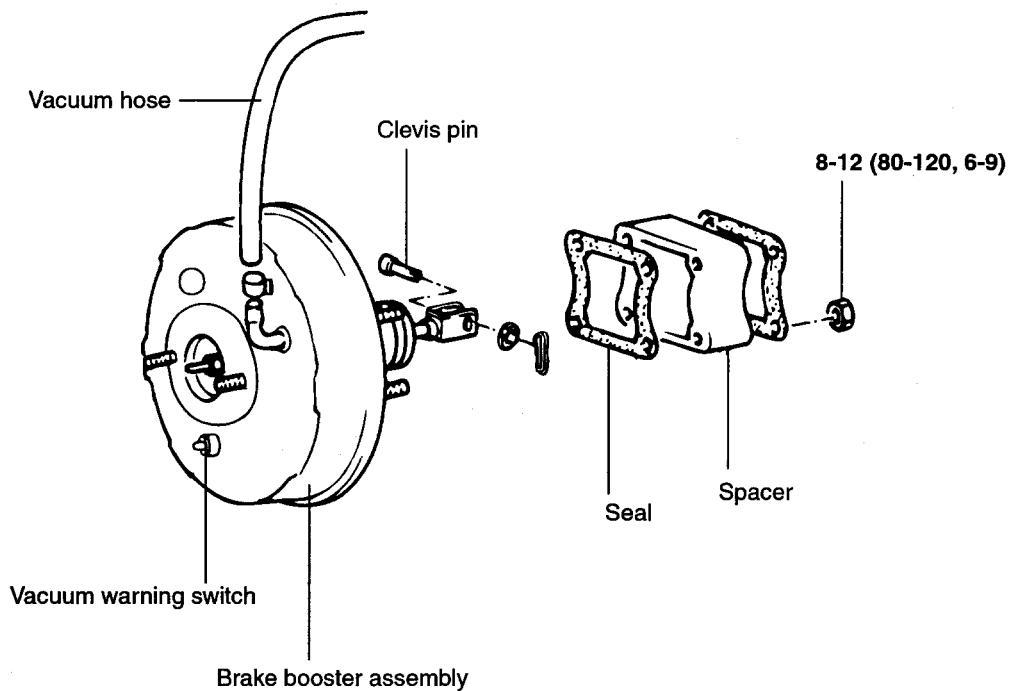
Connecting rod

Mounting bracket

**Tightening torque :**

11-14 Nm (110-140 kg·cm, 8.14-10.36 lb·ft)

## BRAKE BOOSTER

COMPONENTS EJMB0110

**TORQUE : Nm (kg-cm, lb-ft)**

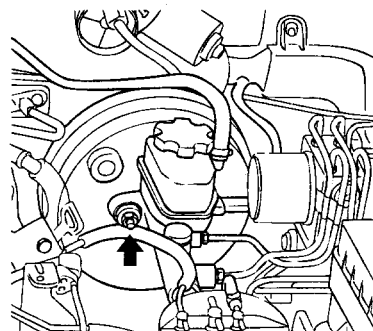
EJMB011A

REMOVAL EJMB0120

1. Remove the master cylinder.

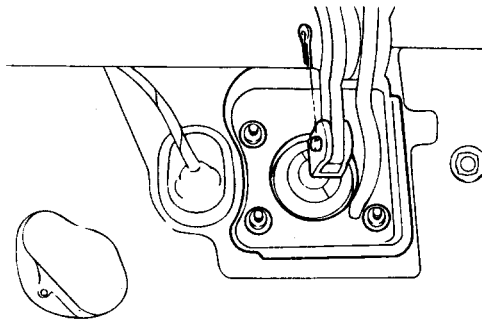
**⚠ CAUTION**

**Do not allow brake fluid to remain on a painted surface. Wash it off immediately.**



KHPBR07A

2. Separate the vacuum tube from the booster.
3. Remove the operating rod from the brake pedal.
4. Remove the booster installation nut.
5. Remove the booster assembly.



EJDA025B

**CAUTION**

While installing the split pin to the clevis pin connecting the booster push rod and brake pedal, the split pin must be bent to approx. 180°.

## INSTALLATION

EJMB0130

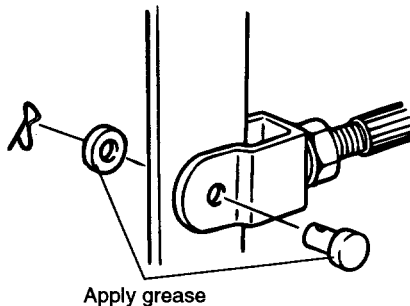
1. When installing the booster assembly, replace the packing of each end of booster installation holder.
2. Install the brake booster and tighten the mounting nut.

### Tightening torque

Booster installation nut :

8 - 12 Nm (80 - 120 kg-cm, 6 - 9 in.)

3. Connect the booster push rod and brake pedal with a clevis pin and install a split pin to the clevis pin.

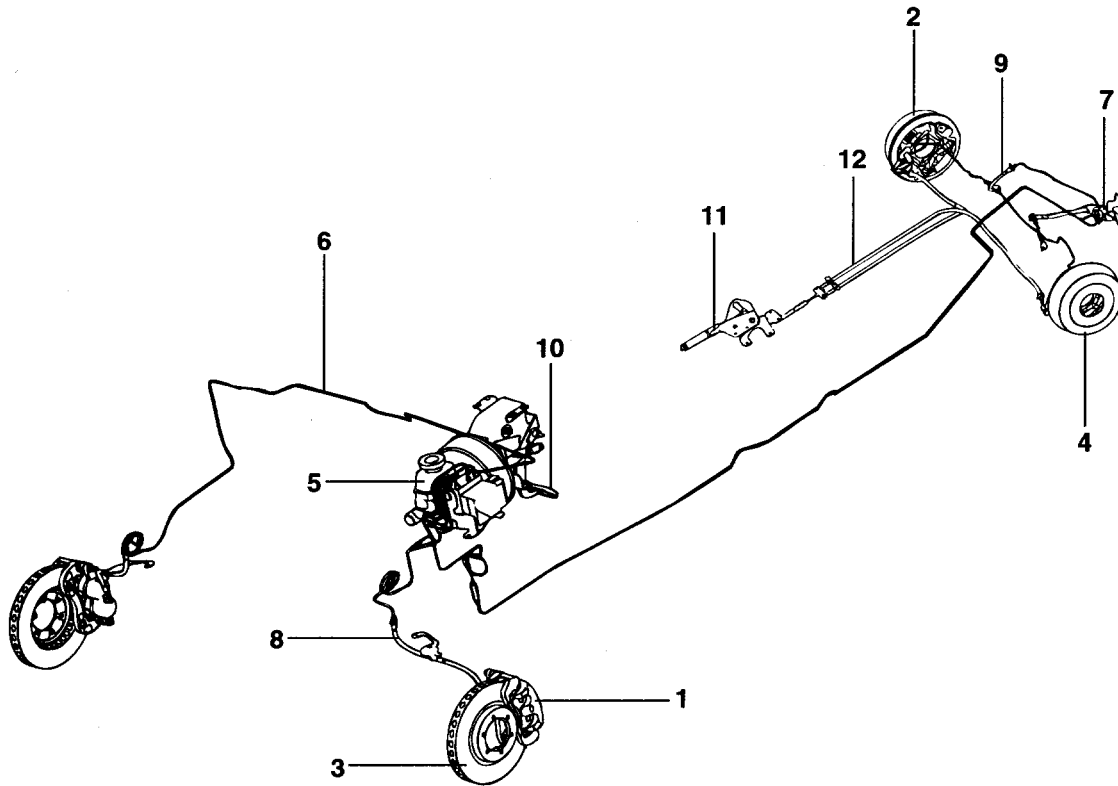


EJA9005B

4. Install the master cylinder.
5. Connect the vacuum hose to the brake booster.
6. After filling the brake reservoir with brake fluid, bleed the system.
7. Check for fluid leakage.
8. Check and adjust the brake pedal for proper operation.
9. After installing, apply grease to the contact parts of the clevis and brake pedal.

## BRAKE LINE

## COMPONENTS EJMB0140



1. Front brake assembly
2. Rear brake assembly
3. Front brake disc
4. Rear dum brake
5. Booster & master cylinder assembly
6. Brake tube

7. L.C.R valve
8. Front brake hose
9. Rear brake hose
10. Brake pedal assembly
11. Parking brake lever assembly
12. Parking brake cable assembly



**REMOVAL** EJMB0150

Holding the nut at the brake hose side, loosen the flare nut of the brake tube.

**INSPECTION** EJMB0160

- Check the brake tubes for cracks, crimps and corrosion.
- Check the brake hoses for cracks, damaged and oil leakage.
- Check the brake tube flare nuts for damage and oil leakage.

**INSTALLATIONS** EJMB0170

1. Install the brake hoses without twisting them.

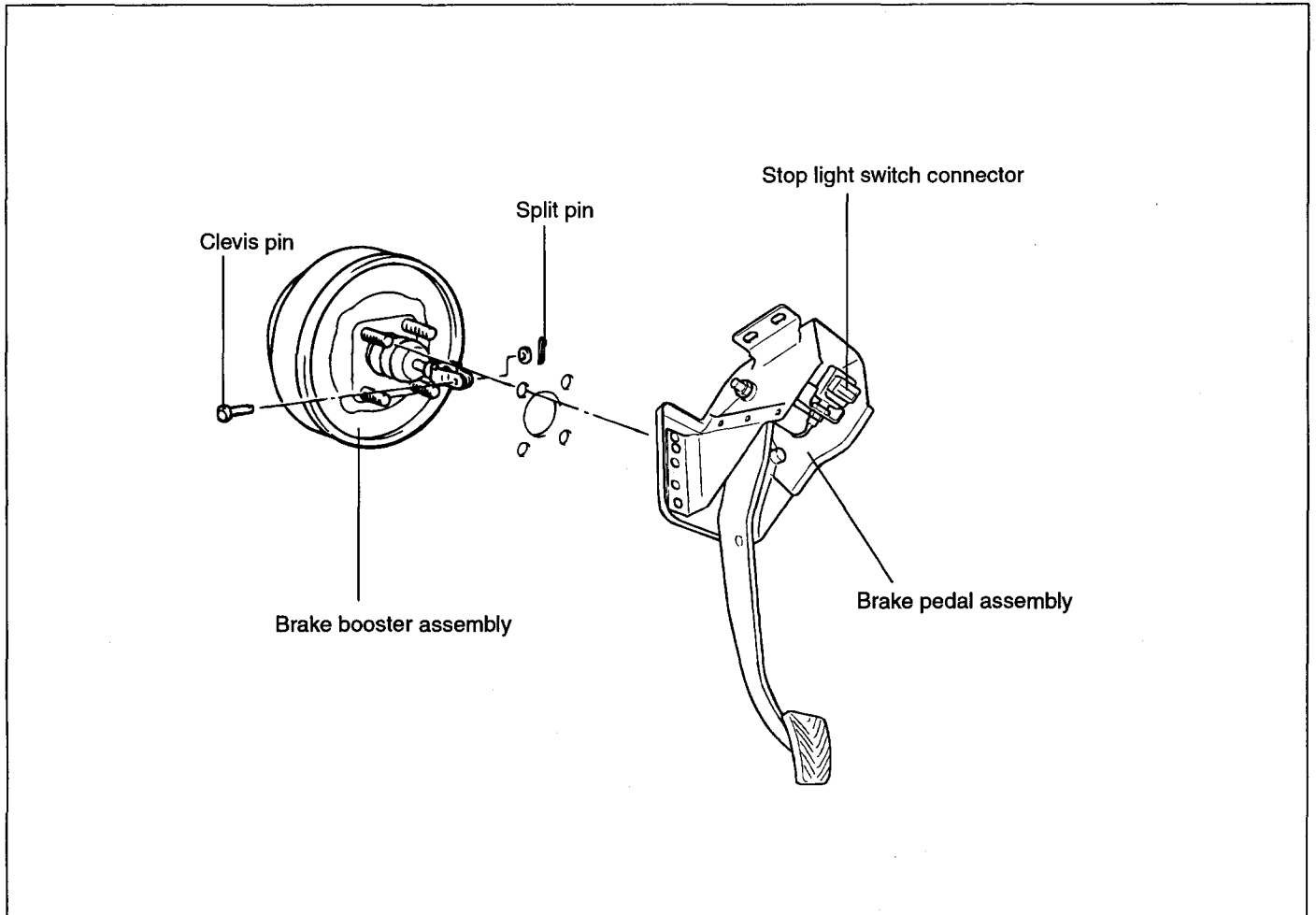
 **CAUTION**

***When installing, be sure the brake hose does not contact edges, welding or moving parts.***

2. Tighten to the specified torque as follows.

Items	Torque Nm (kg·cm, lb·f)
Brake flare nut and brake hose	13-17 (130-170, 9.5-12)
Brake hose and caliper	25-30 (250-300, 18-22)
Air bleed screw	7-9 (70-90, 5-7)
Brake tube and connector	20 (200, 15) or less

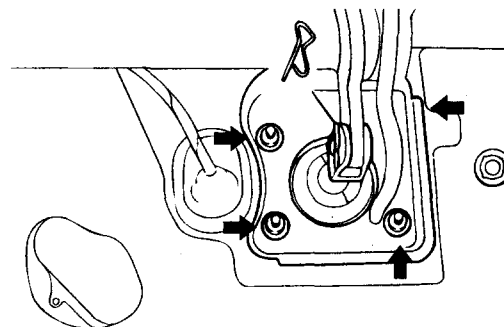
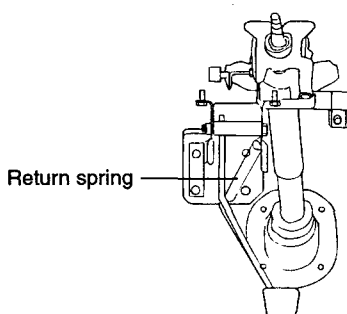
## BRAKE PEDAL

COMPONENTS EJMB0180

EHPBR05A

REMOVAL EJMB0190

1. Remove the lower crash pad assembly.
2. Remove the stop lamp switch connector.
3. Remove the return spring.
4. Remove the split pin and clevis pin.
5. Remove the brake pedal assembly mounting nut.



EJKB010A

EHPBR97A

**INSPECTION** EJJB0095

1. Check the bushing for wear.
2. Check the brake pedal for bending or twisting.
3. Check the brake pedal return spring for damage.
4. Check all parts for crack and wear.

**INSTALLATION** EJMB0210

1. Installation is the reverse of removal.

**CAUTION**

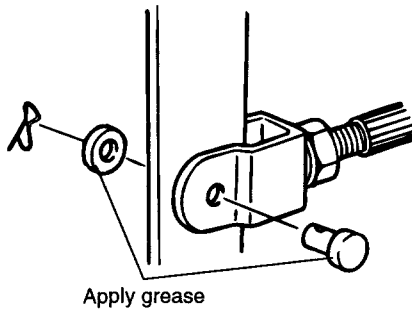
***Coat the inner surface of the bushings with the specified grease.***

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**Specified grease :** Chassis grease LiG - 2

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2. Before inserting the clevis pin, apply the specified grease to the clevis pin and washer.

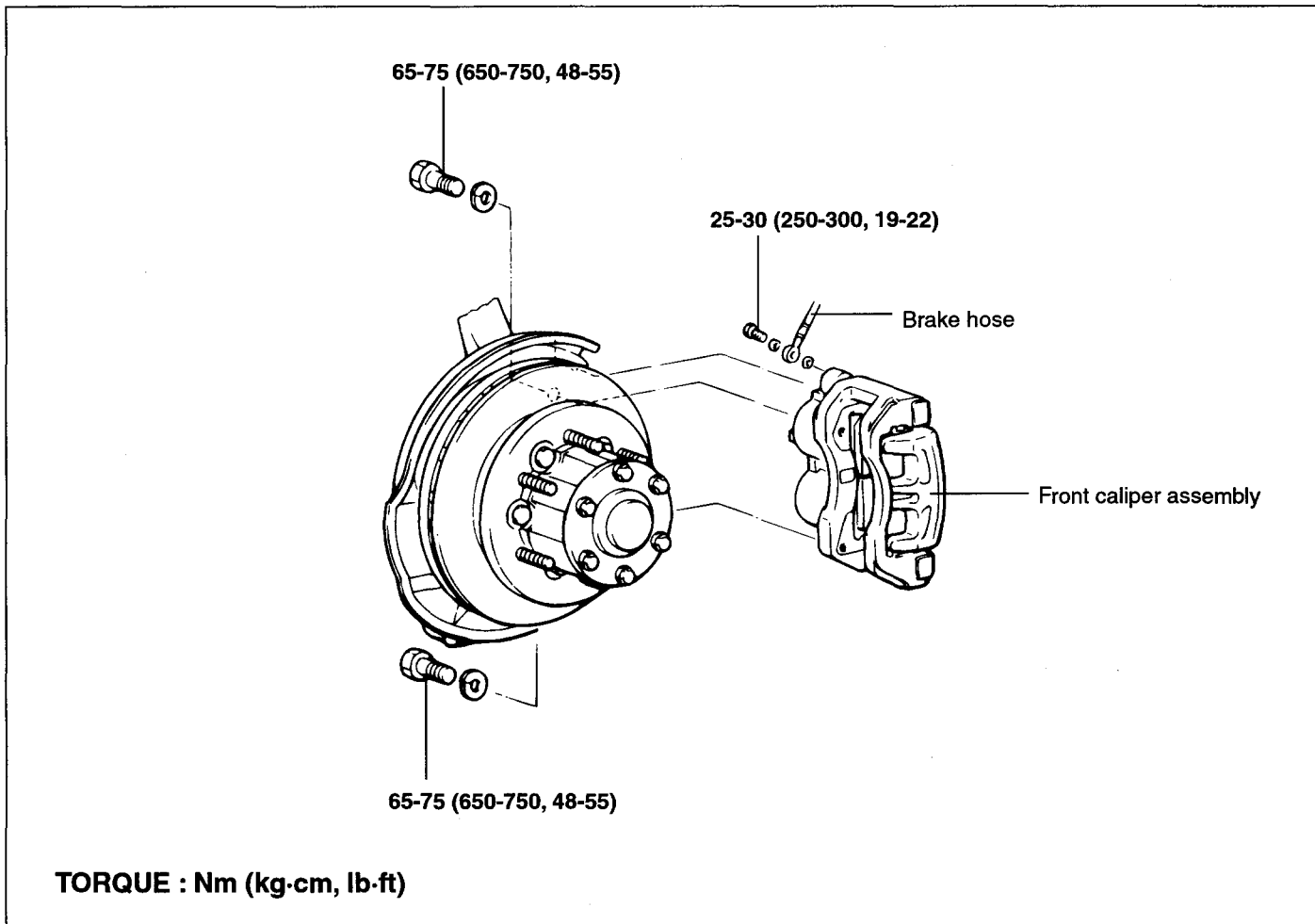


EJA9005B

## FRONT DISC BRAKE

## COMPONENTS

EJMB0220



EHPBR10A

INSPECTION AND REPLACEMENT OF  
FRONT DISC BRAKE PAD

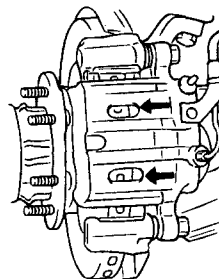
EJMB0230

1. Check the brake pad thickness through the caliper body inspection hole.

**Pad lining thickness**

Standard value : 10mm (0.394 in.)

Service limit : 2.0mm (0.079 in.)



H7BR215A

**CAUTION**

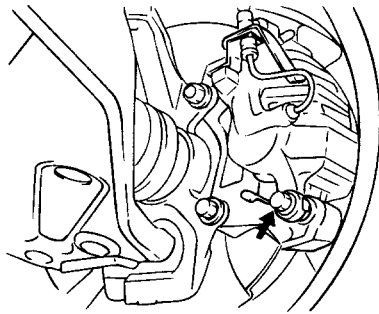
1. If the pad lining thickness is out of specification, left and right pads must be replaced as a complete set.

2. *When the thickness difference between the left pad and right pad is large, check the sliding condition of the piston, the lock pin and the guide pin.*

2. Remove the guide pin, lift the caliper assembly up and suspend it with a wire.

**CAUTION**

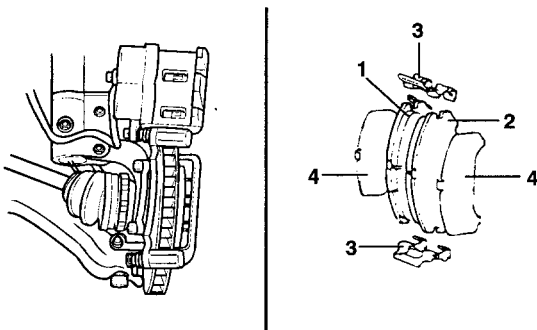
*Be careful not to contaminate the lock pin and guide pin with grease.*



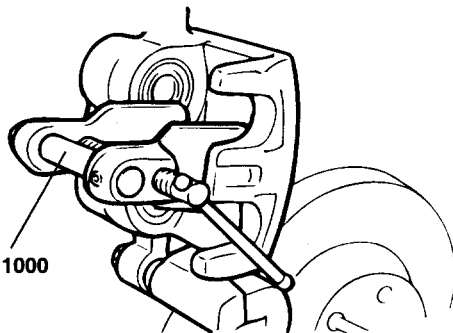
H7BR216A

3. Remove the following parts from the caliper support.

1. Pad and wear sensor assembly
2. Pad assembly
3. Clip
4. Outer shim



KJMB230A



09581-11000

KGX8029A

**INSPECTION** EJMB0240

**FRONT BRAKE THICKNESS CHECK**

1. Remove all rust and contamination from the disc surface, and then measure the disc thickness at 4 positions at least.

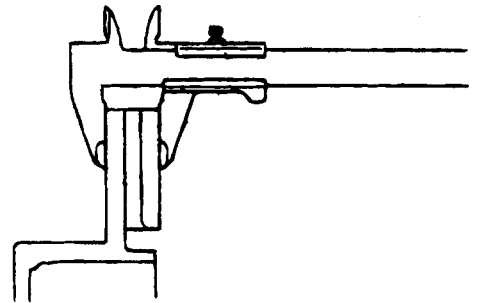
**Front brake disc thickness**

Standard value : 27mm (1.06 in.)

Limit : 25.4mm (1 in.)

2. Thickness variation should not exceed 0.005mm (circumference) and 0.05mm (radisu) at any directions.

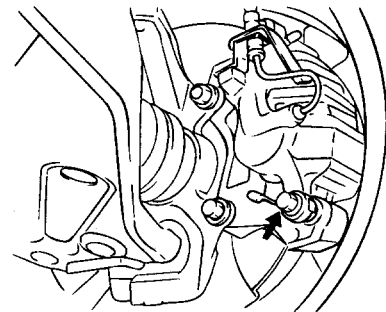
3. If wear exceeds the limit, replace the discs and pad assembly for left and right of the vehicle.



KGX8031A

**FRONT BRAKE DISC RUNOUT CHECK**

1. Remove the caliper support, then raise the caliper assembly upward and suspend with a wire.



H7BR216A

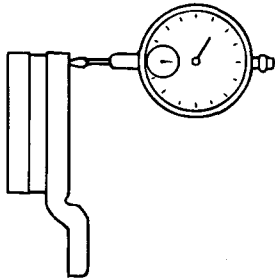
2. Place a dial gauge about 5mm (0.2 in.) from the outer circumference of the brake disc, and measure the runout of the disc.

**Brake disc runout**

Limit : 0.03mm (0.0012 in.) or less

**NOTE**

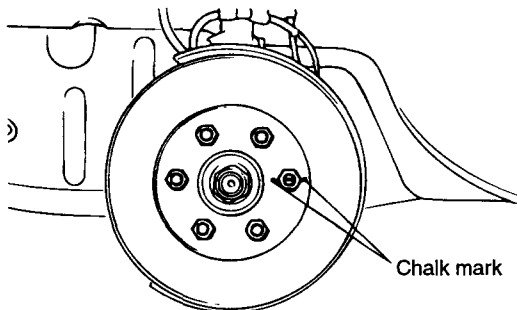
Fix the disc to the hub by tightening the nut.



H7BR221A

**FRONT BRAKE DISC RUN OUT CORRECTION**

1. If the runout of the brake disc is equivalent to or exceeds the limit specification, replace the disc and hub, and then measure the runout again.
  - 1) Before removing the brake disc, chalk both sides of the wheel stud on the side at which the runout is greatest.



EJMB240A

- 2) If it exceeds the limit, disassemble the hub knuckle and check each part.
  - 3) If the runout does not exceed the limit specification, install the brake disc after turning it 180° from the chalk mark, and then check the runout of the brake disc again.
2. If the runout cannot be corrected by changing the position of the brake disc, replace the brake disc.

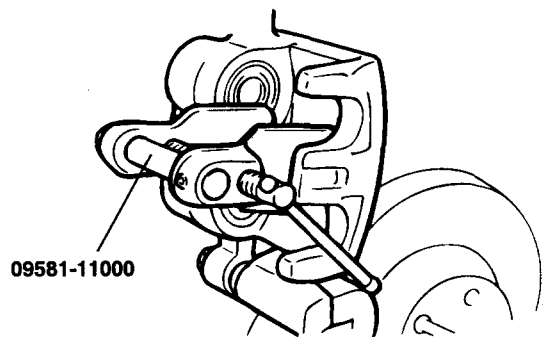
**INSTALLATION**

EJMB0250

1. Install the pad clips.
2. Install the pads on each pad clip.

**CAUTION**

1. **All four pads must be replaced as a complete set.**
  2. **When replacing the brake pads, check for deformation. When replacing the guide spring, use a new one or thoroughly clean the used one.**
3. Press-fit the piston with a hammer handle or the special tool (09581-11000).



KGX8029A

4. Lower and insert the brake cylinder carefully so as not to damage the boot.
5. Tighten the two guide rod bolts to the specified torque.

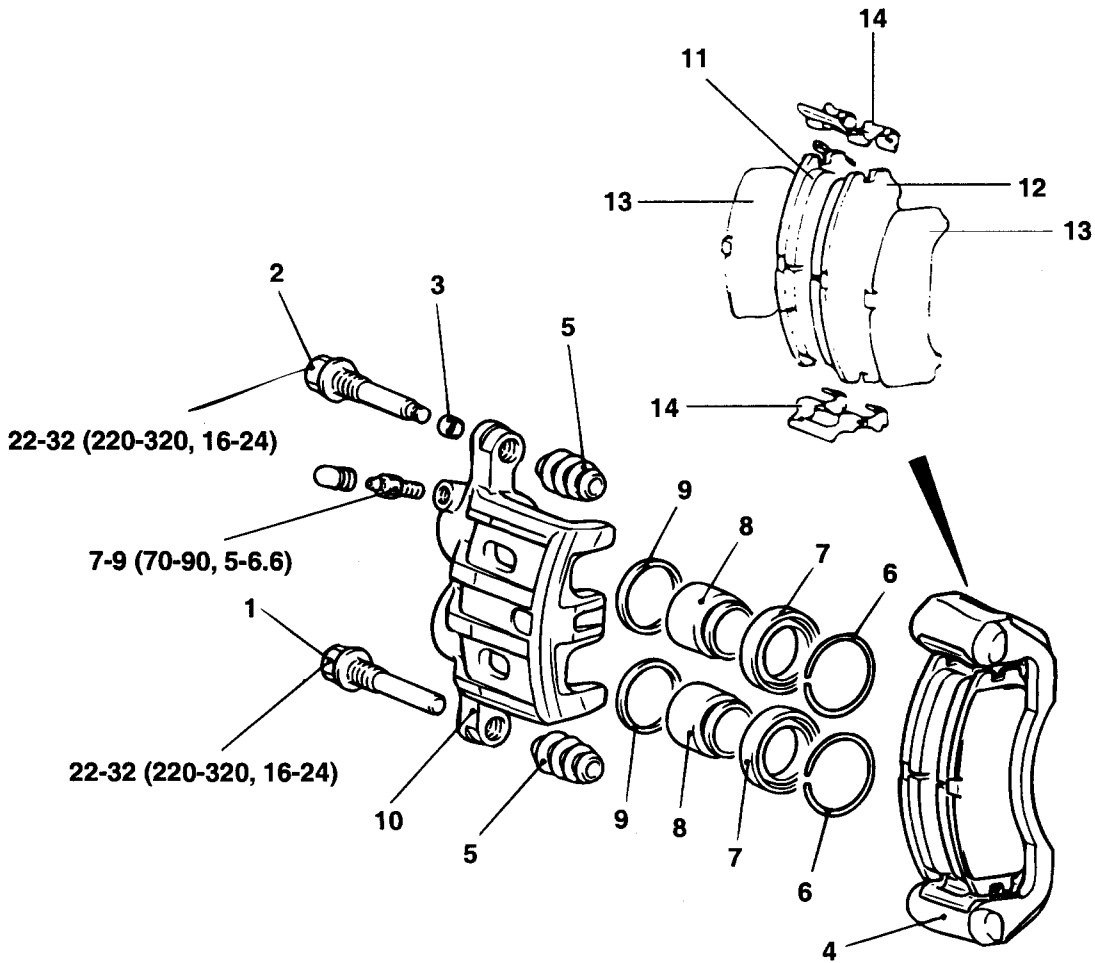
**Tightening torque**

Guide rod bolt :

22 - 32 Nm (220 - 320 kg·cm, 16 - 24 lb·ft)

DISASSEMBLY AND REASSEMBLY

EJJB0230

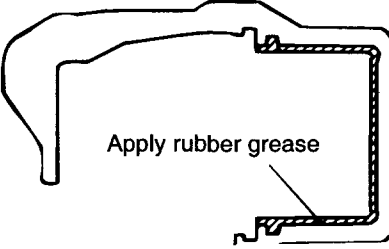


- |                    |                                     |
|--------------------|-------------------------------------|
| 1. Guide bolt      | 8. Piston                           |
| 2. Lock pin        | 9. Piston seal                      |
| 3. Bushing         | 10. Caliper body                    |
| 4. Caliper support | 11. Pad and wear indicator assembly |
| 5. Boot            | 12. Pad assembly                    |
| 6. Boot ring       | 13. Outer shim                      |
| 7. Piston boot     | 14. Clip                            |

**TORQUE : Nm (kg.cm, lb.ft)**

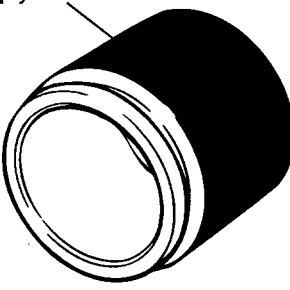
LUBRICATION POINTS

EJJB0240



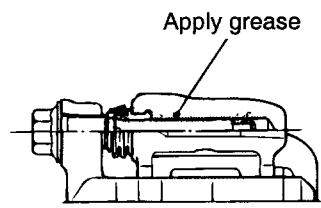
Apply rubber grease

Apply castor oil



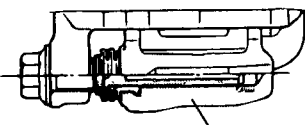
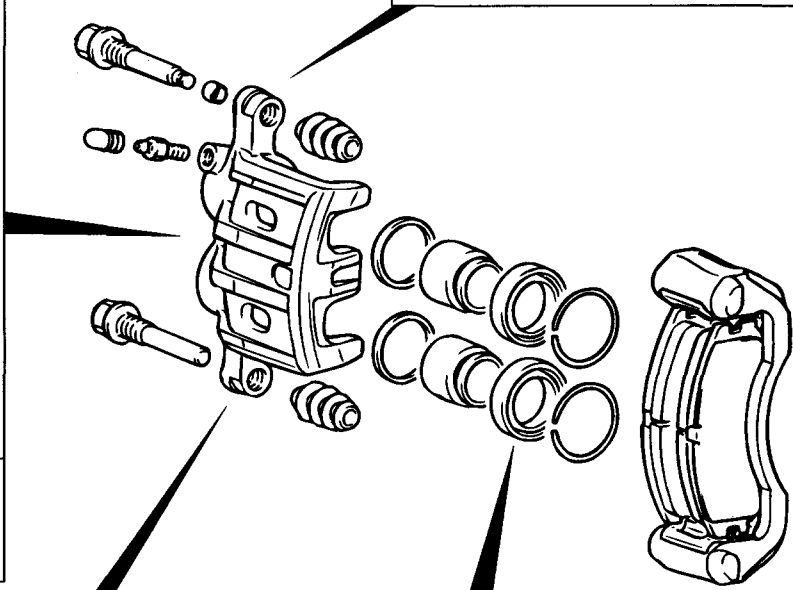
**CAUTION**  
Be careful not to wash off special grease.

Cylinder inner surface :  
Rubber grease  
Piston : Castor oil



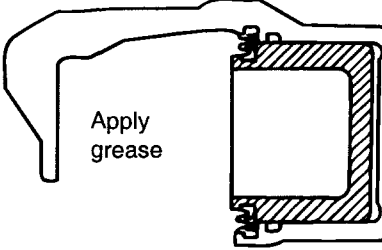
Apply grease

Grease : RX-2



Apply grease

Grease : RX-2 (MES 4-3-065)



Apply grease

Grease : Rubber grease



**DISASSEMBLY** EJMB0260

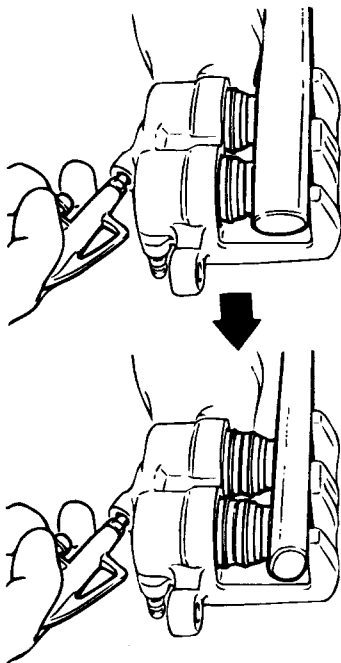
Front disc brakes should be disassembled separately into the left and right as a set.

1. Remove the piston boot/piston.  
Blow compressed air into the brake hose seating hole so as to remove the piston and the piston boot.

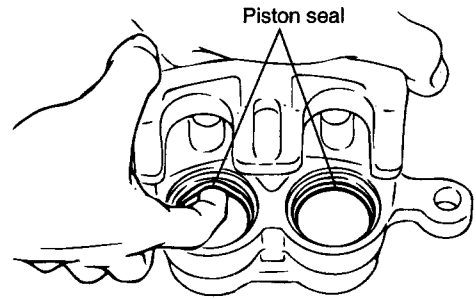
**NOTE**

*When removing the piston, blow air slowly, adjusting the heights of the two pistons to push them out equally.*

*The secondary piston should not be removed before the primary piston is removed completely. Otherwise the secondary piston can't be removed.*



KGX8039A



KGX8040A

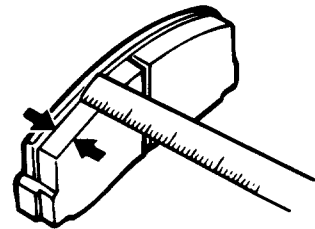
**INSPECTION** EJJB0260

1. Check the cylinder for wear, damage and rust.
2. Check the piston surface for wear, damage and rust.
3. Check the caliper body and sleeve for wear.
4. Check that grease is applied, and the pad and backing metal are not damaged.
5. Check the pad wear. Measure the pad thickness and replace it if it is less than the specified value.

**Pad thickness**

Specification : 10.0 mm (0.39 in.)

Service limit : 2.0 mm (0.08 in.)



KGX8041A

2. Remove the piston seal.
  - 1) Remove the piston seal with your finger.

**CAUTION**

**Do not use a screwdriver or another tool because it may damage the cylinder.**

- 2) Clean the piston surface and inner cylinder using alcohol or the specified brake fluid.

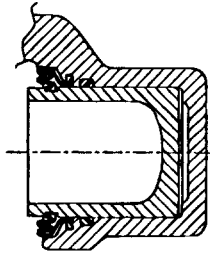
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Brake fluid : DOT 3 or DOT 4

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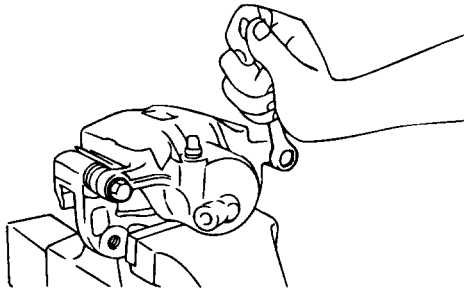
**REASSEMBLY** EJB0270

1. Clean all components with isopropyl alcohol except for the pad and shim.
2. Install the piston seal.
3. After applying the specified brake fluid to the piston outer surface, install the piston into the cylinder.
4. Install the piston boot and boot ring.



EJHA008A

5. Install the guide pin boots and guide pin.



EJA9015J

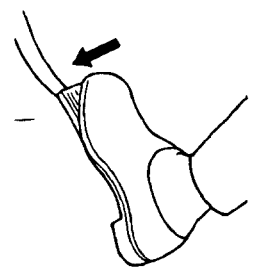
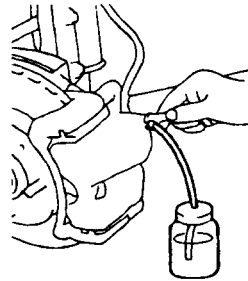
**INSTALLATION** EJMB0280

1. Install the pads and brake cylinder.
2. Install the brake hose to the caliper.

**Tightening torque**

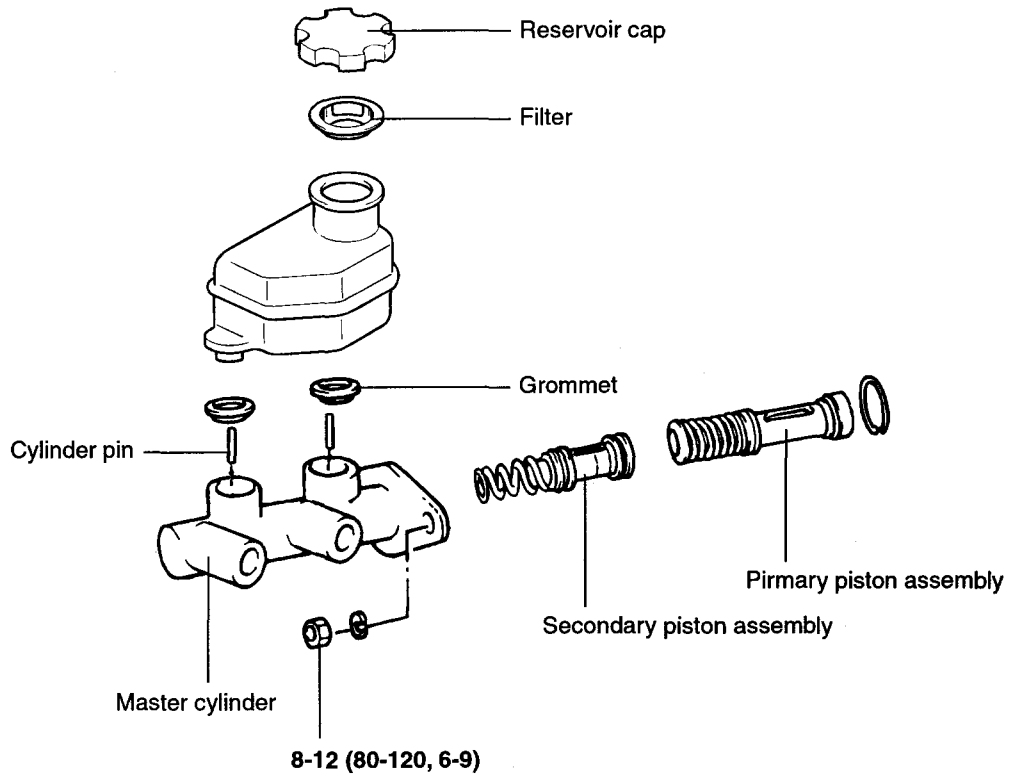
Bleeder screw : 7-9 Nm (70-90 kg-cm, 5-6.6 lb-ft)

3. Fill the brake reservoir with brake fluid.
4. Bleed the system.



EAHA014B

## MASTER CYLINDER

COMPONENTS EJMB0290

**TORQUE : Nm (kg-cm, lb-ft)**

EHPBR06A

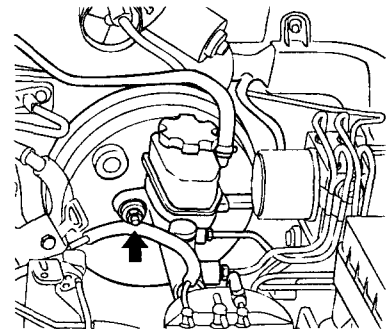
REMOVAL EJMB0291

1. Detach the brake tubes from the master cylinder, and then install the plug.

**⚠ CAUTION**

**Do not allow brake fluid to remain on a painted surface. Wash it off immediately.**

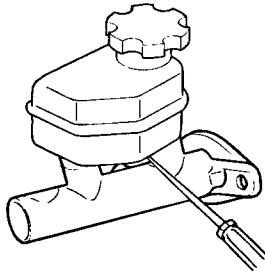
2. Remove the master cylinder mounting nuts and then remove the master cylinder.



KHPBR07A

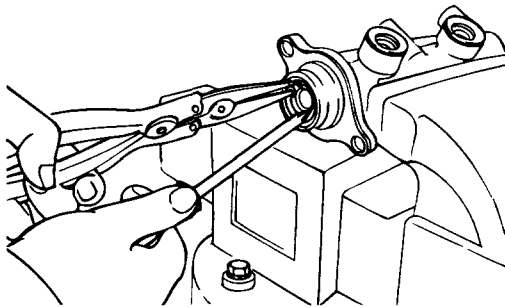
**DISASSEMBLY** EJMB0300

1. Remove the reservoir cap and drain the brake fluid into a suitable container.
2. Remove the reservoir from the master cylinder.



KHPBR08A

3. Using a snap ring pliers, remove the retainer ring.

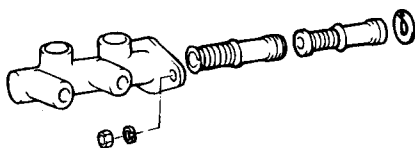


EJDA027B

4. Remove the cylinder pin with the primary piston pushed completely using a screwdriver. Remove the primary piston assembly.
5. Remove the cylinder pin with the secondary piston pushed completely using a screwdriver. Remove the secondary piston assembly.

**NOTE**

Do not disassemble the primary and secondary piston assembly.



EJDA027C

**INSPECTION** EJMB0310

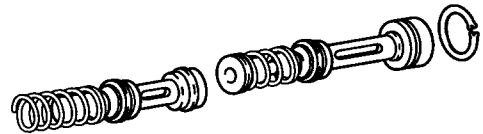
1. Check the master cylinder bore for rust or scratch.
2. Check the master cylinder for wear or damage. If necessary, clean or replace the cylinder.

**CAUTION**

1. If the cylinder bore is damaged, replace the master cylinder assembly.
2. Wash the contaminated parts in alcohol.

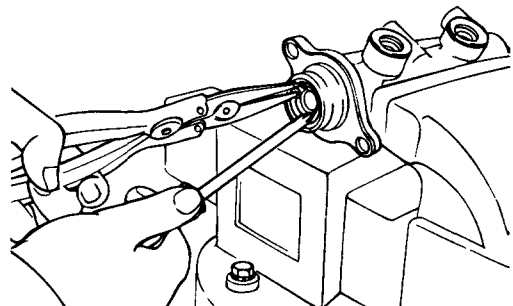
**REASSEMBLY** EJMB0320

1. Apply genuine brake fluid to the rubber parts of the cylinder kit and grommets.



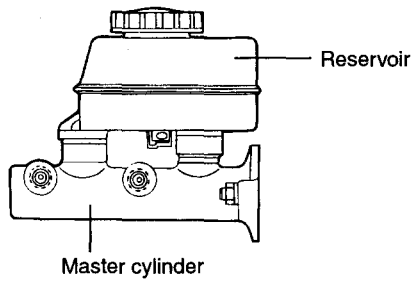
KFW8016A

2. Carefully insert the springs and pistons in the proper direction.
3. Press the piston with a screwdriver and install the retainer ring.



EJDA027B

4. With the piston pushed completely by a screwdriver, install the piston pin.
5. Mount two grommets.
6. Install the reservoir on the cylinder.



EJMB170A

**INSTALLATION**

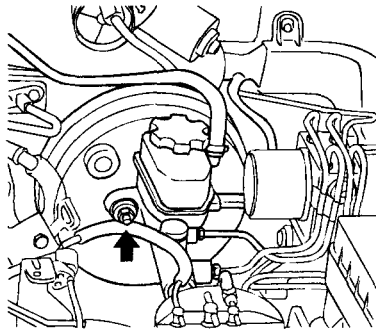
EJMB0330

1. Install the master cylinder the on brake booster with 2 nuts.

**Tightening torque**

Master cylinder installation nut :

8-12 Nm (80-120 kg·cm, 6-9 lb·ft)



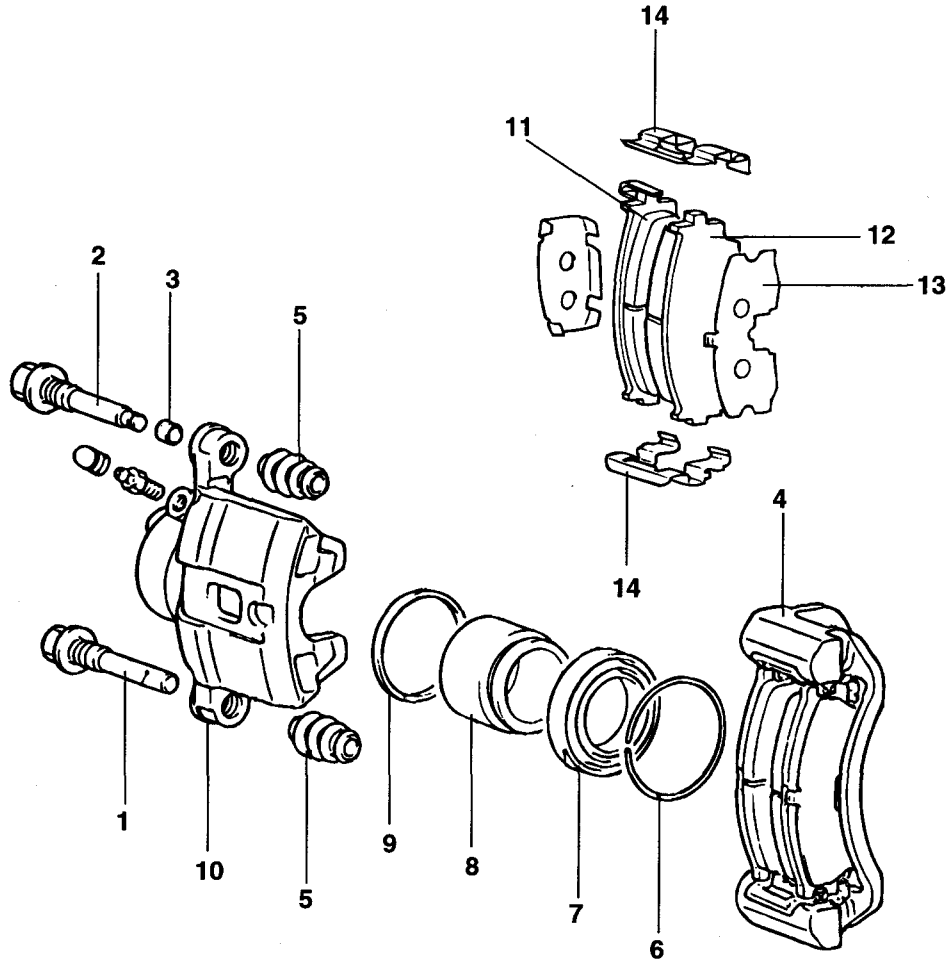
KHPBR07A

2. Connect 2 brake tubes and the brake fluid level warning connector.

**Tightening torque**

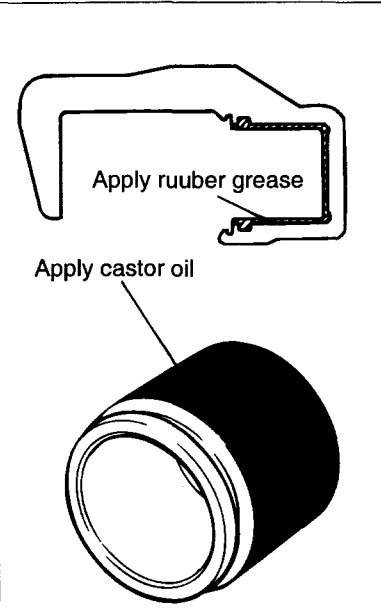
Brake tube flare nut : 13-17 (130-170 kg·cm, 9.5-12 in.)

## REAR DISC BRAKE

COMPONENTS EJMB0340

- |                    |                                     |
|--------------------|-------------------------------------|
| 1. Guide bolt      | 8. Piston                           |
| 2. Lock pin        | 9. Piston seal                      |
| 3. Bushing         | 10. Caliper body                    |
| 4. Caliper support | 11. Pad and wear indicator assembly |
| 5. Boot            | 12. Pad                             |
| 6. Boot ring       | 13. Outer shim                      |
| 7. Piston boot     | 14. Clip                            |

LUBRICATION POINTS EJJ80300

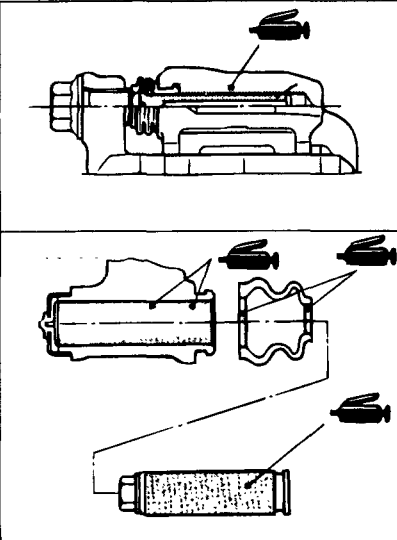


Apply rubber grease

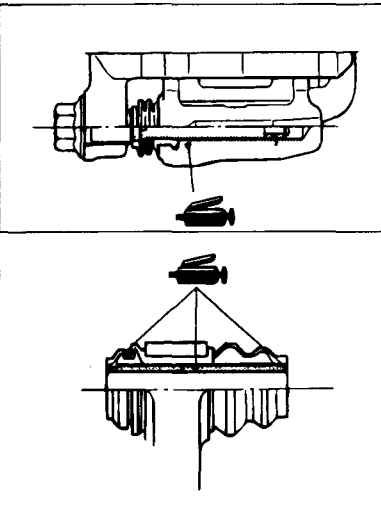
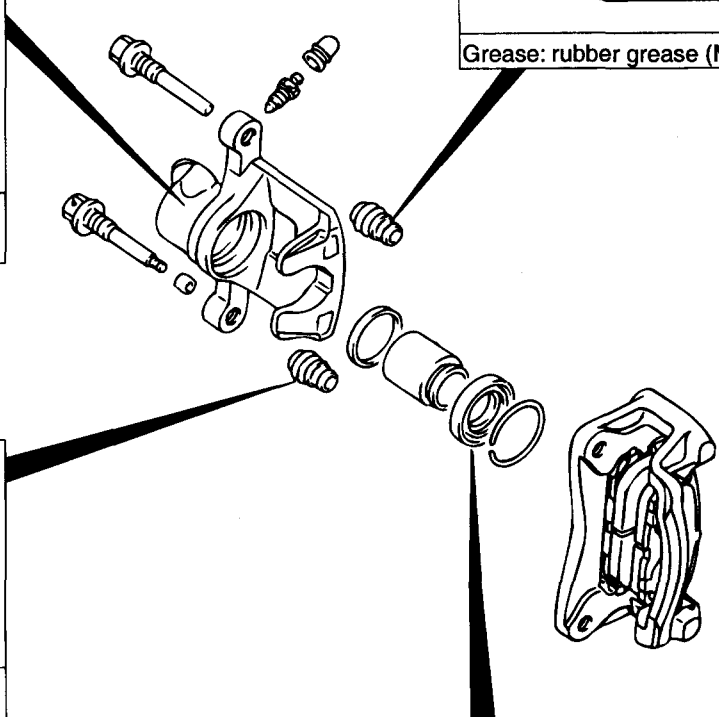
Apply castor oil

**CAUTION**  
Be careful not to wash off special grease.

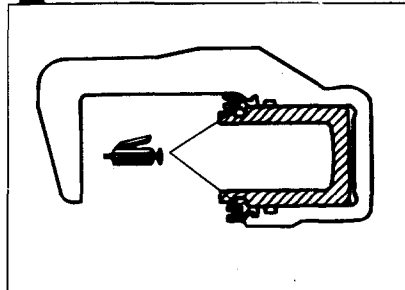
Brake fluid : DOT3 or DOT4



Grease: rubber grease (MES4-3-602)



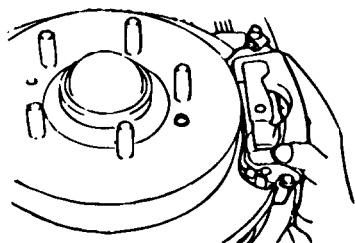
Grease: rubber grease(MES4-3-602)



Grease: rubber grease(MES4-3-602)

**DISC BRAKE PAD** EJMB0350**REMOVAL**

1. Remove the wheel.
2. Remove the guide bolt, lift up the caliper assembly, and remove the pad assembly.



EJJA030B

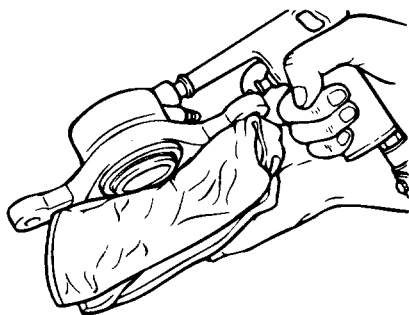
**DISASSEMBLY SERVICE POINT**

Rear disc brakes should be disassembled separately as a set of left and right as a set.

1. Remove the piston boot/piston. Wrap the caliper body with a rag. Blow compressed air into the brake hose, and remove the piston and the piston boot.

**CAUTION**

*Blow air slowly.*



KGX8057A

2. Remove the piston seal.
  - 1) Remove the piston seal with your finger.

**CAUTION**

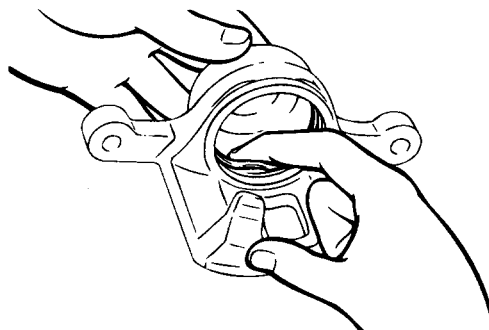
*Do not use a screwdriver or another tool in order to avoid damage the inside of the cylinder.*

- 2) Clean the piston surface and the inside of the cylinder using trichloro-ethylene, alcohol or the specified brake fluid.

---

Brake fluid : DOT 3 or DOT 4

---



KGX8058A

EJMB0360

**INSPECTION**

1. Check the cylinder for wear, damage and rust.
2. Check the piston surface for wear, damage and rust.
3. Check the caliper body and sleeve for wear.
4. Check that grease is adhesive, and the pad and backing metal are damaged.
5. Check the pads for wear or oil contamination and replace if necessary.

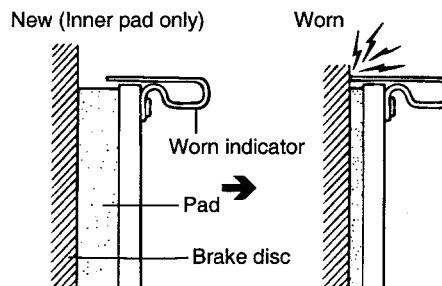
**NOTE**

*The pads for the right and left wheels should be replaced at the same time.*

---

Pad thickness wear limit : 2.0mm (0.08 in.)

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EJA9015E

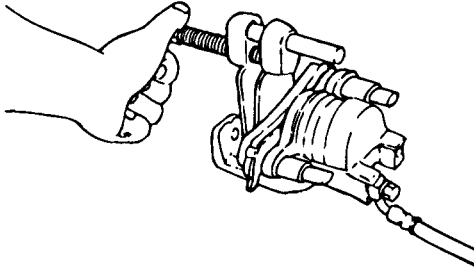
6. Check for worn or damaged dust boots. If dust or mud had entered the caliper assembly through the seal, the caliper assembly must be replaced or repaired.



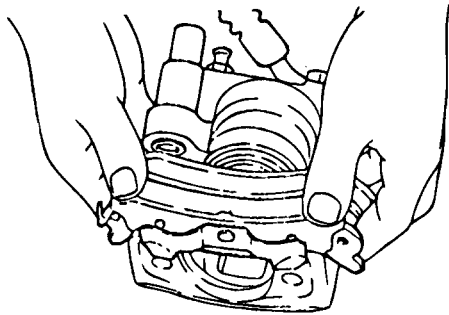
EJMB0370

**INSTALLATION**

1. Before replacing the brake pads, drain brake fluid from the master cylinder reservoir until it remains half full.
2. Remove the brake pad by turning the piston in the housing assembly. Using the special tool (09581-11000), remove the piston.



EJJA035A



EJJA035B

3. Install two caliper guide rods and tighten to a torque of 22-32 Nm (220-320 kg-cm, 16-23 lb-ft)
4. After filling the master cylinder reservoir with the fluid, bleed the brake line.

---

Recommended brake fluid : DOT 3 or DOT 4

---

**CALIPER** EJMB0380**REMOVAL**

1. Remove the rear wheel.
2. Remove the caliper assembly.
3. Remove the brake hose from the caliper.

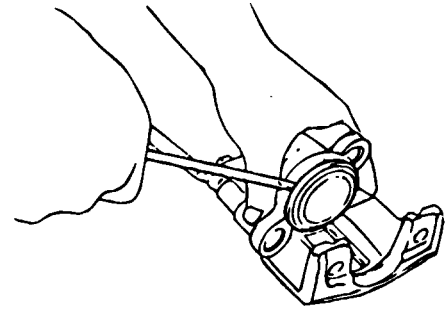
EJMB0390

**DISASSEMBLY**

1. Remove the pad.
2. Remove the piston boot from the housing, and then remove the piston.

**NOTE**

Using a wire hanger or equivalent, remove the caliper so as not to damage the brake hose.

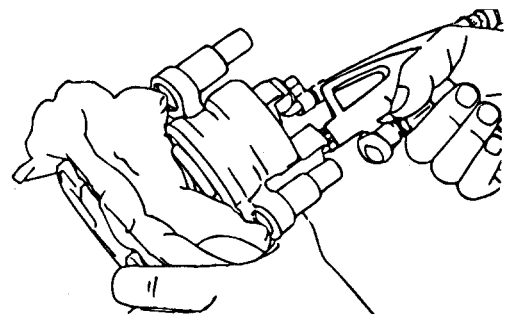


EJJA035D

3. Remove the piston by applying compressed air through the brake hose fitting.

**NOTE**

Do not place your fingers in front of the piston when using compressed air.



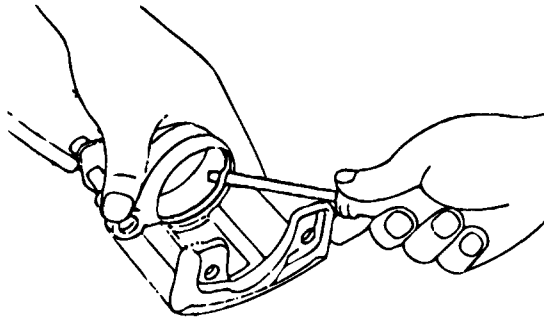
EJJA035E

- Remove the piston seal carefully so as not to damage the cylinder wall.
- Clean all removed parts with the specified fluid.

Item	Specified fluid
Metal section	Trichloroethylene, alcohol or brake fluid
Piston seal	If the oil level is low, add fluid (about 70cc).
Piston boot and other rubber parts	Alcohol

**CAUTION**

Rubber parts should be replaced with new ones but if you want to reuse them, don't put them in alcohol for more than thirty minutes.

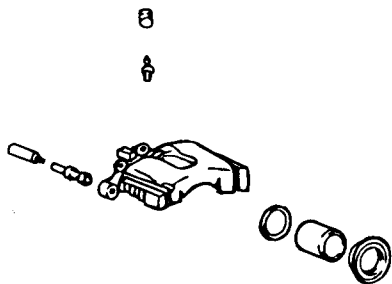


EJJA035F

EJJB0370

**INSPECTION**

- Check the piston and its inside for wear, damage and rust. Replace the damaged parts if necessary.
- Check the piston seal, boot, and pin insulators for wear and damage.



EJJA035G

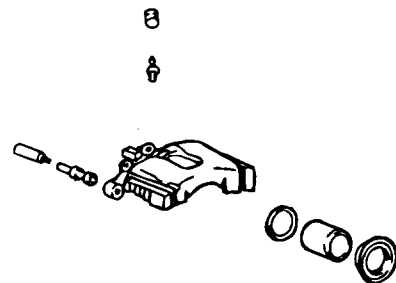
EJMB0400

**REASSEMBLY**

- When disassembling the caliper assembly, use a new piston seal and boot.
- Apply the recommended fluid to the bearing part of the piston seal and piston. Insert the piston seal into grooves inside the caliper, being careful not to twist the seal.

Item	Recommended fluid	Quantity
Piston seal	Brake fluid (DOT3, DOT4)	As required
Inside of piston cylinder	Brake fluid (DOT3, DOT4)	As required
Piston boot	Brake fluid (DOT3, DOT4)	As required
Locating pin insulator	White silicone grease	As required

- Install the piston boot to the piston. Confirm that the concave part of the piston is placed outward and the boot is seated in grooves of the piston completely.



EJJA035G

- Install the piston and boot in the caliper housing. Insert the boot flange in the caliper housing and check that the boot fits in grooves around the piston.
- Apply the recommended oil to the inside of the locating pin insulator.

EJMB0410

**INSTALLATION**

1. Refer to "Brake pad installation" for detail.
2. Install the brake hose connector
3. Install the caliper installation bolt.
4. Bleed the system.

**CAUTION**

***When replacing the piston seal, check the pedal stroke.***

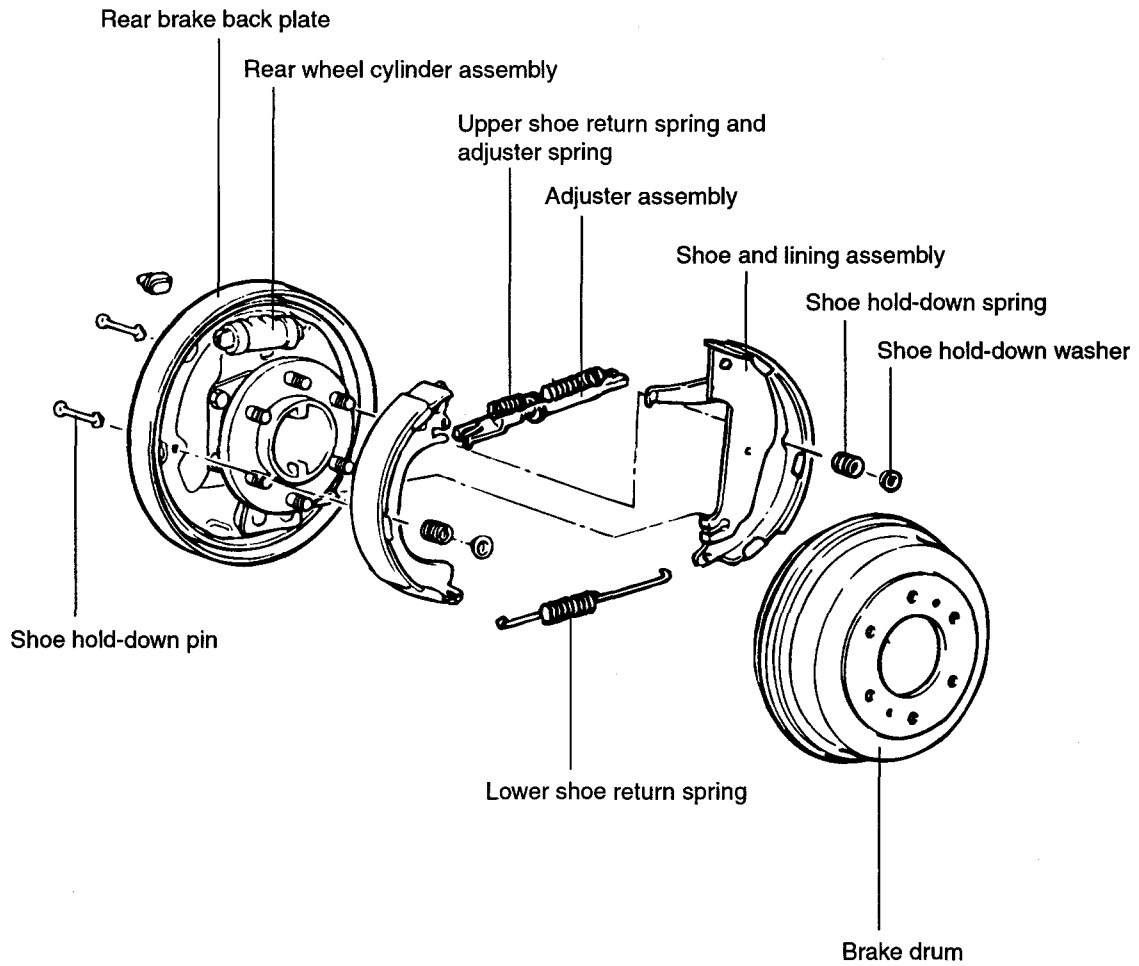
***If the pedal stroke is too excessive, the piston may not retain the piston seal.***

***Adjust as follows :***

1. ***After removing the pad from the piston, push the piston into the cylinder 3-5mm. Put a lever or steel plate (1m x 0.3m) between the piston and disc, being careful not to damage the contact surface of the disc or the piston end.***
2. ***Install the pad. To restore the brake pedal to the original position, step on it 2-3 times.***
3. ***Repeat the above procedure more than 5 times and move the piston outward and inward to assure that the piston seal is properly installed.***
4. ***Before driving a vehicle, step on the brake pedal and release it several times.***
5. ***Perform the road test.***

# REAR DRUM BRAKE

## COMPONENTS EJMB0420



### Removal steps

1. Wheel and tire
2. Brake drum
3. Shoe hold-down spring
4. Adjuster assembly
5. Shoe return spring
6. Shoe and lining assembly

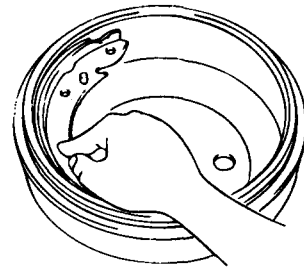
**INSPECTION** EJMB0430

1. Measure the brake drum inside diameter. Check the runout of the brake drum using a dial indicator.

---

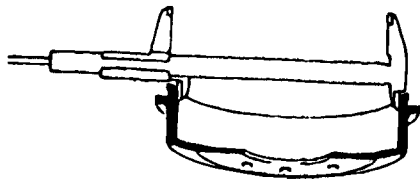
Standard value : 270mm (10.63 in.)  
Service limit : 272mm (10.71 in.)

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**⚠ CAUTION**

*If the brake drum inner diameter is greater than the service limit, replace the brake drum.*

EJA9018E



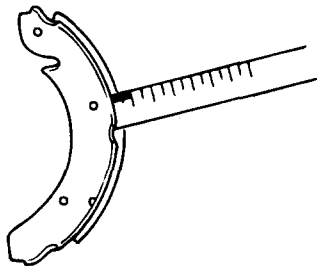
EJA9018C

2. Measure the brake lining thickness.

---

Standard value : 4.7mm (0.185 in.)  
Service limit : 1.5mm (0.059 in.)

---



EJA9018D

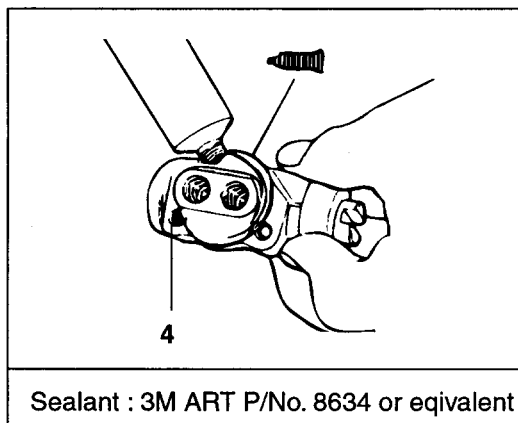
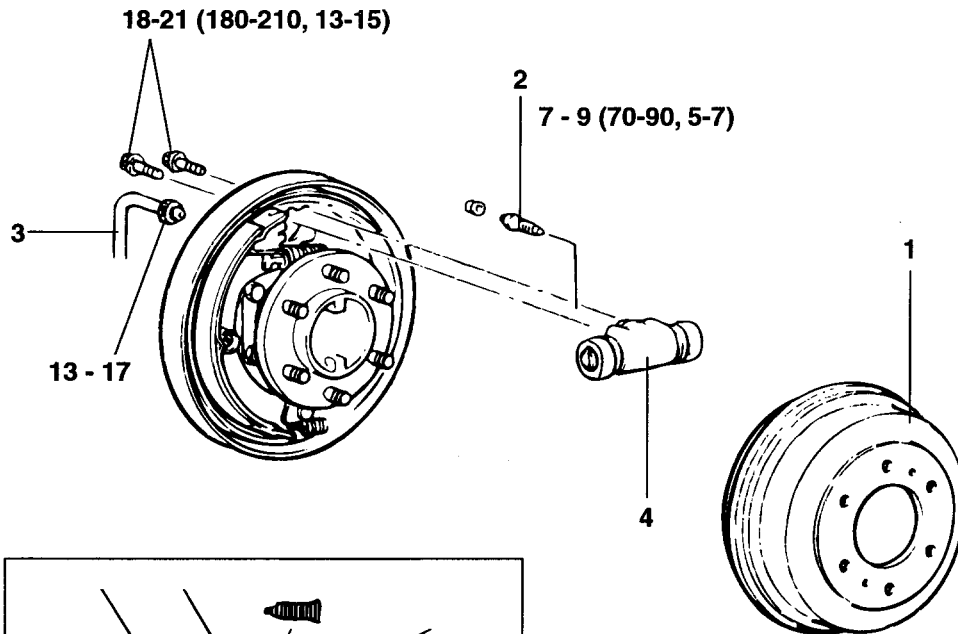
**⚠ CAUTION**

*If the brake lining thickness is less than the service limit, replace the brake lining.*

3. Inspect the brake lining and drum for proper contact.
4. Inspect the outside of the wheel cylinder for excessive corrosion and damage.

## REMOVAL AND INSTALLATION

EJMB0440

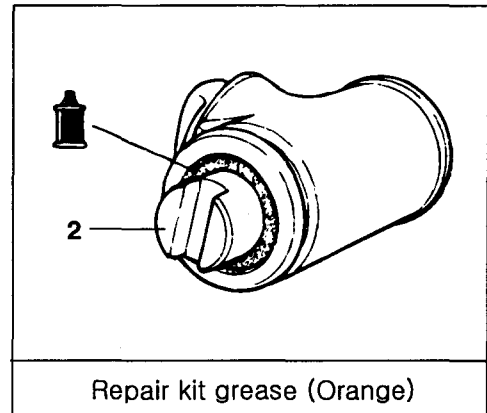
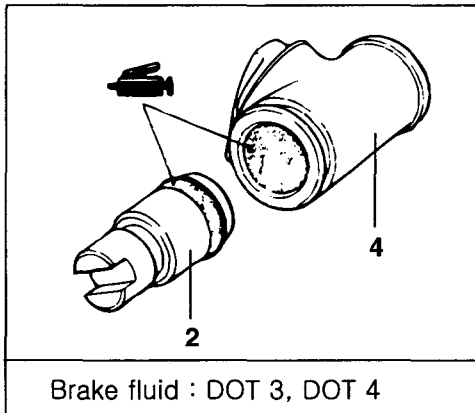
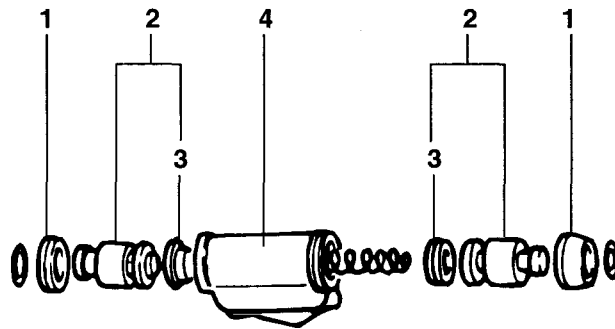
**Removal steps**

1. Brake drum
2. Bleeder screw
3. Brake tube
4. Wheel cylinder assembly

**Procedures after installation**

- Applying brake fluid
- Air bleeding

**TORQUE : Nm (kg-cm, lb-ft)**

DISASSEMBLY AND REASSEMBLY EJMB0450**Disassembly steps**

1. Wheel cylinder boot
2. Piston assembly
3. Piston cup
4. Body machining

**REASSEMBLY** EJMB0460**PISTON CUP**

1. Clean the inside of the wheel cylinder and the outside of the piston with alcohol or brake fluid.
2. Apply the specified brake fluid on piston cup.

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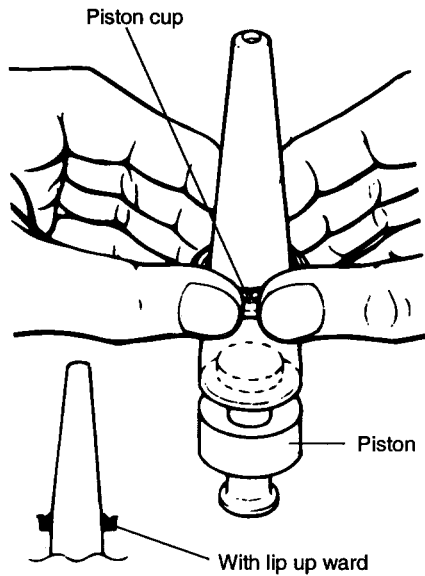
Specified brake fluid : DOT 3 or DOT 4

---

3. Until the piston cup is seated completely, push the special tool with fingers as shown in the illustration.

**⚠ CAUTION**

***When pushing down the piston cup, push slowly with both hands without stopping so that deformation or turn-over will not result.***



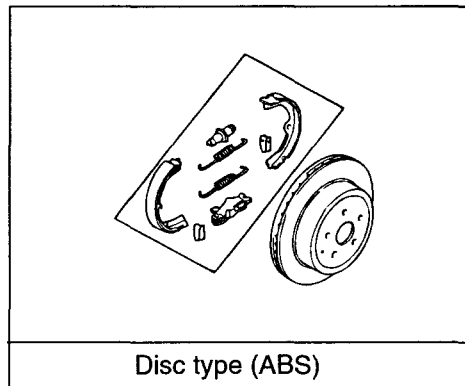
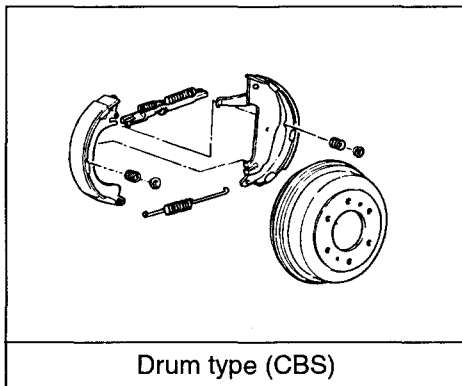
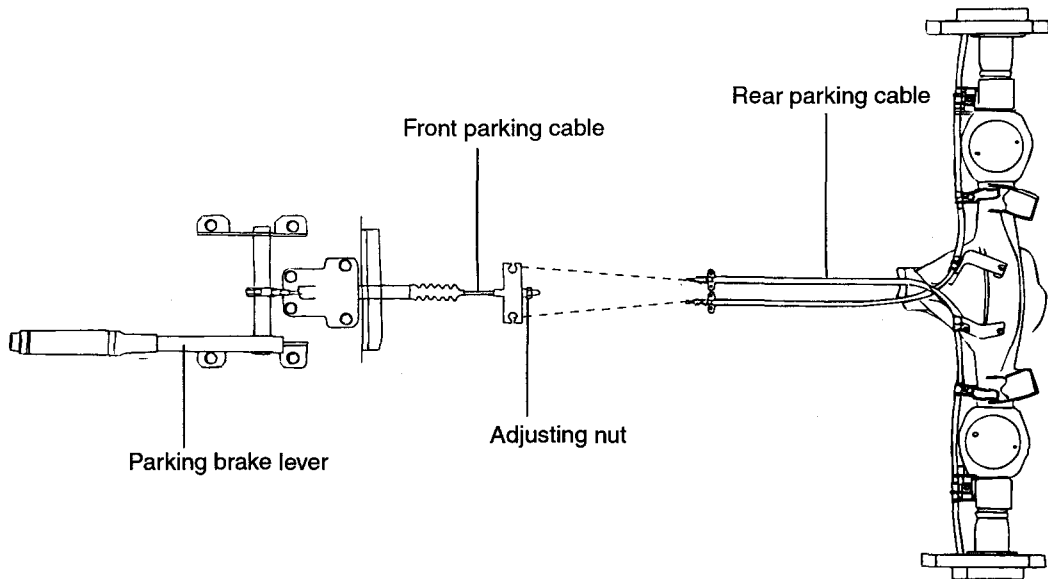
AHBR0840



# PARKING BRAKE SYSTEM

## PARKING BRAKE

### REMOVAL AND INSTALLATION EJMB0470



#### Removal steps for the lever

1. Remove the console
2. Loosen the lever adjusting nut
3. Detach the cable from the lever
4. Remove the lever mounting bolts
5. Disconnect the parking brake switch connector

#### Removal steps for cable

1. Remove the console
2. Loosen the lever adjusting nut
3. Detach the cable from the lever
4. Connect the cable to the body and install the axle housing
5. Remove the cable clip
6. Remove the parking cable from the operating lever

## ADJUSTMENT PROCEDURE EJMB0480

### PARKING BRAKE STROKE ADJUSTMENT

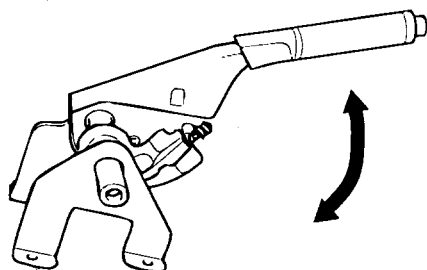
1. Pull the brake lever with force of 200N (20kg, 44lbs) and count the number of notches.

#### CAUTION

*After operating the parking brake at full stroke more than 3 times, operate it in the position of 40mm of lever so as to seat the cable completely.*

#### Parking brake stroke

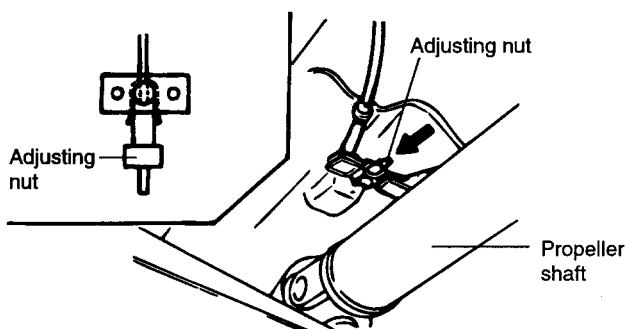
Standard value : 8 clicks



KHPBR13A

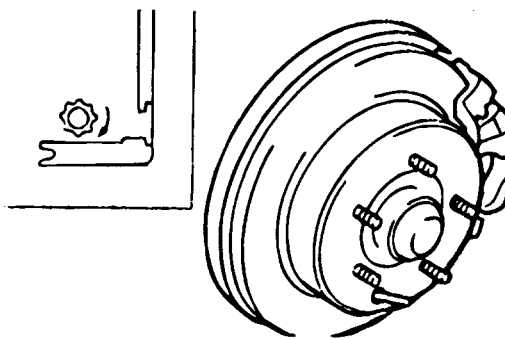
2. If the parking brake stroke is out of the standard value, adjust it as follows :

- 1) Loosen the adjusting nut to release the parking brake cable.



EHPB320A

- 2) Remove the adjusting hole plug, and then turn the adjuster the direction of the arrow. To prevent the disc from rotating, use a screwdriver (flat tip (-)).
- 3) Turn the adjuster 5 notches in the opposite direction of arrow.



EJJA040B

- 4) Turn the adjuster nut to adjust the parking brake stroke to the specification.

#### CAUTION

*If the number of parking brake notches is less than the specification, loosen the adjusting nut and readjust.*

- 5) After adjusting, check that there is no gap between the adjusting nut and pin and that the adjusting nut is fixed in the nut holder precisely.
- 6) After adjusting the parking brake stroke, raise the rear of vehicle with a jack.
- 7) Check that the rear brakes do not drag by turning the rear wheel when the parking brake lever is released.

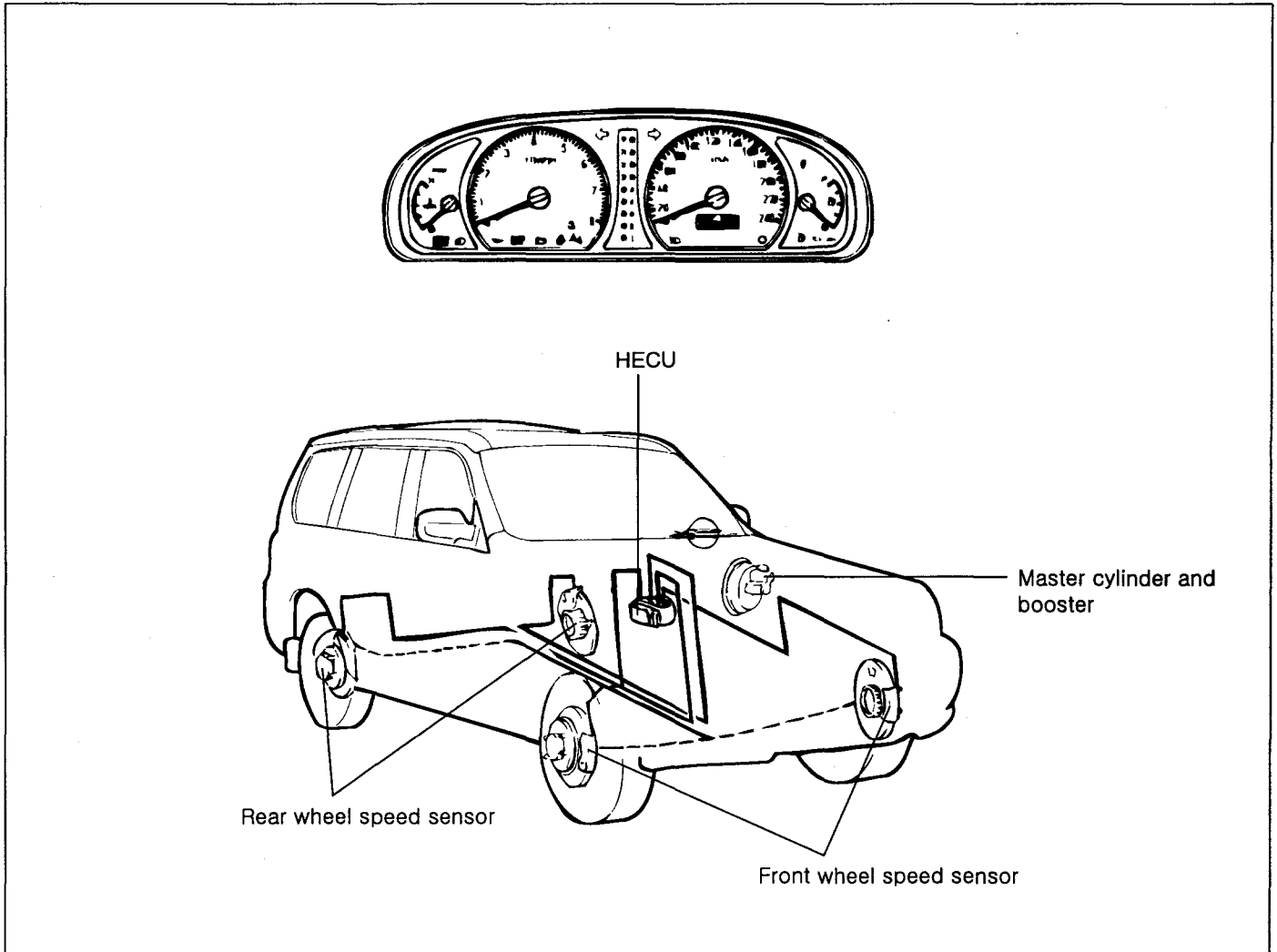
### PARKING BRAKE BED-IN (DIH)

1. When the parking brake lever is pulled with force of 20-25 kg(f), drive the vehicle 400m at 60 kph.
2. Repeat step 1 more than 2 times.
3. Parking should be possible on a hill of 30%.

# ABS (ANTI-LOCK BRAKE SYSTEM)

## SYSTEM COMPONENT

EJMB2100



EJMB210A

The Anti-Lock Brake System (ABS) controls the hydraulic brake pressure of all four wheels during sudden braking and braking on hazardous road surfaces, preventing the wheels from locking up. ABS provides the following benefits :

1. Enables steering around obstacles with a greater degree of certainty, even during emergency braking.
2. Enables stopping during emergency braking while keeping stability and steerability even on curves.

If a malfunction occurs, a diagnosis function and fail-safe system are included for serviceability.

The traction control is a variable system designed to enhance traction during acceleration and cornering. It does

so by determining the optimum amount of wheel spin for any given driving situation, and then suppressing surplus engine power accordingly.

The hydraulic electronic control unit (HECU) receives signals concerning the vehicle's speed, direction and road conditions from sensors at the wheels. Based on these signals, the control unit will determine the optimum amount of wheel spin. Because the system is variable, the control unit may determine, depending on the driving conditions, that some wheel spin is beneficial (thus enhancing straight-line acceleration), or that no wheel spin is beneficial (thus enhancing cornering). For any given driving situation, the control unit will determine the amount of wheel

spin best suited to the driver's needs. The system is automatically read whenever the engine is started, but can be manually canceled with the TCS switch.

However, once actuated, the system cannot be canceled until it is once again in the ready state.

## EBD (ELECTRONIC BRAKE-FORCE DISTRIBUTION)

EJMB2150

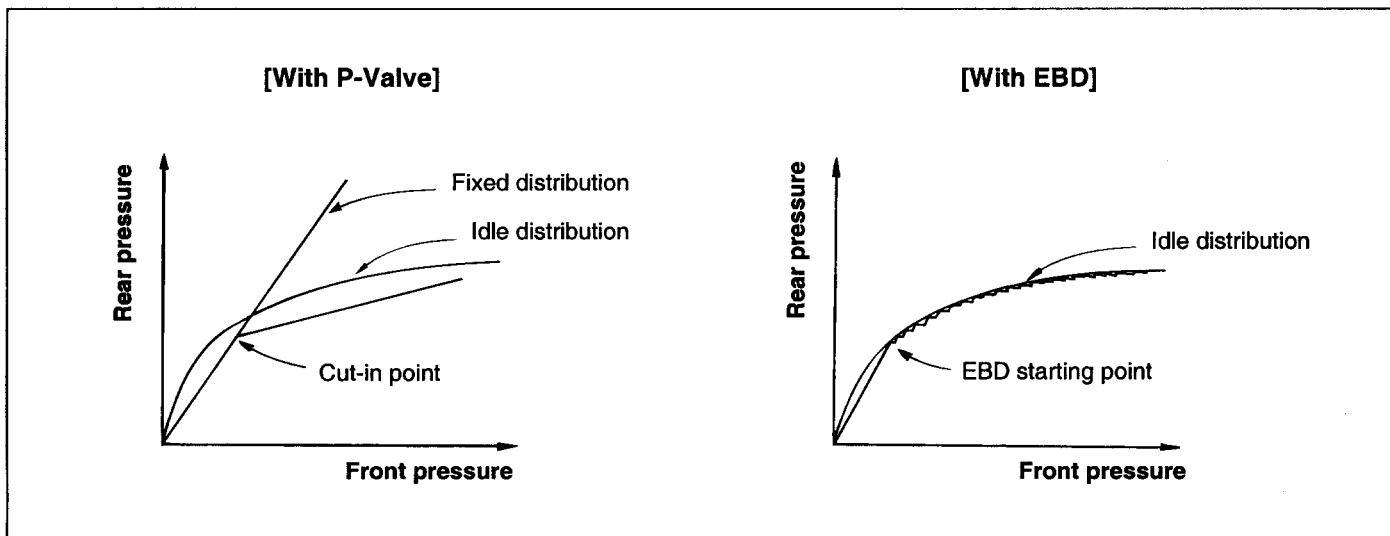
EBD is additionally applied, instead of the proportioning valve, to deliver ideal distribution of fluid pressure to the

front and rear brakes. This prevents the brakes from skidding in the event of rear wheel lock up and provides higher brake efficiency within the range of brake application.

### ADVANTAGES

- Functional improvement of base-brake system
- Compensation of different friction coefficients
- Elimination of proportioning valve
- Failure recognition by warning lamp

### COMPARISON BETWEEN PROPORTIONING VALVE AND EBD

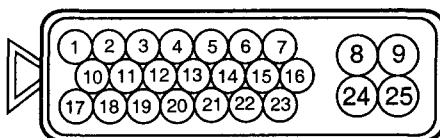


EJA0032A

INSPECTION AT HECU TERMINALS

EJMB2200

TERMINAL VOLTAGE CHART



EJHA025A

Terminal No.	Description	Condition	Output
9	<ul style="list-style-type: none"> <li>Battery power source 1</li> <li>Solenoid valve power source</li> </ul>	Always	System voltage
8	Ground	G12	
7	Diagnosis interface (K-Line)	Data to the Hi-Scan	
5 1 19 23	Wheel speed sensor (Left rear) Wheel speed sensor (Left front) Wheel speed sensor (Right front) Wheel speed sensor (Right rear)		Resistance $R=1.1k\Omega \pm 50\%$ Min. detectable voltage 130mV peak to peak voltage at 50Hz
6 2 20 22	Wheel speed sensor (Left rear) Wheel speed sensor (Left front) Wheel speed sensor (Right front) Wheel speed sensor (Right rear)		
4	Start/ON input	Ignition 2 condition	Over voltage detection : between $16.5V \pm 0.5V$ and 20V Suspend voltage detection : between $7.0V \pm 0.5$ and $9.5V \pm 0.5$ System off : below $5.5V \pm 0.5$
25	<ul style="list-style-type: none"> <li>Battery power source 2</li> <li>Motor power source</li> </ul>	Always	<ul style="list-style-type: none"> <li>System voltage</li> <li>Max. current : below 100A (before 100msec.)</li> <li>Rated current : below 30A (after 100msec.)</li> </ul>
24	Ground	G12	
16	ABS & EBD warning lamp	Energized ABS relay	Max. current : below 200mA Max. voltage 40V
18	Stop lamp switch input		Input voltage threshold $1.00V - 2.75V$ $5.00V - 16.00V$
14	ECU Check pin		
3	Front right speed sensor output		
12	Rear left speed sensor output		
17	Front right speed sensor output		
21	Rear right speed sensor output		

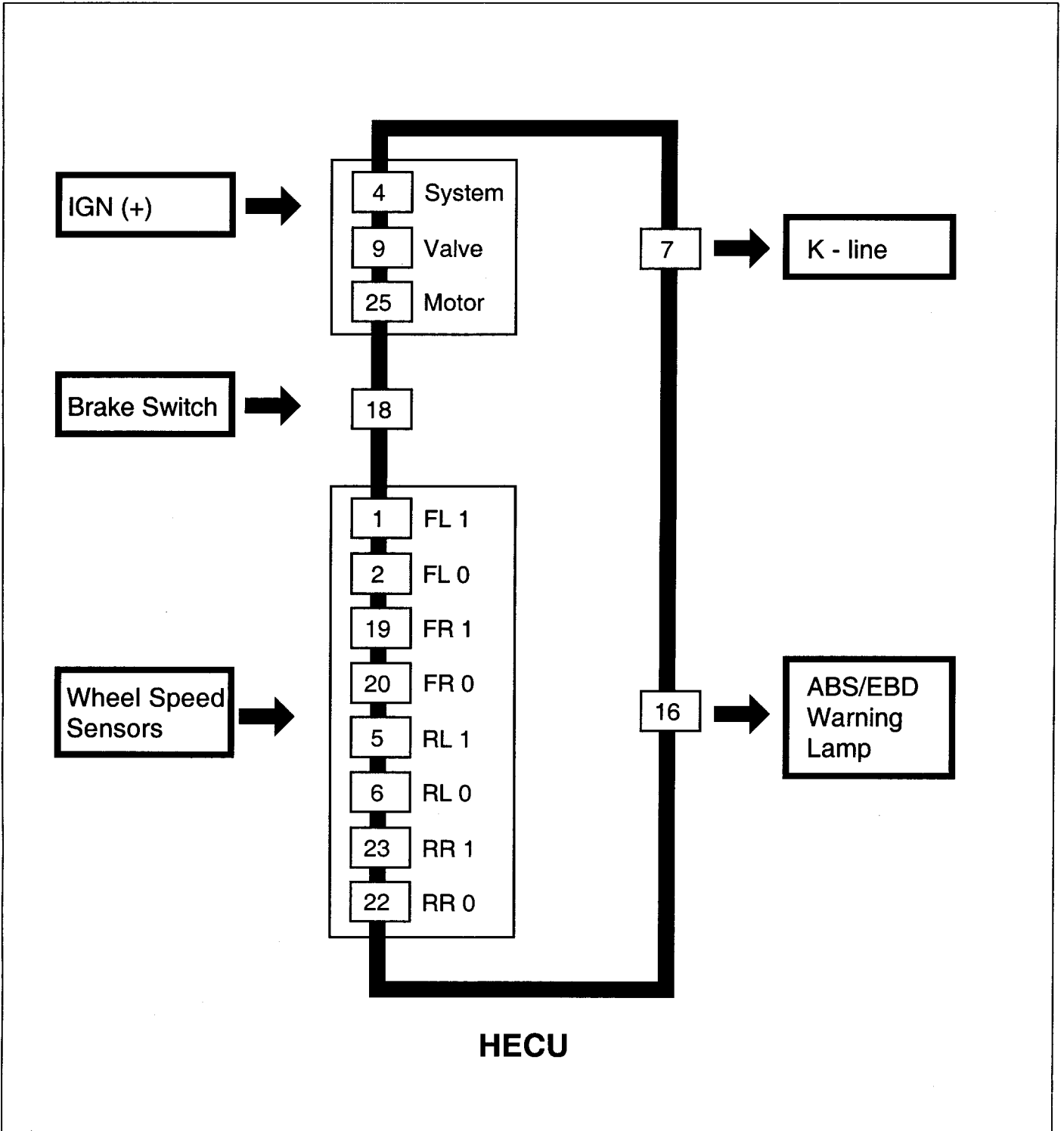
## Input-output specification

No.	Mark	Terminal Name	Specification	Note
9	BATT1	Battery power source 1 terminal (Valve power source)	Max. current : $I < 20A$ Rated current : $I < 20mA$ Dark current: $I < 1mA$	When all valves activated When non ABS control
25	BATT2	Battery power source 2 terminal (Motor power source)	Max. current : $I < 100A$ Rated current : $I < 40A$	Rush current
4	IGN	Power source via IG2 SW terminal	Rated voltage : 12V Over voltage detection : $16.5V < V < 20.2V$ Suspend voltage detection : $8.5V < V < 9.5V$ System off : $4.5V < V < 7.5V$ Rated current : $I < 300mA$	
8 24	GND1 GND2	Ground terminal	Max. current : (Total of 2 terminals) Continuous valve Activated time : 14s Rated current : $I < 300mA$	In ABS control  When non ABS control
18	STP	Brake Lamp Switch input terminal	Voltage range : $-5V \leq V_{in} \leq 16V$ Input voltage threshold : $V_{IL} < 1.2V, V_{IH} > 4.0V$	
1 19 5 23 2 20 6 22	FL1 FR1 RL1 RR1 FL0 FR0 RL0 RR0	Wheel sensor input terminal	Detectable frequency range : $F = 15 - 2000Hz$ Resistance : $1.1k\Omega \pm 50\%$ Inductance : $L=0.7H \pm 50\%$	Should be use the twist pair cable for connect between sensor and ECU
16 3	WLAS WLE	ABS Warning Lamp output terminal  Brake warning lamp output terminal	Max. current : $I < 200mA$ Max. voltage : 40V Low level output voltage : $V < 2.0V(at 200mA)$ Leakage current : $I < 1mA$	
7	K	Diagnosis interface terminal	Input voltage threshold : $V_{IL} < 0.3VB V$ $V_{IH} < 0.7VB V$ Output voltage threshold : $V_{OL} < 0.2VB V$ $V_{OH} > 0.8VB V$ Receiving, sending signal "1" : $R > 50k\Omega$ Sending signal "0" : $R < 110k\Omega$	VB : Ignition voltage  Should be no use the unsettled  unsettled voltage area $0.3*IGN \text{ voltage} - 0.7*GN$ voltage
17	IDL	Idle-up Solenoid output	Coil current : $I \leq 400mA$ Output voltage threshold : $V_{OL} 1.5V(ON), V_{OH} > V_{IGN} - 1.0V(OFF)$ Max. voltage : 40V Low level output voltage	
11	DMY IDL	Dummy idle-up output	Input voltage : $-0.5V \leq V \leq 16V$ Output current : $I \leq 1mA$	
13	GS	G-sensor input	Input voltage range : $-0.5V \leq V \leq 5.0V$	No connection to the chassis GND out of ECU.

No.	Mark	Terminal Name	Specification	Note
15	GSG	G-sensor input	Input voltage range : $-0.5V \leq V \leq 5.0V$	No connection to the chassis GND out of ECU.
10	TOD	TOD ECU Communication output	Output voltage threshold : $V_{OL} < 0.5V$ Output current : $I < 2mA$	NO ABS CONTROL > 4.0V (High) ABS IN CONTROL < 0.5V
12	NC	No connection		
14	NC	No connection		
21	NC	No connection		

DIAGRAM OF INPUT/OUTPUT FOR  
HECU

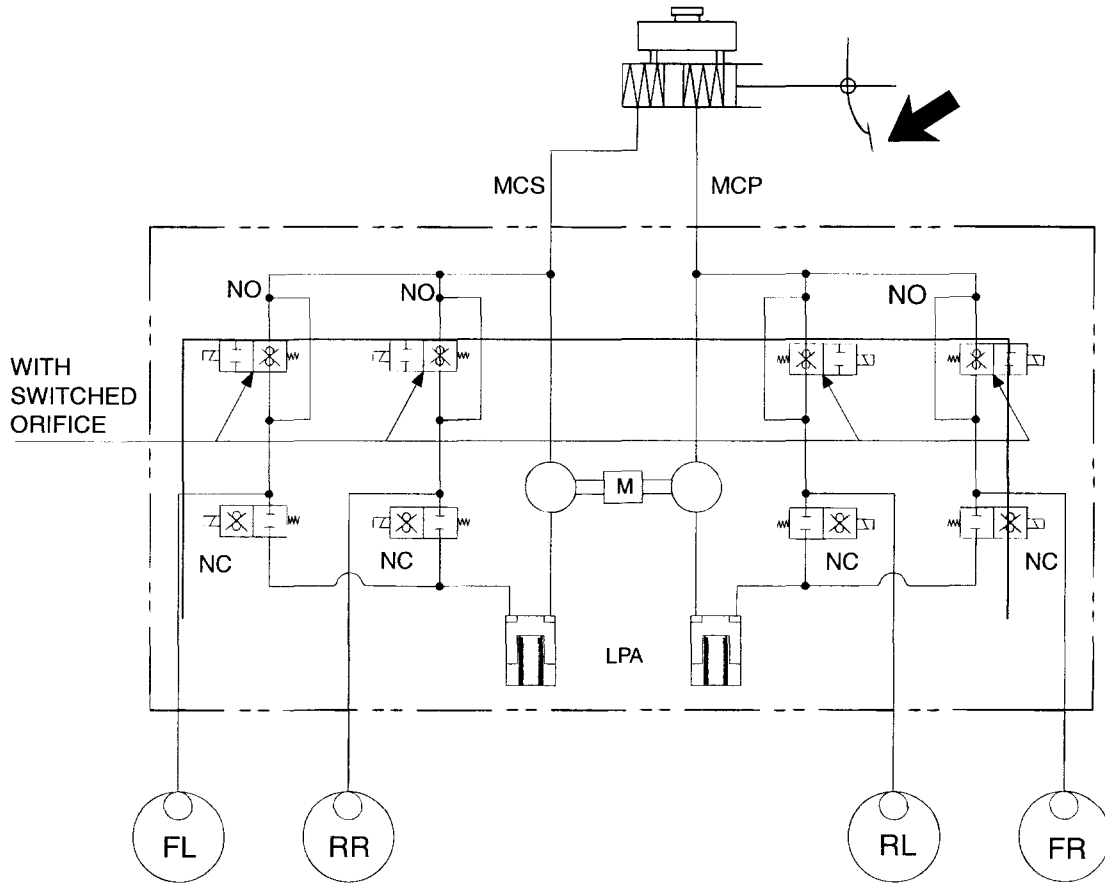
EJHA2250





SYSTEM DIAGRAM EJHA2300

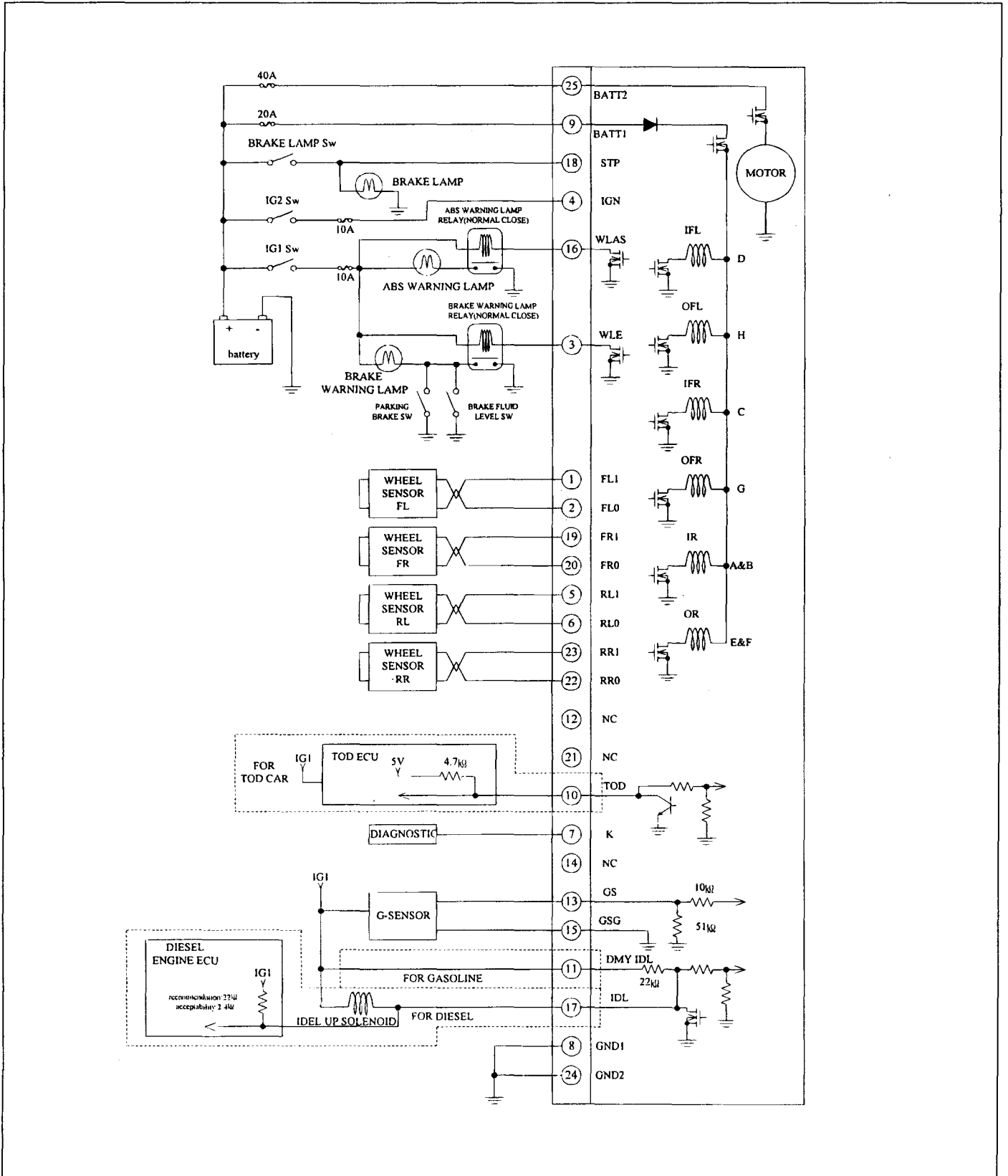
[ ABS ]



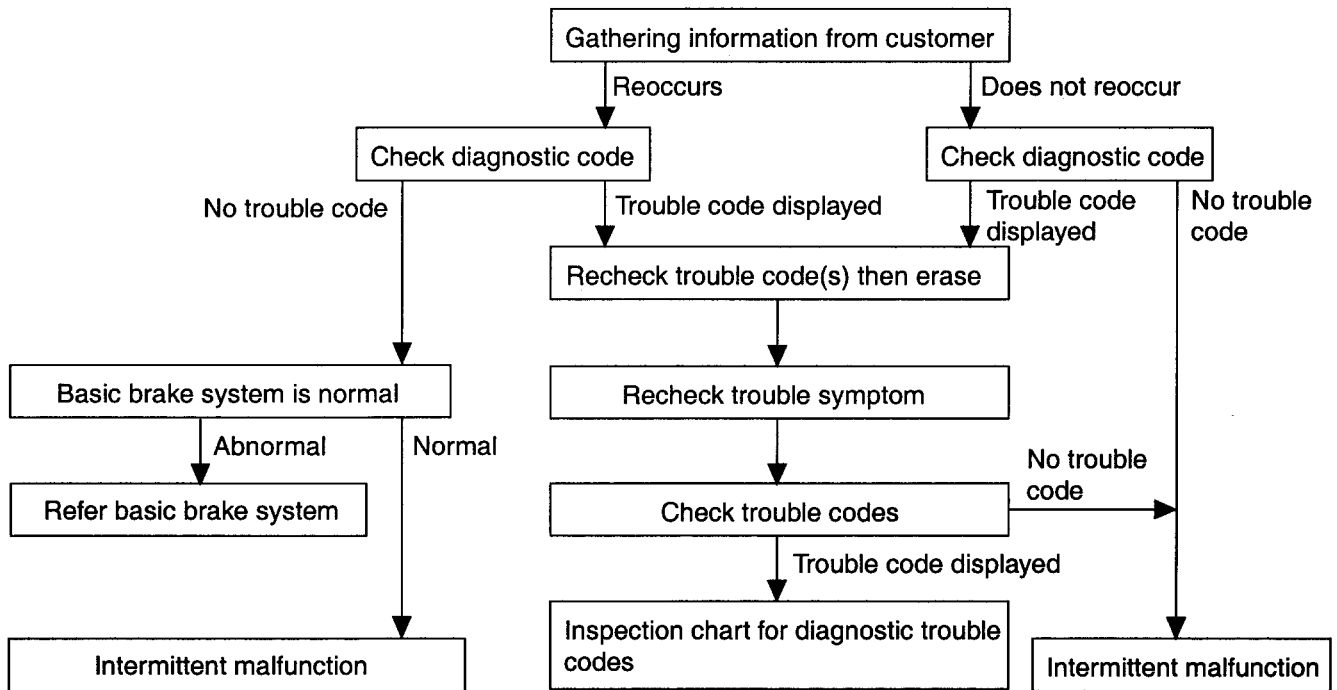
MCS : Master Cylinder Secondary  
 MCP : Master Cylinder Primary  
 NO : Normal Open  
 NC : Normal Close  
 M : Motor & Pump  
 LPA : Low Pressure Accumulator

INPUT/OUTPUT CIRCUIT DIAGRAM EJM5050

ABS E.C.U



**STANDARD FLOW OF DIAGNOSTIC TROUBLESHOOTING** EJHA2400



\* Using the customer problem analysis check sheet for reference, ask the customer as much detail as possible about the problem.

EJDA015A

**NOTES WITH REGARD TO DIAGNOSIS** EJHA2450

The phenomena listed in the following table are not abnormal.

Phenomenon	Explanation
System check sound	When starting the engine, a thudding sound can sometimes be heard coming from inside the engine compartment. This is because the system operation check is being performed.
ABS operation sound	1. Sound of the motor inside the ABS hydraulic unit operation (whine). 2. Sound is generated along with vibration of the brake pedal (scraping). 3. When ABS operates, sound is generated from the vehicle chassis due to repeated brake application and release. (Thump : suspension; squeak: tires)
ABS operation (Long braking distance)	For road surfaces such as snow-covered and gravel roads, the braking distance for vehicles with ABS can sometimes be longer than that for other vehicles. Accordingly, advise the customer to drive safely on such roads by lowering the vehicle speed.
Pedal kickback	It's normal operation.

Diagnosis detection conditions can vary depending on the diagnosis code. When checking the trouble symptom after the diagnosis code has been erased, ensure that the requirements listed in "Comment" are met.

ABS CHECK SHEET EJHA2500

**ABS Check Sheet**

Inspector's Name \_\_\_\_\_

<b>Customer's Name</b>		<b>Registration No.</b>	
		<b>Registration Year</b>	/ /
		<b>VIN.</b>	
<b>Date Vehicle Brought In</b>	/ /	<b>Odometer</b>	Km Miles

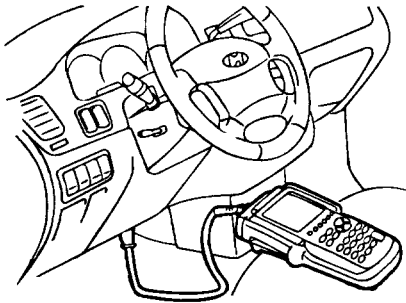
<b>Date the Problem First Occurred</b>	/ /
<b>Frequency of Occurence of Problem</b>	<input type="checkbox"/> Continuous <input type="checkbox"/> Intermittent (      times a day)

<b>Symptoms</b>	<input type="checkbox"/> ABS does not operate.		
	<input type="checkbox"/> ABS does not operate efficiently.	<input type="checkbox"/> Intermittent (      times a day)	
	<b>ABS Warning Light Abnormal</b>	<input type="checkbox"/> Remains ON	<input type="checkbox"/> Does not light up

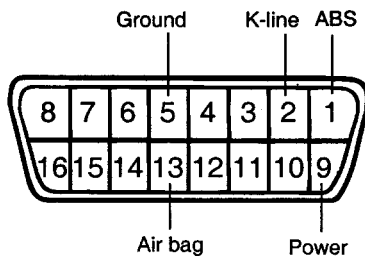
<b>Diagnostic Trouble Code Check</b>	<b>1st Time</b>	<input type="checkbox"/> Normal Code	<input type="checkbox"/> Malfunction Code (Code      )
	<b>2nd Time</b>	<input type="checkbox"/> Normal Code	<input type="checkbox"/> Malfunction Code (Code      )

**HI-SCAN (PRO) CHECK** EJHA2550

1. Turn the ignition "OFF".
2. Connect the Hi-scan to the data link connector located underneath low crash pad panel.
3. Turn the ignition "ON".
4. Use the Hi-scan to check the self-diagnosis codes.
5. After completion of the repair or correction of the problems, turn the ignition switch; then erase the stored faults codes using the clear key.
6. Disconnect the Hi-scan.



ERHA006A

**DATA LINK CONNECTOR**

EJHA100A

## INSPECTION CHART FOR DIAGNOSTIC TROUBLE CODES

EJMB2600

Inspect according to the inspection chart that is appropriate for the malfunction code.

DTC on Hi-Scan	Description
C1101	Too high battery voltage (over 18V)
C1102	Too low battery voltage (below 9V)
C1200	FL wheel sensor : open or short to GND
C1201	-Range / Performance : exciter or speed jump error
C1202	- No signal : air-gap error
C1203	FR wheel sensor : open or short to GND
C1204	- Range / Performace : exciter or speed jump error
C1205	- No signal : air-gap error
C1206	RL wheel sensor : open or short to GND
C1207	- Range / Performanace : exciter or speed jump error
C1208	Battery voltage over volt (over 18V)
C1209	RR whel sensor : open or short to GND
C1210	- Range / Performance : exciter or speed jump error
C1211	Battery voltage over volt (over 18V)
C1274	G-sensor signal is fail
C1275	G-sensor open or short to GND
C1506	Idle-up failure
C1604	Harware (including valve failures)
C1615	TOD line failure
C2112	Valve relay (including fuse failure)
C2201	Without setting vehicle selection code
C2402	Electrical (Pump-Motor)

**ACTUATOR DRIVING**

No.	Description	Condition	Recognition	Time
01	Motor	KEY ON ENG. OFF	Motor pump relay operation (Click sounds)	2 seconds
02	Front left valve (In)		Front left solenoid valve operation (Click sounds)	
03	Front right valve (In)		Front right solenoid valve operation (Click sounds)	
04	Rear left valve (In)		Rear left solenoid valve operation (Click sounds)	
05	Rear right valve (In)		Rear right solenoid valve operation (Click sounds)	
06	Front left valve (Out)		Front left solenoid valve operation (Click sounds)	
07	Front right valve (Out)		Front right solenoid valve operation (Click sounds)	
08	Rear left valve (Out)		Rear left solenoid valve operation (Click sounds)	
09	Rear right valve (Out)		Rear right solenoid valve operation (Click sounds)	

**CURRENT DATA**

No.	Description	Recognition	Unit
1	Battery	Battery	Voltage
2	FL wheel speed SNSR	Front left wheel speed sensor	km/h
3	FR wheel speed SNSR	Front right wheel speed sensor	
4	RL wheel speed SNSR	Rear left wheel speed sensor	
5	RR wheel speed SNSR	Rear right wheel speed sensor	
6	ABS SRI status	Warning lamp	
7	Brake SW	Brake switch	
8	Motor pump relay	Motor relay	
9	Valve relay	Valve relay	
10	Motor pump status	Motor	
11	FL valve (In)	Front left valve (In)	
12	FR valve (In)	Front right valve (In)	
13	RL valve (In)	Rear left valve (In)	
14	RR valve (In)	Rear right valve (In)	
15	FL valve (Out)	Front left valve (Out)	
16	FR valve (Out)	Front right valve (Out)	
17	RL valve (Out)	Rear left valve (Out)	
18	RR valve (Out)	Rear right valve (Out)	

# FAILSAFE SPECIFICATION

Detect timing A : Initial check mode B : Out of control C : ABS control mode D : EBD control mode E : Diagnostic mode

No.	DTC	Failure Locations	Detect mode	Condition for Detection	Management			Conditions for Restoration	ABS W/L	EBD W/L	Detect timing				
					Out of control	EBD control mode	ABS control mode				A	B	C	D	E
1	C1101	Power supply	Over voltage of VIGN	When VIGN>18V continue 224ms, ECU detects the failure.	All wheel inhibit	All wheel inhibit	All wheel inhibit	VIGN < 17V	○	○	○	○	○	○	
	C1102		Voltage drop of VIGN	When VIGN<9V or VREF<9V continues 224ms, ECU detects the failure.	ABS inhibit (permit EBD control)	Continue EBD control	ABS inhibit	VIGN>10V and VREF>10V continue 224ms. But in case of ABS control mode, all wheels inhibit until end of ABS control.	○	-	○	○	○	○	
			Voltage drop of VIGN (EBD inhibit)	When VIGN<7.5V or VREF<7.5V continues 70ms, ECU detects the failure.	All wheel inhibit	All wheel inhibit	All wheel inhibit	VIGN>9V and VREF>9V continue 70ms	○	○					
2	C1604	Actuator	Interruption or short circuit of actuator	Master CPU always sends a test pulse (about 200s) to valves, and feedback signal returns into master and slave CPU. When feedback signal is not equal to test signal, CPU recognizes the actuator failure. Monitoring time is 56ms. If the CPU detects a voltage drop or overvoltage, failure of the actuator is not detected.	System down	System down	System down	Restart	○	○	○	○	○	○	
	C2112	Main relay	Interruption or short circuit of main relay								○	○	○	○	



No.	DTC	Failure Locations	Detect mode	Condition for Detection	Management			Conditions for Restoration	ABS W/L	EBD W/L	Detect timing										
					Out of control	EBD control mode	ABS control mode				A	B	C	D	E						
3	C1604	Main relay	Interruption or short circuit of inhibit signal	With the initial check, the main CPU checks the functions of sub CPU inhibit signal and custom IC inhibit circuit.	System down	-	-	Restart	○	○	○										
			Interruption or short circuit of main relay	1) IG-SW ECU checks VREF just after IGN-SW ON, and detects the failure.	System down	-	-	Restart	○	○	○										
			<table border="1"> <tr> <td>OFF</td> <td>voltage is below 2.5V, voltage is over 4.2V (short or leak)</td> <td>105ms</td> <td></td> </tr> <tr> <td>ON</td> <td>voltage is below 6V (open)</td> <td>105ms</td> <td>If the ECU detects unusual Vign, failure isn't detected</td> </tr> </table>	OFF	voltage is below 2.5V, voltage is over 4.2V (short or leak)	105ms		ON	voltage is below 6V (open)	105ms	If the ECU detects unusual Vign, failure isn't detected										
OFF	voltage is below 2.5V, voltage is over 4.2V (short or leak)	105ms																			
ON	voltage is below 6V (open)	105ms	If the ECU detects unusual Vign, failure isn't detected																		
	C112			When voltage is below for 224ms, ECU detects the failure. But if the ECU detects a voltage drop or overvoltage, the failure is not detected.	System down	System down	System down	Restart	○	○	○	○	○	○	○	○					
4	FL : C1200 FR : C1203 RL : C1206 RR : C1209	Wheel speed sensor	Interruption or short circuit of wheel speed sensor	The CPU detects the failure by checking voltage of the wheel speed sensor with a velocity of 0km/h.  Sensor voltage is below 0.4V or over 2.7V Monitoring time=196ms	Management A	Management B	Management C	Restart	○	○ *a	○	○	○	○							

No.	DTC	Failure Locations	Detect mode	Condition for Detection	Management			Conditions for Restoration	ABS W/L	EBD W/L	Detect timing				
					Out of control	EBD control mode	ABS control mode				A	B	C	D	E
4	FL : C1201 FR : C1204 RL : C1207 RR : C1210	Wheel speed sensor	Intermittent interruptions or short circuit of sensor. Defect of air gap, or sensor wheels, or clearance of bearing	After wheel velocity changes over 30km/h per 7ms (over 120G), if there is the difference between calibrated wheel velocity and monitoring velocity continuously beyond the constant, ECU detects the failure.	Management B	Management B	Management C	To meet EC regulations, all wheel sensing inhibits and ABS warning lamp turns on until vehicle velocity > 20km/h after restart.	O	O *a	O	O	O	O	
	FL : C1202 FR : C1205 RL : C1208 RR : C1211		Missing sensor signal Too large air gap Sensor wheel is not installed	When starting the vehicle, ECU detects the following conditions. 1. $V_{MAX} \geq 40\text{km/h}$ and $V_{ref} \leq 0.6 \times V_{MAX}$ Monitoring time 120s. 2. Within the range of 7 to 20km/h, if the wheel speed sensor reports 6 km/h continuously, the ECU will report a failure for that wheel. 3. If the vehicle speed is over 20km/h for 120 seconds but the wheel speed sensor reports 6km/h continuously for 120 seconds, the ECU will report failure for that wheel.	Management B	Management B	Management C	To meet EC regulations, all wheel sensing inhibits and ABS warning lamp turns on until vehicle velocity > 20km/h after restart.	O	O *a	O	O	O		
					Management B	-	-				O				
					Management B	-	-				O				
			Too large air gap Long term EMI	In ABS control, if the pressure decrease mode and hold mode continue, for 14sec., ECU detects the failure.	-	-	Management C	To meet EC regulations, all wheel sensing inhibits and ABS warning lamp turns on until vehicle velocity > 20km/h after restart.	O	O *a		O			
C1604	Defect of clearance of bearing EMI/IGN noise	When there are over 32 pulses from the wheel sensor within 7ms, ECU detects the failure.	System down	System down	System down	Restart	O	O	O	O	O	O			

No.	DTC	Failure Locations	Detect mode	Condition for Detection	Management			Conditions for Restoration	ABS W/L	EBD W/L	Detect timing								
					Out of control	EBD control mode	ABS control mode				A	B	C	D	E				
5	C2402	Motor Motor relay	Interruption or short circuit of motor/motor relay	Monitoring VMS, ECU detects the failure. <table border="1"> <tr> <td>over 6.5V</td> <td>1785ms</td> </tr> <tr> <td>below 6.5V</td> <td>196ms</td> </tr> </table> <p>When VIGN is unusual, ECU does not detect the failure.</p>	over 6.5V	1785ms	below 6.5V	196ms	ABS inhibit (permit EBD control)	Continue EBD control	ABS inhibit	If ECU detects the failure of motor relay output ON or motor lock(see 7-(2)), after checking main relay failure at initial check, ECU unconditionally checks motor and motor relay with motor ON for 560ms. If ECU detects motor lock, ECU repeats the same check. After that, in case of an unusual condition, ECU recognizes the failure. This step meets the EC regulation.	O	-	O	O	O	O	
			over 6.5V	1785ms															
			below 6.5V	196ms															
Interruption of motor Motor lock	1. Monitoring decrease of Vms, ECU detects the failure. <p>Monitoring Vms every 7ms after the, motor relay output changes from ON to OFF.                      It is recognized as normal condition in case that ECU detects Vms&gt;5V over 6 times. If it is abnormal, ECU does the same check again with motor ON for 560ms. If it is abnormal again, ECU repeats the same process with motor ON for 553ms. After that, if the state is abnormal again, ECU recognizes the failure.</p> <p>After initial check, in case that more than predetermined acceleration continues for a fixed period, ECU checks in the same way as the above, with motor ON for 560ms. If that is abnormal, motor ON for 553ms and ECU repeats the same process. After that, in case of abnormal condition, ECU recognizes the failure.</p> If VIGN is abnormal, ECU does not detect the failure.	O	O	O	O														
Failure of motor relay circuit / motor relay over current	By comparing the voltage of the motor relay monitor and DIAG signal output from the custom IC, ECU detects the failure. But ECU does not check the failure for 1000ms from the time the motor is turned off.																		
							Restart			O	O	O	O						

No.	DTC	Failure Locations	Detect mode	Condition for Detection	Management			Conditions for Restoration	ABS W/L	EBD W/L	Detect timing						
					Out of control	EBD control mode	ABS control mode				A	B	C	D	E		
6	C1604	ECU	CPU failure	1.When ECU starts, main and sub CPU execute the following checks : a) ECU checks the value of the result of fixed multiplications, whether it becomes the value decided in advance or not. b) ECU executes read/write for RAM. c) ECU executes sum check of ROM.	System down	System down	System down	Restart	○	○	○					○	
				2. IGN After IGN ON, main and sub CPU communicate each other for synchronization. When one or the other CPU can't synchronize within 1sec., the main CPU shuts system down and sub CPU stops running.	System down	System down	System down	Restart	○	○	○						○
				3.Main and sub CPU always execute the following checks.  ECU checks whether the program is finished or not	System down	System down	System down	Restart	○	○	○	○	○	○	○	○	○

No.	DTC	Failure Locations	Detect mode	Condition for Detection	Management			Conditions for Restoration	ABS W/L	EBD W/L	Detect timing				
					Out of control	EBD control mode	ABS control mode				A	B	C	D	E
6	C1604	ECU	CPU failure	4. In every program cycle, the main CPU and sub CPU communicate with each other for synchronization. When one or the other can't synchronize within 300 $\mu$ sec, main CPU shuts the system down and sub CPU stops running.	System down	System down	System down	Restart	○	○	○	○	○	○	○
				5. Sub CPU checks the following : a) Sub CPU always compares the result of analog sent by main CPU with the result of data calculated by sub CPU, in case that there is a difference above 7 bits for 112ms, ECU recognizes the failure. b) In case that wheel velocity of FL calculated by main CPU is different from that calculated by sub CPU above 10km/h for 504ms, ECU recognizes the failure. c) Sub CPU calculates the slip from Vref calculated by main CPU and wheel velocity of FL calculated by sub CPU. ECU recognizes a failure when the main CPU judges ABS phase as pressure decrease phase for 1sec. with no slip calculated by sub CPU break. d)When the main CPU does not judge ABS phase as pressure decrease phase, in that case the main CPU sets the valves as pressure decrease state for 1 sec., ECU recognizes the failure. e)When main CPU judges ABS phase as out of ABS control, in which case the valve driven information from main CPU is in a pressure hold state for 1 sec., ECU recognizes the failure.	System down	System down	System down	Restart	○	○	○	○	○	○	○

\*1 In case of main relay ON only

\*2 In case of motor initial check only, ECU detects the failure of motor relay output ON.

\*3 In case of motor initial check only

\*4 In case of over two wheels failure

## Management A

Conditions	Management
$V_{max} > 5\text{km/h}$	Management B
$V_{max} < 5\text{km/h}$	One front wheel failure detected causes ABS inhibit
	One rear wheel or more than two wheels failure causes all wheels to inhibit ABS

## Management B

Conditions	Management
Failure of one wheel	ABS inhibit (permit EBD control)
Failure of over two wheels	System down

## Management C

Conditions Management	Management
Failure of one front wheel	ECU discontinues ABS control of defective wheel and continues ABS control of normal wheels. ABS inhibit after end of ABS control.
Failure of two front wheels	ECU discontinues ABS control of defective wheel and continues ABS control of normal wheels. System down after end of ABS control.
Failure of one rear wheel	ECU continues ABS control of rear wheels using information of normal rear wheel and front wheels. System down after end of ABS control.
Failure of two rear wheels	System down
Failure of one front wheel and one rear wheel	ECU discontinues ABS control of defective front wheel, and continues rear wheels using information of normal rear wheel. System down after end of ABS control.
Failure of over three wheels	System down

**ADDITIONAL EXPLANATION OF FAILSAFE**

## 1. Warning lamp initial lighting time

- 1) Immediately after IG-SW ON, warning lamp is lit for 3 sec. This term is called 'warning lamp initial lighting time'.
- 2) Within this term, in case that the ECM detects the failure, warning lamp is lighted continuously.

**NOTE**

## 1. System down

The system changes to normal braking with warning lamp ON after detecting the failure by its software. ECM restart is caused by IG-SW OFF → ON once.

After the failure is corrected, the ECM returns a to normal mode with warning lamp OFF.

## 2. All wheel inhibit

ECM discontinues ABS control of all wheels. (Equivalent to normal brake)

When the failure is corrected, it returns to normal mode with warning lamp OFF.

(But during ABS control, it does not return to a normal mode.)

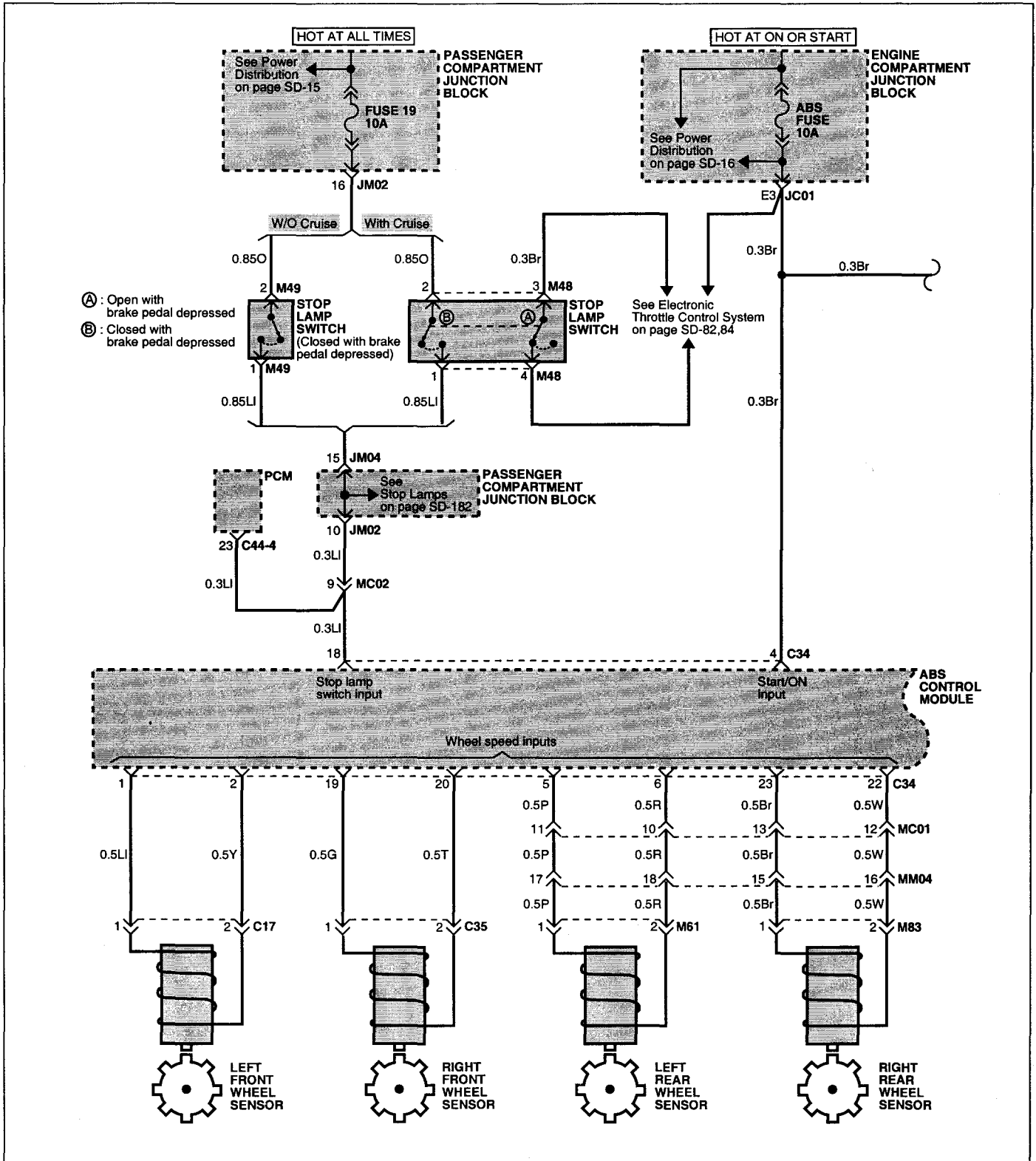
**TERM COMMENTARY**

VIGN : Terminal voltage of IGN, VREF : Terminal voltage of REF

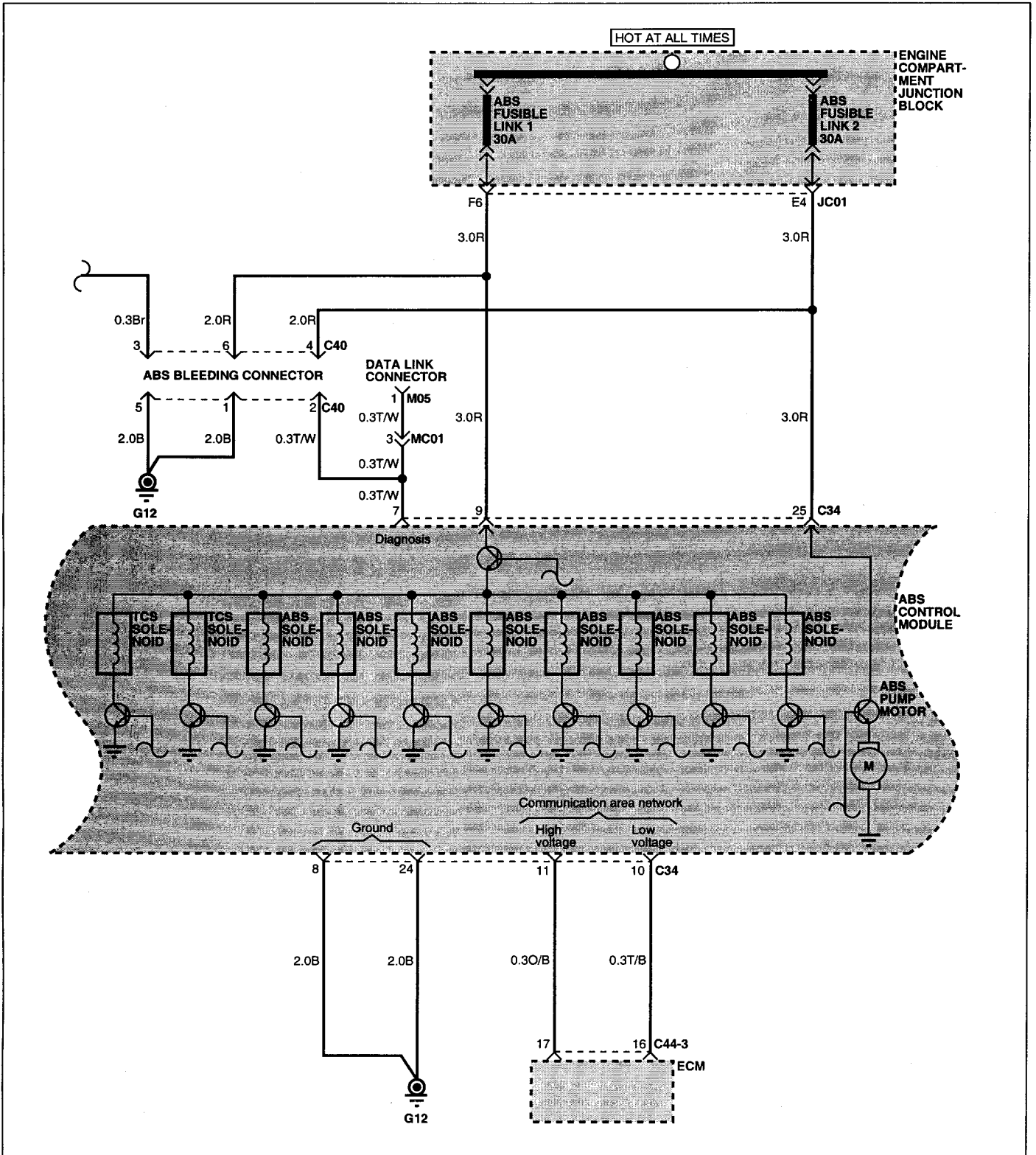
VMAX : Maximum wheel velocity, Vref : estimated vehicle velocity

SCHEMATIC DIAGRAM EJBB2650

ABS CIRCUIT (1)

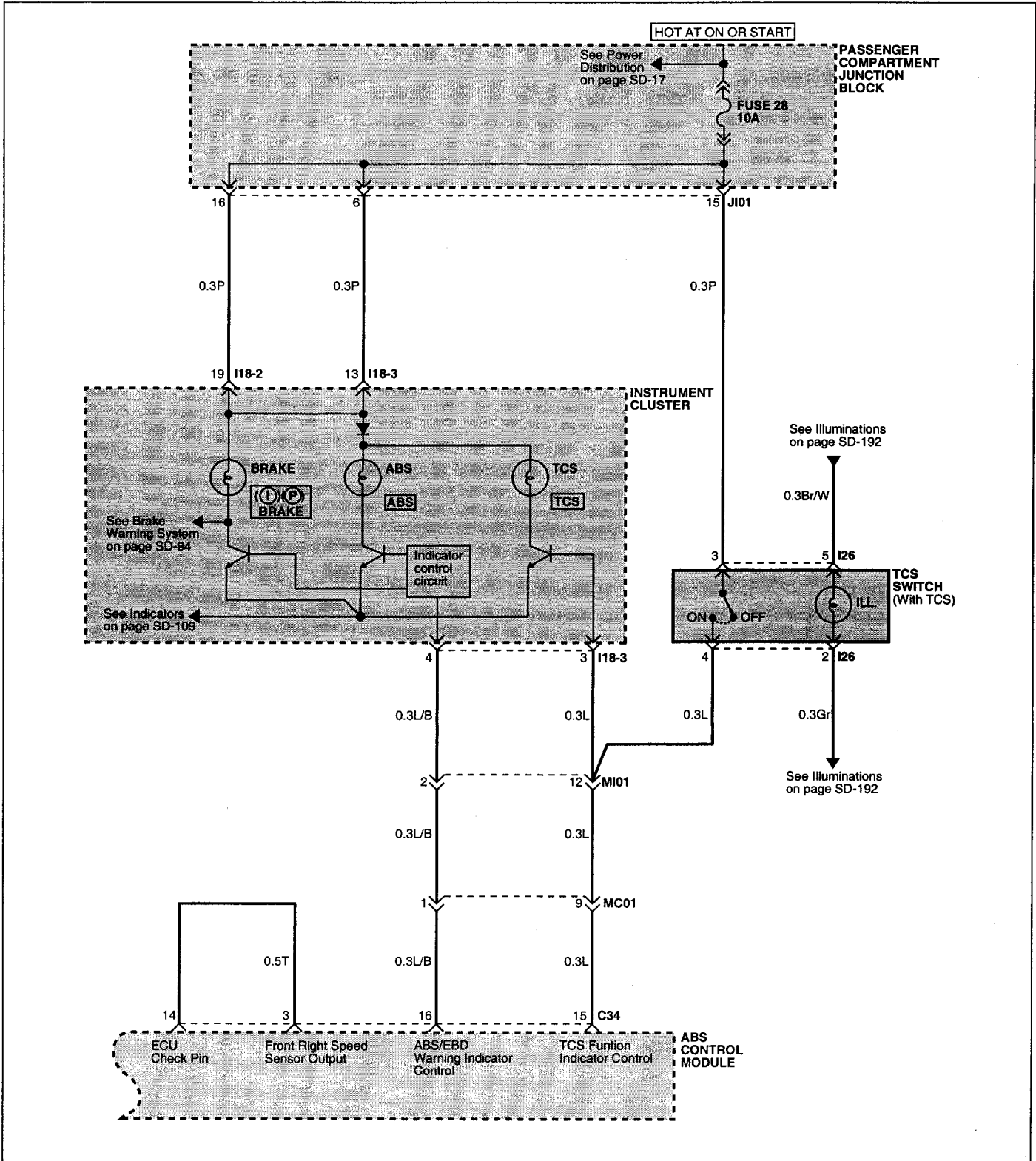


ABS CIRCUIT (2)





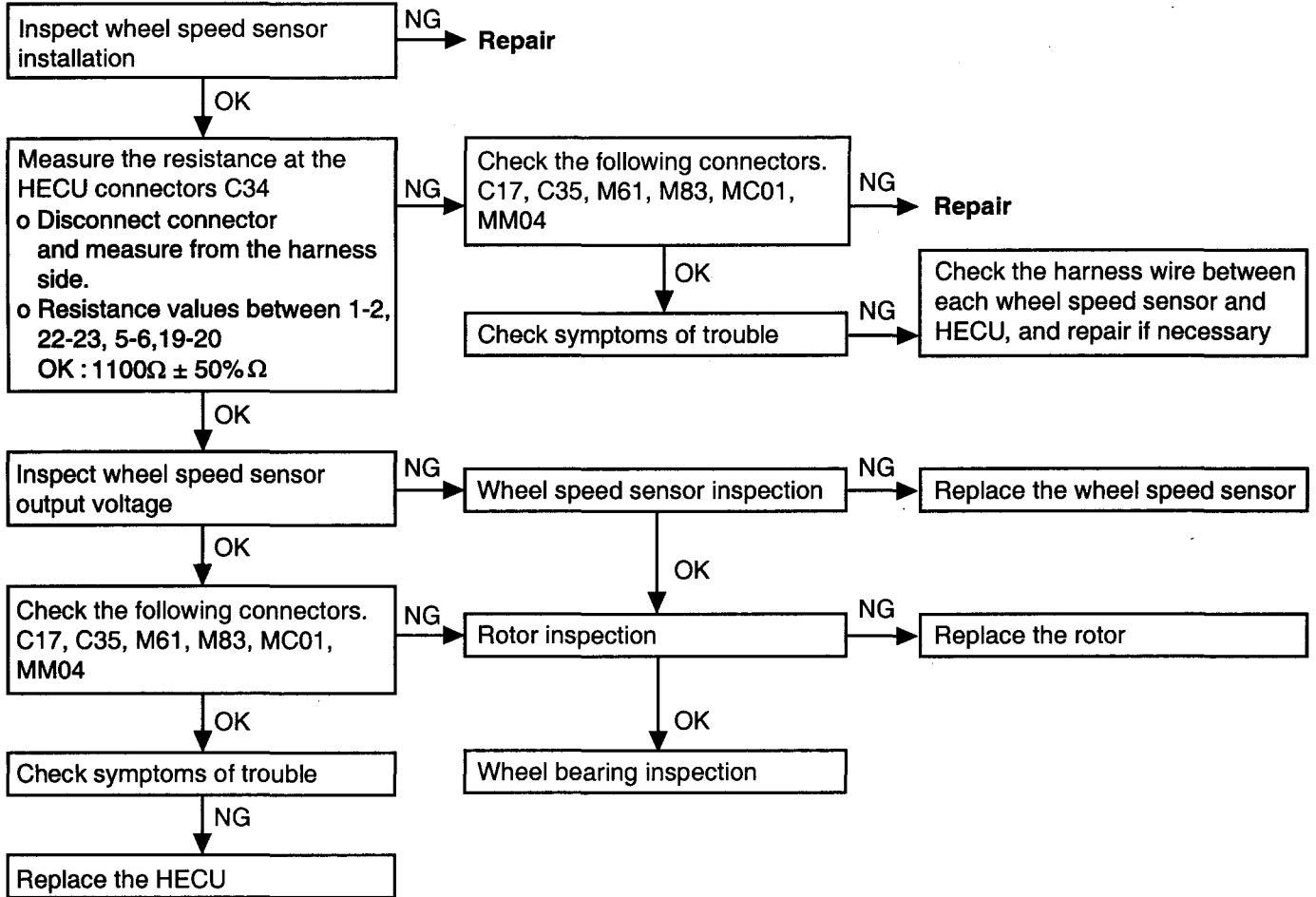
ABS CIRCUIT (3)



**INSPECTION PROCEDURE FOR  
DIAGNOSTIC TROUBLE CODES**

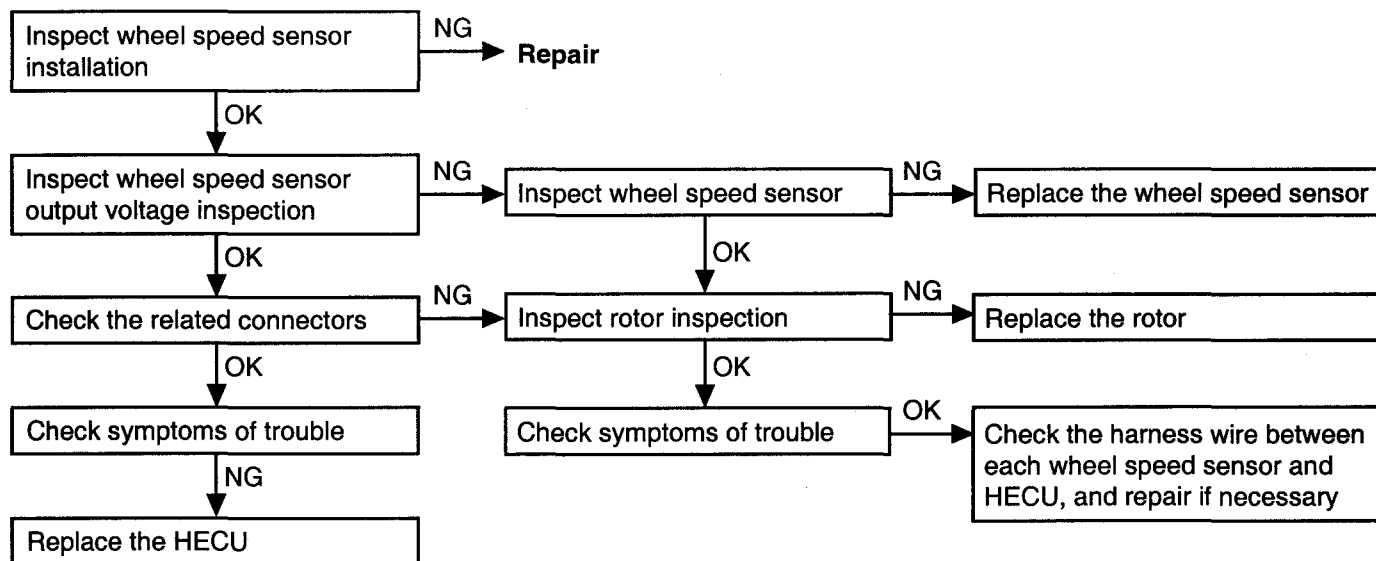
EJBB2700

<p>DTC No. C1200, C1203, C1206, C1209 Wheel speed sensor open or short to GND circuit</p>	<p>Probable cause</p>
<p>The HECU determines that an open or short circuit has occurred in more than one wire of the wheel speed sensors</p>	<ul style="list-style-type: none"> <li>• Malfunction of wheel speed sensor</li> <li>• Malfunction of wiring harness or connector</li> <li>• Malfunction of HECU</li> </ul>



EJBB2750

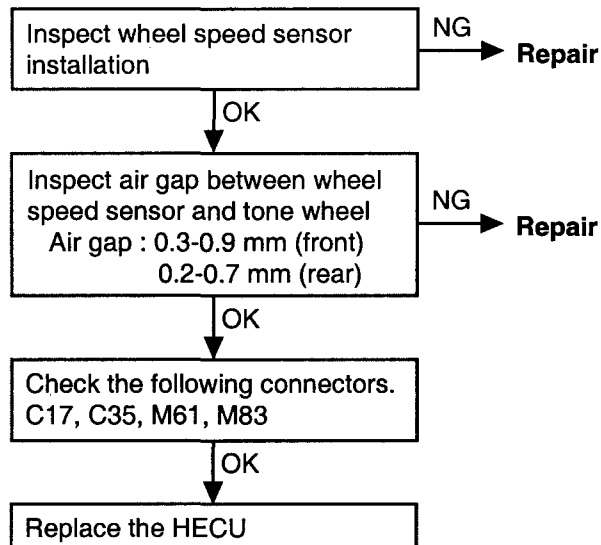
DTC No. C1201, C1204, C1207, C1210 (Speed jump or wrong exciter)	Probable cause
A wheel speed sensor outputs an abnormal signal (other than an open short-circuit).	<ul style="list-style-type: none"> <li>• Improper installation of wheel speed sensor</li> <li>• Malfunction of wheel speed sensor</li> <li>• Malfunction of rotor</li> <li>• Malfunction of wheel bearing</li> <li>• Malfunction of wiring harness or connector</li> <li>• Malfunction of HECU</li> </ul>



EJBB275A

EJBB2800

DTC No. C1202, C1205, C1208, C1211 (Large air gap)	Probable cause
A wheel speed sensor outputs no signal	<ul style="list-style-type: none"> <li>• Malfunction of wheel speed sensor</li> <li>• Improper installation of wheel speed sensor</li> <li>• Malfunction of rotor (excitor)</li> <li>• Malfunction of wiring harness or connector</li> <li>• Malfunction of HECU</li> </ul>



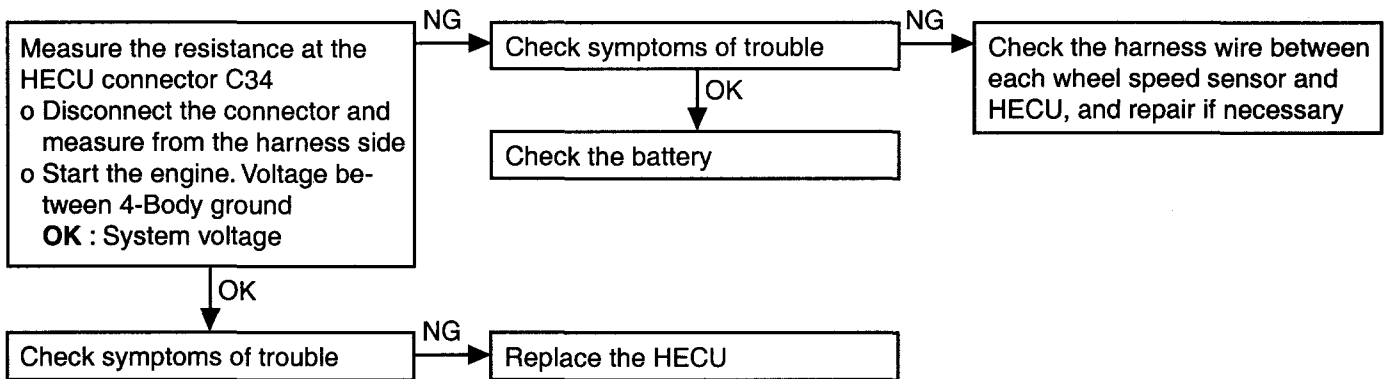
EJBB280A

EJBB2850

DTC No. C1101, C1102 Voltage out of range (Low and over voltage)	Probable cause
The voltage of the HECU power supply drops lower than or rises higher than the specified value. If the voltage returns to the specified value, this code is no longer output.	<ul style="list-style-type: none"> <li>• Malfunction of wiring harness or connector</li> <li>• Malfunction of HECU.</li> </ul>

**⚠ CAUTION**

***If battery voltage drops or rises during inspection, this code will be output as well. If the voltage returns to the standard value, the code is no longer output. Before carrying out the following inspection, check the battery level and refill if necessary.***



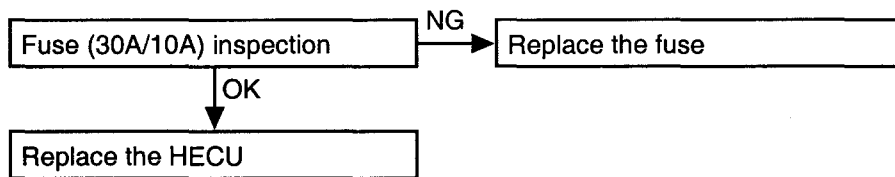
EJBB285A

EJHA2900

DTC No. C1604 ECU Hardware (EEPROM and ECU failure)	Probable cause
The HECU always monitors the solenoid valve drive circuit. It determines that there is an open or short-circuit in the solenoid coil or in a harness even if no current flows in the solenoid or through the HECU.	<ul style="list-style-type: none"> <li>• Malfunction of wiring harness</li> <li>• Malfunction of hydraulic unit</li> <li>• Malfunction of HECU</li> </ul>

EJHA2950

DTC No. C2112 Valve relay (Including fuse failure)	Probable cause
<p>When the ignition switch is turned ON, the HECU switches the valve relay off and on during the initial check. In that way, the HECU compares the signals sent to the valve relay with the voltage in the valve power monitor line. That is how to check if the valve relay is operating normally. The HECU always checks if current flows in the valve power monitor line. It determines that there is an open circuit when no current flows. If no current flows in the valve power monitor line, this diagnosis code is output.</p>	<ul style="list-style-type: none"><li>• Malfunction of wiring harness or connector</li><li>• Malfunction of HECU</li></ul>

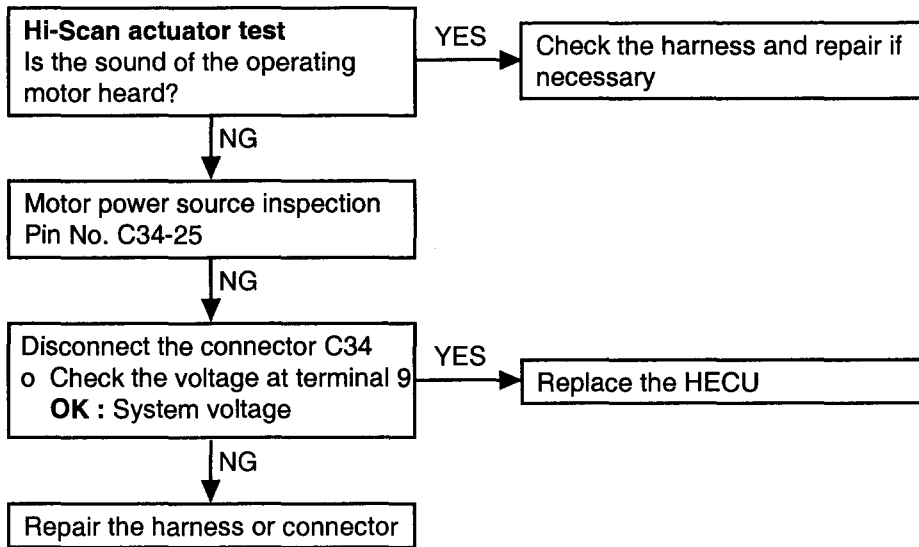


EJBB3000

DTC No. C2402 Electrical (Motor relay, motor)	Probable cause
When the motor power line is normal but no signal is input to the motor monitor line, it is abnormal.	<ul style="list-style-type: none"> <li>• Malfunction of hydraulic unit</li> <li>• Malfunction of HECU</li> </ul>

**⚠ CAUTION**

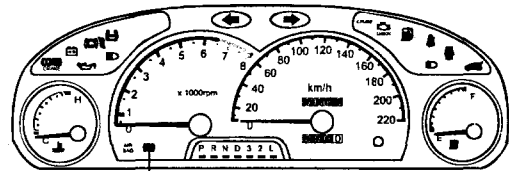
*Because powering of the motor with the Hi-Scan or Hi-Scan Pro 3 will discharge the battery, the engine should be run for a while after testing is completed.*



**ABS WARNING LAMP INSPECTION** EJHA3050

Check that the ABS warning lamp illuminates as follows.

When the ignition key is turned "ON", the ABS warning lamp comes on for approximately 2 seconds and then goes out.



ABS

ERHA003A

**INSPECTION CHART FOR TROUBLE SYMPTOMS** EJHA3100

Find out the symptoms and check according to the inspection procedure chart.

Trouble system		Inspection procedure No.
Communication with Hi-Scan is not possible	Communication with any system is not possible.	1
	Communication with ABS only is not possible.	2
When the ignition key is turned "ON" (engine stopped), the ABS warning lamp does not illuminate.		3
After the engine starts, the lamp remains illuminated.		4
Faulty ABS operation	Unequal braking power on both sides	5
	Insufficient braking power	
	ABS operates under normal braking conditions	
	ABS operates before vehicle stops under normal braking conditions	
	Large brake pedal vibration (Caution 2.)	-

**CAUTION**

*During ABS operation, the brake pedal may vibrate or may not be able to be depressed. Such phenomena are due to intermittent changes in hydraulic pressure inside the brake line to prevent the wheels from locking and is not an abnormality.*



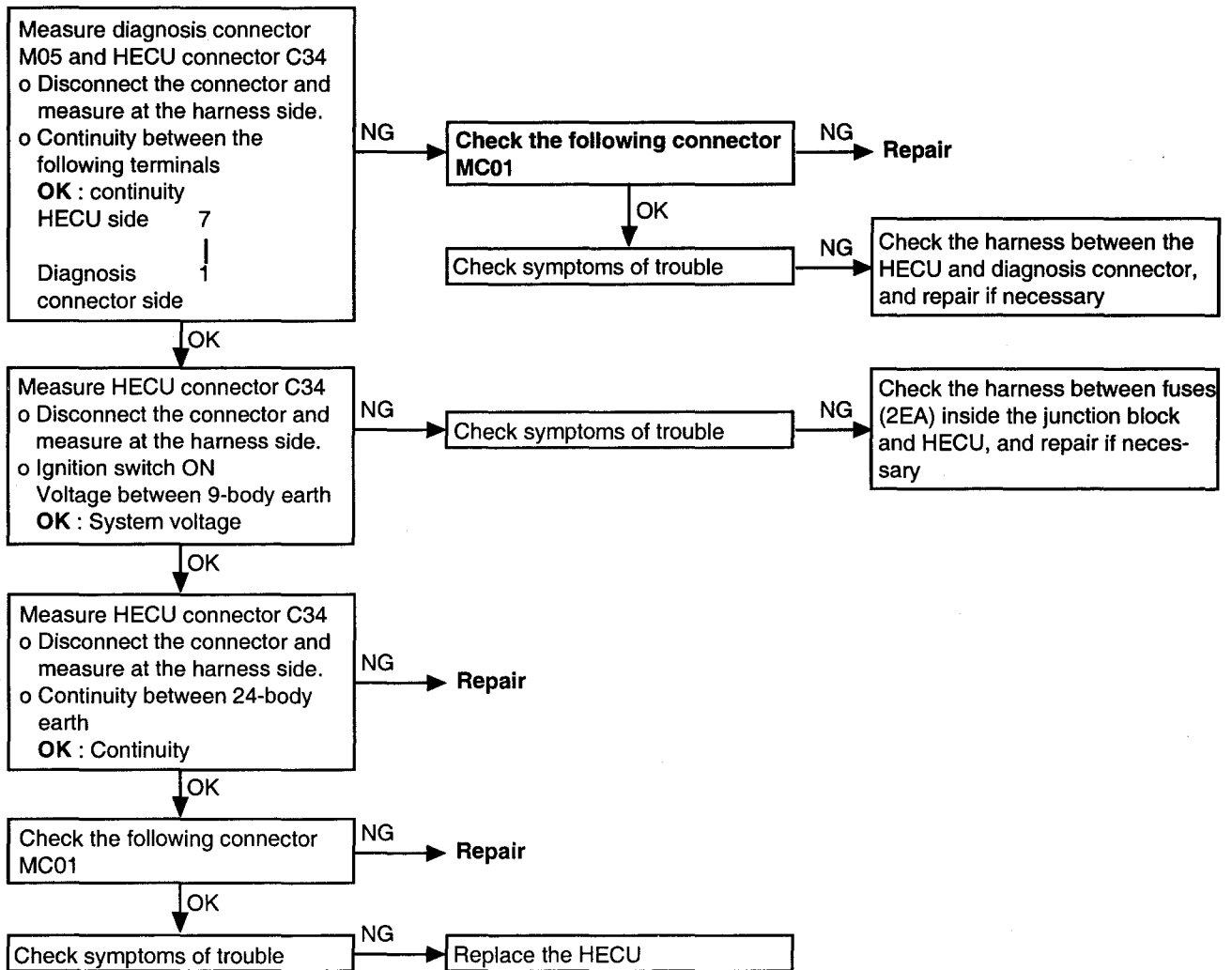
**INSPECTION PROCEDURE FOR TROUBLE SYMPTOMS** EJB83150

**INSPECTION PROCEDURE 1**

Communication with Hi-Scan is not possible. (Communication with all systems is not possible.)	Probable cause
The reason is probably a defect in the power supply system (including ground) for the diagnosis line.	<ul style="list-style-type: none"> <li>• Malfunction of connector</li> <li>• Malfunction of wiring harness</li> </ul>

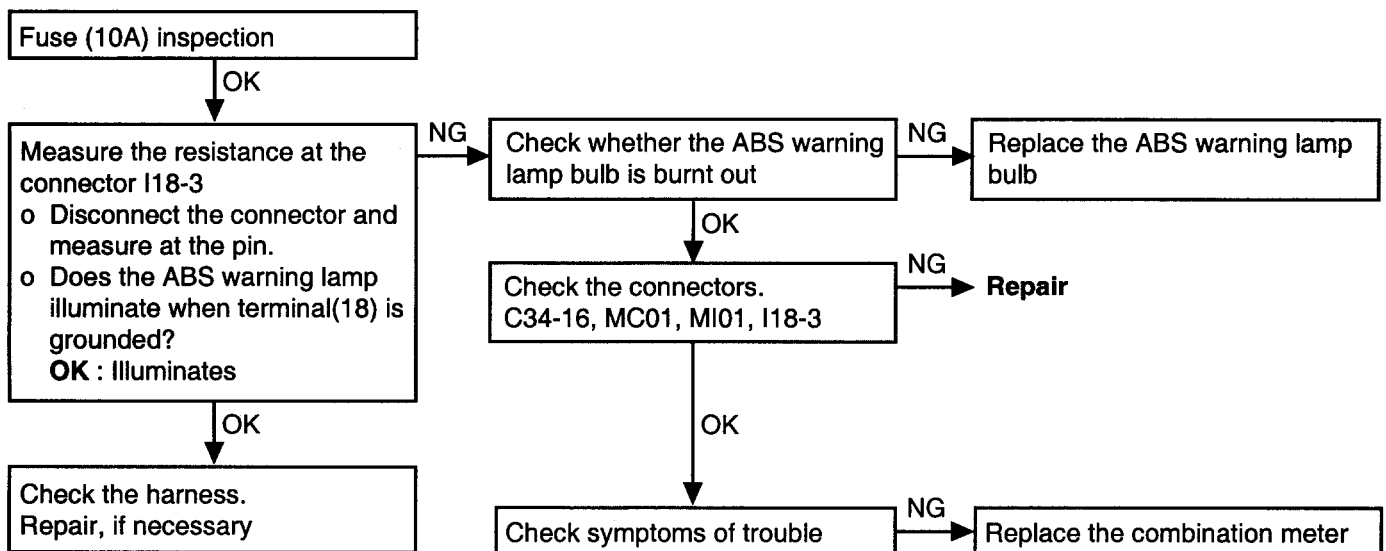
**INSPECTION PROCEDURE 2**

Communication with Hi-Scan is not possible. (Communication with ABS only is not possible.)	Probable cause
When communication with Hi-Scan is not possible, the cause is probably an open circuit in the HECU power circuit or an open circuit in the diagnosis output circuit.	<ul style="list-style-type: none"> <li>• Blown fuse</li> <li>• Malfunction of wiring harness or connector</li> <li>• Malfunction of HECU</li> </ul>



## INSPECTION PROCEDURE 3

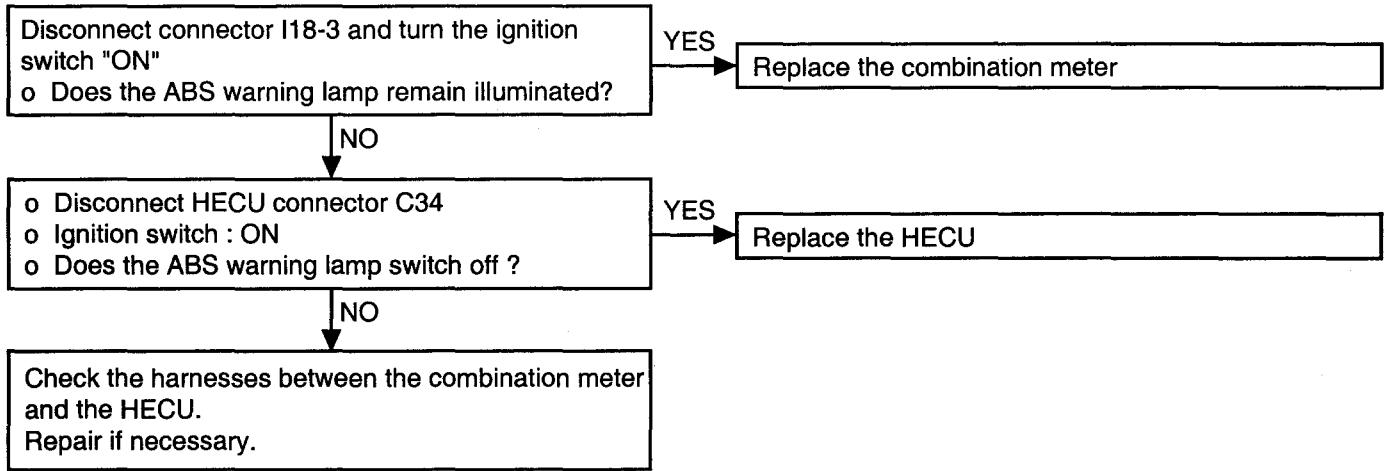
When the ignition key is turned "ON" (engine stopped), ABS warning lamp does not illuminate	Probable cause
<p>When current flows through the HECU, the ABS relay turns from on to off as the initial check. The ABS warning lamp will illuminate when the ABS relay is "Off" even if there is a problem with the circuit between the ABS warning lamp and the HECU.</p> <p>Therefore, if the lamp does not illuminate, the cause may be an open circuit in the lamp power supply circuit, a blown bulb, or an open circuit in both the circuits between the ABS warning lamp and the HECU and in the circuit between the ABS warning lamp and the ABS relay.</p>	<ul style="list-style-type: none"> <li>• Blown fuse</li> <li>• Burnt out ABS warning lamp bulb</li> <li>• Malfunction of wiring harness or connector</li> </ul>



**INSPECTION PROCEDURE 4**

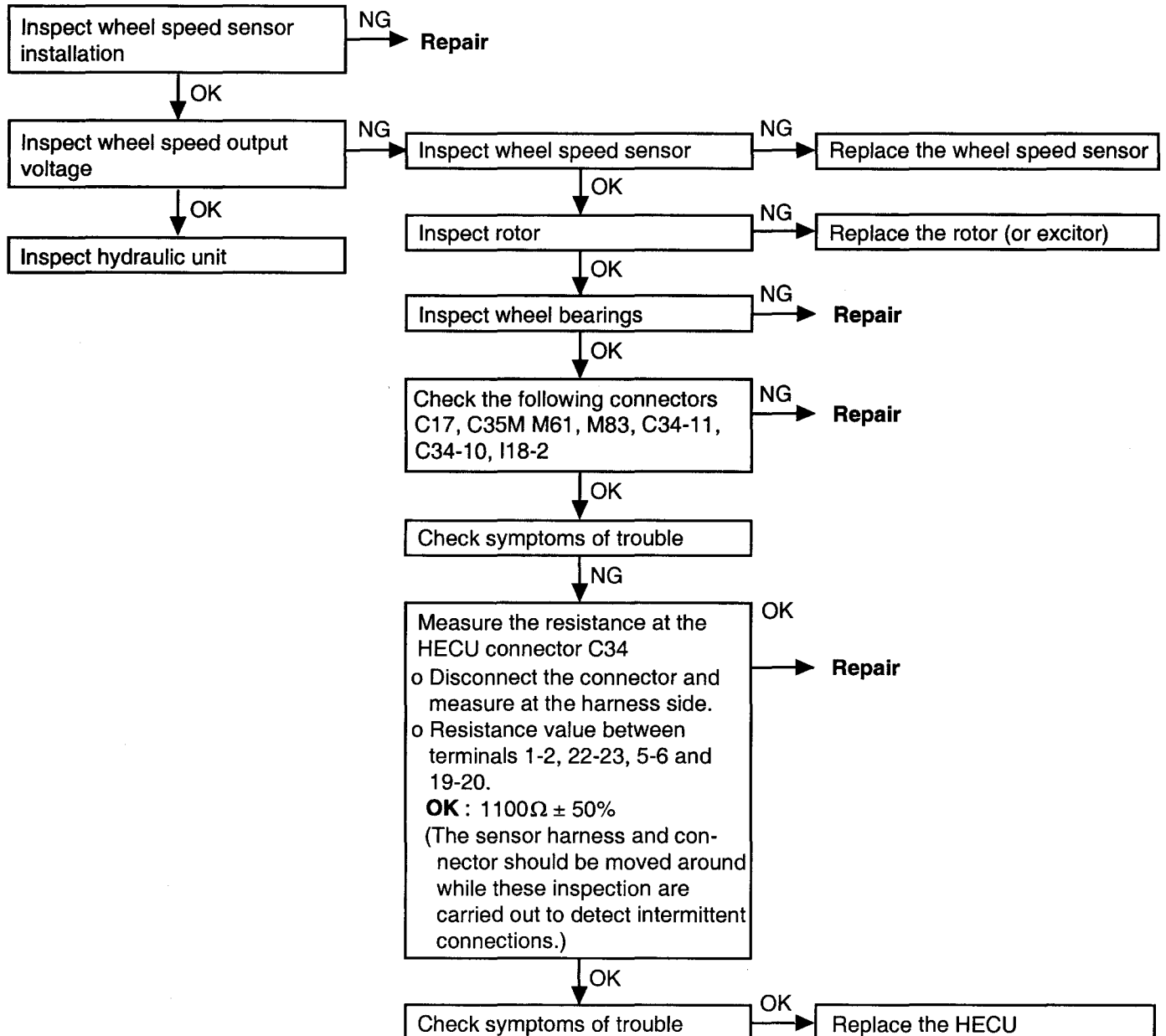
Even after the engine is started, the ABS warning lamp remains illuminated	Probable cause
The cause is probably a short-circuit in the ABS warning lamp illumination circuit	<ul style="list-style-type: none"> <li>• Malfunction of combination meter</li> <li>• Malfunction of HECU</li> <li>• Malfunction of wiring harness</li> </ul>

**This trouble symptom is limited to cases where communication with the Hi-Scan is possible (HECU power supply is normal) and the diagnosis code is normal.**



## INSPECTION PROCEDURE 5

Brake operation is abnormal	Probable cause	
This varies depending on driving conditions and road surface conditions, so problem diagnosis is difficult. However, if a normal diagnosis code is displayed, carry out the following inspection.	<ul style="list-style-type: none"> <li>• Improper installation of wheel speed sensor</li> <li>• Incorrect sensor harness contact</li> <li>• Foreign material adhering to wheel speed sensor</li> </ul>	<ul style="list-style-type: none"> <li>• Malfunction of wheel speed sensor</li> <li>• Malfunction of rotor</li> <li>• Malfunction of wheel bearing</li> <li>• Malfunction of hydraulic unit</li> <li>• Malfunction of HECU</li> </ul>



**BLEEDING OF BRAKE SYSTEM** EJBB3560

This procedure should be used to insure adequate bleeding and filling of ABS unit, brake lines, master cylinder.

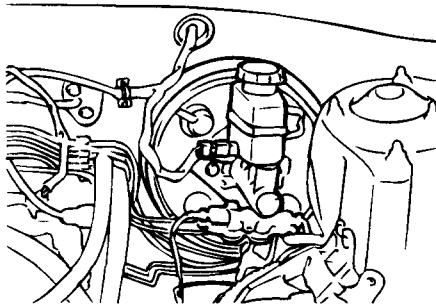
1. Remove the reservoir cap and fill the brake reservoir with brake fluid.

**CAUTION**

*Do not allow brake fluid remain on a painted surface. Wash it off immediately.*

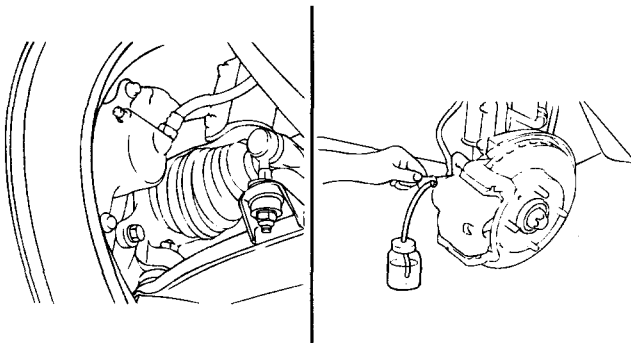
**NOTE**

*When bleeding by pressured fluid, do not depress the brake pedal.  
Recommended fluid.....DOT3 or equivalent*



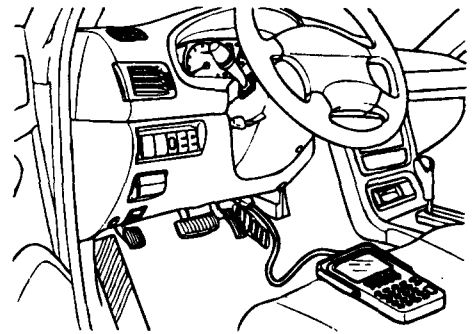
EJA9003A

2. Connect the clear plastic tube to the wheel cylinder bleeder plug and insert the other end of tube in a half filled clear plastic bottle.



EJBB356A

3. Connect Hi-Scan to Data Link Connector located underneath the dash panel.



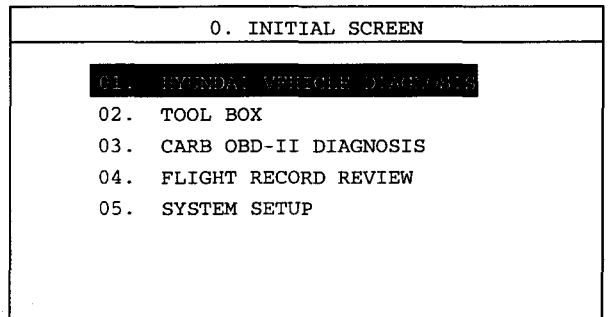
EJBB356B

4. Select and operate according to the instruction on the Hi-Scan screen.

**CAUTION**

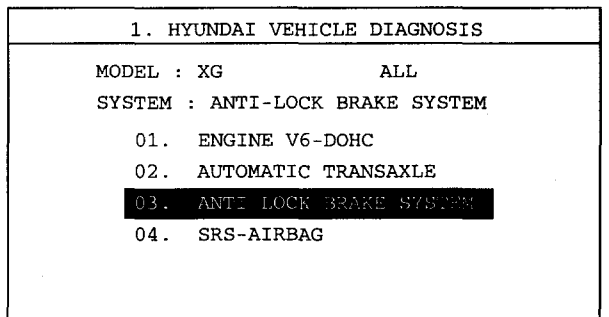
*You have to obey maximum operating time (60sec) of ABS motor with Hi-Scan to prevent motor pump burnt.*

- 1) Select hyundai vehicle diagnosis.



EJBB356C

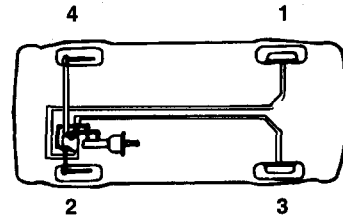
- 2) Select Anti-Lock brake system.



EJBB356D

- 3) Select air bleeding mode.

1. HYUNDAI VEHICLE DIAGNOSIS	
MODEL :	XG ALL
SYSTEM :	ANTI-LOCK BRAKE SYSTEM
01.	DIAGNOSTIC TROUBLE CODES
02.	CURRENT DATA
03.	FLIGHT RECORD
04.	ACTUATION TEST
05.	SIMU-SCAN
	<b>1.6 AIR BLEEDING MODE</b>



EJBB356E

EJA9004A

- 4) Press 'YES' to operate motor pump and solenoid valve.

1.6 AIR BLEEDING MODE	
ABS AIR BLEEDING STATUS	
0.1	SOLENOID VALVE STATUS CLOSE
02.	MOTOR PUMP STATUS OFF
DO YOU WANT TO START ?	
(PRESS [YES] KEY)	

EJBB356F

- 5) 'ON' and 'OFF' controls are automatically performed to prevent the motor pump from being burnt. (If not, you may damage the motor)

1.6 AIR BLEEDING MODE	
ABS AIR BLEEDING STATUS	
0.1	SOLENOID VALVE STATUS OPEN
02.	MOTOR PUMP STATUS ON
TIME : 2SEC	

EJBB356G

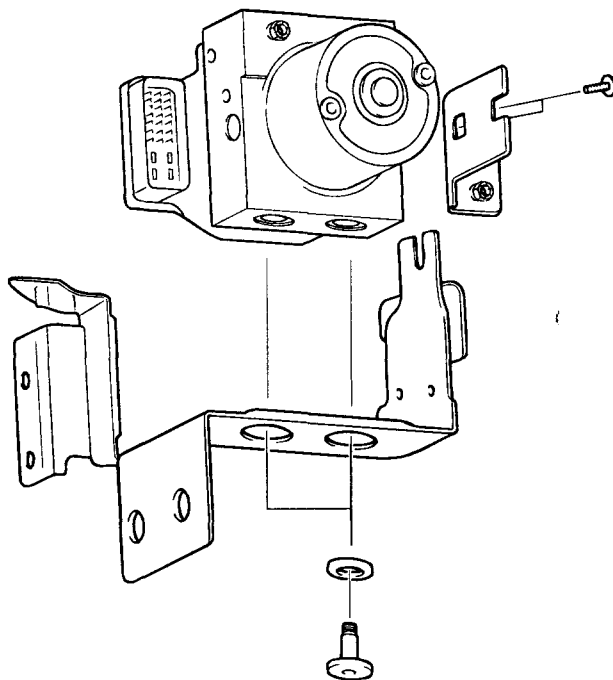
5. Pump the brake pedal several times, and then loosen the bleeder screw until fluid starts to run out without bubbles. Then close the bleeder screw.
6. Repeat the step 5. until there are no more bubbles in the fluid for each wheel in the sequence shown in the illustration.
7. Tighten the bleeder screw.

#### Bleeder screw tightening torque

7-9 Nm (70-90 kg-cm, 5-6.6 lb-ft)

## ANTI-LOCK BRAKING SYSTEM CONTROL MODULE

### COMPONENTS EJHA3200

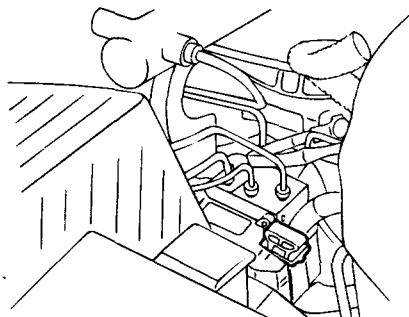


**TORQUE : Nm (kg-cm, lb-ft)**

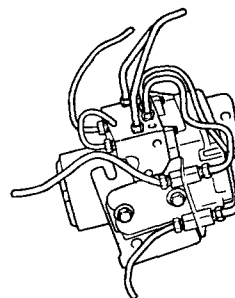
EJHA040A

### REMOVAL EJHA3250

1. Disconnect the HECU (Hydraulic and electronic Control Unit) and motor connector.



EJHA022A



EJHA045A

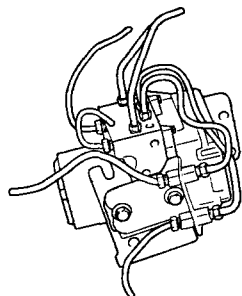
3. Remove the HECU bracket mounting bolt and the HECU.

**! CAUTION**

1. **Never attempt to disassemble the HECU.**

2. Disconnect the brake lines from the HECU.

2. *The HECU must be transported and stored in the upright position and with sealed ports. The HECU must not be drained.*



EJHA045A

## INSTALLATION

EJHA3300

1. Follow the reverse order for removal.
2. Tighten the modulator mounting bolts and brake tube nuts to the specified torque.

---

### Tightening torque

HECU mounting bolt :

8-10 Nm (80-100 kg-cm, 5.6-6.9 lb-ft)

Brake tube nut :

13-17 Nm (130-170 kg-cm, 9-12 lb-ft)

---



## ANTI-LOCK BRAKING SYSTEM MODULATOR

### HYDRAULIC MODULE INSPECTION EJHA3600

 **CAUTION**

*Turn the ignition switch off before connecting or disconnecting the Hi-Scan.*

1. Jack the vehicle up and support the vehicle with rigid racks at the specified jack-up points or replace the wheels which are checked on the rollers of the braking force tester.

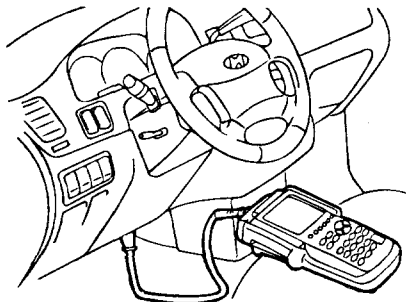
 **CAUTION**

1. *The roller of the braking force tester and the tire should be dry during testing.*
2. *When testing the front brakes, apply the parking brake, and when testing the rear brakes, stop the front wheels by chocking them.*
2. Release the parking brake and feel the drag force (drag torque) on each road wheel.  
When using the braking force tester, take a reading of the brake drag force.
3. Turn the ignition key "OFF" and set the Hi-Scan or Hi-Scan Pro as shown in the diagram.
4. After checking that the shift lever <M/T> or the selector lever <A/T> is in neutral, start the engine.

 **NOTE**

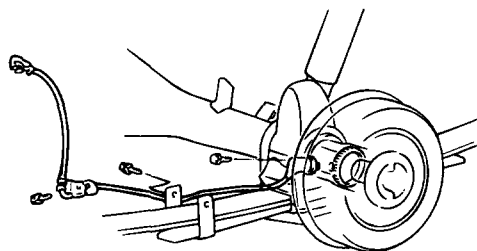
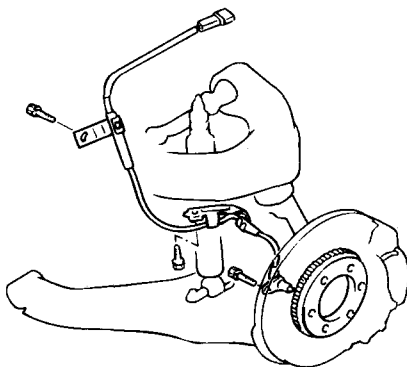
*If the ABS is in fail-safe mode, the Hi-Scan actuator test cannot be used.*

5. Use the Hi-Scan to force-drive the ABS actuator.



# ANTI-LOCK BRAKING SYSTEM WHEEL SPEED SENSOR

## COMPONENTS EJHA3350



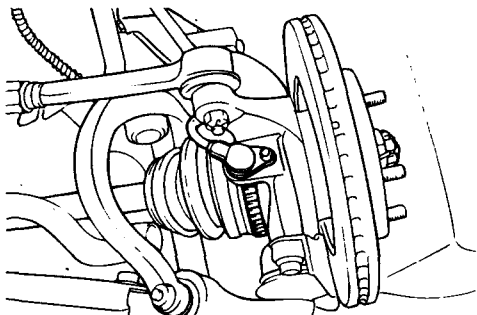
**TORQUE : Nm (kg-cm, lb-ft)**

EJHA055A

## REMOVAL EJHA3400

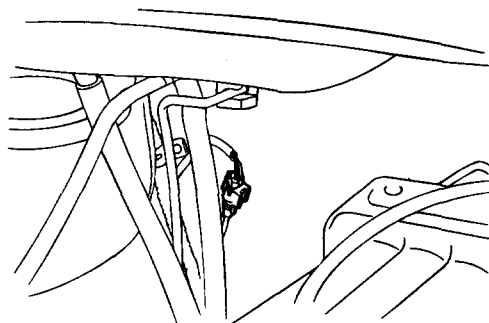
### FRONT WHEEL SPEED SENSOR

1. Remove the front wheel speed sensor mounting bolt.



KFW8059A

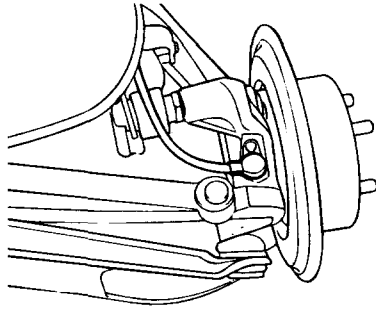
2. Remove the front wheel speed sensor after disconnecting the wheel speed sensor connector.



EJHA023B

**REAR WHEEL SPEED SENSOR**

Remove the rear wheel speed sensor after disconnecting the wheel speed sensor connector.



KFW8060A

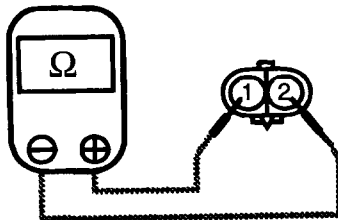
**INSPECTION** EJBB3450

1. Connect an ohmmeter between the wheel speed sensor terminals and measure the resistance.

**Service standard**

Front : 1385 ± 110Ω

Rear : 1385 ± 110Ω

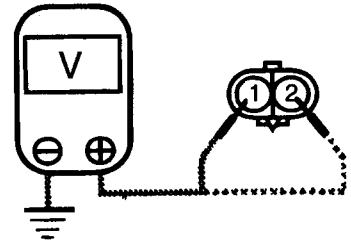


EJA9031E

2. Connect a voltmeter between the wheel speed sensor terminals and measure the voltage by turning the wheel.

**NOTE**

Set the voltmeter to measure AC voltage.  
Service standard : AC voltage detected.



EJA9031F

**ABS OPERATION CHECK** EJHA3550

**WHEEL SPEED SENSOR OUTPUT VOLTAGE CHECK**

1. Lift the vehicle up and release the parking brake.
2. Disconnect the HECU harness connector and measure from the harness side connector.

**CAUTION**

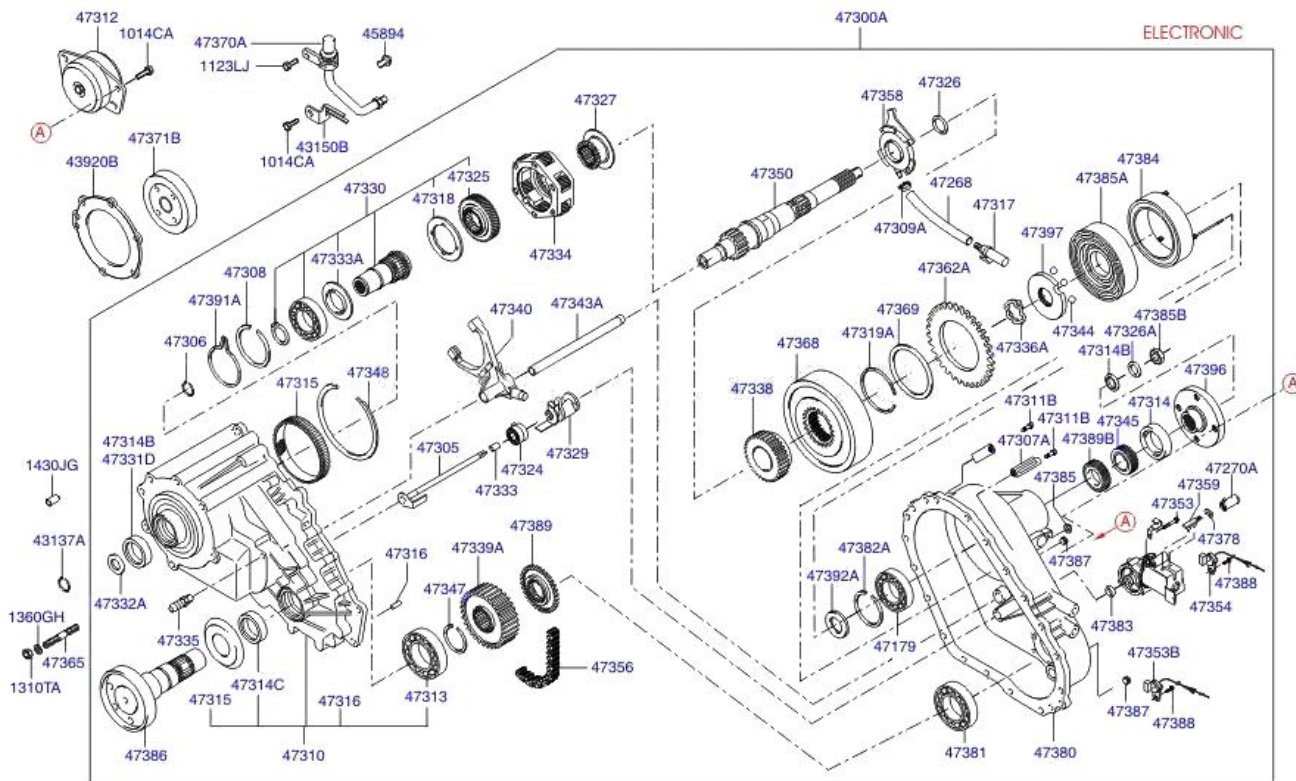
*Be sure to remove the connector double lock and insert the probe into the harness side. Inserting it into the terminal side will result in a bad connection.*

3. Rotate the wheel to be measured at approximately 1/2–1 rotation per second, and check the output voltage using a circuit tester or an oscilloscope.

Wheel speed sensor	Front left	Front right	Rear left	Rear right
Terminal No.	1	19	5	22
	2	20	6	23

**Output voltage**

When measuring with an oscilloscope : 130 mV peak-to-peak or more

**Układ aktywnego przeniesienia momentu napędowego ATT (Active Torque Transfer)**

Nazwa	Numer	Opis
BOLT	10141-10251	2900 CC, 3500 CC
BOLT	11234-10351	2900 CC, 3500 CC, MPI-DOHC, T/C INTER COOLER, 5 SPEED MT 4WD
BOLT-FLANGE	11405-08351	5 SPEED MT 4WD
NUT	13104-10001	2900 CC, 3500 CC, MPI-DOHC, T/C INTER COOLER, 5 SPEED MT 4WD
WASHER-SPRING	13602-10001	2900 CC, 3500 CC, MPI-DOHC, T/C INTER COOLER, 5 SPEED MT 4WD
PIN-DOWEL	14303-12240	2900 CC, 3500 CC, MPI-DOHC, T/C INTER COOLER, 4 SPEED AT 4WD; AUTO TRANSFER(ELECTRONIC)

PLATE-BAFFLE	MD704128A	D4BH(4D56 TCI), T/C INTER COOLER, 5 SPEED MT 4WD; FUEL INJ-ELECTRONIC TYPE
CLIP-MNL T/A CASE	43150-34000	2900 CC, 3500 CC, MPI-DOHC, T/C INTER COOLER, 5 SPEED MT 4WD
GASKET-ADAPTER	43920-H1300	D4BH(4D56 TCI), T/C INTER COOLER, 5 SPEED MT 4WD; AUTO TRANSFER(ELECTRIC), FUEL INJ-ELECTRONIC TYPE
MAGNET	47301-4B000	ALL
PLUG	MD704168A	D4BH(4D56 TCI), T/C INTER COOLER, 5 SPEED MT 4WD; FUEL INJ-ELECTRONIC TYPE
BEARING	47304-H1000	ALL
HOSE	47302-H1000	ALL
CONNECTOR	47352-H1000	ALL
TRANSFER ASSY	47000-H1031	2900 CC, 3500 CC, MPI-DOHC, T/C INTER COOLER, 4 SPEED AT 4WD; AUTO TRANSFER(ELECTRONIC)
	47000-H1072	2900 CC, 3500 CC, MPI-DOHC, T/C INTER COOLER, 5 SPEED MT 4WD; AUTO TRANSFER(ELECTRIC)
	47000-H1061	2900 CC, 3500 CC, MPI-DOHC, T/C INTER COOLER, 5 SPEED MT 4WD; AUTO TRANSFER(ELECTRONIC)
	47000-H1080	2900 CC, T/C INTER COOLER, 4 SPEED AT 4WD; AUTO TRANSFER(ELECTRIC)
	47000-H1080	2900 CC, T/C INTER COOLER, 4 SPEED AT 4WD; AUTO TRANSFER(ELECTRIC)
	47000-H1081	2900 CC, T/C INTER COOLER, 4 SPEED AT 4WD; AUTO TRANSFER(ELECTRIC)
	47000-H1030	2900 CC, T/C INTER COOLER, 4 SPEED AT 4WD; AUTO TRANSFER(ELECTRONIC)

	47000-H1071	2900 CC, T/C INTER COOLER, 5 SPEED MT 4WD; AUTO TRANSFER(ELECTRIC)
	47000-H1070	2900 CC, T/C INTER COOLER, 5 SPEED MT 4WD; AUTO TRANSFER(ELECTRIC)
	47000-H1070	2900 CC, T/C INTER COOLER, 5 SPEED MT 4WD; AUTO TRANSFER(ELECTRIC)
	47000-H1071	2900 CC, T/C INTER COOLER, 5 SPEED MT 4WD; AUTO TRANSFER(ELECTRIC)
	47000-H1060	2900 CC, T/C INTER COOLER, 5 SPEED MT 4WD; AUTO TRANSFER(ELECTRONIC)
	47000-H1080	3500 CC, MPI-DOHC, 4 SPEED AT 4WD; AUTO TRANSFER(ELECTRIC)
	47000-H1081	3500 CC, MPI-DOHC, 4 SPEED AT 4WD; AUTO TRANSFER(ELECTRIC)
	47000-H1030	3500 CC, MPI-DOHC, 4 SPEED AT 4WD; AUTO TRANSFER(ELECTRONIC)
	47000-H1071	3500 CC, MPI-DOHC, 5 SPEED MT 4WD; AUTO TRANSFER(ELECTRIC)
	47000-H1070	3500 CC, MPI-DOHC, 5 SPEED MT 4WD; AUTO TRANSFER(ELECTRIC)
	47000-H1060	3500 CC, MPI-DOHC, 5 SPEED MT 4WD; AUTO TRANSFER(ELECTRONIC)
	47000-H1080	D4BH(4D56 TCI), T/C INTER COOLER, 4 SPEED AT 4WD; FUEL INJ-ELECTRONIC TYPE
	47000-H1090	D4BH(4D56 TCI), T/C INTER COOLER, 5 SPEED MT 4WD; FUEL INJ-ELECTRONIC TYPE
MOTOR ASSY	47303-H1010	2900 CC, T/C INTER COOLER, 4 SPEED AT 4WD; AUTO TRANSFER(ELECTRIC)
	47303-H1010	2900 CC; AUTO TRANSFER(ELECTRIC)
	47303-H1000	2900 CC; AUTO TRANSFER(ELECTRONIC)

	47303-H1010	3500 CC; AUTO TRANSFER(ELECTRIC)
	47303-H1000	3500 CC; AUTO TRANSFER(ELECTRONIC)
	47303-H1010	D4BH(4D56 TCI); FUEL INJ-ELECTRONIC TYPE
SHAFT-ACCESSORY	47305-4B000	ALL
RING-RETAINING	47306-4B000	ALL
WIRE CLIP	47307-H1000	ALL
RING-RETAINING	47308-4B000	ALL
CLAMP-HOSE	47309-H1000	ALL
CASE ASSY	47310-H1000	2900 CC, T/C INTER COOLER, 4 SPEED AT 4WD; AUTO TRANSFER(ELECTRIC)
	47310-H1000	2900 CC, T/C INTER COOLER, 4 SPEED AT 4WD; AUTO TRANSFER(ELECTRIC)
	47310-H1000	2900 CC, T/C INTER COOLER, 4 SPEED AT 4WD; AUTO TRANSFER(ELECTRONIC)
	47310-H1010	2900 CC, T/C INTER COOLER, 5 SPEED MT 4WD; AUTO TRANSFER(ELECTRIC)
	47310-H1010	2900 CC, T/C INTER COOLER, 5 SPEED MT 4WD; AUTO TRANSFER(ELECTRONIC)
	47310-H1000	3500 CC, MPI-DOHC, 4 SPEED AT 4WD; AUTO TRANSFER(ELECTRIC)
	47310-H1000	3500 CC, MPI-DOHC, 4 SPEED AT 4WD; AUTO TRANSFER(ELECTRONIC)
	47310-H1010	3500 CC, MPI-DOHC, 5 SPEED MT 4WD; AUTO TRANSFER(ELECTRIC)
	47310-H1010	3500 CC, MPI-DOHC, 5 SPEED MT 4WD; AUTO TRANSFER(ELECTRONIC)

	47310-H1000	D4BH(4D56 TCD), T/C INTER COOLER, 4 SPEED AT 4WD; FUEL INJ-ELECTRONIC TYPE
	47310-H1010	D4BH(4D56 TCD), T/C INTER COOLER, 5 SPEED MT 4WD; FUEL INJ-ELECTRONIC TYPE
BOLT	47311-H1000	ALL
DAMPER ASSY-DYNAMIC	47312-M1000	2900 CC, 3500 CC
BEARING	47313-H1000	ALL
SEAL-OIL	47314-4B000	ALL
SEAL-OIL	47314-H1000	ALL
SEAL-OIL	47314-4B000A	ALL
RING-GEAR	47315-4B000	ALL
PIN	47316-4B000	ALL
FILTER	47317-H1000	ALL
PLATE	47318-4B000	ALL
SNAP RING	47319-H1000	2900 CC, 3500 CC
SPRING	47324-4B000	ALL
GEAR-SUN	47325-4B000	ALL
WASHER-THRUST	47395-H1000	2900 CC, 3500 CC
WASHER	47326-H1000	ALL
SLEEVE-SYNCHRONIZER	47327-4B000	ALL
FORK-SHIFT	47328-H1010	ALL



CAM	47329-4B000	2900 CC, T/C INTER COOLER, 4 SPEED AT 4WD; AUTO TRANSFER(ELECTRIC)
	47361-H1000	2900 CC, T/C INTER COOLER, 5 SPEED MT 4WD; AUTO TRANSFER(ELECTRIC)
	47329-4B000	2900 CC; AUTO TRANSFER(ELECTRIC)
	47361-H1000	2900 CC; AUTO TRANSFER(ELECTRONIC)
	47329-4B000	3500 CC; AUTO TRANSFER(ELECTRIC)
	47361-H1000	3500 CC; AUTO TRANSFER(ELECTRONIC)
	47329-4B000	D4BH(4D56 TCI); FUEL INJ-ELECTRONIC TYPE
SHAFT ASSY	47330-H1000	2900 CC, T/C INTER COOLER, 4 SPEED AT 4WD; AUTO TRANSFER(ELECTRIC)
	47330-H1000	2900 CC, T/C INTER COOLER, 4 SPEED AT 4WD; AUTO TRANSFER(ELECTRIC)
	47330-H1000	2900 CC, T/C INTER COOLER, 4 SPEED AT 4WD; AUTO TRANSFER(ELECTRONIC)
	47330-H1020	2900 CC, T/C INTER COOLER, 5 SPEED MT 4WD; AUTO TRANSFER(ELECTRIC)
	47330-H1020	2900 CC, T/C INTER COOLER, 5 SPEED MT 4WD; AUTO TRANSFER(ELECTRONIC)
	47330-H1000	3500 CC, MPI-DOHC, 4 SPEED AT 4WD; AUTO TRANSFER(ELECTRIC)
	47330-H1000	3500 CC, MPI-DOHC, 4 SPEED AT 4WD; AUTO TRANSFER(ELECTRONIC)
	47330-H1020	3500 CC, MPI-DOHC, 5 SPEED MT 4WD; AUTO TRANSFER(ELECTRIC)
	47330-H1020	3500 CC, MPI-DOHC, 5 SPEED MT 4WD; AUTO TRANSFER(ELECTRONIC)
	47330-H1000	D4BH(4D56 TCI), T/C INTER COOLER, 4 SPEED AT 4WD; FUEL INJ-ELECTRONIC TYPE

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# Body Electrical System

<b>GENERAL .....</b>	<b>BE -2</b>
<b>AUDIO SYSTEM .....</b>	<b>BE -22</b>
<b>MULTI FUNCTION SWITCH .....</b>	<b>BE -28</b>
<b>HORNS .....</b>	<b>BE -32</b>
<b>KEYLESS ENTRY AND BURGLAR ALARM .....</b>	<b>BE -33</b>
<b>ETACS (ELECTRONIC TIME AND ALARM CONTROL SYSTEM) .....</b>	<b>BE -38</b>
<b>FUSES AND RELAYS .....</b>	<b>BE -43</b>
<b>INDICATORS AND GAUGES .....</b>	<b>BE -48</b>
<b>POWER DOOR LOCKS .....</b>	<b>BE -55</b>
<b>POWER DOOR MIRRORS .....</b>	<b>BE -57</b>
<b>POWER WINDOWS .....</b>	<b>BE -60</b>
<b>REAR WINDOW DEFOGGER .....</b>	<b>BE -64</b>
<b>WINDSHIELD WIPER/WASHER .....</b>	<b>BE -66</b>
<b>REAR WIPER/WASHER .....</b>	<b>BE -71</b>
<b>SEAT WARMER .....</b>	<b>BE -75</b>
<b>SUN ROOF .....</b>	<b>BE -76</b>
<b>LIGHTING SYSTEM .....</b>	<b>BE -79</b>
<b>HEAD LAMP LEVELLING DEVICE .....</b>	<b>BE -90</b>
<b>IMMOBILIZER CONTROL SYSTEM .....</b>	<b>BE -92</b>

# GENERAL

## SPECIFICATIONS ETMB0050

### MULTIFUNCTION SWITCH

Items	Specifications
Rated Voltage	DC 12V
Operating temperature range	-30°C - +80°C (-22 - +176°F)
Rated load Dimmer & passing switch	High : 1A (Relay load) Low : 1A (Relay load) Passing : 1A (Relay load)
Lighting switch	Lighting : 1A (Relay load)
Turn signal switch & lane change	6.6 ± 0.5A (Lamp load)
Wiper switch	Low, High : 4.5A (Motor load) Int. : 0.22 ± 0.05A (Relay load) Lock : Max. 28A (Motor load)
Wiper mist switch	1A (Relay load)
Washer switch	4 A (Motor load)
Variable intermittent wiper volume switch	Max. 25mA
Front fog lamp switch	1A (Relay load)
Horn switch	1A (Relay load)

### INSTRUMENTS AND WARNING SYSTEM

Warning lamps	Bulb wattage (W)	Color
Illumination	3.4W x 5EA	Yellow green
High beam	3.0	Blue
Low fuel	3.0	Amber
Turn signal (LH, RH)	1.4	Green
Battery (charge)	1.4	Red
Oil pressure	1.4	Red
Air bag	1.4	Red
Parking brake	1.4	Red
Seat belt	1.4	Red
Check engine	1.4	Amber
ABS	1.4	Amber
A/T temperature	1.4	Red
Snow	1.4	Amber
Door ajar	1.4	Red
Tailgate open	1.4	Amber
Cruise	1.4	Green
O/D OFF	1.4	Amber
Immobilizer	1.4	Amber
Front fog lamp	1.4	Green

Warning lamps	Bulb wattage (W)	Color
4WD	1.4	Green
4WD LOW	1.4	Green
Water separator (for DSL)	1.4	Red
Vacuum brake (for DSL)	1.4	Red
Glow (for DSL)	1.4	Amber
<b>A/T</b>		
P	1.4	Green
R	1.4	Amber
N	1.4	Green
D	1.4	Green
2	1.4	Green
L	1.4	Green

## SERVICE SPECIFICATIONS ETMB0100

## INDICATORS AND GAUGES

Items	Specifications																																																																																						
Speedometer																																																																																							
Type	o Cross - coil type																																																																																						
Input spec.	o Hall IC type : 4 pulses/rev.																																																																																						
Indication	o Km/h : 637rpm x 4 pulses/rev. indicates 60Km/h																																																																																						
	o MPH : 1026 rpm x 4 pulses/rev. indicates 60MPH																																																																																						
Standard values	<table border="1"> <tr> <td>Velocity (Km/h)</td> <td>20</td> <td>40</td> <td>60</td> <td>80</td> <td>100</td> <td>120</td> <td></td> </tr> <tr> <td>Tolerance (Km/h)</td> <td>20.5-24.5</td> <td>41-43.9</td> <td>61.1-64.9</td> <td>81.5-85.9</td> <td>102-106.8</td> <td>122.4-127.8</td> <td></td> </tr> <tr> <td>Velocity (Km/h)</td> <td>140</td> <td>160</td> <td>180</td> <td>200</td> <td colspan="2">Remarks</td> <td></td> </tr> <tr> <td>Tolerance (Km/h)</td> <td>142.8-148.8</td> <td>163.4-169.8</td> <td>183.4-190.2</td> <td>203.4-211</td> <td colspan="2">All area</td> <td></td> </tr> </table> <table border="1"> <tr> <td>Velocity (MPH)</td> <td>10</td> <td>20</td> <td>40</td> <td>60</td> <td>80</td> <td>100</td> <td></td> </tr> <tr> <td>Tolerance (MPH)</td> <td>10.3-12.8</td> <td>20.5-22.5</td> <td>40.8-43.4</td> <td>61-64.4</td> <td>81.3-85.1</td> <td>101.8-106.2</td> <td></td> </tr> <tr> <td>Tolerance (MPH)</td> <td>8.5-11.5</td> <td>18.5-21.5</td> <td>38.5-41.5</td> <td>58.3-61.7</td> <td>78-82</td> <td>97.7-102.3</td> <td></td> </tr> <tr> <td>Velocity (MPH)</td> <td>120</td> <td>140</td> <td colspan="4">Remarks</td> <td></td> </tr> <tr> <td>Tolerance (MPH)</td> <td>122-127</td> <td>142.3-147.9</td> <td colspan="4">EXCEPT USA</td> <td></td> </tr> <tr> <td>Tolerance (MPH)</td> <td>117.5-122.5</td> <td>137.3-142.7</td> <td colspan="4">USA</td> <td></td> </tr> </table>							Velocity (Km/h)	20	40	60	80	100	120		Tolerance (Km/h)	20.5-24.5	41-43.9	61.1-64.9	81.5-85.9	102-106.8	122.4-127.8		Velocity (Km/h)	140	160	180	200	Remarks			Tolerance (Km/h)	142.8-148.8	163.4-169.8	183.4-190.2	203.4-211	All area			Velocity (MPH)	10	20	40	60	80	100		Tolerance (MPH)	10.3-12.8	20.5-22.5	40.8-43.4	61-64.4	81.3-85.1	101.8-106.2		Tolerance (MPH)	8.5-11.5	18.5-21.5	38.5-41.5	58.3-61.7	78-82	97.7-102.3		Velocity (MPH)	120	140	Remarks					Tolerance (MPH)	122-127	142.3-147.9	EXCEPT USA					Tolerance (MPH)	117.5-122.5	137.3-142.7	USA				
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Type	o Cross - coil type (4cyl : 4pulses/rev, 6cyl : 3pulses/rev)																																																																																						
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Fuel gauge																																																																																							
Type	o Cross - coil type (Fixed point type : Pointer should not fall into the "E" point but indicate remaining fuel level when the ignition is off)																																																																																						
Standard values	<table border="1"> <tr> <th rowspan="2">Level</th> <th colspan="2">Gauge</th> <th rowspan="2">Gauge angle (°)</th> </tr> <tr> <th colspan="2">Resistance (Ω)</th> </tr> <tr> <td>E (Empty)</td> <td colspan="2">95</td> <td>-40 ± 2.4</td> </tr> <tr> <td>1/2</td> <td colspan="2">32.5</td> <td>0 ± 4.0</td> </tr> <tr> <td>F (Full)</td> <td colspan="2">7</td> <td>40 ± 2.4</td> </tr> </table>							Level	Gauge		Gauge angle (°)	Resistance (Ω)		E (Empty)	95		-40 ± 2.4	1/2	32.5		0 ± 4.0	F (Full)	7		40 ± 2.4																																																														
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	o Inspection order : E → F → E																																																																																						
	The level must be reached within 7 minutes after the resistance is set for Full or Empty.																																																																																						
	o Point stability tolerance : Within 9°																																																																																						
	Apply power for 10 minutes. Then turn off the power for 30 minutes and read the position of the pointer.																																																																																						

Items	Specifications															
Temperature gauge	<ul style="list-style-type: none"> <li>o Cross - coil type (Intermedia stability type).</li> </ul> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Temperature</th> <th>Angle (°)</th> <th>Assembled tolerance (°)</th> </tr> </thead> <tbody> <tr> <td>55°C</td> <td>-40</td> <td>-</td> </tr> <tr> <td>85°C - 110°C</td> <td>-7<sup>+2</sup><sub>-3</sub></td> <td>+3 -2</td> </tr> <tr> <td>Red zone (over 125°C)</td> <td>over 35±5</td> <td>+7 -4</td> </tr> </tbody> </table>				Temperature	Angle (°)	Assembled tolerance (°)	55°C	-40	-	85°C - 110°C	-7 <sup>+2</sup> <sub>-3</sub>	+3 -2	Red zone (over 125°C)	over 35±5	+7 -4
Temperature					Angle (°)	Assembled tolerance (°)										
55°C					-40	-										
85°C - 110°C					-7 <sup>+2</sup> <sub>-3</sub>	+3 -2										
Red zone (over 125°C)	over 35±5	+7 -4														
Type																
Indication standard																
Resistance of temperature sender (NTC)	<ul style="list-style-type: none"> <li>o Inspection order : OFF → C → H</li> </ul> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Temperature (°C)</th> <th>55</th> <th>85</th> <th>110</th> <th>125</th> </tr> </thead> <tbody> <tr> <td>Resistance (Ω)</td> <td>157</td> <td>48.4</td> <td>24</td> <td>15.2</td> </tr> </tbody> </table>				Temperature (°C)	55	85	110	125	Resistance (Ω)	157	48.4	24	15.2		
Temperature (°C)	55	85	110	125												
Resistance (Ω)	157	48.4	24	15.2												

ETMB010B

## LIGHTING SYSTEM

Items	Bulb wattage(W)
Head lamp	55W / 55W (High / Low)
Front turn signal lamp	21W
Front position lamp	5W
Front fog lamp	55W
Rear combination lamps	5W / 21W
Tail/stop lamp	
Back up lamp	
Turn signal lamp	
Rear fog lamp	21W
Side repeater lamp	5W
License plate lamp	5W
Luggage lamp	10W
Room lamp	10W
Map lamp	10W

## AUDIO

Items	H240	H260	H280
Rated output	Max. 20W x 4	Max. 25W x 4	Max. 20W x 4
Speaker impedance	4ΩX4	4ΩX4	4ΩX4
Band	AM/FM, LW/MW/FM	AM/FM, LW/MW/FM	AM/FM, LW/MW/FM
Tuning type	PLL Synthesized type	PLL Synthesized type	PLL Synthesized type
Dark current	Max. 2mA	Max. 3.8mA	Max. 2mA

Items	H240	H260	H280
Frequency range / Channel	AM : 531~1602KHZ/9KHZ	AM : 531~1602KHZ/9KHZ	AM : 531~1602KHZ/9KHZ
	FM : 87.5~108MHZ/100KHZ	FM : 87.5~108MHZ/100KHZ	FM : 87.5~108MHZ/100KHZ
	LW : 153~279KHZ/1KHZ	LW : 153~279KHZ/1KHZ	LW : 153~279KHZ/1KHZ
	MW : 531~1602KHZ/9KHZ	MW : 531~1602KHZ/9KHZ	MW : 531~1602KHZ/9KHZ
	FM : 87.5~108MHZ/50KHZ	FM : 87.5~108MHZ/50KHZ	FM : 87.5~108MHZ/50KHZ

## WINDSHIELD WIPER AND WASHER

Items	Specifications
Wiper motor Speed/current at 10kg.cm load test (1.0Nm, 0.7lb-ft) Speed/current at 40kg.cm load test (4.0Nm, 2.9lb-ft) Current when parking	Low : 44-52rpm/3.5A or less High : 64-78rpm/4.5A or less Low : 39-47rpm/5.5A or less High : 56-68rpm/7.0A or less Low : 24A or less High : 28A or less
Windshield washer Motor type Pump type Current Discharge pressure Flow rate Overload capacity (Continuous operation) With water Without water	DC ferrite magnet Centrifugal 5.0A or less 1.8kg/cm <sup>2</sup> or more 1,500cc/min. or more 60sec. or less 20sec. or less

## TROUBLESHOOTING ETMB0150

## INSTRUMENTS AND WARNING SYSTEM

Symptom	Possible cause	Remedy
Tachometer does not operate	No.21 fuse (10A) blown Tachometer faulty Wiring faulty	Check for short and replace fuse Check tachometer Repair if necessary
Fuel gauge does not operate	No.21 fuse (10A) blown Fuel gauge faulty Fuel sender faulty Wiring faulty	Check for short and replace fuse Check gauge Check fuel sender Repair if necessary
Low fuel warning lamp does not light	No.21 fuse (10A) blown Bulb burned out Fuel level sensor faulty Wiring or ground faulty	Check for short and replace fuse Replace bulb Check sensor Repair if necessary
Water temperature gauge does not operate	No.21 fuse (10A) blown Water temperature gauge faulty Water temperature sender faulty Wiring or ground faulty	Check for short and replace fuse Check gauge Check sender Repair if necessary



Symptom	Possible cause	Remedy
Oil pressure warning lamp does not light	No.21 fuse (10A) blown Bulb burned out Oil pressure sender faulty Wiring or ground faulty	Check for short and replace fuse Replace bulb Check sender Repair if necessary
Low brake fluid warning lamp does not light	No.21 fuse (10A) blown Bulb burned out Brake fluid level warning switch faulty Parking brake switch faulty Wiring or ground faulty	Check for short and replace fuse Replace bulb Check switch Check switch Repair if necessary
Open door warning lamp does not light	Power connector (10A) blown Bulb burned out Door switch faulty Wiring or ground faulty	Check for connection Replace bulb Check switch Repair if necessary
Seat belt warning lamp does not light	No.21 fuse (10A) blown Bulb burned out Buckle switch faulty Wiring or ground faulty	Check for short and replace fuse Replace bulb Check switch Repair if necessary

## LIGHTING SYSTEM

Symptom	Possible cause	Remedy
One lamp does not light (all exterior)	Bulb burned out Socket, wiring or ground faulty	Replace bulb Repair if necessary
Head lamps do not light	Bulb burned out Fusible link (40A) blown Head lamp relay faulty Lighting switch faulty Wiring or ground faulty	Replace bulb Replace fusible link Check relay Check switch Repair if necessary
Tail lamps do not light	Tail lamp fuse blown (10A) Fusible link blown Tail lamp relay faulty Lighting switch faulty Wiring or ground faulty	Replace fuse and check for short Replace fusible link Check relay Check switch Repair if necessary
Stop lamps do not light	No.3 fuse (15A) blown Stop lamp switch faulty Wiring or ground faulty Stop lamp relay faulty	Replace fuse and check for short Adjust or replace switch Repair if necessary Replace relay
Stop lamps stay on	Stop lamp switch faulty Stop lamp relay faulty	Adjust or replace switch Replace relay
Instrument lamps do not light (Tail lamps light)	Rheostat faulty Wiring or ground faulty	Check rheostat Repair if necessary
Turn signal lamp does not flash on one side	Bulb burned out Turn signal switch faulty Wiring or ground faulty	Replace bulb Check switch Repair if necessary
Turn signal lamps do not operate	No.20 fuse (10A) blown Flasher faulty Turn signal switch faulty Wiring or ground faulty	Replace fuse and check for short Check flasher Check switch Repair if necessary

Symptom	Possible cause	Remedy
Hazard warning lamps do not operate	No.2 fuse (15A) blown Flasher faulty Hazard switch faulty Wiring or ground faulty	Replace fuse and check for short Check flasher Check switch Repair if necessary
Flasher rate too slow or too fast	Lamps' wattages are smaller or larger than specified Defective flasher	Replace lamps Replace flasher
Back up lamps do not light up	No.18 fuse (10A) blown Back up lamp switch faulty Wiring or ground faulty	Replace fuse and check for short Check switch Repair if necessary
Overhead console lamp does not light up	Fusible link (50A) blown Wiring or ground faulty	Replace fusible link Repair if necessary

AUDIO

There are six areas where a problem can occur: wiring harness, the radio, the cassette tape deck, the CD player, the speaker, and antenna. Troubleshooting enables you to confine the problem to a particular area.

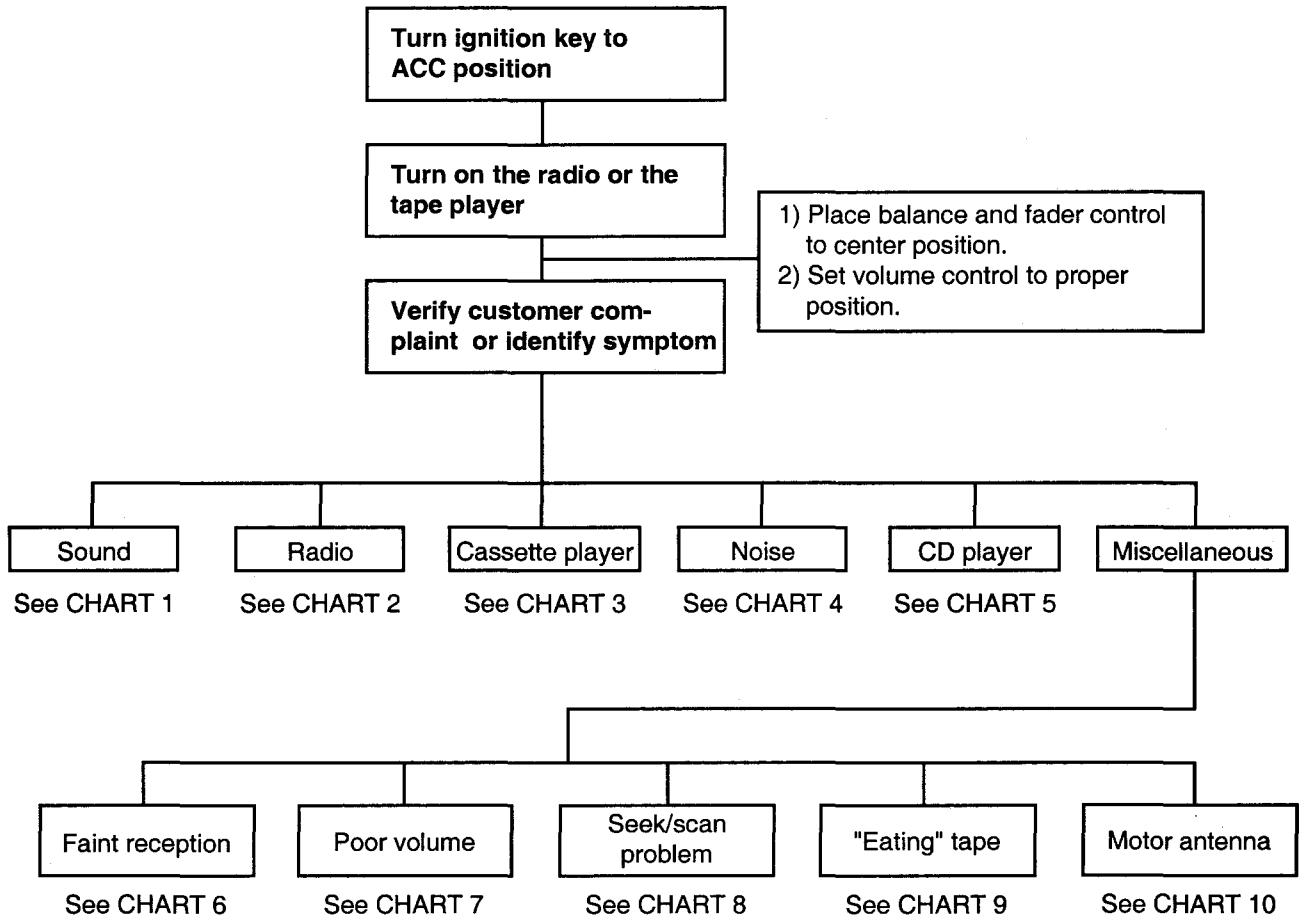
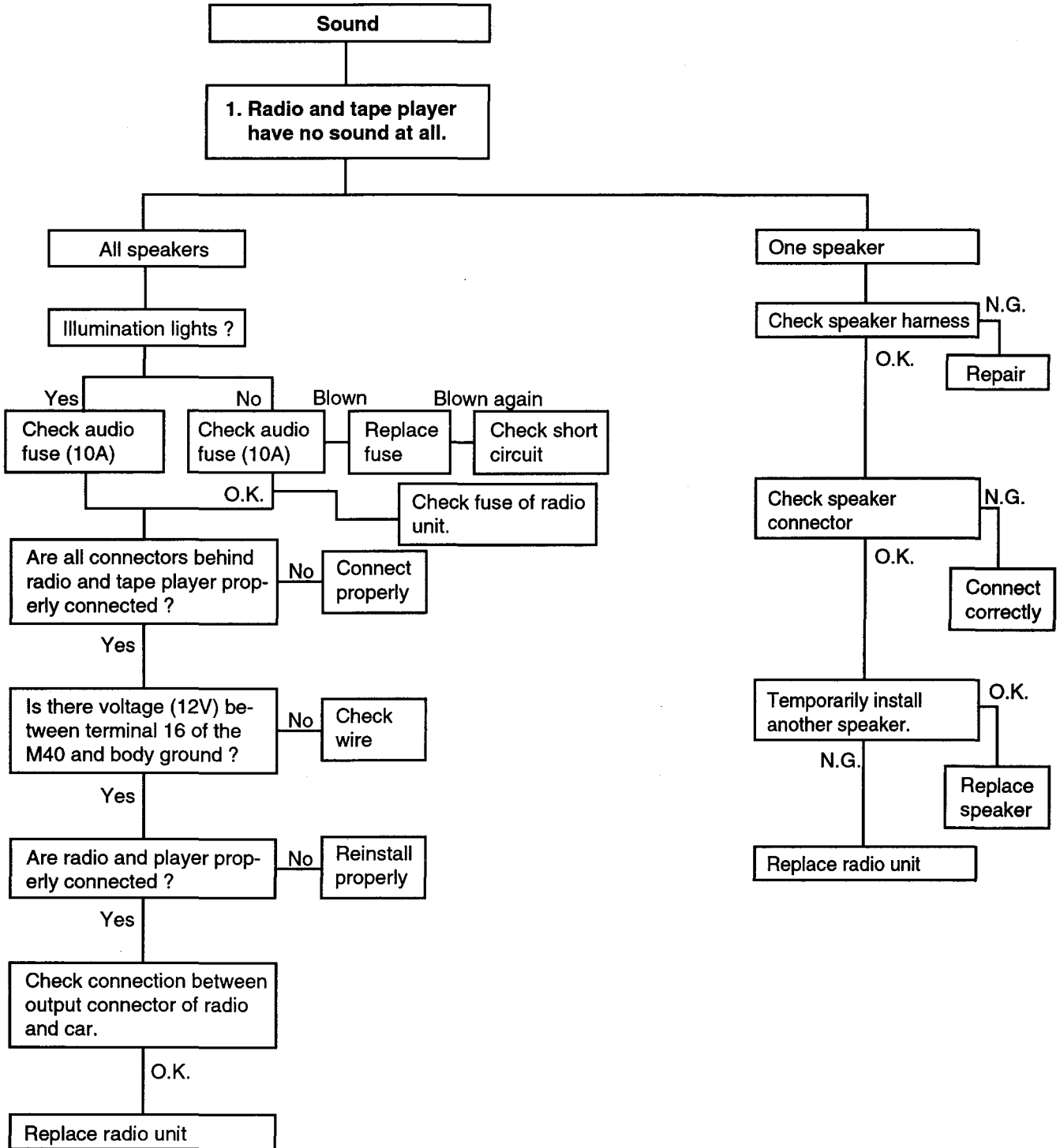
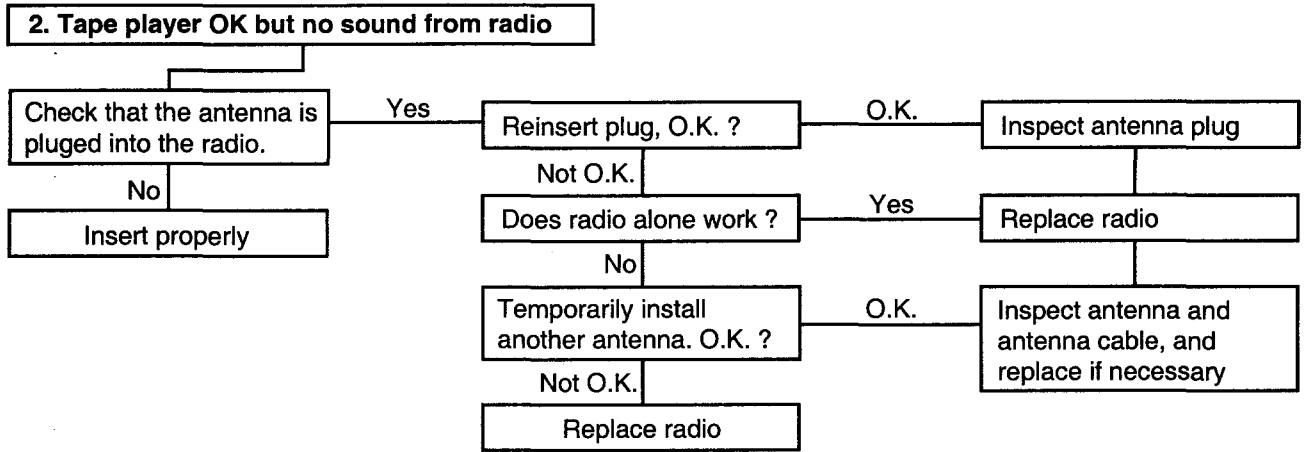


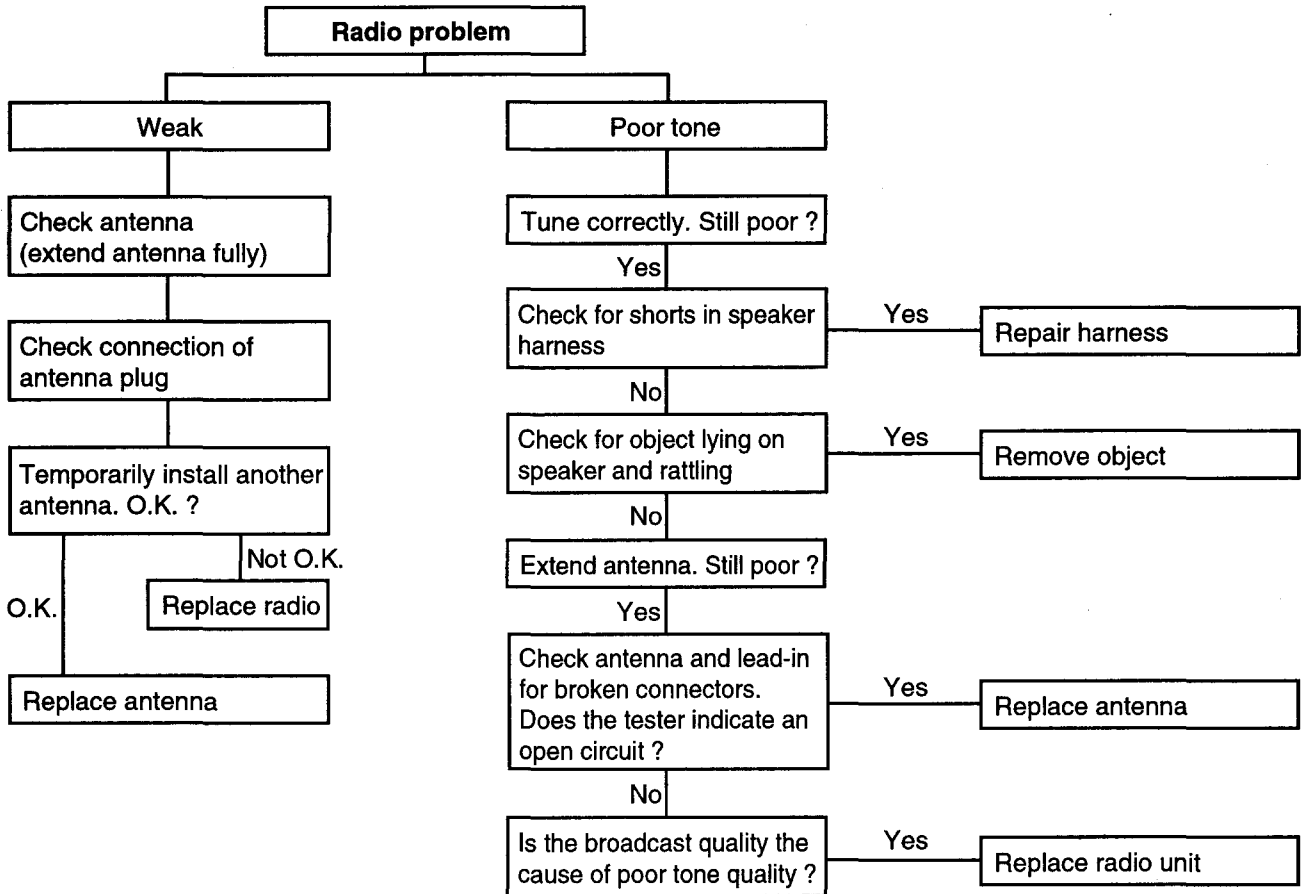
CHART 1





ETA9010C

CHART 2



ETA9010D

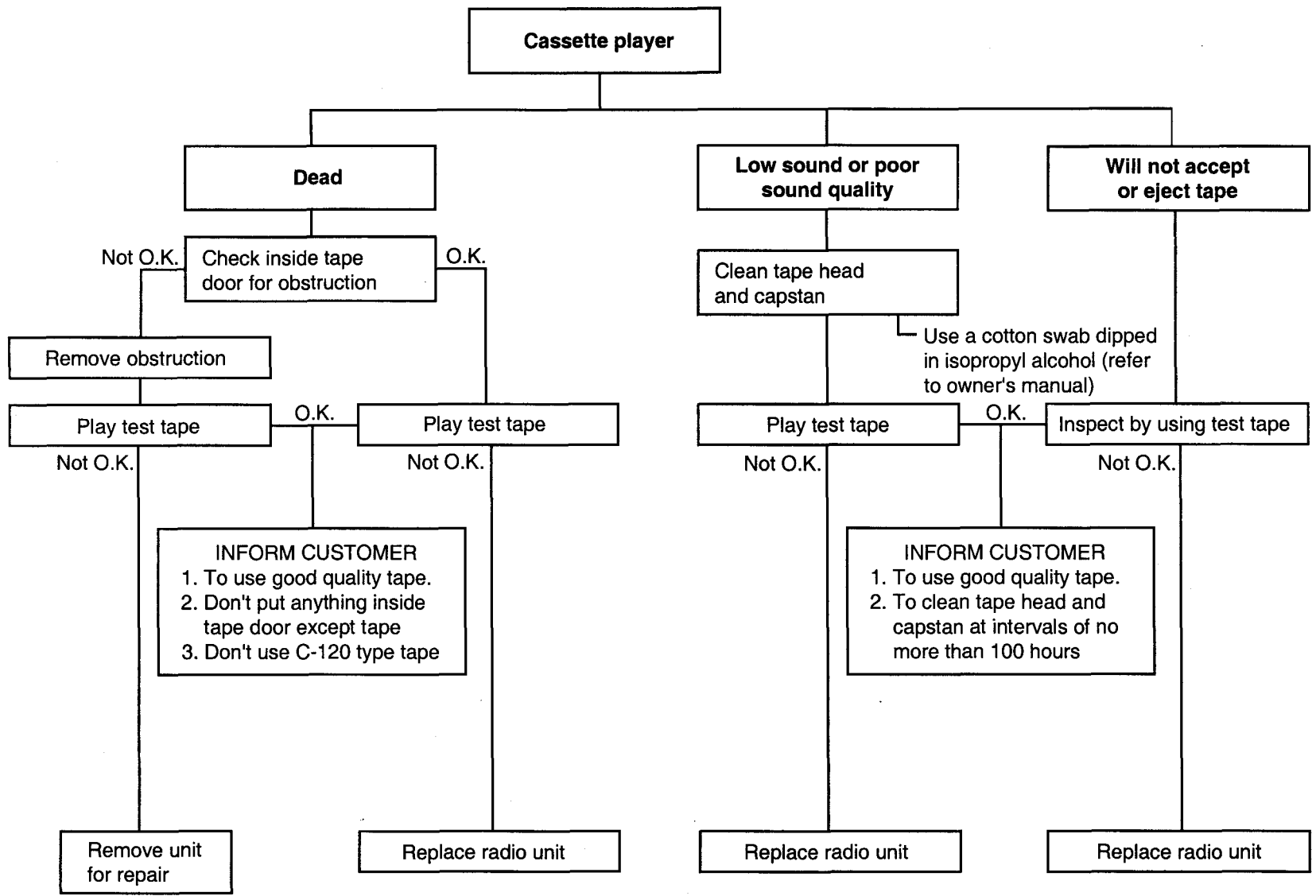
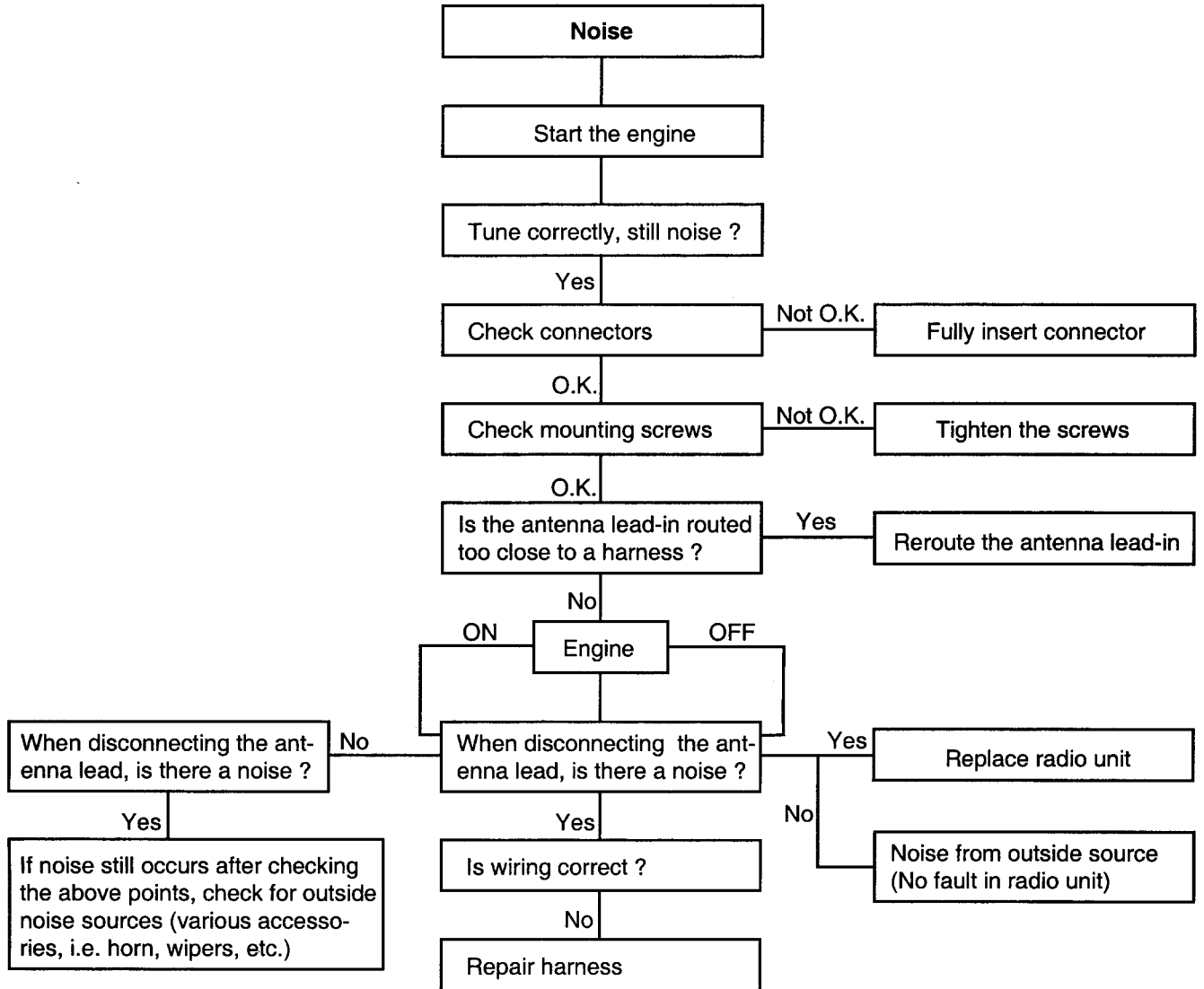
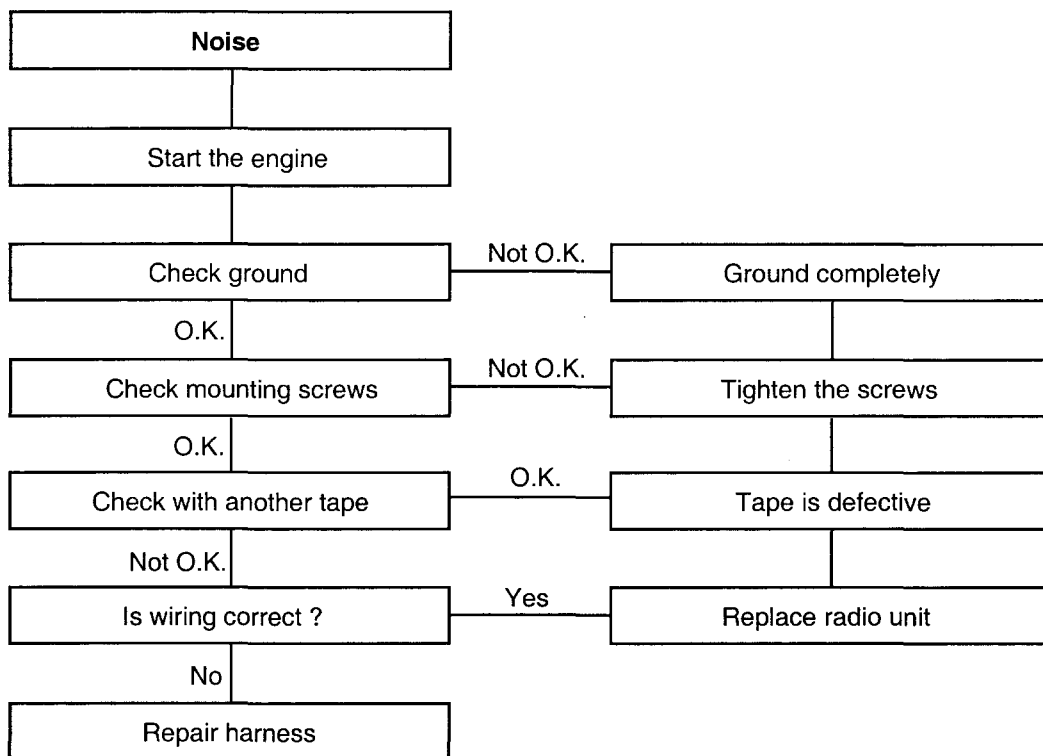


CHART 4

1. RADIO



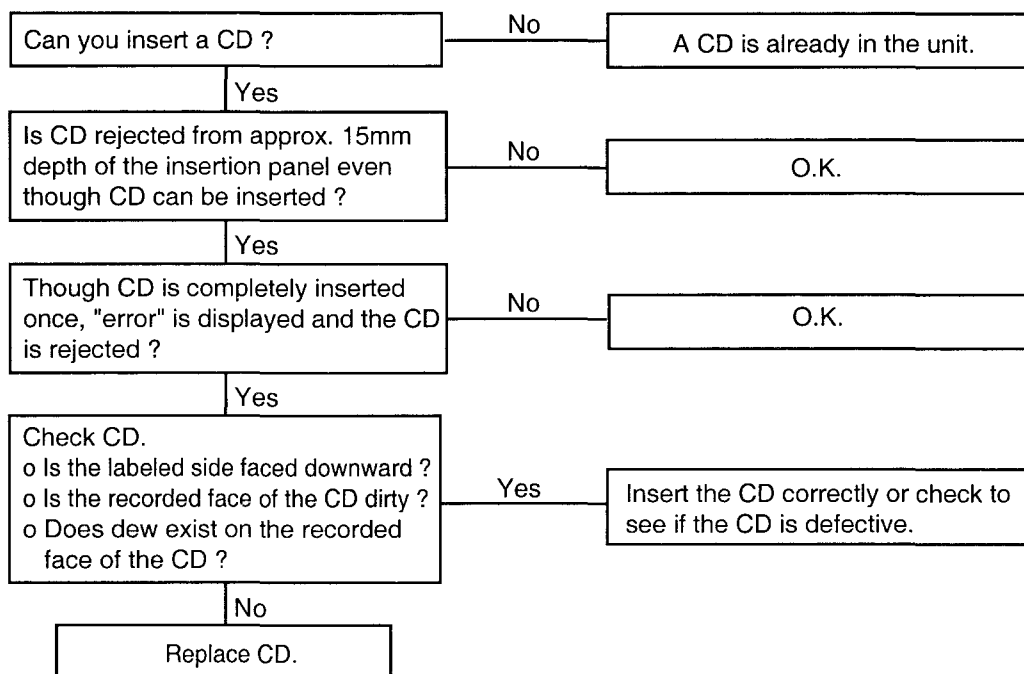
2. TAPE



ETA9010G

CHART 5

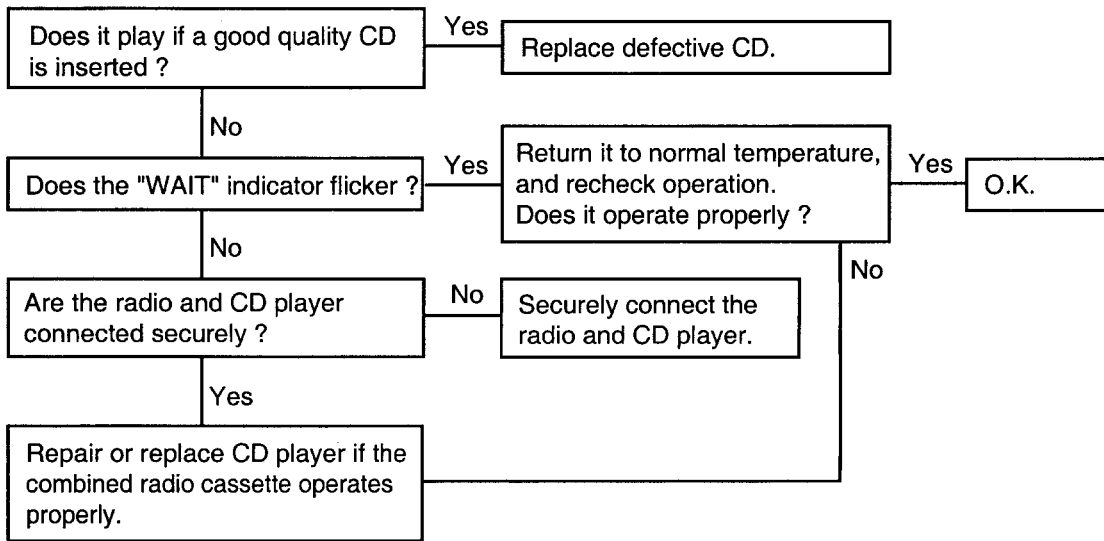
1. CD WILL NOT BE ACCEPTED



ETA9010H



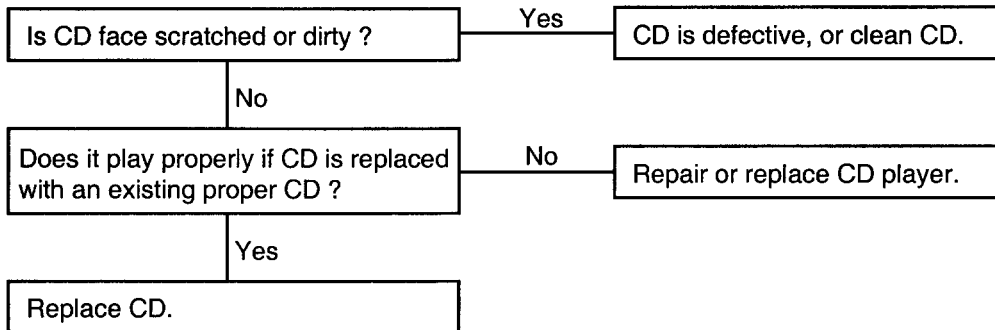
2. NO SOUND



ETA90100

3. CD SOUND SKIPS

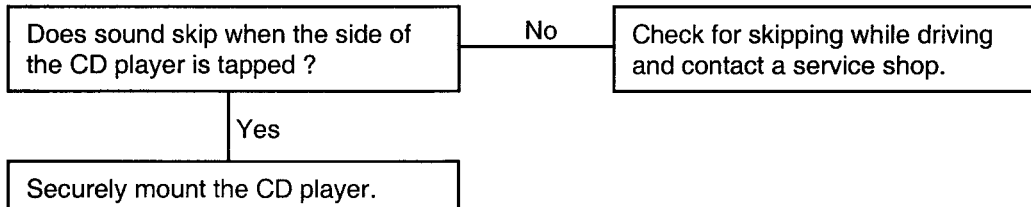
1. Sound sometimes skips when parking.



2. Sound sometimes skips when driving.

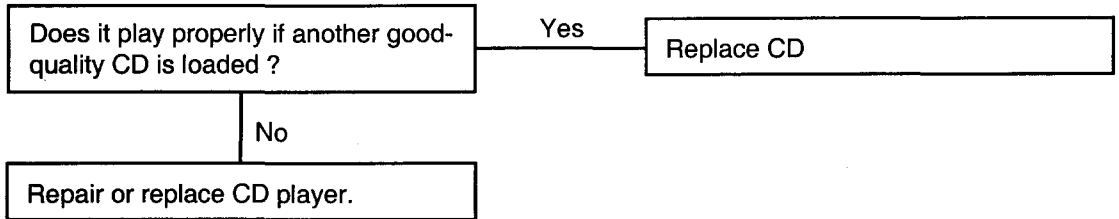
(Stop vehicle, and check it.)

(Check by using a CD which is free of scratches, dirt or other damage.)

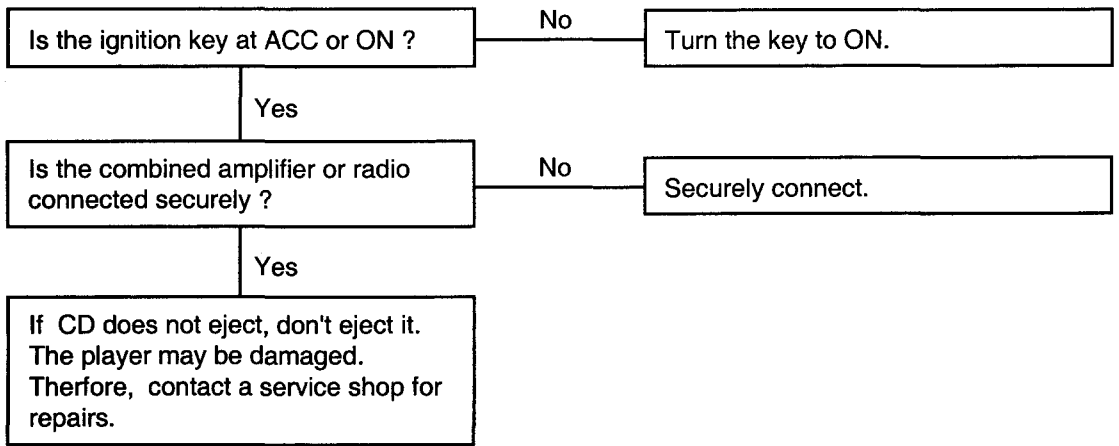


ETA90101

4. SOUND QUALITY IS POOR



5. CD WILL NOT EJECT



6. NO SOUND FROM ONE SPEAKER

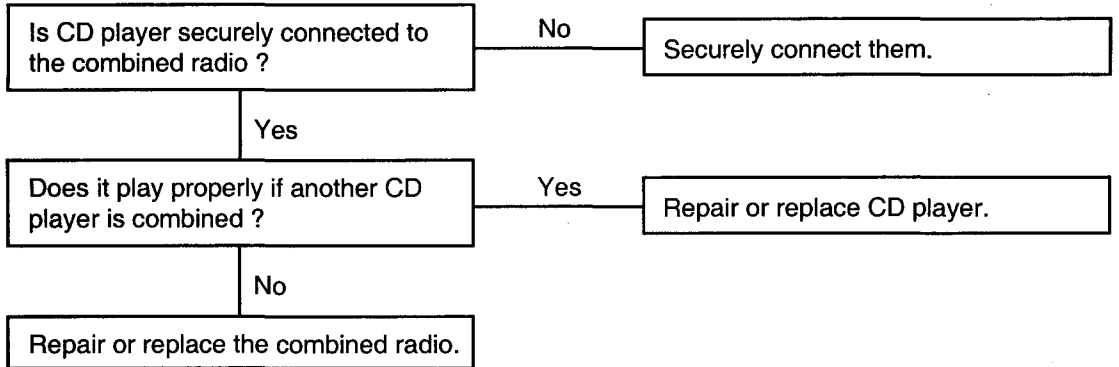
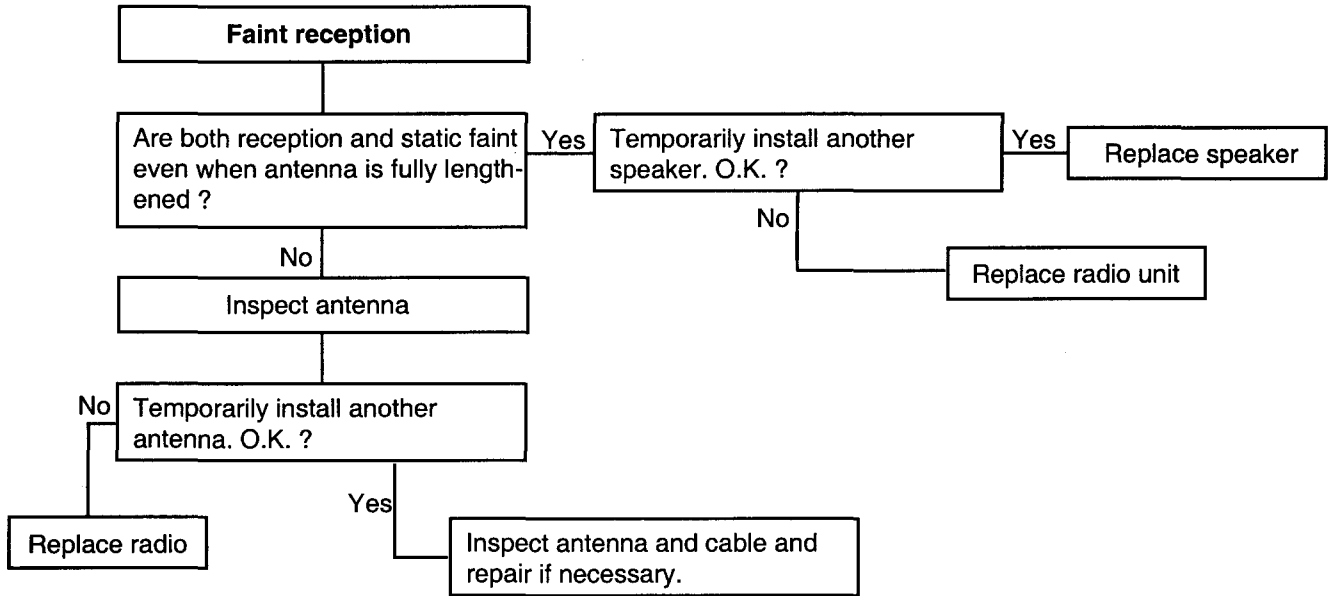
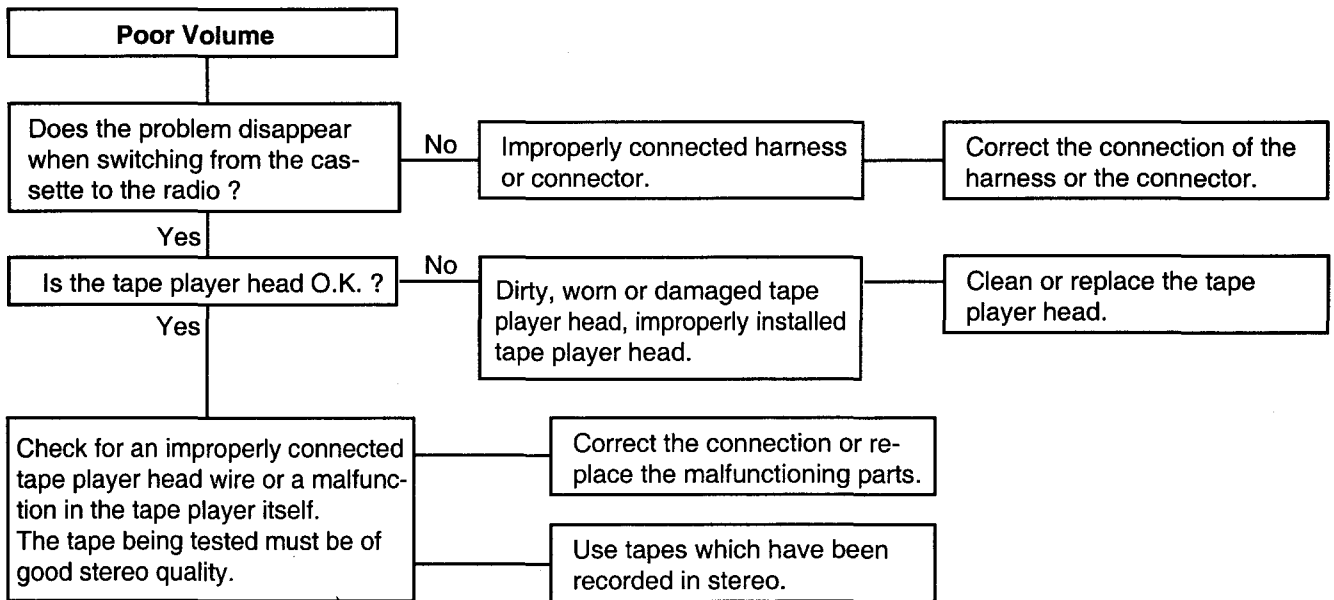


CHART 6



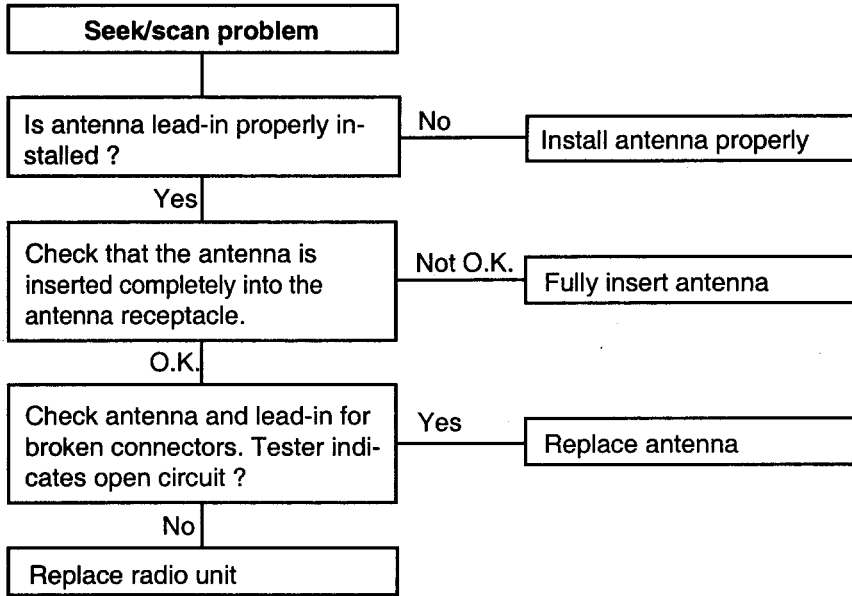
ETA9010K

CHART 7



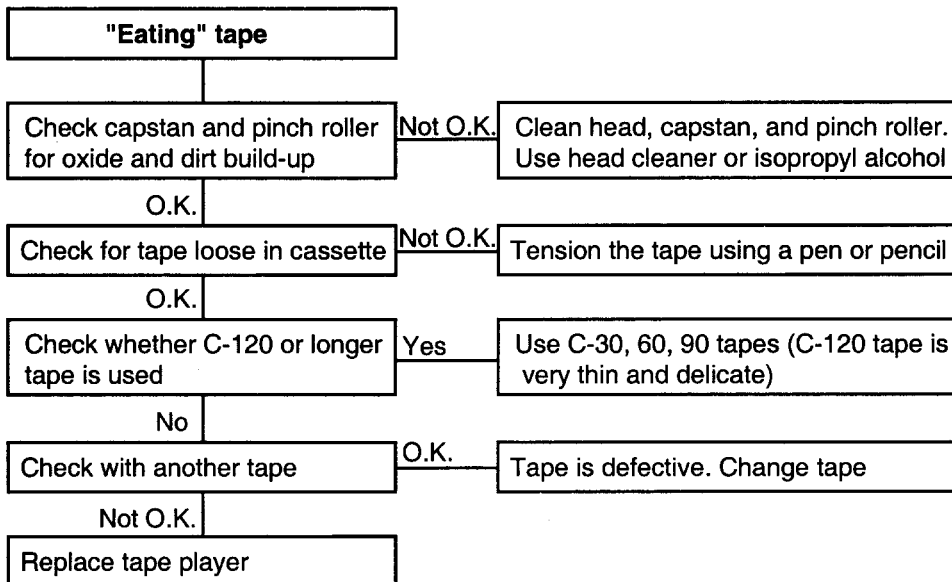
ETA9010L

CHART 8



ETA9010M

CHART 9

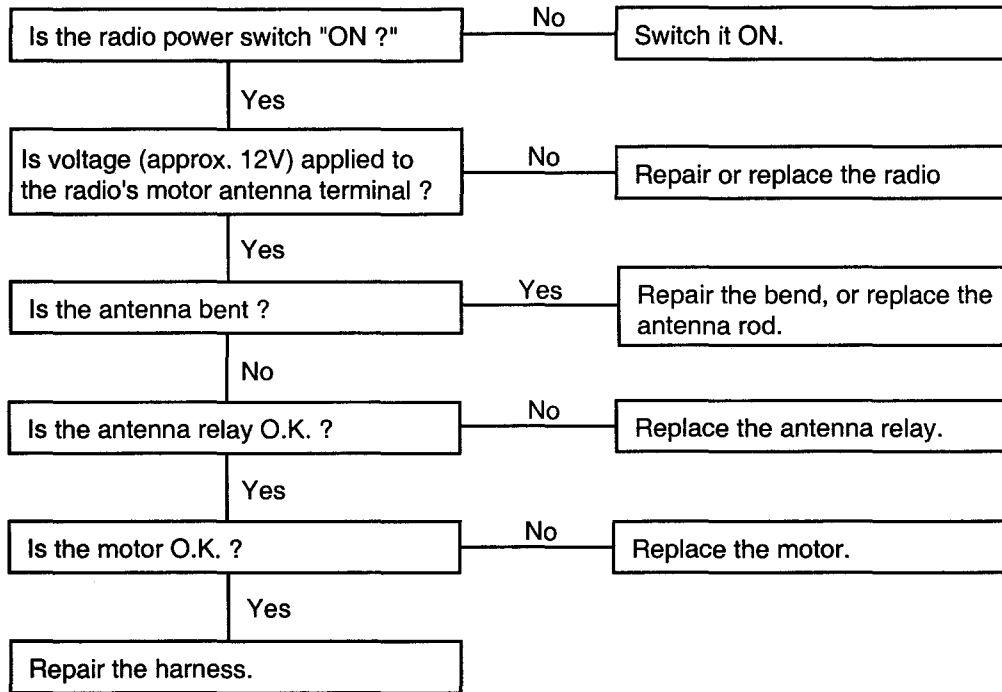


ETA9010N

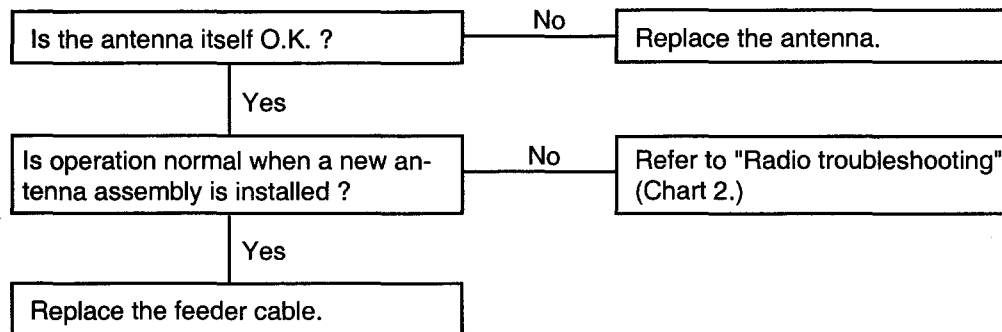
CHART 10

1. MOTOR ANTENNA WON'T EXTEND OR RETRACT

Clean and polish the surface of the antenna rod.



2. MOTOR ANTENNA EXTENDS AND RETRACTS BUT DOES NOT RECEIVE



ETAA010P

WINDSHILD WIPER

Symptom	Possible cause	Remedy
Wipers do not operate or return to off position.	Wiper fuse (No.27; 15A) blown Wiper motor faulty Wiper switch faulty Wiring or ground faulty	Check for short and replace fuse Check motor Check switch Repair if necessary
Wipers do not operate in INT position	ETACS CM faulty Wiper switch faulty Wiper motor faulty Wiring or ground faulty	Check ETACS CM Check switch Check motor Repair if necessary

## POWER WINDOW

Symptom	Possible cause	Remedy
No windows operate from the main switch on the driver's door	Fusible link (30A for P/Window) blown Poor ground  Defective power window main switch  Open circuit in wires or loose or disconnected connector	Replace the fusible link Clean and retighten the ground terminal mounting bolt Check the switch Replace if necessary Repair or replace
Driver's side window does not operate	Defective power window main switch Defective motor or circuit breaker Open circuit in wires or loose or disconnected connector	Check for driver's window switch Replace the motor Check the harness and the connector
Passenger's side window does operate	Defective power window subswitch Defective motor or circuit breaker Wiring faulty or disconnected connector	Replace the switch Replace the motor Repair if necessary

## POWER DOOR MIRROR

Symptom	Possible cause	Remedy
No mirrors operate	No.12 fuse (10A) blown Poor ground  Defective mirror switch  Open circuit in wires or loose or disconnected connector	Check the circuit and replace fuse Clean and retighten the ground terminal mounting bolt Check the switch Replace if necessary Repair or replace
One mirror does not operate	Defective mirror switch  Defective mirror actuator Open circuit wires or loose or disconnected connector	Check the switch Replace if necessary Replace the actuator Repair or replace

## ETACS

Symptom	Possible cause	Remedy
The system is not armed (The siren doesn't sound)	Transmitter faulty Receiver faulty Damaged or disconnected wiring of door switch input circuit ETACS module faulty	Replace the transmitter Replace the receiver Repair the harness  Replace the ETACS module
The siren sounds in error when a door or tailgate is unlocked with the key while the system is armed	Damaged or disconnected wiring of a door key cylinder and tailgate key cylinder switch input circuit ETACS module faulty	Repair the harness or replace a door key cylinder and the tailgate key cylinder switch Replace the ETACS module
Engine does not start in disarm state	Burglar alarm relay faulty Damage or disconnected wiring of burglar alarm relay activation circuit Malfunction of the ETACS module	Replace the burglar alarm relay Repair the harness  Replace the ETACS module

Symptom	Possible cause	Remedy
There is no alarm when, as an alarm test, a door is opened without using the key (The arming and disarming are normal, and the alarm is activated when the tailgate or hood is opened)	Damaged or disconnected wiring of door switch (all doors) input circuit Malfunction of the door switch Malfunction of the ETACS module	Repair the harness or replace the door switch Check the door switch Replace the ETACS module
There is no alarm when, as an alarm test, the tailgate is opened without using the key. (The alarm is activated, however, by opening a door or the hood)	Damaged or disconnected wiring of luggage compartment light switch input circuit Malfunction of the tailgate switch Malfunction of the ETACS module	Repair the harness or replace the gage compartment light switch  Check the tailgate switch Replace the ETACS module
There is no alarm when, as an alarm test the hood is opened from within the vehicle (The alarm is activated, however, by opening a door or tailgate)	Damaged or disconnected wiring of hood switch input circuit Malfunction of the hood switch Malfunction of the ETACS module	Repair the harness or replace the hood switch Check the hood switch Replace the ETACS module

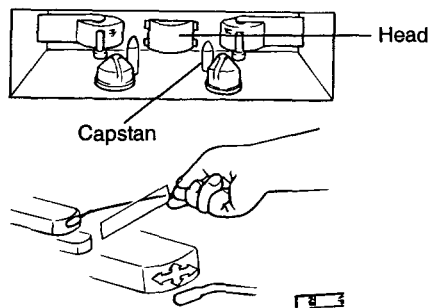
# AUDIO SYSTEM

## AUDIO UNIT

### SERVICE INSTRUCTIONS ETHA0750

#### TAPE HEAD AND CAPSTAN CLEANING

1. To obtain optimum performance, clean the head, and capstan as often as necessary, depending on frequency of use and tape cleanness.
2. To clean the tape head and capstan, use a cotton swab dipped in ordinary rubbing alcohol. Wipe the head and capstan.

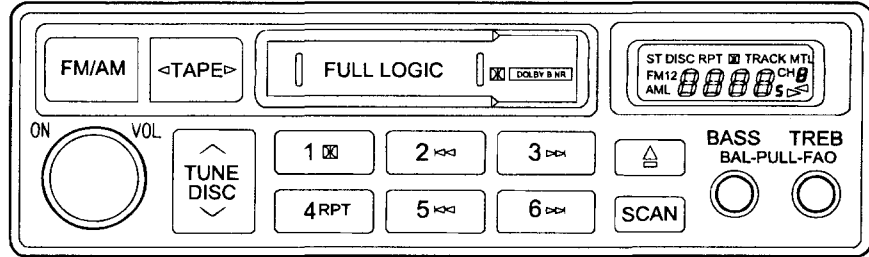


ETA9035A

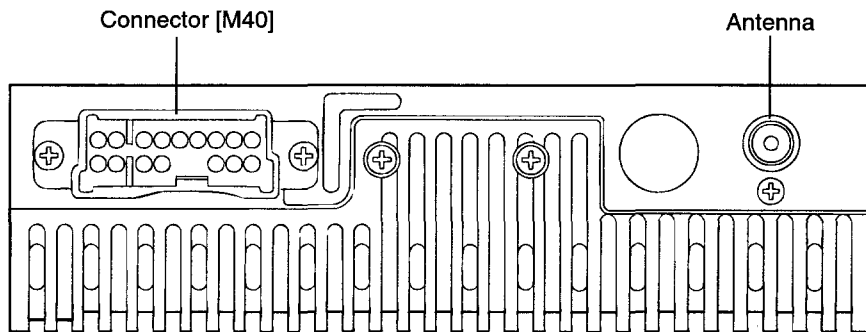


COMPONENTS ETMB0200

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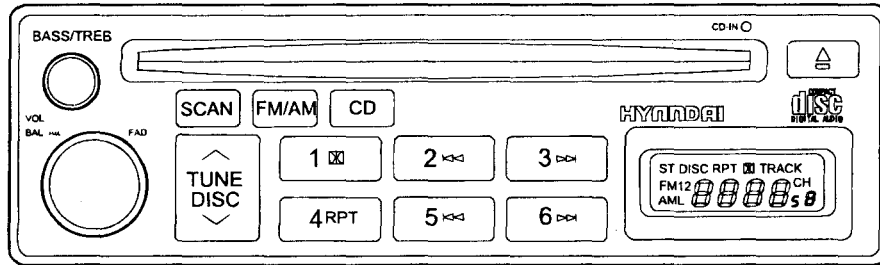
ETJA001B



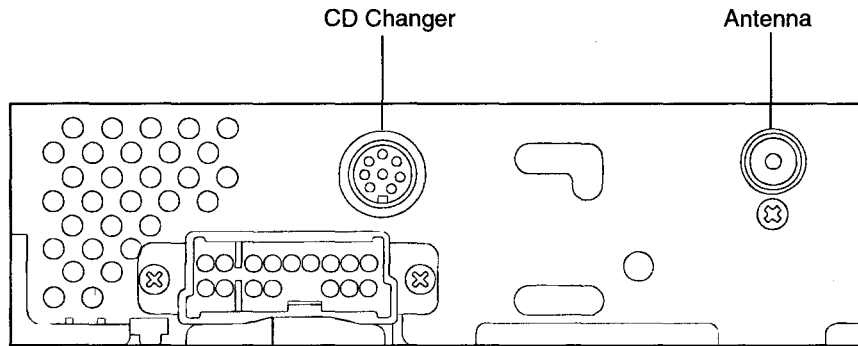
ETJA001A

Connector [M40]	Terminal	Description
<p>[M40]</p> <p>ETJA001C</p>	1	Antenna
	2	Rear left speaker(-)
	3	Front left speaker(-)
	4	Front right speaker(-)
	5	Rear right speaker(-)
	6	Illumination(-)
	7	ACC(+)
	8	Ground
	9	Rear left speaker(+)
	10	Front left speaker(+)
	11	N.C.
	12	N.C.
	13	Front right speaker(+)
	14	Rear right speaker(+)
	15	Illumination(+)
	16	Battery(+)

<H260>



ETJA001E



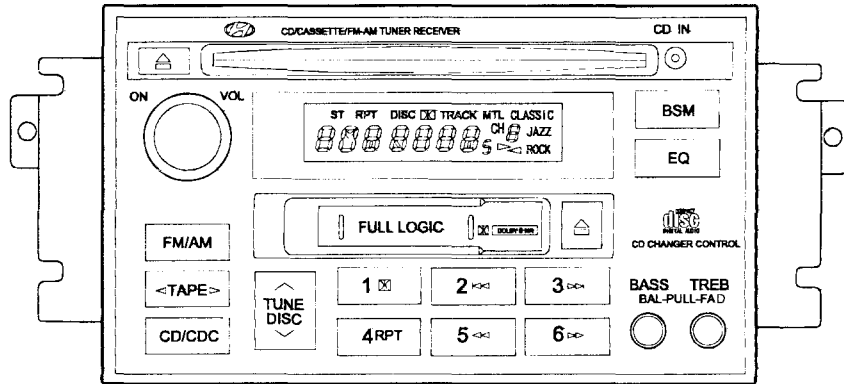
ETJA001D

Connector [M40]

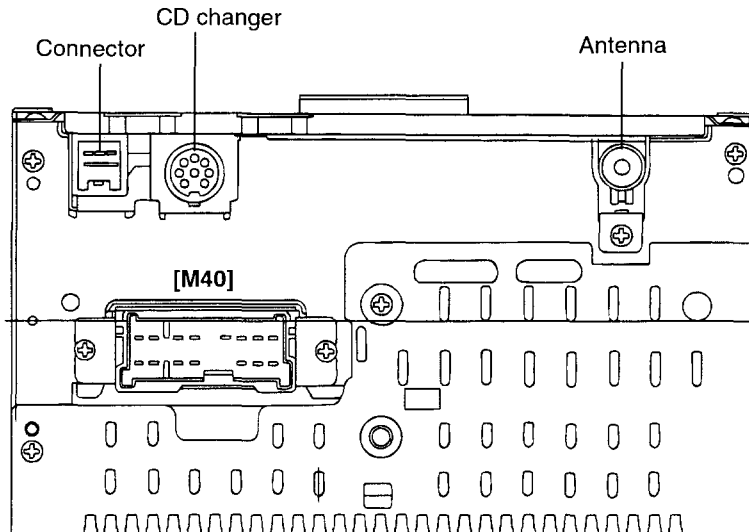
Connector [M40]	Terminal	Description
<p>[M40]</p> <p>ETJA001C</p>	1	N.C.
	2	Rear left speaker(-)
	3	Front left speaker(-)
	4	Front right speaker(-)
	5	Rear right speaker(-)
	6	Illumination(-)
	7	ACC(+)
	8	Ground
	9	Rear left speaker(+)
	10	Front left speaker(+)
	11	N.C.
	12	N.C.
	13	Front right speaker(+)
	14	Rear right speaker(+)
	15	Illumination(+)
	16	Battery(+)

Connector	Terminal	Description
<p>(CD Changer)</p> <p>ETJA001G</p>	1	R
	2	CD ON
	3	BUS
	4	B+
	5	M. Ground
	6	N.C.
	7	L
	8	A.Ground

<H280>



KTMB001M



KTMB001L

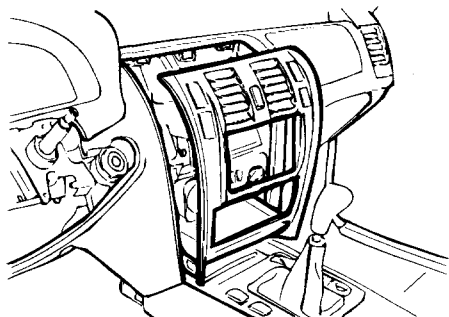
Connector [M40]	Terminal	Description
<p>ETJA001C</p>	1	Antenna
	2	Rear left speaker(-)
	3	Front left speaker(-)
	4	Front right speaker(-)
	5	Rear right speaker(-)
	6	Illumination(-)
	7	ACC(+)
	8	Ground
	9	Rear left speaker(+)
	10	Front left speaker(+)
	11	N.C.
	12	N.C.
	13	Front right speaker(+)
	14	Rear right speaker(+)
	15	Illumination(+)
	16	Battery(+)

Connector	Terminal	Description
<p>ETHA005F</p>	1	Ground
	2	Signal
	3	Rear signal

Connector	Terminal	Description
<p>ETJA001G</p>	1	R
	2	CD ON
	3	BUS
	4	B+
	5	M. Ground
	6	N.C.
	7	L
	8	A. Ground

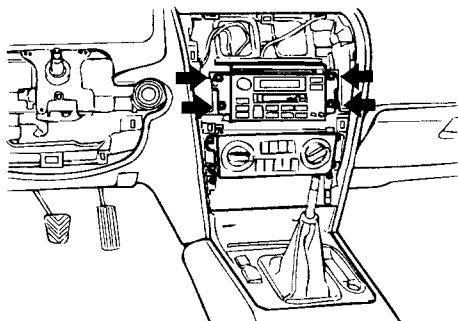
**REMOVAL AND INSTALLATION** ETMB0250

1. Disconnect the negative(-) battery terminal.
2. Remove the center facia panel and disconnect the wire connectors.



KSMB008L

3. Remove the 4 screws holding the audio unit then remove the audio assembly.



KTMB171A

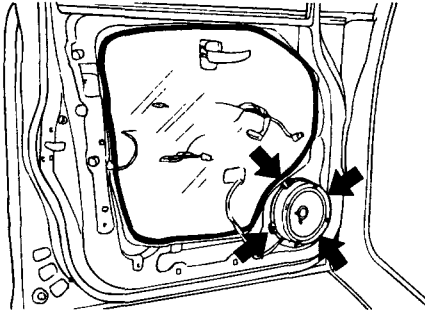
4. Installation is the reverse of removal.

## SPEAKERS

### REMOVAL AND INSTALLATION ETMB0300

#### FRONT SPEAKER

1. Remove the front door trim panel and remove the front speaker.

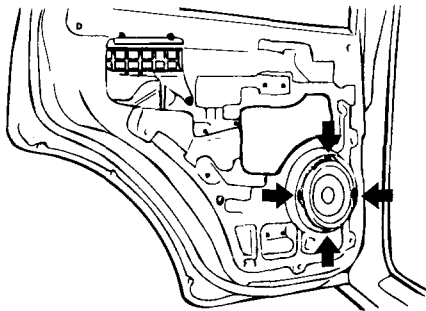


KTMB075A

2. Installation is the reverse of removal.

#### REAR SPEAKER

1. Remove the rear door trim panel and remove the rear speaker.

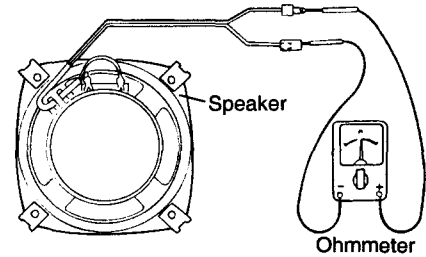


KSMB003D

2. Installation is the reverse of removal.

### SPEAKER CHECKING ETA90400

1. Check the speaker with an ohmmeter. If an ohmmeter indicates the correct impedance of the speaker when checking between the speaker (+) and speaker (-) of the same channel, the speaker is ok.
2. If a clicking sound is emitted from the speaker when the ohmmeter is connected to the speaker terminals, the speaker is ok.



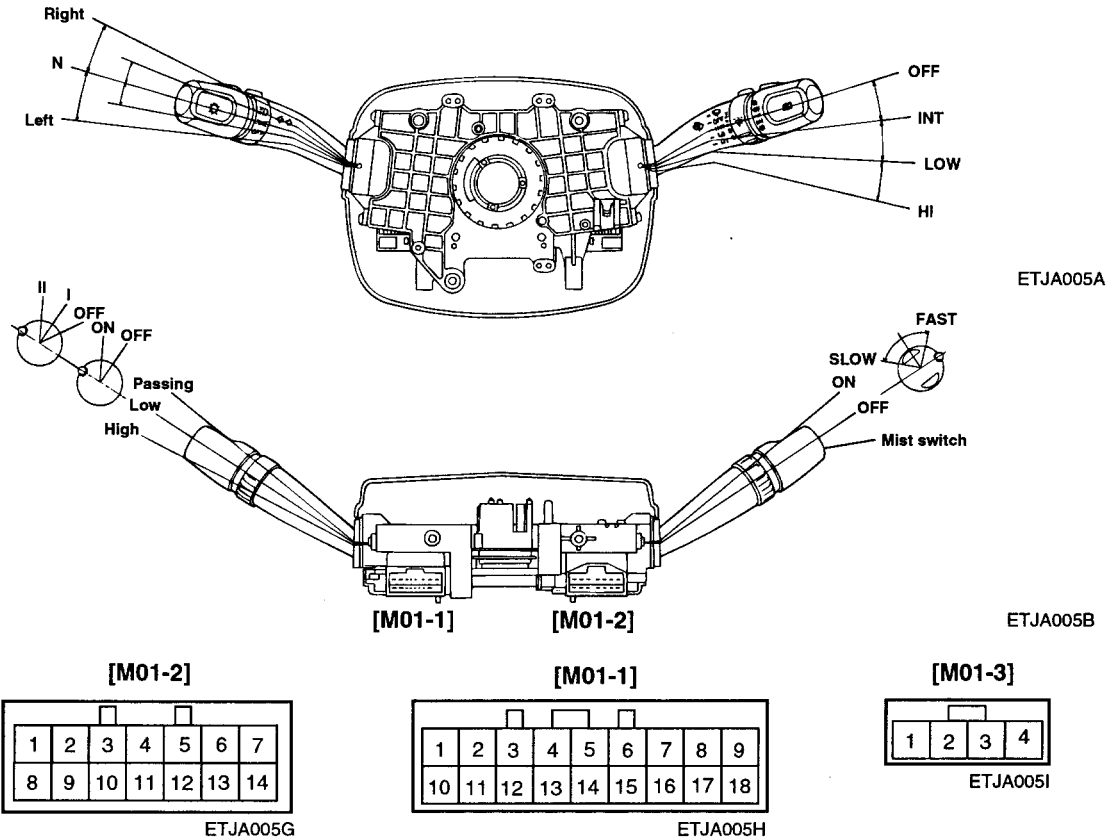
ETA9040A

# MULTI FUNCTION SWITCH

## MULTI FUNCTION SWITCH

### COMPONENTS ETMB0350

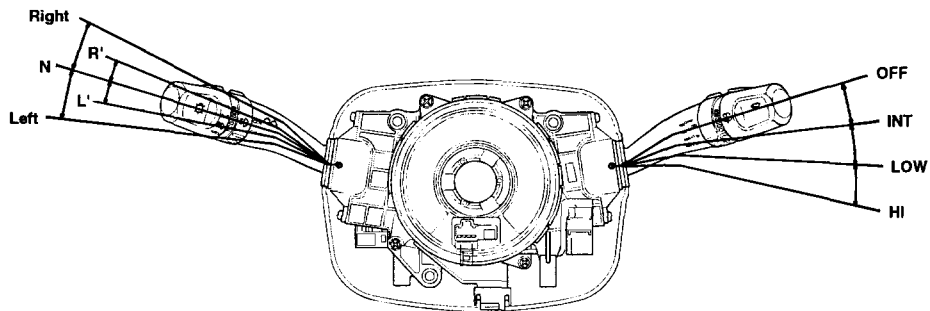
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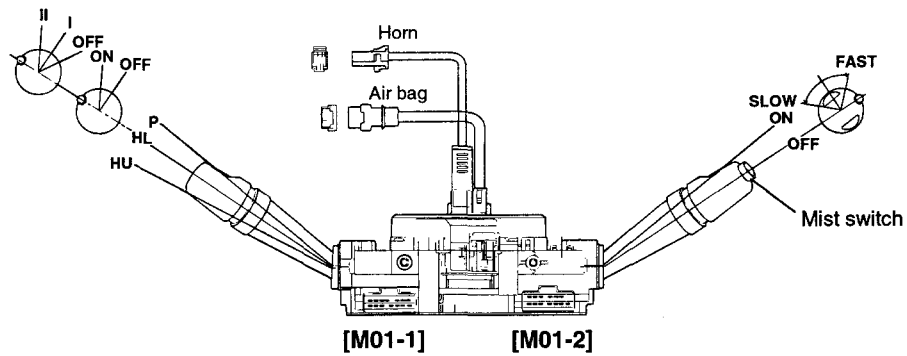
#### Circuit connection

Connector No.	Terminal No.	Description	Connector No.	Terminal No.	Description
M01-1	1	Head lamp passing switch	M01-2	1	Wiper high speed
	2	Head lamp high beam power		2	Wiper low speed
	3	-		3	Wiper parking
	4	-		4	Intermittent wiper
	5	-		5	Wiper & washer ground
	6	-		6	Front washer switch
	7	Turn signal RH lamp switch		7	-
	8	Flasher unit power		8	Horn
	9	Turn signal LH lamp switch		9	-
	10	Head lamp low beam power		10	Mist switch
	11	Dimmer & passing ground		11	Mist switch ground
	12	Front fog lamp switch		12	-
	13	Front fog lamp switch ground		13	Intermittent wiper volume
	14	Tail lamp switch		14	Intermittent wiper volume ground
	15	Head lamp switch	M01-3	1	Remote control signal
16	-	2		Horn relay	
17	Lighting switch ground	3		-	
18	-	4		Remote control ground	

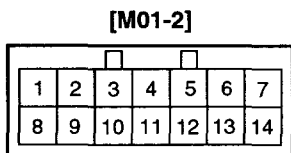
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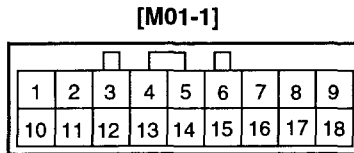
KTMB001Q



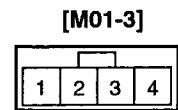
KTMB001R



ETJA005G



ETJA005H



ETJA005I

Circuit connection

Connector No.	Terminal No.	Description	Connector No.	Terminal No.	Description
M01-1	1	Head lamp passing switch	M01-2	1	Wiper high speed
	2	Head lamp high beam power		2	Wiper low speed
	3	-		3	Wiper parking
	4	-		4	Intermittent wiper
	5	-		5	Wiper & washer ground
	6	-		6	Front washer switch
	7	Turn signal RH lamp switch		7	-
	8	Flasher unit power		8	-
	9	Turn signal LH lamp switch		9	-
	10	Head lamp low beam power		10	Mist switch
	11	Dimmer & passing ground		11	Mist switch ground
	12	Front fog lamp switch		12	-
	13	Front fog lamp switch ground		13	Intermittent wiper volume
	14	Tail lamp switch		14	Intermittent wiper volume ground
M01-1	15	Head lamp switch	M01-3	1	Remote control signal
	16	-		2	Horn relay
	17	Lighting switch ground		3	-
	18	-		4	Remote control ground

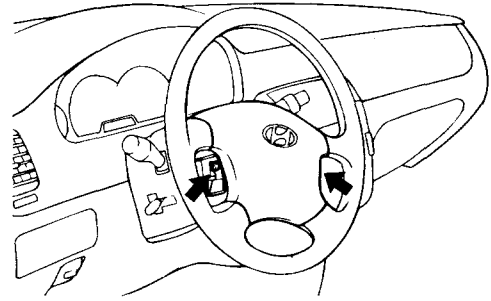
## REMOVAL AND INSTALLATION ETMB0400

Prior to removing of the multi function switch assembly in vehicles equipped with air bags, be careful to follow the following:

### CAUTION

- **Never attempt to disassemble or repair the air bag module or clock spring. If faulty, replace it.**
- **Do not drop the air bag module or clock spring or allow contact with water, grease or oil. Replace if a dent, crack, deformation or rust is detected.**
- **The air bag module should be stored on a flat surface and placed so that the pad surface is facing upward. Do not place anything on top of it.**
- **Do not expose the air bag module to temperatures over 93°C (200°F).**
- **After deployment of an air bag, replace the clock spring with a new one.**
- **Wear gloves and safety glasses when handling an air bag that has been deployed.**
- **An undeployed air bag module should only be disposed of in accordance with the procedures mentioned in the restraints section.**
- **When you disconnect the air bag module-clock spring connector, take care not to apply excessive force.**
- **The removed air bag module should be stored in a clean, dry place.**
- **Prior to installing the clock spring, align the mating mark and "NEUTRAL" position indicator of the clock spring, and after turning the front wheels to the straight-ahead position, install the clock spring to the column switch. If the mating mark of the clock spring is not properly aligned, the steering wheel may not completely rotate during a turn, or the flat cable within the clock spring may be broken obstructing normal operation of the SRS and possibly leading to serious injury to the vehicle's driver. To inspect the clock spring, refer to the restraints section.**

1. Remove the air bag module.

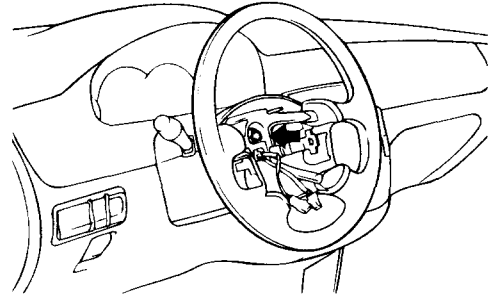


ESHA040M

### Tightening torque

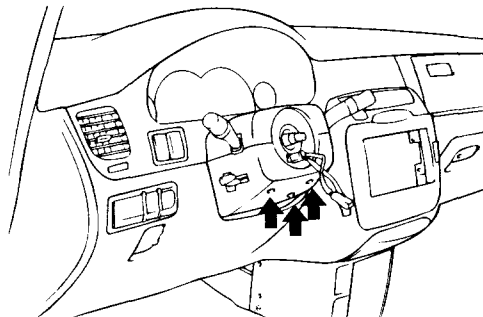
Air bag module mounting bolts :  
4-6Nm (40-60kg-cm, 2.9-4.4lb-ft)

2. Remove the steering wheel.



ESHA040N

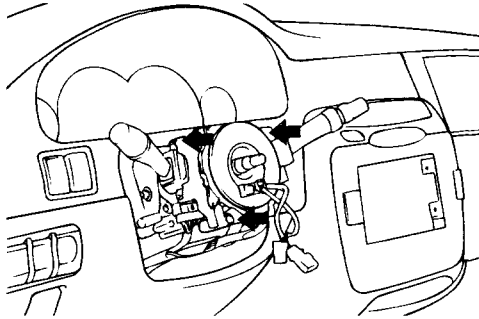
3. Remove the steering column upper shroud and steering column lower shroud.



ESHA040O



- Remove the 3 screws holding the multi function switch and disconnect the connectors. Remove the multi function switch assembly.



ESHA040P

- Installation is the reverse of removal.

**INSPECTION** ETMB0450

Check the continuity between the terminals while operating the switch.

**LIGHTING SWITCH [M01-1]**

Terminal Position	14	15	17
OFF			
I	○	—	○
II	○	—	○

KTJA040A

**DIMMER AND PASSING SWITCH [M01-1]**

Terminal Position	1	2	10	11
HU		○	—	○
HL			○	○
P	○	○	—	○

HU : Head lamp high beam  
 HL : Head lamp low beam  
 P : Head lamp passing switch

KTDA040B

**TURN SIGNAL AND LANE CHANGE SWITCH [M01-1]**

Hazard switch	Turn signal switch	Terminal 7	Terminal 8	Terminal 9
OFF	L		○	○
	N			
	R	○	○	

KTDA040C

**FRONT FOG LAMP SWITCH [M01-1]**

Terminal Position	12	13
OFF		
ON	○	○

ETMB045A

**WIPER AND INTERMITTENT VOLUME SWITCH [M01-2]**

Terminal Position	1	2	3	4	5	13	14
OFF		○	○				
INT		○	○	○	○	○	○
LOW		○	—	—	○		
HI	○	—	—	—	○		

ETMB045B

**WASHER SWITCH [M01-2]**

Terminal Position	5	6
OFF		
ON	○	○

ETMB045C

**MIST SWITCH [M01-2]**

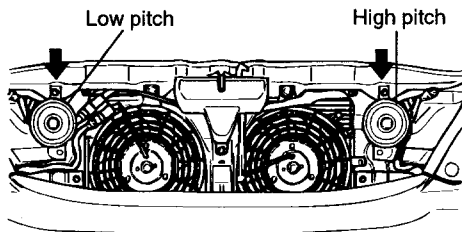
Terminal Position	10	11
OFF		
ON	○	○

ETMB045D

# HORNS

## REMOVAL AND INSTALLATION ETMB0500

1. Remove the bolts holding the horn and remove the horn assembly.



ETMB050A

2. Installation is the reverse of removal.

## INSPECTION ETHA1200

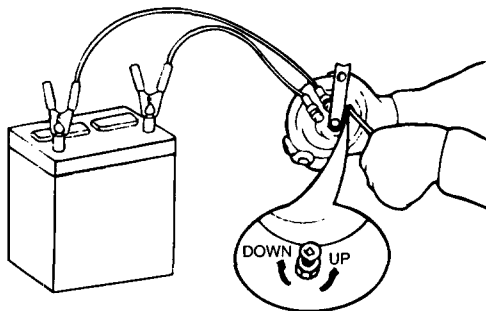
1. Test the horn by connecting battery voltage to the 1 terminal and ground the 2 terminal.
2. The horn should make a sound. If the horn fails to make a sound, replace it.

## ADJUSTMENT

Operate the horn, and adjust the tone to a suitable level by turning the adjusting screw.

### NOTE

*After adjustment, apply a small amount of paint around the screw head to keep it from loosening.*

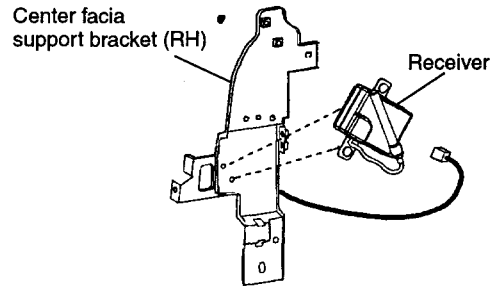


ETDA050A

# KEYLESS ENTRY AND BURGLAR ALARM

## DESCRIPTION ETMB0550

The keyless entry and burglar alarm system consists of ETACS components and some other parts. When anybody attempts to forcibly enter the car or open tailgate or engine hood without a key, or when the battery terminals are removed and reconnected, the burglar alarm system sounds the siren for about 30 seconds as an alert. At the same time, it locks all the door and electrically disconnects the starting system. Also, the keyless entry system is able to lock and unlock all the doors at a distance, transmitting a weak radio wave from a transmitter.



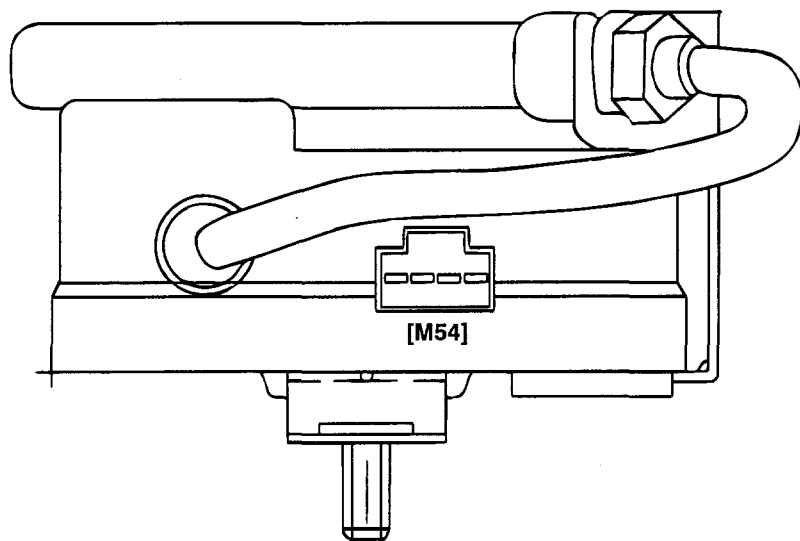
ETMB055A

## SPECIFICATIONS

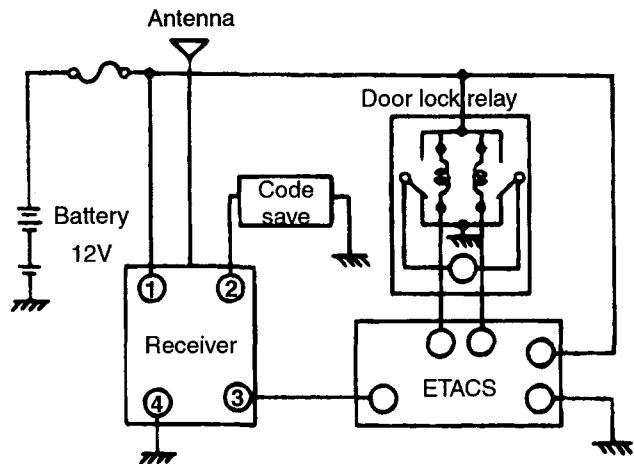
Items	Specifications
Keyless entry transmitter	
Power source	Lithium 3V battery(1EA)
Transmissible distance	5m or more
Life of battery	2 years or more (at 10 times per day)
Button	Door lock, unlock
Receiver	
Operating voltage	DC 9V - 16V
Operating temperature range	-30°C - +80°C
Maximum standby current	3mA or less
Output pattern	Door lock, unlock
Modulation type	FSK (Frequency Shift Keying)

CIRCUIT DIAGRAM

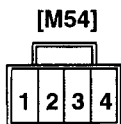
ETMB0600



KTMB001E



KTAB190A



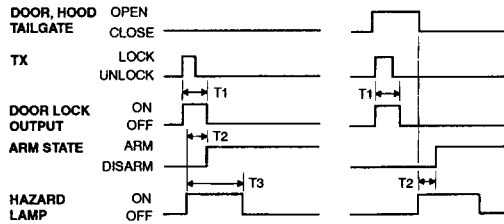
PIN CONNECTION

Pin No.	Description
1	Battery (B+)
2	Memory
3	Signal output
4	Ground

ANTI-THEFT FUNCTION ETMB0650

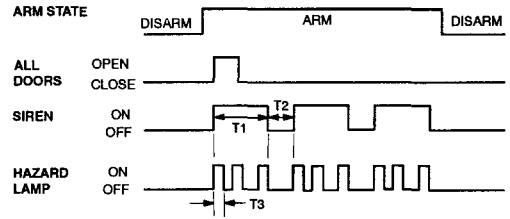
b. Except EC Area

1. Arm function



ETHA115Q

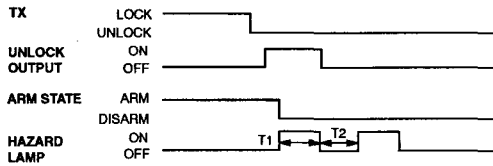
Time specification  
 T1 : 0.5sec.  
 T2 : Max 2sec.  
 T3 : 1.0±0.2sec.



ETHA115S

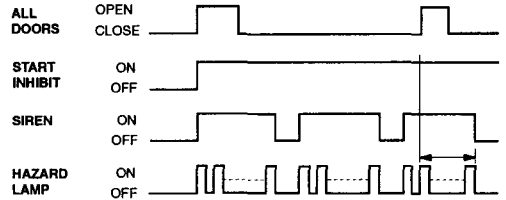
Time specification  
 T1 : 27±2sec.  
 T2 : 10±1sec.  
 T3 : 0.5±0.1sec.  
 c. New alarm occurs during the alarm state.

2. Disarm function



ETHA115R

Time specification  
 T1, T2 : 0.5±0.1sec.

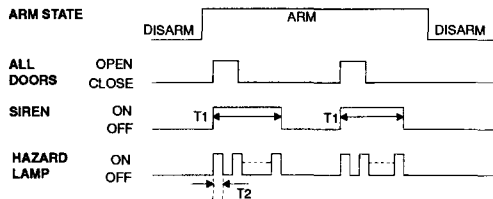


ETHA115T

d. Disarmed with TX (Transmitter) during the alarm state.

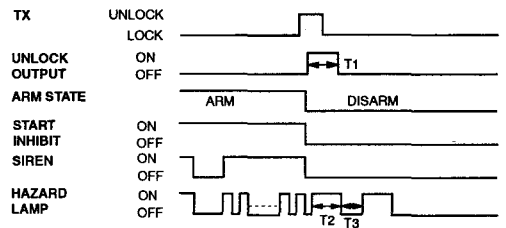
3. Alarm function

a. Only EC Area



ETHA120F

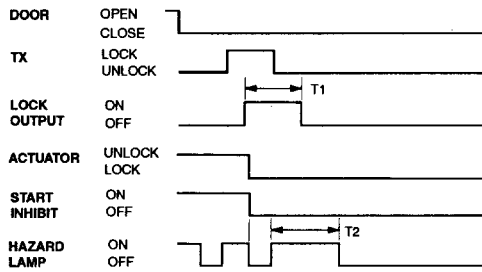
Time specification  
 T1 : 27±2sec.  
 T2 : 0.5±0.1sec.



ETHA115U

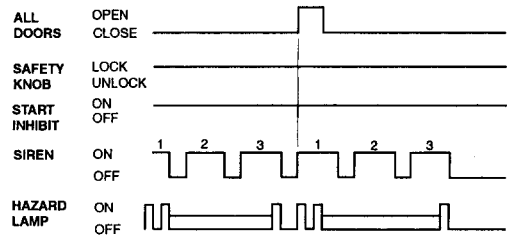
Time specification  
 T1, T2, T3 : 0.5±0.1sec.

- e. TX lock button pressed when the door closed during the alarm state.



ETHA115V

- h. Start inhibit is "ON" regardless of safety knob lock state.



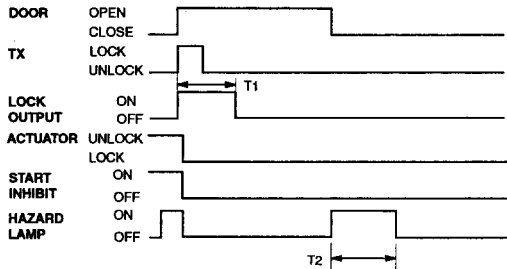
ETHA115Y

Time specification

T1 : 0.5sec.

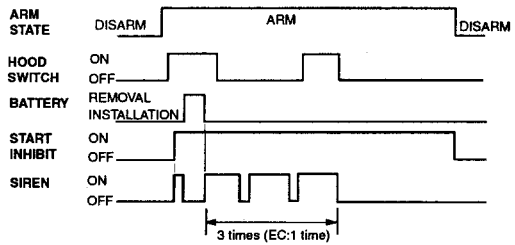
T2 : 1.0±0.2sec.

- f. TX lock button pressed when the door opened during the alarm state.



ETHA115W

- i. Battery is separated during the alarm state.



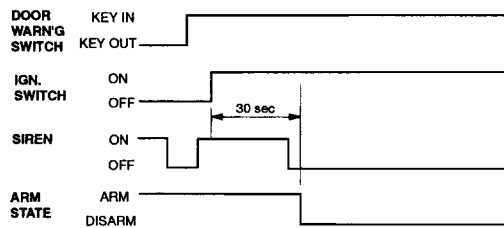
ETHA115Z

Time specification

T1 : 0.5sec.

T2 : 1.0±0.2sec.

- g. Disarmed after 30 sec when the ignition switch turned on during the alarm state.



ETHA115X

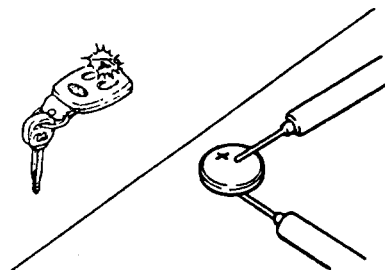
## INSPECTION OF COMPONENTS

ETMB0700

### TRANSMITTER

1. Check that the red light flickers when the door lock button or unlock button is pressed on the transmitter.
2. Remove the battery and check voltage if the red light doesn't flicker.

Standard voltage : 3V



KTAB195A

3. Replace the battery if voltage is below 3V and replace the remote control switch if it is inoperable after replacing the battery.

---

Battery : Lithium CR2032 (3V, 220mA/h)

---

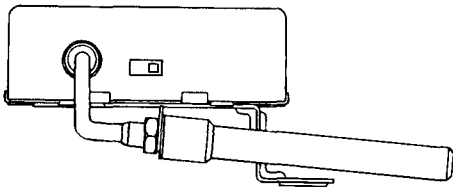
### CODE SAVING METHOD

1. Remove the center facia panel.

 **NOTE**

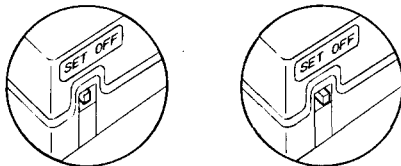
*Don't disconnect the negative (-) battery terminal.*

2. To store new codes :
  - Activate the keyless entry/receiver unit and change the code saving switch of the receiver unit from "OFF" to "SET".
  - The secret codes from the transmitter will be stored into the receiver unit when the door lock button or unlock button is pressed on the transmitter.
  - Save the 2nd transmitter codes in the same manner.



ETDA085R

3. Return the code saving switch of the receiver unit from "SET" to "OFF".



ETHA120D

4. Install the center facia panel.

# ETACS (ELECTRONIC TIME AND ALARM CONTROL SYSTEM)

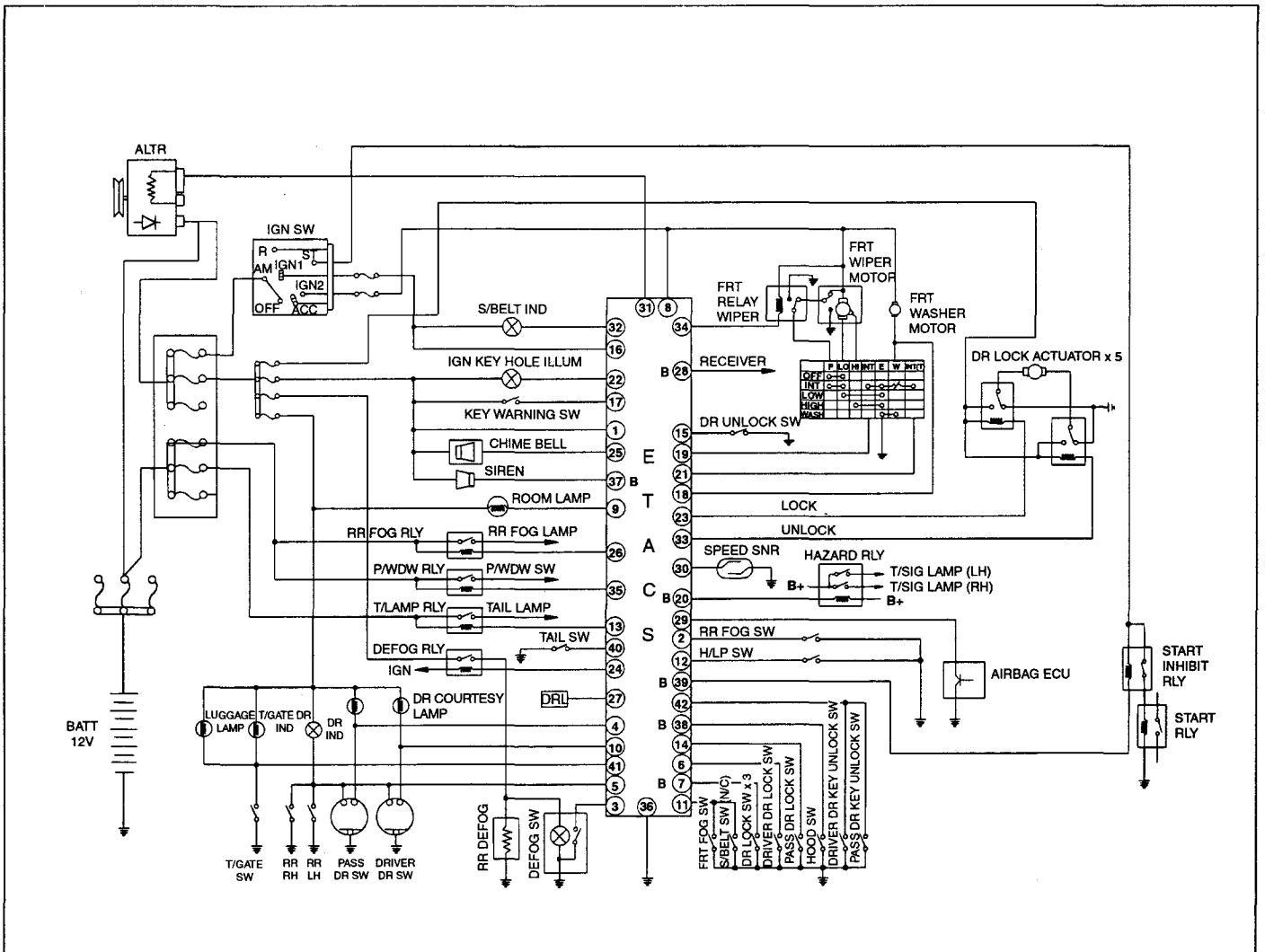
## SPECIFICATIONS ETMB0750

Items	Specifications
Rated voltage	DC 12V
Operating voltage	DC 9 - 16V
Operating temperature	-30°C - 80°C
Insulation resistance	100MΩ or more
Rated load	
Siren	DC 12V, 260mA (Relay load)
Chime bell	DC 12V, 350mA (Relay load)
Tail lamp relay	DC 12V, 200mA (Relay load)
Rear defogger relay	DC 12V, 200mA (Relay load)
Start inhibit relay	DC 12V, 200mA (Relay load)
Hazard relay	DC 12V, 200mA (Relay load)
Power window relay	DC 12V, 200mA (Relay load)
Seat belt warning indicator	DC 12V, 1.4W (Lamp load)
Ignition key illumination	DC 12V, 1.4W (Lamp load)
Room lamp	DC 12V, 10W x 2(Lamp load)
Intermittent wiper relay	DC 12V, 200mA (Relay load)
Rear fog lamp relay	DC 12V, 200mA (Relay load)

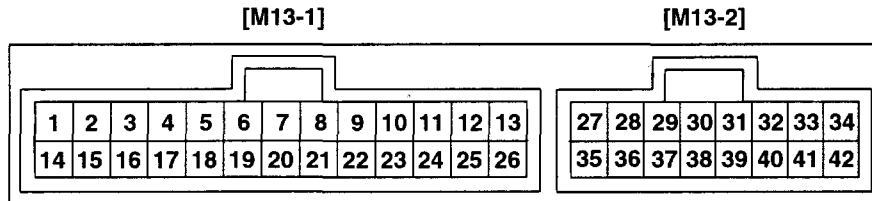


# ELECTRONIC TIME & ALARM CONTROL MODULE

## CIRCUIT DIAGRAM ETMB0800



KTMB001C



KTMB001D

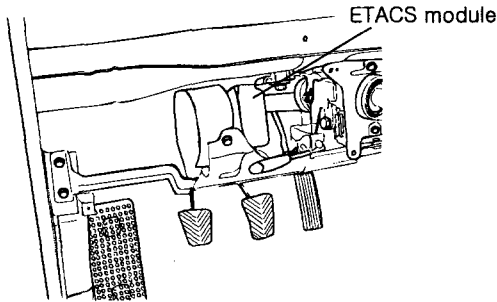
**NOTE)**

**B : Keyless entry & Burglar alarm system**

**REMOVAL AND INSTALLATION**

ETMB0850

1. Disconnect the negative (-) battery terminal.
2. Remove the lower crash pad (Refer to BD group).
3. Remove the 2 bolts holding the ETACS module and disconnect the connectors.



ETMB085A

4. Installation is the reverse of removal.

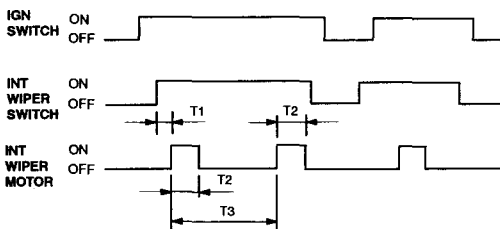
**INSPECTION**

ETMB0900

While operating the components, check whether the operations are normal with timing chart.

**ETACS FUNCTION**

1. Vehicle speed sensing intermittent wiper

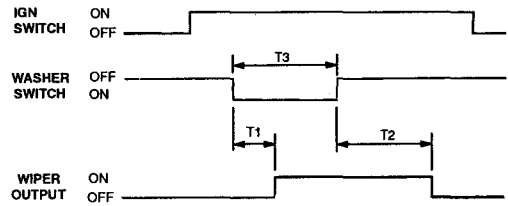


ETHA115C

Time specification

- T1 : Max. 0.6 sec.
- T2 : 0.6-0.7 sec. (Time of wiper motor 1 rotation)
- T3 : At vehicle speed = 0km/h.  
2.6±0.7 sec. (VR=0kΩ) - 18.0±1sec (VR=50KΩ)  
At vehicle speed = 100km/h or more.  
1.0±0.2sec (VR=0kΩ) - 10.0±1sec (VR=50KΩ)

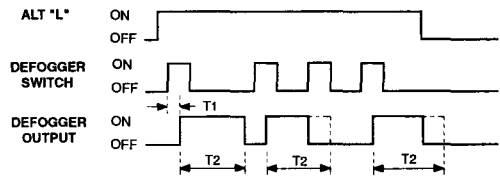
2. Washer



ETHA115D

- a. Time specification (at T2 : 0.2 - 0.6sec.)  
T1 : 0.3sec.  
T3 : 0.6-0.8sec.
- b. Time specification (at T2 : 0.6sec. or more)  
T1 : 0.3sec.  
T3 : 2.5-3.8sec.
- c. This function should be operated preferentially even though the variable intermittent wiper is operating.

3. Rear window defogger

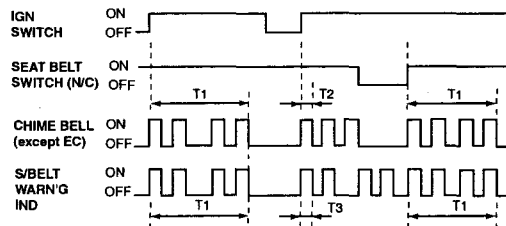


ETJA020B

Time specification

- T1 : 60msec
- T2 : 20±1min.

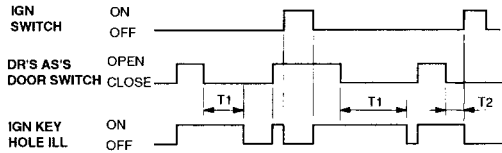
4. Seat belt warning



ETHA115F

Time specification  
 T1 : 6±1sec.  
 T2 : 0.45±0.1sec.  
 T3 : 0.3±0.1sec.

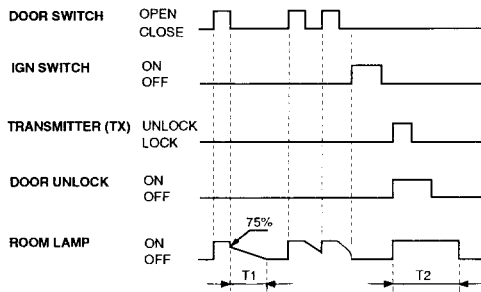
5. Ignition key hole illumination



ETJA070A

Time specification  
 T1 : 10±1sec.  
 T2 : 0-10sec.

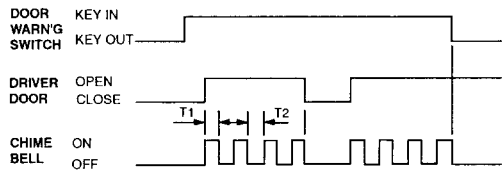
6. Delayed out room lamp&keyless unlock timer



ETJA020C

Time specification  
 T1 : 5.5±0.5sec.  
 T2 : 30±3sec.

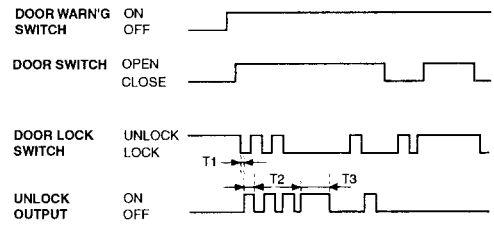
7. Key operated warning



ETHA115L

Time specification  
 T1, T2 : 0.45±0.1sec.

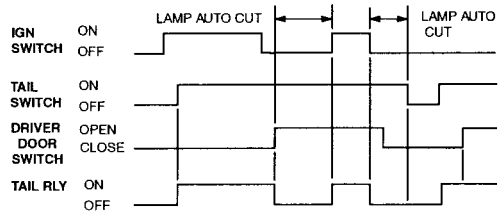
8. Ignition key reminder



ETJA020D

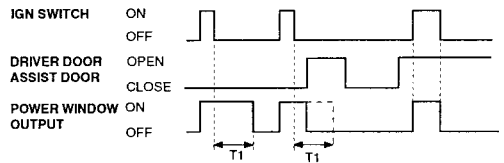
Time specification  
 T1 : 0.5sec.  
 T2 : 1sec.  
 T3 : 0.5sec., 3 times

9. Tail lamp auto cut



ETHA115M

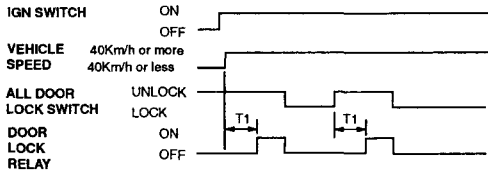
10. Power window timer



ETJA020E

Time specification  
 T1 : 30±3sec.

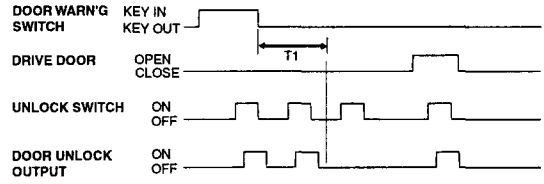
11. Auto door lock



ETHA115N

Time specification  
T1 : 2.5±0.5sec.

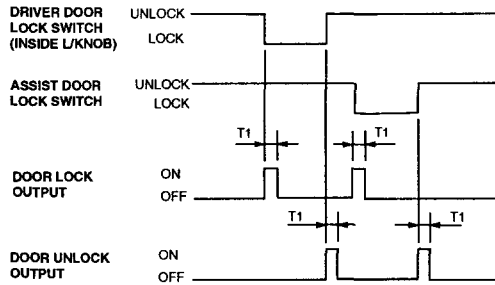
14. Dead central locking



ETMB090A

Time specification  
T1 : 30sec.

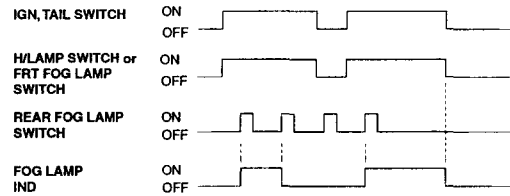
12. Central door lock/unlock



ETHA115H

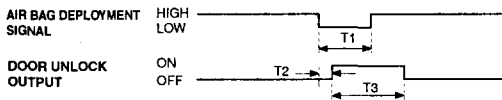
Time specification  
T1 : 0.5±0.1sec.

15. Rear fog lamp control



ETHA120E

13. Crash door unlock



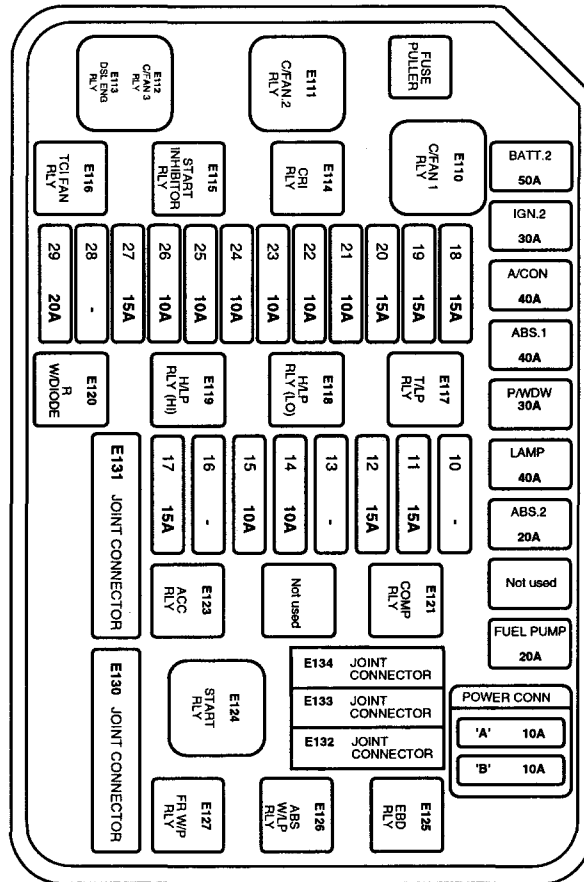
ETJA020F

Time specification  
T1 : 200msec  
T2 : 40msec  
T3 : 5±0.5sec.

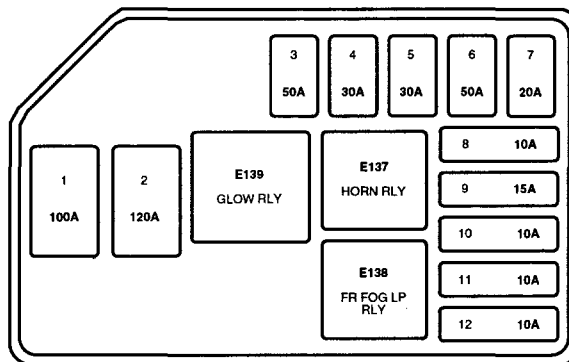
# FUSES AND RELAYS

## RELAY BOX (ENGINE COMPARTMENT)

### SPECIFICATIONS ETMB0950



E2MA001B



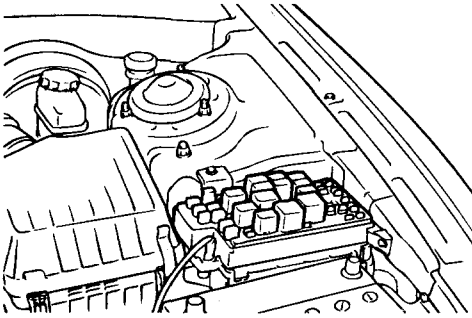
E2MA001C

**INSPECTION** ETMB1000

1. Check for a burnt fusible link with an ohmmeter.
2. If a fusible link burns out, there is a short or some other problem in the circuit. Carefully determine the cause and correct it before replacing the fusible link.

**⚠ CAUTION**

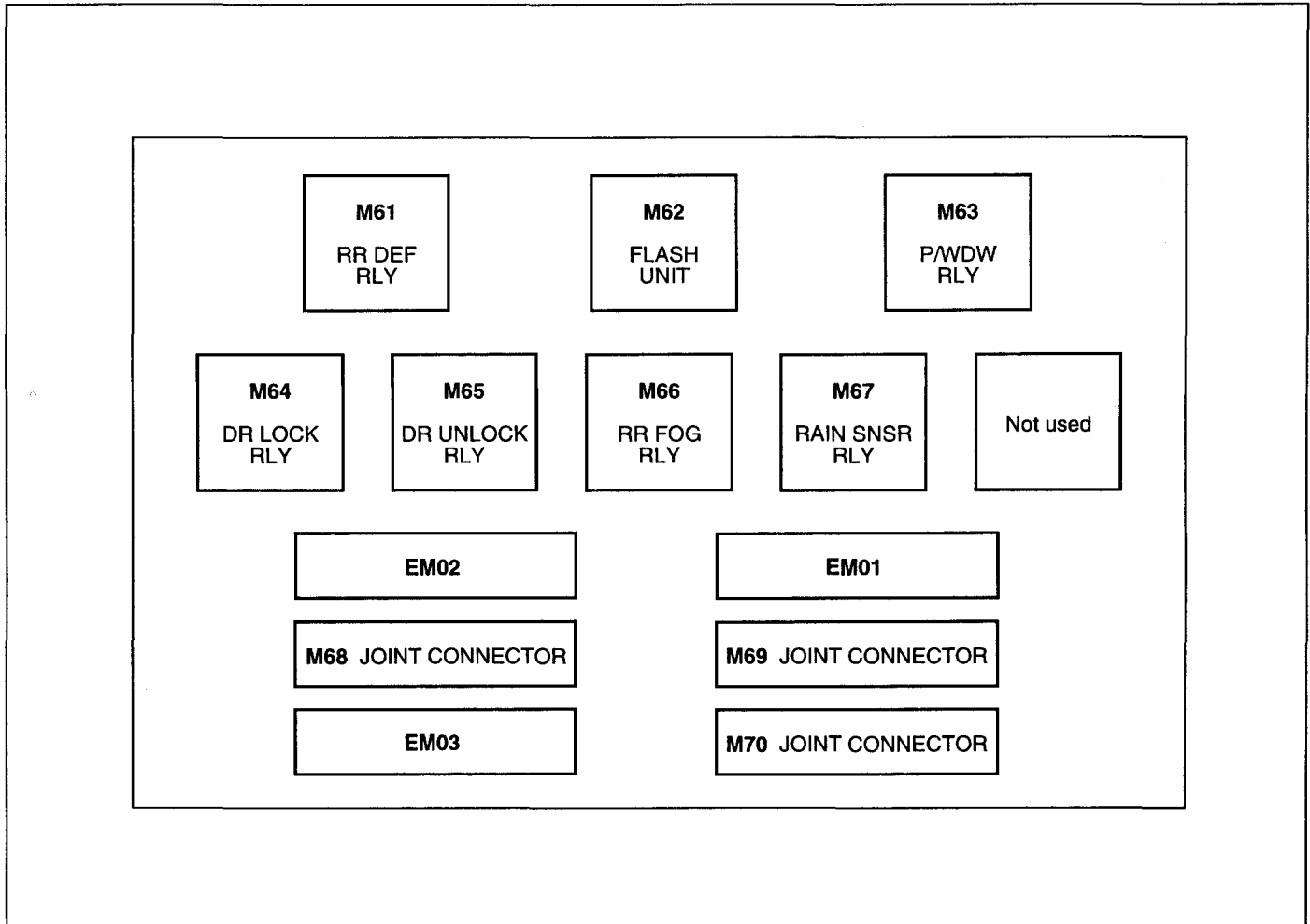
***The fusible link will burn out within 15 seconds if a higher than specified current flows through the circuit.***



KTMB510A

**RELAY BOX** ETMB1050

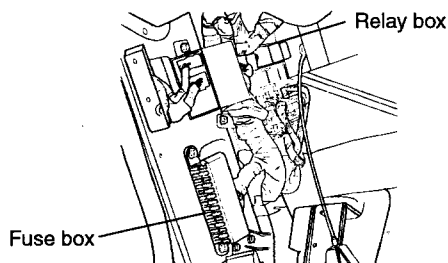
**SPECIFICATION**



ETMB105A

**INSPECTION** ETMB1100

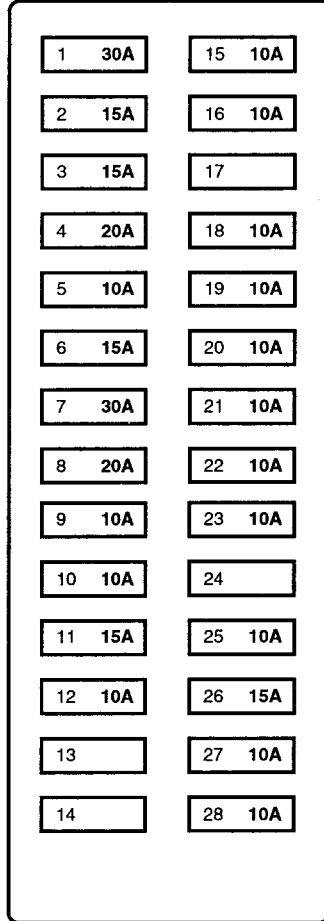
1. Check for a burnt relay with an ohmmeter.
2. If a relay burns out, there is a short or some other problem in the circuit. Carefully determine the cause and correct it before replacing the relay.



ETMB110A

# FUSES

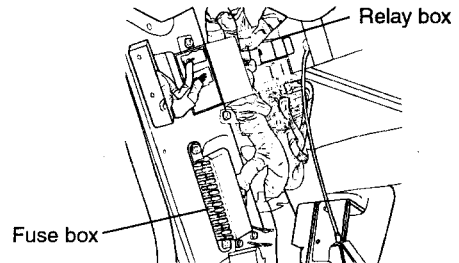
## SPECIFICATION ETMB1150



ETMB115A

## INSPECTION ETMB1200

1. Be sure there is no play in the fuse holders, and that the fuses are held securely.
2. Are the fuse capacities for each circuit correct?
3. Are there any blown fuses?  
If a fuse is to be replaced, be sure to use a new fuse of the same capacity. Always determine why the fuse blew first and completely eliminate the problem before installing a new fuse.



ETMB110A

**⚠ CAUTION**

**Never use a fuse of higher capacity than specified.**

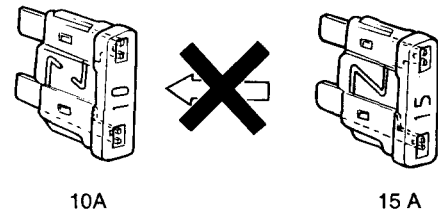


**INSPECTION OF FUSES**

When a fuse is blown, there are two probable causes. The two causes can easily be determined by a visual check after removing the fuses.

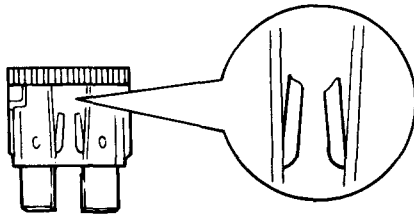
**1. Fuse blown due to over-current.**

Prior to replacing the fuse with a new one, check the circuit for a short and the related parts for abnormal conditions. Only after the correction of a short or replacement of abnormal parts, should a fuse with the same ampere rating be installed.



ETDA086C

Blown fuse due to overcurrent

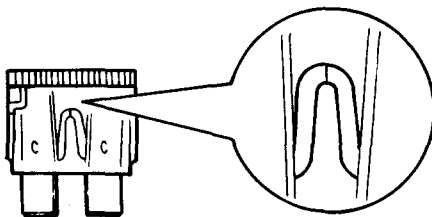


ETDA086A

**2. Fuse blown due to repeated on-off current.**

Normally, this type of problem occurs after a fairly long period of use, and is less frequent than #1 above. In this case, you may simply replace with a new fuse of the same capacity.

Blown fuse due to thermal fatigue



ETDA086B

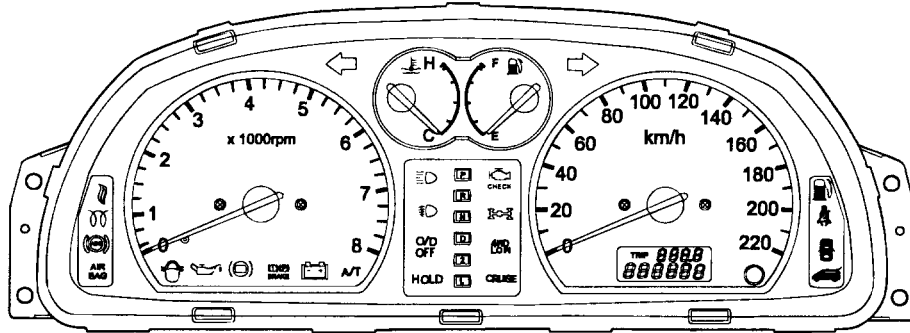
**⚠ CAUTION**

**A blade type fuse is identified by the numbered value in amperes. If the fuse is blown, be sure to replace a fuse with the same ampere rating. If a fuse of higher capacity than specified is used, parts may be damaged and a danger of fire exists. To remove or insert a fuse, use the fuse puller in the fuse box.**

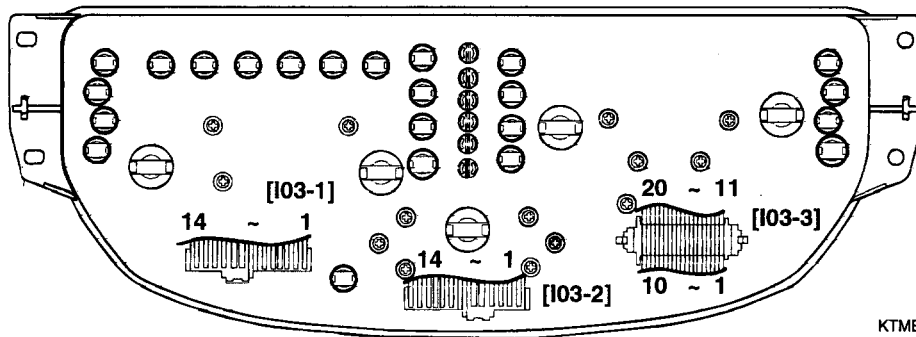
# INDICATORS AND GAUGES

## INSTRUMENT CLUSTER

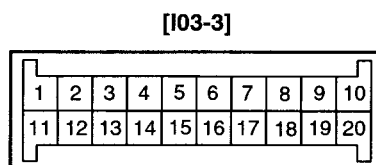
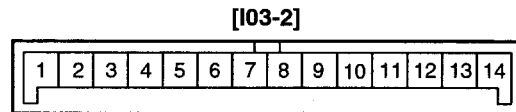
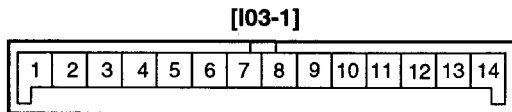
### COMPONENTS ETMB1250



KTMB002C



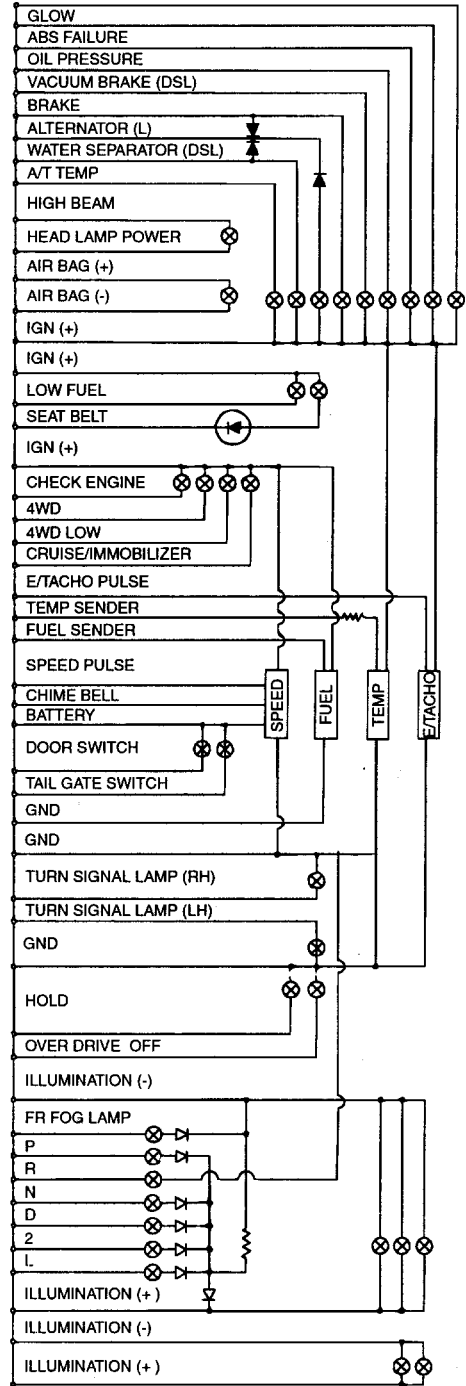
KTMB002B



CIRCUIT DIAGRAM

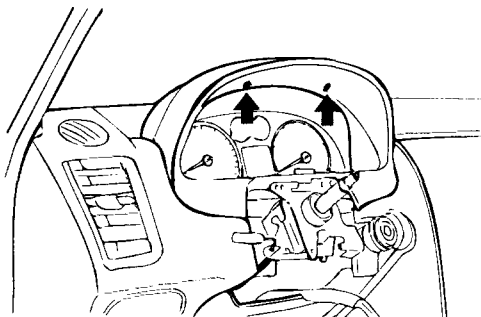
ETMB1300

I03-1	I03-2	I03-3
13		
12		
11		
6		
5		
4		
3		
7		
2		
	5	
	8	
10		
9		
14		
		4
		3
		2
		9
		20
		19
		18
		17
8		
	12	
	1	
		13
		10
		14
		5
		12
		6
	2	
		7
	14	
	13	
1		
	11	
		1
	10	
		8
	3	
	4	
	9	
		15
		16
		11
	6	
	7	



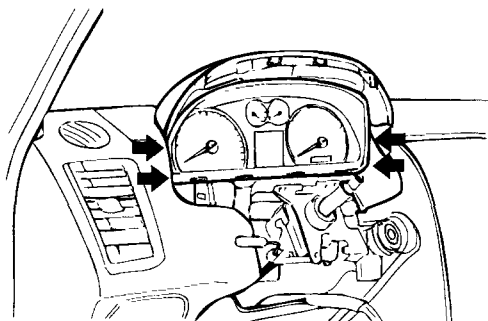
**REMOVAL AND INSTALLATION** ETMB1350

1. Disconnect the negative (-) battery terminal.
2. Remove the cluster housing after removing 2 screws.



KSMB008I

3. Remove the 4 screws holding the cluster and remove the instrument cluster.



KSMB008J

4. Installation is the reverse of removal.

**INSPECTION OF COMPONENTS** ETMB1400

**SPEEDOMETER**

1. Adjust the pressure of the tires to the specified level.
2. Drive the vehicle onto a speedometer tester. Use wheel chocks as appropriate.
3. Check if the speedometer indicator range is within the standard values.

**CAUTION**

*Do not operate the clutch suddenly or increase/decrease speed rapidly while testing.*

**NOTE**

*Tire wear and tire over or under inflation will increase the indication error.*

Velocity (Km/h)	20	40	60	80	100	120
Tolerance (Km/h)	20.5-24.5	41-43.9	61.9-64.9	81.5-85.9	102-106.8	122.4-127.8
Velocity (Km/h)	140	160	180	200	Remarks	
Tolerance (Km/h)	142.8-148.8	163.4-169.8	183.4-190.2	203.4-211	All area	

Velocity (MPH)	10	20	40	60	80	100
Tolerance (MPH)	10.3-12.8	20.5-22.5	40.8-43.4	61-64.4	81.3-85.1	101.8-106.2
Tolerance (MPH)	8.5-11.5	18.5-21.5	38.5-41.5	58.3-61.7	78-82	97.7-102.3
Velocity (MPH)	120	140	Remarks			
Tolerance (MPH)	122-127	142.3-147.9	EXCEPT USA			
Tolerance (MPH)	117.5-122.5	137.3-142.7	USA			

**TACHOMETER**

1. Connect the scan tool to the diagnostic link connector or install a tachometer.
2. With the engine started, compare the readings of the tester with that of the tachometer. Replace the tachometer if the tolerance is exceeded.

**CAUTION**

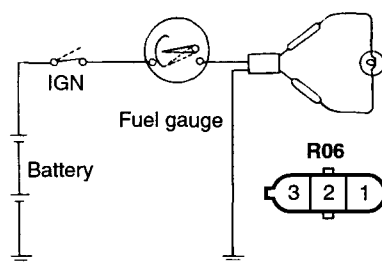
1. *Reversing the connections of the tachometer will damage the transistor and diodes inside.*
2. *When removing or installing the tachometer, be careful not to drop it or subject it to severe shock.*

Revolution (RPM)	1,000	2,000	3,000	4,000	5,000	6,000	7,000	Remark
Tolerance (RPM)	±120	±140	±170	±170	±200	-	-	Diesel
Tolerance (RPM)	±120	±140	±170	±170	±200	±240	±260	Gasoline

**FUEL GAUGE**

**OPERATION CHECK**

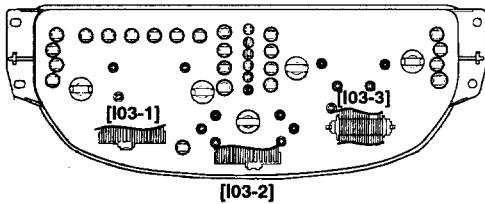
1. Disconnect the fuel sender connector from the fuel sender.
2. Connect a 3.4 watt, 12V test bulb to terminals 1 and 2 on the wire harness side connector.
3. Turn the ignition switch to the ON, and then check that the bulb lights up and the fuel gauge needle moves to full.



**RESISTANCE CHECK**

1. Remove the instrument cluster.
2. Measure the resistance between terminal 1(I03-2) and terminal 6(I03-3).

Resistance ( $\Omega$ )	Gauge level
95	E(Empty)
32.5	1/2
7	F(Full)



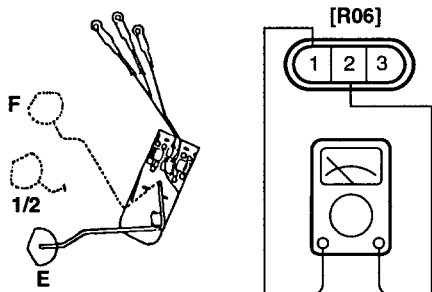
KTMB002B

**FUEL SENDER**

1. Using an ohmmeter, measure the resistance between terminals 1 and 2 at each float level.

Float position	F	1/2	E
Resistance ( $\Omega$ )	4	32.5	105

2. Also check that the resistance changes smoothly when the float is moved from "E" to "F".



ETMB140B

**LOW FUEL LEVEL SENSOR**

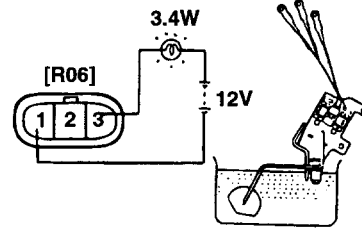
1. Connect a test lamp (12V, 3.4W) and the battery to the sender. Immerse the sender in water.
2. The lamp should be off while the thermister is submerged in the water, and should illuminate when the sender is taken out of the water.

**NOTE**

If there is a malfunction, replace the fuel sender as an assembly.

**CAUTION**

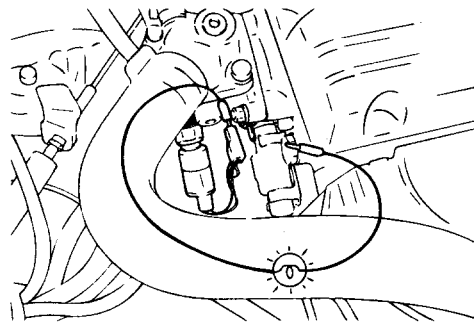
After completing this test, wipe the sender dry and reinstall it in the fuel tank.



ETLA060E

**ENGINE COOLANT TEMPERATURE GAUGE**

1. Disconnect the wiring connector from the engine coolant temperature sender in the engine compartment.
2. Turn the ignition switch ON. Check that the gauge needle indicates cool. Turn the ignition switch OFF.
3. Connect a 12V, 3.4 watt test bulb between the harness side connector and ground.



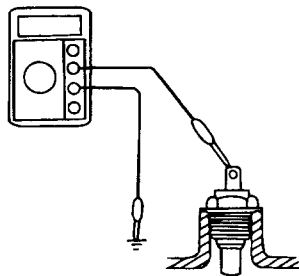
ETLA605D

4. Turn the ignition switch ON.
5. Verify that the test bulb flashes and that the indicator moves to HOT.

If operation is not as specified, replace the sender. Then recheck the system.

**ENGINE COOLANT TEMPERATURE SENDER**

1. Using an ohmmeter, measure the resistance between the terminal and ground.



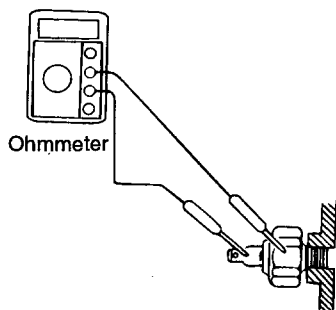
ETLA605E

2. If the resistance value is not as shown in the table, replace the temperature sender.

Temperature (°C)	55	85	110	125
Resistance (Ω)	157	48.4	24	15.2

**OIL PRESSURE SWITCH**

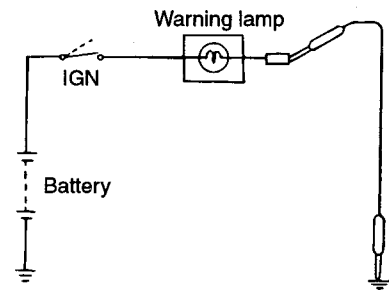
1. Check that there is continuity between the switch's terminal and ground with the engine stopped.
2. Check that there is no continuity between the terminal and ground with the engine running.
3. If operation is not as specified, replace the switch.



ETMB140C

**OIL PRESSURE WARNING LAMP**

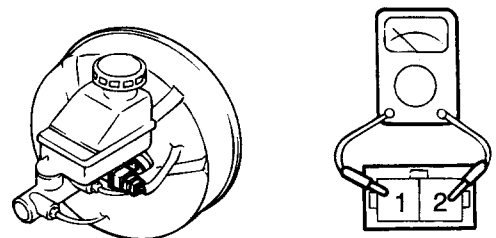
1. Disconnect the connector from the warning switch and ground the terminal on the wire harness side connector.
2. Turn the ignition switch ON. Check that the warning lamp lights up. If the warning lamp doesn't light, test the bulb or inspect wire harness.



ETMB140D

**BRAKE FLUID LEVEL WARNING SWITCH**

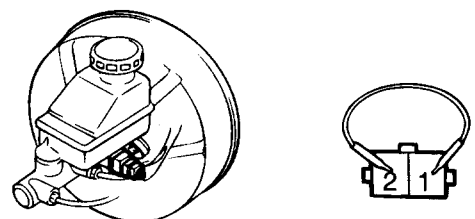
1. Remove the connector from the switch located at the brake fluid reservoir.
2. Verify that continuity exists between switch terminals 1 and 2 while pressing down the switch (float) with a rod.



V5BE060M

**BRAKE FLUID LEVEL WARNING LAMP**

1. Start the engine.
2. Release the parking brake.
3. Remove the connector from the brake fluid level warning switch.
4. Ground the connector at the harness side.
5. Verify that the warning lamp lights.



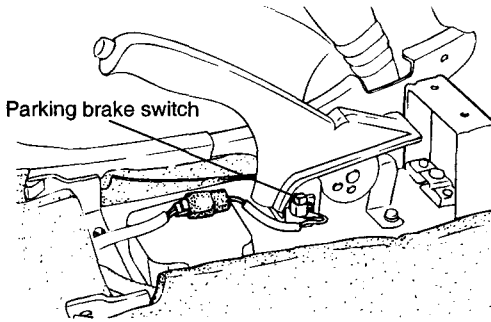
V5BE060N

**PARKING BRAKE SWITCH**

The parking brake switch is a push type located under the parking brake lever. To adjust, move the switch mount up and down with the parking brake lever released all the way.

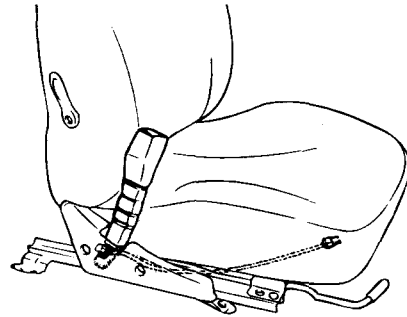
1. Check that there is continuity between the terminal and switch body with the switch ON (Lever is pulled).
2. Check that there is no continuity between the terminal and switch body with the switch OFF (Lever is released).

If continuity is not as specified, replace the switch or inspect its ground connection.



V5BE0600

Seat belt condition	Continuity
Fastened	Non-conductive ( $\infty\Omega$ )
Not fastened	Conductive( $0\Omega$ )



V5BE0600

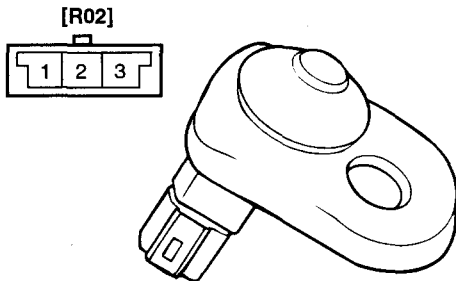
**SEAT BELT WARNING LAMP**

With the ignition switch turned ON, verify that the lamp glows.

Seat belt condition	Warning lamp
Fastened	OFF
Not fastened	ON

**DOOR SWITCH**

Remove the door switch and check for continuity between the terminals.



KTMB501A

Lead wire	1	2	3
Position			
Free (Door open)	○	○	○
Push(Door close)			

ETMB140E

**SEAT BELT SWITCH**

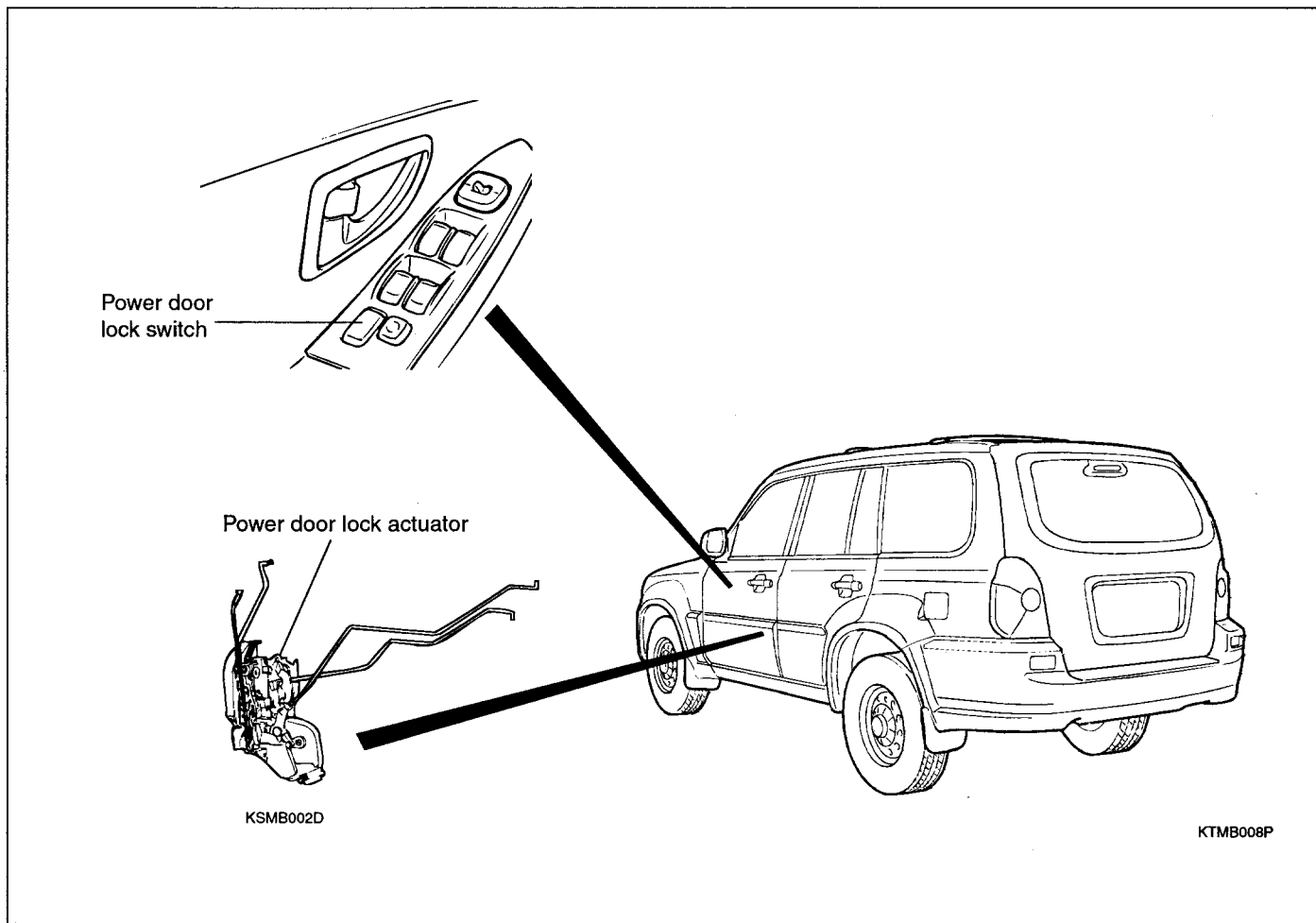
1. Remove the connector from the switch.
2. Check for continuity between terminals.



# POWER DOOR LOCKS

## POWER DOOR LOCK ACTUATORS

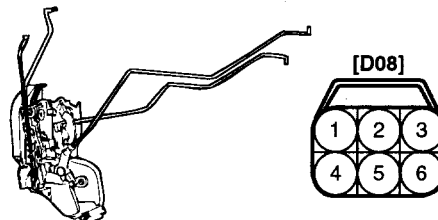
### COMPONENTS ETMB1450



ETMB145A

### INSPECTION ETMB1500

1. Disconnect the actuator connector from the wiring harness.
2. Apply battery voltage (12V) to each terminal as shown in the table and verify that the actuator operates correctly.



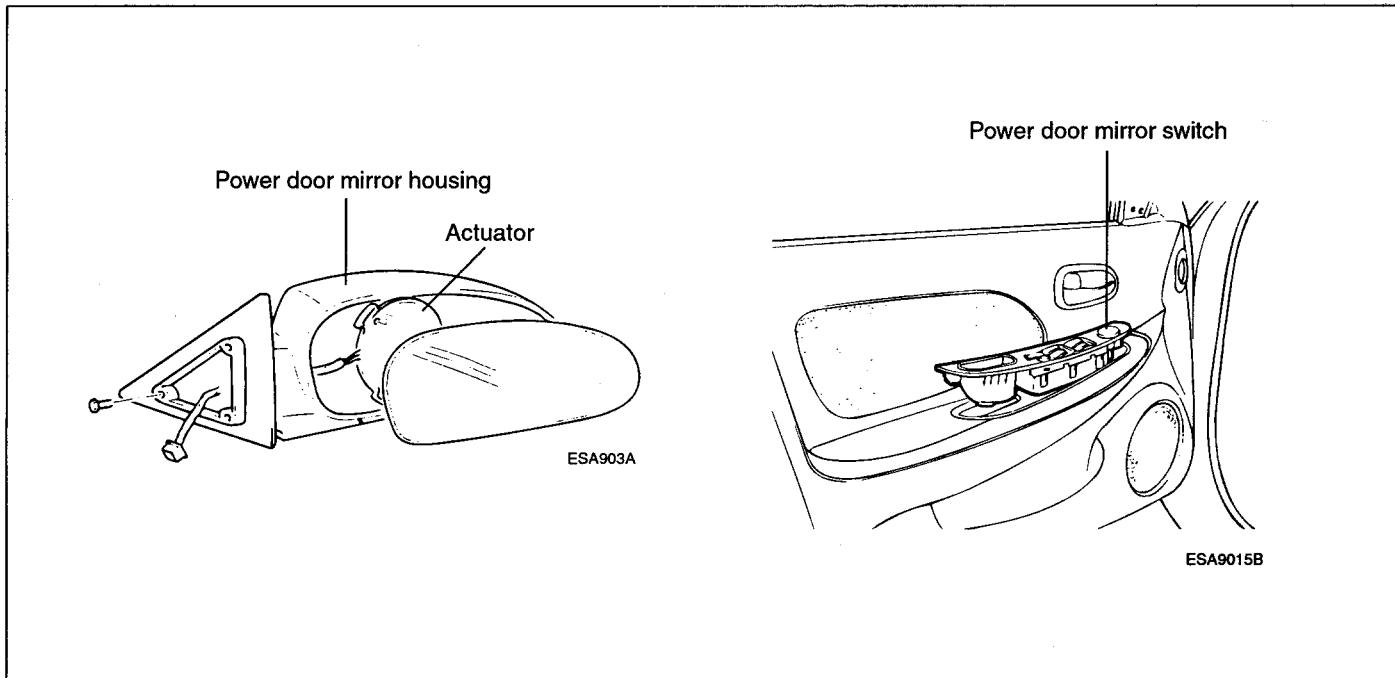
KTMB275B

Position \ Terminal		Terminal			
		2	3	4	6
Front Left [D08]	LOCK			⊖	⊕
	UNLOCK			⊕	⊖
Front Right [D18]	LOCK			⊕	⊖
	UNLOCK			⊖	⊕
Rear Left [D21]	LOCK	⊖	⊕		
	UNLOCK	⊕	⊖		
Rear Right [D31]	LOCK	⊕	⊖		
	UNLOCK	⊖	⊕		

ETMB150A

# POWER DOOR MIRRORS

## COMPONENTS ETMB1550

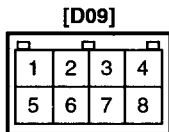
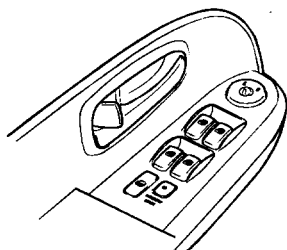


ETMB155A

## POWER DOOR MIRROR SWITCH

### INSPECTION ETMB1600

1. Remove the power door mirror switch from the door trim panel.
2. Check for continuity between the terminals in each switch position according to the table. If continuity is not as specified, replace the power door mirror switch.



KTMB240B

[D09]

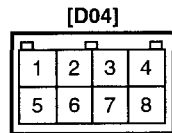
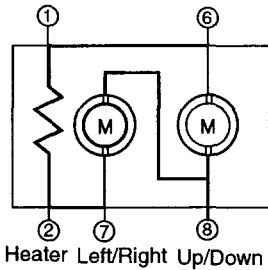
Class	Terminal	1	2	3	4	5	6	7	8	
	Direction									
LEFT HAND	UP			○	—	○	—	○	—	○
	DOWN			○	—	○	—	○	—	○
	OFF			○	—	○	—	○	—	○
	LEFT			○	—	○	—	○	—	○
	RIGHT			○	—	○	—	○	—	○
RIGHT HAND	UP		○	—	○	—	○	—	○	
	DOWN		○	—	○	—	○	—	○	
	OFF		○	—	○	—	○	—	○	
	LEFT		○	—	○	—	○	—	○	
	RIGHT		○	—	○	—	○	—	○	

ETMB160A

# POWER DOOR MIRROR ACTUATOR

## INSPECTION ETMB1650

1. Disconnect the power door mirror connector from the harness.
2. Apply battery voltage to each terminal as shown in the table and verify that the mirror operates properly.



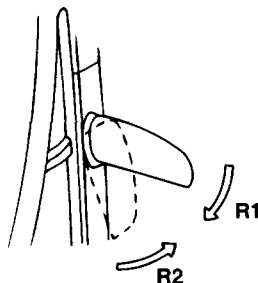
ETMB165A

[D04]

Terminal Position	6	7	8
UP	⊖	⊕	⊕
DOWN	⊕	⊖	⊖
LEFT	⊖	⊕	⊖
RIGHT	⊕	⊖	⊕

ETMB165B

## MIRROR FOLDING INSPECTION



ETHA030A

[D04]

Terminal Direction	3	4
R1	⊖	⊕
R2	⊕	⊖

ETMB165C

## MIRROR HEATER INSPECTION

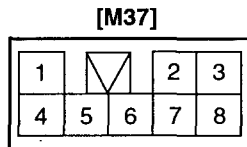
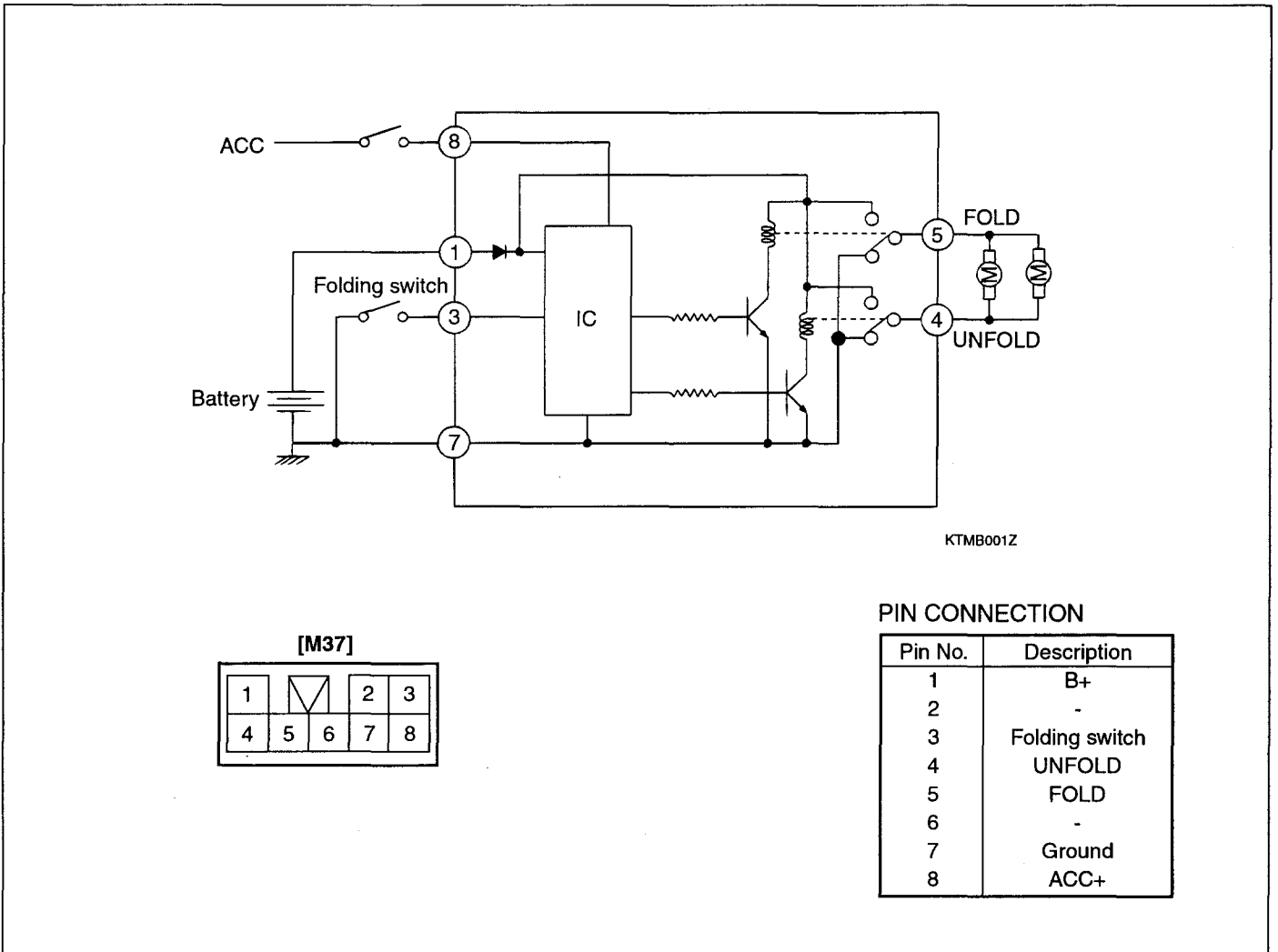
[D04]

Terminal Position	1	2
Heater	No polarity	

ETMB165D

# DOOR MIRROR FOLDING CONTROL MODULE

## CIRCUIT DIAGRAM ETMB1700



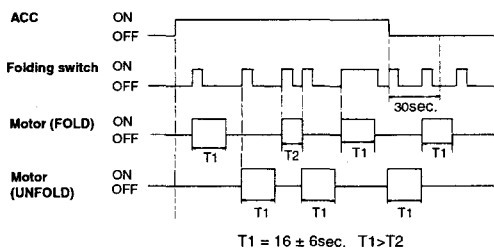
### PIN CONNECTION

Pin No.	Description
1	B+
2	-
3	Folding switch
4	UNFOLD
5	FOLD
6	-
7	Ground
8	ACC+

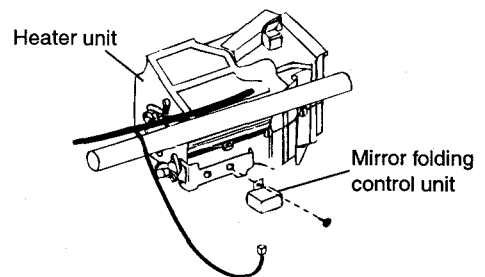
ETMB170A

## INSPECTION ETMB1750

1. Check that the folding mirror operate according to the following timing chart.



2. If operation is not normal, inspect the wire connector on the mirror folding control unit

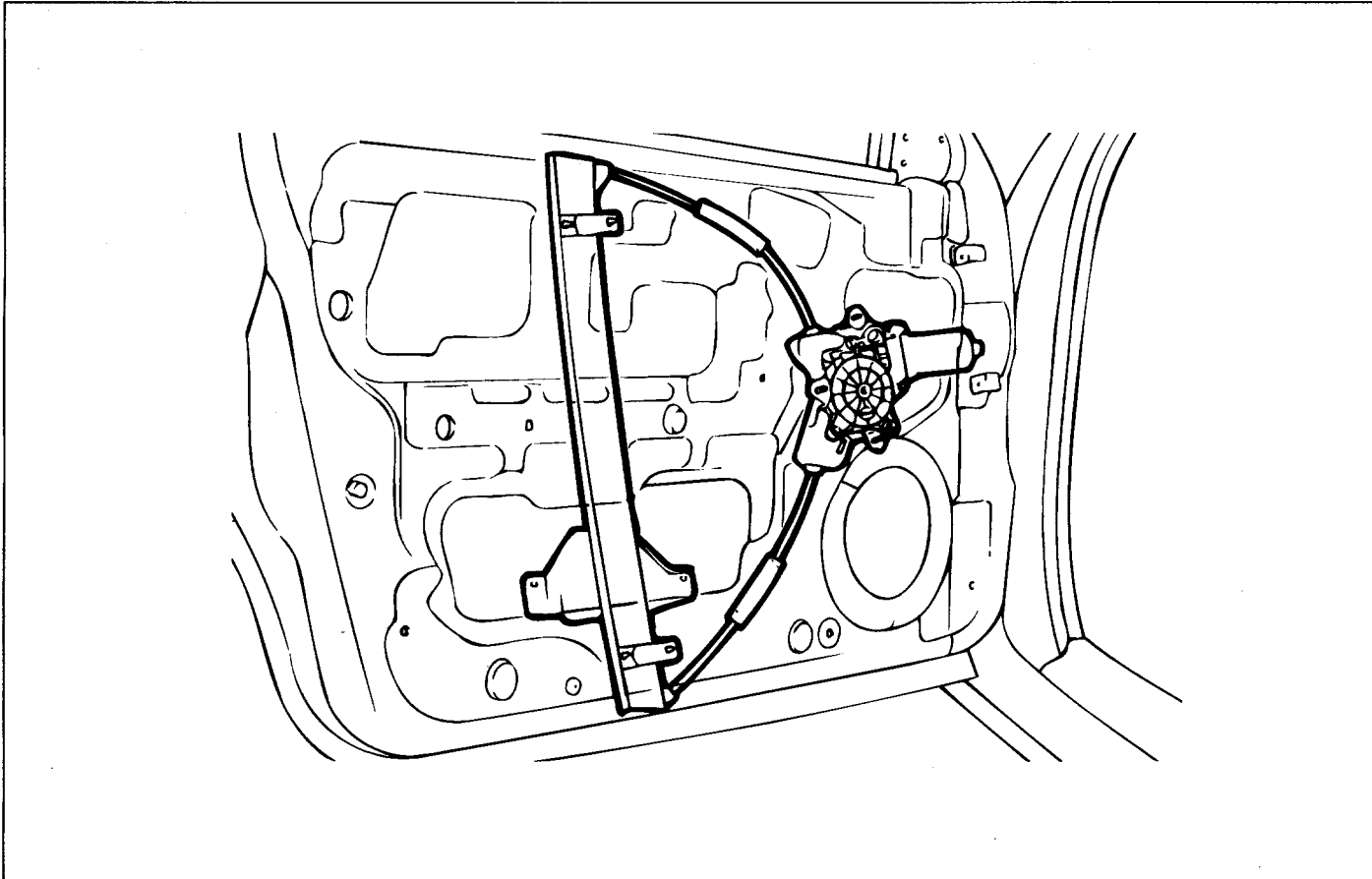


ETMB175B

# POWER WINDOWS

## POWER WINDOW MOTOR

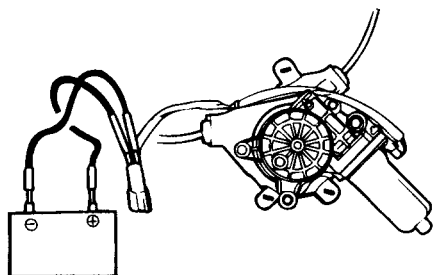
### COMPONENTS ETMB1800



KTMB250A

### INSPECTION ETJA1200

Connect the motor terminals directly to battery voltage (12V) and check that the motor operates smoothly. Next, reverse the polarity and check that the motor operates smoothly in the reverse direction. If the operation is abnormal, replace the motor.

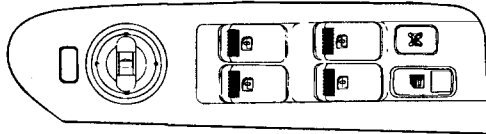


ETDA135A

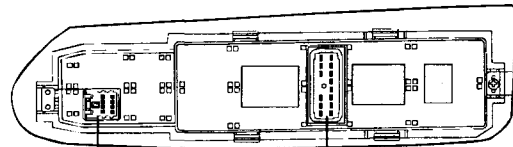
# POWER WINDOW SWITCH

## CIRCUIT DIAGRAM ETMB1850

### [POWER WINDOW MAIN SWITCH]



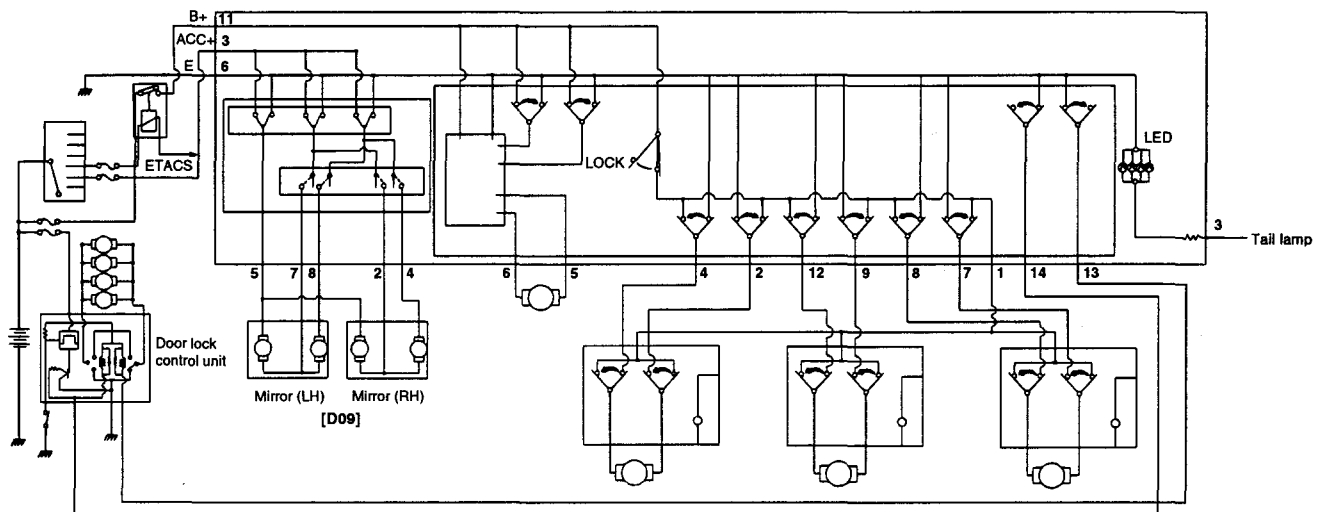
KTMB003S



[D09]

[D10]

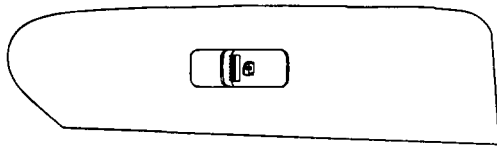
KTMB001T



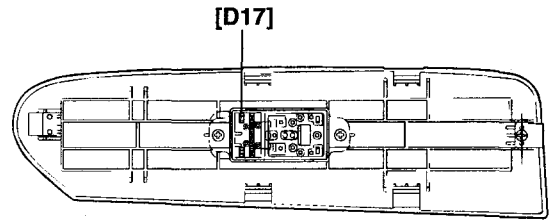
[D10]

KTMB001U

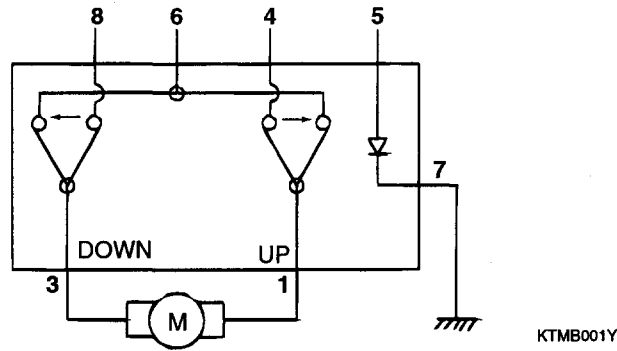
[POWER WINDOW SUB SWITCH]



KTMB001W



KTMB001X



KTMB001Y

ETMB185B

**INSPECTION** ETMB1900

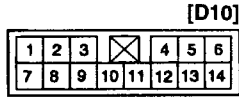
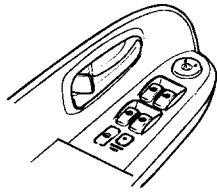
1. Remove the switch from the door trim panel.
2. Check for continuity between the terminals. If continuity is not as specified in the table, replace the power window switch.

[D10]

Terminal / Position	FRONT LEFT				FRONT RIGHT				REAR LEFT				REAR RIGHT			
	5	6	10	11	2	4	10	11	9	10	11	12	7	8	10	11
UP	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
OFF	○	○	○		○	○	○		○	○	○	○	○	○	○	○
DOWN	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○

ETMB190A





KTMB265F

[D17]

Terminal Position	1	3	4	6	8
UP	○	○	○	○	○
OFF	○	○	○	○	○
DOWN	○	○	○	○	

ETMB190D

DOOR LOCK SWITCH

[D10]

Terminal Position	10	13	14
LOCK	○	○	○
OFF			
UNLOCK	○	○	

ETMB190B

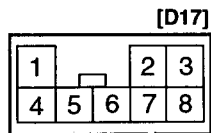
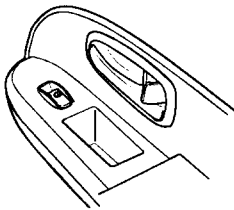
WINDOW LOCK SWITCH

[D10]

Terminal Position	1	11
NORMAL	○	○
LOCK		

ETMB190C

POWER WINDOW SUB SWITCH



KTMB265B

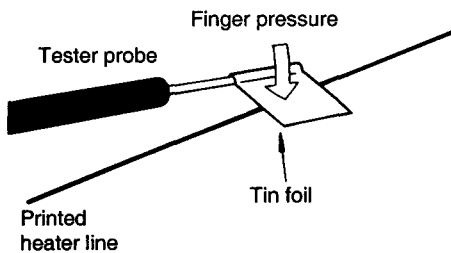
# REAR WINDOW DEFOGGER

## REAR WINDOW DEFOGGER PRINTED HEATER

### INSPECTION ETA91650

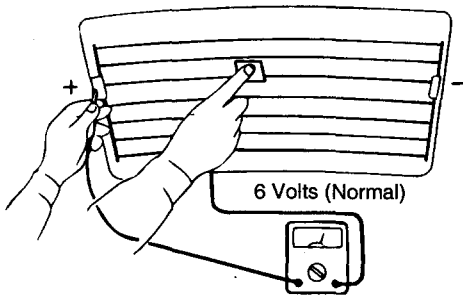
**⚠ CAUTION**

Wrap tin foil around the end of the voltmeter test lead to prevent damaging the heater line. Apply finger pressure on the tin foil, moving the tin foil along the grid line to check for open circuits.



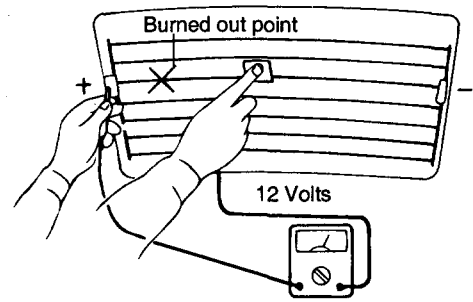
ETA9165A

1. Turn on the defogger switch and use a voltmeter to measure the voltage of each heater line at the glass center point. If a voltage of approximately 6V is indicated by the voltmeter, the heater line of the rear window is considered satisfactory.



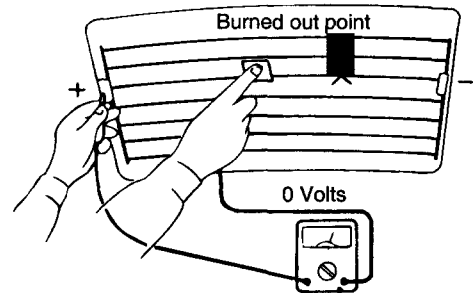
ETA9165B

2. If a heater line is burned out between the center point and (+) terminal, the voltmeter will indicate 12V.



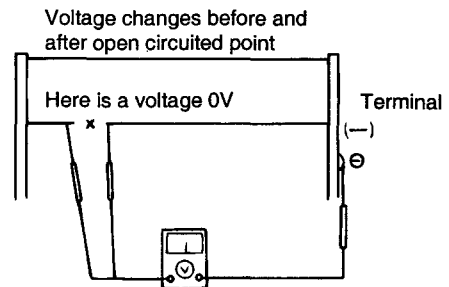
ETA9165C

3. If a heater line is burned out between the center point and (-) terminal, the voltmeter will indicate 0V.



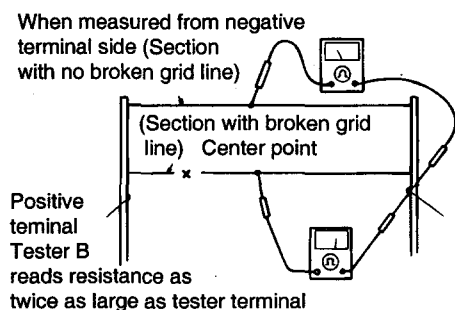
ETA9165D

4. To check for open circuits, slowly move the test lead in the direction that the open circuit seems to exist. Try to find a point where a voltage is generated or changes to 0V. The point where the voltage has changed is the open-circuit point.



ETA9165E

5. Use an ohmmeter to measure the resistance of each heater line between a terminal and the center of a grid line, and between the same terminal and the center of one adjacent heater line. The section with a broken heater line will have a resistance twice as that in other sections. In the affected section, move the test lead to a position where the resistance sharply changes.



ETA9165F

**REPAIR OF BROKEN HEATER LINE**

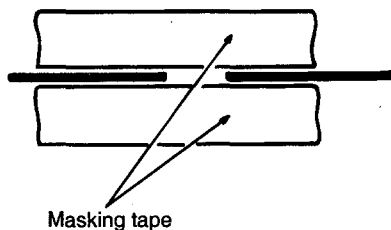
Prepare the following items:

1. Conductive paint.
2. Paint thinner.
3. Masking tape.
4. Silicone remover.
5. Thin brush.

Wipe the glass adjacent to the broken heater line, clean with silicone remover and attach the masking tape as shown. Shake the conductive paint container well, and apply three coats with a brush at intervals of about 15 minutes apart. Remove the tape and allow sufficient time for drying before applying power. For a better finish, scrape away excess deposits with a knife after the paint has completely dried. (Allow 24 hours).

**! CAUTION**

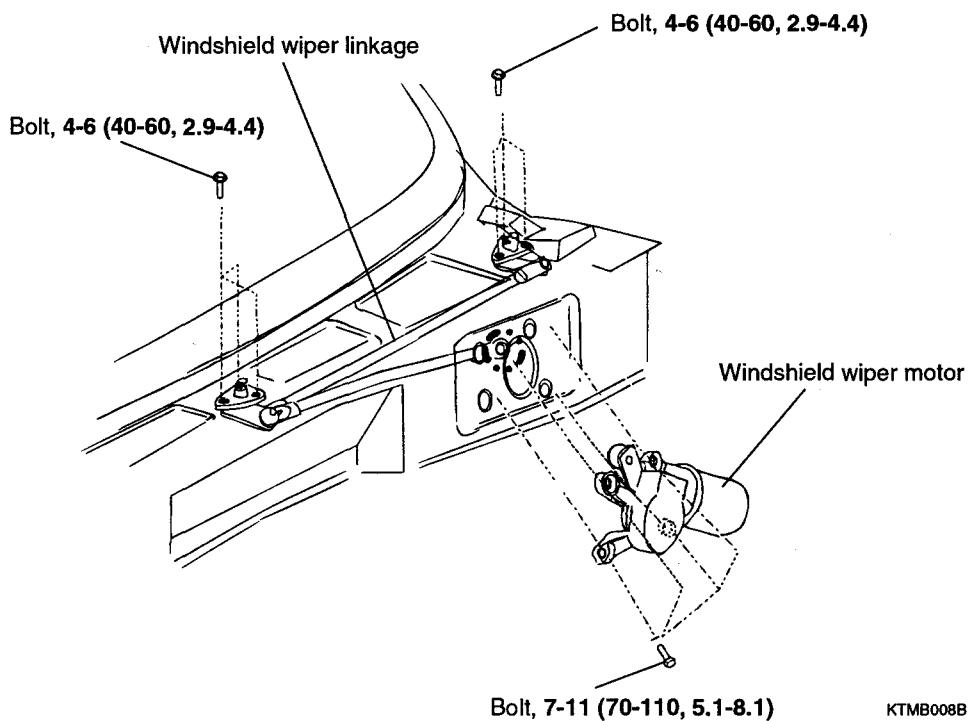
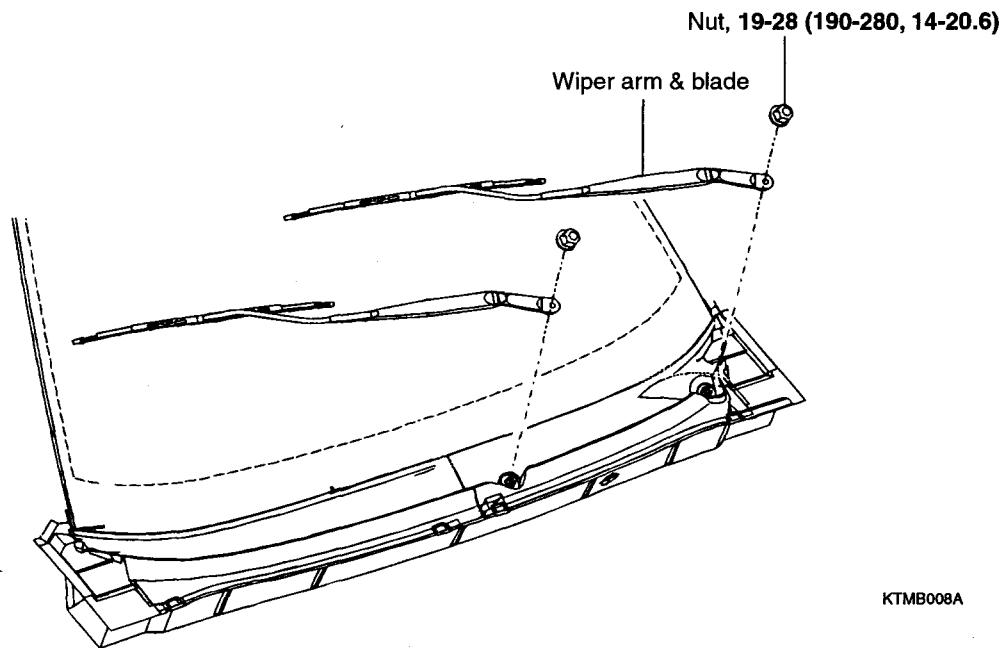
*After repairing, clean the glass with a soft dry cloth or wipe along the grid line with a slightly moistened cloth.*



ETA9165G

# WINDSHIELD WIPER/WASHER

## COMPONENTS ETMB1950



**TORQUE : Nm (kg-cm, lb-ft)**

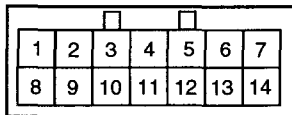
# WINDSHIELD WIPER/WASHER SWITCH

## INSPECTION ETMB2120

Remove the multifunction switch and disconnect the wire connectors.

Check the switch for continuity between the terminals.  
If continuity is not as specified, replace the wiper and washer switch.

[M01-2]



ETMB212A

## WIPER AND INTERMITTENT VOLUME SWITCH [M01-2]

Terminal Position	1	2	3	4	5	13	14
OFF		○—○					
INT		○—○		○—○		○—○	○—○
LOW		○—○	○—○	○—○	○—○		
HI	○—○	○—○	○—○	○—○	○—○		

ETMB045B

## WASHER SWITCH [M01-2]

Terminal Position	5	6
OFF		
ON	○—○	○—○

ETMB045C

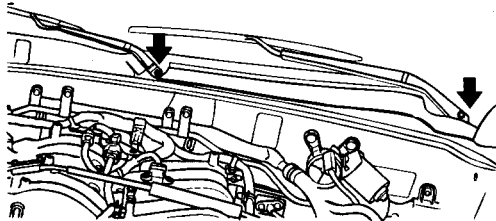
# FRONT WIPER MOTOR

## REMOVAL ETMB2000

1. Remove the windshield wiper arm and blade after removing the 2 nuts.

**NOTE**

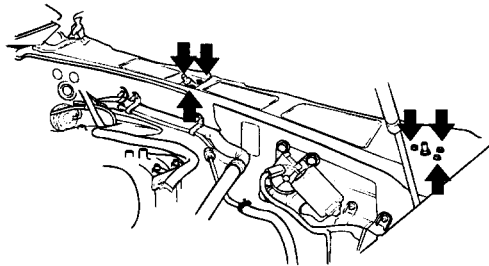
Care must be taken not to scratch the engine hood.



KTMB007H

**Tightening torque :**  
19-28Nm (190-280kg·cm, 14-20.6lb·ft)

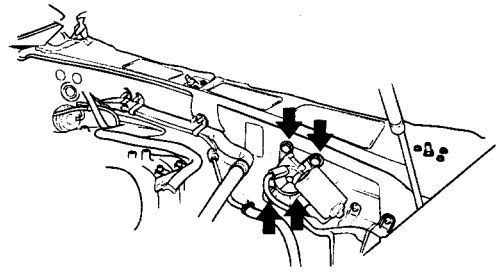
2. Remove the weatherstrip and the cowl top cover then remove the 6 bolts holding the linkage.



KTMB007I

**Tightening torque :**  
4-6Nm (40-60kg·cm, 2.9-4.4lb·ft)

3. Disconnect the windshield wiper motor connector and remove the windshield wiper motor and the linkage.

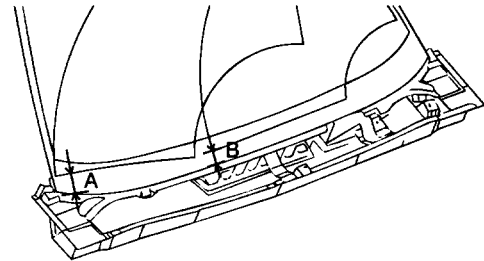


KTMB290A

## INSTALLATION ETMB2050

1. Install the wiper arm to the specified position.

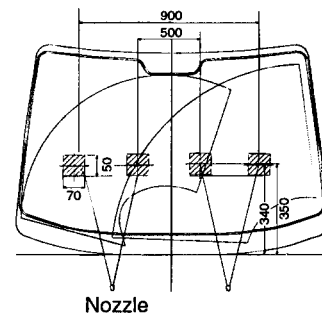
Specified position	A	B
Distance (mm)	40-50	38-42



ETJA060I

2. Set the washer nozzle on the specified spray position.

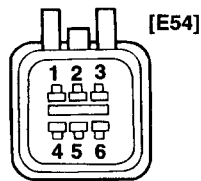
Unit : mm



ETMB205A

**INSPECTION** ETMB2100**SPEED OPERATION CHECK**

1. Remove the connector from the wiper motor.
2. Attach the positive (+) lead from the battery to terminal 4 and the negative (-) lead to terminal 1.
3. Check that the motor operates at low speed.
4. Connect the positive (+) lead from the battery to terminal 4 and the negative (-) lead to terminal 2.
5. Check that the motor operates at high speed.

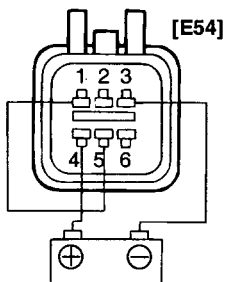


- |           |            |
|-----------|------------|
| 1. Low    | 4. IGN+    |
| 2. High   | 5. Parking |
| 3. Ground | 6. Blank   |

ETMB210A

**AUTOMATIC STOP OPERATION CHECK**

1. Operate the motor at low speed using the stalk control.
2. Stop the motor operation anywhere except at the off position by disconnecting terminal 1.
3. Connect terminals 1 and 5.
4. Connect the positive (+) lead from the battery to terminal 4 and the negative (-) lead to terminal 3.
5. Check that the motor stops running at the off position.

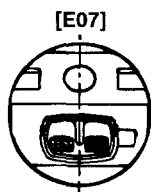
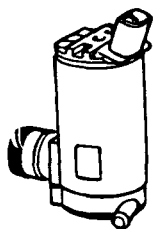


KTMB295B

## FRONT WASHER MOTOR

### INSPECTION ETMB2150

1. With the washer motor connected to the reservoir tank, fill the reservoir tank with water.
2. Connect positive (+) and negative (-) battery cables to terminals 2 and 1 respectively to see that the washer motor runs and water sprays from the front nozzles.
3. Check that the motor operates normally.



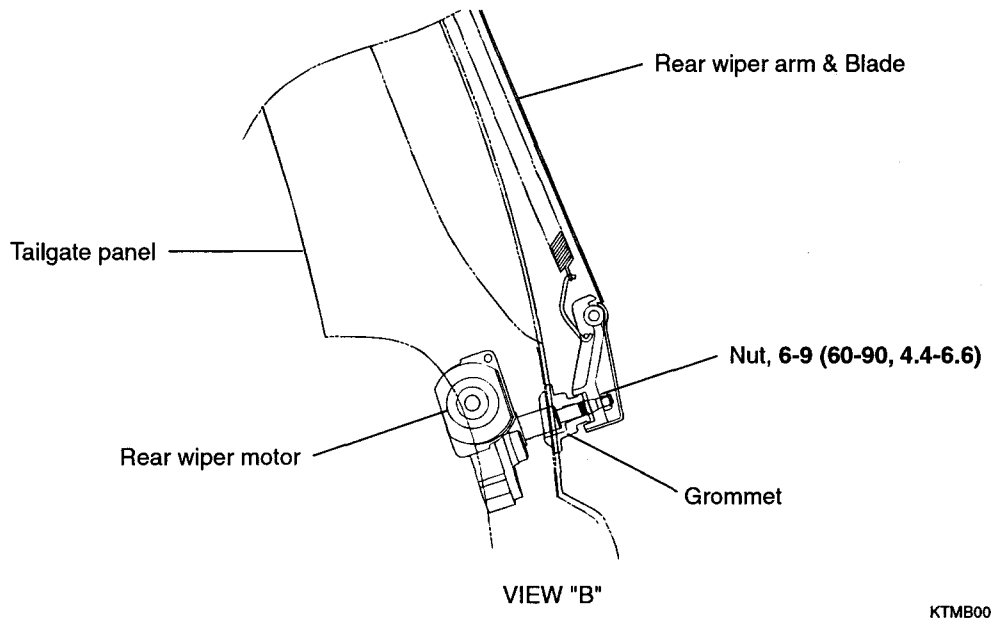
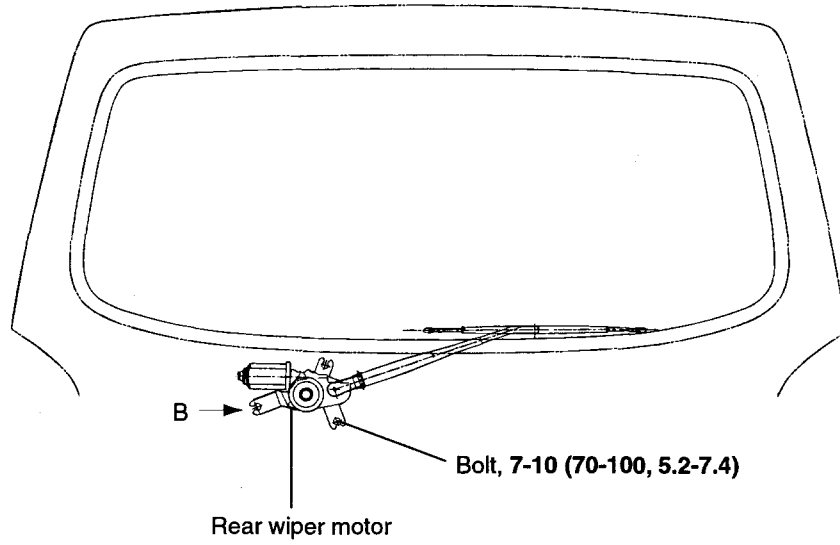
1. Washer(-)
2. IGN(+)

ETMB215A



# REAR WIPER/WASHER

## COMPONENTS ETMB2200

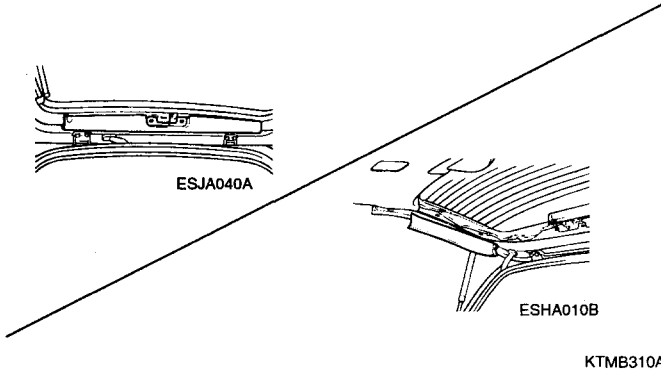


**TORQUE : Nm (kg·cm. lb·ft)**

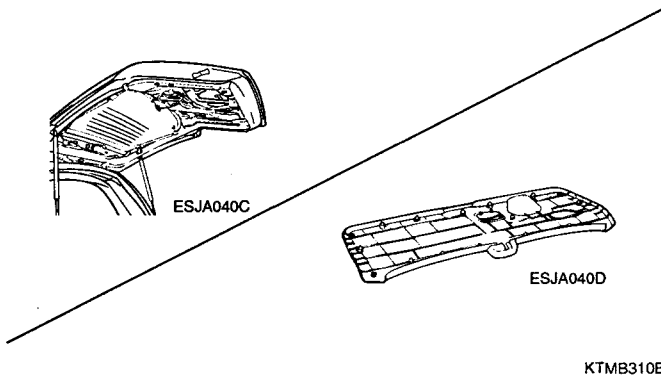
# REAR WIPER MOTOR

## REMOVAL ETMB2250

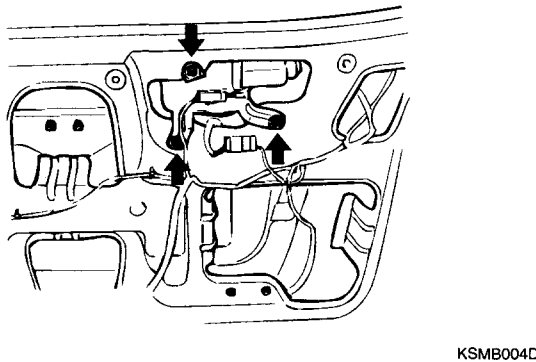
1. Pry the upper and side trim loose from the tailgate frame.



2. Remove the screws and the trim grip and then remove the tailgate trim panel.



3. Remove the 3 bolts holding the rear wiper motor and disconnect the wire connector.



4. Installation is the reverse of removal.

## INSPECTION ETMB2300

1. Remove the connector from the rear wiper motor.

2. Connect battery positive (+) and negative (-) cables to terminals 1 and 4 respectively.
3. Check that the motor operates normally. Replace the motor if it operates abnormally.

[R34]			
1	2	3	4

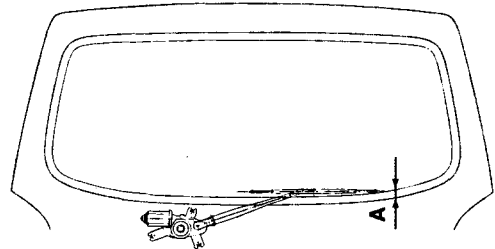
- 1. IGN(+)
- 2. Parking
- 3. Switch
- 4. Ground

ETMB230A

## INSTALLATION ETMB2260

1. After replacing all the removed components, install the rear wiper arm to the specified stop position.

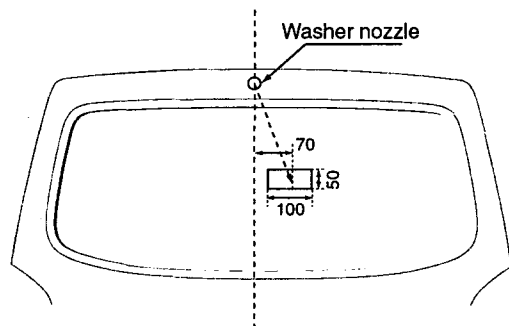
Specified position	A
Distance	30mm



KTMB008C

2. Set the washer nozzle on the specified spray position.

Unit : mm

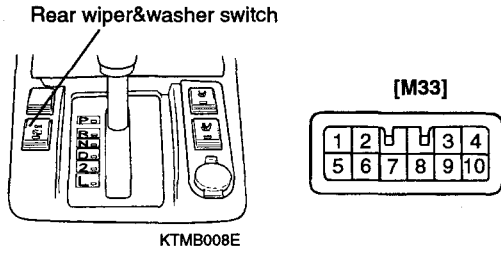


ETMB226A

# REAR WASHER SWITCH

## INSPECTION ETMB2400

1. Disconnect the connector from the rear wiper&washer switch.
2. Check for continuity between the terminals.



ETMB240A

[M33]

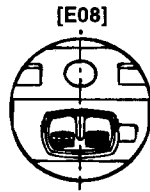
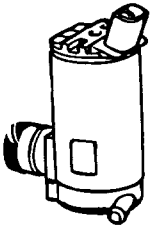
Rear wiper		Terminal		1	2	3	4	9	10
		Rear washer							
Rear wiper switch	ON	ON		○	○		○	○	○
		OFF					○	○	
	OFF	ON				○	○	○	○
		OFF				○	○	○	

ETMB240B

## REAR WASHER MOTOR

### INSPECTION ETMB2350

1. With the washer motor connected to the reservoir tank, fill the reservoir tank with water.
2. Connect positive(+) and negative(-) battery cables to terminals 2 and 1 respectively to see that the washer motor runs and water sprays from the rear nozzles.
3. Check that the motor operates normally.

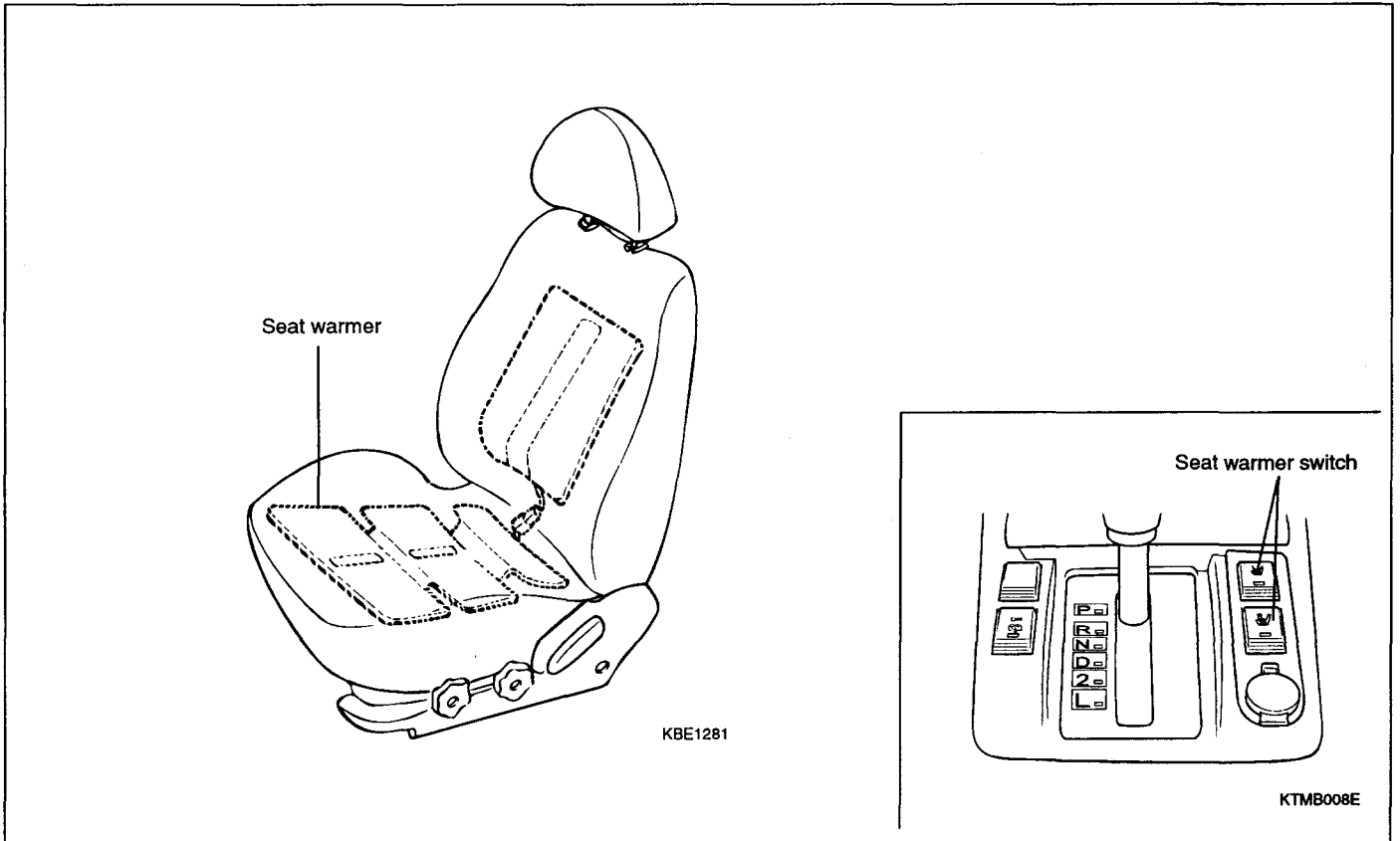


1. Rear washer(-)
2. IGN(+)

ETMB235A

# SEAT WARMER

## COMPONENTS ETMB2450



ETMB245A

## SEAT WARMER SWITCH

### INSPECTION ETMB2500

1. Disconnect the negative(-) battery terminal.
2. Remove the seat warmer switch from the floor console upper cover.

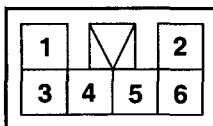
3. Check for continuity between the terminals.

[M49 / M50]

Terminal Position	2	5	1	4	3
ON	○	○	○	○	○
OFF	○ — (M) — ○				

ETMB250A

[LH : M49/ RH : M50]

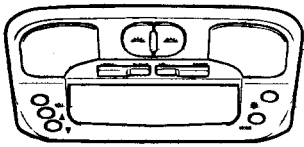


# SUN ROOF

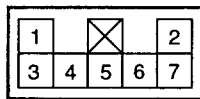
## SUN ROOF SWITCH

### INSPECTION ETMB2550

1. Using an ohmmeter, check for continuity between the terminals.
2. If the continuity is not as specified, replace the switch.



KTMB008F



KTMB341A

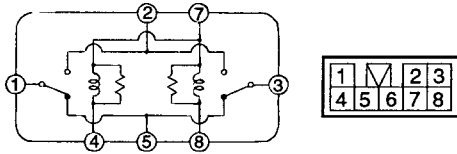
Terminal		Position						
		1	2	3	4	5	6	7
Slide switch	Open	○	○	—	—	—	○	
	Off		○	—	—	—	○	
	Close	○	○	—	—	○	○	
Tilt switch	Up	○	○	—	○	—	○	
	Off		○	—	—	—	○	
	Down	○	○	○	—	—	○	

ETMB255A

# SUN ROOF RELAY

## INSPECTION ETMB2600

1. Check for continuity between the terminals.



KTMB342A

Terminal	1	2	3	4	5	6	7	8
Battery voltage not supplied (coils not energized)				○	—		○	○
Battery voltage supplied (coils energized)	○	○		⊖	---		⊕	
		○	○				⊕	⊖

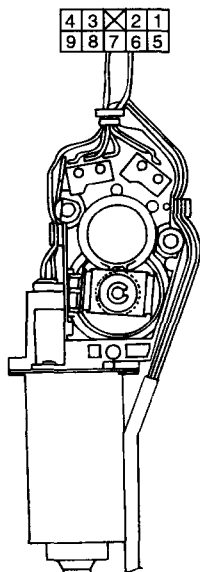
⊕ - ⊖ Indicates battery connection

ETMB260A

## SUN ROOF MOTOR

### INSPECTION ETMB2650

1. Remove the overhead console.
2. Disconnect the motor connector from sun roof harness.
3. After applying DC 12V to the terminal 8, apply the terminal 3 to the ground.
4. Check that the motor turns in the direction of the sun-roof when tilted down and is open.
5. Reverse the connections and check that the motor turns in the direction when the sunroof is closed and tilted up.



KTMB343A

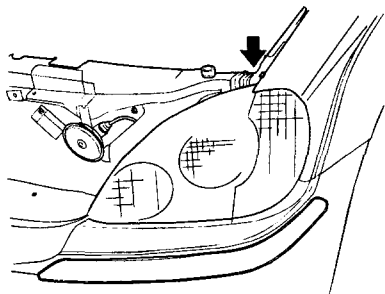


# LIGHTING SYSTEM

## REPLACEMENT OF LAMPS ETMB2700

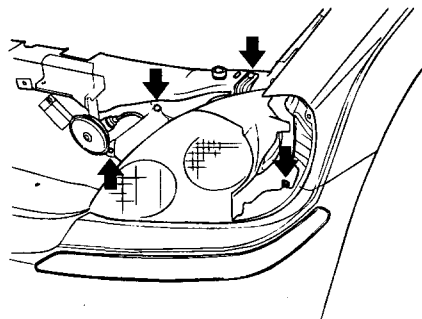
### HEAD LAMP/TURN SIGNAL LAMP

1. Disconnect the negative battery terminal.
2. Remove the turn signal lamp mounting screw(1EA) and remove the lamp assembly.



KTMB007E

3. Remove the head lamp mounting bolts(4EA). Disconnect the wire connector and remove the head lamp assembly.

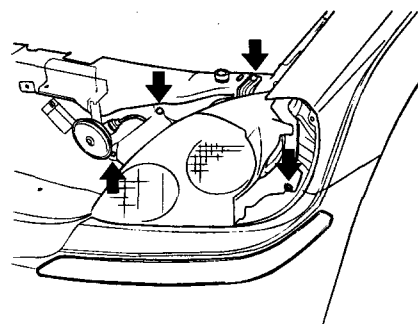


KTMB007F

4. Installation is the reverse of removal.

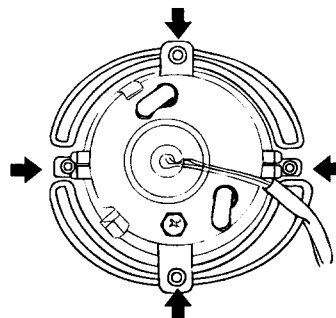
### FRONT FOG LAMP

1. Disconnect the negative battery terminal.
2. Remove the turn signal lamp and head lamp assembly.



KTMB007F

3. Remove the front bumper cover (Refer to BD group). Disconnect the wire connector and remove the front fog lamp.

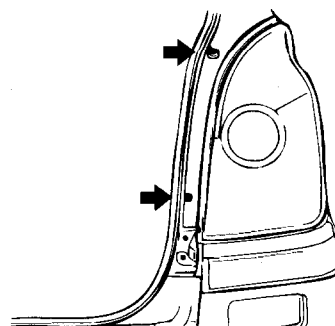


KTMB007A

4. Installation is the reverse of removal.

### REAR COMBINATION LAMP

1. Disconnect the negative battery terminal.
2. Remove the 2 bolts holding the rear combination lamp.

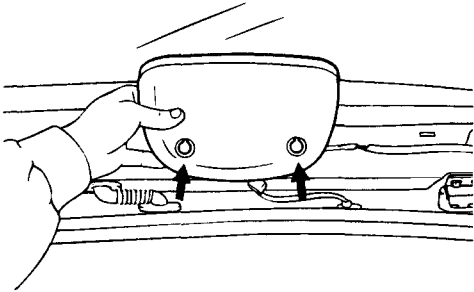


KTMB350A

3. Disconnect the connector and remove the lamp assembly.
4. Installation is the reverse of removal.

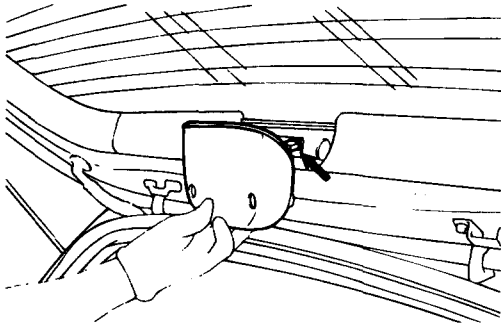
**CENTER HIGH MOUNTED STOP LAMP**

1. Disconnect the negative battery terminal.
2. Using a flat-bladed screwdriver detach 2 blanking covers on both sides of the lamp.
3. Remove the two mounting bolts.



ESJA040N

4. Disconnect the connector and then remove the lamp assembly.

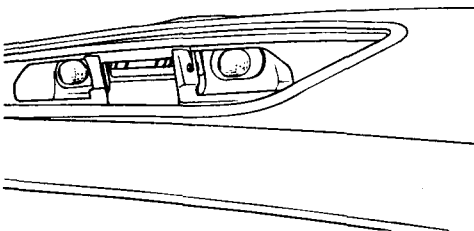


V5BE075I

5. Installation is the reverse of removal.

**LICENSE PLATE LAMP**

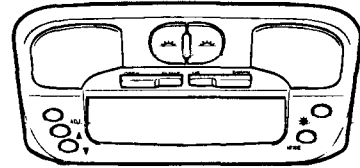
1. Disconnect the negative battery terminal.
2. Detach the lamp assembly and disconnect the lamp connector.
3. Installation is the reverse of removal.



KSMB004B

**OVERHEAD CONSOLE LAMP**

1. Disconnect the negative battery terminal.
2. Detach the lamp assembly from the headliner after removing the 2 screws.

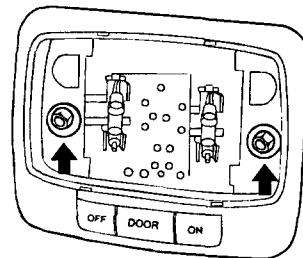


KTMB008F

3. Installation is the reverse of removal.

**ROOM LAMP**

1. Disconnect the negative battery terminal.
2. Using a flat-bladed screwdriver detach the room lamp lens.
3. Detach the lamp assembly from the headliner after removing the 2 bolts.



KTMB008G

4. Disconnect the connector from the roof harness.
5. Installation is the reverse of removal.

**LUGGAGE LAMP**

1. Using a flat-bladed screwdriver detach the luggage lamp lens.
2. Detach the lamp assembly from the headliner.

**INSPECTION OF COMPONENTS** ETMB2750

**HEAD LAMP RELAY**

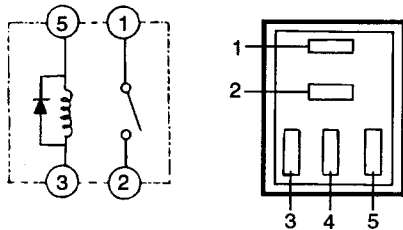
1. Remove the headlamp relay from the relay box in the engine compartment.
2. Check for continuity between terminals on the relay.

Terminal Position	1	2	3	5
When de-energized			○ — ○	
When energized	○ — ○		⊖ — ⊕	

**NOTE:**

1. ○ — ○ : Indicates that there is continuity between the terminals.
2. ⊖ — ⊕ : Indicates that power is supplied.

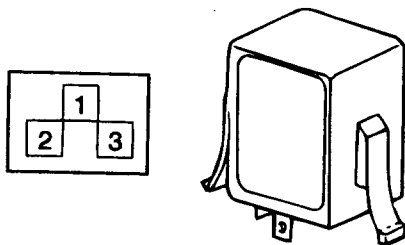
ETMB275A



KTMB385B

**FLASHER UNIT**

1. Remove the flasher unit from the relay box.
2. Connect the positive (+) lead from the battery to terminal 2 and the negative (-) lead to terminal 3.



KTDA212A

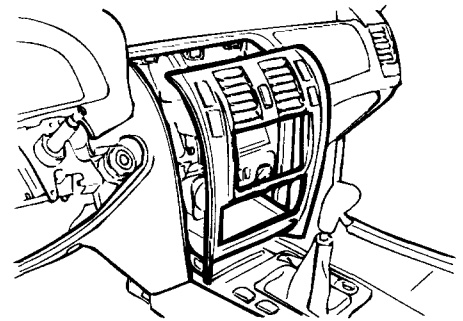
3. Connect the two turn signal lamps in parallel to terminals 2 and 3. Check that the bulbs turn on and off.

**NOTE**

The turn signal lamps should flash 60 to 120 times per minute. If one of the front or rear turn signal lamps has an open circuit, the number of flashes will be more than 120 per minute. If operation is not as specified, replace the flasher unit.

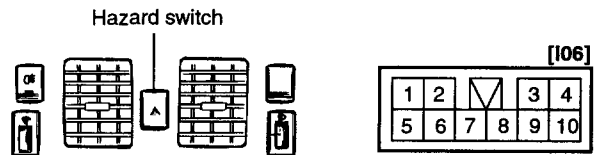
**HAZARD SWITCH**

1. Disconnect the negative (-) battery terminal.
2. Remove the center facia panel(Refer to BD group).



KSMB008L

3. Disconnect the connector from the hazard lamp switch.



KTMB008K

ETMB275B

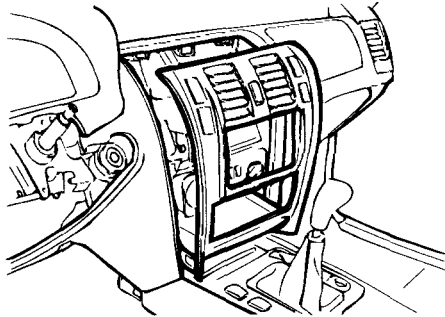
4. Operate the switch and check for continuity between terminals with an ohmmeter.

Terminal Position	2	3	5	6	7	8	9	10
OFF			○ — ○			○ — ○		
ON	○ — ○			○ — ○	○ — ○		○ — ○	

ETMB275C

**RHEOSTAT**

1. Disconnect the negative (-) battery terminal.
2. Remove the center facia panel.



KSMB008L

3. Disconnect the connector from the rheostat.

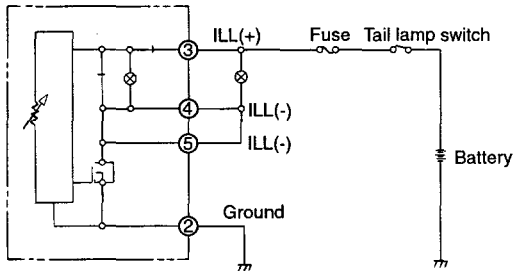


Rheostat

KTMB008K

ETMB275D

4. Check for intensity. If the light intensity of the lamps changes smoothly without any flickering when the rheostat is turned, it can be assumed that the rheostat is normal.



ETMB275E

**REAR FOG LAMP SWITCH**

1. Disconnect the negative (-) battery terminal.
2. Remove the center facia panel.
3. Disconnect the connector from the rear fog lamp switch.

Rear fog lamp switch



KTMB008K

ETJA045B

ETMB275F

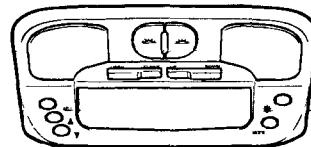
4. Operate the switch and check for continuity between the terminals with an ohmmeter.

Terminal Position	1	2	3	4	5
ON	○	○	○	○	○
OFF		○	○	○	○

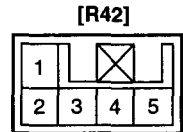
ETMB275G

**MAP LAMP**

Remove the overhead console and check for continuity between terminals.



KTMB008F



[R42]

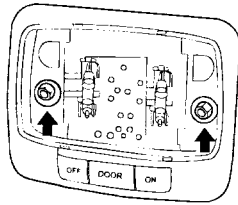
KTMB400A

Terminal Position	Map lamp switch			
	LH		RH	
	ON	OFF	ON	OFF
2	○		○	
5	○		○	

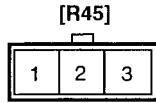
ETMB275H

ROOM LAMP

Remove the room lamp and check for continuity between terminals.



KTMB008G



KTMB401A

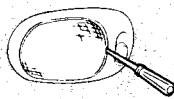
[R45]

Terminal Position	1	2	3
ON		○ — (m) — ○	
DOOR	○ —	(m) —	○
OFF			

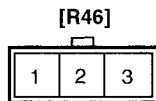
ETMB275I

TAILGATE LAMP

Remove the tailgate lamp and check for continuity between terminals.



KTMB911A



KTMB405A

[R46]

Terminal Position	1	2	3
ON	○ —	(m) —	○
DOOR		○ — (m) —	○
OFF			

ETMB275J

HEAD LAMPS

HEAD LAMP AIMING INSTRUCTIONS

ETMB2800

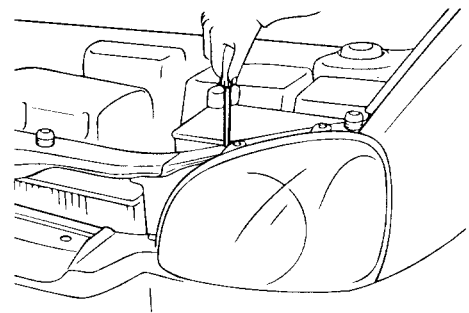
The headlamps should be aimed with the proper beam-setting equipment, and in accordance with the equipment manufacturer's instructions.

**NOTE**

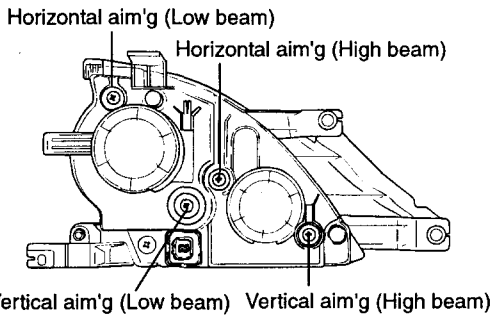
*If there are any regulations pertinent to the aiming of headlamps in the area where the vehicle is to be used, adjust so as to meet those requirements.*

Alternately turn the adjusting gear to adjust the headlamp aiming. If beam-setting equipment is not available, proceed as follows:

1. Inflate the tires to the specified pressure and remove any loads from the vehicle except the driver, spare tire, and tools.
2. The vehicle should be placed on a flat floor.
3. Draw vertical lines (Vertical lines passing through respective headlamp centers) and a horizontal line (Horizontal line passing through center of headlamps) on the screen.
4. With the headlamp and battery in normal condition, aim the headlamps so the brightest portion falls on the horizontal and vertical lines. Make vertical and horizontal adjustments to the lower beam using the adjusting wheel.

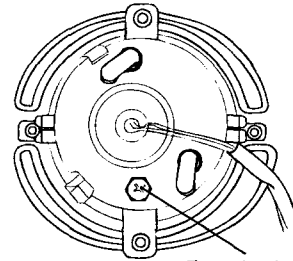


ETJA010F



ETMB280B

With the front fog lamps and battery normal condition, aim the front fog lamps by turning the adjusting gear.

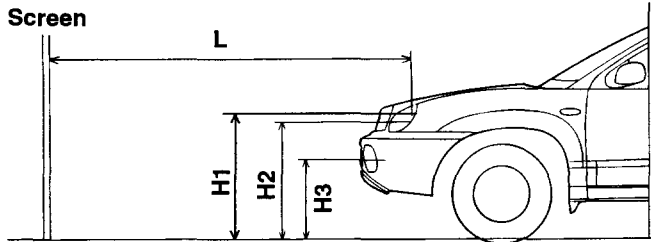


Front fog lamp aim'g screw

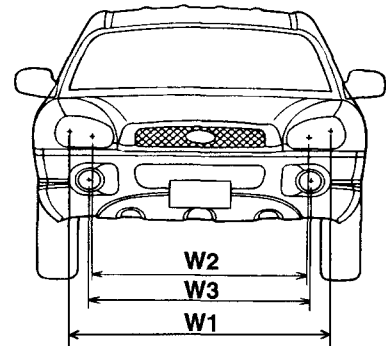
ETMB280A

**FRONT FOG LAMP**

The front fog lamps should be aimed as the same manner of the head lamps aiming.



KTMB117C



KTMB117D

- H1 : Height between the head lamp bulb center and ground (low beam)
- H2 : Height between the head lamp bulb center and ground (high beam)
- H3 : Height between the fog lamp bulb center and ground

- W1 : Distance between the head lamp bulb center (low beam)
- W2 : Distance between the head lamp bulb center (high beam)
- W3 : Distance between the fog lamp bulb center

L : Distance between the head lamp bulb center and screen.

ETMB280C

**HEAD LAMP AND FOG LAMP AIMING POINT**

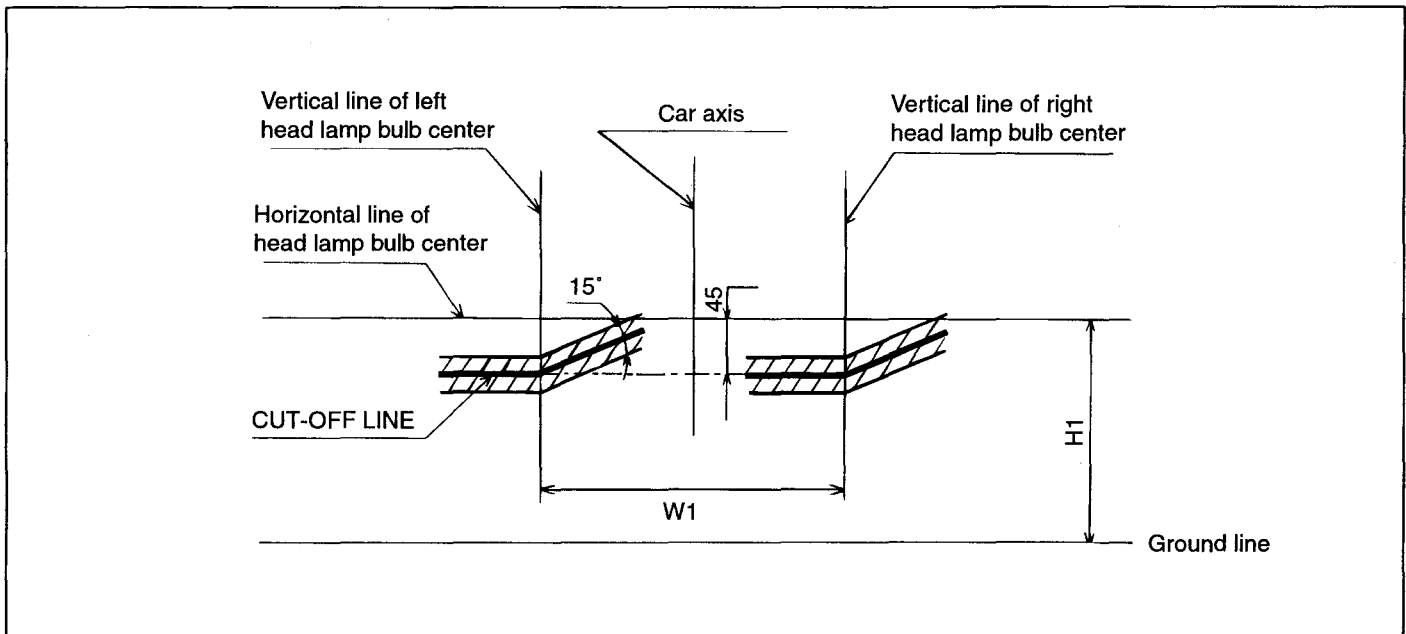
Unit : mm

Vehicle condition	H1	H2	H3	W1	W2	W3	L
Without driver	908	853	559	1,316	1,076	1,254	3,000
With driver	894	839	545				

ETMB280D

1. Turn the low beam on without the driver aboard.  
The cut-off line should be projected in the allowable range (shaded region).

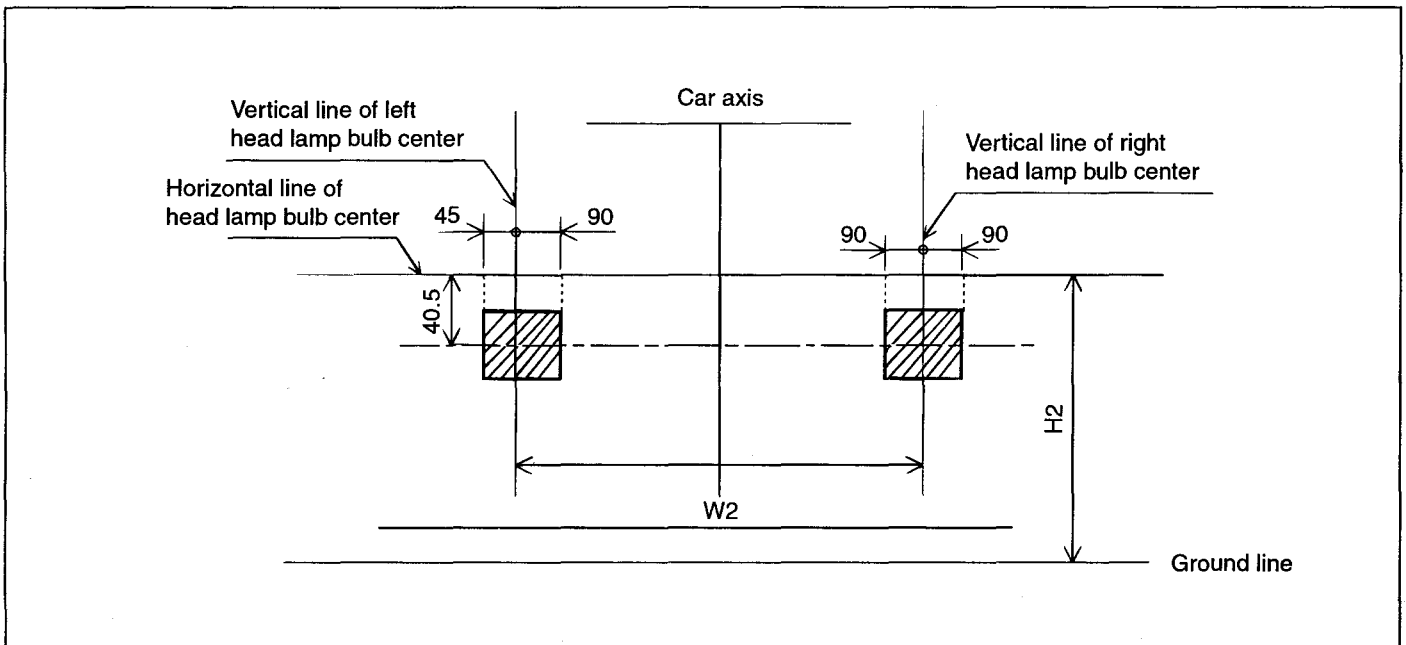
Unit : mm



ETMB280E

2. Turn the high beam on without the driver aboard.  
The cut-off line should be projected in the allowable range (shaded region).

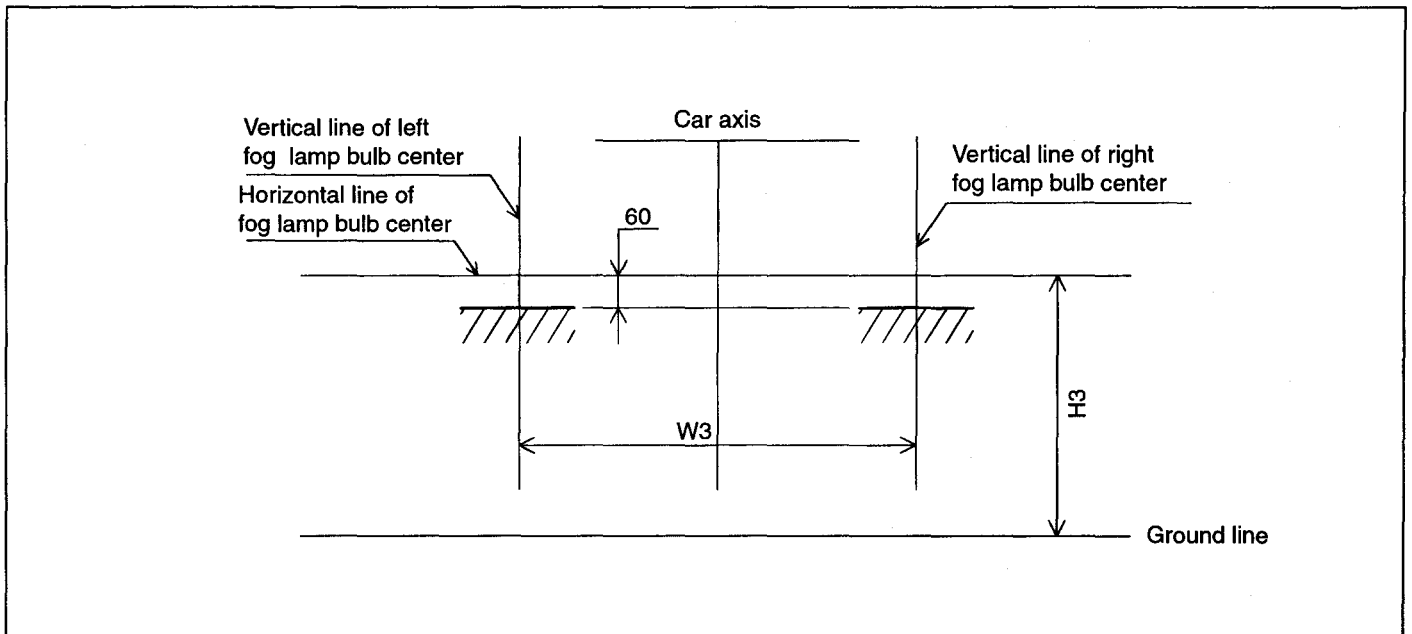
Unit : mm



ETMB280F

- Turn the front fog lamp on without the driver aboard.  
The cut-off line should be projected in the allowable range (shaded region).

Unit : mm

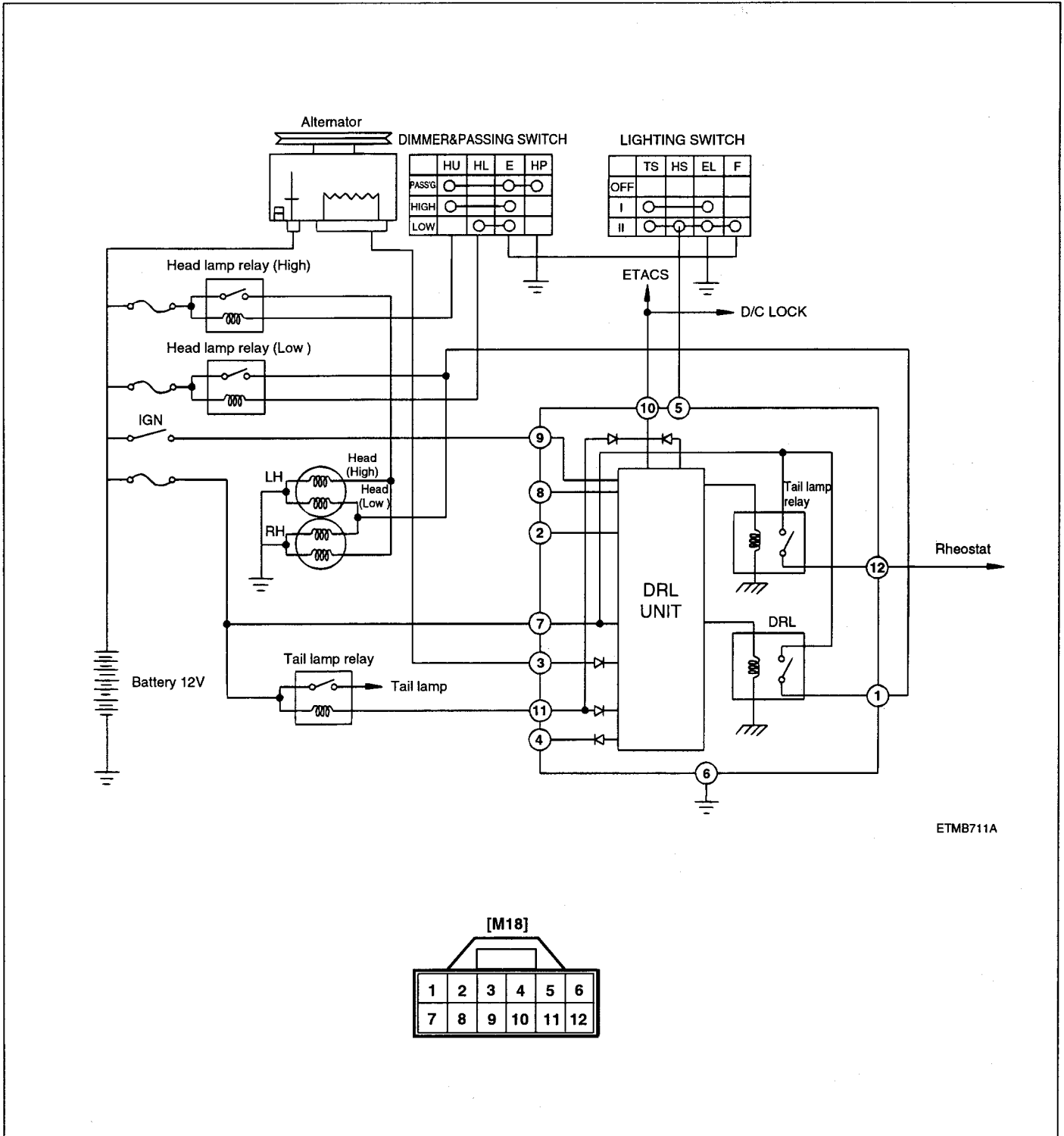


ETMB280G



DAYTIME RUNNING LIGHTS

CIRCUIT DIAGRAM ETMB2850

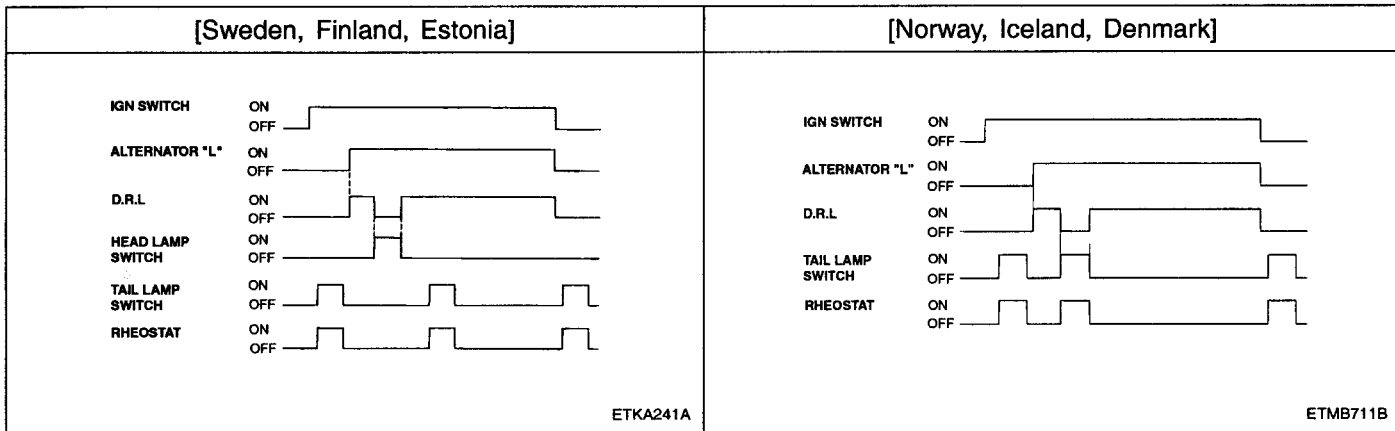


ETMB711A

**INSPECTION** ETMB2900

**OPERATION CHECK**

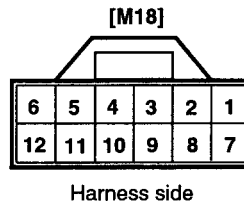
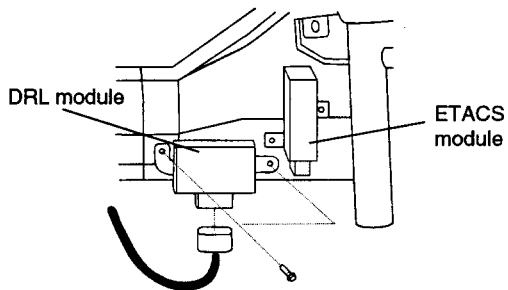
Check that the lights operate according to the following timing chart.



**INSPECT CIRCUITS FOR DAYTIME RUNNING LIGHT SYSTEM**

1. Remove the driver side lower crash pad panel and disconnect the wire connector to DRL module.

2. Inspect the connector on wire harness side as shown.



ETMB290A

ETMB711F

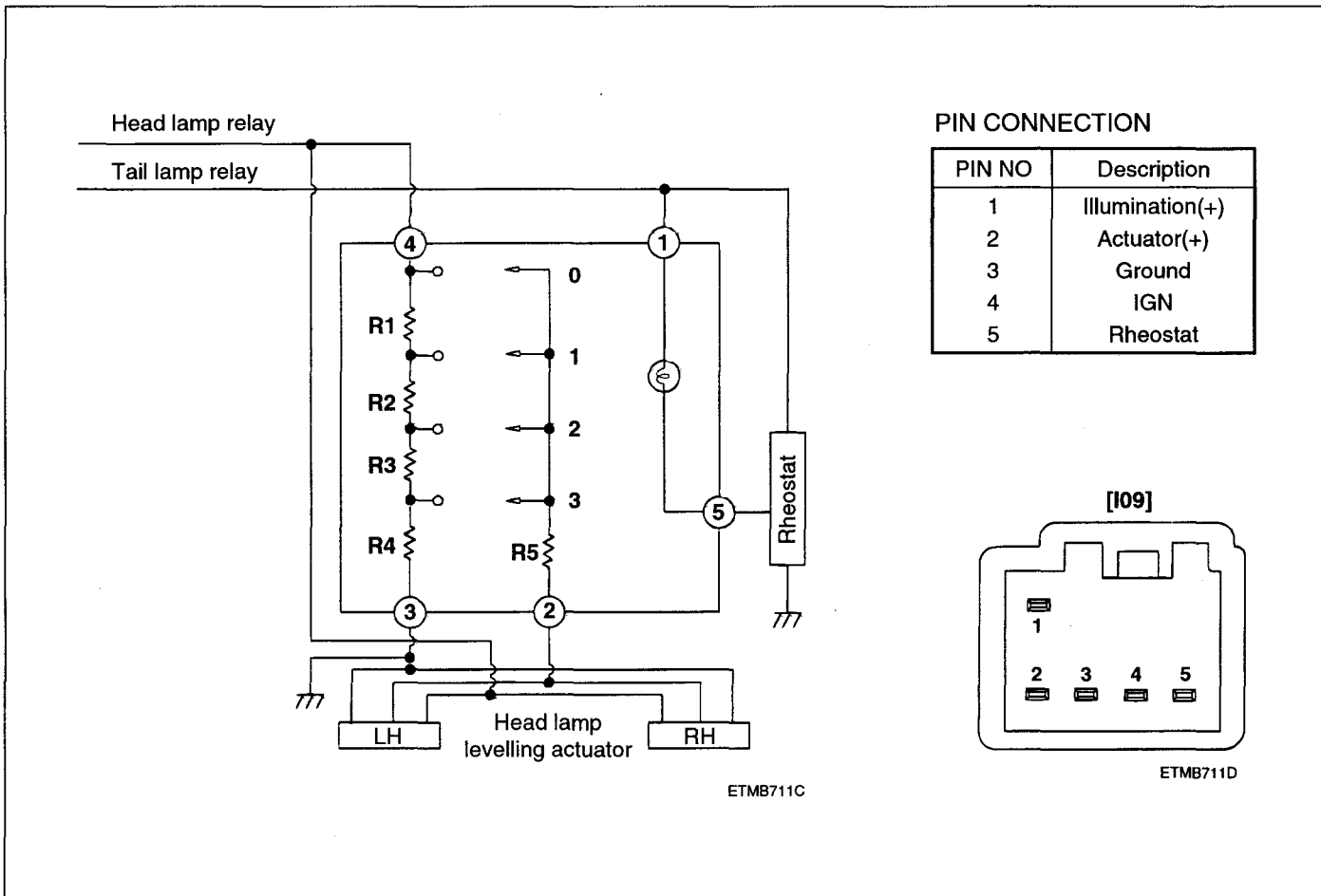
Check For	Test Connection	Condition	Test Specification	
Continuity	10-Ground	Tail lamp switch	OFF	No continuity
			ON	Continuity
	5-Ground	Head lamp switch	OFF	No continuity
ON			Continuity	
	6-Ground	Constant	Continuity	
Voltage	7-Ground	Constant	Battery voltage	
	9-Ground	Ignition switch	ON	Battery voltage
			ACC or LOCK	No voltage
	11-Ground	Constant	Battery voltage	
3-Ground	Engine	Stop	No voltage	
		Running	Battery voltage	

If circuit is not as specified, refer to schematic diagram and inspect short or circuits.

# HEAD LAMP LEVELLING DEVICE

## HEAD LAMP LEVELLING SWITCH

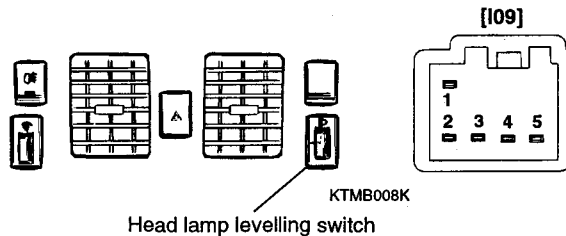
### CIRCUIT DIAGRAM ETMB2950



ETMB295A

### INSPECTION ETMB3000

1. Disconnect the switch from harness side, center facia panel.



ETMB300A

2. Connect the battery voltage between terminals 3 and 4(Reference voltage =  $V_B$ ).
3. Measure the voltage between terminals 2 and 3(V).

4. Check the percent ratio( $V/V_B \times 100\%$ ) between voltages  $V_B$  and  $V$  at each position.

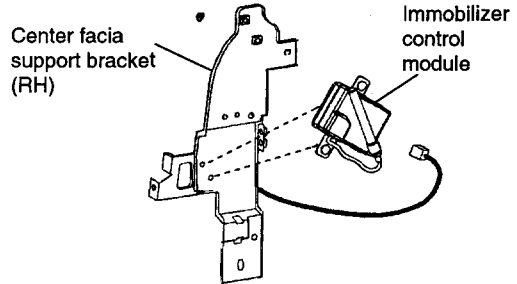
Position No.	Rotation	Ratio( $\pm 5\%$ )	Voltage(V)
0	0°	99.52%	11.94 $\pm$ 0.5V
1	20°	82.67%	9.92 $\pm$ 0.5V
2	40°	68.58%	8.23 $\pm$ 0.5V
3	60°	58.33%	7.00 $\pm$ 0.5V

5. If the voltage is not as specified, replace the head lamp levelling switch.

# IMMOBILIZER CONTROL SYSTEM

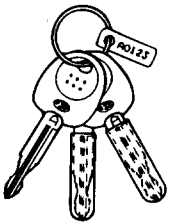
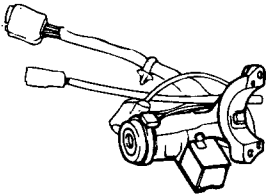
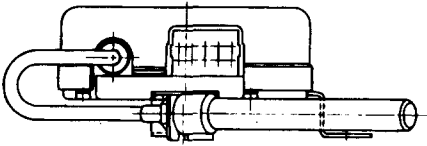
## DESCRIPTION ETMB3050

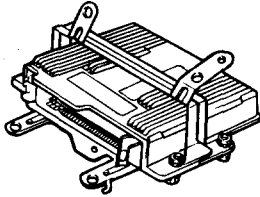
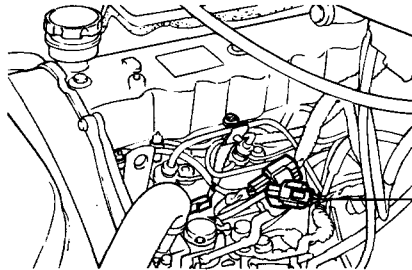
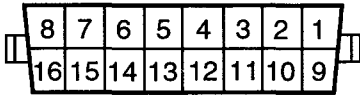

The immobilizer system is an anti-theft device which enables starting to be possible only when the mechanical and wireless secret codes are aligned simultaneously. The transponder built in the ignition key signals its unique frequency code and at this time the ICM compares it with the memorized code. When the codes are aligned, the ICM sends signals to the ECM so that starting is possible.  
 ICM : Immobilizer Control Module  
 ECM : Engine Control Module



ETMB305A

## SYSTEM COMPONENTS ETMB3100

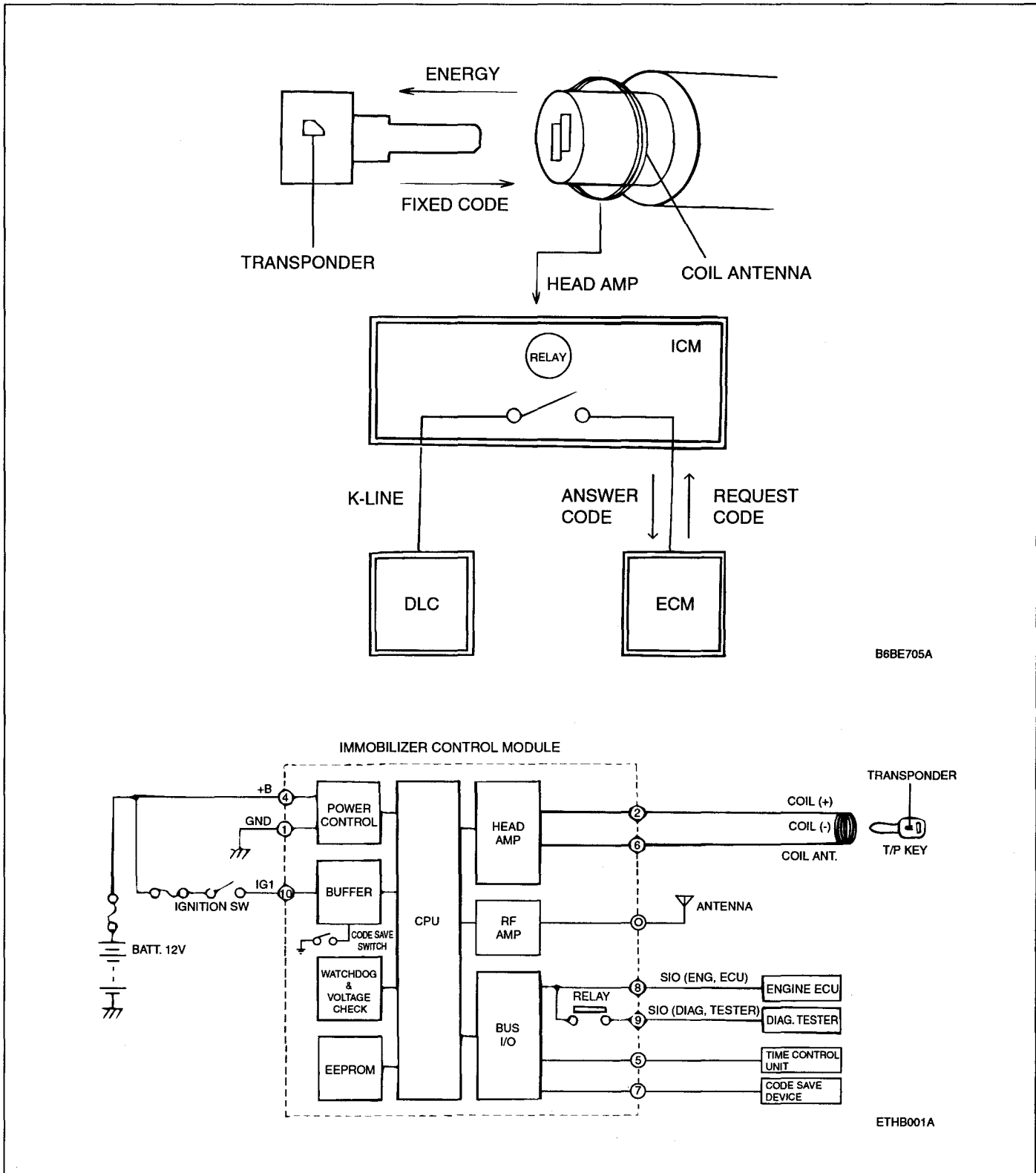
COMPONENT		DESCRIPTION
KEYS	ID KEY	Must be used first to register unique ID code in the ICM. This ID code is then recorded into the master keys.
 <p>TH600043</p>	MASTER KEY	Once the ID code is recorded into the MASTER KEY, this key is for general use.
	TRANSPONDER (built-in-keys)	When ignition is ON, the coil supplies energy to the transponder, which in turn accumulates energy in the condenser. Once the energy supplied from the coil has stopped, using the stored energy in the condenser, the transponder transmits the ID code.
COIL ANTENNA		Supplies energy to the transponder. Receives signal from the transponder. Sends transponder signal to the ICM.
 <p>B6BE225C</p>		
IMMOBILIZER CONTROL MODULE		Supplies power to the coil antenna. Receives and analyses signal from the coil antenna. Transmits signal to ECM. Stores VIN which is composed of ID code and password.
 <p>ETHB001E</p>		

COMPONENT	DESCRIPTION
<p data-bbox="136 196 635 227">ENGINE CONTROL MODULE (COVEC-F)</p>  <p data-bbox="589 476 665 497">B6BE710E</p>	<p data-bbox="687 238 1421 300">In the ignition ON position, the ECM receives information from the ICM and permits injection to take place.</p>
<p data-bbox="219 518 551 549">FCVC (EXCEPT COVEC-F)</p>  <p data-bbox="582 756 642 777">FCVC</p> <p data-bbox="589 859 665 880">H8CL004A</p>	<p data-bbox="687 559 1323 652">In the ignition ON position, the FCVC (Fuel cut valve controller) receives information from the ICM and permits injection to take place.</p>
<p data-bbox="234 901 536 932">DATA LINK CONNECTOR</p>  <p data-bbox="589 1181 665 1201">B6BE710F</p>	<p data-bbox="687 942 1383 1004">By connecting the voltmeter or Hi-scan, the control module diagnostic code can be read.</p>
<p data-bbox="249 1222 521 1253">DIAGNOSTIC TESTER</p>  <p data-bbox="589 1502 665 1522">ETHB001T</p>	<p data-bbox="687 1263 1428 1295">Has the function of ICM, ECM, and keys diagnosis and change.</p>

# IMMOBILIZER CONTROL MODULE

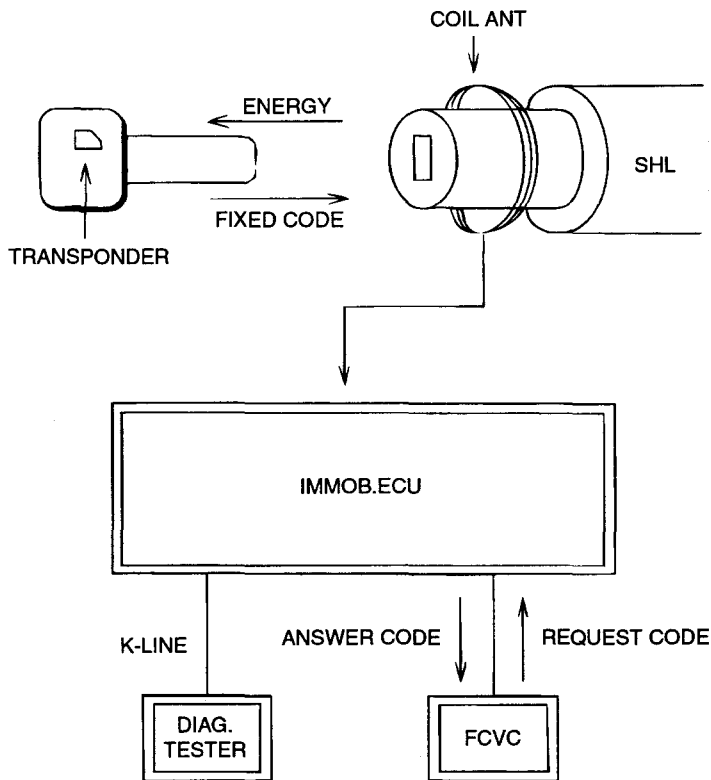
## SYSTEM BLOCK DIAGRAM ETMB3150

### 1. COVEC-F (WITH ECM)

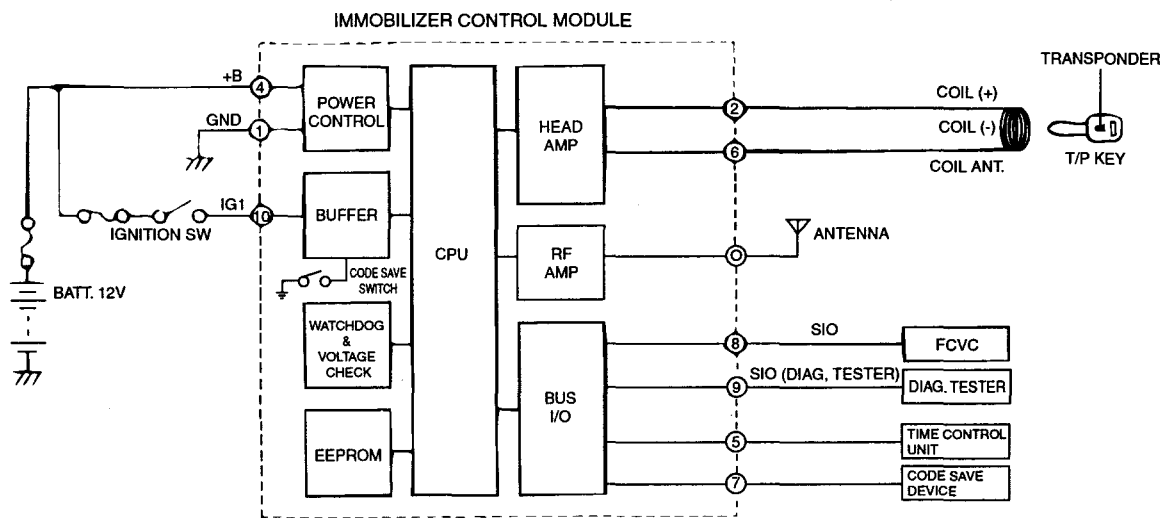




2. EXCEPT COVEC-F (WITHOUT ECM)

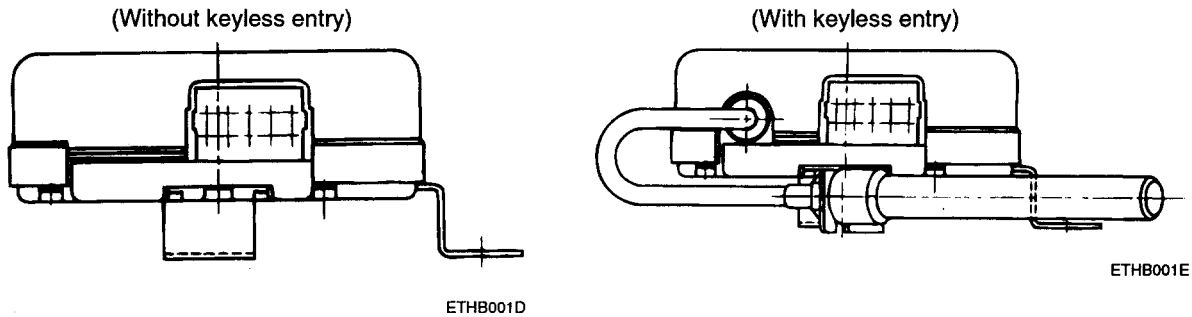


H7BE080B

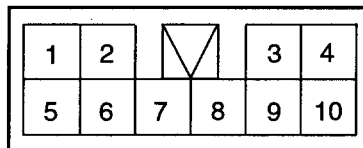


ETHB001B

3. PIN CONNECTION



[M55]



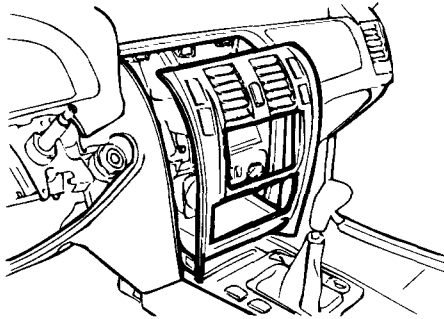
ETHB001F

PIN CONNECTION

Terminal	Type	EXCEPT COVEC-F (WITHOUT ECM)		COVEC-F (WITH ECM)	
		WITHOUT KEYLESS ENTRY	WITH KEYLESS ENTRY	WITHOUT KEYLESS ENTRY	WITH KEYLESS ENTRY
1		Ground	Ground	Ground	Ground
2		Coil antenna (+)	Coil antenna (+)	Coil antenna (+)	Coil antenna (+)
3		-	-	-	-
4		Battery (+)	Battery (+)	Battery (+)	Battery (+)
5		-	Time control code	-	Time control code
6		Coil antenna (-)	Coil antenna (-)	Coil antenna (-)	Coil antenna (-)
7		-	Time control save	-	Time control save
8		SIO (FCVC)	SIO (FCVC)	SIO (ECM)	SIO (ECM)
9		SIO (DIAG. Tester)	SIO (DIAG. Tester)	SIO (DIAG. Tester)	SIO (DIAG. Tester)
10		IGN. 1	IGN. 1	IGN. 1	IGN. 1

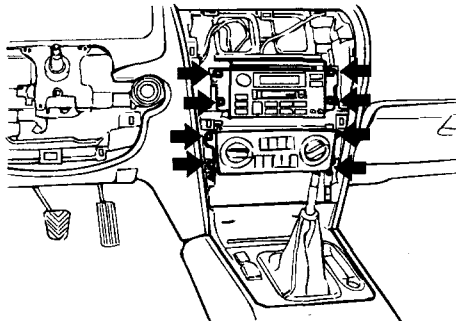
**REMOVAL** ETMB3200

1. Remove the center facia panel using a screwdriver and disconnect the switch connectors.



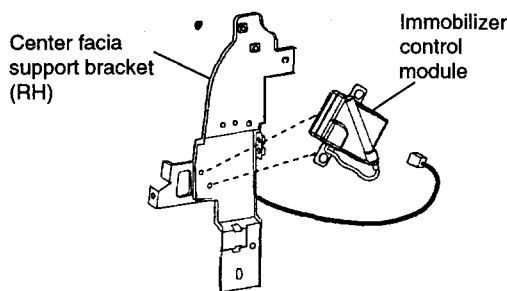
KSMB008L

2. Remove the audio unit.



KSMB008M

3. Remove the flange nuts(2EA) holding the ICM(Immobilizer Control Module) from right hand center facia support bracket.



ETMB305A

**PASSWORD SETTING** ETMB3250

Password can be used to register the master keys when you lost the ID key by using a tester (such as Hi-scan).

1. INITIAL PASSWORD

The initial password for ICM has been set by the manufacturer as 2345.

Key can be registered and corrected by using the initial password until a new password is registered.

2. PASSWORD REGISTRATION AND CHANGE

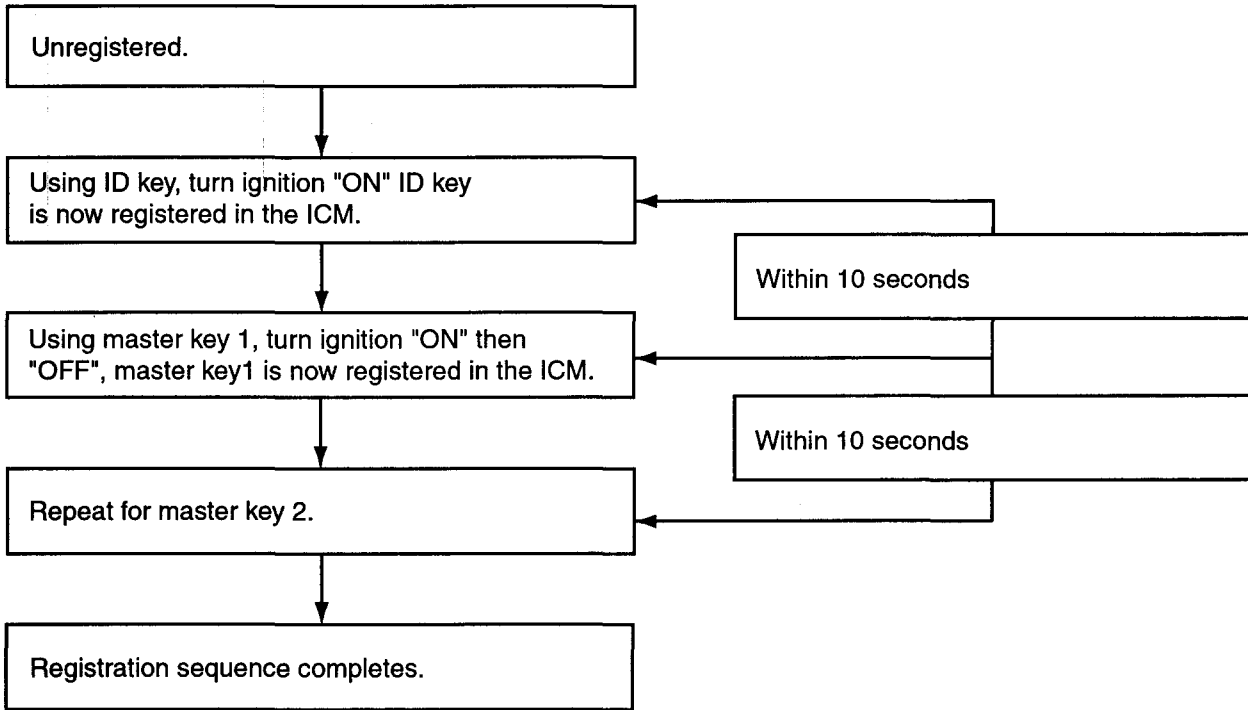
Using a tester(Hi-scan), the initial password(preset as 2345 all) can be replaced by a new password nominated by the owner.

4 numbers among 0-9 can be registered as password. Once the password has been changed from 2345, the ICM is ready to record the ID code.

# KEYS REGISTRATION AND CORRECTION

ETMB3300

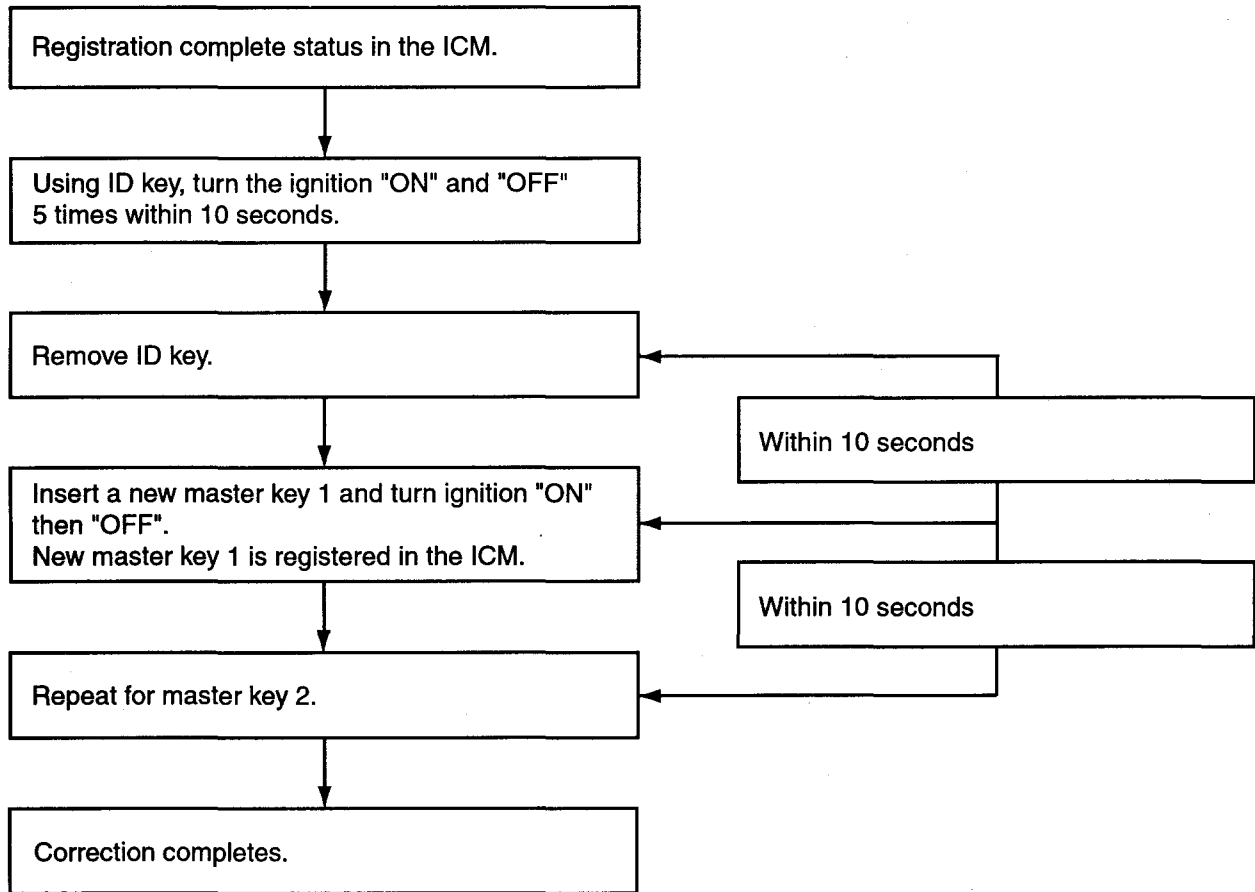
## 1. INITIAL REGISTRATION METHOD



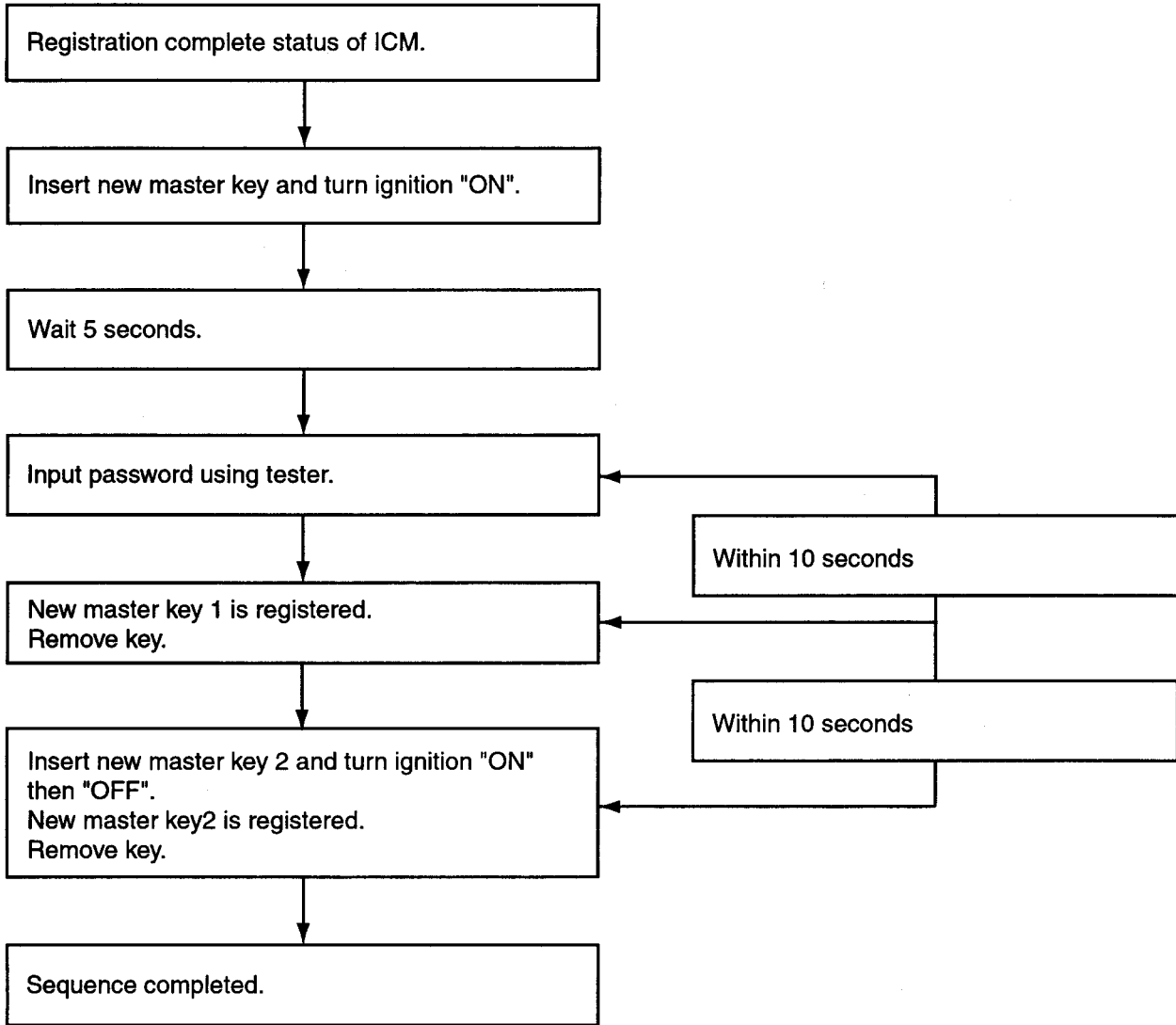
2. REGISTRATION CORRECTION FOR MASTER KEYS

1) Using ID key

In cases when the master key is lost or where a new set of master keys need to be produced, it can be achieved using two methods.



- 2) Using password  
 When the customers lost the ID key, new master keys can be registered by using Hi-scan only.  
 ID key can not be corrected and reproduced.



ETMB330C

 **NOTE**

Once the password is mis-registered, it is impossible to register new password during 10 seconds regardless of ignition ON/OFF.  
 When the new master keys have been registered, the codes for existing master keys are all cleared.  
 The password should consist of 4 numbers among ten (0-9) numbers.

**DIAGNOSIS OF IMMOBILIZER RELATED  
FAULTS** ETMB3350

Type	Immobilizer related faults	Possible cause
COVEC-F (WITH ECM)	Transponder communication error	- Invalid transponder data
	ECM communication link error	- Invalid request from ECM or corrupted data
	ETACS RF communication error (with ETACS)	- Keyless code is not received normally - Code saver receives a code except door lock or unlock data
	ETACS C/S communication error (with ETACS)	- Invalid memorized data from code save device (Start Format, Stop Format, ID Format)
	EEPROM communication error	- Inconsistent data of EEPROM - Invalid write operation to EEPROM
	ECM request signal error	- There is no request code from ECM for 5 sec after ignition on
EXCEPT COVCE-F (WITHOUT ECM)	Transponder communication error	- Invalid transponder data
	FCVC (Fuel Cut Valve Controller) request signal error	- There is no request code from FCVC for 5 sec after ignition on
	ETACS RF communication error (with ETACS)	- Keyless code is not received normally - Code saver receives a code except door lock or unlock data
	ETACS C/S communication error (with ETACS)	- Invalid memorized data from code save device (Start Format, Stop Format, ID Format)
	EEPROM communication error	- Inconsistent data of EEPROM - Invalid write operation to EEPROM

# Body (Interior & Exterior)

<b>GENERAL .....</b>	<b>BD - 2</b>
<b>EXTERIOR .....</b>	<b>BD - 6</b>
<b>INTERIOR .....</b>	<b>BD -31</b>
<b>BUMPER .....</b>	<b>BD -49</b>
<b>SEAT .....</b>	<b>BD -54</b>



# GENERAL



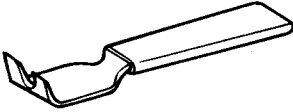
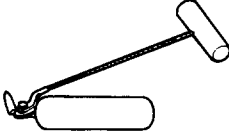
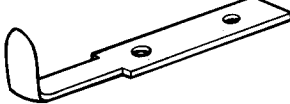
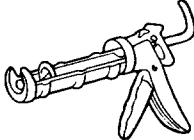

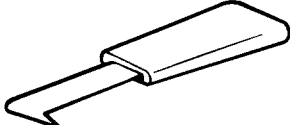
## SPECIFICATIONS ESMB0010

<b>Hood</b> Type	Rear hinged, front opening type, gas lifter type
<b>Front door</b> Construction Regulator system Locking system	Front hinged, full door construction Wire drum type Pin-fork system
<b>Rear door</b> Construction Regulator system Locking system	Front hinged, full door construction Wire drum type Pin-fork system
<b>Tailgate</b> Type	Inner hinged, gas lifter type
<b>Glass thickness</b> mm (in) Windshield glass Front door glass Rear door glass Rear fixed glass Tailgate glass	5 (0.20) 3.2 (0.13) 3.2 (0.13) 3.2 (0.13) 3.2 (0.13)
<b>Seat belt</b>	E.L.R (Emergency Locking Retractor)

## TIGHTENING TORQUE ESMB0050

	Nm	kg-cm	lb-ft
<b>Front and rear doors</b>			
Door hinge to body	21-33	210-330	15.5-24.3
Door hinge to door	17-26	170-260	12.5-19.2
<b>Tailgate</b>			
Tailgate hinge to body	11-16	110-160	8.1-11.8
Tailgate hinge to tailgate	11-16	110-160	8.1-11.8
Gas lifter to body	11-16	110-160	8.1-11.8
Gas lifter to tailgate	11-16	110-160	8.1-11.8
<b>Hood</b>			
Hood hinge to body	9-14	90-140	6.6-10.3
Hood hinge to hood	9-14	90-140	6.6-10.3
Hood latch to body	7-11	70-110	5.2-8.1
Gas lifter mounting bolts	7-11	70-110	5.2-8.1
<b>Seat belt</b>			
Front seat belt upper anchor	35-55	350-550	25.8-40.6
Front seat belt retractor	35-55	350-550	25.8-40.6
Height adjuster	35-55	350-550	25.8-40.6
Second and third seat belt upper anchor	35-55	350-550	25.8-40.6
Second and third seat belt lower anchor	35-55	350-550	25.8-40.6
Second and third seat belt retractor	35-55	350-550	25.8-40.6
<b>Seat</b>			
Front seat mounting bolts	35-55	350-550	25.8-40.6
Rear seat mounting bolts	35-55	350-550	25.8-40.6

## SPECIAL TOOLS ESHA0100

Tool (Number and name)	Illustration	Use
09793-21000 Door hinge adjusting wrench	 <p style="text-align: right;">ESA9010F</p>	Adjustment, removal, and installation of the door hinge
09800-21000 Ornament remover	 <p style="text-align: right;">ESA9010G</p>	Trim removal
09853-31000 Headliner clip remover	 <p style="text-align: right;">ESA9010H</p>	Removal of the headliner clip
09861-31100 Sealant cut-out tool	 <p style="text-align: right;">ESA9010I</p>	Cutting the sealant of the windshield (use with 09861-31200)
09861-31200 Sealant cutting blade	 <p style="text-align: right;">ESA9010J</p>	Cutting the sealant of the windshield (use with 09861-31100)
09861-31300 Sealant gun	 <p style="text-align: right;">ESA9010K</p>	Application of the sealant to the windshield
09861-31400 Glass holder	 <p style="text-align: right;">ESA9010L</p>	Removal and installation of the windshield
09861-31000 Windshield moulding remover	 <p style="text-align: right;">ESA9010M</p>	Removal of the windshield moulding

## TROUBLESHOOTING

ESHA0150

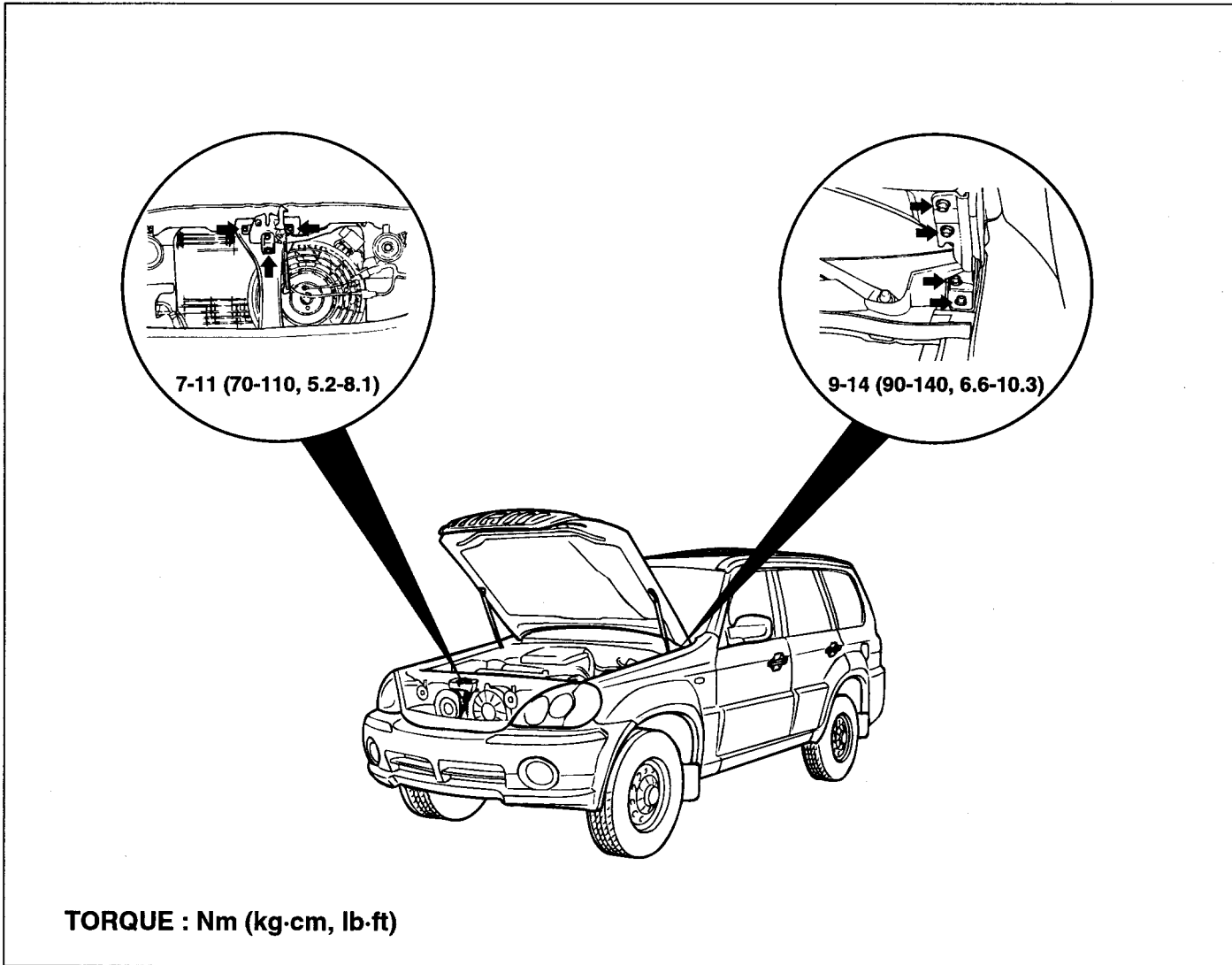
Trouble symptom	Probable cause	Remedy
Water leaks from sunroof	Dirt accumulated in drain tube	Clear dirt inside of drain
	Clogged drain tube	Blow air into drain to remove dirt
	Broken or dislocated drain tube, defective or cracked clip	Check tube installation and flange contact
	Deteriorated roof lid weatherstrip	Replace
	Excessive roof lid-to-body clearance and improperly fitted weatherstrip	Adjust
Wind noise around sunroof	Loose or deformed deflector, gaps in body work	Retighten adjust or replace
Sunroof makes a noise when moved	Foreign particles lodged in guide rail	Check drive cable and guide rails for foreign particles
	Loose guide rails and lid	Retighten
Motor runs but sunroof does not move or moves only halfway	Foreign particles lodged in guide rail	Check drive cable and guide rails for foreign particles
	Incorrect engagement of motor pinion with drive cable	Check for loose motor installation and damaged pinion
	Decrease in motor's clutch slipping force	Adjust
	Increased sunroof sliding resistance or interference of sunroof with drive cables, weatherstrip, etc. due to maladjustment of sunroof	Adjust or replace
Noise in motor (clutch slipping noise from motor when sunroof is fully opened or closed is not an unusual noise.)	Incorrect engagement of motor pinion with drive cable	Check pinion installation and retighten motor
	Worn out or damaged motor pinion bearing	Replace motor assembly
	Worn out or deformed drive cable	Replace
Door glass fails to operate up and down	Incorrect window glass installation	Adjust position
	Damaged or faulty regulator arm or regulator	Correct or replace
Door does not open or close completely	Incorrect door installation	Adjust position
	Defective door check assembly	Correct or replace
	Door hinge requires grease	Apply grease
Hood does not open or close completely	Striker and latch not properly aligned	Adjust
	Incorrectly installed hood	Adjust
	Incorrect hood bumper height	Adjust
Water leak through windshield and rear window	Defective seal	Fill with sealant
	Defective flange	Correct

Trouble symptom	Probable cause	Remedy
Wind noise around door	Weatherstrip not holding firmly	Adjust fit of door
	Improperly installed weatherstrip	Repair or replace
	Improperly closed door	Adjust
	Improperly fit door	Adjust
	Improper clearance between door glass and division channel	Adjust
	Deformed door	Repair or replace

# EXTERIOR

## HOOD

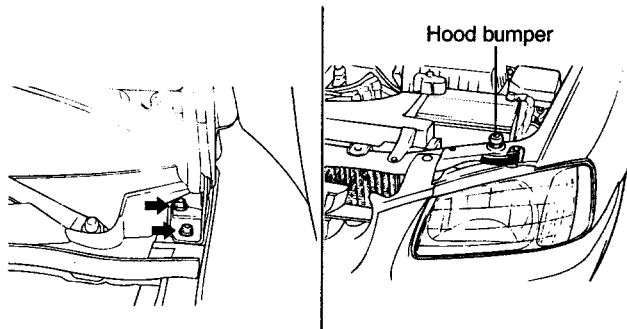
### COMPONENTS ESMB0100



ESMB010A

### HOOD ALIGNMENT ADJUSTMENT ESMB0150

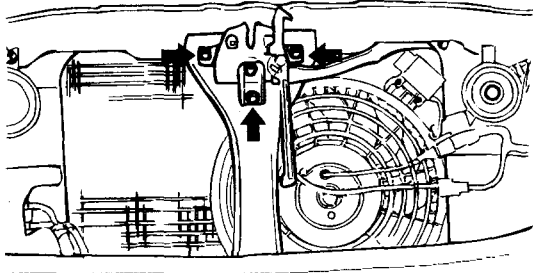
1. Adjust the longitudinal and lateral positions of the hood by utilizing the holes in the hinge.
2. Turn the hood bumpers either clockwise or counter-clockwise to adjust the height of the hood.



ESMB015A

3. Loosen the bolts holding the hood latch.

4. Adjust the alignment of the hood striker and the hood latch by adjusting the horizontal and vertical position of the latch and the height of the hood.

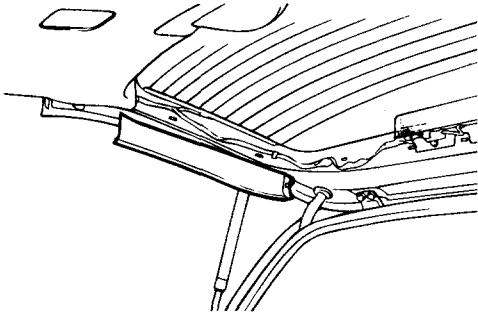


KSMB012B

## TAILGATE

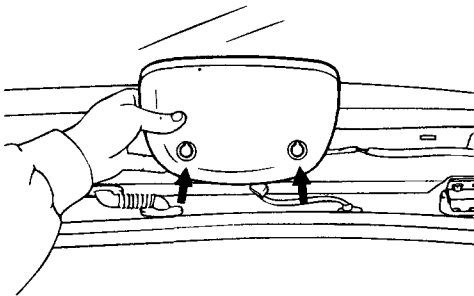
### REMOVAL AND INSTALLATION ESMB0200

1. Remove the side trim from the tailgate frame.



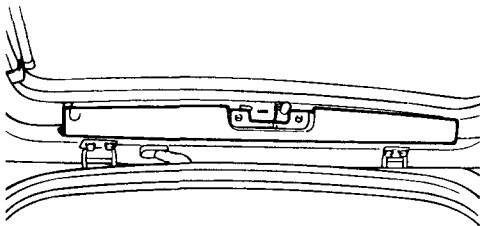
ESHA010B

2. Remove the high mounted stop lamp after removing the mounting bolts (2EA).



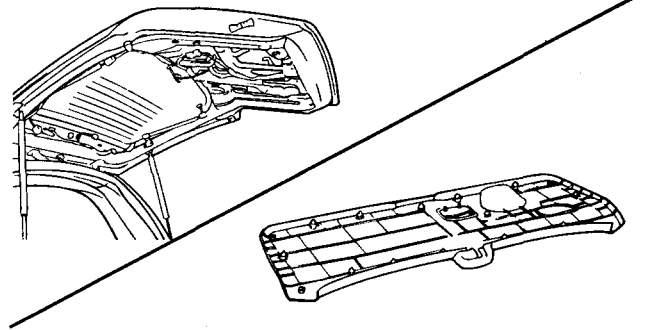
ESJA040N

3. Remove the upper trim from the tailgate frame.



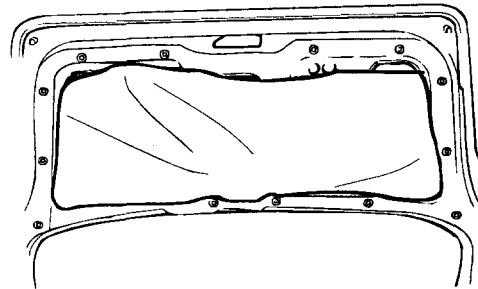
ESJA040A

4. Remove the tapping screw and the trim grip and then the tailgate trim panel.



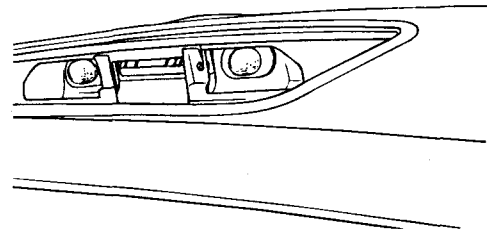
ESJA100D

5. Remove the tailgate trim seal.



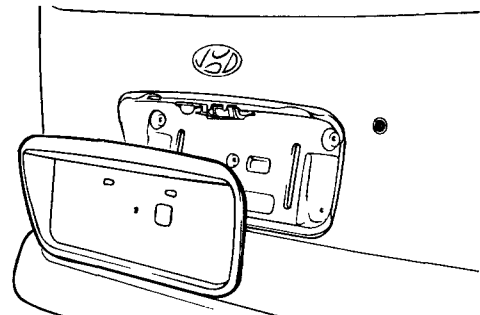
KSMB004A

6. Remove the license lamp.



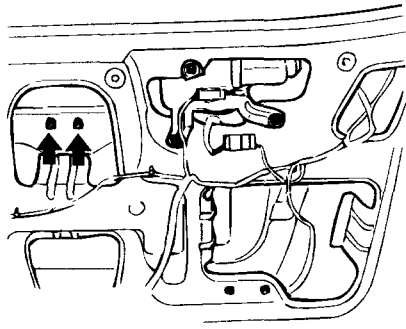
KSMB004B

7. Remove the back panel molding after removing the mounting nuts (5EA).



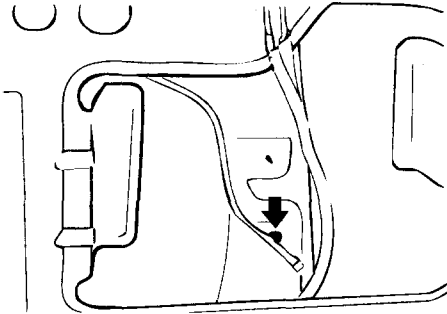
KSMB004C

8. Remove the tailgate outside handle after removing the mounting nuts (2EA), and then disconnect the rod.



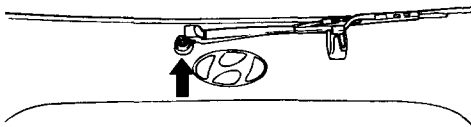
KSMB801A

9. Remove the key cylinder after removing the mounting bolt and then disconnect the rod.



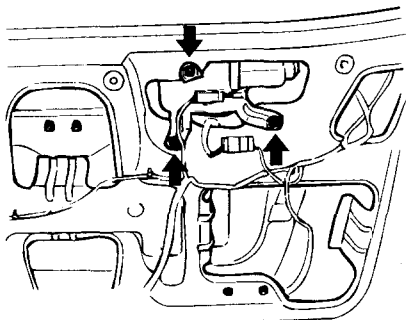
KSMB004E

10. Remove the rear wiper motor after removing the mounting nut.



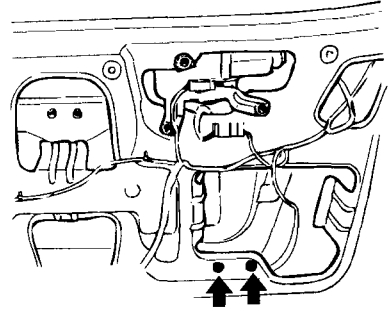
ESJA040H

11. Remove the rear wiper motor after removing the mounting bolts (3EA), and then disconnect the wire connectors.



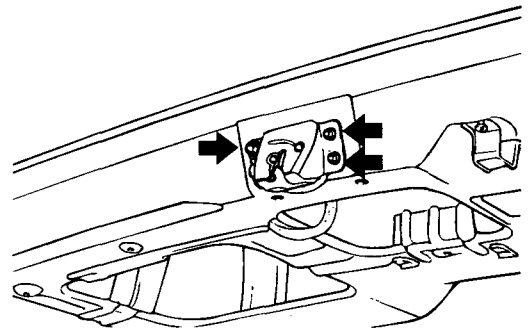
KSMB004D

12. Remove the tailgate actuator after removing the mounting bolts (2EA) and then disconnect the wire connectors and rod.

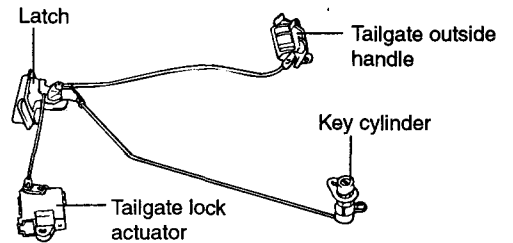


KSMB004F

13. Remove the tailgate latch after removing the mounting screws (3EA).

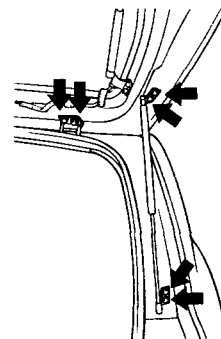


KSMB004G



ESMB020A

14. Remove the tailgate lifter and hinge mounting bolts.



KSMB025A



**Tightening torque**

Tailgate hinge mounting bolts :

11-16 Nm (110 - 160 kg·cm, 8.1-11.8 lb·ft)

Tailgate lifter mounting bolts :

11-16 Nm (110 - 160 kg·cm, 8.1-11.8 lb·ft)

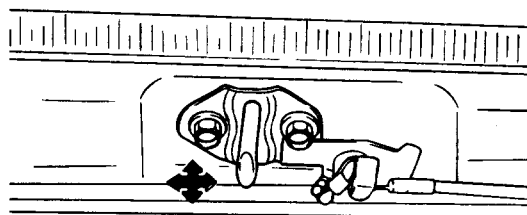
15. Remove the tailgate.

16. Installation is the reverse of removal.

**ADJUSTMENT**

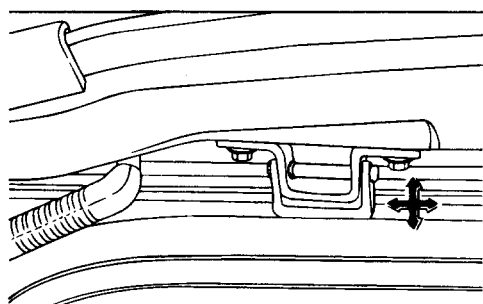
ESMB0250

1. Adjust the striker up or down, and right or left until the tailgate is flush with the rear edge of the body.



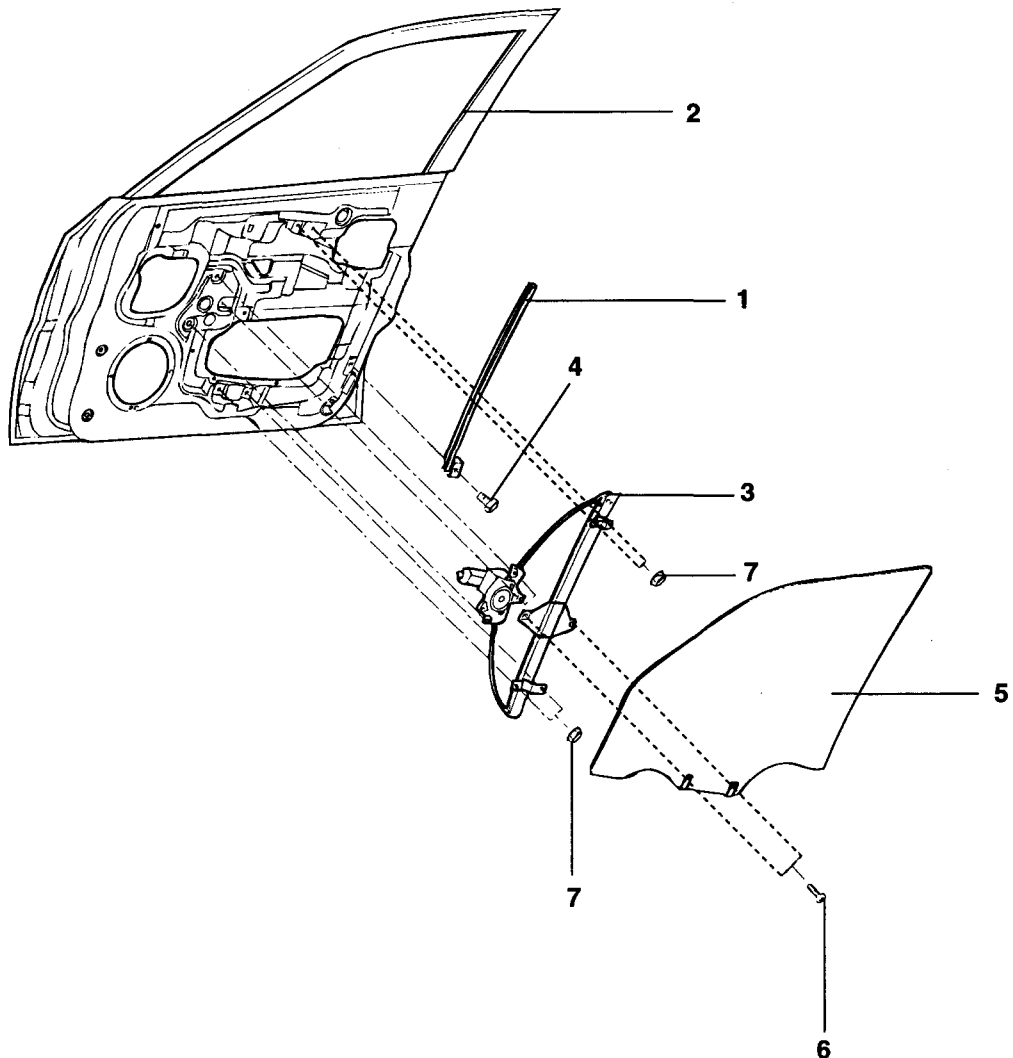
KSMB030A

2. Adjust the tailgate hinges up or down, and right or left as necessary to equalize the gap between the tailgate and body.



KSMB030B

## FRONT DOOR

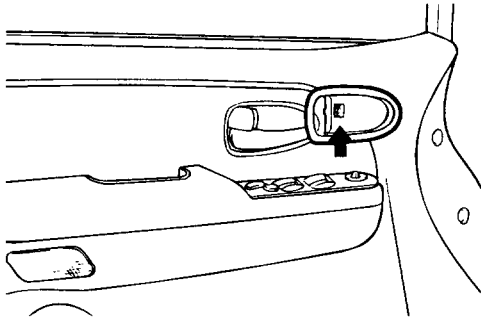
COMPONENTS ESMB0300

1. Front door rear channel
2. Front door glass run
3. Power window regulator assembly
4. Bolts
5. Front door glass
6. Tapping screws
7. Flange nuts

## REMOVAL AND INSTALLATION

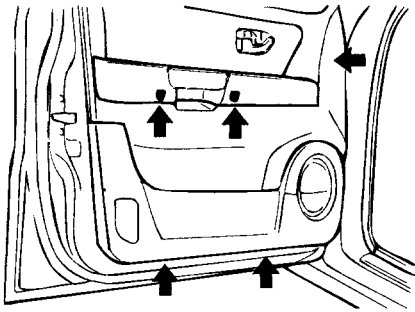
ESMB00350

1. Loosen the screw holding the handle inside door.



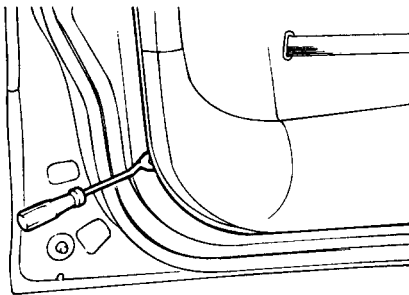
KSMB006A

2. Loosen the screws holding the door trim panel.



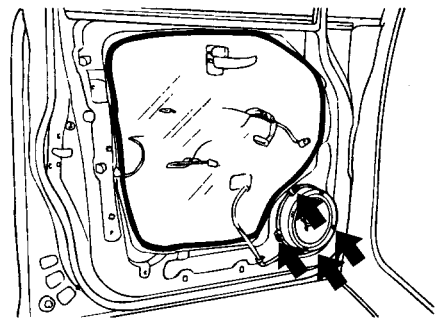
KSMB006B

3. Insert a trim panel remover between the trim fasteners and the door trim panel to pry off.  
Disconnect the wire connectors from the front door.



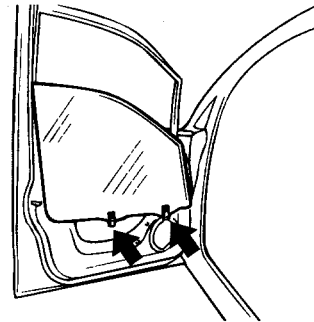
ESHA015D

4. Remove the front speaker and the door trim seal after removing the inside door handle.



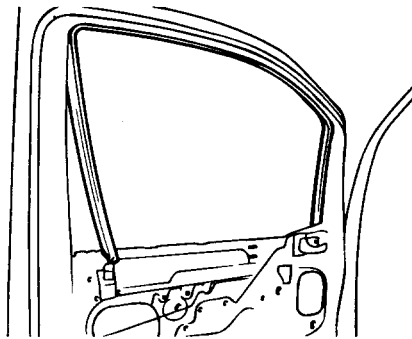
ESHA015E

5. Remove the front door glass from the power window regulator after removing tapping screws (2EA).



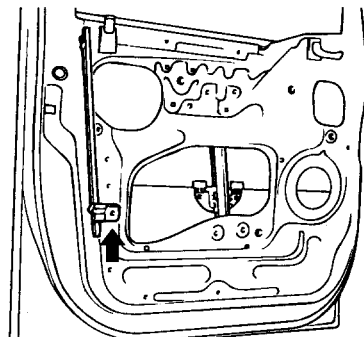
ESHA015F

6. Remove the front door window glass run.



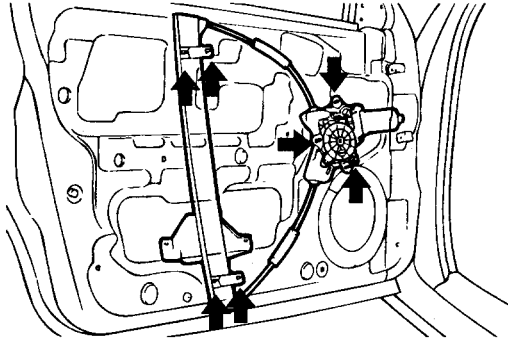
ESLA010H

7. Remove the rear channel from the front door after removing a bolt.



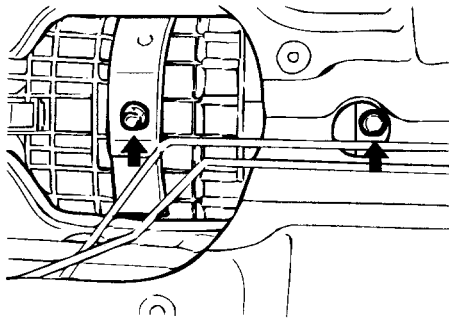
ESLA010G

8. Loosen the 4 nuts holding front door window regulator and 3 nuts holding power window motor. Remove the regulator assembly.



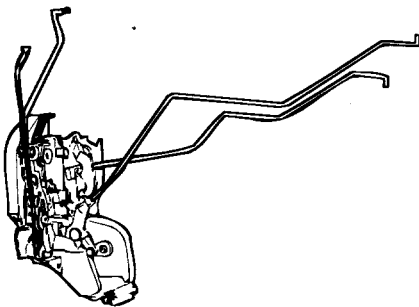
KSMB040D

9. Remove the door outside handle and key cylinder after removing bolts and rod.



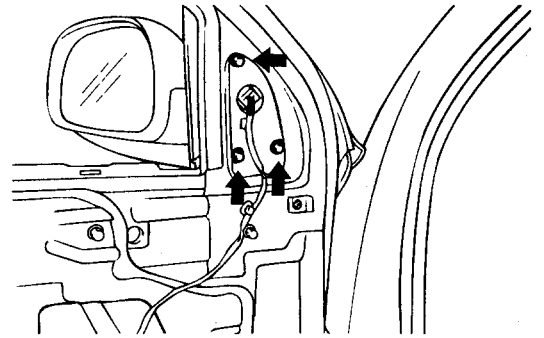
KSMB006C

10. Remove the front door lock actuator and latch assembly after removing the mounting screws and wire connectors.



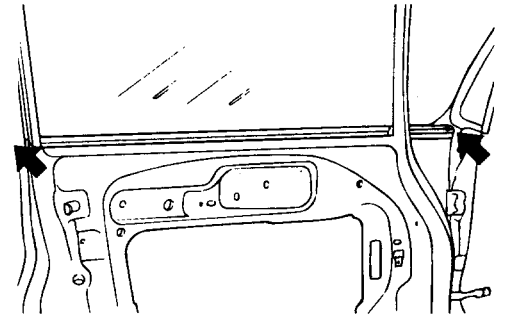
KSMB002D

11. Remove the outside rear view mirror.



ESJA060L

12. Remove the door belt outside weatherstrip.



ESHA015L

13. Installation is the reverse of the removal process. When installing the door trim seal, butyl tape should not be placed over the area when installing the door trim fastener.

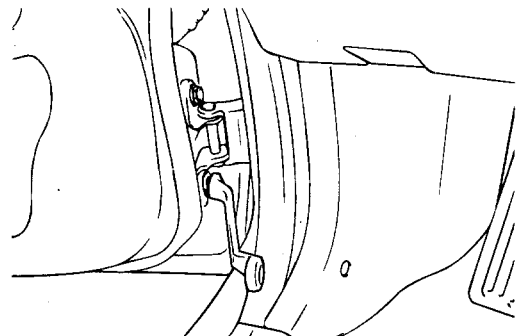
**ADJUSTMENT** ESHA0400

**DOOR POSITION**

Check for a flush fit with the body, then check for an equal gap between the front and rear, top and bottom door edges and the body. The door and body edges should also be parallel.

**! CAUTION**

**Attach protective tape to the fender edges where the hinge is installed.**

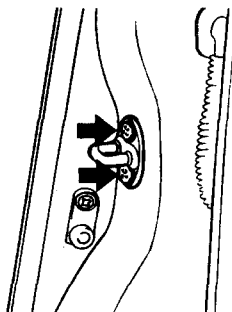


ESA9095A

**DOOR STRIKER**

Make sure the door is not loose, and that it latches securely without slamming. If necessary, adjust the door as follows :

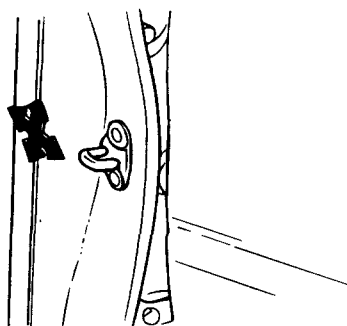
1. Draw a line around the striker plate for reference.
2. Loosen the striker screws, and move the striker IN and OUT to make the latch fit tighter or looser. Move the striker UP and DOWN to align it with the latch opening. Then lightly tighten the screws and recheck.



ESHA015N

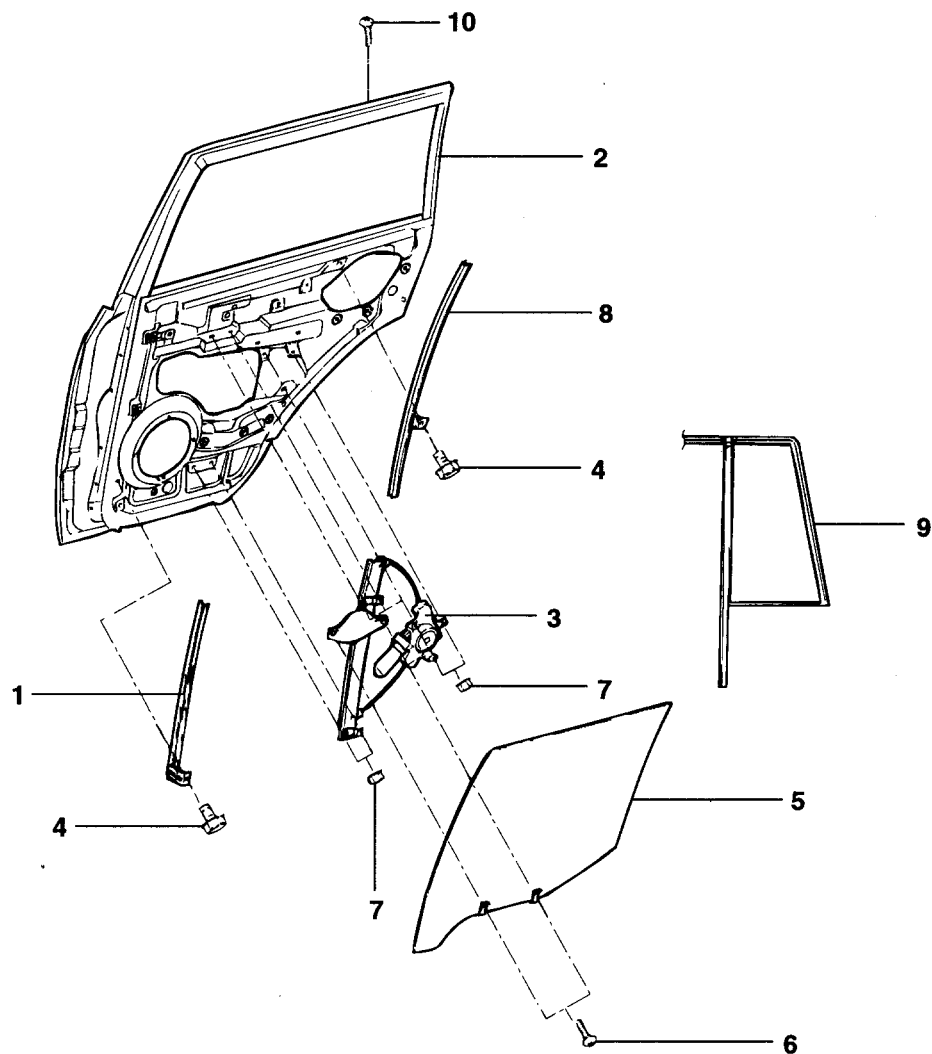
** NOTE**

*Hold the outside handle outward and push the door against the body to verify the striker provides a tight fit.*



ESA9095B

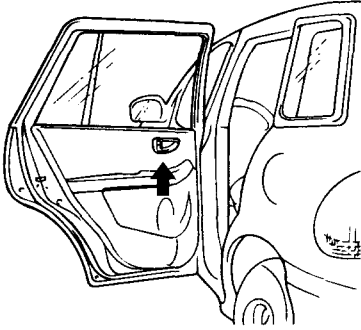
## REAR DOOR

COMPONENTS ESMB0450

1. Rear door front channel
2. Rear door glass run
3. Power window regulator assembly
4. Bolt
5. Rear door glass
6. Tapping screws
7. Flange nuts
8. Rear door division channel
9. Fixed glass
10. Screw

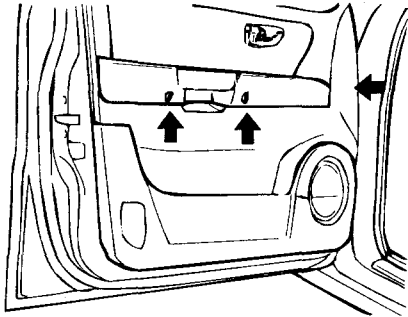
## REMOVAL AND INSTALLATION ESMB0500

1. Loosen the screw holding the handle inside the door.



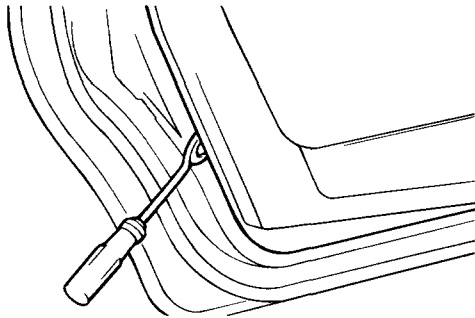
ESJA045A

2. Remove the 3 screws holding door trim panel.



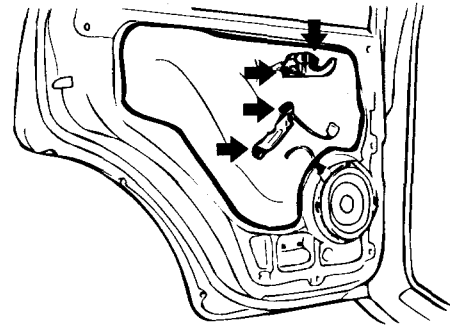
KSMB003B

3. Insert a trim panel remover between the trim fasteners and the door trim panel to pry off.  
Disconnect the wire connectors from the rear door.



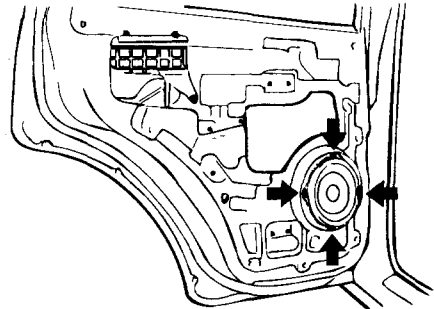
ESHA020D

4. Remove the door trim seal after removing the door inside handle.



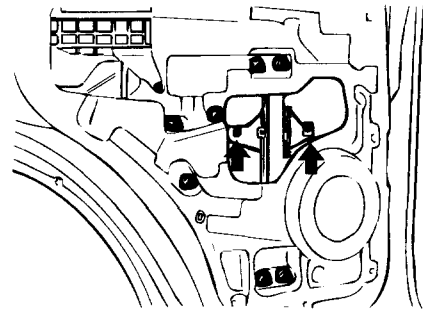
KSMB003C

5. Remove the rear door speaker after removing 4 screws.



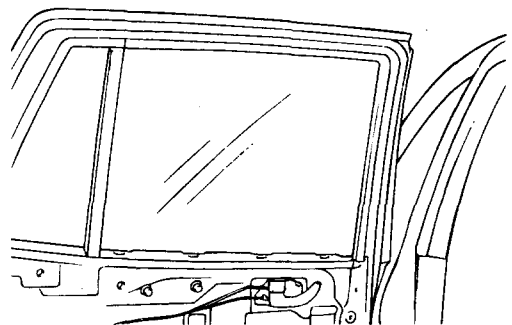
KSMB003D

6. Remove the 2 screws holding rear door glass.



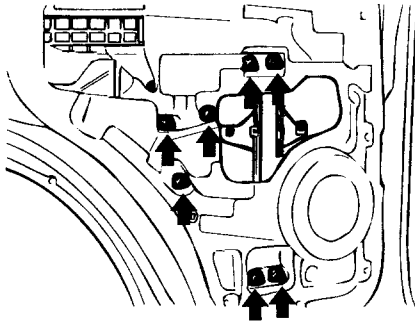
KSMB801B

7. Remove the rear door glass from the regulator assembly.



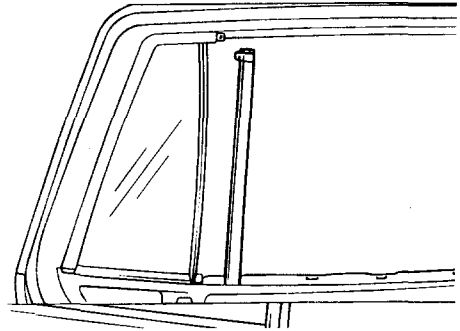
ESJA045F

8. Loosen the 4 nuts holding rear door window regulator and 3 nuts holding power window motor. Remove the regulator assembly.



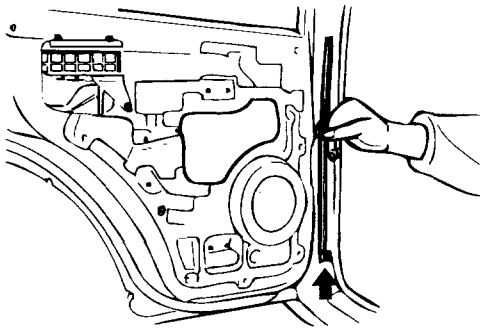
KSMB003E

11. Remove the rear door division channel.



ESJA045H

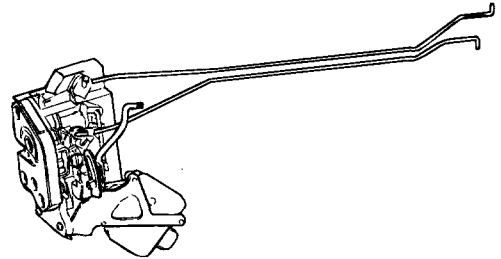
9. Remove the front channel from the rear door after removing a bolt.



KSMB003F

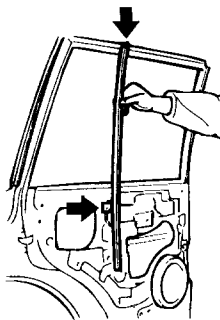
12. Remove the rear door fixed glass.

13. Disconnect rod to outside handle and remove the rear door lock and latch assembly.



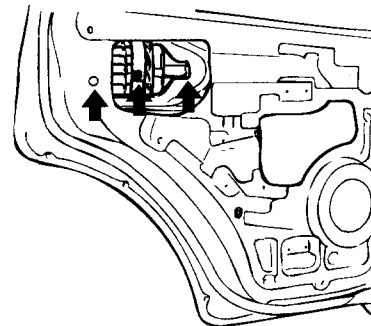
KSMB002E

10. Loosen the 2 bolts holding division channel after removing the rear door glass run.



KSMB003G

14. Remove the outside handle after removing 3 bolts.



KSMB003H

15. Installation is the reverse of the removal process. When installing the door trim seal, butyl tape should not be placed over the area installing the door trim fastener.



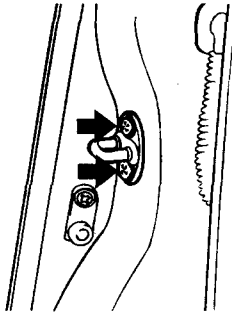
**ADJUSTMENT** ESHA0500**DOOR POSITION**

Check for a tight fit with the body, then check for an equal gap between the front and rear, top and bottom door edges and the body. The door and body edges should also be parallel.

**DOOR STRIKER**

Make sure the door is not loose, and that it latches securely without slamming. If necessary, adjust the door as follows :

1. Draw a line around the striker plate for reference.
2. Loosen the striker screws, and move the striker IN and OUT to make the latch fit tighter or looser. Move the striker UP and DOWN to align it with the latch opening. Then lightly tighten the screws and recheck.



ESHA015N

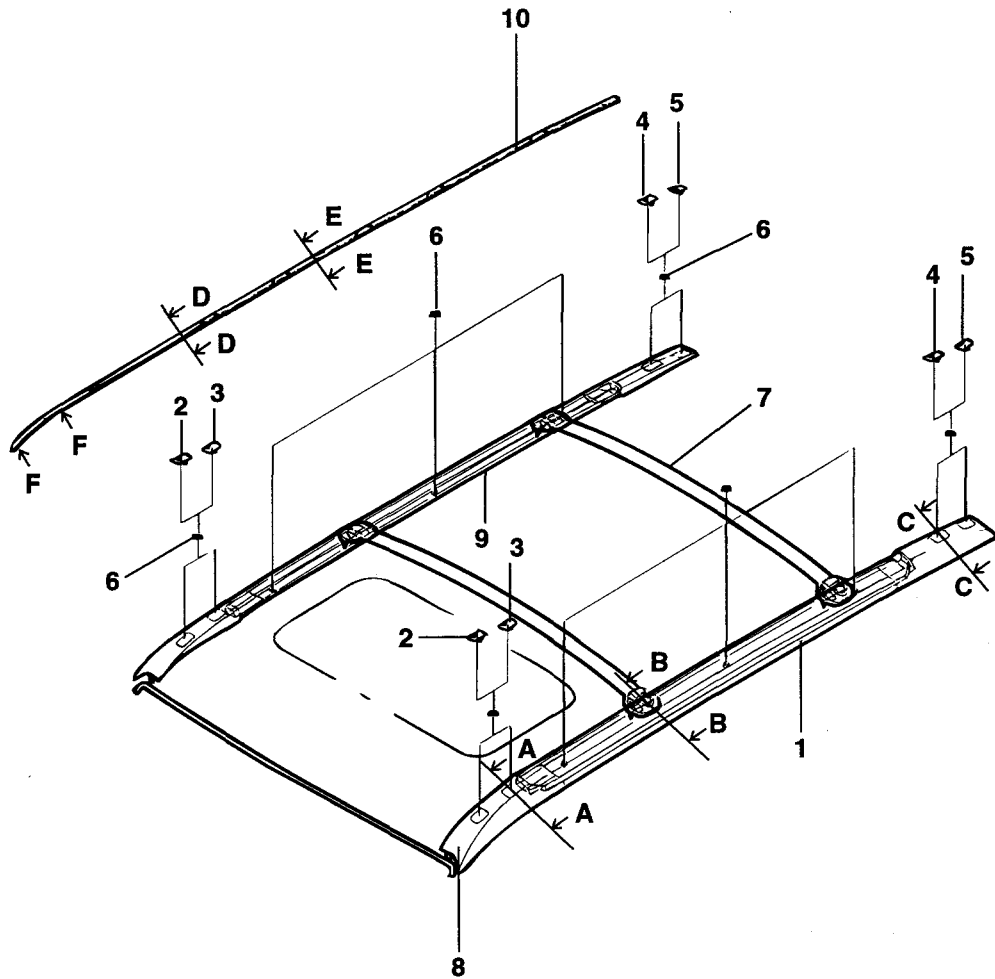
**NOTE**

*Hold the outside handle outward and push the door against the body to verify that the striker provides a tight fit.*

**BODY SIDE MOLDINGS**

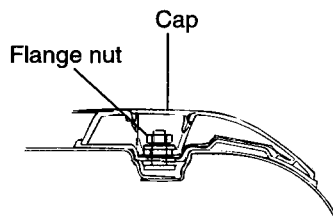
**ROOF CARRIER & MOLDINGS** ESMB0550

**COMPONENTS**

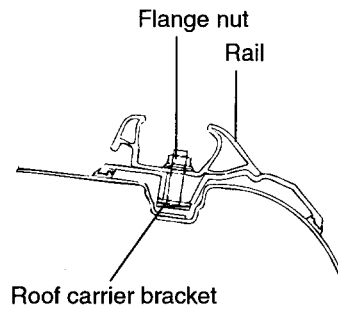


- 1. Roof carrier assembly
- 2. Cap (No.1)
- 3. Cap (No.2)
- 4. Cap (No.3)
- 5. Cap (No.4)
- 6. Flange nuts
- 7. Roof carrier bar
- 8. Roof carrier base
- 9. Roof carrier rail
- 10. Roof moldings

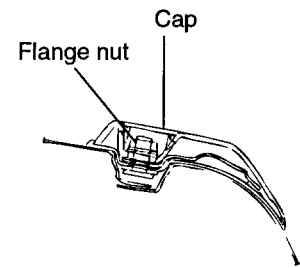
## [ ROOF CARRIER ]



Section A-A

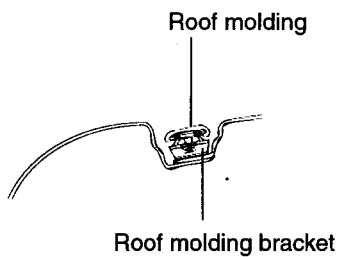


Section B-B

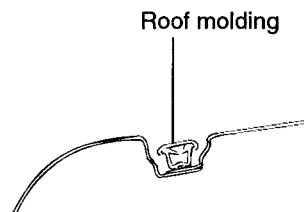


Section C-C

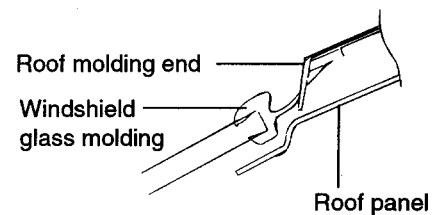
## [ ROOF MOLDINGS ]



Section D-D



Section E-E



Section F-F

ESMB055B

## REMOVAL AND INSTALLATION

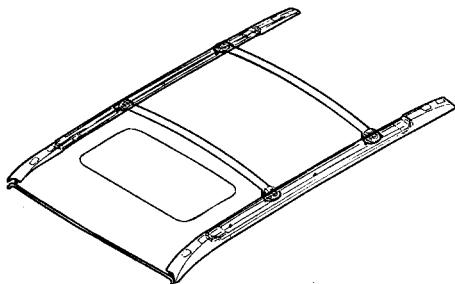
ESMB0600

## ROOF CARRIER

Remove the roof carrier assembly after removing caps and nuts.

 **NOTE**

The maximum load weight of roof carrier is 34kg(75lbs) and the load is evenly distributed.



KSMB001J

## ROOF MOLDINGS

1. Remove the roof moldings by using a flat bladed screwdriver.

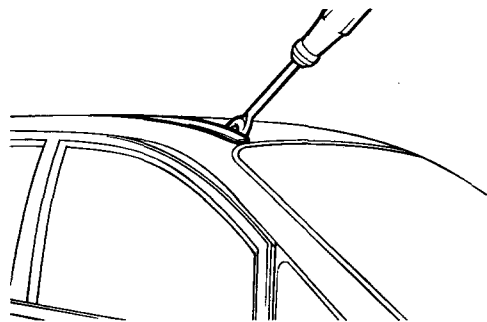
 **CAUTION**

*When prying with a flat bladed screwdriver, wrap it with protective tape to prevent damage. In order not to scratch the body and roof side garnish, use protective tape on the body.*

2. Pull the roof moldings up, then remove the roof moldings.
3. Installation is the reverse of removal.

 **NOTE**

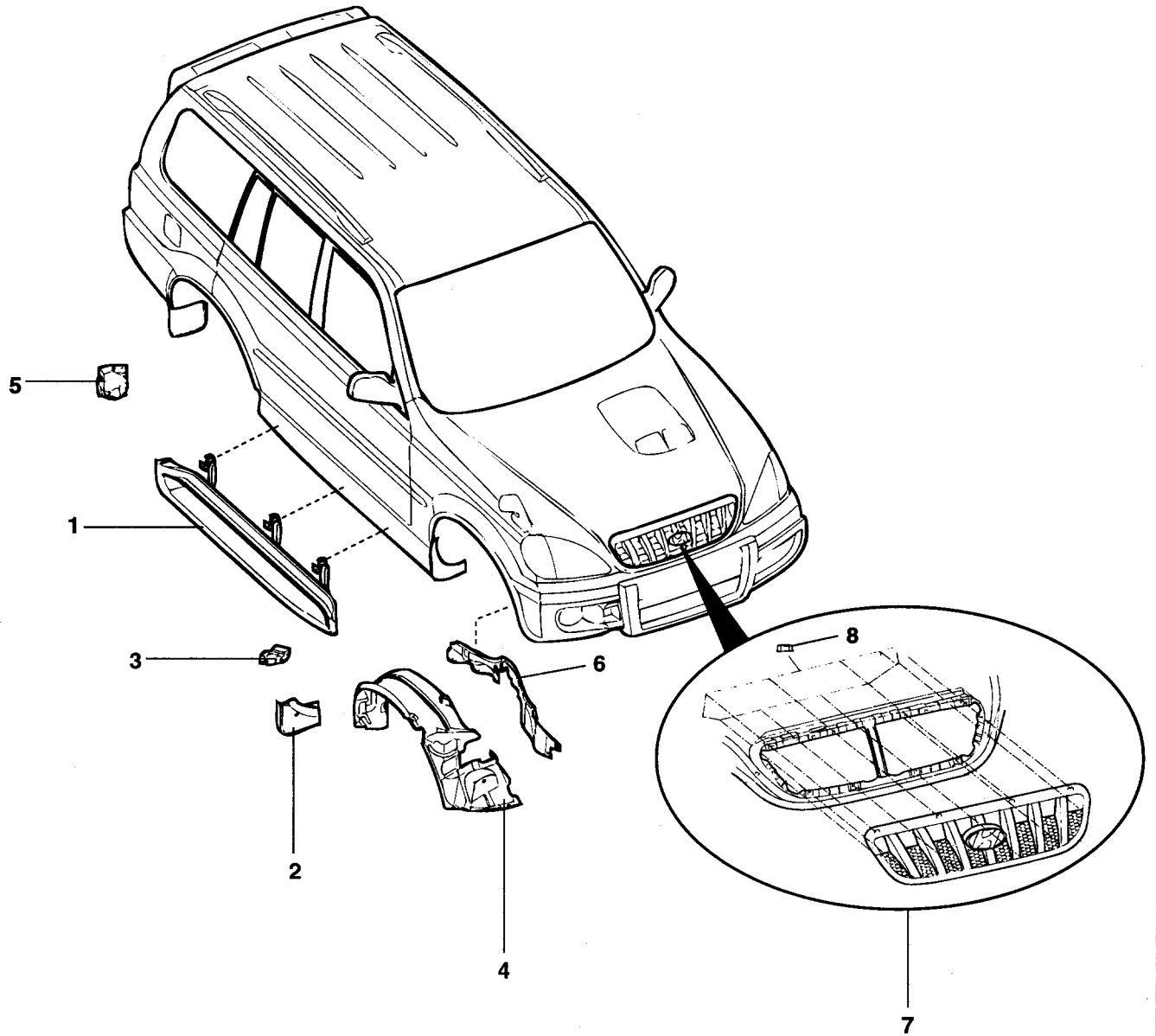
*If necessary, replace any damaged clips.*



ESHA025B

## BODY SIDE GARNISH ESMB0650

## COMPONENTS



1. Side step
2. Side step cover
3. Side step front mounting bracket
4. Front splash shield
5. Rear splash shield
6. Rubber shield
7. Radiator grille
8. Nuts

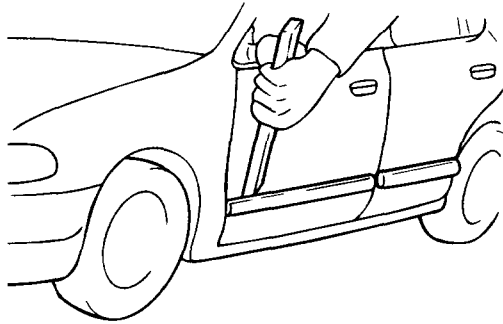
REMOVAL AND INSTALLATION ESMB0660

WAISTLINE MOLDING

Beginning from either end, remove the waistline molding using the special tool (09800-21000) from the front and rear doors.

**CAUTION**

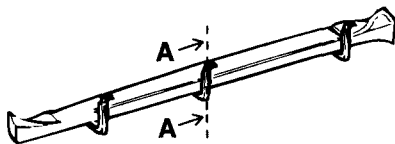
Take care not to scratch or bend the door moldings.



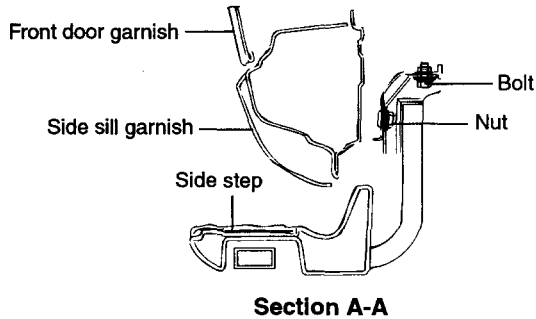
ESKA535A

SIDE STEP

Remove the side step after removing bolts and nuts.



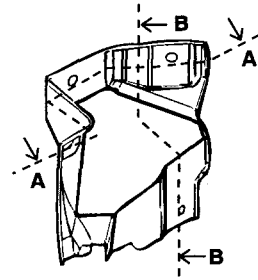
KSMB002R



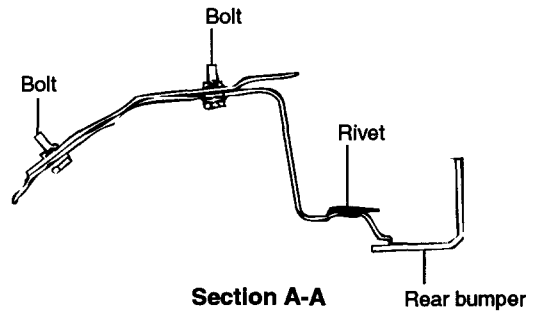
ESMB066A

REAR SPLASH SHIELD

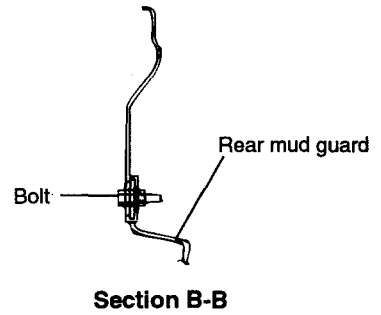
Remove the rear splash shield after removing bolts.



KSMB002T



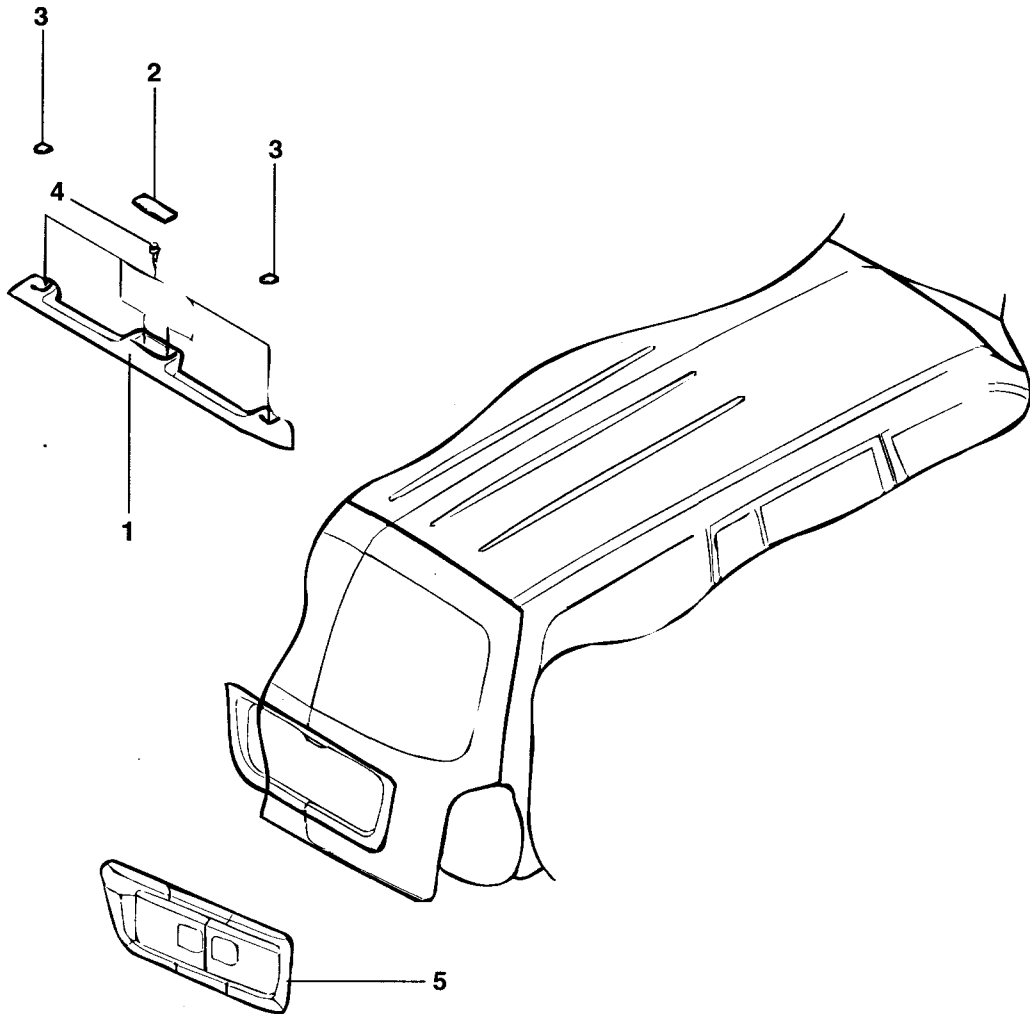
ESMB066B



ESMB066C

TAILGATE GARNISH ESMB0700

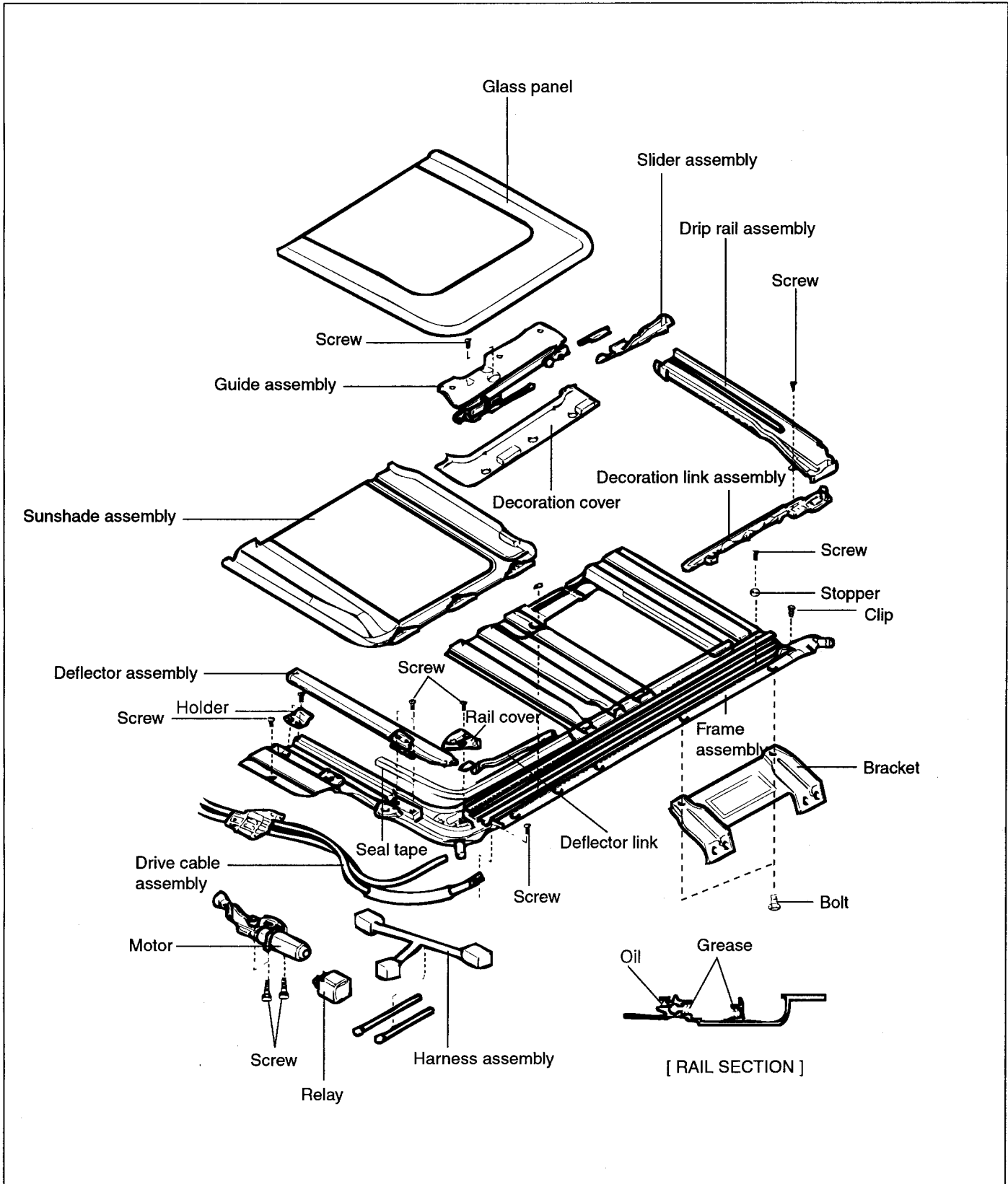
## COMPONENTS



1. Spoiler
2. Center cap
3. Side cap
4. Bolts
5. Back panel moldings

# SUN ROOF

## COMPONENTS ESMB0750





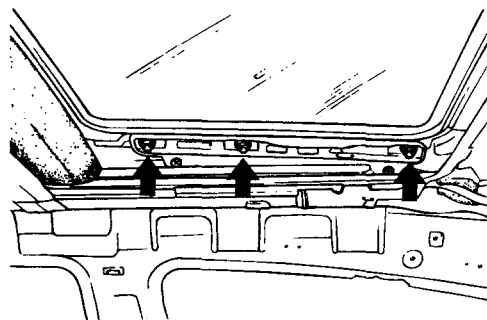
**REMOVAL** ESHA0700

1. To remove the sunroof, first remove the following parts :
  - 1) Overhead console lamp.
  - 2) Sun visor and grip handle.
  - 3) Pillar trims.
2. Remove the decoration cover and the glass panel.

**Tightening torque**

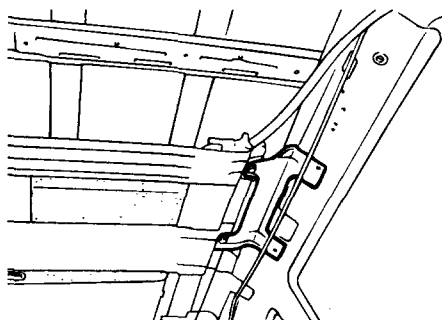
Glass panel mounting nuts :

4-6 Nm (40-60 kg·cm, 2.9-4.4 lb·ft)



ESA9011K

3. Disconnect the drain hose.



ESHA027A

4. Loosen the bolts and nuts holding the sunroof and then remove the sunroof assembly.

**Tightening torque**

Sunroof mounting bolts:

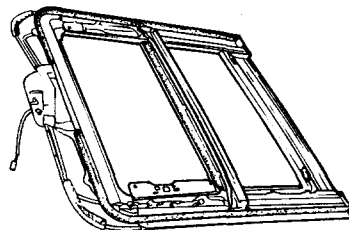
7-11 Nm (70-110 kg·cm, 5.1-8.0 lb·ft)

Sunroof mounting nuts:

4-6 Nm (40-60 kg·cm, 2.9-4.4 lb·ft)

**NOTE**

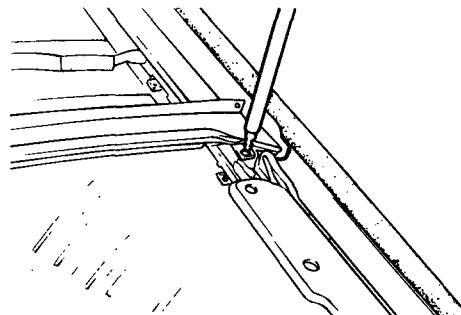
When removing the sunroof assembly, carefully pull out the assembly to avoid damaging other parts.



ESA9011B

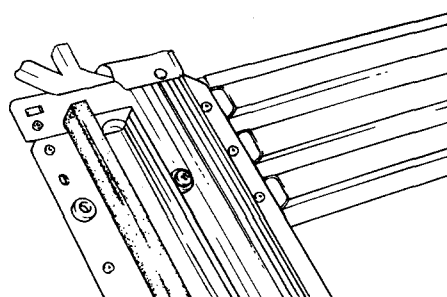
**DISASSEMBLY** ESHA0750

1. Remove the drip rail.



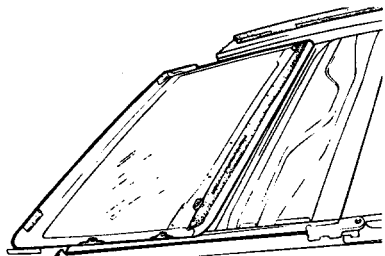
ESA9011C

2. Remove the stopper.

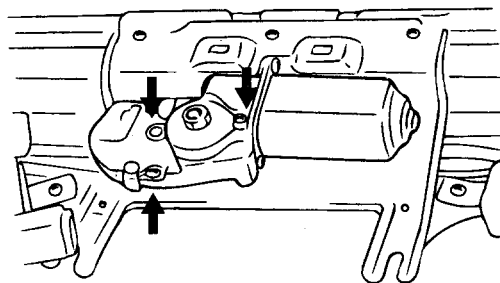


ESA9011D

3. Remove the sun shade.

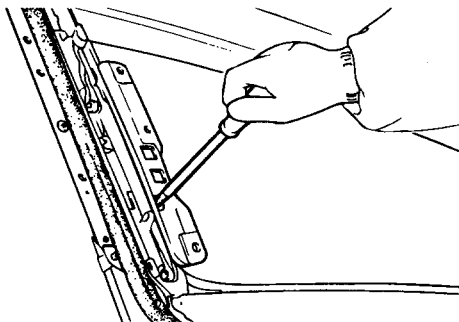


ESA9011E



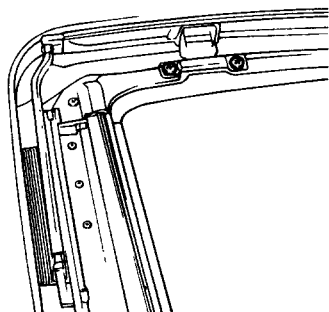
ESA9060N

4. Remove the guide assembly.



ESA9011F

5. Remove the deflector.



ESA9011G

6. Remove the motor assembly.

**CAUTION**

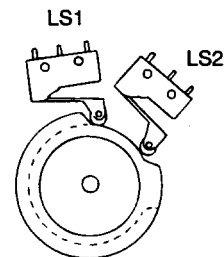
*When removing the motor, the slider assembly should always be in a fully closed position. If there is discrepancy between the glass position and the motor pulley in a fully closed position, the sunroof will not operate correctly.*

**INSTALLATION** ESHA0850

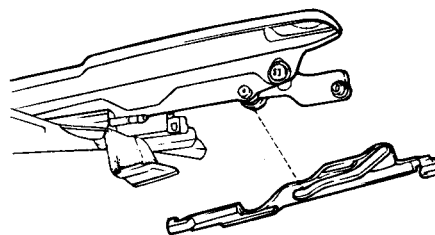
Installation is the reverse of removal.

**NOTE**

*Check that the limit switches (LS1 and LS2) of the motor are fully closed. Align the guide roller center and slider mating marks in the fully closed position.*



ESA9070D



ESA9011H

## VERIFY OPERATING CONDITION AFTER INSTALLATION

ESHA0900

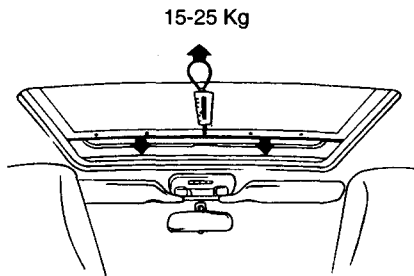
If the glass panel moves slowly, check and adjust.

1. Make sure the battery is fully charged.
2. Make sure that the sunroof sliding unit is free of abrasive materials.
3. Make sure that, when the glass panel opens, the rear of the panel does not jam against the roof panel. If there is interference, fully open the glass panel and move the stopper forward.

### NOTE

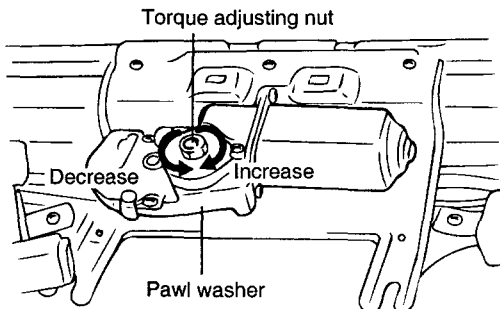
If the stopper is moved forward too far, it may cause malfunction or leaks. Make sure the gap between the glass panel and roof panel is not more than 0.3 mm (0.012 in.).

4. Measure the driving force of the motor, and adjust it to 15-25 kg (33.1-55.7 lb) with the torque adjustment nut on the motor.



ESA9075D

5. After adjustment, be sure to lock the nut with the pawl washer.



ESA9075E

## ADJUSTMENT

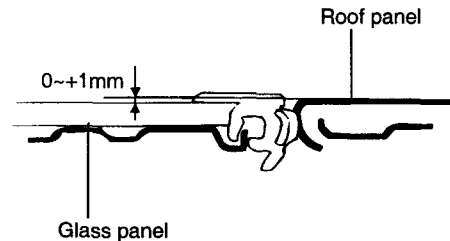
ESHA0950

Adjust the difference between the height of the glass panel and the roof panel.

Front side : 0 (+0, -1.0) mm

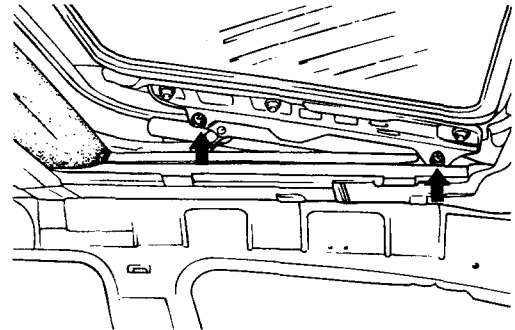
Rear side : 0 (+1, +0) mm

If the difference is not as specified, adjust using the following procedure.



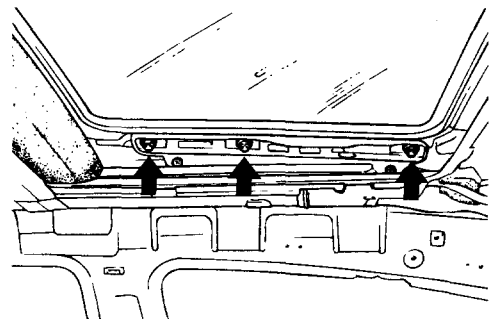
ESA9011J

1. Loosen the front screw and rear screw. Adjust the height between the glass panel and roof panel.



ESA9011I

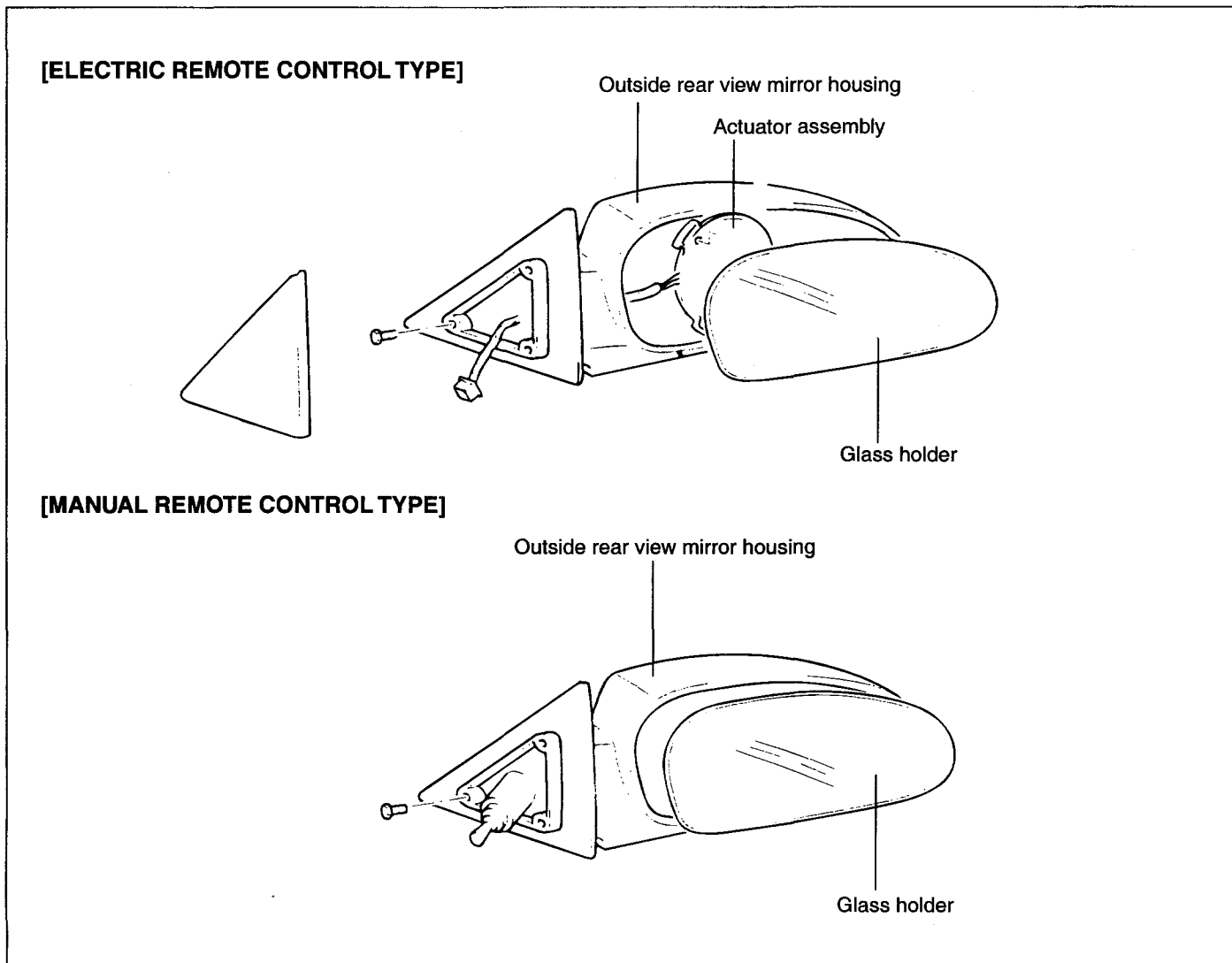
2. Loosen the nuts holding the glass panel and adjust the gap between the glass panel and roof panel.



ESA9011K

# OUTSIDE REAR VIEW MIRROR

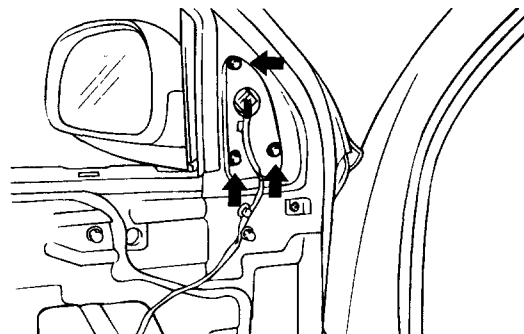
## COMPONENTS ESJA0950



ESA9030A

## REMOVAL AND INSTALLATION ESMB0800

Remove the 3 bolts holding outside rear view mirror and disconnect the wire connector.

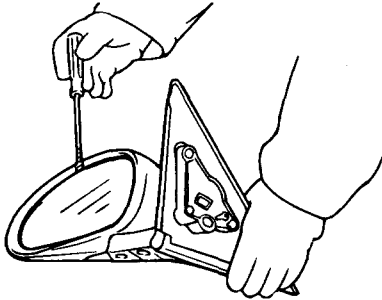


ESJA060L

**DISASSEMBLY** ESMB0850**⚠ CAUTION**

***Wear gloves to remove and install the mirror holder.***

1. Insert flat bladed screwdriver between the outside rear view mirror holder and the mirror assembly.

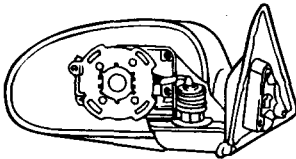


ESA9030B

**⚠ CAUTION**

***When prying with a flat bladed screwdriver, wrap it with a shop towel to prevent damage.***

2. Remove the outside rear view mirror actuator from the outside rear view mirror housing.



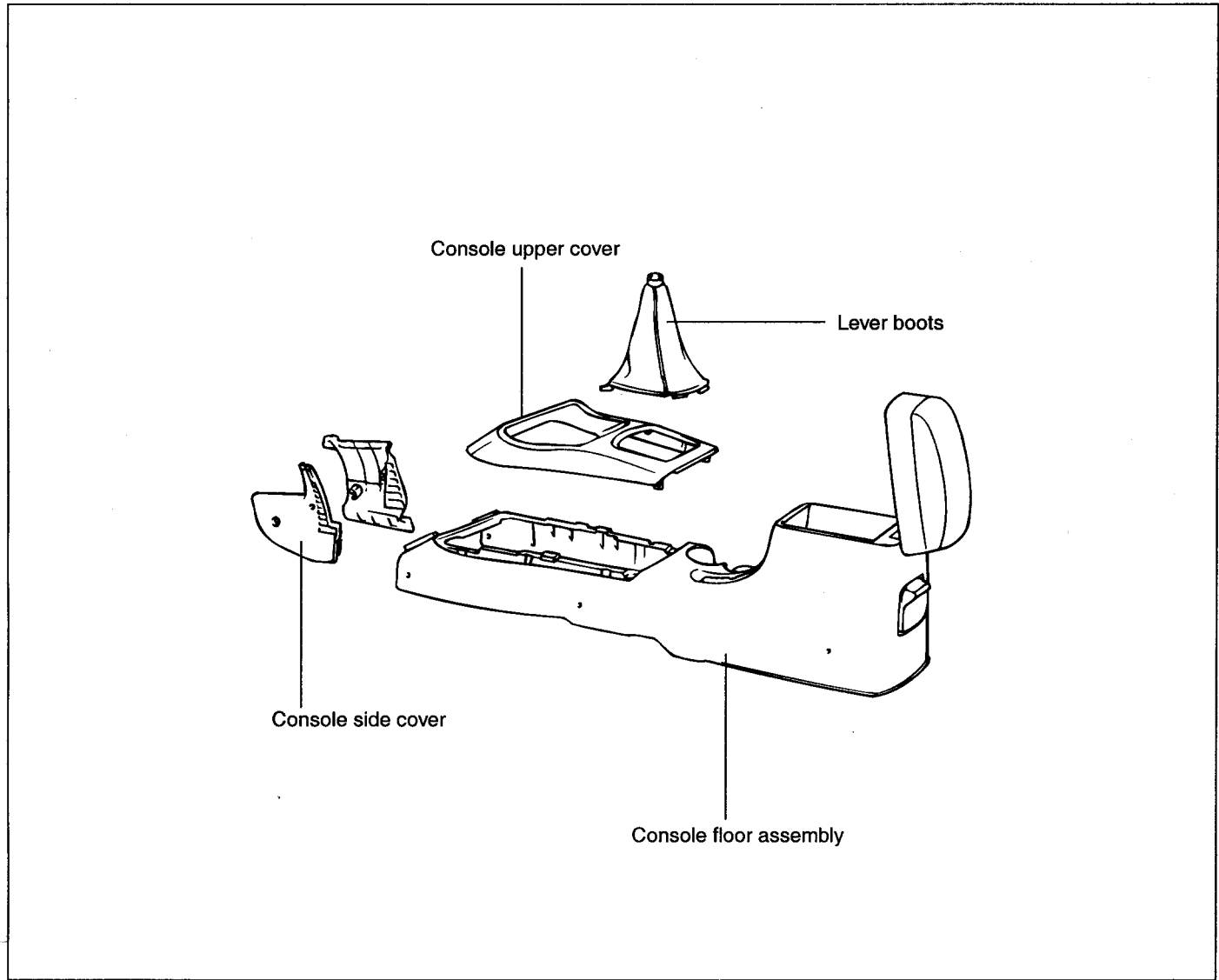
ESA9030C

3. Installation is the reverse of removal.

# INTERIOR

## CONSOLE

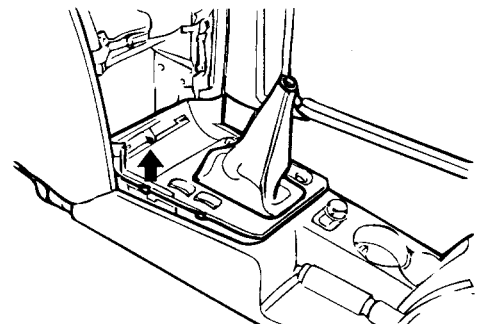
### COMPONENTS ESKA0450



ESKA020D

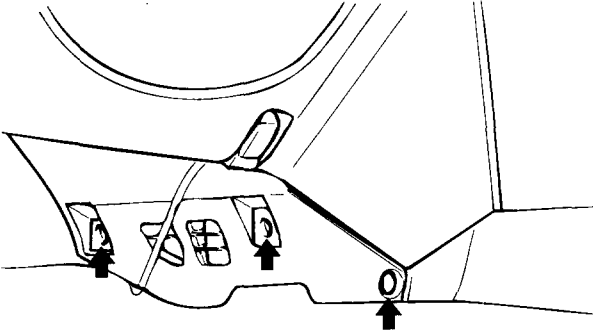
### REMOVAL AND INSTALLATION ESMB0900

1. Remove the screw holding floor console upper cover and then pry the floor console upper cover loose with a flat-bladed screw driver.



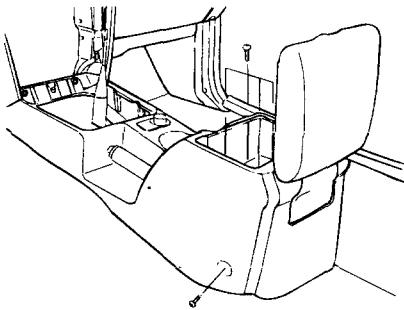
KSMB008N

2. Remove the console side cover.



KSMB008O

3. Remove the screws holding the floor console assembly and then pull the floor console out.

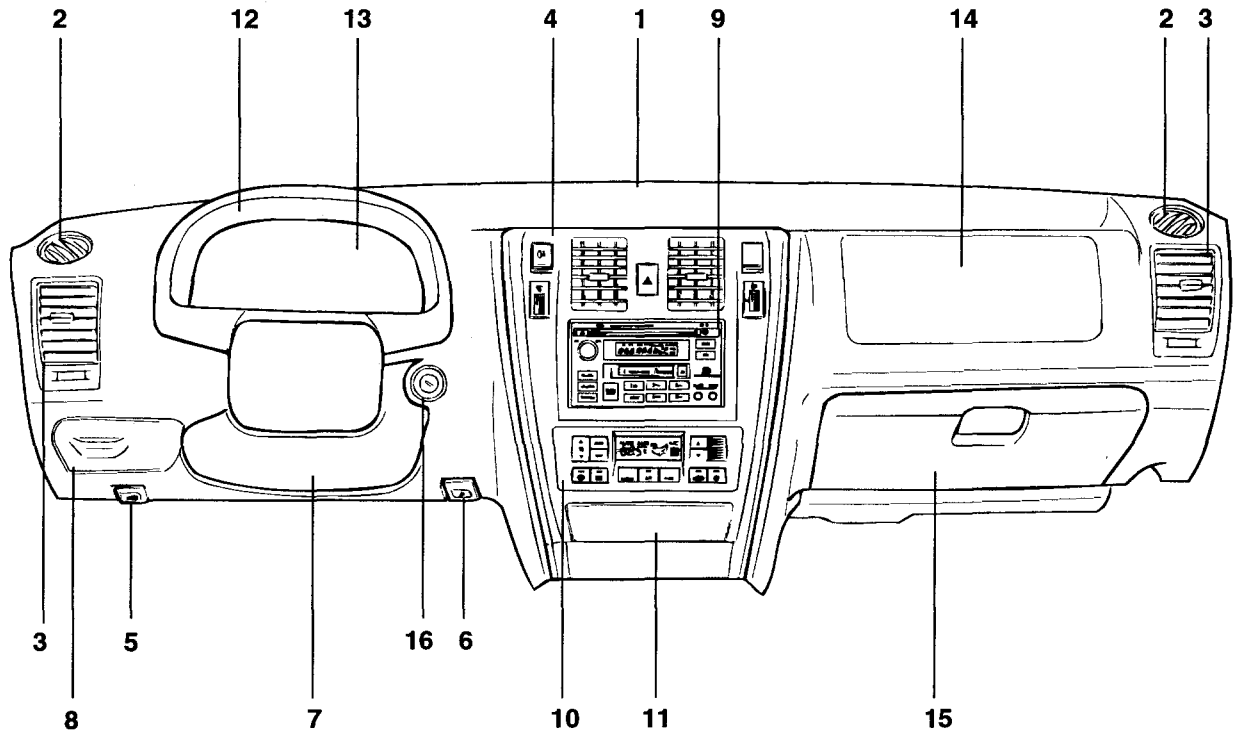


KSMB008P

4. Installation is the reverse of removal.

CRASH PAD

COMPONENTS ESMB0950



- 1. Crash pad assembly
- 2. Side defroster garnish
- 3. Side air vent
- 4. Center facia panel
- 5. Hood release handle
- 6. Fuel filler door release handle
- 7. Steering column under cover
- 8. Tray

- 9. Audio unit
- 10. Heater control unit
- 11. Ash tray
- 12. Cluster housing
- 13. Cluster
- 14. Passenger side airbag
- 15. Glove box
- 16. Key cylinder

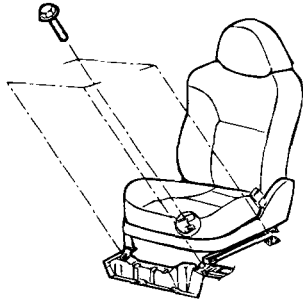


## REMOVAL AND INSTALLATION ESMB1000

1. Disconnect the negative (-) battery terminal.
2. Disconnect the wire connectors from the front seats and then remove the front seats.

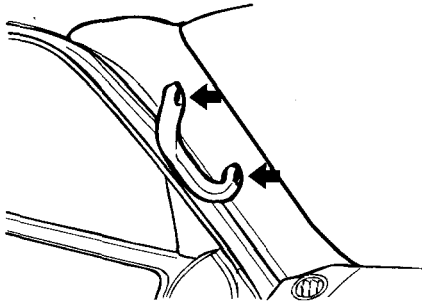
**CAUTION**

**Take care not to scratch the trim when removing the front seats.**



KSMB008G

3. Pry loose the front pillar trim after removing the assist grip.

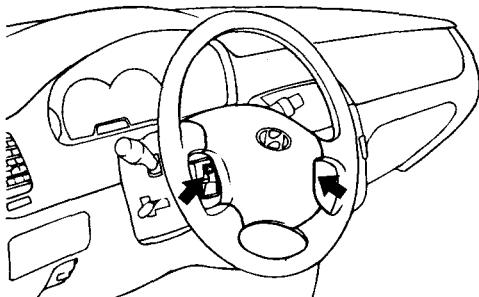


KSMB008H

4. Remove the air bag module.

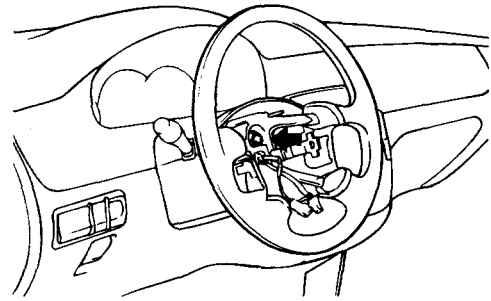
**CAUTION**

**For instructions on the removal of the air bag module and clock spring, refer to RT group.**



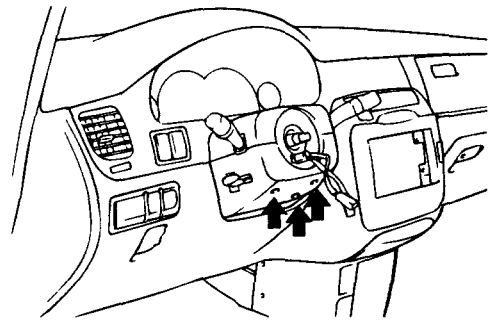
ESHA040M

5. Remove the steering wheel.



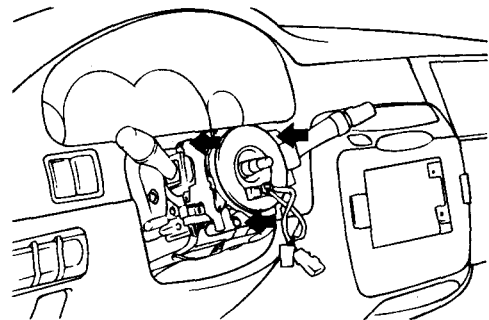
ESHA040N

6. Remove the 3 screws holding the steering column lower shroud and then remove the steering column lower and upper shroud.



ESHA040O

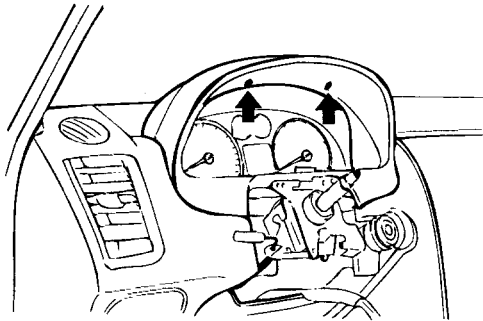
7. Disconnect the wire connectors and remove the multifunction switch (3 screws).



ESHA040P

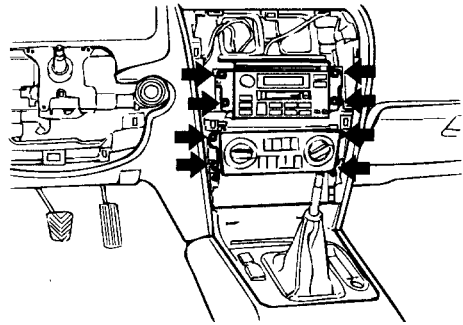
8. Remove the steering column under cover.

9. Remove the cluster housing (2 screws).



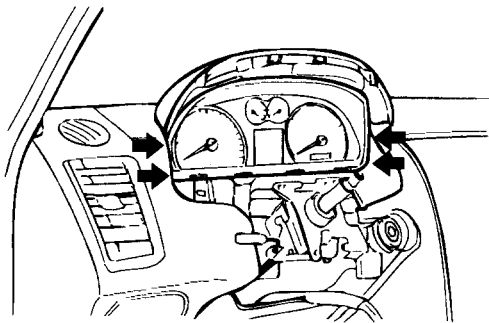
KSMB008I

13. Remove the audio unit (4 screws) and heater control unit (4 screws).



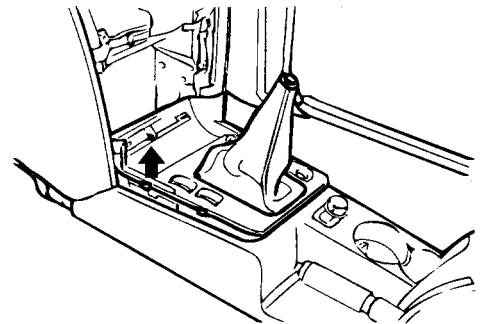
KSMB008M

10. Remove the instrument cluster (4 screws).



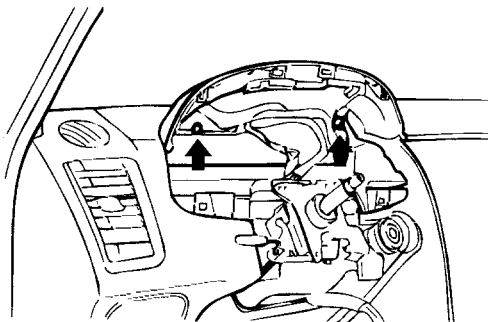
KSMB008J

14. Remove the floor console upper cover (1 screw).



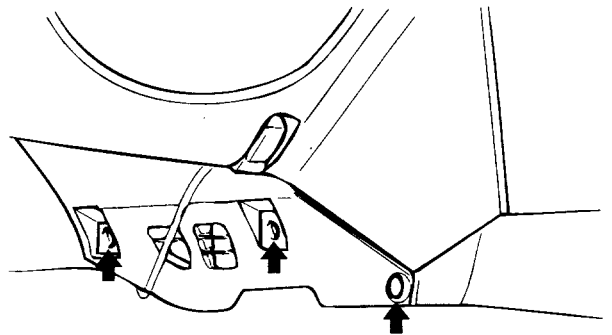
KSMB008N

11. Remove the cluster upper cover (2 screws).



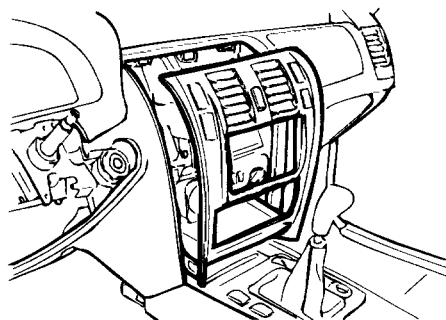
KSMB008K

15. Remove the console side cover.



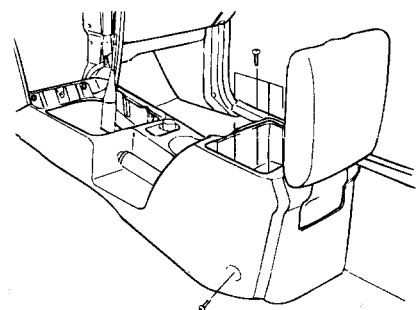
KSMB008O

12. Pry the center facia panel loose and disconnect the wire connectors.



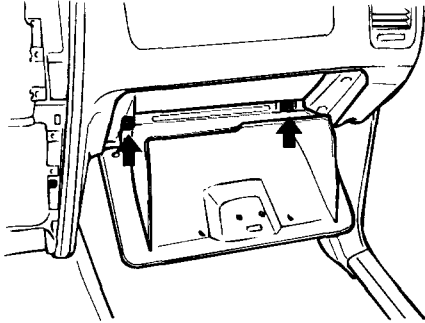
KSMB008L

16. Remove the screws holding floor console assembly and pull the floor console out.

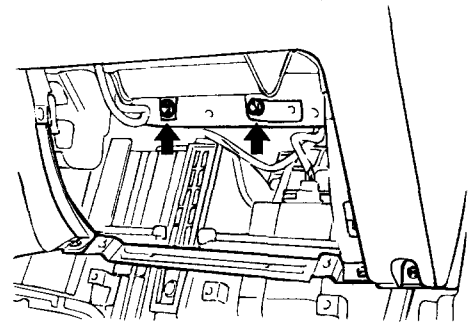


KSMB008P

17. Remove the glove box (2 bolts).

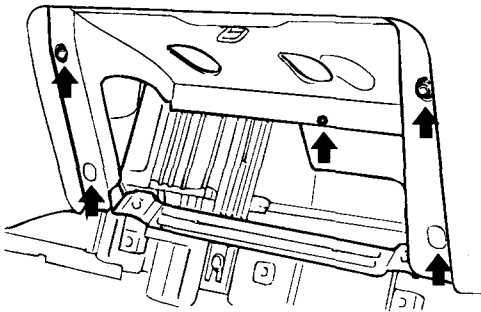


KSMB008Q



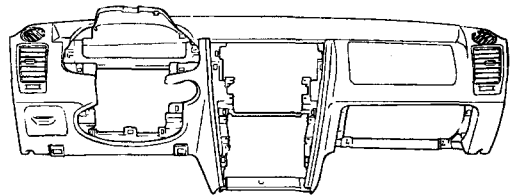
KSMB008U

18. Remove the glove box upper cover (5 bolts).



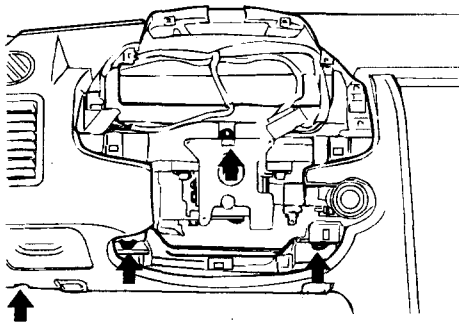
KSMB008R

20. Disconnect the hood release cable and fuel filler door release cable. Remove the main crash pad and disconnect the wire connectors.



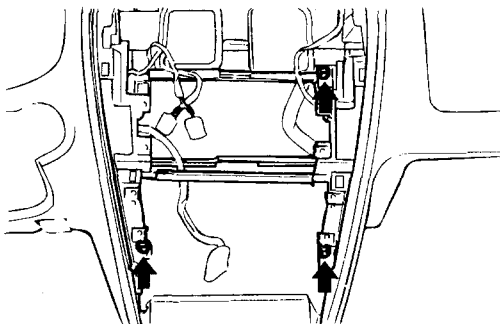
KSMB008V

19. Remove the bolts holding main crash pad.



KSMB008S

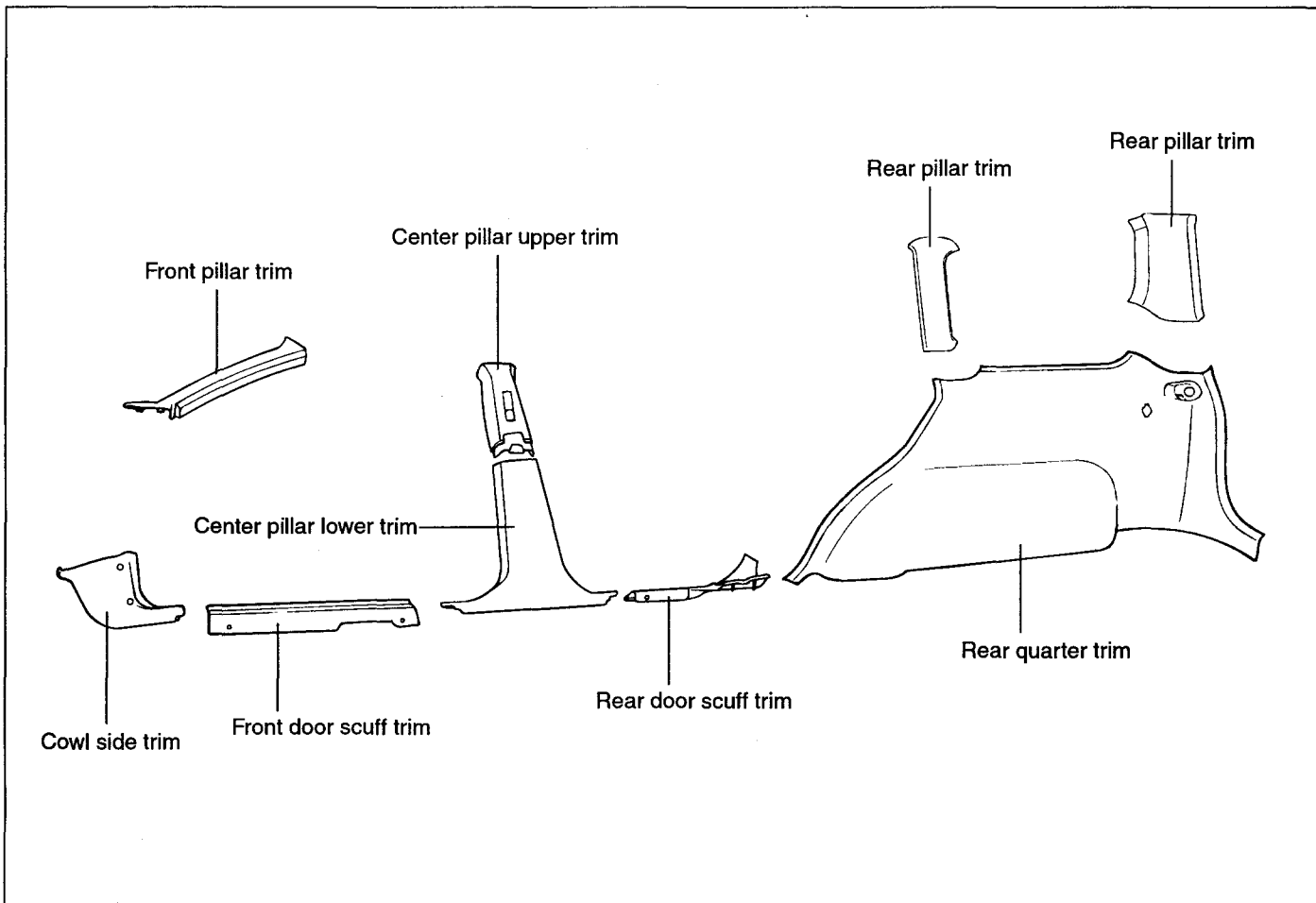
21. Installation is the reverse of removal. Connect all wire connectors securely.



KSMB008T

# INTERIOR TRIM

## COMPONENTS ESMB1050

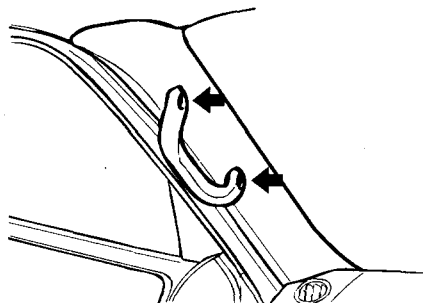


ESMB105A

## REMOVAL ESMB1100

### FRONT PILLAR TRIM

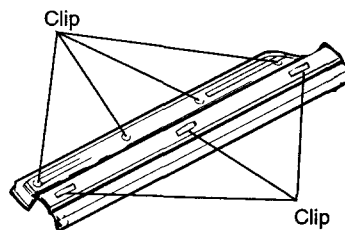
Pry the front pillar trim loose with a screwdriver after removing the assist grip.



KSMB008H

### FRONT DOOR SCUFF TRIM

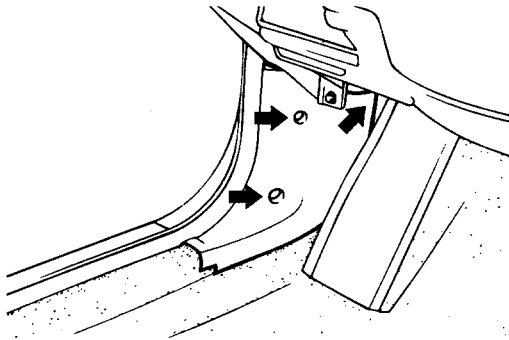
Pry the front door scuff trim loose with a screwdriver.



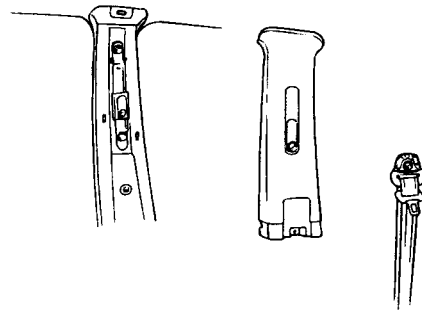
ESMB110A

**COWL SIDE TRIM**

Remove the screws and nut holding the cowl side trim and remove it.



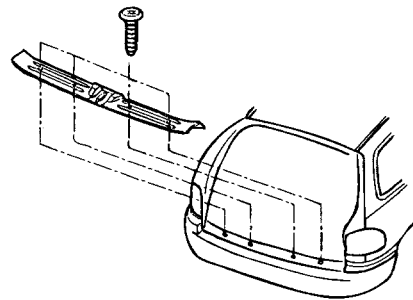
ESKA045C



ESHA045B

**REAR TRANSVERSE TRIM**

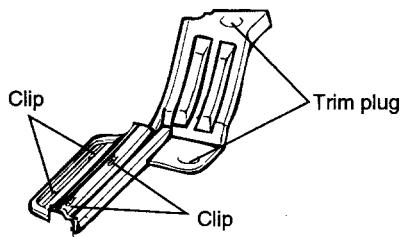
Remove the 4 screws holding the rear transverse trim and remove the trim.



KSMB011F

**REAR DOOR SCUFF TRIM**

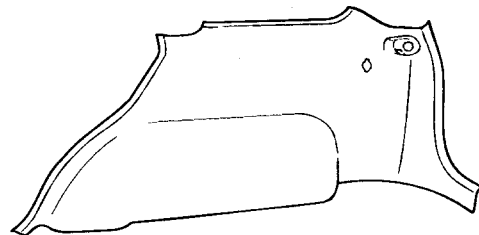
1. Remove the 2 screws holding the rear door scuff trim after removing trim plug.
2. Remove the rear door scuff trim.



ESMB110B

**QUARTER TRIM**

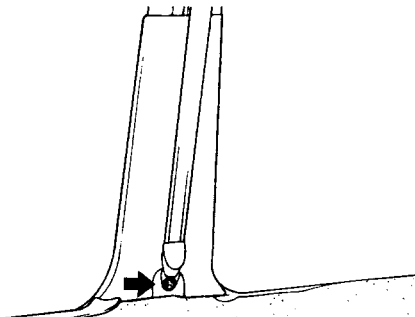
Remove the bolt holding the rear seat belt lower anchor and remove the screws holding the quarter trim.



KSMB011C

**CENTER PILLAR TRIM**

1. Remove the bolt holding the seat belt lower anchor and pry loose the center pillar lower trim.

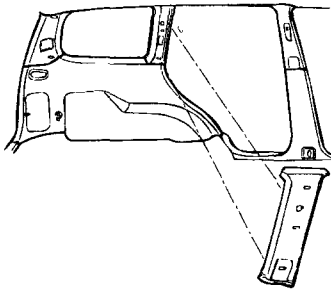


ESHA040I

2. Remove the bolt holding the seat belt upper anchor and pry loose the center pillar upper trim.

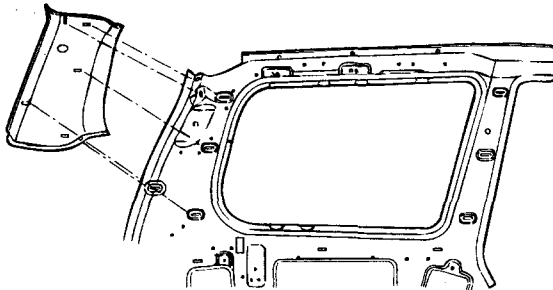
**REAR PILLAR TRIM**

1. Pry the rear pillar (C pillar) trim loose with a screwdriver.



KSMB011I

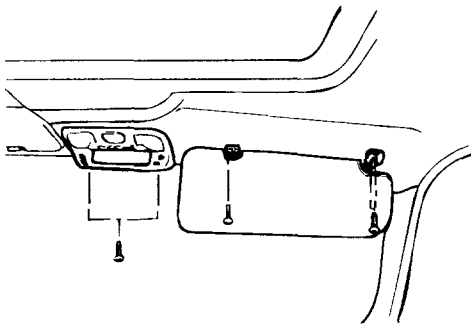
2. Pry the rear pillar (D pillar) trim loose with a screwdriver.



KSMB011H

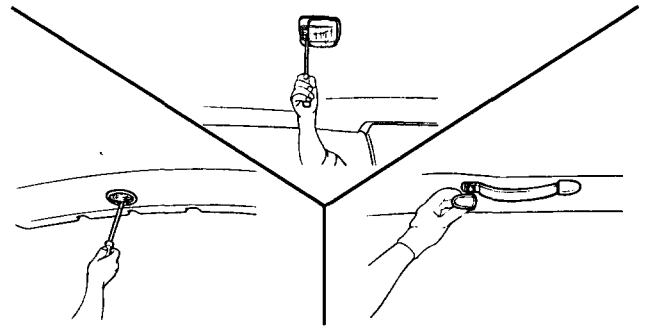
**HEADLINER**

1. To remove the headliner, first remove the following parts :
  - Overhead console and sunvisor.



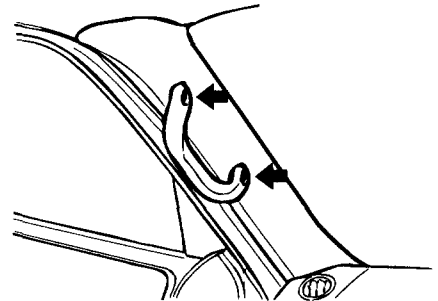
KSMB011J

- Room lamp, luggage lamp and assist grip.

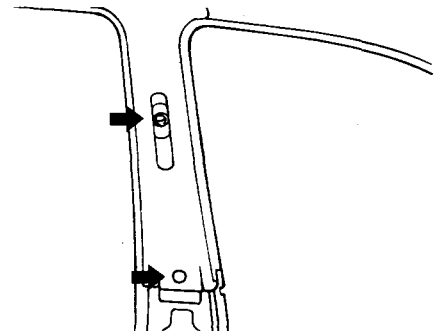


ESHA045H

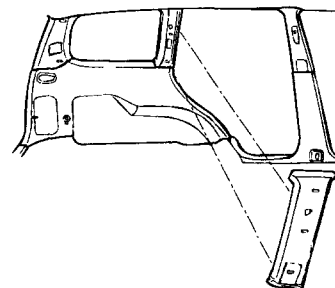
2. Remove front pillar trim, center pillar upper trim and rear pillar trim.



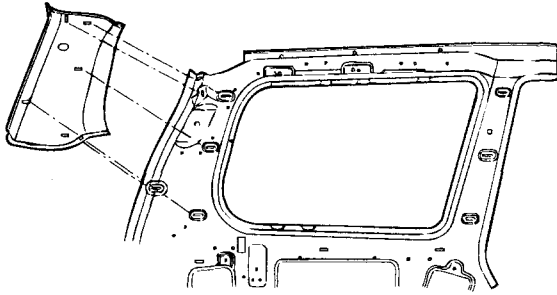
KSMB008H



ESKA045E

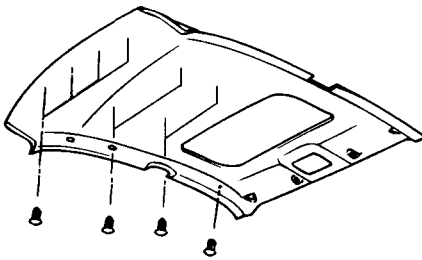


KSMB011I



KSMB011H

3. Remove the headliner after removing the clip holding the headliner.

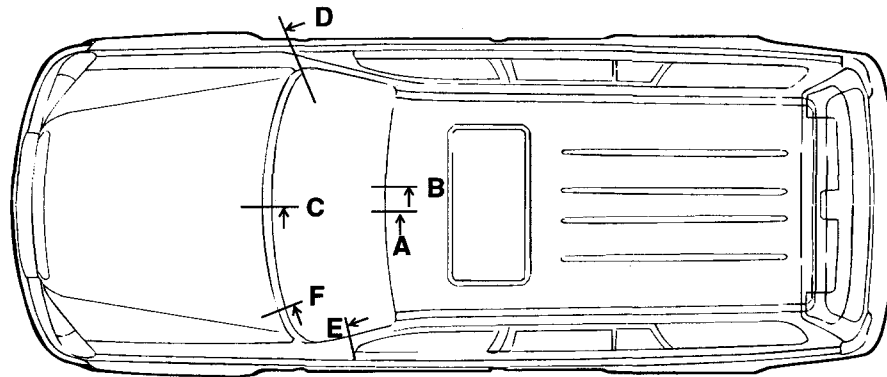


KSMB115B

4. Installation is the reverse of removal.

# WINDSHIELD GLASS

## COMPONENTS ESMB1150



Unit : mm

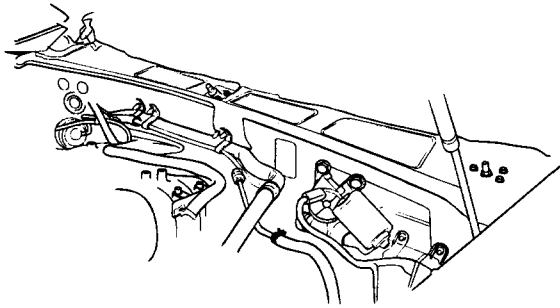
<p>Roof panel Molding Sealant Dam 12 18.2 Inside mirror</p> <p><b>SECT. A-A</b></p>	<p>Glass Coupler Rain sensor</p> <p><b>SECT. B-B</b></p>	<p>Wiper arm &amp; blade Hood outer panel 12</p> <p><b>SECT. C-C</b></p>
<p>Fender panel Molding Glass Cowl top cover</p> <p><b>SECT. D-D</b></p>	<p>Dam Sealant 12 18</p> <p><b>SECT. E-E</b></p>	<p>Glass Spacer 8 12 12</p> <p><b>SECT. F-F</b></p>



**REMOVAL** ESMB1200

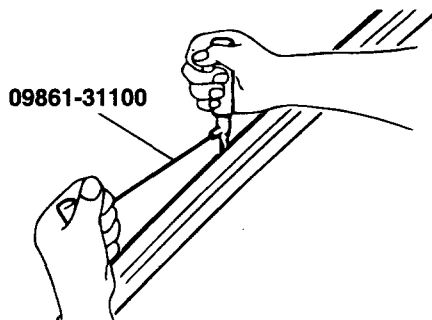
1. To remove the windshield, first remove the following parts :

- 1) Front pillar trims
- 2) Inside rear view mirror
- 3) Wiper arms
- 4) Cowl top cover
- 5) Windshield glass molding



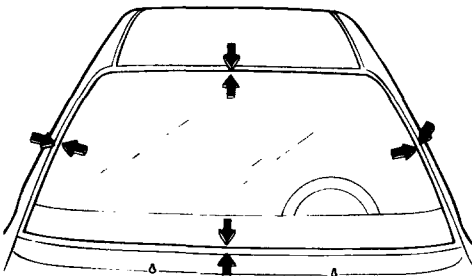
KTMB802R

2. Use the special tool (09861-31100) to cut through the sealant.



ESDA230B

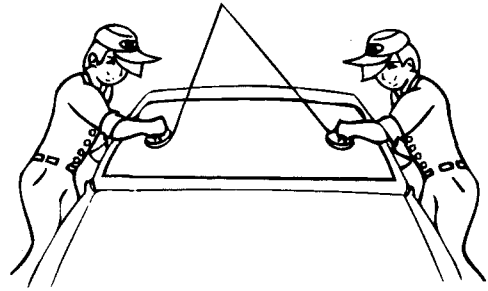
3. Make mating marks on the glass and body if the glass is to be reinstalled.



KSHA125A

4. Take out the windshield glass with the special tool using the Glass Holder.

09861-31400



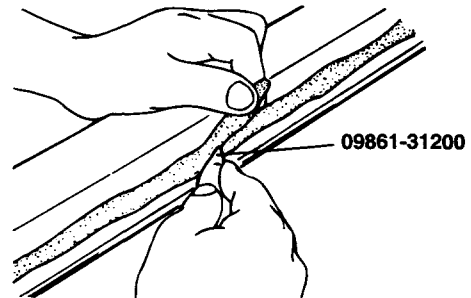
ESDA230D

**INSTALLATION** ESMB1250

1. Using a cutter knife or the special tool, scrape the old sealant smoothly to a thickness of about 2 mm (0.08 in.) on the bonding surface around the entire windshield flange.

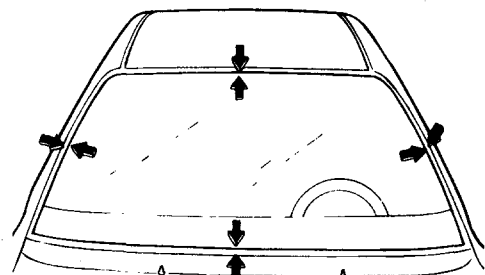
**CAUTION**

*Be careful not to remove more adhesive than necessary, and also not to damage the paintwork on the body surface with the knife. If the paintwork is damaged, repair the damaged area with touch-up paint.*



ESDA235B

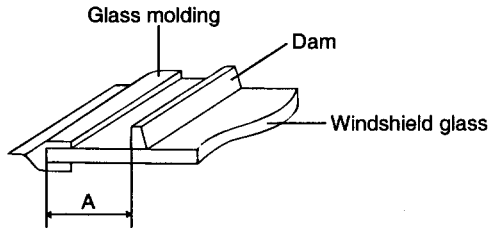
2. Clean the body bonding surface with a sponge dampened in alcohol or wax and grease remover.
3. Center a new windshield glass in the opening. Mark the location by marking lines across the glass and body with a grease pencil at the four points as shown.



KSHA125A

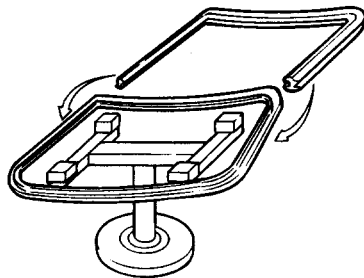
4. Glue the rubber dam to the inside surface of the windshield glass around the entire edge as shown, to contain the sealant during installation.

Part	"A"	Remarks
Upper	13.2mm	Glass molding sub
Side	13mm	



ESHA050E

5. Install the windshield glass molding without any gaps.

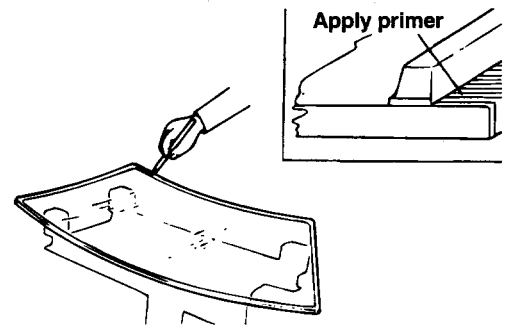


KSHA130B

6. Apply a light coat of glass primer to the outside of the dam.

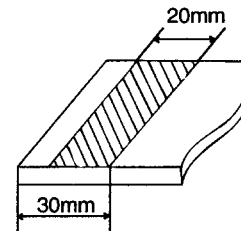
**NOTE**

1. Never touch the surface applied primer with your hand. If you do, the adhesive may not bond to the glass properly, causing a leak after the windshield glass is installed.
2. Do not apply body primer to the glass.
3. Keep water, dust, and abrasive materials away from the surface applied primer.



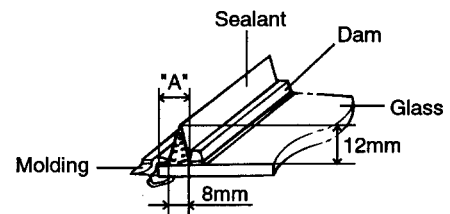
ESDA235E

7. Apply a primer to the lower glass as shown.



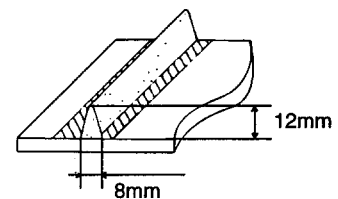
ESHA050F

8. Apply a sealant around the edge of the glass.



**UPPER AND SIDE**

ESMB126A



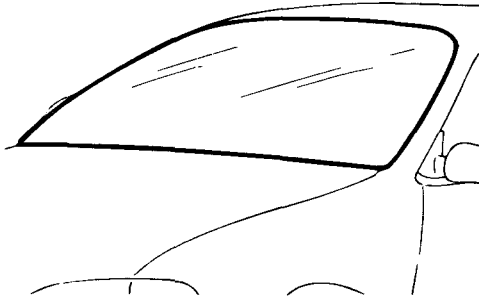
**LOWER**

ESMB126B

**NOTE**

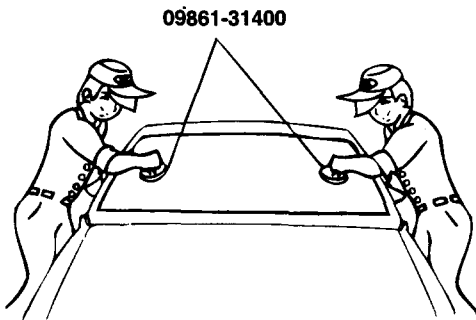
Apply the adhesive within 5 minutes after applying the primer to the glass.

9. Apply a light coat of body primer to the original sealant remaining around the window opening flange. The glass should be installed within 5 minutes after you apply the primer.



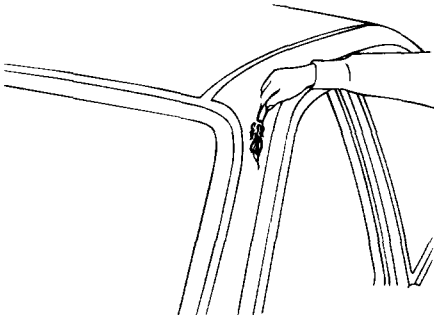
ESDA235F

10. Using suction cups or the special tool, lower the glass over the opening, align it with the marks made in step 3 and set it down on the sealant.
11. Scrape or wipe excess adhesive off with a putty knife or gauze. Fill all cavities around the windshield glass.



ESDA230D

12. Perform a water-leak test for the windshield. Use a cold water spray, being careful not to direct a powerful stream of water on the new adhesive material. Allow water to spill over the edges of the glass.
13. If there are leaks, dry the affected area, then apply sealant.



ESDA235G

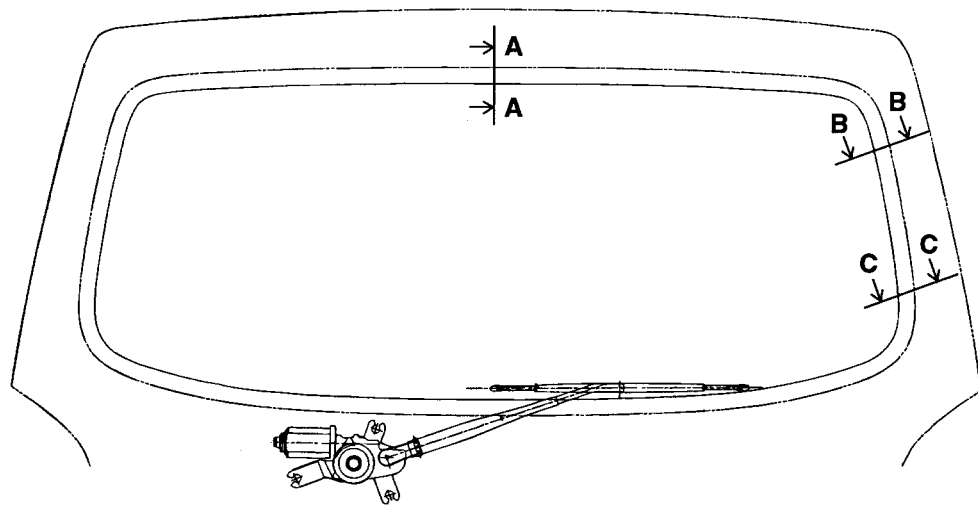
14. Install the removed parts.

**⚠ CAUTION**

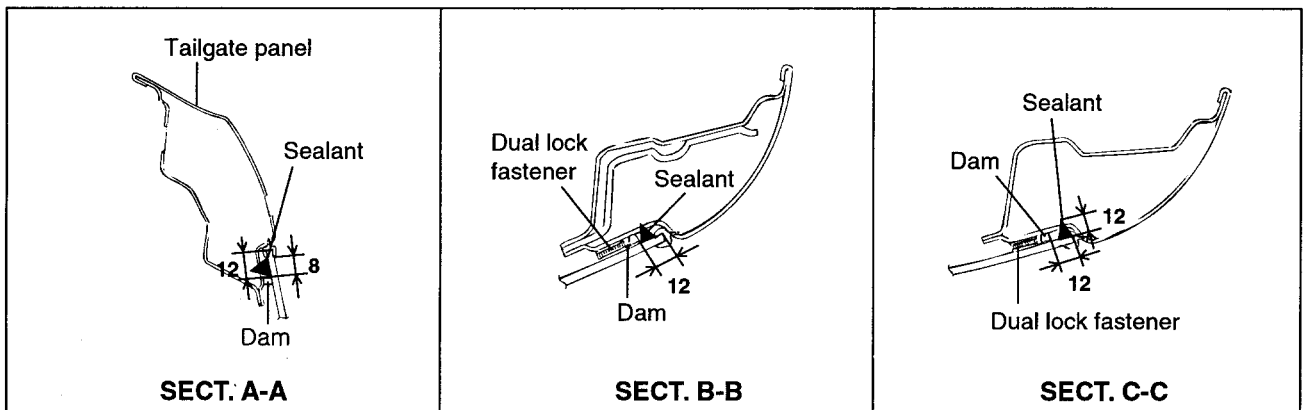
1. **Keep the windshield dry for the first hour after installation.**
2. **Let the car stand for at least four hours after windshield installation. If the car has to be used within the first 8 hours, it must be driven slowly.**
3. **Take care not to slam the doors with all the windows rolled up.**
4. **Take care not to twist the vehicle excessively (such as when going in and out of driveways at an angle or driving over rough, uneven roads).**

# TAILGATE GLASS

## COMPONENTS ESMB1300



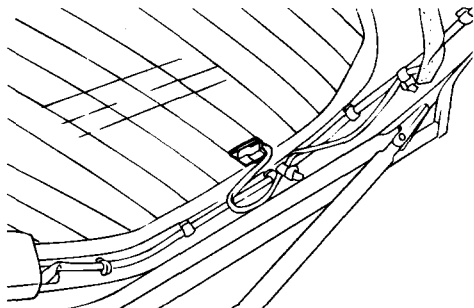
Unit : mm



**REMOVAL** ESMB1350

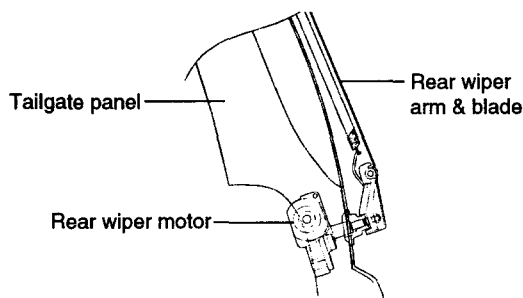
1. To remove the tailgate glass, first remove the following parts :

- 1) Rear window defogger wire connector.



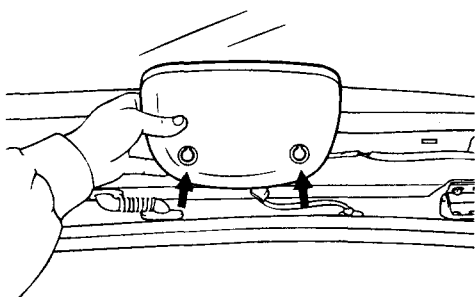
KSMB135A

- 2) Tailgate trims.
- 3) Rear wiper and wiper motor.



ETMB008D

- 4) High mounted stop lamp.



ESJA040N

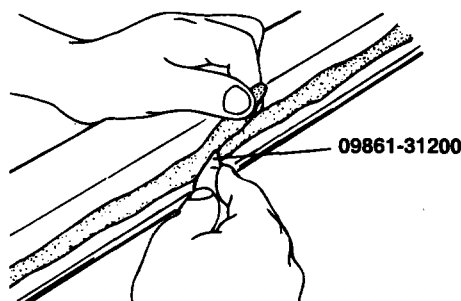
2. Remove the tailgate glass in the same manner as the windshield glass.

**INSTALLATION** ESMB1400

1. Using a cutter knife or the special tool (09861-31200), scrape the old sealant smoothly to a thickness of about 2 mm (0.08 in.) on the bonding surface around the entire tailgate glass.

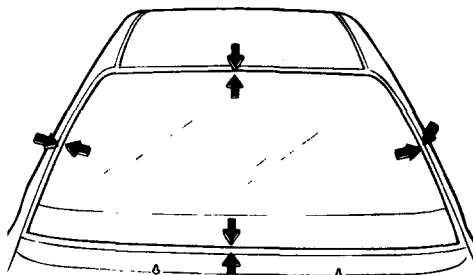
**CAUTION**

*Be careful not to remove more adhesive than necessary, and also not to damage the paintwork on the body surface with the knife. If the paintwork is damaged, repair the damaged area with touch-up paint.*



ESDA235B

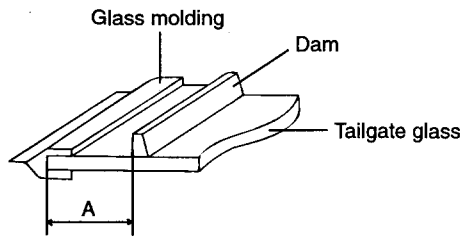
- 2. Clean the body bonding surface with a sponge dampened in alcohol or wax and grease remover.
- 3. Center a new tailgate glass in the opening. Mark the location by marking lines across the glass and body with a grease pencil at the four points as shown.



ESHA150B

4. Glue the rubber dam to the inside surface of the tailgate glass around the entire edge as shown, to contain the sealant during installation.

Part	A	Remarks
Upper	12mm	Glass molding sub
Side		
Lower		

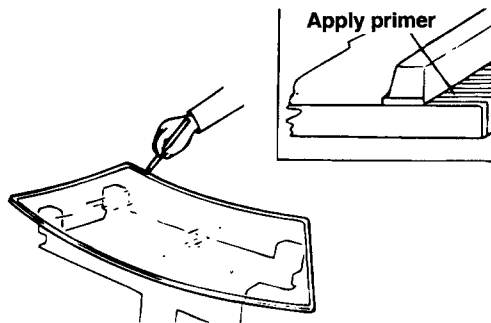


ETMB833A

5. Install the tailgate glass molding without any gaps.
6. Apply a light coat of glass primer to the outside of the dam.

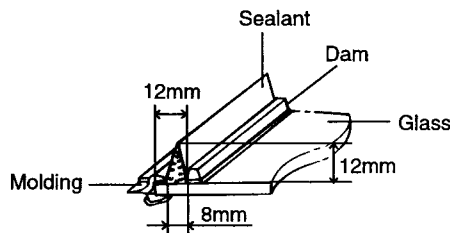
**NOTE**

1. *Never touch the surface applied primer with your hands. If you do, the adhesive may not bond to the glass properly, causing a leak after the tailgate glass has been installed.*
2. *Do not apply body primer to the glass.*
3. *Keep water, dust, and abrasive materials away from the surface applied primer.*



ESDA235E

7. Apply a sealant around the edge of the glass.

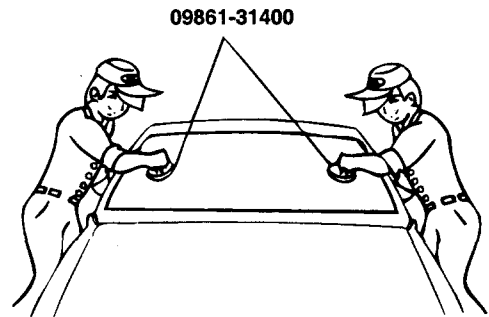


ESMB135B

**NOTE**

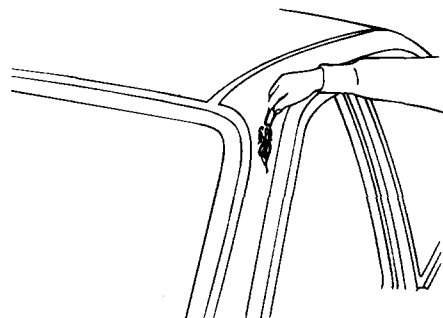
*Apply the adhesive within 5 minutes after applying the primer to the glass.*

8. Apply a light coat of body primer to the original sealant remaining around the window opening flange. The glass should be installed within 5 minutes after you apply the primer.
9. Use suction cups or the special tool, lower the glass over the opening, align it with the marks made in step 3 and set it down on the sealant.



ESDA230D

10. Scrape or wipe excess adhesive off with putty knife or gauze. Fill all cavities around the tailgate glass.
11. Perform a water-leak test for the tailgate glass. Use a cold water spray, being careful not to direct a powerful stream of water on the new adhesive material. Allow water to spill over the edges of the glass.
12. If there are leaks, dry the affected area, then apply sealant.



ESDA235G

13. Install the removed parts.

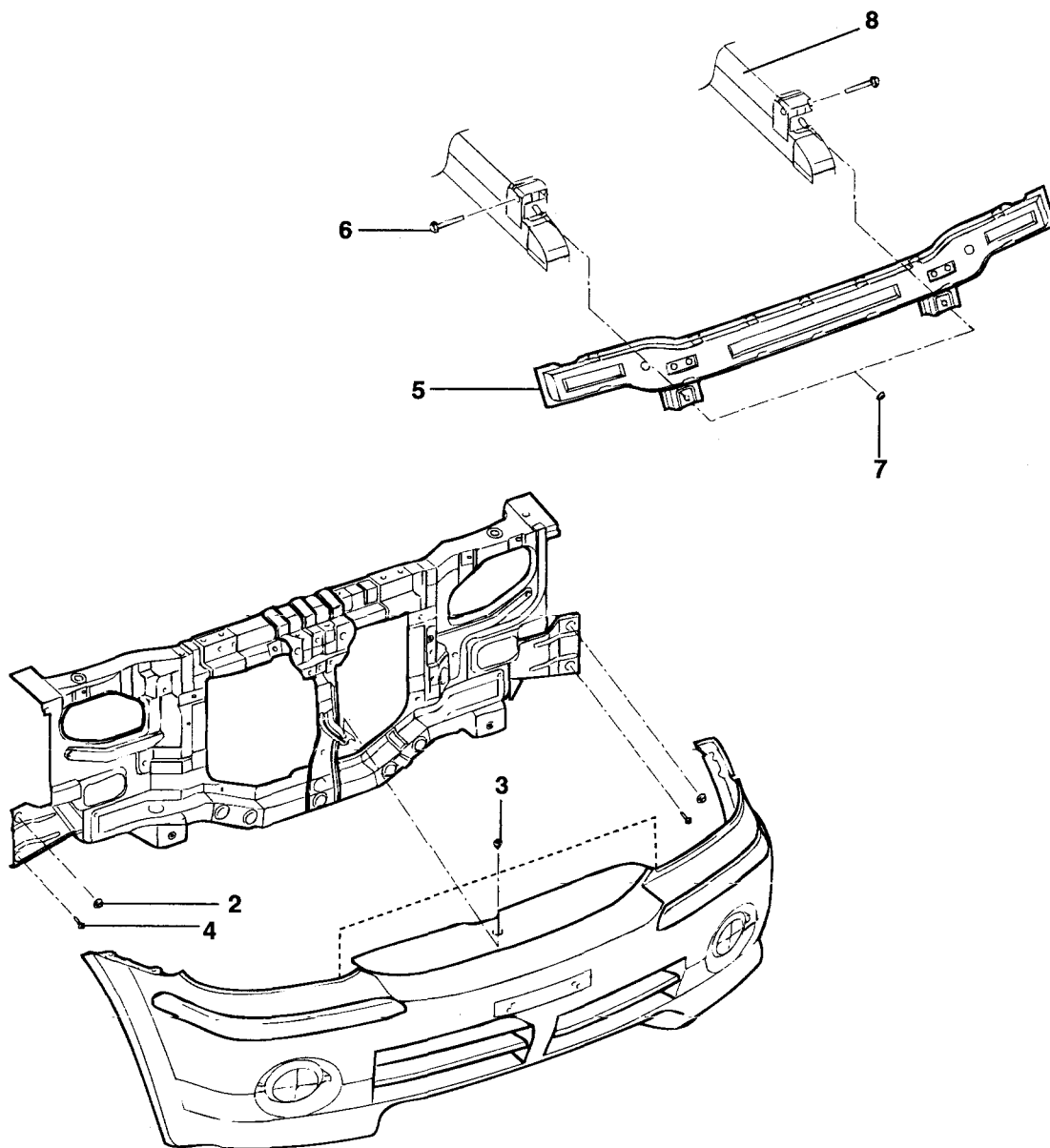
**CAUTION**

1. **Keep the tailgate glass dry for the first hour after installation.**
2. **Let the car stand for at least four hours after tailgate glass installation. If the car has to be used within the first 8 hours, it must be driven slowly.**
3. **Take care not to slam the doors with all the windows rolled up.**

4. *Take care not to twist the vehicle excessively (such as when going in and out of driveways at an angle or driving over rough, uneven roads).*

## BUMPER

## FRONT BUMPER

COMPONENTS ESMB1450

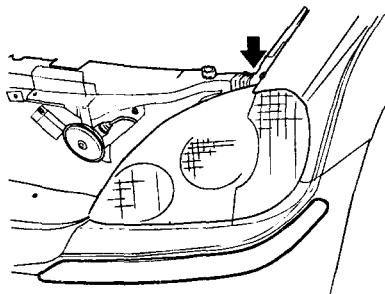
1. Front bumper cover
2. Flange nut
3. Retainer
4. Bolt

5. Front bumper beam
6. Bolt
7. Flange nut
8. Chassis frame



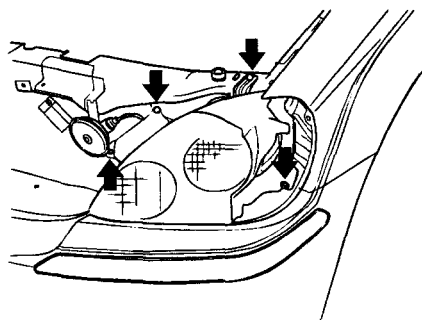
**REMOVAL AND INSTALLATION** ESMB1500

1. Remove the screw holding the turn signal lamp and disconnect the wire connector.



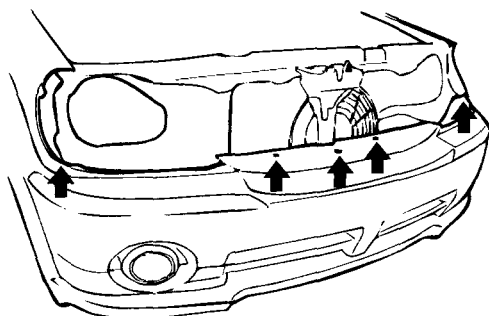
KTMB007E

2. Remove the 4 bolts holding the head lamp and disconnect the wire connectors.



KTMB007F

3. Remove the 3 screws and 2 nuts holding the front bumper upper cover.



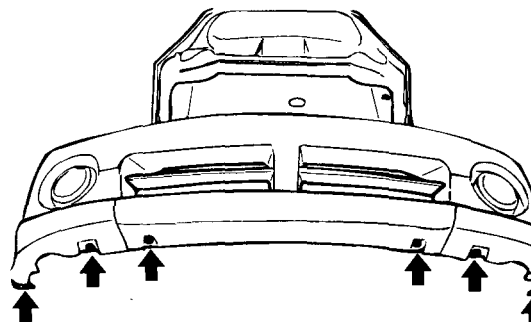
KSMB008A

4. Remove the bolt and nut holding the bumper cover bracket.



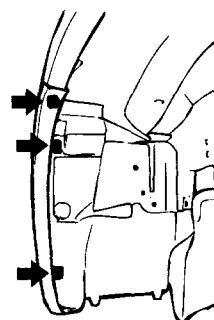
KSMB008B

5. Raise the vehicle then remove the 4 bolts and 2 screws holding the front bumper lower cover.



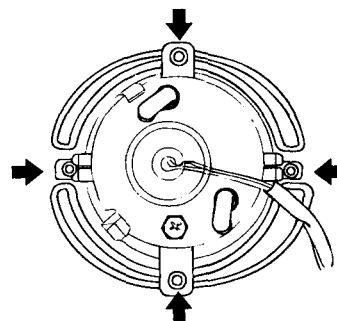
KSMB008C

6. Remove the screws holding the front wheel guard.



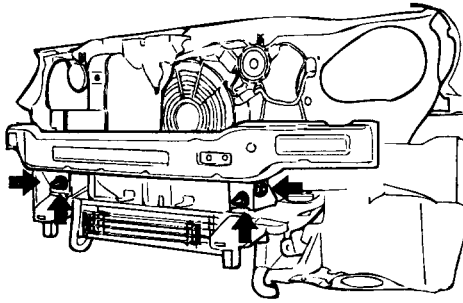
KSMB008D

7. Remove the front fog lamp after removing the front bumper cover.



KTMB007A

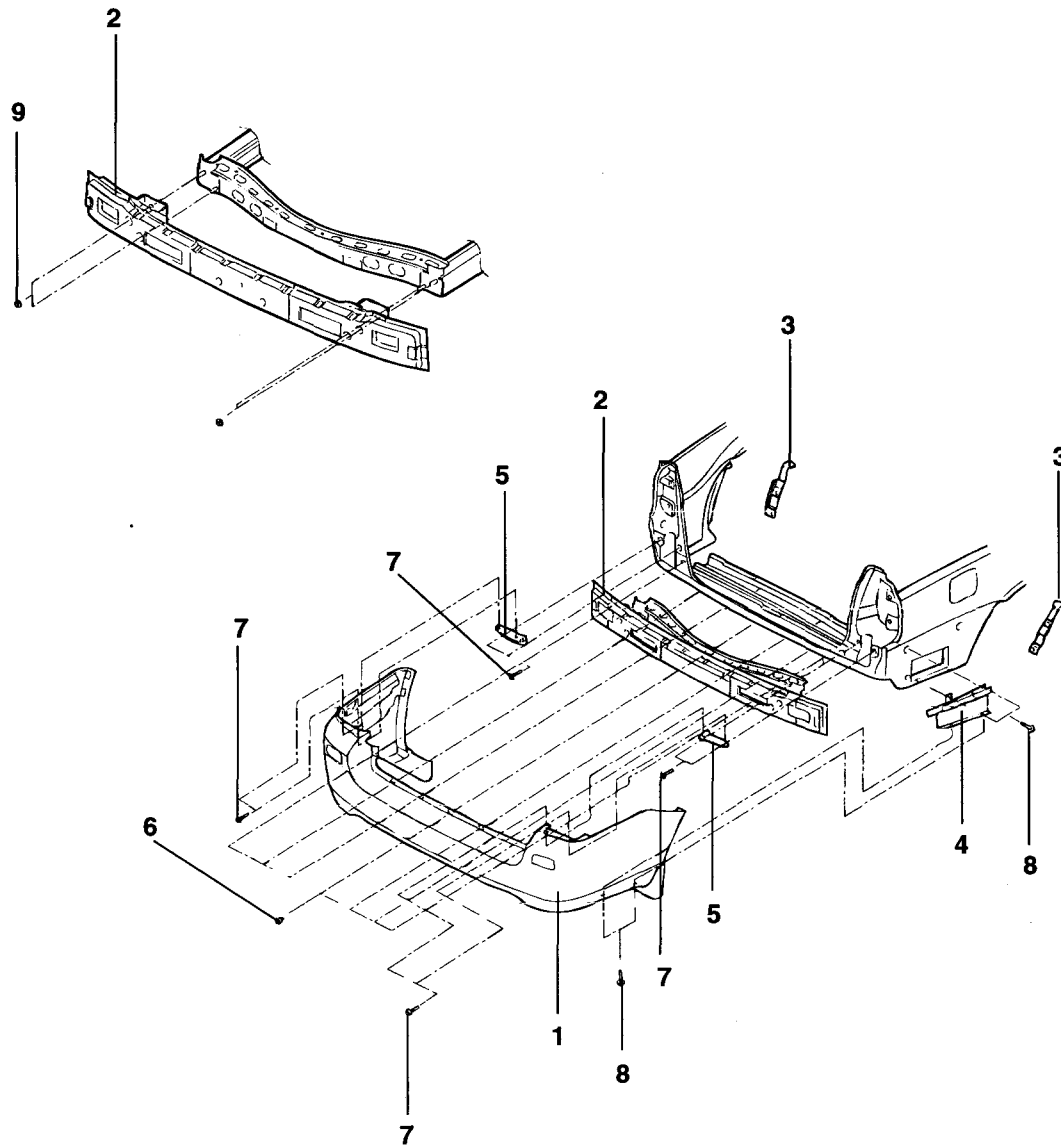
8. Remove the front bumper beam after removing the 2 bolts and 2 nuts.



KSMB008E

9. Installation is the reverse of removal.

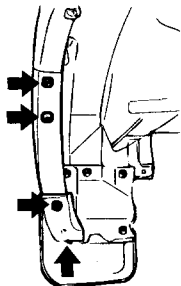
## REAR BUMPER

COMPONENTS ESMB1550

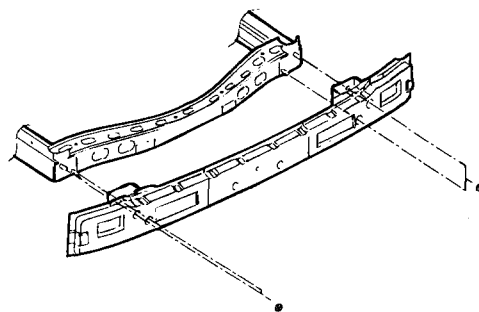
- |                            |                  |
|----------------------------|------------------|
| 1. Rear bumper cover       | 6. Retainer      |
| 2. Rear bumper beam        | 7. Bolt          |
| 3. Side bracket            | 8. Tapping screw |
| 4. Rear bumper lower guard | 9. Nut           |
| 5. Upper bracket           |                  |

## REMOVAL AND INSTALLATION ESMB1600

1. Remove the screws and bolts holding the rear mud guard.

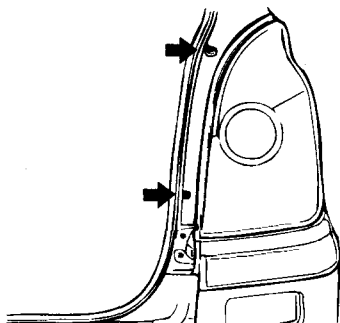


KSMB006D



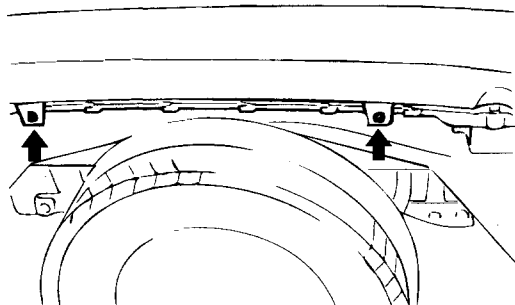
KSMB002I

2. Remove the rear combination lamp after removing the 2 bolts.



KSMB006E

3. Remove the screws and bolts holding the rear bumper upper cover.
4. Raise the vehicle then remove the screws holding the rear bumper lower cover.



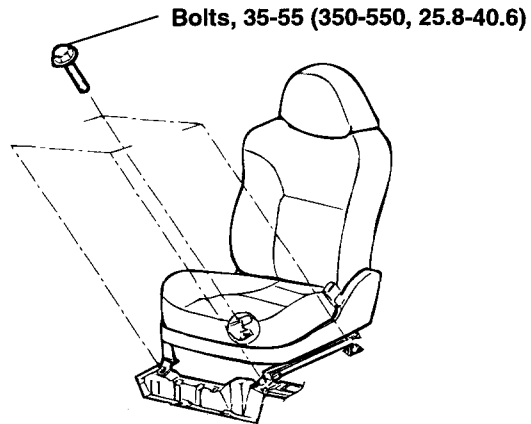
KSMB006F

5. Remove the nuts holding the rear bumper beam and remove it.

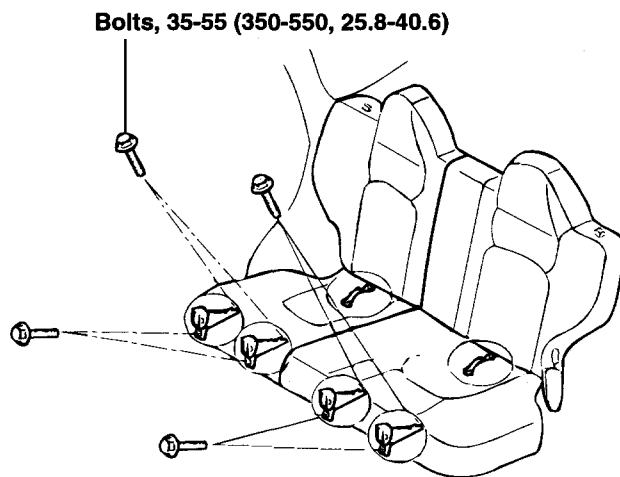
# SEAT

## COMPONENTS ESMB1650

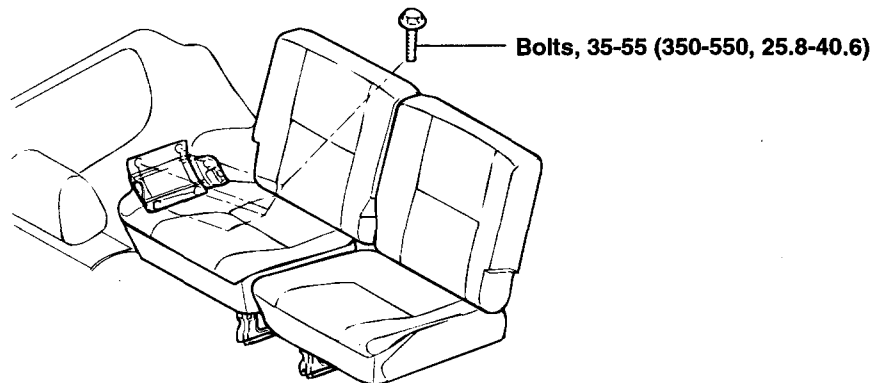
### [ FRONT SEAT ]



### [ REAR SEAT ]



### [ THIRD SEAT ]

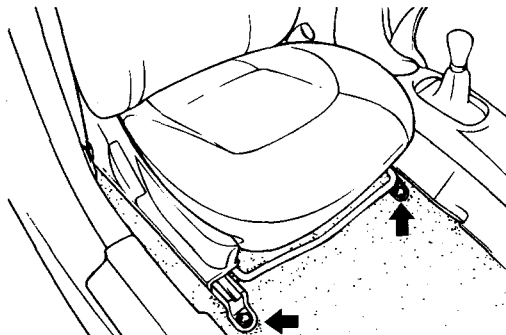


**TORQUE : Nm (kg·cm, lb·ft)**

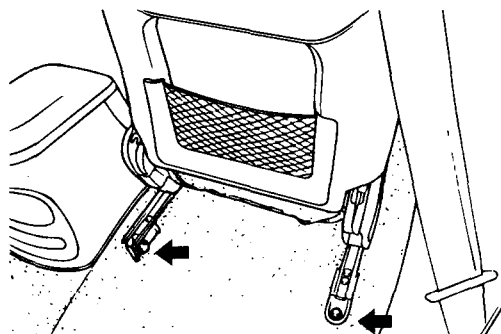
## FRONT SEAT

REMOVAL AND INSTALLATION ESMB1700

1. Remove the front seat mounting bolts (4EA), and disconnect the wire connectors. Remove the front seat assembly.



ESJA070A

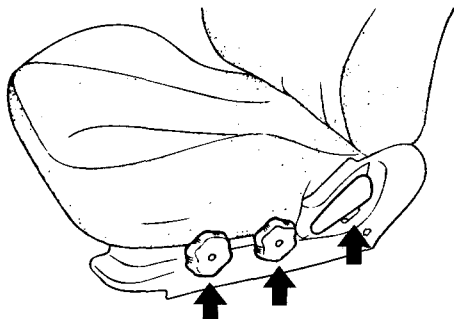


ESJA070B

## Tightening torque

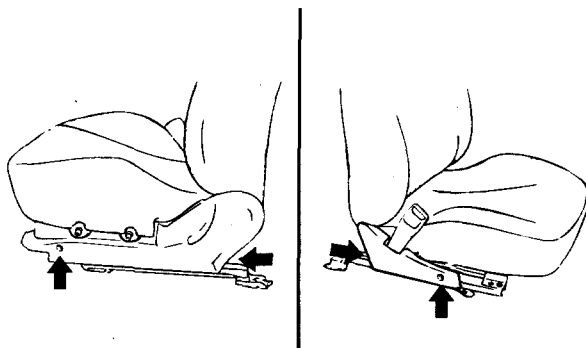
35 - 55 Nm (350 - 550 kg·cm, 25.8 - 40.6 lb·ft)

2. Remove the seat recliner lever and the height adjuster knob.



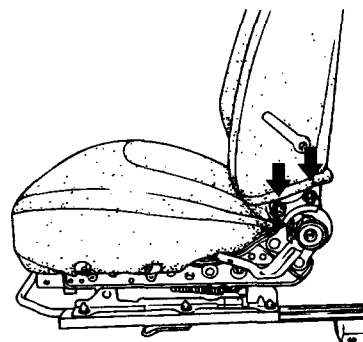
KSMB195A

3. Remove the seat shield cover.



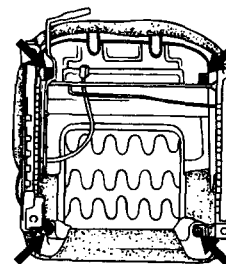
KSMB195B

4. Remove the seat back.



ESKA055F

5. Remove the front seat track.



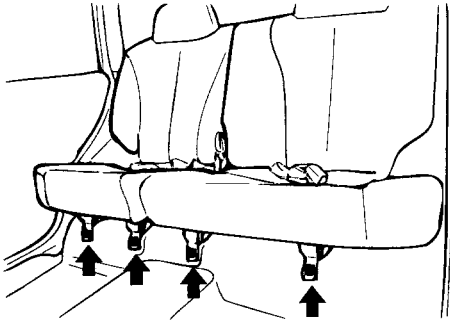
KSMB195C

6. Installation is the reverse of removal.

## REAR SEAT

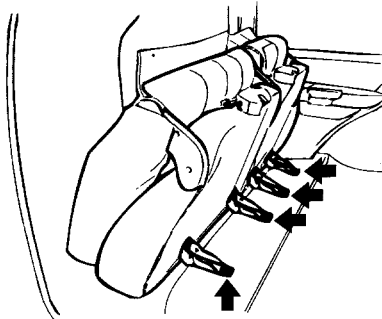
### REMOVAL AND INSTALLATION ESMB1750

1. Remove the rear seat mounting bolts (4EA).



KSMB011K

2. Remove the rear seat mounting bolts (4EA) with folding the rear seat up.  
Remove the rear seat assembly.



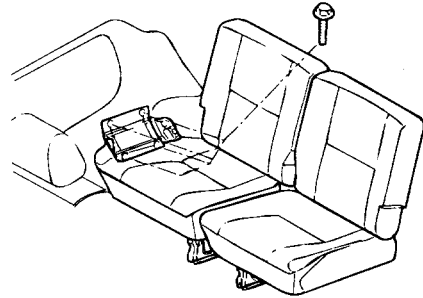
KSMB011L

#### Tightening torque

35 - 55 Nm (350 - 550 kg·cm, 25.8 - 40.6 lb·ft)

## THIRD SEAT

Remove the third seat mounting bolts and remove the third seat assembly.



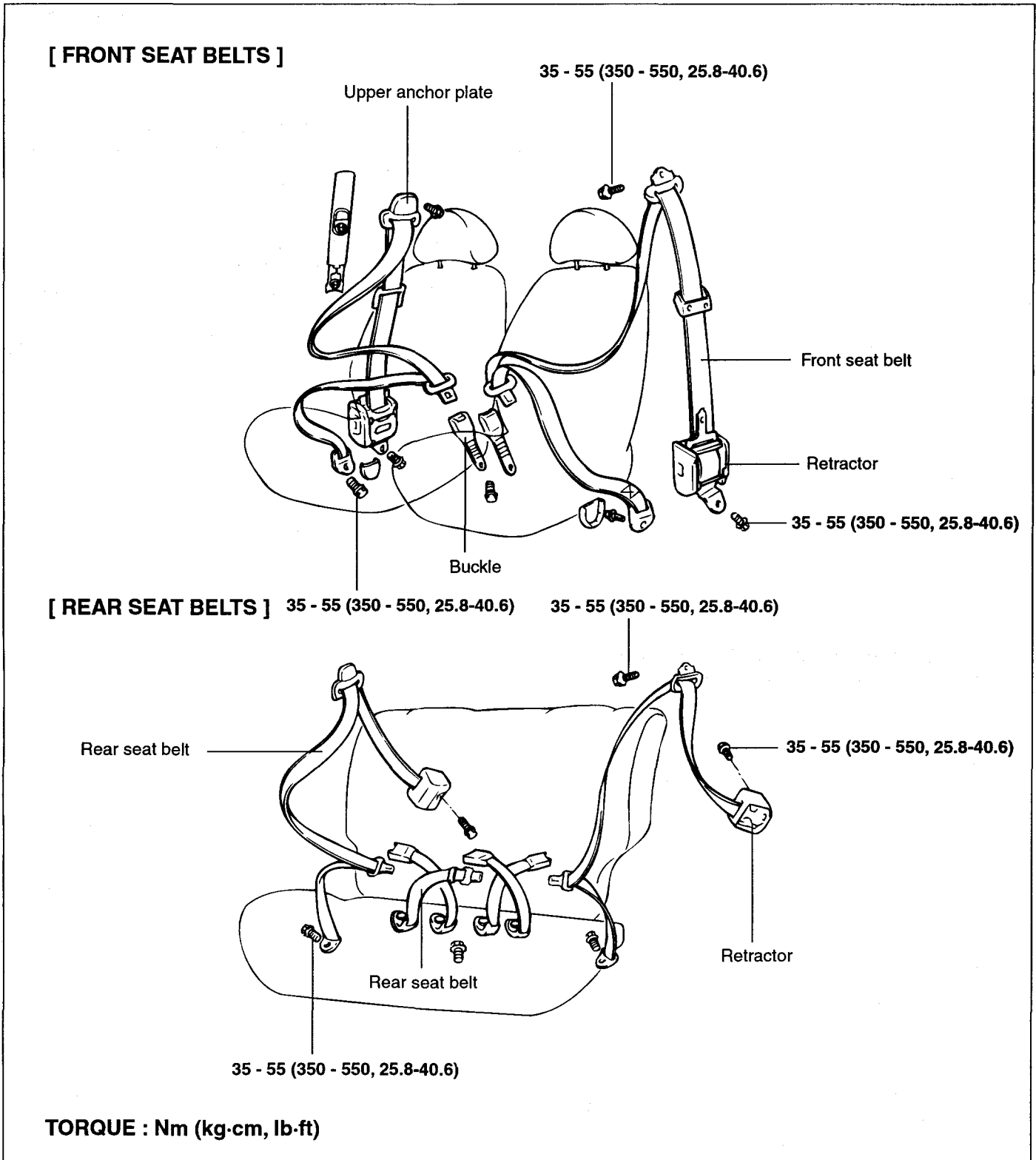
KSMB011N

#### Tightening torque

35 - 55 Nm (350 - 550 kg·cm, 25.8 - 40.6 lb·ft)

# FRONT SEAT BELT

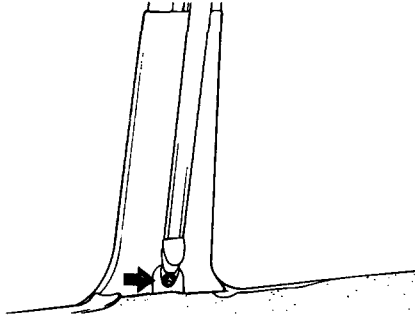
## COMPONENTS ESMB1800





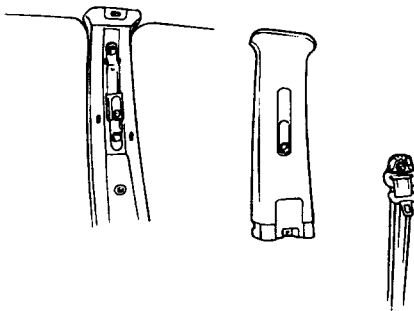
**REMOVAL AND INSTALLATION** ESHA1850

1. Loosen the seat belt lower anchor bolt and remove the center pillar lower trim.



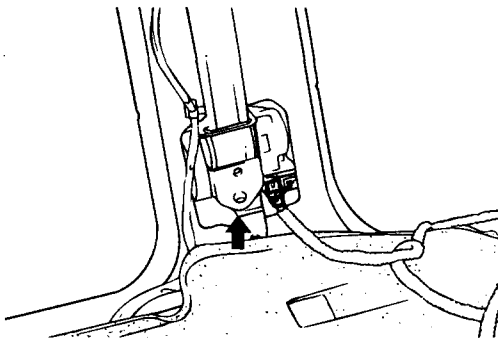
ESHA040I

2. Loosen the seat belt upper anchor bolt.



ESHA045B

3. In case of vehicles equipped with pretensioner seat belt, disconnect the negative (-) battery terminal and disconnect the connector from the gas generator and then remove the retractor.



ESHA040J

4. Installation is the reverse of removal.

**⚠ CAUTION**

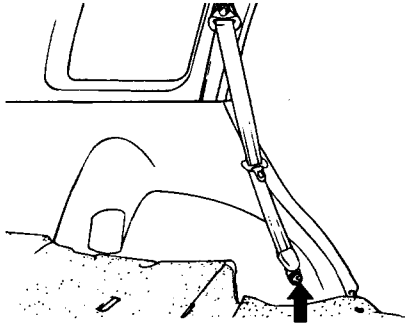
1. **A pretensioner functions one time only. Be sure to replace the pretensioner seat belt after it is deployed.**
2. **Do not attempt to disassemble or repair the seat belt pre-tensioner. When it malfunctions, replace with a new pre-tensioner seat belt.**

3. **Be cautious in handling a pre-tensioner seat belt, and do not drop it in water, or oil. If crushed, damaged, or deformed, replace it with a new one.**
4. **Only connect the battery after installation of the pretensioner seat belt has been correctly completed.**
5. **Removal of the pretensioner seat belt :**
  - **Make sure that ignition is "Off".**
  - **Disconnect the negative (-) battery terminal and make sure it does not come into contact with the body.**
  - **Wait for about 1 minute.**
  - **Pull the plug out from the appropriate connector at the gas generator.**
  - **Loosen the bolt and remove the belt from the vehicle body.**

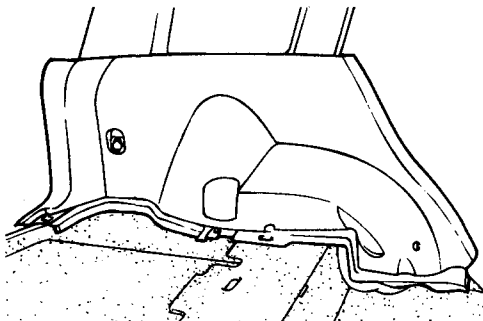
## REAR SEAT BELT

### REMOVAL AND INSTALLATION ESMB1900

1. Loosen the seat belt lower anchor bolt and remove the quarter trim.

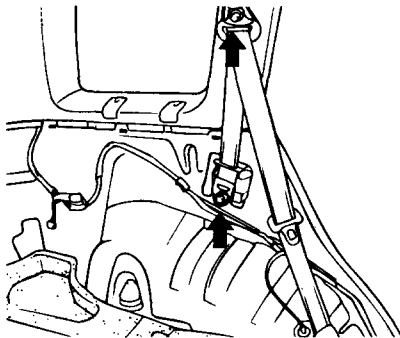


KSMB210A



KSMB210B

2. Loosen the seat belt upper anchor bolt and retractor mounting bolt, then remove the rear seat belt.



KSMB210C

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#### Tightening torque

35 - 55 Nm (350 - 550 kg·cm, 25.8 - 40.6 lb·ft)

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3. Installation is the reverse of removal.