

## SECTION 6

# ENGINE GENERAL INFORMATION AND DIAGNOSIS (G16/J20 ENGINES)

**WARNING:**

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

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

**NOTE:**

Whether following systems (parts) are used in the particular vehicle or not depends on specifications. Be sure to bear this in mind when performing service work.

- MAP sensor
- EGR valve
- Heated oxygen sensor(s) or CO adjusting resistor
- Three way catalytic converter, warm-up three way catalytic converter
- Ignition timing adjusting register or CKP sensor
- Diagnosis connector

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## Precaution on fuel system service

- Work must be done with no smoking, in a well-ventilated area and away from any open flames.
- As fuel feed line (between fuel pump and fuel pressure regulator) is still under high fuel pressure even after engine was stopped, loosening or disconnecting fuel feed line directly may cause dangerous spout of fuel to occur where loosened or disconnected. Before loosening or disconnecting fuel feed line, make sure to release fuel pressure according to “Fuel Pressure Relief Procedure” in this section.

A small amount of fuel may be released after fuel line is disconnected.

In order to reduce the chance of personal injury, cover fitting to be disconnected with a shop cloth. Put that cloth in an approved container when disconnection is completed.

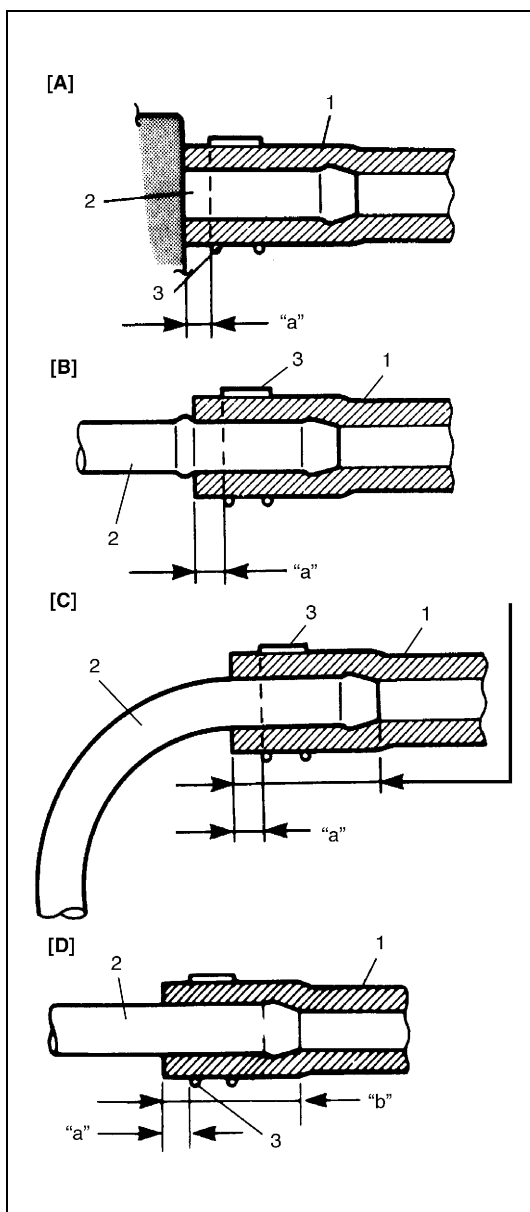
- Never run engine with fuel pump relay disconnected when engine and exhaust system are hot.

- Fuel or fuel vapor hose connection varies with each type of pipe.

When reconnecting fuel or fuel vapor hose, be sure to connect and clamp each hose correctly referring to figure “Hose Connection”.

After connecting, make sure that it has no twist or kink.

- When installing fuel feed pipe union bolt or fuel delivery pipe plug bolt, always use new gasket and tighten it to specified torque. See “Fuel Delivery System” in Section 6 for specified torque.
- When installing injector, fuel feed pipe or fuel pressure regulator, lubricate its O-ring with spindle oil or gasoline.



[A] :	With short pipe, fit hose as far as it reaches pipe joint as shown.
[B] :	With following type pipe, fit hose as far as its peripheral projection as shown.
[C] :	With bent pipe, fit hose as far as its bent part as shown or till pipe is about 20 to 30 mm (0.79 – 1.18 in.) into the hose.
[D] :	With straight pipe, fit hose till pipe is about 20 to 30 mm (0.79 – 1.18 in.) into the hose.
1.	Hose
2.	Pipe
3.	Clamp
“a” :	Clamp securely at a position 3 to 7 mm (0.12 – 0.27 in.) from hose end.
“b” :	20 to 30 mm (0.79 – 1.18 in.)

## Scan Tool Data

As the data values given below are standard values estimated on the basis of values obtained from the normally operating vehicles by using a scan tool, use them as reference values. Even when the vehicle is in good condition, there may be cases where the checked value does not fall within each specified data range. Therefore, judgment as abnormal should not be made by checking with these data alone.

Also, conditions in the below table that can be checked by the scan tool are those output from ECM (PCM) as Commands and there may be cases where the engine or actuator is not operating (in the condition) as indicated by the scan tool. Be sure to use the timing light to check the ignition timing.

### NOTE:

- For asterisk (\*) marked item in OTHER column, item can be read only SUZUKI scan tool.
- When checking the data with the engine running at idle or racing, be sure to shift M/T gear to the neutral gear position and A/T gear to the “Park” position and pull the parking brake fully. Also, if nothing or “no load” is indicated, turn OFF A/C, all electric loads, P/S and all the other necessary switches.

SCAN TOOL DATA	CONDITION		NORMAL CONDITION/ REFERENCE VALUE		OTHER
COOLANT TEMP. (Engine Coolant Temp.)	At specified idle speed after warming up		G16	80 – 105°C (176 – 221°F)	
			J20	70 – 100°C (158 – 212°F)	
INTAKE AIR TEMP.	At specified idle speed after warming up		Environmental temp. +35°C –5°C (+63°F –9°F)		
DESIRE IDLE (Desired Idle Speed)	At idling with no load after warming up		750 rpm		*
CLOSED THROT POS (Closed Throttle Position)	Ignition switch ON	Accelerator pedal released	ON		*
		Accelerator pedal depressed	OFF		
IAC FLOW DUTY	At specified idle speed after warming up		5 – 30%		*
ENGINE SPEED	At idling with no load after warming up		Desired idle speed ± 50 rpm		
SHORT FT B1 (Short Term Fuel Trim)	At specified idle speed after warming up		–20 – +20%		
LONG FT B1 (Long Term Fuel Trim)	At specified idle speed after warming up		–15 – +15%		
IGNITION ADVANCE	At specified idle speed with no load after warming up		G16	6 – 10°	
			J20	12 – 16°	
BATTERY VOLTAGE	Ignition switch ON/engine stopped		10 – 14 V		*
MAF (Mass Air Flow Rate)	At specified idle speed with no load after warming up.		G16	1.1 – 2.9 g/s 0.14 – 0.38 lb/min.	
			J20	1.5 – 4.0 g/s 0.20 – 0.53 lb/min.	
	At 2500 r/min. with no load after warming up.		G16	5.0 – 9.0 g/s 0.66 – 1.12 lb/min.	
			J20	6.0 – 11.0 g/s 0.66 – 1.32 lb/min.	

**DTC DETECTING CONDITION AND TROUBLE AREA**

DTC DETECTING CONDITION	TROUBLE AREA
CKP sensor signal is not input while 20 pulses of CMP sensor signal are input after engine start.	<ul style="list-style-type: none"> <li>• CKP sensor circuit</li> <li>• CKP sensor</li> <li>• ECM (PCM)</li> </ul>

**DTC CONFIRMATION PROCEDURE****NOTE:**

Check to make sure that the following conditions are satisfied when using this “DTC Confirmation Procedure”.

- Intake air temp. : -8°C, 18°F or higher
- Engine coolant temp. : -8 – 110°C (18 – 230°F)
- Altitude (barometric pressure) : 2400 m, 8000 ft or less (560 mmHg, 75 kPa or more)

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool and run engine at idle speed for 10 sec.
- 3) Check DTC and pending DTC by using scan tool.

**TROUBLESHOOTING (DTC P0335)**

Step	Action	Yes	No
1	Was “Engine Diag. Flow Table” performed?	Go to Step 2.	Go to “Engine Diag. Flow Table”.
2	CKP Sensor and Its Circuit Resistance Check : 1) With ignition switch OFF, disconnect ECM (PCM) coupler (C51-2). 2) Check for proper connection to ECM (PCM) at C51-2-19 and C51-2-20 terminals. 3) If OK, check resistance of followings. <b>CKP resistance between C51-2-19 and C51-2-20 terminals of ECM (PCM)</b> <b>360 – 460 Ω at 20°C, 68°F (G16)</b> <b>484 – 656 Ω at 20°C, 68°F (J20)</b> <b>CKP resistance between each terminal of ECM (PCM) and ground : 1M Ω or more</b> Is check result satisfactory?	Go to Step 4.	Go to Step 3.
3	CKP Sensor Resistance Check : 1) With ignition switch OFF, disconnect CKP sensor coupler. 2) Check resistance between terminals of CKP sensor coupler for G16 engine, between “WHT” wire terminal (1) and “RED” wire terminal (2) for J20 engine. 3) Check resistance between each terminal and ground. (See Fig.) Were measured resistance values as specified in Step 2?	Faulty “WHT/BLU” wire or “ORN/BLU” wire.	Faulty CKP sensor.

**1. CUSTOMER COMPLAINT ANALYSIS**

Record details of the problem (failure, complaint) and how it occurred as described by the customer. For this purpose, use of such an inspection form will facilitate collecting information to the point required for proper analysis and diagnosis.

**CUSTOMER PROBLEM INSPECTION FORM (EXAMPLE)**

User name:	Model:	VIN:	
Date of issue:	Date of reg.:	Date of problem:	Mileage:

PROBLEM SYMPTOMS	
<input type="checkbox"/> <b>Difficult Starting</b> <input type="checkbox"/> No cranking <input type="checkbox"/> No initial combustion <input type="checkbox"/> No combustion <input type="checkbox"/> Poor starting at ( <input type="checkbox"/> cold <input type="checkbox"/> warm <input type="checkbox"/> always ) <input type="checkbox"/> Other _____	<input type="checkbox"/> <b>Poor Driveability</b> <input type="checkbox"/> Hesitation on acceleration <input type="checkbox"/> Back fire/ <input type="checkbox"/> After fire <input type="checkbox"/> Lack of power <input type="checkbox"/> Surging <input type="checkbox"/> Abnormal knocking <input type="checkbox"/> Other _____
<input type="checkbox"/> <b>Poor Idling</b> <input type="checkbox"/> Poor fast idle <input type="checkbox"/> Abnormal idling speed ( <input type="checkbox"/> High <input type="checkbox"/> Low ) (      r/min. ) <input type="checkbox"/> Unstable <input type="checkbox"/> Hunting (      r/min. to      r/min. ) <input type="checkbox"/> Other _____	<input type="checkbox"/> <b>Engine Stall when</b> <input type="checkbox"/> Immediately after start <input type="checkbox"/> Accel. pedal is depressed <input type="checkbox"/> Accel. pedal is released <input type="checkbox"/> Load is applied <input type="checkbox"/> A/C <input type="checkbox"/> Electric load <input type="checkbox"/> P/S <input type="checkbox"/> Other _____ <input type="checkbox"/> Other _____
<input type="checkbox"/> OTHERS:	

VEHICLE/ENVIRONMENTAL CONDITION WHEN PROBLEM OCCURS	
Environmental Condition	
Weather	<input type="checkbox"/> Fair <input type="checkbox"/> Cloudy <input type="checkbox"/> Rain <input type="checkbox"/> Snow <input type="checkbox"/> Always <input type="checkbox"/> Other _____
Temperature	<input type="checkbox"/> Hot <input type="checkbox"/> Warm <input type="checkbox"/> Cool <input type="checkbox"/> Cold (    °F/    °C ) <input type="checkbox"/> Always
Frequency	<input type="checkbox"/> Always <input type="checkbox"/> Sometimes (    times/    day, month ) <input type="checkbox"/> Only once <input type="checkbox"/> Under certain condition
Road	<input type="checkbox"/> Urban <input type="checkbox"/> Suburb <input type="checkbox"/> Highway <input type="checkbox"/> Mountainous ( <input type="checkbox"/> Uphill <input type="checkbox"/> Downhill ) <input type="checkbox"/> Tarmacadam <input type="checkbox"/> Gravel <input type="checkbox"/> Other _____
Vehicle Condition	
Engine Condition	<input type="checkbox"/> Cold <input type="checkbox"/> Warming up phase <input type="checkbox"/> Warmed up <input type="checkbox"/> Always <input type="checkbox"/> Other at starting <input type="checkbox"/> Immediately after start <input type="checkbox"/> Racing without load <input type="checkbox"/> Engine speed (      r/min )
Vehicle Condition	<input type="checkbox"/> During driving: <input type="checkbox"/> Constant speed <input type="checkbox"/> Accelerating <input type="checkbox"/> Decelerating <input type="checkbox"/> Right hand corner <input type="checkbox"/> left hand corner <input type="checkbox"/> When shifting (Lever position    ) <input type="checkbox"/> At stop <input type="checkbox"/> Vehicle speed when problem occurs (    km/h,    Mile/h ) <input type="checkbox"/> Other _____

Malfunction Indicator Lamp Condition	<input type="checkbox"/> Always ON <input type="checkbox"/> Sometimes ON <input type="checkbox"/> Always OFF <input type="checkbox"/> Good condition
Diagnostic Trouble Code	First check: <input type="checkbox"/> No code <input type="checkbox"/> Normal code <input type="checkbox"/> Malfunction code (      )
	Second check: <input type="checkbox"/> No code <input type="checkbox"/> Normal code <input type="checkbox"/> Malfunction code (      )

**NOTE:**

The above form is a standard sample. It should be modified according to conditions characteristic of each market.

**WARNING:**

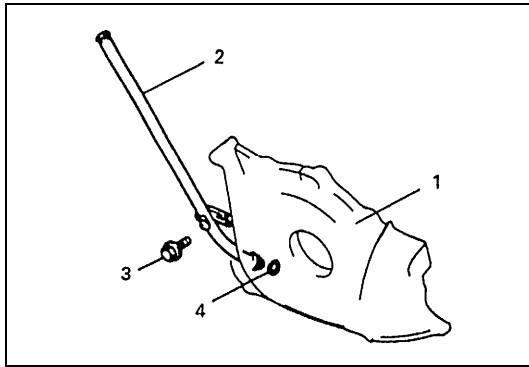
- When performing a road test, select a place where there is no traffic or possibility of a traffic accident and very careful during to avoid occurrence of an accident.
- Road test, should be carried out with 2 person, a driver and tester, on a level road.

- Intake air temperature : between  $-14^{\circ}\text{C}$  and  $70^{\circ}\text{C}$  ( $6.8^{\circ}\text{F}$  and  $158^{\circ}\text{F}$ )
- Atmospheric pressure : higher than 560 mmHg (Altitude : lower than 2790 m (9150 ft))
- Following DTCs are not detected : P0110 (No.23, 25), P0335, P0460, P01450 and P01451

- 1) With ignition switch OFF, connect scan tool.
- 2) Turn ON ignition switch and clear DTC by using scan tool if any.
- 3) Start engine and warm up to normal operating temperature.
- 4) Increase vehicle speed to 56 km/h (35 mph) or more.
- 5) Keep above vehicle speed for 5 min. (Throttle valve operating is kept constant in this step.)
- 6) Increase vehicle speed to 80 – 100 km/h (50 – 60 mph). (engine speed; 2500 – 3000 r/min.)
- 7) Keep above vehicle speed for 1 min. (Throttle valve operating is kept constant in this step.)
- 8) Release accelerator pedal and with engine brake applied, keep vehicle coasting and then stop vehicle.
- 9) Check DTC and pending DTC by using scan tool.

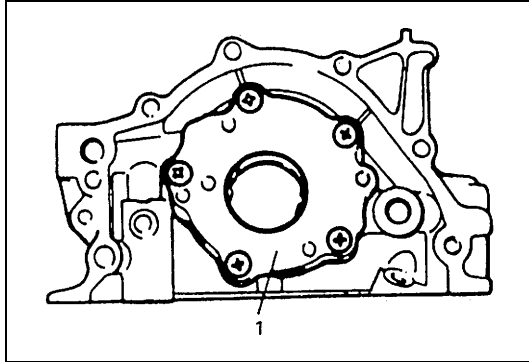
**DTC TROUBLESHOOTING**

Step	Action	Yes	No
1	Was "Engine Diag. Flow Table" performed?	Go to Step 2.	Go to "Engine Diag. Flow Table".
2	HO2S Voltage check : 1) With ignition switch OFF, install scan tool. 2) Start engine and check "O2S B2 S2" (HO2S voltage) displayed on scan tool while repeating racing engine. Does the voltage deflect between 0 – 0.25 V and 0.35 – 2.0 V?	Intermittent trouble. If OK, substitute a known-good ECM (PCM) and recheck.	Go to Step 3.
3	Wire Harness check : 1) Check "RED/YEL" and "GRN/YEL" wire. Are they in good condition?	Go to Step 4.	Repair or replace.
4	Fuel Injector Circuit check : 1) Check fuel injector circuit referring to "Table B-2" in this section. Is it in good condition?	Go to Step 5.	Repair or replace.
5	Fuel Injector inspection : 1) Inspect fuel injectors (No.2, 4, 6) referring to "Fuel Injector" in Section 6E2. Are they in good condition?	Go to Step 6.	Faulty fuel injector(s).
6	Fuel Pressure inspection : 1) Check fuel pressure referring to following "Table B-3" in this section. Is fuel pressure within specification?	Replace HO2S and recheck. If DTC P0156 detected, substitute a known-good ECM (PCM) and recheck.	Repair or replace.

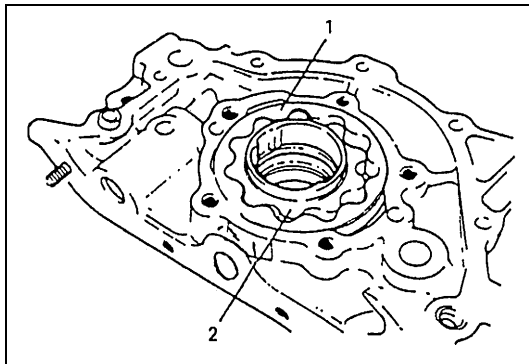
**DISASSEMBLY**

- 1) Remove oil level gauge guide bolt (3) and pull out guide (2) from oil pump (1).

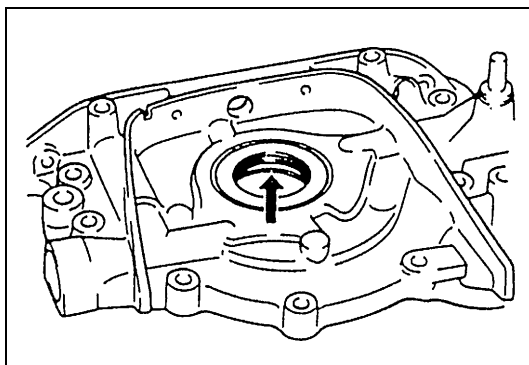
4. Guide seal
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- 2) Remove rotor plate (1).



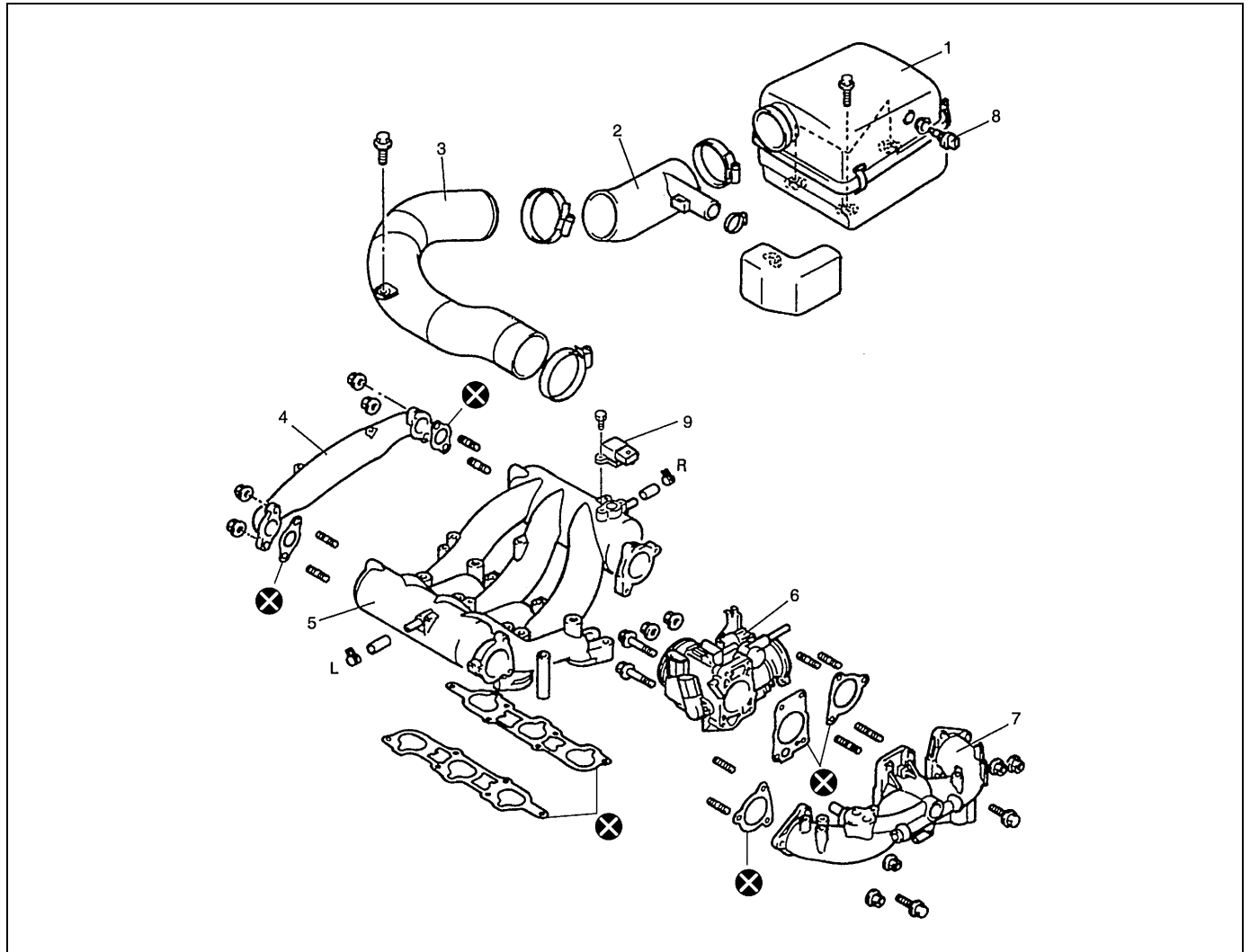
- 3) Remove outer rotor (1) and inner rotor (2).

**INSPECTION**

- Check oil seal lip for fault or other damage. Replace as necessary.

# Throttle Body and Intake Manifold

## COMPONENTS



1. Air cleaner box	3. Intake air pipe	5. Intake manifold	7. Intake collector	9. Manifold absolute pressure (MAP) sensor
2. Intake air hose	4. Surge tank pipe	6. Throttle body	8. Intake air temperature sensor	⊗ Do not reuse

### REMOVAL

- 1) Release fuel pressure in fuel feed line by referring to "Fuel Pressure Relief Procedure" in Section 6-1.

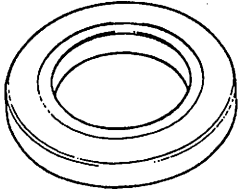
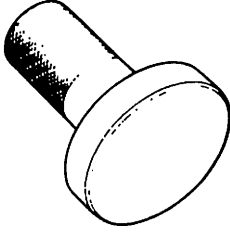
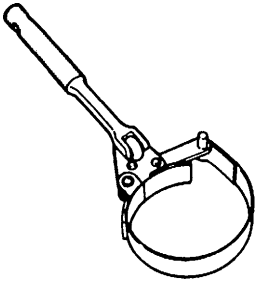
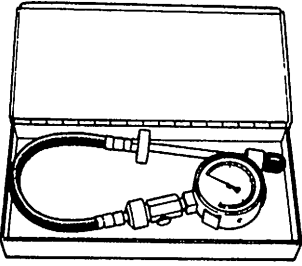
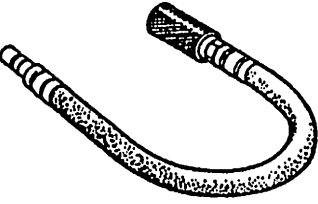
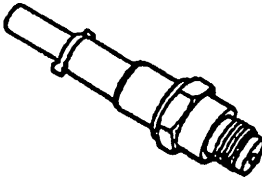
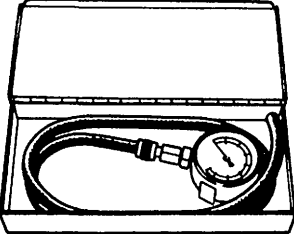
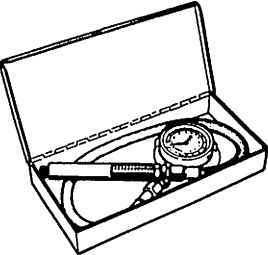
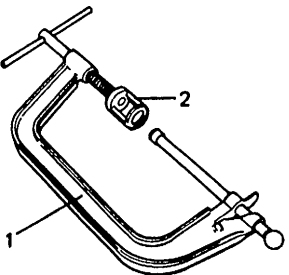
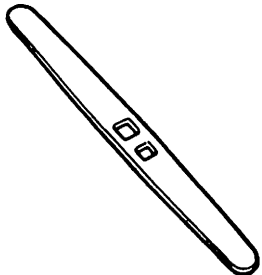
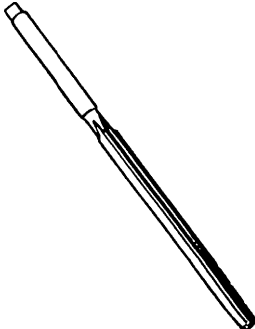
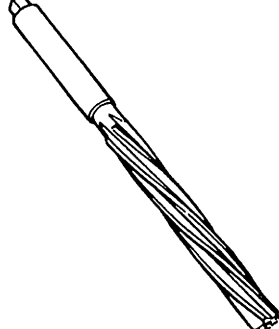
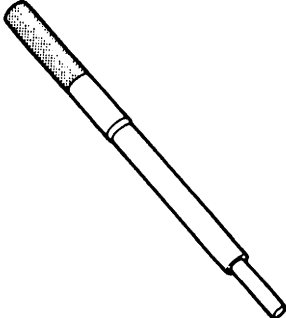
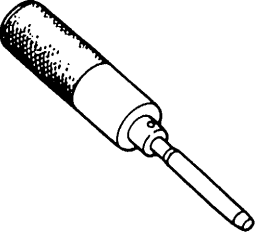
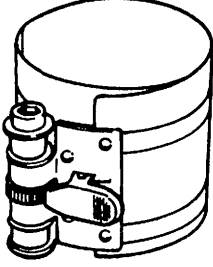
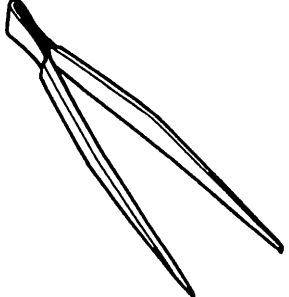
#### CAUTION:

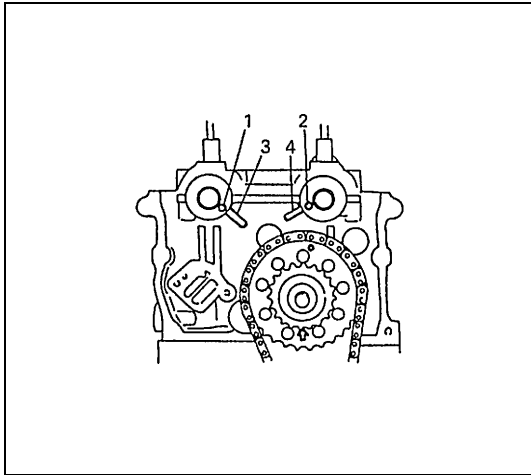
**This work must not be done when engine is hot. If done so, it may cause adverse effect to catalyst.**

- 2) Disconnect negative cable at battery.



## Special Tool

 <p>09911-97811 Oil seal installer</p>	 <p>09913-75510 Bearing installer</p>	 <p>09915-47311 Oil filter wrench</p>	 <p>09915-64512 Compression gauge</p>
 <p>09915-64530 Compression gauge hose</p>	 <p>09915-67010 Compression gauge attachment (c)</p>	 <p>09915-67311 Vacuum gauge</p>	 <p>09915-77311 Oil pressure gauge</p>
 <p>See NOTE.</p>	 <p>09916-34542 Reamer handle</p>	 <p>09916-37810 Reamer (6 mm)</p>	 <p>09916-38210 Reamer (11 mm)</p>
 <p>09916-44910 Valve guide remover</p>	 <p>09916-58210 Valve guide installer handle</p>	 <p>09916-77310 Piston ring compressor</p>	 <p>09916-84511 Forceps</p>

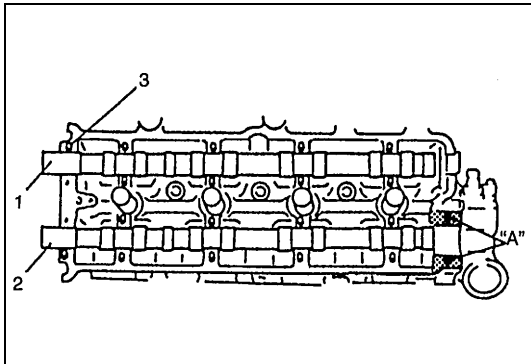


- 4) Install camshafts.  
Apply oil to sliding surface of each camshaft and camshaft journal then install them by aligning match marks on cylinder head and pins on camshafts as shown in figure.

**NOTE:**

**Install camshaft in such direction that its end with groove for CMP sensor installation comes to exhaust side.**

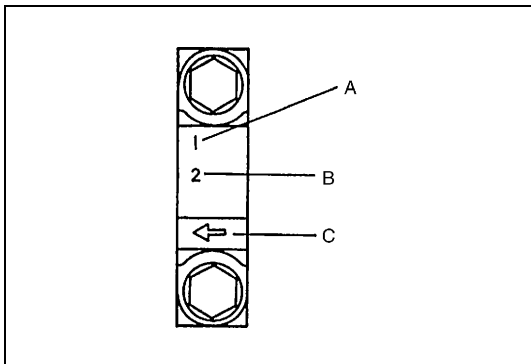
1. Knock pin of intake camshaft
2. Knock pin of exhaust camshaft
3. Match mark for intake camshaft
4. Match mark for exhaust camshaft



- 5) Install camshaft housing pins (3) as shown in figure.  
6) Apply sealant "A" to exhaust camshaft (2) end housing sealing surface area as shown in figure.

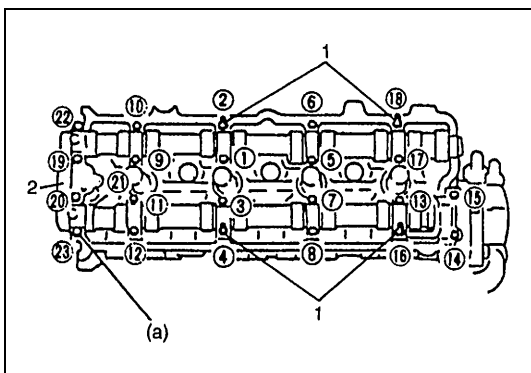
**"A" : Sealant 99000-31250**

1. Intake camshaft
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- 7) Check position of camshaft housings.  
Embossed marks are provided on each camshaft housing, indicating position and direction for installation. Install housings as indicated by these marks.

A : I : Intake side or E : Exhaust side
B : Position from timing chain side
C : Timing chain side



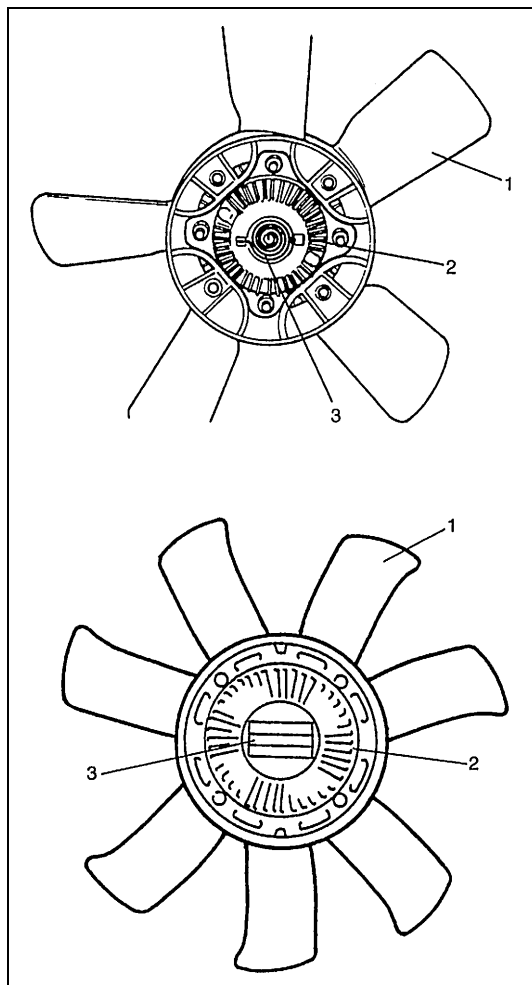
- 8) After applying oil to housing bolts, tighten them temporarily first. Then tighten them by following sequence as indicated in figure. Tighten a little at a time and evenly among bolts and repeat tightening sequence three or four times before they are tightened to specified torque.

**Tightening torque**

**Camshaft housing bolt (a) : 11 N-m (1.1 kg-m, 8.0 lb-ft)**

1. Stud bolt
2. Timing chain guide

## Cooling Fan Clutch



Fluid is enclosed in the cooling fan clutch (2) and at its center front, there is a bimetal (3) whose thermal reaction and the engine speed control the cooling fan (1) speed.

### CAUTION:

**Do not disassemble fan clutch.**

### WARNING:

**Keep hands, tools, and clothing away from engine cooling fan (1) to help prevent personal injury.**

## Coolant

The coolant recovery system is standard. The coolant in the radiator expands with heat, and the overflow is collected in the reservoir.

When the system cools down, the coolant is drawn back into the radiator.

The cooling system has been filled at the factory with a quality coolant that is a 50/50 mixture of water and ethylene glycol antifreeze.

This 50/50 mixture coolant solution provides freezing protection to  $-36^{\circ}\text{C}$  ( $-33^{\circ}\text{F}$ ).

- Maintain cooling system freeze protection at  $-36^{\circ}\text{C}$  ( $-33^{\circ}\text{F}$ ) to ensure protection against corrosion and loss of coolant from boiling.

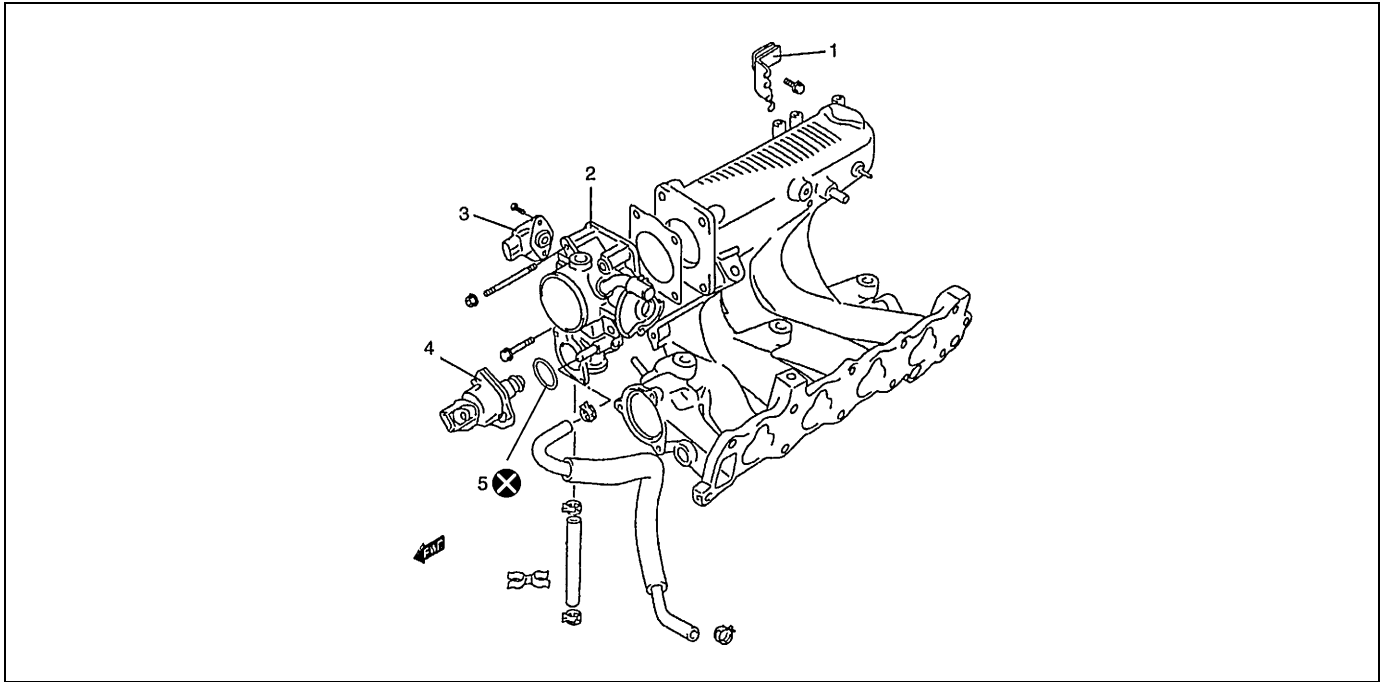
This should be done even if freezing temperatures are not expected.

- Add ethylene glycol base coolant when coolant has to be added because of coolant loss or to provide added protection against freezing at temperature lower than  $-36^{\circ}\text{C}$  ( $-33^{\circ}\text{F}$ ).

# Air Intake System

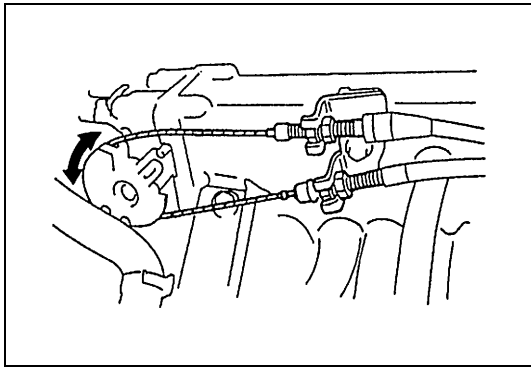
## Throttle body

### THROTTLE BODY COMPONENTS



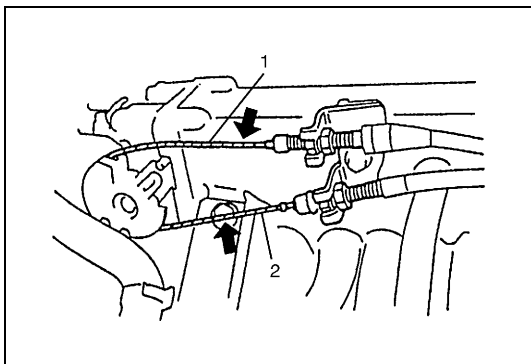
1. Cable bracket	3. TP sensor	5. O-ring
2. Throttle body	4. Idle air control valve	⊗ Do not reuse

### ON-VEHICLE INSPECTION

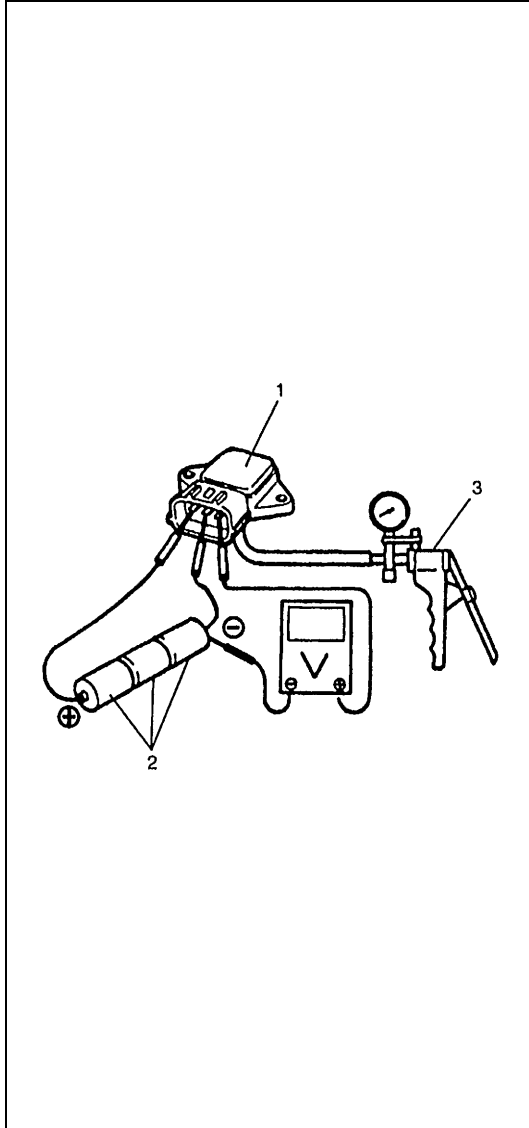


- Check that throttle valve lever moves smoothly.

### REMOVAL



- 1) Disconnect negative cable at battery.
- 2) Drain cooling system.
- 3) Disconnect accelerator cable (1) and/or A/T throttle cable (2) from throttle body.
- 4) Remove air cleaner outlet hose.

**Manifold absolute pressure sensor****INSPECTION**

- 1) Disconnect coupler from MAP sensor (1).
- 2) Remove MAP sensor (1).
- 3) Arrange 3 new 1.5 V batteries (2) in series (check that total voltage is 4.5 – 5.0 V) and connect its positive terminal to “Vin” terminal of sensor and negative terminal to “Ground” terminal. Then check voltage between “Vout” and “Ground”. Also, check if voltage reduces when vacuum is applied up to 400 mmHg by using vacuum pump (3).  
If check result is not satisfactory, replace MAP sensor (1).

**MAP sensor output voltage (Vin voltage 4.5 – 5.5 V, ambient temp. 20 – 30°C, 68 – 86°F)**

ALTITUDE (Reference)		BAROMETRIC PRESSURE		OUTPUT VOLTAGE
(ft)	(m)	(mmHg)	(kPa)	(V)
0	0	760	100	3.3 – 4.3
2 000	610	707	94	3.0 – 4.1
		Under 707 over 634		
2 001	611	Under 634 over 567	94	2.7 – 3.7
5 000	1 524	Under 567 over 526	85	2.5 – 3.3
5 001	1 525	76	76	
8 000	2 438	70	70	
8 001	2 439			
10 000	3 048			

- 4) Install MAP sensor (1) securely.
- 5) Connect MAP sensor (1) coupler securely.




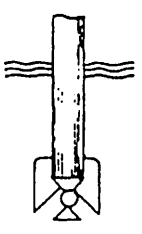
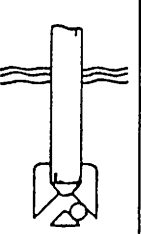
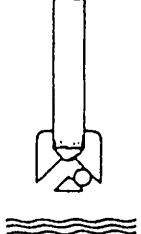
**Crankshaft position sensor****REMOVAL/INSTALLATION**

Refer to “Timing Chain Cover” in Section 6A2.

**INSPECTION**

Refer to “DTC P0335 Diag. Flow Table” in Section 6-1.

### Built-in indicator (If equipped)

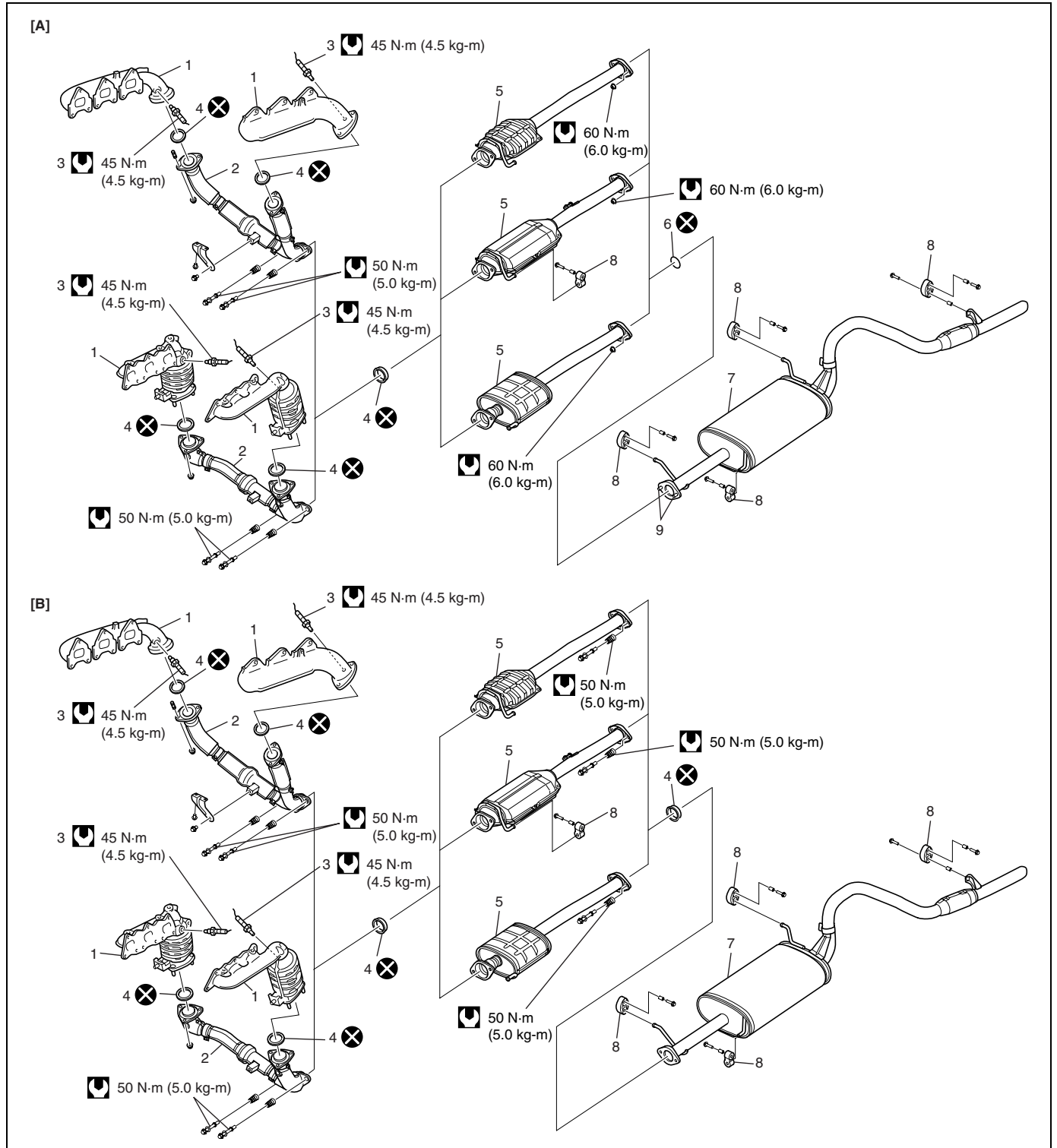
D I A G N O S I S	OK	CHARGING NECESSARY	LOW LEVEL ELECTROLYTE REPLACE BATTERY
I N D I C A T O R	Green dot 	Dark 	Clear 
G R A V I T Y  B A L L			

The battery has a built-in temperature compensated indicator in the top of the battery. This indicator is to be used with the following diagnostic procedure. When checking the indicator, make sure that the battery has a clean top. A light may be needed in some poorly-lit areas.

Three types of indication available under normal operation are as follows.

- Green Dot  
Battery is sufficiently charged for testing.
- Dark  
Battery must be charged before testing.  
If there is a cranking complaint, battery should be tested as described in Diagnosis section. Charging and electrical systems should also be checked at this time.
- Clear or Light Yellow  
This means that fluid level is below the bottom of hydrometer. Its possible cause is excessive or prolonged charging, a broken case, excessive tipping or normal battery deterioration.  
When the battery is found in such condition, it is possible that high charging voltage is caused by the faulty charging system and therefore, charging and electrical systems need to be checked. If there is a trouble in cranking and its cause lies in the battery, it should be replaced.

For H25 engine model



[A]: For type with muffler flange weld bolt	2. Exhaust No.1 pipe	5. Exhaust No.2 pipe	8. Rubber mounting	⊗ Do not reuse
[B]: For type without muffler flange weld bolt	3. Heated oxygen sensor	6. Gasket	9. Weld bolt	
1. Exhaust manifold	4. Gasket	7. Muffler	⤵ Tightening torque	