SECTION 6

ENGINE GENERAL INFORMATION AND DIAGNOSIS (M13/M16 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).**

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NOTE:

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

- **EGR valve**
- **Heated oxygen sensor(s) or CO adjusting resistor**
- **Three way catalytic converter**
- **Immobilizer indicator lamp**
- **Knock sensor**

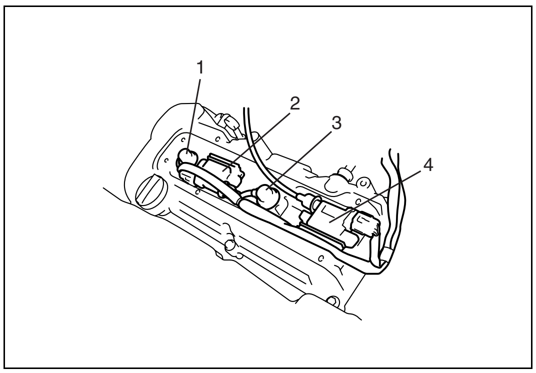
CONTENTS

General Information

Statement on Cleanliness and Care

An automobile engine is a combination of many machined, honed, polished and lapped surfaces with tolerances that are measured in the thousands of an millimeter (ten thousands of an inch).
Accordingly, when any internal engine parts are serviced, care and cleanliness are important.
Throughout this section, it should be understood that proper cleaning and protection of machined surfaces and friction areas is part of the repair procedure. This is considered standard shop practice even if not specifically stated.

- A liberal coating of engine oil should be applied to friction areas during assembly to protect and lubricate the surfaces on initial operation.
- Whenever valve train components, pistons, piston rings, connecting rods, rod bearings, and crankshaft journal bearings are removed for service, they should be retained in order.
  At the time of installation, they should be installed in the same locations and with the same mating surfaces as when removed.
- Battery cables should be disconnected before any major work is performed on the engine.
  Failure to disconnect cables may result in damage to wire harness or other electrical parts.



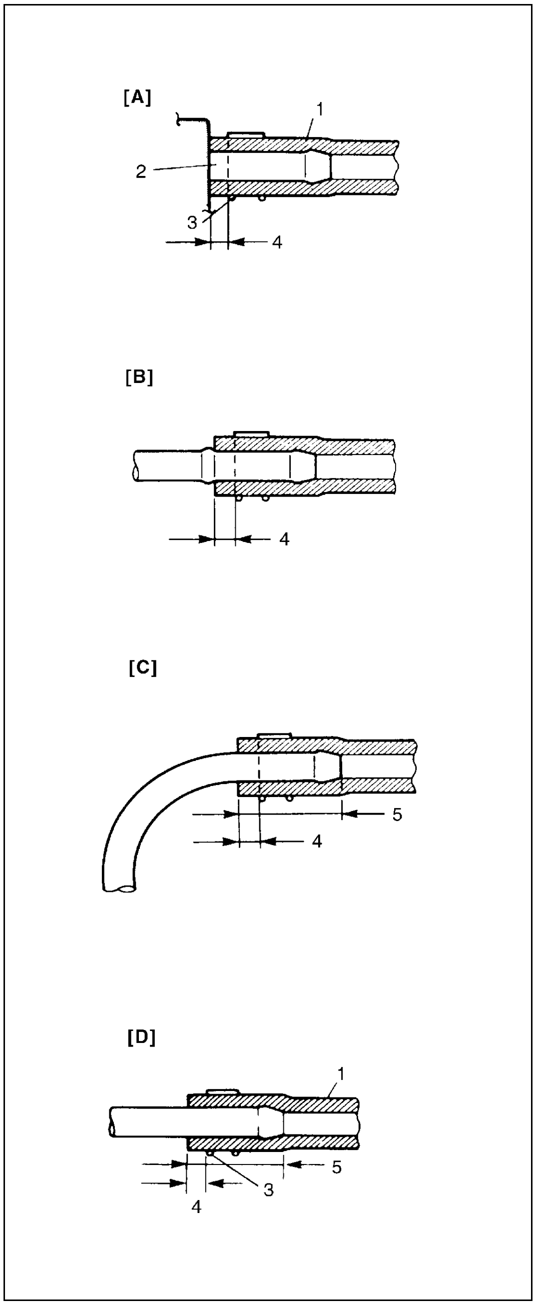
- Throughout this manual, the four cylinders of the engine are identified by numbers; No.1 (1), No.2 (2), No.3 (3) and No.4 (4) counted from crankshaft pulley side to flywheel side.

General Information on Engine Service

THE FOLLOWING INFORMATION ON ENGINE SERVICE SHOULD BE NOTED CAREFULLY, AS IT IS IMPORTANT IN PREVENTING DAMAGE, AND IN CONTRIBUTING TO RELIABLE ENGINE PERFORMANCE.

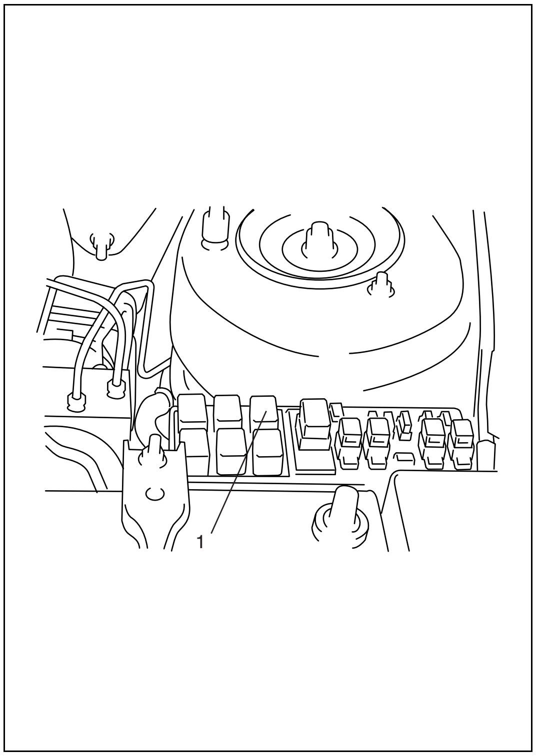
- When raising or supporting engine for any reason, do not use a jack under oil pan. Due to small clearance between oil pan and oil pump strainer, jacking against oil pan may cause it to be bent against strainer resulting in damaged oil pick-up unit.
- It should be kept in mind, while working on engine, that 12-volt electrical system is capable of violent and damaging short circuits.
  When performing any work where electrical terminals can be grounded, ground cable of the battery should be disconnected at battery.
- Any time the air cleaner, throttle body or intake manifold is removed, the intake opening should be covered. This will protect against accidental entrance of foreign material which could follow intake passage into cylinder and cause extensive damage when engine is started.

Precaution on fuel system service



- Work must be done with no smoking, in a well-ventilated area and away from any open flames.
- As fuel feed line (between fuel pump and fuel delivery pipe) is still under high fuel pressure even after engine was stopped, loosening or disconnecting fuel feed line directly may cause dangerous spout of fuel to occur where loosened or disconnected.
  Before loosening or disconnecting fuel feed line, make sure to release fuel pressure according to “FUEL PRESSURE RELIEF PROCEDURE”. A small amount of fuel may be released after the fuel line is disconnected. In order to reduce the chance of personal injury, cover the fitting to be disconnected with a shop cloth. Put that cloth in an approved container when disconnection is completed.
- Never run engine with fuel pump relay disconnected when engine and exhaust system are hot.
- Fuel or fuel vapor hose connection varies with each type of pipe. When reconnecting fuel or fuel vapor hose, be sure to connect and clamp each hose correctly referring to figure Hose Connection.
  After connecting, make sure that it has no twist or kink.
- When installing injector or fuel delivery pipe, lubricate its O-ring with spindle oil or gasoline.
- When connecting fuel pipe flare nut, first tighten flare nut by hand and then tighten it to specified torque.

[A] :	With short pipe, fit hose as far as it reaches pipe joint as shown.
[B] :	With following type pipe, fit hose as far as its peripheral projection as shown.
[C] :	With bent pipe, fit hose as its bent part as shown or till pipe is about 20 to 30 mm (0.79 – 1.18 in.) into the hose.
[D] :	With straight pipe, fit hose till pipe is, about 20 to 30 mm (0.79 – 1.18 in.) into the hose.
1.	Hose
2.	Pipe
3.	Clamp
4.	Clamp securely at a position 3 to 7 mm (0.1 2 – 0.27 in.) from hose end.
5.	20 to 30 mm (0.79 – 1.18 in.)



Fuel pressure relief procedure

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

After making sure that engine is cold, release fuel pressure as follows.

1) Place transmission gear shift lever in “Neutral” (Shift selector lever to “P” range for A/T model), set parking brake, and block drive wheels.
2) Remove relay box cover.
3) Disconnect fuel pump relay (1) from relay box.
4) Remove fuel filler cap to release fuel vapor pressure in fuel tank and then reinstall it.
5) Start engine and run it till it stops for lack of fuel. Repeat cranking engine 2 – 3 times for about 3 seconds each time to dissipate fuel pressure in lines. Fuel connections are now safe for servicing.
6) Upon completion of servicing, connect fuel pump relay (1) to relay box and install relay box cover.

Fuel leakage check procedure

After performing any service on fuel system, check to make sure that there are no fuel leakages as follows.

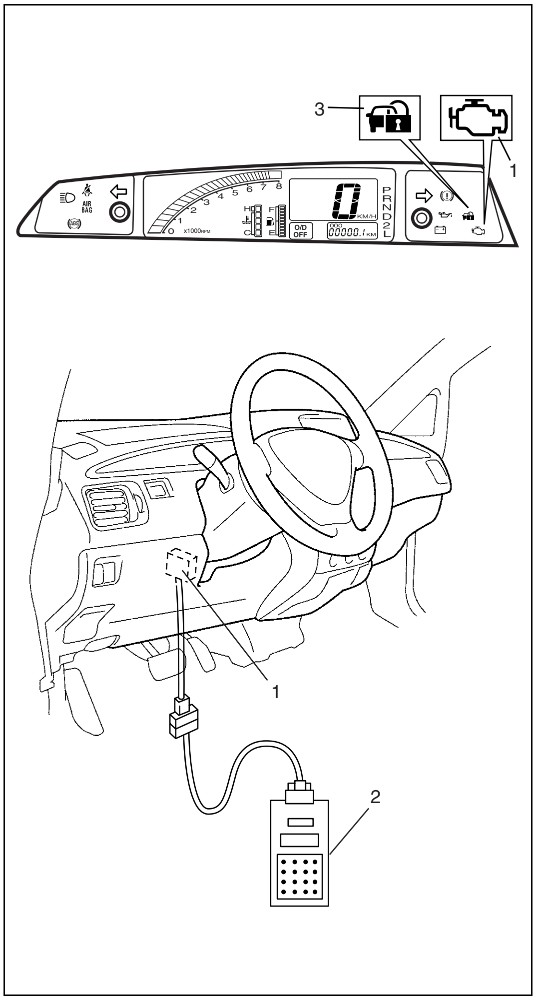
1) Turn ON ignition switch for 3 seconds (to operate fuel pump) and then turn it OFF.
   Repeat this (ON and OFF) 3 or 4 times and apply fuel pressure to fuel line. (till fuel pressure is felt by hand placed on fuel feed hose.)
2) In this state, check to see that there are no fuel leakages from any part of fuel system.

Engine Diagnosis

General Description

This vehicle is equipped with an engine and emission control system which are under control of ECM.
The engine and emission control system in this vehicle are controlled by ECM. ECM has an On-Board Diagnostic system which detects a malfunction in this system and abnormality of those parts that influence the engine exhaust emission. When diagnosing engine troubles, be sure to have full understanding of the outline of “On-Board Diagnostic System” and each item in “Precaution in Diagnosing Trouble” and execute diagnosis according to “ENGINE DIAGNOSTIC FLOW TABLE”.
There is a close relationship between the engine mechanical, engine cooling system, ignition system, exhaust system, etc. and the engine and emission control system in their structure and operation. In case of an engine trouble, even when the malfunction indicator lamp (MIL) doesn’t turn ON, it should be diagnosed according to this flow table.

On-Board Diagnostic System (Vehicle with Immobilizer Indicator Lamp)



ECM in this vehicle has following functions.

- When the ignition switch is turned ON with the engine at a stop, malfunction indicator lamp (MIL) (1) turns ON to check the bulb of the malfunction indicator lamp (1).
- When ECM detects a malfunction which gives an adverse effect to vehicle emission while the engine is running, it makes the malfunction indicator lamp (1) in the meter cluster of the instrument panel turn ON or flash (flashing only when detecting a misfire which can cause damage to the catalyst) and stores the malfunction area in its memory.
  (If it detects that continuously 3 driving cycles are normal after detecting a malfunction, however, it makes MIL (1) turn OFF although DTC stored in its memory will remain.)
- As a condition for detecting a malfunction in some areas in the system being monitored by ECM and turning ON the malfunction indicator lamp (1) due to that malfunction, 2 driving cycle detection logic is adopted to prevent erroneous detection.
- When a malfunction is detected, engine and driving conditions then are stored in ECM memory as freeze frame data. (For the details, refer to description on Freeze frame data.)
- It is possible to communicate by using not only SUZUKI scan tool (2) but also generic scan tool. (Diagnostic information can be accessed by using a scan tool.)

3. Immobilizer indicator lamp

WARM-UP CYCLE

A warm-up cycle means sufficient vehicle operation such that the coolant temperature has risen by at least 22°C (40°F) from engine starting and reaches a minimum temperature of 70°C (160°F).

DRIVING CYCLE

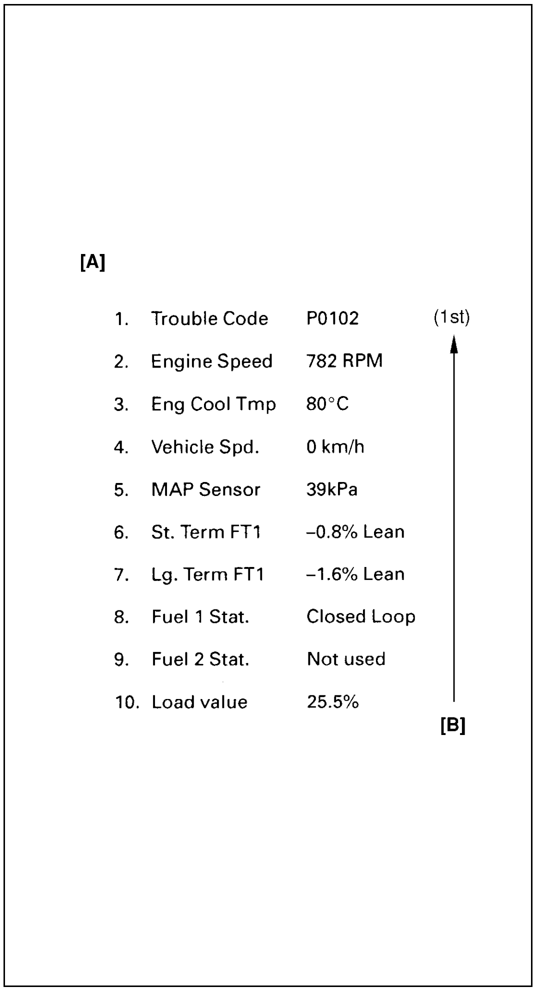
A "Driving Cycle" consists of engine startup, driving mode where a malfunction would be detected if present, and engine shutoff.

2 DRIVING CYCLES DETECTION LOGIC

The malfunction detected in the first driving cycle is stored in ECM memory (in the form of pending DTC and freeze frame data) but the malfunction indicator lamp does not light at this time. It lights up at the second detection of same malfunction also in the next driving cycle.

PENDING DTC

Pending DTC means a DTC detected and stored temporarily at 1 driving cycle of the DTC which is detected in the 2 driving cycle detection logic.



FREEZE FRAME DATA

ECM stores the engine and driving conditions (in the from of data as shown in the figure) at the moment of the detection of a malfunction in its memory. This data is called “Freeze frame data”.
Therefore, it is possible to know engine and driving conditions (e.g., whether the engine was warm or not, where the vehicle was running or stopped, where air/fuel mixture was lean or rich) when a malfunction was detected by checking the freeze frame data. Also, ECM has a function to store each freeze frame data for three different malfunctions in the order as the malfunction is detected. Utilizing this function, it is possible to know the order of malfunctions that have been detected. Its use is helpful when rechecking or diagnosing a trouble.

Priority of freeze frame data :

ECM has 4 frames where the freeze frame data can be stored. The first frame stores the freeze frame data of the malfunction which was detected first. However, the freeze frame data stored in this frame is updated according to the priority described below. (If malfunction as described in the upper square “1” below is detected while the freeze frame data in the lower square “2” has been stored, the freeze frame data “2” will be updated by the freeze frame data “1”.)

[A] :	An Example of Freeze Frame Data
[B] :	1st, 2nd or 3rd in parentheses here represents which position in the order the malfunction is detected.

PRIORITY	FREEZE FRAME DATA IN FRAME 1
1	Freeze frame data at initial detection of malfunction among misfire detected (P0300-P0304), fuel system too lean (P0171) and fuel system too rich (P0172)
2	Freeze frame data when a malfunction other than those in “1” above is detected

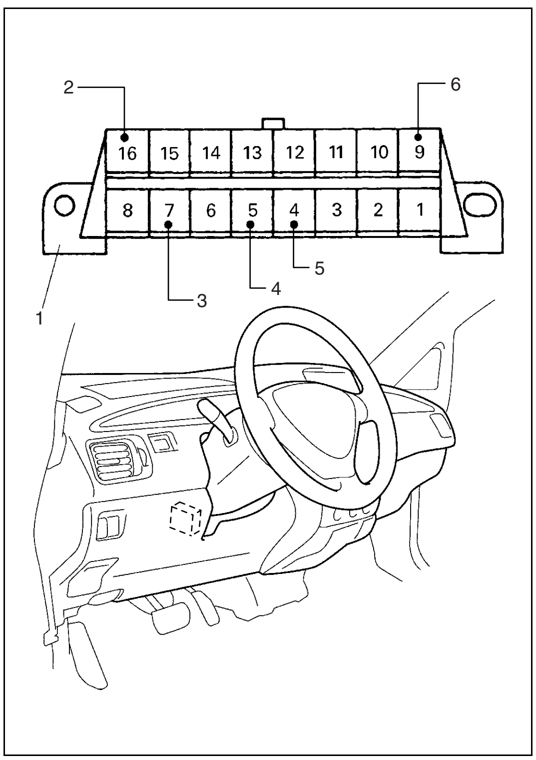
In the 2nd through the 4th frames, the freeze frame data of each malfunction is stored in the order as the malfunction is detected. These data are not updated.
Shown in the table below are examples of how freeze frame data are stored when two or more malfunctions are detected.

			FRAME			
			FRAME 1	FRAME 2	FRAME 3	FRAME4
			FREEZE FRAME DATA to be updated	1st FREEZE FRAME DATA	2nd FREEZE FRAME DATA	3rd FREEZE FRAME DATA
MALFUNCTION DETECTED ORDER		No malfunction	No freeze frame data			
	1	P0400 (EGR) detected	Data at P0400 detection	Data at P0400 detection	–	–
	2	P0171 (Fuel system) detected	Data at P0171 detection	Data at P0400 detection	Data at P0171 detection	–
	3	P0300 (Misfire) detected	Data at P0171 detection	Data at P0400 detection	Data at P0171 detection	Data at P0300 detection
	4	P0301 (Misfire) detected	Data at P0171 detection	Data at P0400 detection	Data at P0171 detection	Data at P0300 detection

Freeze frame data clearance :

The freeze frame data is cleared at the same time as clearance of diagnostic trouble code (DTC).

DATA LINK CONNECTOR (DLC)

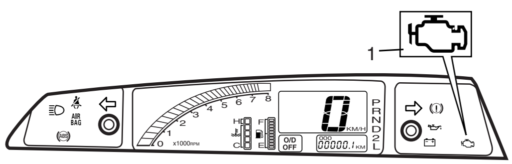


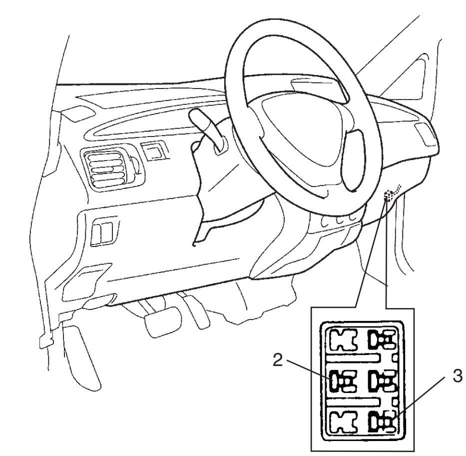
DLC (1) is in compliance with SAEJ1962 in its installation position, the shape of connector and pin assignment.

Serial data line (K line of ISO 9141) is used for SUZUKI scan tool or generic scan tool to communicate with ECM, TCM, ABS control module and Air bag SDM.
SUZUKI serial data line is used for SUZUKI scan tool to communicate with immobilizer control module.

2.	B+
3.	Serial data line (K line of ISO 9141)
4.	ECM ground
5.	Body ground
6.	SUZUKI serial data line

On-Board Diagnostic System (Vehicle without Immobilizer Indicator Lamp)





ECM diagnosis troubles which may occur in the area including the following parts when the ignition switch is ON and the engine is running, and indicates the result by turning on or flashing malfunction indicator lamp (1).

- Heated oxygen sensor (if equipped)
- ECT sensor
- TP sensor
- IAT sensor
- MAP sensor
- CMP sensor
- CKP sensor
- Knock sensor (if equipped)
- VSS
- CPU (Central Processing Unit) of ECM

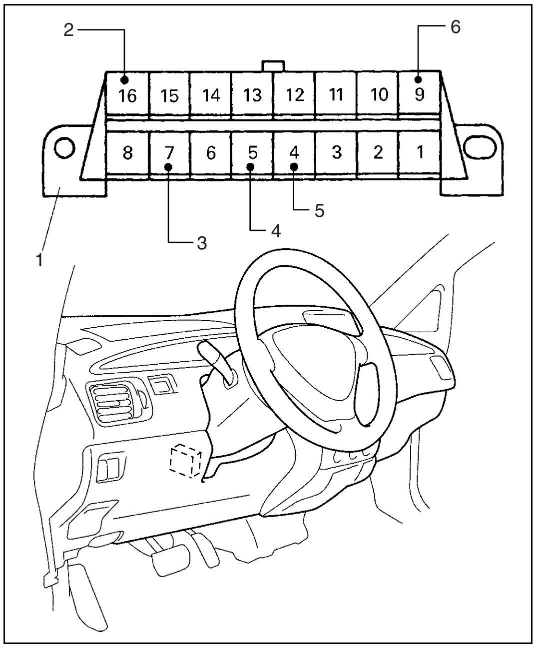
ECM and malfunction indicator lamp (1) operate as follows.

- Malfunction indicator lamp (1) lights when the ignition switch is turned ON (but the engine at stop) with the diagnosis switch terminal ungrounded regardless of the condition of Engine and Emission control system. This is only to check the malfunction indicator lamp (1) bulb and its circuit.
- If the above areas of Engine and Emission control system is free from any trouble after the engine start (while engine is running), malfunction indicator lamp (1) turns OFF.
- When ECM detects a trouble which has occurred in the above areas, it makes malfunction indicator lamp (1) turn ON while the engine is running to warn the driver of such occurrence of trouble and at the same time it stores the trouble area in ECM back-up memory. (The memory is kept as it is even if the trouble was only temporary and disappeared immediately. And it is not erased unless the power to ECM is shut off for specified time or it is cleared by SUZUKI scan tool.)

  ECM also indicates trouble area in memory by means of flashing of malfunction indicator lamp (1) at the time of inspection. (i.e. when diagnosis switch terminal (2) is connected to ground terminal (3) with a service wire and ignition switch is turned ON.)

NOTE:

- **When a trouble occurs in the above areas and disappears soon while the diagnosis switch terminal is ungrounded and the engine is running, malfunction indicator lamp (1) lights and remains ON as long as the trouble exists but it turns OFF when the normal condition is restored.**



DATA LINK CONNECTOR (DLC)

ELC (1) is in compliance with SAEJ1962 in its installation position, the shape of connector and pin assignment.

Serial data line (K line of ISO 9141) is used for SUZUKI scan tool to communicate with ECM, TCM, ABS control module and Air bag SDM.
SUZUKI serial data line is used for SUZUKI scan tool to communicate with immobilizer control module.

2.	B+
3.	Serial data line (K line of ISO 9141)
4.	ECM ground
5.	Body ground
6.	SUZUKI serial data line

Precaution in Diagnosing Trouble

- Don't disconnect couplers from ECM, battery cable from battery, ECM ground wire harness from engine or main fuse before confirming diagnostic information (DTC, freeze frame data, etc.) stored in ECM memory. Such disconnection will erase memorized information in ECM memory.
- Diagnostic information stored in ECM memory can be cleared as well as checked by using SUZUKI scan tool or generic scan tool (Vehicle with immobilizer indicator lamp). Before using scan tool, read its Operator's (Instruction) Manual carefully to have good understanding as to what functions are available and how to use it.
- Priorities for diagnosing troubles (Vehicle with immobilizer indicator lamp).
  If two or more DTCs are stored, proceed to the flow table of the DTC which has detected earliest in the order (it can be identified by referring freeze frame data) and follow the instruction in that table.
  If no instructions are given, troubleshoot diagnostic trouble codes according to the following priorities.
  – Diagnostic trouble codes (DTCs) other than DTC P0171/P0172 (Fuel system too lean/too rich), DTC P0300/P0301/P0302/P0303/P0304 (Misfire detected) and DTC P0400 (EGR flow malfunction)
  – DTC P0171/P0172 (Fuel system too lean/too rich) and DTC P0400 (EGR flow malfunction)
  – DTC P0300/P0301/P0302/P0303/P0304 (Misfire detected)
- Be sure to read "Precautions for Electrical Circuit Service" in Section 0A before inspection and observe what is written there.
- ECM Replacement
  When substituting a known-good ECM, check for following conditions. Neglecting this check may cause damage to a known-good ECM.
  – Resistance value of all relays, actuators is as specified respectively.
  – MAP sensor and TP sensor are in good condition and none of power circuits of these sensors is shorted to ground.

Engine Diagnostic Flow Table

Refer to the following pages for the details of each step.

Step	Action	Yes	No
1	Customer Complaint Analysis 1) Perform customer complaint analysis referring to the followings. Was customer complaint analysis performed?	Go to Step 2.	Perform customer complaint analysis.
2	DTC and Freeze Frame Data Check, Record and Clearance 1) Check for DTC (including pending DTC) referring to the followings. Is there any DTC(s)?	Print DTC and freeze frame data or write them down and clear them by referring to "DTC Clearance" section. Go to Step 3.	Go to Step 4.
3	Visual Inspection 1) Perform visual inspection referring to the followings. Is there any faulty condition?	Repair or replace malfunction part. Go to Step 11.	Go to Step 5.
4	Visual Inspection 1) Perform visual inspection referring to the followings. Is there any faulty condition?		Go to Step 8.
5	Trouble Symptom Confirmation 1) Confirm trouble symptom referring to the followings. Is trouble symptom identified?	Go to Step 6.	Go to Step 7.
6	Rechecking and Record of DTC/Freeze Frame Data 1) Recheck for DTC and freeze frame data referring to "DTC Check" section. Is there any DTC(s)?	Go to Step 9.	Go to Step 8.
7	Rechecking and Record of DTC/Freeze Frame Data 1) Recheck for DTC and freeze frame data referring to "DTC Check" section. Is there any DTC(s)?		Go to Step 10.
8	Engine Basic Inspection and Engine Diagnosis Table 1) Check and repair according to "Engine Basic Inspection" and "Engine Diagnosis Table" section. Are check and repair complete?	Go to Step 11.	Check and repair malfunction part(s). Go to Step 11.
9	Trouble shooting for DTC 1) Check and repair according to applicable DTC diag. flow table. Are check and repair complete?		
10	Check for Intermittent Problems 1) Check for intermittent problems by referring to the followings. Is there any faulty condition?	Repair or replace malfunction part(s). Go to Step 11.	Go to Step 11.
11	Final Confirmation Test 1) Clear DTC if any. 2) Perform final confirmation test by referring to the followings. Is there any problem symptom, DTC or abnormal condition?	Go to Step 6.	End.

1. CUSTOMER COMPLAINT ANALYSIS

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

2. DTC/FREEZE FRAME DATA CHECK, RECORD AND CLEARANCE

First, check DTC (including pending DTC), referring to “DTC check” section. If DTC is indicated, print it and freeze frame data or write them down and then clear them by referring to “DTC clearance” section. DTC indicates malfunction that occurred in the system but does not indicate whether it exists now or it occurred in the past and the normal condition has been restored now. To check which case applies, check the symptom in question according to Step 4 and recheck DTC according to Step 5.
Attempt to diagnose a trouble based on DTC in this step only or failure to clear the DTC in this step will lead to incorrect diagnosis, trouble diagnosis of a normal circuit or difficulty in troubleshooting.

NOTE:

If only Automatic transmission DTCs (P0702-P1895) or Immobilizer DTCs (P1620-P1623) are indicated in this step, perform trouble diagnosis according to “Diagnosis” in Section 7B or Section 8G.

3. and 4. VISUAL INSPECTION

As a preliminary step, be sure to perform visual check of the items that support proper function of the engine referring to “Visual Inspection” section.

5. TROUBLE SYMPTOM CONFIRMATION

Based on information obtained in Step 1 Customer complaint analysis and Step 2 DTC/freeze frame data check, confirm trouble symptoms. Also, reconfirm DTC according to “DTC Confirmation Procedure” described in each DTC Diagnosis section.

6. and 7. RECHECKING AND RECORD OF DTC/FREEZE FRAME DATA

Refer to “DTC check” section for checking procedure.

8. ENGINE BASIC INSPECTION AND ENGINE DIAGNOSIS TABLE

Perform basic engine check according to the “Engine Basic Inspection Flow Table” first. When the end of the flow table has been reached, check the parts of the system suspected as a possible cause referring to ENGINE DIAGNOSIS TABLE and based on symptoms appearing on the vehicle (symptoms obtained through steps of customer complaint analysis, trouble symptom confirmation and/or basic engine check) and repair or replace faulty parts, if any.

9. TROUBLESHOOTING FOR DTC (See each DTC Diag. Flow Table)

Based on the DTC indicated in Step 5 and referring to the applicable DTC diag. flow table in this section, locate the cause of the trouble, namely in a sensor, switch, wire harness, connector, actuator, ECM or other part and repair or replace faulty parts.

10. CHECK FOR INTERMITTENT PROBLEM

Check parts where an intermittent trouble is easy to occur (e.g., wire harness, connector, etc.), referring to “INTERMITTENT AND POOR CONNECTION” in Section 0A and related circuit of DTC recorded in Step 2.

11. FINAL CONFIRMATION TEST

Confirm that the problem symptom has gone and the engine is free from any abnormal conditions. If what has been repaired is related to the DTC, clear the DTC once, perform DTC confirmation procedure and confirm that no DTC is indicated.

Customer problem inspection form (example)

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

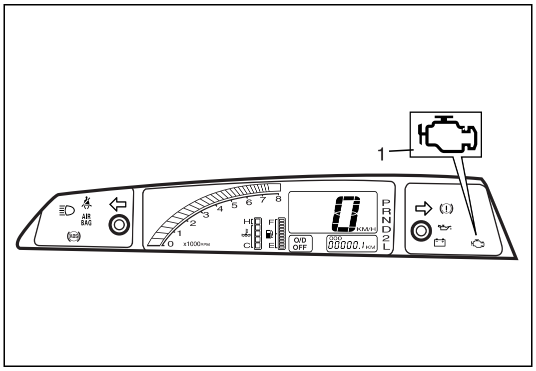
PROBLEM SYMPTOMS	
☐ **Difficult Starting** ☐ No cranking ☐ No initial combustion ☐ No combustion ☐ Poor starting at (☐cold ☐warm ☐always) ☐ Other__________	☐ **Poor Driveability** ☐ Hesitation on acceleration ☐ Back fire/☐After fire ☐ Lack of power ☐ Surging ☐ Abnormal knocking ☐ Other__________
☐ **Poor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

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

Malfunction indicator lamp condition	☐Always ON ☐Sometimes ON ☐Always OFF ☐Good condition	
Diagnostic trouble code	First check:	☐No code ☐Malfunction code ( )
	Second check:	☐No code ☐Malfunction code ( )

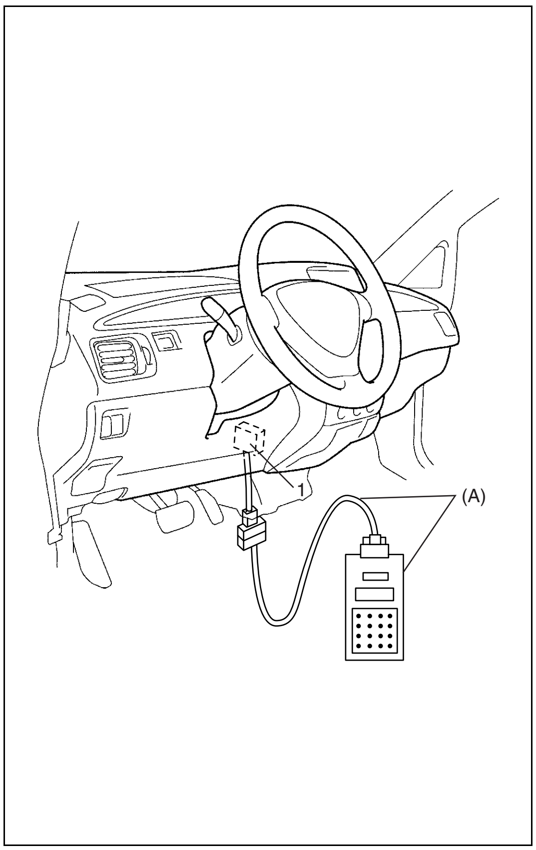
NOTE:

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



Malfunction indicator lamp (MIL) check

1) Turn ignition switch ON (but the engine at stop) and check that MIL (1) lights.
   If MIL does not light up (or MIL dims), go to “Diagnostic Flow Table A-1” for troubleshooting.
   If MIL flushes, go to “Diagnostic Flow Table A-3” (vehicle without immobilizer indicator lamp).
2) Start engine and check that MIL turns OFF.
   If MIL remains ON and no DTC is stored in ECM, go to “Diagnostic Flow Table A-2” for troubleshooting.



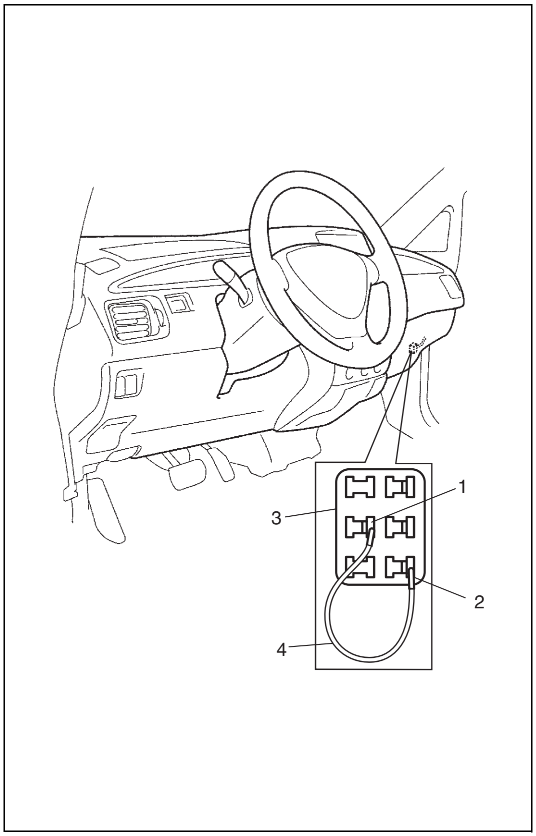
Diagnostic trouble code (DTC) check

[Using SUZUKI scan tool]

1) Prepare SUZUKI scan tool.
2) With ignition switch OFF, connect it to data link connector (DLC) (1) located on underside of instrument panel at driver’s seat side.

   Special tool
   (A) : SUZUKI scan tool

3) Turn ignition switch ON and confirm that MIL lights.
4) Read DTC, pending DTC and freeze frame data according to instructions displayed on scan tool and print it or write it down.
   Refer to scan tool operator’s manual for further details.
   If communication between scan tool and ECM is not possible, check if scan tool is communicable by connecting it to ECM in another vehicle. If communication is possible in this case, scan tool is in good condition. Then check data link connector and serial data line (circuit) in the vehicle with which communication was not possible.
5) After completing the check, turn ignition switch off and disconnect scan tool from data link connector.



[Without using SUZUKI scan tool] (vehicle without immobilizer indicator lamp)

1) Check malfunction indicator lamp referring to “Malfunction Indicator Lamp Check” in this section.
2) With the ignition switch OFF position, disconnect SUZUKI scan tool if connected and using service wire (4), connect diagnosis switch terminal (1) to ground terminal (2) in monitor coupler (3).
3) With the ignition switch ON position and leaving engine OFF, read DTC from flashing pattern of malfunction indicator lamp. Refer to “Diagnostic Trouble Code Table”.
   If lamp remains ON, go to “Diagnostic Flow Table A-4”.

NOTE:
- **If abnormality or malfunction lies in two or more areas, malfunction indicator lamp indicates applicable codes three times each.**
  And flashing of these codes is repeated as long as diagnosis terminal is grounded and ignition switch is held at ON position.
- **Take a note of diagnostic trouble code indicated first.**

4) After completing the check, turn the ignition switch OFF position and disconnect service wire from monitor coupler.

Diagnostic Trouble Code (DTC) Clearance

Using scan tool

1) Connect SUZUKI scan tool or generic scan tool (Vehicle with immobilizer indicator lamp) to data link connector in the same manner as when making this connection for DTC check.
2) Turn ignition switch ON.
3) Erase DTC and pending DTC according to instructions displayed on scan tool. Refer to scan tool operator’s manual for further details.
4) After completing the clearance, turn ignition switch off and disconnect scan tool from data link connector.

NOTE:

DTC and freeze frame data stored in ECM memory are also cleared in following cases. Be careful not to clear them before keeping their record.
- **When power to ECM is cut off (by disconnecting battery cable, removing fuse or disconnecting ECM connectors)**
- **When the same malfunction (DTC) is not detected again during 40 engine warm-up cycles. (Vehicle with immobilizer indicator lamp)**

Without using scan tool

1) Turn the ignition switch OFF position.
2) Disconnect battery negative cable for specified time below to erase diagnostic trouble code stored in ECM memory and reconnect it.

Time required to erase DTC :

Ambient temperature	Time to cut power to ECM
Over 0°C (32°F)	30 sec. or longer
Under 0°C (32°F)	Not specifiable. Select a place with higher than 0°C (32°F) temperature.

Diagnostic trouble code (DTC) table

DTC NO.	DETECTING ITEM	DETECTING CONDITION (DTC will set when detecting :)	MIL (vehicle with immobilizer indicator lamp)	MIL (vehicle without immobilizer indicator lamp)
P0105 (No.11)	Manifold absolute pressure circuit malfunction	Low pressure-high vacuum-low voltage (or MAP sensor circuit shorted to ground) High pressure-low vacuum-high voltage (or MAP sensor circuit open)	1 driving cycle	1 driving cycle
P0110 (No.18)	Intake air temp. circuit malfunction	Intake air temp. circuit low input Intake air temp. circuit high input	1 driving cycle	1 driving cycle
P0115 (No.19)	Engine coolant temp. circuit malfunction	Engine coolant temp. circuit low input Engine coolant temp. circuit high input	1 driving cycle	1 driving cycle
P0120 (No.13)	Throttle position circuit malfunction	Throttle position circuit low input Throttle position circuit high input	1 driving cycle	1 driving cycle
P0121	Throttle position circuit performance problem	Poor performance of TP sensor	2 driving cycles	Not applicable
P0130 (No.14)	HO2S circuit malfunction (Sensor-1)	Min. output voltage of HO2S-higher than specification Max. output voltage of HO2S-lower than specification	2 driving cycle	1 driving cycle
P0133	HO2S circuit slow response (Sensor-1)	Response time of HO2S-1 output voltage between rich and lean is longer than specification.	2 driving cycles	Not applicable
P0134	HO2S circuit no activity detected (Sensor-1)	Output voltage of HO2S-1 fails to go above specification. (or HO2S-1 circuit open or short)	2 driving cycles	1 driving cycle
P0135 (No.14)	HO2S heater circuit malfunction (Sensor-1)	Terminal voltage is lower than specification at heater OFF or it is higher at heater ON.	2 driving cycles	1 driving cycle

DTC NO.	DETECTING ITEM	DETECTING CONDITION (DTC will set when detecting :)	MIL (vehicle with immobilizer indicator lamp)	MIL (vehicle without immobilizer indicator lamp)
P0136	HO2S circuit malfunction (Sensor-2)	Max. voltage of HO2S-2 is lower than specification or its min. voltage is higher than specification	2 driving cycles	Not applicable
P0141	HO2S heater circuit malfunction (Sensor-2)	Terminal voltage is lower than specification at heater OFF or it is higher at heater ON. (or heater circuit or short)	2 driving cycles	Not applicable
P0171	Fuel system too lean	Short term fuel trim or total fuel trim (short and long terms added) is larger than specification for specified time or longer. (fuel trim toward rich side is large.)	2 driving cycles	Not applicable
P0172	Fuel system too rich	Short term fuel trim or total fuel trim (short and long term added) is smaller than specification for specified time or longer. (fuel trim toward lean side is large.)	2 driving cycles	Not applicable
P0300 P0301 P0302 P0303 P0304	Random misfire detected Cylinder 1 misfire detected Cylinder 2 misfire detected Cylinder 3 misfire detected Cylinder 4 misfire detected	Misfire of such level as to cause damage to three way catalyst	MIL flashing during misfire detection	Not applicable
		Misfire of such level as to deteriorate emission but not to cause damage to three way catalyst	2 driving cycles	Not applicable
P0325 (No.17)	Knock sensor circuit malfunction	Knock sensor circuit low input Knock sensor circuit high input	1 driving cycle	1 driving cycle
P0335 (No.23)	Crankshaft position sensor circuit malfunction	No signal for 2 sec. During engine cranking	1 driving cycle	1 driving cycle
P0340 (No.15)	Camshaft position sensor circuit malfunction	No signal during engine running	1 driving cycle	1 driving cycle
P0400	Exhaust gas recirculation flow malfunction detected	Excessive or insufficient EGR flow	2 driving cycles	Not applicable
P0420	Catalyst system efficiency below threshold	Output waveforms of HO2S-1 and HO2S-2 are similar. (Time from output voltage change of HO2S-1 to that of HO2S-2 is shorter than specification.)	2 driving cycles	Not applicable
P0443	Purge control valve circuit malfunction	Purge control valve circuit is open or shorted to ground	2 driving cycles	Not applicable
P0480	Radiator fan control circuit malfunction	Radiator cooling fan relay terminal voltage is low when cooling temp. is lower than specification	2 driving cycles	Not applicable
P0500 (No.16)	Vehicle speed sensor malfunction	No signal while running in “D” range or during fuel cut at decelerating	2 driving cycles	1 driving cycle
P0505	Idle control system malfunction	No closed signal to IAC valve is detected	2 driving cycles	Not applicable

DTC NO.	DETECTING ITEM	DETECTING CONDITION (DTC will set when detecting :)	MIL (vehicle with immobilizer indicator lamp)	MIL (vehicle without immobilizer indicator lamp)
P0601 (No.71)	Internal control module memory check sum error	Data write error (or check sum error) when written into ECM	2 driving cycles	1 driving cycle
P1450 (No.29)	Barometric pressure sensor circuit malfunction	Barometric pressure is lower or higher than specification. (or sensor malfunction)	1 driving cycle	1 driving cycle
P1451	Barometric pressure sensor performance problem	Difference between manifold absolute pressure (MAP sensor value) and barometric pressure (barometric pressure sensor value) is larger than specification during cranking.	2 driving cycles	Not applicable
P1500	Starter signal circuit malfunction	Starter signal is not inputted from engine cranking till its start and after or it is always inputted	2 driving cycles	Not applicable
P1510	ECM backup power source malfunction	No backup power after starting engine	1 driving cycle	Not applicable
P1600	Serial communication problem between ECM and TCM	No signal or check sum error while engine running	1 driving cycle	Not applicable
P1717	AT D-range signal circuit malfunction	No “D” range (park/neutral position signal) is inputted while vehicle running	2 driving cycles	Not applicable

DTC NO.	DETECTING ITEM	DETECTING CONDITION (DTC will set when detecting :)	MIL
✱P0705	Transmission Range Sensor Circuit Malfunction	Refer to Section 7B.	
☆✱P0710	Transmission Fluid Temperature Sensor Circuit Malfunction		
✱P0715	Input/turbine Speed Sensor Circuit Malfunction		
✱P0720	Output Shaft Speed Sensor Circuit Malfunction		
✱P0725	Engine Speed Input Circuit Malfunction		
✱P0741	Torque Converter Clutch System Performance or Stuck Off		
✱P0743	Torque Converter Clutch System Electrical		
✱P0748	Pressure Control Solenoid A Electrical		
✱P0751	Shift solenoid A (No.1) performance or stuck off		
✱P0753	Shift Solenoid A (No.1) Electrical		
✱P0756	Shift solenoid B (No.2) performance or stuck off		
✱P0758	Shift Solenoid B (No.2) Electrical		
✱P1700	Throttle Position Signal Input Malfunction		
✱P1702	Internal Control Module Memory Check Some Error		

DTC NO.	DETECTING ITEM	DETECTING CONDITION (DTC will set when detecting :)	MIL
✱P1705	Engine coolant temp. signal input malfunction	Refer to Section 7B.	
☆✱P1895	TCM to ECM torque reduction circuit malfunction		
P1620 (No.84)	ECU code not registered	Refer to Section 8G.	
P1621 (No.83)	No ECU code transmitted from Immobilizer Control Module		
P1622 (No.82)	Fault in ECM		
P1623 (No.81)	ECU code not matched		

NOTE:
- **For parenthetic No. in DTC column, it is used for vehicle without immobilizer indication lamp.**
- **For star (☆) marked items in MIL column, MIL does not light even when DTC is detected. DTC is erased after turning ignition switch OFF. Bear these in mind when diagnosing troubles.**
- **DTC No.12 appears when none of the other codes is identified.**
- **For vehicle with immobilizer indication lamp, star (✱) marked DTCs can be read with SUZUKI scan tool ECM application.**

Fail-safe table

When any of the following DTCs is detected, ECM enters fail-safe mode as long as malfunction continues to exist but that mode is canceled when ECM detects normal condition after that.

DTC NO.	TROUBLE AREA	FAIL-SAFE OPERATION	SYMPTOM
P0105 (No.11)	MAP SENSOR	ECM uses value determined by throttle opening and engine speed. ECM stops EGR, EVAP purge and idle air control.	Hard starting/ rough or incorrect idle/ excessive fuel consumption/ hesitation/ poor acceleration/ surge/ detonation or spark knock
P0110 (No.18)	IAT SENSOR	ECM controls actuators assuming that intake air temperature is 20°C.	Hard starting/ rough or incorrect idle/ excessive fuel consumption/ hesitation poor acceleration/ detonation or spark knock
P0115 (No.19)	ECT SENSOR	ECM controls actuators assuming that engine coolant temperature is 80°C. Radiator fan motor ON.	Hard starting/ rough or incorrect idle/ excessive fuel consumption/ hesitation poor acceleration/ detonation or spark knock
P0120 (No.13)	TP SENSOR	ECM controls actuators assuming that throttle opening is 20°.	Rough or incorrect idle/ excessive fuel consumption/ hesitation/ poor acceleration
P0130, P0134 (No.14)	HEATED OXYGEN SENOR-1	–	Hard starting/rough or incorrect idle/ excessive fuel consumption/ hesitation/ poor acceleration
P0325 (No.17)	KNOCK SENSOR	–	Detonation/ spark knock

DTC NO.	TROUBLE AREA	FAIL-SAFE OPERATION	SYMPTOM
P0335 (No.23)	CKP SENSOR	• Fix ignition timing. • ECM changes injection control system from sequential injection to simultaneous one.	Hard staring/ engine stall
P0340 (No.15)	CMP SENSOR	ECM changes injection control system from sequential injection to simultaneous one.	Hard starting
P0400	EGR VALVE	–	Hard starting/rough or incorrect idle/ excessive fuel consumption/ hesitation/ poor acceleration/ surge/ detonation or spark knock/ engine stall
P0420	CATALYST	–	–
P0443	PURGE CONTROL VALVE	–	Rough or incorrect idle/ surge/ hard starting/ engine stall
P0480	RADIATOR FAN CONTROL SYSTEM	–	Engine overheating
P0500 (No.16)	VEHICLE SPEED SENSOR	ECM stops idle air control.	Rough or incorrect idle
P0505	IDLE CONTROL SYSTEM	–	Engine stall/ rough or incorrect idle
P0601 (No.71)	ECM INTERNAL	–	Hard starting/ rough or incorrect idle/ excessive fuel consumption/ detonation or spark knock/ hesitation poor acceleration/
P1450 (No.29)	BAROMETRIC PRESSURE SENSOR	ECM controls actuators assuming that barometric pressure is 100 kPa (760 mmHg).	Hard starting/ rough or incorrect idle

Visual inspection

Visually check following parts and systems.

INSPECTION ITEM	REFERRING SECTION
• Engine oil – level, leakage	Section 0B
• Engine coolant – level, leakage	Section 0B
• Fuel – level, leakage	Section 0B
• A/T fluid – level, leakage	Section 0B
• Air cleaner element – dirt, clogging	Section 0B
• Battery – fluid level, corrosion of terminal	
• Water pump belt – tension, damage	Section 0B
• Throttle cable – play, installation	
• Vacuum hoses of air intake system – disconnection, looseness, deterioration, bend	Section 6E1
• Connectors of electric wire harness – disconnection, friction	
• Fuses – burning	Section 8
• Parts – installation, bolt – looseness	
• Parts – deformation	
• Other parts that can be checked visually	
• Check following items at engine start, if possible	
– Malfunction indicator lamp – Operation	Section 6
– Charge warning lamp – Operation	Section 6H
– Engine oil pressure warning lamp – Operation	Section 8 (Section 6 for pressure check)
– Engine coolant temp. meter – Operation	Section 8
– Fuel level meter – Operation	Section 8
– Tachometer, if equipped – Operation	
– Abnormal air being inhaled from air intake system	
– Exhaust system – leakage of exhaust gas, noise	

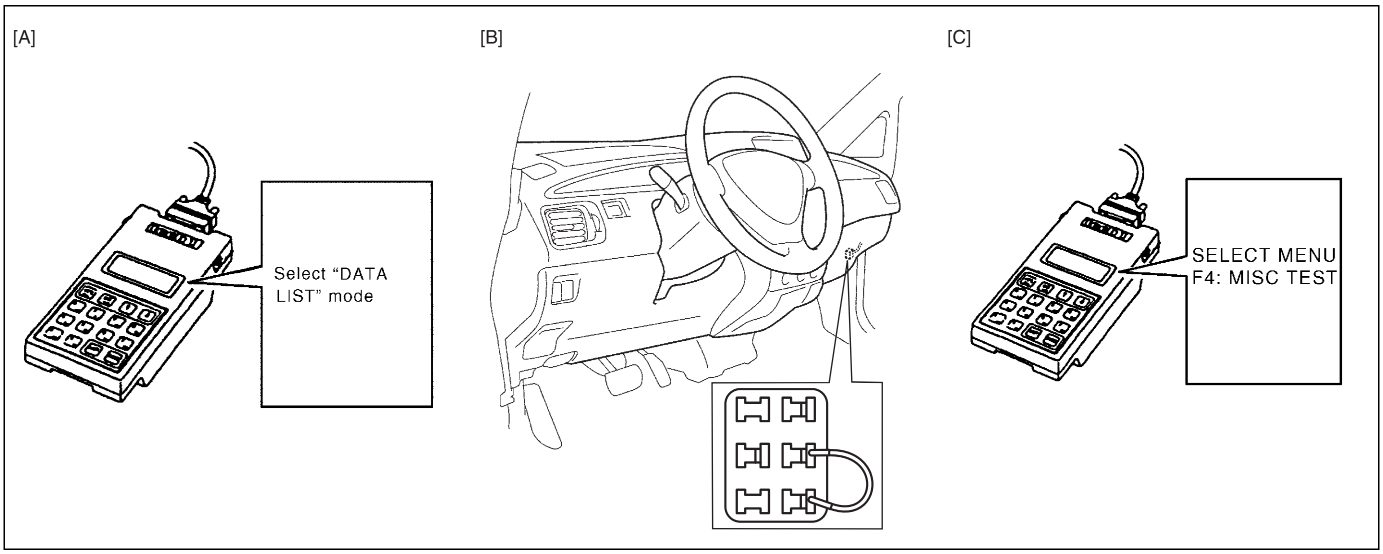
Engine basic inspection

This check is very important for troubleshooting when ECM has detected no DTC and no abnormality has been found in visual inspection.
Follow the flow table carefully.

Step	Action	Yes	No
1	Was “ENGINE DIAG. FLOW TABLE” performed?	Go to Step 2.	Go to “ENGINE DIAG. FLOW TABLE”.
2	Check battery voltage. Is it 11 V or more?	Go to Step 3.	Charge or replace battery.
3	Is engine cranked?	Go to Step 4.	Go to “DIAGNOSIS” in Section 6G.
4	Does engine start?	Go to Step 5.	Go to Step 7.
5	Check idle speed as follows : 1) Warm up engine to normal operating temp. 2) Shift transmission to neutral position for M/T (“P” position for A/T). 3) All of electrical loads are switched off. 4) Check engine idle speed with scan tool. See Fig. 1. Is it 650 – 750 r/min (700 – 800 r/min. for A/T vehicle)?	Go to Step 6.	Go to “ENGINE DIAGNOSIS TABLE”.
6	Check ignition timing as follows : 1) When SUZUKI scan tool is not available, connect test switch terminal of monitor connector to ground. See Fig. 2. When using SUZUKI scan tool, select “MISC” mode on SUZUKI scan tool and fix ignition timing to initial one. See Fig. 3. 2) Using timing light (1), check initial ignition timing. See Fig. 4. Is it 5° ± 3° BTDC at specified idle speed?	Go to “ENGINE DIAGNOSIS TABLE”.	Check ignition control related parts referring to Section 6F1.
7	Is immobilizer control system equipped?	Go to Step 8.	Go to Step 9.
8	Check immobilizer system malfunction as follows. 1) Check immobilizer indicator lamp or MIL (malfunction indicator lamp) for flashing. Is it flashing when ignition switch is turned to ON position?	Go to “DIAGNOSIS” in Section 8G.	Go to Step 9.
9	Check fuel supply as follows : 1) Check to make sure that enough fuel is filled in fuel tank. 2) Turn ignition switch ON for 2 seconds and then OFF. Is fuel pressure felt from fuel feed hose (1) when ignition switch is turned ON? See Fig. 5.	Go to Step 11.	Go to Step 10.
10	Check fuel pump for operating. Was fuel pump operating sound heard from fuel filler for about 10 seconds after ignition switch ON and stop?	Go to “DIAG. FLOW TABLE B-3”.	Go to “DIAG. FLOW TABLE B-2”.

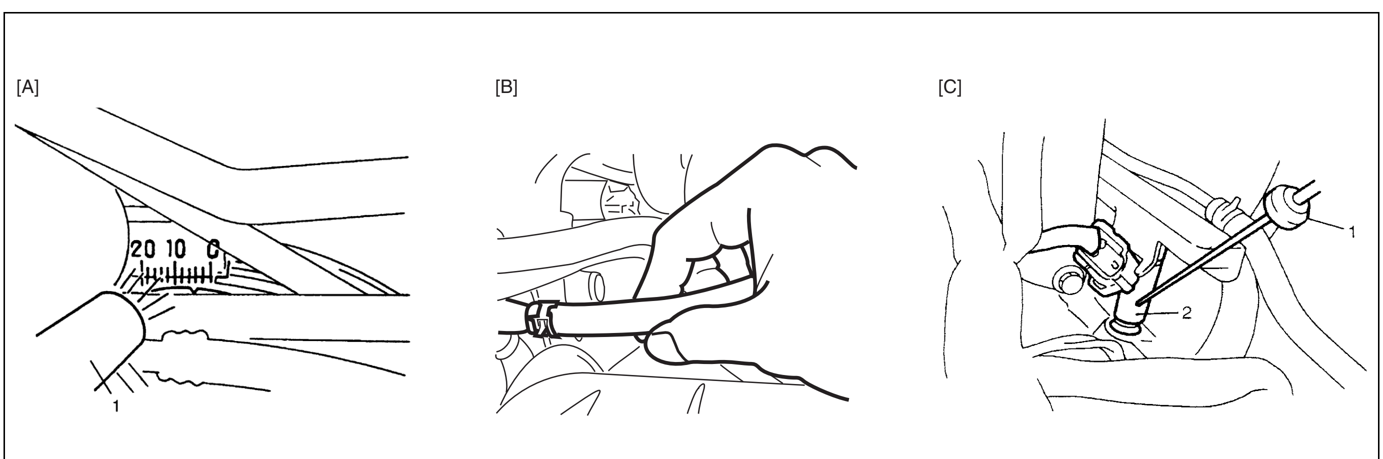
Step	Action	Yes	No
11	Check ignition spark as follows : 1) Disconnect injector couplers. 2) Remove spark plugs and connect them to high tension cords. 3) Ground spark plugs. 4) Crank engine and check if each spark plug sparks. Is it in good condition?	Go to Step 12.	Go to “DIAGNOSIS” in Section 6F1.
12	Check fuel injector for operation as follows : 1) Install spark plugs and connect injector connectors. 2) Using sound scope (1), check operating sound of each injector (2) when cranking engine. See Fig. 6. Was injector operating sound heard from all injectors?	Go to “ENGINE DIAGNOSIS TABLE”.	Go to “DIAG. FLOW TABLE B-1”.

[A] Fig. 1 for Step 5 / [B] Fig. 2 for Step 6 / [C] Fig. 3 for Step 6



[B] :	When not using SUZUKI scan tool:
[C] :	When using SUZUKI scan tool

[A] Fig. 4 for Step 6 / [B] Fig. 5 for Step 9 / [C] Fig. 6 for Step 12



Engine diagnosis table

Perform troubleshooting referring to following table when ECM has detected no DTC and no abnormality has been found in visual inspection and engine basic inspection previously.

Condition	Possible Cause	Reference Item
Hard Starting (Engine cranks OK)	Faulty spark plug	Spark plugs in Section 6F1.
	Leaky high-tension cord	High-tension cords in Section 6F1.
	Loose connection or disconnection of high-tension cords or lead wires	High-tension cords in Section 6F1.
	Faulty ignition coil	Ignition coil in Section 6F1.
	Dirty or clogged fuel hose or pipe	Diagnostic Flow Table B-3.
	Malfunctioning fuel pump	Diagnostic Flow Table B-3.
	Air inhaling from intake manifold gasket or throttle body gasket	
	Faulty idle air control system	Diagnostic Flow Table B-4.
	Faulty ECT sensor or MAP sensor	ECT sensor or MAP sensor in Section 6E1.
	Faulty ECM	
	Low compression	Compression check in Section 6A1.
	Poor spark plug tightening or faulty gasket	Spark plugs in Section 6F1.
	Compression leak from valve seat	Valves inspection in Section 6A1.
	Sticky valve stem	Valves inspection in Section 6A1.
	Weak or damaged valve springs	Valve springs inspection in Section 6A1.
	Compression leak at cylinder head gasket	Cylinder head inspection in Section 6A1.
	Sticking or damaged piston ring	Cylinders, pistons and piston rings inspection in Section 6A1.
	Worn piston, ring or cylinder	Cylinders, pistons and piston rings inspection in Section 6A1.
	Malfunctioning PCV valve	PCV system in Section 6E1.
Low oil pressure	Improper oil viscosity	Engine oil and oil filter change in Section 0B.
	Malfunctioning oil pressure switch	Oil pressure switch inspection in Section 8.
	Clogged oil strainer	Oil pan and oil pump strainer cleaning in Section 6A1.
	Functional deterioration of oil pump	Oil pump in Section 6A1.
	Worn oil pump relief valve	Oil pump in Section 6A1.
	Excessive clearance in various sliding parts	

Condition	Possible Cause	Reference Item
Engine noise **Note : Before checking mechanical noise, make sure that : Specified spark plug is used. Specified fuel is used.**	Improper valve lash	Valve lash in Section 6A1.
	Worn valve stem and guide	Valves inspection in Section 6A1.
	Weak or broken valve spring	Valve springs inspection in Section 6A1.
	Warped or bent valve	Valves inspection in Section 6A1.
	Worn piston, ring and cylinder bore	Pistons and cylinders inspection in Section 6A1.
	Worn rod bearing	Crank pin and connecting rod bearing inspection in Section 6A1.
	Worn crank pin	Crank pin and connecting rod bearing inspection in Section 6A1.
	Loose connecting rod nuts	Connecting rod installation in Section 6A1.
	Low oil pressure	Previously outlined.
	Low oil pressure	Previously outlined.
	Worn bearing	Crankshaft and bearing inspection in Section 6A1.
	Worn crankshaft journal	Crankshaft and bearing inspection in Section 6A1.
	Loose bearing cap bolts	Crankshaft inspection in Section 6A1.
	Excessive crankshaft thrust play	Crankshaft thrust play inspection in Section 6A1.
Overheating	Inoperative thermostat	Thermostat in Section 6B.
	Poor water pump performance	Water pump in Section 6B.
	Clogged or leaky radiator	Radiator in Section 6B.
	Improper engine oil grade	Engine oil and oil filter change in Section 0B.
	Clogged oil filter or oil strainer	Oil pressure check in Section 6A1.
	Poor oil pump performance	Oil pressure check in Section 6A1.
	Faulty radiator fan control system	Radiator fan control system in Section 6E1.
	Dragging brakes	Trouble diagnosis in Section 5.
	Slipping clutch	Trouble diagnosis in Section 7C1.
	Blown cylinder head gasket	Cylinder head in Section 6A1.

Condition	Possible Cause	Reference Item
Poor gasoline mileage	Leaks or loose connection of high-tension cord	High-tension cords in Section 6F1.
	Faulty spark plug (improper gap, heavy deposits and burned electrodes, etc.)	Spark plugs in Section 6F1.
	Malfunctioning EGR valve (if equipped)	EGR system in Section 6E1.
	High idle speed	Refer to item “Improper engine idling” latterly outlined.
	Poor performance of TP sensor, ECT sensor or MAP sensor	TP sensor, ECT sensor or MAP sensor in Section 6E1.
	Faulty fuel injector(s)	Diagnostic Flow Table B-1.
	Faulty ECM	
	Low Compression	Previously outlined
	Poor valve seating	Valves inspection in Section 6A1.
	Dragging brakes	Trouble diagnosis in Section 5.
	Slipping clutch	Trouble diagnosis in Section 7C1.
	Thermostat out of order	Thermostat in Section 6B.
	Improper tire pressure	Refer to Section 3.
Excessive engine oil consumption	Blown cylinder head gasket	Cylinder head in Section 6A1.
	Leaky camshaft oil seals	Camshaft in Section 6A1.
	Sticky piston ring	Piston cleaning in Section 6A1.
	Worn piston and cylinder	Pistons and cylinders inspection in Section 6A1.
	Worn piston ring groove and ring	Pistons inspection in Section 6A1.
	Improper location of piston ring gap	Pistons assembly in Section 6A1.
	Worn or damaged valve stem seal	Valves removal and installation in Section 6A1.
	Worn valve stem	Valves inspection in Section 6A1.
Engine hesitates (Momentary lack of response as accelerator is depressed. Can occur at all vehicle speeds. Usually most severe when first trying to make vehicle move, as from a stop sign.)	Spark plug faulty or plug gap out of adjustment	Spark plugs in Section 6F1.
	Leaky high-tension cord	High-tension cords in Section 6F1.
	Fuel pressure out of specification	Diagnostic Flow Table B-3.
	Malfunctioning EGR valve (if equipped)	EGR system in section 6E1.
	Poor performance of TP sensor, ECT sensor or MAP sensor	TP sensor, ECT sensor or MAP sensor in Section 6E1.
	Faulty fuel injector	Diagnostic Flow Table B-1.
	Faulty ECM	
	Engine overheating	Refer to “Unit Repair Overhaul” in Section 6A1.
	Low compression	Previously outlined.
Surge (Engine power variation under steady throttle or cruise. Feels like vehicle speeds up and down with no change in accelerator pedal.)	Leaky or loosely connected high-tension cord	High-tension cords in Section 6F1.
	Faulty spark plug (excess carbon deposits, improper gap, and burned electrodes, etc.)	Spark plugs in Section 6F1.
	Variable fuel pressure	Diagnostic Flow Table B-3.
	Kinky or damaged fuel hose and lines	
	Faulty fuel pump (clogged fuel filter)	
	Malfunctioning EGR valve	EGR system in Section 6E1.
	Poor performance of MAP sensor	MAP sensor in Section 6E1.
	Faulty fuel injector	Diagnostic Flow Table B-1.
	Faulty ECM	

Condition	Possible Cause	Reference Item
Excessive detonation (Engine makes continuously sharp metallic knocks that change with throttle opening. Sounds like pop corn popping.)	Faulty spark plug	Spark plugs in Section 6F1.
	Loose connection of high-tension cord	High-tension cords in Section 6F1.
	Engine overheating	Refer to “Unit Repair Overhaul” in Section 6A1.
	Clogged fuel filter (faulty fuel pump) or fuel lines	Diagnostic Flow Table B-1 or B-2.
	Air inhaling from intake manifold or throttle body gasket	
	Malfunctioning EGR valve (if equipped)	EGR system in Section 6E1.
	Poor performance of knock sensor, ECT sensor or MAP sensor	Knock sensor malfunction in this section, ECT sensor or MAP sensor in Section 6E1.
	Faulty fuel injector(s)	Diagnostic Flow Table B-1.
	Faulty ECM	
	Excessive combustion chamber deposits	Piston and cylinder head cleaning in Section 6A1.
Engine has no power	Faulty spark plug	Spark plugs in Section 6F1.
	Faulty ignition coil with ignitor	Ignition coil in Section 6F1.
	Leaks, loose connection or disconnection of high-tension cord	High-tension cords in Section 6F1.
	Faulty knock sensor	Knock sensor malfunction in this section.
	Clogged fuel hose or pipe	Diagnostic Flow Table B-3.
	Malfunctioning fuel pump	Diagnostic Flow Table B-2.
	Air inhaling from intake manifold gasket or throttle body gasket	
	Engine overheating	Refer to “Unit Repair Overhaul” in Section 6A1.
	Malfunctioning EGR valve (if equipped)	EGR system inspection in Section 6E1.
	Maladjusted accelerator cable play	Accelerator cable play in Section 6E1.
	Poor performance of TP sensor, ECT sensor or MAP sensor	TP sensor, ECT sensor or MAP sensor in Section 6E1.
	Faulty fuel injector(s)	Diagnostic Flow Table B-1.
	Faulty ECM	
	Dragging brakes	Trouble diagnosis in Section 5.
	Slipping clutch	Trouble diagnosis in Section 7C1.
	Low compression	Compression check in Section 6A1.

Condition	Possible Cause	Reference Item
Improper engine idling or engine fails to idle	Faulty spark plug	Spark plugs in Section 6F1.
	Leaky or disconnected high-tension cord	High-tension cords in Section 6F1.
	Faulty ignition coil with ignitor	Ignition coil in Section 6F1.
	Fuel pressure out of specification	Diagnostic Flow Table B-3.
	Leaky manifold, throttle body, or cylinder head gasket	
	Malfunctioning EGR valve (if equipped)	EGR system in Section 6E1.
	Faulty idle air control system	Diagnostic Flow Table B-4.
	Faulty evaporative emission control system	EVAP emission control system in Section 6E1.
	Faulty EGR system (if equipped)	EGR system in Section 6E1.
	Faulty fuel injector(s)	Diagnostic Flow Table B-1.
	Poor performance of ECT sensor, TP sensor or MAP sensor	ECT sensor, TP sensor or MAP sensor in Section 6E1.
	Faulty ECM	
	Loose connection or disconnection of vacuum hoses	
	Malfunctioning PCV valve	PCV system in Section 6E1.
	Engine overheating	Refer to “Overheating” section.
	Low compression	Compression check in Section 6A1.
Excessive hydrocarbon (HC) emission or carbon monoxide (CO)	Faulty spark plug	Spark plugs in Section 6F1.
	Leaky or disconnected high-tension cord	High-tension cords in Section 6F1.
	Faulty ignition coil with ignitor	Ignition coil assembly in Section 6F1.
	Low compression	Compression check in Section 6A1.
	Lead contamination of three way catalytic converter	Check for absence of filler neck restrictor.
	Faulty evaporative emission control system	EVAP emission control system in Section 6E1.
	Fuel pressure out of specification	Diagnostic Flow Table B-3.
	Closed loop system (A/F feed back compensation) fails • Faulty TP sensor • Poor performance of ECT sensor or MAP sensor	 TP sensor in Section 6E1. ECT sensor or MAP sensor in Section 6E1.
	Faulty injector(s)	Diagnostic Flow Table B-1
	Faulty ECM	
	Engine not at normal operating temperature	
	Clogged air cleaner	
	Vacuum leaks	
Excessive nitrogen oxides (NOx) emission	Improper ignition timing	See Section 6F1.
	Lead contamination of catalytic converter	Check for absence of filler neck restrictor.
	Faulty EGR system (if equipped)	EGR system in Section 6E1.
	Fuel pressure out of specification	Diagnostic Flow Table B-3.
	Closed loop system (A/F feed back compensation) fails • Faulty TP sensor • Poor performance of ECT sensor or MAP sensor	 TP sensor in Section 6E1. ECT sensor or MAP sensor in Section 6E1.
	Faulty injector(s)	Diagnostic Flow Table B-1.
	Faulty ECM	

Scan Tool Data

As the data values given below are standard values estimated on the basis of values obtained from the normally operating vehicles by using a scan tool, use them as reference values. Even when the vehicle is in good condition, there may be cases where the checked value does not fall within each specified data range. Therefore, judgment as abnormal should not be made by checking with these data alone.
Also, conditions in the table below that can be checked by the scan tool are those detected by ECM and output from ECM as commands and there may be cases where the engine or actuator is not operating (in the condition) as indicated by the scan tool. Be sure to use the timing light to check the ignition timing.

NOTE:

- **With the generic scan tool, only star (✱) marked data in the table below can be read.**
- **The triangle (∆) marked data in the table below can not be read for vehicle without immobilizer indicator lamp.**
- **When checking the data with the engine running at idle or racing, be sure to shift M/T gear to the neutral gear position and A/T gear to the "Park" position and pull the parking brake fully. Also, if nothing or "no load" is indicated, turn OFF A/C, all electric loads, P/S and all the other necessary switches.**

		SCAN TOOL DATA	VEHICLE CONDITION	NORMAL CONDITION/ REFERENCE VALUES
	✱	FUEL SYSTEM B1 (FUEL SYSTEM STATUS)	At specified idle speed after warming up	CLOSED (closed loop)
	✱	CALC LOAD (CALCULATED LOAD VALUE)	At specified idle speed with no load after warming up	3 – 9%
			At 2500 r/min with no load after warming up	12 – 17%
	✱	COOLANT TEMP. (ENGINE COOLANT TEMP.)	At specified idle speed after warming up	80 – 100°C, 176 – 212°F
	✱	SHORT FT B1 (SHORT TERM FUEL TRIM)	At specified idle speed after warming up	– 20 – +20%
	✱	LONG FT B1 (LONG TERM FUEL TRIM)	At specified idle speed after warming up	– 15 – +15%
	✱	MAP (INTAKE MANIFOLD ABSOLUTE PRESSURE)	At specified idle speed with no load after warming up	24 – 37 kPa, 180 – 280 mmHg
	✱	ENGINE SPEED	At idling with no load after warming up	Desired idle speed ±50 r/min
	✱	VEHICLE SPEED	At stop	0 km/h, 0 MPH
	✱	IGNITION ADVANCE (IGNITION TIMING ADVANCE FOR NO.1 CYLINDER)	At specified idle speed with no load after warming up	1.3L : 5 - 11° BTDC 1.6L : 5 - 15° BTDC
	✱	INTAKE AIR TEMP.	At specified idle speed after warming up	Ambient temp. : +30°C –5°C
	✱	MAF (MASS AIR FLOW RATE)	At specified idle speed with no load after warming up	1 – 4 gm/sec
			At 2500 r/min with no load after warming up	4 – 9 gm/sec

		SCAN TOOL DATA	VEHICLE CONDITION		NORMAL CONDITION/ REFERENCE VALUES
	✱	THROTTLE POS (ABSOLUTE THROTTLE POSITION)	Ignition switch ON/engine stopped	Throttle valve fully closed	7 – 18%
				Throttle valve fully open	70 – 90%
	✱	O2S B1 S1 (HEATED OXYGEN SENSOR-1)	At specified idle speed after warming up		0 – 0.95 V
∆	✱	O2S B1 S2 (HEATED OXYGEN SENSOR-2)	When engine is running at 2000 r/min. for 3 min or longer after warming up.		0 – 0.95 V
∆	✱	O2S FT B1 S1	At specified idle speed after warning up		– 20 – +20%
∆	✱	DIS. WITH MIL ON	–		–
		DESIRED IDLE (DESIRED IDLE SPEED)	At idling with no load after warming up, M/T at neutral, A/T at “P” range		M/T 700 r/min
					A/T 750 r/min
		TP SENSOR VOLT (THROTTLE POSITION SENSOR OUTPUT VOLTAGE)	Ignition switch ON/engine stopped	Throttle valve fully closed	More than 0.2 V
				Throttle valve fully open	Less than 4.8 V
		INJ PULSE WIDTH (FUEL INJECTION PULSE WIDTH)	At specified idle speed with no load after warming up		2.0 – 4.0 msec.
			At 2500 r/min with no load after warming up		2.0 – 3.6 msec.
		IAC FLOW DUTY (IDLE AIR CONTROL FLOW DUTY)	At idling with no load after warming up		5 – 25%
		TOTAL FUEL TRIM	At specified idle speed after warming up		– 35 – +35%
		BATTERY VOLTAGE	Ignition switch ON/engine stop		10 – 14 V
		CANIST PRG DUTY (EVAP CANISTER PURGE FLOW DUTY)	–		0 – 100%
		CLOSED THROT POS (CLOSED THROTTLE POSITION)	Throttle valve at idle position		ON
			Throttle valve opens larger than idle position		OFF
		FUEL CUT	When engine is at fuel cut condition		ON
			Other than fuel cut condition		OFF
		RADIATOR FAN (RADIATOR FAN CONTROL RELAY)	Ignition switch ON	Engine coolant temp. : Lower than 95°C (203°F)	OFF
				Engine coolant temp. : 97.5°C (208°F) or higher	ON
		ELECTRIC LOAD	Ignition switch ON/Headlight, small light and rear window defogger all turned OFF		OFF
			Ignition switch ON/Headlight, small light or rear window defogger turned ON		ON
		A/C SWITCH	Engine running after warming up, A/C not operating		OFF
			Engine running after warming up, A/C operating		ON

		SCAN TOOL DATA	VEHICLE CONDITION		NORMAL CONDITION/ REFERENCE VALUES
		PNP SIGNAL (PARK/NEUTRAL POSITION SIGNAL) A/T only	Ignition switch ON	Selector lever in “P” or “N” position	P/N Range
				Selector lever in “R”, “D”, “2” or “L” position	D Range
		EGR VALVE	At specified idle speed after warming up		0%
∆		FUEL TANK LEVEL	–		0 – 100%
		BAROMETRIC PRESS	–		Display the barometric pressure
		FUEL PUMP	Within 3 seconds after ignition switch ON or engine running		ON
			Engine stop at ignition switch ON.		OFF
		BRAKE SW	Ignition switch ON	Brake pedal is depressing	ON
				Brake pedal is releasing	OFF
		BLOWER FAN	Ignition switch ON	Blower fan switch ON	ON
				Blower fan switch OFF	OFF
		A/C MAG CLUTCH	Ignition switch ON	A/C switch ON	ON
				A/C switch OFF	OFF

SCAN TOOL DATA DEFINITIONS :

FUEL SYSTEM (FUEL SYSTEM STATUS)

Air/fuel ratio feedback loop status displayed as either open or closed loop. Open indicates that ECM ignores feedback from the exhaust oxygen sensor.
Closed indicates final injection duration is corrected for oxygen sensor feedback.

CALC LOAD (CALCULATED LOAD VALUE, %)

Engine load displayed as a percentage of maximum possible load. Value is calculated mathematically using the formula : actual (current) intake air volume ÷ maximum possible intake air volume x 100%.

COOLANT TEMP. (ENGINE COOLANT TEMPERATURE, °C, °F)

It is detected by engine coolant temp. sensor

SHORT FT B1 (SHORT TERM FUEL TRIM, %)

Short term fuel trim value represents short term corrections to the air/fuel mixture computation. A value of 0 indicates no correction, a value greater than 0 means an enrichment correction, and a value less than 0 implies an enleanment correction.

LONG FT B1 (LONG TERM FUEL TRIM, %)

Long term fuel trim Value represents long term corrections to the air/fuel mixture computation. A value of 0 indicates no correction, a value greater than 0 means an enrichment correction, and a value less than 0 implies an enleanment correction.

MAP (INTAKE MANIFOLD ABSOLUTE PRESSURE, kPa, inHg)

It is detected by manifold absolute pressure sensor and used (among other things) to compute engine load.

ENGINE SPEED (rpm)

It is computed by reference pulses from crankshaft position sensor.

VEHICLE SPEED (km/h, MPH)

It is computed based on pulse signals from vehicle speed sensor.

IGNITION ADVANCE (IGNITION TIMING ADVANCE FOR NO.1 CYLINDER, °)

Ignition timing of NO.1 cylinder is commanded by ECM. The actual ignition timing should be checked by using the timing light.

INTAKE AIR TEMP. (°C, °F)

It is detected by intake air temp. sensor and used to determine the amount of air passing into the intake manifold as air density varies with temperature.

MAF (MASS AIR FLOW RATE, gm/s, lb/min)

It represents total mass of air entering intake manifold which is computed based on signals from MAP sensor, IAT sensor, TP sensor, etc.

THROTTLE POS (ABSOLUTE THROTTLE POSITION, %)

When throttle position sensor is fully closed position, throttle opening is indicated as 0% and 100% full open position.

OXYGEN SENSOR B1 S1 (HEATED OXYGEN SENSOR-1, V)

It indicates output voltage of HO2S-1 installed on exhaust manifold (pre-catalyst).

OXYGEN SENSOR B1 S2 (HEATED OXYGEN SENSOR-2, V)

It indicates output voltage of HO2S-2 installed on exhaust pipe (post-catalyst). It is used to detect catalyst deterioration.

DESIRED IDLE (DESIRED IDLE SPEED, rpm)

The Desired Idle Speed is an ECM internal parameter which indicates the ECM requested idle. If the engine is not running, this number is not valid.

TP SENSOR VOLT (THROTTLE POSITION SENSOR OUTPUT VOLTAGE, V)

The Throttle Position Sensor reading provides throttle valve opening information in the form of voltage.

INJ PULSE WIDTH (FUEL INJECTION PULSE WIDTH, msec.)

This parameter indicates time of the injector drive (valve opening) pulse which is output from ECM (but injector drive time of NO.1 cylinder for multiport fuel injection).

IAC FLOW DUTY (IDLE AIR (SPEED) CONTROL DUTY, %)

This parameter indicates current flow time rate within a certain set cycle of IAC valve (valve opening rate) which controls the amount of bypass air (idle speed).

TOTAL FUEL TRIM (%)

The value of Total Fuel Trim is obtained by putting values of short Term Fuel Trim and Long Term Fuel Trim together. This value indicates how much correction is necessary to keep the air/fuel mixture stoichiometrical.

BATTERY VOLTAGE (V)

This parameter indicates battery positive voltage inputted from main relay to ECM.

CANIST PURGE DUTY (EVAP CANISTER PURGE FLOW DUTY, %)

This parameter indicates valve ON (valve open) time rate within a certain set cycle of EVAP purge solenoid valve which controls the amount of EVAP purge.
0% means that the purge valve is completely closed while 100% is a fully open valve.

CLOSED THROTTLE POSITION (ON/OFF)

This parameter will read ON when throttle valve is fully closed, or OFF when the throttle is not fully closed.

FUEL CUT (ON/OFF)

ON : Fuel being cut (output signal to injector is stopped)
OFF : Fuel not being cut

RADIATOR FAN (RADIATOR FAN CONTROL RELAY, ON/OFF)

ON : Command for radiator fan control relay operation being output.
OFF : Command for relay operation not being output.

ELECTRIC LOAD (ON/OFF)

ON : Headlight, small light or rear window defogger ON signal inputted.
OFF : Above electric loads all turned OFF.

A/C SWITCH (ON/OFF)

ON : Command for A/C operation being output from ECM to A/C compressor magnet clutch.
OFF : Command for A/C operation not being output.

FUEL TANK LEVEL (%)

This parameter indicates approximate fuel level in the fuel tank. As the detectable range of the fuel level sensor is set as 0 to 100%, however, with some models whose fuel tank capacity is smaller, the indicated fuel level may be only 70% even when the fuel tank is full.

PNP SIGNAL (PARK/NEUTRAL POSITION SIGNAL, P/N RANGE or D RANGE)

It is detected by signal from TCM.
D range : A/T is in “R”, “D”, “2” or “L” range.
P/N range : A/T is in “P” or “N” range or the above signal is not inputted from TCM.

EGR VALVE (%)

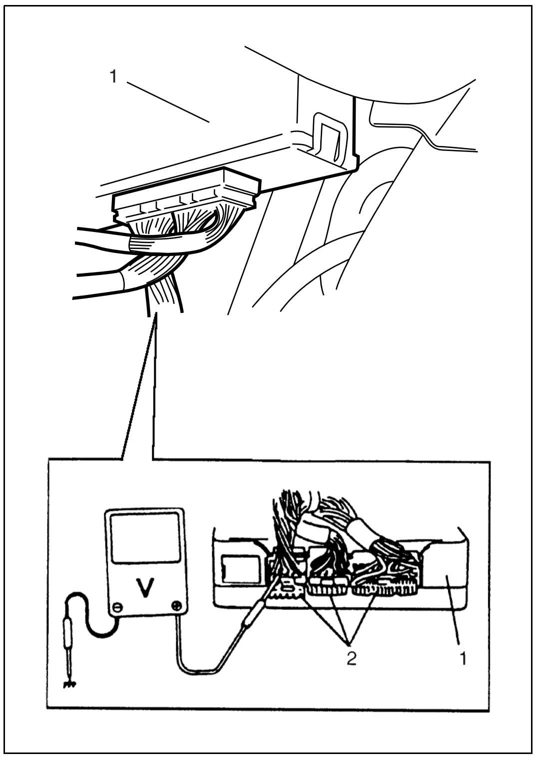
This parameter indicates opening rate of EGR valve which controls the amount of EGR flow.

Inspection of ECM and Its Circuits

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

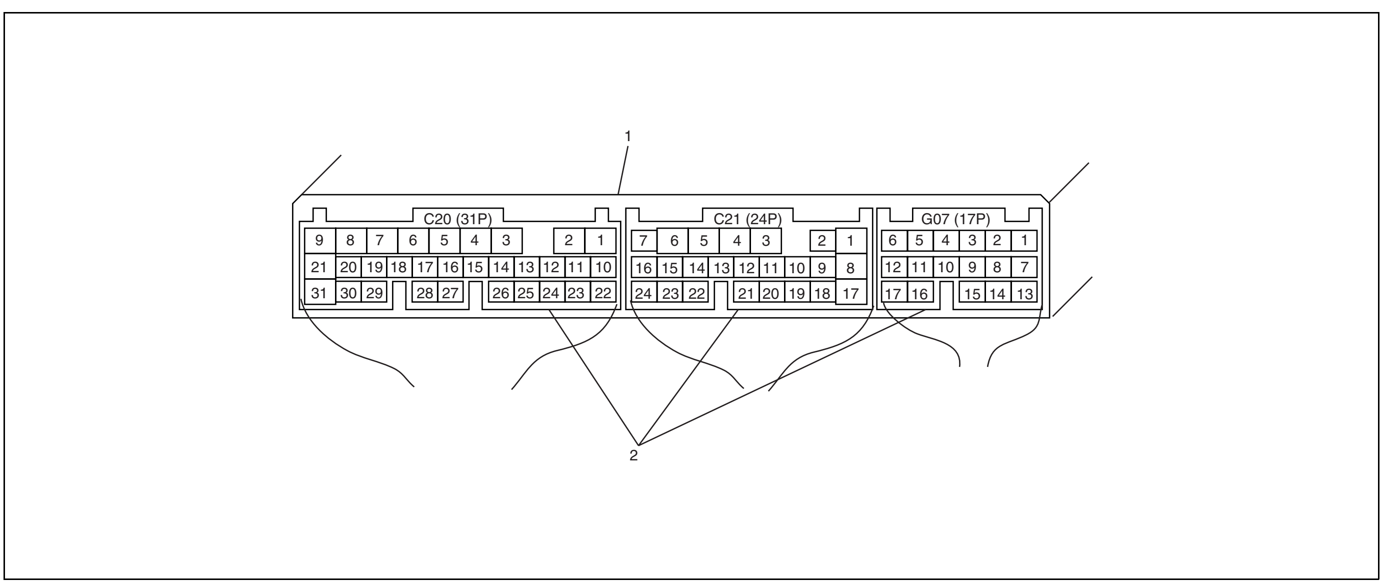
> **CAUTION:**
> **ECM cannot be checked by itself. It is strictly prohibited to connect voltmeter or ohmmeter to ECM with coupler disconnected from it.**

VOLTAGE CHECK



1) Remove ECM (1) from vehicle body referring to Section 6E.
2) Check voltage at each terminal of couplers (2) connected.

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



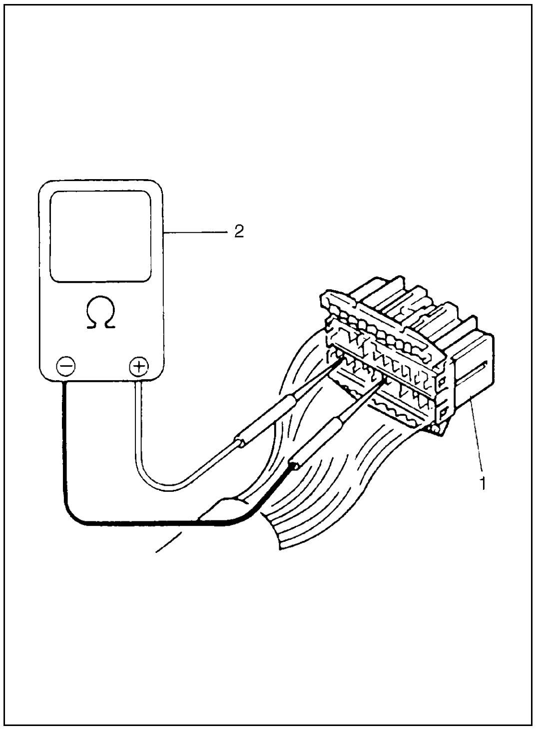
1.	ECM
2.	ECM couplers (Viewed from harness side)

TERMINAL NO.		CIRCUIT	NORMAL VOLTAGE	CONDITION
C20	1	Ground	–	–
	2	Ground	–	–
	3	Ground	–	–
	4	EVAP canister purge valve	10 – 14 V	Ignition switch ON
	5	Power steering pressure switch (if equipped)	10 – 14 V	Ignition switch ON
			0 – 1.5 V	With engine running at idle, turning steering wheel to the right or left as far as it stops, repeating it a few times
	6	Idle air control valve	0 – 13 V	At specified idle speed after engine warmed up
	7	Heater of HO2S-1 (Vehicle with EGR)	10 – 14 V	Ignition switch ON
	8	Fuel injector No.4	10 – 14 V	Ignition switch ON
	9	Fuel injector No.1	10 – 14 V	Ignition switch ON
	10	Sensor ground	–	–
	11	Camshaft position sensor	0 – 0.8 V and 4 – 6 V	Ignition switch ON
	12	Generator control signal	Min. 4.8 V	Ignition switch ON
	13	Heated oxygen sensor-1 (Vehicle with EGR system)	Refer to DTC P0130 diag. flow table	
		CO adjusting resistor (if equipped)	–	–
	14	Engine coolant temperature sensor	0.55 - 0.95 V	Ignition switch ON Engine coolant temp. : 80°C (176°F)
	15	Intake air temperature sensor	2.0 – 2.7 V	Ignition switch ON Intake air temp. : 20°C (68°F)
	16	Throttle position sensor	0.2 – 1.0 V	Ignition switch ON Throttle valve at idle position
			2.8 – 4.8 V	Ignition switch ON Throttle valve at full open position
	17	EGR valve (stepper motor coil 3)	10 – 14 V	Ignition switch ON
	18	EGR valve (stepper motor coil 1)	10 – 14 V	Ignition switch ON
	19	Ignition coil No.2	–	–
	20	Ignition coil No.1	–	–
	21	Fuel injector No.2	10 – 14 V	Ignition switch ON
	22	Power source for sensors	4.75 – 5.25 V	Ignition switch ON
	23	Crankshaft position sensor	–	–
	24	Fuel pump relay	0 – 1 V	For 2 seconds after ignition switch ON
			10 – 14 V	After the time shown above
	25	Knock sensor (vehicle with EGR)	2.1 – 2.9 V	Ignition switch ON
	26	Manifold absolute pressure sensor	3.3 – 4.0 V	Ignition switch ON and Barometric pressure : 100 kPa (760 mmHg)
	27	Diag. switch terminal (vehicle without immobilizer)	4 – 6 V	Ignition switch ON
	28	EGR valve (stepper motor coil 4)	10 – 14 V	Ignition switch ON
	29	EGR valve (stepper motor coil 2)	10 – 14 V	Ignition switch ON
	30	Engine start switch (Engine start signal)	6 – 12 V	While engine cranking
			0 V	Other than above
	31	Fuel injector No.3	10 – 14 V	Ignition switch ON

TERMINAL NO.		CIRCUIT	NORMAL VOLTAGE	CONDITION
C21	1	A/C compressor relay (if equipped)	0 – 1 V	A/C operated
			10 – 14 V	A/C not operated
	2	Stop lamp switch	0 V	Ignition ON and stop lamp switch OFF
			10 – 14 V	Ignition ON and stop lamp switch ON
	3	Radiator fan relay No.2	10 – 14 V	Ignition switch ON and Engine coolant temp. : 100°C (212°F) or lower
			0 – 1 V	Ignition switch ON and Engine coolant temp. : 102.5°C (216.5°F) or higher
	4	Heater of HO2S-2 (if equipped)	10 – 14 V	Ignition switch ON
	5	Power source	10 – 14 V	Ignition switch ON
	6	Power source	10 – 14 V	Ignition switch ON
	7	A/C triple pressure switch	10 – 14 V	A/C not operated
	8	Monitor output (without immobilizer)	–	–
	9	A/C condenser fan relay (if equipped)	0 – 1 V	Ignition switch ON Condenser fan motor operated
			10 – 14 V	Ignition switch ON Condenser fan motor not operated
	10	Main relay	10 – 14 V	Ignition switch OFF
			0.4 – 1.5 V	Ignition switch ON
	11	A/C evaporator inlet air temp. sensor	–	–
	12	Blank	–	–
	13	Heated oxygen sensor-2 (if equipped)	Refer to DTC 0130 diag. flow table	
	14	A/C evaporator outlet air temp. sensor	–	–
	15	Test switch terminal (vehicle without immobilizer)	–	–
	16	A/C input signal (if equipped)	10 – 14 V	Ignition ON and A/C switch OFF
			0 – 2 V	Ignition ON and A/C switch ON
	17	Electric load signal (+)	0 V	Ignition switch ON Small light and rear defogger OFF
			10 – 14 V	Ignition switch ON Small light or rear defogger ON
	18	Radiator fan relay No.1	10 – 14 V	Ignition switch ON and Engine coolant temp. : 95°C or lower (203°F)
			0 – 1 V	Ignition switch ON and Engine coolant temp. : 97.5°C or higher (208°F)
	19	Immobilizer indicator lamp (vehicle with immobilizer)	0 – 1 V	Ignition switch ON
			10 – 14 V	When engine running
	20	Sensor ground (vehicle body)	–	–
	21	Blank	–	–
	22	Blank	–	–
	23	Ignition switch	10 – 14 V	Ignition switch ON
	24	Vehicle speed sensor	0 V and 4 – 6 V	Ignition switch ON Front left tire turned slowly with front right tire locked

TERMINAL NO.		CIRCUIT	NORMAL VOLTAGE	CONDITION
G07	1	Tachometer	0 – 1 V	Ignition switch ON
	2	Blank	–	–
	3	Blank	–	–
	4	Blank	–	–
	5	Engine coolant temp. signal for TCM (A/T)	0 V and 10 – 14 V	Ignition switch ON
	6	D-range ID-up signal (A/T)	10 – 14 V	Ignition switch ON
	7	Malfunction indicator lamp	0 – 1 V	Ignition switch ON
			10 – 14 V	When engine running
	8	Data link connector (SUZUKI serial data line) (Vehicle with immobilizer)	4 – 6 V	Ignition switch ON
	9	Engine coolant temp. signal for meter	0 – 1 V and 10 – 14 V	Ignition switch ON
	10	Electric load signal (–)	0 – 2 V	Ignition ON and blower fan turned OFF
			10 – 14 V	Ignition ON and blower fan turned ON
	11	Power source for back-up	10 – 14 V	Anytime
	12	Torque control input signal (A/T)	0 V and 10 – 14 V	Ignition switch ON
	13	Data link connector (K line of ISO 9141)	10 – 14 V	Ignition switch ON
	14	Throttle opening signal for TCM (A/T)	0 V and 10 – 14 V	Ignition switch ON
	15	Fuel level sensor (gauge) (vehicle with heated oxygen sensor 2)	0 – 2 V	Ignition ON and fuel tank fully filled
			4.5 – 7.5 V	Ignition ON and fuel tank emptied
	16	Blank	–	–
	17	Serial data for TCM (A/T)	10 – 14 V and 0 – 1 V	Ignition switch ON

Resistance Check



1) Disconnect ECM couplers from ECM with ignition switch OFF.

CAUTION:
Never touch terminals of ECM itself or connect voltmeter or ohmmeter.

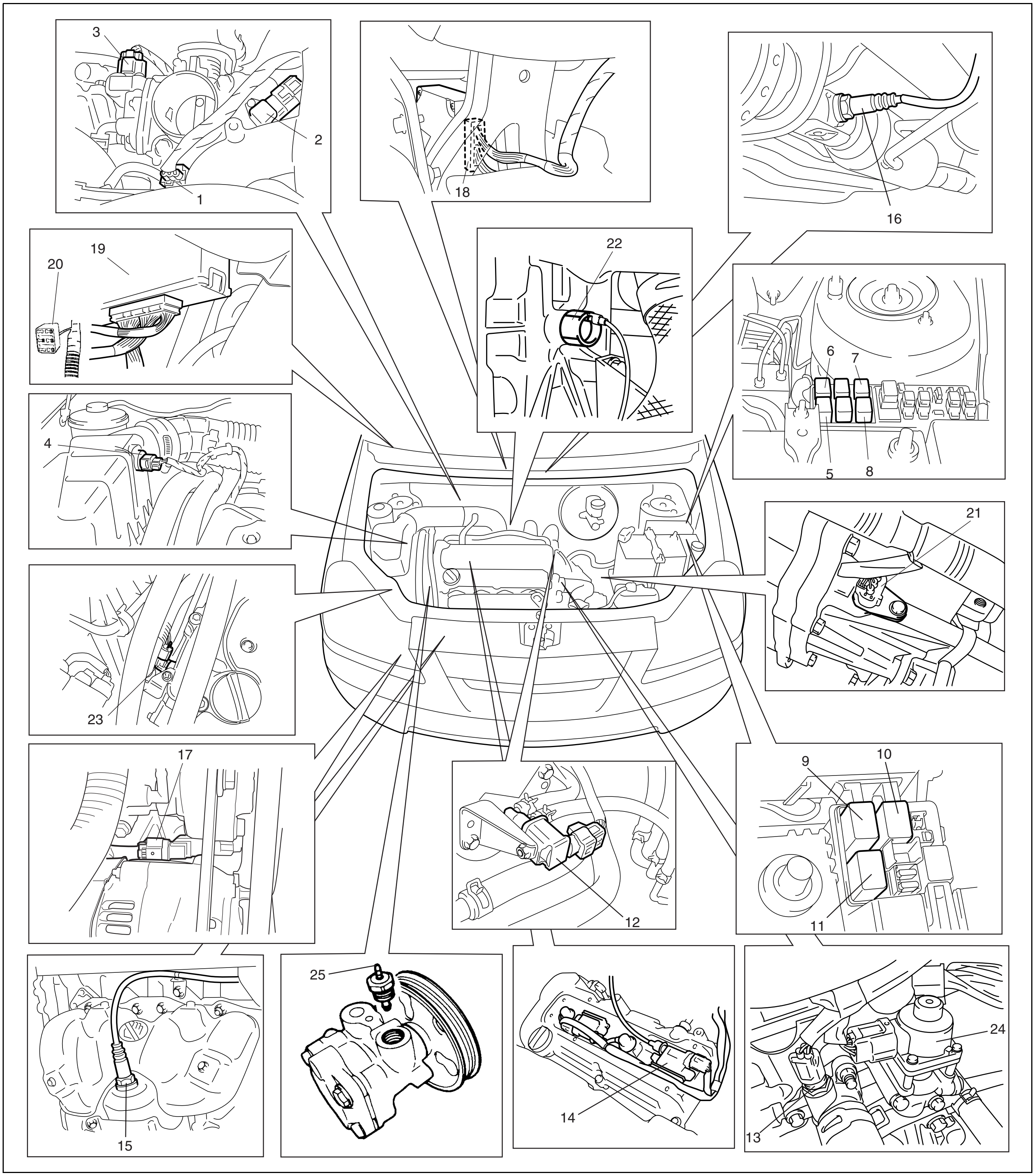
2) Check resistance between each terminal of connectors disconnected.

CAUTION:
- **Be sure to connect ohmmeter probe from wire harness side of coupler.**
- **Be sure to turn OFF ignition switch for this check.**
- **Resistance in table below represents that when parts temperature is 20°C (68°F).**

1.	ECM coupler disconnected
2.	Ohmmeter

TERMINALS	CIRCUIT	STANDARD RESISTANCE
C20-7 to C21-23	HO2S-1 heater (if equipped)	5.0 – 6.4 Ω
C21-4 to C21-23	HO2S-2 heater (if equipped)	12.0 – 14.3 Ω
C20-9 to C21-5/6	No.1 injector	11.3 – 13.8 Ω
C20-21 to C21-5/6	No.2 injector	11.3 – 13.8 Ω
C20-31 to C21-5/6	No.3 injector	11.3 – 13.8 Ω
C20-8 to C21-5/6	No.4 injector	11.3 – 13.8 Ω
C20-18 to C21-5/6	EGR valve (stepper motor coil 1) (if equipped)	20 – 24 Ω
C20-29 to C21-5/6	EGR valve (stepper motor coil 2) (if equipped)	20 – 24 Ω
C20-17 to C21-5/6	EGR valve (stepper motor coil 3) (if equipped)	20 – 24 Ω
C20-28 to C21-5/6	EGR valve (stepper motor coil 4) (if equipped)	20 – 24 Ω
C20-4 to C21-5/6	EVAP canister purge valve	30 – 34 Ω
C20-24 to C21-23	Fuel pump relay	56 – 146 Ω
C21-1 to C21-23	A/C compressor relay	56 – 146 Ω
C21-9 to C21-23	A/C condenser fan relay	56 – 146 Ω
C21-18 to C21-23	Radiator fan relay 1	56 – 146 Ω
C21-10 to G07-11	Main relay	56 – 146 Ω
C20-1 to Body ground	Ground	Continuity
C20-2 to Body ground	Ground	Continuity
C20-3 to Body ground	Ground	Continuity

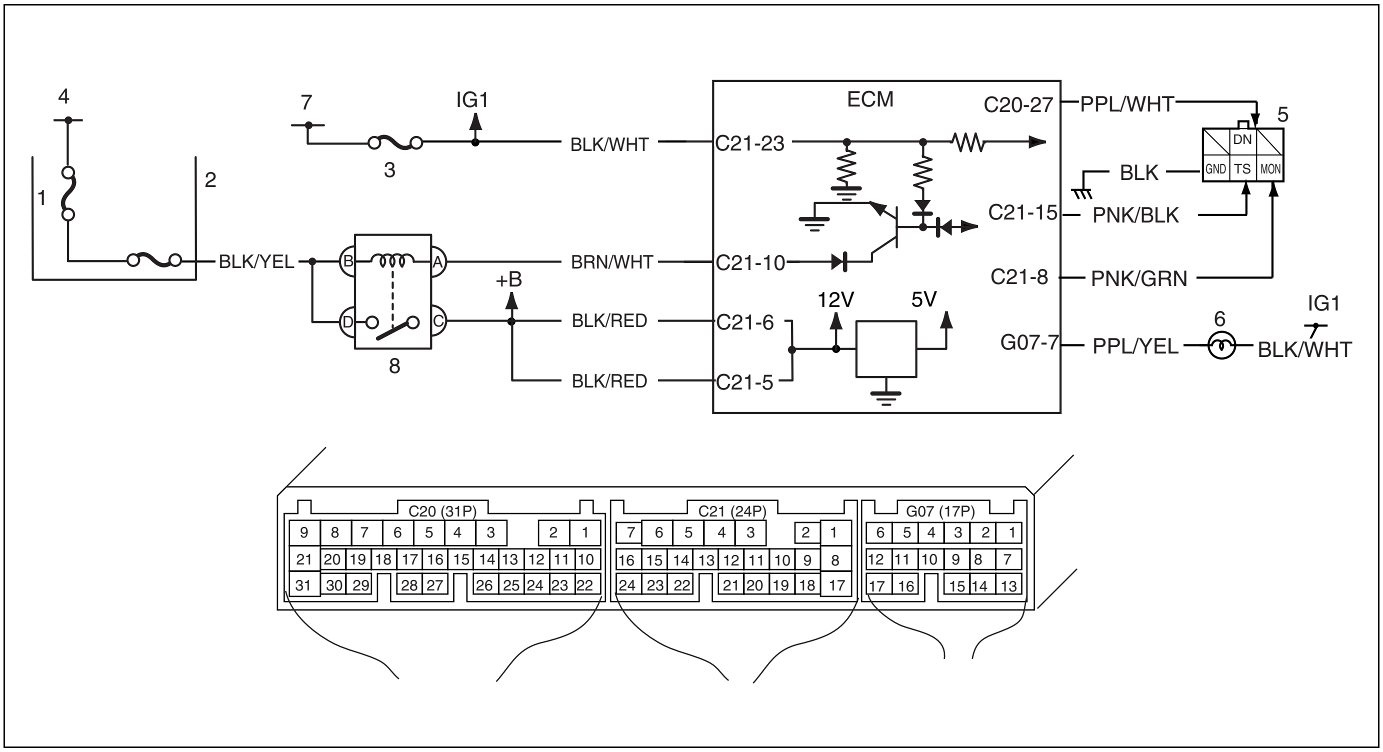
Component Location



1. TP sensor	10. Radiator fan control relay No.2	19. ECM
2. MAP sensor	11. Radiator fan control relay No.3	20. Monitor connector
3. IAC valve	12. EVAP canister purge valve	21. VSS
4. IAT sensor	13. ECT sensor	22. Knock sensor (if equipped)
5. A/C compressor relay	14. Ignition coil with igniter	23. CMP sensor
6. A/C condenser fan relay	15. HO2S-1 (if equipped)	24. EGR valve (if equipped)
7. Fuel pump relay	16. HO2S-2 (if equipped)	25. Power steering pressure switch
8. Main relay	17. CKP sensor	✱ : This figure shows left-hand steering vehicle, these parts are installed at the other side for right-hand steering vehicle.
9. Radiator fan control relay No.1	18. TCM	

Table A-1 Malfunction Indicator Lamp Circuit Check - Lamp Does Not Come "ON" at Ignition Switch ON (But Engine at Stop)

WIRING DIAGRAM



1. BATT fuse	3. IG fuse	5. Monitor connector (vehicle without immobilizer indicator lamp)	7. To ignition switch
2. Main fuse box	4. To battery	6. MIL	8. Main relay

CIRCUIT DESCRIPTION

When the ignition switch is turned ON, ECM causes the main relay to turn ON (close the contact point). Then, ECM being supplied with the main power, turns ON the malfunction indicator lamp (MIL). When the engine starts to run and no malfunction is detected in the system, MIL goes OFF but if a malfunction was or is detected, MIL remains ON even when the engine is running.

INSPECTION

Step	Action	Yes	No
1	MIL Power Supply Check 1) Turn ignition switch ON. Do other indicator/warning lights in combination meter comes ON?	Go to Step 2.	"IG METER" fuse blown, main fuse blown, ignition switch malfunction, "BLK/WHT" circuit between "IG" fuse and combination meter or poor coupler connection at combination meter.
2	ECM Power and Ground Circuit Check Does engine start?	Go to Step 3.	Go to TABLE A-5 ECM POWER AND GROUND CIRCUIT CHECK. If engine is not cranked, go to DIAGNOSIS in Section 6G.

Step	Action	Yes	No
3	MIL Circuit Check 1) Turn ignition switch OFF and disconnect connectors from ECM. 2) Check for proper connection to ECM at terminal G07-7. 3) If OK, then using service wire, ground terminal G07-7 in connector disconnected. Does MIL turn on at ignition switch ON?	Substitute a known-good ECM and recheck.	Bulb burned out or “PPL/YEL” wire circuit open. Test switch terminal circuit grounded (vehicle without immobilizer indicator lamp).

Table A-2 Malfunction Indicator Lamp Circuit Check - Lamp Remains “ON” after Engine Starts

WIRING DIAGRAM / CIRCUIT DESCRIPTION

Refer to table A-1.

INSPECTION

Step	Action	Yes	No
1	Diagnostic Trouble Code (DTC) Check 1) Check DTC referring to DTC CHECK section. Is there any DTC(s)?	Go to Step 2 of ENGINE DIAG. FLOW TABLE.	Go to Step 2.
2	DTC Check 1) Start engine and recheck DTC while engine running. Is there any DTC(s)?		Go to Step 3.
3	MIL Circuit Check 1) Turn OFF ignition switch. 2) Disconnect connectors from ECM. Does MIL turn ON at ignition switch ON?	“PPL/YEL” wire circuit shorted to ground.	Substitute a known-good ECM and recheck.

Table A-3 MIL Check - MIL Flashes at Ignition Switch ON (Vehicle without Immobilizer Indicator Lamp)

WIRING DIAGRAM / CIRCUIT DESCRIPTION

Refer to TABLE A-1.

INSPECTION

Step	Action	Yes	No
1	MIL Flashing Pattern Check 1) Turn ignition switch ON. Does lamp flashing pattern indicate diagnostic trouble code?	Go to Step 2.	Substitute a known-good ECM and recheck.
2	Diag. Switch Circuit Check Is diag. switch terminal connected to ground via service wire?	System is in good condition.	“PPL/WHT” circuit shorted to ground. If circuit is OK substitute a known-good ECM and recheck.

Table A-4 MIL Check - MIL Does Not Flash or Just Remains ON Even with Grounding Diagnosis Switch Terminal (Vehicle without Immobilizer Indicator Lamp)

WIRING DIAGRAM / CIRCUIT DESCRIPTION

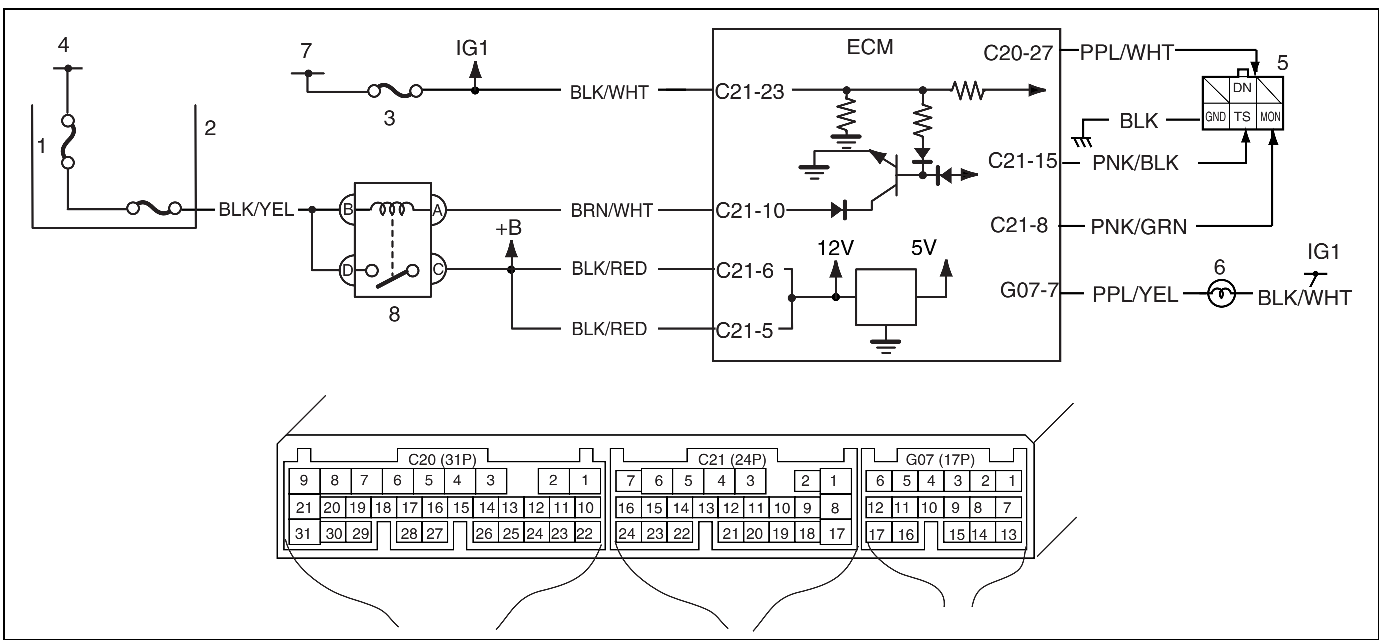
Refer to TABLE A-1.

INSPECTION

Step	Action	Yes	No
1	MIL Circuit Check 1) Turn ignition switch OFF and disconnect connectors from ECM. Does MIL turn ON at ignition switch ON?	"PPL/YEL" circuit shorted to ground.	Go to Step 2.
2	ECM/PCM Connection Check 1) Turn ignition switch OFF. Is connector (C20-27 connection) connected to ECM/PCM properly?	Go to Step 3.	Poor connector connection.
3	Diag. Switch Terminal Circuit Check 1) Connect connectors to ECM. 2) Using service wire, ground C20-27 terminal with connectors connected to ECM. 3) Turn ignition switch ON. Does MIL flash?	"PPL/WHT" or "BLK" circuit open.	Substitute a known-good ECM and recheck.

Table A-5 ECM Power and Ground Circuit Check - MIL Does Not Light at Ignition Switch ON and Engine Doesn't Start Though It Is Cranked Up

WIRING DIAGRAM



1. BATT fuse	3. IG fuse	5. Monitor connector (vehicle without immobilizer indicator lamp)	7. To ignition switch
2. Main fuse box	4. To battery	6. MIL	8. Main relay

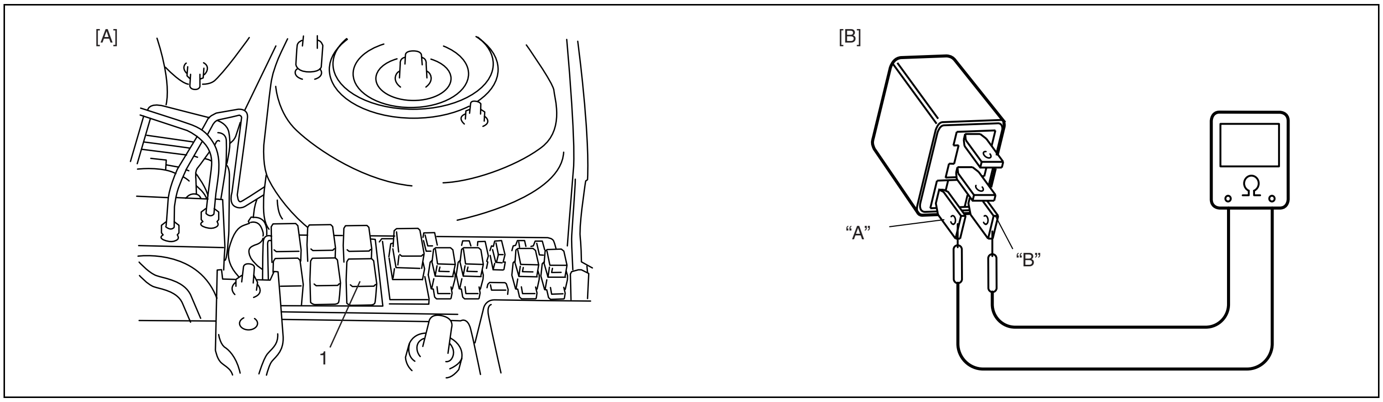
CIRCUIT DESCRIPTION

When the ignition switch tuned ON, the main relay turns ON (the contact point closes) and the main power is supplied to ECM.

INSPECTION

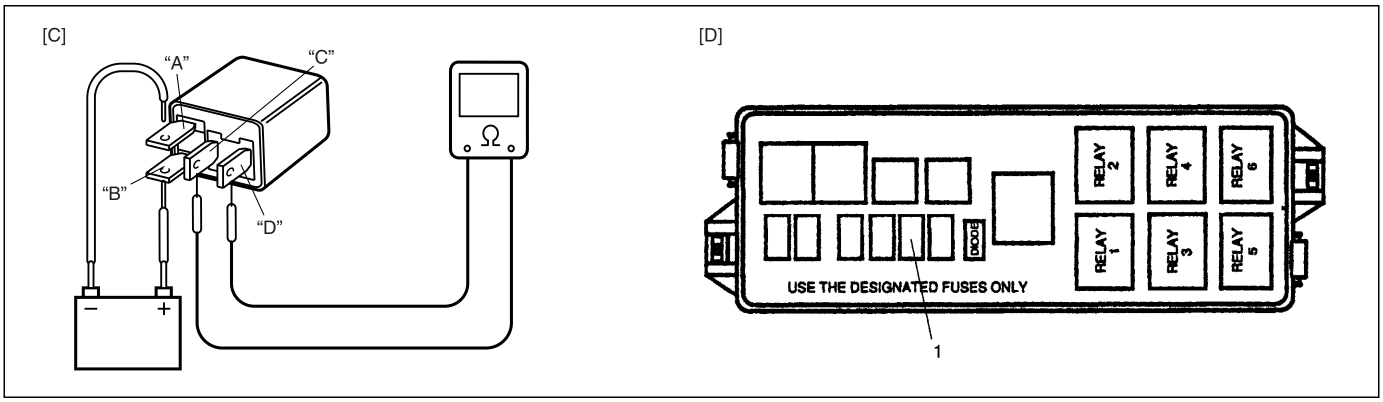
Step	Action	Yes	No
1	Main Relay Operating Sound Check Is operating sound of main relay heard at ignition switch ON?	Go to Step 5.	Go to Step 2.
2	Main Relay Check 1) Turn OFF ignition switch and remove main relay (1). 2) Check for proper connection to main relay (1). 3) Check resistance between each two terminals. See Fig. 1 and 2. Between terminals C and D : Infinity Between terminals A and B : 56 – 146 Ω 4) Check that there is continuity between terminals C and D when battery is connected to terminals A and B. See Fig. 3. Is main relay in good condition?	Go to Step 3.	Replace main relay.
3	Fuse Check Is main fuse in good condition? See Fig. 4.	Go to Step 4.	Check for short in circuits connected to this fuse.
4	ECM Power Circuit Check 1) Turn OFF ignition switch, disconnect connectors from ECM and install main relay. 2) Check for proper connection to ECM at terminals C21-23, C21-10, C21-5 and C21-6. 3) If OK, then measure voltage between terminal C21-23 and ground, C21-10 and ground with ignition switch ON. Is each voltage 10 – 14 V?	Go to Step 5.	“BLK/WHT”, “BLK/YEL” or “BRN/WHT” circuit open.
5	ECM Power Circuit Check 1) Using service wire, ground terminal C21-10 and measure voltage between terminal C21-5 and ground at ignition switch ON. Is it 10 – 14 V?	Check ground circuits “BRN/WHT” and “BLK/YEL” for open. If OK, then substitute a known-good ECM and recheck.	Go to Step 6.
6	Is operating sound of main relay heard in Step 1?	Go to Step 7.	“BLK/YEL” or “BLK/RED” wire open.
7	Main relay check 1) Check main relay according to procedure in Step 2. Is main relay in good condition?	“BLK/YEL” or “BLK/RED” wire open.	Replace main relay.

[A] Fig. 1 for Step 2 / [B] Fig. 2 for Step 2



1. Main relay

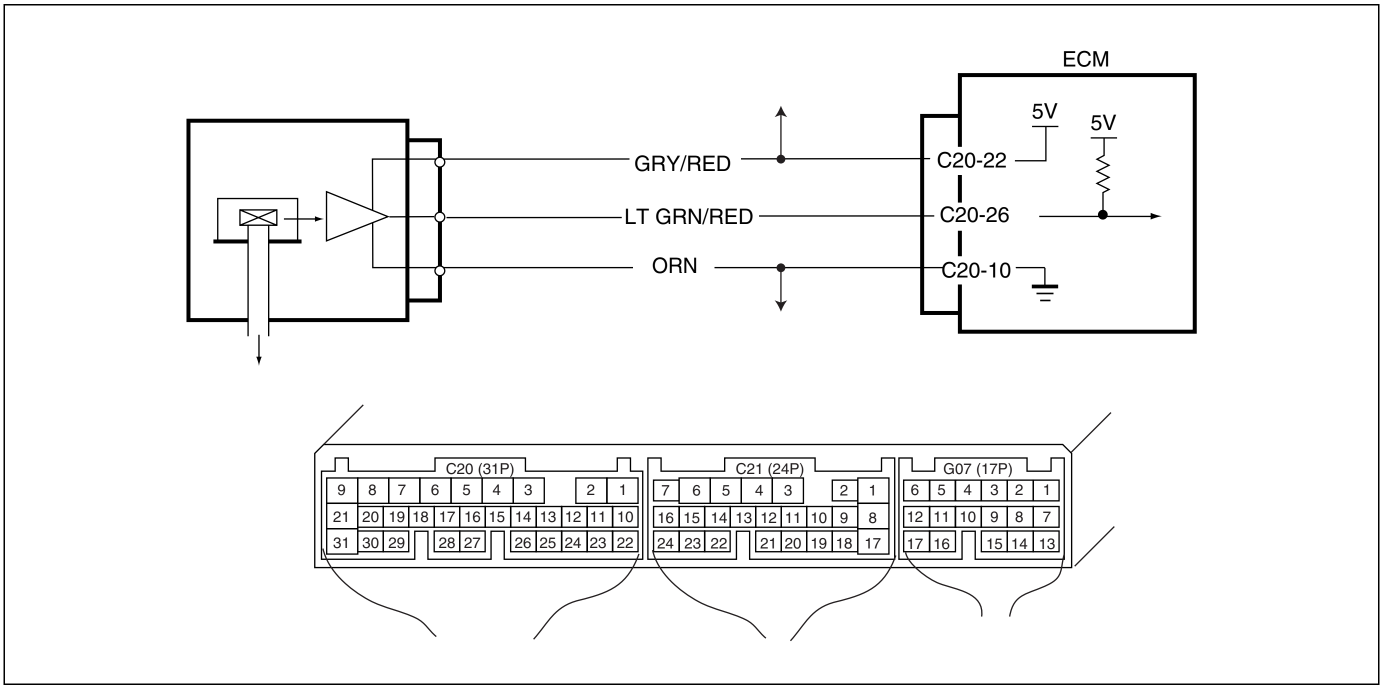
[C] Fig. 3 for Step 2 / [D] Fig. 4 for Step 3



1. Fuse

DTC P0105 (DTC No.11) Manifold Absolute Pressure (MAP) Circuit Malfunction

WIRING DIAGRAM / CIRCUIT DESCRIPTION



DTC DETECTING CONDITION	POSSIBLE CAUSE
• MAP sensor signal is 0.19 V or lower (Low pressure – High vacuums – Low voltage) or • MAP sensor signal is 4.5 V or higher (High pressure – Low vacuums – High voltage)	• “ORN” circuit open • “GRY/RED” circuit open or shorted to ground • “LT GRN/RED” circuit open or shorted to ground • MAP sensor malfunction • ECM malfunction

NOTE:

- **When this DTC and DTC P0120 (No.13) are indicated together, it is possible that “GRY/RED” circuit is open.**
- **When DTC P0105 (No.11), P0110 (No.18), P0115 (No.19) and P0120 (No.13) are indicated together, it is possible that “ORN” circuit is open.**

DTC CONFIRMATION PROCEDURE

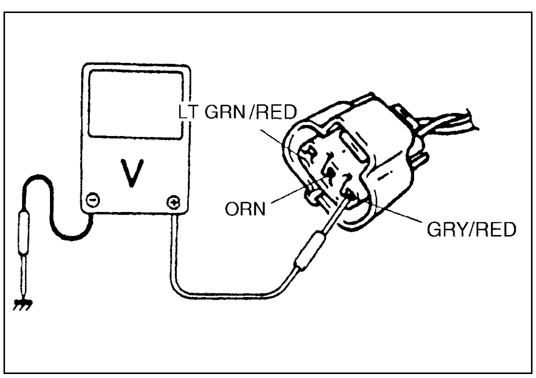
1) Clear DTC, start engine and keep it at idle for 1 min.
2) Select “DTC” mode on scan tool and check DTC.

INSPECTION

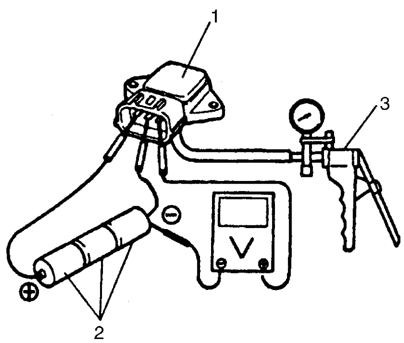
Step	Action	Yes	No
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Check MAP Sensor and Its Circuit. 1) Connect scan tool to DLC with ignition switch OFF. 2) Turn ignition switch ON. 3) Check intake manifold pressure. Is it 114 kPa or more or 43 kPa or less?	Go to Step 3.	Intermittent trouble. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A.
3	Check Wire Harness. 1) Disconnect MAP sensor connector with ignition switch OFF. 2) Check for proper connection of MAP sensor at "LT GRN/RED" and "GRY/RED" wire terminals. 3) If OK, then with ignition switch ON, check voltage between each of "GRY/RED" or "LT GRN/RED" wire terminals and body ground. See Fig. 1. Is voltage about 4 – 6 V at each terminal?	Go to Step 4.	"GRY/RED" wire open or shorted to ground circuit or shorted to power circuit (See NOTE), "LT GRN/RED" wire open or shorted to ground, poor C20-26 connection or C20-22 connection. If wire and connection are OK, confirm that MAP sensor is normal and then substitute a known-good ECM and recheck.
4	Check MAP sensor. Check MAP sensor according to "MAP Sensor Individual Check" below. Is it in good condition?	"GRY/RED" wire shorted to "ORN" wire, "LT GRN/RED" wire open, poor C20-10 connection. If wire and connection are OK, substitute a known-good ECM and recheck.	Replace MAP sensor.

NOTE:
When battery voltage is applied to "GRY/RED" wire, it is possible that MAP sensor is also faulty.

Fig. 1 for Step 3



Map sensor individual check



1) Disconnect connector from MAP sensor (1).
2) Remove MAP sensor (1).
3) Arrange 3 new 1.5 V batteries (2) in series (check that total voltage is 4.5 – 5.0 V) and connect its positive terminal to "Vin" terminal of sensor and negative terminal to "Ground" terminal. Then check voltage between "Vout" and "Ground". Also, check if voltage reduces when vacuum is applied up to 400 mmHg by using vacuum pump (3).

Output voltage (When input voltage is 4.5 – 5.5 V, ambient temp. 20 – 30°C, 68 – 86°F)

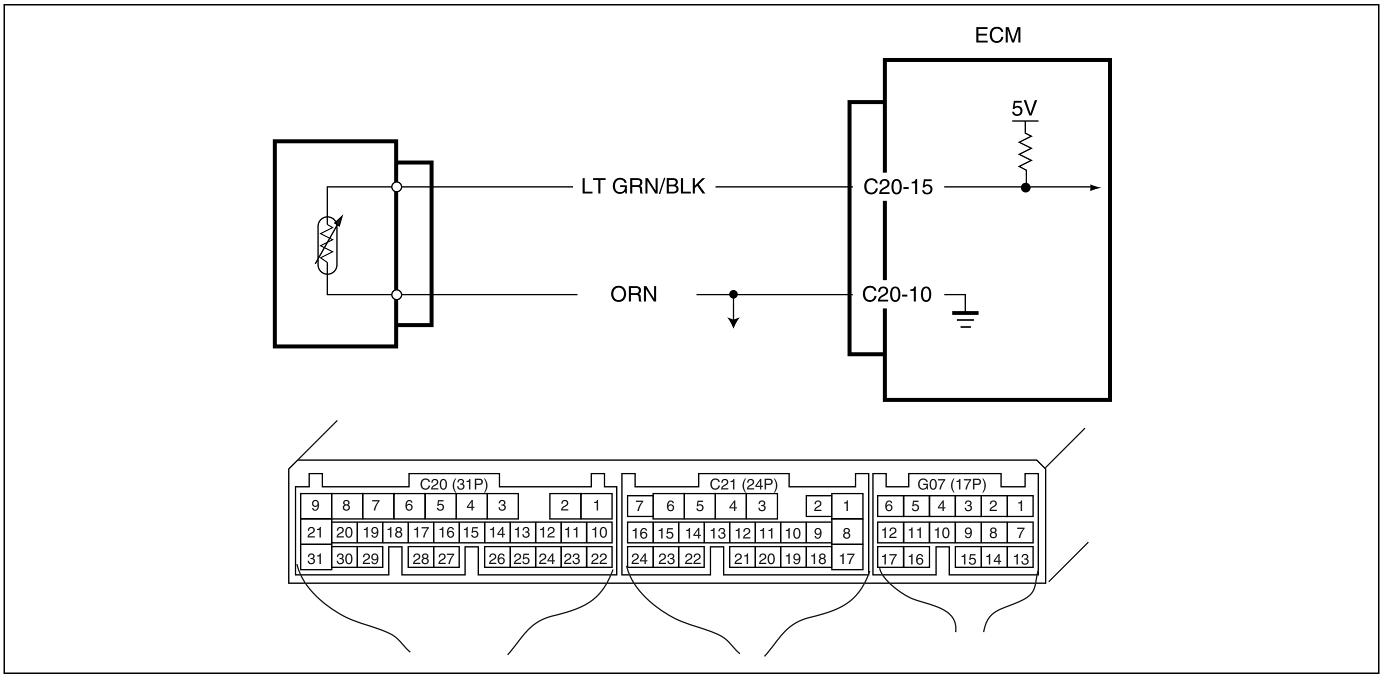
ALTITUDE (Reference)		BAROMETRIC PRESSURE		OUTPUT VOLTAGE
(ft)	(m)	(mmHg)	(kPa)	(V)
0 l 2 000	0 l 610	760 l 707	100 l 94	3.3 – 4.3
2 001 l 5 000	611 l 1 524	Under 707 over 634	94 l 85	3.0 – 4.1
5 001 l 8 000	1 525 l 2 438	Under 634 over 567	85 l 76	2.7 – 3.7
8 001 l 10 000	2 439 l 3 048	Under 567 over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

If check result is not satisfactory, replace MAP sensor (1).

4) Install MAP sensor (1) securely.
5) Connect MAP sensor (1) connector securely.

DTC P0110 (DTC No.18) Intake Air Temp. (IAT) Circuit Malfunction

WIRING DIAGRAM / CIRCUIT DESCRIPTION



DTC DETECTING CONDITION	POSSIBLE CAUSE
• Low intake air temperature (High voltage-High resistance) or • High intake air temperature (Low voltage-Low resistance)	• “LT GRN/BLK” circuit open or shorted to power. • “ORN” circuit open • IAT sensor malfunction • ECM malfunction

NOTE:
- **When DTC P0105 (No.11), P0110 (No.18), P0115 (No.19) and P0120 (No.13) are indicated together, it is possible that “ORN” circuit is open.**
- **Before inspecting, be sure to check that ambient temperature is higher than – 40°C (– 40°F).**

DTC CONFIRMATION PROCEDURE
1) Clear DTC, start engine and keep it at idle for 1 min.
2) Select “DTC” mode no scan tool and check DTC.

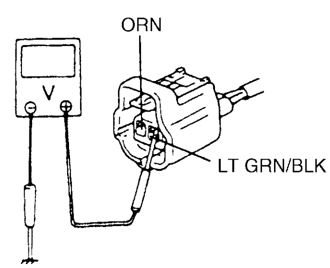
INSPECTION

Step	Action	Yes	No
1	Was “ENGINE DIAG. FLOW TABLE” performed?	Go to Step 2.	Go to “ENGINE DIAG. FLOW TABLE”.
2	Check IAT Sensor and Its Circuit. 1) Connect scan tool to DLC with ignition switch OFF. 2) Turn ignition switch ON. 3) Check intake air temp. displayed on scan tool. Is – 40°C (– 40°F) or 119°C (246°F) indicated?	Go to Step 3.	Intermittent trouble. Check for intermittent referring to “Intermittent and Poor Connection” in Section 0A.

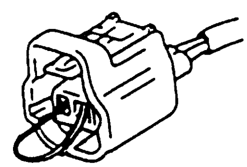
Step	Action	Yes	No
3	Check Wire Harness. 1) Disconnect IAT sensor connector with ignition switch OFF. 2) Check for proper connection to IAT sensor at "LT GRN/BLK" and "ORN" wire terminals. 3) If OK, then with ignition switch ON, is voltage applied to "LT GRN/BLK" wire terminal about 4 – 6 V? See Fig. 1.	Go to Step 5.	"LT GRN/BLK" wire open or shorted to power, or poor C20-15 connection. If wire and connection are OK, substitute a known-good ECM and recheck.
4	Does scan tool indicate – 40°C (– 40°F) at Step 2.	Go to Step 6.	Go to Step 5.
5	Check Wire Harness 1) Check intake air temp. displayed on scan tool with ignition switch ON. Is – 40°C (– 40°F) indicated?	Replace IAT sensor.	"LT GRN/BLK" wire shorted to ground. If wire is OK, substitute a known-good ECM and recheck.
6	Check Wire Harness. 1) Using service wire, connect IAT sensor connector terminals. 2) Check intake air temp. displayed on scan tool with ignition switch ON. Is 119°C (246°F) indicated?	Replace IAT sensor.	"LT GRN/BLK" wire open or poor C20-10 connection. If wire and connection are OK, substitute a known-good ECM and recheck.

[A] Fig. 1 for Step 3 / [B] Fig. 2 for Step 4

[A]

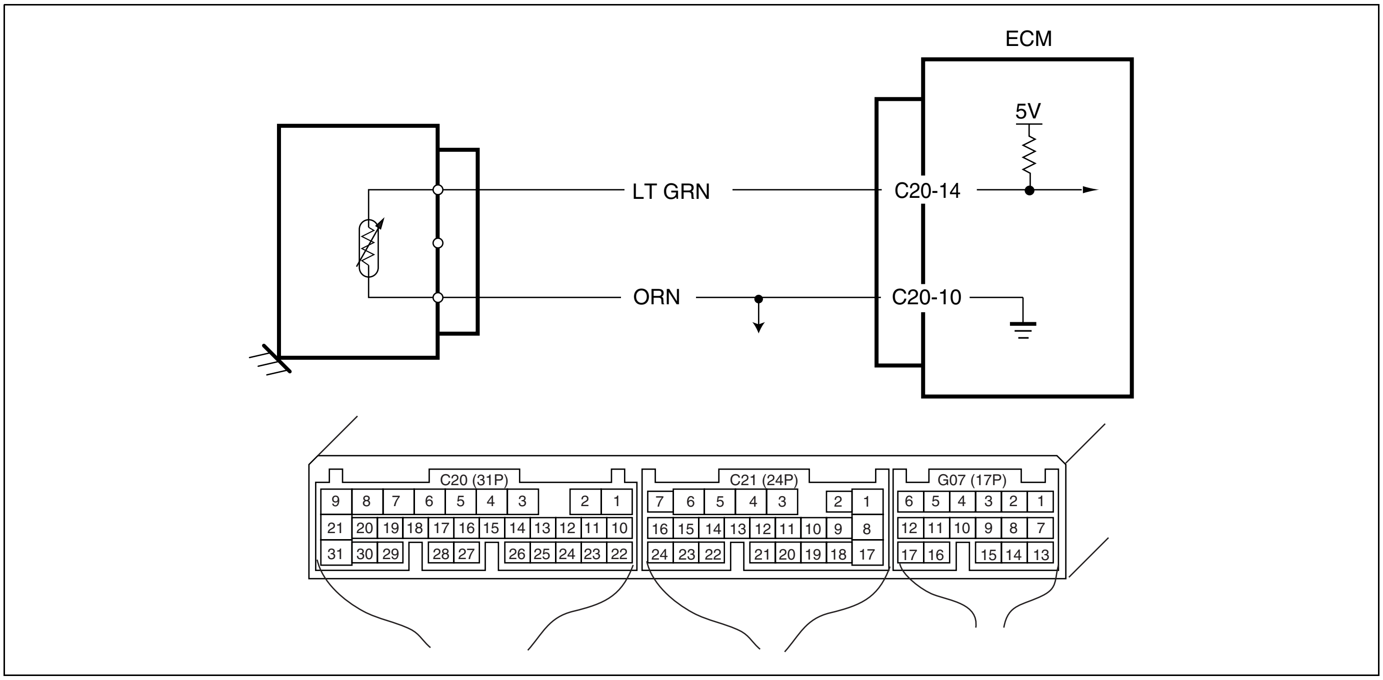


[B]



DTC P0115 (DTC No.19) Engine Coolant Temperature (ECT) Circuit Malfunction

WIRING DIAGRAM / CIRCUIT DESCRIPTION



DTC DETECTING CONDITION	POSSIBLE CAUSE
• Low engine coolant temperature (High voltage-High resistance) or • High engine coolant temperature (Low voltage-Low resistance)	• “LT GRN” circuit open or shorted to power • “ORN” circuit open • ECT sensor malfunction • ECM malfunction

NOTE:

- **Before inspecting, be sure to check that coolant temp. meter in combination meter indicates normal operating temperature (Engine is not overheating).**
- **When this DTC and P1709 are stored together, also clear DTC stored in TCM after completion of repair.**
- **When DTC P0105 (No.11), P0110 (No.18), P0115 (No.19) and P0120 (No.13) are indicated together, it is possible that “ORN” circuit be open.**

DTC CONFIRMATION PROCEDURE

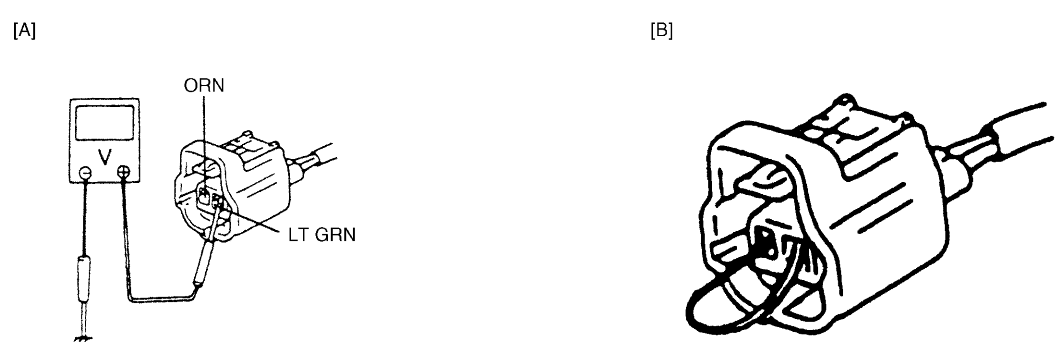
1) Clear DTC, start engine and keep it at idle for 1 min.
2) Select “DTC” mode no scan tool and check DTC.

INSPECTION

Step	Action	Yes	No
1	Was “ENGINE DIAG. FLOW TABLE” performed?	Go to Step 2.	Go to “ENGINE DIAG. FLOW TABLE”.

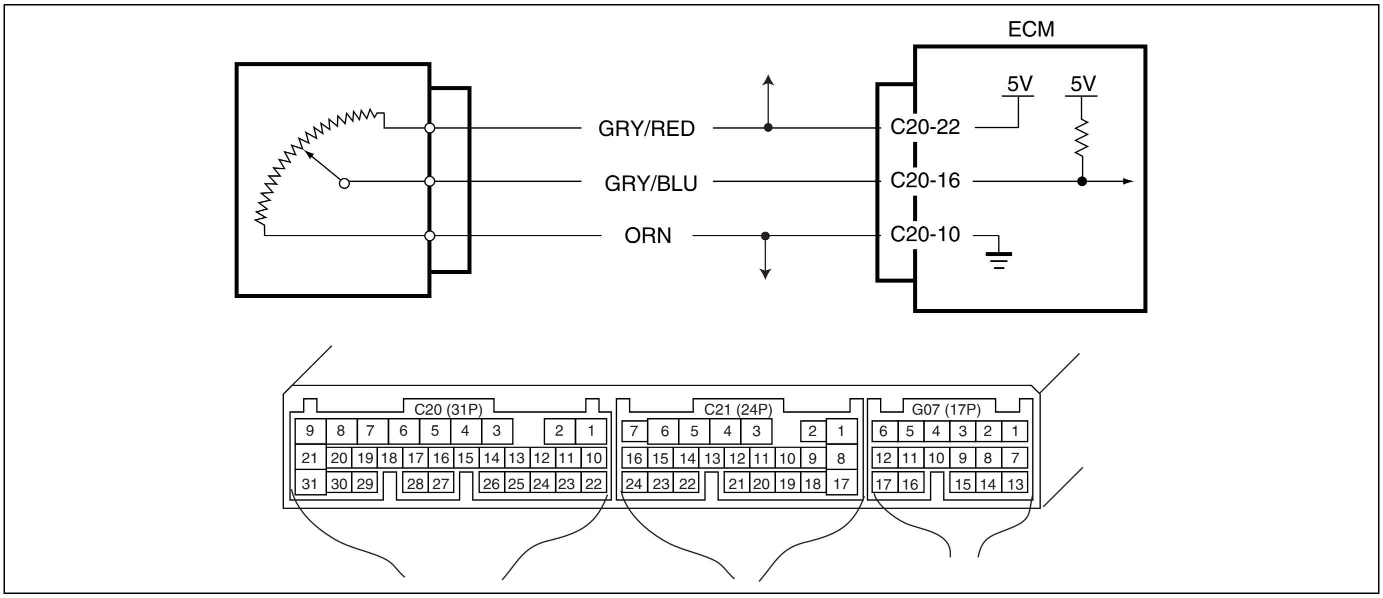
Step	Action	Yes	No
2	Check ECT Sensor and its Circuit. 1) Connect scan tool with ignition switch OFF. 2) Turn ignition switch ON. 3) Check engine coolant temp. displayed on scan tool. Is – 40°C (– 40°F) or 119°C (246°F) indicated?	Go to Step 3.	Intermittent trouble. Check for intermittent referring to “Intermittent and Poor Connection” in Section 0 A.
3	Check Wire Harness. 1) Disconnect ECT sensor connector. 2) Check engine coolant temp. displayed on scan tool. Is – 40°C (– 40°F) indicated?	Replace ECT sensor.	“LT GRN” wire shorted to ground. If wire is OK, substitute a known-good ECM and recheck.
4	Does scan tool indicate – 40°C (– 40°F) at Step 2.	Go to Step 6.	Go to Step 5.
5	Check Wire Harness. 1) Disconnect ECT sensor connector with ignition switch OFF. 2) Check for proper connection to ECT sensor at “ORN” and “LT GRN” wire terminals. If OK, then with ignition switch ON, is voltage applied to “LT GRN” wire terminal about 4 – 6 V? See Fig. 1.	Go to Step 4.	“LT GRN” wire open or shorted to power, or poor C20-14 connection. If wire and connection are OK, substitute a known-good ECM and recheck.
6	Check Wire Harness. 1) Using service wire, connect ECT sensor connector terminals. See Fig. 2. 2) Turn ignition switch ON and check engine coolant temp. displayed on scan tool. Is 119°C (246°F) indicated?	Replace ECT sensor.	“ORN” wire open or poor C20-10 connection. If wire and connection are OK, substitute a known-good ECM and recheck.

[A] Fig. 1 for Step 5 / [B] Fig. 2 for Step 6



DTC P0120 (DTC No.13) Throttle Position Circuit Malfunction

WIRING DIAGRAM / CIRCUIT DESCRIPTION



DTC DETECTING CONDITION	POSSIBLE CAUSE
• Signal voltage high or • Signal voltage low	• "ORN" circuit open • "GRY/BLU" circuit open or shorted to ground • "GRY/RED" circuit open or shorted to power or ground • TP sensor malfunction • ECM malfunction

NOTE:

- **When DTC P0105 (No.11), P0110 (No.18), P0115 (No.19) and P0120 (No.13) are indicated together, it is possible that "ORN" or "GRY/RED" circuit be open.**
- **When this DTC and P1700 are stored together, also clear DTC stored in TCM after completion of repair.**
- **When this DTC and DTC P0105 (No.11) are indicated together, it is possible that "GRY/RED" circuit be open.**

DTC CONFIRMATION PROCEDURE

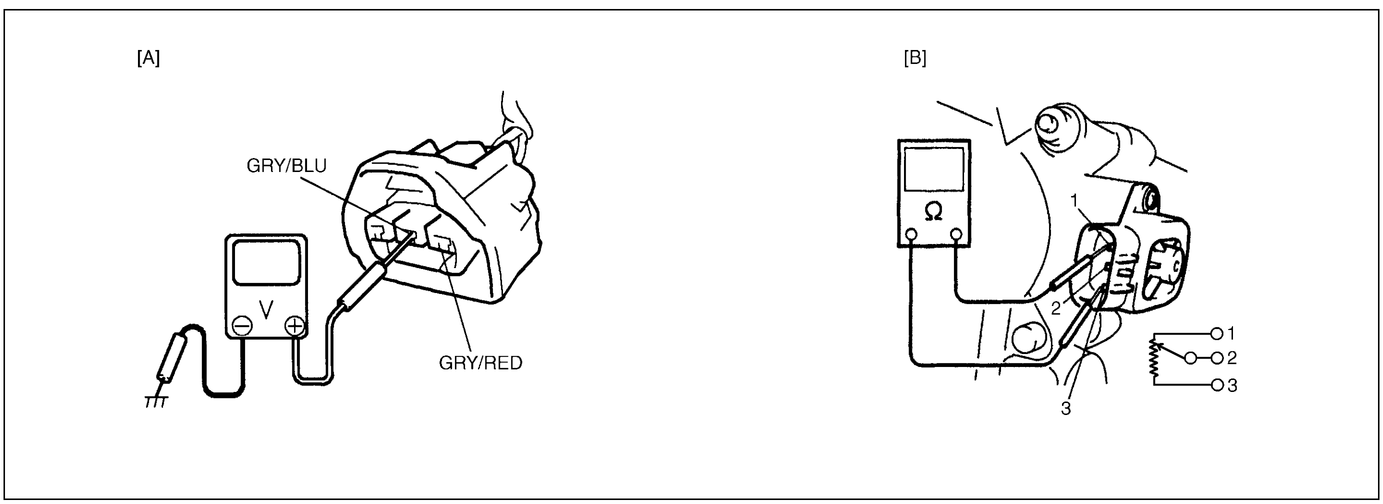
1) Clear DTC, start engine and keep it at idle for 1 min.
2) Select "DTC" mode no scan tool and check DTC.

INSPECTION

Step	Action	Yes	No
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".

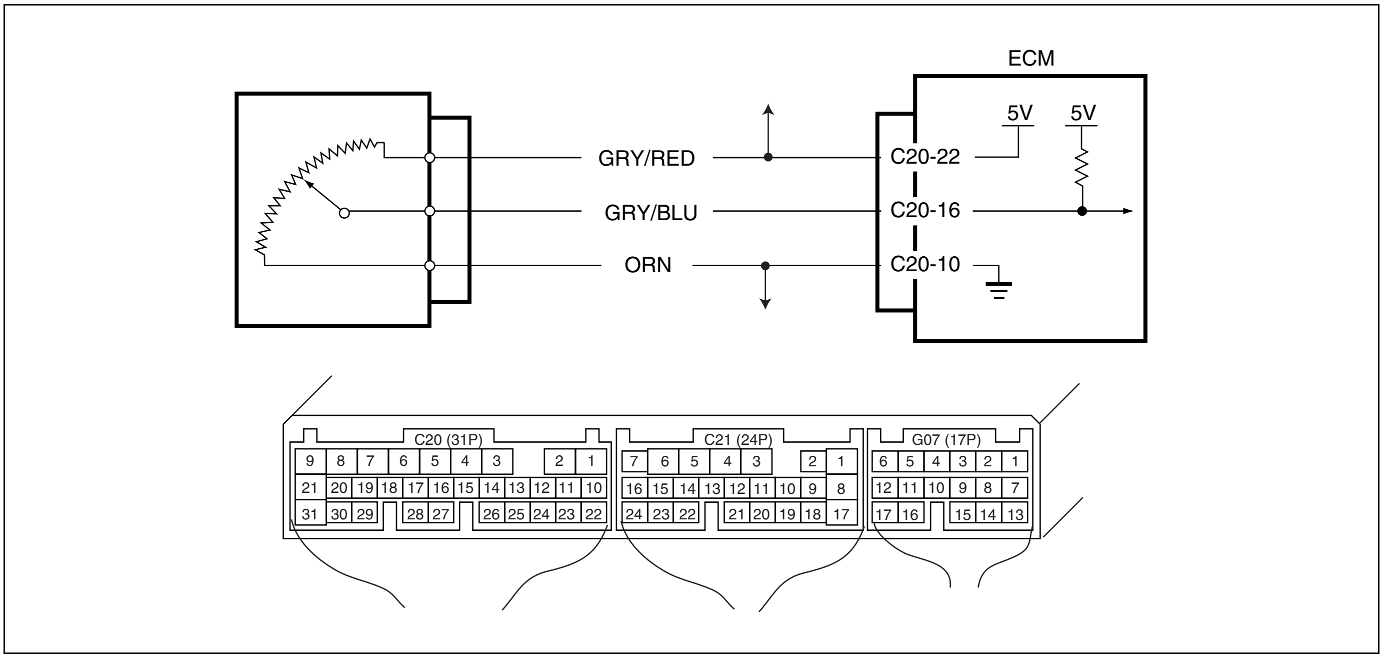
Step	Action	Yes	No
2	Check TP Sensor and Its Circuit. 1) Connect scan tool to DLC with ignition switch OFF and then turn ignition switch ON. 2) Check throttle valve opening percentage displayed on scan tool. Is it displayed 2% or less? 3) Check throttle valve opening percentage displayed on scan tool while opening throttle valve from idle position to full open position. Is it displayed 96% or higher?	Go to Step 3.	Intermittent trouble. Check for intermittent referring to “Intermittent and Poor Connection” in Section 0A.
3	Check Wire Harness. 1) Disconnect connector from TP sensor with ignition switch OFF. 2) Check for proper connection to TP sensor at “GRY/RED”, “GRY/BLU” and “ORN” wire terminals. 3) If OK, then with ignition switch ON, check voltage between each of “GRY/RED” or “GRY/BLU” wire terminals and body ground. See Fig. 1. Is voltage about 4 – 6 V at each terminal?	Go to Step 4.	“GRY/RED” wire open, “GRY/RED” wire shorted to ground or power circuit or “GRY/BLU” wire, “ORN” wire open or shorted to ground circuit or poor C20-22 or C20-16 connection. If wire and connection are OK, substitute a known-good ECM and recheck.
4	Check TP Sensor. 1) Check resistance between terminals of TP sensor. See Fig. 2. Between 1 and 2 : 2.5 – 6.0 kΩ Between 1 and 3 : 100 Ω – 20 kΩ varying according to throttle valve opening Are measured values within specifications?	“ORN” wire open or poor C20-10 connection. If wire and connection are OK, substitute a known-good ECM and recheck.	Replace TP sensor.

[A] Fig. 1 for Step 3 / [B] Fig. 2 for Step 4



DTC P0121 Throttle Position Circuit Range/Performance Problem

WIRING DIAGRAM / CIRCUIT DESCRIPTION



DTC DETECTING CONDITION	POSSIBLE CAUSE
DTC will set when the following conditions are detected. • After engine warmed up. • While vehicle running at specified engine speed. • No change in intake manifold pressure (constant throttle opening) • Difference between actual throttle opening (detected from TP sensor) and opening calculated by ECM (obtained on the basis of engine speed and intake manifold pressure) is larger than specified value. ✱2 driving cycle detection logic, continuous monitoring	• TP sensor malfunction • High resistance in the circuit • ECM malfunction

DTC CONFIRMATION PROCEDURE

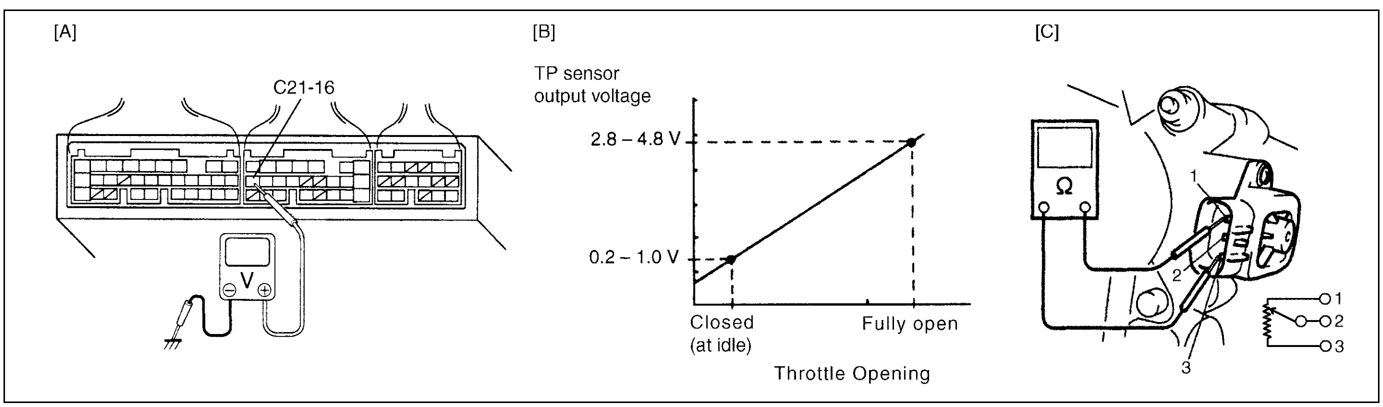
WARNING:
- **When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident.**
- **Road test should be carried out with 2 persons, a driver and a tester, on a level road.**

1) Turn ignition switch OFF. Clear DTC with ignition switch ON, check vehicle and environmental condition for :
   – Altitude (barometric pressure) : 2400 m, 8000 ft or less (560 mmHg, 75 kPa or more)
   – Ambient temp. : –10°C, 14°F or higher
   – Intake air temp. : 70°C, 158°F or lower
   – Engine coolant temp. : 70 – 110°C, 158 – 230°F
2) Warm up engine to normal operating temperature.
3) Increase vehicle speed to 50 – 60 km/h, 30 – 40 mph in 3rd gear or “D” range and hold throttle valve at that opening position for 1 min.
4) Stop vehicle.
5) Check DTC in “DTC” mode and pending DTC in “ON BOARD TEST” or “PENDING DTC” mode.

INSPECTION

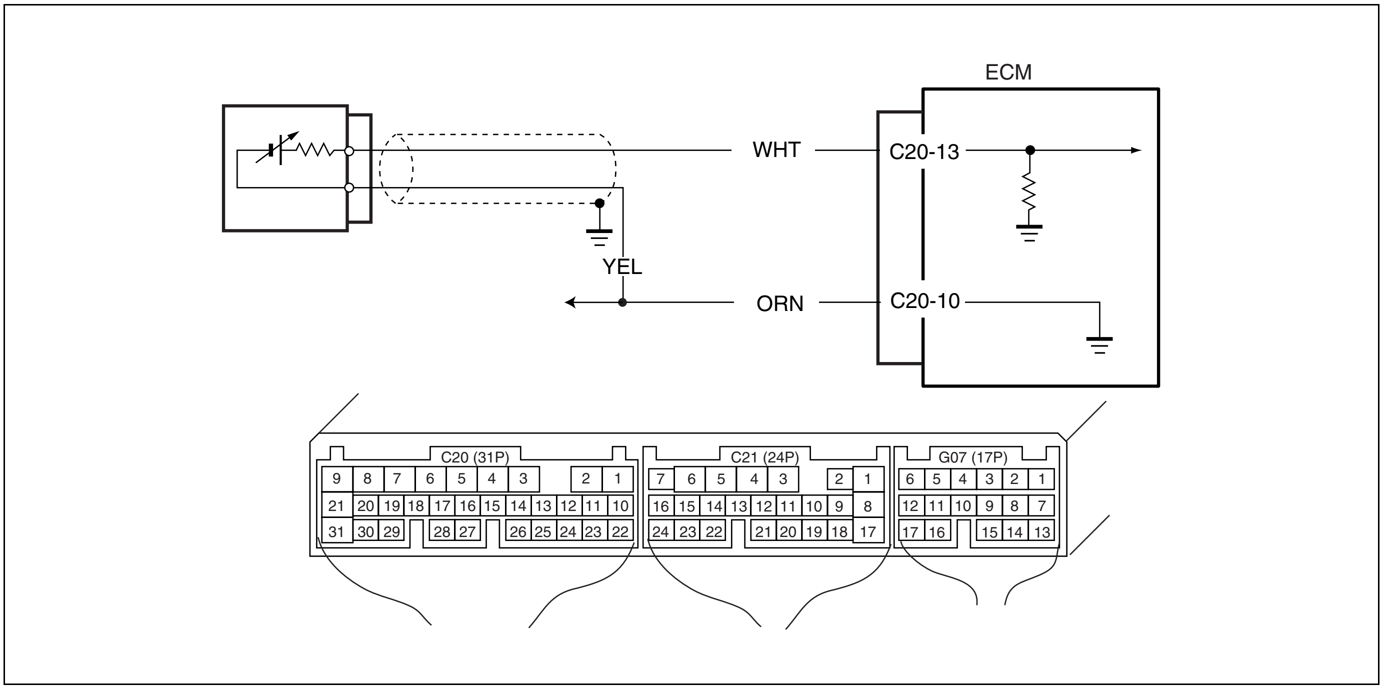
Step	Action	Yes	No
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Is SUZUKI scan tool available?	Go to Step 3.	Go to Step 4.
3	Check TP Sensor and its Circuit. 1) Turn ignition switch OFF and connect SUZUKI scan tool to DLC. 2) Turn ignition switch ON and check TP sensor output voltage when throttle valve is at idle position and fully opened. See Fig. 2. Dose voltage vary within specified value linearly as shown in figure?	If voltmeter was used, check terminal C20-16 for poor connection. If OK, substitute a known-good ECM and recheck.	Go to Step 5.
4	Check TP Sensor and its Circuit. 1) Turn ignition switch ON. 2) Check voltage at terminal C20-16 of ECM connector connected, when throttle valve is at idle position and fully opened. See Fig. 1. Dose voltage vary within specified value linearly as shown in figure?	If voltmeter was used, check terminal C20-16 for poor connection. If OK, substitute a known-good ECM and recheck.	Go to Step 5.
5	Check TP Sensor. 1) Turn ignition switch OFF. 2) Disconnect TP sensor connector. 3) Check for proper connection to TP sensor at each terminal. 4) If OK, then measure resistance between terminals and check if each measured value is as specified below. See Fig. 3. Between 1 and 2 : 4.0 – 6.0 kΩ Between 1 and 3 : 0.02 – 6.0 kΩ, varying according to throttle valve opening. Are measured values as specified?	High resistance in "GRY/RED", "GRY/BLU" or "ORN" circuit. If wire and connection are OK, substitute a known-good ECM and recheck.	Replace TP sensor.

[A] Fig. 1 for Step 4 / [B] Fig. 2 for Step 3 and 4 / [C] Fig. 3 for Step 5



DTC P0130 (DTC No.14) Heated Oxygen Sensor (HO2S) Circuit Malfunction (Sensor-1)

WIRING DIAGRAM / CIRCUIT DESCRIPTION



DTC DETECTING CONDITION	POSSIBLE CAUSE
• When running at idle speed after engine warmed up and running at specified vehicle speed, HO2S-1 output voltage does not go below 0.3 V or over 0.6 V. ✱2 driving cycle detection logic, Monitoring once/1 driving.	• Heated oxygen sensor-1 malfunction • "WHT" or "ORN" circuit open (poor connection) or short

DTC CONFIRMATION PROCEDURE

WARNING:

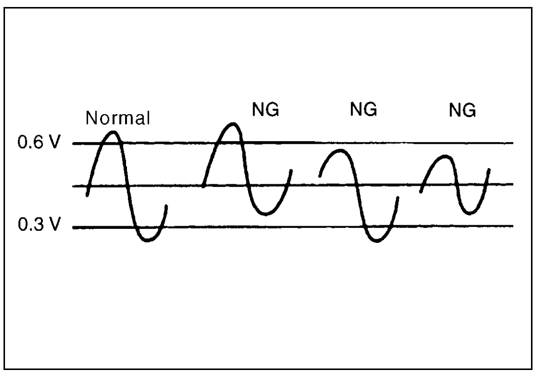
- **When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident.**
- **Road test should be carried out with 2 persons, a driver and a tester.**

1) Turn ignition switch OFF. Clear DTC with ignition switch ON, check vehicle and environmental condition for :
   – Altitude (barometric pressure) : 2400 m, 8000 ft or less (560 mmHg, 75 kPa or more)
   – Ambient temp. : –10°C, 14°F or higher
   – Intake air temp. : 70°C, 158°F or lower
2) Warm up engine to normal operating temperature.
3) Drive vehicle at 50 – 60 km/h, 30 – 40 mph for 2 min.
4) Stop vehicle and run engine at idle for 2 min.
5) Check DTC in "DTC" mode and pending DTC in "ON BOARD TEST" or "PENDING DTC" mode.

INSPECTION

Step	Action	Yes	No
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Is there DTC(s) other than HO2S-1 (DTC P0130)?	Go to applicable DTC Diag. Flow Table.	Go to Step 3.
3	Check HO2S-1 signal. 1) Connect scan tool to DLC with ignition switch OFF. 2) Warm up engine to normal operating temperature and keep it at 2000 r/min. for 60 sec. 3) Repeat racing engine (Repeat depressing accelerator pedal 5 to 6 times continuously and take foot off from pedal to enrich and enlean A/F mixture). See Fig. 1. Does HO2S-1 output voltage deflect between 0.3 V and over 0.6 V repeatedly?	Intermittent trouble. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A.	Check "WHT" and "ORN" wires for open and short, and connections for poor connection. If wires and connections are OK, replace HO2S-1.

Fig. 1 for Step 3



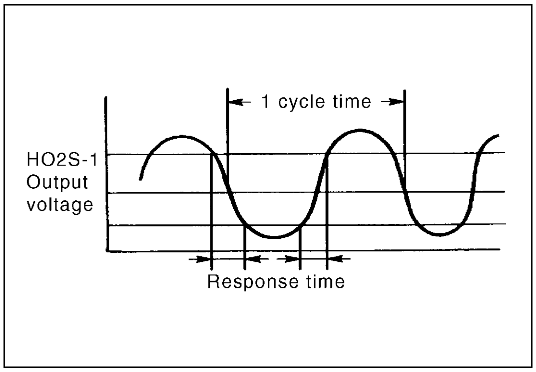
DTC P0133 Heated Oxygen Sensor (HO2S) Circuit Slow Response (Sensor-1)

WIRING DIAGRAM / CIRCUIT DESCRIPTION

Refer to DTC P0130 section.

DTC DETECTING CONDITION	POSSIBLE CAUSE
• When running at specified idle speed after engine warmed up and running at specified vehicle speed, response time (time to change from lean to rich or from rich to lean) of HO2S-1 output voltage is about 1 sec. at minimum or average time of 1 cycle is 5 sec. at minimum. See. Fig. 1 ✱2 driving cycle detection logic, Monitoring once/1 driving.	• Heated oxygen sensor-1 malfunction

Fig. 1



DTC CONFIRMATION PROCEDURE

Refer to DTC P0130 section.

INSPECTION

Step	Action	Yes	No
1	Was “ENGINE DIAG. FLOW TABLE” performed?	Go to Step 2.	Go to “ENGINE DIAG. FLOW TABLE”.
2	Is there DTC(s) other than HO2S-1 (DTC P0133)?	Go to applicable DTC Diag. Flow Table.	Replace HO2S-1.

DTC P0134 Heated Oxygen Sensor (HO2S) Circuit No Activity Detected (Sensor-1)

WIRING DIAGRAM / CIRCUIT DESCRIPTION

Refer to DTC P0130 section.

DTC DETECTING CONDITION	POSSIBLE CAUSE
• Engine warmed up. • While running under other than high load and high engine speed conditions or at specified idle speed (engine is in closed loop condition), HO2S-1 output voltage is high or low continuously. ✱2 driving cycle detection logic, Continuous monitoring.	• “WHT” or “ORN” circuit open or short • Heated oxygen sensor malfunction • Fuel system malfunction • Exhaust gas leakage

DTC CONFIRMATION PROCEDURE

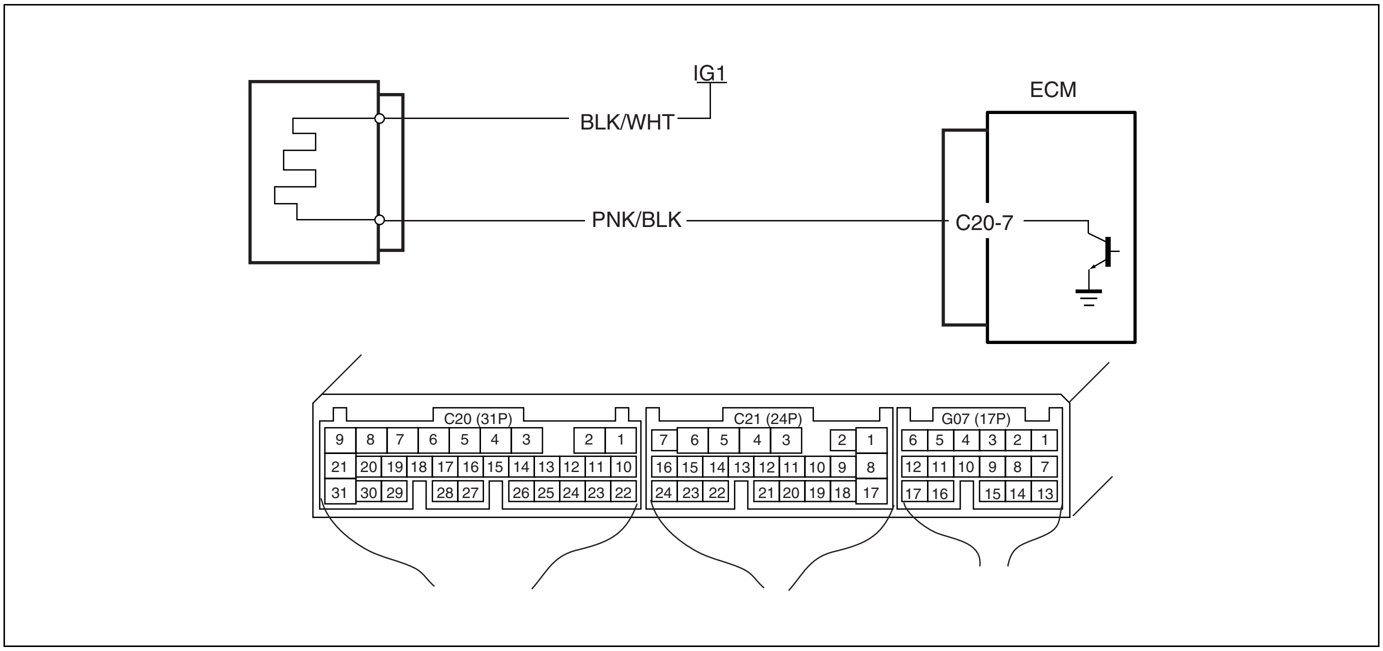
Refer to DTC P0130 section.

INSPECTION

Step	Action	Yes	No
1	Was “ENGINE DIAG. FLOW TABLE” performed?	Go to Step 2.	Go to “ENGINE DIAG. FLOW TABLE”.
2	Is there DTC(s) other than Fuel system (DTC P0171/P0172) and HO2S-1 (DTC P0134)?	Go to applicable DTC Diag. Flow Table.	Go to Step 3.
3	Check HO2S-1 and Its Circuit. 1) Connect scan tool to DLC with ignition switch OFF. 2) Warm up engine to normal operating temperature and keep it at 2000 r/min. for 60 sec. 3) Repeat racing engine (Repeat depressing accelerator pedal 5 to 6 times continuously and take foot off from pedal to enrich and enlean A/F mixture). Does HO2S-1 output voltage deflect between 0.3V and over 0.6V repeatedly?	Go to DTC P0171 and P0172 Diag. Flow Table (Fuel System Check).	Check “WHT” and “ORN” wires for open and short, and connections for poor connection. If wires and connections are OK, replace HO2S-1.

DTC P0135 (DTC No.14) Heated Oxygen Sensor (HO2S) Heater Circuit Malfunction (Sensor-1)

WIRING DIAGRAM / CIRCUIT DESCRIPTION



DTC DETECTING CONDITION	POSSIBLE CAUSE
DTC will set when one of the following conditions is met. • Low voltage at terminal C20-7 when engine is running at high load. • High voltage at terminal C20-7 when engine is running under condition other than above. ✱2 driving cycle detection logic, Continuous monitoring.	• HO2S-1 heater circuit open or shorted to ground • ECM malfunction

DTC CONFIRMATION PROCEDURE

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

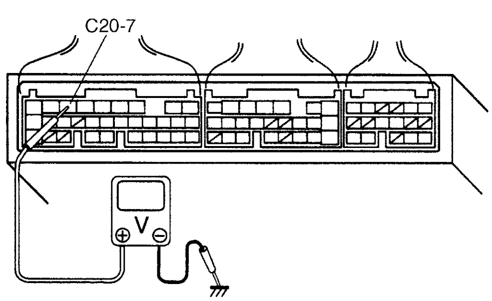
1) Turn ignition switch OFF.
2) Clear DTC with ignition switch ON, start engine and keep it at idle for 1 min.
3) Start vehicle and depress accelerator pedal fully for 5 sec. or longer.
4) Stop vehicle.
5) Check DTC in “DTC” mode and pending DTC in “ON BOARD TEST” or “PENDING DTC” mode.

INSPECTION

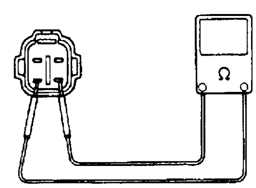
Step	Action	Yes	No
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Check Heater for operation. 1) Check voltage at terminal C20-7. See Fig. 1. 2) Warm up engine to normal operating temperature. 3) Stop engine. 4) Turn ignition switch ON and Check voltage at terminal C20-7. See Fig. 1. Voltage should be over 10 V. 5) Start engine, run it at idle and check voltage at the same terminal. Voltage should be below 1.9 V. Are check results specified ones?	Intermittent trouble Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A.	Go to Step 3.
3	Check Heater of Sensor-1. 1) Disconnect HO2S-1 coupler with ignition switch OFF. 2) Check for proper connection to HO2S-1 at "BLK/WHT" and "PNK/BLK" wire terminals. 3) If OK, then check heater resistance. See Fig. 2. Is it 5.0 – 6.4 Ω at 20°C, 68°F?	"PNK/BLK" wire open or shorted to ground or poor connection at C20-7. If wire and connection are OK, substitute a known-good ECM and recheck.	Replace HO2S-1.

[A] Fig. 1 for Step 2 / [B] Fig. 2 for Step 3

[A]

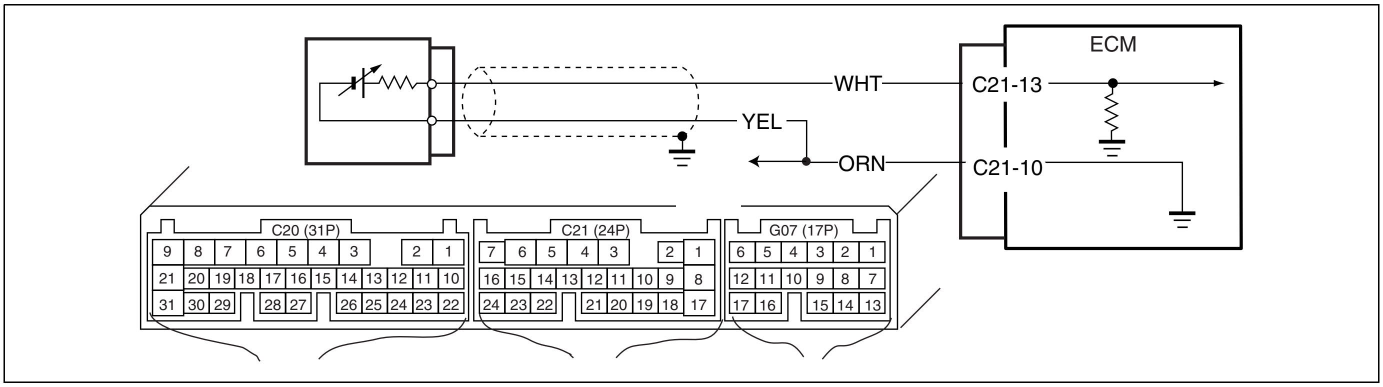


[B]



DTC P0136 Heated Oxygen Sensor (HO2S) Circuit Malfunction (Sensor-2)

WIRING DIAGRAM / CIRCUIT DESCRIPTION



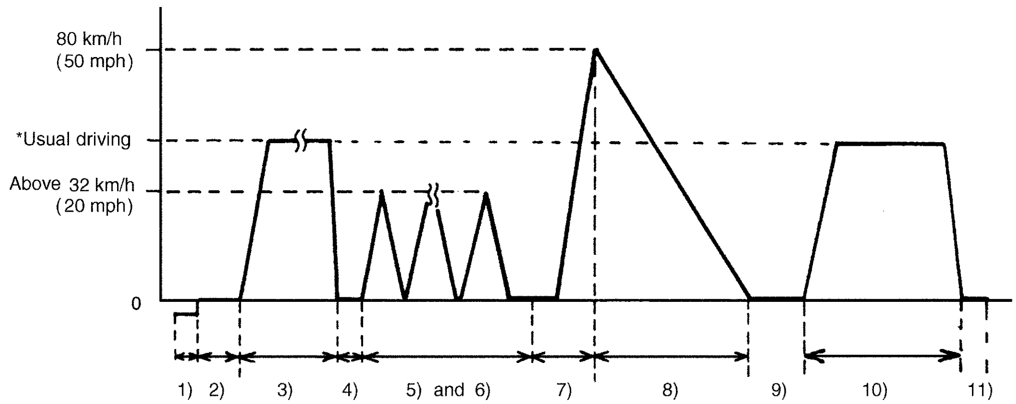
DTC DETECTING CONDITION	POSSIBLE CAUSE
DTC will set when one of the following conditions is detected. • Max. output voltage of HO2S-2 is lower than specified value or Min. output voltage is higher than specified value while vehicle driving. • Engine is warmed up and HO2S-2 voltage is 4.5 V or more. (circuit open) ✱2 driving cycle detection logic, monitoring once/1 driving.	• Exhaust gas leakage • “WHT” or “ORN” circuit open or short • Heated oxygen sensor-2 malfunction • Fuel system malfunction

DTC CONFIRMATION PROCEDURE

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

1) Turn ignition switch OFF.
   Clear DTC with ignition switch ON, check vehicle and environmental condition for :
   – Altitude (barometric pressure) : 2400 m, 8000 ft or less (560 mmHg, 75 kPa or more)
   – Ambient temp. : –10°C, 14°F or higher
   – Intake air temp. : 70°C, 158°F or lower
   – No exhaust gas leakage and loose connection
2) Warm up engine to normal operating temperature.
3) Drive vehicle under usual driving condition for 5 min. and check HO2S-2 output voltage and “short term fuel trim” with “Data List” mode on scan tool, and write it down.
4) Stop vehicle (don’t turn ignition switch OFF).
5) Increase vehicle speed to higher than 20 mph, 32 km/h and then stop vehicle.
6) Repeat above steps 5) 4 times.
7) Increase vehicle speed to about 80 km/h (50 mph) in 3rd gear or 2 range.
8) Release accelerator pedal and with engine brake applied, keep vehicle coasting (fuel cut condition) for 10sec. or more.
9) Stop vehicle (do not turn ignition switch OFF) and run engine at idle for 2 min.
   After this step 9), if “Oxygen Sensor Monitoring TEST COMPLETED” is displayed in “READINESS TESTS” mode and DTC is not displayed in “DTC” mode, confirmation test is completed.
   If “TEST NOT COMPLTD” is still being displayed, proceed to next step 10).

10) Drive vehicle under usual driving condition for 10 min. (or vehicle is at a stop and run engine at idle for 10 min. or longer)
11) Stop vehicle (do not turn ignition switch OFF). Confirm test results according to “Test Result Confirmation Flow Table” in “DTC CONFIRMATION PROCEDURE” of DTC P0420.



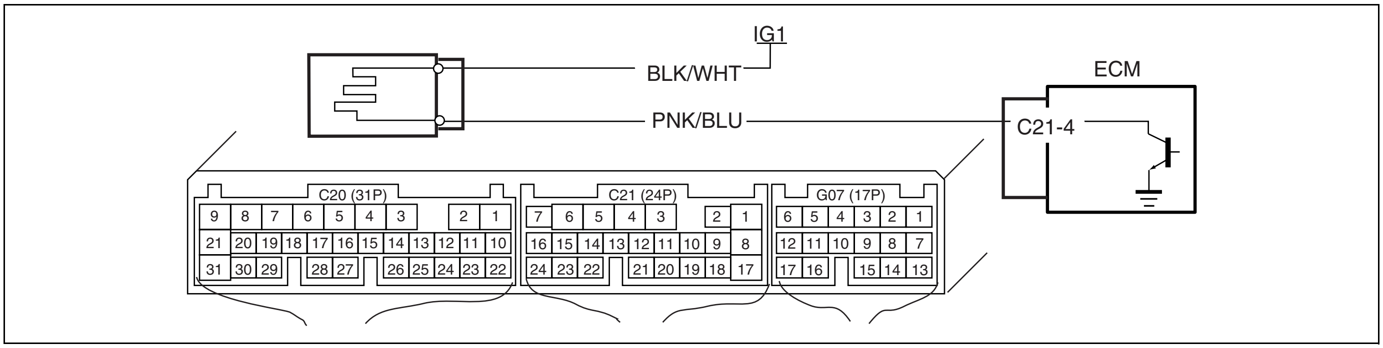
★Usual driving :	Driving at 50 – 60 km/h, 30 – 40 mph including short stop according to traffic signal. (under driving condition other than high-load, high-engine speed, rapid accelerating and decelerating)

INSPECTION

Step	Action	Yes	No
1	Was “ENGINE DIAG. FLOW TABLE” performed?	Go to Step 2.	Go to “ENGINE DIAG. FLOW TABLE”.
2	Check Exhaust System for leakage, loose connection and damage. Is it good condition?	Go to Step 3.	Repair or replace.
3	Check HO2S-2 and Its Circuit. Was HO2S-2 output voltage indicated on scan tool in step 3) of DTC confirmation test less than 1.275 V?	Go to Step 4.	“WHT” or “ORN” circuit short to power supply circuit or HO2S-2 malfunction.
4	Check Short Term Fuel Trim. Did short term fuel trim very within – 20 – + 20% range in step 3) of DTC confirmation test?	Check “WHT” or “ORN” wire for open and short, and connection for poor connection. If wire and connection are OK, replace HO2S-2.	Check fuel system. Go to DTC P0171/P0172 Diag. Flow Table.

DTC P0141 Heated Oxygen Sensor (HO2S) Heater Circuit Malfunction (Sensor-2)

WIRING DIAGRAM / CIRCUIT DESCRIPTION



DTC DETECTING CONDITION	POSSIBLE CAUSE
DTC will set when one of the following conditions is met. • Low voltage at terminal C21-4 for specified time after engine start or while engine running at high load. • High voltage at terminal C21-4 while engine running under other than above condition. ✱2 driving cycle detection logic, continuous monitoring.	• HO2S-2 heater circuit open or shorted to ground • ECM malfunction

DTC CONFIRMATION PROCEDURE

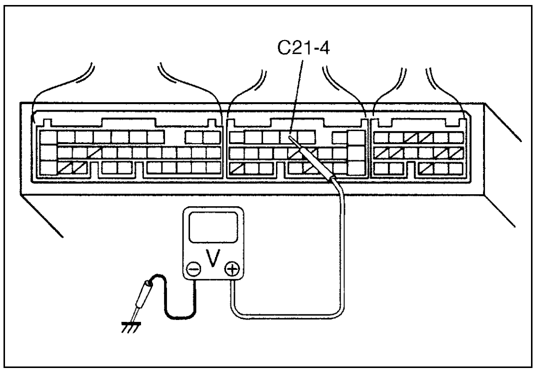
1) Turn ignition switch OFF once and then ON.
2) Clear DTC, start engine and warm up engine to normal operating temperature.
3) Keep it at 2000 r/min for 2 min.
4) Check pending DTC in “ON BOARD TEST” or “PENDING DTC” mode and DTC in “DTC” mode.

INSPECTION

Step	Action	Yes	No
1	Was “ENGINE DIAG. FLOW TABLE” performed?	Go to Step 2.	Go to “ENGINE DIAG. FLOW TABLE”.
2	Check HO2S-2 Heater and Its Circuit. 1) Warm up engine to normal operating temperature. 2) Stop engine. 3) Turn ignition switch ON and check voltage at terminal C21-4 See Fig. 1. Voltage should be over 10 V. 4) Start engine, run it at idle and check voltage at the same terminal after 1 min. from engine start. Voltage should be below 1.9 V. Are check result as specified?	Intermittent trouble. Check for intermittent referring to “Intermittent and Poor Connection” in Section 0A.	Go to Step 3.

Step	Action	Yes	No
3	Check Heater of Sensor-2. 1) Disconnect HO2S-2 coupler with ignition switch OFF. 2) Check for proper connection to HO2S-2 at "BLK/WHT" and "PNK/BLU" wire terminals. 3) If OK, then check heater resistance. Is it 12.0 – 14.3 Ω at 20°C, 68°F?	"PNK/BLU" wire open or shorted to ground or poor connection at C21-4. If wire and connection are OK, substitute a known-good ECM and recheck.	Replace HO2S-2.

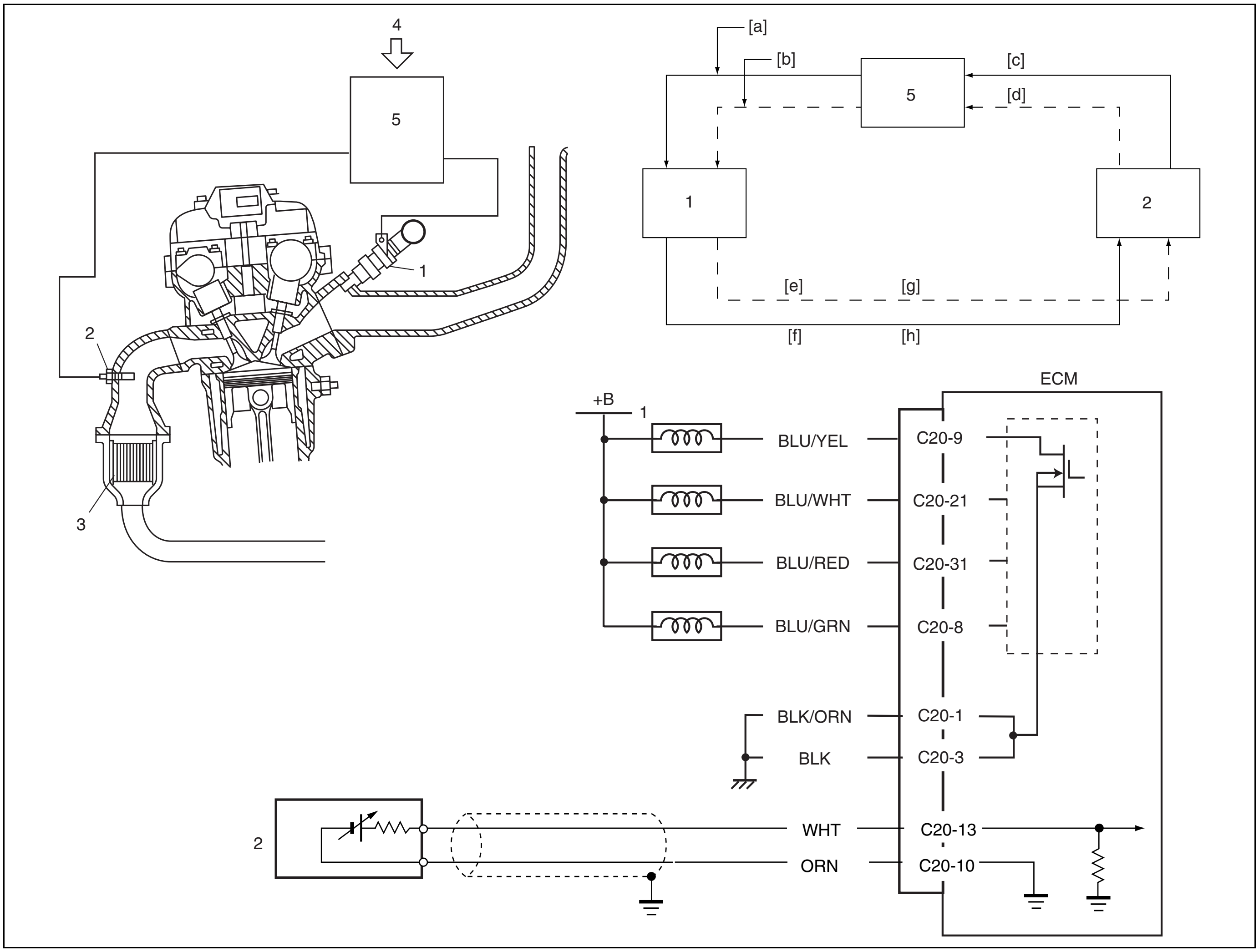
Fig. 1 for Step 2



DTC P0171 Fuel System Too Lean

DTC P0172 Fuel System Too Rich

WIRING DIAGRAM / CIRCUIT DESCRIPTION



1. Injector	[a] : Signal to decrease amount of fuel injection	[f] : A/F mixture becomes leaner
2. HO2S-1	[b] : Signal to increase amount of fuel injection	[g] : Oxygen concentration decreases
3. WU-TWC (Warm up-three way catalytic convector)	[c] : High voltage	[h] : Oxygen concentration increases
4. Sensed information	[d] : Low voltage	
5. ECM	[e] : A/F mixture becomes richer	

DTC DETECTING CONDITION	POSSIBLE CAUSE
When one of the following conditions is met while engine running under closed loop condition. • Air/fuel ratio too lean (Total fuel trim (short and long terms added) is more than 30%) • Air/fuel ratio too rich (Total fuel trim is less than – 30%) ✱2 driving cycle detection logic, continuous monitoring.	• Vacuum leaks (air drawn in). • Exhaust gas leakage. • Heated oxygen sensor-1 circuit malfunction. • Fuel pressure out of specification. • Fuel injector malfunction (clogged or leakage). • MAP sensor poor performance. • ECT sensor poor performance. • IAT sensor poor performance. • TP sensor poor performance. • EVAP control system malfunction. • PCV valve malfunction.

DTC CONFIRMATION PROCEDURE

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

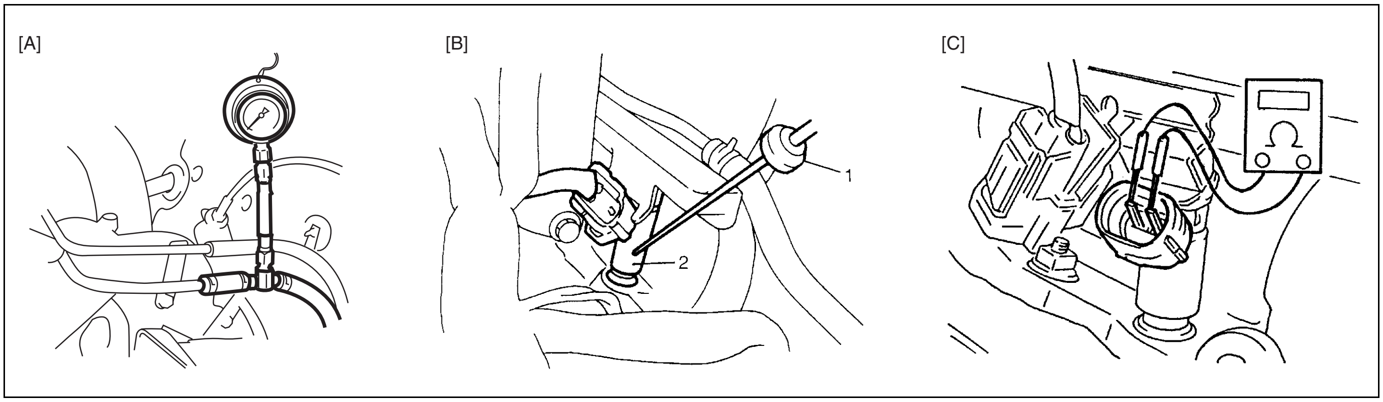
1) Turn ignition switch OFF.
2) Clear DTC with ignition switch ON.
3) Check vehicle and environmental condition for :
   – Altitude (barometric pressure) : 2400 m, 8000 ft or less (560 mmHg, 75 kPa or more)
   – Ambient temp. : –10°C, 14°F or higher
   – Intake air temp. : 70°C, 158°F or lower
4) Start engine and drive vehicle under usual driving condition (described in DTC confirmation procedure of DTC P0136) for 5 min. or longer and until engine is warmed up to normal operating temperature.
5) Keep vehicle speed at 50 – 60 km/h, 30 – 40 mph in 5th gear or "D" range for 5 min. or more.
6) Stop vehicle (do not turn ignition switch OFF).
7) Check pending DTC in "ON BOARD TEST" or "PENDING DTC" mode and DTC in "DTC" mode.

INSPECTION

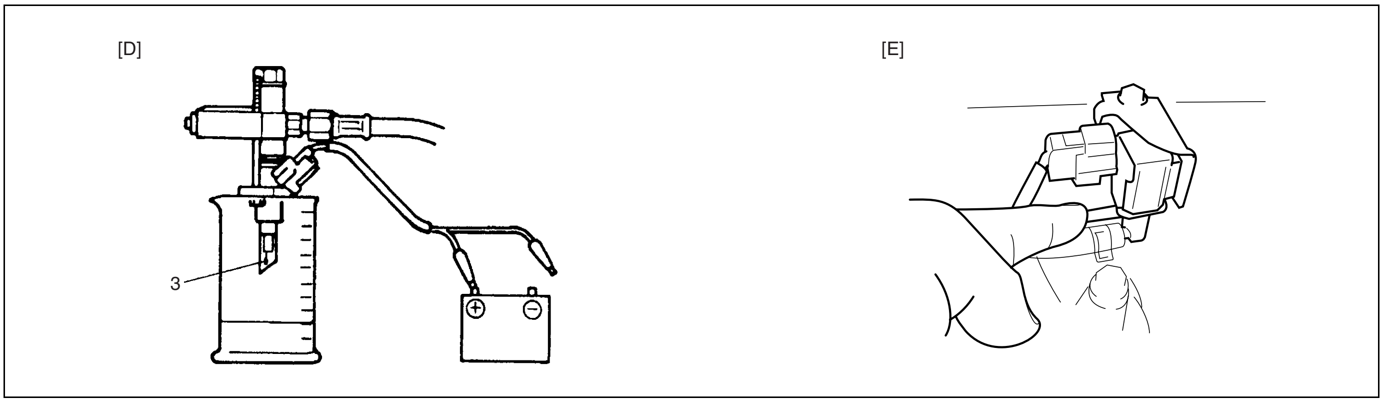
Step	Action	Yes	No
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Is there DTC(s) other than fuel system (DTC P0171/P0172)?	Go to applicable DTC Diag. Flow Table.	Go to Step 3.
3	Check HO2S-1 Output Voltage. 1) Connect scan tool to DLC with ignition switch OFF. 2) Warm up engine to normal operating temperature and keep it at 2000 r/min. for 60 sec. 3) Repeat racing engine (Repeat depressing accelerator pedal 5 to 6 times continuously and take foot off from pedal to enrich and enlean A/F mixture). Does HO2S-1 output voltage deflect between below 0.3 V and over 0.6 V repeatedly?	Go to Step 4.	Go to DTC P0130 Diag. Flow Table (HO2S-1 circuit check).
4	Check Fuel Pressure (Refer to section 6E1 for details). 1) Release fuel pressure from fuel feed line. 2) Install fuel pressure gauge. 3) Check fuel pressure. See Fig. 1. With fuel pump operating and engine at stop : 270 – 310 kPa, 2.7 – 3.1 kg/cm^2, 38.4 – 44.0 psi. At specified idle speed : 270 – 310 kPa, 2.7 – 3.1 kg/cm^2, 38.4 – 44.0 psi. Is measured value as specified?	Go to Step 5.	Go to Diag. Flow Table B-3 Fuel Pressure Check.

Step	Action	Yes	No
5	Check Fuel Injectors and Circuit. 1) Using sound scope (1) or such, check operating sound of each injector (2) when engine is running. Cycle of operating sound should vary according to engine speed. See Fig. 2. If no sound or an unusual sound is heard, check injector circuit (wire or coupler) or injector. 2) Turn ignition switch OFF and disconnect a fuel injector connector. 3) Check for proper connection to fuel injector at each terminal. See Fig. 3. 4) If OK, then check injector resistance. Injector Resistance : 11.3 – 13.8 Ω at 20°C (68°F) 5) Carry out steps 1) and 3) on each injector. 6) Check each injector for injected fuel volume (1) referring to Section 6E1. See Fig. 4. Injected Fuel Volume : 43 – 47 cc/15 sec 1.45/1.51 – 1.58/1.65 US/Imp.oz/15 sec) 7) Check each injector for fuel leakage after injector closed. Fuel Leakage : Less than 1 drop/min (3). Is check result in step 1) and 3) to 7) satisfactory?	Go to Step 6.	Check injector circuit or replace fuel injector(s).
6	Check EVAP Canister Purge Valve. 1) Disconnect purge hose from EVAP canister purge valve. 2) Place finger against the end of EVAP canister purge valve. 3) Check that vacuum is not felt there when engine is cool and running at idle. See Fig. 5. Is vacuum felt?	Check evaporative emission control system (See Section 6E1).	Go to Step 7.
7	Check Intake Manifold Absolute Pressure Sensor for performance (See DTC P0105 (No.11) Diag. Flow Table). Is it in good condition?	Go to Step 8.	Repair or replace.
8	Check Engine Coolant Temp. Sensor for performance (See Section 6E1). Is it in good condition?	Go to Step 9.	Replace engine coolant temp. sensor.
9	Check Intake Air Temp. Sensor for performance (See Section 6E1). Is it in good condition?	Go to Step 10.	Replace intake air temp. sensor.
10	Check Throttle Position Sensor for performance (See Step 4 of DTC P0121 Diag. Flow Table). Is it in good condition?	Go to Step 11.	Replace throttle position sensor.
11	Check PCV Valve for valve clogging (See Section 6E1). Is it in good condition?	Substitute a known-good ECM and recheck.	Replace PCV valve.

[A] Fig. 1 for Step 4 / [B] Fig. 2 for Step 5 / [C] Fig. 3 for Step 5

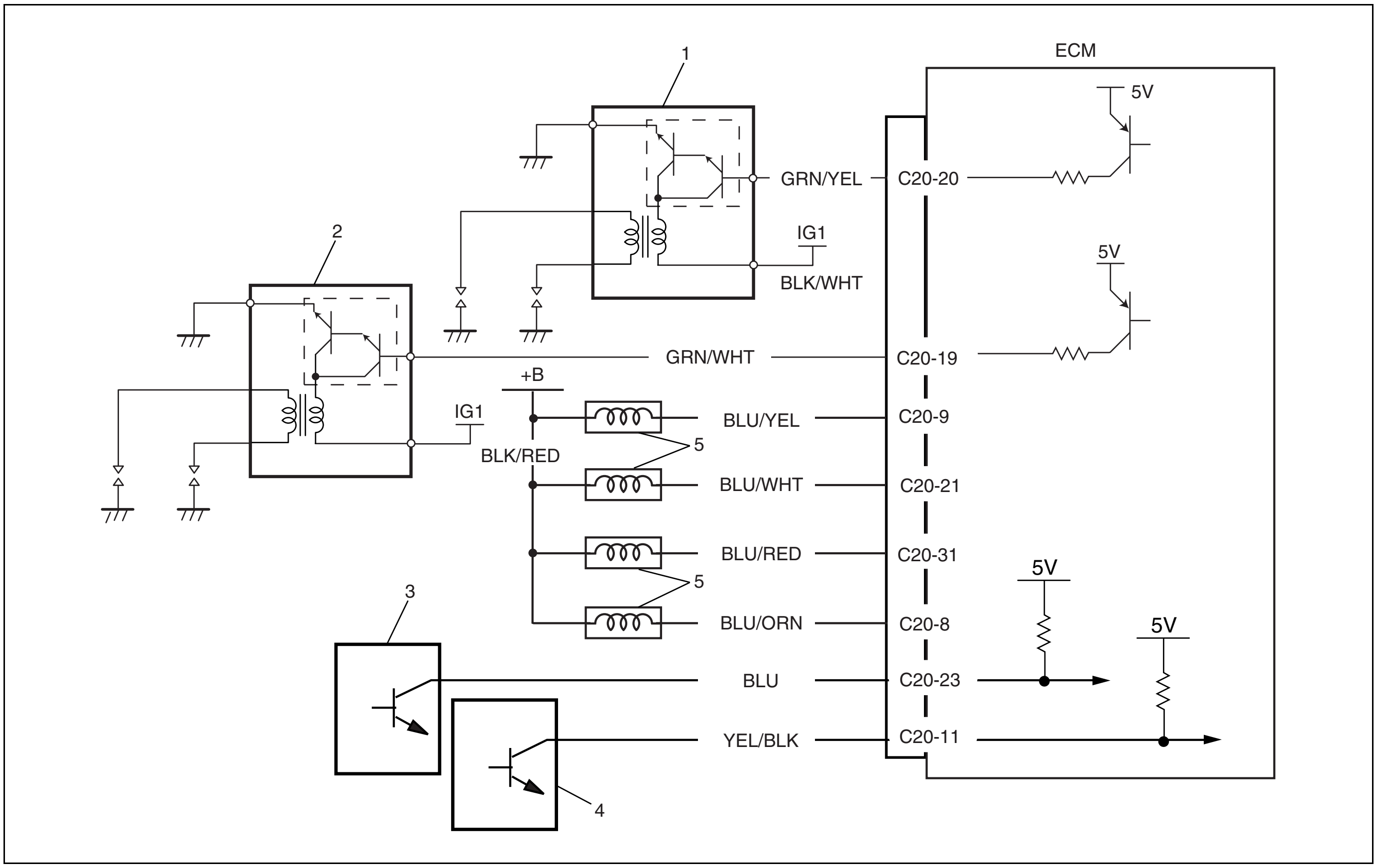


[D] Fig. 4 for Step 5 / [E] Fig. 5 for Step 6



DTC P0300 Random Misfire Detected (Misfire Detected at 2 or More Cylinders)
DTC P0301 Cylinder 1 Misfire Detected
DTC P0302 Cylinder 2 Misfire Detected
DTC P0303 Cylinder 3 Misfire Detected
DTC P0304 Cylinder 4 Misfire Detected

WIRING DIAGRAM



1.	Ignition coil No. 1
2.	Ignition coil No. 2
3.	CKP sensor
4.	CMP sensor
5.	Fuel injector

CIRCUIT DESCRIPTION

ECM monitors crankshaft revolution speed and engine speed via the crankshaft position sensor and cylinder No. via the camshaft position sensor. Then it calculates the change in the crankshaft revolution speed and from how many times such change occurred in every 200 or 1000 engine revolutions, it detects occurrence of misfire.

When ECM detects a misfire (misfire rate per 200 revolutions) which can cause overheat and damage to the three way catalytic converter, it makes the malfunction indicator lamp (MIL) flash as long as misfire occurs at that rate.

After that, however, when the misfire rate drops, MIL remains ON until it is judged as normal 3 times under the same driving conditions.

Also, when ECM detects a misfire (misfire rate per 1000 revolutions) which will not cause damage to three way catalytic converter but can cause exhaust emission to be deteriorated, it makes MIL light according to the 2 driving cycle detection logic.

DTC DETECTING CONDITION	POSSIBLE CAUSE
• Engine under other than high revolution condition • Not on rough road • Engine speed changing rate (below specified value) • Manifold absolute pressure changing rate (below specified value) • Throttle opening changing rate (below specified value) • Misfire rate per 200 or 1000 engine revolutions (how much and how often crankshaft revolution speed changes) is higher than specified value	• Engine overheating • Vacuum leaks (air inhaling) from air intake system • Ignition system malfunction (spark plug(s), high-tension cord(s), ignition coil assembly) • Fuel pressure out of specification • Fuel injector malfunction (clogged or leakage) • Engine compression out of specification • Valve lash (clearance) out of specification • Manifold absolute pressure sensor malfunction • Engine coolant temp. sensor malfunction • PCV valve malfunction • EVAP control system malfunction • EGR system malfunction

DTC CONFIRMATION PROCEDURE

NOTE:

Among different types of random misfire, if misfire occurs at cylinders 1 and 4 or cylinders 3 and 2 simultaneously, it may not possible to reconfirm DTC by using the following DTC confirmation procedure. When diagnosing the trouble of DTC P0300 (Random misfire detected) of the engine which is apparently misfiring, even if DTC P0300 cannot be reconfirmed by using the following DTC confirmation procedure, proceed to the following Diag. Flow Table.

WARNING:

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

1) Turn ignition switch OFF.
2) Clear DTC with ignition switch ON.
3) Check vehicle and environmental condition for :
   – Altitude (barometric pressure) : 2400 m, 8000 ft or less (560 mmHg, 75 kPa or more)
   – Ambient temp. : –10°C, 14°F or higher
   – Intake air temp. : 70°C, 158°F or lower
   – Engine coolant temp. : – 10 – 110°C, 14 – 230°F
4) Start engine and keep it at idle for 2 min. or more.
5) Check DTC in “DTC” mode and pending DTC in “ON BOARD TEST” or “PENDING DTC” mode.
6) If DTC is not detected at idle, consult usual driving based on information obtained in “Customer complaint analysis” and “Freeze frame data check”.

INSPECTION

CAUTION:

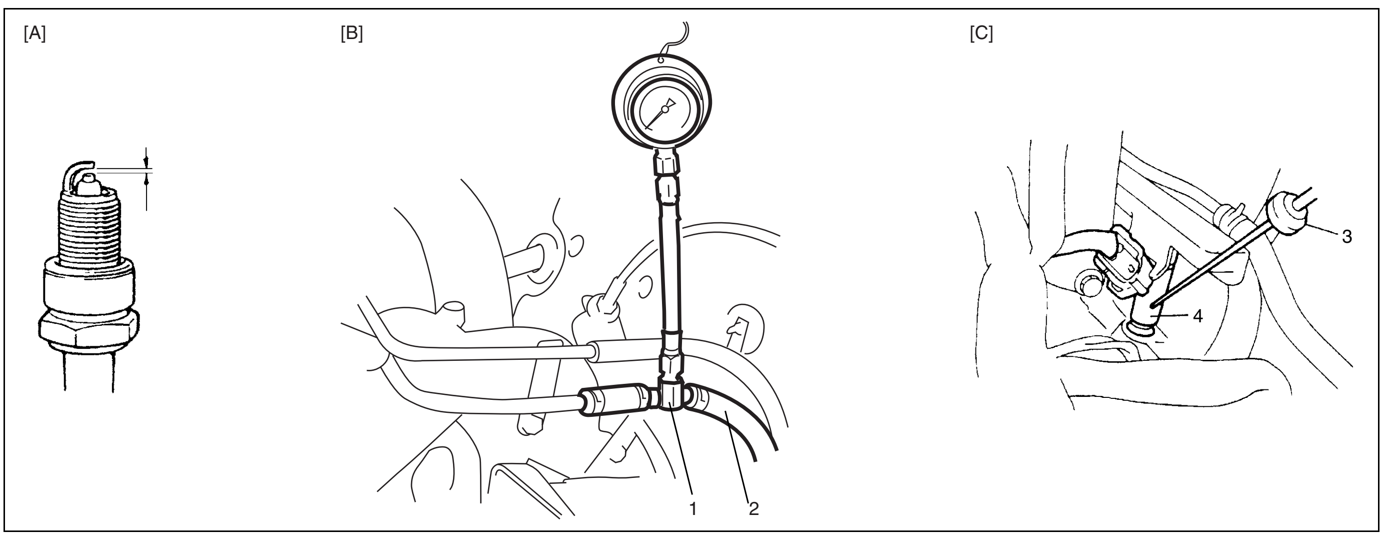
For iridium spark plugs, do not adjust air gap or clean.

Step	Action	Yes	No
1	Was “ENGINE DIAG. FLOW TABLE” performed?	Go to Step 2.	Go to “ENGINE DIAG. FLOW TABLE”.

Step	Action	Yes	No
2	Is there DTC other than Fuel system (DTC P0171/ P0172) and misfire (DTC P0300-P0304)?	Go to applicable DTC Diag. Flow Table.	Go to Step 3.
3	Check Ignition System. 1) Remove spark plugs and check them for; • Air gap : 1.0 – 1.1 mm (0.040 – 0.043 in.) See Fig. 1. • Carbon deposits/Insulator damage/Plug type If abnormality is found, adjust, clean or replace. 2) Disconnect all injector connectors. 3) Connect spark plugs to high tension cords and then ground spark plugs. 4) Crank engine and check that each spark plug sparks. Are above check results satisfactory?	Go to Step 4.	Check ignition system parts (Refer to Section 6F1).
4	Check Fuel Pressure (Refer to Section 6E1 for details). 1) Release fuel pressure from fuel feed line. 2) Install fuel pressure gauge. See Fig. 2. 3) Check fuel pressure. With fuel pump operating and engine at stop : 270 – 310 kPa, 2.7 – 3.1 kg/cm^2, 38.4 – 44.0 psi. At specified idle speed : 270 – 310 kPa, 2.7 – 3.1 kg/cm^2, 38.4 – 44.0 psi. Is measured value as specified?	Go to Step 5.	Go to Diag. Flow Table B-3 fuel pressure check.
5	Check Fuel Injectors and Circuit. 1) Using sound scope (3) or such, check operating sound of each injector (4) when engine is running. Cycle of operating sound should very according to engine speed. See Fig 3. If no sound or an unusual sound is heard, check injector circuit (wire or connector) or injector. 2) Turn ignition switch OFF and disconnect a fuel injector connector. 3) Check for proper connection to fuel injector at each terminal. See Fig. 4. 4) If OK, then check injector resistance. Injector Resistance : 11.3 – 13.8 Ω at 20°C (68°F) 5) Carry out steps 1) and 3) on each injector. 6) Check each injector for injected fuel volume referring to Section 6E1. See Fig. 5. Injected Fuel Volume : 43 – 47 cc/15 sec (1.45/1.51 – 1.58/1.65 US/Imp. oz/15 sec) 7) Check each injector for fuel leakage after injector closed. Fuel Leakage : Less than 1 drop/min. Is check result in step 1) and 3) to 7) satisfactory?	Go to Step 6.	Check injector circuit or replace fuel injector(s).
6	Check PCV Valve for clogging (See Section 6E1). Is it in good condition?	Go to Step 7.	Replace PCV valve.

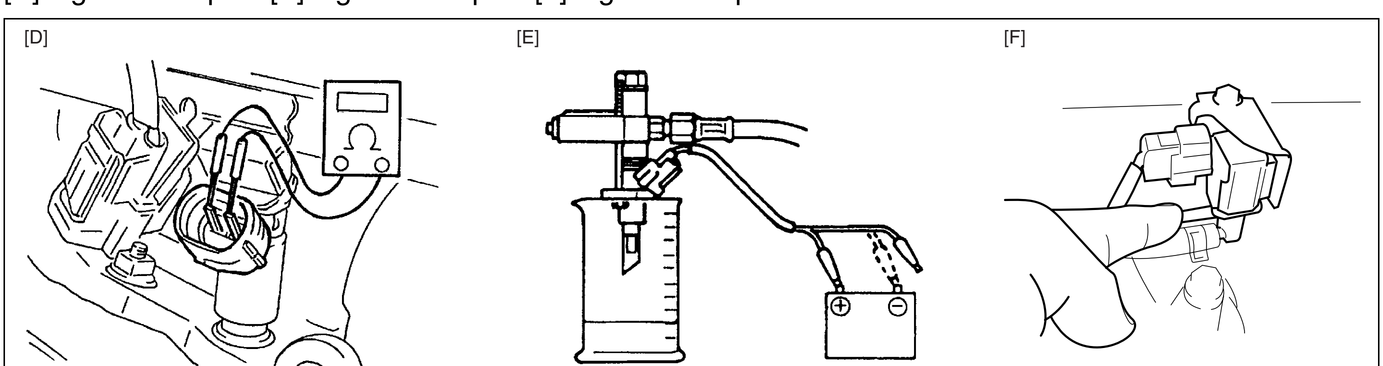
Step	Action	Yes	No
7	Check EVAP Canister Purge Valve for Closing. 1) Disconnect purge hose from EVAP canister purge valve. 2) Place finger against the end of EVAP canister purge valve. 3) Check that vacuum is not felt there, when engine is cool and running at idle. See Fig. 6. Is vacuum felt?	Check evaporative emission control system (See Section 6E1).	Go to Step 8.
8	Check MAP Sensor for performance (See DTC P0105 Diag. Flow Table). Is it in good condition?	Go to Step 9.	Repair or replace.
9	Check ECT Sensor for performance (See Section 6E1). Is it in good condition?	Go to Step 10.	Replace engine coolant temp. sensor.
10	Check Parts or System which can cause engine rough idle or poor performance. • Engine compression (See Section 6A1). • Valve lash (See Section 6A1). • Valve timing (Timing belt installation. See Section 6A1). Are they in good condition?	Check wire harness and connection of ECM ground, ignition system and fuel injector for intermittent open and short.	Repair or replace.

[A] Fig. 1 for Step 3 / [B] Fig. 2 for Step 4 / [C] Fig. 3 for Step 5



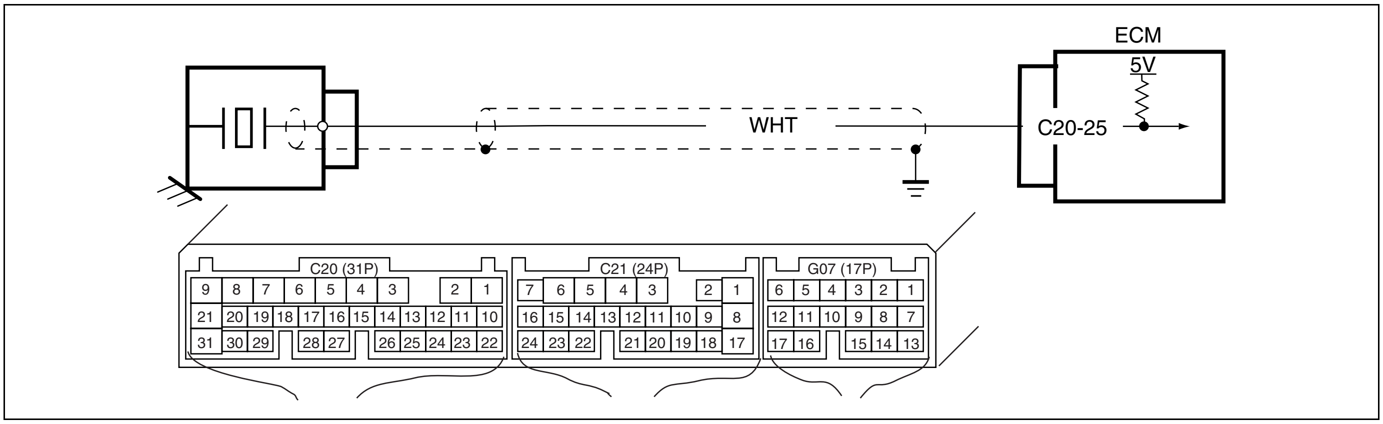
1.	Fuel pressure gauge & 3 way joint
2.	Fuel feed hose

[D] Fig. 4 for Step 5 / [E] Fig. 5 for Step 5 / [F] Fig. 6 for Step 7



DTC P0325 (DTC No.17) Knock Sensor Circuit Malfunction

WIRING DIAGRAM / CIRCUIT DESCRIPTION



DTC DETECTING CONDITION	POSSIBLE CAUSE
• Knock sensor voltage is 3.91 V or more or • Knock sensor voltage is 1.23 V or less	• "WHT" circuit open or shorted to ground • Knock sensor malfunction • ECM malfunction

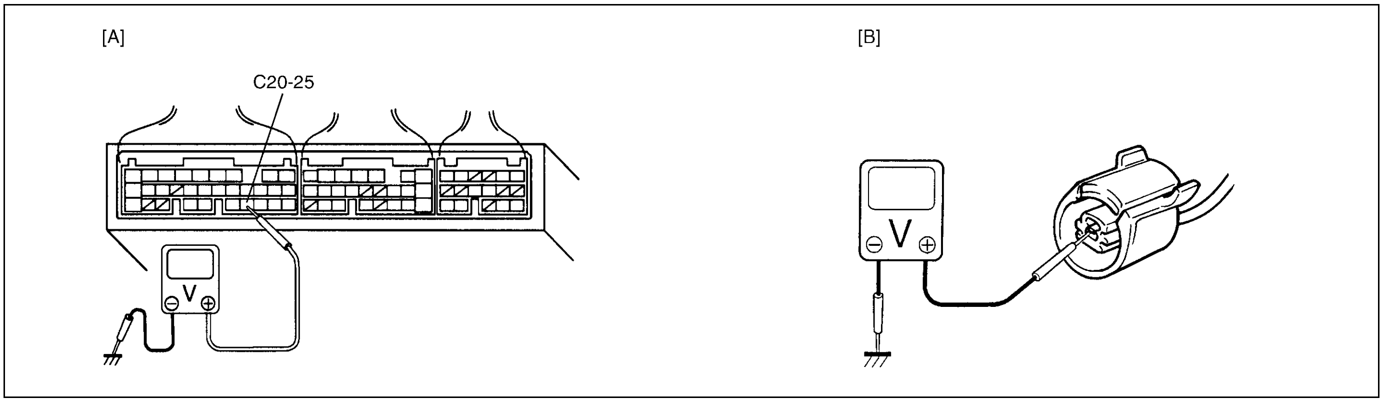
DTC CONFIRMATION PROCEDURE

1) Clear DTC, start engine and keep it at idle for 1 min.
2) Select "DTC" mode on scan tool and check DTC.

INSPECTION

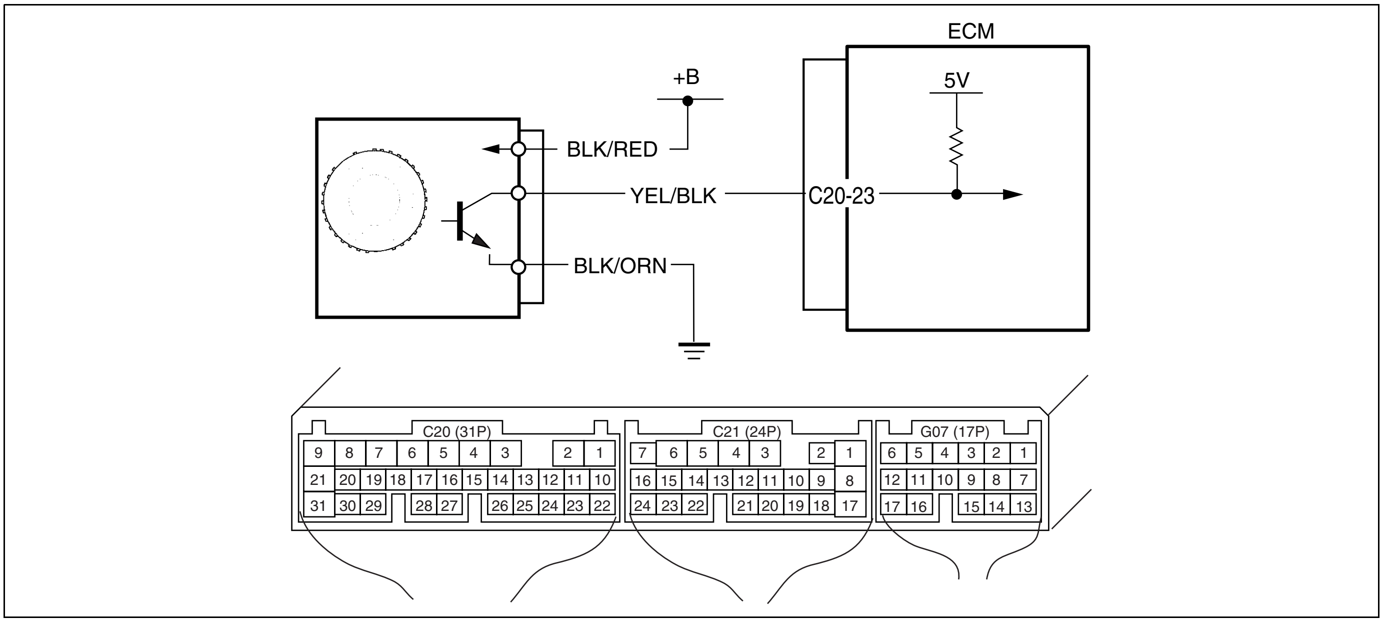
Step	Action	Yes	No
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Check Knock Sensor Signal. 1) With engine running, check voltage from C20-25 terminal of ECM connector to body ground. See Fig. 1. Is voltage about 1.23 – 3.91 V?	Knock sensor and its circuit are in good condition. Intermittent trouble or faulty ECM. Recheck, referring to "Intermittent and Poor Connection" in Section 0A.	Go to Step 3.
3	Check Knock Sensor Output. 1) Stop engine. 2) With ignition switch at OFF position, disconnect knock sensor connector. 3) With ignition switch at ON position, check voltage from "WHT" terminal of knock sensor connector to body ground. See Fig. 2. Is it 4 – 5 V?	Faulty knock sensor. Substitute a known-good knock sensor and recheck.	"WHT" wire open, shorted to ground circuit or poor C20-25 connection. If wire and connection are OK, substitute a known-good ECM and recheck.

[A] Fig. 1 for Step 2 / [B] Fig. 2 for Step 3



DTC P0335 (DTC No.23) Crankshaft Position (CKP) Sensor Circuit Malfunction

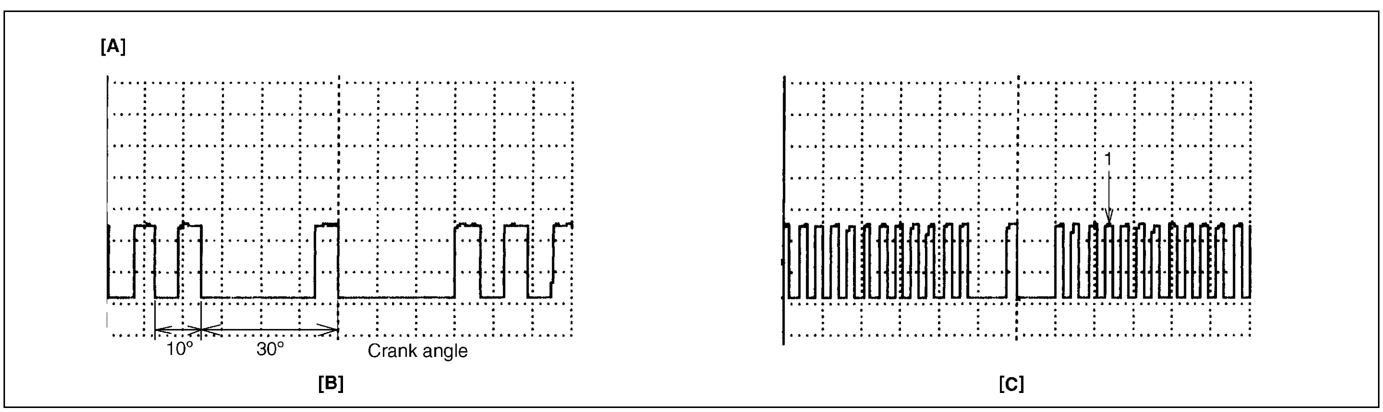
WIRING DIAGRAM / CIRCUIT DESCRIPTION



DTC DETECTING CONDITION	POSSIBLE CAUSE
• No CKP sensor signal for 2 seconds at engine cranking.	• CKP sensor circuit open or short. • Crankshaft timing belt pulley teeth damaged. • CKP sensor malfunction, foreign material being attached or improper installation. • ECM malfunction.

REFERENCE

Connect oscilloscope between terminals C20-23 of ECM connector connected to ECM and ground and check CKP sensor signal.



1. BTDC 5° (Crank angle)	[B] : Waveforms at specified idle speed
[A] : Oscilloscope Waveforms	[C] : Waveforms at 2000 r/min

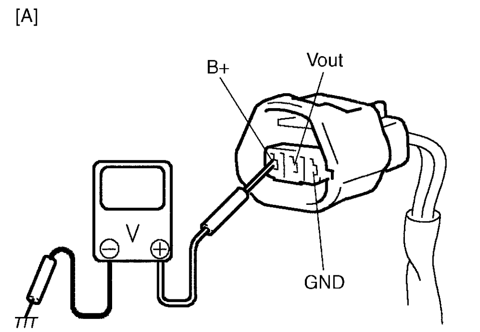
DTC CONFIRMATION PROCEDURE

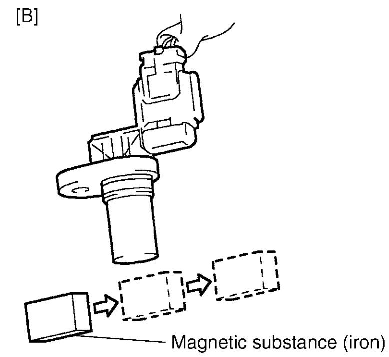
1) Clear DTC and crank engine for 2 sec.
2) Select “DTC” mode on scan tool and check DTC.

INSPECTION

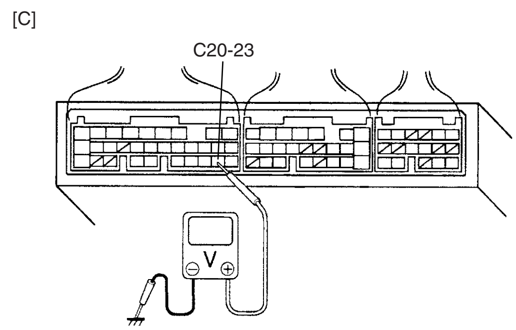
Step	Action	Yes	No
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Check CKP Sensor and Connector for proper installation. Is CKP sensor installed properly and connector connected securely?	Go to Step 3.	Correct.
3	Check Wire Harness and Connection. 1) Disconnect connector from CKP sensor. 2) Check for proper connection to CKP sensor at each terminal. 3) If OK, turn ignition switch ON and check for voltage at each terminal of sensor connector disconnected. See Fig. 1. Terminal "B+" : 10 – 14 V Terminal "Vout" : 4 – 5 V Terminal "GND" : 0 – 1 V Is check result satisfactory?	Go to Step 5.	Go to Step 4.
4	Was terminal "Vout" voltage out of specification in Step 3 check?	"YEL/BLK" wire open, short or poor connection. If wire and connection are OK, substitute a known-good ECM and recheck.	"BLK/RED" or "BLK/ORN" wire open, short or poor connection.
5	Check Ground Circuit for open. 1) Turn ignition switch OFF. 2) Check for continuity between "GND" terminal of CKP sensor connector and engine ground. Is continuity indicated?	Go to Step 6.	"BLK/ORN" wire open or poor ground connection.
6	Check CKP Sensor for operation. 1) Remove CKP sensor from sensor case. 2) Remove metal particles on end face of CKP sensor, if any. 3) Connect each connector to ECM and CKP sensor. 4) Turn ignition switch ON. 5) Check for voltage at terminal C20-23 of connector connected to ECM by passing magnetic substance (iron) while keeping approximately 1 mm (0.03 in.) gap with respect to end face of CKP sensor. See Fig. 2 and 3. Does voltage vary from low (0 –1 V) to high (4 – 5 V) or from high to low?	Go to Step 7.	Replace CKP sensor.
7	Check Signal Rotor for the following. See Fig. 4. • Damage • No foreign material attached Is it in good condition?	Intermittent trouble or faulty ECM. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A.	Clean rotor teeth or replace CMP sensor.

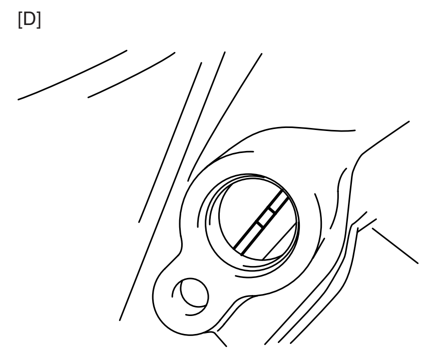
[A] Fig. 1 for Step 3 / [B] Fig. 2 for Step 6





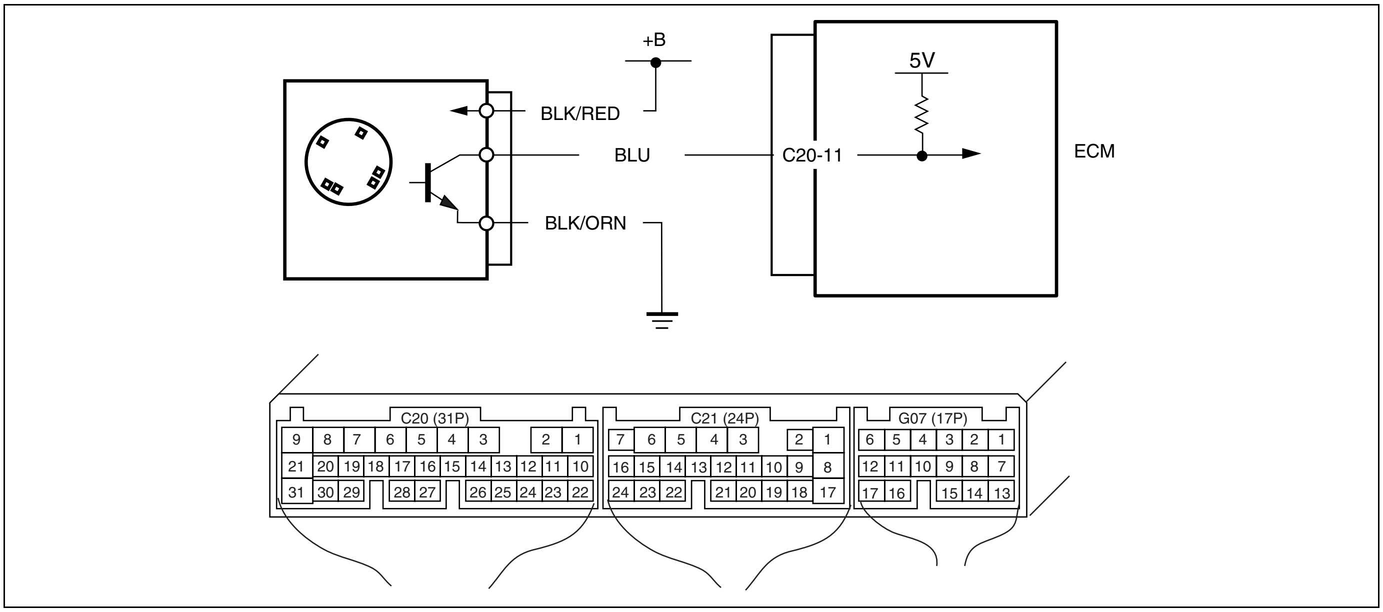
[C] Fig. 3 for Step 6 / [D] Fig. 4 for Step 7





DTC P0340 (DTC No.15) Camshaft Position (CMP) Sensor Circuit Malfunction

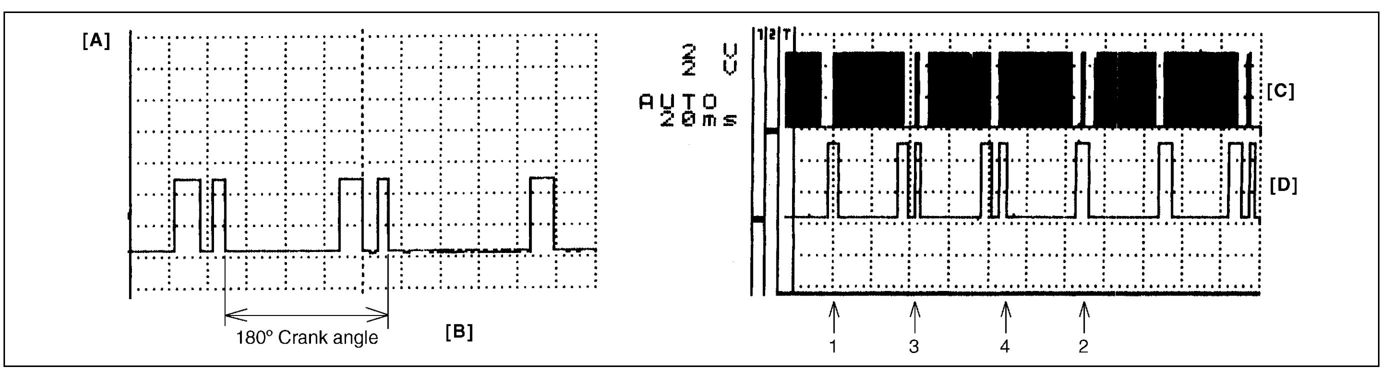
WIRING DIAGRAM / CIRCUIT DESCRIPTION



DTC DETECTING CONDITION	POSSIBLE CAUSE
• No CMP sensor signal during engine running (CKP sensor signal is inputted).	• CMP sensor circuit open or short. • Signal rotor teeth damaged. • CMP sensor malfunction, foreign material being attached or improper installation. • ECM malfunction.

REFERENCE

Connect oscilloscope between terminals C20-11 of ECM connector connected to ECM and body ground and check CMP sensor signal. When CKP circuit is failed (open or short), ECM identify the cylinder only by CMP sensor signal.



1. No.1 cylinder	3. No.3 cylinder	[A] : Oscilloscope Waveforms	[C] : CKP sensor signal
2. No.2 cylinder	4. No.4 cylinder	[B] : Waveforms at specified idle speed	[D] : CMP sensor signal

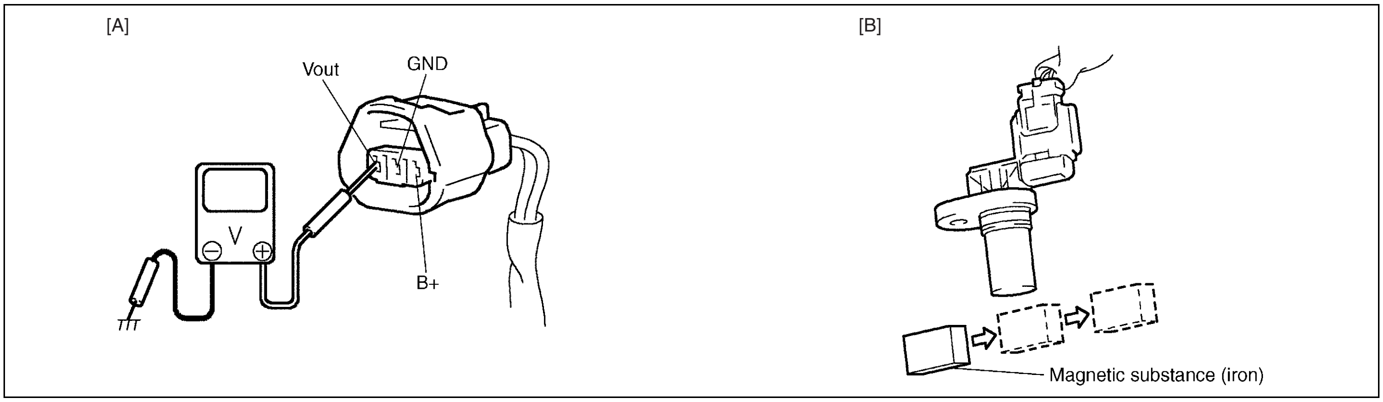
DTC CONFIRMATION PROCEDURE

1) Clear DTC.
2) Start engine and keep it at idle for 1 min.
3) Select “DTC” mode on scan tool and check DTC.

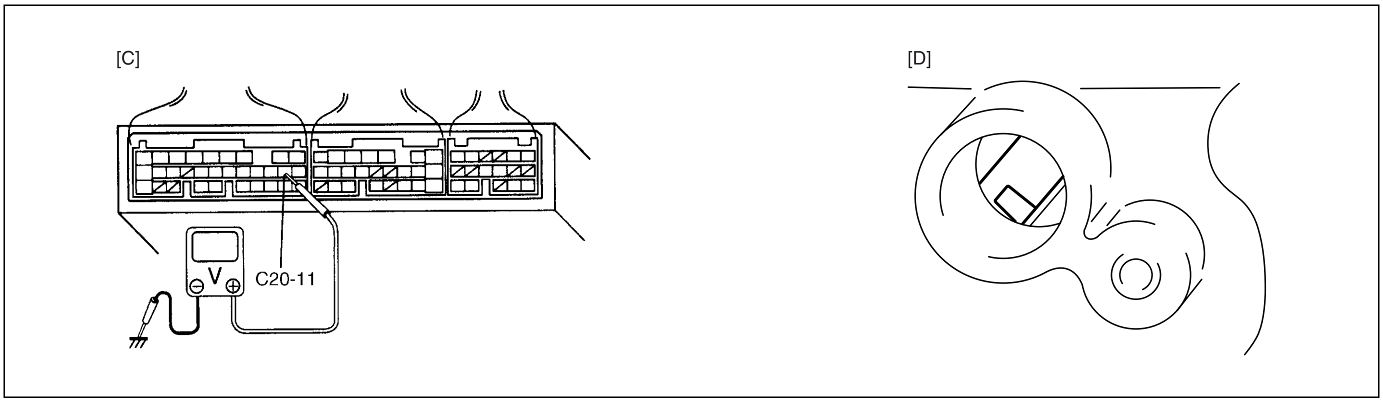
INSPECTION

Step	Action	Yes	No
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Check CMP Sensor and connector for proper installation. Is CMP sensor installed properly and connector connected securely?	Go to Step 3.	Correct.
3	Check Wire Harness and Connection. 1) Disconnect connector from CMP sensor. 2) Check for proper connection to CMP sensor at each terminal. 3) If OK, turn ignition switch ON and check for voltage at each terminal of sensor connector disconnected. See Fig. 1. Terminal "B+" : 10 – 14 V Terminal "Vout" : 4 – 5 V Terminal "GND" : 0 – 1 V Is check result satisfactory?	Go to Step 5.	Go to Step 4.
4	Was terminal "Vout" voltage out of specification in Step 3 check?	"BLU" wire open, short or poor connection. If wire and connection are OK, substitute a known-good ECM and recheck.	"BLK/RED" or "BLK/ORN" wire open, short or poor connection.
5	Check Ground Circuit for open. 1) Turn ignition switch OFF. 2) Check for continuity between "GND" terminal of CMP sensor connector and engine ground. Is continuity indicated?	Go to Step 6.	"BLK/ORN" wire open or poor ground connection.
6	Check CMP Sensor for operation. 1) Remove CMP sensor from sensor case. 2) Remove metal particles on end face of CMP sensor, if any. 3) Connect each connector to ECM and CMP sensor. 4) Turn ignition switch ON. 5) Check for voltage at terminal C20-11 of connector connected to ECM by passing magnetic substance (iron) while keeping approximately 1 mm (0.03 in.) gap with respect to end face of CMP sensor. See Fig. 2 and 3. Does voltage vary from low (0 – 1 V) to high (4 – 5 V) or from high to low?	Go to Step 7.	Replace CMP sensor.
7	Check Signal Rotor for the following. See Fig. 4. • Damage • No foreign material attached Is it in good condition?	Intermittent trouble or faulty ECM. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A.	Clean rotor teeth or replace CMP sensor.

[A] Fig. 1 for Step 3 / [B] Fig. 2 for Step 6

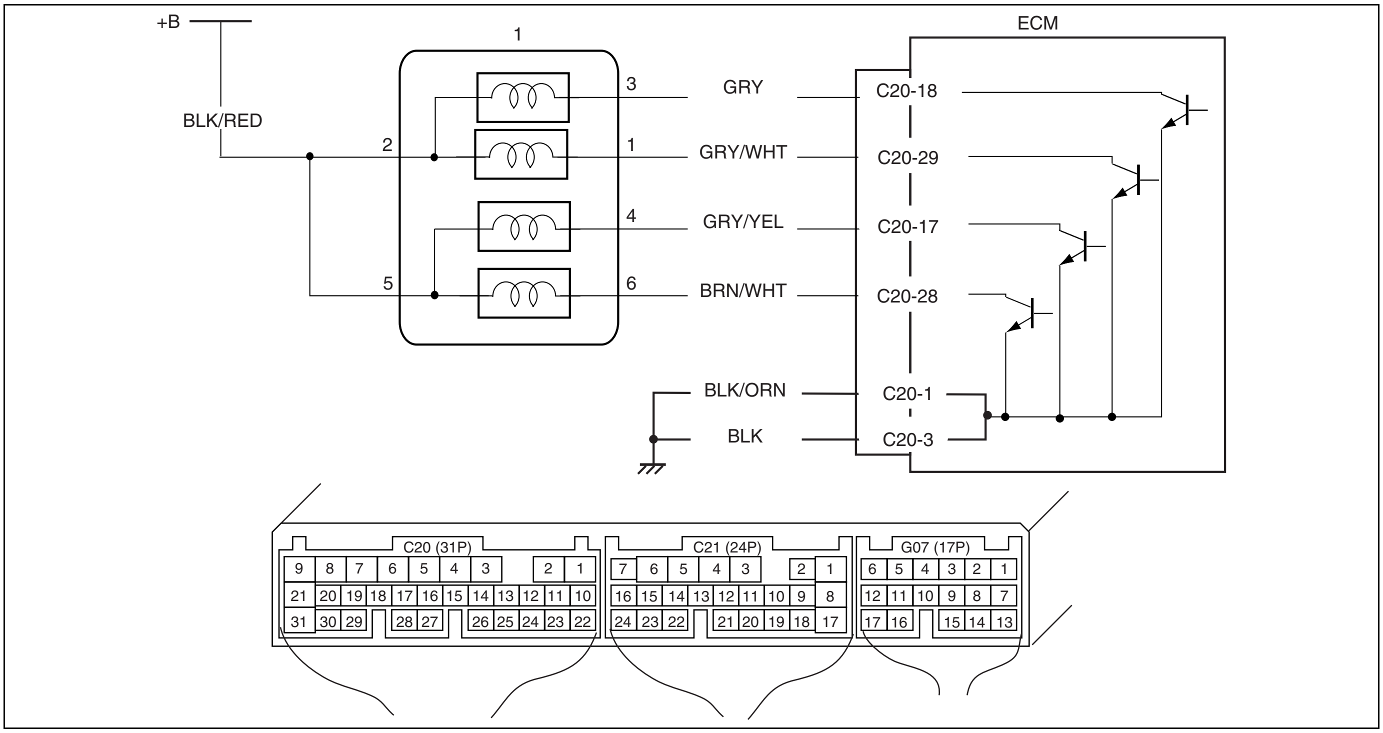


[C] Fig. 3 for Step 6 / [D] Fig. 4 for Step 7



DTC P0400 Exhaust Gas Recirculation Flow Malfunction

WIRING DIAGRAM / CIRCUIT DESCRIPTION



1. EGR valve

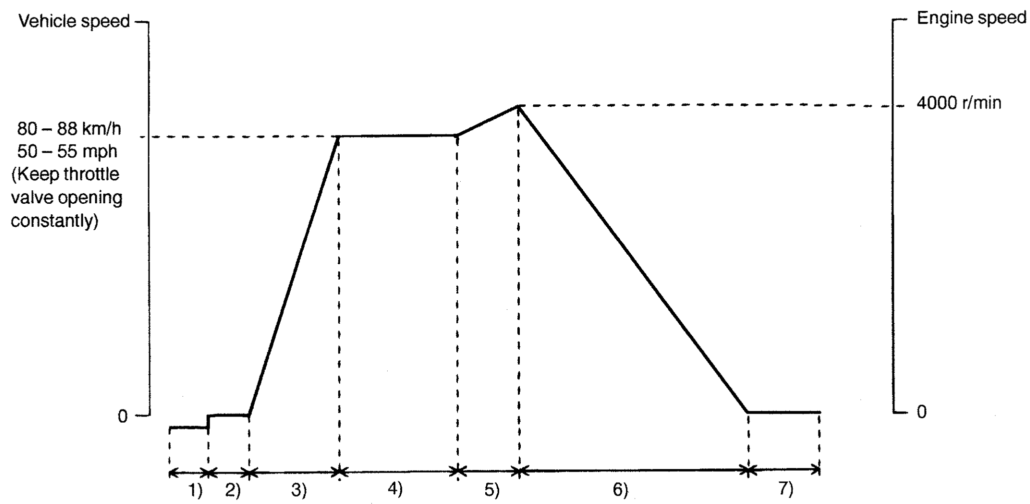
DTC DETECTING CONDITION	POSSIBLE CAUSE
• While running at specified vehicle speed after engine warm-up • During deceleration (engine speed high with closed throttle position ON) in which fuel cut is involved, difference in intake manifold absolute pressure between when EGR valve is opened at specified value and when it is closed is larger or smaller than specified value. ✱2 driving cycle detection logic, monitoring once/1 driving	• EGR valve or its circuit • EGR passage • ECM

DTC CONFIRMATION PROCEDURE

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

1) Turn ignition switch OFF.
   Clear DTC with ignition switch ON, check vehicle and environmental condition for :
   – Altitude (barometric pressure) : 2400 m, 8000 ft or less (560 mmHg, 75 kPa or more)
   – Ambient temp. : –10°C, 14°F or higher
   – Intake air temp. : 70°C, 122°F or lower
2) Start engine and warm it up to normal operating temperature (70 – 110°C, 158 – 230°F) and run it at idle for 5 min.
3) Increase vehicle speed to 80 – 88 km/h, 50 – 55 mph in 5th gear or in “D” range.
4) Hold throttle valve at that opening position for 2 min. or longer.
5) Increase engine speed to 4000 r/min. in 3rd gear or in “2” range.
6) Release accelerator pedal and with engine brake applied, keep vehicle coasting (fuel cut condition) till engine speed reaches 1500 r/min.

7) Stop vehicle (don't turn ignition switch OFF) and confirm test results according to following “Test Result Confirmation Flow Table”.



TEST RESULT CONFIRMATION FLOW TABLE

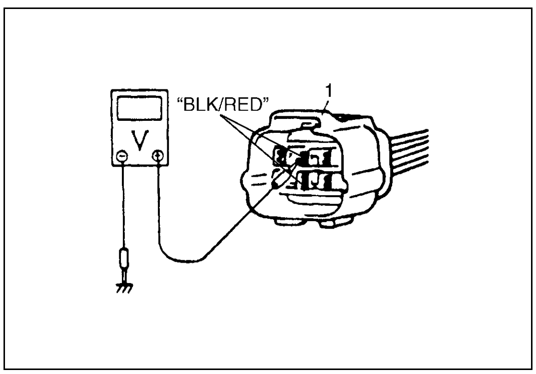
Step	Action	Yes	No
1	Check DTC in “DTC” mode and pending DTC in “ON BOARD TEST”. Is DTC or pending DTC displayed?	Proceed to applicable DTC flow table.	Go to Step 2.
2	Set scan tool to “READINESS TESTS” mode and check if testing has been completed. Is test completed?	No DTC is detected. (Confirmation test is completed)	Repeat DTC confirmation procedure.

INSPECTION

Step	Action	Yes	No
1	Was “ENGINE DIAG. FLOW TABLE” performed?	Go to Step 2.	Go to “ENGINE DIAG. FLOW TABLE”.
2	Do you have SUZUKI scan tool?	Go to Step 4.	Go to Step 5.
3	EGR Valve Operation Check : 1) With ignition switch OFF, install SUZUKI scan tool. 2) Check EGR system referring to Section 6E1. Is it in good condition?	Go to Step 4.	Go to Step 5.
4	MAP Sensor Check : 1) Check MAP sensor for performance referring to Section 6E1. Is check result satisfactory?	Intermittent trouble or faulty ECM. Check for intermittent referring to “Intermittent and Poor Connection” in Section 0A.	Repair or replace.

Step	Action	Yes	No
5	EGR Valve Power Supply Circuit Check : 1) With ignition switch OFF, disconnect EGR valve coupler. 2) With ignition switch ON, check voltage between terminal 2 and terminal 5 of EGR valve connector and ground. See Fig.1. Is each voltage 10 – 14 V?	Go to Step 7.	Faulty “BLK/RED” wire.
6	EGR Valve Stepper Motor Coil Circuit Check : 1) With ignition switch OFF, connect EGR valve coupler and disconnect ECM couplers. 2) Check resistance between C21-5 and C20-18, 29, 17, 28. Is each resistance 20 – 24 Ω at 20°C, 68°F?	Go to Step 8.	Faulty “GRY”, “GRY/WHT”, “GRY/YEL”, “BRN/WHT” wire or EGR valve.
7	MAP sensor Check : 1) Check MAP sensor for performance referring to Section 6E1. Is check result satisfactory?	EGR passage clogged or EGR valve malfunction. If all above are OK, intermittent trouble or faulty ECM. Check for intermittent referring to “Intermittent and Poor Connection” in Section 0A.	Repair or replace.

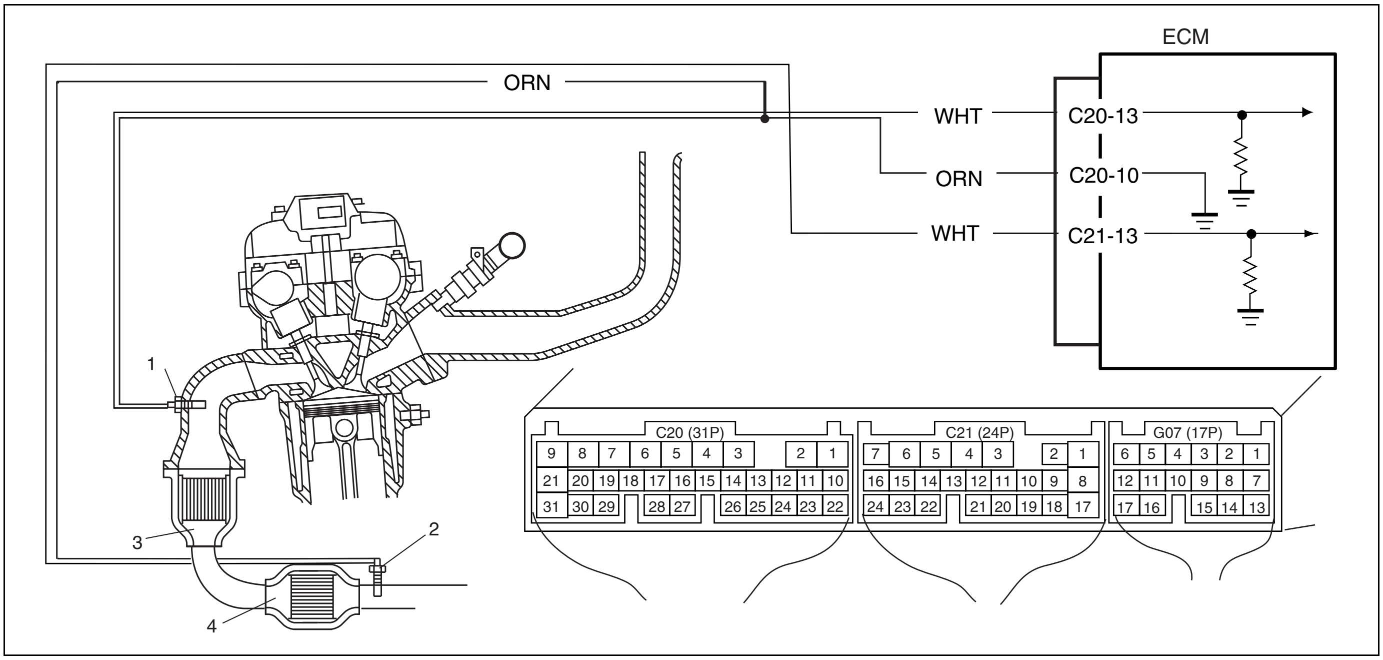
Fig. 1 for Step 5



1. EGR valve connector

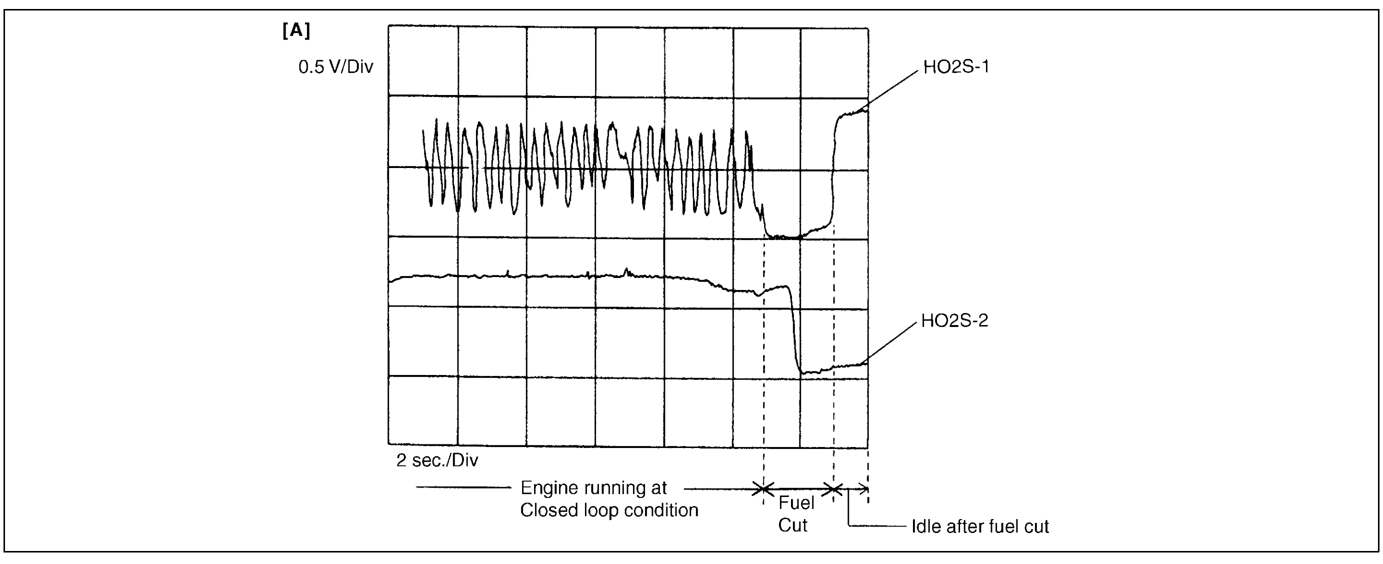
DTC P0420 Catalyst System Efficiency below Threshold

WIRING DIAGRAM / CIRCUIT DESCRIPTION



ECM monitors oxygen concentration in the exhaust gas which has passed the three way catalytic converter by HO2S-2 (2).
When the catalyst is functioning properly, the variation cycle of HO2S-2 (2) output voltage (oxygen concentration) is slower than that of HO2S-1 (1) output voltage because of the amount of oxygen in the exhaust gas which has been stored in warm up three way catalytic converter (3) and three way catalytic converter (4).

REFERENCE



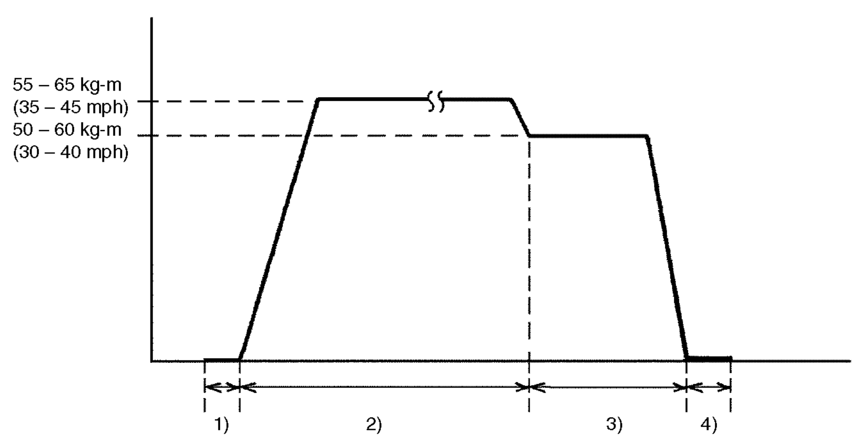
[A] : Oscilloscope Waveforms

DTC DETECTING CONDITION	POSSIBLE CAUSE
• While vehicle running at constant speed under other than high load. • Time from rich or lean switching command is output till HO2S-2 output voltage crosses 0.45 V is less than specified value. ✱2 driving cycle detection logic, monitoring once/1 driving	• Exhaust gas leak • Three way catalytic converter malfunction • Fuel system malfunction • HO2S-2 malfunction • HO2S-1 malfunction

DTC CONFIRMATION PROCEDURE

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

1) Turn ignition switch OFF.
   Clear DTC with ignition switch ON, check vehicle and environmental condition for :
   – Altitude (barometric pressure) : 2400 m, 8000 ft or less (560 mmHg, 75 kPa or more)
   – Ambient temp. : –10°C, 14°F or higher
   – Intake air temp. : 70°C, 158°F or lower
   – Engine coolant temp. : 70 – 110°C, 158 – 230°F
2) Start engine and drive vehicle at 55 – 65 km/h, 35 – 45 mph for 8 min. or longer.
   While this driving, if “Catalyst Monitoring TEST COMPLETED” is displayed in “READINESS TESTS” mode and DTC is not displayed in “DTC” mode, confirmation test is completed.
   If “TEST NOT COMPLETE” is still being displayed, continue test driving.
3) Decrease vehicle speed at 50 – 60 km/h, 30 – 40 mph, and hold throttle valve at that opening position for 2 min. and confirm that short term fuel trim vary within – 20% – +20% range.
4) Stop vehicle (do not turn ignition switch OFF) and confirm test results according to following “Test Result Confirmation Flow Table”.



TEST RESULT CONFIRMATION FLOW TABLE

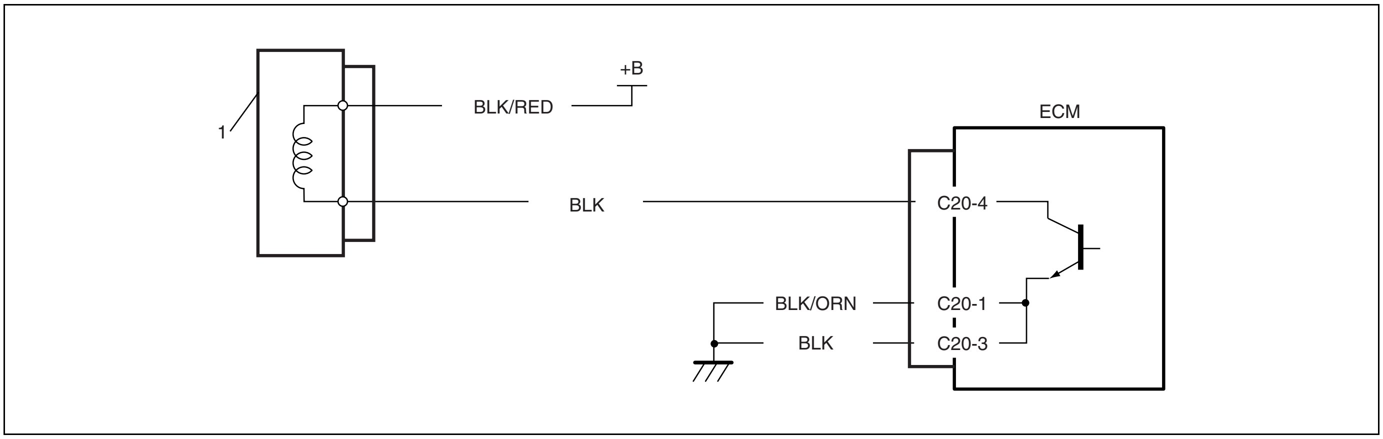
Step	Action	Yes	No
1	Check DTC in “DTC” mode and pending DTC in “ON BOARD TEST” or “PENDING DTC” mode. Is DTC or pending DTC displayed?	Proceed to applicable DTC Diag. Flow Table.	Go to Step 2.
2	Set scan tool to “READINESS TESTS” mode and check if testing has been completed. Is test completed?	No DTC is detected (confirmation test is completed).	Repeat DTC confirmation procedure.

INSPECTION

Step	Action	Yes	No
1	Was “ENGINE DIAG. FLOW TABLE” performed?	Go to Step 2.	Go to “ENGINE DIAG. FLOW TABLE”.
2	Check Short Term Fuel Trim. Did short term fuel trim vary within – 20% – +20% range in step 3) of DTC confirmation test?	Go to Step 3.	Check fuel system. Go to DTC P0171/P0172 Diag. Flow Table.
3	Check HO2S-2 for Output Voltage. Perform steps 1) through 9) of DTC confirmation procedure for DTC P0136 (HO2S-2 malfunction) and check output voltage of HO2S-2 then. Is over 0.6 V and below 0.3 V indicated?	Replace three way catalytic converter.	Check “WHT” and “ORN” wires for open and short, and connections for poor connection. If wires and connections are OK, replace HO2S-2.

DTC P0443 Purge Control Valve Circuit Malfunction

WIRING DIAGRAM / CIRCUIT DESCRIPTION



1. EVAP canister purge valve

DTC DETECTING CONDITION	POSSIBLE CAUSE
Canister purge control valve circuit is opened or shorted.	• "BLK" circuit open or short • "BLK/RED" circuit open or short • Canister purge valve malfunction

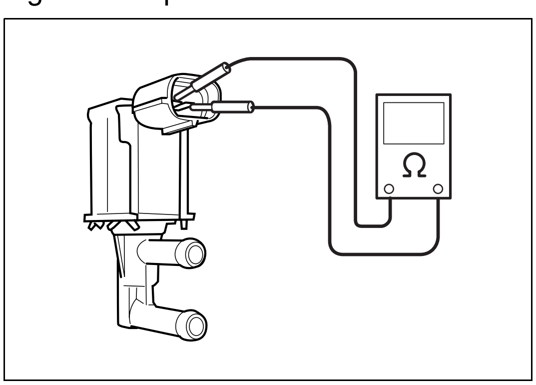
DTC CONFIRMATION PROCEDURE

1) Clear DTC with ignition switch ON.
2) Select "DTC" mode on scan tool and check DTC.

INSPECTION

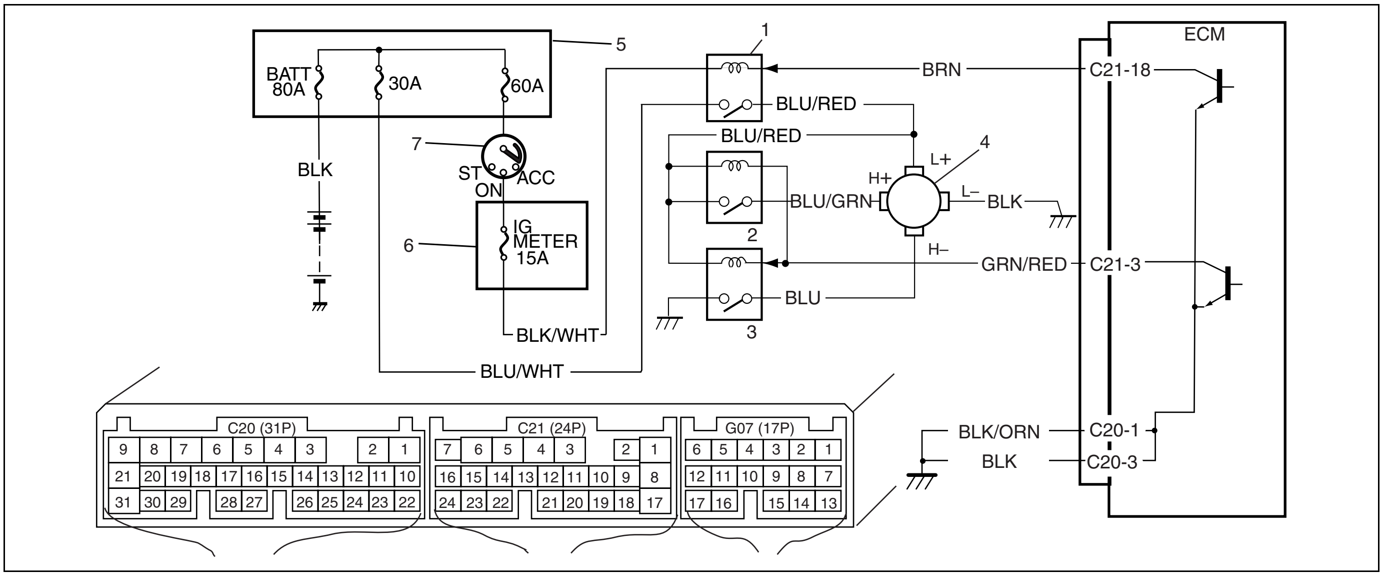
Step	Action	Yes	No
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2	Go to "ENGINE DIAG. FLOW TABLE".
2	Check EVAP Canister Purge Valve operation. 1) With ignition switch OFF, disconnect coupler from canister purge valve. 2) Check resistance of EVAP canister purge valve. Resistance between two terminals : 30 – 34 Ω at 20°C (68°F) Resistance between terminal and body : 1 MΩ or higher See Fig.1. Is it as specified?	"BLK" circuit open or short. "BLK/RED" circuit open or short.	Replace EVAP canister purge valve.

Fig. 1 for Step 2



DTC P0480 Radiator Cooling Fan Control System Malfunction

WIRING DIAGRAM / CIRCUIT DESCRIPTION



1. Radiator fan relay No.1	3. Radiator fan relay No.3	5. Main fuse	7. Ignition switch
2. Radiator fan relay No.2	4. Radiator fan motor	6. J/B	

DTC DETECTING CONDITION	POSSIBLE CAUSE
Low voltage at terminal C21-18 when engine coolant temp. is below 97.5°C, 207.5°F. ✱2 driving cycle detection logic, continuous monitoring.	• “BLK/WHT” or “BRN” circuit open or short • Radiator cooling fan relay malfunction • ECM malfunction

DTC CONFIRMATION PROCEDURE

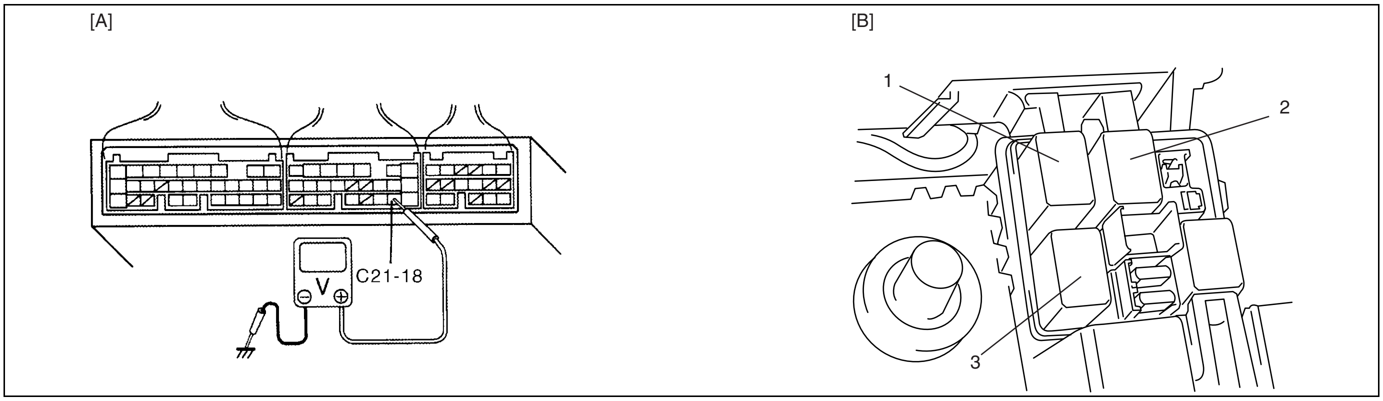
1) Turn ignition switch OFF.
2) Clear DTC with ignition switch ON.
3) Warm up engine until radiator cooling fan starts to operate.
4) Check pending DTC in “ON BOARD TEST” or “PENDING DTC” mode and DTC in “DTC” mode.

INSPECTION

Step	Action	Yes	No
1	Was “ENGINE DIAG. FLOW TABLE” performed?	Go to Step 2.	Go to “ENGINE DIAG. FLOW TABLE”.
2	Check Radiator Cooling Fan Relay and Its Circuit. 1) Turn ignition switch ON. 2) Check for voltage at terminal C21-18 of ECM connector connected, under following condition. See Fig. 1. When engine coolant temp. is lower than 97.5°C, 207.5°F and A/C switch turns OFF : 10 – 14 V Is voltage as specified?	Intermittent trouble or faulty ECM. Check for intermittent referring to “Intermittent and Poor Connection” in Section 0A.	Go to Step 3.

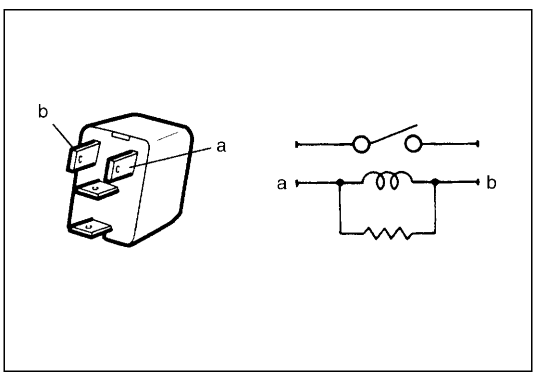
Step	Action	Yes	No
3	Check Radiator Cooling Fan Control Relay. 1) Turn ignition switch OFF and remove radiator cooling fan relay. 2) Check for proper connection to the relay at “BLK/WHT”, “BRN”, “BLU/RED” and “BLU/GRN” wire terminals. 3) If OK, then measure resistance between terminals a and b. See Fig. 2 and 3. Is it 56 – 146 Ω?	“BLK/WHT” or “BRN” circuit open or short. If wires and connections are OK, substitute a known-good ECM and recheck.	Replace radiator cooling fan relay.

[A] Fig. 1 for Step 2 / [B] Fig. 2 for Step 3



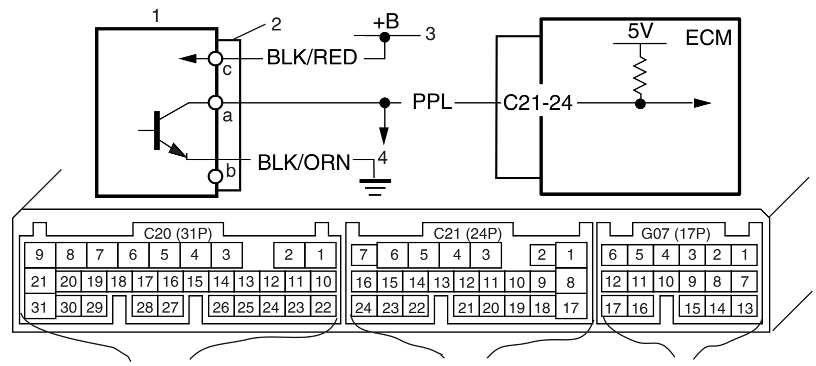
1.	Radiator fan relay No.1
2.	Radiator fan relay No.2
3.	Radiator fan relay No.3

Fig. 3 for Step 3



DTC P0500 (DTC No.16) Vehicle Speed Sensor (VSS) Malfunction

WIRING DIAGRAM / CIRCUIT DESCRIPTION



1. VSS (vehicle speed sensor)	3. Power supply from ignition switch
2. VSS connector	4. Speedometer, P/S control module and multi information display

DTC DETECTING CONDITION	POSSIBLE CAUSE
• VSS signal not inputted while vehicle running in “D” range or during fuel cut at deceleration. ✱2 driving cycle detection logic, continuous monitoring	• “BLK/ORN” circuit open • “PPL” or “BLK/RED” circuit open or short • VSS malfunction • ECM malfunction • Speedometer malfunction

DTC CONFIRMATION PROCEDURE

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

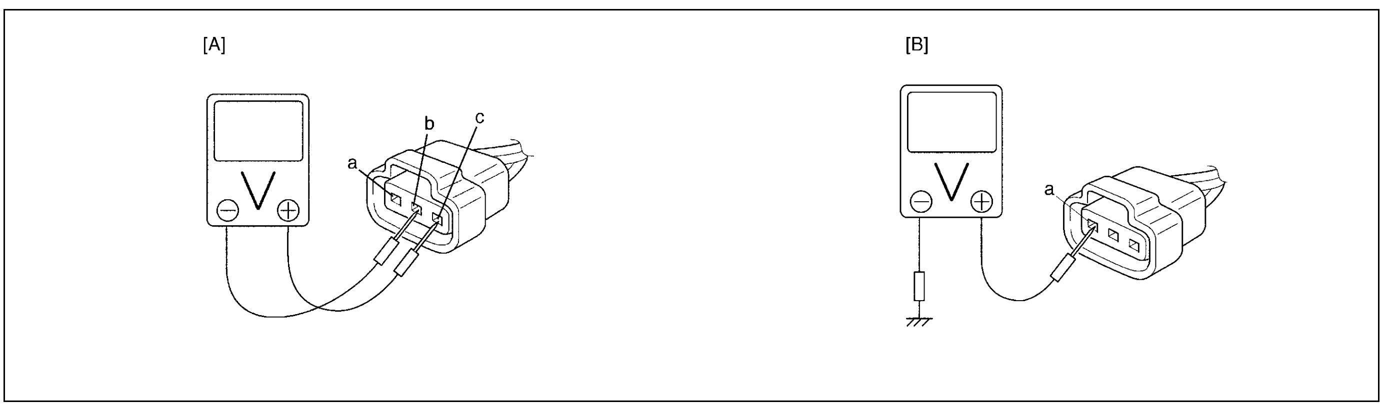
1) Clear DTC and warm up engine to normal operating temperature.
2) Increase vehicle speed to 80 km/h, 50 mph in 3rd gear or “2” range while observing vehicle speed displayed on scan tool.
3) Release accelerator pedal and with engine brake applied, keep vehicle coasting (fuel cut condition) for 4 sec. or more.
4) Check pending DTC and DTC.

INSPECTION

Step	Action	Yes	No
1	Was “ENGINE DIAG. FLOW TABLE” performed?	Go to Step 2.	Go to “ENGINE DIAG. FLOW TABLE”.
2	Does speedometer indicate vehicle speed?	Go to Step 3.	Go to Step 5.
3	Check Vehicle Speed Signal. Is vehicle speed displayed on scan tool in step 2) and 3) of DTC confirmation procedure?	Intermittent trouble or faulty ECM. Check for intermittent referring to “Intermittent and Poor Connection” in Section 0A.	Go to Step 4.

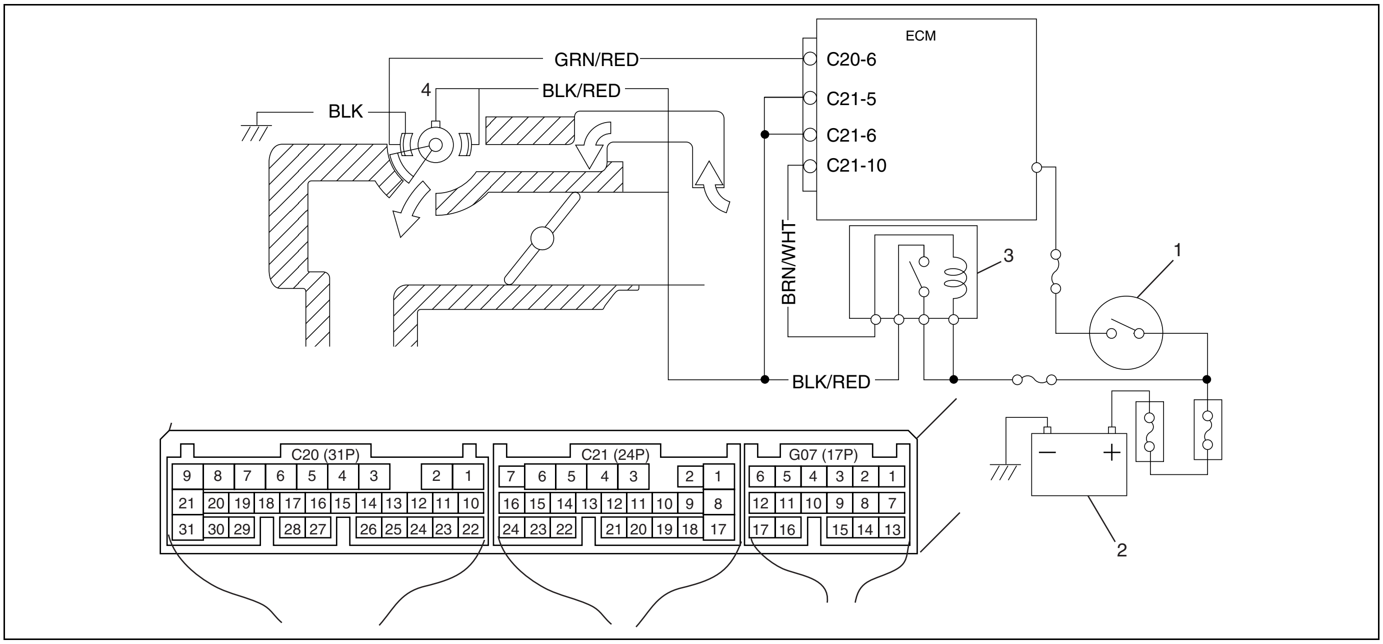
Step	Action	Yes	No
4	Check VSS Signal Circuit. 1) Turn ignition switch to OFF position. 2) Disconnect combination meter connectors. Refer to Section 8. 3) Disconnect P/S control module connector (if equipped). 4) Turn ignition switch to ON position, without running engine. 5) Measure voltage from terminal “a” of VSS connector to ground. See Fig. 2. Is voltage within 4 – 5 V?	Faulty speedometer. Faulty P/S control module. Faulty multi information display.	“PPL” wire open or short. Poor connection of ECM connector terminal. If OK, substitute a known-good ECM and recheck.
5	Check VSS Power Supply. 1) With ignition switch at OFF position, disconnect VSS connector. 2) Turn ignition switch to ON position, without running engine. 3) Measure voltage from terminal “b” to “c” of VSS connector. See Fig. 1. Is voltage within 10 – 14 V?	Go to Step 6.	“BLK/RED” or “BLK/ORN” wire open or short.
6	Check VSS Signal Circuit. 1) Measure voltage from terminal “a” of VSS connector to ground. See Fig. 2. Is voltage more than 4 V?	Go to Step 7.	“PPL” wire open or short. Poor connection of ECM connector terminal. If OK, substitute a known-good ECM and recheck.
7	Check Signal Rotor. 1) Remove VSS. 2) Visually inspect VSS sensor signal rotor for damage. Was any damage found?	Faulty VSS signal rotor.	Poor connection of VSS connector terminal. If OK, substitute a known-good VSS and recheck.

[A] Fig. 1 for Step 5 / [B] Fig. 2 for Step 4 and Step 6



DTC P0505 (DTC No.26) Idle Control System Malfunction

CIRCUIT DESCRIPTION



1. Ignition switch	3. Main relay
2. Battery	4. IAC valve

DTC DETECTING CONDITION	POSSIBLE CAUSE
• No closed signal to IAC valve is detected after engine start. ✱2 driving cycle detection logic, continuous monitoring.	• “BLK/RED”, “GRN/RED” or “BLK” circuit open or short • IAC valve malfunction • ECM malfunction

DTC CONFIRMATION PROCEDURE

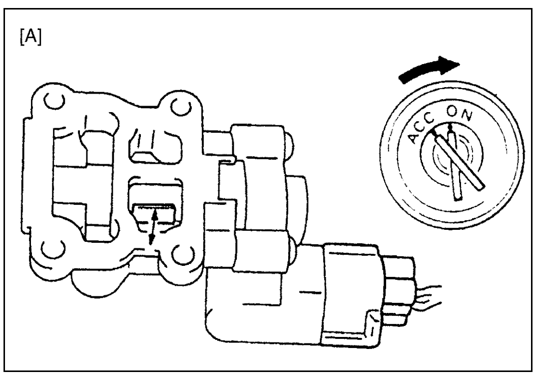
1) Turn ignition switch OFF.
2) Clear DTC with ignition switch ON.
3) Start engine and run it at idle for 1 min.
4) Check DTC and pending DTC.

INSPECTION

Step	Action	Yes	No
1	Was “ENGINE DIAG. FLOW TABLE” performed?	Go to Step 2.	Go to “ENGINE DIAG. FLOW TABLE”.
2	Is SUZUKI scan tool available?	Go to Step 3.	Go to Step 4.
3	Check Idle Air Control System. 1) Connect SUZUKI scan tool to DLC with ignition switch OFF, set parking brake and block drive wheels. 2) Warm up engine to normal operating temperature. 3) Clear DTC and select “MISC TEST” mode on SUZUKI scan tool. Is it possible to control (increase and reduce) engine idle speed by using SUZUKI scan tool?	Intermittent trouble or faulty ECM. Check for intermittent referring to “Intermittent and Poor Connection” in Section 0A.	Go to Step 5.

Step	Action	Yes	No
4	Check Idle Air Control System. 1) Remove IAC valve from throttle body referring to “IAC Valve Removal” in Section 6E1. 2) Check IAC valve for operation referring to “IAC Valve Inspection” in Section 6E1. See Fig. 1. Is check result satisfactory?	Intermittent trouble or faulty ECM. Check for intermittent referring to “Intermittent and Poor Connection” in Section 0A.	Go to Step 5.
5	Check Wire Harness for open and short. 1) Turn ignition switch OFF. 2) Disconnect IAC valve connector. 3) Check for proper connection to IAC valve at each terminals. 4) If OK, disconnect ECM connector. 5) Check for proper connection to ECM at C20-6 terminal. 6) If OK, check “BLK/RED”, “GRN/RED” and “BLK” circuit for open and short. Are they in good condition?	Replace IAC valve and recheck.	Repair or replace.

Fig. 1 for Step 4



DTC P1450 Barometric Pressure Sensor Low/High Input

DTC P1451 Barometric Pressure Sensor Performance Problem

WIRING DIAGRAM / CIRCUIT DESCRIPTION

Barometric pressure sensor is installed in ECM.

DTC DETECTING CONDITION	POSSIBLE CAUSE
DTC P1450 : Barometric pressure : Sensor voltage is 4.7 V or higher, or 1.6 V or lower	• ECM (barometric pressure sensor) malfunction
DTC P1451 : • Vehicle stopped • Engine cranking • Difference between barometric pressure and intake manifold absolute pressure is 26 kPa, 200 mmHg or more • Difference between intake manifold absolute pressure at engine start and the pressure after engine start is 1.3 kPa, 10 mmHg or less. ✱2 driving cycle detection logic, monitoring once/1 driving.	• Manifold absolute pressure sensor and its circuit malfunction • ECM (barometric pressure sensor) malfunction

DTC CONFIRMATION PROCEDURE

1) Turn ignition switch OFF.
2) Clear DTC with ignition switch ON.
3) Turn ignition switch ON for 2 sec., crank engine for 2 sec. and run it at idle for 1 min.
4) Check pending DTC in “ON BOARD TEST” or “PENDING DTC” mode and DTC in “DTC” mode.

INSPECTION

DTC P1450 :

Step	Action	Yes	No
1	Was “ENGINE DIAG. FLOW TABLE” performed?	Substitute a known-good ECM and recheck.	Go to “ENGINE DIAG. FLOW TABLE” in this section.

DTC P1451 :

NOTE:

Note that atmospheric pressure varies depending on weather conditions as well as altitude.
Take that into consideration when performing these check.

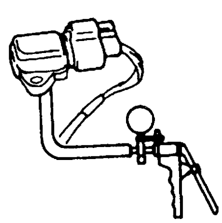
Step	Action	Yes	No
1	Was “ENGINE DIAG. FLOW TABLE” performed?	Go to Step 2.	Go to “ENGINE DIAG. FLOW TABLE” in this section.

Step	Action	Yes	No
2	Check Barometric Pressure Sensor. 1) Connect scan tool to DLC with ignition switch OFF. 2) Turn ignition switch ON and select “DATA LIST” mode on scan tool. 3) Check manifold absolute pressure. Is it barometric pressure (approx. 100 kPa, 760 mmHg) at sea level?	Go to Step 3.	Substitute a known-good ECM and recheck.
3	Check MAP Sensor. 1) Remove MAP sensor from intake manifold and connect vacuum pump gauge to MAP sensor. See Fig. 1. 2) Connect scan tool to DLC and turn ignition switch ON. 3) Check intake manifold absolute pressure displayed on scan tool for specified valve. See Table 1. Is check result satisfactory?	Check air intake system for air being drawn in and engine compression. If OK, then substitute a known-good ECM and recheck.	Replace MAP sensor.

Table 1

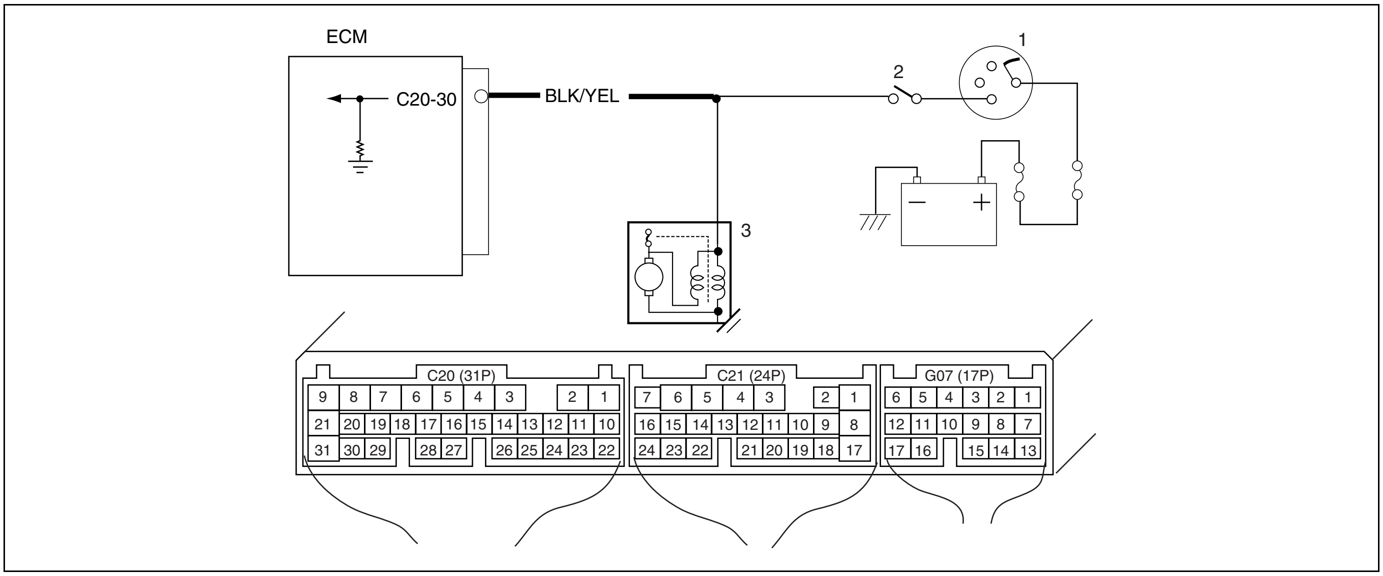
Applying Vacuum	Displayed Value on Scan Tool
0	Barometric pressure (Approx. 100 kPa, 760 mmHg)
27 kPa 200 mmHg	Barometric pressure – 27 kPa (Approx. 73 kPa, 560 mmHg)
67 kPa 500 mmHg	Barometric pressure – 67 kPa (Approx. 33 kPa, 260 mmHg)

Fig. 1 for Step 3



DTC P1500 Engine Starter Signal Circuit Malfunction

CIRCUIT DESCRIPTION



1. Ignition switch	2. Transmission range switch (A/T)	3. Starter motor

DTC DETECTING CONDITION	POSSIBLE CAUSE
• Low voltage at terminal C20-30 when cranking engine or • High voltage at terminal C20-30 after starting engine. ✱2 driving cycle detection logic, continuous monitoring.	• "BLK/YEL" circuit open • ECM malfunction

DTC CONFIRMATION PROCEDURE

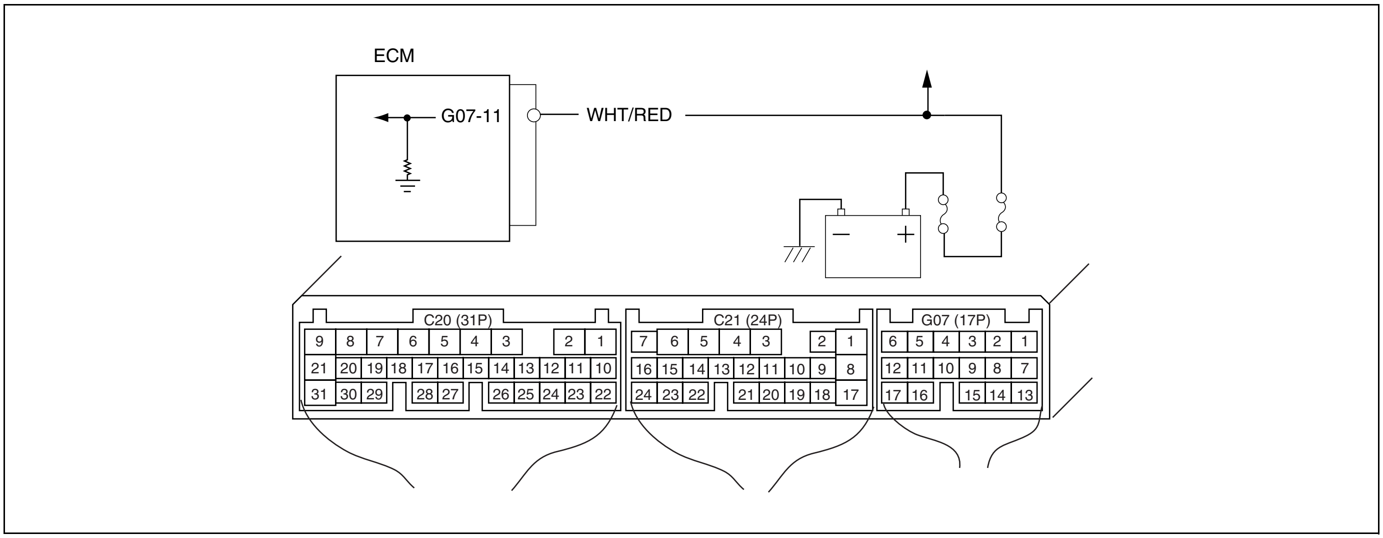
1) Turn ignition switch OFF.
2) Clear DTC with ignition switch ON, crank engine and run it at idle for 3 min.
3) Check pending DTC in "ON BOARD TEST" or "PENDING DTC" mode and DTC in "DTC" mode.

INSPECTION

Step	Action	Yes	No
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Check Terminal Voltage. 1) Check for voltage at terminal C20-30 of ECM connector connected, under following condition. **While engine cranking : 6 – 10 V** **After starting engine : 0 V** Is voltage as specified?	Poor C20-30 connection or intermittent trouble. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A. If wire and connections are OK, substitute a known-good ECM and recheck.	"BLK/YEL" circuit open.

DTC P1510 ECM Back-Up Power Supply Malfunction

WIRING DIAGRAM / CIRCUIT DESCRIPTION



Battery voltage is supplied so that diagnostic trouble code memory, values for engine control learned by ECM, etc. are kept in ECM even when the ignition switch is turned OFF.

DTC DETECTING CONDITION	POSSIBLE CAUSE
• Low voltage at terminal G07-11 after starting engine.	• “WHT/RED” circuit open • ECM malfunction

DTC CONFIRMATION PROCEDURE

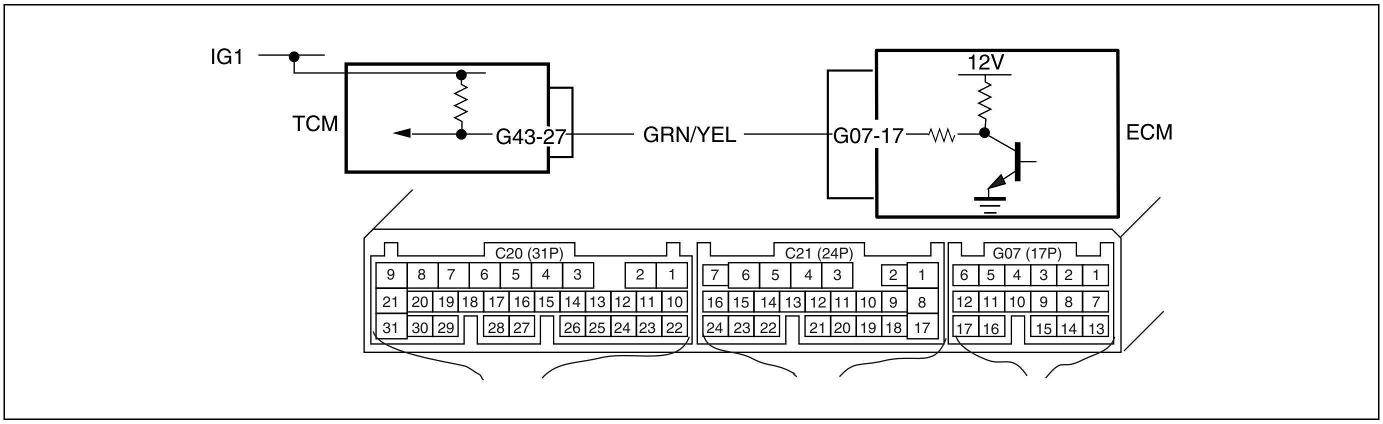
1) Clear DTC, start engine and run it at idle for 1 min.
2) Select “DTC” mode on scan tool and check DTC.

INSPECTION

Step	Action	Yes	No
1	Was “ENGINE DIAG. FLOW TABLE” performed?	Go to Step 2.	Go to “ENGINE DIAG. FLOW TABLE” in this section.
2	Check Terminal Voltage. 1) Check for voltage at terminal G07-11 of ECM connector connected, under each condition, ignition switch OFF and engine running. Is it 10 – 14 V at each condition?	Poor G07-11 connection or intermittent trouble. Check for intermittent referring to “Intermittent and Poor Connection” in Section 0A. If wire and connections are OK, substitute a known- good ECM and recheck.	“WHT/RED” circuit open.

DTC P1600 Serial Communication Problem Between ECM and TCM

WIRING DIAGRAM



CIRCUIT DESCRIPTION

TCM constantly sends information while ignition switch is ON as to whether judgement was made or not with respect to all detectable DTCs as well as whether or not abnormality exists after judgement.

DTC DETECTING CONDITION	POSSIBLE CAUSE
No signal inputted from TCM to ECM or check sum error while engine running	• "GRN/YEL" circuit open or short • TCM power or ground circuit open • TCM malfunction • ECM malfunction

DTC CONFIRMATION PROCEDURE

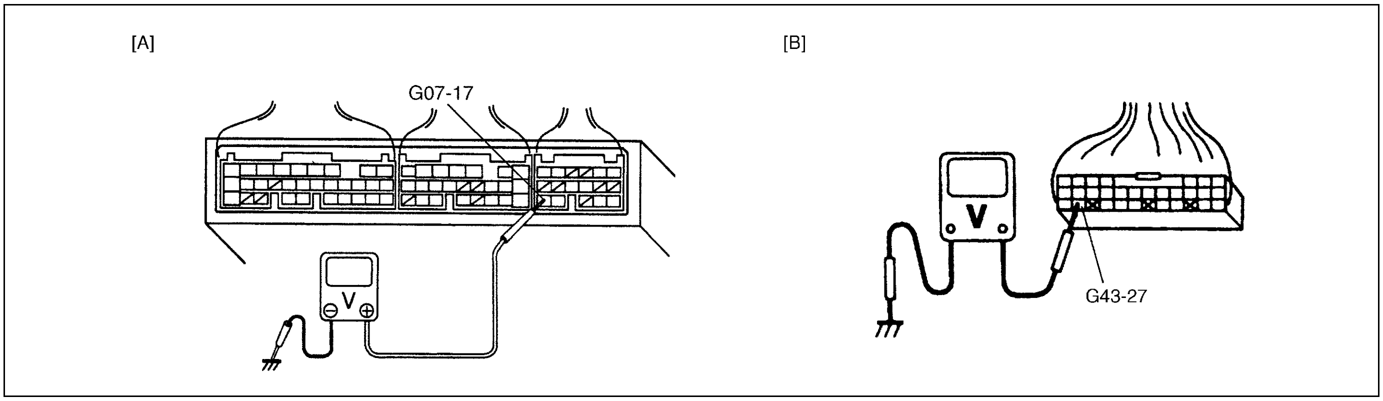
1) Turn ignition switch OFF.
2) Clear DTC with ignition switch ON.
3) Start engine and run it at idle for 1 min.
4) Select "DTC" mode on scan tool and check DTC.

INSPECTION

Step	Action	Yes	No
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Check Signal Voltage. Check voltage between terminal G07-17 and body ground with ignition switch ON. Does it change between 0 – 12 V? See Fig. 1.	Intermittent trouble or faulty ECM or TCM. Check for intermittent trouble referring to "Intermittent and poor connection" in Section 0A.	Go to Step 3.
3	Is it about 12 V at Step 2?	"GRN/YEL" wire open, poor G43-27 connection or TCM power or ground circuit open. If wires and connections are OK, substitute a known-good TCM and recheck.	Go to Step 4.

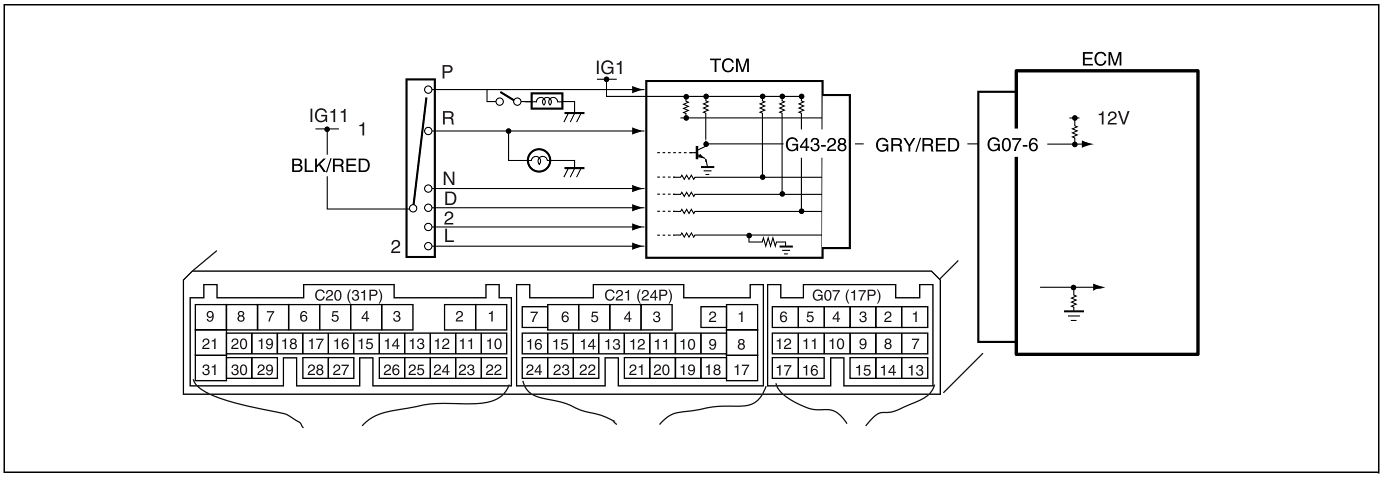
Step	Action	Yes	No
4	Check Signal Circuit. 1) Disconnect TCM coupler with ignition switch OFF. 2) Check voltage between G43-27 terminal and body ground with ignition switch ON. See Fig. 2. Is it about 12 V?	Check TCM power and ground circuit for open. If OK, substitute a known-good TCM and recheck.	"GRN/YEL" wire shorted to ground or poor G07-17 terminal connection. If wire and connection are OK, substitute a known-good ECM and recheck.

[A] Fig. 1 for Step 2 / [B] Fig. 2 for Step 4



DTC P1717 A/T Drive Range (Park/Neutral Position) Signal Circuit Malfunction

WIRING DIAGRAM / CIRCUIT DESCRIPTION



1. From ignition switch	2. Transmission range switch

DTC DETECTING CONDITION	POSSIBLE CAUSE
• "D" range signal not inputted (Park/Neutral position signal inputted) to ECM while vehicle running ✱2 driving cycle detection logic, continuous monitoring.	• "GRY/RED" circuit open • Transmission range switch malfunction • "R", "D", "2" or "L" range signal circuit open • TCM power or ground circuit open • TCM or ECM malfunction

DTC CONFIRMATION PROCEDURE

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

1) Turn ignition switch OFF.
2) Clear DTC with ignition switch ON.
3) Start engine and shift selector lever to "D" range.
4) Increase vehicle speed to higher than 32 km/h, 20 mph and then stop vehicle.
5) Repeat above step 4) 9 times.
6) Shift selector lever to "2" range and repeat above step 4) and 5).
7) Shift selector lever to "L" range and repeat above step 4) and 5).
8) Check DTC in "DTC" mode and pending DTC in "ON BOARD TEST" or "PENDING DTC" mode.

INSPECTION

Step	Action	Yes	No
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Is SUZUKI scan tool available?	Go to Step 3.	Go to Step 4.

Step	Action	Yes	No
3	Check PNP Signal (“D” range signal). 1) Connect SUZUKI scan tool to DLC with ignition switch OFF. 2) Turn ignition switch ON and check PNP signal (“P/N” or “D” range) on display when shifting selector lever to each range. Is “D” range on display (Is 0 – 1 V indicated) no matter which of “R”, “D”, “2” and “L” range positions selector lever may be at? See Table 1.	Intermittent trouble or faulty ECM. Check for intermittent referring to “Intermittent and poor connection” in Section 0A.	Go to Step 5.
4	Check PNP Signal (“D” range signal). 1) Turn ignition switch ON. 2) Check voltage at terminal G07-6 of ECM connector connected. See Fig. 1. Is “D” range on display (Is 0 – 1 V indicated) no matter which of “R”, “D”, “2” and “L” range positions selector lever may be at? See Table 1.	Intermittent trouble or faulty ECM. Check for intermittent referring to “Intermittent and poor connection” in Section 0A.	Go to Step 5.
5	Is “P/N range on display (Is 10 – 14 V indicated) when selector lever is at one of “R”, “D”, “2” and “L” range positions only?	Check transmission range sensor and circuits referring to section 7B1.	Go to Step 6.
6	Check PNP Signal Circuit. 1) Turn ignition switch OFF. 2) Disconnect TCM connectors. 3) Check for proper connection to TCM at terminal. 4) If OK, then check voltage at terminal in TCM connector disconnected, with ignition switch ON. Is it 10 – 14 V? See Fig. 2.	“BLK/RED” circuit open, poor transmission range switch connector connection, select cable maladjusted, transmission range sensor maladjusted or transmission range sensor malfunction. If all above are OK, substitute a known-good TCM and recheck.	“GRY/RED” circuit open or poor G07-6 connection. If wire and connection are OK, substitute a known-good ECM and recheck.

[A] Fig. 1 for Step 4 / [B] Fig. 2 for Step 6

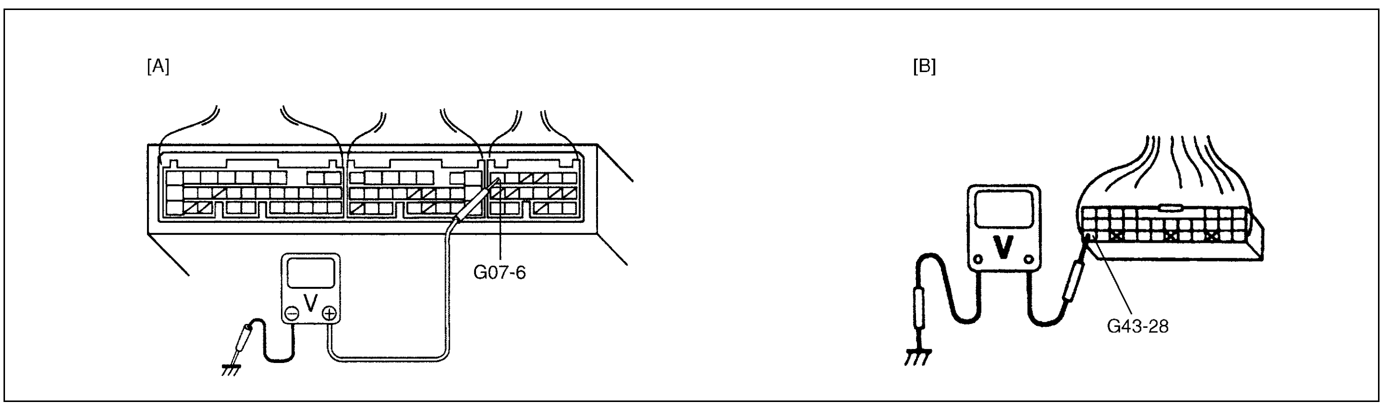
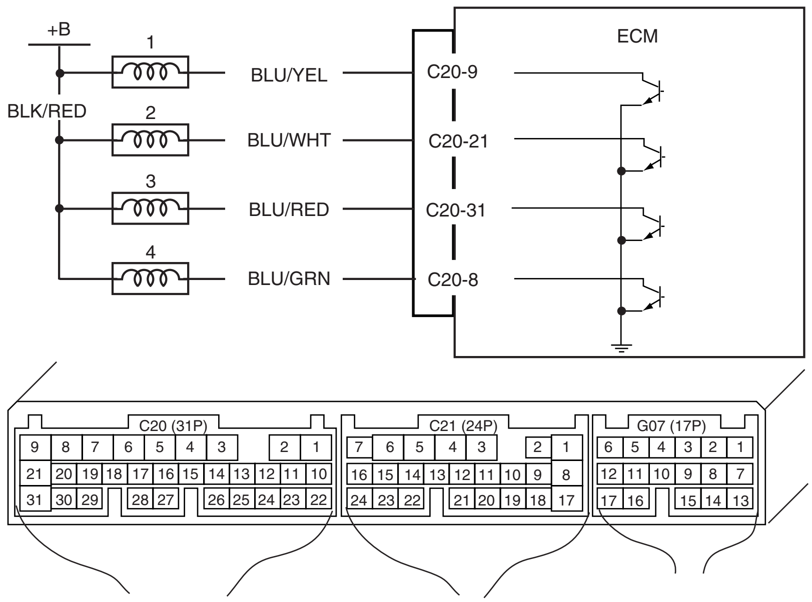


Table 1 for Step 3 and 4

		Scan tool or voltmeter	
		SUZUKI SCAN TOOL	VOLTAGE AT G07-6
Selector lever position	“P” and “N” range	P/N range	10 – 14V
	“R”, “D”, “2” and “L” range	D range	0 – 1V

Table B-1 Fuel Injector Circuit Check

WIRING DIAGRAM



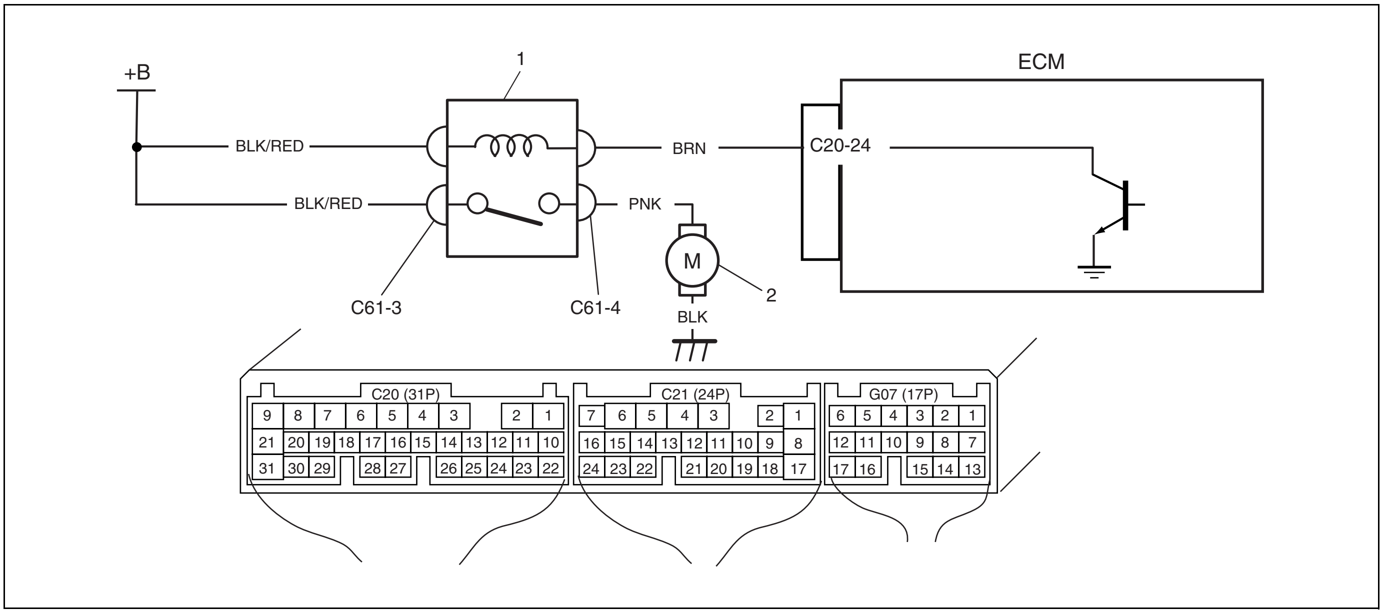
1. No.1 injector	3. No.3 injector
2. No.2 injector	4. No.4 injector

INSPECTION

Step	Action	Yes	No
1	Was “ENGINE DIAG. FLOW TABLE” performed?	Go to Step 2.	Go to “ENGINE DIAG. FLOW TABLE”.
2	Check Injector for operating sound. Using sound scope, check each injector for operating sound at engine cranking. Do all 4 injectors make operating sound?	Fuel injector circuit is in good condition.	Go to Step 3.
3	Dose none of 4 injectors make operating sound at Step 2?	Go to Step 4.	Check coupler connection and wire harness of injector not making operating sound and injector itself (Refer to Section 6E1).
4	Check power circuit of injectors for open and short. Is it normal?	Check all 4 injectors for resistance respectively. If resistance is OK, substitute a known-good ECM and recheck.	Power circuit open or short.

Table B-2 Fuel Pump and Its Circuit Check

WIRING DIAGRAM



1. Fuel pump relay	2. Fuel pump

INSPECTION

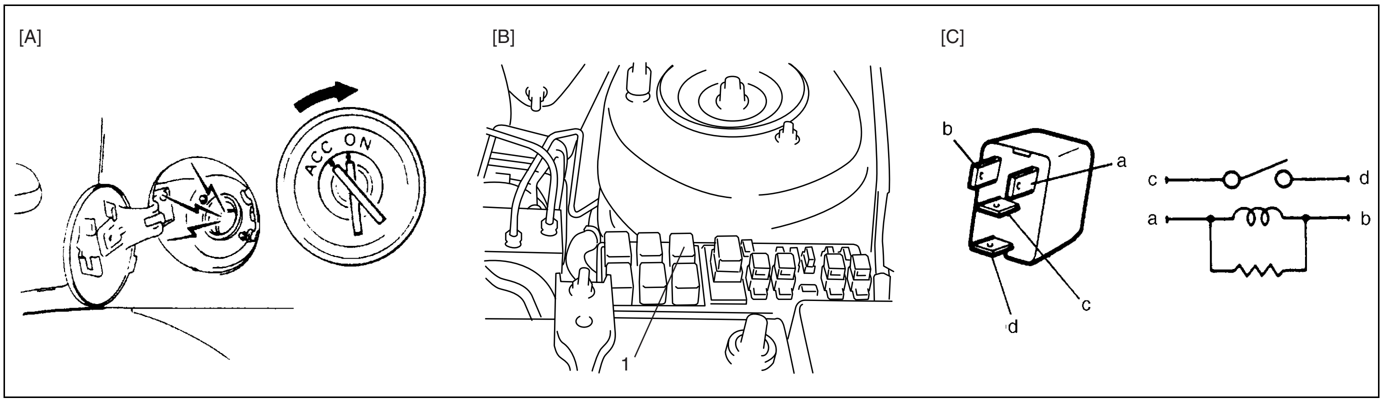
CAUTION:

Check to make sure that connection is made between correct terminals. Wrong connection can cause damage to ECM, wire harness, etc.

Step	Action	Yes	No
1	Was “ENGINE DIAG. FLOW TABLE” performed?	Go to Step 2.	Go to “ENGINE DIAG. FLOW TABLE”.
2	Check Fuel Pump Control System for operation. See Fig. 1. Is fuel pump heard to operate for 2 sec. after ignition switch ON?	Fuel pump circuit is in good condition.	Go to Step 3.
3	Check Fuel Pump for operation. 1) Remove fuel pump relay from relay box with ignition switch OFF. 2) Check for proper connection to relay at each terminals. 3) If OK, using service wire, connect terminals C61-3 and C61-4 of relay connector. See Fig. 2. Is fuel pump heard to operate at ignition switch ON?	Go to Step 4.	“PNK”, “BLK” or “BLK/RED” circuit open or fuel pump malfunction.

Step	Action	Yes	No
4	Check Fuel Pump Relay for operation. 1) Check resistance between each two terminals of fuel pump relay. See Fig.3. **Between terminals “c” and “d” : Infinity** **Between terminals “a” and “b” : 56 – 146 Ω** 2) Check that there is continuity between terminals “c” and “d” when battery is connected to terminals “a” and “b”. See Fig. 3. Is fuel pump relay in good condition?	“BRN” circuit open or poor C20-24 connection. If wire and connection are OK, substitute a known-good ECM and recheck.	Replace fuel pump relay.

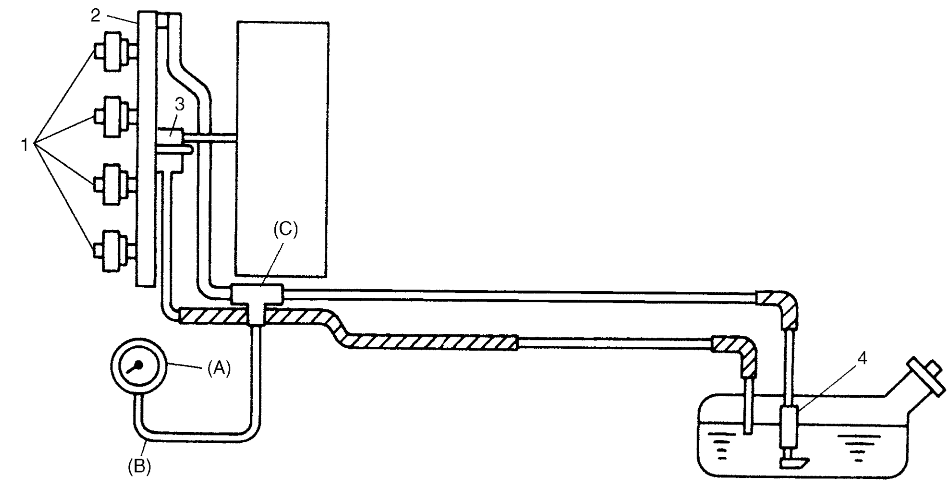
[A] Fig. 1 for Step 2 / [B] Fig. 2 for Step 3 / [C] Fig. 3 for Step 4



1. Fuel pump relay

Table B-3 Fuel Pressure Check

WIRING DIAGRAM



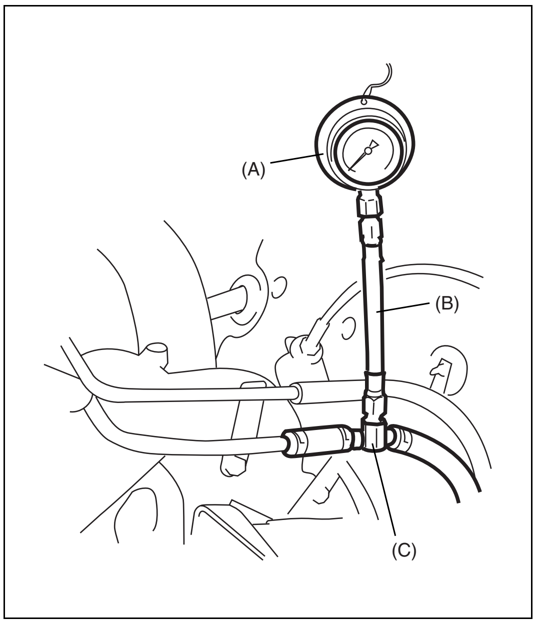
1. Injector	3. Fuel pressure regulator	(A) : Fuel pressure gauge	(C) : Attachment
2. Delivery pipe	4. Fuel pump	(B) : Hose	

INSPECTION

Step	Action	Yes	No
1	Check Fuel Pressure (Refer to Section 6E1 for details). 1) Release fuel pressure from fuel feed line. 2) Install fuel pressure gauge. 3) Check fuel pressure by repeating ignition switch ON and OFF. See Fig. 1. Is fuel pressure then 270 – 310 kPa (2.7 – 3.1 kg/cm^2, 38.4 – 44.0 psi)?	Go to Step 2.	Go to Step 5.
2	Is 200 kPa (2.0 kg/cm^2, 28.4 psi) or higher fuel pressure retained for 1 minute after fuel pump is stopped at Step 1?	Go to Step 3.	Go to Step 4.
3	Check Fuel Pressure Regulator for Operation. 1) Start engine and warm it up to normal operating temperature. 2) Keep it running at specified idle speed. Is fuel pressure then within 200 – 240 kPa (2.0 – 2.4 kg/cm^2, 28.4 – 34.1 psi)?	Normal fuel pressure.	Clogged vacuum passage for fuel pressure regulator or faulty fuel pressure regulator.
4	Is there fuel leakage from fuel feed line hose, pipe or their joint?	Fuel leakage from hose, pipe or joint.	Go to Step 10.
5	Was fuel pressure higher than spec. in Step 1?	Go to Step 6.	Go to Step 7.
6	1) Disconnect fuel return hose from fuel pressure regulator and connect new return hose to it. 2) Put the other end of new return hose into approved gasoline container. 3) Operate fuel pump. Is specified fuel pressure obtained then?	Restricted fuel return hose or pipe.	Faulty fuel pressure regulator.
7	Was no fuel pressure applied in Step 1?	Go to Step 8.	Go to Step 9.

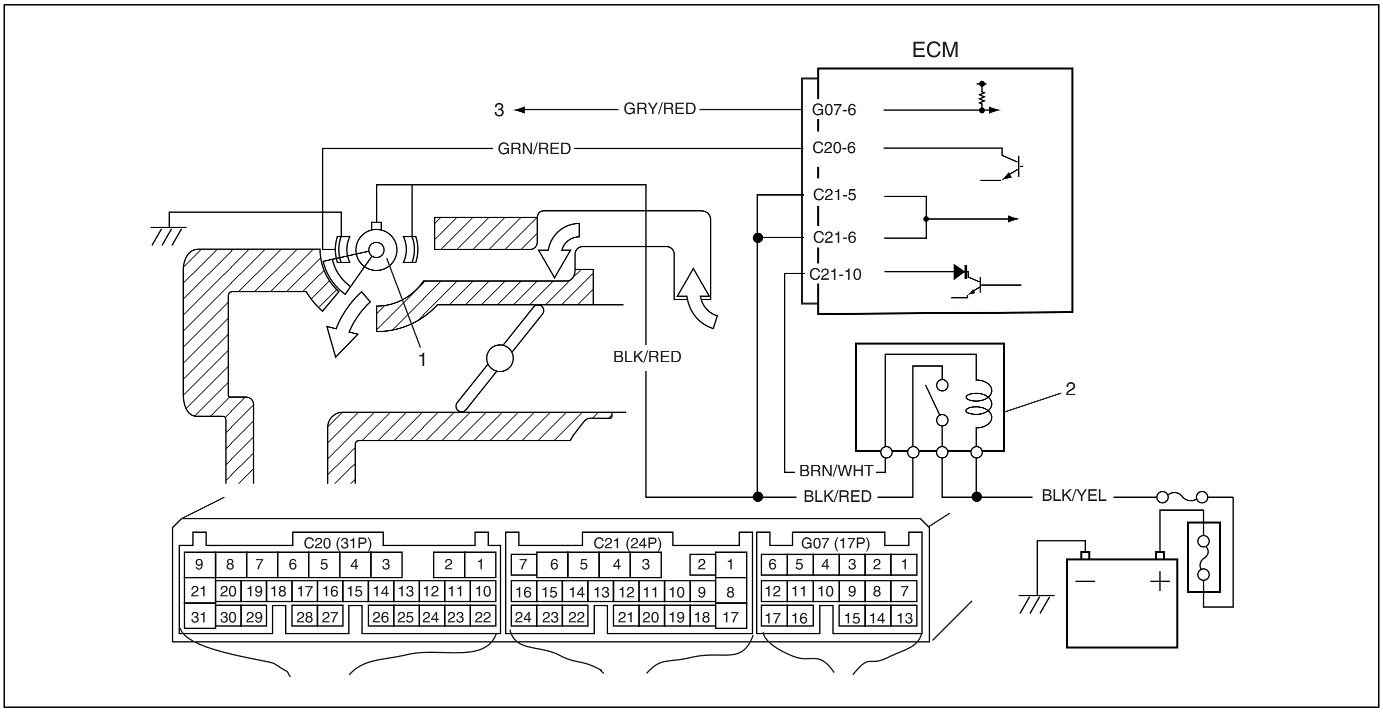
Step	Action	Yes	No
8	With fuel pump operated and fuel return hose blocked by pinching it, is fuel pressure applied?	Faulty fuel pressure regulator.	Shortage of fuel or fuel pump or its circuit malfunction (refer to TABLE B-2 FUEL PUMP AND ITS CIRCUIT CHECK).
9	1) Operate fuel pump. 2) With fuel return hose blocked by pinching it, check fuel pressure. Is it 450 kPa (4.5 kg/cm^2, 63.9 psi) or more?	Faulty fuel pressure regulator.	Clogged fuel filter, Restricted fuel feed hose or pipe, Faulty fuel pump or Fuel leakage from hose connection in fuel tank.
10	1) Disconnect fuel return hose from pressure regulator and connect new return hose to it. 2) Insert the other end of new return hose into approved gasoline container. 3) Check again if specified pressure is obtained. While doing so, does fuel come out of return hose?	Faulty fuel pressure regulator.	Fuel leakage from injector, Fuel leakage from between injector and delivery pipe, Faulty fuel pump (faulty check valve in fuel pump) or Fuel leakage from fuel pressure regulator diaphragm.

Fig. 1 for Step 1



Special tool
(A) : 09912-58441
(B) : 09912-58431
(C) : 09912-58490

Table B-4 Idle Air Control System Check



1. IAC valve	2. Main relay	3. To TCM

INSPECTION

Step	Action	Yes	No
1	Check engine idle speed and IAC duty referring to “Idle Speed/IAC Duty Inspection” in Section 6E1. Is idle speed within specification?	Go to Step 2.	Go to Step 4.
2	Is IAC duty within specification in Step 1?	Go to Step 3.	Check for followings : Vacuum leak EVAP canister purge control system Clog of IAC air passage Accessory engine load Closed throttle position (TP sensor) Stuck of PCV valve
3	Is engine idle speed kept specified speed even with headlight ON?	Vehicle with power steering system: Go to Step 4. Vehicle without power steering system: System is in good condition.	Check electric load signal circuit referring to TABLE B-6. If check result is OK, check IAC system for operation referring to Step 3 or Step 4 of DTC P0505 Diag. Flow Table.

Step	Action	Yes	No
4	Is engine idle speed kept specified speed even with steering wheel turned to the right or left as far as it stops (vehicle with power steering system)?	System is in good condition.	Check power steering pressure switch signal circuit referring to TABLE B-8. If check result is OK, check IAC system for operation referring to Step 3 or Step 4 of DTC P0505 Diag. Flow Table.
5	Was idle speed higher than specification in Step 1?	Go to Step 6.	Go to Step 9.
6	Check A/C (input) signal circuit referring to Step 1 of Table B-5 A/C Signal Circuits Check, if equipped. (A/C signal can be also checked by using SUZUKI scan tool.) Is it in good condition?	Go to Step 7.	Repair or replace A/C signal circuit or A/C system.
7	Check IAC system referring to Step 3 or Step 4 of DTC P0505 Diag. Flow Table. Is check result satisfactory?	Go to Step 8.	Go to Step 5 of DTC P0505 Diag. Flow Table.
8	Was IAC duty less than about 3% (or more than about 97% for OFF duty meter) in Step 1 of this table?	Check abnormal air inhaling from air intake system, PCV valve and EVAP canister purge control system.	Check TP sensor (closed throttle position) and ECT sensor for performance. If sensors are OK, substitute a known-good ECM.
9	Is SUZUKI scan tool available?	Go to Step 10.	Go to Step 11.
10	Check PNP signal (“D” range signal). 1) Connect SUZUKI scan tool to DLC with ignition switch OFF. 2) Turn ignition switch ON and check PNP signal (“P/N” and “D” range) on display when shifting selector lever to each range. See Table 1. Is check result satisfactory?	Go to Step 12.	Repair or replace.
11	Check PNP signal (“D” range signal). 1) Turn ignition switch ON. 2) Check voltage at terminal G07-6 of ECM connector connected. See Fig. 1 and Table 1. Is check result satisfactory?	Go to Step 12.	Repair or replace.
12	Check IAC system referring to Step 3 or Step 4 of DTC P0505 Diag. Flow Table. Is check result satisfactory?	Go to Step 11.	Go to Step 5 of DTC P0505 Diag. Flow Table.
13	Was IAC duty more than about 30% (or less than 70% for OFF duty meter) in Step 1 of this table?	Check parts or system which can cause engine low idle. Accessory engine load Clog of air passage Etc.	Substitute a known-good ECM and recheck.

Fig. 1 for Step 11

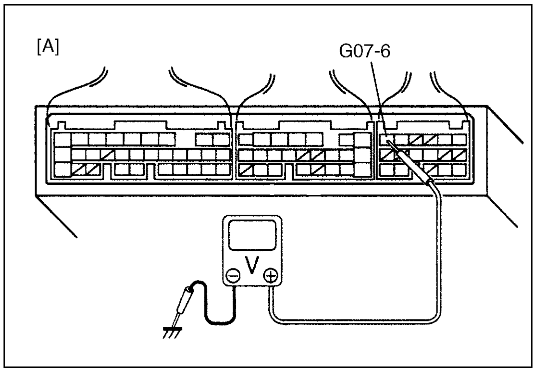
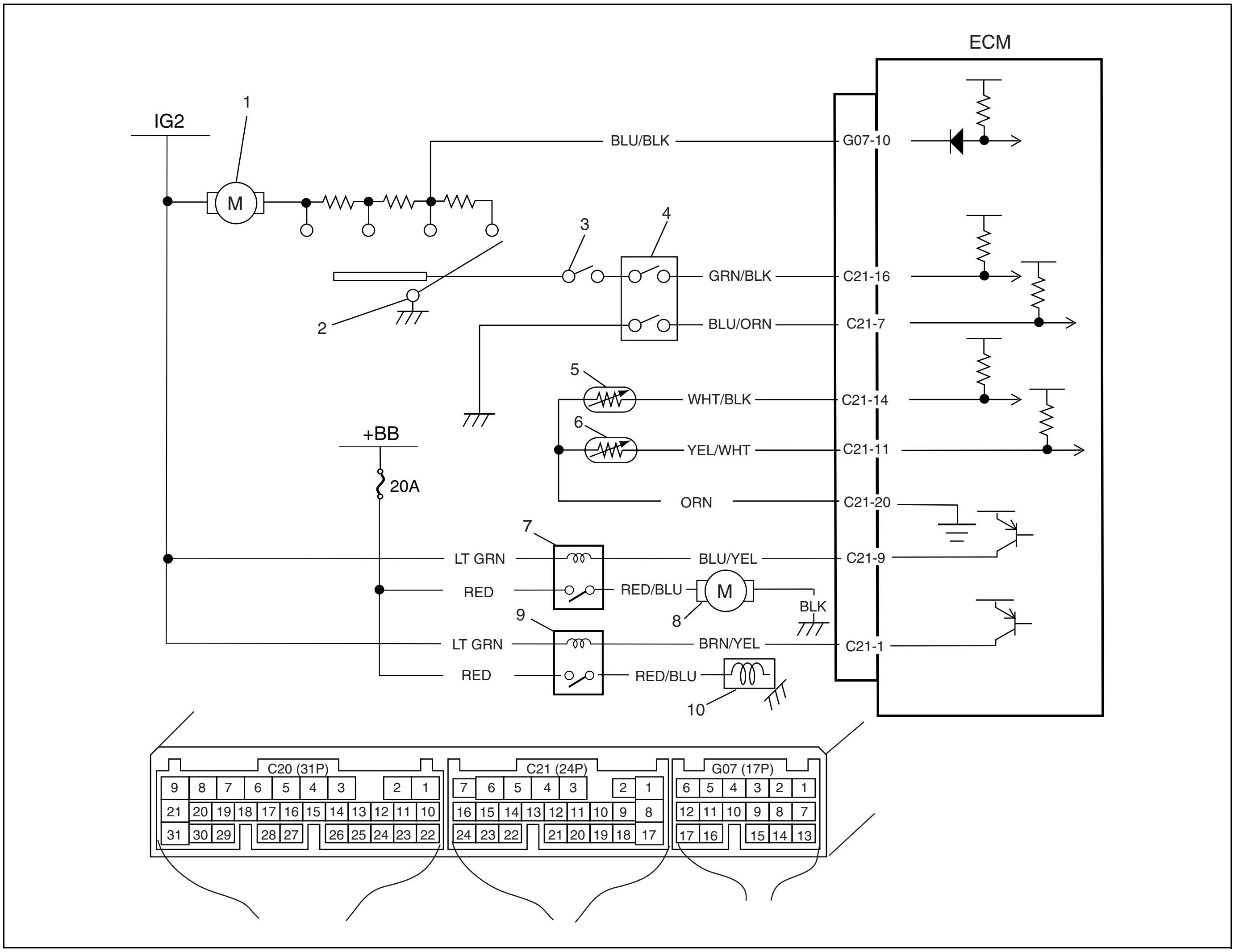


Table 1 for Step 10 and 11

		Scan tool or voltmeter	
		SUZUKI SCAN TOOL DISPLAY	VOLTAGE AT G07-6
Selector lever position	“P” and “N” range	P/N range	10 – 14V
	“R”, “D”, “2” and “L” range	D range	0 – 1V

Table B-5 A/C Signal Circuits Check (Vehicle with A/C)



1. Blower fan motor	4. A/C pressure switch	7. A/C condenser fan relay	10. A/C compressor
2. Blower fan switch	5. A/C evaporator outlet air temp. sensor	8. A/C condenser fan motor	
3. A/C switch	6. A/C evaporator inlet air temp. sensor	9. A/C compressor relay	

INSPECTION

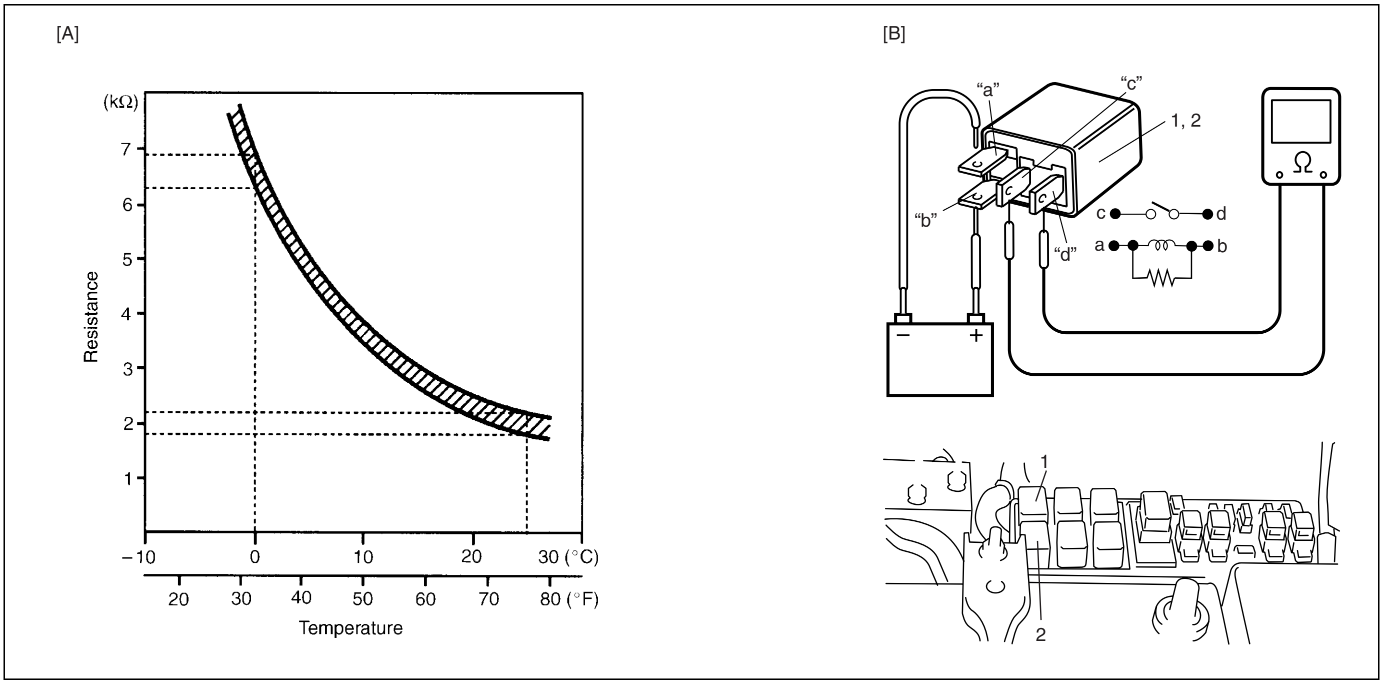
Step	Action	Yes	No
1	Check evaporator temp. sensor resistance. 1) Disconnect ECM connectors with ignition switch at OFF position. 2) Check resistance between terminals C21-14 and C21-20 and terminals C21-11 and C21-20. See Fig. 1. Is it within specification? **At 0°C 6.3 – 6.9 kΩ** **At 25°C 1.8 – 2.2 kΩ**	Go to Step 2.	Faulty A/C evaporator temp. sensor or its circuit.
2	Check A/C switch signal. 1) Check voltage at terminal C21-16 under each condition given below. **Ignition switch ON A/C switch OFF** **: 10 – 14V** **Ignition switch ON A/C switch ON** **: 0 – 1V** Is check result satisfactory?	Go to Step 3.	"GRN/BLK" wire open or short Poor C21-16 terminal connection If wire and connection are OK, substitute a known-good ECM and recheck. Go to Step 3.
3	Check A/C Condenser Fan Control System. Is A/C cooling fan started when A/C switch and heater blower switch turned ON?	Go to Step 7.	Go to Step 4.
4	Check A/C Condenser Fan Control Relay and its Circuit. 1) Check voltage at terminal C21-9 under each condition given below. **Ignition switch ON A/C switch OFF** **: 10 – 14V** **Ignition switch ON A/C switch ON** **: 0 – 1V** Is check result satisfactory?	Go to Step 5.	"BLU/YEL" wire open or short Poor C21-9 terminal connection If wire and connection are OK, substitute a known-good ECM and recheck. Go to Step 5.
5	Check A/C Condenser Fan Control Relay. 1) Turn ignition switch OFF and remove A/C condenser fan control relay. 2) Check for proper connection to relay at terminals "c" and "d". 3) If OK, check that there is continuity between "c" and "d" when battery is connected to terminals "a" and "b". See Fig.2. Is check result satisfactory?	Go to Step 6.	Replace A/C condenser fan control relay.

Step	Action	Yes	No
6	Check A/C Condenser Fan. 1) Turn ignition switch OFF. 2) Disconnect A/C condenser fan motor connector. 3) Check for proper connection to motor at "RED/BLU" and "BLK" terminals. 4) If OK, connect battery to motor and check for operation. See Fig. 3. Is it in good condition?	"RED/BLU" or "BLK" circuit open.	Replace A/C condenser fan motor.
7	Check A/C Compressor Control System. Is A/C compressor started when A/C switch and heater blower switch turned ON while engine running?	A/C control system is in good condition.	Go to Step 8.
8	1) Check voltage at C21-1 terminal under each condition given below. **While engine running, A/C switch OFF** **: 0 V** **While engine running, A/C switch ON** **: 10 – 14V** Is check result satisfactory?		"BRN/YEL" wire open or short Poor C21-1 terminal connection If wire and connection are OK, substitute a known-good ECM and recheck. Go to Step 9.
9	Check A/C Compressor Control Relay. 1) Turn ignition switch OFF and remove A/C compressor control relay. 2) Check for proper connection to relay at terminals "c" and "d". 3) If OK, check that there is continuity between "c" and "d" when battery is connected to terminals "a" and "b". See Fig. 2. Is check result satisfactory?	Check A/C compressor referring to Section 1B.	Replace A/C compressor control relay.

NOTE:

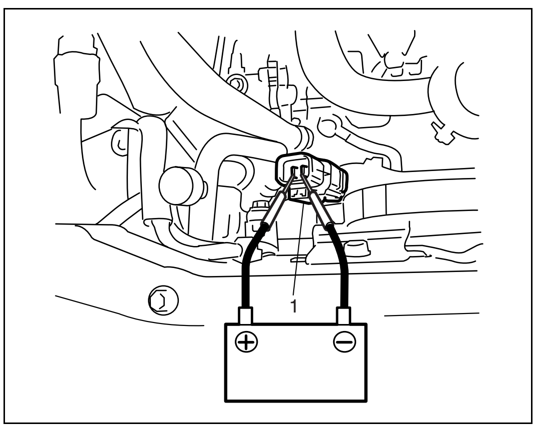
When A/C evaporator thermistor temp. is below 2.5°C (36.5°F), A/C remains OFF (C21-1 terminal voltage becomes 0 – 1 V). This condition is not abnormal.

[A] Fig. 1 for Step 1 / [B] Fig. 2 for Step 5 and 9



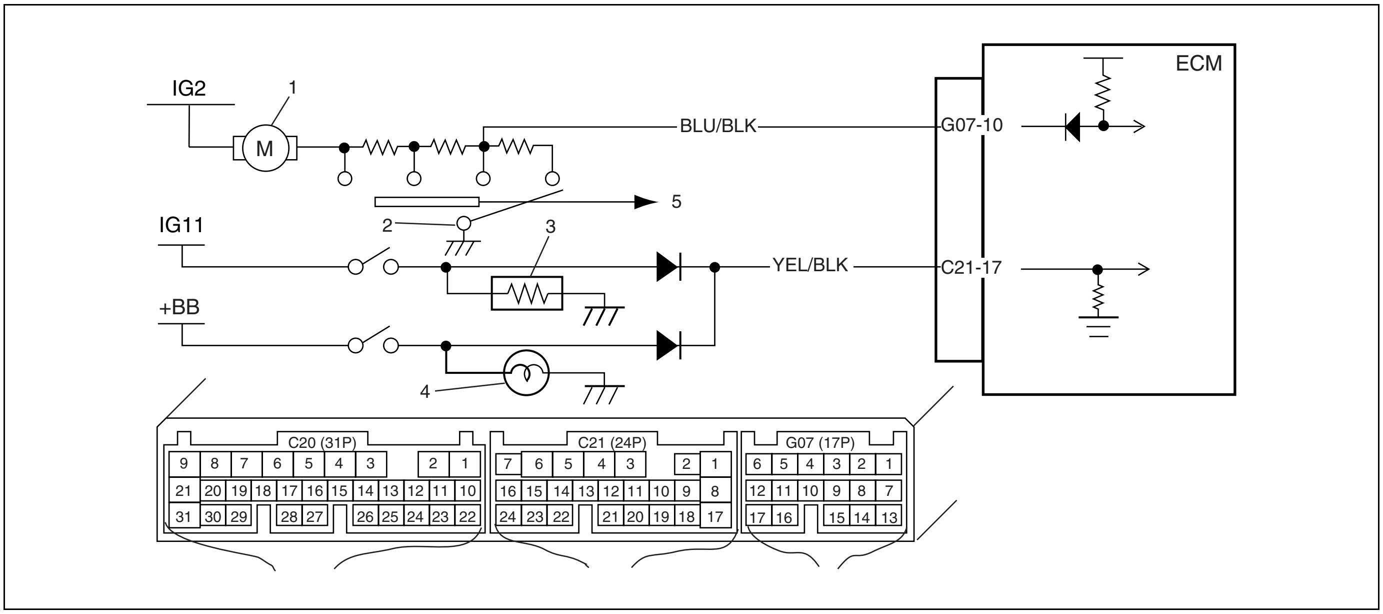
1.	A/C condenser fan relay
2.	A/C compressor relay

Fig. 3 for Step 6



1.	A/C condenser fan connector

Table B-6 Electric Load Signal Circuit Check



1. Blower fan motor	3. Rear defogger	5. To A/C switch
2. Blower fan switch	4. Position lamp	

INSPECTION

Step	Action	Yes	No
1	Is SUZUKI scan tool available?	Go to Step 2.	Go to Step 3.
2	Check Electric Load Signal Circuit. 1) Connect SUZUKI scan tool to DLC with ignition switch OFF. 2) Start engine and select “DATA LIST” mode on scan tool. 3) Check electric load signal under following each condition. See Table 1. Is check result satisfactory?	Electric load signal circuit is in good condition.	“YEL/BLK” and/or “BLU/BLK” circuit open or short, Electric load diodes malfunction or Each electric load circuit malfunction.
3	Check Electric Load Signal Circuit. 1) Turn ignition switch ON. 2) Check voltage at each terminals C21-17 and G07-10 of ECM connector connected, under above each condition. See Fig. 1 and Table 1. Is each voltage as specified?	Electric load signal circuit is in good condition.	“YEL/BLK” and/or “BLU/BLK” circuit open or short, Electric load diodes malfunction or Each electric load circuit malfunction.

Fig. 1 for Step 3

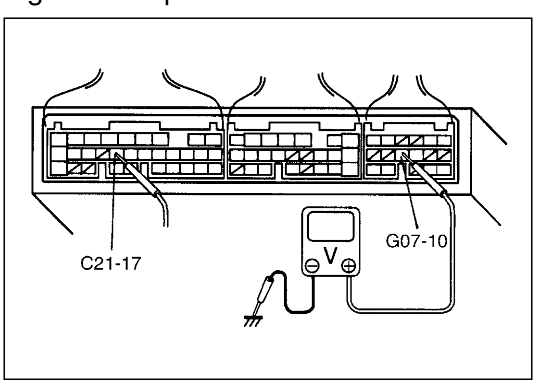
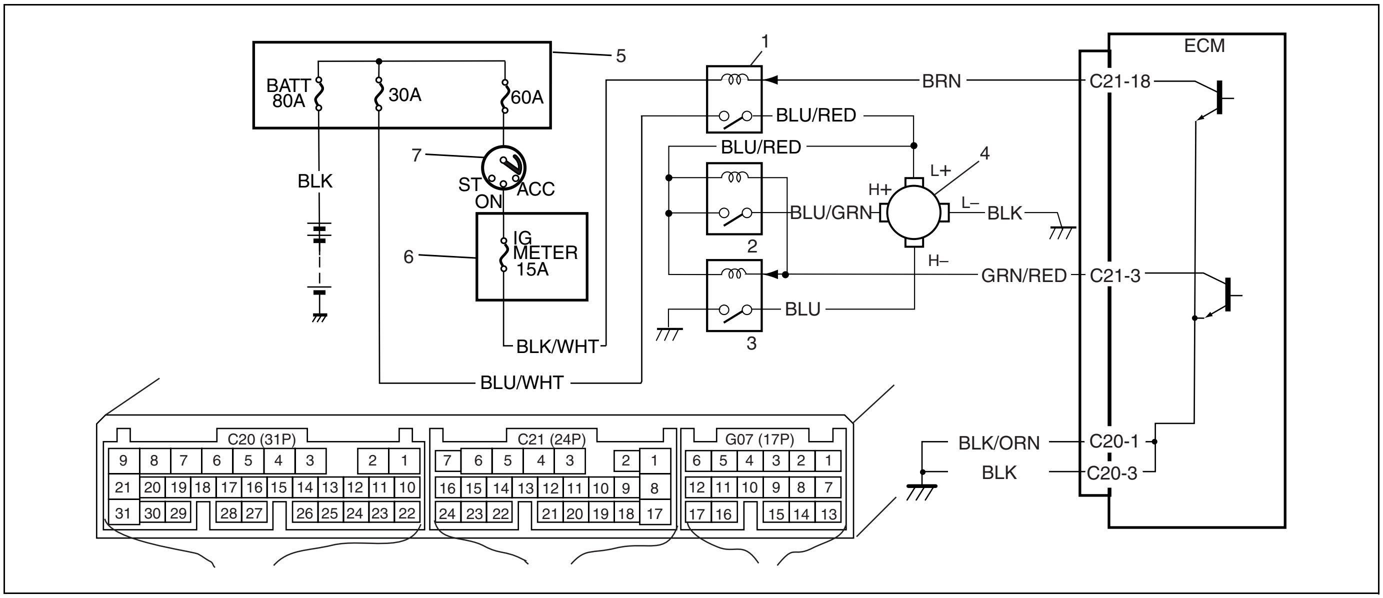


Table 1 for Step 2 and 3

		Scan tool or voltmeter		
		SUZUKI SCAN TOOL	VOLTAGE AT C21-17	VOLTAGE AT G07-10
Ignition switch ON, Small light, heater blower fan and rear defogger all turned	OFF	OFF	0V	10 – 14V
	ON	ON	10 – 14V	0V

TAble B-7 Radiator Fan Control System Check



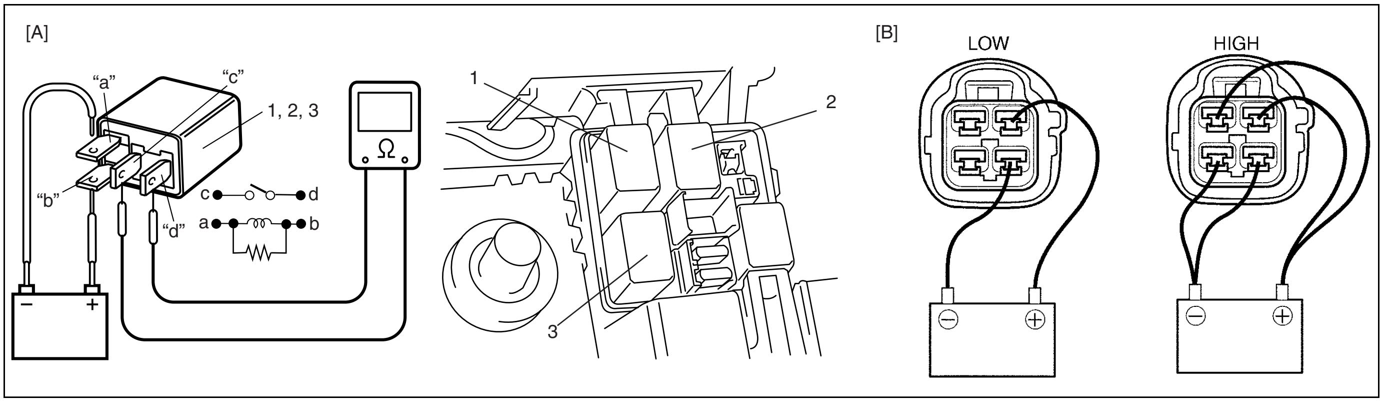
1. Radiator fan relay No.1	3. Radiator fan relay No.3	5. Main fuse box	7. Ignition switch
2. Radiator fan relay No.2	4. Radiator fan	6. Circuit fuse box	

INSPECTION

Step	Action	Yes	No
1	Check Fan Control System. 1) Connect scan tool to DLC with ignition switch OFF. 2) Start engine and select “DATA LIST” mode on scan tool. 3) Warm up engine until coolant temp. is 97.5°C, 208°F or higher and A/C switch turn OFF. (If engine coolant temp. does not rise, check engine cooling system or ECT sensor.) Is radiator cooling fan started when engine coolant temp. reached above temp.?	Radiator cooling fan control system is in good condition.	Go to Step 2.
2	Check Radiator Fan Relay and Its Circuit. 1) Check DTC and pending DTC with scan tool. Is DTC P0480 displayed?	Go to DTC P0480 Diag. Flow Table.	Go to Step 3.
3	Check Radiator Fan Relays. 1) Turn ignition switch OFF and remove radiator cooling fan relays. (No.1 – No.3) 2) Check for proper connection to relay at terminals “c” and “d”. 3) If OK, check that there is continuity between “c” and “d” when battery is connected to terminals “a” and “b”. See Fig. 1. Is check result satisfactory?	Go to Step 4.	Replace radiator fan relay(s).

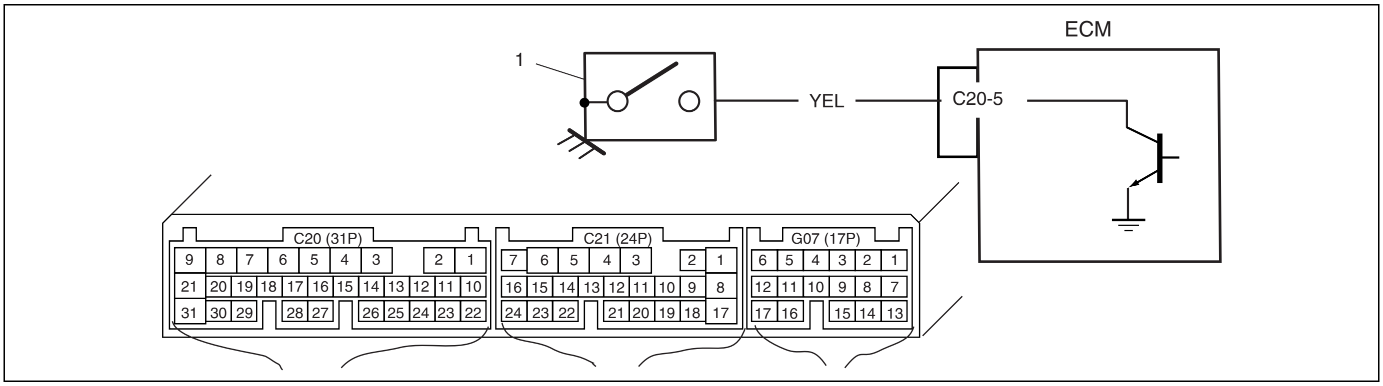
Step	Action	Yes	No
4	Check Radiator Fan. 1) Turn ignition switch OFF. 2) Disconnect cooling fan motor connector. 3) Check for proper connection to motor at “BLU/RED” and “BLK” terminals. 4) If OK, connect battery to motor and check for operation. See Fig. 2. Is it in good condition?	“BLU/WHT”, “BLU/RED” or “BLK” circuit open.	Replace radiator fan motor.

[A] Fig. 1 for Step 3 / [B] Fig. 2 for Step 4



1.	Radiator fan relay No.1
2.	Radiator fan relay No.2
3.	Radiator fan relay No.3

Table B-8 Power Steering Pressure (PSP) Switch Signal Circuit Check (If equipped)

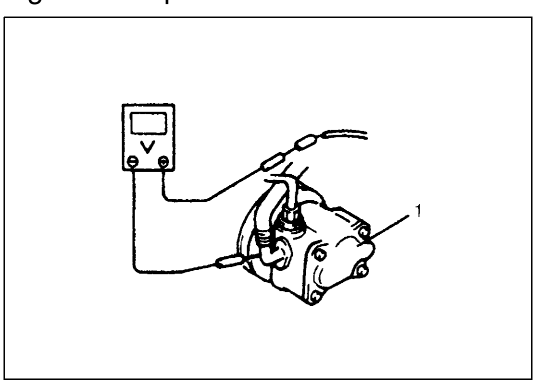


1. Power steering pressure switch

INSPECTION

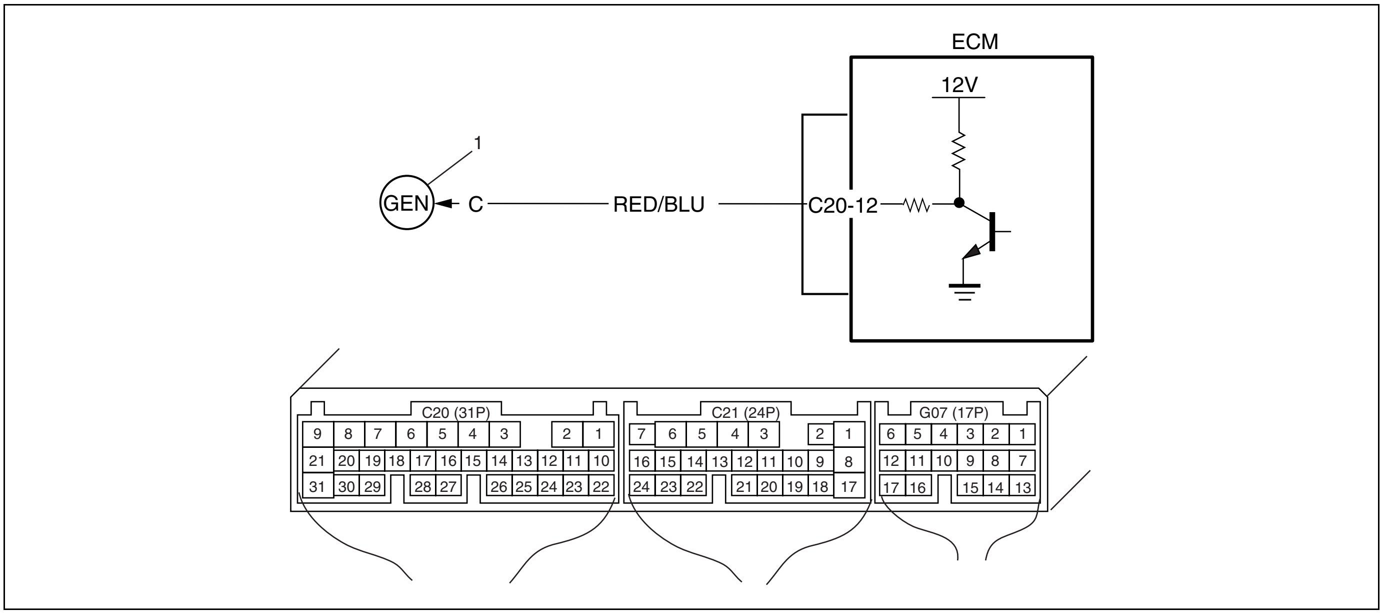
Step	Action	Yes	No
1	Check PSP Switch Signal Circuit. 1) Connect SUZUKI scan tool to DLC with ignition switch OFF. 2) Start engine and select "DATA LIST" mode on scan tool. 3) Check power steering pressure switch. Engine running and steering wheel at straight-ahead position : OFF Engine running and steering wheel turned to the right or left as far as it stops : ON Is it in good condition? Is each voltage as specified?	Signal circuit is in good condition.	Go to Step 2.
2	Check Wire Harness. 1) Turn ignition switch OFF and disconnect PSP switch connector. 2) Check for proper connection to PSP switch. 3) If OK, then check voltage at "YEL" PSP switch wire terminal with ignition switch ON. See Fig. 1. Is it 10 – 14V?	Power steering switch malfunction or power steering system malfunction.	"YEL" wire open or shorted to ground or Poor C20-5 connection. If wire and connection are OK, Substitute a known-good ECM (PCM) and recheck.

Fig. 1 for Step 2



1. Power steering pump

Table B-9 Generator Control Signal Circuit Check



1. Generator

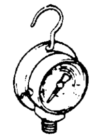
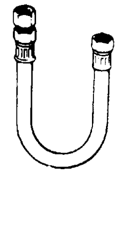
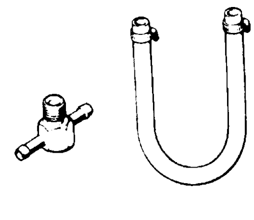
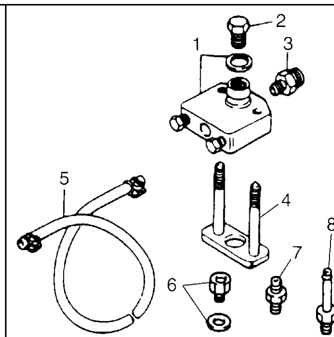
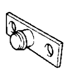
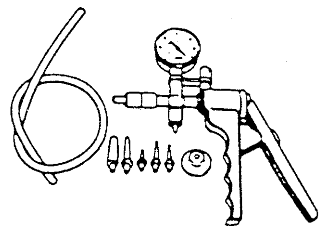
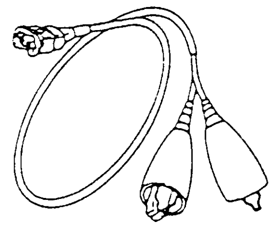
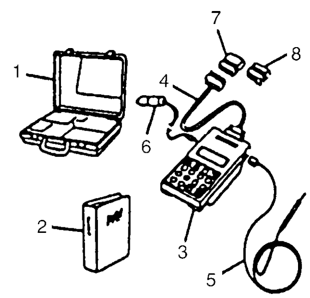
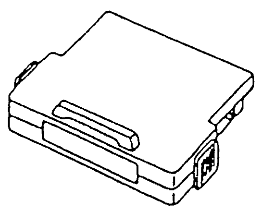
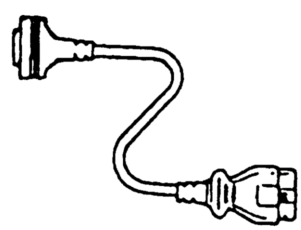
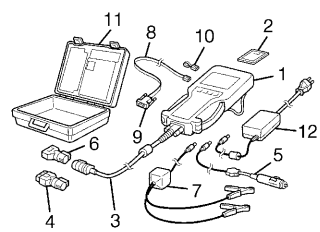
CIRCUIT DESCRIPTION

ECM sends signal (0 – 1V) to generator terminal C to suspend charging during vehicle take off or fast acceleration.

INSPECTION

Step	Action	Yes	No
1	Check Generator Control Signal Circuit. 1) Check voltage at terminal C20-12 under each condition given below (vehicle at stop). **While engine idling** **: 10 – 14 V** **While engine running at 2000 rpm or less and throttle valve is not totally closed** **: 0 – 1 V** Is check result satisfactory?	Generator Control signal circuit is in good condition.	“RED/BLU” wire open or short. Poor C20-12 terminal connection. If wire and connection are OK, substitute a known-good ECM and recheck.

Special Tool

 09912-58441 Pressure gauge	 09912-58431 Pressure hose	 09912-58490 3-way joint & hose	 09912-58421 Checking tool set (See NOTE “A”.)
 09912-57610 Checking tool plate	 09917-47010 Vacuum pump gauge	 09930-88530 Injector test lead	 09931-76011 Tech 1A kit (SUZUKI scan tool) (See NOTE “B”.)
 Mass storage cartridge for Tech 1A	 09931-76030 16/14 pin DLC adapter for Tech 1A	 Tech 2 kit (SUZUKI scan tool) (See NOTE “C”.)	

NOTE:
- **“A” : This kit includes the following items.**
  1. Tool body & washer, 2. Body plug, 3. Body attachment, 4. Holder, 5. Return hose & clamp, 6. Body attachment-2 & washer, 7. Hose attachment-1, 8. Hose attachment-2
- **“B” : This kit includes the following items and substitutes for the Tech 2 kit.**
  1. Storage case, 2. Operator’s manual, 3. Tech 1A, 4. DLC cable, 5. Test lead/probe, 6. Power source cable, 7. DLC cable adaptor, 8. Self–test adaptor
- **“C” : This kit includes the following items and substitutes for the Tech 1A kit.**
  1. Tech 2, 2. PCMCIA card, 3. DLC cable, 4. SAE 16/19 adapter, 5. Cigarette cable, 6. DLC loopback adapter, 7. Battery power cable, 8. RS232 cable, 9. RS232 adapter, 10. RS232 loopback connector, 11. Storage case, 12. Power supply

SECTION 6A1

ENGINE MECHANICAL (M13 AND M16 ENGINES)

WARNING:

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

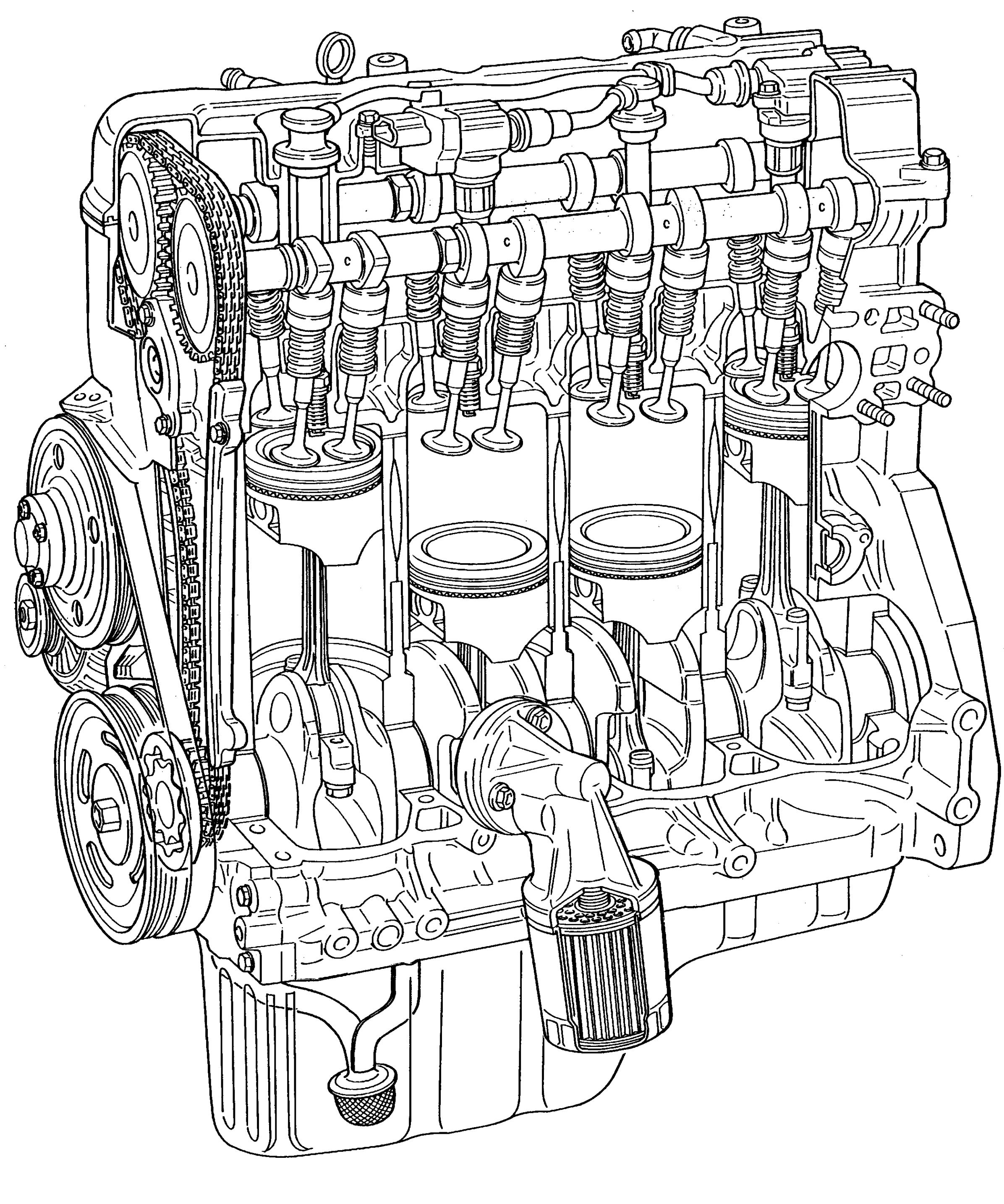
- **Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to "Air Bag System Components and Wiring Location View" under "General Description" in air bag system section in order to confirm whether you are performing service on or near 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).**

CONTENTS

General Description

Engine

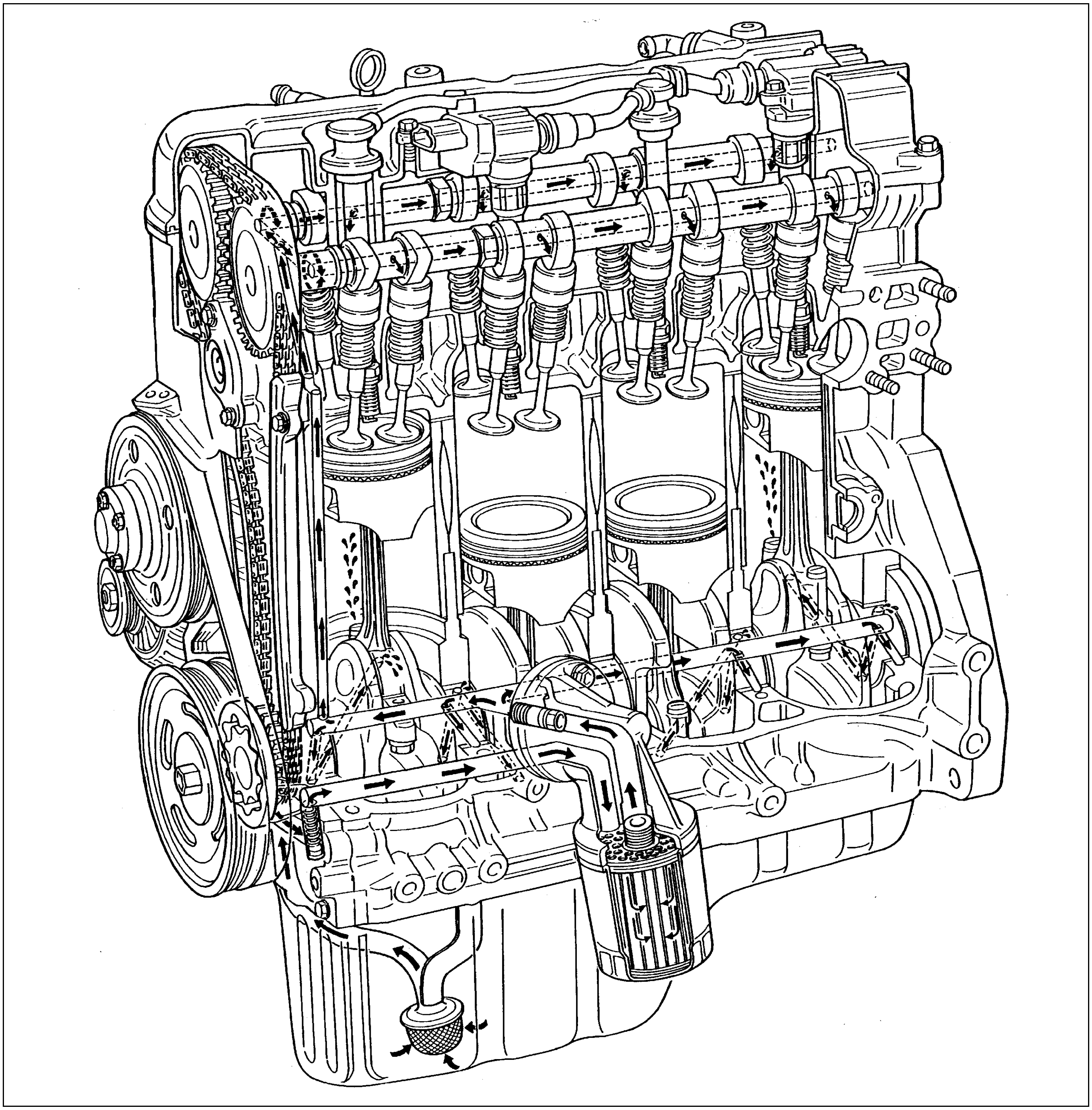
The engine is water-cooled, in line 4 cylinders, 4 stroke cycle gasoline unit with its DOHC (Double overhead camshaft) valve mechanism arranged for “V” type valve configuration and 16 valves (4 valves/one cylinder). The double overhead camshaft is mounted over the cylinder head; it is driven from crankshaft through timing chain, and no push rods are provided in the valve train system.



Engine Lubrication

The oil pump is of a trochoid type, and mounted on the crankshaft. Oil is drawn up through the oil pump strainer and passed through the pump to the oil filter.
The filtered oil flows into 2 paths in cylinder block.
In one path, oil reaches the crankshaft journal bearings. Oil from the crankshaft journal bearings is supplied to the connecting rod bearings by means of intersecting passages drilled in the crankshaft, and then injected from the big end of connecting rod to lubricate piston, rings, and cylinder wall.
In other path oil goes up to the cylinder head and lubricates valves and camshafts, etc., after passing through the internal oilway of camshafts.

An oil relief valve is provided on the oil pump. This valve starts relieving oil pressure when the pressure exceeds about 400 kPa (4.0 kg/cm^2, 56.9 psi).



Diagnosis

Diagnosis Table

Refer to “ENGINE DIAGNOSIS FLOW TABLE” in Section 6.

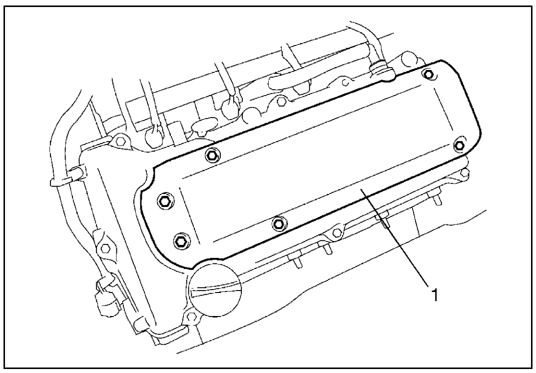
Compression Check

Check compression pressure on all 4 cylinders as follows:

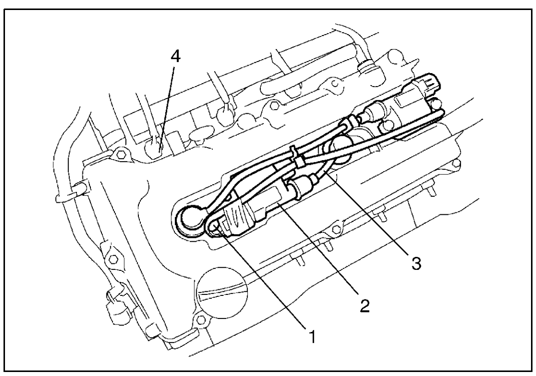
1) Warm up engine to normal operating temperature.
2) Stop engine after warming up.

NOTE:

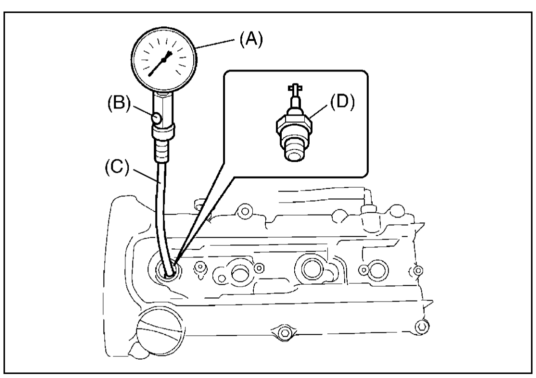
After warming up engine, place transaxle gear shift lever in “Neutral” (shift selector lever to “P” range for A/T model), and set parking brake and block drive wheels.



3) Remove cylinder head upper cover (1).

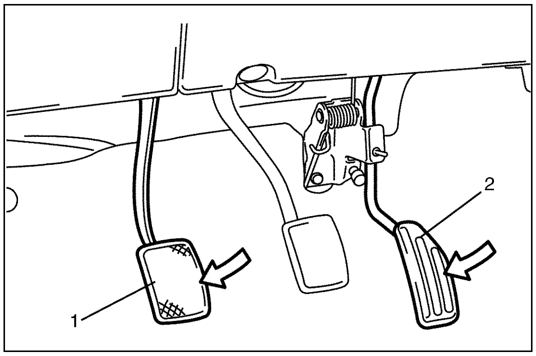


4) Disconnect ignition coil couplers (1).
5) Remove ignition coil assemblies (2) with high-tension cord (3).
6) Remove all spark plugs.
7) Disconnect fuel injector wires (4) at the coupler.



8) Install special tools (compression gauge) into spark plug hole.

Special tool
(A) : 09915-64510-001
(B) : 09915-64510-002
(C) : 09915-64530
(D) : 09915-67010



9) Disengage clutch (1) (to lighten starting load on engine) for M/T vehicle, and depress accelerator pedal (2) all the way to make throttle fully open.

10) Crank engine with fully charged battery, and read the highest pressure on compression gauge.

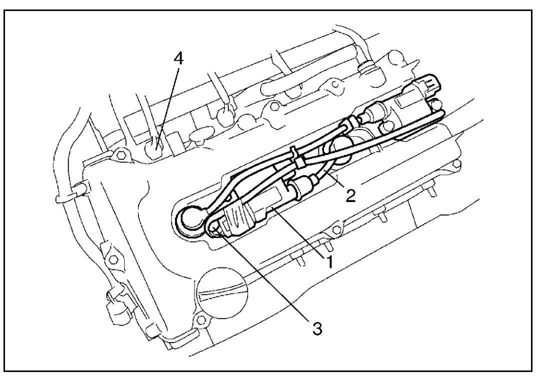
NOTE:

- **For measuring compression pressure, crank engine at least 250 rpm by using fully charged battery.**
- **If measured compression pressure is lower than limit value, check installation condition of special tool. If it is properly installed, possibility is compression pressure leakage from where piston ring and valve contact.**

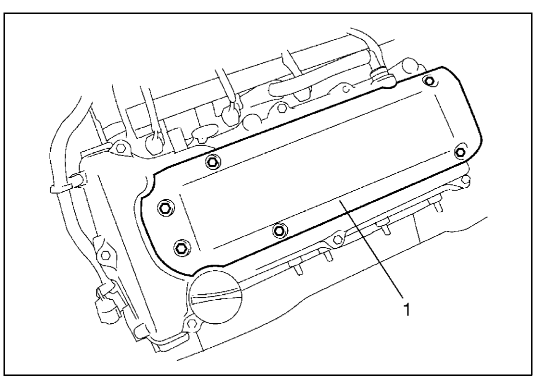
Compression pressure

Standard	**1400 kPa (14.0 kg/cm^2, 199.0 psi)**
Limit	**1100 kPa (11.0 kg/cm^2, 156.0 psi)**
Max. difference between any two cylinders	**100 kPa (1.0 kg/cm^2, 14.2 psi)**

11) Carry out Steps 8) through 10) on each cylinder to obtain 4 readings.



12) After checking, install spark plugs and ignition coil assemblies (1) with high-tension cord (2).
13) Connect ignition coil couplers (3).
14) Connect fuel injector wires(4) at the coupler.



15) Check cylinder head upper cover gasket for deterioration and then install it into groove of cylinder head upper cover (1) securely.

16) Install cylinder head upper cover with gasket on to cylinder head cover.

Engine Vacuum Check

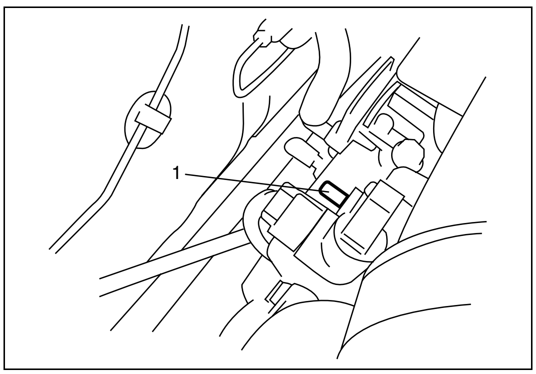
The engine vacuum that develops in the intake line is a good indicator of the condition of the engine. The vacuum checking procedure is as follows :

1) Warm up engine to normal operating temperature.

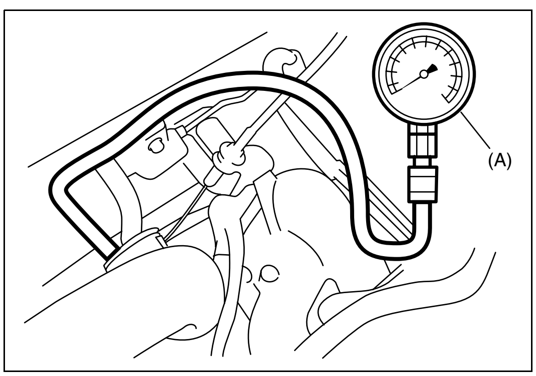
NOTE:

After warming up engine, be sure to place transaxle gear shift lever in "Neutral" (shift selector lever to "P" range for A/T model), and set parking brake and block drive wheels.

2) Stop engine and turn off the all electric switches.



3) Remove cap (1) from intake manifold.



4) Connect special tool (Vacuum gauge) to intake manifold.

Special tool
(A) : 09915-67310

5) Run engine at specified idle speed and read vacuum gauge. Vacuum should be within specification.

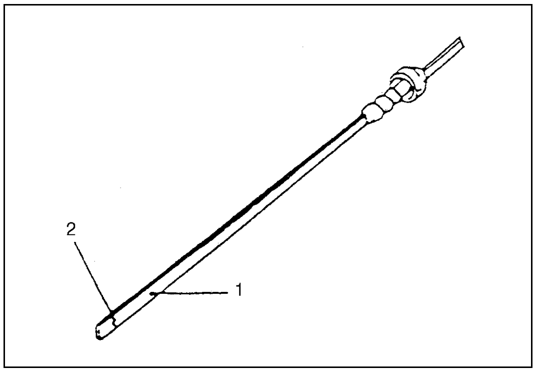
Vacuum specification (at sea level)
59 – 73 kPa (45 – 55 cmHg, 17.7 – 21.6 inHg)
at specified idle speed

6) After checking, disconnect special tool (Vacuum gauge) from intake manifold.
7) Install cap to intake manifold.

Oil Pressure Check

NOTE:

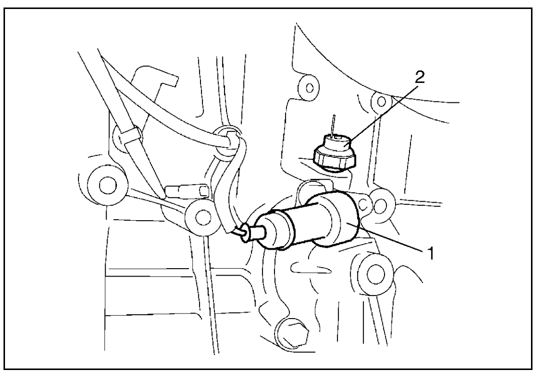
Prior to checking oil pressure, check the following items.



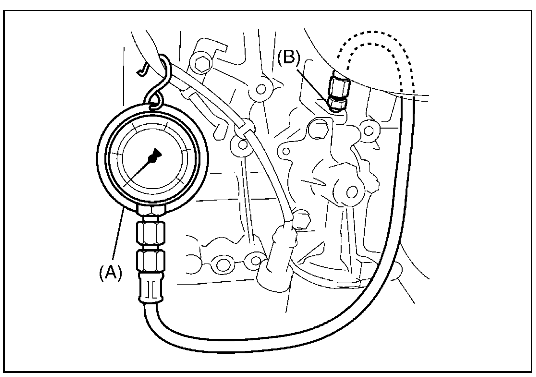
- Oil level in oil pan
  If oil level is low, add oil up to Full level mark (hole) on oil level gauge.

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

- Oil quality
  If oil is discolored, or deteriorated, change it.
  For particular oil to be used referring to the table in Section 0B.
- Oil leaks
  If leak is found, repair it.



1) Disconnect oil pressure switch coupler (1).
2) Remove exhaust manifold cover, if necessary.
3) Remove oil pressure switch (2) from cylinder block.



4) Install special tools (Oil pressure gauge) to vacated threaded hole.

Special tool
(A) : 09915-77310
(B) : 09915-78211

5) Start engine and warm it up to normal operating temperature.

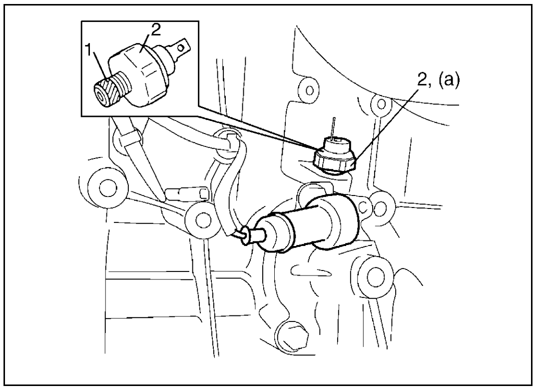
NOTE:

Be sure to place transaxle gear shift lever in “Neutral” (shift selector lever to “P” range for A/T model), and set parking brake and block drive wheels.

6) After warming up, raise engine speed to 4,000 rpm and measure oil pressure.

Oil pressure specification
More than 270 kPa (2.7 kg/cm^2, 39.8 psi) at 4,000 rpm

7) Stop engine and remove oil pressure gauge and attachment.

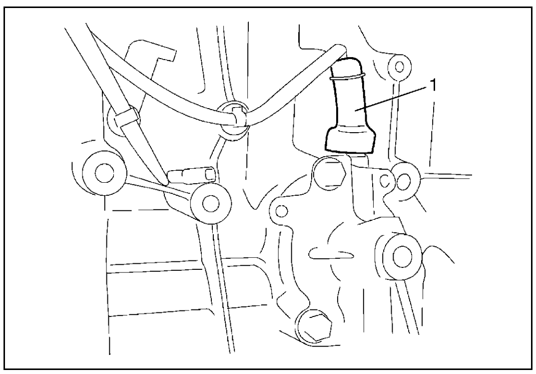


8) Before reinstalling oil pressure switch (2), be sure to wrap its screw threads with sealing tape (1) and tighten switch to specified torque.

NOTE:

If sealing tape edge is bulged out from screw threads of switch, cut it off.

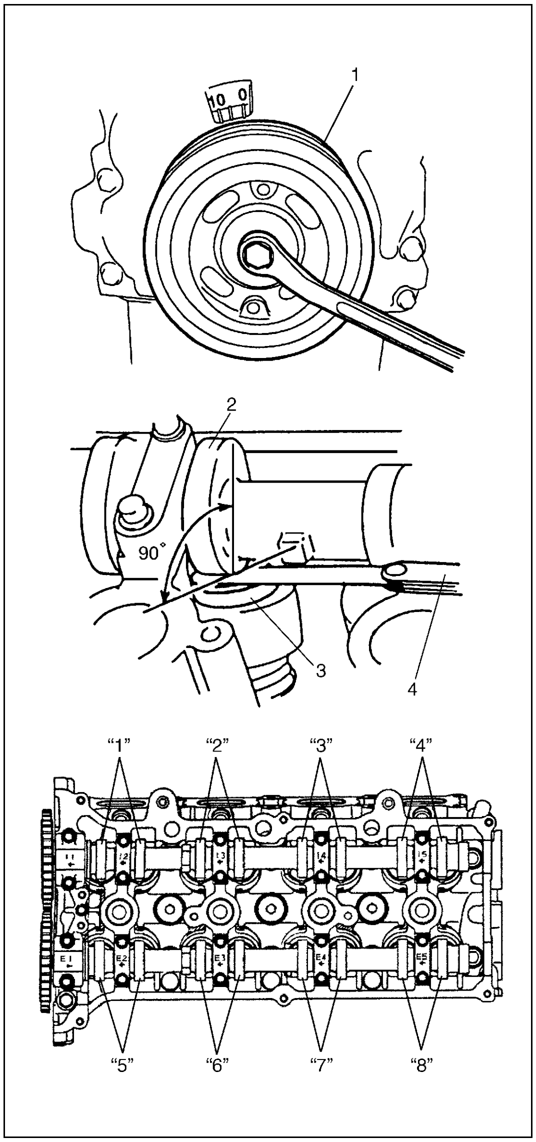
Tightening torque
Oil pressure switch (a) : 14 N·m (1.4 kg-m, 10.5 lb-ft)



9) Start engine and check oil pressure switch for oil leakage. If oil leakage is found, repair it.
10) Connect oil pressure switch coupler (1).

Valve Lash (Clearance)

INSPECTION



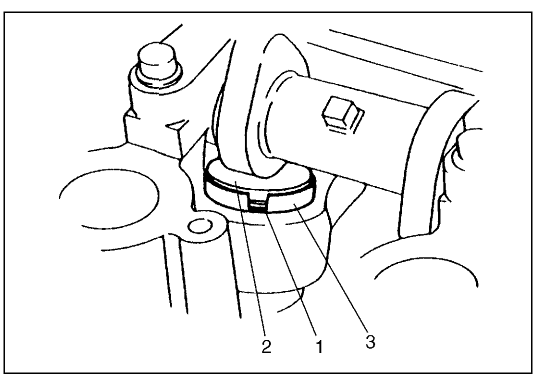
1) Remove negative cable at battery.
2) Remove cylinder head cover referring to “CYLINDER HEAD COVER”.
3) Remove right side engine under cover, if necessary.
4) Using 17 mm wrench, turn crankshaft pulley (1) clockwise until cam lobes (2) become perpendicular to shim faces (3) at valves “1” and “7” as shown in figure.
5) Check valve lashes with thickness gauge (4) according to the following procedure.
   a) Check valve lashes at valves “1” and “7”.
   b) Turn camshafts by 90° (by turning crankshaft with wrench).
   c) Make sure that cam lobes are perpendicular to shim faces at valves to be checked (in this case, “3” and “8”), if not, adjust it by turning crankshaft. Check valve lashes.
   d) In the same manner as b) – c), check valve lashes at valves “4” and “6”.
   e) In the same manner as b) – c) again, check valve lashes at valves “2” and “5”.

If valve lash is out of specification, record valve lash and adjust it to specification by replacing shim.

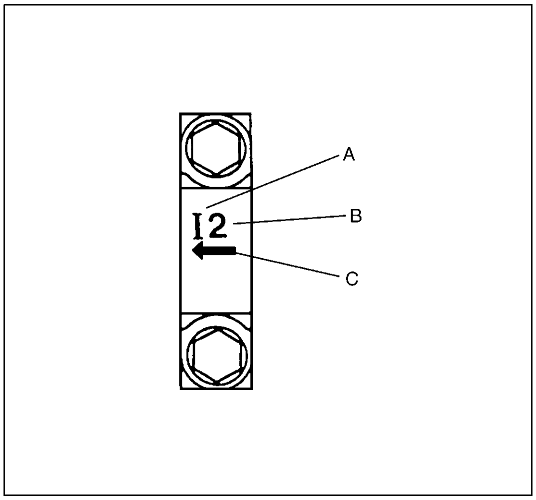
Valve clearance specification

	When cold (Coolant temperature is 15 – 25°C (59 – 77°F))	When hot (Coolant temperature is 60 – 68°C (140 – 154°F))
Intake	0.18 – 0.22 mm (0.007 – 0.009 in.)	0.21 – 0.27 mm (0.008 – 0.011 in.)
Exhaust	0.28 – 0.32 mm (0.011 – 0.013 in.)	0.30 – 0.36 mm (0.012 – 0.014 in.)

REPLACEMENT OF SHIM



1) Close the valve whose shim (2) is to be replaced by turning crankshaft, then turn tappet (3) till its cut section (1) faces inside as shown in figure.
2) Lift down the valve by turning crankshaft to 360°.
3) Hold tappet at that position using special tool as follows.
   a) Remove its housing bolts.

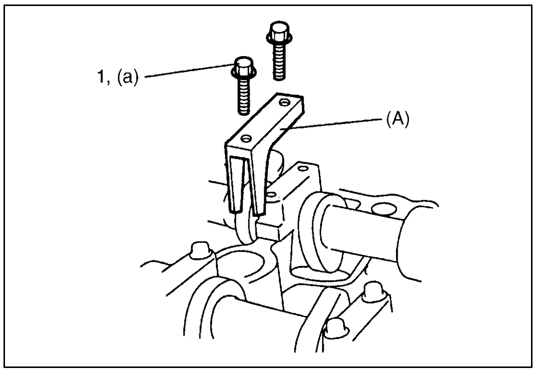


b) Check housing No. and select special tool corresponding to housing No., referring to "special tool selection table".

Special tool selection table

No. on camshaft housing	Embossed mark on special tool
I2	IN2
I3, I4, I5	IN345
E2	EX2
E3, E4, E5	EX345

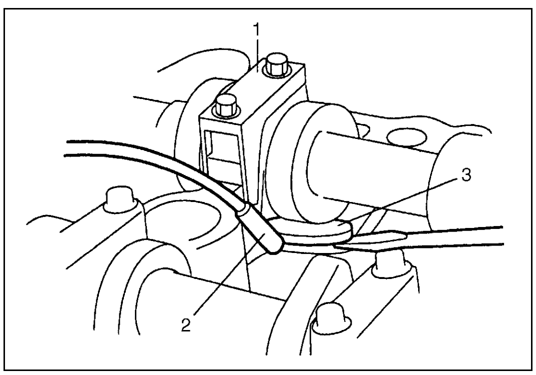
A:	I : Intake side or E : Exhaust side
B:	Position from timing chain side
C:	Pointing to timing chain side



c) Hold down the tappet so as not to contact the shim by installing special tool on camshaft housing with housing bolt (1) tighten housing bolts to specified torque.

Special tool
(A) : 09916-67020

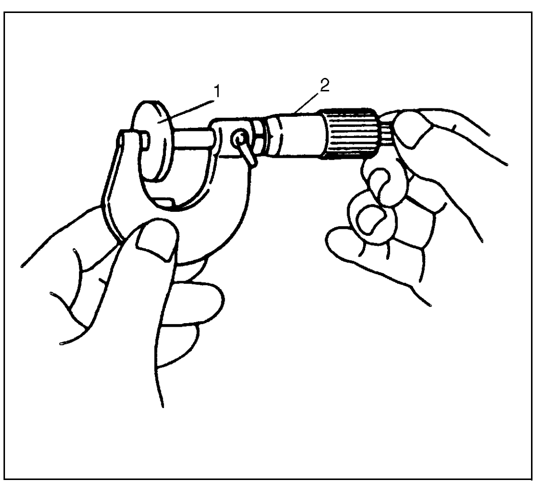
Tightening torque
Camshaft housing bolts (for tightening of special tool)
(a) : 8 N·m (0.8 kg-m, 6.0 lb-ft)



4) Turn camshaft by approximately 90° clockwise and remove shim (3).

WARNING:
Never put in the hand between cam shaft and tappet.

1.	Special tool
2.	Magnet



5) Using a micrometer (2), measure the thickness of the removed shim (1), and determine replacement shim by calculating the thickness of new shim with the following formula and table.

Intake side:
A = B + C – 0.20 mm (0.008 in.)
Exhaust side:
A = B + C – 0.30 mm (0.012 in.)

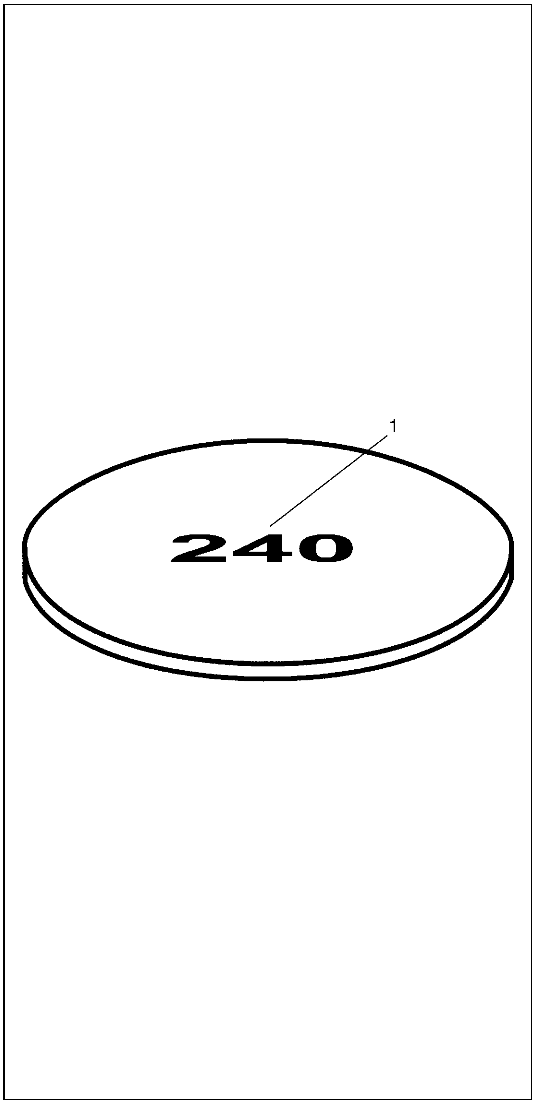
A : Thickness of new shim
B : Thickness of removed shim
C : Measured valve clearance

For example of intake side :

When thickness of removed shim is 2.40 mm (0.094 in.), and measured valve clearance is 0.45 mm (0.018 in.).

A = 2.40 mm (0.094 in.) + 0.45 mm (0.018 in.) – 0.20 mm (0.008 in.) = 2.65 mm (0.104 in.)

Calculated thickness of new shim = 2.65 mm (0.104 in.)

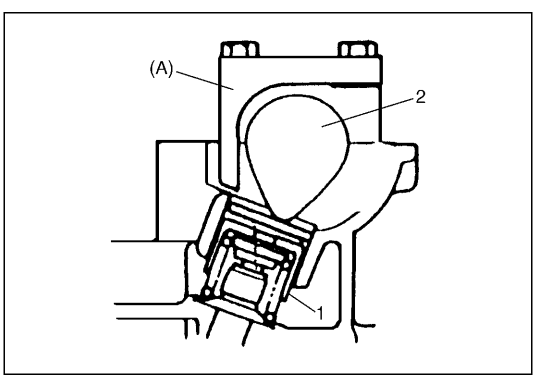


6) Select new shim No. (1) with a thickness as close as possible to calculated value.

Available new shims No.

Thickness mm (in.)	Shim No.	Thickness mm (in.)	Shim No.
2.175 (0.0856)	**218**	**2.675 (0.1053)**	**268**
2.200 (0.0866)	**220**	**2.700 (0.1063)**	**270**
2.225 (0.0876)	**223**	**2.725 (0.1073)**	**273**
2.250 (0.0886)	**225**	**2.750 (0.1083)**	**275**
2.275 (0.0896)	**228**	**2.775 (0.1093)**	**278**
2.300 (0.0906)	**230**	**2.800 (0.1102)**	**280**
2.325 (0.0915)	**233**	**2.825 (0.1112)**	**283**
2.350 (0.0925)	**235**	**2.850 (0.1122)**	**285**
2.375 (0.0935)	**238**	**2.875 (0.1132)**	**288**
2.400 (0.0945)	**240**	**2.900 (0.1142)**	**290**
2.425 (0.0955)	**243**	**2.925 (0.1152)**	**293**
2.450 (0.0965)	**245**	**2.950 (0.1161)**	**295**
2.475 (0.0974)	**248**	**2.975 (0.1171)**	**298**
2.500 (0.0984)	**250**	**3.000 (0.1181)**	**300**
2.525 (0.0994)	**253**		
2.550 (0.1004)	**255**		
2.575 (0.1014)	**258**		
2.600 (0.1024)	**260**		
2.625 (0.1033)	**263**		
2.650 (0.1043)	**265**		

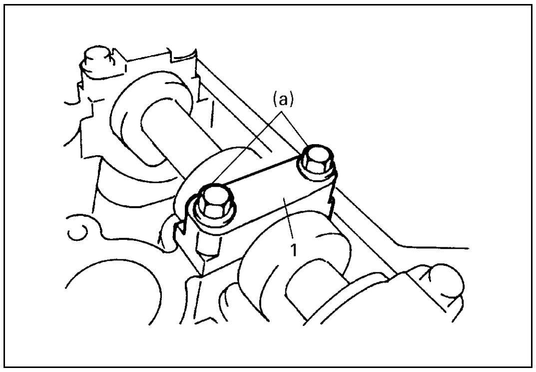
7) Install new shim facing shim No. side with tappet.



8) Lift valve by turning crankshaft counterclockwise (in opposite direction against above Step 4) and remove special tool.

Special tool
(A) : 09916-67020

1.	Tappet
2.	Camshaft



9) Install camshaft housing (1) and tighten bolts to specified torque.

Tightening torque
Camshaft housing bolts (a) : 11 N·m (1.1 kg-m, 8.0 lb-ft)

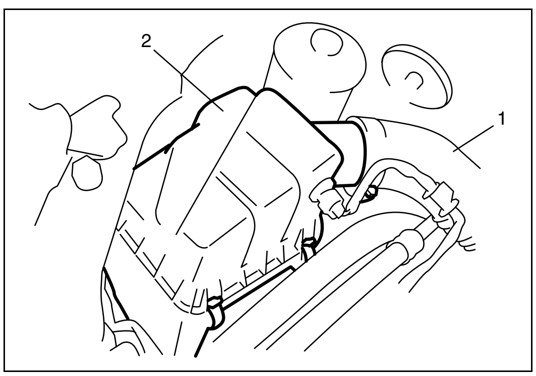
10) Check valve clearance again after adjusting it.

11) After checking and adjusting all valves.
12) Install cylinder head cover referring to “CYLINDER HEAD COVER”.

On-Vehicle Service

Air Cleaner Element

REMOVAL



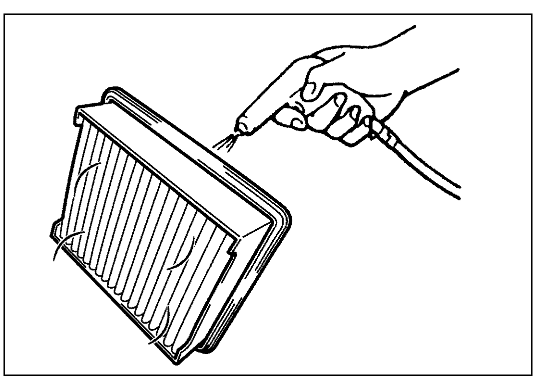
1) Disconnect air cleaner outlet No.1 hose (1) from air cleaner case (2).
2) Open air cleaner case by unhooking its clamps.
3) Remove air cleaner element from case.

INSTALLATION

Reverse removal procedure for installation.

INSPECTION AND CLEANING

- Check air cleaner element for dirt. Replace excessively dirty element.



- Blow off dust by compressed air from air outlet side of element.

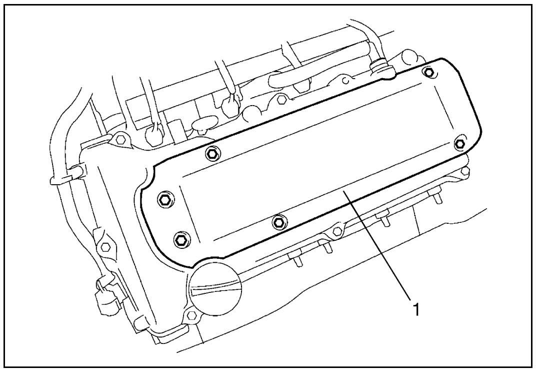
Knock Sensor

Refer to “KNOCK SENSOR” in Section 6E1.

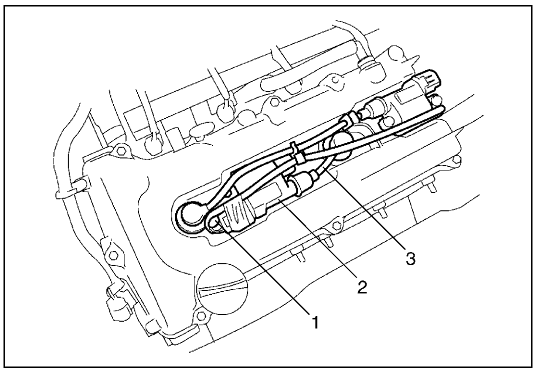
Cylinder Head Cover

REMOVAL

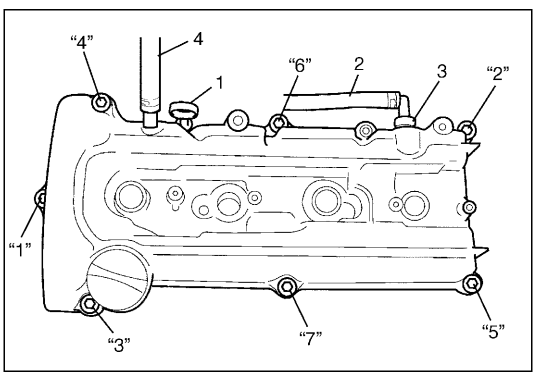
1) Disconnect negative cable at battery.
2) Remove cylinder head upper cover (1).



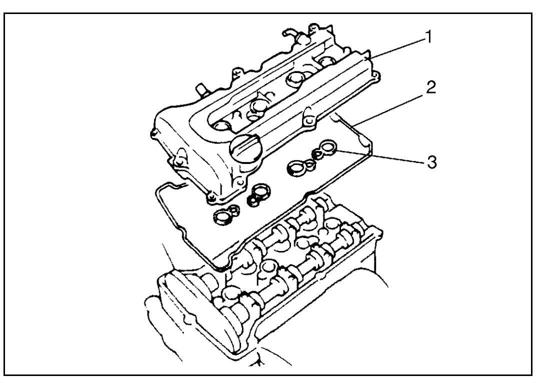
3) Disconnect ignition coil couplers (1).
4) Remove ignition coil assemblies (2) with high-tension cord (3).



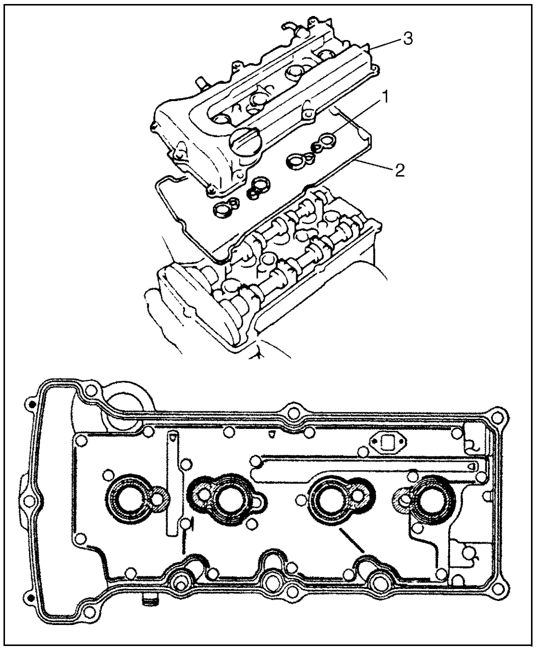
5) Remove oil level gauge (1).
6) Disconnect PCV hose (2) from PCV valve (3) and disconnect breather hose (4) from cylinder head cover.
7) Remove power steering hose bracket from cylinder head cover, if equipped.
8) Remove cylinder head cover mounting bolts in such order as indicated in figure.



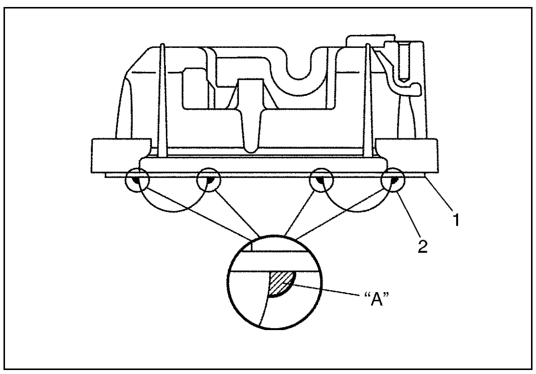
9) Remove cylinder head cover (1) with cylinder head cover gasket (2) and spark plug hole gasket (3).



INSTALLATION

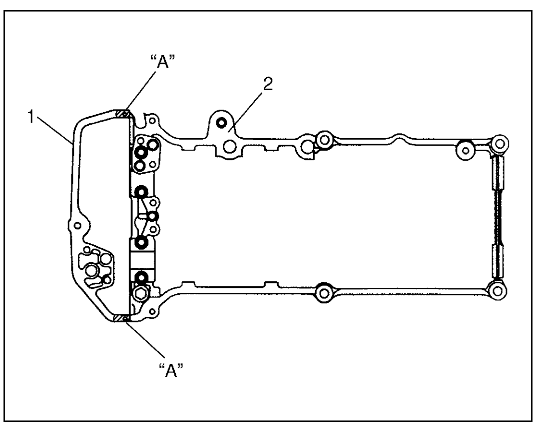


1) Install new spark plug hole gaskets (1) and new cylinder head cover gasket (2) to cylinder head cover (3) as shown in figure.
2) Remove oil, old sealant, and dust from sealing surface on cylinder head and cover. After cleaning, apply sealant “A” to the following point.



- Cylinder head cover gasket (1) sealing surface area (2) as shown.

“A” : Sealant 99000-31150



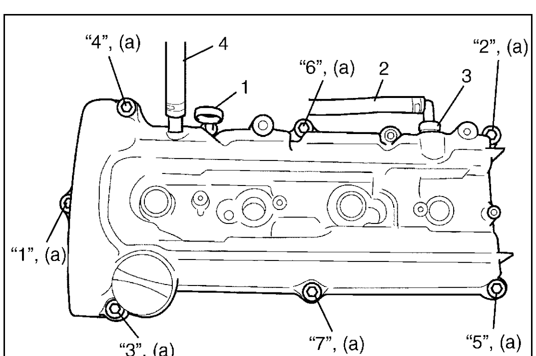
- Timing chain cover (1) and cylinder head (2) matching surface as shown.

“A” : Sealant 99000-31150

3) Install cylinder head cover to cylinder head.

NOTE:

When installing cylinder head cover, use care so that cylinder head cover gasket or spark plug hole gaskets will not get out of place or fall off.



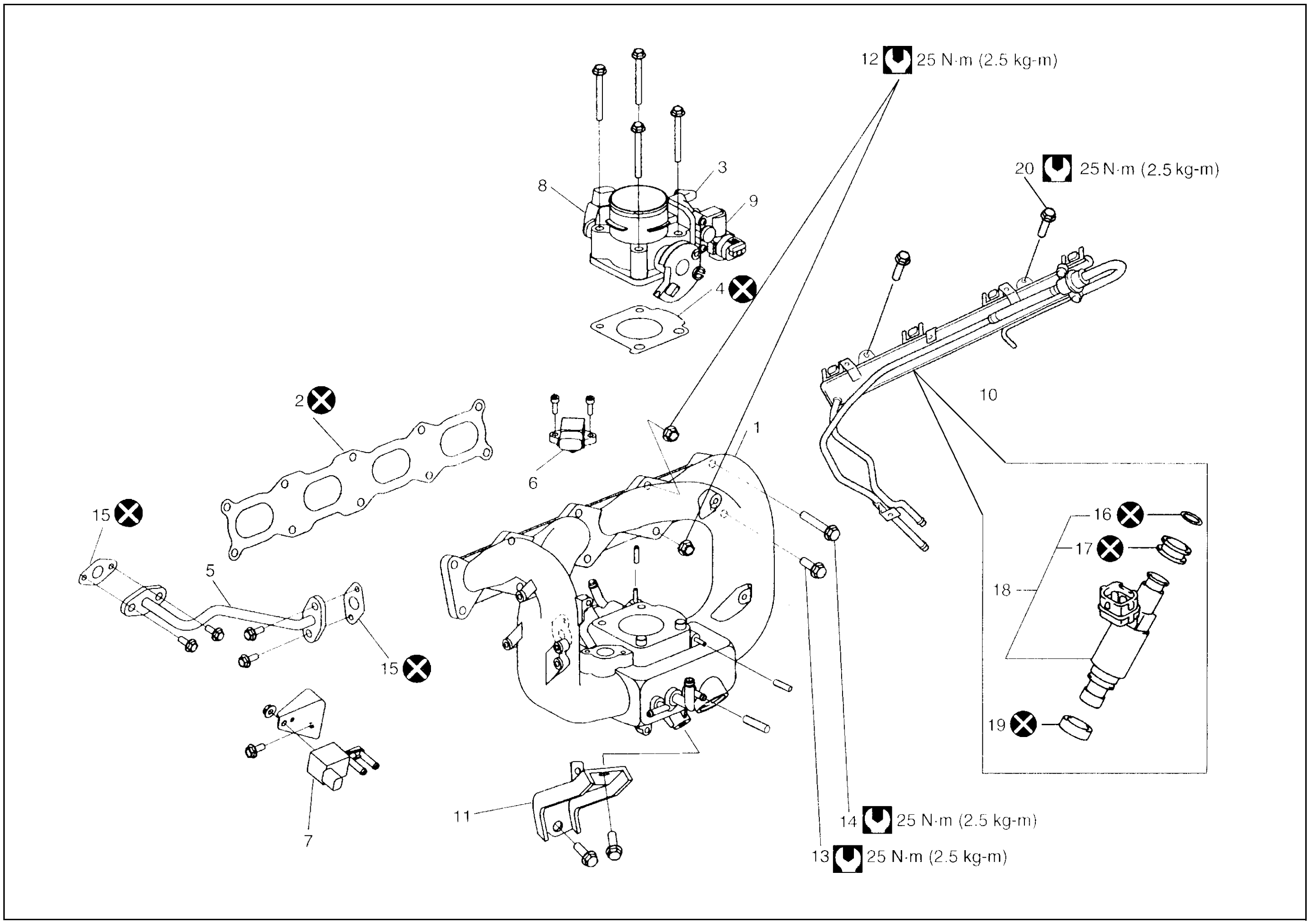
4) Tighten bolts in such order as indicated in figure a little at a time till they are tightened to specified torque.

Tightening torque
Cylinder head cover bolts (a) : 8 N·m (0.8 kg-m, 6.0 lb-ft)

5) Connect PCV hose (2) to PCV valve (1).
6) Connect breather hose (4).
7) Install oil level gauge (3).

8) Install power steering hose bracket to cylinder head cover, if removed.
9) Install ignition coil assemblies with high-tension cord.
10) Connect ignition coil couplers and clamp harness securely.
11) Install cylinder head upper cover.
12) Connect negative cable at battery.

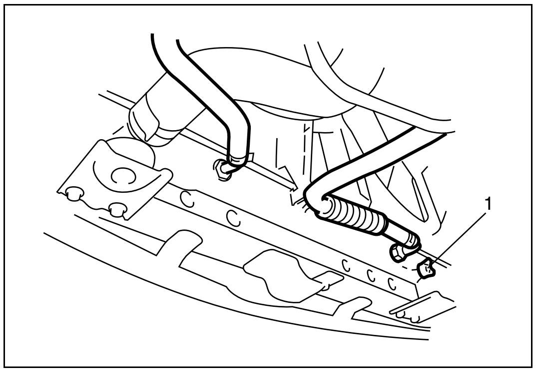
Throttle Body and Intake Manifold



1. Intake manifold	7. EVAP canister purge valve	13. Intake manifold mounting bolt (short)	19. Cushion
2. Intake manifold gasket	8. TP sensor	14. Intake manifold mounting bolt (long)	20. Fuel delivery pipe mounting bolt
3. Throttle body	9. IAC valve	15. EGR pipe gasket	Tightening torque
4. Gasket	10. Fuel delivery pipe	16. O-Ring	Do not reuse.
5. EGR pipe	11. Intake manifold stiffener	17. Grommet	
6. MAP sensor	12. Intake manifold mounting nut	18. Injector assembly	

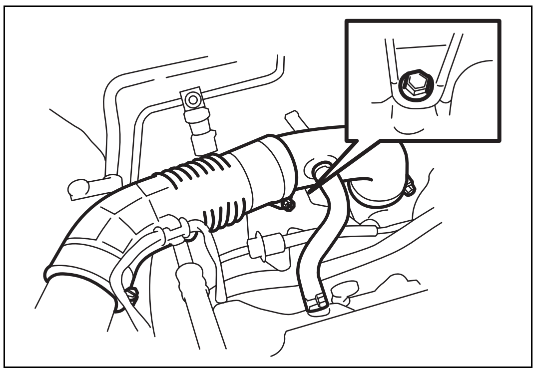
REMOVAL

1) Relieve fuel pressure according to fuel pressure relief procedure described in Section 6.
2) Disconnect negative cable at battery.

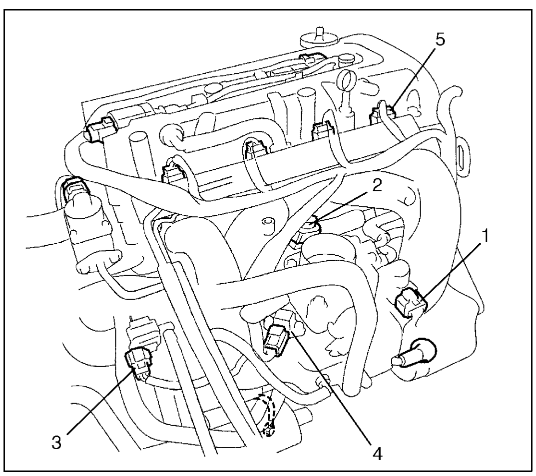


3) Drain coolant by loosening drain plug (1).

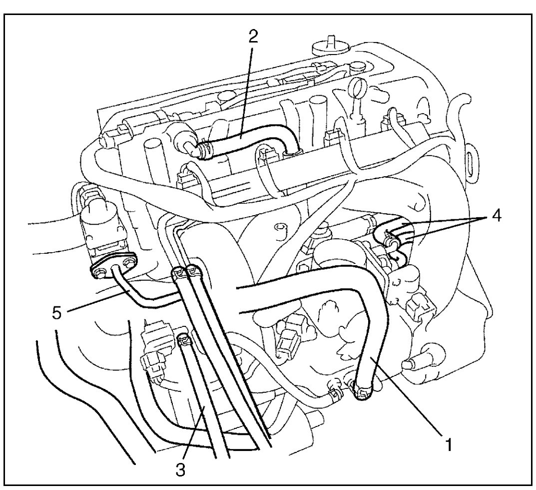
WARNING:
To help avoid danger of being burned, do not remove drain plug (1) and radiator cap while engine and radiator are still hot. Scalding fluid and steam can be blown out under pressure if plug and cap are taken off too soon.



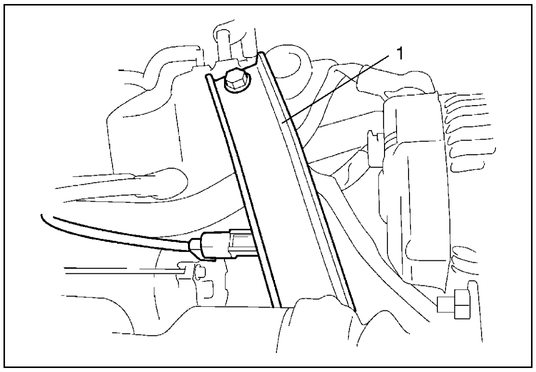
4) Remove air cleaner outlet No.1 and No.2 hoses.



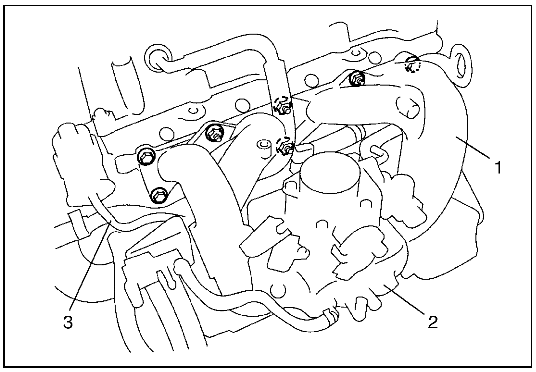
5) Disconnect the following electric lead wires :
   - IAC valve (1)
   - TP sensor (2)
   - EVAP canister purge valve (3)
   - MAP sensor (4)
   - Fuel injector wire harness at couplers (5)
   - Ground terminal from intake manifold
   - Each wire harness clamps
6) Disconnect accelerator cable from throttle body and remove its bracket from intake manifold.



7) Disconnect the following hoses :
   - Brake booster hose (1) from intake manifold
   - PCV hose (2) from PCV valve
   - Canister purge hose (3) from EVAP canister purge valve
   - Water hoses (4) from throttle body and thermostat case
   - Fuel pressure regulator vacuum hose from intake manifold
   - Fuel feed hose and return hose from each pipe
8) Remove fuel delivery pipe with fuel injectors from cylinder head.
9) Disconnect EGR pipe (5) from EGR valve.



10) Remove intake manifold stiffener (1).

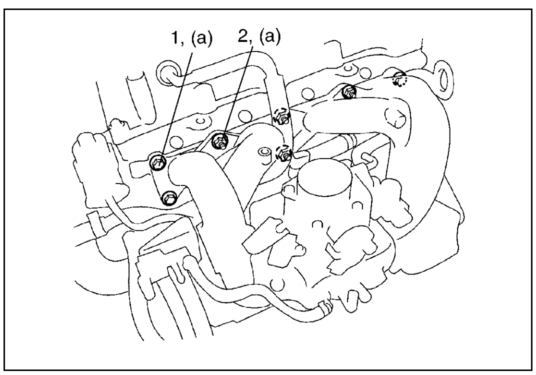


11) Remove intake manifold (1) with throttle body (2) and EGR pipe (3) from cylinder head, and then its gasket.

INSTALLATION

Reverse removal procedure for installation noting the followings.

- Use new intake manifold gasket and EGR pipe gasket.

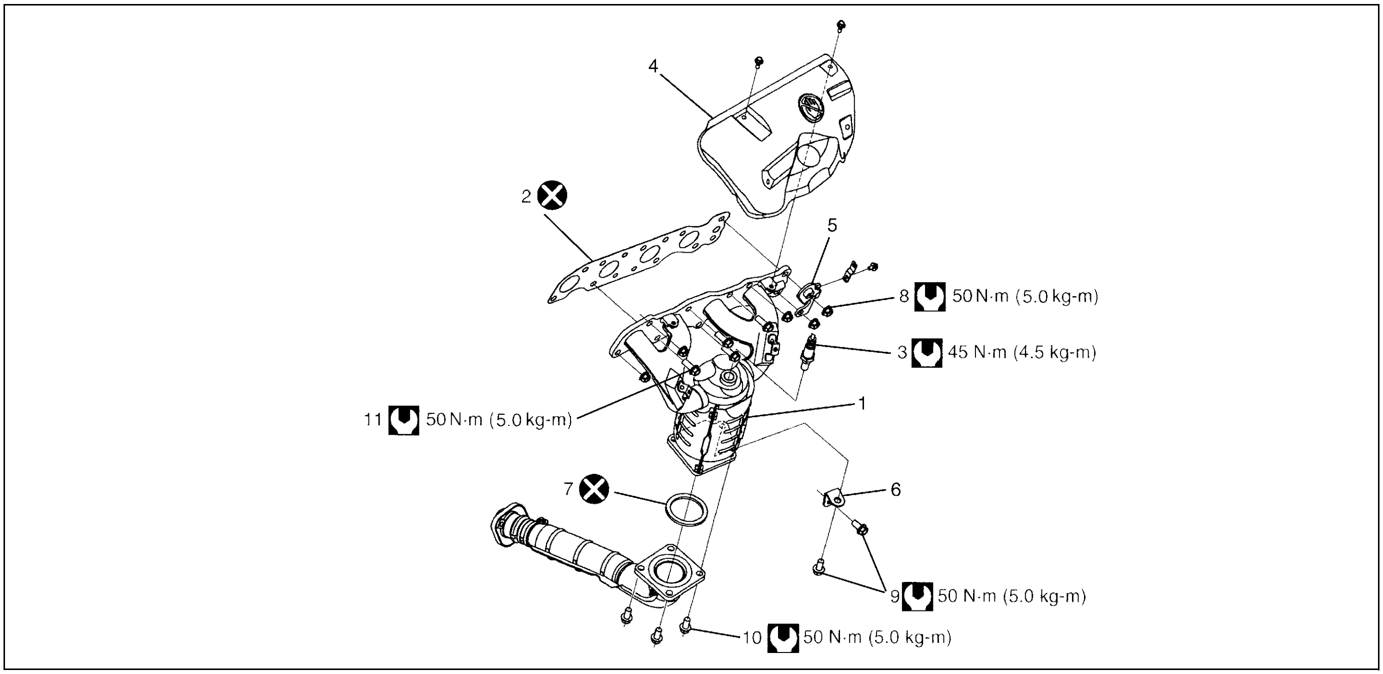


- Tighten bolts (1) and nuts (2) to specified torque.

  Tightening torque
  Intake manifold bolts and nuts
  (a) : 25 N·m (2.5 kg-m, 18.0 lb-ft)

- Check to ensure that all removed parts are back in place. Reinstall any necessary parts which have not been reinstalled.
- Adjust accelerator cable play referring to Section 6E1.
- Refill cooling system referring to Section 6B.
- Upon completion of installation, turn ignition switch ON but engine OFF and check for fuel leaks.
- Finally, start engine and check for engine coolant leaks.

Exhaust Manifold

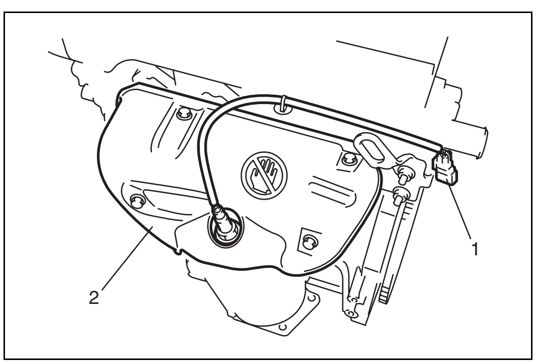


1. Exhaust manifold	6. Exhaust manifold stiffener	11. Exhaust manifold mounting bolt
2. Exhaust manifold gasket	7. Gasket	Tightening torque
3. Heated oxygen sensor (if equipped)	8. Exhaust manifold mounting nut	Do not reuse.
4. Exhaust manifold cover	9. Exhaust manifold stiffener bolt	
5. Engine hook	10. Exhaust pipe bolt	

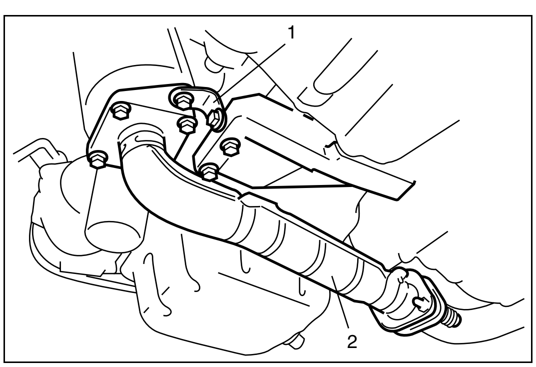
WARNING:

To avoid danger of being burned, do not service exhaust system while it is still hot. Service should be performed after system cools down.

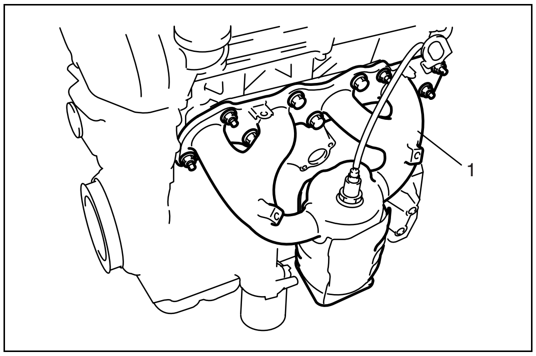
REMOVAL



1) Disconnect negative cable at battery.
2) connect heated oxygen sensor coupler (1) (if equipped) and detach it from its stay.
3) Remove exhaust manifold cover (2).

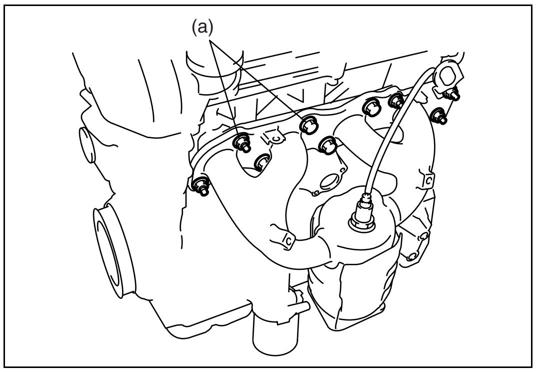


4) Remove exhaust manifold stiffener (1).
5) Disconnect exhaust No.1 pipe (2) from exhaust manifold.



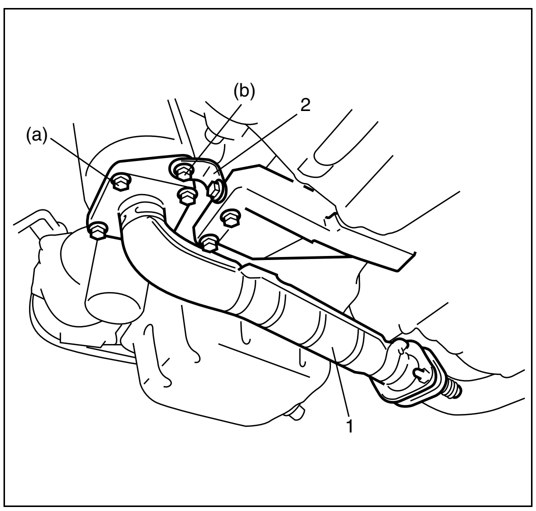
6) Remove exhaust manifold (1) and its gasket from cylinder head.

INSTALLATION



1) Install new gasket to cylinder head.
   Then install exhaust manifold.
   Tighten manifold bolts and nuts to specified torque.

Tighting torque
Exhaust manifold bolts and nuts
(a) : 50 N·m (5.0 kg-m, 36.5 lb-ft)

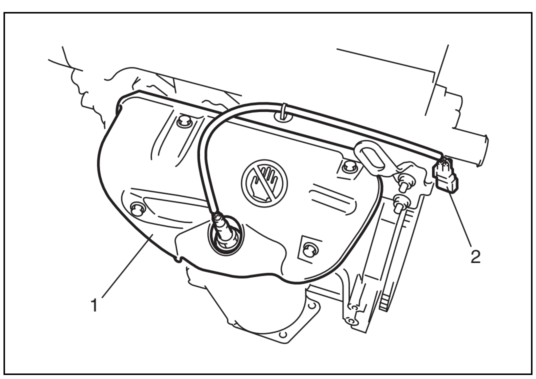


2) Install seal ring and connect exhaust No.1 pipe (1) to exhaust manifold.
   Before installing seal ring, check it for deterioration or damage, and replace as necessary.
   Tighten pipe fasteners to specified torque.

Tightening torque
Exhaust No.1 pipe bolts (a) : 50 N·m (5.0 kg-m, 36.5 lb-ft)

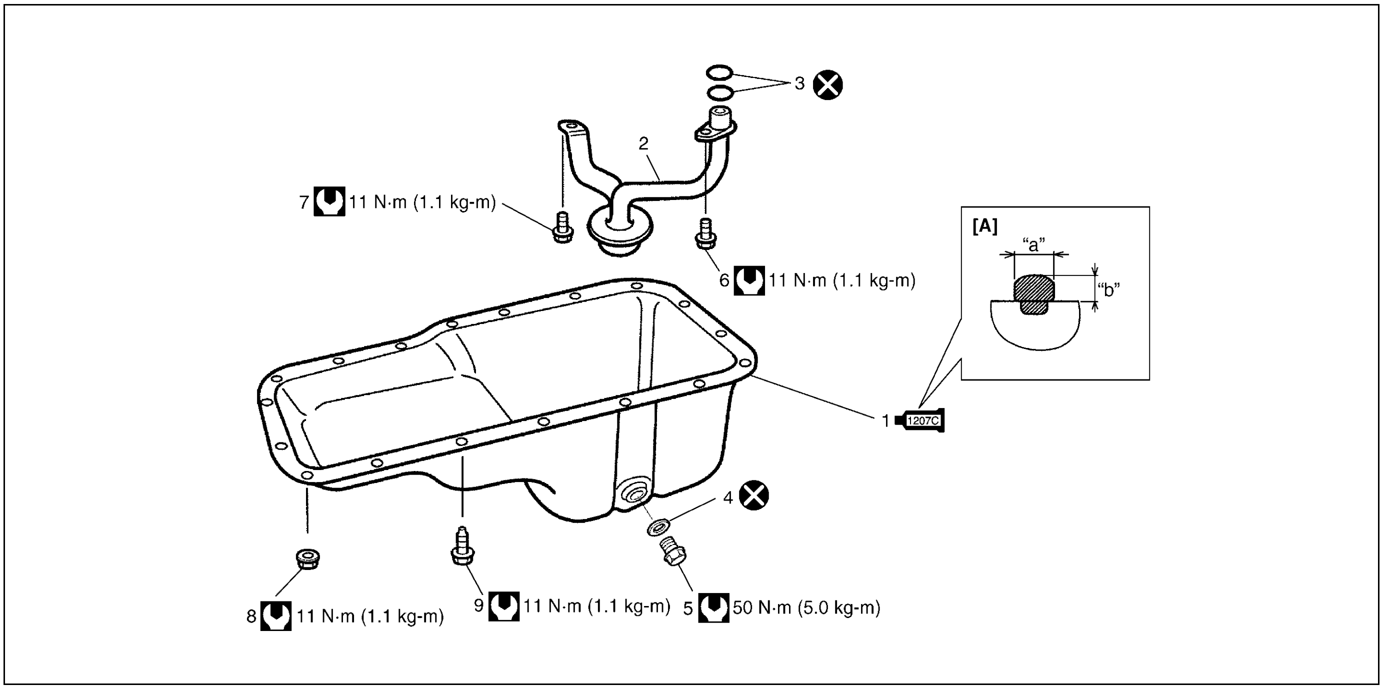
3) Install exhaust manifold stiffener (2).
   Tighten exhaust manifold stiffener bolts to specified torque.

Tightening torque
Exhaust manifold stiffener bolts
(b) : 50 N·m (5.0 kg-m, 36.5 lb-ft)



4) Install exhaust manifold cover (1) .
5) Connect heated oxygen sensor coupler (2) and fit coupler to bracket securely (if equipped).
6) Connect negative cable to battery.
7) Check exhaust system for exhaust gas leakage.

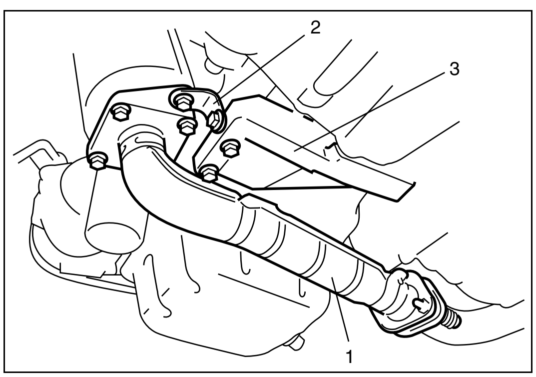
Oil Pan and Oil Pump Strainer



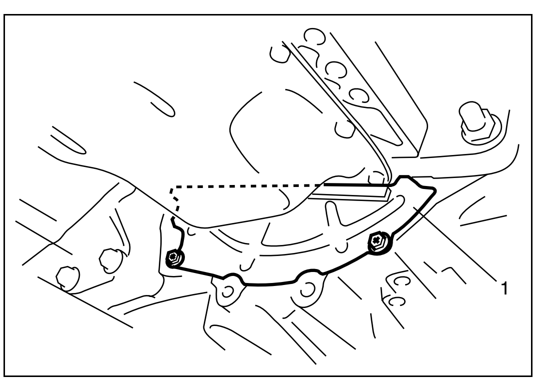
[A] :	Sealant application amount	3. O-ring	8. Oil pan nut
"a" :	3 mm (0.12 in.)	4. Gasket	9. Oil pan bolt
"b" :	2 mm (0.08 in.)	5. Drain plug	Tightening torque
1207C 1.	Oil pan : Apply sealant 99000-31150 to mating surface.	6. Strainer bolt	Do not reuse.
2.	Strainer	7. Bracket bolt	

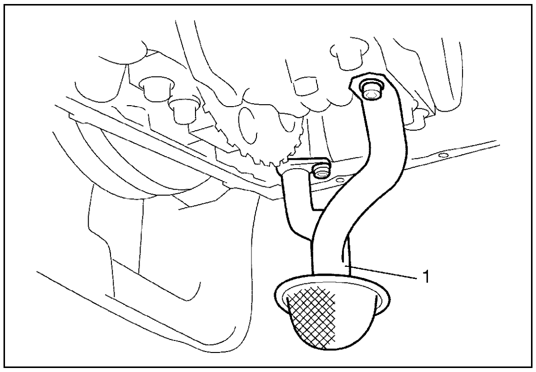
REMOVAL

1) Remove oil level gauge.
2) Remove exhaust No.1 pipe (1), exhaust manifold stiffener (2) and transaxle stiffener (3).



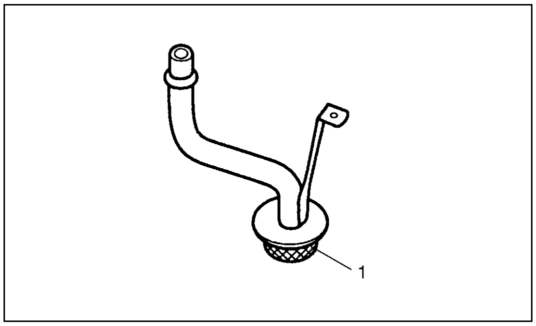
3) Drain engine oil by removing drain plug.
4) For 4WD vehicle remove clutch housing (torque converter housing for A/T vehicle) lower plate (1).
5) For 2WD vehicle, remove transaxle stiffener.
6) For 4WD vehicle, remove transfer referring to Section 7D.



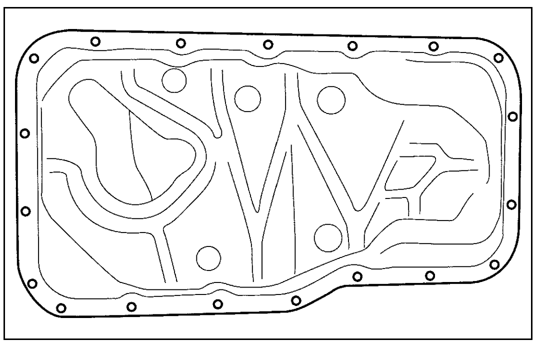


7) Remove oil pan and then oil pump strainer (1) from cylinder block.

CLEAN

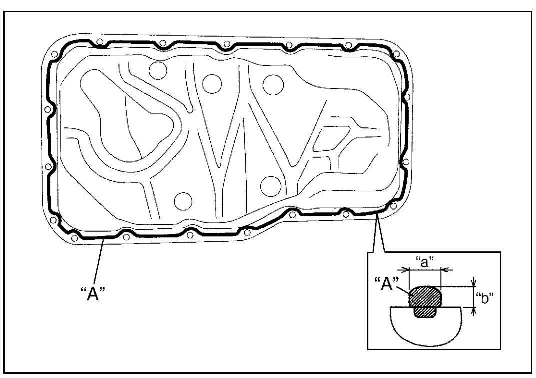


- Clean oil pump strainer screen (1).



- Clean sealing surface on oil pan and cylinder block. Remove oil, old sealant and dust from sealing surface.

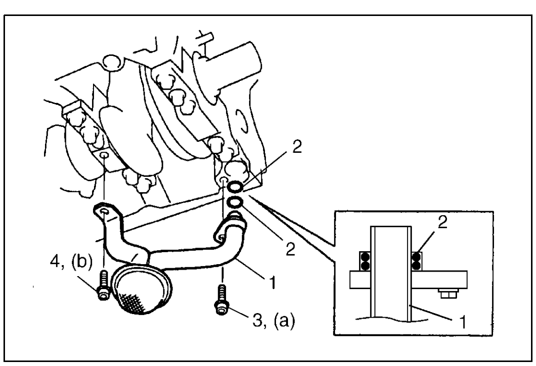
INSTALLATION



1) Apply sealant continuously to oil pan mating surface as shown in figure.

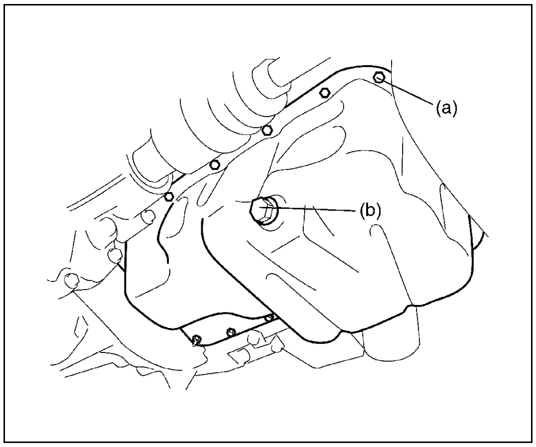
"A" : sealant 99000-31150

Sealant amount for oil pan
Width "a" : 3 mm (0.12 in.)
Height "b" : 2 mm (0.08 in.)



2) Install new O-rings (2) in the position as shown in figure and install oil pump strainer (1).
Tighten strainer bolt (3) first and then bracket bolt (4) to specified torque.

Tightening torque
Oil pump strainer bolt (a) : 11 N·m (1.1 kg-m, 8.0 lb-ft)
Oil pump strainer bracket bolt
(b) : 11 N·m (1.1 kg-m, 8.0 lb-ft)

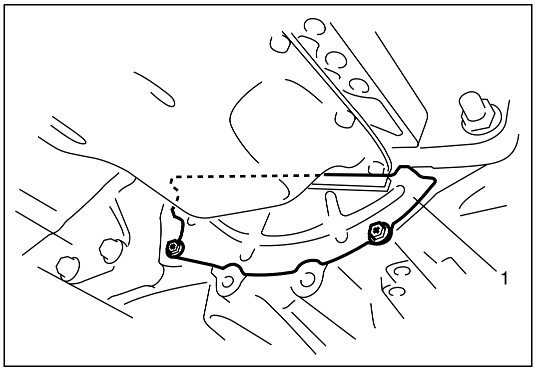


3) After fitting oil pan to cylinder block, run in securing bolts and start tightening at the center :
   move wrench outward, tightening one bolt at a time. Tighten bolts and nuts to specified torque.

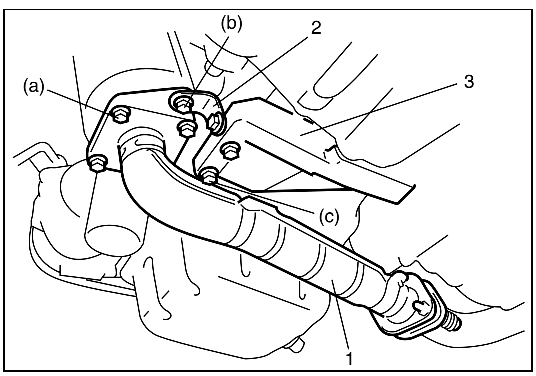
Tightening torque
Oil pan bolts and nuts (a) : 11 N·m (1.1 kg-m, 8.0 lb-ft)

4) Install new gasket and drain plug to oil pan.
   Tighten drain plug to specified torque.

Tightening torque
Oil pan drain plug bolt (b) : 50 N·m (5.0 kg-m, 36.5 lb-ft)



5) For 4WD vehicle, install clutch housing (torque converter housing for A/T vehicle) lower plate (1).
6) For 2WD vehicle, install transaxle stiffener.
7) For 4WD vehicle, install transfer referring to Section 7D.

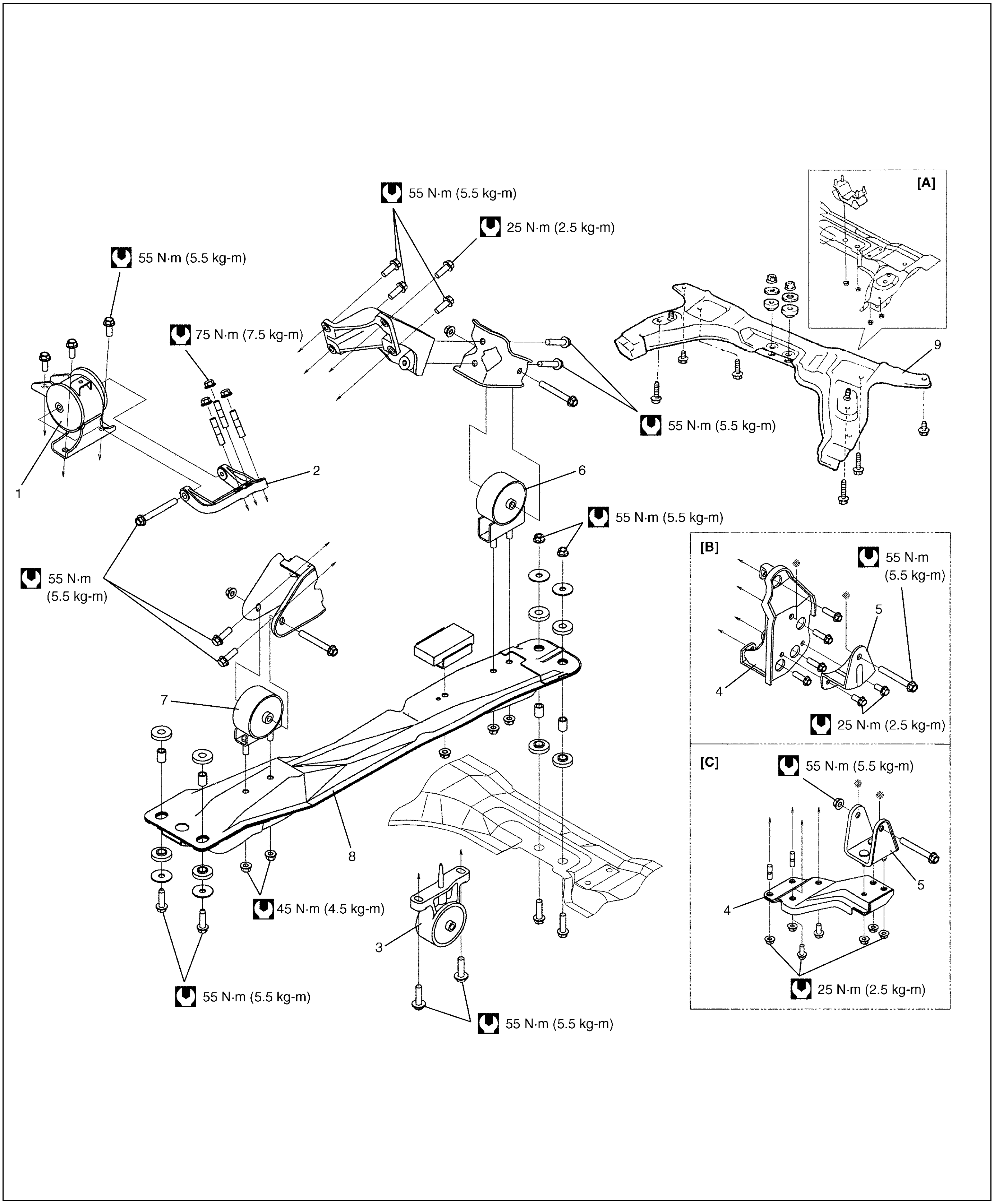


8) Install transaxle stiffener (3), exhaust manifold stiffener (2) and exhaust No.1 pipe (1).
   Tighten bolts to specified torque.

Tightening torque
Exhaust No.1 pipe bolts (a) : 50 N·m (5.0 kg-m, 36.5 lb-ft)
Exhaust manifold stiffener bolts (b) :
50 N·m (5.0 kg-m, 36.5 lb-ft)
Transaxle stiffener bolts (c) :
50 N·m (5.0 kg-m, 36.5 lb-ft)

9) Install oil level gauge.
10) Refill engine with engine oil referring to “ENGINE OIL AND OIL FILTER” in Section 0B.
11) Verify that there is no engine oil leakage and exhaust gas leakage at each connection.

Engine Mountings



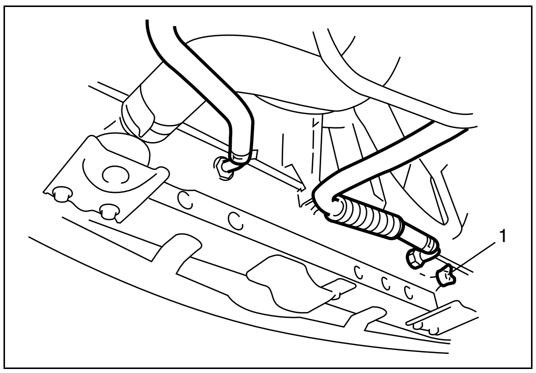
[A] : 4WD MODEL	3. Engine left mounting	8. Mounting member
[B] : AT MODEL	4. Engine left mounting bracket No.1	9. Suspension frame
[C] : MT MODEL	5. Engine left mounting bracket No.2	Tightening torque
1. Engine right mounting	6. Engine rear mounting	
2. Engine right mounting bracket	7. Engine front torque bush	

Unit Repair Overhaul

Engine Assembly

REMOVAL

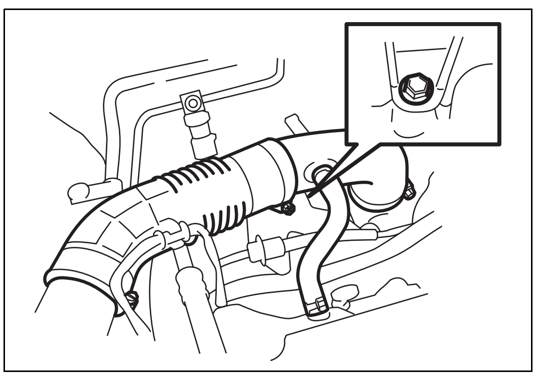
1) Relieve fuel pressure according to procedure described in Section 6.
2) Disconnect negative and positive cables at battery.
3) Remove engine hood after disconnecting windshield washer hose.
4) Remove right and left side engine under covers.
5) Remove A/C compressor and/or P/S belt (if equipped).
6) Remove water pump belt.
7) Drain engine oil, transaxle oil or A/T fluid (for A/T vehicle) and transfer oil (for 4WD vehicle).



8) Drain coolant.

WARNING:

To help avoid danger of being burned, do not remove drain plug (1) and radiator cap while engine and radiator are still hot. Scalding fluid and steam can be blown out under pressure if plug and cap are taken off too soon.

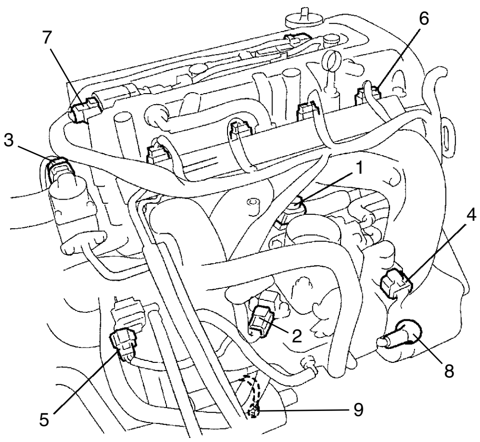


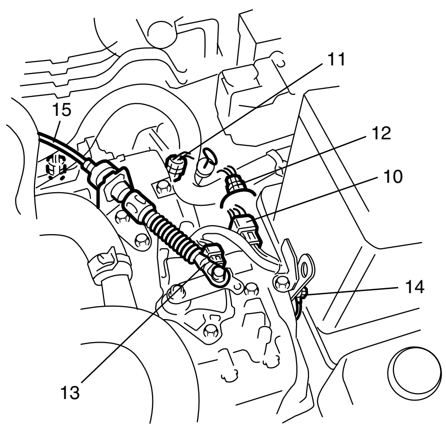
9) Remove air cleaner case and hoses.

10) With hose connected, detach A/C compressor and/or P/S pump from its bracket (if equipped).

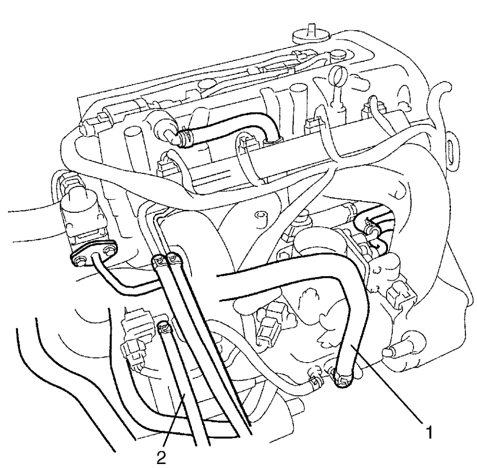
NOTE:

Suspend removed A/C compressor and/or P/S pump at a place where no damage will be caused during removal and installation of engine assembly.

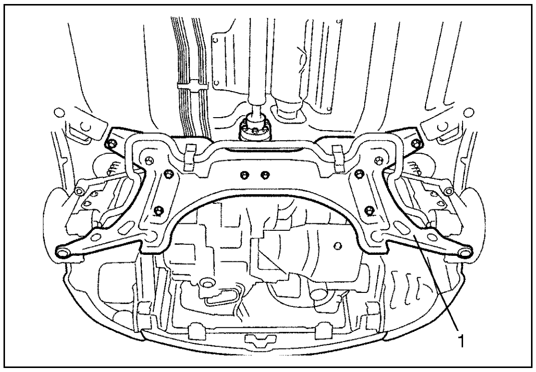




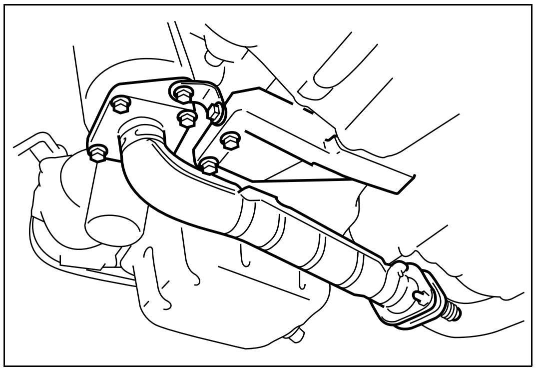
11) Disconnect the following electric lead wires:
   - TP sensor (1)
   - MAP sensor (2)
   - ECT sensor
   - CMP sensor
   - CKP sensor
   - Knock sensor
   - Heated oxygen sensor
   - EGR valve (3)
   - IAC valve (4)
   - EVAP canister purge valve (5)
   - Injectors (6)
   - Ignition coil assembly (7)
   - Engine oil pressure switch
   - Generator (8)
   - Starting motor
   - Magnet clutch switch of A/C compressor (if equipped)
   - Ground terminal (9) from intake manifold and cylinder block
   - VSS
   - Back up light switch (For M/T vehicle)
   - Shift switch (10) (For A/T vehicle)
   - A/T VSS (11) (For A/T vehicle)
   - NC1 sensor (12)
   - A/T shift solenoid (13) (For A/T vehicle)
   - Speedometer sensor
   - Battery ground cable (14) from transaxle
   - Each wire harness clamps
12) Remove fuse box from its bracket.
13) Disconnect the following cables :
   - Accelerator cable
   - Gear select control cable (For M/T vehicle)
   - Gear shift control cable (For M/T vehicle)
   - Gear select cable (15) (For A/T vehicle)



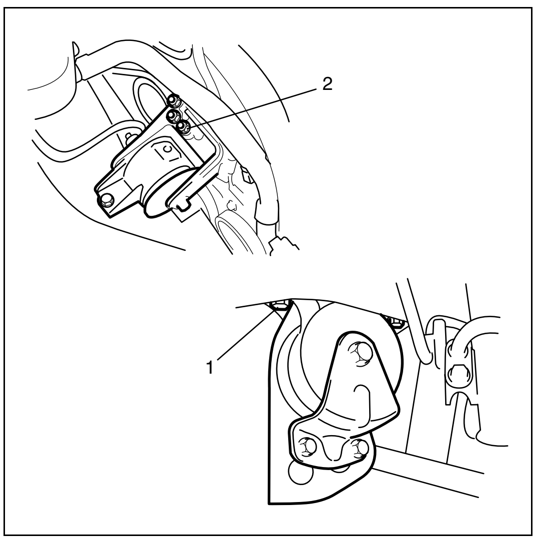
14) Disconnect the following hoses :
   - Brake booster hose (1) from intake manifold
   - Canister purge hose (2) from EVAP canister purge valve
   - Fuel feed and return hoses from each pipe
   - Heater inlet and outlet hoses from each pipe
   - Radiator inlet and outlet hoses from each pipe
   - A/T fluid hoses from each pipe



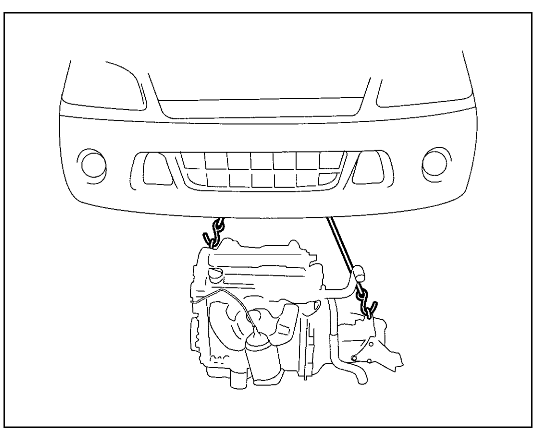
15) Remove suspension frame (1) with stabilizer bar and suspension control arms.
    Refer to Section 3.



16) Remove exhaust No.1 and No.2 pipes.
17) Disconnect right and left drive shaft joints from differential gear referring to Section 4A.
    For engine and transaxle removal, it is not necessary to remove drive shafts from steering knuckle.
18) For 4WD vehicle, remove propeller shaft referring to Section 4B.
19) Remove generator referring to Section 6H.
20) Remove clutch operation cylinder from transaxle. (For M/T vehicle)



21) Install lifting device.
22) Remove engine left mounting bolts (1) and engine right mounting bracket nuts (2).



23) Before removing engine with transaxle from body, recheck to make sure all hoses, electric wires and cables are disconnected from engine and transaxle.
24) Lower engine with transaxle from body.

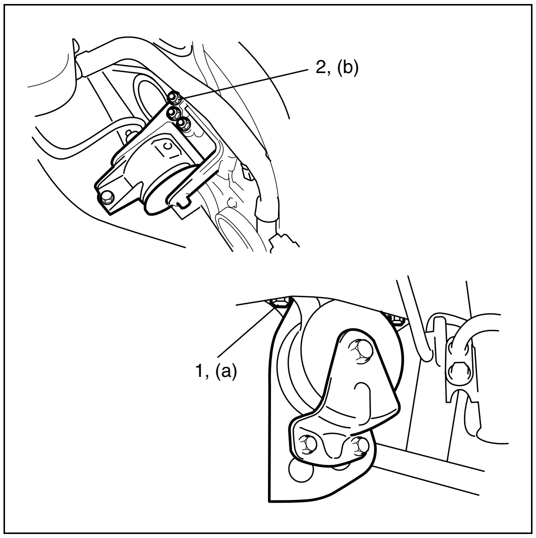
NOTE:

Before lowering engine, to avoid damage to P/S pump and/or A/C compressor, raise it through clearance made on engine crankshaft pulley side. At this time, use care so that no excessive force is applied to hoses.

25) Disconnect transaxle from engine, referring to Section 7A1 or 7B1.
26) Remove clutch cover and clutch disk, referring to Section 7C1 (M/T).

INSTALLATION

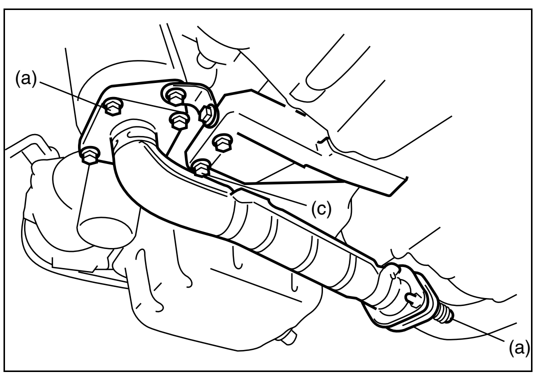
1) Install clutch cover and clutch disk referring to Section 7C1.
2) Connect transaxle to engine referring to Section 7A1 or 7B1.
3) Lift engine with transaxle into engine compartment, but do not remove lifting device.



4) Install engine left mounting bolts (1) and engine right mounting bracket nuts (2).
   Tighten these bolts and nuts to specified torque.

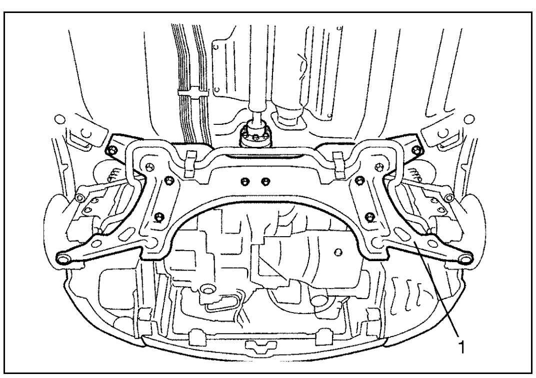
Tightening torque
Engine left mounting bolts
(a) : 55 N·m (5.5 kg-m, 40.0 lb-ft)
Engine right mounting bracket nuts
(b) : 75 N·m (7.5 kg-m, 54.5 lb-ft)

5) Remove lifting device.
6) Install clutch operating cylinder to transaxle.
7) Install generator referring to Section 6H.
8) For 4WD vehicle, install propeller shaft referring to Section 4B.
9) Connect drive shaft joints referring to Section 4A.



10) Install exhaust No.1 and No.2 pipes and tighten pipe fasteners to specified torque.

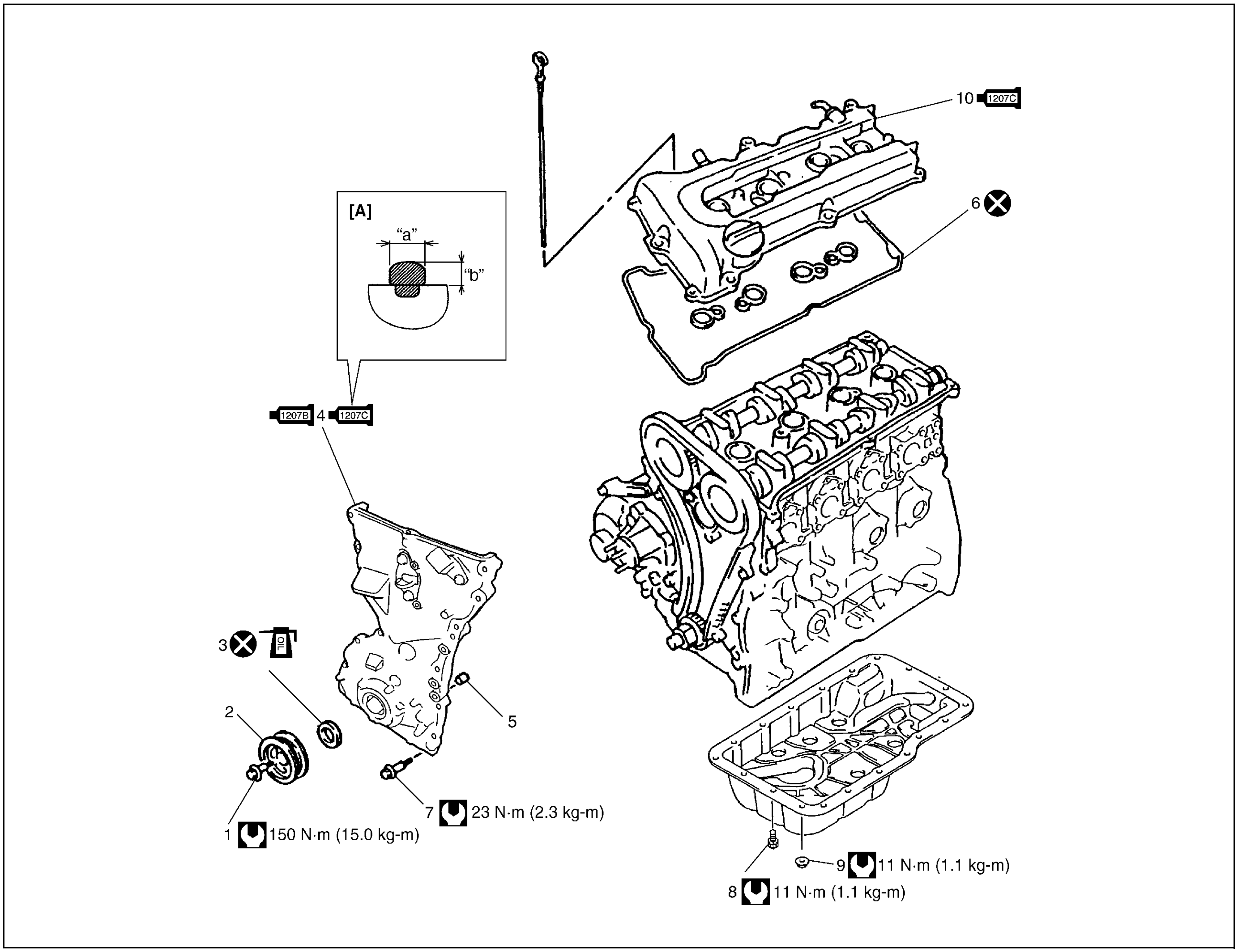
Tightening torque
Exhaust pipe bolts (a) : 50 N·m (5.0 kg-m, 36.5 lb-ft)



11) Install suspension frame (1) with stabilizer bar and suspension control arms.
    Refer to Section 3.
12) Reverse disconnected hoses, cables and electric wires for connection.
13) Install air cleaner case and hoses referring to “AIR CLEANER OUTLET HOSE”.
14) Install A/C compressor and/or P/S pump to its bracket (if equipped).
15) Adjust water pump belt tension referring to Section 0B.
16) Adjust A/C compressor and/or P/S belt tension (if equipped) referring to Section 0B.
17) Adjust accelerator cable play referring to Section 6E1.

18) Check to ensure that all removed parts are back in place. Reinstall any necessary parts which have not been reinstalled.
19) Refill cooling system with coolant, engine with engine oil and A/T with specified A/T fluid (vehicle with A/T).
20) Connect negative cable at battery.
21) Verify that there is no fuel leakage, coolant leakage, oil leakage, A/T fluid leakage (vehicle with A/T) and exhaust gas leakage at each connection.

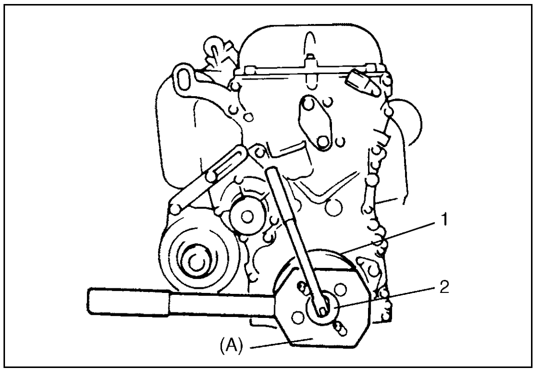
Timing Chain Cover



[A] : Sealant application amount	OIL	3. Oil seal : Apply engine oil to oil seal lip.	8. Oil pan mounting bolt
"a" : 3 mm (0.12 in.)	1207B 1207C	4. Timing chain cover : Apply sealant 99000-31140 to the mating surface of cylinder and cylinder head. : Apply sealant 99000-31150 to the mating surface of timing chain cover referring to the figure of Step 1) in INSTALLATION.	9. Oil pan mounting nut
"b" : 2 mm (0.08 in.)		5. Pin	1207C 10. Cylinder head cover : Apply sealant 99000-31150 to the sealing point for timing chain cover mating surface and cylinder head gasket sealing point. Refer to "CYLINDER HEAD COVER INSTALLATION".
1. Crankshaft pulley bolt		6. Cylinder head cover gasket	Tightening torque
2. Crankshaft pulley		7. Timing chain cover mounting bolts	Do not reuse.

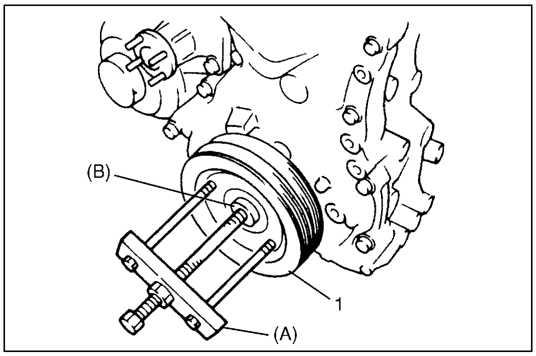
REMOVAL

1) Remove engine assembly from vehicle referring to "REMOVAL" of "ENGINE ASSEMBLY" in this section.



2) Remove crankshaft pulley bolt (2).
   To lock crankshaft pulley (1), use special tool with it as shown in figure.

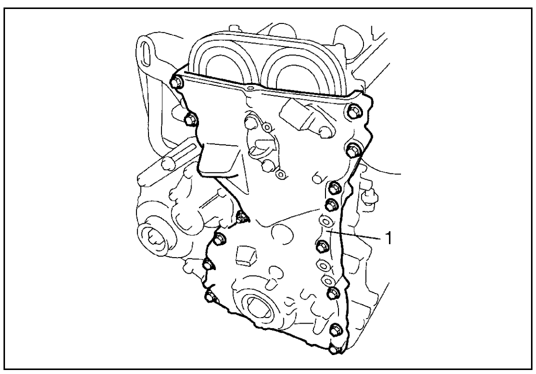
Special tool
(A) : 09917-68221



3) Remove crankshaft pulley (1).
   If it is hard to remove, use special tools as shown in figure.

Special tool
(A) : 09944-36011
(B) : 09926-58010

4) Remove cylinder head cover and oil pan.
5) Remove P/S pump bracket (if equipped).
6) Remove water pump pulley.

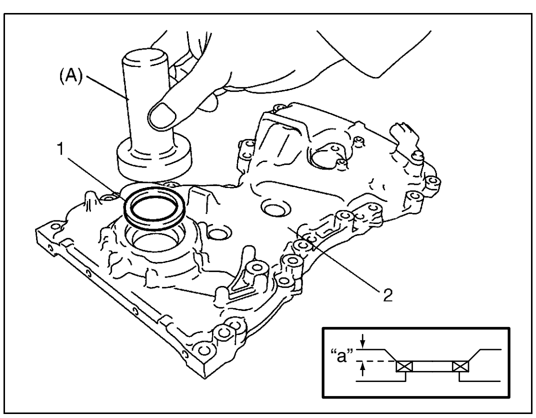


7) Remove timing chain cover (1).

CLEAN

- Clean sealing surface on timing chain cover, cylinder block and cylinder head.
  Remove oil, old sealant and dust from sealing surface.

INSPECTION



- Check oil seal (1) lip for fault or other damage.
  Replace as necessary.

NOTE:

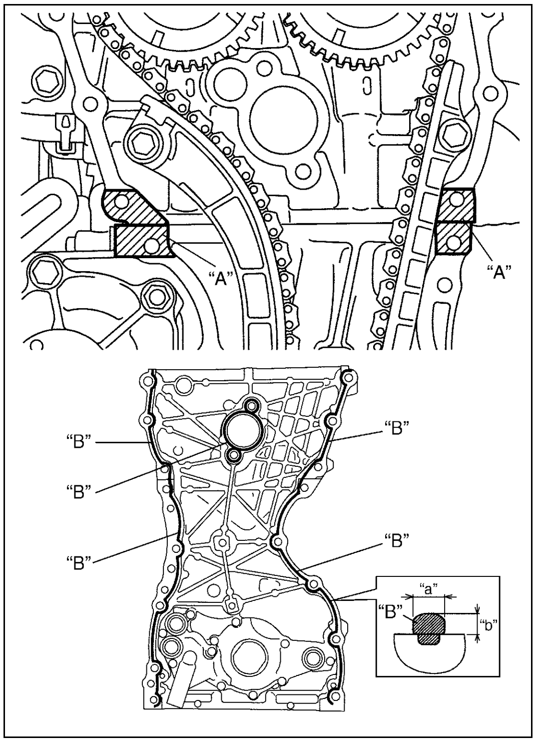
When installing new oil seal, press fit to timing chain cover (2) by using special tool (Bearing installer) as shown in the figure.

Special tool
(A) : 09913-75810

Drive in dimension
“a” : 1.5 mm (0.06 in.)

INSTALLATION

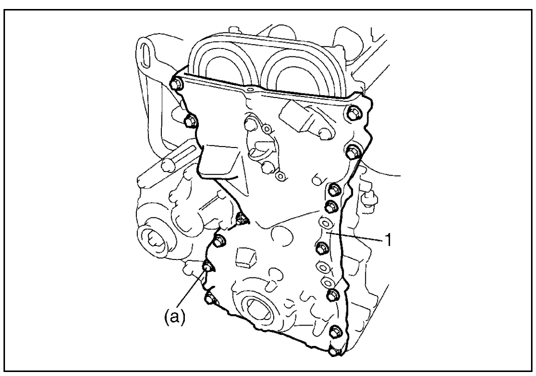
Reverse removal procedure to install timing chain cover, noting the following points.



1) Apply sealant “A” to mating surface of cylinder and cylinder head and “B” to mating surface of timing chain cover as shown in figure.

“A” : Sealant 99000-31140
“B” : Sealant 99000-31150

Sealant amount for timing chain cover
Width “a” : 3 mm (0.12 in.)
Height “b” : 2 mm (0.08 in.)



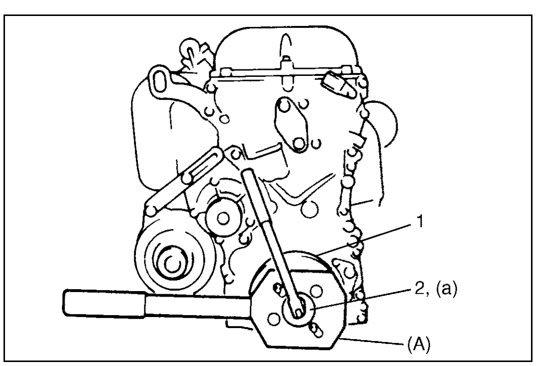
2) Apply engine oil to oil seal lip, then install timing chain cover (1).
   Tighten bolts and nut to specified torque.

NOTE:

Before installing timing chain cover, check that pin is securely fitted.

Tightening torque
Timing chain cover bolts (a) : 23 N·m (2.3 kg-m, 17.0 lb-ft)

3) Install water pump pulley.
4) Install P/S pump bracket (if equipped).
5) Install cylinder gear cover.
6) Install oil pan.



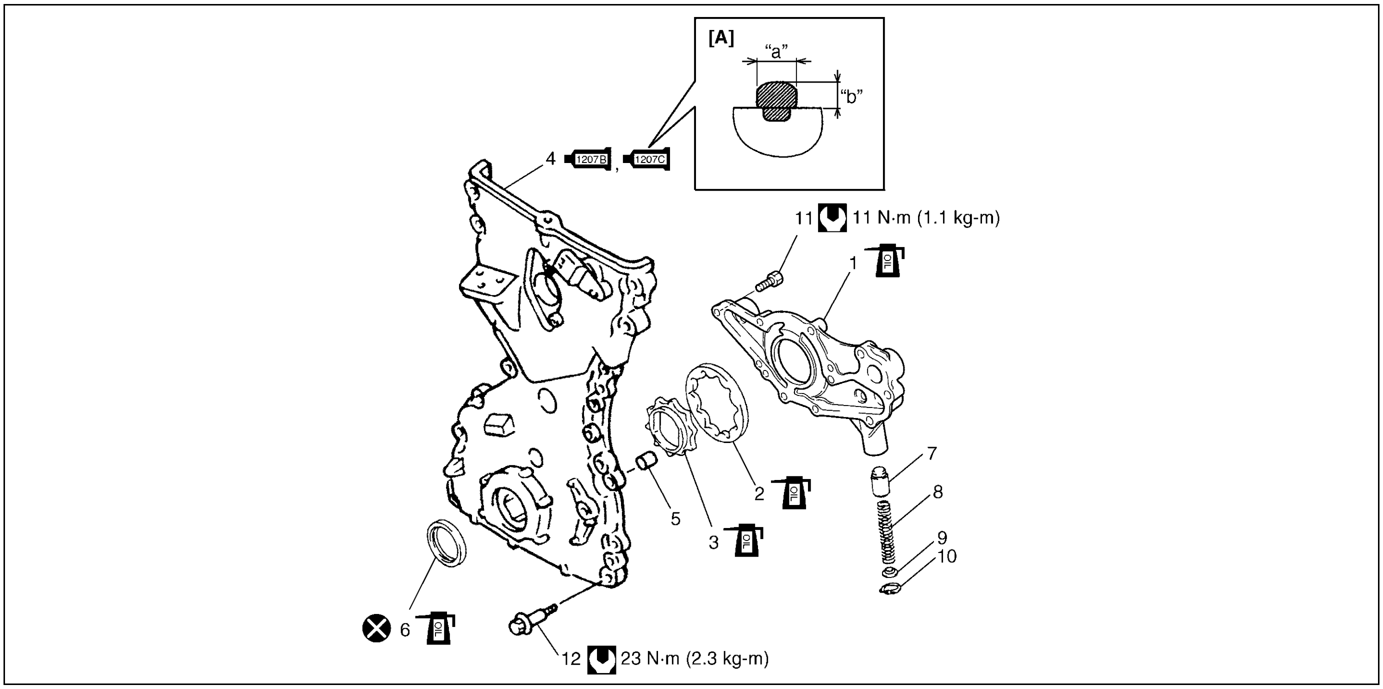
7) Install crankshaft pulley (1). Tighten bolt (2) to specified torque. To lock crankshaft pulley, use special tool with it as shown in the figure.

Special tool
(A) : 09917-68221

Tightening torque
Crankshaft pulley bolt (a) : 150 N·m (15.0 kg-m, 108.5 lb-ft)

8) Install engine assembly to vehicle referring to “INSTALLATION” of “ENGINE ASSEMBLY” in this section.

Oil Pump

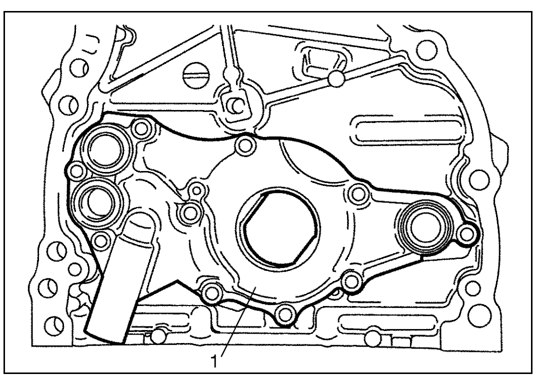


[A] :	Sealant application amount	4.	Timing chain cover : Apply sealant 99000-31140 to the mating surface of cylinder and cylinder head. : Apply sealant 99000-31150 to mating surface of timing chain cover referring to the figure of Step 1) in "TIMING CHAIN COVER INSTALLATION".	10.	Circlip
"a" :	3 mm (0.12 in.)	5.	Pin	11.	Oil pump mounting bolt
"b" :	2 mm (0.08 in.)	6.	Oil seal	12.	Timing chain cover mounting bolts
1.	Rotor plate	7.	Relief valve		Tightening torque
2.	Outer rotor	8.	Spring		Do not reuse.
3.	Inner rotor	9.	Retainer		Apply thin coat of engine oil to sliding surface of each parts.

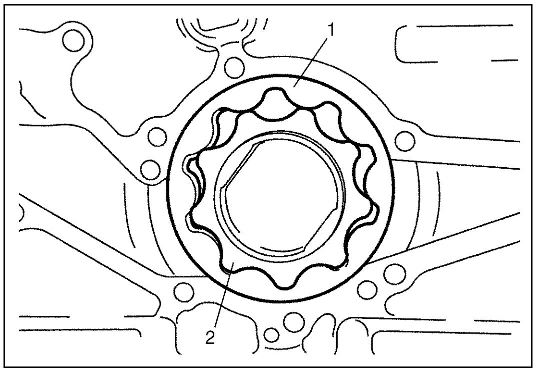
REMOVAL

Remove timing chain cover referring to "TIMING CHAIN COVER".

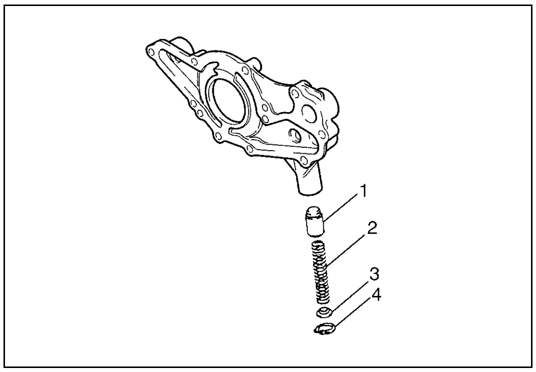
DISASSEMBLY



1) Remove rotor plate (1) by removing its mounting bolts.

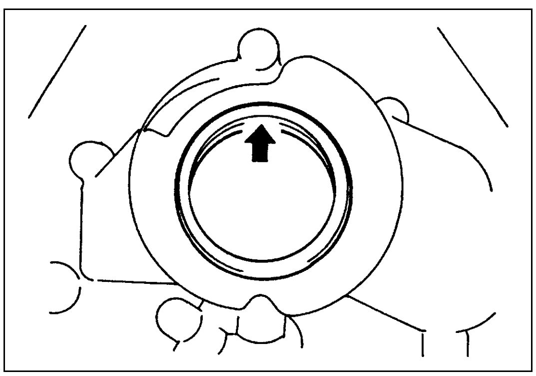


2) Remove outer rotor (1) and inner rotor (2).

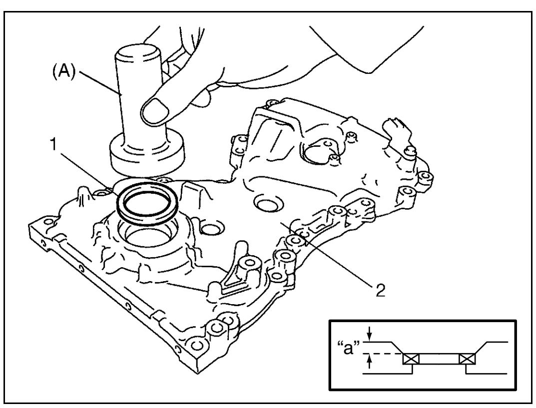


3) Remove relief valve (1), spring (2) and retainer (3) by removing circlip (4).

INSPECTION



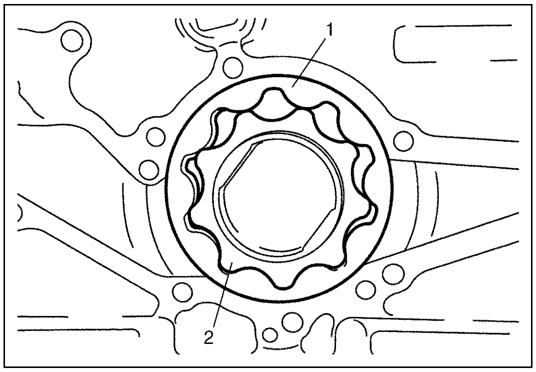
- Check oil seal lip for fault or other damage. Replace as necessary.



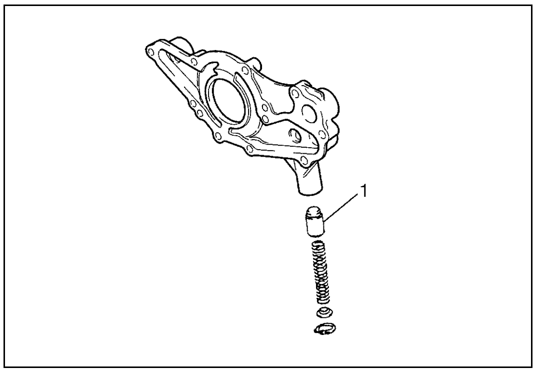
NOTE:
When installing new oil seal (1), press-fit it to oil pump case (2) by using special tool as shown in the figure.

Special tool
(A) : 09913-75810

Drive in dimension
"a" : 1.5 mm (0.06 in.)



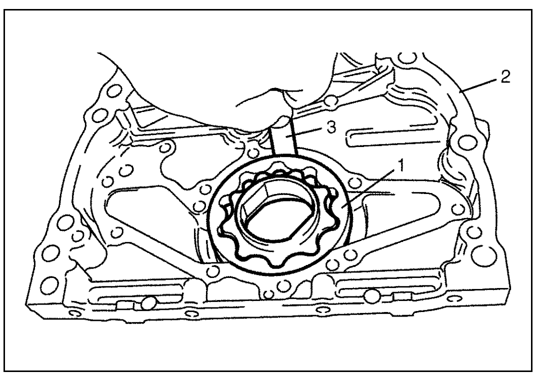
- Check outer (1) and inner rotors (2), rotor plate, and oil pump case for excessive wear or damage.



- Check relief valve (1) for excessive wear or damage and operates smoothly.

MEASUREMENT

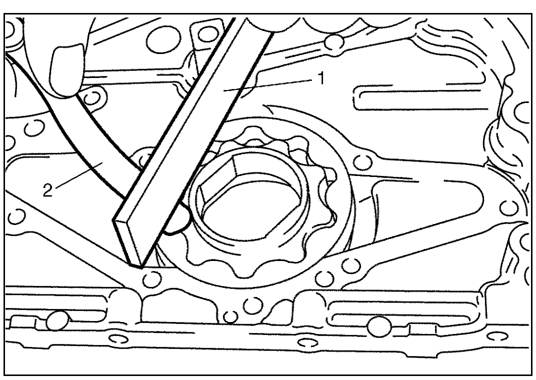
Radial clearance



Check radial clearance between outer rotor (1) and case (2), using thickness gauge (3).
If clearance exceeds its limit, replace outer rotor or case.

Limit on radial clearance between outer rotor and case for oil pump
: 0.310 mm (0.0122 in.)

Side clearance

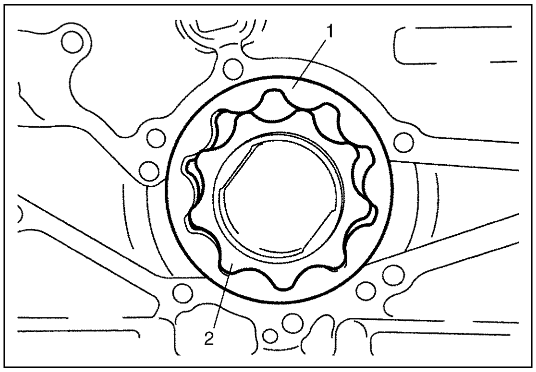


Using straight edge (1) and thickness gauge (2), measure side clearance.

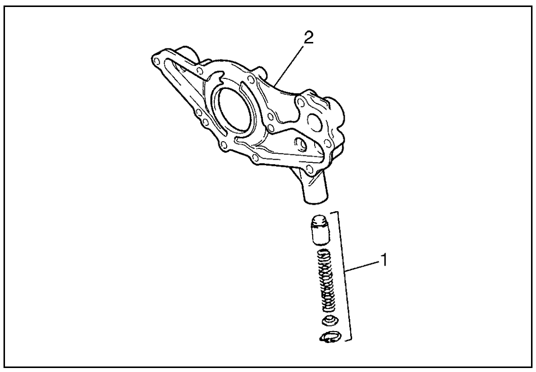
Limit on side clearance for oil pump inner rotor
: 0.15 mm (0.0059 in.)

ASSEMBLY

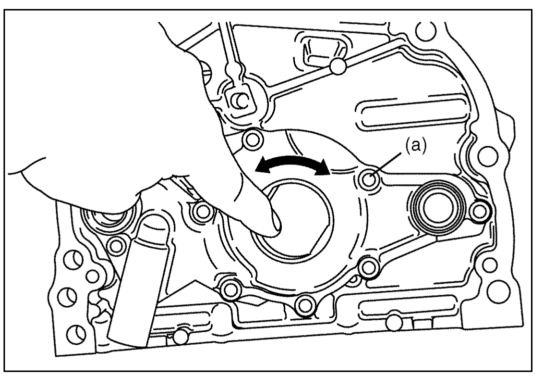
1) Wash, clean and then dry all disassembled parts.
2) Apply thin coat of engine oil to inner and outer rotors, oil seal lip portion, and inside surfaces of oil pump case and plate.



3) Install outer (1) and inner rotors (2) to oil pump case.



4) Install relief valve component (1) to rotor plate (2).



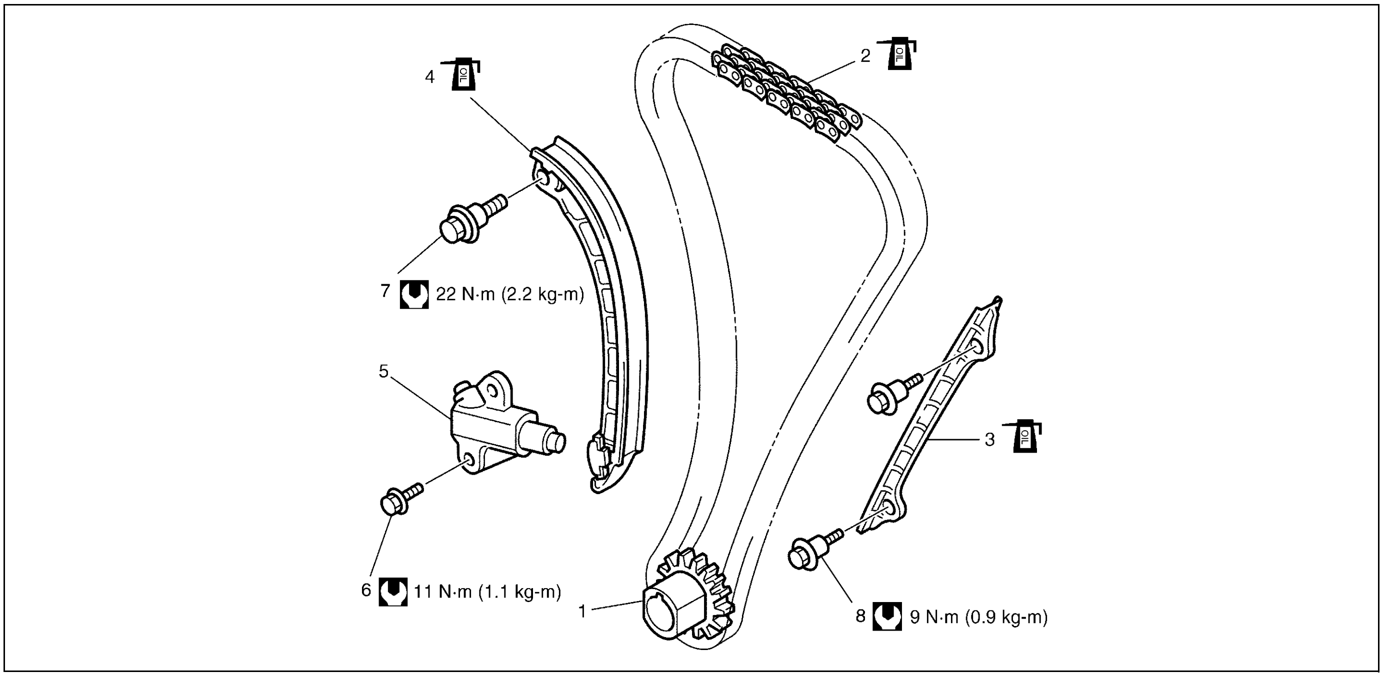
5) Install rotor plate and tighten all bolts to specified torque. After installing plate, check to be sure that rotors turn smoothly by hand (0.3 N·m (0.03 kg-m, 0.25 lb-ft) torque or below).

Tightening torque
Oil pump rotor plate bolts (a) : 11 N·m (1.1 kg-m, 8.0 lb-ft)

INSTALLATION

For installation referring to “TIMING CHAIN COVER”.

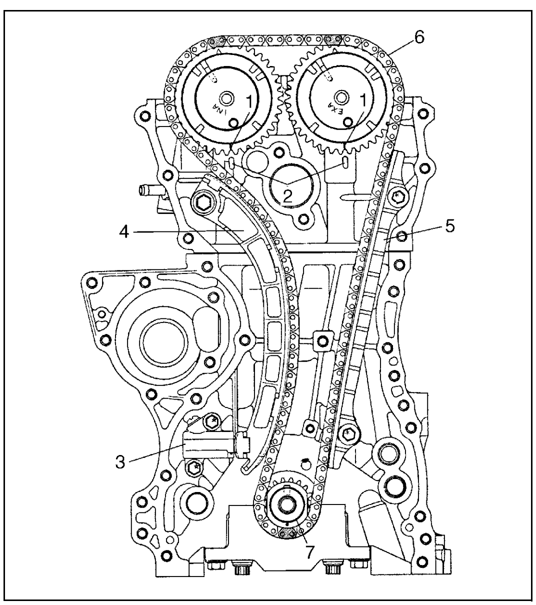
Timing Chain and Chain Tensioner



1. Crankshaft timing sprocket	4. Timing chain tensioner : Apply engine oil to sliding surface.	7. Chain tensioner mounting bolt
2. Timing chain : Apply engine oil.	5. Timing chain tensioner adjuster assembly	8. Chain guide mounting bolt
3. Timing chain No.1 guide : Apply engine oil to sliding surface.	6. Chain tensioner adjuster mounting bolt	Tightening torque

REMOVAL

1) Remove timing chain cover referring to “TIMING CHAIN COVER”.

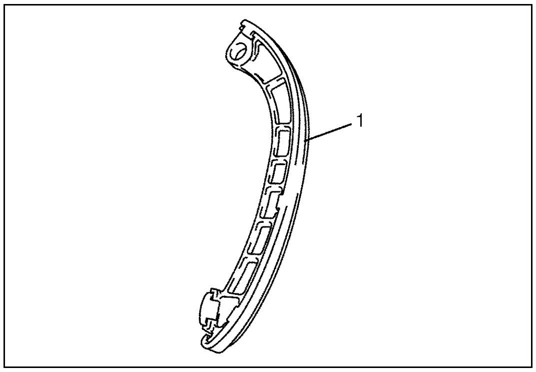


2) Align both intake and exhaust camshaft timing sprocket marks (1) with notches (2) of cylinder head respectively by turning crankshaft.
3) Remove timing chain tensioner adjuster assembly (3).
4) Remove timing chain tensioner (4).
5) Remove timing chain No.1 guide (5).
6) Remove timing chain (6) with crankshaft timing sprocket (7).

CAUTION:

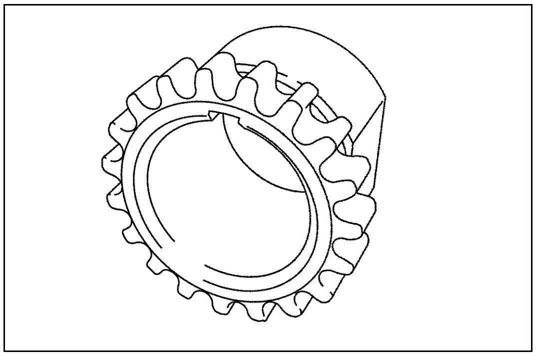
After timing chain is removed, never turn crankshaft and camshafts independently more than its allowable turning range described in “INSTALLATION” section.
If turned, interference may occur between piston and valves and valves themselves, and parts related to piston and valves may be damaged.

INSPECTION



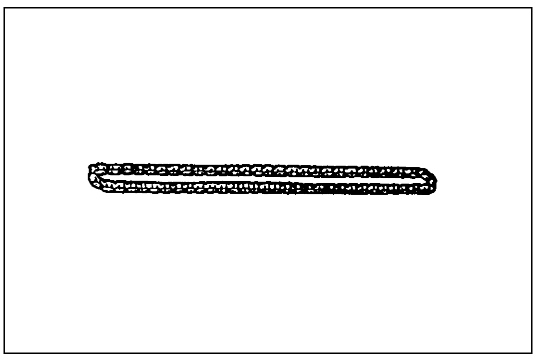
Timing chain tensioner

- Check shoe (1) for wear or damage.



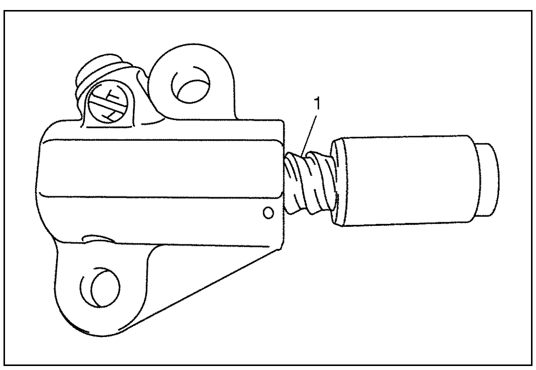
Crankshaft timing sprocket

- Check teeth of sprocket for wear or damage.



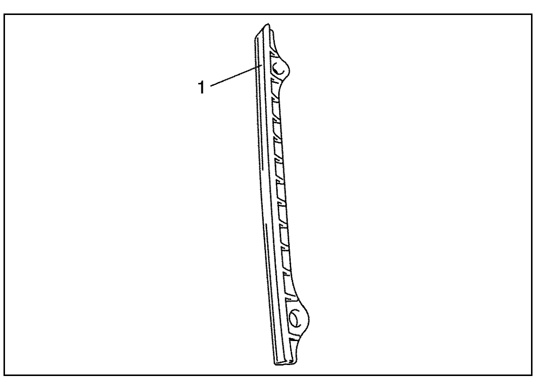
Timing chain

- Check timing chain for wear or damage.



Timing chain tensioner adjuster

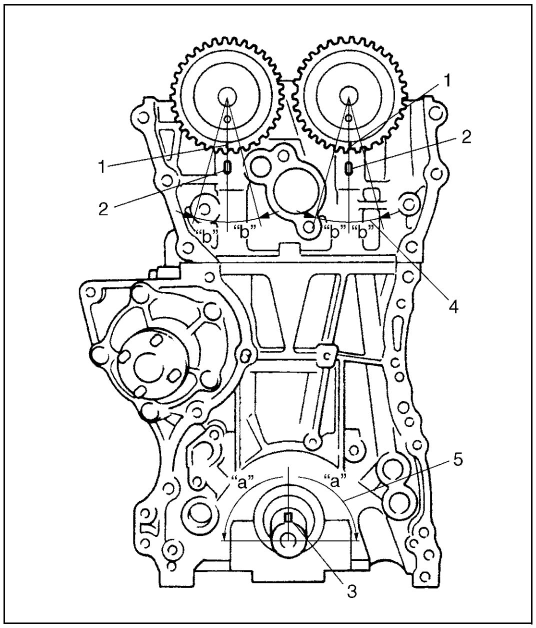
- Check that tooth surface (1) are free from damage.



Timing chain No.1 guide

- Check shoe (1) for wear or damage.

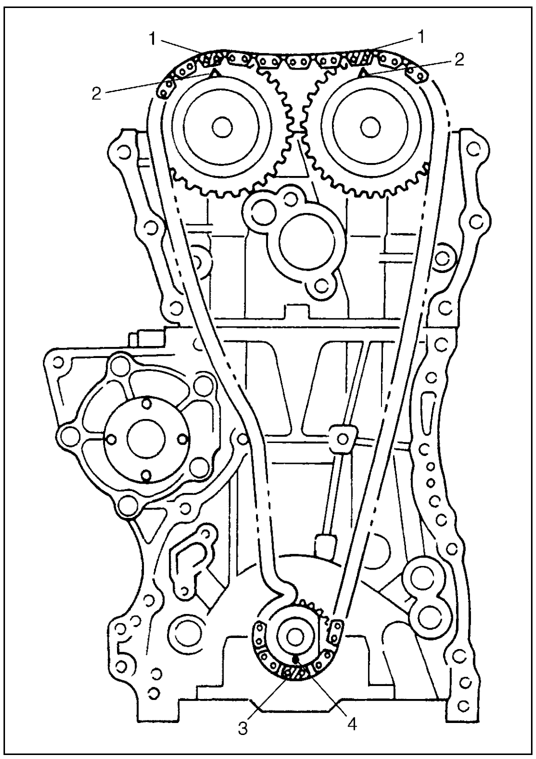
INSTALLATION



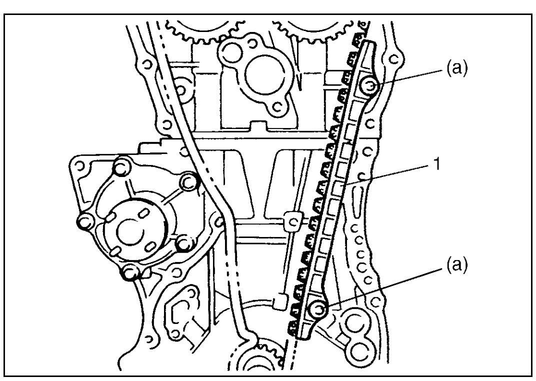
> **CAUTION:**
>
> **After timing chain is removed, never turn crankshaft and camshafts independently more than such an extent ("a", "b") as shown in figure.**
> **If turned, interference may occur between piston and valves and valves themselves, and parts related to piston and valves may be damaged.**

1) Check that match marks (1) on intake and exhaust camshaft timing sprockets are in match with notches (2) on cylinder head as shown in figure.
2) Set key (3) and turn crankshaft to position key on upside of crankshaft.

"a" : 90°	4. Camshaft (IN and EX) allowable turning range. By marks on camshaft timing sprocket within 15° from notches on cylinder head on both right and left.
"b" : 15°	5. Crankshaft allowable turning range. By key on crankshaft, within 90° from top on both right and left.

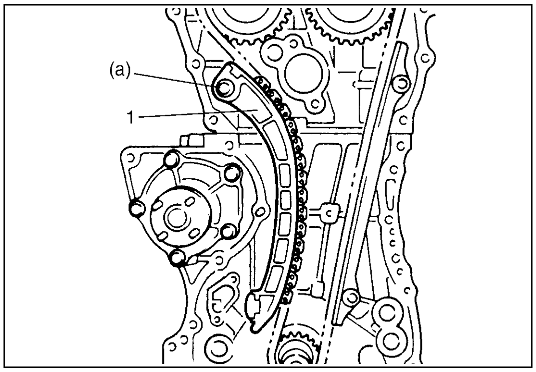


3) Install timing chain by aligning dark blue plate (1) of timing chain and triangle mark (2) on camshaft timing sprocket as shown in figure.
4) Fit crankshaft timing sprocket to timing chain by aligning gold plate (3) of timing chain and mark (4) on crankshaft timing sprocket. Then install crankshaft timing sprocket fitted with chain to crankshaft.



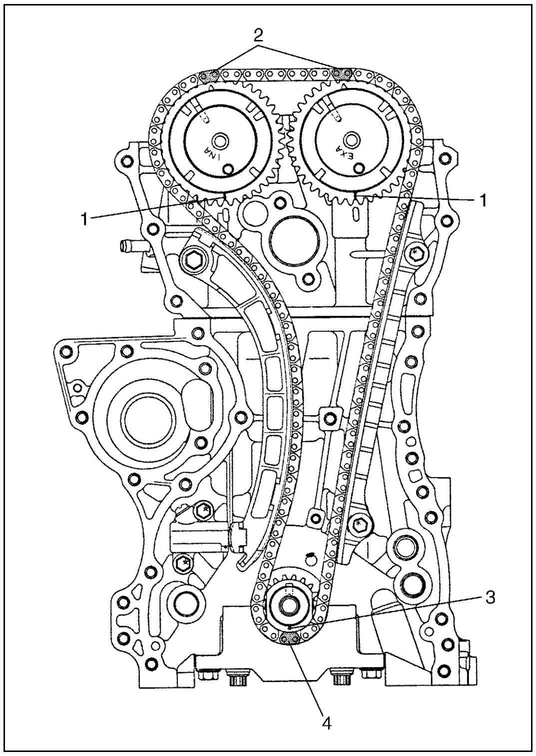
5) Apply engine oil to sliding surface of timing chain No.1 guide (1) and install it as shown in figure.
   Tighten guide bolts to specified torque.

Tightening torque
Timing chain No.1 guide bolts
(a) : 9 N·m (0.9 kg-m, 6.5 lb-ft)

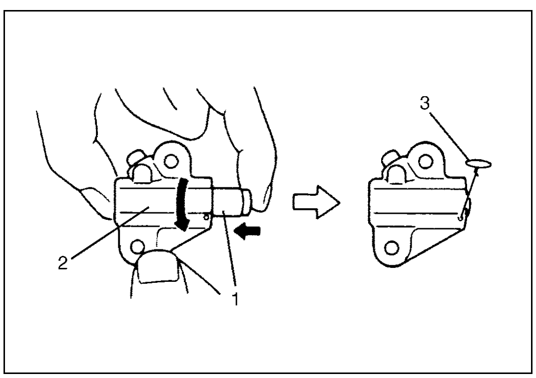


6) Apply engine oil to sliding surface of chain tensioner (1) and install chain tensioner and spacer.
   Tighten tensioner bolt to specified torque

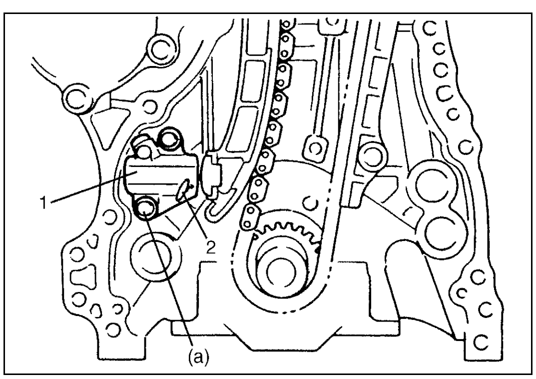
Tightening torque
Timing chain tensioner bolt
(a) : 22 N·m (2.2 kg-m, 16.0 lb-ft)



7) Check that match marks (1) on intake and exhaust camshaft timing sprockets are in match with making timing chain (2) and match mark on crankshaft timing sprocket (3) are in with marking timing chain(4).

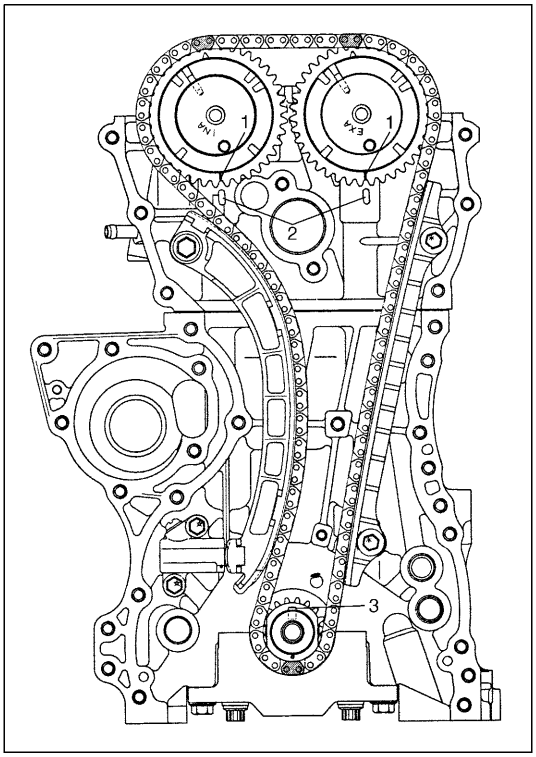


8) Screw in plunger (1) by turning body (2) in arrow direction and install a retainer (3) (wire) to hold plunger in place.



9) Install timing chain tensioner adjuster assembly (1) with a retainer (2).
   Tighten adjuster bolts to specified torque and then remove a retainer from chain tensioner adjuster assembly.

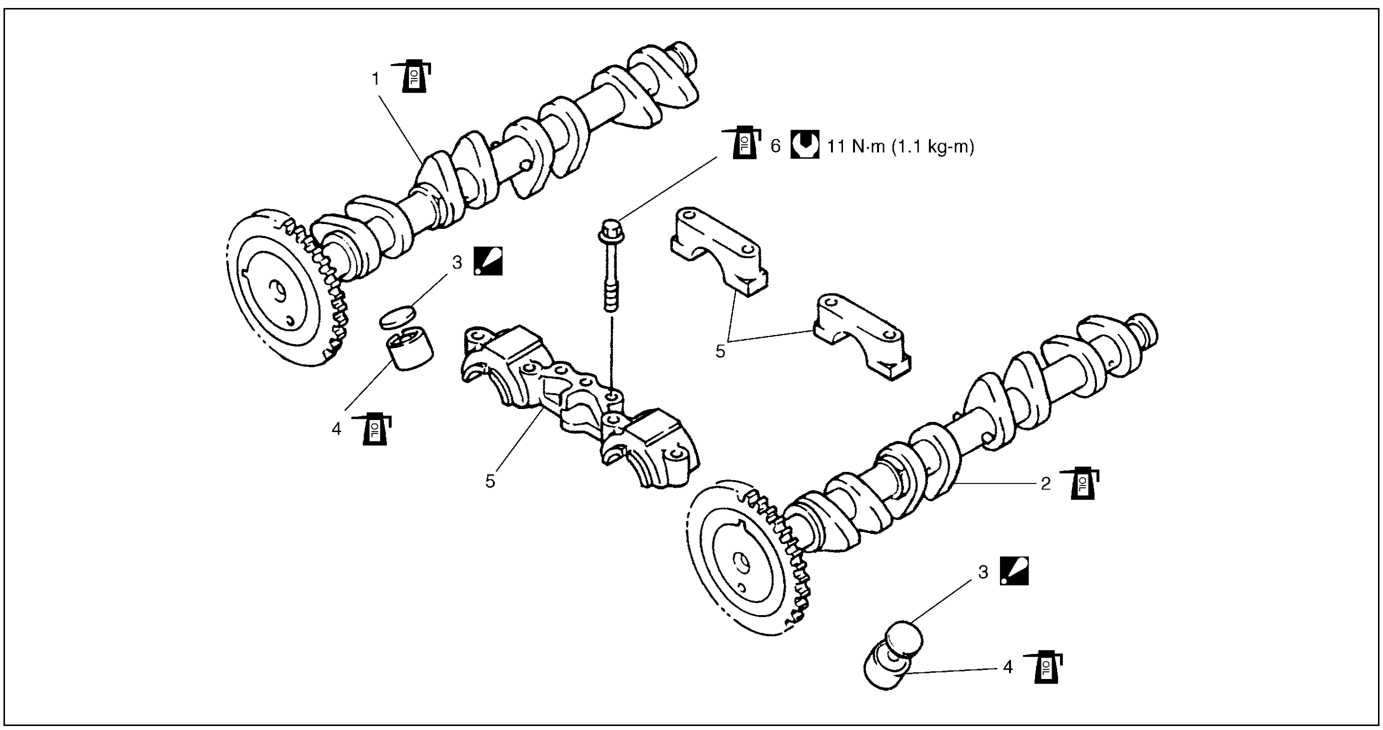
Tightening torque
Timing chain tensioner adjuster bolts
(a) : 11 N·m (1.1 kg-m, 8.0 lb-ft)



10) Apply engine oil to timing chain and then turn crankshaft clockwise by 2 revolutions and check that match marks (1) on intake and exhaust camshaft timing sprockets are in match with notches (2) on cylinder head and key (3) is on upside of crankshaft as shown in figure.
If each marking chain and each match mark are no matches, adjust each sprockets and timing chain.

11) Install timing chain cover referring to "TIMING CHAIN COVER".
12) Perform Steps 3) to 8) of "INSTALLATION" of "TIMING CHAIN COVER" in this section.

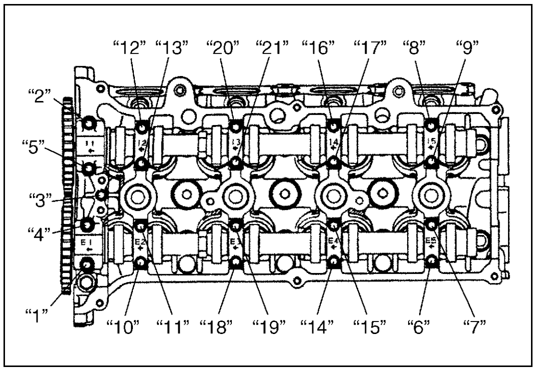
Camshaft, Tappet and Shim



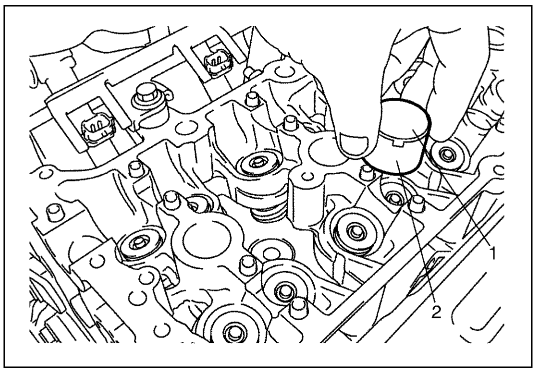
1. Intake camshaft	4. Tappet	Tightening torque
2. Exhaust camshaft	5. Camshaft housing	Apply engine oil to sliding surface of each part.
3. Shim : Shim No. on it faces tappet side.	6. Camshaft housing bolt	

REMOVAL

1) Remove timing chain cover referring to “TIMING CHAIN COVER”.
2) Remove timing chain referring to “TIMING CHAIN AND CHAIN TENSIONER”.



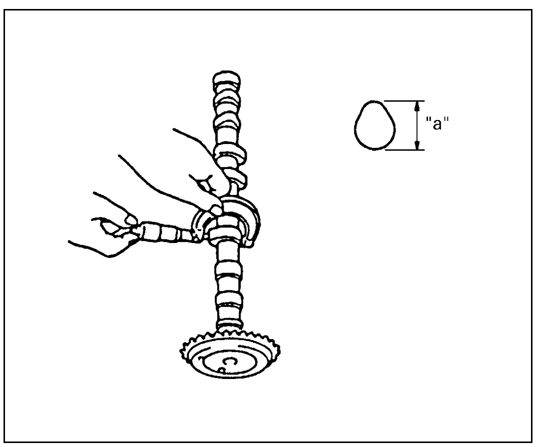
3) Loosen camshaft housing bolts in such order as indicated in figure and remove them.
4) Remove camshaft housings.
5) Remove intake and exhaust camshafts.



6) Remove tappets (2) with shims (1).

INSPECTION

Cam wear

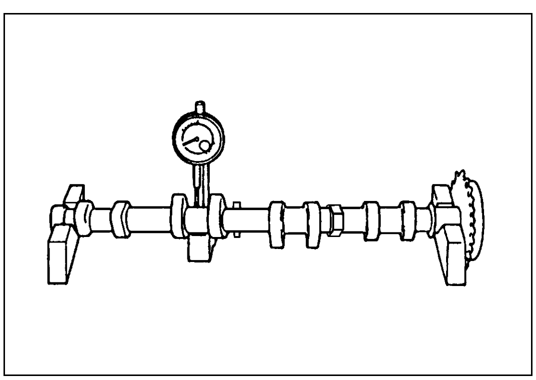


Using a micrometer, measure cam height “a”. If measured height is below its limit, replace camshaft.

Cam height “a” of camshaft

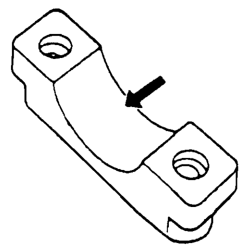
	Standard	Limit
Intake cam	**44.919 – 45.079 mm (1.768 – 1.775 in.)**	**44.80 mm (1.764 in.)**
Exhaust cam	**44.399 – 44.559 mm (1.748 – 1.754 in.)**	**44.28 mm (1.743 in.)**

Camshaft runout



Set camshaft between two “V” blocks, and measure its runout by using a dial gauge.
If measured runout exceeds below limit, replace camshaft.

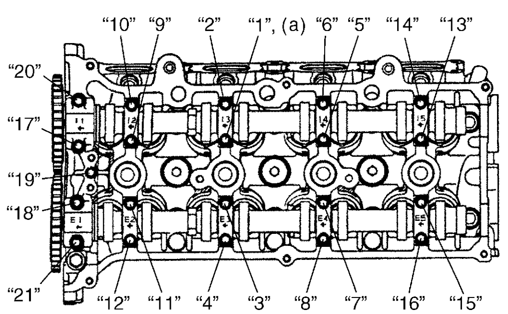
Camshaft runout limit
: 0.10 mm (0.0039 in.)



Camshaft journal wear

Check camshaft journals and camshaft housings for pitting, scratches, wear or damage.
If any malcondition is found, replace camshaft or cylinder head with housing. Never replace cylinder head without replacing housings.
Check clearance by using gaging plastic. Checking procedure is as follows.

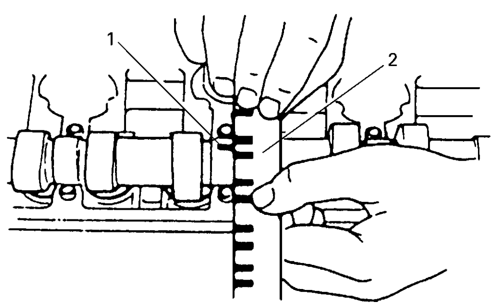
1) Clean housings and camshaft journals.
2) Remove all tappets with shims.
3) Install camshafts to cylinder head.
4) Place a piece of gaging plastic to full width of journal of camshaft (parallel to camshaft).
5) Install camshaft housing.



6) Tighten camshaft housing bolts in such order as indicated in figure a little at a time till they are tightened to specified torque.

NOTE:
Do not rotate camshaft while gaging plastic is installed.

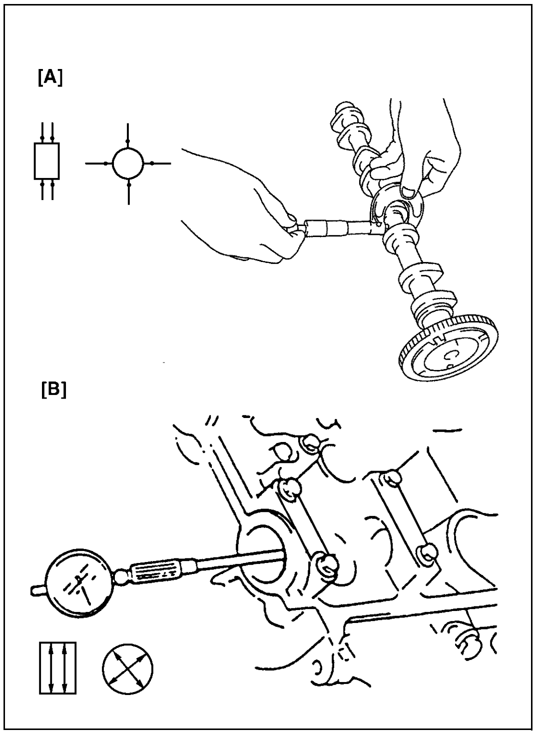
Tightening torque
Camshaft housing bolts (a) : 11 N·m (1.1 kg-m, 8.0 lb-ft)



7) Remove housing, and using scale (2) on gaging plastic (1) envelop, measure gaging plastic width at its widest point.

Camshaft journal clearance

Standard	Limit
0.045 – 0.087 mm (0.0018 – 0.0034 in.)	0.12 mm



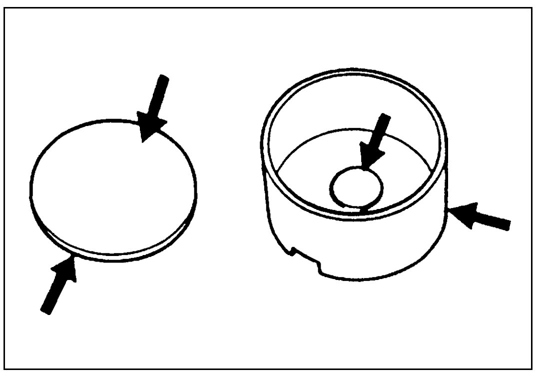
If measured camshaft journal clearance exceeds limit, measure journal (housing) bore and outside diameter of camshaft journal. Replace camshaft or cylinder head assembly whichever the difference from specification is greater.

Camshaft journal diameter [A]

Item	Standard
No.1	26.934 – 26.955 mm (1.0604 – 1.0612 in.)
Other	22.934 – 22.955 mm (0.9029 – 0.9037 in.)

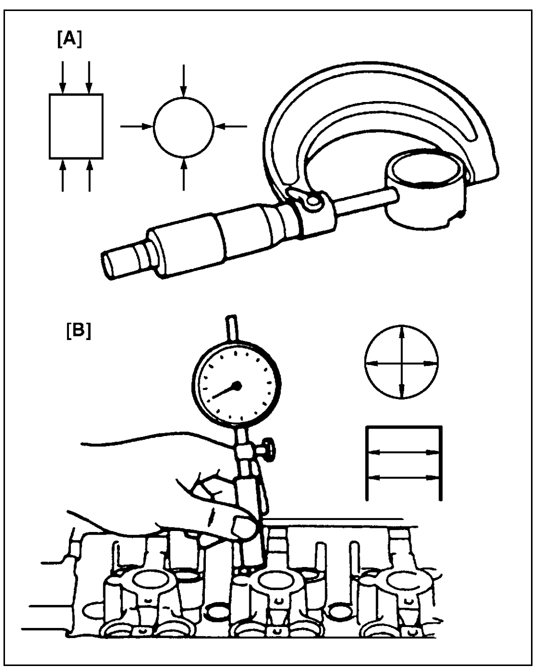
Camshaft journal bearing bore [B]

Item	Standard
No.1	27.000 – 27.021 mm (1.0630 – 1.0638 in.)
Other	23.000 – 23.021 mm (0.9055 – 0.9063 in.)



Wear of tappet and shim

Check tappet and shim for pitting, scratches or damage.
If any malcondition is found, replace.



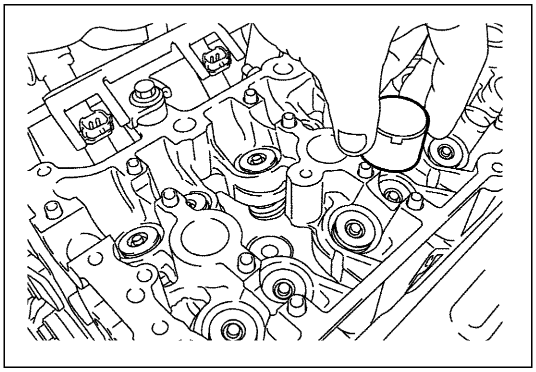
Measure cylinder head bore and tappet outside diameter to determine cylinder head-to-tappet clearance. If clearance exceeds limit, replace tappet or cylinder head.

Cylinder head to tappet clearance
Standard : 0.025 – 0.066 mm (0.0010 – 0.0026 in.)
Limit : 0.15 mm (0.0059 in.)

Tappet outside diameter [A]
Standard : 30.959 – 30.975 mm (1.2189 – 1.2195 in.)

Cylinder head tappet bore [B]
Standard : 31.000 – 31.025 mm (1.2205 – 1.2215 in.)

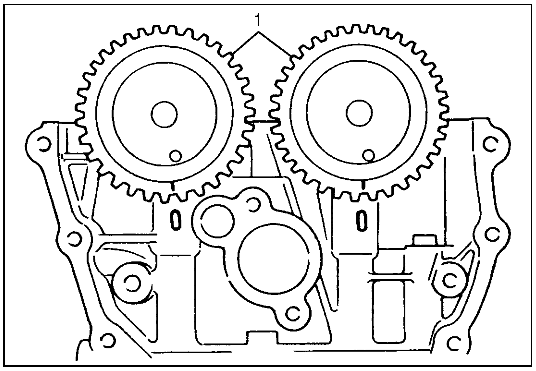
INSTALLATION



1) Install tappets and shims to cylinder head.
   Apply engine oil around tappet and then install it to cylinder head.

NOTE:

When installing shim, make sure to direct shim No. side toward tappet.

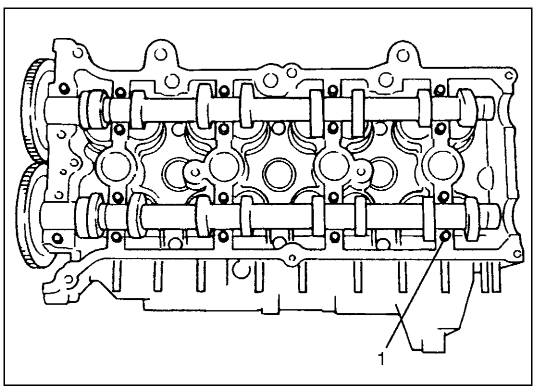


2) Install camshafts (1).

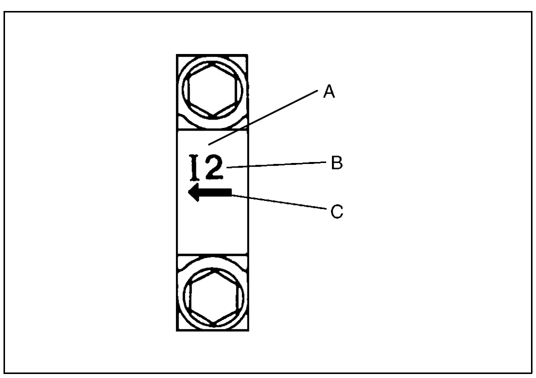
NOTE:

Before installing camshafts, turn crankshaft until key position faces upward. Refer to "TIMING CHAIN AND CHAIN TENSIONER".

Apply engine oil to sliding surface of each camshaft and camshaft journal then install them as shown in figure.

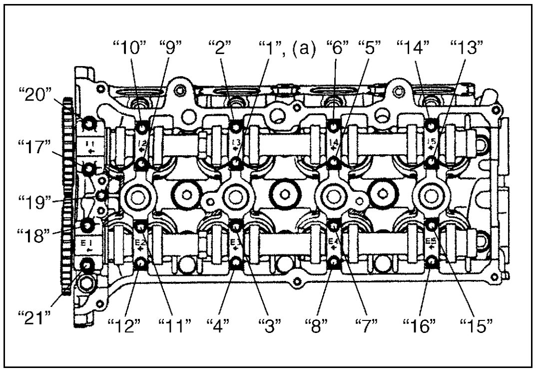


3) Install camshaft housing pins (1) as shown in figure.



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

A.	I : Intake side or E : Exhaust side
B.	Position from timing chain side
C.	Pointing to timing chain side

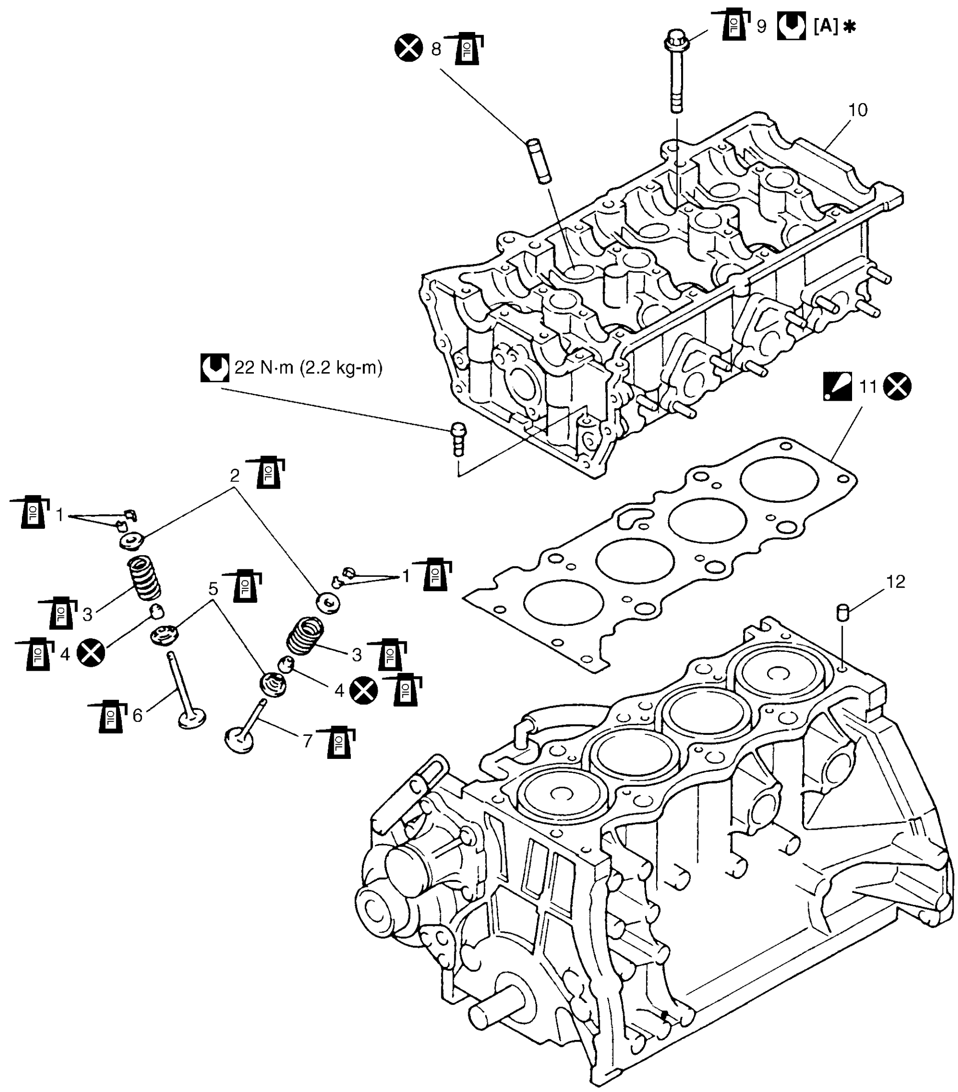


5) After applying engine oil to housing bolts, tighten them temporarily first. Then tighten them by the following numerical order in figure. Tighten a little at a time and evenly among bolts and repeat tightening sequence two or three times before they are tightened to specified torque.

Tightening torque
Camshaft housing bolts (a) : 11 N·m (1.1 kg-m, 8.0 lb-ft)

6) Install timing chain with crankshaft sprocket referring to "TIMING CHAIN AND CHAIN TENSIONER".
7) Install timing chain cover referring to "TIMING CHAIN COVER".
8) Check valve lashes as previously outlined.
9) Perform Steps 3) to 8) of "INSTALLATION" of "TIMING CHAIN COVER" in this section.

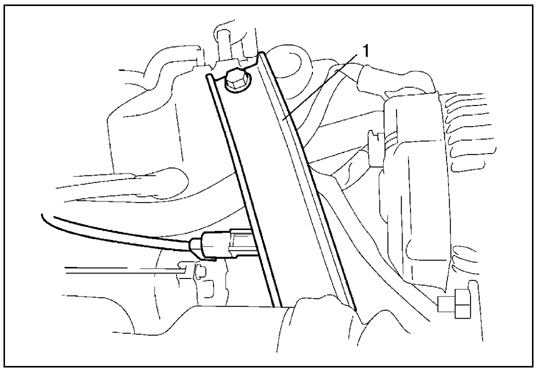
Valves and Cylinder Head



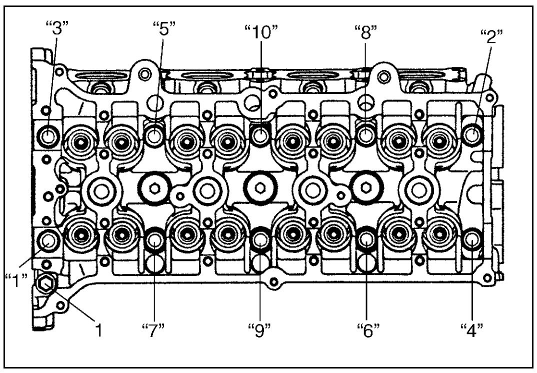
[A]✱ 1) Tighten all bolts at 40 N·m (4.0 kg-m) 2) Turn all bolts at 60° 3) Then, Turn all bolt at 60° once again	6. Intake valve	12. Knock pin
1. Valve cotters	7. Exhaust valve	Tightening torque
2. Valve spring retainer	8. Valve guide	Do not reuse.
3. Valve spring	9. Cylinder head bolt	Apply engine oil to sliding surface of each part.
4. Valve stem seal	10. Cylinder head	
5. Valve spring seat	11. Cylinder head gasket : “TOP” mark provided on gasket comes to crankshaft pulley side, facing up.	

REMOVAL

1) Remove engine assembly from vehicle referring to "REMOVAL" of "ENGINE ASSEMBLY" in this section.



2) Remove intake manifold stiffener (1).
3) Remove oil pan.
4) Remove cylinder head cover.
5) Remove timing chain cover referring to Steps 2) to 7) of "REMOVAL" in "TIMING CHAIN COVER".
6) Remove timing chain referring to Steps 2) to 6) of "REMOVAL" in "TIMING CHAIN AND CHAIN TENSIONER".
7) Remove intake and exhaust camshafts referring to Steps 3) to 7) of "REMOVAL" in "CAMSHAFT, TAPPET AND SHIM".



8) Loosen cylinder head bolts in such order as indicated in figure by using a 12 corner socket wrenches and remove them.

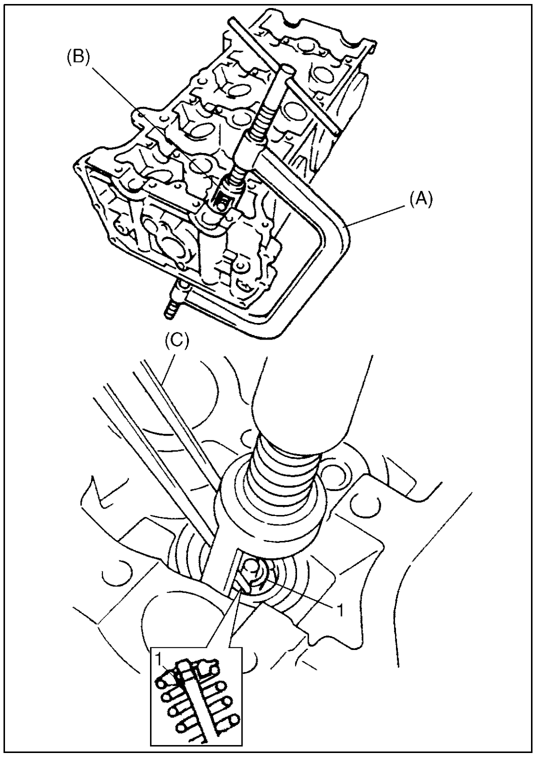
NOTE:

Don't forget to remove bolt (M8) (1) as shown in figure.

9) Check all around cylinder head for any other parts required to be removed or disconnected and remove or disconnect whatever necessary.
10) Remove exhaust manifold, if necessary, referring to "EXHAUST MANIFOLD".
11) Remove cylinder head with intake manifold and exhaust manifold. Use lifting device, if necessary.

DISASSEMBLY

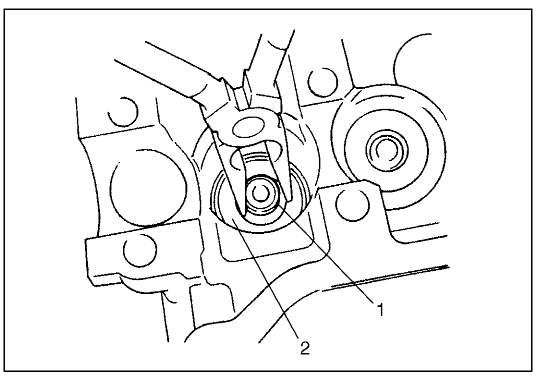
1) For ease in servicing cylinder head, remove intake manifold, injectors and exhaust manifold from cylinder head.



2) Using special tools (Valve lifter), compress valve spring and then remove valve cotters (1) by using special tool (Forceps).

Special tool
(A) : 09916-14510
(B) : 09916-14910
(C) : 09916-84511

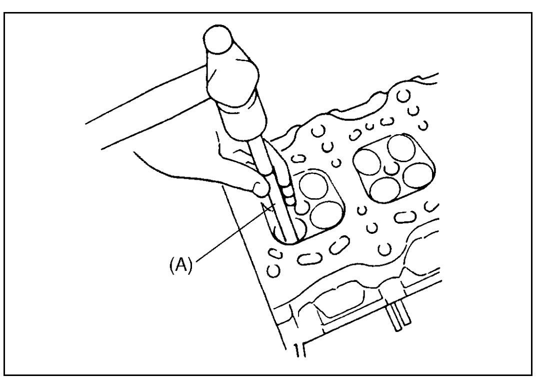
3) Release special tool, and remove spring retainer and valve spring.
4) Remove valve from combustion chamber side.



5) Remove valve stem seal (1) from valve guide, and then valve spring seat (2).

NOTE:

Do not reuse seal once disassembled. Be sure to use new oil seal when assembling.



6) Using special tool (valve guide remover), drive valve guide out from combustion chamber side to valve spring side.

Special tool
(A) : 09916-44910

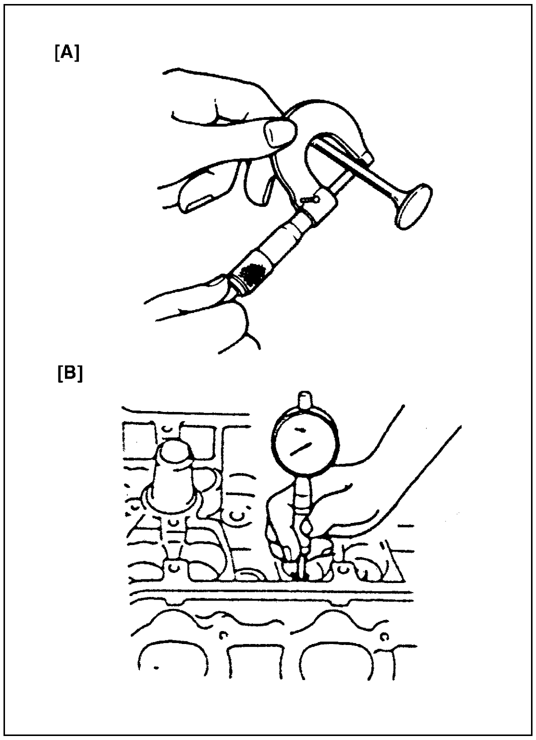
NOTE:

Do not reuse valve guide once disassembled. Be sure to use new valve guide (Oversize) when assembling.

7) Place disassembled parts except valve stem seal and valve guide in order so that they can be installed in their original position.

INSPECTION

Valve guides



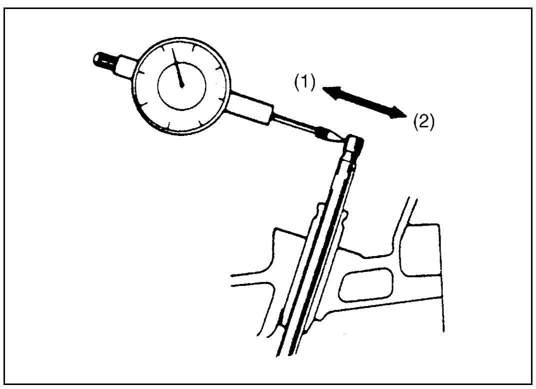
Using a micrometer and bore gauge, take diameter readings on valve stems and guides to check stem-to-guide clearance. Be sure to take reading at more than one place along the length of each stem and guide.
If clearance exceeds limit, replace valve and valve guide.

Valve stem-to-guide clearance

Item	Standard	Limit
In	0.005 – 0.045 mm (0.0002 – 0.0017 in.)	0.07 mm (0.0028 in.)
Ex	0.03 – 0.07 mm (0.0012 – 0.0027 in.)	0.09 mm (0.0035 in.)

Valve stem diameter [A] standard
In : 5.465 – 5.480 mm (0.2150 – 0.2157 in.)
Ex : 5.440 – 5.455 mm (0.2142 – 0.2148 in.)

Valve guide bore [B] standard
In and Ex : 5.485 – 5.51 mm (0.2160 – 0.2170 in.)

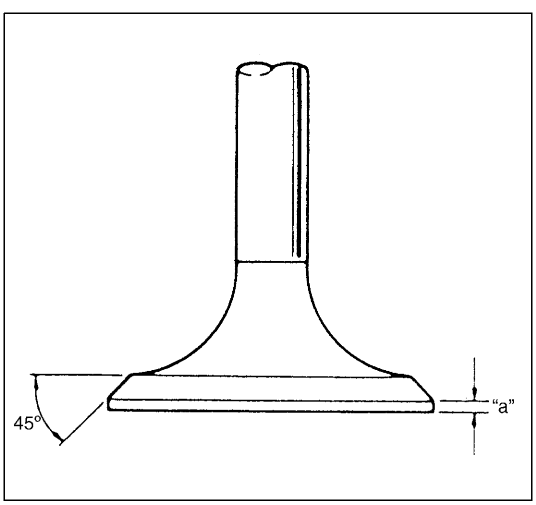


If bore gauge is not available, check end deflection of valve stem with a dial gauge instead.
Move stem end in directions (1) and (2) to measure end deflection.
If deflection exceeds its limit, replace valve stem and valve guide.

Valve stem end deflection limit
In : 0.14 mm (0.005 in.)
Ex : 0.18 mm (0.007 in.)

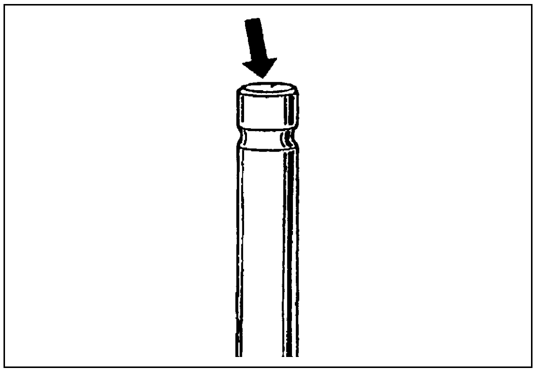
Valves

- Remove all carbon from valves.
- Inspect each valve for wear, burn or distortion at its face and stem end, as necessary, replace it.

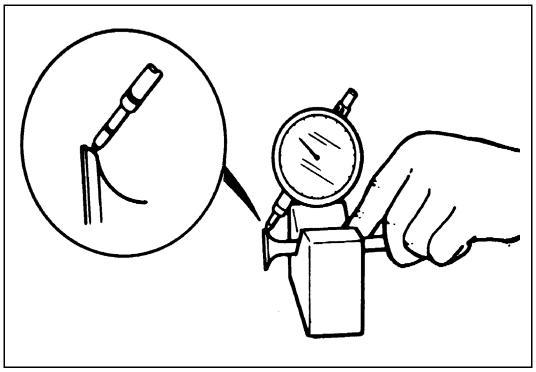


- Measure thickness "a" of valve head. If measured thickness exceeds limit, replace valve.

Valve head thickness (In and Ex)
Standard : 1.25 – 1.55 mm (0.049 – 0.061 in.)
Limit : 0.9 mm (0.035 in.)

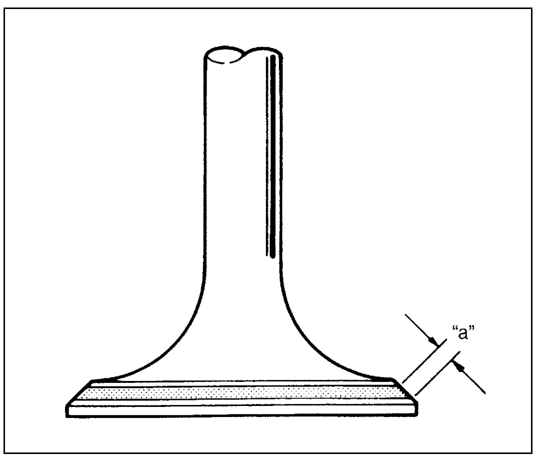


- Inspect valve stem end face for pitting and wear. If pitting or wear is found there, valve stem end may be resurfaced, but not too much to grind off its chamber. When it is worn out too much that its chamber is gone, replace valve.



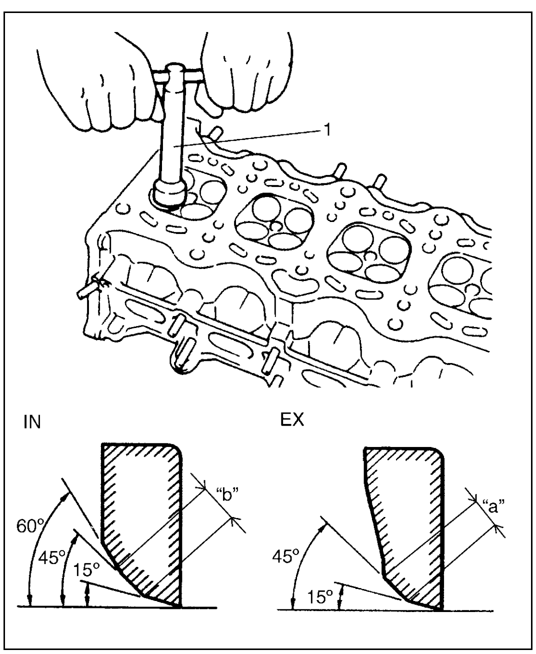
- Check each valve for radial runout with a dial gauge and "V" block. To check runout, rotate valve slowly. If runout exceeds its limit, replace valve.

Limit on valve head radial runout
0.08 mm (0.003 in.)



- Seating contact width:
  Create contact pattern on each valve in the usual manner, i.e. by giving uniform coat of marking compound to valve seat and by rotatingly tapping seat with valve head. Valve lapper (tool used in valve lapping) must be used.
  Pattern produced on seating face of valve must be a continuous ring without any break, and the width of pattern must be within specified range.

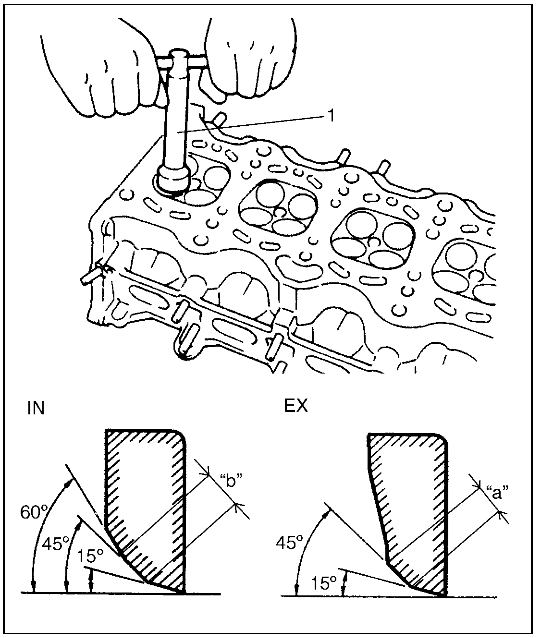
Standard seating width "a" revealed by contact pattern on valve face
In and Ex : 1.1 - 1.3 mm (0.0433 - 0.0512 in.)



- Valve seat repair:
  A valve seat not producing a uniform contact with its valve or showing width of seating contact that is out of specified range must be repaired by regrinding or by cutting and regrinding and finished by lapping.

a) EXHAUST VALVE SEAT : Use valve seat cutters (1) to make two cuts as illustrated in figure. Two cutters must be used: the first for making 15° angle, and the second for making 45° angle. The second cut must be made to produce desired seat width.

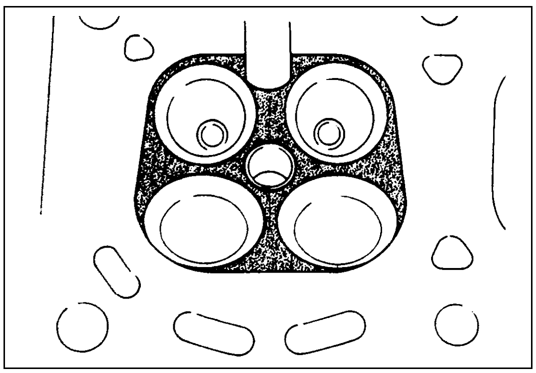
Seat width for exhaust valve seat
"a" : 1.1 – 1.3 mm (0.0433 – 0.0512 in.)



b) INTAKE VALVE SEAT : Use valve seat cutters (1) to make three cuts as illustrated in figure. Three cutters must be used: the 1st for making 15° angle, the 2nd for making 60° angle, and 3rd for making 45° angle. The 3rd cut (45°) must be made to produce desired seat width.

Seat width for intake valve seat
"b" : 1.1 – 1.3 mm (0.0433 – 0.0512 in.)

c) VALVE LAPPING : Lap valve on seat in two steps, first with coarse size lapping compound applied to face and the second with fine-size compound, each time using valve lapper according to usual lapping method.

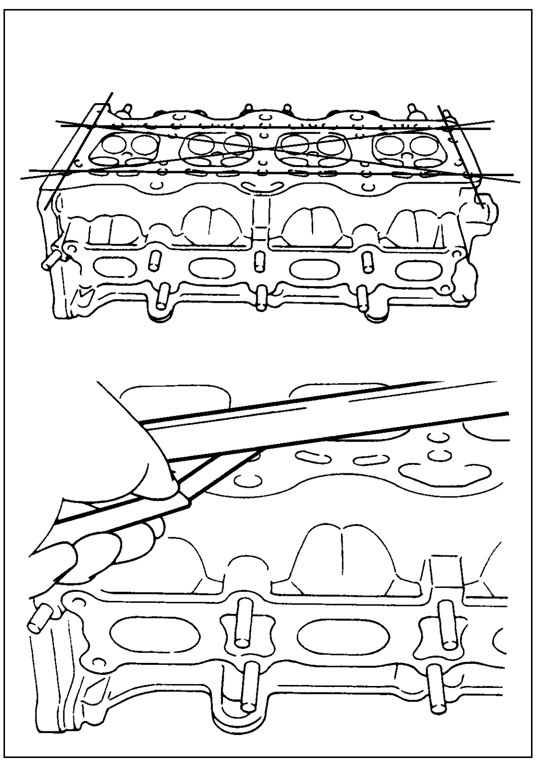


Cylinder head

- Remove all carbon deposits from combustion chambers.

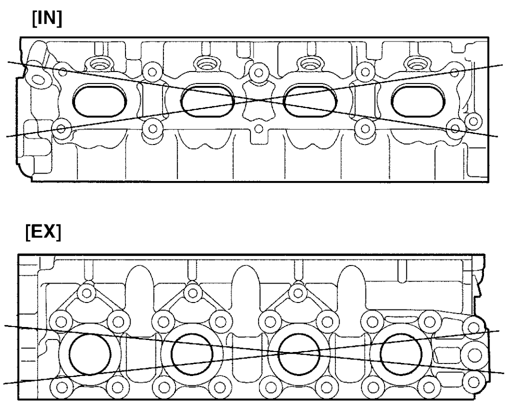
NOTE:

Do not use any sharp-edged tool to scrape off carbon deposits. Be careful not to scuff or nick metal surfaces when decarbonizing. The same applies to valves and valve seats, too.



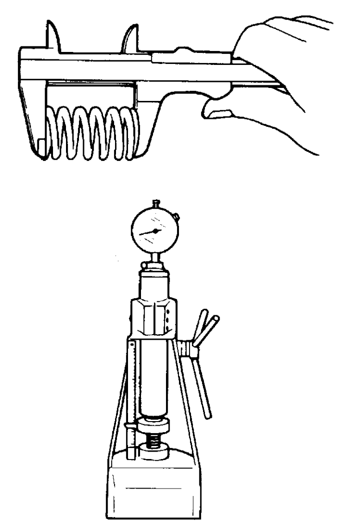
- Check cylinder head for cracks on intake and exhaust ports, combustion chambers, and head surface.
  Using a straightedge and thickness gauge, check flatness of gasketed surface at a total of 6 locations. If distortion limit, given below, is exceeded, correct gasketed surface with a surface plate and abrasive paper of about #400 (Waterproof silicon carbide abrasive paper): place abrasive paper on and over surface plate, and rub gasketed surface against paper to grind off high spots. Should this fail to reduce thickness gauge readings to within limit, replace cylinder head.
  Leakage of combustion gases from this gasketed joint is often due to warped gasketed surface: such leakage results in reduced power output.

Limit of distortion for cylinder head surface on piston side : 0.03 mm (0.001 in.)



- Distortion of manifold seating faces:
  Check seating faces of cylinder head for manifolds, using a straightedge and thickness gauge, in order to determine whether these faces should be corrected or cylinder head replaced.

Limit of distortion for cylinder head surface on intake and exhaust manifold
0.05 mm (0.002 in.)

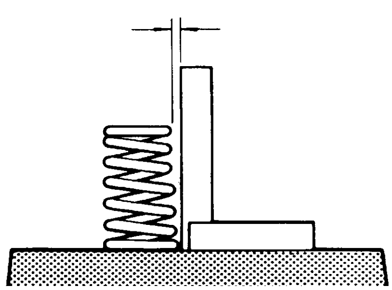


Valve springs

- Referring to data given below, check to be sure that each spring is in sound condition, free of any evidence of breakage or weakening. Remember, weakened valve springs can cause chatter, not to mention possibility of reducing power output due to gas leakage caused by decreased seating pressure.

Valve spring free length
Standard : 36.83 mm (1.450 in.)
Limit : 35.83 mm (1.411 in.)

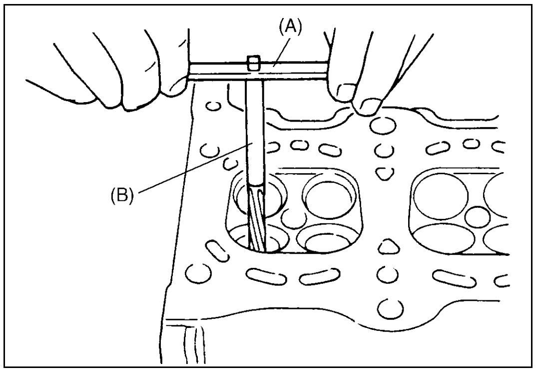
Valve spring preload
Standard : 107 – 125 N (10.7 – 12.5 kg) for 31.50 mm (23.6 – 27.6 lb/1.240 in.)
Limit : 102 N (10.2 kg) for 31.5 mm (22.5 lb/1.240 in.)



- Spring squareness:
  Use a square and surface plate to check each spring for squareness in terms of clearance between end of valve spring and square. Valve springs found to exhibit a larger clearance than limit given below must be replaced.

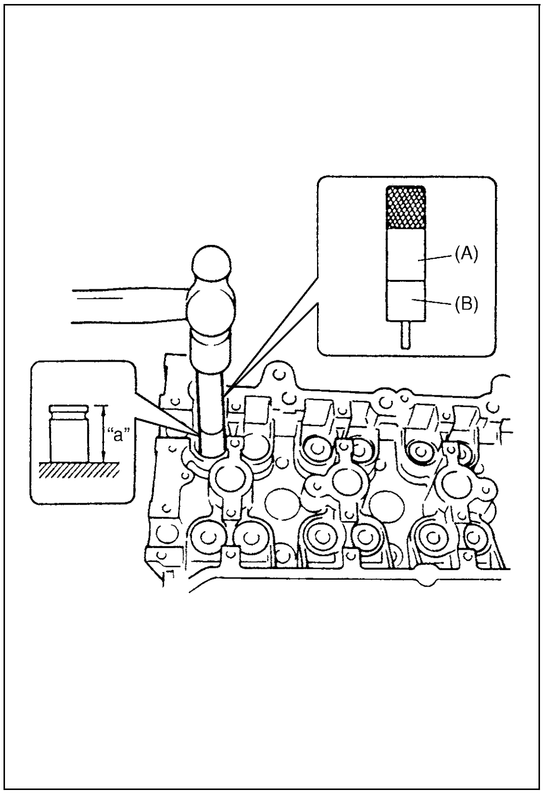
Valve spring squareness limit
1.6 mm (0.079 in.)

ASSEMBLY



1) Before installing valve guide into cylinder head, ream guide hole with special tool (10.5 mm reamer) so as to remove burrs and make it truly round.

Special tool
(A) : 09916-34542
(B) : 09916-37320



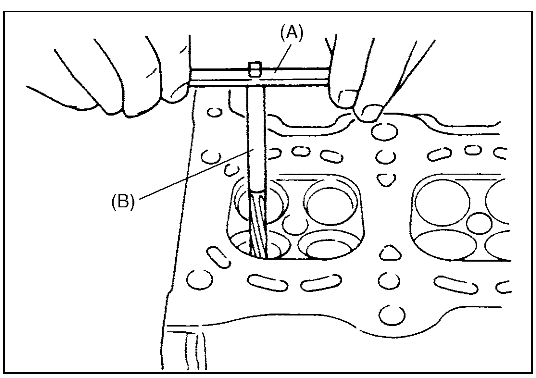
2) Install valve guide to cylinder head.
Heat cylinder head uniformly to a temperature of 80 to 100 °C (176 to 212 °F) so that head will not be distorted, and drive new valve guide into hole with special tools. Drive in new valve guide until special tool (Valve guide installer) contacts cylinder head.
After installing, make sure that valve guide protrudes by specified dimension "a" from cylinder head.

Special tool
(A) : 09916-56011
(B) : 09916-58210

NOTE:

- **Never reuse once-disassembled valve guide. Make sure to install new valve guide.**
- **Intake and exhaust valve guides are identical.**

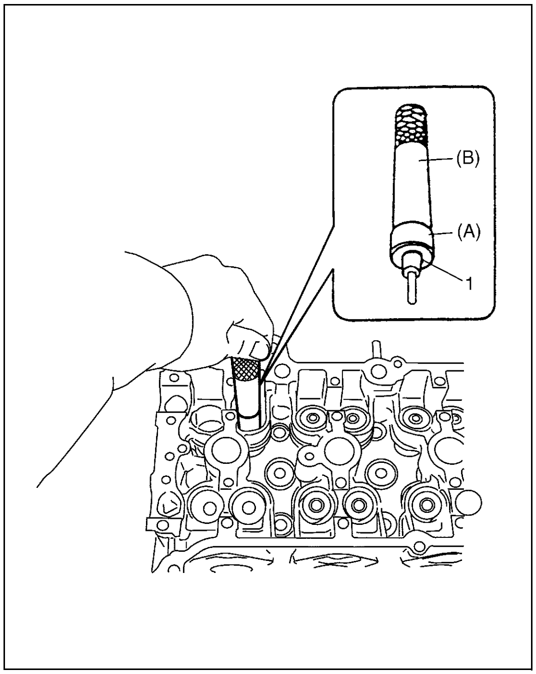
Specification for valve guide protrusion "a"
Intake side : 11.3 mm (0.44 in.)
Exhaust side : 11.3 mm (0.44 in.)



3) Ream valve guide bore with special tool (5.5 mm reamer). After reaming, clean bore.

Special tool
(A) : 09916-34542
(B) : 09916-34550

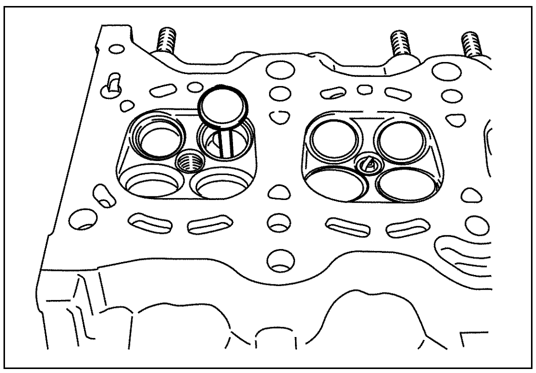
4) Install valve spring seat to cylinder head.



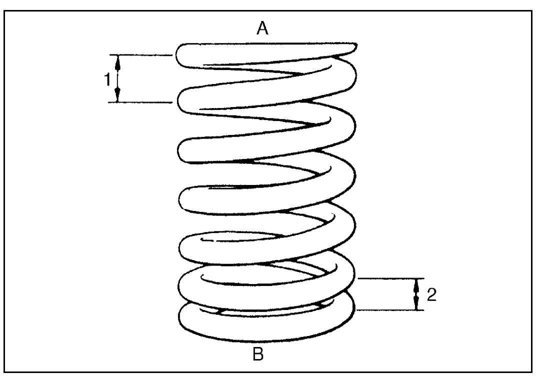
5) Install new valve stem seal (1) to valve guide.
   After applying engine oil to seal and spindle of special tool (Valve guide installer handle), fit oil seal to spindle, and then install seal to valve guide by pushing special tool by hand.
   After installing, check to be sure that seal is properly fixed to valve guide.

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

NOTE:
- **Do not reuse once-disassembled seal. Be sure to install new seal.**
- **When installing, never tap or hit special tool with a hammer or else. Install seal to guide only by pushing special tool by hand. Tapping or hitting special tool may cause damage to seal.**

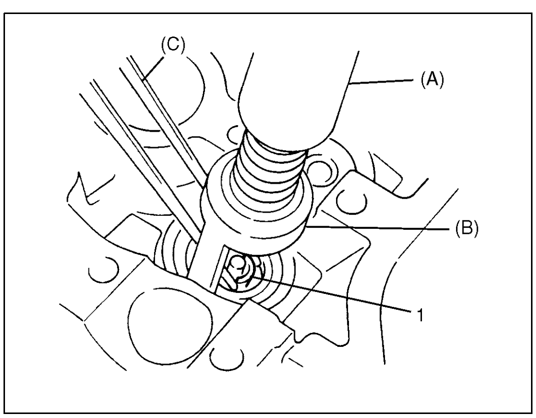


6) Install valve to valve guide.
   Before installing valve to valve guide, apply engine oil to stem seal, valve guide bore and valve stem.



7) Install valve spring and spring retainer.
   Each valve spring has top end (large-pitch end (1)) and bottom end (small-pitch end (2)). Be sure to position spring in place with its bottom end (small-pitch end) facing the bottom (valve spring seat side).

A :	Valve spring retainer side
B :	Valve spring seat side



8) Using special tools (Valve lifter), compress valve spring and fit two valve cotters (1) into groove in valve stem.

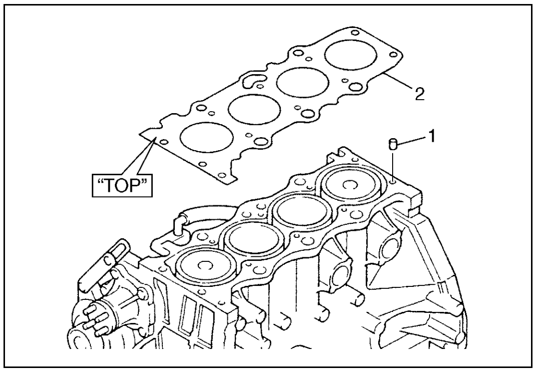
Special tool
(A) : 09916-14510
(B) : 09916-14910
(C) : 09916-84511

NOTE:
When compressing the valve spring, be carefully to free from damage in inside face of tappet installing hole.

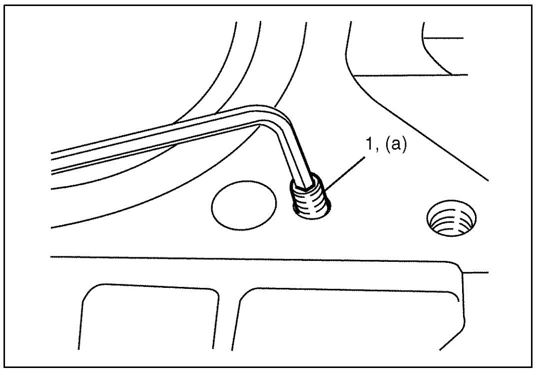
9) Install intake manifold, injectors and exhaust manifold to cylinder head.

INSTALLATION

1) Clean mating surface of cylinder head and cylinder block. Remove oil, old gasket and dust from mating surface.

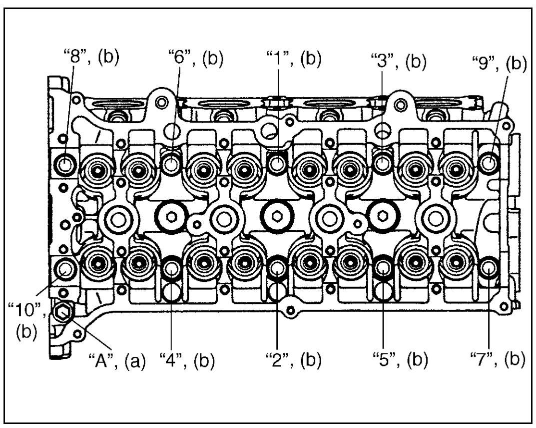


2) Install knock pins (1) to cylinder block.
3) Install new cylinder head gasket (2) to cylinder block. "TOP" mark provided on gasket comes to crankshaft pulley side, facing up (toward cylinder head side).

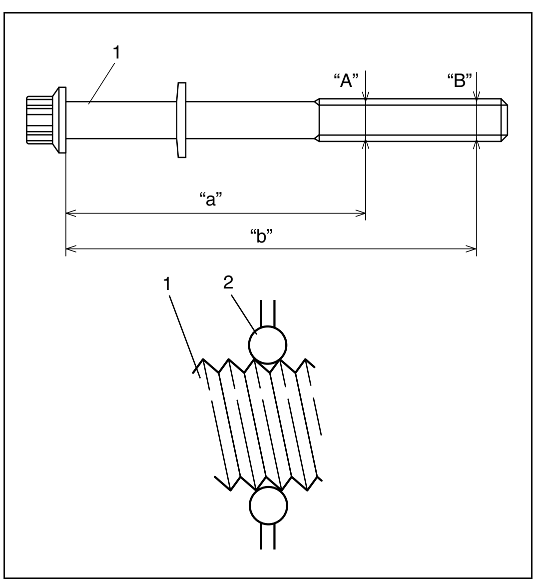


4) Make sure that oil jet (venturi plug) (1) is installed and if it is, that it is not clogged. When installing it, be sure to tighten to specified torque.

Tightening torque
Venturi plug (a) : 5 N·m (0.5 kg-m, 3.5 lb-ft)



5) Install cylinder head to cylinder block. Apply engine oil to new cylinder head bolts and tighten them gradually as follows.
   a) Tighten cylinder head bolts ("1" – "10") to 20 N·m (2.0 kg-m, 14.5 lb-ft) according to numerical order as shown by using a 12 corner socket wrenches.
   b) In the same manner as in Step a), tighten them to 40 N·m (4.0 kg-m, 29.0 lb-ft).
   c) Turn all bolts 60° according to numerical order in figure.
   d) Repeat Step c).
   e) Tighten bolt "A" to specified torque.



NOTE:

Use new cylinder head bolts. If they are reused, check thread diameters of cylinder head bolt for deformation according to the follows and replace them with new ones if thread diameter difference exceeds limit.

Measure each thread diameter of cylinder head bolt (1) at "A" on 83.5mm(2.81in.) from seat side of flange bolt and "B" on 115mm(4.53in.) from seat side of flange bolt by using a micrometer (2).
Then calculate difference in diameters ("A" – "B").
If it exceeds limit, replace with new one.

Cylinder head bolt diameter measurement points
“a” : 83.5mm (2.81in.)
“b” : 115mm (4.53in.)

Cylinder head bolt diameter difference (deformation)
Limit (“A” – “B”) : 0.1mm (0.004in.)

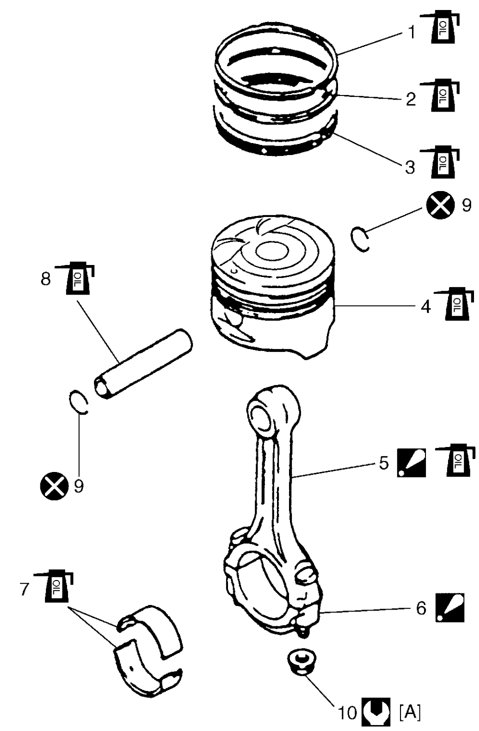
NOTE:

Be sure to tighten M8 bolt (“A”) after securing the other bolt.

Tightening torque
Cylinder head bolt for M8 (a) : 22 N·m (2.2 kg-m, 16.0 lb-ft)
Cylinder head bolts for M10
(b) : 40 N·m (4.0 kg-m, 29.0 lb-ft) and then turn to 60° twice

6) Install exhaust manifold stiffener.
7) Install camshafts, timing chain and chain cover as previously outlined.
8) Install cylinder head cover and oil pan.
9) Install intake manifold stiffener and connect each hoses.
10) Perform Steps 3) to 8) of “INSTALLATION” of “TIMING CHAIN COVER” in this section.

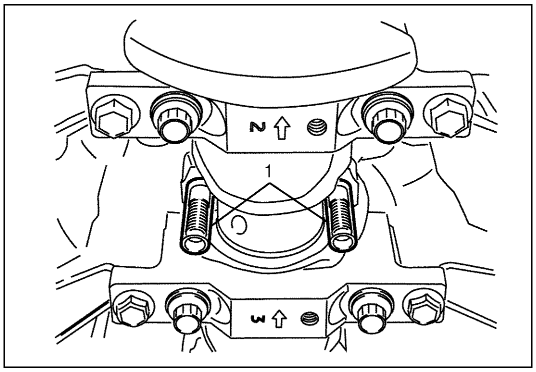
Pistons, Piston Rings, Connecting Rods and Cylinders



	[A] :	1) Tighten all nuts to 15 N·m (1.5 kg-m) 2) Turn all nuts to 45° 3) Then, Turn all nuts to 45° once again	7.	Connecting rod bearing
	1.	Top ring	8.	Piston pin
	2.	2nd ring	9.	Piston pin circlip
	3.	Oil ring	10.	Bearing cap nut
	4.	Piston		Tightening torque
	5.	Connecting rod : Apply engine oil to sliding surface except inner surface of big end, and rod bolts. Make sure rod bolt diameter when reuse it due to plastic deformation tightening. Refer to "INSPECTION" of "CONNECTING ROD".		Apply engine oil to sliding surface of each parts.
	6.	Connecting rod bearing cap : Point arrow mark on cap to crankshaft pulley side.		Do not reuse.

REMOVAL

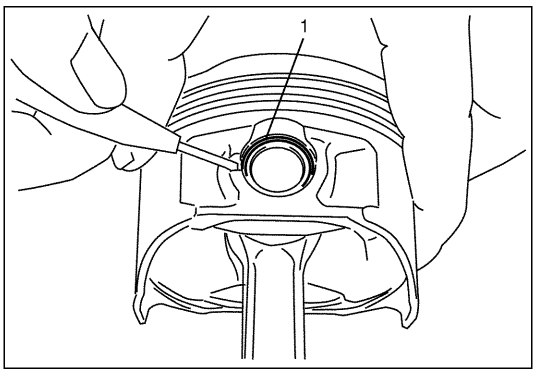
1) Remove engine assembly from vehicle referring to "REMOVAL" of "ENGINE ASSEMBLY" in this section.
2) Remove cylinder head referring to "VALVES AND CYLINDER HEAD".
3) Mark cylinder number on all pistons, connecting rods and connecting rod caps using silver pencil or quick drying paint.
4) Remove rod bearing caps.



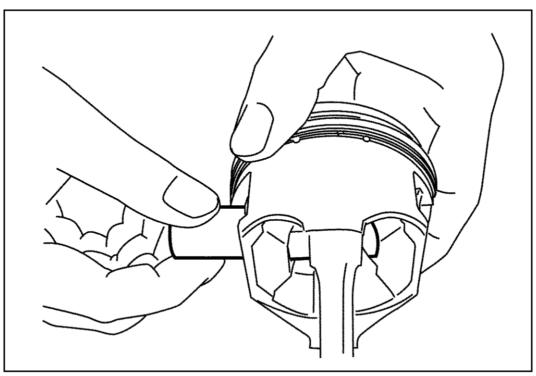
5) Install guide hose (1) over threads of rod bolts.
   This prevents damage to bearing journal and rod bolt threads when removing connecting rod.
6) Decarbonize top of cylinder bore before removing piston from cylinder.
7) Push piston and connecting rod assembly out through the top of cylinder bore.

DISASSEMBLY

1) Using piston ring expander, remove two compression rings (Top and 2nd) and oil ring from piston.
2) Remove piston pin from connecting rod.



- Ease out piston pin circlips (1), as shown.



- Force piston pin out.

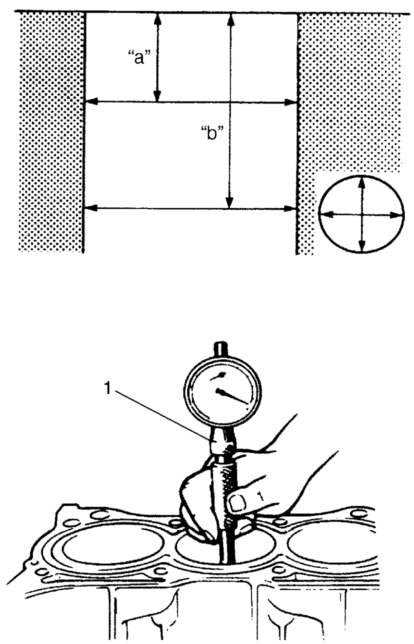
CLEANING

Decarbonize piston head and ring grooves, using a suitable tool.

INSPECTION

Cylinder

- Inspect cylinder walls for scratches, roughness or ridges which indicate excessive wear. If cylinder bore is very rough or deeply scratched or ridged, rebore cylinder and use oversize piston.



- Using a cylinder gauge (1), measure cylinder bore in thrust and axial directions at two positions ("a" and "b") as shown in figure.
  If any of the following conditions is noted, rebore cylinder.

1) Cylinder bore dia. exceeds limit.
2) Difference of measurements at two positions exceeds taper limit.
3) Difference between thrust and axial measurements exceeds out-of-round limit.

Cylinder bore diameter
Standard : 78.00 – 78.014 mm (3.0709 – 3.0714 in.)
Limit : 78.114 mm (3.073 in.)

Cylinder taper and out-of-round
Limit : 0.10 mm (0.004 in.)

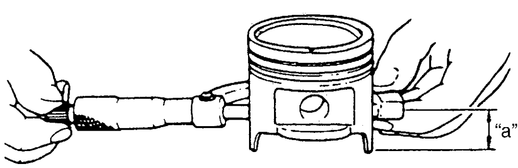
"a" :	50 mm (1.96 in.)
"b" :	95 mm (3.74 in.)

NOTE:

If any one of four cylinders has to be rebored, rebore all four to the same next oversize. This is necessary for the sake of uniformity and balance.

Pistons

- Inspect piston for faults, cracks or other damaged.
  Damaged or faulty piston should be replaced.

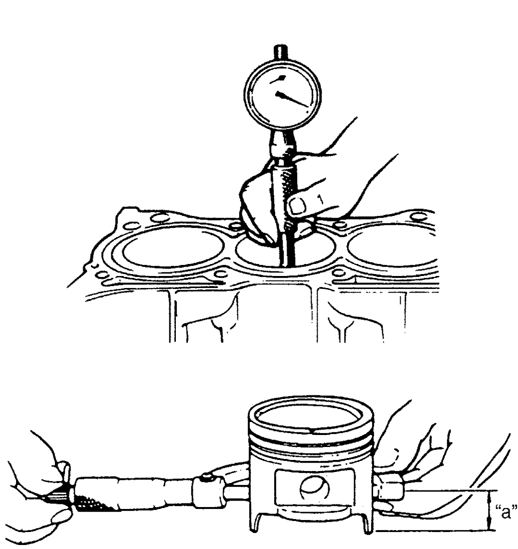


- Piston diameter :
  As indicated in figure, piston diameter should be measured at a position 19.5 mm (0.77 in.) from piston skirt end in the direction perpendicular to piston pin.

Piston diameter specification

Standard size	**77.953 – 77.968 mm (3.0690 – 3.0696 in.) new one (with coating) 77.969 – 77.984 mm (3.0696 – 3.0702 in.)**
Oversize 0.25 mm (0.0098 in.)	**78.203 – 78.218 mm (3.0789 – 3.0794 in.)**
Oversize 0.50 mm (0.0196 in.)	**78.453 – 78.468 mm (3.0887 – 3.0893 in.)**

"a" :	19.5 mm (0.77 in.)



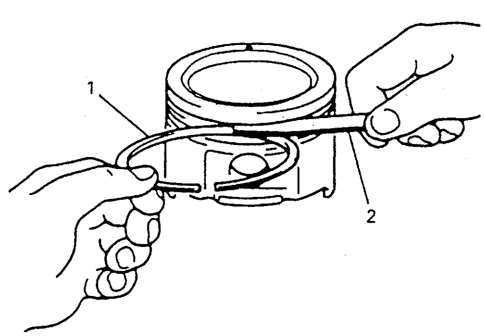
"a" : 19.5 mm (0.77 in.)

- Piston clearance:
  Measure cylinder bore diameter and piston diameter to find their difference which is piston clearance. Piston clearance should be within specification as given below. If it is out of specification, rebore cylinder and use oversize piston.

Piston clearance
Standard : 0.032 – 0.061 mm (0.0013 – 0.0024 in.)
Standard : 0.016 – 0.045 mm (0.0006 – 0.0018 in.) piston with coating (new one)
Limit : 0.161 mm (0.0065 in.)

NOTE:

Cylinder bore diameters used here are measured in thrust direction at two positions.

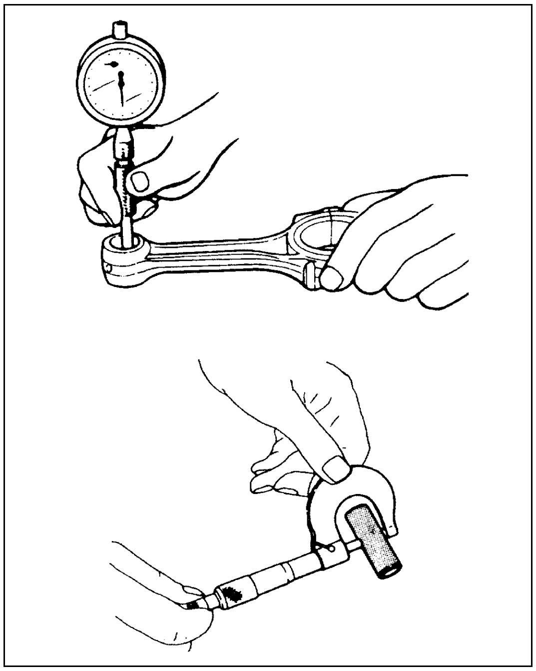


- Ring groove clearance:
  Before checking, piston grooves must be clean, dry and free of carbon deposits.
  Fit new piston ring (1) into piston groove, and measure clearance between ring and ring land by using thickness gauge (2). If clearance is out of limit, replace piston.

Ring groove clearance
Top ring
Standard : 0.03 – 0.07 mm (0.0012 – 0.0028 in.)
Limit : 0.12 mm (0.0047 in.)
2nd ring
Standard : 0.02 – 0.06 mm (0.0008 – 0.0024 in.)
Limit : 0.10 mm (0.0039 in.)
Oil ring
Standard : 0.03 – 0.17 mm (0.0012 – 0.0067 in.)

Piston pin

- Check piston pin, connecting rod small end bore and piston bore for wear or damage, paying particular attention to condition of small end bore bush. If pin, connecting rod small end bore or piston bore is badly worn or damaged, replace pin, connecting rod and/or piston.



- Piston pin clearance :
  Check piston pin clearance in small end and piston. Replace connecting rod and/or piston if its small end is badly worn or damaged or if measured clearance exceeds limit.

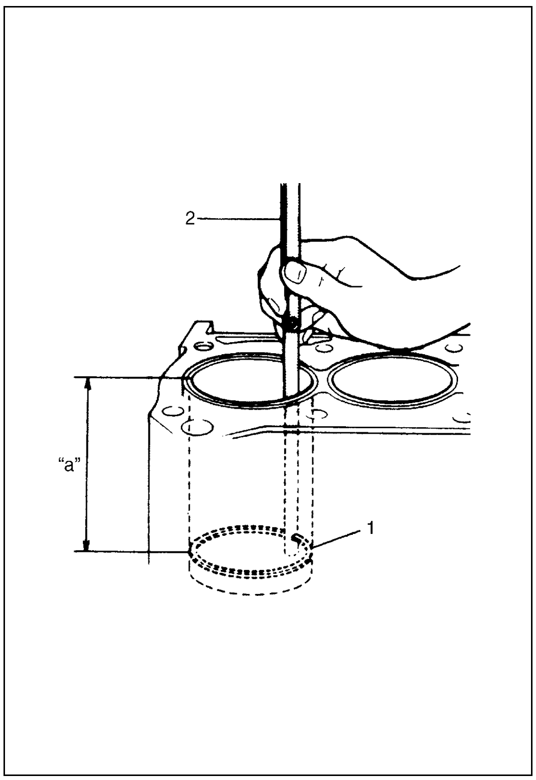
Piston pin clearance in connecting rod small end
0.003 – 0.014 mm (0.0001 – 0.0006 in.)

Piston pin clearance in piston
0.006 – 0.017 mm (0.00024 – 0.00067 in.)

Small-end bore
20.003 – 20.011 mm (0.7875 – 0.7878 in.)

Piston pin dia.
19.997 – 20.000 mm (0.7873 – 0.7874 in.)

Piston bore
20.006 – 20.014 mm (0.7876 – 0.7880 in.)



Piston rings

To measure end gap, insert piston ring (1) into cylinder bore and then measure the gap by using thickness gauge (2).
If measured gap is out of specification, replace ring.

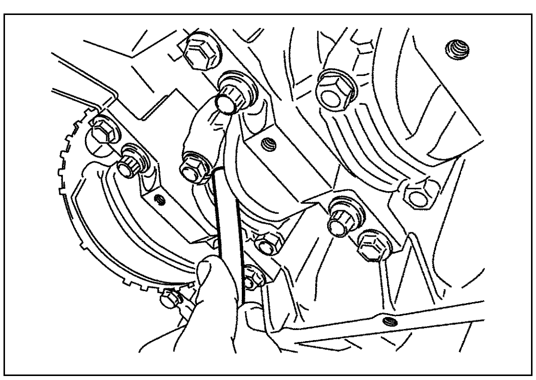
NOTE:
Decarbonize and clean top of cylinder bore before inserting piston ring.

Piston ring end gap

Item	Standard	Limit
Top ring	0.20 – 0.35 mm (0.0079 – 0.0138 in.)	0.7 mm (0.0276 in.)
2nd ring	0.30 – 0.45 mm (0.0118 – 0.0177 in.)	1.0 mm (0.0394 in.)
Oil ring	0.20 – 0.70 mm (0.0079 – 0.0276 in.)	1.5 mm (0.0591 in.)

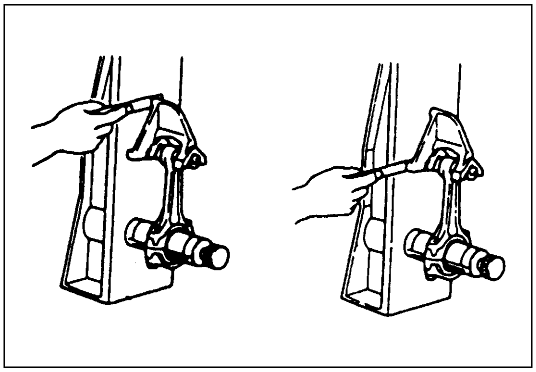
"a" : 120 mm (4.72 in.)

Connecting rod



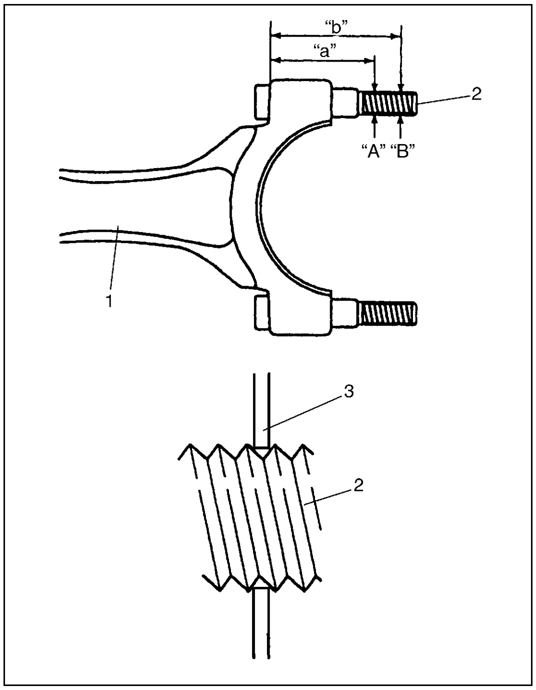
- Big-end side clearance:
  Check big-end of connecting rod for side clearance, with rod fitted and connected to its crank pin in the normal manner. If measured clearance is found to exceed its limit, replace connecting rod.

Big-end side clearance
Standard : 0.25 - 0.40 mm (0.0098 - 0.0157 in.)
Limit : 0.55 mm (0.0217 in.)



- Connecting rod alignment :
  Mount connecting rod on aligner to check it for bow and twist. If limit is exceeded, replace it.

Connecting rod alignment
Limit on bow : 0.05 mm (0.0020 in.)
Limit on twist : 0.10 mm (0.0039 in.)

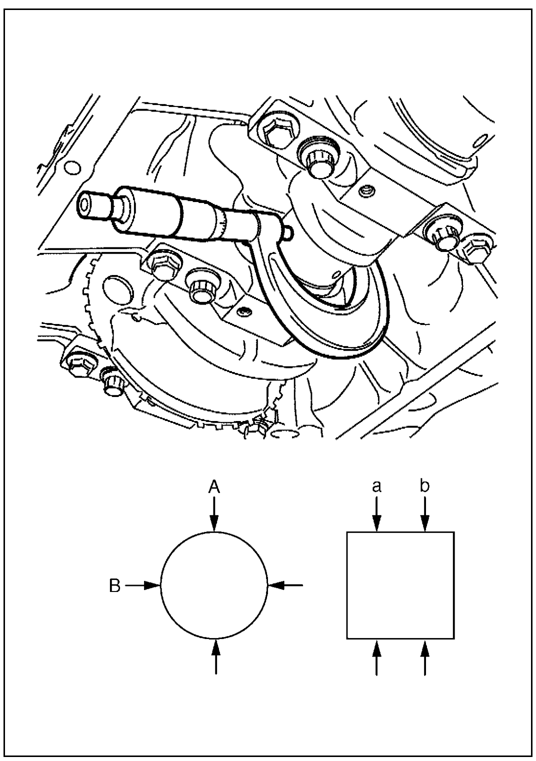


- Connecting rod bolt deformation (Plastic deformation tightening bolt)
  Measure each thread diameter of connecting rod (1) bolt (2) at “A” on 32 mm (1.25 in.) from bolt mounting surface and “B” on 40 mm (1.57 in.) from bolt mounting surface by using a micrometer (3).
  Calculate difference in diameters (“A” – “B”). If it exceeds limit, replace connecting rod.

Connecting rod bolt measurement points
“a” : 32 mm (1.25 in.)
“b” : 40 mm (1.57 in.)

Connecting rod bolt diameter difference limit (“A” – “B”) : 0.1 mm (0.004 in.)

Crank pin and connecting rod bearings

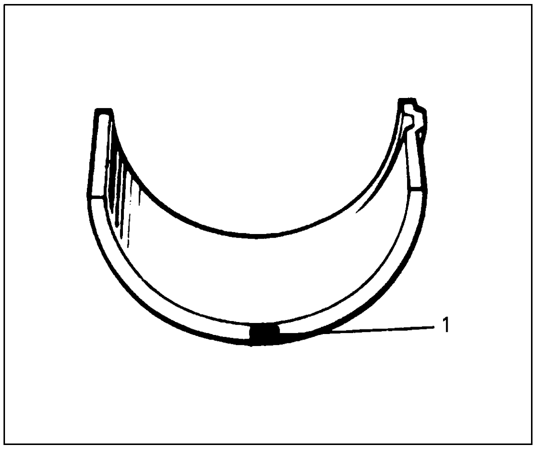


- Inspect crank pin for uneven wear or damage. Measure crank pin for out-of-round or taper with a micrometer. If crank pin is damaged or out-of round or taper is out of limit, replace crankshaft or regrind crank pin to undersize and use undersize bearing.

Crank pin diameter

Connecting rod bearing size	Crank pin diameter
Standard	41.982 – 42.000 mm (1.6528 – 1.6535 in.)
Undersize 0.25 mm (0.0098 in.)	41.732 – 41.750 mm (1.6430 – 1.6437 in.)

Crank pin taper and out-of-round
Limit : 0.01 mm (0.0004 in.)
Out-of-round : A – B
Taper : a – b

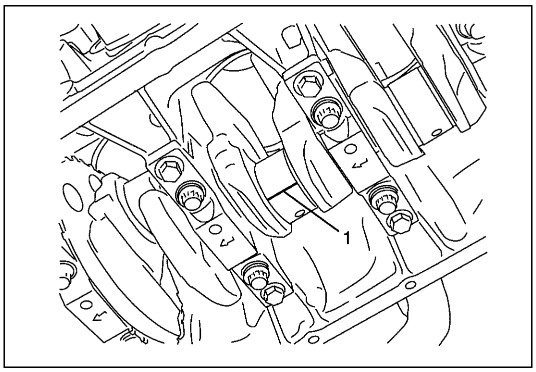


- Rod bearing :
  Inspect bearing shells for signs of fusion, pitting, burn or flaking and observe contact pattern. Bearing shells found in defective condition must be replaced.
  Two kinds of rod bearing are available; standard size bearing and 0.25 mm (0.0098 in.) undersize bearing. For identification of undersize bearing, it is painted red at the position as indicated in figure, undersize bearing thickness is 1.605 – 1.615 mm (0.0632 – 0.0635 in.) at the center of it.

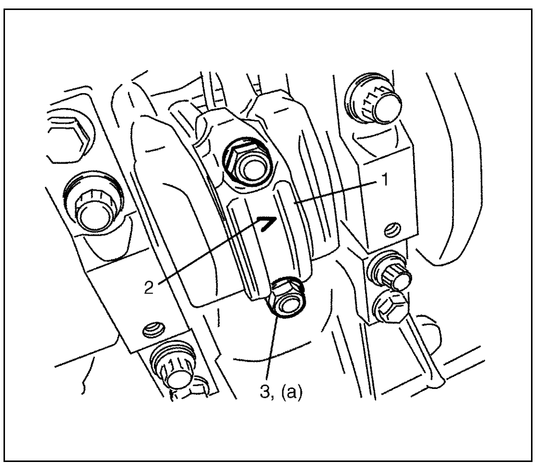
1. Red paint

- Rod bearing clearance :

1) Before checking bearing clearance, clean bearing and crank pin.
2) Install bearing in connecting rod and bearing cap.

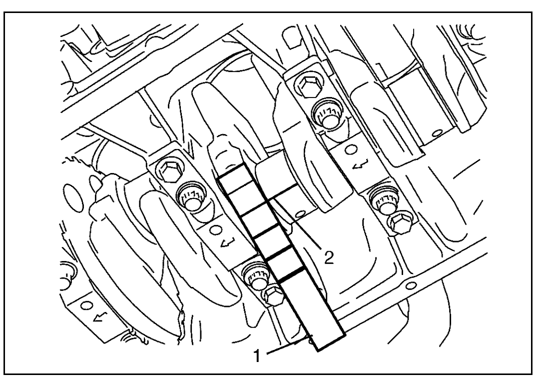


3) Place a piece of gaging plastic (1) to full width of crank pin as contacted by bearing (parallel to crankshaft), avoiding oil hole.



4) Install rod bearing cap (1) to connecting rod.
   When installing cap, be sure to point arrow mark (2) on cap to crankshaft pulley side, as shown in figure. After applying engine oil to rod bolts and tighten cap nuts (3) gradually as follows.
   a) Tighten all cap nuts to 15 N·m (1.5 kg-m, 11.0 lb-ft).
   b) Retighten them to 45°.
   c) Repeat step b) once again.

Tightening torque
Connecting rod bearing cap nuts
(a) : 15 N·m (1.5 kg-m, 11.0 lb-ft) and extra tighten 90°



5) Remove cap and using a scale (1) on gaging plastic (2) envelope, measure gaging plastic width at the widest point (clearance).
   If clearance exceeds its limit, use a new standard size bearing and remeasure clearance.

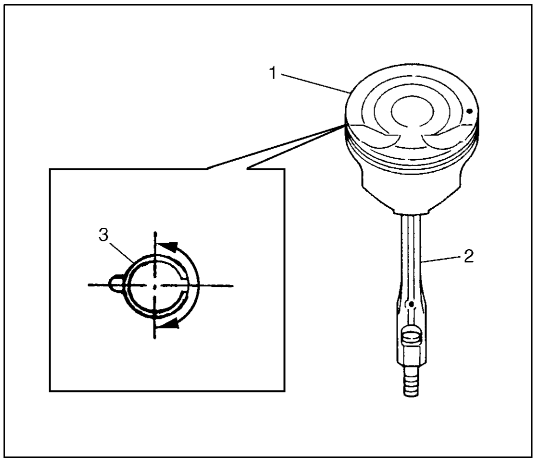
Connecting rod bearing clearance
Standard : 0.029 – 0.047 mm (0.0011 – 0.0019 in.)
Limit : 0.065 mm (0.0026 in.)

6) If clearance can not be brought to within its limit even by using a new standard size bearing, regrind crankpin to undersize and use 0.25 mm undersize bearing.

NOTE:

After checking the rod bearing clearance, make sure that checking for Connecting rod bolt deformation.
Refer to “INSPECTION” of “CONNECTING ROD”.

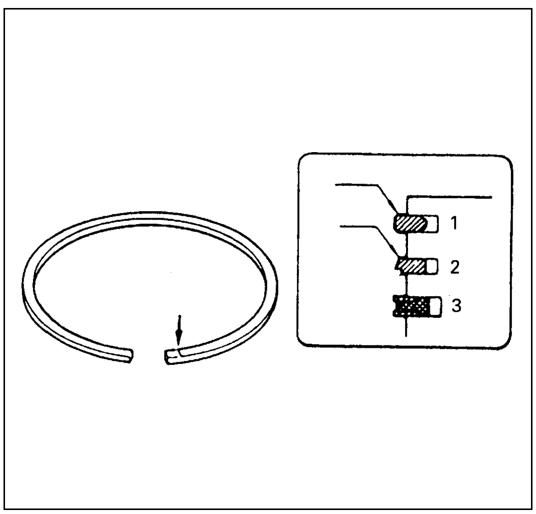
ASSEMBLY



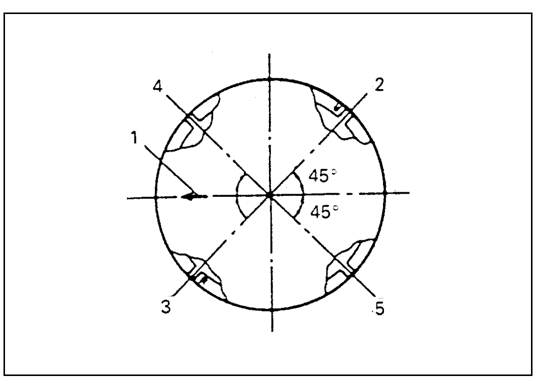
1) Install piston pin to piston (1) and connecting rod (2) :
   a) After applying engine oil to piston pin and piston pin holes in piston and connecting rod.
   b) Fit connecting rod as shown in figure.
   c) Insert piston pin to piston and connecting rod.
   d) Install piston pin circlips (3).

NOTE:

Circlip should be installed with its cut part facing as shown in figure. Install so that circlip end gap comes within such range as indicated by arrow.



2) Install piston rings to piston :
   a) As indicated in figure, 1st and 2nd rings have “T” mark respectively. When installing these piston rings to piston, direct marked side of each ring toward top of piston.
   b) 1st ring (1) differs from 2nd ring (2) in thickness, shape and color of surface contacting cylinder wall.
   Distinguish 1st ring from 2nd ring by referring to figure.
   c) When installing oil ring (3) install spacer first and then two rails.



3) After installing three rings (1st, 2nd and oil rings), distribute their end gaps as shown in figure.

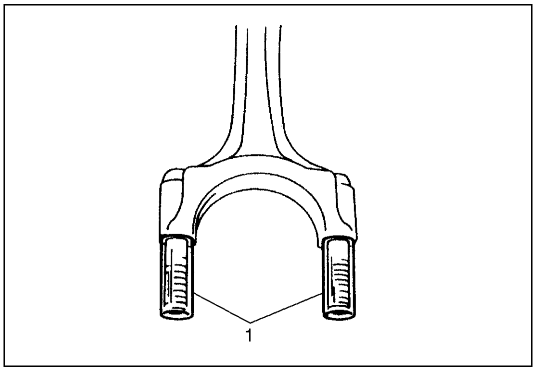
1.	Arrow mark
2.	1st ring end gap
3.	2nd ring end gap and oil ring spacer gap
4.	Oil ring upper rail gap
5.	Oil ring lower rail gap

INSTALLATION

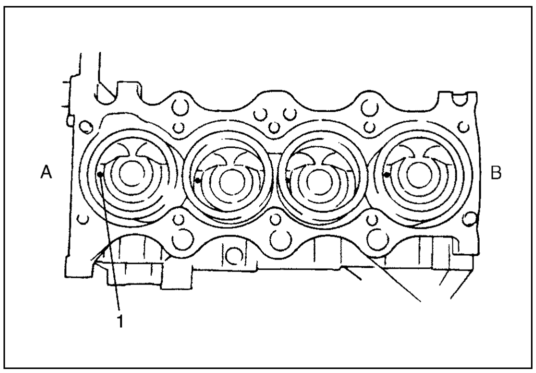
1) Apply engine oil to pistons, rings, cylinder walls, connecting rod bearings and crankpins.

NOTE:

Do not apply oil between connecting rod and bearing or between bearing cap and bearing.

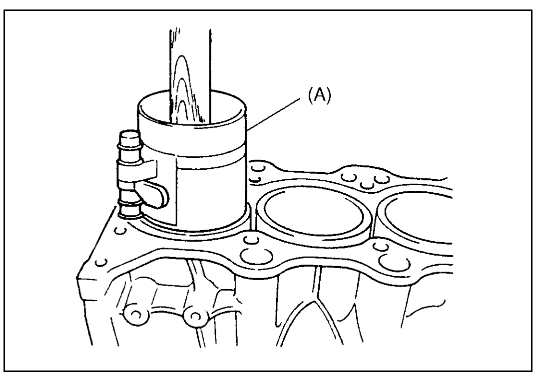


2) Install guide hoses (1) over connecting rod bolts.
These guide hoses protect crank pin and threads of rod bolt from damage during installation of connecting rod and piston assembly.



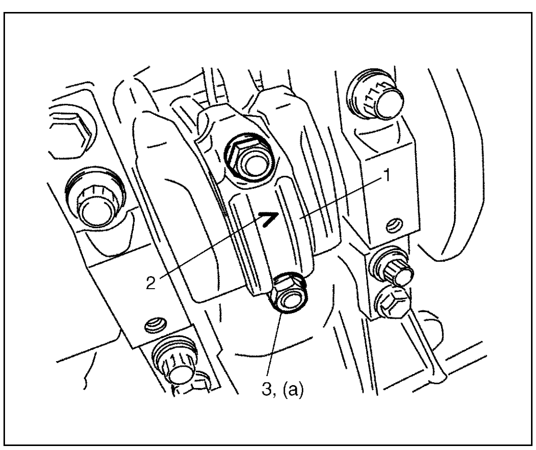
3) When installing piston and connecting rod assembly into cylinder bore, point front mark (1) on piston head to crankshaft pulley side.

A :	Crankshaft pulley side
B :	Flywheel side



4) Install piston and connecting rod assembly into cylinder bore. Use special tool (Piston ring compressor) to compress rings. Guide connecting rod into place on crankshaft.
Using a hammer handle, tap piston head to install piston into bore. Hold ring compressor firmly against cylinder block until all piston rings have entered cylinder bore.

Special tool
(A) : 09916-77310



5) Install bearing cap (1):
Point arrow mark (2) on cap to crankshaft pulley side.
After applying oil to rod bolts and tighten cap nuts (3) gradually as follows.
a) Tighten all cap nuts to 15 N·m (1.5 kg-m, 11.0 lb-ft).
b) Retighten them to 45°.
c) Repeat Step b) once again.

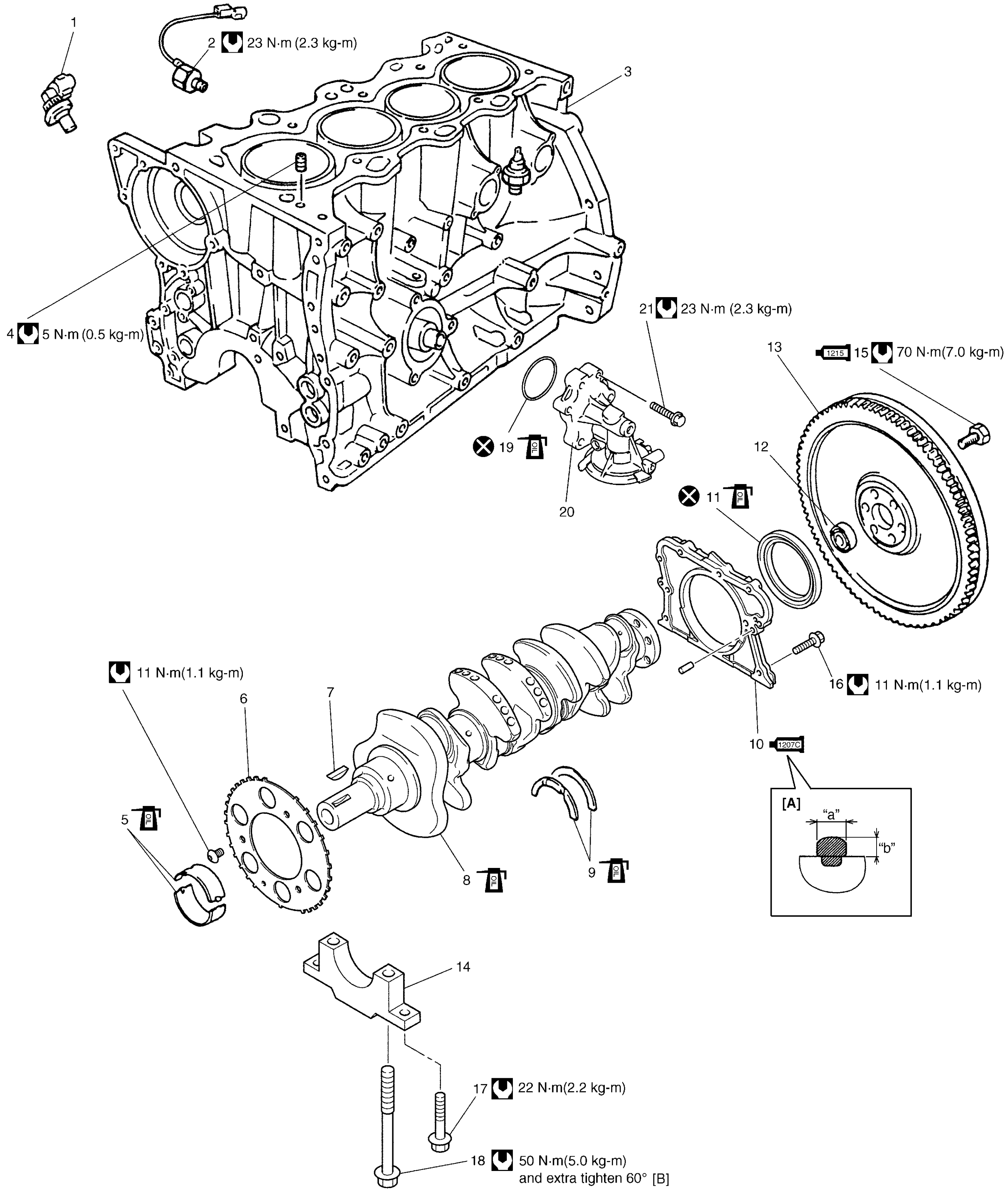
Tightening torque
Connecting rod bearing cap nuts
(a) : 15 N·m (1.5 kg-m, 11.0 lb-ft) and then turn to 45° twice.

NOTE:

Before installing bearing cap, make sure that checking for connecting rod bolt deformation.
Refer to "INSPECTION" of "CONNECTING ROD".

6) Reverse removal procedure for installation as previously outlined.
7) Perform Steps 3) to 8) of "INSTALLATION" of "TIMING CHAIN COVER" in this section.

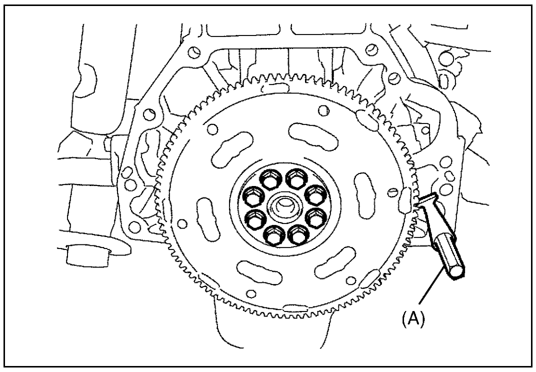
Main Bearings, Crankshaft and Cylinder Block



[A] :	Sealant application amount	4.	Venturi plug	14.	Main bearing cap
[B] :	1) Tighten all bolts to 50 N·m (5.0 kg-m) 2) Then, turn all bolts to 60°	5.	Main bearing	15.	Flywheel mounting bolt : Apply sealant 99000-31110 to thread part.
	Tightening torque	6.	Sensor plate	16.	Rear oil seal housing mounting bolt
	Do not reuse.	7.	Crankshaft timing sprocket key	17.	Main bearing mounting No.2 bolt
	Apply engine oil to inside / sliding surface.	8.	Crankshaft	18.	Main bearing mounting No.1 bolt
"a" :	3 mm (0.12 in.)	9.	Thrust bearing	19.	O-ring
"b" :	2 mm (0.08 in.)	10.	Rear oil seal housing : Apply sealant 99000-31150 to mating surface.	20.	Oil filter adapter case
1.	CKP sensor (if equipped) : When installing CKP sensor, use new sensor mounting bolt.	11.	Rear oil seal	21.	Oil filter adapter bolt
2.	Knock sensor	12.	Input shaft bearing		
3.	Cylinder block	13.	Flywheel		

REMOVAL

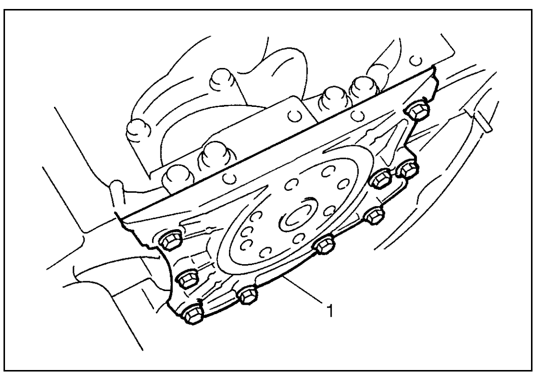
1) Remove engine assembly from vehicle as previously outlined.



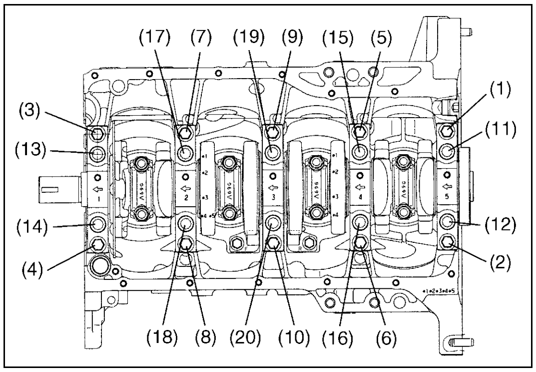
2) Remove clutch cover, clutch disc and flywheel (drive plate for A/T) by using special tool.

Special tool
(A) : 09924-17810

3) Remove the following parts from engine as previously outlined.
 - Oil pan and oil pump strainer
 - Intake manifold and exhaust manifold
 - Cylinder head cover
 - Timing chain cover
 - Timing chain guide, chain tensioner adjuster, chain tensioner, timing chain and crankshaft timing sprocket
 - Camshaft, tappet and shim
 - Cylinder head assembly
 - Piston and connecting rod

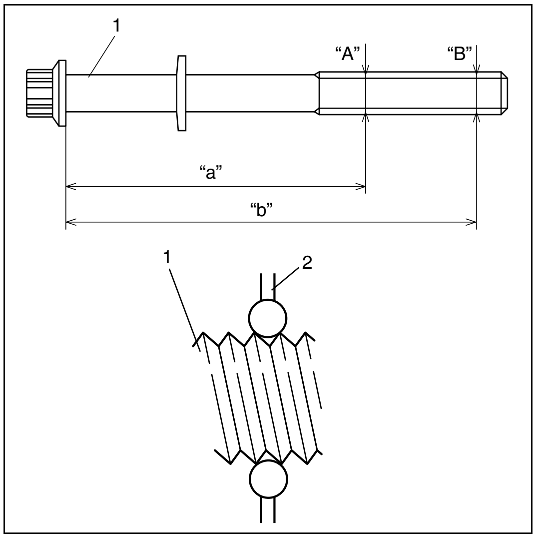


4) Remove rear oil seal housing (1).



5) Loosen bearing cap No.1 and No.2 bolts in such order as indicated in figure and remove them.
6) Remove crankshaft from cylinder block.

INSPECTION



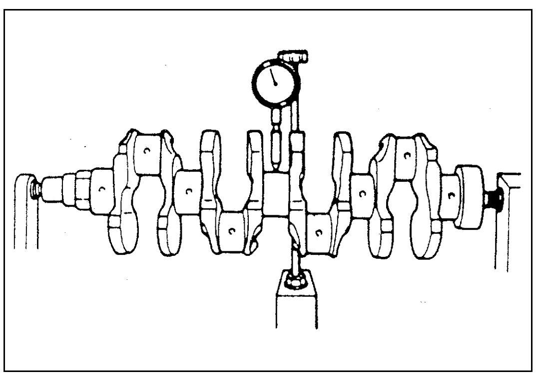
Measure each thread diameter bearing cap bolts (1) at "A" on 60mm(2.36in.) from seat side of flange bolt and "B" on 90mm(3.54in.) from seat side of flange bolt by using a micrometer (2).
Calculate difference in diameters ("A" – "B").
If it exceeds limit, replace with new one.

Bearing cap No.1 bolt diameter measurement points
"a" : 60mm (2.36in.)
"b" : 90mm (3.54in.)

Bearing cap No.1 bolt diameter difference
Limit ("A" – "B") : 0.2mm (0.008in.)

Crankshaft

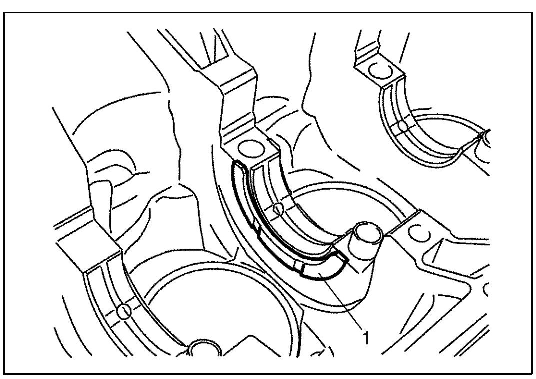
Crankshaft runout



Using a dial gauge, measure runout at center journal. Rotate crankshaft slowly. If runout exceeds its limit, replace crankshaft.

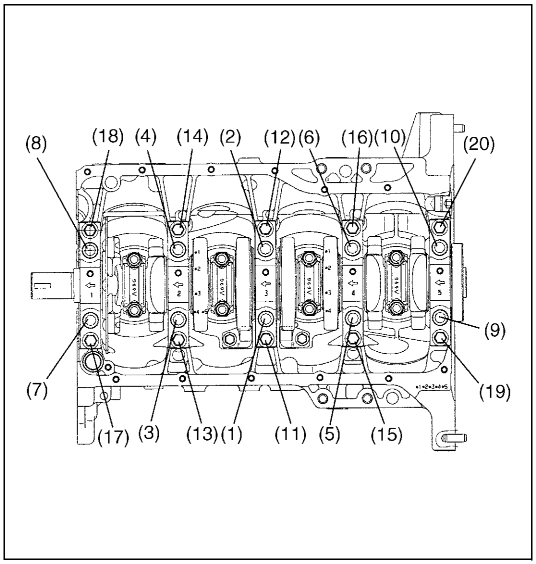
Crankshaft runout
Limit : 0.04 mm (0.0016 in.)

Crankshaft thrust play



Measure this play with crankshaft set in cylinder block in the normal manner, that is with thrust bearing (1) and journal bearing caps installed.

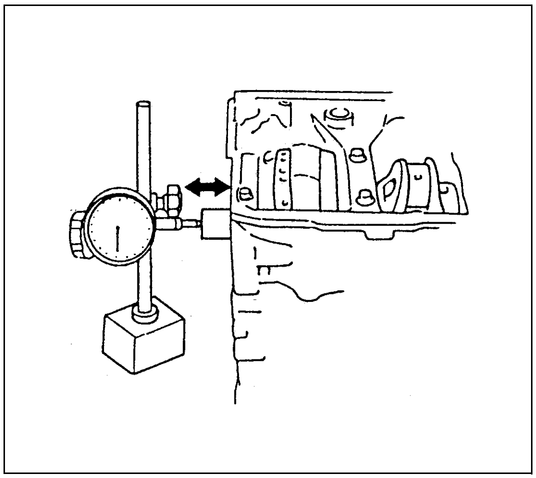
Thickness of crankshaft thrust bearing
Standard : 2.500 mm (0.0984 in.)
Oversize (0.125 mm (0.0049 in.)) : 2.563 mm (0.1009 in.)



Tighten bearing cap No.1 bolts (1) – (10) and No.2 bolts (11) – (20) gradually as follows.

1) Tighten bolts (1) – (10) to 30 N·m (3.0 kg-m, 22.0 lb-ft) according to numerical order in figure.
2) In the same manner as in Step 1), tighten them to 50 N·m (5.0 kg-m, 36.5 lb-ft).
3) In the same manner as in step 1), retighten them to 60°.
4) Tighten bolts (11) – (20) to 22 N·m (2.2 kg-m, 16.0 lb-ft) according to numerical order in figure.

Tightening torque
Crank shaft bearing cap No.1 bolts (1) – (10) :
50 N·m (5.0 kg-m, 36.5 lb-ft) and extra tighten 60 °
Crank shaft bearing cap No.2 bolts (11) – (20) :
22 N·m (2.2 kg-m, 16.0 lb-ft)

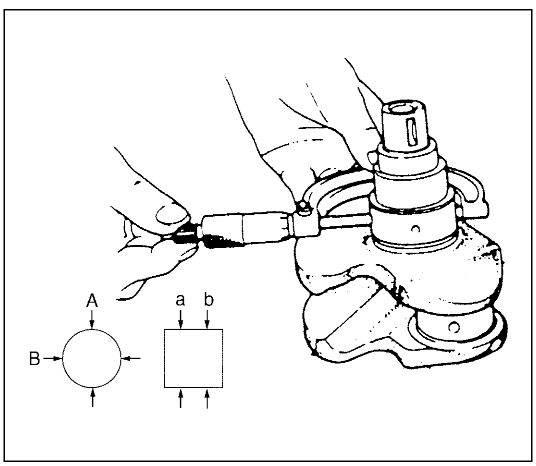


Use a dial gauge to read displacement in axial (thrust) direction of crankshaft.
If its limit is exceeded, replace thrust bearing with new standard one or oversize one to obtain standard thrust play.

Crankshaft thrust play
Standard : 0.11 – 0.31 mm (0.0043 – 0.0122 in.)
Limit : 0.35 mm (0.0138 in.)

NOTE:

After checking the thrust play, make sure that thread deformation of each bearing cap No.1 bolt according to previous mentioned “Bearing Cap No.1 Bolt” once again.



Out-of-round and taper (uneven wear) of journals

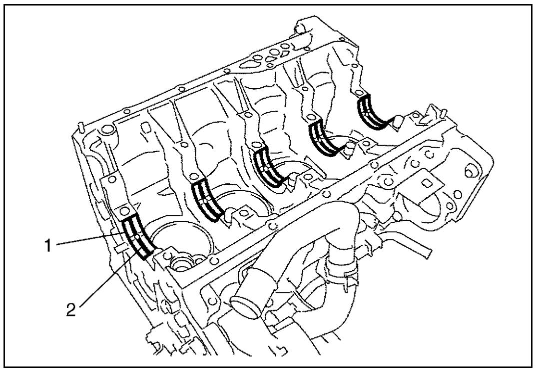
An unevenly worn crankshaft journal shows up as a difference in diameter at a cross section or along its length (or both). This difference, if any, is determined by taking micrometer readings. If any one of journals is badly damaged or if amount of uneven wear in the sense explained below exceeds its limit, regrind or replace crankshaft.

Crankshaft out-of-round and taper
Limit : 0.01 mm (0.0004 in.)
Out-of-round : A – B
Taper : a – b

Main bearings

General information

- Service main bearings are available in standard size and 0.25 mm (0.0098 in.) undersize, and each of them has 5 kinds of bearings differing in tolerance.



- Upper half of bearing (1) has an oil groove (2) as shown in figure.
  Install this half with oil groove to cylinder block.
- Lower half of bearing does not have an oil groove.

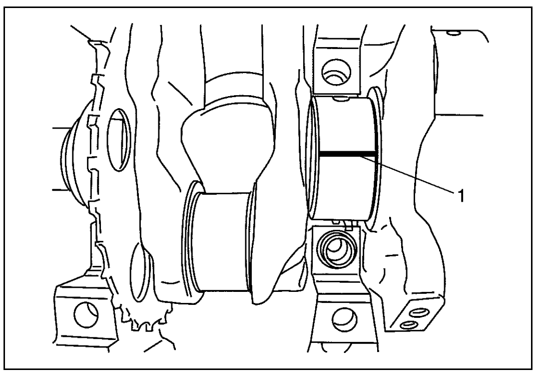
Visual inspection

Check bearings for pitting, scratches, wear or damage.
If any malcondition is found, replace both upper and lower halves.
Never replace either half without replacing the other half.

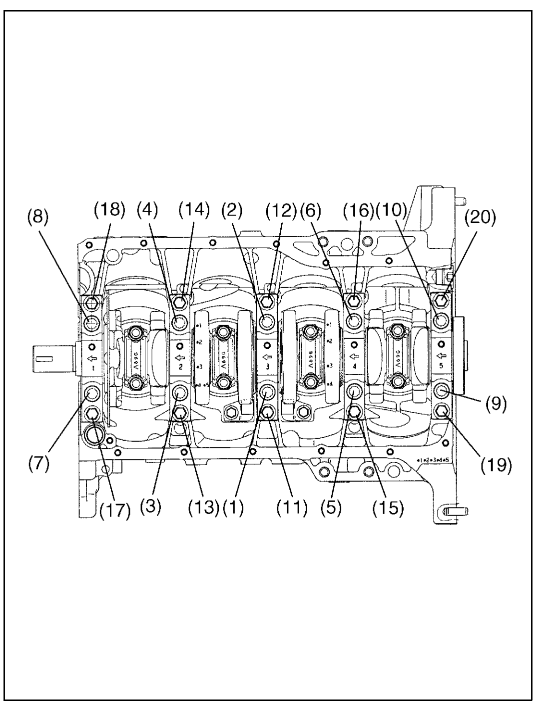
Main bearing clearance

Check clearance by using gaging plastic according to the following procedure.

1) Remove bearing caps.
2) Clean bearings and main journals.



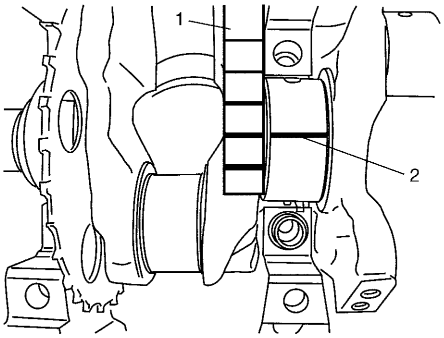
3) Place a piece of gaging plastic (1) the full width of bearing (parallel to crankshaft) on journal, avoiding oil hole.



4) Tighten bearing cap No.1 bolts (1) – (10) and No.2 bolts (11) – (20) gradually as follows.
   a) Tighten bolts (1) – (10) to 30 N·m (3.0 kg-m, 22.0 lb-ft) according to numerical order in figure.
   b) In the same manner as in Step a), tighten them to 50 N·m (5.0 kg-m, 36.5 lb-ft).
   c) In the same manner as in step a), retighten them to 60°.
   d) Tighten bolts (11) – (20) to 22 N·m (2.2 kg-m, 16.0 lb-ft) according to numerical order in figure.

Tighteninq torque
Crank shaft bearing No.1 bolts (1) – (10) :
50 N·m (5.0 kg-m, 36.5 lb-ft) and extra tighten 60°
Crank shaft bearing No.2 bolts (11) – (20) :
22 N·m (2.2 kg-m, 16.0 lb-ft)

NOTE:
Do not rotate crankshaft while gaging plastic is installed.



5) Remove bearing caps and using scale (1) on gaging plastic (2) envelop, measure gaging plastic width at its widest point. If clearance exceeds its limit, replace bearing. Always replace both upper and lower inserts as a unit.
   A new standard bearing may produce proper clearance. If not, it will be necessary to regrind crankshaft journal for use of 0.25 mm undersize bearing.
   After selecting new bearing, recheck clearance.

Main bearing clearance
Standard : 0.025 – 0.045 mm (0.0010 – 0.0018 in.)
Limit : 0.065 mm (0.0026 in.)

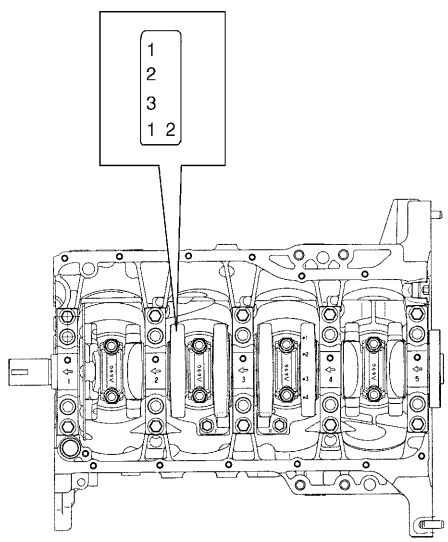
NOTE:

After checking the bearing clearance, make sure that thread deformation of each bearing cap No.1 bolt according to previous mentioned Step 4) once again.

Selection of main bearings

STANDARD BEARING :

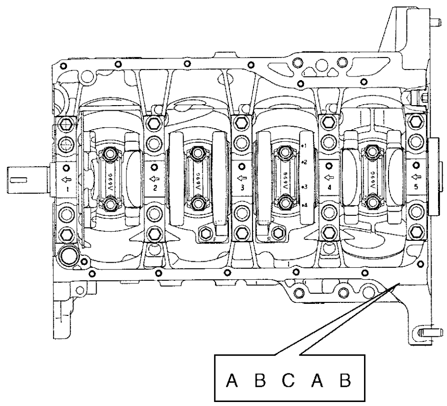
If bearing is in malcondition, or bearing clearance is out of specification, select a new standard bearing according to the following procedure and install it.



1) First check journal diameter. As shown in figure, crank web No.2 has stamped numbers.
   Three kinds of numbers (“1”, “2” and “3”) represent the following journal diameters.
   Stamped numbers on crank web No.2 represent journal diameters marked with an arrow in figure respectively.
   For example of M13 engine, stamped number “1” indicates that corresponding journal diameter is 44.994 – 45.000 mm (1.7714 – 1.7717 in.).

Crankshaft journal diameter

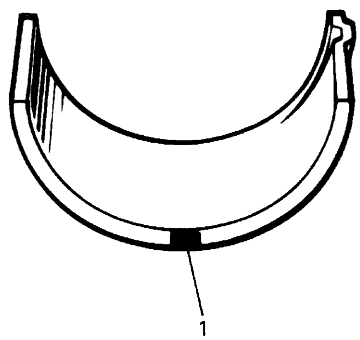
Engine model	Stamped numbers	Journal diameter
M13 engine	1	44.994 – 45.000 mm (1.7714 – 1.7717 in.)
	2	44.988 – 44.994 mm (1.7712 – 1.7714 in.)
	3	44.982 – 44.988 mm (1.7709 – 1.7712 in.)
M16 engine	1	51.994 – 52.000 mm (2.0470 – 2.0472 in.)
	2	51.988 – 51.994 mm (2.0468 – 2.0470 in.)
	3	51.982 – 51.988 mm (2.0465 – 2.0468 in.)



2) Next, check bearing cap bore diameter without bearing. On mating surface of cylinder block, five alphabets are stamped as shown in figure.
   Three kinds of alphabets (“A”, “B” and “C”) represent the following cap bore diameters.
   Stamped alphabets on cylinder block represent bearing cap bore diameter marked with an arrow in figure respectively. For example of M13 engine, stamped “A” indicates that corresponding bearing cap bore diameter is 49.000 – 49.006 mm (1.9291 – 1.9294 in.).

Crankshaft bearing cap bore

Engine model	Stamped alphabet	Bearing cap bore diameter (without bearing)
M13 engine	A	49.000 – 49.006 mm (1.9291 – 1.9294 in.)
	B	49.006 – 49.012 mm (1.9294 – 1.9296 in.)
	C	49.012 – 49.018 mm (1.9296 – 1.9298 in.)
M16 engine	A	56.000 – 56.006 mm (2.2047 – 2.2050 in.)
	B	56.006 – 56.012 mm (2.2050 – 2.2052 in.)
	C	56.012 – 56.018 mm (2.2052 – 2.2054 in.)



3) There are five kinds of standard bearings differing in thickness. To distinguish them, they are painted in the following colors at the position as indicated in figure.
   Each color indicated the following thickness at the center of bearing.

1. Paint

Standard size of crankshaft main bearing thickness
[For M13 engine]

Color painted	Bearing thickness
Pink	1.990 – 1.994 mm (0.0783 – 0.0785 in.)
Purple	1.993 – 1.997 mm (0.0785 – 0.0786 in.)
Brown	1.996 – 2.000 mm (0.0786 – 0.0787 in.)
Green	1.999 – 2.003 mm (0.0787 – 0.0789 in.)
Black	2.002 – 2.006 mm (0.0788 – 0.0790 in.)

[For M16 engine]

Color painted	Bearing thickness
Purple	1.992 – 1.996 mm (0.0784 – 0.0786 in.)
Brown	1.995 – 1.999 mm (0.0785 – 0.0787 in.)
Green	1.998 – 2.002 mm (0.0787 – 0.0788 in.)
Black	2.001 – 2.005 mm (0.0788 – 0.0789 in.)
Colorless (no paint)	2.004 – 2.008 mm (0.0789 – 0.0791 in.)

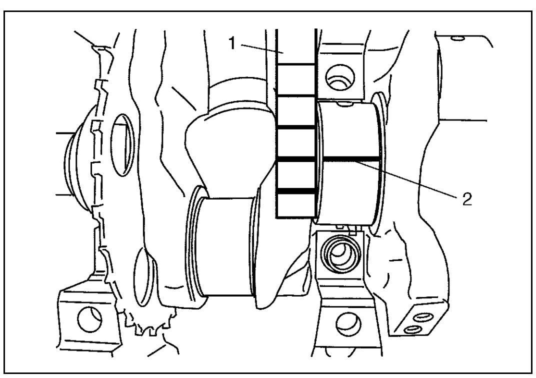
4) From number stamped on crank web No.2 and alphabets stamped on cylinder block, determine new standard bearing to be installed to journal, by referring to table shown below.
   For example of M13 engine, if number stamped on crank web No.2 is “1” and alphabet stamped on cylinder block is “B”, install a new standard bearing painted in “Purple” to its journal.

Specification of new standard crankshaft main bearing size
[For M13 engine]

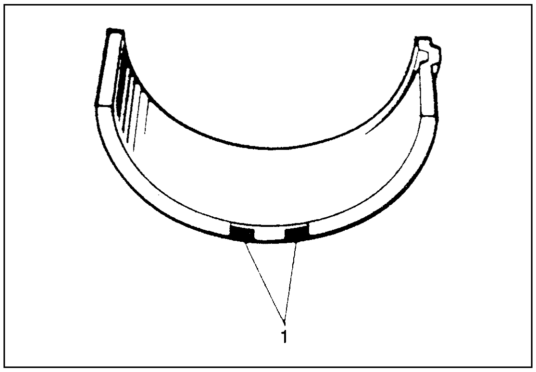
		Number stamped on crank web No.2 (Journal diameter)		
		1	2	3
Alphabet stamped on cylinder block (Cap bore dia.)	A	Pink	Purple	Brown
	B	Purple	Brown	Green
	C	Brown	Green	Black
		New standard bearing to be installed.		

[For M16 engine]

		Number stamped on crank web No.2 (Journal diameter)		
		1	2	3
Alphabet stamped on cylinder block (Cap bore dia.)	A	Purple	Brown	Green
	B	Brown	Green	Black
	C	Green	Black	Colorless
		New standard bearing to be installed.		



5) Using scale (1) on gaging plastic (2), check bearing clearance with newly selected standard bearing.
   If clearance still exceeds its limit, use next thicker bearing and recheck clearance.
6) When replacing crankshaft or cylinder block due to any reason, select new standard bearings to be installed by referring to number stamped on new crankshaft or alphabets stamped on new cylinder block.



UNDERSIZE BEARING (0.25 mm) :

- 0.25 mm undersize bearing is available, in five kinds varying in thickness.
  To distinguish them, each bearing is painted in the following colors at such position as indicated in figure.
  Each color represents the following thickness at the center of bearing.

1. Paint

Undersize of crankshaft main bearing thickness
[For M13 engine]

Color painted	Bearing thickness
Red and Pink	2.115 - 2.119 mm (0.0833 - 0.0834 in.)
Red and Purple	2.118 - 2.122 mm (0.0834 - 0.0835 in.)
Red and Brown	2.121 - 2.125 mm (0.0835 - 0.0837 in.)
Red and Green	2.124 - 2.128 mm (0.0836 - 0.0838 in.)
Red and Black	2.127 - 2.131 mm (0.0837 - 0.0839 in.)

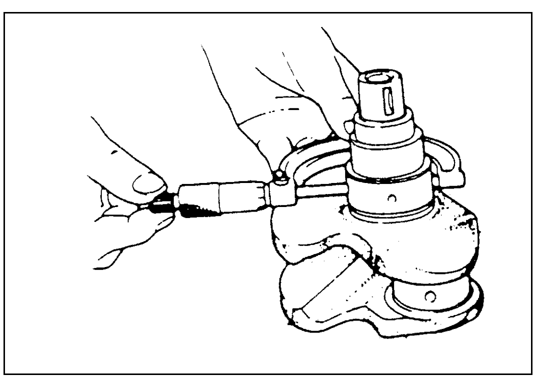
[For M16 engine]

Color painted	Bearing thickness
Red and Purple	2.117 - 2.121 mm (0.0833 - 0.0835 in.)
Red and Brown	2.120 - 2.124 mm (0.0835 - 0.0836 in.)
Red and Green	2.123 - 2.127 mm (0.0836 - 0.0837 in.)
Red and Black	2.126 - 2.130 mm (0.0837 - 0.0839 in.)
Red only	2.129 - 2.133 mm (0.0838 - 0.0840 in.)

- If necessary, regrind crankshaft journal and select undersize bearing to use with it as follows.

a) Regrind journal to the following finished diameter.

Finished diameter
For M13 engine : 44.732 – 44.750 mm (1.7611 – 1.7618 in.)
For M16 engine : 51.732 – 51.750 mm (2.0367 – 2.0374 in.)



1) Using micrometer, measure reground journal diameter. Measurement should be taken in two directions perpendicular to each other in order to check for out-of-round.
2) Using journal diameter measured above and alphabets stamped on cylinder block, select an undersize bearing by referring to table given below.
   Check bearing clearance with newly selected undersize bearing.

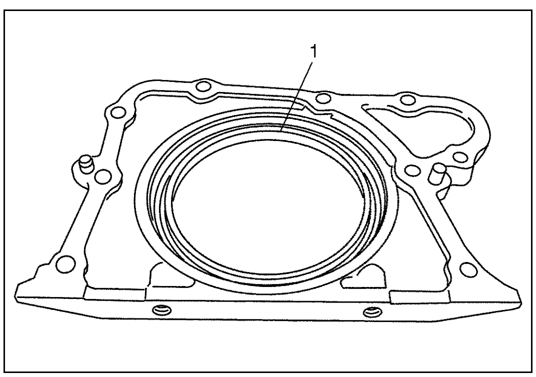
Specification of new standard undersize crankshaft main bearing
[For M13 engine]

		Measured journal diameter		
		44.732 – 44.738 mm (1.7611 – 1.7613 in.)	44.738 – 44.744 mm (1.7613 – 1.7616 in.)	44.744 – 44.750 mm (1.7616 – 1.7618 in.)
Alphabets stamped on cylinder block	A	Red and Brown	Red and Purple	Red and Pink
	B	Red and Green	Red and Brown	Red and Purple
	C	Red and Black	Red and Green	Red and Brown
		Undersize bearing to be installed		

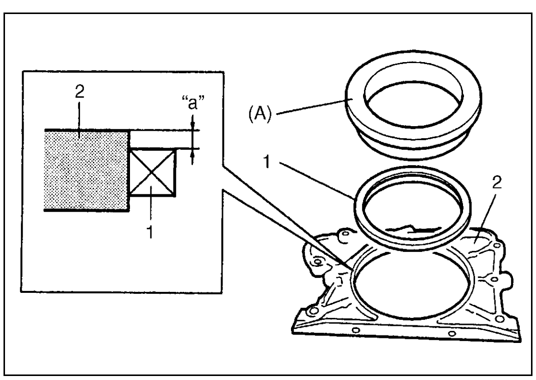
[For M16 engine]

		Measured journal diameter		
		51.732 – 51.738 mm (2.0367 – 2.0369 in.)	51.738 – 51.744 mm (2.0369 – 2.0372 in.)	51.744 – 51.750 mm (2.0372 – 2.0374 in.)
Alphabets stamped on cylinder block	A	Red and Green	Red and Brown	Red and Purple
	B	Red and Black	Red and Green	Red and Brown
	C	Red only	Red and Black	Red and Green
		Undersize bearing to be installed		

Rear oil seal



Carefully inspect oil seal (1) for wear or damage.
If its lip is worn or damaged, replace it.



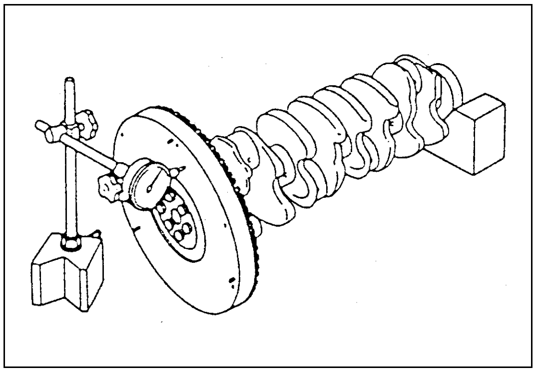
For oil seal installation, press-fit rear oil seal (1) to oil seal housing (2) by using special tool as shown in the figure.

Special tool
(A) : 09911-97820

Crank rear oil seal installing position (dimension)
“a” : 3 mm (0.12 in.)

Flywheel

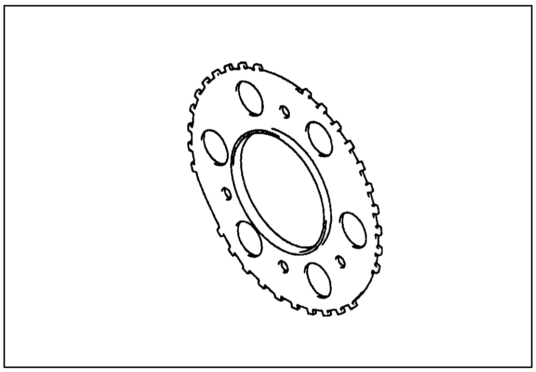
- If ring gear is damaged, cracked or worn, replace flywheel.
- If the surface contacting clutch disc is damaged, or excessively worn, replace flywheel.



- Check flywheel for face runout with a dial gauge.
  If runout exceeds its limit, replace flywheel.

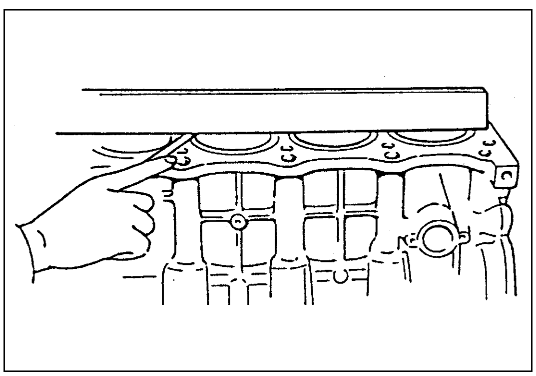
Flywheel on runout
Limit : 0.2 mm (0.0079 in.)

Sensor plate



- Check sensor plate for crack or damage. If malcondition is found, replace it.

Cylinder block



Distortion of gasketed surface

- Using straightedge and thickness gauge, check gasketed surface for distortion and, if flatness exceeds its limit, correct it.

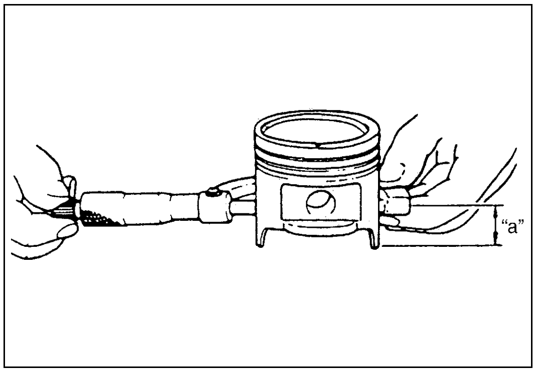
Cylinder block flatness
Limit : 0.05 mm (0.0020 in.)

Honing or reboring cylinders

1) When any cylinder needs reboring, all other cylinders must also be rebored at the same time.
2) Select oversized piston according to amount of cylinder wear.

Oversize piston diameter

Size	Piston diameter
Oversize 0.25	78.203 - 78.218 mm (3.0789 - 3.0794 in.)
Oversize 0.50	78.453 - 78.468 mm (3.0887 - 3.0893 in.)



3) Using micrometer, measure piston diameter.

Measurement position for piston diameter
"a" : 19.5 mm (0.77 in.)

4) Calculate cylinder bore diameter to be rebored as follows.
   D = A + B – C
   D : Cylinder bore diameter to be rebored.
   A : Piston diameter as measured.
   B : Piston clearance = 0.02 – 0.04 mm (0.0008 – 0.0016 in.)
   C : Allowance for honing = 0.02 mm (0.0008 in.)
5) Rebore and hone cylinder to calculated dimension.

NOTE:

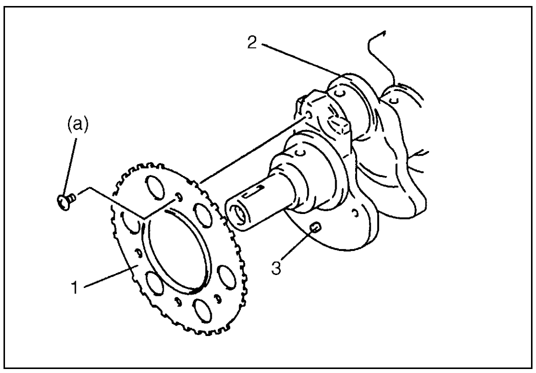
Before reboring, install all main bearing caps in place and tighten to specification to avoid distortion of bearing bores.

6) Measure piston clearance after honing.

INSTALLATION

NOTE:

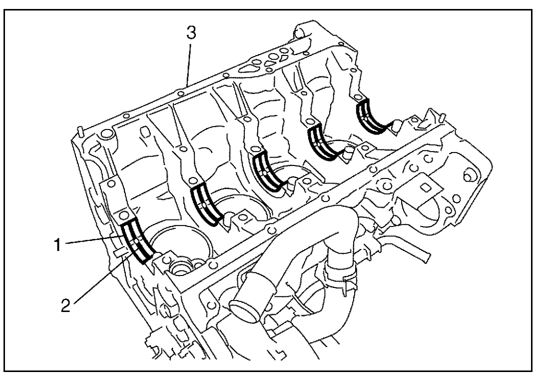
- **Use new bearing cap No.1 bolts. If they are reused, check thread diameters of bearing cap No.1 bolt for deformation according to previous mentioned “Bearing Cap No.1 Bolt” check and replace them with new ones if thread diameter exceeds limit.**
- **All parts to be installed must be perfectly clean.**
- **Be sure to oil crankshaft journals, journal bearings, thrust bearings, crankpins, connecting rod bearings, pistons, piston rings and cylinder bores.**
- **Journal bearings, bearings caps, connecting rods, rod bearings, rod bearing caps, pistons and piston rings are in combination sets. Do not disturb such combination and make sure that each part goes back to where it came from, when installing.**



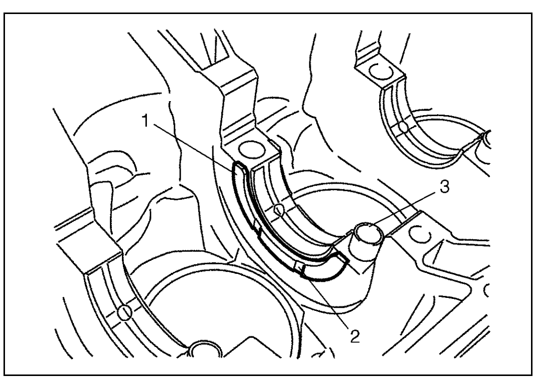
1) Install sensor plate (1) to crankshaft (2) and tighten bolts to specified torque.

NOTE:
When installing sensor plate, align spring pin (3) on crankshaft and hole of sensor plate.

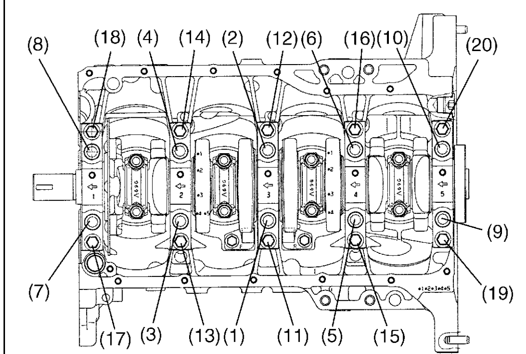
Tightening torque
Sensor plate bolts (a) : 11 N·m (1.1 kg-m, 8.0 lb-ft)



2) Install main bearings to cylinder block.
   Upper half of bearing (1), has an oil groove (2).
   Install it to cylinder block (3), and the other half without oil groove to bearing cap.
   Make sure that two halves are painted in the same color.



3) Install thrust bearings (1) to cylinder block between No.2 and No.3 cylinders. Face oil groove (2) sides to crank webs.
4) Confirm that dowel pins (3) are installed to intake side of each journal.
5) Install crankshaft to cylinder block.

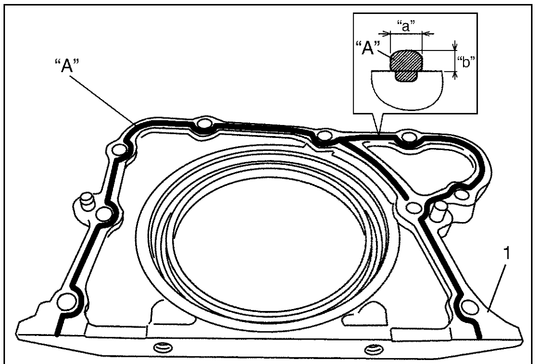


6) Install bearing cap to cylinder block, making sure to point arrow mark (on each cap) to crankshaft pulley side. Fit them sequentially in ascending order, 1, 2, 3, 4 and 5, starting from pulley side.
   After applying engine oil to new bearing cap No.1 bolts ((1) – (10)) and bearing cap No.2 bolts ((11) – (20)), tighten them gradually as follows.
   a) Tighten bolts (1) – (10) to 30 N·m (3.0 kg-m, 22.0 lb-ft) according to numerical order as shown by using a 12 corner socket wrenches.
   b) In the same manner as in Step a), tighten them to 50 N·m (5.0 kg-m, 36.5 lb-ft).
   c) In the same manner as in Step a), retighten them to 60°.
   d) Tighten bolts (11) – (20) to 22 N·m (2.2 kg-m, 16.0 lb-ft) according to numerical order as shown.

Tightening torque
Crankshaft bearing cap No.1 bolts (1) – (10)
: 50 N·m (5.0 kg-m, 36.5 lb-ft) and then turn to 60°
Crankshaft bearing cap No.2 bolts (11) – (20)
: 22 N·m (2.2 kg-m, 16.0 lb-ft)

NOTE:

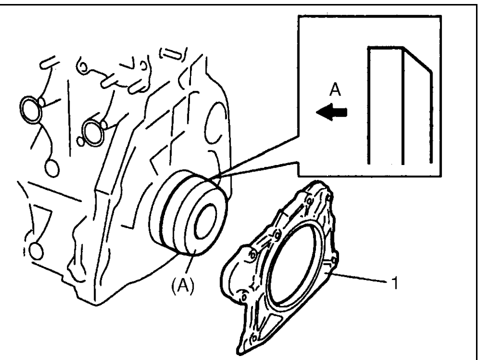
After tightening cap bolts, check to be sure that crankshaft rotates smoothly when turning it by 12 N·m (1.2 kg-m, 9.0 lb-ft) torque or below.



7) Apply sealant to mating surface of rear oil seal housing (1).

"A" : Sealant 99000-31150

Sealant amount for rear oil seal housing
Width "a" : 3 mm, 0.12 in.
Height "b" : 2 mm, 0.08 in.

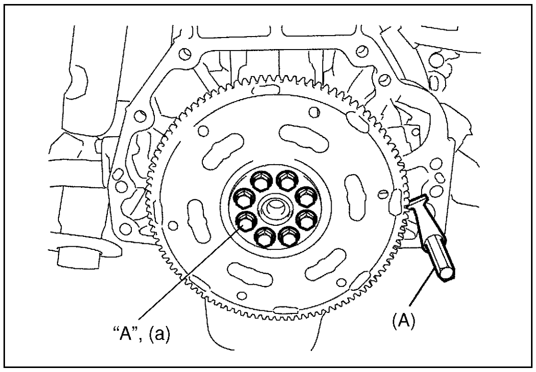


8) Install rear oil seal housing (1) and tighten bolts to specified torque by using special tool.

Special tool
(A) : 09911-97720

Tightening torque
Rear oil seal housing bolts : 11 N·m (1.1 kg-m, 8.0 lb-ft)

A : Crankshaft side



9) Install flywheel (drive plate for A/T).
   Using special tool, lock flywheel or drive plate, and tighten flywheel or drive plate bolts applied with sealant to specification.

   "A" : Sealant 99000-31110

   Special tool
   (A) : 09924-17810

   Tightening torque
   Flywheel or drive plate bolts
   (a) : 70 N·m (7.0 kg-m, 51.0 lb-ft)

10) Install the following parts to engine as previously outlined.
    - Piston and connecting rod
    - Cylinder head assembly
    - Camshaft, tappet and shim
    - Timing chain guide, chain tensioner adjuster, chain tensioner, timing chain and crankshaft timing sprocket
    - Timing chain cover
    - Cylinder head cover
    - Intake manifold and exhaust manifold
    - Oil pan and oil pump strainer
11) Install clutch to flywheel (vehicle with M/T) referring to Section 7C1.
12) Install engine assembly to vehicle as previously outlined.

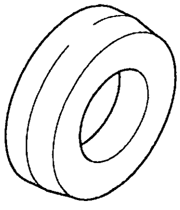
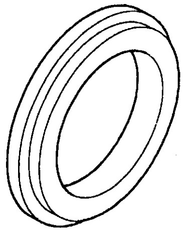
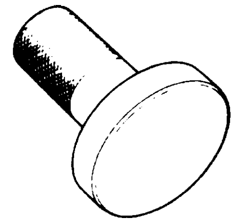
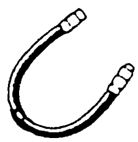
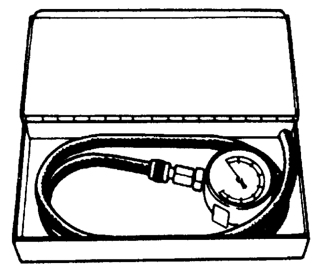
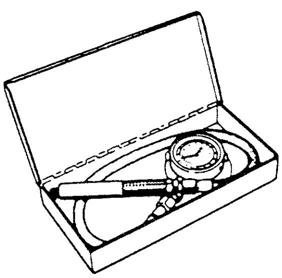
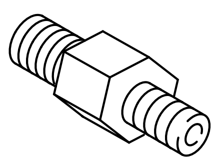
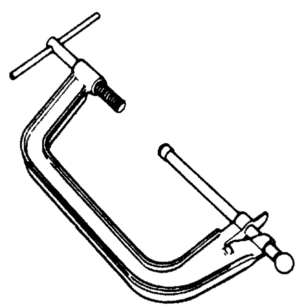
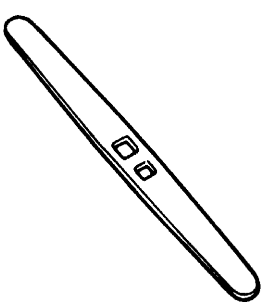
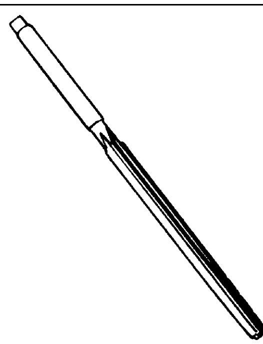
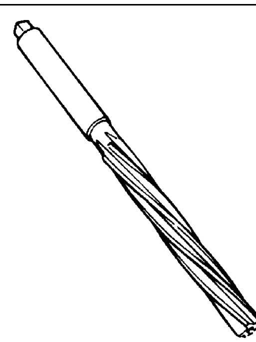
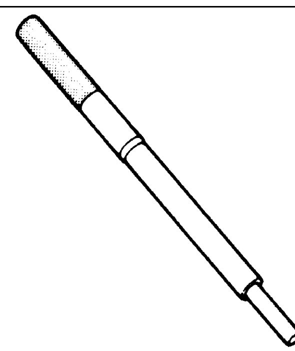
Required Service Material

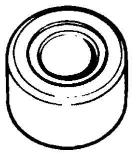
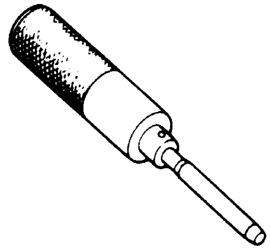
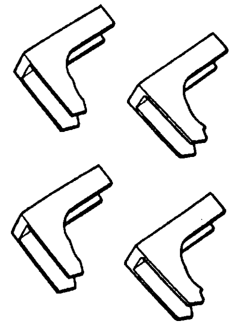
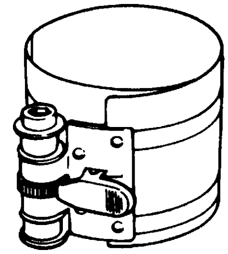
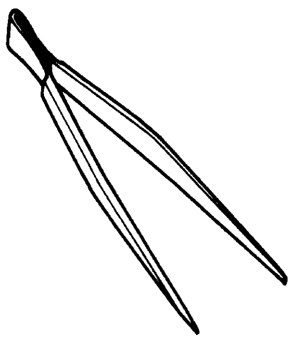
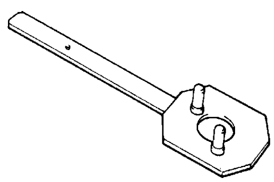
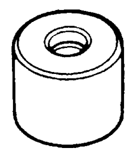
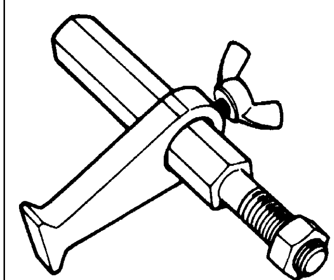
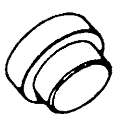
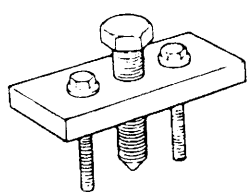
Material	Recommended SUZUKI product (Part Number)	Use
Sealant	Sealant 1207C (99000-31150)	• To apply to mating surfaces of cylinder block and oil pan. • To apply to mating surfaces of cylinder block and timing chain cover. • To apply to sealing surfaces of cylinder head cover. • To apply to mating surfaces to rear oil seal housing.
	Sealant 1207B (99000-31140)	• To apply to mating surface of cylinder block, cylinder head and timing chain cover.
	Sealant 1215 (99000-31110)	• To apply to the thread of the bolt of water outlet pipe. • To flywheel (M/T) or drive plate (A/T) bolts.

Tightening Torque Specification

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Oil pressure switch	14.0	1.4	10.5
Camshaft housing bolts (for replacement of shim)	8.0	0.8	6.0
Camshaft housing bolts	11.0	1.1	8.0
Cylinder head cover bolts	8.0	0.8	6.0
Intake manifold bolts and nuts	25.0	2.5	18.0
Exhaust manifold bolts and nuts	50.0	5.0	36.5
Exhaust pipe bolts	50.0	5.0	36.5
Exhaust manifold stiffener bolts	50.0	5.0	36.5
Oil pump strainer bolt	11.0	1.1	8.0
Oil pump strainer bracket bolt	11.0	1.1	8.0
Oil pan bolts and nuts	11.0	1.1	8.0
Oil pan drain plug bolt	50.0	5.0	36.5
Timing chain cover bolts	23.0	2.3	17.0
Crank shaft pulley bolt	150.0	15.0	108.5
Oil pump rotor plate bolts	11.0	1.1	8.0
Timing chain No.1 guide bolts	9.0	0.9	6.5
Timing chain tensioner adjuster bolts	11.0	1.1	8.0
Venturi plug	5.0	0.5	3.5
Cylinder head bolt for M8	22.0	2.2	16.0
Cylinder head bolts for M10	a) Tighten 40 N·m b) Turn 60° c) Turn 60°	a) Tighten 4.0 kg-m b) Turn 60° c) Turn 60°	a) Tighten 29.0 lb-ft b) Turn 60° c) Turn 60°
Connecting rod bearing cap nuts	a) Tighten 15 N·m b) Turn 45° c) Turn 45°	a) Tighten 1.5 kg-m b) Turn 45° c) Turn 45°	a) Tighten 11.0 lb-ft b) Turn 45° c) Turn 45°
Engine mounting bolts and nuts for M10	55.0	5.5	40.0
Engine mounting bolts and nuts for M12	75.0	7.5	54.5
Crankshaft bearing cap No.1 bolts (for inspection of crankshaft thrust play)	50.0	5.0	36.5
Crankshaft bearing cap No.2 bolts	22.0	2.2	16.0
Sensor plate bolts	11.0	1.1	8.0
Crankshaft bearing cap No.1 bolts	a) Tighten 50 N·m b) Turn 60°	a) Tighten 5.0 kg-m b) Turn 60°	a) Tighten 36.5 lb-ft b) Turn 60°
Rear oil seal housing bolts	11.0	1.1	8.0
Flywheel or drive plate bolts	70.0	7.0	51.0
Transaxle stiffener bolts	50.0	5.0	36.5
Timing chain tensioner bolt	22.0	2.2	16.0

Special Tool

 09911-97720 Oil seal guide	 09911-97820 Oil seal installer	 09913-75810 Bearing installer	 09915-64510-001 Compression gauge
 09915-64510-002 Connector	 09915-64530 Hose	 09915-67010 Attachment	 09915-67310 Vacuum gauge
 09915-77310 Oil pressure gauge	 09915-78211 Oil pressure gauge attachment	 09916-14510 Valve lifer	 09916-14910 Valve lifer attachment
 09916-34542 Reamer handle	 09916-34550 Reamer (5.5 mm)	 09916-37320 Reamer (10.5 mm)	 09916-44910 Valve guide remover

 09916-56011 Valve guide installer	 09916-58210 Valve guide installer han-dle	 09916-67020 Tappet holder	 09916-77310 Piston ring compressor
 09916-84511 Forceps	 09917-68221 Camshaft lock holder	 09917-98221 Valve stem seal installer	 09924-17810 Flywheel holder
 09926-58010 Bearing puller attachment	 09944-36011 Steering wheel remover		

SECTION 6B

ENGINE COOLING

CONTENTS

General Description

The cooling system consists of the radiator cap, radiator, coolant reservoir tank, hoses, water pump, cooling fan and thermostat. The radiator is of tube-and-fin type.

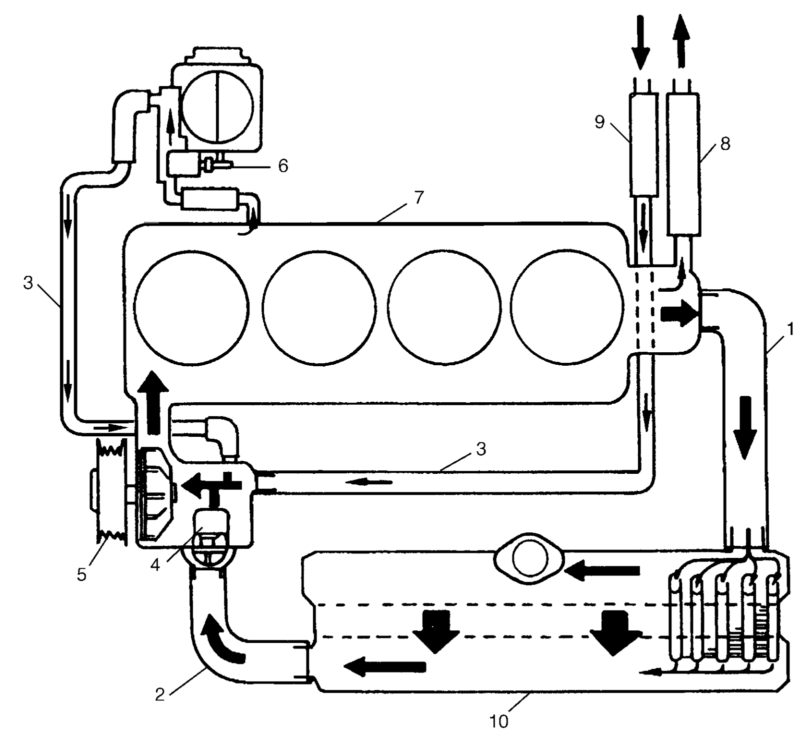
Cooling System Circulation

While the engine is warmed up (thermostat closed), coolant circulates as follows.

Water pump → Cylinder block → Cylinder head → Throttle body / Heater unit → Water intake pipe

Thermostat closed

When coolant is warmed up to normal temperature and the thermostat opens, coolant passes through the radiator core to be cooled as well as the above flow circuit.



1. Radiator inlet hose	5. Water pump	9. Heater outlet hose
2. Radiator outlet hose	6. Throttle body (Fast idle control plunger)	10. Radiator
3. Water inlet pipe	7. Engine	
4. Thermostat	8. Heater inlet hose	

Coolant

The coolant recovery system is standard. The coolant in the radiator expands with heat, and the overflow is collected in the reservoir.
When the system cools down, the coolant is drawn back into the radiator.

The cooling system has been filled at the factory with a quality coolant that is a 50/50 mixture of water and ethylene glycol antifreeze (70/30; in a market where no freezing temperature is anticipated).

This 50/50 mixture coolant solution provides freezing protection to –36°C (–33°F).

- Maintain cooling system freeze protection at –36°C (–33°F) to ensure protection against corrosion and loss of coolant from boiling. This should be done even if freezing temperatures are not expected.
- Add ethylene glycol base coolant when coolant has to be added because of coolant loss or to provide added protection against freezing at temperature lower than –36°C (–33°F).

NOTE:

- **Alcohol or methanol base coolant or plain water alone should not be used in cooling system at any time as damage to cooling system could occur.**
- **Even in a market where no freezing temperature is anticipated, mixture of 70% water and 30% ethylene glycol antifreeze (Antifreeze/Anticorrosion coolant) should be used for the purpose of corrosion protection and lubrication.**

Anti-freeze proportioning table

Freezing temperature	°C	–16	–36
	°F	3	–33
Anti-freeze/Anti-corrosion coolant concentration	%	30	50
Ratio of compound to cooling water	ltr.	2.07/4.83	3.45/3.45
	US pt.	4.38/10.22	7.29/7.29
	Imp pt.	3.65/8.51	6.08/6.08

Coolant capacity

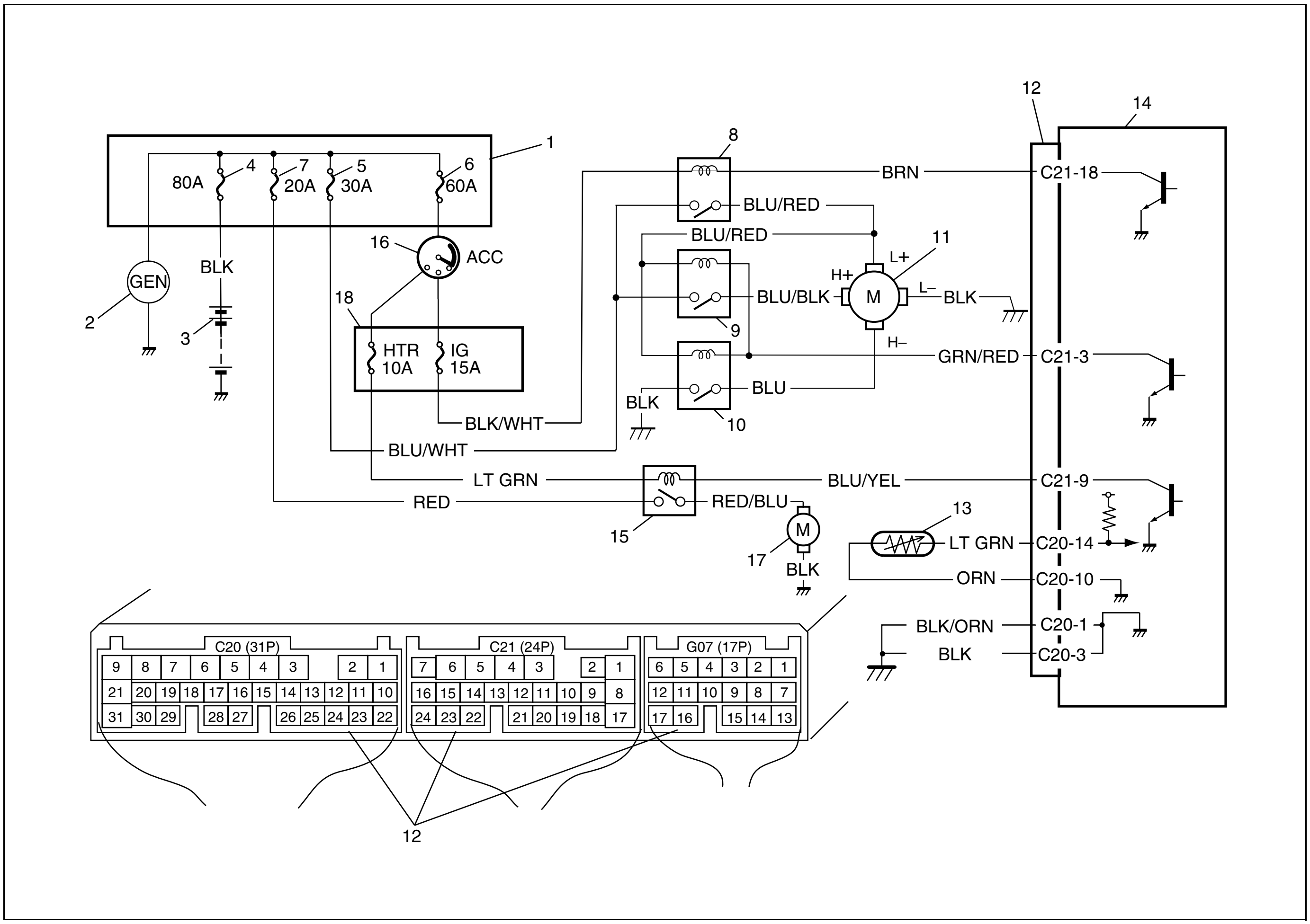
Engine radiator and heater	6.50 liters (8.87/7.39 US/Imp. pt.)
Reservoir tank	0.40 liters (0.85/0.70 US/Imp. pt.)
Total	6.90 liters (9.72/8.10 US/Imp. pt.)

Diagnosis

Diagnosis Table

Condition	Possible Cause	Correction
Engine overheats (It is in case that radiator fan operates)	Loose or broken water pump belt	Adjust or replace.
	Not enough coolant	Check coolant level and add as necessary.
	Faulty thermostat	Replace.
	Faulty water pump	Replace.
	Dirty or bent radiator fins and/or A/C condenser fins	Clean or remedy.
	Coolant leakage on cooling system	Repair.
	Clogged radiator and/or A/C condenser	Check and replace radiator and/or A/C condenser as necessary.
	Faulty radiator cap	Replace.
	Improper ignition timing	Adjust.
	Dragging brakes	Adjust brake.
	Slipping clutch	Adjust or replace.
	Poor charge battery	Check and replace as necessary.
	Poor generation generator	Check and repair.
	ECT sensor faulty	Check and replace as necessary.
	Radiator cooling fan relay No.2 and/or No.3 faulty	Check and replace as necessary.
	Radiator fan motor faulty	Check and replace as necessary.
	A/C condenser cooling fan relay faulty	Check A/C condenser cooling fan relay (Refer to Section 1B).
	A/C condenser cooling fan motor faulty	Check A/C condenser cooling fan motor (Refer to Section 1B).
	ECM faulty	Check and replace as necessary.
	Wiring or grounding faulty	Repair as necessary.
	Equipped with too much electric load part	Dismount.
	Equipped with too much part to bumper air inlet	Dismount.
	A/C system faulty	Check A/C system (Refer to Section 1B).
	Power steering system faulty	Check power steering system (Refer to Section 3).
	EGR system faulty	Check EGR system (Refer to Section 6E).
	IAC system faulty	Check IAC system (Refer to Section 6).
Engine overheats (It is in case that radiator fan won't operates)	Fuse blown	Check "RADTR fan" fuse and check for short circuit to ground.
	Radiator cooling fan relay No.1	Check and replace as necessary.
	ECT sensor faulty	Check and replace as necessary.
	Radiator cooling fan motor faulty	Check and replace as necessary.
	Wiring or grounding faulty	Repair as necessary.
	ECM faulty	Check and replace as necessary.

System Circuit



1. Main fuse box	7. A/C fuse	13. ECT sensor
2. Generator	8. Radiator and condenser cooling fan relay No.1	14. ECM
3. Battery	9. Radiator and condenser cooling fan relay No.2	15. Condenser fan relay (if equipped with A/C)
4. Battery fuse	10. Radiator and condenser cooling fan relay No.3	16. Ignition switch
5. RADTR fuse	11. Radiator cooling fan motor	17. Condenser fan motor (if equipped with A/C)
6. Ignition switch fuse	12. ECM connectors (viewed from harness side)	18. Circuit fuse box

System Circuit Inspection

Refer to “TABLE B-7 RADIATOR FAN CONTROL SYSTEM CHECK” in Section 6.

Maintenance

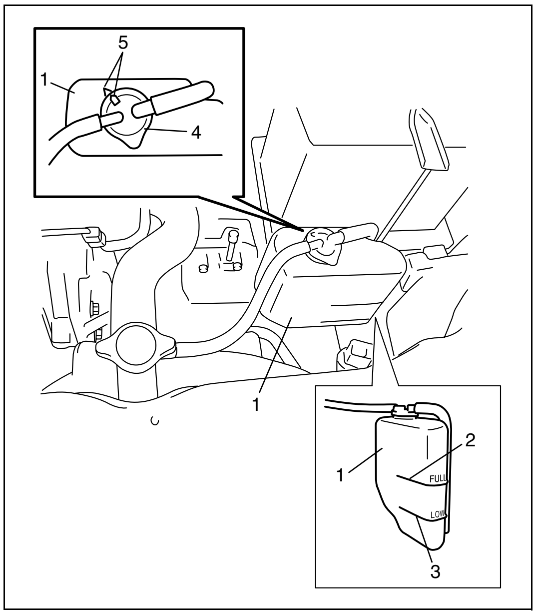
WARNING:

- **Do not remove radiator cap to check engine coolant level; check coolant visually at the see-through coolant reservoir.**
  Coolant should be added only to reservoir as necessary.
- **As long as there is pressure in the cooling system, the temperature can be considerably higher than the boiling temperature of the solution in the radiator without causing the solution to boil. Removal of the radiator cap while engine is hot and pressure is high will cause the solution to boil instantaneously and possibly with explosive force, spewing the solution over engine, fenders and person removing cap. If the solution contains flammable anti-freeze such as alcohol (not recommended for use at any time), there is also the possibility of causing a serious fire.**

Coolant Level Check

To check level, lift hood and look at "see-through" coolant reservoir tank.
It is not necessary to remove radiator cap to check coolant level.

> **WARNING:**
> **To help avoid danger of being burned:**
> - **do not remove reservoir tank cap while coolant is boiling, and**
> - **do not remove radiator cap while engine and radiator are still hot.**
>
> **Scalding fluid and steam can be blown out under pressure if either cap is taken off too soon.**



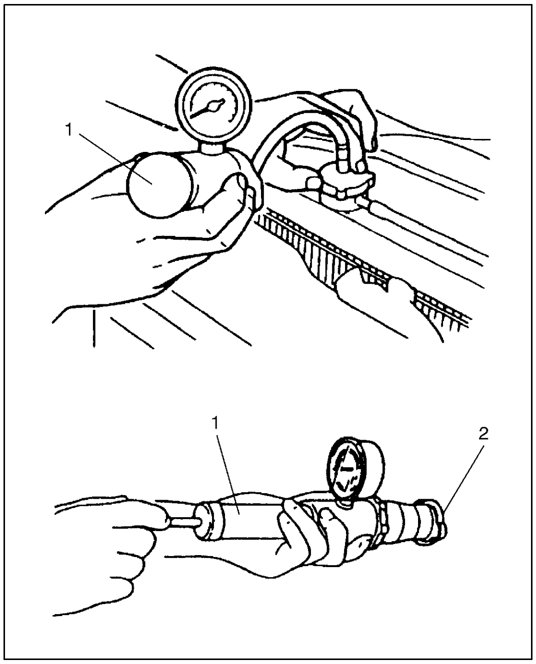
When engine is cool, check coolant level in reservoir tank (1).
A normal coolant level should be between FULL mark (2) and LOW mark (3) on reservoir tank (1).
If coolant level is below LOW mark (3), remove reservoir tank cap (4) and add proper coolant to tank to bring coolant level up to FULL mark (2). Then, reinstall cap (4) and align match marks (5) on tank and cap (4).

NOTE:
- **If proper quality antifreeze is used, there is no need to add extra inhibitors or additives that claim to improve system.**
  They may be harmful to proper operation of system, and are unnecessary expense.
- **When installing reservoir cap, align arrow marks on reservoir and cap.**

Engine Cooling System Inspection and Service

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

1) Check cooling system for leakage or damage.
2) Wash radiator cap and filler neck with clean water by removing radiator cap when engine is cold.
3) Check coolant for proper level and freeze protection.



4) Using a pressure tester (1), check system and radiator cap (2) for proper pressure holding capacity.
   If replacement of cap is required, use a proper cap for this vehicle.

Cooling system and radiator cap holding pressure (for inspection)
: 110 kPa (1.1 kg/cm^2, 15.6 psi)

NOTE:
After installing radiator cap to radiator, make sure that the ear of cap lines is parallel to radiator.

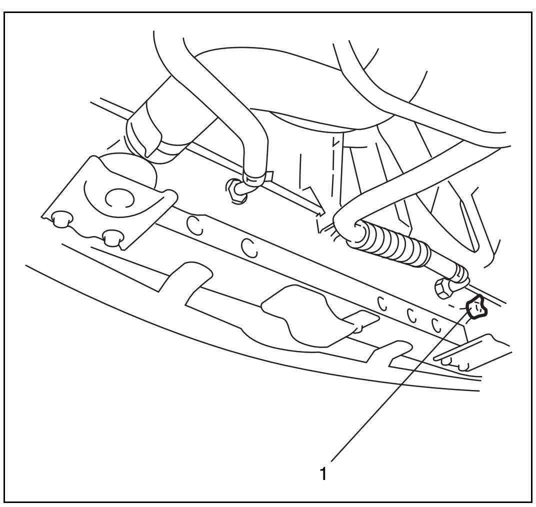
5) Tighten hose clamps and inspect all hoses. Replace hoses whenever cracked, swollen or otherwise deteriorated.
6) Clean frontal area of radiator core.

Cooling System Flush and Refill

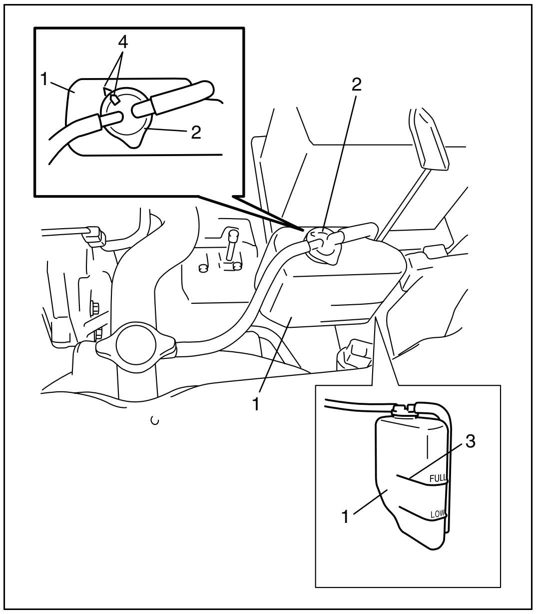
1) Remove radiator cap when engine is cool.
   a) Turn cap counterclockwise slowly until it reaches a “stop”. (Do not press down while turning it).
   b) Wait until pressure is relieved (indicated by a hissing sound) then press down on cap and continue to turn it counterclockwise.

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

2) With radiator cap removed, run engine until upper radiator hose is hot (this shows that thermostat is open and coolant is flowing through system).



3) Stop engine and drain coolant.
4) Close drain plug. Add water until system is filled and run engine until upper radiator hose is hot again.
5) Repeat Steps 3) and 4) several times until drained liquid is nearly colorless.
6) Drain system and then close radiator drain plug (1) tightly.

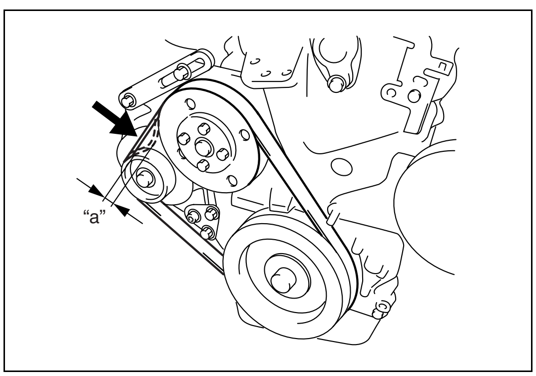


7) Remove reservoir tank (1) and remove cap (2) from reservoir tank (1) and pour out any fluid, scrub and clean inside of tank with soap and water.
   Flush it well with clean water and drain. Reinstall tank.
8) Add coolant that is a mixture of good quality ethylene glycol antifreeze and water to radiator and reservoir tank. For coolant concentration referring to “COOLANT”.
   Fill radiator to the bottom of filler neck and reservoir tank to FULL level mark (3).
9) Reinstall reservoir tank cap and align match marks (4) on reservoir tank and its tank cap.
10) Run engine with radiator cap removed, until radiator inlet hose is hot.
11) With engine idling, add coolant to radiator until level reaches the bottom of filler neck. Install radiator cap, making sure that the ear of cap lines is parallel to radiator.

Water Pump/Generator Drive Belt Tension Inspection and Adjustment

WARNING:
- **Disconnect negative cable at battery before checking and adjusting belt tension.**
- **To help avoid danger of being burned, do not remove radiator cap while engine and radiator are still hot. Scalding fluid and steam can be blown out under pressure if cap is taken off too soon.**

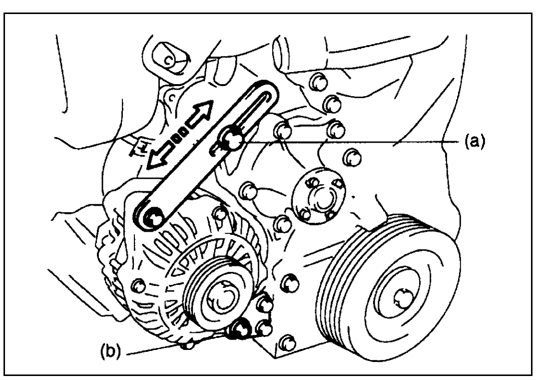
1) Inspect belt for cracks, cuts, deformation, wear and cleanliness. If it is necessary to replace belt, refer to “WATER PUMP/GENERATOR DRIVE BELT” in this section.



2) Check belt for tension. Belt is in proper tension when it deflects 4.5 to 5.5 mm (0.18 – 0.22 in.) under thumb pressure (about 10 kg or 22 lb.).

Water pump / generator drive belt tension “a”
4.5 – 5.5 mm (0.18 – 0.22 in.) as deflection/10 kg (22 lbs)

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



3) If belt is too tight or too loose, adjust it to proper tension by displacing generator position.
4) Tighten generator adjusting bolt and pivot bolts as specified torque.

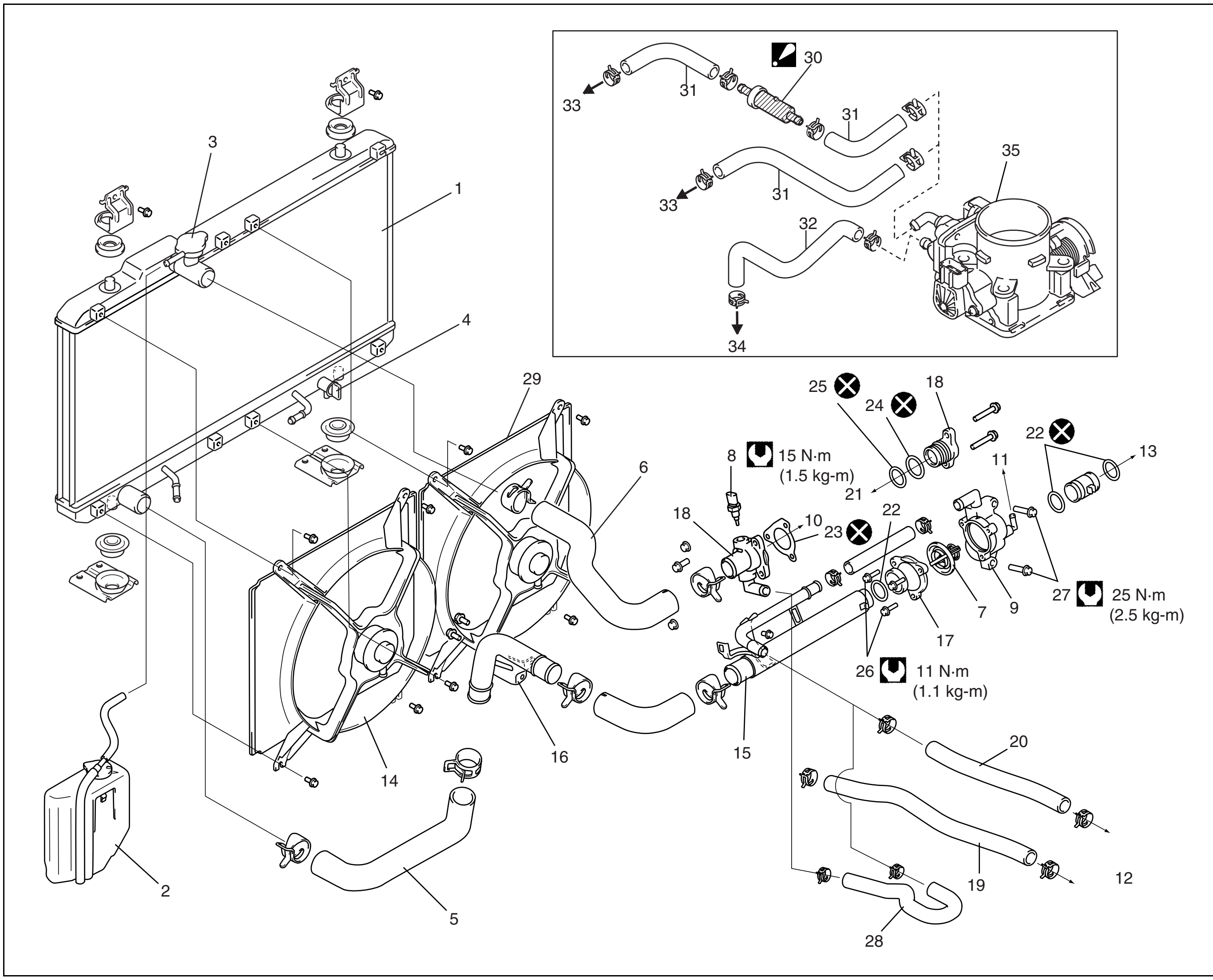
Tightening torque
Generator adjusting bolt (a) : 23 N·m (2.3 kg-m, 17.0 lb-ft)
Generator pivot bolt (b) : 50 N·m (5.0 kg-m, 36.0 lb-ft)

5) Connect negative cable at battery.

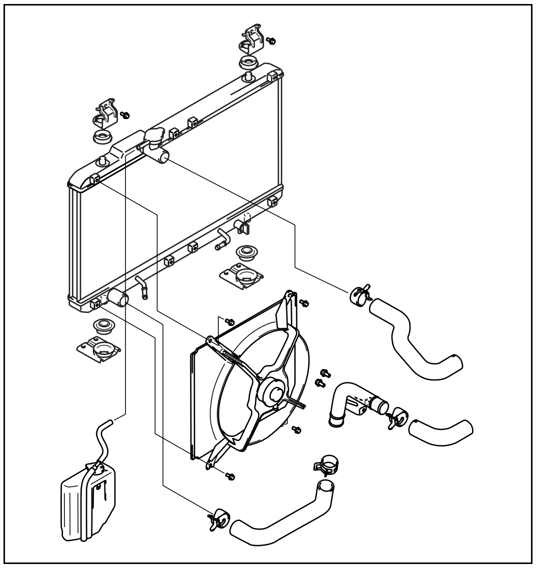
On-Vehicle Service

WARNING:
- **Check to make sure that engine coolant temperature is cold before removing any part of cooling system.**
- **Also be sure to disconnect negative cord from battery terminal before removing any part.**

System Components



1. Radiator	14. Radiator cooling fan assembly	27. Thermostat case bolts
2. Reservoir tank	15. Water inlet pipe No.1	28. Heater circulation hose (if equipped)
3. Radiator cap	16. Water inlet pipe No.2	29. Condenser cooling fan assembly (if equipped)
4. Drain plug	17. Thermostat cap	30. Water valve (if equipped) : Install noting its direction as shown
5. Radiator outlet hose	18. Water outlet cap	31. Throttle body water inlet valve
6. Radiator inlet hose	19. Heater inlet hose	32. Throttle body water outlet valve
7. Thermostat	20. Heater outlet hose	33. To cylinder head
8. ECT sensor	21. To timing chain cover	34. To thermostat case
9. Thermostat case	22. O-Ring	35. Throttle body
10. To cylinder head	23. Gasket	Tightening torque
11. To throttle body	24. Water outlet cap O-ring No.1	Do not reuse.
12. To heater unit	25. Water outlet cap O-ring No.2	
13. To water pump	26. Thermostat cap bolts	



Cooling Water Pipes or Hoses

REMOVAL

1) Drain cooling system.
2) To remove these pipes or hoses, loosen clamp on each hose and pull hose end off.

INSTALLATION

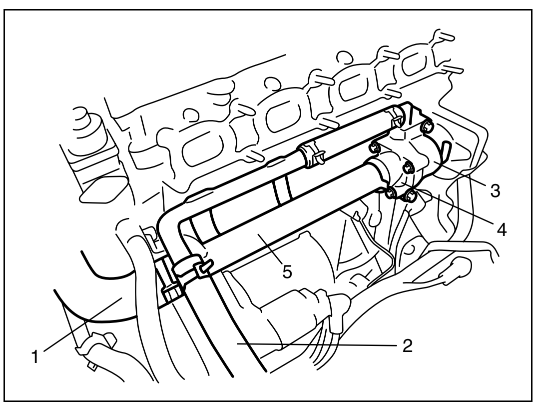
Install removed parts in reverse order of removal procedure, noting the following.

- Tighten each clamp securely.
- Refill cooling system with proper coolant referring to “COOLING SYSTEM FLUSH AND REFILL”.

Thermostat

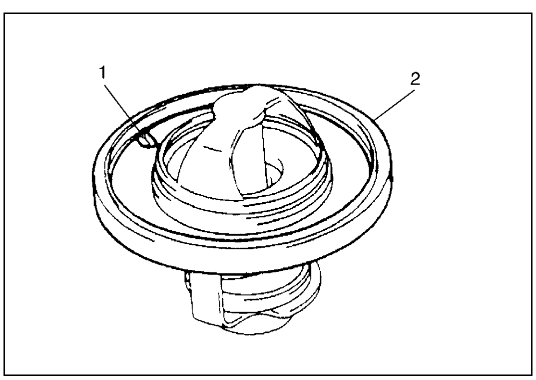
REMOVAL

1) Drain cooling system by loosening drain plug of radiator referring to “COOLING SYSTEM DRAINING”.
2) Remove air cleaner assembly and resonator referring to section 6A1.
3) Remove intake manifold referring to Section 6A1.
4) Remove generator referring to Section 6H.

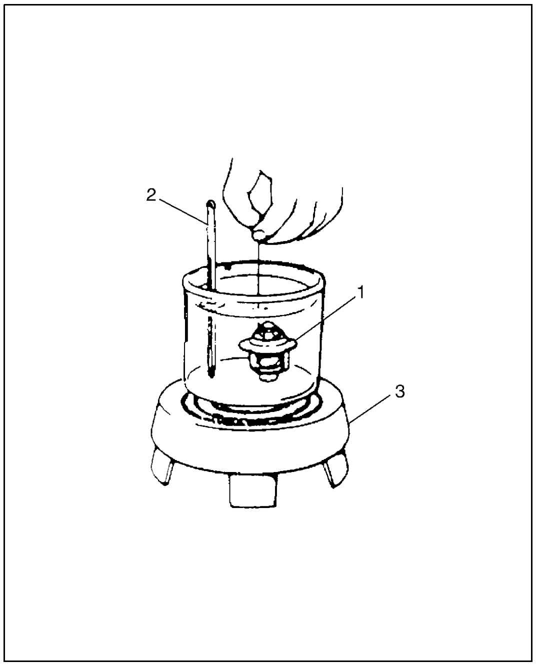


5) Disconnect water hose (1) and heater hose (2) from each pipe.
6) Remove thermostat case (3) with thermostat cap (4) and water inlet pipe (5).
7) Remove water inlet pipe with thermostat cap from thermostat case.
8) Remove thermostat.

INSPECTION



- Make sure that air bleed valve (1) of thermostat is clean. Should this valve be clogged, engine would tend to overheat.
- Check to make sure that valve seat is free from foreign matters which would prevent valve from seating tight.
- Check thermostat seal (2) for breakage, deterioration or any other damage.



- Check thermostatic movement of wax pellet as follows:

a) Immerse thermostat (1) in water, and heat water gradually.
b) Check that valve starts to open at specific temperature.

Temperature at which valve begins to open
: 80 – 84°C (176 – 183°F)

Temperature at which valve become fully open
: 95 – 97°C (203°F)

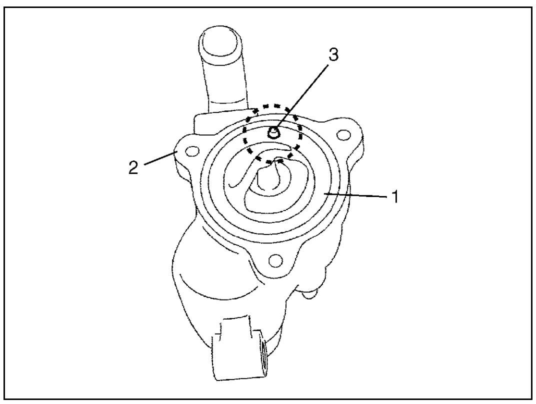
Valve lift
: More than 8 mm at 95°C (203°F)

If valve starts to open at a temperature substantially below or above specific temperature, thermostat unit should be replaced with a new one. Such a unit, if reused, will bring about overcooling or overheating tendency.

2. Thermometer
3. Heater

INSTALLATION

Reverse removal procedure for installation noting the following points.

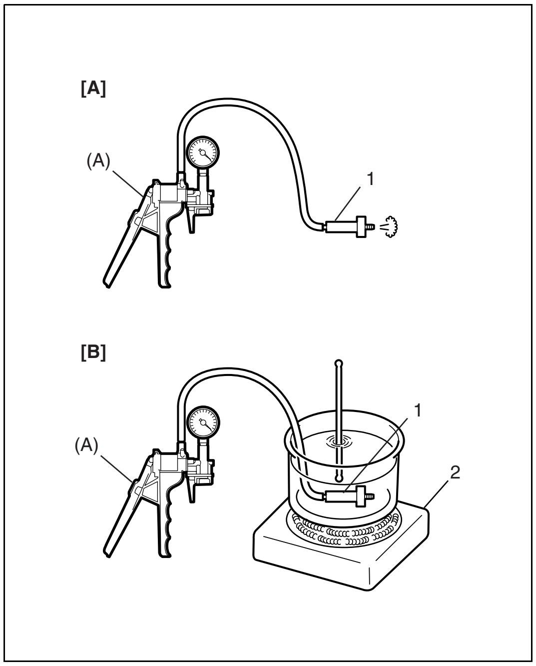


- When positioning thermostat (1) on thermostat case (2), be sure to position it so that air bleed valve (3) comes at position as shown in figure.
- Use new O-rings when installing.
- Adjust water pump belt tension referring to WATER PUMP/ GENERATOR DRIVE BELT TENSION INSPECTION AND ADJUSTMENT in this section.
- Adjust A/C compressor belt tension (if equipped) referring to Section 1B.
- Refill cooling system with proper coolant referring to “COOLING SYSTEM FLUSH AND REFILL”.
- Verify that there is no coolant leakage at each connection.

Water Valve (If Equipped)

REMOVAL

1) Drain cooling system by loosening drain plug of radiator referring to “COOLING SYSTEM DRAINING” in this section.
2) Remove water valve referring to “SYSTEM COMPONENT” in this section.



INSPECTION

Check water valve operation as follows:

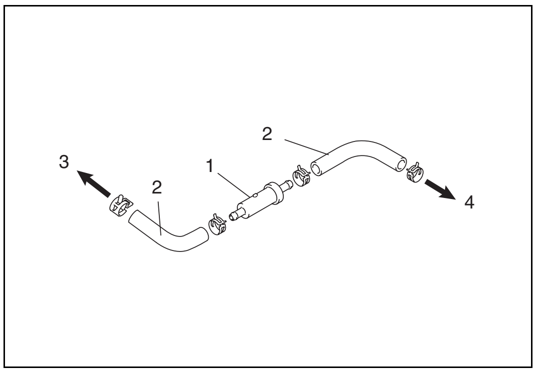
a) Connect water valve (1) to vacuum pump gauge (A) discharge side as shown, and then check that air comes out from water valve (1).

Special tool
(A) : 09917-47010

b) Immerse water valve (1) in heated water (more than 90°C (194°F)) for 5 minutes, and then check that air does not come out from water valve (1).

If check result is not as specified, replace water valve.

[A]:	Fig. for step a)
[B]:	Fig. for step b)
2.	Heater



INSTALLATION

Reverse removal procedure to install water valve noting the followings.

- Insert water valve (1) to throttle body water inlet hoses (2) directing gold side (5) to cylinder head.

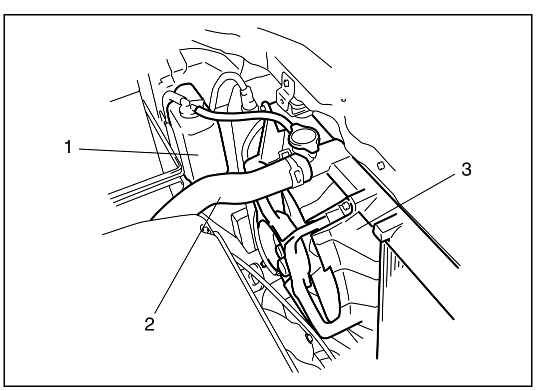
3.	To throttle body
4.	To cylinder head

- Refill cooling system with proper coolant referring to “COOLING SYSTEM FLUSH AND REFILL”.
- Verify that there is no coolant leakage at each connection.

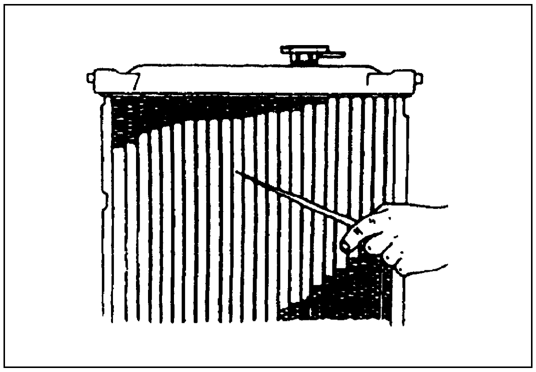
Radiator

REMOVAL

1) Disconnect negative cable at battery.
2) Drain cooling system by loosening drain plug of radiator. Refer to “COOLING SYSTEM DRAINING”.
3) Disconnect connector of cooling fan motor.
4) Remove A/C condenser cooling fan assembly, if equipped with A/C.



5) Remove reservoir tank (1), if equipped with A/C.
6) Disconnect radiator inlet (2) and outlet hoses from radiator.
7) Remove cooling fan assembly (3).
8) Disconnect A/T fluid hoses from radiator, if equipped with A/T vehicle.
9) Remove radiator.



INSPECTION

Check radiator for leakage or damage. Straighten bent fins, if any.

CLEANING

Clean frontal area of radiator cores.

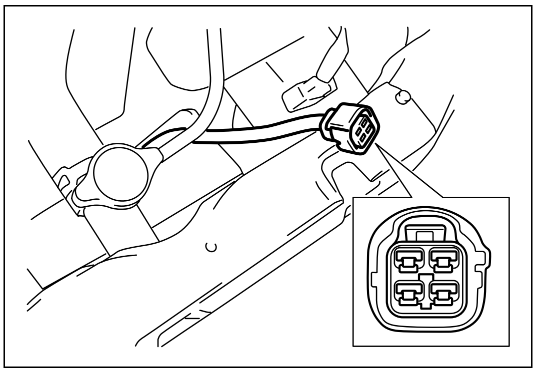
INSTALLATION

Reverse removal procedures, noting the followings.

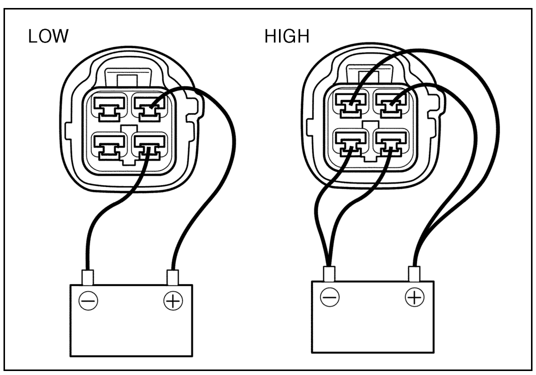
- Refill cooling system with proper coolant referring to “COOLING SYSTEM FLUSH AND REFILL”.
- After installation, check each joint for leakage.

Radiator Cooling Fan

INSPECTION

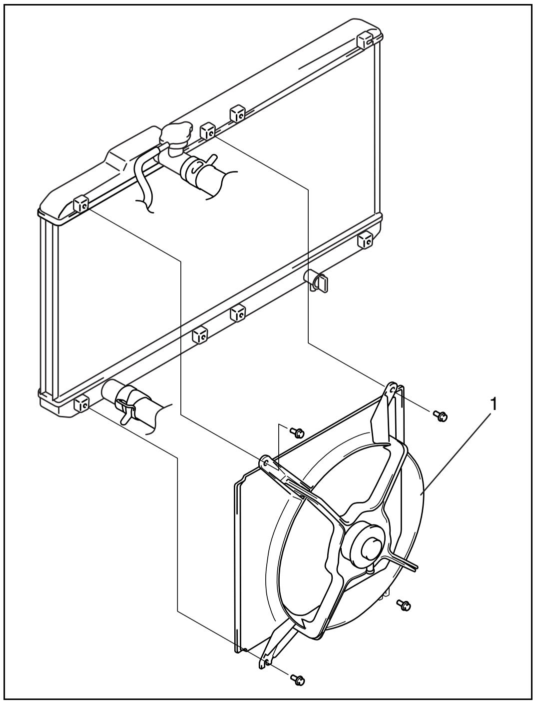


1) Check continuity between each terminals.
   If there is no continuity, replace radiator fan motor.



2) Connect battery to radiator fan motor coupler as shown in figure, then check that the radiator fan motor operates smoothly, fan speed varies and that specified current.
   If radiator fan motor does not operate smoothly, replace motor.

Radiator cooling fan motor specified current at 12 V
LOW : 10 A maximum
HIGH : 15 A maximum



REMOVAL

1) Disconnect negative cable at battery.
2) Disconnect connector of cooling fan motor.
3) Remove A/C condenser cooling fan motor, if equipped with A/C.
4) Remove radiator cooling fan motor (1) from radiator.

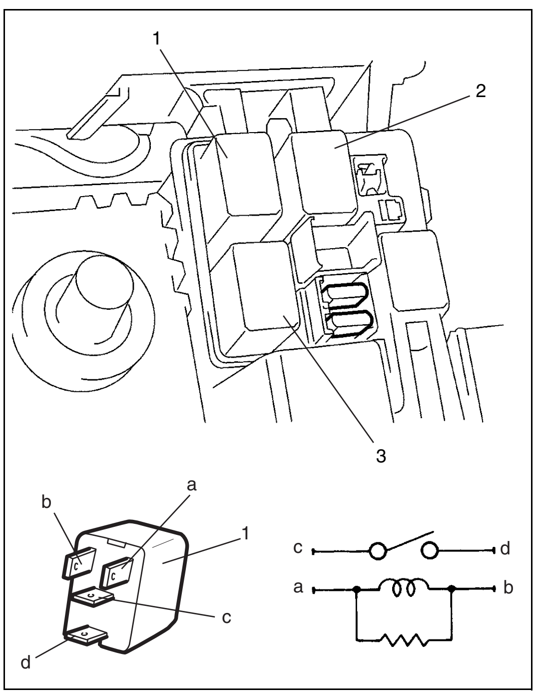
INSTALLATION

Reverse removal procedure for installation.

Radiator Cooling Fan Relay

INSPECTION

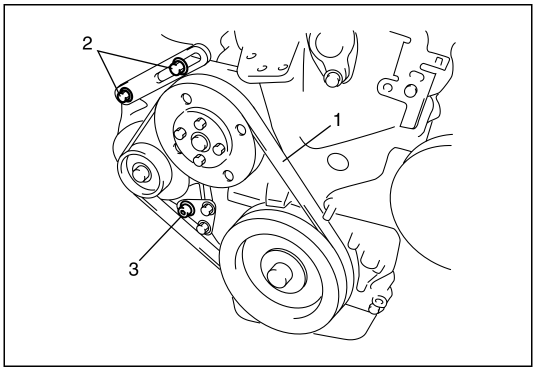
1) Disconnect negative (–) cable at battery.



2) Remove radiator cooling fan relay No.1 (1), No.2 (2) and No.3 (3) from relay box.
3) Check that there is no continuity between terminal “c” and “b”. If there is continuity, replace relay.
4) Connect battery positive (+) terminal to terminal “b” of relay.
   Connect battery negative (–) terminal “a” of relay.
   Check continuity between terminal “c” and “d”.
   If there is no continuity when relay is connected to the battery, replace relay.

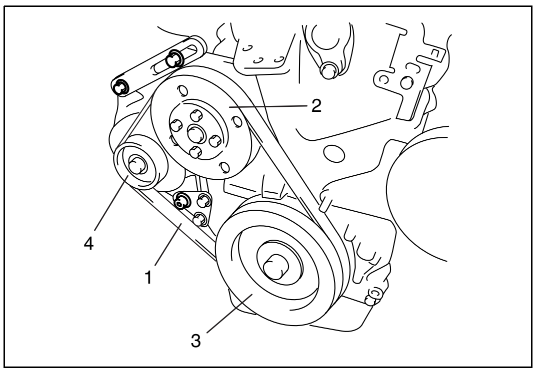
Water Pump/Generator Drive Belt

REMOVAL

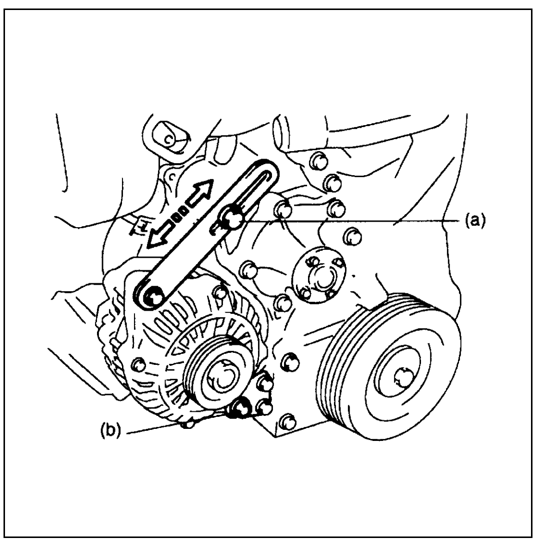


1) Disconnect negative cable at battery.
2) Remove right side engine under cover and generator cover (if equipped).
3) Loosen drive belt adjusting bolt (2) and generator pivot bolt (3).
   When servicing car equipped with A/C, remove compressor drive belt before removing water pump belt (1).
   Refer to "COMPRESSOR DRIVE BELT" in Section 1B.
4) Slacken belt by displacing generator and then remove it.

INSTALLATION



1) Install belt (1) to water pump pulley (2), crankshaft pulley (3) and generator pulley (4).
   When servicing car equipped with A/C, install compressor drive belt, too.



2) Adjust belt tension by referring to "WATER PUMP/GENERATOR DRIVE BELT TENSION INSPECTION AND ADJUSTMENT" in this section.
   For adjustment of compressor drive belt tension, refer to COMPRESSOR DRIVE BELT in Section 1B.
3) Tighten water pump belt adjusting bolt and pivot bolt to specified torque.

Tightening torque
Generator adjusting bolt (a) : 23 N·m (2.3 kg-m, 17.0 lb-ft)
Generator pivot bolt (b) : 50 N·m (5.0 kg-m, 36.0 lb-ft)

4) Install right side engine under cover and generator cover (if equipped).
5) Connect negative cable at battery.

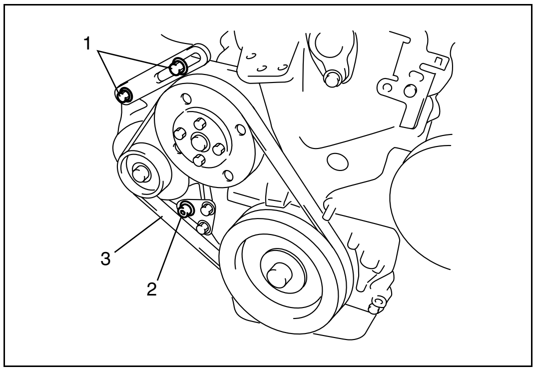
WATER PUMP BELT TENSION INSPECTION AND ADJUSTMENT

For this inspection or adjustment, refer to "WATER PUMP/GENERATOR DRIVE BELT TENSION INSPECTION AND ADJUSTMENT".

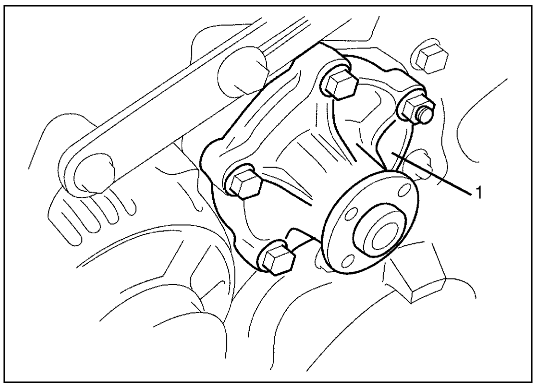
Water Pump

REMOVAL

1) Disconnect negative cable at battery.
2) Drain coolant. Refer to “COOLING SYSTEM DRAINING”.
3) Remove A/C compressor belt by referring to “COMPRESSOR DRIVE BELT” in Section 1B. (if equipped).



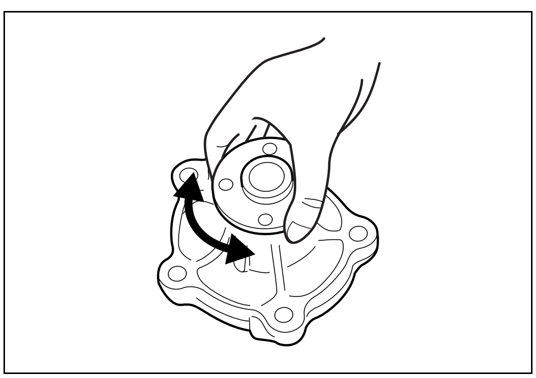
4) Loosen water pump/generator drive belt adjusting bolt (1) and generator pivot bolt (2). Then remove water pump/generator drive belt (3) and water pump pulley.
   Refer to “WATER PUMP/GENERATOR DRIVE BELT” in this section.



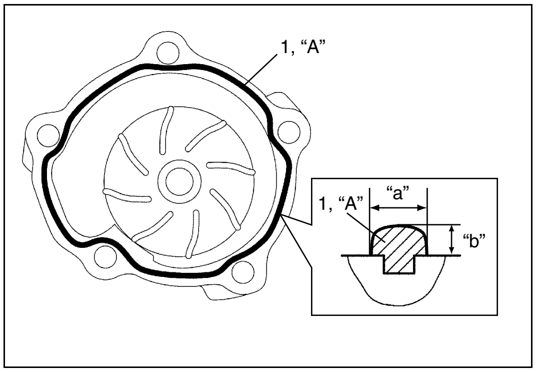
5) Remove water pump assembly (1).

INSPECTION

> **CAUTION:**
> **Do not disassemble water pump.**
> **If any repair is required on pump, replace it as assembly.**



- Rotate water pump by hand to check for smooth operation. If pump does not rotate smoothly or makes abnormal noise, replace it.

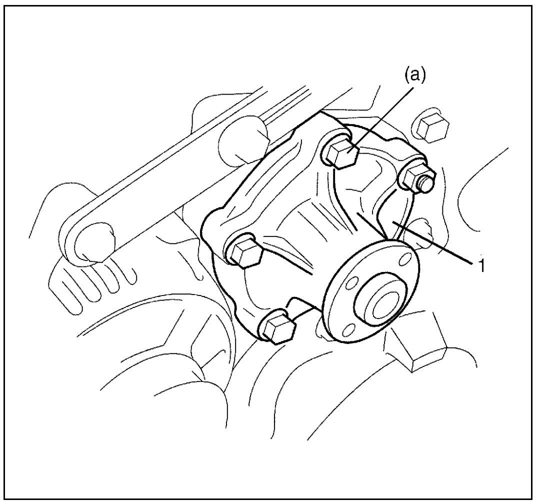


INSTALLATION

1) Apply sealant (1) to mating surface of water pump as shown in figure.

   "A" : Sealant 99000-31150

   Sealant quantity (to mating surface of water pump)
   Width "a" : 3mm (0.12 in.)
   Height "b" : 2mm (0.08 in.)



2) Install water pump assembly (1) to cylinder block and tighten bolts and nut to specified torque.

   Tightening torque
   Water pump bolts and nut (a) : 22 N·m (2.2 kg-m, 16.0 lb-ft)

3) Install water pump pulley.
4) Install water pump/generator drive belt. Refer to "WATER PUMP/GENERATOR DRIVE BELT" in this Section.
5) Install A/C compressor belt (if equipped). Refer to "COMPRESSOR DRIVE BELT" in Section 1B.
6) Fill coolant. Refer to "COOLING SYSTEM FLUSH AND REFILL".
7) Connect negative cable at battery.
8) Check each part for leakage.

ECT Sensor

Refer to "ECT SENSOR" in Section 6E1.

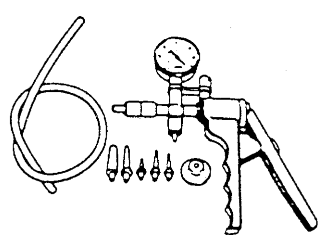
Required Service Material

Material	Recommended SUZUKI product (Part Number)	Use
Ethylene glycol base coolant (Anti-freeze/ Anti-corrosion coolant)	—	Additive to engine cooling system for improving cooling efficiency and for protection against rusting.
Sealant	SUZUKI BOND NO. 1207C (99000-31150)	To apply to mating surface of water pump

Tightening Torque Specification

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Generator adjusting bolt	23	2.3	17
Generator pivot bolt	50	5.0	36
Water pump bolts and nut	22	2.2	16

Special Tool



09917-47010
Vacuum pump gauge

SECTION 6C

ENGINE FUEL

WARNING:

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

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

CAUTION:

The engine of this vehicle requires the use of unleaded fuel only. Use of leaded and/or low lead fuel can result in engine damage and reduce the effectiveness of the emission control system.

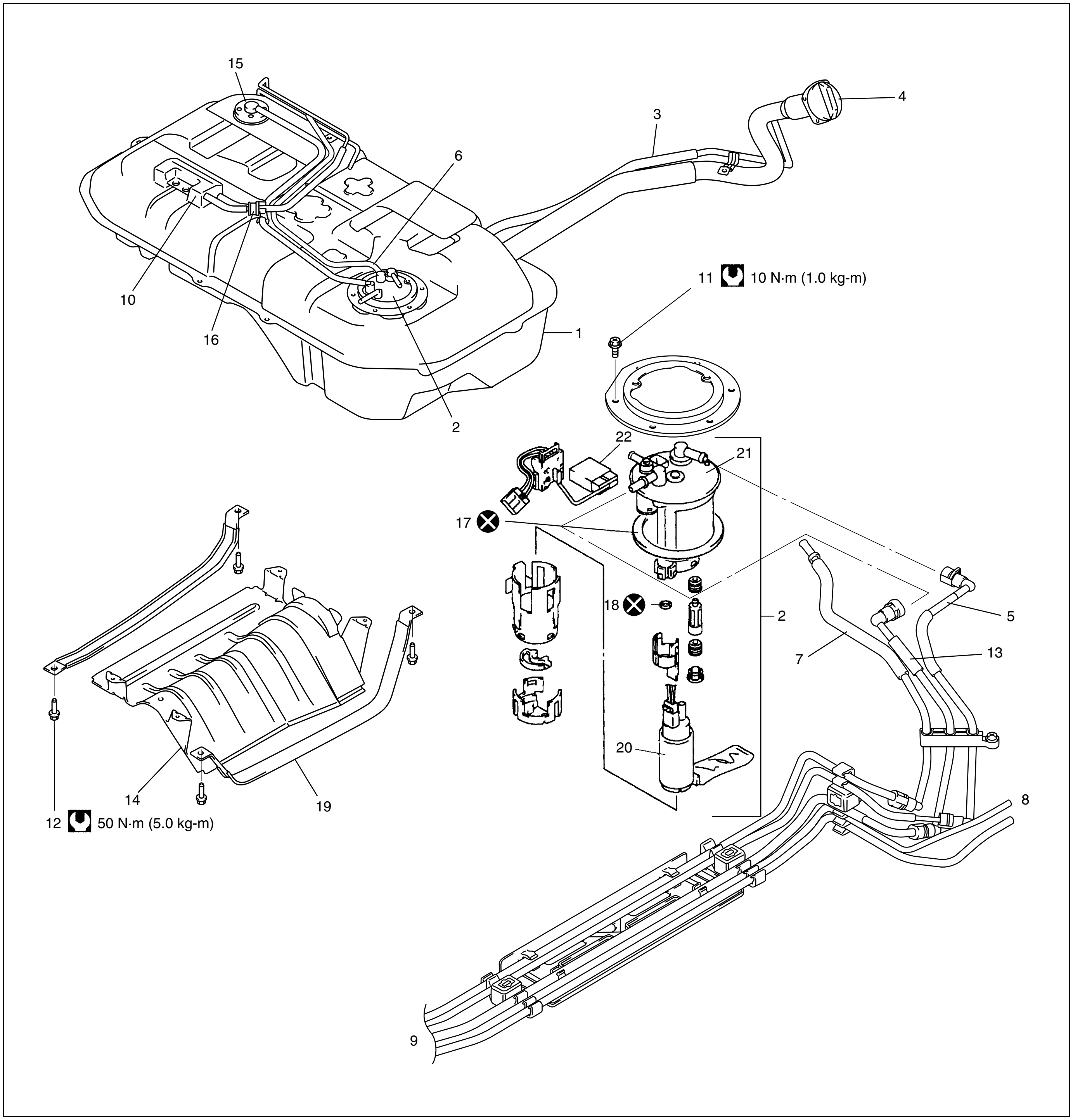
CONTENTS

General Description

The main components of the fuel system are fuel tank, fuel pump assembly (with fuel filter, fuel level gauge and tank pressure control valve), fuel/vapor separator fuel feed line and fuel vapor line.
For the details of fuel flow and fuel vapor flow, refer to "GENERAL DESCRIPTION" in Section 6E1.

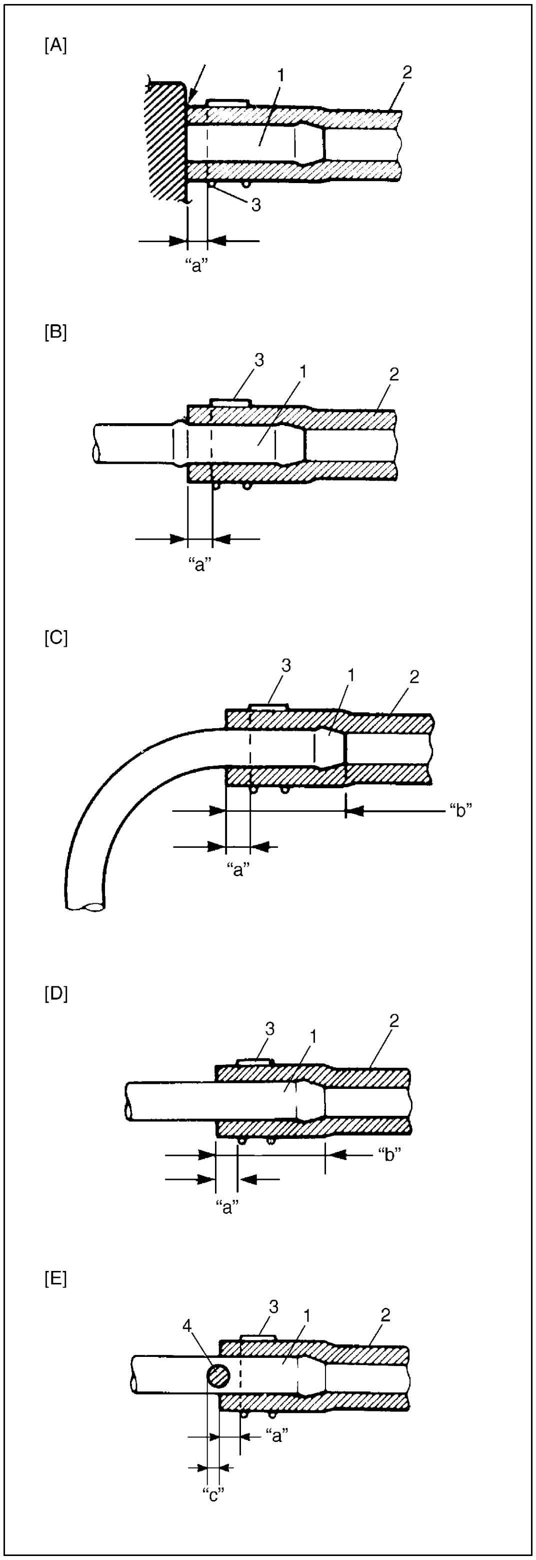
On-Vehicle Service

Components



1. Fuel tank	7. Fuel purge line	13. Fuel return line	19. Fuel tank belt pad
2. Fuel pump assembly	8. To EVAP canister	14. Tank protector	20. Fuel pump
3. Breather hose	9. To Delivery pipe	15. Fuel cut valve	21. Fuel filter assembly
4. Fuel filler cap	10. Fuel/vapor separator	16. 2 way check valve	22. Fuel level gauge (Fuel sender gauge)
5. Fuel feed line	11. Fuel pump bolt (6 pcs.)	17. Gasket	Do not reuse.
6. Wire harness for fuel pump	12. Fuel tank bolt (4 pcs.)	18. O-ring	Tightening torque

Precautions



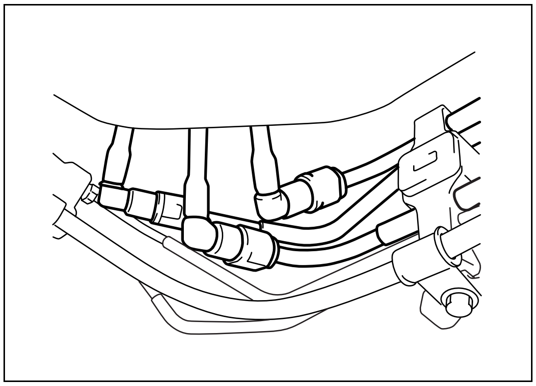
WARNING:

Before attempting service of any type on fuel system, the followings should be always observed in order to reduce the risk or fire and personal injury.

- **Disconnect negative cable at battery.**
- **Do not smoke, and place no smoking signs near work area.**
- **Be sure to have CO_2 fire extinguisher handy.**
- **Be sure to perform work in a well-ventilated area and away from any open flames (such as gas hot heater).**
- **Wear safety glasses.**
- **To relieve fuel vapor pressure in fuel tank, remove fuel filler cap from fuel filler neck and then reinstall it.**
- **As fuel feed line is still under high fuel pressure even after engine was stopped, loosening or disconnecting fuel feed line directly may cause dangerous spout of fuel to occur where loosened or disconnected.**
  Before loosening or disconnecting fuel feed line, make sure to relieve fuel pressure "FUEL PRESSURE RELIEF PROCEDURE" in Section 6.
- **A small amount of fuel may be released after the fuel line is disconnected. In order to reduce the chance of personal injury, cover the fitting to be disconnected with a shop cloth. Be sure to put that cloth in an approved container when disconnection is completed.**
- **Note that fuel hose connection varies with each type of pipe. Be sure to connect and clamp each hose correctly referring to the figure.**

[A] :	With short pipe, fit hose as far as it reaches pipe joint as shown.
[B] :	With the following type pipe, fit hose as far as its peripheral projection as shown.
[C] :	With bent pipe, fit hose as far as its bent part as shown or till depth "b".
[D] :	With straight pipe, fit hose till depth "b".
[E] :	With red marked pipe, fit hose end reaches red mark on pipe.
1.	Pipe
2.	Hose
3.	Clamp
4.	Ped mark
"a" :	Clamp securely at a position 3 to 7 mm (0.12 – 0.27 in.) from hose end.
"b" :	20 to 30 mm (0.79 – 1.18 in.)
"c" :	0 to 5 mm (0 – 0.19 in.)

Fuel Lines



CAUTION:
Due to the fact that fuel feed line is under high pressure, use special care when servicing it.

INSPECTION

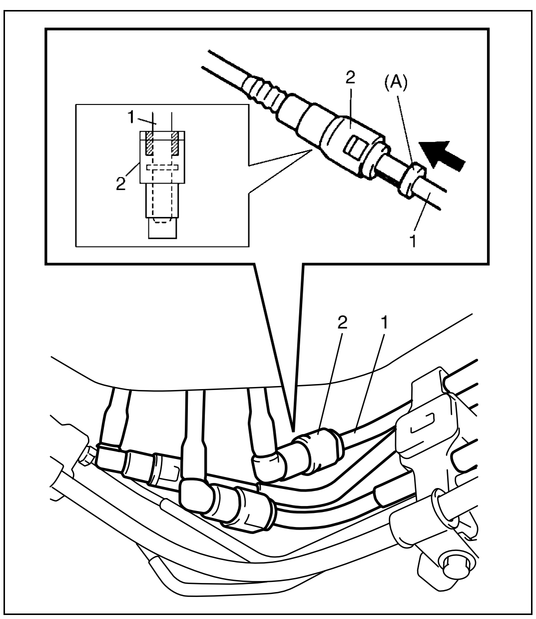
Visually inspect fuel lines for evidence of fuel leakage, hose crack and deterioration, or damage.
Make sure all clamps are secure.
Replace parts as needed.

Fuel Pipe

WARNING:
A small amount of fuel may be released after fuel hose is disconnected. In order to reduce the chance of personal injury, cover hose and pipe to be disconnected with a shop cloth.
Be sure to put that cloth in an approved container when disconnection is completed.

REMOVAL

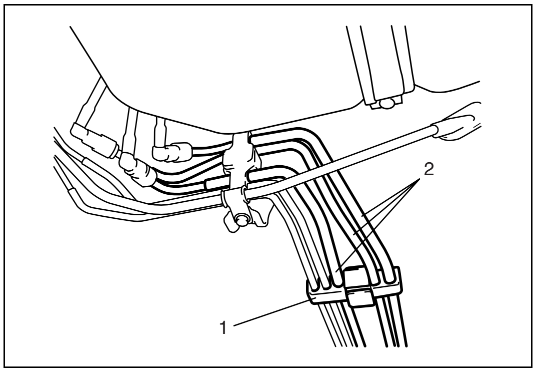
1) Relieve fuel pressure in fuel feed line according to “FUEL PRESSURE RELIEF PROCEDURE” in Section 6.
2) Disconnect negative cable at battery.



3) Disconnect fuel pipe joint and fuel hose from fuel pipe at the front and rear of each fuel pipe.
   For quick joint (2), disconnect it as follows :
   a) Remove mud, dust and/or foreign material between pipe (1) and joint by blowing compressed air.
   b) Unlock joint lock by inserting special tool between pipe and joint.

   Special tool
   (A) : 09919-47020

   c) Disconnect joint (2) from pipe (1).
4) Disconnect brake pipe from pipe joint referring to Section 5.



5) Mark the location of clamps (1) on fuel pipes (2), so that the clamps can be reinstalled to where they were.
6) Remove pipes (2) with clamp (1) from vehicle.
7) Remove clamp (1) from pipes (2).

INSTALLATION

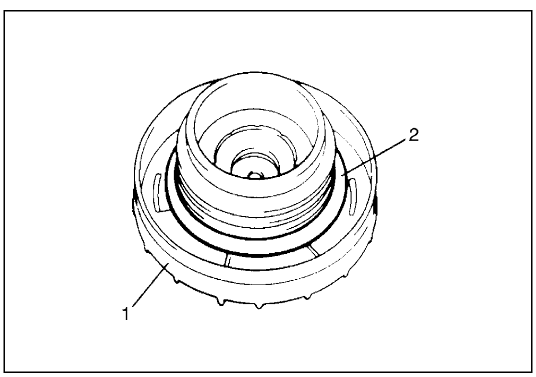
1) Install clamps to marked location on pipes. If clamp is deformed or its claw is bent or broken, replace it with new one.
2) Install pipes with pipe clamps to vehicle.
3) Connect fuel hoses and pipes to each pipe.

CAUTION:
When connecting joint, clean outside surfaces of pipe where joint is to be inserted, push joint into pipe till joint lock clicks and check to ensure that pipes are connected securely, or fuel leak may occur.

4) With engine OFF, turn ignition switch to ON position and check for fuel leaks.

Fuel Filler Cap

INSPECTION



Remove cap (1), and check gasket for even filler neck imprint, and deterioration or any damage. If gasket (2) is in malcondition, replace cap.

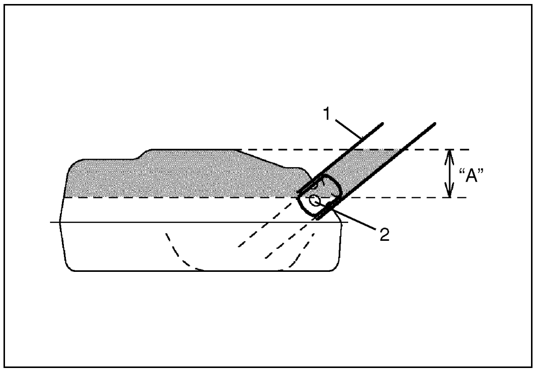
NOTE:
If cap requires replacement, only a cap with the same features should be used. Failure to use correct cap can result in critical malfunction of system.

Fuel Tank

REMOVAL

WARNING:
Before starting the following procedure, be sure to observe "PRECAUTIONS".

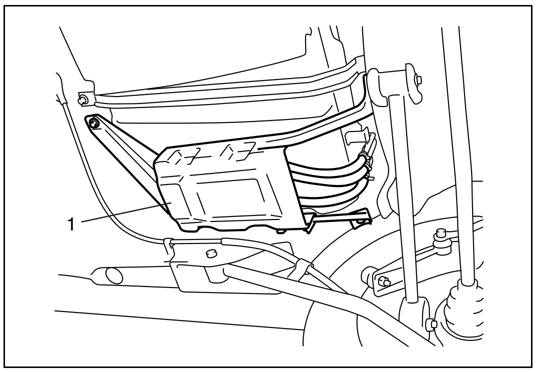
1) Relieve fuel pressure in fuel feed line according to "FUEL PRESSURE RELIEF PROCEDURE" in Section 6.
2) Disconnect negative cable at battery.



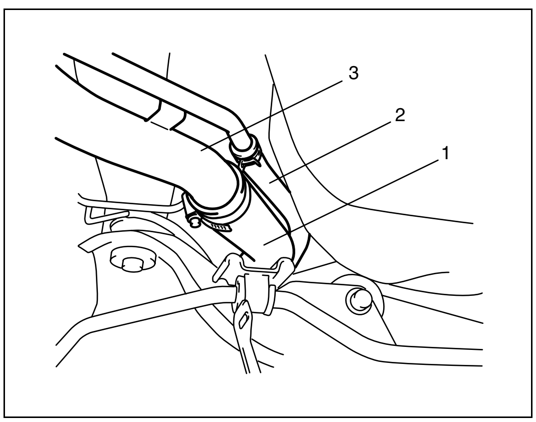
3) Remove fuel filler cap.
4) Insert hose of a hand operated pump into fuel filler hose (1) and drain fuel in space "A" in the figure.

CAUTION:
Do not force pump hose into fuel tank, or pump hose may damage fuel tank inlet valve (2).

5) Hoist vehicle.
6) Remove muffler referring to Section 6K.
7) Remove propeller shaft No.2 referring to Section 4B. (If equipped)



8) Remove EVAP canister with its bracket (1) from vehicle.

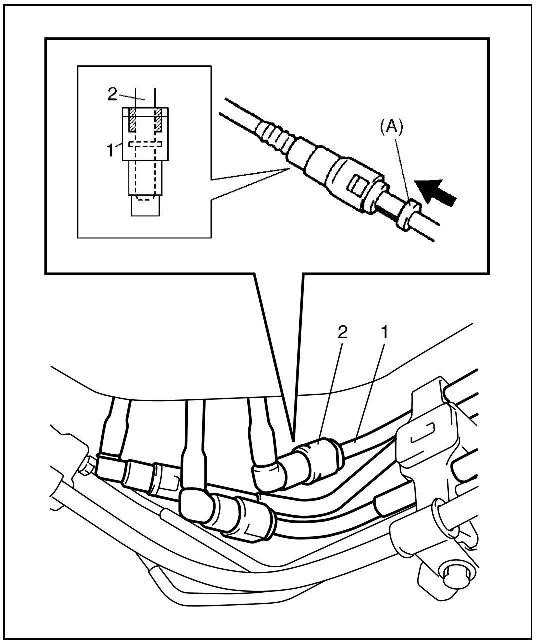


9) Disconnect fuel filler hose (1) and breather hose (2) from filler neck (3).

CAUTION:
Never disconnect fuel filler hose (1) from fuel tank inlet. If half or more of fuel is remaining to fuel tank, fuel over flows in this case and come out.

10) Due to absence of fuel tank drain plug, drain fuel tank by pumping fuel out through fuel tank filler.
Use hand operated pump device to drain fuel tank.

CAUTION:
- **Do not force pump hose into fuel tank, or pump hose may damage fuel tank inlet valve.**
- **Never drain or store fuel in an open container due to possibility of fire or explosion.**

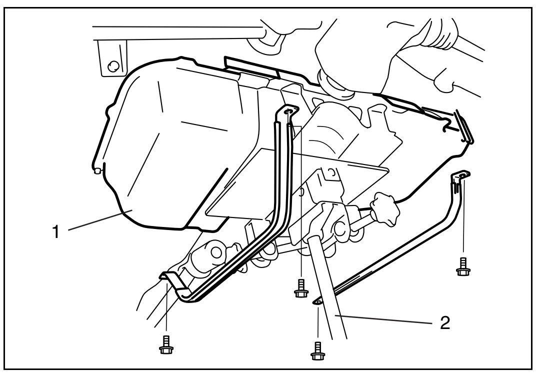


11) Disconnect fuel pipe joints from pipes.
    For quick joint, disconnect it as follows:
    a) Remove mud, dust and/or foreign material between pipe and joint by blowing compressed air.
    b) Unlock joint (1) lock by inserting special tool between pipe (2) and joint (1).

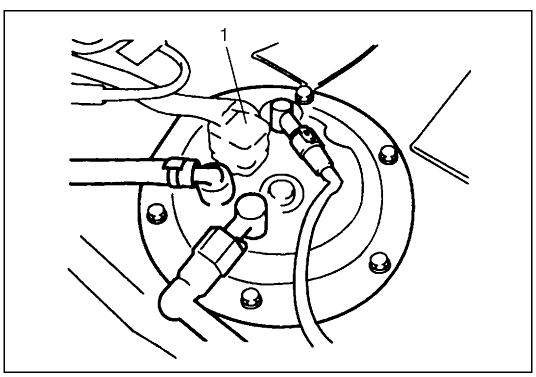
Special tool
(A) : 09919-47020

    c) Disconnect joint from pipe.

WARNING:
A small amount of fuel may be released after the fuel hose is disconnected. In order to reduce the chance of personal injury, cover the hose and pipe to be disconnected with a shop cloth. Be sure to put that cloth in an approved container when disconnection is completed.



12) Support fuel tank (1) with jack (2) and remove its mounting bolts.



13) Lower fuel tank a little as to disconnect wire harness at connector (1) and ground wire harness, then remove fuel tank.

INSPECTION

After removing fuel tank, check hoses and pipes connected to fuel tank for leaks, loose connections, deterioration or damage. Also check fuel pump assembly gaskets for leaks, visually inspect fuel tank for leaks and damage.
Replace any damaged or mal-conditioned parts.

FUEL TANK PURGING PROCEDURE

WARNING:
This purging procedure will not remove all fuel vapor. Do not attempt any repair on tank using heat of flame as an explosion resulting in personal injury could occur.

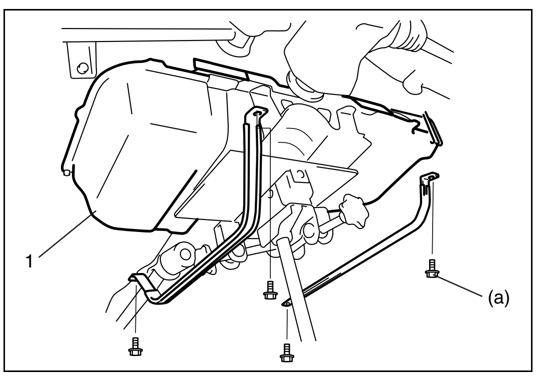
The following procedure is used for purging fuel tank.

1) After removing fuel tank, remove all hoses, pipes, fuel pump assembly from fuel tank.
2) Drain all remaining fuel from tank.
3) Move tank to flushing area.
4) Fill tank with warm water or tap water, and agitate vigorously and drain. Repeat this washing until inside of tank is clean. Replace tank if its inside is rusty.
5) Completely flush out remaining water after washing.

CAUTION:
Never remain water in fuel tank after washing, or fuel tank inside will get corrosion.

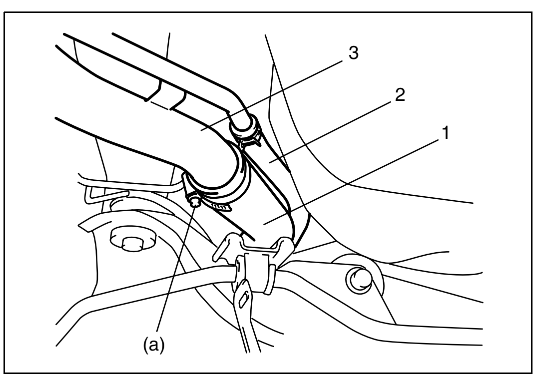
INSTALLATION

1) If parts have been removed from fuel tank, install them before installing fuel tank to vehicle.



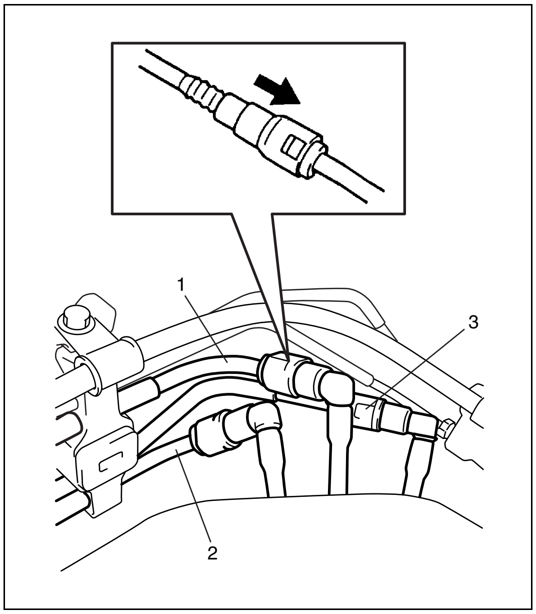
2) Raise fuel tank (1) with jack and connect connector of fuel pump and ground wire harness and clamp wire harness.
3) Install fuel tank to vehicle.

Tightening torque
Fuel tank bolt (a): 50 N·m (5.0 kg-m, 69.5 lb-ft)



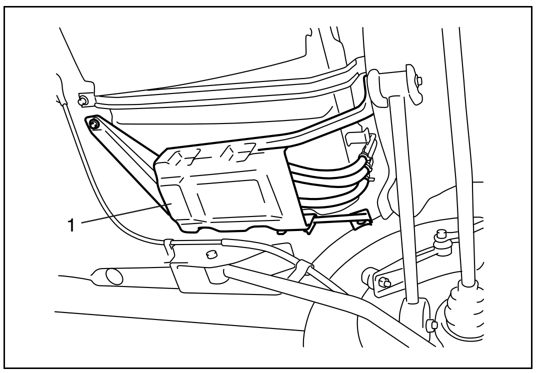
4) Connect fuel filler hose (1) and breather hose (2) to filler neck (3) as shown in figure and clamp them securely.

Tightening torque
Fuel filler hose clamp (a) : 1.5 N·m (0.15 kg-m, 1.0 lb-ft)



5) Connect fuel feed pipe (1), fuel return pipe (3) and purge pipe (2) to each pipe as shown in figure and clamp them securely.

CAUTION:
- **When connecting joint, clean outside surfaces of pipe where joint is to be inserted, push joint into pipe till joint lock clicks and check to ensure that pipes are connected securely, or fuel leak may occur.**
- **Never let the fuel hoses touch the ABS sensor harness (if equipped).**



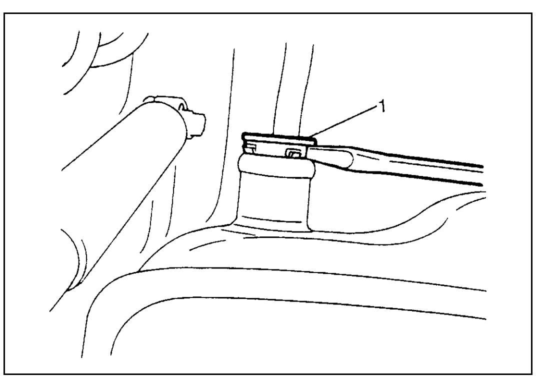
6) Install EVAP canister with its bracket (1) to vehicle.
7) Install propeller shaft No.2 referring to Section 4B.
8) Remove muffler referring to Section 6K.
9) Connect negative cable at battery.
   With engine OFF, turn ignition switch to ON position and check for fuel leaks.

Fuel Tank Inlet Valve

WARNING:
Refer to the WARNING at the beginning of ON-VEHICLE SERVICE in this section.

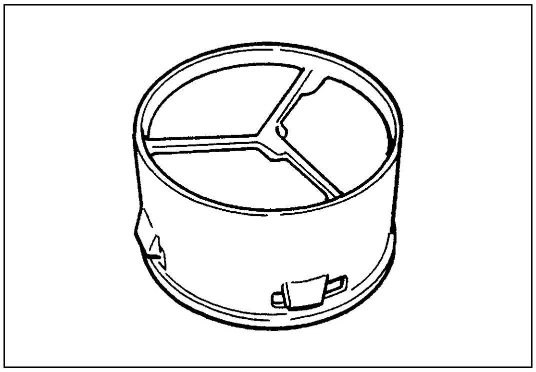
REMOVAL

1) Remove fuel tank from vehicle. Refer to “FUEL TANK” in this section.
2) Remove clamp and fuel filler hose from fuel tank.



3) Remove fuel tank inlet valve (1) using flat-bladed screw-driver.

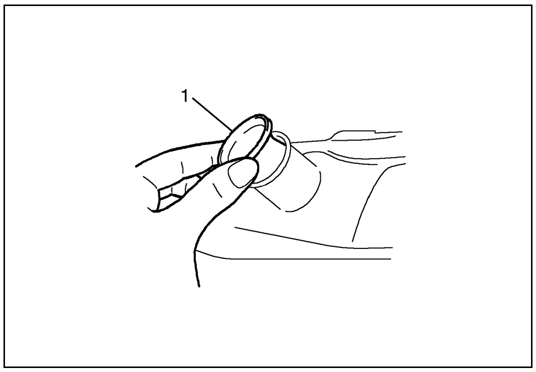
CAUTION:
Be careful not to damage fuel tank inlet valve (1) with flat-bladed screwdriver.



INSPECTION

Check fuel tank inlet valve for the followings.
- Damage
- Smooth opening and closing

If any damage or malfunction is found, replace.



INSTALLATION

1) Install fuel tank inlet valve (1) to fuel tank and then install fuel filler hose.
2) Install fuel tank to vehicle. Refer to “FUEL TANK” in this section.

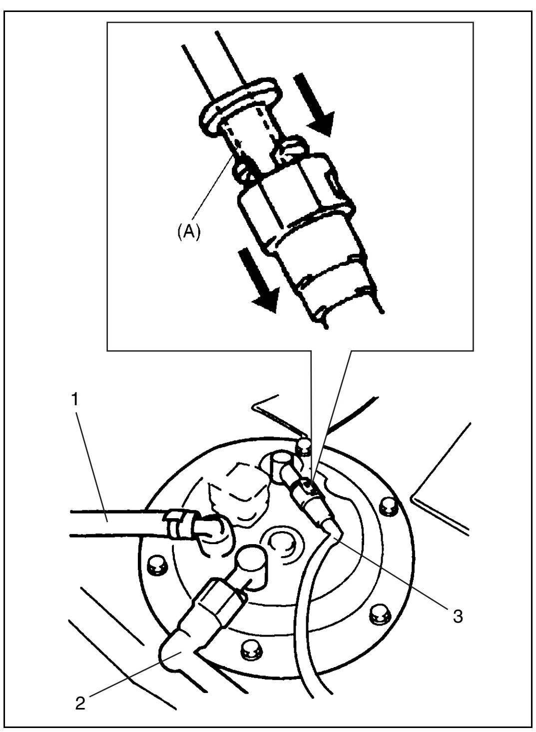
Fuel Pump Assembly

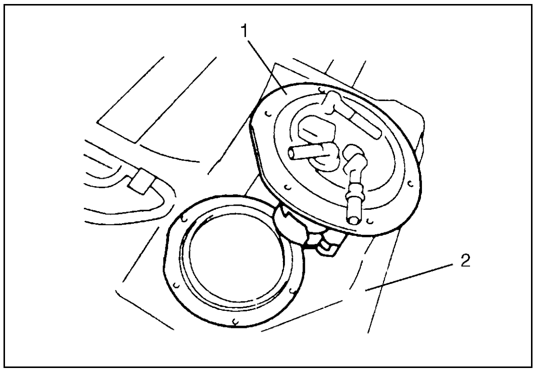
WARNING:
Refer to the PRECAUTIONS at the beginning of ON-VEHICLE SERVICE.

REMOVAL

1) Remove fuel tank from vehicle. Refer to “FUEL TANK”.
2) Disconnect fuel cut valve hose (1), fuel feed line (2) and fuel return pipe (3) from fuel pump assembly.
When disconnecting joint of fuel feed pipe (2) and fuel return pipe (3) from fuel pump, unlock joint by inserting special tool between pipe and joint lock first.

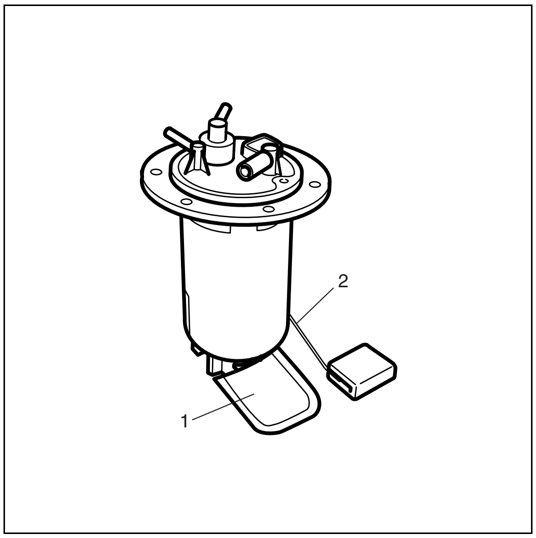
Special tool
(A): 09919-47020





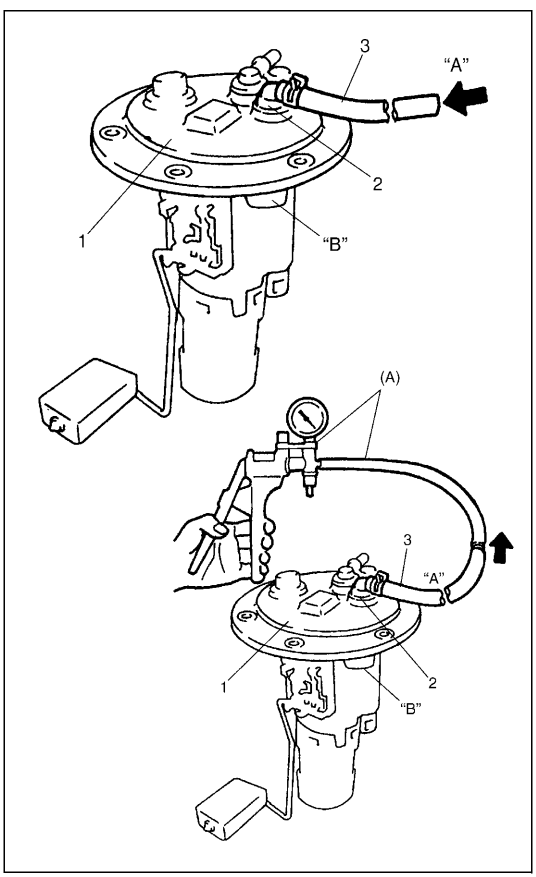
3) Remove fuel pump assembly (1) from fuel tank (2).

INSPECTION



- Check fuel pump assembly for damage.
- Check fuel suction filter (1) for evidence of dirt and contamination.
  If present, replace or clean and check for presence of dirt in fuel tank.
- For operation or electrical circuit inspection by referring to Section 6E1.
- For inspection of fuel level gauge (2) by referring to Section 8.
- Check tank pressure control valve referring to the following procedures.

WARNING:
Do not such air through fuel vapor line hose. Fuel vapor inside valve is harmful.

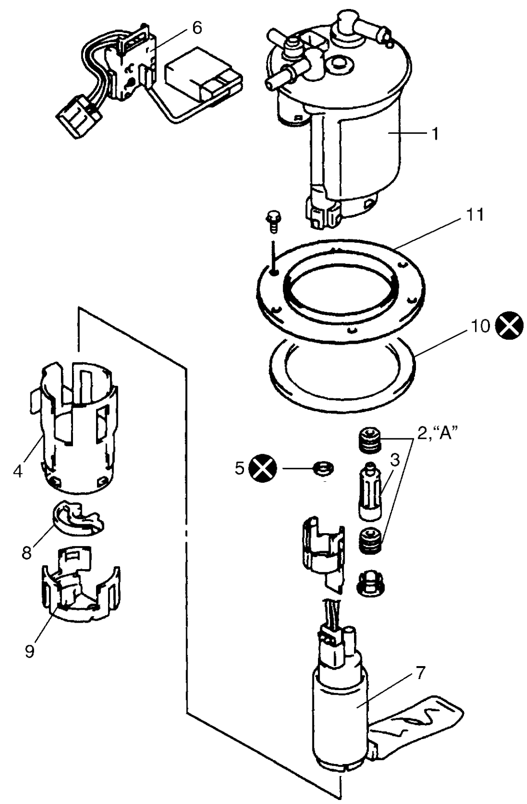


a) Air should pass through valve (2) smoothly from fuel vapor line hose (3) "A" to "B" when blown hard.
b) Also, when vacuum pump (4) is connected to fuel vapor hose and pump air through valve, air should pass from "B" to "A".

Special tool
(A) : 09917-47011

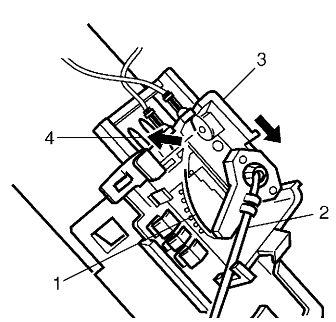
If air doesn't pass through valve in Step a) or vacuum is maintained in Step b), replace fuel filter assembly (1).

DISASSEMBLY AND REASSEMBLY



“A” : Apply oil.	5. O-ring	10. Gasket
1. Fuel filter assembly (including check valve)	6. Fuel level sensor (Fuel sender gauge)	11. Fuel pump plate
2. Grommet	7. Fuel pump	⊗ Do not reuse.
3. Tube	8. Cushion	
4. Housing	9. Bracket	

Disassemble and reassemble fuel pump assembly, noting the fol-lowings.



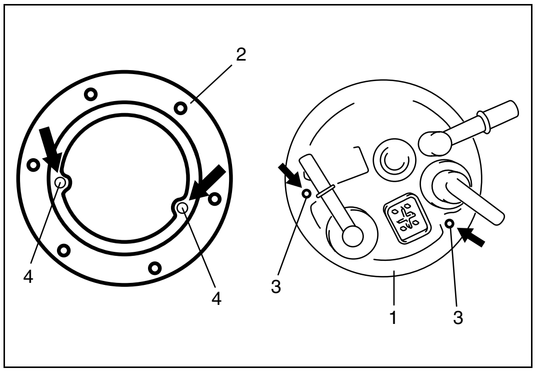
CAUTION:

- **While removing fuel level gauge, do not contact resis-tor plate (1) or deform arm (2). It may cause fuel level gauge to fail.**
- **When removing grommet from fuel tube or bracket sub assembly, be very careful not to cause damage to grommet installed section (sealed section in bore). Should it be damaged, replace it with new one, or fuel will leak from that part.**

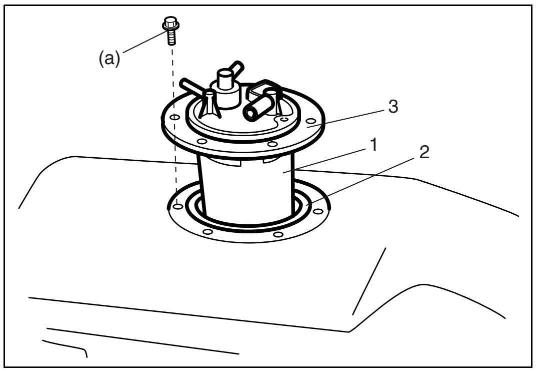
- When removing fuel level sensor (3), press snap-fit part (4) and slide it in the arrow direction as shown in figure.
- When installing fuel level sensor to housing, fit fuel level sen-sor securely.

INSTALLATION

1) Clean mating surfaces of fuel pump assembly (1) and fuel tank.

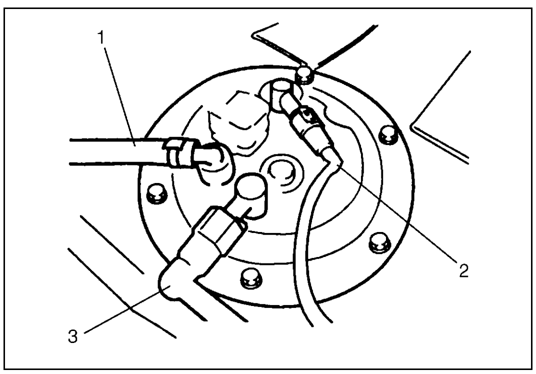


2) Put plate (2) on fuel pump assembly (1) by matching the protrusion of fuel pump assembly (3) to plate hole (4) as shown.



3) Install new gasket (2) and fuel pump assembly (1) with plate (3) to fuel tank.

Tightening torque
Fuel pump assembly bolts (a) : 10 N·m (1.0 kg-m, 7.5 lb-ft)

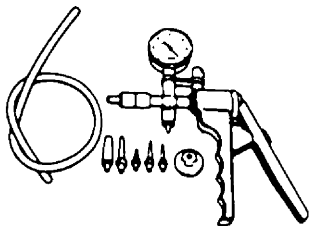
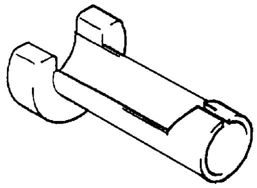


4) Connect fuel cut valve hose (1), fuel return pipe (2) (pipe joint) and fuel feed line (3) (pipe joint) to fuel pump assembly.

CAUTION:
When connecting joint, clean outside surface of pipe where joint is to be inserted, push joint into pipe till joint lock clicks and check to ensure that pipes are connected securely, or fuel leak may occur.

5) Install fuel tank (1) to vehicle. Refer to “FUEL TANK” in this section.

Special Tool

	
09917-47011 Vacuum pump gauge	09919-47020 Quick joint remover

Tightening Torque Specification

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Fuel tank bolts	50	5.0	69.5
Fuel pump assembly bolts	10	1.0	7.5

SECTION 6E1

ENGINE AND EMISSION CONTROL SYSTEM (M13 AND M16 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:

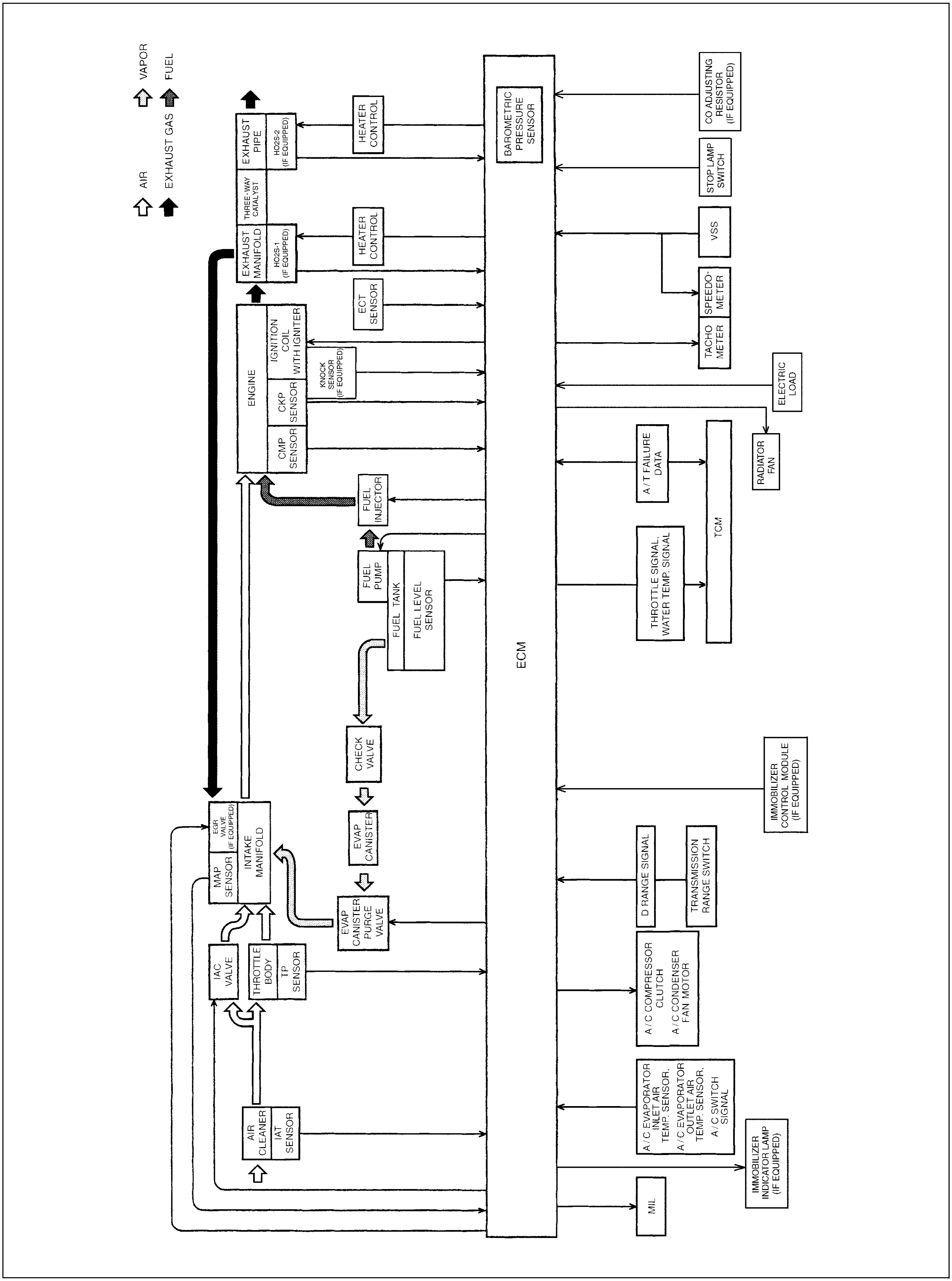
Whether the following system (parts) are used in the particular vehicle or not depends on vehicle specifications. Be sure to bear this in mind when performing service work.

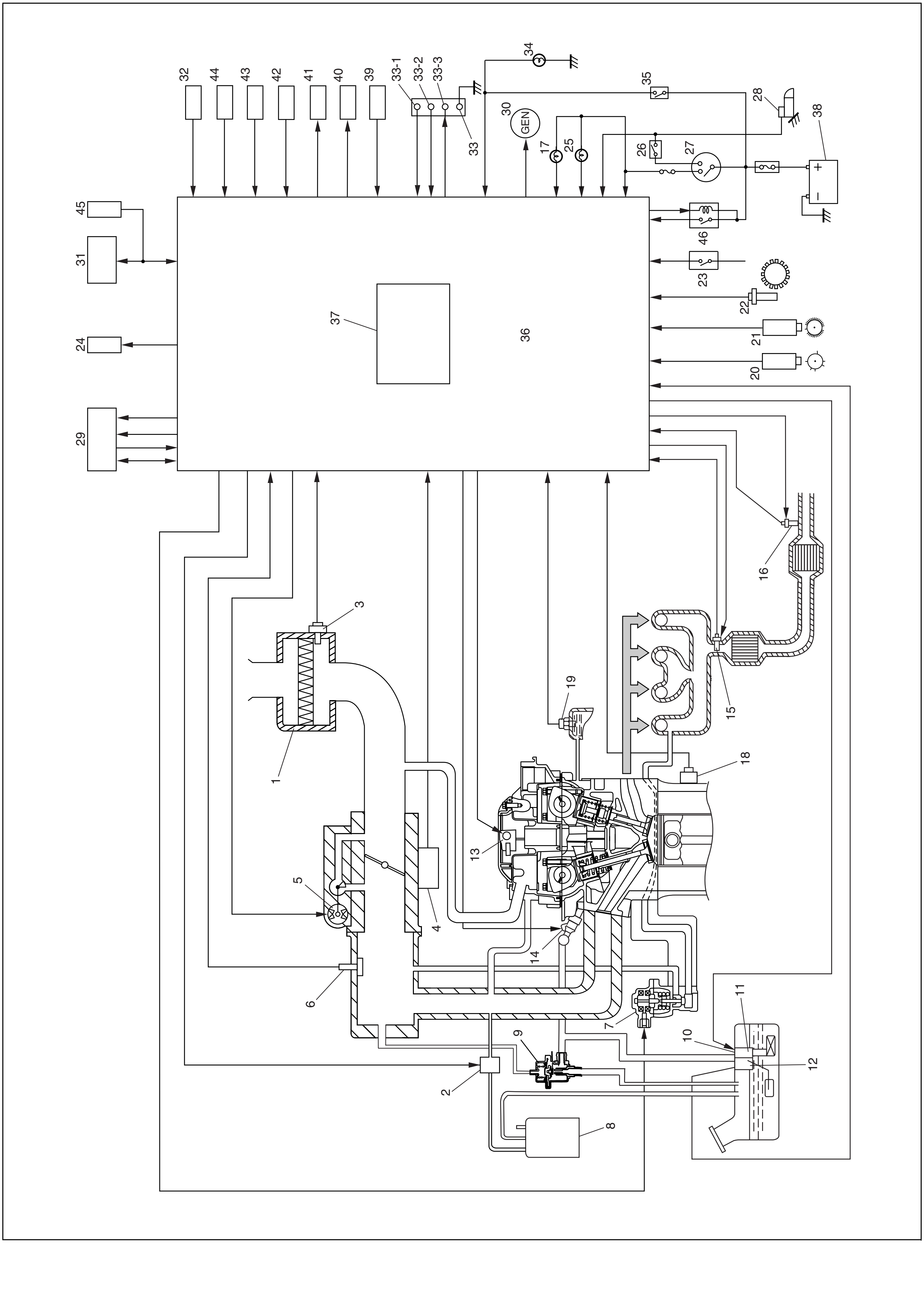
- **EGR valve**
- **Heated oxygen sensor(s) or CO adjusting resistor**
- **Three way catalytic converter**
- **Immobilizer indicator lamp**
- **Knock sensor**

CONTENTS

General Description

The engine and emission control system is divided into 4 major sub-systems : air intake system, fuel delivery system, electronic control system and emission control system.
Air intake system includes air cleaner, throttle body, IAC valve and intake manifold.
Fuel delivery system includes fuel pump, delivery pipe, fuel pressure regulator, etc. Electronic control system includes ECM, various sensors and controlled devices.
Emission control system includes EGR, EVAP and PCV system.


AIR
EXHAUST GAS
VAPOR
FUEL
EXHAUST MANIFOLD
HO2S-1 (IF EQUIPPED)
THREE-WAY CATALYST
EXHAUST PIPE
HO2S-2 (IF EQUIPPED)
HEATER CONTROL
HEATER CONTROL
ECT SENSOR
ENGINE
IGNITION COIL WITH IGNITER
KNOCK SENSOR (IF EQUIPPED)
CKP SENSOR
CMP SENSOR
FUEL INJECTOR
FUEL PUMP
FUEL TANK
FUEL LEVEL SENSOR
CHECK VALVE
EVAP CANISTER
EVAP CANISTER PURGE VALVE
EGR VALVE (IF EQUIPPED)
MAP SENSOR
INTAKE MANIFOLD
IAC VALVE
THROTTLE BODY
TP SENSOR
AIR CLEANER
IAT SENSOR
ECM
BAROMETRIC PRESSURE SENSOR
CO ADJUSTING RESISTOR (IF EQUIPPED)
STOP LAMP SWITCH
VSS
SPEEDO-METER
TACHO METER
ELECTRIC LOAD
RADIATOR FAN
A/T FAILURE DATA
TCM
THROTTLE SIGNAL, WATER TEMP. SIGNAL
IMMOBILIZER CONTROL MODULE (IF EQUIPPED)
D RANGE SIGNAL
TRANSMISSION RANGE SWITCH
A/C COMPRESSOR CLUTCH
A/C CONDENSER FAN MOTOR
A/C EVAPORATOR INLET AIR TEMP. SENSOR,
A/C EVAPORATOR OUTLET AIR TEMP. SENSOR,
A/C SWITCH SIGNAL
IMMOBILIZER INDICATOR LAMP (IF EQUIPPED)
MIL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33-1
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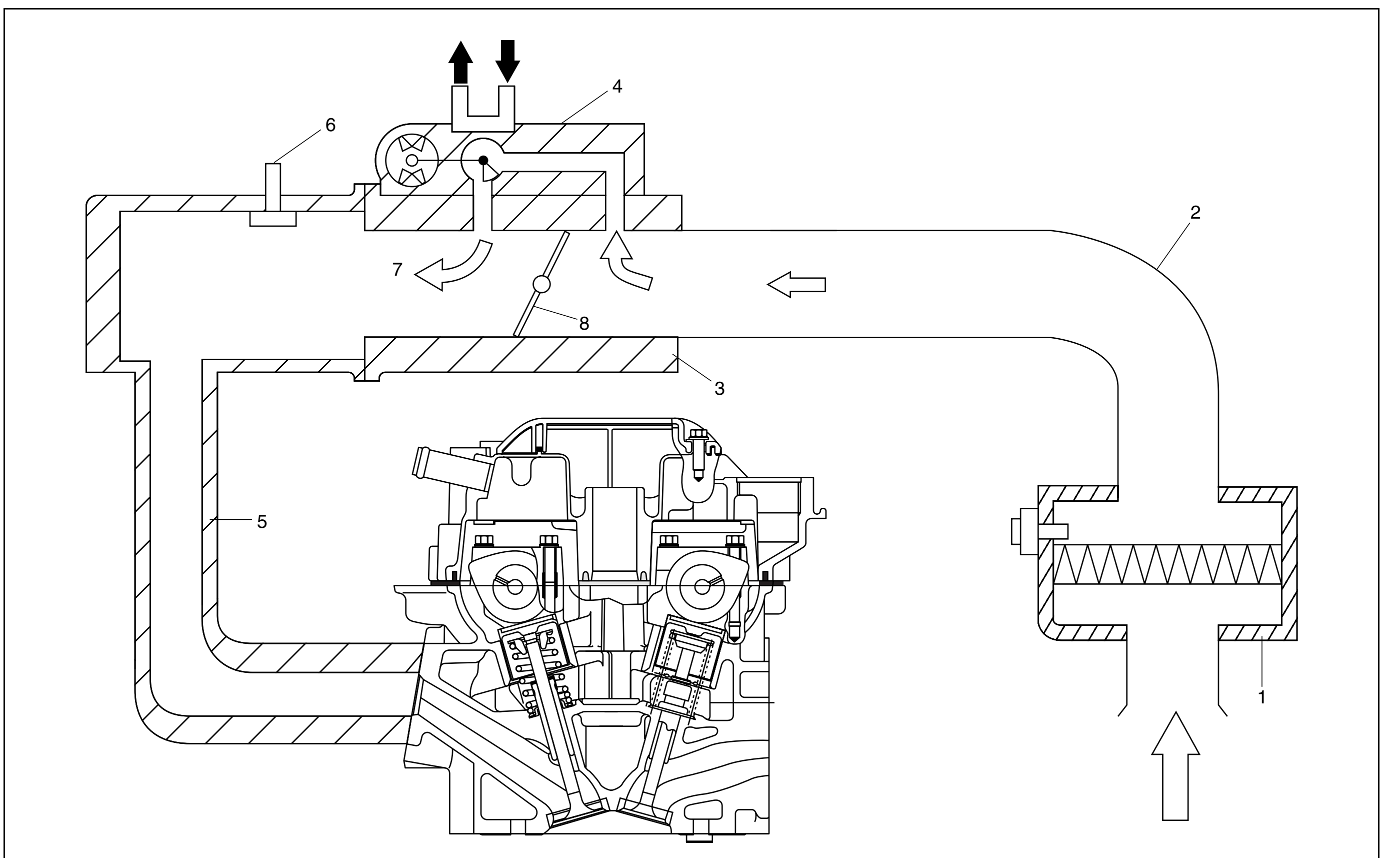
1. Air cleaner	18. Knock sensor (vehicle with EGR)	33-2. Test switch terminal (vehicle without immobilizer indicator lamp)
2. EVAP canister purge valve	19. ECT sensor	33-3. Duty output terminal (vehicle without immobilizer indicator lamp)
3. IAT sensor	20. CMP sensor	34. Stop lamp
4. TP sensor	21. CKP sensor	35. Stop lamp switch
5. IAC valve	22. VSS	36. ECM
6. MAP sensor	23. Power steering pressure switch (if equipped)	37. Barometric pressure sensor (if equipped)
7. EGR valve (if equipped)	24. Radiator fan	38. Battery
8. EVAP canister	25. Malfunction indicator lamp in combination meter	39. CO adjusting resistor (vehicle without EGR)
9. Fuel pressure regulator	26. Park/Neutral position switch (A/T)	40. A/C compressor clutch (if equipped)
10. Tank pressure control valve (built-in fuel pump)	27. Ignition switch	41. A/C condenser fan motor (if equipped)
11. Fuel pump	28. Starter magnetic switch	42. A/C switch (if equipped)
12. Fuel level sensor (vehicle with immobilizer indicator lamp)	29. TCM	43. A/C evaporator inlet air temperature sensor (if equipped)
13. Ignition coil assembly	30. Generator	44. A/C evaporator outlet air temperature sensor (if equipped)
14. Fuel injector	31. DLC	45. Immobilizer control module (if equipped)
15. Heated oxygen sensor (HO2S)-1 (vehicle with EGR)	32. Electric load	46. Main relay
16. Heated oxygen sensor (HO2S)-2 (if equipped)	33. Monitor connector (vehicle without immobilizer indicator lamp)	
17. Immobilizer indicator lamp (if equipped)	33-1. Diagnosis switch terminal (vehicle without immobilizer indicator lamp)	

Air Intake System

The main components of the air intake system are air cleaner (1), air cleaner outlet hose (2), throttle body (3), idle air control valve (4) and intake manifold (5).

The air (by the amount corresponding to manifold absolute pressure (6) and engine speed) is filtered by the air cleaner (1), passes through the throttle body (3), is distributed by the intake manifold (5) and finally drawn into each combustion chamber.

When the idle air control valve (4) is opened according to the signal from ECM, the air (7) bypasses the throttle valve (8) through bypass passage and is finally drawn into the intake manifold (5).



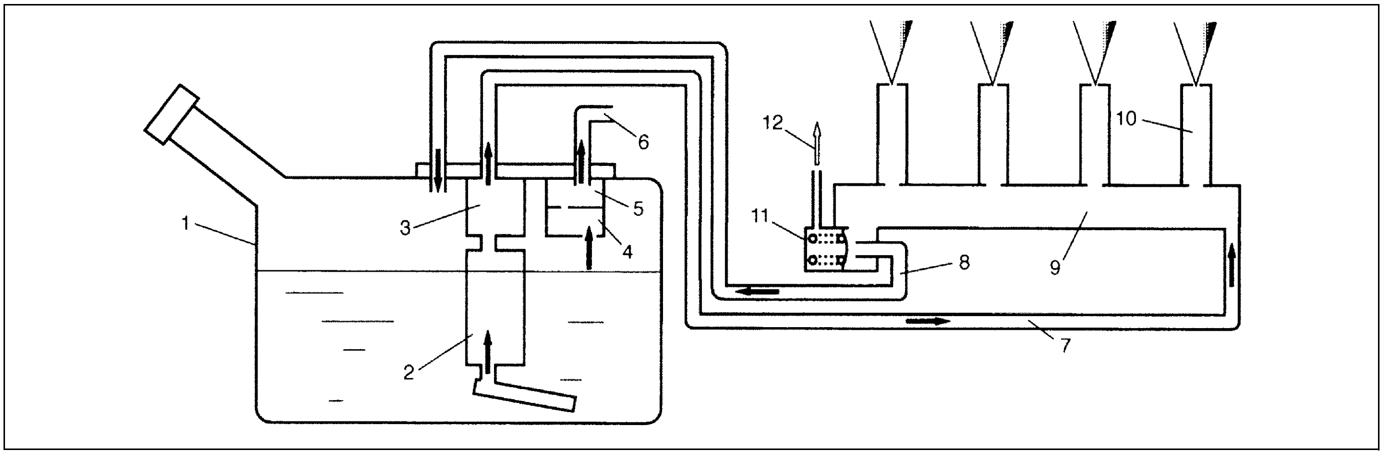
Fuel Delivery System

The fuel system consists of fuel tank (1), fuel pump (2) (with built-in fuel filter (3)), fuel pressure regulator (11), delivery pipe (9) and fuel injectors (10).

The fuel in the fuel tank is pumped up by the fuel pump, filtered by the fuel filter and fed under pressure to each injector through the delivery pipe.

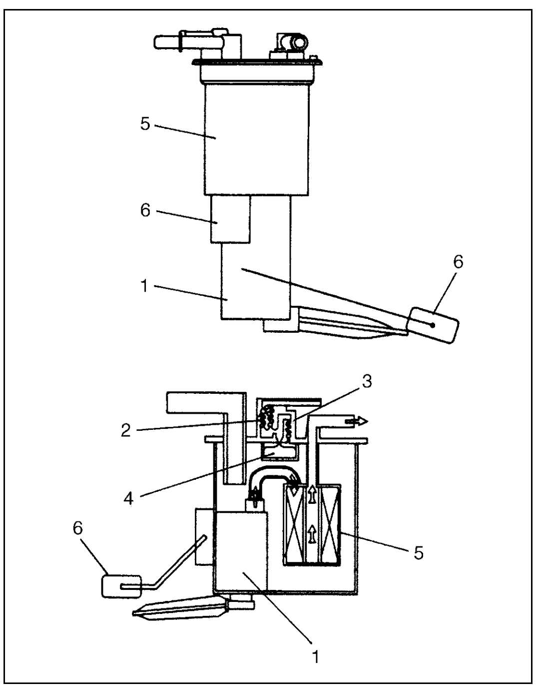
As the fuel pressure applied to the injector (the fuel pressure in the fuel feed line) is always kept a certain amount higher than the pressure in the intake manifold by the fuel pressure regulator, the fuel is injected into the intake port of the cylinder head when the injector opens according to the injection signal from ECM.

The fuel relieved by the fuel pressure regulator returns through the fuel return line to the fuel tank.



4. Fuel cut valve	6. To EVAP canister	8. Fuel return line
5. Fuel tank pressure control valve	7. Fuel feed line	12. To intake manifold (vacuum passage)

Fuel pump



An in-tank type electric pump has been adopted for the fuel pump (1). Incorporated in the pump assembly are;

- Tank pressure control valve (2) which keeps the pressure in the fuel tank constant, and prevents the fuel from spouting and tank itself from being deformed.
- Relief valve (3) which prevents the pressure in tank from rising excessively.
- Fuel cut valve (4) which closes as the float rises so that the fuel will not enter the canister when the fuel level in the tank rises high depending on the fuel level in the tank and the vehicle tilt angle.

Also, a fuel filter (5) is included and a fuel level gauge (6) is attached.

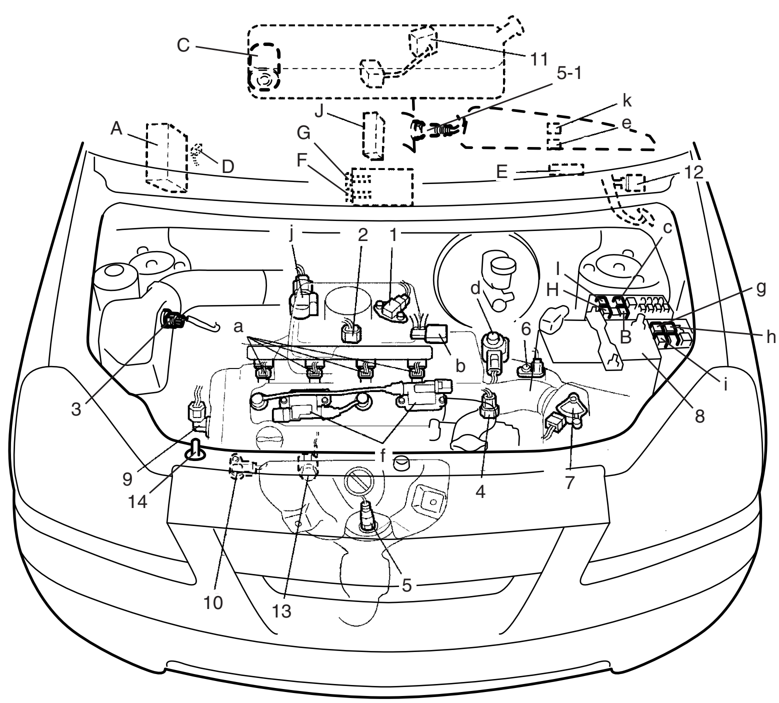
Electronic Control System

The electronic control system consists of 1) various sensors which detect the state of engine and driving conditions, 2) ECM which controls various devices according to the signals from the sensors and 3) various controlled devices.

Functionally, it is divided into nine sub systems :

- Fuel injection control system
- Idle speed control system
- Fuel pump control system
- A/C control system (if equipped)
- Radiator fan control system
- EGR system (if equipped)
- Evaporative emission control system
- Oxygen sensor heater control system (if equipped)
- Ignition control system

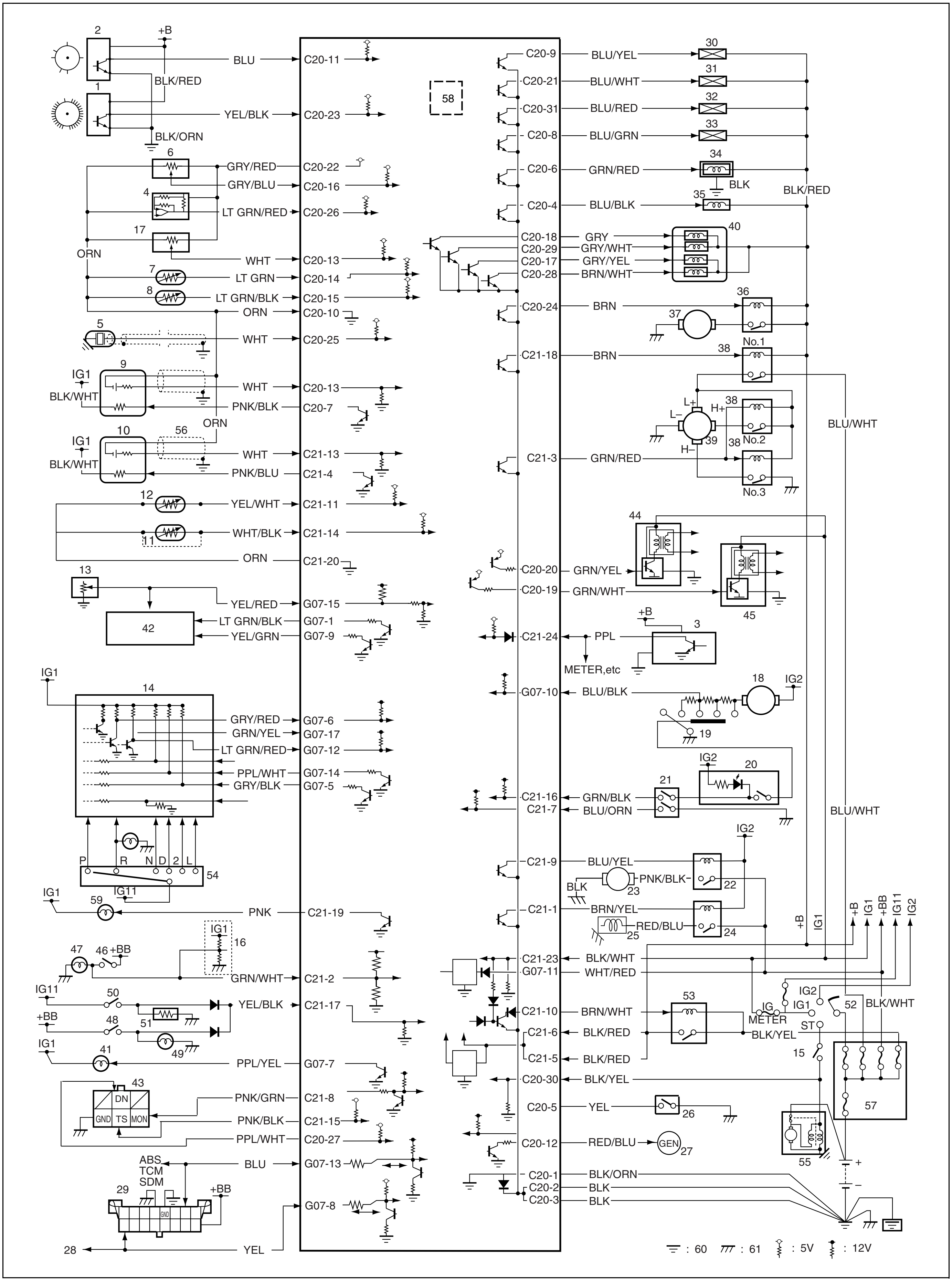
Also, with A/T model, ECM sends throttle valve opening signal and coolant temp. signal to transmission control module to control A/T.



INFORMATION SENSORS	CONTROL DEVICES	OTHERS
1. MAP sensor	a : Fuel injector	A : ECM
2. TP sensor	b : EVAP canister purge valve	B : Main relay
3. IAT sensor	c : Fuel pump relay	C : EVAP canister
4. ECT sensor	d : EGR valve (step motor) (if equipped)	D : Monitor connector
5. Heated oxygen sensor-1 (if equipped)	e : Malfunction indicator lamp	E : Data link connector
5-1. Heated oxygen sensor-2 (if equipped)	f : Ignition coil assembly	F : A/C EVAP inlet air temp. sensor (if equipped)
6. VSS	g : Radiator fan control relay No.1	G : A/C EVAP outlet air temp. sensor (if equipped)
7. Transmission range switch (A/T)	h : Radiator fan control relay No.2	H : A/C compressor relay
8. Battery	i : Radiator fan control relay No.3	I : A/C condenser fan relay
9. CMP sensor	j : IAC valve	J : TCM (A/T)
10. CKP sensor	k : Immobilizer indicator lamp	
11. Fuel level sensor (gauge) (in fuel tank)		
12. Stop lamp switch		
13. Knock sensor (if equipped)		
14. PSP switch (if equipped)		

Engine & emission control input/output table

OUTPUT / INPUT	ELECTRIC CONTROL DEVICE													
SIGNAL FROM SENSOR, SWITCH AND CONTROL MODULE	FUEL PUMP RELAY	FUEL INJECTOR	HO2S HEATER	IAC VALVE	IGNITION COIL WITH IGNITER	EGR VALVE (IF EQUIPPED)	EVAP CANISTER PURGE VALVE	A/C COMPRESSOR RELAY	A/C CONDENSER FAN RELAY	RADIATOR FAN RELAY	GENERATOR	MIL	MAIN RELAY	TRANSMISSION CONTROL MODULE
DIAGNOSIS SWITCH (VEHICLE WITHOUT EGR)												○		
FUEL LEVEL SENSOR (VEHICLE WITH HO2S-2)	For detecting fuel level													
BAROMETRIC PRESSURE SENSOR (VEHICLE WITH EGR)		○		○	○		○					○		
STOP LAMP SWITCH				○										
START SWITCH	○	○	○	○		○		○	○		○	○		
IGNITION SWITCH	○	○	○	○	○	○	○	○	○	○	○		○	○
POWER STEERING PRESSURE SWITCH (IF EQUIPPED)				○										
LIGHTING SWITCH				○							○			
REAR DEFOGGER SWITCH				○							○			
BLOWER SWITCH				○				○	○		○			
A/C SWITCH				○			○	○	○	○				
A/C EVAP INLET / OUTLET AIR TEMP. SENSORS								○	○					
VSS		○		○		○		○	○	○	○	○		○
HEATED OXYGEN SENSOR-1 (VEHICLE WITH EGR VALVE)		○					○					○		
HEATED OXYGEN SENSOR-2 (IF EQUIPPED)	For detecting deterioration of three way catalytic converter											○		
IAT SENSOR		○		○	○	○	○	○	○	○		○		
ECT SENSOR		○	○	○	○	○	○	○	○	○		○		○
TP SENSOR		○		○	○	○	○	○	○		○	○		○
MAP SENSOR		○	○	○	○	○	○	○	○			○		
CMP SENSOR	○	○			○							○		
CKP SENSOR	○	○	○	○	○	○	○	○	○		○	○		
TEST SWITCH TERMINAL(VEHICLE WITHOUT EGR)		○		○	○									
KNOCK SENSOR (VEHICLE WITH EGR)					○							○		



+B
BLU
C20-11
BLK/RED
YEL/BLK
C20-23
BLK/ORN
58
GRY/RED
C20-22
GRY/BLU
C20-16
LT GRN/RED
C20-26
ORN
WHT
C20-13
LT GRN
C20-14
LT GRN/BLK
C20-15
C20-10
C20-25
IG1
BLK/WHT
C20-13
PNK/BLK
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WHT
C21-13
PNK/BLU
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YEL/WHT
C21-11
WHT/BLK
C21-14
C21-20
YEL/RED
G07-15
LT GRN/BLK
G07-1
YEL/GRN
G07-9
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GRY/RED
G07-6
GRN/YEL
G07-17
LT GRN/RED
G07-12
PPL/WHT
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YEL/BLK
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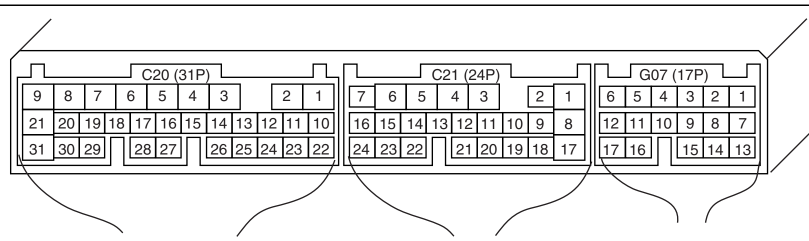
PNK/GRN
C21-8
PNK/BLK
C21-15
PPL/WHT
C20-27
ABS
TCM
SDM
G07-13
GND
G07-8
YEL
C20-9
BLU/YEL
C20-21
BLU/WHT
C20-31
BLU/RED
C20-8
BLU/GRN
C20-6
GRN/RED
BLK
C20-4
BLU/BLK
BLK/RED
C20-18
GRY
C20-29
GRY/WHT
C20-17
GRY/YEL
C20-28
BRN/WHT
C20-24
BRN
C21-18
No.1
L+
H+
L−
H−
No.2
No.3
C21-3
BLU/WHT
C20-20
GRN/YEL
C20-19
GRN/WHT
C21-24
PPL
METER,etc
G07-10
BLU/BLK
IG2
C21-16
GRN/BLK
C21-7
BLU/ORN
C21-9
BLU/YEL
PNK/BLK
C21-1
BRN/YEL
RED/BLU
+B
+BB
C21-23
BLK/WHT
G07-11
WHT/RED
C21-10
BRN/WHT
IG
METER
C21-6
BLK/RED
BLK/YEL
ST
C21-5
C20-30
BLK/YEL
C20-5
YEL
C20-12
RED/BLU
GEN
C20-1
BLK/ORN
C20-2
C20-3
: 60
: 61
: 5V
: 12V

1. CKP sensor	22. A/C condenser fan relay	43. Monitor connector (vehicle without immobilizer indicator lamp)
2. CMP sensor	23. A/C condenser fan motor	44. Ignition coil assembly (for No.1 and No.4 spark plugs)
3. VSS	24. A/C compressor relay	45. Ignition coil assembly (for No.2 and No.3 spark plugs)
4. MAP sensor	25. A/C compressor magnet clutch	46. Stop lamp switch
5. Knock sensor (if equipped)	26. Power steering pressure switch	47. Stop lamp
6. TP sensor	27. Generator	48. Lighting switch
7. ECT sensor	28. Immobilizer control module (if equipped)	49. Position lamp
8. IAT sensor	29. Data link connector	50. Rear defogger switch
9. Heated oxygen sensor-1 (if equipped)	30. Injector No.1	51. Rear defogger
10. Heated oxygen sensor-2 (if equipped)	31. Injector No.2	52. Ignition switch
11. A/C evaporator outlet air temp. sensor	32. Injector No.3	53. Main relay
12. A/C evaporator inlet air temp. sensor	33. Injector No.4	54. Transmission range switch (A/T)
13. Fuel level sensor (vehicle with immobilizer indicator lamp)	34. IAC valve	55. Starting motor
14. TCM (A/T)	35. EVAP canister purge valve	56. Shield wire
15. Transmission range switch (A/T)	36. Fuel pump relay	57. Main fuse
16. ABS control module	37. Fuel pump	58. Barometric pressure sensor
17. CO adjusting resistor (if equipped)	38. Radiator fan relay	59. Immobilizer indicator lamp (if equipped)
18. Blower fan motor	39. Radiator fan motor	60. Engine ground
19. Blower fan switch	40. EGR valve (if equipped)	61. Body ground
20. A/C switch	41. Malfunction indicator lamp	
21. A/C pressure switch	42. Combination meter	

CONNECTOR	TERMINAL	WIRE COLOR	CIRCUIT
C20	1	BLK/ORN	Ground
	2	BLK	Ground
	3	BLK	Ground
	4	BLU/BLK	EVAP canister purge valve
	5	YEL	Power steering pressure switch (if equipped)
	6	GRN/RED	Idle air control valve
	7	PNK/BLK	Heater of HO2S-1 (vehicle with EGR)
	8	BLU/GRN	Fuel injector No.4
	9	BLU/YEL	Fuel injector No.1
	10	ORN	Sensor ground
	11	BLU	Camshaft position sensor
	12	RED/BLU	Generator control signal
	13	WHT	Heated oxygen sensor-1 (vehicle with EGR)
	14	LT GRN	Engine coolant temperature sensor
	15	LT GRN/BLK	Intake air temperature sensor
	16	GRY/BLU	Throttle position sensor
	17	GRY/YEL	EGR valve (stepper motor coil 3)
	18	GRY	EGR valve (stepper motor coil 1)
	19	GRN/WHT	Ignition coil No.2
	20	GRN/YEL	Ignition coil No.1
	21	BLU/WHT	Fuel injector No.2
	22	GRY/RED	Power source for sensors
	23	YEL/BLK	Crankshaft position sensor
	24	BRN	Fuel pump relay
	25	RED	Knock sensor (if equipped)
	26	LT GRN/RED	Manifold absolute pressure sensor
	27	PPL/WHT	Diag. switch terminal (vehicle without immobilizer indicator lamp)
	28	BRN/WHT	EGR valve (stepper motor coil 4)
	29	GRY/WHT	EGR valve (stepper motor coil 2)
	30	BLK/YEL	Engine start switch (Engine start signal)
	31	BLU/RED	Fuel injector No.3
C21	1	BRN/YEL	A/C compressor relay (if equipped)
	2	GRN/WHT	Stop lamp switch
	3	GRN/RED	Radiator fan relay 2
	4	PNK/BLU	Heater of HO2S-2 (Vehicle with EGR)
	5	BLK/RED	Power source
	6	BLK/RED	Power source
	7	BLU/ORN	A/C triple pressure switch
	8	PNK/GRN	Monitor output (vehicle without immobilizer indicator lamp)
	9	BLU/YEL	A/C condenser fan relay (if equipped)
	10	BRN/WHT	Main relay
	11	YEL/WHT	A/C evaporator inlet air temp. sensor
	12	–	–
	13	WHT	Heated oxygen sensor-2 (if equipped)
	14	WHT/BLK	A/C evaporator outlet air temp. sensor
	15	PNK/BLK	Test switch terminal (vehicle without immobilizer indicator lamp)
	16	GRN/BLK	A/C input signal (if equipped)
	17	YEL/BLK	Electric load signal (+)
	18	BRN	Radiator fan relay 1
	19	PNK	Immobilizer indicator lamp (if equipped)
	20	ORN	Sensor ground (vehicle body)
	21	–	–
	22	–	–
	23	BLK/WHT	Ignition switch
	24	PPL	Vehicle speed sensor
G07	1	LT GRN/BLK	Tachometer
	2	–	–
	3	–	–
	4	–	–
	5	GRY/BLK	Engine coolant temp. signal for TCM (A/T)
	6	GRY/RED	D-range ID-up signal (A/T)
	7	PPL/YEL	Malfunction indicator lamp
	8	YEL	Data link connector (SUZUKI serial data line)
	9	YEL/GRN	Engine coolant temp. signal for meter
	10	BLU/BLK	Electric load signal (-)
	11	WHT/RED	Power source for back-up
	12	LT GRN/RED	Torque control input signal (A/T)
	13	BLU	Data link connector
	14	PPL/WHT	Throttle opening signal for TCM (A/T)
	15	YEL/RED	Fuel level sensor (gauge) (vehicle with immobilizer indicator lamp)
	16	–	–
	17	GRN/YEL	Serial data for TCM

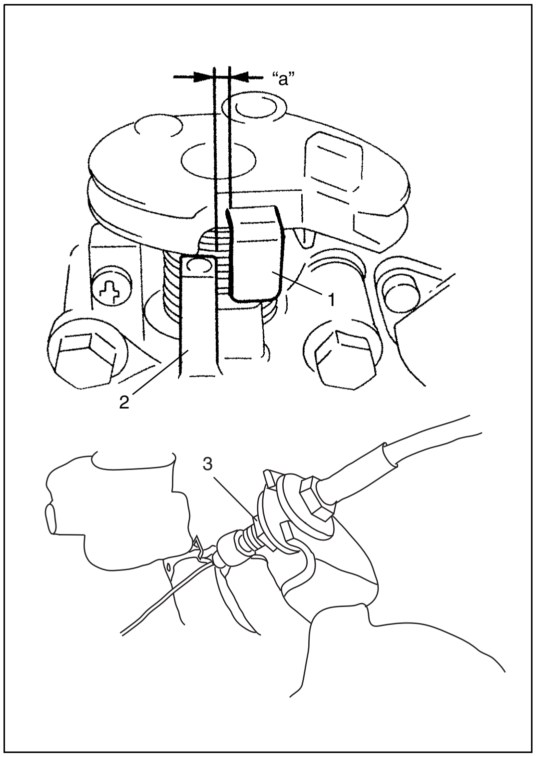


NOTE:

For abbreviation of wire color, refer to Section 0A.

On-vehicle Service

Accelerator cable adjustment



With accelerator pedal depressed fully, check clearance between throttle lever (1) and lever stopper (2) (throttle body) which should be within following specification.
If measured value is out of specification, adjust it to specification with cable adjusting nut (3).

Accelerator cable adjustment clearance (with pedal depressed fully)
"a" : 0.5 – 2.0 mm (0.02 – 0.07 in.)

Idle speed/idle air control (IAC) duty inspection

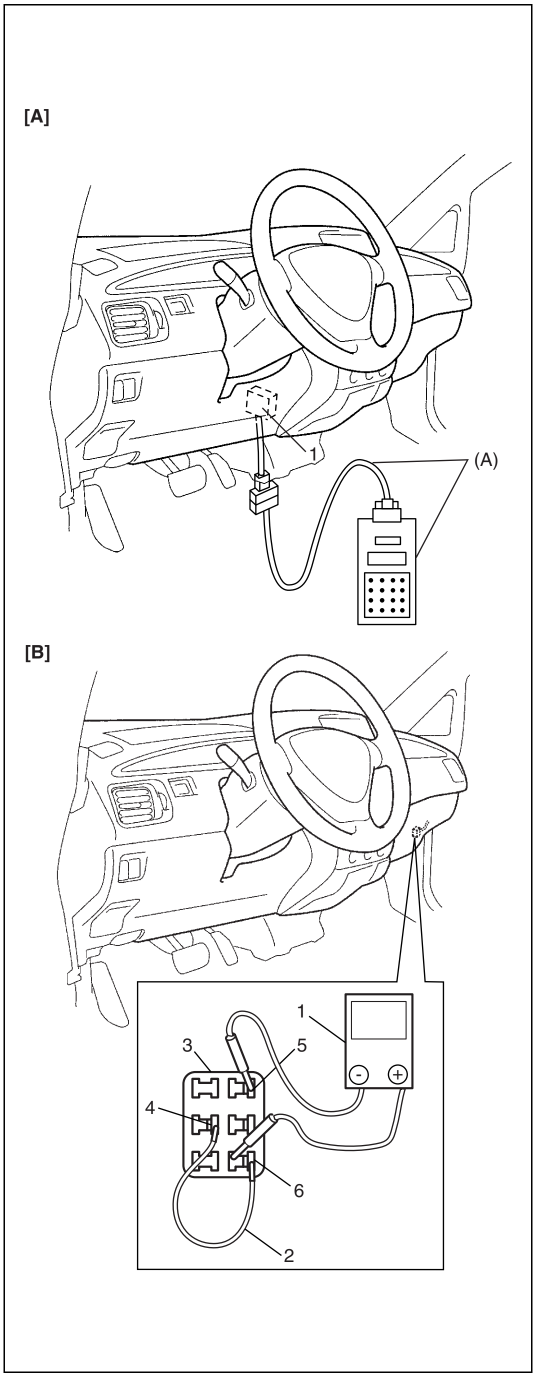
Before idle speed/IAC duty check, make sure of the following.

- Lead wires and hoses of Electronic Fuel Injection and engine emission control systems are connected securely.
- Accelerator cable has some play, that is, it is not tight.
- Valve lash is checked and adjusted according to maintenance schedule.
- Ignition timing is within specification.
- All accessories (wipers, heater, lights, A/C, etc.) are out of service.
- Air cleaner has been properly installed and is in good condition.
- No abnormal air inhaling from air intake system.

After above items are all confirmed, check idle speed and IAC duty as follows.

NOTE:

Before starting engine, place transmission gear shift lever in "Neutral" (shift selector lever to "P" range for A/T vehicle), and set parking brake and block drive wheels.



1) Connect SUZUKI scan tool to DLC (1) with ignition switch OFF, if it is available.
2) Warm up engine to normal operating temperature.
3) Check engine idle speed and "IAC duty" as follows :

When using SUZUKI scan tool :

a) Select "Data List" mode on scan tool to check "IAC duty".

(A) : SUZUKI scan tool

[A] :	When using SUZUKI scan tool
[B] :	When using duty meter (Vehicle without immobilizer indicator lamp)

When using duty meter (vehicle without immobilizer indicator lamp) :

NOTE:

IAC duty can be checked using monitor connector only for vehicle not equipped with immobilizer indicator lamp.

b) Set tachometer.
c) Using service wire (2), ground "Diag. switch terminal" (4) in monitor connector (3) and connect duty meter between "Duty output terminal" (5) and "Ground terminal" (6) of monitor connector (3).

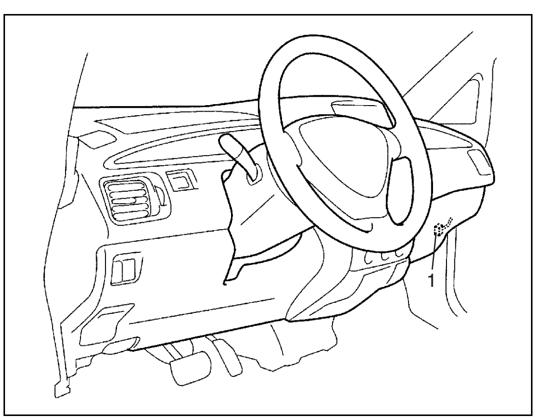
4) If duty and/or idle speed is out of specifications, inspect idle air control system referring to Diagnostic Flow Table B-4 IDLE AIR CONTROL SYSTEM CHECK in Section 6.

Engine idle speed and IAC duty

	A/C OFF	A/C ON
M/T vehicle	**700 ± 50 r/min (rpm)** **5 – 25 %**	**850 ± 50 r/min (rpm)**
A/T vehicle at P/N range	**750 ± 50 r/min (rpm)** **5 – 25 %**	**850 ± 50 r/min (rpm)**

NOTE:

Above duty values are ON duty (low voltage rate) meter indications.



5) Remove service wire from monitor connector (1).
6) Check that specified engine idle speed is obtained with A/C ON if vehicle is equipped with A/C.

   If not, check A/C ON signal circuit and idle air control system, referring to Table B-5 A/C Signal Circuit Check and Table B-4 Idle Air Control System Check in Section 6.

Idle mixture inspection / adjustment (vehicle without heated oxygen sensor)

All vehicles not equipped with heated oxygen sensor are shipped with their CO % factory adjusted as follows.

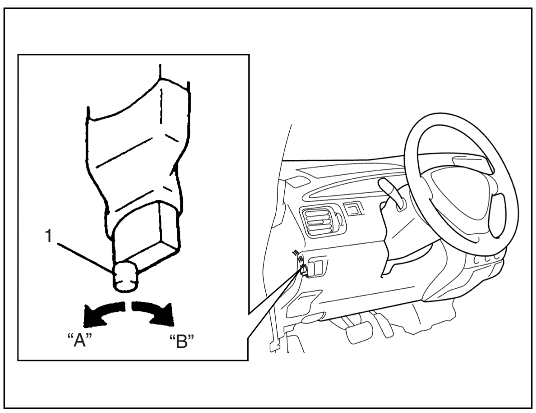
Engine idle mixture (CO %)
0.5 – 1.5 % at specified idle speed

Idle mixture adjustment should never be changed from the original factory setting. However, if during diagnosis, the check indicates idle mixture to be the cause of a driver performance complaint or emission failure, the idle mixture can be adjusted using the following procedures.

NOTE:

For this inspection and adjustment, exhaust gas tester (CO meter) and engine tachometer are necessary.

1) Check idle speed according to “Idle Speed Inspection” section.
2) Using exhaust gas tester, check that idle mixture CO % is within above specification. If it is out of specification, adjust it to specification by turning resistor knob.



NOTE:

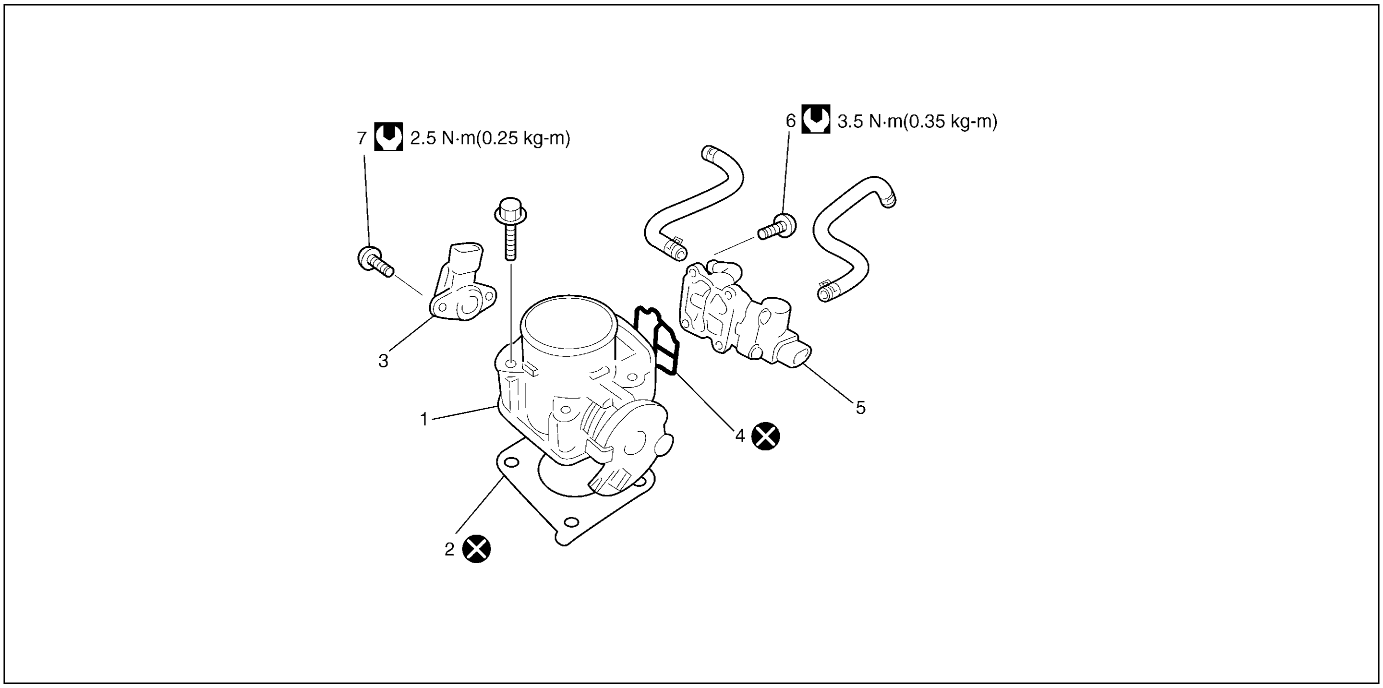
Turning CO adjusting resistor knob to “A” increases CO % (A/F mixture becomes rich) and turning it to “B” decreases CO % (A/F mixture becomes lean).

1. CO adjusting resistor

3) If idle mixture has been adjusted, confirm that idle speed is within specification.

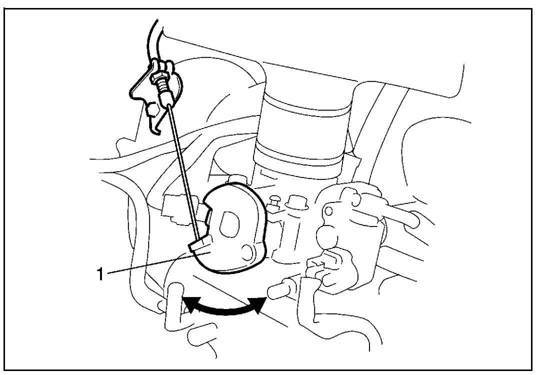
Air Intake System

Throttle body



1. Throttle body	4. Gasket	7. TP sensor screws
2. Throttle stop screw	5. Idle air control valve	Tightening torque
3. TP sensor	6. IAC valve screws	Do not reuse.

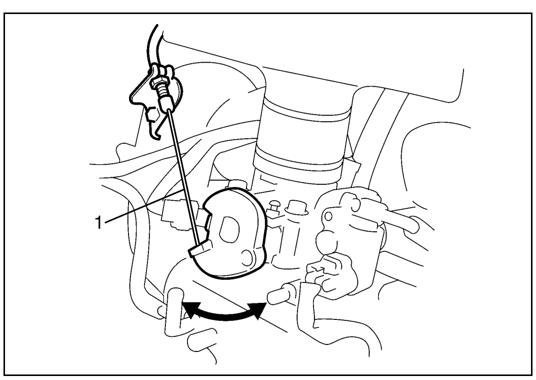
ON-VEHICLE INSPECTION



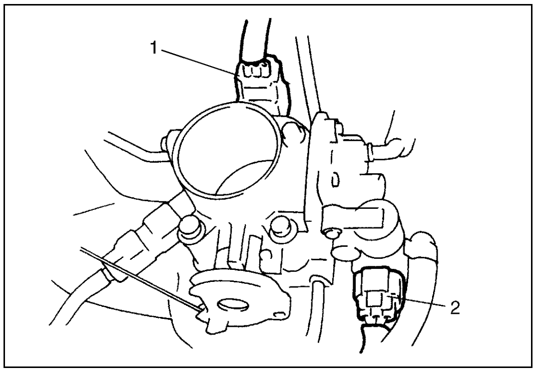
- Check that throttle valve lever (1) moves smoothly.

REMOVAL

1) Disconnect negative cable at battery.
2) Drain cooling system.



3) Disconnect accelerator cable (1) from throttle valve lever.
4) Disconnect IAT sensor connector and remove air cleaner assembly with air cleaner outlet hose.



5) Disconnect electric connector from TP sensor (1) and IAC valve (2).
6) Remove throttle body from intake manifold.
7) Disconnect engine coolant hoses from throttle body.

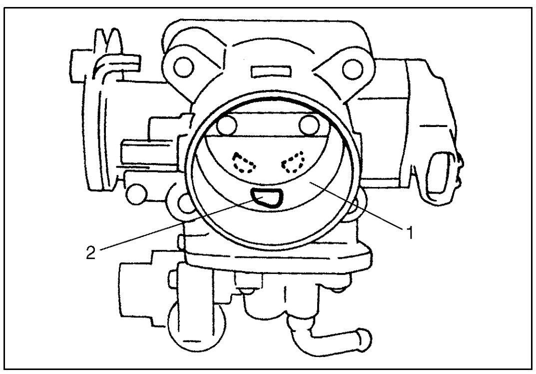
DISASSEMBLY

Remove TP sensor and IAC valve from throttle body.

NOTE:

While disassembling and assembling throttle body, use special care not to deform levers on throttle valve shaft or cause damage to any other parts.

CLEANING



Clean throttle body bore (1) and idle air passage (2) by blowing compressed air.

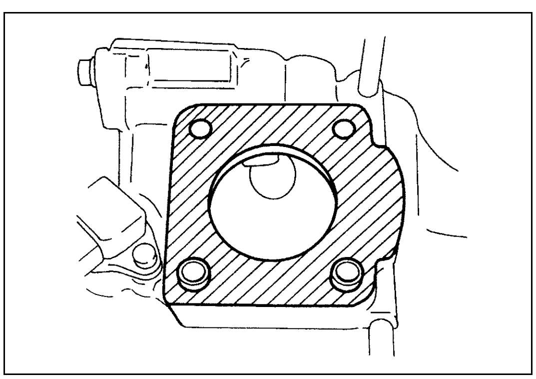
NOTE:

TP sensor, idle air control valve or other components containing rubber must not be placed in a solvent or cleaner bath. A chemical reaction will cause these parts to swell, harden or get distorted.

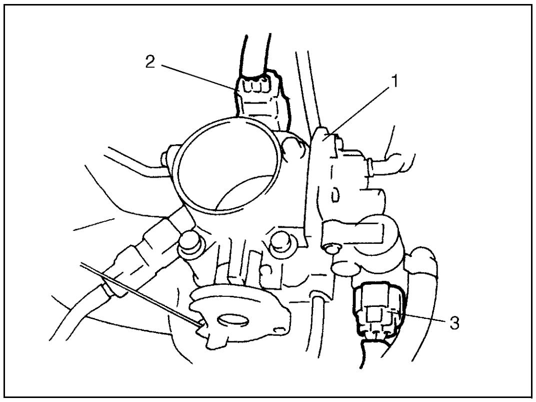
REASSEMBLY

1) Install IAC valve to throttle body referring to “IAC valve Installation” section.
2) Install TP sensor to throttle body referring to “TP sensor Installation” section.

INSTALLATION



1) Clean mating surfaces and install throttle body gasket to intake manifold.
   Use new gasket.
2) Connect engine coolant hoses.



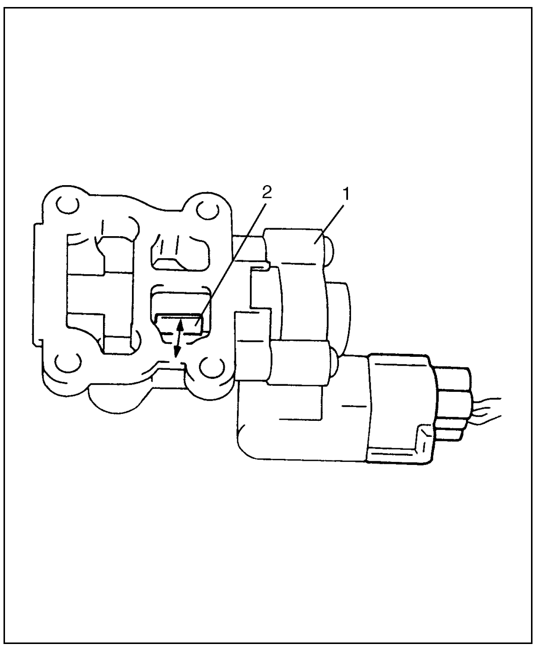
3) Install throttle body (1) to intake manifold.
4) Connect connector to TP sensor (2) and IAC valve (3) securely.
5) Connect accelerator cable and adjust cable play to specification.
6) Install air cleaner assembly with air cleaner outlet hose and connect IAT sensor connector.
7) Refill cooling system.
8) Connect negative cable at battery.

Idle air control valve (IAC valve)

REMOVAL

1) Remove throttle body from intake manifold referring to “Throttle Body Removal” section.
2) Remove IAC valve from throttle body.

INSPECTION

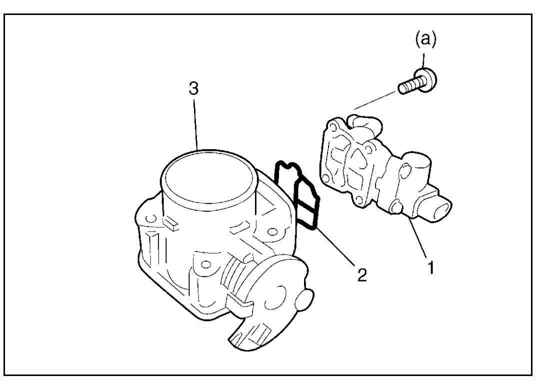


1) Connect each connector to IAC valve (1), TP sensor and IAT sensor.
2) Check that rotary valve (2) of IAC valve opens and closes once and then stops in about 60 ms as soon as ignition switch is turned ON.

NOTE:

- **This check should be performed by two people, one person turns ignition switch ON while the other checks valve operation.**
- **As valve operation is momentary, it may be overlooked. To prevent this, perform this operation check 3 times or more continuously.**
  If rotary valve of IAC valve does not operate at all, check wire harness for open and short. If wire harness is in good condition, replace IAC valve and recheck.

INSTALLATION



1) Install new gasket (2) to IAC valve (1).
2) Install IAC valve (1) to throttle body (3).
   Tighten IAC valve screws to specified torque.

Tightening torque
IAC valve screw (a) : 3.5 N·m (0.35 kg-m, 2.5 lb-ft)

3) Install throttle body to intake manifold referring to “Throttle Body Installation” section.

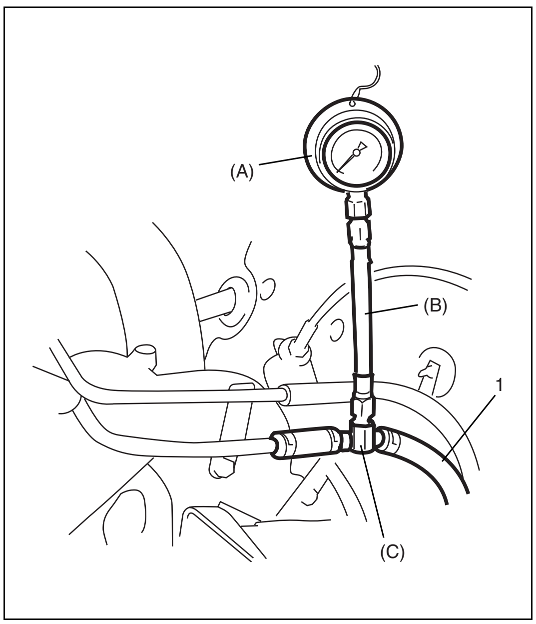
Fuel Delivery System

Fuel pressure inspection

> **WARNING:**
> **Be sure to perform work in a well-ventilated area and away from any open flames, or there is a risk of a fire breaking out.**

1) Relieve fuel pressure in fuel feed line referring to “Fuel Pressure Relief Procedure” in Section 6.
2) Disconnect fuel feed hose from fuel delivery pipe.

> **CAUTION:**
> **A small amount of fuel may be released when fuel hose is disconnected. Place container under the joint with a shop cloth so that released fuel is caught in container or absorbed in cloth. Place that cloth in an approved container.**



3) Connect special tools and hose between fuel delivery pipe and fuel feed hose (1) as shown in figure, and clamp hoses securely to ensure no leaks occur during checking.

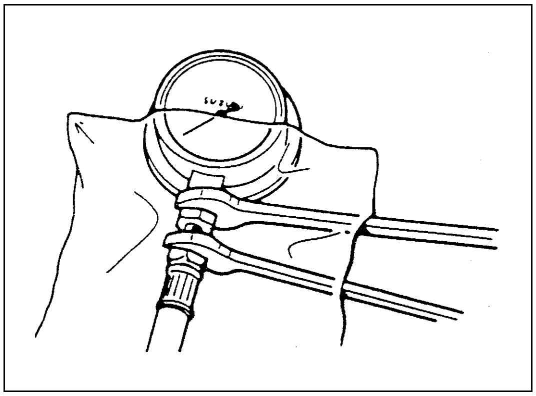
Special tool
(A) : 09912-58441
(B) : 09912-58431
(C) : 09912-58490

4) Check that battery voltage is above 11 V.
5) Turn ignition switch ON to operate fuel pump and after 2 seconds turn it OFF. Repeat this 3 or 4 times and then check fuel pressure.

Fuel pressure specification

CONDITION	FUEL PRESSURE
With fuel pump operating and engine stopped	270 – 310 kPa ($2.7 – 3.1\ kg/cm^2$, 38.4 – 44.0 psi)
At specified idle speed	
With 1 min. after engine (fuel pump) stop (Pressure reduces as time passes)	over 250 kPa ($2.5\ kg/cm^2$, 35.6 psi)

6) Start engine and warm it up to normal operating temperature.
7) Measure fuel pressure at idling.
   If measured pressure does not satisfy specification, refer to "Diagnostic Flow Table B-3" in section 6 and check each possibly defective part. Replace if found defective.



8) After checking fuel pressure, remove fuel pressure gauge.

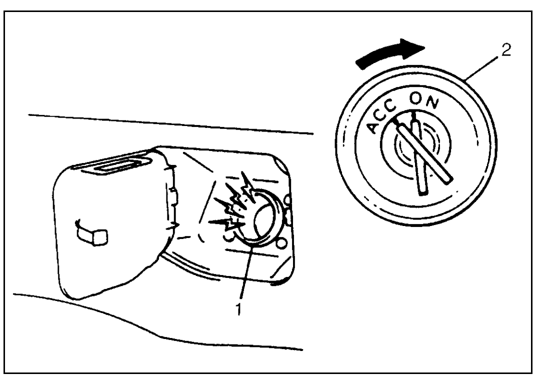
CAUTION:
As fuel feed line is still under high fuel pressure, make sure to release fuel pressure according to following procedures.
- **Place fuel container under joint.**
- **Cover joint with rag and loosen joint nut slowly to release fuel pressure gradually.**

9) Remove special tools from fuel delivery pipe.
10) Connect fuel feed hose to fuel delivery pipe and clamp it securely.
11) With engine "OFF" and ignition switch "ON", check for fuel leaks.

Fuel pump

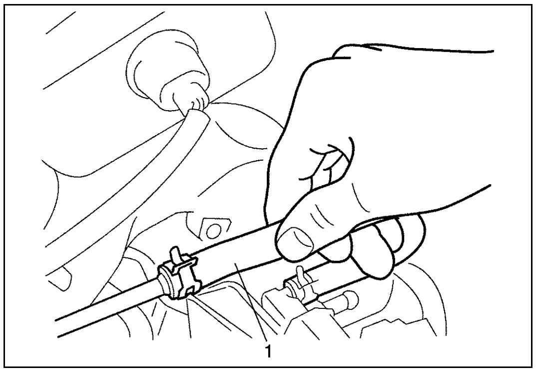
ON-VEHICLE INSPECTION

CAUTION:
When fuel filler cap is removed in any procedure, work must be done in a well-ventilated area, keep away from any open flames and without smoking.



1) Remove filler cap and turn ignition switch ON. Then fuel pump operating sound should be heard from fuel filler for about 2 seconds and stop. Be sure to reinstall fuel filler cap after checking.
   If above check result is not satisfactory, advance to "Diagnostic Flow Table B-2".

1.	Fuel filler
2.	Ignition switch



2) Turn ignition switch OFF and leave over 10 minutes as it is.
3) Fuel pressure should be felt at fuel feed hose (1) for about 2 seconds after ignition switch ON.
   If fuel pressure is not felt, advance to "Diagnostic Flow Table B-3".

REMOVAL

Remove fuel tank from body according to procedure described in Section 6C and remove fuel pump from fuel tank.

INSPECTION

Check fuel pump filter for evidence of dirt and contamination. If present, clean and check for presence of dirt in fuel tank.

INSTALLATION

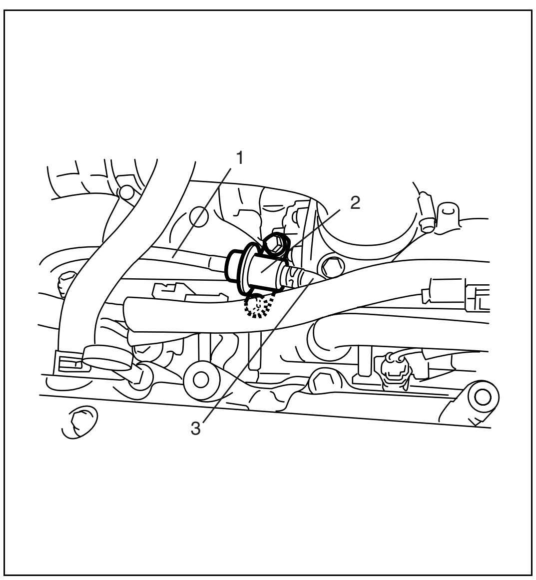
1) Install fuel pump to its bracket.
2) Install fuel pump to fuel tank and then install fuel tank to body according to procedure described in Section 6C.

Fuel pressure regulator

ON-VEHICLE INSPECTION

Perform fuel pressure inspection according to procedure described in "Fuel Pressure Inspection".

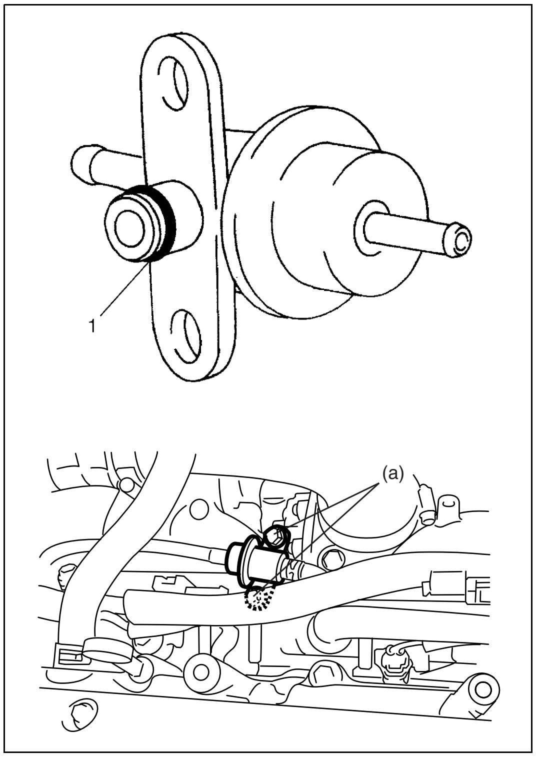
REMOVAL



1) Relieve fuel pressure according to procedure described on Section 6.
2) Disconnect negative cable at battery.
3) Disconnect vacuum hose (1) from fuel pressure regulator (2).
4) Remove fuel pressure regulator from fuel delivery pipe.

CAUTION:
A small amount of fuel may be released when it is from delivery pipe
Place a shop cloth under delivery pipe so that released fuel is absorbed in it.

5) Disconnect fuel return hose (3) from fuel pressure regulator.



INSTALLATION

For installation, reverse removal procedure and note following precautions.

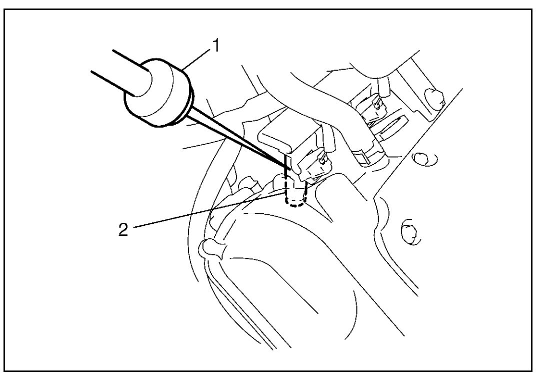
- Use new O-ring (1).
- Apply thin coat of gasoline to O-ring to facilitate installation.
- Tighten fuel pressure regulator bolts to specified torque.

Tightening torque
Fuel pressure regulator bolts
(a) : 10 N·m (1.0 kg-m, 7.5 lb-ft)

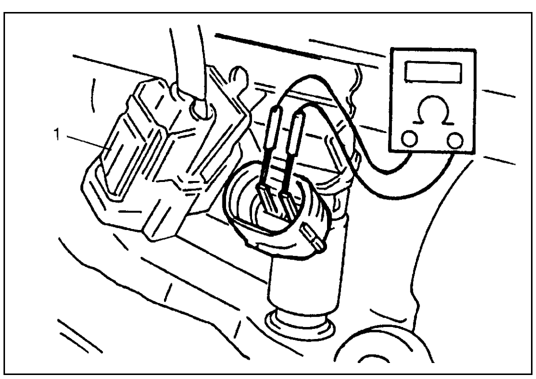
- With engine "OFF" and the ignition switch ON position, check for fuel leaks around fuel line connection.

Fuel injector

ON-VEHICLE INSPECTION



1) Using sound scope (1) or such, check operating sound of injector (2) when engine is running or cranking.
   Cycle of operating sound should vary according to engine speed.
   If no sound or an unusual sound is heard, check injector circuit (wire or connector) or injector (2).

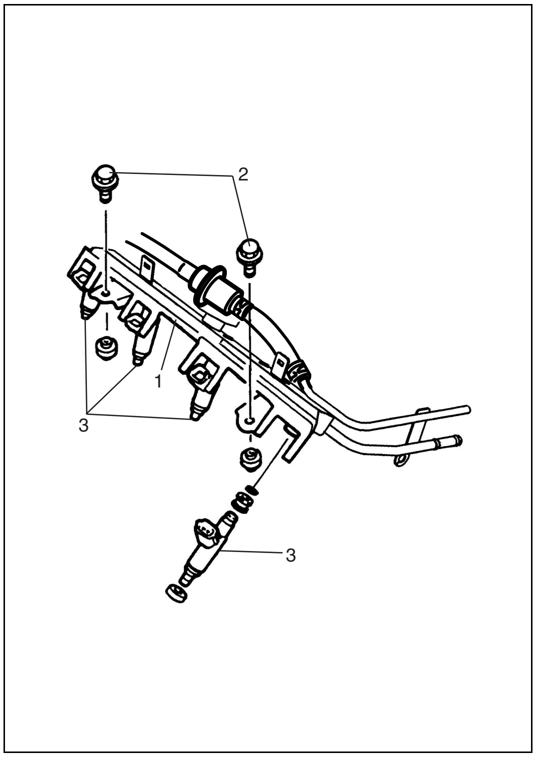


2) Disconnect connector (1) from injector, connect ohmmeter between terminals of injector and check resistance.
   If resistance is out of specification, replace.

   Resistance of fuel injector
   : 11.3 – 13.8 Ω at 20°C (68°F)

3) Connect connector (1) to injector securely.

REMOVAL



1) Relieve fuel pressure according to procedure described in Section 6.
2) Disconnect negative cable at battery.
3) Disconnect fuel injector couplers and release wire harness from clamps.
4) Remove clamp bolt for fuel feed pipe and return pipe.
5) Remove fuel delivery pipe bolts (2).
6) Remove fuel injector(s) (3).

CAUTION:

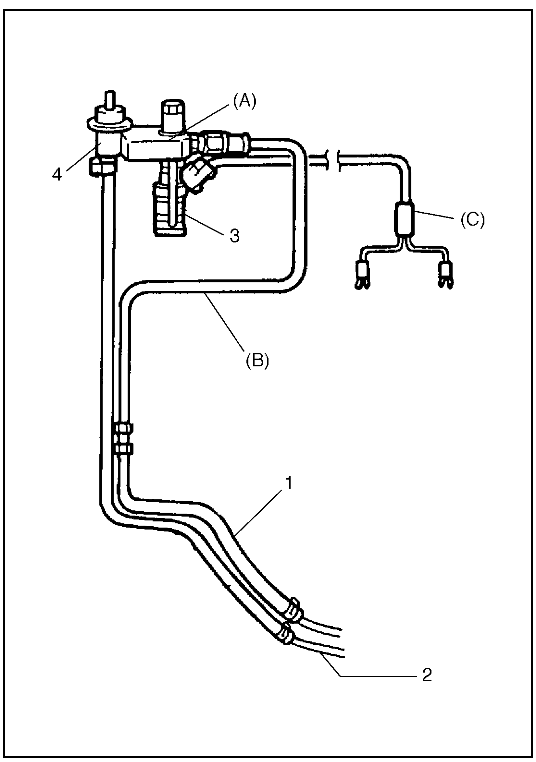
A small amount of fuel may come out after removal of fuel injectors, cover them with shop cloth.

1. Fuel delivery pipe

INSPECTION

WARNING:

As fuel is injected in this inspection, perform in a well ventilated area and away from open flames.
Use special care to prevent sparking when connecting and disconnecting test lead to and from battery.



1) Install injector (3) and fuel pressure regulator (4) to special tool (injector checking tool).

Special tool
(A) : 09912-58421

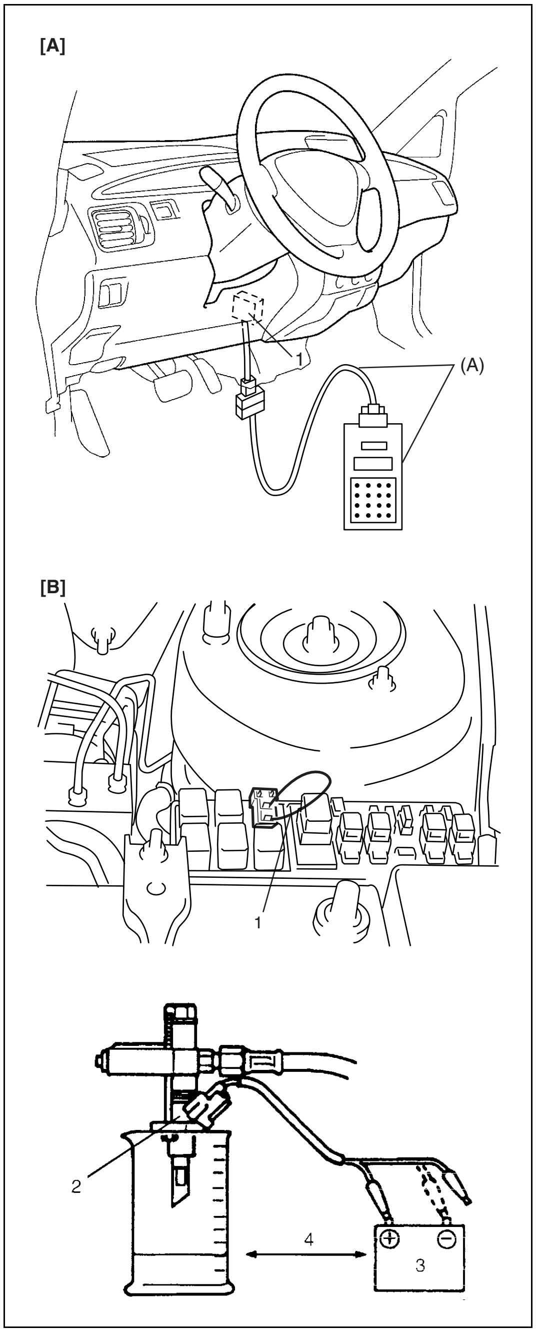
2) Connect special tools (hose and attachment) to fuel feed hose (1) of vehicle.

Special tool
(B) : 09912-58431

3) Connect special tool (test lead) to injector.

Special tool
(C) : 09930-88530

2. Fuel return line



4) Install suitable vinyl tube onto injector nozzle to prevent fuel from splashing out when injecting.
5) Put graduated cylinder under injector as shown.
6) Operate fuel pump and apply fuel pressure to injector as follows:

When using SUZUKI scan tool :

a) Connect SUZUKI scan tool to DLC with ignition switch OFF.
b) Turn ignition switch ON, clear DTC and select “MISC TEST” mode on SUZUKI scan tool.
c) Turn fuel pump ON by using SUZUKI scan tool.

(A) : SUZUKI scan tool

Without using SUZUKI scan tool :

a) Remove fuel pump relay from connector.
b) Connect two terminals of relay connector using service wire (1) as shown in figure.

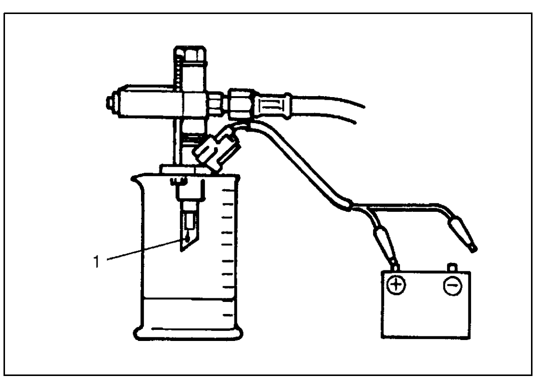
CAUTION:
Check to make sure that connection is made between correct terminals. Wrong connection can cause damage to ECM, wire harness, etc.

c) Turn ignition switch ON.

7) Apply battery voltage (3) to injector (2) for 15 seconds and measure injected fuel volume with graduated cylinder.
Test each injector two or three times.
If not within specification, replace injector.

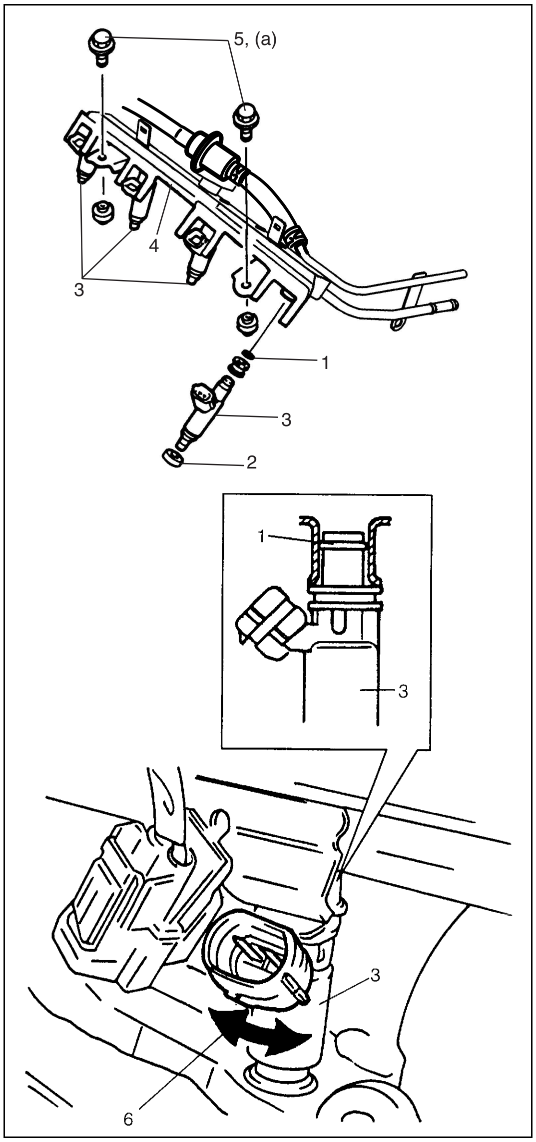
Injected fuel volume
: 43 – 47 cc/15 sec. (1.45/1.51 – 1.58/ 1.65 US/Imp. oz/15 sec.)

4.	Keep as far apart as possible
[A] :	When using SUZUKI scan tool
[B] :	When not using SUZUKI scan tool



8) Check fuel leakage from injector nozzle. Do not operate injector for this check (but fuel pump should be at work).
If fuel leaks (1) more than following specifications, replace.

Fuel leakage (1)
: Less than 1 drop/min.



INSTALLATION

For installation, reverse removal procedure and note following precautions.

- Replace injector O-ring (1) with new one using care not to damage it.
- Check if cushion (2) is scored or damaged. If it is, replace with new one.
- Apply thin coat of fuel to O-rings (1) and then install injectors (3) into delivery pipe (4) and intake manifold.
  Make sure that injectors (3) rotate smoothly (6). If not, probable cause is incorrect installation of O-ring (1). Replace O-ring (1) with new one.
- Tighten delivery pipe bolts (5) and make sure that injectors (3) rotate smoothly (6).

Tightening torque
Delivery pipe bolts (a) : 28 N·m (2.8 kg-m, 20.5 lb-ft)

- After installation, with engine “OFF” and ignition switch “ON”, check for fuel leaks around fuel line connection.

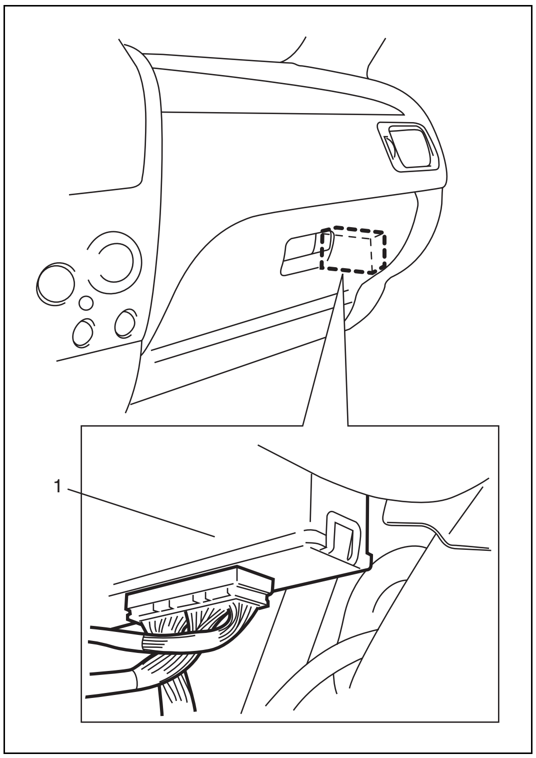
Electronic Control System

Engine control module (ECM)

CAUTION:
As ECM consists of precision parts, be careful not to expose it to excessive shock.

REMOVAL

1) Disconnect negative cable at battery.
2) Disable air bag system, referring to “DISABLING AIR BAG SYSTEM” in Section 10B if equipped.
3) Disconnect ECM (1) connectors.
4) Remove bolt and nuts, remove ECM.



INSTALLATION

Reverse removal procedure noting the following:

- Connect connectors to ECM securely.

Manifold absolute pressure sensor (MAP sensor)

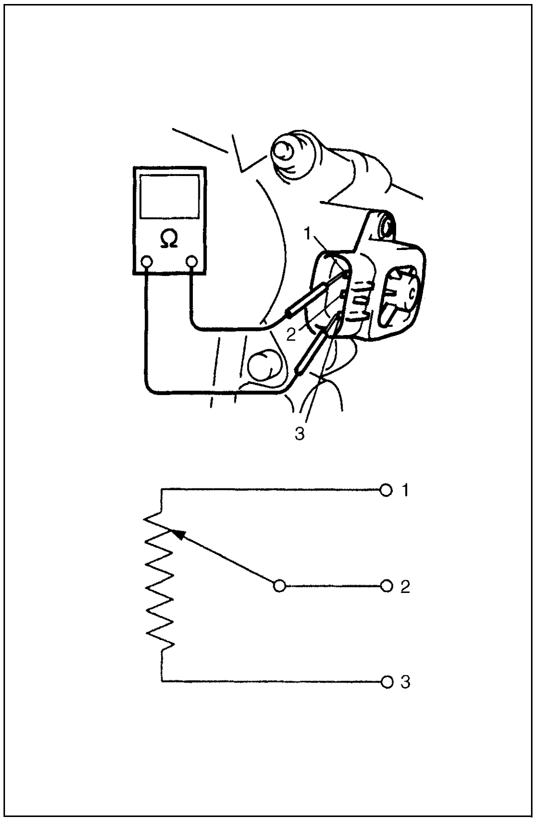
INSPECTION

Check MAP sensor referring to “MAP Sensor Individual Check” in DTC P0105 (No.11) Flow Table in Section 6. If malfunction is found, replace.

Throttle position sensor (TP sensor)

INSPECTION

1) Disconnect negative cable at battery and connector from IAT sensor.
2) Remove air cleaner assembly with air cleaner outlet hose and disconnect TP sensor connector.



3) Using ohmmeter, check resistance between terminals under each condition given in table below.
   If check result is not satisfactory, replace TP sensor.

TP sensor resistance

TERMINALS	RESISTANCE
Between terminals 1 and 3	4.0 – 6.0 kΩ
Between terminals 2 and 3	20 Ω – 6.0 kΩ, varying according to throttle valve opening.

NOTE:

There should be more than 2 kΩ resistance difference between when throttle valve is at idle position and when it is fully open.

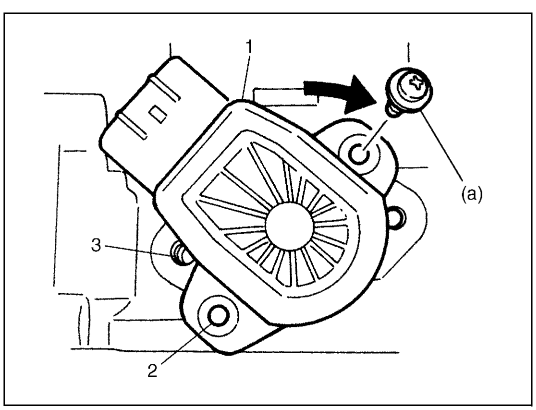
4) Connect TP sensor connector securely.
5) Connect negative cable to battery.

1.	Reference voltage terminal
2.	Output voltage terminal
3.	Ground terminal

REMOVAL

1) Disconnect negative cable at battery.
2) Remove throttle body from intake manifold referring to "Throttle Body Removal" in this section.
3) Remove TP sensor from throttle body.

INSTALLATION



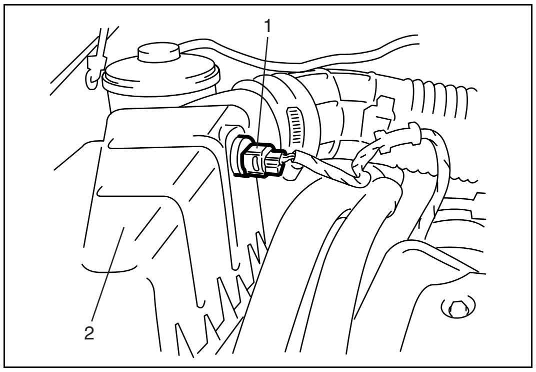
1) Install TP sensor (1) to throttle body.
   Fit TP sensor to throttle body in such way that its holes (3) are a little away from TP sensor screw holes (2) as shown in left figure and turn TP sensor clockwise so that those holes align (3).

Tightening torque
TP sensor screw (a) : 2.5 N·m (0.25 kg-m, 1.8 lb-ft)

2) Connect connector to TP sensor securely.
3) Connect negative cable to battery.

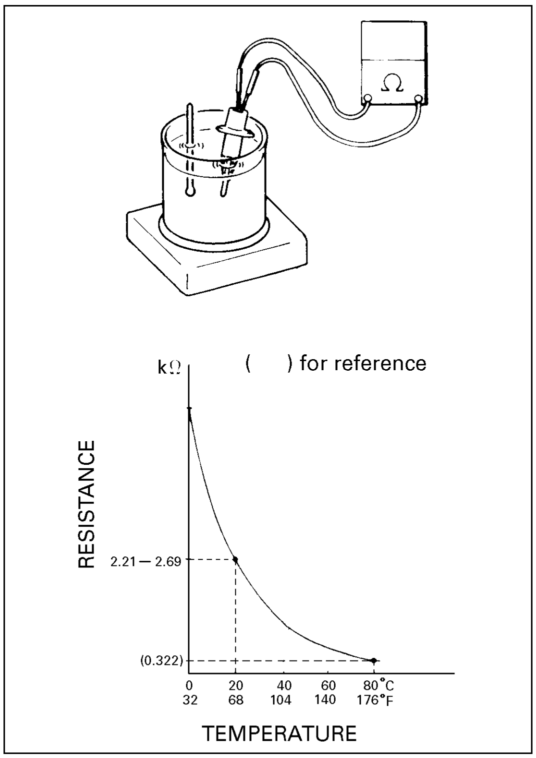
Intake air temperature sensor (IAT sensor)

REMOVAL



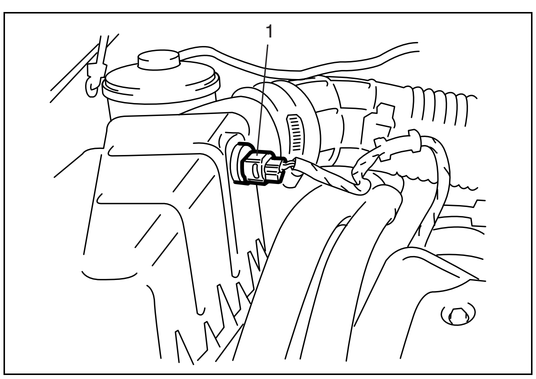
1) Disconnect negative cable at battery.
2) Disconnect coupler (1) from IAT sensor.
3) Remove IAT sensor from air cleaner case (2).

INSPECTION



Immerse temperature sensing part of IAT sensor in water (or ice) and measure resistance between sensor terminals while heating water gradually.
If measured resistance does not show such characteristic as shown in left figure, replace IAT sensor.

INSTALLATION

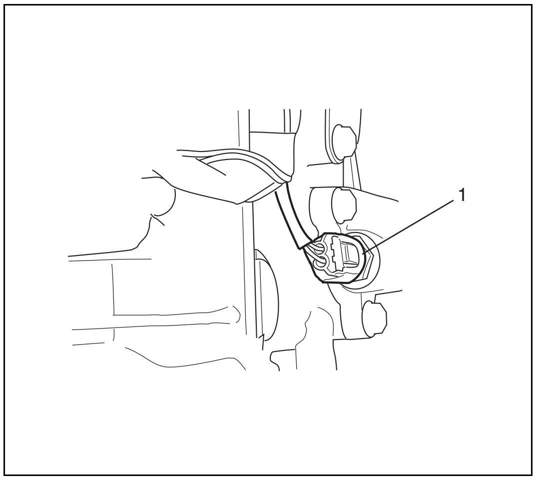


Reverse removal procedure noting the following.

- Clean mating surfaces of IAT sensor and air cleaner case.
- Connect IAT sensor connector (1) securely.

Engine coolant temperature sensor (ECT sensor)

REMOVAL

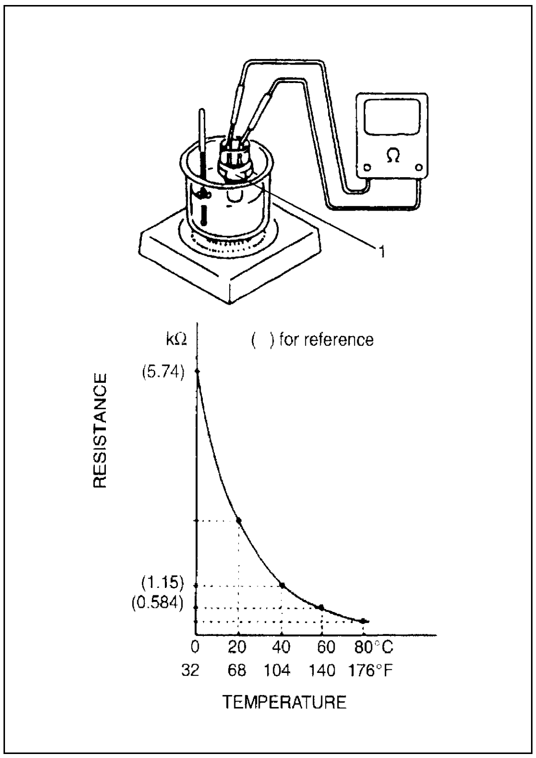


1) Disconnect negative cable at battery.
2) Drain coolant referring to Section 6B.

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

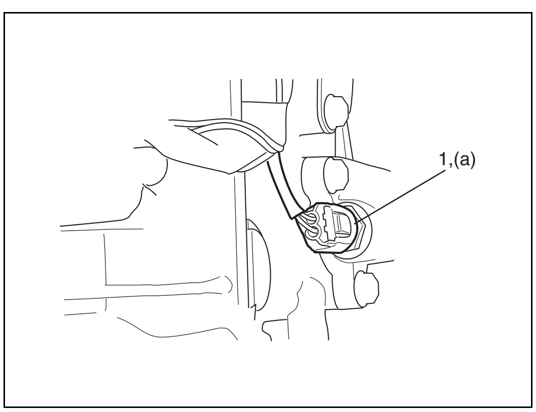
3) Remove air intake pipe.
4) Disconnect connector from ECT sensor.
5) Remove ECT sensor (1) from thermostat case.

INSPECTION



Immerse temperature sensing part of ECT sensor (1) in water (or ice) and measure resistance between sensor terminals while heating water gradually.
If measured resistance does not show such characteristic as shown in left figure, replace ECT sensor (1).

INSTALLATION



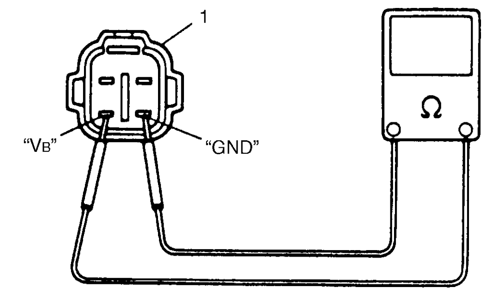
Reverse removal procedure noting the following:
- Clean mating surfaces of ECT sensor (1) and thermostat case.
- Check O-ring for damage and replace if necessary.
- Tighten ECT sensor (1) to specified torque.

Tightening torque
ECT sensor (a) : 15 N·m (1.5 kg-m, 11.5 lb-ft)

- Connect connector to ECT sensor (1) securely.
- Refill coolant referring to Section 6B.

Heated oxygen sensor (HO2S-1 and HO2S-2)

Oxygen sensor heater inspection



1) Disconnect sensor connector.
2) Using ohmmeter, measure resistance between terminals “V_B” and “GND” of sensor connector.
   If found faulty, replace oxygen sensor.

NOTE:
Temperature of sensor affects resistance value largely. Make sure that sensor heater is at correct temperature.

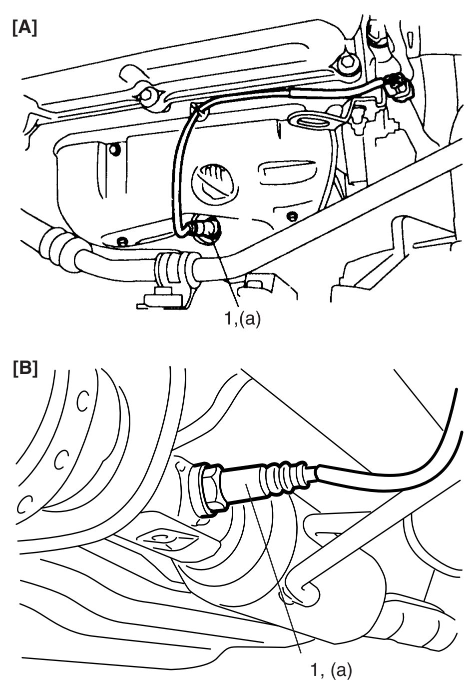
Resistance of oxygen sensor heater
HO2S-1 : 5.0 – 6.4 Ω at 20°C (68°F)
HO2S-2 : 11.7 – 14.3 Ω at 20°C (68°F)

3) Connect sensor connector securely.

1. Viewed from terminal side

REMOVAL

WARNING:
To avoid danger of being burned, do not touch exhaust system when system is hot. Oxygen sensor removal should be performed when system is cool.



1) Disconnect negative cable at battery.
2) For HO2S-1, disconnect connector of heated oxygen sensor and release its wire harness from clamps, then remove front bumper and heat insulator panel.
3) For HO2S-2, disconnect connector of heated oxygen sensor and release its wire harness from clamp and hoist vehicle.
4) Remove heated oxygen sensor (1) from exhaust manifold or exhaust pipe.

INSTALLATION

Reverse removal procedure noting the following.

- Tighten heated oxygen sensor (1) to specified torque.

Tightening torque
Heated oxygen sensor (a) : 45 N·m (4.5 kg-m, 32.5 lb-ft)

- Connect connector of heated oxygen sensor (1) and clamp wire harness securely.
- After installing heated oxygen sensor (1), start engine and check that no exhaust gas leakage exists.

[A] :	HO2S-1
[B] :	HO2S-2

Camshaft position sensor

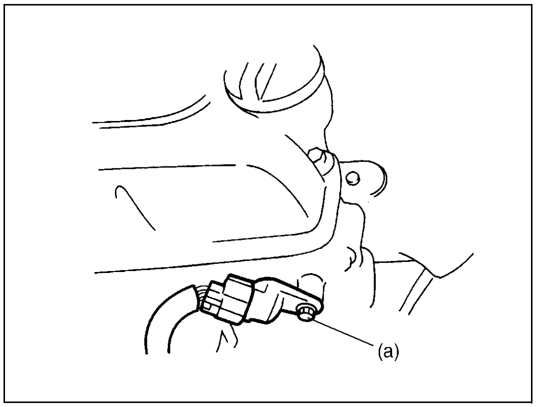
INSPECTION

Check camshaft position sensor referring to DTC P0340 (No.15) Diag. Flow Table in Section 6. If malfunction is found, replace.

REMOVAL

1) Disconnect negative cable at battery.
2) Disconnect connector from camshaft position sensor.
3) Remove camshaft position sensor from cylinder head.

INSTALLATION



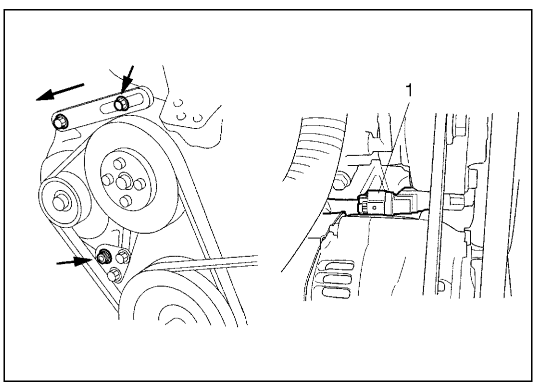
1) Check that O-ring is free from damage.
2) Check that camshaft position sensor and signal rotor teeth are free from any metal particles and damage.
3) Install camshaft position sensor to cylinder head.

Tightening torque
Camshaft position sensor bolt
(a) : 10 N·m (1.0 kg-m, 7.5 lb-ft)

4) Connect connector to it securely.
5) Connect negative cable to battery.

Crankshaft position sensor

INSPECTION

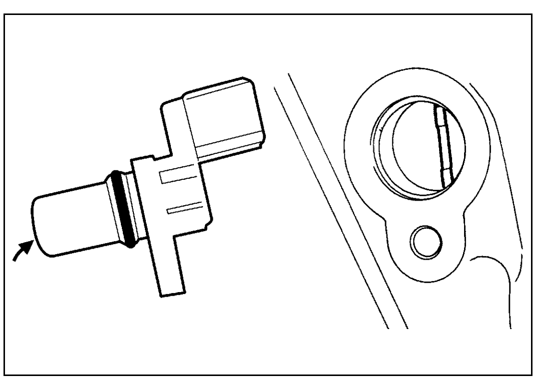


Check crankshaft position sensor referring to step 1 and 2 of DTC P0335 (No.23) Flow Table. If malfunction is found, replace.

REMOVAL

1) Disconnect negative cable at battery.
2) Remove generator drive belt, loosen pivot bolt and move generator outward.
3) Disconnect connector from crankshaft position sensor.
4) Remove crankshaft position sensor (1) from cylinder block.

INSTALLATION



1) Check to make sure that crankshaft position sensor and pulley teeth are free from any metal particles and damage.
2) Install crankshaft position sensor to cylinder block.
3) Connect connector to it securely.
4) Adjust generator drive belt tension, refer to Section 6B.
5) Connect negative cable to battery.

Vehicle speed sensor (VSS)

INSPECTION

Check vehicle speed sensor referring to step 3 of DTC P0500 (No.16) Flow Table. If malfunction is found, replace.

REMOVAL/INSTALLATION

Refer to Section 7A1.

Fuel level sensor (gauge)

INSPECTION

Refer to Section 8.

REMOVAL/INSTALLATION

Refer to Section 6C.

Knock sensor (if equipped)

INSPECTION

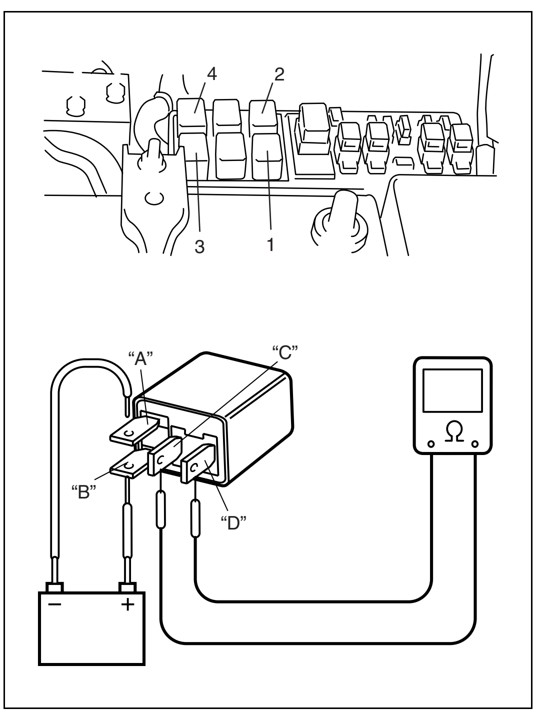
Check knock sensor referring to DTC P0325 (No.17) Flow Table. If malfunction is found, replace.

REMOVAL/INSTALLATION

Refer to Section 6A1.

Main relay, fuel pump relay, A/C compressor relay and A/C condenser fan relay

INSPECTION



1) Disconnect negative cable at battery.
2) Remove main relay (1), fuel pump relay (2), A/C compressor relay (3) and A/C condenser fan relay (4) from vehicle.
3) Check that there is no continuity between terminal “C” and “D”. If there is continuity, replace relay.
4) Connect battery positive (+) terminal to terminal “B” of relay.
   Connect battery negative (–) terminal “A” of relay.
   Check continuity between terminal “C” and “D”.
   If there is no continuity when relay is connected to the battery, replace relay.

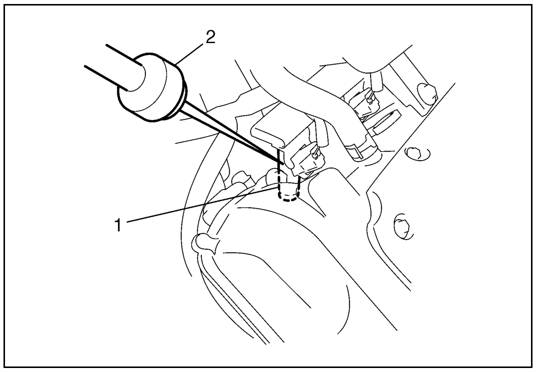
Fuel cut operation

INSPECTION

NOTE:

Before inspection, check to make sure that gear shift lever is in neutral position (with A/T model, selector lever in "P" range), A/C is OFF and that parking brake lever is pulled all the way up.

1) Warm up engine to normal operating temperature.



2) While listening to sound of injector (1) by using sound scope (2) or such, increase engine speed to higher than 3,000 r/min.
3) Check to make sure that sound to indicate operation of injector stops when throttle valve is closed instantly and it is heard again when engine speed is reduced to less than about 2,000 r/min.

Radiator fan control system

SYSTEM INSPECTION

WARNING:

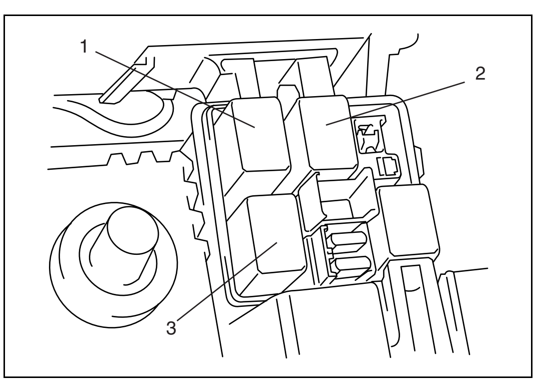
Keep hands, tools, and clothing away from engine cooling fan to help prevent personal injury. This fan is electric and can come on whether or not the engine is running. The fan can start automatically in response to the ECT sensor with the ignition switch in the "ON" position.

Check system for operation referring to Flow Table B-7 in Section 6.

If radiator fan fails to operate properly, check relay, radiator fan and electrical circuit.

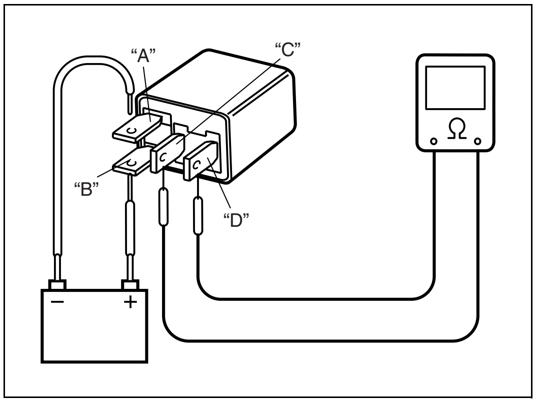
Radiator fan relay No. 1, No. 2 and No.3

INSPECTION



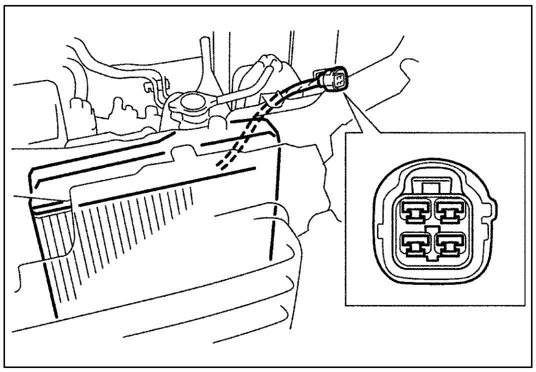
1) Disconnect negative cable at battery.
2) Remove relay(s) from connector(s).

1.	Radiator fan relay No. 1
2.	Radiator fan relay No. 2
3.	Radiator fan relay No. 3

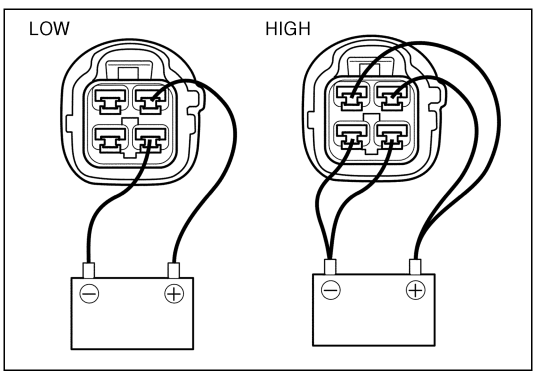


3) Check that there is no continuity between terminal "C" and "D". If there is continuity, replace relay.
4) Connect battery positive (+) terminal to terminal "B" of relay.
   Connect battery negative (–) terminal "A" of relay.
   Check continuity between terminal "C" and "D".
   If there is no continuity when relay is connected to the battery, replace relay.

RADIATOR FAN INSPECTION



1) Check continuity between each terminals.
   If there is no continuity, replace radiator fan motor.



2) Connect battery to radiator fan motor coupler as shown in figure, then check that the radiator fan motor operates smoothly and that fan speed varies.
   If radiator fan motor does not operate smoothly, replace motor.

Output signals of throttle valve opening and engine coolant temp. (vehicle with A/T only)

THROTTLE VALVE OPENING SIGNAL INSPECTION

Check throttle valve opening (throttle position) signal referring to step 1 of DTC P1700 (No.32 or 33) Flow Table in Section 7B1. If check result is not satisfactory, check each wire harness, circuit connections and TP sensor.

ENGINE COOLANT TEMP. SIGNAL INSPECTION

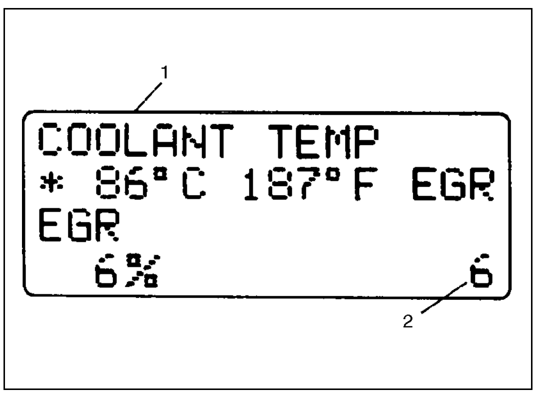
Check engine coolant temp. signal referring to step 1 of DTC P1705 (NO.51) Flow Table in Section 7B1.
If check result is not satisfactory, check each wire harness, circuit connection and ECT sensor.

Emission Control System

EGR system

SYSTEM INSPECTION (USING SUZUKI SCAN TOOL)

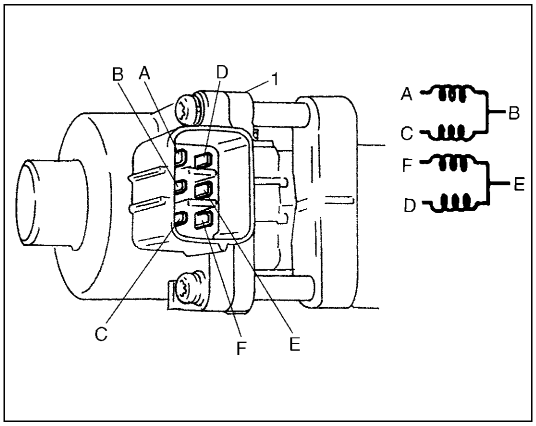
1) Connect SUZUKI scan tool to DLC with ignition switch OFF.
2) Turn ignition switch ON and then select “DATA LIST” mode on scan tool.
3) Make sure that vehicle condition is as following.
   - Vehicle speed = 0 km/h (0 KPH)
   - Engine speed ≤ 3000 rpm
4) Clear DTC by using “CLEAR INFO” mode.
5) With engine idling (without depressing accelerator pedal), open EGR valve by using “STEP EGR” mode in “MISC TEST” menu. In this state, according as EGR valve opening increases engine idle speed drops. If not, possible cause is clogged EGR gas passage, stuck or faulty EGR valve, poor performance of ECT sensor or TP sensor or DTC and/or pending DTC is (are) stored in ECM memory.



1. SUZUKI scan tool display	
2. EGR valve opening (0: Close, 100: Full Open)	

REMOVAL

1) Disconnect negative cable at battery.
2) Remove air intake pipe.
3) Remove EGR pipe.
4) Disconnect EGR valve connector.
5) Remove EGR valve and gasket from intake manifold.

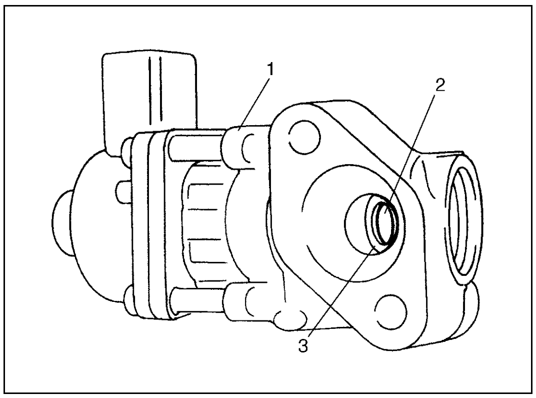


INSPECTION

1) Check resistance between following terminals of EGR valve (1) in each pair.
   If found faulty, replace EGR valve assembly.

EGR valve resistance

Terminal	Standard resistance
A – B C – B F – E D – E	20 – 24 Ω



2) Remove carbon from EGR valve gas passage.

NOTE:

Do not use any sharp-edged tool to remove carbon.
Be careful not to damage or bend EGR valve (1), valve seat (3) and rod.

3) Inspect valve (2), valve seat and rod for fault, cracks, bend or other damage.
   If found faulty, replace EGR valve assembly.

INSTALLATION

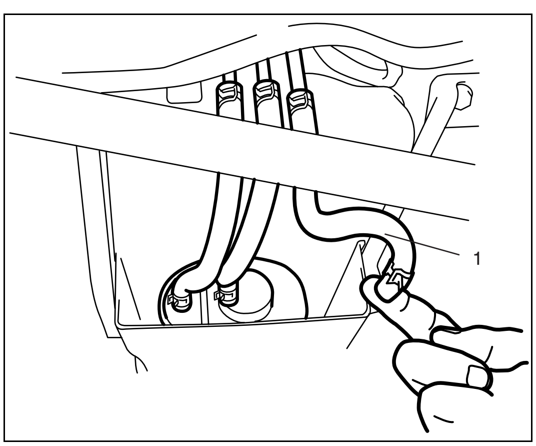
Reverse removal procedure noting following.
- Clean mating surface of valve and intake manifold.
- Use new gaskets.

Evaporative emission control system

EVAP CANISTER PURGE INSPECTION

NOTE:

Before inspection, check to make sure that gear shift lever is in neutral position (with A/T model, selector lever in “P” range) and that parking brake lever is pulled all the way up.



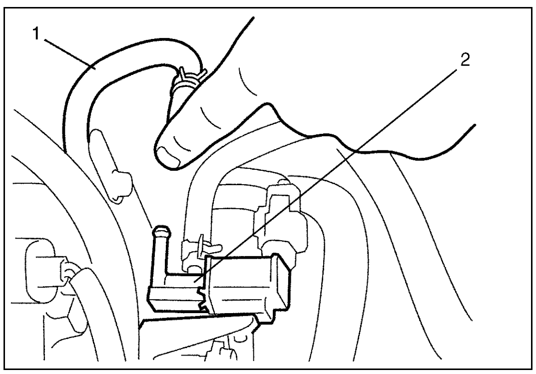
1) Hoist vehicle.
2) Disconnect purge hose (1) from EVAP canister.
3) Place finger against the end of disconnected hose and check that vacuum is not felt there when engine is cool and running at idle speed.

4) Connect purge hose to EVAP canister and warm up engine to normal operating temperature.
5) Disconnect purge hose from EVAP canister.
6) Also check that vacuum is felt when engine is running at idle speed.
   If check result is not satisfactory, check vacuum passage, hoses, EVAP canister purge valve, wire harness and ECM.

NOTE:

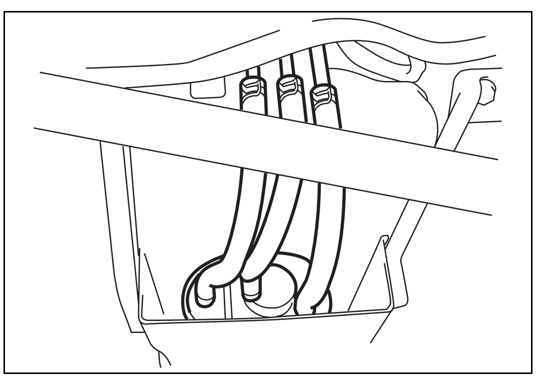
The EVAP canister purge system does not perform purging (vacuum is not detected at the purge hose) unless the engine is sufficiently warmed up and the heated oxygen sensor is activated fully. Also, when the purge hose is disconnected in Step 5), the air is drawn into the purge line. As a result, ECM detects a change in the purge gas concentration and sometimes stops purging but this indicates nothing abnormal.

VACUUM PASSAGE INSPECTION



Start engine and run it at idle speed. Disconnect vacuum hose (1) from EVAP canister purge valve (2). With finger placed against hose disconnected, check that vacuum is applied.
If it is not applied, clean vacuum passage by blowing compressed air.

VACUUM HOSE INSPECTION



Check hoses for connection, leakage, clog and deterioration. Replace as necessary.

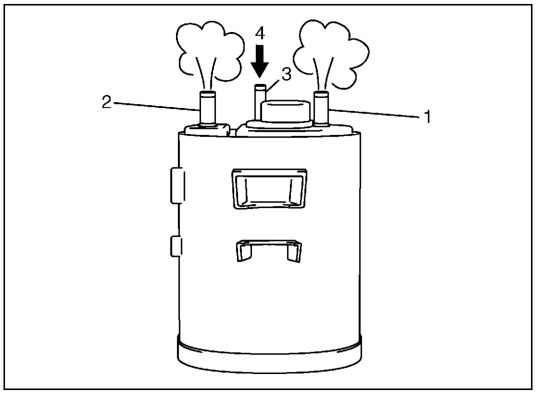
EVAP CANISTER PURGE VALVE INSPECTION

Check EVAP canister purge valve referring to step 1 of DTC P0443 Flow Table in Section 6.
If found malfunction, replace.

EVAP CANISTER INSPECTION

WARNING:
DO NOT SUCK nozzles on EVAP canister. Fuel vapor inside EVAP canister is harmful.

1) Check outside of EVAP canister visually.
2) Disconnect vacuum hoses from EVAP canister.



3) Check that there should be no restriction of flow through purge pipe (1) and air pipe (2) when air is blown (4) into tank pipe (3).
   If any faulty condition is found in above inspection, replace.

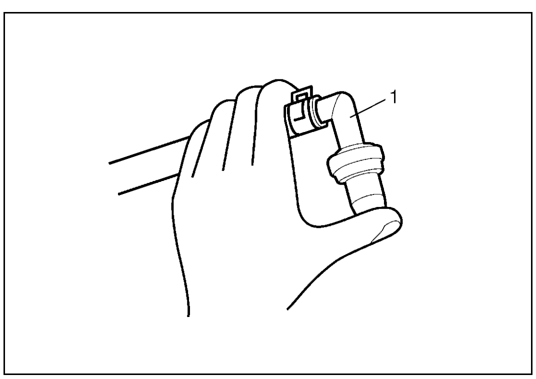
PCV system

NOTE:
Be sure to check that there is no obstruction in PCV valve or its hoses before checking IAC duty, for obstructed PCV valve or hose hampers its accurate adjustment.

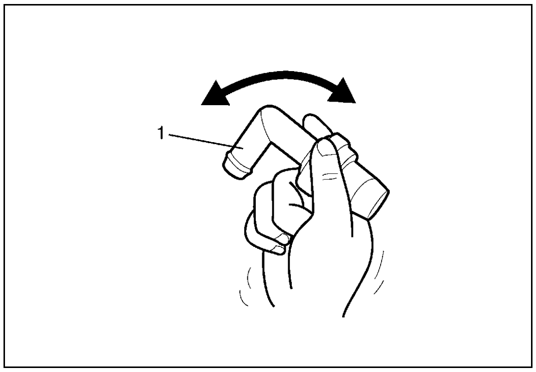
PCV HOSE INSPECTION

Check hoses for connection, leakage, clog and deterioration. Replace as necessary.

PCV VALVE INSPECTION

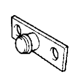
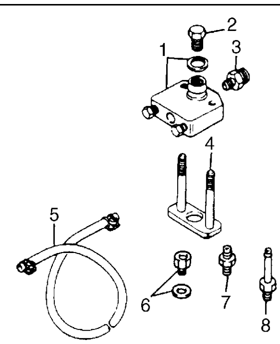
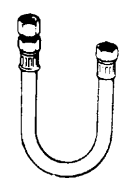
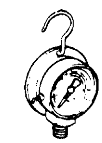
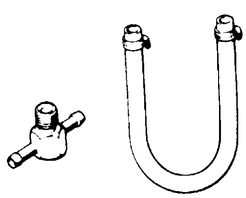
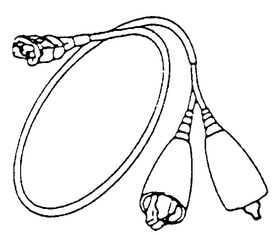
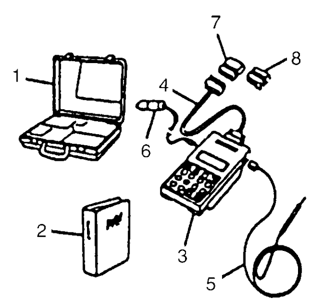
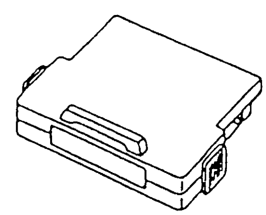


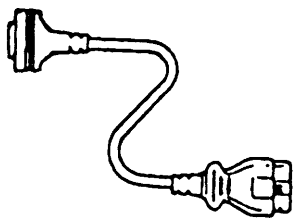
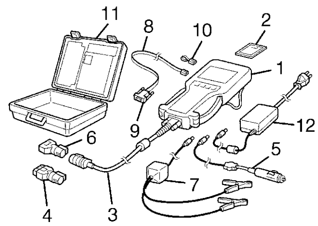
1) Disconnect PCV valve (1) from cylinder head cover and install plug to head cover hole.
2) Run engine at idle.
3) Place your finger over end of PCV valve (1) to check for vacuum.
   If there is no vacuum, check for clogged valve. Replace as necessary.



4) After checking vacuum, stop engine and remove PCV valve (1).
   Shake valve and listen for the rattle of check needle inside the valve. If valve does not the rattle, replace valve.
5) After checking, remove plug and install PCV valve (1).

Special Tool

 09912-57610 Checking tool plate	 09912-58421 Checking tool set (See NOTE “A”.)	 09912-58431 Pressure hose	 09912-58441 Pressure gauge
 09912-58490 3-way joint & hose	 09930-88530 Injector test lead	 09931-76011 Tech 1A kit (SUZUKI scan tool) (See NOTE “B”.)	 Mass storage cartridge for Tech 1A

 09931-76030 16/14 pin DLC adapter for Tech 1A	 Tech 2 kit (SUZUKI scan tool) (See NOTE “C”.)

NOTE:

- **“A”: This kit includes the following items.**
  1. Tool body & washer, 2. Body plug, 3. Body attachment-1, 4. Holder, 5. Return hose & clamp, 6. Body attachment-2 & washer, 7. Hose attachment-1, 8. Hose attachment-2
- **“B”: This kit includes the following items and substitutes for the Tech 2 kit.**
  1. Storage case, 2. Operator’s manual, 3. Tech 1A, 4. DLC cable (14/26 pin, 09931-76040), 5. Test lead/probe, 6. Power source cable, 7. DLC cable adaptor, 8. Self-test adaptor
- **“C” : This kit includes the following items and substitutes for the Tech 1A kit.**
  1. Tech 2, 2. PCMCIA card, 3. DLC cable, 4. SAE 16/19 adapter, 5. Cigarette cable, 6. DLC loopback adapter, 7. Battery power cable, 8. RS232 cable, 9. RS232 adapter, 10. RS232 loopback connector, 11. Storage case, 12. Power supply

Tightening Torque Specification

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
TP sensor screw	2.5	0.25	1.8
IAC valve screw	3.5	0.35	2.5
ECT sensor	15	1.5	11.5
Heated oxygen sensor-1 and -2	45	4.5	32.5
Camshaft position sensor bolt	10	1.0	7.5
Fuel pressure regulator bolts	10	1.0	7.5
Delivery pipe bolts	28	2.8	20.5

SECTION 6F1

IGNITION SYSTEM (ELECTRONIC IGNITION SYSTEM)

WARNING:

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

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

CONTENTS

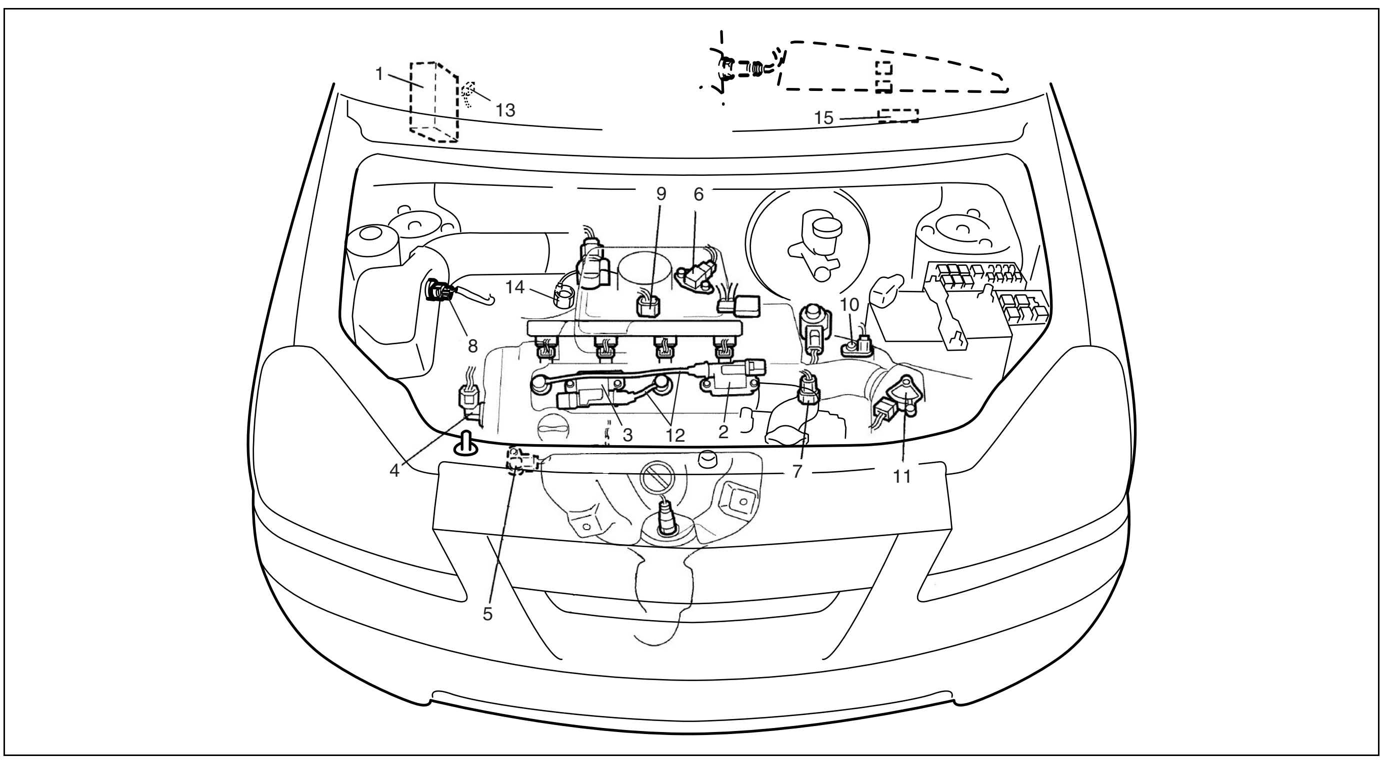
General Description

The ignition system is an electronic (distributorless) ignition system. It consists of the parts as described below and has an electronic ignition control system.

- ECM
  It detects the engine and vehicle conditions through the signals from the sensors, determines the most suitable ignition timing and time for electricity to flow to the primary coil and sends a signal to the ignitor (power unit) in the ignition coil assembly.
- Ignition coil assembly (including an igniter)
  The ignition coil assembly has a built-in ignitor which turns ON and OFF the current flow to the primary coil according to the signal from ECM. When the current flow to the primary coil is turned OFF, a high voltage is induced in the secondary coil.
- High tension cords and spark plugs.
- CMP sensor (Camshaft position sensor) and CKP sensor (Crankshaft position sensor)
  Using signals from these sensors, ECM identifies the specific cylinder whose piston is in the compression stroke, detects the crank angle and adjusts initial ignition timing automatically.
- TP sensor, ECT sensor, MAP sensor and other sensors/switches
  Refer to Section 6E1 for details.

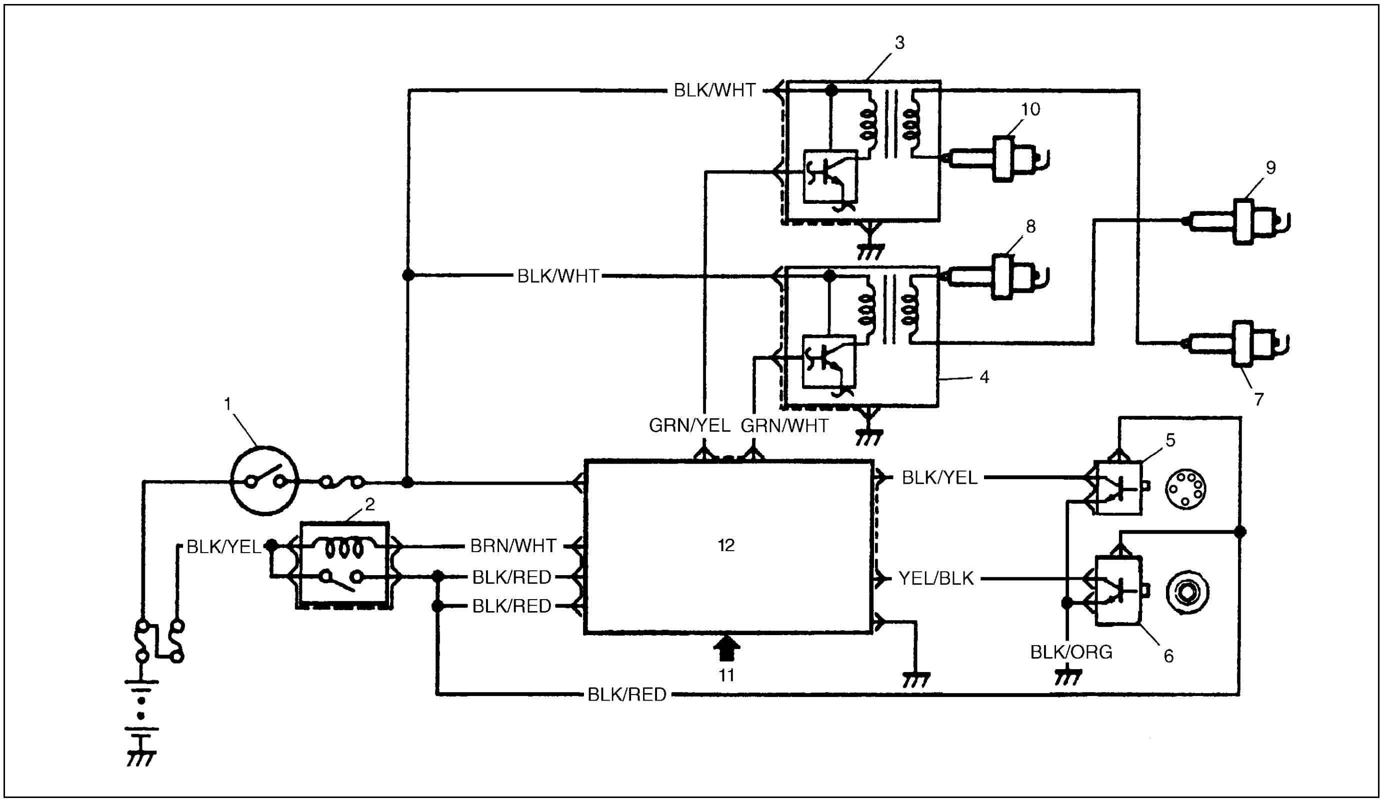
Although this ignition system does not have a distributor, it has two ignition coil assemblies (one is for No.1 and No.4 spark plugs and the other is for No.2 and No.3 spark plugs). When an ignition signal is sent from ECM to the ignitor in the ignition coil assembly for No.1 and No.4 spark plugs, a high voltage is induced in the secondary coil and that passes through the high-tension cords and causes No.1 and No.4 spark plugs to spark simultaneously. Likewise, when an ignition signal is sent to the ignitor in the other ignition coil assembly, No.2 and No.3 spark plugs spark simultaneously.

System Components



1. ECM	6. MAP sensor	11. Transmission range switch (A/T)
2. Ignition coil assembly for No.1 and No.4 spark plugs	7. ECT sensor	12. High-tension cords
3. Ignition coil assembly for No.2 and No.3 spark plugs	8. IAT sensor	13. Monitor connector
4. CMP sensor	9. TP sensor	14. Knock sensor (if equipped)
5. CKP sensor	10. VSS	15. Data link connector

System Wiring Diagram



1. Ignition switch	7. No.1 spark plug
2. Main relay	8. No.2 spark plug
3. Ignition coil assembly for No.1 and No.4 spark plugs	9. No.3 spark plug
4. Ignition coil assembly for No.2 and No.3 spark plugs	10. No.4 spark plug
5. CMP sensor	11. Sensed information (MAP sensor, ECT sensor, IAT sensor, TP sensor, Knock sensor (if equipped), VSS, Park/Neutral position signal, Electric load signal, Engine start signal, Test switch terminal (Vehicle without immobilizer indicator lamp))
6. CKP sensor	12. ECM

Diagnosis

Condition	Possible Cause	Correction
Engine cranks, but will not start or hard to start (No spark)	Blown fuse for ignition coil	Replace.
	Loose connection or disconnection of lead wire or high-tension cord(s)	Connect securely.
	Faulty high-tension cord(s)	Replace.
	Faulty spark plug(s)	Adjust, clean or replace.
	Faulty ignition coil	Replace ignition coil assembly.
	Faulty CKP sensor or CKP sensor plate	Clean, tighten or replace.
	Faulty ECM	Replace.
Poor fuel economy or engine performance	Incorrect ignition timing	Check related sensors and CKP sensor plate.
	Faulty spark plug(s) or high-tension cord(s)	Adjust, clean or replace.
	Faulty ignition coil assembly	Replace.
	Faulty CKP sensor or CKP sensor plate	Clean, tighten or replace.
	Faulty ECM	Replace.

IGNITION SYSTEM DIAGNOSTIC FLOW TABLE

Step	Action	Yes	No
1	Was “ENGINE DIAG. FLOW TABLE” in Section 6 performed?	Go to Step 2.	Go to “ENGINE DIAG. FLOW TABLE” in Section 6.
2	Ignition Spark Test 1) Check all spark plugs for condition and type referring to “Spark Plugs” section. 2) If OK, perform ignition spark test, referring to “Ignition Spark Test” in this section. Is spark emitted from all spark plugs?	Go to Step 11.	Go to Step 3.
3	Diagnostic Trouble Code (DTC) Check Is DTC stored in ECM?	Go to applicable DTC Diag. Flow Table in Section 6.	Go to Step 4.
4	Electrical Connection Check 1) Check ignition coil assemblies and high-tension cords for electrical connection. Are they connected securely?	Go to Step 5.	Connect securely.
5	High-tension Cords Check 1) Check high-tension cord for resistance referring to “High-Tension Cords” in this section. Is check result satisfactory?	Go to Step 6.	Replace high-tension cord(s).
6	Ignition Coil Assembly Power Supply and Ground Circuit Check 1) Check ignition coil assembly power supply and ground circuits for open and short. Are circuits in good condition?	Go to Step 7.	Repair or replace.
7	Ignition Coil Assembly Check 1) Check ignition coil for resistance referring to “Ignition Coil Assembly” in this section. Is check result satisfactory?	Go to Step 8.	Replace ignition coil assembly.
8	Crankshaft Position (CKP) Sensor Check 1) Check crankshaft position sensor referring to Step 3 and 4 of “DTC P0335 (No.23) Diag. Flow Table” in Section 6. Is check result satisfactory?	Go to Step 9.	Tighten CKP sensor bolt, replace CKP sensor or CKP sensor plate.
9	Ignition Trigger Signal Circuit Check 1) Check ignition trigger signal wire for open, short and poor connection. Is circuit in good condition?	Go to Step 10.	Repair or replace.
10	A Known-good Ignition Coil Assembly Substitution 1) Substitute a known-good ignition coil assembly and then repeat Step 2. Is check result of Step 2 satisfactory?	Go to Step 11.	Substitute a known-good ECM and then repeat Step 2.
11	Ignition Timing Check 1) Check initial ignition timing and ignition timing advance referring to “Ignition Timing” in this section. Is check result satisfactory?	System is in good condition.	Check CKP sensor, CKP sensor plate and input signals related to this system.

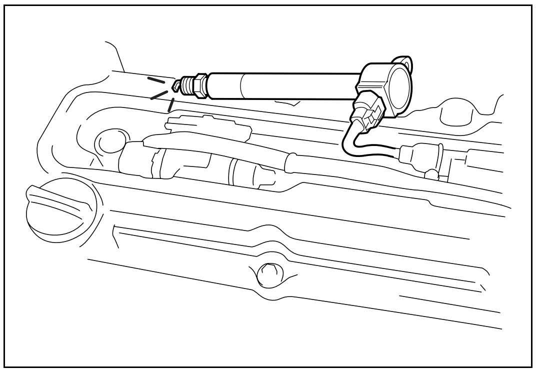
On-vehicle Service

Ignition Spark Test

1) Disconnect all injector couplers from injectors.

WARNING:
Without disconnection of injector couplers, combustible gas may come out from spark plug holes during this test and may get ignited in engine room.

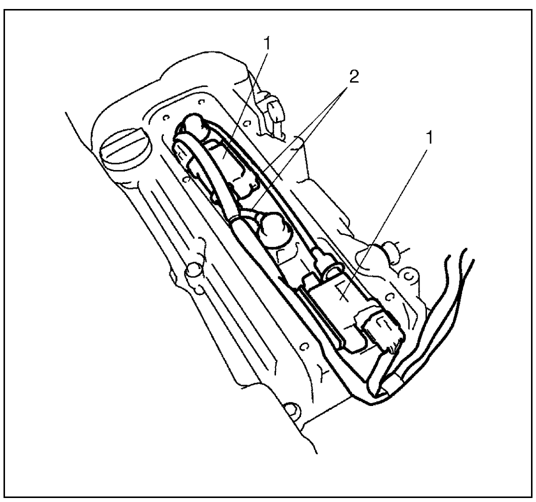
2) Remove spark plug and check it for condition and type referring to "Spark Plugs" in this section.



3) If OK, connect ignition coil coupler to ignition coil assembly and connect spark plug to ignition coil assembly or high-tension cord. Ground spark plug.
4) Crank engine and check if each spark plug sparks.
5) If no spark is emitted, inspect the related parts as described under "Diagnosis" earlier in this section.

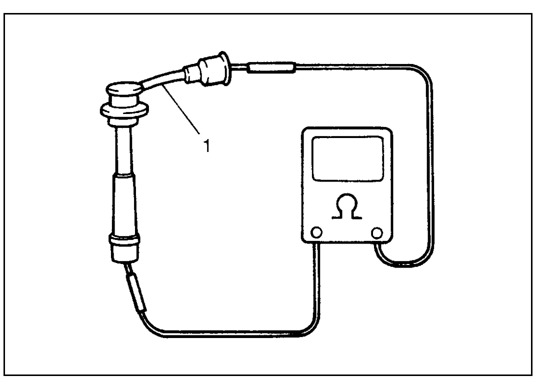
High-tension Cords

1) Remove cylinder head upper cover.



2) Disconnect high-tension cords (2) from ignition coil assemblies (1) while gripping each cap.
3) Pull out high-tension cords from spark plugs while gripping each cap.

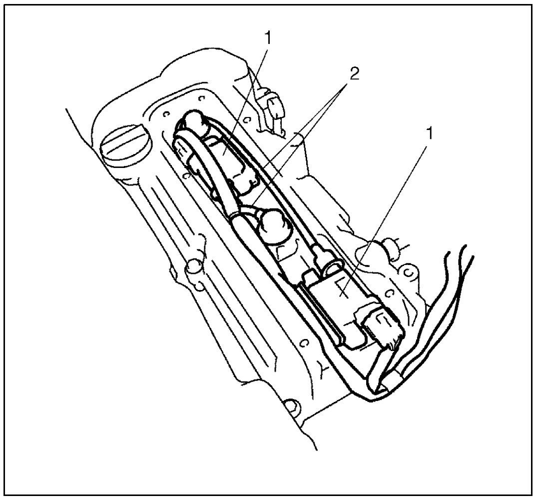
CAUTION:
- **Removal of high-tension cords together with clamps will be recommended so as not to damage their inside wire (resistive conductor).**
- **For the same reason, pull out each connection by gripping cap portion.**



4) Measure resistance of high-tension cord (1) by using ohmmeter.

High-tension cord resistance
: 4 -10 kΩ/m (1.2 - 3.0 kΩ/ft)

5) If resistance exceeds specification, replace high-tension cord(s).

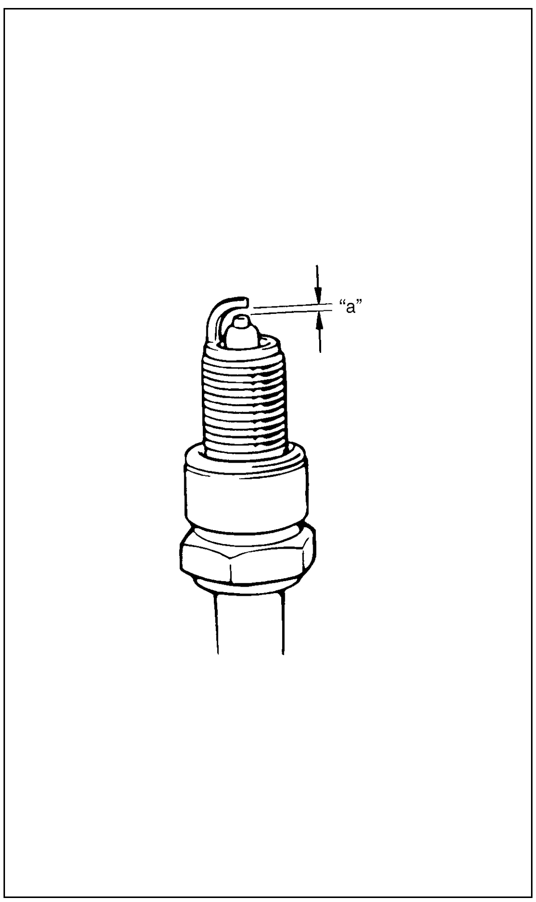


6) Install high-tension cords (2) to spark plugs and ignition coil assemblies (1) while gripping each cap.

CAUTION:
- **Never attempt to use metal conductor high-tension cords as replacing parts.**
- **Insert each cap portion fully when installing high-tension cords.**

Spark Plugs

1) Remove air intake pipe and cylinder head upper cover.
2) Pull out high-tension cords by gripping their caps and then remove ignition coil assemblies referring to "IGNITION COIL ASSEMBLY" in this section.
3) Remove spark plugs.
4) Inspect them for:
- Electrode wear
- Carbon deposits
- Insulator damage



5) If any abnormality is found, adjust air gap, clean with spark plug cleaner or replace them with specified new plugs.
For iridium/platinum spark plugs, replace them with new plugs.

Spark plug air gap
"a" : 1.0 - 1.1 mm (0.040 - 0.043 in.)

Spark plug type
NGK : BKR6E-11, IFR6E11
DENSO : K20PR-U11

NOTE:
NGK IFR6E11 is highly recommended for better engine starting performance under -25°C(-13°F).

CAUTION:
- **When servicing the iridium/platinum spark plugs (slender center electrode type plugs), do not touch the center electrode to avoid damage to it. The electrode is not strong enough against mechanical force as it is slender and its material is not mechanically tough.**
- **Do not clean or adjust gap for the iridium/platinum spark plugs.**

6) Install spark plugs and torque them to specification.

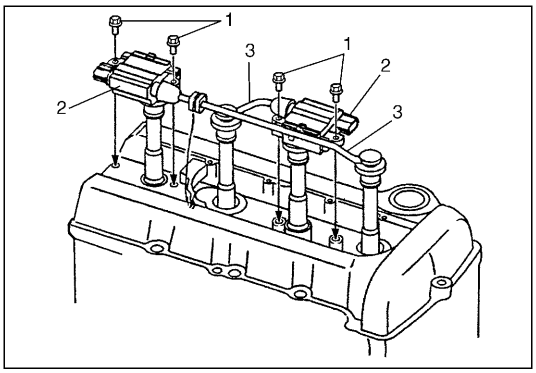
Tightening torque
Spark plug : 25 N·m (2.5 kg-m, 18.0 lb-ft)

7) Install ignition coil assemblies referring to “IGNITION COIL ASSEMBLY” in this section.
8) Install high-tension cords securely by gripping their caps.
9) Install cylinder head upper cover.

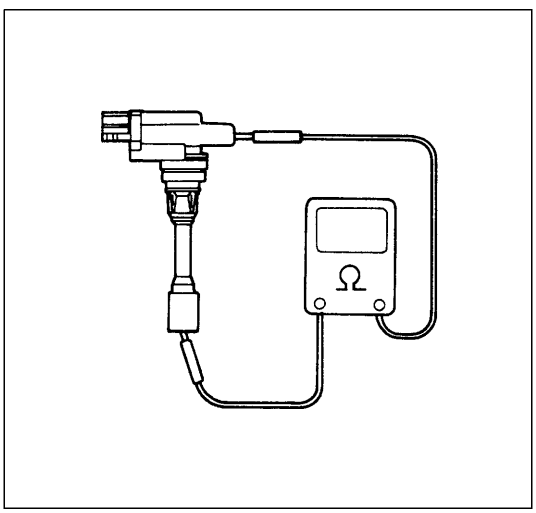
Ignition Coil Assembly (Including Igniter)

Inspection

1) Disconnect negative cable at battery.
2) Remove cylinder head upper cover.
3) Disconnect ignition coil coupler.



4) Disconnect high-tension cord (3) from ignition coil assembly (2).
5) Remove ignition coil bolts (1) and then pull out ignition coil assembly.



6) Measure secondary coil for resistance.
   If resistance is out of specification, replace ignition coil assembly.

Secondary coil resistance
: 7.6 - 10.2 kΩ at 20°C, 68°F

7) Install ignition coil assembly.
8) Tighten ignition coil bolts, and then connect ignition coil coupler.
9) Install high-tension cord to ignition coil assembly while gripping its cap.
10) Install cylinder head upper cover.

Crankshaft Position Sensor (CKP Sensor)

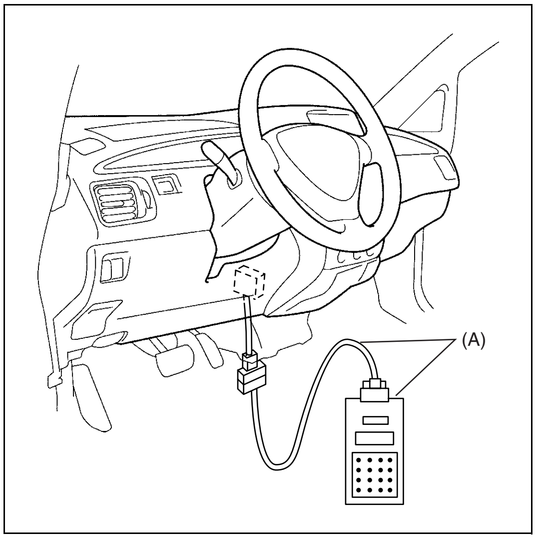
Refer to Section 6E1 for removal, inspection and installation.

Ignition Timing

NOTE:

- **Ignition timing is not adjustable. If ignition timing is out of specification, check system related parts.**
- **Before starting engine, place transmission gear shift lever in "Neutral" (shift selector lever to "P" range for A/T model), and set parking brake.**

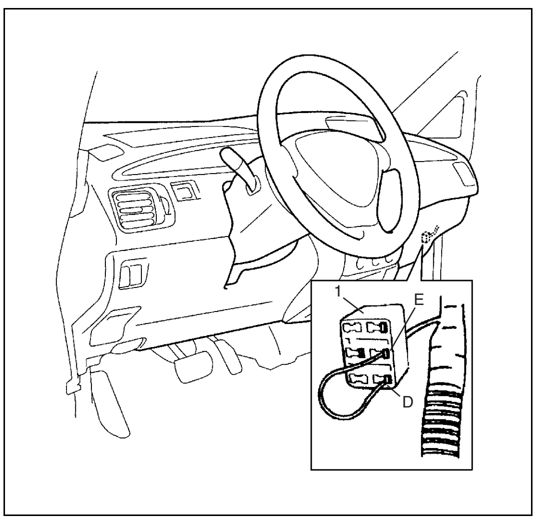
INSPECTION



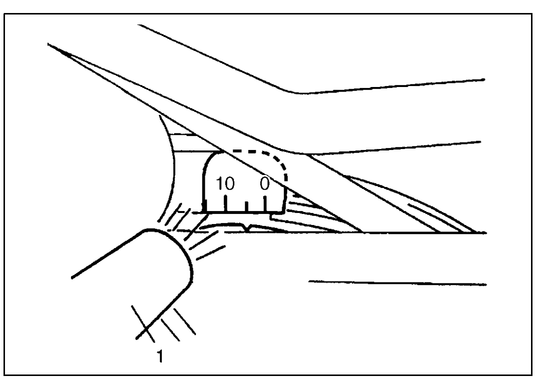
1) When using SUZUKI scan tool, connect SUZUKI scan tool to DLC with ignition switch OFF.

Special tool
(A) : SUZUKI scan tool

2) Start engine and warm it up to normal operating temperature.
3) Make sure that all of electrical loads except ignition are switched off.
4) Check to be sure that idle speed is within specification. (Refer to Section 6E1.)



5) Fix ignition timing to initial one as follows.
   Select "MISC" mode on SUZUKI scan tool and fix ignition timing to initial one.
   If scan tool is not available (vehicle without immobilizer indicator lamp), connect D and E terminals of monitor connector (1) by using service wire so that ignition timing is fixed to initial one.



6) Using timing light (1), check that ignition timing is within specification.

Initial ignition timing (test switch terminal grounded or fixed with SUZUKI scan tool)
: 5 ± 3° BTDC at idle speed

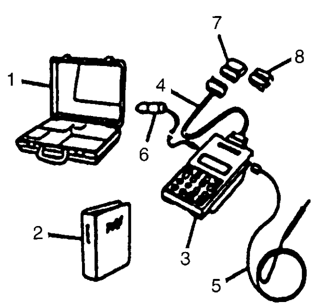
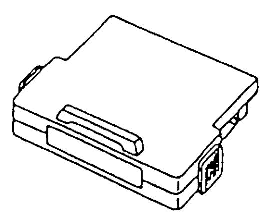
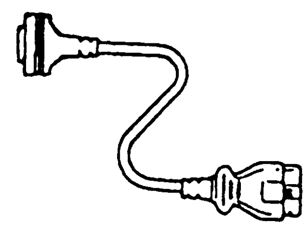
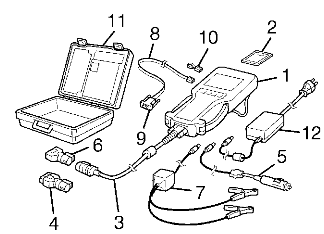
Ignition order
: 1-3-4-2

7) If ignition timing is out of specification, check the followings:
- CKP sensor
- CKP sensor plate
- TP sensor
- Test switch signal circuit
- VSS
- Timing chain cover installation

8) After checking Initial Ignition Timing, release ignition timing fixation by using SUZUKI scan tool or disconnect service wire from monitor connector.

9) With engine idling (test switch terminal ungrounded, throttle opening at closed position and car stopped), check that ignition timing is about 3°–17° BTDC. (Constant variation within a few degrees from 3°–17° indicates no abnormality but proves operation of electronic timing control system.) Also, check that increasing engine speed advances ignition timing. If above check results are not satisfactory, check CKP sensor, test switch terminal circuit and ECM.

Special Tool

			
09931-76011 Tech 1A kit (SUZUKI scan tool) (See NOTE “A”.)	Mass storage cartridge for Tech 1A	09931-76030 16/14 pin DLC adapter for Tech 1A	Tech 2 kit (SUZUKI scan tool) (See NOTE “B”.)

NOTE:
- **“A” : This kit includes the following items and substitutes for the Tech 2 kit.**
  1. Storage case, 2. Operator’s manual, 3. Tech 1A, 4. DLC cable (14/26 pin, 09931-76040), 5. Test lead/probe, 6. Power source cable, 7. DLC cable adaptor, 8. Self-test adaptor
- **“B” : This kit includes the following items and substitutes for the Tech 1A kit.**
  1. Tech 2, 2. PCMCIA card, 3. DLC cable, 4. SAE 16/19 adapter, 5. Cigarette cable, 6. DLC loopback adapter, 7. Battery power cable, 8. RS232 cable, 9. RS232 adapter, 10. RS232 loopback connector, 11. Storage case, 12. Power supply

SECTION 6G

CRANKING SYSTEM

WARNING:

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

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

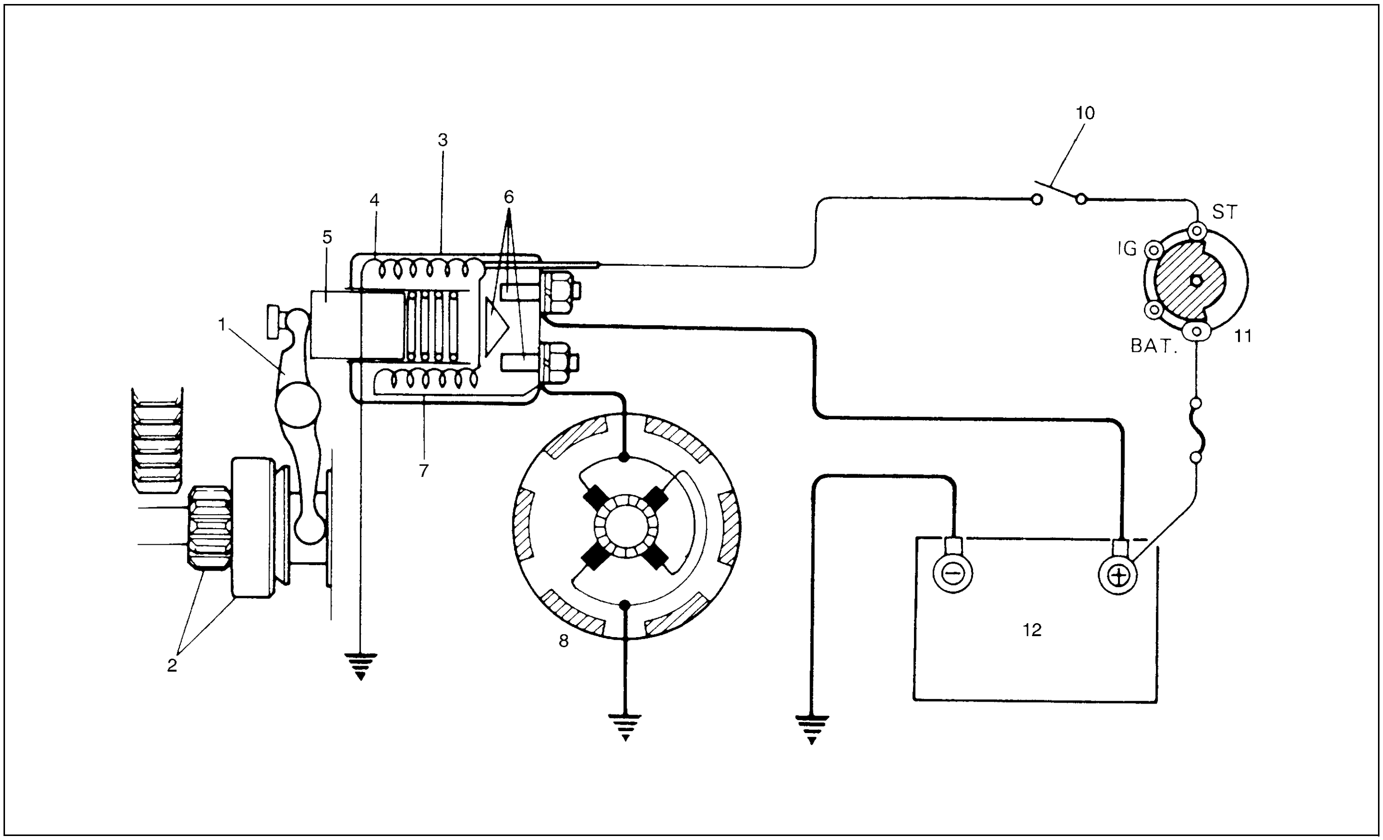
NOTE:

Starting motor varies depending on specifications, etc. Therefore, be sure to check model and specification of the vehicle being serviced before replacing parts.

CONTENTS

General Description

Cranking Circuit



1. Pinion drive lever	5. Plunger	9. Blank
2. Pinion & Over-running clutch	6. Magnetic switch contacts	10. A/T: Transmission range switch (shift lever switch)
3. Magnetic switch	7. Pull-in coil	11. Ignition & Starter switch
4. Hold-in coil	8. Starting motor	12. Battery

Diagnosis

Diagnosis Table

Possible symptoms due to starting system trouble would be as follows:

- Starting motor does not run (or runs slowly)
- Starting motor runs but fails to crank engine
- Abnormal noise is heard

Proper diagnosis must be made to determine exactly where the cause of each trouble lies.....in battery, wiring harness, (including starting motor switch), starting motor or engine.
Do not remove motor just because starting motor does not run. Check following items and narrow down scope of possible causes.

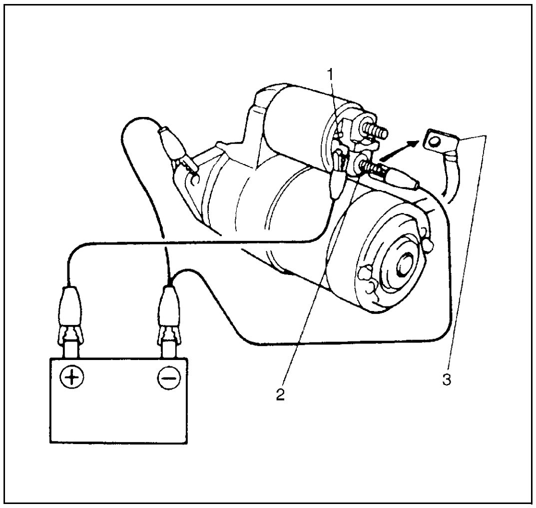
1) Condition of trouble
2) Tightness of battery terminals (including ground cable connection on engine side) and starting motor terminals
3) Discharge of battery
4) Mounting of starting motor

Condition	Possible Cause	Correction
Motor not running (No operating sound of magnetic switch)	Shift lever switch is not in P or N, or not adjusted (A/T)	Shift in P or N, or adjust switch.
	Battery run down	Recharge battery.
	Battery voltage too low due to battery deterioration	Replace battery.
	Poor contact in battery terminal connection	Retighten or replace.
	Loose grounding cable connection	Retighten.
	Fuse set loose or blown off	Tighten or replace.
	Poor contacting action of ignition switch and magnetic switch	Replace.
	Lead wire coupler loose in place	Retighten.
	Open-circuit between ignition switch and magnetic switch	Repair.
	Open-circuit in pull-in coil	Replace magnetic switch.
	Brushes are seating poorly or worn down	Repair or replace.
	Poor sliding of plunger and/or pinion	Repair.
Motor not running (Operating sound of magnetic switch heard)	Battery run down	Recharge battery.
	Battery voltage too low due to battery deterioration	Replace battery.
	Loose battery cable connections	Retighten.
	Burnt main contact point, or poor contacting action of magnetic switch	Replace magnetic switch.
	Brushes are seating poorly or worn down	Repair or replace.
	Weakened brush spring	Replace.
	Burnt commutator	Replace armature.
	Layer short-circuit of armature	Replace.
	Crankshaft rotation obstructed	Repair.
Starting motor running but too slow (small torque) (If battery and wiring are satisfactory, inspect starting motor)	Insufficient contact of magnetic switch main contacts	Replace magnetic switch.
	Layer short-circuit of armature	Replace.
	Disconnected, burnt or worn commutator	Repair commutator or replace armature.
	Worn brushes	Replace brush.
	Weakened brush springs	Replace spring.
	Burnt or abnormally worn end bush	Replace bush.
Starting motor running, but not cranking engine	Worn pinion tip	Replace over-running clutch.
	Poor sliding of over-running clutch	Repair.
	Over-running clutch slipping	Replace over-running clutch.
	Worn teeth of ring gear	Replace flywheel.
Noise	Abnormally worn bush	Replace bush.
	Worn pinion or worn teeth of ring gear	Replace pinion or flywheel.
	Poor sliding of pinion (failure in return movement)	Repair or replace.
	Worn internal or planetary gear teeth	Replace.
	Lack of oil in each part	Lubricate.
Starting motor does not stop running	Fused contact points of magnetic switch	Replace magnetic switch.
	Short-circuit between turns of magnetic switch coil (layer short-circuit)	Replace magnetic switch.
	Failure of returning action in ignition switch	Replace.

Performance Test

> **CAUTION:**
> **Each test must be performed within 3 - 5 seconds to avoid coil from burning.**

Pull-in test

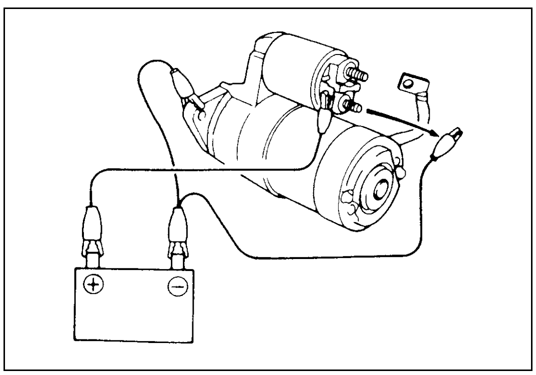


Connect battery to magnetic switch as shown.
Check that plunger and pinion move outward.
If plunger and pinion don't move, replace magnetic switch.

NOTE:
Before testing, disconnect lead wire from terminal M.

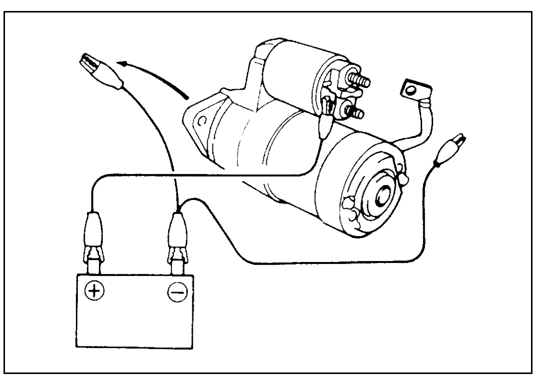
1.	Terminal "S"
2.	Terminal "M"
3.	Lead wire (switch to motor)

Hold-in test

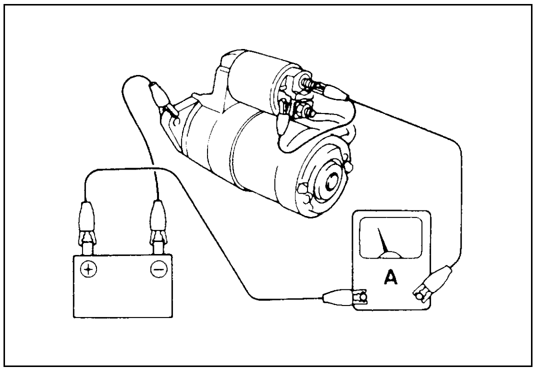


While connected as above with plunger out, disconnect negative lead from terminal "M".
Check that plunger and pinion remain out.
If plunger and pinion return inward, replace magnetic switch.

Plunger and pinion return test



Disconnect negative lead from starting motor body.
Check that plunger and pinion return inward.
If plunger and pinion don't return, replace magnetic switch.



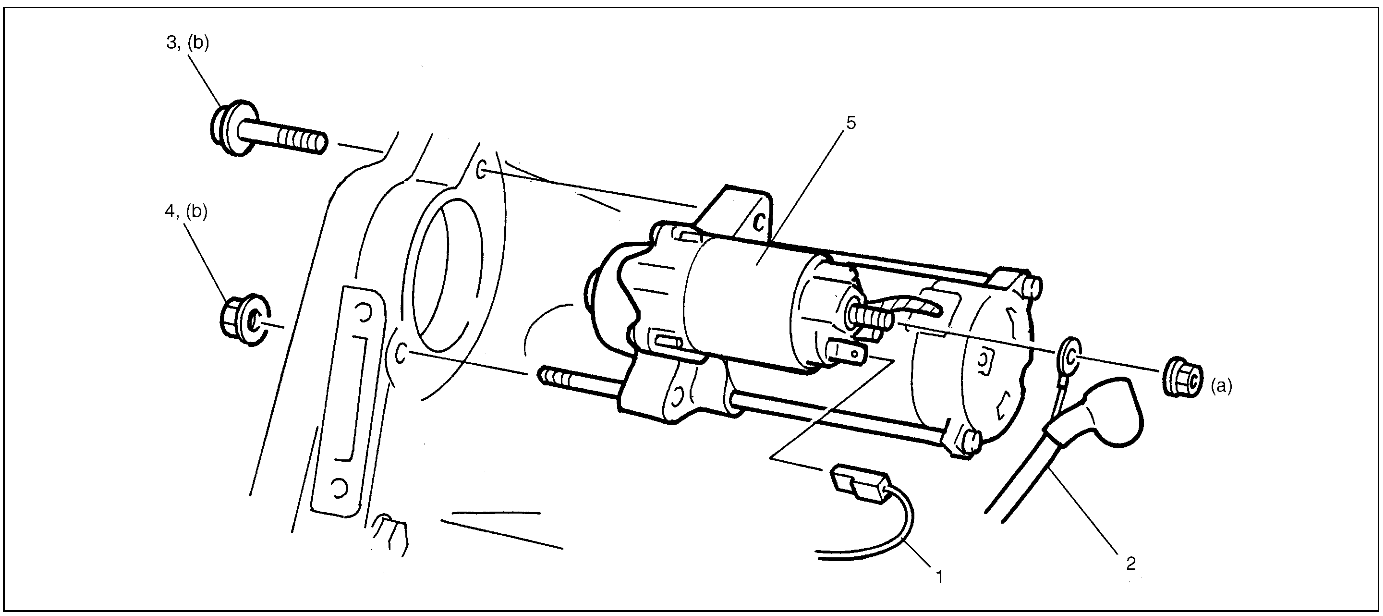
No-load performance test

Connect battery and ammeter to starter as shown.
Check that starter rotates smoothly and steadily with pinion moving out. Check that ammeter indicates specified current.

Specified current (No-load performance test)
: 90 A MAX. at 11 V

ON-Vehicle Service

Starting Motor



Dismounting

1) Disconnect negative (–) battery lead at battery.
2) Disconnect magnetic switch lead wire (1) and battery cable (2) from starting motor terminals.
3) Remove starting motor mount bolt (3) and nut (4).
4) Remove starting motor (5).

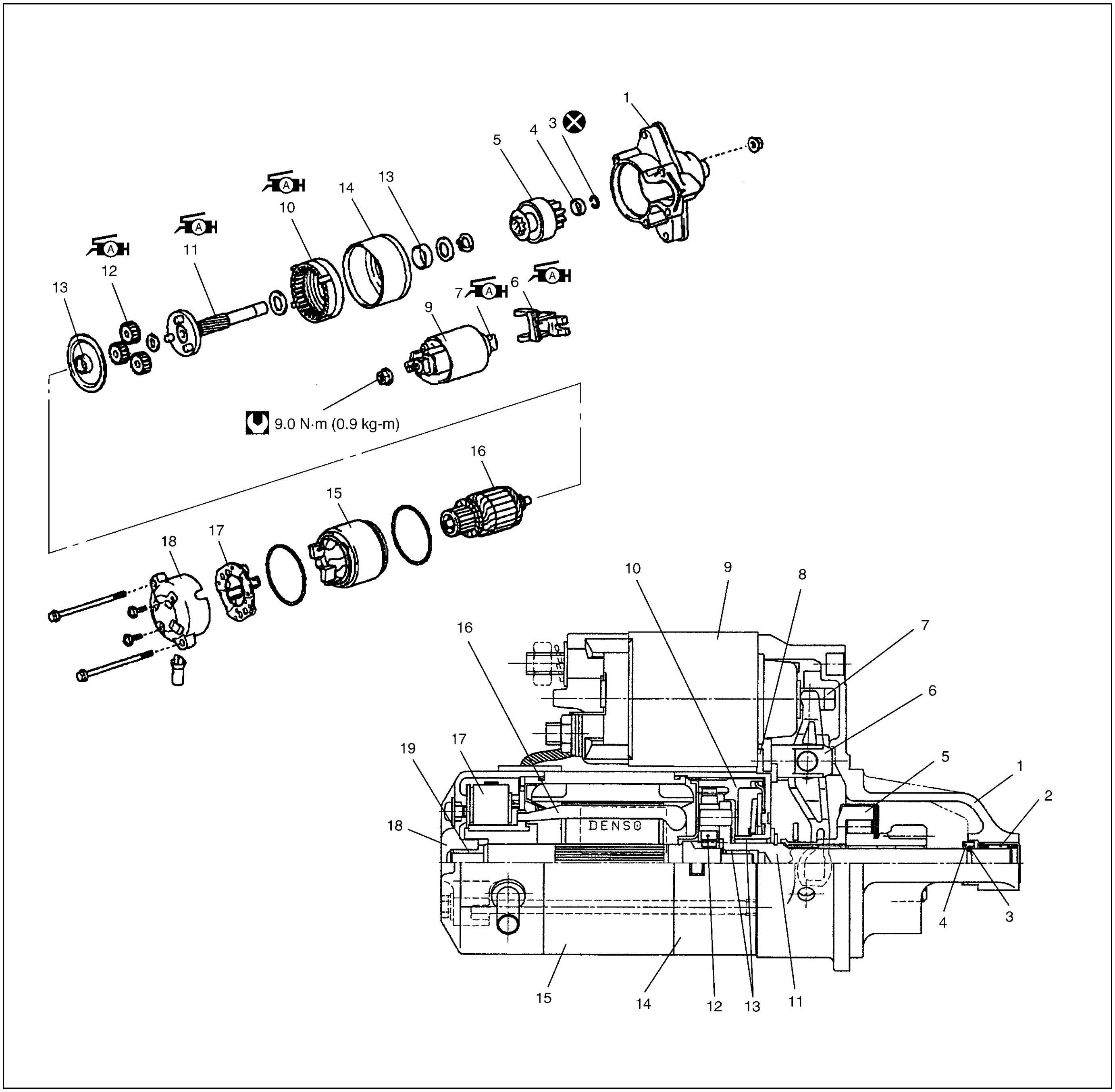
Remounting

Reverse the dismounting procedure.

Tightening torque
Starting motor battery cable nut (a) : 10 N·m (1.0 kg-m, 7.5 lb-ft)
Starting motor mount bolt and nut (b) : 23 N·m (2.3kg-m, 16.5 lb-ft)

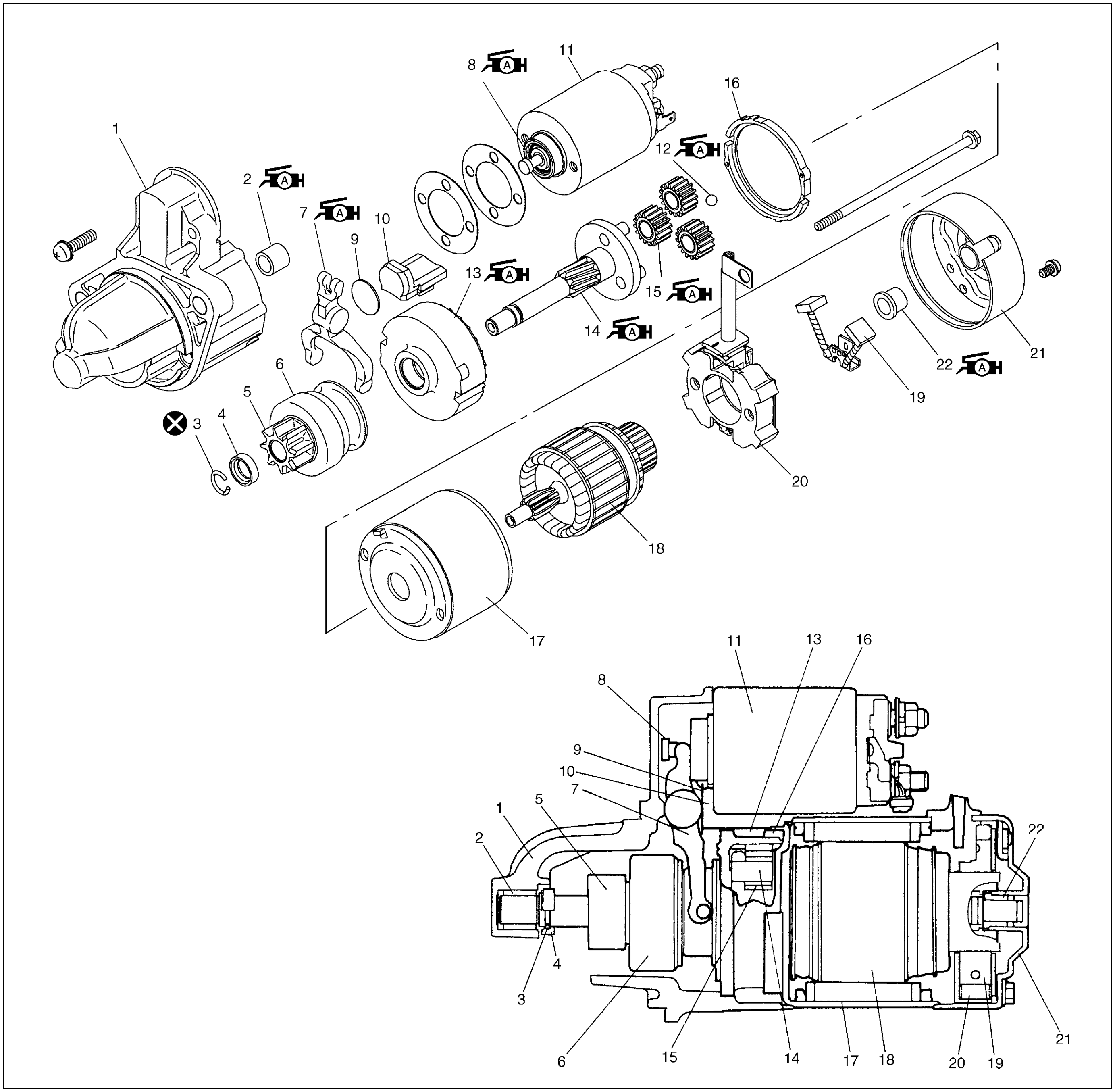
Disassembly and reassembly

1.0 kW TYPE

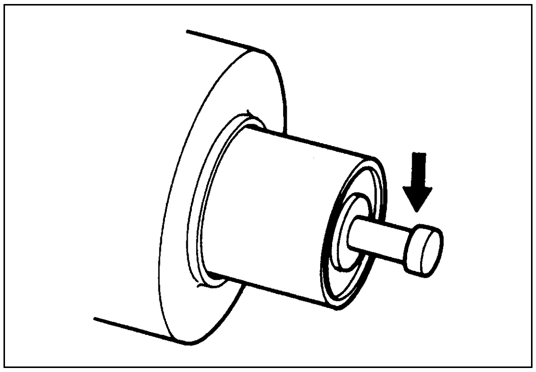


1. Front housing	7. Plunger	13. Oilless bearing	19. Rear bush
2. Needle bearing	8. Seal rubber	14. Center bearing with shock absorber	Tightening torque
3. Snap ring	9. Magnetic switch	15. Yoke	Do not reuse.
4. Pinion stop ring	10. Internal gear	16. Armature	
5. Over-running clutch	11. Planetary carrier shaft	17. Brush holder	
6. Lever	12. Planetary gear	18. Rear bracket	

1.2 kW AND 1.4 kW TYPES



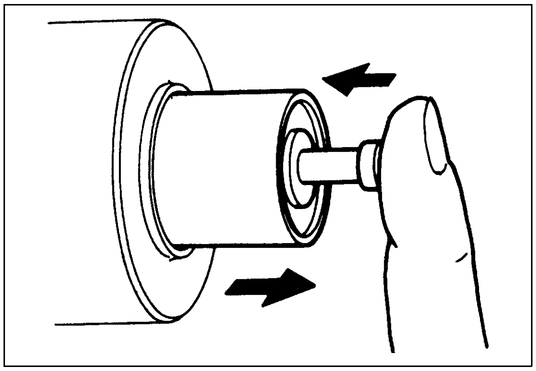
1. Front housing	8. Plunger	15. Planetary gear	22. Rear bush
2. Bush	9. Plate	16. Packing	Tightening torque
3. Snap ring	10. Seal rubber	17. Yoke	Do not reuse.
4. Pinion stop ring	11. Magnetic switch	18. Armature	
5. Pinion gear	12. Ball	19. Brush	
6. Over-running clutch	13. Internal gear	20. Brush holder	
7. Lever	14. Planetary carrier shaft	21. Rear bracket	



Inspection

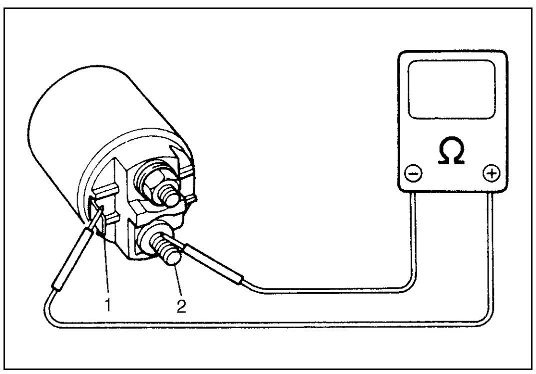
PLUNGER

Inspect plunger for wear. Replace if necessary.



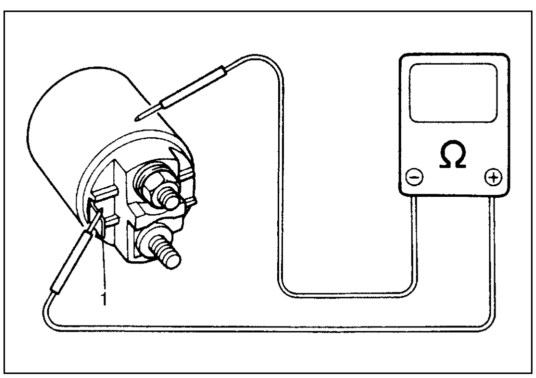
MAGNETIC SWITCH

Push in plunger and release it. The plunger should return quickly to its original position. Replace if necessary.



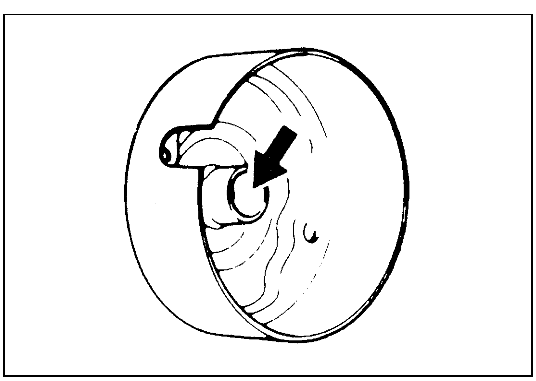
Pull-in coil open circuit test

Check for continuity across magnetic switch ‘S’ terminal (1) and ‘M’ terminal (2). If no continuity, coil is open and should be replaced.



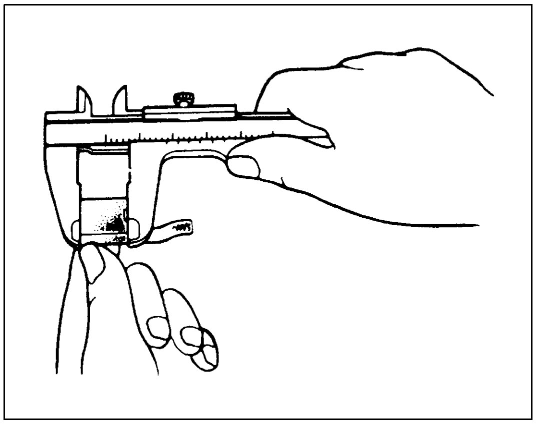
Hold-in coil open circuit test

Check for continuity across magnetic switch ‘S’ terminal (1) and coil case. If no continuity, coil is open and should be replaced.



REAR BRACKET BUSH

Inspect bush for wear or damage. Replace if necessary.



BRUSH

- Check brushes for wear.
  Measure length of brushes and if below limit, replace brush.

Brush length

	1.0 kW	1.2 kW and 1.4 kW
Standard	14.0 mm (0.55 in.)	12.3 mm (0.48 in.)
Limit	9.0 mm (0.35 in.)	7.0 mm (0.28 in.)

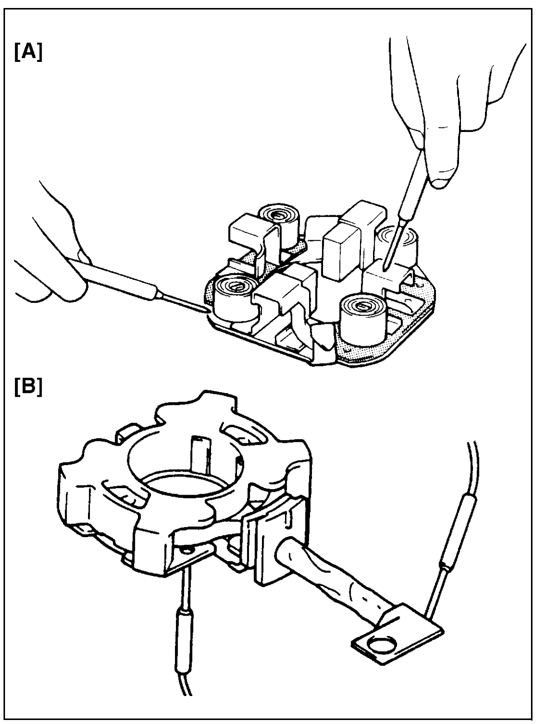
- Install brushes to each brush holder and check for smooth movement.

SPRING

Inspect brush springs for wear, damage or other abnormal conditions. Replace if necessary.

Brush spring tension

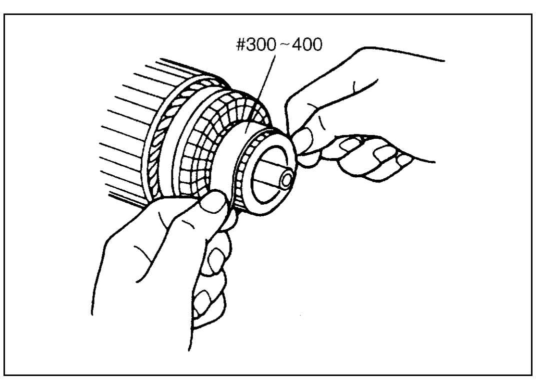
	1.0 kW	1.2 kW and 1.4 kW
Standard	1.6 kg (3.53 lb)	2.2 kg (4.85 lb)
Limit	0.9 kg (1.98 lb)	0.6 kg (1.32 lb)



BRUSH HOLDER

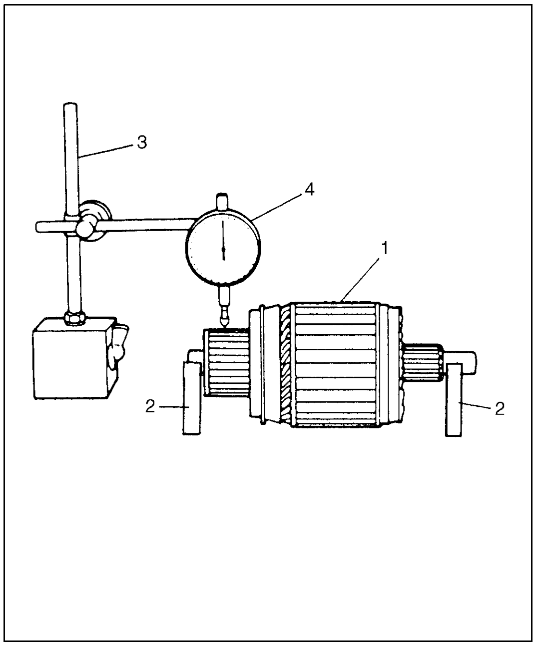
- Check movement of brush in brush holder. If brush movement within brush holder is sluggish, check brush holder for distortion and sliding faces for contamination.
  Clean or correct as necessary.
- Check for continuity across insulated brush holder (positive side) and grounded brush holder (negative side).
  If continuity exists, brush holder is grounded due to defective insulation and should be replaced.

[A]:	1.0 kW
[B]:	1.2 kW and 1.4 kW



ARMATURE

- Inspect commutator for dirt or burn. Correct with sandpaper or lathe, if necessary.



- Check commutator for uneven wear with armature supported on V-blocks. If deflection of dial gauge pointer exceeds limit, repair or replace.

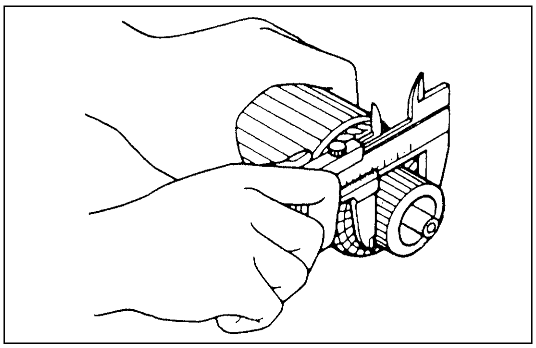
NOTE:

Below specification presupposes that armature is free from bend. Bent armature must be replaced.

Commutator out of round

	1.0 kW	1.2 kW and 1.4 kW
Standard	0.02 mm (0.0008 in.) or less	0.05 mm (0.002 in.) or less
Limit	0.05 mm (0.002 in.)	0.4 mm (0.015 in.)

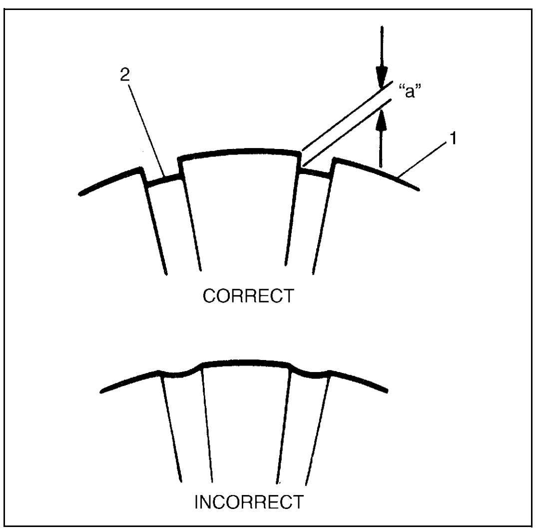
1.	Armature
2.	V-block
3.	Magnetic stand
4.	Dial gauge



- Inspect commutator for wear. If diameter is below limit, replace armature.

Commutator outside diameter

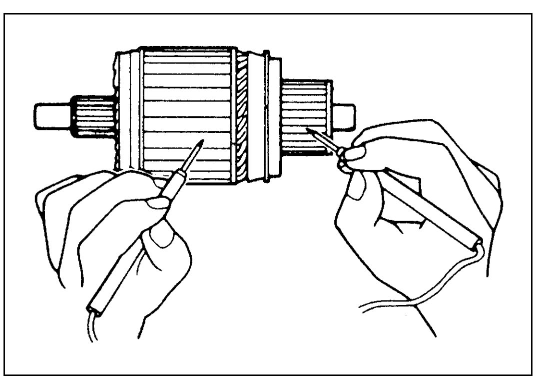
	1.0 kW	1.2 kW and 1.4 kW
Standard	28.0 mm (1.10 in.)	29.4 mm (1.16 in.)
Limit	27.0 mm (1.06in.)	28.8 mm (1.13 in.)



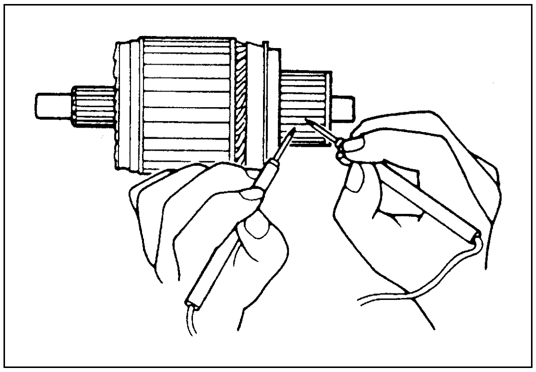
- Inspect commutator for insulator depth. Correct or replace if below limit.

Commutator insulator depth "a"
Standard: 0.4 – 0.6 mm (0.015 – 0.024 in.)
Limit: 0.2 mm (0.008 in.)

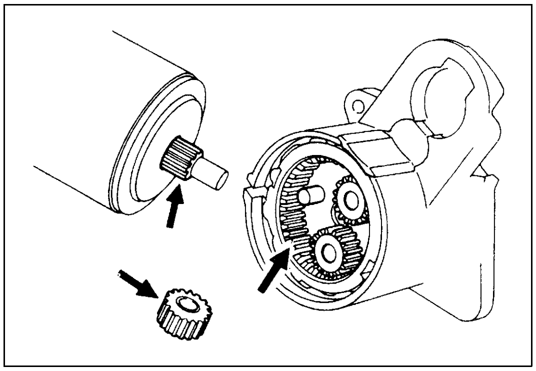
1.	Commutator segment
2.	Insulator



- Check commutator and armature core. If there is continuity, armature is grounded and must be replaced.

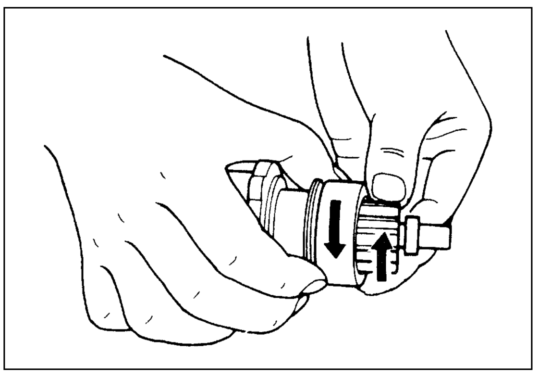


- Check for continuity between segments. If there is no continuity at any test point, there is an open circuit and armature must be replaced.



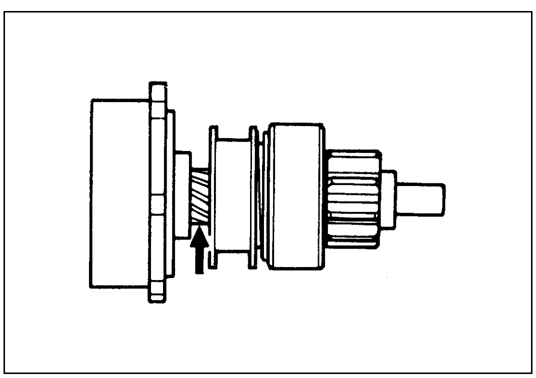
GEARS

Inspect internal gear and planetary gears for wear, damage or other abnormal conditions. Replace if necessary.

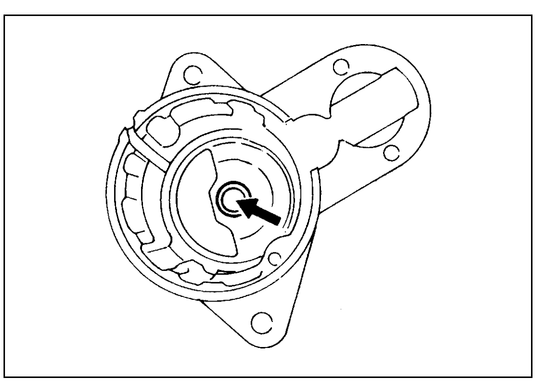


PINION AND OVER-RUNNING CLUTCH

- Inspect pinion for wear, damage or other abnormal conditions.
  Check that clutch locks up when turned in direction of drive and rotates smoothly in reverse direction. Replace if necessary.



- Inspect spline teeth for wear or damage. Replace if necessary.
  Inspect pinion for smooth movement.



FRONT HOUSING NEEDLE BEARING OR BUSH

Inspect needle bearing (for 1.0 kW type) or bush (for 1.2 and 1.4 kW types) for wear or damage. Replace if necessary.

Specification

1.0 kW type

Voltage			12 volts	
Output			1.0 kW	
Rating			30 seconds	
Direction of rotation			Clockwise as viewed from pinion side	
Brush length			Standard: 14.0 mm (0.55 in.)	Limit: 9.0 mm (0.35 in.)
Number of pinion teeth			8	
Performance		Condition	Guarantee	
Around at 20°C (68°F)	No load characteristic	11.5 V	90 A maximum 3,000 rpm minimum	
	Load characteristic	8.7 V 230 A	6.9 N·m (0.69 kg-m, 5.0 lb-ft) minimum 1130 rpm minimum	
	Locked characteristic	2.5 V	325 A maximum 8.2 N·m (0.82 kg-m, 6.0 lb-ft) minimum	
	Magnetic switch operating voltage		8 volts maximum	

1.2 kW type

Voltage			12 volts	
Output			1.2 kW	
Rating			30 seconds	
Direction of rotation			Clockwise as viewed from pinion side	
Brush length			Standard: 12.3 mm (0.48 in.)	Limit: 7.0 mm (0.27 in.)
Number of pinion teeth			8	
Performance		Condition	Guarantee	
Around at 20°C (68°F)	No load characteristic	11.0 V	90 A maximum 2,500 rpm minimum	
	Load characteristic	7.5 V 300 A	10.5 N·m (1.05 kg-m, 7.59 lb-ft) minimum 880 rpm minimum	
	Locked characteristic	4.0 V	760 A maximum 19.5 N·m (1.95 kg-m, 14.1 lb-ft) minimum	
	Magnetic switch operating voltage		8 volts maximum	

1.4 kW type

Voltage			12 volts	
Output			1.4 kW	
Rating			30 seconds	
Direction of rotation			Clockwise as viewed from pinion side	
Brush length			Standard: 12.3 mm (0.48 in.)	Limit: 7.0 mm (0.27 in.)
Number of pinion teeth			8	
Performance		Condition	Guarantee	
Around at 20°C (68°F)	No load characteristic	11.0 V	90 A maximum 2,400 rpm minimum	
	Load characteristic	7.5 V 300 A	10.8 N·m (1.08 kg-m, 8.0 lb-ft) minimum 870 rpm minimum	
	Locked characteristic	3.0 V	840 A maximum 19.8 N·m (1.98 kg-m, 14.5 lb-ft) minimum	
	Magnetic switch operating voltage		8 volts maximum	

Required Service Material

Material	Recommended SUZUKI product (Part Number)	Use
Lithium grease	SUZUKI SUPER GREASE A (99000-25010)	• Front and rear bush (for 1.2 kW and 1.4 kW types only) • Plunger • Pinion drive lever • Internal gear • Planetary carrier shaft • Planetary gear • Ball

SECTION 6H

CHARGING SYSTEM

WARNING:

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

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

CONTENTS

General Description

Battery

The battery has three major functions in the electrical system.

- It is a source of electrical energy for cranking the engine.
- It acts as a voltage stabilizer for the electrical system.
- It can, for a limited time, provide energy when the electrical load exceeds the output of the generator.

Carrier and hold-down

The battery carrier should be in good condition so that it will support the battery securely and keep it level.
Before installing the battery, the battery carrier and hold-down clamp should be clean and free from corrosion and make certain there are no parts in carrier.
To prevent the battery from shaking in its carrier, the hold-down bolts should be tight enough but not over-tightened.

Electrolyte freezing

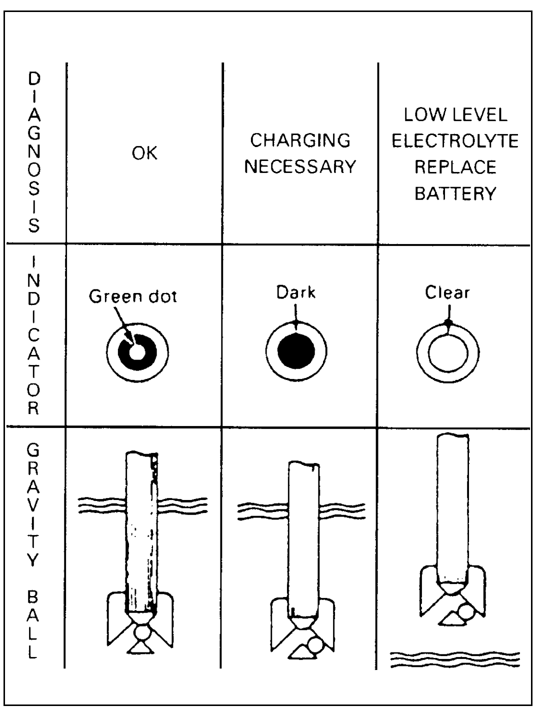
The freezing point of electrolyte depends on its specific gravity. Since freezing may ruin a battery, it should be protected against freezing by keeping it in a fully charged condition. If a battery is frozen accidentally, it should not be charged until it is warmed.

Sulfation

If the battery is allowed to stand for a long period in discharged condition, the lead sulfate becomes converted into a hard, crystalline substance, which will not easily turn back to the active material again during the subsequent recharging. "Sulfation" means the result as well as the process of that reaction. Such a battery can be revived by very slow charging and may be restored to usable condition but its capacity is lower than before.

Built-in indicator (if equipped)

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



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

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

Care of battery

WARNING:
- **Never expose battery to open flame or electric spark because of battery generate gas which is flammable and explosive.**
- **Do not allow battery fluid to contact eyes, skin, fabrics, or painted surfaces as fluid is a corrosive acid. Flush any contacted area with water immediately and thoroughly.**
- **Batteries should always be kept out of reach of children.**

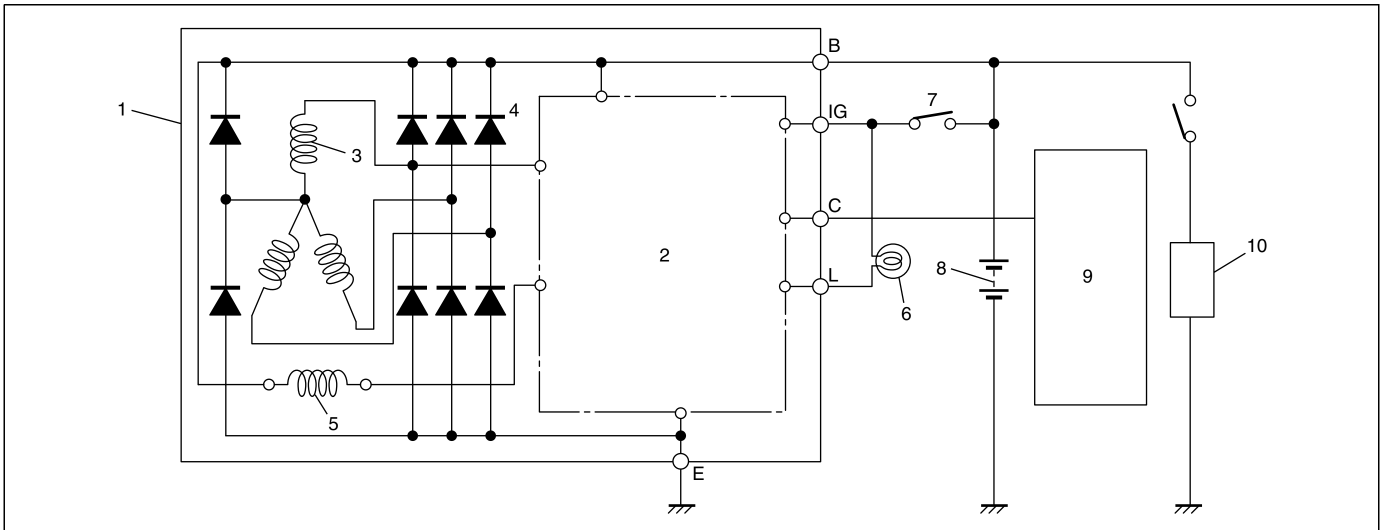
1) The battery is a very reliable component, but needs periodical attentions.
   - Keep the battery carrier clean
   - Prevent rust formation on the terminal posts
   - Keep the electrolyte up to the upper level uniformly in all cells.
   - When keeping battery on vehicle over a long period of time, follow instructions given below.
     - Weekly, start the engine and run it until it reaches normal operating temperature with engine speed of 2000 to 3000 rpm. Make sure all electric switches are off before storing the vehicle.
     - Recharge the battery twice a month to prevent it from discharging excessively. This is especially important when ambient temperature is low.
       The battery discharges even when it is not used, while vehicles are being stored. Battery electrolyte can freeze and battery case can crack at cold ambient condition if battery is not properly charged.
2) Keep the battery cable connections clean.
   The cable connections, particularly at the positive (+) terminal post, tend to become corroded. The product of corrosion, or rust, on the mating faces of conductors resists the flow of current.
   Clean the terminals and fittings periodically to ensure good metal-to-metal contact, and grease the connections after each cleaning to protect them against rusting.
3) Be always in the know as to the state of charge of the battery. The simplest way to tell the state of charge is to carry out a hydrometer test. The hydrometer is an instrument for measuring the specific gravity (S.G.) of the battery electrolyte. The S.G. of the electrolyte is indicative of the state of charge. Refer to “BATTERY” under “DIAGNOSIS” in this section.

Generator

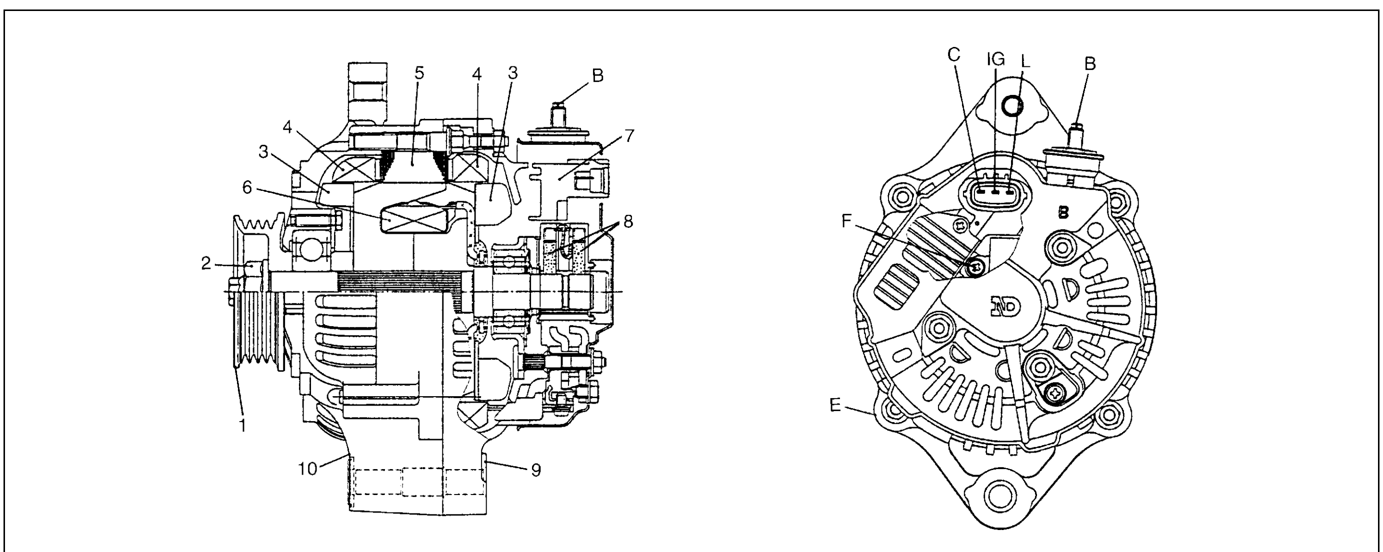
The generator is a small and high performance type with an IC regulator incorporated.
The internal components are connected electrically as shown below figure.

The generator features are as follows:

- Solid state regulator is mounted inside the generator.
- All regulator components are enclosed into a solid mold.
- This unit along with the brush holder assembly is attached to the rear housing.
- The IC regulator uses integrated circuits and controls the voltage produced by the generator, and the voltage setting cannot be adjusted.
- The generator rotor bearings contain enough grease to eliminate the need for periodic lubrication. Two brushes carry current through the two slip rings to the field coil mounted on the rotor, and under normal conditions will provide long period of attention-free service.
- The stator windings are assembled on the inside of a laminated core that forms part of the generator frame.
- A condenser mounted in the rear housing suppresses radio noise.



1. Generator with regulator ass'y	3. Stator coil	5. Field coil (rotor coil)	7. Main switch	9. ECM
2. I.C. regulator	4. Diode	6. Charge indicator light	8. Battery	10. Load



1. Pulley	5. Stator core	9. Rear end frame	E: Ground
2. Pulley nut	6. Field coil	10. Drive end frame	F: Field coil terminal
3. Rotor fan	7. Regulator	B: Generator output (Battery terminal)	IG: Ignition terminal
4. Stator coil	8. Brush	C: C terminal	L: Lamp terminal

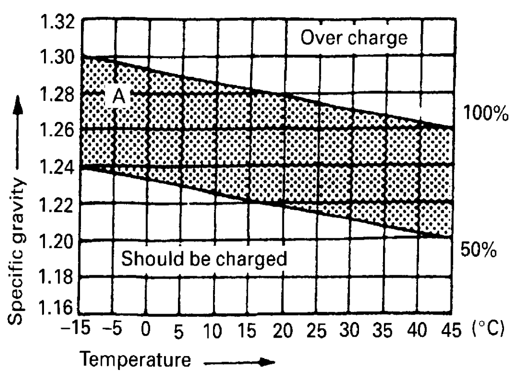
Diagnosis

Battery

Visual inspection

Check for obvious damage, such as cracked or broken case or cover, that could permit loss of electrolyte. If obvious damage is noted, replace battery. Determine cause of damage and correct as needed.

Hydrometer test



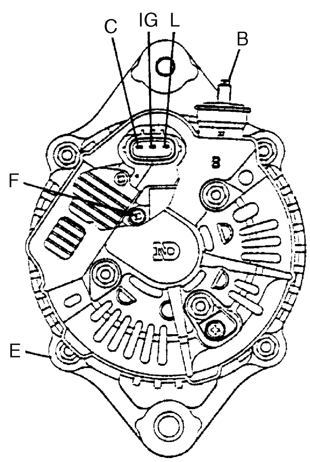
The direct method of checking the battery for state of charge is to carry out a high rate discharge test, which involves a special precise voltmeter and an expensive instrument used in the service shops, but not recommendable to the user of the vehicle.
At 20 °C of battery temperature (electrolyte temperature):

- The battery is in FULLY CHARGED STATE if the electrolyte S.G. is 1.280.
- The battery is in HALF CHARGED STATE if the S.G. is 1.220.
- The battery is in NEARLY DISCHARGED STATE if the S.G. is 1.150 and is in danger of freezing.

As the S.G. varies with the temperature, if battery temperature is not at 20°C (68°F), you have to correct your S.G. reading (taken with your hydrometer) to the value at 20°C (68°F) and apply the corrected S.G. value to the three-point guide stated value.
For the manner of correction, refer to the graph showing the relation between S.G. value and temperature at the left.

How to use the temperature-corrected state-of-charge graph
Suppose your S.G. reading is 1.28 and the battery temperature is –5°C (23°F). Locate the intersection of the –5°C line and the 1.28 S.G. line.
The intersection is within the "A" zone (shaded area in the graph) and that means CHARGED STATE.
To know how much the battery is charged, draw a line parallel to the zone demarcation line and extend it to the right till it meets with the percentage scale. In the present example, the line meets at about 85% point on the percentage scale. Therefore, the battery is charged up to the 85% level.

Generator



CAUTION:
- **Do not mistake polarities of IG terminal and L terminal.**
- **Do not create short circuit between IG and L terminals. Always connect these terminals through a lamp.**
- **Do not connect any load between L and E.**
- **When connecting charger or booster battery to vehicle battery, refer to this section describing battery charging.**

Trouble in charging system will show up as one or more of the following conditions:
1) Faulty indicator lamp operation.
2) An undercharged battery as evidenced by slow cranking or indicator dark.
3) An overcharged battery as evidenced by excessive spewing of electrolyte from vents.

Noise from generator may be caused by loose drive pulley, loose mounting bolts, worn or dirty bearings, defective diode, or defective stator.

B:	Generator output (Battery terminal)
C:	C terminal
E:	Ground
F:	Field coil terminal
IG:	Ignition terminal
L:	Lamp terminal

Charging indicator lamp operation

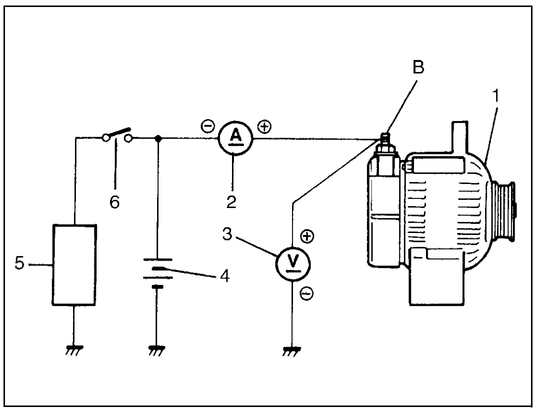
Condition	Possible Cause	Correction
Charge light does not light with ignition ON and engine off	Fuse blown	Check fuse.
	Light burned out	Replace light.
	Wiring connection loose	Tighten loose connection.
	IC regulator or field coil faulty	Check generator.
	Poor contact between brush and slip ring	Repair or replace.
Charge light does not go out with engine running (battery requires frequent recharging)	Drive belt loose or worn	Adjust or replace drive belt.
	IC regulator or generator faulty	Check charging system.
	Wiring faulty	Repair wiring.

Undercharged battery

This condition, as evidenced by slow cranking or low specific gravity can be caused by one or more of the following conditions even though indicator lamp may be operating normal.
Following procedure also applies to cars with voltmeter and ammeter.

- Make sure that undercharged condition has not been caused by accessories left on for extended period of time.
- Check drive belt for proper tension.
- If battery defect is suspected, refer to BATTERY section.
- Inspect wiring for defects. Check all connections for tightness and cleanliness, battery cable connections at battery, starting motor and ignition ground cable.

NO-LOAD CHECK

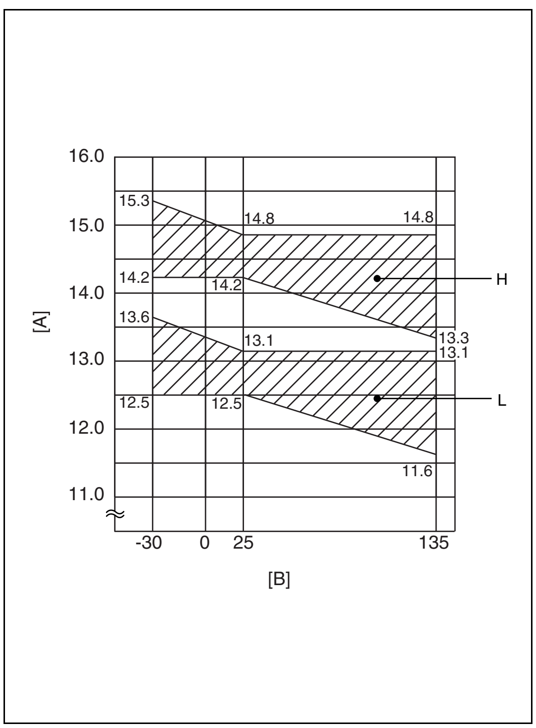


1) Connect voltmeter and ammeter as shown in left figure.

NOTE:

Use fully charged battery.

1.	Generator
2.	Ammeter (between generator (B) terminal and battery (+) terminal)
3.	Voltmeter (between generator (B) terminal and ground)
4.	Battery
5.	Load
6.	Switch



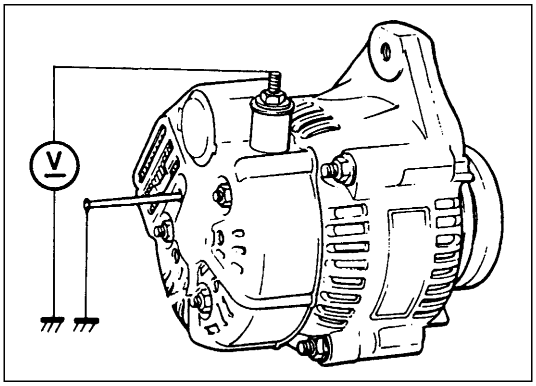
2) Run engine from idling up to 2,000 rpm with all accessories turned off and read meters.
   If voltage is higher than standard value, check ground of brushes.
   If brushes are not grounded, replace IC regulator.
   If voltage is lower than standard value, proceed to following check.

Specification for undercharged battery (No-load check)
Current: 10 A
Voltage: 14.2 – 14.8 V at Hi (H) (at 25°C, 77°F)
Voltage: 12.5 – 13.1 V at Lo (L) (at 25°C, 77°F)

NOTE:

Consideration should be taken that voltage will differ somewhat with regulator case temperature as shown in left figure.

A:	Regulated voltage (V)
B:	Heatsink temperature (°C)



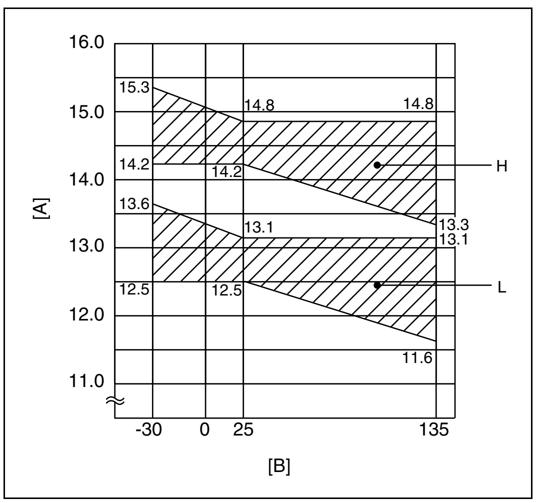
3) Ground F terminal and start engine, then measure voltage at B terminal as shown in left figure.
   - Voltage is higher than standard value
     It is considered that generator itself is good but IC regulator has been damaged, replace IC regulator.
   - Voltage is lower than standard value
     It is considered that generator itself has problem, check the generator.
     If the generator is in good condition, check generator control signal (See Diag. Flow Table B-9 in Section 6).

LOAD CHECK

1) Run engine at 2,000 rpm and turn on head light and heater motor.
2) Measure current and if it is less than 20 A repair or replace generator.

Overcharged battery

1) To determine battery condition, refer to BATTERY section.
2) If obvious overcharge condition exists as evidenced by excessive spewing of electrolyte, measure generator B terminal voltage at engine 2000 rpm.
3) If measured voltage is higher than upper limit value, disassemble generator.
4) Check ground of brushes. If brushes are not grounded, replace IC regulator. Then check field coil for grounds and shorts.



A:	Regulated voltage (V)
B:	Heatsink temperature (°C)

On-Vehicle Service

Battery

Jump starting in case of emergency

WITH AUXILIARY (BOOSTER) BATTERY

CAUTION:
If vehicle is manual transmission model and has a catalytic converter, do not push or tow it to start. Damage to its emission system and/or to other parts may result.

Both booster and discharged battery should be treated carefully when using jumper cables. Follow procedure outlined below, being careful not to cause sparks.

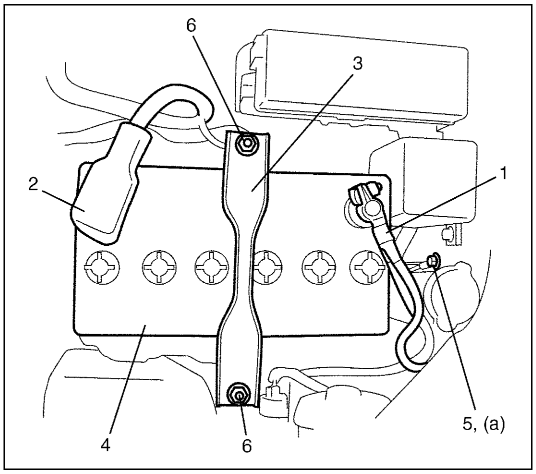
WARNING:
- **Departure from these conditions or procedure described below could result in:**
  - **Serious personal injury (particularly to eyes) or property damage from such causes as battery explosion, battery acid, or electrical burns.**
  - **Damage to electronic components of either vehicle.**
- **Remove rings, watches, and other jewelry. Wear approved eye protection.**
- **Be careful so that metal tools or jumper cables do not contact positive battery terminal (or metal in contact with it) and any other metal on vehicle, because a short circuit could occur.**

WARNING:
Do not connect negative cable directly to negative terminal of dead battery.

1) Set parking brake and place automatic transmission in PARK (NEUTRAL on manual transmission). Turn off ignition, turn off lights and all other electrical loads.
2) Check electrolyte level. If it is below low level line, add distilled water.
3) Attach end of one jumper cable to positive terminal of booster battery and the other end of the same cable to positive terminal of discharged battery. (Use 12-volt battery only to jump start engine).
4) Attach one end of the remaining negative cable to negative terminal of booster battery, and the other end to a solid engine ground (such as exhaust manifold) at least 45 cm (18 in.) away from battery of vehicle being started.
5) Start engine of vehicle with booster battery and turn off electrical accessories. Then start engine of the vehicle with discharged battery.
6) Disconnect jumper cables in the exact reverse order.

WITH CHARGING EQUIPMENT

CAUTION:
When jump starting engine with charging equipment, be sure equipment used is 12-volt and negative ground. Do not use 24-volt charging equipment. Using such equipment can cause serious damage to electrical system or electronic parts.



Dismounting

1) Disconnect negative cable (1).
2) Disconnect positive cable (2).
3) Remove retainer (3).
4) Remove battery (4).

5.	Body ground bolt
6.	Nut

Handling

When handling battery, following safety precautions should be followed:

- Hydrogen gas is produced by battery. A flame or spark near battery may cause the gas to ignite.
- Battery fluid is highly acidic. Avoid spilling on clothing or other fabric. Any spilled electrolyte should be flushed with large quantity of water and cleaned immediately.

Remounting

1) Reverse removal procedure.
2) Torque battery cables to specification.

NOTE:

Check to be sure that ground cable has enough clearance to hood panel by terminal.

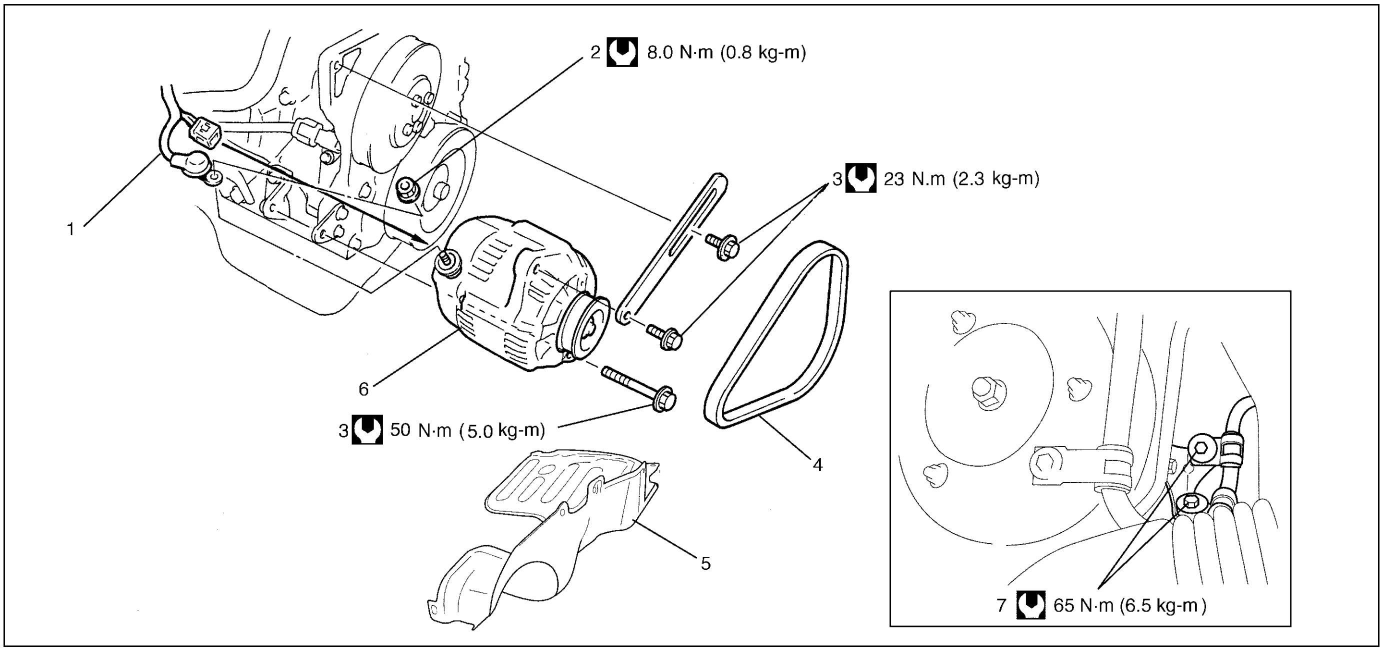
Tightening torque
Body ground bolt
(a): 8.0 N·m (0.8 kg-m, 6.0 lb-ft)

Generator

Generator belt

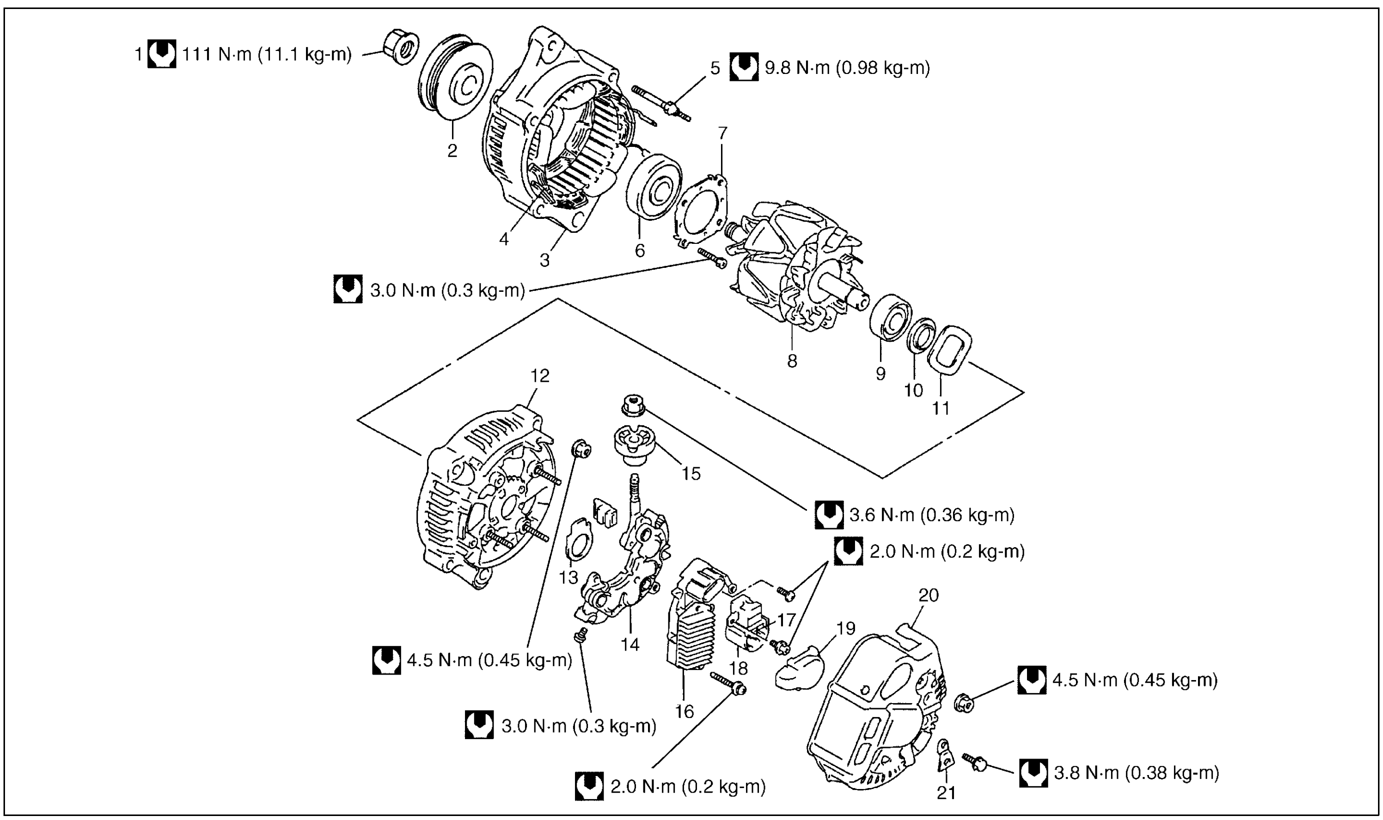
Refer to “WATER PUMP/GENERATOR DRIVE BELT” in Section 6B “ENGINE COOLING”.

Dismounting and remounting



1. "B" terminal wire	3. Generator bolt	5. Splash cover (Right)	7. P/S pipe mounting bolt
2. "B" terminal nut	4. Generator belt	6. Generator	Tightening torque

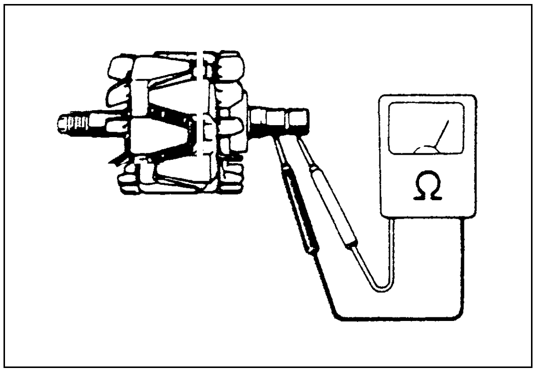
Disassembly and reassembly



1. Pulley nut	7. Bearing retainer	13. Seal plate	19. Brush holder cover
2. Pulley	8. Rotor	14. Rectifier	20. Rear end cover
3. Drive end frame	9. End housing bearing	15. Insulator	21. Terminal plate
4. Stator	10. Bearing cover	16. Regulator	Tightening torque
5. Stud bolt	11. Wave washer	17. Brush	
6. Drive end bearing	12. Rear end frame	18. Brush holder	

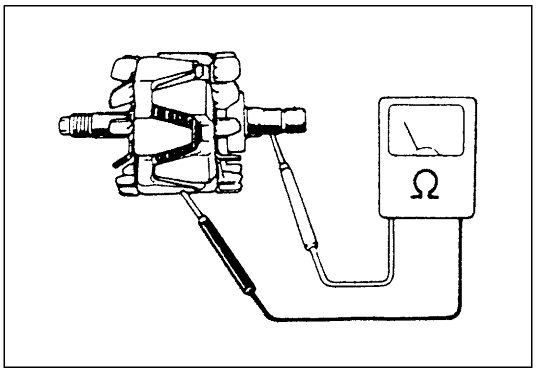
Inspection

ROTOR

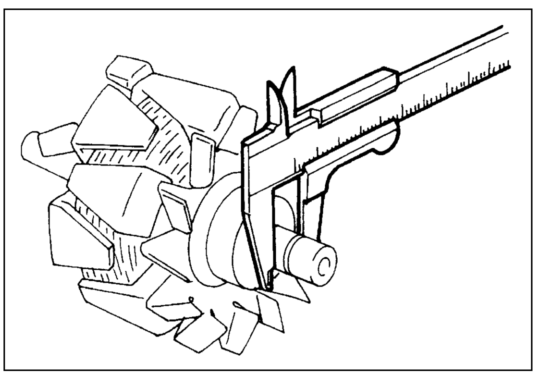


1) Using ohmmeter, check for continuity between slip rings of rotor. If there is no continuity, replace rotor.

Standard resistance between slip rings of rotor
: 2.7 – 3.1 Ω at 20°C (68°F)



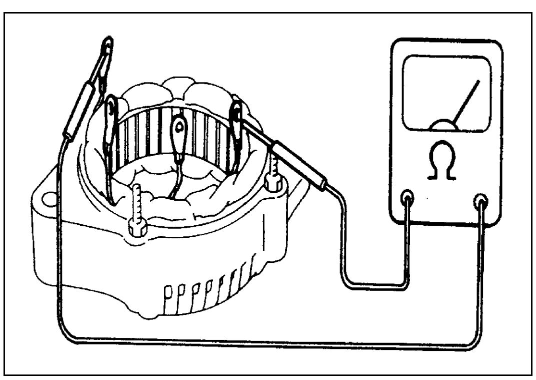
2) Using ohmmeter, check that there is no continuity between slip ring and rotor. If there is continuity, replace rotor.



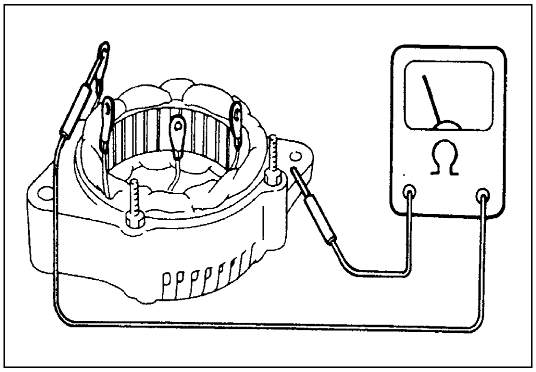
3) Check slip rings for roughness or scoring. If rough or scored, replace rotor.
   Using a vernier caliper, measure the slip ring diameter.
   If the diameter is less than minimum, replace the rotor.

Slip ring diameter
Standard: 14.2 – 14.4 mm (0.557 – 0.567 in.)
Limit: 12.8 mm (0.504 in.)

STATOR

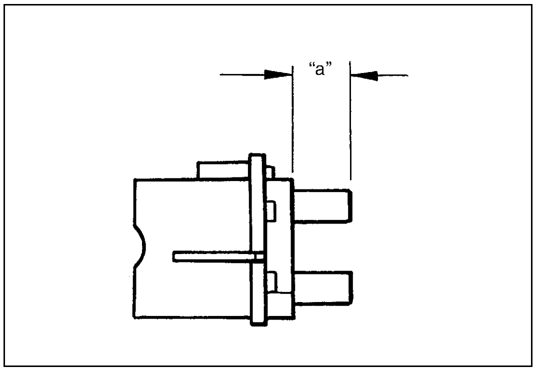


1) Using an ohmmeter, check all leads for continuity. If there is no continuity, replace stator.



2) Using ohmmeter, check that there is no continuity between coil leads and stator core. If there is continuity, replace stator.

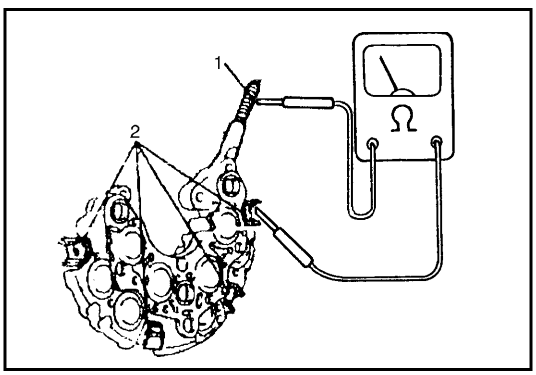
BRUSH AND BRUSH HOLDER



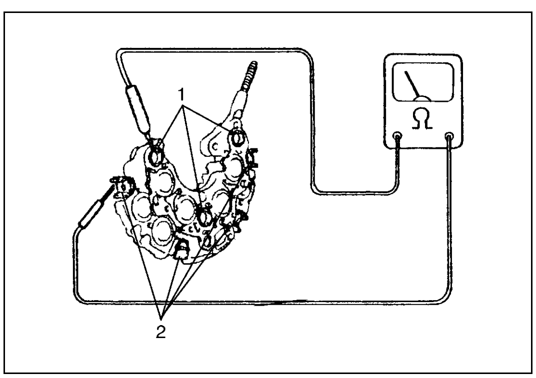
Check each brush for wear by measuring its length as shown. If brush is found worn down to service limit, replace brush.

Exposed brush length "a"
Standard: 10.5 mm (0.41 in.)
Limit: 1.5 mm (0.06 in.)

RECTIFIER



1) Using an ohmmeter, connect one tester probe to the "B" terminal (1) and the other to each rectifier terminal (2).
2) Reverse the polarity of the tester probes and repeat step 1).
3) Check that one shows continuity and the other shows no continuity.
   If there is continuity, replace the rectifier.



4) Using an ohmmeter, connect one tester probe to each negative terminal (1) and the other to each rectifier terminal (2).
5) Reverse the polarity of the tester probes and repeat step 4).
6) Check that one shows continuity and the other shows no continuity.
   If there is continuity, replace the rectifier.

Specification

Battery

NOTE:

The battery used in each vehicle is one of the following three types, depending on specification.

Battery type		38B20L	55B24L	75D23L
Rated capacity	AH/5HR, 12 Volts	28	38	54
Electrolyte	L (US/Imp. pt)	2.1 (4.44/3.70)	2.8 (5.92/4.93)	3.9 (8.24/6.86)
Electrolyte S.G.		1.28 when fully charged at 20°C (68°F)		

Generator

Type	75 A type
Rated voltage	12 V
Nominal output	75 A
Permissible max. speed	18000 r/min.
No-load speed	1020 r/min (rpm)
Setting voltage	14.2 – 14.8 V (Hi), 12.5 – 13.1 V (Lo)
Exposed brush length	Standard: 10.5 mm (0.41 in.) Limit: 1.5 mm (0.06 in.)
Permissible ambient temperature	–30 to 90°C (–22 to 194°F)
Polarity	Negative ground
Rotation	Clockwise viewed from pulley side

Tightening Torque Specification

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Body ground bolt	8	0.8	6.0
Generator bolts	23	2.3	16.5
“B” terminal inner nut	3.6	0.36	2.5
“B” terminal outer nut	8	0.8	6.0
Pulley nut	111	11.1	80.5
Rear end frame nuts	4.5	0.45	3.5
Rear end cover nuts	4.5	0.45	3.5
Stator stud bolts	9.8	0.98	7.0
Drive end bearing plate screws	3.0	0.30	2.0
Rectifier screws	3.0	0.30	2.0
Regulator and brush holder screws	2.0	0.20	1.5
Terminal plate bolt	3.8	0.38	3.0