SECTION 6

ENGINE DIAGNOSIS

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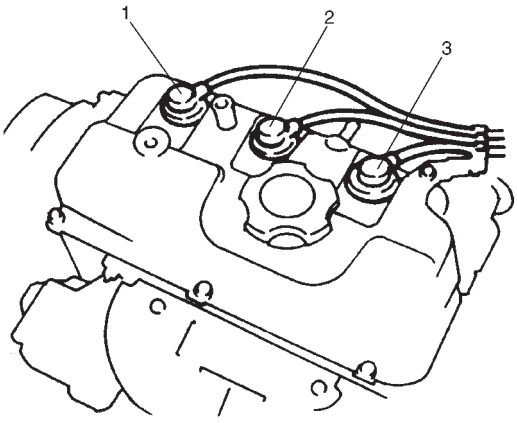
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GENERAL INFORMATION

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 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.



1. No.1 cylinder
2. No.2 cylinder
3. No.3 cylinder

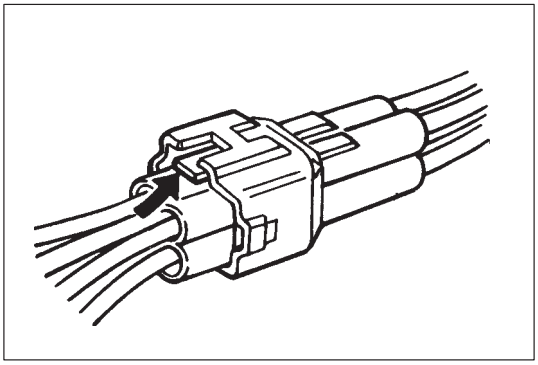
- Throughout this manual, the four cylinders of the engine are identified by numbers: No.1, No.2, and No.3 as counted from crankshaft pulley side to flywheel side.

GENERAL INFORMATION ON ENGINE SERVICE

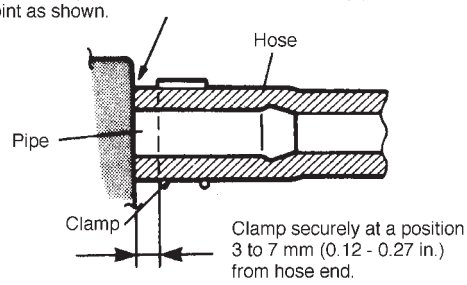
THE FOLLOWING INFORMATION ON ENGINE SERVICE SHOULD BE NOTED CAREFULLY, AS IT IS IMPORTANT IN PREVENTING DAMAGE, AND IN CONTRIBUTING TO RELIABLE ENGINE PERFORMANCE.

- 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.

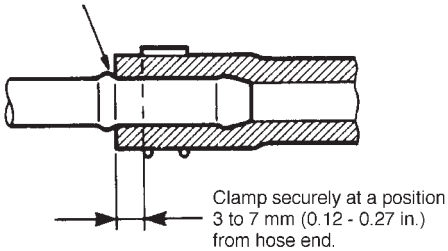
  When performing any work where electrical terminals could possibly be grounded, ground cable of the battery should be disconnected at battery.
- Any time the air cleaner, air intake hose, throttle body or intake manifold is removed, the intake opening should be covered. This will protect against accidental entrance of foreign material which could follow intake passage into cylinder and cause extensive damage when engine is started.
- When disconnecting couplers, don't pull wire harness but make sure to hold coupler itself. With lock type coupler, be sure to unlock before disconnection. Attempt to disconnect coupler without unlocking may result in damage to coupler. When connecting lock type coupler, insert it till clicking sound is heard and connect it securely.



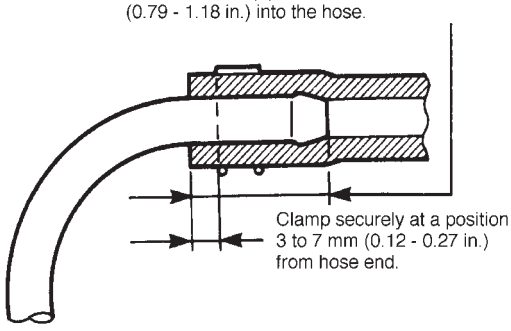
With short pipe, fit hose as far as it reaches pipe joint as shown.



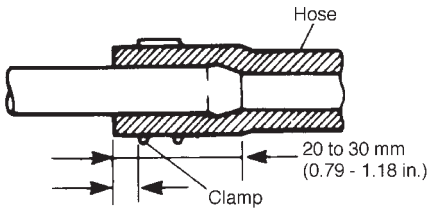
With following type pipe, fit hose as far as its peripheral projection as shown.



With bent pipe, fit hose as far as its bent part as shown or till pipe is about 20 to 30 mm (0.79 - 1.18 in.) into the hose.



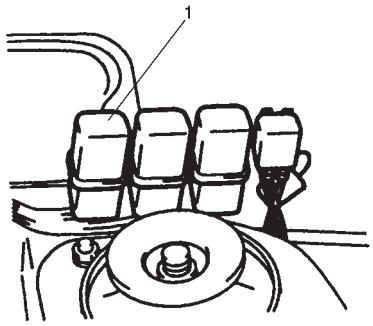
With straight pipe, fit hose till pipe is about 20 to 30 mm (0.79 - 1.18 in.) into the hose.



Clamp securely at a position 3 to 7 mm (0.12 - 0.27 in.) from hose end.

PRECAUTION ON FUEL SYSTEM SERVICE

- Work must be done with no smoking, in a well-ventilated area and away from any open flames.
- As fuel feed line (between fuel pump and fuel pressure regulator) is still under high fuel pressure even after engine was stopped, loosening or disconnecting fuel feed line directly may cause dangerous spout of fuel to occur where loosened or disconnected.
  Before loosening or disconnecting fuel feed line, make sure to release fuel pressure according to FUEL PRESSURE RELIEF PROCEDURE.
  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 left figure.
  After connecting, make sure that the hose has no twist or kink.
- When installing fuel union bolt gasket, always use new gasket and tighten union bolt to specified torque. See Section 6C for specified torque.
- When installing injector, fuel feed pipe or fuel pressure regulator, lubricate its O-ring with gasoline.
- When connecting fuel pipe flare nut, first tighten flare nut by hand and then tighten it to specified torque.



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

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 the ignition switch ON position for 3 seconds (to operate fuel pump) and then turn it OFF position.
   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 return hose).
2) In this state, check to see that there are no fuel leakages from any part of fuel system.

ENGINE DIAGNOSIS

This vehicle is equipped with an engine and emission control system, which controls the A/F mixture, ignition timing, emission, etc. suitably to engine conditions by ECM. ECM has an On-Board Diagnostic system which detects a malfunction in this system.
When diagnosing a trouble in the engine including this system, be sure to have understanding of the outline of "On-Board Diagnostic system" and each item in "Precaution in Diagnosing Trouble" and follow "ENGINE DIAGNOSTIC FLOW TABLE" given below to obtain correct result smoothly.

ON-BOARD DIAGNOSTIC SYSTEM

Refer to "On-Board Diagnostic System" in Section 6E1.

PRECAUTION IN DIAGNOSING TROUBLES

Be sure to read "Precaution in Diagnosing Troubles" in Section 6E1 and observe what is written there.

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. Was customer complaint analysis performed?	Go to Step 2.	Perform customer complaint analysis.
2	Diagnostic Trouble Code (DTC) Check, Record and Clearance 1) Check for DTC referring to “DTC Check” in Section 6E1. Is there any malfunction DTC(s)?	1) Print DTC or write it down and clear it by referring to “DTC Clearance” in section 6E1. 2) Go to Step 3.	Go to Step 4.
3	Visual Inspection 1) Perform visual inspection referring to the “Visual Inspection” in this section. Is there any faulty condition?	1) Repair or replace malfunction part. 2) Go to Step 11.	Go to Step 5.
4	Visual Inspection 1) Perform visual inspection referring to the “Visual Inspection” in this section. Is there any faulty condition?		Go to Step 8.
5	Trouble Symptom Confirmation 1) Confirm trouble symptom referring to the “Trouble-Symptom Confirmation” in this section. Is trouble symptom identified?	Go to Step 6.	Go to Step 7.
6	Rechecking and Record of DTC 1) Recheck for DTC referring to “DTC Check” in Section 6E1. Is there any DTC(s)?	Go to Step 9.	Go to Step 8.
7	Rechecking and Record of DTC 1) Recheck for DTC referring to “DTC Check” in Section 6E1. Is there any malfunction DTC(s)?		Go to Step 10.
8	Engine Basic Inspection and Engine Diagnosis Table 1) Check and repair according to “Engine Basic Check” and “Engine Diagnosis Table” in this section. Are check and repair complete?	Go to Step 11.	1) Check and repair malfunction part(s). 2) Go to Step 11.
9	Trouble shooting for DTC 1) Check and repair according to applicable DTC diag. flow table in Section 6E1. Are check and repair complete?		
10	Check for Intermittent Problems 1) Check for intermittent problems referring to “Check for Intermittent Problem” in this section. Is there any faulty condition?	1) Repair or replace malfunction part(s). 2) Go to Step 11.	Go to Step 11.
11	Final Confirmation Test 1) Clear DTC if any. 2) Perform final confirmation test referring to “Final Confirmation Test” in this section. Is there any problem symptom, malfunction 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.

CUSTOMER PROBLEM INSPECTION FORM (EXAMPLE)

User name:	Model:	VIN:	
Date of issue:	Date of 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 ☐ Axal. 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 Temperature Frequency Road	☐ Fair ☐ Cloudy ☐ Rain ☐ Snow ☐ Always ☐ Other_____ ☐ Hot ☐ Warm ☐ Cool ☐ Cold (°F/ °C) ☐ Always ☐ Always ☐ Sometimes (times/ day, month) ☐ Only once ☐ Under certain condition ☐ 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 ☐ Normal code ☐ Malfunction code ( )
	Second check:	☐ No code ☐ Normal code ☐ Malfunction code ( )

NOTE:

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

2. DIAGNOSTIC TROUBLE CODE (DTC) CHECK, RECORD AND CLEARANCE

First, check DTC referring to “DTC Check” in Section 6E1. If DTC is indicated, print it or write it down and then clear it by referring to “DTC Clearance” in Section 6E1. 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 5 and recheck DTC according to Step 6 or 7.

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.

3. and 4. VISUAL INSPECTION

Be sure to perform visual check of the following items that support proper function of the engine.

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

5. TROUBLE SYMPTOM CONFIRMATION

Based on information obtained in Step 1 customer complaint analysis and Step 2 DTC check, confirm trouble symptoms. Also, reconfirm DTC according to “DTC Confirmation Procedure” in Section 6E1.

6. and 7. RECHECKING AND RECORD OF DTC

Refer to “DTC Check” in section 6E1 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.

ENGINE BASIC INSPECTION FLOW TABLE

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 engine idle speed/IAC duty referring to “Idle Speed/IAC Duty Inspection” in section 6E1. Is check result as specified?	Go to Step 6.	Go to “ENGINE DIAGNOSIS TABLE” in this section.
6	Check ignition timing referring to “Ignition Timing Inspection” in section 6F. Is check result as specified?	Go to “ENGINE DIAGNOSIS TABLE” in this section.	Adjust ignition timing.
7	Check fuel supply as follows: 1) Check to make sure that enough fuel is filled in fuel tank. 2) Turn the ignition switch ON position for 3 seconds and then turn it OFF position. Repeat this a few times. Is fuel return pressure (returning sounds) felt from fuel return hose when the ignition switch is turned ON position?	Go to Step 9.	Go to Step 8.
8	Check fuel pump for operating. 1) Was fuel pump operating sound heard from fuel filler for about 3 seconds after turning the ignition switch ON position and stop?	Go to “Diag. Flow Table B-3” in section 6E1.	Go to “Diag. Flow Table B-1” in section 6E1.
9	Check ignition spark referring to “Ignition Spark Test” in section 6F. Is it in good condition?	Go to Step 10.	Go to “DIAGNOSIS” in section 6F.
10	Check fuel injector referring to “Fuel Injector Inspection” in section 6E1. Is it in good condition?	Go to “ENGINE DIAGNOSIS TABLE” in this section.	Go to “Diag. Flow Table B-2 in section 6E1.

9. TROUBLESHOOTING FOR DTC

Based on the DTC indicated in Step 6 or 7 and referring to the applicable DTC diag. flow table in Section 6E1, 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 malfunction DTC (a normal code) is indicated.

ENGINE DIAGNOSIS TABLE

Condition	Possible Cause	Reference Item
Hard starting (Engine cranks OK)	**Engine and emission control system out of order.**	
	● Faulty CMP sensing rotor	CMP sensing rotor inspection in section 6E1.
	● Faulty idle air control system	Diag. Flow Table B-4 in Section 6E1.
	● Faulty ECT sensor or MAP sensor	ECT sensor or MAP sensor in Section 6E1.
	● Faulty ECM	Inspection of ECM and its circuit in Section 6E1.
	Low compression.	Compression check in Section 6A or 6A1.
	● Compression leak from valve seat	Valves inspection in Section 6A or 6A1.
	● Sticky valve stem	Valves inspection in Section 6A or 6A1.
	● Weak or damaged valve springs	Valves spring inspection in Section 6A or 6A1.
	● Compression leak at cylinder head gasket	Cylinder head inspection in Section 6A or 6A1.
	● Sticking or damaged piston ring	Piston ring inspection in Section 6A or 6A1.
	● Worn piston, ring or cylinder	Cylinders, pistons and piston rings inspection in Section 6A or 6A1.
	Others	
	● Malfunctioning PCV valve	PCV system inspection in Section 6E1.

Condition	Possible Cause	Reference Item
Engine has no power	**Engine overheating.**	Refer to “Overheating” Section.
	Ignition system out of order.	
	● Defective spark plug	Spark plugs in Section 6F.
	● Faulty ignition coil	Ignition coil in Section 6F.
	Fuel system out of order.	
	● Fuel pressure out of specification	Diag. Flow Table B-3 in Section 6E1.
	– Dirty fuel filter	
	– Dirty or clogged fuel hose or pipe	
	– Malfunctioning fuel pressure regulator	
	– Malfunctioning fuel pump	
	Engine and emission control system out of order.	
	● Faulty injector	Fuel injector in Section 6E1.
	● Faulty TP sensor, ECT sensor or MAP sensor	TP sensor, ECT sensor or MAP sensor in Section 6E1.
	● Faulty ECM	Inspection of ECM and its circuit in Section 6E1.
	Low compression.	Previously outlined.
	Others	
	● Dragging brakes	Diagnosis in Section 5.
	● Slipping clutch	Diagnosis in Section 7C.
Improper engine idling or engine fails to idle	**Ignition system out of order.**	
	● Faulty spark plug	Spark plugs in Section 6F.
	● Faulty ignition coil	Ignition coil in Section 6F.
	Fuel system out of order.	
	● Fuel pressure out of specification	Diag. Flow Table B-3 in Section 6E1.
	– Malfunctioning fuel pressure regulator	
	Engine overheating.	Refer to “Overheating” Section.
	Engine and emission control system out of order.	
	● Faulty idle air control system	Diag. Flow Table B-4 in Section 6E1.
	● Faulty evaporative emission control system	Diag. Flow Table B-5 in Section 6E1.
	● Faulty injector	Fuel injector in Section 6E1.
	● Faulty ECT sensor, TP sensor or MAP sensor	ECT sensor, TP sensor or MAP sensor in Section 6E1.
	● Faulty ECM	Inspection of ECM and its circuit in Section 6E1.
	Low compression.	Previously outlined.
	Others	
	● Malfunctioning PCV valve	PCV system inspection in Section 6E1.

Condition	Possible Cause	Reference Item
Engine hesitates (Momentary lack of response as the accelerator is depressed. Can occur at all vehicle speeds. Usually most severe when first trying to make the vehicle move, as from a stop sign.)	**Ignition system out of order.**	
	● Spark plug faulty or plug gap as out of adjustment	Spark plugs in Section 6F.
	Fuel system out of order.	
	● Fuel pressure out of specification	Diag. Flow Table B-3 in Section 6E1.
	– Clogged fuel filter	
	– Faulty fuel pressure regulator	
	● Clogged fuel filter, hose or pipe	Fuel pressure check in Section 6E1.
	Engine overheating	Refer to “Overheating” Section.
	Engine and emission control system out of order.	
	● Faulty injector	Fuel injector in Section 6E1.
	● Faulty TP sensor, ECT sensor or MAP sensor	TP sensor, ECT sensor or MAP sensor in Section 6E1.
	● Faulty ECM .	Inspection of ECM and its circuit in Section 6E1.
	Low compression	Previously outlined.
Surges (Engine power variation under steady throttle or cruise. Feels like the vehicle speeds up and down with no change in the accelerator pedal.)	**Ignition system out of order.**	
	● Defective spark plug (excess carbon deposits, improper gap, and burned electrodes, etc.)	Spark plugs in Section 6F.
	Fuel system out of order.	
	● Variable fuel pressure	Diag. Flow Table B-3 in Section 6E1.
	– Clogged fuel filter	
	– Kinky or damaged fuel hose and line	
	– Faulty fuel pressure regulator	
	Engine and emission control system out of order.	
	● Faulty MAP sensor	MAP sensor in Section 6E1.
	● Faulty injector	Fuel injector in Section 6E1.
	● Faulty ECM	Inspection of ECM and its circuit in Section 6E1.

Condition	Possible Cause	Reference Item
Excessive detonation (The engine makes sharp metallic knocks that change with throttle opening. Sounds like pop corn popping.)	**Engine overheating**	Refer to “Overheating” Section.
	Ignition system out of order.	
	● Faulty spark plug	Spark plugs in Section 6F.
	● Improper ignition timing	Ignition timing in Section 6F.
	Fuel system out of order.	
	● Clogged fuel filter and fuel lines	Fuel pressure check in Section 6E1.
	Engine and emission control system out of order.	
	● Faulty ECT sensor or MAP sensor	ECT sensor or MAP sensor in Section 6E1.
	● Faulty injector	Fuel injector in Section 6E1.
	● Faulty ECM	Inspection of ECM and its circuit in Section 6E1.
	Others	
	● Excessive combustion chamber deposits	Piston and cylinder head cleaning in Section 6A or 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 6A or 6A1.
	● Poor oil pump performance	Oil pressure check in Section 6A or 6A1.
	● Dragging brakes	Diagnosis in Section 5.
	● Slipping clutch	Diagnosis in Section 7C.
	● Blown cylinder head gasket	Cylinder head inspection in Section 6A or 6A1.
Poor gasoline mileage	**Ignition system out of order.**	
	● Faulty spark plug (improper gap, heavy deposits, and burned electrodes, etc.)	Spark plugs in Section 6F.
	Engine and emission control system out of order.	
	● Fuel pressure out of specification	Diag. Flow Table B-3 in Section 6E1.
	● Faulty TP sensor, ECT sensor or MAP sensor	TP sensor, ECT sensor or MAP sensor in Section 6E1.
	● Faulty injector	Fuel injector in Section 6E1.
	● Faulty ECM	Inspection of ECM and its circuit in Section 6E1.
	Low compression	Previously outlined.
	Others	
	● Poor valve seating	Valves inspection in Section 6A or 6A1.
	● Dragging brakes	Diagnosis in Section 5.
	● Slipping clutch	Diagnosis in Section 7C.
	● Thermostat out of order	Thermostat in Section 6B.
	● Improper tire pressure	

Condition	Possible Cause	Reference Item
Excessive engine oil consumption	**Oil entering combustion chamber**	
	● Sticky piston ring	Piston cleaning in Section 6A or 6A1.
	● Worn piston and cylinder	Cylinders, pistons and piston rings inspection in Section 6A or 6A1.
	● Worn piston ring groove and ring	Pistons and piston rings inspection in Section 6A or 6A1.
	● Improper location of piston ring gap	Pistons installation in Section 6A or 6A1.
	● Worn or damaged valve stem seal	Valves and cylinder head in Section 6A or 6A1.
	● Worn valve stem	Valves inspection in Section 6A or 6A1.
Low oil pressure	● Improper oil viscosity	Engine oil and oil filter change in Section 0B.
	● Malfunctioning oil pressure switch	Oil pressure switch inspection in Section 8.
	● Clogged oil strainer	Oil pan and oil pump strainer cleaning in Section 6A or 6A1.
	● Functional deterioration of oil pump	Oil pump in Section 6A or 6A1.
	● Worn oil pump relief valve	Oil pump in Section 6A or 6A1.
	● Excessive clearance in various sliding parts	
Engine noise Note: Before checking the mechanical noise, make sure that: ● Ignition timing is properly adjusted. ● Specified spark plug is used. ● Specified fuel is used.	**Valve noise**	
	● Improper valve lash	Valve lash in Section 6A or 6A1.
	● Worn valve stem and guide	Valves inspection in Section 6A or 6A1.
	● Weak or broken valve spring	Valve springs inspection in Section 6A or 6A1.
	● Warped or bent valve	Valves inspection in Section 6A or 6A1.
	● Loose camshaft housing bolts	Camshafts in Section 6A or 6A1.
	Piston, ring and cylinder noise	
	● Worn piston, ring and cylinder bore	Pistons and cylinders inspection in Section 6A or 6A1.
	Connecting rod noise	
	● Worn crankpin bearing	Crankpin and connecting rod bearing inspection in Section 6A or 6A1.
	● Worn crankpin	Crankpin and connecting rod bearing inspection in Section 6A or 6A1.
	● Loose connecting rod nuts	Connecting rod installation in Section 6A or 6A1.
	● Low oil pressure	Previously outlined.
	Crankshaft noise	
	● Low oil pressure	Previously outlined.
	● Worn crankshaft journal bearing	Crankshaft and bearing inspection in Section 6A or 6A1.
	● Worn crankshaft journal	Crankshaft and bearing inspection in Section 6A or 6A1.
	● Loose lower crankcase (bearing cap) bolts	Crankshaft installation in Section 6A or 6A1.
	● Excessive crankshaft thrust play	Crankshaft inspection in Section 6A or 6A1.

Condition	Possible Cause	Referring Item
Excessive hydrocarbon (HC) emission or Excessive carbon monoxide (CO) emission	**Ignition system out of order** ● Defective spark plug	
	Fuel system out of order ● Fuel pressure out of specification	Fuel pressure check in Section 6E1.
	Engine and Emission control system out of order.	
	● Lead contamination of three way catalytic converter (if equipped)	Check for absence of filler neck restrictor.
	● Malfunctioning PCV valve	PCV valve in Section 6E1.
	● Faulty EVAP control system	EVAP control system check in Section 6E1.
	● Closed loop system (A/F feed back compensation) fails – Faulty TP sensor – Faulty ECT sensor or MAP sensor – Faulty O_2 sensor	Check oxygen sensor output voltage referring to DTC No.14 Diag. Flow Table in Section 6E1.
	● Faulty injector	Fuel injector in Section 6E1.
	● Faulty ECM	Inspection of ECM and its circuit in Section 6E1.
	Low compression	Previously outlined.
Excessive nitrogen oxides (NOx) emission	**Fuel system out of order** ● Fuel pressure out of specification	Fuel pressure check in Section 6E1.
	Engine and emission control system ● Lead contamination of three way catalytic converter (if equipped)	Check for absence of filler neck restrictor.
	● Closed loop system (A/F feed back compensation) fails (vehicle with O_2 sensor) – Faulty TP sensor – Faulty ECT sensor or MAP sensor – Faulty O_2 sensor	Check oxygen sensor output voltage referring to DTC No.14 Diag. Flow Table in Section 6E1.
	● Faulty injector	Fuel injector Section 6E1.
	● Faulty ECM	Inspection of ECM and its circuit in Section 6E1.

SECTION 6A

ENGINE MECHANICAL (F8B ENGINE)

CONTENTS

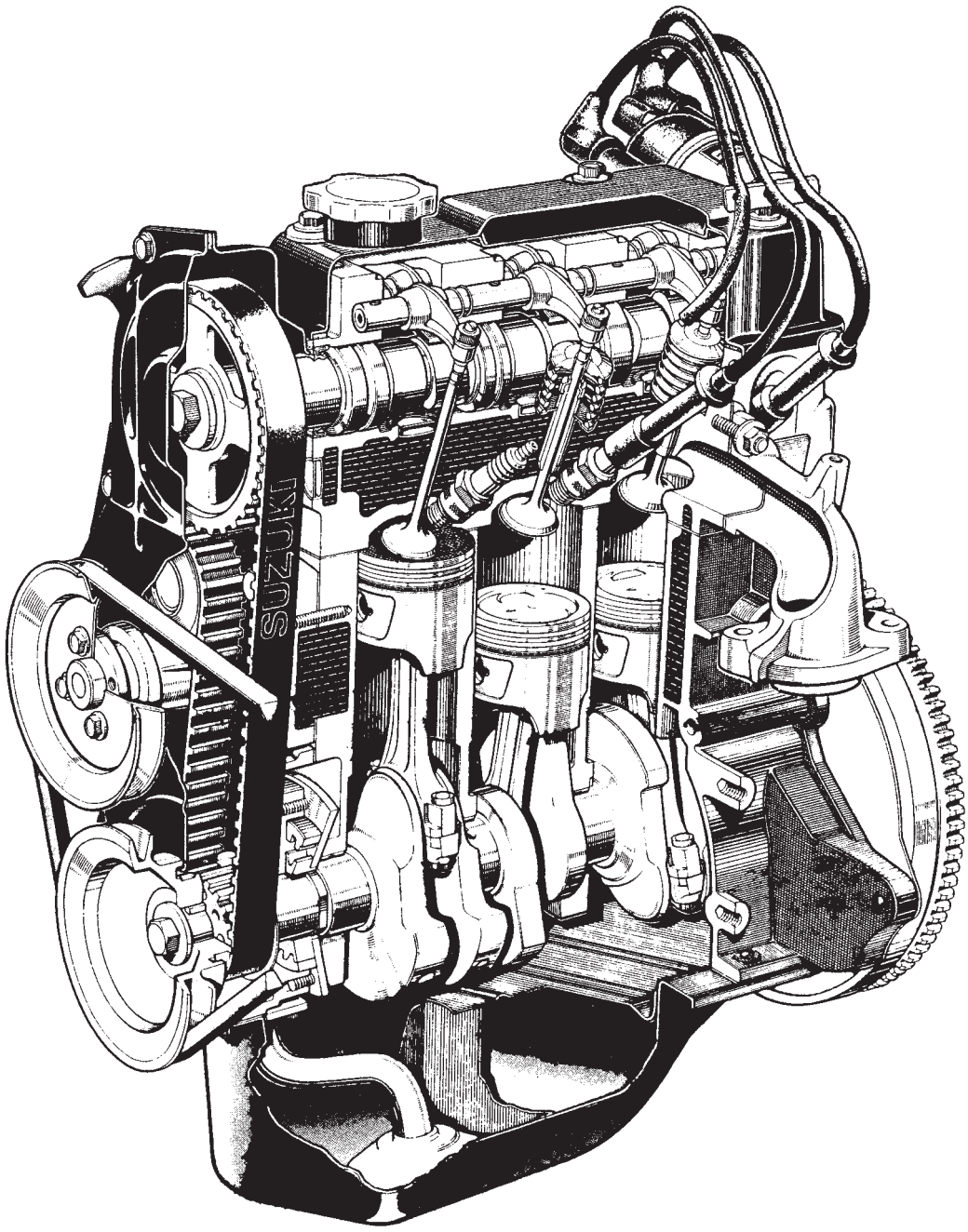
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GENERAL DESCRIPTION

Engine

The engine is a water-cooled, in-line 3 cylinders, 4-stroke cycle gasoline unit with its S.O.H.C. (single overhead camshaft) valve mechanism arranged for “V”-type valve configuration.

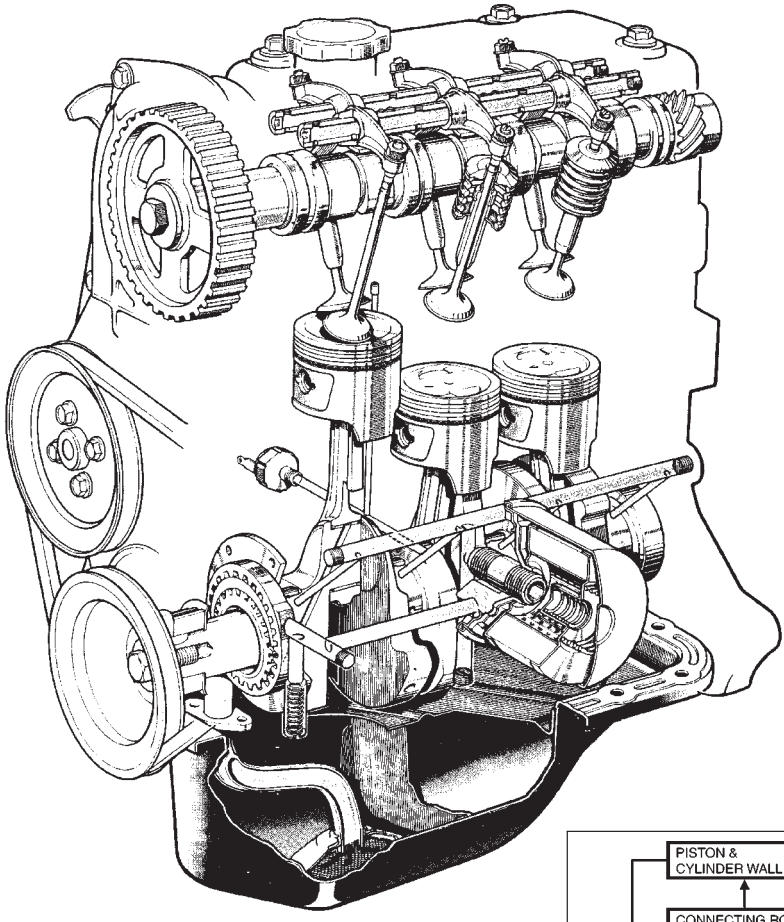
The single overhead camshaft (S.O.H.C.) is mounted over the cylinder head; it is driven from crankshaft through timing belt. Unlike conventional overhead valve (O.H.V.) engines, this engine has no pushrods. Thus, drive for valve is more direct and enables the valves to follow the crankshaft without any delay.

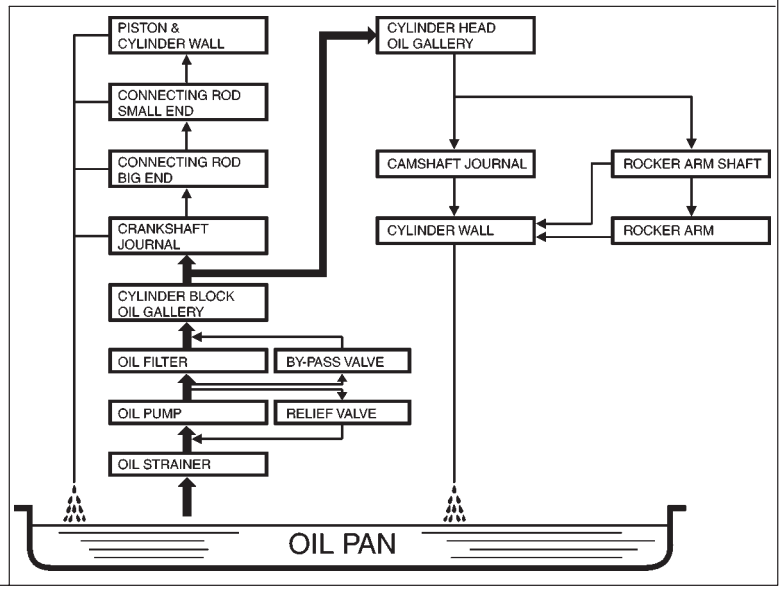


Engine Lubrication

The oil pump is of a internal gear type, and mounted on the crankshaft at the crankshaft pulley side.
Oil is drawn up through the oil pump strainer and passed through the pump to the oil filter.
The filtered oil flows into two 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 a small hole provided on the big end of connecting rod to lubricate piston, rings, and cylinder wall.
In another path, oil goes up to the cylinder head and lubricates rocker arms, valves and camshaft, etc., after passing through the internal oilway of rocker arm shafts.

An oil relief valve is provided on the oil pump. This valve starts relieving oil pressure when the pressure comes over about 3.3 kg/cm^2 (46.9 psi, 330 kPa). Relieved oil drains back to the oil pan.





ENGINE SERVICES NOT REQUIRING ENGINE REMOVAL

The following parts or components do not require engine removal to receive services (replacement, inspection or adjustment):

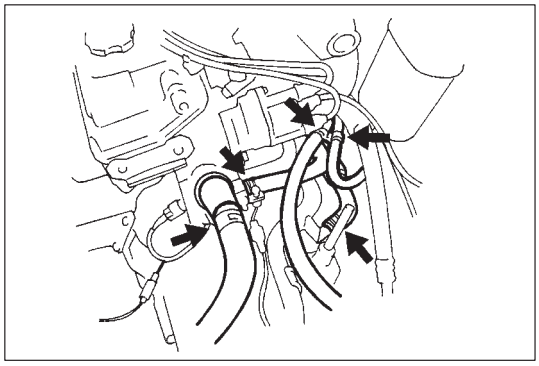
Part or Component	Nature of Service
1. Spark plug	Replacement or inspection
2. Distributor	Replacement, inspection or adjustment
3. Exhaust manifold	Replacement or inspection
4. Oil filter	Replacement
5. Oil pressure unit	Replacement
6. Cylinder head cover	Replacement
7. Rocker shaft	Replacement or inspection
8. Rocker-arm	Replacement or inspection
9. Rocker-arm spring	Replacement or inspection
10. Cam shaft	Replacement or inspection
11. Cylinder head	Replacement or inspection
12. Radiator	Replacement or inspection
13. Distributor gear case	Replacement
14. Camshaft timing belt pulley	Replacement or inspection
15. Crankshaft timing belt pulley	Replacement or inspection
16. Timing belt	Replacement or inspection
17. Fuel pump	Replacement
18. Throttle body	Replacement, inspection
19. Intake manifold	Replacement
20. Generator	Replacement or inspection
21. Starter motor	Replacement or inspection
22. Water pump belt	Replacement, inspection or tension adjustment
23. Water pump	Replacement
24. Pulleys (crank, water pump)	Replacement
25. Timing belt cover	Replacement
26. Water hose	Replacement or inspection

DISMOUNTING ENGINE

1) Release fuel pressure in fuel feed line, refer to Section 6.
2) Disconnect negative cable at battery.
3) Remove engine hood after disconnecting windshield washer hose.
4) Remove front bumper, refer to Section 9.
5) Drain cooling system.

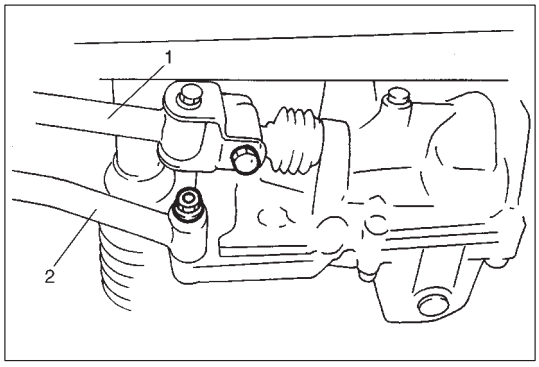
WARNING:
To help avoid danger of being burned, do not remove drain plug and radiator cap while engine and radiator are still hot. Scalding fluid and steam can be blown out under pressure if plug and cap are taken off too soon.

6) Remove radiator with cooling fan and reserve tank, refer to Section 6B.
7) Remove air cleaner assembly (1) with air cleaner hose (2) and breather hose (3).
8) Disconnect following cables.
   - Accelerator cable from throttle body
   - Clutch cable from clutch release lever
   - Speedometer cable from transmission case

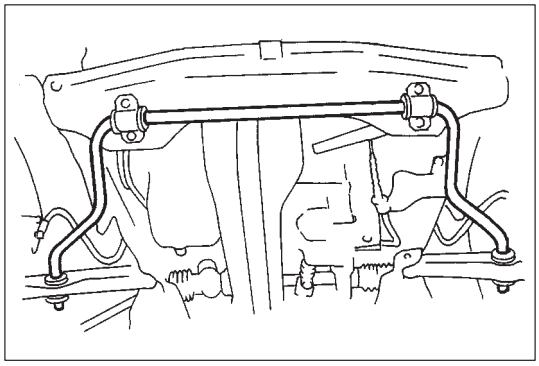


9) Disconnect following hoses.
   - Radiator outlet hose from outlet pipe
   - Radiator inlet hose from thermostat cap
   - Heater inlet and outlet hoses from heater unit (if equipped)
   - Fuel return and inlet hoses from pipes
   - Canister purge hose from canister purge control valve

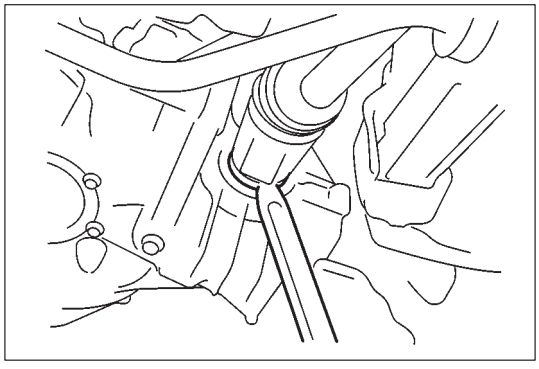
10) Disconnect the following electric wires.
- Radiator fan
- Distributor (High-tension cord and terminal)
- Starter motor
- Generator
- Back-up light switch
- Oil pressure switch
- Oxygen sensor
- ECT sensor
- Right side of engine harness
- Ground wire from cylinder block
- Ground wire from transmission case
- A/C compressor (if equipped)



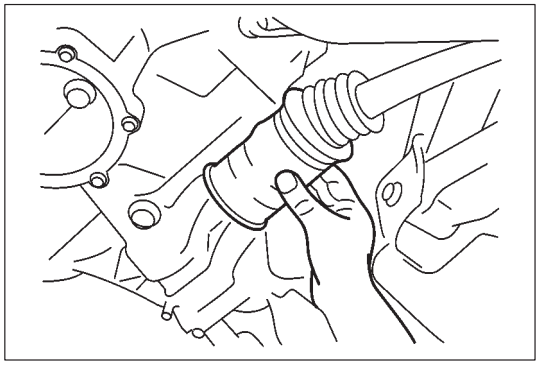
11) Remove exhaust center pipe.
12) Disconnect gear shift control shaft (1) and extension rod (2) from transmission case.
13) Drain engine and transmission oil.



14) Remove stabilizer bar, refer to Section 3D.



15) Disconnect right and left drive shaft joints from differential side gear snap rings.



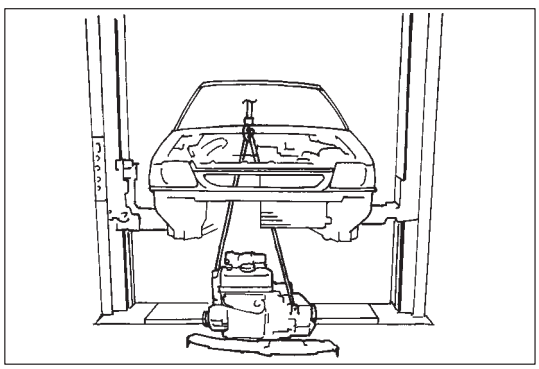
16) Draw right and left drive shafts out of differential side gears.

NOTE:
Be careful not to damage brake flexible hose.

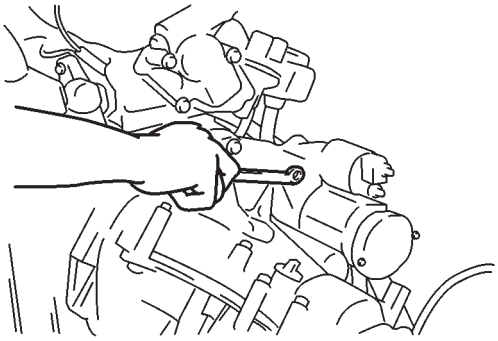
17) Remove water pump and A/C compressor belts (if equipped). When removing A/C compressor belt, first remove water pump pulley.
18) Recover refrigerant from refrigeration system by using recovery and recycling equipment, refer to Section 1B (if equipped).
19) Disconnect suction and discharge hoses from compressor, refer to Section 1B (if equipped).

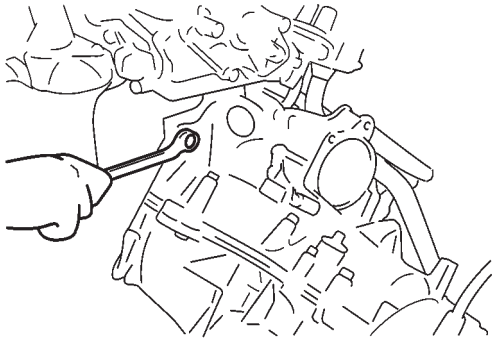
NOTE:
Cap open fittings immediately to keep moisture out of system.

20) Remove A/C compressor, upper and lower bracket (if equipped).
21) Check to ensure all hoses, electric wires and cables are disconnected from engine and transmission.
22) Set a piece of wire across the hook on intake manifold and transmission case so that engine can be lifted by using chain block.
23) Remove transmission left side mounting and mounting bracket.
24) Remove bolts securing engine member to make engine ready for removal.



25) Lower engine assembly together with transmission and engine member out of vehicle slowly and carefully.





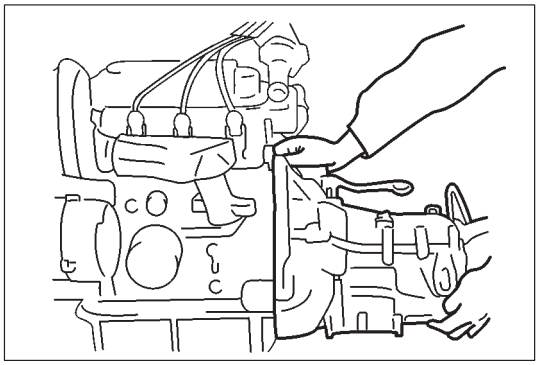
ENGINE DISASSEMBLY

NOTE:

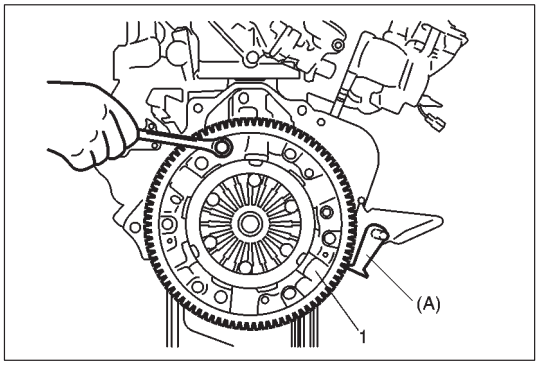
- **Observe critically before starting to remove a component or part by loosening bolts, nuts and the like. What you may find before and during disassembly is valuable information necessary for successful reassembly.**
- **Be careful in handling aluminum-alloy parts. They are softer than steel or cast-iron parts and their finished surfaces more easily take scratch marks.**
- **Have trays and pans ready for setting aside the disassembled parts in an orderly manner. Place the parts in the trays and pans in such a way that they can be readily identified. Put match marks or tags on them, as necessary, so that they will go back to where they came from.**

Carry out engine disassembly in the following sequence:

1) Remove starter motor, engine mounting with engine member and clutch housing lower plate, and loosen the transmission securing bolts after removing the radiator outlet pipe.

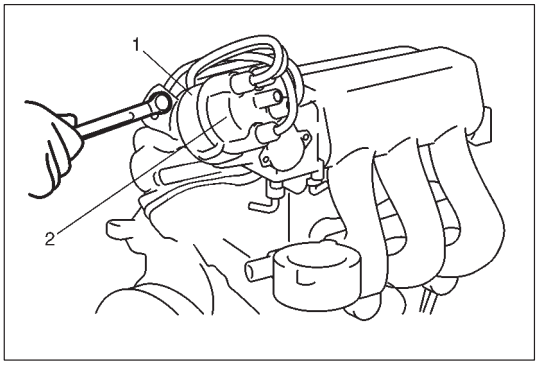


2) Take off transmission from cylinder block.

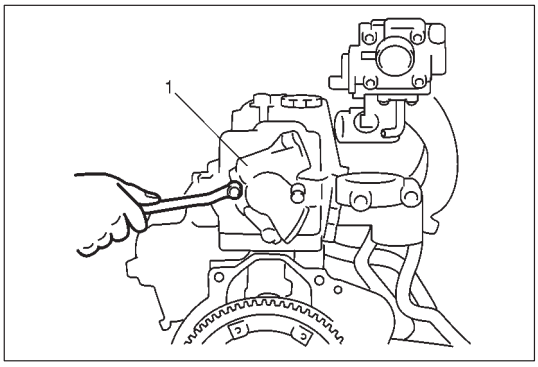


3) Remove clutch cover (1) and clutch disc by using special tool.

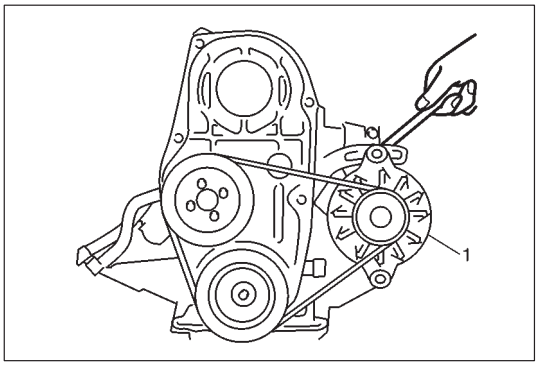
Special Tool
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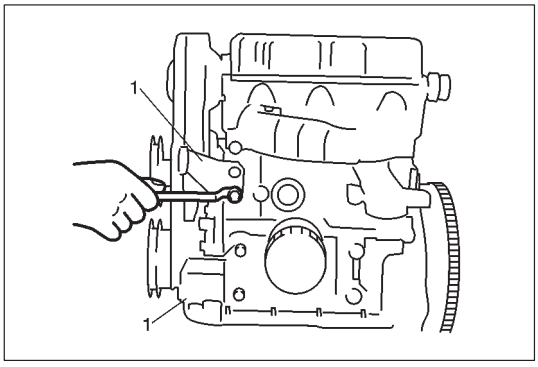
4) Remove distributor cap (2) and then remove distributor assembly (1).



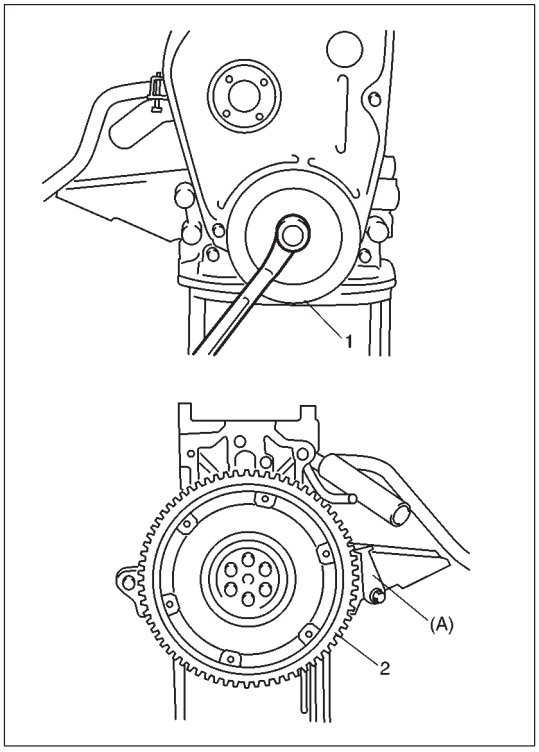
5) Remove distributor case (1).



6) Remove generator (1), refer to Section 6H.

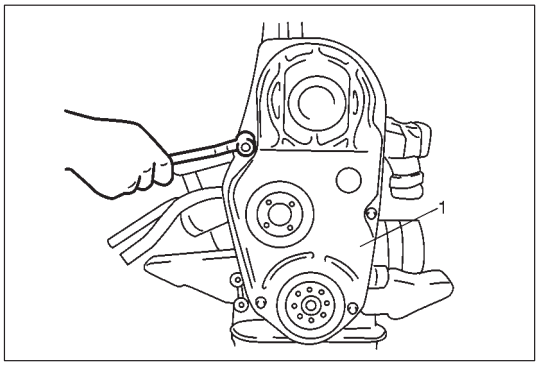


7) Remove generator brackets (1).

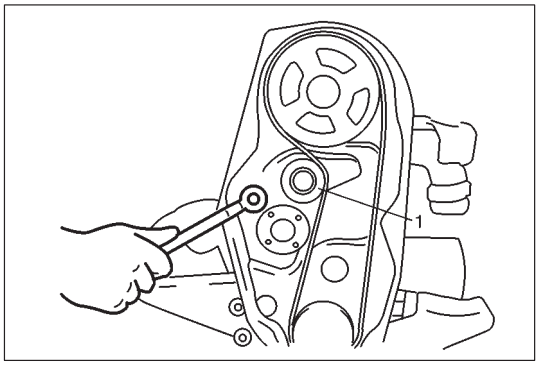


8) Remove crank pulley (1) similarly, by using special tool hitched to flywheel (2) so that crankshaft will not turn.

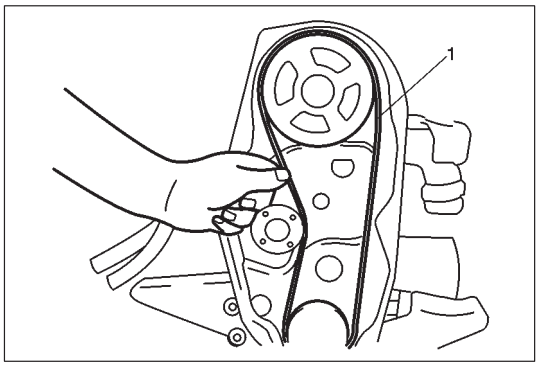
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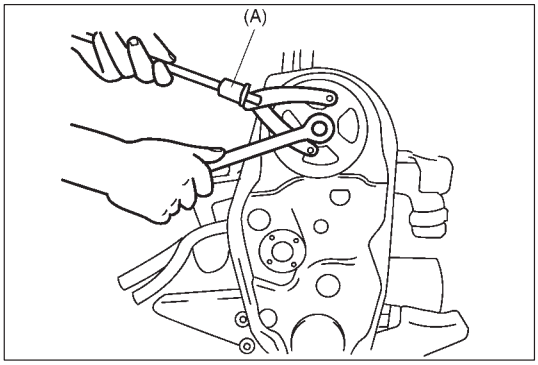
9) Remove water pump pulley and then remove timing belt cover (1).



10) Remove timing belt tensioner (1) after removing a part of tensioner spring from water pump securing bolt.

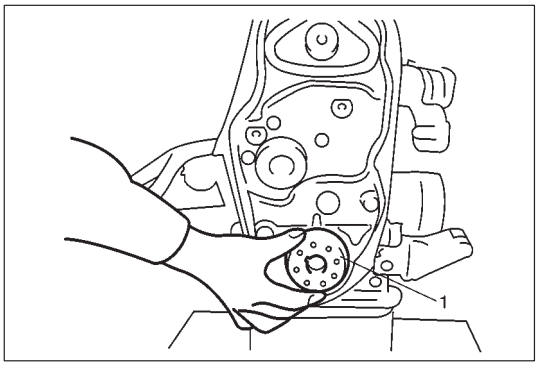


11) Remove timing belt (1).

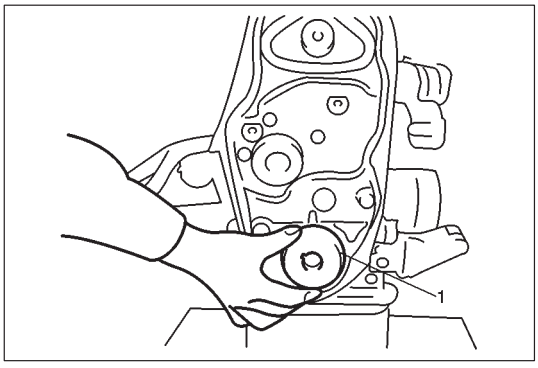


12) Remove camshaft timing belt pulley, by using special tool attached, as shown, to lock camshaft.

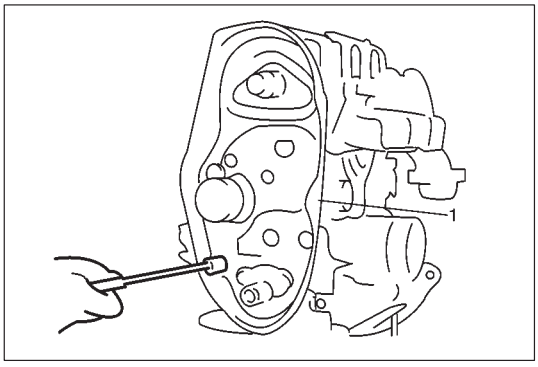
Special Tool
(A): 09930-40113



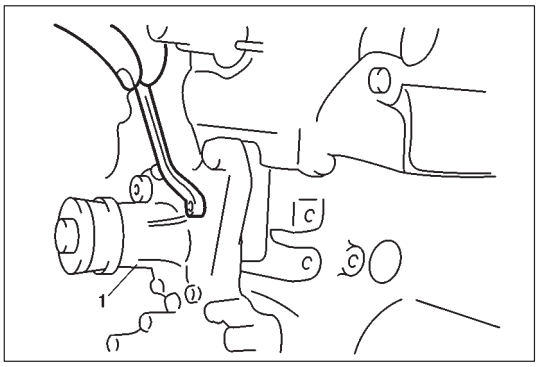
13) Similarly remove crankshaft timing belt pulley (1).



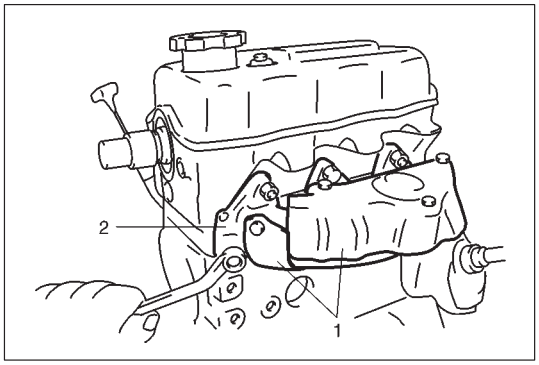
14) After removing pulley key, take out timing belt guide (1).



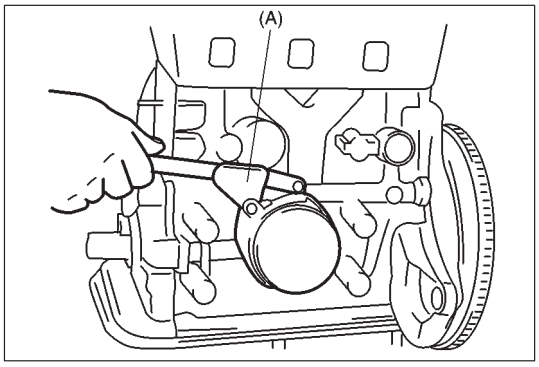
15) Remove timing belt inside cover (1).



16) Remove water pump case (1).



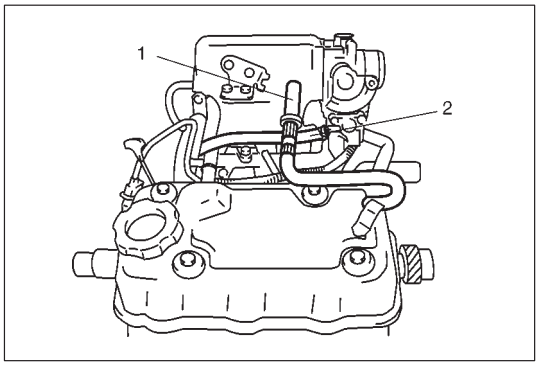
17) Remove exhaust manifold covers (1) and exhaust manifold (2).



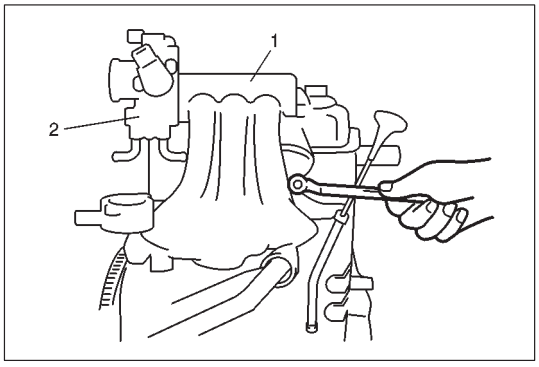
18) Remove oil filter by using special tool.

NOTE:
Be careful not to spill the oil when removing filter.

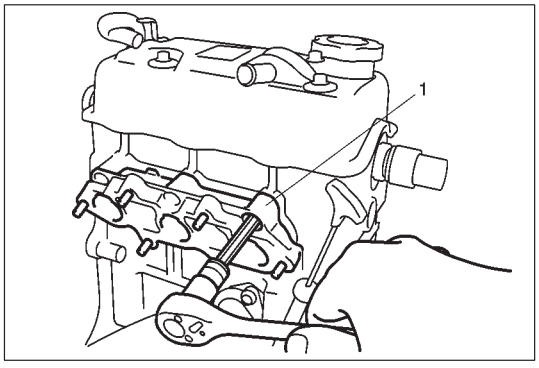
Special Tool
(A): 09915-47310



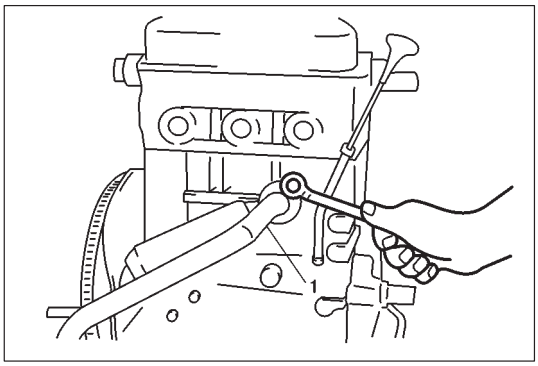
19) Disconnect PCV outlet hose (1) and bypass hose (2).



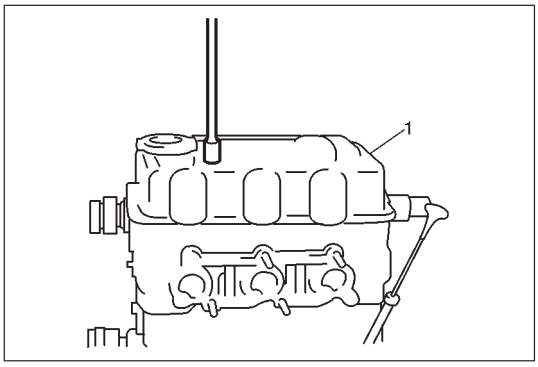
20) Remove intake manifold (1) with throttle body (2).



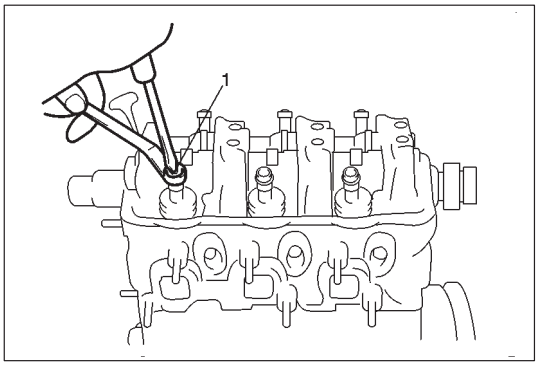
21) Remove intake manifold plate (1).



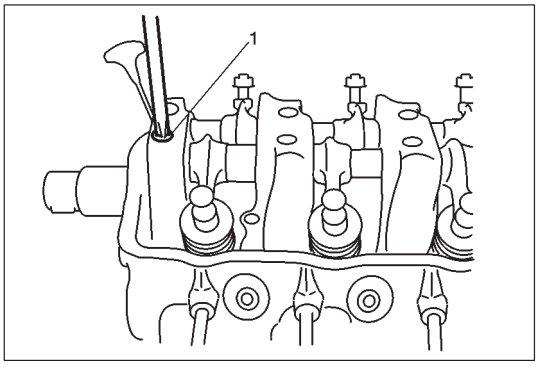
22) Remove water inlet pipe (1).



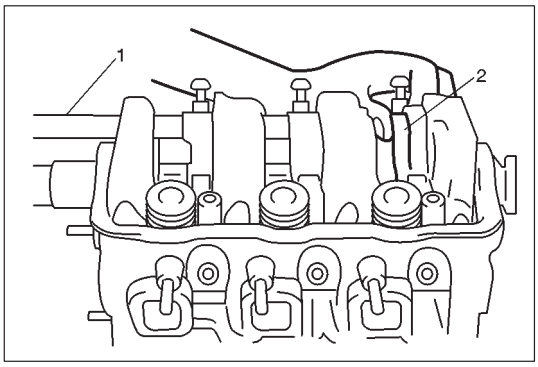
23) Remove cylinder head cover (1).



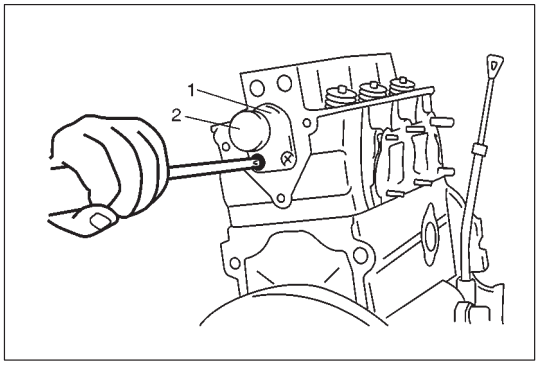
24) Loosen valve adjusting screws (1) fully.
Leave the screws in place.



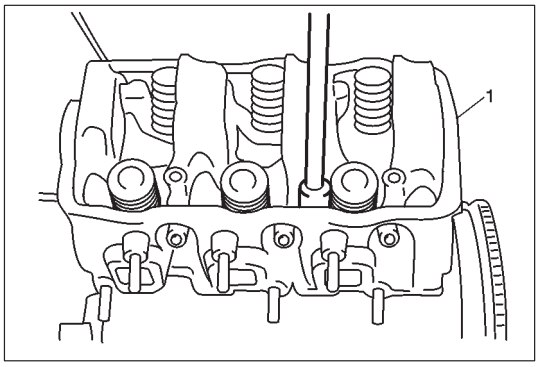
25) Loosen rocker arm shaft securing screws (1).



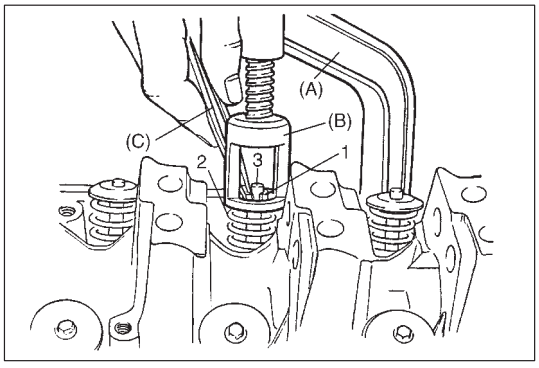
26) While drawing out rocker arm shaft (1), separate valve rocker arms (2) and rocker arm springs.



27) Remove camshaft thrust plate (1), and draw camshaft (2) out toward distributor gear case side.

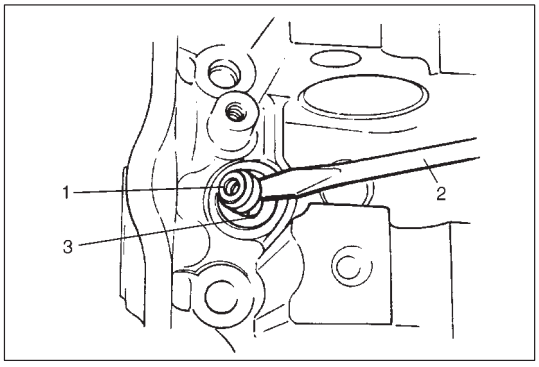


28) Remove cylinder head (1).



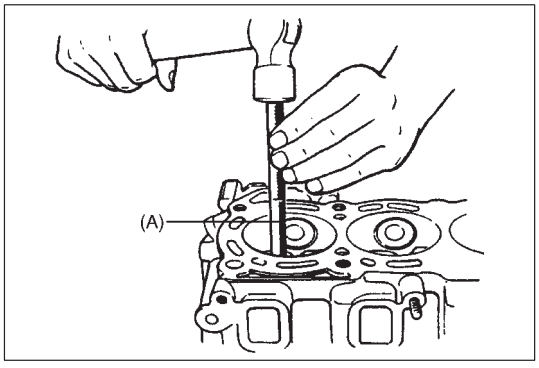
a) Using special tool (valve lifter) to compress valve spring and then remove valve cotters (1) by using special tool (Forceps). Release special tool, and remove valve spring (2) and valves (3).

Special Tool
(A): 09916-14510
(B): 09916-48210
(C): 09916-84511



b) Remove valve stem oil seal (1) from valve guide by using flat head rod (2) or the like, and then valve spring seat (3).

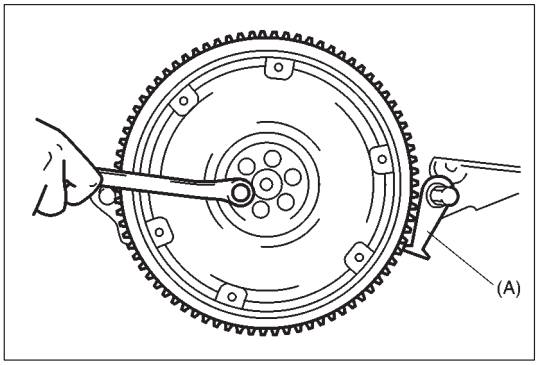
NOTE:
Do not reuse oil seal once disassembled. Be sure to use new oil seal when assembling.



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

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

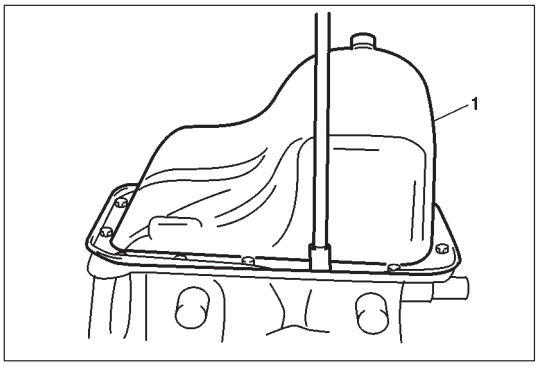
Special Tool
(A): 09916-44511



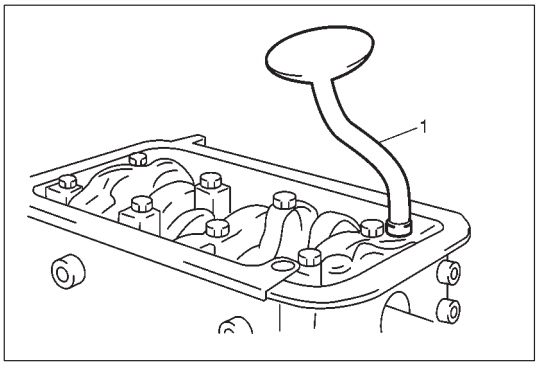
NOTE:
Place disassembled parts except valve stem oil seal and valve guide in order, so that they can be installed in their original positions.

29) Remove flywheel by using special tool as shown.

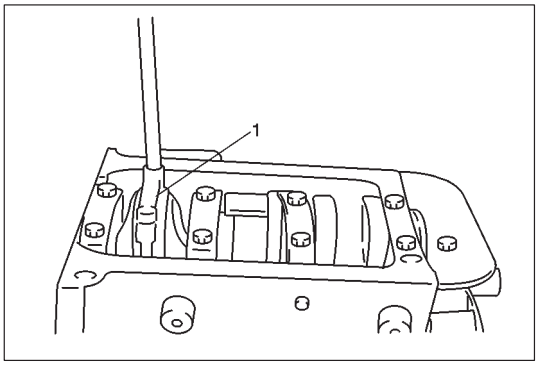
Special Tool
(A): 09924-17810



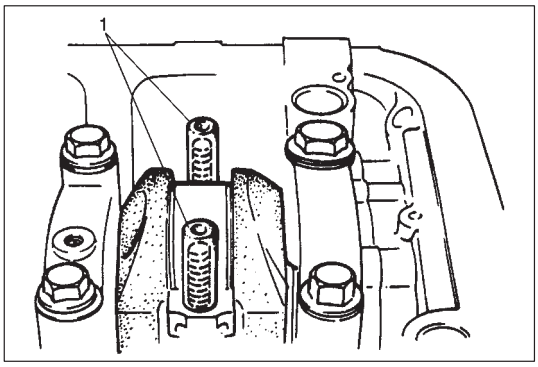
30) Remove oil level gauge and then remove oil pan (1).



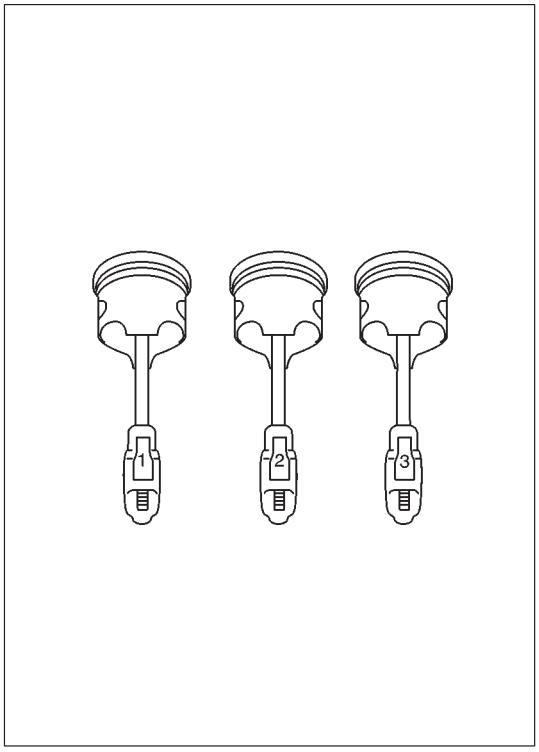
31) Remove oil pump strainer (1).



32) Remove connecting rod caps (1).

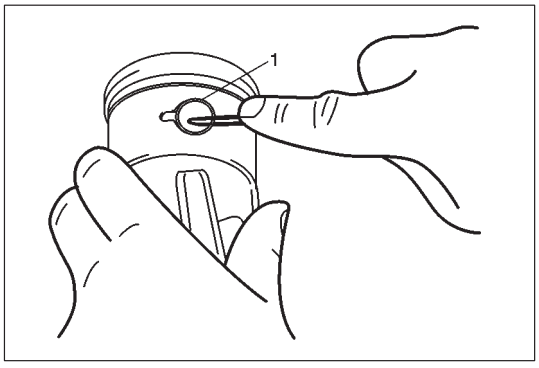


33) Install guide hose (1) over threads of rod bolts.
This is to prevent damage to bearing journal and cylinder wall when removing connection rod.

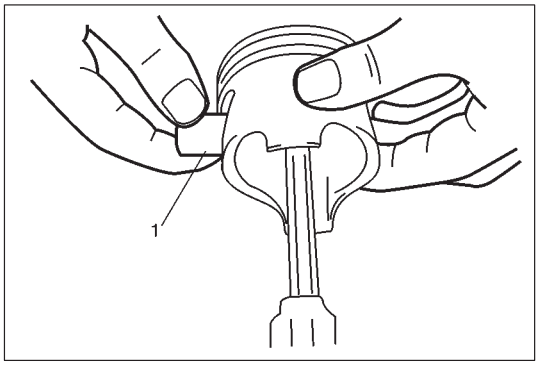


34) Decarbon top of cylinder bore, before removing piston from cylinder.
35) Push piston and connecting rod assembly out through the top of cylinder bore.

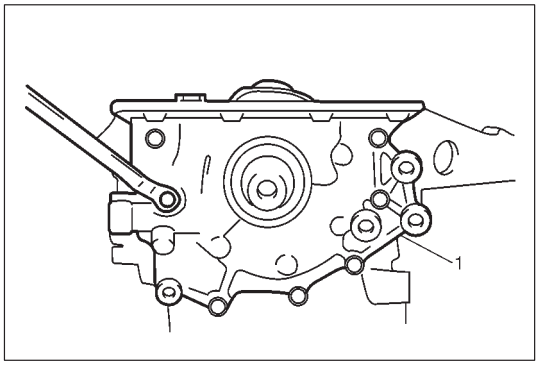
CAUTIONS:
- **Before pushing piston out, scribe cylinder number on its crown.**
- **Be sure to identify each bearing cap for its connecting rod by using cylinder number. Set cap and rod aside in combination.**



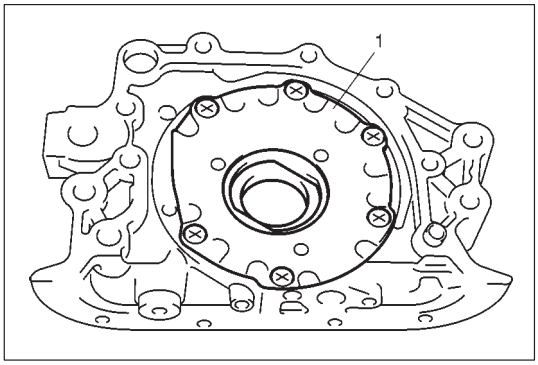
a) From each piston, ease out piston pin circlips (1), as shown.



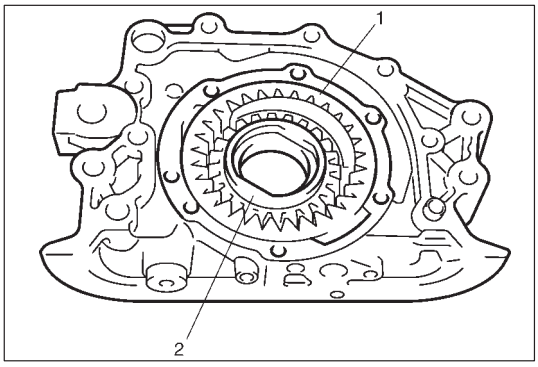
b) Force piston pin (1) out.



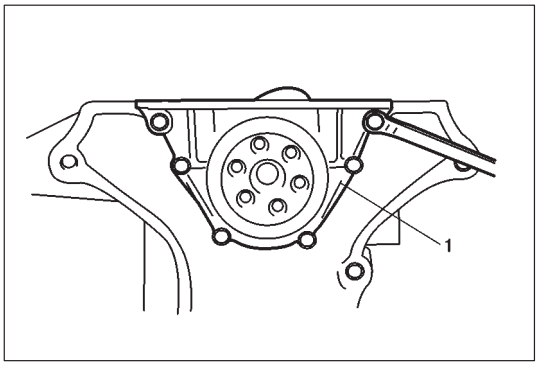
36) Remove oil pump case (1).



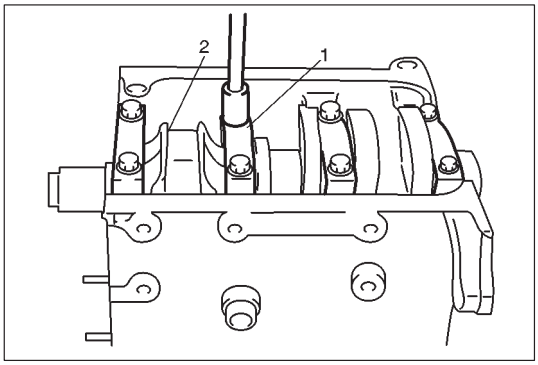
a) Remove oil pump gear plate (1).



b) Take out inner gear (2) and outer gear (1).



37) Remove oil seal housing (1).

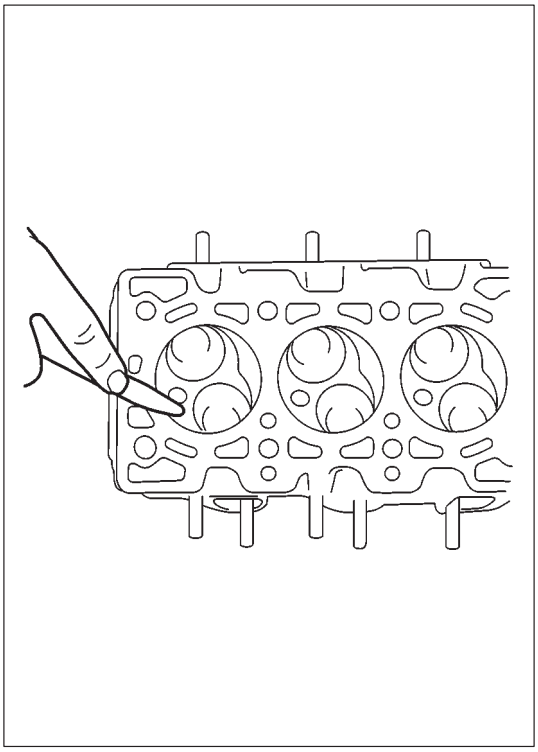


38) Remove crankshaft bearing caps (1), and take out crankshaft (2).

INSPECTION OF ENGINE COMPONENTS

NOTE:

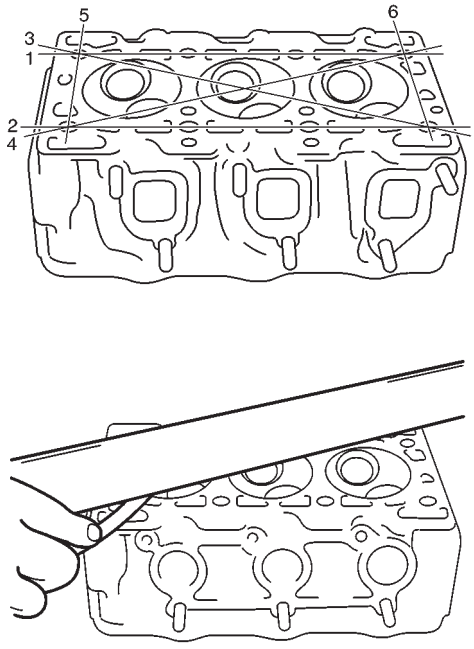
- **During and immediately after disassembly, inspect cylinder block and head for evidence of water leakage or damage and, after washing them clean, inspect more closely.**
- **Wash all disassembled parts clean, removing grease, slime, carbon and scales, before inspecting them to determine whether repair is necessary or not.**
  Be sure to de-scale the water jackets.
- **Use compressed air to clear internal oil holes and passages.**
- **Do not disturb the set combinations of valves, bearings and bearing caps, etc.**
  Have the sets segregated and identified.



Cylinder head

- De-carbon cylinder head:
  Deposits of carbon will be found on its combustion chamber surfaces and exhaust ports. Remember, overheating tendency and loss of output are often due to excessive carbon accumulation. De-carbon valves, too.

  NOTE:
  Do not use any sharp-edged tool to scrape off carbon. Be careful not to scuff or nick metal surfaces when de-carboning. This applies to valves and valve seats, too.

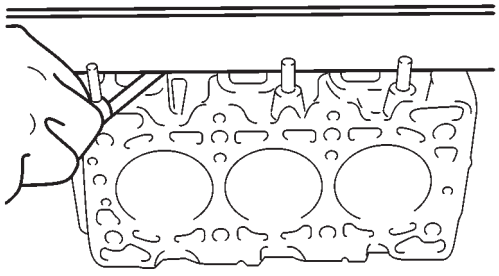


- Distortion of gasketed surface:
  Using a straightedge and thickness gauge, check the flatness at a total of 6 locations. If the limit, stated below, is exceeded, correct the gasketed surface with a surface plate and abrasive paper of about # 400 (waterproof silicon carbide abrasive paper): place the paper on and over the surface plate, and rub the gasketed surface against the paper to grind off high spots. Should this fail to reduce the thickness gauge readings to within the limit, replace the cylinder head.

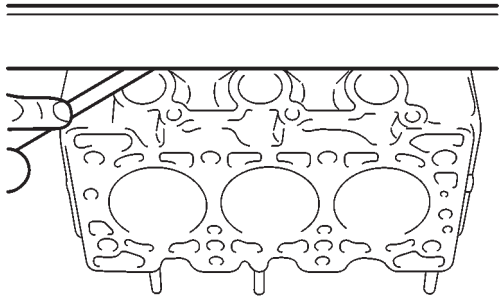
  Leakage of combustion gases from this gasketed joint is often due to warped gasketed surface; such leakage results in reduced power output and hence a higher cost of fuel per kilometer.

Limit of distortion	0.05 mm (0.002 in.)

Checking exhaust manifold seating face

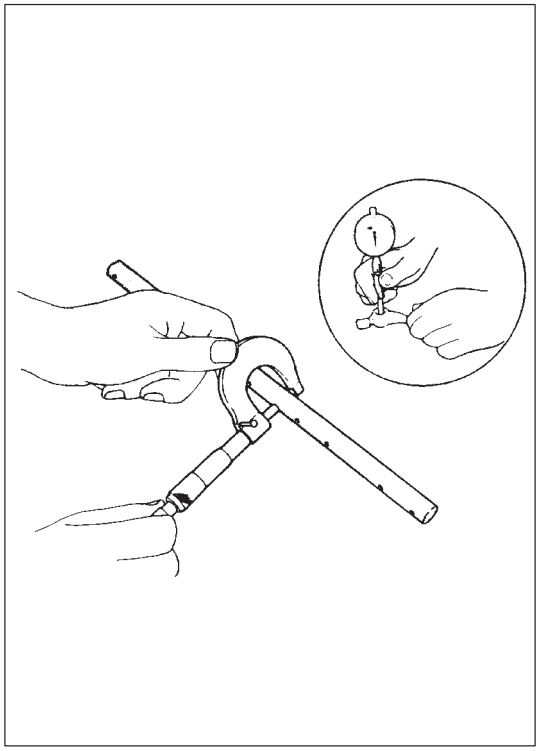


Checking intake manifold seating face



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

Limit of distortion	0.10 mm (0.004 in.)

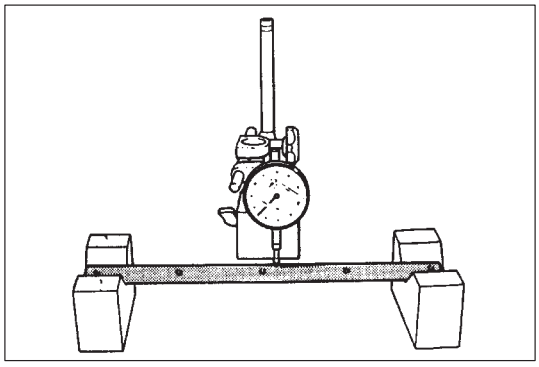


Rocker-arm shaft and rocker arms

- Wear:
  Check these parts for wear and, as necessary, replace them. The extent of wear is determined on the basis of two readings, one on rocker arm I.D. and the other on shaft diameter.

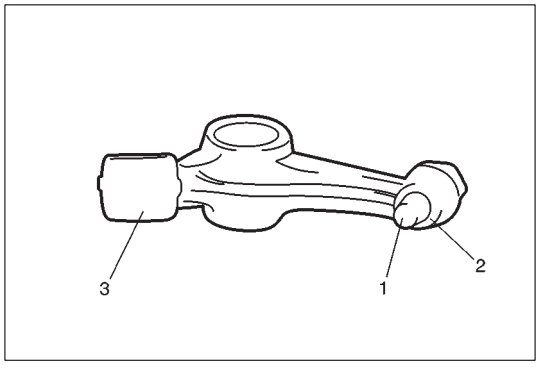
  NOTE:
  Use a micrometer on rocker-arm shaft and a bore gauge rocker arm. The difference between the two readings is the arm-to-shaft clearance on which a limit is specified. If the limit is exceeded, replace shaft or arm, or both.

Item	Standard	Limit
Rocker arm I.D.	15.000 – 15.018 mm (0.590 – 0.591 in.)	———
Rocker arm shaft dia.	14.983 – 14.994 mm (0.589 – 0.590 in.)	———
Arm-to-shaft clearance	0.006 – 0.035 mm (0.0002 – 0.0014 in.)	0.070 mm (0.0028 in.)

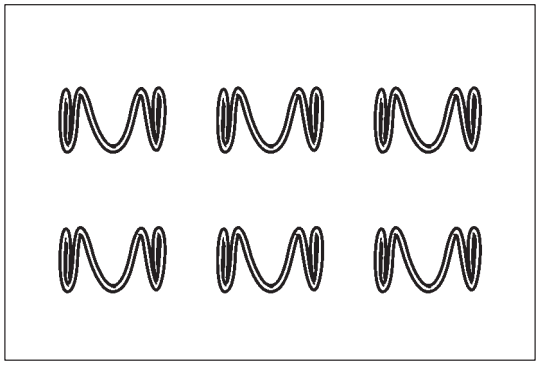


- Rocker-arm shaft deflection:
  Using “V” blocks and a dial gauge, check the shaft for straightness in terms of deflection.
  If the limit is exceeded, replace it.

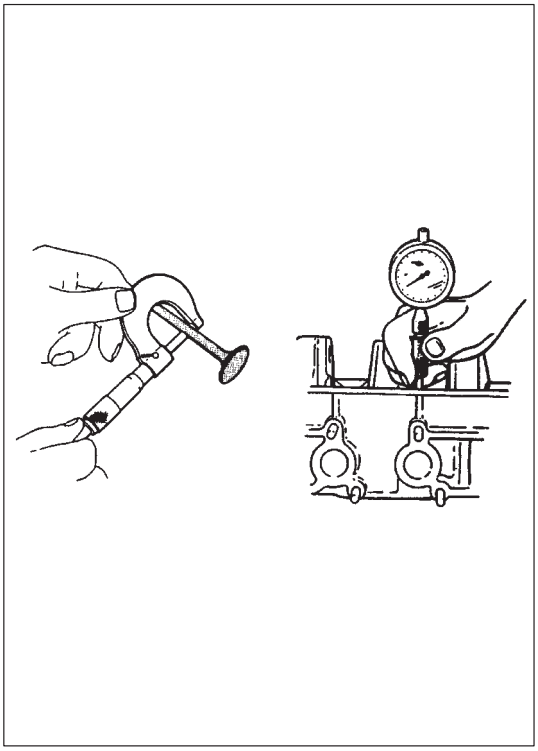
Deflection limit	0.06 mm (0.0024 in.)



- Wear of rocker-arm and adjusting screw:
  If the tip (1) of adjusting screw (2) is badly worn, replace the screw. The arm must be replaced if its cam-riding face (3) is badly worn.



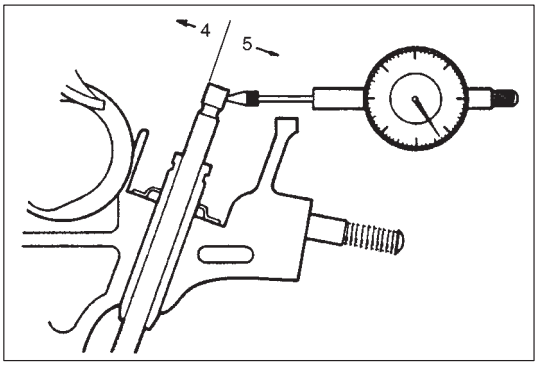
- Visually examine each rocker-arm spring for evidence of breakage or weakening. Be sure to replace springs found in bad condition.



Valve guides

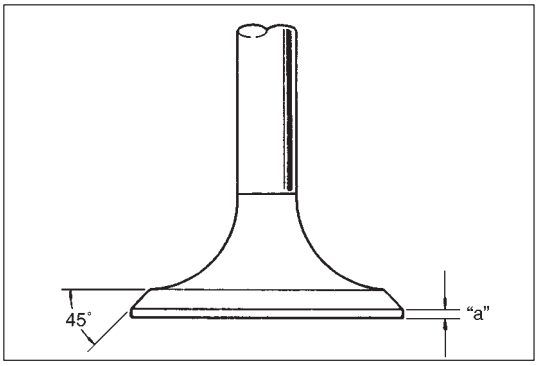
- Using a micrometer and bore gauge, take diameter readings on valve stems and guides to determine the stem clearance in the guide. Be sure to take a reading at more than one place along the length of each stem and guide.

Item		Standard	Limit
Valve stem diameter	In	6.965 – 6.980 mm (0.274 – 0.275 in.)	———
	Ex	6.950 – 6.970 mm (0.273 – 0.274 in.)	———
Valve guide I.D.	In	7.000 – 7.015 mm (0.275 – 0.276 in.)	———
	Ex		
Stem-to-guide clearance	In	0.020 – 0.050 mm (0.0008 – 0.0020 in.)	0.07 mm (0.0028 in.)
	Ex	0.030 – 0.065 mm (0.0012 – 0.0025 in.)	0.09 mm (0.0035 in.)



If the bore gauge is not available, check the end deflection of the valve stem in place with a dial gauge rigged. Move the stem end in the directions (4) (5) and determine whether replacement is necessary or not, by referring to these limiting values:

Valve stem end deflection	Intake	0.12 mm (0.0047 in.)
	Exhaust	0.16 mm (0.0063 in.)

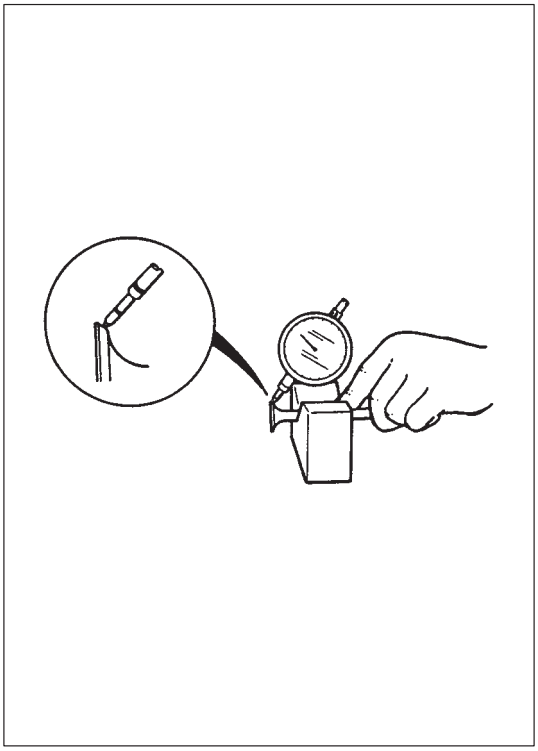


Valves

- Inspect each valve for wear, burn or distortion at its face and stem and, as necessary, replace it.
- Measure the thickness "a" of valve head. If the limit given to this thickness is exceeded, the valve must be replaced.

Valve head thickness "a"

Standard	Limit	
0.8 – 1.2 mm	Intake	0.6 mm (0.024 in.)
	Exhaust	0.7 mm (0.028 in.)



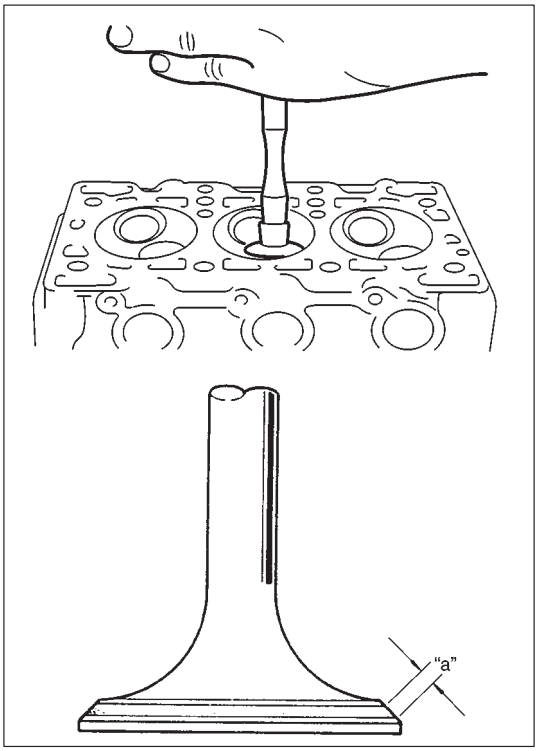
- Check the end face of each valve stem for wear. This face meets the rocker arm intermittently in operation, and might become concaved or otherwise irregular. As necessary, smoothen the end face with an oil stone and, if this grinding removes the end stock by as much as 0.5 mm (0.0196 in.) (as measured from the original face), replace the valve.

Limit on stock allowance of valve stem end face	0.5 mm (0.0196 in.)

- Check each valve for radial runout with a dial gauge and "V" block. The object of this check is to determine whether the valve stem is true and square relative to the head.

Limit on valve head radial runout	0.08 mm (0.0031 in.)

If the limit is exceeded, do not attempt to correct the stem; replace the valve, instead.



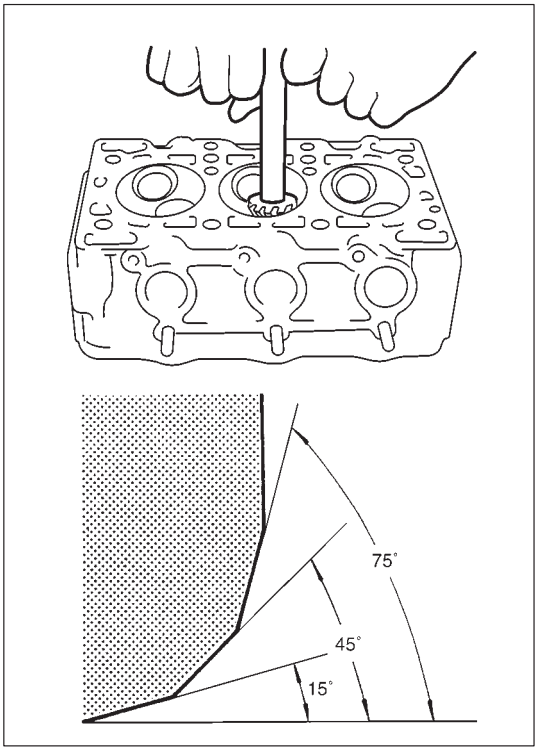
Valve seats

CAUTION:
The valves to be checked and serviced for seating width and contact pattern must be those found satisfactory in regard to stem clearance in the guide and also the requirements stated in the preceding part titled VALVES.

- Seating contact width:
  Produce a contact pattern on each valve in the usual manner, namely, by giving a uniform coat of marking compound (Red-lead paste) to the valve seat and by rotatingly tapping the seat with the valve head. The valve lapper (the tool used in valve lapping) must be used.

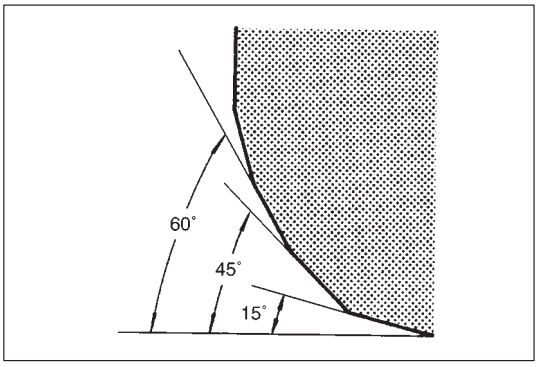
  The pattern produced on the seating face of the valve must be a continuous ring without any break, and the width "a" of the pattern must be within the stated range.

"a"	Standard seating width revealed by contact pattern on valve face	Intake	1.3 – 1.5 mm (0.05 – 0.06 in.)
		Exhaust	



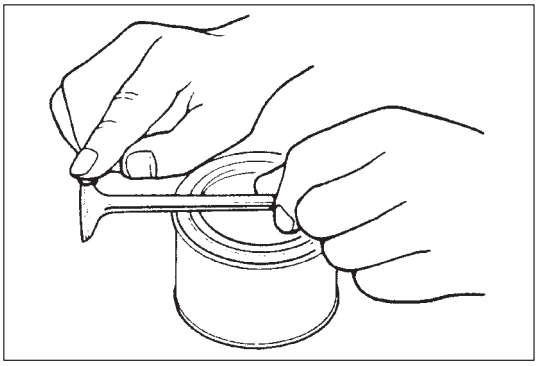
- Valve seat repair:
  A valve seat not producing a uniform contact with its valve or showing a width of the seating contact that is off the specified range must be repaired by regrinding or by cutting and regrinding and finished by lapping.
  1) EXHAUST VALVE SEAT: Use a valve seat cutter to make three cuts in the order illustrated in figure. Three cutters must be used: the first for making the 15° angle, the second for making the 75° angle and the last for making the 45° seat angle. The third cut must be made to produce the desired seat width.

Seat width for exhaust valve seat	1.3 – 1.5 mm (0.0512 – 0.0591 in.)

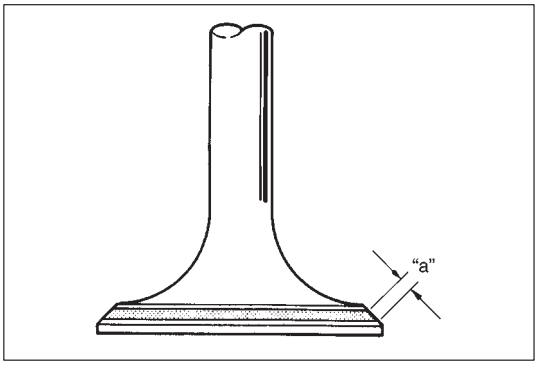


  2) INTAKE VALVE SEAT: The cutting sequence is the same as for exhaust valve seats but the second angle differs, as will be noted in figure.

Seat width for intake valve seat	1.3 – 1.5 mm (0.0512 – 0.0591 in.)

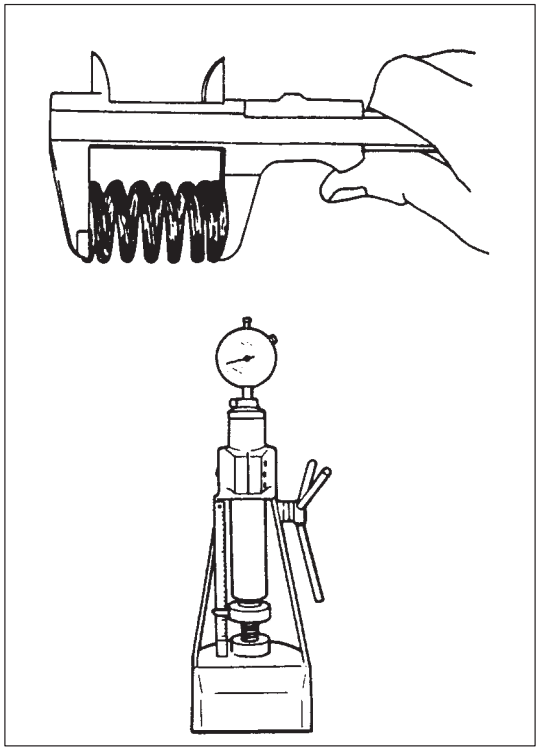


  3) VALVE LAPPING: Lap the valve on the seat in two steps, first with a coarsesize lapping compound applied to the face and the second with a fine-size compound, each time using a valve lapper according to the usual lapping method.



NOTE:

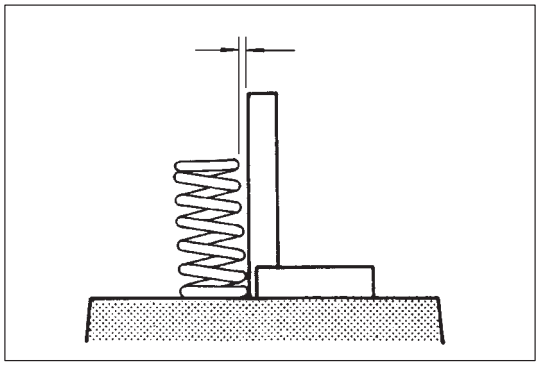
- **After lapping, wipe the compound off the valve face and seat, and produce a contact pattern with a marking compound (red-lead paste). Check to be sure that the contact is centered widthwise "a" on the valve seat and that there is no break in the contact pattern ring.**
- **Be sure to check and, as necessary, adjust the valve clearance after re-installing the cylinder head and valve mechanism.**



Valve springs

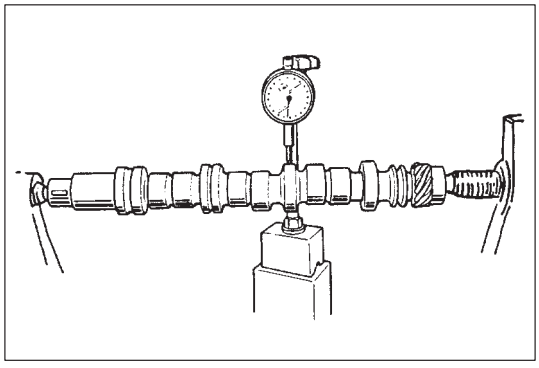
- Referring to the criterion data given below, check to be sure that each spring is in sound condition, free of any evidence of breakage or weakening. Remember, weakened valve springs can be the cause of chatter, not to mention the possibility of reducing the power output due to gas leakage caused by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

Item	Standard	Limit
Valve spring free length	48.9 mm (1.925 in.)	47.6 mm (1.874 in.)
Valve spring pre-load	23.6 – 27.6 kg for 40 mm (52.0 – 60.8 lb/1.57 in.)	22.0 kg for 40 mm (48.5 lb/1.57 in.)



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

Valve spring squareness limit	2.0 mm (0.079 in.)

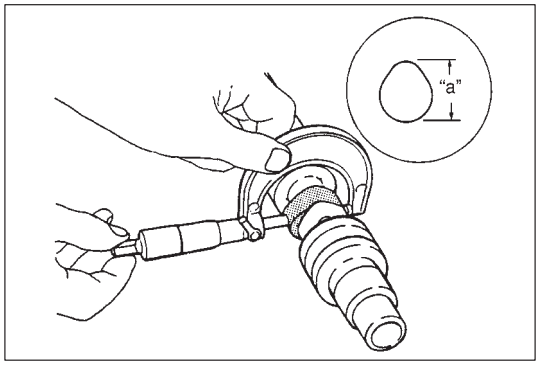


Camshaft

A noisy engine or an engine producing not enough power is frequently due to its camshaft excessively worn or bent or bowed. The wear could occur on its cams and journals.

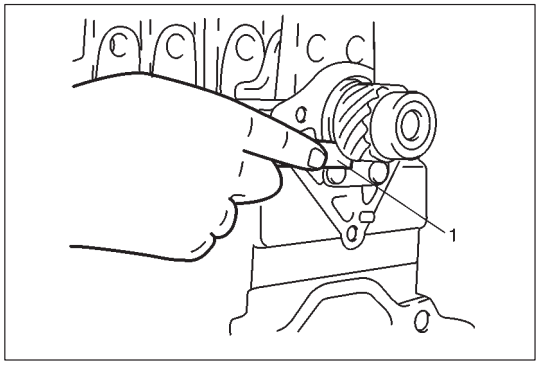
- Camshaft runout:
  Hold the camshaft between two center points, with a dial gauge rigged up to measure its runout. Replace the camshaft if the amount of runout so measured exceeds the limit.

Camshaft runout limit	0.10 mm (0.0039 in.)



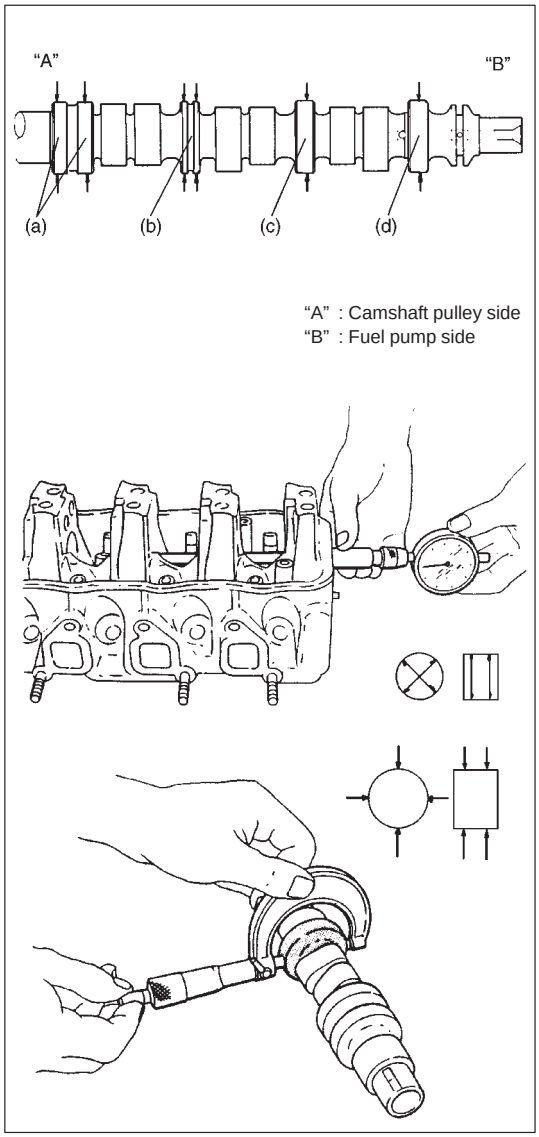
- Cam wear:
  Measure the height "a" of each cam. If any of the micrometer readings taken is down to or less than the limit, replace the camshaft.

Cam height "a"	Standard	Limit
Intake cam	36.152 mm (1.423 in.)	36.100 mm (1.421 in.)
Exhaust cam		
Pump drive cam	33.300 mm (1.311 in.)	33.000 mm (1.299 in.)



- Thrust clearance:
  Using a thickness gauge (1), measure this clearance as shown in figure, at the thrust plate. If the limit is exceeded, replace thrust plate or camshaft.

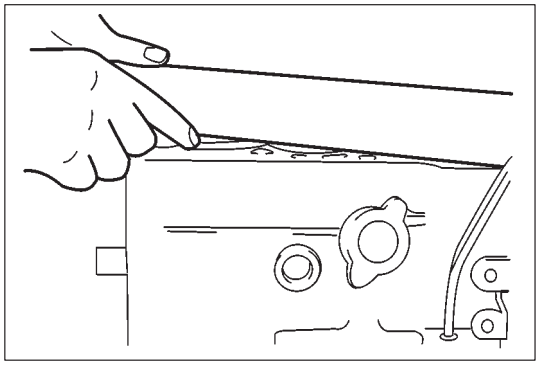
Item	Standard	Limit
Thrust clearance	0.050 – 0.150 mm (0.002 – 0.006 in.)	0.300 mm (0.012 in.)



- Journal wear:
  Measure the journal diameter in two directions at two places to obtain four readings on each journal; and check the journal bores with a bore gauge, producing four readings on each. From these readings, compute the radial clearance (camshaft journal clearance). If the service limit is exceeded by any of the computed radial clearances, replace the camshaft and, as necessary, cylinder head, too.

Item	Standard	Limit
Journal clearance	0.050 – 0.091 mm (0.0020 – 0.0036 in.)	0.15 mm (0.0060 in.)

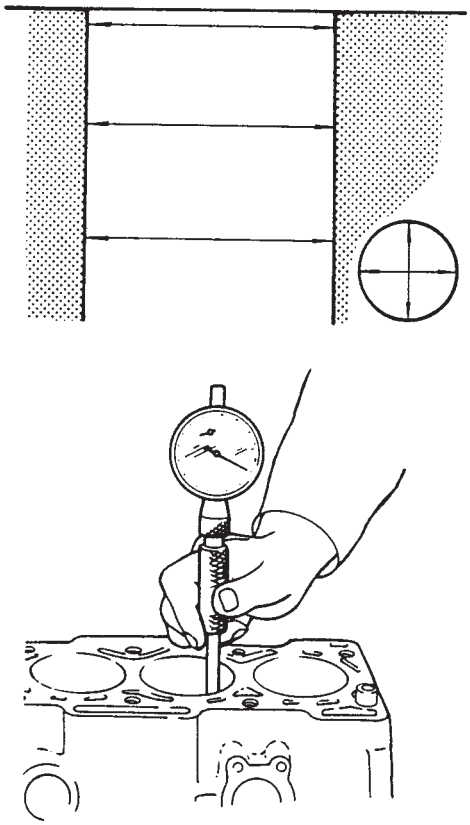
Camshaft journal dia.		Journal bore dia.
(a)	43.425 – 43.450 mm (1.710 – 1.711 in.)	43.500 – 43.516 mm (1.712 – 1.713 in.)
(b)	43.625 – 43.650 mm (1.718 – 1.719 in.)	43.700 – 43.716 mm (1.720 – 1.721 in.)
(c)	43.825 – 43.850 mm (1.725 – 1.726 in.)	43.900 – 43.916 mm (1.728 – 1.729 in.)
(d)	44.025 – 44.050 mm (1.733 – 1.734 in.)	44.100 – 44.116 mm (1.736 – 1.737 in.)



Cylinder block

- Distortion of gasketed surface:
  By the same method that is prescribed for checking the distortion of the gasketed surface of the cylinder head, check the top face of the cylinder block for distortion and, if the distortion is found to exceed the limit, machine the face with a surface grinder.

	Standard	Limit
Distortion of gasketed surface	0.03 mm (0.0012 in.)	0.05 mm (0.0020 in.)



- Cylinder bore:
  Using a cylinder bore gauge, measure the diameter of each bore in two directions, longitudinal and transverse, at three places, top, middle and bottom, to obtain a total of 6 readings. On the basis of these readings taken on each bore, determine whether the maximum difference in diameter between any two bores exceeds the limit. If the limit, stated below, is exceeded or if the bore wall is badly scored or burned, re-bore all cylinders to the next oversize and use oversize pistons in engine reassembly.

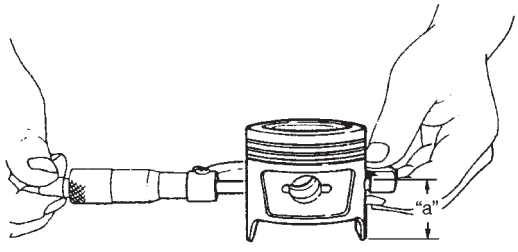
Piston oversize	0.25 mm (0.0098 in.)
	0.50 mm (0.0196 in.)

CAUTION:
If any one of the three cylinders has to be re-bored, re-bore the three to the same next oversize. This is necessary for the sake of uniformity and balance.

When replacing the pistons or installing oversize pistons, be sure that the piston-to-cylinder clearance comes within the stated range:

Wear limit on bore	0.05 mm (0.0020 in.)

Piston-to-cylinder clearance	0.045 – 0.055 mm (0.0018 – 0.0022 in.)

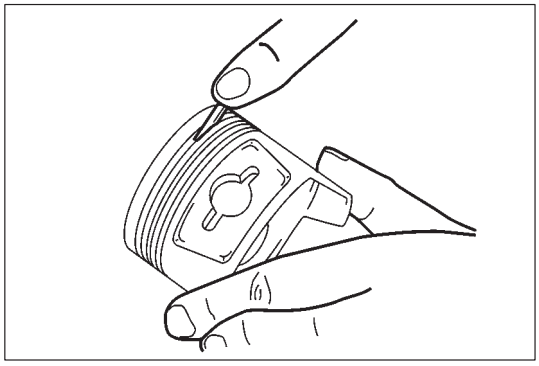


"a". 30 mm (1.18 in.)

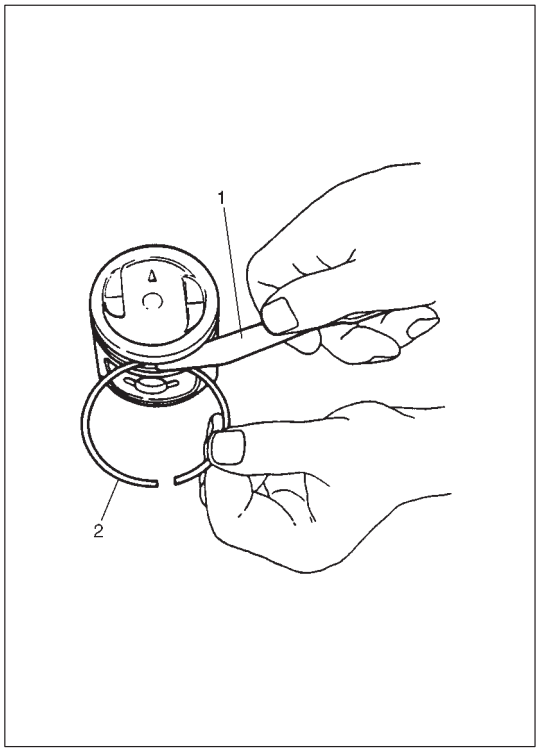
Piston and piston rings

- Piston diameter:
  Piston-to-cylinder clearance, mentioned above, is equal to the bore diameter minus the piston diameter, which is to be measured by measuring at the level of the piston in the direction transverse to piston pin axis, as shown in below figure. This level from the skirt end is 30 mm (1.18 in.) high.

Piston diameter	Standard	68.450 – 68.475 mm (2.6949 – 2.6959 in.)
	Oversize: 0.25 mm (0.0098 in.)	68.720 – 68.740 mm (2.7055 – 2.7063 in.)
	0.50 mm (0.0196 in.)	68.970 – 68.990 mm (2.7154 – 2.7161 in.)



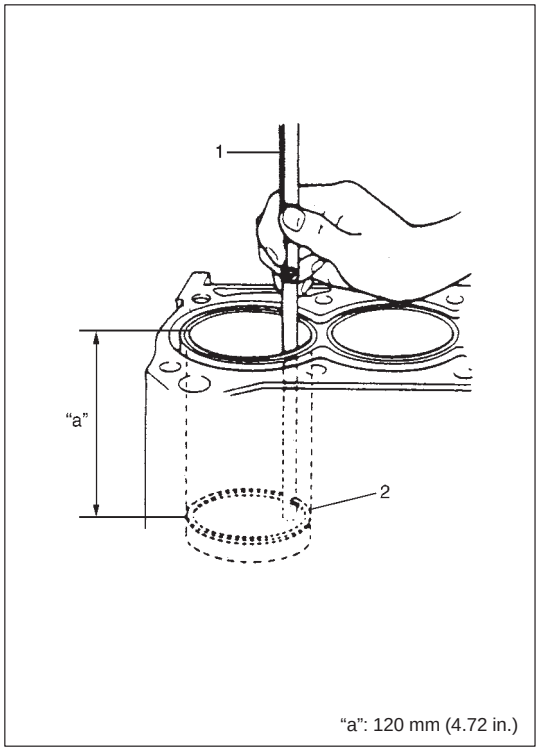
- Inspect the outer surface of each cylinder for evidence of burn and for scratch or groove marks. Minor flaws can be removed by grinding with fine-grain sandpaper.
- De-carbon the piston crown and ring grooves, using a soft-metal scraping tool.



- Ring clearance in the groove:
  Using a thickness gauge (1), check each piston ring (2) in its groove for side clearance and, if the limit stated below is exceeded, measure the groove width and ring width to determine whether the piston or the ring or both have to be replaced.

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

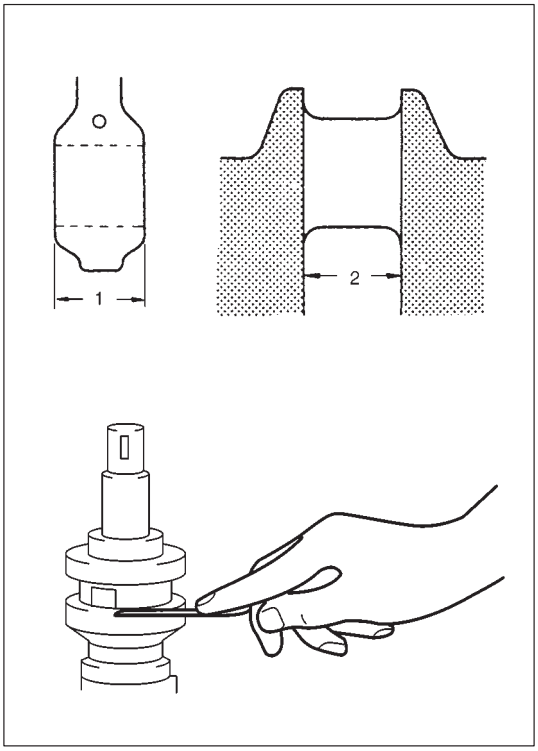
Piston ring thickness	Top ring	1.47 – 1.49 mm (0.0579 – 0.0587 in.)
	2nd ring	
	Oil ring	0.45 mm (0.0177 in.)
Ring groove width	Top ring	1.52 – 1.54 mm (0.0598 – 0.0606 in.)
	2nd ring	1.51 – 1.53 mm (0.0594 – 0.0602 in.)
	Oil ring	2.81 – 2.83 mm (0.1106 – 0.1114 in.)



"a": 120 mm (4.72 in.)

- Piston ring end gap:
  To measure the end gap, insert the piston ring (2) into the cylinder bore, locating it at the lowest part of the bore and holding it true and square; then use a thickness gauge (1) to measure the gap. If the gap measured exceeds the limit, replace the ring.

Item		Standard	Limit
Piston ring end gap	Top ring	0.15 – 0.30 mm (0.006 – 0.012 in.)	0.7 mm (0.028 in.)
	2nd ring	0.10 – 0.30 mm (0.004 – 0.012 in.)	0.7 mm (0.028 in.)
	Oil ring	0.20 – 0.70 mm (0.008 – 0.028 in.)	1.8 mm (0.040 in.)

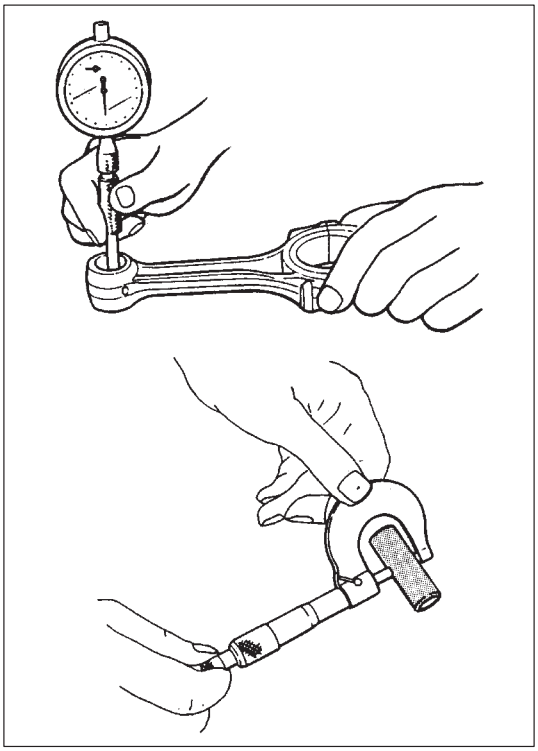


Connecting rods

- Big-end thrust clearance:
  Check the big end of each connecting rod for thrust clearance, with the rod fitted and connected to its crank pin in the normal manner. If the clearance measured is found to exceed the limit, the connecting rod or the crankshaft, whichever is responsible for the excessive clearance, must be replaced.

Item	Standard	Limit
Big-end thrust clearance	0.10 – 0.20 mm (0.004 – 0.008 in.)	0.30 mm (0.012 in.)

(1) Width of big end	21.95 – 22.00 mm (0.864 – 0.866 in.)
(2) Width of crank pin	22.10 – 22.15 mm (0.870 – 0.872 in.)



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

Limit on bow	0.05 mm (0.002 in.)
Limit on twist	0.10 mm (0.004 in.)

- Inspect the small end of each connecting rod for wear and evidence of crack or any other damage, paying particular attention to the condition of its bush. Check the piston pin clearance in the small end. Replace the connecting rod if its small end is badly worn or damaged or if the clearance checked exceeds the limit.

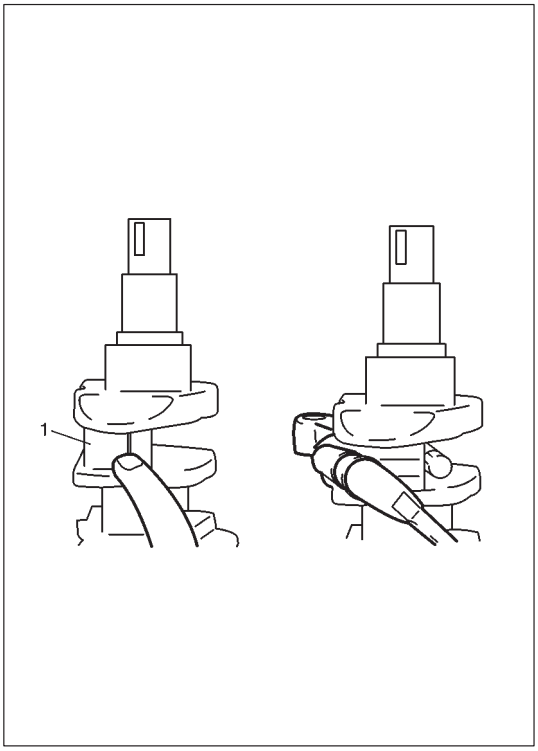
Item	Standard	Limit
Pin clearance in small end	0.003 – 0.016 mm (0.0001 – 0.0006 in.)	0.05 mm (0.0020 in.)

Small-end I.D.	16.003 – 16.011 mm (0.6300 – 0.6304 in.)
Piston pin dia.	15.995 – 16.000 mm (0.6297 – 0.6299 in.)

Connecting-rod big end bearings

- Inspect the bearing shells for signs of fusion, pitting, burn or flaking and observe the contact pattern. Bearings found in defective condition through this inspection must be replaced.

CAUTION:
Bearing shells are not meant to be repaired by scraping or grinding with sandpaper or by any machining. The remedy is to replace them.

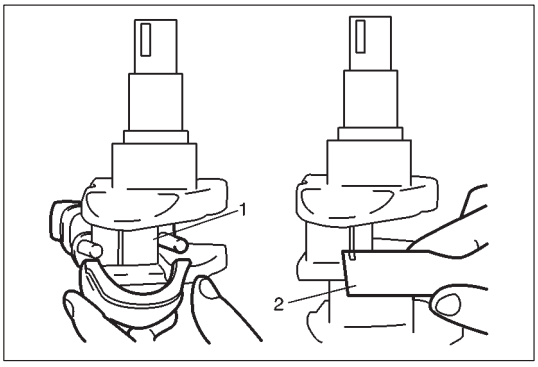


- Crankpin-to-bearing clearance:
  Check this clearance by using gaging plastic (1). Here's how to use gaging plastic:
  1) Prepare, by cutting, a length of gaging plastic roughly equal to bearing width and place it axially on crankpin, avoiding the oil hole.
  2) Make up the big end in the normal manner, with bearing shells in place and by tightening the cap to the specification.

NOTE:
Never rotate crankshaft or turn connecting rod when a piece of gaging plastic is in the radial clearance.

Tightening Torque
(a): 30 N·m (3.0 kg-m, 22.0 lb-ft)

NOTE:
When fitting bearing cap to crankpin, be sure to discriminate between its two ends, right and left.



3) Remove the cap, and measure the width of flattened gaging plastic (1) piece with the gaging plastic envelope scale (2). This measurement must be taken at the widest part.

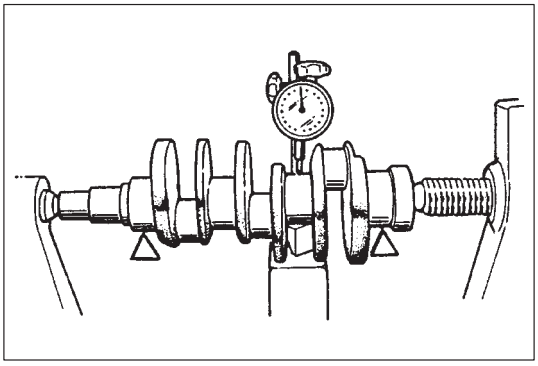
Item	Standard	Limit
Crankpin-to-bearing clearance	0.020 – 0.040 mm (0.0008 – 0.0016 in.)	0.080 mm (0.0031 in.)

4) If the limit, indicated above, is exceeded, re-grind the crankpin to the undersize and use the undersize bearing, both of which are stated below:

Bearing size	Crankpin diameter
Standard	37.982 – 38.000 mm (1.4953 – 1.4960 in.)
0.25 mm undersize	37.732 – 37.750 mm (1.4855 – 1.4862 in.)
0.50 mm undersize	37.482 – 37.500 mm (1.4757 – 1.4764 in.)

Where undersize bearings are used, the clearance specification is slightly lenient:

Radial clearance for undersize bearing	0.020 – 0.070 mm (0.0008 – 0.0028 in.)

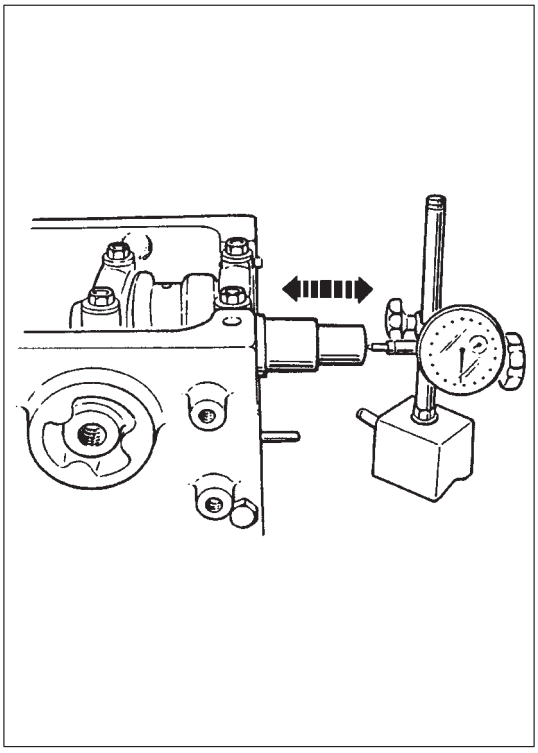


Crankshaft

- Runout:
  Check the crankshaft for runout and if the dial gauge reading exceeds the limit, replace the crankshaft.

Limit on crankshaft runout	0.06 mm (0.002 in.)

NOTE:
Measure the runout at the center journal. Rotate the crankshaft slowly.

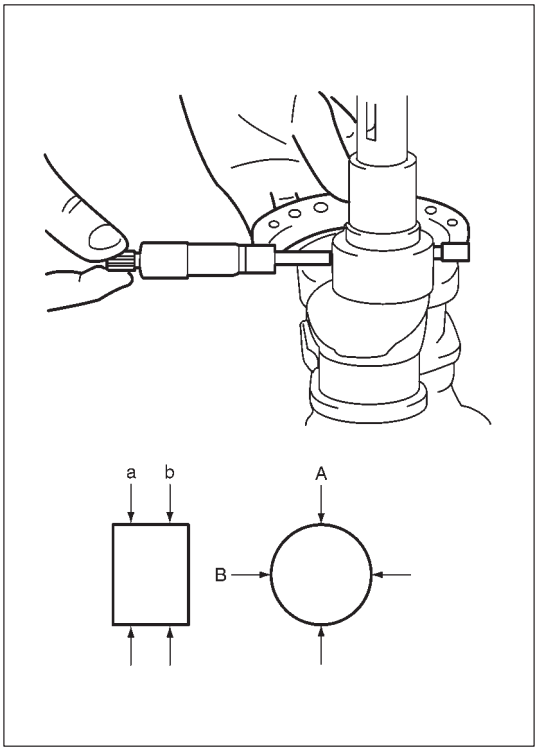


- Crankshaft thrust play:
  Measure this play with crankshaft set in the cylinder block in the normal manner, that is, with the thrust bearing fitted and the bearing caps installed. Tighten bearing cap bolts to specified torque. Use a dial gauge to read the displacement in axial (thrust) direction of the crankshaft. If the limit is exceeded, replace thrust bearing with new standard one or oversize one to obtain standard thrust play.

Item	Standard	Limit
Crankshaft thrust play	0.13 – 0.28 mm (0.005 – 0.011 in.)	0.35 mm (0.014 in.)

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.)
	Oversize:	0.250 mm (0.0098 in.)	2.625 mm (0.1033 in.)

Tightening Torque
(a): 46 N·m (4.6 kg-m, 33.5 lb-ft)



- Out-of-round and taper (uneven wear):
  An unevenly worn crankshaft journal or crankpin shows up as a difference in diameter at a cross section or along its length (or both). This difference, if any, is to be determined from micrometer readings taken as shown in figure.
  If any of the journals or crankpins is badly damaged or if the amount of uneven wear in the sense explained above exceeds the limit, repair (by re-grinding) or replace the crankshaft.

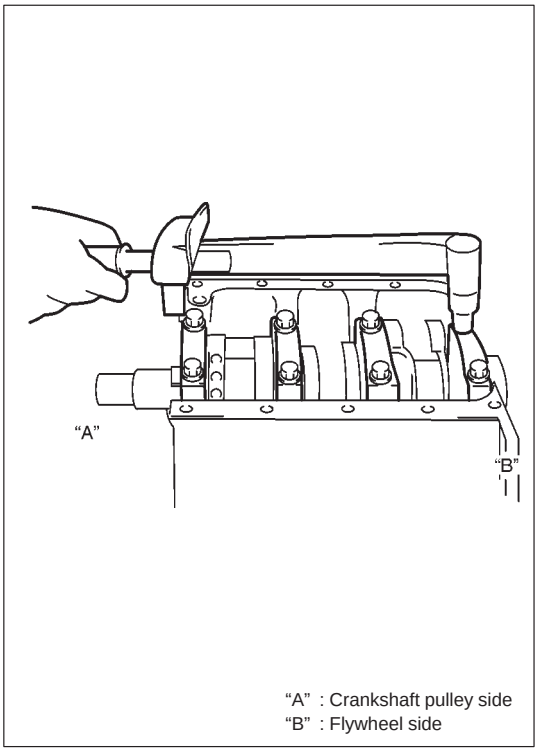
Limit on uneven wear	0.01 mm (0.0004 in.)

NOTE:
Where journal or crankpin re-grinding is necessary, finish the diameter to the size necessary for the undersize bearing. (Refer to Crankpin-to-bearing clearance of previous page.)

Crankshaft journal bearings

- Inspect the bearing shells for signs of fusion, pitting, burn or flaking and observe the contact pattern. Defective shells must be replaced.

CAUTION:
As in the case of connecting-rod bearings, the journal bearing shells are not meant to be repaired by scraping or grinding with sandpaper or by any machining.

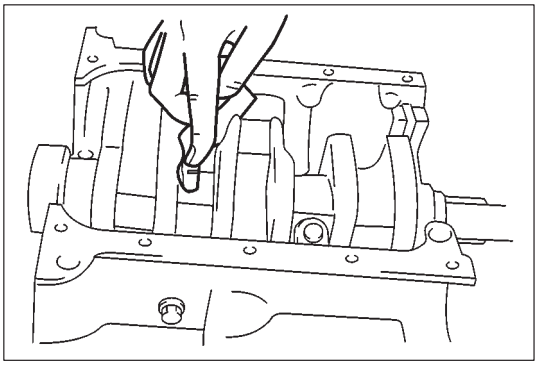


"A" : Crankshaft pulley side
"B" : Flywheel side

- Journal-to-bearing clearance:
  Check this clearance by using gaging plastic. The following method is based on the use of gaging plastic:
  1) Cut the gaging plastic stock to the required length (equal to the width of the bearing), and place it axially on the journal, avoiding the oil hole.
  2) Mount the crankshaft in the usual manner, tightening the bearing caps to the specified torque value. (It is assumed that a gaging plastic piece is pinched at each journal.)
     Do not rotate the crankshaft when gaging plastic is in.

Tightening Torque
(a): 46 N·m (4.6 kg-m, 33.5 lb-ft)

CAUTION:
Each of the four bearing caps has an arrow marked on it. Be sure to position each cap with its arrow pointing to crankshaft pulley side and to match it (by the cylinder number) to its journal. Remember, the three cylinders are numbered, 1, 2 and 3, as counted from crankshaft pulley side.



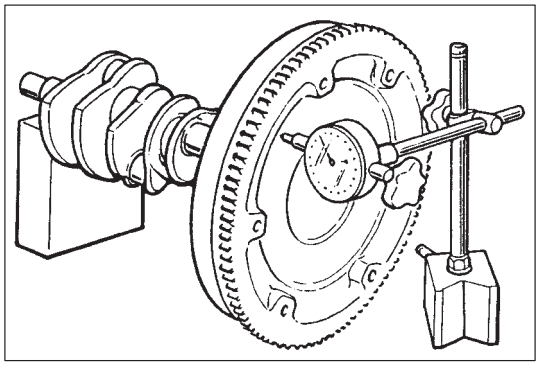
3) Remove the caps. By referring to the envelop scale, measure the width of the widest part of the piece, and determine whether the radial clearance checked (obtained from the gaging plastic piece) is within the limit.

Item	Standard	Limit
Journal-to-bearing clearance	0.020 – 0.040 mm (0.0008 – 0.0016 in.)	0.080 mm (0.003 in.)

4) If the limit is exceeded, re-grind the journals to the undersize and use the undersize bearing.

Bearing size	Journal diameter
Standard	49.982 – 50.000 mm (1.9678 – 1.9685 in.)
0.25 mm undersize	49.744 – 49.750 mm (1.9584 – 1.9587 in.)
0.50 mm undersize	49.494 – 49.500 mm (1.9486 – 1.9488 in.)

Radial clearance for undersize bearing	0.020 – 0.070 mm (0.0008 – 0.0028 in.)

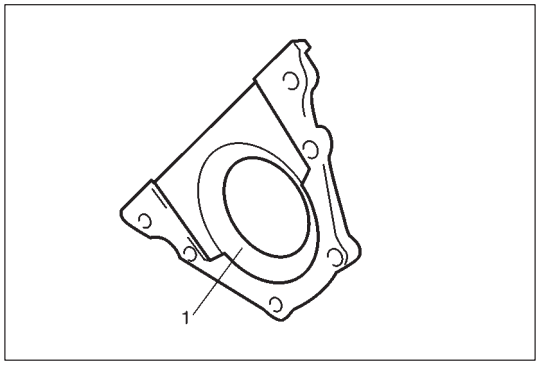


Flywheel

- Inspect the friction surface – the surface in contact with clutch disc – for wear and damage. Most of surface flaws, if any, can be removed by simple machining. A badly damaged flywheel must be replaced.
- Face runout:
  Check the flywheel for face runout with a dial gauge, as shown in figure. Be sure that the runout is less than the limit.

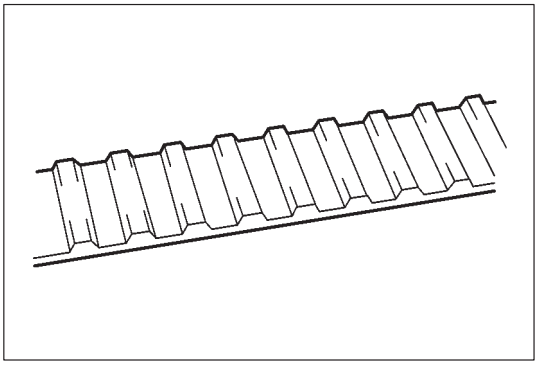
Limit on runout	0.2 mm (0.008 in.)

- Ring gear tooth wear:
  Inspect the teeth for wear and for evidence of crack, chipping or any other damage. Replace the ring gear if its teeth are found in bad condition.



Oil seals

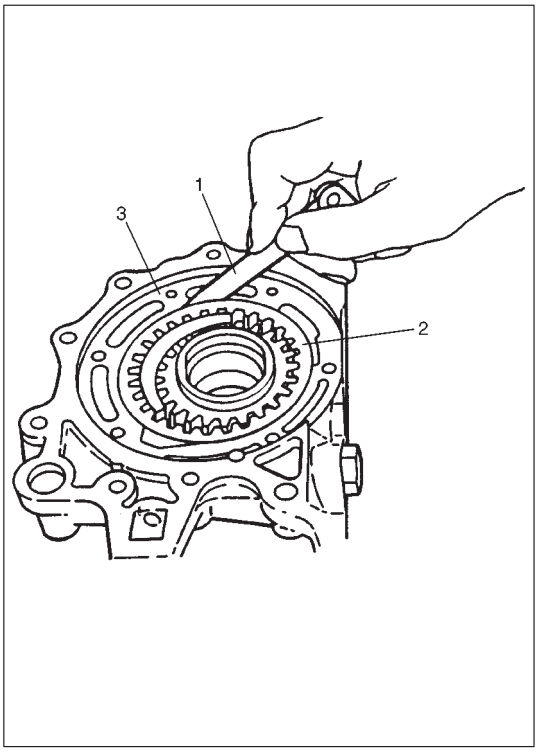
Carefully inspect the oil seals removed in disassembly, examining the lip portion (1) of each oil seal for wear and damage. Use of new oil seals in reassembly is recommended.



Timing belt and timing pulleys

Inspect the belt and pulleys for wear, cracks and signs of failure. Replace them as necessary.

CAUTION:
- **Do not bend the belt. Keep away oil and water from the belt. The belt must be kept clean.**
- **The pulleys and belt tensioner, too, must be kept clean and free of oil and water.**

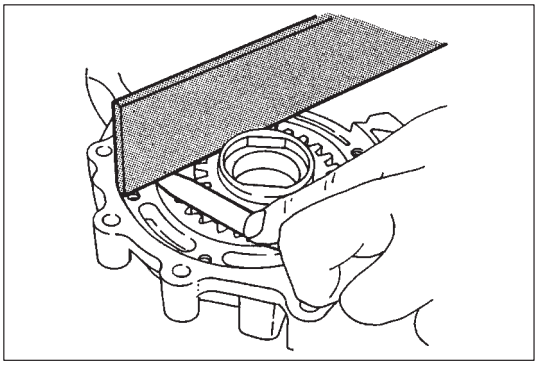


Oil pump

1) Inspect oil seal lip for fault or other damage.
   Replace as necessary.
2) Inspect outer and inner gears, gear plate, and oil pump case for excessive wear or damage.

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

Item	Standard	Limit
Radial clearance between outer gear and case	0.12 – 0.20 mm (0.005 – 0.008 in.)	0.3 mm (0.012 in.)



- Side clearance:
  Using straight edge and thickness gauge, measure side clearance.

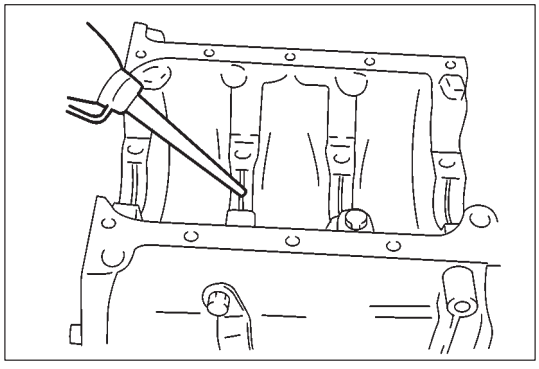
Item	Standard	Limit
Side clearance	0.045 – 0.120 mm (0.0018 – 0.0047 in.)	0.17 mm (0.0067 in.)

ENGINE REASSEMBLY

NOTE:

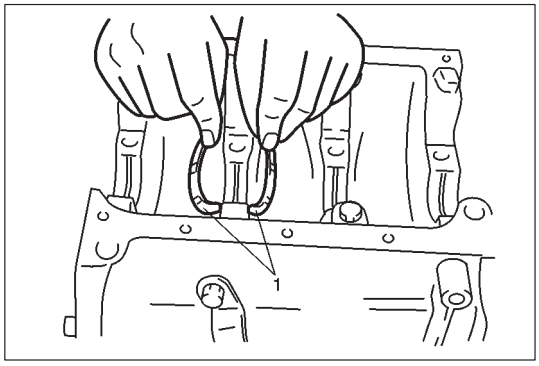
- **All parts to be used in reassembly must be perfectly clean.**
- **Oil the sliding and rubbing surfaces of engine parts just before using them in reassembly. Use engine oil (Refer to Section 0B).**
- **Have the liquid packing ready for use. SUZUKI BOND No. 1215 is specified for the liquid. Use it wherever its use is specified in order to ensure leak-free (oil and water) workmanship of reassembly.**
- **There are many running clearances. During the course of engine reassembly, be sure to check these clearances, one after another, as they form.**
- **Gaskets, O-rings and similar sealing members must be in perfect condition. For these members, use replacement parts in stock.**
- **Tightening torque is specified for important fasteners – bolts and nuts in the main – of the engine and other components. Use torque wrenches and constantly refer to the specified values given in the text of this manual.**
- **Do not disregard the match marks provided on parts. Some of them are those given at the time of disassembly.**
- **There are many sets of parts. Crankshaft bearings, connecting rods, pistons, etc., are in combination sets. Do not disturb the combinations and try to see that each part goes back to where it came from.**

Engine reassembly is the reverse of engine disassembly as far as sequence is concerned, but there are many reassembling steps that involve measures necessary for restoring the engine as close to the factory-assembled condition as possible. Only those steps will be dealt with.

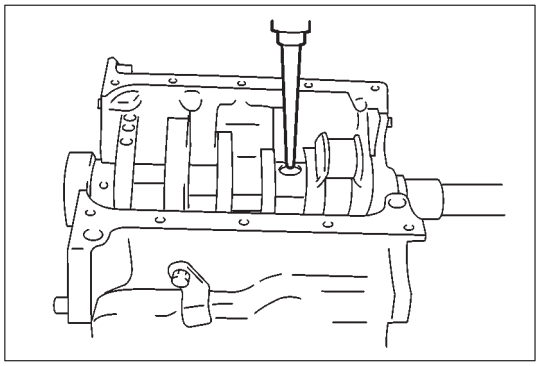


Crankshaft

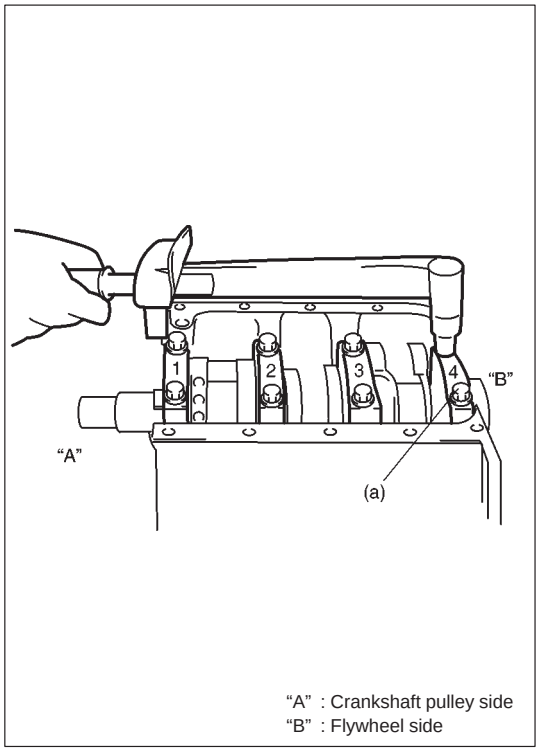
Be sure to oil crankshaft journal bearings as shown.



Thrust bearings (1) for the crankshaft are an item prone to escape the attention: be careful not to leave them out. These bearings go into place with their oil groove side facing the crank web.



Be sure to oil crankshaft journals as shown.

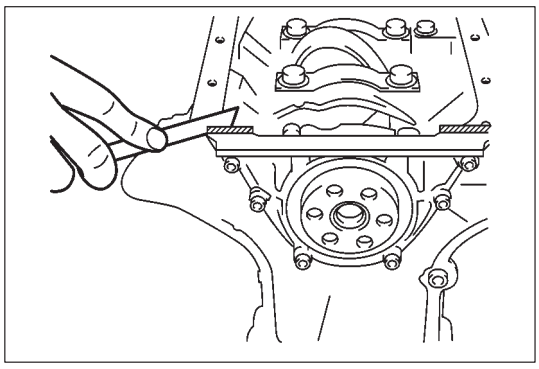


When fitting crankshaft bearing caps to journals after setting the crankshaft in place, be sure to point the arrow mark (on each cap) to crankshaft pulley side. Fit them sequentially in the ascending order, 1, 2, 3 and 4, starting from pulley side.

Tightening Torque
(a): 46 N·m (4.6 kg-m, 33.5 lb-ft)

Gradual and uniform tightening is important for bearing cap bolts. Make sure that the four caps become tight equally and uniformly progressively to the stated torque value.

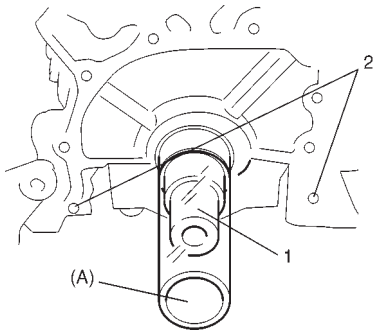
NOTE:
After tightening cap bolts, check to be sure that crankshaft rotates smoothly when turned over by hand.



Oil seal housing

This housing demands a new gasket: do not reuse the gasket removed in disassembly. After bolting the housing to the block, the gasket edges might bulge out; if so, cut off the edges to make the joint seam flat and smooth: use a sharp knife.

NOTE:
Just before mounting the housing, oil the lip portion of the oil seal.



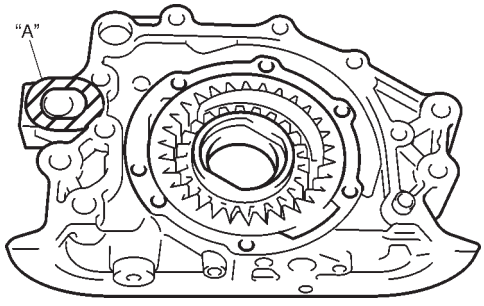
Oil Pump

NOTE:
Reassemble components of oil pump assembly according to following procedure, if disassembled.

a) Wash, clean and then dry all disassembled parts.
b) Apply thin coat of engine oil to inner and outer gears, oil seal lip portion, and inside surfaces of oil pump case and plate.
c) Install outer and inner gears to pump case.
d) Install gear plate.
e) After installing plate, check to be sure that gears turn smoothly by hand.

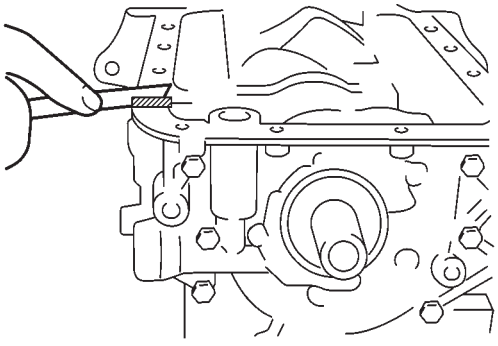
1) Install two oil pump pins (2) and oil pump gasket to cylinder block. Use new gasket.
2) To prevent oil seal lip from being damaged or upturned when installing oil pump to crankshaft (1), fit oil seal guide (special tool) to crankshaft, and apply engine oil to it.

   Special Tool
   (A): 09926-18210

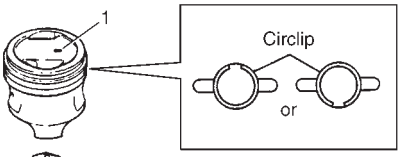


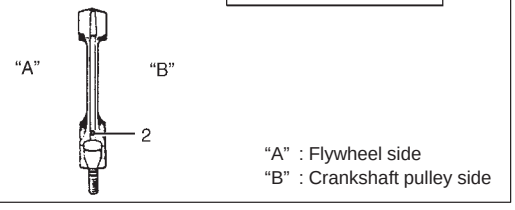
3) Before fitting the pump case, apply sealant to mating surfaces around the oil discharging port of both the oil pump case and the cylinder block, install oil pump to crankshaft and cylinder block. After installing oil pump, check to be sure that oil seal lip is not upturned, and then remove special tool.

   "A": Sealant 99000-31110



4) Edge of oil pump gasket might bulge out: if it does, cut bulge off with a sharp knife, making edge smooth and flush with end faces of the pump case and cylinder block.

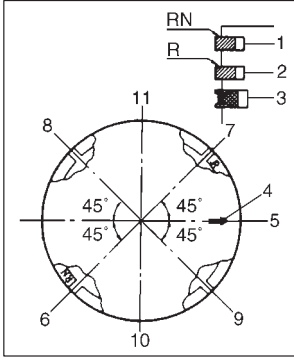




Piston and piston rings

POSITION OF PISTON RELATIVE TO CONNECTING ROD: The arrow (1) on the crown points to crankshaft pulley side, and the oil hole (2) comes on intake port side.

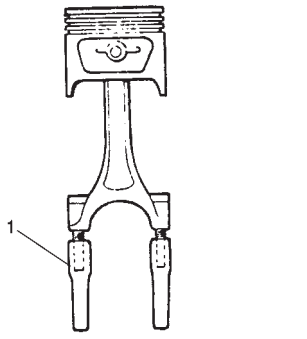
NOTE:
Before pinning piston to connecting rod, oil the small end and pin holes.

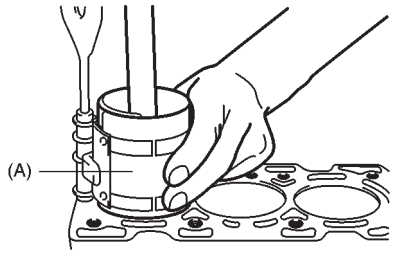


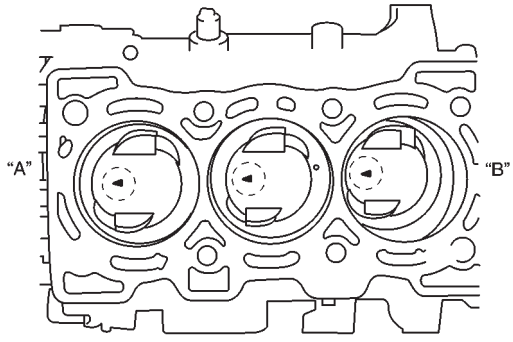
3. Oil ring
4. Arrow mark
5. Crankshaft pulley side
6. 1st ring end gap
7. 2nd ring end gap and oil ring spacer gap
8. Oil ring lower rail gap
9. Oil ring upper rail gap
10. Intake side
11. Exhaust side

Before fitting rings to piston, check to be sure that first ring (1) has RN mark and second ring (2) R mark. After mounting the three rings, distribute their end gaps as illustrated in figure. Remember, the marked side of each ring (1st and 2nd) comes on top side.

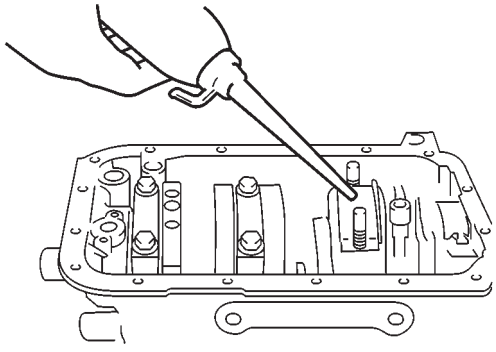
NOTE:
After fitting the rings, oil them in the grooves.







"A": Crankshaft pulley side
"B": Flywheel side



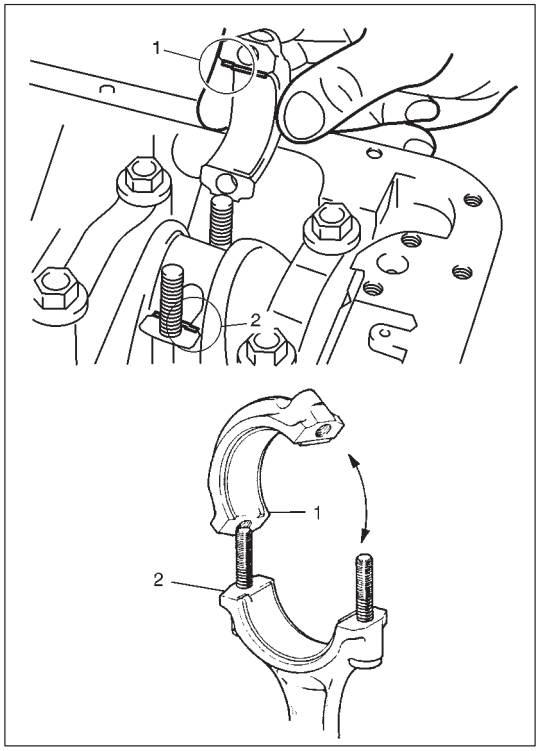
After covering the connecting rod bolts with plastic or rubber pipes (1) as shown in figure, use special tool (piston ring compressor), is mandatory in inserting pistons into cylinder block. Using this special tool, feed the piston and connecting rod combination into the bore from the upper side of cylinder block.

Special Tool
(A): 09916-77310

Pay attention to these reminders:

- Point the piston crown arrow to pulley side.
- Be sure that the number (marked on the crown at the time of disassembly) tallies with the cylinder number.
- Liberally oil the big-end bearings before fitting them to crankpins.
- Oil the bore just before feeding in the piston.

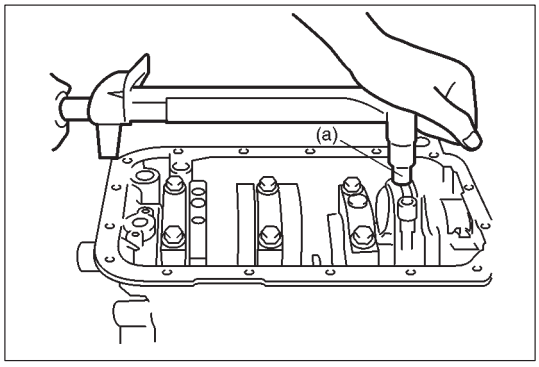
CAUTION:
When inserting the piston and connecting rod combination into the cylinder bore, care must be taken to ensure the big end section of the connecting rod and the connecting rod bolts do not contact the cylinder wall nor the crankshaft journal, otherwise damage can occur.



Connecting rods

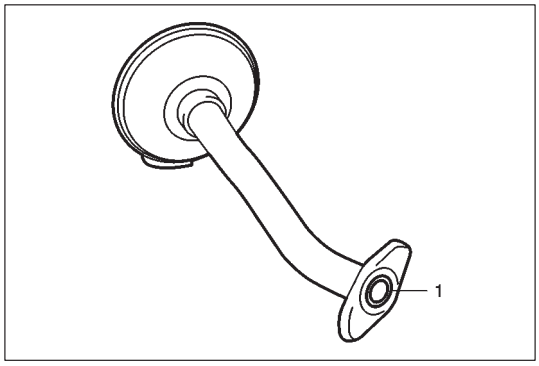
Two stoppers (1), (2) determine the position of each big-end bearing cap relative to the big end. At the time of installing these caps, be sure to locate stopper (1) of cap in the direction of stopper (2).

NOTE:
The two stoppers do not coincide in longitudinal direction: the coincidence is meant in the direction shown in figures.



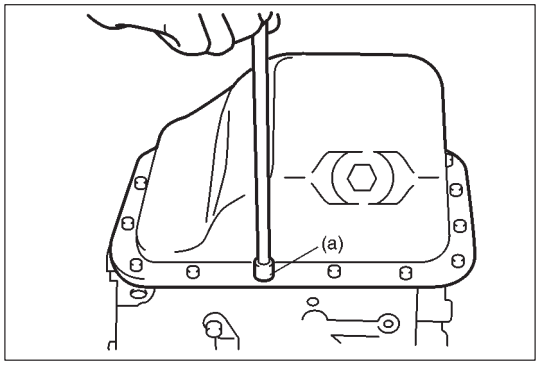
After fitting all three big-end bearing caps, start tightening them uniformly, being sure to equalize tightness between right and left on each cap. The sequence here is similar to that for crankshaft bearing caps.

Tightening Torque
(a): 30 N·m (3.0 kg-m, 22.0 lb-ft)



Oil pump strainer

Bear in mind that O-ring (1) is often forgotten and left out in reassembly. Absence of this ring defeats the purpose served by the strainer.



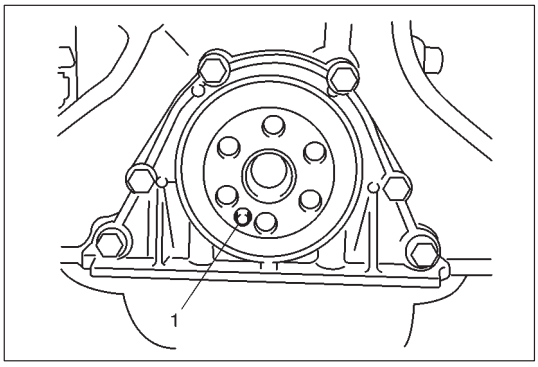
Oil pan

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

   Tightening Torque
   (a): 5 N·m (0.5 kg-m, 4.0 lb-ft)

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

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

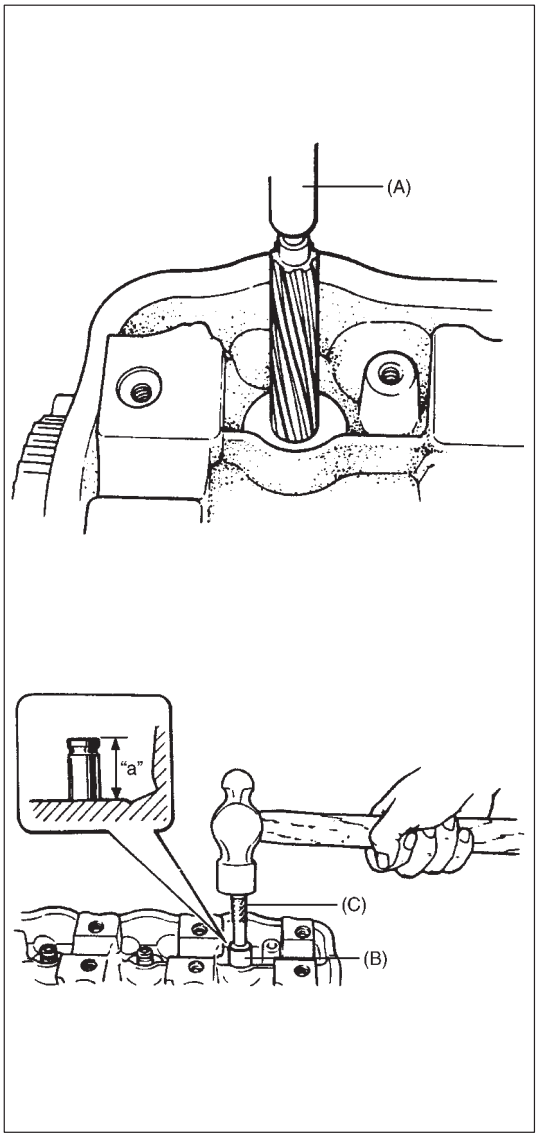


Flywheel

1) Check to be sure that locating pin (1) is studded in the crankshaft.
2) Install flywheel to crankshfat by using special tool hitched to flywheel so that crankshaft will not turn.

   Special tool:
   09924-17810

   Tightening Torque for flywheel bolt:
   43 N·m (4.3 kg-m, 31.5 lb-ft)



Cylinder head

NOTE:

- **Do not reuse valve guide once disassembled. Install new valve guide (Oversize).**
- **Intake and exhaust valve guide are identical.**

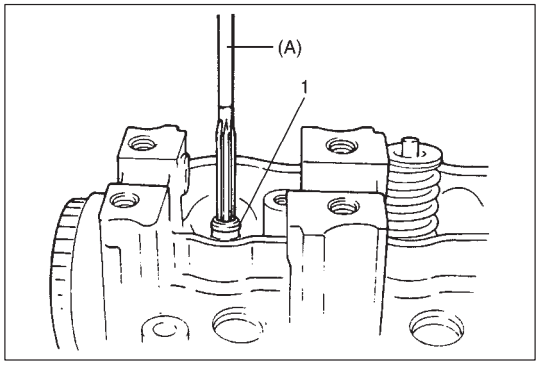
Valve guide oversize	0.03 mm (0.001 in.)
Valve guide protrusion (In and Ex)	14.0 mm (0.551 in.)

1) Install new valve guide into cylinder head.
   a) Before installing new valve guide into cylinder head, ream guide hole with special tool (12 mm reamer) to remove burrs, making sure that guide hole diameter after reaming comes within specified range.

Valve guide hole Dia. (In & Ex)	12.030 – 12.048 mm (0.4736 – 0.4743 in.)

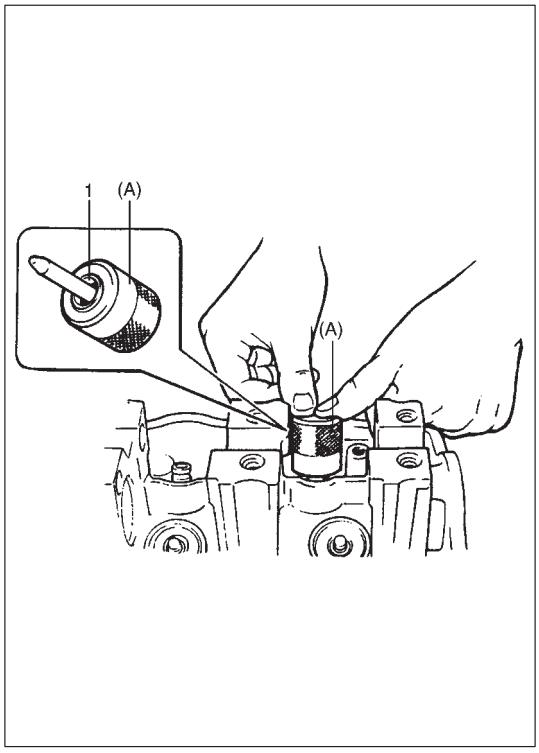
   b) Install valve guide to cylinder head.
   Heat cylinder head uniformly at a temperature of 80 to 100°C (176 to 212°F), using care not to distort head, and drive new valve guide into hole with special tools.
   Drive in new valve guide until valve guide installer (Special tool) contacts cylinder head. After installation, make sure that valve guide protrudes “a” by 14.0 mm (0.551 in.) from cylinder head.

   Special Tool
   (A): 09916-37310
   (B): 09917-88210
   (C): 09916-57321



c) Ream valve guide (1) bore with special tool (7 mm reamer). After reaming, clean bore.

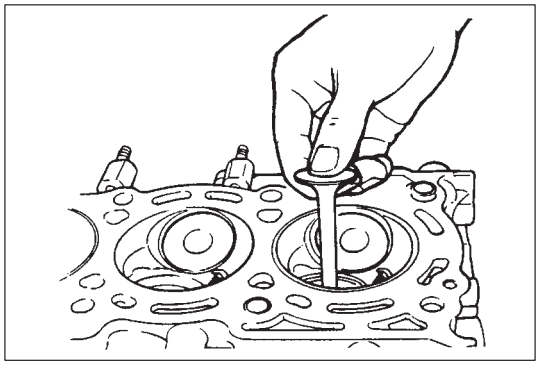
Special Tool
(A): 09916-34520



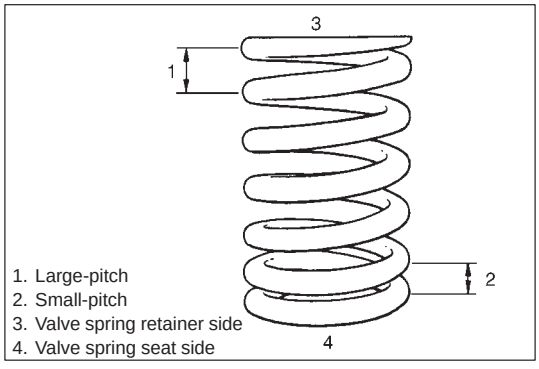
2) Install valve spring seat to cylinder head.
3) Install new valve stem seal (1) to valve guide.
After applying engine oil to seal and spindle of special tool (valve stem seal installer), fit oil seal to spindle, and then install seal to valve guide by pushing special tool by hand.
After installation, check to be sure that seal is properly fixed to valve guide.

Special Tool
(A): 09917-98210

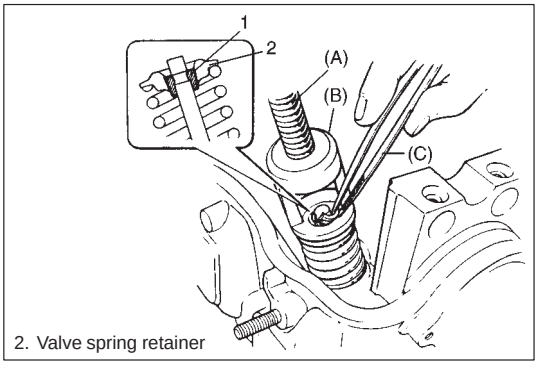
NOTE:
- **Do not reuse oil seal disassembled. Be sure to install new oil seal.**
- **When installing, never tap or hit special tool with a hammer or else. Install seal to guide only by pushing special tool with hand. Tapping or hitting special tool may cause damage on seal.**



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



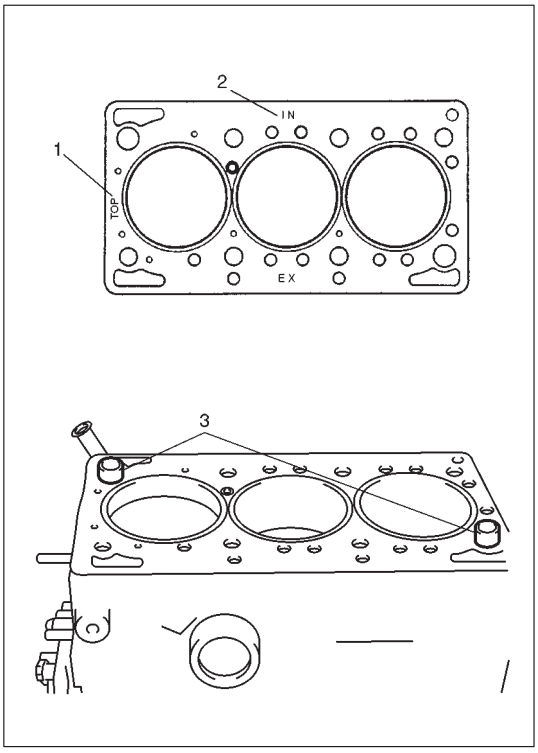
5) Install spring and spring retainer.
Each valve spring has top end (large-pitch end) and bottom end (small-pitch end). Be sure to position spring in place with its bottom end (small-pitch end) down to valve spring seat side.



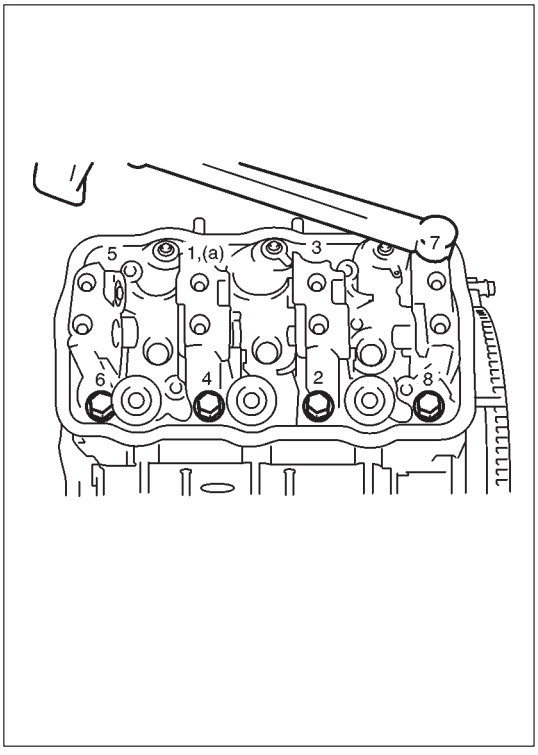
2. Valve spring retainer

6) Using special tool (Valve lifter), compress valve spring and fit two valve cotters (1) to groove provided in valve stem.

Special Tool
(A): 09916-14510
(B): 09916-48210
(C): 09916-84511

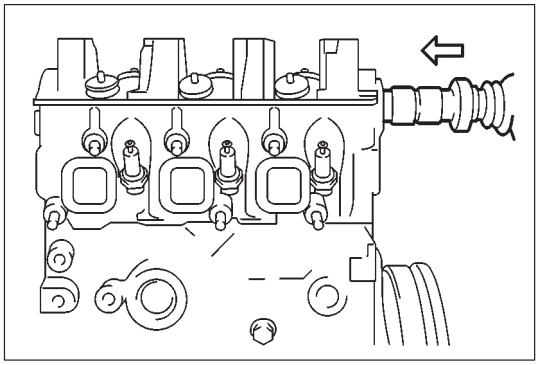


7) Be sure that locating pins (3) are in place and then install new head gasket, in such a way that “TOP” mark (1) provided on the gasket comes crankshaft pulley side, facing up (toward cylinder head side), “IN” mark (2) comes on intake manifold side and “EX” mark comes on exhaust side.



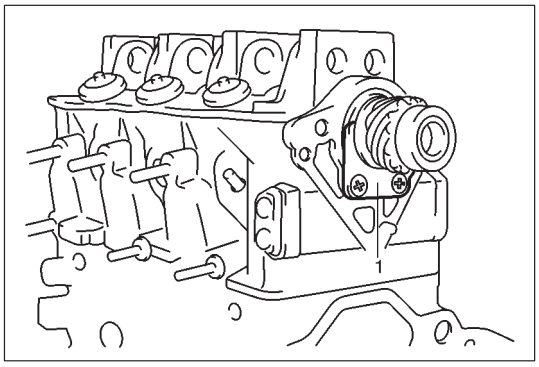
8) Install cylinder head onto cylinder block.
9) Apply engine oil to cylinder head bolts and tighten them gradually as follows.
   a) Tighten all bolts to 34 N·m (3.4 kg-m, 24.5 lb-ft) according to numerical order in figure.
   b) In the same manner as a), tighten them to 54 N·m (5.4 kg-m, 39.0 lb-ft).
   c) Loosen all bolts to 0 N·m (0 kg-m, 0 lb-ft), reversing to numerical order in figure.
   d) In the same manner as a) again, tighten them to 54 N·m (5.4 kg-m, 39.0 lb-ft).
   e) In the same manner as a) again, tighten them to specified torque.

Tightening Torque
(a): 68 N·m (6.8 kg-m, 49.5 lb-ft)

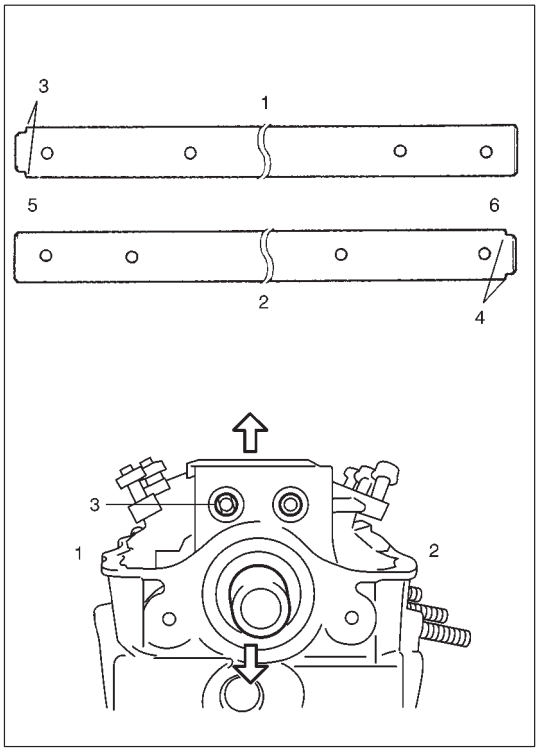


Camshaft

The camshaft goes into cylinder head from distributor gear case side. Before inserting it, be sure to oil its journals.



Be careful not to leave out the thrust plate (1) when installing the camshaft. After setting this shaft in place, with its thrust plate properly fitted, turn the shaft by hand to be sure it rotates smoothly.

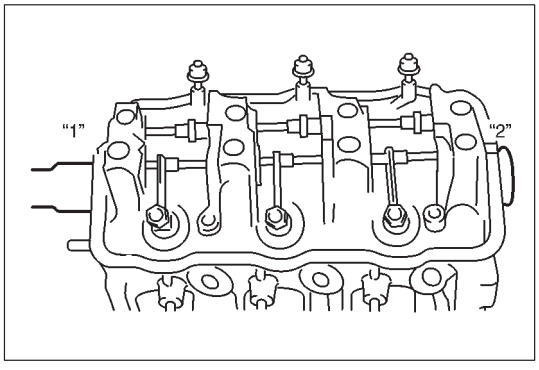


Rocker-arm shafts

1) Apply engine oil to rocker arms and rocker arm shafts.
2) Install rocker arms, springs and rocker arm shafts.

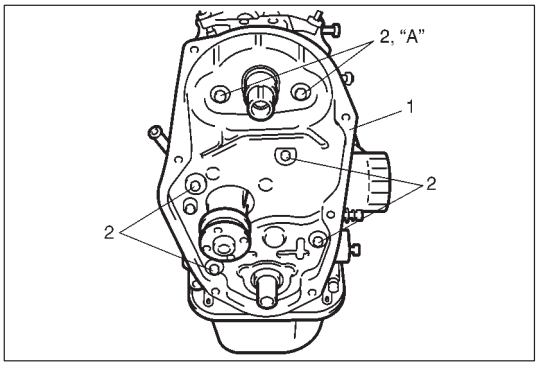
The two rocker-arm shafts are identical, there being no need to distinguish between the two. However, each shaft takes but one position in place. See figure.

- On the intake side (1), the stepped end (3) comes on camshaft pulley side (5).
- On the exhaust side (2), the stepped end (4) comes on flywheel side (6).



As to the positions of rocker arms and springs on each rocker-arm shaft, refer to figure. "Camshaft pulley side" is meant by "1"; "distributor gear side" by "2".

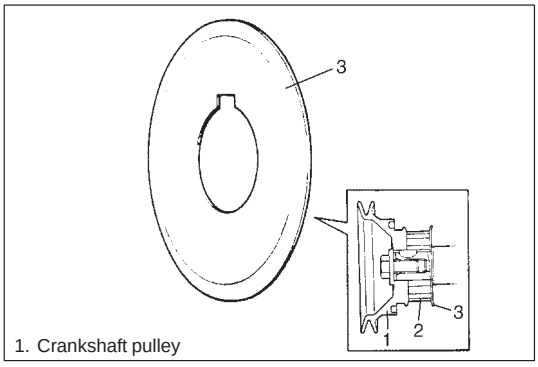
NOTE:
When installing rocker-arm shafts, be sure to have valve adjusting screws loosened fully but do not remove then.



Timing belt inside cover

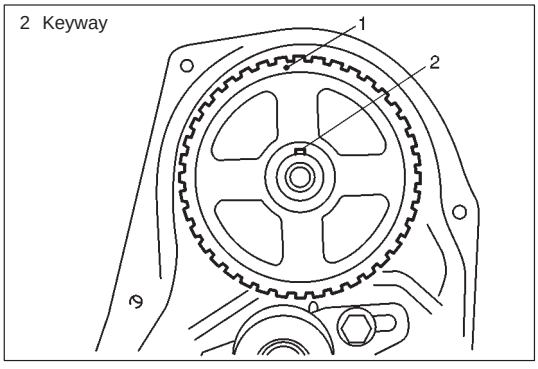
When reinstalling the inside cover (1) to cylinder head, apply sealant to the threads of upper side screws (2) as shown, because the bolt holes for the two extend into the interior of cylinder head.

"A" Sealant 99000-31110



Crankshaft timing belt guide

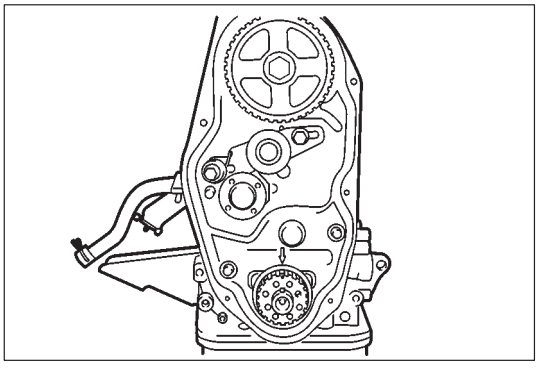
This guide takes its position on crankshaft as shown in figure. Remember, one side of this guide (3) faces the cylinder block and the other side faces the timing belt pulley (2): the former side being distinct from the latter.



Camshaft and crankshaft timing belt pulleys

These pulleys have a punch-mark (1) to show that the marked side faces the timing belt outside cover. When installing each pulley, direct this mark to timing belt outside cover side.
Tighten camshaft pulley bolt to specified torque.

Tightening Torque for camshaft pulley bolt:
55 N·m (5.5 kg-m, 40.0 lb-ft)

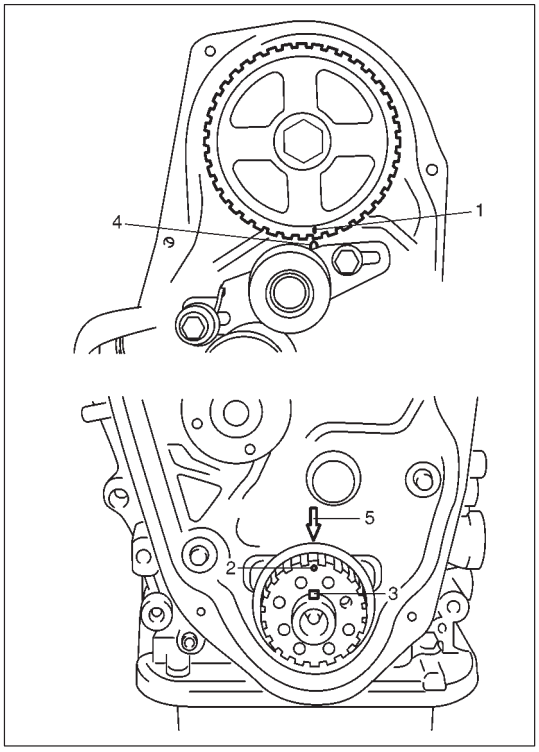


Timing belt

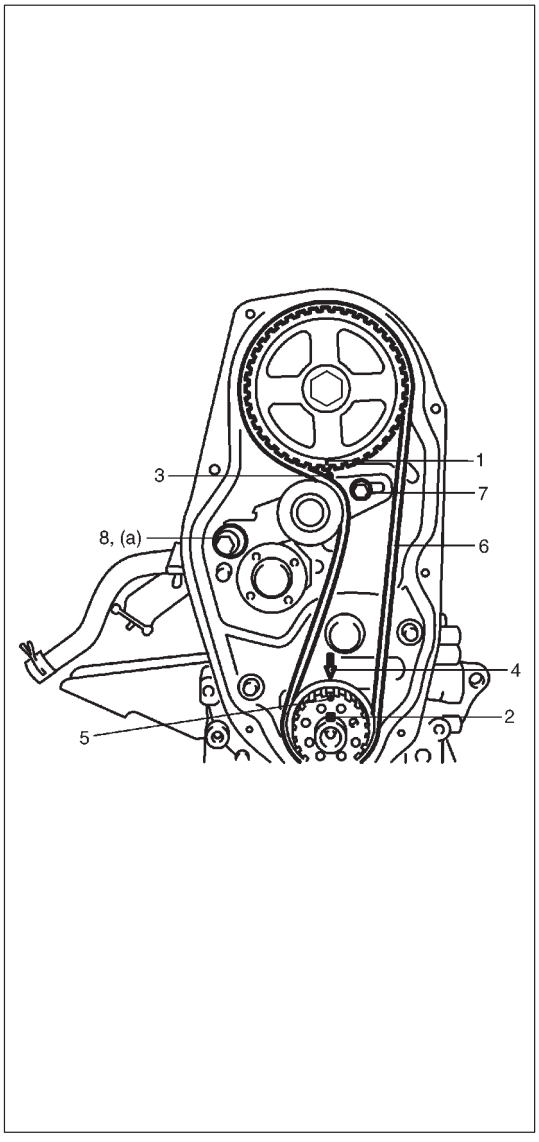
A certain sequence must be followed installing the timing belt. Here's the sequence:

1) Put the tensioner and the spring together before installing them as one to the timing belt cover. Tighten the bolts to the extent that the tensioner can be moved by hand easily.

   NOTE:
   When carrying out the above job, make sure to loosen each lock nut and then each valve clearance adjusting screw so that the camshaft and the pulley can rotate freely.



2) Timing belt inside cover has an embossed mark (4).
   Turn camshaft timing belt pulley to the position where punch-mark (1) meets mark (4).
3) The inside cover has another embossed mark (5). Turn crankshaft to match key-way (3) and punch-mark (2) of crankshaft timing belt pulley to mark (5).



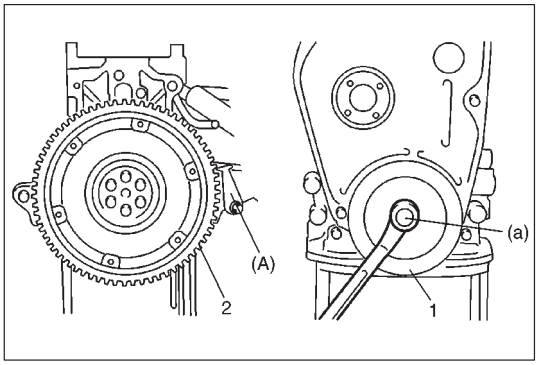
4) You now have the two pulleys correctly related to each other in angular sense. Under this condition, put on the timing belt in such a way that portion of belt indicated as (6) is free of any slack.

   NOTE:
   When installing timing belt, match arrow mark (➪) on timing belt with rotating direction of crankshaft.

5) After putting the belt, hook the spring on the water pump securing bolt as shown in figure. The spring, with its own tension, adjust the belt tension to the specified value. Rotate the crankshaft clockwise fully twice and tighten the bolt (7) first and then the bolt (8).

   Tightening Torque
   (a): 19 N·m (1.9 kg-m, 14 lb-ft)

> **CAUTION:**
> **After setting the belt tensioner, turn crankshaft 2 rotations in clockwise direction to see if marks (1) (3) (4) (5) and crankshaft keyway (2) locate themselves on the same straight line. If they do not line up straight, the foregoing procedure must be repeated to satisfy this requirement.**

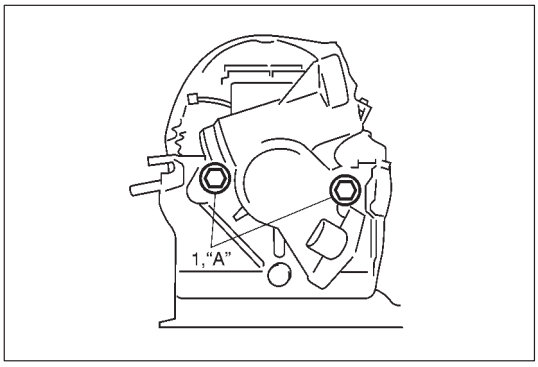


Crank Pulley

Install crank shaft pulley (1) by using special tool hitched to flywheel (2) so that crakshaft will not turn.

Special tool
(A): 09924-17810

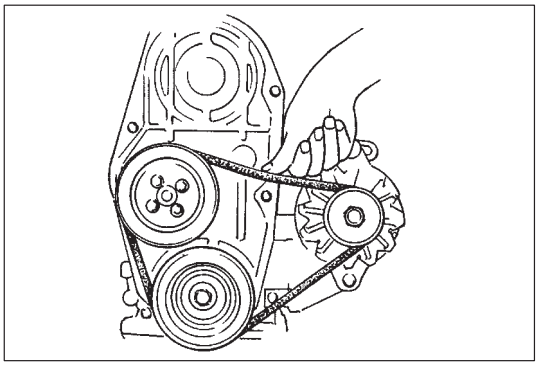
Tightening Torque
(a): 55 N·m (5.5 kg-m, 40.0 lb-ft)



Distributor gear case

Bolts (1) are for securing this gear case to the cylinder block. When installing the case, be sure to apply sealant to the threads of these bolts.

"A": Sealant 99000-31110



Generator

The water pump drive belt, by which the generator too is driven, must be tensioned to the specification after the alternator is installed. Check the tension at the middle point of the belt between water pump pulley and alternator pulley. To vary the tension for adjustment, displace the alternator in place.
For belt tension specification, refer to MAINTENANCE SERVICE of SECTION 0B in this manual.

Clutch disc and cover

Install clutch disc and cover.
For installation, refer to SECTION 7A CLUTCH in this manual and torque each bolt to specification.

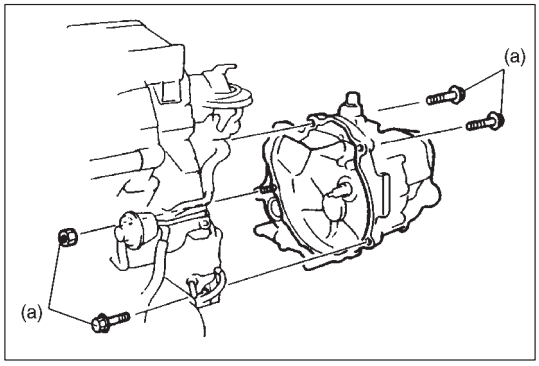
Distributor

Install distributor to case.
For installation, be sure to refer to SECTION 6F IGNITION SYSTEM in this manual.

NOTE:
Check and adjust ignition timing with engine installed to car body and after installing and connecting all necessary parts. For procedure, refer to SECTION 6F IGNITION SYSTEM in this manual.

Valve lash (clearance) adjustment

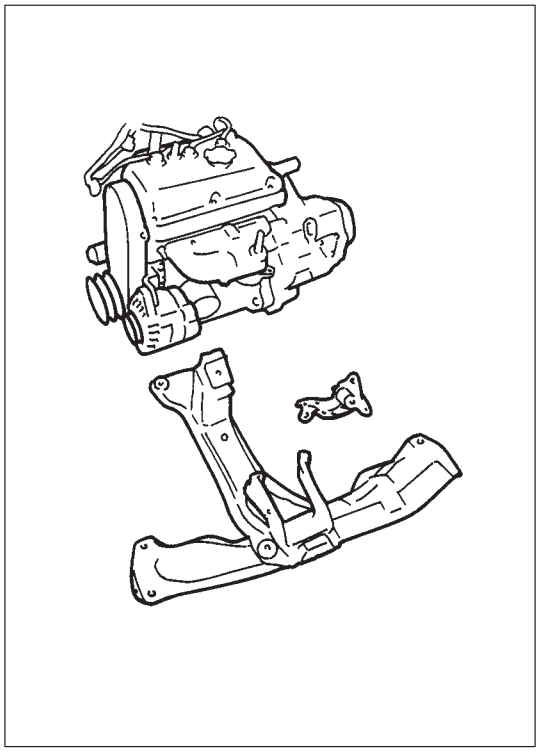
Adjust valve lash of all intake and exhaust valves to specification, referring to description on valve lash in following item ENGINE MAINTENANCE SERVICE in this section.



MOUNTING ENGINE

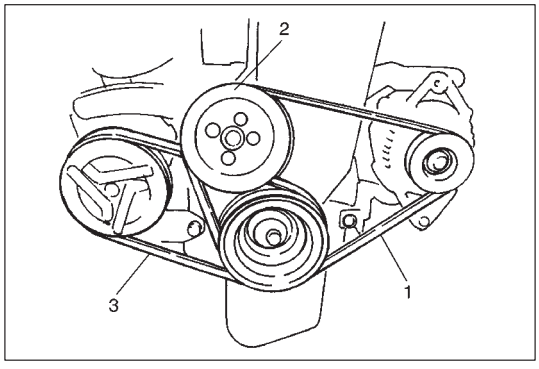
1) Install transmission to engine.

   Tightening Torque
   (a): 50 N·m (5.0 kg-m, 36.5 lb-ft)



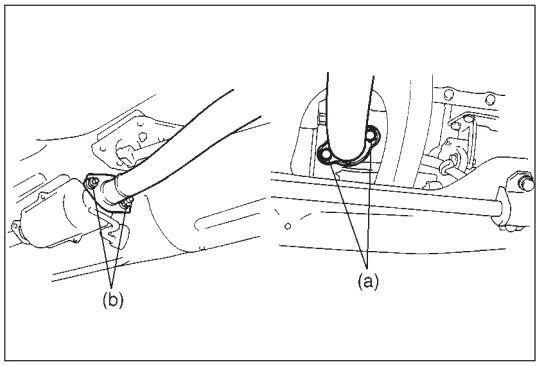
2) Install engine member to engine and then install engine assembly to vehicle.
   Install transmission left side mounting to transmission case and body.

3) Install A/C compressor, upper and lower bracket and then connect suction and discharge hoses to A/C compressor (if equipped). Refer to Section 1B.



4) Install A/C compressor belt (3) and adjust its tension, refer to Section 1B (if equipped).
5) Install water pump belt (1) after installed water pump pulley (2) and adjust its tension, refer to Section 0B.

6) Install right and left drive shafts, refer to Section 4.
7) Install stabilizer bar, refer to Section 3D.
8) Connect gear shift control shaft and extension rod to transmission case.



9) Install exhaust center pipe.

Tightening Torque
(a): 55 N·m (5.5 kg-m, 40.0 lb-ft)
(b): 55 N·m (5.5 kg-m, 40.0 lb-ft)

10) Refill transmission gear oil, refer to Section 0B.
11) Connect cables, hoses, wires and couplers which were disconnected in dismounting engine procedure.
    - Adjust accelerator play, refer to Section 6E1.
    - Adjust clutch pedal free travel, refer to Section 7C.
12) Install air cleaner assembly with air cleaner hose and breather hose.
13) Install radiator with cooling fan and reserve tank, refer to Section 6B.
14) Install engine hood and connect windshield washer hose.
15) Install front bumper.
16) Connect negative cable at battery.
17) Refill engine with engine oil, refer to Section 0B.
18) Refill cooling system with coolant, refer to Section 6B.
19) Evacuate and charge A/C system, refer to Section 1B (if equipped).
20) Upon completion of installation, verify that there is no fuel, coolant, transmission oil, engine oil or exhaust gas leakage at each connection.
21) Check ignition timing and adjust it as necessary, refer to Section 6F1.

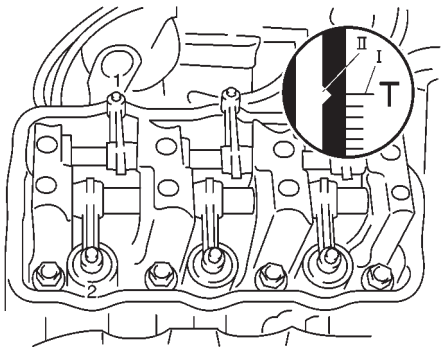
MAINTENANCE SERVICES

Water pump belt

Adjust the belt tension as outlined in the SECTION 0B MAINTENANCE SERVICE.

Ignition timing

Refer to SECTION 6F IGNITION SYSTEM.

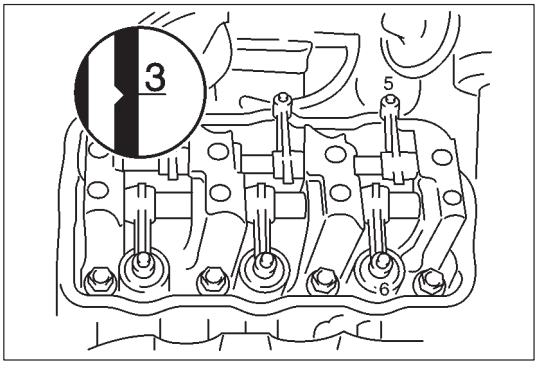


Valve clearance (lash)

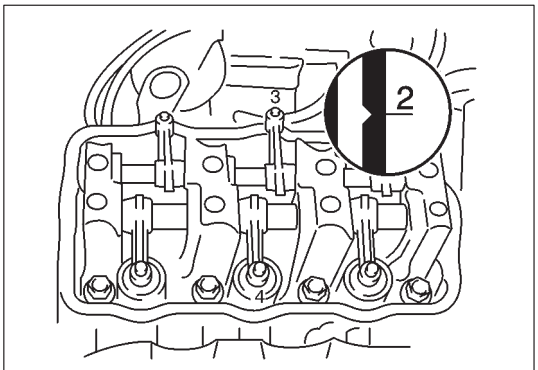
		When cold (Coolant temperature is 15 – 25°C or 59 – 77°F)	When hot (Coolant temperature is 60 – 68°C or 140 – 154°F)
Valve clearance specification	Intake	0.13 – 0.18 mm (0.005 – 0.007 in.)	0.15 – 0.19 mm (0.006 – 0.007 in.)
	Exhaust	0.13 – 0.18 mm (0.005 – 0.007 in.)	0.15 – 0.19 mm (0.006 – 0.007 in.)

To check and adjust valve clearance with the engine mounted in place, that is, secured to the chassis, be sure to remove the cylinder head cover, so that you can take a good look at rocker arms and camshaft. Remember, a clearance reading is meaningful only when it is taken with the rocker arm clear of and not riding on the cam.

Remove the ignition timing check hole plug provided at the joint between engine and transmission to gain visual access to the “T” mark. Turn over crankshaft to index mark (I) to timing match mark (II), and see if the rocker arms of No. 1 cylinder are off the respective cam lobes (of camshaft); if so, valves (1) and (2), in figure, are ready for clearance checking and adjustment: if not, turn over crankshaft further by 360° to index mark (I) to mark (II) again. This 360° turning should bring about the desired state. (in which the two valves are ready for checking and adjustment).

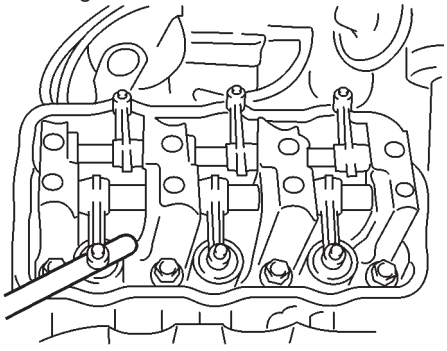


Turn over the crankshaft 240° from “T” mark, check and adjust the valves (5) and (6).

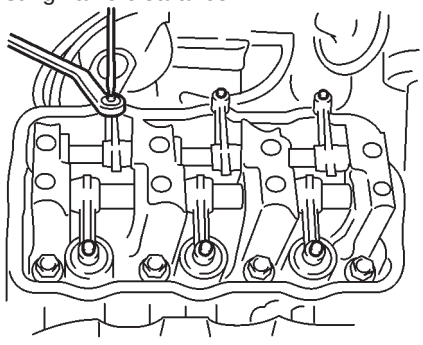


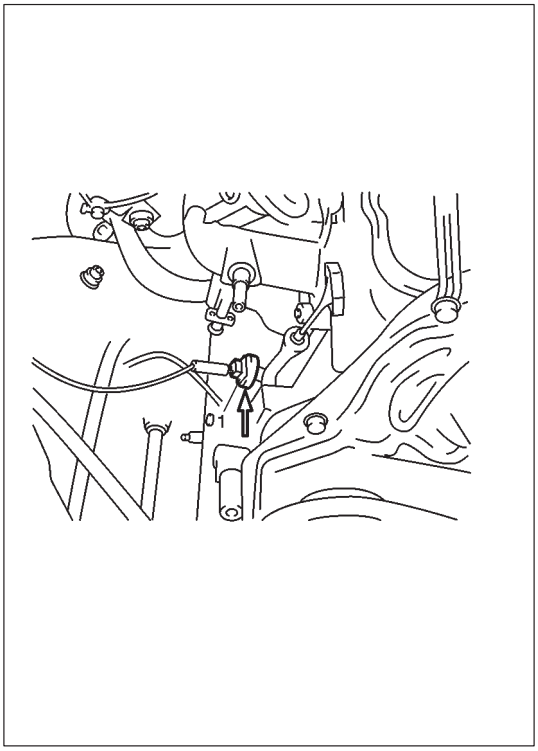
Turn over the crankshaft 240° from “3” mark, check and adjust the valves (3) and (4).

Measuring valve clearance



Adjusting valve clearance



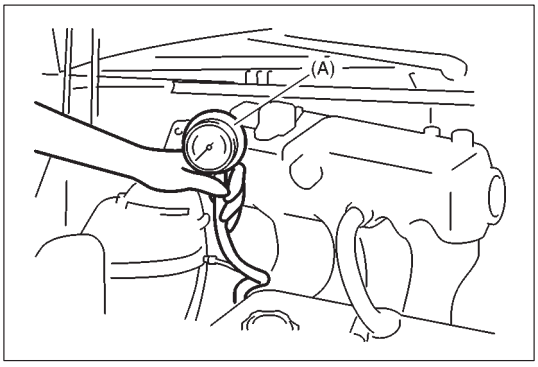


Oil pump discharge pressure measurement

NOTE:
Prior to checking oil pressure, check the following.

- **Oil level in oil pan.**
  If level is low, add oil up to Full level hole on oil level gauge.
- **Oil quality.**
  If oil is discolored, or deteriorated, change oil. For particular oil to be used, refer to table in SECTION 0B MAINTENANCE SERVICE.
- **Oil leak.**
  If leak is found, repair it.

1) Disconnect lead wire from oil pressure switch.
2) Remove oil pressure switch (1) from cylinder block.



3) Install special tool (oil pressure gauge) to vacated threaded hole.

   Special Tool
   (A): 09915-77310

4) Start engine and warm it up to normal operating temperature.
5) After warming up, raise engine speed to 3,000 r/min and measure oil pressure.

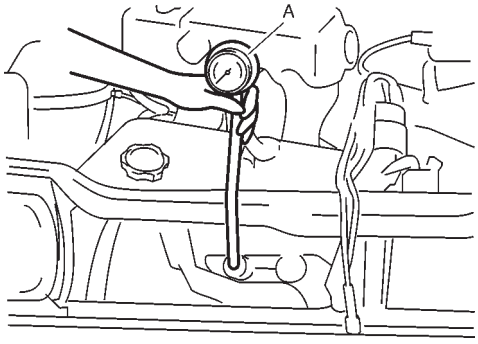
Oil pressure specification	300 – 450 kPa (3.0 – 4.5 kg/cm^2, 42.7 – 64.0 psi) at 3,000 r/min (rpm)

6) After checking oil pressure, stop engine and remove oil pressure gauge.
7) Before reinstalling oil pressure switch, be sure to wrap its screw threads with sealing tape and tighten switch to specified torque.

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

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

8) After installing oil pressure switch, start engine and check switch for oil leakage.



Compression pressure measurement

Check the compression pressure on all three cylinders, as follows:

1) Warm up engine.
2) Stop engine after warming up.

NOTE:
After warming up engine, place transmission gear shift lever in "Neutral" and set parking brake and block drive wheels.

3) Disconnect fuel injector wire harness connector.
4) Remove front grille, high-tension cords and all spark plugs.
5) Disconnect ignition coil wire harness at coupler.

WARNING:
Failure in disconnecting the coupler can cause spark to occur in engine room possibly resulting in a dangerous explosion.

6) Install special tool (Compression gauge) into spark plug hole.

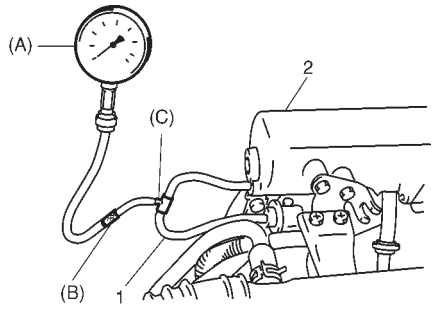
Special Tool
(A): 09915-64510

7) Disengage the clutch (to lighten starting load on engine), and depress the accelerator all the way to make the throttle full-open.
8) Crank the engine with the starter motor, and read the highest pressure on the compression gauge.
9) Carry out the steps 5) through 7) on each cylinder to obtain three readings.

NOTE:
For measuring compression pressure, crank engine at least 400 r/min. by using fully charged battery.

	Compression pressure
Standard	1350 kPa (13.5 kg/cm^2, 192.0 psi)
Limit	1000 kPa (10.0 kg/cm^2, 142.2 psi)
Max. difference between any two cylinders	100 kPa (1.0 kg/cm^2, 14.2 psi)

10) Be sure to install spark plugs, high-tension cords and front grille.
11) Connect fuel injector and ignition coil wire harness connector securely.



Vacuum measurement

The vacuum that develops in the intake line is a good indicator of the condition of the engine.
It is for this reason that the vacuum is measured. The measuring procedure is as follows:

1) Warm up engine until it is normal operating temperature.

   NOTE:
   After warming up engine, place transmission gear shft lever in "Neutral" (shift select lever to "P" range for A/T model), and set parking brake and block drive wheels.

2) With engine stopped, disconnect pressure regulator vacuum hose (1) from intake manifold (2) and connect 3-way joint, hoses and special tool (vacuum gauge and joint) between intake manifold and vacuum hose disconnected.

   Special Tool
   (A): 09915-67310
   (B): 09918-08210

   SUZUKI GENUINE PARTS
   (C): 3-way joint 09367-04002

3) Run the engine at the specified idling speed and, under this running condition, read the vacuum gauge. The vacuum should be not lower than 53.7 kPa (40 cm Hg, 15.7 in. Hg).

   A low vacuum reading means that any combination of the following malconditions is the cause, which must be corrected before releasing the machine to the customer:
   (a) Leaky cylinder head gasket
   (b) Leaky intake manifold gasket
   (c) Leaky valves
   (d) Weakened valve springs
   (e) Maladjusted valve clearance
   (f) Valve timing out of adjustment
   (g) Ignition mistimed

Standard vacuum	53.7 – 60.4 kPa (40 – 45 cm Hg, 15.7 – 17.7 in. Hg)
Idling speed specification	900 r/min (rpm) (Take vacuum reading at this speed.)

4) After checking, remove vacuum gauge and connect vacuum hose to intake manifold.
5) Before reinstalling vacuum checking plug, be sure to wrap its screw threads with sealing tape and tighten plug.

Engine oil
Refer to the SECTION 0B MAINTENANCE SERVICE.

Engine oil filter
The methods of servicing the oil filter are outlined under SECTION 0B MAINTENANCE SERVICE.

Engine coolant
This subject is covered in the SECTION 6B for ENGINE COOLING SYSTEM.

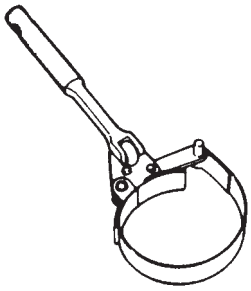
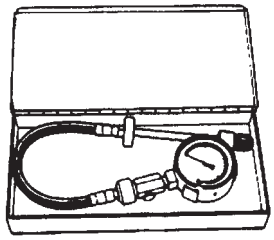
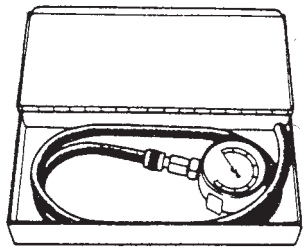
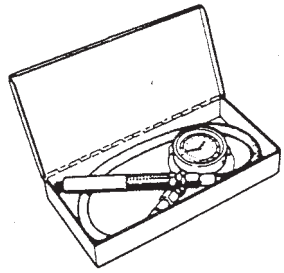
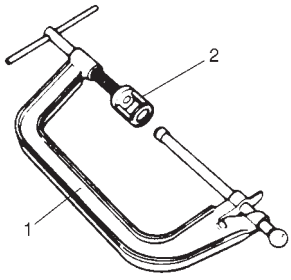
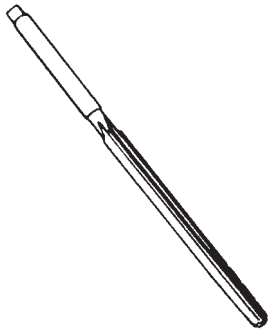
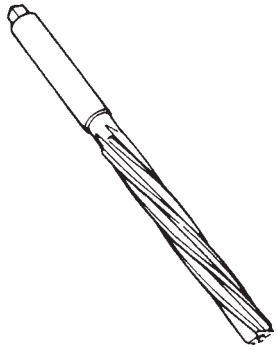
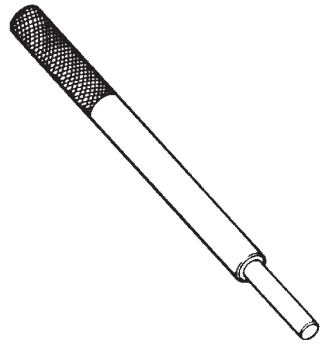
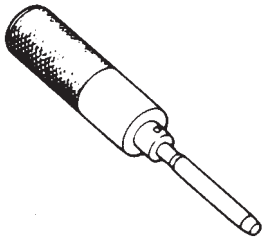
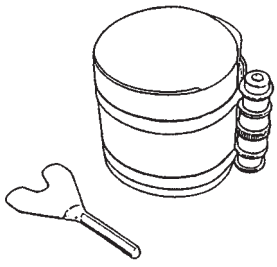
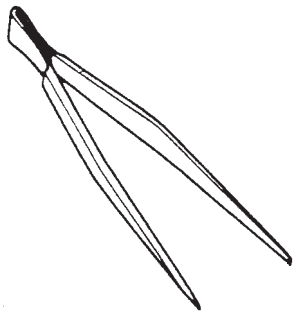
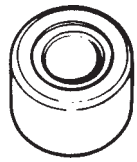
Exhaust line and muffler
Inspect each exhaust line connection for tightness, and examine the muffler and other parts for evidence of breakage and leakage of gases. Repair or replace defective parts, if any.

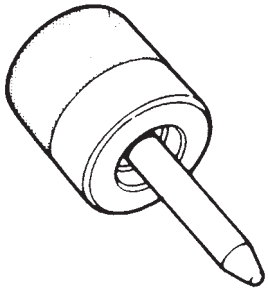
Oil filler cap
The cap has a packing. Be sure that packing is in good condition, free of any damage and signs of deterioration, and is tight in place. If any defective, replace.

REQUIRED SERVICE MATERIALS

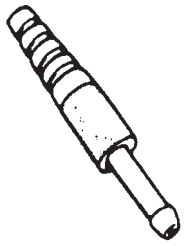
MATERIAL	RECOMMENDED SUZUKI PRODUCT	USE
Sealant	SUZUKI BOND No. 1215 (99000-31110)	● Mating surfaces around the oil discharging port of oil pump case and cylinder block ● Threads of timing belt inside cover stud bolts ● Threads of distributor gear case bolts

SPECIAL TOOLS

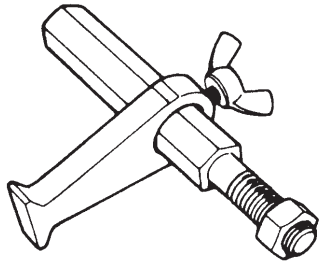
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Oil filter wrench</td>
<td>
09915-64510
Compression gauge</td>
<td>
09915-67310
Vacuum gauge</td>
<td>
09915-77310
Oil pressure gauge</td>
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1. 09916-14510
Valve lifter
2. 09916-48210
Valve lifter attachment</td>
<td>
09916-34520
7 mm reamer</td>
<td>
09916-37310
12 mm reamer</td>
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09916-44511
Valve guide remover</td>
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09916-57321
Valve guide installer handle</td>
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09916-77310
Piston ring compressor</td>
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09916-84511
Forceps</td>
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Valve guide installer attachment</td>
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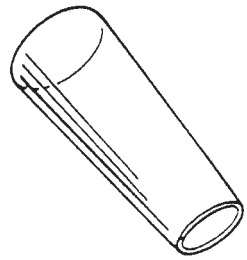
09917-98210
Valve stem seal installer



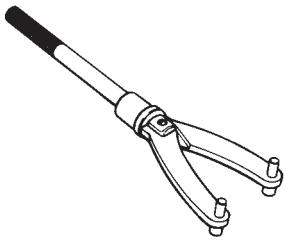
09918-08210
Vacuum gauge hose joint



09924-17810
Flywheel holder



09926-18210
Oil seal guide (Vinyl resin)



09930-40113
Camshaft lock holder

SECTION 6A1

ENGINE MECHANICAL (F8D ENGINE)

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Main Bearings, Crankshaft and Cylinder Block 6A1-52
REQUIRED SERVICE MATERIALS 6A1-64
SPECIAL TOOLS 6A1-64

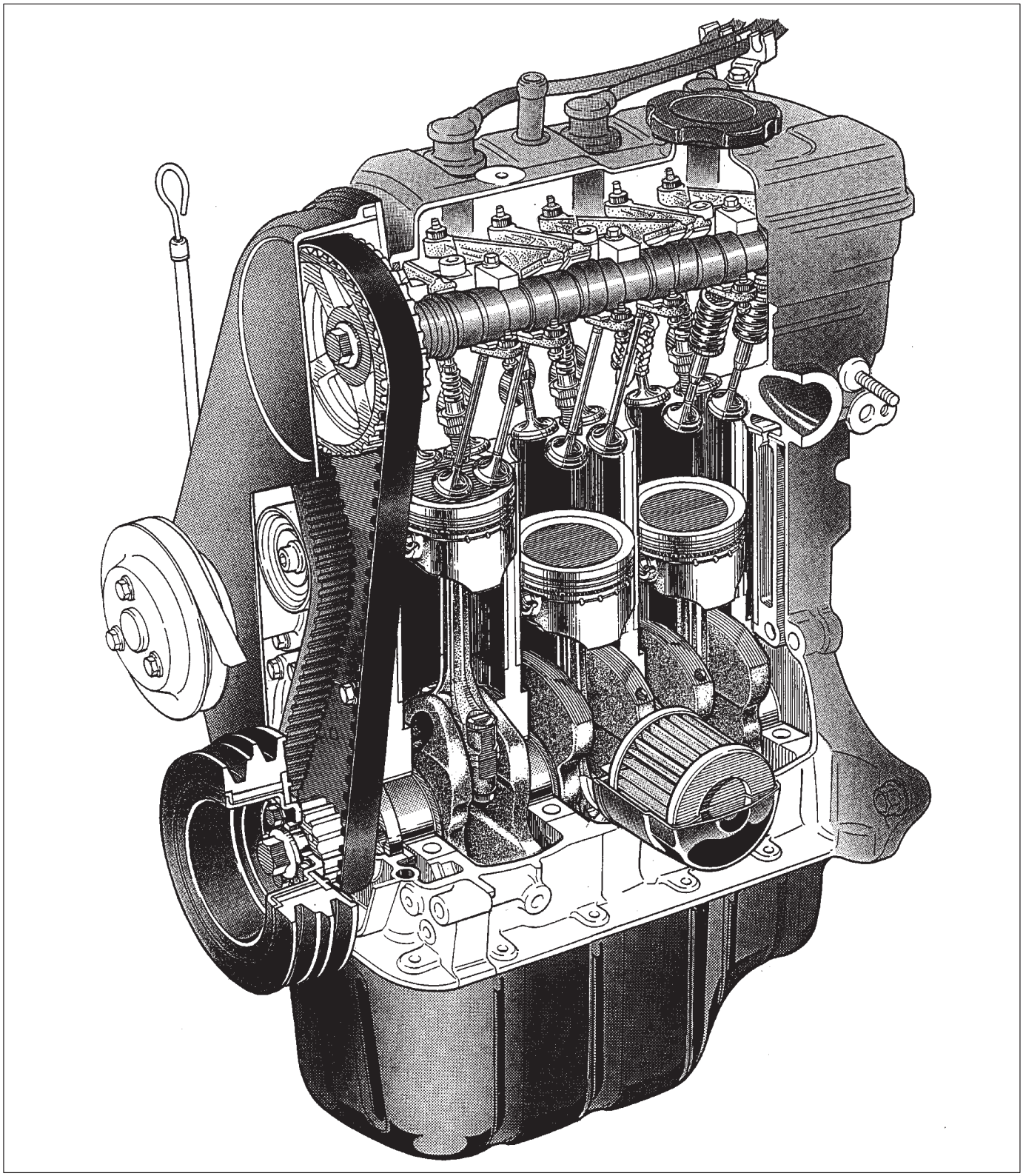
NOTE:
For what each abbreviation stands for (i.e., full term), refer to SECTION 0A.

GENERAL DESCRIPTION

ENGINE

The engine is a water-cooled, in line 3 cylinders, 4 stroke cycle gasoline unit equipped with its S.O.H.C. (Single Overhead Camshaft) valve mechanism arranged for “V”-type valve configuration and 12 valves (IN 2 and EX 2/one cylinder).

The single overhead camshaft is mounted over the cylinder head: it is driven from crankshaft through timing belt and opens and closes its valves via the rocker arms.

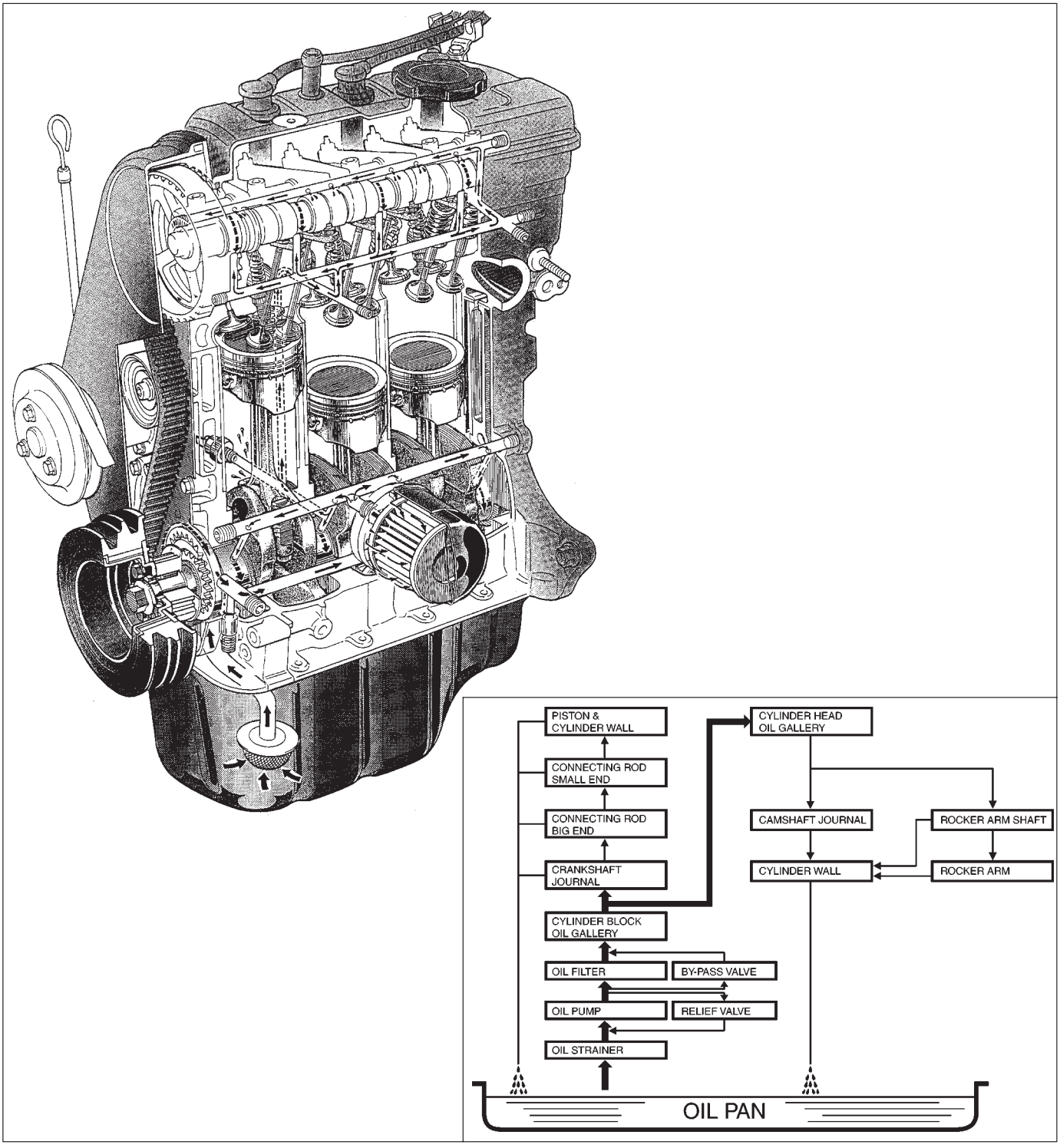


ENGINE LUBRICATION

The oil pump for pressure-feeding lubrication oil to the running parts of the engine is of an internal gear type, in which an outer ring-like gear is internally meshed with an inner gear, there being a separating crescent-like stator between the two. The pump is mounted on the front end of the engine, and is driven by the crankshaft.

The oil pump lifts oil through the strainer and discharges it under pressure, forcing the oil through the oil filter. The filtered oil flows into two paths inside the cylinder block. In one path, oil reaches the crankshaft journal bearings and big-end bearings on crankpins. Some of this oil goes to the connecting-rod small ends and lubricates piston pins there and also the walls of cylinder bores.
In the other path, oil goes up to the cylinder head and enters the oil gallery of rocker arm shafts to lubricate the sliding parts of these shafts and also journals of the camshaft.

An oil relief valve is provided on the oil pump. This valve starts relieving oil pressure when the pressure comes over about 3.3 kg/cm^2 (46.9 psi, 330 kPa). Relieved oil flows back to the oil pan.



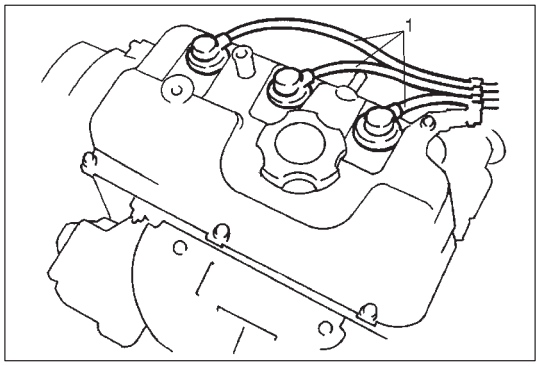
ON-VEHICLE SERVICE

COMPRESSION CHECK

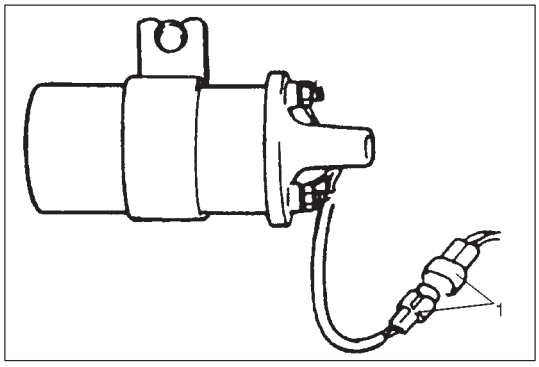
Check compression pressure on all three cylinders as follows:

1) Warm up engine.
2) Stop engine after warming up.

NOTE:
After warming up engine, place transmission gear shift lever in "Neutral" and set parking brake and block drive wheels.

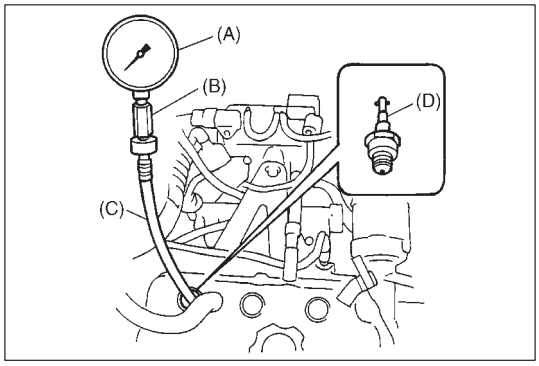


3) Disconnect fuel injector wire harness connector.
4) Remove high-tension cords (1) and all spark plugs referring to Section 6F.



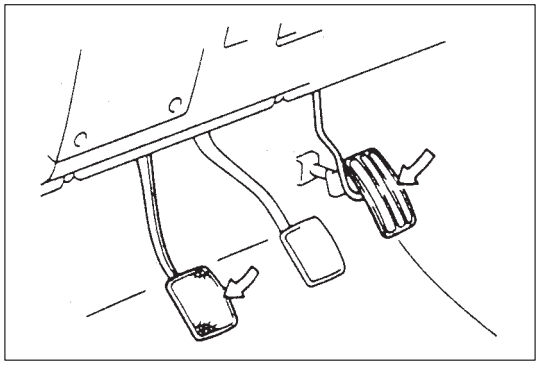
5) Disconnect ignition coil wire harness at coupler (1).

WARNING:
Failure in disconnecting the coupler can cause spark to occur in engine room possibly resulting in a dangerous explosion.



6) Install special tool (Compression gauge) into spark plug hole.

Special Tool
(A): 09915-64510-001
(B): 09915-64510-002
(C): 09915-64530
(D): 09915-64550

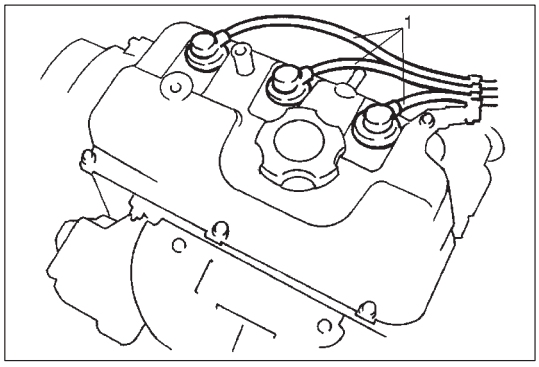


7) Disengage clutch (to lighten starting load on engine) and depress accelerator pedal all the way to make throttle valve full-open.

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

NOTE:
For measuring compression pressure, crank engine at least 250 r/min. by using fully charged battery.

	Compression pressure
Standard	1350 kPa (13.5 kg/cm^2, 192.0 psi)
Limit	1000 kPa (10.0 kg/cm^2, 142.2 psi)
Max. difference between any two cylinders	100 kPa (1.0 kg/cm^2, 14.2 psi)



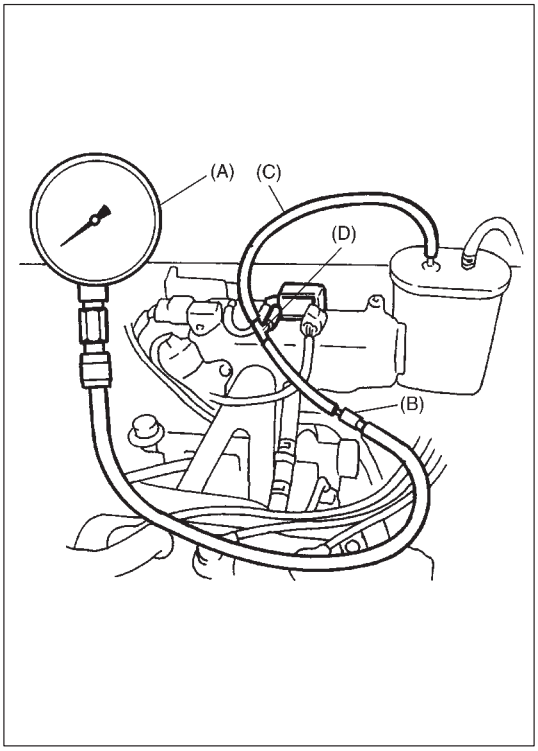
9) Carry out steps 5) through 7) on each cylinder to obtain three readings.
10) After checking, install spark plugs and high-tension cords (1) and connect injector and ignition coil wire harness connector securely.

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, place transmission gear shift lever in "Neutral" and set parking brake and block drive wheels.



2) With engine stopped, disconnect canister purge control vacuum hose from canister purge control valve and connect 3-way joint, hose and special tool (vacuum gauge and joint) to canister purge control valve and vacuum hose disconnected.

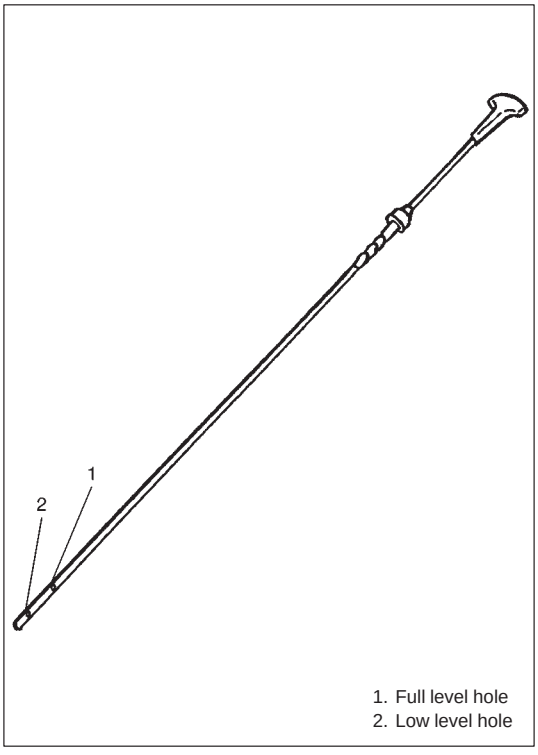
Special Tool
(A): 09915-67310
(B): 09918-08210

SUZUKI GENUINE PARTS
(C): Hose 09343-03087
(D): 3-way joint 09367-04002

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

Vacuum specification (at sea level):
at specified idling speed
53.7 – 60.4 kPa (40 – 45 cmHg, 15.7 – 17.7 in.Hg)

4) After checking, connect vacuum hose to canister purge control valve.

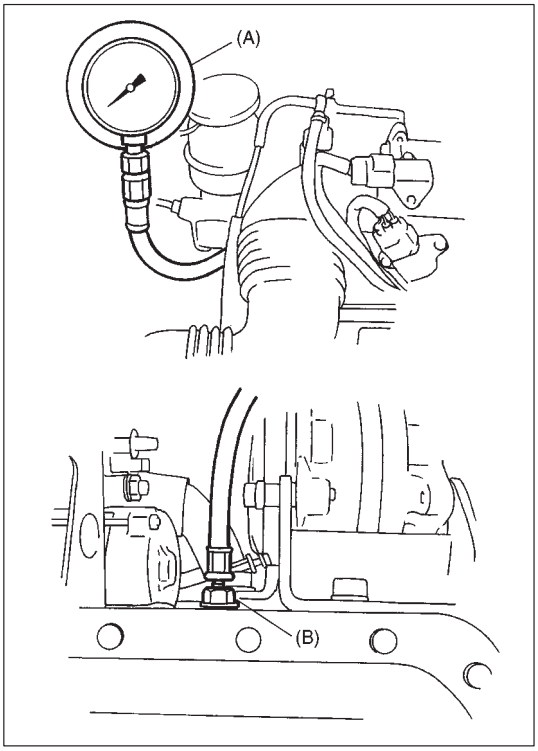


1. Full level hole
2. Low level hole

OIL PRESSURE CHECK

NOTE:
Prior to checking oil pressure, check following items.

- **Oil level in oil pan.**
  If oil level is low, add oil up to Full level hole on oil level gauge.
- **Oil quality.**
  If oil is discolored, or deteriorated, change it.
  For particular oil to be used, refer to the table in MAINTENANCE SERVICE of Section 0B.
- **Oil leaks.**
  If leak is found, repair it.



1) Hoist vehicle. Remove oil pressure switch from cylinder block.
2) Install special tool (Oil pressure gauge) to vacated threaded hole. Then lower vehicle.

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

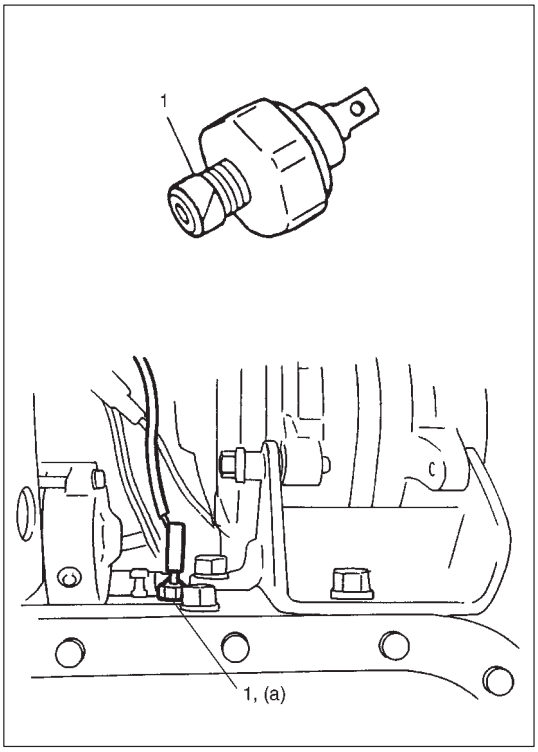
3) Start engine and warm it up to normal operating temperature.

   NOTE:
   Be sure to place transmission gear shift lever in "Neutral" and set parking brake and block drive wheels.

4) After warming up, raise engine speed to 4,000 r/min and measure oil pressure.

   Oil pressure specification:
   300 – 450 kPa (3.0 – 4.5 kg/cm², 42.7 – 64.0 psi) at 4,000 r/min (rpm)

5) Stop engine and remove oil pressure gauge.

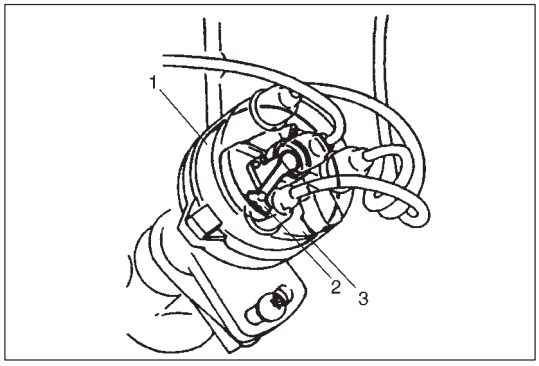


6) Before reinstalling oil pressure switch (1), be sure to wrap its screw threads with sealing tape and tighten switch to specified torque.

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

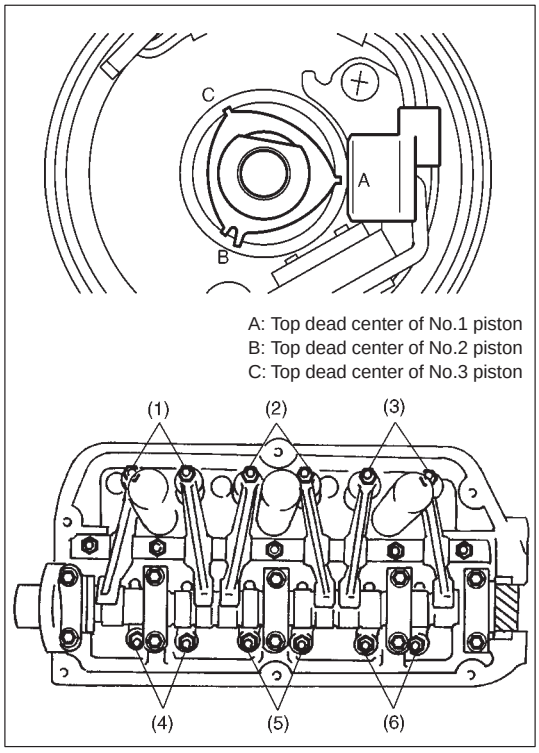
   Tightening Torque
   (a): 14 N·m (1.4 kg-m, 10.5 lb-ft)

7) Start engine and check oil pressure switch for oil leakage.
8) Stop engine and connect terminal to pressure switch terminal.

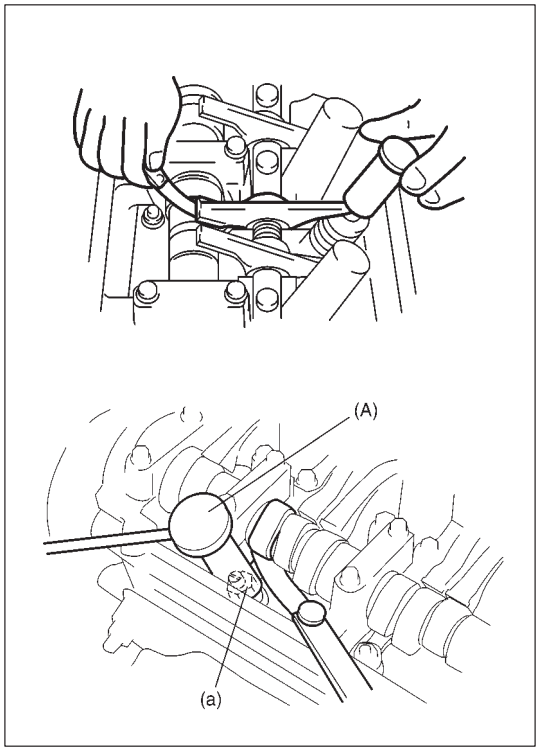


VALVE LASH (CLEARANCE)

1) Remove negative cable at battery.
2) Remove cylinder head cover referring to CYLINDER HEAD COVER in this section.
3) Remove distributor cap (1), rotor (2) and cover (3).



4) Using 17 mm wrench, turn crankshaft pulley clockwise until lug of signal rotor aligned to CMP sensor as shown in figure.
5) If signal rotor is positioned as shown in figure (i.e. No.1 piston is at top dead center of compression stroke), check valve lashes at valves (1) and (4).

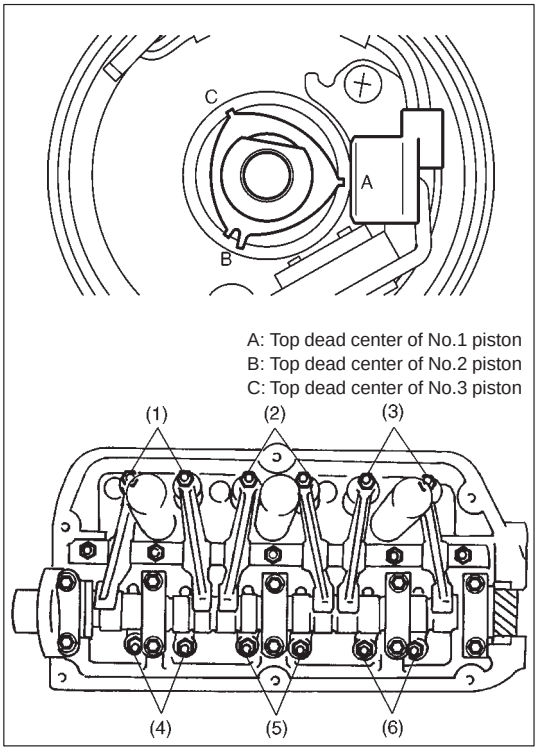


6) If valve lash is out of specification, adjust it to specification by turning adjusting screw after loosening lock nut.
   After adjustment, tighten lock nut to specified torque while holding adjusting screw stationary, and then make sure again that valve lash is within specification.

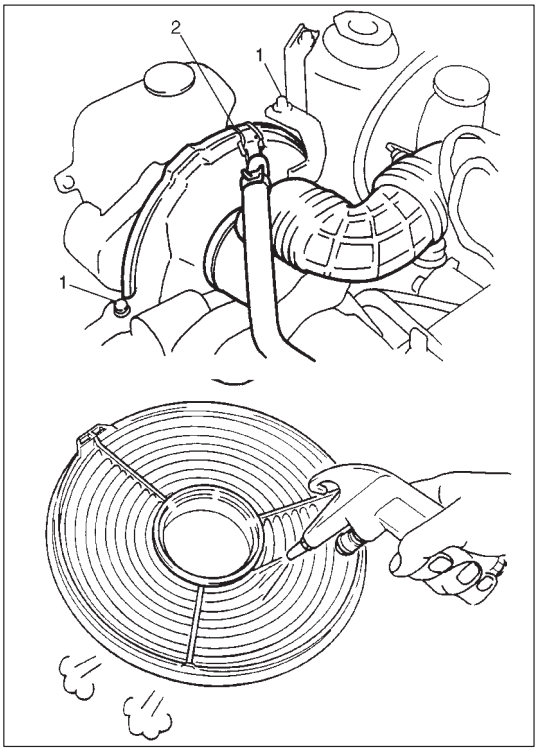
		When cold (Coolant temperature is 15 – 25°C or 59 – 77°F)	When hot (Coolant temperature is 60 – 68°C or 140 – 154°F)
Valve clearance specification	Intake	0.13 – 0.17 mm (0.005 – 0.007 in.)	0.15 – 0.19 mm (0.006 – 0.007 in.)
	Exhaust	0.13 – 0.17 mm (0.005 – 0.007 in.)	0.14 – 0.18 mm (0.006 – 0.007 in.)

Special Tool
(A): 09917-18210

Tightening Torque
(a): 12 N·m (1.2 kg-m, 9.0 lb-ft)



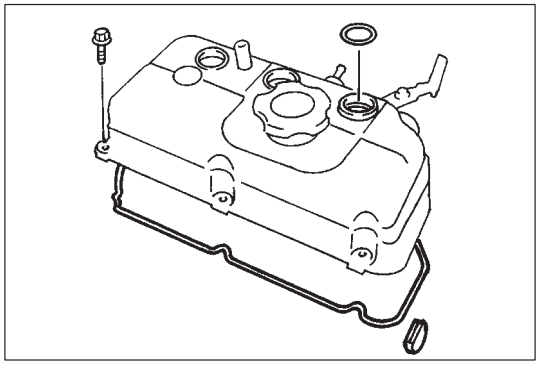
7) After checking and adjusting valve lashes at valves (1) and (4), rotate crankshaft pulley clockwise until lug “C” of signal rotor aligned to CMP sensor and check the same valves at (3) and (6). Adjust them as necessary.
8) After checking and adjusting valve lashes at valves (3) and (6), rotate crankshaft pulley clockwise until lug “B” of signal rotor aligned to CMP sensor and check the same valves at (2) and (5). Adjust them as necessary.



AIR CLEANER FILTER

REMOVAL AND INSTALLATION

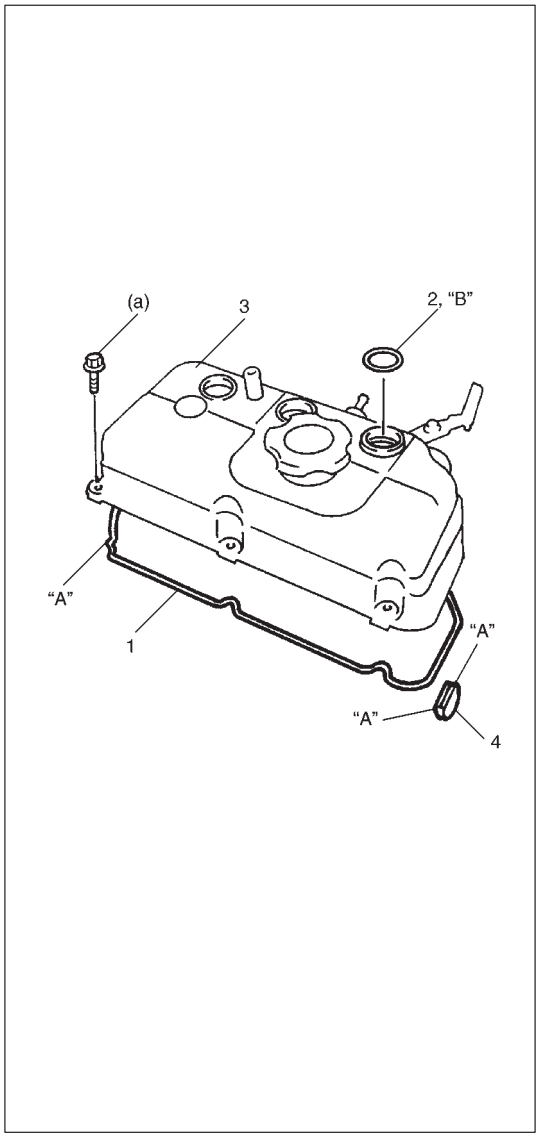
1) Remove air cleaner case bracket bolts (1).
2) Remove air cleaner case clamps (2).
3) Remove air cleaner filter from case.
4) Check air cleaner filter for dirt.
5) If necessary, blow off dust by compressed air from air outlet side of air cleaner filter.
   If excessively dirty, replace filter.
6) Reverse removal procedure for installation.



CYLINDER HEAD COVER

REMOVAL

1) Disconnect negative cable at battery.
2) Remove high-tension cords.
3) Disconnect PCV valve and breather hoses from head cover.
4) Remove cylinder head cover.



INSTALLATION

1) Install O-rings (2) and cylinder head cover gasket (1) to cylinder head cover (3).
   - Apply sealant to cylinder head cover gasket and cylinder head side seal (4) indicated part.

     "A": sealant: 99000-31150

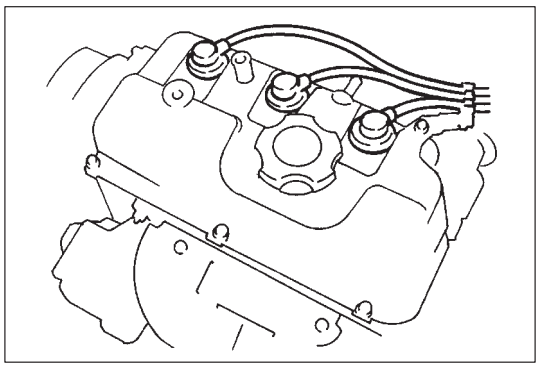
   - Apply grease to O-rings.

     "B": grease: 99000-25010

   NOTE:
   Be sure to check each of these parts for deterioration or any damage before installation and replace if found defective.
2) Install cylinder head cover to cylinder head and tighten cover bolts to specified torque.

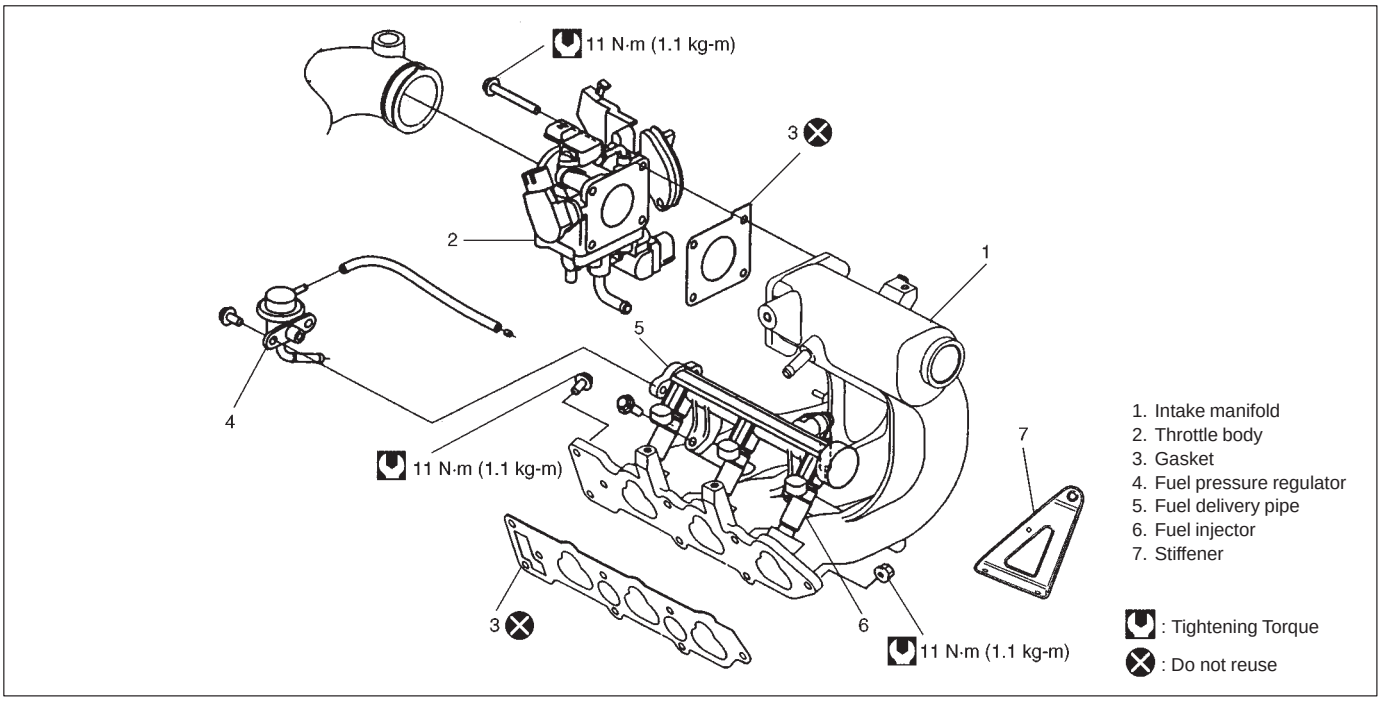
   Tightening Torque
   (a): 11 N·m (1.1 kg-m, 8.0 lb-ft)

   NOTE:
   When installing cylinder head cover, use care so that cylinder head cover gasket, cylinder head side seal or O-rings will not get out of place or fall off.



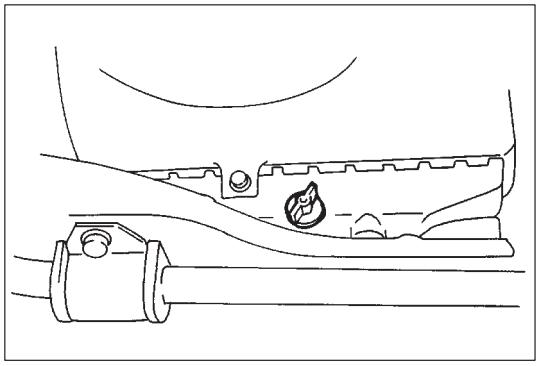
3) Install high-tension cords.
4) Connect PCV valve and breather hoses to head cover.
5) Connect negative cable at battery.

THROTTLE BODY AND INTAKE MANIFOLD



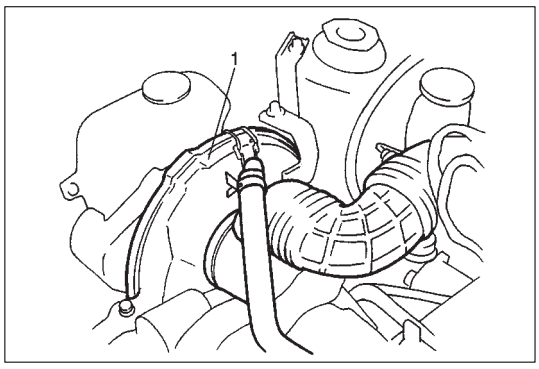
REMOVAL

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



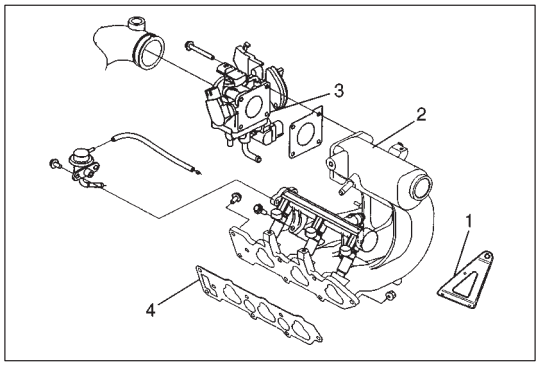
3) Drain cooling system.

WARNING:
To help avoid danger of being burned, do not remove drain plug 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.

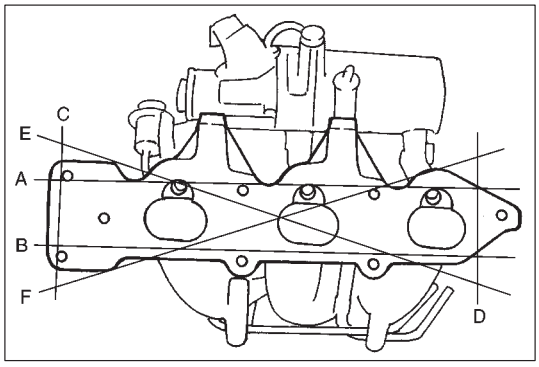


4) Remove air cleaner case (1).
5) Disconnect following electric lead wires:
   - Injectors lead wires at the coupler
   - Canister purge control valve
   - Throttle position sensor/Idle air control valve
   - Pressure sensor

6) Disconnect accelerator cable from throttle body.
7) Disconnect following hoses:
   - Canister purge hose from canister purge control valve
   - Engine cooling water (coolant) hoses from throttle body
   - PCV hose from intake manifold
   - Fuel return and inlet hoses from each pipe



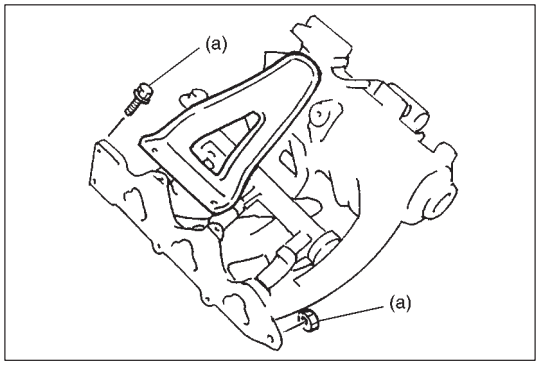
8) Remove intake manifold stiffener (1).
9) Remove intake manifold (2) with throttle body (3) from cylinder head, and then its gasket (4).



INSPECTION

- Using a straight edge and thickness gauge, check surface at a total of 6 locations. If distortion limit, given below, is exceeded, correct gasketed surface or replace intake manifold.

  Limit of distortion: 0.05 mm (0.002 in.)



INSTALLATION

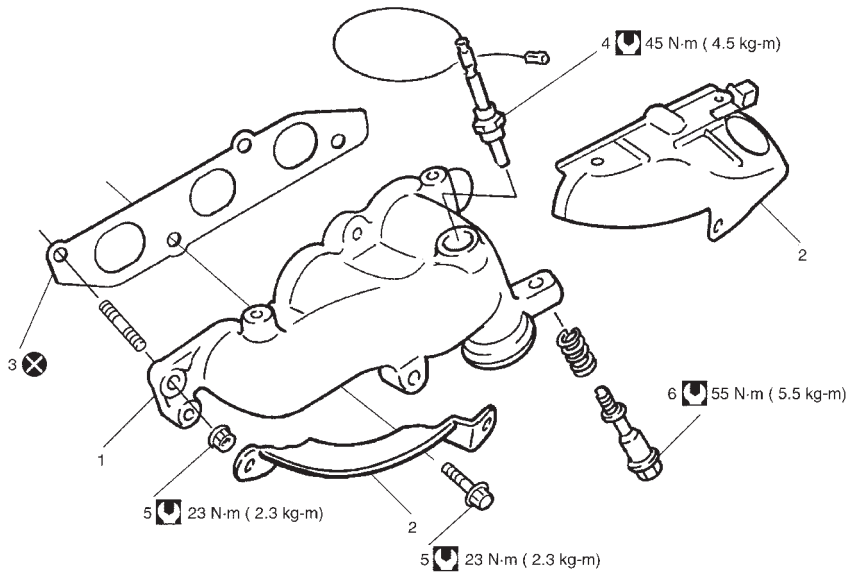
Reverse removal procedure for installation noting the followings.

- Use new intake manifold gasket.
- Tighten bolts and nuts to specified torque.

  Tightening Torque
  (a): 11 N·m (1.1 kg-m, 8.0 lb-ft)

- Adjust accelerator cable play, referring to Section 6E.
- Check to ensure that all removed parts are back in place. Reinstall any necessary parts which have not been reinstalled.
- Refill cooling system, referring to Section 6B.
- Adjust water pump drive belt tension, 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.

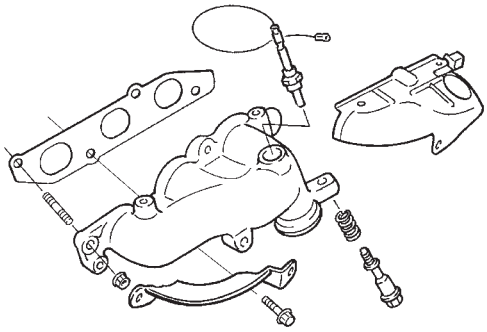
EXHAUST MANIFOLD



1. Exhaust manifold
2. Exhaust manifold cover
3. Gasket
4. Oxygen sensor
5. Exhaust manifold bolt and nut
6. Exhaust pipe bolt

: Tightening Torque

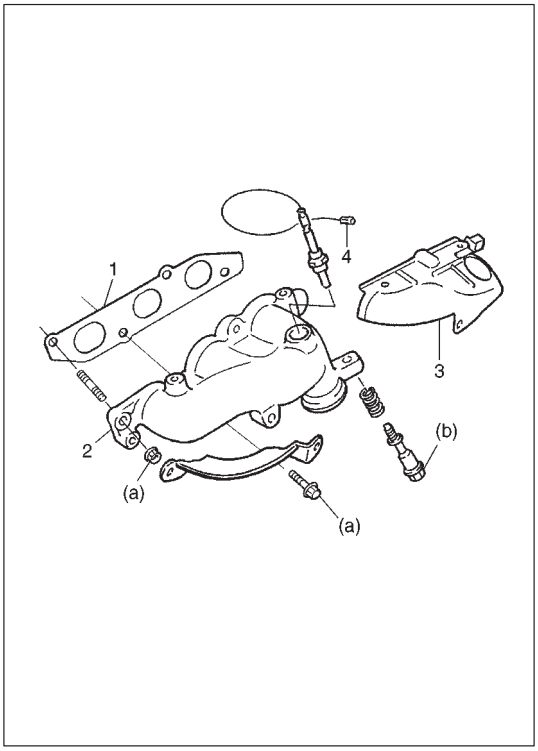
: Do not reuse



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

REMOVAL

1) Disconnect negative cable at battery.
2) Disconnect oxygen sensor coupler (if equipped).
3) Remove exhaust manifold covers of exhaust manifold.
4) Remove exhaust pipe from exhaust manifold.
5) Remove exhaust manifold and its gasket from cylinder head.



INSTALLATION

1) Install new gasket (1) to cylinder head.
2) Install exhaust manifold (2).
   Tighten bolts and nuts to specified torque.

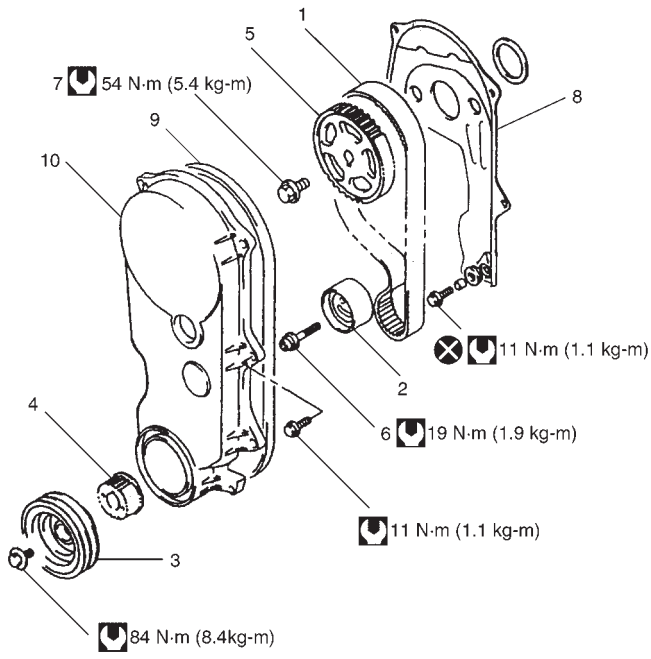
   Tightening Torque
   (a): 23 N·m (2.3 kg-m, 17.0 lb-ft)

3) Install pipe gasket and install exhaust pipe to exhaust manifold.
   Before installing pipe gasket, check it for deterioration or damage, and replace as necessary.
   Tighten pipe fasteners to specified torque.

   Tightening Torque
   (b): 55 N·m (5.5 kg-m, 40.0 lb-ft)

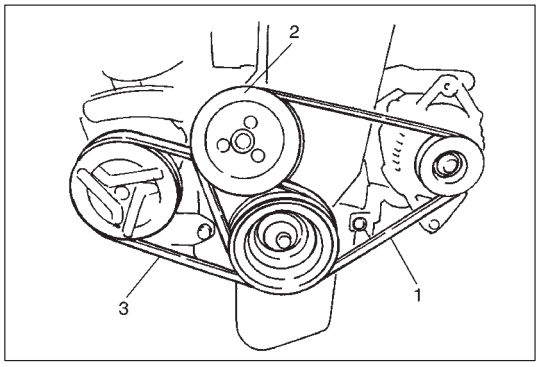
4) Install upper cover (3) to exhaust manifold.
5) Connect oxygen sensor connector (4) and fit connector to bracket.
6) Connect negative cable at battery.
7) Check exhaust system for exhaust gas leakage.

TIMING BELT AND BELT TENSIONER



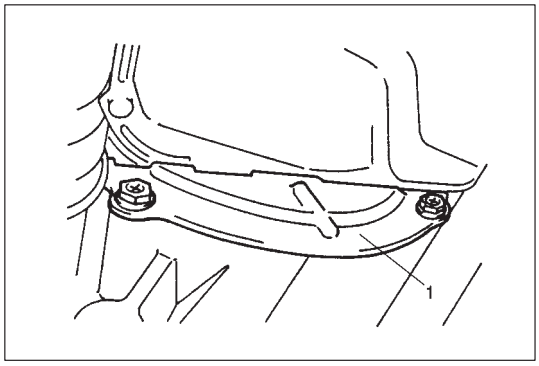
1. Timing belt
2. Tensioner
3. Crank shaft pulley
4. Camshaft timing belt pulley
5. Camshaft timing pulley
6. Tensioner bolt
7. Pulley bolt
8. Inside cover
9. Outside cover seal
10. Outside cover

: Tightening Torque
: Do not reuse

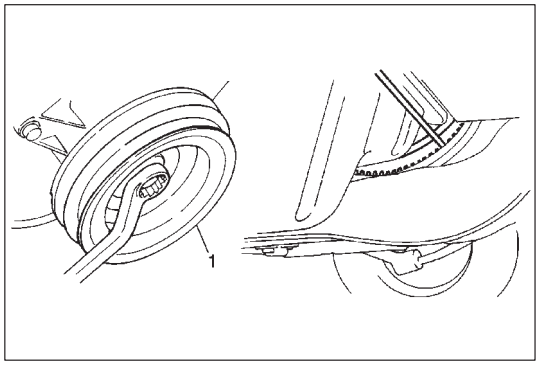


REMOVAL

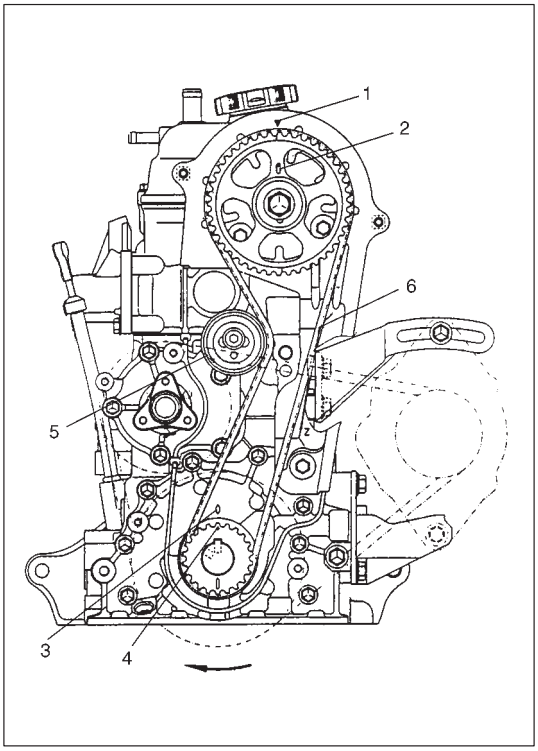
1) Disconnect negative cable at battery.
2) Remove air cleaner case and hose.
3) Remove water pump drive belt (1) and water pump pulley (2).
4) Remove A/C compressor belt (3), if equipped.



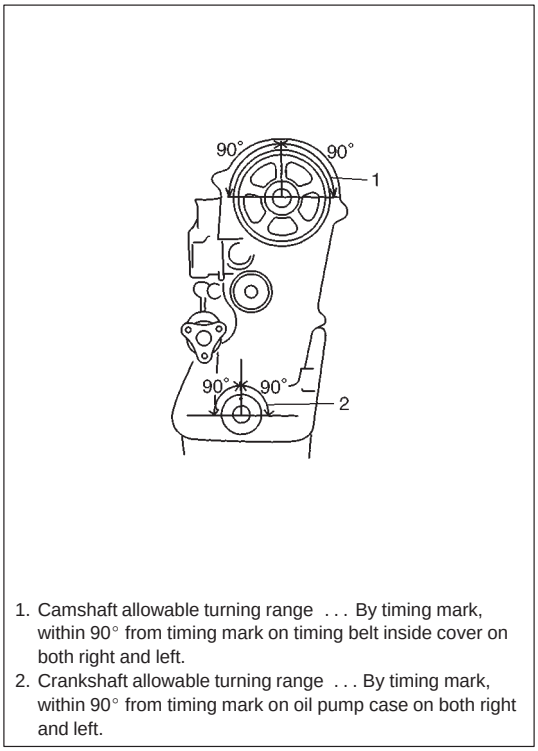
5) Remove clutch housing lower plate (1).



6) Remove crankshaft pulley (1) with crankshaft locked.

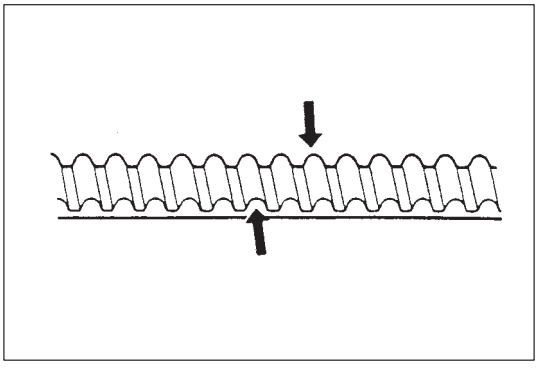


7) Remove timing belt outside cover.
8) For installation of timing belt, align 4 timing marks (1), (2), (3), (4) as shown in figure by turning crankshaft.
9) Remove timing belt tensioner (5) and timing belt (6).



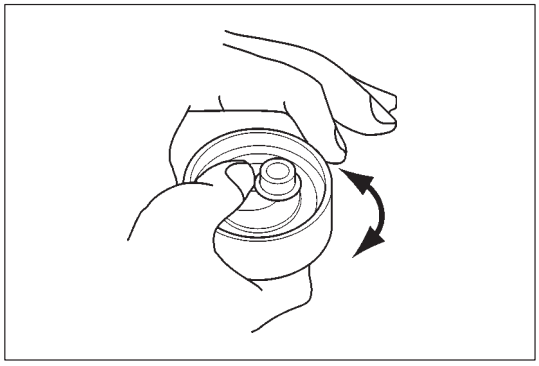
1. Camshaft allowable turning range . . . By timing mark, within 90° from timing mark on timing belt inside cover on both right and left.
2. Crankshaft allowable turning range . . . By timing mark, within 90° from timing mark on oil pump case on both right and left.

CAUTION:
- **After timing belt is removed, never turn camshaft and crankshaft independently more than such an extent as shown in figure. If turned, interference may occur among piston and valves, and parts related to piston and valves may be damaged.**
- **Never bend timing belt.**

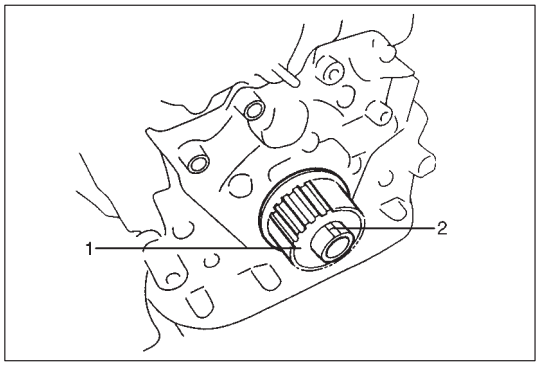


INSPECTION

- Inspect timing belt for wear or crack. Replace it as necessary.

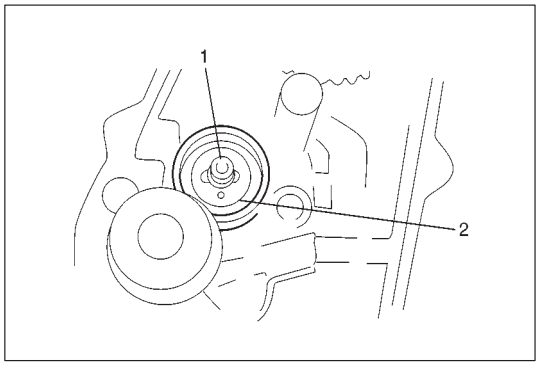


- Inspect tensioner for smooth rotation.

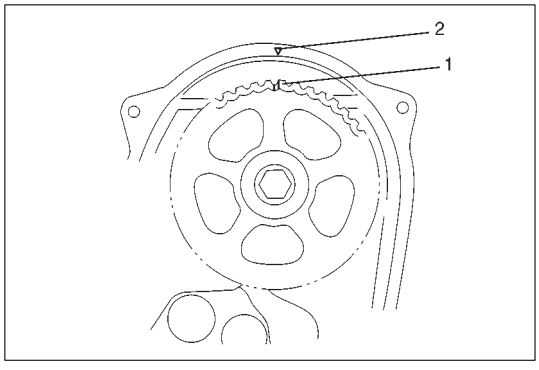


INSTALLATION

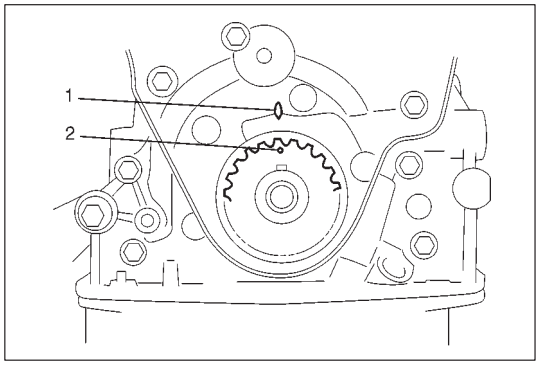
1) Install crank pulley key (2) to crankshaft.
   Install crankshaft timing belt pulley (1) to crankshaft, if removed.



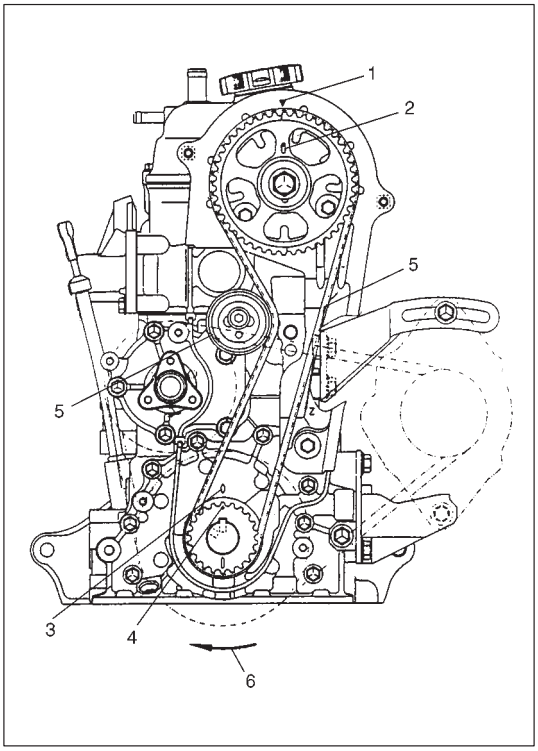
2) Install tensioner (2).
   Do not tighten tensioner bolt (1) with wrench yet. Hand tighten only at this time.



3) Check that timing mark (1) on camshaft timing belt pulley is aligned with mark (2) on timing belt inside cover. If not, align two marks by turning camshaft but be careful not to turn it more than its allowable turning range which is described on previous page.



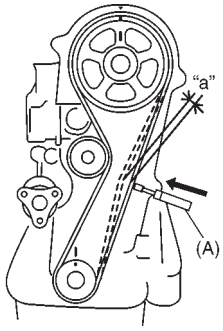
4) Check that punch mark (2) on crankshaft timing belt pulley is aligned with arrow mark (1) on oil pump case. If not, align two marks by turning crankshaft but be careful not to turn it more than its allowable turning range which is described on previous page.

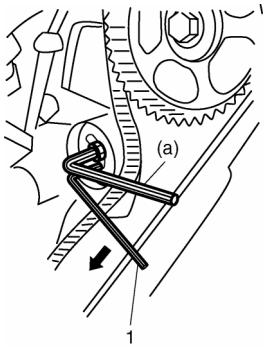


5) Check to ensure that valve clearance is adjusted correctly.
6) Remove spark plugs.
7) Install timing belt.
With two sets of marks (1), (2) and (3), (4) aligned, install timing belt on two pulleys in such a way that drive side (5) of belt is free from any slack.

NOTE:

- **When installing timing belt, match arrow mark (⇨) on timing belt with rotating direction (6) of crankshaft.**





8) Attach hexagon wrench (1) to belt tensioner hole and adjust belt tension to specified.
(a) Move tensioner till timing belt tension is specification by turning hexagon wrench clockwise as shown in figure and measure timing belt tension by using special tool.

Special Tool
(A): 09919-56010

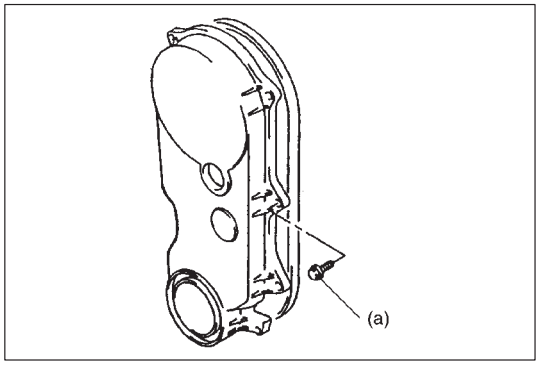
Belt tension under pressure 7 kg or 15.5 lb
"a": 10.5 mm (0.413 in.) . . . New belt
12.0 mm (0.472 in.) . . . Reuse belt

(b) Tighten tensioner bolt.

Tightening Torque
(a): 19 N·m (1.9 kg-m, 14.0 lb-ft)

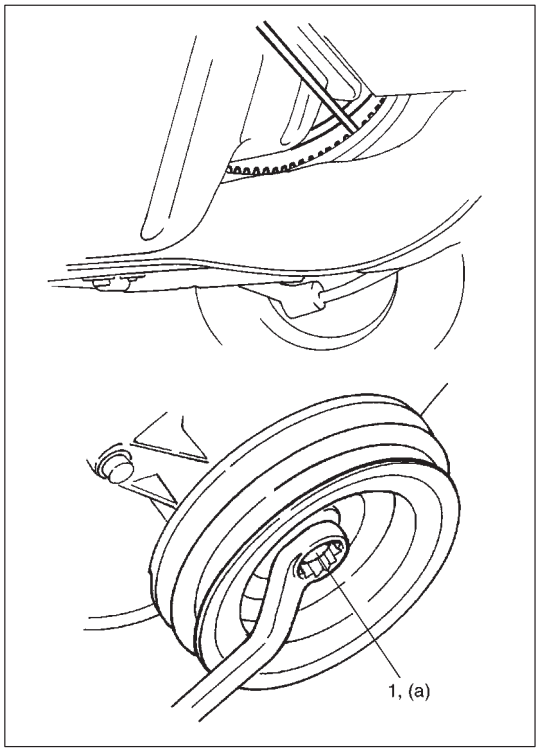
(c) To take up slack of timing belt, turn crankshaft two rotations clockwise.
Then confirm again that two sets of marks are aligned respectively. And confirm belt tension again as previously outlined.

NOTE:
Perform step 8) repeatedly, after loosen tensioner bolt, if belt tension is out of standards.



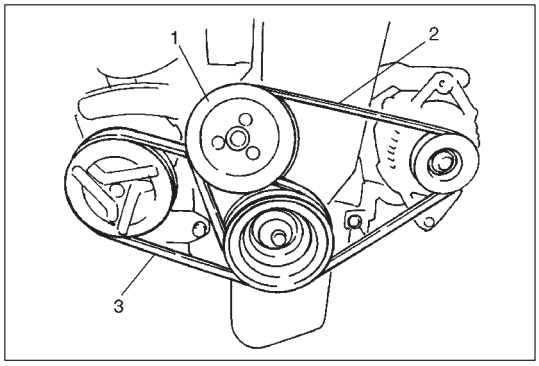
9) Install spark plugs.
10) Install timing belt outside cover.
Before installing, make sure that seal is between water pump and oil pump case.

Tightening Torque
(a): 11 N·m (1.1 kg-m, 8.0 lb-ft)



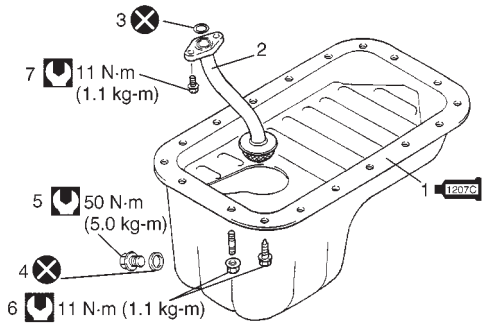
11) Install crankshaft pulley (1).
Install crankshaft timing belt pulley with crankshaft locked, and tighten pulley bolts to specified torque.

Tightening Torque
(a): 84 N·m (8.4 kg-m, 61.0 lb-ft)



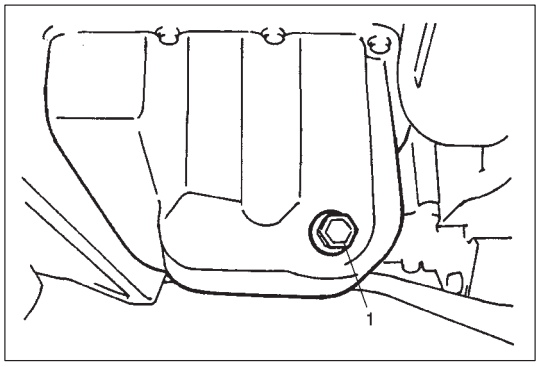
12) Install A/C compressor belt (3), if equipped.
Adjust its belt tension, referring to Section 0B.
13) Install water pump pulley (1) and water pump drive belt (2).
Adjust water pump drive belt tension, referring to Section 6B.
14) Install air cleaner case and hose.
15) Connect negative cable at battery.

OIL PAN AND OIL PUMP STRAINER

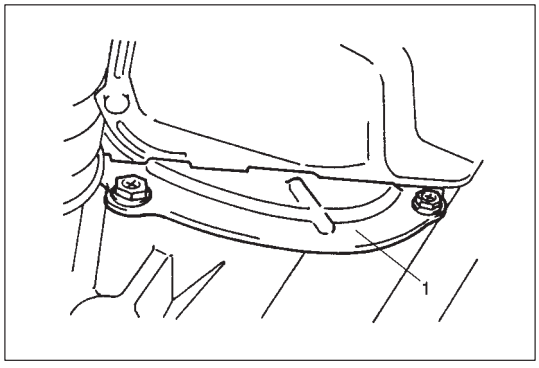


1207C 1. Oil pan:
Apply SUZUKI BOND No. 1207C
99000-31150 to mating surface.
2. Oil pump strainer
3. Seal
4. Drain plug gasket
5. Drain plug
6. Oil pan bolt and nut
7. Strainer bolt

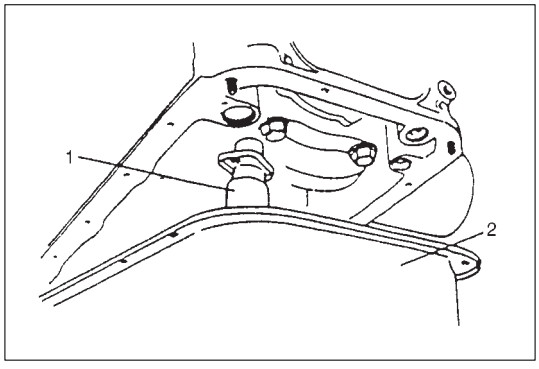
: Tightening Torque
: Do not reuse



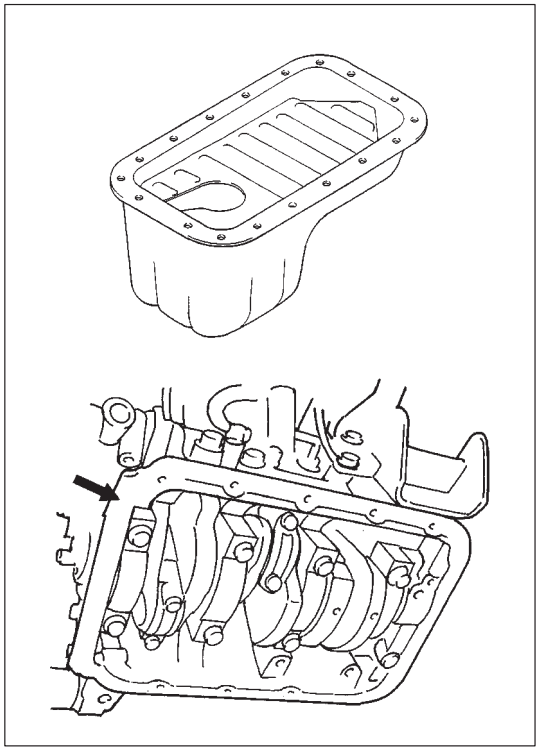
1) Drain engine oil by removing drain plug (1).



2) Remove clutch housing lower plate (1).

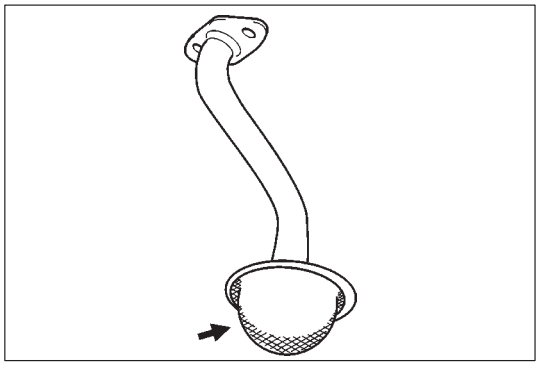


3) Disconnect exhaust pipe from exhaust manifold.
4) Remove oil pan (2) and then oil pump strainer (1).

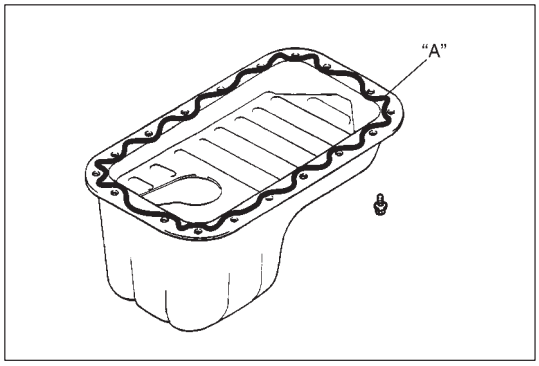


CLEANING

- Clean mating surfaces of oil pan and cylinder block.
  Remove oil, old sealant, and dusts from mating surfaces and oil pan inside.



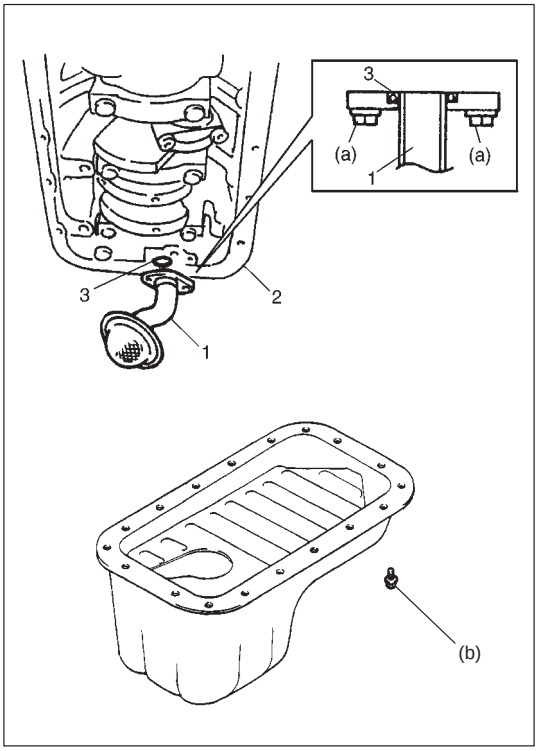
- Clean oil pump strainer screen.



INSTALLATION

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

   "A" Sealant: 99000-31150

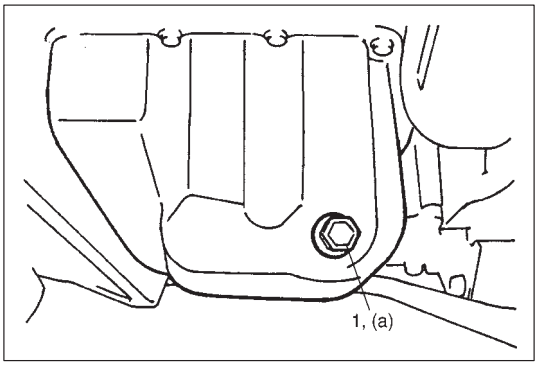


2) Install oil pump strainer (1) and oil pan (2).
   Install new O-ring (3) to oil pump strainer in the position as shown in figure.
   Install strainer to cylinder block, then tighten strainer bolt to specified torque.

   Tightening Torque
   (a): 11 N·m (1.1 kg-m, 8.0 lb-ft)

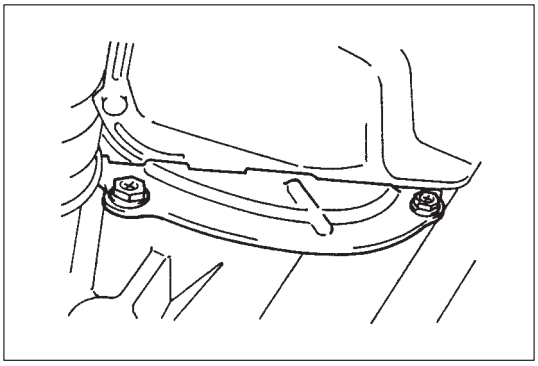
   After fitting oil pan to cylinder block, run in securing bolts and start tightening at the center: move wrench outward, tightening one bolt at a time.
   Tighten bolts to specified torque.

   Tightening Torque
   (b): 11 N·m (1.1 kg-m, 8.0 lb-ft)



3) Install new gasket and drain plug (1) to oil pan.
   Tighten drain plug (1) to specified torque.

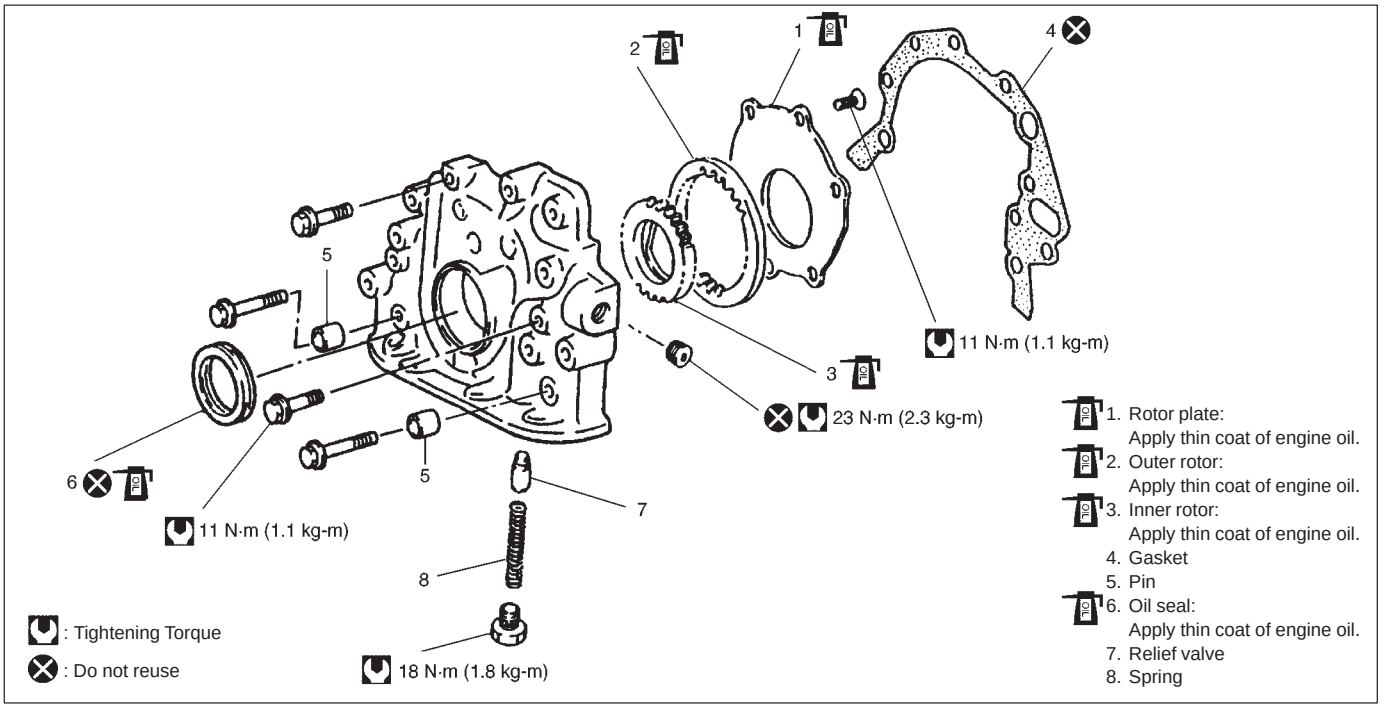
   Tightening Torque
   (a): 50 N·m (5.0 kg-m, 36.5 lb-ft)

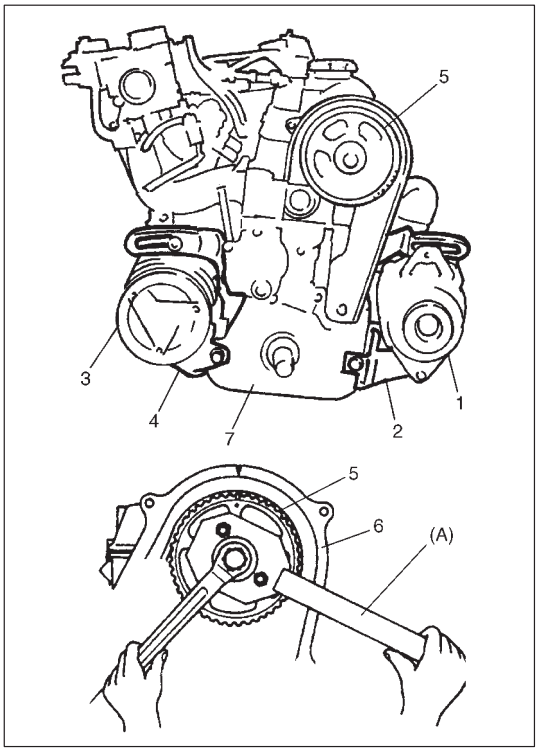


4) Install clutch (torque converter) housing lower plate.

5) Connect exhaust manifold pipe to exhaust manifold.
6) Refill engine with engine oil, referring to item ENGINE OIL CHANGE in Section 0B.
7) Verify that there is no engine oil leakage and differential oil leakage at each connection.

OIL PUMP



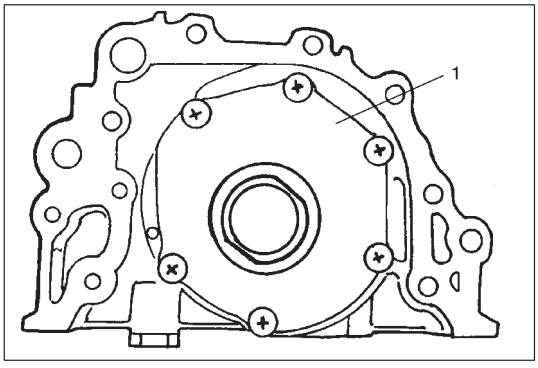


REMOVAL

1) Disconnect negative cable at battery.
2) Remove timing belt as previously outlined.
3) Remove generator (1) and its bracket (2).
4) Remove A/C compressor (3) and its bracket (4) (if equipped).
5) Remove camshaft timing pulley (5) by using special tool.

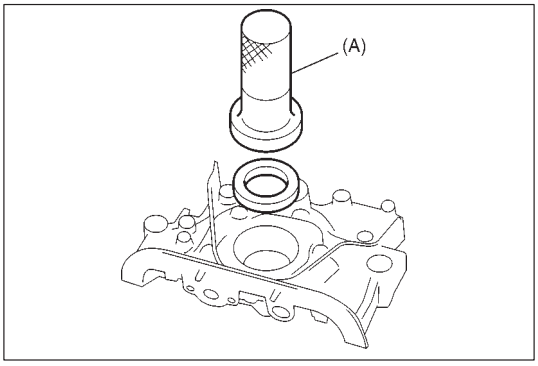
Special Tool
(A): 09917-68221

6) Remove timing belt inside cover (6).
7) Remove oil pan and oil pump strainer as previously outlined.
8) Remove oil pump assembly (7) after removing bolts.



DISASSEMBLY

1) Remove rotor plate (1).

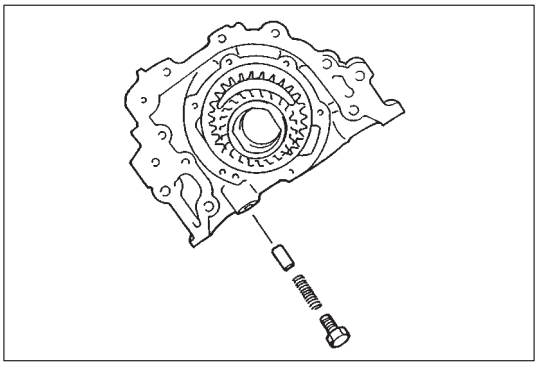


INSPECTION

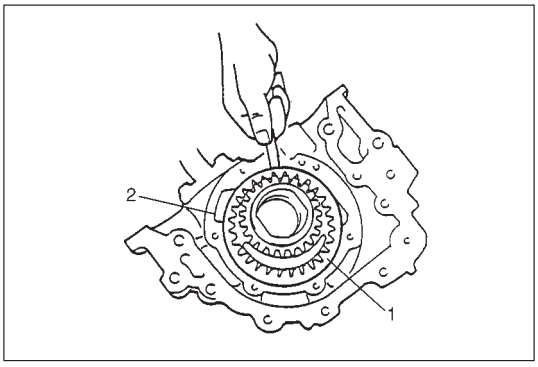
- Check oil seal lip for fault or other damage. Replace as necessary.

  Special Tool
  (A): 09913-75520

  NOTE:
  When installing oil seal, press-fit it till its end face is flush with oil pump case end face.



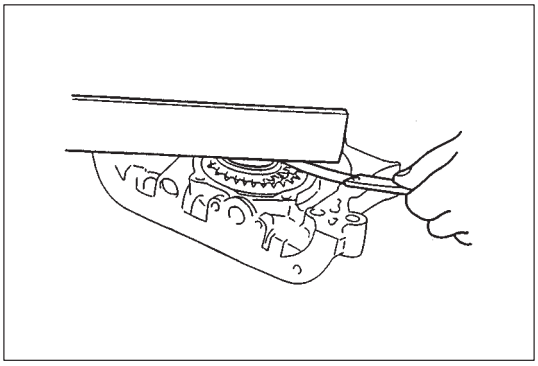
- Check outer and inner rotors, rotor plate, and oil pump case for excessive wear or damage.



MEASUREMENT

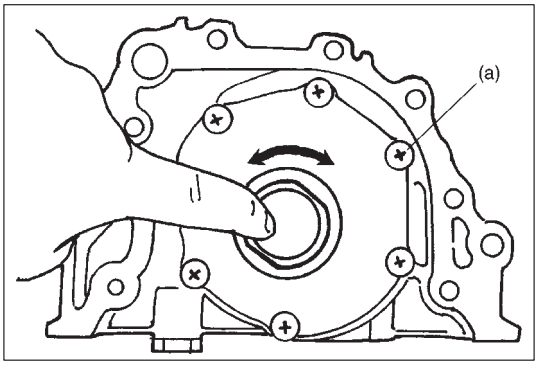
- **Radial clearance**
  Check radial clearance between outer rotor (1) and case (2), using thickness gauge.
  If clearance exceeds its limit, replace outer rotor or case.

  Limit on radial clearance between outer rotor and case: 0.320 mm (0.0126 in.)



- **Side clearance**
  Using straight edge and thickness gauge, measure side clearance.

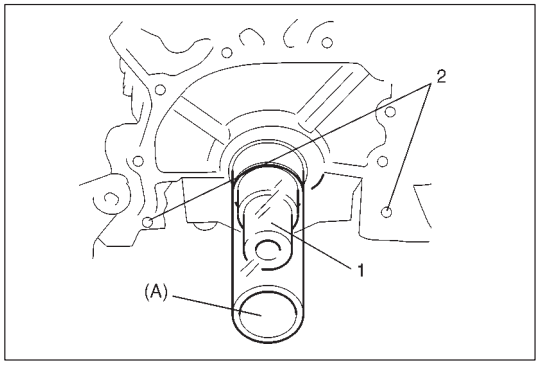
  Limit on side clearance: 0.17 mm (0.0067 in.)



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 and inner rotors to pump case.
4) Install rotor plate. Tighten screws to specified torque.
   After installing plate, check to be sure that gears turn smoothly by hand.

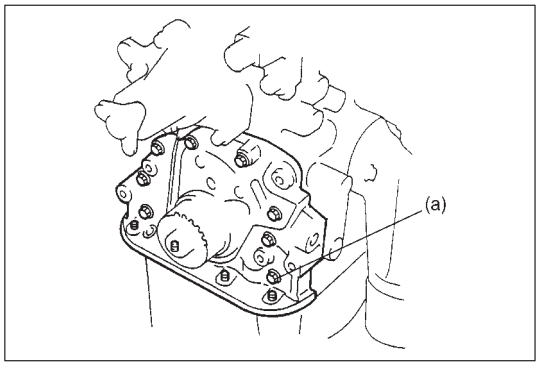
   Tightening torque
   (a): 11 N·m (1.1 kg-m, 8.0 lb-ft)



INSTALLATION

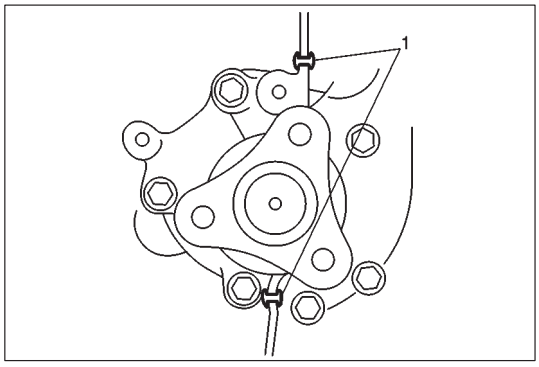
1) Install two oil pump pins (2) and oil pump gasket to cylinder block. Use a new gasket.
2) To prevent oil seal lip from being damaged or upturned when installing oil pump to crankshaft, fit special tool (Oil seal guide) to crankshaft (1), and apply engine oil to special tool.

Special Tool
(A): 09926-18210



3) Install oil pump to cylinder block.

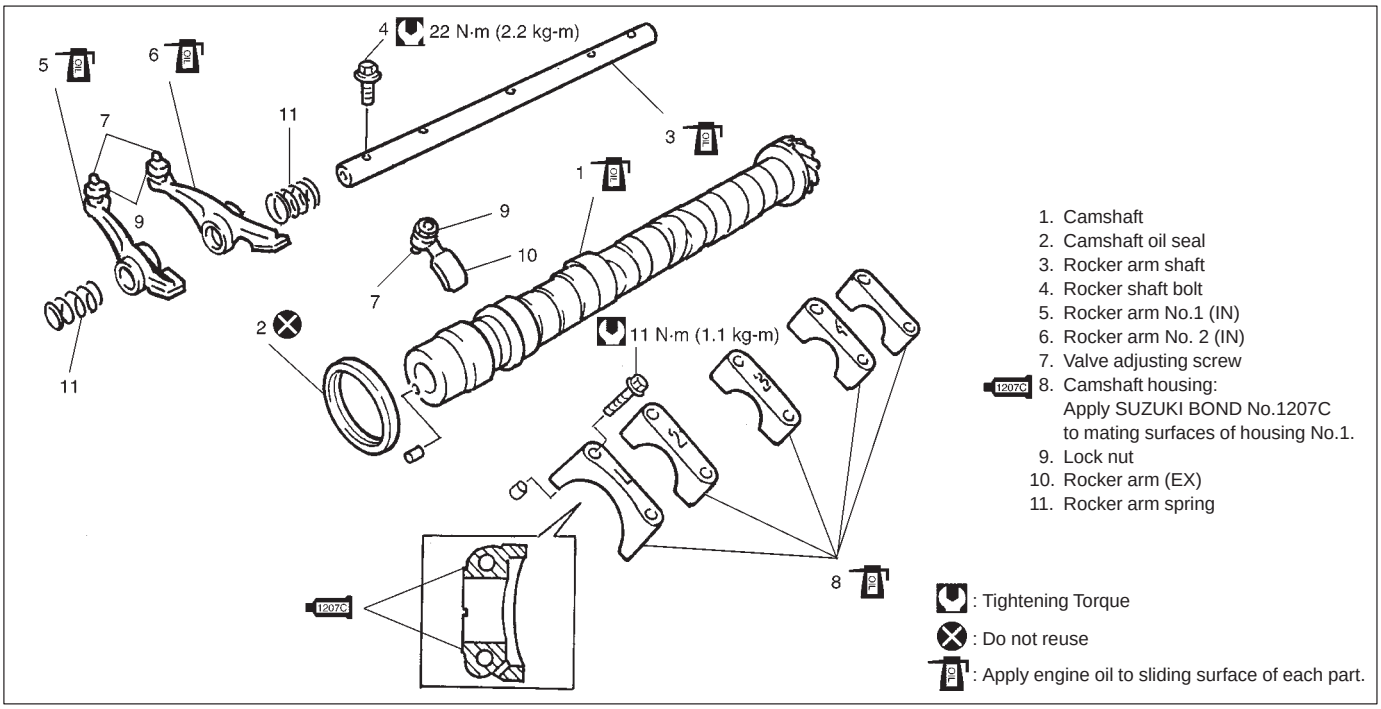
Tightening Torque
(a): 11 N·m (1.1 kg-m, 8.0 lb-ft)



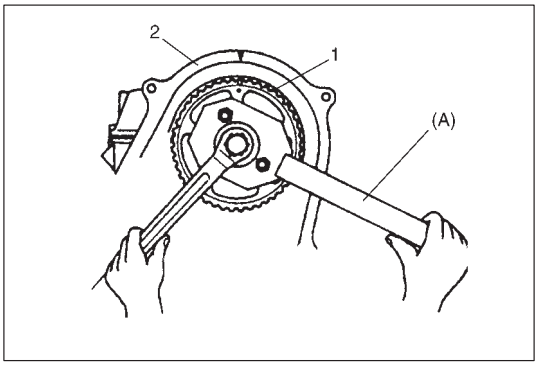
4) Install rubber seals (1) between oil pump and water pump.

5) Install timing belt, tensioner, oil pump strainer, oil pan and other parts as previously outlined.
6) Check to ensure that all removed parts are back in place. Reinstall any necessary parts which have not been reinstalled.
7) Adjust water pump drive belt tension, referring to Section 0B.
8) Adjust A/C compressor belt tension, if equipped. Refer to Section 0B.
9) Refill engine with engine oil, referring to item ENGINE OIL CHANGE in Section 0B.
10) Connect negative cable at battery.
11) Verify that there is no coolant leakage and each oil leakage at each connection.
12) After completing installation, check oil pressure by running engine.

ROCKER ARMS, ROCKER SHAFT AND CAMSHAFT



1. Camshaft
2. Camshaft oil seal
3. Rocker arm shaft
4. Rocker shaft bolt
5. Rocker arm No.1 (IN)
6. Rocker arm No. 2 (IN)
7. Valve adjusting screw
8. Camshaft housing: Apply SUZUKI BOND No.1207C to mating surfaces of housing No.1.
9. Lock nut
10. Rocker arm (EX)
11. Rocker arm spring

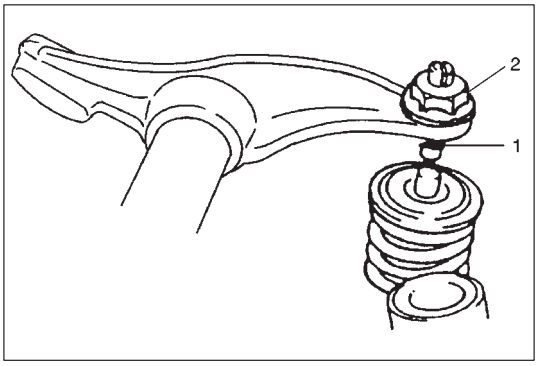


REMOVAL

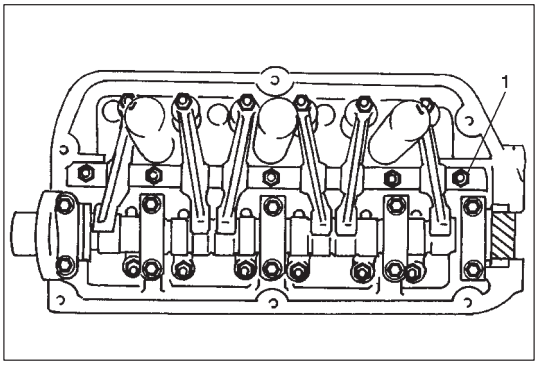
1) Disconnect negative cable at battery.
2) Remove timing belt as previously outlined.
3) Remove camshaft timing belt pulley (1) by using special tool and then remove timing belt inside cover (2).

   Special Tool
   (A): 09917-68221

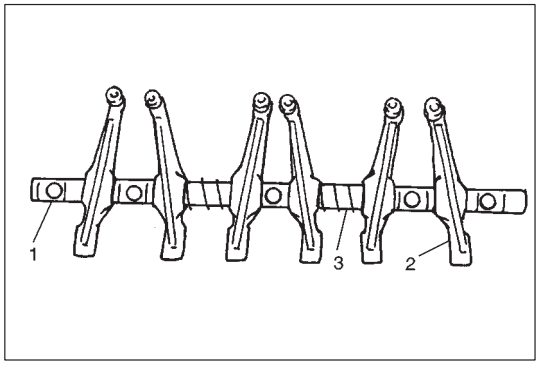
4) Remove cylinder head cover as previously outlined.



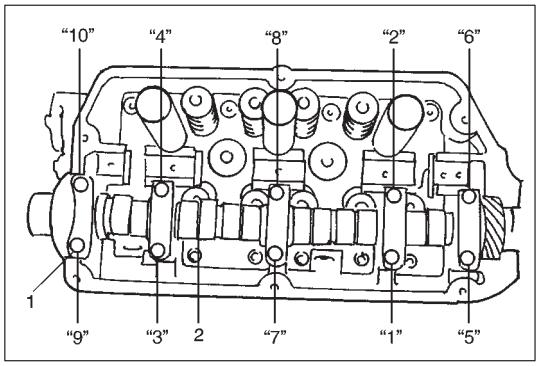
5) After loosening all valve adjusting screw lock nuts (2), turn adjusting screws (1) back all the way to allow all rocker arms to move freely.



6) Remove rocker arm shaft bolts (1).



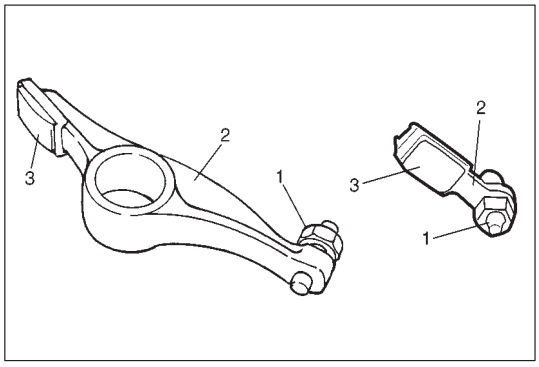
7) Remove rocker arm shaft (1) with intake rocker arms (2) and rocker arm spring (3).



8) Remove camshaft housing (1), camshaft (2) and distributor. For distributor removal, refer to Section 6F.

NOTE:
To remove camshaft housing bolts, loosen them in such order as indicated in figure, a little at a time.

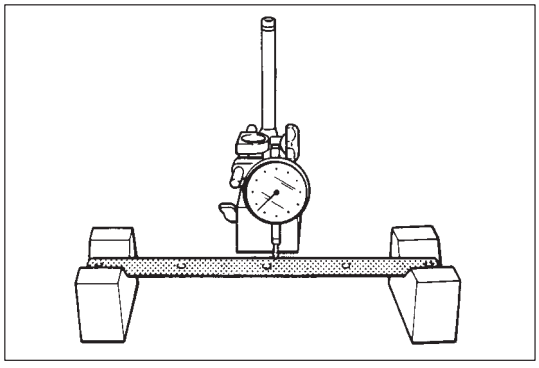
9) Remove exhaust rocker arms.



INSPECTION

Adjusting Screw and Rocker Arm

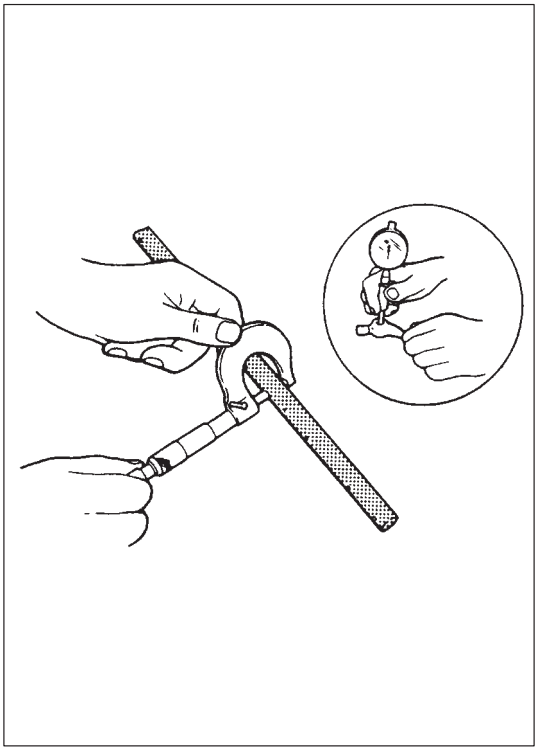
If tip of adjusting screw (1) is badly worn, replace it.
Rocker arm (2) must be replaced if its cam-riding face (3) is badly worn.



Rocker Arm Shaft Runout

Using "V" blocks and dial gauge, check runout. If runout exceeds its limit, replace rocker arm shaft.

Runout limit: 0.06 mm (0.0024 in.)



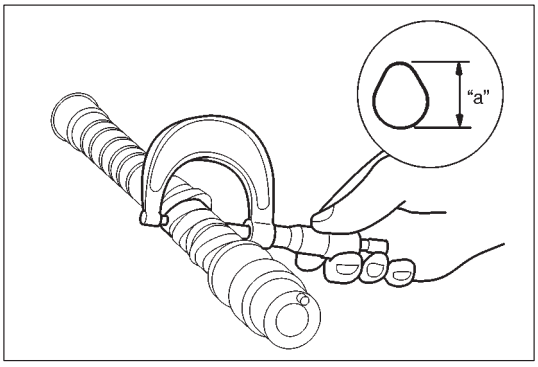
Rocker Arm-to-Rocker Arm Shaft Clearance

Using a micrometer and a bore gauge, measure rocker shaft dia. and rocker arm I.D.

Difference between two readings is arm-to-shaft clearance on which a limit is specified.

If limit is exceeded, replace shaft or arm, or both.

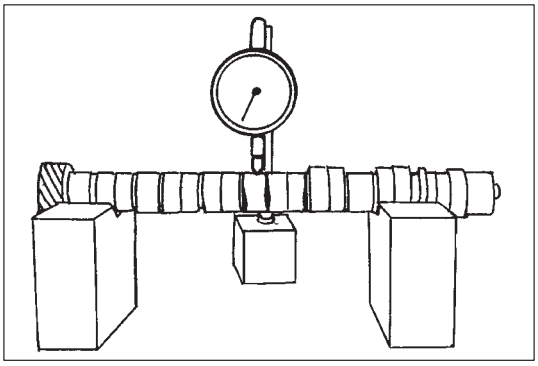
Item	Standard	Limit
Rocker arm I.D.	15.985 – 16.005 mm (0.629 – 0.630 in.)	———
Rocker arm shaft dia.	15.965 – 15.980 mm (0.6285 – 0.6291 in.)	———
Arm-to-shaft clearance	0.005 – 0.040 mm (0.0002 – 0.0016 in.)	0.06 mm (0.0024 in.)



Cam Wear

Using a micrometer, measured height of cam. If measured height is below limit, replace camshaft.

Cam height	Standard	Limit
Intake cam	30.406 – 30.566 mm (1.1971 – 1.2034 in.)	30.362 mm (1.1954 in.)
Exhaust cam	29.719 – 29.879 mm (1.1700 – 1.1763 in.)	29.676 mm (1.1683 in.)

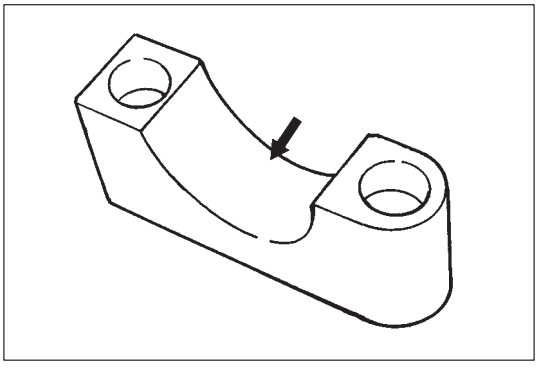


Camshaft Runout

Hold camshaft between two "V" blocks, and measure runout by using a dial gauge.

If runout exceeds the limit, replace camshaft.

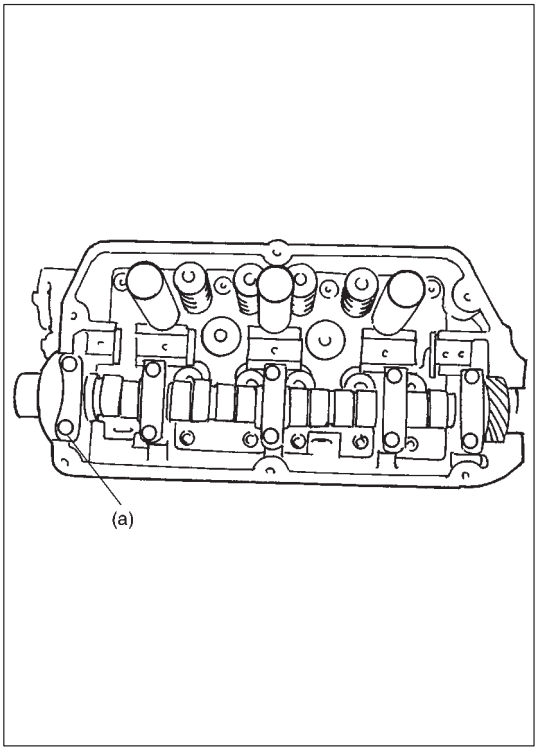
Runout limit: 0.10 mm (0.0039 in.)



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 housing.

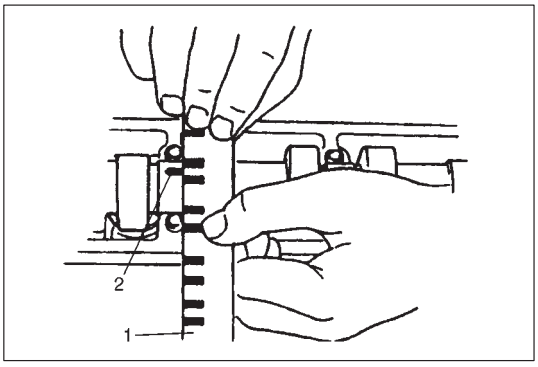


Check clearance by using gaging plastic.
The procedure is as follows.

1) Clean housing and camshaft journals.
2) Install camshaft to cylinder head.
3) Place a piece of gaging plastic the full width of journal of camshaft (parallel to camshaft).
4) Install camshaft housing, referring to the following page.
5) Tighten camshaft housing bolts in such order as indicated in figure a little at a time till they are tightened to specified torque.

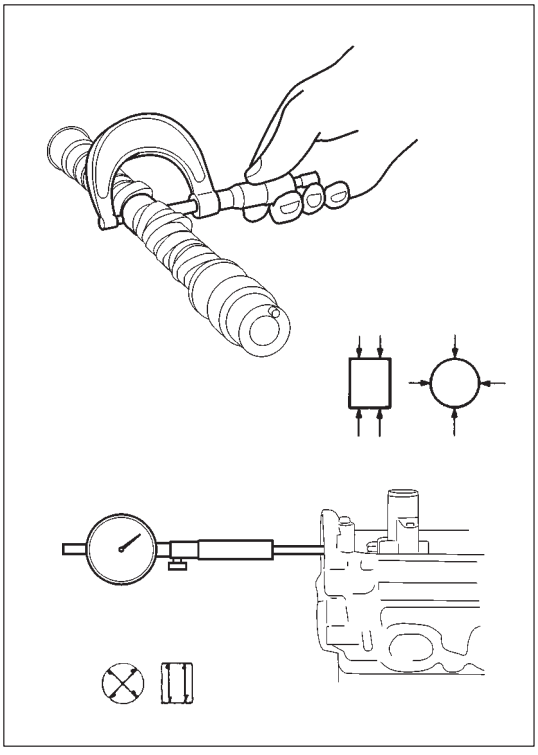
Tightening Torque
(a): 11 N·m (1.1kg-m, 8.0 lb-ft)

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



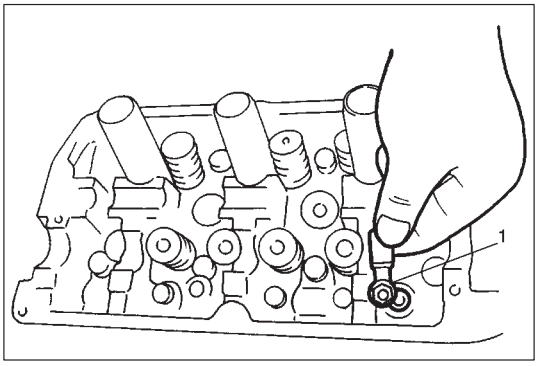
6) Remove housing and using scale (1) on gaging plastic (2) envelope, measure gaging plastic width at its widest point.

	Standard	Limit
Journal clearance	0.045 – 0.087 mm (0.0018 – 0.0034 in.)	0.12 mm (0.0047 in.)



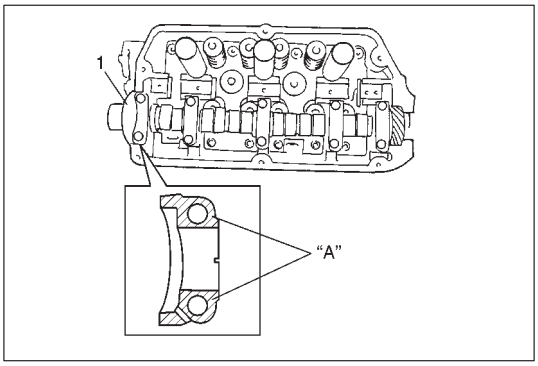
If measured camshaft journal clearance exceeds limit, measure journal (housing) bore and outside diameter of camshaft journal. Replace camshaft or cylinder head assembly whichever the difference from specification is greater.

Item	Standard
Camshaft Journal bore dia.	27.000 – 27.021 mm (1.0630 – 1.0638 in.)
Camshaft journal O.D.	26.934 – 26.955 mm (1.0603 – 1.0612 in.)



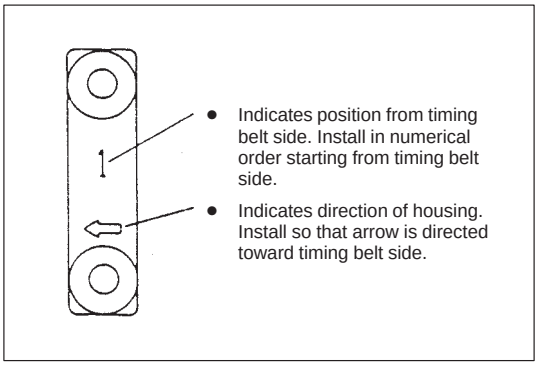
INSTALLATION

1) Fill small amount of engine oil into arm pivot holding part of cylinder head. Install rocker arm (exhaust side) (1).

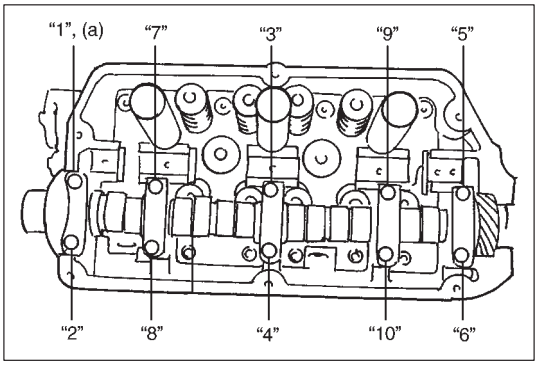


2) Apply engine oil to cams and journals on camshaft and put camshaft on cylinder head. Install camshaft housing to camshaft and cylinder head.
   - Apply engine oil to sliding surface of each housing against camshaft journal.
   - Apply sealant to mating surface of No.1 housing (1) which will mate with cylinder head.

     "A" Sealant: 99000-31150

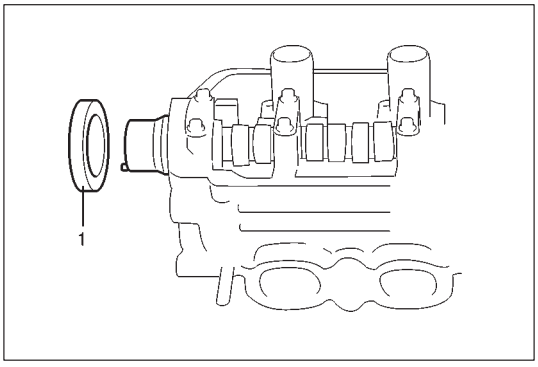


   - Embossed marks are provided on each camshaft housing, indicating position and direction for installation.
     Install housing as indicated by these marks.
   - As camshaft housing No. 1 retains camshaft in proper position as to thrust direction, make sure to first fit No. 1 housing to No. 1 journal of camshaft securely.

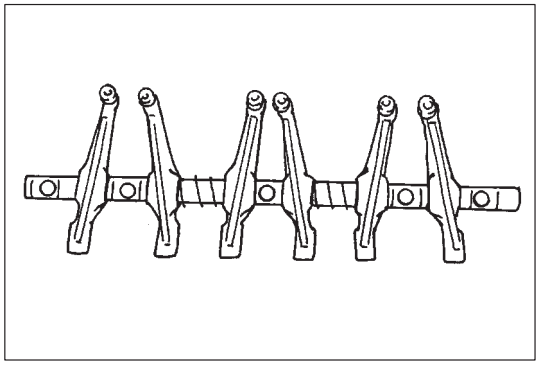


   - After applying engine oil to housing bolts, tighten them temporarily first. Then tighten them by following sequence as indicated in figure.
     Tighten a little at a time and evenly among bolts and repeat tightening sequence three to four times before they are tightened to specified torque.

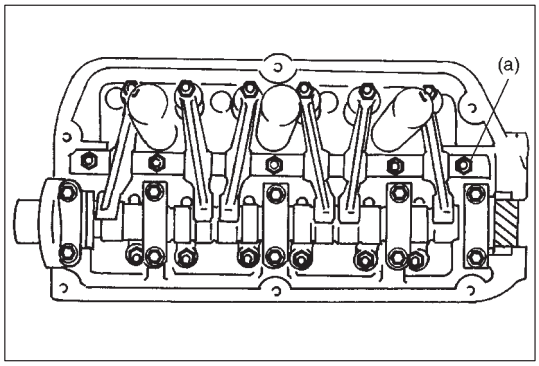
     Tightening Torque
     (a): 11 N·m (1.1 kg-m, 8.0 lb-ft)



3) Install new camshaft oil seal (1).
   After applying engine oil to oil seal lip, press-fit camshaft oil seal till oil seal surface becomes flush with housing surface.
4) Install distributor, refer to Section 6F.

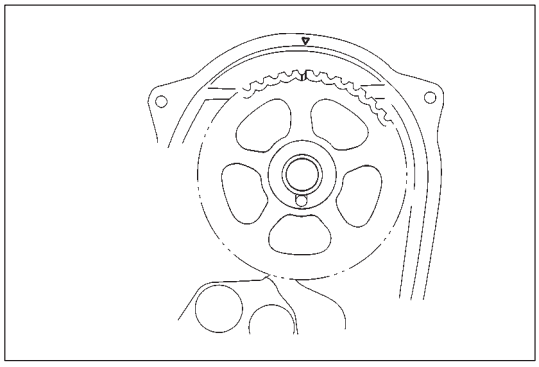


5) Apply engine oil to rocker arm shaft and rocker arms.
6) Install rocker arm shaft, rocker arm (intake side) and rocker arm spring.

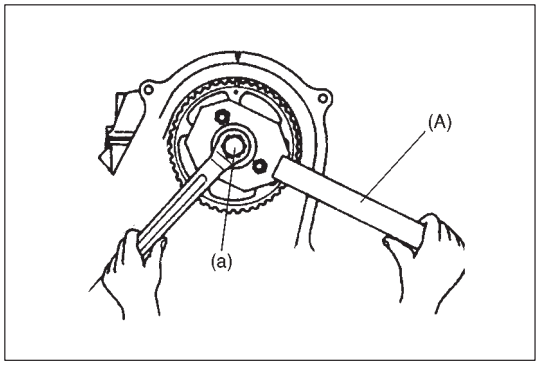


7) Install rocker arm shaft bolts and tighten them to specified torque.

Tightening Torque
(a): 22 N·m (2.2 kg-m, 16.0 lb-ft)



8) Install camshaft timing belt inside cover.
9) Install camshaft timing belt pulley to camshaft while fitting pin on camshaft into slot.



10) Using special tool, tighten pulley bolt to specified torque.

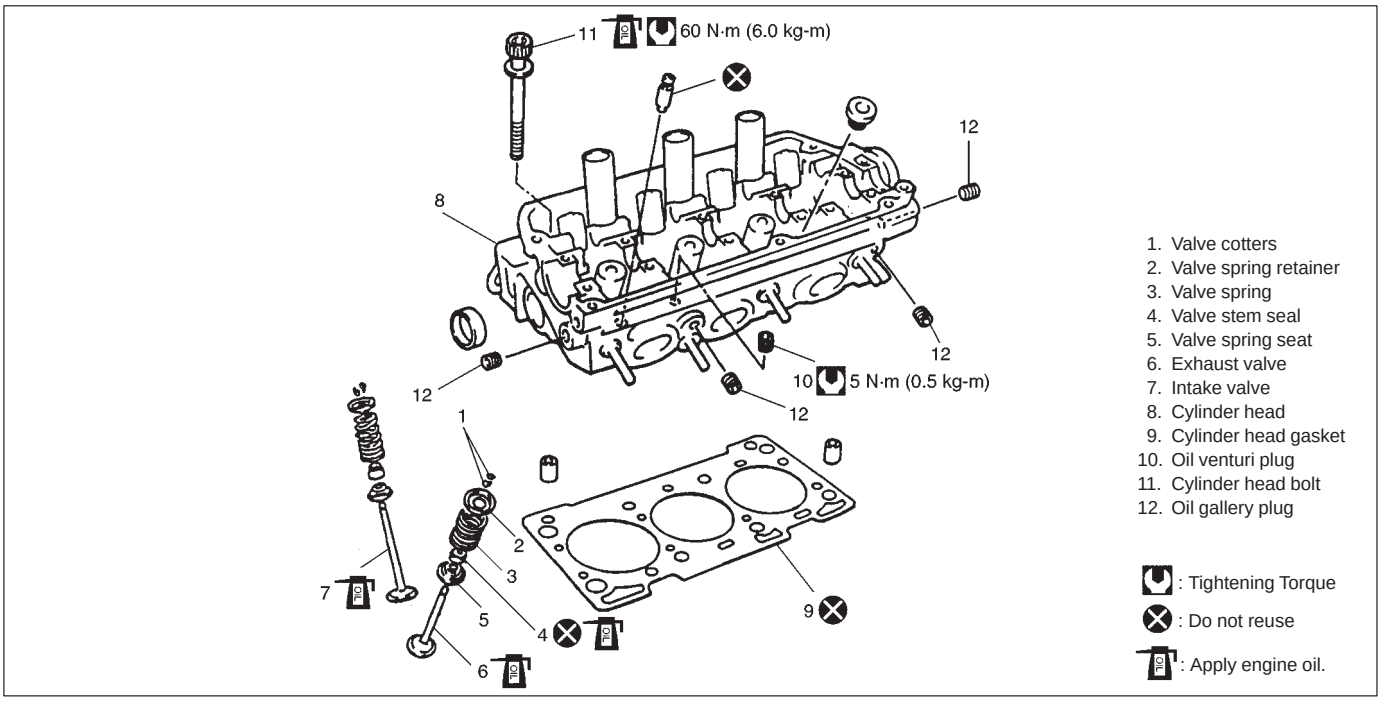
Tightening Torque
(a): 54 N·m (5.4 kg-m, 39.0 lb-ft)

Special Tool
(A): 09917-68221

11) Install belt tensioner, timing belt, outside cover, crankshaft pulley, A/C compressor belt (if equipped) and water pump belt as previously outlined.

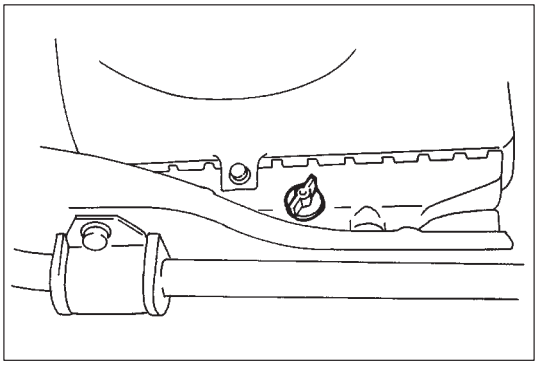
12) Adjust valve clearance as previously outlined.
13) Install cylinder head cover.
14) Connect negative cable at battery.
15) Confirm that ignition timing is within specification referring to Section 6F.

VALVES AND CYLINDER HEAD

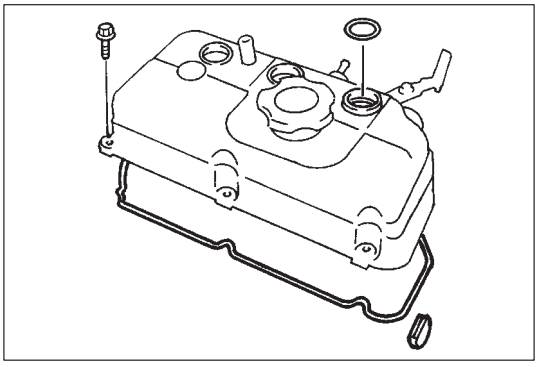


REMOVAL

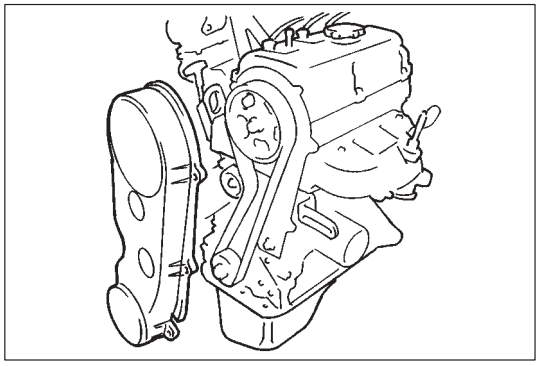
1) Relieve fuel pressure according to fuel pressure relief procedure described in Section 6.
2) Disconnect negative cable at battery.



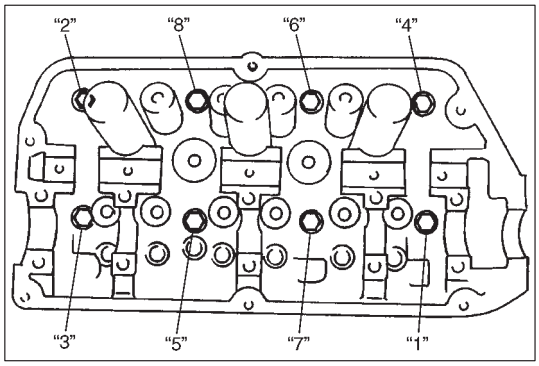
3) Drain cooling system.



4) Remove cylinder head cover as previously outlined. Loosen all valve lash adjusting screws fully.

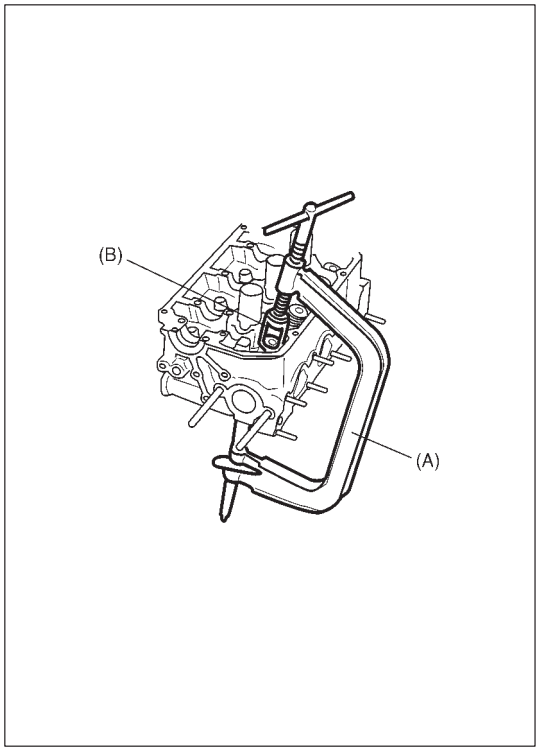


5) Remove timing belt, timing belt inside cover rocker arm shaft with, intake rocker arms, exhaust rocker arms and camshaft as previously outlined.



6) Disconnect exhaust pipe from exhaust manifold.
7) Loosen cylinder head bolts in such order as indicated in figure and remove them.
8) Check all around cylinder head for any other parts required to be removed or disconnected and remove or disconnect whatever necessary.

9) Remove cylinder head with intake manifold and exhaust manifold.

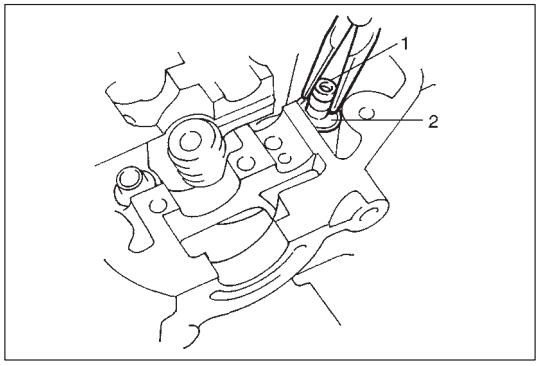


DISASSEMBLY

1) For ease in servicing cylinder head, remove intake manifold, exhaust manifold and thermostat case from cylinder head.
2) Using special tool (Valve lifter), compress valve springs and then remove valve cotters by using special tool (Forceps) as shown.

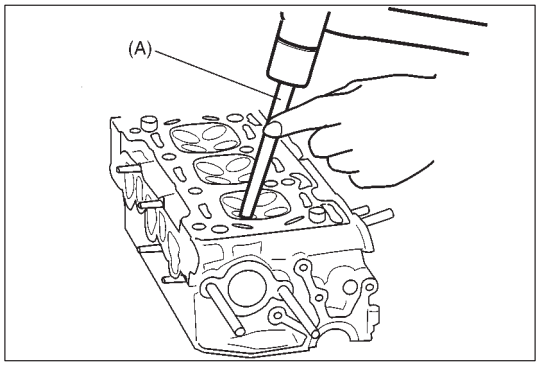
   Special Tool
   (A): 09916-14510
   (B): 09916-14910

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



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

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

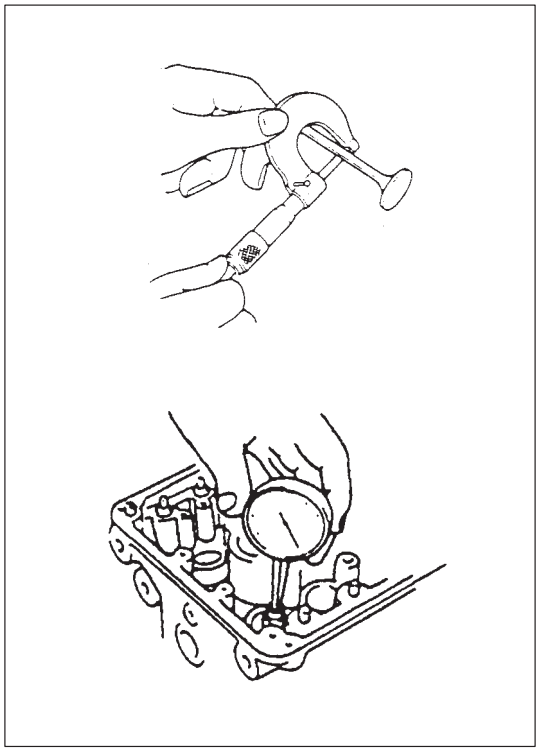


6) Using special tool (Valve guide remover), drive valve guide out from combustion chamber side to valve spring side.

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.

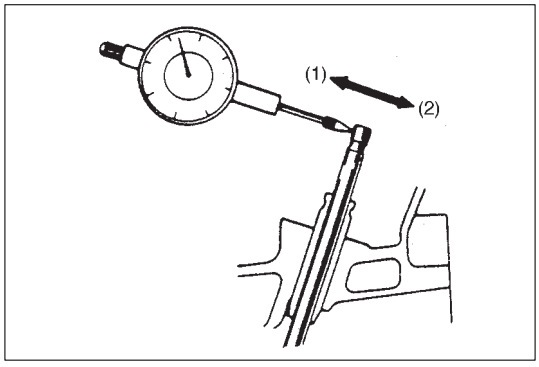


INSPECTION

Valve Guides

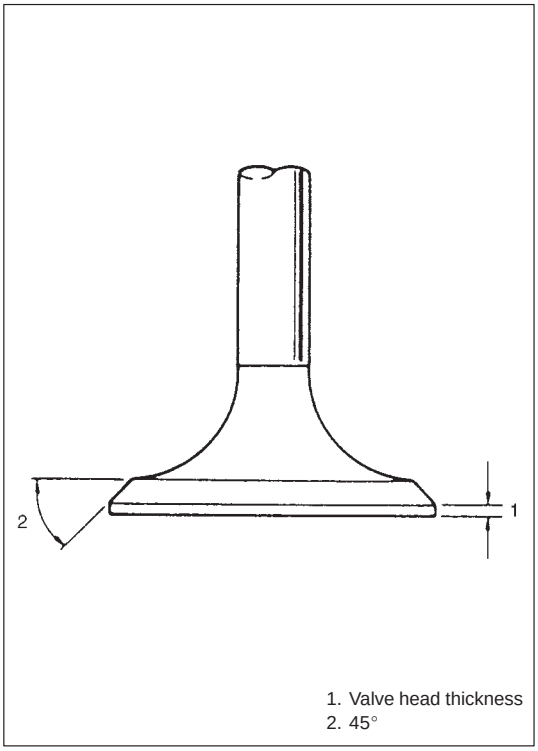
Using a micrometer and caliper gauge, take diameter readings on valve stems and guides to check stem-to-guide clearance.
Be sure to take reading at more than one place along the length of each stem and guide.
If clearance exceeds limit, replace valve and valve guide.

Item		Standard	Limit
Valve stem diameter	In	5.465 – 5.480 mm (0.2152 – 0.2157 in.)	—
	Ex	5.440 – 5.455 mm (0.2142 – 0.2148 in.)	—
Valve guide I.D.	In	5.500 – 5.512 mm (0.2166 – 0.2170 in.)	—
	Ex		
Stem-to-guide clearance	In	0.020 – 0.047 mm (0.0008 – 0.0018 in.)	0.07 mm (0.0027 in.)
	Ex	0.045 – 0.072 mm (0.0018 – 0.0028 in.)	0.09 mm (0.0035 in.)



If caliper 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.)

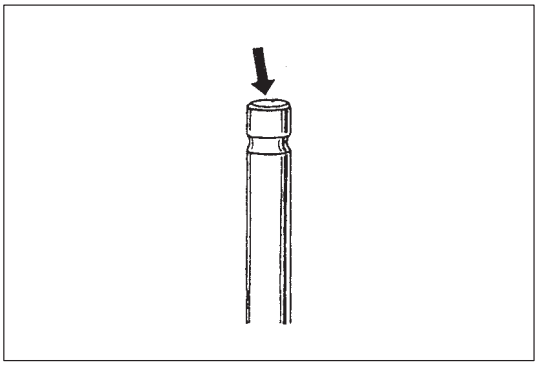


1. Valve head thickness
2. 45°

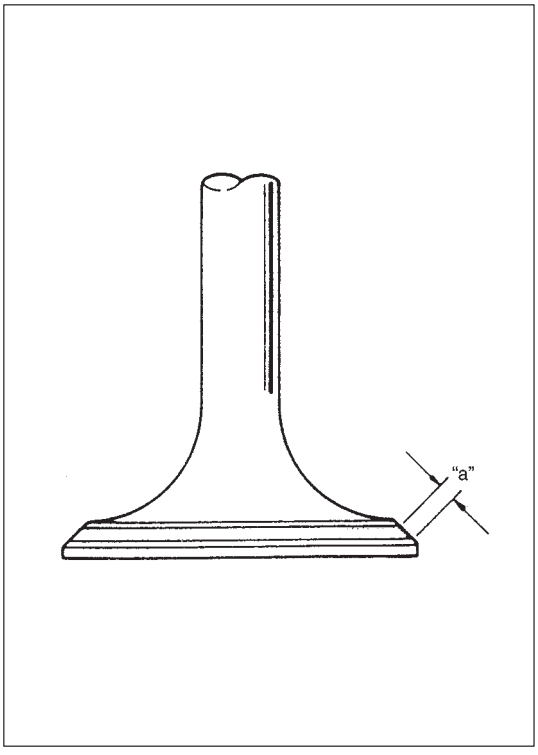
Valves

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

Valve head thickness		
	Standard	Limit
IN	0.8 – 1.2 mm (0.03 – 0.047 in.)	0.6 mm (0.024 in.)
EX		0.7 mm (0.027 in.)



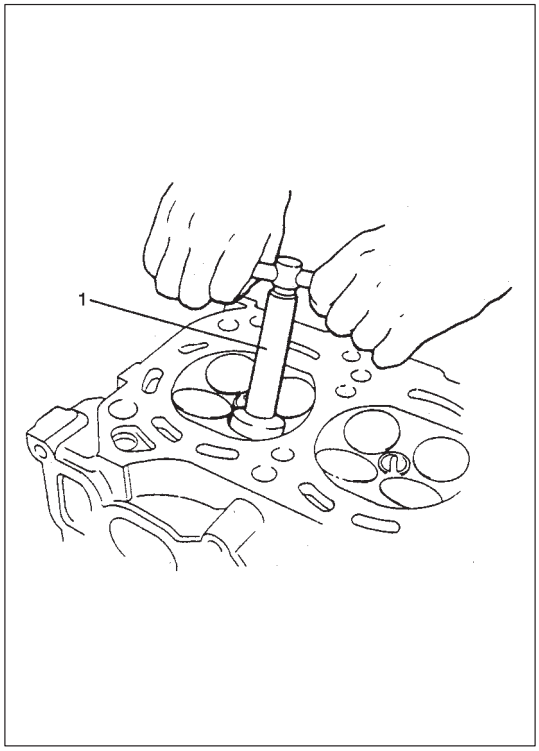
- Inspect valve stem end face for pitting and wear. If pitting or wear is found there, valve stem end may be resurfaced, but not so much as to grind off its chamfer. When it is worn so much that its chamfer is gone, replace valve.



- 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.

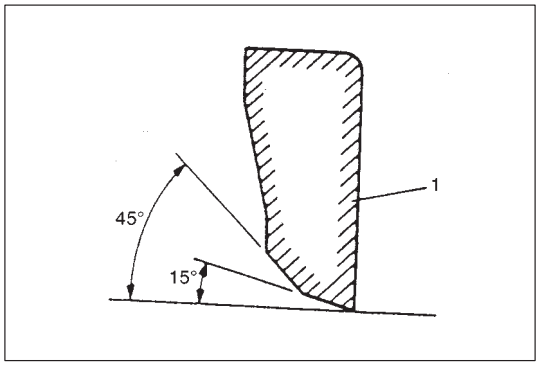
  Pattern produced on seating face of valve must be a continuous ring without any break, and the width "a" of pattern must be within specified range.

Standard seating width revealed by contact pattern on valve face	In	1.80 – 2.20 mm (0.0709 – 0.0866 in.)
	Ex	1.65 – 2.05 mm (0.0650 – 0.0807 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.
  1) EXHAUST VALVE SEAT: Use valve seat cutter (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.

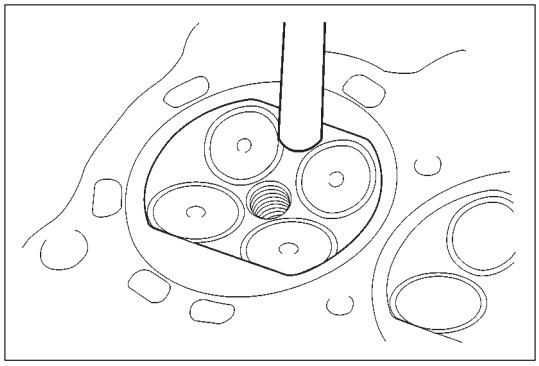
     Seat width for exhaust valve seat:
     1.65 – 2.05 mm (0.0650 – 0.0807 in.)



  2) INTAKE VALVE SEAT: Cutting sequence is the same as for exhaust valve seats (1).

     Seat width for intake valve seat:
     1.80 – 2.20 mm (0.0709 – 0.0866 in.)

  3) 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.

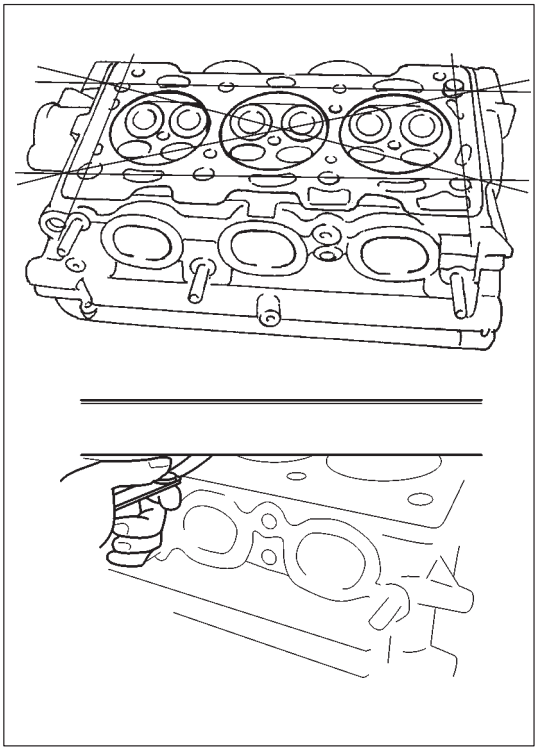


Cylinder Head

- Remove all carbon from combustion chambers.

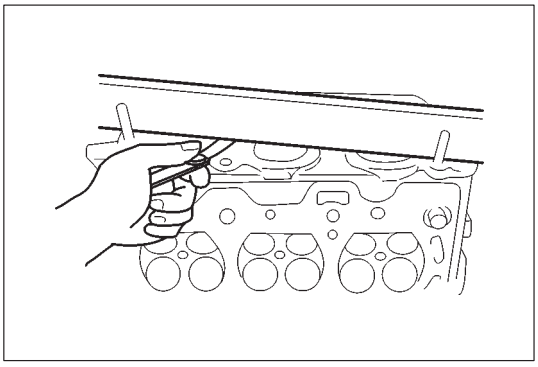
  NOTE:
  Do not use any sharp-edged tool to scrape off carbon. Be careful not to scuff or nick metal surfaces when decarboning. The same applies to valves and valve seats, too.

- Check cylinder head for cracks in intake and exhaust ports, combustion chambers, and head surface.



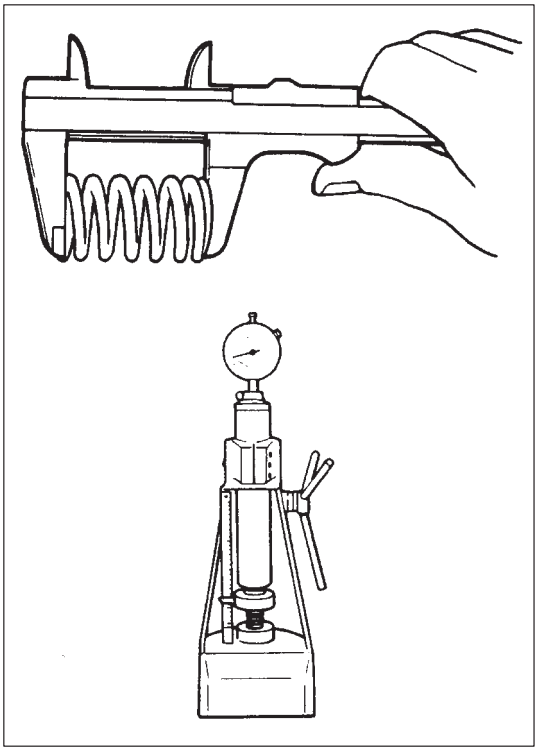
- Flatness of gasketed surface:
  Using a straightedge and thickness gauge, check surface at a total of 6 locations. If distortion limit, given below, is exceeded, correct gasketed surface with a surface plate and abrasive paper of about #400 (Waterproof silicon carbide abrasive paper): place paper on 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: 0.05 mm (0.002 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.

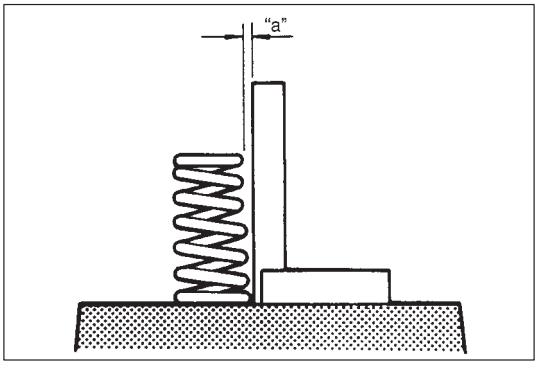
  Limit of distortion: 0.10 mm (0.004 in.)



Valve Springs

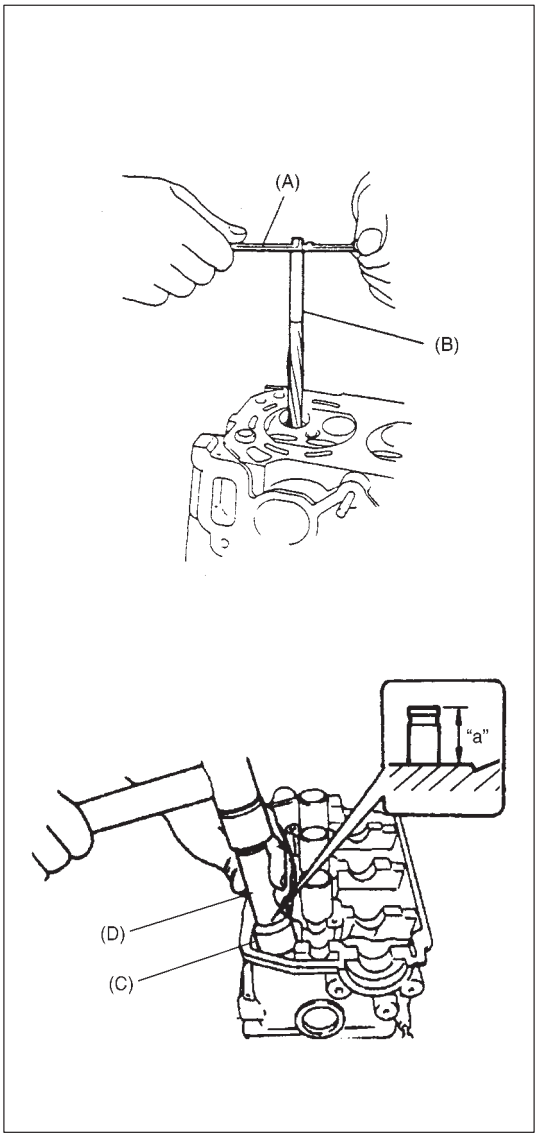
- Referring to data given below, check to be sure that each spring is in sound condition, free of any evidence of breakage or weakening. Remember, weakened valve springs can cause chatter, not to mention possibility of reducing power output due to gas leakage caused by decreased seating pressure.

Item	Standard	Limit
Valve spring free length	37.09 mm (1.460 in.)	36.2 mm (1.4252 in.)
Valve spring preload	13.3 – 15.7 kg for 32.0 mm (29.3 – 34.6 lb/1.26 in.)	13.0 kg for 32.0 mm (28.7 lb/1.26 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 "a": 2.0 mm (0.079 in.)



ASSEMBLY

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

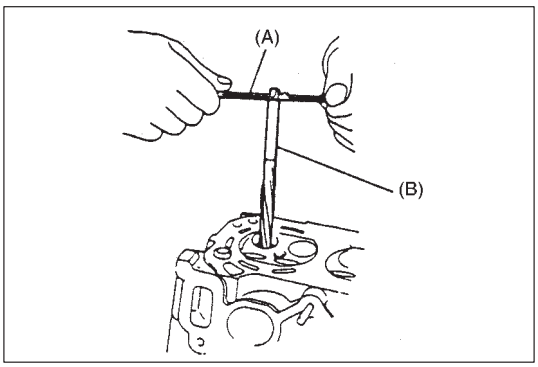
   Special Tool
   (A): 09916-34542
   (B): 09916-37320

2) Install valve guide to cylinder head.
   Heat cylinder head uniformly at 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 13.0 mm (0.51 in.) from cylinder head.

   Special Tool
   (C): 09916-57340
   (D): 09916-58210

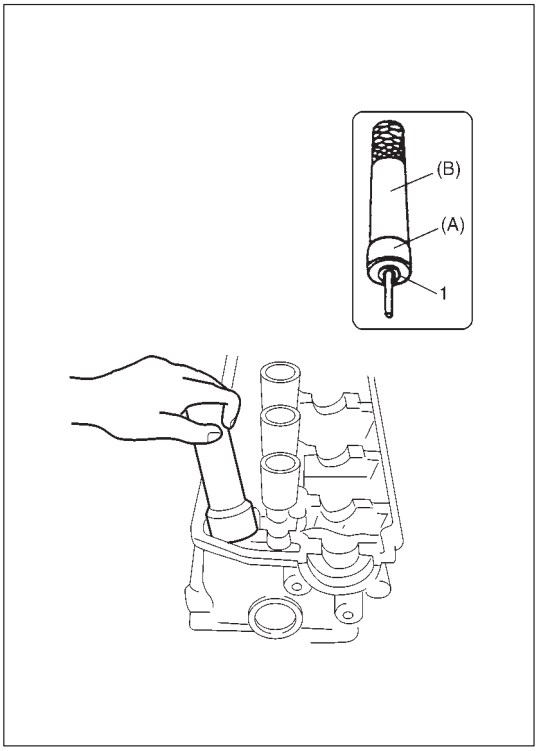
   NOTE:
   - **Do not reuse valve guide once disassembled. Install new valve guide (Oversize).**
   - **Intake and exhaust valve guides are identical.**

   Valve guide oversize: 0.03 mm (0.0012 in.)
   Valve guide protrusion "a" (In and Ex): 13.0 mm (0.51 in.)



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

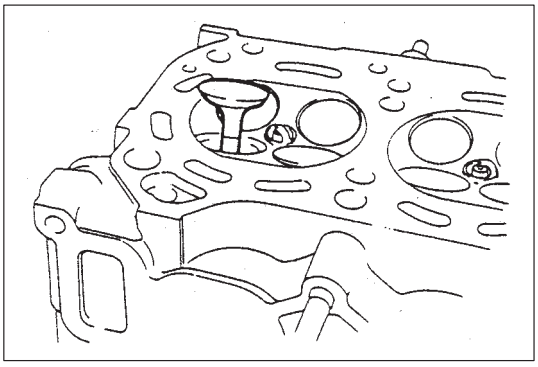
   Special Tool
   (A): 09916-34542
   (B): 09916-34550



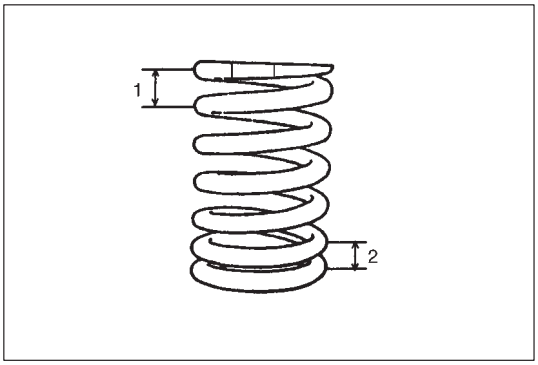
4) Install valve spring seat to cylinder head.
5) Install new valve stem seal (1) to valve guide.
After applying engine oil to seal and spindle of special tool (Valve guide installer handle), fit stem seal to spindle, and then install seal to valve guide by pushing special tool by hand.
After installing,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

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

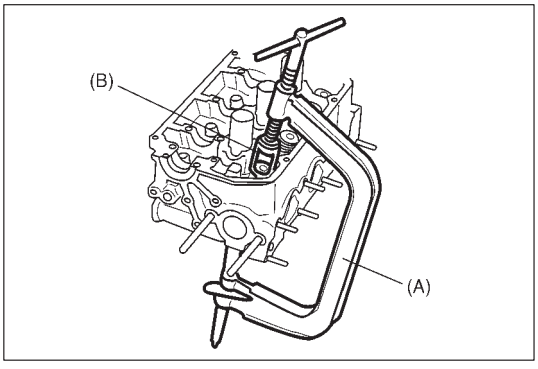
NOTE:
- **Do not reuse valve stem seal once disassembled. Be sure to install new seal.**
- **When installing, never tap or hit special tool with a hammer or else. Install seal to guide only by pushing special tool by hand. Tapping or hitting special tool may cause damage to seal.**



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



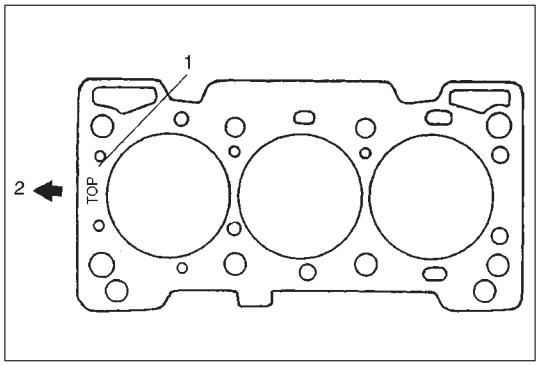
7) Install valve spring and spring retainer.
Each valve spring has top end (large-pitch end) (1) and bottom end (small-pitch end) (2). Be sure to position spring in place with its bottom end (small-pitch end) facing the bottom (valve spring seat side).



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

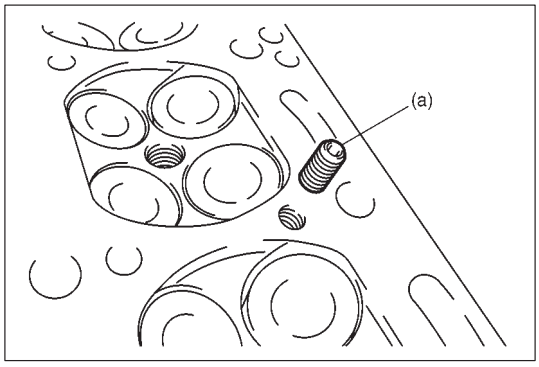
Special Tool
(A): 09916-14510
(B): 09916-14910

9) Install rocker arms, springs and rocker arm shaft as previously outlined.
10) Install intake manifold, exhaust manifold and thermostat case.



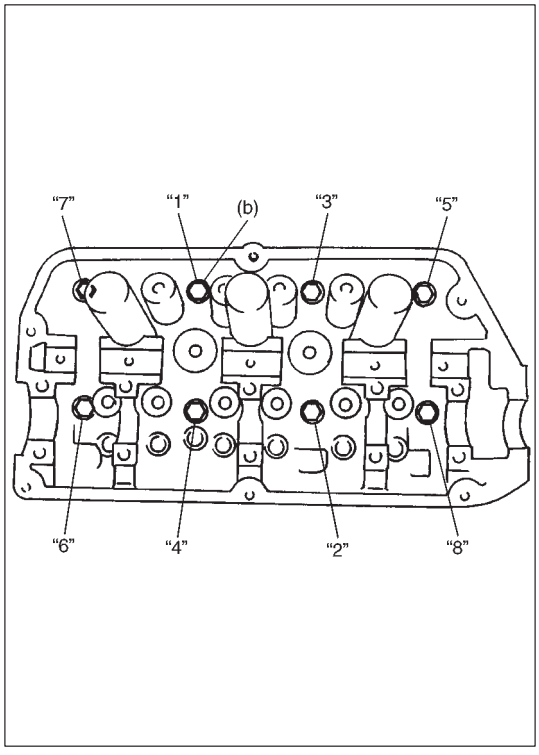
INSTALLATION

1) Remove old gasket and oil on mating surfaces and install new head gasket as shown in figure, that is, “TOP” mark (1) provided on gasket comes to crankshaft pulley side (2), facing up (toward cylinder head side).



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

Tightening Torque
(a): 5 N·m (0.5 kg-m, 4.0 lb-ft)

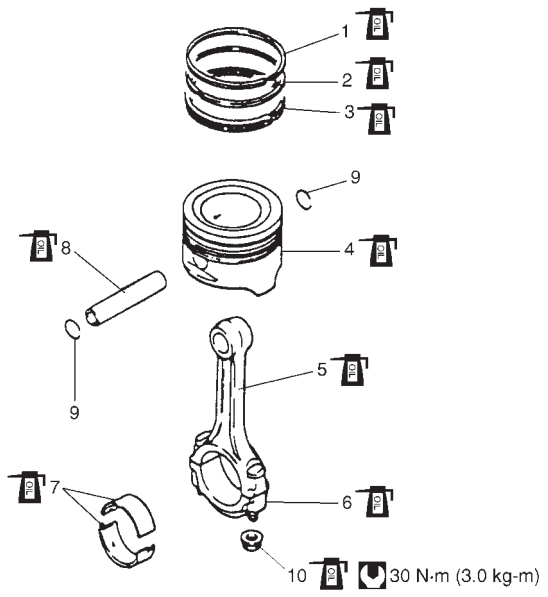


3) Apply engine oil to cylinder head bolts and tighten them gradually as follows.
   (1) Tighten all bolts to 30 N·m (3.0 kg-m, 22.0 lb-ft) according to numerical order in figure.
   (2) In the same manner as in (1), tighten them to 48 N·m (4.8 kg-m, 35.0 lb-ft).
   (3) Loosen all bolts to 0 N·m (0 kg-m, 0 lb-ft) reversing to numerical order in figure.
   (4) In the same manner as in (1) again, tighten them to 48 N·m (4.8 kg-m, 35.0 lb-ft).
   (5) In the same manner as in (1) again, tighten them to specified torque.

Tightening Torque
(b): 60 N·m (6.0 kg-m, 43.5 lb-ft)

4) Reverse removal procedure for installation.
5) Adjust water pump drive belt tension, referring to Section 6B.
6) Adjust A/C compressor belt tension, if equipped. Refer to section 0B.
7) Adjust intake and exhaust valve lashes as previously outlined.
8) Adjust accelerator cable play. Refer to Section 6E.
9) Check to ensure that all removed parts are back in place. Reinstall any necessary parts which have not been reinstalled.
10) Refill cooling system referring to Section 6B.
11) Connect negative cable at battery.
12) Verify that there is no fuel leakage, coolant leakage and exhaust gas leakage at each connection.
13) Confirm that ignition timing is within specification referring to Section 6F.

PISTON, PISTON RINGS, CONNECTING RODS AND CYLINDERS



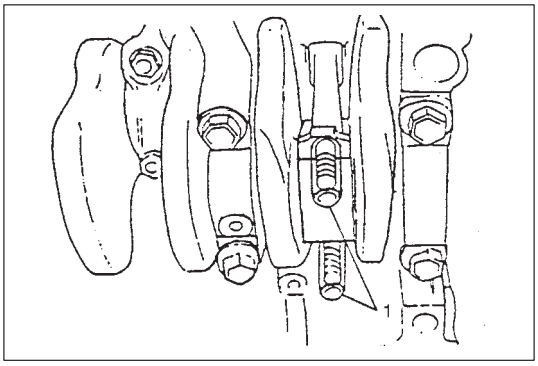
1. Top ring
2. 2nd ring
3. Oil ring
4. Piston
5. Connecting rod
6. Connecting rod bearing cap
7. Connecting rod bearing
8. Piston pin
9. Piston pin circlip
10. Bearing cap nut

: Tightening Torque

: Apply engine oil to sliding surface of each part.

REMOVAL

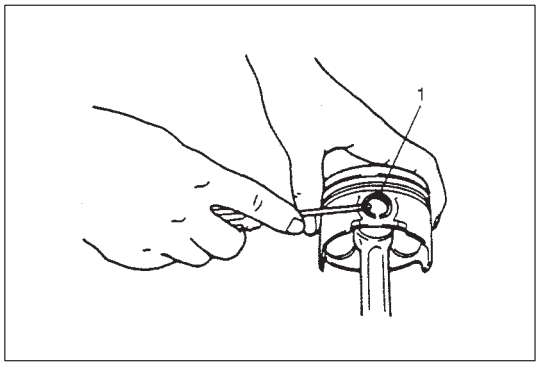
1) Remove cylinder head from cylinder block as previously outlined.
2) Drain engine oil.
3) Remove oil pan and oil pump strainer as previously outlined.
4) Mark cylinder number on all pistons, connecting rods and rod bearing caps, using silver pencil or quick drying paint.



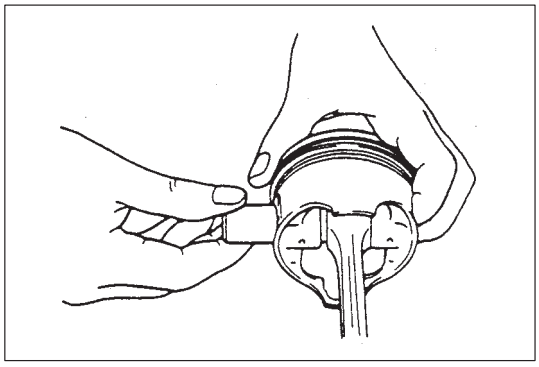
5) Remove rod bearing caps.
6) Install guide hose (1) over threads of rod bolts. This is to prevent damage to bearing journal and rod bolt threads when removing connecting rod.
7) Decarbon top of cylinder bore before removing piston from cylinder.
8) Push piston and connecting rod assembly out through 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.

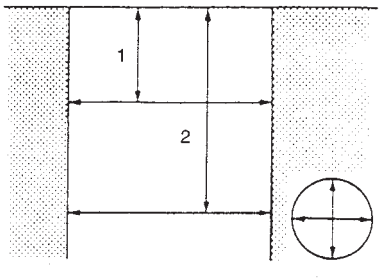
CLEANING

Clean carbon from piston head and ring grooves, using a suitable tool.

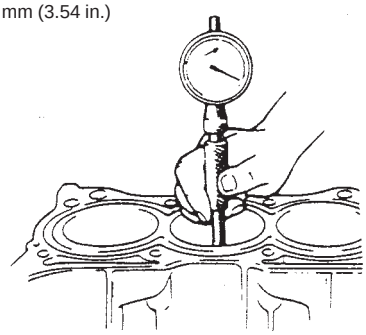
INSPECTION

Cylinders

- 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.



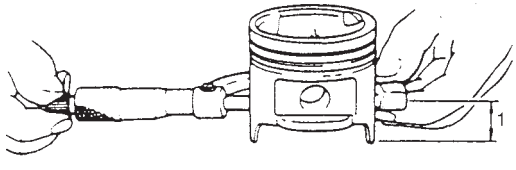
1. 50 mm (1.96 in.)
2. 90 mm (3.54 in.)



- Using a cylinder gauge, measure cylinder bore in thrust and axial directions at two positions as shown in figure.
  If any of 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 dia. limit: 68.57 mm (2.6996 in.)
  Taper and out-of-round limit: 0.10 mm (0.0039 in.)

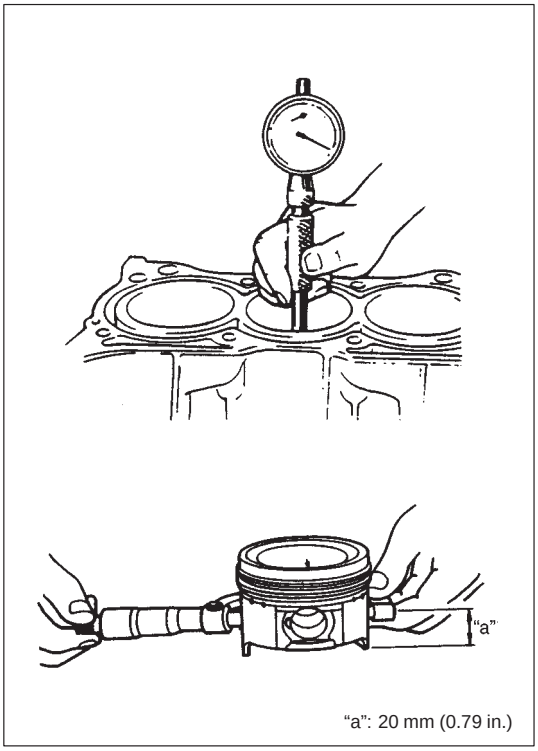
  NOTE:
  If any one of three cylinders has to be rebored, rebore all three to the same next oversize. This is necessary for the sake of uniformity and balance.



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 (1) 20 mm (0.79 in.) from piston skirt end in the direction perpendicular to piston pin.

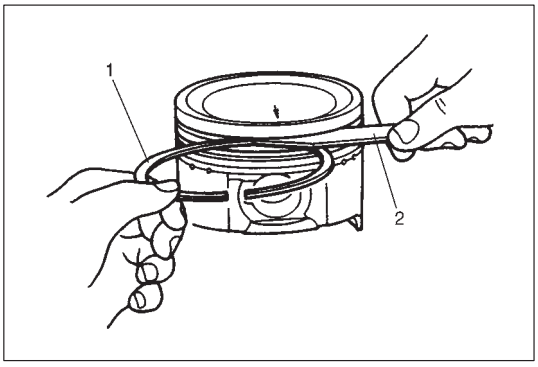
Piston diameter	Standard	68.465 – 68.485 mm (2.6955 – 2.6962 in.)
	Oversize: 0.25 mm (0.0098 in.)	68.720 – 68.740 mm (2.7055 – 2.7063 in.)
	0.50 mm (0.0196 in.)	68.970 – 68.990 mm (2.7153 – 2.7161 in.)



- 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, re-bore cylinder and use oversize piston.

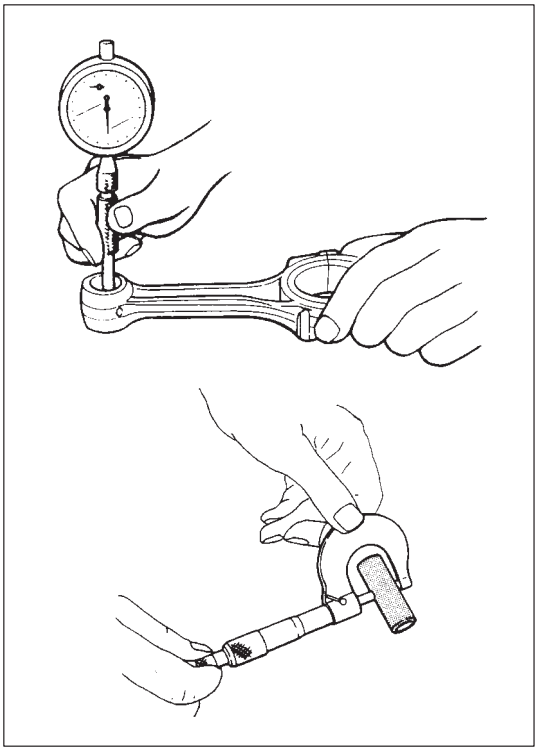
  Piston clearance : 0.025 – 0.045 mm (0.0009 – 0.0017 in.)

  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.
  Fit new piston ring into piston groove, and measure clearance between ring (1) and ring land by using thickness gauge (2).
  If clearance is out of specification, replace piston.

  Ring groove clearance:
  Top: 0.03 – 0.07 mm (0.0012 – 0.0027 in.)
  2nd: 0.02 – 0.06 mm (0.0008 – 0.0023 in.)



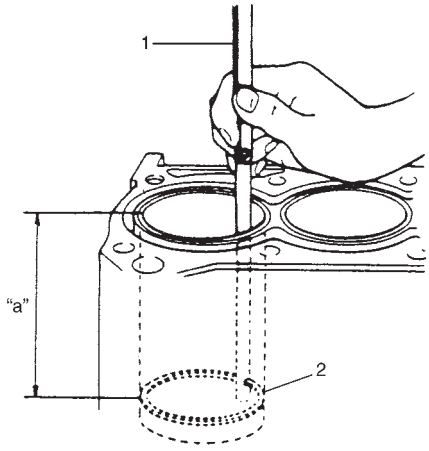
Piston Pin

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

Item	Standard	Limit
Piston clearance in small end	0.003 – 0.016 mm (0.0001 – 0.0006 in.)	0.05 mm (0.0020 in.)

Small-end bore:
16.003 – 16.011 mm (0.6300 – 0.6303 in.)

Piston pin dia.:
15.995 – 16.000 mm (0.6297 – 0.6299 in.)



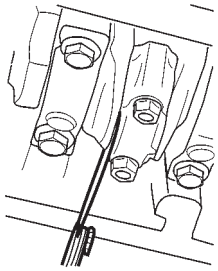
"a": 120 mm (4.72 in.)

Piston Rings

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

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

Item		Standard	Limit
Piston ring end gap	Top ring	0.12 – 0.26 mm (0.0047 – 0.0102 in.)	0.7 mm (0.0275 in.)
	2nd ring	0.12 – 0.26 mm (0.0047 – 0.0102 in.)	0.7 mm (0.0275 in.)
	Oil ring	0.2 – 0.7 mm (0.0079 – 0.0275 in.)	1.8 mm (0.0709 in.)



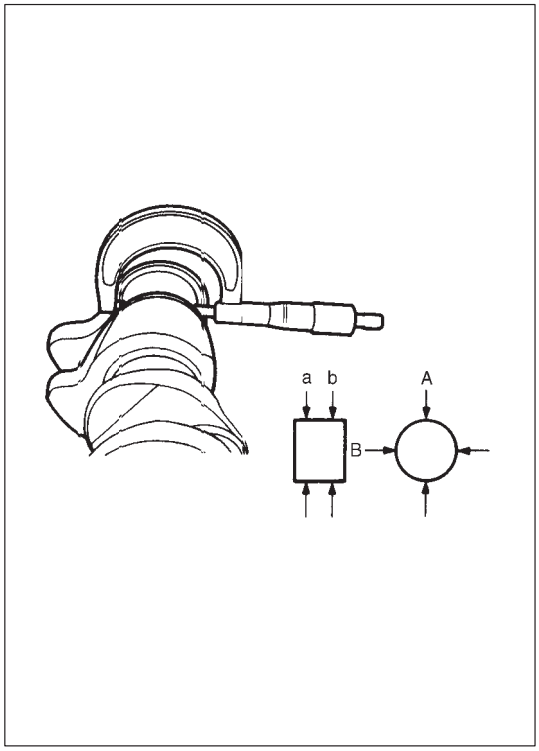
Connecting Rod

- 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.

Item	Standard	Limit
Big-end side clearance	0.10 – 0.20 mm (0.0039 – 0.0079 in.)	0.35 mm (0.0137 in.)

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

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

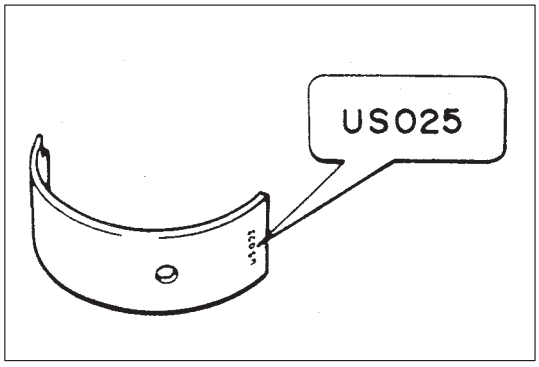


Crank Pin and Connecting Rod Bearings

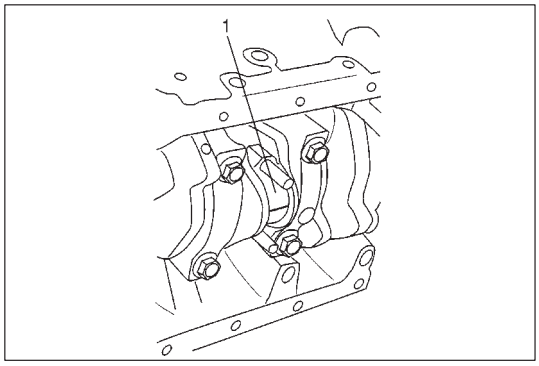
- Inspect crank pin for uneven wear or damage. Measure crank pin for out-of-round or taper with a micrometer. If crank pin is damaged, or out-of-round or taper is out of limit, replace crankshaft or regrind crank pin referring to following step 6) of Rod bearing clearance.

Connecting rod bearing size	Crank pin diameter
Standard	37.982 – 38.000 mm (1.4953 – 1.4960 in.)
0.25 mm (0.0098 in.) undersize	37.732 – 37.750 mm (1.4855 – 1.4862 in.)

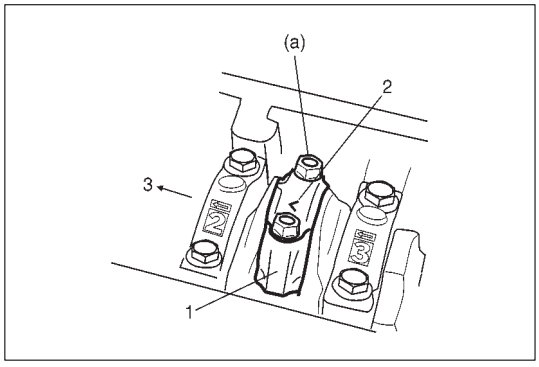
Out-of-round limit
(difference between A and B): 0.01 mm (0.0004 in.)
Taper limit
(difference between a and b): 0.01 mm (0.0004 in.)



- 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 undersize bearing. To distinguish them, 0. 25 mm undersize bearing has the stamped number (US025) on its backside as indicated in figure, but standard size one has no number.

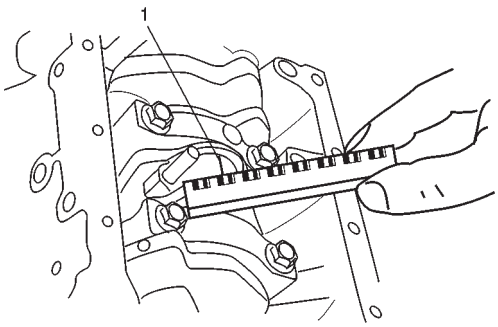


- Rod bearing clearance:
  1) Before checking bearing clearance, clean bearing and crank pin.
  2) Install bearing in connecting rod and bearing cap.
  3) Place a piece of gaging plastic (1) to full width of crankpin as contacted by bearing (parallel to crankshaft), avoiding oil hole.



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 (3), as shown in figure. After applying engine oil to rod bolts, tighten cap nuts to specified torque. DO NOT turn crankshaft with gaging plastic installed.

   Tightening Torque
   (a): 30 N·m (3.0 kg-m, 22.0 lb-ft)



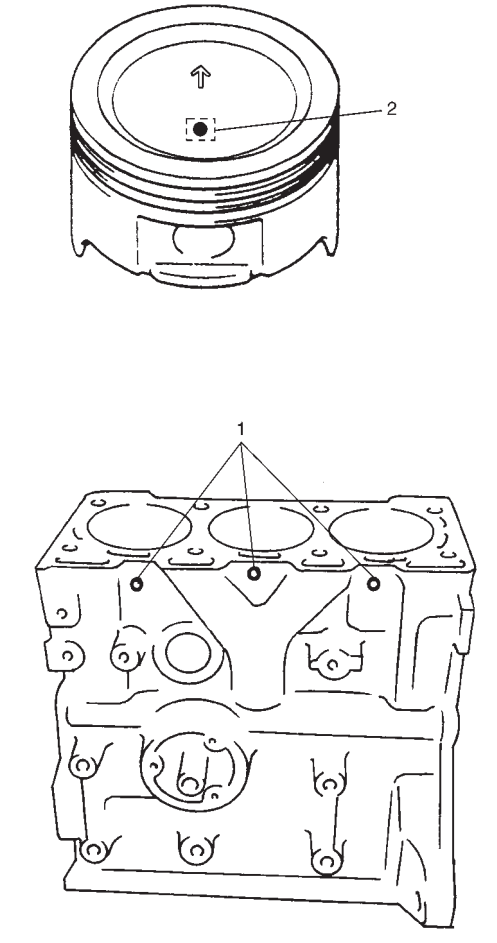
5) Remove cap and using a scale on gaging plastic envelope, measure gaging plastic (1) width at the widest point (clearance). If clearance exceeds its limit, use a new standard size bearing and remeasure clearance.

Item	Standard	Limit
Bearing clearance	0.020 – 0.040 mm (0.0008 – 0.0016 in.)	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, replace crankshaft or regrind crankpin to undersize as follows.
   – Install 0.25 mm undersize bearing to connecting rod big end.
   – Measure bore diameter of connecting rod big end.
   – Regrind crankpin to following finished diameter.

Finished crankpin dia.	=	Measured big end bore dia. (including undersize bearing)	–	0.030 mm (0.0012 in.)

   – Confirm that bearing clearance is within above standard value.



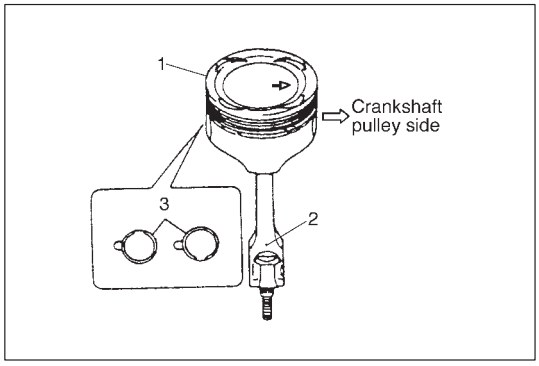
ASSEMBLY

NOTE:

Two sizes of piston are available as standard size spare part so as to ensure proper piston-to-cylinder clearance. When installing a standard size piston, make sure to match piston with cylinder as follows.

a) Each piston has painted color red or blue (2) as shown. It represents outer diameter of piston.
b) There are paints (1) on the cylinder block as shown. The color (red or blue) of each paint represents cylinder bore diameter. The first paint from crank pulley side represents inner diameter of No.1 cylinder, the second paint of No.2 cylinder, the third paint of No.3 cylinder.
c) Painted color on piston and cylinder block should correspond. That is, install blue color painted piston to cylinder which is identified with blue paint and a red color painted piston to cylinder with red paint.

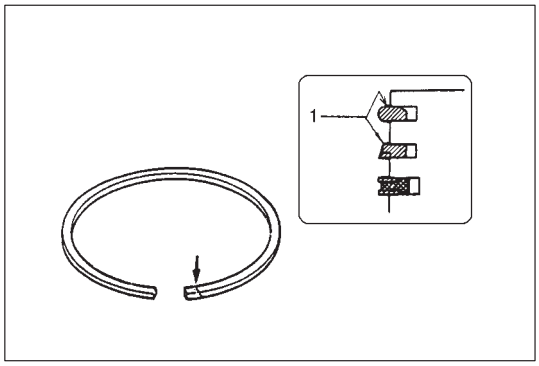
Piston	Cylinder		Piston-to-cylinder clearance
Outer diameter	Color (paint)	Bore diameter	
68.475 – 68.485 mm (2.6959 – 2.6962 in.)	Red	68.51 – 68.52 mm (2.6973 – 2.6976 in.)	0.02 – 0.04 mm (0.0008 – 0.0015 in.)
68.465 – 68.475 mm (2.6955 – 2.6959 in.)	Blue	68.50 – 68.51 mm (2.6968 – 2.6973 in.)	0.02 – 0.04 mm (0.0008 – 0.0015 in.)



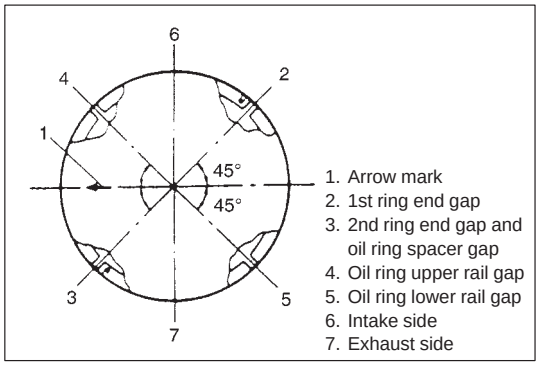
1) Install piston pin to piston (1) and connecting rod:
After applying engine oil to piston pin and piston pin holes in piston and connecting rod, fit connecting rod to piston as shown in figure and insert piston pin to piston and connecting rod, and install piston pin circlips (3).

NOTE:
Circlip should be installed with its cut part facing either up or down as shown in figure.

The oil hole (2) should come on intake side



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

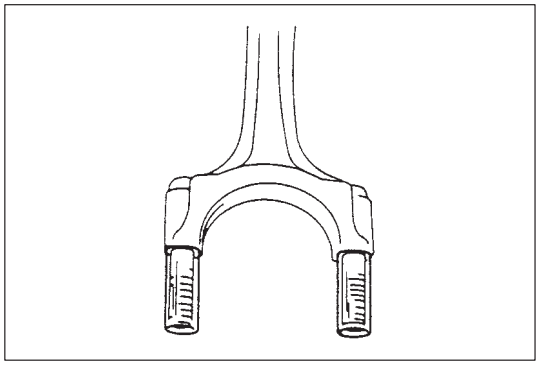


3) After installing three rings (1st, 2nd and oil rings), distribute their end gaps as shown in figure.

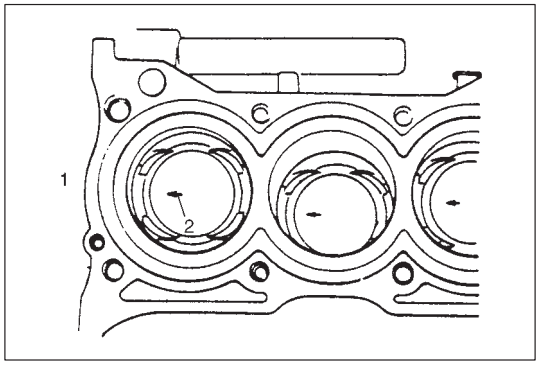
INSTALLATION

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

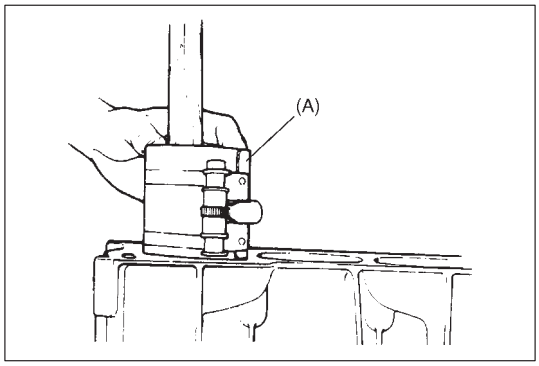
NOTE:
Do not apply oil between connecting rod and bearing or between bearing cap and bearing.



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

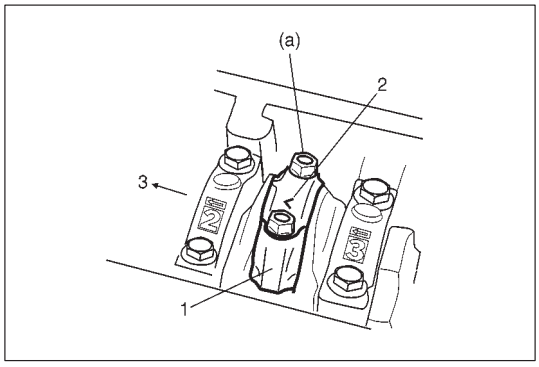


3) When installing piston and connecting rod assembly into cylinder bore, point arrow mark (2) on piston head to crankshaft pulley side (1).



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:
Point arrow mark (2) on cap (1) to crankshaft pulley side (3).
Tighten cap nuts to specification.

Tightening Torque
(a): 30 N·m (3.0 kg-m, 22.0 lb-ft)

6) Reverse removal procedure for installation, as previously outlined.
7) Adjust water pump drive belt tension, referring to Section 0B.
8) Adjust A/C compressor belt tension, if equipped. Refer to Section 0B.
9) Adjust intake and exhaust valve lashes as previously outlined.
10) Adjust accelerator cable play. Refer to Section 6E.
11) Check to ensure that all removed parts are back in place. Reinstall any necessary parts which have not been reinstalled.
12) Refill engine with engine oil, referring to item ENGINE OIL CHANGE in Section 0B.
13) Refill cooling system referring to Section 6B.
14) Connect negative cable at battery.
15) Verify that there is no fuel leakage, coolant leakage, oil leakage and exhaust gas leakage at each connection.
16) Verify that ignition timing is within specification referring to Section 6F.

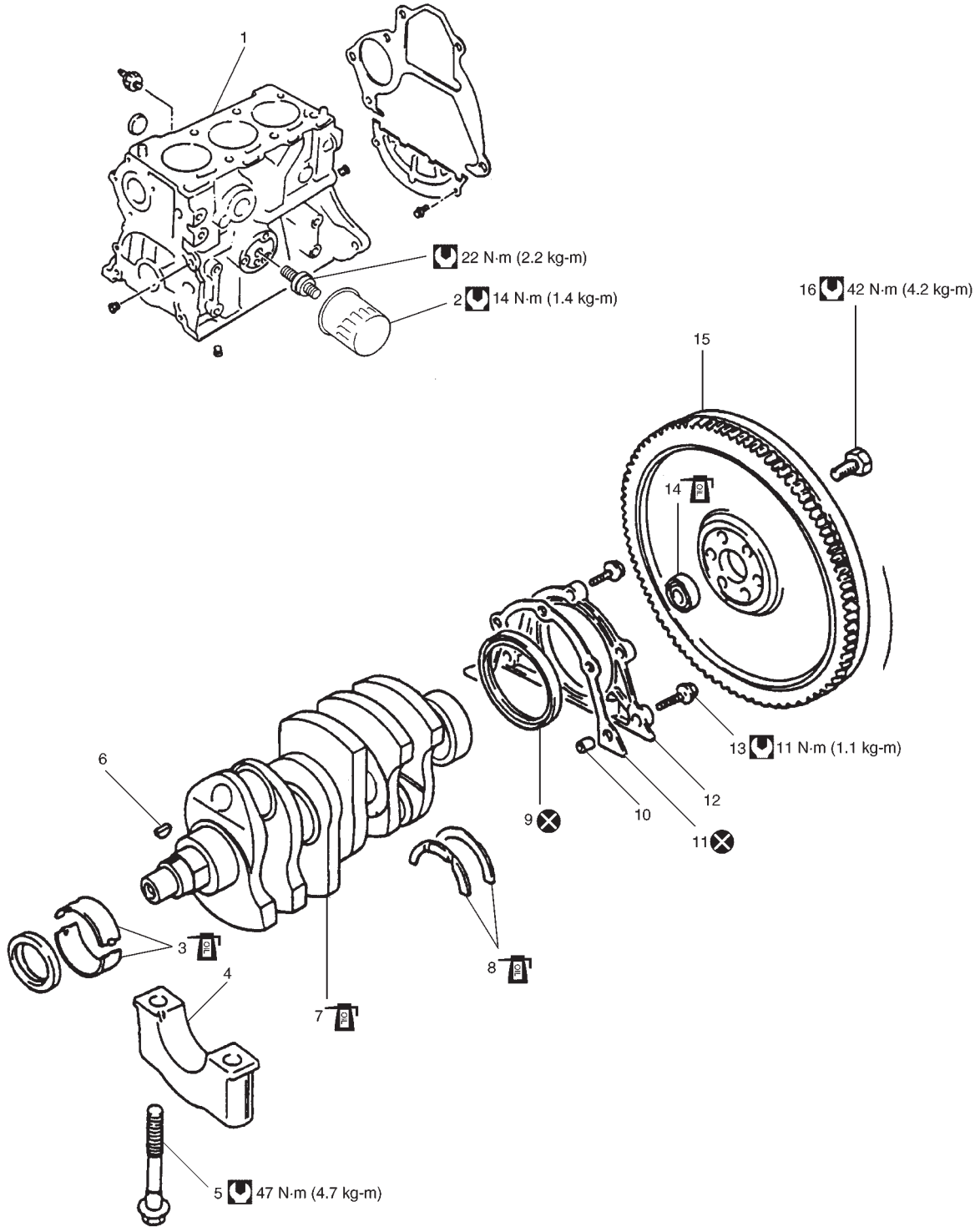
UNIT REPAIR OVERHAUL

ENGINE ASSEMBLY

REMOVAL AND INSTALLATION

Refer to Section 6A.

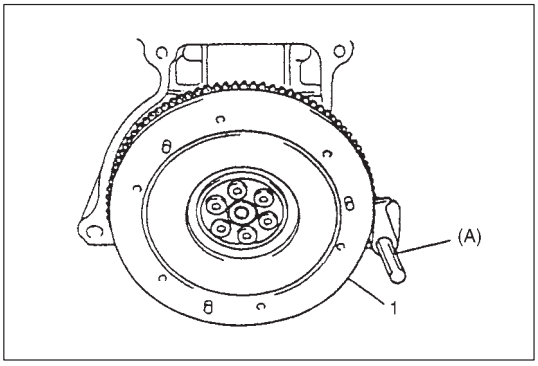
MAIN BEARINGS, CRANKSHAFT AND CYLINDER BLOCK



: Tightening Torque

: Do not reuse

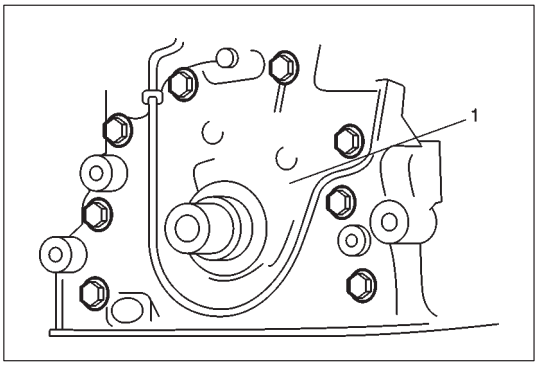
1. Cylinder block
2. Oil filter
3. Main bearing: Apply engine oil to bearing inside surfaces.
4. Bearing cap
5. Cap bolt: Apply engine oil.
6. Timing pulley key
7. Crankshaft: Apply engine oil to crankshaft journals.
8. Thrust bearing: Apply engine oil.
9. Rear oil seal
10. Pin
11. Oil seal housing gasket
12. Oil seal housing
13. Housing bolt
14. Input shaft bearing: Apply engine oil.
15. Flywheel
16. Flywheel bolt



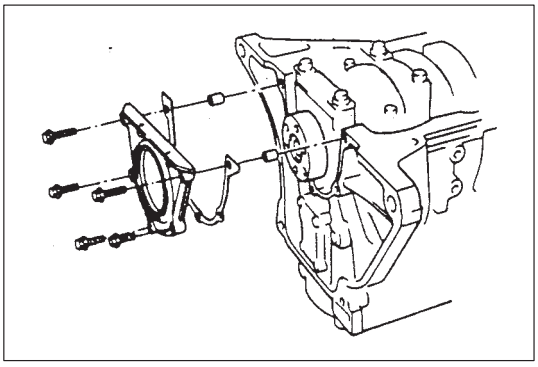
REMOVAL

1) Remove engine assembly with transmission and engine member from body as previously outlined.
2) Remove clutch cover, clutch disc and flywheel (1).

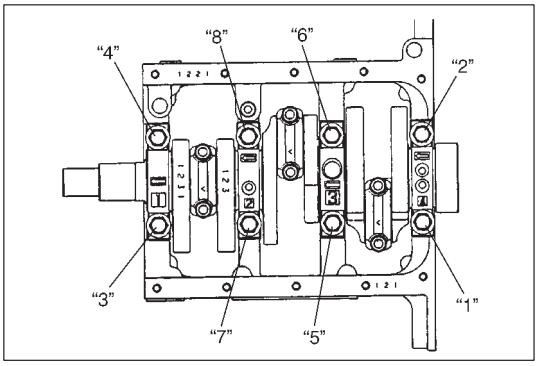
Special Tool
(A): 09924-17810



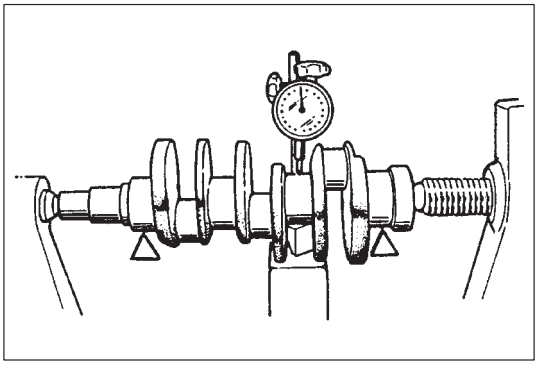
3) Remove crankshaft pulley, timing belt, timing belt inside cover and crankshaft timing pulley.
4) Remove cylinder head assembly as previously outlined.
5) Remove oil pan and oil pump strainer as previously outlined.
6) Remove oil pump (1).



7) Remove oil seal housing.
8) Remove connecting rod bearing caps.



9) Loosen crankshaft bearing cap bolts in such order as indicated in figure a little at a time and remove bearing caps.
10) Remove crankshaft from cylinder block.



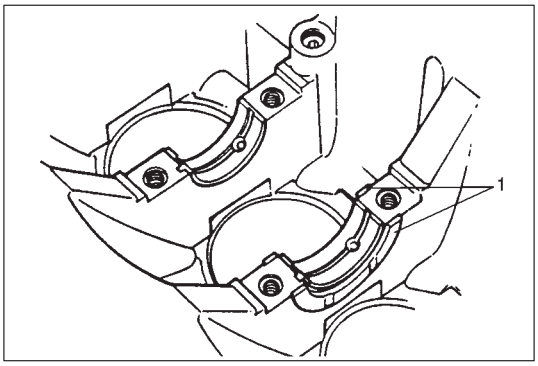
INSPECTION

Crankshaft

Crankshaft runout

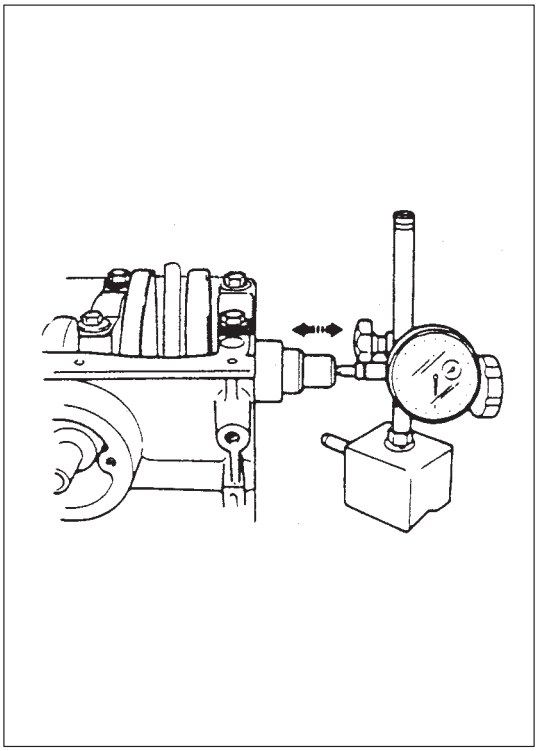
Using a dial gauge, measure runout at center journal. Rotate crankshaft slowly. If runout exceeds its limit, replace crankshaft.

Limit on runout: 0.06 mm (0.0023 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.

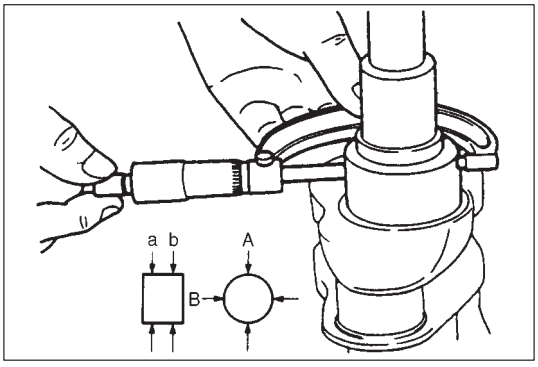


Use a dial gauge to read displacement in axial (thrust) direction of crankshaft.

If its limit is exceeded, replace thrust bearing with new standard one or oversize one to obtain standard thrust play.

Item	Standard	Limit
Crankshaft thrust play	0.11 – 0.31 mm (0.0044 – 0.0122 in.)	0.35 mm (0.0138 in.)

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.)

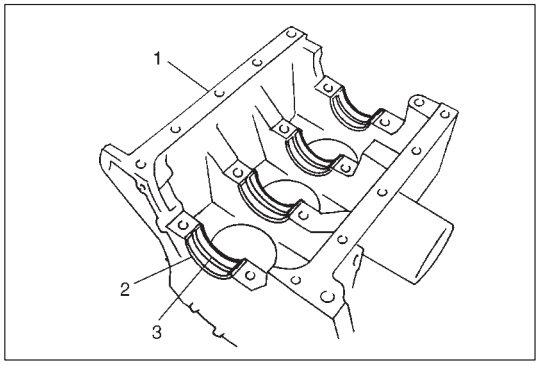


Out-of-round and taper (uneven wear) of journals

An unevenly worn crankshaft journal shows up as a difference in diameter at a cross section or along its length (or both). This difference, if any, is determined by taking micrometer readings.

If any one of journals is badly damaged or if amount of uneven wear in the sense explained above exceeds its limit, regrind or replace crankshaft.

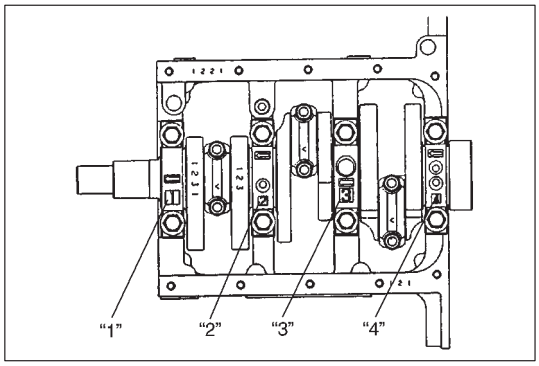
Out-of-round limit
(difference between A and B): 0.01 mm (0.0004 in.)
Taper limit
(difference between a and b): 0.01 mm (0.0004 in.)



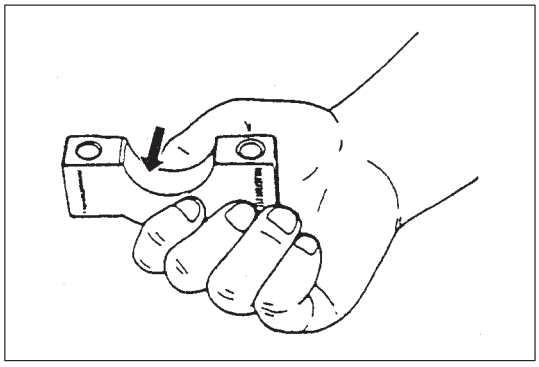
Main Bearings

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 (2) has oil groove (3) as shown in figure. Install this half with oil groove to cylinder block (1).

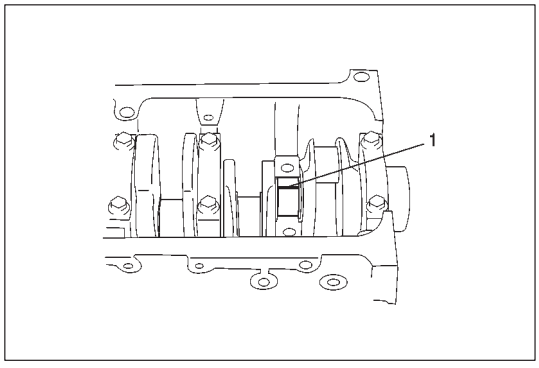


- On each main bearing cap, arrow mark and number are embossed as shown in figure.
  When installing each bearing cap to cylinder block, point arrow mark toward crankshaft pulley side and install each cap from that side to flywheel side in ascending order of numbers "1", "2", "3" and "4". Tighten cap bolts to specified torque.



Inspection

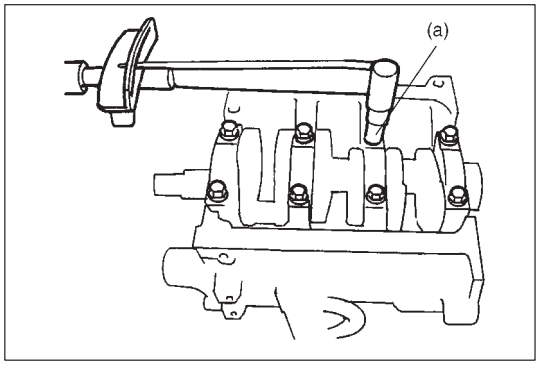
Check bearings for pitting, scratches, wear or damage.
If any malcondition is found, replace both upper and lower halves.
Never replace one half without replacing the other half.



Main bearing clearance

Check clearance by using gaging plastic according to following procedure.

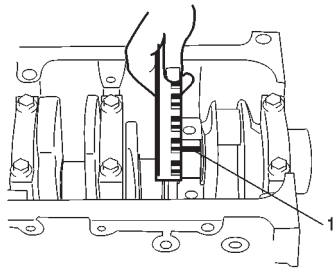
1) Remove bearing caps.
2) Clean bearings and main journals.
3) Place a piece of gaging plastic (1) to full width of bearing (parallel to crankshaft) on journal, avoiding oil hole.



4) Install bearing cap as previously outlined and evenly torque cap bolts to specified torque.
   Bearing cap must be torqued to specification in order to assure proper reading of clearance.

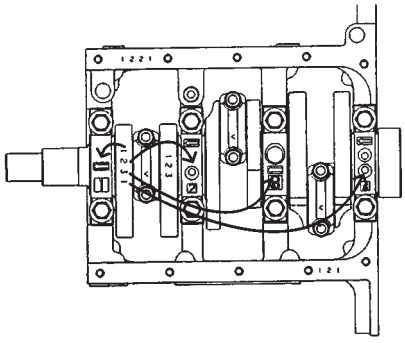
   Tightening Torque
   (a): 47 N·m (4.7 kg-m, 34.0 lb-ft)

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



5) Remove cap and using scale on gaging plastic envelope, measure gaging plastic (1) 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.

	Standard	Limit
Bearing clearance	0.020 – 0.040 mm (0.0008 – 0.0016 in.)	0.065 mm (0.0026 in.)



Selection of main bearings

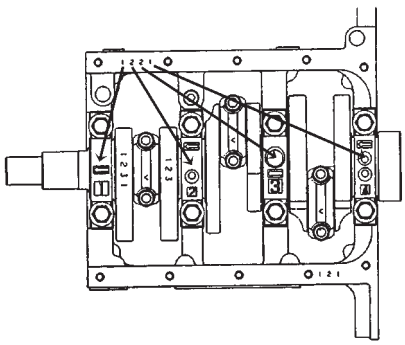
STANDARD BEARING:

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

1) First check journal diameter by using following procedure.
   As shown in figure, crank webs of No.1 cylinder have four stamped numerals.
   Three kinds of numerals (“1”, “2” and “3”) represent following journal diameters.

Numeral stamped	Journal diameter
1	49.994 – 50.000 mm (1.9683 – 1.9685 in.)
2	49.988 – 49.994 mm (1.9680 – 1.9683 in.)
3	49.982 – 49.988 mm (1.9678 – 1.9680 in.)

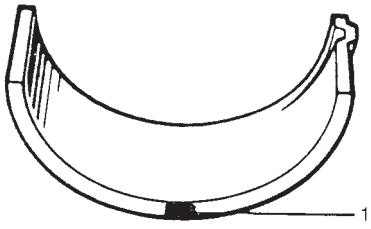
   The first, second, third and fourth (left to right) stamped numerals represent journal diameters at bearing caps “1”, “2”, “3” and “4” respectively.
   For example, in figure, the first (leftmost) numeral “1” indicates that journal dia. at bearing cap “1” is within 49.994 – 50.000 mm, and second one “2” indicate that journal dia. at cap “2” is within 49.988 – 49.994 mm.



2) Next, check bearing cap bore diameter without bearing. On mating surface of cylinder block, four numerals are stamped as shown in figure.
Three kinds of numerals (1, 2 and 3) represent following cap bore diameters.

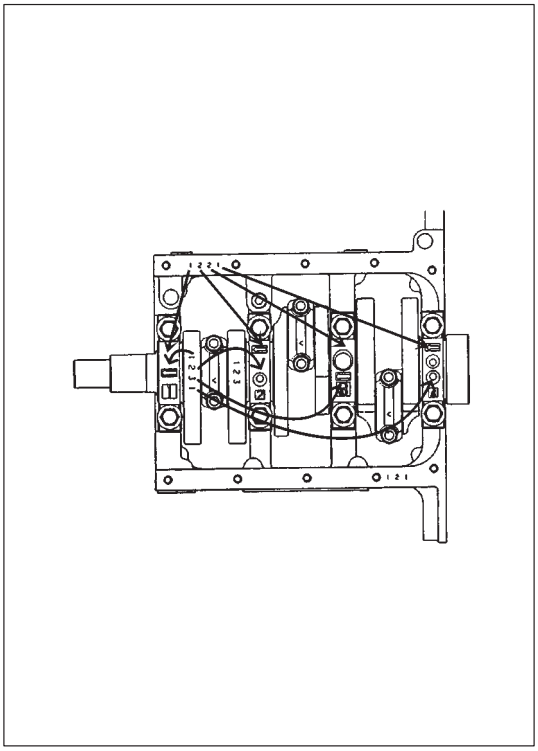
Numeral stamped	Bearing cap bore diameter (without bearing)
1	54.000 – 54.006 mm (2.1260 – 2.1262 in.)
2	54.006 – 54.012 mm (2.1262 – 2.1265 in.)
3	54.012 – 54.018 mm (2.1265 – 2.1267 in.)

The first, second, third and fourth (left to right) stamped numerals represent cap bore diameters of bearing caps “1”, “2”, “3” and “4”, respectively.
For example, in figure, the first (leftmost) numeral “1” indicates that cap bore dia. of bearing cap “1” is within 54.000 – 54.006 mm, and the fourth (rightmost) numeral “2” indicates that cap bore dia. of cap “4” is within 54.006 – 54.012 mm.



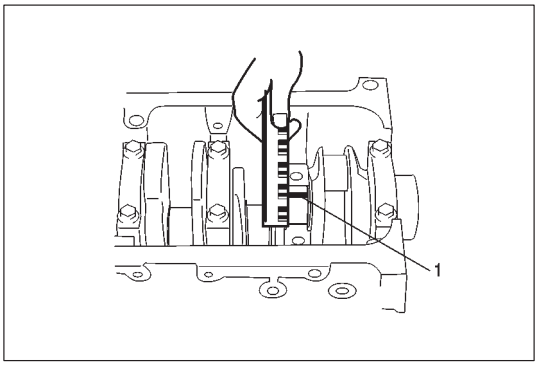
3) There are five kinds of standard bearings differing in thickness. To distinguish them, they are painted in following colors at the position as indicated in figure.
Each color indicates following thickness at the center of bearing.

Color painted	Bearing thickness
Green	1.986 – 1.990 mm (0.0782 – 0.0783 in.)
Black	1.989 – 1.993 mm (0.0783 – 0.0784 in.)
Colorless (no paint)	1.992 – 1.996 mm (0.0784 – 0.0785 in.)
Yellow	1.995 – 1.999 mm (0.0785 – 0.0787 in.)
Blue	1.998 – 2.002 mm (0.0781 – 0.0788 in.)

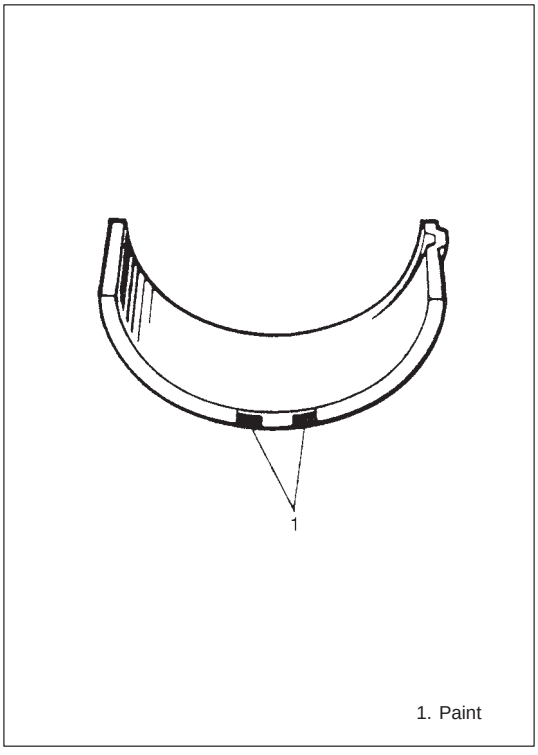


4) From numerals stamped on crank webs of No.1 and No.2 cylinders and the numerals stamped on mating surface of cylinder block, determine new standard bearing to be installed to journal, by referring to table given below.
For example, if numeral stamped on crank web is “1” and numeral stamped on mating surface is “1”, install a new standard bearing painted in “Green” to its journal.

		Numeral stamped on crank web (Journal diameter)		
		1	2	3
Numeral stamped on mating surface (Bearing cap bore dia.)	1	Green	Black	Colorless
	2	Black	Colorless	Yellow
	3	Colorless	Yellow	Blue
		New standard bearing to be installed.		



5) Using gaging plastic (1), 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 numerals stamped on new crankshaft or alphabets stamped on mating surface of new cylinder block.



1. Paint

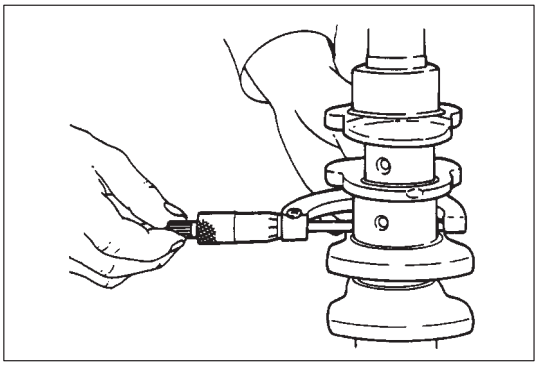
UNDERSIZE BEARING (0.25 mm):

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

Color painted	Bearing thickness
Green & Red	2.111 – 2.115 mm (0.0831 – 0.0832 in.)
Black & Red	2.114 – 2.118 mm (0.0832 – 0.0833 in.)
Red only	2.117 – 2.121 mm (0.0833 – 0.0835 in.)
Yellow & Red	2.120 – 2.124 mm (0.0835 – 0.0836 in.)
Blue & Red	2.123 – 2.127 mm (0.0836 – 0.0837 in.)

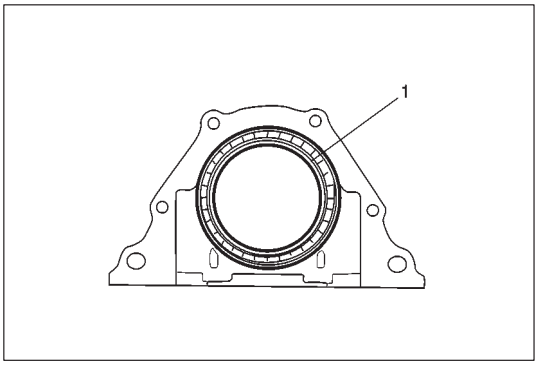
- If necessary, regrind crankshaft journal and select under-size bearing to use with it as follows.
  1) Regrind journal to following finished diameter.

Finished diameter: 49.732 – 49.750 mm (1.9580 – 1.9586 in.)



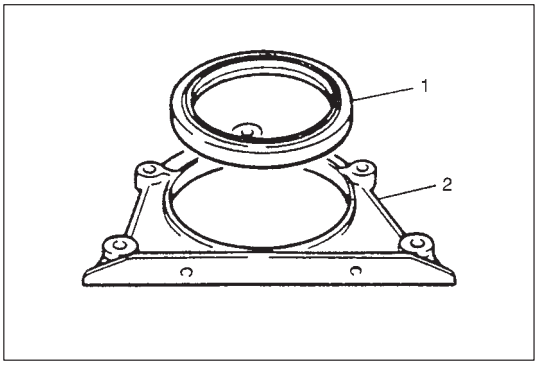
2) Using micrometer, measure reground journal diameter. Measurement should be taken in two directions perpendicular to each other in order to check for out-of-round.
3) Using journal diameter measured above and numerals stamped on mating surface of cylinder block, select an under-size bearing by referring to table given below.
   Check bearing clearance with newly selected undersize bearing.

		Measured journal diameter		
		49.744 – 49.750 mm (1.9584 – 1.9587 in.)	49.738 – 49.744 mm (1.9582 – 1.9584 in.)	49.732 – 49.738 mm (1.9579 – 1.9582 in.)
Numeral stamped on mating surface of cylinder block	1	Green & Red	Black & Red	Red only
	2	Black & Red	Red only	Yellow & Red
	3	Red only	Yellow & Red	Blue & Red
		Undersize bearing to be installed		

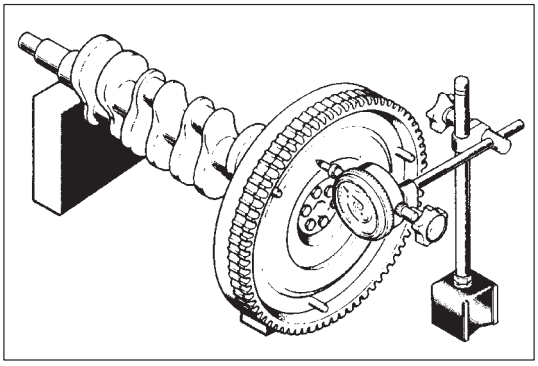


Rear Oil Seal

Carefully inspect oil seal (1) for wear or damage. If its lip is worn or damaged, replace it.



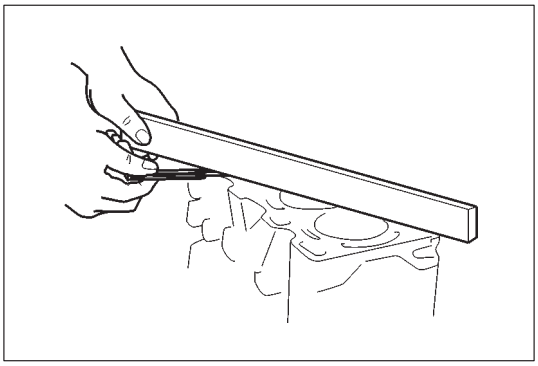
For oil seal installation, press-fit rear oil seal (1) so that oil seal housing (2) end face is flush with oil seal end face.



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 dial gauge.
  If runout exceeds its limit, replace flywheel.

  Limit on runout: 0.2 mm (0.0078 in.)



Cylinder Block

Distortion of gasketed surface

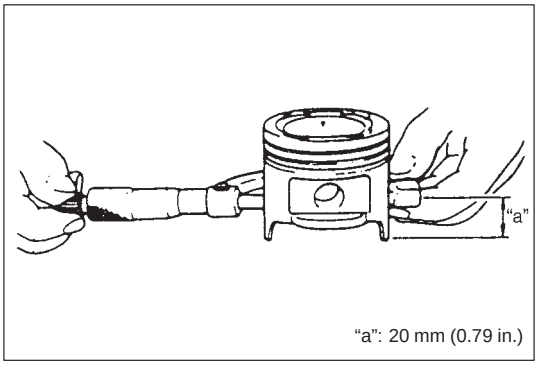
Using straightedge and thickness gauge, check gasketed surface for distortion and, if flatness exceeds its limit, correct it.

Item	Limit
Flatness	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.

Size	Piston diameter
O/S 0.25	68.720 – 68.740 mm (2.7055 – 2.7062 in.)
O/S 0.50	68.970 – 68.990 mm (2.7154 – 2.7161 in.)



3) Using micrometer, measure piston diameter.

4) Calculate cylinder bore diameter to be rebored.

   D = A + B – C

   D: Cylinder bore diameter to be rebored.
   A: Piston diameter as measured.
   B: Piston clearance = 0.025 – 0.045 mm (0.0009 – 0.0017 in.)
   C: Allowance for honing = 0.02 mm (0.0008 in.)

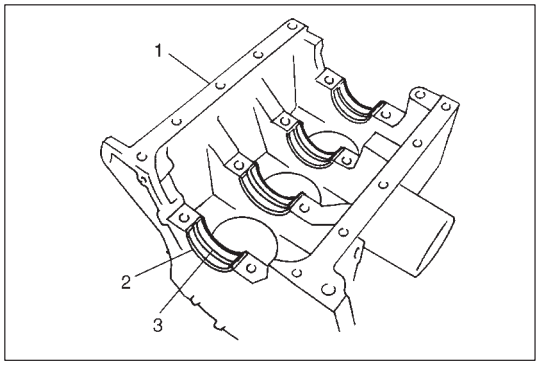
5) Rebore and hone cylinder to calculated dimension.

NOTE:
Before reboring, install all main bearing caps in place and tighten to specification to avoid distortion of bearing bores.

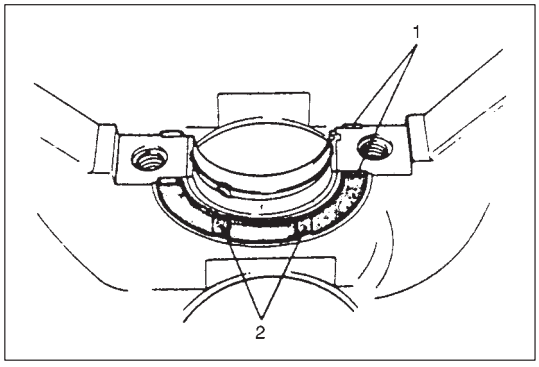
6) Measure piston clearance after honing.

INSTALLATION

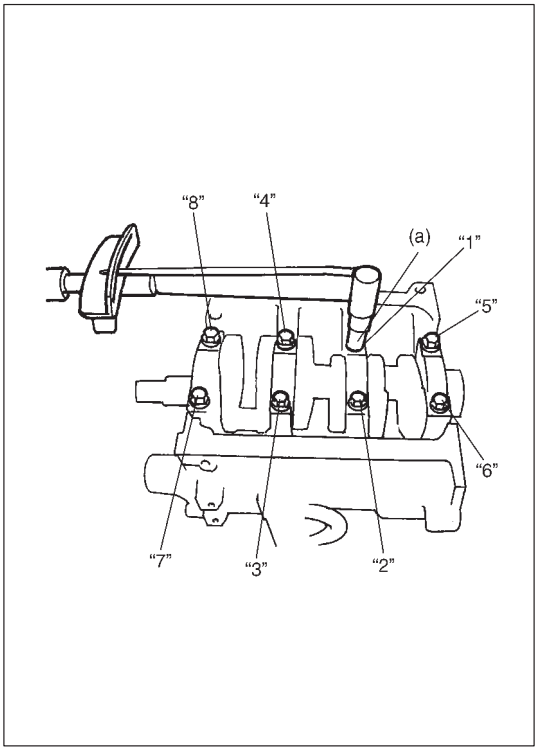
NOTE:
- **All parts to be installed must be perfectly clean.**
- **Be sure to oil crankshaft journals, journal bearings, thrust bearings, crankpins, connecting rod bearings, pistons, piston rings and cylinder bores.**
- **Journal bearings, bearing caps, connecting rods, rod bearings, rod bearing caps, 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 main bearings to cylinder block (1).
One of two halves of main bearing (2), has an oil groove (3). Install it to cylinder block, and the other half without oil groove to bearing cap.
Make sure that two halves are painted in the same color.



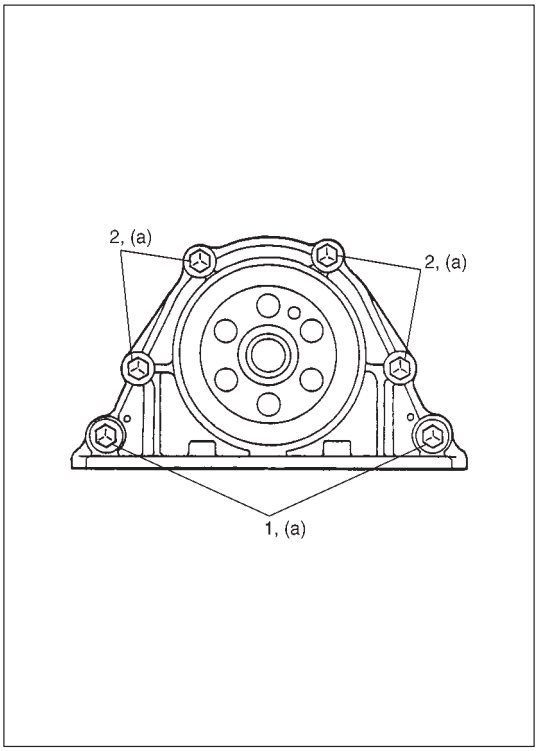
2) Install thrust bearings (1) to cylinder block between No.2 and No.3 cylinders. Face oil groove (2) sides to crank webs.



3) Install crankshaft to cylinder block.
4) 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 and 4, starting from pulley side. Tighten bearing cap bolts in such order as shown in figure a little at a time and repeat it till they are tightened to specified torque.

Tightening Torque
(a): 47 N·m (4.7 kg-m, 34.0 lb-ft)

NOTE:
After tightening cap bolts, check to be sure that crankshaft rotates smoothly when turning it by 7.0 N·m (0.7 kg-m, 5.0 lb-ft) torque or below.



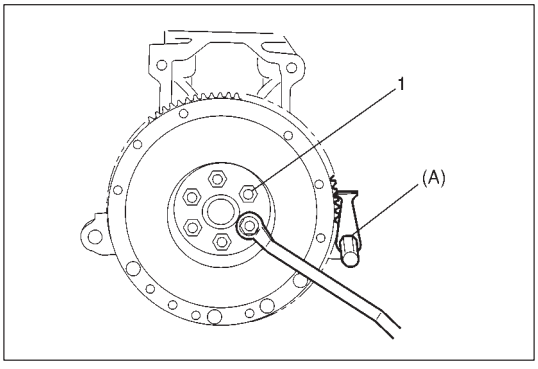
5) Install new gasket and oil seal housing.
Do not reuse gasket removed in disassembly. Apply engine oil to oil seal lip before installation. Tighten housing bolts to specification.

Tightening Torque
(a): 11 N·m (1.1 kg-m, 8.0 lb-ft)

NOTE:
As there are 2 types (long bolts (1) and short bolts (2)) of housing bolts, refer to figure for their correct use.

After installing oil seal housing, gasket edges might bulge out; if so, cut them off to make them flush with cylinder block and oil seal housing.

6) Install oil pump.
Refer to item OIL PUMP for installation of oil pump.

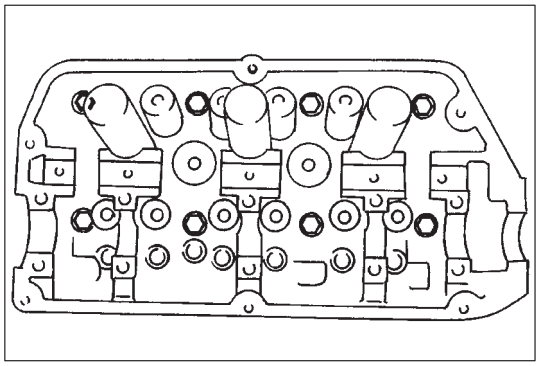


7) Install flywheel.
Using special tool, lock flywheel, and torque its bolts (1) to specification.

Special Tool
(A): 09924-17810

Tightening Torque
(a): 42 N·m (4.2 kg-m, 30.5 lb-ft)

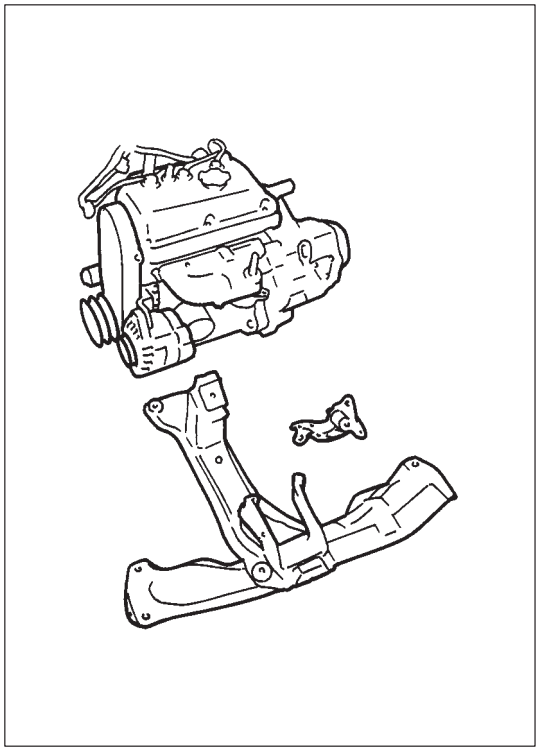
8) Install pistons and connecting rods as previously outlined.
9) Install oil pump strainer and oil pan as previously outlined.



10) Install cylinder head assembly to cylinder block as previously outlined.

    NOTE:
    Tighten cylinder head bolts to specified torque as previously outlined.

11) Install camshaft, crankshaft timing belt pulley, timing belt, crankshaft pulley, water pump pulley, etc., as previously outlined.
12) Install clutch to flywheel. For clutch installation, refer to Section 7C.

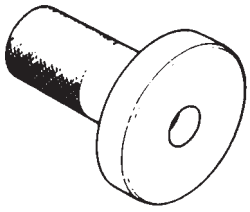
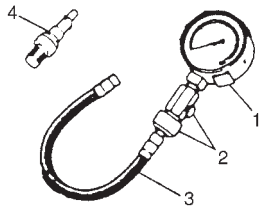
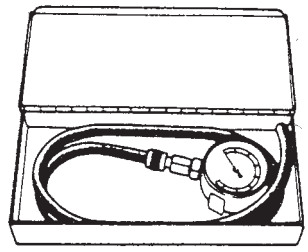
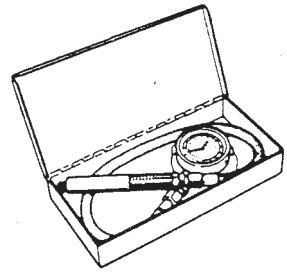
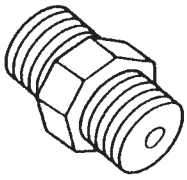
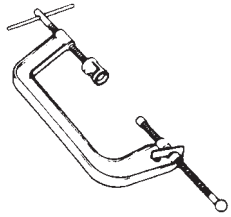
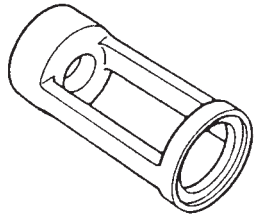
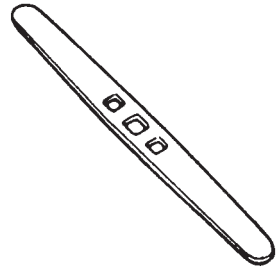
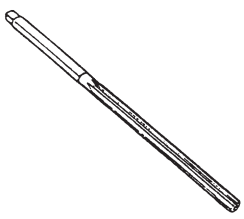
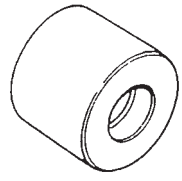


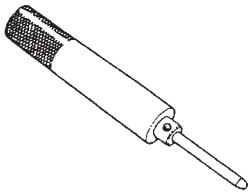
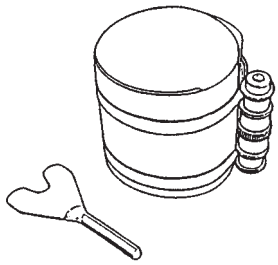
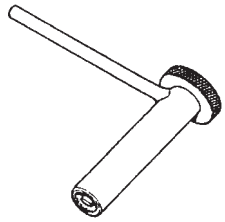
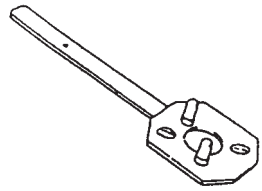
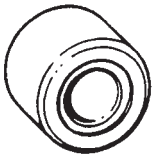
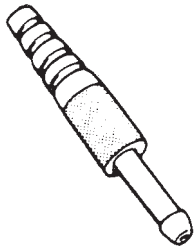
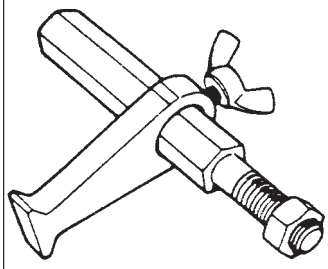
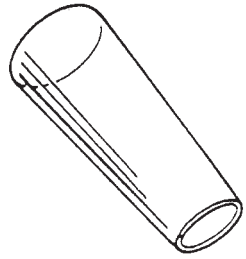
13) Install transmission and engine member to engine.
14) Install engine assembly to vehicle as previously outlined.

REQUIRED SERVICE MATERIALS

MATERIALS	RECOMMENDED SUZUKI PRODUCT	USE
Sealant	SUZUKI BOND NO. 1207C (99000-31150)	● Mating surfaces of cylinder block and oil pan. ● Mating surface of camshaft housing No.1. ● Cylinder head cover gasket and cylinder head side seal.
Grease	SUZUKI SUPER GREASE A (99000-25010)	● O-rings of plug cap.

SPECIAL TOOLS

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<td>
09913-75520
Bearing installer</td>
<td>
1. 09915-64510-001
Compression gauge
2. 09915-64510-002
Connector
3. 09915-64530
Hose
4. 09915-64550
Attachment</td>
<td>
09915-67310
Vacuum gauge</td>
<td>
09915-77310
Oil pressure gauge</td>
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<td>
09915-78211
Oil pressure gauge attachment</td>
<td>
09916-14510
Valve lifter</td>
<td>
09916-14910
Valve lifter attachment</td>
<td>
09916-34542
Reamer handle</td>
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<tr>
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09916-34550
Reamer (5.5 mm)</td>
<td>
09916-37320
Reamer (10.5 mm)</td>
<td>
09916-44910
Valve guide remover</td>
<td>
09916-57340
Valve guide installer attachment</td>
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 09916-58210 Valve guide installer handle	 09916-77310 Piston ring compressor	 09917-18210 Tappet adjuster wrench	 09917-68221 Camshaft pulley holder
 09917-98221 Valve stem seal installer	 09918-08210 Vacuum gauge hose joint	 09924-17810 Flywheel holder	 09926-18210 Oil seal guide (Vinyl resin)

SECTION 6B

ENGINE COOLING

CONTENTS

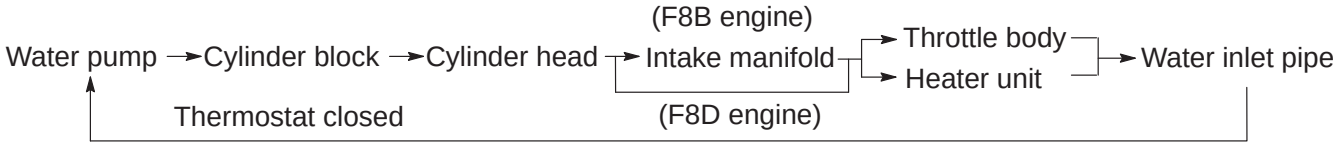
GENERAL DESCRIPTION 6B- 2
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Coolant 6B- 4
Coolant Level 6B- 5
Cooling System Service 6B- 5
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Water Pump Belt Tension 6B- 7
ON-VEHICLE SERVICE 6B- 8
Cooling System Draining 6B- 8
Cooling Water Pipes or Hoses 6B- 8
Thermostat 6B- 9
Water Pump Belt 6B-10
Radiator 6B-11
Water Pump 6B-12
REQUIRED SERVICE MATERIALS 6B-14

GENERAL DESCRIPTION

The cooling system mainly consists of the radiator cap, radiator, coolant reservoir, hoses, water pump, cooling fan and thermostat. The radiator is of tube-and-fin type.

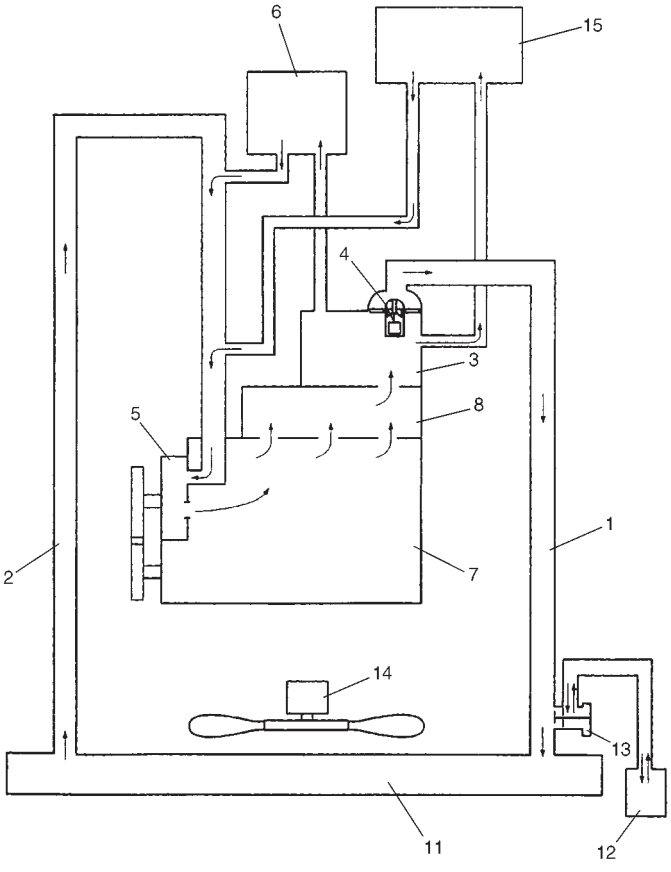
COOLING SYSTEM CIRCULATION

1) While the engine is warmed up (thermostat closed), coolant circulates as follows.

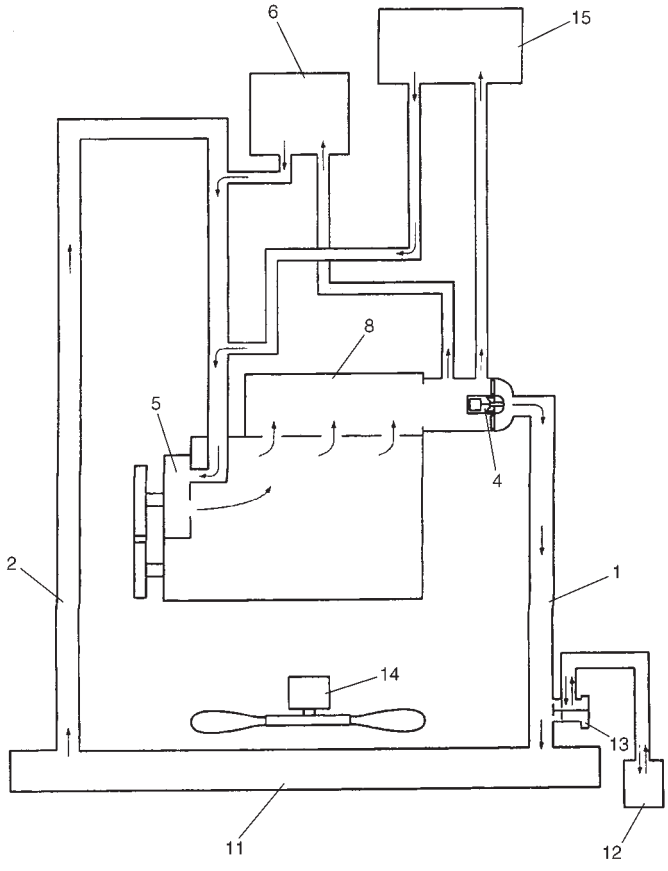


2) When coolant is warmed up to normal operating temperature and the thermostat opens, coolant passes through the radiator core to be cooled as well as the above flow circuit.

F8B engine



F8D engine



1. Radiator inlet hose
2. Radiator outlet hose
3. Intake manifold
4. Thermostat
5. Water pump
6. Throttle body
7. Cylinder block
8. Cylinder head
9. Heater inlet hose (if equipped)
10. Heater outlet hose (if equipped)
11. Radiator
12. Reservoir
13. Radiator cap
14. Cooling fan
15. Heater unit

DIAGNOSIS

Symptom	Possible Cause	Remedy
Engine overheats	● Loose or broken water pump belt	Adjust or replace.
	● Not enough coolant	Check coolant level and add as necessary.
	● Faulty thermostat	Replace.
	● Faulty water pump	Replace.
	● Dirty or bent radiator fins	Clean or remedy.
	● Coolant leakage on cooling system	Repair.
	● Defective cooling fan motor	Check and replace as necessary.
	● Faulty fan motor control circuit	Refer to SECTION 6E1.
	● Plugged radiator	Check and replace radiator as necessary.
	● Faulty radiator cap	Replace.
	● Improper ignition timing	Adjust.
	● Dragging brakes	Adjust brake.
	● Slipping clutch	Adjust or replace.

MAINTENANCE

COOLANT

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

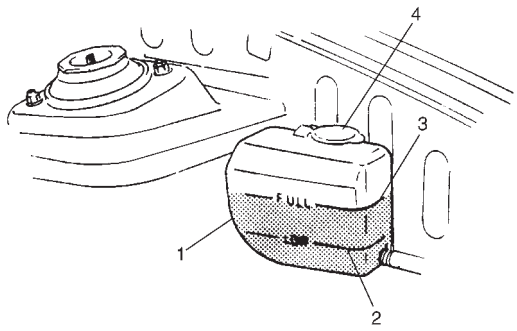
- Maintain cooling system freeze protection at –36°C (–33°F) to ensure protection against corrosion and loss of coolant from boiling. This should be done even if freezing temperatures are not expected.
- Add ethylene glycol base coolant when coolant has to be added because of coolant loss or to provide 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 CHART

ANTI-FREEZE PROPORTIONING CHART	Freezing temperature	°C	–16	–36
		°F	3	–33
	Anti-freeze/Anti-corrosion coolant concentration	%	30	50
	Ratio of compound to cooling water	ltr.	1.05/2.45	1.75/1.75
		US pt.	2.22/5.18	3.70/3.70
		lmp pt.	1.85/4.31	3.08/3.08
COOLANT CAPACITY	Engine radiator and heater		3.0 liters (6.34/5.28 US/Imp. pt.)	
	Reservoir tank		0.5 liters (1.06/0.88 US/Imp. pt.)	
	Total		3.5 liters (7.40/6.16 US/Imp. pt.)	



COOLANT LEVEL

Coolant Level

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.

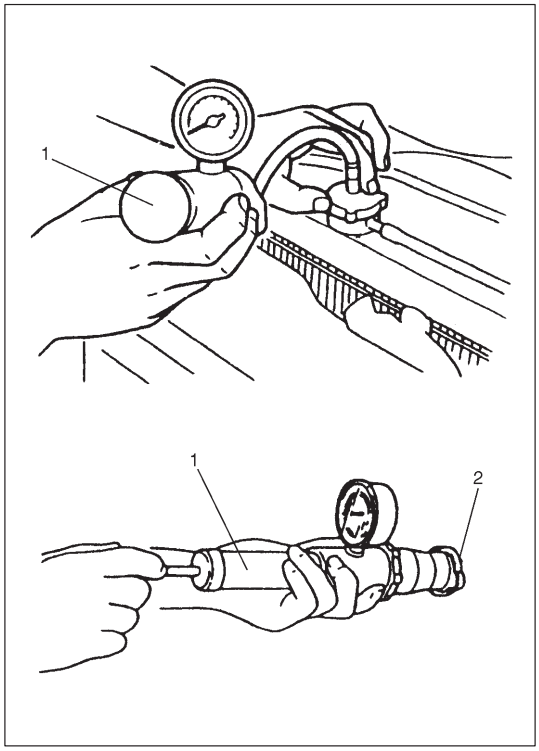
When engine is cool, check coolant level in reservoir tank (1).
A normal coolant level should be between FULL and LOW marks on reservoir tank.
If coolant level is below LOW mark (2), remove reservoir tank cap and add proper coolant to tank to bring coolant level up to FULL mark (3). Then, reinstall cap (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.

COOLING SYSTEM 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.

Cooling system should be serviced as follows.
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 about 90 kPa (0.9 kg/cm^2, 12.8 psi). If replacement of cap is required, use a proper cap for this vehicle.

   NOTE:
   After installing radiator cap to radiator, make sure that the ear of cap lines is parallel to radiator.

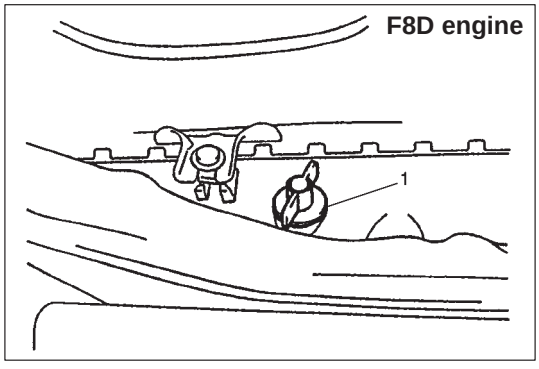
5) Tighten hose clamps and inspect all hoses. Replace hoses whenever cracked, swollen or otherwise deteriorated.
6) Clean frontal area of radiator core.

COOLING SYSTEM FLUSH AND REFILL

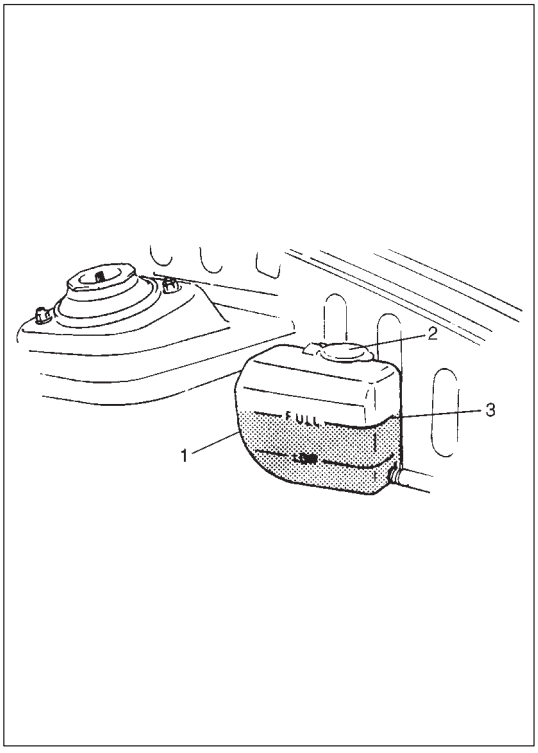
1) Remove radiator cap when engine is cool:
   Turn cap counterclockwise slowly until it reaches a “stop”. (Do not press down while turning it.)
   Wait until pressure is relieved (indicated by a hissing sound) then press down on cap and continue to turn it counterclockwise.

   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 (for F8D engine).

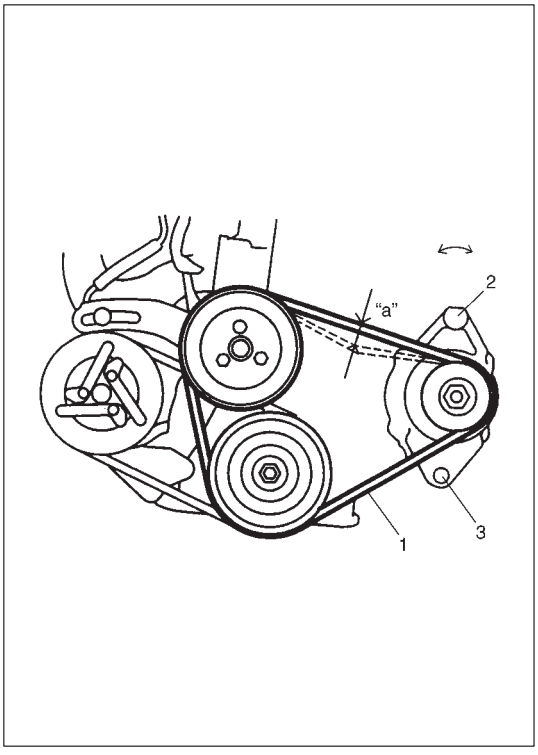


7) Remove reservoir tank (1) and remove cap (2) from reservoir tank and pour out any fluid, scrub and clean inside of tank with soap and water.
   Flush it well with clean water and drain. Reinstall tank.
8) Add 50/50 mixture of good quality ethylene glycol antifreeze and water to radiator and tank.
   Fill radiator to the base of radiator filler neck and reservoir tank to FULL level mark (3). Reinstall reservoir tank cap.
9) Run engine, with radiator cap removed, until radiator upper hose is hot.
10) 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 BELT TENSION

WARNING:
- **Disconnect negative cable at battery before checking and adjusting belt tension.**
- **See WARNING described in COOLING SYSTEM SERVICE.**

1) Inspect belt for cracks, cuts, deformation, wear and cleanliness. If it is necessary to replace belt, refer to page 6B-10 for procedure.



2) Check belt (1) for tension. Belt is in proper tension when it deflects 6 – 7 mm (0.24 – 0.27 in.) under thumb pressure (about 10 kg or 22 lb.).

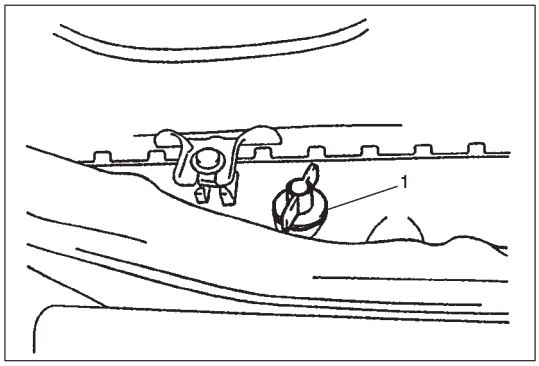
   Belt tension "a": 6 – 7 mm (0.24 – 0.27 in.) as deflection

   NOTE:
   When replacing belt with a new one, adjust belt tension to 5 – 6 mm (0.20 – 0.24 in.).

3) If belt is too tight or too loose, adjust it to proper tension by displacing generator position.
4) Tighten belt adjusting bolt (2) and generator pivot bolts (3).
5) Connect negative cable at battery terminal.

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.**

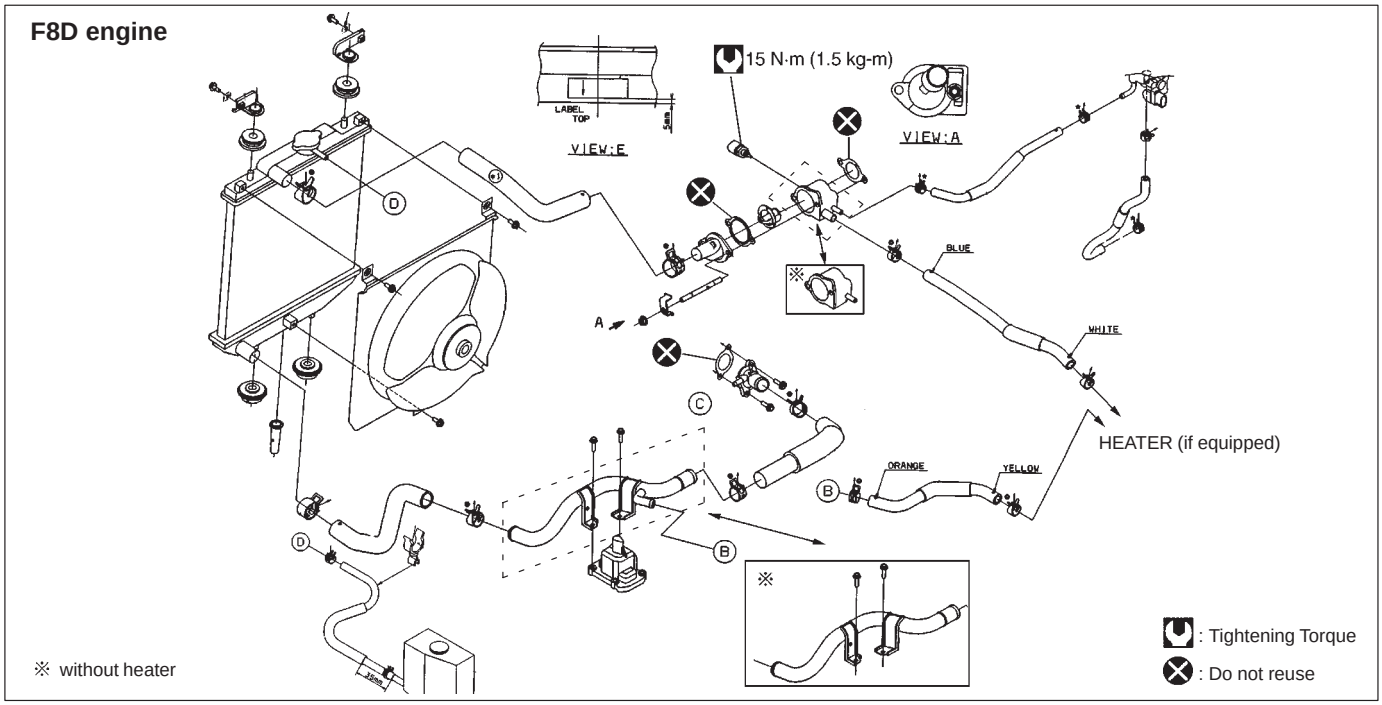


COOLING SYSTEM DRAINING

1) Remove radiator cap.
2) Loosen drain plug (1) on radiator (F8D engine) or disconnect radiator outlet hose (F8B engine) to drain coolant.
3) After draining coolant, be sure to tighten drain plug securely.
4) Fill cooling system. (Refer to Item COOLANT of MAINTENANCE.)

COOLING WATER PIPES OR HOSES

F8D engine



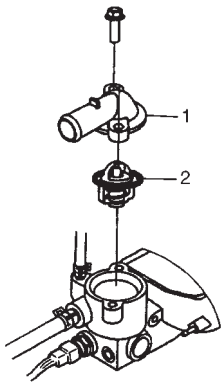
REMOVAL

1) Drain cooling system.
2) To remove these pipes or hoses, loosen clamp on each hose and pull hose end off.

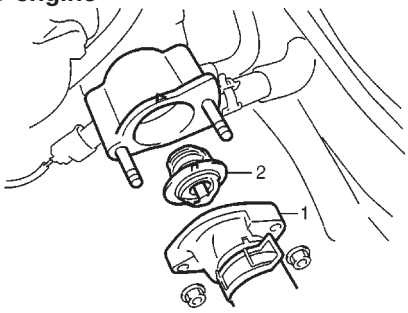
INSTALLATION

Install removed parts in reverse order of removal procedure, noting the following.
- Tighten each clamp securely.
- Refill cooling system with proper coolant, referring to description on COOLANT of MAINTENANCE.

F8B engine



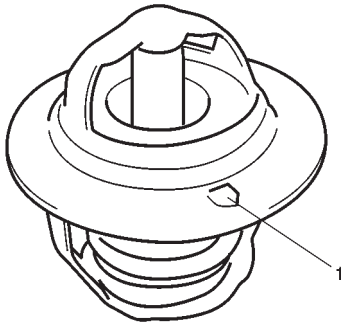
F8D engine



THERMOSTAT

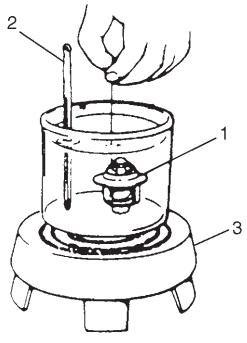
REMOVAL

1) Drain coolant and tighten drain plug.
2) Remove air cleaner case together with air inlet hose.
3) Remove thermostat cap (1) with air cleaner case bracket.
4) Remove thermostat (2) and gasket.



INSPECTION

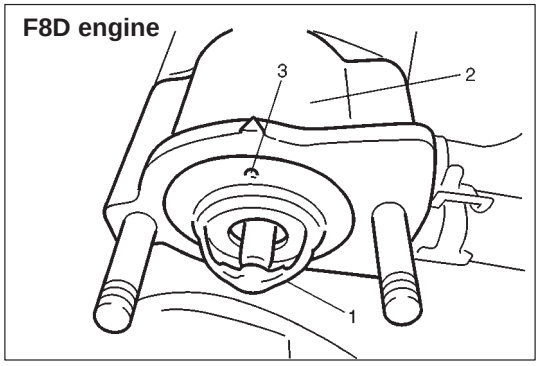
1) Make sure that air bleed valve (1) of thermostat is clean. Should this valve be clogged, engine would tend to overheat.
2) Check to make sure that valve seat is free from foreign matters which would prevent valve from seating tight.



1. Thermostat
2. Thermometer
3. Heater

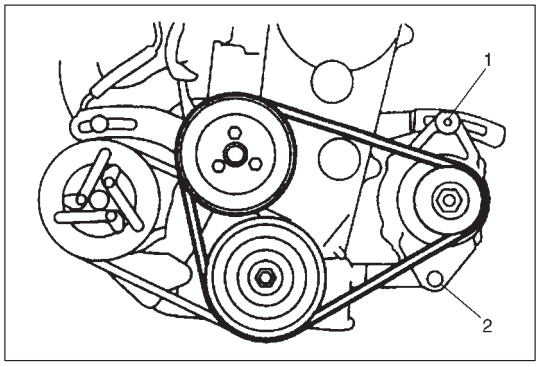
4) Check thermostatic movement of wax pellet as follows:
   (1) Immerse thermostat in water, and heat water gradually.
   (2) Check that valve starts to open at specific temperature.
   (3) If valve starts to open at a temperature substantially below or above specific temperature, thermostat unit should be replaced with a new one. Such a unit, if reused, will bring about overcooling or overheating tendency.

Thermostat functional spec. ±1.5°C (2.7°F)	
Temp. at which valve begins to open	82°C (179°F)
Temp. at which valve become fully open	95°C (203°F)
Valve lift	More than 8 mm at 95°C



INSTALLATION

1) When positioning thermostat (1) on thermostat case (2), be sure to position it so that air bleed valve (3) aligns with arrow mark on case as shown in figure (F8D engine).
2) Install new gasket.
3) Install thermostat cap to thermostat case.
4) Connect cooling water hose.
5) Fill cooling system (refer to page 6B-6, 6B-7).
6) Install air cleaner case.
7) Connect negative cable at battery.
8) After installation, check each part for leakage.



WATER PUMP BELT

REMOVAL

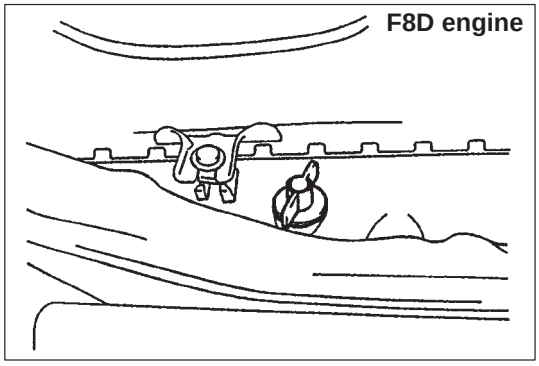
1) Disconnect negative cable at battery.
2) Loosen drive belt adjusting bolt (1) and generator pivot bolts (2).
3) Slacken belt by displacing generator and then remove it.

INSTALLATION

1) Install belt to water pump pulley, crankshaft pulley and generator pulley.
2) Tighten water pump belt adjusting bolt and pivot bolts.
3) Connect negative cable at battery.

WATER PUMP BELT TENSION INSPECTION AND ADJUSTMENT

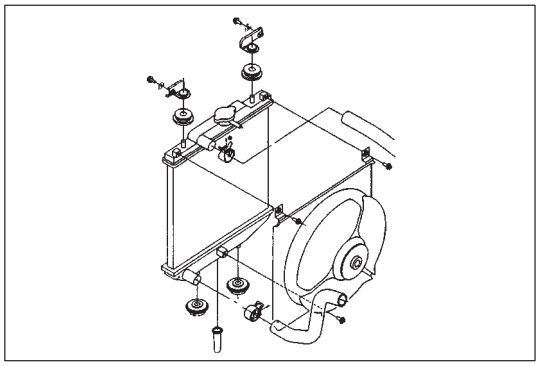
For this inspection or adjustment, refer to WATER PUMP BELT TENSION.



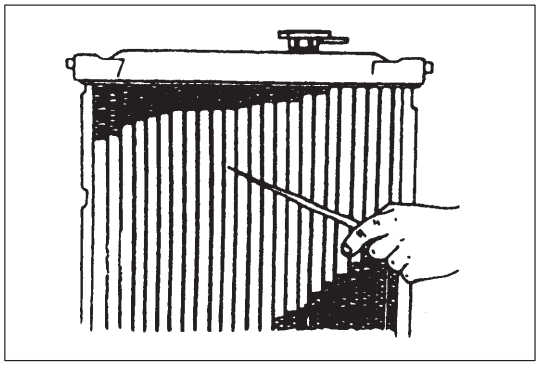
RADIATOR

REMOVAL

1) Disconnect cables at battery and remove battery and its tray.
2) Drain cooling system by loosening drain plug or disconnecting radiator outlet hose.



3) Disconnect coupler of cooling fan motor.
4) Remove radiator bolts.
5) Disconnect radiator inlet and outlet hoses and reservoir tank hose from radiator.
6) Remove radiator from vehicle.



INSPECTION

Check radiator for leakage or damage. Straighten bent fins, if any.

CLEANING

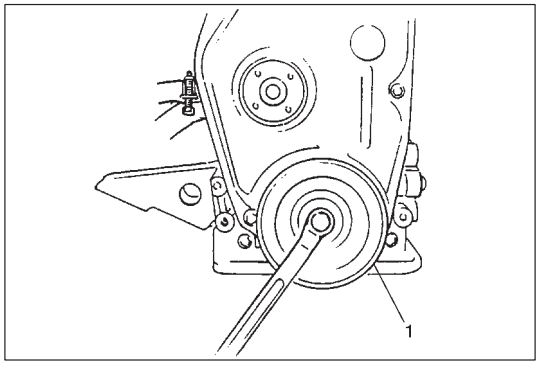
Clean frontal area of radiator cores.

INSTALLATION

Reverse removal procedures.

NOTE:

- **Refill cooling system with proper coolant referring to COOLANT item of MAINTENANCE.**
- **Refer to the figure at REMOVAL for tightening torque.**
- **After installation, check each joint for leakage.**

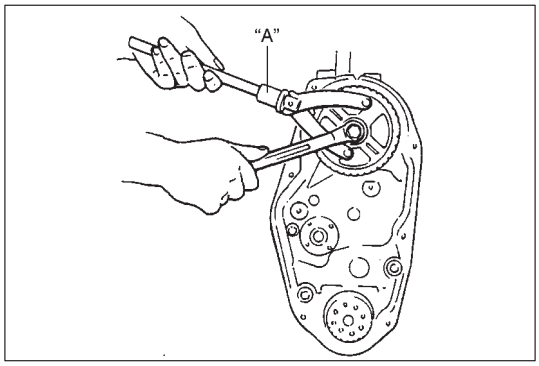


WATER PUMP

REMOVAL

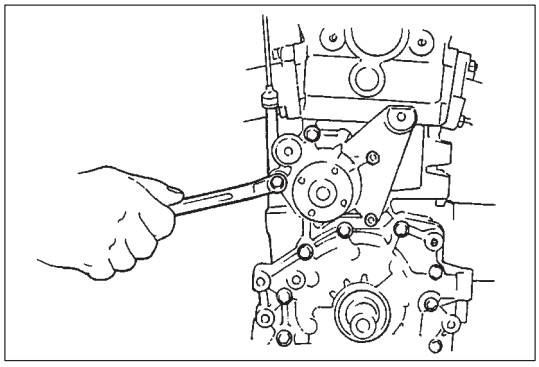
F8B engine

1) Disconnect negative cable at battery.
2) Drain cooling system.
3) Remove A/C compressor drive belt (if equipped) and water pump drive belt. Remove water pump pulley.
4) Remove crankshaft pulley (1).
   Remove timing belt and tensioner according to procedure described in TIMING BELT AND TENSIONER of SECTION 6A.



5) Remove timing belt tensioner and crankshaft timing belt pulley by using special tool.

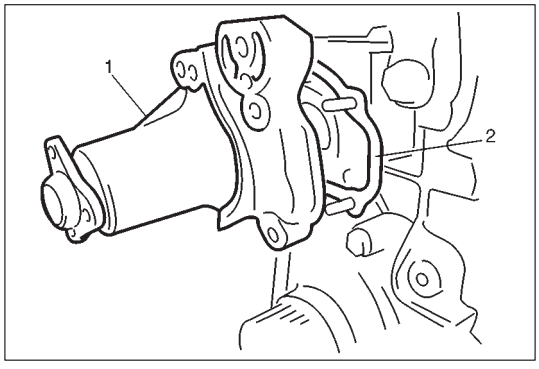
   Special Tool
   (A): 09930-40113



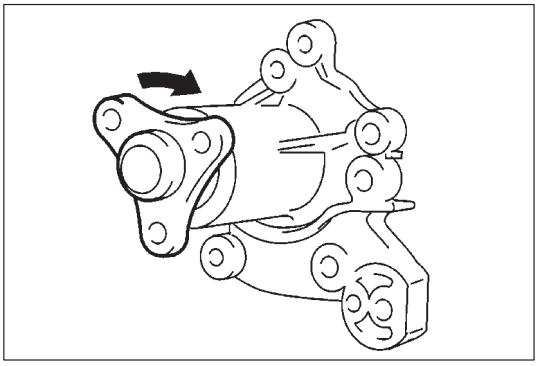
6) Remove crankshaft timing belt pulley and timing belt inside cover.
7) Remove generator adjusting arm.
8) Remove water pump, gasket and rubber seal.

F8D engine

1) Disconnect negative cable at battery.
2) Drain cooling system.
3) Remove water pump belt, A/C compressor drive belt (if equipped) and water pump pulley.
4) Remove crankshaft pulley and timing belt outside cover.
5) Remove timing belt and tensioner according to procedure described in item TIMING BELT AND TENSIONER of SECTION 6A1.



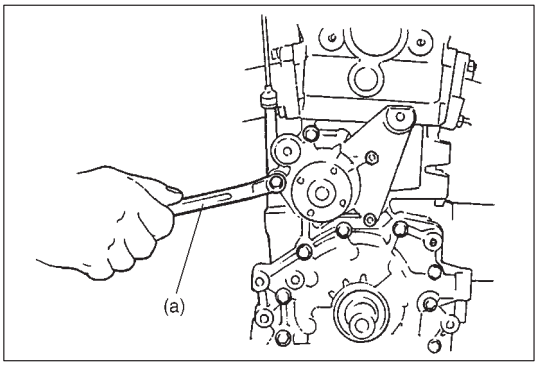
6) Remove water pump (1), gasket (2) and rubber seal.



INSPECTION

NOTE:
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.

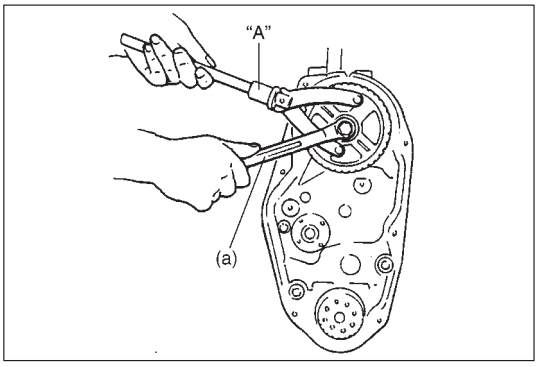


INSTALLATION

F8B engine

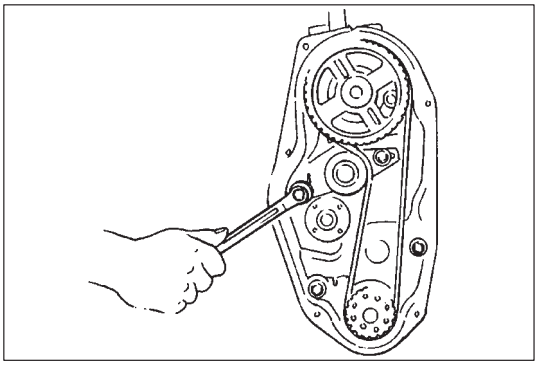
1) Install new gasket to cylinder block.
2) Install water pump to cylinder block.

Tightening Torque
(a): 11 N·m (1.1 kg-m, 8.0 lb-ft)

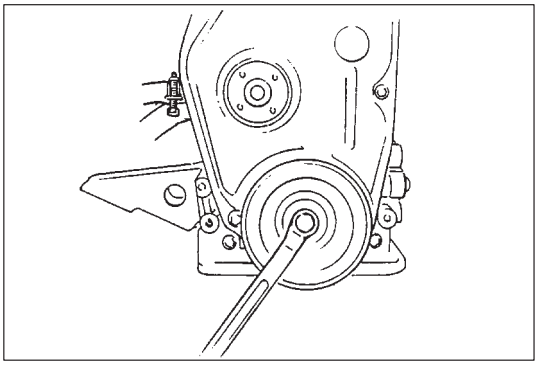


3) Install timing belt inside cover.
4) Install crankshaft timing belt guide, pulley and camshaft timing belt pulley.

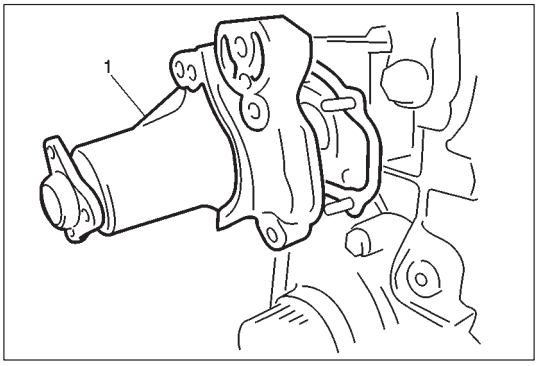
Tightening Torque
(a): 55 N·m (5.5 kg-m, 40.0 lb-ft)



5) Remove cylinder head cover and loosen all valve adjusting screws of intake and exhaust rocker arms fully.
6) Install belt tensioner, tensioner spring and timing belt and adjust timing belt tension according to procedure described in TIMING BELT AND TENSIONER of SECTION 6A.

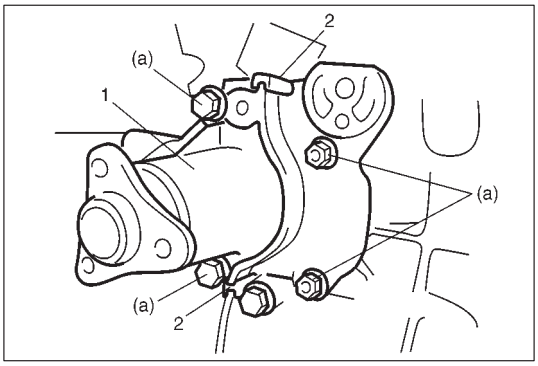


7) Install timing belt outside cover, crankshaft pulley, water pump pulley and drive belts Refer to SECTION 6A.
8) Adjust all valve lashes refer to SECTION 6A.
9) Adjust water pump drive belt tension and A/C compressor drive belt tension (if equipped).
10) Connect negative cable at battery.
11) Fill cooling system.



F8D engine

1) Install new pump gasket (1) to cylinder block.



2) Install water pump (1) to cylinder block.

   Tightening Torque
   (a): 11 N·m (1.1 kg-m, 8.0 lb-ft)

3) After installing water pump, install rubber seal (2).
4) Install belt tensioner and timing belt and adjust timing belt according to procedure described in item TIMING BELT AND TENSIONER of SECTION 6A1.
5) Adjust drive belt tension.
6) Fill cooling system.
7) After installation, check each part for leakage.

REQUIRED SERVICE MATERIAL

MATERIALS	USE
Ethylene glycol base coolant (Anti-freeze/Anti-corrosion coolant)	Additive to engine cooling system for improving cooling efficiency and for protection against rusting.

SECTION 6C

ENGINE FUEL

CONTENTS

GENERAL DESCRIPTION 6C- 1
Fuel System 6C- 1
Fuel Tank 6C- 2
Fuel Pump . . . . . Refer to SECTION 6E1
Fuel Filter 6C- 2
Fuel Filler Cap 6C- 2

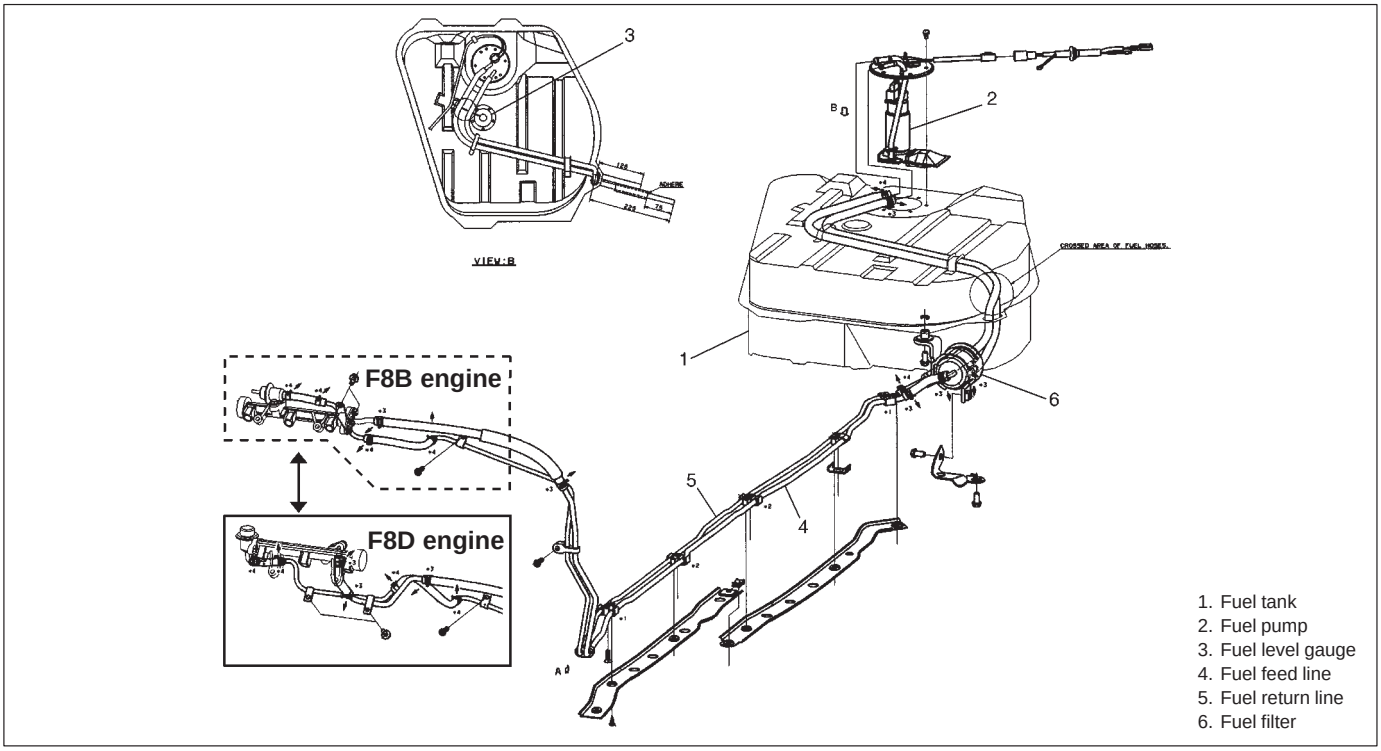
ON-VEHICLE SERVICE 6C- 3
Fuel Lines 6C- 3
Fuel Pipe 6C- 4
Fuel Filler Cap 6C- 4
Fuel Filter 6C- 5
Fuel Tank 6C- 5
Fuel Pump 6C- 8

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.

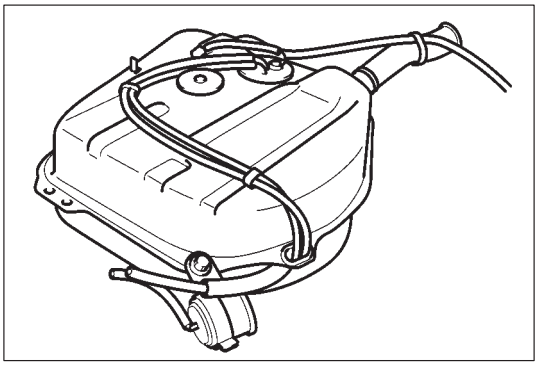
GENERAL DESCRIPTION

FUEL SYSTEM

The main components of the fuel system are fuel tank, fuel pump, fuel filter and fuel level gauge and it includes three lines; fuel feed line, fuel return line and fuel vapor line.
For the details of fuel flow and fuel vapor flow, refer to ENGINE AND EMISSION CONTROL SYSTEM section.

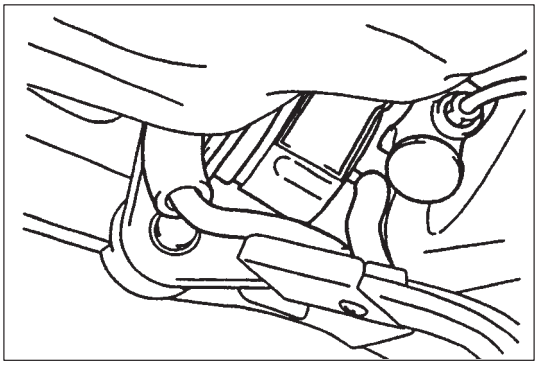


1. Fuel tank
2. Fuel pump
3. Fuel level gauge
4. Fuel feed line
5. Fuel return line
6. Fuel filter



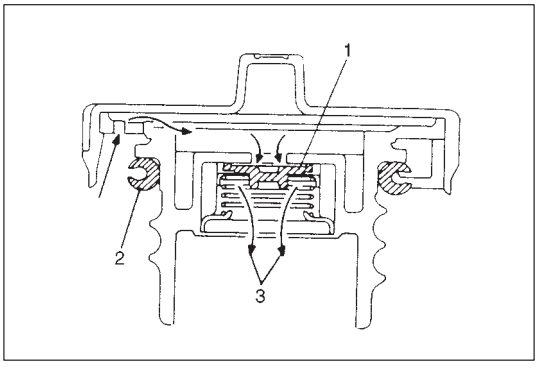
FUEL TANK

The fuel tank is located under the rear of the vehicle. The fuel pump and fuel level gauge are installed on the upper part of fuel tank. Whenever servicing the fuel level gauge or the fuel pump, the fuel tank must be removed from the body.



FUEL FILTER

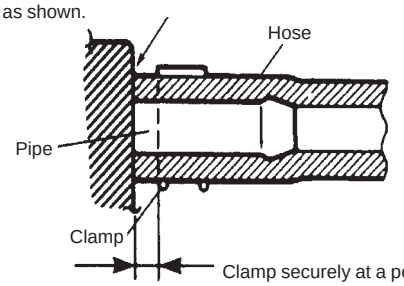
The fuel filter is located in front of fuel tank as shown in figure and filters the fuel sent under pressure from the fuel pump.
As it can't be disassembled, it must be replaced as an assembly.



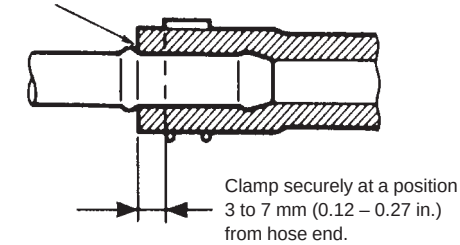
FUEL FILLER CAP

A ratchet tightening device on the threaded fuel filler cap reduces the chances of incorrect installation, which would prevent sealing fuel vapors.
After the gasket (2) on fuel filler cap and the filler neck flange contact, the ratchet produces a loud clicking noise, indicating the seal has been set.
This cap has a vacuum relief valve (1) inside.
The vacuum relief valve opens to relieve the vacuum created in the fuel tank (supplies air (3) into tank).

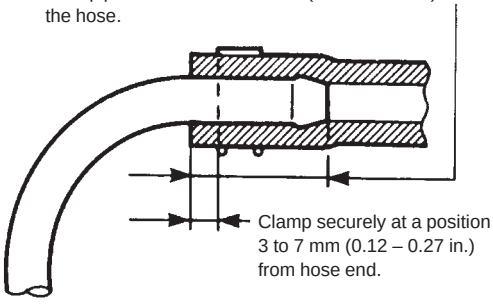
With short pipe, fit hose as far as it reaches pipe joint as shown.



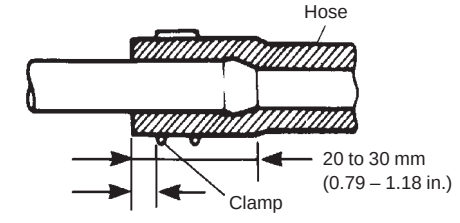
With following type pipe, fit hose as far as its peripheral projection as shown.



With bent pipe, fit hose as far its bent part as shown or till pipe is about 20 to 30 mm (0.79 – 1.18 in.) into the hose.



With straight pipe, fit hose till pipe is about 20 to 30 mm (0.79 – 1.18 in.) in the hose.

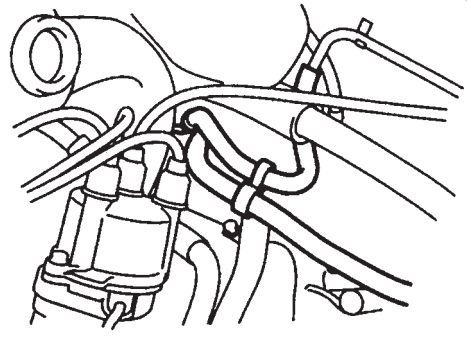


Clamp securely at a position 3 to 7 mm (0.12 – 0.27 in.) from hose end.

ON-VEHICLE SERVICE

WARNING:
Before attempting service of any type on fuel system, following cautions should be always observed.

- **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 according to procedure described on p. 6-4.**
- **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 left figure.**



FUEL LINES

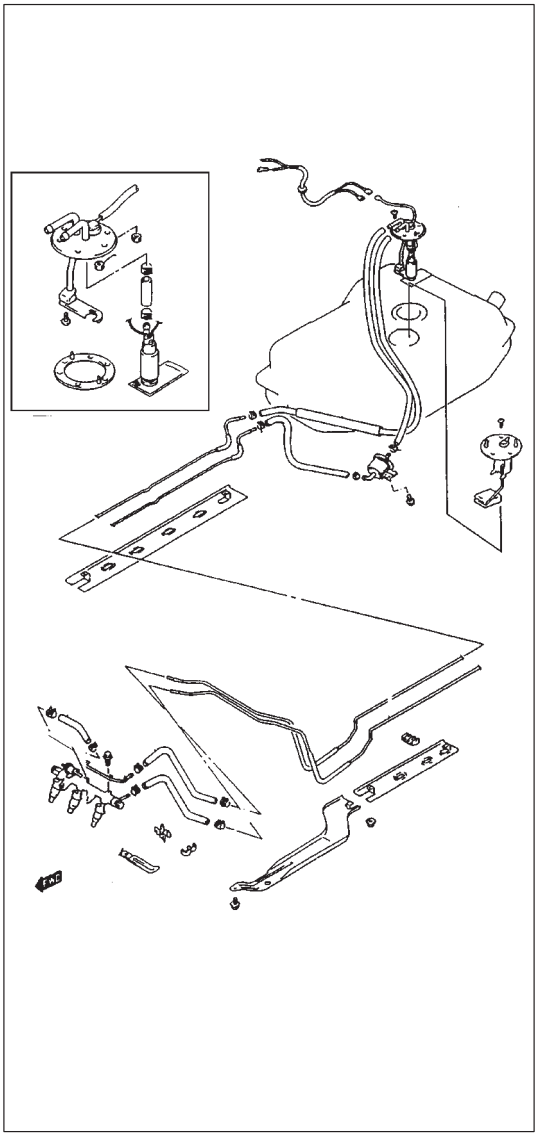
Due to the fact that fuel feed line is under high pressure, use special care when servicing it.

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

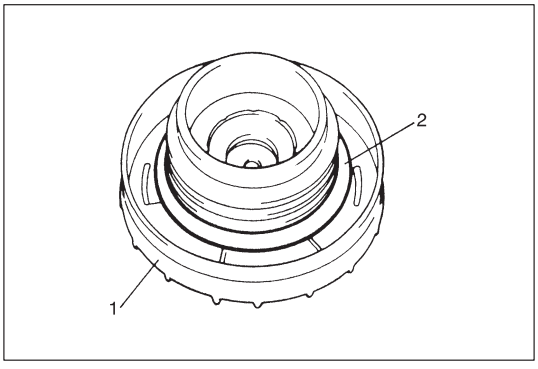
REMOVAL

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.

1) Relieve fuel pressure in fuel feed line according to procedure on p. 6-4.
2) Disconnect negative cable at battery.
3) Disconnect fuel hose from fuel pipe at the front and rear of each fuel pipe.
4) Remove pipe cover from body.
5) Put clamp position mark on pipes so that clamps can be installed on original position.
6) Remove pipes with clamp from body.
7) Remove clamp from pipes.

INSTALLATION

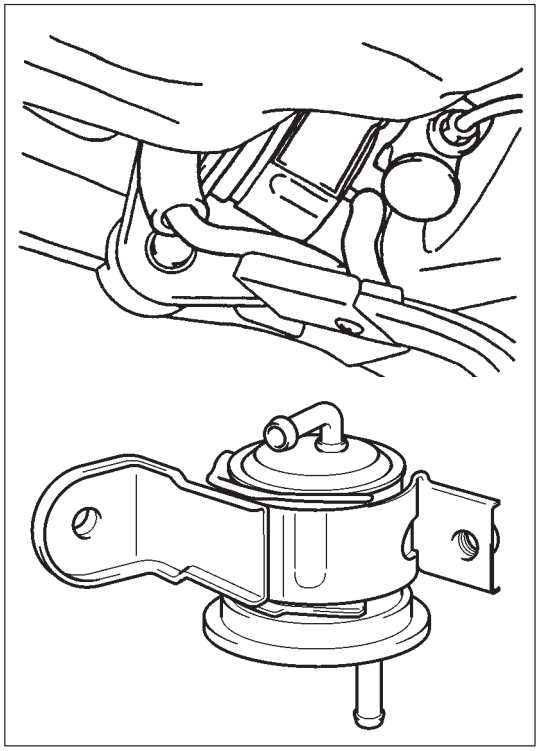
1) Install clamps to marked position on pipes referring to the figure in p.6C-2. If clamp is deformed or its claw is bent or broken, replace it with new one.
2) Install pipes with pipe clamp to body.
3) Install pipe cover to body. Be sure to use new nuts.
4) Connect fuel hoses to fuel pipes.
5) With engine “OFF” and ignition switch “ON”, check for fuel leaks.



FUEL FILLER CAP

Remove cap (1), and check gasket (2) for even filler neck imprint, and deterioration or any damage. If gasket 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.

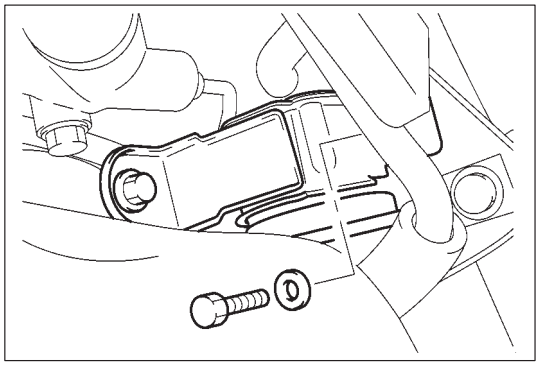


FUEL FILTER

REMOVAL

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.

1) Relieve fuel pressure in fuel feed line according to procedure described on p. 6-4.
2) Disconnect negative cable at battery.
3) Place fuel container under fuel filter.
4) Disconnect inlet and outlet hoses from fuel filter.
5) Remove fuel filter with bracket.



INSTALLATION

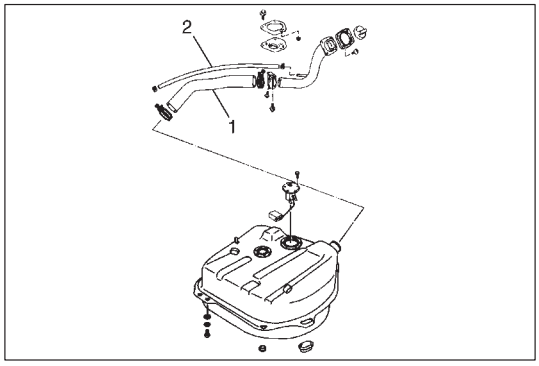
1) Install filter.
2) Connect outlet and inlet hoses.
   Clamp hoses securely.
3) Connect negative cable to battery.
4) With engine “OFF” and ignition switch “ON”, check for fuel leaks.

FUEL TANK

WARNING:
- **Refer to the WARNING at the beginning of ON-VEHICLE SERVICE in this section.**
- **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.**

REMOVAL

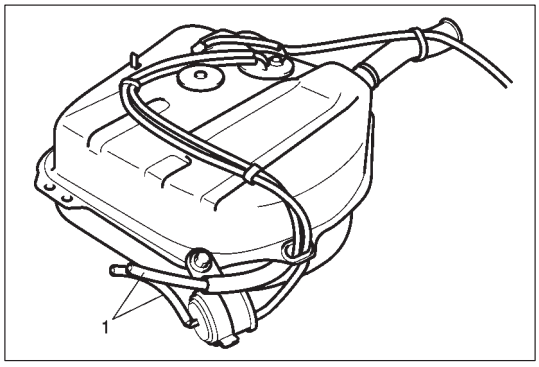
1) Relieve fuel pressure in fuel feed line according to procedure described on p. 6-4.
2) Disconnect negative cable at battery.
3) Hoist vehicle.



4) Disconnect fuel filler hose (1) and breather hose (2) from filler neck.

5) As fuel tank has no drain plug, drain fuel tank by pumping fuel through fuel tank filler.
Use hand operated pump device to drain fuel tank.

CAUTION:
Never drain or store fuel in an open container to avoid possibility of fire or explosion.



6) Disconnect fuel hoses (1).

7) Support fuel tank with jack and lower fuel tank gradually until connector of fuel pump and terminal of fuel level gauge can be disconnected. Then disconnect wire harness at connector and terminal.
8) Remove fuel tank from vehicle.

INSPECTION

After removing fuel tank, check hoses and pipes connected to fuel tank for leaks, loose connections, deterioration or damage. Also check fuel pump, level gauge and fuel cut valve gaskets for leaks, visually inspect fuel tank for leaks and damage.
Replace any damaged or malconditioned parts.

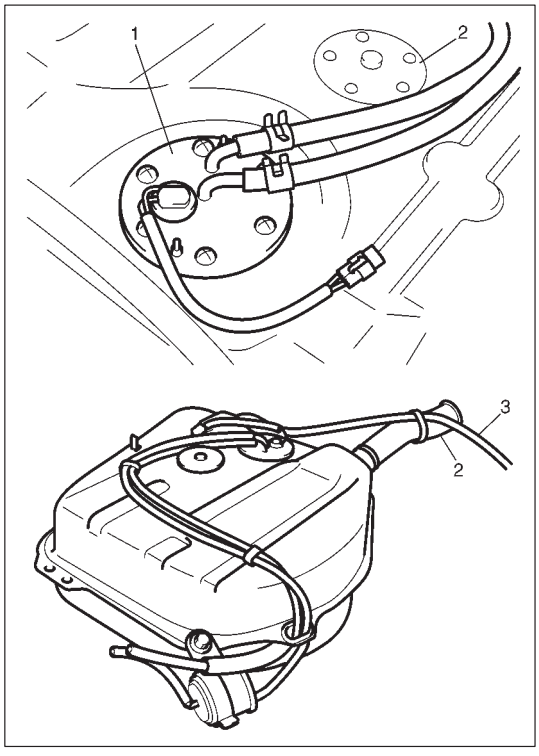
FUEL TANK PURGING PROCEDURE

WARNING:
This purging procedure will NOT remove all fuel vapor. Do not attempt any repair on tank using heat of flame as an explosion resulting in personal injury could occur.

Following procedure is used for purging fuel tank.

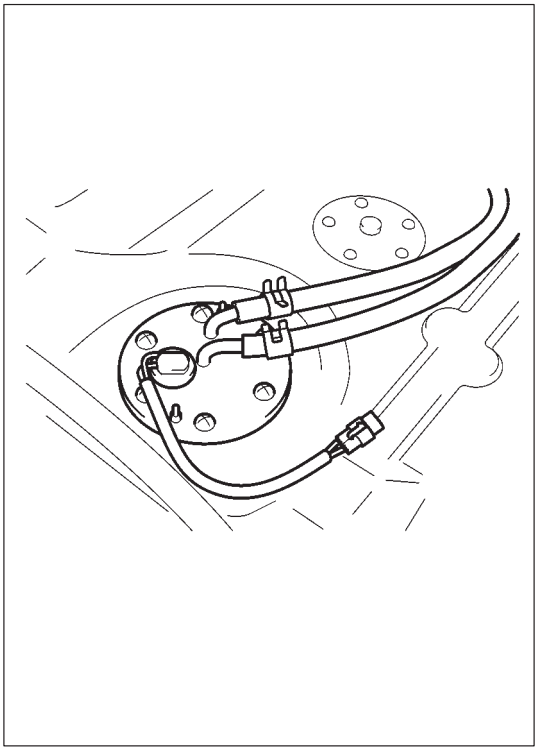
1) After removing fuel tank, remove all hoses, pipes, fuel cut valves, fuel pump and fuel level gauge from fuel tank.
2) Drain all remaining fuel from tank.
3) Move tank to flushing area.
4) Fill tank with warm water or tap water, and agitate vigorously and drain. Repeat this washing until inside of 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) Install fuel pump (1) and fuel level gauge (2) to fuel tank. Use new gaskets.
2) Connect fuel hoses and pipes to fuel tank as shown. Clamp hoses and wire harness securely.
3) Connect fuel breather hose to fuel tank.
4) Install fuel tank to vehicle after connecting connecter and terminal.
5) Connect fuel filler hose (2) to tank and breather hose (3) to filler neck as shown in figure and clamp them securely.
6) Connect fuel and return hoses to pipes and clamp them securely.
7) Connect negative cable at battery.
8) With engine “OFF” and ignition switch “ON”, check for fuel leaks.
9) Start engine and check each joint of exhaust system for leakage.

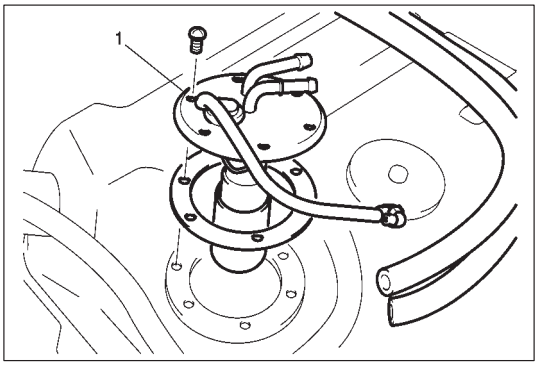


FUEL PUMP

WARNING:
Refer to the WARNING at the beginning of ON-VEHICLE SERVICE in this section.

REMOVAL

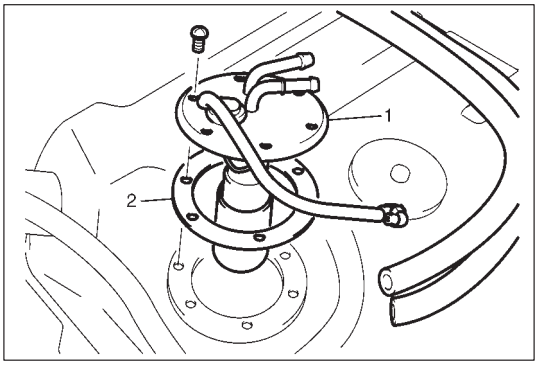
1) Remove fuel tank from vehicle. Refer to FUEL TANK REMOVAL in this section.



2) Remove fuel pump assembly (1) from fuel tank.

INSPECTION

Check fuel pump assembly for damage.
For inspection of fuel pump itself, refer to Section 6E1 of this manual.



INSTALLATION

1) Clean mating surfaces of fuel pump assembly (1) and fuel tank.
2) Install new gasket (2) to fuel pump assembly then install fuel pump assembly to fuel tank.
3) Install fuel tank to vehicle. Refer to FUEL TANK INSTALLATION in this section.

SECTION 6E1

ENGINE AND EMISSION CONTROL SYSTEM

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GENERAL DESCRIPTION

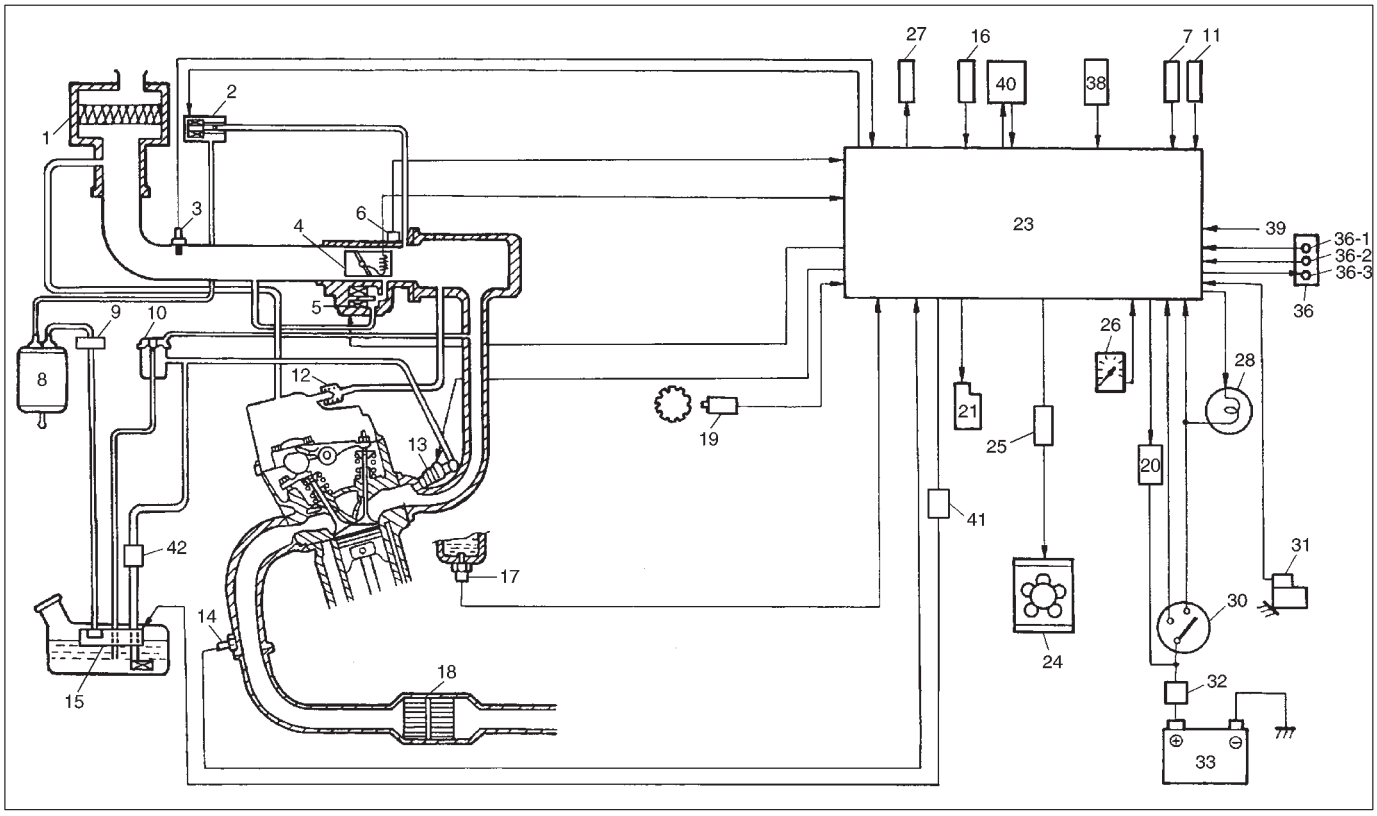
The engine and emission control system has 4 major sub-systems: air intake system, fuel delivery system, electronic control system and emission control system.

Air intake system includes air cleaner, MAP sensor, throttle body, IAC valve and intake manifold.

Fuel delivery system includes fuel pump, delivery pipe, fuel pressure regulator, fuel injectors, etc.

Electronic control system includes ECM, various sensors and controlled devices.

Emission control system includes EVAP and PCV systems.



1. Air Cleaner
2. EVAP canister purge valve
3. IAT sensor
4. TP sensor
5. IAC valve
6. MAP sensor
7. A/C evaporator temp. sensor (if equipped)
8. EVAP canister
9. Tank pressure control valve
10. Fuel pressure regulator
11. A/C dual pressure switch (if equipped)
12. PCV valve
13. Fuel injector
14. Oxygen sensor
15. Fuel pump
16. Stop light switch
17. ECT sensor
18. Three way catalytic convertor
19. CMP sensor
20. Main relay
21. Ignitor
22. Blank
23. ECM
24. Radiator fan
25. Radiator fan control relay
26. VSS in combination meter
27. A/C compressor control relay
28. Malfunction indicator lamp in combination meter
29. Blank
30. Ignition switch
31. Starter magnetic switch
32. Main fuse
33. Battery
34. Blank
35. Blank
36. Monitor connector

36-1. Diagnosis switch terminal
36-2. Test switch terminal
36-3. Duty output terminal

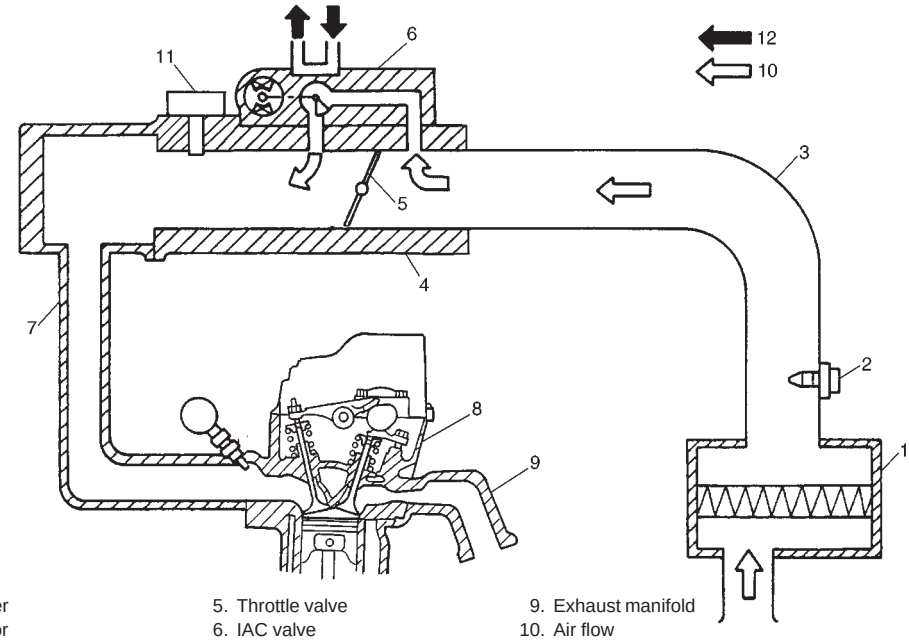
37. Blank
38. Heater blower fan switch
39. Electric load (blower fan and small light)
40. Data link connector (DLC)
41. Fuel pump relay
42. Fuel filter

AIR INTAKE SYSTEM

The main components of the air intake system are air cleaner, air cleaner outlet hose, throttle body, IAC valve and intake manifold.

The air (by the amount corresponding to the throttle valve opening and engine speed) is filtered by the air cleaner, passes through the throttle body, is distributed by the intake manifold and finally drawn into each combustion chamber.

When the IAC valve is opened according to the signal from ECM, the air bypasses the throttle valve through bypass passage and is finally drawn into the intake manifold.



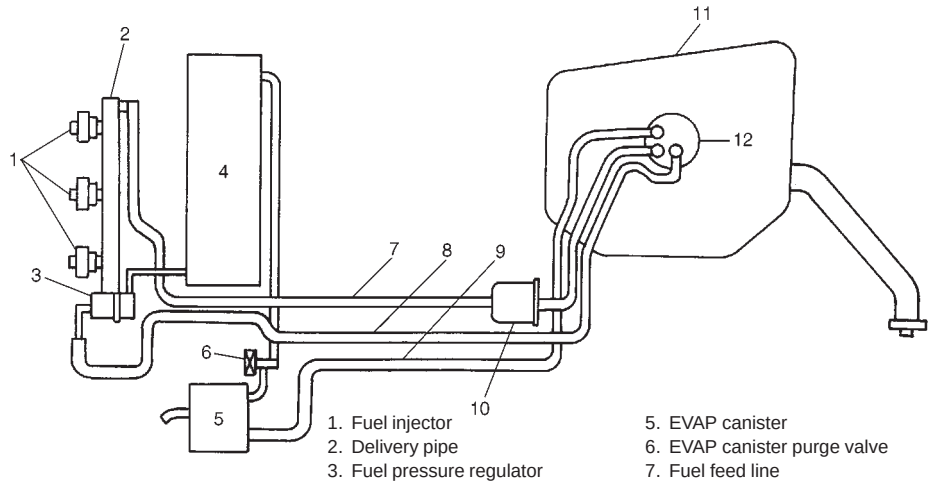
1. Air cleaner
2. IAT sensor
3. Air cleaner outlet hose
4. Throttle body
5. Throttle valve
6. IAC valve
7. Intake manifold
8. Cylinder head
9. Exhaust manifold
10. Air flow
11. MAP sensor
12. Engine coolant

FUEL DELIVERY SYSTEM

The fuel delivery system consists of the fuel tank, fuel pump, fuel filter, fuel pressure regulator, delivery pipe and fuel injectors.

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.



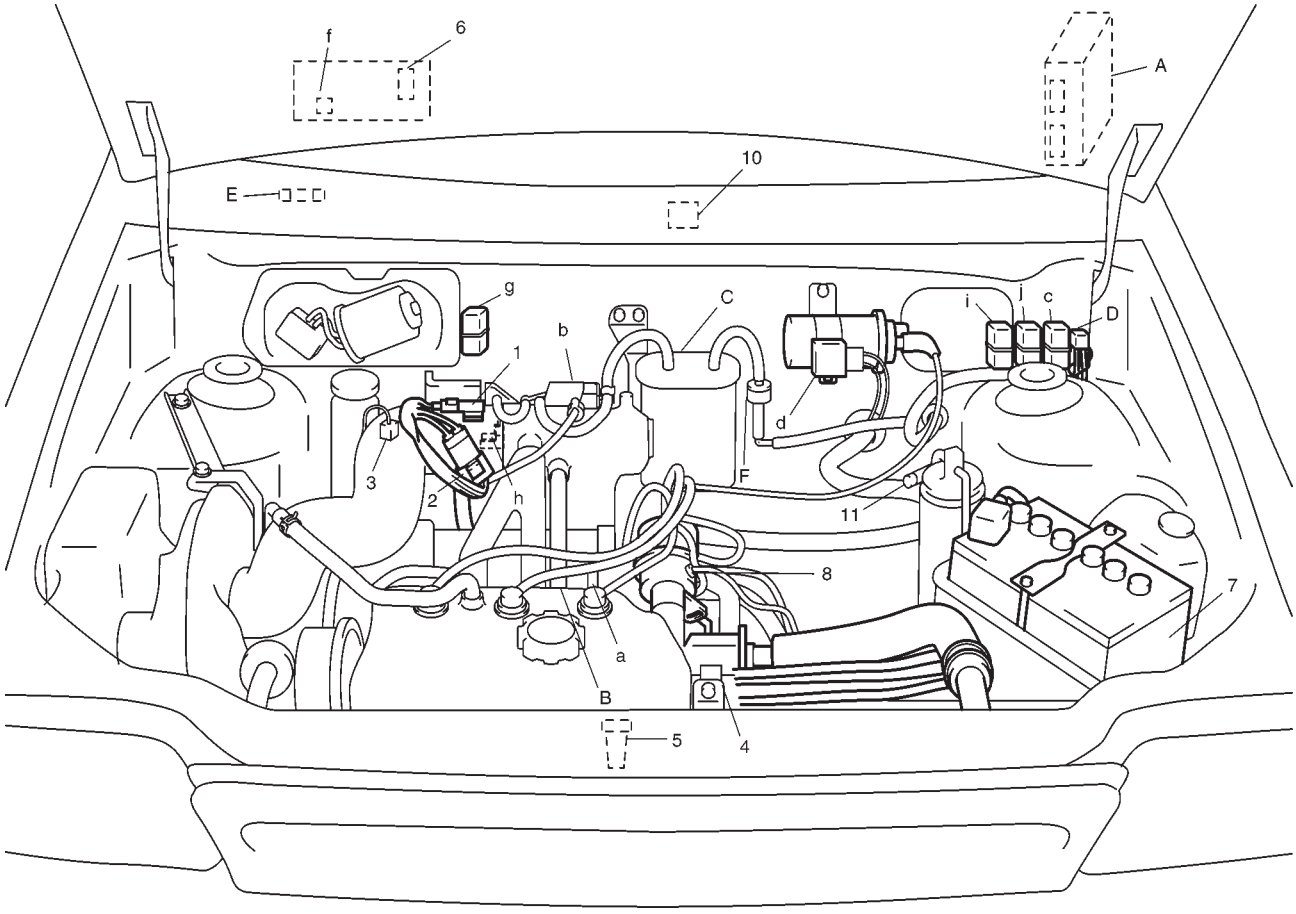
1. Fuel injector
2. Delivery pipe
3. Fuel pressure regulator
4. Intake manifold
5. EVAP canister
6. EVAP canister purge valve
7. Fuel feed line
8. Fuel return line
9. Fuel vapor line
10. Fuel filter
11. Fuel tank
12. Fuel pump

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 the following sub systems:

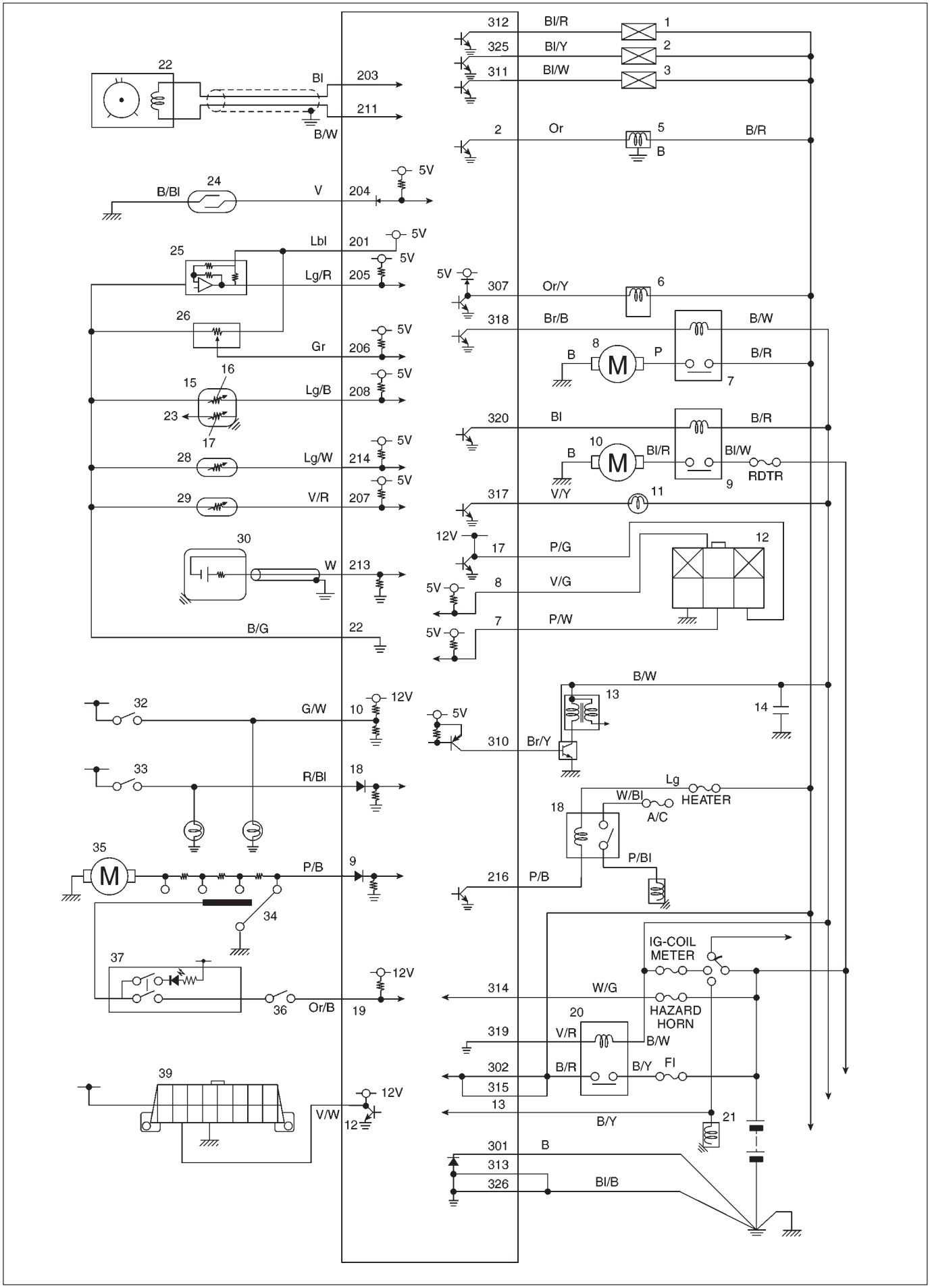
- Fuel injection control system
- Idle speed control system
- Fuel pump control system
- Ignition control system
- Radiator fan control system
- Evaporative emission control system
- A/C control system (if equipped)



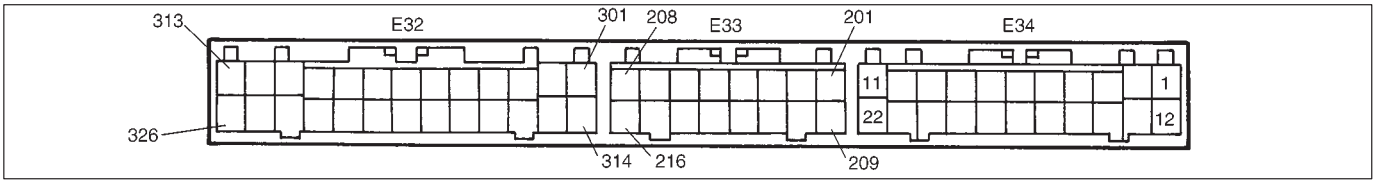
INFORMATION SENSORS
1. MAP sensor
2. TP sensor
3. IAT sensor
4. ECT sensor
5. Oxygen sensor
6. VSS
7. Battery
8. CMP sensor
9. Blank
10. A/C evaporator temp. sensor (if equipped)
11. A/C dual pressure switch (if equipped)

CONTROL DEVICES
a : Fuel injectors
b : EVAP canister purge valve
c : Fuel pump relay
d : Igniter
e : Blank
f : Malfunction indicator lamp
g : Radiator fan control relay
h : IAC valve
i : A/C compressor control relay (if equipped)
j : Main relay

OTHERS
A : ECM
B : PCV valve
C : EVAP canister
D : Monitor connector
E : DLC
F : Tank pressure control valve


22
Bl
203
211
B/W
B/Bl
24
V
204
5V
Lbl
201
25
Lg/R
205
26
Gr
206
16
15
Lg/B
208
23
17
28
Lg/W
214
29
V/R
207
30
W
213
B/G
22
32
G/W
10
12V
33
R/Bl
18
35
P/B
9
34
37
36
Or/B
19
39
V/W
12
312
Bl/R
1
325
Bl/Y
2
311
Bl/W
3
2
Or
5
B
B/R
307
Or/Y
6
318
Br/B
B/W
8
P
B/R
7
320
Bl
10
Bl/R
Bl/W
RDTR
9
317
V/Y
11
12
17
P/G
8
V/G
7
P/W
310
Br/Y
13
14
Lg
W/Bl
HEATER
A/C
18
P/Bl
216
IG-COIL
METER
314
W/G
HAZARD
HORN
20
319
V/R
B/W
302
B/R
B/Y
Fl
315
13
21
301
313
326
Bl/B

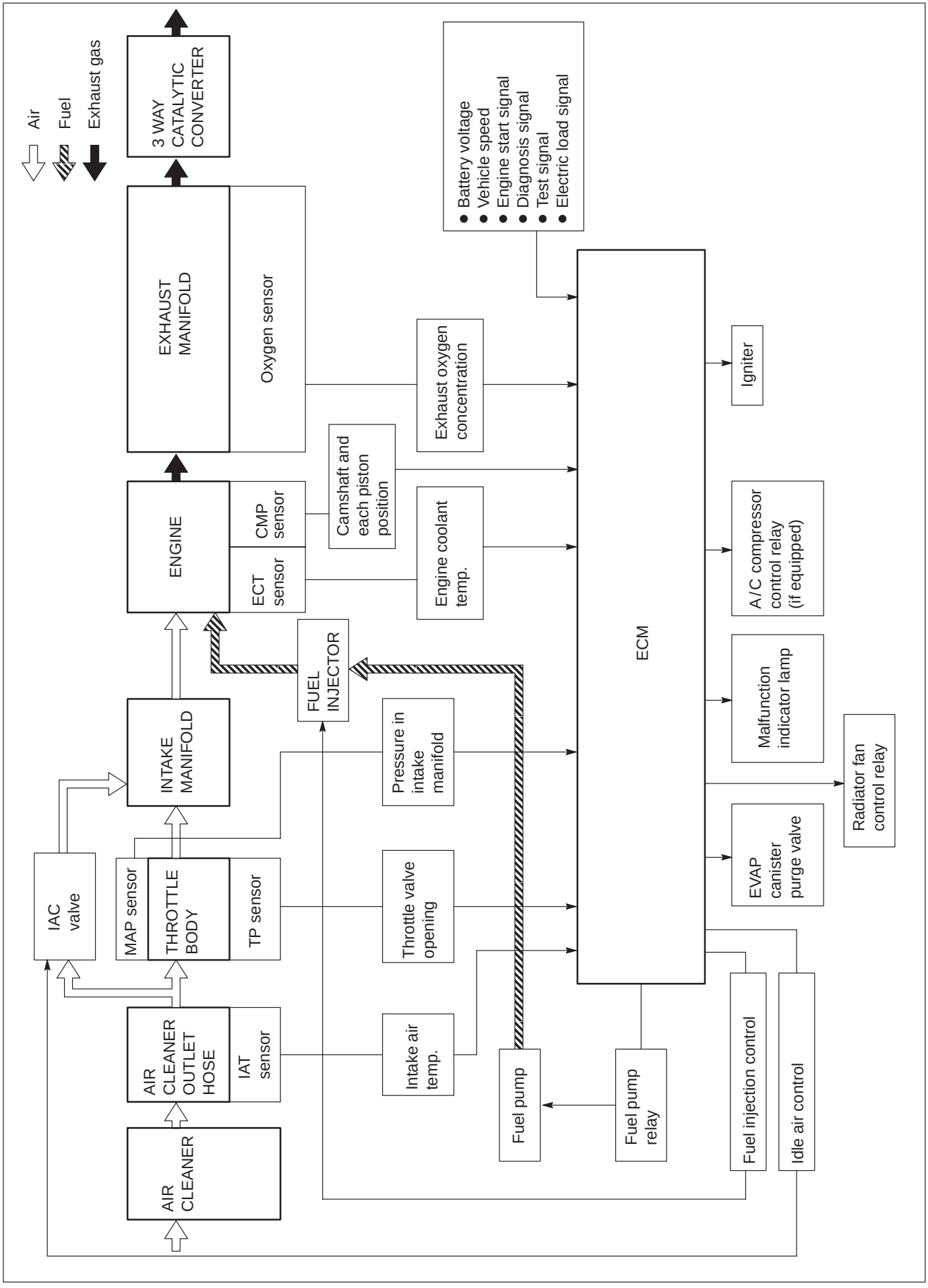
TERMINAL ARRANGEMENT OF ECM COUPLER (VIEWED FROM HARNESS SIDE)



1. Fuel injector No.1
2. Fuel injector No.2
3. Fuel injector No.3
4. Blank
5. Idle air control (IAC) valve
6. EVAP canister purge valve
7. Fuel pump relay
8. Fuel pump
9. Radiator fan control relay
10. Radiator fan motor
11. Malfunction indicator light
12. Monitor connector
13. Igniter
14. Capacitor (noise suppressor)
15. Engine coolant temp. (ECT) sensor with gauge
16. ECT sensor
17. ECT gauge
18. A/C compressor control relay (if equipped)
19. Blank
20. Main relay
21. Starter magnetic switch
22. Camshaft position (CMP) sensor
23. To Combination meter
24. Vehicle speed sensor (VSS) (reed switch)
25. Manifold absolute pressure (MAP) sensor
26. Throttle position (TP) sensor
27. Blank
28. Intake air temp.(IAT) sensor
29. A/C evaporator temp. sensor (if equipped)
30. Oxygen sensor
31. Blank
32. Stop light switch
33. Small light switch
34. Heater blower motor switch
35. Heater blower motor
36. A/C dual pressure switch (if equipped)
37. A/C switch (if equipped)
38. Blank
39. Data link connector

TERMINAL	CIRCUIT
E34-1	Blank
E34-2	IAC valve
E34-3	Blank
E34-4	Blank
E34-5	Blank
E34-6	Blank
E34-7	Test switch terminal
E34-8	Diagnosis switch terminal
E34-9	Electric load signal for blower fan motor
E34-10	Stop light switch (brake pedal switch)
E34-11	Blank
E34-12	Data link connector
E34-13	Engine starter switch (engine starter signal)
E34-14	Blank
E34-15	Blank
E34-16	Blank
E34-17	Duty output terminal
E34-18	Electric load signal for small light switch and rear defogger
E34-19	A/C ON signal from A/C switch (if equipped)
E34-20	Blank
E34-21	Blank
E34-22	Sensor ground
E33-201	Power supply for sensor
E33-202	Blank
E33-203	CMP sensor (+)
E33-204	VSS
E33-205	MAP sensor
E33-206	TP sensor
E33-207	A/C evaporator temp. sensor (with A/C)
E33-208	ECT sensor
E33-209	Blank
E33-210	Blank
E33-211	CMP sensor (–)
E33-212	Blank
E33-213	Oxygen sensor
E33-214	IAT sensor
E33-215	Blank
E33-216	A/C compressor magnet clutch (with A/C)

TERMINAL	CIRCUIT
E32-301	Ground
E32-302	Power source
E32-303	Blank
E32-304	Blank
E32-305	Blank
E32-306	Blank
E32-307	EVAP canister purge valve
E32-308	Blank
E32-309	Blank
E32-310	Igniter
E32-311	Fuel injector No. 3
E32-312	Fuel injector No. 1
E32-313	Ground
E32-314	Power source for backup
E32-315	Power source
E32-316	Blank
E32-317	Malfunction indicator light
E32-318	Fuel pump relay
E32-319	Main relay
E32-320	Radiator fan control relay
E32-321	Blank
E32-322	Blank
E32-323	Blank
E32-324	Blank
E32-325	Fuel injector No. 2
E32-326	Ground

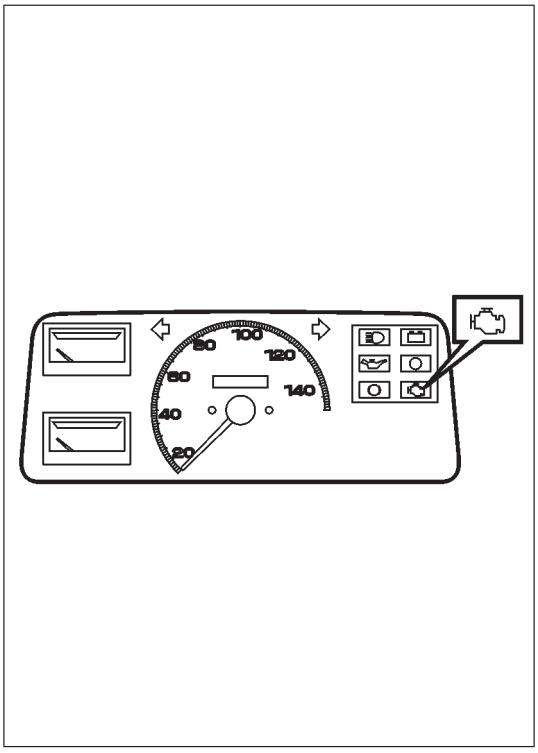

Air
Fuel
Exhaust gas
3 WAY CATALYTIC CONVERTER
EXHAUST MANIFOLD
Oxygen sensor
ENGINE
CMP sensor
ECT sensor
INTAKE MANIFOLD
FUEL INJECTOR
IAC valve
MAP sensor
THROTTLE BODY
TP sensor
AIR CLEANER OUTLET HOSE
IAT sensor
AIR CLEANER
Pressure in intake manifold
Throttle valve opening
Intake air temp.
Fuel pump
Fuel pump relay
Camshaft and each piston position
Engine coolant temp.
Exhaust oxygen concentration
Battery voltage
Vehicle speed
Engine start signal
Diagnosis signal
Test signal
Electric load signal
ECM
Igniter
A/C compressor control relay (if equipped)
Malfunction indicator lamp
EVAP canister purge valve
Radiator fan control relay
Fuel injection control
Idle air control

ENGINE & EMISSION CONTROL INPUT/OUTPUT TABLE

INFORMATION SENSORS (input) / CONTROL DEVICE (output)	CMP sensor	MAP sensor	TP sensor	ECT sensor	IAT sensor	O2 sensor	VSS	Electric load signal	Starter switch	Battery voltage	Stop lamp switch	A/C switch	Diagnosis switch	Test switch
Fuel injector	○	○	○	○	○	○			○	○				
IAC valve	○	○	○	○	○		○	○			○			
Fuel pump relay	○								○					
Igniter	○	○		○	○			○						○
EVAP canister purge valve	○	○	○	○			○							○
MIL	○	○	○	○	○	○	○						○	
Radiator fan relay				○								○		
A/C compressor relay		○		○				○		○		○		

DIAGNOSIS

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.
When diagnosing troubles, be sure to have full understanding of the outline of ON-BOARD DIAGNOSTIC SYSTEM and each item in PRECAUTION IN DIAGNOSING TROUBLE and execute diagnosis according to ENGINE DIAGNOSTIC FLOW TABLE in SECTION 6.



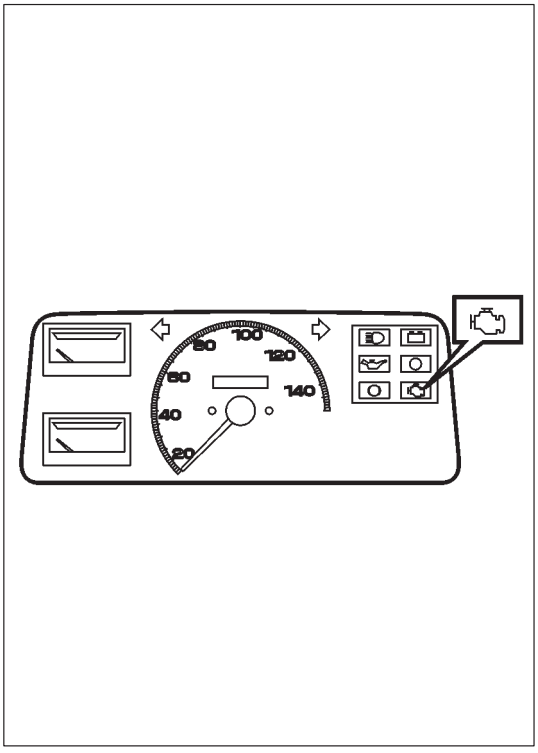
ON-BOARD DIAGNOSTIC SYSTEM

ECM performs on-board diagnosis (self-diagnosis) on the system and operates malfunction indicator lamp as follows.

- Malfunction indicator lamp lights when the ignition switch is turned ON (but the engine at stop) regardless of the condition of engine and emission control system. This is only to check the malfunction indicator lamp bulb and its circuit.
- If the areas monitored by ECM is free from any trouble after the engine start (while engine is running), malfunction indicator lamp turns OFF.
- When ECM detects a trouble which has occurred in the areas,it makes malfunction indicator lamp turn ON while the engine is running to warn the driver of such occurrence of trouble and at the same time it stores the exact trouble area in ECM back-up memory.

PRECAUTIONS IN DIAGNOSING TROUBLES

- Before identifying diagnostic trouble code, don't disconnect couplers from ECM, battery cable from battery, ECM ground wire harness from engine. Such disconnection will erase memorized trouble in ECM memory.
- 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 known-good ECM.
  – Resistance value of all relays, actuators is as specified respectively.
  – TP sensor and MAP sensor are in good condition and none of power circuits of these sensors is shorted to ground.



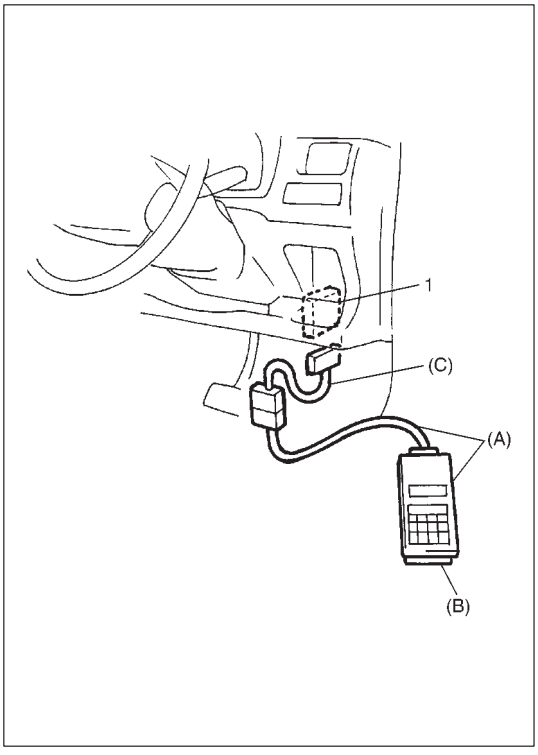
MALFUNCTION INDICATOR LAMP (MIL) CHECK

1) Turn ON ignition switch (but engine at stop) and check that malfunction indicator lamp lights up.
   If lamp does not light up, go to DIAGNOSTIC FLOW TABLE A-1 in this section.
   If lamp flashes, go to DIAGNOSTIC FLOW TABLE A-2 in this section.
2) Start engine and check that malfunction indicator lamp turns OFF.
   If lamp remains ON, go to DTC CHECK NOT USING SUZUKI SCAN TOOL in this section.

DIAGNOSTIC TROUBLE CODE (DTC) CHECK

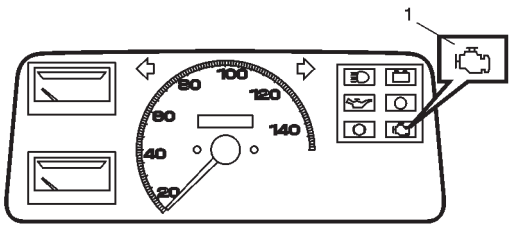
[Using SUZUKI scan tool]

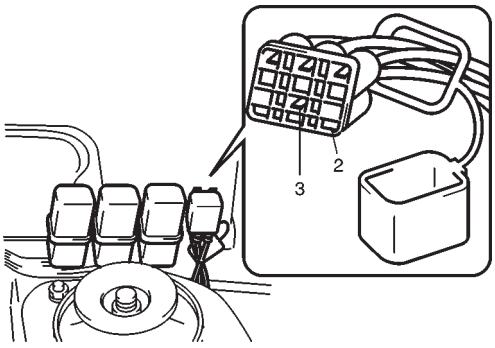
1) Check malfunction indicator lamp referring to MALFUNCTION INDICATOR LAMP (MIL) CHECK in this section.



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

   Special Tool
   (A): 09931-76011 (SUZUKI scan tool)
   (B): Mass storage cartridge
   (C): 09931-76030 (16/14-pin DLC adapter)
4) Turn ignition switch ON.
5) Read DTC according to instructions displayed on SUZUKI scan tool and print it or write it down. Refer to SUZUKI scan tool operator's manual for further details.
   If communication between SUZUKI scan tool and ECM is not possible, check if SUZUKI scan tool is communicable by connecting it to ECM in another vehicle. If communication is possible in this case, SUZUKI 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.
6) After completing the check, turn ignition switch OFF and disconnect SUZUKI scan tool from data link connector (DLC).



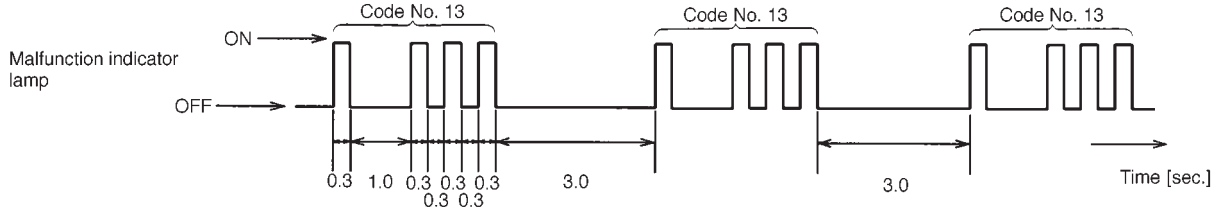


[Not using SUZUKI scan tool]

1) Check malfunction indicator lamp (1) referring to MALFUNCTION INDICATOR LAMP (MIL) CHECK in this section.
2) Using service wire, ground diagnosis switch terminal in monitor coupler (2).
3) Read DTC from flashing pattern of malfunction indicator lamp. Refer to DTC TABLE.
   If lamp remains ON, go to Table A-3 in this section.

   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 (3) 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 ignition switch OFF and disconnect service wire from monitor connector.

EXAMPLE: When throttle position sensor is defective (Code No. 13)



DIAGNOSTIC TROUBLE CODE (DTC) CLEARANCE

[Using SUZUKI scan tool]

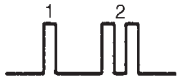
1) Turn ignition switch OFF.
2) Connect SUZUKI scan tool to data link connector (DLC) in the same manner as when making this connection for DTC check.
3) Turn ignition switch ON.
4) Erase DTC according to instructions displayed on SUZUKI scan tool.
   Refer to SUZUKI scan tool operator's manual for further details.
5) After completing the clearance, turn ignition switch OFF and disconnect SUZUKI scan tool from data link connector (DLC).

[Not using SUZUKI scan tool]

1) Turn OFF ignition switch.
2) Disconnect battery negative cable for specified time below to erase diagnostic trouble code stored in ECM memory and re-connect it.
   Time required to erase DTC:

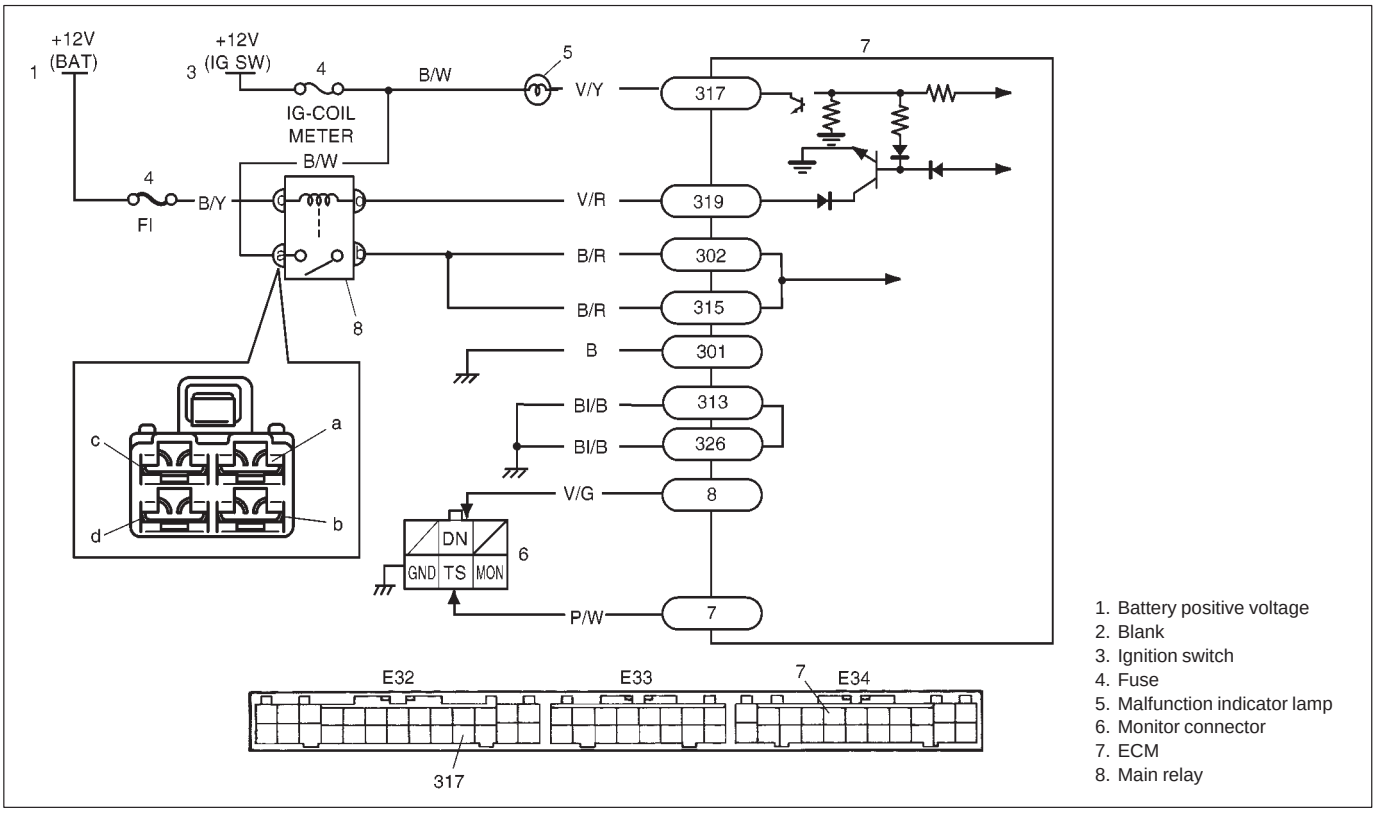
Ambient temperature	Time to cut power to ECM
Over 0°C (32°F)	30 sec. or longer
Under 0°C (32°F)	Not specifiable. Select a place with higher than 0°C (32°F) temperature.

DIAGNOSTIC TROUBLE CODE (DTC) TABLE

DIAGNOSTIC TROUBLE CODE NO.		MALFUNCTION INDICATOR LAMP FLASHING PATTERN	DIAGNOSTIC ITEM	DIAGNOSIS
SUZUKI SCAN TOOL	MIL			
P0105	11		Manifold absolute pressure sensor	Diagnose trouble according to DIAGNOSTIC FLOW TABLE corresponding to each code No.
P0120	13		Throttle position sensor	
P0130	14		Oxygen sensor	
P0340	15		Camshaft position sensor	
P0500	16		Vehicle speed sensor	
P0110	18		Intake air temperature sensor	
P0115	19		Engine coolant temperature sensor	
—	12		Normal	This code appears when none of the other codes (above codes) are identified.

A-1 MALFUNCTION INDICATOR LAMP CIRCUIT CHECK

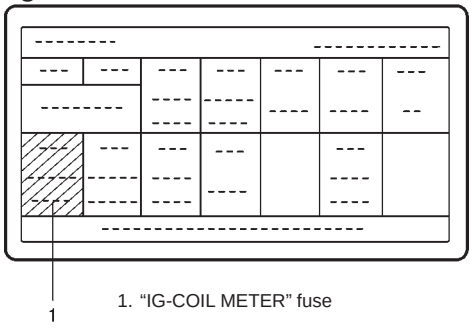
(MALFUNCTION INDICATOR LAMP DOES NOT LIGHT AT IGNITION SWITCH ON.)



1. Battery positive voltage
2. Blank
3. Ignition switch
4. Fuse
5. Malfunction indicator lamp
6. Monitor connector
7. ECM
8. Main relay

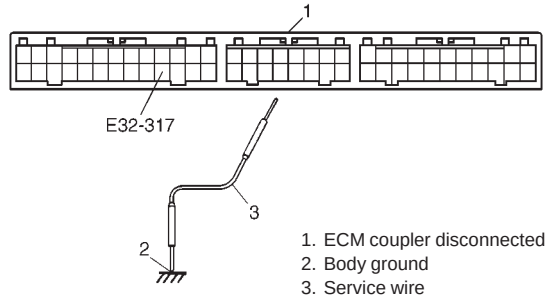
STEP	ACTION	YES	NO
1	Test switch terminal circuit check: 1) With the ignition switch ON position, check voltage between E34-7 terminal of ECM coupler and ground. Is voltage 4-5V?	Go to Step 2.	"P/W" wire (test switch terminal) shorted to ground circuit. If OK, substitute a known good ECM and recheck.
2	MIL bulb and circuit check: 1) Using service wire, ground E32-317 terminal of ECM coupler. Does MIL turn ON at ignition ON position?	Go to TABLE A-4.	MIL bulb burned out. "IG-COIL METER" fuse(s) blown. Ignition switch malfunction. "V/Y" wire open. "B/W" wire open.

Fig. for STEP 1



1. "IG-COIL METER" fuse

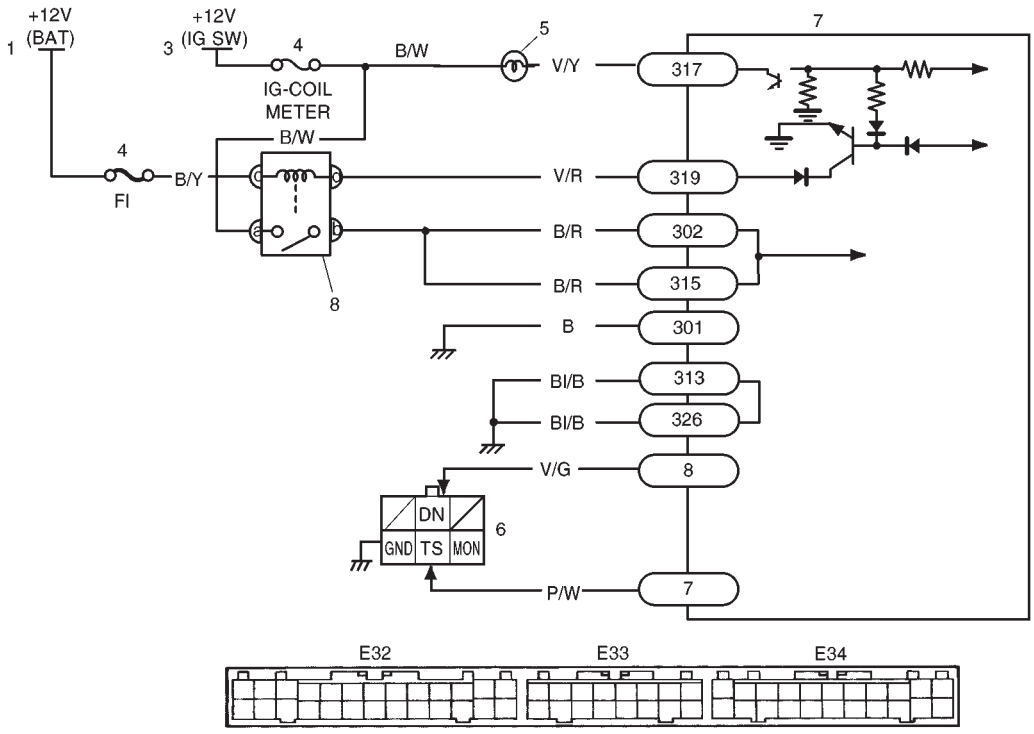
Fig. for STEP 2



1. ECM coupler disconnected
2. Body ground
3. Service wire

A-2 MALFUNCTION INDICATOR LAMP CIRCUIT CHECK

(MALFUNCTION INDICATOR LAMP FLASHES AT IGNITION SWITCH ON.)

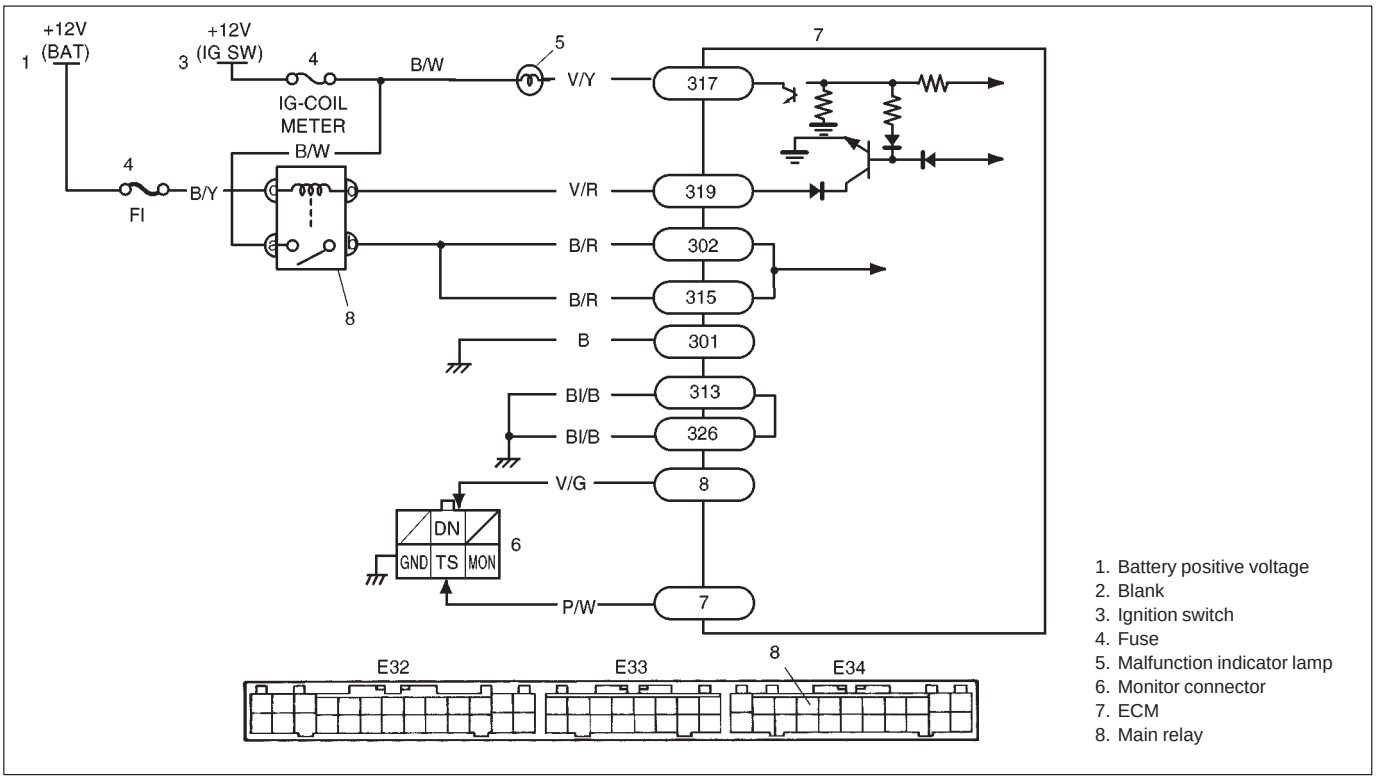


1. Battery positive voltage
2. Blank
3. Ignition switch
4. Fuse
5. Malfunction indicator lamp
6. Monitor connector
7. ECM
8. Main relay

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.	“V/G” circuit shorted to ground. If circuit is OK, substitute a known-good ECM and recheck.

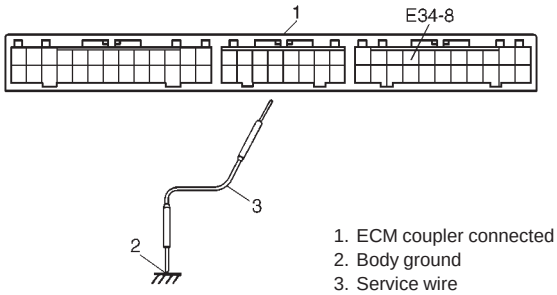
A-3 MALFUNCTION INDICATOR LAMP CIRCUIT CHECK

(MALFUNCTION INDICATOR LAMP DOES NOT FLASH OR JUST REMAINS ON EVEN WITH GROUNDING DIAGNOSIS SWITCH TERMINAL.)



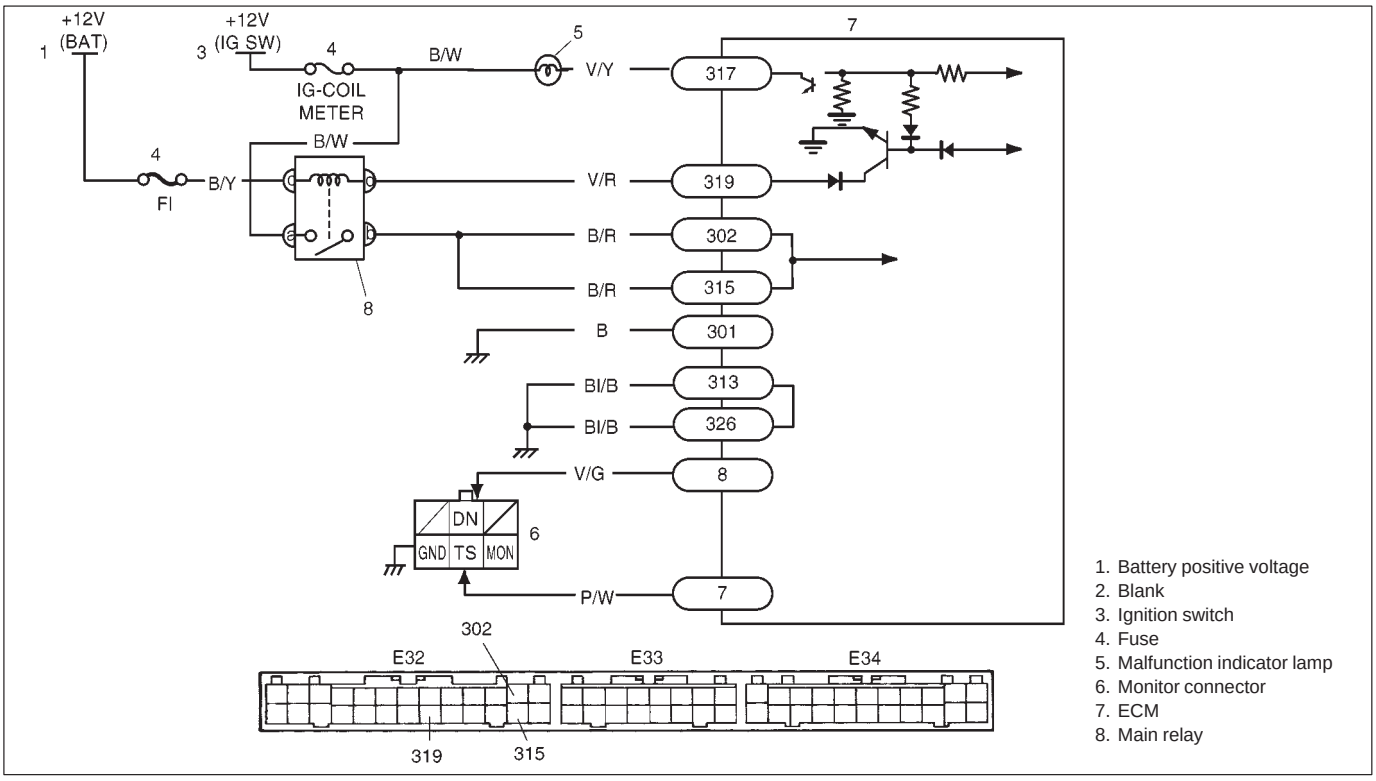
STEP	ACTION	YES	NO
1	MIL Circuit Check 1) Turn ignition switch OFF and disconnect connectors from ECM. Does MIL turn ON at ignition switch ON?	"V/Y" circuit shorted to ground.	Go to Step 2.
2	ECM Connection Check 1) Turn ignition switch OFF. Is connector (E34-8 connection) connected to ECM properly?	Go to Step 3.	Poor connector connection.
3	Diag. Switch Terminal Circuit Check 1) Connect connectors to ECM. 2) Using service wire, ground E34-8 terminal with connectors connected to ECM. 3) Turn ignition switch ON. Does MIL flash?	"V/G" or "Bl/B" circuit open.	Substitute a known-good ECM and recheck.

Fig. for STEP 3



A-4 ECM POWER AND GROUND CIRCUIT CHECK (Page 1 of 2)

(MALFUNCTION INDICATOR LAMP DOES NOT LIGHT AT IGNITION SWITCH ON AND ENGINE DOES NOT START THOUGH IT IS CRANKED UP.)

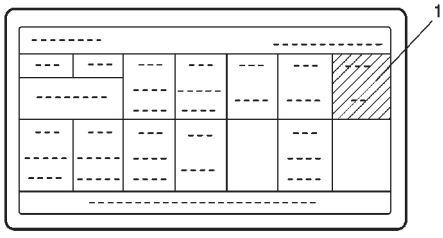


STEP	ACTION	YES	NO
1	Main Relay Operating Sound Check Is operating sound of main relay heard at ignition switch ON?	Go to Step 5.	Go to Step 2.
2	Fuse Check Is main “FI” fuse in good condition?	Go to Step 3.	Check for short in circuits connected to this fuse.
3	Main Relay Check 1) Turn OFF ignition switch and remove main relay. 2) Check for proper connection to main relay at terminal “a” and “b”. 3) If OK, check main relay for resistance and operation referring to MAIN RELAY INSPECTION in this section. Is check result satisfactory?	Go to Step 4.	Replace main relay.
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 302, 315 and 319 of E32. 3) If OK, then measure voltage between terminal E32-319 and ground with ignition switch ON. Is each voltage 10 – 14 V?	Go to Step 5.	“V/R” or “B/Y” circuit open.

A-4 ECM POWER AND GROUND CIRCUIT CHECK (Page 2 of 2)

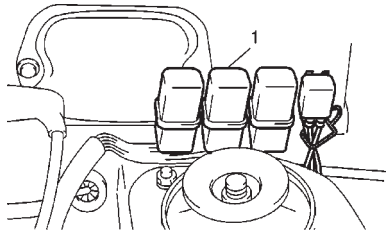
STEP	ACTION	YES	NO
5	ECM Power Circuit Check 1) Using service wire, ground terminal E32-319 and measure voltage between terminal E32-302 (E32-315) and ground at ignition switch ON. Is it 10 – 14 V?	Check ground circuits "Bl/B" and "B" for open. If OK, then substitute a known-good ECM and re-check.	Go to Step 6.
6	Is operating sound of main relay heard in Step 1?	Go to Step 7.	"B/Y" or "B/R" wire open.
7	Main Relay Check 1) Check main relay according to procedure in Step 3. Is main relay in good condition?	"B/Y" or "B/R" wire open.	Replace main relay.

Fig. for STEP 2



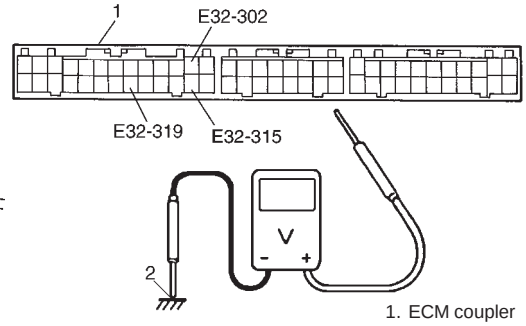
1. "FI" fuse

Fig. for STEP 3



1. Main relay

Fig. for STEP 4

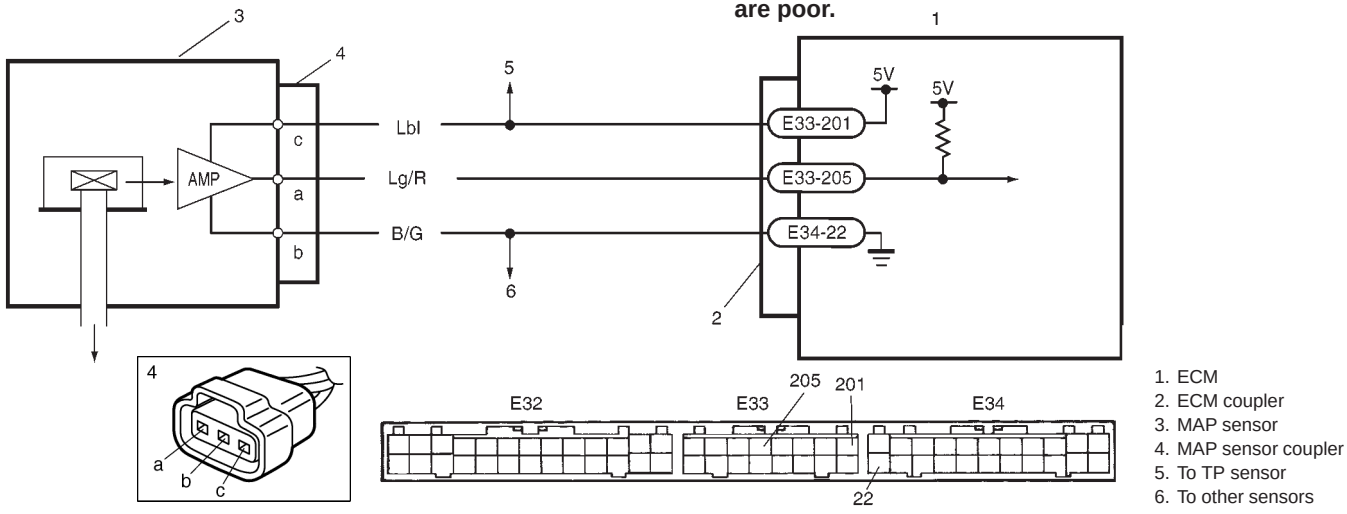


1. ECM coupler
2. Body ground

CODE NO.11 (P0105) MAP SENSOR CIRCUIT

(SIGNAL VOLTAGE LOW, HIGH OR PERFORMANCE PROBLEM)

NOTE:
When Code No.11 (P0105), 13 (P0120), 18 (P0110) and 19 (P0115) are indicated together, it is possible that "B/G" wire is open or "E34-22" terminal connections are poor.



1. ECM
2. ECM coupler
3. MAP sensor
4. MAP sensor coupler
5. To TP sensor
6. To other sensors

STEP	ACTION	YES	NO
1	1) Disconnect MAP sensor coupler with ignition switch OFF. 2) Check voltage between "c" wire terminal of MAP sensor coupler and ground with ignition switch ON. Is voltage about 4 – 5 V?	Go to Step 2.	● "Lbl" wire open or short. ● Poor "E33-201" connection. If wire and connection are OK, substitute a known-good ECM and recheck.
2	1) Check voltage between "a" wire terminal of MAP sensor coupler and ground with ignition switch ON. Is voltage about 4 – 5 V?	Go to Step 3.	● "Lg/R" wire open or short. ● Poor "E33-205" connection. If wire and connection are OK, substitute a known-good ECM and recheck.
3	1) Connect "a" and "b" wire terminals of MAP sensor coupler using service wire. 2) Check voltage between "Lg/R" wire terminal of MAP sensor coupler and ground. Is voltage about 0 V?	Go to Step 4.	● "B/G" wire open. ● Poor "E34-22" connection. If wire and connection are OK, substitute a known-good ECM and recheck.
4	1) Remove MAP sensor. 2) Visually inspect air pressure inlet passage of MAP sensor for clogging. Is there any blockage?	Clean air passage or replace as necessary.	Go to Step 5.
5	1) Perform MAP SENSOR INSPECTION in this section. Is MAP sensor in good condition?	Poor connection of MAP sensor coupler terminals. If connection is OK, substitute a known-good ECM and recheck.	Faulty MAP sensor.

Fig. for STEP 1

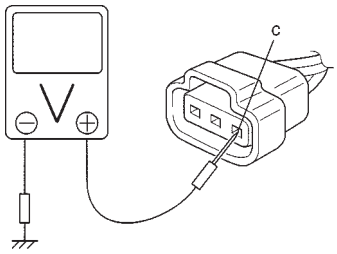


Fig. for STEP 2

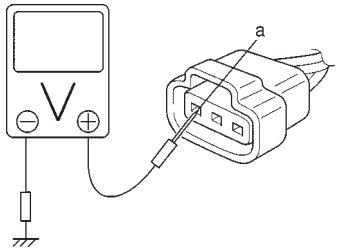
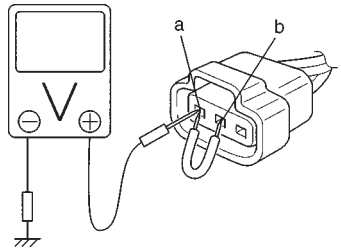


Fig. for STEP 3

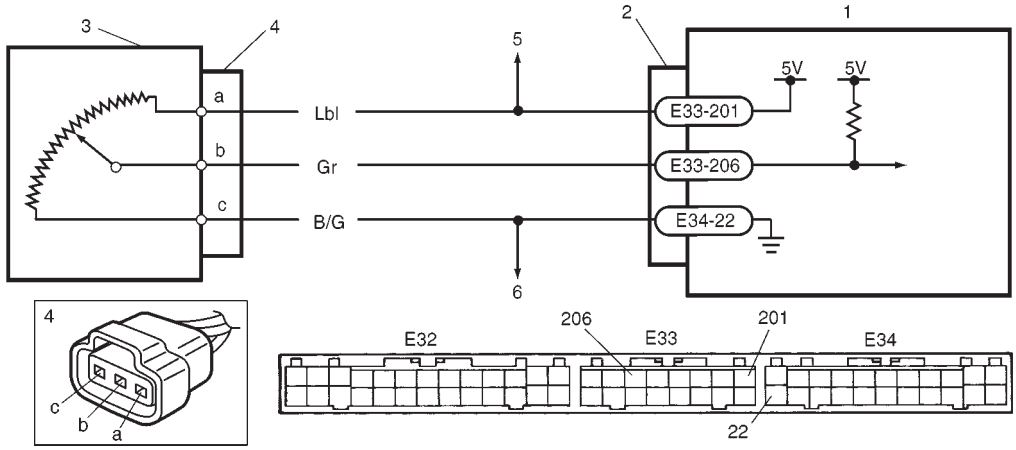


NOTE:
Upon completion of inspection and repair work, perform DTC Confirmation Procedure, referring to page 6E1-30 to confirm that the trouble has been corrected.

CODE NO.13 (P0120) TP SENSOR CIRCUIT

(SIGNAL VOLTAGE HIGH OR LOW)

NOTE:
When Code No.11 (P0105), 13 (P0120), 18 (P0110) and 19 (P0115) are indicated together, it is possible that "B/G" wire is open or "E34-22" terminal connection are poor.



1. ECM
2. ECM coupler
3. TP sensor
4. TP sensor coupler
5. To MAP sensor
6. To other sensors

STEP	ACTION	YES	NO
1	1) Disconnect TP sensor coupler with ignition switch OFF. 2) Check voltage between "a" wire terminal of TP sensor coupler and ground with ignition switch ON. Is voltage about 4 – 5 V?	Go to Step 2.	● "Lbl" wire open or short. ● Poor "E33-201" connection. If wire and connection are OK, substitute a known-good ECM and recheck.
2	1) Check voltage between "b" wire terminal of TP sensor coupler and ground with ignition switch ON. Is voltage about 4 – 5 V?	Go to Step 3.	● "Gr" wire open or short. ● Poor "E33-206" connection. If wire and connection are OK, substitute a known-good ECM and recheck.
3	1) Connect "b" and "c" wire terminal of TP sensor coupler using service wire. 2) Check voltage between "b" wire terminal of TP sensor coupler and ground with ignition switch ON. Is voltage about 0 V?	Go to Step 4.	● "B/G" wire open. ● Poor "E34-22" connection. If wire and connection are OK, substitute a known-good ECM and recheck.
4	1) Perform TP SENSOR INSPECTION in this section. Is TP sensor in good condition?	Poor connection of TP sensor coupler terminals. If connection is OK, substitute a known-good ECM and recheck.	Faulty TP sensor.

Fig. for STEP 1

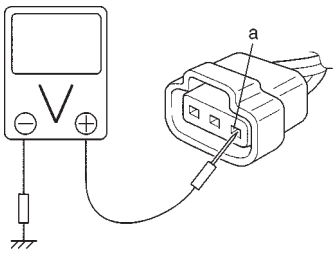


Fig. for STEP 2

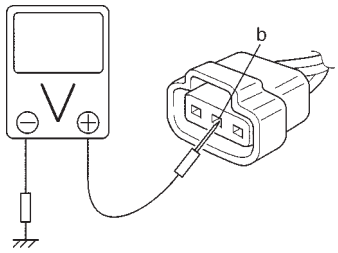
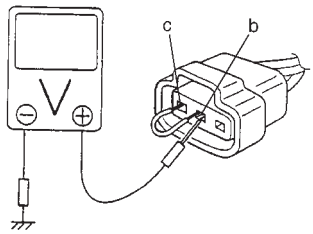


Fig. for STEP 3

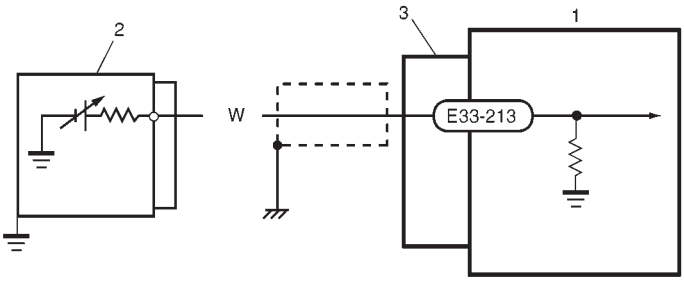


NOTE:

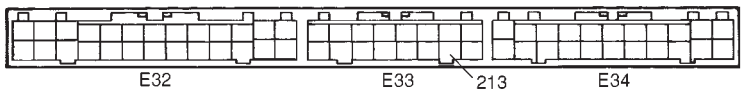
Upon completion of inspection and repair work, perform DTC Confirmation Procedure, referring to page 6E1-30 to confirm that the trouble has been corrected.

CODE NO.14 (P0130) OXYGEN SENSOR CIRCUIT

(SIGNAL VOLTAGE DOESN'T CHANGE)



1. ECM
2. Oxygen sensor
3. Coupler

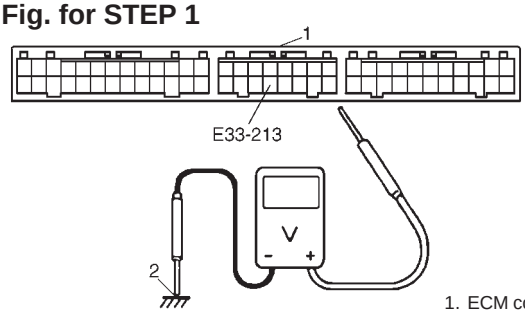


NOTE:

- **Before diagnosing trouble according to flow table given below, check to make sure that following system and parts other than Electronic Fuel Injection system are in good condition.**
  - **Air cleaner (clogged)**
  - **Vacuum leaks (air inhaling)**
  - **Spark plugs (contamination, gap)**
  - **High-tension cords (crack, deterioration)**
  - **Ignition timing**
  - **Engine compression**
  - **Any other system and parts which might affect A/F mixture or combustion.**
- **If code No.14 (P0130) and another code No. are indicated together, the latter has priority. Therefore, check and correct what is represented by that code No. first and then proceed to the following check.**
- **Be sure to use a voltmeter with high impedance (MΩ/V minimum) or digital type voltmeter for accurate measurement.**

STEP	ACTION	YES	NO
1	1) Warm up engine to normal operating temperature. 2) Connect voltmeter between E33-213 terminal of ECM coupler and body ground. 3) Maintain engine speed at 2000 rpm and after 60 seconds, check voltmeter. Does the voltage deflect between above and below 0.45 V repeatedly?	Oxygen sensor and its circuit (closed loop system, A/F ratio feed back system) are in good condition. Intermittent trouble or faulty ECM. Recheck, referring to INTERMITTENT AND POOR CONNECTION in SECTION 0A.	Go to Step 2.
2	Does the voltage remain unchanged at 0.45 V above?	"W" circuit shorted to power circuit or rich A/F mixture. If circuit is OK, check MAP sensor, ECT sensor, fuel pressure, injectors and their circuit. If all above are OK, check ECM and its circuit.	Go to Step 3.
3	1) Maintain engine speed at 2000 rpm for 60 seconds. 2) Check voltmeter while repeating racing engine. Does it indicate 0.45 V or more even once?	Poor E33-213 connection or lean A/F mixture. If connection is OK, check MAP sensor, ECT sensor, fuel pressure, injectors and their circuit. If all above are OK, check ECM and its circuit.	"W" circuit open/short or oxygen sensor malfunction. If wire and connection are OK, replace oxygen sensor and recheck.

Fig. for STEP 1



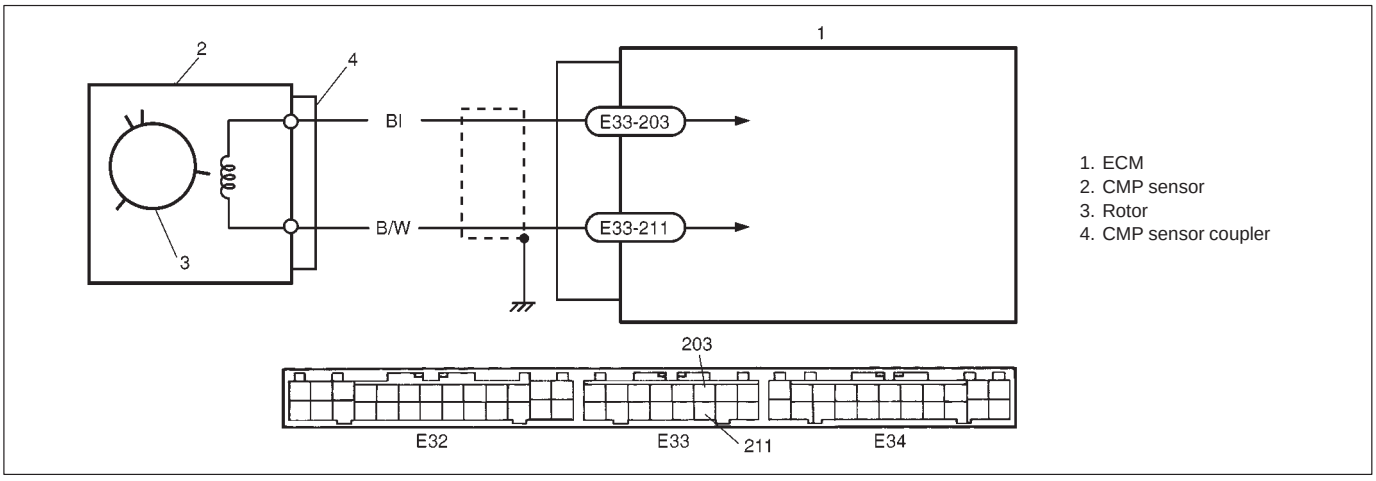
1. ECM coupler connected
2. Body ground

NOTE:

Upon completion of inspection and repair work, perform DTC Confirmation Procedure, referring to page 6E1-30 to confirm that the trouble has been corrected.

CODE NO.15 (P0340) CMP SENSOR CIRCUIT

(SENSOR SIGNAL NOT INPUTTED FOR 2 SECONDS AT ENGINE CRANKING)

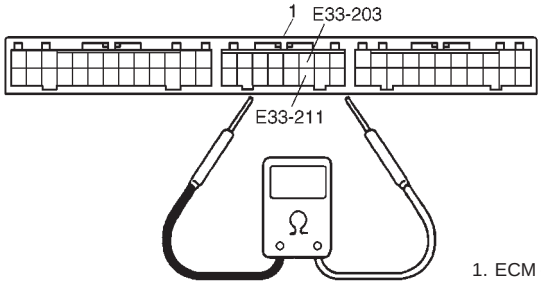


1. ECM
2. CMP sensor
3. Rotor
4. CMP sensor coupler

NOTE:
If starter circuit is open (i.e., start signal circuit is OK but starter fails to run), this DTC is stored in memory at starter switch ON, even through CMP sensor is in good condition.
When starter motor fails to run and this DTC appears, check starter circuit first.

STEP	ACTION	YES	NO
1	1) Disconnect couplers from ECM. 2) Measure resistance between "E33-203" and "E33-211" terminals of ECM coupler. CMP sensor resistance: 185 – 275 Ω at –10 – 50 °C (14 – 122 °F) 3) Measure resistance between "E33-203" terminal of ECM coupler and ground. Insulation resistance: 1 MΩ or more Were measured resistance values in above 2) and 3) as specified?	Go to Step 2.	● "Bl" wire open or short. ● "B/W" wire open or short. ● Poor terminal connection of CMP sensor coupler. If wire and connection are OK, replace CMP sensor.
2	1) Check CMP sensor referring to Section 6F. Is it in good condition?	● Poor "E33-203" or "E33-211" terminal connection of ECM coupler. If connection is OK, substitute a known-good ECM and recheck.	Faulty CMP sensor.

Fig. for STEP 1

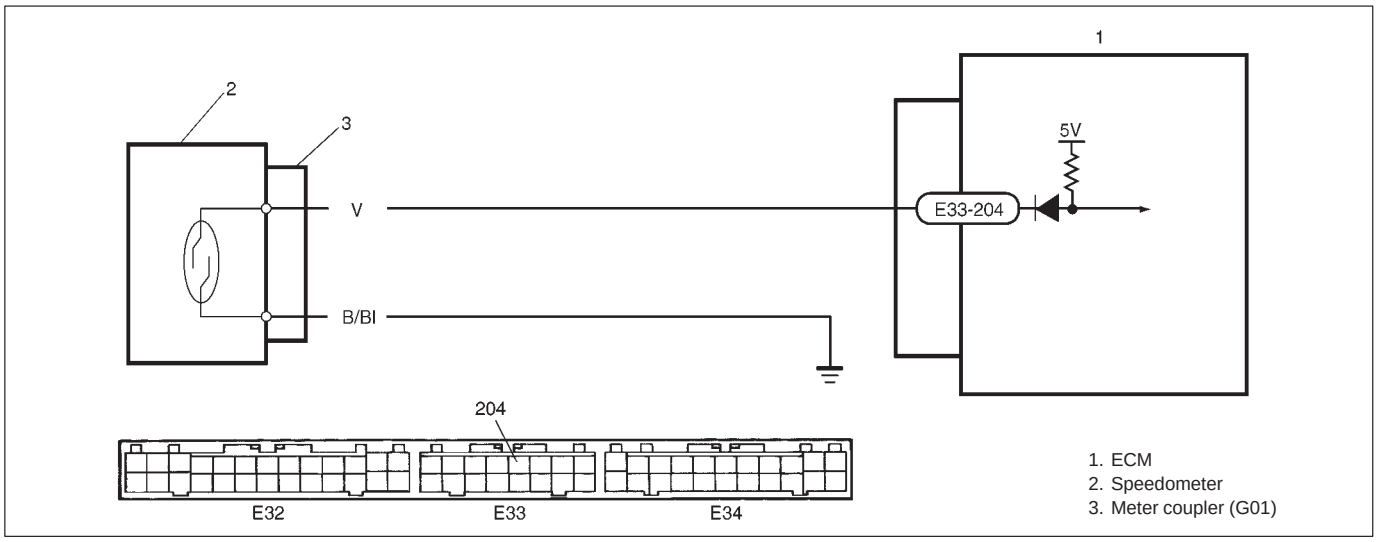


1. ECM coupler disconnected

NOTE:
Upon completion of inspection and repair work, perform DTC Confirmation Procedure, referring to page 6E1-30 to confirm that the trouble has been corrected.

CODE NO.16 (P0500) VSS CIRCUIT

(VSS SIGNAL NOT INPUTTED ALTHOUGH FUEL IS KEPT CUT AT LOWER THAN 4000 R/MIN. FOR LONGER THAN 4 SECONDS)



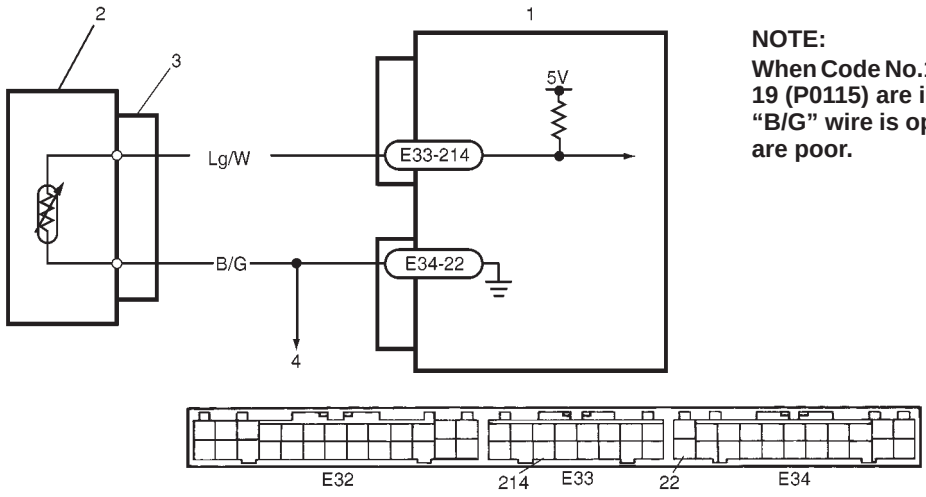
STEP	ACTION	YES	NO
1	Does speedometer indicate vehicle speed?	● "V" wire open. ● Poor "E33–204" connection. If OK, substitute a known-good ECM and recheck.	Broken speed meter cable. If if it OK, go to Step 2.
2	1) Disconnect ECM coupler with ignition switch at OFF position. 2) Connect ohmmeter between E33-204 terminal of ECM coupler and body ground. 3) Hoist front end of car and lock front right tire. 4) Turn front left tire slowly. Does ohmmeter indicator deflect between 0 and ∞ a few times while tire is turned one revolution?	Poor E33-204 connection. If connection is OK, intermittent trouble or faulty ECM. Recheck referring to INTERMITTENT TROUBLE.	Go to Step 3.
3	1) Remove combination meter. 2) Check speed sensor referring to VEHICLE SPEED SENSOR (VSS) INSPECTION under ON-VEHICLE SERVICE. Is it good condition?	Faulty speedometer.	"V" wire open, "B/BI" wire open, poor coupler-to-meter connection or poor "B/BI" wire ground. If OK, substitute a known-good ECM and recheck.

NOTE:

Upon completion of inspection and repair work, perform DTC Confirmation Procedure, referring to page 6E1-30 to confirm that the trouble has been corrected.

CODE NO.18 (P0110) IAT SENSOR CIRCUIT

(SIGNAL VOLTAGE HIGH OR LOW)

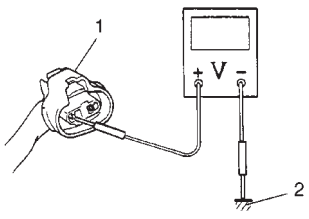


NOTE:
When Code No.11 (P0105), 13 (P0120), 18 (P0110) and 19 (P0115) are indicated together, it is possible that "B/G" wire is open or "C52-9" terminal connections are poor.

1. ECM
2. IAT sensor
3. IAT sensor coupler
4. To other sensors

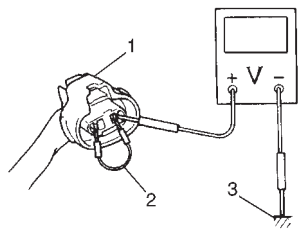
STEP	ACTION	YES	NO
1	1) Disconnect IAT sensor coupler with ignition switch OFF. 2) Check voltage between "Lg/W" wire terminal of IAT sensor coupler and ground with ignition switch ON. Is voltage about 4 – 5 V?	Go to Step 2.	● "Lg/W" wire open or short. ● Poor "E33-214" connection.
2	1) Connect IAT sensor coupler terminals using service wire. 2) Check voltage between "Lg/W" wire terminal of IAT sensor coupler and ground with ignition switch ON. Is voltage 0.15 V or less?	Go to Step 3.	"B/G" wire open or poor "E34-22" connection. If wire and connection are OK, substitute a known-good ECM and recheck.
3	1) Perform IAT SENSOR INSPECTION in this section. Is IAT sensor in good condition?	Poor connection of IAT sensor coupler terminals. If connection is OK, substitute a known-good ECM and recheck.	Faulty IAT sensor.

Fig. for STEP 1



1. IAT sensor coupler disconnected
2. Engine ground

Fig. for STEP 2

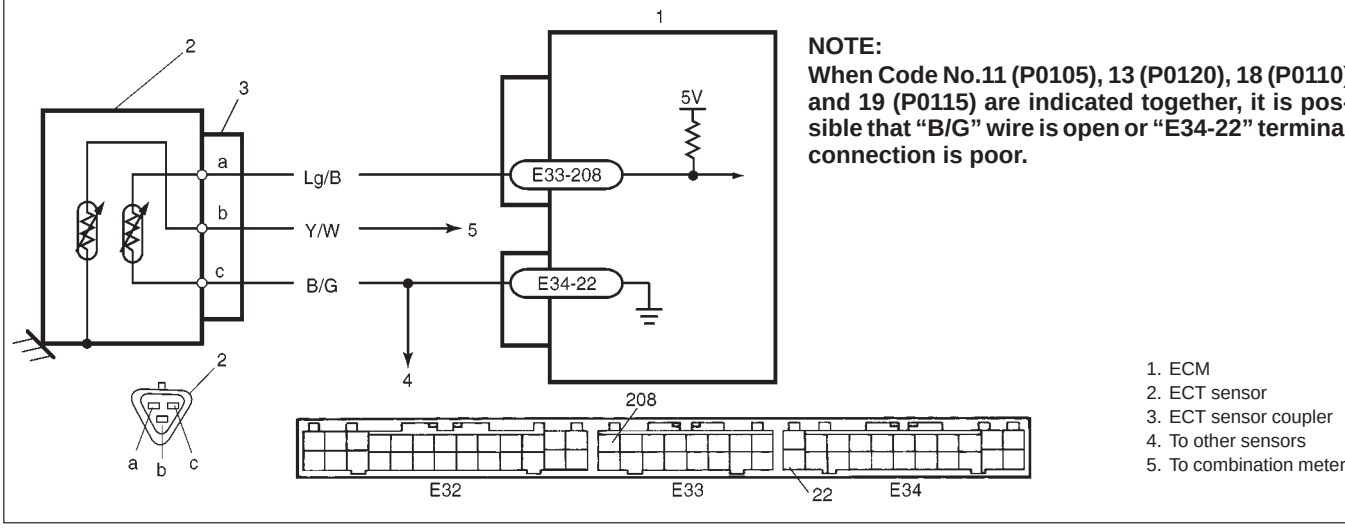


1. IAT sensor coupler disconnected
2. Service wire
3. Engine ground

NOTE:
Upon completion of inspection and repair work, perform DTC Confirmation Procedure, referring to page 6E1-30 to confirm that the trouble has been corrected.

CODE NO.19 (P0115) ECT SENSOR CIRCUIT

(SIGNAL VOLTAGE HIGH OR LOW)

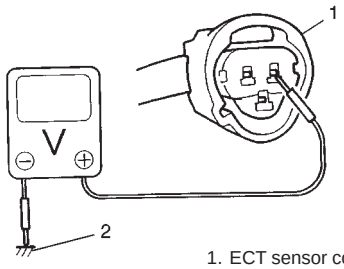


NOTE:
When Code No.11 (P0105), 13 (P0120), 18 (P0110) and 19 (P0115) are indicated together, it is possible that "B/G" wire is open or "E34-22" terminal connection is poor.

1. ECM
2. ECT sensor
3. ECT sensor coupler
4. To other sensors
5. To combination meter

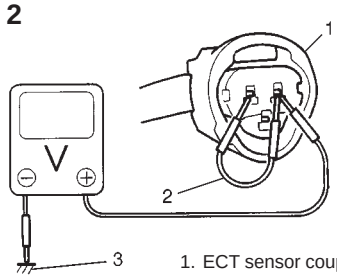
STEP	ACTION	YES	NO
1	1) Disconnect ECT sensor coupler with ignition switch OFF. 2) Check voltage between "Lg/B" wire terminal of ECT sensor coupler and ground with ignition switch ON. Is voltage about 4 – 5 V?	Go to Step 2.	● "Lg/W" wire open or short. ● Poor "C52-8" connection.
2	1) Connect ECT sensor couple terminals using service wire. 2) Check voltage between "Lg/B" wire terminal of ECT sensor coupler and ground with ignition switch ON. Is voltage 0.15 V or less?	Go to Step 3.	"B/G" wire open or poor "C51-22" connection. If wire and connection are OK, substitute a known-good ECM and recheck.
3	1) Perform ECT SENSOR INSPECTION in this section. Is ECT sensor in good condition?	Poor connection of ECT sensor coupler terminals. If connection is OK, substitute a known-good ECM and recheck.	Faulty ECT sensor.

Fig. for STEP 1



1. ECT sensor coupler disconnected
2. Engine ground

Fig. for STEP 2



1. ECT sensor coupler disconnected
2. Service wire
3. Engine ground

NOTE:

Upon completion of inspection and repair work, perform DTC Confirmation Procedure, referring to page 6E1-30 to confirm that the trouble has been corrected.

DIAGNOSTIC TROUBLE CODE (DTC) CONFIRMATION PROCEDURE

WARNING:
- **When performing a road test, select a safe place where there is not 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) Clear DTC stored in ECM memory referring to DTC CLEARANCE in this section.
2) Perform DTC confirmation test under the following conditions.
3) Check DTC referring to DTC CHECK in this section.

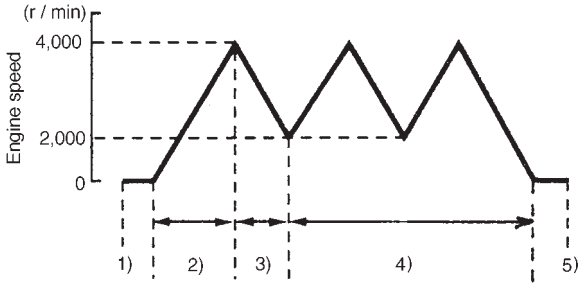
Test Condition for Code No. 13 (P0120), 18 (P0110), 19 (P0115)

Turn ignition switch ON.

Test Condition for Code No. 15 (P0340)

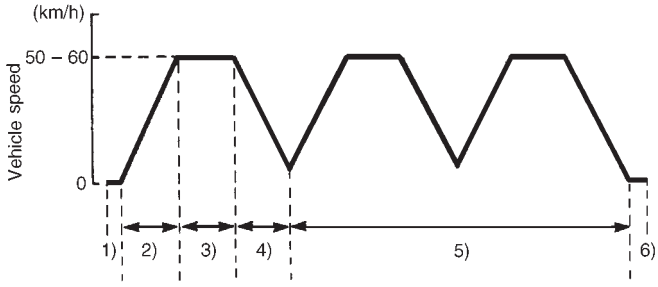
Crank engine for 3 sec.

Driving Test Condition for Code No. 16 (P0500)



1) Start engine and warm up engine to normal operating temperature.
2) Increase engine speed to 4,000 r/min. in 3rd gear.
3) Release accelerator pedal and with engine brake applied, keep vehicle coasting for 5 to 8 seconds till engine speed reaches 2,000 r/min.
4) Repeat above steps 2) and 3) 3 times or more.
5) Stop vehicle.

Driving Test Condition for Code No. 14 (P0130)



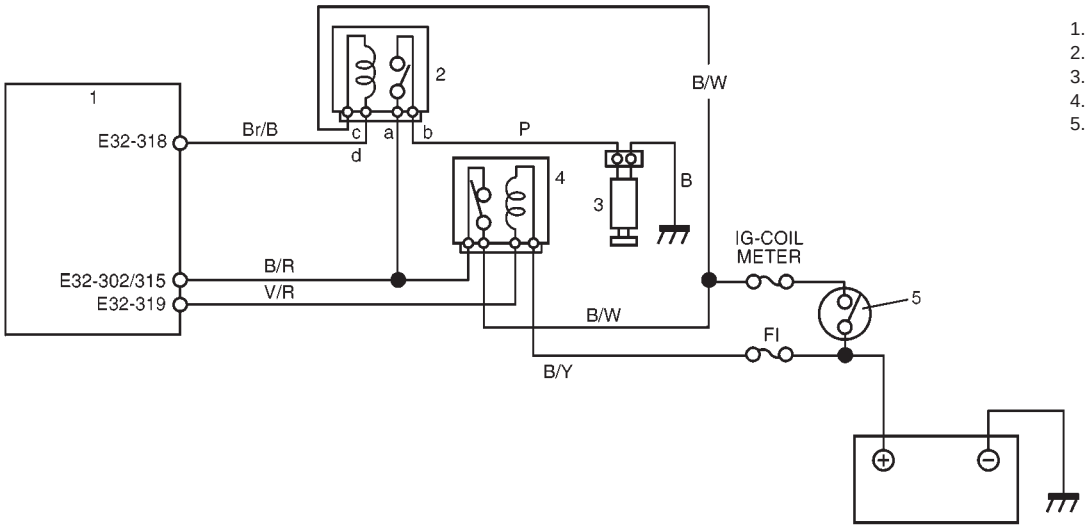
1) Start engine and warm up engine to normal operating temperature.
2) Increase vehicle speed to 31 to 37 mile/h (50 – 60 km/h) in 5th gear.
3) Keep driving at above vehicle speed for 25 to 30 seconds.
4) Release accelerator pedal and with engine brake applied, decrease vehicle speed to about 18 mile/h (30 km/h).
5) Repeat above steps 2) to 4) 3 times or more.
6) Stop vehicle.

NOTE:
If the above driving test can not be performed, check oxygen sensor for voltage referring to Step 1 and 2 of Code No. 14 (P0130) Diag. Flow Table and confirm that oxygen sensor and its circuit (Closed Loop System) are in good condition.

Test Condition for Code No. 11 (P0105)

1) Start engine.
2) Maintain engine speed at 2000RPM for 5 seconds.

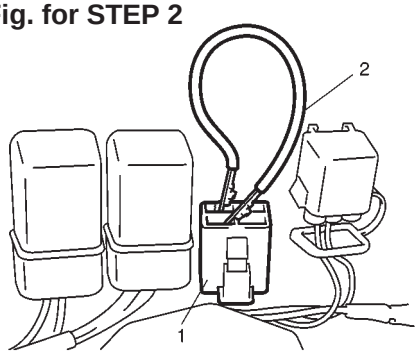
B-1 FUEL PUMP AND ITS CIRCUIT CHECK



1. ECM
2. Fuel pump relay
3. Fuel pump
4. Main relay
5. Ignition switch

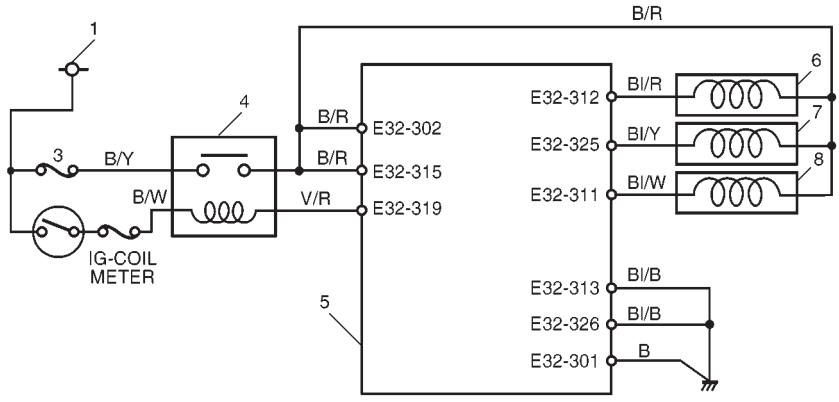
STEP	ACTION	YES	NO
1	Is fuel pump heard to operate 2 seconds after ignition switch ON?	Fuel pump and its circuit are in good condition.	Go to Step 2.
2	1) Remove fuel pump relay from relay box with ignition switch OFF. 2) Connect two terminals (a and b) of relay connector as shown in figure using service wire. Is fuel pump heard to operate with ignition switch ON?	Go to Step 3.	"B/R" or "P" wire open, poor fuel pump relay-to-coupler connection or faulty fuel pump.
3	1) Check fuel pump relay, referring to p.6E1-68. Is it in good condition?	Poor fuel pump relay-to-coupler connection, "Br/B", "B/W" wire open or poor E32-318 connection. If wire and connection are OK, substitute a known-good ECM and recheck.	Faulty fuel pump relay.

Fig. for STEP 2



1. Fuel pump relay coupler
2. Service wire

B-2 FUEL INJECTOR AND ITS CIRCUIT CHECK

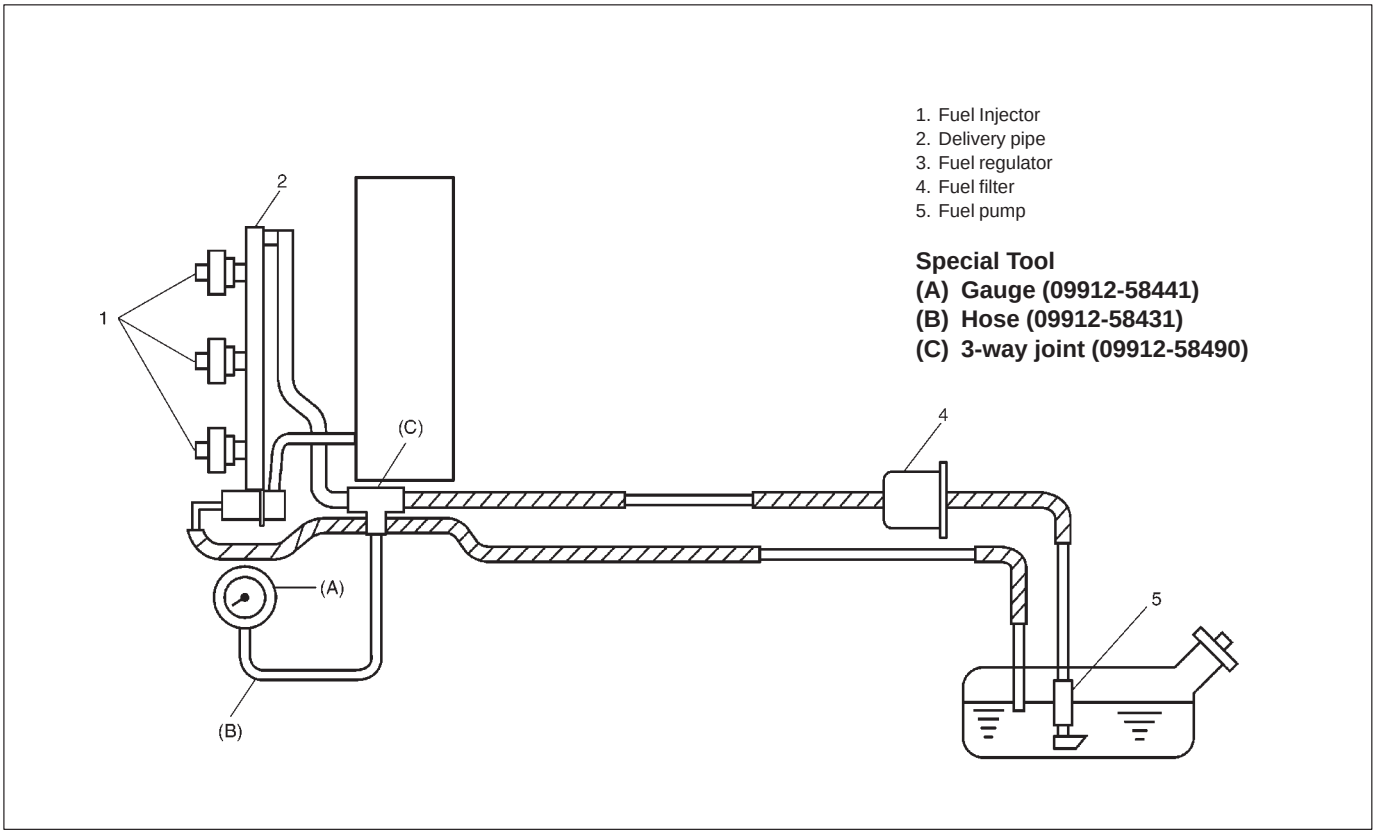


1. Battery positive voltage
2. Blank
3. "FI" fuse in fuse/relay box
4. Main relay
5. ECM
6. No.1 injector
7. No.2 injector
8. No.3 injector

STEP	ACTION	YES	NO
1	Check each injector for operating sound at engine cranking using sound scope. Do all 3 injector make operating sound?	Fuel injector circuit is in good condition.	Go to Step 2.
2	Does none of 3 injectors make operating sound at Step 1?	Go to Step 4.	Go to Step 3.
3	Check fuel injector(s) referring to p. 6E1-58. Is it in good condition?	Check coupler connection and wire harness of injector not making operating sound.	Faulty fuel injector(s).
4	Check power circuit of injectors for open and short. Is it in normal condition?	Check all 3 injectors for resistance respectively. If resistance is OK, substitute a known-good ECM and recheck.	Power circuit open or short.

Blank

B-3 FUEL PRESSURE CHECK (Page 1 of 2)

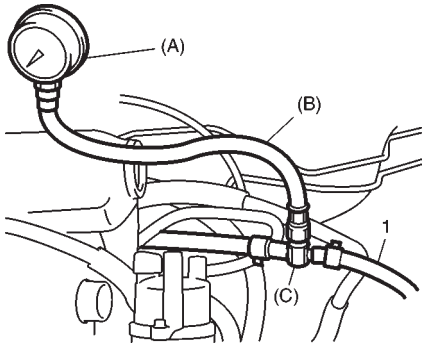


STEP	ACTION	YES	NO
1	1) Release fuel pressure from fuel feed line. 2) Install fuel pressure gauge. 3) Check fuel pressure by repeating ignition switch ON and OFF. Is fuel pressure then 270 – 310 kPa (2.7 – 3.1 kg/cm^2, 38.4 – 44.0 psi)?	Go to Step 2.	Go to Step 5.
2	Is 200 kPa (2.0 kg/cm^2, 28.4 psi) 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	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.

B-3 FUEL PRESSURE CHECK (Page 2 of 2)

STEP	ACTION	YES	NO
7	Was no fuel pressure applied in step 1?	Go to Step 8.	Go to Step 9.
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.
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.

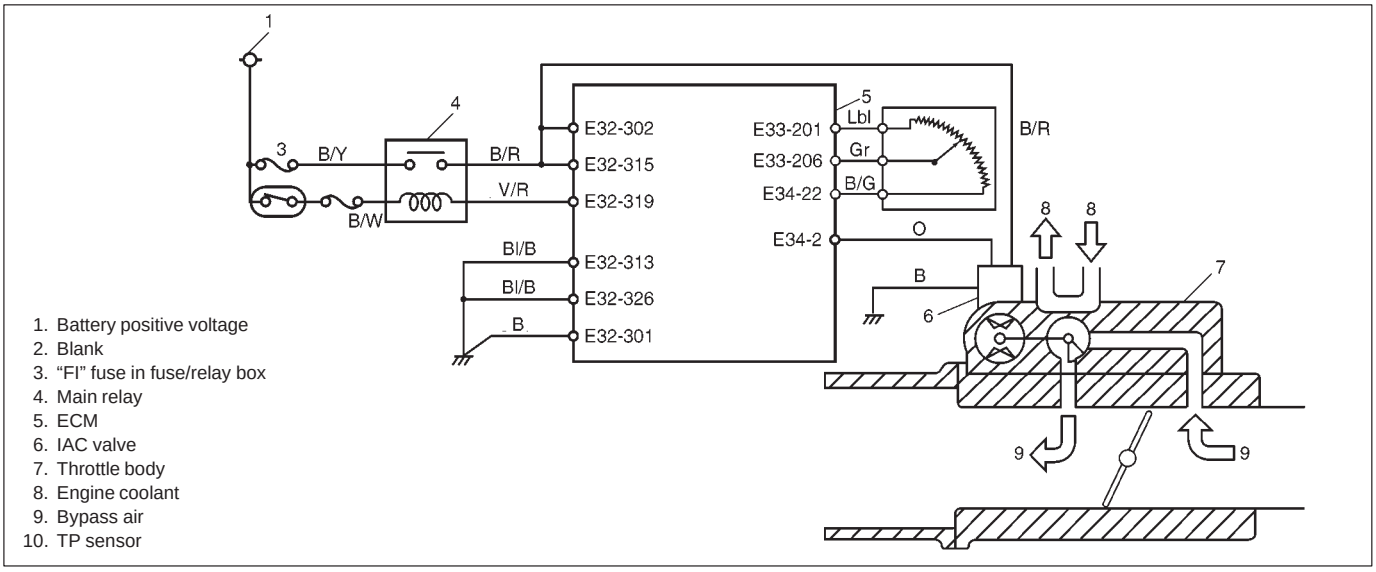
Fig. for STEP 1



1. Fuel feed hose

Special Tool
(A) Gauge
(B) Hose
(C) 3-way joint

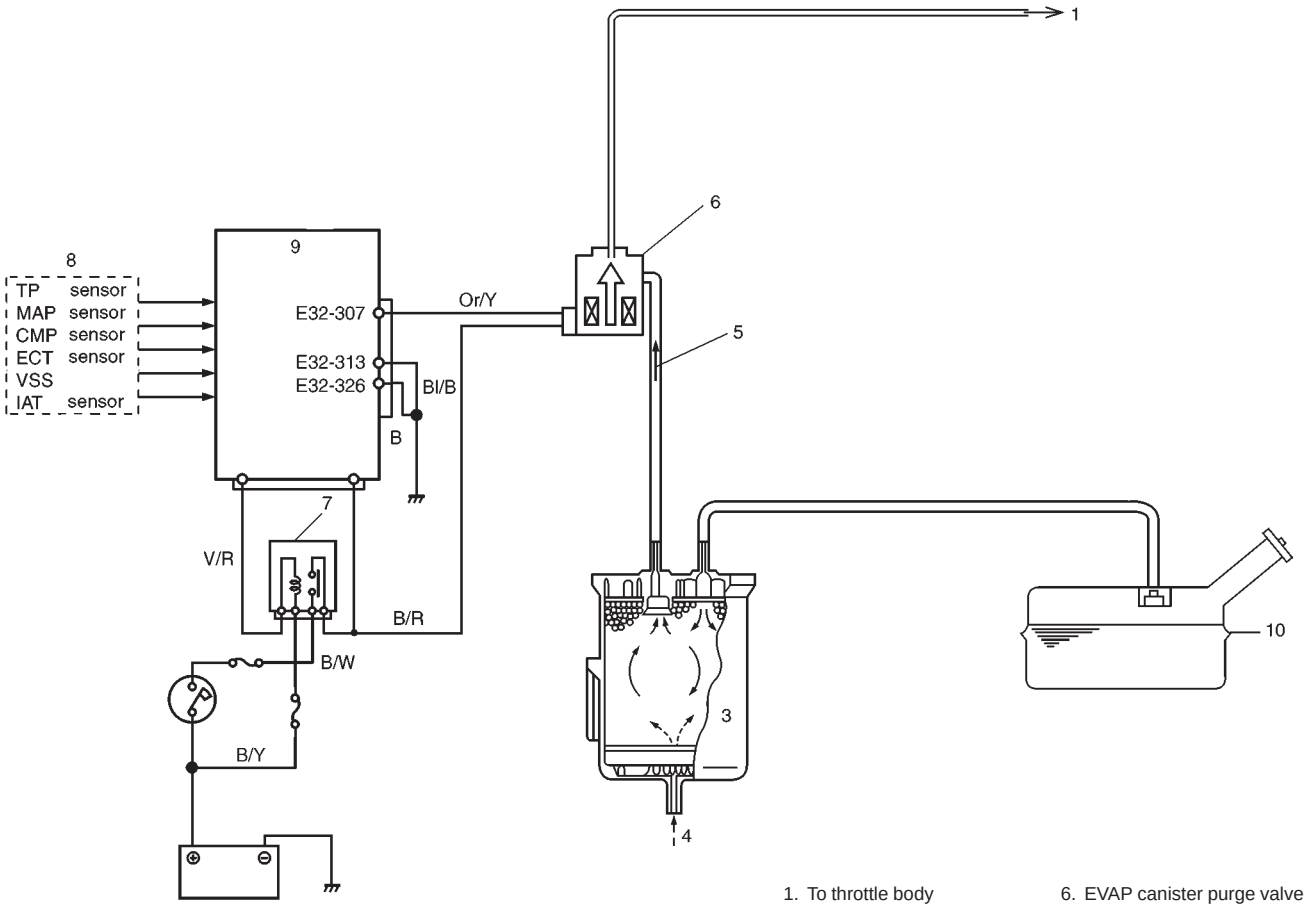
B-4 IDLE AIR CONTROL SYSTEM CHECK (Page 1 of 2)



1. Battery positive voltage
2. Blank
3. "FI" fuse in fuse/relay box
4. Main relay
5. ECM
6. IAC valve
7. Throttle body
8. Engine coolant
9. Bypass air
10. TP sensor

STEP	ACTION	YES	NO
1	IAC valve function check: 1) Check IAC valve referring to IAC VALVE INSPECTION in this section. Is check result in good condition?	Go to Step 2.	Go to Step 5.
2	Closed throttle position check: 1) Connect SUZUKI scan tool to DLC. 2) With the ignition switch ON position, check "CLOSED THROT POS" in parameter data list. Throttle valve fully close : ON Throttle valve slight open : OFF Is each check result as specified?	Check for following: EVAP canister purge valve Accessory engine load PCV system Idle air passage A/C signal	Go to Step 3.
3	Closed throttle position recheck: 1) With the ignition switch OFF position disconnect negative battery cable for 30 seconds and connect it. 2) Recheck closed throttle position referring to Step 2. Is each check result as specified?	Recheck engine idle speed.	Go to Step 4.
4	TP sensor signal voltage check: 1) With the ignition switch ON position, check voltage between E33-206 and ground. Throttle valve fully close: 0.78 – 0.83V Is each check result as specified?	Substitute a known good ECM and recheck.	Check TP sensor referring TP SENSOR INSPECTION in this section.
5	IAC valve circuit check: 1) Check "O", "B/R" and "B" wire for open and short. Are they in good condition?	Go to Step 6.	Repair or replace.
6	IAC valve substitution: 1) Substitute a known good IAC valve. 2) Check IAC valve referring to IAC VALVE INSPECTION in this section. Is check result in good condition?	IAC valve malfunction.	Substitute a known good ECM and recheck.

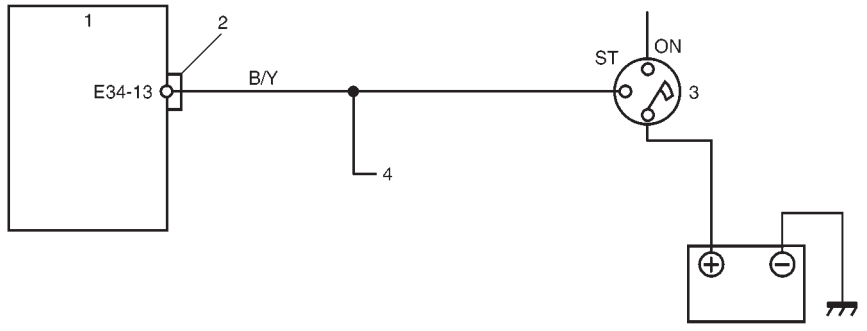
B-5 EVAPORATIVE EMISSION CONTROL SYSTEM CHECK



1. To throttle body
2. To fuel tank
3. EVAP canister
4. Air
5. Air and vapor
6. EVAP canister purge valve
7. Main relay
8. Sensed information
9. ECM
10. Fuel tank

STEP	ACTION	YES	NO
1	Check canister purge system for operation referring to p.6E1-73. Is it in good condition?	Check EVAP canister referring to p.6E1-76 and fuel filler cap referring to Section 6C. If OK, system is in good condition.	Go to Step 2.
2	Check vacuum passage, hoses and EVAP canister purge valve referring to p.6E1-74. Are they in good condition?	● "O/Y" wire open, ● "O/Y" wire shorted to ground, ● Poor EVAP canister purge valve coupler connection, ● Poor "E32-307" connection, ● Poor performance of ECT sensor or MAP sensor or TP sensor If none of the above exists, substitute a known-good ECM and recheck.	● Vacuum passage clogged, ● Vacuum leakage or ● Faulty EVAP canister purge valve

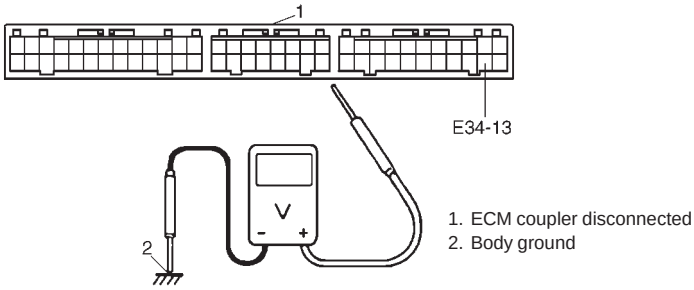
B-6 ENGINE START SIGNAL CHECK



1. ECM
2. ECM coupler
3. Main switch
4. To starting motor

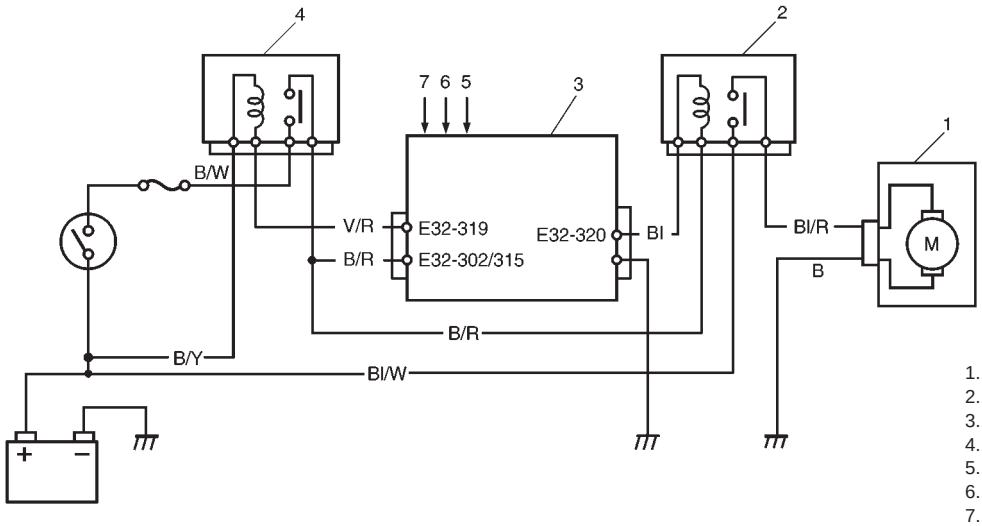
STEP	ACTION	YES	NO
1	1) With ignition switch OFF, disconnect couplers from ECM. 2) Is 6 – 12 V voltage applied to E34-13 terminal of coupler only when cranking engine.	Engine starter signal circuit is in good condition.	● "B/Y" wire open or ● Poor "E34-13" connection

Fig. for STEP 1



1. ECM coupler disconnected
2. Body ground

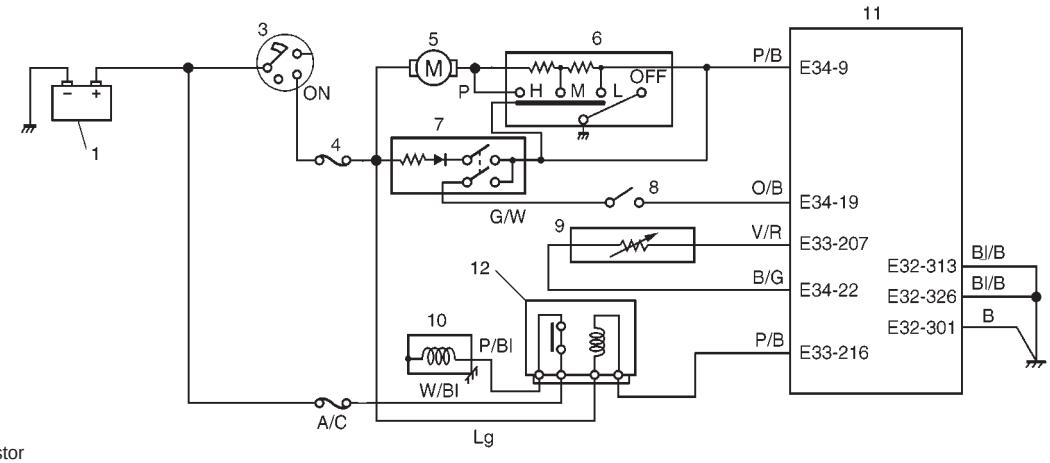
B-7 RADIATOR FAN CONTROL SYSTEM CHECK



1. Radiator fan motor
2. Radiator fan control (RFC) relay
3. ECM
4. Main relay
5. Engine coolant temp. (ECT) sensor
6. Vehicle speed sensor
7. A/C signal

STEP	ACTION	YES	NO
1	Check radiator fan control system referring to p. 6E1-71. Is it in good condition?	RFC system is in good condition.	Go to Step 2.
2	Check RFC relay referring to p. 6E1-71. Is it in good condition?	Go to Step 3.	Faulty RFC relay.
3	Check wire harnesses and connections for open or short. Are they in good condition?	Poor performance of ECT sensor. If ECT sensor is OK, substitute a known-good ECM and recheck.	● Wire open or short ● Poor connection or ● Faulty radiator fan motor

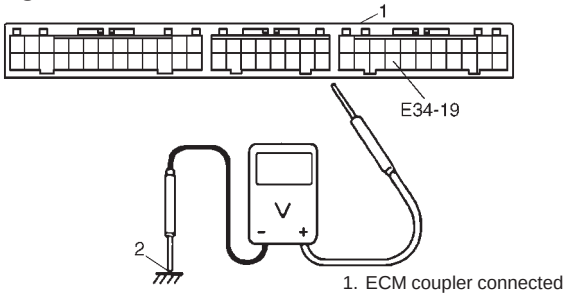
B-8 A/C CONTROL SIGNAL CHECK (IF EQUIPPED)



1. Battery
2. Main fuse box
3. Ignition switch
4. "HEATER" fuse
5. Blower fan motor
6. Blower fan switch
7. A/C switch
8. Dual pressure switch
9. A/C evaporator thermistor
10. A/C compressor
11. ECM
12. A/C compressor control relay

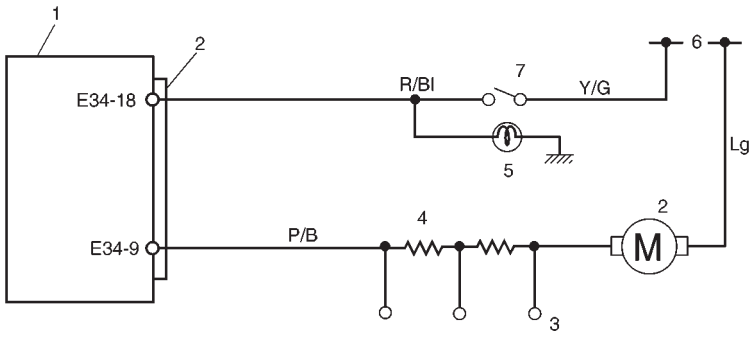
STEP	ACTION	YES	NO
1	1) Check voltage at "E34-19" terminal under each condition given in table below. Ignition switch ON, A/C switch OFF, Blower fan switch OFF: 10 – 14 V Ignition switch ON, A/C switch ON, Blower fan switch ON: 2 V or less 2) Is check result satisfactory?	A/C control signal is in good condition.	● "G/B" wire open or short ● Poor "E34-19" terminal connection If wire and connection are OK, check dual pressure switch and A/C switch referring to Section 1B.

Fig. for STEP 1



1. ECM coupler connected
2. Body ground

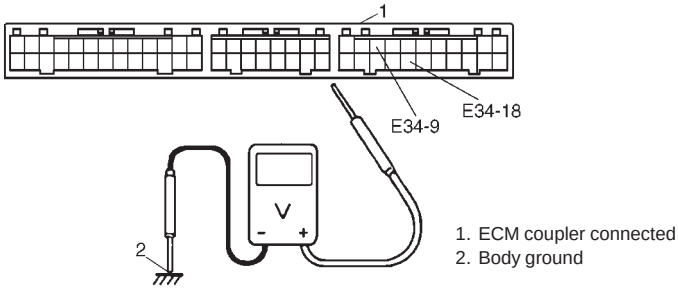
B-9 ELECTRIC LOAD SIGNAL CIRCUITS CHECK



1. Ignition switch
2. Blower fan motor
3. Blower fan switch
4. Heater blower register
5. Clearance light
6. From battery
7. Clearance light switch

STEP	ACTION	YES	NO
1	Check voltage at E34-18 terminal under each condition given below. Small light turned OFF : 0 V Small light turned ON : 10 – 14 V Is check result satisfactory?	Go to Step 2.	● “Br/R” wire open or short ● Poor “E34-18” terminal connection
2	Check voltage at E34-9 terminal under each condition given below. Ignition switch ON and heater blower fan turned OFF : 10 – 14 V Ignition switch ON and heater blower fan turned ON : 2 V or less Is check result satisfactory?	Electric load signal circuit are in good condition.	● “P/B” wire open or short ● Poor “E34-9” terminal connection

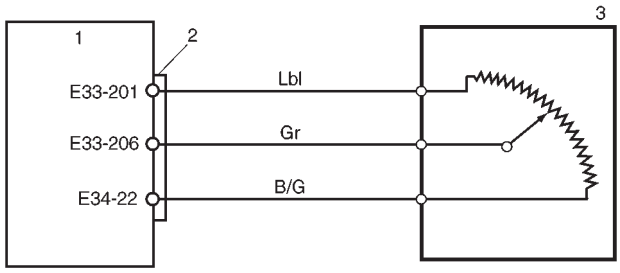
Fig. for STEP 1 and 2



1. ECM coupler connected
2. Body ground

B-10 FUEL CUT OPERATION CHECK

1. ECM
2. ECM coupler
3. TP sensor

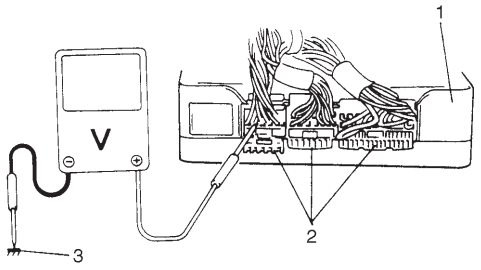


STEP	ACTION	YES	NO
1	Check fuel cut operation referring FUEL CUT OPERATION INSPECTION in this section. Does fuel injector operate as specified?	Fuel cut operation is in good condition.	Go to step 2.
2	Closed throttle position check: 1) Connect Tech-1 to DLC. 2) With the ignition switch ON position, check “CLOSED THROT POS” in parameter data list. Throttle valve fully close : ON Throttle valve slight open : OFF Is each check result as specified?	Substitute a known good ECM and recheck.	Go to step 3.
3	Closed throttle position recheck: 1) With the ignition switch OFF position disconnect negative battery cable for 30 seconds and connect it. 2) Recheck closed throttle position referring to Step 2. Is each check result as specified?	Recheck fuel cut operation.	Go to step 4.
4	TP sensor signal voltage check: 1) With the ignition switch at ON position, check voltage between E33-206 and ground. Throttle valve fully close: 0.78 – 0.83V Throttle valve fully open: 3.7 – 4.7V Is each check result as specified?	Substitute a known good ECM and recheck fuel cut operation.	Check TP sensor referring to TP SENSOR INSPECTION in this section.

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 couplers disconnected from it.



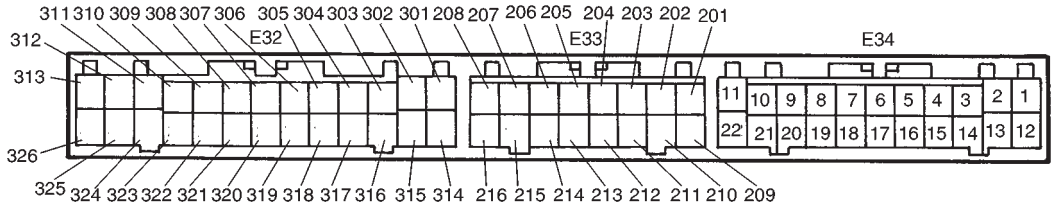
1. ECM
2. Couplers
3. Body ground

VOLTAGE CHECK

1) Remove ECM from body with ignition switch OFF referring to ECM REMOVAL.
2) Connect ECM couplers to ECM.
3) Check voltage at each terminal of couplers connected.

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

TERMINAL ARRANGEMENT OF ECM COUPLER (VIEWED FROM HARNESS SIDE)

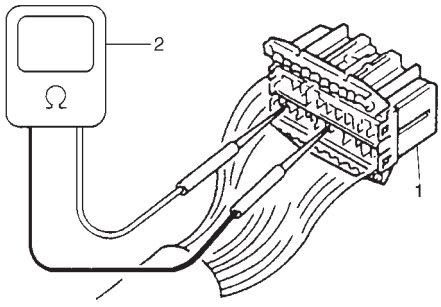


TERMINAL	CIRCUIT	NORMAL VOLTAGE	CONDITION
E34-1	Blank	—	—
E34-2	IAC valve	—	—
E34-3	Blank	—	—
E34-4	Blank	—	—
E34-5	Blank	—	—
E34-6	Blank	10 – 14 V	Ignition switch ON, selector lever: “L” range
E34-7	Test switch terminal	4.5 – 5.5 V	Ignition switch ON
		1 V or less	Ignition switch ON, Test switch terminal grounded
E34-8	Diagnosis switch terminal	4.5 – 5.5 V	Ignition switch ON
		1 V or less	Ignition switch ON, Test switch terminal grounded
E34-9	Electric load signal for blower fan motor	2 V or less	Ignition switch ON, Blower fan switch : High or Middle position
		4.0 – 14.0 V	Ignition switch ON, Blower fan switch : OFF or Low position
E34-10	Stop lamp switch (brake pedal switch)	1.5V or less	Brake pedal released (switch OFF), Ignition switch ON
		10 – 14 V	Brake pedal depressed (switch ON), Ignition switch ON
E34-11	Blank	—	—
E34-12	Data link connector	10 – 14 V	Ignition switch ON
E34-13	Engine starter switch (engine starter signal)	1.5V or less	Ignition switch ON
		6 – 12 V	While engine cranking
E34-14	Blank	10 – 14 V	Ignition switch ON, selector lever: “L” range
E34-15	Blank	—	—
E34-16	Blank	—	—
E34-17	Duty output terminal	1 V or less	Ignition switch ON
E34-18	Electric load signal for small light switch	1 V or less	Ignition switch ON and Small light turned OFF
		10 – 14 V	Ignition switch ON and Small light turned ON
E34-19	A/C ON signal from A/C switch (if equipped)	10 – 14 V	Ignition switch ON, A/C switch OFF, Blower fan switch OFF
		2 V or less	Ignition switch ON, A/C switch ON, Blower fan switch ON
E34-20	Blank	—	—
E34-21	Blank	—	—
E34-22	Sensor ground	—	—

TERMINAL	CIRCUIT	NORMAL VOLTAGE	CONDITION
E33-201	Power supply for sensor	4.5 – 5.5 V	Ignition switch ON
E33-202	Blank	—	—
E33-203	CMP sensor (+)	1 V or less	Ignition switch ON
E33-204	VSS	Indicator deflection repeated between 0 – 1 V and 4 – 14 V	Ignition switch ON, Front left tire turned quickly with front right tire locked
E33-205	MAP sensor	About 3.6 V	Ignition switch ON, engine stop
		About 1 – 3 V	Engine running at idle speed, A/C OFF
E33-206	TP sensor	0.78 – 0.83 V	Throttle valve at idle position
		3.7 – 4.7 V	Throttle valve at full open position
E33-207	A/C evaporator temp. sensor (with A/C)	2.0 – 2.5 V	A/C ventilator outlet temp.: at 20°C
E33-208	ECT sensor	2.5 – 3.0 V	Engine coolant temp.: at 20°C
		0.6 – 0.9 V	Engine coolant temp.: at 80°C
E33-209	Blank	—	—
E33-210	Blank	—	—

TERMINAL	CIRCUIT	NORMAL VOLTAGE	CONDITION
E33-211	CMP sensor (–)	About 0 V	—
E33-212	Blank	—	—
E33-213	Oxygen sensor	Deflect between 0 and 1 V	Engine running, after engine warmed up
E33-214	IAT sensor	2.0 – 2.5 V	IAT sensor ambient temp.: at 20°C
		0.4 – 0.6 V	IAT sensor ambient temp.: at 80°C
E33-215	Blank	—	—
E33-216	A/C compressor magnet clutch (with A/C) relay	1 V or less	Engine running, A/C compressor: ON
		10 – 14 V	Engine running, A/C compressor: OFF

TERMINAL	CIRCUIT	NORMAL VOLTAGE	CONDITION
E32-301	Ground	—	—
E32-302	Power source	10 – 14 V	Ignition switch ON
E32-303	Blank	—	—
E32-304	Blank	—	—
E32-305	Blank	—	—
E32-306	Blank	—	—
E32-307	EVAP canister purge valve	10 – 14 V	Ignition switch ON
E32-308	Blank	—	—
E32-309	Blank	—	—
E32-310	Ignition coil assembly	1 V or less	Ignition switch ON
E32-311	Fuel injector No.3	10 – 14 V	Ignition switch ON
E32-312	Fuel injector No.1	10 – 14 V	Ignition switch ON
E32-313	Ground	—	—
E32-314	Power source for backup	10 – 14 V	—
E32-315	Power source	10 – 14 V	Ignition switch ON
E32-316	Blank	—	—
E32-317	Malfunction indicator light	About 0.5 V or less	Ignition switch ON, engine stops
		10 – 14 V	Engine running
E32-318	Fuel pump relay	1 V or less	For 3 seconds after ignition switch ON or while engine running
		10 – 14 V	After 3 seconds from ignition switch ON with engine stopped
E32-319	Main relay	1 V or less	Ignition switch ON
E32-320	Radiator fan control relay	10 – 14 V	Ignition switch ON
		1 V or less	Engine cooling fan ON
E32-321	Blank	—	—
E32-322	Blank	—	—
E32-323	Blank	—	—
E32-324	Blank	—	—
E32-325	Fuel injector No.2	10 – 14 V	Ignition switch ON
E32-326	Ground	—	—



1. ECM coupler disconnected
2. Ohmmeter

RESISTANCE CHECK

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

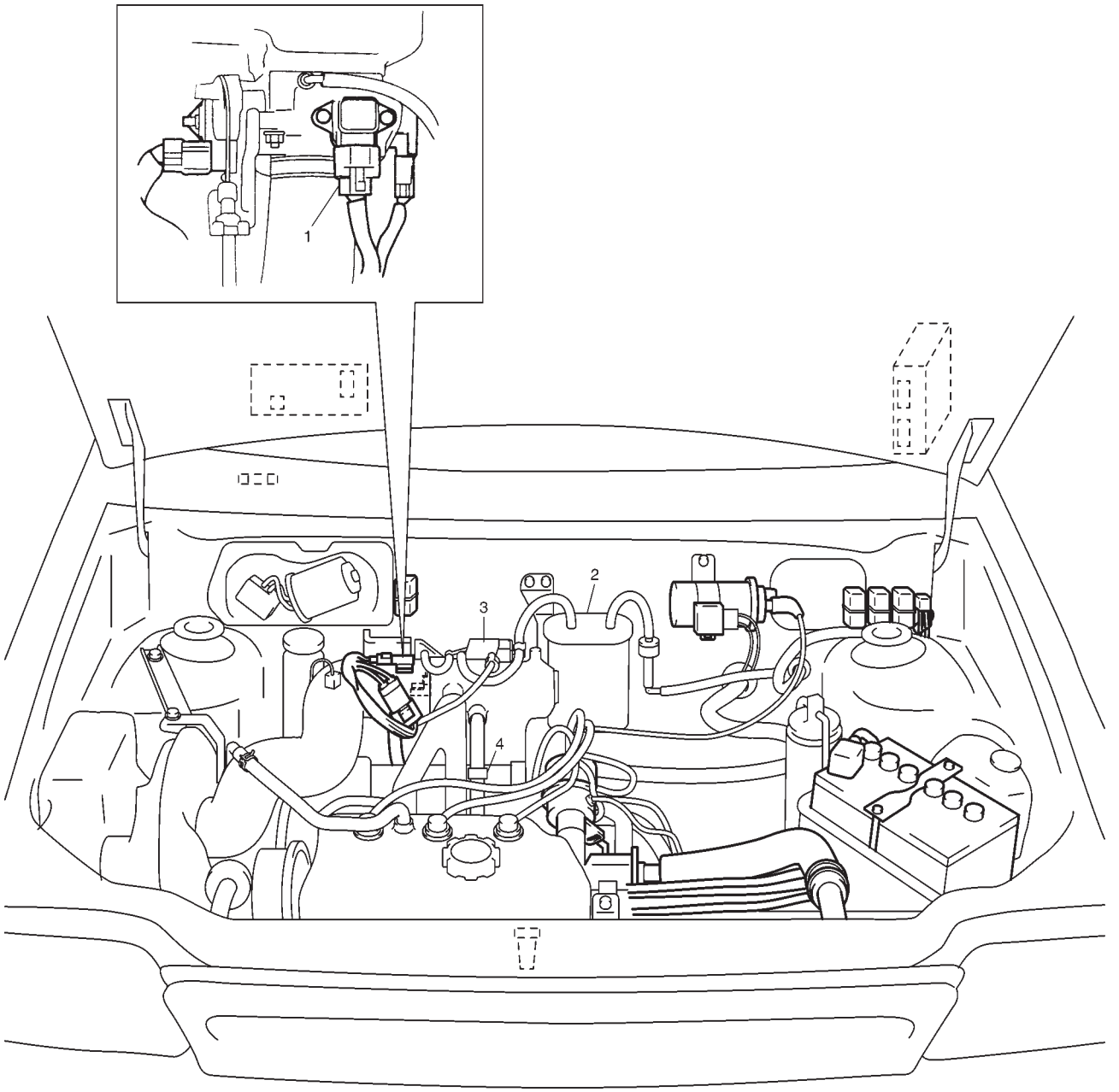
CAUTION:
Never touch terminals of ECM itself or connect voltmeter or ohmmeter.

2) Check resistance between each pair of terminals of disconnected couplers as listed in following table.

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).**

TERMINAL	CIRCUIT	NORMAL RESISTANCE	CONDITION
E32-312 – E32-302	Fuel Injector No.1	11.3 – 13.8 Ω	
E32-325 – E32-302	Fuel injector No.2	11.3 – 13.8 Ω	
E32-311 – E32-302	Fuel Injector No.3	11.3 – 13.8 Ω	
E32-307 – E32-302	EVAP canister purge valve	37 – 44 Ω	F8D engine
		28 – 36 Ω	F8B engine
E32-320 – E32-302	Radiator fan control relay	90 – 110 Ω	omron made
		60 – 88 Ω	interface made
E33-302 – E32-311	CMP sensor	185 – 275 Ω	–10 – 50 °C (14 – 122 °F)
E32-318 – E32-314	Fuel pump relay	80 – 100 Ω	Battery disconnected and ignition switch ON
E32-318 – E32-314	Main relay	80 – 100 Ω	Battery disconnected and ignition switch ON
E32-301/313/326 – Body ground	Ground	Continuity	

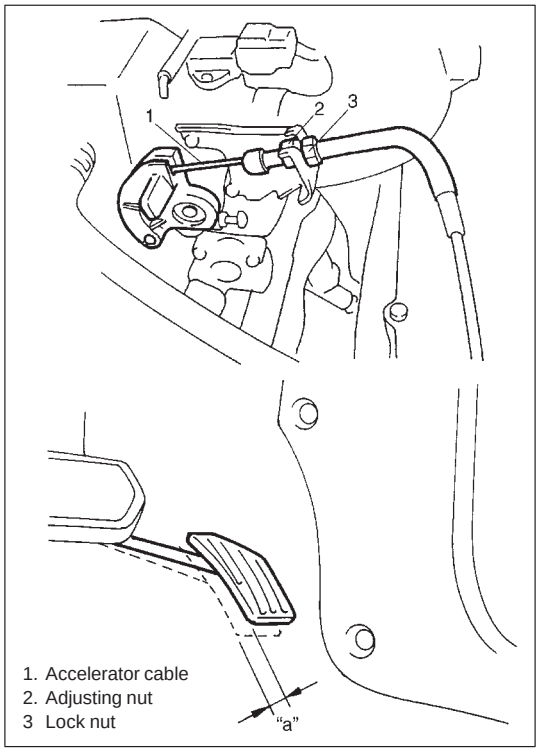
ON-VEHICLE SERVICE



1. MAP sensor
2. EVAP canister
3. EVAP canister purge valve (if equipped)
4. PCV valve

GENERAL

When hoses are disconnected and system components are removed for service, reinstall components properly, and route and connect hoses correctly after service. Refer to figure on previous page for proper routing of hoses.



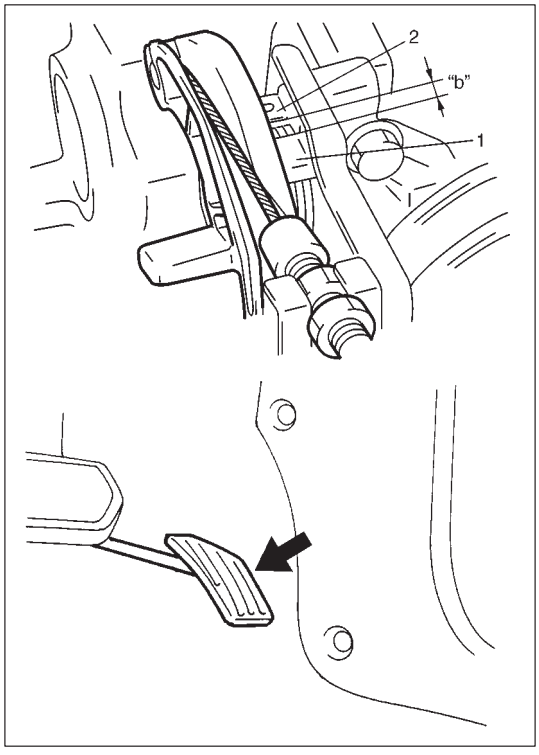
1. Accelerator cable
2. Adjusting nut
3 Lock nut

ACCELERATOR CABLE ADJUSTMENT

1) With throttle valve closed, check accelerator pedal play which should be within the following specification.

   Pedal play "a" : 2 – 7 mm (0.08 – 0.27 in.)

   If measured value is out of specification, adjust it to specification with cable adjusting nut.



2) With accelerator pedal depressed fully, check clearance between throttle lever (2) and lever stopper (1) (throttle body) which should be within following specification.

   Clearance "b" : 0.5 – 2.0 mm (0.02 – 0.07 in.)
   (With pedal depressed fully)

IDLE SPEED/IAC DUTY INSPECTION

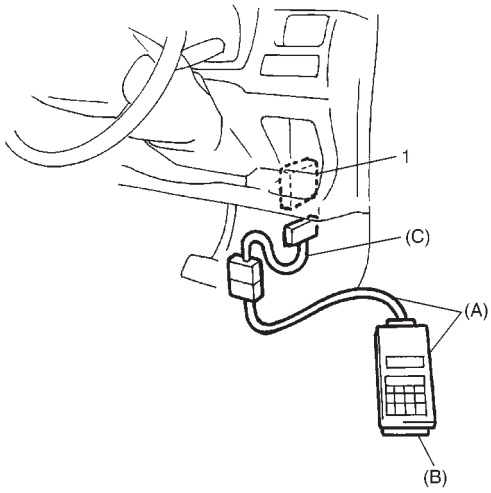
Before idle speed/IAC duty check, make sure of the following.

- Lead wires and hoses of Electronic Fuel Injection system is 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.
- ECM does not detect any malfunction DTC.

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", and, set parking brake and block drive wheels.

When using SUZUKI scan tool:



[Using SUZUKI scan tool]

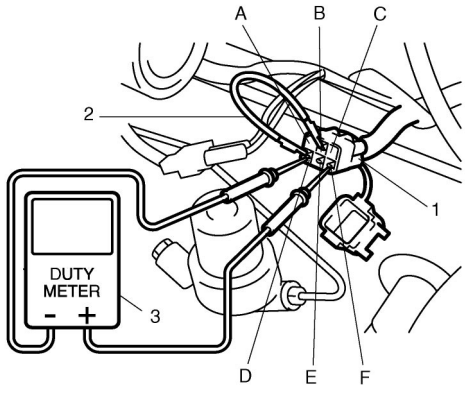
1) Connect SUZUKI scan tool to DLC (1) with ignition switch OFF.

   Special Tool
   (A): 09931-76011 (SUZUKI scan tool)
   (B): Mass storage cartridge
   (C): 09931-76030 (16/14 pin DLC cable)

2) Start engine and warm it up to normal operating temperature.
3) Check idle speed and IAC duty by using "DATA LIST" mode of SUZUKI scan tool.

   NOTE:
   - **Check to ensure that radiator fan is not running and then measure IAC-duty.**
   - **Duty values with (*) are applicable to vehicle used at high place (higher than 2000 in or 6560 ft.)**

ENGINE IDLE SPEED AND IAC DUTY	
A/C OFF	A/C ON
900 ± 50 r/min. 3 – 30 or *40%	1000 ± 50 r/min.



1. Monitor connector
2. Service wire
3. Duty meter

A: Blank
B: Diagnosis switch terminal
C: Blank
D: Ground terminal
E: Test switch terminal
F: Duty output terminal

[Not using SUZUKI scan tool]

1) Using service wire, ground diagnosis switch terminal in monitor connector.
2) Connect duty meter between duty output terminal and ground terminal of monitor connector.
3) Set tachometer.
4) Start engine and warm it up to normal operating temperature.
5) Confirm that all accessories (light, A/C, blower fan, etc.) are out of service.
6) Check idle speed and IAC duty.

NOTE:
Check to ensure that radiator fan is not running and then measure IAC-duty.

If duty and/or idle speed is out of specifications, inspect idle air control system referring to “B-4 Idle Air Control System Check” in this section.

ENGINE IDLE SPEED AND IAC DUTY	
A/C OFF	A/C ON
900 ± 50 r/min. 3 – 30 or *40%	1000 ± 50 r/min.

NOTE:

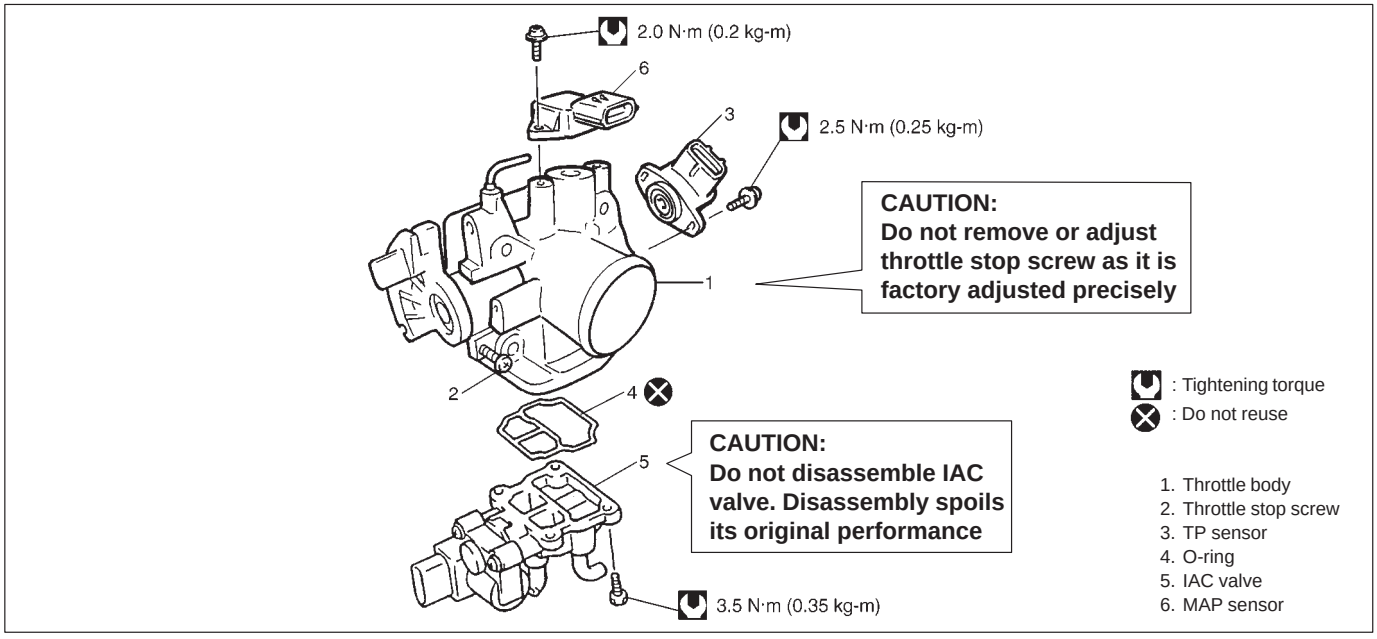
- **Duty values with (*) are applicable to vehicle used at high place (higher than 2000 m or 6560 ft.)**
- **Above duty values are on duty meter indications (high voltage rate).**
- **IAC duty can be checked roughly by using voltmeter. IAC duty to voltage relation is as follows.**

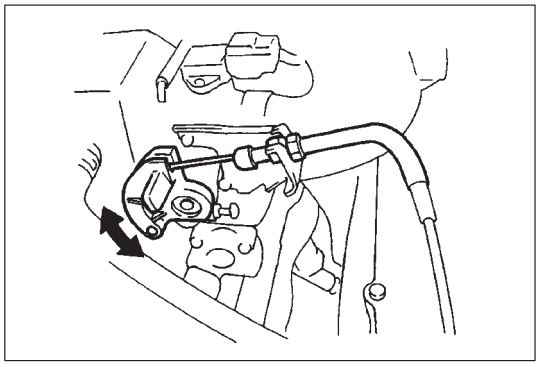
ON DUTY METER INDICATION (%)	OFF DUTY METER INDICATION (%)	VOLTMETER INDICATION (V)
0	100	0
50	50	0.5 × V_B
100	0	V_B

– **“OFF DUTY METER” is such duty meter that indicates approx. 100% when terminal voltage is approx. “0V”.**
– **“V_B” represents battery voltage while engine of vehicle being checked is running.**

AIR INTAKE SYSTEM

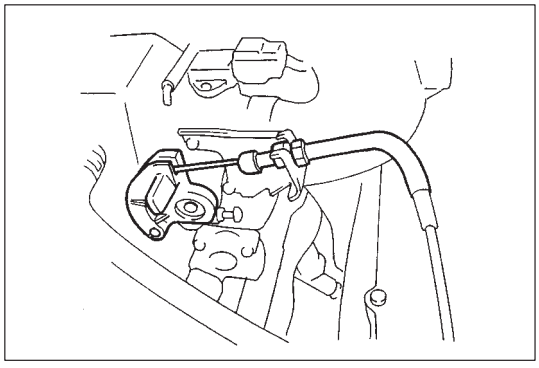
THROTTLE BODY





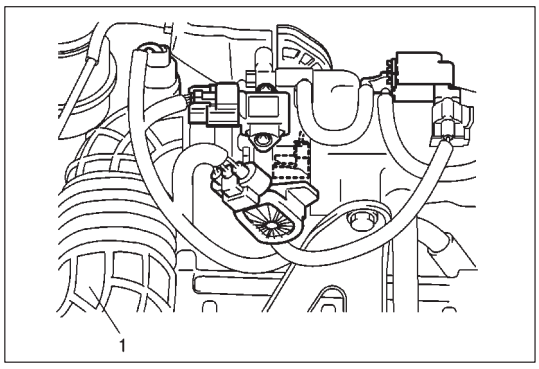
ON-VEHICLE INSPECTION

Check that throttle valve lever moves smoothly.

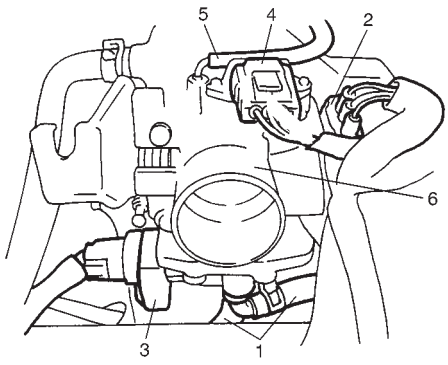


REMOVAL

1) Disconnect negative cable at battery.
2) Drain cooling system referring to Section 6B.
3) Disconnect accelerator cable from throttle body.



4) Remove air cleaner outlet hose (1).



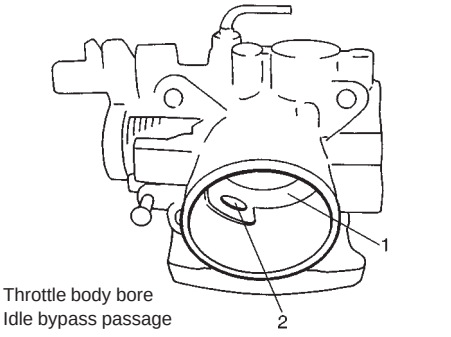
1. Engine coolant hose
2. TP sensor
3. IAC valve
4. MAP sensor
5. EVAP canister purge valve hose
6. Throttle body

5) Disconnect couplers from TP sensor, MAP sensor and IAC valve.
6) Remove throttle body from intake manifold.
7) Disconnect engine coolant hoses and EVAP canister purge valve hose from throttle body.

DISASSEMBLY

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.

1) Remove TP sensor, MAP sensor and IAC valve from throttle body.



1. Throttle body bore
2. Idle bypass passage

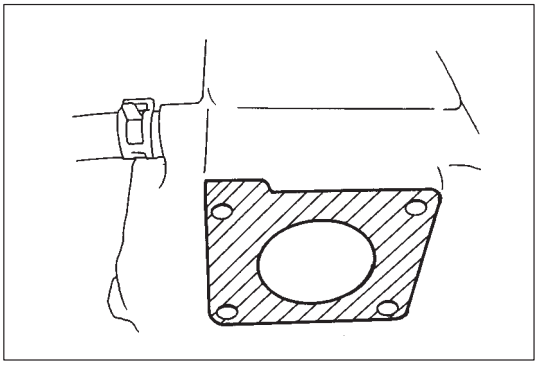
CLEANING

Clean throttle body bore and idle air passage by blowing compressed air.

CAUTION:
- **TP sensor, IAC valve, MAP sensor 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.**
- **Do not blow compressed air through bypass air passage with IAC valve installed to throttle body. This will cause IAC valve to malfunction.**

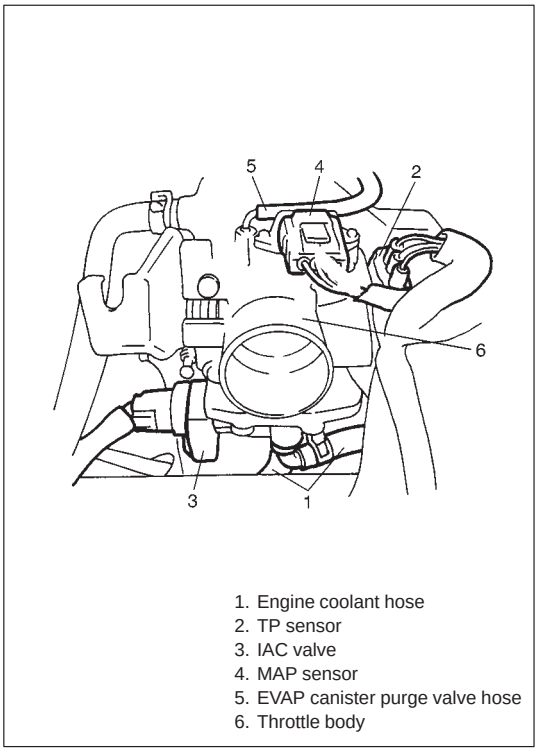
REASSEMBLY

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.
3) Install MAP sensor to throttle body referring to MAP sensor Installation section.



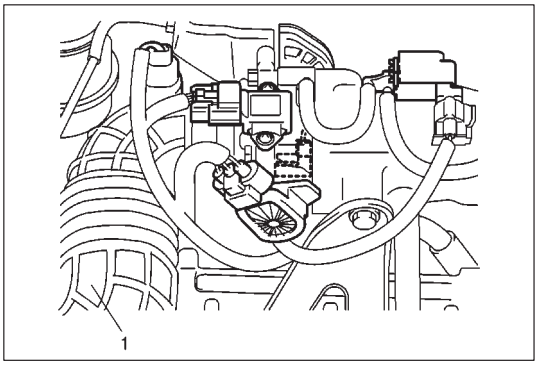
INSTALLATION

1) Clean mating surfaces and install throttle body gasket to intake manifold.
   Use new gasket.

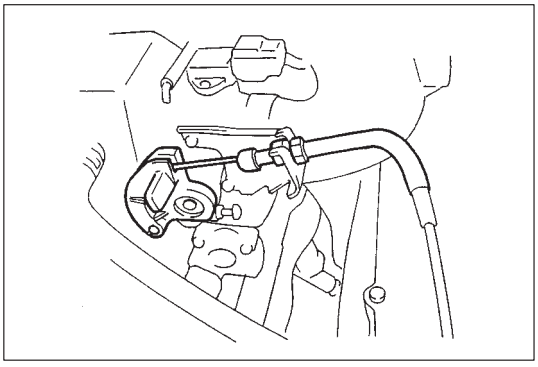


1. Engine coolant hose
2. TP sensor
3. IAC valve
4. MAP sensor
5. EVAP canister purge valve hose
6. Throttle body

2) Install throttle body to intake manifold.
3) Connect engine coolant hoses and EVAP canister purge valve hose.
4) Connect couplers to TP sensor, MAP sensor and IAC valve securely.



5) Install air cleaner outlet hose (1).

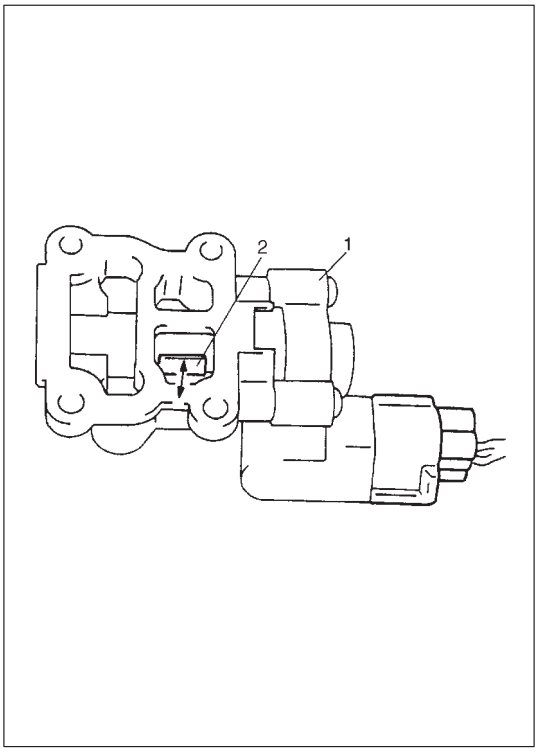


6) Connect accelerator cable and adjust cable play to specification.
7) Refill cooling system.
8) Connect negative cable at battery.

IAC VALVE

REMOVAL

1) Remove throttle body from intake manifold referring to “Throttle Body Removal” section.
2) Remove IAC valve from throttle body.

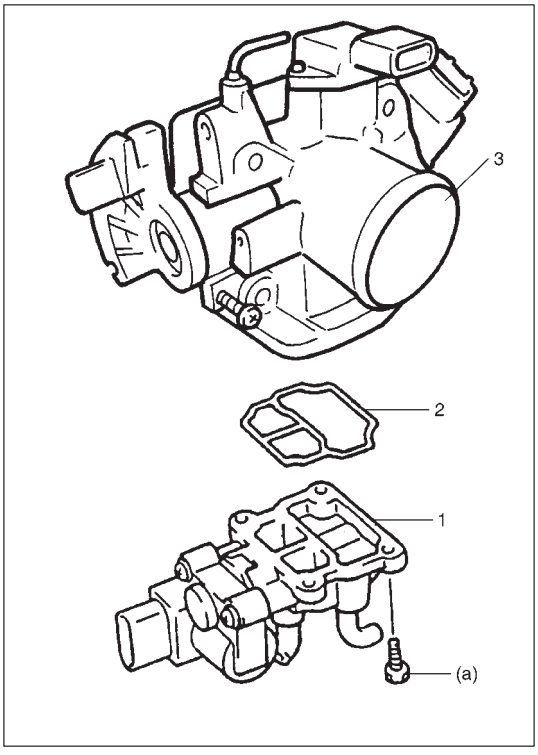


INSPECTION

1) Remove IAC valve (1) from throttle body.
2) Connect each connector to IAC valve, MAP sensor, TP sensor and IAT sensor.
3) Check that rotary valve (2) of IAC valve opens and closes once and then stops in about 60 ms as soon as ignition switch is turned ON.

NOTE:

- **This check should be performed by two people, one person turns on ignition switch while the other checks valve operation.**
- **As valve operation is momentary, it may be overlooked. To prevent this, perform this operation check 3 times or more continuously.**
  If rotary valve of IAC valve does not operate at all, check wire harnesses for open and short. If wire harnesses are in good condition, replace IAC valve and recheck.

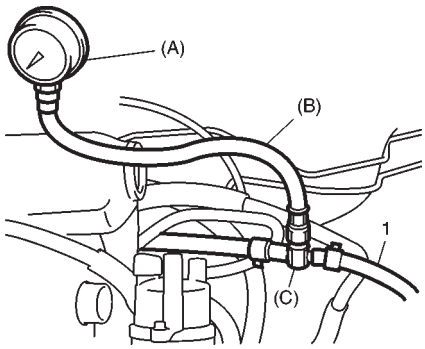


INSTALLATION

1) Install new O-ring (2) to IAC valve (1).
2) Install IAC valve to throttle body (3).
   Tighten IAC valve screws to specified torque.

   Tightening Torque
   (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.

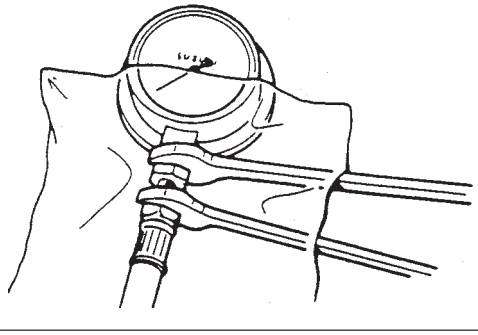
3) Connect special tools and hose between fuel delivery pipe and fuel feed hose (1) as shown in figure, and clamp hoses securely to ensure no leaks occur during checking.

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

4) Check that battery voltage is above 11V.

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	200 – 240 kPa 2.0 – 2.4 kg/cm^2 28.4 – 34.1 psi
With 1 min. after engine (fuel pump) stop (Pressure reduces as time passes)	over 200 kPa 2.0 kg/cm^2 28.4 psi

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.
6) Start engine and warm it up to normal operating temperature.
7) Measure fuel pressure at idling.
   If measured pressure doesn't satisfy specification, refer to B-3 FUEL PRESSURE CHECK in this section and check each possibly defective part. Replace if found defective.



8) After checking fuel pressure, remove fuel pressure gauge.

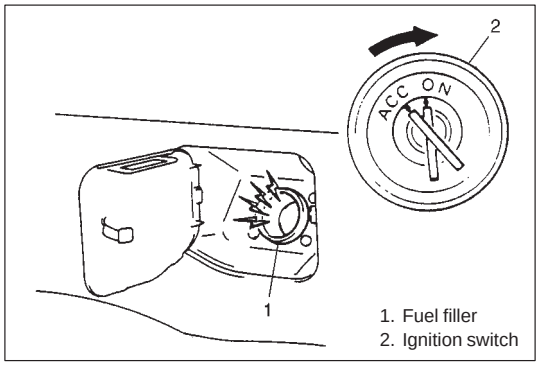
CAUTION:
As fuel feed line is still under high fuel pressure, make sure to release fuel pressure according to following procedures.
- **Place fuel container under joint.**
- **Cover joint with rag and loosen joint nut slowly to release fuel pressure gradually.**

9) Remove special tools from fuel delivery pipe.
10) Connect fuel feed hose to fuel delivery pipe and clamp it securely.
11) With engine “OFF” and ignition switch “ON”, check for fuel leaks.

FUEL PUMP

ON-VEHICLE INSPECTION

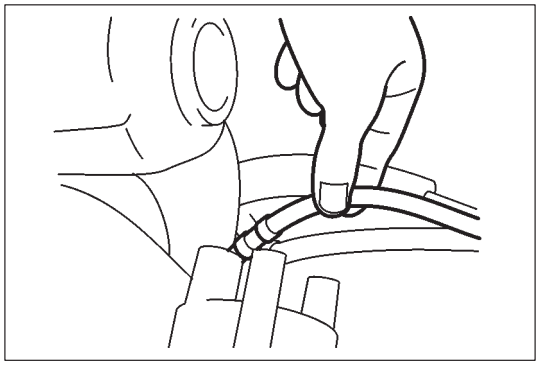
CAUTION:
When fuel filler cap is removed in any procedure, work must be done in a well-ventilated area, keep away from any open flames and without smoking.



1. Fuel filler
2. Ignition switch

1) Remove filler cap and turn ON ignition switch. Then fuel pump operating sound should be heard from fuel filler for about 2 seconds and stop. Be sure to reinstall fuel filler cap after checking.

   If above check result is not satisfactory, advance to DIAGNOSTIC FLOW TABLE B-1.



2) Fuel pressure should be felt at fuel return hose for 2 seconds after ignition switch ON.

   If fuel pressure is not felt, advance to DIAGNOSTIC FLOW TABLE B-3.

REMOVAL

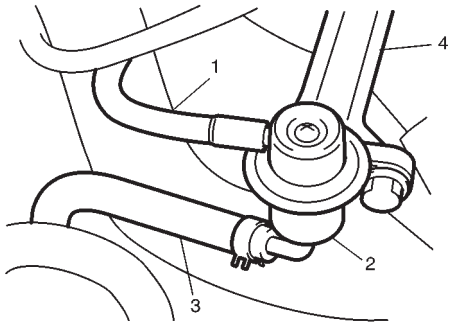
1) Remove fuel tank from body according to procedure described in Section 6C and remove fuel pump from fuel tank.

INSPECTION

Check fuel pump filter for evidence of dirt and contamination. If present, clean and check for presence of dirt in fuel tank.

INSTALLATION

Install fuel pump to fuel tank and then install fuel tank to body according procedure described in Section 6C.



FUEL PRESSURE REGULATOR

ON-VEHICLE INSPECTION

Perform fuel pressure inspection according to procedure described in FUEL PRESSURE INSPECTION in this section.

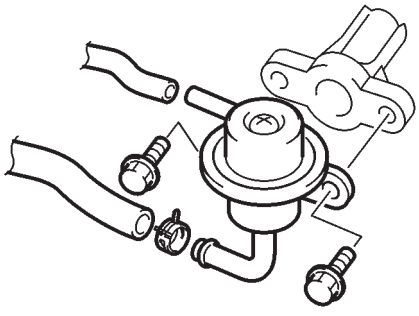
REMOVAL

1) Relieve fuel pressure according to procedure described in Section 6.
2) Disconnect battery negative cable at battery.
3) Remove air cleaner outlet hose referring to Section 6A.
4) Remove air cleaner case by removing its fastening bolts.
5) Disconnect vacuum hose (1) from fuel pressure regulator (2).
6) Disconnect fuel return hose (3) from fuel pressure regulator.

CAUTION:
A small amount of fuel may be released when hose is disconnected. Cover hose to be disconnected with a shop cloth.

7) Remove fuel pressure regulator from fuel delivery pipe (4).

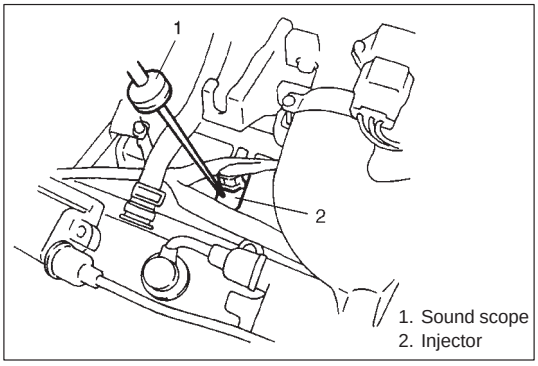
CAUTION:
A small amount of fuel may be released when it is from delivery pipe.
Place a shop cloth under delivery pipe so that released fuel is absorbed in it.



INSTALLATION

For installation, reverse removal procedure and note following precautions.

- Use new O-ring.
- Apply thin coat of spindle oil or gasoline to O-ring to facilitate installation.
- With engine “OFF” and ignition switch “ON”, check for fuel leaks around fuel line connection.

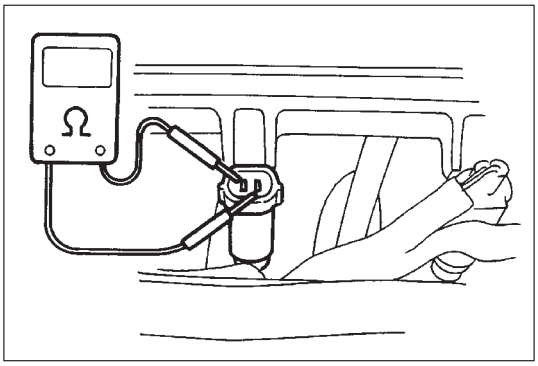


1. Sound scope
2. Injector

FUEL INJECTOR

ON-VEHICLE INSPECTION

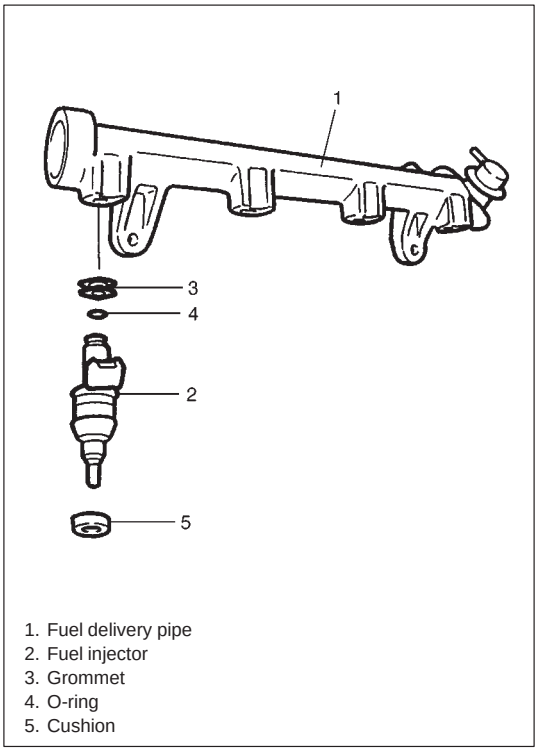
1) Using sound scope or such, check operating sound of injector when engine is running or cranking.
   Cycle of operating sound should vary according to engine speed.
   If no sound or an unusual sound is heard, preform B-2 FUEL INJECTOR AND ITS CIRCUIT CHECK in this section.



2) Disconnect coupler from injector, connect ohmmeter between terminals of injector and check resistance.

   Resistance of injector : 10 – 15 Ω

   If resistance is out of specification, replace.
3) Connect coupler to injector securely.



1. Fuel delivery pipe
2. Fuel injector
3. Grommet
4. O-ring
5. Cushion

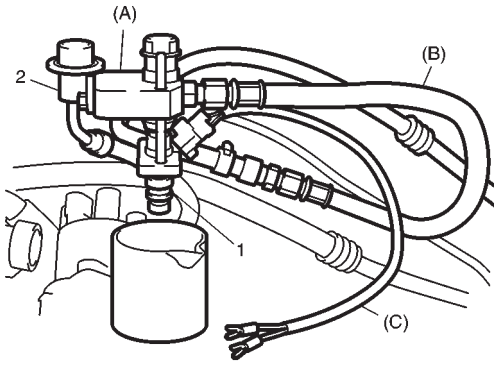
REMOVAL

1) Relieve fuel pressure according to procedure described in Section 6.
2) Disconnect battery negative cable at battery.
3) Remove air cleaner outlet hose referring to Section 6A.
4) Remove intake manifold stiffener.
5) Disconnect fuel injector couplers.
6) Remove fuel delivery pipe bolts.
7) Remove fuel injector(s).

CAUTION:
A small amount of fuel may come out after removal of fuel injectors, cover them with shop cloth.

INSPECTION

WARNING:
As fuel is injected in this inspection, perform in a well ventilated area and away from open flames.
Use special care to prevent sparking when connecting and disconnecting test lead to and from battery.



1) Install injector (1) and fuel pressure regulator (2) to special tool (injector checking tool).

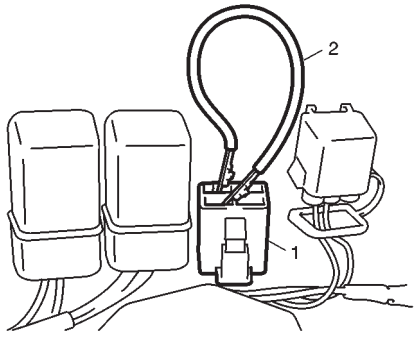
   Special Tool
   (A): 09912-58421

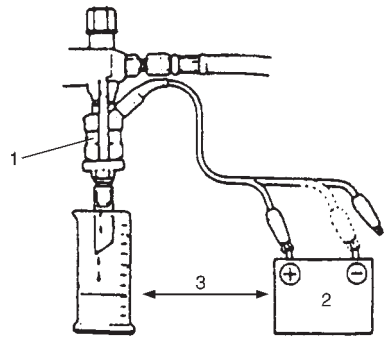
2) Connect special tools (hoses and attachment) to pipes of vehicle.

   Special Tool
   (B): 09912-58431

3) Connect special tool (test lead) to injector.

   Special Tool
   (C): 09930-88530





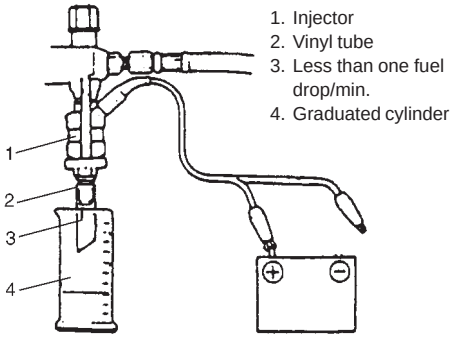
1. Injector
2. Battery
3. Keep as far apart as possible
4. Fuel pump relay coupler
5. Service wire

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) Remove fuel pump relay.
7) To operate fuel pump and apply fuel pressure to injector, connect two terminals of disconnected connecter (1) by using service wire (2) as shown in figure.

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

8) Apply battery voltage to injector for 15 seconds and measure injected fuel volume with graduated cylinder.
   Test each injector two or three times.
   If not within specification, replace injector.

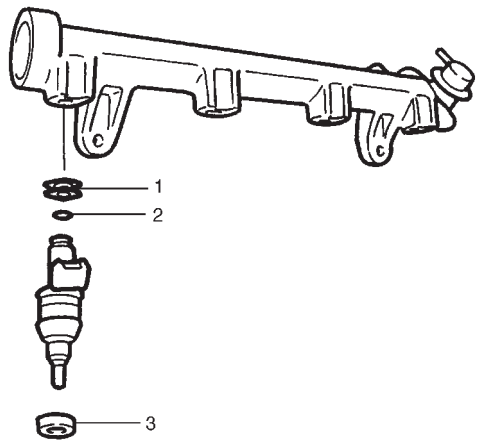
   Injected fuel volume:
   35 – 37 cc/15 sec. (1.18/1.23 – 1.25/1.30 US/Imp. oz/15 sec.) ... F8B
   38.3 – 40.7 cc/15 sec. (1.29/1.35 – 1.37/1.43 US/Imp. oz/15 sec.) ... F8D



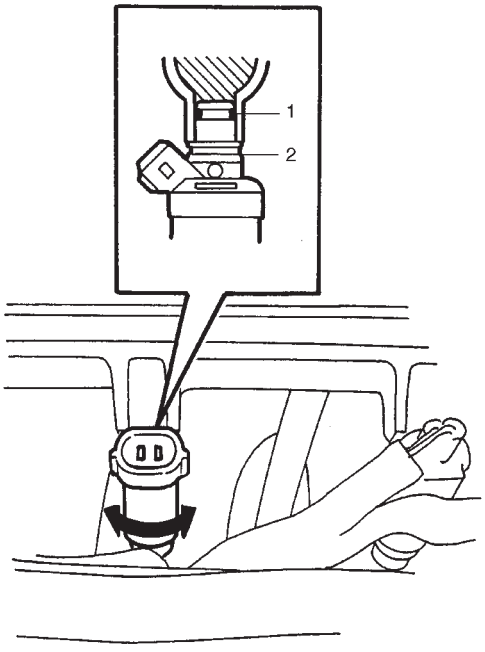
1. Injector
2. Vinyl tube
3. Less than one fuel drop/min.
4. Graduated cylinder

9) Check fuel leakage from injector nozzle. Do not operate injector for this check (but fuel pump should be at work). If fuel leaks more than following specification, replace.

Fuel leakage: Less than 1 drop/min.



1. Grommet
2. O-ring
3. Cushion

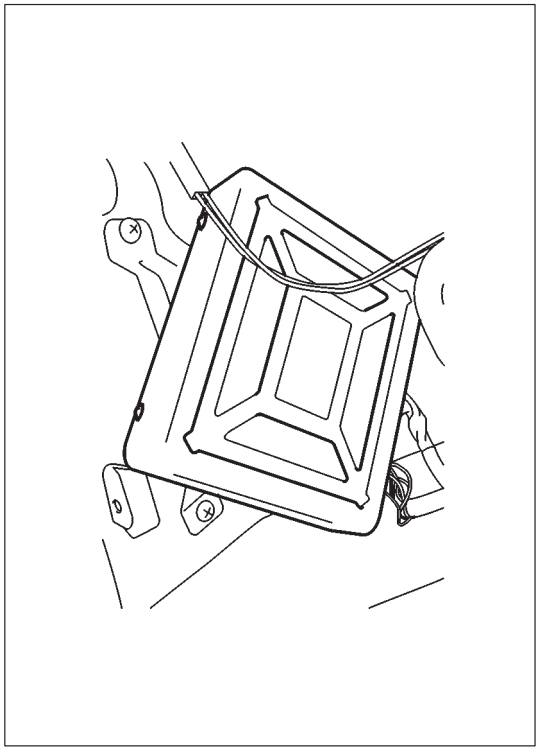


1. O-ring
2. Grommet

INSTALLATION

For installation, reverse removal procedure and note following precautions.

- Replace injector O-ring with new one using care not to damage it.
- Check if cushion is scored or damaged. If it is, replace with new one.
- Apply thin coat of fuel to O-rings and then install injectors into delivery pipe and intake manifold.
  Make sure that injectors rotate smoothly. If not, probable cause is incorrect installation of O-ring. Replace O-ring with new one.
- Tighten delivery pipe bolts and make sure that injectors rotate smoothly.
- With engine “OFF” and ignition switch “ON”, check for fuel leaks around fuel line connection.



ELECTRONIC CONTROL SYSTEM

ECM

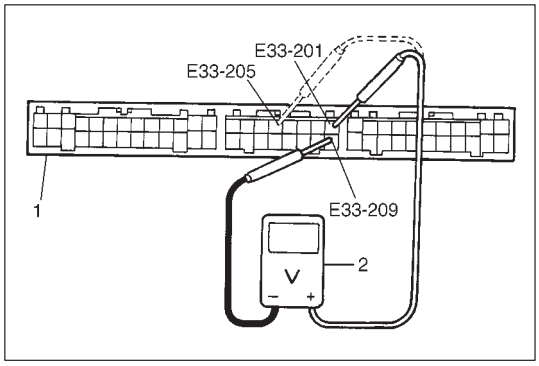
CAUTION:
As ECM consists of precision parts, be careful not to expose it to excessive shock.

REMOVAL

1) Disconnect battery negative cable at battery.
2) Remove ECM from body.
3) Disconnect couplers from ECM.

INSTALLATION

1) Install ECM to body.
2) Connect couplers to ECM securely.
3) Connect battery negative cable at battery.



MAP SENSOR

OUTPUT VOLTAGE CHECK

1) Remove ECM according to previously outlined.
2) Connect couplers (1) to ECM securely.
3) With coupler connected to ECM, connect digital type voltmeter (2) as shown and check that ECM supply voltage 4.75 – 5.25 V is applied to coupler terminal E33-201.

4) Check output voltage at coupler terminal E33-205.
Note that it varies with atmospheric pressure and altitude. Also, start engine, it it can, and check if output voltage varies.

Output voltage (ECM supply voltage 4.75 – 5.25 V, ambient temp. 10 – 40°C, 50 – 104°F)

ALTITUDE (Reference)		BAROMETRIC PRESSURE	OUTPUT VOLTAGE
(ft)	(m)	(kPa(mmHg))	(V)
0	0	101.3 (760)	3.3 – 3.9
1000	305	97.7 (733)	3.2 – 3.8
2000	610	94.3 (707)	3.1 – 3.7
3000	914	90.9 (682)	3.0 – 3.6
4000	1219	87.7 (658)	3.0 – 3.5
5000	1524	84.5 (634)	2.9 – 3.4
6000	1829	81.5 (611)	2.8 – 3.3
7000	2133	78.5 (589)	2.7 – 3.2
8000	2438	75.6 (567)	2.6 – 3.1
9000	2743	72.8 (546)	2.5 – 3.0
10000	3048	70.1 (526)	2.5 – 3.0

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

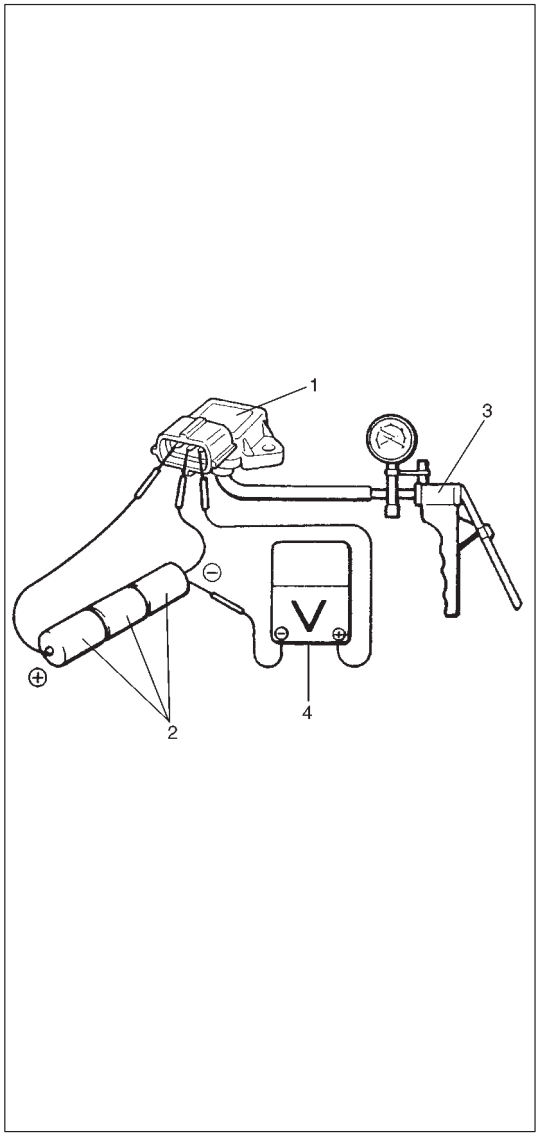
If check result is not satisfactory in previous step 3) or 4), check MAP sensor and its circuit according to Diagnostic Flow Table for Code No. 11 (P0105).

NOTE:
If output voltage does not vary when engine is started, it is possible that vacuum passage is clogged. Clean them.
Another possibility is that filter in MAP sensor is clogged from freezing. If it is suspected, leave it at room temperature (20°C, 68°F) for a while and recheck.

5) Upon completion of checking, install ECM and connect ECM couplers securely.

MAP SENSOR INDIVIDUAL CHECK

1) Remove MAP sensor referring MAP sensor removal.



2) Arrange 3 new 1.5 V batteries in series (2) (check that total voltage is 4.5 – 5.0 V) and connect its positive terminal to "Vcc" terminal of MAP sensor (1) and negative terminal to "Ground" terminal. Then check voltage between "Vout" and "Ground". Also, check if voltage reduces when vacuum is applied up to 40 cmHg by using vacuum pump (3) and volt meter (4).

Output voltage (Vin voltage 4.5 – 5.0 V, ambient temp. 20 – 30°C, 68 – 86°F)

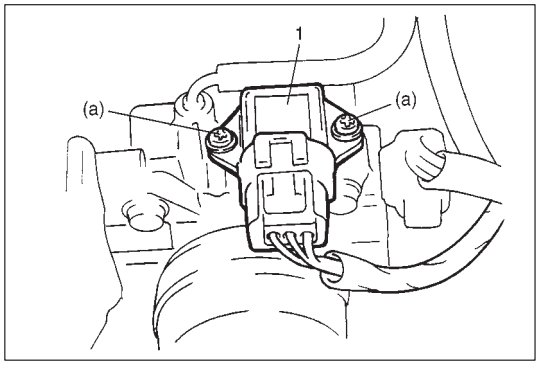
ALTITUDE (Reference)		BAROMETRIC PRESSURE	OUTPUT VOLTAGE
(ft)	(m)	(kPa(mmHg))	(V)
0 | 2000	0 | 610	760 | 707	3.1 – 3.6
2001 | 5000	611 | 1524	Under 707 over 634	2.8 – 3.4
5001 | 8000	1525 | 2438	Under 634 over 567	2.6 – 3.1
8001 | 10000	2439 | 3048	Under 567 over 526	2.4 – 2.9

If check result is not satisfactory, replace MAP sensor.

3) Install MAP sensor referring to MAP SENSOR INSTALLATION.

REMOVAL

1) Disconnect battery negative cable at battery.
2) Disconnect coupler from MAP sensor.
3) Remove MAP sensor from throttle body.

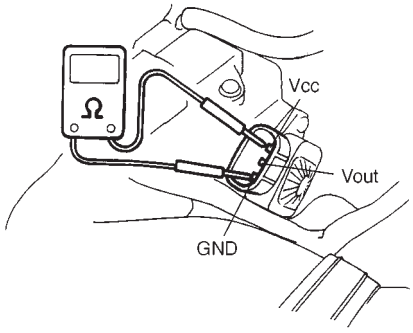


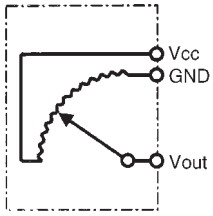
INSTALLATION

1) Before installation check vacuum passage hole for clogged install MAP sensor (1) to throttle body.

Tightening Torque
(a): 2.0 N·m (0.2 kg-m, 1.5 lb-ft)

2) Connect coupler to MAP sensor.
3) Connect battery negative cable to battery.





"GND": Ground terminal
"Vcc": Reference voltage terminal
"Vout": Output voltage terminal

TP SENSOR

INSPECTION

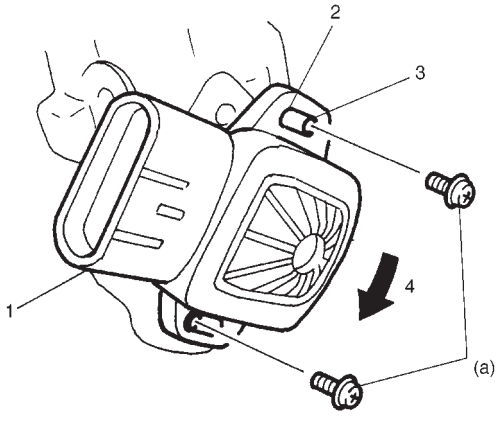
1) Disconnect negative cable at battery and coupler from TP sensor.
2) Using ohmmeter, check resistance between terminals under each condition given in table below.

TERMINAL	RESISTANCE	
Between "Vcc" and "GND" terminals	4 – 6 kΩ	
Between "Vout" and "GND" terminals	Throttle valve is at idle position	0.6 – 1.2 kΩ
	Throttle valve is fully opened	3.2 – 5.4 kΩ

NOTE:
There should be more than 1.5 kΩ resistance difference between when throttle valve is at idle position and when it is fully open.

If check result is not satisfactory, replace TP sensor.

3) Connect TP sensor coupler securely.
4) Connect negative cable to battery.



REMOVAL

1) Disconnect battery negative cable at battery.
2) Disconnect coupler from TP sensor.
3) Remove TP sensor from throttle body.

INSPECTION

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 and turn TP sensor clockwise (4) so that those holes align.

   Tightening Torque
   (a): 2.5 N·m (0.25 kg-m, 2.0 lb-ft)

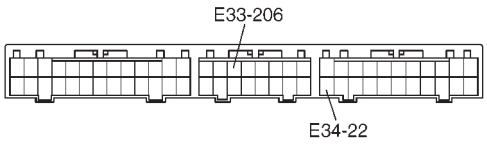
2) Connect coupler to TP sensor securely.
3) Connect battery negative cable to battery.

ADJUSTMENT

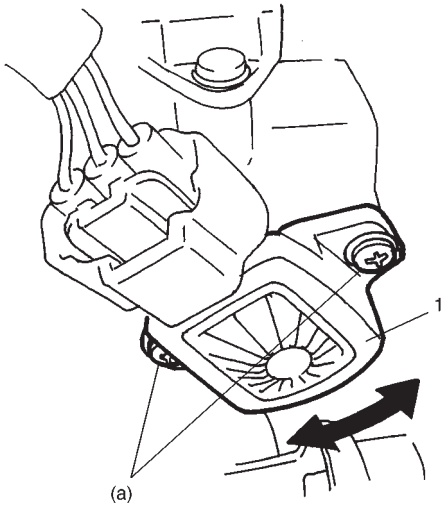
1) Warm up engine to normal operating temperature.
1) Loosen TP sensor screws.

[Not using SUZUKI scan tool]

TERMINAL ARRANGEMENT OF ECM COUPLER (VIEWED FROM HARNESS SIDE)



3) [Using SUZUKI scan tool]
   Connect SUZUKI scan tool to DLC with ignition switch OFF and check “TP SENSOR VOLT” value displayed on scan tool by using “DATA LIST” mode.
   [Not using SUZUKI scan tool]
   Remove ECM as previously outlined and with couplers connected to ECM, connect digital type voltmeter between “E33-206” and “E34-22” terminal.



4) Turn TP sensor (1) clockwise or counterclockwise and tighten TP sensor screw at a position where voltage as specified below is obtained.

   TP sensor output voltage when throttle is fully close:
   0.805 ± 0.025 V

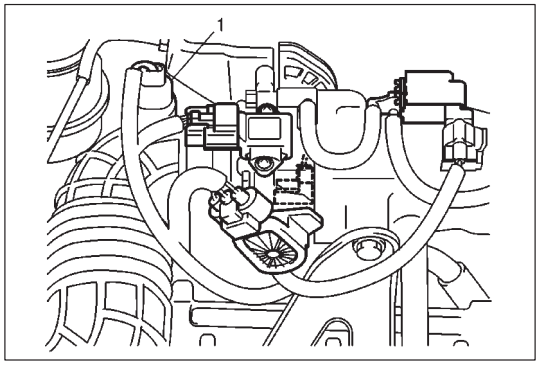
5) Tighten TP sensor screw to specified torque.

   Tightening Torque
   (a): 2.0 N·m (0.20 kg-m, 2.0 lb-ft)

6) Check to make sure that TP sensor voltage is as shown below when throttle is fully open.

   TP sensor output voltage when throttle is fully open:
   4.2 ± 0.5 V

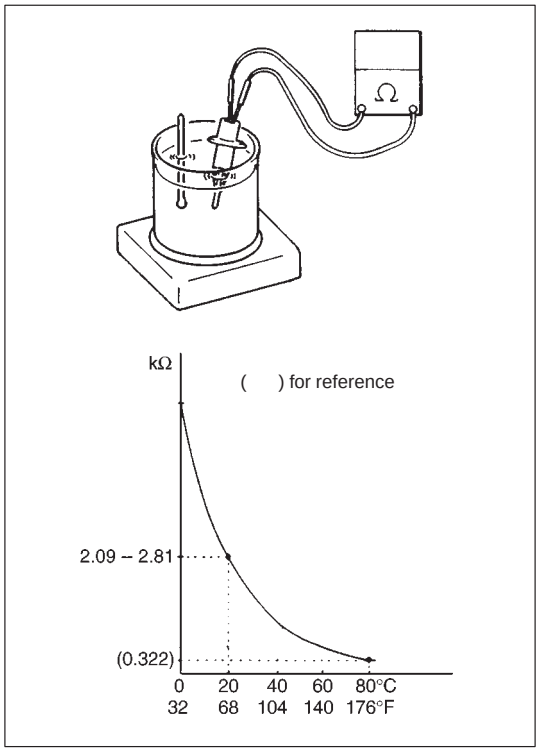
7) Install ECM as previously outlined.
8) With ignition switch at OFF position, disconnect negative cable at battery for 30 seconds and connect it.



IAT SENSOR

REMOVAL

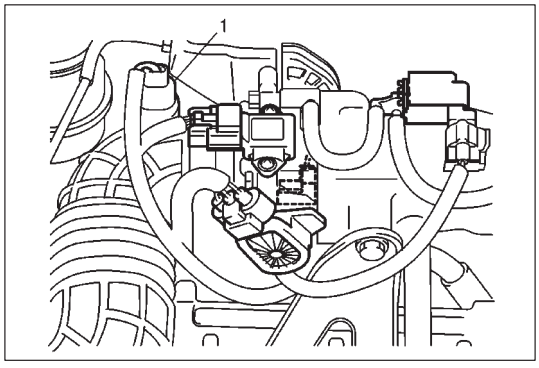
1) Disconnect battery negative cable at battery.
2) Disconnect coupler from IAT sensor (1).
3) Remove IAT sensor from air cleaner outlet hose.



INSPECTION

Immerse temperature sensing part of IAT sensor in water (or ice) and measure resistance between sensor terminals while heating water gradually.

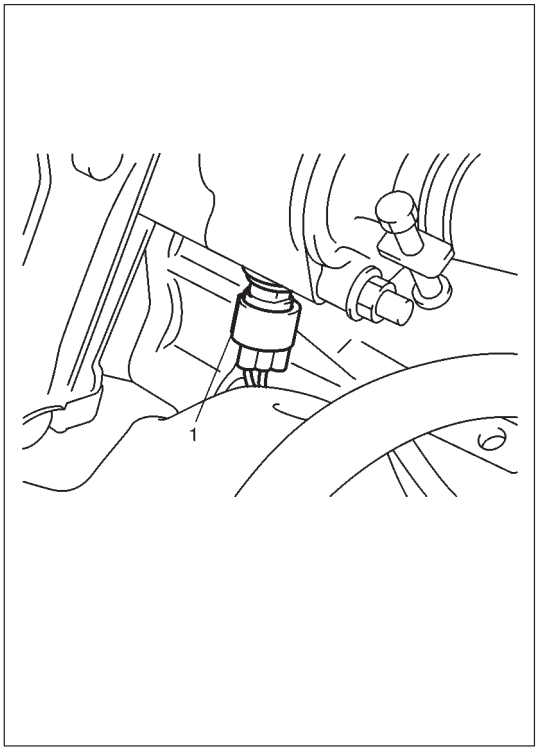
If measured resistance doesn't show such characteristic as shown in left figure, replace IAT sensor.



INSTALLATION

Reverse removal procedure noting the following.

- Clean mating surfaces of IAT sensor (1) and air cleaner outlet hose.
- Connect IAT sensor coupler securely.



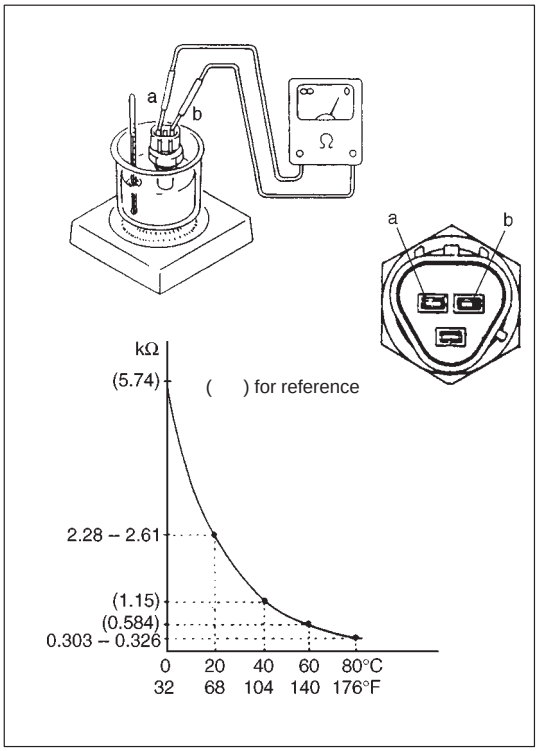
ECT SENSOR

REMOVAL

1) Disconnect battery negative cable at battery.
2) Drain coolant referring to Section 6B.

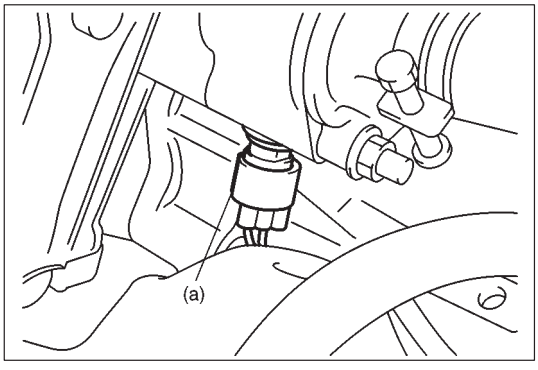
> **WARNING:**
> **To help avoid danger of being burned, do not remove radiator cap while engine and radiator are still hot. Scalding fluid and steam can be blown out under pressure it cap is taken off too soon.**

3) Disconnect coupler from ECT sensor.
4) Remove ECT (1) sensor from water outlet pipe.



INSPECTION

Immerse temperature sensing part of ECT sensor in water (or ice) and measure resistance between sensor terminals while heating water gradually.
If measured resistance doesn't show such characteristic as shown in left figure, replace ECT sensor.



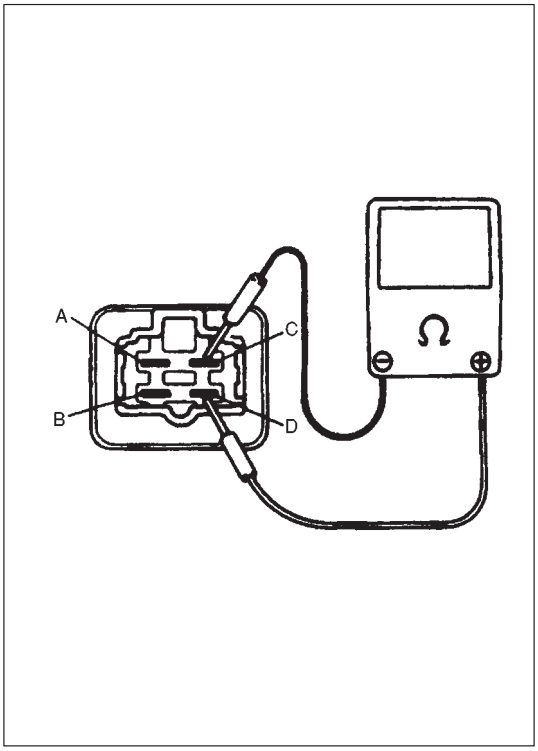
INSTALLATION

Reverse removal procedure noting the following.

- Clean mating surfaces of ECT sensor and water outlet pipe.
- Check O-ring for damage and replace if necessary.
- Tighten ECT sensor to specified torque.

  Tightening Torque
  (a): 12 N·m (1.2 kg-m, 9.0 lb-ft)

- Connect coupler to ECT sensor securely.
- Refill coolant referring to Section 6B.

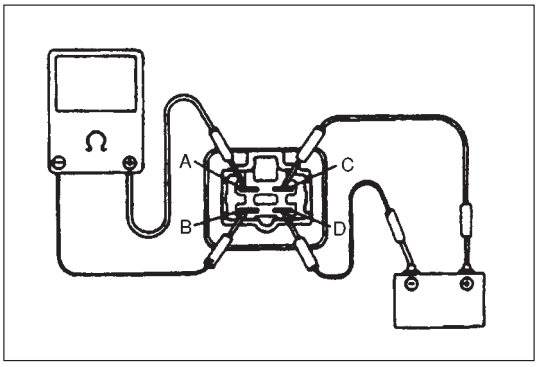


MAIN RELAY/FUEL PUMP RELAY

INSPECTION

1) Disconnect negative cable at battery.
2) Remove ECM main/fuel pump relay from main fuse box after disconnecting its coupler.
3) Check resistance between each two terminals as in table below. If check results are as specified, proceed to next operation check. If not, replace.

TERMINALS	RESISTANCE
Between A and B	∞ (infinity)
Between C and D	80 – 100 Ω at 20°C (68°F)



4) Check that there is continuity between terminals “A” and “B” when battery is connected to terminals “C” and “D”. If found defective, replace.
5) Install the relay and connect its coupler securely.

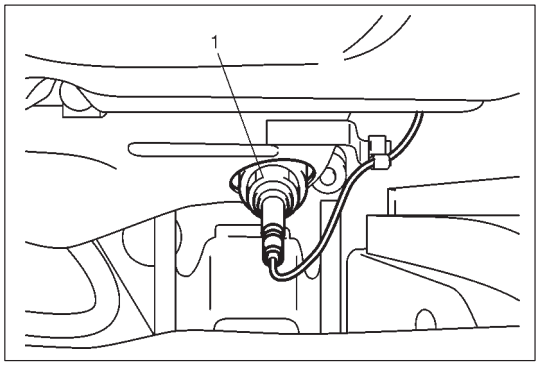
OXYGEN SENSOR

INSPECTION

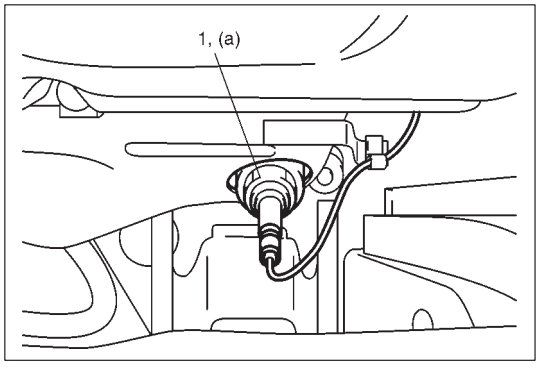
Inspect oxygen sensor referring to flow table of diagnostic trouble code No. 14 (P0130).

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) Disconnect coupler of oxygen sensor and release its wire harness from clamps.
3) Remove oxygen sensor (1) from exhaust manifold.



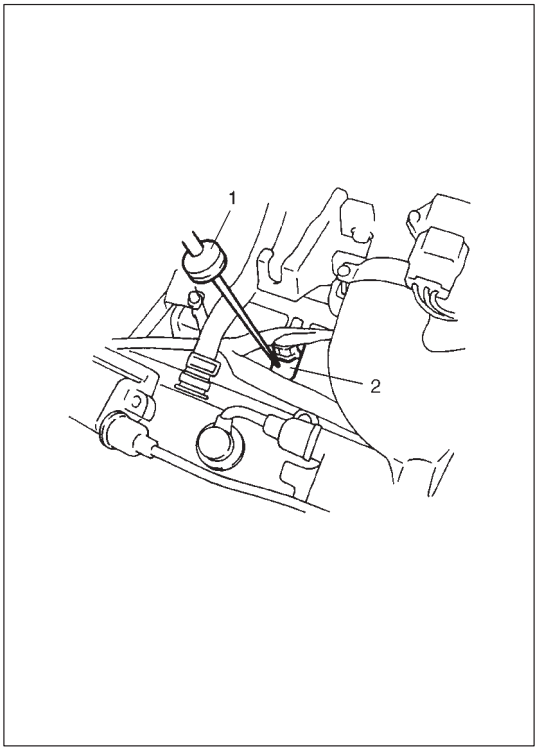
INSTALLATION

Reverse removal procedure noting the followings.

- Tighten oxygen sensor (1) to specified torque.

  Tightening Torque
  (a): 45 N·m (4.5 kg-m, 32.5 lb-ft)

- Connect coupler of oxygen sensor and clamp wire harness securely.
- After installing oxygen sensor, start engine and check that no exhaust gas leakage exists.



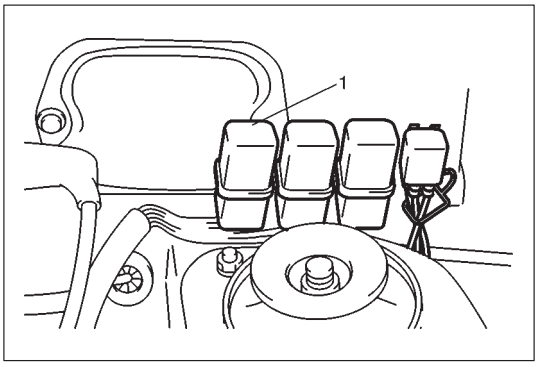
FUEL CUT OPERATION

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) 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 (2) by using sound scope (1) 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.



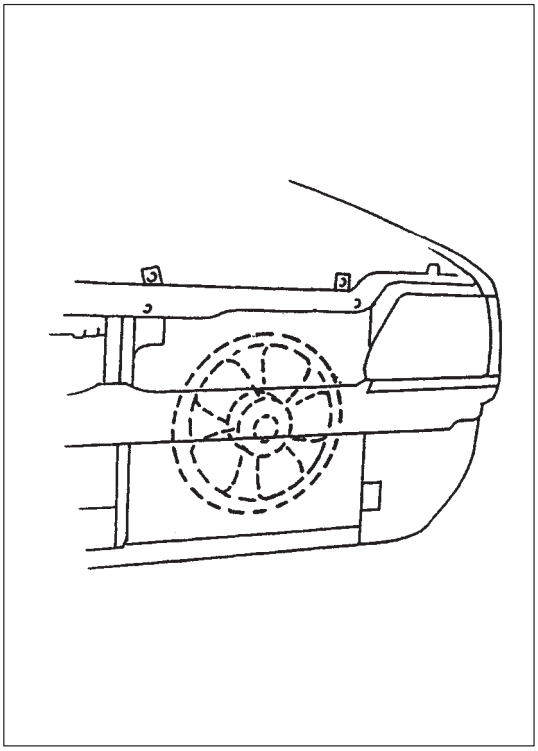
A/C COMPRESSOR CONTROL RELAY (IF EQUIPPED)

INSPECTION

1) Disconnect negative cable at battery.
2) Remove A/C compressor control relay from its connecter.
3) Structure of A/C compressor control relay (1) is the same as that of main relay. Check its resistance and operation using the same procedure as that for main relay.
   If found defective, replace.

CMP SENSOR

Refer to Section 6F for removal, installation, inspection and adjustment of CMP sensor.



RADIATOR FAN CONTROL SYSTEM

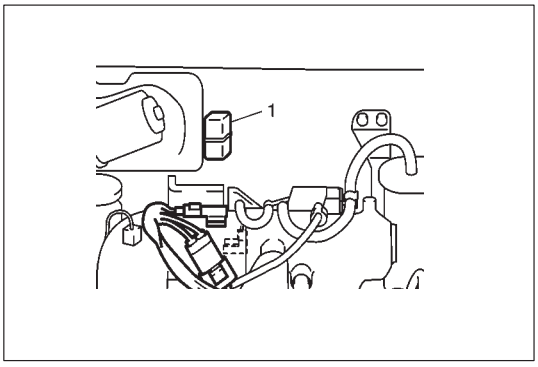
SYSTEM INSPECTION

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.

Start engine and keep it running to warm it up.
Now check to ensure that radiator fan is started under either following condition:

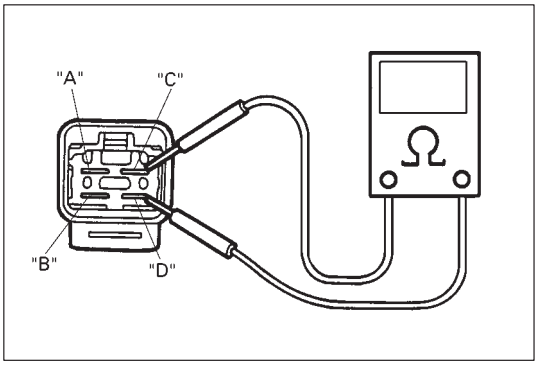
- A/C compressor magnet clutch operates (if equipped A/C).
- Engine coolant temperature value on scan tool is over 98 °C (208 °F).

If check result is not satisfactory, check RFC relay, wire harness, ECT sensor, ECM.



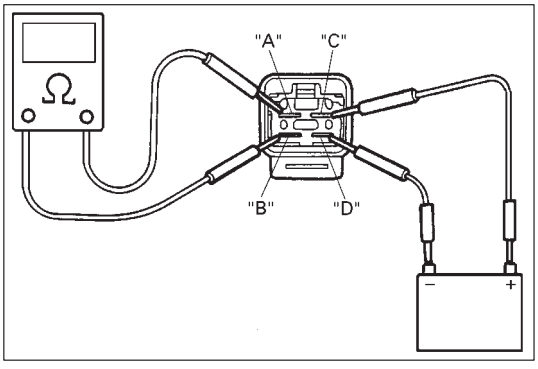
RADIATOR FAN CONTROL RELAY (RFC RELAY) INSPECTION

1) Disconnect negative cable at battery.
2) Remove RFC relay (1) from its connecter.

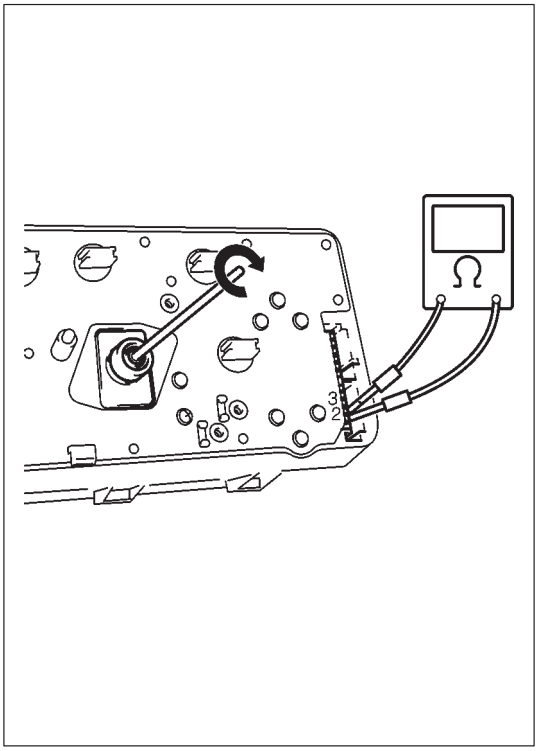


3) Check resistance between each two terminals as in table below. If check results are as specified, proceed to next operation check. If not, replace.

TERMINALS	RESISTANCE
Between "A" and "B"	∞ (infinity)
Between "C" and "D"	90 – 110 Ω at 20°C (68°F) . . omron made
	60 – 88 Ω at 20°C (68°F) . . . interface made



4) Check that there is continuity between terminals "A" and "B" when battery is connected to terminals "C" and "D". If found defective, replace.
5) Install relay and connect its coupler securely.



VEHICLE SPEED SENSOR (VSS)

INSPECTION

1) Remove combination meter from instrument panel.
2) Connect ohmmeter between vehicle speed sensor terminal and ground terminal of combination meter and turn cable joint of speedometer with a screwdriver.
   Ohmmeter indicator should move back and forth between continuity and infinity 4 times while cable joint is turned one full revolution.
   Replace speedometer, if check result is not satisfactory.

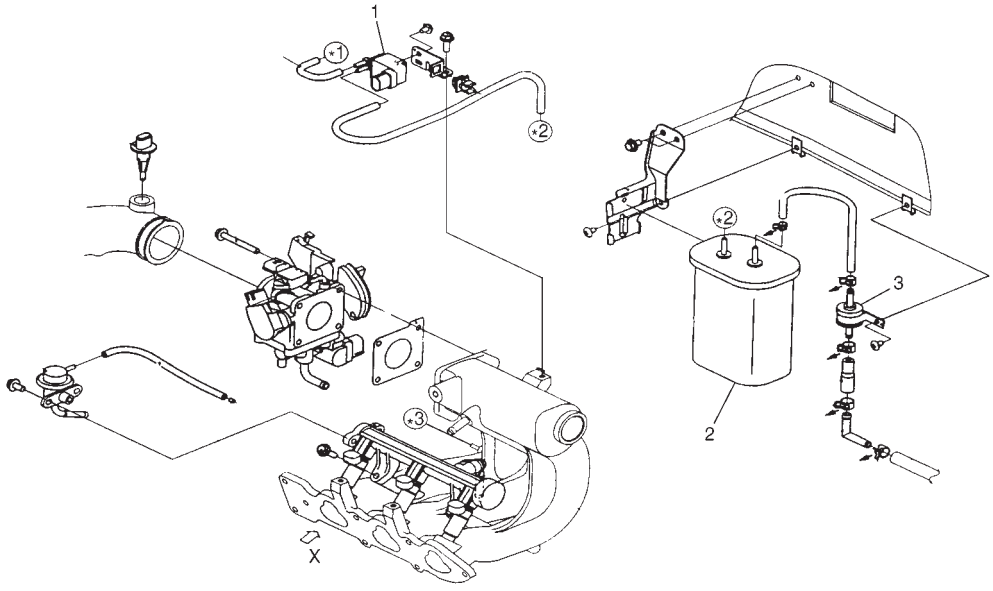
EVAP CONTROL SYSTEM

EVAP CANISTER PURGE INSPECTION

NOTE:

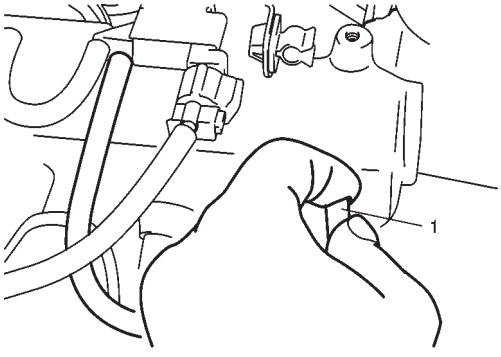
Before inspection, check to make sure that gear shift lever is in neutral position (with A/T model, selector lever in "P" range) and that parking brake lever is pulled all the way up.

F8D engine

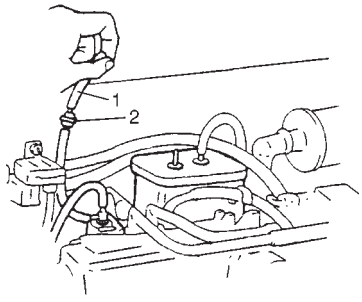


1. EVAP canister purge valve
2. EVAP canister
3. Tank pressure control valve

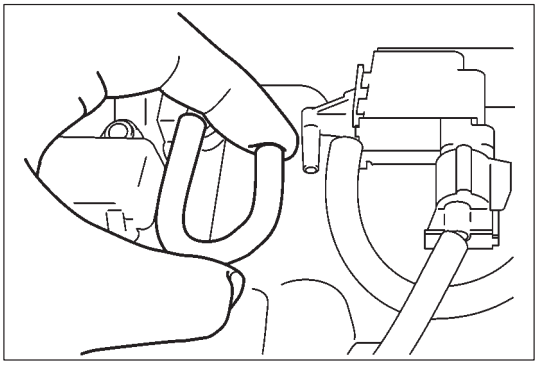
F8D engine



F8B engine

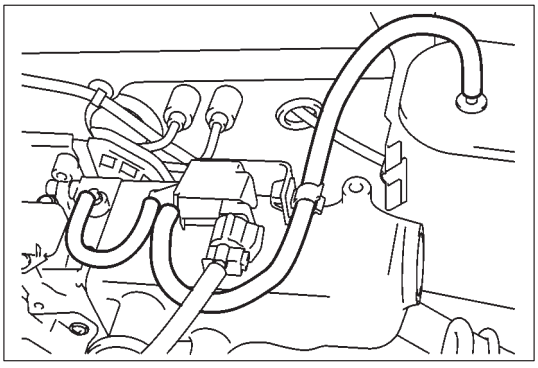


1) Warn up engine to normal operating temperature.
2) Disconnect purge hose (1) from EVAP canister.
3) Place finger against the end of disconnected hose and check that vacuum is not felt there when engine is running at idle speed.
4) Also check that vacuum is felt when engine speed is increased to higher than about 3000 r/min.
   If check result is not satisfactory, check vacuum passage, hoses, EVAP canister purge valve, 1-way valve (if equipped) (2), wire harness and ECM.
   Refer to TABLE B-5 EVAPORATIVE EMISSION CONTROL SYSTEM CHECK.



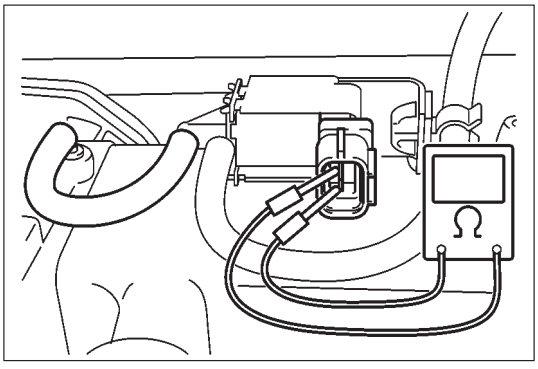
VACUUM PASSAGE INSPECTION

Start engine and run it at idle speed. Disconnect vacuum hose from EVAP canister purge valve. 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

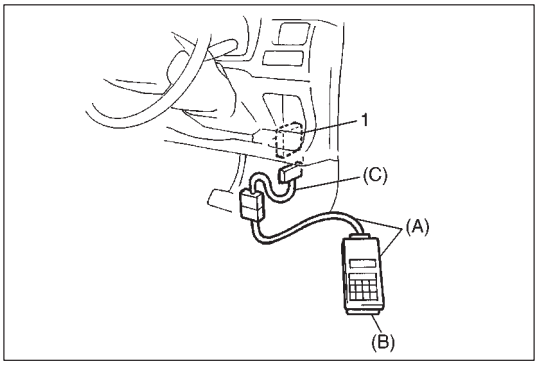
Check hoses for connection, leakage, clog and deterioration.
Replace as necessary.



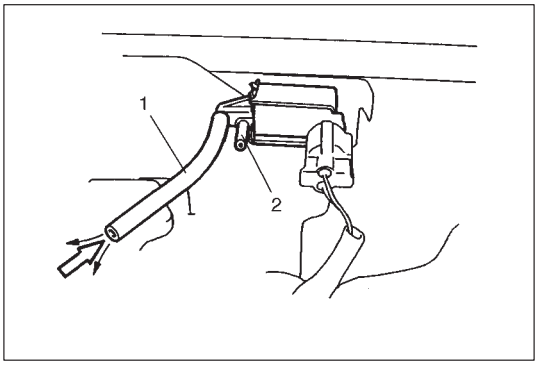
EVAP CANISTER PURGE VALVE INSPECTION

[Using SUZUKI scan tool]

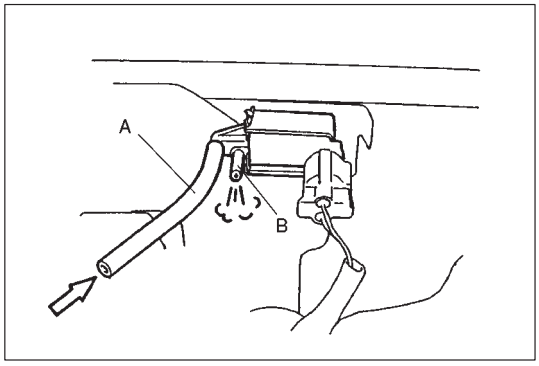
1) With ignition switch OFF, disconnect coupler from EVAP canister purge valve.
2) Check resistance between two terminals of EVAP canister purge valve.
   Resistance of EVAP canister purge valve:
   28 – 36 Ω at 20°C (68°F) F8B engine
   37 – 44 Ω at 20°C (68°F) F8D engine
   If resistance is as specified, proceed to next operation check. If not, replace.
3) Connect coupler to EVAP canister purge valve.
4) Connect SUZUKI scan tool to DLC (1) with ignition switch OFF.



Special Tool
(A): 09931-76011 (SUZUKI scan tool)
(B): Mass Storage Cartridge
(C): 09931-76030 (16/14-pin DLC cable)



5) Disconnect vacuum hoses from intake manifold.
   Blow into hose (1). Air should not come out of nozzle (2).

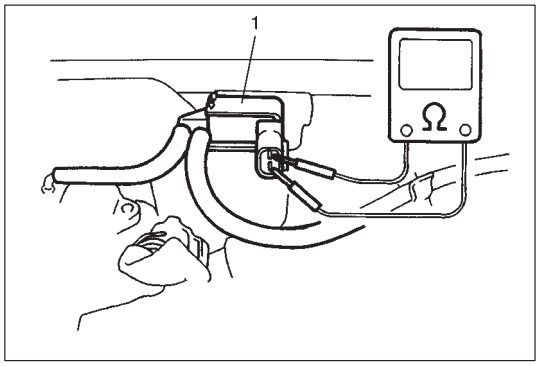


6) Open EVAP canister purge valve using “MISC TEST” mode of SUZUKI scan tool with ignition switch ON. In this state, blow hose “A”.
Air should come out of nozzle “B”.

WARNING:
Do not suck the air through valve. Fuel vapor inside valve is harmful.

If check result is not as described, check wire harnesses for open or short. If it is in good condition, replace EVAP canister purge valve and recheck.

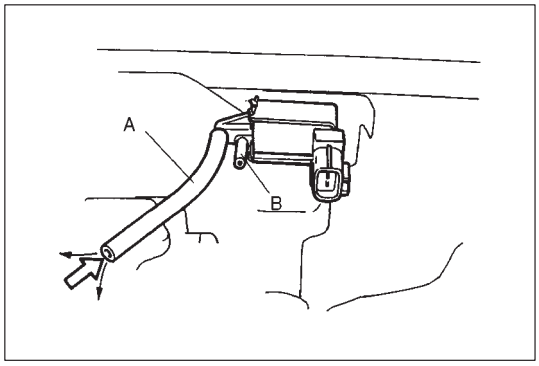
7) Connect vacuum hoses.



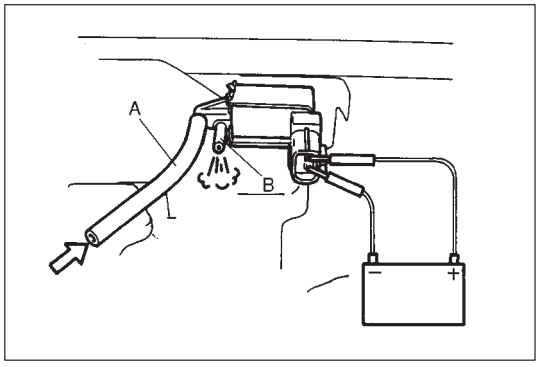
[Not using SUZUKI scan tool]
1) With ignition switch OFF, disconnect coupler from EVAP canister purge valve (1).
2) Check resistance between two terminals of EVAP canister purge valve (1).

Resistance of EVAP canister purge valve:
28 – 36 Ω at 20°C (68°F) F8B engine
37 – 44 Ω at 20°C (68°F) F8D engine

If resistance is as specified, proceed to next operation check. If not, replace.



3) Disconnect vacuum hoses from intake manifold.
4) With coupler disconnected, blow into hose “A”. Air should not come out of hose “B”.

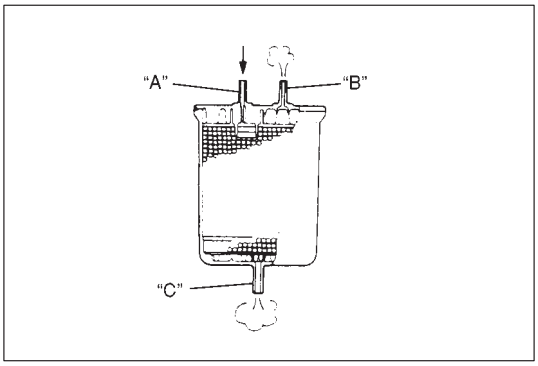


5) Connect 12V-battery to EVAP canister purge valve terminals. In this state, blow hose “A”.
Air should come out of hose “B”.

WARNING:
Do not suck the air through valve. Fuel vapor inside valve is harmful.

If check result is not as described, replace EVAP canister purge valve.

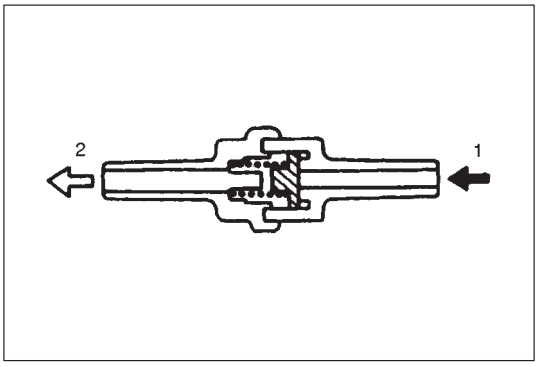
6) Connect vacuum hoses.
7) Connect EVAP canister purge valve coupler securely.



EVAP CANISTER/1-WAY VALVE INSPECTION

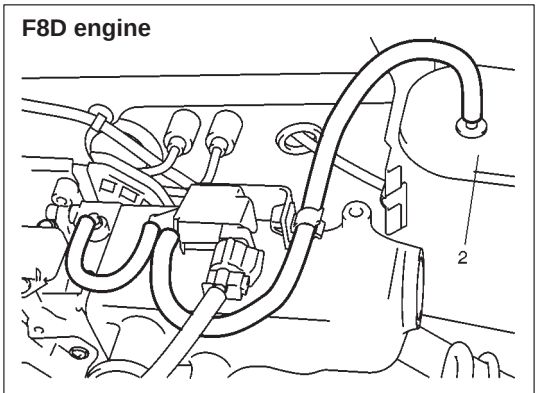
WARNING:
DO NOT SUCK nozzles on canister/1-way valve. Fuel vapor inside canister/1-way valve is harmful.

1) Disconnect vacuum hoses from EVAP canister.
2) When air is blown into pipe "A", there should be no restriction of flow through purge pipes "B" and "C".
3) If operation differs from above description, EVAP canister must be replaced.

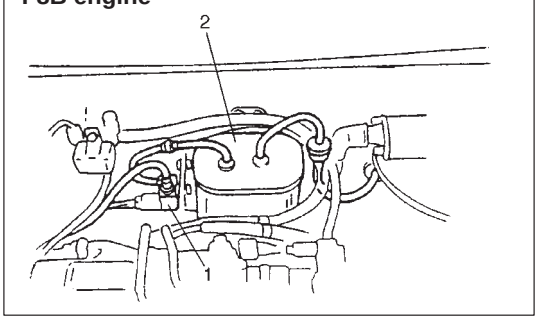


4) Disconnect vacuum hoses from 1-way valve (F8B engine).
5) Air should pass through valve smoothly from EVAP canister side (green side of valve) (1) when blown hard.
6) Air should not pass through valve from EVAP canister purge valve (2) side to EVAP canister side.
7) If operation differs from above description, 1-way valve must be replaced.

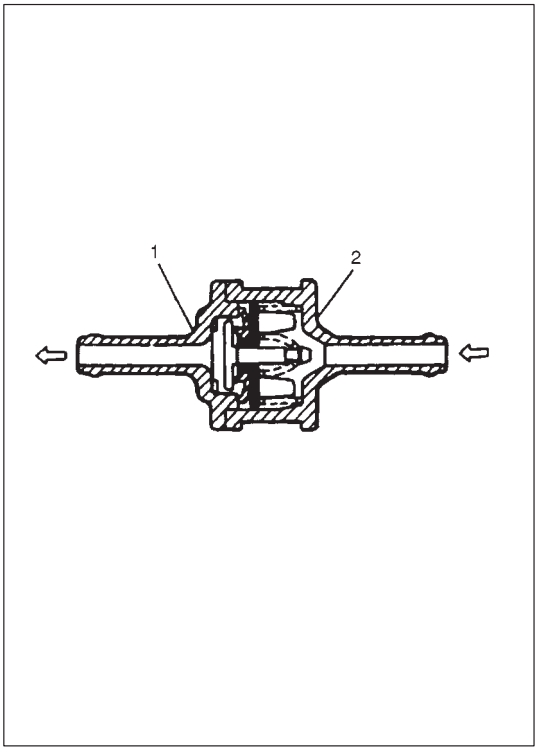
F8D engine



F8B engine



8) Connect hoses to canister (2) and canister purge valve (1).



TANK PRESSURE CONTROL VALVE INSPECTION

1) Remove tank pressure control valve installed on the side of EVAP canister.
2) Air should pass through valve smoothly from fuel tank side (3) (black side (2) of check valve) to orange side (1) when blown hard.
3) From orange side, even when blown softly, air should come out of black side.
4) If air doesn't pass through valve in step 2) or hard blow is required in step 3), replace tank pressure control valve.

WARNING:
DO NOT SUCK air through tank pressure control valve. Fuel vapor inside the valve is harmful.

5) Install tank pressure control valve.

NOTE:
When connecting tank pressure control valve between hoses, refer to left figure for installing direction.

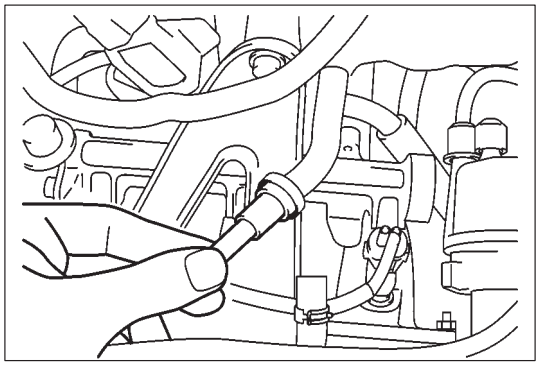
PCV SYSTEM

NOTE:

Be sure to check that there is no obstruction in PCV valve or its hoses before checking engine idle speed/IAC duty, for obstructed PCV valve or hose hampers its accurate checking.

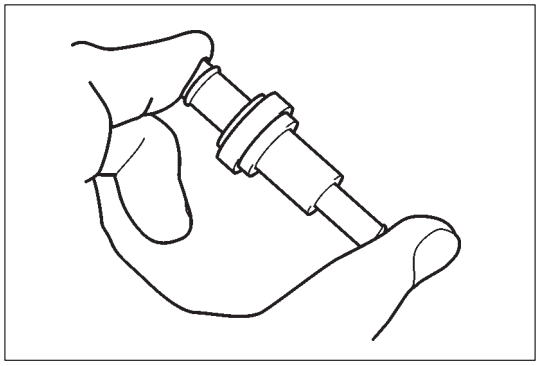
PCV HOSE INSPECTION

Check hoses for connection, leakage, clog and deterioration. Replace as necessary.



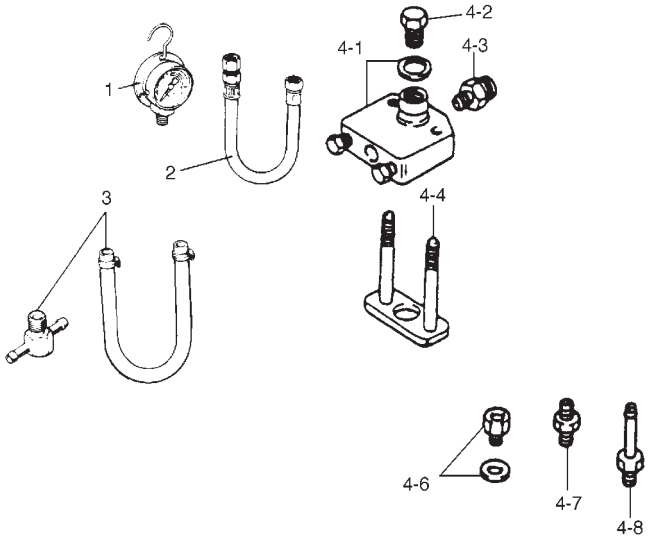
PCV VALVE INSPECTION

1) Disconnect PCV valve from cylinder head cover and install plug to head cover hole.
2) Run engine at idle speed.
3) Place your finger over end of PCV valve to check for vacuum. If there is no vacuum, check for clogged valve. Replace as necessary.



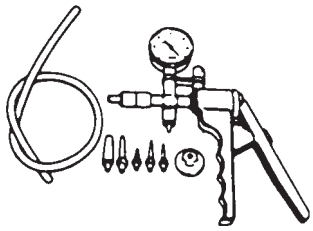
4) After checking vacuum, stop engine and remove PCV valve. Shake valve and listen for the rattle of check needle inside the valve.
   If valve does not rattle, replace it.
5) After checking, remove plug and install PCV valve.

SPECIAL TOOLS

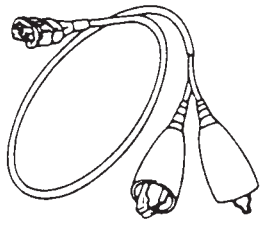


1. Pressure gauge
   09912-58441
2. Pressure hose
   09912-58431
3. 3-way joint & hose
   09912-58490
4. Checking tool set
   09912-58421

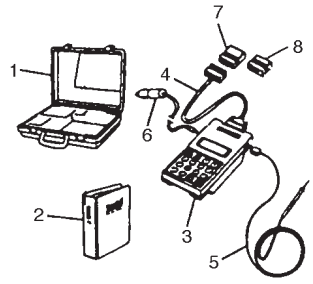
4-1. Tool body & washer
4-2. Body plug
4-3. Body attachment
4-4. Holder
4-5. Return hose & clamp
4-6. Body attachment-2 & washer
4-7. Hose attachment-1
4-8. Hose attachment-2



09917-47910
Vacuum pump gauge

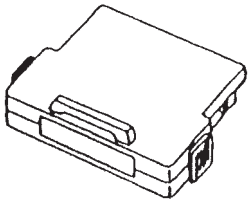


09930-88530
Injector test lead

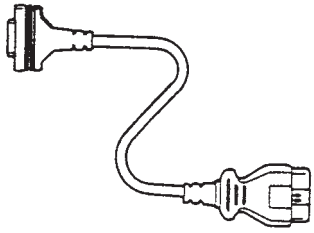


09931-76011
SUZUKI scan tool (Tech 1A) kit

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



Mass storage cartridge



09931-76030
16/14 pin DLC cable

SECTION 6F

IGNITION SYSTEM

CONTENTS

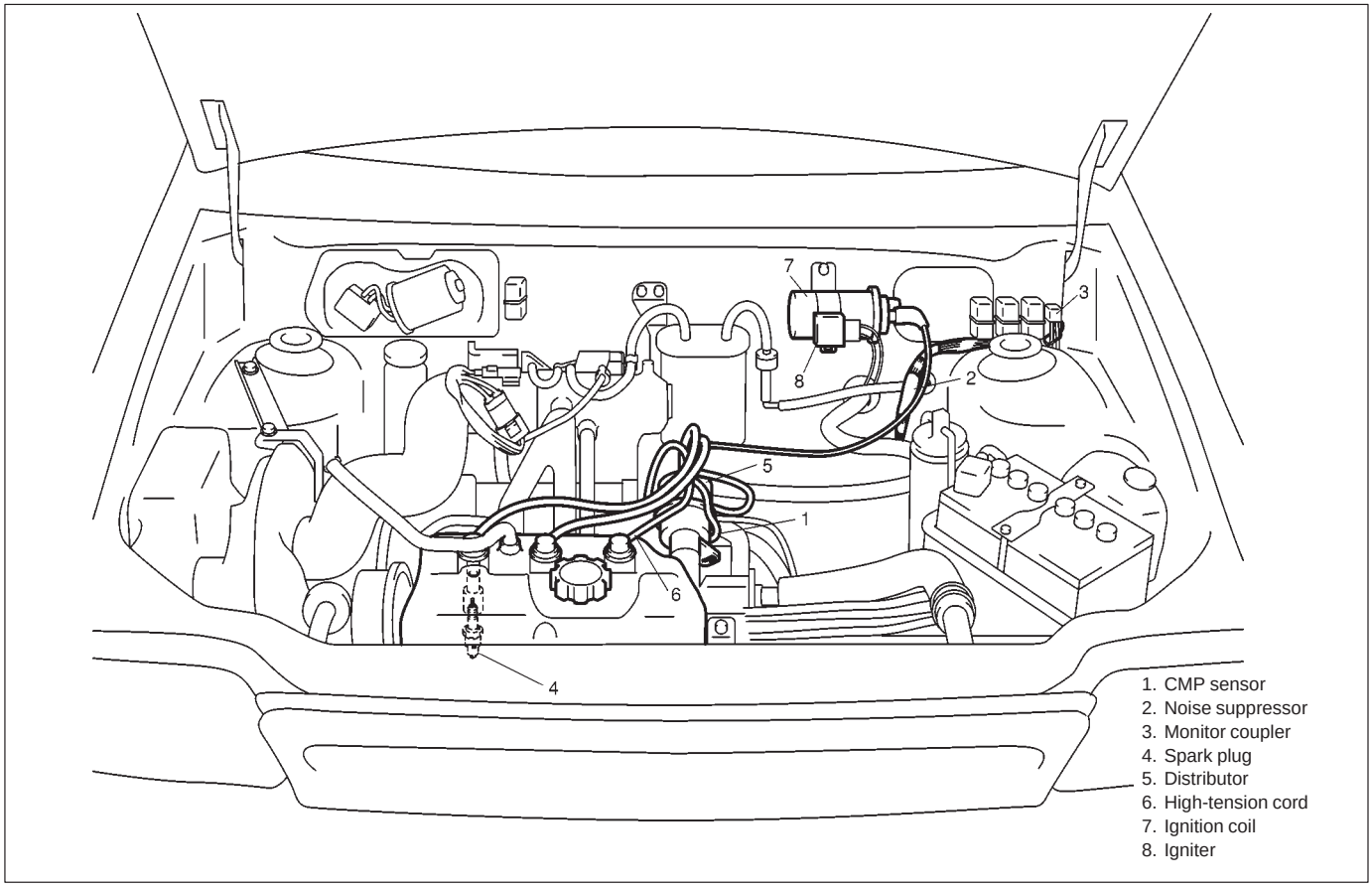
GENERAL DESCRIPTION 6F- 2
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DIAGNOSIS 6F- 4
Diagnostic Flow Table 6F- 4
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High-Tension Cords 6F- 6
Spark Plugs 6F- 7
Noise suppressor 6F- 8
Igniter 6F- 8
Ignition Coil 6F- 9
Distributor 6F- 9
Ignition Timing 6F-11
DISTRIBUTOR UNIT 6F-13
SPECIAL TOOLS 6F-15

GENERAL DESCRIPTION

The ignition system used for this vehicle has an electronic ignition control system and consists of the following parts.

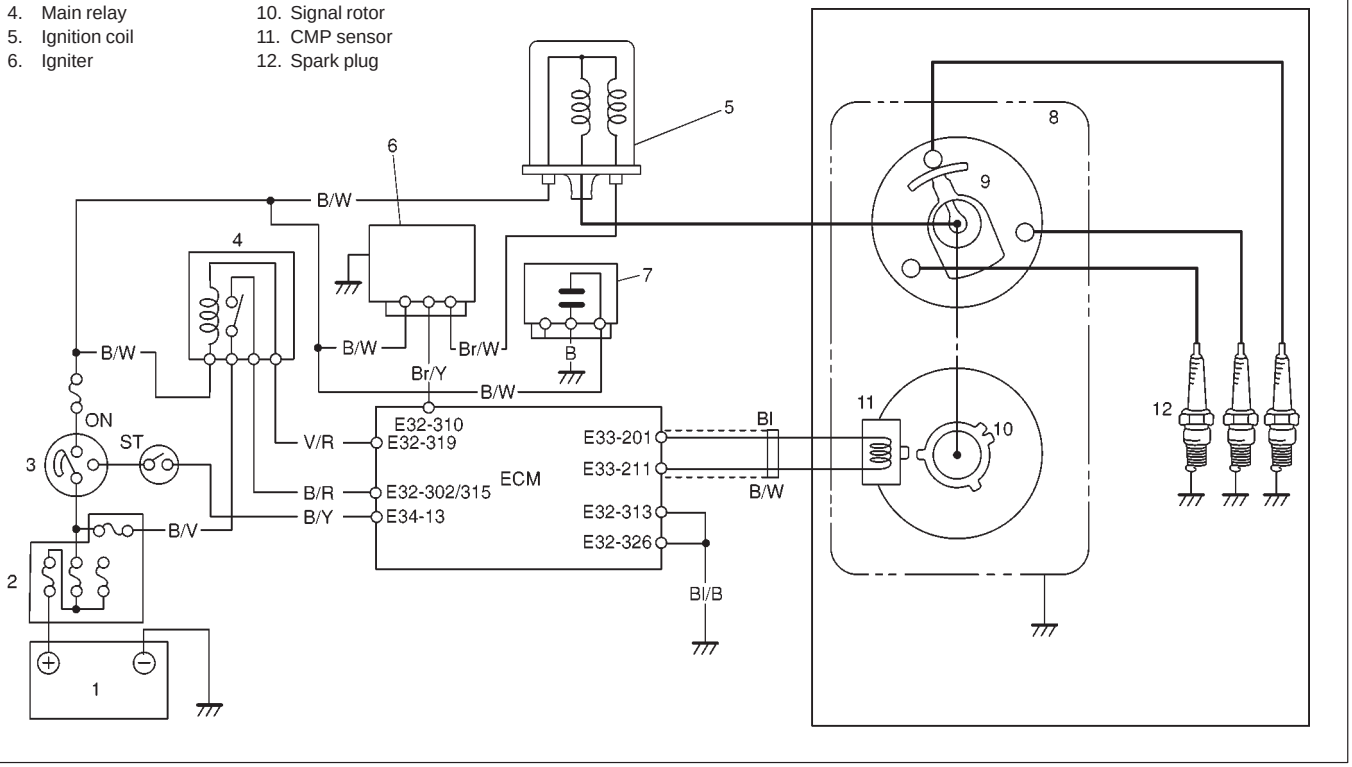
- ECM
  It detects the engine condition through the signals from the sensors, determines the most suitable ignition timing and time for electricity to flow to the primary coil and sends a signal to the igniter.
- Igniter
  It turns ON and OFF the primary current of the ignition coil according to the signal from ECM.
- Ignition coil
  When the ignition coil primary current is turned OFF, a high voltage is induced in the secondary winding.
- Distributor
  It distributes a high voltage current to each plug.
- High-tension cords, spark plugs and noise suppressor.
- CMP sensor (Camshaft position Sensor)
  Located in the distributor, it converts the crank angle into voltage variation and sends it to ECM. For its details, refer to SECTION 6E.
- TP sensor, ECT sensor and MAP sensor
  For their details, refer to SECTION 6E.

COMPONENTS



SYSTEM WIRING

1. Battery
2. Main fuse box
3. Ignition switch
4. Main relay
5. Ignition coil
6. Igniter
7. Noise suppressor
8. Distributor
9. Distributor rotor
10. Signal rotor
11. CMP sensor
12. Spark plug



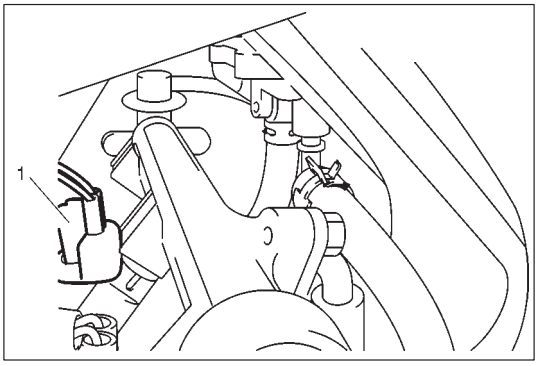
DIAGNOSIS

Condition	Possible Cause	Correction
Engine cranks, but will not start or hard to start	● 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
	● Cracked rotor or cap	Replace
	● Maladjusted signal rotor air gap	Adjust
	● Faulty ignition coil	Replace
	● Faulty noise suppressor	Replace
	● Faulty CMP sensor	Replace
	● Faulty igniter	Replace
	● Faulty ECM	Replace
	● Maladjusted ignition timing	Adjust
Poor fuel economy or engine performance	● Incorrect ignition timing	Adjust
	● Faulty spark plug(s) or high-tension cord(s)	Adjust, clean or replace
	● Faulty ECM	Replace

DIAGNOSTIC FLOW TABLE

STEP	ACTION	YES	NO
1	Was ENGINE DIAGNOSTIC FLOW TABLE in SECTION 6 performed?	Go to Step 2.	Go to ENGINE DIAGNOSTIC FLOW TABLE in SECTION 6.
2	Ignition Spark Test 1) Check all spark plug for condition and type, referring to SPARK PLUG in this 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 on the next page.	Go to Step 3.
3	Diagnostic Trouble Code (DTC) Check 1) Check DTC stored in ECM, referring to DIAGNOSTIC TROUBLE CODE (DTC) CHECK in SECTION 6E1. Is DTC stored?	Go to applicable flow table corresponding to that code No. in SECTION 6E1.	Go to Step 4.
4	Electrical Connection Check/Noise Suppressor Check 1) Check ignition coil for electrical connection. 2) Check noise suppressor referring to NOISE SUPPRESSOR. Are they in good condition?	Go to Step 5.	Connect securely. Replace noise suppressor.
5	High-tension Cord 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	Igniter Check 1) Check igniter, referring to IGNITER in this section. Is check result satisfactory?	Go to Step 7.	Replace igniter.

STEP	ACTION	YES	NO
7	Ignition Coil Power Supply And Ground Circuit Check 1) Check ignition coil power supply (“B/W” wire) circuit for open and short. Are circuits in good condition?	Go to Step 8.	Repair or replace.
8	Ignition Coil Check 1) Check ignition coil for resistance, referring to IGNITION COIL in this section. Is check result satisfactory?	Go to Step 9.	Replace ignition coil assembly.
9	CMP Sensor Check 1) Check CMP sensor and signal rotor, referring to DISTRIBUTOR in this section. Is check result satisfactory?	Go to Step 10 on the next page.	Adjust or replace.
10	Ignition Trigger Signal Circuit Check 1) Check ignition trigger signal (“Br/W” wire) circuit for open, short and poor connection. Are circuits in good condition?	Go to Step 11.	Repair or replace.
11	Ignition Timing Check 1) Check initial ignition timing and ignition timing advance, referring to IGNITION TIMING in this section. Is check result satisfactory?	Substitute a known-good ECM and then repeat STEP 2.	Go to Step 12.
12	Ignition Timing Adjustment And Recheck 1) Adjust initial ignition timing, referring to IGNITION TIMING in this section. 2) Recheck initial ignition timing and ignition timing advance, referring to IGNITION TIMING in this section. Is check result satisfactory?	System is in good condition.	Substitute a known-good ECM and then repeat STEP 2.

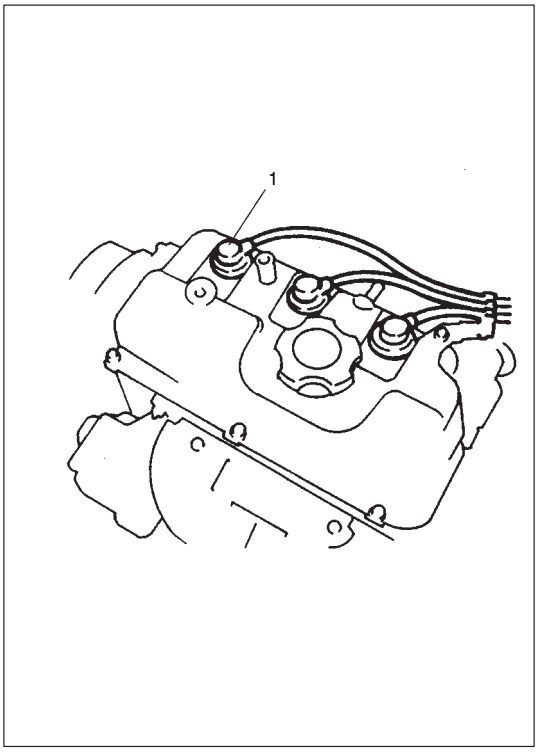


IGNITION SPARK TEST

1) Disconnect injector couplers (1) from injectors.

WARNING:
Without disconnection of injector coupler, combustible gas may come out from spark plug holes during this test and may get ignited in engine room.

2) Remove spark plugs and connect them to high-tension cords, and then ground spark plugs.
3) Crank engine and check if each spark plug sparks.
4) If no spark is emitted, inspect high-tension cords, spark plugs, ignition coil, distributor, etc.



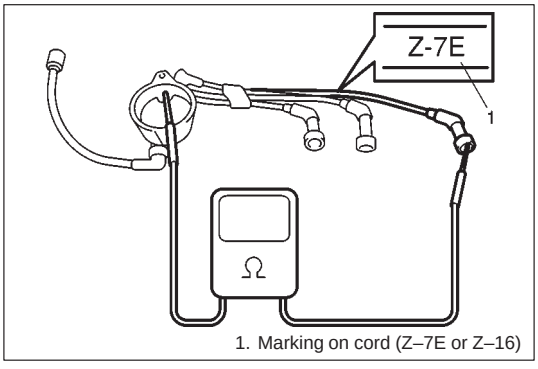
ON-VEHICLE SERVICE

HIGH-TENSION CORDS

REMOVAL

1) Remove high-tension cord at ignition coil while gripping its cap.
2) Remove distributor cap (1) installed with high-tension cords.
3) Remove high-tension cord clamp from cylinder head cover.
4) 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.**



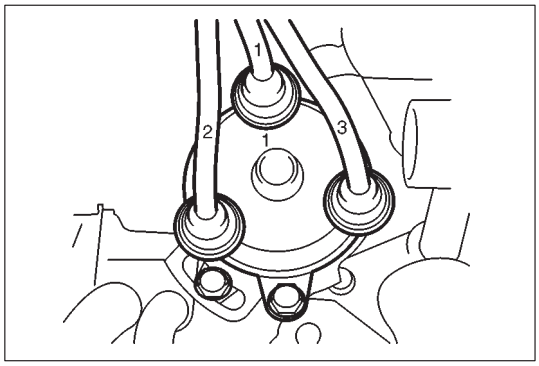
1. Marking on cord (Z–7E or Z–16)

5) Measure resistance of high-tension cord by using ohmmeter.

High-tension cord resistance:
10 – 22 kΩ/m (3.0 – 6.7 kΩ/ft) . . . Z–16 marked
4 – 10 kΩ/m (1.3 – 3.3 kΩ/ft) . . . Z– 7 marked

6) If resistance exceeds specification, inspect distributor terminal and replace high-tension cord(s) and/or distributor cap as required.

CAUTION:
- **Never attempt to use metal conductor high-tension cords as replacing parts.**
- **Insert each cap portion fully when installing high-tension cords.**



INSTALLATION

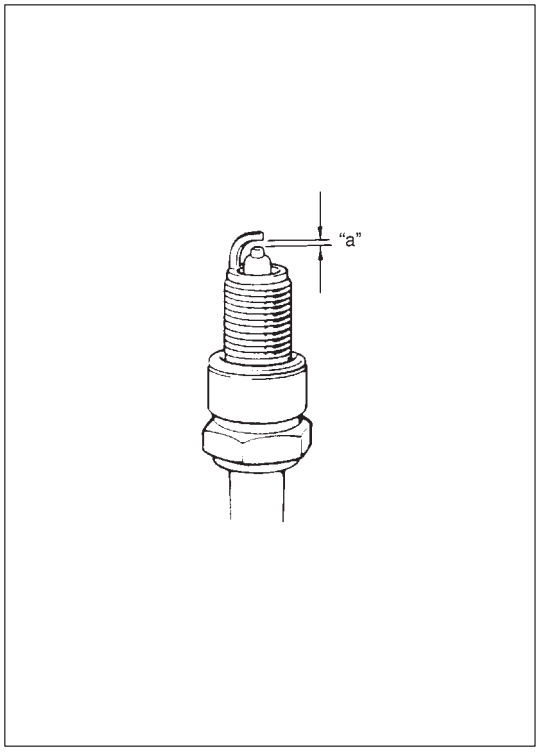
1) Reverse removal procedure for installation.

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

REMOVAL

1) Remove high-tension cords, referring to HIGH-TENSION CORDS under ON-VEHICLE SERVICE earlier in this section.
2) Remove spark plugs.



INSPECTION

1) Inspect them for:
   - Electrode wear
   - Carbon deposits
   - Insulator damage
2) If any abnormality is found, adjust air gap, clean with spark plug cleaner or replace them with specified new plugs.

F8D engine
Spark plug air gap "a": 0.8 – 0.9 mm (0.031 – 0.035 in.)
Spark plug type: NGK DCPR7E

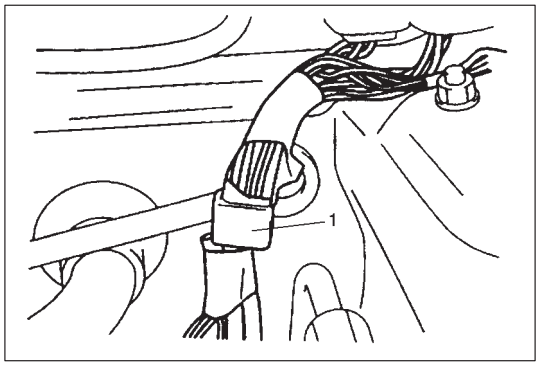
F8B engine
Spark plug air gap "a": 0.7 – 0.8 mm (0.028 – 0.031 in.)
Spark plug type: NGK BPR5ES
: DENSO W16EXR-U

INSTALLATION

1) Install spark plugs and torque them to specification.

Tightening Torque for spark plug
15 N·m (1.5 kg-m, 10.5 lb-ft) . . . . F8D engine
25 N·m (2.5 kg-m, 18.0 lb-ft) . . . . F8B engine

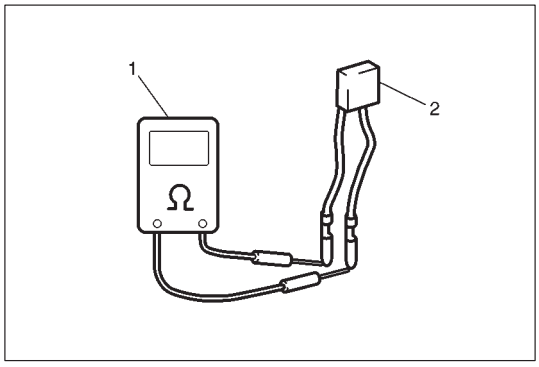
2) Install high-tension cords, referring to HIGH-TENSION CORDS under ON-VEHICLE SERVICE earlier in this section.



NOISE SUPPRESSOR

REMOVAL

1) Unwrap tape from nose suppressor.
2) Disconnect coupler of noise suppressor (1).
3) Remove noise suppressor.

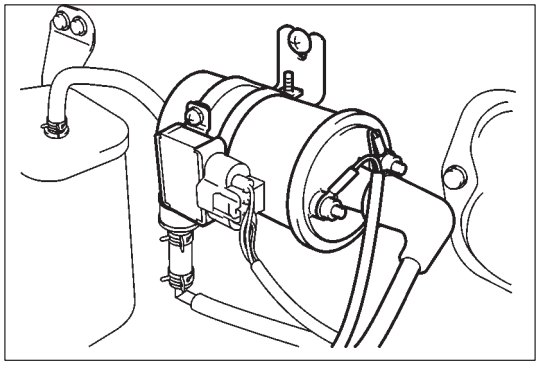


INSPECTION

Using ohmmeter (1), check to be sure that capacitor (Condenser) in noise suppressor (2) is not conductive.
If check result is not satisfactory, replace noise suppressor (2).

INSTALLATION

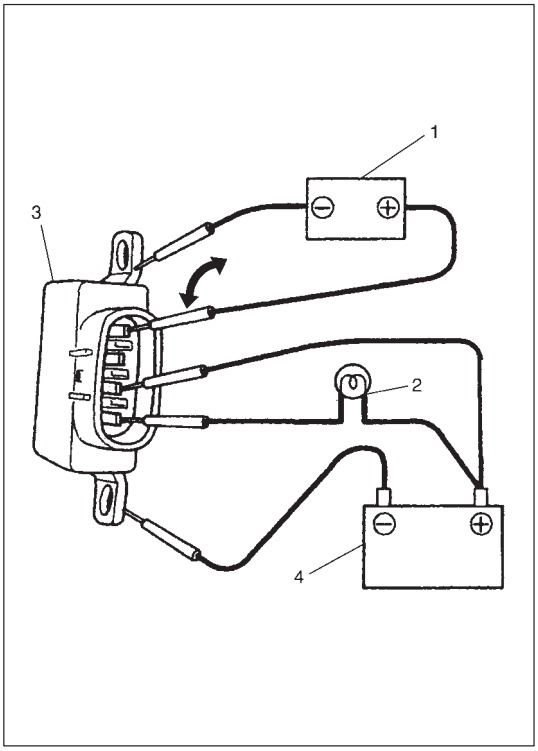
Reverse removal procedure for installation.



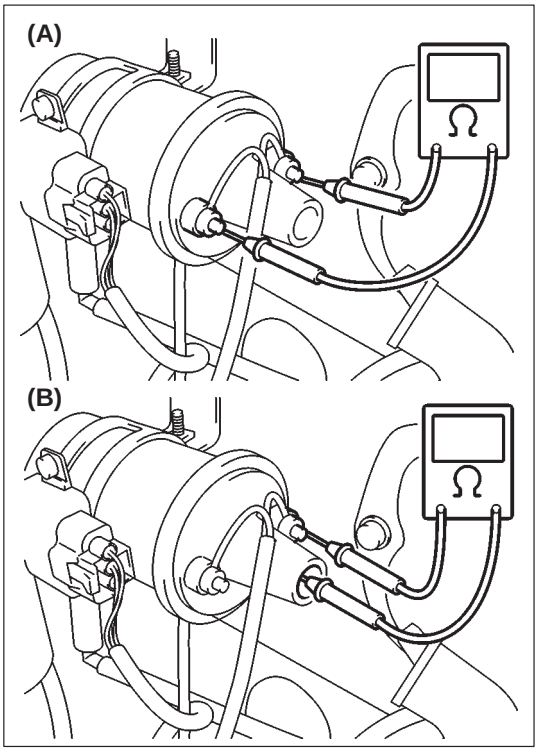
IGNITER

Before this inspection, prepare 5V power supply (3 new 1.5V batteries), one 12V 3.4W light bulb and one 12V battery (fully charged).

1) Remove ignition coil/igniter unit assembly from vehicle.
2) Remove igniter from bracket.



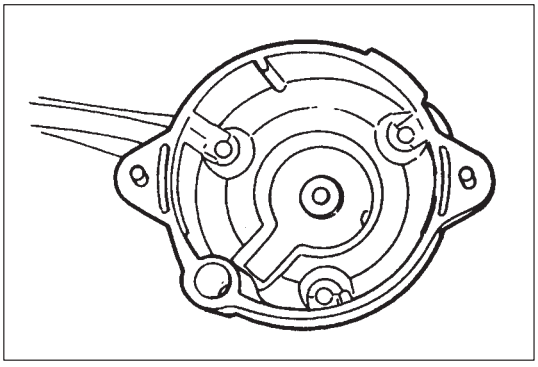
3) Arrange 3 new batteries in series (1) (check total voltage is above 4.7V)
4) Connect light bulb (2) between "c" terminal of igniter (3) and battery (4) positive (+) terminal, then connect battery negative (–) terminal to igniter body.
   Also connect battery positive (+) terminal, and "b" terminal/ of igniter.
   Check that the light bulb does not illuminate.
5) Connect negative (–) terminal of batteries and igniter body.
   Check that the light bulb illuminate when positive (+) terminal of batteries is connected to "a" terminal of igniter.
   If inspection result is not satisfactory, replace igniter.
6) Install igniter.



IGNITION COIL

1) Pull out high-tension cord by gripping its cap.
2) Disconnect ignition coil coupler.
3) Measure primary and secondary coil resistances.

Ignition coil resistance (at 20°C/68°F)
Primary : 1.33 – 1.63 Ω . . (A)
Secondary: 10.7 – 14.5 kΩ . (B)

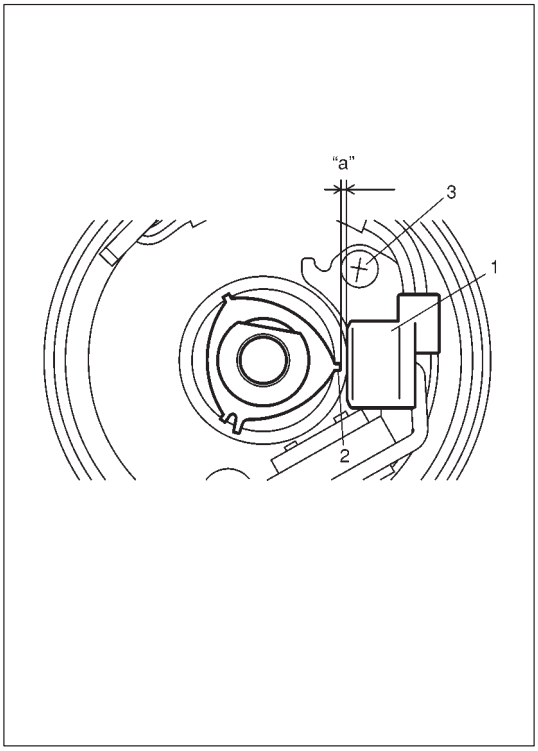


DISTRIBUTOR

INSPECTION

Distributor Cap and Rotor

Check cap and rotor for crack and their terminals for corrosion and wear. Replace as necessary.



Signal Rotor Air Gap

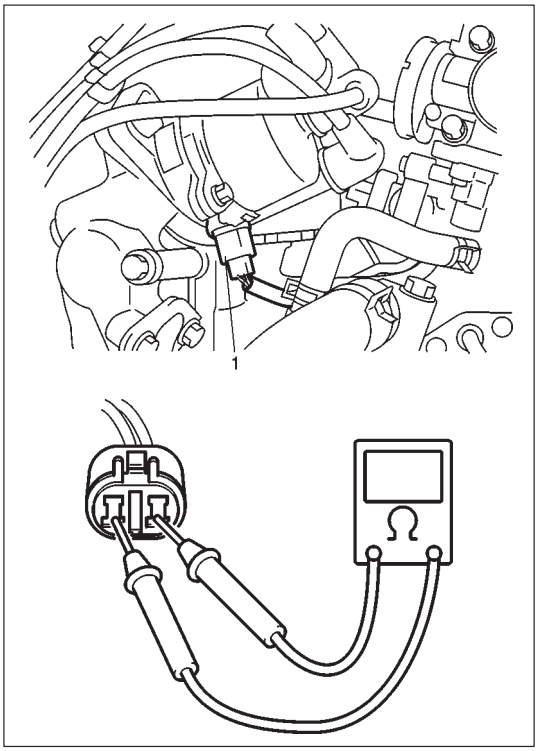
1) Remove distributor cap and rotor.
2) Using thickness gauge, measure air gap, between signal rotor tooth (2) and CMP sensor (generator) (1).

   Signal rotor air gap "a": 0.2 – 0.4 mm (0.008 – 0.016 in.)

3) If gap is out of specification, loosen CMP sensor (signal generator) securing screws (3). Move CMP sensor (generator) and adjust gap to specification. After adjustment, tighten securing screws and recheck gap.

   NOTE:
   Check to make sure that CMP sensor (signal generator) tooth is free from any metal particles.

4) Install distributor cap and rotor.

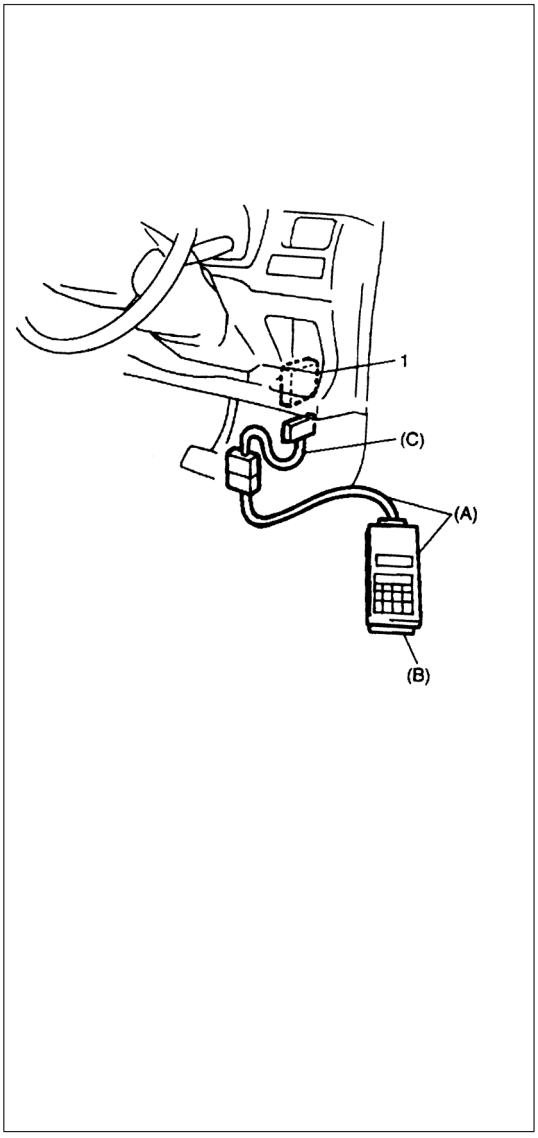


CMP Sensor Resistance

1) Disconnect distributor lead wire coupler (1).
2) Measure resistance of CMP sensor by using ohmmeter.

   CMP sensor resistance:
   185 – 275 Ω (at -10–50°C/ 14–122°F)
   240 – 325 Ω (at 50–100°C/122–212°F)

3) If resistance is out of specification, replace CMP sensor as follows.
4) Remove distributor cap and rotor.
5) Remove CMP sensor securing screws.
6) Replace CMP sensor.
7) Adjust signal rotor air gap to specifications as previously outlined.
8) Install rotor, distributor cap seal and cap.



IGNITION TIMING

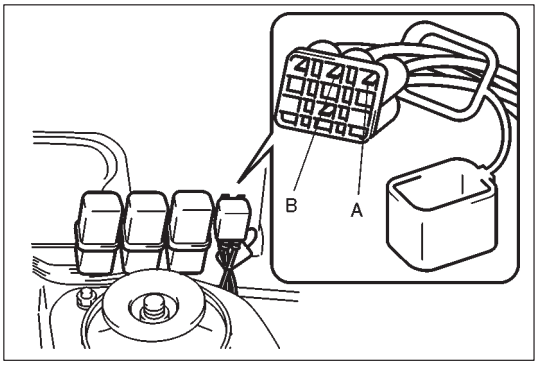
NOTE:
Before starting engine, place transmission gear shift lever in "Neutral" and set parking brake.

INSPECTION AND ADJUSTMENT

1) When using SUZUKI scan tool, connect SUZUKI scan tool to DLC with ignition switch OFF.

   Special Tool (when using SUZUKI scan tool)
   (A): 09931-76011 (SUZUKI scan tool)
   (B): Mass storage cartridge
   (C): 09931-76030 (16/14 pin DLC adapter)

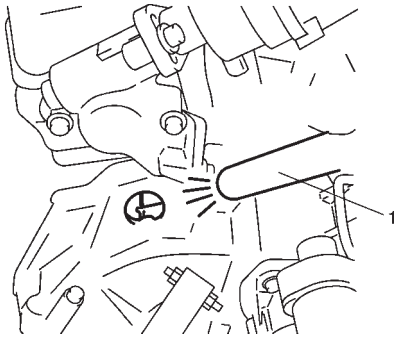
2) Start engine and warm it up to normal operating temperature.
3) Make sure that all of electrical loads except ignition are switched off.
4) Check to be sure that idle speed is within specification. (Refer to SECTION 6E1).



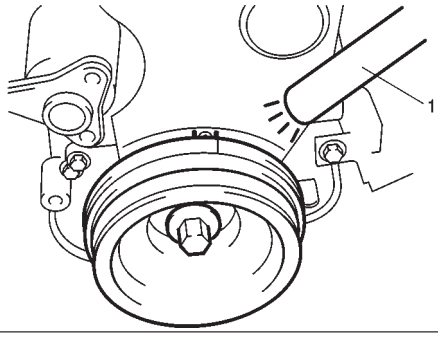
5) Set timing light to No.1 high-tension cord.
6) Fix ignition timing to initial one as follows:
   When using SUZUKI scan tool:
   a) Select "MISC" mode on SUZUKI scan tool and fix ignition timing to initial one.

   When not using SUZUKI scan tool:
   a) Disconnect scan tool from DLC if connected and connect A and B terminals of monitor coupler by using service wire so that ignition timing is fixed on initial one.

F8B engine

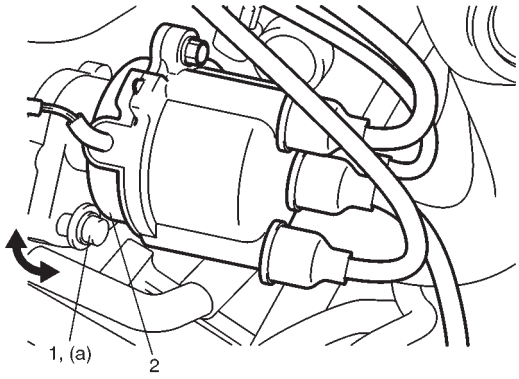


F8D engine



7) Using timing light (1), check that timing is within specification.

Initial ignition timing (Test switch terminal grounded or fixed by scan tool):
5 ± 1° BTDC (at idle speed)
Ignition order 1-3-2

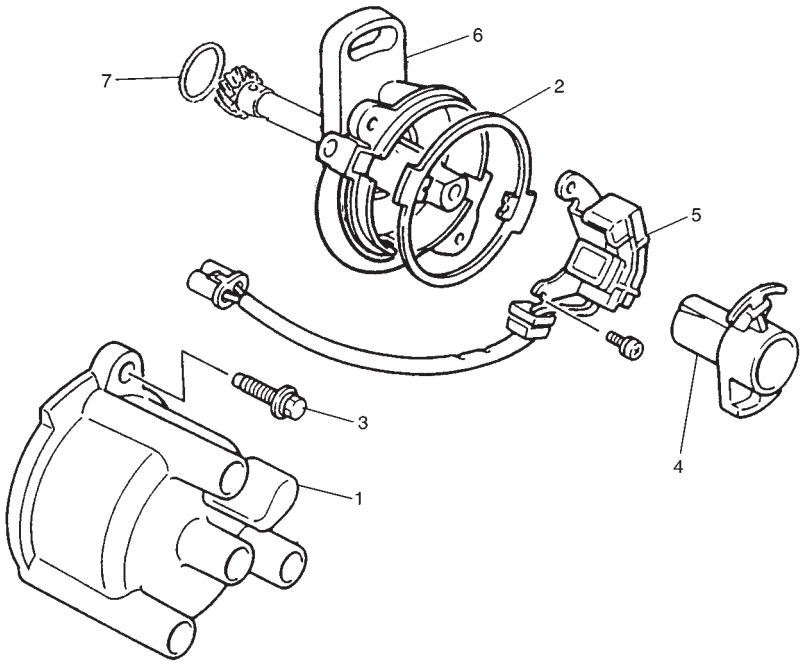


8) If ignition timing is out of specification, remove air cleaner assembly then loosen flange bolts (1), adjust timing by turning distributor assembly (2) while engine is running, and then tighten bolts (1).

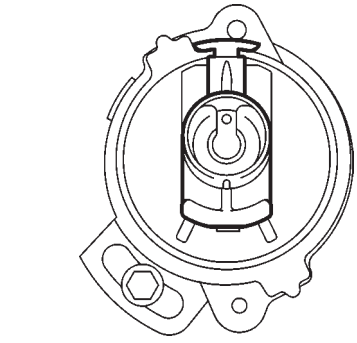
Tightening Torque
(a): 23 N·m (2.3 kg-m, 14.0 lb-ft)

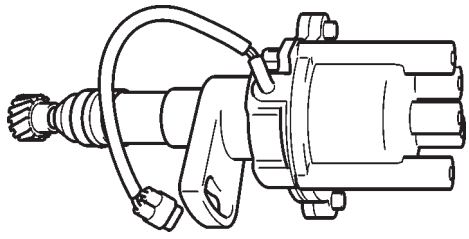
9) After tightening distributor flange bolts, recheck that ignition timing is within specification.
10) After checking and/or adjusting initial ignition timing, release ignition timing fixation by SUZUKI scan tool or disconnect service wire from monitor coupler.
11) With engine idling (test switch terminal ungrounded, vehicle stopped), check that ignition timing is about 8° BTDC (Constant variation within a few degrees from 8° 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 test switch terminal circuit and ECM.

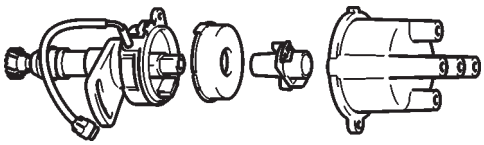
DISTRIBUTOR UNIT



1. Cap
2. Cap seal
3. Cap screw
4. Rotor
5. CMP sensor (Signal generator)
6. Housing
7. O-ring

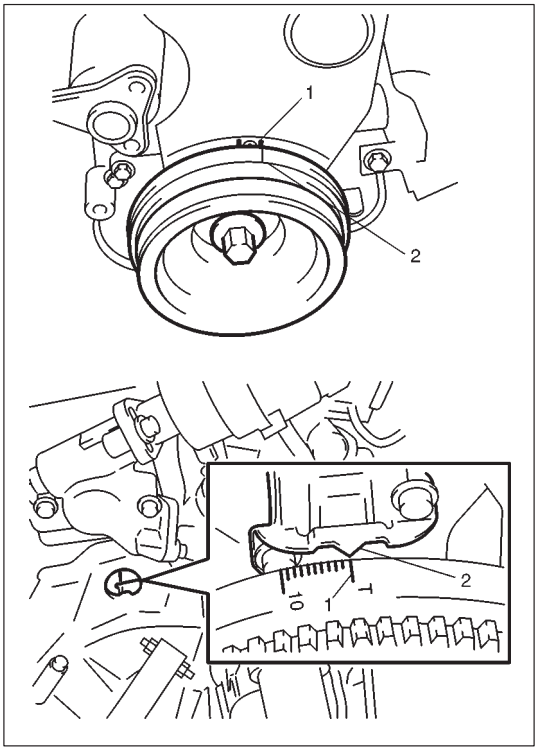






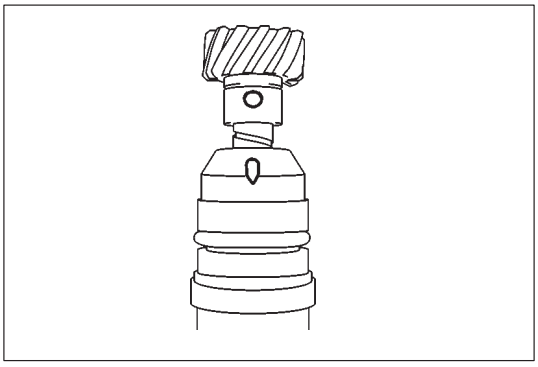
REMOVAL

1) Disconnect negative cable at battery.
2) Disconnect distributor connector.
3) Disconnect high tension cords from distributor cap.
4) Remove distributor cap. Then to facilitate re-installation, turn crankshaft in normal direction (clockwise as viewed from crankshaft pulley side) so that distributor rotor is positioned at No.1 terminal of distributor cap.
5) Remove distributor flange bolt.
6) Pull out distributor housing assembly.



INSTALLATION

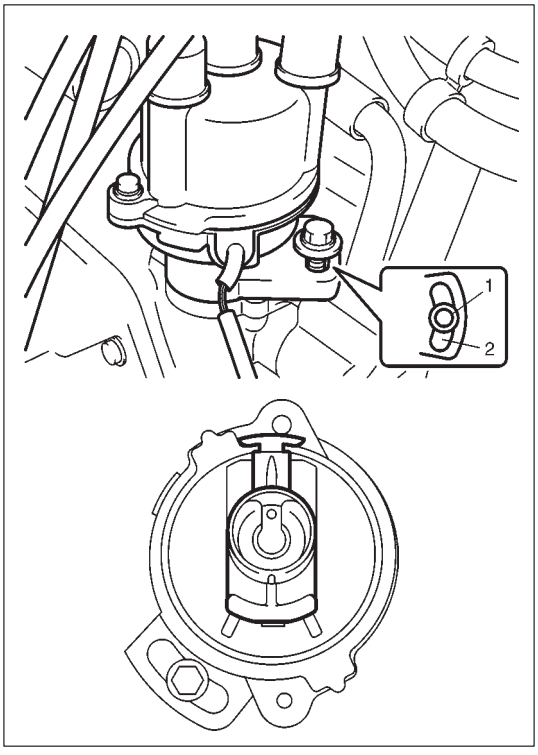
1) If distributor rotor has not been positioned at No.1 terminal of distributor cap in distributor removal, perform following step.
   a) Turn over crankshaft in normal direction (clockwise as viewed from crankshaft pulley side) until Timing notch (2) on pulley aligns with timing mark "0" (1) on timing tab or "T" mark on flywheel (1).
   b) After aligning two marks, remove cylinder head cover to visually confirm that rocker arms are not riding on camshaft cams at No.1 cylinder. If the arms are found to be riding on the cams, turn over crankshaft 360° to align two marks anew.



2) Check O-ring for damage and deterioration.
   Replace if necessary.

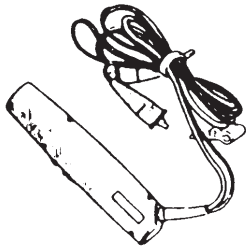
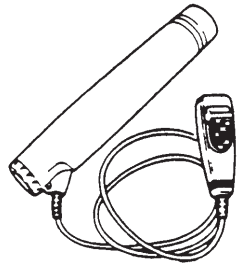
   NOTE:
   If O-ring is installed, apply engine oil to it.

3) Align punch mark on gear with dent mark on housing.



4) Insert distributor into gear case in such a way that the center of distributor flange bolt (1) will coincide with distributor flange bolt hole (2) provided in distributor gear case. When inserting the distributor completely, position of distributor rotor becomes as shown in figure. Secure distributor in place tentatively by making flange bolt finger-tight.
5) Check to make sure that rotor is in good condition.
6) Inspect distributor cap and clean or replace as required.
7) Make sure that distributor cap seal is placed properly and install cap, and then fasten it with screws.
8) Connect distributor coupler.
9) Connect negative cable at battery.
10) Check and adjust ignition timing as previously outlined, refer to IGNITION TIMING in this section.

SPECIAL TOOLS

		
09900-25002 Pocket tester	09900-27301 Timing light (DC 12 V)	09930-76420 Timing light (Dry cell type)

SECTION 6G

CRANKING SYSTEM

CONTENTS

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Starting Motor Circuit 6G-2
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No-load performance test 6G-12
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GENERAL DESCRIPTION

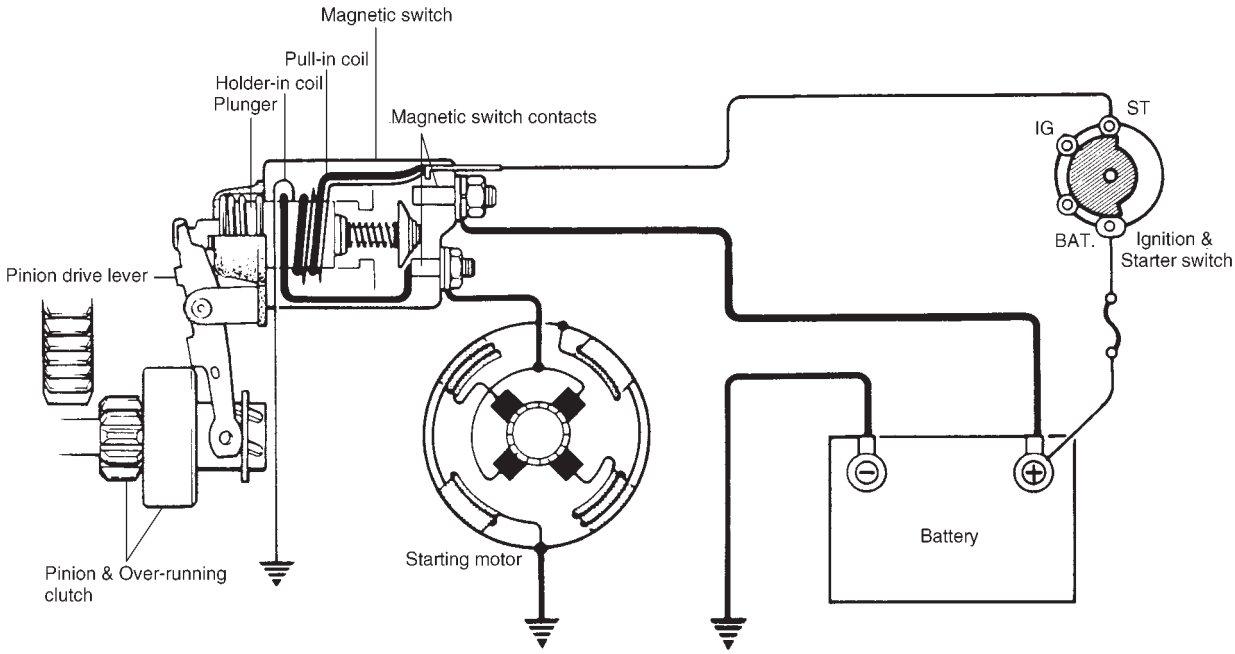
CRANKING CIRCUIT

The cranking circuit consists of the battery, starting motor, ignition switch, and related electrical wiring. These components are connected electrically.

Only the starting motor will be covered in this section.

STARTING MOTOR CIRCUIT

- The magnetic switch coils are magnetized when the ignition switch is closed.
- The resulting plunger and pinion drive lever movement causes the pinion to engage the engine flywheel gear and the magnetic switch main contacts to close, and cranking takes place.
- When the engine starts, the pinion over-running clutch protects the armature from excessive speed until the switch is opened, at which time the return spring causes the pinion to disengage.



DIAGNOSIS

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.

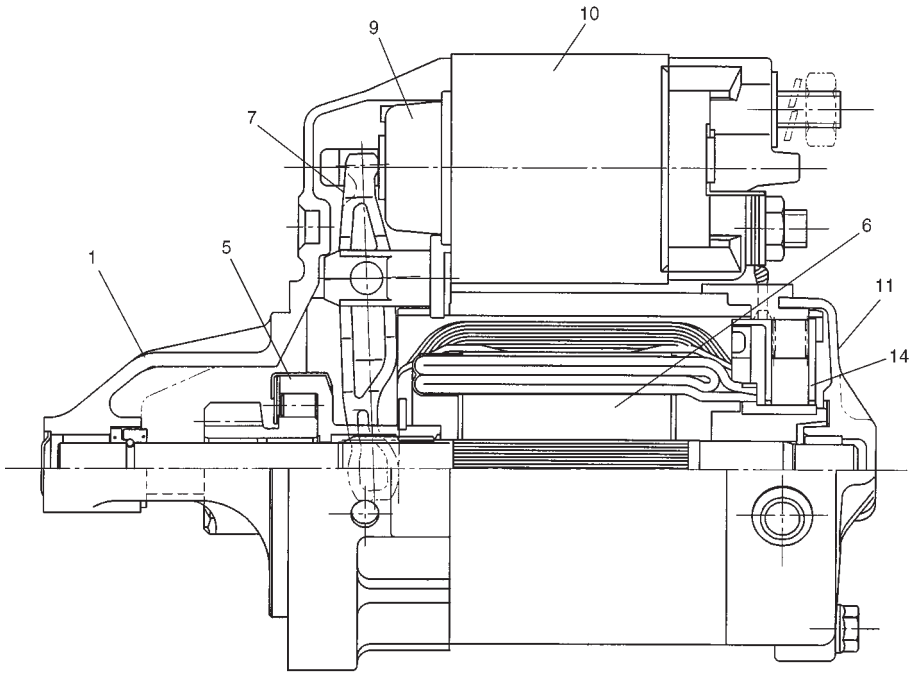
Do not remove motor just because starting motor does not run. Check following items and narrow down scope of possible causes.

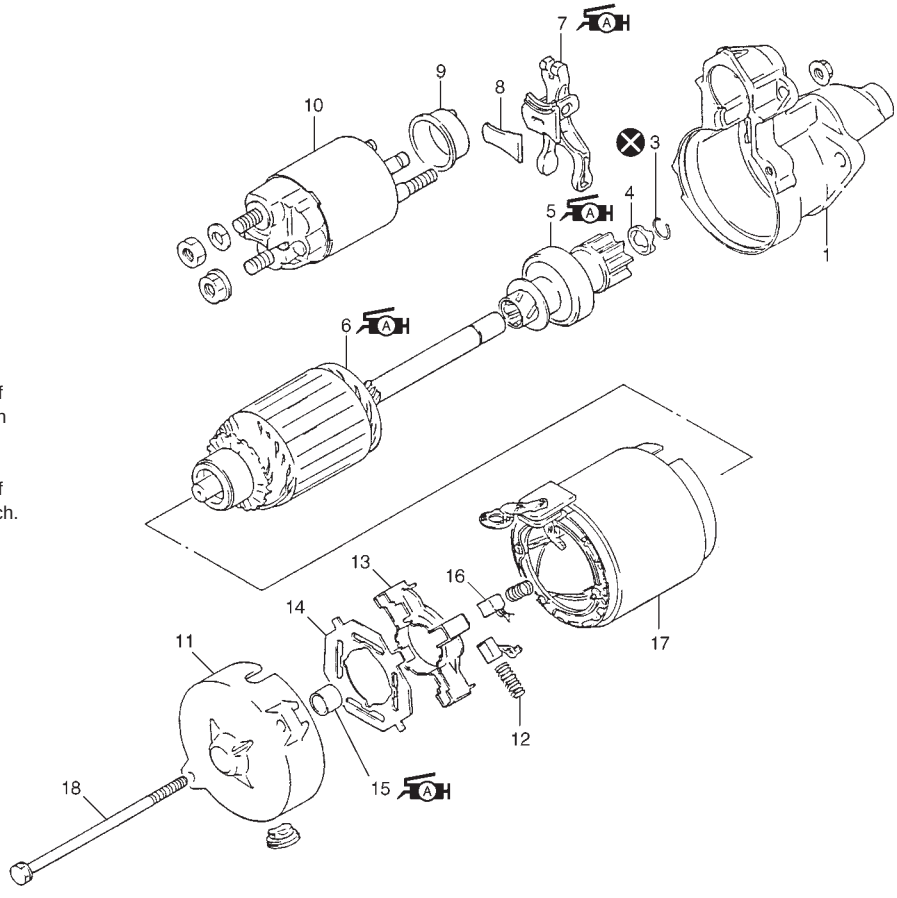
1) Condition of trouble
2) Tightness of battery terminals (including ground cable connection on engine side) and starting motor terminals
3) Discharge of battery
4) Mounting of starting motor

Condition	Possible Cause	Correction
Motor not running	**No operating sound of magnetic switch**	
	● 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.
	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.
	● Poor grounding of field coil	Repair.
	● Layer short-circuit of armature	Replace.
	● Crankshaft rotation obstructed	Repair.

Condition	Possible Cause	Correction
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.
	● Poor grounding of field coil	Repair.
	● Worn brushes	Replace brush.
	● Weakened brush springs	Replace spring
	● Burnt or abnormally worn end bush	Replace bush.
Starting motor running, but not cranking engine	● Worn pinion tip	Replace over-running clutch.
	● Poor sliding of over-running clutch	Repair.
	● Over-running clutch slipping	Replace over-running clutch.
	● Worn teeth of pinion gear or flywheel	Replace pinion or flywheel.
Noise	● Abnormally worn bush	Replace bush.
	● Worn pinion or worn teeth of pinion gear	Replace pinion or flywheel.
	● Poor sliding of pinion (failure in return movement)	Repair or replace.
	● 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.

UNIT REPAIR OVERHAUL



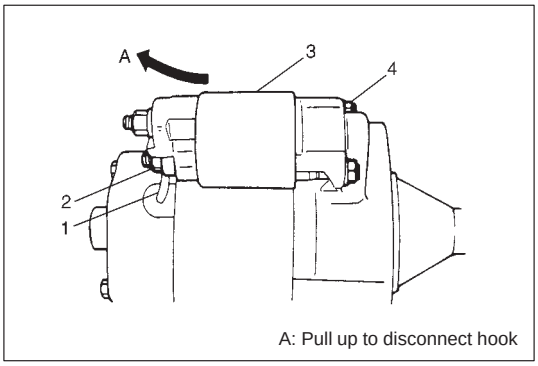


1. Drive housing assembly
2. Blank
3. Snap ring
4. Pinion stop ring
5. Over-running clutch assembly:
   Apply grease A 99000-25010 to inside and outside of spline.
6. Armature:
   Apply grease A 99000-25010 to joint of drive housing bush, over-running clutch and armature shaft bush.
7. Pinion drive lever:
   Apply grease A 99000-25010 to joint of magnetic switch and over-running clutch.
8. Seal
9. Boot
10. Magnetic switch
11. Rear housing
12. Brush spring
13. Brush holder
14. Insulator
15. Bush:
    Apply grease A 99000-25010 to inside and outside.
16. Brush
17. Yoke assembly
18. Housing bolt

⊗ : Do not reuse

DISMOUNTING AND REMOUNTING

1) Disconnect negative cable at battery.
2) Remove A/C compressor (if equipped), refer to SECTION 1B.
3) Disconnect magnetic switch lead wire and battery cable from starting motor terminals.
4) Remove 2 mounting bolts.
5) Remove starting motor.
6) To remount, reverse above procedure.

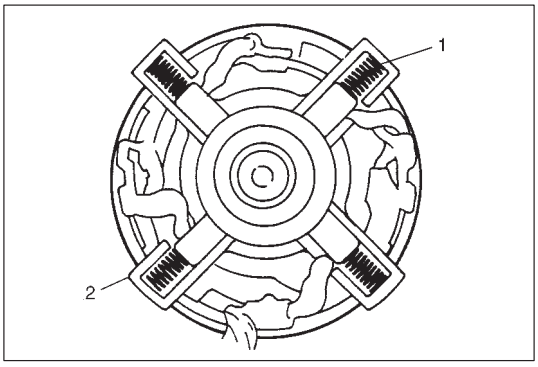


A: Pull up to disconnect hook

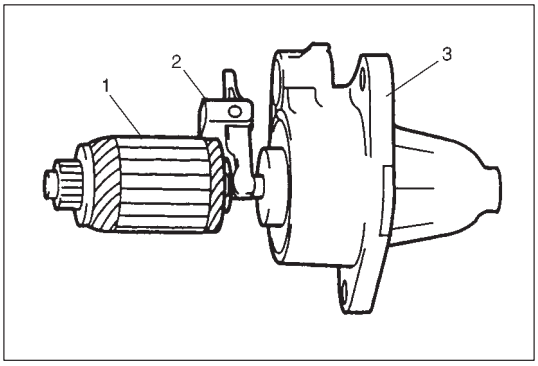
DISASSEMBLY

1) Remove nut (2) and disconnect lead wire (1) from magnetic switch (3).
2) Remove 2 nuts (4) and then take out magnetic switch by pulling up its rear portion so as to inside hook is disconnected from drive lever.

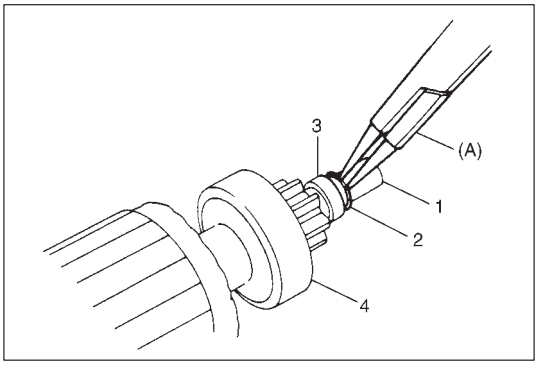
NOTE:
Do not disassemble magnetic switch. Replace it as assembly, when required.



3) Remove housing bolts (through bolts) and then pull out commutator end housing.
4) Remove insulator, brush springs (1) and then brush holder (2).

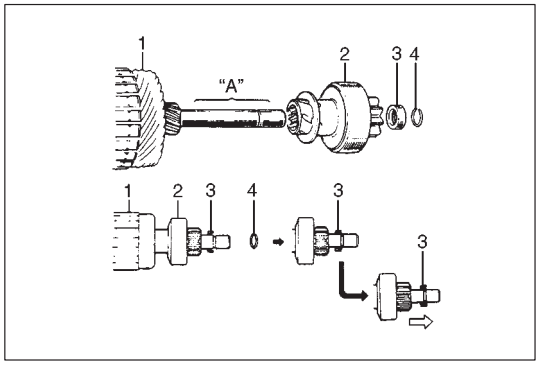


5) Remove yoke, armature (1) and drive lever (2) from drive housing (3).



6) Draw pinion stop ring (3) toward over-running clutch (4) side and remove snap ring (2) by using snap ring pliers assisted with screwdriver, then pull out pinion stop ring and over-running clutch from armature (1).

Special Tool
(A) : 09900-06107

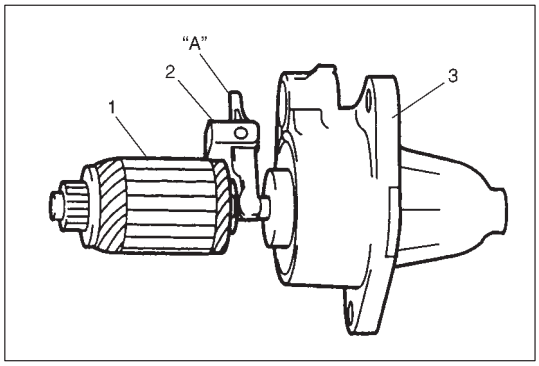


REASSEMBLY

1) Inspect component parts (Refer to INSPECTION) and replace with new ones as necessary.
2) Before installing over-running clutch (2) to armature (1), apply grease as shown in figure and then fasten stop ring (3) with snap ring (4).

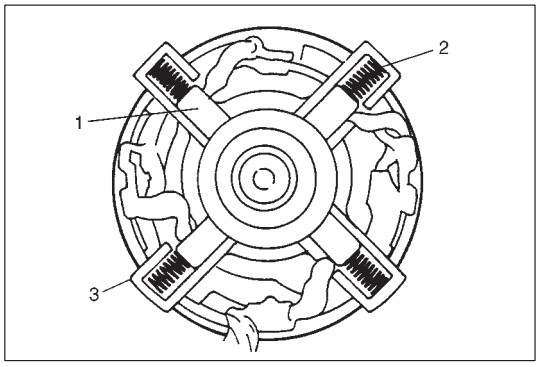
   "A" : Grease 99000-25010

   NOTE:
   Use new snap ring on shaft for installation. Do not reuse snap ring.



3) Apply grease to drive lever (2) and combine it with armature (1). Then assemble them with drive housing (3).

   "A" : Grease 99000-25010

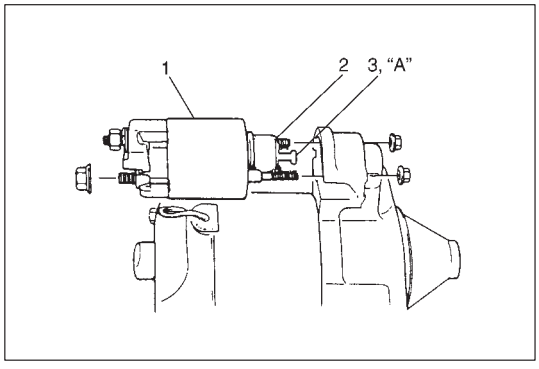


4) Install yoke and brush holder (3), then set 4 brushes (1) with their springs (2). Install insulator.

   NOTE:
   - **When installing brushes, make sure that brushes and commutator have been degreased thoroughly.**
   - **Check to confirm that brush parts do not have unnecessary contacts with others.**

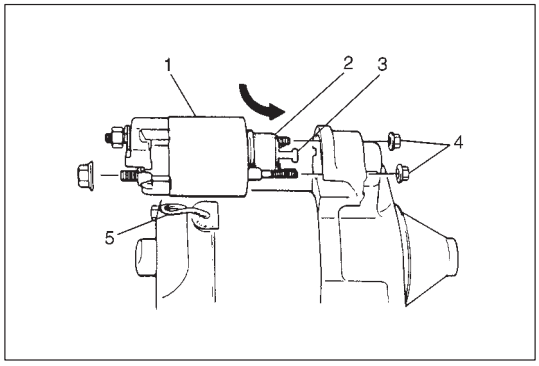
5) Install rear housing applied with grease in its bush inside.

   Grease 99000-25010



6) Replace magnetic switch (1) or its boot (2) with new one, if required, then apply grease to plunger (3).

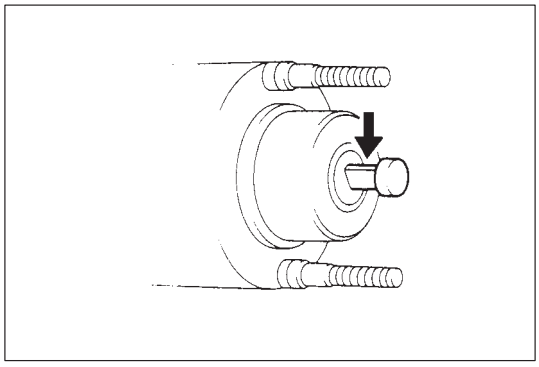
   "A" : Grease 99000-25010



7) Hook magnetic switch plunger (3) with drive lever and then fasten magnetic switch assembly (1) with nuts (4).
8) Connect lead wire (5) as it was and then check magnetic switch for operation.

NOTE:
- **Before installing nuts, make sure that plunger hook is connected with drive lever without fail.**
- **Face boot (2) breather down.**

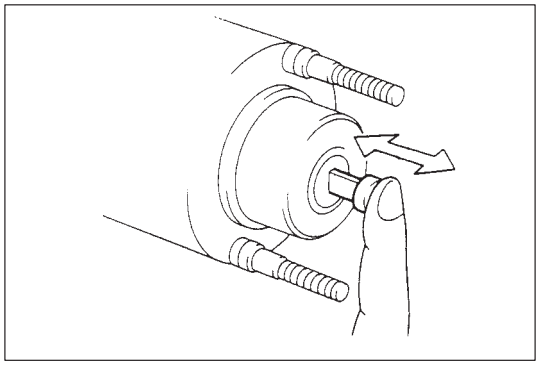
Upon completion of assembly, carry out PERFORMANCE TEST.



INSPECTION

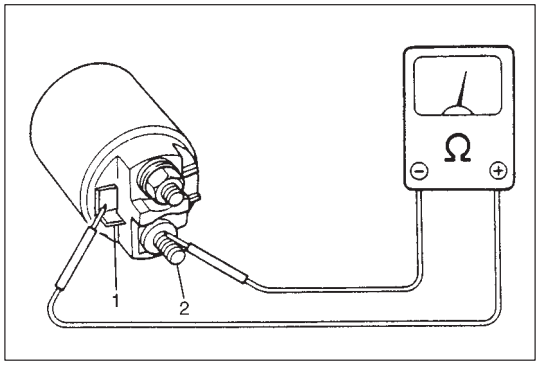
PLUNGER

Inspect plunger for wear. Replace if necessary.

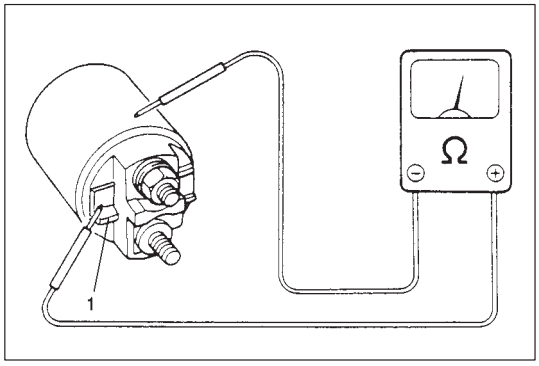


MAGNETIC SWITCH

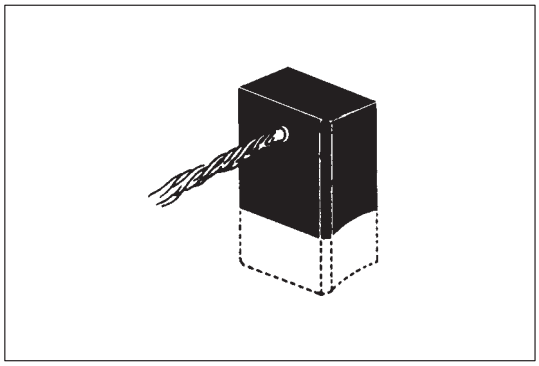
Push in plunger and release it. The plunger should return quickly to its original position. Replace if necessary.



- **Pull-In Coil Open Circuit Test**
  Check for continuity across magnetic switch 'S' terminal (1) and 'M' terminal (2). If no continuity exists, 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 exists, coil is open and should be replaced.



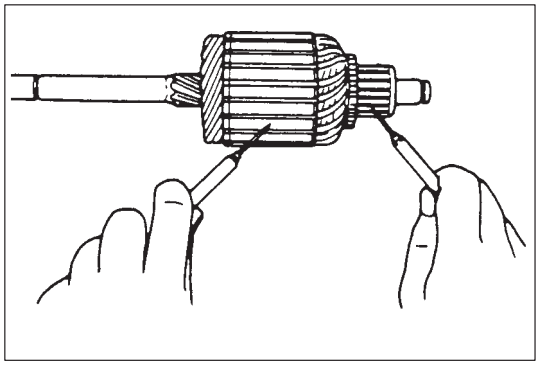
BRUSH

Measure length of brushes and replace them as necessary.

Brush length
Limit : 6.0 mm (0.236 in.)

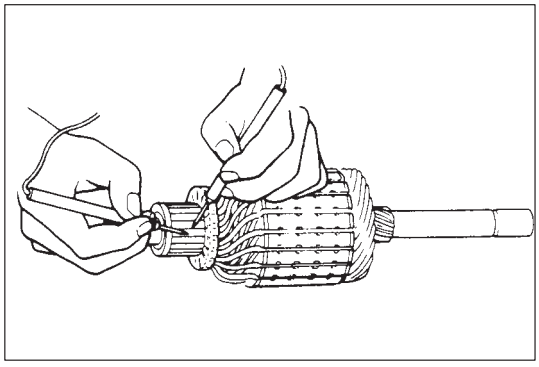
BRUSH HOLDER

Check brush springs for rust or breakage. Also check brush holder for rust and insulation. Replace it as assembly, if required.

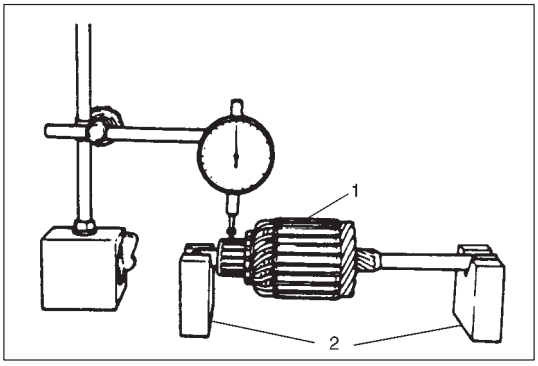


ARMATURE

- **Ground Test**
  Between commutator segment and armature core should be insulated. Use ohmmeter for inspection.

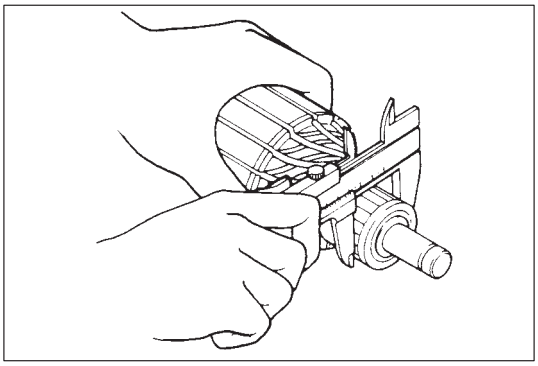


- **Open Circuit Test**
  Check for continuity between segments. If there is no continuity at any test point, there is an open circuit and armature must be replaced.



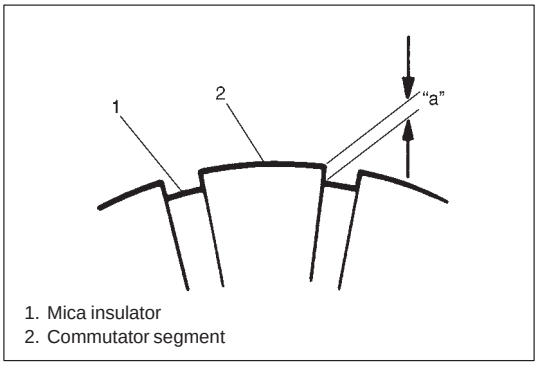
- Check commutator for run-out with armature (1) supported on V-blocks (2). Correct it by using lathe, if required.

  Commutator out of round
  Limit (maximum value): 0.4 mm (0.015 in.)



- Check for wear and replace armature if diameter is below limit.

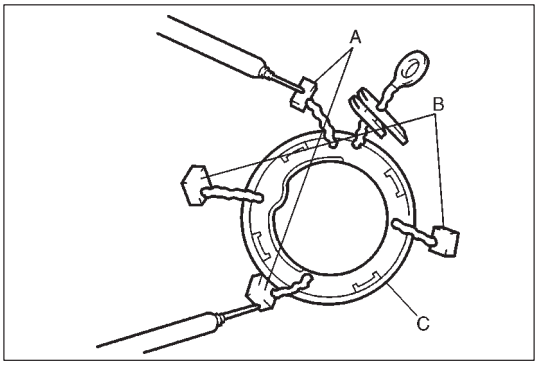
  Commutator outside diameter
  Limit (minimum value): 27 mm (1.063 in.)



1. Mica insulator
2. Commutator segment

- Correct and clean surface by using #400 emery cloth. Also check mica depth and correct it as required.

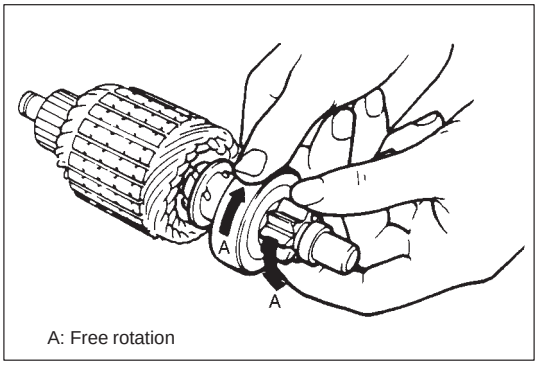
  Commutator insulator depth "a"
  Limit (minimum value): 0.2 mm (0.008 in.)



YOKE

Check field coil for continuity. There should be continuity between following terminals.

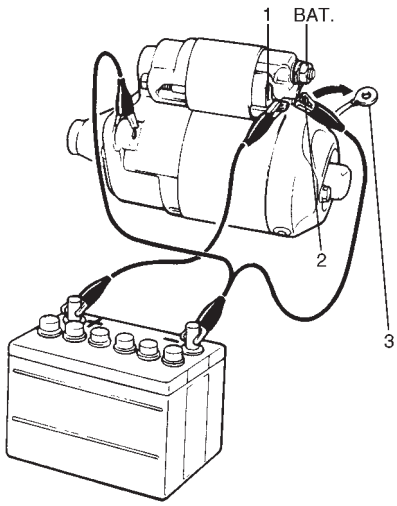
- Between A terminals.
- Between B terminals.
- Between B terminal and C (bare metal part of yoke body).



A: Free rotation

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.



1. Terminal 'S'

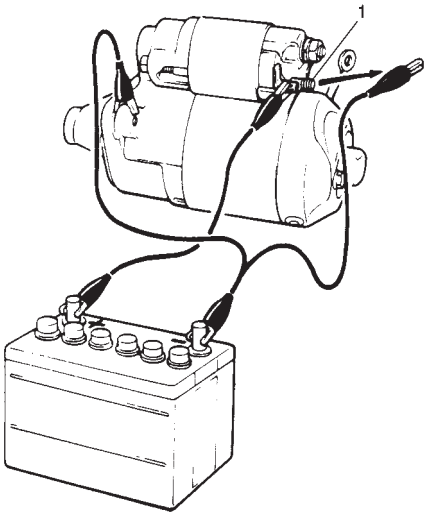
PERFORMANCE TEST

CAUTION:
Each test must be performed within 3 – 5 seconds to avoid coil from burning.

PULL-IN TEST

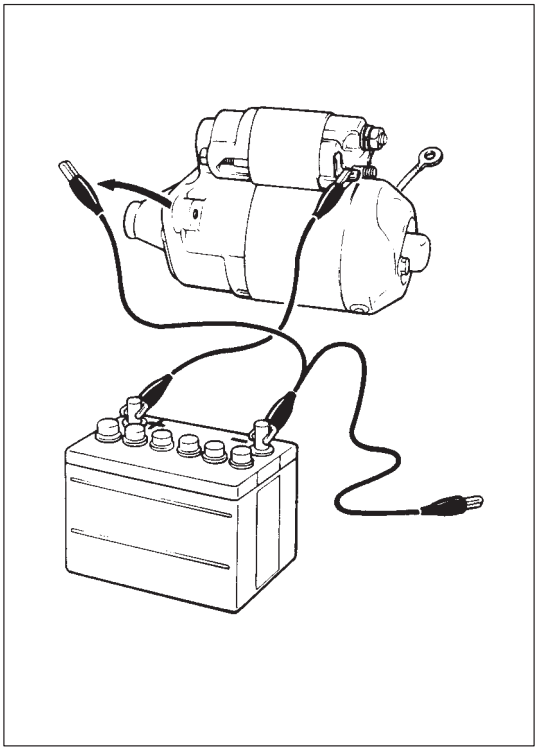
Connect test leads as shown in figure and check that pinion (over-running clutch) move outward. If it does not, replace magnetic switch.

NOTE:
Before testing, disconnect field coil lead wire (3) from 'M' terminal (2).



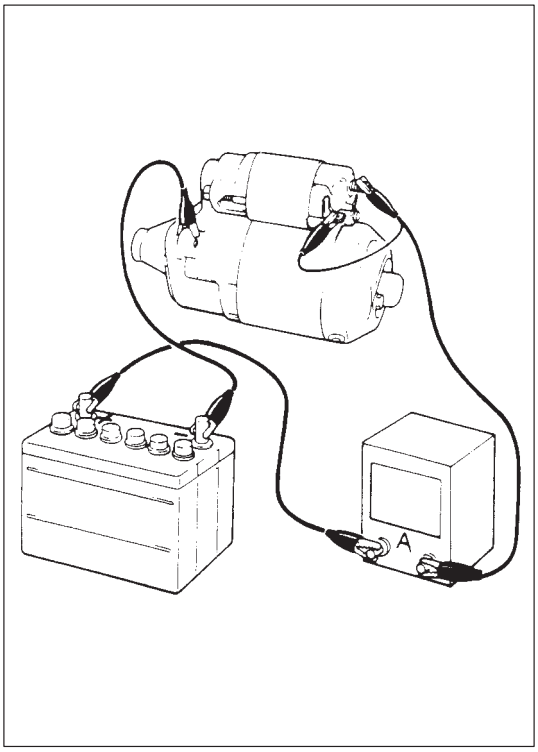
HOLD-IN TEST

While connected as the above with pinion out, disconnect negative lead from 'M' terminal (1) and check that pinion remains out. If not, replace magnetic switch.



PINION (PLUNGER) RETURN TEST

As a next step to the above, disconnect negative lead and check to make sure that pinion returns inward quickly.



NO-LOAD PERFORMANCE TEST

Connect test leads as shown in left figure and check that motor runs without fail with pinion moved out. Also check that ammeter indicates specified current.

Specified Current: 50A at 11.5V

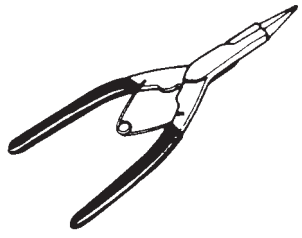
SPECIFICATIONS

Voltage			12 volts
Output			0.6 kW
Rating			30 seconds
Direction of rotation			Clockwise as viewed from pinion side (F8D engine) Counterclockwise as viewed from pinion side (F8B engine)
Brush length			10.0 mm (0.394 in.)
Number of pinion teeth			8
Performance		Condition	Guarantee
Around at 20℃ (68℉)	No load characteristic	11.5 V	50 A maximum 6,000 rpm minimum
	Load characteristic	9 V 150 A	2.75 N·m minimum 1,900 rpm minimum
	Locked rotor current	5.5 V	400 A maximum 5.89 N·m (0.5 kg-m, 4.6 lb-ft) minimum
	Magnetic switch operating voltage		8 volts maximum

REQUIRED SERVICE MATERIAL

MATERIAL	RECOMMENDED SUZUKI PRODUCT	USE
Lithium grease	SUZUKI SUPER GREASE A (99000-25010)	● Armature shaft. ● Over-running clutch. ● Commutator end cap. ● Drive lever. ● Bush.

SPECIAL TOOL



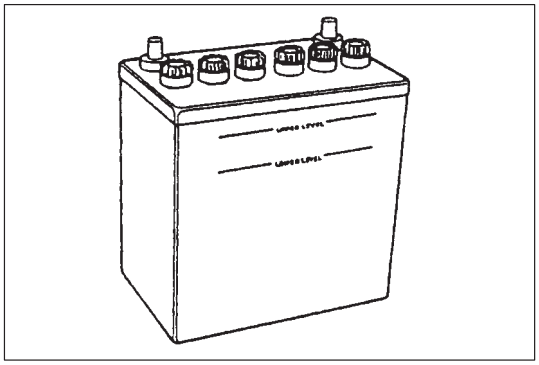
09900-06107
Snap ring pliers
(Opening type)

SECTION 6H

CHARGING SYSTEM

CONTENTS

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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.

The battery mounted in each vehicle is the following type.

38B20R TYPE

Rated capacity	28 AH/5HR, 12 Volts
Electrolyte S.G.	1.24 when fully charged at 20°C (68°F)

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.

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.

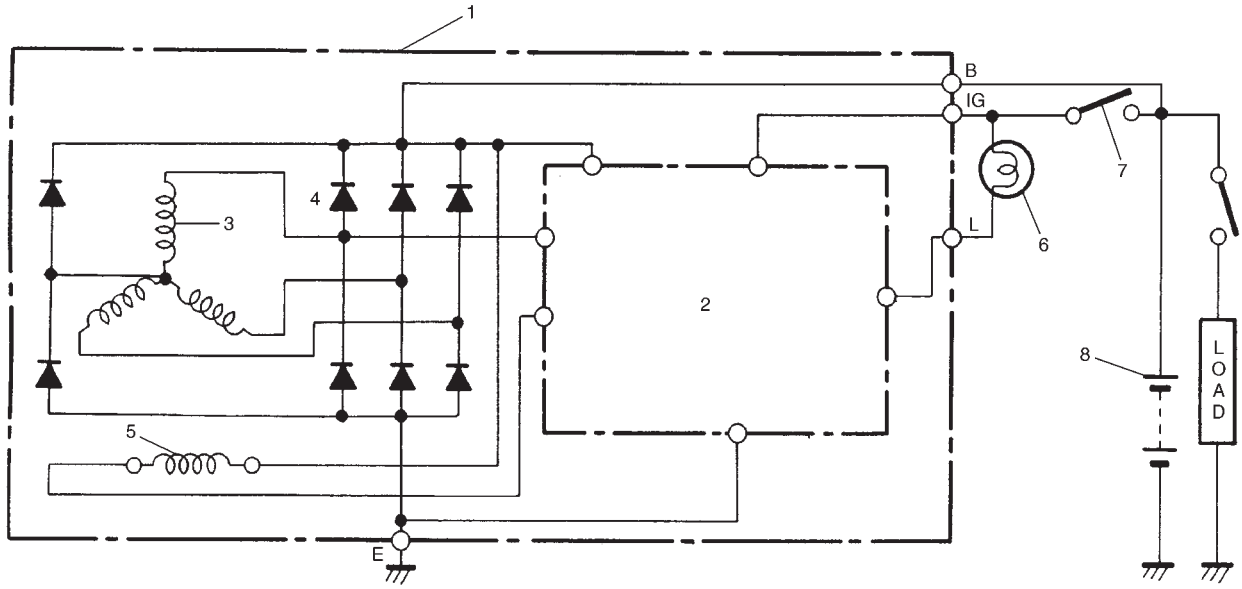
3) Be always in the know as to the state of charge of the battery.
   The simplest way to tell the state of charge is to carry out a hydrometer test. The hydrometer is an instrument for measuring the specific gravity (S.G.) of the battery electrolyte. The S.G. of the electrolyte is indicative of the state of charge. Refer to “BATTERY” of DIAGNOSIS in this section.

GENERATOR

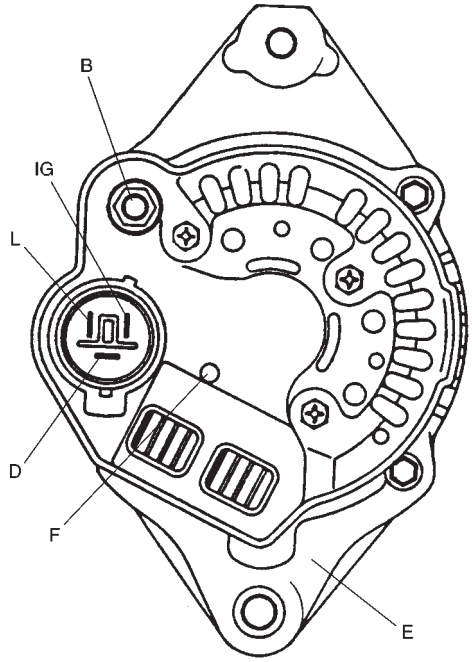
The generator is a small and high performance type with an IC regulator incorporated.
The internal components are connected electrically as shown below figure.

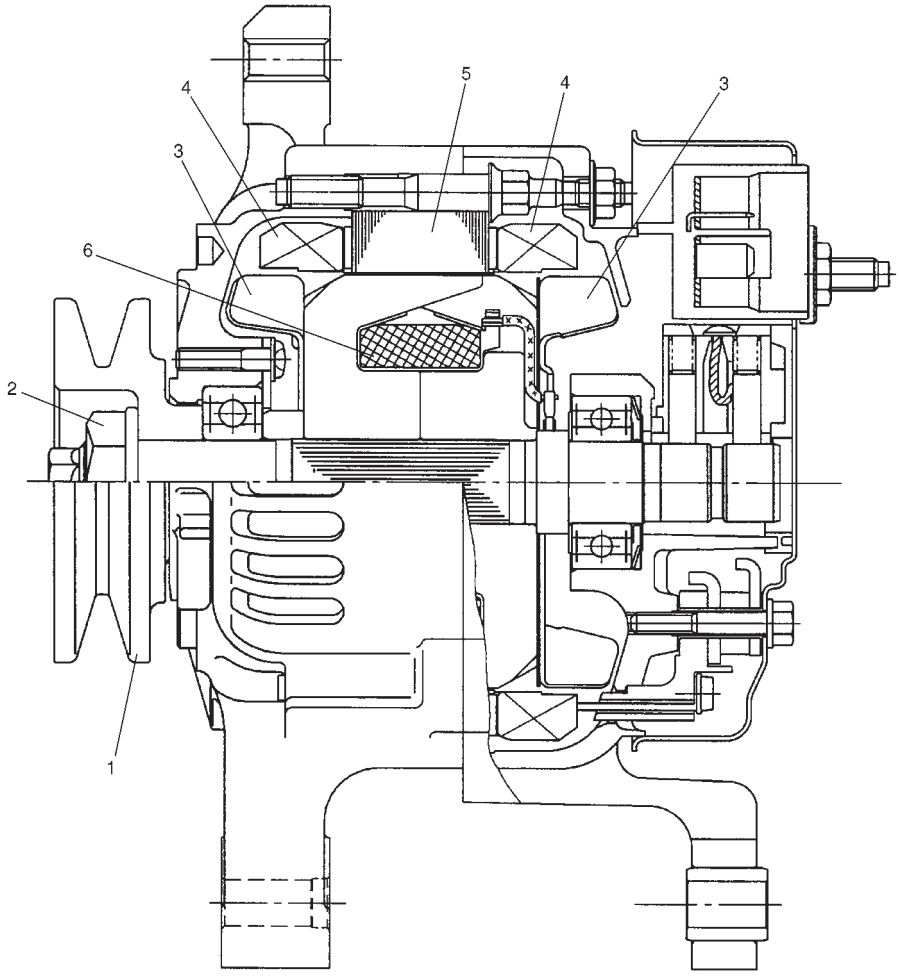
The generator features are as follows:

- 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.



1. Generator with regulator ass'y
2. I.C. regulator
3. Stator coil
4. Diode
5. Field coil (rotor coil)
6. Charge indicator light
7. Main switch
8. Battery





1. Pulley
2. Pulley nut
3. Rotor fan
4. Stator coil
5. Stator core
6. Field coil
7. Regulator
8. Brush
9. Rear end frame
10. Drive end frame

B : Generator output (Battery terminal)
D : Dummy terminal
E : Ground
F : Field coil terminal
IG : Ignition 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):

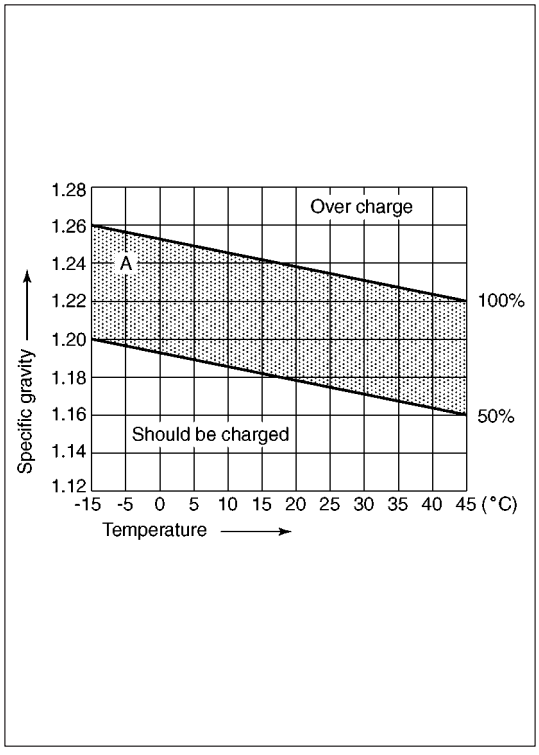
— The battery is in FULLY CHARGED STATE it the electrolyte S.G. is 1.24.

— 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.

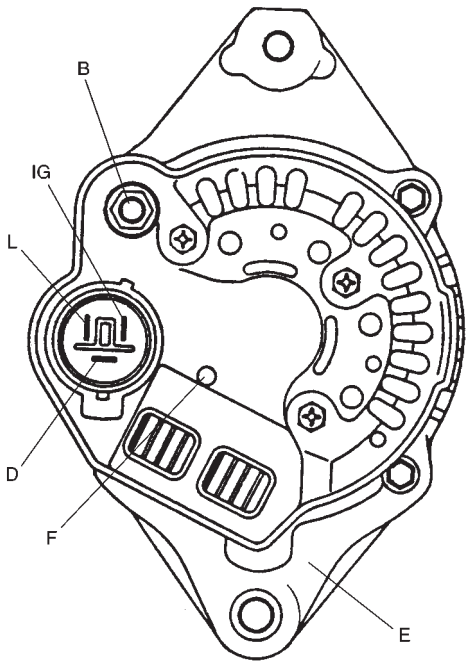


HOW TO USE THE TEMPERATURE-CORRECTED STAGE-OF-CHARGE GRAPH

Suppose your S.G. reading is 1.24 and the battery temperature is –5 °C (23°F). Locate the intersection of the –5 °C line and the 1.24 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.



B : Generator output (Battery terminal)
D : Dummy terminal
E : Ground
F : Field coil terminal
IG : Ignition terminal
L : Lamp terminal

GENERATOR

CAUTION:
- **Do not mistake polarities of IG terminal and L terminal.**
- **Do not create a 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 a charger or a booster battery to vehicle battery, refer to this section describing battery charging.**

Trouble in charging system will show up as one or more of following conditions:
1) Faulty indicator lamp operation.
2) Undercharged battery as evidenced by slow cranking or indicator dark.
3) Overcharged battery as evidenced by excessive spewing of electrolyte from vents.

Noise from generator may be caused by a loose drive pulley, loose mounting bolts, worn or dirty bearings, defective diode, or defective stator.

FAULTY INDICATOR LAMP OPERATION

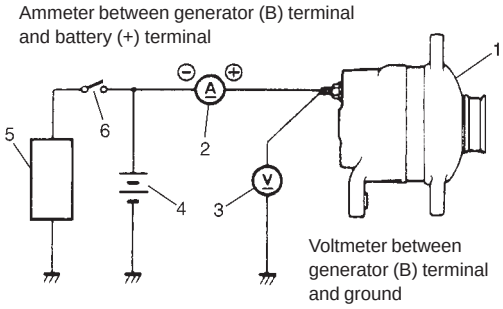
PROBLEM	POSSIBLE CAUSE	CORRECTION
Charge light does not light with ignition ON and engine off	● Fuse blown ● Light burned out ● Wiring connection loose ● IC regulator or field coil faulty ● Poor contact between brush and slip ring	Check fuse. Replace light. Tighten loose connection. Check generator. Repair or replace.
Charge light does not go out with engine running (battery requires frequent recharging)	● Drive belt loose or worn ● IC regulator or alternator faulty ● Wiring faulty	Adjust or replace drive belt. Check charging system. Repair wiring.

UNDERCHARGED BATTERY

This condition, as evidenced by slow cranking 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.

1) Make sure that undercharged condition has not been caused by accessories left on for extended period of time.
2) Check drive belt for proper tension.
3) If battery defect is suspected, refer to Battery section.
4) Inspect wiring for defects. Check all connections for tightness and cleanliness, battery cable connections at battery, starter and ignition ground cable.
5) Connect voltmeter and ammeter as shown in figure.



1. Generator
2. Ammeter
3. Voltmeter
4. Battery
5. Load
6. Switch

Voltmeter

Set between generator B terminal and ground.

Ammeter

Set between generator B terminal and battery (+) terminal.

NOTE:
Use fully charged battery.

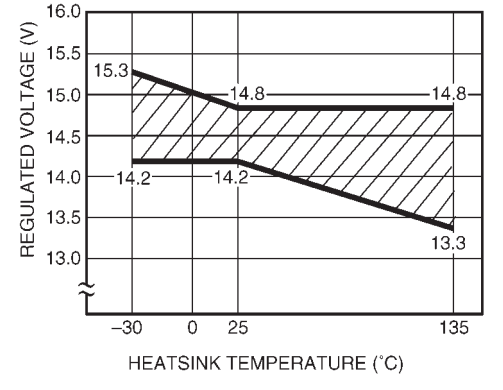
6) Measure current and voltage.

No-load Check

1) Run engine from idling up to 2,000 rpm and read meters.

NOTE:
Turn off switches of all accessories (wiper, heater etc.).

Standard current	10 A
Standard voltage	14.2 – 14.8 v at 25 °C (77 °F)



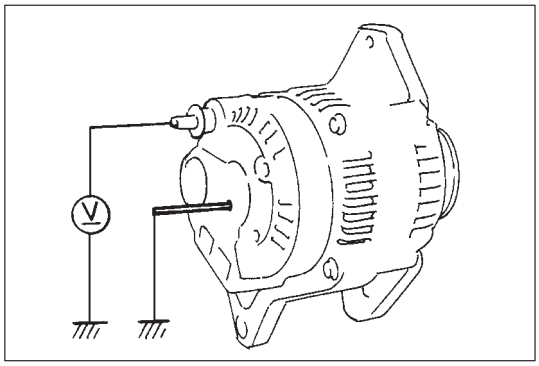
NOTE:
Consideration should be taken that voltage will differ somewhat with regulator case temperature as shown in graph.

Higher Voltage

If voltage is higher than standard value, check ground of brush.
If brush ground is correct, replace IC regulator.

Lower Voltage

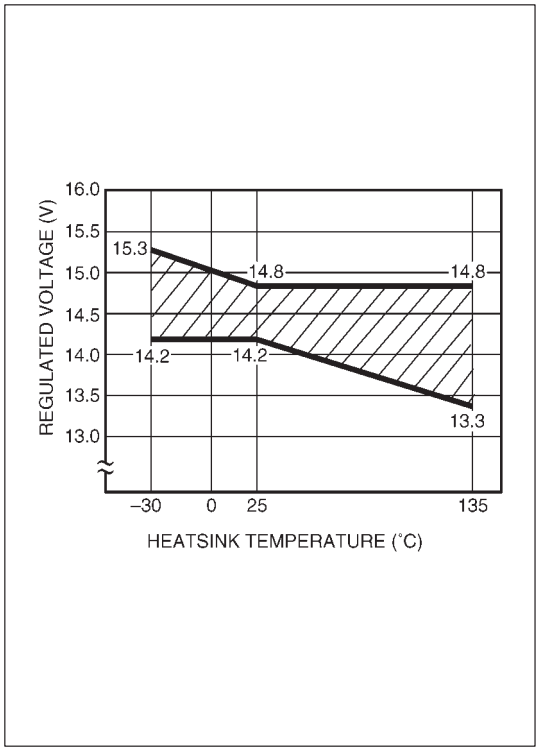
If voltage is lower than standard value, proceed to following check.



2) Ground F terminal and start engine, then measure voltage at B terminal as shown in figure.
   - Voltage is higher than standard value
     It is considered that generator itself is good but IC regulator has been damaged, replace IC regulator.
   - Voltage is lower than standard value
     Generator itself has problem, check the generator.

Load Check

1) Run engine at 2,000 rpm and turn on head light and heater motor.
2) Measure current and if it is less than 20 A repair or replace generator.



OVERCHARGED BATTERY

1) To determine battery condition, refer to Battery section in this DIAGNOSIS.
2) If obvious overcharge condition exists as evidenced by excessive spewing of electrolyte, proceed to disassembly section of generator service and check field windings for grounds and shorts. If problem exists, replace rotor.
3) With engine running at 2,000 rpm, measure voltage.
4) If measured voltage is out of standard value, check brush ground or IC regulator.

ON-VEHICLE SERVICE

BATTERY

JUMP STARTING IN CASE OF EMERGENCY WITH AUXILIARY (BOOSTER) BATTERY

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:**
  1) **Serious personal injury (particularly to eyes) or property damage from such causes as battery explosion, battery acid, or electrical burns.**
  2) **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.**

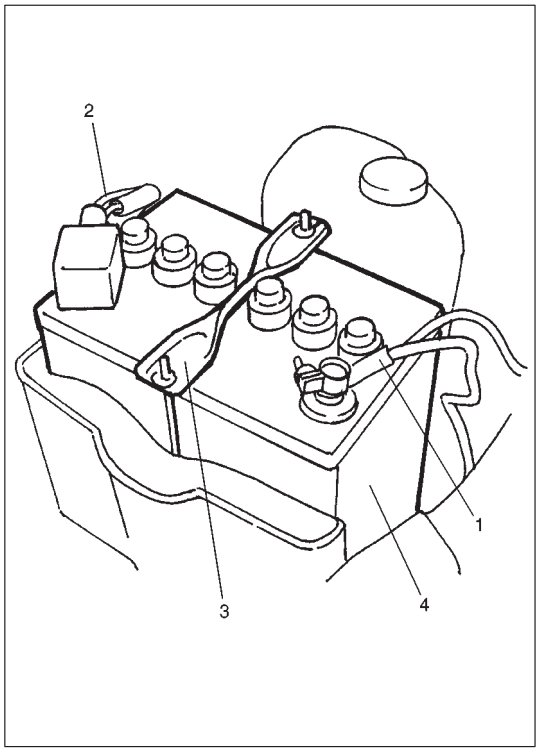
1) Set parking brake and place manual transmission in NEUTRAL. Turn off ignition, turn off lights and all other electrical loads.
2) Check electrolyte level. If it is below low level line, add distilled water.
3) Attach end of one jumper cable to positive terminal of booster battery and the other end 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.

WARNING:
Do not connect negative cable directly to negative terminal of dead battery.

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.



REMOVAL

1) Open engine hood.
2) Disconnect negative cable (1).
3) Disconnect positive cable (2).
4) Remove retainer (3).
5) Remove battery (4).

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.

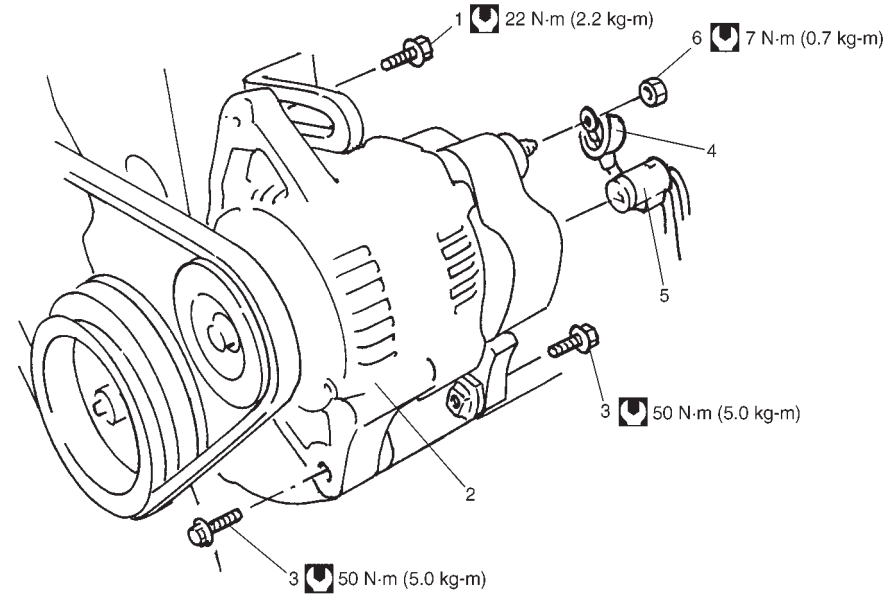
INSTALLATION

1) Reverse removal procedure.
2) Torque battery cables.

NOTE:

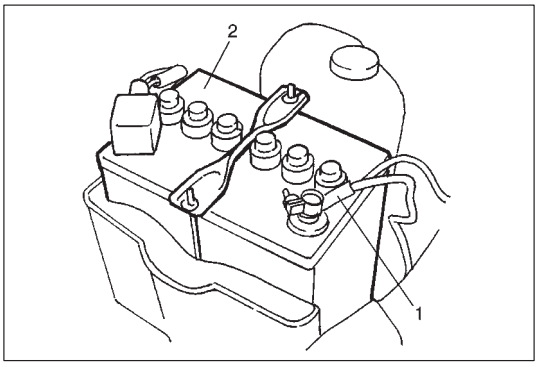
- **Check to be sure that ground cable has enough clearance to hood panel by terminal.**
- **Body and battery cable should not interfere with each other.**
- **After tightening positive terminal, be sure to put cap onto it securely.**

GENERATOR



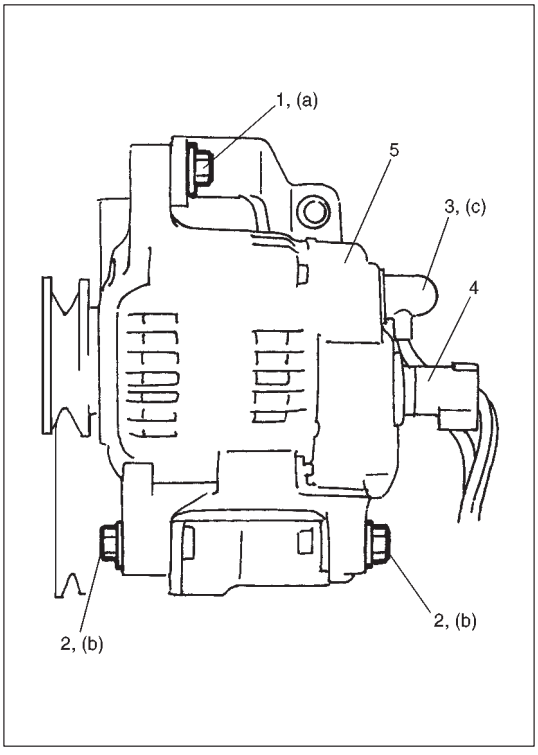
1. Adjusting bolt
2. Generator
3. Pivot bolt
4. "B" terminal wire
5. Coupler
6. Nut

: Tightening Torque



REMOVAL

1) Disconnect negative cable (1) at battery (2).
2) Remove front bumper.



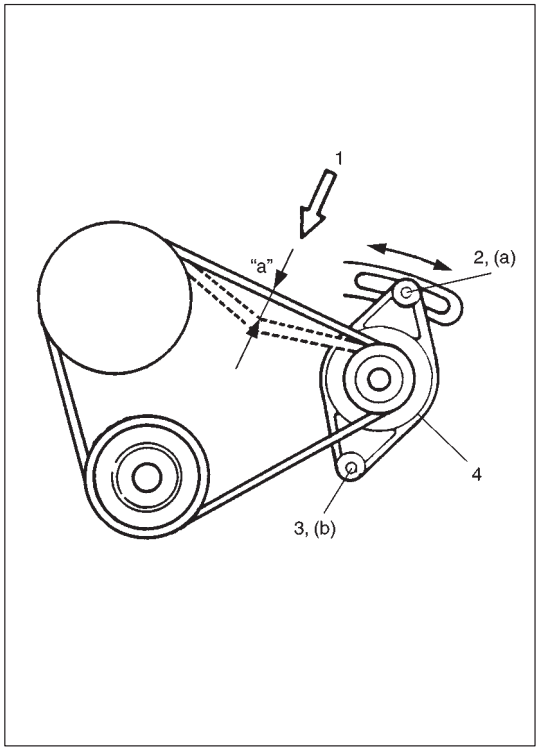
3) Disconnect "B" terminal wire (3) and coupler (4) from generator (5).
4) Remove adjusting bolt (1) and pivot bolts (2).
5) Remove generator.

INSTALLATION

Reverse above procedure giving specified tension to drive belt. Refer to "Generator (Water Pump) Belt" for belt tension.

Tightening Torque

(a): 22 N·m (2.2 kg-m, 16.0 lb-ft)
(b): 50 N·m (5.0 kg-m, 36.5 lb-ft)
(c): 7 N·m (0.7 kg-m, 5.0 lb-ft)



GENERATOR (WATER PUMP) BELT

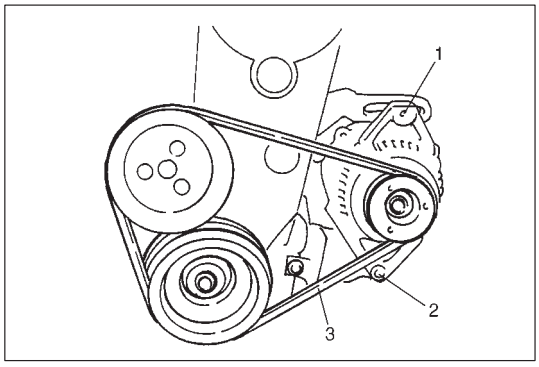
BELT TENSION INSPECTION

1) Inspect belt cracks, cuts, deformation, wear and cleanliness.
2) Check belt for tension. Belt is in proper tension when it deflects 12 to 15 mm (0.47 – 0.59 in.) under thumb pressure (1) (about 10 kg or 22 lb.).

   Belt tension "a" : 6 – 7 mm (0.24 – 0.28 in.) as deflection

   NOTE:
   When replacing belt with a new one, adjust belt tension to 5 – 6 mm (0.20 – 0.24 in.).
3) If belt is too tight or too loose, loosen adjusting bolt (2) and pivot bolts (3) and adjust it to proper tension by displacing generator (4) position.
4) Tighten generator adjusting bolt and pivot bolts.

   Tightening Torque
   (a): 22 N·m (2.2 kg-m, 16.0 lb-ft)
   (b): 50 N·m (5.0 kg-m, 36.5 lb-ft)
5) Connect negative cable at battery terminal.



REMOVAL

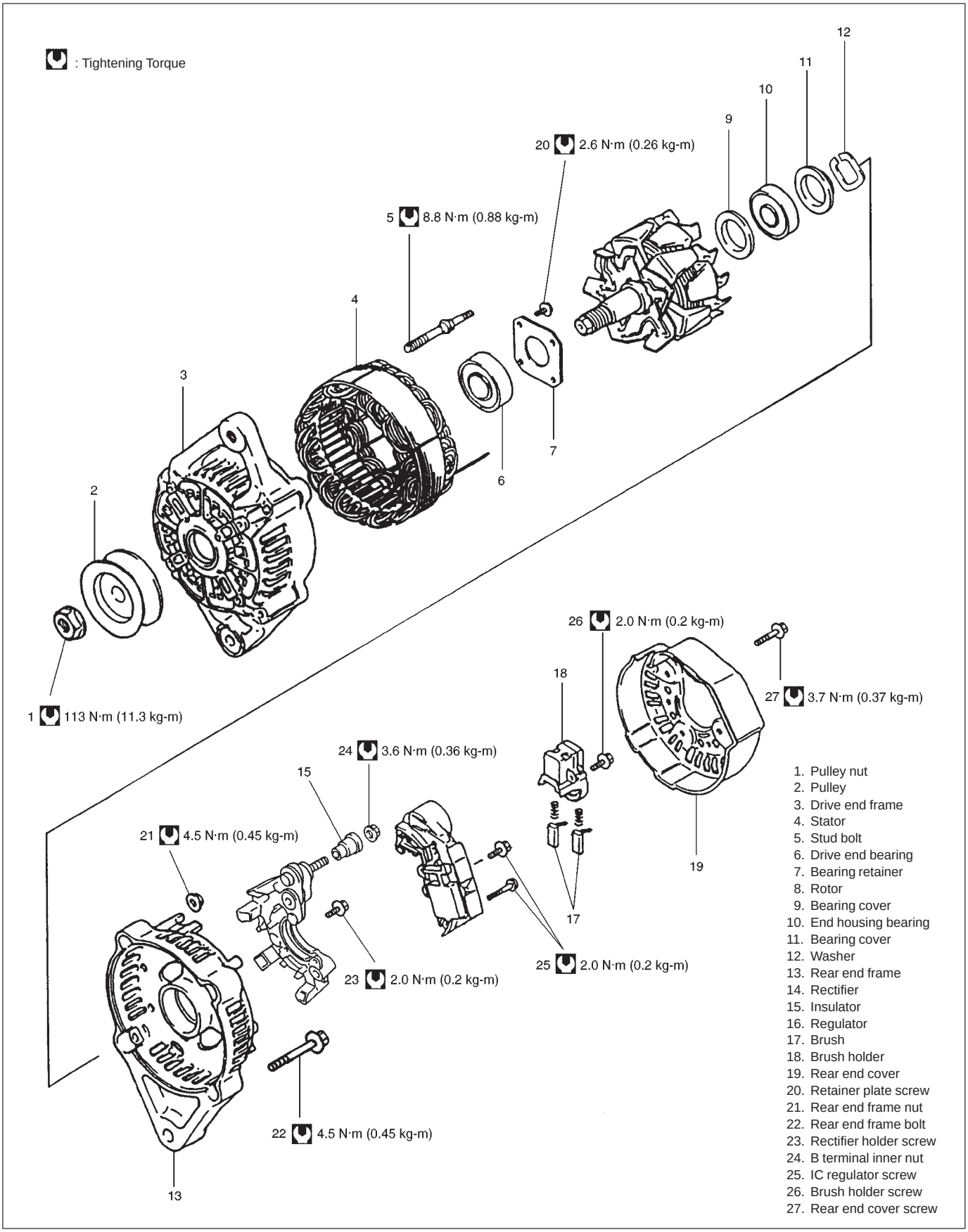
1) Disconnect negative cable at battery.
2) Remove front bumper.
3) Loosen generator adjusting bolt (1) and generator pivot bolts (2).
4) Slacken belt (3) by displacing generator and then remove it.

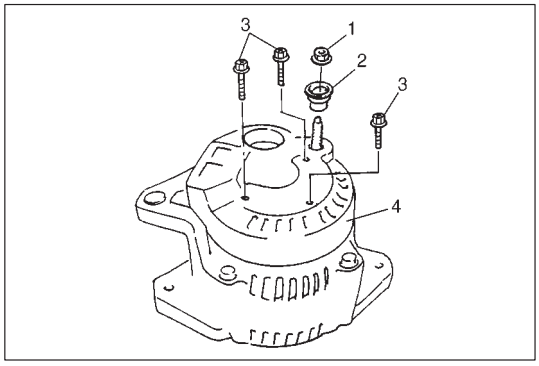
INSTALLATION

1) Install belt to water pump pulley, crankshaft pulley and generator pulley.
2) Adjust belt tension.
3) Tighten water pump belt adjusting bolt and pivot bolts.
4) Connect negative cable at battery.

UNIT REPAIR OVERHAUL

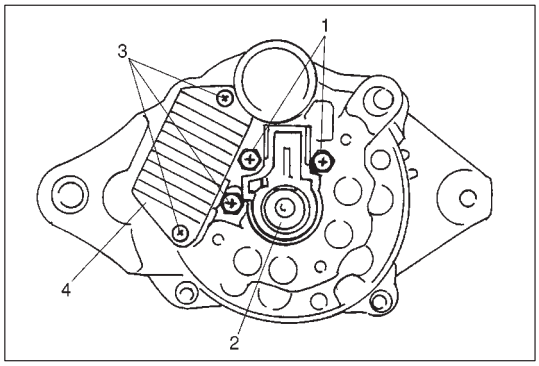
GENERATOR



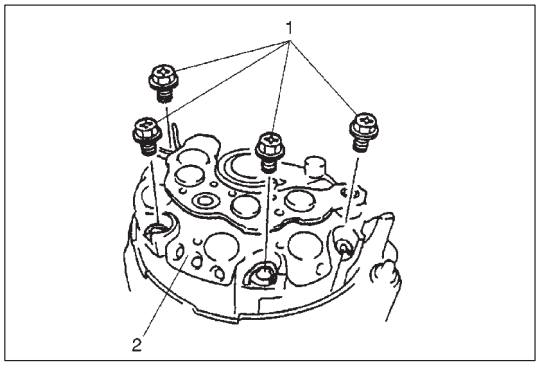


DISASSEMBLY

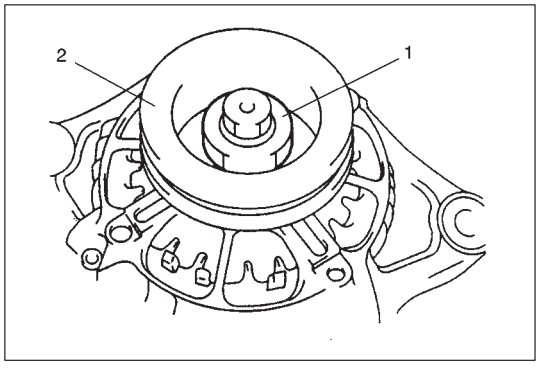
1) Remove B terminal inner nut (1) and insulator (2).
2) Remove 3 screws (3) and remove rear end cover (4).



3) Remove 2 screws (1) and pull out brush holder assembly (2).
4) Remove 3 screws (3) and IC regulator (4).
5) Remove brush holder cover from brush holder.

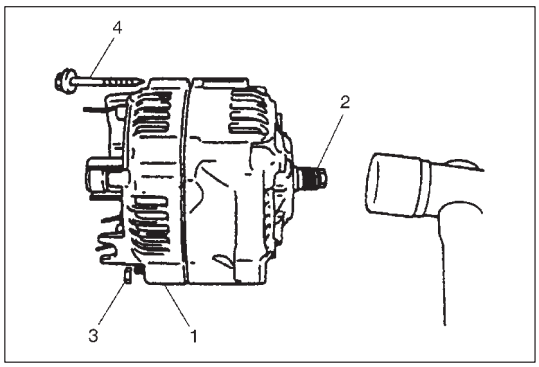


6) Remove rectifier holder screws (1).
7) Remove rectifier holder (2).



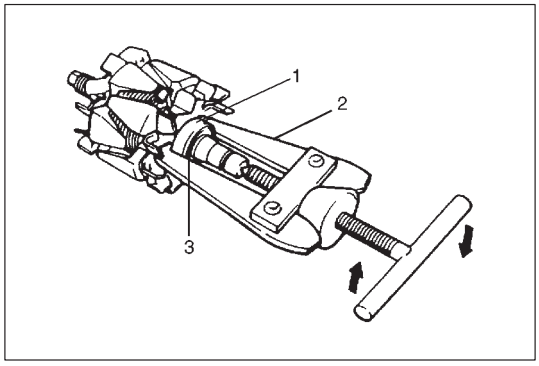
8) Hold shaft by using hexagonal box wrench and remove pulley nut (1), and then pull out pulley (2).

CAUTION:
- **To hold shaft, use hexagonal box. Duodecimal box may cause slipping and consequential shaft or tool damage.**
- **Do not attempt to hold pulley by using vise or pipe wrench so as not to distort it.**



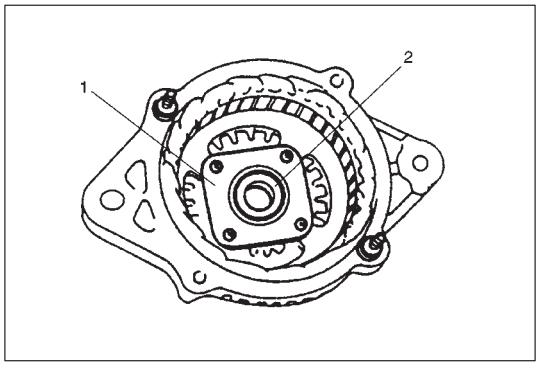
9) Remove rear end frame nuts (3) and bolts (4).
10) Drive out rear end frame (1) with rotor tapping shaft (2) lightly by using plastic hammer.
11) Separate rear end frame from rotor evenly by using plastic hammer.

CAUTION:
Do not hit shaft at slip ring side, when separating rotor and rear end frame.



12) If required, use bearing puller (2) to remove end housing bearing (1) and bearing cover (3).

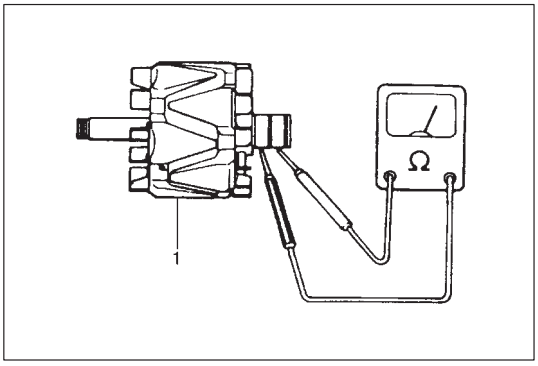
CAUTION:
Care must be exercised so as not to distort cooling fan blade while applying puller.



13) If required, remove 4 screws, retainer plate (1) and then drive out drive end bearing (2).

14) If required, remove stud bolts and then pull out stator.

NOTE:
Heating drive end frame may facilitate removal of stator.



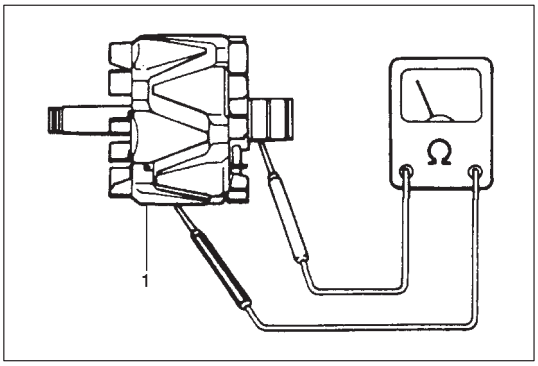
INSPECTION

Rotor

Open Circuit

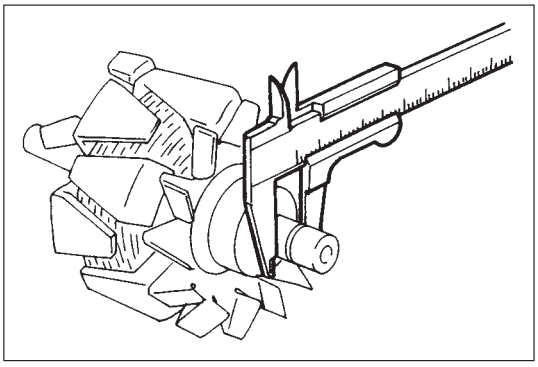
Using ohmmeter, check for continuity between slip rings of rotor (1). If there is no continuity, replace rotor.

Standard resistance: About 2.9 Ω



Ground

Using ohmmeter, check that there is no continuity between slip ring and rotor (1). If there is continuity, replace rotor.

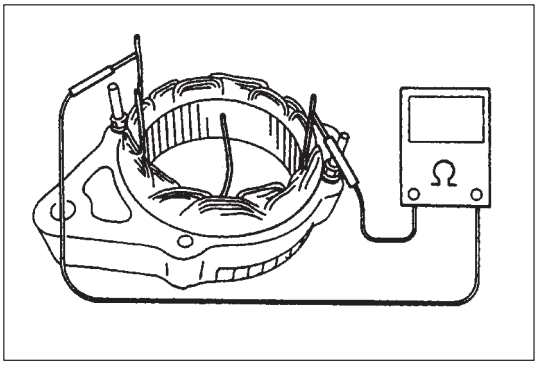


Slip Rings

- Check slip rings for roughness or scoring. If rough or scored, replace rotor.
- Using a vernier caliper, measure slip ring diameter.

  Standard diameter: 14.4 mm (0.567 in.)
  Minimum diameter: 12.8 mm (0.504 in.)

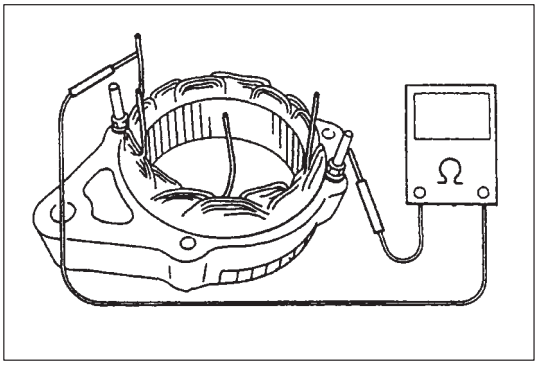
  If the diameter is less than minimum, replace the rotor.



Stator

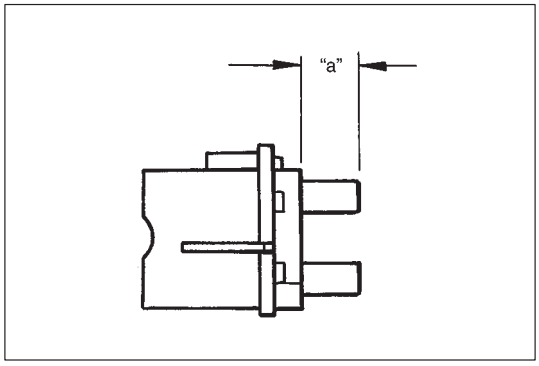
Open Circuit

Using ohmmeter, check all leads for continuity. If there is no continuity, replace stator.



Ground

Using ohmmeter, check that there is no continuity between coil leads and stator core. If there is continuity, replace stator.



Brush

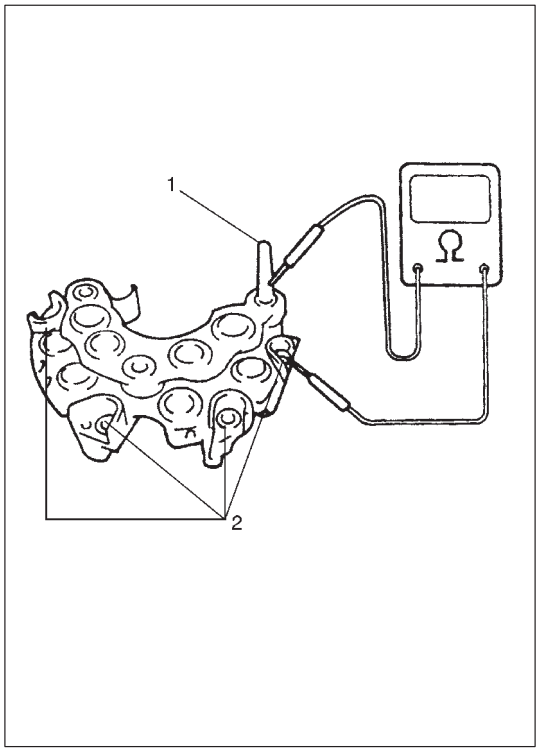
Exposed Brush Length

Check each brush for wear by measuring its length as shown. If brush is found worn down to service limit, replace brush. Refer to "Replace Brush" in this section.

Exposed brush length "a"

Standard : 10.5 mm (0.413 in.)

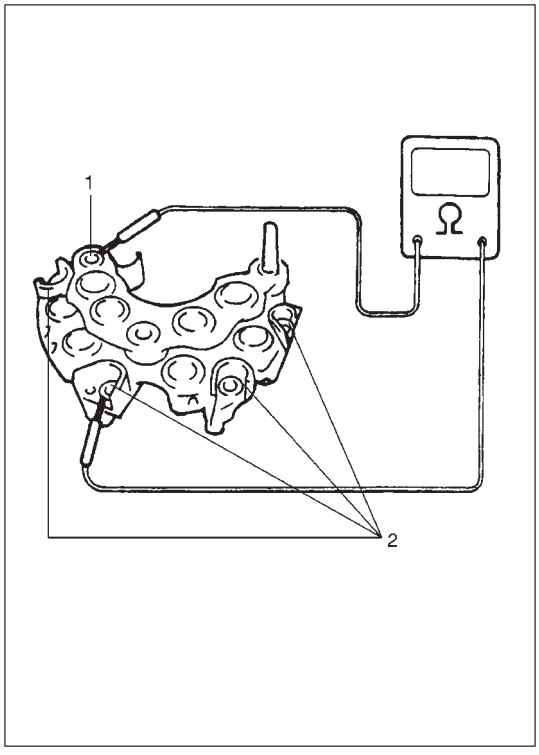
Limit : 1.5 mm (0.059 in.)



Rectifier

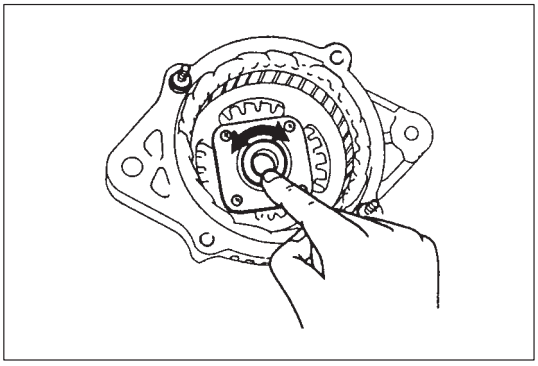
Positive Rectifier

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 tester probes and repeat step 1).
3) Check that one shows continuity and the other shows no continuity.
   If there is continuity, replace rectifier holder.



Negative Rectifier

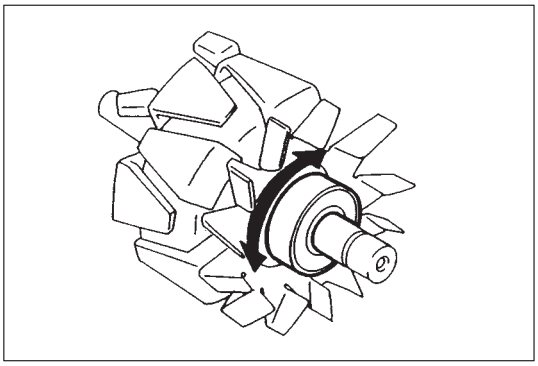
1) Using ohmmeter, connect one tester probe to each negative terminal (1) and the other to each rectifier terminal (2).
2) Reverse the polarity of tester probes and repeat step 1).
3) Check that one shows continuity and the other shows no continuity.
   If there is continuity, replace rectifier holder.



Bearing

Drive End Bearing

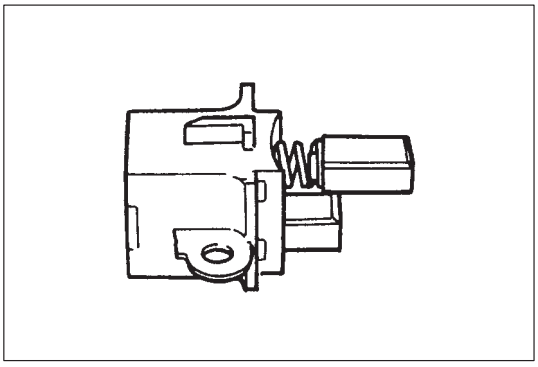
Check that bearing is not rough or worn.



End Housing Bearing

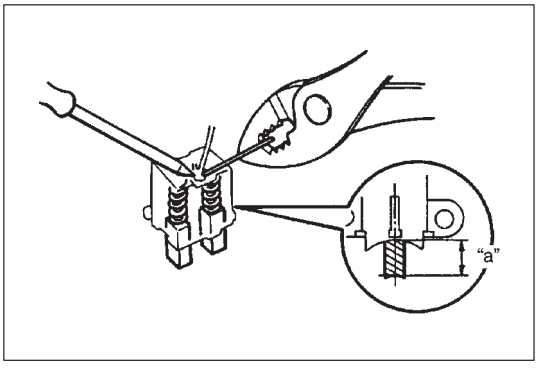
Check that bearing is not rough or worn.

When removal is necessary, refer to disassembly of UNIT REPAIR OVERHAUL.



REPLACE BRUSH

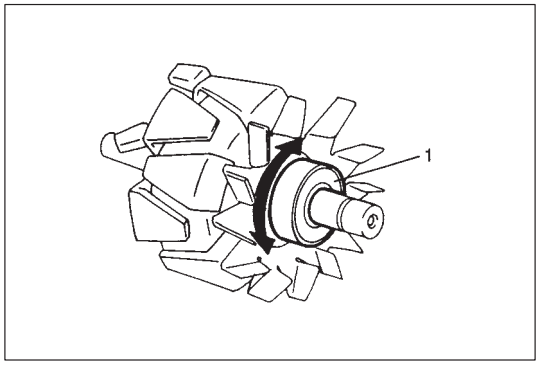
1) Unsolder and remove brush and spring.
2) Run wire of new brush through the hole in the brush holder, and insert spring and brush into brush holder.



3) Solder brush wire to brush holder at specified exposed length.

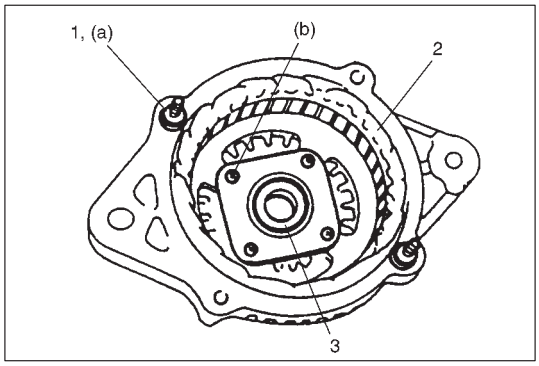
   Exposed length "a": 10.5 mm (0.413 in.)

4) Check that brush moves smoothly in brush holder.
5) Cut off excess wire.
6) Apply insulation paint to the soldered area.



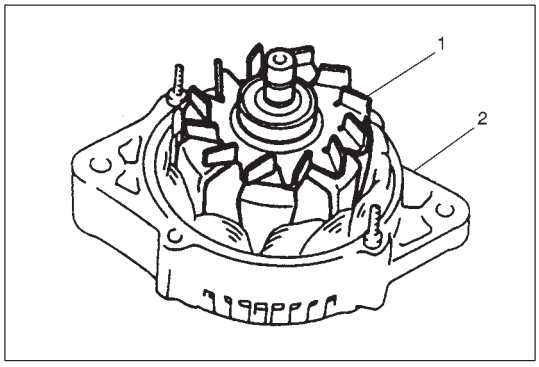
ASSEMBLY

1) If end housing bearing (1) is removed, install it.
2) Check end housing bearing turns smoothly.

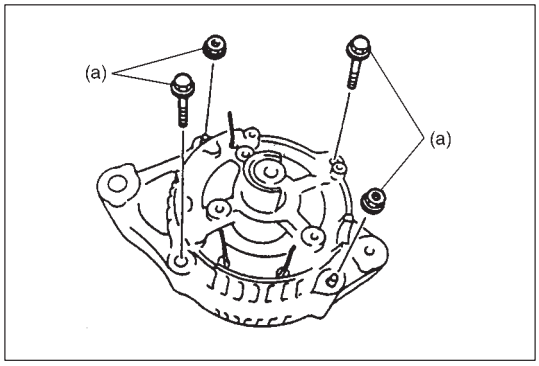


3) If stator (2) is removed, install stator and tighten stud bolts (1).
4) If drive end bearing (3) is removed, install it.
5) Check drive end bearing turns smoothly.

Tightening Torque
(a): 8.8 N·m (0.88 kg-m, 6.5 lb-ft)
(b): 2.6 N·m (0.26 kg-m, 2.0 lb-ft)

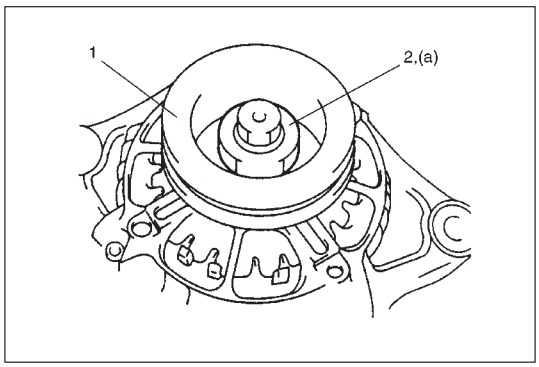


6) Place space collar and drive end frame (2) on pulley, and then install rotor (1) to drive end frame.



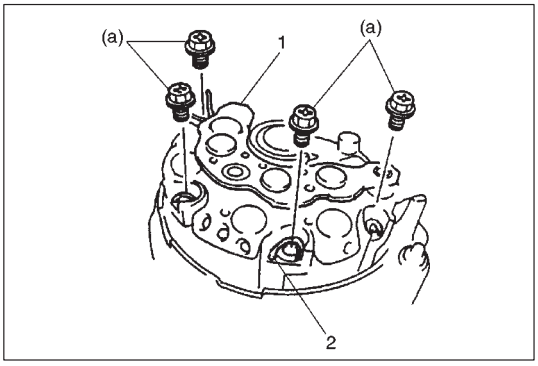
7) Install rear end frame to drive end frame.
8) Tighten bolts and nuts to specified torque.

Tightening Torque
(a): 4.5 N·m (0.45 kg-m, 3.5 lb-ft)



9) Install pulley (1) and tighten pulley nut (2) with holding shaft using hexagonal box wrench to specified torque.

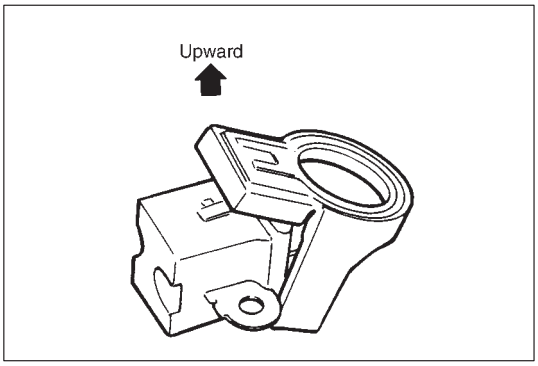
Tightening Torque
(a): 113 N·m (11.3 kg-m, 81.5 lb-ft)



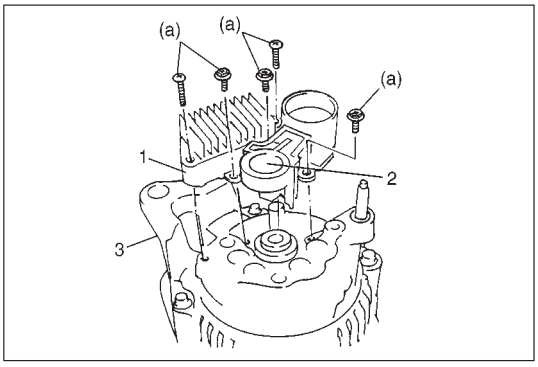
10) Install rectifier holder (1). Curl stator leads (2) as shown in figure.

CAUTION:
When installing rectifier, check to confirm that stator leads have enough clearance with cooling fan blades.

Tightening Torque
(a): 2.0 N·m (0.2 kg-m, 1.5 lb-ft)

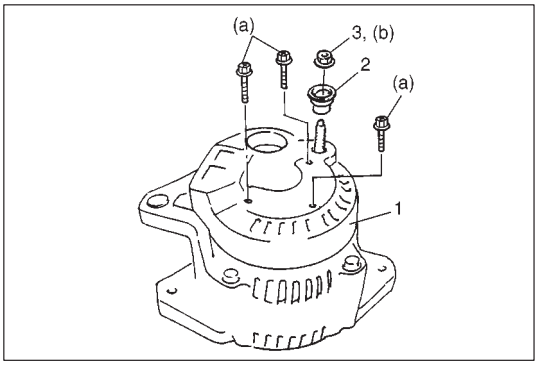


11) Install brush holder cover to brush holder.



12) Place IC regulator (1) together with brush holder (2) horizontally on rear end frame (3).
13) Install 5 screws.

Tightening Torque
(a): 2.0 N·m (0.2 kg-m, 1.5 lb-ft)

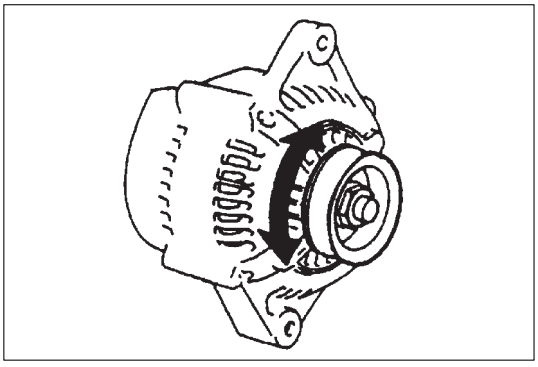


14) Install rear end cover (1).

Tightening Torque
(a): 3.7 N·m (0.37 kg-m, 3.0 lb-ft)

15) Install insulator (2) and tighten B terminal inner nut (3) to specified torque.

Tightening Torque
(b): 3.6 N·m (0.36 kg-m, 3.0 lb-ft)



16) Make sure that rotor turns smoothly.

SPECIFICATIONS

BATTERY

Rated capacity	28 AH/5 HR, 12 Volts
Electrolyte	2.5 L (5.28/4.40 US/Imp pt)
Electrolyte S.G.	1.24 when fully charged at 20°C (68°F)

GENERATOR

NOTE:

The generator used in each vehicle is one of the following two types, depending on specification.

Type	40 A type	50 A type
Rated voltage	12 V	
Nominal output	40 A (at 13.5 V)	50 A (at 13.5 V)
Permissible max. speed	18,000 rpm	
No-load speed	1,110 r/min (rpm)	
Setting voltage	14.2 to 14.8 V	
Permissible ambient temperature	–30 to 90 °C (–22 to 194 °F)	
Polarity	Negative ground	
Rotation	Clockwise viewed from pulley side	